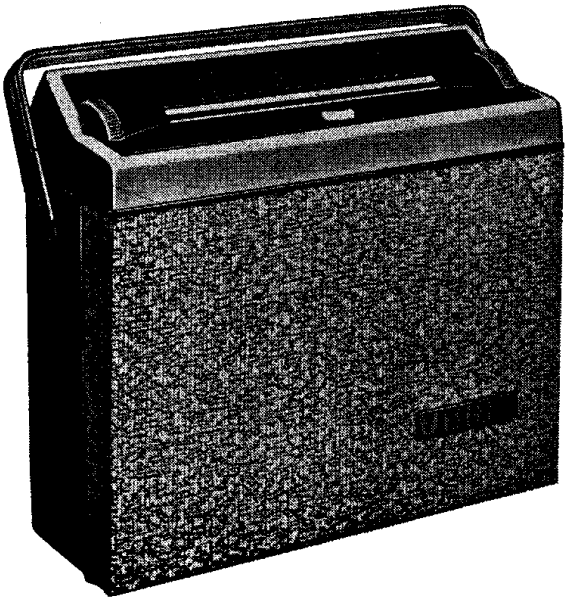
FERGUSON

TRANSISTOR PORTABLE MODEL 349BT

SERVICE MANUAL



SERVICE NOTES

This receiver employs germanium alloy junction (P-N-P) type transistors. This type of transistor has been used for a number of years in various applications and has proved to be a thoroughly reliable component. When the receiver requires servicing, therefore, the source of the fault is not likely to be due to transistor failure and attention should first be directed to other parts of the circuit.

Fault finding may be carried out in the usual way, but the following points should be particularly noted :—

1. Make full use of the voltage measurements given in the circuit diagram. Although the receiver will still operate when the total battery voltage falls to about 8 volts, new batteries should be used for checking purposes. Distortion will be apparent if the voltages of the two batteries differ appreciably.

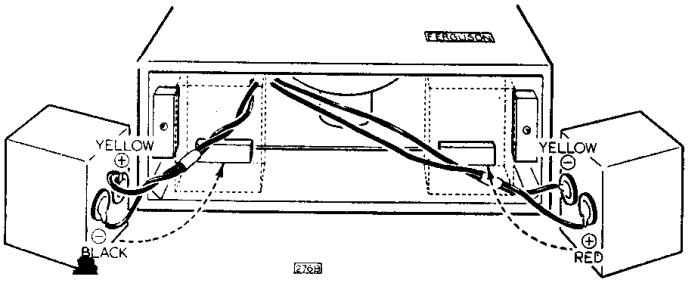


Fig. 1. Battery replacement. Care should be taken to ensure correct insertion of the batteries, with the four studs in line and facing the scale end of the receiver.

SPECIFICATION

Batteries

This receiver requires two similar 6 volt batteries, any of the following types being suitable :—

Ever Ready	PP1
Drydex	DT1
GEC	BB21
Vidor	T6001

Waveranges

Medium	182— 552 Metres
Long	1,090—1,940 Metres

Loudspeaker. PM, 4½" dia. 35Ω speech coil.

Case Dimensions

10 in. wide x 8 in. high x 3½ in. deep.

Power Output .... 400 mW

Battery Consumption. 20mA for average output.

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2. Apart from total current consumption, no other current measurements should be attempted. Under 'no signal' conditions, the total current consumption will be approximately 12 mA. Consumption rises immediately a signal is applied, to approximately 20 mA for average listening volume.

3. When a signal generator is used for circuit checking, use the direct output, and inject via a 0.1uF capacitor.

4. To check oscillator operation, measure the voltages at the emitter and base of VT 1. These should be approximately as given on the circuit diagram, with the emitter voltage slightly more negative than the base. Failure to oscillate is indicated when this relationship is reversed and the base voltage is more negative than the emitter.

5. Transistors should not be replaced unless voltage checks, etc., indicate that replacement is necessary. Use only a Service Replacement (obtainable from our Service Depots) to ensure that the performance of the receiver is not impaired. The power output transistors are a matched pair. If one becomes faulty both must be replaced by a new matched pair.

