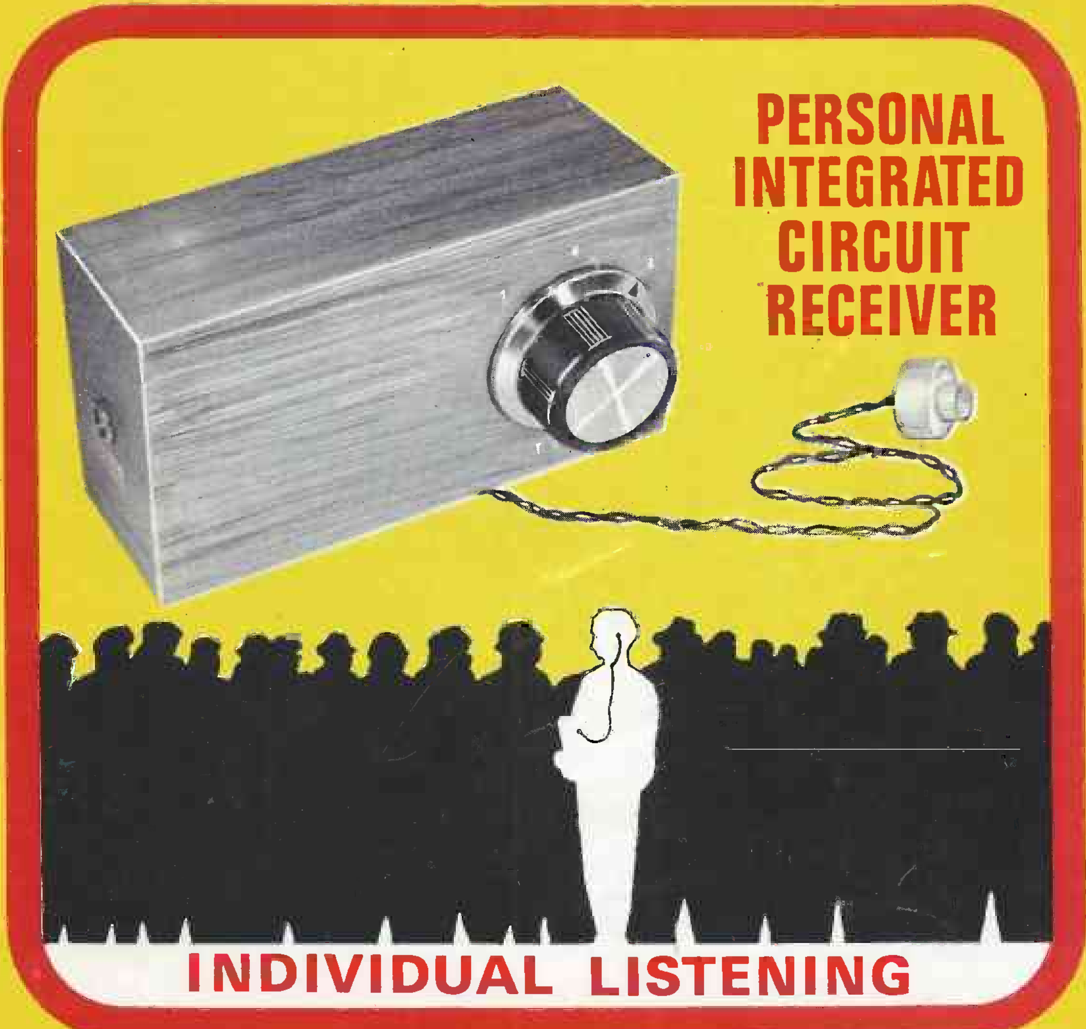
RADIO & ELECTRONICS CONSTRUCTOR

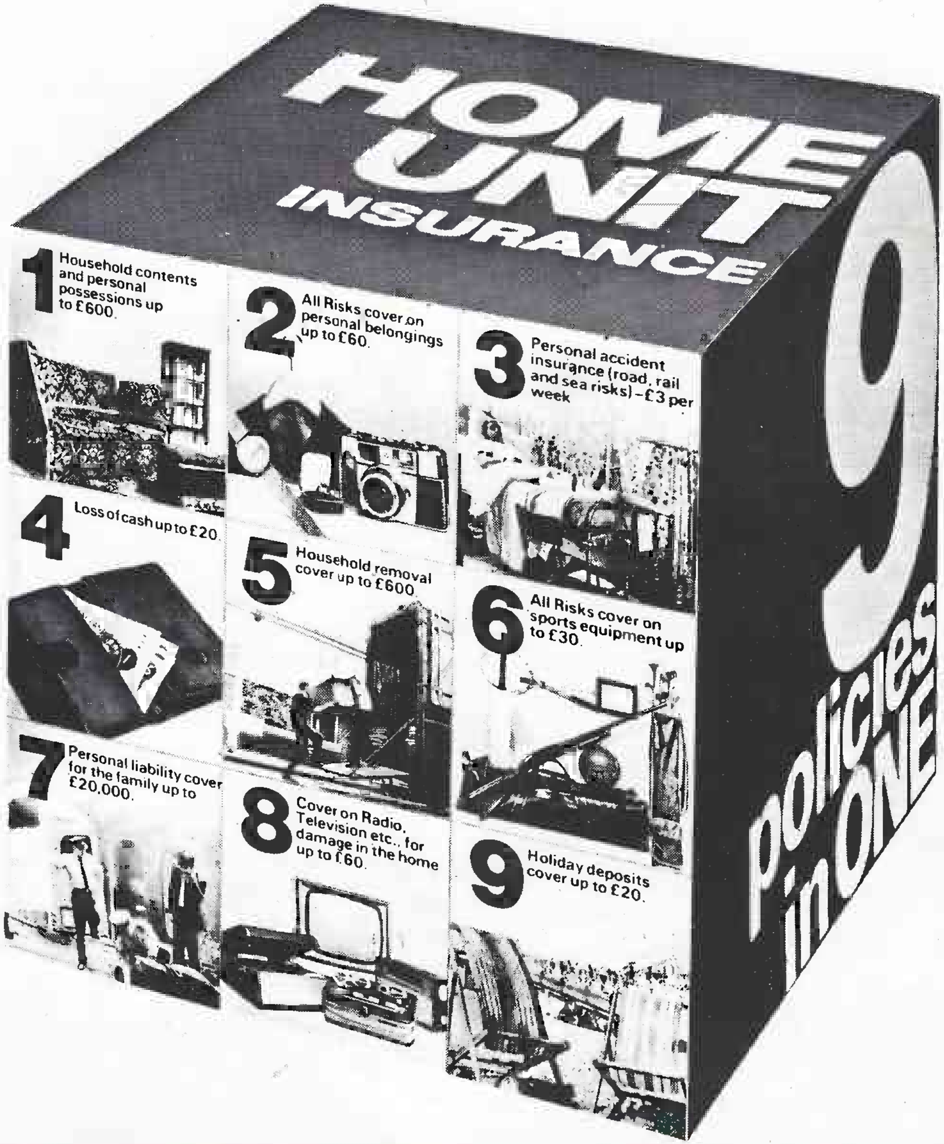
MARCH 1975

30p



ALSO FEATURED

OSCILLOSCOPE CALIBRATION GENERATOR


HOME
UNIT
INSURANCE
1 Household contents and personal possessions up to £600.
2 All Risks cover on personal belongings up to £60.
3 Personal accident insurance (road, rail and sea risks) – £3 per week
4 Loss of cash up to £20.
5 Household removal cover up to £600.
6 All Risks cover on sports equipment up to £30.
7 Personal liability cover for the family up to £20,000.
8 Cover on Radio, Television etc., for damage in the home up to £60.
9 Holiday deposits cover up to £20.
9 policies in ONE

DENCO (CLACTON) LIMITED
355-7-9 OLD ROAD, CLACTON-ON-SEA, ESSEX

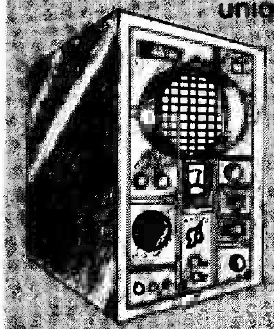
Our components are chosen by Technical Authors and Constructors throughout the World for their performance and reliability, every coil being inspected twice plus a final test and near spot-on alignment as a final check.

Our General Catalogue showing full product range ..	28p
DTB4 Transistor & Valve circuitry for D.P. Coils ..	28p
DTB9 Valve Type Coil Pack Application circuity ..	28p
MD 1 Decoder Circuitry for Stereo Reception ..	28p

All post paid, but please enclose S.A.E. with all other requests in the interests of retaining lowest possible prices to actual consumers

1. Understand electronics.

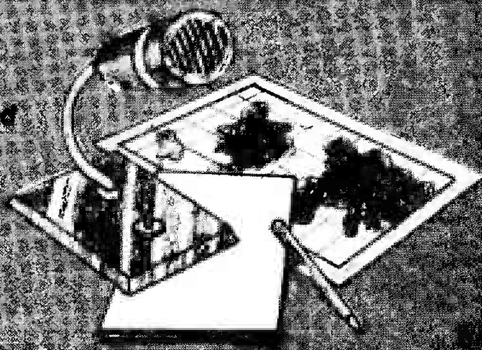
Step by step, we take you through all the fundamentals of electronics and show you how easily the subject can be mastered using our unique Lerna-Kit course.



(1) Build an oscilloscope.
(2) Read, draw and understand circuit diagrams.
(3) Carry out over 40 experiments on basic electronic circuits and see how they work.

2. Become a radio amateur.

Learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence.



Free!

Brochure, without obligation to:
BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL, Dept AX 1574
P.O. Box 156, Jersey, Channel Islands.

NAME ____________________

ADDRESS ____________________ Block caps please

The largest selection

EX-COMPUTER STABILISED POWER MODULES
Complete with circuit diagrams etc 99p each + P. & P. 22p.

LOW COST CAPACITORS
0·01 μF 400V. 3p each
500μF 50V. Elect. 10p each

FIBRE-GLASS PRINTED CIRCUIT BOARDS
16½ × 4" approx. 2 for 55p

DECON-DALO 33PC Marker
Etch, resistant printed circuit marker pen 99p each.

VEROBOARDS
Packs containing approx. 50sq. in various sizes, all0·1 matrix 55p

REPANCO CHOKES & COILS
RF Chokes
CH1. 2·5mH 29p CH2. 5·0mH 30p
CH3. 7·5mH 31p CH4. 10mH 33p
CH5. 105mH 28p
COILS
DRX1 Crystal set 31p DR R2 Dual range 45p

COIL FORMERS & CORES
NORMAN ¼" Cores & Formers 8p
⅜" Cores & Formers 10p

SWITCHES
DP/DT Toggle 36p SP/ST Toggle 30p

FUSES
1¼" and 20mm. 100mA, 200mA, 250mA, 500mA, 1A, 1·5A, 2A.
QUICK-BLOW 5p each.

EARPHONES
Crystal 2·5mm plug 42p
Crystal 3·5mm plug 42p
8 ohms 2·5mm plug 22p
8 ohms 3·5mm plug 22p

DYNAMIC MICROPHONES
B1223. 200 ohms plus on/off switch and 2·5mm and 3·5mm plugs £1·85

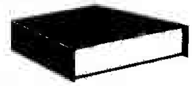
3-WAY STEREO HEADPHONE JUNCTION BOX
H1012 £1·87

2-WAY CROSSOVER NETWORK
K4007 .80 ohms Imp. Insertion loss 3dB £1·21

CAR STEREO SPEAKERS
(Angled) £3·85 per pair.

BI-PAK
CATALOGUE AND LISTS
Send S.A.E. and 10p.

INSTRUMENT CASES



(Black Vinyl covered)

No.	Length		Width		Height	Price
BV1	8"	×	5¼"	×	2"	£1·35
BV2	11"	×	6"	×	3"	£1·75

ALUMINIUM BOXES

BA1	5¼"	×	2¼"	×	1½"	49p
BA2	4"	×	4"	×	1½"	49p
BA3	4"	×	2¼"	×	1½"	49p
BA4	5¼"	×	4"	×	1½"	58p
BA5	4"	×	2½"	×	2"	49p
BA6	3"	×	2"	×	1"	42p
BA7	7"	×	5"	×	2½"	85p
BA8	8"	×	6"	×	3"	£1·10p
BA9	6"	×	4"	×	2"	70p

P. & P. 15p on each box

BIB HI-FI ACCESSORIES

De Luxe Groov-Kleen
Model 42 £1.95
Chrome Finish
Model 60 £1.50

Ref. 36A. Record/Stylus Cleaning Kit 33p
Ref. 43. Record Care Kit £2·42
Ref. 31. Cassette Head Cleaner 58p
Ref. 32. Tape editing Kit £1·68
Model 9. Wire Stripper/Cutter 83p
Ref. 46. Spirit Level 62p
Ref. B. Stylus and Turntable Cleaning Kit 34p
Ref. P. Hi-Fi Cleaner 31p
Ref. 32A. Stylus Balance £1·37
Ref. J. Tape Head Cleaning Kit 62p
Ref. 56. Hi-Fi Stereo Hints and Tips 42p
Ref. 45. Auto Changer Groove Cleaner £1·08

ANTEX SOLDERING IRONS
X25. 25 watt £2·05
CCN 240. 15 watt £2·48
Model G. 18 watt £2·26
SK2. Soldering Kit £3·25
STANDS: ST3, suitable for all models £1
SOLDER: 18SWG Multicore 7oz £1·61
22SWG 7oz £1·61 18SWG 22ft 51p
22SWG Tube 33p

ANTEX BITS and ELEMENTS
Bits No.

102	For model CN240 3/32	42p
104	For model CN240 3/16"	42p
1100	For model CCN240 3/32"	42p
1101	For model CCN240 1/8"	42p
1102	For model CCN240 1/4"	42p
1020	For model G240 3/32"	42p
1021	For model G240 1/8"	42p
1022	For model G240 3/16"	42p
50	For model X25 3/32"	48p
51	For model X25 1/8"	48p
52	For model X25 3/16"	48p

ELEMENTS
ECN 240 £1·30 ECCN 240 £1·32
EG 240 £1·07 EX 25 £1·16

ANTEX HEAT SINKS 10p

VAT included in all prices. Please add 10p P. & P. (U.K. only). Overseas orders—please add extra for postage.

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C1	200	Resistors mixed values approx. count by weight	0·54
C2	150	Capacitors mixed values approx. count by weight	0·54
C3	50	Precision Resistors 0·1%, 0·01% mixed values	0·54
C4	75	⅛th W Resistors mixed preferred values	0·54
C5	5	Pieces assorted Ferrite Rods	0·54
C6	2	Tuning Gangs, MW/LW VHF	0·54
C7	1	Pack Wire 50 metres assorted colours	0·54
C8	10	Reed Switches	0·54
C9	3	Micro Switches	0·54
C10	15	Assorted Pots & Pre-Sets	0·54
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Type	0·54
C12	30	Paper Condensers preferred types mixed values	0·54
C13	20	Electrolytics Trans. types	0·54
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets, etc.	0·54
C15	5	Mains Slide Switches	0·54
C16	20	Assorted Tag Strips & Panels	0·54
C17	10	Assorted Control Knobs	0·54
C18	4	Rotary Wave Change Switches	0·54
C19	2	Relays 6—24V Operating	0·54
C20	1	Pack Sheets of Copper Laminate approx. 20 sq. ins.	0·54

PLUGS AND SOCKETS
PLUGS

PS 1	D.I.N. 2 Pin (Speaker)	0·11
PS 2	D.I.N. 3 Pin	0·12
PS 3	D.I.N. 4 Pin	0·15
PS 4	D.I.N. 5 Pin 180°	0·16
PS 5	D.I.N. 5 Pin 240°	0·16
PS 6	D.I.N. 6 Pin	0·17
PS 7	D.I.N. 7 Pin	0·18
PS 8	Jack 2·5mm Screened	0·18
PS 9	Jack 3·5mm Plastic	0·12
PS 10	Jack 3·5mm Screened	0·18
PS 11	Jack ¼" Plastic	0·15
PS 12	Jack ¼" Screened	0·22
PS 13	Jack Stereo Screened	0·36
PS 14	Phono	0·10
PS 15	Car Aerial	0·22
PS 16	Co-Axial	0·15

INLINE SOCKETS

PS 21	D.I.N. 2 Pin (Speaker)	0·14
PS 22	D.I.N. 3 Pin	0·20
PS 23	D.I.N. 5 Pin 180°	0·20
PS 24	D.I.N. 5 Pin 240°	0·20
PS 25	Jack 2·5mm Plastic	0·16
PS 26	Jack 3·5mm Plastic	0·16
PS 27	Jack ¼" Plastic	0·30
PS 28	Jack ¼" Screened	0·35
PS 29	Jack Stereo Plastic	0·30
PS 30	Jack Stereo Screened	0·38
PS 31	Phono Screened	0·18
PS 32	Car Aerial	0·22
PS 33	Co-Axial	0·22

SOCKETS

PS 35	D.I.N. 2 Pin (Speaker)	0·08
PS 36	D.I.N. 3 Pin	0·11
PS 37	D.I.N. 5 Pin 180°	0·11
PS 38	D.I.N. 5 Pin 240°	0·11
PS 39	Jack 2·5mm Switched	0·12
PS 40	Jack 3·5mm Switched	0·12
PS 41	Jack ¼" Switched	0·20
PS 42	Jack Stereo Switched	0·30
PS 43	Phono Single	0·08
PS 44	Phono Double	0·10
PS 46	Co-Axial Surface	0·10
PS 47	Co-Axial Flush	0·20

LEADS

LS 1	Speaker Lead 2 pin D.I.N. plug to open ends approx 3 metres long (coded)	0·20

CABLES

CP 1	Single Lapped Screen	0·07
CP 2	Twin Common Screen	0·11
CP 3	Stereo Screened	0·12
CP 4	Four Core Common Screen	0·23
CP 5	Four Core Individually Screened	0·30
CP 6	Microphone Fully Braided Cable	0·10
CP 7	Three Core Mains Cable	0·09
CP 8	Twin Oval Mains Cable	0·07
CP 9	Speaker Cable	0·05
CP 10	Low Loss Co-Axial	0·18

CARBON POTENTIOMETERS
Long and Lin
4·7K. 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M.

VC 1	Single Less Switch	0·15
VC 2	Single D.P. Switch	0·28
VC 3	Tandem Less Switch	0·46
VC 4	1K Lin Less Switch	0·15
VC 5	100 K anti-Log	0·46

HORIZONTAL CARBON PRE-SETS
0·1 watt 0·06 each
100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4·7M.

SOLVE THOSE STICKY PROBLEMS!
with

CYANOACRYLATE C2 ADHESIVE
The wonder bond which works in seconds - bond plastic, rubber, metals, transistors, components permanently immediately!

OUR PRICE ONLY 54p
for 2gm phial

BATTERY HOLDER
Takes 4, HP7's complete with terminal, clip and lead. 34p

WORLD SCOOP
JUMBO SEMICONDUCTOR PACK
Transistors, Germ. and Silicon Rectifiers, Diodes, Triacs, Thyristors, I.Cs and Zeners. ALL NEW AND CODED.

APPROX 100 PIECES

Offering the amateur a fantastic bargain Pak and an enormous saving—identification and data sheet in every Pak.

Only £2 p. & p. 20p

RECORD STORAGE/ CARRY CASES
7in EP. 18½in × 7in × 8in (50 records) £2·10
12in LP. 13½in × 7½in × 12½in (50 records) £2·95

CASSETTE CASES £1·30
Holds 12 10in × 3½in × 5in. Lock handle

8-TRACK CART' CASES
Holds 14. 13 × 5 × 6 in. £1·95p
Holds 24, 13½ × 8 × 5½ in. £2·70p
Both with lock handle

SPECIAL PURCHASE
2N3055. Silicon Power Transistors NPN. Famous manufacturers out-of-spec devices free from open and short defects—every one able! 115W. TO3. Metal Case.
OUR SPECIAL PRICE 8 for £1

REPANCO TRANSFORMERS
240V. Primary. Secondary voltages available from selected tappings 4V, 7V, 8V, 10V, 14V, 15V, 17V, 19V, 21V, 25V, 31V, 33V, 40, 50 and 25V-0-25V

Type	Amps	Price	P. & P.
MT50/½	½	£1·93	45p
MT50/1	1	£2·42	48p
MT50/2	2	£3·30	60p

CARTRIDGES
ACOS

GP91-1SC 200mV at 1·2cm/sec	£1·35
GP93-1 280mV at 1cm/sec	£1·85
GP96-1 100mV at 1cm/sec	£2·80
J-2005 Crystal/Hi Output	£1·05
J-2010C Crystal/Hi Output Compatible	£1·20
J-2006S Stereo/Hi Output	£1·75
J-2105 Ceramic/Med Output	£1·95
J-2203 Magnetic 5mV/5cm/sec, including stylus	£4·95
J-2203S Replacement stylus for above	£3·00
AT-55 Audio-technica magnetic cartridge 4mV/5cm sec	£3·30

CARBON FILM RESISTORS
The E12 Range of Carbon Film Resistors, ⅛ watt available in PAKS of 50 pieces, assorted into the following groups:

R1	50 Mixed 100 ohms–820 ohms	50p
R2	50 Mixed 1k Ω–8·2k Ω	50p
R3	50 Mixed 10k Ω–82k Ω	50p
R4	50 Mixed 100k Ω–1M Ω	50p

THESE ARE UNBEATABLE PRICES—JUST 1p EACH INCL. V.A.T

BI-PAK SUPERIOR QUALITY LOW - NOISE CASSETTES
C60, 36p; C90, 48p; C120, 60p

VISIT OUR COMPONENT SHOP
18 BALDOCK ST., WARE, Herts. (A10)
Open Mon.-Sat. 9–5.30 p.m. Tel. 61593

-the lowest prices!

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. Rl = 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)	95p
SPM 80. (Use with AL60)	£3·25
FRONT PANELS FP 12 with Knobs	£1·00

PRE-AMPLIFIERS

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

TRANSFORMERS

T461 (Use with AL10)	£1·60 P. & P. 22p
T538 (Use with AL20, AL30)	£2·30 P. & P. 22p
BMT80 (Use with AL60)	£2·75 P. & P. 40p

PA12 PRE-AMPLIFIER SPECIFICATION

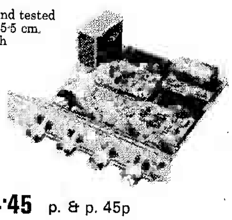
The PA12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while 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

Look for our
SEMICONDUCTOR ADVERTISEMENTS in
Practical Wireless Wireless World Practical Electronics

ALL PRICES INCLUDE V.A.T.

The STEREO 20



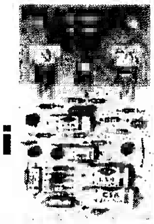
The "Stereo 20" amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attactively printed front panel and matching 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 p. & p. 45p

TC20 TEAK VENEERED CABINET
For Stereo 20 (front board undrilled) Size 10½″ × 8¾″ × 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 £4·25



- 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 £2·75 p. & p. 40p

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 £14·25

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: £29·75 plus 45p postage.

TEAK 60 AUDIO KIT
Comprising: Teak veneered cabinet size 16¾″ × 11½″ × 3¾″, other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets, etc. Kit price: £9·95 plus 45p postage.

All prices quoted in new pence *Giro No. 388-7006*
Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 20p. Overseas add extra for airmail
Minimum order 50p. Cash with order please.
Guaranteed Satisfaction or Money Back

COMPONENTS

HOBBYIST - AMATEUR - DOMESTIC - SURPLUS - INDUSTRIAL - JUST A FEW OF OUR BARGAINS ARE LISTED BELOW - SEND STAMPED ADDRESSED ENVELOPE FOR A QUOTE ON OTHER REQUIREMENTS. THESE OFFERS APPLY ONLY TO MAIL ORDER AND NOT SHOP SALES, UNLESS CURRENT MAGAZINE PRODUCED.

Goods sent at customer's risk, unless sufficient payment for insurance included (2p per £1 Min 5p) U.K. only.

VALVE BASES

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

TAG STRIP – 6 way **3p** 9 way **5p** Single **1p**

WRIST COMPASS **30p** with Needle Lock

TO3 Mica Washer **2p**

18 volt 4 amp charger, bridge rectifies **50p**

GC10/4B Cold Cathode **£3.00**

Telescopic aerial
Closed $9\frac{1}{2}''$, open $38\frac{1}{2}''$ Fitted right angle TV plug, **50p**

$1\frac{1}{4}$ glass fuses— 250 m/a or 3 amp (box of 12)	18p
3" tape spools	8p
Brand new Boxed 6K7G	25p
PVC or metal clip on M.E.S. bulb holder	5p
Geared Knob, Inner to Outer Ratio 8:1	60p
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	30p

SWITCHES

Pole	*Way*	*Type*	
4	2	Sub. Min. Slide	18p
6	2	Slide	20p
4	2	Lever Slide	15p
2	2	Slide	10p
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	16p
1	2	Toggle	10p
Wafer Rotary, all types			30p

Speaker, 6" x 4", 5 ohm, ideal for car radio etc. **£1**

COMPUTER AND AUDIO BOARDS

VARYING PANELS WITH ZENER, GOLD BOND, SILICON, GERMANIUM, LOW AND HIGH POWER TRANSISTORS AND DIODES, HI STAB RESISTORS, CAPACITORS, ELECTROLYTICS, TRIMPOTS, POT CORES, CHOKES ETC.

3lb. for **85p** + **40p** post and packing
7lb. for **£1.75** + **60p** post and packing

Skeleton Presets
Slider, horizontal or vertical standard or submin. **5p**

Clear Plastic Boxes
For component storage or projects, sliding lid. $1\frac{3}{4}''$ x $1\frac{1}{2}''$ x 1" **10p**

KNOBS

SILVER METAL PUSH ON WITH POINTER, OR WHITE PLASTIC, GRUB SCREW WITH POINTER AND SILVER CENTRE **8p** EACH.

ZM1162A INDICATOR TUBE

0-9 Inline End View. Rectangular Envelope 170V 2.5M/A **£2.00**

RESETTABLE COUNTER

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

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**

POTS

Log or Lin carbon	12p
Switched	25p
Double Pots	38p
Double & switch	50p
Lin wirewound	25p
Slider Pot	26p
Double Slider	48p

THERMISTORS

VA1008, VA1034, VA1039, VA1040, VA1055, VA1066, VA1082, VA1100 **7p**
VA1077, **10p**
VA1005, VA1026 **17p**

PARMEKO P480

6000/55, 20 Henry ·12A, potted choke **60p**

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

MFD \ Up to	10V	25V	50V	75V	100V	250V	350V	500V
10	4p	5p	6p	8p	8p	12p	16p	20p
25	4p	5p	6p	8p	8p	15p	18p	20p
50	4p	5p	6p	9p	13p	18p	—	—
100	5p	6p	10p	12p	19p	20p	—	—
250	9p	10p	11p	17p	28p	—	—	—
500	10p	11p	17p	24p	45p	—	—	—
1000	13p	17p	40p	—	—	—	—	—
2000	23p	37p	45p	—	—	—	—	—

As total number of values are too numerous to list, use this price guide to work out cost of your actual value requirements, i.e. 2MFD, 30V would be 5p, or 330MFD, 50V would be 14p, etc. etc.

8/20, 10/20, 12/20 **Solid tantalum 15p each**
16–32/275, 32–32/275, 100–100/150, 100–100/275 50–50/300 **20p each**
12,000/12, 32–32–50/300, 700/200, 100–100–100–150–150/320 **50p each**
20–20–20/350 **40p each**

INDICATORS

Arcolectric green, takes M.E.S. bulb	20p
Bulgin D676 red, takes M.E.S. bulb	20p
12 volt red, small pushfit	20p
Mains neon, red, pushfit	18p

CAPACITOR GUIDE – maximum 500V

Up to .01 ceramic **2p.** Up to .01 poly **3p.** Up to 1000PF silver mica **5p.** 1,200PF up to .01 silver mica **10p.** .013 up to .25 poly etc. **4p.** .27 up to .68 poly etc. **6p**

Over 500 volt order from above guide and few others listed below.

6p. .1/600: **10p.** .01/1000, 1/350, 8/20, .1/900, .22/900, 4/16. .25/250 AC (600vDC) .1/1500 **40p.** 5/150, 9/275AC, 10/150, 15/150, 40/150.

