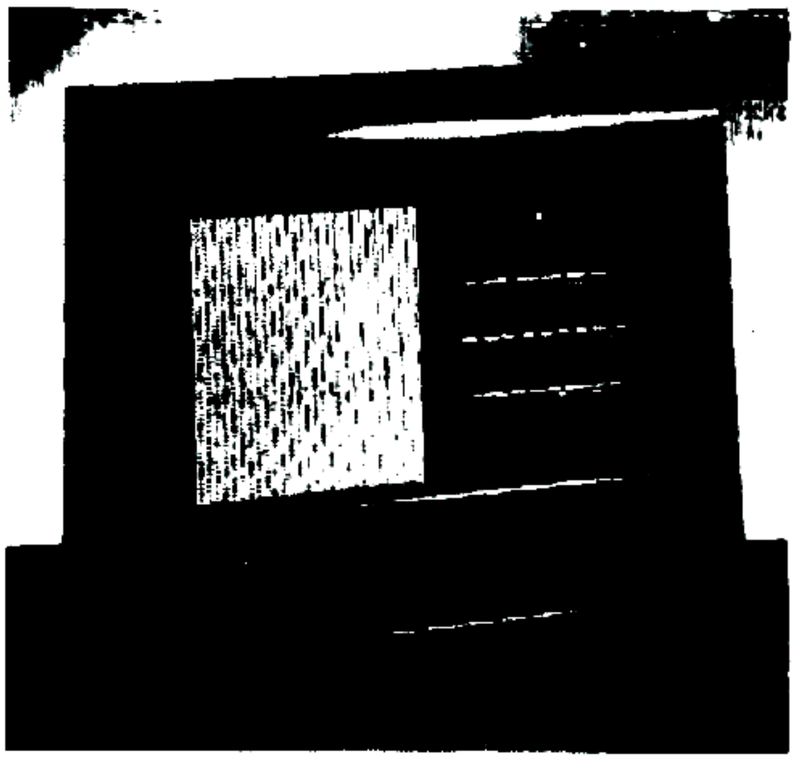
BUSH AC31



THE use of the frequency changer oscillator as a pick-up pre-amplifier, and the inclusion of a delayed A.G.C. system, are features of the Bush AC31 receiver, a 3-valve (plus rectifier) 3-band superhet designed to operate from A.C. mains of 100-250 V, 40-100 c/s. A companion model designed for A.C./D.C. mains operation is covered in *Service Sheet* 1067. The waveband ranges are 14.3-35.5 m, 176-575 m and 1,000-2,000 m.

Release date and original price: April 1952. £16 1s 2d, *plus purchase tax.*

CIRCUIT DESCRIPTION

Aerial input via coupling coils **L1** (S.W.) and **L2** (L.W.) to single-tuned circuits **L3, C27** (S.W.), **L4, C27** (M.W.) and **L5, C27** (L.W.). These precede triode hexode valve **(V1, Mullard ECH42)** which operates as frequency changer with internal coupling. Aerial coupling on M.W. is via a tapping on the tuning coil **L4.**

Oscillator grid coils **L6** (S.W.), **L7** (M.W.) and **L8** (L.W.) are tuned by **C26.** Parallel trimming by **C29** (S.W.), **C30** (M.W.) and **C10, C12** (L.W.); series tracking by **C9** (M.W.) and **C11** (L.W.), although tracking adjustments are made by iron-dust cores. Reaction coupling is via **L9** on S.W. and **L10** on M.W., but on L.W. it is derived from the common impedance of **C11.**

Second valve **(V2, Mullard EBF80)** is a variable-mu R.F. pentode with two diodes. The

(*Continued col.* 1 *overleaf*)

COMPONENTS AND VALUES

	CAPACITORS	Values	Locations
C1	L.W. aerial shunt	600pF	G4
C2	L.W. aerial trim	85pF	G1
C3	V1 C.G.	100pF	F4
C4	1st I.F. trans. tuning	110pF	A2
C5	1st I.F. trans. tuning	110pF	A2
C6	P.U. tone corrector	0·002μF	G4
C7	V1 osc. C.G.	56pF	G3
C8	A.G.C. decoupling	0·05μF	F4
C9	M.W. osc. tracker	515pF	G3
C10	L.W. osc. trim.	33pF	G3
C11	L.W. osc. tracker	365pF	G3
C12	L.W. osc. trim.	240pF	G3
C13	Oscillator couplers	0·001μF	F3
C14	Oscillator couplers	56pF	G3
C15	S.G. decoupling	0·05μF	F4
C16	2nd I.F. trans. tuning	110pF	B2
C17	2nd I.F. trans. tuning	110pF	B2
C18	I.F. by-passes	100pF	F4
C19	I.F. by-passes	100pF	E4
C20	A.F. coupling	0·002μF	E4
C21	Tone corrector	0·01μF	D3
C22*	V3 cath. by-pass	50μF	E3
C23*	H.T. smoothing	32μF	B1
C24*	H.T. smoothing	32μF	B1
C25†	S.W. aerial trim.	120pF	G3
C26†	M.W. aerial trim.	40pF	G3
C27†	Aerial tuning	528pF	A2
C28†	Oscillator tuning	528pF	A1
C29‡	S.W. osc. trim.	120pF	G3
C30‡	M.W. osc. trim.	40pF	G3

