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MODEL U353

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MODEL U353 is a five valve (plus rectifier and tuning indicator) AM/FM radio receiver for the reception of broadcasts on Long and Medium wavebands, and VHF/FM transmissions on band II. Internal Ferrite rod and frame aerials are incorporated for A.M. and F.M. reception respectively, and sockets are provided for connecting external aerials for all bands. The receiver is housed in a two-tone plastic cabinet, with provision for the connection of an extension loud-speaker.

MAINS SUPPLY : 200-250 volts A.C. 50 c/s., or D.C.

MAINS CONSUMPTION : Approximately 45 watts.

WARNING : The voltage adjustment must be correctly set for the voltage of the supply before the receiver is connected. As the chassis connects to one side of the mains supply, care should be taken to ensure that the chassis is connected to the neutral side of the supply.

LOUD-SPEAKER : 8" x 5", elliptical. Impedance 3 ohms at 400 c/s.

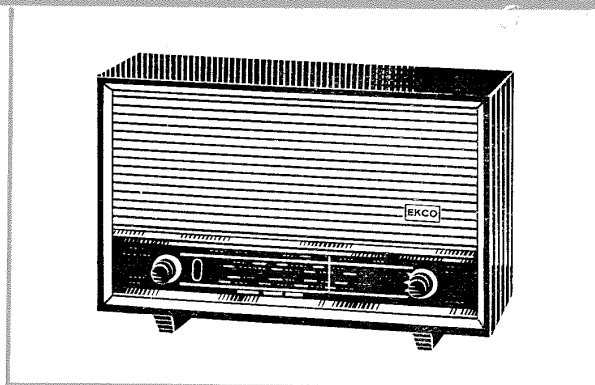
VALVES :

V1 UCC85	VHF R.F. Amplifier and Mixer
V2 UCH81	Frequency Changer (AM) I.F. Amplifier (FM)
V3 UF89	I.F. Amplifier
V4 UABC80	Ratio Detector (FM) Demodulator (AM) A.F. Amp.
V5 UL84	A.F. Output
V6 UY85	H.T. Rectifier
V7 DM70	Tuning Indicator

CONTROLS : The operating controls are arranged in two concentric pairs, one pair at either end of the scale.

They are :—

L.H. (outer)—Volume	R.H. (outer)—Tuning
L.H. (inner)—On/Off. Tone.	R.H. (inner)—Wavechange

**WAVEBAND COVERAGE :**

M.W. 540 Kc/s.—1640 Kc/s.

L.W. 150 Kc/s.—260 Kc/s.

F.M. 85.5 Mc/s.—101.5 Mc/s.

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

OUTPUT : 3 watts, approximately.

CHASSIS REMOVAL : Disconnect the receiver from the mains supply, and remove the back cover. Slacken the grub screws of the inner control knobs and remove them from their spindles; the outer knobs can then be pulled off. Remove the four screws from the base of the cabinet and withdraw the chassis to the extent of the loud-speaker leads.

NOTE : On later production models it is necessary to unsolder the internal aerial connection from the tuner unit before removing the chassis from the cabinet.

