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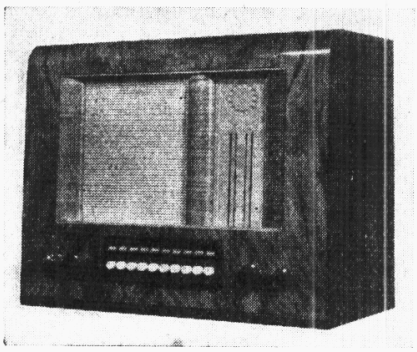
"TRADER" SERVICE SHEET

428

BUSH PB63, SUG64, RG64 AND RG64G



The Bush PB63 Table Receiver.

THE Bush PB63 includes press-button tuning for six stations, employing trimmers for the aerial circuit and permeability tuning for the oscillator circuit, and press-buttons for manual wave-changing and gram. The receiver is a 5-valve (plus rectifier) AC 3-band superhet with a short-wave range of 16·5-51m and is suitable for mains of 200-250 V, 40-100 C/S.

A very similar chassis is fitted in the SUG64 console and the differences are explained under "Model SUG64 Modifications," while the chassis of the RG64 and RG64G radiograms and record changing radiograms are also very similar, the differences being explained under "Models RG64, RG64G and RG64G Auto."

This *Service Sheet* was prepared on a PB63.

Release Dates: PB63, May, 1939; *SUG64, June,* 1939; *RG64, RG64G and RG64G Auto, July,* 1939.

CIRCUIT DESCRIPTION

The aerial circuit coupling coils are permanently connected as shown in the diagram, no switches being used for waveband changing; there are three aerial sockets: **A1** (direct); **A2** (via filter circuit **L1, C1, C2**); **A3** (via series condenser **C3**).

On SW, input from **A1** is via condenser **C4** and coupling coil **L2** to single-tuned circuit **L5, C44,** manual tuning only being employed on this band.

MW coupling coil **L3,** and LW coupling coil **L4** with its shunt **C5,** are connected in series with each other across the aerial circuit in parallel with **C4, L2,** and couple the aerial to single-tuned circuits **L6, C44** (MW manual) and **L7, C44** (LW manual).

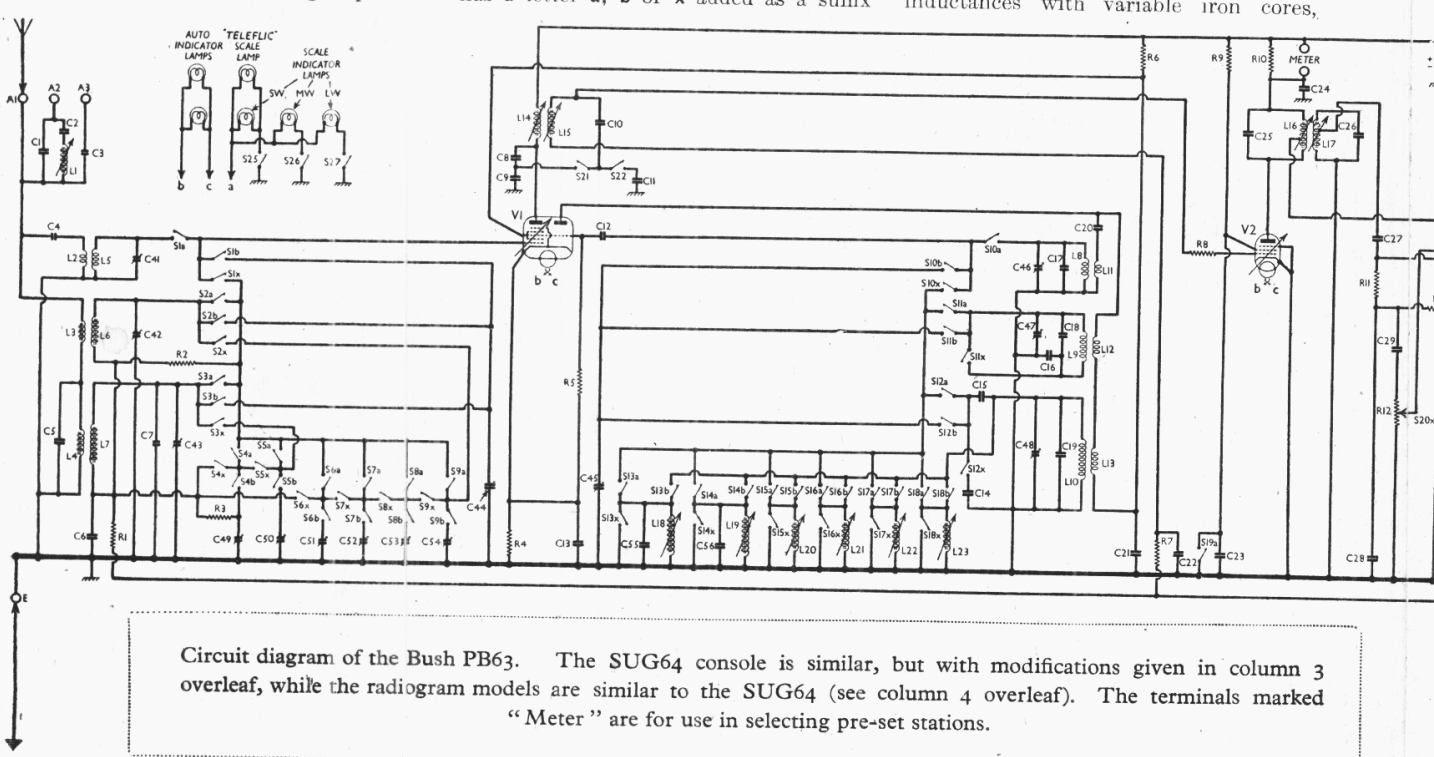
Waveband switching for manual tuning in this receiver is effected by press-button switches similar to those used for the automatic tuning. These switches are arranged in groups of three and in the diagram each group has been given a number, while each arm of each group has a letter **a, b** or **x** added as a suffix to its number, so that the SW group is numbered **S1a, S1b** and **S1x,** the MW group **S2a, S2b** and **S2x** and so on throughout the waveband and automatic switching.

