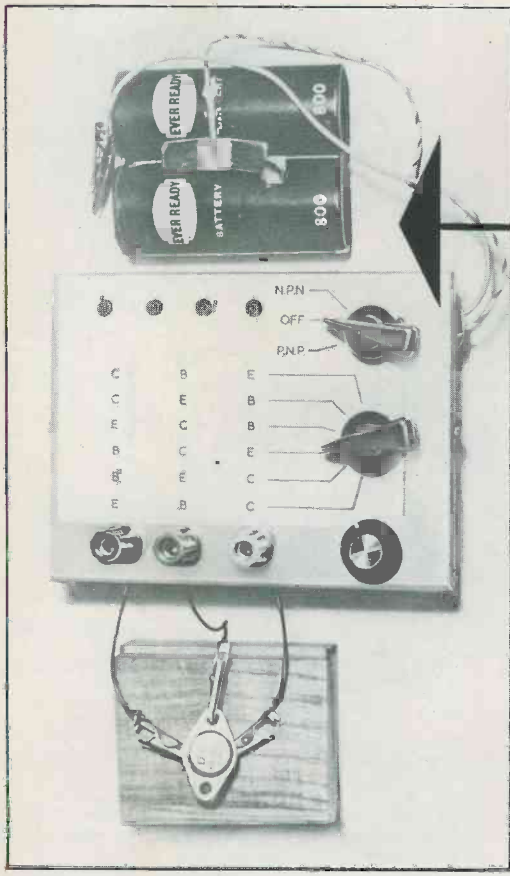
RADIO & ELECTRONICS CONSTRUCTOR

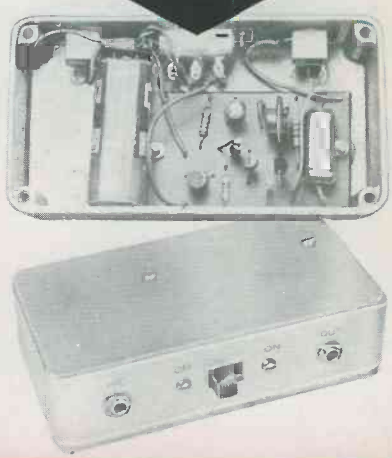
OCTOBER 1974

25p



TRANSISTOR LEAD LOCATER PART 1

LOW Z MICROPHONE PRE-AMPLIFIER



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TESTED AND GUARANTEED PAKS

B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV lamp plastic	50p
B81	10	Reed Switches, 1" long, ⅛" dia. High speed P.O. type	50p
H35	100	Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked.	50p
H38	30	Short lead Transistors, NPN Silicon Planar types.	50p
H39	6	Integrated Circuits. 4 Gates BMC 962, 2 Flip Flops BMC 945	50p
H41	2	Sil Power transistors comp pair BD131/132	50p
H63	4	2N3055 Type NPN Sil. power transistors. Below spec. devices	50p
H64	4	3819 N Channel F.E.T.'s ZN3819 in plastic case	50p
H65	4	40361 Type NPN Sil. transistors TO-5 can comp. to H66	50p
H66	4	40362 Type PNP Sil. transistors TO-5 can comp. to H65	50p

Unmarked Untested Paks

UNMARKED UNTESTED PAKS

B1	50	Germanium Transistors PNP, AF and RF	50p
B66	150	Germanium Diodes Min. glass type	50p
B83	200	Transistors, manufacturers rejects, AF, RF, Silicon and Germanium	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	100	Sil. Diodes sub. min. IN914 and IN916 types	50p
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.	50p
H67	10	3819 N Channel F.E.T.'s plastic case type	50p

Make a rev counter for your car

The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system.

£1.00 each

EXTENSION TELEPHONES

Ideal for childrens toys ONLY 70p p.p. 25p

ELECTRONIC TRANSISTOR IGNITION £6.00

Now in kit form, we offer this "up to the minute" electronic ignition system. Simple to make, full instructions supplied with these outstanding features: Transistor and conventional switchability, burglar proof lock-up and automatic alarm, negative and positive compatibility.

NEW X HATCH

Our new vastly improved Mark Two Cross Hatch Generator is now available

Essential for alignment of colour guns on all colour T.V. receivers.
Featuring plug-in IC's and a more sensitive sync. pick-up circuit. The case is virtually unbreakable - ideal for the engineer's tool box - and only measures 3" x 5½" x 3".

Ready built unit only **£9.95** Complete Kit **£7.95**

(and p&p but no batteries)

LM380 AUDIO IC

We have just received a large consignment of LN380 IC's. These are specially selected to a higher grade and are marked with the number SL 60745.
This fantastic little 3watt audio IC only requires two capacitors and two potentiometers to make an amplifier with volume and tone control. The quality is good and has to be heard to be believed.

Our special price **£1.00 ea** complete with data and projects book

Over 1,000,000 Transistors in stock

We hold a very large range of fully marked, tested and guaranteed transistors, power transistors, diodes and rectifiers at very competitive prices. Please send for free catalogue.

Our very popular 4p Transistors

TYPE "A" PNP Silicon alloy, TO-5 can.
TYPE "B" PNP Silicon, plastic encapsulation.
TYPE "E" PNP Germanium AF or RF.
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TYPE "G" NPN Silicon similar ZTX 300 range
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8 RELAYS FOR £1.00 p. & p. 27p.

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Brand new by a famous manufacturer

Data supplied £2.50

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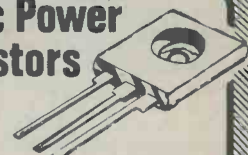

NOW IN TWO RANGES

There are 40W and 90W Silicon Plastic Power Transistors of the very latest design, available in NPN or PNP at the most shatteringly low prices of all time. We have been selling these successfully in quantity to all parts of the world and we are proud to offer them under our Tested and Guaranteed terms.

Range 1. VCE. Min. 15. HFE Min 15.

	1–12	13–25	26–50
40 Watt	20p	18p	16p
90 Watt	24p	22p	20p

Range 2. VCE. Min 40. HFE Min 40.

	1–12	13–25	26–50
40 Watt	30p	28p	26p
90 Watt	35p	33p	30p

Please state NPN or PNP on order.

HIGH SPEED MAGNETIC COUNTERS EX GPO

4 digit (non reset) 4 x 1 x 1 in. 30p

INTEGRATED CIRCUITS

We stock a large range of I.C.s at very competitive prices (from 10p each). These are all listed in our FREE Catalogue, see coupon below.

METRICATION CHARTS now available

This fantastically detailed conversion calculator carries thousands of classified references between metric and British (and U.S.A.) measurements of length, area, volume, liquid measure, weights etc.
Pocket Size 15p Wall Chart 18p

LOW COST DUAL IN LINE I.C. SOCKETS

14 pin type at 15p each
16 pin type at 17p each } Now new low profile type

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Our famous P1 Pak is still leading in value

Full of Short Lead Semiconductors and Electronic Components, approx. 170. We guarantee at least 30 really high quality factory marked Transistors PNP & NPN, and a host of Diodes & Rectifiers mounted on Printed Circuit Panels. Identification Chart supplied to give some information on the Transistors.

Please ask for Pak P.1. only 50p

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BI-PAK *QUALITY* COMES TO AUDIO!

AL10 AL20 AL30 AUDIO AMPLIFIER MODULES

The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
HARMONIC DISTORTION	Po = 3 WATTS f = 1KHz	0·25%
LOAD IMPEDANCE	—	8–16 Ω
INPUT IMPEDANCE	f = 1KHz	100 k Ω
FREQUENCY RESPONSE —3dB	Po = 2 WATTS	50 Hz-25KHz
SENSITIVITY for RATED O/P	Vs = 25V. R1 = 8Ω f = 1KHz	75mV. RMS
DIMENSIONS	—	3" × 2½" = 1"

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power out for 2% T.H.D. (RL = 8Ω f = 1KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

AUDIO AMPLIFIER MODULES

AL 10.	3 watts	£2·19
AL 20.	5 watts	£2·59
AL 30.	10 watts	£3·01

POWER SUPPLIES

PS 12. (Use with AL10, AL20, AL30)	88p
SPM 80. (Use with AL60)	£3·25
FRONT PANELS PA 12 with Knobs	£1·00

PRE-AMPLIFIERS

PA 12. (Use with AL10 & AL20)	£4·35
PA 100. (Use with AL30 & AL60)	£13·15

TRANSFORMERS

T461 (Use with AL10)	£1·38 P. & P. 15p
T538 (Use with AL20, AL30)	£1·93 P. & P. 15p
BMT80 (Use with AL60)	£2·15 P. & P. 25p

PA12 PRE-AMPLIFIER SPECIFICATION

The PA12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm × 84mm × 35mm.

Frequency response— 20Hz-50KHz (—3dD)
Bass control— ± 12dB at 60Hz
Treble control— ± 14dB at 14KHz
*Input 1. Impedance 1 Meg. ohm
Sensitivity 300mV
†Input 2. Impedance 30 K ohms
Sensitivity 4mV

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ALL PRICES INCLUDE V.A.T.

The STEREO 20

The "Stereo 20" amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attactively printed front panel and matching control knobs. The "Stereo 20" has been designed to fit into most turntable plinths without interfering with the mechanism or alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control ± 12dB at 60Hz typically 0·25% at 1 watt. Treble con. ± 14dB at 14kHz.

£14·45

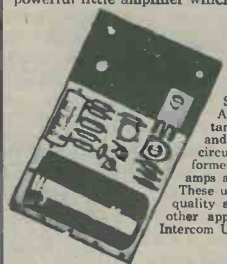
TC20 TEAK VENEERED CABINET
For Stereo 20 (front board undrilled) Size 10½" × 8½" × 3", £3·95 plus 30p postage.

SHP80 STEREO HEADPHONES
4–16 ohms impedance. Frequency response 20 to 20,000Hz. Stereo/mono switch and volume controls, £4·95

NOW WE GIVE YOU 50w PEAK (25w R.M.S.) *PLUS* THERMAL PROTECTION! The *NEW* AL60 Hi-Fi Audio Amplifier FOR ONLY £3·95

- Max Heat Sink temp 90°C.
- Frequency Response 20Hz to 100KHz
- Distortion better than 0·1% at 1KHz
- Supply voltage 15-50 volts
- Thermal Feedback
- Latest Design Improvements
- Load — 3, 4, 8 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm × 105mm × 13mm

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



STABILISED POWER
MODULE SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm.
These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address, Intercom Units, etc. Handbook available 10p **PRICE £3·25**

TRANSFORMER BMT80 £2·15 p. & p. 28p

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL60 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATIONS

Frequency Response	20Hz—20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs: 1. Tape Head	3·25 mV into 50KΩ
2. Radio, Tuner	75 mV into 50KΩ
3. Magnetic P.U.	3 mV into 50KΩ

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Base Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters: Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than —65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

ONLY £13·15

MK 60 AUDIO KIT
Comprising: 2 × AL60, 1 × SPM80, 1 × BTM80, 1 × PA 100, 1 front panel, 1 kit of parts to include on-off switch, neon indicator, stereo headphone sockets plus instruction booklets. **Complete Price:** £28·75 plus 30p postage.

TEAK 60 AUDIO KIT
Comprising: Teak veneered cabinet, size 16¾" × 11½" × 3½", other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets, etc. **Kit price:** £9·95 plus 30p postage.

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BI-PAK

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VALVE BASES

Printed circuit B9A – B7G	4p
Chassis B7 – UX5 – B9G – B7G	4p
Shrouded chassis B7G –	6p
B8A – B9A chassis – B12A tube	6p

TAG STRIP 6 way 4p Single 1p

WRIST COMPASS 20p with Needle Lock

TO3 Mica Washer **2p**

18 volt 4 amp charger, bridge rectifies **60p**

GC10/4B Cold Cathode **£5.00**

Brand New Boxed 6K7G **25p**

$1\frac{1}{4}$ glass fuses— 250 m/a or 3 amp (box of 12)	18p
3" tape spools	8p
FX2236 Ferrox Cores	5p
PVC or metal clip on M.E.S. bulb holder	5p
All metal equipment Phono plug	2p
Bulgin, 5mm Jack plug and switched socket (pair)	30p
12 volt solenoid and plunger	40p
250 RPM 50 c/s locked frequency miniature mains motor	50p
200 OHM coil, $2\frac{1}{4}$" long, hollow centre	10p
Belling Lee white plastic surface coax outlet Box	30p
R.S. 12 way standard plug and shell	50p

SWITCHES

Pole	Way	Type	
4	2	Sub. Min. Slide	18p
6	2	Slide	20p
4	2	Lever Slide	15p
6	4	Wafer Rotary	30p each
4	3	Wafer Rotary	30p each
3	7	Wafer Rotary	30p each
2	5	Wafer Rotary	30p each
1	3	+ off Sub. min. edge	10p
1	3	13 amp small rotary	12p
2	2	Locking with 2 to 3 keys	£1.50
2	1	2 Amp 250V A.C. rotary	20p
1	2	Toggle	10p

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HOST OF QUALITY, REASONABLE LEAD TRANSISTORS, SOME POWER. SILICON, GERMANIUM, ZENER DIODES, POT CORES HI-STAB RESISTORS, SOME WIREWOUND, CONDENSERS, CHOKES, TRIMPOTS, ELECTROLYTICS, ETC.

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7lb. for **£1.50** + **50p** post and packing

SUBMIN VERTICAL SKELETON PRESET 50, 100, 220, 470, 680 OHM 1, 2.2, 4.7, 6.8, 15, 22, 47, 68, 100, 220 K OHM. ONLY 5p EACH

KNOBS

SILVER METAL PUSH ON WITH POINTER, OR WHITE PLASTIC, GRUB SCREW, WITH POINTER AND SILVER CENTRE 10p EACH.

ZM1162A INDICATOR TUBE

0-9 Inline End View. Rectangular Envelope 170V 2.5M/A **£3.60**

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English Numbering Machines LTD.
MODEL 4436-159-989
6–14 volt, 6 digit, illuminated, fully enclosed. **£2.50**

RESISTORS

$\frac{1}{8}$-$\frac{1}{4}$-$\frac{1}{2}$ watt	1p
1 watt	2p
Up to 5 watt wire	10p
10 watt wire wound	12p
15 watt	14p

SKELETON PRESETS

5K or 500K	4p
5K wirewound	5p

500k Dual Concentric Potentiometer **40p**

WIREWOUND POTS

250, 300 OHM, 1K, 4 watt, 5K, 10K, 11K, 20K, 50K, all at **12p each**

Philips transformer, safety fused. In 200-220-240v. Out 240v 60ma + 6.3v 1a approx 2" x $2\frac{1}{4}$" x $2\frac{1}{2}$" **£1.50**

5K, 20K, Log Pot **15p**

1meg Tandem Pot **25p**

2M, 5M, Log Switched pot **25p**

THERMISTORS

VA1034, VA1040, VA1055, VA1066, VA1077, VA1100 **15p**
VA1005, VA1026 **25p**

PARMEKO P480

6000/55, 20 Henry ·12A, potted choke **£1**

RELAYS

12 volt S.P.C.O. octal mercury wetted high speed **75p**

P.O. 3000 type, 1,000 OHM coil, 4 pole c/o **60p**

ELECTROLYTICS MFD/VOLT. Many others in stock

5p. 1/75.2/75, 2.5/64, 4/60, 5/50, 6/3, 6/25, 8/6, 8/40, 8/50. 8/150, 12/50, 15/35, 16/40, 16/50, 20/12, 25/3, 25/6, 25/12, 25/25, 25/30, 50/10, 50/12, 50/25, 50/50, 64/10, 100/6, 100/12, 100/15, 100/18, 100/25, 125/10, 150/12, 150/25, 200/3, 250/6, 200/12, 500/6.

6p. 1/350, 2/350, 150/40, 250/18, 250/30, 260/12. 330/10

9p. 400/16, 550/12.

20p. 8/500, 16/450, 100/200, 100/250–275, 16–32/275, 32–32/275, 100–100/150, 100–100/275. 50-50/300: **Solid Tantalum**, 8/20, 10/20, 12/20.

50p. 8/800, 2000/50, 12,000/12, 32–32–50/350.

£1. 100–100–100–150–150/320.

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Arcolectric green, takes M.E.S. bulb	15p
Bulgin D676 red, takes M.E.S. bulb	15p
12 volt red, small pushfit	20p
Mains neon, red. pushfit	20p

CAPACITORS

Mixed type PFDS, 2p. 1, 3.3, 4.7, 5.6, 10, 12, 15, 16, 18, 20, 22, 24, 25, 27, 30, 33, 37, 39, 47, 50, 56, 68, 88, 100, 110, 120, 150, 200, 220, 250, 300, 330, 470, 500, 600, 680, 800, 1000, 2200, 3000, 3300, 5000.

Poly, met., film, paper, etc. MFD/Volt, 3p. .001/1250, .005/250, .03/350, .03/12, .03/200 .033/100, .0068/70, .056/350, .061/035, .069/350, .075/350, .08/350, .1/350, .1/500, .13/350, .25/150.

4p. 1500, 1800, 2200, 3000, 3300, 6800, 8200 PFD. .01/350, .013/350, .05/125, .05/250, .068/200 .25/350.

5p. .033/100, .1/250, .5/350.

6p. .1/600, .1/1500, .22/250. .5/250

10p. .01/1000, 1/350, 2/150, 2/200, 2/250 .1/900, .22/900, 4/16. .25/250 AC (600vDC)

40p. 5/150, 9/275AC, 10/150, 15/150, 40/150.

TRIMMERS, 15p each

100PF Ceramic, 30PF Beehive, 12PF PTFE 2500PF 750 volt, 33PF MIN. AIR SPACED 5PF, MIN. AIR SPACED, 50PF CERAMIC.

CONNECTOR STRIP

Belling Lee L1469, 4 way polythene. **3p each**

CAN CLIPS

1" or $1\frac{3}{8}$" or $\frac{3}{4}$" **2p**

LABGEAR MAINS DROPPER

36 ohm 25 watt + 79 ohm 9 watt **25p**

TUNING CONDENSERS 50PF, **25p**

2 Amp Suppression Choke **5p**

PAXOLINE

3 x $2\frac{1}{2}$ x $\frac{1}{16}$"	2p
$4\frac{5}{8}$ x $\frac{1}{2}$ x $\frac{1}{8}$",	2 for 1p
220K 3 watt resistors	2p
100 ohm 3 watt resistor	4p
VALVE RETAINER CLIP, adjustable	2p

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Sub-miniature Transistor Type	20p
Valve type, centre tapped or straight	40p

3 pin din to open end, $1\frac{1}{2}$yd twin screened lead **35p**

Whiteley Stentorian 3 ohm constant impedance volume control way below trade at **£1**

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AC188	12p	BC158A/B	13p	BF173	22p
ACY28	18p	BC159C, 157A	13p	BF178	27p
AD149	40p	BC178	15p	BF179	30p
AD162	30p	BC186	25p	BF180	25p
AF116/7	14p	BC187	25p	BF181	30p
AF124	20p	BC213L	11p	BF182/3	40p
AF127	20p	BC547	12p	BF184/5	17p
AF139	30p	BC558A	12p	BF194/5	10p
AF178	30p	BCY40	87p	BF196/7	13p
AF180/1	45p	BCY70/1/2	12p	BF200	25p
AF239	34p	BD112/3	63p	BF262/3	23p
ASY27	30p	BD116	75p	BF336	35p
ASY73	26p	BD115	65p	BFX29	28p
BC107A or B	13p	BD131/2	35p	BFX30	25p
BC107/8/9	7p	BD135	38p	BFX84/88	22p
BC108A/B	13p	BD203	£1.41	BFY50/1/2	15p
BC109B	13p	BD232	£1.70	BSV64	50p
BC147/8/9	9p	BD234/5	75p	BSX21	20p

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GET111	55p	2N1302	15p
MA393	50p	2N2219	20p
OC35	40p	2N2401 (ASY26-27)	25p
TAA570	£1.39	2N2904	18p
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2G302	19p	2N2906	15p
2N393	50p	2N2907	18p
		2N3053	15p

THYRISTORS

Amp	Volt		
1	240	BTX18-200	75p
1	240	BTX30-200	40p
6.5	300	BT102-300R	68p
6.5	500	BT102-500R	82p
10	700	BT106	99p
15	500	BT107	90p
6.5	500	BT101-500R	83p
6.5	500	BT109-500R	90p
20	600	BTW92-600RM	£3.90
15	800	BTX95-800R Pulse Modulated	£18.00

BRIDGE RECTIFIERS

Amp	Volt RMS		
½	1,600	BYX10	30p
1	140	OSH01-200	38p
1.4	42	BY164	57p

Plastic types

Amp	Volt RMS		
2	30	LT120	30p
0.6	6-110	EC433	

Encapsulated with built-in heat sink 15p

OTHER DIODES

Centercel	10p
IN916	4p
IN4148	5p
BA145	17p
BA182	24p
OA5/7/10	15p

BZY88 Up to 15 volt 7p

5lb New Mixed Components £2 plus 40p p & p

TRIACS

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25	900	BTX94-900	£7.50
25	1200	BTX94-1200	£10.20

DIAC BR100 38p

CQY11B Infra red transmitter £5

WESTINGHOUSE 28TIO 30 AMP 1000 VOLT THYRISTER WITHOUT NUT £5

PHOTO SILICON CONTROLLED SWITCH BPX66 PNPN 10 amp £1.50

1 AMP RECTIFIERS

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BZY88 series	5p	2N1091	8p
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LOW Z MICROPHONE PRE-AMPLIFIER

By A. P. Roberts

A 2-transmitter pre-amplifier intended primarily for use with low impedance dynamic microphones.

WITH THE ADVENT OF THE CASSETTE TAPE RECORDER came an upsurge in the availability of the low impedance dynamic, or moving-coil, microphones that many of these units employ. These microphones give a fairly high quality output and are very rugged in construction. They are also surprisingly inexpensive.

IMPEDANCE DIFFERENCES

However, many older pieces of equipment, particularly those employing valves, do not have a suitable input for this type of microphone. For instance, the author's tape recorder has two inputs, one requiring 10mV at 2MΩ, and the other 50mV at 100kΩ. A typical low impedance dynamic microphone as used with cassette recorders requires an input circuit having an input impedance of only 200Ω at a sensitivity of about 0.2mV.

The pre-amplifier circuit which forms the subject of this article was built to enable a low impedance dynamic microphone to be used with the author's tape recorder, but it could of course be employed with any piece of equipment which does not already have an input for one of these mircophones but does have an input with a sensitivity of 100mV or less. The unit is completely self-contained, and is simply plugged in between the microphone and the input of the tape recorder or other equipment. A high resistance voltmeter is required for setting up the pre-amplifier after it has been built.

Results given by the prototype are very good, and high quality recordings with a low noise level are obtained. The unit is very compact, the components being housed in a case measuring only 108 by 57 by 25mm (4¼ by 2¼ by 1 in.). The 2-transistor circuit is inexpensive and simple to build, and is economically run from a PP3 battery. This has a very long life as the current drain is only about 1.5mA.

LOW IMPEDANCE INPUTS

Two of the most obvious ways of obtaining a low noise low impedance input stage are to use either a low noise bipolar transistor as a grounded base amplifier, or an f.e.t. as a grounded gate amplifier. These two basic types of circuit are shown in Figs. 1(a) and (b) respectively.

In this type of circuit the input signal is developed across a low value emitter or source resistor. The current gain between the input and output is almost exactly unity but since, in a practical circuit, RC or RD has a much higher value than RE or RS, some voltage gain is obtained.

A third method is shown in Fig. 1(c). It was found that this gave the best results in practice, and is the one finally adopted for use in the pre-amplifier. It employs an f.e.t. in the common source mode, which is the equivalent of the common emitter mode in a bipolar transistor. This gives a voltage gain of about 10 times, and the input impedance is roughly equal

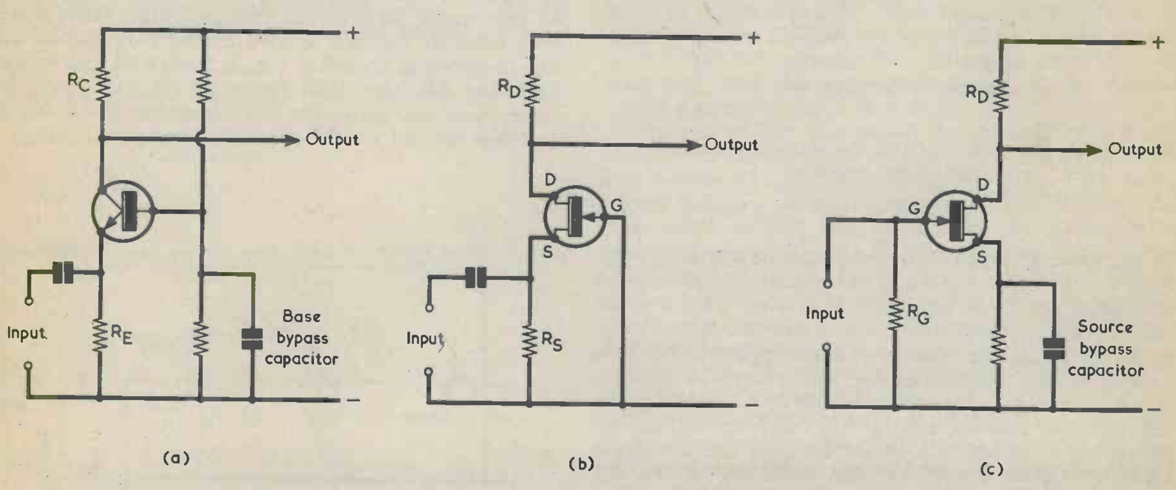


Fig. 1. Three methods of obtaining a low input impedance. A grounded base transistor stage is shown in (a) and a grounded gate f.e.t stage in (b). In (c) an f.e.t. is used as a grounded source amplifier with a low value gate resistor. In practice, the capacitors in the diagrams would need to be electrolytic types

COMPONENTS

Resistors
(All fixed values ¼ watt 5 or 10%)

R1	220Ω
R2	470Ω
R3	4.7kΩ
R4	33Ω
R5	5.6kΩ
R6	5.6kΩ
VR1	2.5kΩ potentiometer, standard size skeleton, vertical mounting

Capacitors

C1	100μF electrolytic, 10 V.Wkg.
C2	30μF electrolytic, 10 V.Wkg.
C3	10μF electrolytic, 10 V.Wkg.

