FERGUSON TRANSISTOR PORTABLE MODEL 348BT

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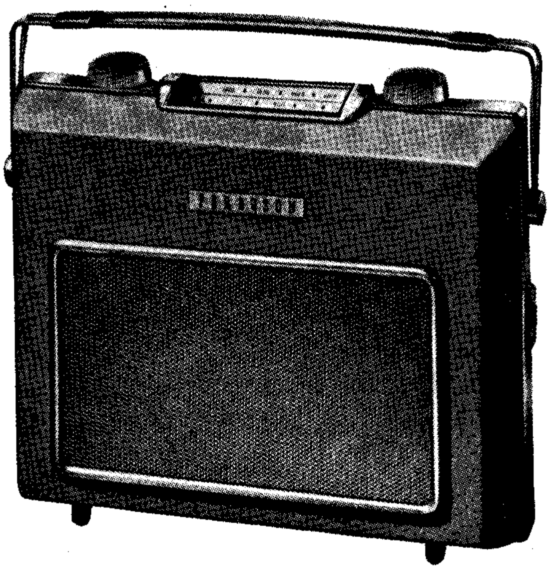
SERVICE MANUAL



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.

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 TR1. 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.

7. Capacitor and resistor replacements on the printed board may be made by cutting away the component to enable the replacement to be soldered to the original lead wires. Avoid soldering direct to the copper side of the board. If connection must be made to the copper foil, use a small iron, non-corrosive flux and 60-40 solder. Do not apply the iron for longer than necessary.

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

High flux PM, 5 in. diameter, 35Ω speech coil.

Case Dimensions

10 in. wide x 9½ in. high x 3½ in. deep.

Power Output .... 400 mW

Battery Consumption

Approximately 20 mA for average output.