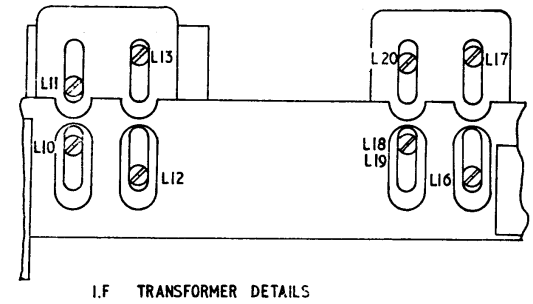
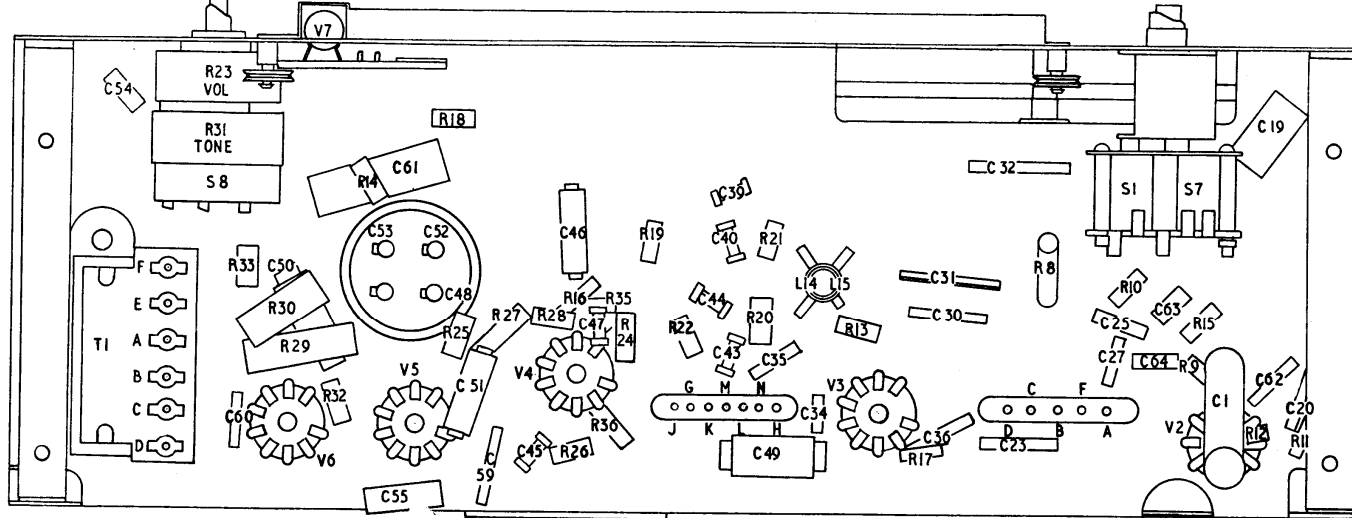
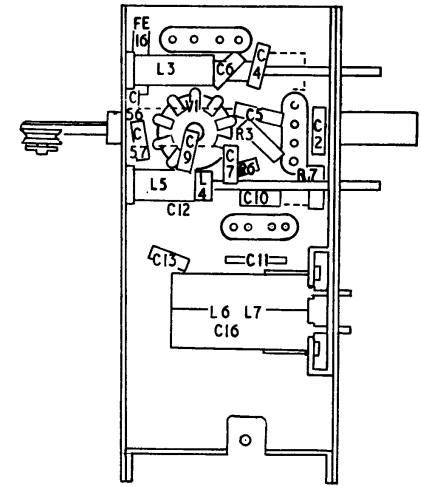
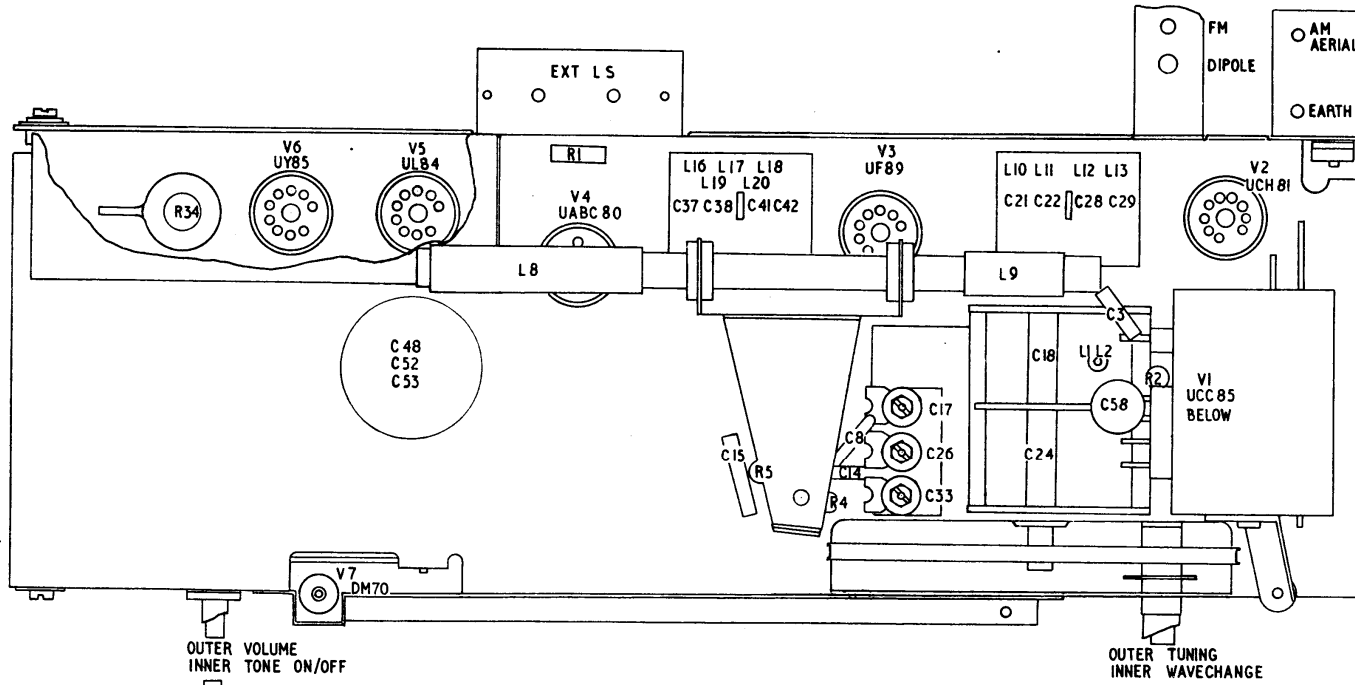
CIRCUIT DETAILS—F.M. OPERATION

