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'TRADER' SERVICE SHEET 276

FERGUSON 502, 502C AND 502RG

A SHORT-WAVE range of 16-50 metres is covered by the Ferguson 502 6-valve (plus rectifier) A.C. 3-band superhet, special features being push-pull output and a cathode-ray tuning indicator. The receiver is suitable for mains of 200-250 V, 40-60 C/S, and includes provision for both an extension speaker and a gramophone pick-up.

An identical chassis is fitted in the 502C console and the chassis in the 502RG radiogram is very similar, the difference being explained in "General Notes." This *Service Sheet* was prepared on a 502.

CIRCUIT DESCRIPTION

Aerial input via series condenser **C1,** coupling condenser **C2,** coupling coil **L2** (S.W.) and coupling condenser **C3** (M.W. and L.W.) to single tuned circuits **L3, C32** (S.W.), **L4, C32** (M.W.) and **L5, C32** (L.W.) which precede heptode valve (**V1, National Union 6A7**), operating as frequency changer with electron coupling.

The choke **L1** across aerial circuit is claimed to prevent mains hum modulating a carrier and resistance **R1** damps the rejector circuit to prevent a resonance peak.

Oscillator grid coils **L6** (S.W.), **L7** (M.W.) and **L8** (L.W.) are tuned by **C33**; parallel trimming by **C35** (S.W.), **C36** (M.W.) and **C7, C37** (L.W.); series tracking by **C38** (S.W.), **C34** (M.W.) and **C39** (L.W.). Reaction by coils **L9** (S.W.) and **L10** (M.W.); on L.W. anode is coupled back to low potential end of **L8.**

Second valve (**V2, National Union 6D6**) is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings **C40, L11, L12, C41** and **C42, L13, L14, C43.**

Intermediate frequency 465 KC/S.

Diode second detector is part of double diode triode valve (**V3, National Union 75**). Audio frequency component in rectified output is developed across load resistance **R12** and passed via A.F. coupling condenser **C15** and manual volume control **R11** to C.G. of triode section, which operates as A.F. amplifier. Fixed tone correction by **C16** in grid circuit and variable tone control by **R10, C14** across diode load. I.F. filtering by **R9, C12** and **C13.**

Second diode of **V3,** fed from **L14** via **C17,** provides D.C. potential which is developed across load resistance **R16** and fed back through decoupling circuit as G.B. to F.C. and I.F. valves, giving automatic volume control. Delay voltage is obtained from drop along **R13** in **V3** cathode lead.

