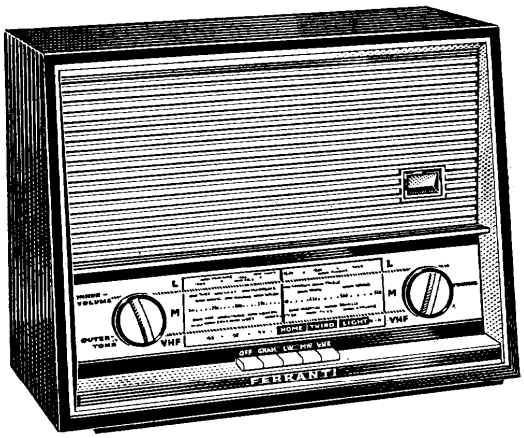
FERRANTI RADIO & TELEVISION LTD.

SERVICE MANUAL

MODEL A1016



MODEL A1016 is an AM/FM receiver employing five valves plus rectifier and electronic tuning indicator.

The receiver offers free tuning on the Long, Medium and F.M. broadcast bands. Waveband switching is by piano key type press buttons.

A directional Ferrite rod aerial is employed for the Long and Medium wavebands with additional provision for connecting an external aerial.

For the F.M. band, the internal dipole will give good reception in suitable localities whilst an external aerial may be connected to the sockets provided.

A dual loud-speaker system is incorporated and provision is included for connecting an external low impedance loud-speaker. Sockets are also fitted for connecting a gramophone pick-up.

MAINS SUPPLY : 200-250 Volts A.C. 50 c/s.

MAINS CONSUMPTION : 56 Watts F.M. 53 Watts A.M. approx.

CONTROLS : The concentric pair of knobs on the left of the scale are :—VOLUME (inner) and TONE (outer). TUNING is the combination knob on the right of the scale.

The five press buttons are, from left to right :—OFF, GRAM, L.W., M.W., F.M.

The MUTING switch for the internal loud-speakers is at the rear of the chassis.

PILOT LAMPS : 6.5V 0.3 Amps. M.E.S.

VALVES : These are all Mullard with B9A base connections :

V1	F.M. R.F. ampl. and freq. changer	ECC85
V2	F.M. I.F. ampl., A.M. freq. changer	ECH81
V3	I.F. amplifier F.M. and A.M.	EF89
V4	Detector, A.G.C. diode and A.F. ampl.	EABC80
V5	Audio Output	EL84
V6	H.T. rectifier	EZ80
V7	Electronic Tuning Indicator	EM84

WAVEBAND COVERAGE : F.M. 86—100 Mc/s.
A.M. M.W. 550—1650 Kc/s. 545— 182 Metres.
L.W. 150— 250 Kc/s. 2000—1200 Metres.

LOUD-SPEAKERS : 8″ x 5″ elliptical and 4″ dia. tweeter. Impedance 3 ohms at 400 c/s and 3000 c/s respectively.

OUTPUT : 3.5 Watts approximately.

INTERMEDIATE FREQUENCIES : A.M. 470 Kc/s. F.M. 10.7 Mc/s.

