WALLACE

RADIO & ELECTRONICS CONSTRUCTOR

AUGUST/SEPTEMBER 1981 **60p**

LAST ISSUE

✱ FULLY PROPORTIONAL 5 CHANNEL R/C SYSTEM
— SIMPLE 2 IC CONSTRUCTION

✱ STYLISH HI-FI STEREO-AMP 30w + 30w
COMPLETE PARTS SUPPORT

AN EXTRA 16 PAGES OF CONSTRUCTIONAL ARTICLES AND FEATURES

The beginning of the WORLD is nigh...

IT'S ALL AT ARROW

"Didn't know you stocked those", they said. "Oh, yes!" we said, "plus Yaesu Musen, Standard, Shure, Microwave Modules, Hi-Mound, CDE, Stolle, Vibroplex, Telecomm, Cushcraft, Swan ...". "OK, that's enough", they said. "I'll send for your list—how much?" "FREE, of course", we said. "But a stamped addressed envelope would be nice."

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TS280FM
£199.00

World's most compact 80 channel 50W 2 metre mobile rig. With auto select of repeater/simplex. Digital readout of channel.
AND NOW WITH VOLUME CONTROL ON MIC AND AUTOMATIC TONEBURST R0-R7 PLUS INPUT MONITOR CAPABILITY.
(Optional extra).
TS280LP NEW LOW PRICE £159.00
16Watt version 80Ch
NOW WITH AUTO TONEBURST R0-R7 & INPUT LISTEN.
(Optional extra).

(YM-35 Mike not included)

FT107 Yaesu Basic set £690.00
FT307DMS Sommerkamp with Int. PSU & DMS unit. Mic. .... POA

AND SOME OF THE REST:

FT7B— Still one of the best HF Mobiles—with mike and mobile mount £399.00

C8800— Standard 2m FM mobile with digital display, scan with Microphone control: come and see it £252.00

C7800— Standard's beautiful 70cm FM Box. Really nice unit, scans, mic. control etc. £275.00

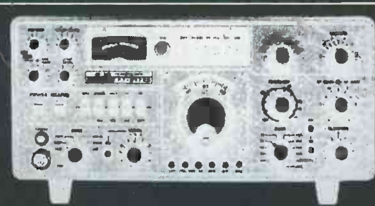
SX200— Revco's super scanner with 26-514MHz (less a couple of gaps!!) Clock, Digital display, 16-channel memory and much more ... £239.00

DX8A— Hustler discone antenna for the SX200 or sim. £17.95

IC2E ICOM's famous "pocket" portable supplied with free leather case £159.00

DP1— Trap Dipoles for 80/40/20/10 or 80/40/15/10 from stock £25.30

G4MH— "Jim's" famous beam from ARROW, a two Element for 20/15/10 for £79.95 cant be bad!!

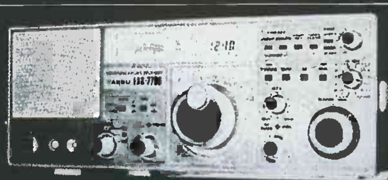


ARROW now stock 4 versions of this excellent transceiver:

FT101Z with Analogue dial £445.00
FT101ZD Digital with Fan & Mic. £515.00
FT101ZD Digital—WARC version £569.00
FT277ZD Sommerkamp Digital + WARC and all options £649.00

Two versions of the "Wayfarer" from stock.

FT707 Yaesu £529.00
FT767DX Sommerkamp with CW Filter & Mic. £559.00



FREE THIS MONTH WITH RECEIVERS (NOT FRG7700) HEADPHONES by YAESU

R1000 Kenwood £289.00
FRG-7 Yaesu £189.00
FRG7700 Yaesu £309.00
FRG7700 + Mem. £389.00
FRG7000 .... £259.00

FT207R 12·5kHz model with leather case, nicad, and Helical £195.00
NC3A Slot in charger £39.50
YM24 Speaker Mic. £16.85

MASPRO 7/8 wavelength 2m antennas now in £17.85

NEW: 2 metre ground planes beautifully made 6dB gain £34.95
70cm version 6dB gain £34.95

PLEASE SEND FOR OUR 1981 LIST, MAYBE THERE WILL BE SOMETHING YOU CAN'T GET ELSEWHERE—REMEMBER ALSO OUR LARGE COMPONENT STOCK IS STILL AVAILABLE MAIL ORDER—PLEASE ASK IF YOU'D LIKE A COPY OF OUR COMPONENTS LIST.
REMEMBER ARROW *ONLY* STOCK FOR THE AMATEUR & ELECTRONIC ENTHUSIAST WE DON'T OFFER YOU A SHOWROOM OF DOMESTIC HI-FI & ONE EYED MONSTERS!!

ALL-IN POLICY: ALL ADVERTISED PRICES INCLUDE TAX AND FREE DELIVERY (SECURICOR FOR RIGS)

ARROW ELECTRONICS LTD

7 Coptfold Road, Brentwood, Essex CM14 4BN
Tel: 0277 226470 or 219435 Ansafone on 219435 Telex: 995801
Open 5 days a week. Closed Thurs.
ACCESS ● VISA ● INSTANT HP ● TWO YEARS' WARRANTY
FREE QSLs ● BEST TRADE-IN PRICES
NEW 1981 CATALOGUE FREE ON REQUEST (SAE PLEASE)

Access

BARCLAYCARD VISA

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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 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.

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The Last Issue
RIP +

Where is "Suggested Circuit"?
G.A. French obviously opted out!

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OUR NEXT ISSUE WILL BE PUBLISHED 3rd SEPTEMBER

C.B. P.A. MICROPHONES,

Hand held with thumb switch & Curly Lead, Type 1 600Ω dynamic at £4.25. Type 2 600Ω, noise cancelling type at £7.25 Type 3 Power type, with volume control 1KΩ Imp, £7.95

SEMICONDUCTORS

LM340 80p. BY103 10p. 2N5062 100V 800mA SCR 18p MC4741 (Quad 741) 14 pin 50p. CA3130 95p. MC4741CP 50p. 741 22p. 741S 35p. 723 35p. NE555 24p. 2N3773 £1.70. NE556 50p. ZN414 75p. BD238 28p. BD438 28p. CB4069 15p. 4" Red Led Displays, c.c. or c.a. 95p. TIL209 Red Leds 10 for 75p. Man3A 3mm Led Displays 40p. 2N3055 39p.

PROJECT BOXES

Sturdy ABS black plastic boxes with brass inserts and lid. 75 x 56 x 35mm 65p. 95 x 71 x 35mm 75p. 115 x 95 x 37mm 85p.

MOTOROLA PIEZO CERAMIC TWEETERS

No crossover required

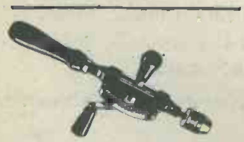
2.5" Direct Radiating Tweeter, maximum rating 25 volts R.M.S. 100 watts across 8 ohms. Freq. range 3.8kHz-28kHz, £3.65

TOOL SALE

Small side cutters 5" insulated handles £1. Radiopliers, snipe nosed insulated handles £1. Heavy duty pliers insulated handles £1.10. Draper side cutters spring loaded £1.

HANDY BENCH VICE

1" Jaw opening, £2.95.



Hand drill, double pinion with machine cut gears, ¼", only £2.75p plus 87p p&p.

MORSE KEYS

Beginners practice key £1.05. All metal full adjustable type. £2.60

F.M. MICROPHONE,

Electret condenser type, tuneable 85-95Mhz. Arrival distance 50 mtrs. (Approx outdoors) Size 163 x 35 mm £10.25. (Not licenseable in U.K.).

JVC NIVICO STEREO CASSETTE MECHANISM. Music centre type. Rev. counter, remote operation £13.50 and £1.00 p&p.

JUMPER TEST LEAD SETS

10 pairs of leads with various coloured croc clips each end (20 clips) 90p per set.

TRANSFORMERS

All 240VAC Primary (postage per transformer is shown after price). MINIATURE RANGE: 6-0-6V 100mA, Volts 100mA, 12-0-12V 50mA both 79p each (15p). 0-6, 0-6V, 280mA £1.20 (20p). 6V 500mA £1.20 (15p). 12V 2 amp £2.75 (45p). 30-0-30V 1 amp £2.85 (54p). 20-0-20V 2 amp £3.65 (54p). 0-12-15-20-24-30V 2 amp £4.75 (54p). 24 volt 2 Amp £2.45 (54p).

T.V. AERIAL AMPLIFIERS

Wide Band, 240 VAC operated, with two outlets, £7.75

MICROPHONES

Min. tie pin. Omni, uses deaf aid battery (supplied), £4.95. ECM105 low cost condenser, Omni, 600 ohms, on/off switch, standard jack plug, £2.95. EM507 Condenser, uni, 600 ohms, 30-18kHz., highly polished metal body £7.92. EM103 Microphones, Omni, Electret, 600Ω, 50-16000Hz, 170 long, £6.50p. EM506 dual impedance condenser microphone 600ohms or 50K, heavy chromed copper body, £12.95. CASSETTE replacement microphone with 2.5/3.5 plugs £1.35. GRUNDIG electric inserts with FET pre amp, 3-6VDC operation £1.00.

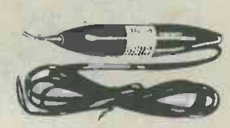
LIGHT DIMMER

240VAC 800 watts max. wall mounting, has built in photo cell for automatic swich on when dark £4.50

C.B. 40 CHANNEL RECEIVER

For car use, operates on 12v DC., £7.95

SPECIAL OFFER TAPE HEAD DEMAGNETIZER



240VAC with curved probe suitable for reel to reel or cassette machines, £1.95.

STEREO FM/GRAM TUNER AMPLIFIER CHASSIS, VHF and AM. Bass, treble and volume controls, Gram. 8-track inputs, headphone output jack, 3 watts per channel with power supply. £14.95 and £1.20 p&p

MULTIMETER BARGAINS

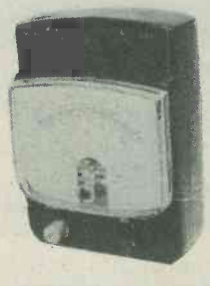
Pocket Multimeter, 1,000 opv sensitivity. Ranges 1KV AC/DC Volts, 150ma DC current, resistance 0-2.5K, 0-100K, £4.50

20,000 opv., 1,000 volts AC/DC, DC current to 500ma, 5 ranges, resistance 4 ranges to 6 meg. Mirror scale, carrying handle, £975.

40kHz Transducers. Rec/Sender £3.50 pair.

TELEPHONE PICK UP COIL

Sucker type with lead and 3.5mm plug 62p.



500v electronic megger, push button operation. Ranges:– L0 ohm Range 0 – 100Ω (MW scale 5Ω)0 – 100MΩ Mid scale 5MHΩ) £46.75p

Stabilized power supplies, 240V A.C. input output 13.8 volts at 3/5 amps D.C. £14.75p

TERMS:

Cash with order (Official Orders welcomed from colleges etc). 30p postage please unless otherwise shown. VAT Inclusive.

MULTI-TESTER

KRT5001 50k/v range doubler multimeter, 0-1kv (125mv LO range) 0 – 1kv AC. 0 – 10amp DC. 0 – 20MΩ res. (LO ohm 0 – 2k range) 170 x 124 x 50mm £15.50.

YN360TR MULTIMETER

YN360 M/Meter. 20,000 ohms per volt. IKV AC/DC volts, 250ma dc current, 4 resistance ranges to 20meg, also has built in transistor tester with leakage and gain ranges. £12.50

CRIMPING TOOL

Combination type for crimping red blue and yellow terminations also incorporates a wire stripper (6 gauges) and wire cutter, with insulated handles only £2.30.

POWER SUPPLIES

SWITCHED TYPE PLUGS into 13 amp socket, 3-6-9 volts DC out at 300mA, £2.95.

12 volts DC out at 250mA., £1.00 each.

Panel Vu meter, rectangular 55 x 50m/m 150μA FSD. £1.00p.

AMPHENOL CONNECTORS

(PL259) PLUGS 47p. Chassis sockets 42p. Elbows PL259/SO239 90p. Double in line male connector (2XPL259) 65p. Plug reducers 13p. PL259 Dummy load, 52 ohms 1 watt with indicator bulb 95p.

BUZZERS

MINIATURE SOLID STATE BUZZERS, low consumption, available in either 6 or 12 volts D.C. 75p each. LOUD 12VDC BUZZER, Heavy duty metal body, 50mm diam. x 30mm high 63p. Carters 12 volt Minimite Alarm sirens £7.65p. 12VDC siren, all metal rotary type, high pitched wail, £6.25.

New catalogue at printers, apologies for delay, all S.A.E's received are being held until catalogue is ready.

TOOLS

Set of ten screwdrivers, in wallet, good mixture £1.00 per set.

Automatic wire stripper, cuts and strips 1.1, 1.4, 1.6, 1.8, 2.4 and 3.5 m/m, £5.75p.

Antex Model C 15 watt soldering irons, 240VAC £4.45

Antex Model CX 17 watt soldering irons, 240VAC £4.45

Antex Model X25 25 watt soldering irons, 240VAC £4.45

ANTEX ST3 iron stands, suits all above models £1.65

Antex heat shunts 12p each.

Servisol Solder Mop 50p each.

Neon Tester Screwdrivers 8" long 59p each.

Miyarna IC test clips 16 pin £1.95

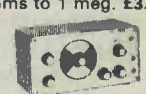
SWITCHES

Sub. miniature toggles: SPST (8 x 5 x 7mm) 42p. DPDT (8 x 7 x 7mm) 55p. DPDT centre off 12 x 11 x 9mm 77p. PUSH SWITCHES, 16mm x 6mm, red top, push to make 14p each, push to break version (black top) 16p each.

TEI Mobile SWR metre, with field strength, PL259 connection, £8.35.

RES. SUB BOX

Resistance Substitution Box. Swivelling disc provides close tolerance resistors of 36 values from 5 ohms to 1 meg. £3.95.



Signal Generator. Ranges 250Hz-100MHz in 6 Bands, 100MHz-300MHz (harmonics) internal modulator at 100Hz. R.F., output Max. 0.1vRMS. All transistorised unit with calibrating device. 220-240VAC operation, £48.95.

TAPE HEADS

Mono cassette £1.75. Stereo cassette £3.90. Standard 8 track stereo £1.95 BSR MN1330 ½ track 50p. BSR SRP90 ¼ track £1.95. TD10 tape head assembly — 2 heads both ¼ track R/P with built in erase, mounted on bracket £1.20

PROGRESSIVE RADIO

31 CHEAPSIDE, LIVERPOOL 2.

ALL ORDERS DESPATCHED BY RETURN POST

FREPAR

plug-in cases

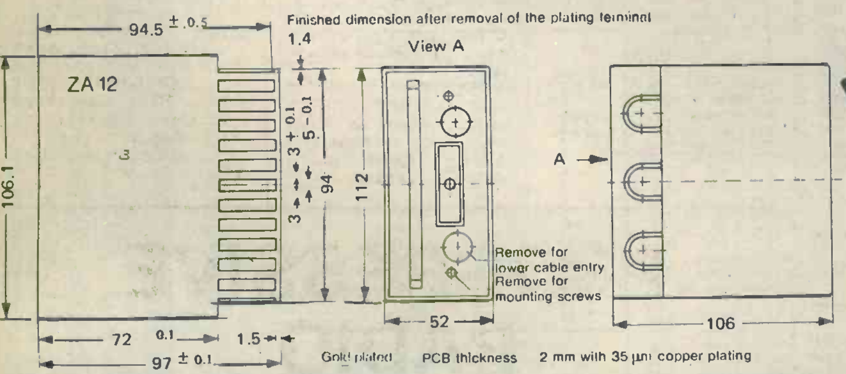
12 & 16 TERMINALS

Mounting base Connection screws M 3,5 with self-lifting clamping plates, maximum cable cross section 2 x 1,5 mm^2 (also suitable for use with cable shoes).
Gold plated contact springs guarantee good contact even at low currents or voltages (contact resistance approximately 10 m Ω).
Separators between the terminals guarantee leakage path and voltage spacings in accordance with VDE. VDE 0110/11,72, § 5, insulation group C at 250V AC/300V DC.
Cable entries: 5 (in ZA 12) or 6 (in ZA 16) PVC cable entry sleeves 2 prestamped cable entries in the base.

Cover: Closed, without holes, with a recess 0,6 mm deep for an adhesive label, two mounting screws for attaching the plug-in upper part to the base. Intermediate plate for covering the equipment space and for retaining the printed circuit board. The cases are normally supplied with covers made of polystyrol

ACCESSORIES:

Printed circuit boards: Made of laminated paper HP 2063, 2,0 mm thick, single clad with a 35 μm copper coating with gold plate contact strips.
Front labels: Made of light grey PVC without printing
Size for ZA 12 = 83,5 x 44,5 mm
Size for ZA 16 = 119,5 x 67,5 mm
Earthing terminal block: 4-pole
Coding Bars: For polarising of printed circuit boards.



Dimensions in millimetres

FREPAR ELECTRONICS LTD
119 Newland Street Witham Essex CM8 1BE England   Tel Witham (0376) 516617

TRANSISTORS

▬ Germanium otherwise silicon
• PNP, otherwise NPN

▬AC122 30v .2w 12p
▬AC126 30v .2w 16p
▬AC128 36v 1wt 5p
▬AC153 32v 1wt 11p
▬AC176 32v .7w 11p
▬AC179 20v 1.1w 40p
▬AC188 25v 1w 10p
▬ACY20 40v .3w 30p
▬ACY21 40v .3w 20p
▬ACY28 40v .2w 22p
▬AD161 20v 6wt 40p
▬AD162 20v 6wt 40p
▬AD164 25v 6w 40p
▬AD165 25v 6w 40p
▬AF119 30v .2w 35p
▬AF124 32v .1w 27p
▬AF126 32v .1w 27p
▬AF127 32v .1w 27p
▬AF139 22v .1w 23p
▬AF178 25v .1w 35p
▬AF180 25v .16w 35p
▬AF181 30v .16w 33p
▬AF239 20v .1w 35p
▬ALZ10 50v .5w 37p
▬ASY60 35p
▬ASY63 26v .1w 4p
▬ASY73 30v .15w 35p
▬ASZ21 20v .12w 4p
▬AU107 200v 30w £1.55
▬AU110 160v 30W £1.43
BC107A/B 7p
BC108/A/B/C 7p
BC109/B 30v .3w 7p
BC109C 30v .3w 7½p
BC125 50v .3w 4p
BC125B 60v .3w 4p
BC129A/B 50v .2w 7p
BC130A/C 25v .2w 7p
BC131C 25v .2w 7p
•BC139 40v .7w 11p
BC140 40v .7w 15p
BC141 60v .7w 11p
•BC143 60v .8w 11p
BC147/A/B/C 5½p
BC148/A/B/C 5½p
BC149/A/B/C/S 5½p
BC154 40v .2w 7p
•BC157/A 50v .4w 5½p
•BC158/A/B 5½p
•BC159/B/C 5½p
•BC160 40v 3.2w 12p
BC168B 20v .3w 7½p
BC171B 45v .3w 4p
BC172 25v .3w 6½p
BC172C 25v .3w 7½p
BC173 25v .3w 4p
•BC177A 45v .4w 10½p
•BC178A/B/C 10½p
•BC179B 20v .3w 14p
BC182/AL 50v .3w 5p
BC182L 50v .3w 5p
BC183A/AL/L/LC 3p
BC184 45v .3w 5p
•BC186 40v .3w 21p
•BC187 30v .3w 8p
BC190B 64v .3w 7½p
•BC196A 30v 50mw 4p
BC197A 50v 50mw 4p
BC198B 30v 50mw
100 for £3.65p
BC199B 30v 50mw
100 for £3.65p
•BC204 50v .3w 11p
•BC212B 50v .3w 5p
•BC213L 45v .3w 5p
•BC213LA 45v .3w 3p
•BC213LB 45v .3w 4p
•BC214B 45v .3w 5p
•BC214L 45v .3w 3½p
BC237A 45v .3w 7½p
BC237B 50v .3w 7½p
BC238 20v .3w 5p
BC238B/C 7½p
BC239C 20v .3w 7½p
•BC251 45v .3w 3p
•BC257B 45v .3w 7½p
•BC258B/C 7½p
•BC259C 20v .3w 7½p
BC301 90v .9w 15p
BC302 80v .9w 15p
•BC304 80v .9w 15p
•BC307 45v .3w 7p
•BC308B/C 25v .3w 7½p
•BC309B 20v .3w 7½p
•BC327 45v .7w 5p
•BC328 25v .7w 6p
BC337 45v .7w 6p
BC338 25v .7w 5p
BC382L 50v .3w 7½p
BC384B 45v .3w 7½p
BC546 80v .6w 5p
BC547/A/B 45v 5p
BC548/A/B/C 5p
BC549C 30v .5w 5p
•BC556 80v .5w 5p
•BCC557/B 5p
•BC558A 30v .5w 5p
•BC559 30v .5w 5p
•BC612L 75v .3w 4p

BCX32 80v .8w 80p
BCX33 60v .75w 10p
BCX 34 40v .8w 10p
•BCX36 60v 1.5w 10p
•BCY11 60v .5w 28p
•BCY31 64v .6w 59p
BCY56 45v .3w 10p
BCY59/8 45v 1w 10½p
•BCY70 50v .35w 9p
•BCY71 45v .35w 9p
•BCY72 25v .3w 9p
•BCY79B 45v .3w 15p
•BCZ11 25v .25w 32p
BD113 60v 15w 57p
BD115 250v 6w 35p
BD116 80v 10w 35p
BD131 45v 15w 15p
•BD132 45v 15w 15p
BD133 90v 15w 28p
BD135 45v 13w 22p
•BD136 45v 13w 14p
BD137 60v 8w 28p
•BD138 60v 8w 28p
BD137/8 mtch pr 60p
BD139 80v 12w 30p
•BD140 80v 8w 26p
BD142 50v 117w 35p
•BD156 70v 25w 50p
BD182 70v 117w 44p
BD201 45v 60w 86p
•BD202 45v 60w 64p
BD203 60v 60w 86p
•BD204 60v 60w 86p
BD232 500v 15w 34p
BD233 45v 25v 20p
BD235 60v 25w 35p
•BD238 80v 25w 25p
BD239C 115v 30w 29p
•BD240 55v 30w 30p
•BD240B 90v 30w 36p
•BD240C 115v 30w 39p
BD241 45v 40w 22p
•BD242B 90v 40w 30p
BD243 55v 65w 32p
•BD244B 90v 65w 43p
•BD244C 115v 65w 45p
•BD246 55v 80w 32p
BD253 350v 50w 44p
•BD277 45v 70w 37p
BD375 50v 25w 35p
BD437 45v 36w 36p
•BD438 45v 36w 28p
BD597 60v 55w 36p
BD677 60v 40w 50p
•BD678 Pwr. Darl. 60v 40w 50p
BDX33A 88v 20w Darlington 44p
BDX42 60v 3w 36p
BDX77 80v 60w 50p
BDY20 60v 117w 86p
BF115 50v .2w 18p
BF137 160v .7w 11p
BF167 30v .15w 18p
BF173 25v .2w 18p
BF178 185v .6w 23p
BF179 250v .6w 23p
BF180 30v .2w 12p
BF181 30v .2w 8p
BF182 25v .12w 18p
BF183 25v .12w 18p
BF184 20v .15w 18p
BF185 20v .15w 18p
BF194A/B 5½p
BF195/C/D 5½p
BF196 40v .25w 5½p
BF197 40v .25w 5½p
BF198 30v .3w 5½p
BF200 30v .2w 13p
BF224 45v .36w 4p
BF244C FET 30v 7½p
BF245 FET 6p
BF254 30v .3w 12p
BF256FET 8p
BF256LB/LC/FET 6p
BF257 160v 5w 20p
BF259 see 2N5058
BF262 30v .12w 29p
BF263 30v .12w 29p
BF274 25v .12w 8p
•BF324 30v .3w 3½p
BF336 185v 3w 16p
BF355 300v 3w 15p
BF394B 3p
•BF451 40v .3w 6p
BF494 20v .3w 10p
BF494B 20v .3w 10½p
BF495 20v .3w 5p
BF595C 30v .25w 9½p
BF615 27p
BF617 27p
•BFQ35 15p
•BFQ37 16p
BFR34A 12v .2w £1
•BFR38 40v .2w 68p
BFR86 120v .8w 19p
BFS21 FET pair £3
BFS28 Dual M/Fet 50p
BFT30 70v .36w 15p
BFT31 60v .36w 15p
BFT39 90v .8w 15p
BFT41 60v .8w 15p
•BFT60 80v .8w 6p
•BFT61 60v .8w 15p
•BFT70 70v .36w 15p
•BFT71 40v .36w 15p
BFW10 FET 30v 46p
BFW11 FET 30v 46p
BFW30 20v .25w 15p

•BFW31 50v .5w 15p
BFW57 80v .5w 18p
BFW58 80v .5w 18p
•BFX12 20v .3w 23p
•BFX29 60v .6w 11p
•BFX30 60v .6w 16p
•BFX37 60v .4w 16p
BFX84 100v .8w 20p
BFX85 100v .8w 14p
•BFX88 40v .6w 20p
BFX89 30v .2w 20p
BFY39 45v .3w 20p
BFY50 35v 1wt 15p
BFY51 60v 1w 15p
BFY52 40v 1w 15p
BFY75 30v .35w 15p
BFY90 30v .2w 59p
BR101 Prog. 20p
BRY39 Uni- 29p
BRY56 Junct 29p
BSV60 45v .8w 30p
BSV64 100v 1w 36p
BSV79 40v .4w 50p
BSV80 40v FET 50p
BSV81 Dep. Mos Fet 75p
BSX19 40v .4w 15p
BSX20 40v .4w 7p
BSX21 120v .3w 10p
BSX78 40v .3w 8p
BSY24 40v .6w 21p
•BSY40 25v .3w 30p
BSY95A 20v .3w 10p
BU105 1k5v 10w 64p
BU105/04 78p
BU204 1k3v 10w 75p
•C1544 4p
C1601 4p
D40C4 40v 8wt Darlington 22p
D40D1 45v 7wt 22p
D40D2 60v 7wt 15p
D40D4 60v 7wt 22p
•D41D2 45v 7wt 22p
•D43C7 70v 13wt 30p
•D43C8 50v 13wt 30p
•D45C2 40v .30w
220HFE 50MHz 50p
DS70 Darl. 10wt 22p
▬GET102 30v .2w 46p
▬GET111 60v .2w 45p
▬GET120 30v .44w 30p
•M103G MOSFET 30p
▬MA393 32v .5w 25p
MD7000 30v .7w dual £2.25
▬ME2 15v .1w 13p
•ME0412 60v .2w 14p
•ME0461 60v .3w 7½p
ME6101 70v .36w 7½p
ME6102 60v .4w 7½p
ME8003 80v .4w 20p
MJ481 60v 90w 25p
•MJE370 30v 25w 32p
•MJE371 40v 40w 40p
•MJE2371 60v 40w 80p
MJE2901T (Higain 2955) 60v 90w 50p
Mn 15 Russian 25p
Mn41 Russian 25p
MP8113 60v 3w 25p
MPF131 Dual MOSFET 21p
•MPS 8513 60v 3w 31p
MPSA13 30v .31w Darl. 21p
MPU131 Prog. Uni J. 15p
MRF502 Improved BFY90 90p
MST 1027 80v 100w 40p
MST1072 300V 100W 50p
MST2007 4p
•MST2013 4p
•MST2015 TO18 4p
•MST2018 TO18 4p
n 16A Russian 25p
n 12A Russian 25p
▬NKT49 23p
▬NKTA52 10v .1w 20p
▬NKTB54 10v .1w 30p
▬NKT152 6v .1w 38p
▬NKT153 32v 1.6w 24p
▬NKT154 6v .1w 26p
▬NKT251 30v .2w 18p
▬NKTME2 15v .1w 13p
NSD102 45v 10wt 23p
NSD104 80v 10w 26p
NSD129 250v 10wt 23p
NSD131 250v 10wt 30p
NSD132 250v 10w 30p
NSD134 300v 10wt 30p
NSD151 30v 10wt Darlington 22p

NSD457 160v 10wt 23p
NSD U45 40v 10wt Darlington 30p
•NSD U51 30v 10wt 22p
•NSD U55 60v 10w 25p
▬OC23 55v 16w 53p
▬OC28 80v 30w 78p
▬OC41 16v .1w 4p
▬OC42 16v .1w 21p
▬OC43 15v .1w 55p
▬OC44 15v .1w 4p
▬OC45 15v .1w 13p
▬OC71 30v .2w 4p
▬OC72 32v .2w 4p
▬OC76 32v .13w 15p
▬OC77 60v .13w 46p
▬OC81 32v .6w 5p
▬OC84 32v .6w 30p
•OC200 30v .25w 41p
•OC201 25v .25w 66p
•OC202 15v .25w 66p
▬OC603 22v .1w 50p
•OC701 80v .35w 50p
ON222 23p
P77 Plastic 10wt 15p
P346A 30v .6w 24p
P7029 30p
▬PXB103 30v .15w 25p
R1039 (2008B) 54p
R2008B 660v 85w £1.18
R2010B £1.18
•R2306 100v 40w 26p
R2540 £1.70
RCA467 Pwr. Darl. 22p
RCP701A/B/D 10wt 30p
RCP703 80v 10w 30p
•S3017 25p
▬SB240 26p
▬SFT357 20v .12w 26p
•SL102 40p
TE886 £1
TIP29 40v 30w 22p
•TIP30 40v 30w 22p
•TIP30C 100v 30w 26p
TIP31C 100v 40w 26p
•TIP32A 60v 40w 22p
•TIP32C 100v 40w 26p
TIP41 40v 65w 15p
•TIP42C 100v 65w 33p
TIP48 300v 40w 33p
TIP 110 60v 50w Darl. 30p
TIP112 100v 50w 45p
•TIP115 60v 50wt Darlington 30p
•TIP2955 100v 90w 45p
TIP3055 100v 90w 34p
TIS44 25v .25w 9½p
TIS60GY 40v .3w 3p
•TIS61 40v .3w 3p
TIS73L FET 7p
TIS90 40v .65w 4p
•TIS91 40v .65w 6p
TIS92GY 40v .65w 14p
TIS98 30v .25w 3p
•TK24 30v .2w 20p
U14710 20p
V435 30v .6w 20p
▬XA101 20v .12w 5p
ZT403P 30v .3w 30p
ZT1486 110v 25w £1.10
ZTX341 100v .3w 9p
▬2G103 15v .3w 33p
▬2G302 20v .2w 12p
▬2G309 20v .3w 30p
▬2G339A 30v .15w 20p
▬2G371 20v .2w 18p
▬2N388 25v .15w 7½p
▬2N456A 40v 90w 71p
▬2N525 45v .3w 12p
▬2N527 45v .2w 12p
▬2N597 45v .25w 16p
▬2N598 35v .25w 16p
▬2N601 35v .75w £1.50
▬2N644 30v .15w 22p
2N698 120v .8w 12p
2N699 120v .6w 12p
2N706/A 25v .3w 10½p
2N708 40v .4w 9p
2N718 60v .4w 10p
2N720A 120v .5w 12p
2N720 120v .5w 12p
2N736 80v .5w 7½p
2N914 40v .4w 15p
2N918 15v .2w 12p
2N929 45v .3w 16p
2N930 45v .3w 7p
▬2N984 15v .1w 28p
▬2N987 40v .1w 45p
▬2N1091 25v .2w 16p
▬2N1132 50v .6w 14p
•2N1302 25v .2w 16p
▬2N1303 30v .2w 16p
▬2N1395 40v .15w 25p

2N1484 100v .25w 36p
2N1485 60v 25w 36p
2N1487 60v 70w 90p
2N1490 100v 70w £3
▬2N1500 15v .1w 30p
2N1507 60v .6w 18p
2N1711 75v .8w 13p
2N1716 90v 15w 15p
2N1724A 118wt RF 180v £2.10
▬2N1748 30v .2w 28p
2N2192A 60v .8w 15p
2N2221A 40v .5w 9p
2N2222A 40v .5w 8p
2N2369 40v .4w 10p
▬2N2401 7½p
•2N2412 25v .3w 27p
2N2483 60v .36w 28p
2N2484 60v .4w 10p
2N2586 60v .3w 15p
▬2N2614 32v .9w 4p
2N2887 £2
•2N2894 12v .36w 11p
•2N2904 60v .6w 9p
•2N2906 60v .4w 9p
•2N2907/A 60v .4w 9p
2N2926Y 25v .2w 4p
2N2926 Orange 25v .2w 4p
2N3020 140v .8w 25p
2N3054 90v 30w 35p
2N3055 100v 115w 38p
2N3055RCA 100v 115wt 68p
•2N3133 50v .6w 24p
2N3235 55v 117w 38p
▬2N3283 25v .1w 25p
2N3375 65v 12wrf £3
2N3418 85v 1wt 15p
2N3442 160v 117w 75p
2N3583 250v 35w 18p
•2N3645 60v .3w 3p
2N3663 30v .2w 6p
•2N3702 40v .4w 4p
•2N3703 50v .3w 3p
2N3704 50v .4w 4p
2N3707 30v .3w 4p
2N3711 30v .3w 8p
2N3714 80v 150w 54p
•2N3792 80v 150w 53p
2N3794 75v .5w 14p
•2N3799 90v .36w 18p
2N3823 FET 30v 25p
2N3878 120v 35w 45p
2N3904 60v .3w 7½p
•2N3905 40v .3w 7½p
•2N3906 40v .3w 8p
2N4000 100v 15w 15p
•2N4026 60v .5w 15p
•2N4031 80v 1w 15p
2N4039 MOSFET 54p
•2N4285 17p
•2N4403 40v .3w 7½p
2N4891 FET 30p
•2N4898 40v 25w 37p
•2N4900 80v 25w 37p
•2N4918 40v 30w 15p
2N5037 70v 83w 52p
2N5058 300v .5w 11p
•2N5147 100v 7w 15p
2N5163 Fet 25v 21p

2N5191 60v 40w 40p
2N5293 80v 36w 30p
2N5294 80v 36w 30p
2N5295 60v 36w 30p
2N5296 60v 36w 30p
2N5297 80v 36w 36p
2N5298 80v 36w 36p
2N5449 30v .3w 3p
2N5484 30v FET 37p
2N5492 75v 50w 36p
2N5915 (16068) 450Mhz 6WT R.F. 12v £2.50
2N6028 PUJT 6p
2N6103 45v 75w 45p
•2N6106 80v 40w 44p
•2N6109 60v 40w 44p
•2N6111 40v 40w 36p
•2N6124 45v 40w 24p
2N6178 100v 25w 30p
•2N6180 100v 25wt 30p
•2N6181 75v 25w 30p
2N6288 30v 40w 36p
2N6290 60v 40w 30p
2N6292 80v 40w 30p
2N6385 80v 100wt Darlington 55p
2N6387 60v 40w 36p
2N6486 40v 75w 36p
2N6488 90v 75w 36p
2S701 30v .5w 18p
▬2SA12 16v .1w 42p
▬2SA50 18v .1w 36p
▬2SA80 20v .1w 36p
▬2SA83 25v .1w 36p
▬2SA141 15v .1w 36p
▬2SA142 15v .1w 36p
▬2SA234 20v .1w 50p
▬2SA236 18v .1w 50p
▬2SA354 25v .1w 38p
▬2SA360 20v .1w 34p
▬2SA367 20v .1w 56p
▬2SA518 18v .1w 38p
•2SA634 50v 10w 80p
▬2SB75 25v .15w 25p
▬2SB77 25v .15w 25p
▬2SB135 30v .1w 25p
▬2SB136 25v .15w 25p
▬2SB156 16v .15w 60p
▬2SB175 30v .15w 20p
▬2SB176 32v .15w 20p
▬2SB457 20v .15w 25p
2SC1061 50v 25w 50p
2SD234 60v 25w 50p
2SD315D 200v 40w 80p
•353-3 40v 5wt 22p
362-4 300v 6wt A/F Video Amp (BF459) 30p
868-01 Plast. 10wt 15p
1034 Plast. 10wt 15p
•16120 (MPSU55/BD238) 19p
40235 45v .2w 50p
40250 50v 30w 36p
40250VI (2N3054 + Ht sink) 40p
40316 40v .50w 36p
40372 (2N3054 + Ht. sink) 40p
40349v2 160v 1w 30p
•40394 60v 1w 30p
40409 90v 3w 32p
40633 40w 36p
•40874 80v 40w 38p
40911 (2N6261 + Ht. sink) 40p

Vidor VT3 9 volt battery 37p
Long life calculator version 39½p

ONE TON OF POWER
Sack fulls of ex-equipment metal power devices. Mainly TO3 transistor, some TO66, some stud rectifiers and S.C.R.'s. From a bankrupt distributor who cleaned them up for industry. All marked. No duds found in a random test. Lucky dip . . 10 for £1.75

HUGHES
MICRO ELECTRONICS 400MW ZENER DIODES 200 IN CLEAR PLASTIC HINGED LID
COMPONENT BOX £2.40
3V, 3.6V, 3.9V, 4.3V, 4.7V, 11V, or 13V.

7 MILLION CARBON FILM RESISTORS PURCHASED
1/8 – 1/4 – 1/2 – 1 – 1½ watt Iskra and Piher, mainly 5%, few 2%. Lucky Dip as the packs come (will not duplicate under 20 packs) due to cartons packed tight and on top of each other to ceiling of warehouse. PACK OF 100 FOR 28p

TRIACS

Amp	Volt		
0.1	40	7W84	11p
1	400	21061650	32p
2.5	600	2N5757	44p
3.5	400	T2710D	58p
4	400	T2716D/40730	74p
6	200	T2500B/41014	54p
6	400	T2700D	65p
8	400	T2850D	72p
8	500	BT137-500	72p
8	500	T2801E	72p
10	600	T4101M	80p
12	500	BT138-500	90p
15	600	T4110M	93p
20	100	TIC253A	80p
25	100	BTX94-100	£2.25
25	200	TIC256	£1.05
25	1200	BTX94-1200	£5

END OF LINE STOCK ITEMS AND COMPUTER & AUDIO BOARDS/ASSEMBLIES WITH VARYING CONTENTS INCLUDE ZENER, GOLD BOND, SILICON, GERMANIUM, LOW AND HIGH POWER TRANSISTORS AND DIODES, HI STAB RESISTORS, CAPACITORS, ELECTROLYTICS, TRIMPOTS, POT CORES, CHOKES, INTEGRATED CIRCUITS, ETC.
3lb for £2.80   7lb for £5.00

PAY A VISIT – THOUSANDS MORE ITEMS BELOW WHOLESALE PRICE. CALLERS PAY LESS ON MANY ITEMS AS PRICES INCLUDE POSTAGE. PRICES INCLUDE VAT AND ADDITIONAL DISCOUNT IN LIEU OF GUARANTEE. GOODS SENT AT CUSTOMERS' RISK UNLESS SUFFICIENT ADDED FOR REGISTRATION OR COMPENSATION FEE POST.

ESTABLISHED 24 YEARS

MARKED FULL SPEC DIGITAL I.C.'s Branded– New 25 for £1.15 Mixed

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161 ST. JOHNS HILL, BATTERSEA, LONDON SW11 1TQ
Open 11 a.m. till 7 p.m. Tues. to Sat. Telephone 01-223 5016
Terms: Payment with order only. Full VAT receipt by request

PRICES SO LOW, THE POLICE INVESTIGATED ME TWICE

ALL ENQUIRIES, ETC. MUST BE ACCOMPANIED BY A STAMPED ADDRESSED ENVELOPE

VAT & POST PAID

(UK 2nd Class or Parcel) Just include stamped addressed envelope (14p) or label

MINIMUM ORDER FIVE POUNDS, OTHERWISE ADD 50% FOR SMALL ORDER HANDLING COSTS

UK – Postal Orders for prompt service. Cheques require days from a Monday banking to ensure clearance. Export [illegible] banker's draft (sterling) prompt service. Foreign currency n[illegible] accepted. VAT content becomes documentation charge. Ad[illegible] additional postage for overseas mail.

OPTO ELECTRONICS

Photo Diodes: 30F2, 31F2, 32F2, 33F2, BPX40, BPY10, BPY68, BPY69, BPY77, CQY17, CQY77, All types 38p

Wire end neons 5p.

