Supplement to The Wireless & Electrical Trader, August 15, 1942

"TRADER" SERVICE SHEET

582

REVISED ISSUE OF SERVICE SHEET No. 168

PILOT U650

CU650, RGU650 AND RGAU650

AN RF amplifier and a cathode ray tuning indicator are included in the specification of the Pilot U650. The receiver is a 5-valve (plus rectifier) 4-band superhet, designed to operate from AC mains of 200-250 V, 40-100 C/S. The SW ranges are: SW1 band, 16-52 m; SW2 band, 48-150 m.

A similar chassis is fitted in the CU650, a console version of the receiver, and in the RGU650 radiogram and RGAU650 automatic record changer models, but the mains frequency range of the radiograms is limited to 40-60 C/S. This *Service Sheet* was prepared from a table model.

Release date, all models: 1936.

CIRCUIT DESCRIPTION

Aerial input via coupling coils **L1** (SW1), **L3** (SW2), **L5** (MW) and **L7** (LW) to single tuned circuits **L2, C35** (SW1), **L4, C35** (SW2), **L6, C35** (MW) and **L8, C35** (LW) which precede variable-mu RF pentode valve **(V1, Pilot 6D6)** operating as signal frequency amplifier.

Tuned-secondary RF transformer coupling by **L9, L10, C40** (SW1), **L11, L12, C40** (SW2), **L13, L14, C40** (MW) and **L15, L16, C40** (LW), with additional capacitative coupling by **C6** on SW1, between **V1** and heptode valve **(V2, Pilot 6A7)** which operates as frequency changer with electron coupling. Oscillator grid coils **L17** (SW1), **L19** (SW2), **L21** (MW) and **L23** (LW) are tuned by **C41.** Parallel trimming by **C42** (SW1), **C43** (SW2), **C44** (MW) and **C46** (LW); series tracking by **C11** (SW1), **C12** (SW2), **C45** (MW) and **C47** (LW). Reaction coupling from anode by coils **L18** (SW1), **L20** (SW2), **L22** (MW) and **L24** (LW).

Third valve **(V3, Pilot 6D6)** is a second RF pentode, operating this time as intermediate frequency amplifier with triple-tuned transformer couplings **C48, L25, L26, C49, L27, C50** and **C51, L28, L29, C52, L30, C53.** Grid bias is obtained from drop along **R14** in the cathode circuit in the usual way, and is fixed.