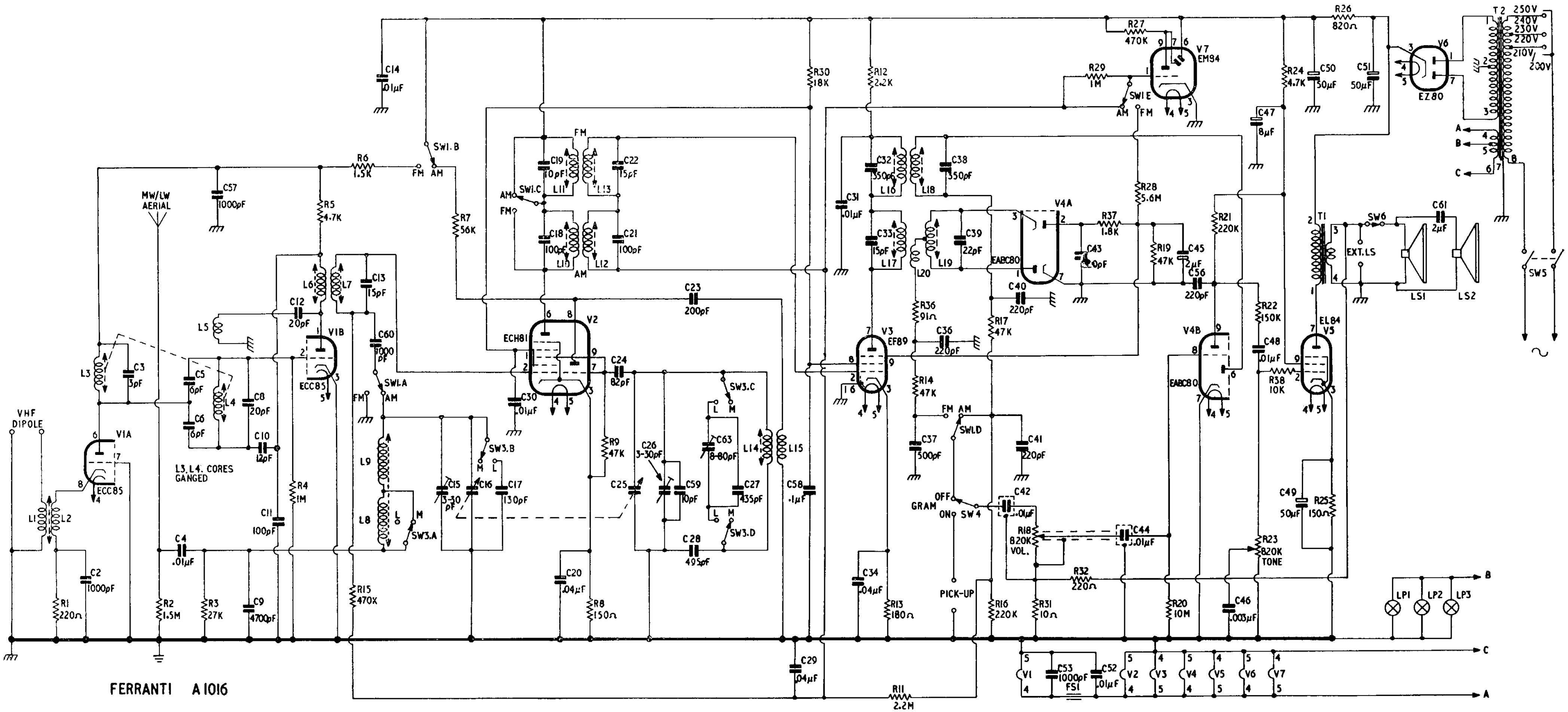
CHASSIS REMOVAL : Disconnect from the mains supply, then remove the rear cover. Remove four screws securing the chassis to the base of the cabinet, slacken the screws securing the ferrite rod aerial bracket to the front of the cabinet then lift the bracket clear.

The chassis complete with scale and knobs can now be withdrawn to the extent of the loud-speaker leads.

DRIVE CORD DETAILS

POINTER DRIVE : A length of nylon cord of approximately 47 inches, having a small loop at one end, is required.

C	57. 12. 13. 60. 14. 19. 18. 22. 21. 23. 31. 32. 33. 36. 38. 39. 40. 43. 45. 56. 47. 50. 51. 61.
	2. 3. 4. 5. 6. 8. 9. 10. 11. 15. 16. 17. 30. 20. 24. 25. 26. 59. 28. 27. 63. 58. 29. 34. 37. 42. 41. 53. 52. 44. 46. 48. 49.
R	5. 6. 7. 30. 12. 36. 17. 29. 37. 27. 28. 19. 21. 22. 24. 26.
	1. 2. 3. 4. 15. 8. 9. 13. 11. 14. 16. 18. 31. 32. 20. 23. 25.
M	L3. L5. L4. L6. V1B. L7. SW1.A. SW1.B. SW1.C. V2. L11. L10. L13. L12. V3. L16. L17. L18. L19. V4A. SW1.E. V7. V4B. V5. SW4. LS1 V6. LS2 T2 SW5.
	L1. L2. V1A. L9. L8. SW2.A. SW2.B. SW2.C. SW2.D. L14. L15. SW1.D. SW3. FS1. T1. PL1. PL2. PL3.



Attach the cord loop to the spring then anchor the spring temporarily near the gang mounting. With the gang fully meshed, the slots in the drive pulley should be to the top. Pass the cord round the left hand pulleys then one turn clockwise round the front section of the drive pulley, through the slot in the central flange, then five turns clockwise round the rear section of the pulley. The cord should now be passed over the rear pulley of the right hand pair, $1\frac{1}{2}$ turns anti-clockwise round the tuning knob spindle, back over the front pulley then tie off at the spring, releasing the latter from its temporary anchor and tensioning slightly. Seal the knots in the cord with adhesive and attach the pointer, near the spring, to coincide with the datum mark on the scale. In the above description the terms left and right are dependent upon the upright chassis being viewed from the front.