Photo transistor: BPX43, BP103, 2N5777, Darlington 36p; LED's (Mullard Siemens) Red 5mm 8p. 3mm 13p; Green 5mm 13p, 3mm 13p; Yellow 5mm 13p, 3mm 13p, micro LD481 8p

AMBER 5mm 13p, 5mm Bar 13p.

PHOTO SILICON CONTROLLED SWITCH BPX66 PNPN 10 amp 36p.

CA3062 Photo Detector and power amp. £1.05p

7 SEGMENT L.E.D. DISPLAYS

.3" Red com. anode 81p

.6" Green C.A. £1.77

5082-7650 Red com. anode.

5082-7653 Red com. cath

5082-7600 Yellow com. anode.

H.P. Highbrilliance .43" 72p

HEWLIT PACKARD MULTIPLEXED .11" 7 SEGMENT LED DISPLAYS

3 Digit HP5082 7413 45p

4 Digit HP 5082 7414 45p

5 Digit HP 5082 7415 45p

Infra red transmit diodes CQY11B or LD271 High power 1.6-2v or 3-3.5v Pulse 32p

LD242 36p

H15B Photon coupled isolator I.R. diode and NPN Photo-Darlington amp 26p

CNY17/1 opto coupler 70p

Cold cathode tubes I.T.T. G517A or 5870L 60p

SPECIAL OFFER

IN4004 or IN4006 Sealed manufacturers carton of 300. £6.85

Transmit – Receive Transducers 40khz murata £3.55p pair.

MONOLITHIC CERAMICS

Proffessional quality to military standards, very stable, high volumetric efficiency giving high capacitance in sub-miniature size.

15PFD	6N8	
22PFD	01	
33PFD	015	
47PFD	022	7½p
68PFD	033	
100PFD	047	
150PFD 6p		
330PFD	068	15p
680PFD	1	
IN		
IN5		
2N2	15	
2N7	22	
3N3	33	24p
4N7	68	
	1MFD	

MERCURY TILT SWITCH

Ex unused equipment 22.5mm x 9.5mm diam. epoxy resin encapsulated contacts 240vac/28vdc 0.5A 40p with free adjustable mounting bracket.

Like Gold Dust! 470mfd, 6.3 volt Tantelum Bead yet only 64p.

DIODES

•Germanium: rest silicon

•AA118 90v 50ma 4p
•AA119 30v 35ma 7p
•AA133 100v 50ma 9p
•AA144 100v 5ma 4p
•AAZ15 100v 250ma 15p
•AAZ17 50v 40ma 6p
B1 11p
BA101B varicap 10p
BA116 20v 100ma 30p
BA127 60v 100ma 3p
BA128 50v 100ma 2½p
BA145 350v 500ma 2½p
BA148 350v 500ma 12p
BA182 Varicap 6p
BAX 13 50v 150ma 3p
BAX14 40v 350ma 2½p
BAX20 25v 115ma 3p
BAX21 50v 120ma 3p
BAX22 100v 120ma 3p
BAX54 8p
BAY36P 30v 3ma 2½p
BAY44 50v 250ma 4p
BAY68 25v 115ma 3p
BAY72 100v 400ma 4p
BB103 Varicap 24p
BB104 Varicap 16p
BB109 Varicap 24p
BB110B Varicap 24p
BB113 3x Varicap 43p
BB139 varicap £1
BR100 Diac. 15p
BY206 350v 600ma 7½p
BY207 600v 600ma 23p
BY402 100v ½A 2½p
BY403 200v ½A 2½p
Centercell 3p
CG651 9p
CR HG/3 10p
CSD117YLZ 40p
CV7095 2½p
CV7098 2½p
D3202Y Diac. 11p
DC2845 Microwave 20p
DOG53 11p
FSY28A 40p
•HG1005 100v 45ma 3p
•HG1012 50v 50ma 10p
MPN3401 VHF switch 30p
•OA5 100v 115ma 25p
•OA7 25v 50ma 25p
•OA10 25v 110ma 25p
•OA40 40v 50ma 4p
•OA47 30v 150ma 7p
•OA51 50v 50ma 4p
•OA70 22v 50ma 10p
•OA75 40v 50ma 11p
•OA79 45v 35ma 11p
•OA81 115v 150ma 3½p
•OA90 30v 45ma 4p
•OA91 115v 150ma 6p
•OA95 115v 150ma 6p
OA200 50v 250ma 2½p
•IN63 100v 40ma 4p
IN337 200v 200ma 4p
•IN447 40v 25ma 3p
IN604 400v 300ma 4p
IN662 80v 40ma 2½p
IN914 75v 225ma 1½p
IN916 100v 300ma 2½p
IN3062 75v 20ma 3p
IN3063 (BAV10) 6p
IN3064 75v 10ma 2½p
IN4009 25v 75ma 2½p
IN4148 100v 200ma 1½p
IN4149 100v 200ma 3p
IN4150 50v 200ma 2½p
IN4151 50v 200ma 2½p
IN4152 40v 200ma 3p
IN4446 100v 200ma 2½p
IN4449 100v 200ma 2½p
IN5154 25v 30ma 3p
IN5456 Varicap 15p
IS922 150v 200ma 4p
IS940 30v 50ma 3p
5082 2900 RF Schotky Barrier 50p

RECTIFIERS

Type	Volt	Amp	Price
BY126	650	1	5p
BY127	1250	1	5p
BY212	15kv	500ma	6p
BY235	600	1½	7½p
BY236	900	1½	7½p
BY264	300	3	9p
BY265	600	3	11½p
BY266	900	3	15p
BY275	600	5	19½p
BY277	1200	5	27p
BY1202	2kV	10mA	6p
BYW55	800	2 (Oxide bead)	15p
BYW56	1000	2 (Oxide bead)	18p
BYX20-200	200	25	72p
BYX22-200	300	1½	25p
BYX38 300R	300	6	48p
BYX38 600	600	6	52p
BYX38 900	900	6	60p
BYX38 1200	1200	6	65p
BYX42 300	300	12	36p
BYX42 600	600	12	46p
BYX42 900	900	12	92p
BYX42 1200	1200	12	£1.07
BYX46 300R	300	15	£1.19
BYX46 400R	400	15 Avalanche	£1.75
BYX46 500R	500	15	£2.00
BYX46 600	600	15	£2.30
BYX48 300R	300	6	47p
BYX48 600	600	6	60p
BYX48 900	900	6	70p
BYX48 1200R	1200	6	92p
BYX49 300R	300	6	35p
BYX49 600	600	6	42p
BYX49 900R	900	6	47p
BYX49 1200	1200	6	60p
BYX52 300	300	48	£2.05
BYX52 1200	1200	48	£2.90
BYX70	500	1	4p
BYX72 150R	150	10	42p
BYX72 300R	300	10	52p
BYX72 500R	500	10	65p
BYX94	1250	1	6p
DD3026	400	2½	10p
E250C50	250	½	14p
KS11394	800	3	23p
LT102	30	2	15p
M1	68	1	5p
MR856	600	3	24p
MSR5	800	3	12p
OA210	400	5	33p
RAS3 1OAF	1250	1½ Avalanche	48p
RAS508AF	1250	1½ (Avalanche)	50p
REC53A	1250	1½ Pack of 4	66p
SKE4G	200	6	22p
SR100	100	1½	9p
SR400	400	1½	10p
SR1825	100	50	75p
IN3254	400	1	4p
IN4002	100	1	4p
IN4004	400	1	4½p
IN4005	600	1	6p
IN4006	800	1	6p
IN4007	1250	1	6p
IN5059	200	1½	10p
IN5401	100	3	12½p
IN5402	200	3	11p
IN5406	600	3	15p
IN5408	1000	3	19p
IS027	800	1½	11p
IS138	800	½	2½p
25G100	100	60	£4.35
3052	200	3	11p
16094P	900	2	15p
16492	700	1½	9½p

BRIDGE RECTIFIERS

½AMP	60VOLT	B30C350	23p
½	1,600	BYX10	34p
0.6	110	EC433	20p
1	100V	B40C800	12p
1	140	OSH01-200	25p
1	400V	MDA104	29p
1½	50V	WO05	27p
1½	75V	IBIBY234	11½p
1½	150V	IBIBY235	15p
1½	200V	WO2 Ex Equip	15p
1½	400V	WO4	28p
1½	400V	UE4R1	12p
1½	800V	WO8	27p
1½	1000	W10	36p
2½	100	I.R.	40p
2½	350V	9F2	53p
2½	500V	9E4	85p
3	50	KBS005	30p
3	100	KBS01	30p
3	200	KBS02	30p
3½	100	B40C 3200	39p
5	400	Texas	85p
Miniature	Meter	Type	34p

THYRISTORS

Amp	Volt	THYRISTORS	
0.8	50	2N5061	15p
0.8	200	2N5064	19p
1	240	BTX18-200	35p
1	240	BTX30-200	35p
1	400	BTX18-300	41p
1	700	BT 106	70p
2	400	S2710D with heatsink	40p
3	600	T3N06C00	53p
3	100	T3N1C00	36p
4	50	S107F Sensitive Gate	36p
4	50	S2060F Sensitive Gate	36p
4	400	S2060D	36p
4	400	S2061D Sensitive Gate	38p
4	500	40506 with heatsink	58p
4	500	17083	36p
4	600	C106M Sensitive Gate	37p
4	600	2N3228	36p
4	600	GAK	36p
5	400	S5800D/R	36p
5	500	17047A	40p
5	600	17058	44p
5	600	S5800M	44p
5	600	BT121	70p
6	100	SCR 6/100	33p
6.5	500	BT107	£1
6.5	500	BT109/SCR957	71p
7	400	S2620D	45p
7	600	S2620M	45p
8	100	S2800A	36p
8	300	83904c(I.T.R.)	50p
8	600	S122M	54p
12	1000	CR121103-RB	£8
15	800	BTX95-800 Pulse Modulated	£1
16	400	2N6403	82p
20	600	BTW92-600RM	£3.40
75	800	71CG80	£6
110	20	72RC2A	£3
150	1000	151RA100	£10
150	1200	151RA120	£11

ZENER DIODES

4/500MW. BZY88, BZX97, etc. 5½p
2v. 2v7. 3v. 3v3. 3v6. 3v9. 4v3. 4v7. 5v1. 5v6. 6v8. 7v5. 8v2. 9v1. 10v. 11v. 12v. 13v. 13v5. 15v. 18v. 20v. 24v. 27v. 30v. 33v. 43v.

BZY61 Laboratory Standard 400MW. 7v5. Voltage Regulator Diode 12p

1.3/1.5WT BZX61, BZY97, etc. 11p
3v. 3v6. 3v9. 4v3. 4v7. 5v6. 6v2. 6v8. 8v2. 10v. 11v. 12v. 15v. 18v. 20v. 27v. 33v.

2.5WT BZX70, etc. 13p
3v6. 3v9. 5v6. 6v2. 7v. 7v5. 8v. 9v. 10v. 11v. 14v. 15v. (8p) 20v. 22v.26v.

5WT BZV40, etc. 15p
3v3. 3v6. 3v9. 4v3. 4v7. 5v1. 5v6. 6v2. 6v8. 7v5. 8v2. 8v7. 9v1. 10v. 11v. 12v. 15v. 20v. 33v. 68v. 120v.

10WT Z5D, ZX, IS50, etc. 23p
4v3. 4v7. 5v1. 5v6. 6v2. 6v8. 7v5. 8v2. 10v. 11v. 12v. 13v. 16v 21v. 22v. 33v. 36v. 39v. 43v. 51v. 56v. 62v. 68v. 75v. 150v.

15WT BZV15C 12R 12volt 37p

20WT BZY93, etc. 44p
8v2. 39v.

TEMPERATURE COMPENSATED REFERENCE
IN935B, IN936B, IN937B 9volt
IN941B, IN942B, IN943B 11.7volt

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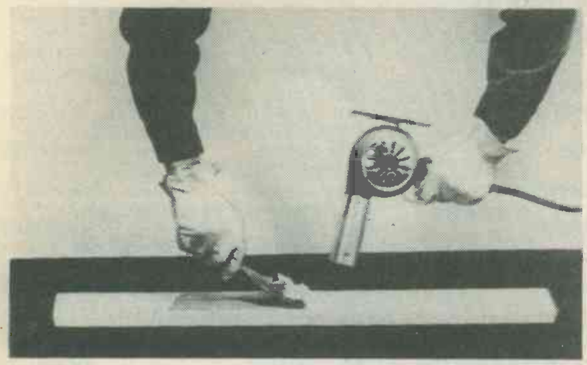
CAPACITORS . . . ELECTROLYTIC; CAN, WIRE END, TANTALUM, MULTIPLE, COMPUTER GRADE. NON POLAR PAPER BLOCK, CAN POLY, MICA, CERAMIC LOW AND HIGH VOLTAGE, RESISTORS ⅛ WATT TO 100 WATT; 0.1% TO 10% CARBON, METAL AND WIRE WOUND + NETWORKS. FANS, BATTERIES, SOLENOIDS, TAPE SPOOLS, VARIABLE CAPACITORS AND RESISTORS, TRIMMERS, PRESETS, POTS . . . SINGLE, DUAL, SWITCHED, CARBON, CERMET AND WIREWOUND. SINGLE OR MULTITURN, ROTORY AND SLIDE. DIODES, RECTIFIERS, BRIDGES, CHARGERS, STYLII, SOCKETS, PLUGS, RELAYS, TRANSISTORS, IC'S, CLIPS, CRYSTALS, ZENERS, TRIACS, THYRISTORS, BOXES, PANELS, DISPLAYS, LED'S, COUPLERS, ISOLATORS, NEONS, OPTO'S, LEADS, CONNECTORS, VALVES, BOOKS, MAGAZINES, TERMINALS, CHOKES, TRANSFORMERS, TIMERS, SWITCHES, COUNTERS, LAMPS, INDICATORS, BELLS, SIRENS, HOLDERS, POWER SUPPLIES, HARDWARE, MODULES, FUSES, CARRIERS, CIRCUIT BREAKERS, KNOBS, THERMISTORS, VDR'S, INSULATORS, CASSETTES, METERS, SOLDER, HANDLES, LOCKS, INDUCTORS, WIRE, UNITS, MOTORS, COILS, CORES, CARTRIDGES, SPEAKERS, EARPHONES, SUPPRESSORS, MIKES, HEATSINKS, TAPE, BOARDS AND OTHERS.

NEWS . . . AND

USEFUL TOOL FOR THE WORKSHOP



Eraser International have announced the availability of a new Heat Gun, the Model 4499E.

The Heat Gun provides controllable blowing hot air at a temperature of up to 750 deg.F which when applied to the work piece will soften paint right through to the bottom layer. The softened paint may then be lifted off with a spatula or scraper, the paint scrapings are dry, not gooey, avoiding the mess traditionally associated with paint stripping.

Unlike chemicals and open torches, the Heat Gun method releases no vaporised lead fumes nor at any time will it scorch the wood surface as a torch will.

The Heat Gun is also a useful tool for such applications as shrinking tubing, soldering, P.C.B. drying, glue curing, and any other application where a controllable flameless heat source is required.

The Heat Gun is light in weight, 1.5lbs and operates from 220/240 volt 50Hz single phase electricity supply.

Further information is available from Eraser International Limited, Unit M, Portway Industrial Estate, Andover, Hants.

HOME VIDEO

Many people buy video recorders for the benefit of recording programmes while they are away or watching another channel and to show the odd pre-recorded tape bought for a special occasion. But the convenience the video tape recorder brings to the home is not the only benefit it provides. When the recorder becomes the heart of a home video system it can provide hours of fun, entertainment and a source of inspiration for the creative members of the family who can select from a wide range of accessories and additional equipment to record everything from family parties to home movies. A most comprehensive range for the beginner or amateur enthusiast is available from Sony.

CAMERAS

The recent introduction of high quality colour video cameras enables owners to produce their own tapes easily, instantly and economically. Sony has a range of colour and black and white cameras to meet all requirements.

Cine cameras have provided much amusement in the past but are more expensive than video to run – just compare 3¼ hours of video fun for under £10 with six minutes of cine film at £12 (including processing and printing).

C7 RECORDERS

Over the last year Sony's SLC7UB has become much sought after due to exceptional picture quality as well as features which offer flexibility and convenience. It is also well styled to fit unobtrusively into the home.

PORTABLE RECORDERS

Having recorded activities in the home and become more enterprising with the addition of a portable recorder, the camera can be taken out of doors for holidays, picnics and sporting occasions. The Sony SL3000 runs off a rechargeable battery pack and is easily carried with the aid of a shoulder strap.

The camera and recording equipment is so easy to use, because most of the critical adjustments can be taken care of automatically, that it does not take long to become an expert. To add the finishing touch to video tapes a Sony Special Effects Generator can be used to superimpose images. With this simple equipment tapes can be given titles and credits, subtitles can be added to pictures and family tapes can be transformed into professional productions.

Shown in this picture are the HVC 200P colour video camera, the SLC7UB video recorder and the KV1612UB Trinitron television.

. . . COMMENT

The beginning of the WORLD is nigh... . . . part 1.

Regular readers of this magazine will have no doubt been wondering where the recent comments, surveys and promises of 'things to come' were leading. The answer is supplied herein, in the shape of a sample from the new-style **Radio & Electronics World.**

We have been taking careful note of the comments we have received (even the rude ones !), and these have all been taken into consideration with the new style and presentation of the magazine. Whilst this new style will seem a complete departure from the current format of ***R&EC***, the aims and objects of the magazine remain essentially similar to those set out by Arthur Gee in the first issue of ***Radio Constructor*** in August 1947.

That issue was launched into the post-war era, when civil electronics was able to reap many of the benefits brought about by the enormous advancement of the science that had been telescoped down into the war years. We entered WW II using bi-planes, yet came out with the first turbo jet aircraft. We enter this new era in supersonic civil transport, yet unless technologists can do something drastic and meaningful, we may emerge at the turn of the century back on our push-bikes.

The age of energy conservation is upon us, and just as the nascent communication age provided much scope for original thought and experiment, so we feel the exploitation of alternative energy sources provides scope for the enthusiastic technologist. And after all is said and done, technology is about serving people and creating a more desirable enviroment in which to live.

Just at the present time, this may seem a rather presumptious statement. But the tools to achieve this end have been at our disposal for some time now. The resolve of the more narrow minded, short sighted - and to be perfectly honest - technologically ignorant and naive politicians seems to have been the main stumbling block.

The key to the course of progress towards a society that is better aware of the technology, and that can thereby lead to an enhancement of the quality of life, is largely in the hands of those who attempt to disseminate the basic knowledge and ideas. Let us hope that the millenium sees us emerging in supersonic transport, powered by ecologically pure hydrogen, created by solar energy. Not on those push bikes - which presently seem to loom all too large.

You and **Radio and Electronics World** could have a very real part to play in the charting of this progress.

NEW AMERICAN POWER SUPPLY SERIES

Telecommunications, military environment, undersea mining, aerospace and high reliability commercial applications are among many uses projected for the new Y-95 Series of modular, encapsulated, switching regulated, DC to DC converters now being offered by Technipower, A Penril Company, of Danbury, Connecticut.

The new power supply series is designed to meet 30,000 hours MTBF at stress levels of 95 deg.C base temperature and has a switching frequency of 25 KHz to assure maximum (80%) efficiency consistent with latest state-of-the-art circuitry. A company spokesman pointed out that there are 100 models in the series, with output voltage ranges from 2.8 VDC to 250 VDC and that design efforts are close to completion for units up to 400 Watts. It was further stated that the modular, sealed and encapsulated package was designed for harsh environment reliability.

VMOS DEVICES AND CONSTANT CURRENT SUPPLIES

Jonathan Charles Burchell

The electronics enthusiast is often faced with the task of building reliable regulated supplies and the introduction of three terminal voltage regulators has made the building of constant voltage supplies a simple matter, and superseded the need for boards full of op-amps and steaming power transistors.

The constant current source, an equally valuable item, is an area which seems to have been sadly neglected, yet the introduction of so much new equipment with rechargeable batteries increases the need for a three terminal approach to such supplies even further.

The Vmos fet offers just such a solution, and perhaps it will come to be regarded as a three terminal current regulator with the same popularity as the 78xx series of voltage regulators.

WHAT IS VMOS TECHNOLOGY?

[redacted]le at po er levels [redacted] their application [redacted] little interest was shown in them as power devices.

The breakthrough came with a new fet technology which allows the production of high current, high voltage fets. This is the so called Vmos technology, which exploits a vertical current flow to achieve its high power capabilities. It is now possible to obtain fets with voltage and current levels similar to the largest bipolar devices.

Fig.1. shows a cross section of both a conventional fet and the new Vmos type, illustrating clearly where the name comes from.

In the conventional fet the current flow is horizontal, unlike Vmos and bipolar devices where the current flow is vertical. For a given current the chip area had to be much larger than its bipolar counterpart, this meant higher cost and lower yield of working devices. Medium power conventional fet's were therefore very costly and higher power devices almost unthinkable.

The epi layer of the Vmos device increases the drain-source breakdown voltage, by absorbing the depletion region from the drain-body junction which is normally reverse biased.

In use, both the gate and drain are positive with respect to the source. The gate produces an electric field which induces an N-type channel in the body facing the gate, allowing electrons to flow from the source, through the n-type channel and epi layer into the drain. The depth of the channel is controlled by the voltage on the gate and the current flow through the device is similarly affected.

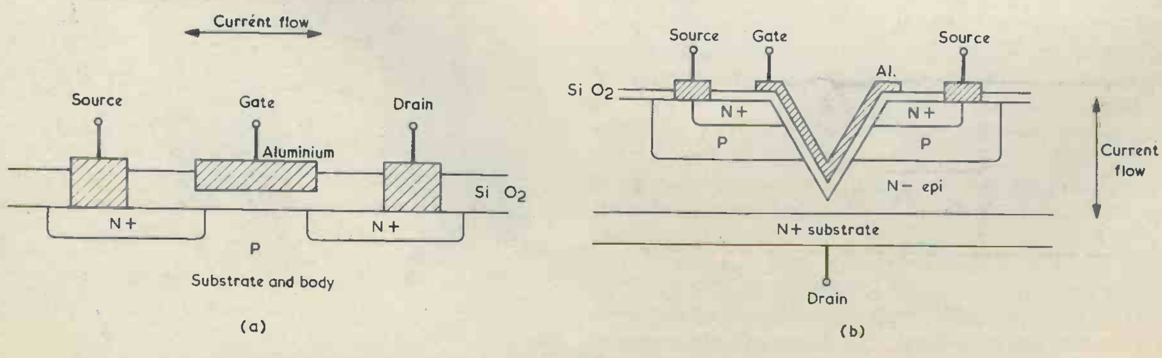


Fig. 1. (a) Cross section of Conventional Mosfet (b) Cross section of Vmos device

VMOS CHARACTERISTICS

Fig.2. shows the output characteristics of a typical Vmos device. The very low output conductance of the device leads to the curves being very flat. (Note that the drain current will remain at 0.4A for a gate voltage of 4V over the range 8V–50V). Unlike bipolar devices the temperature coefficient of the Vmos drain-source voltage is positive, the device therefore draws less current as it heats up, making thermal runaway an impossibility. If the current density were to increase at one point in the channel the local heating would cause a drop of current in that area and a redistribution throughout the rest of the channel. This mechanism prevents the formation of 'hot-spots' – a major cause of breakdown in bipolar devices.

It also means that Vmos devices may be paralleled, and automatic current sharing will take place without the need for ballasting resistors.

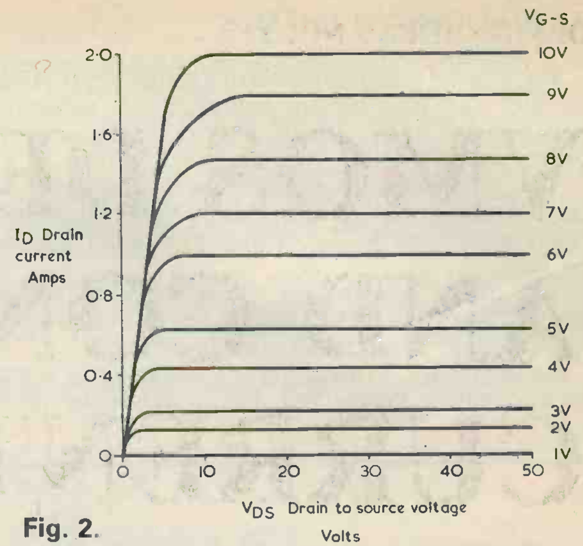


Fig. 2.

CONSTANT CURRENT SUPPLIES

Fig.3. shows three types of constant current supplies 3 (a) is a conventional bipolar circuit. The base of T1 is held at a constant voltage by Zener Z1. R1 serves to monitor the current flowing and the developed voltage is applied to the emitter of T1. The result is that T1 will attempt to pass a current which maintains the voltage across R as close as possible to that of Z1. The performance of this type of circuit is not good, firstly the current measured by R1 is not exactly the load current as it also contains the base current of T1 which can be an appreciable amount of the total current, this also means that Z1 and R2 must be generously rated in order to provide a stable base voltage under all conditions of load.

Secondly, R1 must pass the load current plus the base current and the resulting dissipation leads to the use of large resistors and consequent difficulties. Lastly, the transistor T1 must be generously rated to prevent the possibility of thermal runaway and secondary breakdown.

The circuit of 3 (b) shows the ubiquitous 78xx device as a current regulator, the output current is controlled by R3 which must again pass the full load current and is therefore not easily made variable. The circuit is also limited to supplies of less than 1A and there is a loss of some 7.5V across the typical 5 volt regulator. 3(c) shows the approach using a Vmos device, the gate is held at a constant potential by the potential divider network R4 and R5 and the drain current will thus remain constant, despite the variation in drain source voltage caused by the load.

As the gate current is microscopic (about 10 na) the potential can easily be made variable using a standard potentiometer resulting in a variable constant current source.

In fact the beta or current gain of a Vmos device is well over 10E9 so that it may be considered as truly voltage controlled.

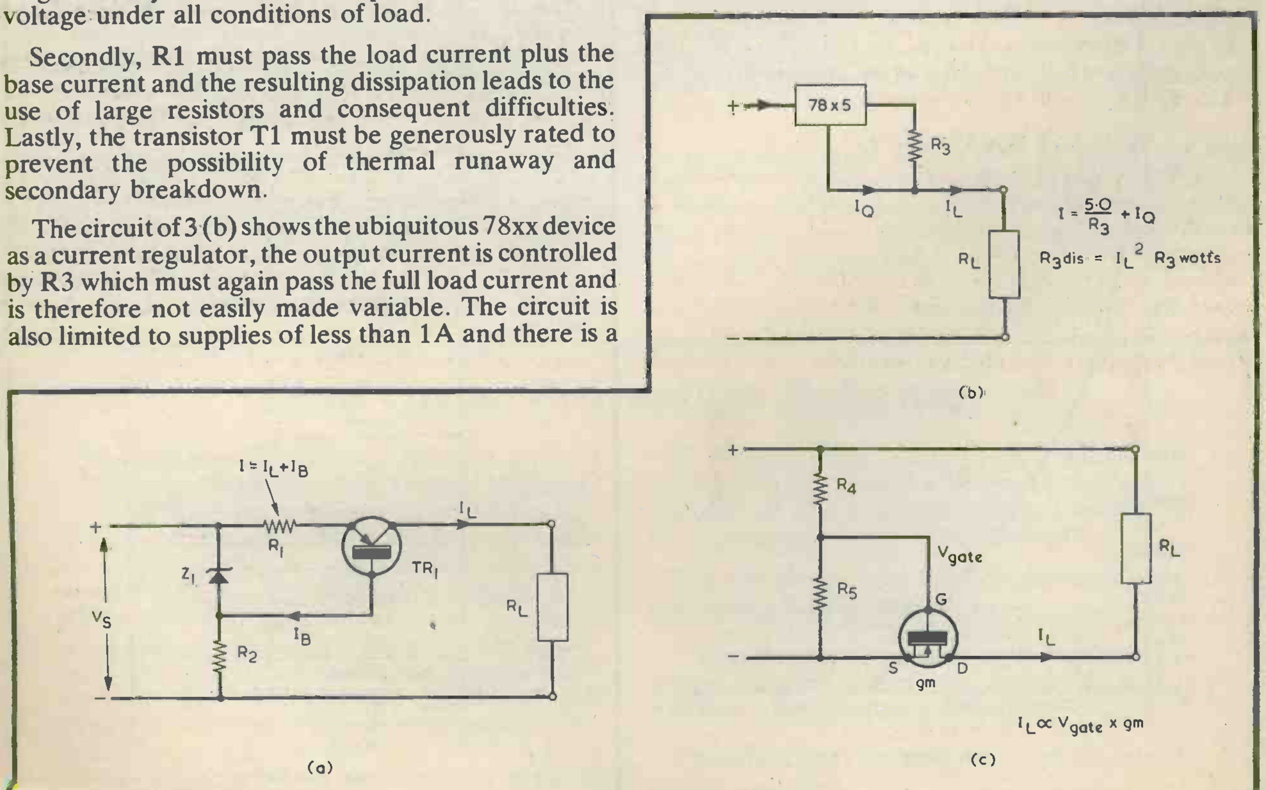


Fig. 3

ACTUAL CIRCUIT DETAILS

Fig.4. is the circuit diagram of a prototype 0-300ma variable constant current source. Fig.5. shows the performance of the circuit, and as can be seen it is pretty good.

The gate voltage is not stabilised in any way and relies on the input voltage current being constant, if this is not so then the Zener stabilisation of Fig.6. may be used.

The device selected for use is the VN66Af, this allows currents of up to 1 amp to be controlled and an input voltage of up to 40 volts to be used.

As the device is operating in a linear mode it must be adequately heatsinked. Fig.7. shows the power dissipation curves for the VN66Af). The prototype used a 20W 6 degree C/watt heatsink and temperature effects were hardly noticeable.

Preset P1 is included as a means to set an upper current limit mainly to protect the included ammeter and transformer etc. rather than the Vmos device. For drain currents greater than .4A the gm of the Vmos device is constant, below this it tends to follow a square law and a resistor may be added at 'X' to improve the lineararity of the output/input voltage for low current variable supplies.

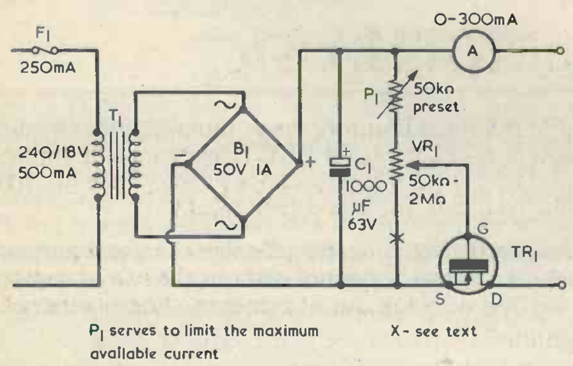
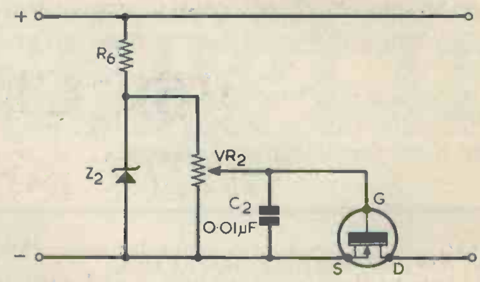


Fig. 4



C_2 serves to decouple the zener noise

Fig. 6

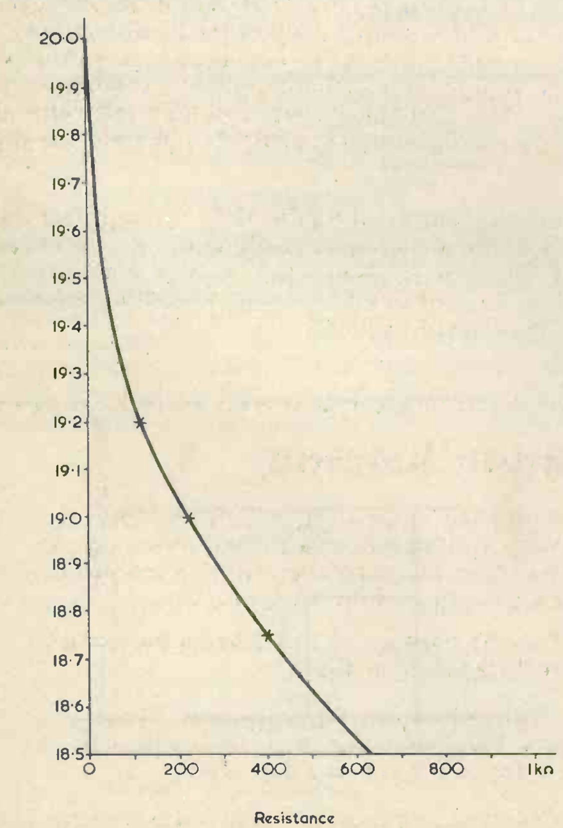


Fig. 5

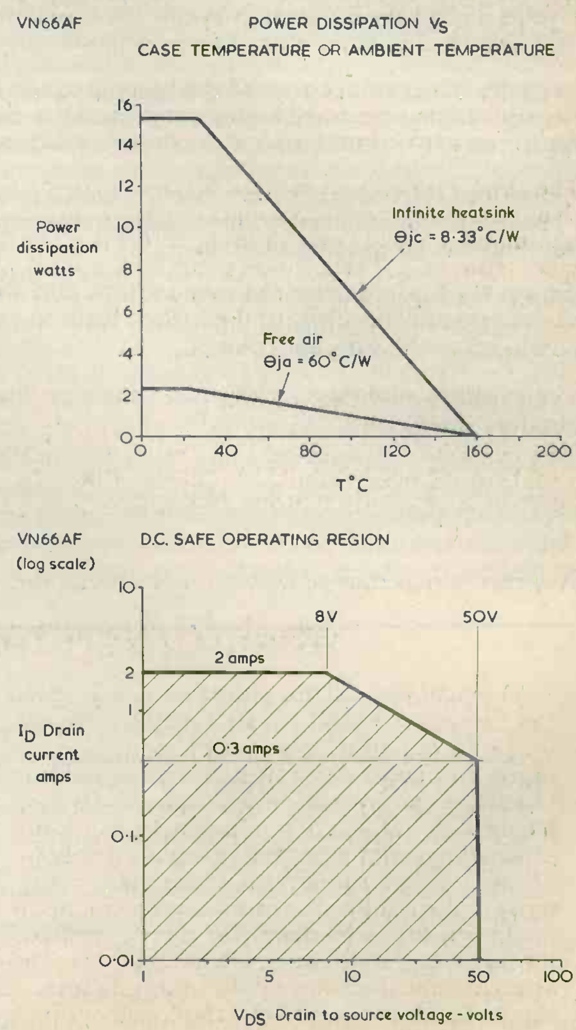


Fig. 7

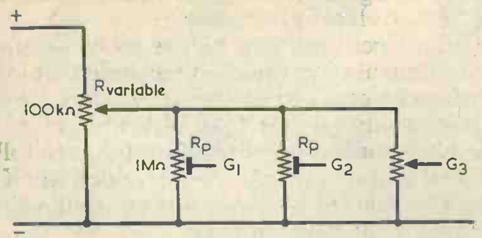


Fig. 8

Because of the inherent current sharing property of these devices any number of them may simply be connected in parallel to increase the load capacity. However sampling of a large batch of VN66AF's showed that there was considerable variation in gm between devices, and so the circuit of Fig.8. is recommended as this allows the devices to 'track together'. Another good idea is to install 0.luf capacitors from gate to earth, as with such a high impedance input, a good deal of noise pickup can occur. ■

BBC CLOCK TO BE MADE BY McMICHAEL

Following an agreement reached between the BBC and McMichael Limited, the equipment that electronically produces the clock and logos, which appears at programme junctions on BBC television, is to be made available to other broadcasters. It will be manufactured by McMichael Limited under licence from the BBC, and will allow other broadcasting organisations to benefit from this advanced technology.

The equipment was developed by Richard Russell of the BBC's Engineering Designs Department, who said, "We needed to find a cheap way of producing a clock and network symbol without the use of cameras. Adopting a solid state approach avoids the problems associated with the use of cameras, slide scanners and mechanical clocks, especially when in continuous operation".

The microprocessor generated symbols have been in use on BBC 2 since last September. Besides producing the clock and its associated logo the equipment can also be programmed to produce static logos such as the Open University symbol, or simple animated logos.

The clock symbol is generated from two components. The first covers the fixed elements of the clock face such as numerals, centre spot and gating circles, which are produced by storing the positional information in a Programmable Read Only Memory (PROM). The other component involves the moving elements, the clock hands themselves. These are generated in a similar fashion, although the data is stored in a random access memory (RAM). A microprocessor keeps track of the time of day, and once every second it calculates the correct angles and positions of the hands. The network logo data is also stored in a PROM and it is possible to generate up to 32 different colours.

The facilities offered by the generating equipment were demonstrated at the IBC 80 exhibition last September. Many visitors to the show expressed an interest in the equipment, resulting in the new licence agreement. BBC designs are often available for licence by British manufacturers and industry; and this is the second such licence taken by McMichael this year. The first, the advanced four fields standards conversion equipment ACE, will be at the Montreux International Television Symposium.

Simple Stereo Amplifier * * * * * *

T. J. Johnson

View of front panel of amplifier

The simple stereo amplifier to be described here was originally constructed to be a useful addition to the workshop as a test instrument. However the design and general appearance is such, that it would not look out of place in any home as the basis of an audio system.

DESIGN

As the amplifier was required to fulfil a specific purpose, a quick and easy way of connecting a signal was needed. For this reason terminals have been used for the input connections. Although a standard DIN socket, wired to suit most equipment has also been included.

The circuit is based on a familiar IC, the TBA810S. Although this type of IC may be considered obsolete when compared with more recent types, it does have the advantage of offering good performance at low cost with a low quiescent current and at the same time being thoroughly tried and tested.

The IC is capable of delivery 7W maximum (RMS) into a 4ohm load when used with a 16 volt supply. At very high outputs the distortion is noticeable, but when used at normal listening levels is insignificant. The full amplifier contains tone controls based on the familiar Baxandall tone network*, and gives a remarkable range of control over the bass and treble frequencies. The table of Fig.1. gives the specification for the complete stereo amplifier.

CIRCUIT DESCRIPTION

The full circuit for the Simple Stereo Amplifier is shown in Fig.2. Only one channel is shown, the second being identical. The power supply is common to both of course.

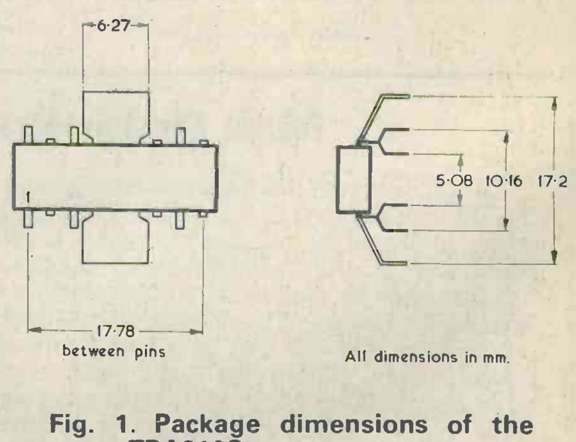


Fig. 1. Package dimensions of the TBA810S

*Baxandall considerations, see National Semiconductor Audio Handbook.

The input signal is applied via the chosen sockets to the volume control VR1. The signal is then tapped off by the wiper and applied to the tone control network consisting of VR2/VR3 and their associated components. Operation of the tone control network is quite complicated* and would be too lengthy to show here. Suffice to say that VR2 has control over the bass frequencies, and VR3 controls the treble frequencies. From the tone control network (wiper of VR3) the signal passes to the input of the IC at pin 8. The majority of components associated with the IC provide for hum rejection and stability.

The overall gain of the IC is dependent on the ratio of the internal feedback resistor, nominally 4kR and the value of R5. With the values shown, the gain is about 80.Capacitor C6 reduces any hum present on IC bias voltages to a very low level. Capacitors C7 and C10 control the overall frequency response of the IC. To some extent the values are affected by the value of R5. With the values here the upper cut-off frequency is about 15kHz, after which the response falls very rapidly. R6 and C8 form a "Zobel" network. These components in parallel with the speaker, present a load to the output of the IC which is close to a pure resistance at RF. This arrangement greatly reduces instability at high frequencies.