	RESISTORS	Values	Locations
R1	V1 C.G.	680kΩ	F4
R2	V1 G.B.	330Ω	G4
R3	P.U. shunt	680kΩ	G4
R4	V1 osc. C.G.	47kΩ	G3
R5	Osc. anode feed	10kΩ	F3
R6	Osc. stabilizer	100Ω	F3
R7	S.G. H.T. feed	39kΩ	F3
R8	A.G.C. decoupling	1·5MΩ	F4
R9	I.F. stopper	47kΩ	F4
R10	Part A.G.C. delay	20MΩ	F3
R11	Part A.G.C. delay bias pot.	680kΩ	F4
R12	Diode load	330kΩ	E4
R13	Volume control	500kΩ	D3
R14	V3 C.G. stopper	47kΩ	E3
R15	V3 G.B.	180Ω	E3
R16	H.T. smoothing	1·5kΩ	E4

	OTHER COMPONENTS	Approx. Values (ohms)	Locations
L1	Aerial coupling coils	0·5	G4
L2	Aerial coupling coils	50·0	G4
L3	Aerial tuning coils	—	G4
L4	Aerial tuning coils	7·0	G4
L5	Aerial tuning coils	20·0	G4
L6	Osc. tuning coils	—	G3
L7	Osc. tuning coils	5·0	G3
L8	Osc. tuning coils	5·0	G3
L9	Osc. reaction coils	0·5	G3
L10	Osc. reaction coils	1·0	G3
L11	1st I.F. trans. Prl.	12·5	A2
L12	1st I.F. trans. Sec.	12·5	A2
L13	2nd I.F. trans. Prl. total	12·5	B2
L14	2nd I.F. trans. Sec.	12·5	B2
L15	Speech coil	2·3	—
T1	O.P. trans. Prl.	410·0	—
T1	O.P. trans. Sec.	—	
T2	Mains trans. Prl. total	45·0	
T2	Mains trans. H.T. sec.	140·0	C2
T2	Mains trans. Rect. htr.	0·9	
T2	Mains trans. Htr. sec. total	0·4	
S1-S22 S23, S24	Waveband switches	—	G3
	Mains sw., g'd R13	—	D3

* Electrolytic. † Variable. ‡ Pre-set.

Circuit diagram of the Bush AC31 A.C. superhet. **V1** triode operates as an A.F. pre-amplifier for pick-up operation. **R10, R11** and **R12** constitute a potential divider across the H.T. circuit, from which a positive bias is obtained to provide A.G.C. delay. The scale lamp is energised from tapping **b** on **T2.**

Circuit Description—*continued*

pentode operates as intermediate frequency amplifier with tuned transformer coupling. **C4, L11, L12, C5** and **C16, L13, L14, C17.**

Intermediate frequency 470 kc/s.

One of the diodes of **V2** operates as signal detector, and the audio frequency component in the rectified output is developed across load resistor **R12.** It passes via **C20,** manual volume control **R13** and grid stopper **R14** to control grid of pentode output valve **(V3, Mullard EL41).** I.F. filtering by **C18, R9, C19.** For operation with a gramophone pick up, the triode section of **V1** acts as an A.F. pre-amplifier. The pick up input, which is shunted by **C6, R3,** is connected via **S12** to the triode grid, and the amplified output developed across **R5** is connected via **C13** and **S20** to the top of **R13,** and handed on to the output valve. **S11** opens for gram, applying G.B. to **V1** triode.

The D.C. potential developed across **R12** is fed back via **R11** and decoupling circuits to F.C. and I.F. valves, giving automatic gain control, but its action is delayed. **R10, R11** and **R12** form an H.T. potential divider from which a positive potential is applied to the second diode of **V2,** maintaining it in a conductive condition in the absence of a signal and thus holding the A.G.C. line down to cathode (chassis) potential.