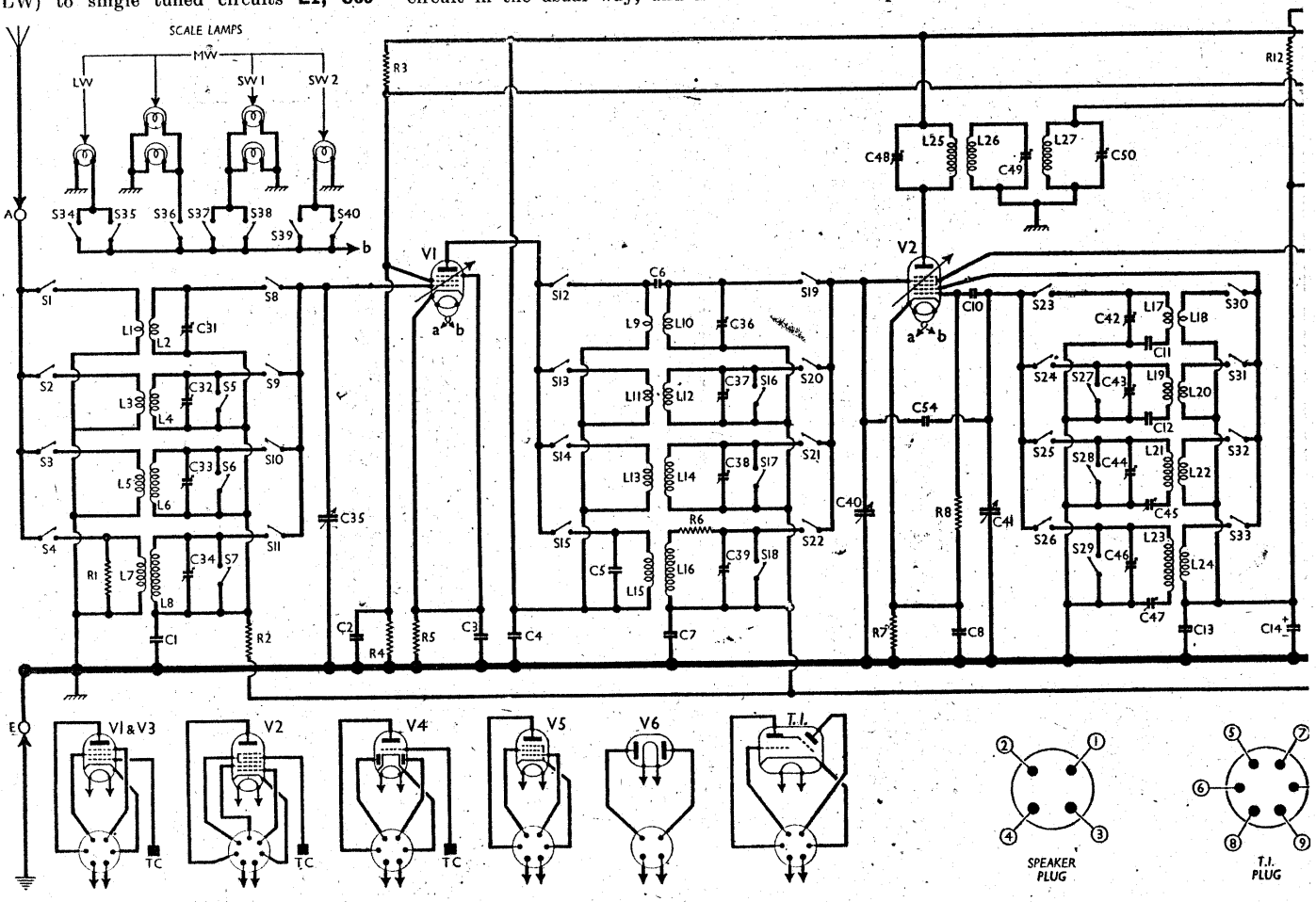
Intermediate frequency 456 KC/S.

Diode second detector is part of double diode triode valve **(V4, Pilot 75)** whose diode anodes are strapped together to operate as a single rectifier. Audio frequency component in rectified output is developed across load resistances **R18, R19** and passed via AF coupling condenser **C19** and manual volume control **R16** to CG of triode section, which operates as AF amplifier. IF filtering by **C18** and **R15.** Provision for connection of gramophone pick-up by jack-type socket across **C19, R16,** radio being muted automatically by breaking the diode circuit upon insertion of the jack.

DC potential developed across **R15, R18, R19** is tapped off and fed back through decoupling circuits as GB to RF and FC valves, giving AVC.

DC potential developed across **R19** only is tapped off and fed via decoupling circuit **R17, C20** as control voltage to cathode ray tuning indicator **(T.I., Pilot 6G5).**

Resistance-capacity coupling by **R22, C24** and **R23** between **V4** triode and pentode output valve **(V5, Pilot 42).** Variable



tone control by **R24, C25** in anode circuit. Fixed tone correction by **C26,** also in anode circuit but returned to cathode. Provision for connection of high impedance external speaker by sockets across the primary of the internal speaker input transformer **T1,** the sockets being isolated from the HT circuit by condensers **C29, C30.**

HT current is supplied by full-wave rectifying valve **(V6, Pilot 80).** Smoothing by speaker field **L33** and dry electrolytic condensers **C23, C28** for all HT supply except that for the oscillator and screen sections of **V2,** which is independently smoothed by **C28, R11, C15, R12** and **C14,** with RF by-passes **C13, C9.**

DISMANTLING THE SET

Removing Chassis.—First remove the tuning control knob (recessed grub screw), then the remaining three knobs (pull-off) from the front of the cabinet;
remove the four bolts (with flat metal washers and lock-washers) holding the chassis to the bottom of the cabinet, when the chassis may be withdrawn.
To free chassis entirely, withdraw the speaker plug (from the rear) and the tuning indicator plug (from the front).
When replacing, do not omit to replace the felt washers, one going on each control spindle.