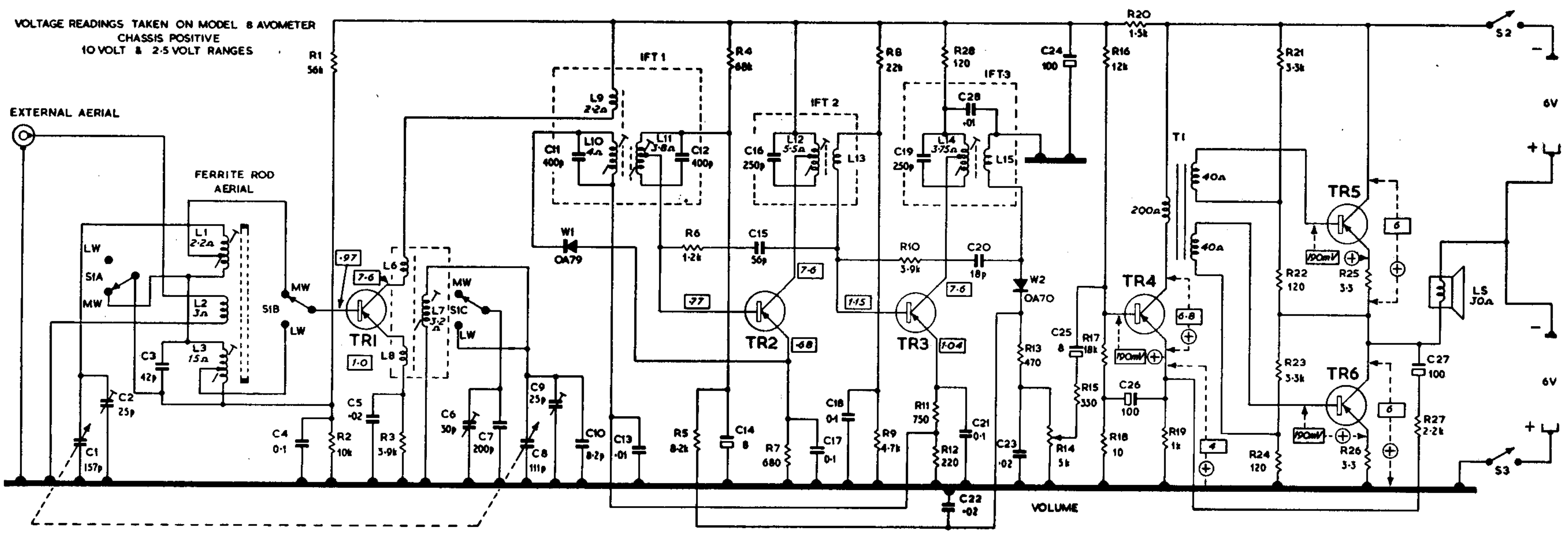


Fig. 1. Model 348BT circuit diagram. Figures in rectangles indicate voltages measured with 20,000 ohm/Volt meter. DC resistance readings are shown against inductances where these are 1 ohm or greater.

CIRCUIT DESCRIPTION

With the receiver switched to medium waves, the long wave winding on the ferrite-rod aerial is short circuited by **S1A** and the medium wave coil **L1** is tuned by **C1, C2.** On long waves, both coils are series connected and tuned by **C1, C2** with **L3** shunted by **C3. L2** provides coupling for an external aerial.

The signal, from a tapping on **L1** or **L3,** is injected into **TR1** base circuit via **S1B. TR1** (OC44) functions as a self oscillating mixer with feedback from collector to emitter circuit provided by **L6** and **L8.** The tertiary winding is tuned by **C8, C9** and **C10** on medium waves and on long waves these are shunted by **C6** and **C7. R3** provides emitter stabilising and **R1, R2** base bias. **C8,** the oscillator section of the tuning gang, has shaped vanes to ensure correct tracking throughout the medium waveband.

The 470 Kc/s IF signal developed across **L9** is then fed to the first IF amplifier **TR2** (OC45) via a double tuned IF transformer **IFT1.** This amplifier operates with base bias provided by **R4,** in conjunction with **R5, R13** and **R14,** and emitter stabilising by **R7.** A single tuned IF transformer **IFT2** in **TR2** collector circuit couples the signal to the second IF amplifier **TR3** (OC45). **IFT3,** also a single tuned transformer, provides the coupling to the crystal diode detector **W2** (OA70).

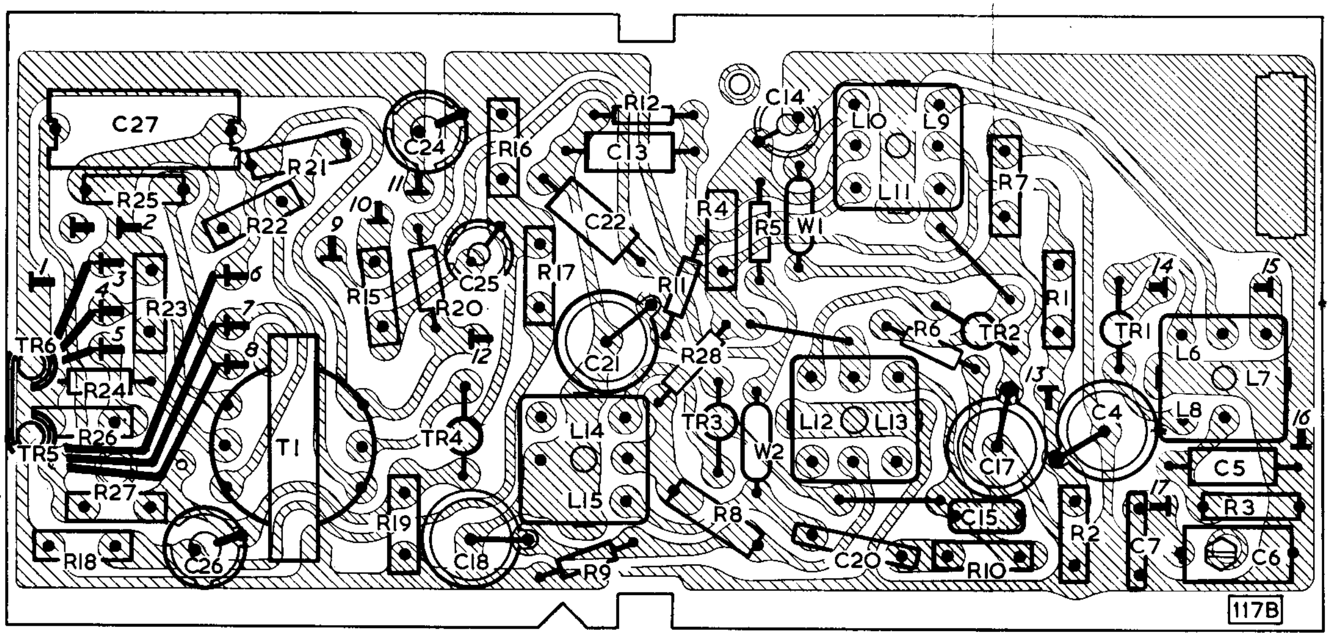
Both IF stages require neutralising to offset internal feedback within the transistors. **TR2** neutralising is effected by **R6** and **C15,** and **TR3** neutralising by **R10** and **C20.** The necessary phase reversal is obtained by including the IF transformers within the feedback loops.