R.F. AND MIXER STAGES : F.M. signals from the dipole are passed via the V.H.F. aerial socket to the aerial transformer, L1,L2, and then to the cathode of V1A, operating as a grounded grid R.F. triode. Amplified signal voltages are developed across the tuned circuit L3,C6, and fed via C9 to the grid circuit of V1B. R.F. tuning is by L3 core. V1B operates as a parallel fed oscillator, L5 core, which is ganged to L3 core, forming the variable tuning element. H.T. is fed to V1A and V1B via SW1.

I.F. STAGES : The I.F. signal at the anode of V1B is transformer coupled by L6,L7 to the control grid of V2 heptode, which operates as an I.F. amplifier on F.M. The triode section of the valve is rendered inoperative on F.M. by the switch SW1 disconnecting the H.T. feed to its anode. Amplified signals appearing at the heptode anode of V2 are fed to the grid of V3 via the transformer L10,L11. To avoid interference from signals at 470 Kc/s., the first A.M. I.F. primary winding is short circuited by SW4. I.F. signals are further amplified by V3, which is coupled to the ratio detector V4A and V4B by the discriminator coils L18,L19, L20. A D.C. voltage, the amplitude of which varies with signal amplitude, is developed across R26,C49, and is fed to the suppressor grid of V3 as A.G.C.

RATIO DETECTOR : V4A and V4B operate as a conventional ratio detector in which the signal voltage across L20 is 90 degrees out of phase with that across L18 when the F.M. signal is at the mean frequency, and the sum total of signal voltages at the ends of L20 are equal and opposite. L19 applies a signal voltage to the centre of L20, that is in constant phase relation with the voltage in the primary winding L18. The voltage across L20 is applied to the opposed diodes V4A,V4B, which at mean frequency, produce a constant output. When the signal voltage in L18 deviates above or below the mean frequency, the phase in L20 changes relative to the degree of deviation. The total

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voltage, $\frac{1}{2} L20 \pm L19$, applied to one diode will therefore increase, while the other will decrease. The resultant output from the diodes varies in direct sympathy with the deviation of the F.M. signal, i.e. in accordance with the audio content, and is fed via the I.F. filter circuit R20, C40, R21, C39 and SW7 to the Volume control. The capacitor C49 operates as a reservoir across the two diodes and assists in removing any A.M. content from the output.

A.M. OPERATION—R.F. AND MIXER STAGES :

L8 and L9 are the Long and Medium wave aerial coils respectively and are located at the ends of a directional Ferrite rod aerial. Provision is made for an external aerial to be coupled into the 'bottom end' of the aerial coils, if required. Aerial waveband selection is by SW3 and SW5, and tuning by C18, with C17 as a pre-set trimmer.

Signal voltages in the aerial circuit are fed via SW2, C63 and L7 to the grid of V2 heptode. The triode section of V2 operates as a conventional parallel-fed tuned grid oscillator in which waveband selection is by SW6, and tuning by C24. C26, C33 are pre-set trimmers. Mixing is by electronic coupling in the valve.

I.F. AND DEMODULATOR STAGES : Intermediate frequency signals at the heptode anode of V2 are transformer coupled by L12, L13 to the grid of V3. The primary of the unwanted F.M.I.F. transformer is short-circuited by SW4. Amplified signals at the anode of V3 are transformer coupled to the demodulator diode of V4C by L16, L17. The demodulator load consists of R22 and R19, together with C43, C44, operating as an I.F. filter. A.F. voltages are fed to the Volume control via SW7.