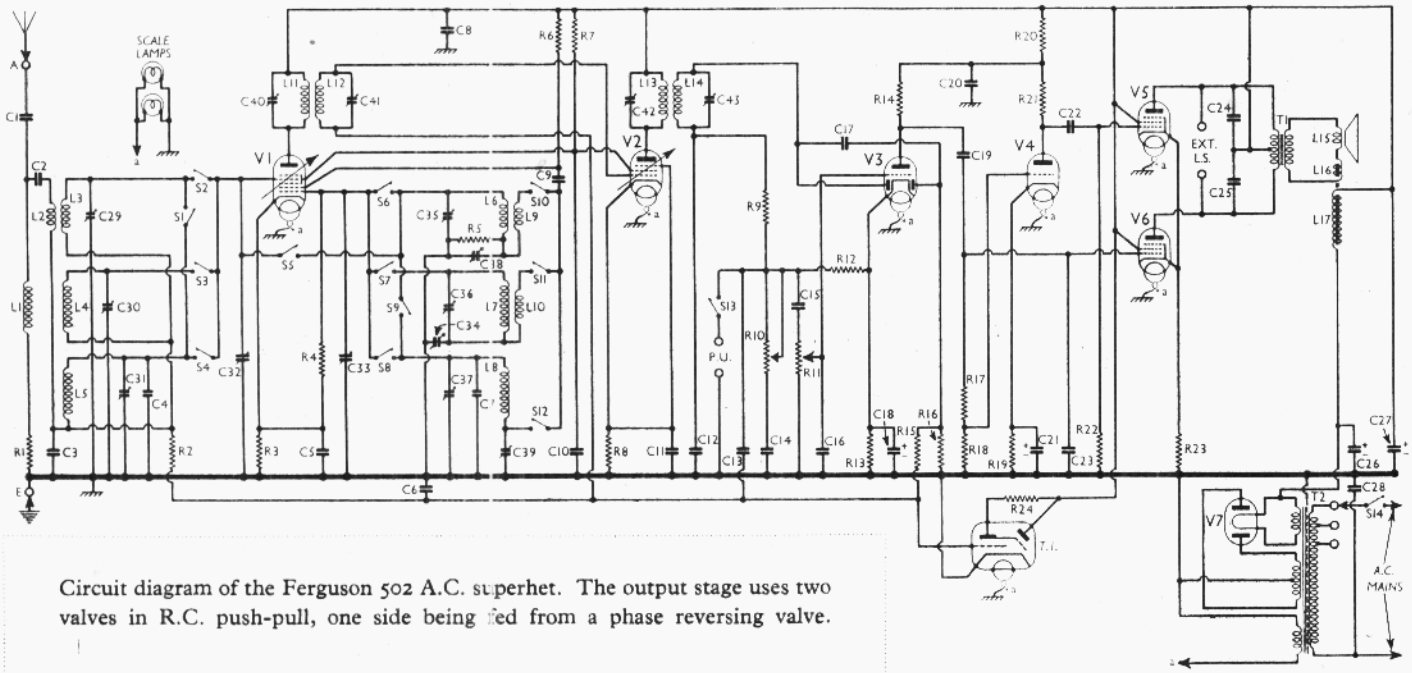
Operating potential for cathode ray tuning indicator (**T.I. National Union 6G5**) is obtained from A.V.C. line.

Resistance-capacity coupling by **R14, C19** and **R17, R18** between **V3** triode and one section (**V6**) of push-pull output stage comprising two pentodes (**V5, V6, National Union 42's**). Second section (**V5**) is fed by phase-reversing valve (**V4, National Union 76**), which obtains its input voltage from junction of **R17, R18.** Fixed tone correction in output stage by condensers **C24, C25.** Provision for connection of high impedance external speaker across primary of **T1.**

H.T. current is supplied by full-wave rectifying valve (**V7, National Union 80**). Smoothing by speaker field **L17** and dry electrolytic condensers **C26, C27.** Mains R.F. filtering by **C28.**

COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	A.F. rejector damping ..	2,500
R2	V1 hexode C.G. decoupling ..	500,000
R3	V1 fixed G.B. resistance ..	200
R4	V1 osc. C.G. resistance ..	25,000
R5	Oscillator S.W. circuit stabiliser	500,000
R6	V1 osc. anode H.T. feed ..	25,000
R7	V1, V2 S.G. H.T. feed ..	50,000
R8	V2 fixed G.B. resistance ..	300
R9	I.F. stopper	25,000
R10	Variable tone control ..	500,000
R11	Manual volume control ..	500,000
R12	V3 signal diode load	500,000
R13	V3 G.B. and A.V.C. delay resistance	10,000
R14	V3 triode anode load	250,000
R15	A.V.C. line decoupling ..	500,000
R16	V3 A.V.C. diode load ..	500,000
R17	V4 C.G. resistances ..	500,000
R18		50,000
R19	V4 G.B. resistance	10,000
R20	V3 triode, V4 anodes H.T. feed	100,000
R21	V4 anode load	250,000
R22	V5 C.G. resistance	500,000
R23	V5, V6 G.B. resistance ..	300
R24	T.I. anode H.T. feed ..	250,000



Circuit diagram of the Ferguson 502 A.C. superhet. The output stage uses two valves in R.C. push-pull, one side being fed from a phase reversing valve.