This method of numbering makes the action of the switches quite clear from a study of the diagram: if a button is depressed the "**a's**" and "**b's**" associated with that button close, while the "**x's**" open, and when the button is released the converse is the case.

When an automatic tuning button is depressed, **S1x, S2x** and **S3x** are closed, connecting **V1** CG, **L6** and **L7** to the automatic selector switches. At the same time the appropriate trimmer is connected to **L6** or **L7,** according to which button is depressed.

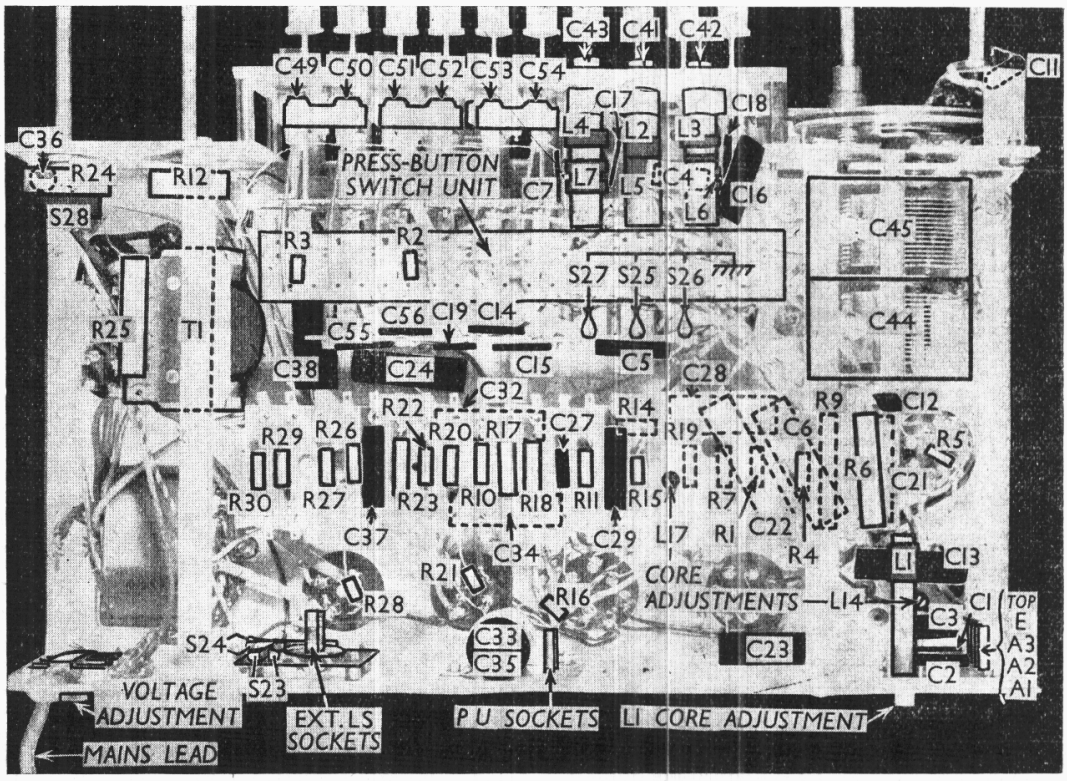
First valve **(V1, Mullard metallised TH4B)** is a triode heptode operating as frequency changer with internal coupling. Triode oscillator grid coils (manual tuning only) **L8** (SW), **L9** (MW) and **L10** (LW) are tuned by **C45**; parallel trimming by **C17, C46** (SW), **C18, C47** (MW) and **C19, C48** (LW); series tracking by **C16** (MW) and **C15** (LW). Reaction by coils **L11** via coupling condenser **C20** (SW), **L12** and **L13** (MW and LW).

