

# BUSH RADIO

## Service Information

### Model TR.104 Personal Portable Radio Receiver



MODEL TR.104

#### SPECIFICATION

##### GENERAL

The TR.104 has coverage of the Medium waveband also the reception of the B.B.C. Light programme on Long wave. The Light programme is selected by a switch actuated by the tuning capacitor when adjusted for maximum capacitance. The receiver is fitted with an internal ferrite rod aerial and a plastic case with sling handle. Provision is made for an earpiece to be used with the receiver. Six transistors and two crystal diodes are used in a superhet circuit.

The r.f. circuit comprises aerial winding L2 tuned by CV1 over the Medium waveband. The Long wave Light programme is tuned when S1A is closed. With S1A contacts made C2 and TC2 are shunted across L2. VT1 (AF117) operates as a self oscillating mixer, base-connected to the aerial coupling coil L1. Feedback is obtained by L3/4 included in the emitter and collector circuits respectively. The oscillator winding L5 is tuned by CV2 on Medium wave and on Long wave shunted by C5 via S1B. The germanium diode MR1 (OA79) is included to damp the primary of IFT1 when large signal inputs occur, giving increased range of automatic gain control.

The i.f. stages VT2 and VT3 (AF117) operate in grounded emitter circuits, IFT3 being connected to an OA90 detector diode. Automatic gain control of the first i.f. stage is obtained by a control voltage derived from the detector diode and applied to the base of VT2.

The audio output from MR2 (OA90) is fed to the driver stage VT4 (OC81D) and transformer coupled to a class B push-pull output stage VT5 and VT6 (2x OC81). The output stage is of the transformerless type and is connected to a loudspeaker of 18 ohms impedance. Negative feedback is applied to the base of VT4 from the junction of C22 and the loudspeaker.

##### CABINET

Two-tone moulded plastic cabinet with satin finished aluminium trim.

Dimensions: height 3½ in. (8.9 cm)  
width 5¾ in. (14.6 cm)  
depth 2 in. (5.1 cm)  
\*weight 1½ lb. (0.68 kg.)

\*including battery but less case.

##### CONTROLS

**Top:** combined volume and on/off

**Front:** tuning control

Both controls are edge-operated

##### TUNING RANGE

M.W. band—187 to 570 metres (1605 to 525kc/s)

L.W. band—Spot frequency only, 1500 metres (200kc/s).

##### INTERMEDIATE FREQUENCY

470kc/s.

##### SCALE CALIBRATION

Top face of scale in station names. Edge of scale in metres.

##### AERIAL

An internal ferrite-rod aerial is fitted for use on both wavebands.

##### AUTOMATIC GAIN CONTROL

Two stages (including OA79).

##### LOUDSPEAKER

3 in. (7.6 cm) circular, 18 ohms impedance. Flux 8000 lines per sq. cm.

##### AUDIO OUTPUT

200mW.

**PHONE SOCKET**

External socket provided into which may be plugged an earpiece having an impedance of between 250 and 1000 ohms. With the earpiece plugged-in the internal loudspeaker is muted.

**TRANSISTORS****Mullard p.n.p. junction types:—**

AF.117	mixer/oscillator
AF.117	1st i.f. amplifier
AF.117	2nd i.f. amplifier
OC81D	driver stage
OC81	} push-pull output
OC81	

**CRYSTAL DIODES****Mullard types**

OA.90	detector and a.g.c.
OA.79	auxiliary a.g.c. and clamp

**BATTERY**

9 Volt Ever-Ready PP7 or equivalent

**BATTERY CONSUMPTION**

13mA quiescent (20mA average)

**MAINTENANCE****DISMANTLING****Chassis**

- 1 Unscrew the coin-slotted screw in the middle of the receiver cover and remove the cover.
- 2 Unclip and remove the battery.
- 3 Loosen and remove the two chassis holding screws, also the nut at the top of the chassis (see Fig. 1).
- 4 Ease the bottom of the cabinet away from the chassis to clear the plastic lug holding the chassis as shown in Fig. 1.