A.G.C. : The rectified signal voltages developed across R19 are applied across C23, and fed as bias to the control grids of V2 and V3.

A.F. AND OUTPUT STAGES : The A.F. amplifier and output stages are common to both A.M. and F.M. operation. A.F. voltages at the Volume control are fed via C46 to the triode grid of V4C, amplified by the valve, then resistance-capacity coupled to the grid of the output valve. Variable tone control is provided by R31 and C54 in the grid circuit of the output valve. Coupling to the loud-speaker is by transformer T1. A tertiary winding on the output transformer provides negative feedback to the input of the A.F. amplifier, V4C.

POWER SUPPLIES : An A.C. or D.C. mains supply is connected between chassis and anode of rectifier valve V6, via part of R34. The D.C. output at the cathode is smoothed and applied to the various circuits. The valve heaters are series connected, the supply volts being dropped to the required value by part of R34.

TUNING INDICATOR : The tuning indicator, V7, derives its signal from the A.G.C. line for A.M. operation, whilst on F.M., the ratio detector load provides the signal.

CIRCUIT ALIGNMENT : The instruments required to align the I.F. and R.F. circuits are :—An AM/FM signal generator, an oscilloscope, an A.F. output meter or a low range A.C. voltmeter, a 0-50 μ A meter, and a matched pair of 220K carbon resistors.

Two methods are given, (a) Visual and (b) Meter.

I.F. ALIGNMENT, F.M. :

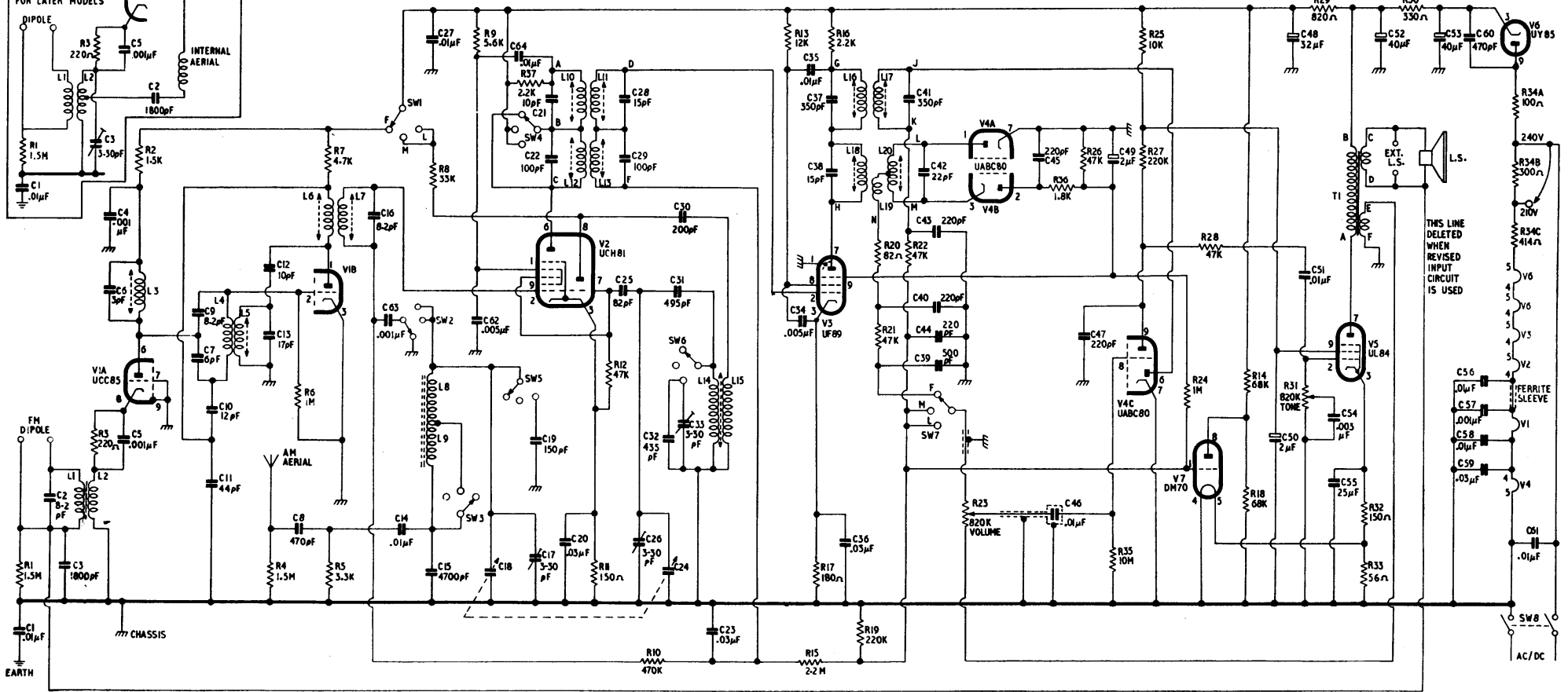
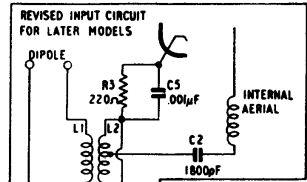
(a) Visual Method :—Disconnect the earthed side of the 2 μ F stabilising capacitor (C49). Tune the receiver to the low frequency end of the band, and switch to F.M. Turn the Volume control to minimum. Inject I.F. sweep input to the control grid (pin 2) of V3, (UF89), and connect the oscilloscope across the ratio detector load, (R26). Tune the primary of the discriminator transformer, (L18), for