The DC component of the rectified signal developed across **R13** and **R14** is applied as a positive AGC bias to the base circuit of **TR2.** This control voltage reduces the negative standing bias at **TR2** base due to **R4.** Additional AGC control is provided by the connection of **W1** (OA79) effectively across the tuned winding **L10/C11** functioning as a damping diode. **W1** operating conditions are determined by the difference between the voltage developed across **R7** and the voltage at the junction of **R11** and **R12,** the emitter stabilising resistors for **TR3.**

Under no signal conditions, **W1** has a reverse bias of approximately ½ volt, its impedance is high and has negligible effect on the receiver gain. As the signal level rises, however, the diode becomes forward biased, its impedance reduces rapidly and the first IF coil is heavily damped. This results in a widening of the bandwidth and allows a much greater input level to be handled.

No AGC is applied to the second IF stage, the base bias being fixed by the potential divider **R8** and **R9.**

The audio amplifier comprises a driver stage **TR4** (OC78D) feeding a push-pull output stage **TR5** and **TR6** (both type OC78). The audio voltage developed across the volume control **R14** is applied to **TR4** base through



1. To battery positive via S3
2. To Loudspeaker
3. To TR6 Collector
4. To TR6 Base
5. To TR6 Emitter
6. To TR5 Collector
7. To TR5 Base
8. To TR5 Emitter
9. To top through R13 — *Volume Control*
10. To slider — *Volume Control*
11. To bottom [chassis] — *Volume Control*
12. To battery negative via S2
13. To wiper of S1A
14. To wiper of S1B
15. To Oscillator section of tuning gang and S1C
16. To chassis via tuning gang
17. To wiper of S1C

117A

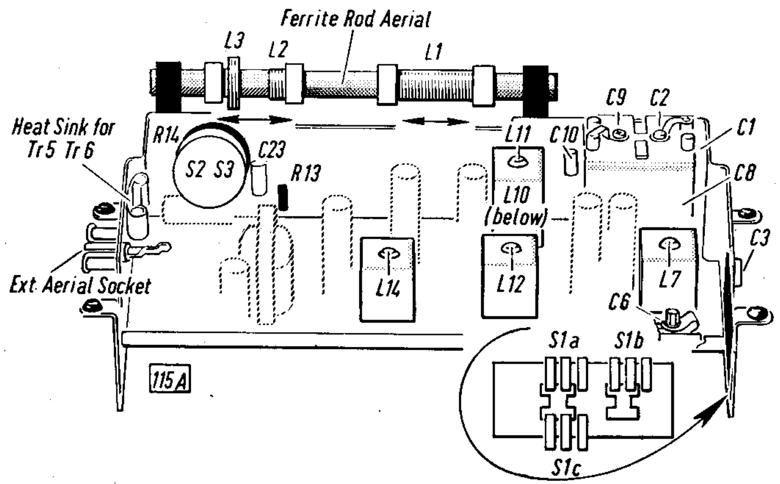


Fig. 2 (above). The printed board viewed from the components side.