Transistors

TR1	2N3819
TR2	BC169C

Sockets
SK1, SK2 3.5mm jack sockets

Switch
S1 Slide switch

Battery
9-volt battery type PP3 (Ever Ready)

Miscellaneous
Eddystone diecast box type 7134P, 108 by 57 by 25mm (Home Radio Cat. No. E896)
Printed circuit board
Battery connectors.

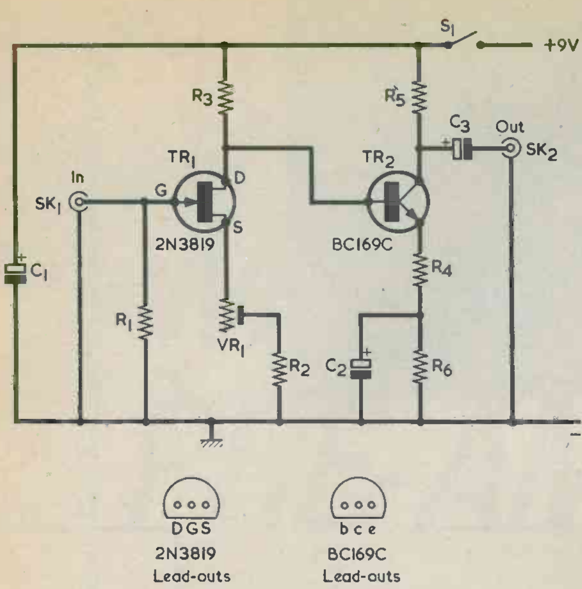


Fig. 2. The circuit of the low impedance microphone pre-amplifier

to the value given to RG, which can be anything from zero to typically 10MΩ. Field-effect transistors have low noise levels in any case, but when they are fed from a very low impedance signal source and the value of RG is small, the noise level becomes extremely low.

One of the advantages of this circuit is that no input coupling capacitor is required. Connecting the microphone directly across RG will not affect the operation of the circuit, whilst the gate current of the f.e.t. is quite negligible and will not affect the microphone.

THE CIRCUIT

Fig. 2 shows the complete circuit diagram of the pre-amplifier.

TR1 and its associated circuitry provide the low noise f.e.t. input stage, and this is basically the same as the stage shown in Fig. 1(c). The only differences are that in Fig. 2 the source resistance has no decoupling capacitor whereupon a level of negative feedback is introduced in the stage, and that the source resistance has been made variable. This enables the circuit to be adjusted so as to compensate for the wide tolerances of the type of f.e.t. used.

The voltage gain of TR1 in Fig. 2 is not very high, and so a high gain common emitter amplifier incorporating TR2 is used to boost its output. The base of TR2 is direct coupled to the drain of TR1. TR2 has R5 as collector load resistor and R6 as emitter bias resistor, this being bypassed by C2. The small unbypassed emitter resistor, R4, is included in the emitter circuit to introduce a certain amount of negative feedback to this stage. C3 couples the output from the collector of TR2 to the output socket. C1 is the supply decoupling capacitor and S1 is the on-off switch.

CONSTRUCTION

The unit is housed in the Eddystone diecast box specified in the Components List. In this application its removable lid becomes the base plate. One of the long sides of the case is used as the front panel, and this is drilled as shown in Fig. 3. Switch S1 and sockets SK1 and SK2 are then mounted on the panel. No dimensions are given for the mounting holes for S1 as these depend on the particular component used.

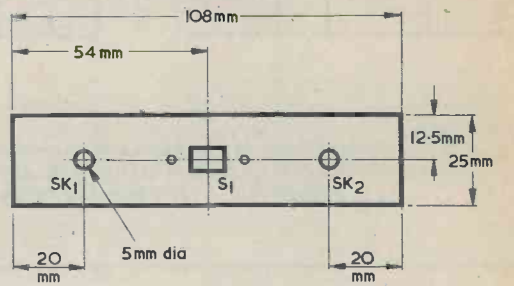
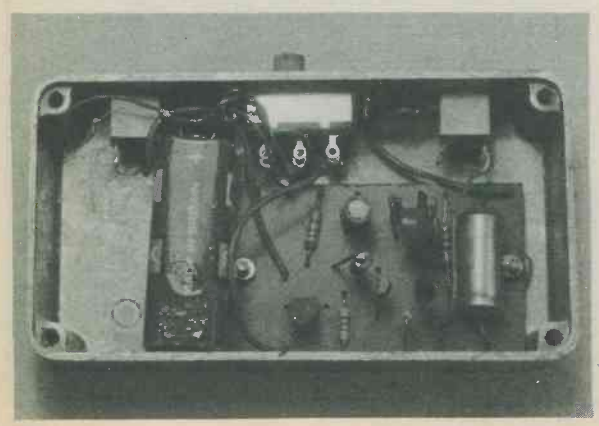


Fig. 3. One of the long sides of the diecast box is employed as a front panel



All the small components are assembled on a printed circuit board

Another view of the interior of the pre-amplifier

All the small components are mounted on a small printed circuit board measuring 2½ by 1½ in. A full size drawing of the copper backing pattern is shown in Fig. 4, together with a view of the component side of the board. It is possible, with some potentiometers, that the three holes required for the tags of VR1 may differ in position slightly from those shown in Fig. 4. Should this be the case the holes in the board should be marked out to suit the particular potentiometer employed and the appropriate part of the printed circuit pattern revised accordingly.

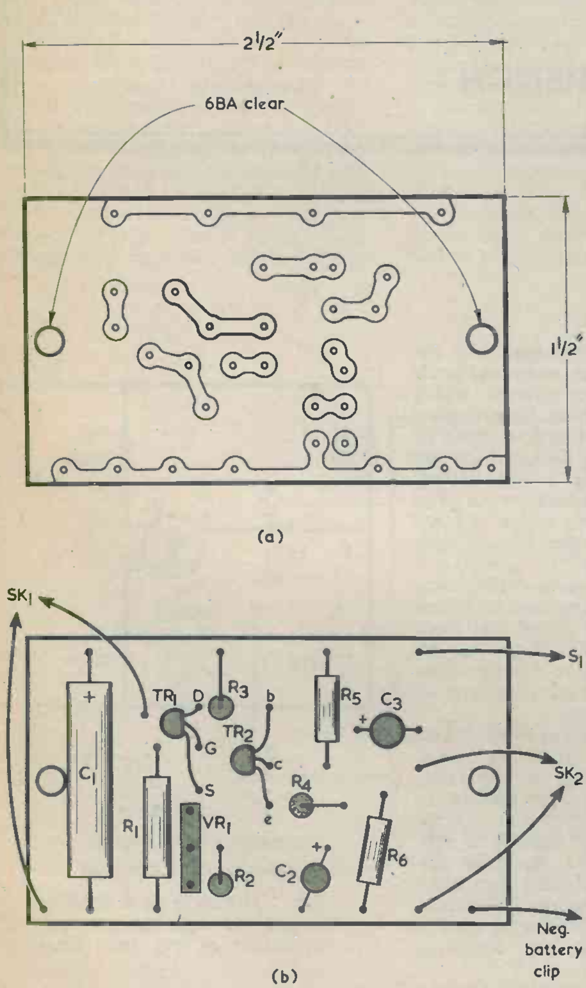


Fig. 4 (a). The copper side of the printed circuit board. This is reproduced full size and the diagram may be traced

(b). The layout on the component side of the board

When it has been completed the printed circuit board is mounted on the inside of what is now the top of the box behind S1 and SK2, using two ½ in. 6BA bolts. A few washers are placed over each bolt between the case inside surface and the printed circuit board to prevent any of the joints on the underside of the board from short-circuiting to the box. The board can be used as a template with which to mark out the positions of the two mounting holes in the box. The holes are drilled 6BA clear.

Before finally mounting the printed circuit board, complete the wiring to S1, SK1, SK2 and the negative battery clip, using any thin insulated wire. The input and output sockets should be wired such that the jack plug sleeve contacts connect to the negative supply. This causes the metal case to be connected to the negative supply rail. If the jack sockets employed have an insulated construction, a solder tag may be fitted under one of the securing nuts for the switch, this being then connected to the appropriate contact on one of the two sockets. The only connection not shown in Fig. 4 is that between the positive battery clip and the tag of S1 which does not connect to the printed circuit board.

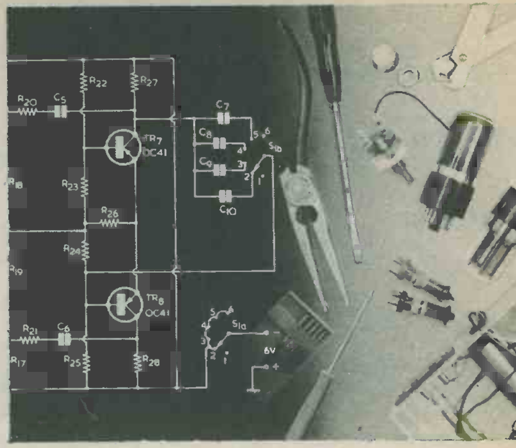
There is a space for the battery behind SK1. A piece of foam rubber or similar material can be glued to the base plate so that it holds the battery firmly in position when the base plate is screwed on.

ADJUSTMENT

Before the completed unit is ready for use it is necessary to adjust VR1 so that the voltage at TR2 collector with respect to the negative supply rail is approximately 6 volts. Start with VR1 adjusted to mid-travel and use a multimeter having a resistance of 10kΩ per volt or more to measure the collector voltage of TR2. It may be necessary to temporarily dismount the printed circuit board to enable VR1 to be adjusted.

The cable connecting the pre-amplifier to the recorder or other equipment must be screened. The leads connecting the printed circuit board to SK1 and SK2 are not individually screened, as these are both screened by the metal case. ■

FLASHING PILOT LIGHTS



by G. A. FRENCH

One of the considerable advantages afforded by transistor radios and test equipment is that these can be powered by dry batteries and thus made portable and completely independent of the mains supply. Unfortunately, this method of operation brings in its train a small disadvantage, the disadvantage being that it is in general uneconomic to fit an item of battery driven transistor equipment with a pilot lamp to indicate that it is switched on. If a transistor radio were fitted with, say, a 60mA pilot lamp, the lamp could consume more power than the entire circuits of the receiver.

A possible alleviation to this situation is given by the use of a light-emitting diode and series resistor connected across the supply rails of the equipment. However, an l.e.d. needs to pass a current of around 10mA or more to give a reasonable level of illumination under normal ambient light conditions, and this current is still relatively high.

FLASHING CIRCUIT

A solution to the problem consists of arranging a flashing circuit in which a bulb or l.e.d. flashes on for a short period at regular intervals. A comparatively high current can then be drawn when the bulb or l.e.d. is turned on and a low current when the bulb or l.e.d. is turned off. The *average* current drawn from the battery is in consequence considerably lower than would be the case if the bulb or l.e.d. were continually illuminated. Two circuits which provide a flashing pilot light facility are discussed in this article, both of these being primarily designed for use in equipment having 9 volt battery supplies. The two circuits do not offer a level of light output which is comparable with, say, the 60mA bulb mentioned earlier, but they should still prove adequate to warn a discerning person that the equipment in which they are fitted is switched on. Both circuits employ an l.e.d. to provide the illumination, and it should be mentioned that they are, to a certain extent, of an experimental nature.

The simplest method of obtaining an intermittent flash from an l.e.d. consists of employing a capacitor, charging slowly via a series resistor, to actuate the l.e.d. when the voltage across the capacitor reaches a predetermined level. The capacitor discharges into the l.e.d. and then commences to charge once more. Obviously, a trigger device of some type is required to provide the discharge function.

Fig. 1 shows a practical flashing circuit of this nature. Here, C1 is the capacitor, R1 its series charging resistor and LED1 the light-emitting diode. The only additional components required are the two resistors, R2 and R3, and the unijunction transistor, TR1.

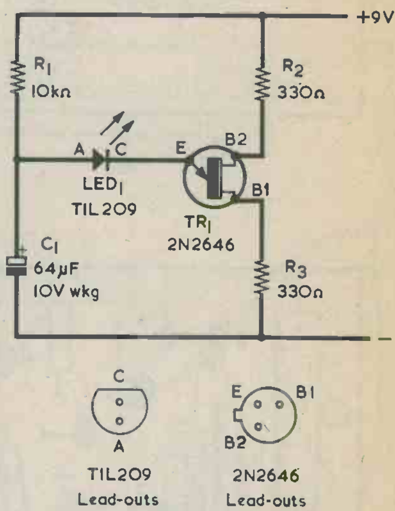


Fig. 1. A simple l.e.d. flashing circuit. Average current consumption is less than 2mA

The operation of the circuit is quite straightforward. When the 9 volt supply is applied, C1 commences to charge via R1. The emitter of the unijunction transistor is taken positive by way of the l.e.d., but the current flowing in the l.e.d. is too low for it to become illuminated. When the voltage on the positive terminal of C1 reaches the trigger potential of the unijunction transistor plus the forward voltage dropped across the l.e.d., the unijunction transistor fires. Capacitor C1 then discharges via the l.e.d., the emitter and base 1 of the unijunction transistor, and via the base 1 resistor, R3. The discharge current causes the l.e.d. to give a visible flash. This flash if observable under normal conditions of indoor ambient lighting and particularly in darkened surroundings.

Due to spread in the working characteristics of unijunction transistors and the fact that the transistor is employed here in a non-standard triggering circuit, there may be some performance variance in different circuits made up to Fig. 1. The author's circuit produced approximately 37 flashes per minute when the supply voltage was 9 volts. The circuit continued to operate when the supply voltage was reduced to 6 volts and also operated satisfactorily with a supply of 12 volts. The flashing frequency reduced as the supply voltage was lowered and increased as the supply voltage was raised. With a 9 volt supply, the unijunction transistor triggered when the voltage across C1 was 7.8 volts. It must be remembered here that the forward voltage drop across the l.e.d. is of the order of 1.6 volts.

The current drawn from the 9 volt supply was around 1.3mA between flashes, increasing momentarily to a much higher level at the instant of flashing. At 6 volts the current between flashes was 1mA and at 12 volts the current between flashes was 1.8mA. It would seem reasonable to assume that the average current drawn was1.5mAat9 volts,s b1.2mA at 6volts and about 2mA at 12 volts.

The effect of reducing the value of R3 was checked to see whether this would increase the intensity of the flash. There was, however, no visible change when R3 was made 150Ω, presumably because, although the lower value might increase the initial discharge current flowing in LED1, it would also shorten the length of the discharge period. R3 was, in consequence, retained at 330Ω.

The length of the period of illumination in LED1 could be increased by increasing the value of C1, but this would also increase the period between flashes. It was felt that the values shown in the diagram offered a good compromise between flashing period length and frequency. To introduce a practical point, it was found that the circuit ceased to oscillate when the value of R1 was experimentally reduced to 4.7KΩ. Since this indicates a lower limiting value in this resistor, there is the slight possibility that some unijunction transistors may not oscillate with R1 at the value of 10kΩ shown in Fig. 1. If it is found that a circuit made up as in Fig. 1 fails to oscillate the effect of increasing the value of R1 should, in consequence, be checked. Anomalies of this nature are feasible, as the presence of LED1 in the emitter circuit of the unijunction transistor causes the latter to work under conditions other than those for which it is intended.

All three resistors can be ¼ watt 5% or 10%. The l.e.d. should be mounted on the front panel of the equipment in which it is fitted and its body can be positioned in the centre of a small black grommet. The black surround given by the grommet gives a subjective impression of greater brightness of flashing.

GREATER FLASH PERIOD

The visible effect offered by the l.e.d. will be more noticeable if the period of each flash is extended whilst still operating at around the same frequency. It is necessary, however, to add a transistor and several more resistors if an extended flash is to be

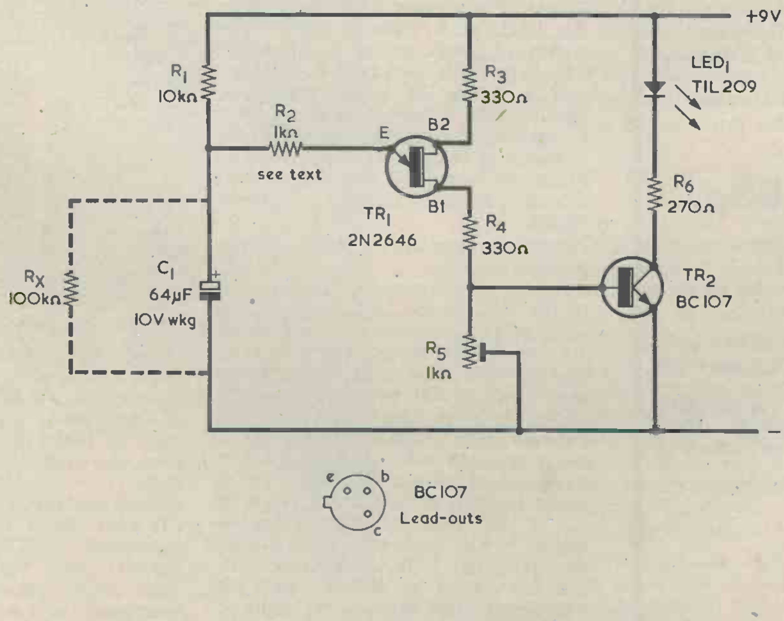


Fig. 2. A more complex circuit. This gives brighter and more sustained flashes from the l.e.d. whilst still consuming a low current from the supply

achieved. The required circuit is shown in Fig. 2, and the disadvantage of its added complexity is balanced by the advantages that the l.e.d. when illuminated passes a steady current of about 25mA, and that the average current drawn from the supply is still low.

In Fig. 2, transistor TR2 became conductive whenever the unijunction transistor is in the triggered condition. Also, unijunction operation is modified by the presence of R2 between its emitter and the positive terminal of the capacitor.

In Fig. 2 C1 charges up, as before, via R1. As soon as the voltage on the positive terminal of C1 reaches triggering level TR1 fires, causing a relatively heavy current to flow in R4 and thereby turning TR2 hard on. The collector voltage of TR2 falls nearly to the level of the negative supply rail and the l.e.d. lights up. The rate of discharge of C1 is slowed by the presence of R2, with the consequence that the unijunction transistor stays in the triggered condition for a period which is approximately equal to one-eighth of the overall length of a cycle of oscillation. The l.e.d. remains illuminated during this period, and therefore offers a more noticeable visible effect than is given by the simpler circuit of Fig. 1.

With the author's circuit, the average current drawn in the unijunction circuit, excluding LED1, was slightly less than 2mA at 9 volts. The circuit functioned satisfactorily at 6 volts, where the average unijunction circuit current was about 1.6mA. At 12 volts the average current was approximately 2.3mA. The average current drawn by the l.e.d. at 9 volts is about one-eighth of its illuminated current of 25mA, and this works out as approximately 3mA. In consequence the circuit offers a fully illuminated l.e.d. for an overall average current of a little in excess of 5mA at 9 volts. As will be explained next, this average current can be reduced by changing the value of R2.

If R2 is taken out of circuit and the positive terminal of C1 is connected direct to the emitter of TR1, the length of the flash in the l.e.d. is about the same as is given by the circuit of Fig. 1. As a result, it becomes possible to control the time in the cycle during which the l.e.d. is lit by experimentally choosing a suitable value for R2 between zero resistance and a maximum value of 1kΩ. If R2 is given a value which causes the l.e.d. to be alight for half as long as occurs with R2 at 1kΩ, then the average current drawn by the l.e.d. at 9 volts will be approximately 1.5mA. Thus, the constructor can, if he desires, reach his own compromise between the length of the flash period and the average current consumption.

As with Fig. 1, spread in TR1 may cause slight performance variations in circuits made up to Fig. 2. Also, the unijunction transistor is once again being used in a circuit somewhat different from that in which it would normally be employed. The author found that the circuit initially failed to oscillate when it was connected to a 12 volt supply, but that it could be made to do so if a 100kΩ resistor was connected across C1. This is the resistor shown as Rx in the diagram. With some unijunction transistors it is feasible that Rx may be needed for operation at 9 volts as well.

With a 9 volt supply, the author's circuit oscillated satisfactorily with values in R2 up to 2.2kΩ. Since there is a practical limiting value to R2, the possibility exists that some unijunction transistors may not oscillate even when R2 has the lower value of 1kΩ. Should this be the case, and if the effect of adding Rx does not alleviate the condition, it will be necessary to give R2 the requisite lower value, determined experimentally, which enables oscillation to take place. When checking for oscillation, it is helpful to insert a meter switched to read 10mA f.s.d. in series with the positive 9 volt supply to R1 and R3 (but not to LED1).

The author's circuit gave a flashing speed of 52 flashes per minute at 9 volts, this frequency decreasing as voltage was lowered and increasing as voltage was raised. The frequency is higher than is given by the circuit of Fig. 1 because in Fig. 2 C1 is charged to a lower voltage when triggering of the unijunction transistor takes place.

Pre-set potentiometer R5 is set up such that TR2 is just turned off during the periods between flashes. Initially, R5 is set to insert zero resistance into circuit, and the supply is applied. R5 is then slowly adjusted to insert more and more resistance. A setting will be found at which the l.e.d. commences to flash when TR1 is triggered. This situation will continue as R5 is advanced, until a further position is arrived at where the l.e.d. is partially illuminated between flashes. R5 is then retarded to a setting just below this condition. The final setting required in R5 is not particularly critical.

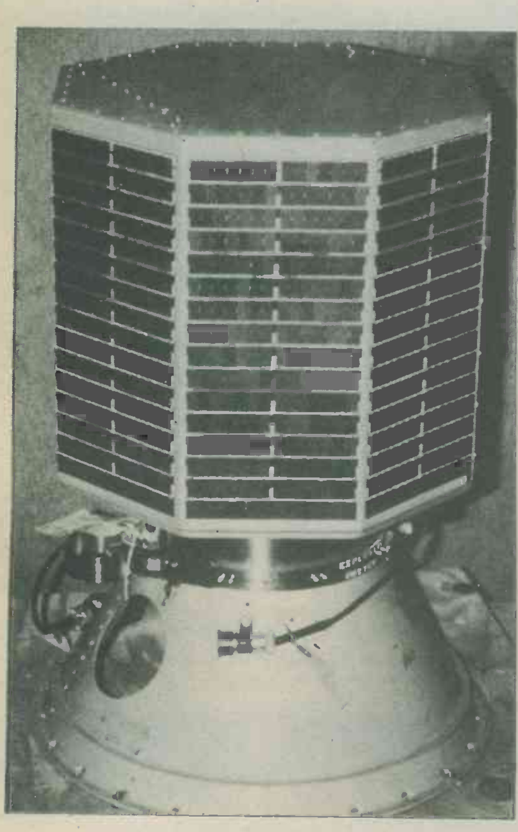
As with Fig. 1, the fixed resistors in Fig. 2 can all be ¼ watt 5% or 10%. R5 may be a skeleton potentiometer.

Both the circuits of Figs. 1 and 2 cause a pulse of increased current to be drawn from the supply when the l.e.d. is illuminated. If this affects the equipment in which the flashing circuit is used, the supply to the flashing circuit must be suitably decoupled. The circuits also produce a small amount of r.f. interference detectable, with the prototypes, as 'clicks' when the l.e.d. flashes. These 'clicks' were picked up on a radio receiver switched to the long wave band and held very close to the circuit wiring. If the circuits are employed in a radio receiver they should be kept separate, and if necessary screened, from the r.f. and i.f. stages. ■

OSCAR 7

By Arthur C. Gee, G2UK

OSCAR 7, the latest of the Orbital Satellites Carrying Amateur Radio, is scheduled for launch on October 16th. It is of course, quite possible, that there may be further delays in its launching, as there are many factors which can influence and delay a launching. From "Oscar News" No. 5 we learn that the latest hold up has been due to some modifications found to be necessary for the ITOS-G launch, on which Oscar 7 will be carried aloft, along with the next NOAH Weather Satellite being put into orbit by NASA. However, at the time of writing, October 16th, is being strongly favoured as "the date".