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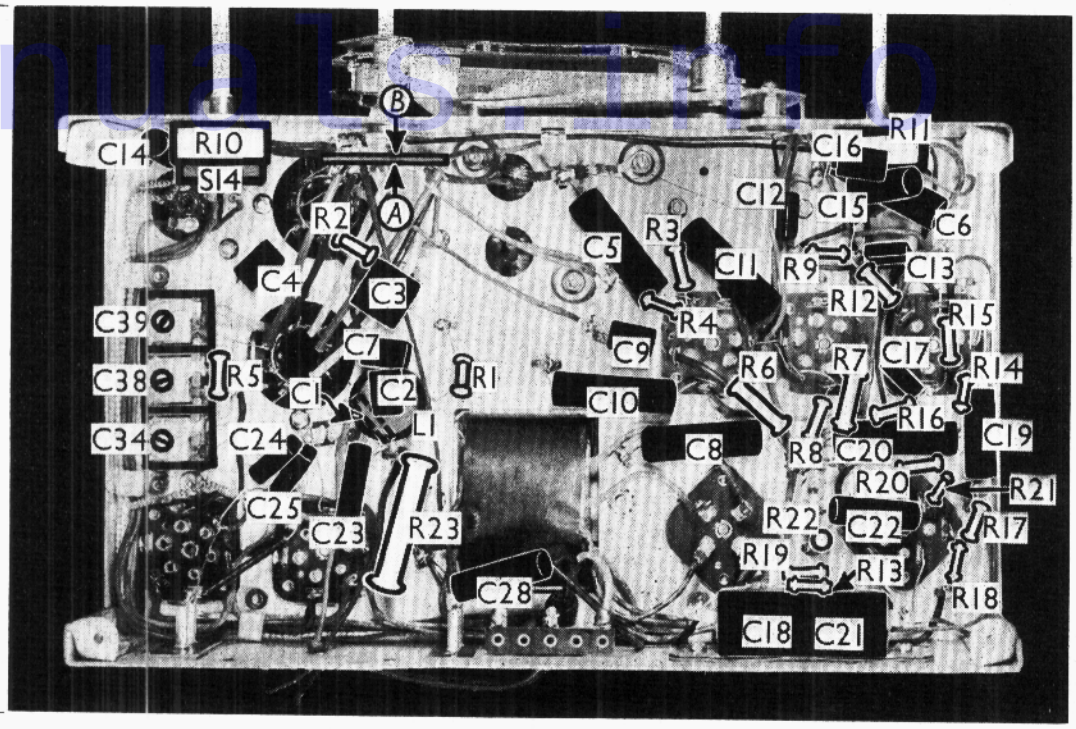
Under-chassis view. The two sides of the single switch unit are marked A and B, and diagrams looking in the directions of the arrows are on page VIII. The trackers **C34**, **C38** and **C39** are adjusted from the chassis deck.



CONDENSERS		Values (μF)
C1	Aerial series condenser	0·0002‡
C2	Aerial coupling condenser	0·0002‡
C3	M.W. and L.W. aerial coupling	0·002
C4	Aerial L.W. fixed trimmer	0·0000‡
C5	V1 cathode by-pass	0·1
C6	A.V.C. line decoupling	0·1
C7	Oscillator L.W. fixed trimmer	0·0000‡
C8	H.T. circuit R.F. by-pass	0·1
C9	V1 osc. anode coupling	0·0002‡
C10	V1, V2 S.G. decoupling	0·1
C11	V2 cathode by-pass	0·1
C12	I.F. by-passes	0·0002‡
C13	I.F. by-passes	0·0002‡
C14	Part of variable T.C. circuit	0·01
C15	A.F. coupling to V3 triode	0·01
C16	Fixed tone corrector	0·0002‡
C17	Coupling to V3 A.V.C. diode	0·0002‡
C18*	V3 cathode by-pass	25·0
C19	V3 triode to V4 and V6 A.F. coupling	0·01
C20	V3, V4 anodes decoupling	0·1
C21*	V4 cathode by-pass	5·0
C22	V4 to V5 A.F. coupling	0·01
C23	Fixed tone correctors	0·001
C24	Fixed tone correctors	0·002
C25	Fixed tone correctors	0·002
C26*	H.T. smoothing	8·0
C27*	H.T. smoothing	8·0
C28	Mains R.F. by-pass	0·01
C29‡	Aerial circuit S.W. trimmer	—
C30‡	Aerial circuit M.W. trimmer	—
C31‡	Aerial circuit L.W. trimmer	—
C32†	Aerial circuit tuning	—
C33†	Oscillator circuit tuning	—
C34‡	Osc. circuit M.W. tracker	—
C35‡	Osc. circuit S.W. trimmer	—
C36‡	Osc. circuit M.W. trimmer	—
C37‡	Osc. circuit L.W. trimmer	—
C38‡	Osc. circuit S.W. tracker	—
C39‡	Osc. circuit L.W. tracker	—
C40‡	1st I.F. trans. pri. tuning	—
C41‡	1st I.F. trans. sec. tuning	—
C42‡	2nd I.F. trans. pri. tuning	—
C43‡	2nd I.F. trans. sec. tuning	—