Removing Speaker.—Withdraw the connecting plug from its socket at the rear of the chassis;
remove the nuts (with fibre washers) from the four bolts holding the speaker to the sub-baffle.
When replacing, the transformer should be on the right.

Removing Tuning Indicator.—If it is desired to gain access to the tuning indicator, the speaker must first be removed as described above. The cradle on which the tuning indicator is mounted can then be removed.
To free the tuning indicator entirely, it is necessary first to remove the chassis, as otherwise the connecting plug cannot be withdrawn.
When replacing, the leads should be brought out to the right.

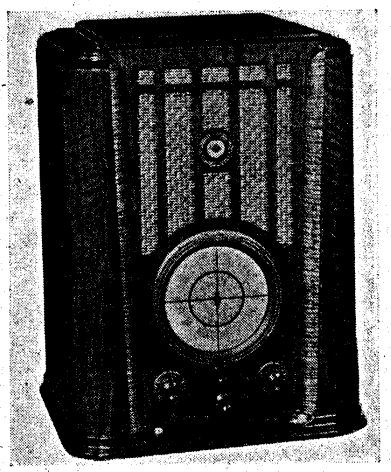
VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 220 V, using the 225 V tapping on the mains transformer. The receiver was tuned to the lowest wavelength on the MW band, and the volume control was at maximum, but there was no signal input, the aerial and earth leads being connected together.

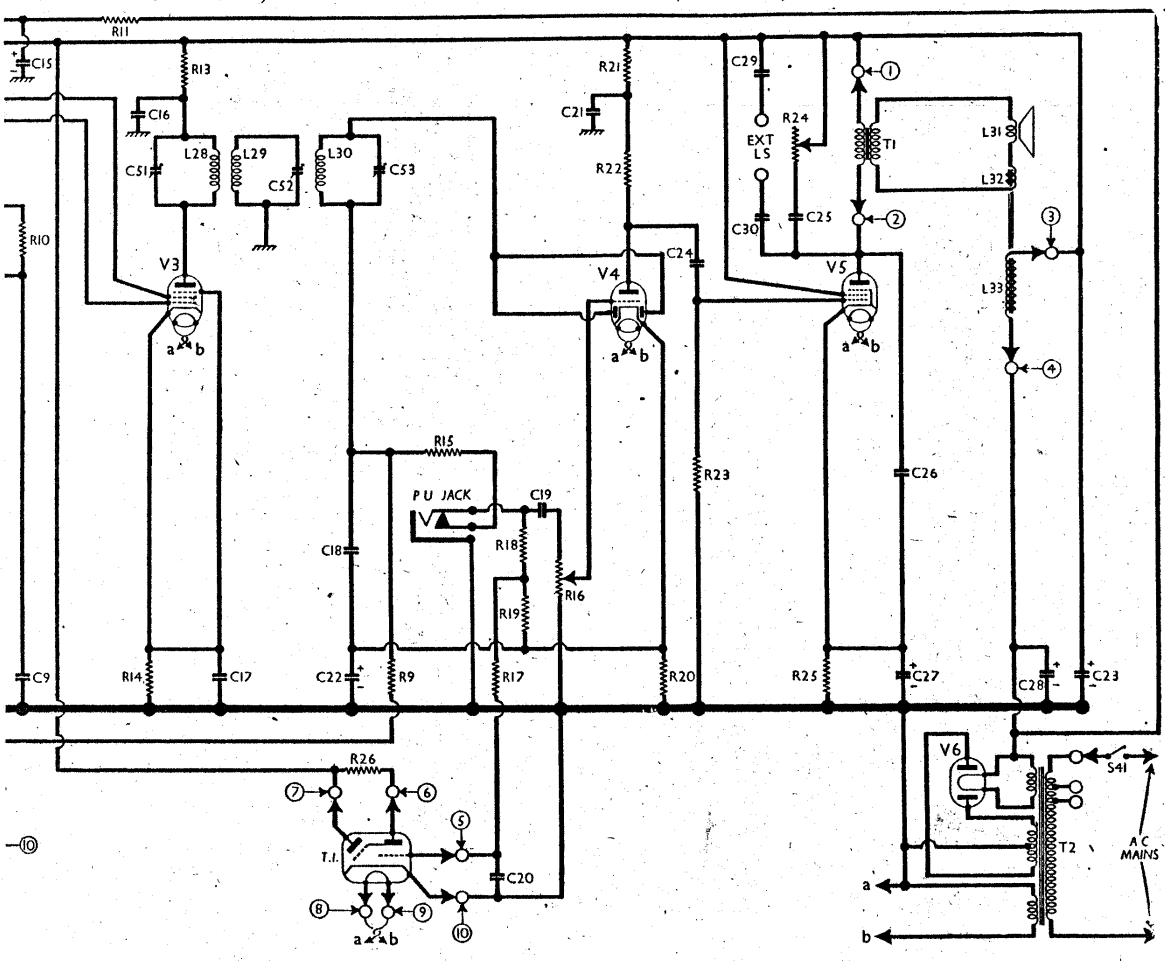
Voltages were measured on the 1,200 V scale of a Universal Avometer, chassis being the negative connection.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 6D6	260	6·5	100	1·5
V2 6A7	260	2·1	100	3·1
	Oscillator			
	180	4·7		
V3 6D6	235	5·1	100	2·0
V4 75	75	0·5	—	—
V5 42	230	37·0	260	5·9
V6 80	310†	—	—	—
T.I. 6G5	20	0·6	—	—
	Target			
	260	0·1		