Oscar 7, like its predecessor Oscar 6, is a long-life satellite, intended for amateur radio communication purposes. It contains two repeaters and four beacons and a morse code and a teletype telemetry encoder. There is a 2 to 10 metre repeater, "up-link" signals being 145.85 to 145.95 MHz; "down-link" signals being from 29.40 to 29.50 MHz. The output power of this system is 2 watts p.e.p. which should make the 10 metre received signal somewhat stronger than that from Oscar 6.

The second repeater has its "up-link" on 432 MHz with a "down-link" on 145.9 MHz.

There are two beacons associated with these repeaters; one on 29.50 MHz and the other on 145.98 MHz. In addition to these two beacons, there are a further two auxiliary ones; one on 435.10 MHz for teletype, morse code or codestore keying and the other on 2304 MHz for C.W. tracking and morse code telemetry. This "S" band beacon was built by the San Bernardio Microwave Society of California and will transmit "HI's" in morse code, followed by 30 seconds of continuous carrier for tracking purposes.

One of the greatest differences between Oscar 7 and Oscar 6, is that Oscar 7 will be able to transmit telemetry by RTTY. Teletype telemetry data will be in Baudot code, using 850 Hz shift. FSK is to be used on the 435.1 MHz beacon and AFSK on the 145.98 and the 29.5 MHz beacons.

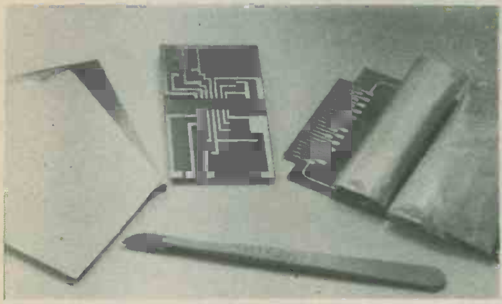
The satellite is octahedral in shape as can be seen from our photo, in which it is shown, mounted on a sheet metal cone, by means of which it is installed in the launch vehicle. It is separated from this on ejection into orbit. Antennas, of steel tape are extended after entry into orbit.

The surface area is covered with eight solar cell panels, to provide adequate power for continuous operation, so that, unlike Oscar 6, it should not need to be commanded into recharging modes periodically. These solar cell panels supply 2.2 amps at 6.4 volts, when illuminated by sunlight. This is converted into a 14 volt supply which charges a Nicad battery, used to supplement the power requirements when the satellite is on the dark side of the earth.

It is intended that Oscar 7's orbit should be very similar to Oscar 6, so that similar tracking procedures as those used for Oscar 6 will be suitable for Oscar 7. It is hoped to place it in an orbit which is half an orbit ahead of, or behind Oscar 6. This will result in there being five or six passes of a useable satellite each evening – assuming Oscar 6 continues to function as it does at present. The same equipment as is used for working through Oscar 6 can be used for Oscar 7. ■

NEWS . . . AND .

PRINTED CIRCUITS



A new approach to printed circuits has been developed by Keltronix Ltd. which allows industry, researchers, development laboratories, universities, colleges and schools to produce low-cost one-off and prototype boards.

The new process, KX2, is simple to use and gives a high degree of precision to the finished product. Track width and spacing down to 0.5 mm are readily obtainable making the technique suitable for discrete- and integrated-circuit layouts.

A paper-surfaced resist allows the printed circuit pattern to be drawn with any conventional drafting implement-pencil, ball-point, etc., the finished pattern being defined by a cut-and-strip operation. Etching, which can be observed as it proceeds, is performed by adding water, and the printed circuit boards, to pre-packed chemicals. The remaining resist is easily removed by hand.

The process may be applied to single- or double-sided boards and is available in the form of a range of standard kits using 1 oz. G10 fibre glass.

For further information please contact Keltronix Ltd. 15 Barra Street, Glasgow, G20 0AX.

FORTY YEARS OF TAPE

In 1932, the German chemical company BASF and AEG were deeply involved in research on recording techniques, and had agreed on a joint working programme: AEG would concentrate on producing a magnetic recorder and BASF on solving the problem of finding a suitable recording medium.

In August 1934 BASF delivered 50,000 metres of the new plastics tape, coated with iron particles, to AEG. It was to be used with their specially developed recorder, but the 'Magnetophon' could not make its debut until the Berlin Radio Exhibition in 1935 when the 'magic tape' went on show. By this time, the tape was coated with iron oxide.

Previous attempts to find a satisfactory medium for recording had employed both steel and coated paper, but it was BASF's idea of substituting plastic as the base material which was the key to their success. The basic principle of electromagnetic recording has remained unchanged to this day.

The London Philharmonic featured in the first public recording of music on magnetic tape a year later. Under Sir Thomas Beecham, the orchestra gave a concert in the BASF Festival Hall in Ludwigshafen on 19 November 1936. The original tape of this historic performance is still preserved in the BASF company archives.

In the forty years since this breakthrough in recording techniques, BASF has built up a flourishing and diversified range of recording media. Besides magnetic recording tape, tape recorders and cassettes, the BASF range also includes peripheral hardware and storage media for the electronic data processing market, video tapes for television and education, and the company has a thriving market in pre-recorded music on tape and records.

FLUORESCENT LIGHTING KIT

You can now construct your own 12 volt fluorescent lighting system with a new, inexpensive, 8 watt kit produced by Electronics Design Associates. With winter and its problems on the way an obvious use is emergency lighting but of course there are many others, for instance caravanning, camping, workshop and garage lighting, as an inspection lamp or for general home use, etc.

In use the light is reverse polarity protected and only takes 0.6 amps from the battery. The kit includes a printed circuit board, ready drilled metalwork, clips, end caps, first quality components, cable, the tube, nuts, bolts, etc. The price of £3.19 includes V.A.T. post and packing. A diffuser is available for an extra 59p including V.A.T. (postage and packing 12p extra when ordered separately). The kit is available from: Electronics Design Associates, 82 Bath Street, Walsall, WS1 3DE.

. . . COMMENT

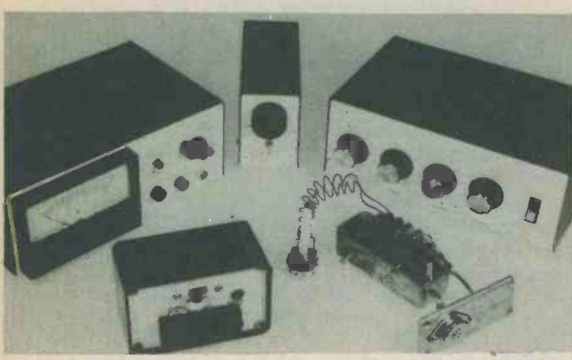
DORAM ELECTRONICS

The Electrocomponents Group, Britain's largest distributors of electronic components, has established a new subsidiary Company dedicated to the needs of amateur radio, electronics and hi fi enthusiasts.

Named Doram Electronics Ltd., the address of the new Company is P.O. Box TR8, Wellington Road Industrial Estate, Leeds LS12 2UF.

In addition to their administrative offices, Doram will have at their disposal a modern 7,500 sq. ft. warehouse in which, from the outset, they will hold in depth stocks of more than 4,000 different product lines.

Electronics Engineer Andrew Dawes (call sign G8HEW) constructing the prototype of a kit to be included in the Doram Range.



A selection of the kits available from Doram Electronics Limited. In addition, Doram will hold over 4,000 product lines of electronic components, kits and accessories and aim to provide a 'by-return-of-post' mail order distribution service for amateur radio, electronics and hi fi enthusiasts.

The entire Doram product range is described in a 64 page catalogue which, priced at 25p including postage, is available from the Leeds address. The catalogue will incorporate full particulars of each product including, where applicable, circuit diagrams, operating parameters, photographs and dimensional diagrams, in addition to the price of each individual item.

The General Manager is 38-year-old Frank Chable, who joined RS Components in 1966.

It is worth noting that on the opening day of the Amateur Radio Traders' Exhibition at Granby Hall, Leicester, (31st October – 2nd November 1974), Mr. Brian Rix, a radio amateur as well as an actor, will be drawing 50 prize winners from all the names of those who purchased the catalogue before the 31st October 1974 – 1st Prize – a £10 voucher, with 49 consolation prizes of £5 vouchers.

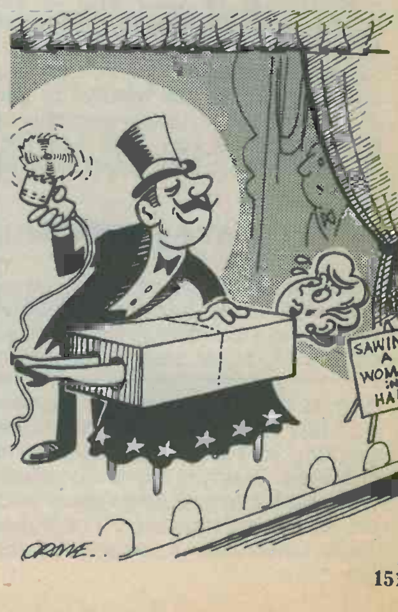
V.H.F./U.H.F. PANORAMIC DISPLAY FROM EDDYSTONE RADIO

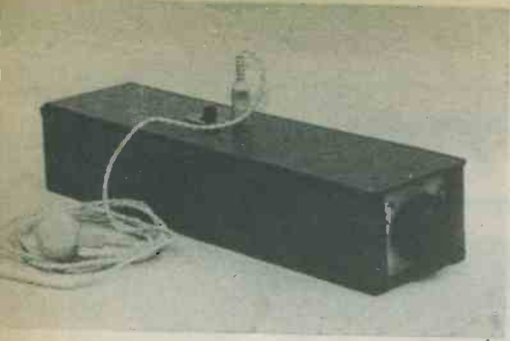
Eddystone Radio Ltd., announces the introduction of a new solid-state Panoramic Display Unit, the 1061B/1 for use with u.h.f. and v.h.f. receivers.

It is expected to find wide use among Post and Telegraph authorities and manufacturers and operators of major v.h.f. and u.h.f. mobile radio systems, enabling them to monitor the mobile radio bands on a continuous basis.

The 1061B/1 has been designed for use in conjunction with receivers having suitable i.f. outputs. The standard version is suitable for an i.f. of 10.7MHz, but other i.f. outputs can be accommodated to meet special requirements. The display unit provides independently variable sweep width from 20kHz/cm to 1MHz/cm and a continuously variable sweep speed. With a 6kHz resolution, mobile radio signals of 12.5kHz channel spacing can be separated.

Calibration facilities are flexible, providing identification of centre frequency and ±5MHz, centre frequency and ±1MHz, and a symmetrical pattern of 100kHz markers with a clear identification of the centre frequency. The visual display can be switched for 'LOG' (40dB) or 'LIN' (26dB) response from the front panel. Screen size is 10cm wide by 6cm in height.





DOUBLE R[...] PERSONA[...]

Although it incorporates only two transistors, this receiver employs a double reflex circuit which enables both of these to amplify at radio frequencies and at audio frequencies. Reception of the short wave broadcast bands from 19 to 49 metres is given, and the output may be fed to a personal earphone or to a suitable a.f. amplifier. No external aerial is required.

THE AUTHOR RECENTLY DESCRIBED A NEW RECEIVER circuit in which two transistors, an n-channel f.e.t. and a silicon p.n.p. bipolar, operated a loudspeaker satisfactorily on fairly powerful stations in the medium and long wave bands. He called the result the 'Biflexette' and the article describing the receiver appeared in the May 1974 issue of this journal. The present article gives a description of a personal receiver with a similar line-up, this employing a small earphone and covering the short wave bands from about 19 metres to about 52 metres. The apparatus may also be used as a short wave tuning head in front of an a.f. amplifier, though with some amplifiers difficulties may occur in the form of instability or distortion, due to the fact that the receiver ferrite rod assembly can pick up fields at audio frequencies. The ferrite rod cannot be screened, as no external aerial of any sort is used. Herein, incidentally, lies an unusual feature, as most short wave portable receivers have to rely on a telescopic aerial for pick-up.

The author cannot undertake to describe how the receiver may be used with all amplifiers, but good results were obtained in conjunction with his 'Sliding Challenger' amplifier described in the August 1970 issue,* provided a 1kΩ resistor was fitted across the output socket of the receiver to act as an output load in place of the earphone normally used. Overall amplification proved very high and for most stations the volume control on the amplifier was set well back.

SHORT WAVE ENTERTAINMENT

This article is not, of course, intended to be a description of a communications receiver! Rather, it is put forward as a simple way of receiving entertainment from the 19, 25, 31, 41 and 49 metre broadcast bands. It is true that c.w. signals can be received on the 20 and 40 metre bands, but this should be looked upon as a bonus. On the broadcast bands the author has received many stations in North and South America, Australia and other distant countries. A high proportion of these have come through at excellent strength.

The circuit has been modified a little from that published for medium and long waves to make it suitable for the higher frequencies it is now required to receive; and, of course, to make it suitable for reception with an earphone rather than a speaker. An earphone of 1kΩ nominal impedance is required. The author has tried many makes. Some have been good, and some quite surprisingly bad. For use with this receiver he recommends a Danavox 'Steto' 1kΩ earphone. This consists of an assembly comprising a 'Steto' earphone Cat. No. 4501-07, an eartip type A.P., and a cord, Cat. No. 7403-67, terminated in a 3.5 mm. jack plug. If desired, a 'Stetoclip' Cat. No. 8500-58 may be employed instead of the eartip type A.P. The 'Stetoclip' is an acoustic headset fitted to both ears in the manner of a stethoscope and is coupled to the single earphone. Readers may obtain whichever of these items they require from Danavox International, 'Broadlands', Bagshot Road, Sunninghill, Ascot, Berkshire, SL5 9JW.

The use of a really efficient earphone is very important in a simple receiver of this sort, and the difference in sensitivity between the one recommended and the worst of the others tried is almost equivalent to the gain given by an extra audio amplification stage. Do not, however, attempt to use high impedance headphones. The use of, say, 4kΩ as an output load will almost certainly result in instability and could also starve the output transistor of direct voltage.

THE CIRCUIT

The circuit is shown in Fig. 1. The signal is picked up by L1, which is wound on a 6 in. by $\frac{3}{8}$ in. ferrite rod. The signal is applied to the gate of TR1, which acts as a radio frequency voltage amplifier with its output directly coupled to the base of TR2. TR2 functions as an emitter follower current amplifier at radio frequen-

*Apart from an automatic bias circuit which enabled its Class A output stage to be biased at a level corresponding to signal amplitude, the 'Sliding Challenger' consisted basically of a common emitter transistor followed by an emitter follower feeding into a common emitter output transistor. The August 1970 issue of *The Radio Constructor* is now out of print. – Editor.

REFLEX S.W. RECEIVER

By Sir Douglas Hall, K.C.M.G., M.A. (Oxon)

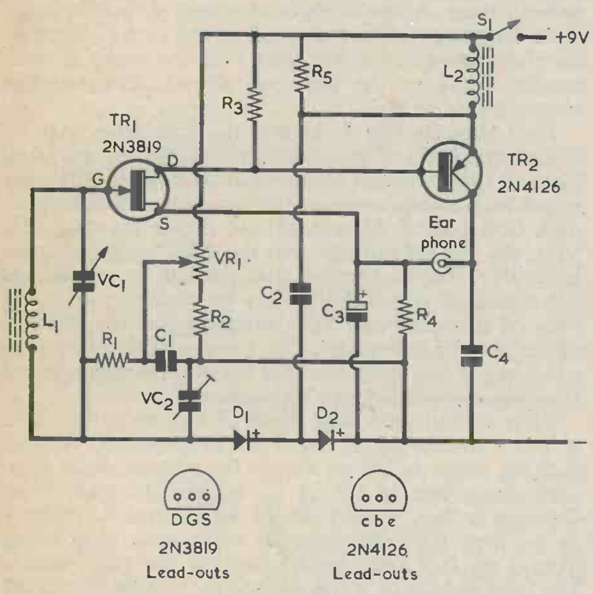


Fig. 1. The circuit of the double reflex short wave receiver

cies and the amplified r.f. signal is built up across choke L2. This signal is applied through C2 to the diode 'pump' formed by D1 and D2. It is essential that D1 be the R.S. Components type specified. Very many other types have been tried and all tend to fail in this particular circuit at or near the 19 metre band.

The signal is rectified by the diodes and applied, in audio form, back to the gate of TR1 which acts again as a voltage amplifier, but this time at audio frequencies. Direct coupling to TR2 once more takes place, with TR2 now acting as a common emitter audio amplifier. The output from TR2 collector is than taken to the earphone

VC2 gives a capacitance tap into the circuit, allowing reaction to be obtained by the Colpitts method, and it is adjusted to offer the optimum capacitance for this purpose. VR1 is the reaction control, and it varies the forward current flowing in the diodes via R1. If there were no forward current in these diodes they would not conduct and would function more as high value resistors.

COMPONENTS

Resistors

(All fixed values ¼ watt 10%)

R1	470kΩ
R2	470kΩ
R3	3.9kΩ
R4	2.2kΩ
R5	1kΩ
VR1	1MΩ potentiometer, log (see text)

Capacitors

C1	0.1μF polyester
C2	470pF silvered mica
C3	100μF electrolytic, 6 V.Wkg.
C4	0.01μF polyester
VC1	100pF variable, type C804 (Jackson)
VC2	40pF mica trimmer

Inductors

L1	Ferrite aerial coil (see text)
L2	1.5mH choke type CH5 (Repanco)

Semiconductors

TR1	2N3819
TR2	2N4126
D1	1S44
D2	1SJ50

Switch

S1 Miniature slide switch

Earphone

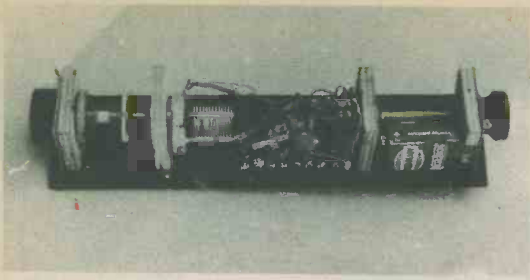
1kΩ magnetic earphone (see text)

Battery

9-volt battery type PP3 (Every Ready)

Miscellaneous

Ball drive with flange type 4511/F (Jackson)
Flexible coupler type 5610 (Jackson)
2 knobs (see text)
3.5mm. jack socket
Battery connector
Group panel, 18-way miniature (R.S. Components)
Ferrite rod, 6 by ⅜ in. diameter
Insulated ¼ in. rod, plywood, s.r.b.p. sheet (see text)



The receiver requires no external aerial and nearly all its components are mounted on a 9-way tagstrip

When forward current is gradually increased the diodes commence to rectify, and their forward resistance reduces as the current is made larger. In consequence VR1 controls the efficiency of the diodes in detecting the signal and also the forward resistance they offer. When VR1 is advanced sufficiently far the circuit oscillates, whereupon VR1 not only gives a control of detector efficiency, and hence of volume, but also functions as a reaction control. R1 limits the maximum current which can be passed by the diodes, whilst R2 enables a reasonably large proportion of the total range of VR1 to give useful control. With R2 at the value specified, reception of powerful signals at a reduced level is still possible when VR1 is set to minimum. Since, however, R2 has a value which allows a very smooth control of reaction to be given, this small shortcoming can be accepted. VR1 is a log potentiometer, connected to give increasing reaction as its spindle is turned anti-clockwise.

The r.f. choke, L2, has R5 connected across it to damp peaks which can otherwise result in instability at some critical reaction settings. This tendency arises from the use of an inductive load, i.e. the earphone, in the collector circuit of TR2.

Dealing next with components, the 1.5mH r.f. choke listed for L2 is available from a number of suppliers, including Henry's Radio, Ltd. Henry's Radio also stock the ferrite rod required for L1. An R.S. Components miniature 18-way group board is required and this can be obtained from Home Radio under Cat. No. BTS12. Alternatively, it may be purchased, in company with diode D1, from retailers of R.S. Components parts. The trimmer employed for VC2 was another R.S. Components part in the prototype, being a compression mica type with a minimum capacitance of 3pF. Other mica trimmers with the same capacitance range can alternatively be used. The 1MΩ potentiometer specified for VR1 is a type P20 without switch, available from Electrovalue Ltd., 28 St. Judes Road, Englefield Green, Egham, Surrey, TW20 0HB. When this is mounted in position there is only ¼ in. of spindle protruding for the knob. Several types of knob can be secured to a spindle length as short as this, and the point has to be borne in mind when selecting knobs. Finally to be considered are two Jackson components, these being the ball drive with flange type 4511/F and the flexible coupler type 5610. They are listed by Home Radio under Cat. Nos. DL50A and DL49A respectively. A ½ in. length of insulated ¼ in. diameter rod is needed between the ball drive and the coupler, and in the author's case this was a piece cut from the spindle of a potentiometer employed in another project.

CONSTRUCTION

Construction starts with the cutting out of the s.r.b.p. ('Paxolin') and plywood pieces shown in Fig. 2. The piece shown in Fig. 2(a) is s.r.b.p., and it requires cutouts for the 3.5mm. earphone jack socket and switch S1. The switch is later fitted with its mounting flanges on the outside of the s.r.b.p. panel, so that its body passes through the rectangular cut-out shown in Fig. 2(a). Some miniature slide switches may require cut-out dimensions slightly different from those shown in the diagram. The pieces illustrated in Figs. 2(b), (c), (d) and (e) are made of ¼ in. plywood. The ¾ in. diameter hole in Fig. 2(b) should be very slightly larger than this figure; it takes the ball drive flange and the latter should be free to rotate in the hole. The ⅜ in. holes in the pieces illustrated in Figs. 2(b) and (c) take the ferrite aerial rod. The right-hand edge of the ¼ in. hole in Fig. 2(e) just meets the ⅝ by 1 in. cut-out, and this is quite in order. After cutting out the four plywood pieces, these are cemented and screwed to the s.r.b.p. piece in the places indicated in Fig. 2(a), with the letters A to H corresponding to the positions shown. Countersunk screws should be used.

Next turn to Fig. 3. Mount the ball drive with its flange inside the ¾ in. diameter hole in the plywood piece of Fig. 2(b), and secure its anchor lug to this piece either with a woodscrew or with a nut and countersunk 6BA bolt passed through a hole in the plywood. Fit VC1, the flexible coupler and the ½ in. length of insulated ¼ in. rod, and ensure that the ball drive controls the capacitor smoothly. It may be necessary to cut a little off the spindle of VC1. When in position, the end of the ceramic base plate of VC1 opposite to the moving vanes tag is just flush with the plywood edge at corner D in Fig. 3. Next mount VR1 as shown.

L1 is wound on a tube made of Fablon or Contact. A piece measuring 2½ by 3 in. is required. All the backing paper is left on except for a strip about ½ in. wide along one of the 2½ in. edges. The Fablon or Contact is then wound on the ferrite rod to make a 2½ in. long tube, the exposed ½ in. wide strip being wound on last and thereby making the tube secure. The tube should be loose enough to be able to slip off and onto the rod. L1 consists of 12 turns of 26 s.w.g. enamelled copper wire spaced out so as to take up the whole length of the tube except for about ⅛ in. at each end. The ferrite rod is then passed through the ⅜ in. holes in the pieces shown in Figs. 2(b) and (c) so that it takes up the position shown in Fig. 3. The coil is then passed over the open end of the rod in the position illustrated in Fig. 3.

Take up the 18-way groupboard and cut out a 9-way single tagstrip from this. Fix the tagstrip to the s.r.b.p. panel in the position shown in Fig. 3 with two 10BA countersunk bolts and nuts. One of these passes through the hole in the second tag from the right (as seen in the diagram) whilst the other passes through the hole in the third tag from the left. If this last bolt is ½ in. long it forms a useful anchoring solder point for some of the rather large number of connections that are later made to this tag.

Next cover the s.r.b.p. panel outside surface (i.e. the surface away from the reader in Fig. 3) and edges with Fablon, making sure that the various screws and bolts passing through it have been correctly countersunk. Then fit the earphone socket and S1. The latter has its mounting flanges outside the Fablon and is secured with bolts and nuts of suitable size.