The LW oscillator circuit, slightly modified by switching, operates also as master oscillator for automatic tuning, the tuning trimmers in this case being inductances with variable iron cores,

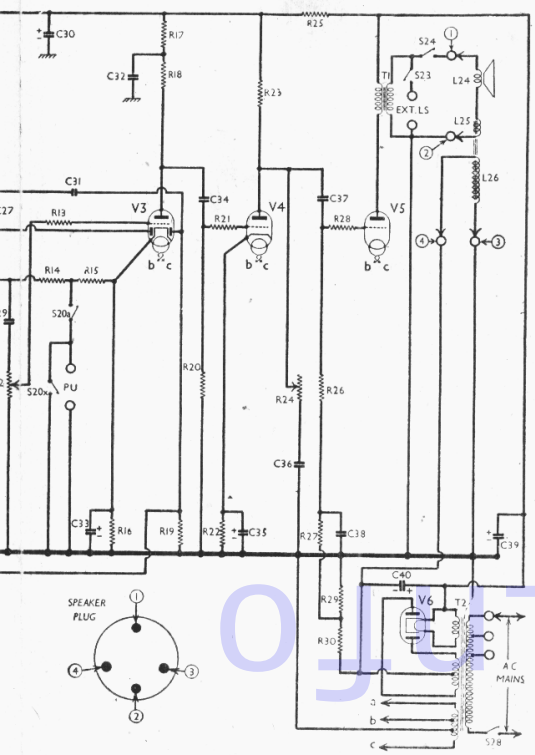


Circuit diagram of the Bush PB63. The SUG64 console is similar, but with modifications given in column 3 overleaf, while the radiogram models are similar to the SUG64 (see column 4 overleaf). The terminals marked "Meter" are for use in selecting pre-set stations.

Under-chassis view. Both sides of the press-button switch unit are shown in columns 4 and 5 overleaf. **S25-S27** are scale lamp switches, associated with the press-button unit. Note the core adjustments of **L14** and **L17**, and the speaker switches **S23,S24.**



connected in turn across the master oscillator tuning coil **L10** according to which button is depressed. The modification is that, as the button controlling **S12** switches is now in the "Out" position, the LW manual tracker **C15** becomes connected in series with **C14** across the master oscillator circuit, the two together forming an additional trimmer.



Second valve **(V2, Mullard metallised VP4B)** is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary iron-cored transformer couplings **C8, C9, L14, L15, C10, C11** and **C25, L16, L17, C26.**

In the normal (1) position of the variable selectivity control, **S22** is closed; when the control is turned to position 2, **S22** opens and **S21** closes, so that **C9** is common to primary and secondary coils, and closer coupling is secured.

Provision is made for connection of a voltmeter across anode feed resistance **R10** for automatic circuit station setting as explained under "General Notes."

Intermediate frequency 465KC/S.