peak response. Re-connect C49, and transfer the oscilloscope to the tertiary output (junction R20/C40). Tune the secondary of the discriminator (L20) for the best 'S' curve shape, re-adjusting the primary (L18) if necessary. If the alignment equipment has the facility to superimpose A.M. on the F.M. signal input, the adjustment of L20 should be made for the best compromise of A.M. rejection at 10.7 Mc/s. and 'S' curve shape, and L18 adjustment for 'S' curve shape only. Transfer the sweep input to the control grid (pin 2) of V2 (UCH81), preferably at the lead out from the F.M. tuner unit. Disconnect C49, and transfer the oscilloscope leads across R26. Tune the secondary L11, and primary L10 of the second I.F. transformer for peak output at 10.7 Mc/s., ensuring that the response curve (± 100 Kc/s. off 10.7 Mc/s.), is substantially flat and symmetrical. Transfer the sweep input to the junction of R2 (1.5K) and C4 (0.001 μ F) on the F.M. tuner unit, care being taken as this point is at H.T. potential. Tune primary (L6) and secondary (L7) of the first I.F. transformer for peak output, ensuring that the response curve is symmetrical, and substantially flat, ± 75 Kc/s. (± 100 Kc/s. within -3 dB).

Re-connect C49.

(b) Meter Method : Connect the output meter with 3 ohms load, to the loud-speaker sockets. Turn the Volume and Tone controls to maximum. Connect the two 220K resistors in series across the ratio detector load (R26). Connect the 0-50 μ A meter between the junction of the two 220K resistors and chassis, and tune the receiver to the low frequency end of the band. Inject a 10.7 Mc/s. input to the control grid, pin 2 of V3 (UF89). When tuning the primary coil, shunt the secondary with a 4.7K resistor in series with a 0.001 μ F capacitor, and vice versa. Tune the ratio detector primary (L18) for peak reading on the micro-ammeter. Connect the micro-ammeter between the junction of the two 220K resistors and the tertiary of the discriminator transformer (junction R20/C40). Tune the secondary (L20) for zero current reading. This current must go from a maximum positive, through zero

C	4. 5. 6.	7. 9.	12. 13.	16. 63. 14.	27.	62.	21. 22.	25. 28. 29.	30. 31.	37. 35.	41. 42. 43.	45.	47. 49.	48. 51.	53.	60.	C					
R	1. 2. 3.	2.	10. 11.	8.	7.	8.	9.	18.	17. 20.	26. 32. 24. 33. 23.	38. 34.	36.	20. 21. 22.	36.	26.	25. 27.	28.	50.	54. 55. 52.	56-59.	61. 34A/B/C.	R



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to a maximum negative. Transfer the micro-ammeter lead from the junction of R20/C40 to chassis, and the generator input to the control grid (pin 2) of V2, (UCH81). Tune the secondary (L11) and the primary (L10) of the second I.F. transformer for maximum meter reading, re-tuning the discriminator primary (L18) if necessary.