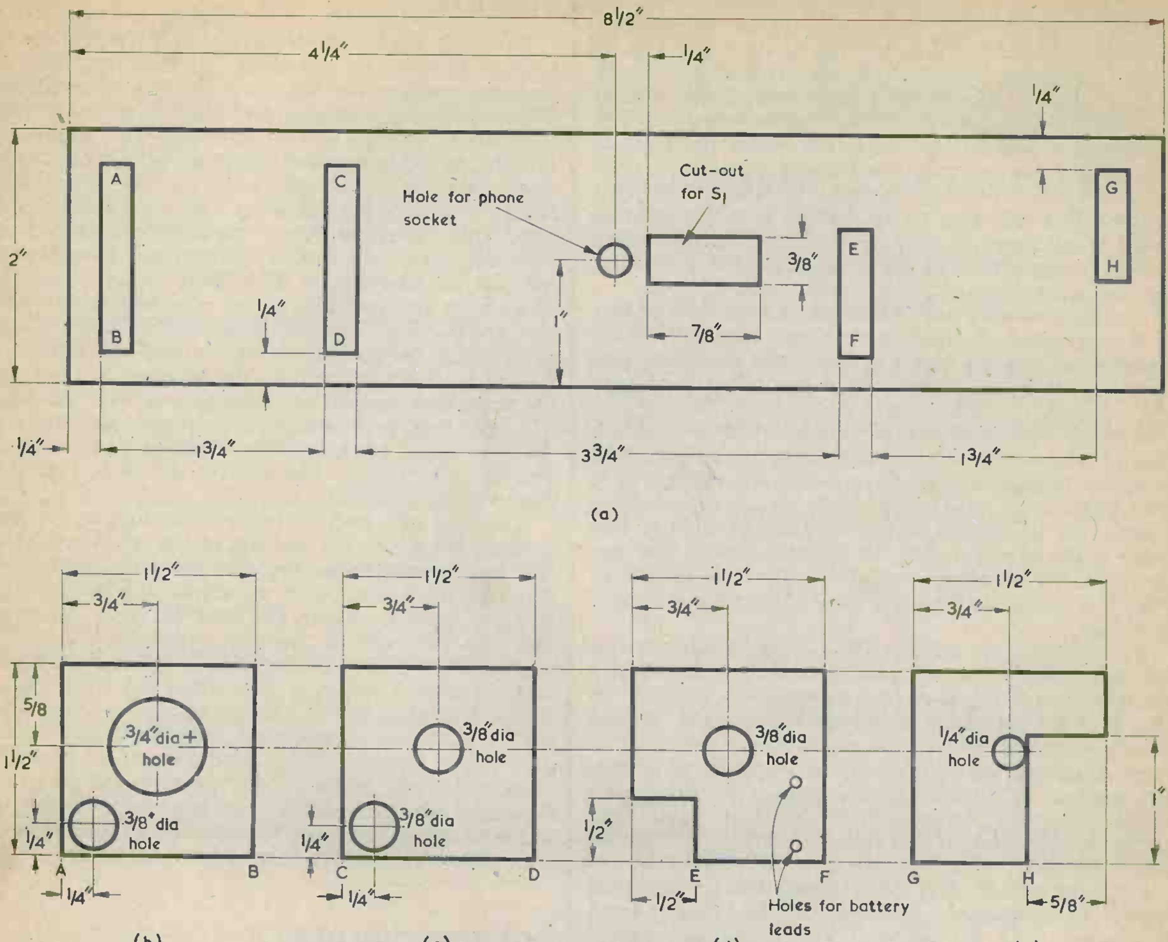


Fig. 2 (a). The s.r.b.p. panel on which the components are mounted
(b). The plywood section which takes the tuning ball drive
(c). The tuning capacitor, VC1, is secured to this section
(d). VR1 is fitted to this plywood piece
(e). End piece which takes the spindle of VR1 and assists in positioning the battery

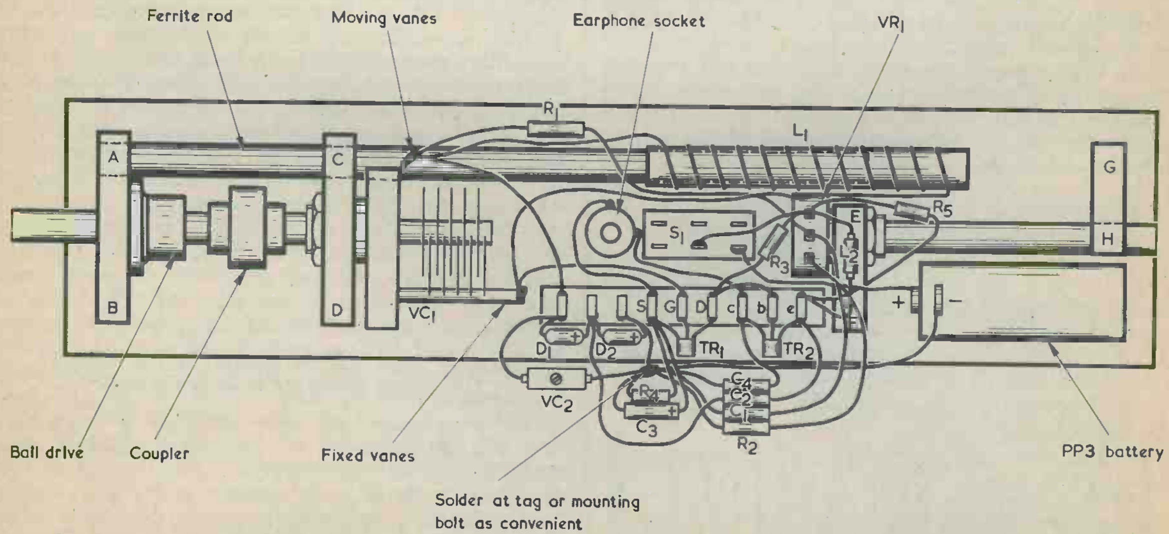


Fig. 3. Layout and wiring diagram for the receiver. The components connecting to the tagstrip are shown spaced out for clarity; in practice they should be positioned above the tagstrip

WIRING AND SETTING UP

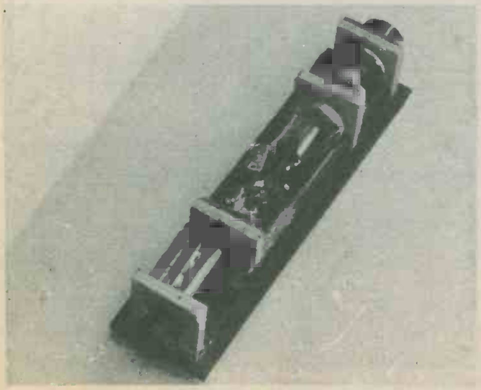
Wire up the small components as shown in Fig. 3. These are shown spaced out in this diagram for clarity but in practice they should be connected into circuit with leads as short as is reasonably possible. The components should be positioned above the tagstrip and should not approach the edge of the s.r.b.p. panel by less than ¼ in. Also connect up and fit the PP3 battery. The two wires to this battery pass through two holes in the plywood piece of Fig. 2(d). The end of the battery remote from its terminals fits in the ⅝ by 1 in. cut-out in the plywood section of Fig. 2(e).

The receiver may now be set up. Adjust VC2 so that it is unscrewed about a quarter turn from maximum capacitance. Set the vanes of VC1 fully enmeshed and turn VR1 fully clockwise. It is possible that the ferrite rod obtained by the constructor may be Blue grade, this being a lower permeability grade which, although recently discontinued by its suppliers, may still be held in some retailers' stocks. Such rods are identified by a blue paint mark at one end. If the rod is, indeed, Blue grade, coil L1 should be pushed fully onto it. If any other grade of rod is used, L1 is positioned so that one or two turns are off the rod and to the right as seen in Fig. 3. A further and more critical adjustment is carried out later.

Switch on and adjust VR1 in an anti-clockwise direction until a hiss is heard. A station in the 49 metre band will probably be picked up with VC1 adjusted so that it is a little below maximum capacitance. Should advancement of VR1 to the oscillation point result in 'motor-boating' or other instability, tighten the adjusting screw of VC2 a little. VC2 should not have a capacitance higher than is necessary to preserve stability on the 49 metre band. It will then be correctly set for all other bands.

If the ferrite rod is other than Blue grade, next adjust the position of L1 on it so that the 19 metre band is tuned in with the vanes of VC1 almost completely open. Do not attempt to make it possible to slide L1 fully onto the rod by removing turns from it. This will not be successful in practice and may render the 19 metre band impossible to receive. It is quite in order for part of L1 to be off the rod.

It will be found that VR1 has to be turned slightly further anti-clockwise to produce oscillation as VC1 is set to reduced capacitance and lower wavelengths are tuned. With typical transistors oscillation will probably start on the 19 metre band with VR1 turned two-thirds of the way to fully anti-clockwise, and on the 49 metre band with VR1 set to about one-third of the way to fully anti-clockwise.



OPERATION

No other setting up procedures are needed and the receiver is ready for operation. Rember that the most sensitive position for VR1 is *just* short of oscillation. The background is so quiet and reaction so smooth that it is easy to set VR1 too far anti-clockwise, whereupon no stations will be received except in the form of whistles. The trick is to use the right hand for VC1 with the left hand simultaneously adjusting VR1 very slowly as the bands are searched for a station. The ferrite rod assembly makes the receiver directional. Orientate the receiver for best results from each station, turning it away from an interfering signal whenever this is advisable and possible. This may prove impracticable in some cases when the unwanted station and the interfering station are both in line with the receiver! Do not hold the receiver in one hand whilst tuning with the other. This will introduce unwanted couplings and may even result in temporary instability, as indicated by a whistle unaffected by tuning. The receiver should be placed on a table or other surface.

A simple case may be made as in Fig. 4. The base consists of s.r.b.p. and the sides of ¼ in. plywood. When this has been screwed together the 'chassis' may be dropped into place. Check the actual dimensions of the 'chassis' before making the case in order to ensure that the two will fit together properly. Plywood is frequently measured in millimetres rather than inches, and sometimes so-called ¼ in. plywood is, in fact, a little thicker than this.

Cover the case with Fablon and glue small pieces of card to the plywood ends under the control knobs for VC1 and VR1. Make a wire pointer and fit to the flange of the ball drive. The positions of the five available bands can then be marked on the card below the pointer. The little receiver is now complete.

CURRENT VALUES

The current passed by TR1 will be between 100 and 150μA whatever the characteristics of the two transistors. The current passed by TR2 will vary, according to the characteristics of TR1, between about 500μA when a low amplification specimen is used for TR1 and about 2mA when TR1 is a high amplification device. There is a greater possibility of variations between specimens with TR1 than with TR2. A high amplification TR1 will give better results than a low amplification specimen, but any that pass the manufacturer's first grade test will be satisfactory. Rejects or seconds must be avoided at all costs. A 20kΩ per volt meter set to

Another view of the interior of the receiver, showing the ferrite aerial rod and coil

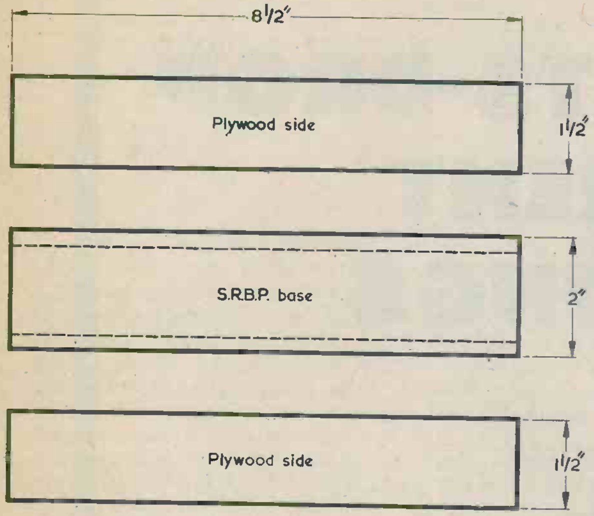


Fig. 4. A simple case may be made up by assembling the three sections shown here

read 10 volts full scale may be connected across R4 to give an indication of the 'goodness' of TR1. A really high gain specimen may give a reading of 5 volts or so. A weaker brother may not cause the needle to move further than between 1 and 2 volts.

Readers who have made the author's 'D.R.C. Junior' short wave receiver, which was described in the October 1973 issue, may like to know how results compare. On the 19 metre band the earlier receiver will probably give superior results, unless a very good specimen is used for TR1 in the current receiver. And, of course, the earlier receiver will give good results on 16 metres as well. Pick-up on these higher frequencies is not very efficient with a ferrite rod aerial and the new receiver is in any case a little less efficient as the frequency arises. On 25 metres sensitivity will prove about the same with both receivers. At 31 metres the present receiver will give louder results from the same station, and there is a marked improvement on the 41 and 49 metre bands with the newer receiver. On these wavelengths the usefulness of a telescopic aerial without an earth begins to decrease, while the ferrite rod becomes more effective. It should be remembered that the 'D.R.C. Junior' has the advantages of variable selectivity and bandspread tuning, but it needs a telescopic aerial: while the present receiver does not have these two refinements and operates without any form of external aerial.

LOW VOLTS-DROP CURRENT READINGS

by S. Jeffrey

A neat way of overcoming a common shortcoming in multimeter performance

Multi-range meters are invaluable in radio and electronic work, and modern instruments have impressively high sensitivities on their voltage ranges. On the other hand, nearly all multimeters, including in particular the more inexpensive types, have one serious shortcoming. This is that, due partly to the use of a universal shunt circuit, excessively high voltages are dropped across their test terminals when they are used for measuring high currents.

UNIVERSAL SHUNT

The reason for the high voltage drop can be understood by examining the typical universal shunt circuit shown in Fig. 1. Here, the lowest current range is given when the range switch is in position 1, whereupon the

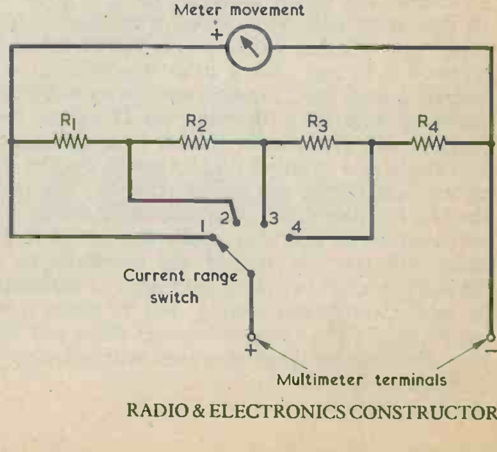


Fig. 1. The basic universal shunt circuit. Standard multimeters have a swamp resistor directly in series with the meter movement which is not shown here

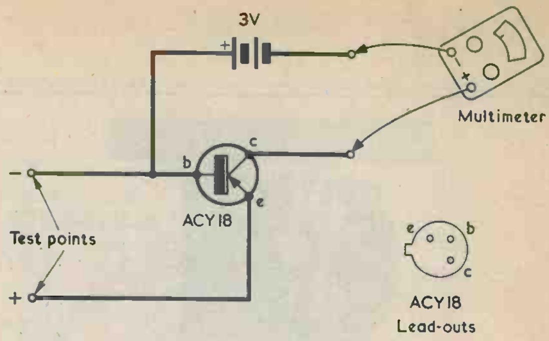


Fig. 2. In this test set-up the current to be measured flows between the two test points. The multimeter is switched to the desired current range

shunt across the meter movement consists of R1, R2, R3 and R4 in series. If the switch is set to position 2 the shunt becomes lower in value, since it is now given by the series combination of R2, R3 and R4 only. In consequence, position 2 of the switch corresponds to a higher current range. Position 3 of the switch selects a higher current range again, whilst position 4 provides the highest current range of which the circuit is capable, since the shunt is now provided by R4 on its own.

On position 4 of the switch, the meter movement connects to R4 via R1, R2 and R3, with the result that a higher voltage has to be built up across R4 to produce full-scale deflection than would be needed if R4 were a single shunt resistor connected directly across the meter movement on its own.

Not shown in Fig. 1 is the swamp resistor which is normally connected directly in series with the meter movement in a multimeter. The purpose of the swamp resistor is to 'swamp out' changes in the resistance of the meter coil due to changes in ambient temperature, and it necessitates yet a higher voltage across the multimeter terminals for full-scale deflection on the current ranges.

It can be seen therefore that, whilst universal shunt circuits provide an excellent answer to the provision of a number of current ranges in a multimeter, they have, in company with the swamp resistor, the disadvantage of requiring quite high voltages across the multimeter terminals to produce an f.s.d. reading on the higher current ranges. The voltages required for f.s.d. can, in practice, be surprisingly large. The author checked a low cost British-made multimeter and found that the voltage across its test terminals for f.s.d. was in excess of 1 volt on its 0–10mA range and was in excess of 1.5 volts on its 0–100mA range. These high voltage drops across the multimeter terminals can lead to confusing inaccuracies when measuring currents in low voltage transistor circuits.

The writer's solution to this problem is shown in Fig. 2. Here, the current to be measured is passed through the emitter-base junction of a germanium transistor, whereupon the voltage drop between the two points at which the current is measured is only of the order of 0.2 volt. The multimeter, switched to the desired current range, is then coupled between the collector of the transistor and the negative terminal of a 3 volt battery. The positive terminal of the battery connects to the base of the transistor.

With this set-up, there is only the 0.2 volt drop between the test points which was just mentioned. Also the multimeter indicates, with only a slight inaccuracy, the current flowing in the emitter-base junction of the transistor!

COMMON BASE TRANSISTOR

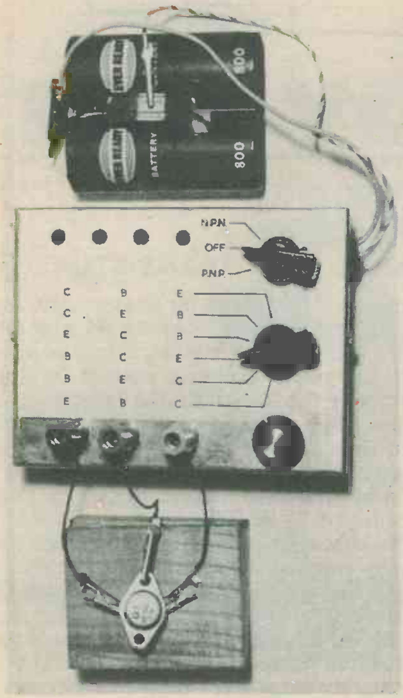
The reason for this little bit of electronic legerdemain is that the transistor is working as a common base amplifier, whereupon it has a current gain of slightly less than unity. The collector current flowing through the multimeter is equal to the emitter-base current minus the small amount of base current required to maintain the collector current. If the transistor has a current gain of 100, the multimeter reads 1% low.

The author has used this set-up for checking currents of the order of 10 to 100mA in transistor circuits and has found that it introduces no difficulties whatsoever. He initially checked the practicability of the scheme by inserting a second multimeter in series with the emitter of the transistor and then applying varying currents up to 100mA through this and the transistor emitter-base junction. There was no significant difference between the readings given by the two meters at any of the currents.

For currents up to 100mA or so, an ACY18 has proved quite adequate. This is a small transistor in a TO5 can and it runs slightly warm when it passes currents of the order of 100mA for long periods. For higher currents it may be advisable to fit it with a heat clip or to use a germanium power transistor such as the OC36. The test current must not exceed the maximum base current rating of the transistor. This is 0.25 amp with the ACY18 and 1 amp with the OC36. Also, avoid heavy current surges which may be given if there are large-value electrolytic capacitors in the circuit whose current is being measured. If possible, select a transistor with a fairly high hFE as this will ensure more accurate readings in the multimeter connected in its collector circuit. A silicon transistor cannot be used because it would present too high a voltage drop across its emitter-base junction.

A suitable and economic choice for the 3 volt battery is a twin cell cycle lamp battery, such as the Ever Ready type 800. A battery of this size will provide currents of the order of 100mA for quite long periods of time. The battery voltage must be greater than that which appears across the multimeter terminals at f.s.d., and 3 volts represents a useful practical figure.

If high current measurements are undertaken only occasionally then the transistor and battery can be hooked up on a temporary basis when required. If such measurements are carried out fairly frequently, then the transistor and battery can be housed in a small case with two input test terminals and two output terminals to which the multimeter can connect. An on-off switch is not needed as current is only drawn from the 3 volt battery when the multimeter is connected. ■



TRANS
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Part 1

ANYONE WHO HANDLES TRANSISTORS IN QUANTITY WILL agree that the vast army of different types which is currently available makes lead-out identification both time-consuming and irritating. The situation is worsened by the fact that there are sometimes different lead layouts in transistors having the same encapsulation, and because transistor manufacturers tend far too frequently to introduce their own individual lines. Even when one has the manuals or handbooks of all the major semiconductor manufacturers, these do not give details of the most recent releases. Nor, of course, do they offer any guide to many imported transistors, or to transistors whose type numbers have become defaced.

The unit to be described in this 2-part series is capable of locating the lead-outs of any normal bipolar transistor and it will also indicate whether that transistor is p.n.p. or n.p.n. Transistor types which can be identified in this way range from small signal amplifiers to power transistors, regardless of whether they are germanium or silicon. The major requirement is that the transistor being checked should have an h_{FE} of around 10 or more. The author has used the unit with 100% success to check a wide variety of transistors, these ranging from very early germanium devices to modern high gain silicon types. Whilst it is feasible that a few transistors will not give the required results with the unit, it would still seem reasonable to assume that the vast majority of transistors can be checked satisfactorily.

PANEL LAYOUT

Fig. 1 shows the front panel layout of the completed unit, and this will assist in explaining how it functions. At the top of the panel are four light-emitting diodes, LED1 to LED4. To the right is a 3-way rotary switch, S1, the three position of which are 'NPN', 'OFF' and 'PNP'. These three legends are marked on a piece of stiff card or similar which is positioned under the pointer knob of the switch. Below S1 is a 6-way rotary switch, S2, whose pointer knob, as it is turned round, points to any of the six possible combinations for the three lead-

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SISTOR
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By J. R. Davies

outs of a transistor. These combinations are also marked on the card, and they appear vertically above the three test terminals, 1, 2 and 3. At the right bottom is a round knob which is fitted to a potentiometer, VR1. This potentiometer is adjusted when checking some transistors in a manner which will be described later.

The three leads of the unknown transistor are connected to the test terminals and, if its polarity is not known, S1 is set to 'NPN'. Switch S2 is then taken through all its six positions. On some positions a single l.e.d. will be illuminated and on other positions no l.e.d. will light up. If a position is found in which two

...ribes the circuit ...t which is capable ...base, collector and ...any normal bipolar ...hich also indicates ...n.p. or n.p.n. The ..., to appear next ...e construction and ...ng up

COMPONENTS

Resistors	
(All fixed values ¼ watt 5%)	
R1	150Ω
R2	150Ω
R3	1.5kΩ
R4	180Ω
R5	150Ω
R6	150Ω
VR1	20kΩ or 22kΩ potentiometer, log
VR2	1kΩ potentiometer, skeleton pre-set, vertical mounting
VR3	1kΩ potentiometer, skeleton pre-set, vertical mounting
Semiconductors	
TR1	BC184L
TR2	BC184L
TR3	BC214L
TR4	BC214L
TR5	BC184L
TR6	BC214L
LED1–4	TIL209 or equivalent
Switches	
S1	4-pole 3-way rotary
S2	3-pole 6-way rotary
Battery	
BY1	3 volt battery

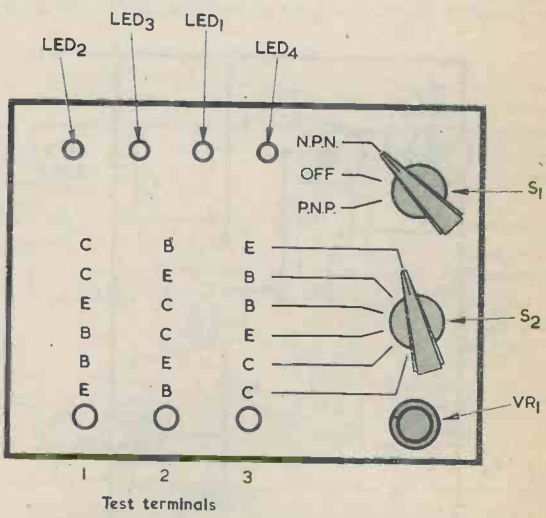
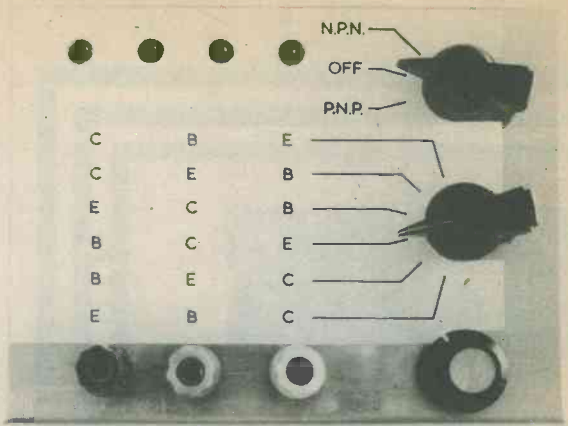


Fig. 1. The front panel of the unit. S1 and S2 are adjusted for illumination in two of the four light-emitting diodes, whereupon these two switches indicate transistor polarity and identify its lead-outs

l.e.d.'s light up then the transistor is an n.p.n. device and the knob of S2 is pointing to the letters which indicate its lead-ous. Thus, if two l.e.d.'s are illuminated when S2 is in its third position anti-clockwise, the emitter of the test transistor is connected to test terminal 1, the collector to test terminal 2 and the base to test terminal 3. If it is not possible to cause two l.e.d.'s to illuminate when S1 is at 'NPN', it is set to 'PNP' and S2 is once more taken through its six positions. Illumination of two l.e.d.'s will then confirm that the test transistor is a p.n.p. type with lead-outs as indicated by S2.

