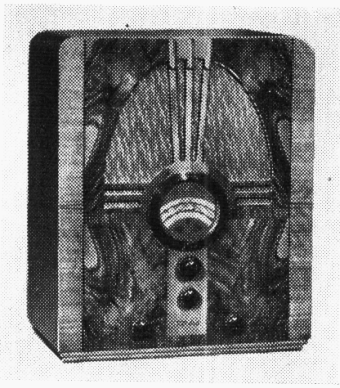
'TRADER' SERVICE SHEET 306

PHILCO P538

3-BAND BATTERY SUPERHET



THE chassis fitted in the Philco P538 is a 5-valve battery-operated 3-band type with a short-wave range of 16·6-52 m. Provision is made for a gramophone pick-up and also for using the Philco all-wave aerial.

CIRCUIT DESCRIPTION

Normal aerial input via sockets **A** and **E** and coupling coils **L1** (SW), **L2** (MW) and **L3** (LW) to single-tuned circuits **L4, C27** (SW), **L5, C27** (MW) and **L6, L7, C27** (LW). On LW, **L3,** with its associated circuit, resonates somewhere beyond the high frequency end of the band; **L7, C1** resonate at the low frequency end; **L6** and **L7** together provide the LW tuning coil; thus, it is claimed, a constant coupling efficiency is maintained throughout the band.

Provision is made for connection of the Philco all-wave anti-static aerial, when the transmission line is connected to **Red** and **Black** sockets. In this case the link must be connected to socket **C,** whereas normally it is left in socket **B.**

First valve (**V1, Philco 1C6**) is a heptode operating as frequency changer with electron coupling. Oscillator grid coils **L8** (SW), **L9** (MW) and **L10** (LW) are tuned by **C28**; parallel trimming by **C29** (SW), **C30** (MW), **C4, C31** (LW); series tracking by **C5** (SW), **C32** (MW) and **C33** (LW). Reaction by coil **L11** (SW), or via condenser **C7** to **L9** (MW) and **L10** (LW).

Second valve (**V2, Philco metallised VP21**) is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary transformer couplings **C34, L12, L14, C35** and **C36, L15, L16, C37.** Reaction, by coupling suppresser grid back to **L14** via coupling coil **L13,** is employed to attain maximum amplification in this stage, stability being secured by adjusting the pre-set "Regeneration" or gain control **R8.**

Intermediate frequency 470 KC/S.

Diode second detector is part of double-diode triode valve (**V3, Philco 2102**). Audio frequency component in rectified output is developed across load resistance **R11** and passed via AF coupling condenser **C12,** tone corrector circuit **R12, C13,** manual volume control **R13,** CG condenser **C14** and resistance **R14,** to CG of triode section, which operates as AF amplifier. IF filtering by **C10, R9, C11, C16** and **C17.** Provision for connection of gramophone pick-up across **R13** via **S28.**

DC potential developed across **R11** is fed back through decoupling circuit as GB to FC and IF valves, giving automatic volume control.