F.M. SWITCH DRIVE : A length of approximately 6 inches of nylon cord will be required. Attach one end of the cord to the top of the lever at the front of the F.M. press button unit, then pass the cord round the pulley and tie off at the actuating spring so that with the button released the cord is taut and the slide switch is released. Seal knots in the cord with adhesive.

F.M. UNIT DRIVE : Replacement of this drive necessitates the complete removal of the F.M. tuner unit and should not be undertaken unless facilities are available to re-align the F.M. circuits.

A length of cord, approximately 10 inches, is required together with a securing nipple, both of which are available from Service Dept. To proceed, disconnect the leads and bonding braid from the F.M. unit, release the pointer drive and remove four screws from beneath the chassis, securing the bracket to the chassis grommets. Remove four screws securing the unit to the bracket and withdraw the unit. The cover on the underside of the unit should now be removed (four 6BA cheese head screws). Make a half inch loop in one end of the cord and seal the knot with adhesive then, holding the cord taut, make a mark $6\frac{5}{8}$" from the end of the loop. Press the tuner carriage forward against the tension of the spring and thread the free end of the cord through the central hole in the front of the unit then through the corresponding holes in the carriage bracket and insulated panel. The eyelet should now be threaded on to the cord so that the shank faces the front of the unit. Tie a small knot at the $6\frac{5}{8}$" mark, seal with adhesive, and pull the cord so that this knot is slightly embedded into the eyelet and the shank of the latter enters the hole in the insulated panel. Release the carriage and ensure that it is free to travel to the full extent of the guides. Apply a small quantity of light grease if necessary.

Replace the cover and re-assemble the unit on to the receiver chassis.

Pass the looped cord round the pulley, then one turn anti-clockwise round the gang spindle and secure to the grub screw on the collar.

Carry out final adjustment and alignment as detailed on page 6.

VOLTAGE AND CURRENT DATA :

F.M.

Valve	*Anode*		*Screen*		*Cathode*	
	Volts	*mA*	*Volts*	*mA*	*Volts*	*mA*
V1A	219	8.45	—	—	1.9	8.45
V1B	198	4.55	—	—	—	—
V2H	234	7.4	108	4.3	1.75	11.7
V2T	0	—	—	—	—	—
V3	215	8.8	108	3.0	2.25	11.8
V4T	74	0.6				
V5	254	35	212	3.5	6.28	38.5
V6	498V A.C. anode to anode					
V7	42	0.41	Target 234V 0.8mA			

A.M. Receiver switched to M.W. tuned to low frequency end of scale, no signal input.

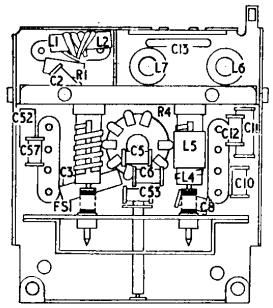
Valve	*Anode*		*Screen*		*Cathode*	
	Volts	*mA*	*Volts*	*mA*	*Volts*	*mA*
V1A	—	—	—	—	—	—
V1B	—	—	—	—	—	—
V2H	254	2.55	99	6.1	1.75	11.79
V2T	72	3.14	—	—	—	—
V3	245	8.0	99	2.7	2.03	10.7
V4T	77	0.7	—	—	—	—
V5	261	38	228	4	6.8	42
V6	499V A.C. anode to anode					
V7	50	.43	Target 254V 0.92mA			

All voltages taken on Avo Model 8 (20,000 ohms per volt) with negative connection to chassis and are D.C. unless otherwise stated.

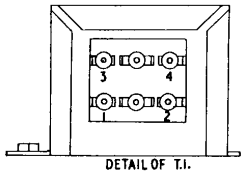
D.C. RESISTANCE OF WINDINGS :

Circuit Ref.	*Component*	*Ohms*
L8	L.W. Aerial Coil	7
L9	M.W. Aerial Coil	*
L10	1st A.M. I.F. Pri.	10
L12	1st A.M. I.F. Sec.	10
L14	A.M. Osc. Sec.	2
L15	A.M. Osc. Pri.	1
L16	2nd A.M. I.F. Pri.	5
L18	2nd A.M. I.F. Sec.	6
T1 Pri.	Output transformer	400
Sec.	Output transformer	*
T2 Pri.	Mains transformer	30
T2 H.T. Sec.		220
T2 L.T. Sec.		*

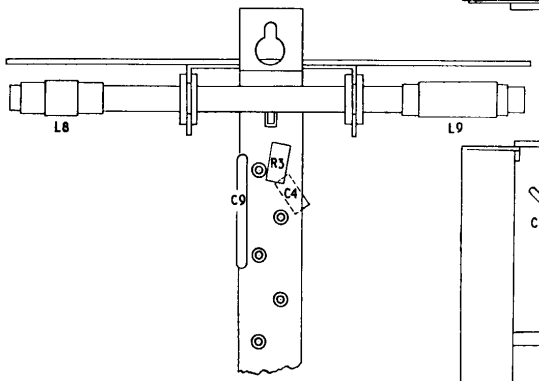
* Less than 1 ohm.