The output coupling capacitor C11, to some extent determines the bass content of the output signal. Basically a high value will give a large amount of bass, while a smaller value will give less bass in the output. The value has been chosen with particular speakers in mind, so some experimenting could be tried here.

POWER SUPPLY

The power supply is conventional and consists of a mains transformer and a few other components. Mains voltage is stepped down by T1 to give about 15V RMS across the bridge rectifier arrangement consisting of D1 to D4. After rectification, approximately 17V appears across the smoothing capacitor C14. No further regulation is required, so the DC voltage is applied directly to the remainder of the circuit. A neon indicator, NE1 is provided across the mains input to indicate that the amplifier is switched on.

COMPONENTS

There are no critical components. All types used here are readily available. It is important to obtain the correct IC. There are two available, one which has its heatsink tabs straight and punched with holes for mounting, and one which has preformed tabs for mounting directly onto a PCB. It is the latter, suffixed "S" which should be purchased.

A metal case measuring 9" x 5" x 2.5" was used for construction. Any other type of case could be used, although it must not be any smaller. A choice must be made at this stage to the type of input sockets to be used. As the main intention for the amplifier was for it to be used as a test instrument a quick and universal method was adopted for connecting a signal to the input. For this reason 4mm terminals were used and have since proved to be very useful. In parallel with the terminals is a standard 5 pin DIN socket wired to suit the majority of "Hi-Fi" equipment. If used as part of a "Hi-Fi" system then the terminals may be omitted, and perhaps phono sockets might also be used. Standard 2 pin DIN sockets are usef for the speakers.

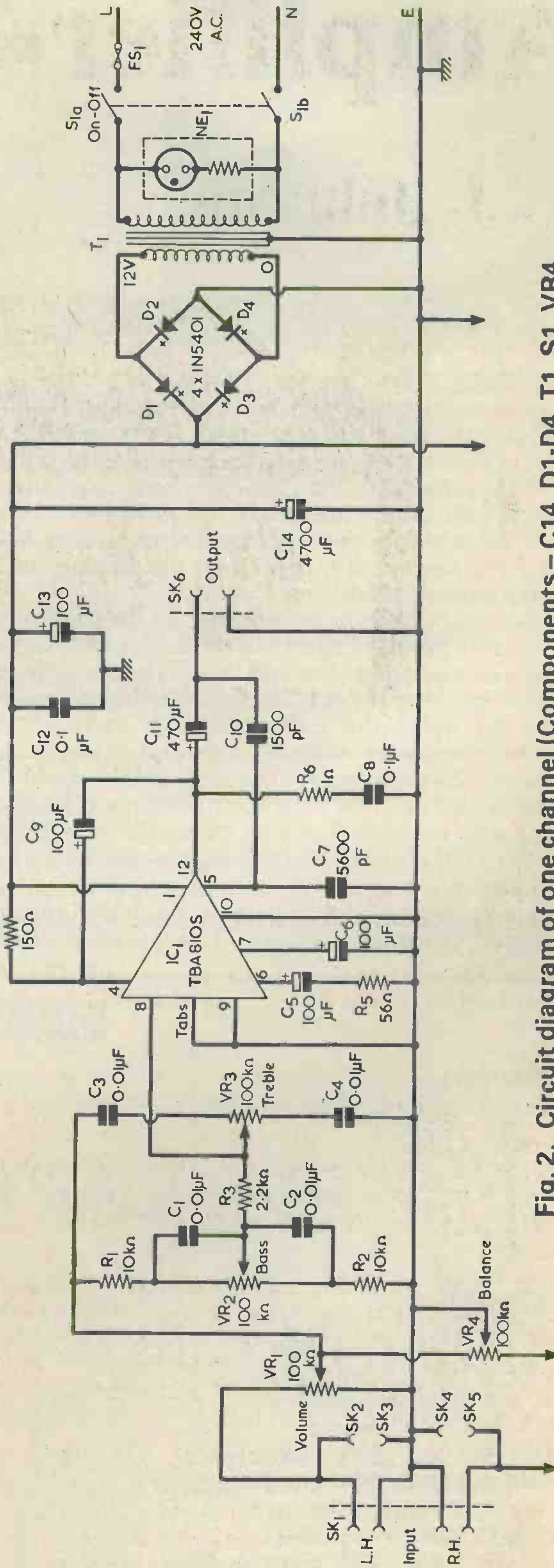
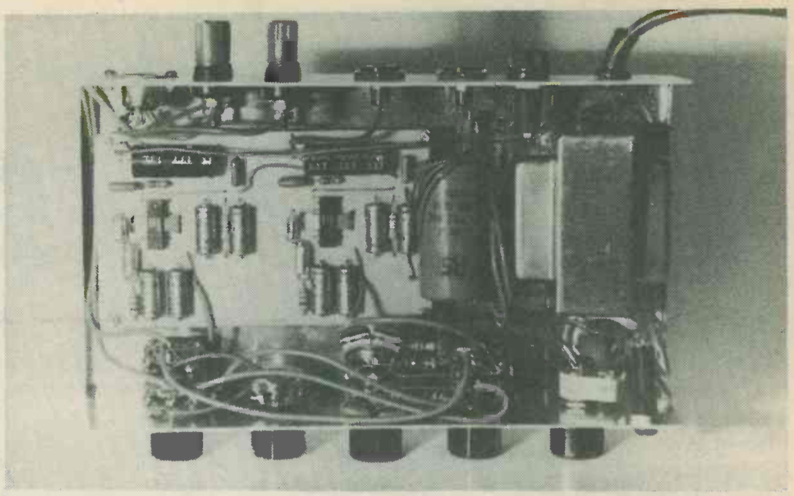


Fig. 2. Circuit diagram of one channel (Components – C14, D1-D4, T1, S1, VR4 and FS1 are common to both channels).

Internal layout of amplifier.



CONSTRUCTION

Construction can commence with the case. Drilling details for the front and rear panels is shown in Fig.3. The rear panel details assume the use of both terminals and DIN sockets. In the prototype both panels were covered with white Fablon and lettered using "Panel Signs" transfers. No drilling details for the base have been given as these will depend on the dimensions of the components used.

If the components to be mounted on the base are to hand, then offer each in turn to the base and mark the holes. The transformer should be mounted near to the right hand edge of the chassis, remembering to mount a solder tag under one fixing nut. The PCB will be mounted eventually at the opposite end of the chassis on four .25in. spacers. The tag strip should be positioned between the PCB and transformer. Position the tag strip so that it is slightly nearer the transformer than the PCB and with its feet facing towards the right hand edge.

Next the front and rear panel components may be mounted. Orientate the tags of the potentiometers upwards vertically. This will then give the correct angle of rotation for the knobs. The body of the mains switch is turned through a slight angle to give a symmetrical appearance of the knob.

PRINTED CIRCUIT

Most of the components are mounted on a printed circuit board measuring 5" x 3". It is not essential to use a PCB, other forms of wiring board such as plain matrix board can be used. Providing the input connections are kept well away from the output no problems should arise. Note however that the PCB has been designed to act as a heatsink for the two ICs, hence the large amount of unetched copper. If a PCB is not used then some other form of heatsinking must be provided. A good alternative consists of a piece of copper board about 2.5" x 1.25" soldered to the tab of the IC. Four such pieces are required for the two ICs.

The copper pattern for the board is shown in Fig.4. This also shows the top side component side. The printed circuit board may be produced easily by an etch resist pen, the tracks are quite large to afford any

COMPONENTS

Resistors.
All .5w 10% 2 of each
- R1 10kΩ
- R2 10kΩ
- R3 2.2kΩ
- R4 150Ω
- R5 56Ω
- R6 1Ω

Capacitors
2 of each
- C1 0.01μF polyester
- C2 0.01μF polyester
- C3 0.01μF polyester
- C4 0.01F polyester
- C5 100μF 25V electrolytic
- C6 100μF 25V electrolytic
- C7 5600pF polystyrene
- C8 0.01μF polyester
- C9 100μF 25V electrolytic
- C10 1500pF polystyrene
- C11 470μF 25V electrolytic
- C12 0.01μF polyester
- C13 100μF 25V electrolytic
- C14 4700μF 5V electrolytic (1 off)

Semiconductors
- IC1 TBA810S (2 off)
- D1-D4 1N5401 rectifier (4 off)

Potentiometers
- VR1 100k + 100k dual gang log
- VR2 100k + 100k dual gang lin
- VR3 100k + 100k dual gang lin
- VR4 100k balance single lin

Miscellaneous
- T1 mains transformer 12V AC secondary at 1A
- NE1 mains neon 240V
- FS1 1A 20mm fuse
- S1 d.p.s.t. switch
- SK1 5 pin DIN socket
- SK2-SK5 4mm terminals 2 off red, 2 off black
- Metal case (see text) e.g. ARBOUR EX2
- Panel mounting 20mm fuseholder
- SK6 2 pin DIN socket (2 off)
- Knobs, spacers, 6BA hardware, printed circuit board etc.

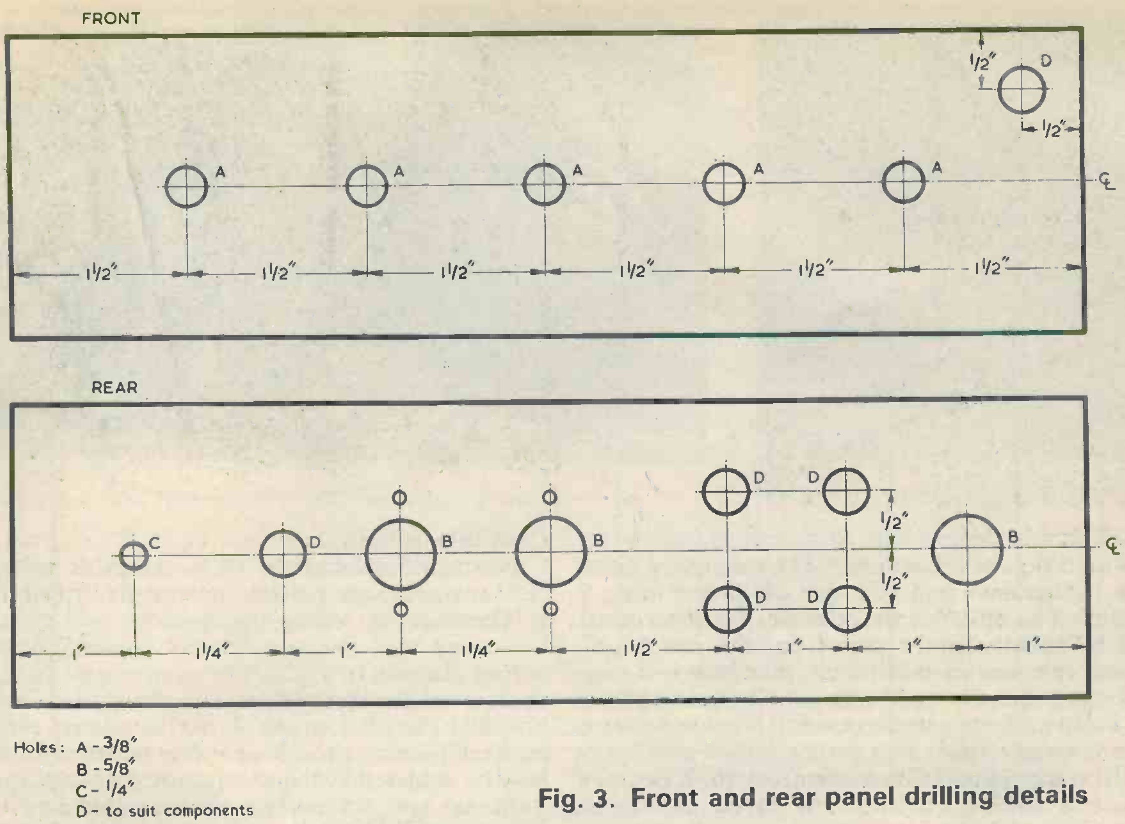


Fig. 3. Front and rear panel drilling details

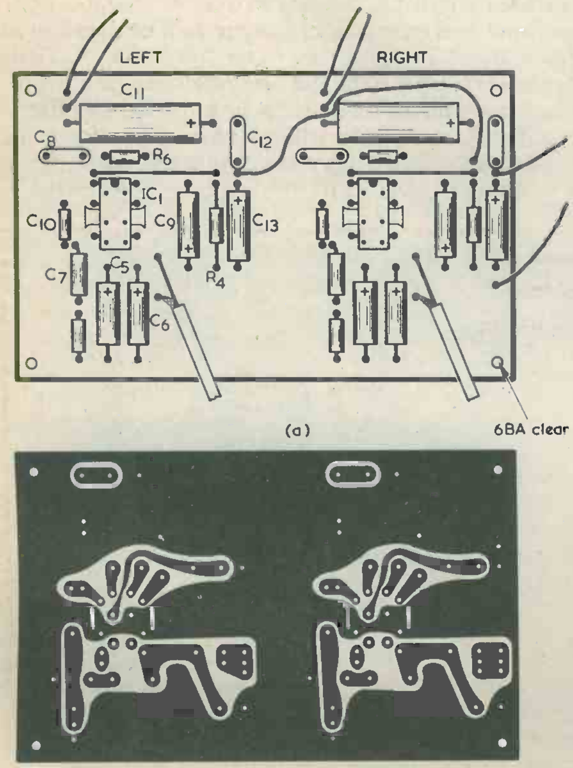


Fig. 4. (a). Component layout on top-side of board
(b) P.C.B. underside (Note the four slots needed for the tabs of the i.c.'s)

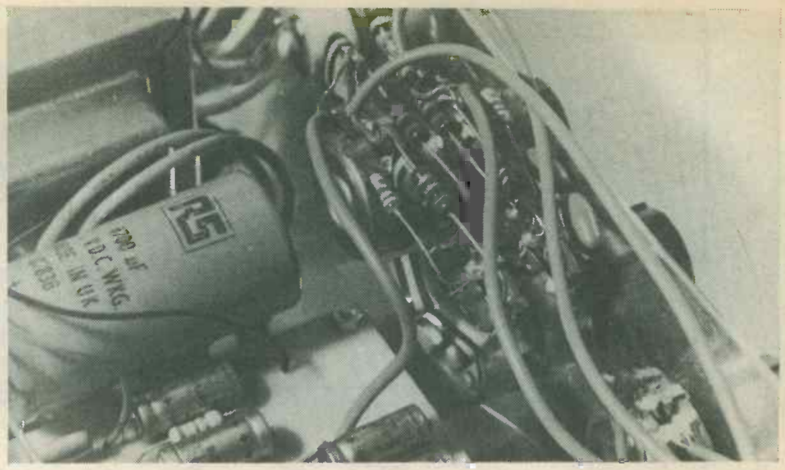
Amplifier Specification

Output;
6w into 4ohm load
Frequency response;
80Hz-19kHz+/ −2dB (Tone controls at mid-range)
Distortion;
At 1W − 0.17%
At 3W − 0.21% } Measured at 1kHz.
At 6W − 3.2%
Input Sensitivity;
(Volume control at max, frequency 1kHz)

Typical Voltages
(IC1 and IC2 pin connections)

Pin
1 – 17V
2 – NC
3 – NC
4 – 16.8V
5 – 0.76V
6 – 0.2V
7 – 8.7V
8 – Input
9 – Earth (OV)
10 – Earth (OV)
11 – NC
12 – 8.6V (Output)
(Measurements taken under no signal conditions with volume control at minimum. Supply voltage of 17.12V. Voltages taken using a DVM).

Details of tone control wiring.



mistakes should the pen slip. Etch resist transfers can also be used to good effect here. After etching, the holes for the components and ICs may be drilled using a 1mm drill. The holes for the screen of the input leads should be drilled slightly larger. The slots for the IC mounting tabs are more difficult, and here it is suggested that a series of 1mm holes are drilled and then with a sharp knife the excess cut out. It is not imperative that the slots are neat, as long as the tabs can pass freely without the pins of the IC becoming distorted. The tabs can then be soldered to sufficient copper and there should be no problems.

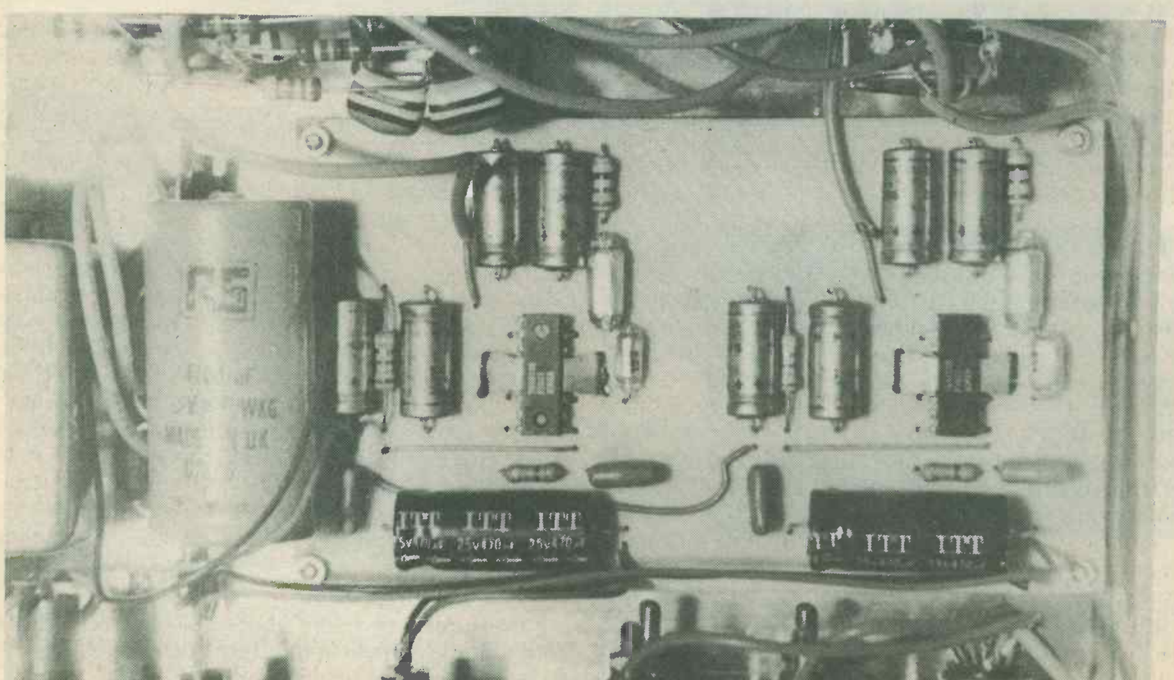
The resistors and capacitors are mounted first, ensuring that the electrolytic capacitors are the correct way round. The two ICs can then next be mounted, observing the precautions mentioned in the previous paragraph. The screened leads can then be soldered, allowing about three or four inches for each. Similarly the speaker leads and supply leads each with a length of about four to five inches. Do not forget the two plain link wires and the insulated wire on the PCB.

CHASSIS WIRING

Having completed the PCB, mount it using four .25" spacers in the position previously drilled out for it. Continue by wiring the resistors and capacitors associated with the tone control network using the wiring diagram of Fig.5. The components have been opened out for clarity here, and should not be wired like this! The photograph shows the relative positions each component should take. The screened leads can now be soldered to their respective resistor/capacitor junctions and soldered at the opposite end to the volume controls. When wiring the balance control, if it is difficult to solder to the metal case of the potentiometer then a short lead can be taken to an earthed tag of one volume control.

The input and output sockets can then be wired in a similar manner.

The power supply is the last section to be wired. Here it is suggested that the leads of the large capacitor be left long and insulated. This will enable the capacitor to rest gently on the PCB thus providing some support for



Close-up of the amplifier p.c.b.

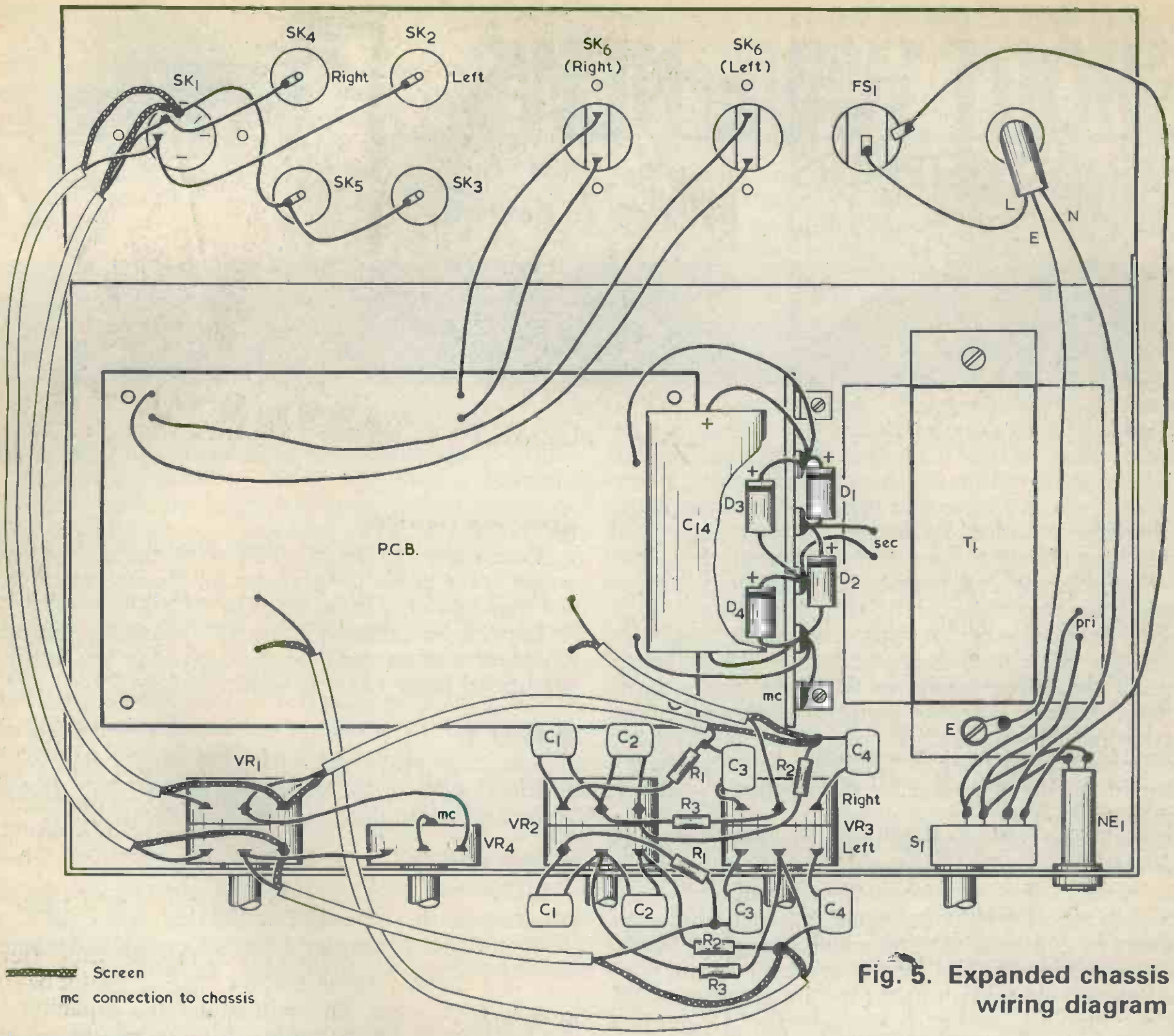


Fig. 5. Expanded chassis wiring diagram

this component. Note that only one tag of the tag strip is earthed and has wiring going to it. For safety reasons the exposed tags of the fuseholder, neon and mains switch should be insulated with tape. Also ensure that the centre tag of the fuseholder cannot touch the case of the transformer.

Finally the knobs may be pushed on and checked to see that their rotation is symmetrical, they should align correctly if the potentiometers have been positioned as mentioned earlier.

TESTING

Before switching on, remove the positive lead connected to the tag strip. Fit a one amp fuse and switch on. If possible measure the voltage across the smoothing capacitor C14. This should be 17 volts, and certainly no more than 20 volts which is the absolute maximum for the ICs. If all is well, switch off and reconnect the positive lead.

Set the volume control fully anticlockwise, and all other controls to mid position. Switch on and apply a signal to one input. A suitable signal if no signal generator is available, would be the loudspeaker output from a cassette or radio. Slowly rotate the volume control until the amplified signal is heard in the appropriate speaker. If no sound is heard check for faults before continuing.

If all is well, transfer the signal to the other input, and check this also.

Once both channels are working the two inputs can be connected together and the tone control operation checked.

Turn the balance control to attenuate one channel, set the volume control to a comfortable listening level. Rotate the Bass control clockwise, the bass frequencies should be accentuated. Conversely, rotating the control in the opposite direction will attenuate the bass frequency response. Rotate the balance control to attenuate the other channel and repeat the tests.

A similar set of tests should be carried out using the Treble control.

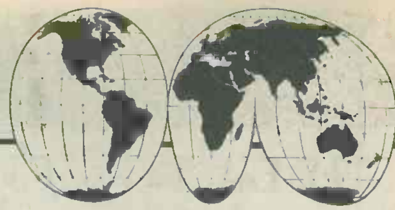
If all checks out, then the amplifier may be connected to its intended input source. When the full rated output is being delivered, the ICs will get very warm over a long period of time, but providing there is sufficient heatsinking – and the heat is being dissipated effectively – there should be no real cause for concern. Note also that for normal listening levels, say up to three watts, the harmonic distortion is very low, typically less than 0.2%. Much above this power the distortion increases rapidly, and this should be kept in mind if comparative listening tests are being made.

CONCLUSIONS

Finally some constructors may prefer to have separate volume controls rather than the ganged controls as in the prototype. Here it is a simple matter to change the existing volume control to a single type and to use the balance control as a second volume control. ■

SHORT WAVE NEWS

FOR DX LISTENERS



By Frank A. Baldwin

Times = GMT *Frequencies = kHz*

From time to time I receive letters from readers and from those within the short wave listening fraternity with whom I have had previous contacts. Much useful information is exchanged in this manner, one of my long standing correspondents being Bob Iball of Worksop – a well-known and respected Dxer of many years experience.

The exchange of Dx information by mail and telephone is a common occurrence in the Dx world and the writer is no exception when it comes to maintaining contacts by these methods. Bob and I have been in regular contact for more years than I care to remember, the arrival of his news and Dx notes – dumped on the doormat by the postman – always being received with great pleasure.

Then there are the general queries I receive, such as which receiver is best; which should I purchase; what is the best type of aerial for reception of so and so; what time should I listen for this or that station, country or continent and on which channels? Which club is the best; should I modify my receiver and how; can you tell me if this or that station sends out QSL cards? What equipment do you operate? Or perhaps the two classics "I cannot receive Sri Lanka, what is wrong with my receiver" and "I note the times in your article, when do you sleep"?

However, one reader has just sent in some items from his log and although I do receive these results from time to time it is the youthfulness and enthusiasm that impressess me. M. Lavocah of Elm Park, Hornchurch, tells me he has received Helsinki on **11835** at 1950 with the English programme, Trans World Radio, Monte Carlo on **9500** at 0749 in English and Radio Norway on **9590** at 0811 also in English. Being 14½ years of age, he has been short wave listening for a year and half and the dedication to the hobby shines out from the pages of his letter. All success to him and the many other readers like him.

AROUND THE DIAL

In which are listed some of the transmissions heard recently and which, I hope, will be of some interest to some readers some of the time.

● NETHERLANDS

Hilversum on **11930** at 0816, when radiating the Dutch programme for Europe and the Middle East, which is scheduled from 0730 to 0820.

● FRANCE

Paris on **11770** at 0820, OM with a talk in the French programme intended for Central and Eastern Europe, scheduled from 0800 through to 1700 on this channel.

● VATICAN CITY

Vatican on **11715** at 0822 with choral religious songs in the music programme for Europe scheduled for Sundays only from 0820 to 0830.

Vatican on **11740** at 1415, OM station identification followed by the Polish programme for Europe, scheduled from 1415 to 1430.

● ITALY

Rome on **11810** at 0850, OM with a talk about tourism in the Spanish programme directed to Australia and scheduled from 0830 to 0930.

● PORTUGAL

Lisbon on **11800** at 0848, OM with the Portuguese programme for Europe, scheduled from 0800 to 1800 on this particular channel on Saturdays and Sundays only.

● SPAIN

Madrid on **11730** at 0840, OM's with a discussion about Spanish democracy in the Spanish programme for Australia, scheduled from 0730 to 0900 (not Sundays).

Madrid on **11920** at 1404, YL announcer with a newscast in the Spanish programme for Africa, the Americas, Australia and the Philippines, scheduled from 1400 to 2045. Also for Europe and the Middle East up to 1800.

● YUGOSLAVIA

Belgrade on **11735** at 0845, OM with a talk in Albanian. This is one of a series of programmes which are relays of various local stations for the benefit of Yugoslavs abroad. The broadcasts are made on Saturdays and Sundays only and are timed from 0700 to 1100. That logged here emanated from Radio Pristina and is scheduled from 0800 to 0900 on Sundays. On Saturdays at the same time a programme in Serbo-Croat is radiated.

● ALBANIA

Tirana on **11985** at 0930, YL with station identification then OM with a newscast in the English programme for Asia and Australia, scheduled from 0930 to 1000. Also logged on the same channel at 1410 when the station identification was made, this being followed by a news review in the English programme to South East Asia and Australia, scheduled from 1400 to 1430.

● **WEST GERMANY**

Cologne on **11785** at 1747, OM with announcements concerning times of transmissions and frequencies, all at the end of the English programme for Asia and Australia, scheduled from 1720 to 1750.

Cologne on **11850** at 0955, YL announcer in a rendering of choral folk music in the English programme to Asia and Australia, scheduled from 0930 to 1030.

● **EAST GERMANY**

Berlin ("Radio Berlin International") on **11700** at 1334, YL with station identification then OM with a talk about Polish internal affairs in the English programme for South East Asia, scheduled from 1300 to 1345.

● **CZECHOSLOVAKIA**

Prague on **11855** at 0904, OM with a talk about local affairs in the English programme for Africa, the Far East, South Asia and the Pacific, scheduled from 0830 to 0900 (to 0930 on Saturdays and Sundays).

● **ROMANIA**

Bucharest on **11775** at 1510, OM and YL with news commentary in the English programme directed to Asia and scheduled from 1500 to 1530.

● **GREECE**

Athens on **11730** at 1515, OM with announcements, local music in typical style all in the Greek programme for North America, scheduled from 1500 to 1550.

● **HUNGARY**

Budapest on **11910** at 1521, when radiating a programme of folk songs and music in the Italian programme for Europe, scheduled from 1500 to 1530 (not on Sundays).

● **FINLAND**

Helsinki on **11755** at 1527, interval signal, station identification in several European languages and Arabic in the Finnish programme intended for Europe, North America and the Middle East and scheduled from 1500 to 1630.

● **BULGARIA**

Sofia on **11720** at 1900, YL with station identification followed by a programme in Italian for European consumption, scheduled from 1900 to 1930.

● **CANADA**

Montreal on **11935** at 1545, YL with station identification followed by "Reports from our Correspondents". All in the English programme for the USSR, scheduled from 1545 to 1600.

● **BANGLADESH**

Dacca on **11765** at 1906, OM with a newscast in English at dictation speed for Europe, scheduled from 1900 to 1915. The English programme is timed from 1815 to 1900.

● **AUSTRALIA**

Melbourne on **11740** at 0758, 'Waltzing Matilda', YL with station identification, time-check, OM with a newscast in English to Europe, the programme scheduled from 0700 to 0900 on this channel.

Melbourne on a measured **11819** at 0738, OM with a newscast in the English programme for Papua New Guinea and the Pacific Islands, scheduled from 0700 to 0845 on this frequency.

● **ZIMBABWE**

Gwelo on **3396** at 1815, OM with a talk in English about local personalities in the General Service, scheduled from 0350 (Sundays from 0500) to 0545; from 1500 to 2200 (Sundays until 2105) on 100kW and from 0545 to 0615 on 10kW.

● **BENIN**

Cotonou on **4870** at 2043, OM & YL's with local music and songs in vernacular. This is the Home Service in French and vernaculars, scheduled from 0415 (Sundays from 0550) to 0800; from 1300 (Saturdays 1100) to 2400, closing time variable. Sundays from 0415 through to 2400. The power is 30kW.

● **NIGERIA**

Lagos on **4990** at 0534, YL with a religious talk in English. This is the National Programme in English and vernaculars being scheduled from 0430 to 1000 and from 1700 to 2310. The power is 20kW – I often listen to this one in the early mornings, it is an old habit as far as I am concerned.

Kaduna on **4770** at 0411, OM and YL with announcements in English then into a programme of local pops on records. This is the Home Service reportedly closing at 2320. The power is 50kW.

● **NAMIBIA**

Windhoek on **3270** at 2303, YL with a ballad in Afrikaans then local pops on records. This is the South West Africa Broadcasting Corporation operating from 1615 through to 0515 (also in parallel on **4965**). The power is 100kW.

● **COLOMBIA**

Radio Super, Medillin, on **4875** at 0359, OM with station identification "Radio Super", YL with announcements in Spanish, Latin American dance music in typical style. Radio Super operates around the clock with a power of 2kW.

Radio Melodia, Bogota, on **6045** at 0421, OM with announcements in Spanish ending with station identification and a few local news 'flashes'. Schedule unknown, power 5kW.

Radio Colosal, Neiva, on **4945** at 0346, OM with a newscast in Spanish of world events. The schedule is qround the clock and the power is 2.5kW.

La Voz del Cinaruco, Arauca, on **4865** at 0141, local pops on records, OM with announcements and commercials. The schedule is from 0900 to 0330 (closing time is variable) and the power is 1kW.

La Voz del Norte, Cucuta, on **4875** at 0041, local style dance music, OM announcer in Spanish, YL with a love song. The schedule is from 0930 to 0500 (both opening and closing times are subject to variation) and the power is 5kW.

● **NICARAGUA**

La Voz de Nicaragua, Managua, on a measured **5949.5** at 0428, OM with station identification followed by a talk about local affairs, all in Spanish. The power is 50kW, and this is the Domestic Service operating around the clock.

Continued overleaf

THE INTERNATIONAL AMATEUR RADIO UNION REGION 1 CONFERENCE

Report by Arthur C. Gee

The I.A.R.U. Region 1 triennial Conference was held at Brighton, between the 27th April and the 2nd May last.

The Conference was opened by the Rt. Hon. Timothy Raison, MP, Minister of State at the Home Office. Lord Wallace of Coslany and other distinguished visitors were also speakers at the opening session.

Some 140 or so delegates from more than 40 countries were present, and included delegates from the USSR, Africa, Middle East, USA and Canada, as well as of course, from European countries. Representatives from Japan and South America were also present.

A very large number of papers were presented covering all aspects of amateur radio activity. There can have been no previous conference of this nature which covered such a diverse range of topics. From I.A.R.U. Region 1 Finance and Administration through technical papers from 1.8 MHz to VHF and UHF and Microwaves, Contests and Direction Finding Rallies, RTTY and Amateur TV, Traffic procedures, Emergency Communications and DX expeditions, CB and its relationship with amateur radio, satellites and propagation studies, so one could go on. An infinite variety of matters affecting the future of amateur radio were very thoroughly discussed.

Amongst some of the interesting recommendations agreed were:- an offer by the RSGB to provide data processing facilities for the IARU Monitoring System; the Observation Service should include the supervision of technical quality of transmissions from amateur transmitters; the production of a pamphlet for distribution to new radio amateurs explaining what is necessary for good amateur operation in an endeavour to stop the deterioration of conduct on the amateur bands; speeds of 50, 75 and 100 bauds for RTTY operation to be encouraged; emergency networks to be fostered in those countries where they do not yet exist; the dividing line between VHF/UHF and microwaves to be 1 GHz; a Region 1 Satellite Co-ordinating Group to be formed; proposals put forward to transfer ATV from 70 cms to 23 cms, to stop the wideband interference on 70 cms from this mode of transmission; a new Locator System was put forward for consideration but was rejected; a proposal to limit the number of contests taking place on the HF bands; and very many more.

The above is of necessity a very brief resumé of some of the activities which took place during a very hectic week, which kept the hard working delegates well occupied. Whilst the recommendations of Conferences such as this one are not often immediately implemented, it is to be hoped that many of the recommendations soon will be.

SHORT WAVE NEWS (Continued)

PERU

Radio Atlantida, Iquitos, on **4790** at 0425, dance music Euro-style, OM announcements in Spanish, station identification and off with the National Anthem at 0500. The schedule is from 0900 to 0500 (Sundays 0400) but sometimes around the clock. The power is 1kW. Be careful however, Sistema de Emisora Atalaya, Guayaquil, Ecuador also sometimes comes through on this channel but closes at 0400.

Radio Chinchaycocha, Junin, on **4860** at 0435, OM with announcements and a clear station identification then local pops on records. The schedule of this one is around the clock but sometimes operates on a Tuesday from 0800 to 0600. The power is 0.5kW.

Radio Loreto on a measured **5049.2** at 0440, OM with announcements in Spanish, local pops in usual style. The schedule is from 1100 to 0500 and the power is 2kW.

COSTA RICA

Radio Reloj, San Jose, on a measured **6006** at 0418, YL with a talk in Spanish about Nicaragua (mentioned several times), OM with announcements at 0420 then into a programme of songs. The schedule is around the clock and the power is 1kW.

(Concluded)

"Short back and sides, and the radio turned down 10 decibels."

NEXT MONTH

The beginning of the WORLD is nigh...

RADIO & ELECTRONICS CONSTRUCTOR
metamorphoses to reappear as

RADIO & ELECTRONICS WORLD

The most feature-packed, up-to-date electronics magazine for the amateur and professional enthusiast. Issue 1 includes...

NBFM DEVIATION METER:

describes a complete 'auto tuning' deviation meter for the UK CB band. A complete auto tuning deviation meter covering up to 500MHz is covered in subsequent instalments.

2m CONVERTER

A state-of-the-art ultra low noise design using helical filters for ease of construction

SCOOP!
CB RIGALISER
THE 'NAUGHTY CB' DETECTOR IS DESCRIBED BY THE DESIGNER

AM/FM portable, 60kHz MSF receiver, loudspeaker protector, IC2E reviewed, 50 circuits for the free Ferranti E-Lines, news, comment - and plenty more. Order your copy now to avoid disappointment .... we are only printing 60,000 !!

On Sale 3rd September

MW AND LW SUPERHET RADIO

John Baker

This article describes a relatively simple MW and LW superhet receiver which is completely self-contained, having an internal ferrite aerial, battery supply, and loudspeaker. A maximum output power of about 300mW is available, and the use of an integrated circuit in the audio stages provides a high quality output despite the simplicity of the circuitry. The only other active devices used in the unit are three inexpensive and readily available transistors.

As the unit is a superhet design, once completed it does need to be accurately aligned in order to produce good results. However, this particular set is quite easy to align and no test equipment is required when adjusting the finished receiver. This ease of alignment is aided by the use of mechanical filters in the IF stages. These filters are pre-aligned and require no adjustment; in fact there is no way of adjusting their operating frequency.

THE CIRCUIT

Fig. 1 shows the complete circuit diagram of the receiver, There are two sets of coils on the ferrite rod; L1 and L2 are the LW tuned and coupling windings respectively, while L3 and L4 perform the same functions on the MW band. S1(a) selects the appropriate tuned winding for the selected wave band and couples it to the tuning capacitor, YC1 is an alignment trimmer. The LW winding requires a small amount of additional tuning capacitance, and this is provided by C3. There is no need to switch the two coupling windings, and these are simply wired in series so that the outputs from both coils are coupled into the input of the mixer by DC blocking capacitor C4.