TRIMMERS, 20p 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**

Strong grey plastic box same design as die cast ali $4\frac{3}{8}''$ x $2\frac{3}{8}''$ x $1\frac{1}{4}''$ **40p**

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

LABGEAR MAINS DROPPER
36 ohm 25 watt + 79 ohm 9 watt **20p**

SPEAKER, EX-EQUIPMENT 3 OHM
$5\frac{1}{4}''$ x $2\frac{3}{4}''$ **30p**

2 Amp Suppression Choke **5p**

PAXOLINE
3 x $2\frac{1}{2}$ x $\frac{1}{16}''$ **2p**
$4\frac{3}{8}$ x $\frac{1}{2}$ x $\frac{1}{4}''$ **2 for 1p**

220K & 100 ohm 3 watt resistors **4p**

VALVE RETAINER CLIP, adjustable **2p**

OUTPUT TRANSFORMERS
Sub-miniature Transistor Type **25p**
Valve type, centre tapped or straight **40p**

THE RADIO SHACK

161 ST. JOHNS HILL, BATTERSEA, LONDON S.W.11
Open 10 a.m. till 7 p.m. Monday to Saturday also most Sundays.
Phone 01-223 5016

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**

SEMICONDUCTORS

Full spec. marked by Mullard, etc. Many other types in stock

AC107	14p	BC178A/B	14p	BF194/5/6/7	8p
AC127/176	11p	BC179B	15p	BF194A	12p
AC128	8p	BC186/7	20p	BF200	20p
ACY28	18p	BC213L	11p	BF262/3	23p
AD149	40p	BC337/8	15p	BF336	25p
AF116/7	13p	BC547/558A	11p	BFX29/30	25p
AF124/6/7	20p	BCY40	60p	BFX84/88	20p
AF139/178	30p	BCY70/1/2	12p	BFY50/1/2	11p
AF180/1	30p	BD112/3/5/6	50p	BFY90	50p
AF239	20p	BD131	24p	BR101 (Programmable Unj Junction)	30p
ASY27/73	25p	BD132	30p	BRY39 (Programmable Unj Junction)	34p
BC107A or B	9p	BD135	28p	BRY56 (Programmable Unj Junction)	34p
BC107/8/9	8p	BD201/2/3/4	£1.00	BSV64	40p
BC108A/B/109B/C	11p	BD232/4/5	49p	BSX21	18p
BC147/8/9	7p	BDX77	£1.40	BU105/01	£1.50
BC147A/B	11p	BF115	15p	CA3001	£1.00
BC148A/B, 9B/C/S	8p	BF167/173	20p	CV7042 (OC41 OC44, ASY63)	10p
BC157/8/9	9p	BF178/9	25p	GET111	40p
BC158A/B	11p	BF180/1/2/3	22p	OC35	35p
BC159C, 157A	11p	BF184/5	15p		

SN7483	82p	2N1302	15p
TAA570	£1.20	2N2219	18p
TAD100	£1.00	2N2401 (ASY26-27)	20p
2G302	15p	2N2904/5/6/7	13p
2N393/MA393	30p	2N2907A	15p
2N706	8p	2N3053	14p
2N987	35p	2N3055 (992)	33p
2N1091	45p	741 8 pin dil	28p

THYRISTORS

Amp	Volt		
1	240	BTX18-200	50p
1	400	BTX18-300	65p
1	240	BTX30-200	40p
6.5	500	BT102-500R	90p
10	700	BT106	85p
15	500	BT107	£1.00
6.5	500	BT101-500R	90p
6.5	500	BT109-500R	90p
20	600	BTW92-600RM	£3.00
15	800	BTX95-800R Pulse Modulated	£10.00

BRIDGE RECTIFIERS

Amp	Volt RMS		
½	1,600	BYX10	30p
1	140	OSH01-200	30p
1.4	42	BY164	35p

Plastic types

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

Encapsulated with built-in heat sink 15p

OTHER DIODES

IN916	6p	BA182	24p
IN4148	4p	OA5/7/10	10p
BA145	14p	BZY88 Up to 33 volt	7p
Centercel	10p	BZX61 11 volt	16p
BZY61	10p	BR100 Diac.	20p

TRIACS

Amp	Volt		
6	400	Plastic	90p
25	900	BTX94-900	£5.00
25	1200	BTX94-1200	£7.00

CQY11B L.E.D. Infra red transmitter £1 One fifth of trade

WESTINGHOUSE 28TIO 30 AMP 1000 VOLT THYRISTER WITHOUT NUT £4

PHOTO SILICON CONTROLLED SWITCH
BPX66 PNPN 10 amp £1.00

1 AMP RECTIFIERS

IN4003	200 volt	5p
IN4005	600 volt	6p
IN4006	800 volt	7p
IN4007	1,000 volt	7p

OPTO ELECTRONICS

ORP12	44p
BPX40	65p
BPX42	£1.50
BPY10 (VOLTIAC)	£1.00
BPY68, BPY69, BPY77 Diodes	£1.00

Photo transistor

BPX29	£1.00
OCP71	35p

BIG L.E.D. 4½mm 2v 50m/A max.
RED 15p
ORANGE, GREEN, YELLOW 16p

HIGH POWER RECTIFIERS

	Amp	Volt	
SR100	1.5	100	7p
SR400	1.5	400	8p
LT102	2	30	10p
BYX38-600	2.5	600	40p
BYX38-300R	2.5	300	36p
BYX38-900	2.5	900	45p
BYX38-1200	2.5	1,200	50p
BYX49-600	2.5	600	34p
BYX49-300	2.5	300	28p
BYX49-900	2.5	900	40p
BYX49-1200	2.5	1,200	52p
BYX48-300	6	300	40p
BYX48-600	6	600	50p
BYX48-900	6	900	60p
BYX48-1200	6	1,200	80p
BYX72-150R	10	150	35p
BYX72-300R	10	300	45p
BYX72-500R	10	500	55p
BYX42-300	10	300	45p
BYX42-600	10	600	65p
BYX42-900	10	900	80p
BYX42-1200	10	1,200	95p
BYX46-300*	15	300	£2.00
BYX46-400*	15	400	£2.50
BYX46-500*	15	500	£2.75
BYX46-600*	15	600	£3.00
BYX20-200	25	200	60p
BYX52-300	40	300	£1.75
BYX52-1200	40	1,200	£2.50

**Avalanche type*

RG4-1250 Mercury vapour rectifier £5.00

1" Terryclips chrome finish .. 4p

Cinch 10-way terminal block 15p

Pair of LA2407 Ferrox cores with adjuster 25p

Chrome Car Radio facia .. 15p
Rubber Car Radio gasket .. 5p

DLI Pal Delayline 80p

Relay socket 10p
Take miniature 2PCO relay

B7G or B9A valve can .. 2p

0-30, or 0-15, black pvc, 360° dial, silver digits, self adhesive, 4½" dia. 10p

F.E.T's

BFW10	45p
BSV79	£1.00
BSV80	90p

N. Channel

BSV81 M.O.S.T.	90p
BFS28 Dual M.O.S.T.	92p

Wire ended glass neons 4p

650 m/h 2amp. 2ohm chokes 60p

Plastic, Transistor or Diode Holder 1p
Transistor or Diode Pad 1p
Holdersorpads 50pper100

PAPER BLOCK CONDENSER

0.25MFD	800 volt	30p
1MFD	250 volt	15p
2MFD	250 volt	20p
2MFD	1.5 kv	50p
4MFD	250 volt	20p
15MFD	150 volt	50p

METAL CHASSIS SOCKETS

Car Aerial, Coax, 5 or 6 pin 240° din, Speaker din switched, 3.5mm Switched Socket — 6p

BY RETURN POST SERVICE

SOLDER

Multicore - 2½p foot

ENAM. COPPER WIRE

SWG.	PER YD.
18	3p
20-24	2p
26-42	1p

TAA300 T0-74 1 Watt A.F. AMPLIFIER I.C. 4·5 to 9v £1.25

GARRARD

GCS23S Crystal Stereo Cartridge £1.00

HANDLES

Rigid light blue nylon 6½" with secret fitting screws 5p

Rotor with neon indicator, as used in Seafarer, Pacific, Fairway depth finders 20p each

Miniature Axial Lead Ferrite Choke formers 2p

DEE PLUG

McMurdo DA15P 15 way chassis plug 15p

Fairway 18009 Coax. socket .. 3p

TIE CLIPS

Nylon self locking 7" or 3½" 2p

CINCH 150

12 way edge socket 10p

1lb Mixed nuts, bolts, washers etc. 35p

Philips Iron Thermostat ... 15p
Bulgin 2-pin flat plug and socket 10p
McMurdo PP108 8 way edge plug 15p

TO3 HEATSINK

Europlec HP1 TO3B individual 'curly' power transistor type. Ready drilled 20p

8 way Cinch standard 0.15 pitch edge socket 20p

U.E.C.L. 10 way pin connector 2B6000 OA1P10 .. 10p

U.E.C.L. 20 way pin connector 2A60000A1P20 20p

U.E.C.L. 10 way pin socket 2B606001R10 10p

U.E.C.L. 20 way pin socketB260800A1R20 20p

BELLING LEE L1354 TV Aerial diplexer 10p

Philips electronic engineer kits add on series E1004 £1.00 each (parts worth more)

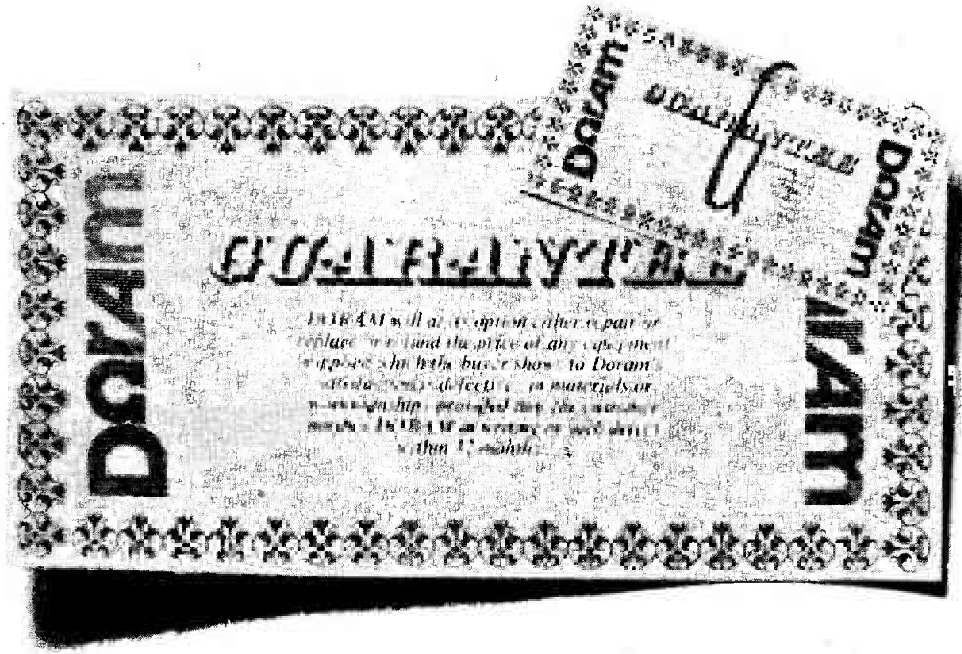
Tested unmarked or marked ample lead ex new equipment

ACY17-20	8p	OC71/2	6p
ASZ20	8p	OC200-5	10p
ASZ21	15p	TIC44	24p
BC186	11p	2G240	2-50
BCY30-34	10p	2G302	6p
BCY70/1/2	8p	2G401	10p
BF115	10p	2N711	25p
BY127	8p	2N2926	7p
BZY88 series	5p	2N598/9	6p
HG1005	2p	2N1091	8p
HG5009	2p	2N1302	8p
HG5079	2p	2N1907	2-50
L78/9	2p	Germ. diode	2p
M3	10p	GET120 (AC128 in 1" sq. heat sink)	20p
OA81	3p		
OA47	2p		
OA200-2	3p	GET872	12p
OC23	20p		

SMALL ORDERS, ENCLOSE SUITABLE STAMPED ADDRESSED ENVELOPE
LARGE ORDERS, ADD SUFFICIENT FOR POSTAGE, INSURANCE, ETC.
TOTAL GOODS PLUS CARRIAGE, ADD 8% V.A.T.

THE RADIO SHACK

161 ST. JOHNS HILL BATTERSEA LONDON S.W.11
Open 10 a.m. till 7 p.m. Monday to Saturday also most Sundays
Phone 01-223 5016



With the Doram catalogue, even the guarantee is guaranteed.

Doram is an entirely new way of buying electronic components.

So, to succeed, it's got to have something going for it, right?

We agree with you. And where Doram scores is in the security it gives the amateur buyer.

We'll give you peace of mind three ways.

No-quibble guarantee.

Firstly, we guarantee to replace any component which arrives faulty. Absolutely free of charge.

And secondly, our guarantee is backed by the biggest electronics distribution Group in Britain.

7-day service.

Thirdly, we guarantee you'll have your components within 7 days from our receipt of your orders.

We're so confident of our service that if we can't supply the part you want within 7 days we'll give you an immediate refund.

So you'll never get a tedious wait.

You know just where you stand with Doram.

All branded goods.

All goods supplied by Doram are made by big-name manufacturers. And they're all to manufacturer's specifications. They're the best money can buy.

In fact, Doram gives the amateur the sort of service only professionals have enjoyed before.

Millions of components.

All in all, we're big enough to offer you stocks of millions of components, on over 4,000 product lines.

All you do is buy the Doram catalogue for 25p (that's a yearly reference book for the price of a pint of lager) and then take your pick from it.

Use the coupon now. Send today for the first-ever Doram catalogue. It can take a lot of worry out of amateur components buying.

And for 25p that's not bad, is it?

I ENCLOSE 25p.* PLEASE SEND ME THE NEW DORAM CATALOGUE.

Name ....

Address ....

....

....

Doram Electronics Limited,
PO Box TR8,
Wellington Road Industrial Estate,
Wellington Bridge, Leeds LS12 2UF.

*This will be refunded on orders of £5 (less VAT) or more received by us before March 31st, 1975.

Doram

REC/3/75

BI-PRE-PAK

Bargains in Semi-Conductors, Components Modules and Equipment

Electronic Transistor Ignition £6·00

Complete kit p. & p. 11p

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 compatability.

Extension Telephones

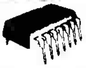
Ideal for toys **70p** each P. & P. 25p.

New X Hatch Generator Mk.2

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 toolbox— only measures 3" x 5½" x 3".

Ready built unit only **£9.93** Complete kit **£7.93**

Takes three U 2 type batteries



LM380 AUDIO IC

We have just received a large consignment of LM380 IC's. These are specially selected to a higher grade and are marked with the number SL60745.
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 **£1·00ea** 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
TYPE "F" NPN Silicon plastic encapsulation
TYPE "G" NPN silicon similar ZTX 300 range

8 RELAYS various types p & p 27p **£1·00p**

UHF TV Tuner Units

Brand new by a famous manufacturer
Data supplied **£2'50**

B.P.P. CATALOGUE

20 pages packed with bargains. Size 11½ × 8½. Send large S.A.E. with 6p stamp.

Plastic Power Transistors IN TWO RANGES

These 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 4 digit (non-reset) 24V or 48V 4 x 1 x 1 in 33p p & p 5p.

INTEGRATED CIRCUITS

We stock a large range of IC'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 12p Wall Chart 18p

LOW COST DUEL IN LINE I.C. SOCKETS

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

BOOKS

We have a large selection of Reference and Technical Books in stock. Details are in our latest Catalogue. Send for it TODAY, using the coupon below. N.B. Books are void of V.A.T.

Send for lists of publications

Our famous P1 Pak is still leading in value

Full of Short Lead Semiconductors & 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.

Pak P.1. 50p

TERMS OF BUSINESS

V.A.T. Prices shown do not include V.A.T. Please add 8% to total value of your order including postage. No V.A.T. on overseas orders.

POSTAGE Except where stated, add 15p for postage & packing in U.K. Overseas—add £1., any difference being charged or refunded.

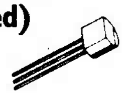
PAYMENT Cash with order, Cheque or money order. Minimum value—50p You can also pay by ACCESS.

IMPORTANT—*Every effort is made to ensure accuracy of prices and description at time of preparing this advertisement and going to press. Prices are subject to alteration without notice.*

SPECIAL BPP PAKS Tested & Guaranteed all at 50p each

B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV 1 amp. plastic
B81	10	Reed Switches, 1" long ⅛" dia. Highspeed P.O. type
H35	100	Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked
H38	30	Short lead Transistors, NPN Silicon Planar types
H39	6	Integrated circuits 4 gates BMC 962, 2 flip flops BMC 945
H41	2	BD131/BD132 Complementary Plastic Transistors
H65	4	40361 Type NPN Sil. transistors TO-5 can comp. to H66
H66	4	40362. Type PNP Sil. transistors TO-5 can comp. to H65

Special Bargain Paks (unmarked, untested) all at 50p each



B1	50	Germanium Transistors PNP, AF and RF
B66	150	Germanium Diodes Min. glass type
B83	200	Transistors, manufacturers' rejects, AF, RF, Sil. and Germ.
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202
B86	100	Sil. Diodes sub. min. IN 914 and IN916 types
H20	20	BY126/7 Type Silicon Rectifiers 1 amp. plastic. Mixed volts
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can
H67	10	3819N Channel FET's plastic case type.

Stirling Sound Audio Modules

A new development by BI-PRE-PAK for enthusiasts who like building at keen prices.

SEE OUR LATEST CATALOGUE

A rev. counter for your car

The "Tacho Block" enables you to turn any 0.1 mA meter into an accurate linear rev. counter. The block is encapsulated and easily fitted into any car with conventional coil ignition. Each **£1·00**

To BI-PRE-PAK 222 West Rd., Westcliff-on-Sea, Essex
Please send latest B.P.P. Catalogue. (I enclose large S.A.E. envelope with 6p stamp.)

Please send ....

....

Enclosed £.............. inc. V.A.T. cheque/money order
(Write on more paper if necessary)

NAME ....

ADDRESS ....

BI-PRE-PAK LTD Dept.C. 222·224 WEST ROAD, WESTCLIFF·ON·SEA, ESSEX. TELEPHONE: SOUTHEND (0702) 46344.

Co Reg No 820919

RADIO & ELECTRONICS CONSTRUCTOR

MARCH 1975

Volume 28 No. 8

Published Monthly (1st of Month)
First Published 1947

Incorporating The Radio Amateur

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9 1SN

Telephone 01-286 6141

Telegrams Databux, London

Annual Subscription: £3.30 (U.S.A. and Canada $8.00) including postage. Remittances should be made payable to "Data Publications Ltd". Overseas readers please pay by cheque or International Money Order.

Technical Queries. We regret that we are unable to answer queries other than those arising from articles appearing in this magazine nor can we advise on modifications to equipment described. We regret that such queries cannot be answered over the telephone; they must be submitted in writing and accompanied by a stamped addressed envelope for reply.

Correspondence should be addressed to the Editor, Advertising Manager, Subscription Manager or the Publishers as appropriate.

Opinions expressed by contributors are not necessarily those of the Editor or proprietors.

Production.—Web Offset.

CONTENTS

Published in Great Britain by the Proprietors and Publishers, Data Publications Ltd, 57 Maida Vale, London, W9 1SN

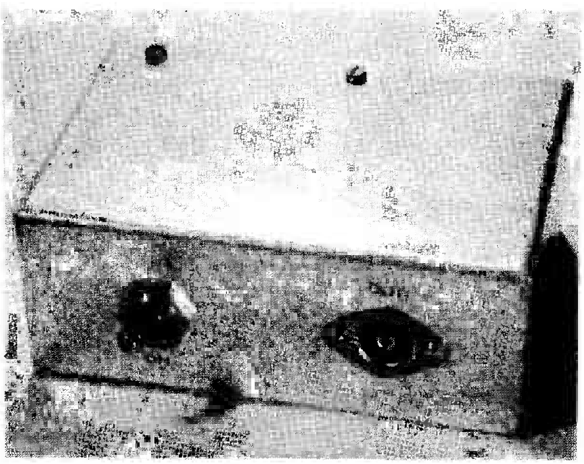
The *Radio & Electronics Constructor* is printed by Carlisle Web Offset.

APRIL ISSUE WILL BE PUBLISHED ON 1st APRIL

OSCILLOSCOPE CALIBRATION GENERATOR

By P. R. Arthur

A useful item of test equipment which may be employed for oscilloscope voltage calibration or as a signal injector.



THIS SIMPLE DEVICE PROVIDES A SQUARE WAVE OUTPUT with an amplitude of 1 volt peak-to-peak. It is primarily intended for use in determining the sensitivity of an oscilloscope which does not have a built-in calibrator, but it can also double as a signal injector.

It is self-contained in an aluminium box measuring approximately 10 cm. by 7 cm. by 4 cm. (3.9 by 2.75 by 1.6 in.). The circuit is very simple, and only three semiconductor devices are employed. A voltmeter with a sensitivity of at least 20kΩ per volt is required for setting-up.

CIRCUIT OPERATION

The circuit of the oscilloscope calibrator is shown in Fig. 1. Basically, it consists of an astable multivibrator feeding an f.e.t. chopper which clips the output to 1 volt peak-to-peak.

The NE555V i.c. is operated as an astable multivibrator. Since C3 charges through R7 and R8 on one part of the cycle, but discharges through R8 only during the remaining part of the cycle, the mark-space ratio will not be exactly 1:1. However, R8 has a very high value in comparison with R7, and the error is less than 1%. The frequency of oscillation with the prototype was approximately 1.5kHz.

The output of the i.c. is developed across R6, and is fed to the gate of TR1 via C1. R5 and D1 provide a stabilized supply for this transistor. R1, VR1 and R2 form a potential divider, and VR1 is adjusted to give a potential of 1 volt with respect to the negative rail at its slider. R3 is the drain load resistor for TR1, and R4 is its gate bias resistor.

When a positive pulse is applied to TR1 gate from the multivibrator TR1 is turned hard on, and has a resistance of only about a hundred ohms. The voltage at TR1 drain is therefore very low, at around 1mV, due to the consequent large voltage drop across the high resistance of R3.

During negative pules TR1 gate is heavily negative biased, and so the f.e.t. exhibits an extremely high drain-to-source resistance. This produces virtually no voltage drop across R3 at all. The peak-to-peak output at TR1 drain is therefore almost exactly identical with the d.c. voltage at VR1 slider, and is in consequence 1 volt. This signal is fed to the output socket via the coupling capacitor, C2.

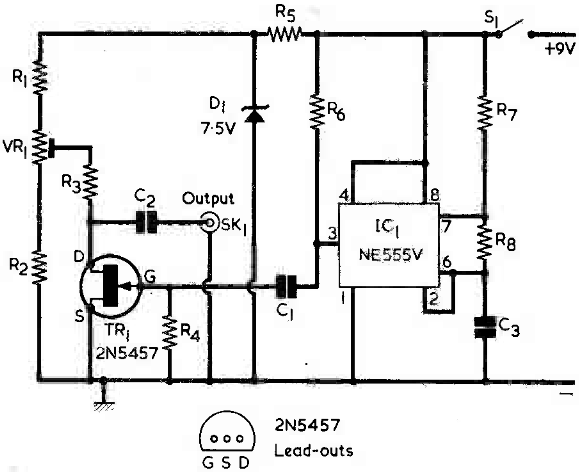


Fig. 1. The circuit of the oscilloscope calibration generator. The output is a square wave having an amplitude of 1 volt peak-to-peak. The pin layout of the i.c. is given in Fig. 2

COMPONENTS

Resistors
(All fixed values ¼ watt 10%)

R1	6.8kΩ
R2	820Ω
R3	68kΩ
R4	27kΩ
R5	470Ω
R6	2.7kΩ
R7	1kΩ
R8	270kΩ
VR1	1kΩ pre-set potentiometer, miniature skeleton (see text)

Capacitors

C1	0.047µF polyester
C2	0.1µF polyester
C3	0.0015µF polystyrene or ceramic

Semiconductors

TR1	2N5457 or MPF103
IC1	NE555V or equivalent (see text)
D1	BZY88C7V5

Switch
S1 s.p.s.t. toggle

Socket
SK1 Coaxial socket, flush mounting

Miscellaneous
9 volt battery type PP3
Battery connector
Veroboard, 0.1 in. matrix
18 s.w.g. aluminium sheet

Due to the necessarily high value of R3, the output of the unit must be fed to a high impedance load if the unit is to give an accurate output. The input impedance of most oscilloscopes is in the region of 2MΩ, and so this is not a major drawback.

The 555 i.c. is available under the type number NE555V as specified, or LM555CN. Another equivalent is the R.S. Components '555 Type' i.c. TR1 may be a 2N5457 or MPF103, both of these having the same lead-out layout.

The only other component which requires comment is the pre-set potentiometer employed for VR1. This should be a miniature horizontal mounting skeleton potentiometer having tag spacing which corresponds with the Veroboard hole positioning shown in the layout diagram of Fig. 2. A potentiometer which specifically meets these requirements is the type PN, horizontal mounting, available from Electrovalue Ltd., 28 St. Judes Road, Englefield Green, Egham, Surrey.

CONSTRUCTION

All the components, with the exception of the battery, on-off switch and output socket, are mounted on a 0.1 in. matrix Veroboard panel having 23 by 16 holes. The copper strips run lengthwise. Details of this panel are shown in Fig. 2.

There are five breaks in the copper strips, and once a board of the correct size has been cut out, the first job is to make these cuts at the appropriate points. Next drill out the two 6BA clear mounting holes and, if necessary, slightly enlarge the holes which take the tags of VR1. Then connect the three insulated link wires and mount and connect the various components, leaving the i.c. until last. The i.c. is carefully soldered into place directly on the component panel. Take care not to overheat it during soldering.

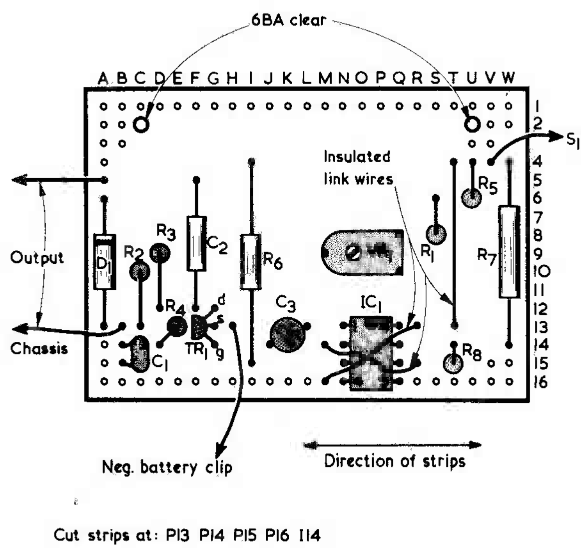


Fig. 2. The layout of the components on the Veroboard panel

THE CASE

The prototype unit is housed in a home-made aluminium box having the dimensions mentioned earlier, but any box of about the same size can be used. It is not recommended that an attempt be made to employ a case which is significantly smaller than that used by the author as there is little excess space in the prototype.

Details of the case used to house the author's calibrator are shown in Fig. 3. The case consists of two parts, these being the main chassis and a detachable baseplate. Both are made from 18 s.w.g. aluminium sheet.

Commence construction of the case by cutting out the two pieces of aluminium to the size and shape shown in the diagram. Then drill the holes in the main part of the case, but not the two in the baseplate. The two holes marked 'A' are clearance size for small self-tapping screws. The positions of the two 6BA clear mounting holes for the component panel are found by using the panel itself as a template. The position taken up by the panel can be judged from the photograph of the unit interior.

When the drilling has been completed, bend both parts of the case to shape with the aid of a small vice. Then place the baseplate in position and use a pencil to mark, through the two 'A' holes in the chassis, the positions of the two holes in the flanges of the baseplate.

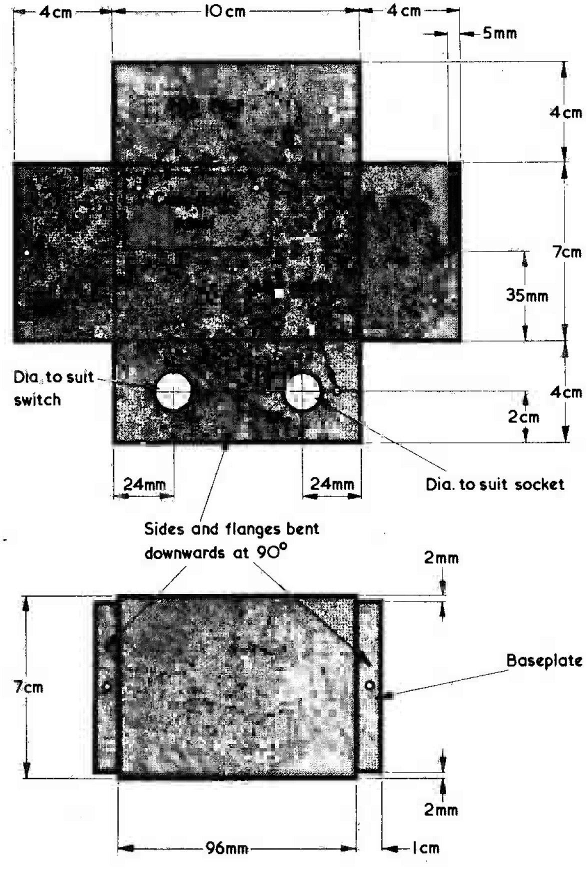
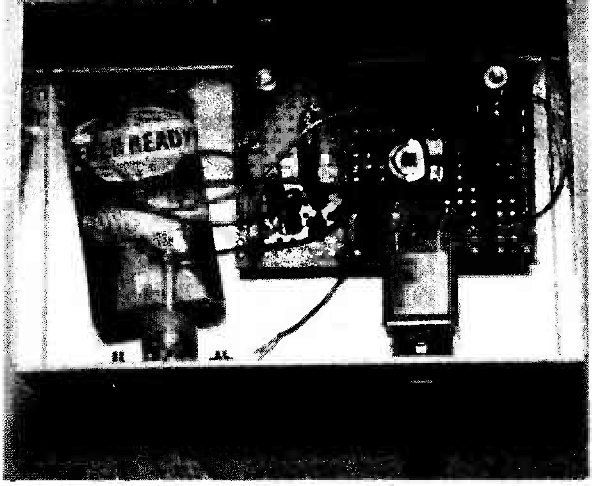


Fig. 3. The two sections which make up the case. The material is 18 s.w.g. aluminium sheet



The components inside the case are spaced out comfortably without crowding

Drill these tapping size for the self-tapping screws. Two of these screws can later be used to secure the baseplate to the chassis after the parts have been fitted to the latter and setting-up has been completed.

Now mount S1 and SK1. Unless a case made from an insulating material is used the component panel will need to be spaced a little way from the inside surface of the case. This can be achieved by using two ½ in. 6BA mounting bolts and fitting two nuts on each between the panel and the case. Before finally mounting the panel, complete the wiring to SK1, S1 and the battery connector. Note that the lead from hole B13 of the Veroboard panel is that which is wired to the outer connector of the output socket. This lead, in consequence, also provides the chassis connection for the unit.

There is ample space for the battery behind SK1. A thick piece of foam plastic or rubber is glued to the inside of the baseplate in such a way that it holds the battery firmly in place when the baseplate is screwed on.

ADJUSTMENTS

Before switching on the unit for the first time, insert a testmeter switched to read a high current in series with the positive battery lead. Switch on and, if there is no evidence of excessive current, switch off again and re-adjust the testmeter to read 10mΩ f.s.d. or more. Then switch on and check the current drawn from the battery. If all is well, this should be of the order of 7.5mA. Should a current reading which is significantly different from this figure be given, switch off at once and check the unit for short-circuits or wiring errors.

Once the circuit is functioning correctly only one setting-up operation has to be carried out before it is ready for use, and that is to set the voltage at VR1 slider to 1 volt. A testmeter with a sensitivity of at least 20kΩ per volt should be used when measuring this voltage. It is connected between chassis and the slider of VR1.

Since the peak-to-peak voltage at the output will be fractionally less than the direct voltage at VR1 slider, this voltage can be set a little on the high side, at about 1.02 or 1.03 volts, to give a slightly higher degree of accuracy.

When VR1 has been adjusted the testmeter connections are removed, and the baseplate is fitted to the chassis. The calibration generator is then ready for use. ■

ZN414 RECEIVER

By G. A. French

Suggested Circuit 292

THAT ADMIRABLE INTEGRATED CIRCUIT, the Ferranti ZN414, has been with us for several years now, and it has formed the basis of a number of home constructor radio receiver designs. As the majority of readers will know, the ZN414, in company with a tuning capacitor, ferrite aerial and a few other components, can provide a.g.c. controlled r.f. amplification together with detection on the medium and long wave bands. As such, it can drive an earphone directly, whereupon a complete radio receiver is provided. Alternatively, its output can be coupled to an a.f. amplifier which then drives a loudspeaker.

The receiver to be described in this article falls into the second category, and the a.f. amplifier following the ZN414 incorporates a transistor and a second integrated circuit. The output power is 250mW, and the amplifier gain is sufficient to allow good loudspeaker reception of stations in the medium wave band. Also, the Radio 2 transmission on 1,500 metres is reproduced at an adequate level in areas where this signal is received at reasonable strength. The receiver incorporates several unusual features and one section of the circuit is a little experimental since it relies on one component, a light-emitting diode, having a performance which is not fully covered by its specification. A voltmeter, capable of giving clear voltage readings around 1.5 volts is necessary in the construction of the receiver.

CIRCUIT OPERATION

The complete circuit of the receiver is shown in Fig. 1. Here, the ZN414 appears as IC1, and its input couples to the tuned circuit given by C2 and L1 or L2 according to the position of wavechange switch S1. L1 and L2 are two separate ferrite aerial coils, L1 being wound for medium waves and L2 for long waves. R1 provides the input bias for the ZN414 and also couples back an a.g.c. voltage developed across the output load resistor R2. The current drawn through R2 by the ZN414 is of the order of 0.3mA.

The supply voltage for the ZN414 must lie between the limits of 1.2 to 1.6 volts, and it is provided by LED1 which functions both as a visual indicator to show that the receiver is turned on and as a voltage stabilizing device. In the latter instance, the voltage across it is typically 1.5 to 1.55 volts. The actual voltage applied to R2 can be varied over small limits by adjusting S2. When this switch is in position '1' the full voltage across LED1 is available for the ZN414 circuit. Setting S2 to position '2' causes the voltage to fall by about 0.2 volt, this being dropped across the forward biased germanium diode, D1. With S2 in position '3' the voltage falls by a further 0.2 volt due to the inclusion of the second germanium diode, D2. As both these diodes pass forward current when they are switched into circuit they offer a low impedance and do not significantly alter the output load resistance for the ZN414. The availability of a variable supply voltage enables the ZN414 to give optimum results with both weak and strong signals and, in the author's view, considerably enhances the performance of the receiver. The idea of employing series germanium diodes in the manner illustrated in the circuit was originally introduced in 'In Your Workshop' in *Radio & Electronics Constructor* for August 1974.

The current passed by the light-emitting diode is approximately 1.3mA This causes it to emit a glow which is too low to be observed in strong daylight but which is quite noticeable in reduced artificial lighting. The glow is more than adequate to give warning that the receiver is switched on if it is used as a bedside radio.

The a.f. output from the ZN414 is fed via C4 to the volume control R4, and then passes via R5 and C5 to the base of TR1. This transistor and the second integrated circuit, IC2, provide a high level of a.f. gain, and the loudspeaker is fed directly from the output of the integrated circuit. The components R8, R9, R10 and C7 complete an a.c. and d.c. feedback loop which takes in both the transistor and the integrated circuit. This loop is discussed in more detail later.