When the signal strength rises sufficiently, the negative D.C. potential developed across **R12** neutralizes the positive bias on the diode, and it ceases to conduct. After that the diode potential becomes more negative with increased signal strength and carries with it the A.G.C. line, via **R8.**

H.T. current is supplied by an I.H.C. rectifying valve **(V4, Mullard EZ40),** whose anodes are strapped to operate as a half-wave rectifier. Smoothing is effected by **R16** and electrolytic capacitors **C23, C24.** The scale lamp is energized from a tapping on the heater winding of the double-wound mains transformer **T2.**

VALVE ANALYSIS

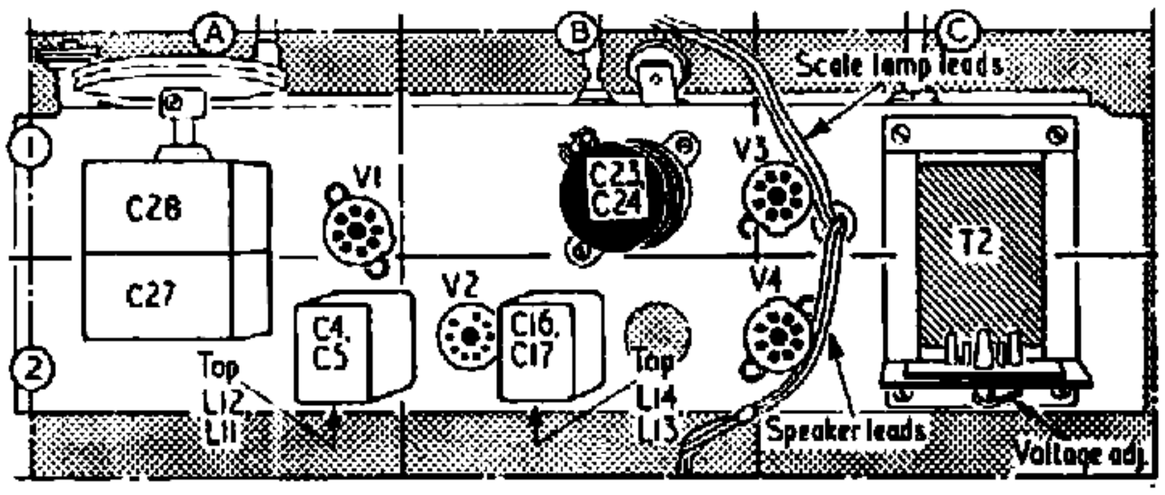
Valve voltages and currents given in the table below are derived from the makers' service manual. Their receivers were operating from mains of 230 V, 50 c/s, and were switched to the M.W. band, but there was no signal input. H.T. voltages were measured in the 1,000 V range of a Model 7 Avometer, but for **V4** cathode voltage the 10 V range was used. Chassis was the negative connection in all cases.

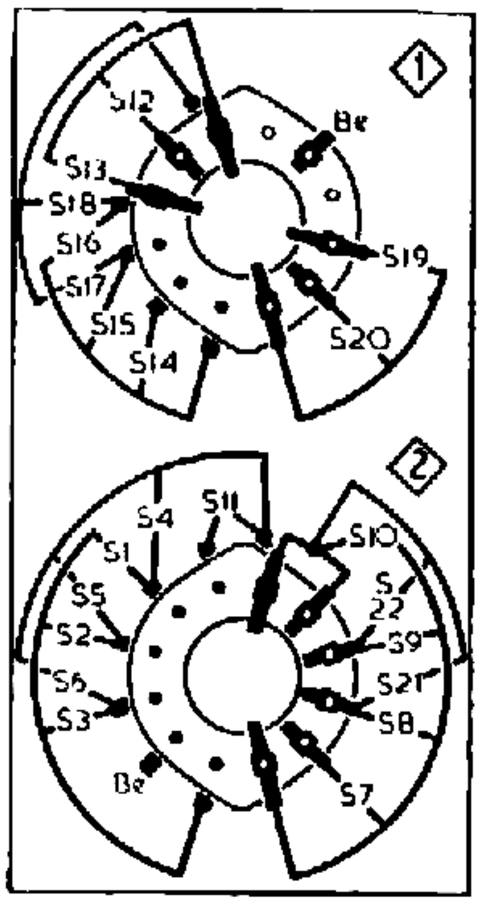
Valves	Anode V	Anode mA	Screen V	Screen mA	Cath. V
V1 ECH42	230	2·0	60	3·0	—
	Oscillator				
	120	5·0			
V2 EBF80	230	4·0	60	1·5	—
V3 EL41	220	32·0	230	5·0	6·8
V4 EZ40	300†	—	—	—	*

† Each anode, A.C. * Cathode current 53mA.