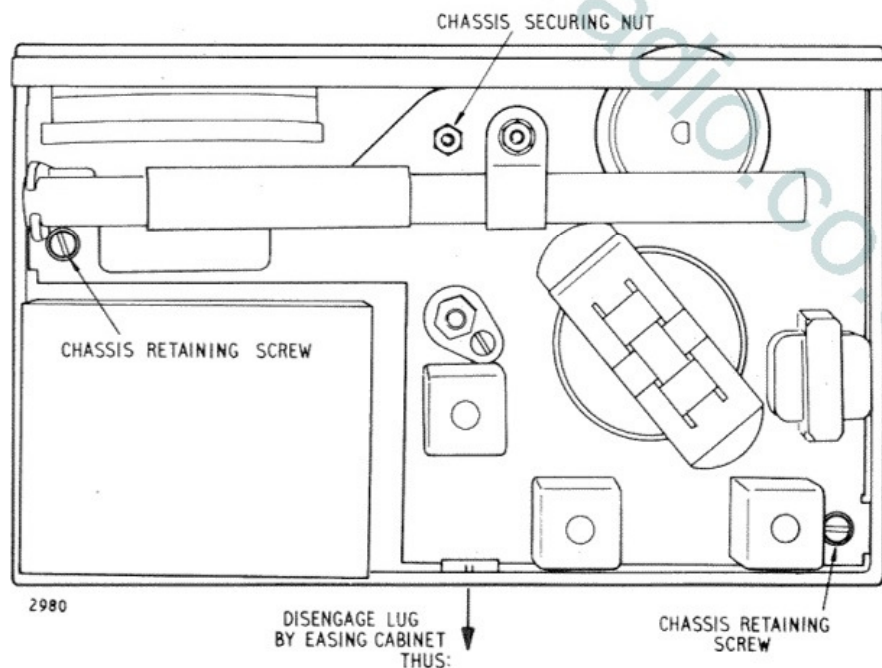
5 Carefully withdraw the chassis together with the top panel from the cabinet. The loudspeaker leads are long enough to permit servicing to be carried out.

To replace the chassis reverse the above procedure.

**Top Panel (Off/Volume and Tuning)**

- 1 Remove the chassis as above.
- 2 Rotate the tuning control to North Regional (to facilitate removal of control).
- 3 Loosen and remove the two countersunk screws located at each side of the panel.
- 4 Lift the panel together with the tuning control clear of the chassis, noting the position where the connector arm engages with the tuning control.

**NOTE.** When replacing the panel, first locate the connector arm with the tuning control (tuned to North Regional) before reversing the above procedure.



*Fig 1 Rear view of receiver showing fixing screws.*

**TRANSISTOR REPLACEMENT**

The usual precautions should be observed when replacing faulty transistors i.e., the use of a suitable soldering iron and heat shunt.

The replacement of individual transistors may be made in all stages of the receiver with the exception of the push-pull output transistors. Where one of the push-pull output transistors is faulty, both transistors must be replaced as they are supplied as a balanced pair and must be replaced as such.

When ordering replacement transistors quote the stage in the receiver for which they are required, the circuit reference number, and the type and colour (if any) on the body of the transistor.