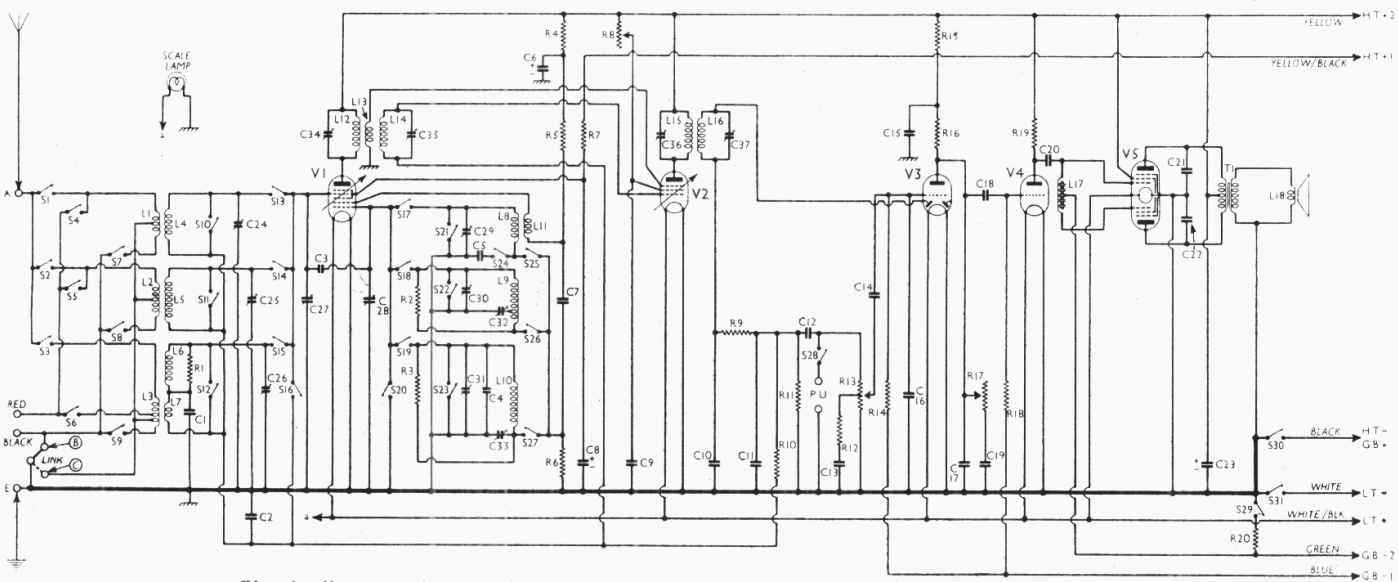
Resistance-capacity coupling by **R16, C18, R18,** via variable tone control filters **R17, C19,** between **V3** triode and AF amplifier (**V4, Philco 30**).

Parallel-fed choke coupling by **R19, C20** and **L17,** between **V4** and quiescent push-pull output valve (**V5, Philco 2103**). Fixed tone correction by **C21, C22** in anodes circuit.