Diode second detector is part of double-diode triode valve **(V3, Mullard metallised TDD4)**, and is parallel-fed via **C27** from tapping on **L17.** Audio frequency component in rectified output is developed across resistances **R14, R15,** and passed via AF coupling condenser **C29,** manual volume control **R12** and grid stopper **R13** to CG of triode section which operates as AF amplifier. IF filtering by **R11, C28.**

Provision for connection of gramophone pick-up, via **S20a,** between the junction of **R14** and **R15,** and chassis. When the gram button is depressed, **S19a** and **S20a** close.

Second diode of **V3,** fed from tapping on **L16** via **C31,** provides DC potential which is developed across load resistance **R19** and fed back through decoupling circuits as GB to FC (except on SW) and IF valves, giving AVC. Delay voltage is obtained from **R16.**

Resistance-capacity coupling by **R18, C34** and **R20** between **V3** triode and triode AF amplifying valve **(V4, Mullard metallised 354V).** Bass-boosting is achieved in **V3** triode anode circuit by suitable arrangement of values: **C32** is 0·1, and its by-passing effect is progressively less noticeable as the frequency falls. Variable tone control by **R24, C36** in **V4** anode circuit.

Resistance-capacity coupling by **R23, C37, R36** between **V4** and triode output valve **(V5, Mullard AC044** or **Cossor 4XP).** Provision for connection of low impedance external speaker across secondary of **T1.** Switches **S23, S24,** which are operated by the Ext. LS sockets, permit either or both of the speakers to be operated.

HT current is supplied by IHC full-wave rectifying valve **(V6, Cossor 431U).** Smoothing by speaker field **L26** (in negative HT lead) and dry electrolytic condensers **C39, C40.** GB for **V5** is obtained from potential divider **R29, R30** across **L26.**

DISMANTLING THE SET

Removing Chassis.—Remove the four control knobs (recessed grub screws), withdraw the speaker plug from its socket on the chassis deck, and remove the two round-head wood screws from the top of the scale assembly.

Now remove the four bolts (with claw washers) holding the chassis to the bottom of the cabinet, when the chassis can be withdrawn. *When replacing,* do not forget to replace the felt washers on the control spindles.

Removing Speaker.—Free the leads from the cleat on the side of the cabinet, withdraw the speaker connecting plug from its socket on the chassis deck, and remove the nuts and washers from

the four bolts holding it to the sub-baffle. *When replacing*, see that the connecting tags are at the top.

COMPONENTS AND VALUES

	RESISTANCES	Values (ohms)
R1	V1 heptode CG decoupling	1,000,000
R2	V1 heptode CG resistance	5,000,000
R3	Aerial LW auto damping	50,000
R4	V1 fixed GB resistance	100
R5	VI osc. CG resistance	30,000
R6	V1 osc. anode & SG HT feed	20,000
R7	V2 CG decoupling	2,000,000
R8	V2 CG stabiliser	50
R9	V2 SG HT feed resistance	100,000
R10	V2 anode HT feed resistance	10,000
R11	IF stopper	250,000
R12	Manual volume control	500,000
R13	V3 triode grid stopper	100,000
R14	V3 signal diode load resistances	250,000
R15		250,000
R16	V3 triode GB; AVC delay	1,000
R17	V3 triode anode decoupling	50,000
R18	V3 triode anode load	5,000
R19	V3 AVC diode load	1,000,000
R20	V4 CG resistance	500,000
R21	V4 grid stopper	100,000
R22	V4 GB resistance	2,000
R23	V4 anode load resistance	50,000
R24	Variable tone control	250,000
R25	V1, V2, V3, V4 HT feed	4,000
R26	V5 CG resistance	250,000
R27	V5 CG decoupling	500,000
R28	V5 grid stopper	10,000
R29	V5 automatic GB potential divider	100,000
R30		100,000