6. Extreme care should be taken when unsoldering or soldering transistors as they can be easily damaged by excessive heat. The lead wires of a replacement transistor must not be shorter than the one removed. Do not apply the iron for longer than necessary, and grip the wires with a pair of pliers, to reduce heat conduction to the transistor.

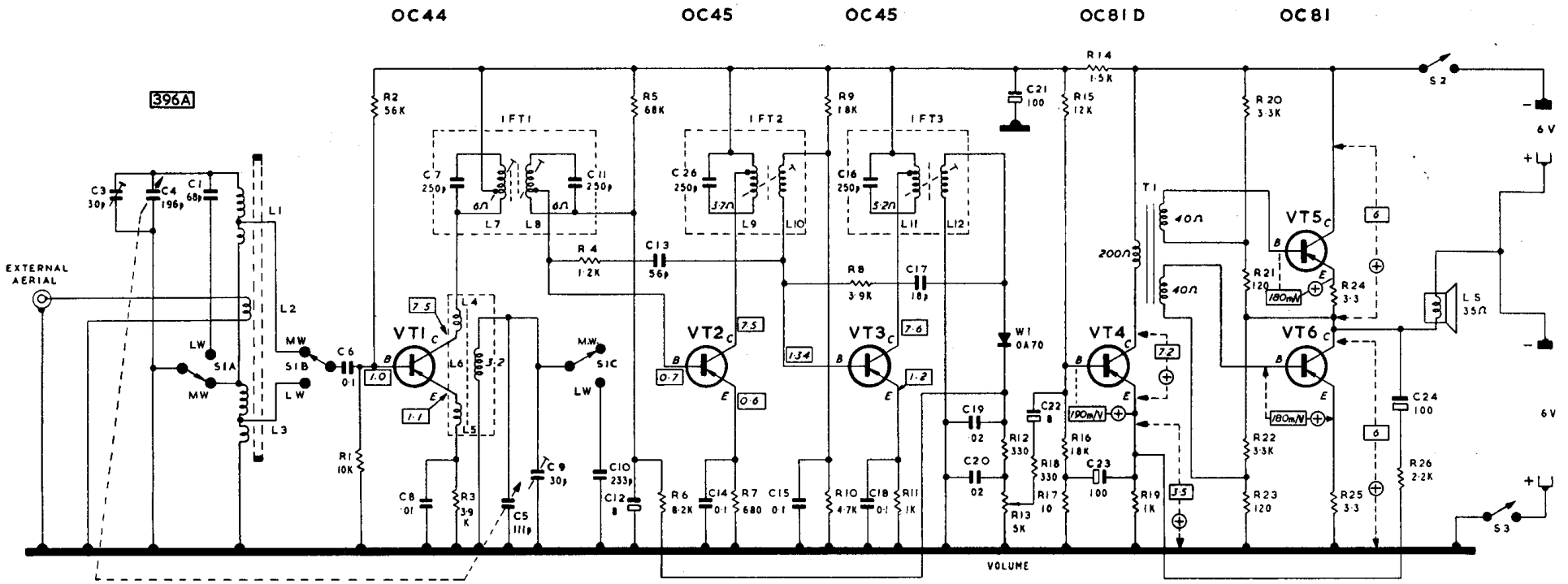


Fig. 2. Model 349BT circuit diagram. Figures in rectangles indicate voltages measured with 20,000 ohm/Volt meter. DC resistance readings are shown against inductances where these are 1 ohm or greater.

CIRCUIT DESCRIPTION

With the receiver switched to MW, **L3** is short circuited by **S1A** and the medium wave winding, **L1** on the ferrite-rod aerial is tuned by **C3** and **C4**. **L2** provides coupling for an external aerial. **L1** and **L3** are series connected with shunt capacitor **C1** to tune the long waverange.