Occasionally, a transistor will be encountered which allows two l.e.d.'s to be illuminated at two settings of S2. An adjustment is then made to VR1 to eradicate the incorrect indication.

When the circuit of the unit is, later, examined, it will be found that S2 is a switch which presents the different transistor lead combinations to a sensing circuit. When the correct combination of base, emitter and collector is presented to the sensing circuit by S2, the two l.e.d.'s become illuminated. The knob of S2 then points to the particular combination it has selected from the test terminals.



Close-up of the front panel. This clearly shows the circuit configurations selected by the two switches

SENSING CIRCUIT

As is evident from Fig. 1 there are six possible lead-out combinations for n.p.n. transistors. The same six combinations are also possible with p.n.p. devices. Since we want to determine the polarity of the test transistor as well as its lead-outs the sensing circuit coupled to S2 must be capable of responding (by lighting two l.e.d.'s) to only one of the total of twelve options.

Fig. 2 shows the sensing circuit which is set up in the unit when S1 is switched to 'NPN'. To avoid confusion, component numbering in Fig. 2 is the same as that in the main circuit diagram for the unit. TR3 and TR4 are two high gain silicon devices coupled in tandem, with LED2 in the collector circuit of TR3. A 'conventional' current (from positive to negative) in the order of tens of microamps flowing from TR4 base is sufficient to cause TR3 to turn hard on and illuminate LED2. VR1 is the potentiometer just referred to which requires adjustment when a test transistor causes two l.e.d.'s to be illuminated at two settings of S2. Until it needs to be adjusted, VR1 is set to the position in which it inserts minimum resistance into circuit. R3 is a current limiting resistor. A third silicon transistor, TR5, controls the second light-emitting diode, LED3 VR2 is set up such that LED3 lights up when a current in the order of milliamps flows through the current limiting resistor R4. The process of setting up VR2 is extremely simple, incidentally, and the final adjustment required is not particularly critical.

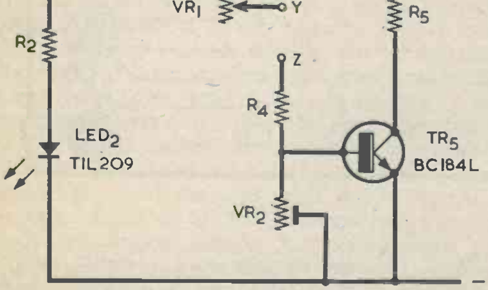


Fig. 2. The sensing circuit which is set up when S1 is set to 'NPN'

The three points, 'X', 'Y' and 'Z' couple to the test terminals of the unit by way of S2 and, thus, to the test transistor. Let us next see how the sensing circuit responds to different modes of connection to the test transistor, remembering that a bipolar transistor can be looked upon as two diodes connected back-to-back.

We can start with a transistor connected as shown in Fig. 3(a), where the transistor is a p.n.p. type with its collector connected to point 'X', its emitter to point 'Y' and its base to point 'Z'. For simplicity we shall call the TR3, TR4 circuit Current Sensor 1 and the TR5 circuit Current Sensor 2. We already know that Current Sensor 1 is much more sensitive than Current Sensor 2. We should also bear in mind that, since it incorporates the two silicon transistors TR3 and TR4, Current Sensor 1 will not indicate the presence of current until point 'Y' is taken at least 1.2 volts negative of the positive supply rail.

In Fig. 3(a), forward current flows through the collector-base junction of the test transistor to Current Sensor 2 and the latter indicates the presence of current by lighting its l.e.d. The base of the test transistor is held about 0.2 volt or 0.6 volt negative of the positive rail according to whether it is a germanium or silicon device, and not even leakage current can flow in Current Sensor 1. Thus, only one l.e.d. is illuminated.

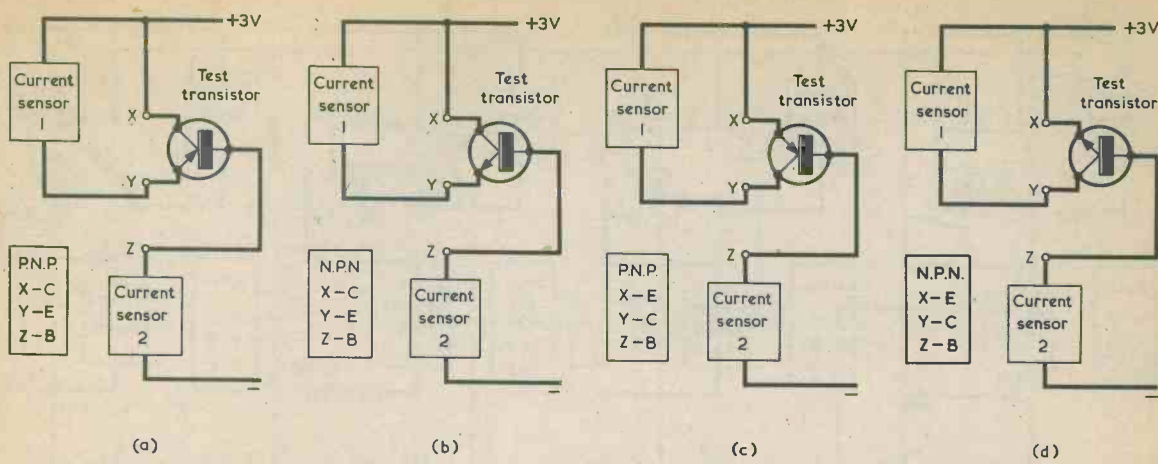


Fig. 3. Four of the twelve possible transistor configurations at points 'X', 'Y' and 'Z'. None of these result in the illumination of two light-emitting diodes

In Fig. 3(b) the transistor has the same connections but is now an n.p.n. type. Both junctions of the transistor are reverse biased and no forward current can flow. Leakage current could flow in the base-emitter junction and, if this were sufficiently large, its presence would be indicated by Current Sensor 1. It would not be indicated by the much less sensitive Current Sensor 2. Thus, either no l.e.d., or only one, will light up. ,

The conjunction of Fig. 3(c) gives the same effect as that of Fig. 3(a). Forward current flows in the emitter-base junction of the test transistor and its presence is indicated by Current Sensor 2. At the same time, the circuit of Fig. 3(d) offers the same results as that of Fig. 3(b).

Four more possible combinations are illustrated in Figs. 4(a) to (d). In Fig. 4(a) the base-emitter junction of the test transistor is reverse biased and no forward current can flow to Current Sensor 2. Since the base is at the same potential as the positive rail, not even leakage current can flow in Current Sensor 1. Similarly, no leakage current can flow in Current Sensor 1 in Fig. 4(b), although forward current can flow through the base-emitter junction of the transistor to Current Sensor 2, which then indicates the presence of this current. Fig. 4(c) offers the same results as Fig. 4(a), with the reverse biased base-collector junction preventing the flow of current to Current Sensor 2. Again, no leakage current can flow in Current Sensor 1. Nor can it

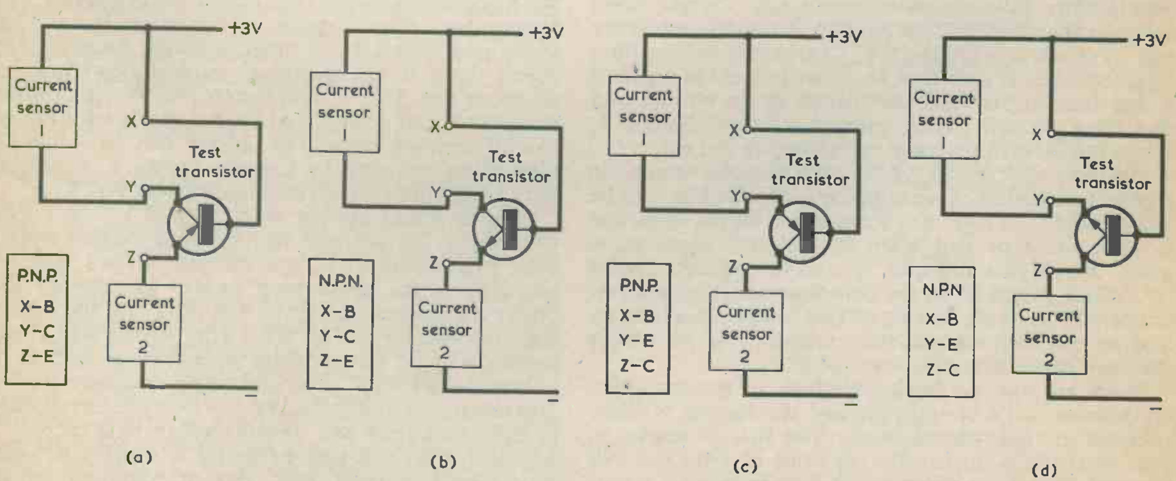


Fig. 4. A further four configurations. Again, none of these give illumination in two of the light-emitting diodes

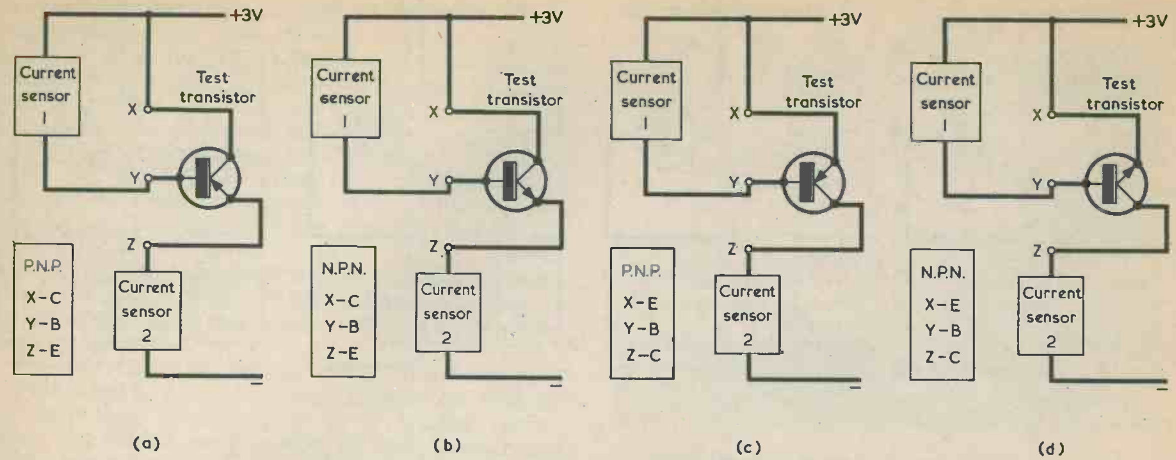


Fig. 5. The final four possible configurations. That at (b) results in the lighting of two l.e.d.s

in Fig. 4(d), which resembles Fig. 4(b) and allows the flow of current to Current Sensor 2 via the forward biased base-collector junction of the test transistor.

We turn next to Fig. 5(a). Here, the base-emitter junction of the test transistor is reverse biased and no forward current can flow in the circuit. Also, the base of the test transistor cannot go negative of the positive supply rail by more than 0.2 or 0.6 volt (according to whether the transistor is germanium or silicon) because of the collector-base junction. In consequence, no leakage current can flow in Current Sensor 1.

We have now examined nine different methods of connecting the test transistor to points 'X', 'Y' and 'Z'. In all instances there is either no indication of current flow by the two Sensors, or only one Sensor indicates the flow of current. The next configuration to be considered appears in Fig. 5(b). Here, we can forget about forward and reverse currents in the test transistor junctions because what we now have is a very recognisable emitter follower. A relatively high current flows through the collector and emitter of the test transistor and its presence is indicated by Current Sensor 2, whose l.e.d. becomes illuminated. A lower current is required at the base to maintain the current at the emitter and this base current passes through Current Sensor 1, which indicates its presence by lighting up its l.e.d.

We have now found the transistor connection mode which is needed to cause both the l.e.d.'s of Fig. 2 to be illuminated. The two l.e.d.'s light up when the transistor is an n.p.n. type and when its collector connects to point 'X', its base to point 'Y' and its emitter to point 'Z'. When switch S2 in the complete unit presents this configuration to the sensing section both l.e.d.'s light up and we can then read off the transistor lead-outs from the chart fitted behind the knob of S2.

There are still two further methods of test transistor connection to be considered, and the second of these presents an unexpected result. The first is shown in Fig. 5(c), which is virtually the same as Fig. 5(a). No forward or leakage currents can flow in either Current Sensor 2 or Current Sensor 1.

The final connection mode appears in Fig. 5(d). Thinking in terms of forward and reverse biased junctions we can see that a forward current can flow through Current Sensor 1, through the forward biased base-collector junction of the test transistor and then through Current Sensor 2. The base-emitter junction of the transistor is reverse biased and would not affect this flow of current. As may be seen from Fig. 2, Current Sensor 1 includes the current limiting resistor R3, whereupon the current which flows is sufficient to be indicated by Current Sensor 1 but is too low to be indicated by Current Sensor 2, with the result that only one l.e.d. would become illuminated. But we cannot think only in terms of forward junction currents with Fig. 5(d), because there is another current to be taken into account as well. This current appears because the transistor in the diagram is another emitter follower!

Due to their symmetric construction, all junction transistors offer a level of current gain when they are connected such that the emitter takes the place of the collector and the collector takes the place of the emitter. With some transistors the current gain offered by this 'wrong way round' mode of operation is very low, whilst with others it is surprisingly high. Because of this effect, there is an additional current flowing in the circuit of Fig. 5(d). This is the current flowing through the emitter and collector of the transistor with the two having reversed roles. The current can be sufficiently high to be indicated by Current Sensor 2, whereupon both l.e.d.'s light up just as occurred with Fig. 5(b).

It is to guard against being misled by the 'wrong way round' current gain of the transistor that VR1 of Fig. 2 is included. If, on turning S2, we find two positions which cause both l.e.d.'s to light up then one is the correct one, as in Fig. 5(b), and the other is the false one as in Fig. 5(d). The 'wrong way round' current gain of the transistor cannot be as high as the 'correct way round' gain, and so we eradicate the Fig. 5(d) situation by adjusting VR1 to insert more resistance in the base circuit and thereby reduce base current. A setting in VR1 will then be found at which the 'wrong way round' current gain cannot maintain current indication in Current Sensor 2, whereas the correct gain can. Switch S2 will then be able to indicate the desired single correct position in which both l.e.d.'s are illumin-

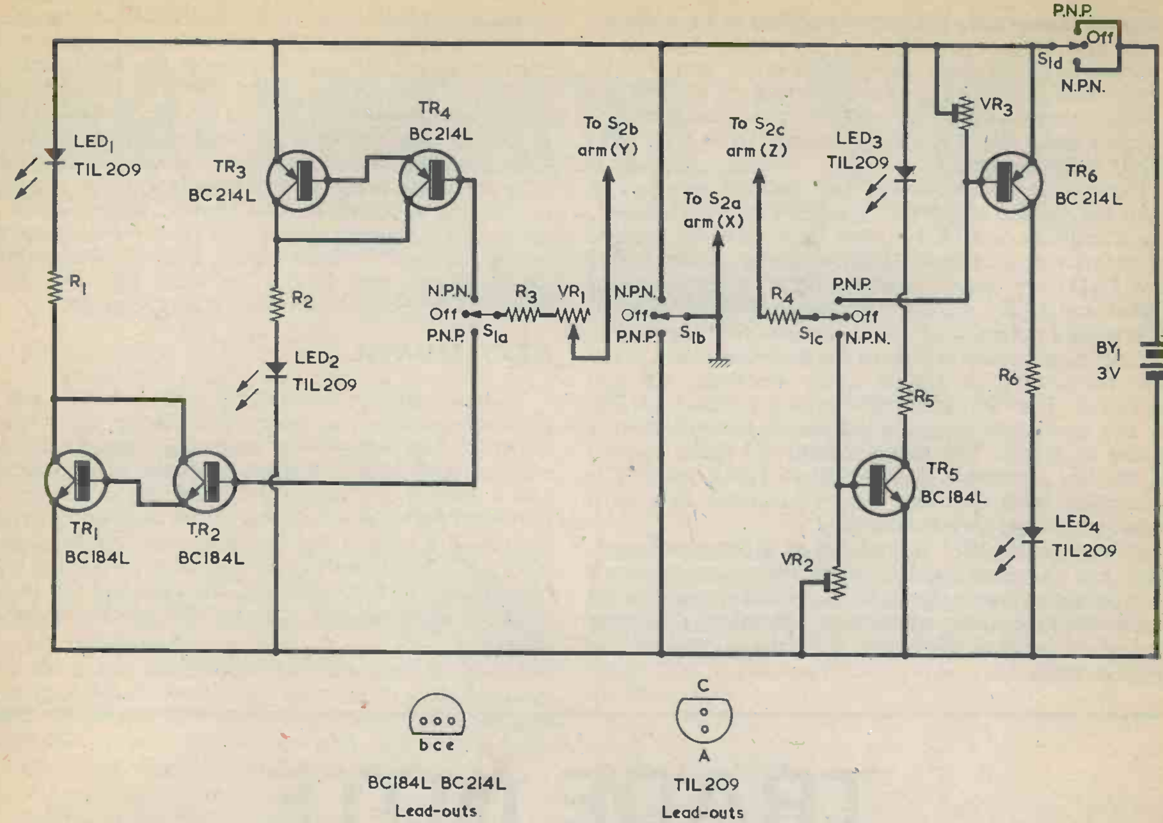


Fig. 6. The main circuit of the transistor lead locater

ated. With most transistors exhibiting the 'wrong way round' current gain effect it is merely necessary to turn the knob of VR1 through about ten degrees or so of travel to eliminate the false indication. It might appear possible to omit VR1 altogether and simply make R3 larger in value; but the writer's experience has been that the variable resistance is desirable since it can cope with the occasional transistor which has an exceptionally high 'wrong way round' gain. Also, an increased value in R3 would prevent the unit from operating with transistors having very low h_{FE} values.

COMPLETE CIRCUIT

The sensing circuit of Fig. 2 enables us to successfully identify the lead-outs of an n.p.n. transistor. If we reverse the supply and transistor polarities we can use the same circuit to identify the lead-outs of a p.n.p. transistor.

Fig. 6 shows the complete unit, with the exception of the S2 switching circuit, which is given in Fig. 7. Point 'X' of Fig. 2 corresponds to the connection to S2(a) arm, point 'Y' to the connection to S2(b) arm and point 'Z' to the connection to S2(c) arm.

In Fig. 6 S1 is a 4-pole 3-way rotary switch. When it is set to 'NPN' the circuit of Fig. 6 is identical with that of Fig. 2. Putting S1 to 'PNP' allows TR1 and TR2 to carry out the Current Sensor 1 function and TR6 to carry out the Current Sensor 2 function. Section S1(b) of the switch changes point 'X' from the positive to the

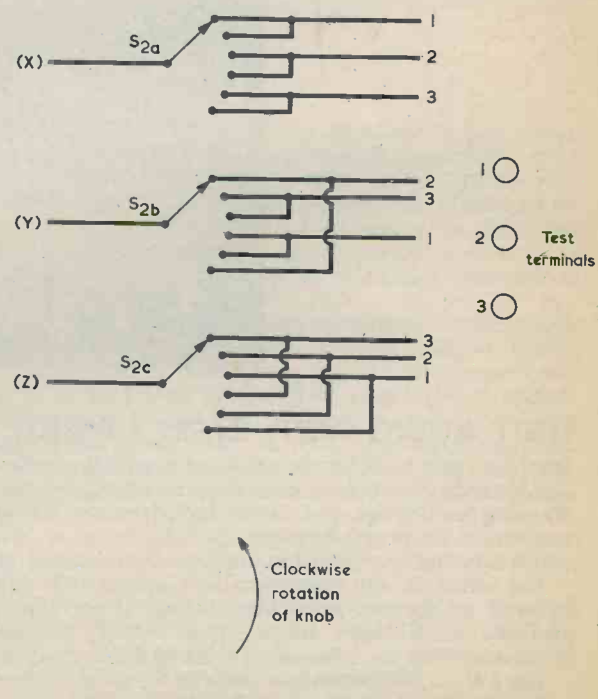


Fig. 7. The switching circuit to the three test terminals

negative supply rail. The centre position of S1 is 'OFF'. This method of switching is convenient because it enables an inexpensive make-before-break switch to be used. Having a central blank contact on S1(b) then ensures that there is no risk of temporarily short-circuiting the battery when changing from 'NPN' to 'PNP' and vice-versa.

It is possible to have R3, VR1 and R4 common to both the 'NPN' and 'PNP' sensing circuits. However, the transistors and l.e.d.'s have to be separate because of polarity requirements. Light-emitting diodes LED2 and LED3 are operative when 'NPN' is selected, and LED1 and LED4 are operative when 'PNP' is selected. The supply potential of 3 volts ensures that the reverse emitter-base voltage ratings of the transistors, and of the test transistors in almost every instance, are not exceeded. The light-emitting diodes are Texas TIL209 or any equivalent having a maximum forward current rating of 40mA. The series resistor R4 limits current in the test transistor to some 10 to 12mA when it is connected such that one of its junctions acts as a diode and passes forward current.

Potentiometer VR1 is specified as a log component. This has the advantage that the resistance it inserts into circuit increases slowly as its spindle is rotated from minimum resistance, whereupon the lower resistance end of its track is effectively 'opened out' and adjustment is eased.

The switching circuit for S2 in Fig. 7 has been made as simple as is reasonably possible and it shows the fixed contacts proceeding round in the same direction as is given when viewing them from the rear, as will be done when they are being wired up. The switch arms are illustrated in the position corresponding to the switch knob (as viewed from the front of the unit) being in the fully clockwise position, whereupon point 'X' connects to terminal 1, point 'Y' to terminal 2 and point 'Z' to terminal 3. As can be seen from Fig. 1, this corresponds to the requisite Collector, Base, Emitter configuration which causes two l.e.d.'s to light up. The other positions of S2 may be similarly traced through.

NEXT MONTH

In next month's concluding article details will be given of construction, wiring and setting up. A Components List specifying resistors, semiconductors, switches and battery is given with the present article, and a further Components List giving details of the hardware required will appear in the concluding article. Readers are advised not to obtain the two switches or VR1 until next month's article appears, when the types required will be fully discussed. Switches and a potentiometer of incorrect type may not fit into the layout of the unit.

(*To be concluded*)

TRADE NOTE

UNIT AUDIO WITH STEEL CASING

Steel has been used for the casing of the Darby "Slimline Harmony" matching turntable and amplifier units. By using pre-finished steel, Darby Industries are making economies in production yet manufacturing a unit which is selling by virtue of its attractive appearance.

The turntable unit comprises the Garrard SP25 Mk IV with smoke-grey transparent lift-off cover and is available in Midnight Black, Arctic White, Sterling Silver and Satellite – a beautiful brushed sateen chrome.

The 5W × 5W amplifier is made in the same colours and is fitted with bass, treble, balance, on/off volume and individual push buttons for radio, tape, mono or stereo. It is fully wired for radio and tape inputs and speaker outlets. Matching F.M. tuners and speakers are available.

The steel used is Stelvetite, one of a range of plastic and paint-coated pre-finished sheets manufactured by the British Steel Corporation, Strip Mills Division. Several are particularly suitable for use in making items for the home, among them soft flock effects, close reproductions of padded leather (both in feel and finish), woodgrains and simulated non-ferrous metals. They offer the strength and price economy of steel yet can be used to produce items with a luxury feel.

SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT

Frequencies = kHz

The subject of clandestine transmissions has often been mentioned in these articles and no excuses are offered for once again brining these to the attention of our readers – after all they are of some interest – both the transmitters and the readers!

In the main, clandestine transmissions are political in content which inevitably means anti-something-or-other. There are however other types of clandestine transmissions not bound up with the 'down-with-Bloggs' style of operation, as witness the following –

● SABBATH CLANDESTINES

Operating mostly on Sunday mornings (hence Sabbath) various stations may be heard in the 6MHz region presenting pop music to their devotees (if they exist). A recent quick survey at 1040 produced three such stations, these being Radio Scandinavia on **6250**, Radio Crystal on **6275** and Time Radio on **6236**. There are additional stations operating over this part of the dial in the clandestine mode – listen on the day indicated.

● POLITICAL CLANDESTINES

Voice of the Arabian Peninsular People has an anti-Saudi programme in Arabic from 1200 to 1300 on **7195, 9525, 9570** and **11950**.

Radio Sorush (Radio Inspiration) to Persia in Farsi on **7100** opens at 0230.

Peyk-e-Iran, also to Persia in Farsi, on **11695**, logged at 1602.

Voice of Free Cyprus, "I Foni tis Elevtheris Kiprou", pro-Makarios in Greek from 1130 to 1200 and from 1530 to 1600 on **6662**.

CURRENT SCHEDULES

● ALBANIA

Radio Tirana operates an External Service, in English to Europe, as follows – from 0630 to 0700 on **7065** and **9500**; from 1630 to 1700, 1830 to 1900, from 2030 to 2100 and from 2200 to 2230 on **7065** and on **9480**.