	CONDENSERS	Values (μF)
C1	A2 filter tuning condensers	0·00045
C2		0·001
C3	A3 series condenser	0·00005
C4	Aerial SW coupling	0·00005
C5	Aerial LW circuit shunt	0·0008
C6	V1 heptode CG decoupling	0·5
C7	Aerial LW fixed trimmer	0·00003
C8	1st IF transformer fixed tuning condensers	0·00015
C9		0·003
C10		0·00015
C11		0·003
C12	V1 osc. CG condenser	0·00003
C13	V1 Cathode by-pass	0·05
C14	Part auto osc. trimmer	0·00034
C15	Osc. LW tracker (manual); part osc. trimmer (auto)	0·000316
C16	Osc. circuit MW tracker	0·000556
C17	Osc. circ. SW fixed trimmer	0·000015
C18	Osc. circ. MW fixed trimmer	0·00001
C19	Osc. circ. LW fixed trimmer	0·00013
C20	V1 osc. anode SW coupling	0·00005
C21	V1 osc. anode and SG decoupling	0·05
C22	V2 CG decoupling	0·05
C23	V2 SG decoupling	0·05
C24	V2 anode decoupling	0·05
C25	2nd IF transformer fixed tuning condensers	0.00015
C26		0·00016
C27	Coupling to V3 signal diode	0·0001
C28	IF by-pass condenser	0·0001
C29	AF coupling to V3 triode	0.005
C30*	V1, V2, V3, V4 HT decoupling	8·0
C31	Coupling to V3 AVC diode	0·00005
C32	V3 anode decoupling	0·1
C33*	V3 cathode by-pass	50·0
C34	V3 triode to V4 AF coupling	0·01
C35*	V4 cathode by-pass	50·0
C36	Part of variable tone control	0·03
C37	V4 to V5 AF coupling	0·01
C38	V5 CG decoupling	0·5
C39*	HT smoothing condensers	16·0
C40*		8·0
C41‡	Aerial circuit SW trimmer	0·00001
C42‡	Aerial circuit MW trimmer	0·00001
C43‡	Aerial circuit LW trimmer	0·00001
C44†	Aerial circuit manual tuning	—
C45†	Osc. circuit manual tuning	—
C46‡	Osc. circuit SW trimmer	0·00001
C47‡	Osc. circuit MW trimmer	0·00001
C48‡	Osc. circuit LW trimmer	0·00001
C49‡	Aerial circuit LW automatic tuning trimmers	0·00045
C50‡		0·00045
C51‡		0·00045
C52‡	Aerial circuit MW automatic tuning trimmers	0·00045
C53‡		0,00015
C54‡		0·00015
C55‡	Oscillator circuit automatic tuning trimmers	0,000316
C56‡		0,000316

* Electrolytic. † Variable. ‡ Pre-set.

	OTHER COMPONENTS	Approx. values (ohms)
L1	Aerial filter coil	2·9
L2	Aerial SW coupling coil	0·1
L3	Aerial MW coupling coil	0·6
L4	Aerial LW coupling coil	30·0
L5	Aerial SW tuning coil	0·05
L6	Aerial MW tuning coil	1·3
L7	Aerial LW tuning coil	14·0
L8	Osc. circuit SW tuning coil	0·1
L9	Osc. circuit MW tuning coil	1·6
L10	Osc. circuit LW tuning coil	3·0
L11	Oscillator SW reaction	0·2
L12	Oscillator MW reaction	1·1
L13	Oscillator LW reaction	2·2
L14	1st IF trans. Pri.	4·0
L15	1st IF trans. Sec.	4·0
L16	2nd IF trans. Pri.	4·0
L17	2nd IF trans. Sec.	4·0
L18	Oscillator circuit LW automatic tuning coils	2·0
L19		2·0
L20		1·4
L21	Oscillator circuit MW automatic tuning coils	1·2
L22		1·0
L23		0·7
L24	Speaker speech coil	2·8
L25	Hum neutralising coil	0·5
L26	Speaker field coil	600·0
T1	Speaker input trans. Pri.	250·0
	Speaker input trans. Sec.	0·8
T2	Mains trans. Pri., total	21.0
	Mains trans. Heater sec., total	0,25
	Mains trans. Rect. heat. sec.	0.1
	Mains trans. HT sec., total	650.0
S1a, b, x to S3a, b, x	Aerial circ. waveband and manual/auto switches	—
S10a,b,xto S12a, b, x	Osc. circuit waveband and manual/auto switches	—
S4a, b, x to S9a, b, x	Aerial circuit auto tuning trimmer selector switches	—
S13a,b,xto S18a b, x	Oscillator circuit auto tuning coil selector switches	—
S19a S20a, x	Radio/gram change switches	—
S21, S22	Variable selectivity switches	—
S23	Ext. L.S. switch	—
S24	Internal LS switch	—
S25-S27	Scale lamps switches	—
S28	Mains switch, ganged R24	—

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 235 V, using the 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.