## ALIGNMENT PROCEDURE

### PRELIMINARY NOTES

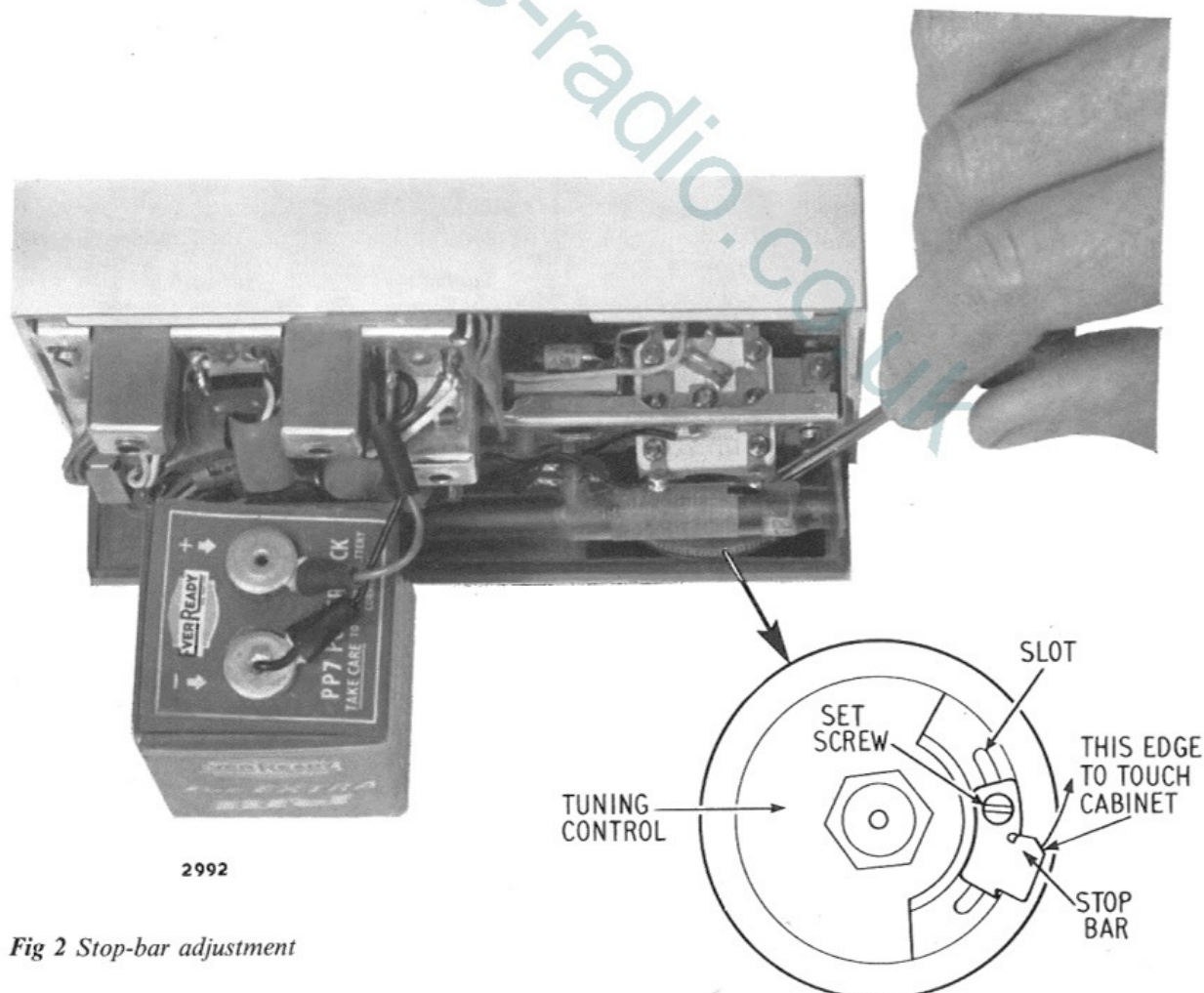
#### 1 Equipment required:—

- (i) A signal generator with a frequency range of 200kc/s to 1500kc/s modulated 30 per cent at 400c/s.
  - (ii) An output wattmeter with a range of 0-200mW load impedance 18 ohms and fitted with screened leads.
  - (iii) A special non-ferrous trimming tool suitable for adjusting the IFT and oscillator cores.
  - (iv) A 2.2pF and 10pF capacitor. Also a desensitizing resistor of 12k ohms.
- 2 The r.f. and i.f. circuits must be aligned with the chassis out of the case.
  - 3 The signal generator should be switched on about 15 minutes before beginning the alignment.
  - 4 For the purpose of alignment, the internal loudspeaker should be disconnected and the output wattmeter connected in its place. The output meter may be connected via the phone socket if a suitable plug is available. With the plug inserted, the L.S. is automatically switched out. **If at any time the low impedance meter is connected across the amplifier output stage when the loudspeaker is connected, care must be exercised to ensure that the power output from the receiver is not allowed to rise to a level high enough to damage the output transistors (not greater than 70mW).**
  - 5 Set the receiver Volume control to maximum. During the alignment the signal input should be adjusted to maintain the output at 50mW each time a trimming adjustment is made. If the internal loudspeaker is left in circuit an output of approximately 20mW should be maintained.