Relays are also made of some parts of the Radio Peking External Service, this often causing some confusion among SWL's. The relays are as follows – in English from 0100 to 0200 and from 0300 to 0400 on **7120** and on **9780**; in Spanish from 0001 to 0100 and from 2300 to 2400 od **7120** and on **9500**; in Portuguese from 2200 to 2300 on **7310**; in Hausa from 2100 to 2130 on **9500**.

● BANGLADESH

Radio Bangladesh, Dacca, directs an External Service to Europe, in English, from 1230 to 1300 on **15520**; from 1815 to 1900 and from 1900 to 1915 on **9550** and on **11635**. The latter transmission consists of a newscast read at slow-speed.

A programme in Bengali to Europe is radiated from 1645 to 1815 on **9550** and on **11635**.

● ZAMBIA

The Zambia Broadcasting Services radiate from Lusaka an External Service in English from 0700 to 0715 (Sundays only) newscast on **7220** and on **17895**; from 1115 to 1130 (Sundays only) newscast on **11880** and on **17895**; from 1600 to 1615 (Monday to Saturday inclusive) programme summary, musical interlude, on **4965** and on **9580**; from 1800 to 1815 (daily) newscast on **4965** and on **9580**.

In English and vernaculars as follows – "Zimbabwe Hour" from 0600 to 0700 on **7220** and on **17895**; "Namibia Hour" from 1100 to 1115 (continued from 1130 to 1215 after newscast) on **11880** and on **17895**; "Zimbabwe Hour" (not Sundays) from 1715 to 1800 (continued from 1815 to 1830 after newscast); the "South Africa Hour" from 1930 to 2030 and the "Namibia Hour" from 2030 to 2130 on **4965** and on **9580**.

● IRAN

Radio Iran, Tehran, currently presents an External Service, in English to Europe, from 2000 to 2030 on **9022**. A programme for Persians abroad is radiated from 2030 to 2130 on **9022** and on **15085**.

The Home Service may be heard at various times throughout the day on **7065, 9050, 15085** and on **17735**.

● **GREECE**

The National Hellenic Broadcasting Institute, Athens, offers an External Service almost entirely in Greek, that for Europe being broadcast from 1900 to 1950 on **7215.**

● **ISRAEL**

Kol Yisrael, Tel-Aviv, radiates a programme in English to Europe from 1900 to 1945 on **7395, 9009, 9495, 9815, 10250, 11700, 12025, 15100** and on **15490.**

● **CHILE**

An External Service is operated from Santiago from 1130 to 1215 in English, Spanish and Arabic and from 2030 through to 0500 in various languages on **15150.** The evening transmission in English is from 2200 to 2240 but from personal observation this is likely to vary at times. Other channels announced are **6290** and **9510.**

● **RHODESIA**

An African Service, in vernaculars is in operation on **5975** from 0530 to 1630, on **3306** from 0328 to 1530 and on **2336** from 0328 to 1700.

● **MALAWI**

The Malawi Broadcasting Corporation presents a Home Service from Blantyre which can be heard here in the U.K. on **3380** during the evenings, some of the programmes being in English. The schedule on this channel is from 0257 to 1110 and from 1300 to 2210. Other channels used by Blantyre are **5995** from 0600 to 1615 with **7100** as an alternative frequency.

● **ZAMBIA**

A General (Home) Service from Lusaka is on **3346** from 0255 to 1545 and on **7250** from 0545 to 1530. Other low-powered transmitters are used on various channels in this service, additionally **6165** is used throughout the periods shown above, this being a medium-powered transmitter. Many of the programmes are in English.

A Home Service is in operation at various time periods throughout the day and early evening on **3295, 4911, 6060, 7220** and on **9505.**

● **GAMBIA**

A Home Service from Radio Gambia, Banjul (formerly Bathurst) is to be heard on **4820** at various times throughout the day and evening. Here in the U.K., listen from around 1900 to 2300 (sign-off), some of the programmes being in English – newscasts etc.

● **VENEZUELA**

"Radio Nacional de Venezuela", Caracas, has an External Service in English and Spanish directed to Europe, North and South America over YVRO **15390** and YVRN **11750**, the English transmission being from 2200 to 2300 and from 0001 to 0100.

● **MONGOLIA**

For Dxers, the Mongolian external broadcasts from Ulan Bator are from 1330 to 1400 on **7235** and on **7260.**

AROUND THE DIAL

Most of our recent loggings have been on the LF bands but some of the more interesting HF band entries were –

● **PAKISTAN – 1**

Radio Pakistan at 1043 on **15115** with a programme of typical local music, with songs in Urdu by YL.

● **INDIA**

AIR Delhi at 1000 on **17775** with station identification and news of Indian affairs in English until 1010 when there followed an account of Indian government proceedings – very interesting.

● **ZAIRE**

Kinshasha at 2018 on **15245** when presenting colourful African music complete with chants, drums and female cries etc. On the LF bands we have –

● **MALAYSIA**

Kuala Lumpur at 2213 on **4845,** Indian-type music and songs in the Tamil Service.

● **ANGOLA**

CR6RW Radio Club de Cabinda at 1942 on **5032.5** with light orchestral music and OM in Portuguese. Sidesplash QRM from Tbilisi on **5040.**

CR6RH Radio Club de Huila at 1945 on **5025** presenting a protracted discussion in Portuguese.

CR6RZ Emisora Official at 2226 on **3375,** dance music and songs in Portuguese.

CR6RD Radio Club do Huambo at 1952 on **3345** with a talk by OM in Portuguese.

● **MOZAMBIQUE**

Radio Club de Mozambique at 2032 on **3210,** programme of light classical music with announcements in Portuguese.

R.C. Mozambique at 1834 on **3265,** OM with song in Portuguese, announcements by YL.

● **TANZANIA**

Radio Tanzania at 1800 on **4825,** six pips time-check, identification by YL "Dar-es-Salaam" then OM with world news in vernacular. Parallel transmission on **5050.**

● **UGANDA**

Kampala at 1937 on **5026,** OM with Moslem chants. Ensure that this transmitter is not confused with CR6RH on **5025** in Portuguese.

● **AFGHANISTAN**

Kabul at 1643 on **4775,** local music, announcements in vernacular then light classical music European-style.

● **BURUNDI**

Bujumbura at 1830 on **3300,** African drums, chants, local music, continuous heterodyne on channel.

Radio Cordac at 1859 on **4900,** OM in French then typical African music as interlude, more talk in French.

● **PAKISTAN – 2**

Radio Pakistan on **4835** at 1805, OM with newscast in English. Sign-off without National Anthem at 1810.

● **NIGERIA**

Kaduna at 2144 on **3396,** OM in vernacular, Euro-style dance music on records from 2148.

● **SOUTH AFRICA**

SABC Johannesburg at 1932 on **3320,** OM with talk in Afrikaans and at 1911 on **3285** with OM in English presenting programme of Glen Miller recordings.

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BLOCK LETTERS PLEASE

SELECTIVE RECEIVER

This second article in our 3-part series gives details of the construction and setting up of the receiver

THE RECEIVER CIRCUITS WERE DISCUSSED IN THE PRECEDING ARTICLE WHICH APPEARED LAST MONTH. Construction now commences with the preparation of the chassis and the case.

METALWORK

The chassis can be prepared from Figs. 4 and 5. All the valveholder holes should be punched out, even if a

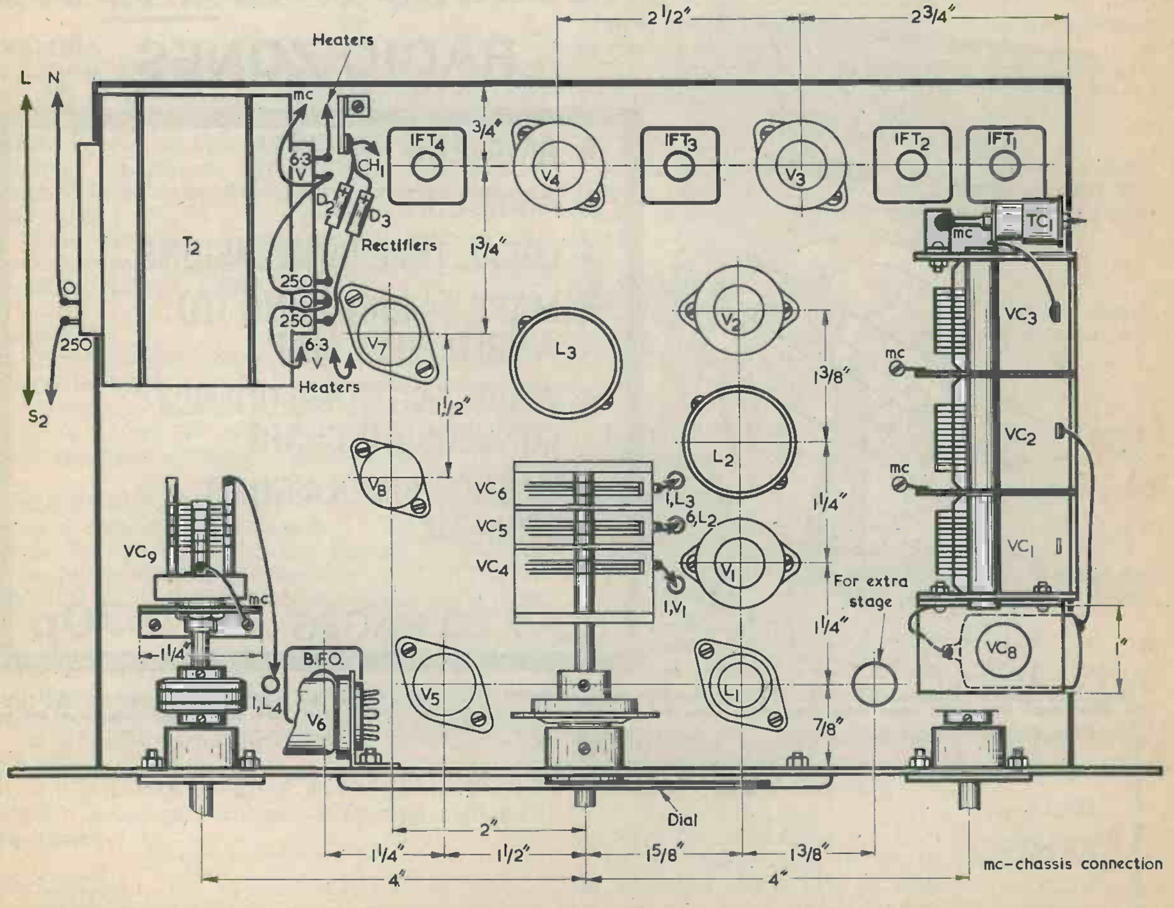


Fig. 4. Component layout above the chassis

For the L.F. Bands

Part 2

By F. G. Rayer, T.Eng (C.E.I.), Assoc. I.E.R.E.

simplified circuit is to be used at first, as cutting out the holes later would be a difficult operation. Fig. 5 shows the orientation required of the valveholders and also whether they are B7G or B9A. V1, V3 and V4 will have skirted B7G valveholders and V2 will have a skirted B9A valveholder. Cut out also the hole marked 'For extra stage' in Fig. 4. This should be for a B7G valveholder. A valveholder will be fitted here later if any of

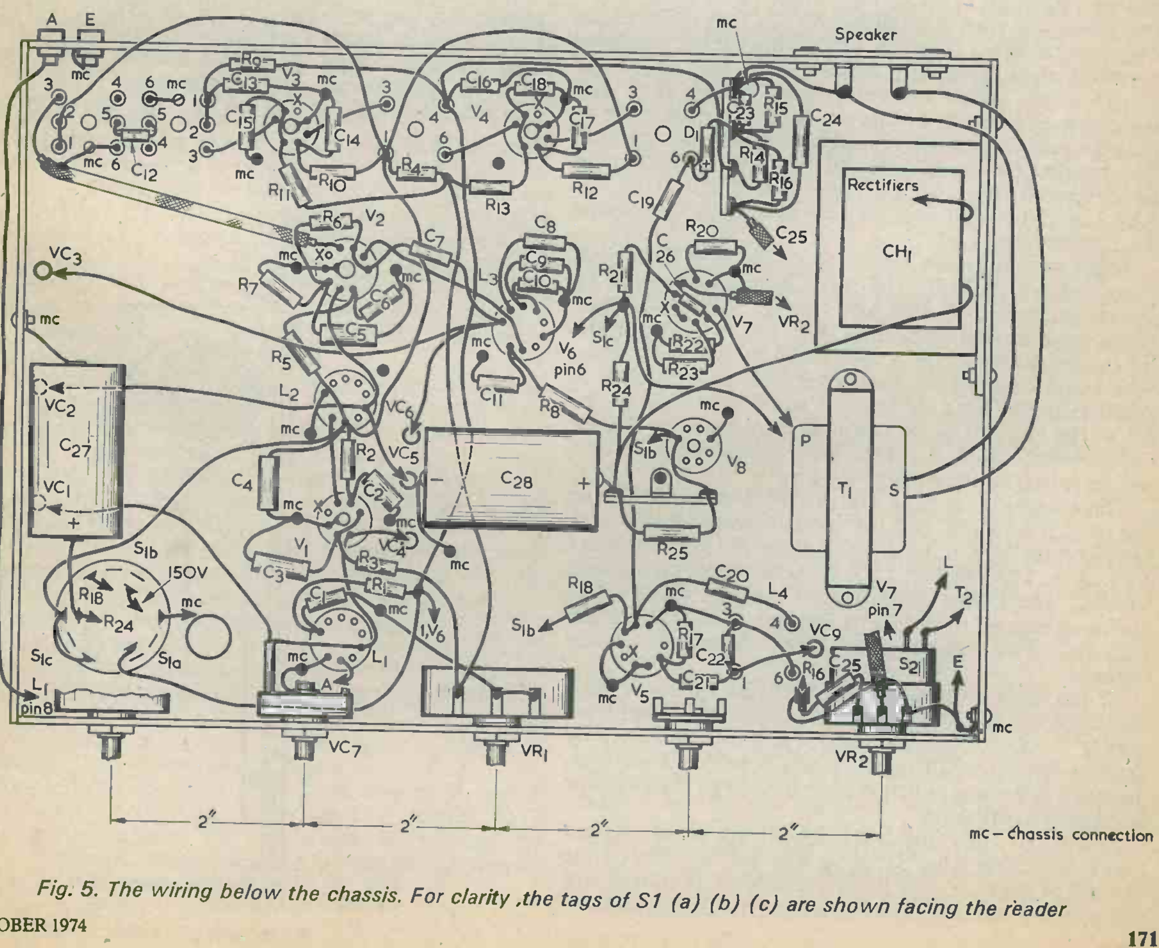


Fig. 5. The wiring below the chassis. For clarity ,the tags of S1 (a) (b) (c) are shown facing the reader

the optional extras are added. Some seven ½ in. holes are punched in the chassis for ventilation, one being between V7 and L3, two to the left (as seen in Fig. 4) of VC4, 5, 6, two on either side of V2, and two to the right of L2 and V1. Their precise positioning is not important. Four further holes are cut out in the chassis rear apron, as may be seen in the photograph in last month's issue. A few further holes may also be made in the chassis sides.

Holes for the i.f. transformers can be located with the aid of the paper template provided with these. A check should be made to see that items will fit correctly, but it is well not to finally mount any components until all drilling is complete and metal fragments have been cleaned away.

Care is necessary in lining up the drives and variable capacitors, so that these turn freely. The large 3-gang capacitor, VC1, 2, 3, is bolted to the chassis, but the central bandspread 3-gang capacitor is raised about ½ in. by the use of long mounting bolts with extra nuts.

Holes are cut out in the front of the chassis and the front panel for the five lower controls. These have the spacing indicated in Fig. 5 and can be a little higher than 1 in. from the chassis bottom according to the size of the controls used. The hole between VR1 and VR2 can, later, take a rotary on-off switch for the crystal marker. Drilled out in the chassis rear are the holes for the aerial, earth and speaker sockets, and for a grommet for the mains lead.

A slot 1⅜ in. by ¼ in. is cut in the front panel for the tuning indicator. This is best done by drilling a few small holes to start a small flat file, so that the opening can then be nicely finished. The EM84 tuning indicator valveholder is fixed to a bracket held by two of the screws which secure the bandspread tuning drive dial surround. See Fig. 6. Locate the holder and aperture so that the indicator display is directly behind the aperture. The bracket for the EM84, and two further brackets to be described, may all be conveniently cut from the 5 by 2 in. 'Universal Chassis' side which was included in the Components List.

Some modifications are made to the case listed, but these are not difficult. The lid is originally secured by six rivets, two each side and two at the back. These rivets are removed by drilling them out, whereupon the lid can be taken off. It is then fitted by two 6BA bolts, with nuts, through the back rivet hole of each side. A small terminal head or knob is screwed on top of the lid at the front. The lid can then be opened to change coils. When closed, it is kept flush by the flanges which will be found on the sides of the case.

Three ventilating slots are provided on each side of the case. Two slots, and the metal between them, were sawn out on the left, to leave an aperture approximately 3 by 2½ in. The speaker, LS1, is placed here (taking care to clear the mains transformer) and its fixing holes are marked and drilled. The speaker is bolted in place with a piece of expanded metal over the aperture inside the case.

At the back an opening 10½ in. wide by 2½ in. high is cut out to allow the back of the chassis to be approximately flush with the case rear. A saw can be started by drilling several small holes closely together. Five ⅜ in. diameter holes are punched near the top of the case, for additional ventilation.

Finally, to allow the underside wiring to be reached easily, a section 9 by 5½ in. in size was cut out of the bottom of the case. The chassis is flanged all round, and this opening matches the open area at the chassis bottom. Extra rigidity is imparted by bolting the back chassis flange to the bottom of the case. The front of the receiver is held by screws passing into the holes provided. A perforated metal or similar cover can be fixed over the bottom opening with self-tapping screws. When this is removed, wiring and components below the chassis can be reached without taking the receiver out of its cabinet. Similarly, components above the chassis can be reached by opening the case lid.

UNDERSIDE WIRING

Wiring can be completed from Fig. 5. It may be worth repeating that construction can be considerably simplified, and a working receiver can be more quickly obtained, by temporarily omitting the r.f. stage, one i.f. amplifier, and the b.f.o. and tuning indicator. This also allows the receiver to be tested in simplified form, and any of these stages can be added later.

A few points arise with regard to wiring and components, and these will next be dealt with.

The valveholders should be oriented as in Fig. 5, with solder tags under the securing nuts at all points marked 'MC'. The valveholders for V1, V2, V3 and V4 have their centre spigots connected to chassis. Tags 4 and 5 of V7 are taken to the lower current 6.3 volt winding of T2. All other valveholder tags marked 'X' are wired together, running the leads up against the chassis underside, and are connected to the remaining 6.3 volt winding of the transformer.

The i.f. transformer tags are numbered and must appear in the positions shown in Fig. 5. Each i.f. transformer is secured by two 6BA bolts with chassis tags where indicated. A central hole is needed under each i.f. transformer so that the lower cores can be reached. Sleeving can be put on the tags to prevent

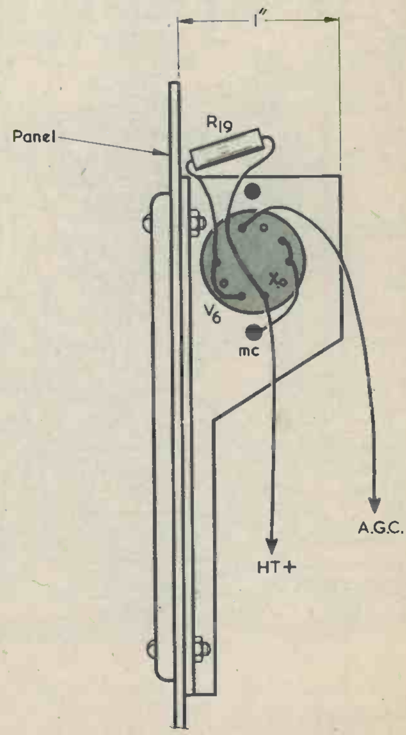
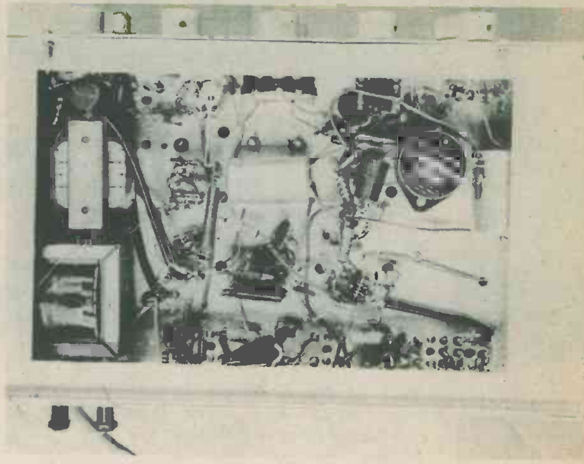


Fig. 6. Wiring and mounting details for the tuning indicator

A view inside the underside of the receiver



fragments of solder or metal short-circuiting them to chassis.

Screened leads are used in three places. The lead from tag 6 of V2 valveholder is screened to maintain stability and to avoid stray coupling to the filter provided by IFT1 and IFT2. The leads from VR2 and C25 to C24 and tag 7 of V7 valveholder are screened to avoid instability and pick-up of hum from the choke and from a.c. wiring. These screened leads are all run as convenient against the chassis underside, and the outer braiding is connected to chassis at the points indicated.

Both VC8 and VC9 are fitted to brackets cut out from the 'Universal Chassis' side referred to earlier. The bracket for VC8 is bolted to the two upper holes in the front plate of VC1, 2, 3, as indicated in Fig. 4. The bracket for VC9 is 2 in. high and also appears in this diagram. Advantage is taken of the existing flanges in the chassis side, and no bending of the brackets is required.

The three B9A valveholders for the coils are all plain types without skirts. L2 and L3 are screened, two of the cans and lids in which they are supplied being used for this purpose. Each lid, after having had a central section cut out, is clamped between the valveholder and chassis, and a small central hole is drilled in the bottom of each can. When the coils are inserted, the cans are screwed in place over them. The scheme is illustrated in the leaflet provided with each coil, the cans being specifically dimensioned for this purpose.

Leads from the bottom fixed vane tags of VC1, 2, 3 pass through holes in the chassis to the points shown in Fig. 5. The lead from VC1 connects to VC7 and is kept clear of VC2 wiring. Other leads pass up to the fixed vane tags of VC4, 5, 6, as in Fig. 4. The moving vanes of all variable capacitors are connected to chassis at chassis tags positioned close to them.

Connections to S1(a) (b) (c) are shown in Fig. 5. S1(a) short-circuits the a.g.c. line to chassis, S1(b) applies the regulated 150 volt supply to R18 and the b.f.o., whilst S1(c) disconnects h.t. from the i.f. and r.f. stages in its central position.

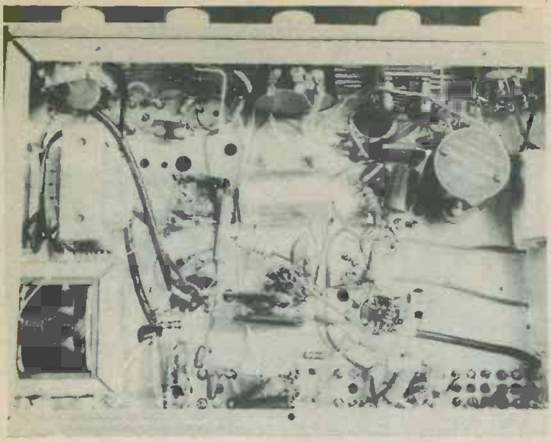
DIODE TAGSTRIP

A 4-way tagstrip takes the components in the circuit following diode D1. This tagstrip is wired as in Fig. 5. The components should be kept close together, near the chassis underside and away from the choke, in order to avoid possible pick-up of hum. D1 must be wired with the polarity shown.

The 3-core mains lead passes through the grommet in the rear chassis apron and should be reliably anchored inside the chassis. Take the blue neutral lead up through a hole in the chassis to tag 'O' of T2 primary. Take the brown live lead to S2, on VR2. Run a lead from the second tag of S2 to the appropriate voltage tag on T2 primary (usually '230V' or '250V'). This last lead and the neutral lead should pass through chassis holes fitted with grommets. Both live and neutral leads should be kept well away from the diode tagstrip. Connect the yellow-green earth lead reliably to the chassis tag adjacent to VR2. Fit the cord with a mains plug having a 2 amp fuse, correctly connected. Make quite certain that the yellow-green lead connects to the earth pin of the plug.

Leads from the secondary of T1 run to the speaker sockets on the rear chassis apron. Connected to the internal speaker are two flexible leads terminated in plugs which are inserted into these sockets. This allows easy connection of an external speaker or a speaker muting circuit.

As was mentioned earlier, the front panel hole between VR1 and VR2 is available for an on-off switch for the crystal marker, should it be decided to add this at a later date. If the crystal marker facility will not be required the hole can alternatively take a 2-pole 2-way rotary switch which controls the beat frequency oscillator. One pole of this switch would apply the 150 volt regulated supply to R18 whilst the other pole short-circuited the a.g.c. line to chassis when the b.f.o. was turned on. S1(a) (b) (c) could then be replaced by a single pole 2-way rotary switch which controlled h.t. in the same manner as S1(c) and which



A closer look at the receiver underside. The crystal marker stage was fitted when these photographs were taken

would function as a standby switch.