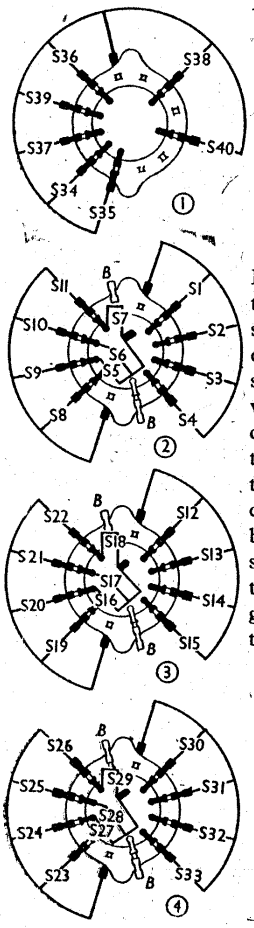
† Each anode, AC.



The Pilot U650 table model.



Circuit diagram of the Pilot U650 four-band superhet. Two short-wave bands are employed, and they are referred to as SW1 and SW2. V1 is an RF amplifier, and the IF transformers have three tuned circuits each. A high impedance external speaker may be connected to sockets which are isolated from HT by condensers **C29, C30.** The cathode ray tuning indicator **T.I.** and the internal speaker unit are connected to chassis by plugs and sockets. Diagrams of the plugs, drawn as seen when viewed from the free ends of their pins, appear beneath the circuit diagram, their pins being numbered to agree with the numbers in circles in the circuit at the points of intersection.



Diagrams of the four switch units, drawn as seen when viewed in the direction of the arrows in the under-chassis view below. The switch positions are given in the table on the right.