### PRE-SETTING THE L.W. LIGHT PROGRAMME

The receiver is fitted with an adjustable stop-bar (set at the factory) which limits the Tuning control travel to the "correctly tuned" position of 200kc/s. Before commencing the L.W. alignment, the stop-bar must be released so that the entire L.W. sector of the tuning dial may be tuned. The method of releasing, and subsequently resetting, the stop-bar is as follows:—

- 1 Place the receiver with the top-panel face downwards and remove the battery.
- 2 Rotate the Tuning control until the stop-bar is accessible between the ferrite rod and chassis (see Fig. 2), then slacken the set screw. The receiver may now be aligned in accordance with the procedure given.



2992

Fig 2 Stop-bar adjustment

**Reset as follows:—**

- 1 Connect the battery as shown in Fig. 2.
- 2 Switch the receiver "ON" and accurately tune the 200kc/s light programme.
- 3 Ensure that the receiver remains correctly tuned then carefully move the stop-bar forward in the slot provided until it touches the front of the cabinet. This may be carried out by inserting a screw driver between the ferrite-rod and the Tuning knob.
- 4 Rotate the Tuning control in a clockwise direction until the setscrew is accessible and then tighten the screw. The Tuning control should now stop at the correctly tuned position of 200kc/s. After setting the stop bar, check that the station is correctly tuned.

**I.F. ALIGNMENT**

*NOTE.* The outer peak is the correct one for all IFT adjustments.

- 1 Switch the receiver on, and set the Tuning control to about 300 metres.
- 2 Set the signal generator to 470kc/s modulated 30 per cent at 400c/s. Connect the output via a 0.1µF isolating capacitor to the junction of C1 and L1 and align IFT3, IFT2 and IFT1, in that order, for maximum audio output. Align each IFT once only.

**R.F. ALIGNMENT**

**Oscillator Circuits**

*NOTE.* For the purpose of r.f. alignment under conditions of interference the receiver may be temporarily desensitized by connecting a 12kΩ resistor between the junction of R12 and R13 and chassis. The signal generator should be connected to CV1 via a 2.2pF capacitor for M.W. and via a 10pF capacitor for the 200kc/s alignment.

The top face of the tuning scale is marked with calibration dots corresponding to 600kc/s, 1000kc/s and 1500kc/s. (see Fig. 3). Before commencing the alignment, ensure that the datum dot coincides with the pointer at the h.f. end of the Medium waveband with CV1 and CV2 tuned to minimum capacitance. The calibration dots are adjacent to the following stations:— 1500kc/s — Luxembourg, 1000kc/s — West, 600kc/s — Lyons.

Calibrate in the following order: M.W., L.W.

Operation	Waveband	Sig. Gen. Frequency (mod. 30% 400c/s)	Tuning Scale Setting	Adjust for Maximum Output
1	M.W.	600kc/s	600kc/s	L3/4/5
2	M.W.	1500kc/s	1500kc/s	TC3
		Repeat operations 1 and 2 and check calibration at both points.		
3	L.W.	200kc/s	Light L.W. sector	CV1, CV2 TC4 (later models)

**Aerial Circuits**

*NOTE.* For M.W. and L.W. alignment, the signal generator should be coupled to the receiver by a loop of insulated wire placed about 3 feet from the chassis and with its plane at right angles to the ferrite-rod aerial.

Operation	Waveband	Sig. Gen. Frequency (mod. 30% 400c/s)	Tuning Scale Setting	Adjust for Maximum Output
1	M.W.	600kc/s	600kc/s	L1/2
2	M.W.	1500kc/s	1500kc/s	TC1
		Repeat operations 1 and 2 for maximum gain at both points.		
3	L.W.	200kc/s	Light L.W. sector	TC2*

\*When adjusting TC2, it may be found helpful to rock the tuning control to obtain maximum output.

A compromise adjustment may be necessary between the L.W. oscillator and aerial circuits. Refer to Modifications, page 8.

After completing the r.f. alignment, remove the 12kΩ desensitizing resistor and ensure that the former of L1/2 is secured to the ferrite-rod with wax. Reset the adjustable stop-bar as described above.