The signal from **L1** or **L3** is injected into **VT1** base circuit via **S1B** and parallel feed capacitor **C6**. **VT1** (OC44) functions as a self oscillating mixer, with feedback from collector to emitter circuit provided by **L4** and **L5**. The tertiary winding is tuned by **C5** and **C9** on medium waves and on long waves these are shunted by **C10**. **R3** provides emitter stabilising and **R1** and **R2** base bias. **C5**, the oscillator section of the tuning gang, has shaped vanes to ensure tracking throughout the medium waveband.

The 470 kc/s signal developed across the windings of the double tuned IF transformer IFT1 is then fed to the 1st IF amplifier **VT2** (OC45). This amplifier operates with base bias provided by **R5**, in conjunction with **R6** **R12** and **R13**, and emitter stabilising by **R7**. A single tuned IF transformer IFT2 in **VT2** collector circuit couples the signal to the 2nd IF amplified **VT3** (OC45). IFT3, also a single tuned IF transformer, provides the coupling to the crystal diode detector **W1** (OA70).

Both IF stages require neutralizing to offset internal feedback within the transistors. **VT2** neutralizing is effected by **R4** and **C13**, and **VT3** neutralizing by **R8** and **C17**. The necessary phase reversal is obtained by including the IF transformers within the feedback loop.

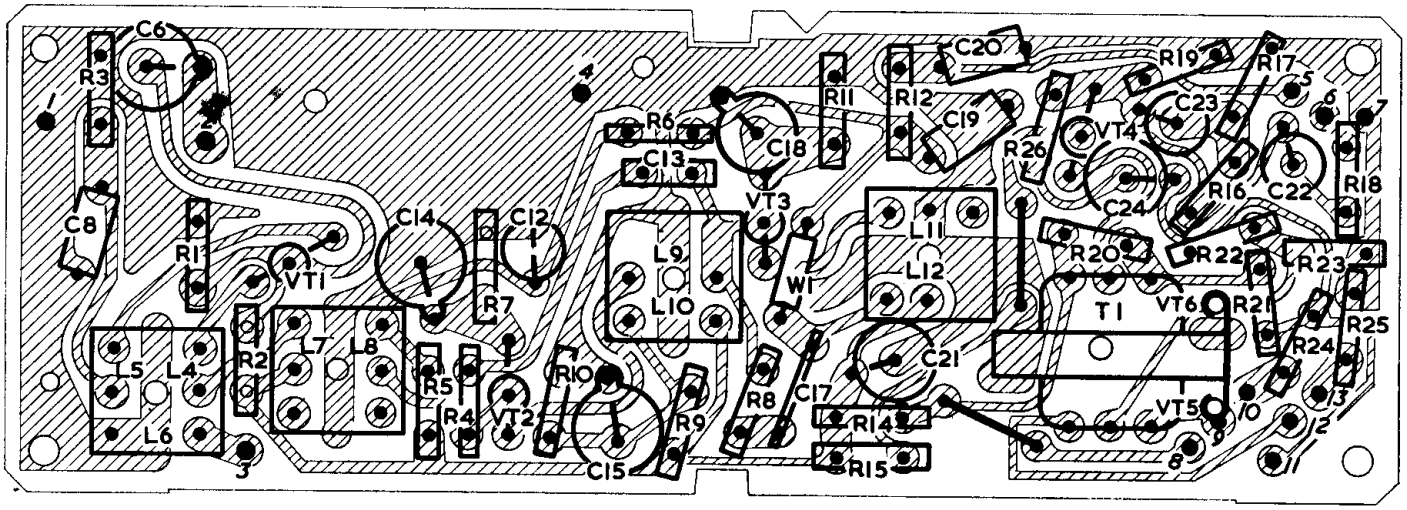
The DC component of the rectified signal developed across **R12** and **R13** is applied as a positive AGC bias to the base circuit of **VT2**. This control voltage reduces the negative standing bias at **VT2** base due to **R6**. **R11** provides emitter stabilising for **VT3**.

No AGC is applied to the 2nd IF stage, the base bias being fixed by the potential divider **R9** and **R10**.