* Electrolytic. † Variable. ‡ Pre-set.

OTHER COMPONENTS		Approx. Values (ohms)
L1	Aerial A.F. modulation rejector	20·0
L2	Aerial S.W. coupling coil	Very low
L3	Aerial S.W. tuning coil	0·05
L4	Aerial M.W. tuning coil	3·0
L5	Aerial L.W. tuning coil	15·5
L6	Oscillator S.W. tuning coil	Very low
L7	Oscillator M.W. tuning coil	2·0
L8	Osc. L.W. tuning and reaction	5·0
L9	Oscillator S.W. reaction coil	0·15
L10	Oscillator M.W. reaction coil	0·7
L11, L12	1st I.F. trans. Pri.	9·5
	1st I.F. trans. Sec.	13·0
L13, L14	2nd I.F. trans. Pri.	13·0
	2nd I.F. trans. Sec.	9·5
L15	Speaker speech coil	1·5
L16	Hum neutralising coil	0·1
L17	Speaker field coil	1,000·0
T1	Speaker input trans. Pri., total	650·0
	Speaker input trans. Sec.	0·15
T2	Mains trans. Pri., total	15·0
	Mains trans. Heater sec.	Very low
	Mains trans. Rect. heat. sec.	0·1
	Mains trans. H.T. sec., total	175·0
S1-S12	Waveband switches	—
S13	Gram. pick-up switch	—
S14	Mains switch, ganged R10	—

DISMANTLING THE SET

Removing Chassis.—If it is desired to remove the chassis from the cabinet, remove the four knobs (pull off) and the felt washers from the control spindles, and remove the four bolts (with washers and spring washers) holding the chassis to the bottom of the cabinet. The chassis can now be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

To free the chassis entirely, unsolder the speaker leads and *when replacing*, connect them as follows, numbering the tags on the transformer terminal panel from bottom to top:—1 and 3 joined together, red; 2, blue; 4, blue; 5, red/white.

Removing Speaker.—To remove the speaker from the cabinet, remove the nuts from the four screws holding it to the sub-baffle and *when replacing*, see that the transformer is on the right and connect the leads as above.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 219 V, using the 220-230 V tapping on the mains transformer. The receiver was tuned to the lowest wavelength on the medium band and the volume control was at maximum, but there was no signal input, and the aerial and earth leads were connected together.

Voltages were measured on the 400 V scale of a model 7 Universal Avometer, chassis being negative.

If **V2** should become unstable when its screen current is being measured, as in our case, it can be stabilised by connecting a non-inductive condenser of about 0·1 μF from grid (top cap) to chassis.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 6A7	257	1·8	62	2·3
	Oscillator			
	168	3·1		
V2 6D6	257	4·2	62	1·2
V3 75	63	0·2	—	—
V4 76	45	0·4	—	—
V5 42	248	26·0	257	5·8
V6 42	248	26·0	257	5·1
V7 80	325†	—	—	—
T.I. 6G5	47	0·9	—	—
	Target anode			
	257	0·1		

† Each anode, A.C.