TR1 is used in what is virtually the standard mixer/oscillator configuration, the only departure from normal practice being the use of a resistor (R3) as the load at the output of the mixer. Normally the

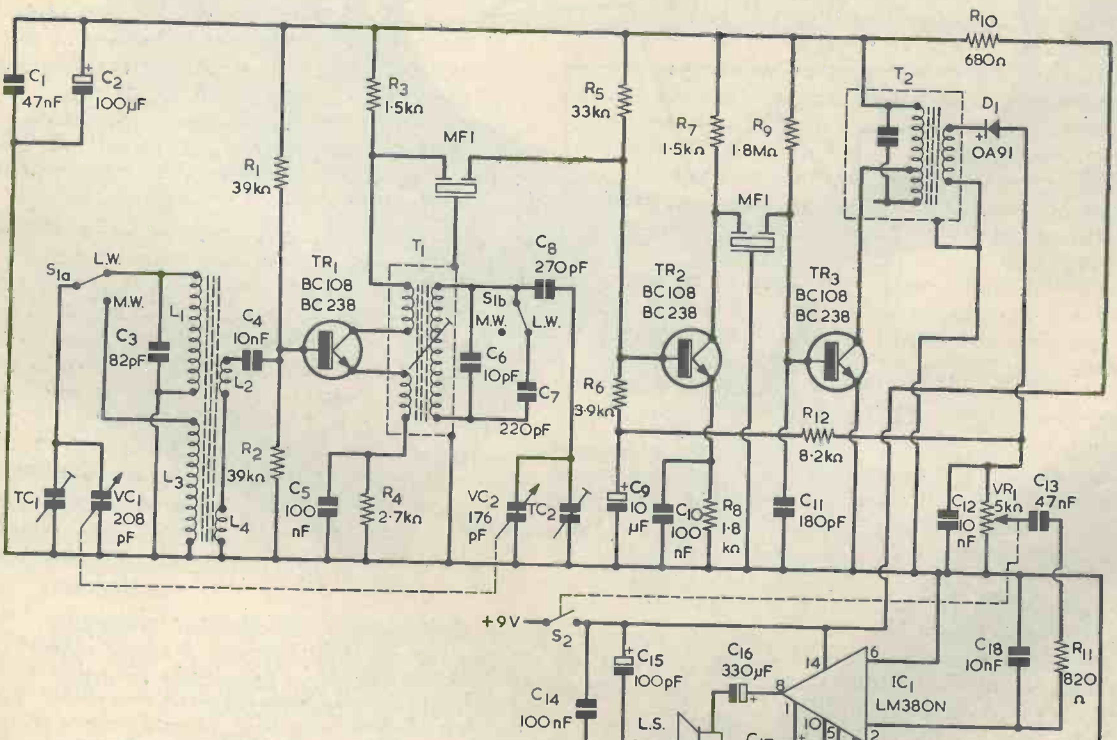
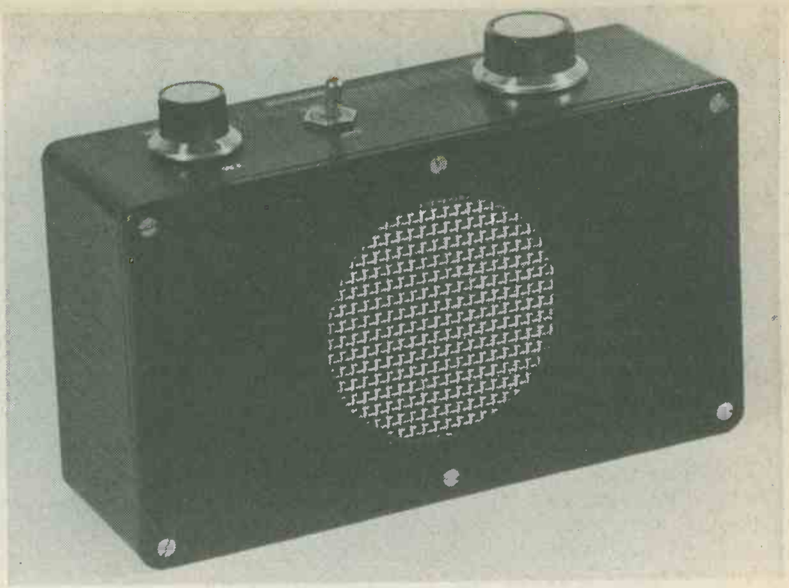


Fig. 1. The complete circuit diagram of MW/LW superhet radio.

External view of LW and MW superhet.



primary of the first IF transformer would be used here, but this is not possible in this case as mechanical filters are used to provide the interstage coupling, and so a resistive load has to be used.

R1 and R2 are the bias resistors for TR1, and R4 plus C5 are the emitter bias resistor and bypass capacitor. T1 is the oscillator transformer, and this produces oscillation by supplying positive feedback between the collector and emitter of TR1 (which is used in the common base mode as far as the oscillator circuit is concerned). The frequency of oscillation is determined by the resonant frequency of the tuned winding of T1. This must always be 455kHz higher than the input frequency in order to produce the required 455kHz IF output signal.

The non-earthy end of the tuned winding is coupled to the oscillator tuning capacitor, VC2, via padder capacitor C8. A small amount of fixed capacitance is required across the tuned winding of T1, and this is provided by C6. Together these two capacitors ensure correct tracking between the RF and oscillator circuits on the MW band provided the unit is aligned properly.

A lower and more restricted range of oscillator frequencies is needed for LW operation, and this is accomplished by C7 shunting the oscillator tuning capacitance when S1(b) is in the LW position.

The two tuning capacitors are ganged, and note that alignment trimmers TC1 and TC2 are also part of this component.

The output from the mixer is coupled by mechanical filter MF1 to the input of the first IF amplifier stage. This is a high gain common emitter stage which is biased by the potential divider chain which is comprised of R5, R6, R12, and VR1. R8 and C10 are the emitter bias resistor and emitter bypass capacitor. R7 is the collector load for TR2.

MF2 couples the output from TR2 collector to the input of the second IF amplifier stage. This is another high gain common emitter amplifier and it uses TR3. R9 provides base biasing and C11 is needed in order to prevent this stage becoming unstable. T2 is an ordinary IF transformer and its primary winding forms the collector load for TR3. Mechanical and ceramic filters tend to have out of band responses which can result in a lot of strong spurious signals reaching the detector unless precautions against this are taken. The normal precaution is to use an ordinary IF transformer (which is free from such responses) at some point in the IF circuitry, and this is the reason T2 is used at the IF output, rather than a third mechanical filter or an untuned coupling.

Detector diode D1 is fed with the IF output signal from T2 secondary. VR1 forms the load for D1, and C12 filters out the RF half cycles to leave the required audio signal. When a strong signal is received there will be a large negative DC bias produced across VR1, and this will result in a reduction in the bias voltage fed to TR2. This reduces the operating current of TR2 with a consequent reduction in its gain. This gives the circuit a simple form of A.G.C. (Automatic Gain Control) with the gain of the unit being reduced on strong signals. This gives a more consistent audio output level, combats fading to a certain degree, and makes the receiver less susceptible to overloading on very strong signals.

An LM380N IC is used as the basis for the audio amplifier. The output from the volume control, VR1, is fed to the non-inverting input of IC1 by way of a simple RF filter which consists of R11 and C18. It is essential that no significant RF signal should be allowed to enter the audio stages as this would almost certainly result in instability. C13 provides DC blocking at the input and C16 provides the same function at the output of the device. The voltage gain of the LM380N is preset at 34dB (50 times) by an internal negative feedback loop. It is possible to raise or lower the gain of the device using a discreet feedback circuit, but this is not necessary in this case as the preset voltage gain is just about right anyway.

The circuit does not seem to need extensive supply decoupling despite the fact that there is a high overall level of gain, and the decoupling provided by C14, C15, C17, R10, C1 and C2 is more than adequate. S2 is the on/off switch and is ganged with VR1. The quiescent current consumption of the circuit is approximately 8mA, but the LM380N has a class B output stage and the supply current rises to several times this level at high output volumes.

COMPONENTS

Resistors
(All miniature 1/3, 1/4, or 1/8 watt 5% tolerance)

R1 39k
R2 39k
R3 1.5k
R4 2.7k
R5 33k
R6 3.9k
R7 1.5k
R8 1.8k
R9 1.8Meg.
R10 680ohms
R11 820ohms
R12 8.2k
VR1 5k log carbon with switch (S2) e.g. ALPS UMBR

Capacitors
C1 47nF type C280/Mylar
C2 100mfd 10vw
C3 82pF ceramic
C4 10nF ceramic, etc.
C5 100nF type C280
C6 10pF polystyrene
C7 220pF ceramic
C8 270pF ceramic
C9 10mfd 10vw
C10 100nF type C280
C11 180pF ceramic
C12 10nF type C280/Mylar
C13 47nF type C280/Mylar
C14 100nF type C280/Mylar
C15 100mfd 10vw
C16 330mfd 10vw
C17 10mfd 10vw
C18 10nF type C280/Mylar
VC1/2 208pF plus 176pF air spaced with trimmers (Jackson type 0)

Semiconductors
TR1 BC108/BC238
TR2 BC108/BC238
TR3 BC108/BC238
IC1 LM380N
D1 OA91

Inductors
L1/L2 MW antenna coil type MWC2
L3/4 LW antenna coil type LWC1
T1 MW oscillator coil type YMRS16726/302
T2 455kHz IFT type YHCS11100AC2
MF1 Mechanical filter type CFM2 B.
MF2 Mechanical filter type CFM2 B.
(All above are available from Ambit International)

Switches
S1 D.P.D.T. toggle type.
S2 Part of VR1

Loudspeaker
LS1 About 3in. diameter, 8 to 80 ohm impedance (see text)

Miscellaneous
Plastic case measuring approx. 185 x 109 x 60mm (or similar non-metallic housing).
Plain 0.15in. matrix board and 0.1in. matrix stripboard.
Two control knobs.
140mm x 9.5mm F14 grade ferrite rod (Ambit type FRA).
Two mounting clips for ferrite aerial (Ambit type FRPC).
PP3 battery and connector to suit.
Speaker fret, connecting wire, etc.

CONSTRUCTION

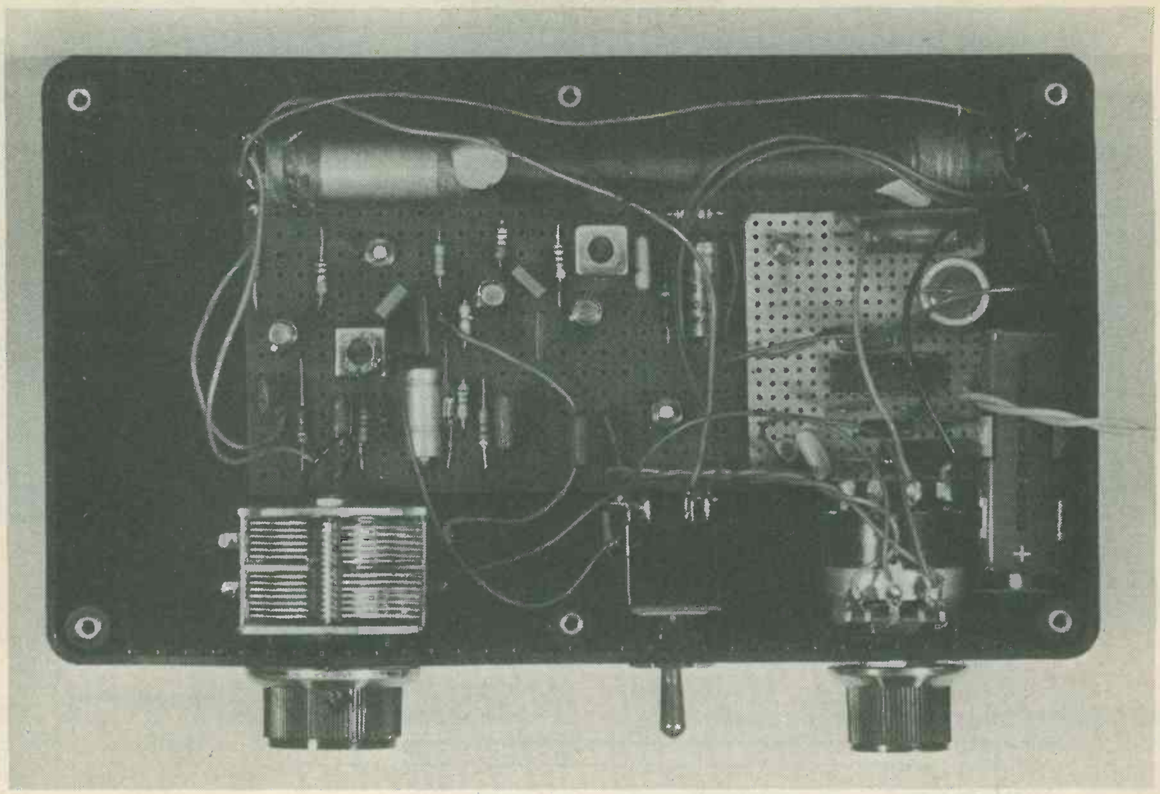
A plastic box having approximate outside dimensions of 185 x 109 x 60mm is used to house the prototype receiver. Any non-metallic case of about the same size should also be suitable, but a metal case cannot be used as it would screen the ferrite aerial and prevent signals from being picked up.

The case has a removable lid which in this application becomes the front panel. A cutout for the speaker is cut in the centre of this panel using a fretsaw or a miniature round file, and then a piece of speaker fret or speaker material is glued in position over the rear of the cutout. The loudspeaker is then carefully glued in place onto the speaker material. Only a small amount of adhesive should be applied to the front rim of the speaker, and care must be taken not to get any of the adhesive onto the diaphragm of the speaker. A good quality adhesive such as an epoxy type must be used.

The speaker can be of any type having a diameter of up to about 89mm (3.5in.) and an impedance in the range 8 to 80 ohms. Ideally the speaker should have an impedance of about 15 to 25 ohms, but such units are not very widely available. In practice an 8ohm speaker seems to give good results, although at the expense of slightly reduced battery life. Higher impedance types give a lower current consumption and longer battery life due to the reduced maximum output power (only about 75mW into an 80ohm speaker). Speakers having an impedance of less than 8ohms should not be used.

The three controls are mounted on the top panel of the case (one of the 185 x 60mm sides). VR1 and S1 are mounted on the lefthand side of the case and VC1/2 is mounted on the right hand side. Assuming VR1 and S1 are standard components they will require 10mm (3.8in.) and 12.5mm (0.5in.) diameter mounting holes respectively.

The tuning capacitor has a rather unusual mounting arrangement which requires a central hole of about 10mm in diameter for the spindle of the component, and three 4BA clearance mounting holes for the short 4BA countersunk mounting screws. These fit into three threaded holes in the front of the tuning capacitor. One way of locating the positions of the three smaller mounting holes is to make up a paper template with the aid of the component itself, but



Internal layout of radio.

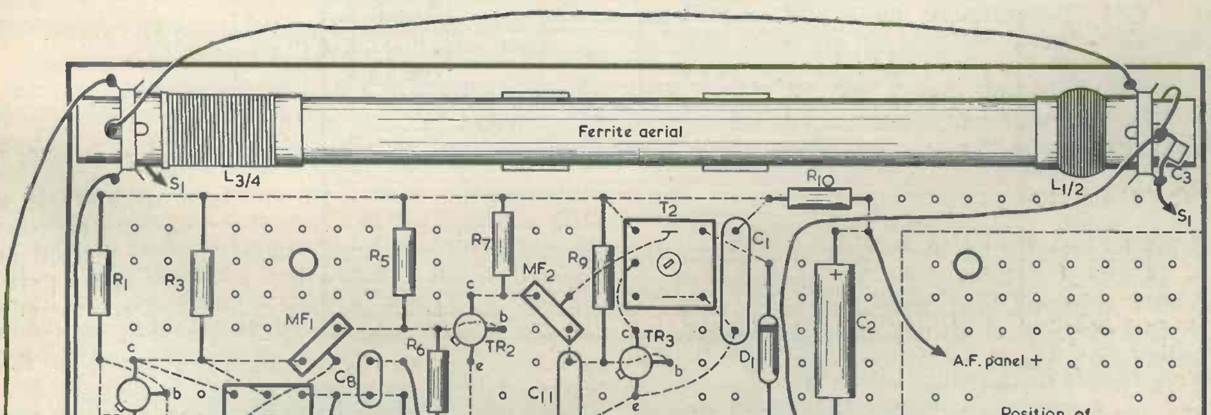


Fig. 2. Details of the plain 0.15in. matrix component panel.

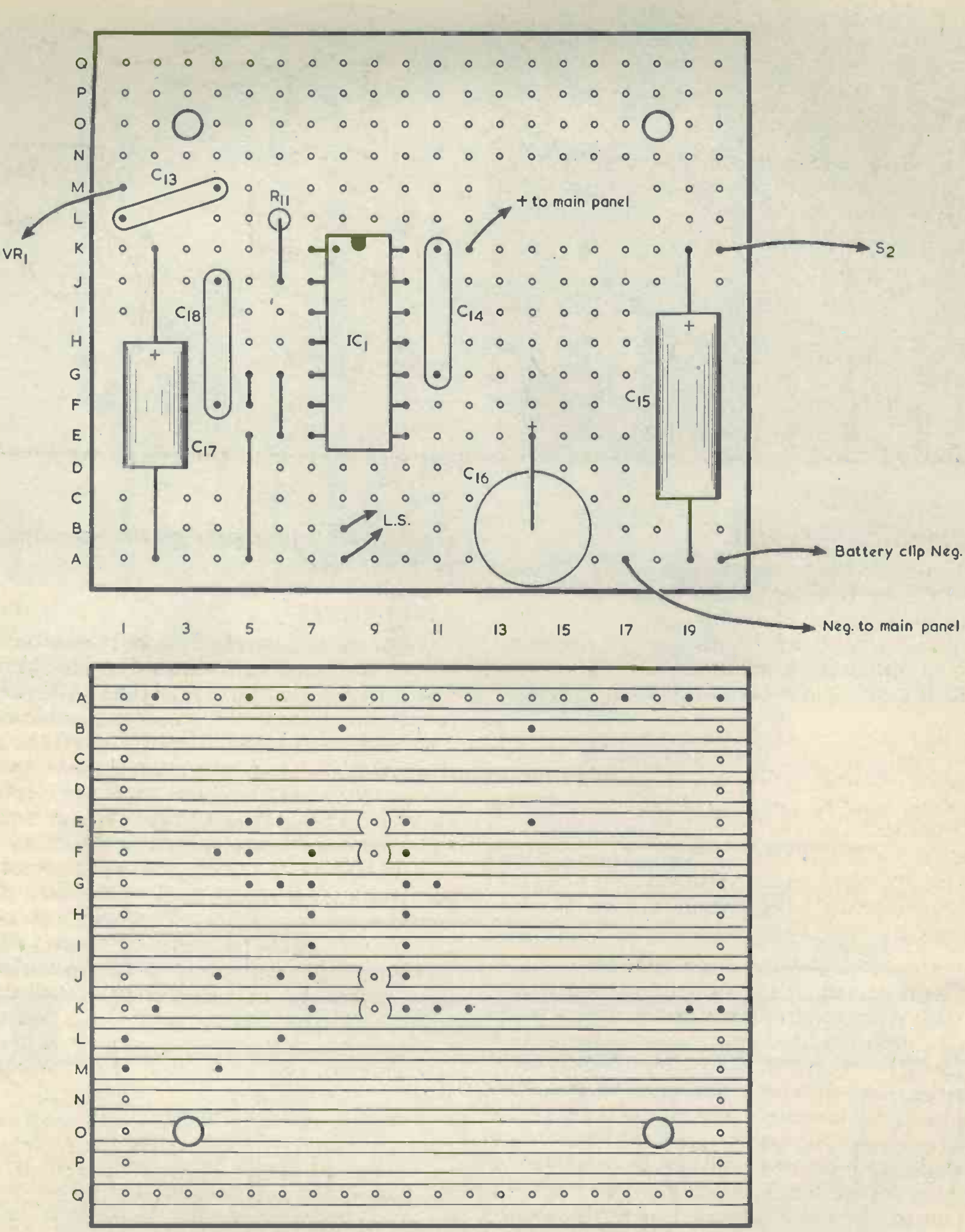


Fig. 3. Details of 0.1in. stripboard panel on which the AF amplifier is assembled.

other methods have been described in previous articles in this magazine. The three 4BA clearance holes are drilled using a No. 24 or similar twist drill.

It is important that suitably short mounting screws are used, or that washers are placed over them, between the front of the tuning capacitor and the case, so that their penetration is limited to an acceptable level. If these screws fit right through the front plate of the tuning capcitor it is likely that the component will be jammed, and it could be irreparably damaged.

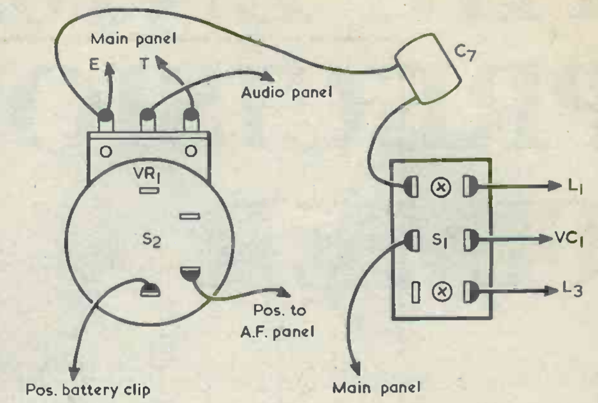


Fig. 4. The wiring to VR1, S1 and S2.

MAIN COMPONENT PANEL

Most of the circuitry is assembled on a plain 0.15in. matrix board which has 33 x 17 holes, and this is cut down from a standard 127 x 95mm (5 x 3.75in. and 33 x 24 holes) board using a hacksaw. The audio amplifier is constructed on 0.1in. stripboard, and this sub-assembly is bolted to the main panel.

Details of the main panel are given in Fig. 2. The ferrite aerial is mounted on two plastic clips which are in turn mounted on the panel using short 6BA bolts and nuts. In order to mount T1 and T2 on the board it is necessary to slightly enlarge four of the holes with a drill bit of about 1.5 to 2mm in diameter in order that they will accommodate the mounting lugs of these two components.

Construction of this type of component panel is quite straightforward with the component being mounted in the positions indicated in the diagram, the leadout wire then bent flat against the underside of the panel, and then these leads are directly connected to one another. In instances where the leadout wires are inadequate to complete the wiring, link wires made from 22 s.w.g. (approx.) tinned copper wire are used. Next the connections between the component panel and the ferrite aerial are completed, and V3, which is mounted directly onto L1, is soldered into position.

The AF board has 17 copper strips by 20 holes and uses the layout shown in Fig. 3. First a board of the required size is cut out, then the two 6BA clearance mounting holes are drilled using a No. 31 or equivalent twist drill, and next the four breaks in the copper strips are made. The components and link wires can then be soldered into place.

The mounting holes for the AF panel are then drilled in the main panel, and the two mounting holes for the main panel itself can also be drilled at this stage. Also, the two mounting holes for this whole assembly can be drilled in the case. However, before the two panels are finally bolted together and fitted in the case, the remaining wiring must be completed including the wiring to the controls. Fig. 4 illustrates the wiring to S1, S2 and VR1. There is plenty of space for the PP3 battery, and on the prototype this is held in position by some strategically placed pieces of Bostik Blue Tack.

ALIGNMENT

With the set switched on and the waveband switch in the 'MW' position, it should be possible to receive a few stations, and by sliding the MW coil along the ferrite rod it should be possible to peak each station. The covereage of the set will probably be found to be rather high in frequency with the low frequency end of the band not covered, and the high frequency coverage extending into the SW spectrum. This can be corrected by screwing the core of T1 inwards.

When the MW coverage is approximately correct, with the set switched to the LW band it should be possible to receive one or two stations and to peak them by adjusting the position of the LW coil on the ferrite rod. It should be possible to find a setting for the core of T1 that causes the BBC 200kHz LW transmission to be received with the tuning capacitor at roughly a central setting, and which gives full MW coverage with S1 set back to the MW position. This is the correct setting.

LW alignment is very simple, and it is merely necessary to tune to the BBC 200kHz transmission and then adjust the position of the LW coil on the ferrite rod for maximum signal strength. The coil is then glued in this position. A multimeter set to a low volts range and connected across R8 (negative test lead connected to the negative rail) will provide a visual indication of signal strength. Maximum signal strength corresponds to minimum voltage.

To align the set on the MW band first tune to a station at the low frequency end of the band (VC1/2 vanes almost fully meshed) and position the MW aerial coil on the ferrite rod for maximum signal strength. Then tune to a station at the high frequency end of the band and adjust TC1 for maximum signal strength. Next retune to the station at the low frequency end of the band and once again adjust the position of the MW coil on the rod for maximum signal strength. Repeat this procedure a few times until the set has good sensitivity over the entire MW band. The setting of TC2 is not important, provided it is not screwed down tightly, otherwise it may then be impossible to accurately align the receiver.

THE ZN1034 PRECISION IC TIMER

R. A. Penfold

Most simple electronic timer devices operate on the simple principle of a capacitor being charged via a resistor. Usually the timing period starts when the capacitor first begins to charge up, and ends when the voltage across the capacitor reaches a certain percentage of the supply rail potential. The popular NE555V timer IC is a good example of a timer of this general type, but virtually all timers featured in the amateur electronics magazines use the same basic arrangement.

While circuits of this sort have the advantage of being relatively simple and inexpensive, the main drawback is that even to obtain quite short times it is necessary to use fairly large timing component values. For example, when used in the monostable mode the NE555V IC has an output pulse length which is approximately equal to 1.1 CR (with C in farads and R in ohms, or more conveniently with C in mfds and R in Meg. ohms). Thus C and R values of say 10mfd and 1 Meg. ohm would produce an output pulse of approximately 11 seconds.

Therefore, even to obtain fairly short timing periods it is necessary to use an electrolytic capacitor in the timing network. The main drawback of this is that electrolytics tend to have comparatively high leakage currents (or low insulation resistances if viewed in this way) and even if a good quality capacitor is used it is not practical to obtain times of more than about 1 or 2 hours. Also, the repetitive timing accuracy may not be particularly good, especially in the long term. Similarly, the insulation resistance of an electrolytic capacitor usually varies significantly with ambient temperature, and so temperature stability may be rather poor as well.

Using a low grade electrolytic in a timing application will almost certainly provide very poor results, if the circuit functions at all that is!

PRECISION TIMER

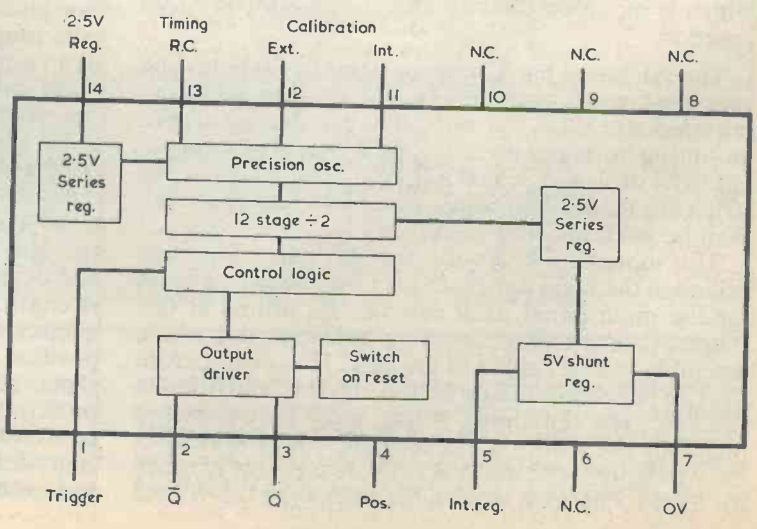
Where short pulses of very high precision are required, such as in digital frequency meters, the usual method of deriving them is by employing a high stability crystal oscillator and a digital frequency divider chain. It is quite feasible to use the same method to obtain long output pulses, but for virtually all practical purposes the accuracy yielded by a crystal oscillator is not required, and a good quality C R oscillator can be used instead.

This system has the advantage of being able to produce quite long timing periods using a non-electrolytic timing capacitor, or extremely long timings by using an electrolytic component.

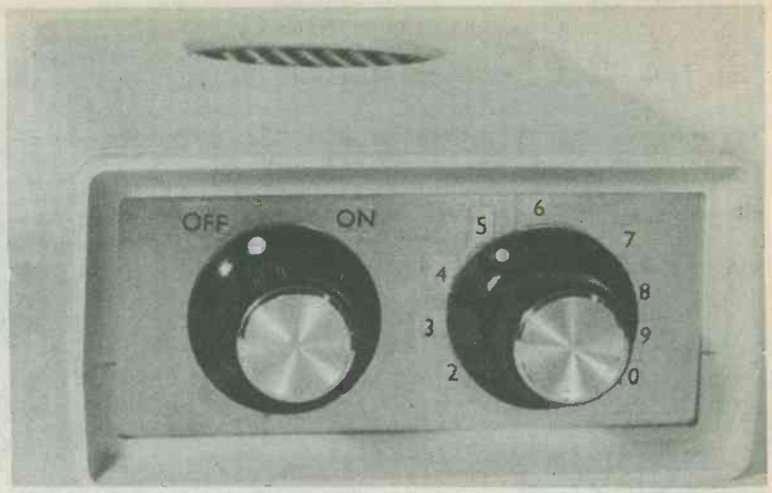
Obviously a timer of this type could be constructed using a separate oscillator and logic circuitry, but this is not necessary since a special precision timer IC is available. This is the Ferranti ZN1034, this is capable of producing an output pulse of less than one second to more than one month! It will provide much better accuracy than simple timer circuits, although the ZN1034 admittedly cost considerably more than the NE555V and similar devices.

Fig.1 shows in block diagram form the internal arrangement of the ZN1034 and it also shows the pin

Fig. 1. Block diagram showing the internal arrangement of the ZN1034E IC



The front of the unit.



function of the ZN1034E, which is the 14 pin DIL plastic package version of the device, and is the version normally supplied by retail sources. As will be seen from Fig.1, the device contains a highly stable oscillator, 12 stage binary divider, control circuitry, and output driver circuitry. The unit can be powered from a stabilised 5 volt supply, or from a nominal supply potential of 6 volts or more using a series resistor and the internal 5 volt shunt regulator.

A practical circuit using the ZN1034 can be very simple, the basic method of using the device is shown in Fig.2.

CT and RT are the frequency determining components of the oscillator, but the frequency of oscillation is also affected by the resistance between pins 11 and 12 of the IC. In many applications these two pins can simply be connected together, and the oscillator then has only a 100k internal Cal. resistor connected into circuit. This gives optimum temperature stability, and the length of the output pulse is approximately equal to 2736 CT RT.

If RT is to be a series of close tolerance resistors which are calculated to give a series of preset times, or RT is to be a potentiometer so that the length of the output pulse can be varied between certain limits, the ability to trim the output pulse using a separate preset resistor is almost essential. It then becomes necessary to connect a preset between pins 11 and 12. With an external Cal. resistance of 200k (300k total Cal. resistance) the output pulse is approximately equal to 7500 RT CT. The total Cal. resistance should not be much more than about 300k.

RT should not be less than 5k or more than about 10 Meg. CT should not be less than 3.3nF, and there is no definite upper limit to the value of this component. This is determined by the required accuracy and the leakage current of the capacitor which is used.

RL is the load resistor for the internal 5 volt shunt regulator, and this must limit the supply current to 50mA or less. On the other hand, it must provide a current of 7mA for the ZN1034 plus the maximum output current that will be required (the device can provide an output current of up to 25mA). CD is merely a supply decoupling capacitor.

If the circuit is supplied from a stabilised 5 volt supply, this is applied to pin 4 and pin 5 is left unconnected.

The output pulse is started by taking 1 to the negative supply rail potential, or a voltage of no more than 1 volt. The circuit is actually a non-retriggerable monostable multivibrator, and so either taking pin 1 low briefly or continuously will produce an output pulse of the correct length, unlike some timer circuits where the trigger terminal must be returned to the high state before the end of the output pulse, or the pulse is extended until the trigger terminal is returned to the high state.

The circuit has both Q and not-Q outputs. The Q output is normally low and produces a positive output pulse and the not-Q output is normally high and produces a negative output pulse.

In an application where it is necessary for the circuit to operate an alarm of some kind for a short time at regular intervals, this can be achieved by connecting the Q output to the trigger terminal via an R – C network. (Fig.3). The length of time between the output pulses is approximately 0.6 C R.

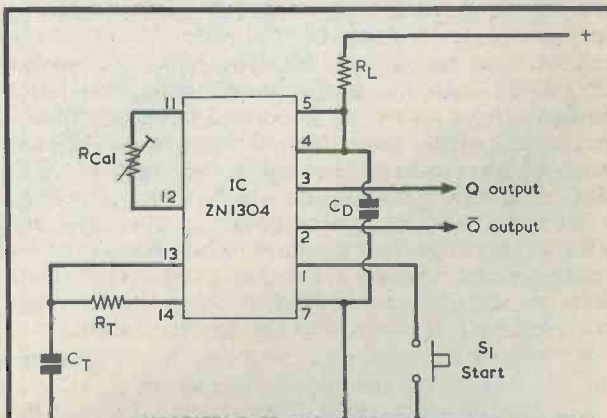


Fig. 2. Basic ZN1034E Timer circuit.

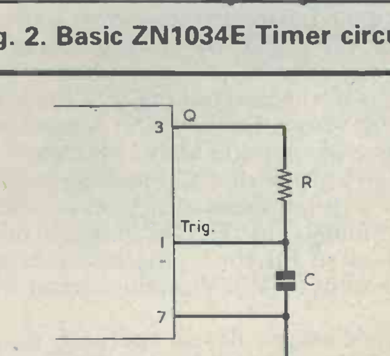
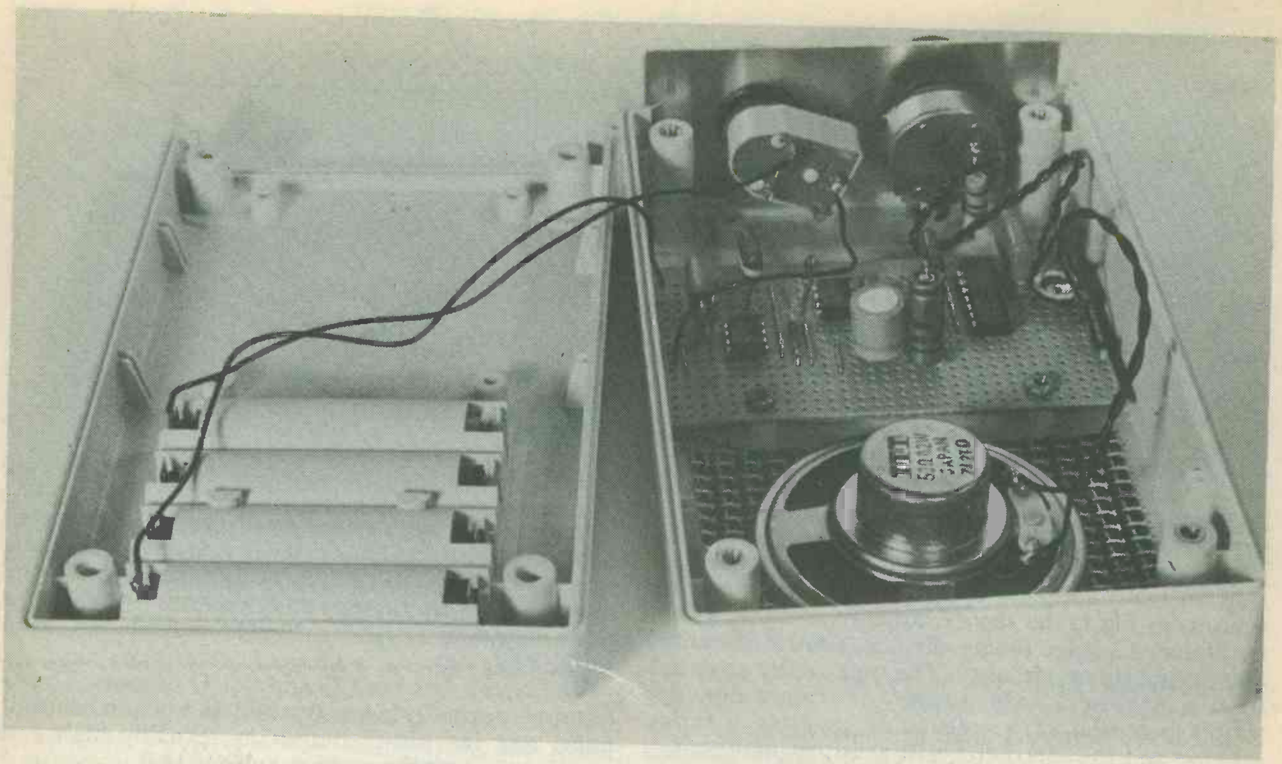


Fig. 3. By coupling the Q output to the trigger terminal, the circuit will continuously retrigger itself.



Layout showing built-in battery box.

SIMPLE TIMER UNIT

Simple timer circuits which provide an audio alarm after some preset length of time has elapsed can be very useful in a number of applications, and the circuit of a simple unit of this type which employs a ZN1034E timer IC is shown in Fig.4. This has a timing period which can be varied from less than 2 minutes to a little more than 10 minutes, but this can easily be altered to suit individual requirements. The alarm is a pulsed audio tone which is very effective.

VR1, R2, and C1 are the timing components, and VR1 enables the timing period to be varied over the limits specified above. R1 is the external calibration resistor, and this is adjusted to bring the coverage provided by VR1 to within the specified limits.

R3 is the load resistor for the 5 volt shunt regulator, and C2 is a supply decoupling capacitor.

The trigger input (pin 1) is connected direct to the negative supply rail so that the circuit is triggered the moment on/off switch S1 is closed, and power is applied to the unit.

The audio alarm used two NE55V timer ICs in the astable mode. One of these (IC3) is used to produce an audio tone of approximately 1kHz which feeds the loudspeaker by way of DC blocking capacitor C5. The NE555V astable circuit will only oscillate when the reset terminal (pin 4) is taken high. In this case the reset terminal of the tone generator is taken to the output of another NE55V astable circuit which uses IC2.

This second astable has an operating frequency of only about 2Hz, and so it has the effect of switching the tone generator on each time its output goes high, which is roughly twice per second. However, the reset terminal of IC2 is not connected to the positive supply rail, but is controlled by the not-Q output of the ZN1034E timer.

The not-Q output will go low as soon as the supply is connected to the circuit, and it will remain in this state until the end of the timing period. Thus IC2 will not oscillate until the end of the timing period and its output will go low until it does start to oscillate. This results in the tone generator also being disabled until IC2 is switched on.

Once the alarm does start to sound, it will continue until the unit is switched off using S1. The circuit is then ready to commence operation from the beginning once again when S1 is returned to the 'on' position.

The circuit is powered from a 6 volt battery supply which comprises four HP7 cells connected in series. The quiescent current consumption is about 25mA. and this increases slightly when the alarm operates.

CONSTRUCTION

The prototype timer is housed in a Verocase type 65-2067G which has approximate outside dimensions of 155 x 92 x 33mm, and has an integral battery compartment for the four HP7 cells. Any similar case of about the same size should also be suitable, but a plastic battery holder for the HP7 cells and a matching battery clip (PP3 type) will then be required.

S1 and VR1 are mounted side by side on the front panel with S1 on the left, and both these components require a 10mm diameter mounting hole. A cutout of about 50mm in diameter is made in the top section of the case above the battery compartment, and a piece of speaker fret or cloth is glued in place behind the cutout. The speaker is then glued in place on the speaker material, and only a small amount of high quality adhesive must be used here, as otherwise adhesive could be smeared over the diaphragm of the speaker. If this should be allowed to happen it could easily impede the operation of the speaker.