The audio amplifier comprises a driver stage **VT4** (OC81D) feeding a push-pull output stage **VT5** and **VT6** (both type OC81). The audio voltage developed across the volume control **R13**, is then applied to **VT4** base through **R18** and **C22**. **R15**, **R16** and **R17** stabilise the DC operating conditions of the stage. The phase splitting transformer **T1** applies push-pull signals to the bases of **VT5** and **VT6**.

The output transistors are biased to class B conditions, a small standing current being permitted, however, to minimise cross-over distortion. When the signal is applied, the transistors conduct alternately and a current flows through the loudspeaker speech coil via one or other of the output transistors. The speech coil has an impedance of 35 ohms and a matching transformer is not required. The resistor chain **R20**, **R21**, **R22 and R23** determine the DC operating conditions and **R24** and **R25** provide emitter stabilising.

Negative feedback is applied to the emitter of the driver transistor from the loudspeaker speech coil via **C24** and **R26**.



1. To Ferrite Rod Aerial (earthy end) and Tuning Gang.
2. To switch wiper of S1B.
3. To switch wiper S1C and Tuning gang.
5. To Volume Control R13.
6. To Volume Control R13 slider.
7. To Volume Control R13 and On/Off switch S3.
8. To On/Off switch S2 and Collector VT5.
9. To Base of VT5.
10. To Emitter VT5.
11. To Collector VT6 and Loudspeaker.
12. To Base VT6.
13. To Emitter VT6.

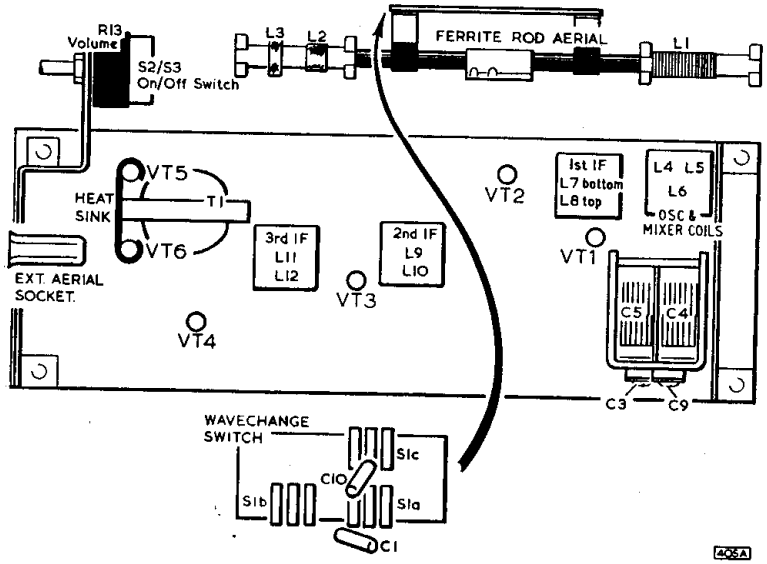


Fig. 3 (above). The printed board viewed from the components side.

Fig. 4 (left). View of receiver chassis showing components not mounted on the printed board and, in addition, the locations of trimmers and coil adjustments used in alignment. VT5 and VT6 are mounted in a spring clip which functions as a heat sink. The transistors are also coated with silicone grease to ensure effective heat transfer.

CIRCUIT ALIGNMENT

A signal from a suitable generator, modulated 30% by an AF signal, is required for circuit alignment. Tuning indication is best obtained either with an output meter having an impedance of 30 Ω and connected across the loudspeaker terminals with the loudspeaker disconnected, or with an AC voltmeter connected across the loudspeaker.

Throughout alignment, the signal input level to the receiver must be adjusted to prevent the audio output from exceeding 5mW (0.4 Volts AC), with the volume control set at maximum, in order to avoid alignment error due to AGC action.

IF Circuits

Switch receiver to MW and turn gang to minimum capacitance position. Apply a 470 Kc/s modulated signal through a 0.1uF capacitor across the aerial section of the tuning gang. Adjust **L11/L12, L9/L10, L8** and **L7** in that order, for maximum output. Repeat in the same order, until no further improvement is obtained.