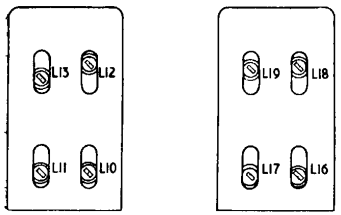
UNDERSIDE OF F.M. UNIT



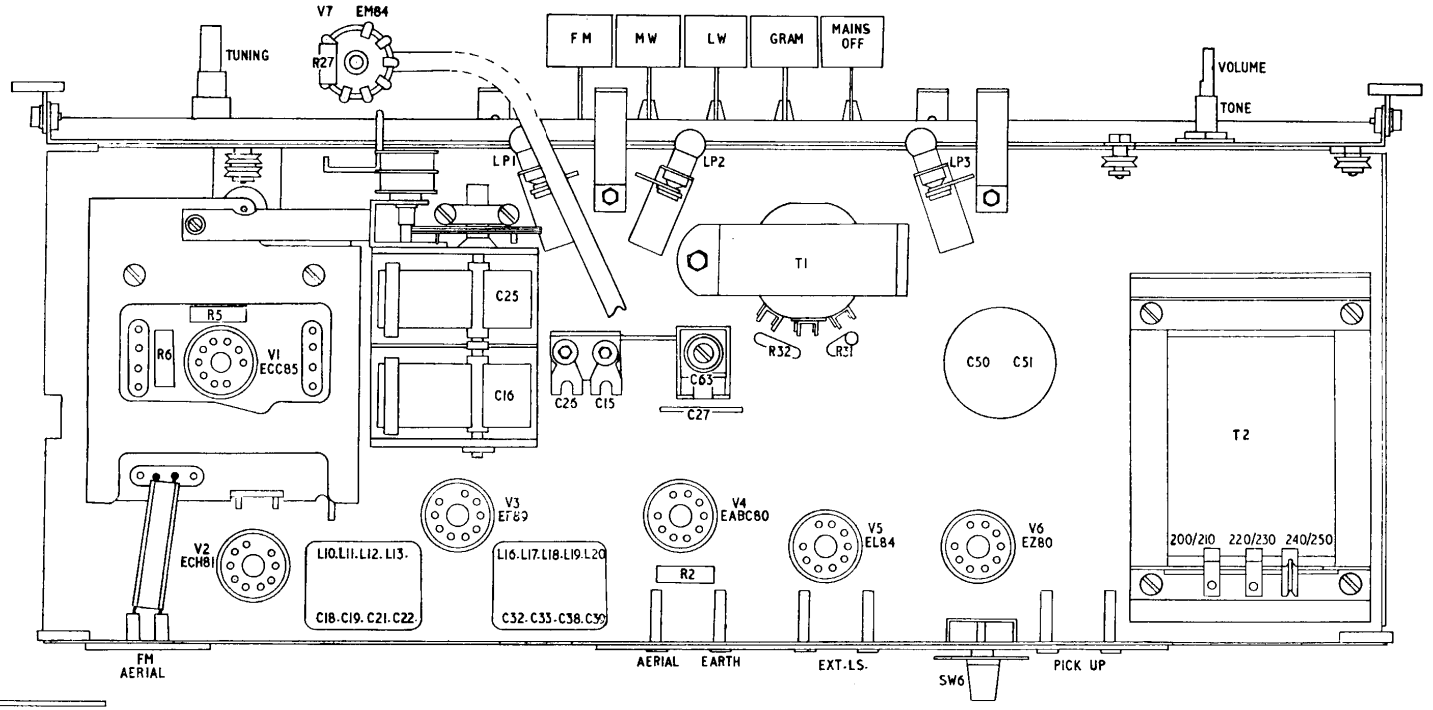
DETAIL OF T.1.