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

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 TH4B	240	2·3	72	1·7
	Oscillator			
	75	8·5		
V2 VP4B	180	4·7	82	1·6
V3 TDD4	100	2·3	—	—
V4 354V	135	1·7	—	—
V5 ACO44	312	4·6	—	—
V6 43IU	370†	—	—	—

†Each anode AC

GENERAL NOTES

Switches.—There are ten press-buttons, and each one controls three 2-pole shorting switches, three on each side of the unit. In our circuit diagram and other illustrations the switches are grouped in threes, so that in this way each button controls two numbered groups of three, the individual switches in each group being indicated by suffix letters **a**, **b** and **x**, following the group number.

The arrangement and operation of the switches is fully explained near the beginning of the Circuit Description, and it should be noted that when a button is "out," the associated **a** and **b** switches are *open*, and the **x** switches *closed*. When a button is "in," its **a** and **b** switches are *closed* and its **x** switches are *open*.

Numbering the buttons from left to right looking at the front of the receiver, the first six buttons control pre-set stations, the seventh is the LW button, the eighth the SW, the ninth the MW, and the tenth, on the right, gram.

In addition to the actual press-button switches, there are three scale lamp switches, **S25-S27,** controlled by the three wavechange buttons. They are shown in our under-chassis view.

S21, S22 are the variable selectivity switches, in a unit on the right at the front of the chassis.

S23, S24.—These are the speaker switches, mounted on the ext. LS panel at the rear of the chassis. A special extension speaker plug is provided which, when inserted in the sockets, operates as a switch control. Except when the internal speaker is switched on, the plug cannot be withdrawn.

S28 is the QMB mains switch, ganged with the tone control **R24.**

Coils.—All the coils, with the exception of **L1** and the IF transformers, are on unscreened tubular formers, built into a unit, together with the press-button switches and the various trimmers. **L2, L5; L8, L11; L9, L12; L10, L13; L8, L11** and **L9, L12** are air-cored. **L3, L6** and **L4, L7** have fixed iron-dust cores, while **L18-L23** have adjustable iron-dust cores for permeability trimming of the oscillator circuits of the six pre-set station buttons.

The IF transformers **L14, L15** and **L16, L17** are in two screened units on the chassis deck. They have adjustable iron cores, and the adjustment screws protrude above and below the cans. The screws are indicated in our chassis illustrations.

L1, with its associated fixed condensers, forms a local station rejector. Its frequency is determined by the locality, and the iron core is adjusted by the dealer upon installation.

Scale and Indicator Lamps.—Two lamps are employed to illuminate the press-button labels. They are connected to tappings **b** and **c** on **T2** heater secondary.

Three more lamps illuminate the waveband scales, and a further one the "Teleflic" dial. These are connected to tapping **a** and chassis.

All the lamps have round bulbs, MES bases, and are rated at 6·2V, 0·3A.

External Speaker.—Two sockets are provided at the rear of the chassis for a low impedance (2·5 O) external speaker. See also under "Switches."

Speaker Plug.—The speaker is connected to the chassis via leads which terminate at a 4-pin plug. A diagram of the plug, looking at the free ends of the pins, is shown beneath the circuit diagram, and the numbers in circles in the diagram correspond with those on the plug.

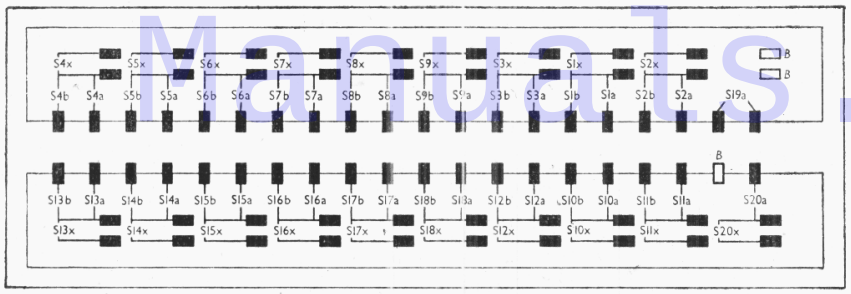
The colours of the four leads are as follows: 1, brown; 2, green; 3, black; 4, blue.