RF Circuits

The chassis must be removed from its cabinet. Holes are provided in the gang mounting plate for use as calibration markers. Fit a temporary pointer, made up from bent wire, on the gang spindle. Turn the gang to maximum capacitance and set the pointer opposite the hole nearest the gang trimmers. The other similar sized holes are the MW pad and trim markers and the larger hole the LW trim point.

MW must be aligned first. Signals to be injected via a loop loosely coupled to the ferrite-rod aerial.

	Range	Cursor Position	Adjust
MW	1300 Kc/s	MW Trim	C9, C3
	600 Kc/s	MW Pad	L6, L1*
LW	215 Kc/s	LW Trim	L3*

*Adjust by sliding coil along the aerial rod.

CHASSIS REMOVAL

1. Remove handle, spring loaded on two pivot screws at each side of cabinet.
2. Unscrew and withdraw pivots.
3. Remove chassis, mounted on grey moulding.
4. If necessary, the scale and moulding can be detached from the chassis by the removal of four $\frac{5}{16}$" hexagonal brass nuts at each corner of the scale and two screws beneath the printed board. Care should be exercised in the replacement of the brass nuts, as excessive pressure will damage the scale.

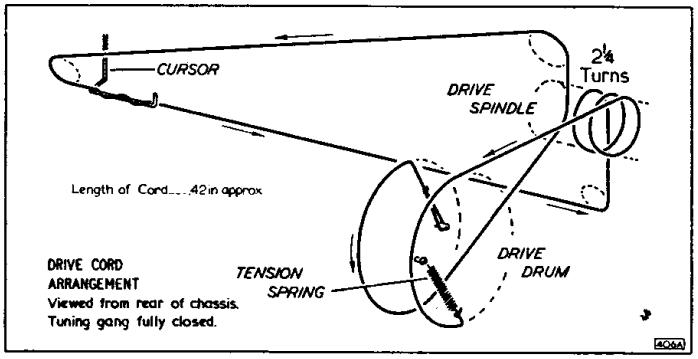


Fig. 5. Drive Cord Assembly.

RESISTORS

All carbon types unless otherwise stated. Where no tolerance or power rating is given for fixed resistors, these should be taken as 20% and $\frac{1}{4}$ Watt respectively.

Ref.	Value	Tolerance	Function
R 1	10KΩ	10%	VT1 base bias pot.
R 2	56KΩ	10%	
R 3	3.9KΩ	10%	VT1 emitter stabilising
R 4	1.2KΩ	10%	Part VT2 neutralising
R 5	68KΩ	10%	VT2 base bias
R 6	8.2KΩ	10%	AGC decoupling
R 7	680Ω	10%	VT2 emitter stabilising
R 8	3.9KΩ	10%	Part VT3 neutralising
R 9	18KΩ	10%	VT3 base bias pot.
R10	4.7KΩ	10%	
R11	1KΩ	10%	VT3 emitter stabilising
R12	330Ω	10%	IF filter
R13	5KΩ	Log pot. *	Volume control
R14	1.5KΩ	10%	DC dropper and decoupling
R15	12KΩ	10%	VT4 base bias pot.
R16	18KΩ	10%	
R17	10Ω	10%	Neg. feedback injection
R18	330Ω	10%	VT4 audio coupling
R19	1KΩ	10%	VT4 emitter stabilisng
R20	3.3KΩ	5%	VT5 base bias
R21	120Ω	5%	
R22	3.3KΩ	5%	VT6 base bias
R23	120Ω	5%	
R24	3.3Ω	±½Ω †	VT5 emitter stabilising
R25	3.3Ω	±½Ω	VT6 emitter stabilising
R26	2.2KΩ	10%	Negative beedback series

* Part No. ZI3163
† Part No. 33XHC02

SPARE PART LIST

Description	Part No.
Aerial Socket	X16540
Battery lead assembly	N18437
Cabinet	V32494
Cabinet base retaining screws	Z26254
Control knobs	
Tuning	Y32546
Volume On/Off	Y32547
Wavechange	Y18426/2
Control knob clip	37307
Handle	N32845
Handle studs	Z32846
Scale	N32493
Transistor Clip (heat sink)	ZI8433