The receiver will function with quite a low bypass capacitance across the 9 volt supply rails when a new battery is fitted. When the battery is very nearly exhausted and has a high internal resistance, however, the performance is noticeably improved by employing a bypass capacitance of 500μF or more. It is for this reason that C9 has been given the rather high value of 1,000μF, and this capacitor allows the receiver to continue functioning satisfactorily even when the battery is so exhausted that its voltage is lower than 6 volts. Thus, the use of a bypass capacitance somewhat higher than would normally be encountered provides a useful economy in battery costs. The voltage available for the ZN414 remains adequately stabilized by LED1 under low supply voltage conditions. The quiescent current consumption of the receiver depends upon the particular component employed in the IC2 position. Typical quiescent current here is specified by the manufacturer as 3.5mA at 9 volts, with a maximum figure of 6mA. To this

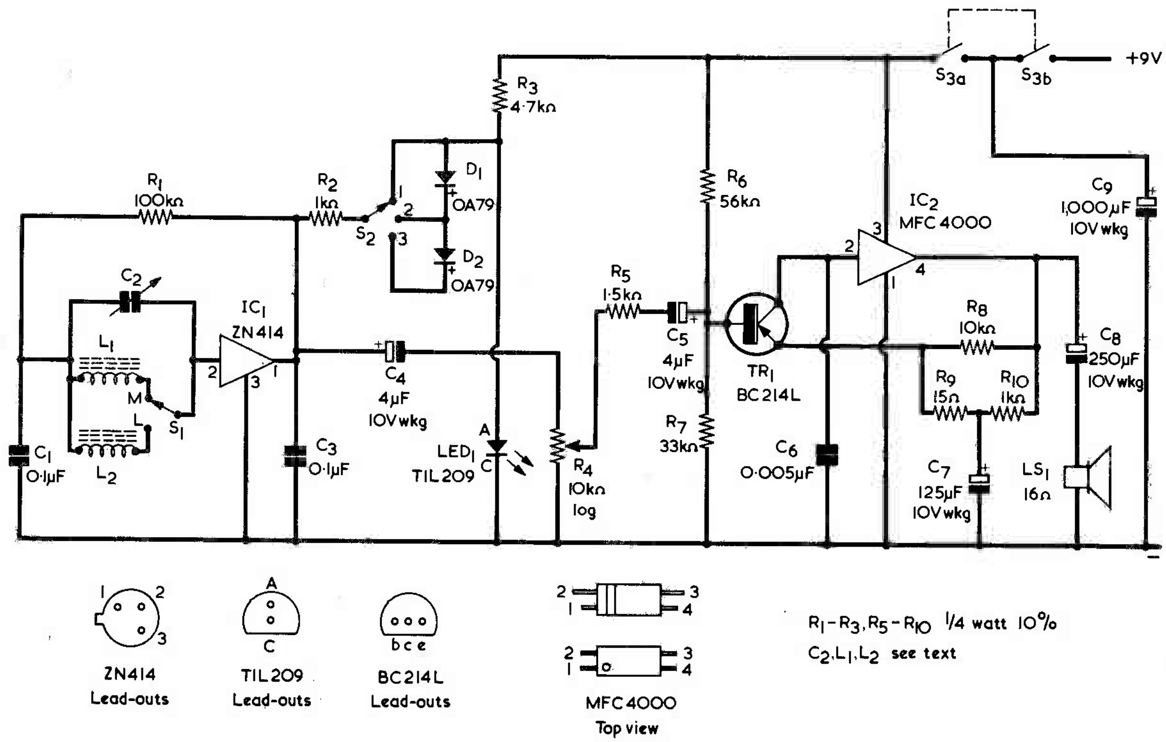


Fig. 1. The complete circuit of the ZN414 receiver. This requires no alignment, and the only tuned circuit is that which couples to the input of the ZN414

current should be added the 1.6mA which flows in R3. The integrated circuit used by the author drew a quiescent current of 2.5mA only, whereupon the quiescent current of his receiver was just a little higher than 4mA. The battery current rises to some 60mA on a.f. output peaks.

A double-pole single-throw switch is employed for S3(a)(b). When this switch is closed, to turn the receiver on, the positive 9 volt supply is applied both to C9 and to the receiver. The receiver is switched off by opening S3(a)(b), whereupon not only is the 9 volt positive supply disconnected from C9, but this capacitor is also disconnected from the receiver circuit. If a single-pole on-off switch were used with C9 connected permanently to the receiver circuit, there would be quite a long delay before the capacitor finally discharged after switch-off. During the discharge period the receiver would continue to play, but at a reduced and distorted level. The on-off switching circuit shown in the diagram prevents this effect from taking place. If desired, S3(a)(b) may be ganged with R4.

A.F. AMPLIFIER

Before concluding the description of circuit functioning, it will be of interest to examine the operation of IC2 in more detail. The internal circuitry of this i.c. is shown in Fig. 2. So far as signal amplification is concerned, the input at terminal 2 of the i.c. is applied to the base of an n.p.n. transistor which offers voltage amplification and also drives the four output transistors. The latter are in a quasi-complementary configuration similar to that commonly employed in a.f. amplifiers incorporating discrete transistors.

The feedback circuit in Fig. 1 can now be described in more detail. Under d.c. conditions, capacitor C7 has no effect on circuit operation and the i.c. output, from terminal 4, couples back to the emitter of TR1 via R8, R9 and R10. If, for any reason, the i.c. output attempts to go positive so also will the emitter and, in consequence, the collector of TR1. This positive excursion will be passed to the base of the driver transistor in the i.c., causing its collector to go negative and counteract the original positive change. The d.c. feedback circuit similarly prevents negative excursions of the i.c. output. The standing i.c. output voltage is set by the potentiometer given by R6 and R7. These resistors hold the base of TR1 slightly below half supply voltage whereupon, allowing for emitter current and the fact that the emitter will be 0.6 volt positive of the base, the i.c. output assumes the required half supply voltage potential. In the author's prototype circuit the output was held very close to half supply voltage even when the battery voltage had fallen to below 6 volts.

Resistors R8 and R9 provide a.c. feedback also, but in this case the feedback level is limited due to the presence of C7, which can be assumed to have zero impedance at audio frequencies. The overall voltage gain, from TR1 base to the output of IC2, is then approximately equal to R8 divided by R9, or 700 times.

The MFC4000 used for IC2 is available in two different encapsulations, and both of these are shown in Fig. 1. It should be emphasised that these are top views, with the i.c. pins pointing away from the reader. The other lead-out insets in Fig. 1 show devices with the leads pointing towards the reader. The MFC4000 is generally available as MFC4000B or MFC4000P. The latter can be obtained from Henry's Radio Ltd.

CONSTRUCTION

The receiver may be assembled in a small insulated case whose dimensions are dictated by the larger components, these being the two ferrite aerials, the speaker, the tuning capacitor and the 9 volt battery. The circuit is intended to be built up as a small but not 'midget' receiver, whose main attraction is the circuit simplicity and lack of alignment which results from the use of the ZN414.

Two separate ferrite aerial rods for medium and long waves allow maximum selectivity and sensitivity on both these bands. The usual approach in a medium and long wave receiver consists of having a medium and long wave coil in series on a single rod, the long wave coil being short-circuited when medium waves is selected. This arrangement takes full advantage of the ferrite rod on long waves, but on medium waves the effective length of the rod is reduced by the short-circuited long wave coil. There will be no interaction between the two ferrite aerials used in the present design if the rods are spaced from each other by an inch or more. The ferrite rod coils may be commercially wound types intended for medium and long waves respectively, or they may be home-wound. A suitable medium wave ferrite aerial is given by 70 turns of 30 s.w.g. enamelled wire close-wound on a 6 in. rod of $\frac{3}{8}$ in. diameter, whilst a long wave coil can consist of 200 turns of 34 s.w.g. enamelled wire close-wound on a rod of the same dimensions. If necessary, the number of turns can be slightly adjusted to obtain a specific coverage. As was mentioned at the beginning of this article, the receiver is capable of reproducing the BBC2 transmission on 1,500 metres at adequate level in districts where this signal is at a reasonable strength. If the receiver is to be used in an area where the 1,500 metre signal strength is low it would be better to dispense with L2 and S1, and merely use the medium wave ferrite coil, L1, connected directly across C2. The receiver then becomes a medium wave model only.

The value of C2 is not very critical. and any air-spaced variable capacitor with a maximum value between some 280 and 350pF may be employed here.

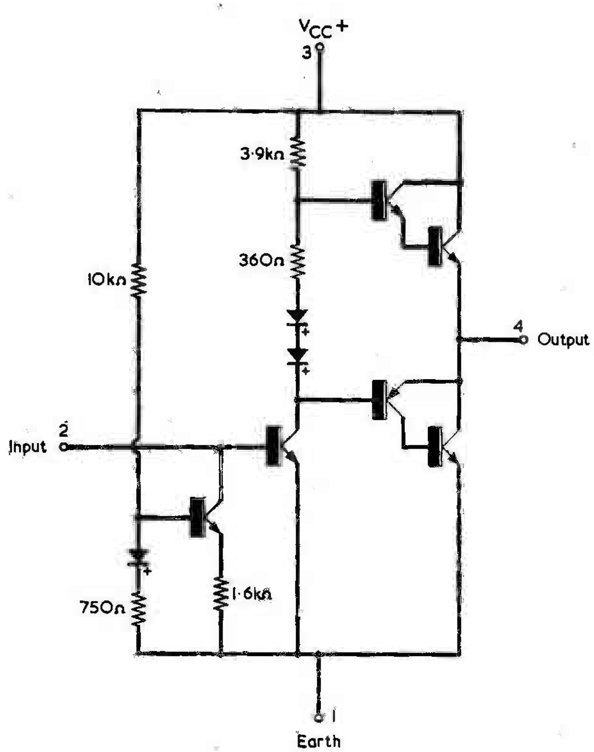


Fig. 2. The internal circuitry of the MFC4000

Its metal frame and moving vanes should connect to the junction of R1 and C1. If the parts are assembled on a small metal chassis, the latter may be made common with the negative supply rail. C2 will need to be insulated from this chassis.

No connection should be made between R2 and S2 until the actual voltage which is dropped across LED1 has been established. The manufacturer's figures for the specified TIL209 quote a typical forward voltage of 1.6 volts and a maximum of 2 volts at a forward current of 20mA, whilst general experience points to a forward voltage of 1.5 to 1.6 volts at currents below 2mA. Since these last figures are not covered by specification it is necessary to measure the forward voltage dropped across the particular l.e.d. to be employed. The 9 volt supply should be applied to R3 and LED1, and the voltage across the latter measured. If this is between 1.5 and 1.6 volts then the circuit to R2 may be wired up as in Fig. 1. If the voltage is just a little higher than 1.6 volts, say up to 1.62, then an additional diode should be inserted, as in Fig. 3(a), this diode being a germanium type such as the 0A79 used for D1 and D2. Should the voltage lie between 1.62 and 1.66 volts the additional diode should be a silicon type, and could be a 1N4001 or 1N4002. In the unlikely event of the voltage being higher than 1.66 volts then a further diode may be inserted, working on the assumption that a forward biased germanium diode drops 0.2 volt and a forward biased silicon diode drops 0.6 volt. It will be equally unlikely that the forward voltage across the l.e.d. will be lower than 1.5 volt, but, should this happen, then a germanium or silicon diode can be added in series, as in Fig. 3(b) to allow a slightly higher voltage to be applied to D1 and S2. The author checked several TIL209's in the LED1 position. These all dropped a forward voltage of 1.55 volts. The forward voltage reduced, incidentally, to 1.5 volts when the supply voltage was 6 volts, this illustrating the efficiency of the l.e.d. as a stabilizing device.

Component layout is not particularly critical provided that wiring from pin 4 of the MFC4000 is kept away from C2, L1, L2 and S1. It is important that C3 be connected to leads 1 and 3 of the ZN414 by very short wires. When a small loudspeaker is employed it should be remembered that this will give an apparently disappointing response unless it is baffled by being placed in a cabinet or fitted with a temporary baffle. The latter can consist of a piece of cardboard about 8 in. square with a hole cut in the middle to act as a speaker aperture. A surprising improvement in response will be given if the speaker is rested on the bench with its cone upwards and the cardboard baffle simply placed over it. The speaker impedance must on no account be lower than 16Ω.

When completed, the receiver can be tuned and operated in the normal manner, after which experience may be gained with the use of S2. It will be found that S2 exerts quite a high level of control over sensitivity, and it is adjusted for the setting which offers best reception conditions commensurate with audio quality. ■

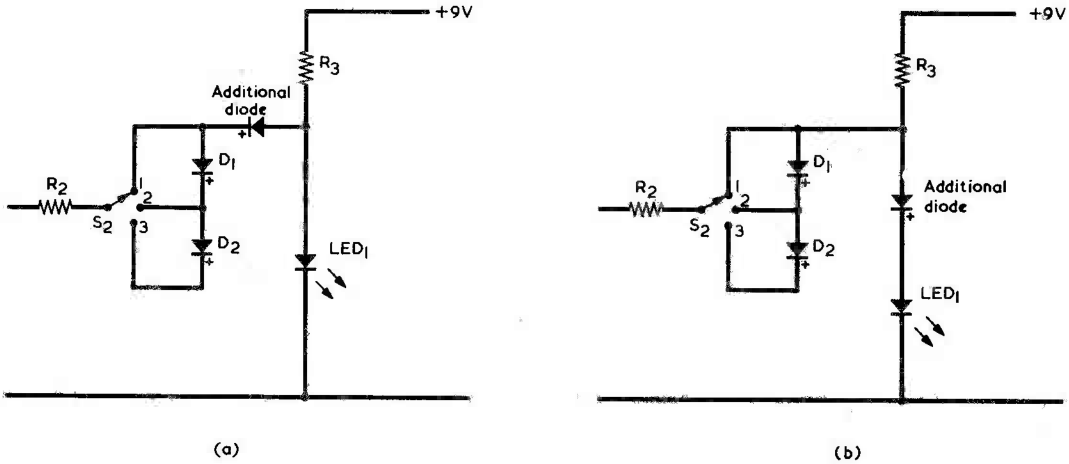


Fig. 3(a). If the voltage across the light-emmitting diode is excessive an additional diode is inserted into circuit as shown here
(b). Circuit position for an additional diode if the voltage across the l.e.d. is too low

FOURTH RADIO CONTROL MODEL EXPO 75

The Fourth Radio Control Model Expo will be held at Sywell Airport, Northampton, on Easter Sunday and Monday, 30/31 March 1975.

The venue has been proved to be ideally situated for this kind of event because of its central position and easy access from major trunk roads and motorways.

With the development of a new marquee, the Exhibition is to be contained under a singular structure, called the Davdome and will be heated throughout.

The lake which proved a great attraction to the boat enthusiasts will be positioned in the centre and doubled in size giving a central focal point yet facilitate clear viewing lines around the marquee.

The General public will be admitted from 9.30 a.m. each morning. Demonstration Model R/C Flying will take place from 10.30 a.m. to 3.00 p.m.; Full Size Flying Display from 3.30 p.m. to 5.00 p.m.; Further R/C Demonstrations will take place after 5.00 p.m.: in addition there will be a Trade Exhibition.

New. Sinclair IC20.
20 watts stereo amplifier kit for only £7.95 (plus VAT)

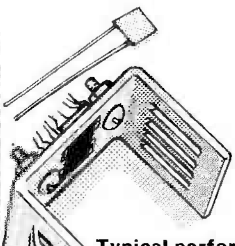
A build-it-yourself stereo power amplifier with latest integrated circuitry... 10 W RMS per channel output... full short-circuit and overheat protection.

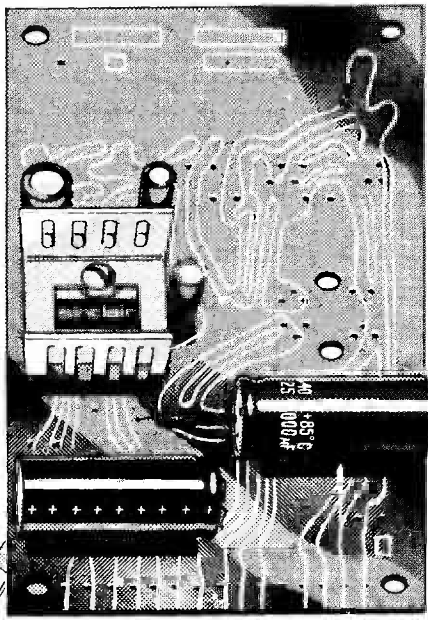
Latest from Sinclair – the brand new IC20 power amp. It incorporates state-of-the-art integrated circuits – 2 monolithic silicon chips each containing the equivalent of over 20 transistors! These deliver 10 W per channel into 4 Ω speakers. And the IC20 has integral short-circuit protection and thermal cut-out – it's virtually indestructible!

How should I use the IC20?

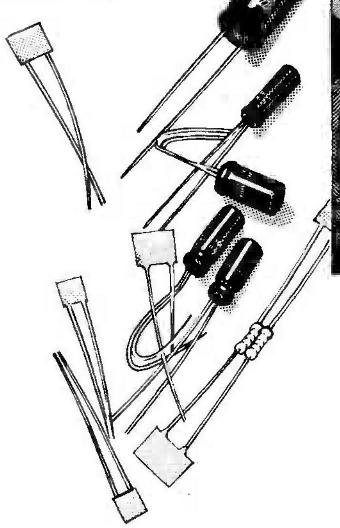
Use the IC20 for converting your mono record player to stereo ... for upgrading your existing stereo ... for improving your car radio/tape player. The IC20 runs off a 9-24 V power supply. If you're running the IC20 off the mains, simply add a Sinclair PZ20 power supply (£4.95 plus VAT).

Using the IC20 to improve your car radio/tape player's quality and volume? Run the IC20 off the car battery direct. You don't need a separate power supply, and you're reducing the drain on the player's dry batteries.





A complete kit!
6 resistors
15 capacitors
2 ICs
2 heatsinks
Printed circuit board
Nuts and bolts



Typical performance of the IC20 stereo amplifier

Supply voltage: absolute maximum 24 V, minimum 6 V.
Current consumption: *24 V, no signal* – 20 mA each channel.
18 V, 9 W into 4 Ω – 770 mA each channel.
Power output: *14 V supply, 4 Ω load, 10% distortion* – 5½ W RMS per channel, *20 V supply, 4 Ω load, 10% distortion* – 10 W RMS per channel.
Total harmonic distortion: at *50 mW, 4 Ω load, 20 V supply* – less than 0.1%.
Input sensitivity: *for 9 W into 4 Ω* – 90 mV.
Frequency response: 3 dB at 40 Hz and 16 KHz.
Load impedance: 4 Ω or 8 Ω, but device is safe with any load.

Improve your audio equipment – today

Both the IC20 and the PZ20 are covered by the Sinclair one-year, no-quibble guarantee – if absolutely any defect arises, Sinclair will replace the whole unit – unconditionally.

You can find both the IC20 and the PZ20 at stores like Laskys and Henry's. But if you have any difficulty, send us a cheque direct and we'll send you an IC20 and/or a PZ20 at once.
14-day money-back undertaking, naturally.

Sinclair Radionics Ltd,
London Road, St Ives,
Huntingdon, Cambs., PE17 4HJ.
Tel: St Ives (0480) 64646
VAT Registration number: 213 8170 88.

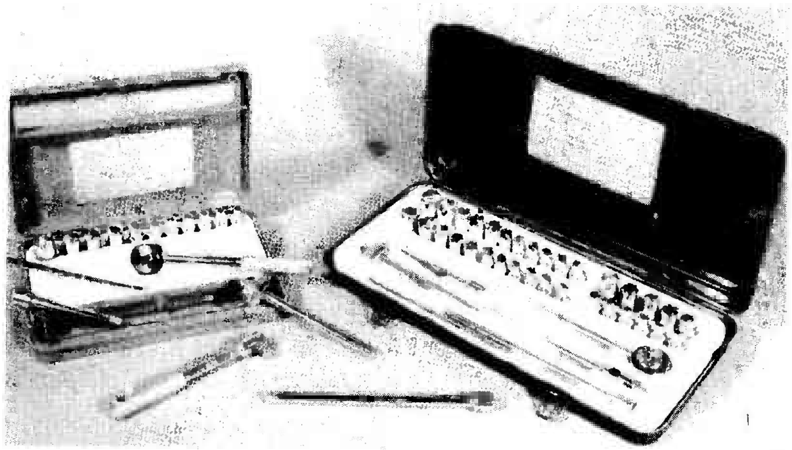
sinclair

LOW PRICED SOCKET SETS

Hi-Way (Automotive) Ltd. of 226 Mary Street, Birmingham B12 9RJ, is offering two very useful Socket Sets, each in its own carrying case which is compartmented to house and protect the various items.

The first set is a 17-piece, $\frac{1}{4}$" drive Socket Set covering B.A. sizes and includes 11 sockets, from 0 BA to 10 BA, two extension bars and one each ratchet handle, flexible handle, cross bar, and sliding bar. The carrying case of plastic has an integral carrying handle.

The second set, a 39-piece $\frac{1}{4}$" drive Socket Set comprises 33 sockets from 0 to 10 BA, 4 mm to 12 mm, and $\frac{5}{32}$" to $\frac{1}{2}$" AF sizes. In addition there is a ratchet handle, two extension bars, a sliding T bar, a flexible handle and one Tommy bar. The carrying case is of metal and is secured by two snap-on latches.



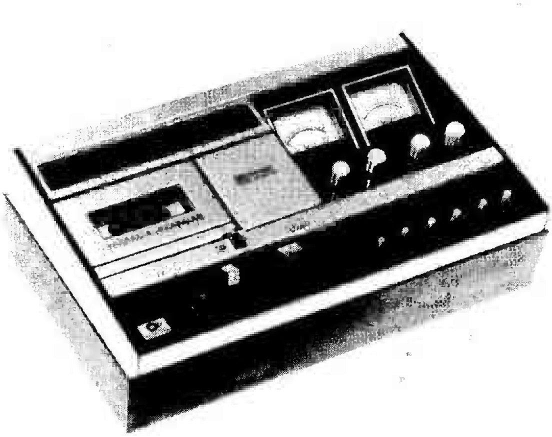
Prices, including VAT, are £4.49 for the 17-piece set and £6.99 for the 39-piece set. Postal orders are 35p extra to cover carriage and packing.

Trade enquiries invited. Hi-Way Automotive give you a "you break it, we replace it", guarantee with each set.

WOLLENSAK 4766 STEREO CASSETTE DECK

Beltless capstan drive, heavy-duty flywheel, powerful AC motor, exceptionally fast forward and rewind operation, Dolby noise reduction, sound mixing, peak overload indicators and three-position bias and equalisation switching are features of the Wollensak 4766 stereo cassette deck, introduced to Britain by 3M United Kingdom Limited.

The transport of the 4766 is Wollensak's proven American-made mechanism, which is familiar here in such quality decks as the Neal 102 and Advent. Its rugged bi-peripheral drive, heavy $3\frac{1}{2}$ in. flywheel and large AC motor contribute to the wow and flutter figure of 0.07% WRMS (0.12% DIN peak-to-peak). The drive mechanism, which carries a full three years' guarantee, also features Wollensak's exclusive Cassette Guardian, an anti-jamming device which instantly stops the unit when it senses a stalled or defective cassette, preventing broken tapes, jammed cassettes or overheating.



The crystal ferrite head used on the 4766 has an ultra-narrow gap for extended frequency range (35–16,000 Hz ± 2 dB), has a quoted operating life 8-10 times longer than metal heads, and never needs demagnetising. Immediate access for head cleaning is provided by a snap-off head cover.

Transport controls include a pause mode lever, designed to operate without introducing any electronic clicks or pops on to the tape, and a fast forward/rewind lever which locks in either position. An entire C.60 cassette may be advanced or rewound in 45 seconds. Input and output controls are provided on the front and back panels.

The three tape selection switches cater for low-noise tapes, chromium dioxide tapes, and 3M's new ferrichrome (Fe-Cr) Scotch Classic cassette tape.

Recommended retail price, excluding VAT, is £231.48, and the unit is available through a network of selected servicing dealers.

COMMENT

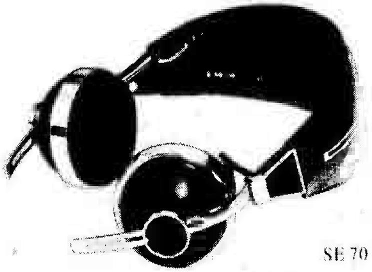
GOOD LISTENING

The latest developments in headphone design are incorporated in the SE 75 and SE 70, two brand new stereo headphones from Eagle International of Wembley, Middlesex.

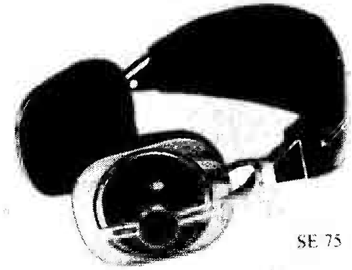
The models utilise the open back principle. Bass response is thereby improved and standing wave effects within the ear dome are minimised, ensuring fatigue-free listening in complete comfort and privacy. Mylar cone transducers on both units produce a uniform frequency response.

A handsome addition to any high quality stereo system, these feather-weight headphones are smartly finished in black stainless steel and chrome, with soft nylon ear pads, black padded fully adjustable stainless steel headbands, and are complete with cable and stereo jack plugs.

The SE 75 and SE 70 are compatible with any Eagle amplifier or other high quality hi-fi systems.



SE 70



SE 75

Readers are reminded that under the terms of the Wireless Telegraphy Act 1949, it is an offence within the U.K. to operate any transmitting apparatus except in accordance with the conditions of a Licence issued by the Minister of Posts and Telecommunications.

UTILISING OLD SATELLITES

Many disused space satellites now have a second working life ahead of them, thanks to Welsh space scientists. Their methods were outlined in a BBC science programme.

Dr. Leonard Kersley, of the Physics department of the Welsh University College at Aberystwyth, has been cleverly making use of out-of-date satellites as an extraordinarily cheap and effective means of exploring the upper atmosphere.

Dr. Kersley and his colleagues use the signals which can still be picked up, years after a satellite has completed its planned working life, from the radio beacons mounted on all big satellites.

The signal from a radio beacon is affected, in several different ways, by passing through the electronically-charged layer of the upper atmosphere, the ionosphere. By studying these effects, and how they vary in different conditions, much can be deduced about the ionosphere itself.

Dr. Kersley and other scientists doing this sort of work are especially fond of geostationary satellites, at the very high and precise altitude of 22,300 miles, at which height the movement of the satellite around the earth exactly balances the spin of the earth beneath it, so that the satellite appears to be stationary over one point of the earth's surface.

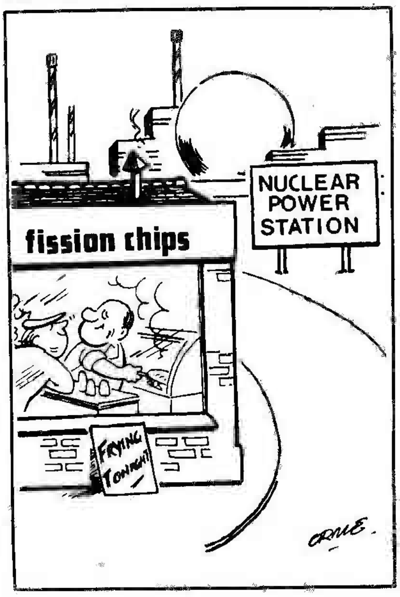
Being so high up, signals from a geostationary satellite's beacon have to pass through the whole thickness of the ionosphere, and so give a comprehensive impression of its properties.

And because a geostationary satellite hovers over the same spot, changes in one region of the ionosphere can be followed for as long as you like and as often as you like.

SINCLAIR REDUCE CALCULATOR PRICES

Price reductions of up to 35 per cent have been announced on the 'Cambridge' and 'Scientific' range of Sinclair pocket calculators.

Sinclair are Europe's largest manufacturers of electronic calculators. Current monthly production is 100,000 units which compares with a monthly production figure of 40,000 units in September 1974. The company exports sixty per cent of all calculators.



IN BRIEF

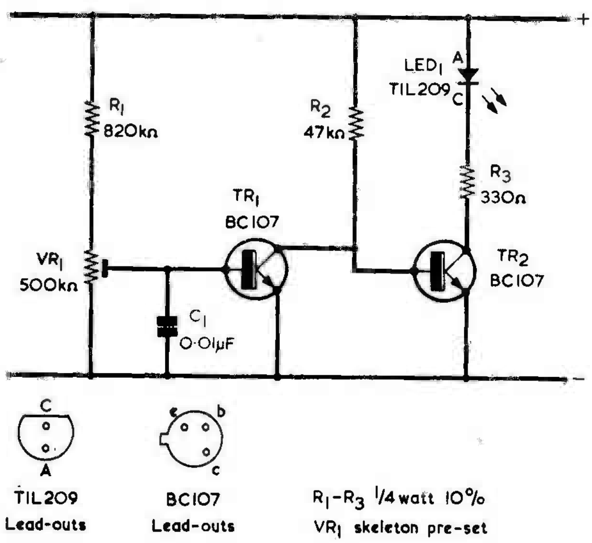
- South London readers will be interested to learn that Radio Shack of 161 St. John's Hill, Battersea, will be open for normal trading on Good Friday and Easter Monday, in addition to their usual weekend trading.
- Tandbergs Radiofabrikk A/S of Oslo, Norway, for whom Farnell-Tandberg Limited are the British distributors, will be opening a factory in Haddington near Edinburgh by the Summer of 1975. Initially they will employ about fifty people, with a daily production of one hundred Colour Television Sets.

VOLTAGE WARNING DEVICE

By D. Stanbury

A useful add-on circuit which monitors supply voltage in battery equipment.

MOST BATTERY DRIVEN ITEMS OF TEST EQUIPMENT require supply voltage stabilization, and this can be readily provided by a zener diode or by a zener diode and a transistor emitter follower. Either of these arrangements provides adequate stabilization, but no indication is given when the battery potential falls below the zener voltage. The equipment may then start giving false readings without its user being aware of the fact.



The circuit of the voltage warning device. The l.e.d. glows when the supply voltage falls to a pre-determined level, as set by VR1. Above this level the circuit draws an almost negligibly low current from the supply

MONITOR CIRCUIT

The accompanying monitor circuit can be added to any equipment powered by a 9 or 12 volt battery, and it causes a light-emitting diode mounted on the front panel to become illuminated when the supply voltage falls below a pre-set level. The circuit is connected across the supply rails with the polarity shown, and potentiometer VR1 is set up so that l.e.d. illumination occurs at a pre-determined supply voltage.

Above this voltage the current flowing into the base of TR1 via R1 and the track of VR1 above its slider is sufficiently high to cause this transistor to be fully turned on. In consequence, its collector is about 0.2 volt positive of the negative rail, and TR2 is cut off.

As supply voltage falls the bias current available for TR1 base decreases, until a point is reached at which this transistor is not fully turned on. Its collector voltage increases until it reaches some 0.5 to 0.6 volt, whereupon current starts to flow into the base of TR2 via R2. As the bias current to TR1 base continues to reduce its collector current decreases still further and its collector voltage rises. This voltage is, however, held at about 0.6 volt positive of the negative rail by the base-emitter junction of TR2, and the situation is soon reached in which TR1 draws zero collector current. All the current flowing in R2 then passes into the base of TR2, and the light-emitting diode in TR2 collector circuit is then fully illuminated.

The main feature of the circuit is that the l.e.d. starts to glow when TR1 collector reaches 0.5 to 0.6 volt positive of the negative rail, and that it becomes fully illuminated when TR1 collector current falls to zero at 0.6 volt. This corresponds to a relatively narrow range of bias current change at TR1 base, with the result that the circuit turns on the light-emitting diode in a fairly abrupt manner. After it has reached full brilliance, the l.e.d. remains illuminated as battery voltage falls until the latter reaches about 1.8 volts.

Thus, the circuit gives visible warning that battery voltage has reached the pre-determined level for which VR1 has been set. Also, the warning is maintained until the battery supply voltage is so low that the supplied equipment will be obviously malfunctioning.