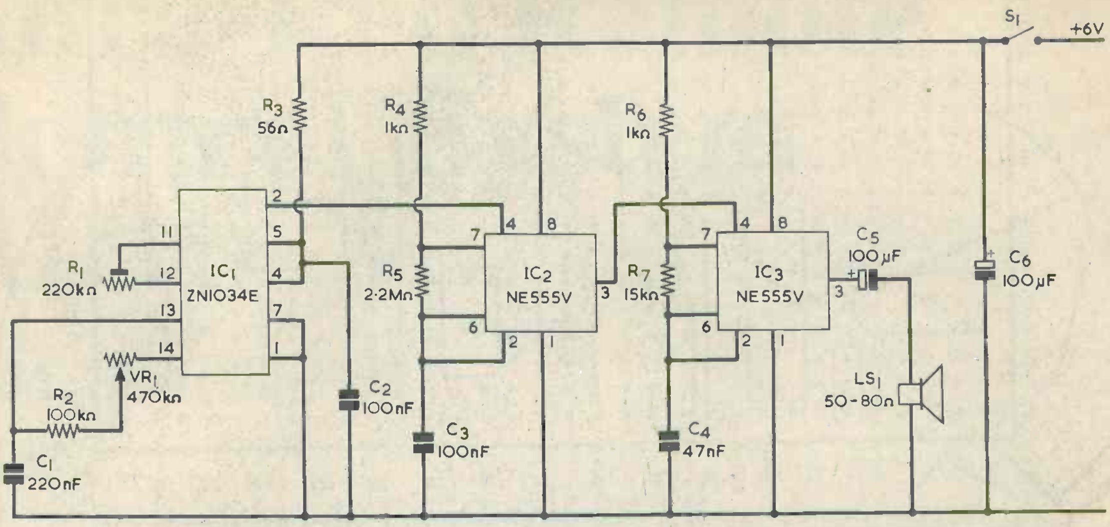


Fig. 4. The circuit diagram of a simple timer using the ZN1034E Timer IC.

COMPONENTS

Resistors

All 1/8 or 1/3 watt 5 or 10% except R1.
R1 220k sub miniature (0.1 watt) horizontal preset.
R2 100k
R3 56 ohms
R4 1k
R5 2.2 Meg.
R6 1k
R7 15k
VR1 470k 1in. carbon

Capacitors

C1 220nF type C280
C2 100nF type C280
C3 100nF type C280
C4 47nF type C280
C5 100mfd. 10vw.
C6 100mfd. 10vw.

Semiconductors

IC1 ZN1034E
IC2 NE555V or equivalent
IC3 NE555V or equivalent

Switch

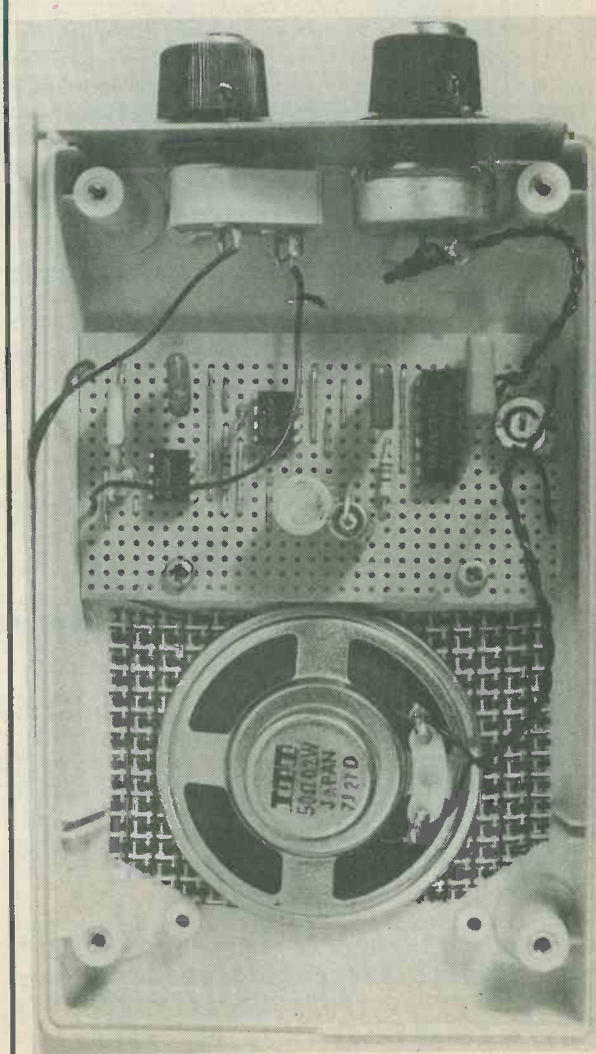
S1 Rotary on/off switch

Loudspeaker

LS1 50 to 80 ohm impedance, about 50 – 66mm in diameter.

Miscellaneous

Verocase type 65-2067G or similar and plastic battery holder for four HP7 size cells.
Two control knobs
Four HP7 cells
0.1in. matrix Veroboard panel.
Speaker fret or cloth, wire, solder, etc.



Internal layout of the unit.

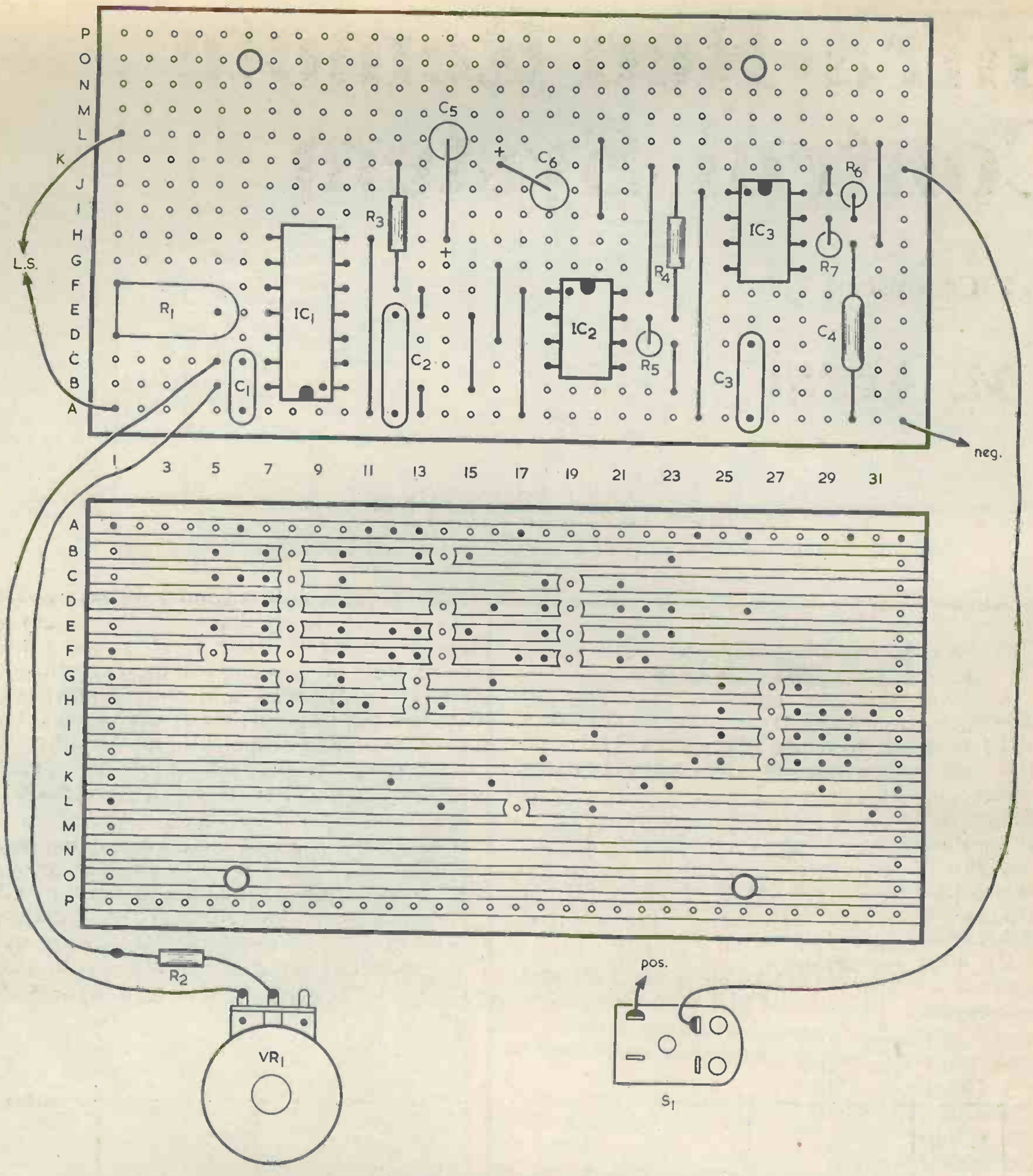


Fig. 5. The wiring of the Timer and details of the component panel.

With the exception of R2, which is mounted on VR1, the other components are assembled on a 0.1in matrix veroboard panel which has 32 holes by 16 copper strips. Details of the component panel and wiring are given in Fig.5. After the completed panel has been wired up to the rest of the unit it is mounted on the two mounting pillars just in front of the speaker using two short 6BA self tapping screws. The case has p.c.b. mounting slots and some of these may well be found to obstruct the component panel. This can be remedied by filing down the offending mounting rails, and this is not difficult as they are made of a reasonably soft plastic.

ADJUSTMENT

With the slider of R1 set at about the centre of its track the range of the unit will probably extend from less than 2 minutes to a little over 10 minutes, but some adjustment of R1 may be needed in order to achieve this coverage. Adjusting R1 in a clockwise direction has the effect of shortening the timings, and adjusting it in an anti-clockwise direction has the opposite effect.

A time scale should be marked around the control knob of VR1, and this can either be calibrated at regular intervals, or just the times which will be required by the user. In either case, finding the calibration points is really a matter of trial and error, and there is no easy short cut here.

If suitable test gear to accurately measure the length of each oscillator cycle is available, the output pulse length can be calculated by multiplying this figure by 4095. However, this may not be entirely reliable as loading by the frequency measuring apparatus could easily affect the frequency of the oscillator to a slight but significant degree. ■

Infra-Red Remote Control System

Part 2 (Conclusion)

I. M. Attrill

THE RECEIVER

The circuit diagram of the receiver is shown in Fig.4.

D1 is the infra-red detector diode, which has a built-in filter so that it is only sensitive to infra-red light. R1 forms the load resistor for D1, and the supply polarity is such that D1 is reverse biased. The pulses of infra-red from the transmitter, cause an increase in the leakage current of D1 which produces a series of negative pulses at the junction of D1 and R1, which are coupled to the amplifier via C2.

The amplifier is a two stage common emitter configuration, with capacitive coupling between the stages provided by C4. C2 and C4 have both been given quite low values so that they are inefficient at low frequencies, and the circuit has poor sensitivity at 100Hz. This is necessary because mains lighting emits a certain amount of infra-red, and this is modulated at 100Hz. If the unit had good sensitivity at 100Hz it would be quite likely that this signal would operate the unit, causing the load to be spuriously switched on and off. With the unit as it stands, no problems of this kind are experienced, and more sophisticated low frequency filtering was found unnecesary. C3 rolls off the high frequency response of the amplifier, and this is necessary to prevent instability. The circuit achieves a high mid-band gain of about 80dB., giving good sensitivity and operating range.

The Schmitt trigger circuit is based on operational amplifier IC1. R8 is used to bias the inverting (-) input to the same potential as appears at the collector of Tr2. R7 couples the voltage at Tr2's collector to the non-inverting (+) input of IC1. Under quiescent conditions the output of IC1 remains in a constant state, but in the presence of an input signal it operates

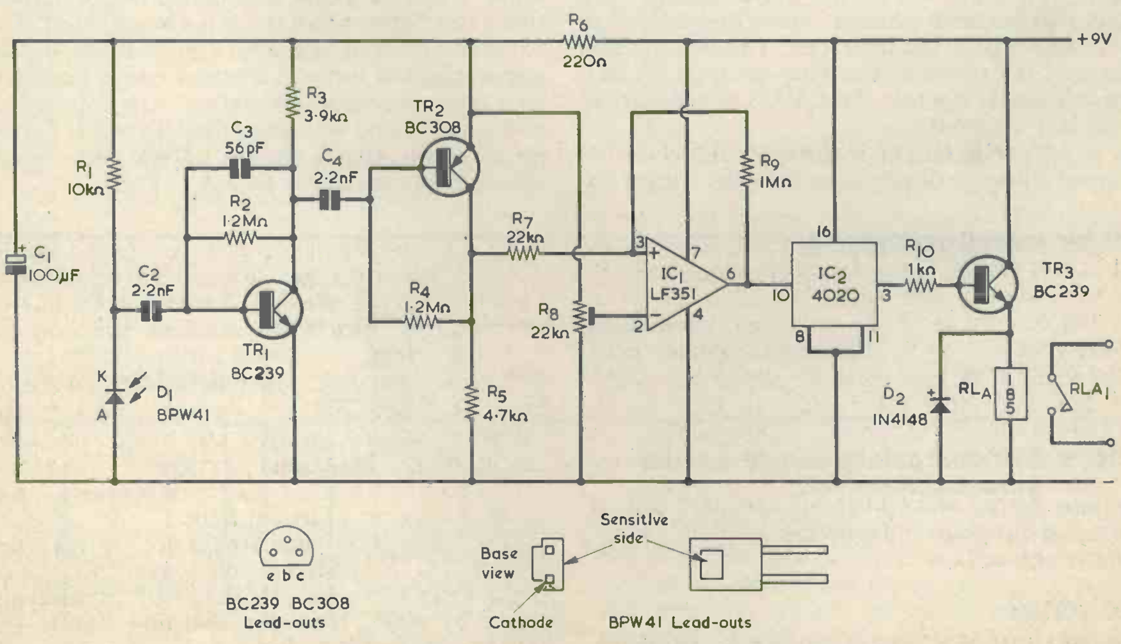
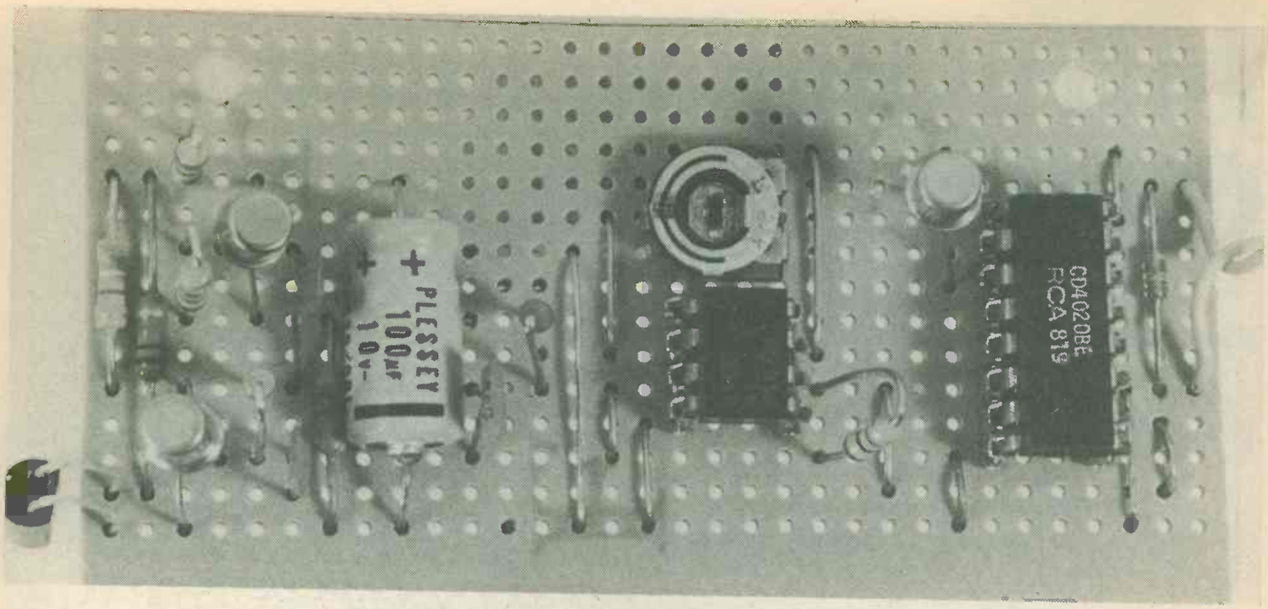


Fig. 4. The circuit diagram of the Infra-Red Receiver.



The receiver layout.

as a voltage comparator. When the voltage fed to the non-inverting input goes above that fed to the inverting input, the output of IC1 goes to the high state.

When the input signal causes Tr2's collector potential to go below the voltage fed to the inverting input, the output of IC1 goes low. Positive feedback is provided by R9, and this also introduces a small amount of hysteresis, which ensures that the output of IC1 triggers rapidly and reliably from one state to the other. For example, if the non-inverting input starts to go to a higher voltage than the inverting one, the output of IC1 starts to change from the high state to the low one.

Due to the coupling through R9, as the output swings more positive it takes the non-inverting input more positive as well.

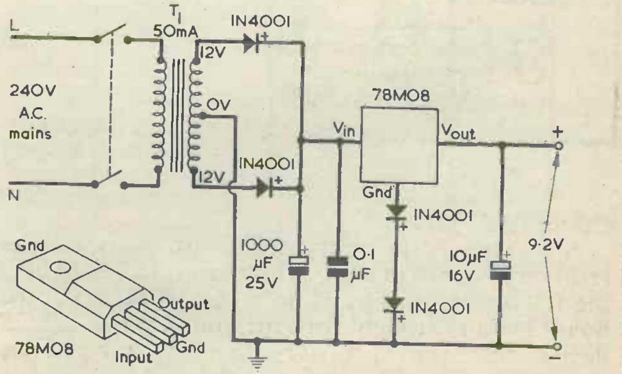
This in turn sends the output more positive, and thus this regenerative process causes the output to almost instantly go to the high state. This ensures that the rise and fall times of the output signal are fast enough to reliably operate the CMOS divider circuit fed from IC1's output.

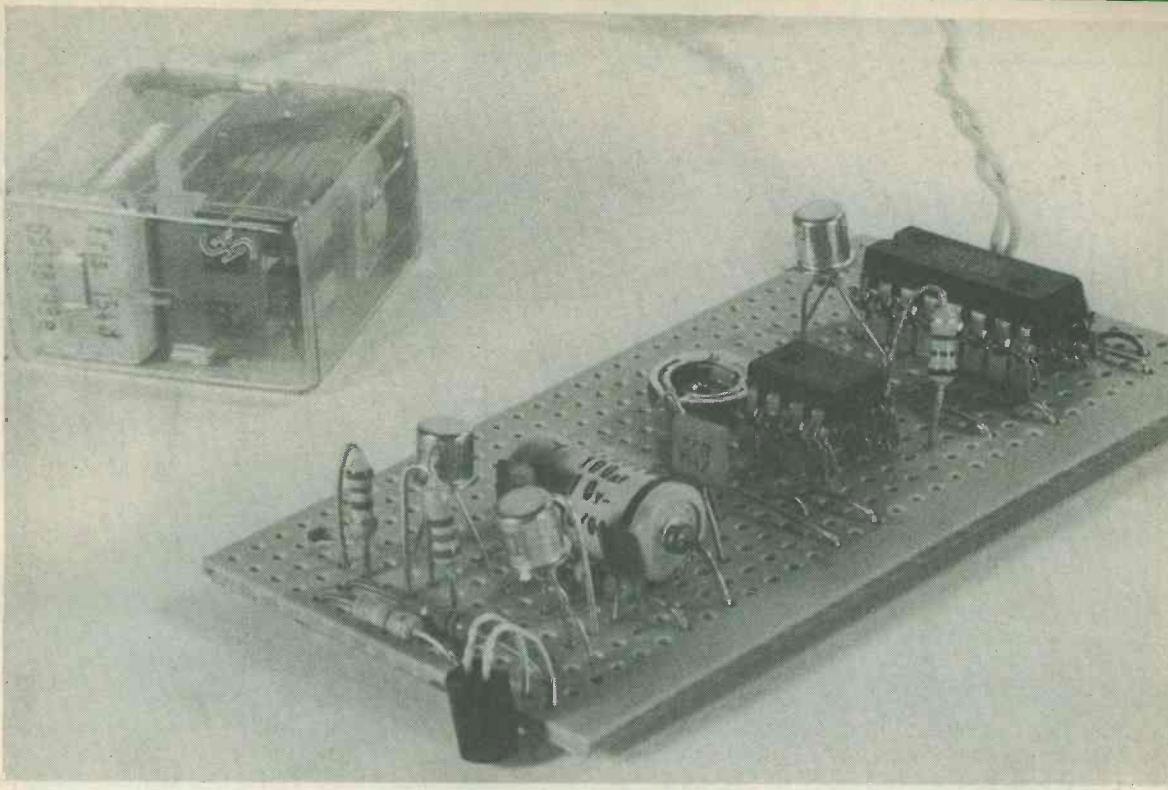
This is advantageous as it prevents noise on the input signal from spuriously operating the trigger circuit, and ensures that under quiescent conditions the output of IC1 rests in a stable state.

The 14 stage divider IC is a CMOS 4020 device, with the output of the 14th stage used to drive the relay coil via the emitter follower stage, Tr3. The reset terminal of IC1 is connected to the negative supply rail, and serves no useful purpose in this application. D2 is the protective diode that is normally included across highly inductive loads in semiconductor circuits. This suppresses the high reverse voltage which is developed across the relay coil as it de-energises. The relay can be any type having a 6/12 volt coil with a resistance of about 185 ohms or more, provided it has contacts of adequate rating for the intended load.

The current consumption of the receiver is about 4mA. when the relay is switched off, and about ten times this figure when the relay is activated. The unit could be powered by a large 9 volt battery, but in most applications of the unit a mains power supply would be a more practical alternative. Any supply that can give a stable and well smoothed 9 volts at currents of up to about 40mA should be suitable. A suitable mains P.S.U. circuit is shown in Fig.5.

Fig. 5. Suitable power supply for the Infra-Red Receiver.





Inside of the receiver.

COMPONENTS

Receiver

Resistors
1/3 watt 5% (10% over 1M), except R8
R1 10k
R2 1.2M
R3 3.9k
R4 1.2M
R5 4.7k
R6 220 ohms
R7 22k
R8 22k 0.1 watt horizontal preset
R9 1M

Capacitors
C1 10μF 10V
C2 2.2nF ceramic plate
C3 56pf ceramic plate
C4 2.2nf ceramic plate

Semi-conductors
Tr1 BC239
Tr2 BC309
Tr3 BC239
IC1 LF351
IC2 4020
D1 BPW41
D2 1N4148

Relay
6/12 volt coil having a resistance of 185 ohms or more, at least one contact of appropriate type and adequate rating.

Miscellaneous
0.1in. matrix stripboard
Wire, solder, etc.

CONSTRUCTION

A suitable 0.1 in. matrix stripboard layout for the receiver is shown in Fig.6. This requires a board having 15 copper strips by 32 holes. Construction of the board is quite straight forward, but IC2 is a CMOS device and normal CMOS handling precuations should be taken. The use of an IC socket is recommended.

The mechanical construction of the unit must be varied to suit individual requirements, and it can either be built as a self contained unit into which any item of equipment can be plugged, or it can be built into another project. In either case D1 must be mounted behind a hole in the front panel of the equipment so that the infra-red beam from the transmitter can reach it. The sensitive surface of D1 must

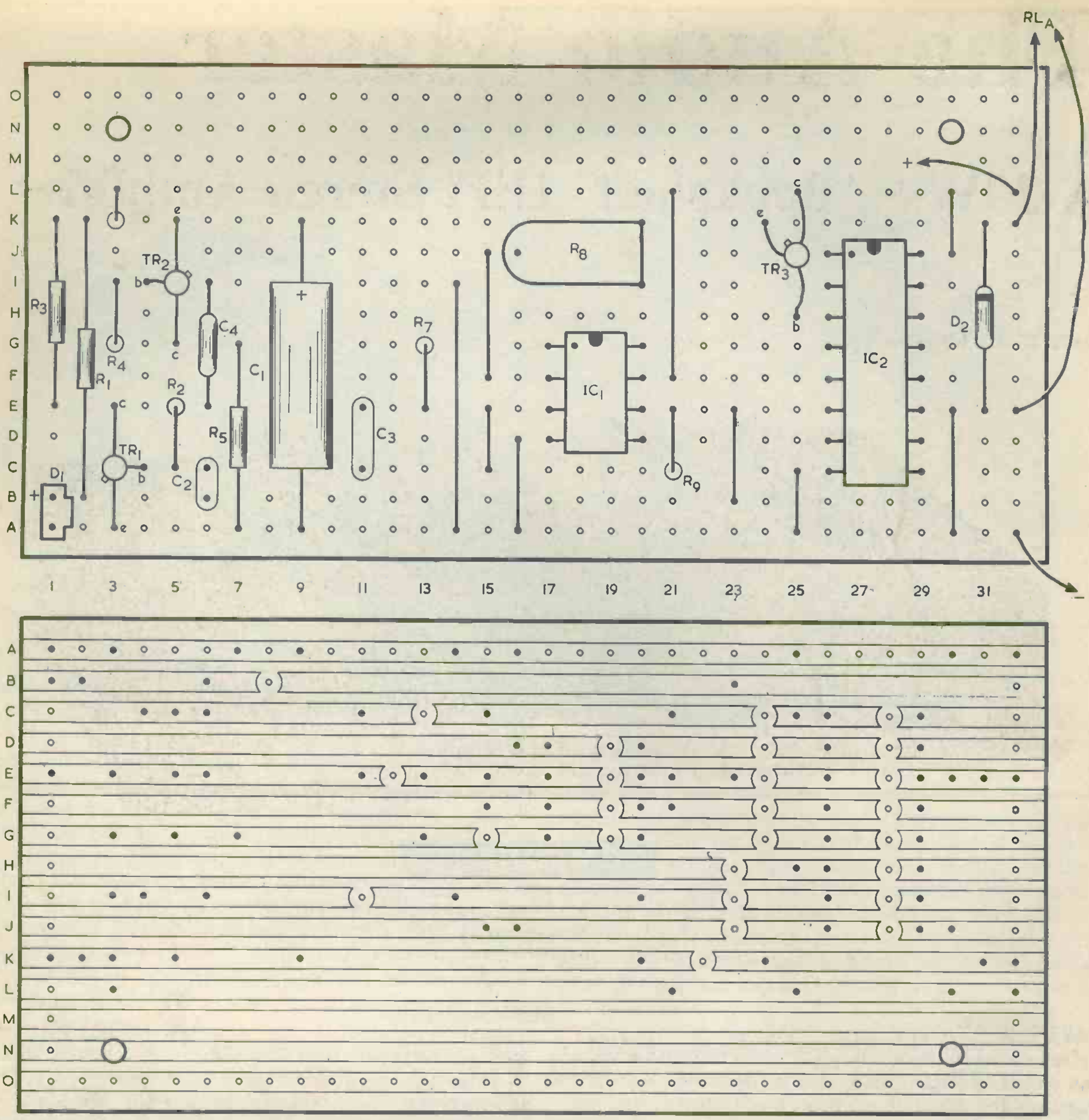


Fig. 6. The 0.1in. matrix stripboard layout for the Infra-Red Receiver.

be facing the hole, and this is opposite the face with writing on. If D1 is mounted direct on the component panel its leads must be bent through 180 degrees in order to face the sensitive surface away from the panel. The unit should not be positioned where it will pick up strong mains hum that could cause spurious operation.

ADJUSTMENT

In order to adjust R8 correctly, a multimeter should be used to monitor the voltage between pin 6 of IC1 and the negative supply rail. With R8 adjusted almost fully clockwise, a low voltage reading of only about 1 volt or so should be obtained. R8 is then slowly adjusted in an anti-clockwise direction until the voltage reading jumps to almost the full supply voltage. The unit should then give optimum sensitivity.

The L.E.D. in the transmitter has an integral lens which gives a fairly narrow beam of infra-red light. For best results the transmitting L.E.D. should therefore be roughly aimed at the detector diode in the receiver.

Components

The VN66AF is available from Maplin Electronic Supplies and Ambit International. The CQY99 and BPW41 diodes are also available from Ambit International. ■

The Audio Master

A 30W+ 'Bookshelf' HiFi Stereo Amplifier

Larsholt Electronics

INTRODUCTION

Before embarking on the trail to that most nebulous of all destinations – the land of High Fidelity, consider for a moment these questions:

How much audio power does an average living room need for 'Hi Fi' sound reproduction?

What levels of distortion can be detected by the trained ear?

Opinions on the first point vary widely, but usually come down to the type of loudspeaker you are aiming to use, and (obviously enough) the dimensions and acoustic nature of the living/listening room. For most popular 'bookshelf' systems, and they are very popular indeed these days, and are frequently used in a secondary system elsewhere in the house, 20-30 watts RMS is considered to be about right by both listeners and loudspeaker manufacturers.

Those with long memories may think back to the days of valve amplifiers when (by the standards of those days, and when loudspeakers tended to be more efficient anyway) the famous Mullard circuits provided 'deafening' sound levels from 15 watts. True enough, a badly distorted 15 watt amplifier does indeed 'sound' intolerably loud, but in order to begin to appreciate the dynamic range of modern audio, 25 watts per channel is where you start, and 200 watts is where you should stop if you wish to retain all your aural faculties.

Anything much less can be acceptable for 'wall-paper' musical reproduction, but cannot really deserve the accolade of 'Hi Fi, when the term is used *correctly*. Anything much more than 30 watts per channel deserves a closer and more thorough approach than can be provided in the space available here. ***'Radio and Electronics World'*** will be publishing a very detailed description of the ultimate in DIY HiFi systems, and the philosophy behind 'real' HiFi based on the widely acclaimed Ambit Mark III series. So if you want a 100 watt+ per channel system, restrain yourself until the autumn.

THE BOOKSHELF AMPLIFIER

This article describes a thoroughly engineered combined stereo preamplifier/30 watt RMS power amplifier developed in Denmark by Larsholt Electronics. Part of the new policy of this magazine is to try to locate and identify worthy subjects for constructional features based purely on the merit of the feature.

Larsholt have been kind enough to permit us to use their descriptive constructional text and diagrams, which you may choose to follow wholly or in part. The one-board construction technique which combines the switching with the associated circuitry makes life a great deal easier for the constructor.

In order that the amplifier can be placed in perspective with its commercial counterparts, the NAD2020 was chosen on the basis of the similarity of specifications and overall concept. The NAD design has been widely acclaimed as the greatest thing to hit 'HiFi' since Johnson's Cotton Ear Buds, so it was interesting to see that none of the listeners managed to hear the difference. When we unravel some of the technicalities, there is a certain similarity, in that both amplifiers are designed to drive into low impedance loads without undue stress, thus masking their relatively low quoted power outputs.

The performance of the amplifier does justice to any loudspeaker capable of producing the necessary sound levels from a 30 watt drive source:

SPECIFICATIONS:

Output per channel		33W/ 4Ω (at 1% THD)
Signal to noise ratio		over 80dB (inputs loaded)
Crosstalk		better than 40dB at 1kHz
Total Harmonic Distortion better than		
		0.1% at 4 watts RMS
		0.5% at 28 watts RMS*
IMD	8kHz/6kHz	–70dB 20W/10W
	8kHz/250Hz	–62dB 20W/10W
Input sensitivity for 25W		100mV (tuner, aux)
		200mV (tape)
		5mV (magnetic PU)
Tone range	BASS	+/– 12dB at 100Hz
	TREBLE	+/– 15dB at 5kHz
	Loudness	+4dB at 400Hz
		+6dB at 20kHz

Apart from simply sounding 'good', this amplifier is notable for its high signal/noise performance (which equates to dynamic range within the limitations of the output power), and the ease with which it handles transients.

CIRCUIT DESIGN

Fig. 1 shows the complete circuit diagram of the unit – the inputs are on the left, working across to the outputs on the right-hand side. Starting at the beginning with the phono/pickup stages . . . .

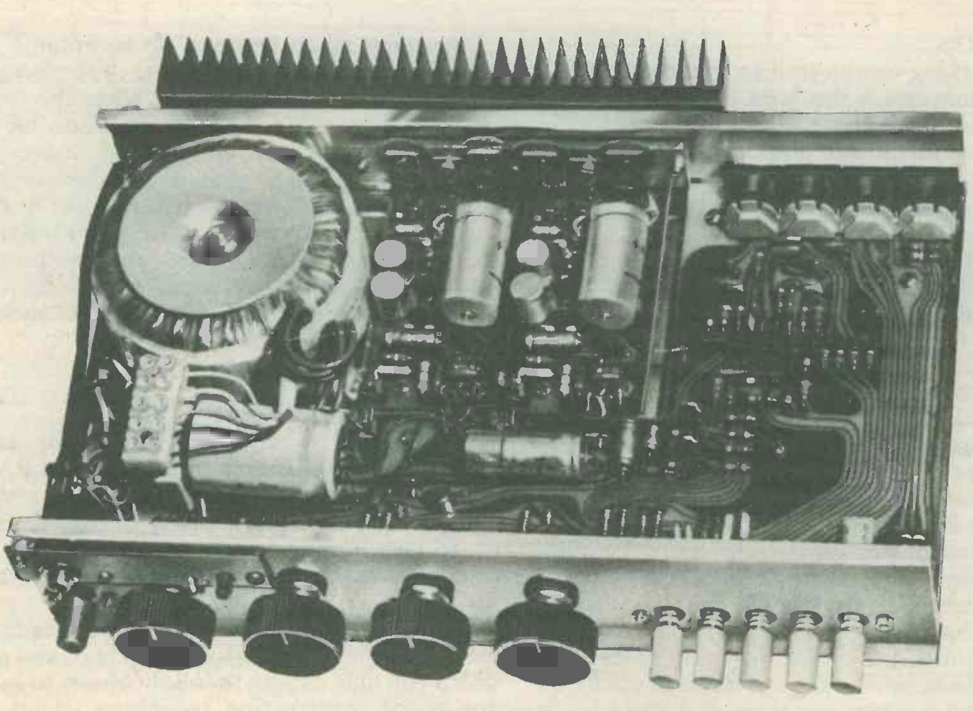
A quad Norton amplifier is used for all the pre-amplifier functions – with two sections being dedicated to boosting the 5mV (nominal – remember it varies with frequency) signal from a typical magnetic cartridge. Correction for the RIAA response curve is applied by the negative feedback from the output to the inverting input in exactly the same way as you would find with a 'regular' operational amplifier.

The 47KΩ cartridge load is presented in series, since this is a classic 'virtual earth' input system, and the 100mV 'equalized signal' is then fed to the switchbank where it is routed, according to selection, to the tone and volume controls.

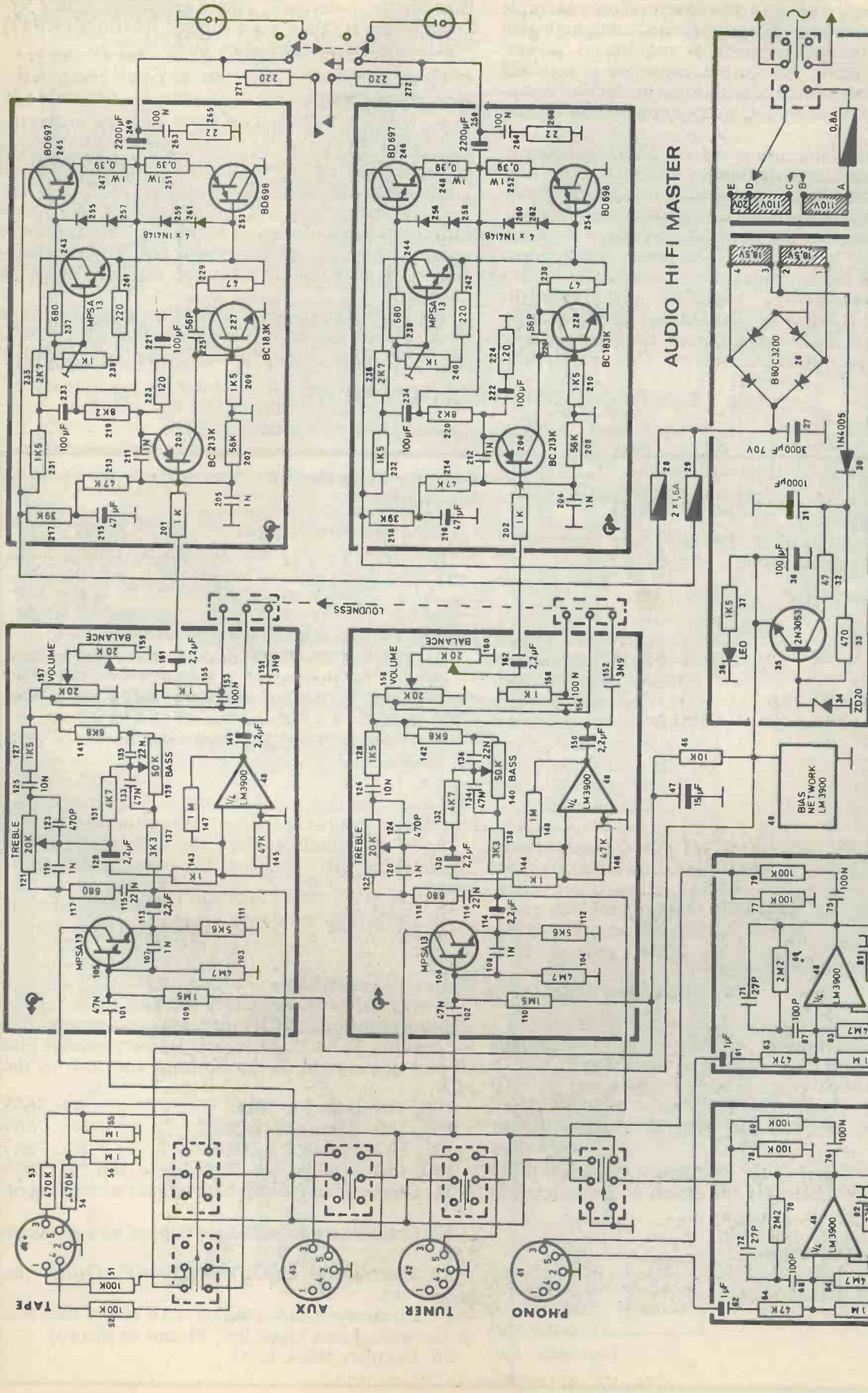
The high input impedance emitter follower stage serves a number of purposes, firstly to present an impedance that can be AC coupled via relatively small capacitors (electrolytics this early in the signal path are invariably bad news, due to charge/discharge times and the occasional leaky one), and secondly to present the tone control stage with a well isolated and low impedance drive source. The 1n0 capacitor (108) provides RF decoupling to prevent your neighbourhood CB operator from getting in where he shouldn't.

The tone control stage utilizes two further sections of the LM3900 in a classic 'Baxandall' arrangement in the negative feedback path. If you subscribe to the 'no tone control' philosophy (you live in an anechoic chamber ??!!), then simply wire the output of the emitter follower to the top of the volume control . . . .

The volume control is tapped to provide a facility for volume related loudness, whereby the physiological response of the ear is compensated for at low listening levels by boosting the low and high frequencies. This boost is progressively decreased until the



The unit assembled in the chassis.



26–162 Operation·unit 8806, 201–266 Output·unit 8807, 271–272 Headphone·jack.
51–271 ODD Numbers = LEFT channel, 52–272 EVEN Numbers = RIGHT channel.

Fig. 1. The complete circuit diagram of the unit.

control is sufficiently advanced for the ear to be operating in its 'linear' frequency response regions.

The power amplifier modules are separately powered and fused, wherein you will see a classic example of the class AB output configuration, using high gain Darlington output devices that require no 'power' driver transistors. An output capacitor is retained rather than introduce the additional protection complexities demanded by DC output connection techniques.

Headphones are connected via 220Ω resistors to prevent premature deafness, although you may choose to alter these values to 'balance' the loudspeaker volume to the particular headphones you use.

Finally, consider the power supply, since the amplifier can only be as good as the power supply 'driving' it. A low field toroidal mains transformer feeds a conventional bridge rectifier and reservoir capacitor. It is arguable that 3000μF is not enough, and if you can find room for more, then this is a wise investment in transient reserves. The preamplifier stages are provided with their own regulated rail via a series pass transistor, which despite being only half-wave rectified does not cause any problems with hum. Bias for the potentially ripple sensitive emitter follower stages is taken via a further RC filter (46/47) which completely eliminates hum.

CONSTRUCTION

Fig. 2 gives the parts layout, and we would be interested to learn of constructors' preferences regarding the use of sequential numbering for all components, without the usual prefixes of 'R–, C–' etc. Perhaps this technique is less ambiguous, but from a publishers point of view, it requires great care not to overlook any part when devising the initial numeration – or all numbers after the omission must be changed.