INDUCTORS AND TRANSFORMERS

Ref.	Function	Part No.
L 1	MW aerial tuning	Ferrite rod aerial Y33414
L 2	External aerial coupling	
L 3	LW aerial tuning	
L 4	Oscillator coils	Y18409
L 5		
L 6		
L 7	IFT 1	Y29916
L 8		
L 9	IFT 2	Y29917
L10		
L11	IFT 3	Y29918
L12		
T1	Audio driver transformer	ZI8413/1

MISCELLANEOUS

Ref.	Description and Function	Part No.
S1A-C	Wavechange Switch	N18414
S2-3	On/Off switc combined with R13	ZI3163
LS	Loudspeaker 35Ω speech coil impedance (DC resistance 30Ω) 4½" dia.	Y16021/8

CAPACITORS

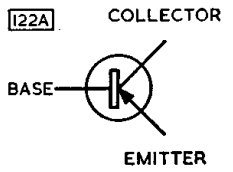
Electrolytics excepted, tolerance ±20% unless otherwise stated. Where no working voltage is given, this should be taken as 350 Volts.

Ref.	Value	Tol.	Volts	Function
C 1	68pF	5%		LW aerial tracking
C 3	30pF	Trimmer*		Aerial trimmer
C 4	196pF	Variable*		Aerial tuning
C 5	111pF	Variable*		Oscillator tuning
C 6	0.1uF			Parallel feed capacitor
C 7	250pF			L7 tuning
C 8	.01uF			VT1 emitter bypass
C 9	30pF	Trimmer*		MW oscillator trimmer
C10	233pF	1%		LW oscillator trimmer
C11	250pF			L8 tuning
C12	8uF	Electrolytic	6V	AGC decoupling
C13	56pF	5%		Part VT2 neutralizing
C14	0.1uF			VT2 emitter bypass
C15	0.1uF			VT3 base bias bypass
C16	250pF			L11 tuning
C17	18pF	5%		Part VT3 neutralizing
C18	0.1uF			VT3 emitter bypass
C19	.02uF			IF filter
C20	.02uF			
C21	100uF	Electrolytic	12V	Supply decoupling
C22	8uF	Electrolytic	6V	VT4 audio coupling
C23	100uF	Electrolytic	6V	VT4 emitter bypass
C24	100uF	Electrolytic	12V	Neg. feedback coupling
C26	250pF			L9 tuning

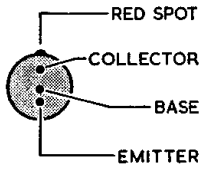
* Part No. Y32373/1, Gang Capacitor Assembly.

TRANSISTORS AND CRYSTAL DIODE

Ref.	Type	Description
VT1	OC44	Frequency changer
VT2	OC45	1st IF amplifier
VT3	OC45	2nd IF amplifier
VT4	OC81D	Audio driver
VT5	OC81	Push-pull audio output
VT6	OC81	
W1	OA70	Detector and AGC rectifier



CIRCUIT SYMBOL



TRANSISTOR CONNECTIONS

FERGUSON RADIO CORPORATION LTD.
Great Cambridge Road, Enfield, Middx.
SERVICE DEPOTS
LONDON : Eleys Estate, Angel Road, N.18 - Edmonton 3060
BIRMINGHAM : 24 Sheepcote Street, 15 - Midland 5291
MANCHESTER : Derby Street, Cheetham, 8 - Deansgate 8484
GLASGOW: 160/162 Battlefield Road, S.2 - Langside 9.51/2/3/4

FERGUSON

TRANSISTOR PORTABLE MODEL 349BT

SERVICE MANUAL SUPPLEMENT

This information sheet should be used in conjunction with model 349BT service manual, part number N19951

MODIFICATIONS IN PRODUCTION

FERRITE-ROD AERIAL

The ferrite-rod aerial and associated switching circuit was modified during early production of this receiver. The service manual, already published, shows the earlier arrangement. The modified circuit, applicable to all current production is shown overleaf.

If the rod aerial on an early production receiver needs to be replaced, the new type should be fitted (Part No. Y33414), and a small wiring modification made.