OPERATING CURRENTS

At supply voltages above the pre-determined level the only current drawn by the circuit is that flowing through R1 and VR1, and through R2. With a supply voltage at 9 volts the current through R1 and VR1 will be of the order of 9µA, and that through R2 will be approximately 0.2mA only. If the l.e.d. were fully illuminated at 9 volts, there would be a further current drain of about 20mA.

VR1 is set up by applying a supply voltage equal to that at which it is desired that the circuit should give warning. The slider of VR1 is then taken down from the upper end of its track until the l.e.d. just commences to glow. VR1 should be adjusted with an insulated screwdriver or trimming tool.

Capacitor C1 is fitted between the base and emitter of TR1 to prevent instability. Over the range of supply voltages where both TR1 and TR2 are conductive there is a very high degree of gain from the base of TR1 to the collector of TR2, and both of these circuit points have the same phase. C1 prevents any possible oscillation taking place. Even with C1 in circuit the base of TR1 is susceptible to mains fields and the l.e.d. may light at a slightly higher supply voltage than it otherwise would if TR1 base is touched with a finger. This effect causes no problems when the circuit is housed in the equipment case, which may be made of insulating material or of metal.

It is possible to set VR1 for operation at any supply voltage between 12 and 5 volts. The l.e.d. commences to glow when the supply voltage reaches the pre-determined level and it reaches full brightness when the supply voltage is approximately 0.4 to 0.5 volt below that level. ■

Simple Wiper Delay Unit

Further Notes

By J. B. Dance, M.Sc.

Some notes following experience in the field with this popular unit.

Since the article 'Simple Wiper Delay Circuit' was published in *Radio & Electronics Constructor* for July 1974, two readers have written to state that their wipers operated continuously without any delay whatever the setting of the timing control, VR1. This occurred even if the car engine was not running, and it could therefore only be due to spurious pulses created when the self-parking switch opened and stopped the current flowing through the inductive motor circuit. These spurious pulses can trigger the thyristor in some vehicles, and occur at such a time that the wipers operate continuously.

Fortunately this unwanted triggering is easily eliminated by connecting a capacitor across the thyristor anode and cathode to bypass the pulses. An 0.1µF capacitor has been found adequate, but a somewhat higher value can be used in the unlikely event of 0.1µF being insufficient. Most car electrical systems will not require any additional capacitor, but one can place a similar capacitor across the wiper motor in addition to the one across the capacitor if any difficulty is experienced in removing the spurious pulses.

One reader, Mr. Marcel Volery of Geneva, has suggested several modifications including the use of a rotary switch with fixed resistors in place of the potentiometer VR1 of the original circuit; he feels that one can obtain the optium delay for the prevailing weather conditions more easily with a rotary switch than with a potentiometer. Some readers may care to take up this modification in their own installations. ■

PILFER PROTECTION UNIT

By F. G. Lloyd

A low-cost device which prevents pilfering of small objects.

ONE OF THE MANY PROBLEMS WHICH BESET SHOP-keepers and store managers is the pilfering of small items laid out on display. The resulting losses can often be quite serious if the items stolen have a relatively high value, such as is given with transistor radios, clocks and similar objects. In this article the author describes a protection circuit which causes an audible warning to be given if any attempt is made to steal display goods. The only requirement is that the protected items should have a hole or loop through which a flexible insulated guard wire may be passed. With transistor radios this guard wire can, for instance, be threaded through the carrying handles if these are fitted. The protected items cannot be removed without cutting or breaking the wire, and the alarm sounds as soon as the guard wire circuit is interrupted.

LOW CURRENT

At first sight it would appear that a suitable alarm circuit would be given by, say, passing the energising current for a relay coil through the guard wire. Such a relay would de-energise when the guard wire circuit was interrupted, and two of its contacts could then cause the warning device to sound.

Unfortunately, a simple solution of this nature suffers from several disadvantages. One of these is that the relatively high energising current drawn by the relay coil would result in excessive running costs if the system was to be powered by a battery. This objection cannot be overcome by energising the relay by means of a mains supply unit since protection would then cease to be given whenever there was a power cut. It is reasonable to assume that the risk of pilfering is higher during a power cut because of the consequent lack of lighting.

It follows that the protection circuit must be battery powered, and that the battery current needs to be kept at a very low level during the period when the guard wire is unbroken. It will, of course, be quite in order for the battery current to increase when the alarm is actuated.

A suitable working circuit is shown in Fig. 1. When on-off switch S1 is closed and the guard wire is unbroken, current from the positive rail flows via the guard wire and R1 to the base of TR1. This base current is sufficient to turn TR1 on, whereupon its collector voltage falls nearly to the negative supply rail, drawing current through R2. Both R1 and R2 have values of 1MΩ, and the current flowing through each is of the order of 12μA only. Since TR1 collector is very nearly at the same voltage as the negative supply rail there is no base bias voltage for TR2 and TR3, and these two transistors are cut off. In consequence no gate current is available for thyristor TH1, and this is also cut off. Under these circumstances, the only current drawn from the 12 volt battery is the 24μA through R1 and R2 plus a few microamps of leakage current in TR2, TR3 and TH1. The relay is in the de-energised condition.

If the guard wire is cut or broken, the circuit to TR1 base is opened and the base bias current to this transistor ceases. It at once cuts off and draws no collector current through R2, with the result that the voltage at the lower end of R2 rises to a level which allows base current to flow into TR2. TR2 and TR3 offer a very high level of current amplification and TR3 turns hard on, causing a current to flow from the positive supply rail

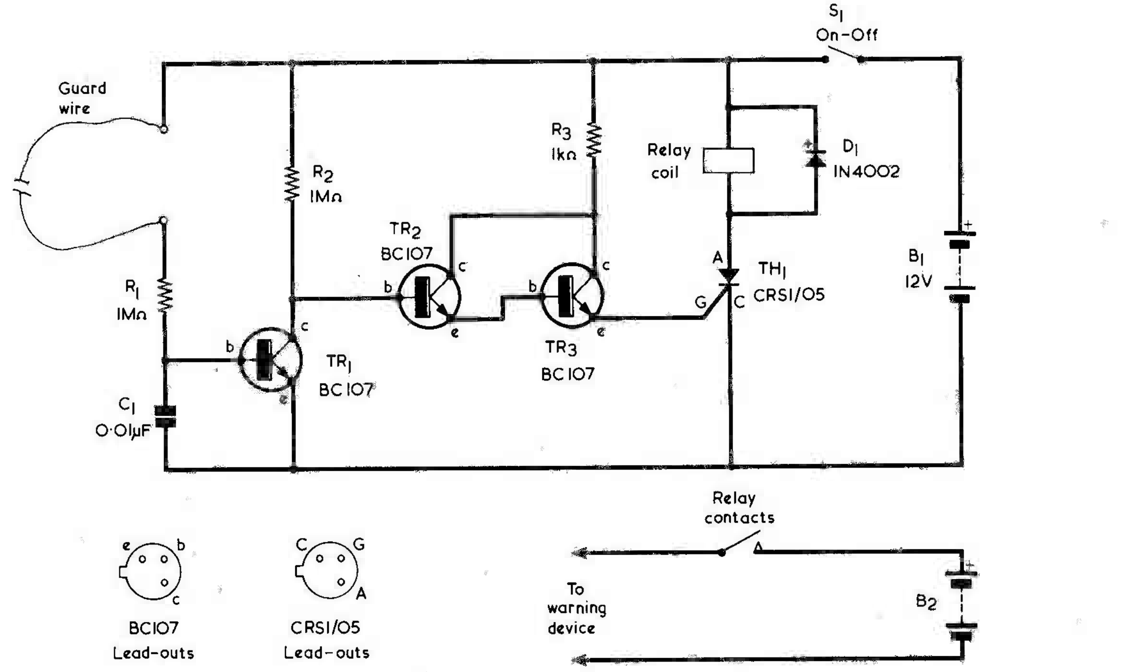


Fig. 1. The basic protection circuit. The relay energises, and remains energised, if the guard wire circuit is broken

through R3 and TR3 collector and emitter to the gate of the thyristor. This turns on and passes current through the coil of the relay, causing the latter to energise. A pair of make contacts on the relay close, connecting a second battery to the warning device, which may be an electric bell or similar.

A characteristic of a thyristor is that after it has been turned on it remains in this condition until the supply current to its anode is removed. Thus the relay remains energised even if the guard wire circuit is completed again, and the warning device can only be silenced by switching off at S1.

Capacitor C1 is included in the circuit to decouple the base of TR1. Without C1 in circuit the guard wire can, when broken, pick up mains hum, radio signals and general noise, whereupon these could be passed to TR2 and TR3 and would reduce the firing current available for the gate of TH1. C1 prevents such signals reaching the base of TR1. Diode D1 is connected across the relay coil to prevent the appearance of a high back e.m.f. when the relay coil de-energises on switching off. Care must be taken to ensure that D1 is wired into circuit with correct polarity; damage may result if it is connected incorrectly.

SCREENED WIRE

The arrangement of Fig. 1 will provide protection in all cases except that in which a would-be thief has time to tamper, unobserved, with the guard wire. If the insulation is stripped from this wire at two places and a second piece of wire is used to bridge these two points, the guard wire can be cut at any point between the bridged places without operating the alarm.

A slightly more complicated type of guard wire circuit can be employed to overcome this possibility and the altered circuit which is required is shown in Fig. 2. Here, the guard wire consists of flexible screened wire of the type which is employed for a.f. amplifier input circuits. The centre wire of the screened cable

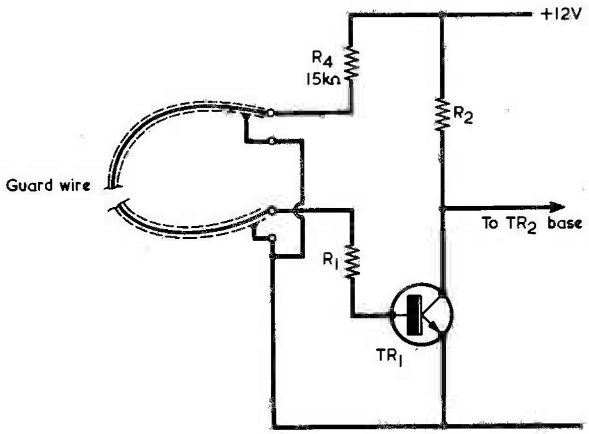


Fig. 2. A modification to the basic circuit which offers a higher degree of protection

carries out the same function as did the guard wire of Fig. 1. An additional 15kΩ resistor, R4, has been interposed between the positive supply rail and the centre wire of the screened cable. The relatively low value of this resistor, when compared with that of R1, does not alter the functioning of the circuit as so far described. As before, TR1 is turned on when the centre wire is unbroken and becomes non-conductive when the centre wire is cut.

The braiding of the screened wire connects to the negative supply rail. If a person now attempts to bridge two parts of the guard wire, he may assume that he merely needs to connect together two parts of the braiding. Should he do this and then cut the screened cable between the bridged points the centre wire circuit will be broken and the alarm will operate. If the pilferer realises that the centre wires at two parts of the screened cable have to be connected together he will first have to remove the insulation *and* the braiding at the two points before he can reach the centre wires. This is a task which is bound to take a great deal of time. Also if, during this operation, there is at any time a momentary short-circuit between the centre wire and the braiding the base of TR1 will at once be taken to the potential of the negative supply rail and the alarm will be actuated.

C1 can be omitted in the arrangement of Fig. 2 because of the screening which is automatically provided for the centre wire.

The two batteries for either circuit can be any convenient types, the main requirement of B1 being that it should be capable of keeping the relay energised for a long period of time. Battery B2 requires a voltage and current capability suitable for the electric bell or other device which is used to provide warning. The relay can be any type capable of energising reliably at a coil voltage of 10 volts or less and having a coil resistance not lower than 250Ω. It may be found that coils having resistances of the order of 1,000Ω or more do not provide sufficient holding current to the thyristor to keep it turned on after it has fired. A fixed resistor across the relay coil which brings the overall resistance below 1,000Ω will clear this difficulty. The relay employed by the author was a P.O. 3000 type having a coil resistance of 500Ω.

All fixed resistors are $\frac{1}{4}$ watt 10% types, and C1 of Fig. 1 is a plastic foil component. Switch S1 may be a toggle switch of the type which is operated by a key. All the components can be assembled in an insulated or metal case. If a metal case is used it should be made common with the negative supply rail. The two pairs of terminals in the circuit of Fig. 2 can be replaced, if desired, by phono sockets, whereupon the outer contacts of these can be bolted direct to the case when this is metal. It is possible also to insert plugs and lead sockets at suitable points along the guard wire. This ensures that the whole length of the wire does not need to be unstrung from the protected goods if any single item needs to be removed.

The current drawn from the 12 volt battery with the prototype unit was 26μA when the guard wire was unbroken. When the guard wire circuit was open the current from the battery was 10mA through R3 plus the relay coil current. If the screened wire of Fig. 2 is short-circuited, a further current of 0.8mA flows through R4.

As a final point it should be noted that, due to the low current and high resistance in the guard wire circuit, the units described here are only intended for use in dry situations indoors. ■

THE PRINCIPLES OF ELECTRONIC FLASH UNITS

Part 2

By A. Foord

In this concluding article, our contributor gives general details of trigger circuits, exposure determination and automatic flash control.

TRIGGER CIRCUITS

THE TRIGGER CIRCUIT PROVIDES A PULSE OF BETWEEN 3 and 15kV to trigger the flash tube. The pulse is applied to the *exterior* of the tube and ionizes the xenon gas in the tube to initiate the discharge path for the accumulated charge in the energy bank capacitor. In Fig. 7 four typical circuits are shown for low power flash tubes of up to 50 joules. The supply voltage appears in all cases across the tube and it also charges a capacitor C. In Figs. 7 (a) and (b) this occurs through a series resistor and the transformer T2, but via a potentiometer chain in Figs. 7 (c) and (d). When the trip or flash contacts are closed the capacitor discharges through T2 and momentarily causes a high voltage

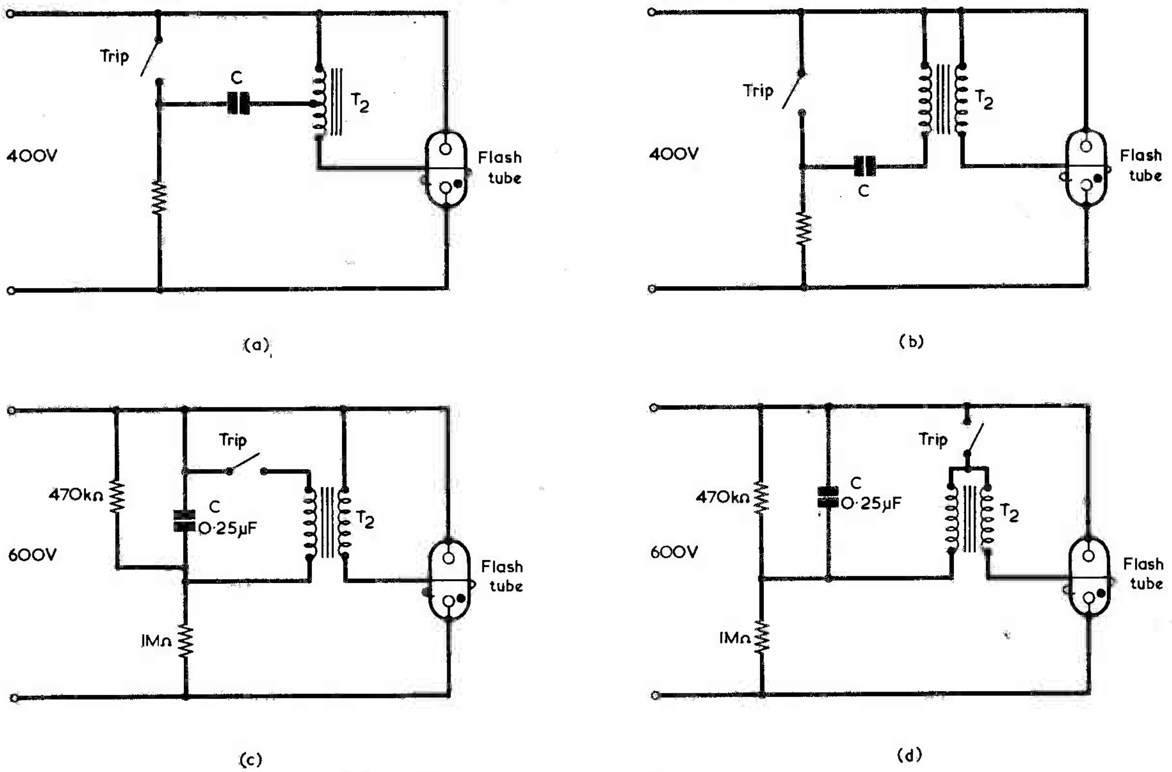


Fig. 7 (a). Trigger circuit incorporating an autotransformer
(b). Employing a double-wound pulse transformer
(c). Here, the capacitor is charged by way of a potential divider
(d). An alternative method of connecting the trip switch

pulse to be applied to the tube. An autotransformer or double-wound transformer can be used. Once the discharge is initiated the voltage on the power supply capacitor rapidly drops until conduction ceases and the flash is over. The flash gun then recycles. The duration of the flash is very short by photographic standards, at about 1mS or less.

In many cases it is convenient to arrange the circuit so that one side of the trip contacts can be connected to one side of the h.t. supply, as shown in the circuits of Fig. 7. In view of the very high pulse voltages in this part of the circuit good insulation is required. The inner polythene covered conductor of good quality coaxial cable is suitable for these high voltages, as also is TV e.h.t. cable.

If a flash unit is constructed it is possible to buy the tube and pulse transformer as an integral unit and so avoid the difficulties of high voltages and insulation requirements inherent in winding the transformer.

THYRATRON TRIGGER CIRCUIT

One disadvantage of basic trigger circuits of the type illustrated in Fig. 7 is that there is a potential source of damage to the delicate camera synchronisation contacts, since the primary current of T2 flows through them. For flash units of up to 50 joules or so this is acceptable on the grounds of circuit economy, but for high power units the current would be too great. In these circumstances a circuit of the type shown in Fig. 8 may be used.

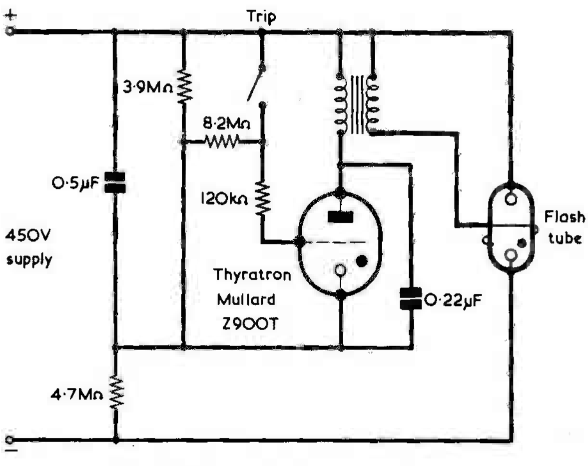


Fig. 8. Trigger circuit using a thyratron

This circuit offers complete protection for the camera contacts since the current through the contacts is limited to a low value (for this circuit) by the 120kΩ resistor, and is suitable for flash tubes up to 200 joules. Initially the 0.5μF capacitor is charged and the thyratron is held off. When the trip contacts are closed the thyratron grid is brought positive with respect to cathode and it fires. This discharges the 0.5μF capacitor through the trigger transformer primary and produces the required high voltage pulse.

As with the previous trigger circuits several variations are possible. The correct supply polarity must be applied across the thyratron.

EXPOSURE DETERMINATION, BY GUIDE NUMBER

An exposure guide number can be calculated for a tube and confirmed experimentally, and is the product of 'tube to subject distance' and 'aperture'. Thus for a guide number of 80 a subject which is 10ft. away from the flash unit will require an aperture of f8 on the camera. This guide number depends on the A.S.A. film speed rating. For a given flash unit, guide number is proportional to the square root of A.S.A. rating.

Typical figures for a monochrome film and a 50 joule unit might be:

A.S.A. film speed	*Guide No.*
25	50
100	100
400	200

The guide number would be a little lower for a colour film.

This method of estimating exposure relies on experience to obtain acceptable results and may not be reliable under widely varying conditions. When exposure is critical, as in colour photography, or when a number of flash units are used at varying distances, then other means of obtaining the correct exposure must be used.

BY FLASH METER

Incident or reflected light can be measured on a flash exposure meter designed on a sample and hold basis to retain the measurement after the flash has extinguished. This is shown in principle in Fig. 9. The photodiode P1 is reverse biased and has a high impedance when not illuminated. Its impedance falls to a low value when it is illuminated, and C is charged up through D1 to a voltage which is proportional to the peak intensity of the flash. At the end of the flash P1 returns to a high impedance, while the voltage across C reverse biases D1 and prevents C from discharging. The voltage across C can be measured by a high impedance voltmeter. The capacitor should be a low leakage type.

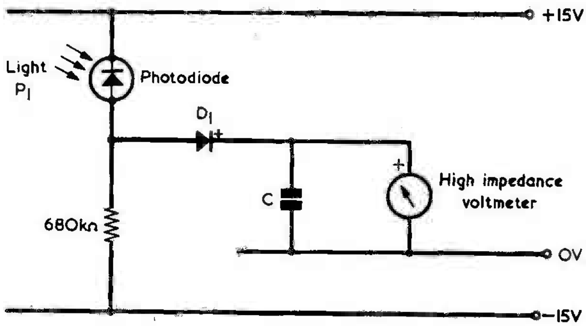


Fig. 9. Basic circuit for a flash exposure meter

BY AUTOMATIC CONTROL

Some of the more recently developed electronic flash units measure the light reflected from the subject and automatically adjust the duration of the flash to provide the total illumination needed to correctly expose the subject. Their circuits are conventional except for the extra control circuit which is added. A block diagram for such a unit is shown in Fig. 10.

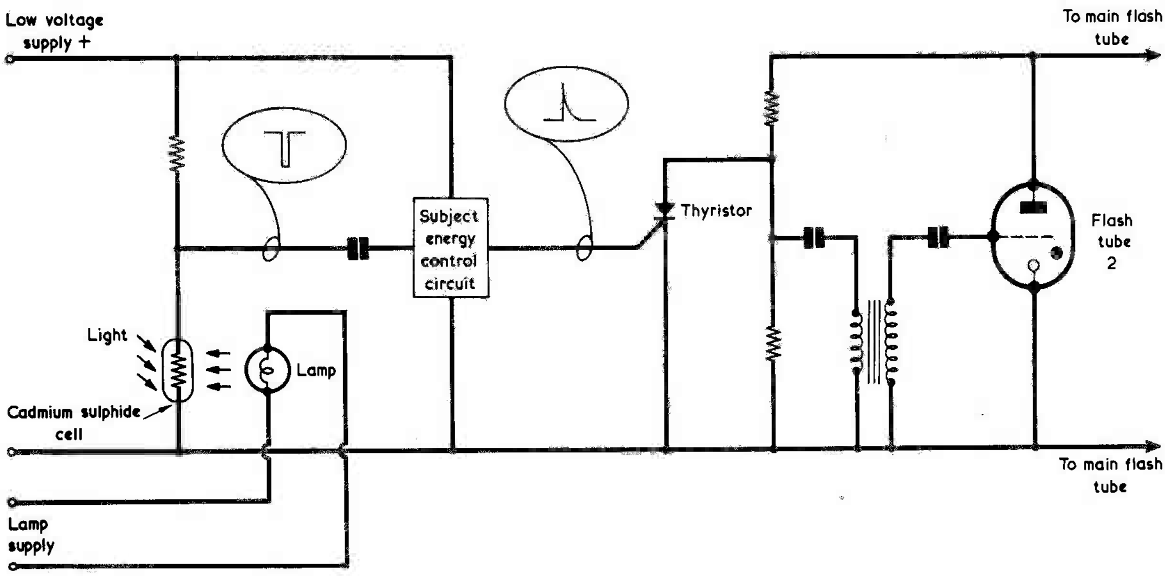


Fig. 10. An automatic exposure control circuit

A cadmium sulphide cell is located so that it receives light reflected from the subject, and is biased so that it operates on a high slope part of its characteristic (by a lamp). In a similar way, a transistor has a d.c. bias on it to produce suitable operating conditions. When the main flash tube is fired, light reflected from the subject reduces the resistance of the cell to produce a negative going edge which is passed to the section designated 'Subject Energy Control Circuit'. After a period dependent upon factors such as the distance between the flash tube and the subject, this circuit produces a pulse which triggers the thyristor. The thyristor, in turn, causes a pulse to be applied to Flash Tube 2.

This is a small specially designed 'crowbar' gas discharge tube in parallel with the main flash tube (the term 'crowbar' being generally applied to a device which intentionally short-circuits a power supply), and it bypasses the main flash tube to 'quench' the flash. 'Crowbar' tubes are designed for rapidly discharging high voltage capacitors in e.h.t. power supplies to prevent damage to the rest of the circuit if a fault occurs, and may be capable of passing 2,000 amps for a *very* short time. The 'crowbar' flash tube will be similar to the main flash tube, but is designed to switch on very rapidly. It may be filled with xenon, krypton, argon or cadmium vapour.

The duration of the flash depends mainly on the distance between the flash tube and the subject For a large distance of, say, 20ft. there may be no quenching and the flash duration could be 1mS. For a close distance of, say, 3ft. minimum the light from the flash tube could be rapidly quenched, with a flash duration of only 20µS. There is an infinite range for the flash duration between the maximum and minimum values to keep the total light exposure of the subject almost constant. How closely this can be achieved depends on the characteristics of the flash tube, the quenching tube, the time constant of the cadmium sulphide cell, and the delay in the electronic control circuit. However, very good results can be obtained.

The automatic method of control suffers from the usual disadvantage inherent in a reflected light measurement in that the background may have an undue effect on the exposure. This can partly be overcome by using a lens in front of the cadmium sulphide cell to reduce its effective beamwidth to 10° to 15° or so in an attempt to measure light from the central, most important, part of the subject. A similar centre weighting is sometimes used for the through-the-lens metering built into some single lens reflex cameras. ■

PERSO
INTEGRATE
RECE

The only active device in this ingenious medium wave design is a single integrated circuit. The receiver is powered by a 1.5 volt cell and current consumption is exceptionally low.

By R. A. F

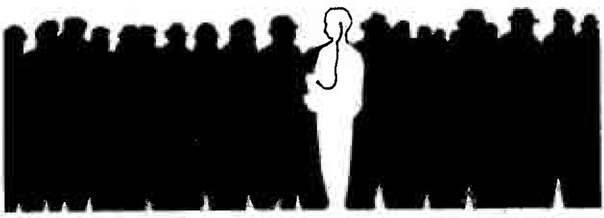
THIS RECEIVER EMPLOYS A GENERAL PURPOSE integrated circuit amplifier in an extremely simple t.r.f. design. Only a few discrete components external to the integrated circuit are required, and so the unit can be readily built by the beginner at a very reasonable cost.

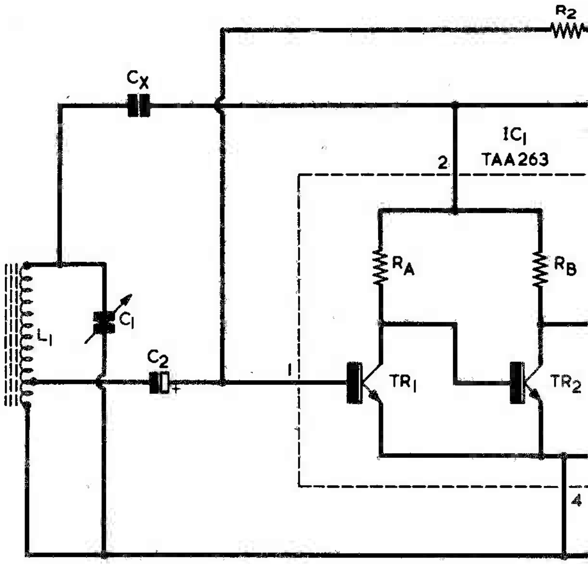
Full coverage of the medium wave band is provided, the receiver being capable of picking up local B.B.C. signals as well as several Continental transmissions, including Radio Luxembourg. An inexpensive penlight cell powers the receiver. Since receiver current consumption is only about 400μA, running costs are negligible. The receiver output feeds a crystal earphone.

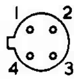
CIRCUIT FUNCTIONING

The circuit of the receiver is shown in Fig. 1. The area inside the broken line represents the internal circuitry of the integrated circuit, which is a type TAA263. As can be seen, this is a very simple device and incorporates three transistors and two resistors. Connection to the i.c. is made at its four lead-outs, numbered 1 to 4 as illustrated in the diagram.

All the three transistors in the i.c. are common emitter amplifiers, with direct coupling between stages. R2 provides the base bias for TR1 from the output of the integrated circuit. Since the i.c. output and input are 180° out of phase, the biasing is stabilized at d.c. by a high level of negative feedback.







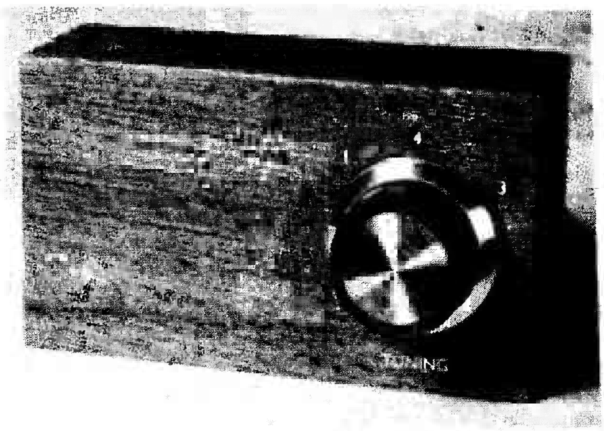
TAA263
Lead-outs

Fig. 1. The circuit of the personal receiver. The internal c
line

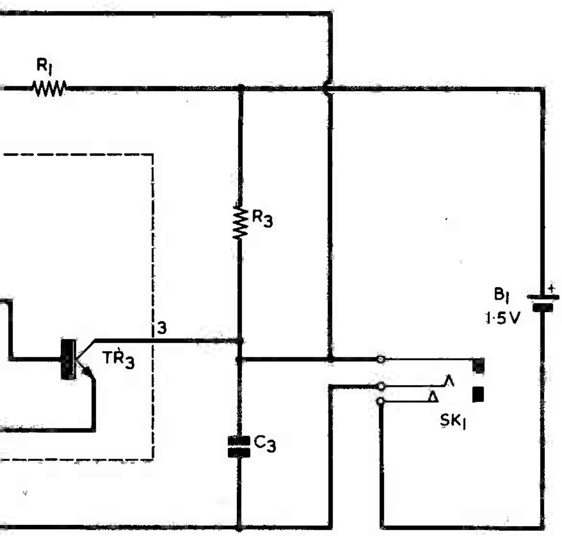
ONAL

D CIRCUIT

VER



enfold



cuitry of the TAA263 is enclosed within the broken

COMPONENTS

Resistors
(All ¼ watt 10%)

R1	150Ω
R2	120kΩ
R3	4.7kΩ

Capacitors

C1	300pF variable (see text)
C2	10μF electrolytic, 2.5 V. Wkg.
C3	0.047μF ceramic disc or plate

Inductor

L1	Ferrite aerial coil (see text)

Integrated Circuit

IC1	TAA263

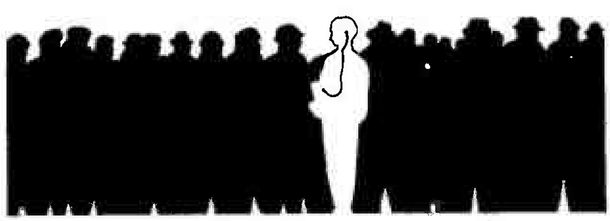
Socket

SK1	Switched 3.5mm. jack socket (see text)

Battery

B1	1.5 volt cell type U7 or HP7 (Ever Ready)

Miscellaneous
Crystal earphone with 3.5mm. jack plug
Control knob
S.R.B.P. for component panel and case
Plywood, Fablon, etc.