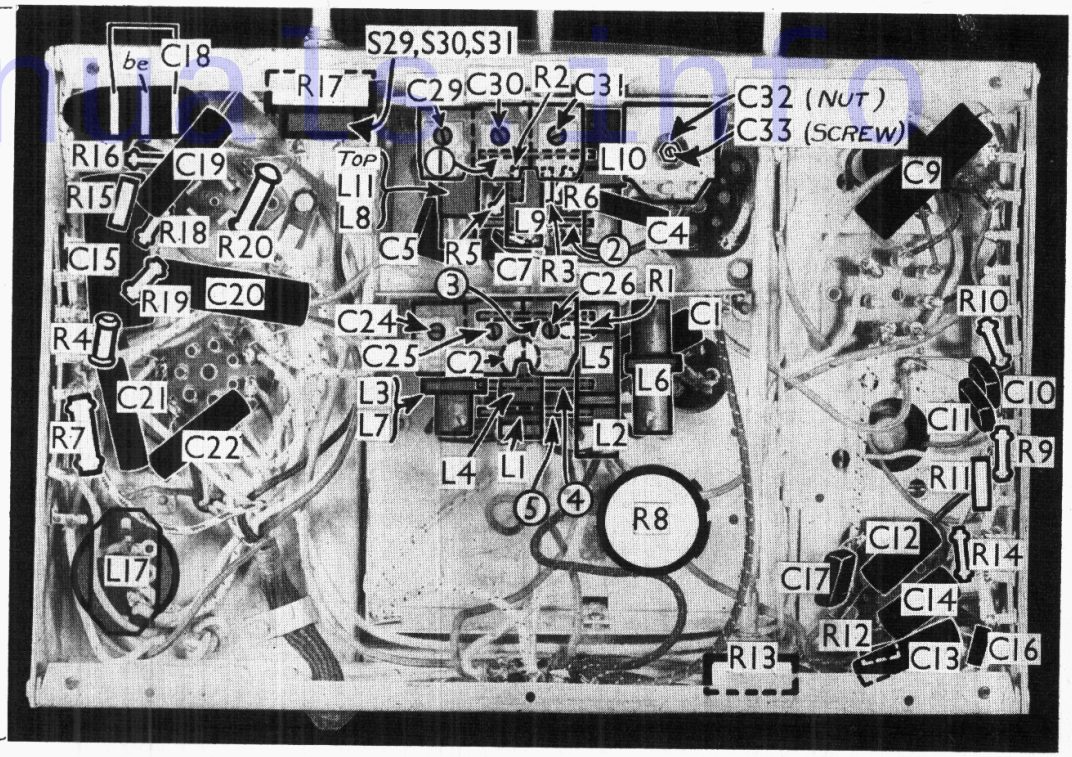
COMPONENTS AND VALUES

	CONDENSERS	Values (μF)
C1	L7 fixed tuning condenser	0·03
C2	AVC line decoupling	0·05
C3	Small coupling	Very low
C4	Osc. circuit LW fixed trimmer	0·00005
C5	Osc. circuit SW tracker	0·0035
C6*	V1 osc. anode decoupling	4·0
C7	V1 osc. anode coupling	0·00025
C8*	V1 SG decoupling	2·0
C9	V2 SG decoupling	0·1
C10	IF by-pass condensers	0·00011
C11	IF by-pass condensers	0·00011
C12	AF coupling to V3 triode	0·01
C13	Part of tone corrector	0·01
C14	V3 triode CG condenser	0·01
C15	V3 triode anode decoupling	0·5
C16	IF by-pass condensers	0·00011
C17	IF by-pass condensers	0·00011
C18	V3 to V4 AF coupling	0·09
C19	Part of variable tone control	0·03
C20	AF coupling to L17	0·1
C21	Fixed tone correctors	0·002
C22	Fixed tone correctors	0·002
C23*	HT reservoir condenser	2·0
C24‡	Aerial circuit SW trimmer	0·000035
C25‡	Aerial circuit MW trimmer	0·000035
C26‡	Aerial circuit LW trimmer	0·000035
C27†	Aerial circuit tuning	—
C28†	Oscillator circuit tuning	—
C29‡	Osc. circuit SW trimmer	0·000035
C30‡	Osc. circuit MW trimmer	0·000035
C31‡	Osc. circuit LW trimmer	0·000035
C32‡	Osc. circuit MW tracker	0·0006
C33‡	Osc. circuit LW tracker	0·000375
C34‡	1st IF trans. pri. tuning	—
C35‡	1st IF trans. sec. tuning	—
C36‡	2nd IF trans. pri. tuning	—
C37‡	2nd IF trans. sec. tuning	—

* Electrolytic. † Variable. ‡ Pre-set.



Circuit diagram of the Philco P538 battery superhet. Note the aerial input arrangements.



Under-chassis view. The five switch units are indicated by numbers in circles and arrows, and are shown in detail on page VIII. Many of the components arranged around the switch units are not clearly visible, but are indicated by arrows. It should be possible to identify them all on an actual chassis.

RESISTANCES		Values (ohms)
R1	Aerial circuit LW damping	490,000
R2	V1 osc. MW CG resistance	51,000
R3	V1 osc. LW CG resistance	160,000
R4	V1 osc. anode decoupling	2,000
R5	V1 osc. anode HT feed	10,000
R6	V1 osc. SW CG resistance	32,000
R7	V1 SG HT feed	45,000
R8	V2 gain control	1,000,000
R9	IF stopper	51,000
R10	AVC line decoupling	1,000,000
R11	V3 signal diode load	330,000
R12	Part of tone corrector	51,000
R13	Manual volume control, total*	2,000,000
R14	V3 triode CG resistance	1,000,000
R15	V3 triode anode decoupling	10,000
R16	V3 triode anode load	51,000
R17	Variable tone control	100,000
R18	V4 CG resistance	160,000
R19	V4 anode load	51,000
R20	GB battery bleeder	1,000

* Centre-tapped.