Early production can easily be identified by the position on the chassis of **C1** (68pF) the LW aerial tracking capacitor. In early models **C1** is suspended between the wavechange switch and the tuning gang. On later models, **C1** is mounted on the switch, with a direct wire connection between the switch and the gang.

The accompanying diagram shows the wiring layout used with the later type rod aerial.

IF FILTER

An additional capacitor, **C27** .01μF is mounted on the underside of the printed board in all current production.

CIRCUIT ALIGNMENT

Receiver calibration has been improved by an alteration to the scale designation and alignment frequencies. Early production receivers should be aligned to the frequencies given in the service manual. These receivers have scale calibration markers at 500 metres ; between 200 and 250 metres and at 1400 metres.

Later production models have calibration markers close to the " Allouis " and " Luxembourg " station markers. For LW calibration the " Light " programme marker should be used.

The alignment frequencies for both types of scales are listed below :

Receivers with early scales

	Range	Cursor Position	Adjust	
MW	1300 Kc/s	MW Trim	C9	C3
	600 Kc/s	MW Pad	L6	L1*
LW	215 Kc/s	LW Trim	L3*	

Receivers with later scales

	Range	Cursor Position	Adjust	
MW	1500 Kc/s	MW Trim	C9	C3
	580 Kc/s	MW Pad	L6	L1*
LW	210 Kc/s	LW Trim	L3*	

* Adjust by sliding coil along the aerial rod

Service Manual Correction. In all production receivers alignment markers are provided on the tuning scale and no calibration marker holes are provided on the gang mounting plate. The instructions to fit a temporary wire pointer on the gang spindle should be ignored.

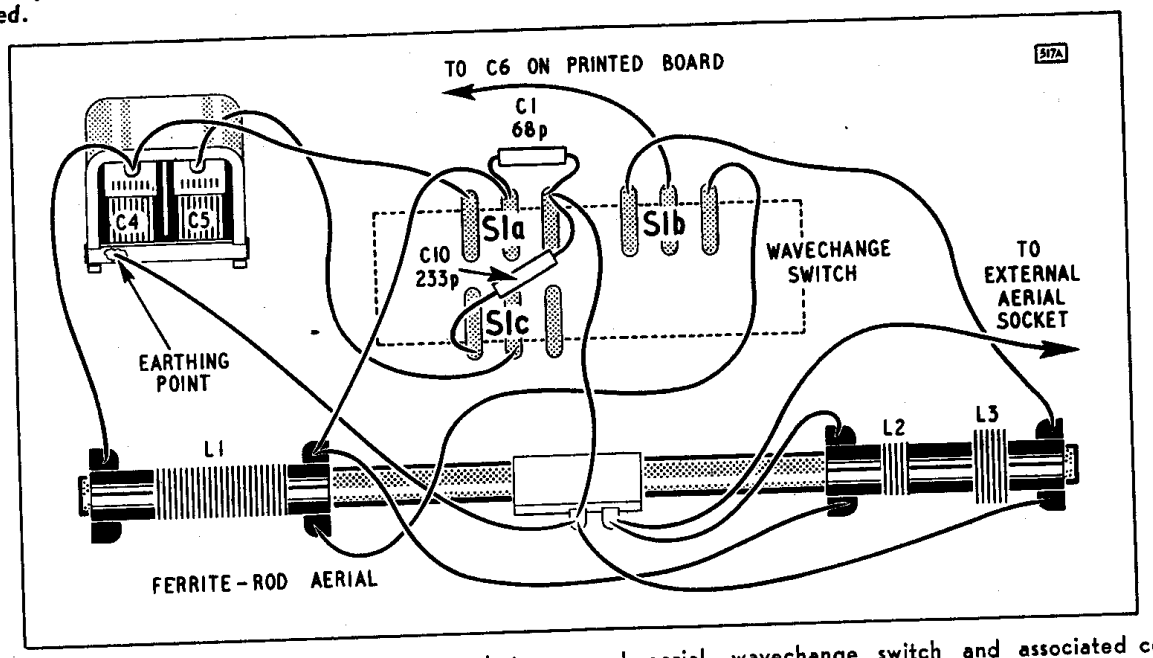


Fig. 1. Wiring diagram showing interconnections between rod aerial, wavechange switch and associated co