L1 is the ferrite rod aerial coil, with C1 as the associated tuning capacitor. Signals picked up by the aerial are coupled to the base of TR1 via C2 from the low impedance tap in the coil. C2 has been given a very large value to ensure that audio frequencies which could otherwise be picked up at TR1 base are effectively short-circuited to the negative supply rail by this capacitor and the lower section of L1. In consequence, a very low audio noise level is obtained, and the input does not respond to 50Hz mains hum fields and the like.

The signal at the base of TR1 is amplified first by TR1 and then by TR2. RA forms the main collector load for TR1, and RB the main collector load for TR2, the relatively low value external resistor R1 being inserted in series with both these loads. In consequence, a small amount of the collector signal from both transistors is built up across R1, but that from TR2 is stronger than that from TR1 because of the added amplification it has been given. As a result, the TR2 collector signal, which is out of phase with that from TR1, cancels out the TR1 collector signal across R1, and the remaining TR2 collector signal appears across this resistor. The TR2 collector signal is in phase with that at the base of TR1, whereupon it becomes possible to provide positive feedback from pin 2 of the i.c. to the upper end of L1 via CX. This positive feedback, or regeneration, gives increased gain and selectivity, and the level of feedback is controlled by varying the capacitance of CX. The latter is not provided by a physical capacitor, but by two insulated wires which are twisted together over a short distance.

TR3 functions as a detector since it gives greater amplification to positive-going half-cycles at its base and therefore has a non-linear characteristic. A detected a.f. signal appears across its collector load resistor, R3, this being fed via jack socket SK1 to the crystal earphone. C3 bypasses the r.f. content which is still present at TR3 collector, and also prevents r.f. negative feedback via R2 to the input. Such feedback, if allowed to exist, would seriously reduce the gain of the receiver.

The supply voltage is very low, at 1.5 volts. A voltage higher than this should not be used as it could result in a significant increase in noise level and, also, instability.

On-off switching is provided by a contact on SK1 which closes when the earphone plug is inserted. Thus, the receiver is switched off merely by removing the earphone plug.

FERRITE AERIAL

The first item to be made up is the ferrite aerial, and details of this are given in Fig. 2. The ferrite rod is 2½in. long by $\frac{5}{16}$in. in diameter. If a 2½in. rod cannot be obtained, it may be broken from a longer rod having the required diameter. A deep groove is cut around the rod with a triangular file at the desired breaking point, and the rod is then smartly broken against the edge of the work-bench. A neat clean break should be obtained, although it does not matter if the break is at all rough.

The aerial coil is wound with 32 s.w.g. enamelled, d.s.c. or d.c.c. copper wire, and the winding starts about 1in. from one end of the rod. Before starting to wind the coil, secure the wire end to the rod with insulating tape, leaving a lead-out about 2½in. long. Carefully close-wind 10 turns of wire around the rod in a single layer and as tidily as possible. A loop of wire about 2in. long is then taken out to form the tap, after which a further 75 turns are close-wound on the rod in the same direction as the first 10 turns.

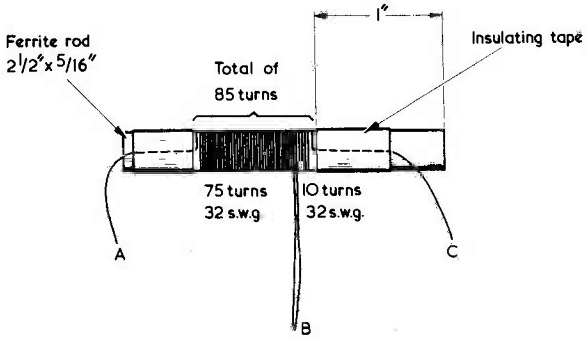


Fig. 2. Details of the ferrite rod aerial coil

Finally, tape the end of the coil to the rod to prevent it unwinding, and cut the last lead-out to a length of about 2½in. A further band of insulating tape is required around the centre of the coil to prevent it unwinding at the tapping point.

JACK SOCKET

The jack socket must be a type having an open construction similar to that shown in Fig. 3 (a). It is necessary to modify the socket so that its break contact becomes a make contact. This is done by bending the appropriate contact so that it assumes the altered shape shown in Fig. 3 (b). Check that the modification is successful by inserting and removing a jack plug. The altered contact must not be bent down too far or the moving contact will not touch it when the plug is fitted.

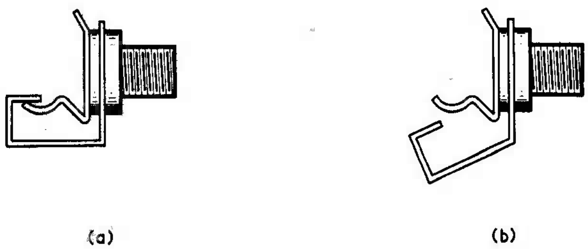


Fig. 3 (a). The earphone jack socket is supplied in the form shown here
(b). The switching contact is bent so that contact is made to it when the plug is inserted

The interior of the receiver. There is ample space for the small components on the panel

COMPONENT PANEL

The component panel consists of $\frac{1}{16}$in. s.r.b.p. ('Paxolin') and construction here depends, to a small extent, upon the capacitor employed for C1. This should be an air-spaced type having a maximum capacitance value of approximately 300pF, and the component used by the author had a width and height of approximately 1$\frac{1}{8}$in. This is secured by three 4BA bolts passing into tapped holes in its front plate. The constructor may have difficulty in obtaining a capacitor of this size, whereupon it is advised that he obtain the slightly larger Jackson Type '00' capacitor, which has a framework measuring approximately 1$\frac{3}{8}$in. wide by 1$\frac{3}{8}$in. high. This type of capacitor is also mounted by three 4BA bolts passing into tapped holes in its front plate. A suitable version of the '00' capacitor is a 2-gang 176 + 123pF component. The two sets of fixed vanes can be connected together to give a total capacitance of approximately 300pF.

Fig. 4 illustrates the component panel full-size, with the capacitor used by the author in the C1 position. If the Jackson Type '00' capacitor is employed, the panel length should be increased from 3$\frac{1}{2}$ to 3$\frac{3}{4}$in. The Type '00' capacitor is then positioned so that its right and top edges are in approximately the same positions as the right and top edges (as seen in Fig. 4) of the capacitor illustrated. The bottom and left hand edges of the capacitor will then be slightly over the corresponding edges of the panel. The capacitor moving vanes should be clear of the ferrite aerial rod when this is later fitted. A $\frac{1}{4}$in. central hole for the capacitor spindle and three 4BA clear mounting holes may next be marked out on the panel, the positions of the latter being found with the aid of a paper template pressed against the front plate of the capacitor. The holes can next be drilled, but the capacitor is not mounted at this stage. Whilst dealing with the variable capacitor it should be mentioned that, when it is mounted in position by the three 4BA bolts, the ends of these should not be allowed to pass inside the capacitor front plate as they may then damage the fixed or moving vanes. Short bolts are required here.

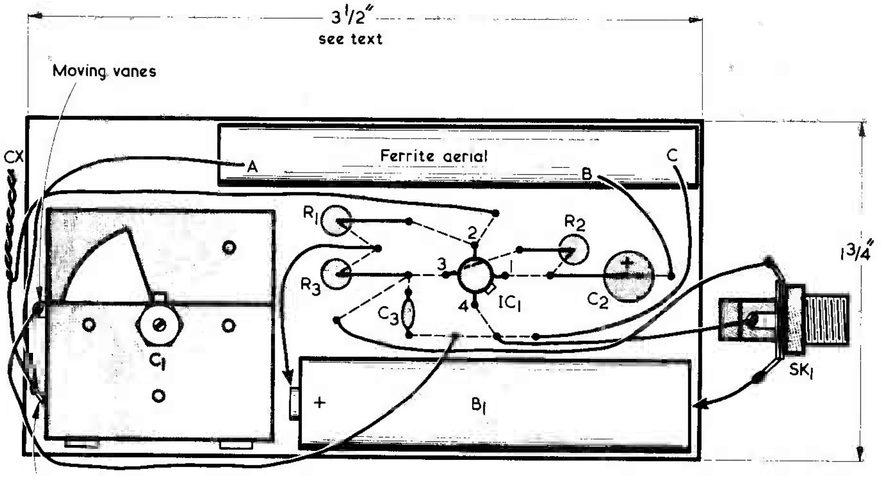
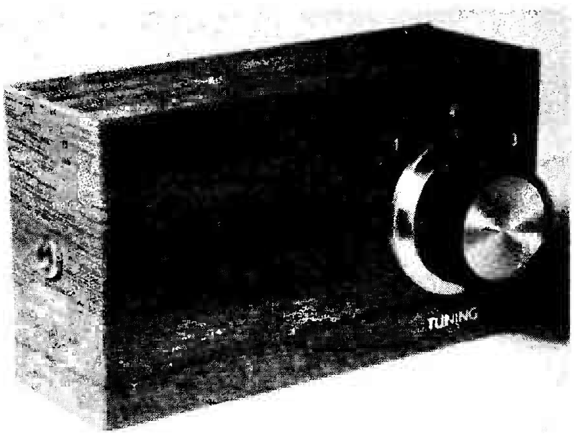


Fig. 4. Layout and wiring on the component panel. This is reproduced full size to assist in construction



The earphone socket is fitted to one of the case sides. Inserting the earphone plug automatically switches on the receiver

Next to be drilled are the small holes for the component lead-outs, and the positions of these may be traced out from Fig. 4. The various small components can then be mounted. Their lead-outs are bent through 90° on the underside of the board and are connected together as shown in the diagram, in which the underside wiring is illustrated in broken line.

Three short flexible leads connect to the jack socket, and this should be connected up in the manner shown in the circuit diagram of Fig. 1. Capacitor C1 may be temporarily mounted (its mounting bolts will eventually pass also through the front panel of the case) and wired up. Two thin insulated single strand wires are twisted together to form CX. The ferrite aerial rod is glued in position with Araldite or any other good quality gap filling adhesive. Its lead-outs are identified by letters which correspond with those in Fig. 2.

The leads to the 1.5 volt cell are terminated in 4BA solder tags, and these are secured to the cell terminals by a broad rubber band which passes from end to end around the cell.

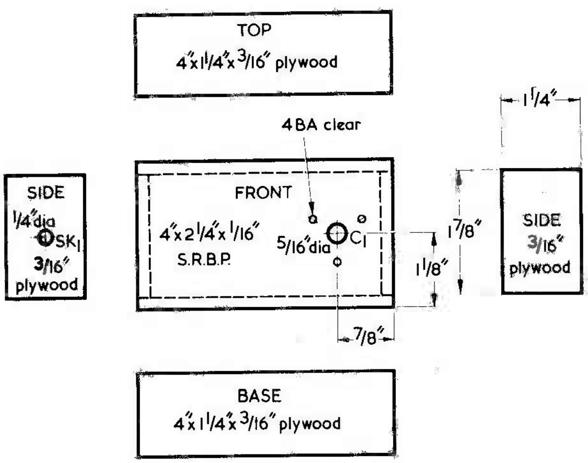


Fig. 5. The parts making up the case for the prototype receiver. Dimensions may need slight alteration if a larger tuning capacitor is used

CASE

The receiver can be housed in any small plastic or wooden case of sufficient size. As a guide, details of the case employed for the prototype are given in Fig. 5. Here, the front panel is s.r.b.p., whilst the side, top and bottom panels are plywood. The dimensions can be slightly modified as necessary to accommodate the receiver when a larger tuning capacitor is used. The front panel is drilled out to take the spindle and the three 4BA mounting bolts of C1, and one of the sides is drilled to enable SK1 to be mounted. The back of the case, which is not shown in the diagram, can be cut out to form a tight push-fit, and it has the same length and width as the front panel less ⅜ in. to allow for the side, top and bottom panels. The back may also be of plywood. The front, side, top and bottom panels are glued together after drilling has been completed.

A very attractive finish can be obtained by covering the case with a self-adhesive plastic material such as Fablon. The three 4BA mounting bolts for C1 pass through the front panel and the component panel, thereby holding the latter in position. The bolt heads are covered by the knob for C1. A simple clamp can be devised to hold the 1.5 volt cell in position.

ADJUSTMENT

The only adjustment required in the completed receiver is the setting up of the regeneration. This adjustment is provided by twisting the two wires forming CX more tightly together to increase the level of regeneration, or less tightly, or over a shorter length, to reduce the regeneration level. The regeneration should be as high as can be obtained without the receiver actually going into oscillation at any setting of the tuning capacitor. Oscillation will be evident as a whistling sound in the earphone as the tuning knob is rotated.

It may be found beneficial not to advance the regenertion level too close to the threshold of oscillation, as this might result in a loss of audio quality. However, it should be possible to find an adjustment level which gives a good compromise between sensitivity and loss of quality. ■

SHOCK EXCITED C—METER

By M. G. Robertson

A novel circuit which allows the measurement of capacitance from some 1.5 to 200pF.

A PERENNIAL PROBLEM FOR THE HOME CONSTRUCTOR is the measurement of small values of capacitance. Typical components involved here are trimmers, fixed capacitors whose markings have become defaced and variable capacitors when it is desired to know their minimum values.

The design presented in this article has a tuned circuit across which the test capacitor to be measured is connected. The resulting change of tuned circuit resonant frequency is then measured by a frequency determining device. The minimum test capacitance which can be resolved is a little less than 1.5pF, whilst the maximum capacitance lies between some 160 to 240pF according to the range of the frequency determining device employed.

Readers who have already glanced at the accompanying drawings may by now be somewhat puzzled about this frequency determining device, since it obviously does not appear in the diagrams. It does not need to. The frequency determining device is simply any medium wave transistor superhet radio!

SHOCK-EXCITATION

The only components which have to be assembled to make up the capacitance meter are shown in Fig. 1. In this diagram, TR1 is a unijunction transistor and, in company with C3, R1, R2 and R3, functions as an a.f. oscillator. During each cycle, capacitor C3 charges via R3 until its upper plate reaches emitter triggering potential. The transistor then exhibits a negative resistance effect between its emitter and base 1, causing C3 to discharge rapidly into R2. C3 commences to charge once more and another cycle starts.

The unijunction oscillator causes a series of sharp current pulses to flow in R2 and, with the component values shown, these have a repetition frequency of the order of 750Hz.

The inductor L1 is a medium wave coil on a ferrite rod, and it is tuned by C1 and any capacitance which is connected across the test terminals. The tuned circuit is coupled by C2 to the pulses at the upper end of R2, with the result that it is shock-excited into a damped oscillation at its resonant frequency by each pulse. The radiation from L1 can be picked up and reproduced as a 750Hz tone by any medium wave superhet receiver whose ferrite rod aerial is about 4 to 8 in. away from the rod on which L1 is wound. Both ferrite rods should be roughly parallel with each other.

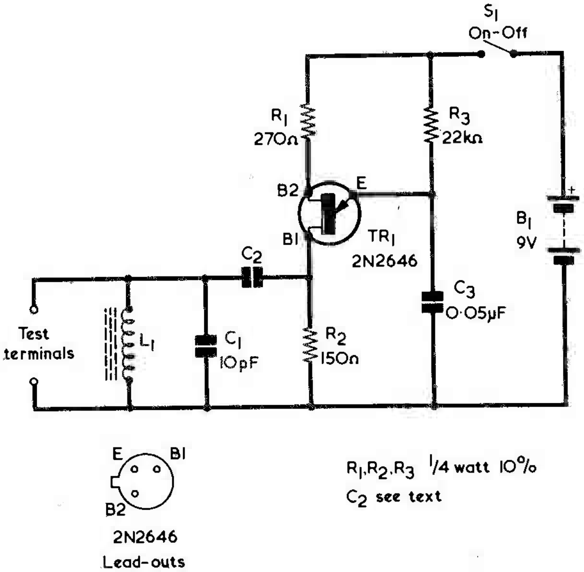


Fig. 1. This circuit represents all that is needed to make up the shock-excited capacitance meter. L1 is a medium wave ferrite rod coil

If C2 is given a very low value the bandwidth of the radiation from L1 is quite narrow and it can be peaked on the receiver tuning as sharply as a normal broadcasting station. L1 is initially set so that, without any capacitance connected to the test terminals, the radiation is picked up at the low wavelength (high frequency) end of the medium wave range of the receiver. Adding test capacitance then reduces the frequency of radiation, whereupon the receiver has to be tuned to a higher wavelength (lower frequency) to pick it up again. The test capacitance can then be determined by checking the wavelength to which the receiver has been re-tuned and consulting a wavelength-capacitance table which has been previously prepared.

This method of operation has the fortuitous advantage that the low wavelength end of the receiver tuning scale is 'opened out' in terms of capacitance change.

Due to the shape of the receiver tuning capacitor vanes there is a relatively small change in receiver tuning capacitance as tuning is advanced from the low wavelength end of the medium wave band. Thus, quite a large change in tuning dial reading corresponds to a small change in tuning capacitance. In consequence, a large change in tuning dial reading corresponds, similarly, to a small change in the test capacitance connected across the radiating coil, L1.

The small capacitor, C1, has to be connected permanently across L1 to provide reliable operation when there is no test capacitance connected across it. The tuned circuit is not so readily shock-excited into damped oscillation if L1 is tuned only by circuit strays and its own self-capacitance.

The current drawn from the 9 volt battery by the circuit of Fig. 1 is 1.5mA only.

CONSTRUCTION

The circuit may be housed in any non-metallic case which can accommodate the battery and the ferrite rod for L1. The battery should be spaced away from the ferrite rod by at least 1½in. The ferrite rod can be any length between 4 and 8in., and a little initial guesswork can be avoided if L1 is a manufactured medium wave coil intended for the rod. Should the coil used have a low impedance tap or winding for coupling to the base of a transistor, this tap or winding may be ignored. There should be no long wave winding on the rod, as this may cause unwanted absorption effects. If a home-wound ferrite rod coil is to be employed, this can consist of 70 turns of 34 s.w.g. enamelled wire close-wound at the centre of a 6in. rod of ⅜in. diameter.

C2 has a very low value and does not consist of a physical capacitor. It is provided instead by a short length of insulated wire held close to, or lightly hooked around, the lead-out of R2 which connects to the base 1 of the transistor, as indicated in Fig. 2. Capacitor C1 is a silvered mica component whilst C3 is plastic foil.

When checking out the unit it is helpful to initially connect a capacitor of some 30 to 60pF across the test terminals. This will bring the radiation to the more central part of the medium wave band and will enable a little experience with the unit to be obtained. The medium wave receiver should have its volume well advanced and its ferrite rod fairly close to the rod on which L1 is wound, and its tuning should be adjusted until the radiation is picked up. The radiation will still be heard even if it corresponds to a powerful transmission but, should this occur, it would be best at this stage to connect up a different test capacitance in order to shift the radiation frequency. The required distance between the two ferrite rods can next be adjudged, and in most cases it will be found that it is merely necessary to have the receiver positioned near the radiating ferrite rod. If necessary, the bandwidth of the radiated signal can be narrowed by reducing the coupling given by C2, and a little experiment here will soon provide a convenient setting which gives good radiation strength and sharp tuning in the receiver.

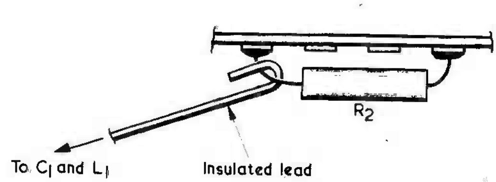


Fig. 2. C2 is not a physical capacitor, and is provided by the very low capacitance given by an insulated lead positioned near R2

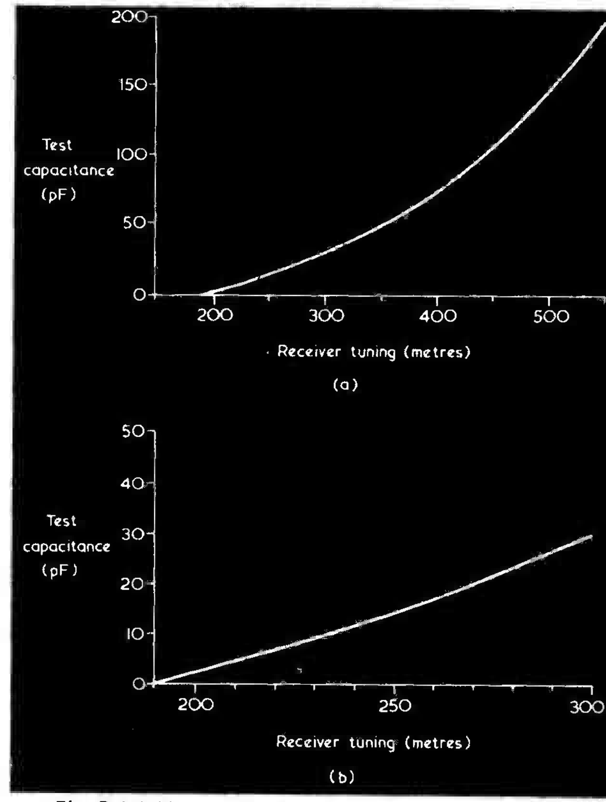


Fig. 3 (a) The wavelength-capitance curve obtained with the author's unit
(b) The lower part of the curve extending up to 300 metres

The temporary test capacitance is then removed and the receiver tuned right to the low wavelength end of the medium wave band. The position of L1 on its ferrite rod is then adjusted until it radiates at this frequency. With a home-wound ferrite coil it may be necessary to add or take off a few turns to arrive at the desired frequency.

CALIBRATION

Calibration is carried out by connecting known values of capacitance to the test terminals and noting the corresponding wavelength on the receiver tuning scale. A graph may then be drawn, and a table finally prepared from this. The graph will be non-linear but should nevertheless have a smooth and reasonably predictable curve. Fig. 3(a) shows the results obtained by the author. Here, a receiver setting of 190 metres corresponds to zero test capacitance, whilst 550 metres corresponds to a little less than 200pF. Fig. 3(b) shows the lower part of the curve, expanded for scale readings up to 300 metres. As an indication of sensitivity, a test capacitance of 1.5pF corresponded to a receiver tuning scale indication of 195 metres, and 3pF to an indication of about 203 metres.

Since there are discrepancies in the tuning scale indications given by different radios, the circuit should be calibrated with one particular receiver and employed, subsequently, with that receiver only. ■

Trade News . . .

PYROMETER FOR CHECKING SOLDERING BIT TEMPERATURES

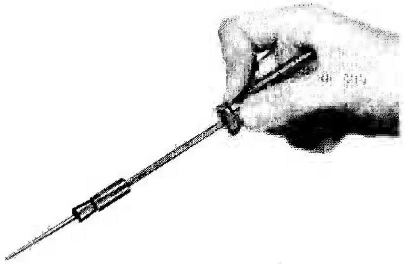
The Litesold Pyrometer has been designed for measuring the bit temperature of small modern soldering irons. Most other industrial pyrometers have a probe of relatively large mass, compared with that of a modern small soldering iron, which chills the bit, producing low readings. The Litesold Pyrometer overcomes this problem by using a very fine thermocouple tip which produces negligible chilling and so faster, more accurate readings are obtained.

The Pyrometer is used to check the performance of soldering instruments and as a safeguard against thermal damage to sensitive components. Its use is particularly recommended with thermostatically controlled instruments to check the exact operating temperature of the bit.

The instrument is calibrated to 500° degrees Celcius in 100 degree divisions with 20 degree sub-divisions and is supplied complete with a polished wood instrument case.

Full details are available from the manufacturers, Light Soldering Developments Limited, 97/99 Gloucester Road, Croydon, Surrey.

INSULATED, SCREWHOLDING AND POCKET TYPE SCREWDRIVERS — RANGE EXTENDED



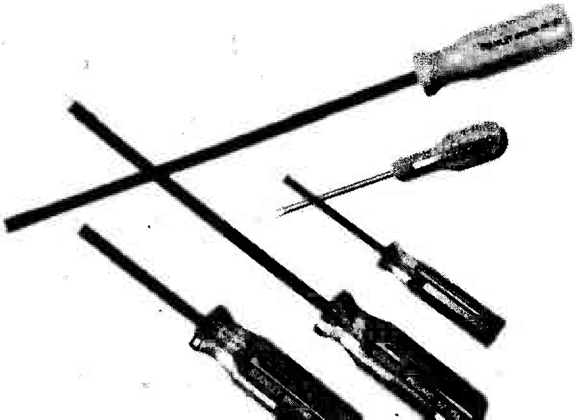
The new range of Stanley Handyman Spee-D-Grip screwdrivers incorporates a 'safe grip' feature which enables a screw to be held firmly and securely even in the most awkward of places.

A rationalisation and development programme has led to fifteen screwdrivers being added to the comprehensive range of hand tools manufactured by Stanley Tools Limited, Sheffield, They include insulated, 'Spee-D-Grip' and pocket type screwdrivers added to the Handyman range, and, with the exception of Spee-D-Grip, similar patterns have been added to the popular 'E-Line' range.

Stanley 'Spee-D-Grip' screwdrivers feature a sliding steel jaw which enables a screw to be securely gripped while manoeuvring into restricted or confined spaces.

Four sizes of insulated screwdrivers have been added to the Handyman range varying in size from 3″ (76mm) to 8″ (203mm). As with all Stanley Handyman screwdrivers, they are fitted with red fluted plastic handles. And, the strong, safe, PVC insulation, which covers the blades, extends well into the handle, having been shrunk fit to the bar for maximum security and safety.

Insulated parallel tipped screwdrivers now form a useful addition to the popular and low-cost E-Line range. As with the Handyman range, these new E-Line screwdrivers have zinc-plated chrome-molybdenum blades and the insulated types are fitted with .025″ thick PVC heat-shrunk to the bar.



SHORT WAVE NEWS
FOR DX LISTENERS

By Frank A. Baldwin

Times = GMT   *Frequencies* = kHz

One of the most interesting countries to hear on the LF bands is Indonesia and for many short wave listeners it is one of the most difficult countries to log. Owing to the relative low powers of most of the transmitters and the high intensity QRM with which the various frequencies used by them are either surrounded or completely covered, a receiver exhibiting good sensitivity and selectivity characteristics used together with an efficient aerial and earth system, all located well away from a densely populated area are a virtual necessity.

The 'season' for Indonesians is roughly mid-September to mid-March with the peak period being December. During the latter month, to illustrate the point, the following were logged.

RRI Semarang on **3935** at 1425, OM in Malindo, local music, YL announcer.

RRI Surabaya on a measured **3974.3** at 1510, YL in Malindo till 1515 then programme of local music.

RRI Ujang Padang on **4719** at 1420, OM in Malindo, songs with local music.

RRI Banda Aceh on **4955** at 2207, OM in Malindo, local music with YL announcer.

RRI Medan on **4764** at 1543, YL with songs, local music programme.

RRI Jambi on **4927** at 1546, YL with songs, local music, off with "Love Ambon" 1600.

RRI Jakarta on **4804** at 1547, YL with songs, local music, also at 2220 with local pops on records with YL announcer.

CURRENT SCHEDULES

● **HUNGARY**

Radio Budapest is currently operating an External Service, in English to Europe, from 1745 to 1800 on **6110, 7265, 9585, 11910, 15415** and on **17780**; from 1945 to 2000 on **6110, 7265, 9655, 11910, 15415** and on **17780**; from 2130 to 2200 **5965, 7180, 7250, 9655, 11910, 15415** and on **17780.**

Dx programmes in English to Europe (Tuesdays and Fridays only) from 1615 to 1630 on **6025, 7220, 9585, 11910, 15415** and on **17780**; from 2245 to 2300 (Tuesdays and Fridays only) on **5965, 7250, 9585, 9833, 11910, 15220** and on **17780.**

● **EGYPT**

From Cairo, the "Holy Qur'an Station", with programmes consisting entirely of readings from the Qur'an (westernised incorrectly as Koran) operates from 0130 to 0900 and from 1200 to 2025 (except from 1730 to 1930) on **9755.**

From 1730 to 1930 on **9755** the "Voice of Palestine, Voice of the Palestine Revolution" radiates in Arabic.

The "Voice of the Arabs" programme, from 0300 to 0030, operates on various channels throughout the period, listen for instance at 2030 for the news in Arabic on **7050** and **11630** in this service.

The "Palestine Service" operates from 0600 to 0800 and from 1400 to 1500 on **15415, 17625** and on **17745.**

The "Sudan Corner" is from 0400 sign-on to 0600 sign-off on **9475**, and from 1200 to 1625 on **11915** and on **15135.**

● **ARGENTINE**

Radiodifusion Argentina al Exterior, Buenos Aires, presents a programme in English to Europe from 2100 to 2200 on **11710.**

● **U.S.S.R.**

Radio Moscow broadcasts in English to the U.K. from 1130 to 1230 on **9450, 11705, 11745, 11830** and on **12050**; from 1900 to 1930 on **5920, 6010, 6020, 7280** and on **7360**; from 2000 to 2030 on **5920, 5950, 5970, 5980, 6010, 6020, 7280** and on **7360**; from 2100 to 2200 on **5920, 5970, 6010, 6055, 7280** and on **7360**; from 2200 to 2230 on **5920, 5970, 6010** and on **6105.**

● **BULGARIA**

Radio Sofia presents an External Service, in English to the U.K., from 1930 to 2000 and from 2130 to 2200 on **6070** and **9700.** Sofia may also be heard in English to Africa from 2105 to 2130 on **9580, 11765** and on **17825.**

● **POLAND**

Radio Warsaw radiates in English to Europe from 0630 to 0700 on **7270, 7285** and on **9675**; from 1200 to 1230 on **7285** and on **9540**; from 1600 to 1630 on **6095, 7125, 7285** and on **9540**; from 1830 to 1900 on **6095, 7125, 7285** and on **9540**; from 2030 to 2100 on **6155** and on **7285** and finally from 2230 to 2300 on **5995, 6135, 6155** and on **7285.**

● **EAST GERMANY**

Radio Berlin International presents programmes in English to Europe from 1730 to 1815 on **7260**; from 1830 to 1915 on **6080, 6115, 7185, 7300** and on **9730**; and from 2115 to 2200 on **7260.**

● **SRI LANKA**

The SLBC, Colombo, now has a one hour transmission in English beamed to Europe from 1900 to 2000 on **9720, 11800** and on **15120.**

● **ISRAEL**

A newscast in English to Western Europe is to be heard at 0500 on **5900, 7395, 9009** and on **9815.**

AROUND THE DIAL

Quite a few interesting transmissions have been logged of late, some of the stations listed here are not often reported in the SWL press. To commence we have –

● **CLANDESTINE**
Radio Pathet Lao on a measured **6211.5** heard from 1318 through till 1349 with song by YL and OM announcer in Lao, then discussion in Lao by YL and OM. Also logged in parallel on an old R. Pathet Lao channel **6199**, the signal strength being much weaker however on this latter frequency.

● **SOUTH KOREA**
The "Voice of Hope" in Seoul on a measured **6348,** logged from 1245, a religious service, hymns and a children's choir, all in Korean.

● **NORTH KOREA**
Radio Pyongyang on **3560,** heard at 2225 with YL talking in Korean, the signal being lost at 2235 under amateur CW and commercial utility QRM.

● **CHINA**
Huhehot in Inner Mongolia (north of the Great Wall) on **4068** at 1450 when we heard Chinese-type music in a relay of the Radio Peking Mongolian Service, YL announcer, schedule for this broadcast being from 1400 to 1500.
Urumchi in Sinkiang Province (Urumchi is junction of many caravan routes) on **4970** at 1453, YL with talk in Kazakh in a relay of the Radio Peking Kazakh Service, schedule for this being from 1400 to 1455, and is in parallel on **5440.**
Probably the most interesting time to log Urumchi is at 2250 when they open on **4110** with a choral (yes, choral) version of the "East is Red" after which there is a single chime then YL announcer with the Uigher Service for the Sinkiang Province.