Switch Table

Switch	LW	MW	SW2	SW1
S1	—	—	—	C
S2	—	—	C	—
S3	—	C	—	—
S4	C	—	—	—
S5	—	—	—	C
S6	—	—	C	C
S7	—	C	—	—
S8	—	—	—	C
S9	—	—	C	—
S10	—	C	—	—
S11	C	—	—	—
S12	—	—	—	C
S13	—	—	C	—
S14	—	C	—	—
S15	C	—	—	—
S16	—	—	—	C
S17	—	—	C	C
S18	—	C	C	—
S19	—	—	—	C
S20	—	—	C	—
S21	—	C	—	—
S22	C	—	—	—
S23	—	—	—	C
S24	—	—	C	—
S25	—	C	—	—
S26	C	—	—	—
S27	—	—	—	C
S28	—	—	C	C
S29	—	C	C	—
S30	—	—	—	C
S31	—	—	C	—
S32	—	C	—	—
S33	C	—	—	—
S34	C	—	—	—
S35	—	C	—	—
S36	—	C	—	—
S37	—	—	—	C
S38	—	C	—	C
S39	—	—	C	—
S40	—	C	—	—

GENERAL NOTES

Switches.—**S1-S33** are the waveband switches, and **S34-S40** the scale lamp switches, ganged together in four rotary units beneath the chassis. These are indicated in our under-chassis view by numbers in circles and shown in detail in the diagrams in col. 1, where they are drawn as seen when viewed in the direction of the arrows in the under-chassis view.

The table (col. 2) gives the switch positions for the various control settings. The vertical columns, from left to right, indicate the control settings as the knob is turned from fully anti-clockwise.

S41 is the QMB mains switch, ganged with the tone control **R24.** A jack switch, not separately numbered, is used for connection of a pick-up.

Coils.—**L1-L24** are in the coil and switch unit, in three separately screened sections. This unit also contains the associated trimmers, indicated at the side of our plan chassis view.

The IF transformers **L25-L27** and **L28-L30** are in two separate screened units on the chassis deck. These units also contain their associated trimmers.

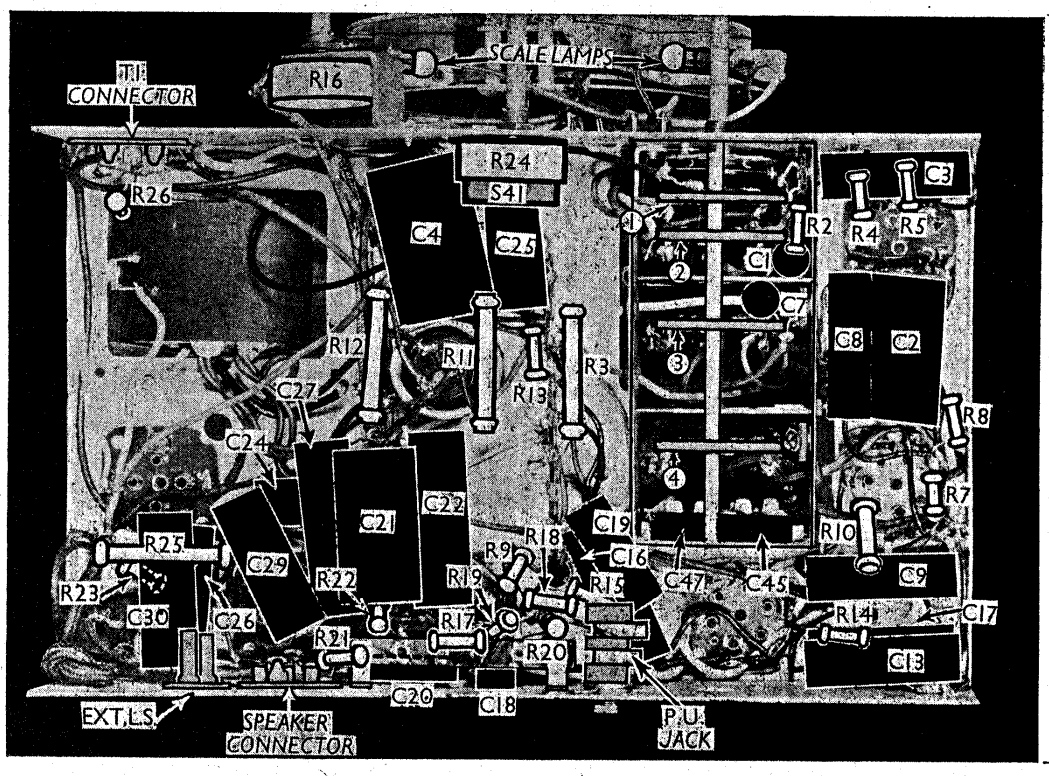
Scale Lamps.—These are American-type 6-8 V bulbs with small centre-contact bayonet caps. There are six in all, switched by **S34-S40.**