OTHER COMPONENTS		Approx. Values (ohms)
L1	Aerial SW coupling coil	0·2
L2	Aerial MW coupling coil	1·4
L3	Aerial LW coupling coil	80·0
L4	Aerial SW tuning coil	0·05
L5	Aerial MW tuning coil	5·0
L6, L7	Aerial circuit LW tuning coils	5·25 / 25·0
L8	Osc. circuit SW tuning coil	0·1
L9	Osc. circuit MW tuning coil	8·0
L10	Osc. circuit LW tuning coil	16·5
L11	Oscillator SW reaction	0·5
L12	1st IF trans. primary	8·0
L13	V2 supp. grid reaction coil	0·1
L14	1st IF trans. secondary	12·0
L15, L16	2nd IF trans. Pri.	12·0
	2nd IF trans. Sec.	8·0
L17	Intervalve coupling choke, total	1,700·0*
L18	Speaker speech coil	2·0
T1	Output transformer Pri., total	500·0
	Output transformer Sec.	0·2
S1-S27	Waveband switches	—
S28	Gram. PU switch	—
S29	GB circuit switch	—
S30	HT circuit switch (ganged R17)	—
S31	LT circuit switch	—

* Centre-tapped.

DISMANTLING THE SET

Removing Chassis.—To remove the chassis from the cabinet, remove the five knobs (pull off) and the four bolts (with washers) holding the chassis to the bottom of the cabinet, when the chassis can be withdrawn to the extent of the speaker leads, which is sufficient for normal purposes.

When replacing, see that there is a rubber washer for each fixing bolt between the chassis and the bottom of the cabinet, and note that the knobs for the wave-change switch and the volume and tone controls are marked, so that they must be replaced on the correct spindles.

If it is desired to free the chassis entirely, unsolder the speaker leads.

Removing Speaker.—To remove the speaker from the cabinet, remove the nuts and spring washers from the four screws holding it to the sub-baffle. *When replacing*, see that the terminal panel is on the right.

VALVE ANALYSIS

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 1C6	135	2·7	95	0·9
	Oscillator			
	46	2·4		
V2 VP21	135	1·0	24	0·3
V3 2102	63	0·6	—	—
V4 30	35	1·7	—	—
V5 2103	133†	2·9†	135	1·7

† Each anode.

Valve voltages and currents given in the table above are those measured in our receiver when it was operating with an HT battery reading 135 V on the HT section, on load. 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.

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

GENERAL NOTES

Switches.—**S1-S27** are the waveband switches and **S28** is the pick-up switch, ganged in five rotary units beneath the chassis. These are indicated in our under-chassis view, and shown in detail in the diagrams on page VIII, where they are drawn as seen looking from the rear of the underside of the chassis. Incidentally, to see all the switches clearly, it will be necessary partly to dismantle the ganged assembly.

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

S29-S31 are the battery circuit switches, ganged with the tone control **R17.** The tag connected to **V4** valveholder and chassis is the common connection of all the switches. The other connections are: **R20, S29**; black lead, **S30**; white lead, **S31.**

Coils.—**L1-L11** are in seven tubular unscreened units beneath the chassis, arranged around the switch units. **L12-L14** and **L15, L16** are in two screened units on the chassis deck, with their associated trimmers.

L17 is a small centre-tapped iron-cored choke beneath the chassis.

Scale Lamp.—This is a Tung-Sol type, fitted with a miniature bayonet cap (centre contact), rated at 2·1 V, 0·12 A. The Philco part number is 34-2150.

External Speaker.—No provision is made for this, but a low resistance (about 2 Ω) type could be connected across the two tags on the internal speaker.