Urumchi can also be heard on **6280** at 2318, at which time they were radiating a programme of Chinese orchestral music when logged here. (Here = Darkest Suffolk). Or, try this channel at 1310 when they are radiating the Sinkiang Regional Service, in Standard Chinese.
Sining (just south of the Great Wall) in Tsinghai Province on **3950** at 1440 when we heard some local music and players in, presumably, a folk drama.

● **TIBET**
Lhasa on **4035** at 1520, YL with song, local music and OM announcer. Lhasa relays the Radio Peking Hindi Service to South Asia daily from 1600 to 1800 and is also in parallel on **5935** and **9490.**

● **NEW GUINEA**
Port Moresby on **4890** at 2002, OM with news in English under some CW QRM. But try Port Moresby on the parallel channel of **3925** where we heard them recently at 1952 with marches on records, opening announcements by OM in English, news summary from 1958, news about Darwin disaster from 2000 followed at 2010 by recorded light music programme with both YL and OM announcers.

● **MALAYSIA**
Penang on **4985** where we logged them from 1530 onwards, commencing with six pips in time check followed by OM with newscast in English.
Kuching on **4835** at 1520 when, after battling with some commercial QRM, the only reward was two OM's in discussion in Malindo. (Malindo = Malaysia and Indonesia have agreed to standardise the common language, thereby eliminating Dutch influence on the latter).

● **BURMA**
Rangoon on a measured **4725.7** at 1415, six pips in time check, YL with song in Burmese, local music, YL announcer.
Rangoon on **5039** at 1452, at which time, under some CW interference, we heard a newscast in English read by OM announcer.

● **THAILAND**
Bangkok on **4830** at 1430, series of chimes, OM in Thai then programme of music by a local orchestra.

● **NEPAL**
R. Katmandu on **3425** at 1445 when we heard a newscast in English read by YL announcer, also heard in parallel on **5007.**

● **SOUTH VIETNAM**
Saigon on **4877** at 1520, programme of local mx with YL providing the vocals, in Vietnamese of course.

● **GREENLAND**
Godthab on **3999** at 2200, OM in Danish with newscast, signal wiped out by utility QRM at 2202.

● **BOLIVIA**
CP75 La Crux del Sur, La Paz, on a measured **4876** at 2231, OM announcer with "Musica del Bolivia", then guitar and flute in a typical Bolivian arrangement.

● **HONDURAS REPUBLIC**
HRPL3 Radio Progresso, El Progresso, on **4920** at 2325 with identification then choir in Spanish "Silent Night, Holy Night".

● **COLOMBIA**
HJOX Radio Surcolombiana, Neiva, on **5010** at 0545 with identification then songs in Spanish with local music.

● **PERU**
Radio Libertad de Junin, Junin, on **5040** at 0552 with announcements in Spanish followed by Andean songs and music.

● **VENEZUELA**
YVKP Radio Tropical, Caracas, on **4870** at 0230, OM with identification then into programme of local pops.

● **PAKISTAN**
Radio Pakistan on a measured **4835.5** at 1540, local music, OM with songs; also heard on **3400** at 1611. OM with newscast in English.

● **AFGHANISTAN**
Kabul on **4775** at 1404, OM with newscast in English also heard on **3390** at 1605 with newscast in vernaculars read by OM and YL alternate.

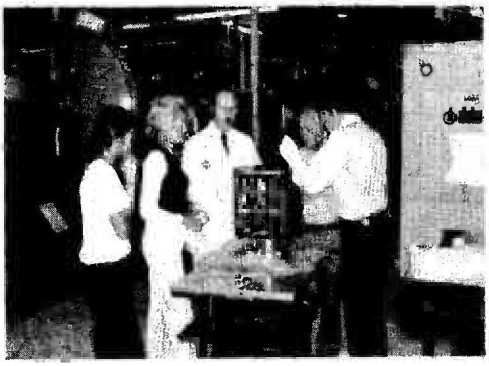
● **SOUTH AFRICA**
Johannesburg on **4835** at 2105, OM with weather forecast for the various districts and also surrounding countries, read in English.
Johannesburg on **4810** at 2110, announcements in English by OM in a pop record programme.

THE LAUNCHING OF OSCAR 7

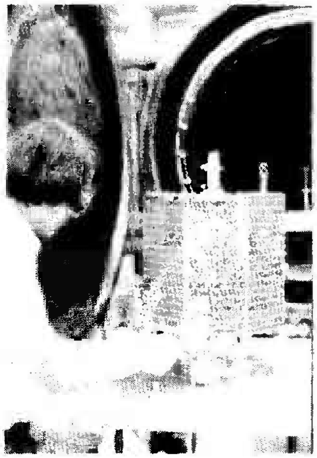
The amateur satellite was finally successfully launched on 15th November, and went into an orbit identical to Oscar 6.

NOW THAT THE AMATEUR RADIO SATELLITE OSCAR 7 is safely launched, news is filtering in of the activities connected with its launching and the following account is compiled from information kindly supplied by Joe Kasser, G3ZCZ/W3 of AMSAT and Nicholas Panagakos of NASA.

November 15th 1974 was quite a special day for Perry Klein, K3JTE, the President of AMSAT, as not only was it the day OSCAR 7 was launched, but it was also his birthday. After the difficulties of getting Oscar 7 launched, he could not have had a nicer present! It was launched by NASA from the Western Test Range in California, from a Delta rocket, which also launched, at the same time, an advanced meteorological satellite, ITOS-G and INTASAT A, Spain's first satellite.



Amsat – Oscar – B being prepared for placing into the thermal-vacuum test chamber, at left



Jan King, W3GEY, Project Manager, also preparing Amsat–Oscar–B before placing it in the Chamber for spacecraft thermal-vacuum testing

News of the launch was transmitted around the world by a network of radio amateurs. The Spacecraft Command Station Conference circuit linked VK3ZDH in Australia; VE3QB in Ottawa; VE2BYG in Bagotsville, with K3JTE and W3GEY at the Goddard Spaceflight Centre in Maryland. The AMSAT net control station W3ZM; the American Radio Relay Station, W1AW; the Club station at the Goddard Spaceflight Centre, WA3NAN; the Club station at the Western

Test Range, W6AB; were all in communication with each other and the launch proceedings were transmitted world-wide by W6AB, W3ZM and WA3NAN on the 15, 20, 40 and 75 metre Amateur Radio bands. WA4JID relayed W3ZM to Europe.

In the Washington D.C. area, where AMSAT has its H.Q., the proceedings were also transmitted on the 2 metre repeater maintained by AMSAT, so that some FCC officials could listen in to the launch proceedings.

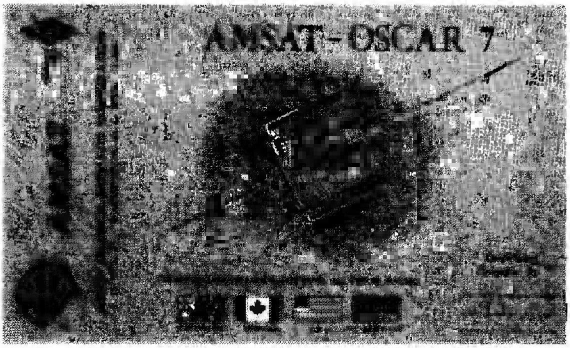
At 1711 GMT, the voice of Dick Damiels, WA4DGU was heard counting "5, 4, 3, 2, 1 zero . . . we have lift off!" OSCAR 7 was off! Up, up and away, flew the Delta rocket carrying OSCAR 7, the NOA 4 weather satellite and the Spanish INTASAT.

The first spacecraft to be separated was NOA 4 Weather Satellite, then OSCAR 7 and finally INTASAT.

Within minutes of separation, Pat Gowen, G3IOR, who was in contact with W3ZM on 14 MHz, reported that he was receiving telemetry from the 435 MHz beacon. GB2SM, the amateur radio station at the Science Museum, South Kensington, London, which had been specially manned to cover the OSCAR launching, also confirmed reception of signals from OSCAR 7. Conditions on 14 MHz not being too good, DJ30S, DL9GU and DJ81M telephoned AMSAT H.Q., from Germany, with telemetry information. Minutes later, DK2ZF phoned in a complete telemetry frame, reporting that he had first acquired signals from the spacecraft at 1828.46 GMT. The information he supplied confirmed that the spacecraft was performing as anticipated.

The Project Manager gives instructions for lifting the A – O – B spacecraft into the thermal-vacuum test chamber. The 10 metre antenna deployment mechanism and 2304 MHz quadrifillar antenna can be seen at the top of the spacecraft

Amsat President Perry Klein, K3JJE, and Tom Clark, WA3LND, with A – O – B following final thermal-vacuum tests of the spacecraft



The Amsat QSL Card

A special RTTY link took place on the 20 metre band between K31VO and PAØAA, the H.Q. station of the Dutch National Amateur Radio Society, VERON. The amateurs at PAØAA had built a special computer which would receive telemetry data from OSCAR 7 which was being transmitted in morse code and convert it into teletype code, which was then retransmitted on the 20 metre amateur band to AMSAT.

OSCAR 7 was built by radio amateurs from Australia, Canada, Germany and the United States and is the culmination of a four year project by AMSAT – the Radio Amateur Satellite Corporation. The group of amateurs who undertook its construction assembled the spacecraft mostly in their evenings and weekends. The final assembly took place in the basement of Jan King, W3GEY, who was the project manager. Like many others of the Group, he is involved professionally in the aerospace industry and he is reported to have said that a satellite performing the functions of OSCAR 7, built professionally, would have cost nearly two million dollars! OSCAR 7 was built largely from volunteer help with a cash investment of about 60,000 dollars. These funds came from contributions by individuals and organisations, a principal sponsor being the ARRL. ■

A.C.G.

PORTABLE 28MHz

This article is the first in a series devoted to transmitting and receiving equipment intended for operation in the 28MHz amateur band. The 'Talkie', a portable transmitter-receiver, will be described in this and next month's issues. Further articles will deal with a simple regenerative receiver, a 30 watt transmitter and with suitable aerials for use on the 28MHz band.

THREE SEPARATE ITEMS ARE TO BE DESCRIBED IN THIS series of articles. These are a portable transmitter-receiver (the 'Talkie'), a simple receiver for those who have no transmitting licence but wish to listen (the 'Receiver'), and a non-portable transmitter (the 'Base Equipment') for use over greater distances. Later articles will give details of the second and third items, and will also discuss suitable aerials.

The 'Talkie' can be carried in a small pack, or even a very large overcoat pocket, and the 'Receiver' is small enough for easy carrying. The 'Base Equipment' transmitter is intended for use at a fixed or temporary location in conjunction with any of the ordinary communications receivers, and as it runs 30 watts and is readily set up for any band from 3.5 to 28MHz it has quite a wide scope in Amateur activities. The transmitters to be described must not be operated by any person who does not have a full transmitting licence.

The licence requirements make it necessary to use crystal control with the transmitters or to employ a stable v.f.o. and provide a means of checking frequency. For simplicity crystal control has been adopted and this is a practical mode of operation in the 28MHz band where relatively little activity may be heard. Limiting operation to one spot frequency (unless other crystals are carried) on this band does not normally represent much disadvantage.

Reducing the size of home-constructed equipment to the minimum possible can prove to be a nuisance; wiring and layout become very cramped and only the smallest components will fit. For this reason the portable equipment is not vest-pocket in size though it is still quite small and light. So far as the 'Talkie' is concerned this has separate circuits for transmission and reception, a feature which simplifies setting up and testing the units.

The various items can, naturally, be used alone or in conjunction with others, or in conjunction with commercially made or home-built transmitters or receivers of similar kind. Further details of the items will now be given to enable the reader to see clearly what they are and to assist in deciding which should be constructed.

INDIVIDUAL ITEMS

The 'Talkie' is a transmitter-receiver with a 48 in. telescopic aerial, operating from an internal 9 volt battery. It was felt best to avoid miniature high capacity batteries on the grounds of their cost. A superhet receiver employing three transistors and one integrated circuit is used. The transmitter r.f. section has an oscillator followed by two transistors in push-pull, these being modulated by a push-pull audio stage. Low cost transistors are employed throughout. The complete unit is housed in a case measuring approximately 8 by 6 by 2 in., and so easily fits a haversack or can be carried on a shoulder strap.

The 'Receiver' is approximately 5 by 3 by 1½ in. with its own internal battery and speaker, and for simplicity is of super-regenerative design. No special licence is necessary for its use. Super-regenerative circuits are found in low priced commercial equipment, and the receiver has excellent sensitivity. It may, in fact, be fitted instead of the superhet receiver in the 'Talkie' if some simplification is wanted.

In view of its power input of 30 watts the 'Base Equipment' is mains operated, being a 28MHz Amateur band transmitter with internal power pack and modulator. As solid state devices are expensive at this power level (and are also easily destroyed) valves are used. It is only necessary to plug in mains, microphone and an aerial to put out an excellent signal. No receiver is included in the 'Base Equipment' as it is supposed that the usual station communications receiver will be employed, or that a similar receiver will be available. The transmitter is easily modified to operate on any of the other Amateur bands (excluding v.h.f.) and so should have wide utility.

TRANSMITTER – RECEIVER

Part 1

By F. G. Rayer, T.Eng. (CEI), Assoc. I.E.R.E., G3OGR

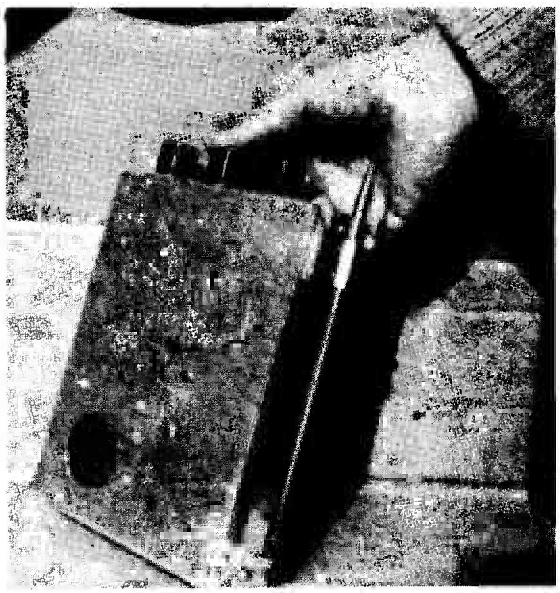
RANGE

Sky-wave signals can travel great distances, but for short-haul purposes communication is by ground wave. The maximum distance which can be covered then depends enormously on local conditions, such as hills, obstacles in the signal path, or buildings near the transmitter or receiver. The 28MHz equipment will often be used for relatively short range working, and no particular difficulty is then likely. The 'Talkie' 48 in. aerial easily gives sufficient signal strength for the regenerative receiver at 100 yards with the receiver aerial not even extended. But when attempts are made to operate at the limit of range local conditions become important.

The base station can easily be heard at several miles across open ground, and has provided fully reliable communication at this range with the regenerative receiver and with other receivers.

The 'Talkie' has been used at a range of well over 1 mile with the regenerative receiver, but for this it was necessary to clip a temporary dipole to the 'Talkie'.

In general, as would be expected, results are similar to those obtained with commercially made equipment of similar transmitting power and receiver sensitivity. The regenerative receiver was found to be a little more sensitive than the superhet.



The completed transmitter-receiver is small and may be easily carried

'TALKIE' TRANSMITTER

Fig. 1 shows the circuit of the r.f. section of the transmitter. TR1 is the crystal controlled oscillator, using a crystal of the required working frequency. Oscillation occurs when the core of the collector coil, L1, is adjusted to resonate at or near the crystal frequency.

The centre-tapped secondary, L2, drives the two output transistors, TR2 and TR3. In the absence of drive, the current drawn by TR2 and TR3 is extremely small, so that incorrect adjustments or loss of oscillation will not damage these transistors. The 2N3704 has a maximum dissipation rating of 360mW. The power dissipated in TR2 and TR3 is the difference between the input power and the power secured as r.f. output. So an input of up to about 50mA at 9 volts, or 450mW, is unlikely to damage the pair, even with some mistuning.

TR1 operates directly from the 9 volt supply and is switched on with the modulator. TR2 and TR3 receive their supply from the modulation transformer secondary. Though modulation is often applied to a driver stage, if fitted, this is best not done with the crystal oscillator in the present circuit.

The circuit can run from a 12 volt supply with an increased output, but a 9 volt battery can be more conveniently accommodated in the 'Talkie' case. Where long periods of transmitter use are expected it would be better to use an external battery pack. The internal 9 volt battery will, however, provide quite a long period of operation, both transmitting and receiving.

The switch shown in Fig. 1 is one section of the main function switch, and this is dealt with in detail in next month's article.

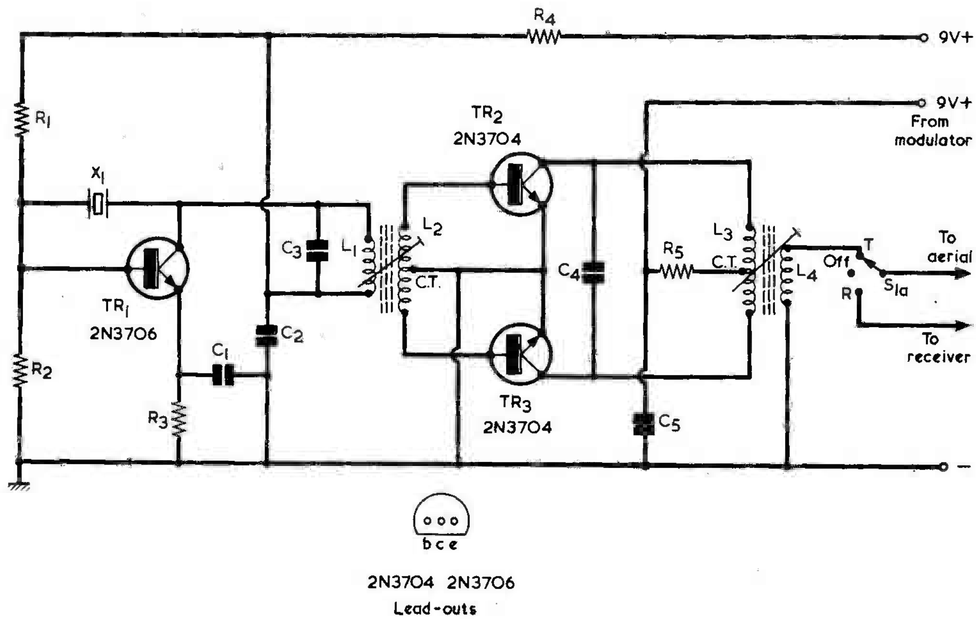


Fig. 1. The circuit of the r.f. section of the transmitter

COMPONENTS

Resistors
(All ¼ watt 5%)

R1	47kΩ
R2	10kΩ
R3	220Ω
R4	220Ω
R5	39Ω
R6	47kΩ
R7	12kΩ
R8	820Ω
R9	680Ω
R10	39Ω
R11	2.2kΩ
R12	4.7Ω

Capacitors

C1	0.047μF disc ceramic
C2	0.1μF disc ceramic
C3	39 or 40pF silvered mica
C4	39 or 40pF silvered mica
C5	0.02μF disc ceramic
C6	4,700pF ceramic or plastic foil
C7	100μF electrolytic, 12 V. Wkg.
C8	2.2 or 2.5μF electrolytic, 6 V. Wkg.
C9	64μF electrolytic, 4 V. Wkg.
C10	250μF electrolytic, 12 V. Wkg.

Inductors

L1-L4	Home wound on 7 mm. cored formers (see text)
T1	Driver transformer type T/T6 (R.S. Components)
T2	Modified output transformer (see text)

Transistors

TR1	2N3706
TR2	2N3704
TR3	2N3704
TR4	BC107
TR5	AC128
TR6	AC128

Crystal

X1	28MHz Amateur band crystal, HC25U encapsulation

Miscellaneous

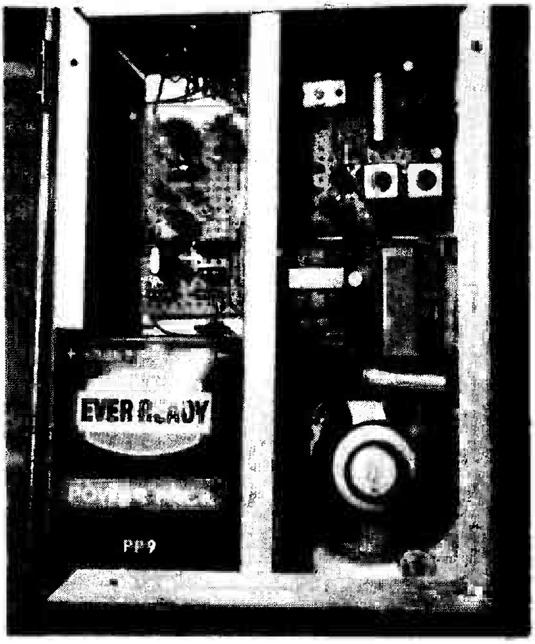
Plain Veroboard, 0.15 in. matrix, 1½ x 2¾ in.
Plain Veroboard, 0.15 in. matrix, 2¼ x 2¾ in.
HC25U crystal holder
Nuts, bolts, solder tags, etc.

ASSEMBLY

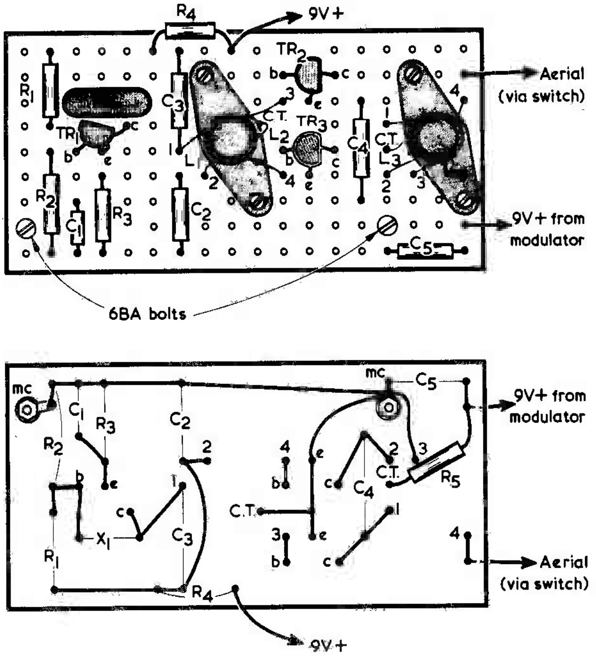
The transmitter r.f. section is assembled on a piece of plain 0.15 in. matrix Veroboard measuring $1\frac{1}{2}$ by $2\frac{3}{4}$ in., and the layout on both sides of this board is shown in Fig. 2.

The coils are wound on two 7 mm. diameter formers with adjustable cores, and suitable formers and cores are listed by Henry's Radio, Ltd. The coils are most easily wound after the formers have been secured to the board and the components to which they connect have been fitted. The formers are held in place by 8BA bolts and nuts or by adhesive if the latter is more convenient.

L1 consists of $10\frac{1}{2}$ turns of 32 s.w.g. enamelled wire, close-wound as near to the circuit board end of the former as possible. L2 is 6 turns close-wound of the same wire, wound against L1 and centre-tapped. The coil leads are numbered 1 to 4 in Fig. 2 for ease of reference. Pass the start of the coil wire through the board at point 1 and connect it to C3. Wind on the $10\frac{1}{2}$ turns, apply a touch of adhesive, then pass the coil wire through the hole at point 2 and connect it to C2. Start L2 by passing the wire through the hole at point 3 and connect it to the base of TR2. Wind on 3 turns, make a small loop for the centre-tap, continue for 3 more turns and take the coil end through hole 4 to the base of TR3. A lead from the centre-tap connects to the emitters of TR2 and TR3.



How the sections are arranged inside the case. The r.f. section of the transmitter is above the battery on the left. On the right are the superhet receiver, the modulator and the speaker.



mc - chassis connection

Fig. 2. Wiring details for the Veroboard panel on which are mounted the components for the r.f. section of the transmitter

L3 has 10 turns of 24 s.w.g. enamelled wire close-wound and centre-tapped. L4 is 4 turns of thin insulated wire wound directly on top of L3 and having 2 turns lying on either side of L3 centre-tap. The points at which the coil ends pass through the board are again numbered 1 to 4.

Two holes in the board are drilled out to take 6BA bolts. These secure solder tags on the wiring side of the board and also enable the board to be mounted, later, to the metal case of the transmitter-receiver. They thus provide the chassis connection to the board. Note that resistor R5 is mounted on the wiring side of the board and connects to the centre-tap of L3 by way of a short lead. Flying leads can be left for later connection to the 9 volt positive input, the 9 volt positive input from the modulator, and the aerial.

The crystal employed by the author was an HC25U type fitted in an HC25U holder, both of which are available from Senator Crystals, 36 Valleyfield Road, London, SW16 2HR. Senator Crystals is a mail-order only house. It is not absolutely essential to use this type of crystal, but whatever crystal is employed must be for the wanted frequency in the 28MHz band.

R.F. ADJUSTMENTS

Final tuning adjustments in the transmitter section are carried out when the r.f. and modulator sections have been fitted into the metal case of the transmitter-receiver. However, the adjustments will be described now so that details of the r.f. section may be completed. Some readers may, also, prefer to make a quick check of the r.f. section before it is fitted in the case; but it should be pointed out that readjustments will still be needed when the r.f. section is finally installed, and that tests with the board on its own cannot include aerial checks.

A meter may first be inserted in the positive supply line to TR1. Current here, with TR1 not oscillating, is about 2mA, and this rises to 5mA or more with TR1 oscillating. The presence of oscillation can also be checked with an indicating wavemeter.

The meter may then be placed temporarily in series with the 9 volt supply from the modulator. For an artificial load, a 6 volt 0.04 amp or 6 volt 0.1 amp bulb may be connected across L4 (from the aerial output to the chassis line) or it may be soldered to a 2 or 3 turn loop which can be placed over L3.

The core of L3 is then adjusted for maximum lamp brilliance. With an input of 30mA from the 9 volt supply a 6 volt 0.04 amp lamp should light brightly. The d.c. input to TR2 and TR3 will depend on the drive from TR1, and the loading on L3. The core of L1 needs to be slightly off the peak setting for proper starting of the oscillator when it is switched on. If the crystal is pulled out of its socket, r.f. output should cease and current input to TR2 and TR3 drop to zero.

With L4 as described and a 48 in. aerial, the input is somewhat under the maximum possible for TR2 and TR3, but there is of course a saving in battery current. To load the output stage so that a higher input and output can be secured it is necessary to alter L4, or place a loading coil in series with the aerial so that the loading and resonance can be adjusted, or have a longer aerial. Maximum portable range would be with a loaded whip. Bottom loading of the circuit is less effective but can nevertheless be given by a coil having about 17 turns on a 7 mm. former with adjustable core, this being fitted in the case near the aerial. Adjustment must be made with the aerial fully extended and clear of earthed objects, and preferably with an indicating wavemeter at a short distance. A setting of the core of the loading coil should be found where the input to TR2 and TR3 rises, with a corresponding rise in r.f. output as shown by the wavemeter.

If substantially more power is required than that given by L4 and the 48 in. aerial, the use of an alternative supply instead of the PP9 battery used in the prototype should be considered.

MODULATOR

The circuit of the modulator unit is given in Fig. 3. The input is provided by the 80Ω speaker of the transmitter-receiver, this operating as a microphone when the function switch is set to 'Transmit'. TR4 is a high gain amplifier and acts also as a driver for the push-pull output pair, TR5 and TR6. The overall amplifier provides adequate gain; it was found that no pre-amplifier

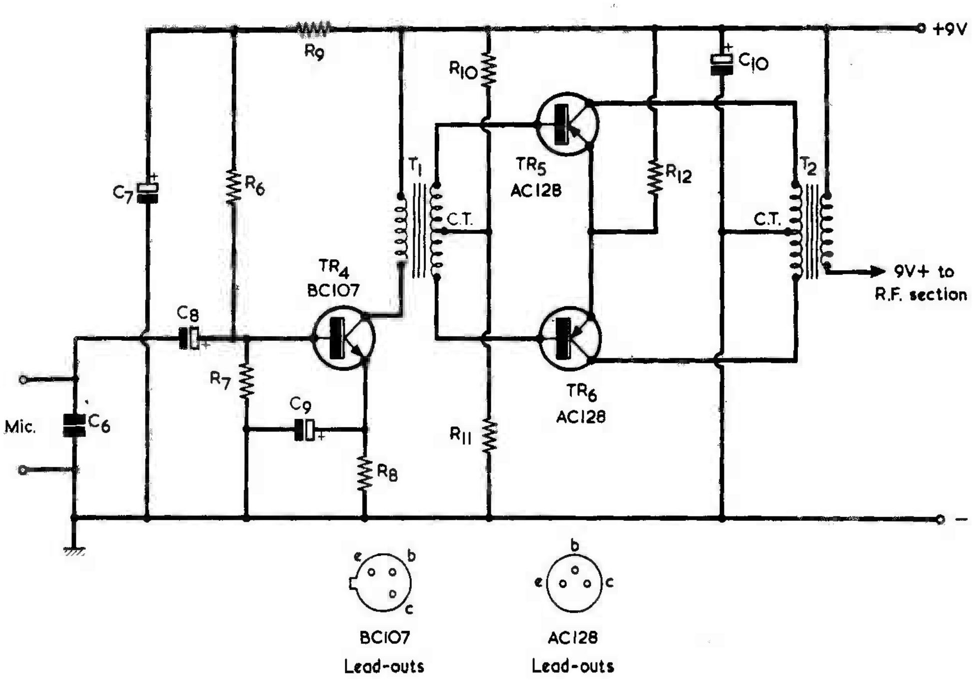


Fig. 3. The circuit of the modulator. The microphone consists of the 80Ω speaker which, on 'Receive', couples to the receiver output

was required and that there was no necessity to talk loudly close to the speaker when transmitting.

It is important that R10 and R11 have the correct values and these should be 5% components. The modulator should draw about 10mA current under no-signal conditions, this rising to 50mA or so on speech peaks. If the no-signal current is low and cross-over distortion is objectionable, R10 needs to be increased *slightly* in value, or R11 reduced. Alternatively, should the no-signal current be too high, R10 should be reduced in value or R11 increased. If desired, a 100Ω pre-set potentiometer could be fitted in place of R10, and a miniature skeleton component would be satisfactory here. This potentiometer is initially set to insert zero resistance into circuit, and is then adjusted to give increasing resistance until the no-signal modulator current reaches the 10mA figure.

The modulation transformer, T2, has to be home-wound, as no component for this function appears to be generally available. It consists of a modified output transformer of a type suitable for coupling two AC128's, or similar, to a 3Ω speaker. The primary of the modified transformer should be 300 turns, centre-tapped, and the secondary 190 turns. The primary will already be present on the transformer but the existing secondary will consist of a relatively few turns of stout wire which need to be removed.

Should a suitable core be to hand, the whole transformer could be made up on this. The transformer used by the author was $1\frac{3}{8}$ in. long by $1\frac{1}{8}$ in. high, and its core was a stack of laminations $\frac{7}{16}$ in. thick. There are many non-miniature output transformers of this type, intended for two AC128's and similar output transistors. Transformers which have been varnished or dipped are difficult to take apart, so are best avoided. If the transformer had the secondary outside the primary, the primary can be left untouched. However, it is usual to find that the secondary was wound first followed by the primary, and so the primary has to be removed.

Assuming the primary must be taken off, unwind it carefully, transferring the wire to a temporary spool. This wire can be re-used for the primary of the modified transformer. If a new wire is to be used for the primary, 28 or 30 s.w.g. enamelled will probably be suitable. The stoutest wire which will let the wanted number of turns be accommodated is preferred. The new secondary can be 30 s.w.g. enamelled wire. Leave projecting wires to take to the appropriate circuit points. The new primary can be bifilar wound, the two wires being wound on simultaneously. If so, one outer end and one inner end form the centre-tap, the remaining ends connecting to the collectors of TR5 and TR6. After rewinding, the laminations are replaced as they were originally.

As is explained shortly, it may be desirable not to modify the transformer until initial tests on the modulator amplifier have been carried out.