External Speaker.—Two sockets are provided at the rear of the chassis for a high impedance (7,000-10,000 Ω) external speaker. The sockets are isolated from the HT circuit by condensers **C29, C30.**

Condensers C23, C28.—These are two 8 μF dry electrolytics in a single tubular unit. The case is isolated, and the black lead is the common negative. There are two red leads for the positives, that connected to one of the heater sockets of **V6** belonging to **C28.**

Condensers C14, C15.—These are two 2 μF dry electrolytics in a tubular unit, the case being isolated. The black lead is the common negative, the green the positive of **C14** and the red of **C15.**

Condenser C54.—This small neutralising condenser is situated beneath **C40** and **C41** in the gang condenser unit. It is formed



Under-chassis view. The four switch units are indicated here, and are numbered to agree with the diagrams in col. 1 above. Immediately above the switch unit assembly, on the chassis deck, is the tuning unit. The tuning indicator and speaker connecting sockets are indicated. The pick-up jack is seen on the rear chassis member.

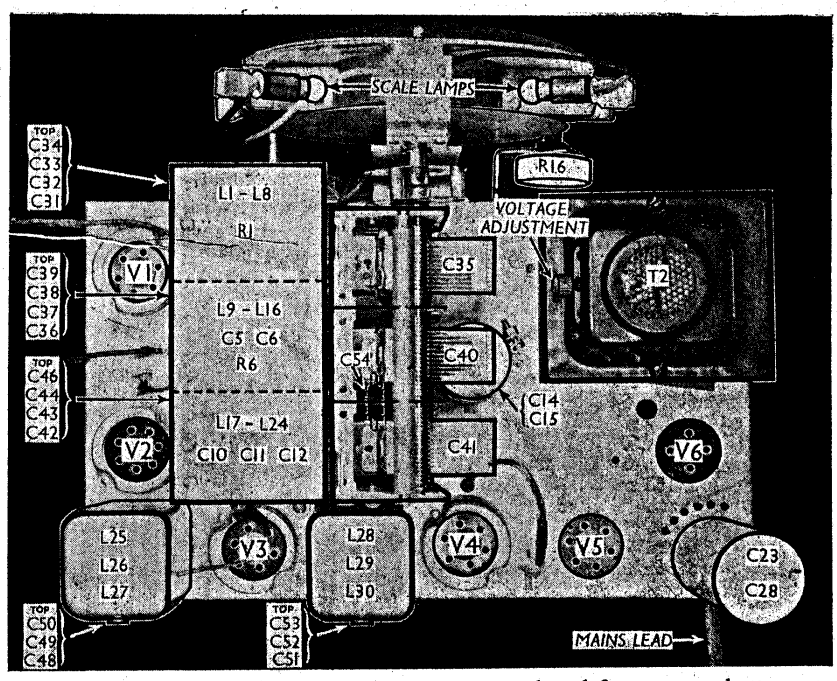
of the capacity between two tags riveted to a strip of insulating material.

COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	Aerial LW coupling shunt	50,000
R2	V1 CG decoupling ...	100,000
R3	V1 and V3 SG's HT potential divider ...	30,000
R4		40,000
R5	V1 fixed GB resistance ...	400
R6	RF trans. LW sec. damping	250
R7	V2 fixed GB resistance ...	400
R8	V2 osc. CG resistance ...	50,000
R9	AVC line decoupling ...	1,000,000
R10	V2 SG HT feed	30,000
R11	V2 osc. anode and SG decoupling ...	10,000
R12		10,000
R13	V3 anode decoupling ...	4,000
R14	V3 GB resistance... ...	600
R15	IF stopper	50,000
R16	Manual volume control ...	1,000,000
R17	T.I. feed decoupling ...	1,000,000
R18	V4 diode load	100,000
R19		200,000
R20	V4 GB resistance... ...	2,000
R21	V4 anode decoupling ...	100,000
R22	V4 anode load	250,000
R23	V5 CG resistance... ...	500,000
R24	Variable tone control ...	100,000
R25	V5 GB resistance... ...	410
R26	T.I. anode HT feed ...	1,000,000

	CONDENSERS	Values (μF)
C1	V1 CG decoupling ...	0·05
C2	V1, V3 SG's decoupling...	0·1
C3	V1 cathode by-pass ...	0·1
C4	V1 anode decoupling ...	0·25
C5	LW RF trans. pri. shunt	0·00025
C6	SW1 RF trans. top coupling	0·00001
C7	V2 pentode CG decoupling	0·05
C8	V2 cathode by-pass ...	0·1
C9	V2 SG by-pass ...	0·05
C10	V2 osc. CG condenser ...	0·00005
C11	Osc. circ. SW1 tracker ...	0·00287
C12	Osc. circ. SW2 tracker ...	0·00137
C13	V1 osc. anode and SG decoupling	0·05
C14*		2·0
C15*		2·0
C16	V3 anode decoupling ...	0·05
C17	V3 cathode by-pass ...	0·1
C18	IF by-pass	0·00025
C19	Coupling to V4 triode ...	0·01
C20	T.I. feed decoupling ...	0·05
C21	V4 triode anode decoupling	0·1
C22*	V4 cathode by-pass ...	10·0
C23*	HT smoothing	8·0
C24	V4 triode to V5 coupling	0·01
C25	Part variable tone control	0.05
C26	Fixed tone corrector ...	0·005
C27*	V5 cathode by-pass ...	10·0
C28*	HT smoothing	8·0
C29	Ext. LS coupling	0·05
C30		0·05
C31‡	Aerial SW1 trimmer ...	—
C32‡	Aerial SW2 trimmer ...	—
C33‡	Aerial MW trimmer ...	—
C34‡	Aerial LW trimmer ...	—
C35†	Aerial circuit tuning ...	0·00045
C36‡	RF trans. sec. SW1 trimmer	—
C37‡	RF trans. sec. SW2 trimmer	—
C38‡	RF trans. sec. MW trimmer	—
C39‡	RF trans. sec. LW trimmer	—
C40†	RF trans. sec. tuning ...	0·00045
C41†	Oscillator circuit tuning	0·00045
C42‡	Osc. circuit SW1 trimmer	—
C43‡	Osc. circuit SW2 trimmer	—
C44‡	Osc. circuit MW trimmer	—
C45‡	Osc. circ. MW tracker ...	0·0005
C46‡	Osc. circuit LW trimmer	—
C47‡	Osc. circ. LW tracker ...	0·00015
C48‡	1st IF trans. pri. tuning	—
C49‡	Absorption coil tuning ...	—
C50‡	1st IF trans. sec. tuning	—
C51‡	2nd IF trans. pri. tuning	—
C52‡	Absorption coil tuning ...	—
C53‡	2nd IF trans. sec. tuning	—
C54	Neutralising condenser...	Very low

* Electrolytic. † Variable. ‡ Pre-set.



Plan view of the chassis. The trimmers are numbered from top to bottom in the same order as they occupy in their units.