GENERAL NOTES

Switches.—**S1-S12** are the waveband switches and **S13** the pick-up switch, all ganged in a double-sided rotary unit beneath the chassis. The two sides are marked with the letters A and B in circles in our under-chassis view, and are shown in detail in the diagrams on page VIII. Note that in many cases

Continued overleaf

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FERGUSON 502—*Continued*

tags opposite each other on either side of the paxolin support are common.

The table below gives the switch positions for the four control settings, starting from fully anti-clockwise. A dash indicates open, and **C** closed.

Switch	S.W.	M.W.	L.W.	Gram.
S1	—	C	—	—
S2	C	—	—	—
S3	—	C	—	—
S4	—	—	C	—
S5	—	—	—	C
S6	C	—	—	—
S7	—	C	—	—
S8	—	—	C	—
S9	—	C	—	—
S10	C	—	—	—
S11	—	C	—	—
S12	—	—	C	—
S13	—	—	—	C

S14 is the Q.M.B. mains switch, ganged with the tone control, **R10.**

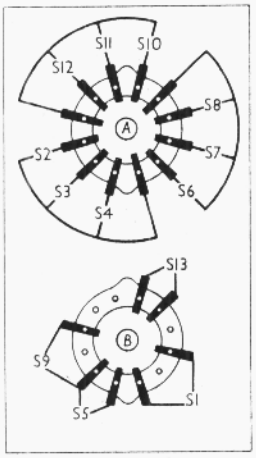
Coils.—**L1** is unscreened, and is mounted beneath the chassis. **L2-L5**; **L6-L10**; **L11, L12** and **L13, L14** are in four screened units on the chassis deck, with their associated trimmers.

Scale Lamps.—These are two miniature bayonet cap types, rated at 4·5 V, 0·3 A.

External Speaker.—Two sockets are provided at the rear of the chassis for a high impedance external speaker.

Condensers C26, C27.—These are two 8 μF dry electrolytics in a single metal can on the chassis deck. The can is the common negative connection, and the two tags projecting beneath the chassis deck are the two positives. One is coded with a blue dot, and this is the positive of **C26.** The plain tag is the positive of **C27.**

Condensers C18, C21.—These are two dry electrolytics in a single carton beneath the chassis, fixed to the rear member. The tag on the left (looking from the rear of the chassis) is the common negative, and the two on the right are the positives. The upper one is the positive of **C18** (25 μF) and the lower the positive of **C21** (5 μF).



The switch unit seen in the directions of the two arrows in the under-chassis view.

Trimmers and Trackers.—All the trimmers are housed inside the cans of the coil units with which they are associated. The three trackers, **C34, C38, C39,** are adjusted by means of screws above the chassis deck, on the right-hand side as seen in our plan chassis view.

A-E Leads.—These are short lengths of insulated wire, terminating in fahnstock clips. The aerial wire has a green covering, and the earth, black.

Valve Bases.—The American valves fitted have bases of the ordinary pin (not octal) type. Full information as to the connections will be found on page 45 of *The Wireless Trader Year Book* for 1938.

Radiogram Model.—The 502RG has a similar chassis, the only difference being that a 25,000 Ω resistance is connected across the pick-up terminals.

CIRCUIT ALIGNMENT

The scale pointer should be vertical when the gang is fully meshed, marks being provided for accurate setting.

I.F. Stages.—Connect signal generator to grid (top cap) of **V2** and earth lead, feed in a 465 KC/S signal and adjust **C42** and **C43** for maximum output. Transfer signal generator to grid (top cap) of **V1,** switch set to L.W., see that gang is fully meshed, and adjust **C40** and **C41** for maximum output. Keep input low.