GENERAL NOTES

Switches. S1-S22 are the waveband and radio gram change-over switches, ganged in two rotary units beneath the chassis. These are indicated in our underside view of the chassis, and shown in detail in the diagrams inset beside the plan view drawing, where they are viewed in the directions of the arrows in the underside drawing. The table below the diagrams gives the switch positions for the four control settings, starting from the fully anti-clockwise position of the control knob. A dash indicates open, and **C,** closed.





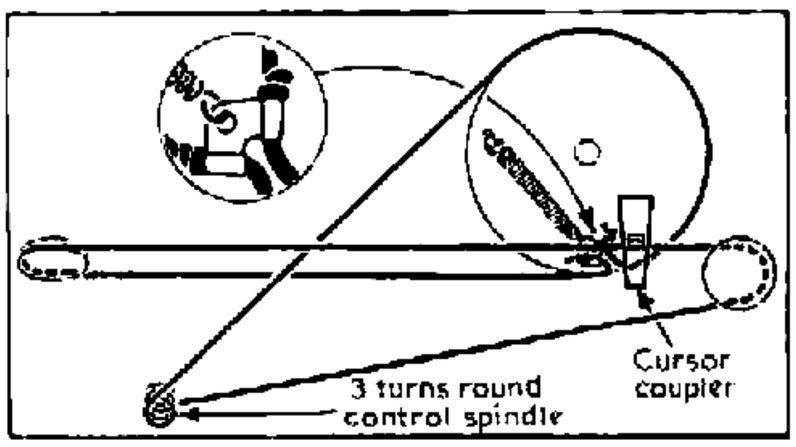
Above: Plan view of the chassis.

Right: Waveband switch diagrams.

Below: Waveband switch table.

Switches	S.W.	M.W.	L.W.	Gram.
S1	C	—	—	—
S2	—	C	—	—
S3			C	
S4		C	C	C
S5	—		C	C
S6				C
S7	C	—	—	—
S8	—	C	—	—
S9	—	—	C	—
S10				C
S11	C	C	C	C
S12				C
S13	C	C	C	—
S14	C	—	—	—
S15	—	C	—	—
S16	—	—	C	—
S17	C	—	—	—
S18	C	C	—	—
S19	C	C	C	—
S20	—	—	—	C
S21	C	—	—	—
S22	C	C	—	—

I.F. Stages.—Turn gang to maximum capacitance and connect output of signal generator via an 0.01 μF capacitor in the "live" lead, to anode (pin 6) of **V2** and chassis. Switch receiver to M.W., feed in a 470 kc/s (638.3 m) signal, and adjust the cores of **L14** (location reference B2) and **L13** (B2) for maximum output. Transfer signal generator "live" lead to control grid (pin 6) of **V1,** and adjust the cores of **L12** (A2) and **L11** (A2) for maximum output, decreasing the input as the circuits come into line to avoid A.G.C. action.



Sketch of the drive cord system. The cord clamp is shown inset.

Drive Cord Replacement.—Forty inches of nylon braided glass yarn is required for a new tuning drive cord, this length allowing plenty for tying off. The cord should be run as shown in the accompanying sketch, where it is drawn as seen from the front of the chassis. The pointer coupler can be fitted afterwards, but its position must be adjusted as explained under "Circuit Alignment" with the chassis in the cabinet.

The cord is terminated at both ends in a small metal plate, and can be made up in advance and fitted afterwards. The makers give the exact circular length of the cord after clamping its ends in the plate as 36¾in.