The tuning indicator holder is mounted as in Fig. 6, with the bracket being held by the tuning escutcheon securing nuts. Colour coded leads pass from point 'X' to the 6.3 volt line, to h.t. positive at the junction of R21 and R24, and to the a.g.c. line at R1.

The rectifiers D2 and D3 are supported by their wire ends between T2 h.t. secondary tags and the insulated tag of a 2-way tagstrip, as in Fig. 4. A lead passes from the insulated tag to choke CH1. Be sure the rectifiers are connected with correct polarity.

The input lead from the aerial socket passes out through the side of the chassis, runs along on the outside and then enters the chassis again near S1(a) (b) (c) to couple to tag 8 of L1.

In general, it is helpful to use several colours for wiring up. For instance, red could be employed for h.t. positive circuits, blue for heaters, and white for a.g.c. wiring. The use of coloured wire simplifies later additions. The h.t. positive, heater and a.g.c. wires are run close to the chassis underside. All other leads should be short and direct.

ALIGNMENT

If a signal generator is available this can be used to help align the i.f. transformers and to set range coverage. However, satisfactory alignment is possible without a generator.

To set up the i.f. transformers, tune in a signal which causes deflection in the EM84 with VR1 at maximum gain. A steady signal is required, such as that from a medium wave B.B.C. transmitter. At the same time the signal input to the receiver should be small, and the signal should be picked up with the aerial disconnected or with a very short wire being used. All the i.f. transformer cores are then adjusted a little, as necessary, for maximum signal strength as shown by the tuning indicator. Once adjusted, these cores are left alone and should not be moved during subsequent trimming.

To adjust the r.f., frequency changer and oscillator circuits, insert one set of coils and place the cans on L2 and L3. Connect a normal aerial. Set VC7, VC8 and TC1 at about half maximum capacitance. Tune in a fairly weak signal near the low frequency end of the range and adjust the cores of L1 and L2 for best signal strength, as shown by the tuning indicator. If, with VC1, 2, 3 at maximum capacitance, the range-end frequency is not suitable, adjust the core of L3 to correct this, and re-adjust the cores of L1 and L2 for best results.

Subsequently tune in a fairly weak signal near the high frequency end of the range. VC7 and VC8 should then peak up quite sharply for maximum sensitivity. Some control over the high frequency range-end frequency is given by TC1, but it must always be possible to peak signals with VC7 and VC8 at settings which are between their maximum and minimum capacitances.

After tuning in a signal near the high frequency end of the range and then setting VC7 and VC8, re-tune to a signal near the low frequency end of the range. Make any small adjustment necessary to the cores of L1 and L2 without altering the settings of the trimmers VC7 and VC8. Satisfactory reception should then be obtained over the whole range, though VC7 can be adjusted to peak up weak signals or when changing the aerial. The core of L3 can be locked with a 6BA nut. On Ranges 4 and 5 avoid trimming, at the high frequency end, to a second channel signal. If a signal is picked up at two points on the dial separated by twice the i.f. (slightly less than 1MHz) the correct receiver tuning point for trimming is that which corresponds to the lower tuning capacitance. This ensures that oscillator frequency is higher than signal frequency.

Any other ranges provided are dealt with in the manner just described. If adjustments to the cores of L1 and L2 are a little in error this is shown by the need for frequent re-adjustment of VC7 and VC8 when tuning across the range.

B.F.O. ADJUSTMENT

To adjust the b.f.o. core, tune in a steady a.m. signal correctly and switch to 'CW/SSB'. Set VC9 to half its maximum capacitance. Adjust the core of the b.f.o. coil, L4, until a strong audio heterodyne is heard, and then set the core to produce zero beat. Rotating VC9 either way from its central position will then produce an audio tone which rises in pitch.

The b.f.o. is not normally used for a.m. reception. To receive c.w., adjust VC9 either side of the signal, to produce the wanted audio tone. Occasionally one side may result in less interference from neighbouring signals than the other.

To receive s.s.b., VC9 has to be tuned to provide a carrier which replaces that suppressed during transmission. If the control is set incorrectly, resolution of the transmitted speech is not possible. The way in which the b.f.o. control operates will soon become clear.

For a.m. reception r.f. gain is normally near maximum, with volume adjusted by the audio gain control. But for c.w. and s.s.b. reception, audio gain must be set near maximum and signal strength reduced as required by turning back VR1.

EXTRA STAGES

In next month's concluding article, details will be given of the optional extra stages which can be added to the receiver.

(To be concluded)

Extension Speakers for Transistor Radios

By R. N. Soar

Improving the audio quality from personal portables

THE DRAWBACK WITH SMALL TRANSISTOR RADIOS IS THE poor quality of the sound they reproduce, this being mainly due to the tiny speakers which are fitted in them. When the receiver is in use at home, however, it is possible for its output to be coupled to a larger speaker or speakers mounted in a cabinet which provides adequate baffling. The external speaker or speakers will then give an improved audio output, this having an extended response at the lower frequencies together with a freedom from the overloading which is evident in the internal speakers of small radios. Furthermore, a fraction of the higher audio frequencies can be fed back to the speaker in the radio, which will then function as a tweeter.

The scheme is feasible with most radios having a personal earphone socket which causes the internal speaker to be muted when an earphone jack plug is inserted. The receiver has to be modified by the fitting of an additional jack socket.

OUTPUT SOCKET

The conventional output circuit for a small transistor radio has the form shown in Fig. 1. When no plug is inserted in the earphone socket the internal speaker is coupled direct to the output stage of the receiver. Inserting a plug in the socket disconnects the internal speaker and couples the a.f. output to the earphone. Both the internal speaker and the earphone have a common connection at one of the supply rails of the receiver. In some sets this will be the rail which connects to chassis, whilst in others it will be the opposite supply rail.

The receiver is modified by fitting an additional jack socket to it, as shown in Fig. 2. The added socket must be a different type to the one already fitted. If the existing jack socket is a 2.5mm component then the added socket must be 3.5mm, and vice versa. The new socket is wired to the speaker and the appropriate

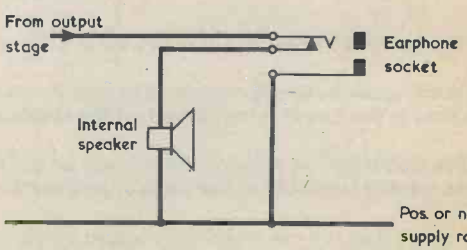


Fig. 1. An output circuit encountered in many portable transistor radios

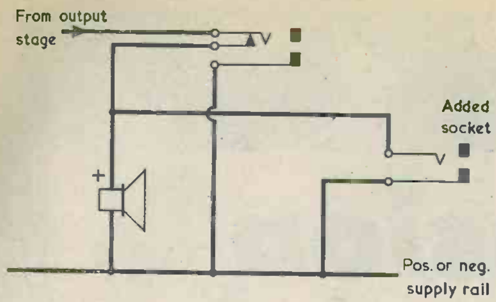


Fig. 2. An added jack socket is fitted to the radio for the modification described in this article

supply rail as shown.

An external speaker or speakers may then be plugged in as illustrated in Fig. 3, where it can be seen that connection is made to the receiver output stage via the earphone socket. The impedance presented by the external speaker or speakers must not be less than the impedance of the internal speaker in the receiver. The author finds that it is possible to obtain 3Ω speakers from discarded television receivers at quite low prices. Three 3Ω speakers in series fitted in a single cabinet would couple comfortably to a receiver whose internal speaker has an impedance of 8Ω. Even a single speaker of the correct impedance and having a diameter of about 4 to 5 in. should give a better performance than the 2 to 2½ in. internal speaker typical with personal portables.

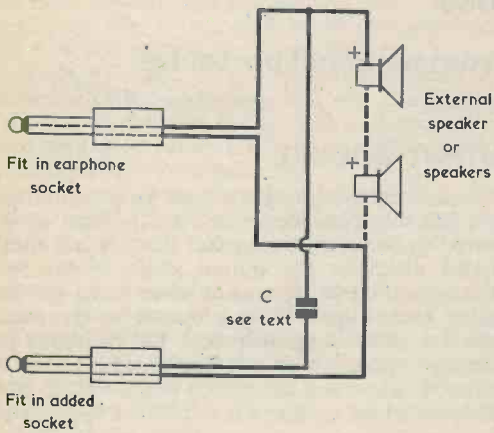


Fig. 3. How the external speaker or speakers and series tweeter capacitor are wired

TWEETER

Coupling back to the receiver internal speaker is provided by a jack plug which fits into the added socket. This coupling is achieved via capacitor C. The capacitor offers reducing reactance as frequency increases, whereupon the receiver internal speaker can function, with a lower signal input than normal, as a tweeter.

If the receiver is stood on top of the external speaker cabinet the high frequency sound from its own speaker will blend in with the lower frequencies from the external speaker cabinet. The receiver speaker and the external speaker or speakers should be correctly phased, as indicated by the plus signs in Figs. 2 and 3. Connect a 1.5 volt cell to the receiver speaker with positive to the non-earthy speaker tag and observe whether the cone moves in or out. Then apply the cell to the external speaker or speakers, find the speaker tag which gives the same cone movement when it is positive, and then mark it in some convenient way. This is the speaker tag, or tags, indicated by the plus sign in Fig. 3.

The value of C in Fig. 3 is left to personal choice. The author obtained good results in an 8Ω system with a 2μF capacitor here. The capacitor has to be a non-electrolytic type, and it can be mounted in the external speaker cabinet.

The receiver modification does not alter its portability When the two jack plugs from the external circuit are removed the radio may be used just as before, either with its own internal speaker or with an earphone. ■

BACK NUMBERS

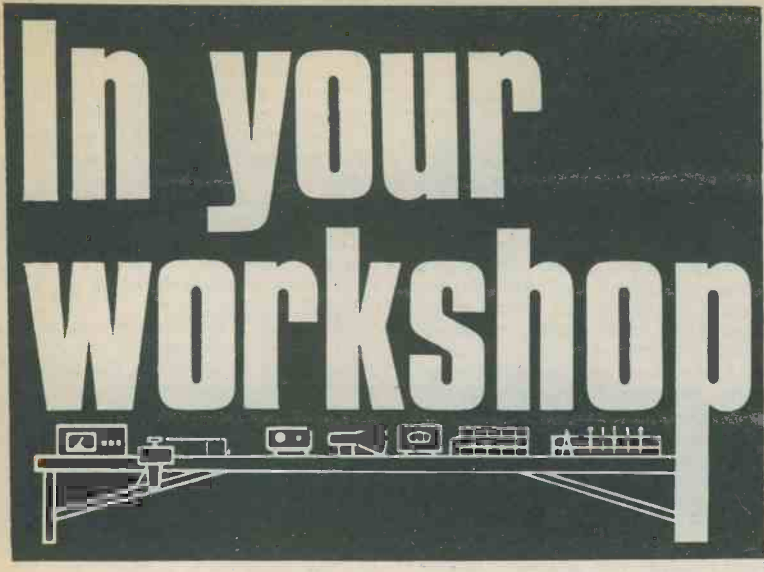
For the benefit of new readers we would draw attention to our back number service.

We retain past issues for a period of two years and we can, occasionally, supply copies more than two year old. The cost is the cover price stated on the issue, plus 6p postage.

Before undertaking any constructional project described in a back issue, it must be borne in mind that components readily available at the time of publication may no longer be so.

We regret that we are unable to supply photo copies of articles where an issue is not available. Libraries and members of local radio clubs can often be very helpful where an issue is not available for sale.

In your workshop



This month Smithy the Serviceman, accompanied by his able assistant Dick, embarks on the repair of a gated a.g.c. circuit in a 625 line monochrome TV receiver. He also exhibits quite unexpected talents in the field of chiropody

SMITHY ENTERED THE WORKSHOP, switched on the lights, and glanced around him keenly. A glint came into his eyes as he noticed the partly disassembled monochrome television receiver which stood on his bench. He had just begun work on this set before the weekend intervened. Now, at the start of a sharp October Monday morning, he looked forward to the challenge that the receiver presented to him.

He took off his raincoat, hung it on the hook behind the door and then slipped on his overall jacket. He walked purposefully towards his bench then stopped and stiffened.

The sound of a shambling, shuffling gait was just audible from the other side of the door.

FOOT TROUBLE

The irregular stumbling footsteps became louder and louder. Suddenly the door was flung wide open and Smithy's assistant, Dick, staggered into the Workshop. He followed an erratic path towards his bench and then sank gratefully down on his stool.

"Ye gods," expostulated Smithy. "What on earth is the matter with you?"

"I'm having trouble with my foot," replied Dick, wincing. "It's been getting gradually worse all over the weekend, and this morning it was really terrible. If I wasn't so dedicated to my work, I wouldn't have come in."

Smithy gazed distrustfully at his assistant.

"Which foot is it?"

"My left one. I can hardly put any weight on it at all."

Smithy looked down at the defective member. For once, Dick was wearing respectable brown leather shoes, and there did not appear to be any obvious irregularity in these or any distortion in the shape of the left ankle.

"Humph," grunted Smithy uncertainly. "Well, I suppose you'd better take things easy for a while. Perhaps your foot will get less painful if you rest it for a bit."

"All right," replied Dick obligingly.

He spied the television receiver on Smithy's bench.

"Tell you what I'll do," he offered eagerly. "If it's O.K. with you, I'll give you a hand with that set you've got there."

Smithy considered this suggestion. It would at least, he decided, enable him to keep an eye on his assistant. Indeed, Dick could actually be of some help.

"Very well then," he stated. "I've got some voltage checks to do on it next, so you might as well tell me what the meter readings are."

Dick hobbled over to Smithy's bench, dragging his stool behind him. Eventually, and after many grimaces indicative of intense pain, he succeeded in perching himself on the stool.

"What," he asked, "is wrong with the set?"

"There's no sound or vision," replied Smithy. "It's one of those single standard 625 line mains-battery jobs, and I'm getting an unmodulated raster on it. But no actual vision."

"No sound or vision, eh?" repeated Dick musingly. "The fact that you're getting a raster does at least mean that the frame and line timebases are working."

"True," confirmed Smithy, "and that's just as far as I got before I packed in work for the weekend. Now, since both sound and vision are missing it's very probable that the fault is in one of the amplifying stages before the 6MHz sound take-off point. As you know, in 625 line receivers the sound is taken off as a 6MHz intercarrier signal after the vision detector. In some sets, it's taken off after the emitter follower which usually comes after the vision detector, but in this receiver the sound take-off point is immediately after the detector itself." (Fig. 1).

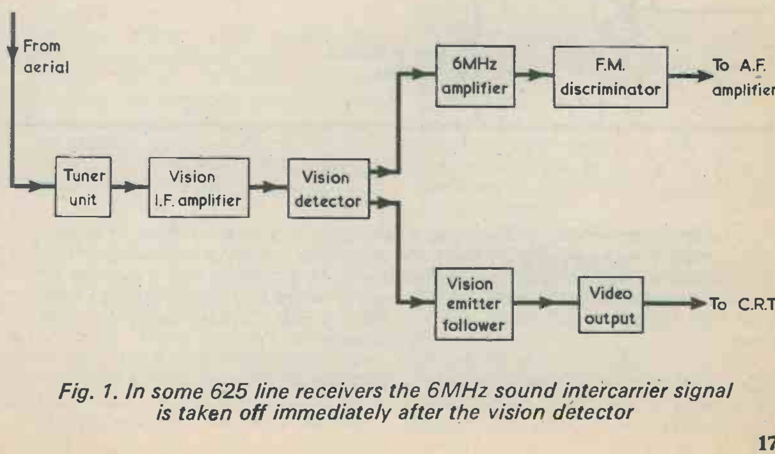


Fig. 1. In some 625 line receivers the 6MHz sound intercarrier signal is taken off immediately after the vision detector

"Fair enough," commented Dick. "Then the troubel should lie in either the tuner unit or in the vision i.f. stages. Or, come to that, in the vision detector circuit as well."

"Correct," confirmed Smithy. "Since it's a straightforward case of loss of signal, we may be fortunate enough to find a nice obvious fault. I've got the service manual out for the set, and I'm now going to have a quick dig around to see what the voltages are in the stages before the vision detector. The i.f. stages will do for a start."

Smithy turned on the receiver, switched his testmeter to a voltage range and clipped its negative lead to the receiver chassis. After consulting the service manual, he applied the positive test lead to the circuit board.

"What voltage have I got here?"

Dick leaned over and glanced at Smithy's testmeter.

"The meter's showing 25 volts," he replied.

EMITTER VOLTAGES

"That seems reasonable enough," commented Smithy, removing the positive test prod. "I'd connected the meter to the positive supply rail for the last two i.f. stages. What's the meter say now?"

"Let's see. Ah yes, 19 volts."

"And that," stated Smithy, "is the positive supply voltage to the first two i.f. transistors. It's lower than the previous voltage because there's a decoupling resistor between the two supply rails."

"Here," put in Dick, "hang on a minute!"

"What's the trouble?"

"Isn't this set one of the type which runs from the mains or from a 12 volt battery?"

"It is."

"Then how do you get supply voltages of the order of 25 volts?"

"You get them," explained Smithy patiently, "from the line output transformer. These mains-battery sets operate with a stabilized supply of around 11 to 11.5 volts. Higher supply voltages are then obtained either from the line output stage boost capacitor or from additional windings on the line output transformer. In this case, the supply for the i.f. stages is obtained from the boost capacitor." (Fig. 2).

"Oh yes of course," said Dick ruefully. "I'd forgotten about the higher supply voltages you get from the line output stage in these sets."

"O.K. then," said Smithy busily. "Now, whenever you suspect any individual amplifying stages, and if these stages have series emitter resistors, it's always a good plan to check the voltages at the emitters. These will at once show up obvious faults such as incorrect bias or open collector circuits." (Fig. 3).

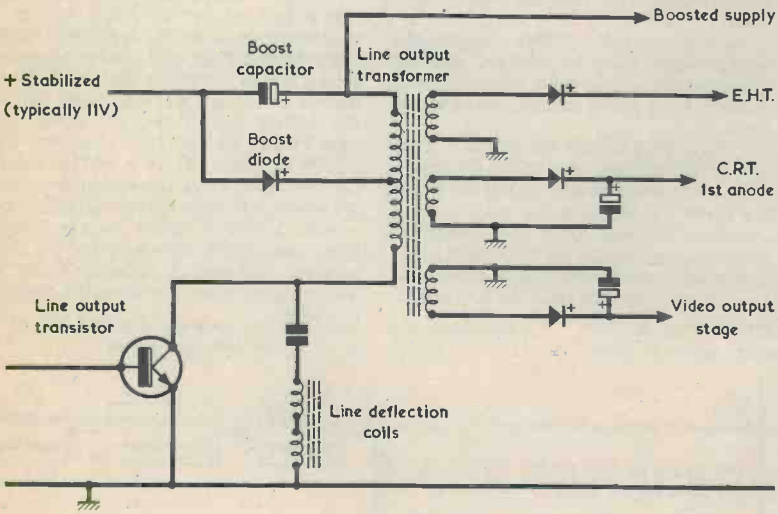


Fig. 2. Basic line output stage, showing a typical manner in which supply voltages higher than the stabilized supply are obtained. The boosted supply may be applied to the i.f. amplifier and a number of other stages in the receiver. The supply to the c.r.t. first anode is given by flyback rectification and that to the video output stage by scan rectification

After another glance at the service manual Smithy re-applied his positive test prod to the circuit board, then waited expectantly.

"Well?" he said irritably after some moments.

"Well, what?" returned his assistant. "I'm waiting for you to connect the meter."

"Darn it all, I've *connected* the meter," snapped Smithy. "I've connected it to the emitter of the first i.f. amplifier transistor."

"There's nothing showing on the meter."

"Blow me," said Smithy unbelievingly. "Don't tell me I've struck oil already! I'm now putting the positive prod on the emitter of the second i.f. transistor. What does the meter say this time?"

"It still says nothing. The needle is just staying at zero volts."

"This is excellent! I've now transferred the prod to the base of the second i.f. transistor. Any reading?"

"Nary a sausage," replied Dick. "Is that good?"

"It couldn't be better," stated Smithy exultantly, as he pointed to the service manual. "If you look at the circuit in which those two transistors are connected you'll see that the second transistor acts, at d.c., as an emitter follower. The base bias current for the first transistor is obtained from the emitter of the second transistor by way of the 100Ω resistor between them. Since there's no base bias on the second transistor, both the transistors are turned off completely, and that's why we're getting no sound or vision in this set."

Dick frowned.

"I don't quite get this bias circuit," he remarked. "Why not simply feed the base of the first transistor via a resistor from a positive supply point in the usual way?"

"Because," explained Smithy, "these two transistors are in the two a.g.c. controlled stages of the i.f. amplifier. Feeding the a.g.c. control voltage to the base resistor of the second transistor automatically ensures that the first transistor is controlled as well. If the a.g.c. control voltage goes positive so also does the base, and consequently the emitter, of the second transistor. This, in turn, causes the base of the first transistor to go positive as well. Coupling the two transistors together in this manner gives a simple way of controlling them both by way of a single a.g.c. voltage input point."

"I see what you mean, now," said Dick thoughtfully. "I suppose that if the a.g.c. causes the bases of the two transistors to go positive they offer increased gain."

"They would do," said Smithy, "if the a.g.c. circuit was the sort of thing you get in portable transistor radios, and which is referred to as 'reverse gain control'. With this circuit, though, you have what is known as 'forward gain control' and it causes the gain of a controlled transistor to *reduce* as the

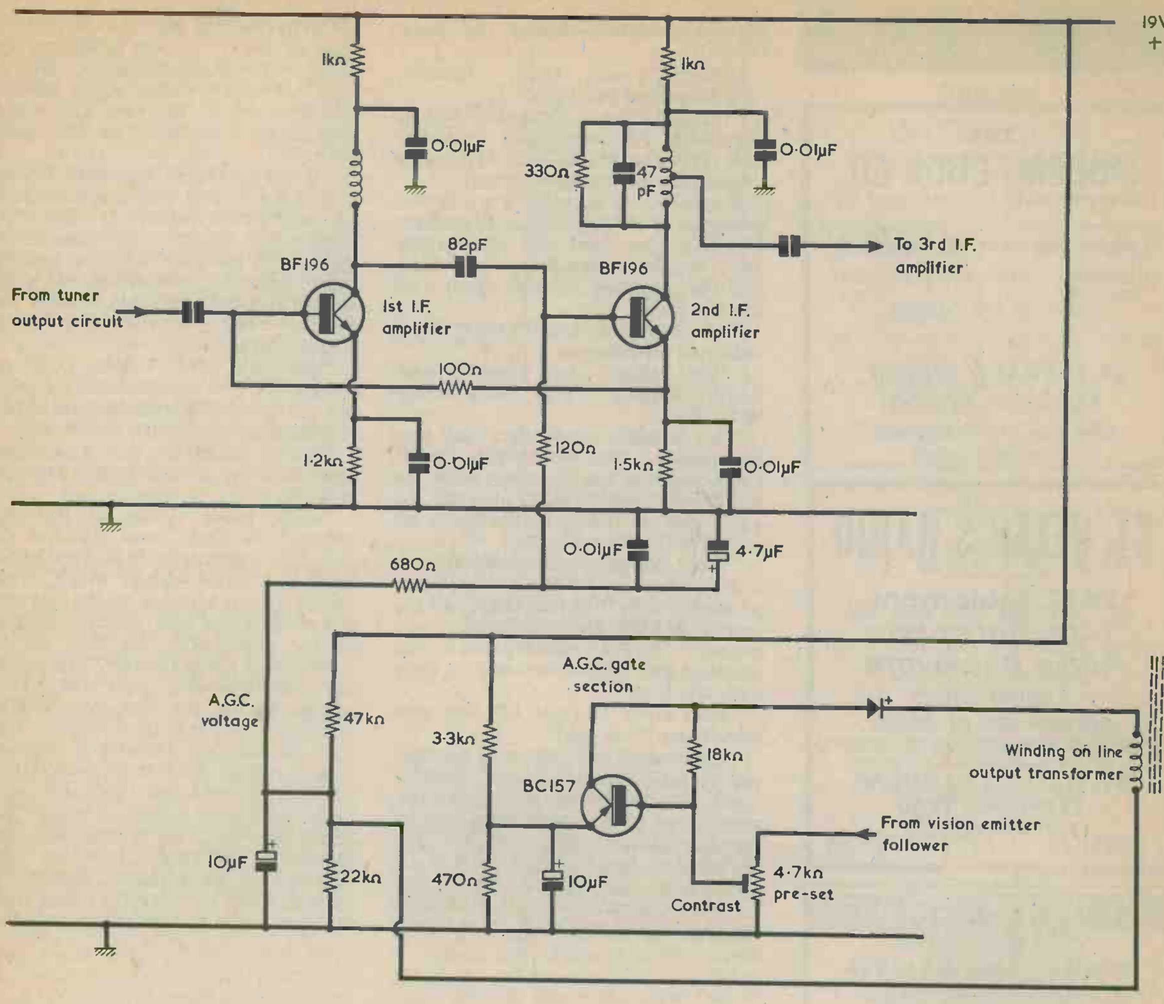


Fig. 3. Normally, not all the transistors in a vision i.f. amplifier are a.g.c. controlled. Here, the first two transistors of a 4-transistor amplifier are those which appear in the a.g.c. loop. (This circuit is a slightly simplified version of the controlled i.f. stages and the a.g.c. gate circuit employed in the Thorn 1590-1591 Series of mains/battery television receivers)

base current increases. The advantage of forward control is that the transistor gives less cross-modulation when it is biased to give low gain. Normally, you only bump into forward gain control circuits in TV receivers, and it can only be used properly with transistors which are specifically designed for it. Anyway that's enough nattering about forward gain control. How's your foot?"