BOARD ASSEMBLY

The modulator components are assembled on a plain 0.15 in. matrix Veroboard measuring $2\frac{3}{4}$ by $2\frac{1}{4}$ in., as in Fig. 4. Fig. 5 shows the wiring under the board.

The two tags marked 'MC' are held by 6BA bolts. In the complete assembly part of the board covers the edge of the speaker, and these 6BA bolts need to be $\frac{3}{4}$ in. long to provide the requisite clearance from the front panel. Two extra nuts on each bolt, one on either side of the panel, then provide the required spacing. The two 6BA bolts also carry the negative supply to the board.

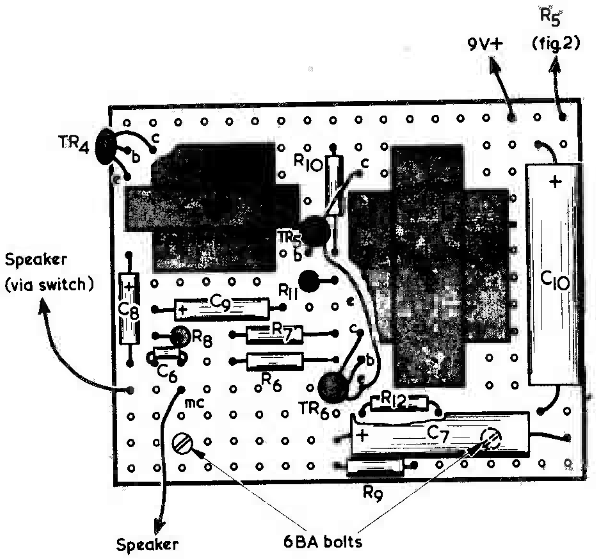


Fig. 4. Components on the modulator board. The flying lead from the hole marked 'MC' takes a chassis connection to the speaker. The other connection to the speaker is via the function switch. An extension lead is soldered to the emitter lead-out of TR5

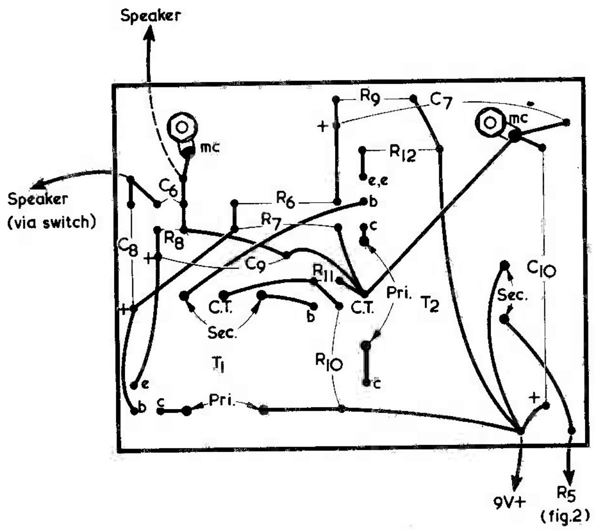
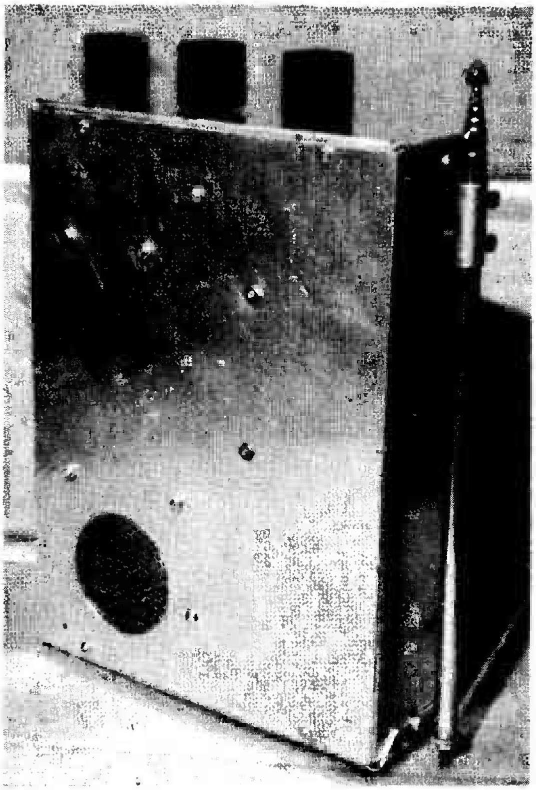


Fig. 5. The wiring under the modulator board



The transmitter-receiver with its telescopic aerial closed

Sleeving must be put on transistor leads and on any other wires which may touch other connections. Transformer T1 has two lugs which pass through slots cut in the board, and are then turned over. These slots can be made by drilling a few very small holes together and cutting between them with a sharp tool or very small file. If the modified transformer employed for T2 has similar lugs it may be mounted in the same fashion. Alternatively, other mounting arrangements for this transformer may be devised as necessary.

It is worth-while testing the modulator before it is fitted and wired up to the other items in the case. A good approach here consists of temporarily connecting the primary of the output transformer which will be later modified to give T2 to the collectors of TR5 and TR6 and the negative supply rail of the amplifier. A 3Ω speaker may then be connected to its secondary. After the amplifier tests have been carried out, the transformer may then be removed, modified, and fitted permanently in the T2 position.

The input to the modulator can be obtained from a tuner, pick-up or similar source, or from the 80Ω speaker which will be used as a microphone. It is recommended that performance with the 80Ω speaker be tried out, but it must be remembered that the other speaker, coupled to the amplifier output, has then to be positioned quite a considerable distance away to prevent acoustic feedback and howling. The output speaker may be connected to the output transformer secondary by way of a long pair of leads.

The modulator should offer good volume and satisfactory quality. Should this not be the case, the bias operating point of the output stage should be adjusted by varying the value of R10 or R11, as described earlier.

NEXT MONTH

The description of the 'Talkie' transmitter-receiver will be concluded in next month's article, and this will give details of the function switch, the superhet receiver and the assembly of the units inside the case.

The Components List accompanying the present article specifies the parts needed for the r.f. and modulator sections of the transmitter. It does not include the switch section shown in Fig. 1, the 9 volt supply battery, or the 80Ω speaker which has been referred to in conjunction with the modulator. There will be a further Components List next month and this will include all the remaining parts required for the construction of the transmitter-receiver.

(*To be continued*)

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 years 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

Smithy the Serviceman, aided as always by his able assistant, Dick, embarks on the repair of a medium wave-v.h.f. receiver. He is also able to demonstrate how a common i.f. amplifier with very few tuned circuits can handle both the amplitude modulated medium wave intermediate frequency and the frequency modulated v.h.f. intermediate frequency.

"AH YES," SAID SMITHY TO HIMSELF. "This should do nicely for my next job."

He placed the little portable receiver on his bench and switched it on. Music, at low volume level but with quite acceptable quality, at once became audible from its loudspeaker. He absently adjusted the tuning and found that he could pick up two other frequencies, these also being at a low volume level.

"Humph," he murmured, frowning. "Apart from the low sensitivity, this tuning seems very broad."

He peered more closely at the receiver dial, then clicked his tongue in mild vexation.

"Now, that's silly of me," he muttered. "This is a medium wave and v.h.f. set, and I'm switched to the v.h.f. band. Deary me, I thought I was on medium waves! And of course the set is insensitive on v.h.f. because I haven't pulled its telescopic aerial out."

SILENT WAVEBAND

Mystified by the undertones emanating from the Serviceman's bench, Dick laid down the test prod he had been applying to the television chassis in front of him and glanced round. Smithy seemed to be fully engrossed in the small radio he was examining. Puzzled, Dick returned to the television chassis.

"Must have been my imagination," he grunted carelessly.

His voice reached Smithy's ears. The Serviceman turned round, to see his assistant busily engaged with a test reading.

"Queer," said Smithy musingly. "I could have sworn I heard someone talking."

Shrugging his shoulders, he resumed his examination of the v.h.f–medium wave receiver.

"Oh well," he mumbled to himself. "I'll try this set out on the other band now. Hello, it seems to be dead on medium waves."

Once again, the muted sound of Smithy's voice reached his assistant and once again Dick turned round, but only to see the Serviceman adjusting the tuning of the small, and now silent, receiver. Shaking his head, Dick again returned to his television chassis.

"Blimey," he complained to himself. "I think it's about time I had a holiday."

The words carried across the Workshop at a just audible level. Smithy looked round once more. Dick was still, apparently, fully occupied with the television set he was examining.

"Hey, Dick," called out Smithy in his normal voice.

"Hello!"

"Have you got a set turned on low, or something like that? I keep hearing a voice."

"Do you?" said Dick in an alarmed tone, as he rose hurriedly from his stool. "That's funny, because I've been hearing a voice, too."

"Very quiet?"

"That's right. *And* indistinct."

"The one I heard was indistinct, too," said Smithy. "Just a sort of muttering in the background."

Dick walked over to the sets on the racks and examined them carefully.

"Everything's switched off here," he announced, "and I've got nothing turned on on my own bench."

They gazed around the Workshop.

"Well, there can't be anyone else in here except ourselves," said Smithy doubtfully. "It's peculiar that we should *both* have heard a voice."

Dick shivered.

"This is getting a bit spooky."

"I must confess," stated Smithy unhappily, "that there does seem to be something odd going on."

Dick looked at the television chassis on his bench with sudden distaste.

"How would it be," he asked, "if we were to work together for a bit? Then if we hear that voice again we can check with each other immediately."

Smithy was patently relieved by this suggestion.

"All right," he said. "It won't hurt us to do a job together for a while. We'll have a go at this little radio I've got here."

"Fair enough," replied Dick eagerly. "What's wrong with it?"

"It's a v.h.f.-medium wave job," pronounced Smithy, "and it's dead on medium waves."

"Have you checked the medium wave oscillator yet?"

"Not so far," replied Smithy. "I'll make that the next thing to do."

Quickly, he stood up, walked over to the "Repaired" rack and selected another small receiver. He returned with this, switched it to medium waves and tuned in a weak signal. He next switched on the faulty radio, which was already set to medium waves, held it near the serviceable set and adjusted its tuning. As he turned the tuning knob a heterodyne beat became audible from the serviceable receiver, and Smithy found that he could take this through zero beat with the tuning of the faulty receiver. (Fig. 1.)

VISUAL CHECKS

"Well," remarked Smithy, encouraged. 'The medium wave oscillator must be running or we wouldn't be able to pick it up on the other set.

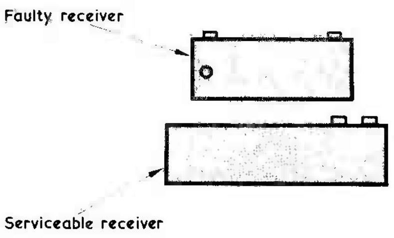


Fig. 1. The oscillator of one medium wave portable can usually produce a heterodyne in another medium wave receiver if the two sets are close to each other. This gives a simple check of oscillator functioning

You'd better take the back off this radio next, Dick, while I get the service sheet out."

Smithy picked up the serviceable radio and returned it to the "Repaired" rack, after which he walked over to the filing cabinet and selected a service sheet. Returning, he opened it out at the circuit diagram and placed it on his bench.

"There's nothing visibly wrong with this set," commented Dick, who had been examining the printed board of the radio. "I've done the usual obvious checks, like looking for wires adrift including, in particular, those between the ferrite aerial and the board."

"Good," remarked Smithy. "Another thing we know is that the common i.f. amplifier section foı both medium waves and v.h.f. must be all right or the f.m. signals wouldn't have got through it."

. "Hey, hang on a bit," protested Dick. "The common i.f. amplifiers in these a.m.-f.m. sets have the a.m. and f.m. i.f. transformer coils in series, with the a.m. transformers working at around 470kHz and the f.m. transformers at 10.7MHz. Couldn't you have a short in one of the a.m. transformer windings?" (Fig. 2.)

"The situation is rather different with the set we've got here," replied Smithy. "There's a trend in the more recent a.m.-f.m. portables to break away from the traditional circuits in which the 470kHz and 10.7MHz i.f. transformers are connected in series. If you take a look at the circuit of this set, you'll see what I mean."

Smithy extended a finger and pointed to the medium wave mixer-oscillator and the common i.f. amplifier in the service sheet circuit. (Fig. 3).

"Blimey," said Dick. "These two i.f. amplifier transistors haven't got a tuned circuit between them!"

"Exactly," confirmed Smithy. "All the i.f. selectivity is given before and after the common i.f. amplifier. Before we get down to this, though, let's take a quick look at the a.m. mixer-oscillator section. The medium wave a.m. signals here are picked up on the ferrite aerial and are then coupled into the mixer-oscillator transistor via a coupling coil in the usual manner. This mixer-oscillator stage is quite conventional and, since it only has to cover medium waves, there's no medium-long wave switching circuits. As you can see, there's a 470Ω resistor between the collector of the transistor and the feedback coil. This will limit feedback current and keep oscillation amplitude reasonably constant over the tuning range."

"The circuit seems to be partly upside-down," stated Dick. "For instance, the emitter of the transistor goes to the 6 volt negative supply line. Also, the collector goes to the oscillator feedback coil and the first 470kHz i.f. transformer winding, and then it goes to the chassis."

"True, true," agreed Smithy. "It so happens that this receiver has a negative supply rail instead of a positive one, with the result that an n.p.n. transistor like this mixer-oscillator has its supply points reversed. You often get that sort of thing with these portable radios and it just needs a little extra thought to remember that one or more of the transistor emitters may go to the supply rail instead of to chassis, as occurs in the more conventional sort of circuit. You soon get used to the idea."

"Fair enough," said Dick. "Well, as I said just now, the collector of the transistor goes to the first 470kHz i.f. transformer winding. This couples to the second 470kHz i.f. winding by way of a 3pF capacitor."

"That's right," confirmed Smithy. "The two windings give a high level of i.f. selectivity. Indeed, these two windings and the 470kHz i.f. output transformer which follows the common amplifier provide all the a.m. selectivity at i.f. for the set. Immediately after the mixer-oscillator, the a.m. signal at 470kHz is taken from the second i.f. transformer winding and is passed to the untuned secondary of the second 10.7MHz i.f. transformer. It then couples to the base of the first common i.f. amplifier transistor. That 10.7MHz i.f. secondary will only have a few turns on it and it won't have any significant effect on the 470kHz signal. Also, the first i.f. transistor is a p.n.p. type, so its emitter goes to deck and its collector circuit goes to the negative supply rail in quite the normal manner."

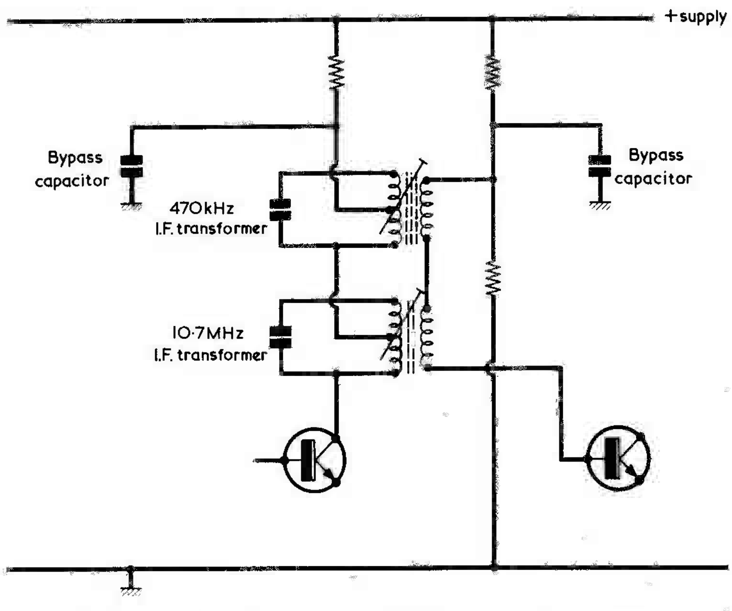


Fig. 2. The coupling between stages in the common i.f. amplifier of a conventional a.m.-f.m. receiver consists of a 10.7MHz and a 470kHz i.f. transformer connected in series, and a typical example is shown here. In practice, the 470kHz transformer may actually be set to any frequency between 450 and 480kHz according to the particular receiver design

I.F. STAGES

"That's a comfort at any rate," remarked Dick. "What happens when a 10.7MHz i.f. signal is fed to the second 10.7MHz i.f. transformer?"

"The signal," said Smithy, "will of course be built up across the untuned secondary of the 10.7MHz transformer. The lower capacitor across the second 470kHZ i.f. winding will then act as a bypass capacitor to chassis and will allow the 10.7MHz signal to be fed to the base of the first common i.f. transistor."

"That's a neat scheme," said Dick appreciatively. "It uses a lot less tuned circuits than you usually have in the i.f. stages of these a.m.-f.m. sets."

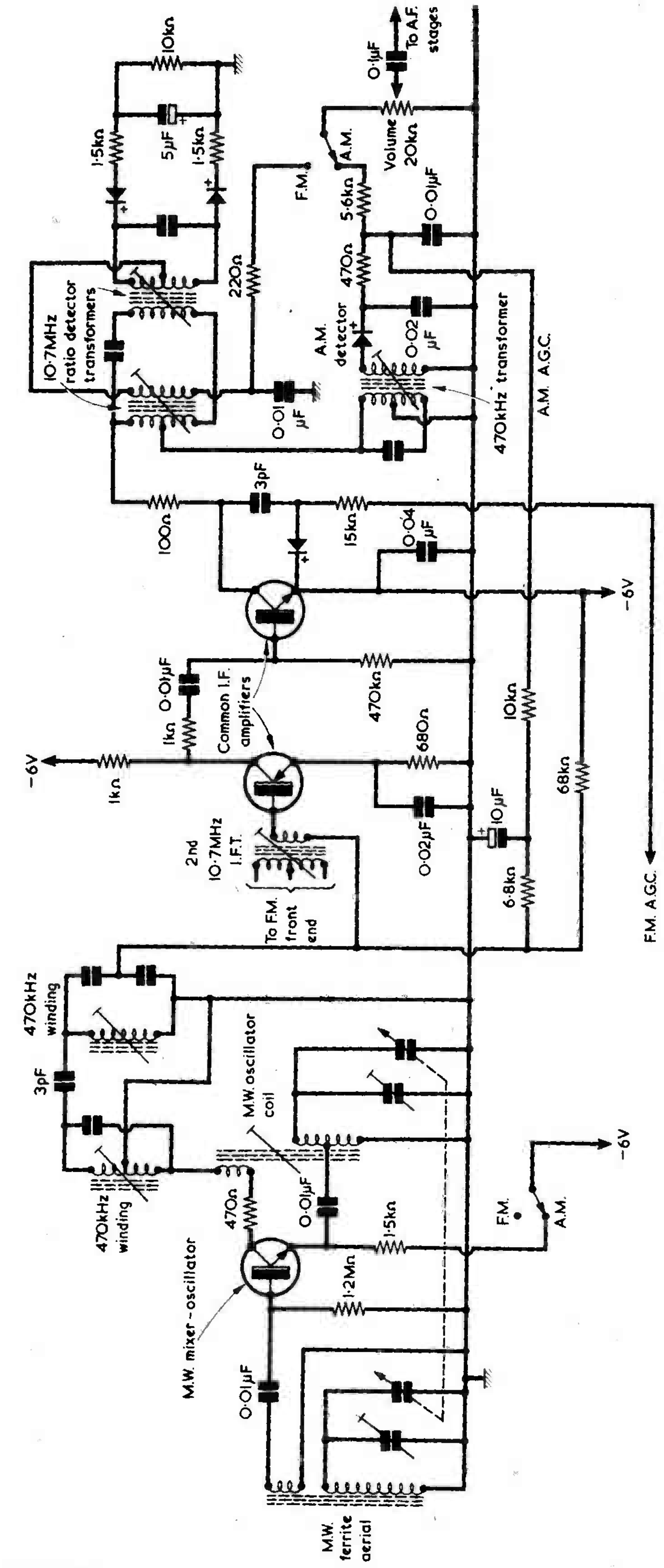


Fig. 3. The medium wave mixer-oscillator (or a.m. 'front end') and common i.f. amplifier stages in the a.m.-f.m. receiver serviced by Smithy. This circuit and that given in Fig. 4 are slightly simplified versions of the corresponding stages in the Pye Model 1409 receiver. The '−6V' volt points shown here connect to a common supply

"Indeed it does," agreed Smithy. "Well now, let's get back to the common i.f. amplifier when it handles the 470kHz i.f. signal. This signal is amplified by the first common i.f. transistor, which is simply resistance-capacitance coupled to the second common i.f. transistor without a suspicion of a tuned circuit anywhere. The second common i.f. transistor is an n.p.n. job, which means that the collector load goes to chassis whilst the emitter goes to the negative supply rail. But you should be able to take a minor aberration like that in your stride by now."

"Nothing to it," replied Dick airily. "Now there's a diode coupling to the collector of the second common i.f. transistor via a 3pF capacitor. What's that diode for?"

"It's to provide an a.g.c. voltage when the receiver is working on f.m.," stated Smithy. "It produces a voltage at its anode which goes negative according to signal strength. It will also produce a negative voltage when a 470kHz i.f. signal goes through the common i.f. amplifier but, since the f.m. front end will then be switched off, the existence of this voltage doesn't matter. The low value of 3pF also means that less signal will be passed to the diode when the 470kHz i.f. is going through than when the 10.7MHz i.f. is going through."

"What are the transformers following the last common i.f. transistor?"

"Two of them," said Smithy, "are in the 10.7MHz ratio detector circuit, and they cause the detected f.m. signal to be passed to the a.m.-f.m. switch via a 220Ω resistor. The arm of the switch then couples to the volume control, after which the detected signal is applied to the a.f. amplifier stages of the set. The other transformer is the one we're more interested in at the moment and this feeds into a standard a.m. detector diode followed by a 470Ω and a 0.01μF i.f. filter circuit. There is then a 5.6kΩ resistor coupling to the a.m.-f.m. switch. The a.g.c. voltage for a.m. is also developed by the detector diode and it's fed back to the base of the first common i.f. transistor via a 10kΩ resistor and a 6.8kΩ resistor, with a 10μF electrolytic going to chassis between the two to give the a.g.c. time constant. This particular a.g.c. circuit is only operative on a.m., because on f.m. there's no 470kHz signal fed into the common i.f. amplifier."

Dick looked more closely at the circuit.

"There are," he remarked, "two resistors in that common i.f. amplifier which I don't quite understand. There's a 1kΩ resistor between the collector and base of the first and second transistors, and there's a 100Ω resistor immediately after the collector of the second transistor. What do these do, Smithy?"

"You encounter series resistors like these in many a.m.-f.m. common i.f. amplifiers," said Smithy. "Normally, their function is to reduce the effect of impulsive interference at f.m. The impulsive interference I'm referring to is what you get from badly suppressed car ignition systems and things like that."

"I see," said Dick, satisfied. "I must say that it's a jolly neat set-up. There's something else I've just noticed."

"What's that?"

"That mysterious voice we were hearing seems to have disappeared."

"Perhaps we haven't been able to hear it because we've been talking all the time ourselves. Let's listen for a bit."

They fell silent for some moments and listened intently.

"Whatever it was must have gone," pronounced Dick in a relieved tone. "I certainly couldn't hear anything then."

"Neither could I."

"Perhaps it was my imagination, after all," continued Dick hopefully. "My nerves are a bit upset this morning because I didn't sleep very well last night. I was having nightmares all the time."

"That's funny," said Smithy, in a surprised tone. "So was I."

"Oh well," stated Dick in a determined tone of voice, "let's forget about the voice and concentrate on this radio. How about the f.m. front end?"

F.M. FRONT END

"Here it is," said Smithy, pointing to another section of the service sheet

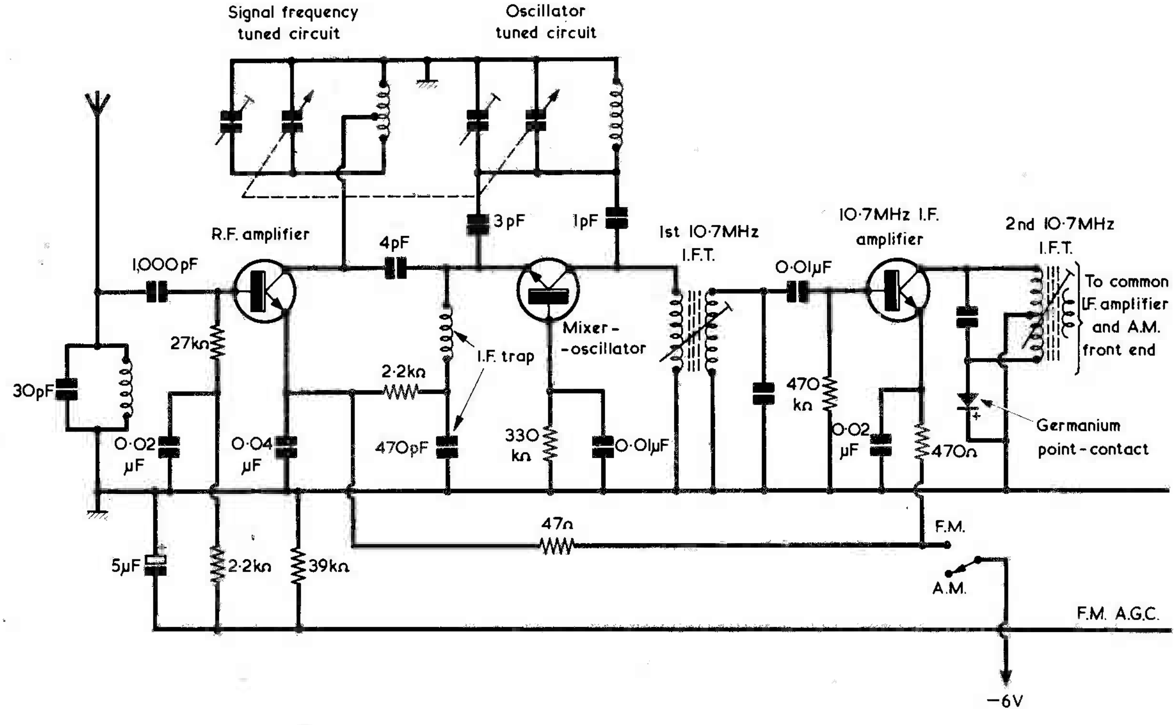


Fig. 4. The v.h.f. front end and the first 10.7MHz i.f. transformer in the a.m.-f.m. receiver. The second 10.7MHz i.f. transformer is the same component as that appearing in Fig. 3

circuit. (Fig. 4).

"This has got three transistors in it," commented Dick. "I thought most f.m. front ends only have two."

"The actual front end has two in this circuit, too," said Smithy. "That third transistor is an extra 10.7MHz i.f. amplifier which comes into use when f.m. is selected. One interesting point with this circuit is that the first transistor, which is the r.f. amplifier, is connected in a common emitter configuration. Usually, the r.f. amplifier in an f.m. front end is connected in common base, partly because the common base configuration gives a higher frequency response. This point is a bit academic these days, though, because current v.h.f. transistors have a pretty fantastic response in common emitter, anyway."

"The telescopic aerial," remarked Dick, "couples to a coil with a 30pF capacitor across it. Is that the input tuned circuit?"

"It is," confirmed Smithy, "and it will be broadly tuned to the centre of the f.m. band of 87.5 to 100MHz when the telescopic aerial is fully pulled out. The signal then passes through a 1,000pF capacitor to the base of the first transistor which is, as I said just now, the r.f. amplifier. We've already seen that a diode in the common i.f. amplifier produces an a.g.c. voltage for f.m. This voltage is fed to the base of the r.f. amplifier and it passes through quite a comprehensive filter comprising a 2.2kΩ resistor, a 27kΩ resistor, an 0.02μF capacitor and a 5μF electrolytic. You may remember that the a.g.c. voltage went negative as signal strength went up, and this is the required polarity for reverse a.g.c. control of the r.f. amplifier, which is an n.p.n. type."

"Which means also," cut in Dick, "that the emitter circuit once again goes to the negative supply line and the collector load to chassis."

"That's it," agreed Smithy. "In this instance the collector load is a signal frequency tuned circuit, which is tuned by a section of the receiver ganged capacitor. The collector connects into a tap in the coil, which then goes to chassis. The collector couples also, via a 4pF capacitor, to the emitter of the mixer-oscillator transistor. As in virtually all standard f.m. front ends this transistor is in common base."

"There's a coil from that emitter which couples to chassis via a 470pF capacitor," commented Dick. "It also couples to the negative supply via a 2.2kΩ resistor."

"The coil and the capacitor form a 10.7MHz i.f. trap," stated Smithy. "Since they are in a series tuned circuit they offer a low impedance at their resonant frequency. And the 2.2kΩ resistor is merely a supply feed resistor to the mixer-oscillator emitter. Which, you'll note, is yet another n.p.n. type."

"Why do you need an i.f. trap?"

"Because," said Smithy, "the circuit is pretty wide open to interference at the f.m. intermediate frequency if such a trap isn't included. The only other tuned circuits preventing i.f. breakthrough are the broadly tuned one at the aerial and the single reasonably sharply tuned one at the r.f. amplifier collector. The inclusion of an i.f. trap is a standard feature in 2-transistor f.m. front ends."

"Which is the oscillator coil?" asked Dick. "Is that the one that's tuned by the remaining section of the receiver ganged capacitor?"

"It is," confirmed Smithy. "The mixer-oscillator collector couples via a 1pF capacitor to this oscillator tuned circuit, and a second capacitor, with a value of 3pF, then couples back to the emitter. One reason why the mixer-oscillator in an f.m. front end in almost always in common base is that this causes the emitter and collector to be in phase. It's then possible to get oscillator feedback from the collector to the emitter by capacitive coupling, with the result that the oscillator coil is just a simple single tuned winding and no coupling windings are necessary. So we've now got the second transistor functioning as an oscillator and its frequency will, of course, be higher than the signal frequency by the 10.7MHz intermediate frequency. The intermediate frequency is present at the collector and this is taken off by the primary of the first 10.7MHz i.f. transformer. In this circuit, the mixer-oscillator collector connects direct to that primary."

"And the i.f. signal," chimed in Dick, "then goes to the third transistor, which amplifies the 10.7MHz signal."

"You've got it," said Smithy approvingly. "Well now, the third transistor is the first 10.7MHz i.f. amplifier, and the primary of the second 10.7MHz i.f. transformer appears in its collector circuit. The secondary of that transformer then couples into the common i.f. amplifier in the manner we saw earlier on."

"There's a diode across part of that primary winding," said Dick. "Don't say you've got another detector circuit there."

"That diode is included," said Smithy, "to prevent overloading by very strong f.m. signals which would otherwise be beyond the ability of the a.g.c. circuit to cope with. It's a garmanium point-contact diode with a relatively low forward voltage, and it becomes conductive when the strong signal is received. Now, so far as I can see that's about all there is to say about this receiver when it's switched to f.m. To finally complete the picture, the f.m. intermediate frequency goes through the common i.f. amplifier and is then detected by the ratio detector. The output from the ratio detector couples to the a.f. amplifier stages via the a.f. section of the a.m.-f.m. switch, and so the f.m. signal is finally reproduced over the speaker."

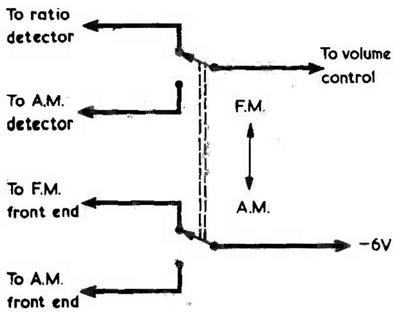


Fig. 5. The receiver circuit enables extremely simple a.m.-f.m. switching to be given

SWITCHING CIRCUIT

"There's something else in this receiver circuit that I've just noticed," said Dick.

"What's that?"

"I've just realised how very simple the a.m.-f.m. switching circuits are."

"Go on."

"Well," said Dick excitedly, "the outputs of the two detectors can be selected by a single pole changeover switch. The only other a.m.-f.m. switch section you need is one which applies the supply to the a.m. or to the f.m. front end, and this can be another single pole changeover switch. The entire a.m.-f.m. switching can be carried out with a double-pole double-throw switch." (Fig. 5).