Condensers C6, C8, C23.—These are three dry electrolytics in a single tubular

Continued overleaf

PHILCO P538—*Continued*

metal-cased unit on the chassis deck. The case forms the common negative connection to chassis. The yellow coded tag on the unit, beneath the chassis, is the positive of **C6** (4 μF); the blue tag is the positive of **C8** (2μF), and the plain tag is the positive of **C23** (2μF).

Condenser C3.—This has a very small capacity, formed by the lead from **C27** tag passing through the **C28** tag.

Condenser C18.—The connections to this are the two outer tags on the black moulded unit. The centre tag is merely used as a bearer.

Resistance R8.—This is a pre-set type, and is adjusted from the chassis deck.

Aerial and Earth Connections.—With an ordinary aerial and earth system, connect aerial to **A** socket, earth to **E** socket, and place link in socket **B.** With a Philco all-wave aerial, connect the red and black transmission line wires to the sockets marked **red** and **black,** and place link in socket **C.**

Batteries.—LT, 2 V accumulator cell, Exide DKG or CZG5; HT and GB, combined 135 V HT plus 9 V GB battery, Exide H1138, Siemens "Full-o'-Power" 1316 or Britannia Type III.

Battery Leads and Voltages.—White lead, spade tag, LT negative; white/black lead, spade tag, LT positive 2 V; black lead and plug, HT negative and GB positive; yellow/black lead, brown plug, HT positive 1, +90 V; yellow lead and plug, HT positive 2, +135 V; blue lead and plug, GB negative 1, −1·5 V; green lead and plug, GB negative 2, −9 V.

CIRCUIT ALIGNMENT

IF Stages.—Switch set to MW, turn volume control to maximum, and tone control to maximum brilliance. Aerial circuit link must be in socket **B.** Connect signal generator to control grid (top cap) of **V1,** leaving existing connection in place, and to chassis.

Feed in a 470 KC/S signal, and adjust **C34, C35, C36** and **C37** in turn for maximum output. If instability occurs, adjust **R8** in an anti-clockwise direction until set is just stable, then re-adjust the trimmers.

RF and Oscillator Stages.—With gang at minimum, indicator should cover the vertical line at the end of the scale, beyond 18 MC/S. Connect signal generator, via a dummy aerial, to **A** and **E** sockets.

LW.—Switch set to LW, and tune to 240 KC/S (1,250 m) on scale. Feed in a 240 KC/S (1,250 m) signal, and adjust **C31** and **C26** for maximum output. Feed in a 160 KC/S (1,875 m) signal, tune it in, and adjust **C33** (nut) for maximum output, while rocking the gang for optimum results. Trim at 240 KC/S and track at 160 KC/S until no further improvement is obtained.

MW.—Switch set to MW, and tune to 1,400 KC/S (214 m) on scale. Feed in a 1,400 KC/S (214 m) signal, and adjust **C30,** then **C25,** for maximum output. Feed in a 600 KC/S (500 m) signal, tune it in, and adjust **C32** for maximum output, while rocking the gang. Trim at 1,400 KC/S and track at 600 KC/S until no further improvement is obtained.

SW.—Switch set to SW, and, using a 400 Ω dummy aerial, feed in an 18 MC/S (16·67 m) signal. Tune to 18 MC/S on scale, and adjust **C29** for maximum output, on the peak requiring the least trimmer capacity (that is, the second peak from the maximum position of the trimmer).

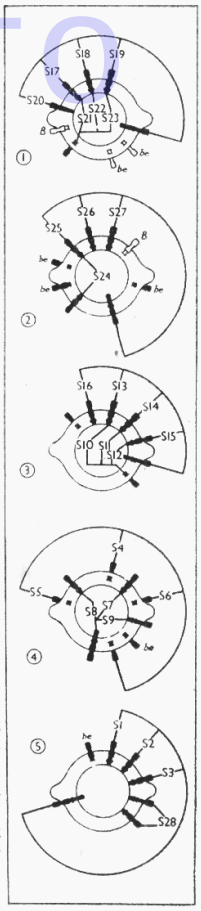
It is sometimes found when adjusting **C24** that it tends to "pull" the oscillator frequency. To avoid this, a 0·00035 μF variable condenser must be shunted temporarily across **C28,** and tuned so that the second harmonic of the normal oscillator frequency beats with the incoming signal. Connect the shunt condenser from the high potential tag of **C29** and chassis, and tune it (about half open) to the 18 MC/S signal. Then adjust **C24** for maximum output. Disconnect shunt condenser and re-trim **C29.** Check that the 18 MC/S image is obtained at about 17·1 MC/S.