If necessary, re-adjust **C42** and **C43.**

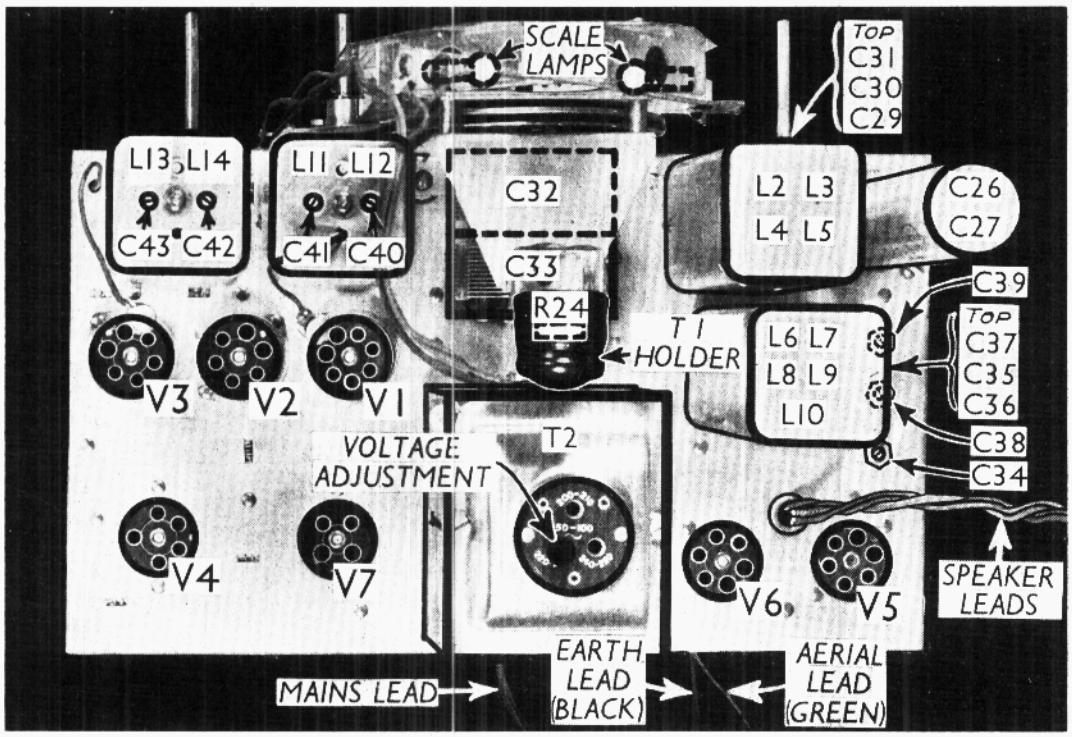
R.F. and Oscillator Stages.—First adjust trackers for maximum output at the top of each band, with the gang fully meshed. To do this, connect a high frequency buzzer via a 50 $\mu\mu$F condenser to the aerial lead of the set, and adjust **C38** on the S.W. band, **C34** on the M.W. band and **C39** on the L.W. band for maximum output.

Switch set to S.W., connect signal generator to **A** and **E** leads and feed in a 21 m. signal. Tune to 21 m. on scale (about 235 m. on M.W. calibrated scale). Adjust **C35** and **C29** for maximum output. Fully mesh the gang again and re-track **C38** as above. Return to 21 m. and re-adjust **C35** and **C29.** Re-track **C38** again.

On the M.W. band, repeat above procedure, trimming **C36** and **C30** at 250 m. and tracking **C34** at the top of the scale.

On L.W., trim **C37** and **C31** at 1,200 m., and track **C39** at top of scale.

On the S.W. band, if **C35** peaks at two places, that with the least trimmer capacity is correct.



Plan view of the chassis. The trimmers of the R.F. and oscillator coil units are reached through holes in the sides of the cans, and are numbered from top to bottom. The trackers are adjusted by the screws on the right of the chassis deck. **R24** is inside the T.I. holder.

Printed in Great Britain as a supplement to *The Wireless & Electrical Trader* by Sanders Phillips & Co., Ltd., The Baynard Press, Chryssell Road, London, S.W.9

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