The PCB patterns are available on request (plus an SAE please), although you will see that we are making the PCBs available via our 'etched but undrilled'

1. SWITCHING AND PREAMP UNIT (Fig. 2)

Components

No. on PCB

10-18 9 solder tags (turn the edges parallel to the edge of PCB)
30 Rectifier diode 1N4005) note position
34 20v zener diode of marker rings

Resistors

32	47Ω yellow-violet-black
33	470Ω yellow-violet-brown
117, 118	680Ω blue-grey-brown
143, 144, 155, 156	1kΩ brown-black-red
37, 127, 128	1,5kΩ brown-green-red
137, 138	3,3kΩ orange-orange-red
131, 132	4,7kΩ yellow-violet-red
111, 112	5,6kΩ green-blue-red
141, 142	6,8kΩ blue-grey-red
46	10kΩ brown-black-orange
63, 64, 145, 146	47kΩ yellow-violet-orange
51, 52, 77, 78, 79, 80	100kΩ brown-black-yellow
53, 54	470kΩ yellow-violet-yellow
55, 56, 65, 66, 147, 148	1MΩ brown-black-green
109, 110	1,5MΩ brown-green-green
69, 70	2,2MΩ red-red-green
73, 74, 83, 84, 103, 104	4,7MΩ yellow-violet-green

Ceramic Capacitors

		Markings
71, 72	27pF (Fig. 2) grey w. black top	27p
67, 68	100pF (Fig. 3) grey w. black top	n10
123, 124	470pF (Fig. 1) cream w. yellow top	n47
107, 108, 119, 120	1nF (Fig. 2) cream w. yellow top	1n0
151, 152	3,9nF (Fig. 3) cream w. yellow top	3n9
81, 82	22nF (Fig. 3) cream w. green top	22n

Electrolytic Capacitors

113, 114, 129, 130, 149, 150, 161, 162	2,2uF-40V)
47	15uF-40V)
36	100uF-25V)
61, 62	Tantalum, 1uF

Polyester Capacitors (Read 3 colour codes from top downwards)

125, 126	10n brown-black-orange
115, 116	22n (red-red)-orange
101, 102, 133, 134	47n yellow-violet-orange
75, 76, 153, 154	100n brown-black-yellow

Further Components

105, 106 MPSA-13 Transistors (Note the position of the flats)

35 2N3053 Transistors (Direction of the lap as shown)

48 IC socket. The LM3900 should be placed with the position mark on the topside in the direction of tag 18.

9 4 pol. terminal block. Mount with the wire openings turned against the edge of the printboard.

28, 29 Fuseholders. Note the little stoplap, the free opening side is against the edge of the printboard.

45 Push-button unit.

41, 42, 43, 44 Input sockets (DIN stereo)

Double Potentiometers

One of the potentiometers has two extra tags in addition to the basic PCB mounting pins – reserve this for position 157-158 (volume). Be very careful that all pins come right to the bottom, and rest on the PCB.

139, 140	Bass 2 x 50kΩ	No. 7668
159, 160	Balance 2 x 20kΩ	No. 7667
121, 122	Treble 2 x 20kΩ	No. 7667
157, 158	Volume 2 x 20kΩ log w. tap	No. 7669

11 Connect tag 11 with bare copper wire to tag on 157

12 Connect tag 12 with bare copper wire to tag on 158

31 Electrolytic cap. 1000uF-40V (Note the groove +)

27 Electrolytic cap. 3000uF-70V (Note that one of the wires has a black dot. Mount as shown)

26 Rectifier B80C3200

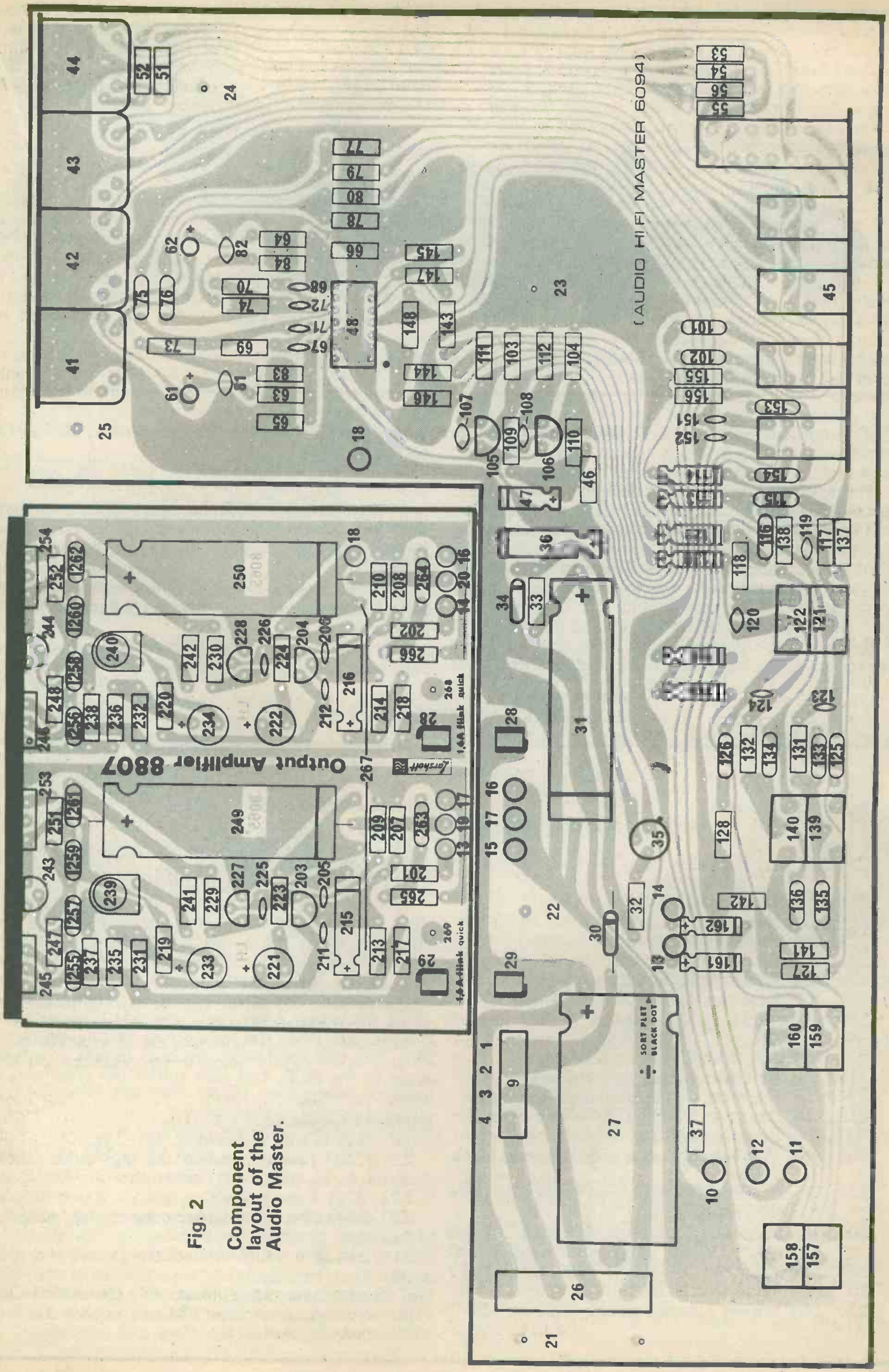
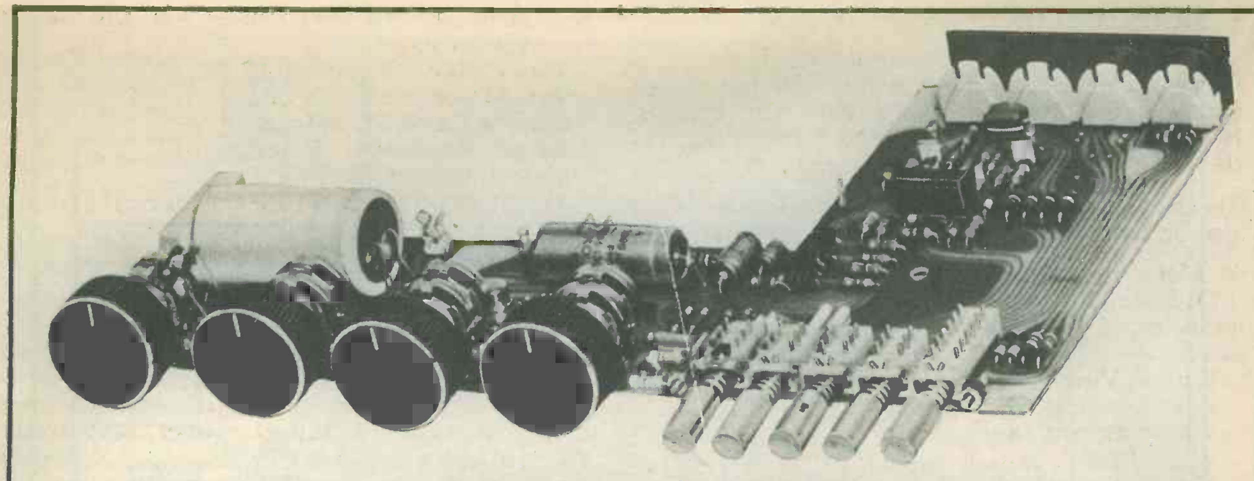


Fig. 2

Component layout of the Audio Master.



Preamplifier and control unit (No. 8806)

PCB service, whereby we feel the low cost is quite persuasive compared to the 'etch-it-yourself' approach.

The following instructions describe a convenient mounting order for the parts on the assemblies. You will find that all the described position numbers are also printed on the PCBs, which should make errors impossible. Your attention is drawn to the notes in the text, concerning the placing of diodes, transistors, electrolytic capacitors and ICs – all of which have a specific orientation which must be observed.

Resistors, non-polarised capacitors and polyester capacitors can all be mounted in either direction – but where possible, place the components so the identification is visible.

Solder the components in place as they are mounted, and clip away the surplus wire ends.

Be careful when soldering on the PCBs to check that there are no short circuits caused by inadvertent bridging of the solder between the tracks of the board.

Now the operation unit 8806 is finished. With the aid of the position plan, you can determine all the locations.

Once again: Inspect the soldering work and be sure that no short circuits are left.

2. OUTPUT AMPLIFIER UNIT NO. 8807

Components

No. on Printboard

13, 14, 16-20 7 solder tags (the flats parallel with the edge of PCB)
255-262 inc. 8 diodes 1N4148 (note position of marker ring)
265, 266 Resistors 22Ω red-red-black
229, 230 Resistors 47Ω yellow-violet-black
223, 224 Resistors 120Ω brown-red-brown
241, 242 Resistors 220Ω red-red-brown
237, 238 Resistors 680Ω blue-grey-brown
201, 202 Resistors 1kΩ brown-black-red
209, 210, 231, 232 Resistors 1,5kΩ brown-green-red
235, 236 Resistors 2,7kΩ red-violet-red
219, 220 Resistors 8,2kΩ grey-red-red
217, 218 Resistors 39kΩ orange-white-orange
213, 214 Resistors 47kΩ yellow-violet-orange
207, 208 Resistors 56kΩ green-blue-orange
263, 264 Polyflat capacitor 100nF brown-black-yellow
225, 226 Ceramic capacitor 56pF (grey with black top) marked 56p
205, 206, 211, 212 Ceramic capacitor 1nF (cream with yellow top) marked 1n0
227, 228 Transistor BC183K) note position of
203, 204 Transistor BC213K) flat side
239, 240 Pre-set potentiometers 1kΩ

Mounting the heatsink complex

(which is supplied ready assembled by Larsholt)
243, 244 2 MPSA-13 Darlington transistors
245, 246 2 BD 697A Darlington transistors
253, 254 2 BD 698A Darlington transistors

The mounting will be easier if the two brass cooling clips, encasing the transistors, are temporarily dismounted, while the 12 wire ends from the power transistors are led through the holes provided in the PCB. When the aluminium block rests close on the board – and at 90 degrees to the PCB, then solder all 12 of the wires. After that, remount the two brass cooling clips (with the transistors) and tighten carefully. See that the block continues to stay at a right angle to the PCB, and then solder the remaining 6 legs.

Further Components

247, 248 4 wire resistors 0,39Ω, 1W
251, 252) (avoid bending the legs close to the body)
221, 222) 4 electrolytic capacitors 100uF-40V
233, 234) (the + leg nearest the cooling block)
249, 250 2 2200uF-40V) Note the position
215, 216 2 47uF-40V) of the groove (+)
28, 29 2 Fuseholders (Note the little retention clip, fix with the opening against the edge of the PCB)

Now the output amplifier 8807 is complete. Inspect the module for correct locations and soldering.

3. MOUNTING OF CHASSIS NO. 8805

1) To ensure safe transportation, the mains transformer is screwed down by Larsholt – but remove the transformer while you assemble the chassis. However, note the position of the wire-out tag, and the order of the steel and rubber washers.

2) The unit with 5 position terminal block should also be temporarily removed.

3) **Mounting the headphone jack**
Dismount the jack from the PCB and solder in the following wires and resistors as shown in the wiring plan:
Wire R Violet 235mm to terminal 6
Wire S Yellow 270mm to terminal 2
Wire T Brown 180mm to terminal 3
Wire U Black 150mm to terminal 7
271, 272 2 resistors 220Ω, red-red-brown respectively to 1 & 8 and to 4 & 5.
Y Sleeve 90mm to pull over violet and yellow wire
X Sleeve 120mm to pull over brown and black wire
Put the jack aside for fixing later.

4) Wire A Grey 60mm between mains switch and fuse unit
Wire B Grey 60mm solder on the fuse unit
Wire C Grey 60mm solder on the mains switch

5) **Mounting the output amplifier module 8807**
a) Put the three protruding screws from the cooling block through the holes in the rear of the chassis. (And through the holes in the extruded ribbed element).
b) Mount 2 screws (6mm) respectively by the fuseholder 28 & 29 at positions 268 and 269 – but do not tighten them yet.
c) Three brass blind nuts with notches should now be fixed onto the ends of screws (point (a) above), which are located between the ribs of the external heatsink. Tighten these evenly and carefully to ensure optimum heat transfer to the radiating element.
d) Now tighten the two screws mentioned in point b.

6) **Mounting the Operation-Unit 8806**
a) Unscrew the nuts and locking washers from the potentiometers, and the two nuts from the push button switch unit.
b) Place the unit in position and refit the lock washers and nuts – but don't tighten them yet.
c) Refit the console with the terminal block in position 21 and mount the remaining 4 screws on positions, 22, 23, 24 and 25 but don't tighten yet.
d) Now tighten the nuts on the front of the chassis (Potentiometers and switch) and then the 5 screws on the PCB (as point (c) above).

7) **Mounting the wires on the loudspeaker sockets**
Wire V Bare copper wire between the two sockets.
Wire L Blue 235mm from the lower socket to operation unit point 15.

8) The jack with wires (mounted as at point 3) should now be fitted.
Push both the sleeves close up to the jack.
Carry the yellow and violet wire (covered by sleeve) back at the same level as the jack, and as far as possible from the open mains voltage points on the main switch and fuse unit – and connect to:
Yellow wire (S) to the output amplifier No. 20
Violet wire (R) to the output amplifier No. 19
(The brown and black wire will be connected later)

9) **Connections between operation unit and the output amplifier unit**
Wire G Red 70mm from 13 to 13
Wire H Green 110mm from 14 to 14
Wire M Black 70mm from 16 to 16
Wire N Bare copper from 17 to 17
Wire P Bare copper from 18 to 18
The white wire from the LED PCB on the front of the chassis should be connected to point 15.
(The grey and orange wires from the same PCB will be mentioned later)

10) **Remounting the Mains Transformer**
Under the bottom of the chassis: Screwhead and 70mm steel-washer
Over the bottom of the chassis: 70mm rubber-washer, transformer, rubber washer, steel washer with centre depression, fixing nut.
Before you tighten, the transformer must be close to the chassis rear and about 1mm from the output PCB.
Turn the transformer so that the tag connector strip is positioned at 4.30 (o'clock) when seen from the front.
Make certain that no wires get caught between the washers.
T (brown wire from jack): connect to the lower loudspeaker socket
U (black wire from jack): connect to the upper loudspeaker socket

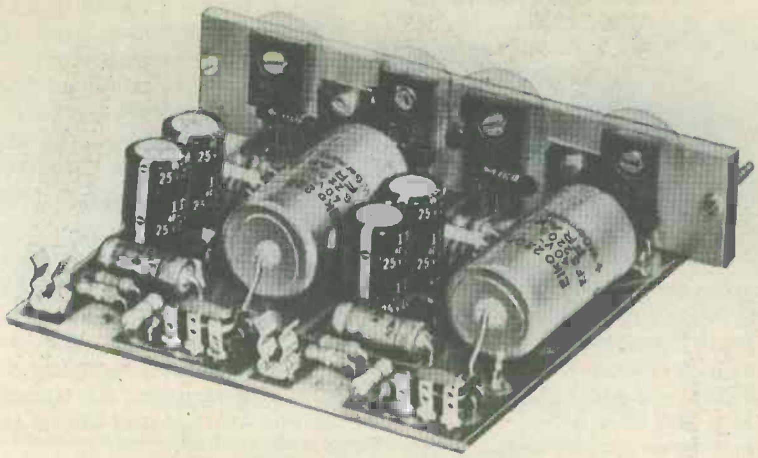
11) **The Mains Transformer connections**
The **thick** wires to the 4 pole terminal block on the operation block on the operation unit
Blue to No. 4
Green to No. 3
Yellow to No. 2
Red to No. 1
The **thin** wires to the 5 pole terminal block on the console
Violet to point A
White to point B
Grey to point C
Black to point D
Brown to point E

12) **Connection to mains supply**
The mains lead and plug are not supplied with the kit, as different rules and regulations exist regarding these in most countries. The mains lead should be passed through the plastic grommet in the bottom of the chassis under the clamps and connected to the on/off switch.

13) Wire B from the fuse unit: connect to pole A
Wire C from on/off switch: connect to pole D and connect pole B to C.
Other Mains Voltages 110, 130 or 240V (see the label under the chassis)

14) Now check all connections with the wiring plan and examine all soldered joints.

15) **Adjustment of the output amplifier**
You will find two resistors enclosed:
47Ω (Yellow-violet-black)
100Ω (brown-black-brown)
a) The orange and grey wire from the LED PCB on the chassis front should be soldered to these resistors as shown here:
b) The end of the 47Ω resistor with the orange wire:
solder lightly to the exterior of the fuseholder 29 on



Stereo output amplifier.

the **output amplifier.**

The end of the 100 ohm:

Solder to fuseholder 29 on the **operation unit.**

c) Turn the two preset potentiometers 239 and 240 to the left (anti-clockwise) completely to the end stop.

d) Volume control in a closed position. Balance, Bass and Treble set midway.

e) Connect the mains and switch on – but not before you are sure that the two preset potentiometers are turned completely anti-clockwise.

Incorrect setting will damage the output stages

f) With the correct tool, turn preset 239 SLOWLY clockwise until the LED glows faintly, and turn back until the diode just extinguishes. Stop at this point and the left hand channel is now adjusted.

g) Repeat the procedure for the right hand channel by moving the resistor network to the fuseholder 28. (as in point b).

h) The set is now adjusted completely. Switch off, and remove the resistor network. The disconnected wire must now be connected to the preamp unit:

Orange to tag No. 17 and

Grey to tag No. 10 after shortening.

i) Finally, the 1.6 amp fuses are placed in fuseholders 28 and 29.

16) After final inspection, and an extra check of the tightening of the transformer cooling block and heatsink, you can now mount the wood veneered cabinet, with the four burnished screws provided, and fit the front panel with the two cross head screws. Now fit the knobs, we suggest that the white line on the knobs be laced at 12 o'clock when the volume control is closed off, and the balance, bass and treble are midway.

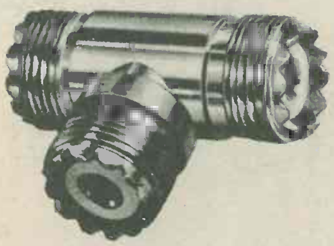
Complete kits of parts, and individual components are available from the R&EW reader services department. Total cost for the complete kit as illustrated herein for this project is £65.00 inc VAT. Postage is £4 extra, or you can collect from our offices at 200 North Service Road, Brentwood, Essex. ■

"He takes these video games very seriously."

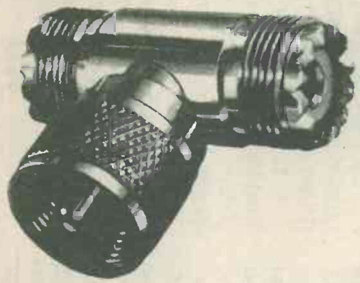
ELECTRONICS DATA

72

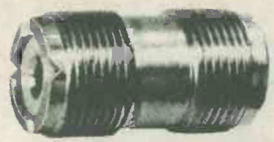
NC-559 T-ADAPTOR
Three female
Delrin insulation
Net weight: 42gr.



NC-560 (M-358) T-CONNECTOR
Double female - single male
Delrin insulation
Net weight: 44gr.

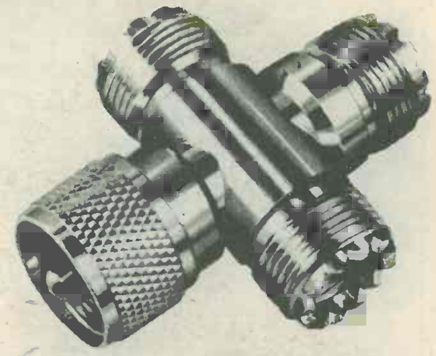


NC-553 (PL-258)
Delrin insulation
Net weight: 22gr.



DOUBLE FEMALE ADAPTOR

NC-580 FOUR CONNECTION ADAPTOR
Three female - single male
Delrin insulation
Net weight: 60gr.

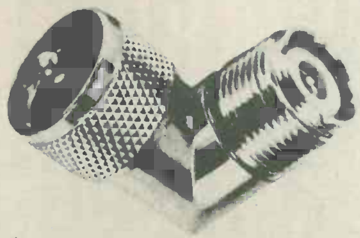


NC-563
Delrin insulation
Net weight: 22gr.

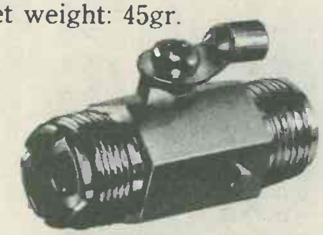
DOUBLE MALE ADAPTOR

NC-558 (M-359)
Delrin insulation
Net weight: 33gr.

RIGHT ANGLE CONNECTOR



NC-567 LIGHTNING ARRESTOR
Double female
Delrin insulation
Net weight: 45gr.



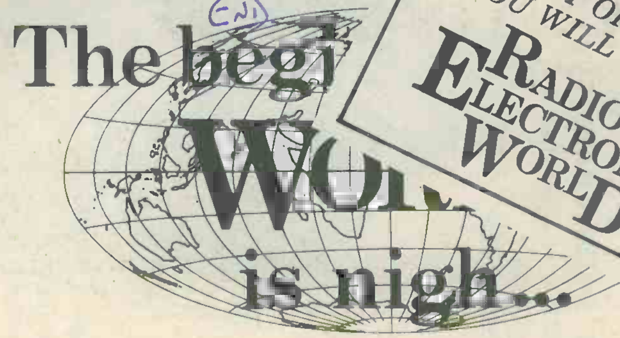
NC-566 LIGHTNING ARRESTOR
Male to female
Delrin insulation
Net weight: 50gr.

Know your RF connectors (2)

Continuing where we left off last time, the PL-259 series extends into a wide range of special function adapters - some of which are shown here. Care should be taken in the use of 'splitters' and 'T' pieces, since the antenna impedance will be completely altered if placed in parallel with some other 'termination'. Such adapters are frequently most useful in test fixtures (oscilloscope inputs etc.) The lightning arrestors provide a spark gap to earth, and consequently must be earthed via the tag provided using the stoutest wire or braid available - or if you rely on the basic equipment mains earth, most of the energy will still pass through the equipment. The enormous energy available from a static discharge through the 'chassis' is still likely to damage sensitive RF enviroments.

EDITORIAL

A SNEAK PREVIEW OF PART OF WHAT YOU WILL FIND IN
RADIO & ELECTRONICS WORLD



Welcome

The beginning of the world is nigh...

The occasion of a launch of a new publication such as **R&EW** is usually accompanied by much smugness and back slapping, with assertions that the universe will be a finer place as a direct result of the publication of 'XYZ'. We don't necessarily subscribe to this attitude, since **R&EW** is very much a publications for the *'sharp end'* of the business of electronics, communications and computing - and not simply for the business of publishing.

Accordingly, you will find that **R&EW** is not constrained by the corporate policies of some of the larger publishing houses, and our route to provide the readers with what they *really* want will accordingly be rather more direct and succinct.

This sneak preview section contains an introduction to some of the features and style that **R&EW** will provide on a monthly basis, but rather than provide a page from a number of incomplete items, we thought you would rather see an example of a complete feature in the **R&EW** style. **R&EW** is a very 'vertically integrated' concept, with all the necessary lab and technical facilities to provide the sort of documentation from within our own organization. This policy of integration extends to the supply of parts to support these features.

If we are responsible for researching/sponsoring state of the art features and articles, then we feel we should carry this through into the supply and support of the necessary parts for those of you wishing to copy an idea or feature *per se;* and those wishing to develop it further. After all, **R&EW's** prime aim is try and spur readers onto greater things, and to try and halt the slide of our electronics industry before too much lands in the lap of foreign equipment makers.

The UK's record on innovation and competitive industrial production over the past few years has not been good. In fact, bearing in mind the skills and brainpower at our disposal, the comment that most frequently springs to mind is 'dismal'. Our electronics industry has mainly shone as a result of tactical considerations (i.e. the government doesn't want to rely too heavily on overseas supply for items of national defence). The consumer and 'volume' business has all but disappeared, with a couple of notable exceptions.

So without getting into too much of the 'cant' mentioned at the outset of this piece, **R&EW** would like to help resuscitate some of the self esteem and confidence of British electronics *user,* be he or she a professional engineer, student or hobbyist. A lot of our success will depend on your contributions - so watch for the first 'real' issue of **R&EW** for details of how we are going to make life easier for those of you with a few ideas of your own to put them into practise using *free* components and design support. And get paid around £50 a page into the bargain.

An invitation

If you have anything to say on the subjects you find covered in **R&EW**, then please write and let us hear about it. If you have any ideas that you would like to offer for publication, then send them in.

If you have ideas, but do not know how to go about presenting them, then watch **R&EW** for details of how to set out feature articles for submission.

If you have viable design ideas for practical features, and would like to avail yourself of the **R&EW** feature sponsership scheme that is available to those groups or individuals with the resolve to see such a project through to a conclusion - then write (enclosing an A5 size SAE) to the 'Readers' Services' department for the details. This scheme may be particularly useful to schools and colleges with good ideas, but hindered by a shortage of funds to implement them using the best and most modern technology.

Radio and Electronics World is keen to support any practical endeavour, and we are pleased to offer advice and information through the medium of our **Readers Q-A** page. There is likely to be a flood of enquiries for this department, and we must point out that we cannot guarantee an answer to all enquirers. (other than '43'). And one rule is absolutely rigid — no SAE, no answer.

Interesting and original enquiries will tend to take precedence, and although we cannot promise to be the fount of all knowledge in electronics, communications and computing — the **R&EW** book service is a most comprehensive and carefully considered 'complement' to provide the readers with 'background support'.

Goodbye RC. RIP.

William Bond

[redacted]

a state-of-the-art vhf converter

timothy edwards

A SNEAK PREVIEW OF PART OF WHAT YOU WILL FIND IN RADIO & ELECTRONICS WORLD

Probably the most advanceu … a UK electronics magazine, givn… to commercial techniques and design philosp… sily made by a relatively inexperienced enthusiast

Despite the plethora of ready made equipment for the 2 metre (144-146MHz) amateur communication band, most radio enthusiasts like to try and salve their consciences as participants in the once exclusively 'practical' art of amateur radio, by making at least one or two items of equipment that can justifiably be described as 'home grown'.

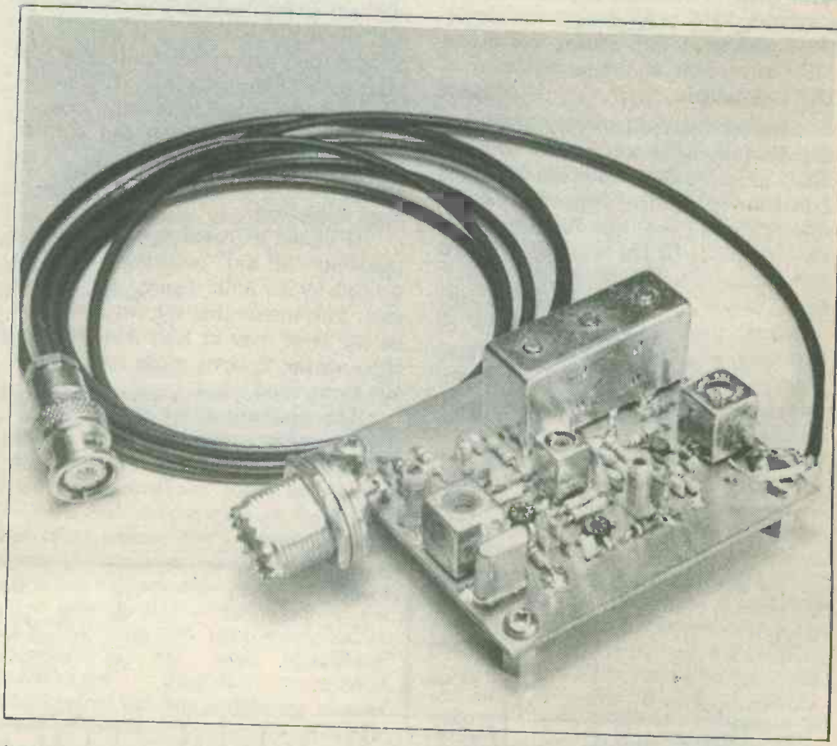
Most of the commercial transceivers for the VHF bands are primarily FM systems for simply 'nattering', and some of the hobby's traditionalists might suggest that the use of 2m NBFM bears more than a passing resemblance to the principles behind CB radio - but that's an entirely more contentious subject......

The exclusive use of NBFM tends to overlook the more interesting aspects of CW and SSB communications (morse code and single sideband to the uninitiated). But since most enthusiasts have an HF communications receiver (or two) at their disposal, it is an easy enough task to make a thoroughly professional converter for 144-146MHz, with an IF output to be tuned on the 28-30MHz section of the HF receiver. The radio enthusiast may thus fulfil the repressed constructional instinct, as well as being able to have a serious look at the CW and SSB aspects of the 2 metre band before launching into a few hundred pounds worth of oriental temptation.

The converter is basically a linear device within the expected range of input signal levels, and so any mode (AM, FM and SSB) can be converted to the required HF output. Some HF receivers are available with NBFM demodulators, but to do the job properly, the correct bandwidth IF filter needs to be used with a purpose made NBFM IF system. In the absence of this facility, slope detection of NBFM is better than nothing. (Slope detection relies on the IF filter passband edge to translate the frequency modulation information into an amplitude variation for detection as simple AM).

However, failing all this, you can build the **R&EW** NBFM tuneable IF, or the **R&EW** add-on NBFM adapter - both of which are scheduled to appear in an early issue.

Judging by the numbers of 'nearly new' SSB transceivers advertised for sale, it is no doubt better to investigate your long term interest in this aspect of communication without first contributing to the wrong side of the balance of payments. This converter provides reception of repeaters, NBFM simplex, and demanding



long range communications using CW or SSB.

The R&EW 2 metre converter

This converter was originally designed to compliment the RX80 receiver described in *"Radio Communication"*, although it will obviously operate with such receivers as the FRG7, R1000, DX160 etc. It has been designed with the latest state-of-the-art components, noteably the *NEC* 3SK88 MOSFET (note one), which has been chosen for its repeatably low noise figure and low cost. The TOKO CBT series helical filter provides an outstanding bandpass and stopband response, but most significantly of all from the point of view of those of you wishing to duplicate this converter, it is supplied prealigned, and requires virtually no trimming to optimize alignment.

Although a VHF converter usually requires considerable expertise, and recourse to a selection of signal generators and other analytical equipment, the **R&EW** converter can be built by anyone with 'kit building experience' and a multimeter.

Circuit Description

Fig.1 shows the complete circuit diagram. C1,C2 and L1 provide the optimum noise match between the 50 ohm antenna input and the RF amplifier - this is a carefully derived selection of values, and not simply a haphazard choice from the junkbox. Gate 2 of Q1 is biased at 5v (externally derived - ie from the main receiver or tuneable IF - negative going AGC may be applied at this point by those with adequate confidence and experience). The source of the RF amplifier Q1 is then taken directly to ground to ensure minimum impedance.

The drain of Q1 ...
through R3 ...
termi...

c... ...
pr... .. to VHF
des... ... circuit 'variable'
has ... substituted by a 'building block' that takes out most of the problems for the less experienced designer and user. More than 75% of the problems associated with VHF radio designs are simply those associated with getting lost in the MHz as a result of the uncertainties of DIY coil designs.

Helical filters will not salvage designs that fall into the all too familiar abyss of 'dry' joints, and a shortage of basic experience in handling components and a soldering iron - but these filters will help allay the fears of the more experienced audio constructor whose neat RF projects have always been relegated to the 'pending' tray, since the problems of alignment associated with the 'green' fingers of the RF engineer, sometimes seem insurmountable.

The circuit below illustrates some of the typical test voltages (nom 12v input)

Unlike the RF amplifier, the mixer does not use any DC bias on either of its gates. This is because the amplitude of the local oscillator injection voltage is designed to be sufficient to switch Q2 *directly* at 116MHz, thereby improving the intermodulation performance of the converter. This technique is used in some professional receivers, and is similar in concept to the esoteric Schottky diode double balanced mixer -except, of course, this system is single ended. It is possibly the first time that this approach has been used in an enthusiasts constructional feature. Unless you know better....

At the drain of Q2, the wanted mixer product (28-30MHz) is selected in the tuned circuit formed by L3 and C8, and matched at the secondary to 50 ohms to feed the main receiver. It is this output network that mainly constitutes the 3dB bandwidth of the converter. This means that the gain is approximately 25dB at 144MHz, 28dB at 145MHz and 25dB at 146MHz. This reduction of gain is of no consequence as the design has plenty in hand at all times.

It should be noted that the ultimate sensitivity of any receiving system is defined by its noise figure, and *not* its gain. This means that the sensitivity will be the same over at least 144-146MHz, although the 'S'meter might read slightly less at the band edges.

The oscillator chain uses a 58MHz crystal, rather than the more usual 116MHz type. Transistor Q3 serves the function of both oscillator, and the frequency doubler. L4 tunes out the capacitive reactance presented to the third overtone crystal and allows fine adjustment of its operating frequency. L5, C15 and C16 select the second harmonic from the oscillator at 116MHz and matches it into Q4 where it is amplified to an adequate level to switch the mixer, Q2. The capacitive divider, C19 and C20, provide the necessary level and impedance adjustment to feed the oscillator injection of approximately 2mW to gate 2 of Q2.

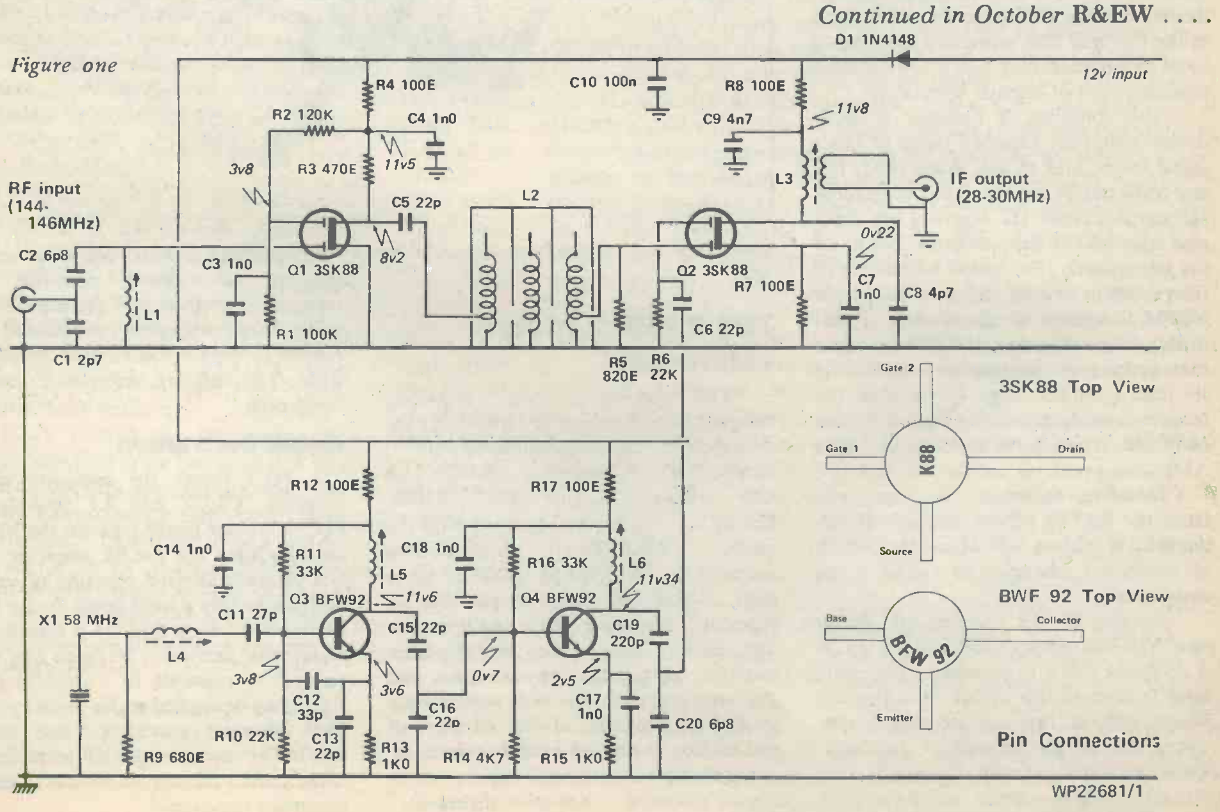
On a general point about decoupling, note the way in which the earthy end of the tuned circuit are decoupled with capacitance and inductance. Taking the example of L3 (R8/C9), R8 is apparently superfluous.

Specifications

Noise figure	less than 2dB
Gain	28dB nominal
3dB Bandwidth	144-146MHz
IF output	28-30MHz
1dB compression	+5dBm output
Saturated output	+7dBm
Supply voltage	8-16v
Supply current	15mA nominal
In out impedance	50 ohms
Size	70 x 60 x 20mm

Continued in October **R&EW** ....

Figure one



READERS Q·A

A SNEAK PREVIEW OF PART OF WHAT YOU WILL FIND IN RADIO & ELECTRONICS WORLD

Dear Sirs,

I have purchased a pulse induction metal locator - but now find that it appears to be susceptible to 'ground' interference - and I am very disappointed, since the immunity to ground effect problems was my main reason for choosing this type of machine.

Are you aware of any modifications that can be employed to eliminate these problems?

JS
Glamorgan

R&EW:

The short answer is that the pulse induction system cannot (by definition) suffer from 'ground effects' in the most frequently used sense of the term. 'Ground effect' is usually associated with tuned search head detectors that rely on the detuning effects of eddy currents induced in the 'target' metal.

But 'tuned' circuits are tuned by a combination of inductance and capacitance, and the 'ground' effect is the capacitive interference (damp ground is usually the cause) with the inductive aspects of the detection process.

In a pulse induction system (PI), the search head is untuned, being simply an inductor used to transmit a pulse of electromagnetic energy at no particular 'resonant' frequency.

The effect you are getting is most likely due to ferrous mineralization of the soil, which is a fairly widespread phenomenon in this country. The PI system is particularly susceptible to iron, due to the magnetization characteristics and the hysteresis of the metal 'storing' the pulse charge particularly effectively and then retransmitting it back to the detector head.

R&EW *will be running a series of articles describing the theory and practise of metal detection in unique detail, and we suggest that you watch for further coverage.*

Dear Sir,

I need a replacement for a 2N5915 or BLY53A. Please advise.