"My foot?" repeated Dick. "Blimey, I'd forgotten about it."

"If the pain's eased off," remarked Smithy hopefully, "perhaps you could get on with some work on your own bench."

Dick's face took on an expression of acute suffering.

"Have a heart, Smithy," he pleaded. "You can't expect a sick person like me to go around fixing sets."

"Come off it," protested Smithy. "You don't do servicing with your left foot!"

He paused.

"Oh," he continued thoughtfully, "I don't know, though."

GATED A.G.C.

"Hey," said Dick hastily, "let's keep off personalities and get back to this set of yours. What I'm really interested in at the moment is why there's no bias voltage on the base of the second i.f. transistor."

"All right, then," conceded Smithy. "I'll let you stay here until we finally run this fault down to earth. Now, the a.g.c. voltage is obtained from the gated a.g.c. circuit, and it's built up across the 10µF electrolytic with the 22kΩ resistor across it. I've now got my positive test prod on the positive lead-out of that 10µF capacitor. Any voltage there?"

Dick looked down at the meter.

"Not a thing."

"Good, good," said Smithy, switching off the receiver. "If this luck of mine holds out we may soon find that we've got nothing else but a simple short-circuit down to chassis."

He switched his testmeter to a low ohms range, held the test leads together and zeroed it carefully. He applied the leads across the 10μF capacitor.

"Blimey," said Dick, excitedly, "there's a dead short there."

"Indeed there is," agreed Smithy cheerfully. "A very likely candidate here is the electrolytic itself. Hang on a jiff, and I'll hook it out of circuit."

He picked up his soldering iron and applied it to the printed circuit pattern. Carefully, he eased one lead of the 10μF capacitor free from the board, and then touched its ends again with the test prods.

The testmeter needle once more indicated zero ohms.

"How about that, then?" said Smithy happily. "This really is my lucky day."

"We certainly found that fault nice and quickly," commented Dick. "What I was dreading was that there would be a horribly complicated snag in the a.g.c. gate section. I'm always a bit scared of these a.g.c. gates"

"Well, this particular gate circuit is a dead easy one to understand," responded Smithy. "In fact, nearly all the current 625 line a.g.c. gate circuits are simple. They're nothing like the involved gate circuits we used to have with 405 lines."

"How come that the 625 line gate circuits are so simple?"

"It's because 625 lines uses negative vision modulation," stated Smithy, "with the result that sync pulse tips correspond to maximum amplitude of the transmitted signal. All the gate circuit then has to do is to turn on during the line flyback period and sample the amplitude of the line sync pulses which appear at the same time."

"Why have a gate circuit at all?" queried Dick. "If sync pulse tips correspond to maximum signal amplitude, why not have a simple a.g.c. detector which is on all the time and which charges up a capacitor to sync pulse tip level?"

"If you did that," responded Smithy, "the a.g.c. circuit would also respond to interference pulses. It's very unlikely that a series of interference pulses will coincide with the line flyback periods, whereupon a gated system produces an a.g.c. voltage that is nearly 100% immune from interference pulses."

"All right then," said Dick reluctantly. "You've convinced me. Now tell me how this particular gate circuit is turned on during the line flyback?"

Smithy indicated the a.g.c. gate section of the overall receiver circuit. (Fig. 4).

"Look more closely at the gate circuit," he said, "and visualise the waveforms appearing in it. First of all, there is a pulse voltage which is obtained from a winding on the line output transformer and which is applied to the diode and, via this, to the collector of the transistor. The pulses are negative-going and they only appear during the line flyback. The transistor is a p.n.p. type, which means that its collector requires a negative supply voltage if it is to be turned on."

"This bit isn't too hard after all," said Dick in a surprised tone. "Because of what you've just said, the transistor can only turn on and function as an amplifier during the periods when the negative pulses from the line output transformer winding

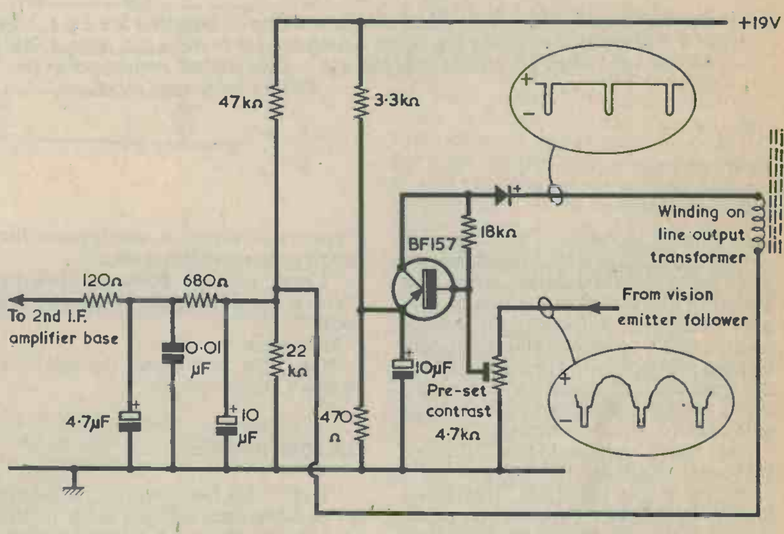


Fig. 4. The waveforms applied to the a.g.c. gate circuit. The 4.7kΩ potentiometer provides a pre-set contrast (i.e. gain) control; the customer-operated control varies the gain of the video amplifier and appears elsewhere in the overall receiver circuit

are present. Blimey, that's the whole gating action then."

"Exactly," confirmed Smithy. "Now the next thing to look at is the waveform applied to the 4.7kΩ pre-set pot which couples to the transistor base. This waveform is taken from the emitter follower which comes after the vision detector, and it consists of the video signal with negative-going sync pulses. So we now have two things going for us. The first of these is a p.n.p. transistor which is turned on only during line flyback. And the second is a series of negative-going sync pulses which are similarly applied to the transistor base during line flyback. What happens if the amplitude of the vision signal increases?"

"The sync pulse tips go more negative."

"So?"

"So the transistor draws more collector current."

'SMOOTHING' CIRCUIT

Smithy beamed at his assistant.

"You're not bad, you know."

Dick polished his finger-nails on the lapel of his jacket, and examined them smugly.

"I tell you," he said boastfully. "There are times when I surprise even myself by my own perspicacity."

"Don't push it," warned Smithy. "Well, we've now got through the first basic stage in understanding this gated a.g.c. circuit. Before passing on to the next stage, let's quickly look at the emitter circuit of the transistor. Connected to this emitter are a 3.3kΩ resistor, a 470Ω resistor, and a second 10μF electrolytic. All that these three components do is to hold the emitter at a convenient voltage level and ensure that it's decoupled, and we don't need to bother about them any more."

"What about the first 10μF electrolytic?" asked Dick. "The one which you found was short-circuit."

"That's what can be loosely described as a 'smoothing' component," replied Smithy. "We know that the transistor draws increased collector current when signal amplitude goes up. However, the increased collector current occurs only in short pulses during the line flyback, and we need some sort of 'smoothing' circuit if we're to obtain a steady a.g.c. voltage from these pulses. The 10μF capacitor provides part of this 'smoothing'. The following 680Ω resistor and 4.7μF capacitor complete the 'smoothing' process."

Dick scratched his head helplessly.

"I'm a bit lost, Smithy," he confessed forlornly. "I just can't see how the transistor collector current pulses get changed to a steady voltage across the 10μF electrolytic."

"I don't blame you getting a bit out of your depth here," remarked Smithy understandingly. "If nothing else, it's easy to get confused because of the different polarities in the circuit."

He pulled his note-pad towards him and sketched out a circuit. (Fig. 5).

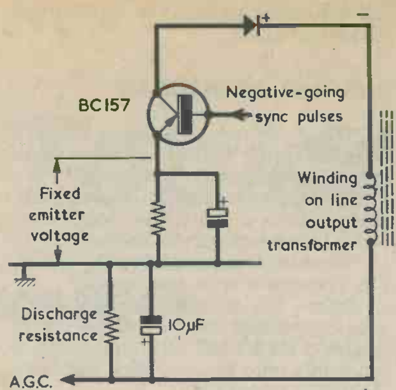


Fig. 5. The situation existing in the gate circuit during a pulse from the line output transformer winding. The 10uF 'smoothing' capacitor is shown here with its positive terminal downwards to assist in illustrating polarity conditions

"This should make things easier for you," he went on. "I've drawn the circuit in simplified form with negative at the top and positive at the bottom. Our 10μF capacitor is now below the chassis with its positive terminal downwards. Between the negative pulses nothing happens because the transistor is turned off. When a pulse comes along you get the situation I've shown in my circuit, where the upper end of the line output transformer winding is negative and the lower end is positive. The transistor conducts when the pulse is present, with the result that the bottom end of the line output transformer winding takes the lower terminal of the 10μF electrolytic capacitor positive. If the transistor turns on harder its collector voltage is lower in the presence of the pulse, whereupon the lower plate of the capacitor goes even more positive."

DISCHARGE CURRENT

"I can see it now," said Dick. "I suppose that, between the pulses, the capacitor discharges a little into the resistor you've drawn in parallel with it."

"That's right," confirmed Smithy. "Now, since the transistor draws more current when signal strength increases, it follows that an increase in signal strength causes the positive terminal of the 10μF capacitor to go more positive. Naturally, the reverse effect will happen when signal strength decreases. This time the positive terminal of the capacitor will go less positive."

"In your simplified circuit," said Dick, "you show a single resistor across the 10μF capacitor. In the actual receiver circuit there are quite a few resistors connected to the capacitor."

"True," agreed Smithy. "I put the single resistor across the capacitor in my simplified circuit to demonstrate that during the pulses from the line output transformer winding the capacitor charges, and that between the pulses it discharges. In the actual circuit the capacitor has a standing voltage across it which is governed by the 47kΩ and 22kΩ resistors across the supply rails, and by the current drawn, via the 680Ω resistor, by the base of the second i.f. transistor. The effect of the gated a.g.c. circuit is to cause this standing voltage to go more positive as signal strength increases. A standing voltage across the capacitor is necessary, of course, because there wouldn't otherwise be any bias available for the two i.f. transistors."

"Ah yes," said Dick keenly. "Well, it's easy to see the overall picture now. When a signal is present it causes the positive terminal of the 10μF electrolytic to go more positive. Increasing signal strength gives a greater positive voltage again; this increases the bias current to the i.f. transistors and therefore, by the forward gain control method, reduces their gain."

"That's it," said Smithy. "And you've now got an a.g.c. system set up. The overall time constant of the system is to some extent a function of the capacitance of the 10μF capacitor and the discharge current which is drawn from it. The subsequent 4.7μF capacitor will also have an effect on time constant. In general the time constant will be such that the a.g.c. voltage remains steady for quite a large number of lines."

Smithy glanced at the circuit board of the receiver and at the short-circuited capacitor which was now hanging on by one lead only. He picked up his soldering iron, removed the capacitor and threw it into a waste-bin at his side.

"Right," he stated briskly. "Will you now please go and get me a new 10μF capacitor from the spares cupboard? I'll then be able to get this receiver finally buttoned up."

"Okey-doke," responded Dick obediently.

He stood up, started to walk towards the spares cupboard, then gave a groan of distress as his left foot took his weight. Limping heavily, he tottered over to the cupboard, found a new 10μF capacitor, then hobbled back to the Serviceman.

Without a word, Smithy took the new capacitor from his assistant and soldered it to the printed circuit board. He then switched on the receiver. The sound channel immediately became audible from the receiver loudspeaker and, after the c.r.t. had warmed up, an impeccable picture appeared on the screen. Smithy checked reception on all the local channels and then turned the set off again.

INSTANT TREATMENT

"*That's* all right," he remarked in a satisfied tone. "Now the next job to do is to clear up that foot of yours."

"Here, take it easy," protested Dick. "My foot is a job for a foot-doctor, not an electronic service engineer."

"Nothing," returned Smithy loftily, "is impossible with electronics."

Before his assistant realised what was happening, Smithy reached down, grabbed Dick's left foot and pulled it up firmly onto his lap. Dick squirmed helplessly on his stool.

"This shoe seems new," commented Smithy, as he examined Dick's neat brown leather footwear. "Usually, the shoes you wear look like throw-outs from a bowling alley."

"I was presented with these shoes by one of my aunts," stated Dick. "I started wearing them last week."

"Did you now?" said Smithy. "Well, we'll have this one off right now."

Deftly, the Serviceman removed the shoe and placed it on his bench. He then quickly removed the sock and examined Dick's foot.

"Ye gods," protested Dick indignantly as he struggled to retain his position on the stool. "This is tantamount to personal assault."

"One obvious thing," remarked Smithy, "is that you won't ever get ingrowing toe-nails. We'll clip those down for a start."

Picking up a pair of side-cutters from his bench Smithy busily applied himself to trimming Dick's toe-nails.

"This is more than personal assault," snorted Dick furiously. "You've now advanced to GBH level."

There was no response from Smithy who, satisfied with the appearance of Dick's now-attenuated toe-nails, turned his attention to the rest of his foot. Picking up a small insulated screwdriver he tapped its handle lightly against the outside of his assistant's big toe.

"Strewth," gasped Dick, trying to pull his foot away. "You've just hit the place where it hurts!"

"I'm not surprised that it hurts, either," chuckled Smithy. "Those new shoes have raised the largest corn in all the world on this big toe of yours. Well, we can soon find an answer for that."

Smithy pulled a cardboard box containing nuts and bolts and other small hardware towards him. He poked an exploratory finger through its contents and then took out a $\frac{5}{8}$ in. rubber grommet. He next picked up a roll of p.v.c. insulating tape. Placing the central hole of the grommet over the corn, he bound it firmly in place by winding the tape round his assistant's big toe. This task accomplished, he replaced the sock and the shoe, tying up the lace of the latter with a neat and dainty bow.

"Try your foot now," he ordered.

Reluctantly, Dick swung down his leg then placed his left foot gingerly on the floor. As he applied more and more weight, his expression of apprehension changed to one of incredulous joy. He took a few experimental steps, then delightedly walked smartly back and forth across the Workshop.

"You must be a magician, Smithy," he exclaimed gratefully. "This foot of mine's as good as new again."

"Well, thank goodness for that," replied Smithy shortly. "I was getting a bit fed up with that Long John Silver act of yours. Do you now feel capable of doing a spot of work?"

And to this question Dick nodded an enthusiastic affirmative, after which peace descended upon the Workshop as the pair resumed their labours at their own respective benches.

As a finishing comment, we would add that had the Serviceman been practicing on a professional footing, the now foot-loose Dick could have had to foot the bill for Smithy's feat in curing his foot, even though such a foot-note might appear both effete and – if you'll pardon the term – corny. ■

6 + 6 Stereo Amplifier

We understand that the PN107 transistor employed in the '6 + 6 Stereo Amplifier' described in the May and June 1974 issues has now become difficult to obtain. A suitable alternative is the BC107, and this has the same lead-out layout as the BC109 employed elsewhere in the amplifier.

Using The TBA820 Power Amplifier

In this article, which appeared in last month's issue, it is regretted that Figs. 2 and 5 on pages 112 and 113 were inadvertently transposed.

"Buy some lucky integrated circuits today Deary?"

Radio Topics

By Recorder

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TYPE NUMBERS

As the years go by, transistors get smaller and smaller. And so, darn it, do the type numbers that are marked on their bodies! Part of my essential workshop kit nowadays consists of a magnifying glass, which I use solely for reading the type numbers on some of the tinier devices which pass through my hands.

A further complication is that the type numbers on at least some transistors, and particularly the plastic ones, are liable to get partly obliterated simply as a result of excessive handling. It has to be remembered here that, once they are made, the vast majority of transistors are boxed, sent to the set-makers and then popped into sets, after which they remain undisturbed for the whole of the life of the set. This represents a minimal amount of handling which any transistor body identification can withstand. But when transistors fall into the hands of experimenters like myself they may be wired up into at least half-a-dozen temporary lash-ups, and the handling involved can sometimes make their type numbers virtually undecipherable. The only practical solution to this problem seems to be that of keeping all one's transistors rigorously separated in small tins or plastic boxes, each of which is marked with a single transistor type number. As soon as an experimental circuit has been tried out, the first things to be removed when the circuit is disassembled are the transistors. These are then carefully put in their respective boxes, ready for the next time. A simple approach like this can save a lot of future frustration, even if it does involve sending your family mildly round the twist as you hunt around the house for further tins in which to keep the latest transistors you've bought.

Incidentally, if you're making up temporary circuits using, say, tagstrips to secure the components, you may find it helpful to solder the transistors in with their bodies pointing downwards and their lead-out wires pointing upwards. The lead layout is then the same as that in the specification diagram for the transistor, and this saves the minor effort which is required to mentally re-orient the lead-outs when the transistor is mounted in its usual manner with its body pointing upwards. In a final permanent circuit based on the temporary one the transistor can, of course, be wired up in the conventional way.

IDEAS AND INVENTIONS

It seems to be quite some time since I told you about my more recent ideas and inventions. I haven't been idle in this field, however, and I now take pride in presenting two of my latest schemes for your enlightenment.

I'll start off with a do-it-yourself idea which stems from the preoccupation of some constructors with dental matters. One quite often sees published hints in which it is suggested that toothpaste tube screw-on caps be employed as terminals, as cabinet feet or even as control knobs. To my mind these schemes do not take things far enough and my first idea involves the use of discarded upper dentures as control knobs. These can normally be obtained from elder relatives or, as surplus, from dental mechanics. A ¼ inch hole is drilled in the approximate centre of the denture and it is then secured to the shaft of the control, with the teeth pointing towards the front panel, by means of Araldite or a similar powerful adhesive. The result is a control knob of individual appearance, having a fluted edge around two-thirds of its periphery together with a shape which fits comfortably in the hand. The denture should not be fitted with the teeth projecting away from the front panel as this gives rather a bizarre effect.

The second scheme has much wider applications and consists of a very long-term delay switch which operates over a period of several weeks. A coil is wound round the outside of a full tube of Alka-Seltzer tablets, and it forms the inductive half of a transistor oscillator tuned circuit. The oscillations are rectified and the resultant direct voltage is applied to the base of a second transistor as a reverse bias, causing it to be cut off. A relay coil, or a triac, is connected in the collector circuit of the second transistor.

The device is set off by removing the lid of the Alka-Seltzer tube, whereupon the anhydrous Alka-Seltzer tablets commence to absorb moisture from the air. After a period of several weeks the water content inside the tube rises to a level which causes considerable damping of the coil wound on the tube. As a result, the transistor oscillator ceases to function, the reverse bias is taken off the second transistor and the relay or triac in its collector circuit is turned on.

The unit is reset for a further timing run by filling the tube with a new set of Alka-Seltzer tablets.

MACHINE DEPENDENCE

Modern retail methods involve the supermarket approach. And a supermarket, as anyone who has ever had to do the shopping will confirm, is an establishment where you whiz round and pick up all the items you want in no time at all and then line up for a quarter of an hour for the privilege of paying for them. About the only pleasure to be obtained at the pay-out queue is that of making morbid guesses at the home-life of fellow-shoppers based on the goods they have selected. Failing that, you can simply watch the numbers whirl round in the windows of the cash registers as they add up the costs of purchases.

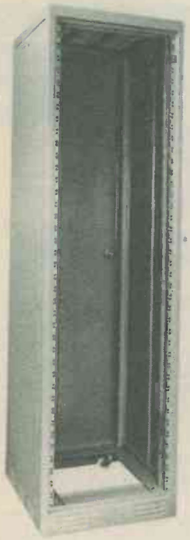
Cash registers which do their own adding up are not at all new, and they do represent an essential part of supermarket organisation. When, however, they appear in the smaller type of shop or business, they can have a marked effect on the people who run them.

The proprietor of a small local cafe recently invested in an add-up till, and it has made a significant change in his mode of operation. Business in the cafe is quite slow, and individual purchases are usually in the region of five to twenty pence or so. When I popped in in the old days for a cup of tea and the odd cake the owner would mentally add up the individual items and then ring up the sum on the register. Now, however, every single item is entered in and then added up by the till. If I buy a cup of tea and a cake, he rings up 5p for the tea, 4p for the cake, and then waits expectantly until the till tells him that the total comes to 9p. Naturally, he isn't going to keep a machine of this nature and do all the adding up himself, but there seems to be something wrong somewhere. With the previous till he had to press the 9p key only; now he presses the 5p button, the 4p button and *then* the 'add-up' button. Three operations where there was previously only one.

The moral, of course, is that we introduce time-saving machinery into our lives and then find that we are quite often devoting extra time to actuating such machinery. To take a further example, most of us, like the good citizens we are, add the postal code to our addresses and to the addresses of people we write to, paving the way to that auspicious day when the Post Office will actually instal a letter sorting machine at our addressee's locality. Without postal coding, Post Office employees, who know the system inside out anyway, simply sort the letters without any trouble at all. The idea behind postal coding is to speed up further what is already a perfectly efficient operation. And at what expense? At the expense of forcing everyone in the country to look up and then add a jumble of letters and figures to each address on every letter. A few man-hours at the Post Office are saved – at the cost of goodness knows how many man-hours on the part of the millions of people who send out letters each day.

After which comments, I shall now clap my hands, summon my runner, and get him to take this lot off chop-chop to Data Publications' Maida Vale office in the end of his little cleft stick. ■

Trade News . . .



DATURR 19″ RACKS

Daturr Ltd. have introduced a new range of high quality 19″ racks. The new racks are of welded steel construction, and are manufactured in seven heights and four depths.

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Daturr supply their racks on castors or skids and also provide electrical connection of all rack components for safety and RF screening.

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The standard finish is Daturr textured acrylic blue but other finishes can be supplied to customers' orders.

Prices start at £70 and current delivery is 8-10 weeks from receipt of order.

For further information contact: Daturr Ltd., Market Road, Richmond, Surrey TW9 4NE.

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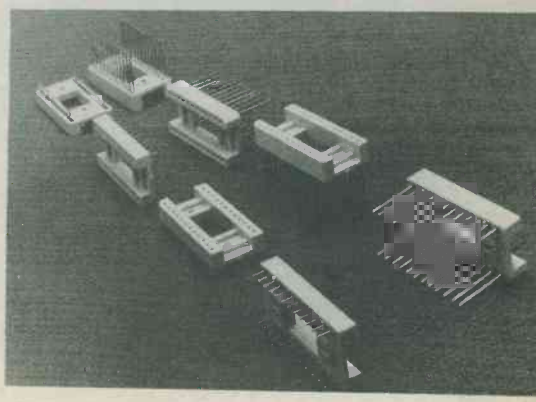

Vero Electronics Limited can now announce the enlargement of their range of high quality D.I.P. Sockets, with the introduction of various 24-way versions.

These are available with mini-wrap or flow-solder terminations, with the contacts either gold or tin plated. Body material is grey glass-filled nylon. They, and the existing range of 8, 14, and 16-way sockets, can all be supplied ex stock.

Details from Vero Electronics Limited, Industrial Estate, Chandler's Ford, Eastleigh, Hants.

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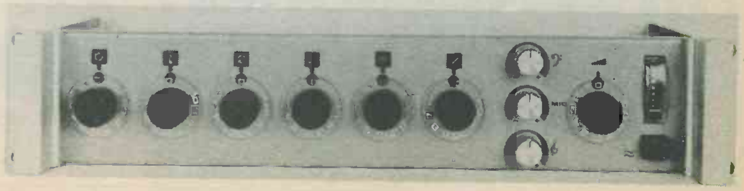

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0.05μF	320	160	64	32	16	6.4	3.2	1.6
0.02μF	800	400	160	80	40	16	8.0	4.0
0.01μF	1,600	800	320	160	80	32	16	8.0
5,000pF	3,200	1,600	640	320	160	64	32	16
2,000pF	8,000	4,000	1,600	800	400	160	80	40
1,000pF	16,000	8,000	3,200	1,600	800	320	160	80
500pF	32,000	16,000	6,400	3,200	1,600	640	320	160
200pF	80,000	40,000	16,000	8,000	4,000	1,600	800	400
100pF	160,000	80,000	32,000	16,000	8,000	3,200	1,600	800
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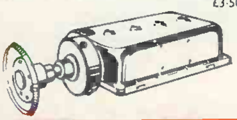

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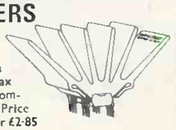

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