"Very good," commended Smithy. "In fact, a simple slide switch is all that's used in this receiver. In some receiver designs, the a.m.-f.m. switch has so many contacts that it's a monster by comparison."

"Look Fred, fifteen years ago a thousand-foot slide rule would have been a sensation . . . . . !"

Dick suddenly shivered and looked around with apprehension.

"Hey, what's up with you?"

"It's that word 'monster'. There was another of those Frankenstein films on again last night."

"I know," said Smithy seriously. "I saw it too. The late night movie."

"It scared the living daylights out of me," confessed Dick. "Do you remember the bit where they've got the monster all strapped down and they're going to put a new brain in him? And then the lightning starts up?"

"When was that?"

"Just before the Wall's sausages ad."

"Blimey, yes I do remember. They had all those sparks leaping about, too. Hundreds of kV's they must have been using there."

The pair fell silent, reliving the horrors of the previous night.

"What I don't understand," said Dick, "are those two things on either side of his neck."

"They're terminals," explained Smithy. "They connect up to those when they want to gee him up again."

"Gosh," breathed Dick, as he absorbed this frightening intelligence. "One of my aunts is always going on about supernatural things. She says 'there are more things in heaven and earth, Horatio, than can ever be defended at the bridge'."

"Very apposite," commented Smithy. "Still, we mustn't let ourselves get too absorbed with what we saw last night."

"No, I suppose not," said Dick, as he shudderingly wrenched his thoughts back to his immediate surroundings. "We'd better get this set fixed next."

"That wouldn't be a bad idea," agreed Smithy. "To recap, the fault on it is that it works O.K. on f.m. but it's dead on medium waves. We've checked that the medium wave oscillator is working and you ensured that the wires from the ferrite aerial to the board circuit weren't broken. If the oscillator is working then there must be a supply getting through to the transistor, and so we won't be taking too much of a risk if we assume for the time being that the medium wave front end is all right. The common i.f. amplifier stages are also all right because they're working on f.m., so the most likely contender for an initial examination is the circuit around the a.m. detector. Let's see if there's any life in that part of the set."

Smithy pulled his testmeter towards him and selected a low voltage range. He clipped its negative lead to the receiver chassis and applied the positive prod to the non-earthy lead of the 0.01μF capacitor following the a.m. detector. After making certain that the receiver was switched to medium waves, he turned it on and slowly adjusted the tuning. Suddenly, the testmeter gave an indication of around 0.2 volt. As Smithy adjusted the tuning he found that he could bring this voltage up to a peak. (Fig. 6 (a)).

"Stap me," said Dick, impressed. "Where's that voltage coming from?"

"It's a detected received signal," replied Smithy, "and it's presence means that the a.m. circuits must be working up to and including this filter capacitor."

Smithy transferred the positive test prod to the other end of the 5.6kΩ resistor following the filter capacitor. The meter gave no indication. (Fig. 6 (b)).

"Well," said Smithy, "there's no voltage there, so either this 5.6kΩ resistor is open-circuit or there's a dead short to chassis at the lead I'm checking."

He turned the receiver volume up to full, unclipped the testmeter negative lead from chassis and applied the testmeter leads across the suspect resistor. The sound of weak music was at once audible from the speaker. (Fig. 6 (c)).

"There you are," said Smithy triumphantly. "That resistor *is* open-circuit. I wasn't using the testmeter to take a reading then but simply having it act as a convenient bridging resistor. The resistance it presents is quite a lot higher than 5.6kΩ, but it is still low enough to allow a little a.f. to pass through. Well, Dick, a new 5.6kΩ resistor is called for here. and perhaps you'd be good enough to oblige."

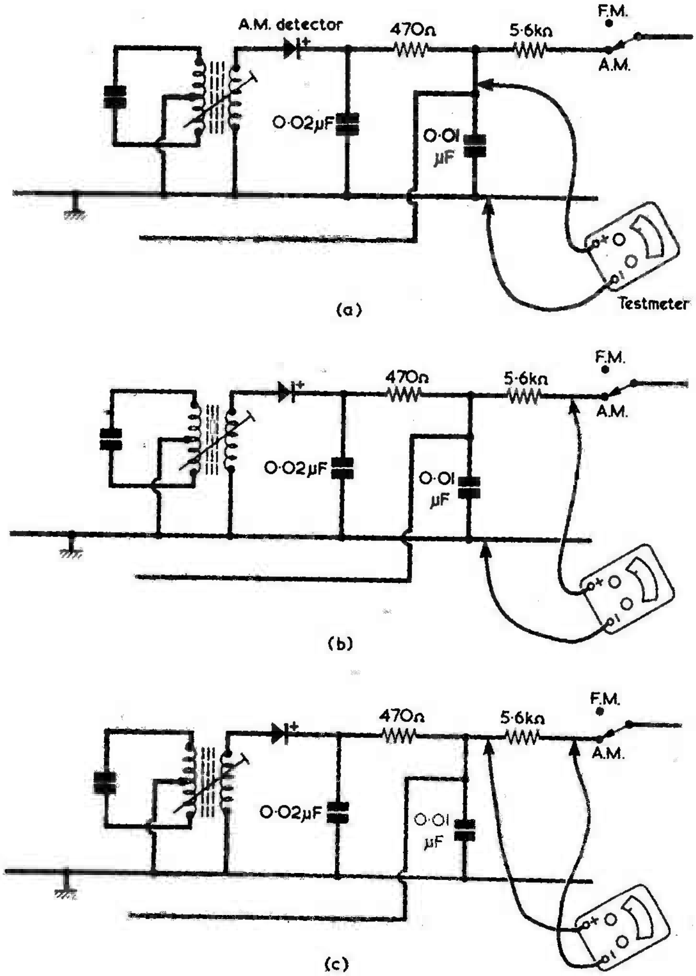


Fig. 6 (a) A check for signal voltage after the a.m. detector
(b) Testing to see whether the signal voltage is present after the 5.6kΩ resistor
(c) Because it can be applied so conveniently, it is often helpful to use a testmeter as a temporary bridging resistor. The meter should be set to a voltage range greater than any voltage to be expected in the circuit, and should be applied with the polarity to be anticipated

NEW RESISTOR

"My pleasure," said Dick.

He soon found a replacement resistor and soldered it onto the board, whereupon the little radio gave a very creditable performance both on medium waves and on f.m.

"Another job done," said Smithy, pleased. "I think you'd better get back to your own bench now, Dick. We can't spend all day working together on single jobs."

"All right," replied his assistant. "Perhaps I was letting myself get a bit too panicky earlier on, just because of that dratted film last night."

"Perhaps I was, too," admitted Smithy. "Let's see if there's something a bit more cheerful on tonight."

He walked over to his mackintosh, pulled a newspaper out of its pocket, then opened it at the page with the television programmes.

Suddenly, his hand faltered and his face went ashen. Alarmed, Dick rushed over towards him.

"What's up, Smithy?"

Smithy pointed a trembling finger at an item in the newspaper.

"Look," he quavered. "There's another late-night movie on tonight."

Dick leaned over and gazed at the item indicated by the trembling Serviceman.

"Ye gods," he gasped, "this is going to be even worse than last night. It's 'The Werewolf Vampire From The Waxworks Museum'." ■

Use the NEW Strip-fix Plastic PANEL SIGNS

★ SET 3 - Wording - WHITE
★ SET 4 - Wording - BLACK

Over 1,000 words and symbols, covering more than 300 terms, in each set

Illustration of actual size = RADIO

★ SET 5 - DIALS

6 sheets containing one Large and two Medium scales, Large Horizontal Tuning scale, Frequencies, 12 Control Panels

- **Easy to fix**
- **Stapled in booklet form**
- **Designed to hang above workbench**
- **Pocket for loose cuttings**
- **Professional finish**

PRICE

SET 3: 38p
SET 4: 50p
SET 5: 38p

(P. & P. 5p per set)

ALL PRICES INCLUDE V.A.T.

The Perfect Transfer for the Home Constructor

To Data Publications Ltd., 57 Maida Vale, London, W.9 1SN

Please supply Panel Signs as follows: Set 3 ..... Set 4 ..... Set 5 .....

I enclose cheque / crossed postal order for .... (Tick which set is required)

NAME ....

ADDRESS ....

....

(BLOCK LETTERS PLEASE)

SMALL ADVERTISEMENTS

Rate: 5p per word. Minimum charge 75p
Box No. 10p extra.

> Advertisements must be prepaid and all copy must be received by the 4th of the month for insertion in the following month's issue. The Publishers cannot be held liable in any way for printing errors or omissions, nor can they accept responsibility for the *bona fides* of Advertisers. (Replies to Box Numbers should be addressed to: Box No. —, *Radio and Electronics Constructor*, 57 Maida Vale, London, W9 1SN

SUPERB INSTRUMENT CASES by Bazelli. Manufactured from heavy duty P.V.C. faced steel. Hundreds of radio, electronic and hi-fi enthusiasts are choosing the case they require from our range of over 200 models. Generous trade discount. Prompt dispatch. Free literature: Bazelli, Dept. No. 26, St. Wilfrids, Foundry Lane, Halton, Lancaster, LA2 6LT.

SERVICE SHEETS for Televisions, Radios, Transistors, Tape Recorders, Record Players, etc., from 5p with free Fault Finding Guide. Over 10,000 models available. S.A.E. enquiries. Catalogue 20p and S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards-on-Sea, Sussex. Telephone Hastings 429066

FOR SALE: Polarised relays, suitable for RTTY terminal units. £1.00. Box No. G235.

UNIQUE VHF KITS, 80-180MHz. Receiver, tuner, converter. World wide sales. Send £5 or s.a.e. for literature. Johnsons Radio (C), Worcester, WR1 3QQ.

FIBRE OPTICS, OPTOELECTRONICS. Complete range fibre optics, photo-detectors, LED's, lenses, retroreflectors, polarisers, ultrasonic transducers. Send 9″ x 6″ s.a.e. for shortform price list: FIBRE OPTIC SUPPLIES, 2 Loudoun Road Mews, London NW8 0DN.

WANTED. Early radio books, prior to 1925. Box No. G236.

FOR SALE: 1973–74 edition *Radio & Television Servicing* by McDonald & Co., £5.50 post paid. Bell's Television Services, 190 Kings Road, Harrogate, Yorkshire.

BUILD THE MULLARD C.C. TV CAMERA. Complete kits now available from Crofton Electronics. Send large s.a e. for details to:– 124 Colne Road, Twickenham, Middlesex, TW2 6QS. Telephone: 01-898-1569.

FOR SALE: Goodmans speakers, 6 watt 8 ohm, complete with 100V line transformer. £3.50 including P. & P. Mahogany finish wall cabinet £2 extra. From: West Country Vending Service Ltd., 5/6 Grove Street, Bath, Avon.

HARDWARE SUPPLIES. Sheet aluminium, screws, nuts, washers, etc. Fascia panels in aluminium, individual requirements. Printed circuit boards, one-off or small runs, individual and for patterns published in this magazine Send 10p for list. Ramar Constructor Services, 29 Shelbourne Road, Stratford-upon-Avon, Warwicks. CV37 9JP.

MINI MAINS TRANSFORMERS. 30 x 30 x 37mm. Cool, quiet, British. Pri: 220/250V. Type MT3, 3-0-3V rms, 300mA, £1. MT7, 7-0-7V, 120mA, £1. VAT included. Use MT3 for 3V or 6V rectified d.c., MT7 for 9V or 18V. Circuits supplied. Mail order only. U.K. post 5p per order. Amatronix Ltd., 396 Selsdon Road, South Croydon, Surrey, CR2 0DE.

TRIACS: 6 amp/400V 74p (3 for £2.10). 4 amp/400V 60p. DIAC 19p. NE555V timer 58p. LED's 0.2″ dia., red, 20p; amber, yellow, green, 25p. P. & P. 10p. Add V.A.T. T.K. Electronics, 106 Studley Grange Road, London W7 2LX.

(Continued on page 508)

BENTLEY ACOUSTIC CORPORATION LTD.

All prices inclusive of V.A.T.

The Old Police Station, Gloucester Road, LITTLEHAMPTON Sussex. PHONE 6743

OB2	.40	10F1	.75	DY802	.35	EL34	1.00	PCL84	.45	UM80	.44
3V4	.70	10F18	.55	E88CC	.75	EL41	.90	PCL805	.55	UY41	.45
5R4GY	.80	10P13	.75	E180F	1.00	EL84	.31	PCL86	.47	UY85	.35
5U4G	.40	10P14	2.00	EA50	.27	EL506	.90	PEN45	.80	X41	1.00
5V4G	.50	12A6	1.00	EABC80	.38	ELL80	1.25	PEN46	.50	X66	1.25
5Y3GT	.45	12AC6	.70	EAF42	.75	EM80	.45	PL36	.60	Z759	5.00
5Z4G	.45	12AD6	.65	EAF801	.75	EM81	.65	PL81	.45	AC165	.28
6/30L2	.60	12AE6	.65	EB91	.20	EM83	.55	PL82	.37	AD140	.40
6AH6	.60	12AT6	.40	EBC41	.75	EM84	.40	PL83	.40	AD149	.55
6AQ5	.45	12AU6	.45	EBC81	.35	EM87	.70	PL84	.40	AD161	.50
6AT6	.45	12AV6	.50	EBF80	.39	EY51	.40	PL504	.75	AD162	.50
6AU6	.30	12BA6	.45	EBF83	.43	EY83	.54	PL508	.90	AF114	.28
6AV6	.45	12BE6	.50	EBF89	.32	EY87/6	.33	PL509	1.45	AF115	.17
6BA6	.28	12BH7	.50	EC92	.45	EY88	.40	PL802	.95	AF121	.33
6BE6	.35	12K5	1.00	ECC33	1.50	EZ40	.50	PY33/2	.45	AF126	.20
6BH6	.60	14S7	.80	ECC35	.95	EZ41	.55	PY81	.35	BC107	.14
6BJ6	.55	19AQ5	.50	ECC40	1.00	EZ80	.28	PY82	.30	BC108	.14
6BQ7A	.55	30C15	.70	ECC81	.34	EZ81	.29	PY83	.38	BC109	.14
6BR7	1.00	30C17	.80	ECC82	.33	GY501	.70	PY88	.40	BC113	.28
6BR8	1.50	30F5	.75	ECC83	.33	GZ32	.50	PY500	.95	BC118	.25
6BW6	.80	30FL1	.67	ECC84	.35	GZ34	.60	PY800	.40	BCZ11	.42
6BW7	.70	30FL2	.67	ECC85	.40	HVR2A	1.00	PY801	.40	BF158	.20
6BZ6	.49	30FL14	.70	ECC88	.44	KTW61	1.50	QQVO3/10	1.75	BF159	.28
6C4	.35	30L15	.70	ECF80	.45	KTW62	1.50	R19	.60	BF163	.22
6C6	.40	30L17	.65	ECF82	.45	KTW63	1.00	U25	.60	BF180	.33
6C9	1.00	30P12	.65	ECF86	.75	KT66	2.50	U26	.66	BY100	.20
6CL6	.65	30P19	.75	ECH35	1.25	PABC80	.38	U191	.50	BY126	.17
6CU5	.75	30PL1	.85	ECH42	.70	PC86	.60	U801	.85	BY127	.20
6E5	1.00	30PL13	.95	ECH81	.33	PC88	.60	UABC80	.40	OA91	.10
6F1	.75	30PL14	1.10	ECH83	.44	PC97	.35	UAF42	.60	OA95	.10
6F6G	.50	35L6GT	.75	ECH84	.44	PC900	.40	UBC41	.60	OC23	.42
6F18	.55	35W4	.50	ECL80	.40	PCC84	.30	UBC81	.45	OC24	.42
6F23	.70	35Z4GT	.70	ECL82	.34	PCC85	.44	UBF80	.40	OC25	.42
6F28	.67	50B5	.85	ECL83	.70	PCC88	.60	UBF89	.40	OC44	.11
6H6GT	.25	50C5	.60	ECL86	.40	PCC89	.45	UC92	.45	OC45	.12
6J5GT	.45	50L6GT	.65	EF22	1.50	PCC189	.48	UCC84	.75	OC46	.17
6J6	.30	85A2	.60	EF40	.75	PCF80	.40	UCC85	.45	OC70	.14
6K7G	.30	5763	1.50	EF41	.70	PCF82	.40	UCF80	.70	OC71	.12
6K8G	.45	ATP4	.50	EF80	.25	PCF84	.59	UCH42	.75	OC72	.12
6L6GC	.58	AZ31	.60	EF83	1.00	PCF86	.60	UCH81	.40	OC74	.25
6Q7G	.50	DAF91	.30	EF85	.30	PCF801	.50	UCL82	.38	OC75	.12
6Q7GT	.50	DAF96	.50	EF86	.45	PCF802	.50	UCL83	.55	OC78	.17
6SG7	.44	DF91	.30	EF89	.27	PCF805	.70	UF41	.70	OC78D	.17
6SJ7	.55	DF96	.50	EF91	.37	PCF806	.50	UF80	.35	OC81	.12
6V6G	.17	DK91	.45	EF92	.30	PCL82	.38	UF85	.44	OC81D	.12
6V6GT	.45	DK92	.70	EF98	.80	PCL83	.45	UF86	1.00	OC82	.12
6X4	.40	DK96	.60	EF183	.30			UF89	.40	OC82D	.12
6X5GT	.45	DL92	.40	EF184	.35			UL41	.75	OC83	.22
7B6	.75	DL96	.55	EH90	.45			UL84	.42	OC84	.26
7Y4	.75	DY87/6	.35	EL32	.50					OC202	.47
9D7	.65									OC205	.47

All goods are unused and boxed, and subject to the standard 90-day guarantee. Terms of business: Cash or cheque with order only. Despatch charges:—Orders below £10, add 25p extra per order Orders over £10 post free. Same day despatch. Terms of business available on request. Any parcel insured against damage in transit for only 3p extra per parcel. Please enclose S.A.E. with any enquiries.

ENGINEERS

FREE

YOURSELF FOR A

BETTER JOB WITH MORE PAY!

Do you want promotion, a better job, higher pay? "New Opportunities" shows you how to get them through our low-cost home study course. There are no books to buy and you can pay-as-you-learn.

This helpful guide to success should be read by every ambitious engineer. Send for this helpful 76 page FREE book now. No obligation and nobody will call on you. It could be the best thing you ever did.

CUT OUT THIS COUPON

POST NOW

CHOOSE A BRAND NEW FUTURE HERE!

Tick or state subject of interest. Post to the address below.

Build-As-You-Learn ☐	Electronic Engineering ☐	CITY & GUILDS Installations and Wiring ☐
PRACTICAL RADIO AND ELECTRONICS (with kit) ☐	Computer Electronics ☐	CITY & GUILDS Electrical Technicians ☐
Electrical Engineering ☐	Computer Programming ☐	CITY & GUILDS Telecommunications ☐
Electrical Installations and Wiring ☐	General Radio and TV Engineering ☐	Radio Amateurs' Exam etc. etc. ☐
Electrical Draughtsmanship ☐	Radio Servicing, Maintenance and Repairs ☐	G.C.E. 58 'O' & 'A' LEVELS
Electrical Mathematics ☐	Transistor Technology ☐	*Coaching for many major examinations*

To ALDERMASTON COLLEGE, Dept. ERE 03 READING RG7 4PF ERE 03

NAME (Block Capitals Please) . . . .

ADDRESS . . . .

. . . . POSTCODE . . . . . .

Other subjects . . . . Age . . . . . .

Accredited by C.A.C.C. *Member of A.B.C.C.*

HOME OF BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

SMALL ADVERTISEMENTS

(Continued from page 507)

VALVES, TRANSISTORS, STYLII. Valves 1930 to 1975, 1,500 types in stock. Many obsolete. List 15p. Transistors list 15p. Diamond stylii 83p each, list 10p. Cox Radio (Sussex) Ltd., The Parade, East Wittering, Sussex. Telephone: West Wittering 2023.

SERVICE SHEETS for Radio & TV etc. 40p each plus s.a.e. Bell's Television Services, 190 Kings Road, Harrogate, Yorkshire, Telephone: 0423-55885.

FERRIC CHLORIDE, VEROBOARD, sirens, relays, electronic components, all cheap. List No. 9 6p. Grimsby Electronics, Lambert Road, Grimsby, Lincs. (Callers Saturdays only).

FOR SALE: Copies of '*Radio Constructor*' January 1968 to June 1974. Offers? Mrs. S. D. Tremlett, 17 Radnor Road, Horfield, Bristol, BS7 8QS.

WANTED: Circuit diagram and/or service sheets of Beme Electronics & Marine Equipment Ltd. direction finders Mini Nav. B604 (transistorized) and BL50A (valve type). Box No. G253.

LARGE PRINTED CIRCUIT BOARDS. New. 500+ components, £1.00 post free. Smaller boards, 25p each; 5 for £1.00. Broken boards £1.00 lots. Callers by appointment. Parker, 42 Mote Road, Maidstone, Kent. Telephone: 50350.

JOIN THE INTERNATIONAL S.W. LEAGUE. Free services to members including Q.S.L. Bureau, Amateur and Broadcast Translation, Technical and Identification Dept. — both Broadcast and Fixed Stations, DX Certificates, contests and activities for the SWL and transmitting members. Monthly magazine, *Monitor*, containing articles of general interest to Broadcast and Amateur SWLs, Transmitter Section and League affairs, etc. League supplies such as badges, headed notepaper and envelopes, QSL cards, etc., are available at reasonable cost. Send for League particulars. Membership including monthly magazines, etc., £2.75 per annum. (U.K. and British Commonwealth), overseas $7.50 or £3.00. Secretary ISWL, 1 Grove Road, Lydney, Glos., GL15 5JE.

FOR SALE: Eddystone E.C.10 short wave receiver in good condition, £30. Avo 8 multimeter, condition as new, £30. Box. No. G254.

FOR SALE: Bound Volumes "*Radio Constructor*", 1956 to 1960 inclusive. £1 each including postage. Box No. G255.

8 VOLUMES Newnes *Radio & Television Servicing* from Volume 1 to 1959/60 edition. £16.00, post paid. Bell's Television Services, 190 Kings Road, Harrogate, Yorkshire. Telephone: 0423-55885.

FOR SALE: 100 unmarked BZY88 type zeners 75p, 1,000–£5.00. 25 unmarked 2W zeners 50p. Selenium solar cells 25p, 10–£1.50. Silicon solar cells 50p, 10–£2.50. 10 mixed LEDs £1.50. 20 mixed crystals £1.00. 4-digit magnetic counters 50p. Transformers, 20-0-20V, 1.5A, £1.00; 12-0-12V, 100mA, 75p. Self-sealing bags $2\frac{1}{4}$" x $2\frac{1}{4}$" 100–50p; 4" x $5\frac{1}{2}$" 100–75p. Super Servisol switch cleaner 80p, 2 tins £1.25. Box No. G256.

TREMENDOUS VALUE. Pack of over 500 components. Resistors, Capacitors, transistors, diodes, etc. Plus circuit boards crammed with components. Send only £1.50 to: Capital Components, BCM 3276, London WC15 6XX.

FOR SALE: General purpose silicon and germ. diodes, 1p. 10 for 8p. OC71 transistors 5p. C60 cassettes 30p, C120 50p. Post 10p. Daniel Collier, Sturtsbury Farm, Middle Street, Bumbles Green, Nazeing, Essex.

(Continued on page 509)

SMALL ADVERTISEMENTS

(Continued from page 508)

WORLD DX CLUB covers all aspects of SWLing on Amateur and Broadcast Bands through its monthly bulletin "*Contact*". Membership costs £1.60 a year. Enquiries to John Rush, 12 Northfield Road, Thatcham, Berks.

FOR SALE: Minuteman 6 calculator £10.00. Sinclair Cambridge £15.50. Sinclair Executive £20.00. Mains auto transformer 8A, £5.00, 16A, £8.00. FM transmitter kit £4.50. Avo 47A £15.00. Low band Pye Rangers £10.00. Philips N2204 cassette recorder £22.00. Portable 8-track with 2 band radio £15.50. Overhauled Avo 8 with calibration certificate £28.50. 110V a.c. 7A stereo amplifier £8.50. C-size rechargeable ni-cad cells £1.50; U7 size £1.25. Box No. G.257.

1972 *World Radio TV Handbook*, only 75p post paid. Bell's Television Services, 190 Kings Road, Harrogate, Yorkshire.

ELECTRONIC PIANO (five octave) with synthesised piano – honky tonk – plucked string bass with harpsichord effects. Complete with carrying case and service information. Perfect working order and condition. £100 o.n.o. Send s.a.e. for full details. Francis Morton, 65 Malmsey House, Vauxhall Street, London SE11 5LU.

RADIO & ELECTRONICS CONSTRUCTOR. Due to loss in warehouse fire, we require copies of the June and July 1973 issues. Cover price paid, remittance by return. Send to Data Publications Ltd., 57 Maida Vale, London W9 1SN.

POSTAL ADVERTISING? This is the Holborn Service. Mailing lists, addressing, enclosing, wrapping, facsimile letters, automatic typing, copy service, campaign planning, design and artwork, printing and stationery. Please ask for price list. – The Holborn Direct Mail Company, Capacity House, 2–6 Rothsay Street, Tower Bridge Road, London. S.E.1. Telephone: 01-407 1495.

FOR SALE: Super Servisol switch cleaner 70p, 5 tins £2.50. 100 feet insulated copper aerial wire 75p. 9-digit calculator £13.50. 4½" watchmaker's pliers £1.00. ¼ H.P. electric motor £5.50. 2" watchmaker's screwdrivers 5p. Second book hi-fi loudspeaker enclosures 60p. Second book transistor equivalents 95p. Sound and loudspeaker manual 50p. BIB34 cassette case £1.50. Hi-Fi test cassettes and cartridges £1.90. Box No. G259.

WANTED: Books, diagrams, on microwave receivers and telemetry modern equipment 1960/1970. For Sale: Back numbers of "*Wireless World*" 1960/1970. Sinclair scientific calculator, assembled, £20. Hughes, 11 Henley Road, Ludlow, Shropshire.

FOR SALE: 10 pre-recorded cartridges and cassettes £9.00. £1.00 for sample. 100 records £7.50. 25p for sample. Box No. G260.

FOR SALE: Daystrom "Cotswold" 3-element Speaker, 25 watts programme capacity. 26 x 23 x 15 in. Current list price of equivalent £68 for £40. Telephone: Dunster 501.

(Continued on page 511)

SMALL ADVERTISEMENTS

(Continued from page 509)

RECITALS OF RECORDED MUSIC. The second Saturday evening of each winter month. Next recital: March 8th, 1975, 8 p.m. at Woodford Green United Free Church, Woodford Green, Essex. Bus routes, 20, 20A, 179 and 275 – alight at "The Castle" stop. Programme consists of works by Handel, Bach and Beethoven.

FREQUENCY LIST TRANSFERS. We have a limited supply of sheets of Dial Frequency Transfers in black. Short Wave frequencies 1.8Mc/s to 32Mc/s and 144Mc/s and 146Mc/s. Includes amateur band marker frequencies at 100kc/s points and other short wave frequencies from 2 to 32Mc/s at every 500kc/s points. Each frequency is repeated. Two sheets for 5p. five sheets for 10p. postage 3p. Data Publications Ltd., 57 Maida Vale. London W9 1SN.

PERSONAL

JANE SCOTT FOR GENUINE FRIENDS. Introductions to opposite sex with sincerity and thoughtfulness. Details free. Stamp to: Jane Scott, 3/Con North St. Quadrant, Brighton, Sussex, BN1 3GJ.

LONDON COMPANY REQUIRES Partner to establish an independent local branch of expanding business in one of a number of selected areas throughout the British Isles. Box No. G258.

HOLIDAY ACCOMMODATION. Burwood Lodge Hotel, Dawlish Road, Teignmouth, South Devon. Especially suitable for parents with young children. Facing south, on the cliffs, direct access by private path to the sea. Mothers' kitchen, automatic washing machines, baby listening service. Licensed lounge. Ample free parking.

ARE YOU ADVENTUROUS? If so, you can make exciting new friends. Write: S.I.M. Computer Dating, (REC/3), 109 Queens Road, Reading, Berks.

YOUNG MAN DISABLED needs work at home. Electronic/wire assembly. Would collect and deliver. Mr. B. Grimes, Llainwen, Glanrhyd, Cardigan, Wales, SA43 3PE.

IF YOU HAVE ENJOYED A HOLIDAY on the Norfolk Broads, why not help to preserve these beautiful waterways. Join the Broads Society and play your part in determining Broadlands future. Further details from: — The Hon. Membership Secretary, The Broads Society, "Icknield", Hilly Plantation, Thorpe St. Andrew, Norwich, NOR 85S.

ESSEX GARDENERS. Buy your Bedding and rock plants, shrubs, etc., also cacti from May's Nurseries, 608 Rayleigh Road, Hutton, Brentwood, Essex. Callers only. Monday to Saturday.

SPONSORS required for exciting scientific project. Norwich Astronomical Society are building a 30" telescope to be housed in a 20' dome of novel design. All labour being given by volunteers. Already supported by Industry and Commerce in Norfolk. Recreational. Educational. You can be involved. Write to: NAS Secretary, The Manse, Back Lane, Wymondham, Norfolk.

SMALL ADVERTISEMENTS

Use this form for your small advertisement

To: **The Advertisement Manager, Data Publications Ltd., 57 Maida Vale, London W9 1SN**

Please insert the following advertisement in the ....issue of RADIO & ELECTRONICS CONSTRUCTOR

15 words at 5p = 75p.

ALL WORDING IN BLOCK LETTERS PLEASE

I enclose remittance of..............being payment at 5p a word. MINIMUM 75p.
Box Number, if required, 10p extra.

NAME..

ADDRESS ....

....

Copy to be received four weeks prior to publication. Published on the 1st of every month.

DATA BOOK SERIES

DB5 TV FAULT FINDING
132 pages. Price **90p**, P. & P. 10p.

DB6 RADIO AMATEUR OPERATOR'S HANDBOOK
88 pages. Price **70p**, P. & P. 8p.

DB16 RADIO CONTROL FOR MODELS
192 pages. Price **75p**, P. & P. 15p.

DB17 UNDERSTANDING TELEVISION
512 pages. Price **£2.10**, P. & P. 30p.

DB18 AUDIO AMPLIFIERS
128 pages. Price **53p**, P. & P. 10p.

DB19 SIMPLE SHORT WAVE RECEIVERS
140 pages. Price **80p**, P. & P. 10p.

I enclose Postal Order/Cheque for..............................in payment for..............................

NAME..

ADDRESS ....

.... (BLOCK LETTERS PLEASE)

Postal Orders should be crossed and made payable to Data Publications Ltd.
Overseas customers please pay by International Money Order.
All publications are obtainable through your local bookseller.
Data Publications Ltd., 57 Maida Vale, London W9 1SN

WEIGHT CONVERSION TABLE II

The Table lists avoirdupois equivalents in oz. and lb. for 'round number' metric weights from 1 gram (gm.) to 100 kilograms (kg.). The avoirdupois values are given to three significant figures.

gm.	oz.	gm.	oz.	kg.	lb.	kg.	lb.
1	0.0353	30	1.06	0.5	1.10	15	33.1
2	0.0705	40	1.41	0.6	1.32	20	44.1
3	0.106	50	1.76	0.7	1.54	25	55.1
4	0.141	60	2.12	0.8	1.76	30	66.2
5	0.176	70	2.47	0.9	1.98	35	77.2
6	0.212	80	2.82	1	2.21	40	88.2
7	0.247	90	3.17	2	4.41	45	99.2
8	0.282	100	3.53	3	6.62	50	110
9	0.317	150	5.29	4	8.82	55	121
10	0.353	200	7.05	5	11.0	60	132
12	0.423	250	8.82	6	13.2	65	143
14	0.494	300	10.6	7	15.4	70	154
16	0.564	350	12.3	8	17.6	80	176
18	0.635	400	14.1	9	19.8	90	198
20	0.705	450	15.9	10	22.1	100	221