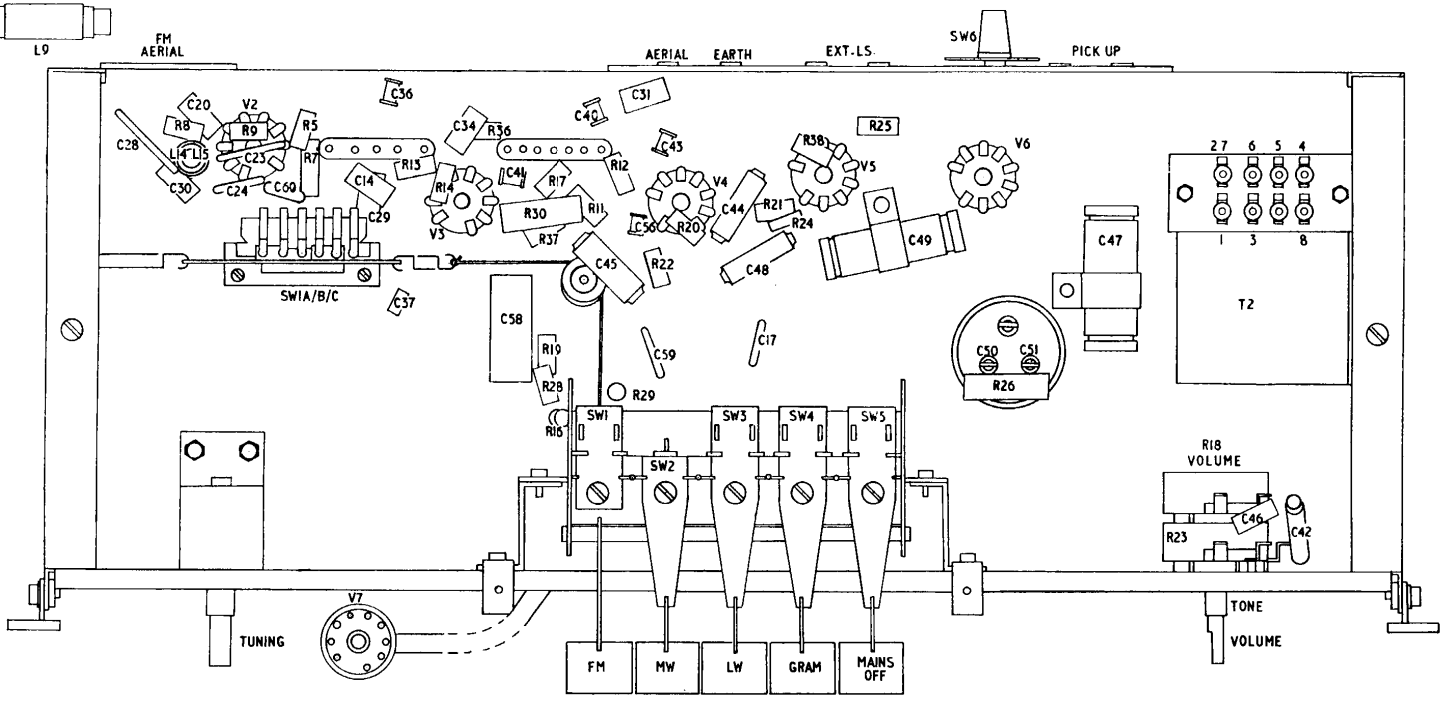


DETAILS OF AERIAL ASSEMBLY



LAYOUT OF I.F. COILS





PRESS BUTTON UNIT SERVICING : Should a fault develop in the press button switch unit the individual parts can be removed easily for servicing or replacement. The sliding and fixed contacts may be removed after disconnecting the leads from the fixed contacts and removing the screw securing the leaf spring of the required switch, to the base of the unit. The contact leaves can then be lifted out. When re-assembling, locate the holding tongue behind the spring loaded rocker plate at the top of the assembly.

CIRCUIT DETAILS

F.M. R.F. AND MIXER STAGE : V.H.F. signals at the dipole are coupled by the aerial coil L1,L2 to the cathode of V1A which operates as a grounded grid R.F. triode. Amplified signal voltages in the anode circuit are then fed to the grid of V1B, L3 forming the variable element of the R.F. tuned circuit. V1B operates as a parallel fed oscillator with the core of L4 providing tuning. The cores of L3 and L4 are ganged to the tuning control and the scale pointer.

I.F. AMPLIFIERS : I.F. signals at the anode of V1B are transformer coupled by L6,L7 to the grid of V2 which operates as the first I.F. amplifier on F.M. The triode section of V2 is rendered inoperative on F.M. by the switch SW1B which disconnects the H.T. supply from the anode. Amplified signals at the heptode anode are transformer coupled by L11,L13 to the grid of V3. The primary of the first A.M. I.F. transformer, L10, is short circuited by SW1C on F.M. to avoid interference from 470 Kc/s signals. I.F. signals amplified by V3 are applied to the ratio detector V4A by the discriminator coil assembly L17,L19,L20.