BR
Hants

R&EW:

The BLY53A is basically a 470MHz, 7w output 13.2v FM RF device. As it happens, Ambit International presently offer this at £5.02 at one off, although an alternative is the Motorola 2N5946. We can't offer you an off-the-cuff price for this part, however, since Motorola RF devices are not easily available in one in the UK (would Motorola care to hel out at **R&EW** *with pricing and availability of their excellent range devices via the World of Radio an.. Electronics catalogue??)*

The 2 watt version (2N5944) of the family is listed at over £9 each, so prepare for a shock...

Dear Sir,

I recently decided to upgrade my PA system (used by a local rock group), and was pleasantly surprised to find the simple and elegant AMBIT PA101 used in conjunction with D.C. Read's active loudspeaker article in April's *Wireless World*.

I am not sure if it is possible to beef the design up by paralleling more FET's. I am after 150w/8 ohms, or 250w/4 ohms. Can you comment on feasibility and potential problems?

MK
Czechoslovakia

R&EW:

A good question. One of the most endearing aspects of the power MOSFET is the ease with which it can be paralleled, and the indestructibility of high powered systems built with them. So the short answer is 'yes'.

The 140v devices used on the PA101 will drop around 10v - leaving, say, a swing of 110v pp across the load -around 180w into 8 ohms. A lot of care should be taken over the PSU design, since the use of a PSU with 5% load regulation as opposed to the more frequently encountered 10-20% regulation transformers will help keep power up, and avoid problems from modulation of the power rail.

The PA101 has recently been superceded by the PA105, which is specifically designed for parallel output devices, and is available with a heatsink bracket designed accordingly. The track layout of any high powered PA is a great deal more critical than most unsuspecting constructors take into account, and can easily make the difference between 0.005% and 1% distortion. Or worse still, complete instability.

R&EW *will be charting a course through such design concepts and problems with our series on 'The Last Word in DIY Audio' - the first part of which describes the* **R&EW** *MOSFET PA, featuring an 80-160w MOSFET power amplifier, with bridging (for over 400w) and a very comprehensive overload and speaker protection circuit. Watch out around the November issue for the start of the series.*

... se
O... es.
About ... ight
to shore) bu... ooster
for 'navigational' ...

The second is a ... M CB transceiver with a relatively ... power requirement, say 5 watts.

WJF
Hants

R&EW:

Hold on there, Mr F. Your secret is safe with us, but you had better take note of the Wireless Telegraphy Act which says many things about the devices you ask about. Most of them boil down to the £400 fine, confiscation and possible prison sentence for such illicit equipment as you have requested - doubtless in all innocence.

The first item is an ideal case for a 934MHz CB transceiver. Since the licensing is simple, and the actual device not as daunting as some would have you believe. And, you've guessed it, **R&EW** *will be covering just this type of application of CB which will probably be getting overlooked by the avaricious Oriental hordes in their anxiety to plunder our balance of payments with a plethora of car mobiles and hand-helds.*

The specification of the 27MHz CB radio is quite plain, and since 4w RF is the maximum, then 5w is relatively high in terms of output. You can pick up a set for around £50 when it all 'happens', although there will be many useful accessories and gadgets to be made to complement your gear.

Dear Sir,

Can you please advise me of a suitable alternative for the J305 FET as used in the Aztec UM1181 FM varicap tunerhead -since I am unable to locate a source.

J.J. Essex

R&EW:

The J305 is a low noise N-channel FET, made by Siliconix. If you cannot get this from any Siliconix source, then you can substitute this by a Hitachi 2SK55, which has a similar noise figure, but remember to watch the base connections.

Please address correspondance to:

Readers Letters
Radio and Electronics World
117a High Street
Brentwood
Essex. CM14 4SG

A 5 CHANNEL DIGITAL-PROPORTIONAL RC SYSTEM

Radio Control is a perennially popular feature in electronics magazines, although the ready availability of complete systems from the mystic orient has tended to suppress the construction instincts of radio modelling enthusiasts. However, there seems to be a sufficiently large number of hard core enthusiasts who are willing to wield a soldering iron in the interests of providing their own electronic control link, and their patience has been rewarded by the arrival of several families of purpose-made integrated circuits that make this task somewhat more straightforward and reliable.

The recently released 35MHz band for radio control within the UK is primarily aimed at model aircraft enthusiasts, and understandably enough, the association governing club flying has decided to try and enforce certain minimum standards on equipment used in competition flying, to prevent interaction and mutual interference. The system described here is primarily aimed at land and water based control, where the uncertainties of home construction will not prove too catastrophic. A subsequent feature in *Radio & Electronics World* will cover a more sophisticated system for the 35MHz band, and also for the UHF 459MHz band which is presently used very little except by the most avid enthusiast and professional modellers.

THE BASICS OF PROPORTIONAL CONTROL SYSTEMS

Once upon a time, the shortage of ready made equipment for model radio control ensured a very widespread appreciation of the principles involved, since the majority of equipment was at least, in part, home constructed. However, the gradual slide into dependency on ready made equipment has somewhat obscured the basic operational principles of a radio control link, and so it is worthwhile to re-examine these concepts in some detail. Fig.1 shows the nature of the control wave form as derived from the control encoder, where you will see the output signals from the control sticks (or other preset control mechanism), is translated into five varying pulse widths that are transmitted as part of a complete "frame". The repetition rate of this frame is approximately 50Hz, hence listening to a model radio control signal on a radio frequently sounds somewhat like a 50 cycle mains hum.

Each of the five channels is represented by an individual pulse width in this frame, which is built up of the standard pulse of 200 micro seconds plus the variable pulse width attributable to the control stick position. The logic clocks along from the leading edge of the pulse in the frame. The long delay between the final pulse of one frame and the first pulse of the next frame allows the reset period to be detected at the receiver, thereby ensures that each servo is fed the correct pulse information each time the frame is updated.

As a matter of interest, it should be borne in mind that pure square waves cannot be modulated upon an RF carrier, since this requires an infinitely wide bandwidth for the transmission (whether AM or FM) and this is obviously a somewhat antisocial practice, which is remedied by passing the frame information through a low pulse filter before modulating the signal onto the RF carrier wave.

In this system, frequency modulation is employed since it offers better immunity from interference, and

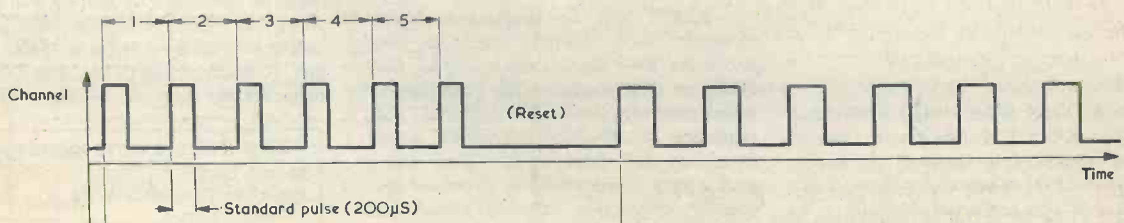
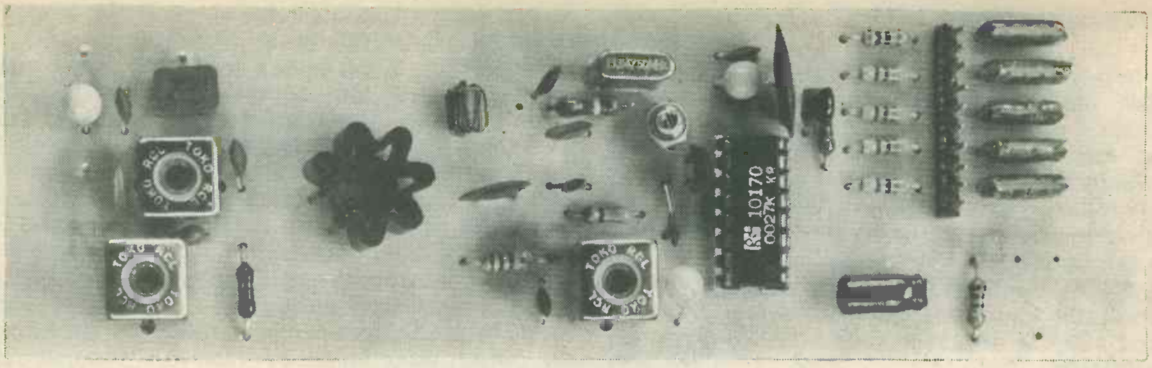


Fig. 1. The control waveform at the encoder output and decoder input.



The completed transmitter board.
(Actual size)

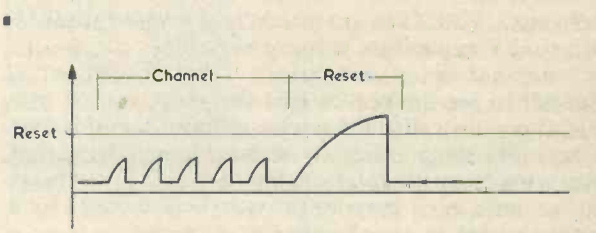


Fig. 2. Derivation of the simple reset pulse on C13 of the receiver/decoder, i.e.

it is widely appreciated as being a more sociable medium in areas of dense activity since the nature of the transmission is not so drastically altered by the effects of different antenna loadings as can be the case with AM. Enthusiastically modulated AM systems have been known to occupy at least ten channels of the radio control band, and are thus perhaps not entirely suitable for amateur construction techniques. An incorrectly aligned FM system will simply produce bad results at the receiver, and it is thus self-evident without such severe effects on channel bandwidth. A grossly overmodulated AM system may still appear to be working perfectly from the point of view of the control of the model.

Fig.2 shows the signal as it arrives at the top of the reset capacitor on the receiver (C13) where you will see that the reset pulse is simply derived by waiting for the voltage on C13 to reach the reset threshold causing all the counters to be returned to the initial setting. If you have access to an oscilloscope, then you can view the demodulated frame at Pin 1 of the receiver IC, and this should look like the waveform in Fig.1. although the edges will be slightly rounded in accordance with the necessity to preserve bandwidth. The rounded edges are sharpened up before passing into the decoder. The composite information frame is decoded into the individual servo control pulses (Fig.3) where you will see that the individual servo pulses (between 1 and 2 milliseconds wide) are directed to the appropriate control mechanism. With a frame time of 20 milliseconds, the refresh period is such that the occasional "glitch" will be quickly covered by a subsequent information update causing no discernible effect on the controls.

ABOUT THE 'R&EC' SYSTEM

The 'R&EC' system is based on a pair of IC's from TOKO that contain virtually all the signal processing and encoder/decoder functions. Some external transmitter power amplification is required at the transmitter end, although for close range operation, the output from the integrated circuit on its own is adequate. The IC's have been designed to provide simple, repeatable and reliable operation in mass production, and thus they present an excellent opportunity for the erstwhile radio control constructor to re-acquaint himself with the state of the art.

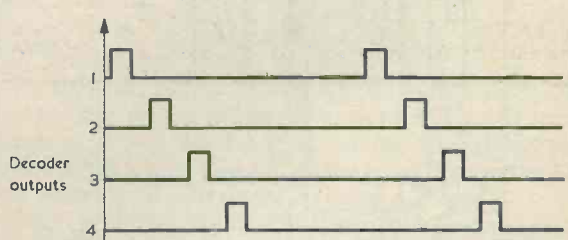


Fig. 3. Decoded output pulses to drive the servos.

THE TRANSMITTER CIRCUIT (Fig. 4).

The transmitter includes an encoder with five input facilities, fed from standard radio control stick assemblies – which can either be of the multi-axis or "preset" varieties. It is designed to be used with FM radio control crystals, which operate in the fundamental mode, on half the RF output frequency. The suggested load capacity is 20 pF, although other values can be used.

The 'R&EC' system uses 220kΩ control pots. The actual value to choose depends on several points:

a) the amount of travel available in the control stick assembly.

b) the "law" (ie relationship between the travel of the wiper and the resistance value at the terminals) of the potentiometer, since some manufacturers use pots where the entire range of the resistance changes occurs over a much smaller arc than you would expect to find from 'normal' volume control type pots. In such cases, 220kΩ is too much, and a value of 22kΩ with 0.1μF capacitors is more suitable.

c) the nature of the 'trim'. This adjustment is essential to set the servos (via the pulse width) at a neutral position with the sticks 'released', and it may be accomplished either by a mechanical trim that adjusts the 'neutral' relationship of the stick-pot body and its shaft, or it may be provided electrically by a preset resistor in series with the stick pot.

The encoded signal modulates the FM carrier by simply switching TC2 across the crystal – which instead of the usual AM 3rd overtone type, is a fundamental cut at half the output frequency. This is because fundamental crystals can be 'pulled' much further than the overtone types – with the frequency doubling, also doubling the deviation.

'Deviation' is perhaps a misnomer, since this is more accurately frequency shift keying (FSK) between two fixed frequencies approx. 2-3kHz apart. TC1 trims the basic centre frequency of the oscillator (used to set the higher of the two frequencies with the switching modulator turned 'off'). TC2 then determines the degree of shift between the 'on' and 'off' periods of the modulator.

The signal from the oscillator is then fed into the IC's doubler/amplifier at pin 14, with T1 providing the 27MHz selectivity and a suitable coupling link for the output stage amplifier transistor. Stopper resistors are used to prevent parametric instability, and render the output stage almost totally stable under any output loading conditions. (Unless you know different . . . . .).

The collector load of TR1 has to perform one of the most trying tasks in radio transmitter design – namely matching the output to an 'electrically short antenna' (ESA). An ESA is basically anything much under a quarter wavelength, and matching is accomplished by considering the antenna as a series RC network to ground. The equivalent capacitance is given by:

$$C_a = \frac{1.42L}{((\ln \times 2L/d) - 1) \times (1 - (fL/2808)^2)} \text{pF}$$

where L is the antenna length in inches (sorry all you metric fans) d is the diameter of the antenna in inches

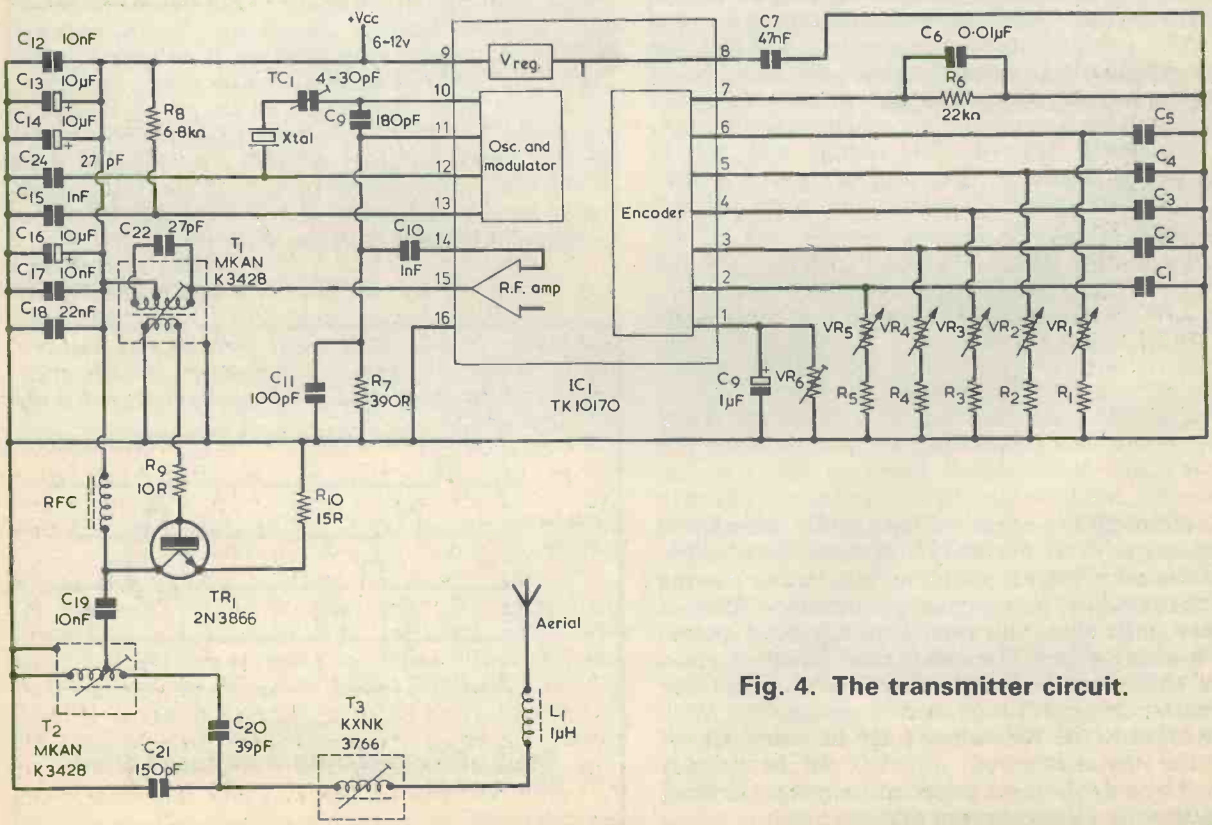


Fig. 4. The transmitter circuit.

COMPONENTS

THE TRANSMITTER

Resistors
(0.25w/0.33w carbon film 5%).

R1-R5 8K2
R6 22K
R7 390Ω
R8 6K8
R9 10Ω
R10 15Ω

VR1-5 220K Stick pots (SEE TEXT)
VR6 50K miniature preset

Semiconductors
IC1 TK10170 (TOKO)
TR1 2N3866/MRF472

Coils
T1 MKANK3428
T2 MKANK3428
T3 KXNK3766
L1 7BA1R0K 1uH
RFC 5 turns on FX1115 ferrite bead

Capacitors
C1-C5 22nF mylar/polyester
C6 10nF
C7 100n
C8 1u0 low leakage electrolytic or tantalum
C9 180pF ceramic
C10 1n0
C11 100pF
C12 10n
C13 10uF 16v electrolytic
C14 10uF
C15 1n0 ceramic
C16 10uF 16v electrolytic
C17 10nF ceramic
C18 22nF ceramic
C19 10nF ceramic
C20 39pF ceramic
C21 150pF ceramic
C22 27pF ceramic

Trimmer Capacitors
TC1/2 4-30pF foil or ceramic

Miscellaneous
Crystals: fundamental cut, 20pF parallel resonance at half output frequency
PCB, heatsink for output transistors, hardware, batteries etc.

f is the frequency in MHz
the equivalent resistance is given by:

$$Ra = 273\,(Lf)^2 \times 10^{-8} \text{ ohms}$$

The radiated power from such a system is that power which would be dissipated in Ra if the antenna was replaced by the equivalent series RC circuit. By placing a loading inductor in series with the antenna, a series resonant circuit is provided that has essentially zero impedance at the transmitter frequency. And this is derived from:

$$L1 = \frac{1}{(2 \times pi \times fc)^2 \times Ca} \mu H$$

The circuit used here has a fixed 1mH coil in series with a 1-2uH variable at the capacitive tap point across the output 'tank circuit', which allows room to trim the loading inductance to suit a variety of antenna conditions. This capacitive tap also provides DC blocking to the antenna. The circuit should be aligned for best field strength as measured on a meter about 4-5 feet away.

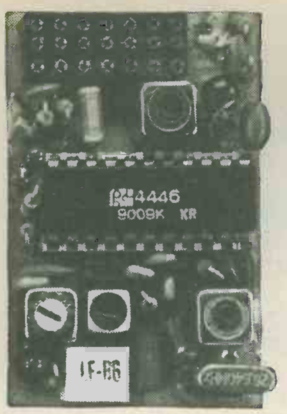
The input to the RF output stage has been set for about 1W from a 9v supply, although the inefficiency of the relatively short antennas ensures that effective radiated power is rather less than half that.

THE RECEIVER CIRCUIT Fig.5.

The most important aspect of this version of the receiver is the fact that the unit employs a ceramic filter (CF1) at 27MHz that provides selectivity which equates to 2 or 3 RF coils. Whilst this is good news for 27MHz users, this means that although the whole system works at 35Mhz, the filter cannot be used, and thus the selectivity relies upon a single 35MHz RF coil. At 35MHz, there is virtually no image rejection – which may bother some users, although at that frequency, there is a great deal less scope for any interference on the image frequencies than is presently the case around the 27Mhz band.

At the start of this article, we did mention that this feature was aimed primarily at land and water based users, so if you want a receiver for 35MHz for airborne applications, wait until we cover that in the first few issues of *Radio and Electronics World.*

TR1 provides about 20dB of voltage gain and a good match for the ceramic filter. The main IC (KB4446) contains a balanced mixer at the input, which is really rather essential if the receiver is to have a sufficiently good overload performance to handle operation in an environment where several models are being operated simultaneously. The RF stages of an RC receiver cannot begin to separate the RF signal in such situations, and they all end up at the mixer input.



The completed receiver board. (Actual size)

The channel selectivity (10kHz) is provided at the output of the mixer in the IF filter assembly at 455kHz (F1A and F1B). The combination of these two filters provides a low cost filter of excellent bandpass, with low weight and volume consumption. F1A possesses an excellent 'out of band characteristic', although the pass band (the 'close-in' response) isn't too hot. F1B is an exact compliment, possessing a good pass band, but indifferent 'out of band' attenuation.

The mixer and IF stages of the IC closely resemble MC3357P (used in the VHF NBFM scanner feature in last month's 'R&EC'), but the oscillator of the KB4446 is designed specifically for parallel 20pf load, third overtone crystals. Pin 10 of the IC is the collector of the oscillator stage, and pin 11 is the base input to the same transistor.

The IF amplifier of the KB4446 has rather high input impedance to match the filter – and this means that it is prone to stray pickup if the layout isn't quite perfect. In fact, if you test the receiver using equipment connected to the mains with mains earth connections, there is a chance that you will be able to hear 909kHz medium wave broadcast stations getting through the works and being audible at pin 1, the demodulated output. This is a result of the imperfect nature of mains wiring at 'RF', since the detector operates at approximately half 909kHz (455kHz).

Most people who have fiddled with a crystal set in their time will probably have discovered that a cold water pipe makes a good antenna – although in terms of house wiring, this is essentially at the same potential as the mains earth. But don't for heaven's sake try connecting a crystal set to the mains earth unless your will is up to date, or you are very certain of what you are doing.

When battery powered and isolated from such things as cleverly disguised earth leads masquerading as MW antennas, the receiver is completely unaware of 909kHz.

The detector output is fed to a differential comparator (input on pin 21). This section provides a paradox in that its prime function is to remove unwanted fast edges, but at the same time to 'clean

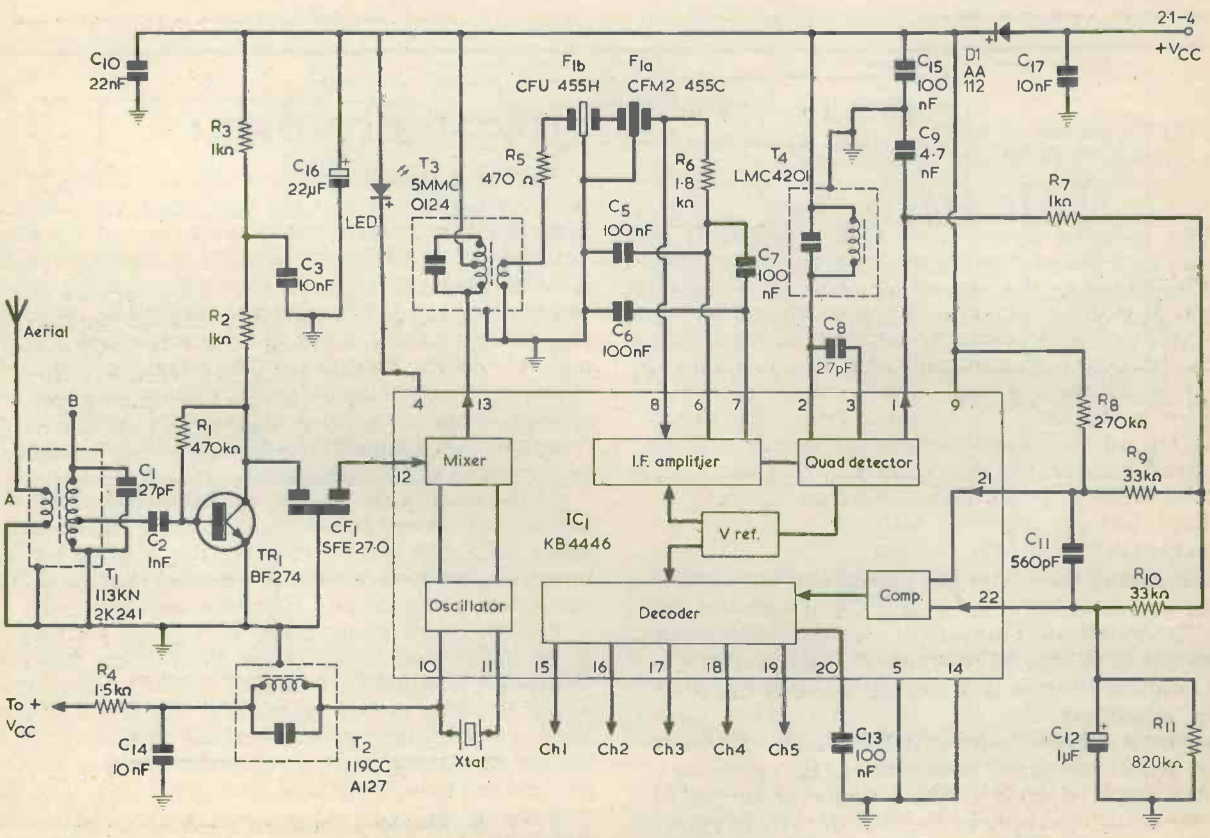


Fig. 5. The receiver circuit.

COMPONENTS

THE RECEIVER

Resistors
(0.25 or 0.125w carbon film)

R1 470K
R2 1K0
R3 1K0
R4 1K5
R5 470E
R6 1K8
R7 1K0
R8 270K
R9 33K
R10 33K
R11 820K

Semiconductors

IC1 KB4446 (TOKO)
TR1 BF274

Inductors
T1 113KN2K241
T2 119CCA127EK
T3 5MMC0124
T4 LMC4201

Capacitors
(all min ceramic disc/plate unless otherwise shown)
C1 27pF
C2 1n0
C3 10n
C4
C5 100n monolithic ceramic
C6 100n
C7 100n
C8 27pF
C9 4n7
C10
C11 560pF
C12 6v 1uF low leakage electrolytic
C13 100n mylar or polyester
C14 10n
C15 100n monolithic ceramic
C16 6v 22uF miniature electrolytic
C17 10n

Filters
F1a LFB6 (NTK)
F1b CFM455D (TOKO)

Miscellaneous
Case (SLM), servo connector block (SLM), PCB etc

NOTE all parts for this project are available either in complete 'kit form' or individually via the 'R&EC' reader services department, please send for details of the kit and prices.

up' and speed up the fast edges of the actual data stream. It provides a very effective noise filter by virtue of the R/C time constant on pin 22, but nevertheless this does not compromise the wanted edges of the data stream which enter the comparator unmolested by the RC roll-off. Spikes and other noises (in an enviroment where a number of high current DC motors are operating in servos, there are a good number of potential interference sources) are thus kept from passing to the decoder logic and causing false operation of the servos.

The decoder clocks along as the data arrives, directing the servo control pulses to the appropriate outputs. The frame reset occurs by checking the voltage on the top of C13, and resetting the decoder to the inital condition when this voltage exceeds the reset threshold voltage.

The servo outputs (pins 15-19) are collector loads of 20k, and if more drive is required (it isn't necessary with modern IC decoders), the outputs can be pulled up to the positive supply by the provision of an external load resistor of not less than 4k7 ohms on each output.

CONSTRUCTION

Fig.6 (a) details the PCB design used for the transmitter. You can etch it yourself, or buy it ready made from the 'R&EC' (shortly to be 'R&EW', don't forget) PCB service. Fig.6 (b) gives component position information. There isn't a lot to say about constructional technique, if you read electronics magazines at all, you will have had all the points to watch drummed in long ago.

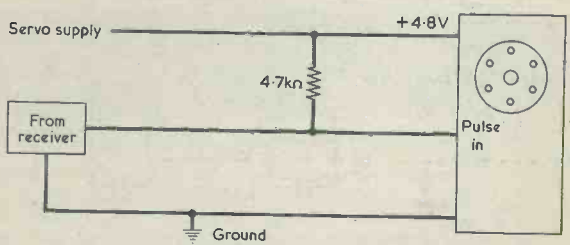
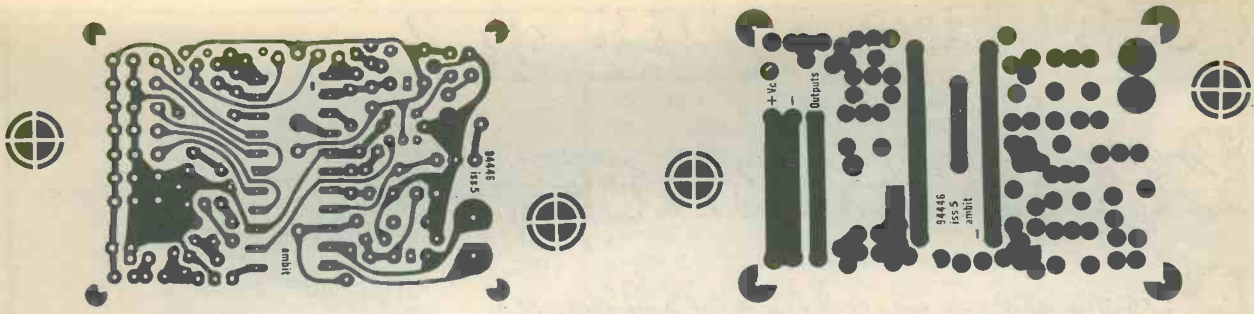
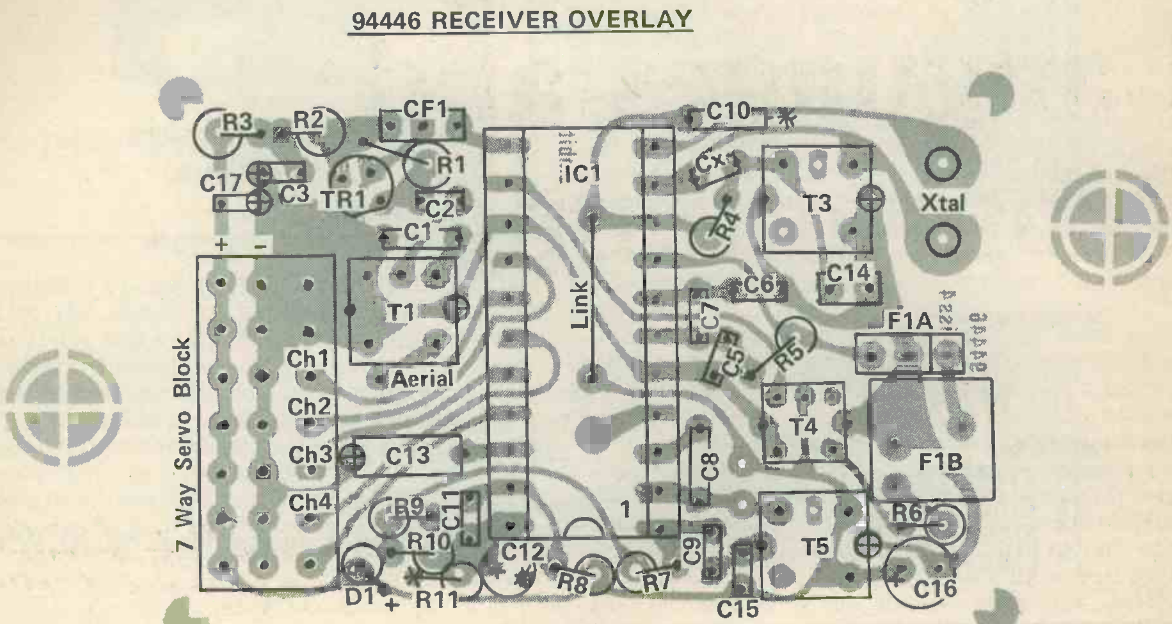


Fig. 6. Using a 'pull-up' resistor at the servo input in cases of marginal operation.



(a)



(b)

⊕ Solder to top and bottom of P.C.B.

⁎ Solder to top side only.

Fig. 7(a). Printed circuit board – actual size. (b) Receiver overlay.

Fig. 7 (a) shows the receiver PCB design (which is double-sided to save space), and Fig. 7 (b) shows the component overlay. Care must be taken to use the correct components, since there is absolutely no space to spare. An SLM servo connector block is used to provide the connection points for the servos and the power plug.

Further details of final assembly and alignment will be given in the first edition of *Radio and Electronics World* on sale on or about September 3rd., but since we appreciate that some of you would prefer to get on with this during the summer months, an SAE to the publishers will bring you a copy of the remainder of the feature to enable you to complete the whole project in one instalment. ■

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 80p, inclusive of postage and packing.

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.

COMPULINK SERIES NO. 2

Programmes, Programming Languages and Programming

Any science as new as computing tends to generate a vast quantity of jargon, buzz-words, and 'in' phrases in an attempt to express new and radically different ideas. This jargon is extremely difficult for the newcomer to start to comprehend.

On the 'software' side of computing, you will be confronted with such words as BASIC, compiler, COBOL, assembler, macro, operating system (OS) monitor, machine code, interpreter, etc.

The task of understanding the implications and relations of these different words is daunting, and is not aided by unhelpful reversion into 'jargon' when many of these expressions and concepts are used, in fact they are quite simple to understand if approached in 'lay' terminology.

WHAT IS A PROGRAMME?

A programme is a set of ordered instructions stored in a readable form which may be read and acted upon by a controlling device.

This broad definition includes knitting patterns, washing machine controllers and computer programmes. It is fundamental to the concept of programming that a difficult and complex task can be subdivided into a number of sequential and simple steps – whether it be.

"knit 1, purl 1 . . . ."

"turn the water on, turn the heaters on . . . ."

or "multiply A by B".

This ability to express complex ideas by limited numbers of fixed statements is something with which we are all familiar. The English language has only 26 such statements (the alphabet), and yet possesses a limitless ability to express concepts and ideas.

Microprocessors usually have between 100 and 400 simple built-in statements referred to as the "Microprocessors Instruction Set". All the programmes are then constructed from these basic instructions, in the same manner that words are constructed from the letters of the alphabet.

HOW PROGRAMMES ARE STORED AND READ

For a knitting pattern, the method of programme storage is one of decipherable marks upon paper. The programme is read by the moving finger of the human who is acting as the controller.

Having read one instruction and acted upon it, the finger moves on to the next instruction. In computing the finger which marks the current position of the controller (NB controlled device) in the programme is referred to as the "Instruction Pointer", or "Programme Pointer". In effect, the Instruction Pointer indicates where the controller must retrieve the next programme step from, having finished the current one. In the case of the washing machine controller, the programme is stored as a series of bumps and dents on the cam surfaces which operate microswitches connected to the motor, water solenoid and heater. In this example the microswitches are the instruction set, the cams are the programme, and the programme pointer is the angular displacement of the cam shaft.

In a computer or microprocessor the programme is stored within a semiconductor device known as a 'memory' chip. The memory chip contains a number of discrete locations which may be selected by the instruction or address counter of the microprocessors. Each of these memory locations can be set to a value which will cause the microprocessor reading it to execute one of the instructions from its instruction set. The value stored in the memory location thus tells the microprocessor which of the instructions to execute. The memory chip and its locations are filled with pointers to the instructions in the microprocessor's instruction set, and is analogous to the paper and marks of the knitting pattern, and the instruction pointer of the microprocessor is the moving finger.

PROGRAMMING LANGUAGES AND THEIR RELATIONSHIPS

Microprocessors are only capable of executing programmes written in terms of their built-in instructions sets, much as an English person cannot inherently read something written in Russian. All the programmes must therefore ultimately be translated into the processors native instruction set.

The steps of the instruction sets are very simple, and of the nature "add A to B", "read from a memory location", and "write to a memory location".

A programme presented entirely in the form of instructions from the processor's instruction set is known as a "machine code programme". Unfortunately, it is extremely tedious for humans to write in machine code, since it is rather like having to work out how to spell each word as you want to use it.

Nevertheless, many applications of simple computers rely on machine code programming, so a thorough understanding of it is fundamental to a complete understanding of computers – and computing in general.

To assist the machine code programmer, nearly all the computer systems contain a small machine code programme stored in a memory device known as the "Monitor Program". When the microprocessor is made to execute (read) the monitor program, instructions within it enable the human to locate and 'access' memory 'locations' within the computer's memory, and write a value into the memory representing the machine code step which the programmer wants the micro to execute.

This 'accessing' is carried out via some sort of computer 'terminal' – and the monitor contains programme steps which allows the micro to 'write' data to the terminal, and read data entered into the terminal by the programmer.

When the programmer has finished entering his programme into memory, he can instruct the microprocessor to go and 'read' (execute) his newly entered programme via the monitor programme. This method of programme construction and entering is really only feasible for very short programmes, such as those programmes of less than a thousand discrete steps.

In order that the programmer can be freed from the tedium of writing machine code programmes, there are programmes which help to write programmes. These programmes are known as "programming languages".

A 'programming language' helps the operator to write 'programmes' by supplying a language which can be used to communicate with the computer using stock words, phrases and even sentences. Thus the effort changes from constructing one's own words, (and writing a dictionary as you go along), to that of stringing together the supplied words and phrases in the correct order.

The programming language creates a pseudo 'instruction set.' This pseudo instruction set is a lot more powerful than the simple inherent instruction set that is supplied with the microprocessor. Instead of instructions such as 'read from memory location', 'add A to B' – the programming language offers instructions such as:

"Print on the terminal A x B"

and

"Input from the terminal the value of A."

Examples of programming languages are BASIC, FORTRAN and COBOL. It should be remembered that these languages are themselves programmes, and are of course written in machine code.

Ultimately, these programmes convert the programmer's programme to machine code, much as a translator converts Russian into English, and then breaks the words down to the alphabet, or the basic 'instruction set'.

There is therefore a hierarchical relationship amongst programming languages, and the further from machine code a language is – the more power the pseudo instruction set has – allowing complete concepts to be expressed by a single 'pseudo instruction', or at least a small group of them.

As you can imagine, the more powerful the pseudo instruction set of a language, the greater the 'overhead' of converting a programme written in that language to machine code becomes. Thus a programme written in an advanced programming language runs more slowly than the same programme written directly in machine code, unless special techniques are employed, e.g. few bilingual English people read Russian as quickly as their own native tongue.

Next month we will begin to look at what machine code is, and how programmes can be 'structured' using it. ■

'BANGS AND BUMPS' AT BROADCASTING HOUSE

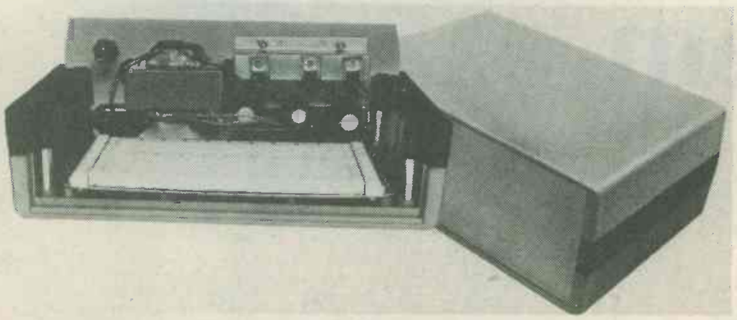
For the past few months workmen have been very busy carrying out repairs and modernisation at BBC Broadcasting House. The work, which will take two years to complete, will result in much needed improvements in the studios used by news and currents affairs programmes. Contractors using special drills and saws have been engaged in cutting through a foot-thick re-inforced concrete chimney, and elaborate schedules were worked out to ensure that 'bangs and bumps' were not picked up by microphones in the studios.

The arrangements have worked extremely well with one notable exception – during a morning news bulletin when the dulcet tones of Radio 4 newsreader Dilly Barlow were interrupted by the banging of a hammer two floors above the studio!

The latest mishap was of a less noisy though equally inconvenient nature. When a workman accidentally cut through a water pipe, part of the second floor became flooded so quickly that special equipment had to be rushed in by the House Services staff in order to prevent the whole floor becoming completely flooded! Fortunately, there was no need for the radio newsreaders to sit at their desks while the waters lapped around their ankles – they work on the third floor!