Fig. 3 (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. TR5 and TR6 are mounted in a spring clip secured to the side chassis member. This clip functions as a heat sink. The transistors are also coated with silicone grease to ensure effective heat transfer.

C25/R15. R16, R17 and **R19** stabilise the DC operating conditions of the stage. The phase splitting transformer **T1** applies push-pull signals to the bases of **TR5** and **TR6.**

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 no matching transformer is required. The resistor chain **R21, R22, R23** and **R24** determine the DC operating conditions and **R25** and **R26** provide emitter stabilising.

Negative feedback is applied to the emitter of the driver transistor from the loudspeaker speech coil via **C27, R27.**

CIRCUIT ALIGNMENT

Throughout alignment, the signal input level to the receiver must be adjusted to prevent the audio output from exceeding 5 mW with the volume control set at maximum.

IF Circuits

Switch receiver to MW and turn gang to minimum capacitance position. Apply a 470 Kc/s modulated signal through a 0.1 uF capacitor across the aerial section of the tuning gang. Adjust **L14, L12, L11** and **L10,** in that order, for maximum output. Repeat in the same order.

RF Circuits

MW must be aligned first. Signals to be injected via a loop loosely coupled to the ferrite-rod aerial. Alignment markers, in the form of notches, are provided in the scale backing plate. Set the cursor to the 'Gang Max' marker. The notch nearest to 'Gang Max' is the 'MW Pad' point (600 Kc/s) and the 'MW Trim' marker (1300 Kc/s) is at the extreme end of the scale. 'LW Trim' (220 Kc/s) is between the MW markers.

Range	Frequency	Cursor Position	Adjust
MW	1300 Kc/s	MW Trim	C9, C2
	600 Kc/s	MW Pad	L7, L1*
LW	220 Kc/s	LW Trim	C6, L3*

* Adjust by sliding coil former along aerial rod.

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	157pF	Variable*		Aerial tuning
C 2	25pF	Pre-set*		Aerial trimmer
C 3	42pF			LW aerial tracking
C 4	0.1uF			TR1 base bias bypass
C 5	.02uF			TR1 emitter bypass
C 6	30pF	Pres-set**		LW oscillator trimmer
C 7	200pF	5%		LW oscillator tracking
C 8	111pF	Variable*		Oscillator tuning
C 9	25pF	Pre-set*		MW oscillator trimmer
C10	8.2pF			MW oscillator tracking
C11	400pF			IFT1 tuning
C12	400pF			IFT1 tuning
C13	.01uF			IF bypass
C14	8uF	Electrolytic	6V	AGC decoupling
C15	56pF	5%		Part TR2 neutralising
C16	250pF			L12 tuning
C17	0.1uF			TR2 emitter bypass
C18	0.1uF			TR3 base bias bypass
C19	250pF			L14 tuning
C20	18pF	5%		Part TR3 neutralising
C21	0.1uF			TR3 emitter bypass
C22	.02uF			IF filter
C23	.02uF			IF filter
C24	100uF	Electrolytic	12V	Supply decoupling
C25	8uF	Electrolytic	6V	TR4 audio coupling
C26	100uF	Electrolytic	6V	TR4 emitter bypass
C27	100uF	Electrolytic	12V	Neg. feedback coupling
C28	.01uF			IFT 3 decoupling

* Part No. Y18407
** Part No. Z25547

MISCELLANEOUS

Ref.	Description and Function	Part No.
S1A-C	Wavechange switch	N18414
S2-3	On/Off switch Combined with R14	
LS	Loudspeaker, 5" diameter, 35Ω speech coil (DC resistance 30Ω)	Y16021/3