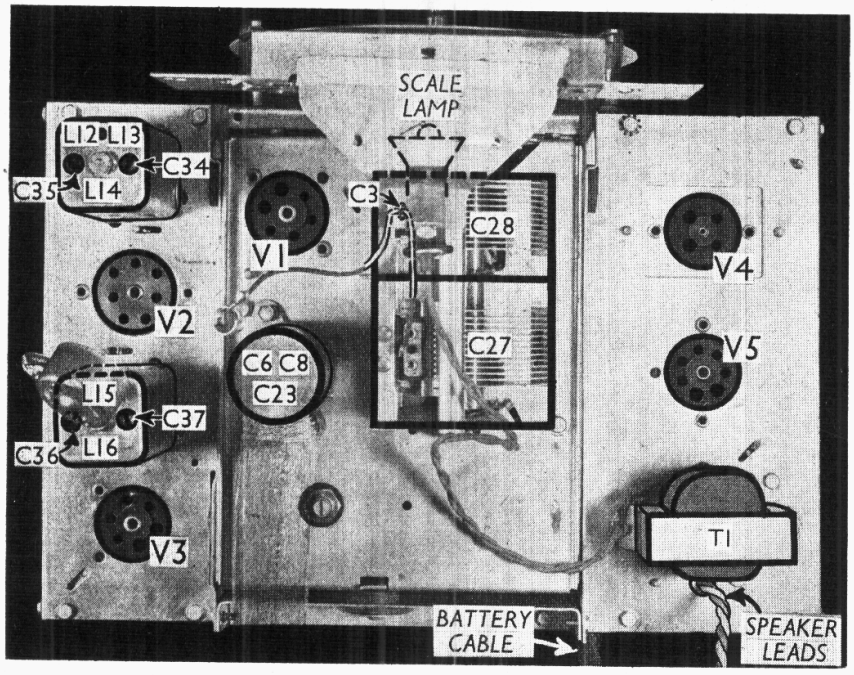
Feed in a 6 MC/S (50 m) signal, and tune it in, checking for correct reading on scale. The tracker **C5** is actually semi-fixed, and should not normally be adjusted. If sensitivity at 6 MC/S is low, however, adjust very slightly, while rocking the gang. Re-adjust **C29** at 18 MC/S.

TABLE AND DIAGRAMS OF THE SWITCH UNITS

Switch	LW	MW	SW	Gram
S1	—	—	C	—
S2	—	C	—	—
S3	C	—	—	—
S4	—	—	C	—
S5	—	C	—	—
S6	C	—	—	—
S7	—	—	C	—
S8	—	C	—	—
S9	C	—	—	—
S10	C	C	—	C
S11	C	—	C	C
S12	—	C	C	C
S13	—	—	C	—
S14	—	C	—	—
S15	C	—	—	—
S16	—	—	—	C
S17	—	—	C	—
S18	—	C	—	—
S19	C	—	—	—
S20	—	—	—	C
S21	C	C	—	C
S22	C	—	C	C
S23	—	C	C	C
S24	—	—	C	—
S25	—	—	C	—
S26	—	C	—	—
S27	C	—	—	—
S28	—	—	—	C

Diagrams of the five switch units, as seen from the rear of the underside of the chassis. To get at some of them, the assembly will have to be partially dismantled.





Plan view of the chassis. Note the small coupling **C3.**

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