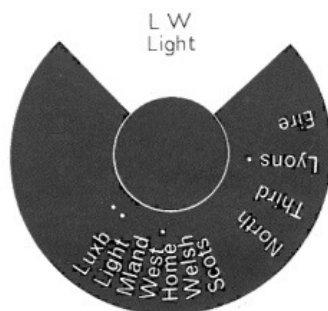


Fig 3 Receiver tuning scale



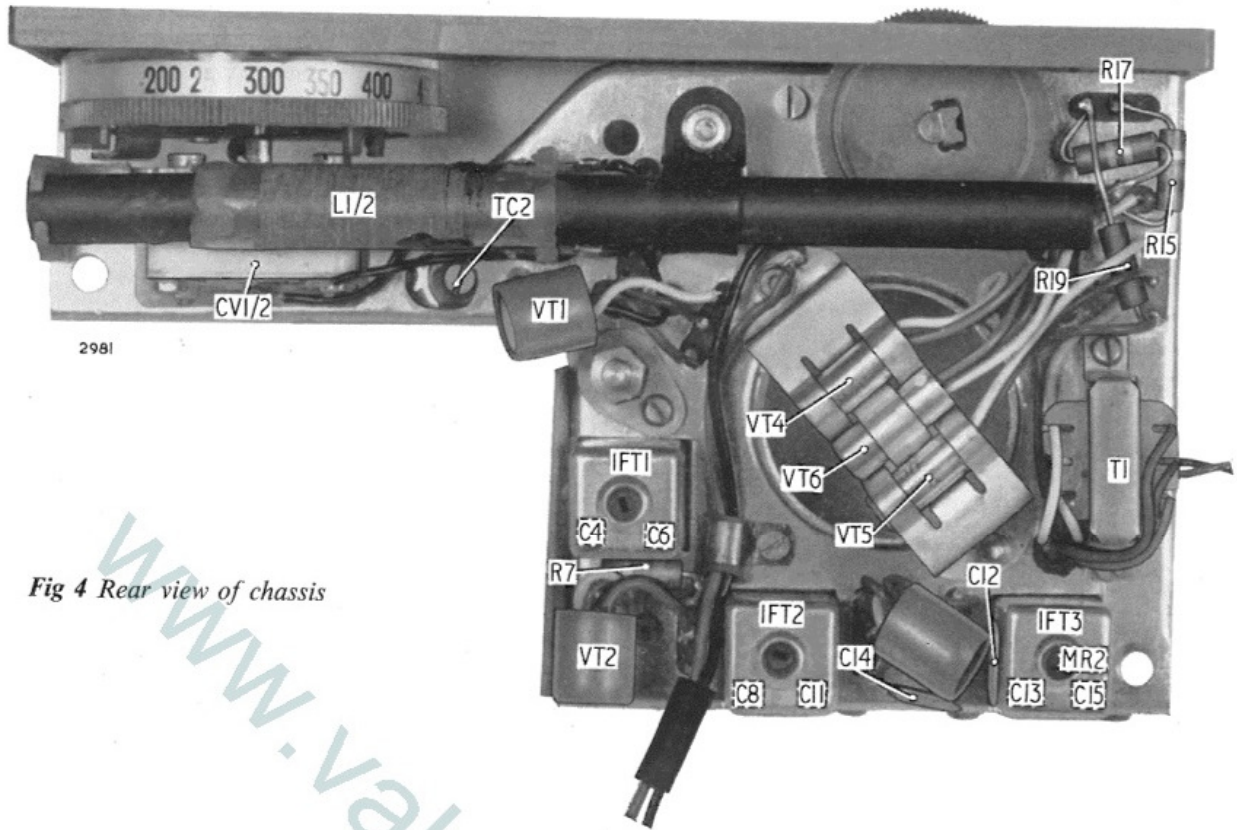


Fig 4 Rear view of chassis

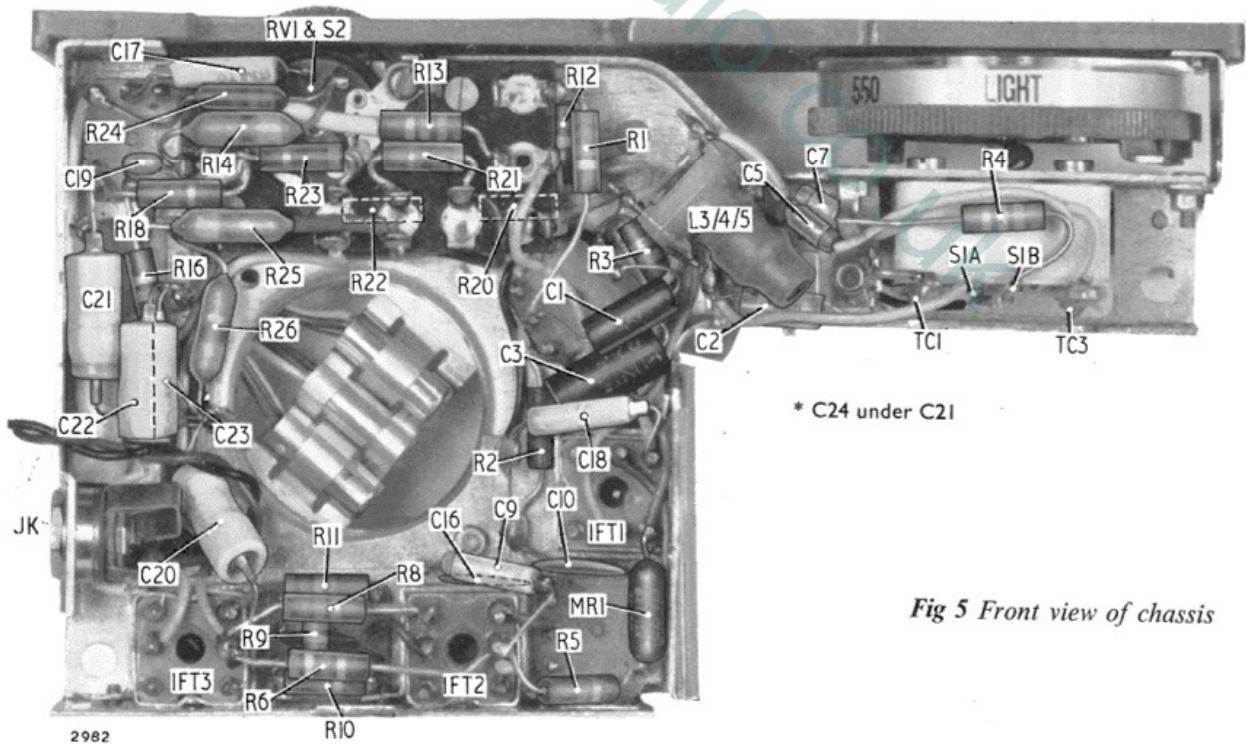


Fig 5 Front view of chassis

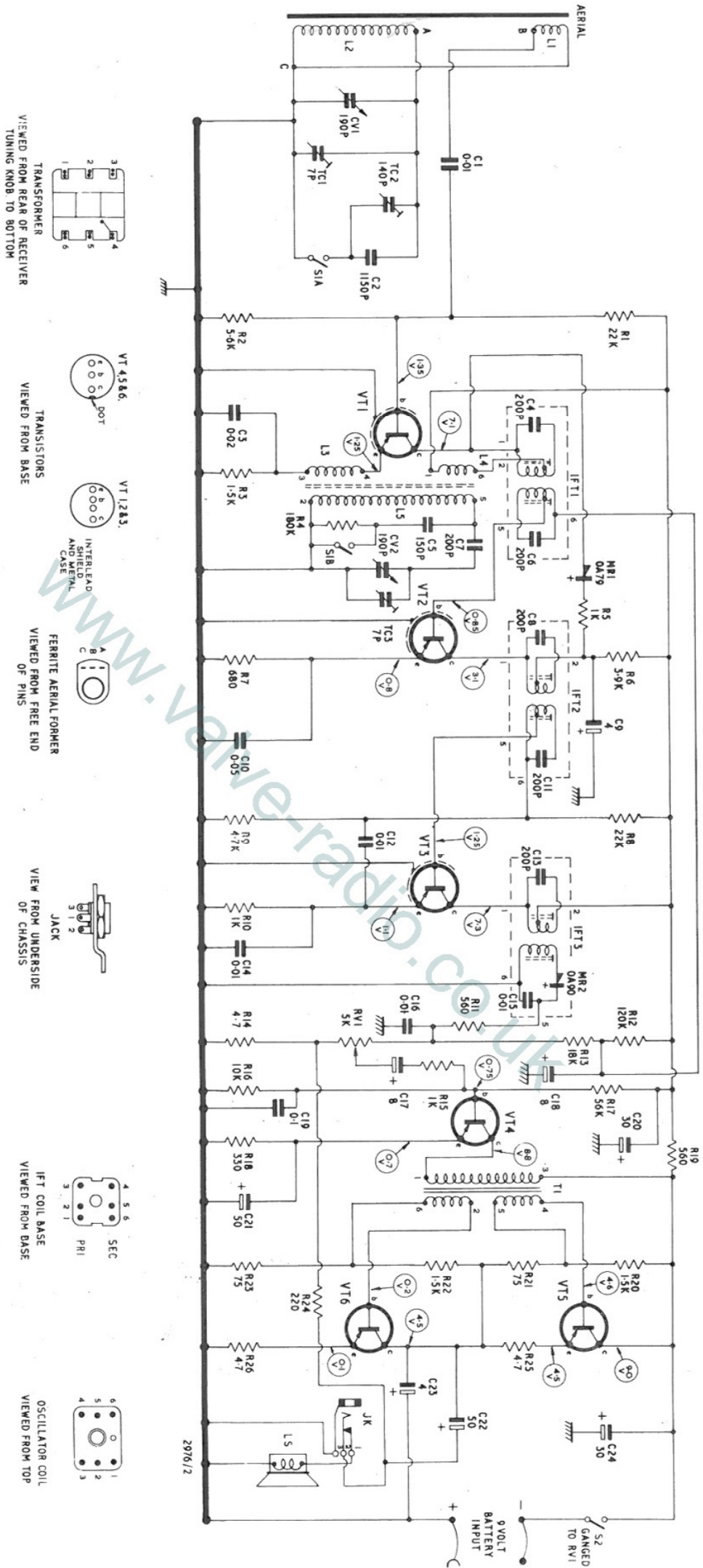


Fig 6 Circuit Diagram TR.104

## PARTS LIST

NOTE. Ordering to these part numbers will give the right type and rating of component. When fitting replacements from stock always use the same type as that of the components being replaced.