CIRCUIT ALIGNMENT

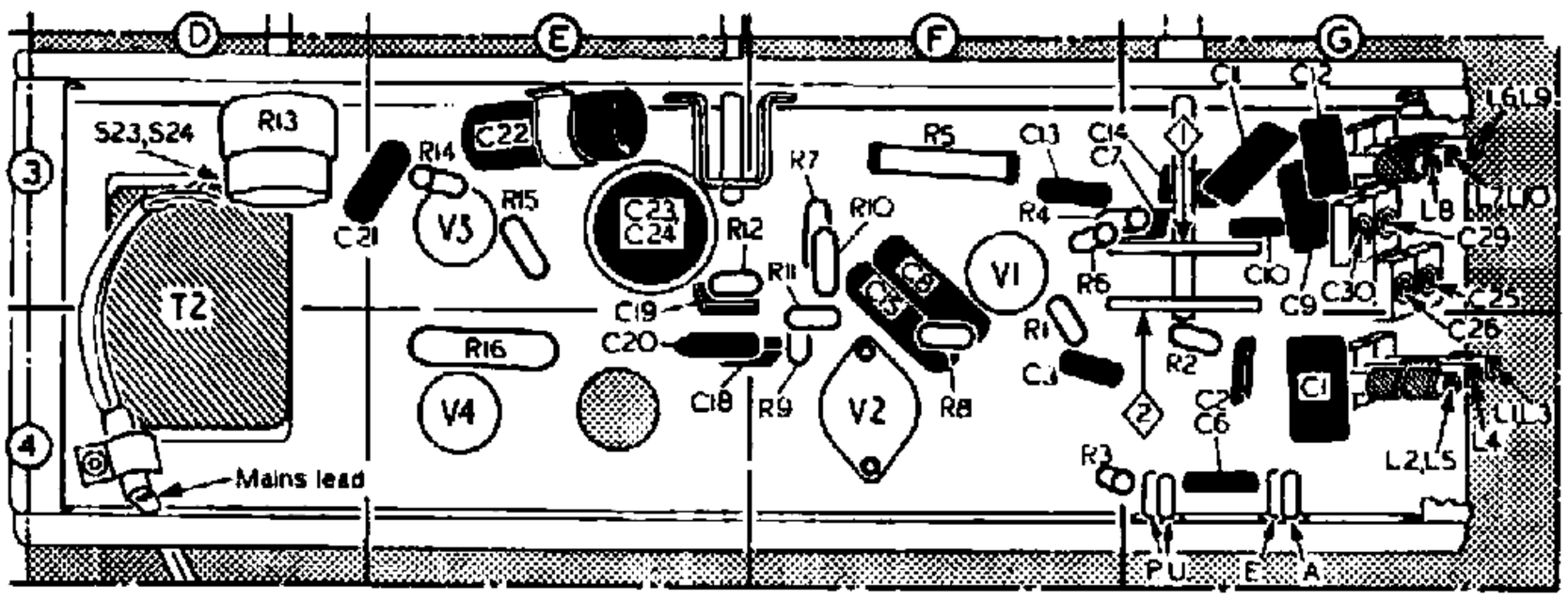
Remove chassis from cabinet and stand it in its normal position on the bench. All the I.F. adjustments are then accessible from the rear of the receiver, and the R.F. and oscillator adjustments from one end of it. Before commencing alignment, the receiver and the signal generator should be switched on and allowed to warm up for about ten minutes.

L.W.—Switch receiver to L.W., tune to 1,400 m on substitute scale, feed in a 1,400 m (214 kc/s) signal and adjust the cores of **L8** (G3) and **L5** (G4) for maximum output. Check calibration over band.

M.W.—Switch receiver to M.W., tune to 500 m, feed in a 500 m (600 kc/s) signal and adjust the cores of **L7** (G3) and **L4** (G4) for maximum output. Tune receiver to 200 m, feed in a 200 m (1,500 kc/s) signal and adjust **C30** (G3) and **C26** (G3) for maximum output. Repeat these adjustments until no further improvement results.

S.W.—Switch receiver to S.W., tune to 30 m, feed in a 30 m (10 Mc/s) signal and adjust the cores of **L6** (G3) and **L3** (G4) for maximum output. Tune receiver to 15 m, feed in a 15 m (20 Mc/s) signal and adjust **C29** (G3) and **C25** (G3) for maximum output. Repeat these adjustments until no further improvement results.

R.F. and Oscillator Stages.—As the tuning scale remains fixed to the cabinet when the chassis is withdrawn, reference is made in the following alignment to the substitute tuning scale fixed to the back of the tuning drive drum. This scale has the trimming and tracking points marked on it in wavelengths, and is read off against the top sloping edge of the thick metal pointer. Check that with the gang at maximum capacitance, the pointer coincides with the datum line on the substitute scale. When the chassis is finally replaced in its cabinet, check that with the gang at maximum capacitance, the cursor coincides with the two dots at the high-wavelength ends of the S.W. and L.W. tuning scales. A dummy aerial, consisting of a 200 pF capacitor should be connected in series with the "live" signal generator lead for M.W. and L.W., and a 400 Ω non-inductive resistor for S.W. Connect output of signal generator, via dummy aerial, to **A** and **E** sockets.



Underside view of the chassis. 1 and 2 in diamonds indicate waveband switch units.

Printed in England by Cornwall Press Ltd., Paris Garden, London, S.E.1.