	OTHER COMPONENTS	Approx. Values (ohms)
L1	Aerial SW1 coupling coil	1·0
L2	Aerial SW1 tuning coil ...	0·05
L3	Aerial SW2 coupling coil	3·0
L4	Aerial SW2 tuning coil ...	0·8
L5	Aerial MW coupling coil	19·5
L6	Aerial MW tuning coil ...	3·0
L7	Aerial LW coupling coil	115·0
L8	Aerial LW tuning coil ...	18·0
L9	RF trans. SW1 pri. ...	3·5
L10	RF trans. SW1 sec. ...	0·05
L11	RF trans. SW2 pri. ...	10·0
L12	RF trans. SW2 sec. ...	0·8
L13	RF trans. MW pri. ...	90·0
L14	RF trans. MW sec. ...	2·6
L15	RF trans. LW pri. ...	120·0
L16	RF trans. LW sec. ...	18·0
L17	Osc. SW1 tuning coil ...	0·05
L18	Osc. SW1 reaction coil ...	0·6
L19	Osc. SW2 tuning coil ...	0·7
L20	Osc. SW2 reaction coil ...	1·3
L21	Osc. MW tuning coil ...	5·5
L22	Osc. MW reaction coil ...	2·0
L23	Osc. LW tuning coil ...	14·0
L24	Osc. LW reaction coil ...	3·7
L25	1st IF trans. Pri. coil...	8·3
L26	1st IF trans. Absorption coil ...	8·5
L27	1st IF trans. Sec. coil...	13·0
L28	2nd IF trans. Pri. coil...	12·2
L29	2nd IF trans. Absorption coil ...	8·5
L30	2nd IF trans. Sec. coil...	8·5
L31	Speaker speech coil ...	1·7
L32	Hum neutralising coil ...	0·2
L33	Speaker field coil ...	1,400·0
T1	Speaker input trans. Pri. ...	750·0
	Speaker input trans. Sec. ...	0·3
—	Mains trans. Pri., total ...	17·5
T2	Mains trans. Heat. sec. ...	0·1
	Mains trans. Rect. heat. sec.	0·05
	Mains trans. HT sec., total...	330·0
S1-33	Waveband switches ...	—
S34-40	Scale lamp switches ...	—
S41	Mains switch, ganged R24	—

CIRCUIT ALIGNMENT

IF Stages.—Switch set to MW and turn gang to maximum. Connect signal generator between top cap of **V3** via a 0.1 μF condenser and chassis. Feed in a 456 KC/S signal, and adjust **C53, C52** and **C51** for maximum output. Transfer the signal generator high potential lead (via the condenser) to the top cap of **V2** and adjust **C50, C49** and **C48** for maximum output. Keep the input low in all cases. Finally, repeat these adjustments.

RF and Oscillator Stages.—Transfer signal generator leads, via a suitable dummy aerial in each case, to **A** and **E** leads. For MW and LW, a 0.0002 μF condenser may be used as a dummy aerial, and for the SW bands, a 400 O resistance may be used. The operations should follow the sequence given below.

MW.—Switch set to MW and tune to 1,500 KC/S on scale. Feed in a 1,500 KC/S (200 m) signal, and adjust **C44** for maximum output. Next adjust **C38,** and then **C33,** for maximum output. Feed in a 600 KC/S (500 m) signal, tune the signal in, and adjust **C45** for maximum output while rocking the gang for optimum results.

SW2.—Switch set to SW2, tune to 49 m on scale, feed in a 49 m (6.13 MC/S) signal, and adjust **C43,** then **C37** and **C32,** for maximum output. Tracking is fixed, but the calibration should be checked.

SW1.—Switch set to SW1, tune to 16.6 m on scale, feed in a 16.6 m (18 MC/S) signal, and adjust **C42** for maximum output. Then adjust **C36** for maximum output while rocking the gang for optimum results; and finally, adjust **C31** for maximum output at 16.6 m. The calibration should again be checked at several points on the scale.

LW.—Switch set to LW, tune to 750 m on scale, feed in a 750 m (400 KC/S) signal, and adjust **C46,** then **C39** and **C34** for maximum output. Feed in a 2,000 m (150 KC/S) signal, tune it in, and adjust **C47** for maximum output while rocking the gang for optimum results.

Printed in Great Britain by The Cornwall Press Ltd., Paris Garden, London, S.E.1