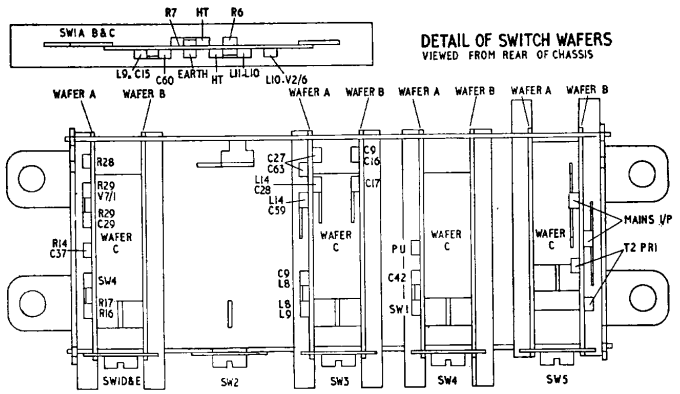
RATIO DETECTOR : V4A operates as a conventional ratio detector in which the signal voltage across L19 is 90 degrees out of phase with the primary voltage when the F.M. signal is at the mean frequency and the sum total of signal voltages at the ends of L19 are equal and opposite. L20 applies a signal voltage, to the centre of L19, which is in constant phase relation with the primary voltage.

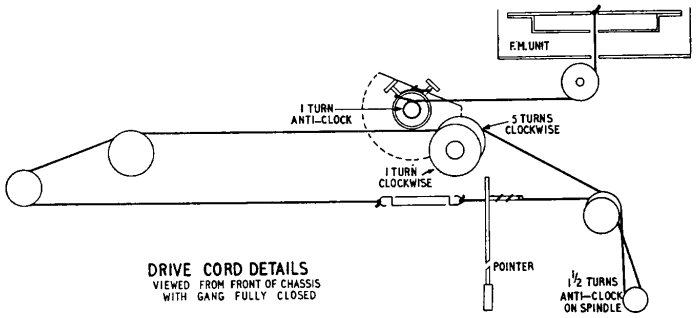
The voltage across L19 is applied to the opposed diodes of V4A which at the mean I.F. frequency produces a constant output. When the signal voltage in L17 deviates above or below the mean frequency, the phase in L19 changes relative to the degree of deviation.

The total voltage applied to one diode, i.e., $\frac{1}{2}$ L19 $\pm$ L20, will increase while the other will decrease. The resultant output from the diodes will vary in direct relation to the deviation of the F.M. signal, i.e., in accordance with the audio content and is fed through the I.F. filter R36,R14,C36,C37 and SW1D,SW4,C42 to the Volume control, R18.

The capacitor C45 operates as a reservoir across the two diodes and assists in removing any A.M. content from the output.

A.G.C.: A D.C. voltage, developed across R19,C45, has an amplitude which varies in direct relation to the input signal amplitude. This voltage is applied to the suppressor grid of V3 as A.G.C.





A.M. R.F. MIXER STAGE : The directional aerial for M.W. and L.W. reception consists of the coils L9 and L8 which are located at the ends of a Ferrite rod. Provision is included for coupling an external aerial into the ' bottom end ' of the aerial coils if required.

Aerial circuit waveband selection is by SW1A,SW3A and SW3B and tuning is effected by C16 with C15 as a pre-set trimmer.

R.F. signals are fed through L7 to the control grid of V2 heptode. The triode section of V2 operates as a conventional parallel fed oscillator in which waveband selection is by SW3C,SW3D and tuning by C25. The pre-set trimmers are C26 and C63. Mixing is by electronic coupling in the valve.

I.F. AMPLIFIER AND DEMODULATOR : I.F. signals at the anode of V2 are transformer coupled by L10,L12 to the grid of V3 which operates as a conventional I.F. amplifier.

SW1C short circuits the primary of the second F.M. I.F. transformer during A.M. operation.

Amplified I.F. voltages at the anode of V3 are fed to the diode demodulator V4B by the coils L16.L18. The diode load consists of R17 and R16. A.F. voltages are fed through SW1D and SW4 to C42 and the Volume control.

A.G.C.: The rectified signal voltages developed across R16 are fed via R11 and R15 as bias to the control grids of V3 and V2 respectively.

GRAM. OPERATION : Sockets for connecting to an external gramophone pick-up are coupled to the Volume control by SW4 and C42.

A.F. AMPLIFIER AND AUDIO OUTPUT STAGES : The A.F. amplifier and audio output stages are common to A.M., F.M. or gramophone operation.