TRADE NEWS

IDEA BOX FROM GLOBAL SPECIALITIES CORPORATION



New prototyping aid combines circuit cards and power supplies in easy-to-use package

The Idea Box from GSC is a new concept in prototyping aids for electronic circuit design. Combining three fully regulated power supplies and three choices of circuit cards in a rugged plastic case, the Idea Box is designed specifically to offer the ease of solderless breadboarding systems to the user who wishes to construct a fully packaged 'one-of-a-kind' instrument.

The basic Idea Box system is an extension of GSC's Experimentor solderless breadboard concept, which allows designers to move from an initial breadboard layout to a fully finished circuit board in the minimum of stages. The Idea Box is available with a choice of a solderless breadboard (Model IDB – 100); a pre-etched, pre-drilled printed-circuit board which emulates the hole and connection pattern of the solderless breadboard. (Model IDB 102); or an unetched printed-circuit board that can be used for existing printed-circuit board designs (Model IDB 103).

For added component capacity and circuit capability, any of three circuit cards can be stacked in any combination in the Idea Box. Additional cards of all three types are available, and other accessories include a blank aluminium front-panel replacement and printed paper pads which also duplicate the hole-and-connection patterns of the circuit cards.

The power supplies, which are mounted on the back plate of the Idea Box, provide three separate outputs: +5V d.c., IA; +15V d.c., 0.5A; and –15V d.c., 0.5A. Line regulation is better than 0.15% at IA output.

The Idea Box measures 178 x 254 x 102mm and weighs 625g.

Enquiries to Global Specialities Corporation, Shire Hill Industrial Estate, Saffron Walden, Essex.

BIB CHANGE COMPANY NAME

Bib Hi-Fi Accessories Limited, one of Britain's leading maker of products for audio and video care and maintenance, has announced that, with effect from 1st July 1981, it will be trading under the name of Bib Audio/Video Products Limited.

Bib, whose business growth coincided with the immense rise in popularity of hi-fi systems in Britain during the 60s and 70s, says the change in name better reflects the company's current trading interests and the development of the market over recent years, particularly the rapid growth in video despite the world economic recession.

Bib, part of Kelsey Industries, which includes Multicore Solders, was founded in 1954, and has established itself as the leading name in its market, not only in Britain but also in the United States where it began manufacturing and marketing its products in 1977.

The comprehensive range of Bib products for the care and maintenance of audio and video equipment is manufactured in the company's plant at Kelsey House, Wood Lane End, Hemel Hempstead, Herts HP2 4RQ.

Plessey Semiconductors wins Queen's Award

Plessey Semiconductors has won the Queen's Award for Export Achievement.

The award, given for outstanding export performance over three consecutive years, demonstrates the success with which the company has penetrated world-wide markets.

Ken Bradshaw, Marketing Director of Plessey Semiconductors said "I personally feel tremendous gratification at this recognition of our success in exporting to 45 countries. It demonstrates the realism with which the company has addressed the international marketplace over the past 7 years." He added: "Indeed, our growth is accelerating and, in the year just closed, exports have grown from 7½ to 10 million units. This continued growth, in a recession, should show the world, once and for all, that Plessey Semiconductors is not merely a high technology job shop!"

The company currently exports over 70 percent of production and its successes include selling integrated circuits for Japanese television receivers and military circuits to the USA.

A Scanning Monitor Receiver System

Part 2

L. Power

CONSTRUCTIONAL CONSIDERATIONS

The only practical solution to a circuit of this complex nature is to use a PCB derived from a 2:1 artwork, and photographic reduction. Fig.4 details the PCB foil pattern, which can be used for a direct photographic reproduction (beware the commercial copyright aspects). It seems unlikely that anyone should want to try to make a hand drawn copy – but if you have a steady hand and a good deal of patience, then the best way is to pin the layout on a piece of PCB, and use a centre punch to locate all the hole centres. Then take away the 'template' and join up the dots with a PCB etch resist pen.

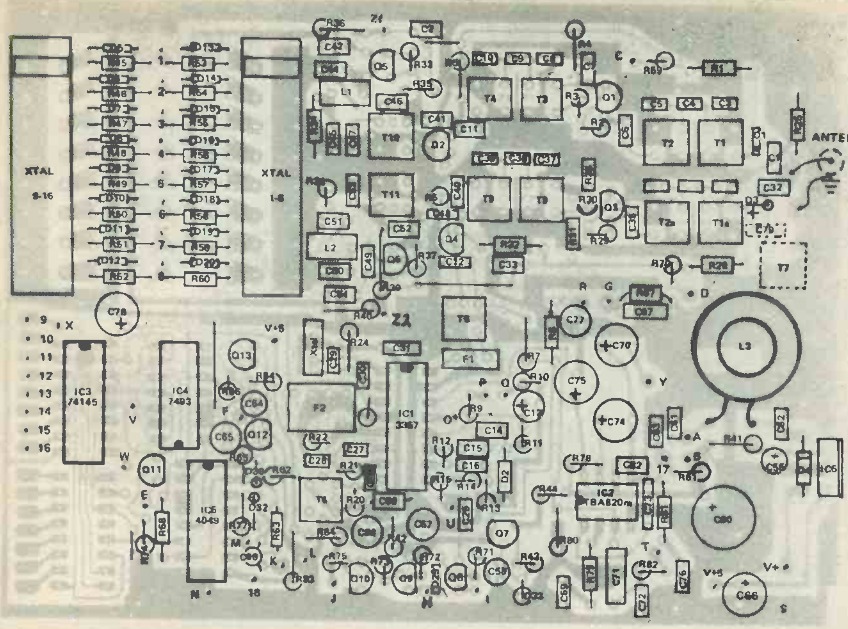
Part of R&EC's evolving range of reader services now includes a low cost photographic film positive master facility for selected projects (this is one of them), where you can obtain a film positive of the PCB to enable those of you with access to a 'Photolab' or similar, to achieve perfect results on the more complex boards. Or failing this, you can go the whole hog and get a complete PCB from Ambit.

The component position overlay of Fig.5, identifies the positioning of the various components used. Between this and the circuit diagram published in part one, you should be able to locate the components with minimum difficulty. The only area for possible misinterpretation concerns the sections of the circuit that are connected via the flying lead terminations (display and lockout switch board, potentiometers etc.), **and these items are shown as clearly as possible on the scale available.**

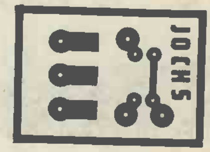
Component identification should present few problems – except for items such as the coils, where a different coil type is used for the RF sections of the different frequency bands covered by this unit.

TABLE

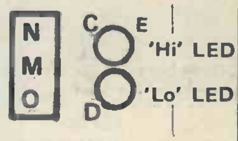
RF range	C3 =C5 =C5 =C8 =C10	T1 =T2 =T3 =T4 =T10	C4/C9
26-32MHz	Not required. . .	119CCA127EK . . .	2p2
32-40MHz	Not required . . .	199KCA314N. . .	2p2
40-60MHz	15 15 15 15	113CN2K159DZ . . .	2p2
60-80MHz	15 15 15 15	214SN10252N . . .	1p8
80-100MHz	10 10 10 10	214SN10252N . . .	1p8
100-130MHz	8p2 8p2 8p2 8p2	214SN10250X . . .	1p8
130-150MHz	5p6 5p6 5p6 5p6	214SN10250X . . .	1p5
150-170MHz	8p2 8p2 8p2 8p2	214SN10248X . . .	1p5



SPDT switch

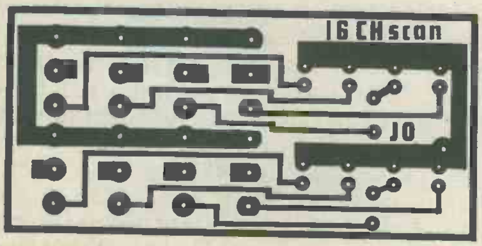


1:1 PC foil detail for the manual/auto scan PCB.

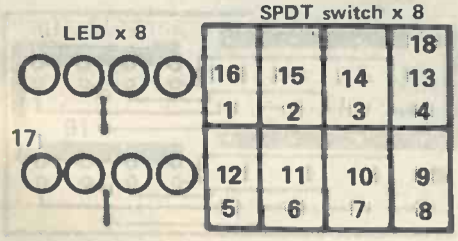


Component position and wiring detail

The numbered points on the PCB should be connected to the corresponding numbered point on the front panel PCBs.



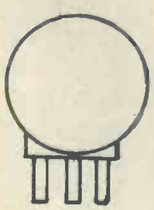
PC foil detail (1:1) for the lockout switch and LED front panel PCB



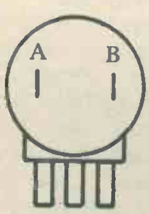
Component position and wiring detail

Interconnections:

A ...	Switch on volume control
B ...	Switch on volume control
C ...	'C' on small manual/auto switch PCB
D ...	'D' .. .. ..
E ...	'E' .. .. ..
F ...	Channel advance push button
G ...	.. .. ..
H ...	Z2 (across board link)
I ...	Z1 (across board link)
J ...	V (across board link)
K ...	'Delay' switch on back panel
L ...	.. .. ..
M ...	'M' on man./auto switch board
N ...	N (across board link)
O ...	O (across board link)
P ...	Mute control......
Q ...	.. ..
R ...	.. ..
S ...	Earth connection point
T ...	Audio from volume control
U ...	Audio to volume control
V ...	J (across board link)
W ...	X (across board link)
Y ...	Loudspeaker output
V +5 ...	V +5 (across board link)



Mute control viewed from behind



Volume control and ON/OFF switch

Fig. 5. Component positions and layout.
NB All overlays are viewed from component side with view of track through the PCB.

*
The value of the coupling capacitor is given for approx 5-6MHz bandwidth. Increasing C4/C9 will increase bandwidth – but too much capacity here will cause the characteristic 'double hump' of an over coupled circuit.

C46 and C52 (the oscillator tripler tank resonanting capacitors) should be approx 10% more than the C3 value for a given band.

For the second band, C37 = C39 = C3, in other words, duplicate the above values for the required second band coverage.

COMPONENTS

Resistors

* = Value changed in the course of optimisation

R1	3k3
R2*	150k
R3	68E
R4	470E
R5*	330k
R6*	68
R7	120E
R8	33k
R9	47k
R10	100k
R11	47k
R12	680k
R13	2k2
R14	18k
R15	8k2
R16	
R17	
R18	
R19	
R20	33k
R21	47k
R22	1k8
R24	100k
R25	1k5
R26	3k3
R27	1k0
R28	470E
R29*	150k
R30*	68k
R31*	470E
R32	330k
R33	100k
R34	100E
R35*	210E
R36	2k2
R37	100k
R38	100E
R39*	210E
R40	2k2
R41	10E
R42	
R43	
R44	
R45–60	2k2
R61	680E
R62	2k2
R63	3k3
R64	33k
R65	33k
R66	2k2
R67	330k
R68	47E
R69	680E
R70	680E
R71	33k
R72	4
R73	4k7
R74	4k7
R75	
R76	
R77	1MO
R78	56E
R79	120E
R80	100k
R81	
R82	
VR1	100k + switch
VR2	10k + switch

X Tals

X1 10.245/30pf 11 channel Xtals – series resonant 3rd O/T $\frac{\text{FRF} - 10.7}{3}$

Coils

L1	
L2	
L3	100t 36 SWG
T1	see table
T2	see table
T3	see table
T4	see table
T5*	119LC30099N
T6	LMC4200 or LMC4201
T7	not used (10.7mm trap)
T8	see table
T9	see table
T10	see table osc tripler
T11	see table osc tripler
T12	

Capacitors

C1	10n
C2	10n
C3	see table
C4	see table
C5	see table
C6	1n0
C7	10n
C8	see table
C9	see table
C10	see table
C11	1n0
C12	10n
C13	1u0 – low leak
C14	10n
C15	470p
C16	470p
C17	
C18	
C19	
C20	
C21	
C22	
C23	
C24	
C25	22n
C26	10pF
C27	47n/100u
C28	47n/100u
C29	120p
C30	47p
C31	47n
C32	10n
C33	10n
C34	
C35	1n0
C36	10n
C37	see table
C38	see table
C39	see table
C40	1n0
C41*	2p2
C42	10n
C43	140p
C44	68p
C45	10n
C46	see table
C47	10n
C48	2p2
C49	150p
C50	82p
C51	10n
C52	see table
C53	10n
C54	10n
C55	3u3
C56	47uF
C57	47uF
C58	10uF
C59	47n
C60	1000pF
C61	47n
C62	47n
C63	10n
C64	1u0
C65	1u0
C66	100uF
C67	47n
C68	2u2
C69	
C70*	1000uF AF/OP
C71	47n
C72	22n
C73	
C74	
C75	

Diodes

D1	BA244
D2	0A91
D3	BA244
D4	1N4002
D5–D20	1N4148
D21–D28	1N4148
D29	1N4148
D30	1N4148
D31/2	LED
D33*	1N4148

Filters

F1	10M15A
F2	LFH 8/CFW445F

ICs

IC1	MC3357/MPS5701
IC2	TBA820M
IC3	74145
IC4	7493
IC5	78L05
IC6	4049
IC7	

Transistors

Q1	BF594
Q2	BF594
Q3	BF594
Q4	BF594
Q5	BF594
Q6	BF594
Q7	BC238
Q8	BC308
Q9	BC308
Q10	BC238
Q11	BC238
Q12	BC238
Q13	BC238
Q14	

Misc.

Micrometals T40/26
Xtal sockets
DC power jack

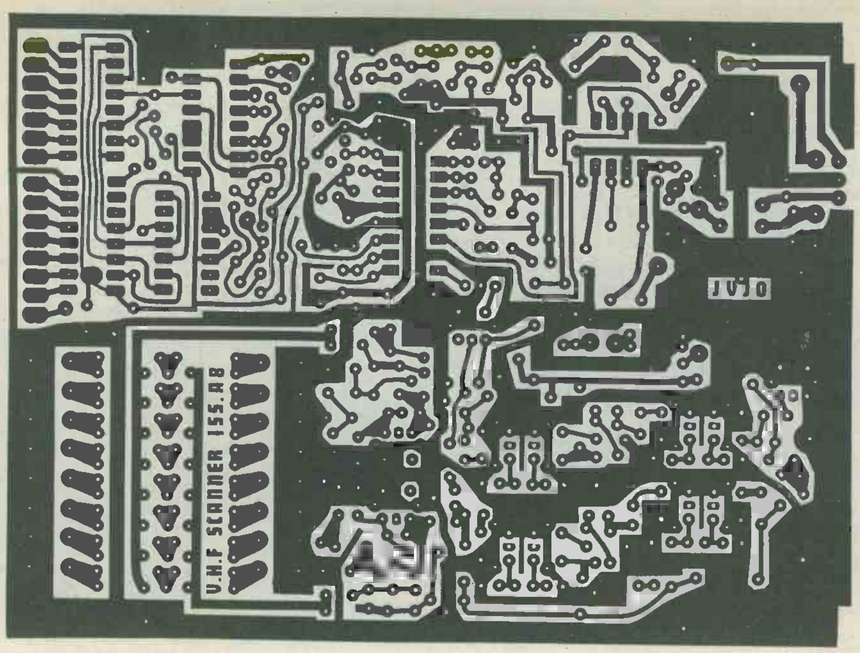


Fig. 6. Foil layout.

CHOOSING THE BANDS

The top coupled RF circuits are consistent in terms of the value of the L/C combinations regardless of the position in the circuit. It may be necessary to clip the centre pin from the base of the RF coils, since some of the above coils are supplied with primary taps that are not required – and could accidentally make contact with the ground plane of the PCB.

The coils for the LF bands are complete with internal capacitors.

CONSTRUCTION

First get your PCB. The author's basic philosophy is to fill as many of the holes as possible with larger components, so that the scope for incorrect insertions of the simpler items such as Rs and Cs is reduced. Things like the IC sockets (make certain pin one is the right end) should be fitted – Zetronix low profile types are probably best, since they are small (important in this layout), forgiving (unlike common TI low profile types which don't like being bent 90 degrees and then returned), and really tight contacts.

The ceramic filters, coils, and crystal holders should be fitted next. If you are concerned about 'progressive' checking, then work backwards from the loudspeaker. Fit all components associated with the audio stage, and then plug in a loudspeaker, apply 12v (remember L3 in supply noise filter) and place your finger on the audio input at pin 3 of IC2. There will be a buzz in the speaker if all is well so far, and quiescent current will be about 10-12mA with no signal.

Switch off, having acquired the first instalment of our sense of achievement, then complete the circuit around IC1 (the main IF system). The power supply voltage at the emitter of Q7 should be checked before inserting IC1 into its socket – assuming 8-10v, fit the IC and switch on. There should be a hiss in the speaker, which changes dramatically as you place your finger near pin 16 of IC1. If you put a piece of wire about 12 inches long on to pin 16, it will act as an antenna and you will hear a load of miscellaneous HF mush from the output. If not, turn the squelch (mute) control Vr1 until the squelch drops out. If nothing happens when doing this, disconnect one end of R14 to prevent the mute amplifier from getting any input, and if there is still nothing, check the component positioning, soldering etc.

The RF, oscillator and first mixer stages are not so easily isolated for progressive testing. Insert the remaining components, check the whole assembly carefully, and prepare yourself for the most tricky part of the operation thus far.

TESTING THE COMPLETE UNIT

First things first, check the current consumption is reasonable (ie between 20 and 50mA). Rather than be defeatist plug in a crystal (or two) and with the mute open (ie noise coming out of the speaker), step the selector along to the crystal position in use. If you have a GDO or similar, you can check to see if anything is happening at the oscillator coil – if not, you will have to rely on a signal generator for your source, or a local strong signal on a known frequency.

If the logic is not selecting the correct crystal and RF section, then check the wiring and component positioning very carefully. There is no scope for any shades of grey here – either it works or it does not. If it does not, the easy mistakes are wrong transistor types (mixed up NPN/PNP – if you use AEG BC308s for the PNP types, you will notice these have a white painted stripe along the top to help easier identification). The band indication LED only lights up when the scanning stops – or the mute is held open. During mute closed conditions, the channel LEDs will step along in sequence until halted.

With the characteristic hiss in the loudspeaker, turn the core of T6 (the detector) until the hiss suddenly changes from being broken and crackling, to a 'balanced' white noise. If you check the DC voltage at pin 9 of IC1 at this point, you should find it settles about midway between the supply voltage and ground when the noise sounds 'cleanest'. This is because the DC offset condition when the detector is not correctly aligned down the centre of the IF passband causes the noise to limit 'hard against' the supply rail, creating the characteristic clipped sound.

Those of you with the means of more precise alignment probably do not need any instruction in their employment for this task. . .

With your signal source to hand, set this to the expected RF frequency, and turn the output of the generator up until some sounds are heard in the speaker. If you do not have an FM source (ie you are relying on a crystal oscillator for alignment) then tune all the cores of the RF and oscillator stages for best quieting, whilst progressively decreasing the signal at the input.

Start with the oscillator coil T10/T11. If you can get absolutely nothing, then check to see that the crystal is selected by measuring the voltage at the appropriate output of IC3, and that the oscillator has been selected by the high/low select circuitry by checking to see that collector volts are present on the appropriate oscillator stage.

Still nothing? Then try and measure the frequency of the oscillator by capacitive coupling (5-20pF) into a reasonable HF DFM, do the sums on the multiplication (x3 +10.7) MHz, and see if this corresponds with your expectations from the value stamped on the crystal. It should not be more than a kHz or two out. If it is a couple of kHz HF of expectations, you can solder up to about 30pF across the crystal base (track side of the board) to trim it onto channel. Take care where you measure the crystal frequency (the collector of Q5/6 seems best), since the loading of the DFM probe would make a small difference on the base of the oscillator.

You probably won't be able to measure the tripled output directly, since the presence of the basic 3rd OT frequency will tend to 'capture' the DFM. All well and good if you can. A simple absorption wavemeter could be constructed for the injection (x3) frequency, and this can be coupled into the secondary of the oscillator tripler coil to provide a means of peaking the LO injection frequency in the absence of any other signals.

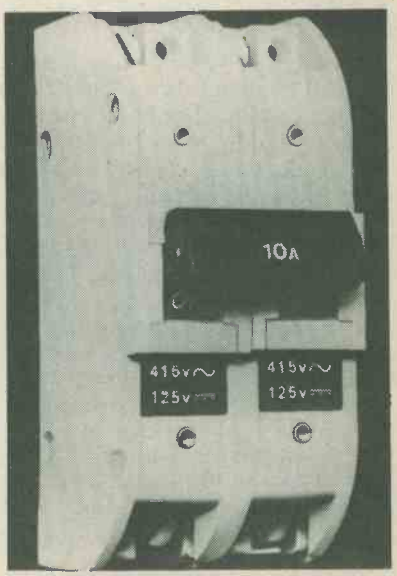
When you have established success at the oscillator, and you still don't have any sound at the output to assist in the trimming RF stages, then check for daft things, like reversed transistors, diodes, solder bridges, capacitors where the pF and nF markings have been swapped over.

If you still haven't got anything to go on, then the best thing is to try and get access to a suitable piece of test gear. R&EC's new constructor services department may be able to help in cases of dire need, but this is strictly for equipment that has been correctly assembled and is working from the 10.7MHz IF on IC1 to the loudspeaker, where no specialised equipment of any sort is required to achieve progress.

MANUFACTURER SWITCHES TO CIBA-GEIGY'S MELOPAS

Ciba-Geigy's Melopas moulding compound has recently been selected for the manufacture of miniature circuit breaker housings after a detailed examination of several materials.

MCB Lupus of Winsford, Cheshire, who produce the "Midget" circuit breakers for incorporation into electrical distribution equipment, chose the Ciba-Geigy compound during a general review of moulding materials used by the company.



"Midget" circuit breaker produced by MCB Lupus of Winsford, Cheshire using Ciba-Geigy's Melopas MPL.

BEST COMBINATION OF PROPERTIES

The company had previously used a wood-filled urea-formaldehyde resin for the moulding. They therefore required a material that would offer the same or better mechanical, electrical and thermal properties with advantages in costs and/or moulding characteristics.

After looking at many materials, including a detailed survey of three or four materials, MCB Lupus chose Melopas MPL. This offered the company the best balance of cost, production speed and usability and also provided more scope for future development in the company's products.

Melopas moulding compounds are a range of phenol-modified melamine resins available for compression, transfer or injection moulding. All offer good mechanical and electrical properties, good resistance to surface cracking and low water absorption. Melopas MPL has a track resistance of class KA3b/KA3c (DIN 53480) and an arc resistance of 120-130s.

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A New Recruit

SMITHY GETS CRACKING ON TRACKING AND TRACKS DOWN THE CRACKLING

"Cripes!" yelled Dick as he leapt back from the window. "It's alive!"

"Well don't touch it then," muttered Smithy unsympathetically, and continued scrutinising the job on his bench.

"Well I'm blowed, it's you, you little perisher," Smithy heard Dick expostulate. Smithy maintained that if someone survived an electric shock well enough to shout about it and then go on to remark about the problems of life, then there couldn't be too much damage done.

However, after a moment or two he turned away, not unthankfully, from the problem-ridden colour TV on his bench. He'd spent several unsuccessful minutes looking for the cause of a persistent but intermittent crackling on the sound.

"What's alive?" he asked, and looking at the small portable radio spread open on Dick's bench added, "You *can't* get a shock from that!"

But Dick wasn't listening, he had now opened the window and was leaning far out, "Come here you!" he exclaimed.

Smithy was again surprised by Dick's abrupt manner but then grinned broadly when Dick re-appeared holding a small tabby kitten.

"Of course its alive," chuckled Smithy.

"Well I meant the aerial actually," said Dick sheepishly. "I opened the window to look at it and it suddenly moved and frightened the wits out of me, but it was only this little chap playing with it out on the roof."

Smithy glanced at Dick's so-called aerial, which was simply a piece of flexible wire run out through the window and strung up to a nearby gutter. A temporary lash-up years ago, it had survived both Smithy's scorn and the gales which had brought down trees in the local park.

"Why the interest in this – er – aerial?" queried Smithy.

"I thought it was shorting to earth or something," explained Dick hurriedly, "I was getting this intermittent crackling noise."

Smithy peered at the small radio on Dick's bench. It was a cheap 'tranny', almost certainly of Far Eastern origin, which wouldn't normally be worth the cost of any repair work.

Dick looked somewhat flustered. "It belongs to a mate at college," he explained and added, "It's rather deaf and I said I'd look at it for him if I had time today." Smithy was silent and Dick continued, rather embarrassed, "I hooked on my aerial to try to get something out of it but all I'm getting now is this 'crackling' which I thought was the aerial." Dick's voice tailed off. "I think he's been fiddling with it," he added and fell into silence.

"Perhaps it would like a saucer of milk," said Smithy.

"Eh?" said Dick, then as the penny dropped he seized the chance to change the subject and added hurriedly, "oh yes – yes could be. Yes its been hanging around for a couple of days now, it does look half starved." Dick lifted the kitten carefully in one hand. "There's nothing of it," he concluded.

Smithy poured a little milk into the workshop's only saucer. "See if he'll drink that," he said. "He's very small. Only a few weeks old by the look of him. Probably unwanted and abandoned."

The kitten sniffed the air as Dick put him on the floor near the saucer and our two heros grinned broadly as the kitten lapped hungrily.

"Well he's enjoying that," said Dick and before the kitten had finished he topped up the saucer to the brim. The kitten continued without a pause, but after a while and with the saucer still nearly full, it looked up, licked its whiskers and moved away to explore the new surroundings.

"Its got the right idea," said Dick brightly. "Its been a busy afternoon – lets have a break. I'll put the kettle on."

Dick busied himself with the tea things and Smithy wandered back to Dick's bench where the deaf 'tranny' lay. "You say you think he's fiddled with it," he remarked non-committally.

"Yes," said Dick cautiously. "The IF was say out. I've re-aligned that but its still fairly deaf."

"Probably disturbed the tracking too then," said Smithy and picking up Dick's aerial between thumb and forefinger and with an exaggerated gesture of distaste he put it to one side adding, "but you shouldn't need *that.*"

Dick came over, stood alongside Smithy and explained, "I've tried moving the aerial coil on the ferrite rod, but I can't seem to get it right. It still seems deaf over most of the band."

"Well we've had a good day so far," said Smithy resignedly, "so lets have a go at 'tracking' this 'foreigner'."

Dick ignored Smithy's sly dig at his 'home service' job and said, "I'm not really sure how. It's a Medium Wave only set so I guess it ought to be dead easy."

Smithy took his note pad off the shelf and started to sketch a circuit (Fig.1). "It helps to understand a little about what 'tracking' is," he said as he finished his sketch. "All these sets are basically similar," he explained. "They have a self-oscillating mixer as the first stage."

"Sounds like two for the price of one," commented Dick.

"Sort of," said Smithy. "The signal from the ferrite rod aerial is the received frequency which in this case is within the Medium Wave band. The oscillator generates its own frequency about 465kHz higher than the received frequency and the difference between them is the 465kHz intermediate frequency."

Smithy paused as Dick frowned slightly. "The *difference* between them?," Dick said uneasily.

"Yes," explained Smithy. "You see this oscillator has two signals being mixed together at its inputs, the Medium Wave frequency on its base and its own frequency on its emitter. And since its working hard as an oscillator it is operating non-linearly and so it also produces the sum and difference frequencies at its output by 'mixing'."

Dick looked at Smithy. "You didn't mention this 'mixing' when you explained about non-linear resistors," he said accusingly.

"That's because with the non-linear resistors we were dealing with dc," explained Smithy. "Even if we had used ac the non-linear effects are due to temperature changes and are far too slow to be considered like this."

"Okay," said Dick, "but perhaps you would explain the idea of 'mixing' some time. But what does this have to do with 'tracking'?"

Smithy was pleased to leave the subject of mixing for the present and said, "the intermediate frequency amplifier includes filters to *select* just this difference in frequency which is usually about 460 to 470 kHz, and to *reject* the other frequencies which come out of the mixer. So we need to ensure that we keep this difference between the tuned input frequency and the oscillator frequency constantly equal to the fixed intermediate frequency."

"But its automatic," objected Dick pointing to Smithy's circuit. "The two variable capacitors are both joined together – mechanically I mean!"

"Yes," agreed Smithy, "the tuning capacitor certainly has two sections on one shaft, but even then its almost impossible to tune two circuits over two separate frequency ranges and still keep the difference constant."

Smithy carefully drew a

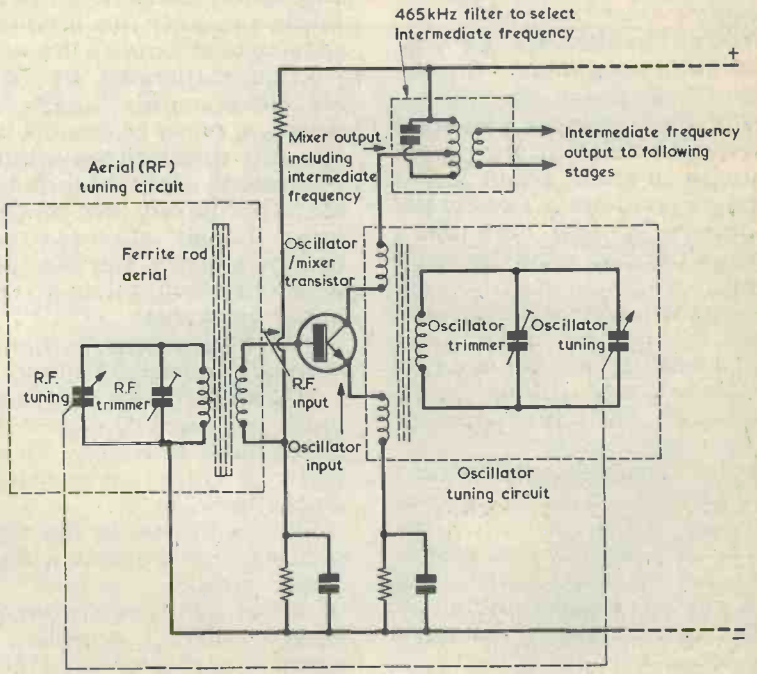

Fig.1. Smithy's sketch of a simple Oscillator/Mixer stage shows the first important sections of Dick's 'tranny' superhet radio. The variable capacitors are 'ganged' together and each has an additional trimmer capacitor to help with the 'tracking'.

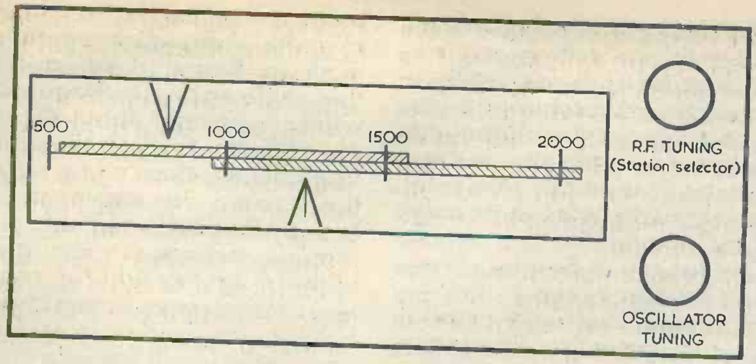

Fig.2. Smithy's idea of the tuning arrangements for a hard-to-tune superhet which nevertheless could achieve perfect tracking. The top pointer is set to select the station. The bottom pointer is then set to be 465kHz higher.

sketch to illustrate his point (Fig.2).

"If radios had two scales and two tuning controls, we could first tune the received signal to the station we want, and then we could adjust the oscillator frequency to be exactly 465kHz higher, so that the IF amplifier could get the signal and do its job."

"Thank goodness we don't have to do that!" snorted Dick. "My uncle Sid would never find the 'Archers', poor chap!"

Smithy wondered if Dick's uncle's penchant for Radio 4's time honoured soap opera was the reason why Dick's family always laughingly referred to him as 'Silly Sid', but dismissed the ignoble thought and continued with his expalnation.

"No," said Smithy, "we don't have to do that because we put the two tuning capacitors onto the one spindle. But," he continued, "we still can't keep the frequency difference constant unless we are very careful with the choice of inductance-capacitor ratios for each circuit."

Smithy switched on the workshop's very dusty old pocket calculator and pointed again to his second sketch (Fig.2). "You see the Medium Wave goes from about 1620kHz down to about 520kHz which is a frequency span of 1100kHz. Now, to give the correct Intermediate Frequency of say 465kHz, the oscillator *must* tune from 2085kHz down to 985kHz which is the same frequency *span*. But look, while the frequency *span* is the same, the *ratios* of the top and bottom frequencies are *different*. For the RF, that's the signal from the ferrite rod, the ratio is 1620kHz to 520kHz which is 3.12:1 while for the oscillator the ratio of the maximum to minimum frequencies is 2085kHz to 985kHz or only 2.12:1. So the tuning capacitors must have not only different maximum to minimum *values* but also different *ratios* and therefore the tuning 'laws' will be different."

"How do you mean 'the tuning "laws" will be different'?" Dick asked as he grappled with the concept of tuning capacitors slowly moving round, with pointers moving over scales and frequencies falling in unison.

"What happens is that you may start at one end with a frequency difference of 465kHz, and you may even finish at the other end with the same 465kHz difference, but in between the difference may well increase or decrease or first go one way and then the other. . ." Smithy's voice trailed off. "It's difficult to make them both keep in step you see," he finished.

Smithy sketched a simple tuned circuit and added two extra preset capacitors, (Fig.3). "If we add a 'trimmer' and a 'padder' to each tuned circuit we can arrange to alter the tuning laws so that they keep more 'in step'. We can even make them be perfectly 'in step' in two, three or more places over the tuning range." Smithy straightened-up and took a deep breath. "Do you follow that?" he asked. While Dick digested this information and pondered over Smithy's sketches, Smithy poured the now well-boiled water over the fresh tea leaves in the tea pot.

"Er – yes," said Dick after a long silence, "but I never realised it was so complicated, this 'tracking' business."

"Oh, this is only the start . . ." But Smithy stopped himself. "Some other time," he said, "I'll tell you about multipoint tracking in communications receivers. That's when you need to really understand trimmers and padders, and you'd give your right arm for a small computer." Then turning again to Dick's bench he added, "but this 'tranny' should be fairly straightforward. *Much* easier in fact."

"Firstly," Smithy instructed "tune in a station near the low frequency end of the band."

"That's easy," said Dick, "it seems quite lively down there."

"Probably because you've been adjusting the coil," remarked Smithy.

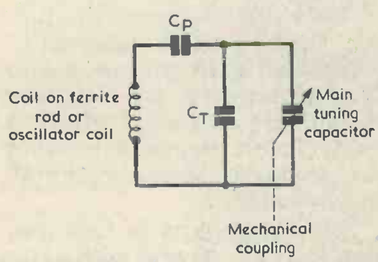

Fig.3. Smithy sketched a simple tuned circuit and added two extra preset capacitors . . . Cp is the 'padder' which can effectively reduce the maximum value of the main tuning capacitor. Ct is the 'trimmer' which can effectively increase the minimum value of the main tuning capacitor. By adjusting Cp and Ct the overall tuning range can be altered.

"Now move the aerial coil along the rod to get maximum signal and then tune to the high frequency end."

"That's where its deaf" explained Dick.

"You've probably adjusted the coil on the ferrite rod and not adjusted the aerial trimmer," said Smithy.

"Which one is that?" asked Dick.

"Well you'll have to trace it on the pcb," said Smithy. "There's no band switching to complicate things so just look for the trimmer which is across the aerial tuning capacitor. It's probably on the main body of the tuning capacitor itself."

"Oh *those,*" said Dick, "I try not to touch those if I can help it."

"Well when you've identified the aerial trimmer try adjusting it carefully," persisted Smithy.

"Suppose we're not tuned to a station?" said Dick.

"Don't worry you'll hear the background noise increase – even that blooming crackling will get louder – there!"

Sure enough as Dick slowly turned the trimmer the radio seemed to come to new life.

"Now you should repeat that operation once more," said Smithy. "Go back to the low frequency end, adjust the coil position slightly to improve the signal level and then come back to the 'top' end and re-tweak the trimmer. Twice at each end should be enough."

Dick was amazed. "That's all there is to it?" he asked, rather surprised.

"For a simple one band receiver, yes," said Smithy.

"Now if it had a Long Waveband as well, the band switching would switch in a different coil on the ferrite rod and some extra fixed capacitors and trimmers across the aerial and oscillator coils." Smithy paused and set two tea cups alongside the teapot.

"You set up the Long Waves in a similar way to the Medium Waves," continued Smithy. "First adjust the coil on the ferrite rod for maximum signal level at the low frequency end, at about 160kHz, then tune to the top end, about 270kHz and set the trimmer, again for maximum signal. Repeat once more and there you are!"

"You said the Long Wave circuit used *extra* capacitors," mused Dick. "Won't the Medium Wave adjustments muck up the Long Wave?"

"Not if you do the Medium Wave first," replied Smithy. "Get that right first and then do the Long Wave."

"Sounds straightforward," said Dick.

"It's not too tricky," agreed Smithy, and added, "but you could take two or three days to track up a multi-band communications receiver." And Smithy remembered briefly some frustrating days which he had spent, many years ago, as a new recruit at his RAF training camp, juggling the settings of waxy trimmers and padders. That was when he had first met John Davies who was to be a lifelong friend and the news of whose recent death had so saddened him.

Smithy's private thoughts about his old friend were suddenly interrupted by his present younger and more explosive company.

"Well that'll please him!" exclaimed Dick as he loudly snapped the back of the case into place on the now squawking 'tranny'.

"You've probably done yourself no favours," commented Smithy. "Once word gets around your crowd at college."

"Oh well," said Dick philosophically, "that's the name of the game."

"Speaking of names," Smithy nodded towards the kitten, "what are you going to call him?"

"He did *me* no favours by playing 'chase' with my aerial," mused Dick. "Properly led me down a false track." Then suddenly he added, "I know, I'll call him 'Tracker'."

"Or 'her'," added Smithy looking at the fluffy bundle which was sitting looking up at them. "Still it is a *trim* little thing *padding* around the workshop," chuckled Smithy.

"Yes, another one for the *gang*," added Dick.

"Good grief!" muttered Smithy turning to the tea things, and then he cried, "Oh no, you've given it the last of the milk! All this tea and no milk!" wailed Smithy pointing to the nearly full saucer.

In the painful silence that followed the two service engineers bent to their tasks to finish off their days work. The silence was broken only by the occasional crackle from Dick's 'tranny' and Smithy's television and the contented purring of the cat as it curled up on Dick's anorak which it had found crumpled on the floor.

Suddenly, "Cripes!" yelled Smithy as he leapt back from his bench, "it's alive!".

"Well don't touch it then," said Dick quickly and as our gentle reader might agree – rather cruelly. "Well I'm blowed – look," cried Smithy pointing into the dusty interior of the television. "That's where the crackling is coming from. Where the EHT lead touches the cabinet – its arcing over. Would you believe it – its *tracking*!" ■

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4017	0.65
4019	0.68
4021	0.75
4022	0.68
4023	0.19
4024	0.45
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4026	1.05
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4075	0.18
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4077	0.23
4078	0.25
4081	0.15
4082	0.25
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40161	0.69
40162	0.69
40163	0.69
40174	0.69
40175	0.69
40192	0.75
40193	0.75
40194	0.69
40195	0.69

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74LS669N	1.05
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74CXX series

74C00	0.20
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74C76	0.48
74C83	0.98
74C85	0.98
74C86	0.26
74C89	2.68
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74C95	0.94
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74C151	1.52
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74C161	0.80
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74C164	0.80
74C165	0.84
74C173	0.72
74C174	0.72
74C175	0.72
74C192	0.80
74C193	0.80
74C195	0.80
74C200	4.52
74C221	1.06
74C901	0.38
74C902	0.38
74C903	0.38
74C904	0.38
74C905	5.64
74C906	0.38
74C907	0.38
74C908	0.84
74C909	1.52
74C910	3.62
74C914	0.86
74C918	0.98
74C925	4.32
74C926	4.32
74C927	4.32

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68B10	2.04
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6821	1.75
68A21	2.10
68B21	2.34
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68A40	4.55
68B40	4.75
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