Modulate the I.F. signal (± 25 Kc/s. deviation at 400 c/s.) and, with Volume and Tone controls at maximum, check that sensitivity and bandwidth are correct, re-tuning if necessary. Connect I.F. input to the junction of R2,C4, via a 0.001 μ F capacitor, care being taken as this point is at H.T. potential. Tune primary (L6) and secondary, (L7) of the first I.F. transformer for maximum meter reading. Remove the two 220K resistors.

I.F. ALIGNMENT, A.M.: Switch to the Medium waveband and turn the tuning gang to full mesh. Connect the output meter with 3 ohms load to the loud-speaker sockets. Set Volume and Tone controls to maximum. Inject a signal of 470 Kc/s., modulated 30% at 400 c/s. via a 0.1 μ F capacitor, to the control grid (pin 2) of V2, (UCH81). Tune L17,L16,L13 and L12, in that order, for maximum output and symmetrical response.

R.F. ALIGNMENT, F.M.: Switch to the F.M. band, with Volume and Tone controls at maximum. Check that, with the tuning gang fully meshed, the carriage of the tuner unit is $\frac{1}{32}$ " from fully open, and that the pointer coincides with the datum mark at the right-hand end of the scale. Adjust, if necessary, by rotating the drive drum, on the tuning gang shaft, and/or sliding the pointer along the drive cord. Set the pointer to the 92 Mc/s. mark on the scale, and inject a signal of that frequency to the aerial socket. Adjust cores of oscillator coil (L5), and R.F. coil (L3), for maximum output. Check calibration at 87 Mc/s., 94 Mc/s. and 99 Mc/s. which should be within ± 0.3 Mc/s. at all points. Check that the oscillator is operating correctly on the low frequency side by tuning the receiver to 100 Mc/s. and identifying the image at 78.6 Mc/s.

NOTE: On later production models, the internal F.M. aerial system and aerial coil have been redesigned, giving improved performance in weak signal areas. The back cover wire is replaced by a wire aerial in the cabinet, which is permanently connected to a tap on a new air cored aerial coil via a loading coil. An aerial circuit trimmer has also been added. The alignment procedure for these receivers has been modified as follows:—

At 92 Mc/s. adjust the oscillator core for calibration, and the anode coil core and aerial trimmer for maximum output. When the receiver has been replaced in the cabinet, and the internal aerial re-connected, it will be necessary to reset C3, the aerial trimmer. This is effected with a normal input to the aerial socket.

R.F. ALIGNMENT, A.M.: Switch to the Medium waveband, and set the Volume and Tone controls to maximum. Tune the receiver to 600 Kc/s. and inject a 600 Kc/s. signal to the aerial socket. Tune the oscillator coil (L14) until the point of maximum output coincides with the 600 Kc/s. mark on the scale. Tune the receiver to 1,500 Kc/s. and inject a 1,500 Kc/s. signal to the aerial socket. Tune the oscillator trimmer (C26) for maximum output. Tune the receiver to 600 Kc/s. and, with a 600 Kc/s. input to the aerial socket, adjust aerial coil (L8) on Ferrite rod for maximum output. Tune the receiver to 1,400 Kc/s. and, with a 1,400 Kc/s. signal input to the aerial socket, tune the aerial trimmer (C17) for maximum output. Check tracking and calibration at 545 Kc/s., 857 Kc/s., and 1,600 Kc/s. Switch to the Long waveband and tune the receiver to 214.3 Kc/s. Inject a 214.3 Kc/s. signal to the aerial socket and tune the oscillator trimmer (C33) for maximum output. Adjust the aerial coil (L9) on the Ferrite rod for maximum output. Check tracking and calibration at 166.6 Kc/s. and 250 Kc/s.

VOLTAGE AND CURRENT DATA: All measurements taken with an Avometer Model 8, 20,000 ohms per volt. Receiver quiescent at 1 Mc/s. Medium wave or 94 Mc/s. F.M. Volume and Tone controls at minimum. Mains input 240V. A.C. 50 c/s. to 240V tap. All voltages are positive with respect to the chassis.