Meter Tags.—Two tags are fitted on an insulating strip at the rear of the chassis deck. They are provided to permit a voltmeter to be connected across **R10,** which serves as an indicator when setting the station selector buttons.

Condensers C30, C39.—These are two dry electrolytics in a single carton on the chassis deck, having a common negative (black) lead. The red lead is the positive of **C39** (16μF), and the yellow lead is the positive of **C40** (8μF). The voltage rating is 550V (peak).

MODEL SUG64 MODIFICATIONS

The SUG64 console has a very nearly similar chassis, with the following differences: A 0·0003μF condenser is connected between the top and slider of **R12; R18** becomes 10,000 O; the ext. LS sockets and **S23, S24** are fitted to the back of the cabinet, instead of the rear of the chassis, via a plug and socket device; the "Teleflic" dial is not fitted, but a filter circuit is connected across **T1** primary winding.



Diagrams of the press-button switch unit. The upper one is as seen looking from the rear of the underside of the chassis, while the lower one shows the reverse side as seen looking from the front of the chassis after the tuning unit has been partially withdrawn.

MODELS RG64, RG64G AND RG64G AUTO

These are similar to the SUG64, except that RG64 is a radiogram; RG64G is the same, but the speaker is replaced by a Rola model G12; while RG64G Auto is the RG64G with automatic record-changer.

ALIGNMENT OF MANUAL CIRCUITS

IF Stages.—Press MW manual tuning button, tune to 300 m on the scale, turn volume control to maximum, variable selectivity to "Normal" (1), and tone control to "low." A damping circuit consisting of a 30,000 Ω resistor in series with a 0·05μF condenser must be used where indicated below.

Connect signal generator between control grid (top cap) of **V2** and chassis, and feed in a 465 KC/S signal. Connect damping circuit between anode of **V2** and chassis, and adjust core of **L17** for maximum output. Connect damping between **V3** signal diode (pin 1) and chassis, and adjust core of **L16** for maximum output.

Connect signal generator between control grid (top cap) of **V1** and chassis, connect damping between anode of **V1** and chassis, and adjust core of **L15** for maximum output. Connect damping circuit between control grid (top cap) of **V2** and chassis, and adjust core of **L14** for maximum output.

RF and Oscillator Circuits.—With gang at maximum, indicator should be opposite wording "Vatican City" at top of SW scale. Remove the escutcheon plate from front of cabinet if chassis has not been removed. Turn volume control to maximum, and tone control to "low." Connect signal generator to A1 and E sockets.

SW.—Press SW button, and tune to 18 m on scale. Feed in an 18 m (16·67 MC/S) signal and adjust **C46** (above SW button) and **C41** (below SW button) for maximum output. Check calibration at 50 m.

MW.—Press MW button, and tune to 300 m on scale. Feed in a 300 m (1,000 KC/S) signal, and adjust **C47** (above MW button) and **C42** (below MW button) for maximum output. Check calibration at 500 m.

LW.—Press LW button, and tune to 1,500 m on scale. Feed in a 1,500 m (200 KC/S) signal, and adjust **C48** (above LW button) and **C43** (below LW button) for maximum output. Check calibration at 1,900 m.

PRE-SET STATION SELECTION

Stations can be selected by buttons 1 to 6, numbering from the left. The wavelength ranges covered by each button are: 1 and 2, 1,200-2,000 m; 3 and 4, 325-550 m; 5 and 6, 200-350 m.

To select a station accurately, it is advisable to use a DC voltmeter (0-60 V), connected across the two tags at the rear of the chassis as an indicator. Adjustments should always be made for *minimum* reading on the meter.

If the chassis is still in the cabinet, remove the escutcheon of the press button unit (two instrument-head screws).

Connect the aerial and earth to the receiver and press the button to be used for the desired station. Turn the core adjustment for the associated oscillator coil (above the button) until the index mark is at the approximate wavelength on the small calibrated scale. Then carefully turn the adjustment until the loudest output from the desired station (*minimum* voltmeter reading) is obtained.