A.F. voltages at the Volume control are fed through C44 to the grid of V4B triode and, after amplification, are coupled by C48 to the grid of the output valve V5. The circuit comprising R23,C46 provides variable tone correction. Negative feedback from the output transformer secondary is applied to V4B.

The loud-speakers are fed from the secondary of the output transformer, T1, with SW6 operating as the internal loud-speaker muting switch.

POWER SUPPLIES : A.C. mains are applied through the on/off switch SW5 to the tapped primary of the mains transformer T2. A tapped secondary winding on T2 provides heater currents for the valves and pilot lamps.

V6 operates as a full wave rectifier, the anodes of which are fed from the H.T. secondary of the mains transformer. The D.C. output is smoothed by C51,C50, C47,R26 and R24.

CIRCUIT ALIGNMENT

INSTRUMENTS REQUIRED : A standard AM/FM signal generator and an A.F. output meter or low range A.C. voltmeter will be required in addition to either (a) a sweep generator and oscilloscope or (b) a 0.50μA meter and two matched 220K carbon resistors.

I.F. F.M. : Two methods are given (a) Visual and (b) Meter.

(a) **VISUAL :** Disconnect the earthed (positive) side of the stabilising capacitor C45. Tune the receiver to the low frequency end of the band. Switch to F.M. and adjust the Volume control for minimum output. Connect the oscilloscope across R19 and inject sweep input to V3, pin 2.

Tune L17 for peak response. Re-connect C45 and connect the oscilloscope across C36. Tune L19 for the best 'S' waveform, re-adjusting L17 if necessary. If the alignment equipment has the facility to superimpose A.M. on the F.M. signal, the adjustment of L19 should be made for the best compromise between A.M. rejection at 10.7 Mc/s and 'S' waveform. L17 adjustment is for 'S' waveform only.

Transfer the input to the junction of R5,R6. This point is live to H.T. potential and should be isolated from the signal generator by a 0.001μF capacitor.

Tune L13,L11,L6 and L7 in that order for maximum output at 10.7 Mc/s. The curve should be substantially flat over ±75 Kc/s and within —2 dB for ±100 Kc/s.

(b) **METER METHOD :** Connect the output meter across the loud-speaker leads. Adjust the Volume and Tone controls to maximum. Connect the 220K resistors in series across R19. Connect the μA meter between the junction of the 220K resistors and chassis. Set the receiver tuning control to the low frequency end of the band. Input to pin 2 V3, tune L17 for peak reading on μA meter. Disconnect the μA lead from chassis and connect to the junction of R14,C36 then tune L19 for zero reading. This should be tunable from a maximum in one direction to a maximum in the other direction. Transfer the μA meter leads so that the meter is now connected between the junction of the 220K resistors and chassis. Input to pin 2 V2, tune L13 and L11 for peak reading on the μA meter. Re-tune L17 if necessary.

Input to the junction of R5 and R6 (this point is at H.T. potential and should be isolated from the generator by a 0·001μF capacitor.) Tune L6 and L7 for maximum reading at 10.7 Mc/s.

Disconnect the test resistors and μA meter.

I.F. A.M. : Switch to M.W. and tune the receiver to 545 Metres. Connect the output meter across the loud-speaker leads. Input at 470 Kc/s A.M. 30% to pin 2 V2, adjust L18,L16,L12 and L10 in that order for maximum output and symmetrical response.

R.F. F.M.: Check that with the gang fully open the tuner carriage is $\frac{1}{16}$" from fully open and that with the gang closed the drive cord is still under tension, adjust if necessary by rotating the collar on the gang shaft. Also check that the pointer coincides with the datum mark at the right hand end of the scale, adjust if necessary by sliding the pointer along the drive cord. Tune the receiver to the 91 Mc/s calibration mark and inject an F.M. signal of that frequency to the aerial input. Adjust L4 for alignment and L3 for peak output.

R.F. A.M.: M.W. Input to the aerial socket. Align L14 at 600 Kc/s and C26 at 1500 Kc/s. Adjust C15 at 1500 Kc/s and L9 at 700 Kc/s L.W. Align C63 at 214.3 Kc/s and adjust L8 for maximum output.

Note : The adjustment of L8 and L9 is carried out by sliding the coils along the Ferrite rod until a point of maximum output is reached. The coils should be sealed on the Ferrite rod after completion of alignment.