INDUCTORS AND TRANSFORMERS

Ref.	Function	Part No.
L 1	MW aerial tuning (Ferrite-rod aerial)	Y18418
L 2	External aerial coupling (Ferrite-rod aerial)	Y18418
L 3	LW aerial tuning (Ferrite-rod aerial)	Y18418
L 6, L 7, L 8	Oscillator coils	Y18409
L 9, L10, L11	IFT 1	Y18410
L12, L13	IFT 2	Y18411
L14, L15	IFT 3	Y18412
T 1	Audio driver transformer	Z18413

SPARE PARTS LIST

DESCRIPTION	PART No.
Battery lead assembly	N18437
Cabinet	V17730
Cabinet trim	X18423
Control knobs (volume and tuning)	Y18427
Clip	37302
Control knob (wavechange)	Y18426
Handle assembly	X18457
Clip	47421
Transistor clip (heat sink)	Z18433
Tuning drive drum	Z1757/2
Tuning scale	Y18421
Tuning scale backing plate	Z18422
Tuning scale fixing stud	Z18460

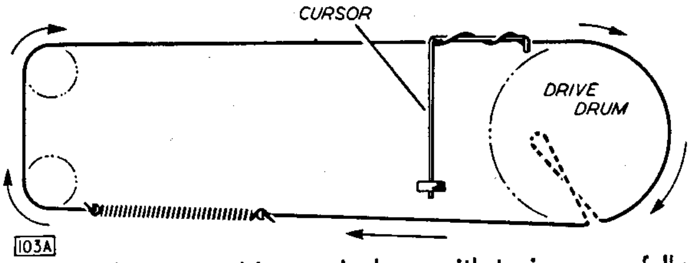


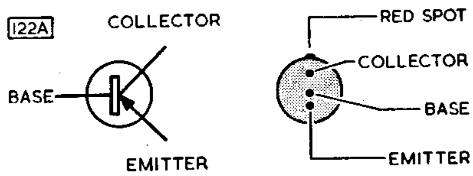
Fig. 4. The tuning drive cord, shown with tuning gang fully closed.

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 ¼ Watt respectively.

Ref.	Value	Tol.	Watts	Function
R 1	56KΩ			TR1 base bias pot.
R 2	10KΩ			TR1 base bias pot.
R 3	3.9KΩ			TR1 emitter stabilising
R 4	68KΩ			TR2 base bias
R 5	8.2KΩ			AGC decoupling
R 6	1.2KΩ			Part TR2 neutralising
R 7	680Ω			TR2 emitter stabilising
R 8	22KΩ			TR3 base bias pot.
R 9	4.7KΩ			TR3 base bias pot.
R10	3.9KΩ			Part TR3 neutralising
R11	750Ω			Part emitter stabilising and W1 bias
R12	220Ω			Part emitter stabilising and W1 bias
R13	470Ω			IF filter
R14	5KΩ	Carbon pot. log.*		Volume control
R15	330Ω			TR4 audio coupling
R16	12KΩ			TR4 base bias
R17	18KΩ			TR4 base bias
R18	10Ω			Neg. feedback injection
R19	1KΩ			TR4 emitter stabilising
R20	1.5KΩ			DC dropper and decoupling
R21	3.3KΩ	5%		TR5 base bias
R22	120Ω	5%		TR5 base bias
R23	3.3KΩ	5%		TR6 base bias
R24	120Ω	5%		TR6 base bias
R25	3.3Ω	±½Ω	†	TR5 emitter stabilising
R26	3.3Ω	±½Ω	†	~~TR6 emitter stabilising~~
R27	1KΩ			Neg. feedback series
R28	120Ω	10%		IFT 3 decoupling

* Part No. Z13117
† Part No. 33XHCO2



CIRCUIT SYMBOL *TRANSISTOR CONNECTIONS*

TRANSISTORS AND CRYSTAL DIODES

Ref.	Type	Description
TR1	OC44	Frequency changer
TR2	OC45	1st IF amplifier
TR3	OC45	2nd IF amplifier
TR4	OC78D	Audio driver
TR5	OC78	Push-Pull audio output
TR6	OC78	Push-Pull audio output
W1	OA79	Damping diode
W2	OA70	Detector and AGC rectifier

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