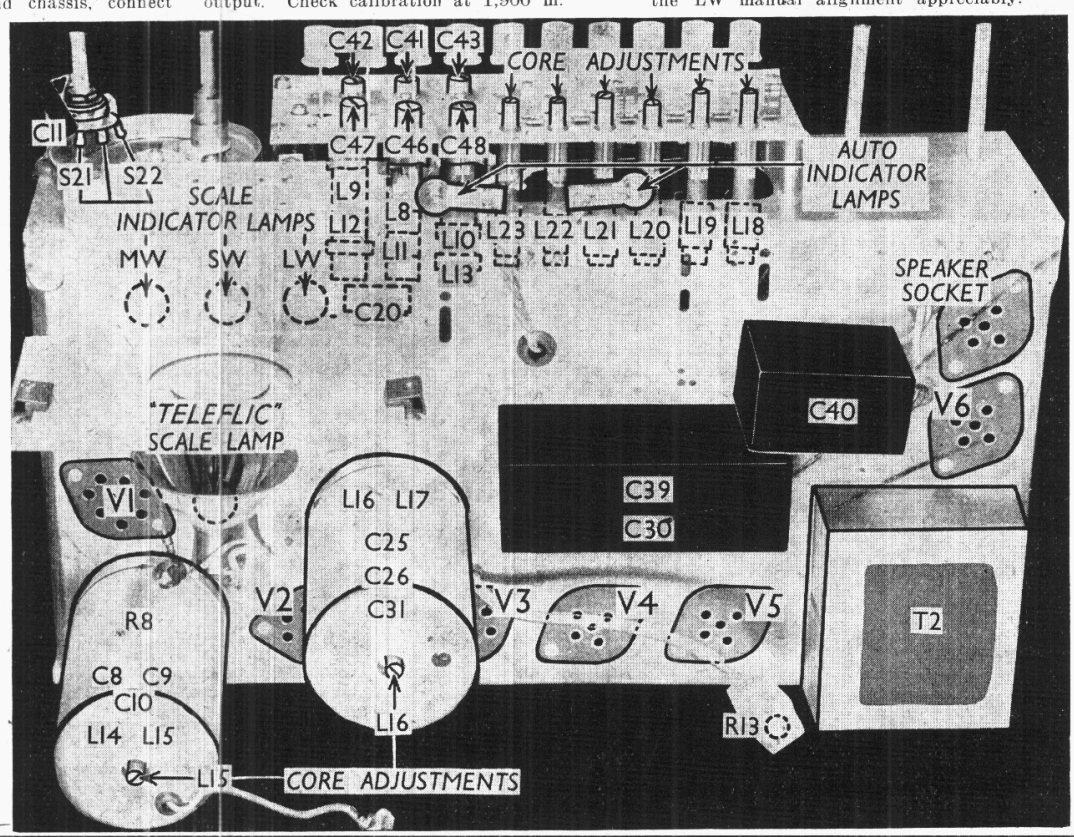
Adjust the associated aerial circuit trimmer (below the button) for maximum output (*minimum* voltmeter reading).

Re-adjust both trimmers carefully as a final check.

NOTE.—Any adjustment of the manual tuning trimmer **C48** will affect the tuning of the pre-selected stations. After manual circuit alignment, therefore, the cores of **L18** to **L23** must be re-adjusted.

Any adjustment of the MW manual tuning aerial trimmer **C42** will necessitate readjustment of the MW pre-set station trimmers. Similarly any adjustment of the LW manual tuning aerial trimmer **C43** will affect the setting of **C49** and **C50**.

If a new TH4B valve has to be fitted, it may be found necessary to re-adjust the pre-set oscillator circuits. The best way to do this is to use the LW manual trimmer **C48** for correction purposes. Press the sixth button, which controls a station near the bottom of the MW band, and adjust **C48** until this station is at its maximum volume. When this is so, all the other pre-selected stations will be correct. The slight adjustment of **C48** which is necessary will not affect the LW manual alignment appreciably.



Plan view of the chassis. **S21** and **S22** are variable selectivity switches. All the core adjustments (except those for **L1**, **L14** and **L17** beneath the chassis) are indicated. Note that each IF coil can contains certain additional components. **R13** is inside the top cap connector of **V3**.

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