## CAPACITORS

Reference	Value		Tolerance (±%)	Rating (volts)	Part Number
	μF	pf			
C1	0.01	—	20	150	AP62651
C2	—	1150	2	125	AP65061
C3	0.02	—	20	150	AP22251
C4	—	200	2½	125	AP65010
C5	—	150	2½	125	AP64589
C6	—	200	2½	125	AP65010
C7	—	200	2	125	AP61842
C8	—	200	2½	125	AP65010
C9	4	—	-20+100	15	AP64288
C10	0.05	—	-20+80	30	AP65060
C11	—	200	2½	125	AP65010
C12	0.01	—	-20+80	30	AP65014
C13	—	200	2½	125	AP65010
C14	0.01	—	-20+80	30	AP65014
C15	0.01	—	-20+80	30	AP65014
C16	0.01	—	-20+80	30	AP65014
C17	8	—	-20+100	6	AP64286
C18	8	—	-20+100	6	AP64286
C19	0.1	—	-20+50	3	AP65078
C20	30	—	-20+100	12	AP64287
C21	50	—	-20+100	6	AP64289
C22	50	—	-20+100	6	AP64289
C23	4	—	-20+100	15	AP64288
C24	30	—	-20+100	12	AP64287
CV1	—	190	—	—	} CP65028
CV2	—	190	—	—	
TC1	—	7pF Swing	—	—	Built-in with CV1
TC2	—	30—140	—	—	AP65058
TC3	—	7pF Swing	—	—	Built-in with CV2