SPARE PARTS LIST

COILS AND TRANSFORMERS :

Circuit Ref.	*Function*	*Part No.*
L1,2	F.M. Coil	DP23003
L3	R.F. Coil (F.M.)	DP24033
L4,5	Osc. Coil (F.M.)	DP24038
L6	F.M. 1st I.F. Trans. Pri.	DP24035
L7	F.M. 1st I.F. Trans. Sec.	DP24036
L8	L.W. Ae. Coil	DP24793
L9	M.W. Ae. Coil	DP24792
L10,11,12,13	1st A.M. & 2nd F.M. I.F.	SA5596B
L14,15	A.M. Osc. Coil	DP25293
L16,17,18,19,20	2nd A.M. I.F. & F.M. Discrim.	SA5595B
T1	Output Trans.	SA5622C
T2	Mains Trans.	SA5620A

RESISTORS :

Circuit Ref.	*Ohms*	*Tol. %*	*Part No.*
R1	220	10	93554
R2	1.5M	20	94032
R3	27K	20	93373
R4	1M	20	93531
R5	4.7K	10	94070
R6	1.5K	10	94064
R7	56K	10	94083
R8,25	150	10	93052
R9,14,17,19	47K	20	93023
R11	2.2M	20	93033
R12	2.2K	20	93015
R13	180	10	93053
R15,27	470K	20	93029
R16,21	220K	20	93027
R18,23	820K		C109030/1
R20	10M	20	93037
R22	150K	20	93026
R24	4.7K	20	93017
R26	820	10	94424B
R28	5.6M	10	93107
R29	1M	10	93098
R30	18K	10	94440B
R31	10	10	93038
R32	220	10	93054
R36	91	5	93134
R37	1.8K	10	93065
R38	10K	20	93019

CAPACITORS :

Circuit Ref.	*Capacity*	*Tol. %*	*Part No.*
C2,53,57,60	1000pF		53802
C3	3pF	±0.5pF	49825/2
C4	0.01μF		C41904/3
C5,6	6pF	10	49825/1
C8	20pF	5	53063
C9	4700pF	5	53597
C10	12pF	10	53069
C11	100pF	5	53714
C12	20pF	10	106278/4
C13,33	15pF	±0.5pF	B48913/6
C14,30,31,52	0.01μF		C41904/4
C15,26	3—30pF		B49373
C16,25			D107898
C17	130pF	2	51930
C18,21	100pF	2	B48913/4
C19	10pF	5	B48913/5
C20,29,34	0.04μF		C41904/10
C22	15pF	±0.5pF	B48913/6
C23	200pF	10	51860
C24	82pF	10	51419
C27	435pF	2	53920
C28	495pF	1	53918
C32,38	350pF	2	B48913/7
C36,40,41,43,56	220pF	20	53622
C37	500pF		53804

CAPACITORS (Contd.) :

Circuit Ref.	*Capacity*	*Tol. %*	*Part No.*
C39	22pF	2	B48913
C42,44	0.01μF		B41852
C45	2μF		C49362/16
C46	0.003μF		C41904/1
C47	8μF		C23686/9
C48	0.01μF		52658/1
C49	50μF		C23686/24
C50,51	50+50μF		C47865
C58	0.1μF		C43077/6
C59	10pF	10	51468
C61	2μF		C43077/2
C63	8.80pF		B40199/6

MISCELLANEOUS COMPONENTS :

Component	*Part No.*
Back Cover	E109103
Cabinet (Aus. Walnut finish)	E108963
Cabinet (Fr. Walnut finish)	E108963/1
Cabinet front panel	DP25165A
Drive Cord (Pointer)	B107637
Drive Cord (F.M. Switch)	B107637/5
Drive Cord (F.M. Unit)	B108229
Eyelet for F.M. Unit Drive Cord	56479/1
Ferrite Rod Fe6	B49298
Ferrite Sleeve Fe1,16	B49338
Iron Dust Core Fe2	DP21697/8
Iron Dust Core Fe3	DP21697/9
Iron Dust Core Fe4,5,7,8,14,15	B41851
Iron Dust Core Fe,9,10,11,12	B18310
Knob (Tone)	C108985
Knob (Vol.)	C108986
Knob (Tuning round)	C108987
Knob (Tuning bar)	C108988
Lampholder PL1,2,3	A106135
Lamp 6.5V 0.3 Amp. PL1,2,3	A5767/2
Loud-speaker 8″ x 5″ LS1	D106843/1
Loud-speaker 4″ LS2	D108887
Pointer	B109238
Scale	D109237
Spring (Cord Drive)	B45885
Spring (Slider Switch Cord)	A109281
Spring (Slider Switch Return)	A109281/1
Switch (Slider) SW1 (Part)	C109125
Switch (L.S. Muting) SW6	DP24479/F
Switch (Press Button Unit) Assy	D109102*

* Individual wafers and sliders are available separately from Service Dept. To order the wafer or slider required please quote the appropriate reference from the drawing on page 5.