VALVE VOLTAGES AND CURRENTS:

VALVE	ANODE			SCREEN			CATHODE		
	Pin	V	mA	Pin	V	mA	Pin	V	mA
V1A F.M.	6†	155	—	—	—	—	8	—	—
V1A A.M.	6	0	—	—	—	—	8	—	—
V1B F.M.	1†	168	—	—	—	—	3	—	—
V1B A.M.	1	0	—	—	—	—	3	—	—
V2H F.M.	6	168	8.7	1	134	5.6	3	2.2	14.3
V2H A.M.	6	182	4.1	1	130	8.1	3	2.4	15.3
V2T F.M.	8	—	—	—	—	—	3	—	—
V2T A.M.	8	70	3.1	—	—	—	3	—	—
V3 F.M.	7	145	9	8	125	3.3	3	2.5	12.3
V3 A.M.	7	157	10	8	137	3.5	3	2.8	13.5
V4 F.M.	9	62	0.4	—	—	—	7	—	—
V4 A.M.	9	65	0.4	—	—	—	7	—	—
V5 F.M.	5	184	49	9	144	2.4	3	9.5	51.4
V5 A.M.	5	192	53	9	156	2.6	3	10.5	55.6
V6 F.M.	9*	235	118	—	—	—	3	235	94
V6 A.M.	9*	240	110	—	—	—	3	243	88
V7 F.M.	8	78	—	—	—	—	—	—	—
V7 A.M.	8	83	—	—	—	—	—	—	—

* All voltages are D.C. except V6 rectifier anode.

† These voltages are measured at junctions R2/C4 and R2/R7 respectively.

	F.M.	A.M. (on M.W.)	
Mains consumption	45.5W*	44W*	
H.T. smoothed	170V D.C.	180V	D.C.
H.T. unsmoothed	230V D.C.	235V	D.C.
H.T. current	85 mA D.C.	80 mA	D.C.
L.T. current	100 mA A.C.	100 mA	A.C.

* Assuming unity power factor.

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D.C. RESISTANCE OF WINDINGS :

Winding	Ohms
T1	Pri. 330
	Sec. 0.4
	Tert. 0.006
L9	8
L12	10

Winding	Ohms
L13	10
L14	2
L15	1
L16	6
L17	6

HEATER VOLTAGES :

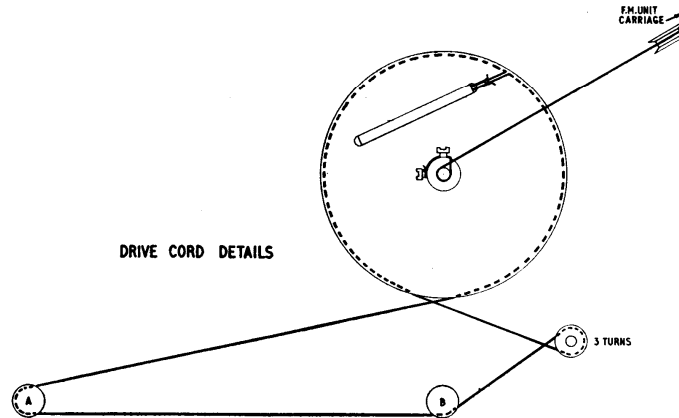
V1	UCC85	26V	A.C.
V2	UCH81	19V	A.C.
V3	UF89	12.6V	A.C.
V4	UABC80	28V	A.C.
V5	UL84	45V	A.C.
V6	UY85	38V	A.C.
V7	DM70	1.4V	D.C.

Total L.T. voltage : 168.6V A.C.

DRIVE CORD DETAILS :

POINTER DRIVE : A length of nylon cord of approximately 36" is required. With the tuning gang fully meshed, pass the cord through the hole in the edge of the drive drum and secure it to the free-end of the spring. The cord now passes clockwise round the drum and anti-clockwise over the pulley 'A'. Passing under pulley 'B' the cord takes three clockwise turns round the drive spindle and on to the drum in a clockwise direction, to pass through the hole and then secured to the spring, maintaining a slight tension. Secure both knots with adhesive. Attach the pointer to the cord between pulleys 'A' and 'B' so that, with the gang fully meshed, it coincides with the datum mark on the right hand end of the scale.

F.M. UNIT DRIVE : A length of nylon cord approximately 8½" long is required. Attach the cord to the end of the tuner unit carriage and pass it over the pulley mounted on the tuner unit. Now take one turn anti-clockwise round the tuning gang shaft, and with the gang fully meshed, pass the cord round the rear of the right-hand screw on the drive drum and secure it firmly to the left-hand screw. The cord should be adjusted so that, with the gang fully meshed, the tuner unit carriage is ½" from the fully returned position.



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