## RESISTORS

Reference	Value (ohms)	Tolerance (±%)	Rating (watts)	Part Number
R1	22k	10	¼	AP6702
R2	5.6k	10	1/10	AP32500
R3	1.5k	10	¼	AP6408
R4	180k	10	¼	AP6930
R5	1k	10	1/10	AP32446
R6	3.9k	10	¼	AP6510
R7	680	10	1/10	AP32434
R8	22k	10	¼	AP6702
R9	4.7k	10	1/10	AP32494
R10	1k	10	1/10	AP32446
R11	560	10	¼	AP6300
R12	120k	10	¼	AP6888
R13	18k	10	¼	AP6678
R14	4.7 ohm	±½ ohm	¼	AP63262
R15	1k	10	1/10	AP32446
R16	10k	10	¼	AP6618
R17	56k	10	¼	AP6804
R18	330	10	1/10	AP32410
R19	560	10	¼	AP6300
R20	1.5k	5	¼	AP6414
R21	75	5	1/10	AP32366
R22	1.5k	5	¼	AP6414
R23	75	5	1/10	AP32366
R24	220	10	¼	AP6198
R25	4.7 ohm	±½ ohm	¼	AP63262
R26	4.7 ohm	±½ ohm	¼	AP63262
RV1	5k	—	—	BP65023



**COILS AND TRANSFORMERS**

<i>Reference</i>	<i>Description</i>	<i>Resistance (ohms)</i>	<i>Part Number</i>
L1 } L2 }	Ferrite aerial	less than 0.5	CS65115
L3 } L4 } L5 }	Oscillator coil	less than 0.5 less than 0.5 less than 0.5	
IFT1	I.F. transformer first	pri & Sec 8.5 each	CS65111
IFT2	I.F. transformer second	pri & Sec 8.5 each	CS65112
IFT3	I.F. transformer third	{ pri 10.0 —Sec 1.0 }	CS65113
T1	Driver transformer	{ —pins 4 & 5 51.0 —pins 6 & 2 56.0 —pins 1 & 3 215.0 }	BS65114

**MISCELLANEOUS**

<i>Description</i>	<i>Part Number</i>
Aerial, ferrite complete with coils	CS65115
Cabinet back	EP65002
Cabinet front	EP65001
Cabinet grille	DP65003
Cabinet top panel	EP65004
Cabinet trim, front	BP65006
Cabinet trim, top	BP65005
Connector arm	BP65056
Ferrite core, (5) for IFT'S	AP65011
Ferrite core, for osc. coil	AP61784
Ferrite rod, for aerial	AP63317
Knob, control	CP65019
Knob, tuning	DP65024
Socket, earpiece	BP65088
Socket, earpiece spacing washer	AP11710
Speaker (3 in. round 18 ohms)	BP65022



## MODIFICATIONS

- (i) In models prior to serial number 101, R18 is 560 ohms  $\pm 10\%$  part number P6300.
- (ii) TC1 and TC3 are adjusted by means of 8BA nuts in early models. Later models are fitted with set-screws.
- (iii) C5 in some models is 137pF  $\pm 2\frac{1}{2}\%$ , 125V, part number AP65095. L.W. oscillator tracking is maintained with two fixed capacitors of 10pF wired in parallel with C5 and removed as required during production.
- (iv) In later models:
  - a. C5 is 125 pF,  $\pm 2\frac{1}{2}\%$ , 125V, part number AP65100 wired in parallel with an additional trimmer TC4 10-40pF part number AP65097.
  - b. R5 is 3.9k ohms  $\pm 10\%$  part number AP32488.  
R6 is 3.3k ohms  $\pm 10\%$  part number AP6492.

www.valve-radio.co.uk

## SPARES AND SERVICE

**When ordering replacement components please quote:**

- 1 Model number and serial number of the receiver.
- 2 Description and part number of component(s) and quantity required.

To avoid unnecessary delay, orders for replacement parts and requests for technical information should be addressed to:—

*THE SERVICE DEPARTMENT*

**BUSH RADIO LIMITED**

KEW WORKS . MORTLAKE ROAD . KEW . RICHMOND . SURREY

Telephone PROspect 8271/4

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