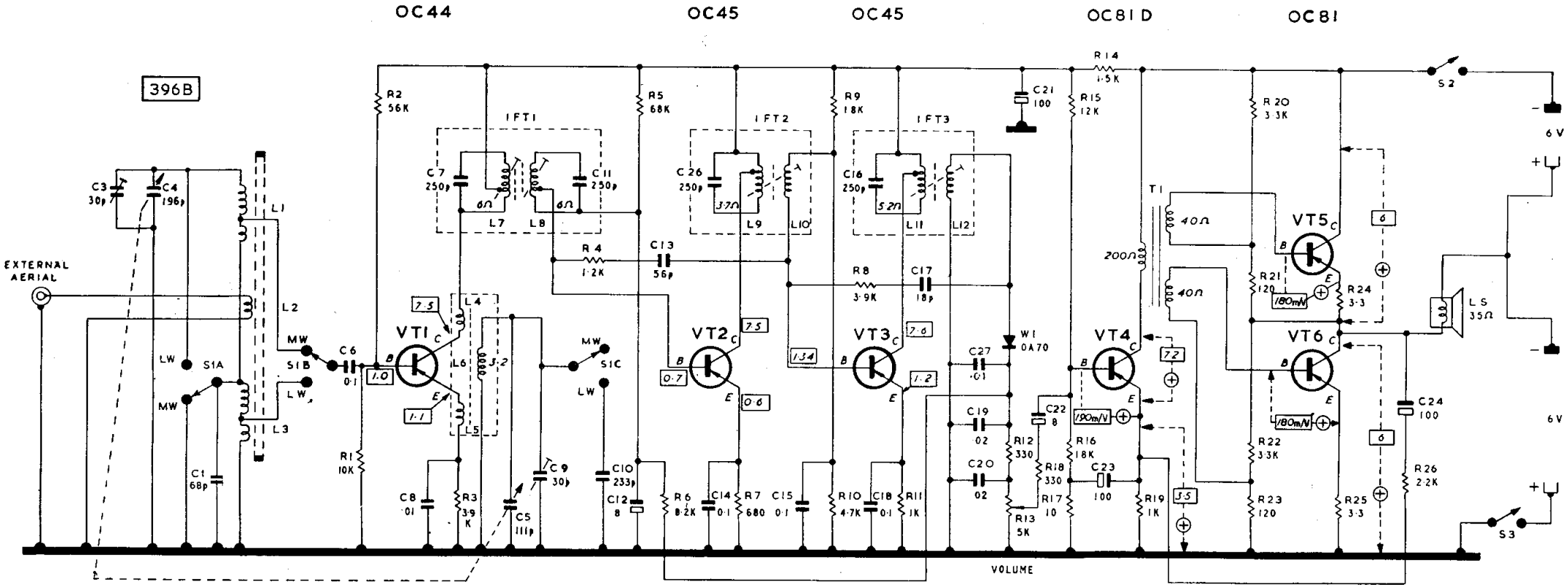


Fig. 2. Model 349BT circuit diagram. Figures in rectangles indicate voltages measured with 20,000 ohm/volt meter. DC resistance readings are shown against inductances where these are 1 ohm or greater.

FERGUSON RADIO CORPORATION LTD., Great Cambridge Road, Enfield, Middlesex

Service Depots :

LONDON : ELEY'S ESTATE, ANGEL ROAD, EDMONTON, N.18. *Telephone :* EDMonton 3060

BIRMINGHAM : 24 SHEEPCOTE STREET, 15. *Telephone :* Midland 5291. *Telegrams :* Eleclampo, Birmingham

MANCHESTER : THORN HOUSE, DERBY STREET, CHEETHAM, 8. *Telephone :* Deansgate 8484

GLAS[redacted]W : 160/162 BATTLEFIELD ROAD, S.2. *Telephone :* Langside 9251/2/3/4