10kW BROADCAST TRANSMITTER BTM-10K

TYPE 5J60090

VOL. 1 OF TWO VOLUMES

INSTALLATION AND OPERATION

260467

Handbook 2-60090R

Amalgamated Wireless (Australasia) Limited,

47 York Street,

SYDNEY.

DANGER

LIVE WIRES

MEAN DEAD MEN

A. **EARTH** ALL EQUIPMENT

B. **DISCONNECT** ALL POWER BEFORE OPENING DOORS OR ENCLOSURES OR REMOVING PROTECTIVE COVERS.

C. **DISCHARGE** ALL CAPACITORS BEFORE WORKING ON EQUIPMENT

D. **CHECK** ALL SAFETY SWITCHES AND H.T. SHORTING BARS AT REGULAR INTERVALS

NEVER WORK ON LIVE CIRCUITS

A.W.A. FORM 6000—A745

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1. BRIEF DESCRIPTION

1.1 Application

The AWA Broadcast Transmitter BTM-10K, type 5J60090, is a crystal controlled, amplitude modulated broadcast transmitter capable of an output of 10kW (carrier) in the frequency range 525 to 1605 kHz.

The transmitter conforms with the current trend towards economy in valve complement, reductionin installation space and simplification of tuning and control.

Simplified power control circuitry allows the transmitter to be brought automatically up to full power in correct switching sequence and with all necessary delays by the operation of a single control. In the event of a mains failure of short duration, the transmitter will automatically revert to full-power in the shortest time commensurate with correct switching sequences and delays.

Comprehensive protection systems for personnel and equipment are incorporated in the transmitter.

1.2 Performance Summary

Frequency Range:	525 to 1605 kHz. (See also Note at end of this Sub-Section).
Frequency Tolerance:	A vernier adjustment allows the carrier frequency to be set accurately to the assigned channel frequency.
Frequency Stability:	±5 Hz.
Power Output:	10.6kW (carrier)
Power Input:	
Carrier only:	22kW
Average Programme:	25kW
100% Tone Modulation:	32kW
Power Factor:	0.9
Audio Input Level for 100% Modulation:	8 dbm ±2 db
Audio Input Impedance:	600Ω (balanced).

Audio Response: (50% Modulation)	±1 db between 30 Hz and 10,000 Hz falling to -30 db at 15000 Hz, referred to 1000 Hz.
Harmonic Distortion:	Less than 2.5% for modulation depths below 96% between 50 Hz and 7500 Hz.
Carrier Shift:	Not more than 5%.
Carrier Noise Level:	-60 db below 100% modulation.
Output Impedance:	200Ω (unbalanced).
Spurious Radiation:	The mean level of any spurious radiation does not exceed 20 mW.
Power Supply:	380V to 440V, 50 Hz, 3-phase with neutral connection.
Filament Supply Regulation: (With accessory regulator fitted)	±2% for variations of +10 to -15% in mains supply.
Monitor Outputs:	
R.F.:	Two; 10% in 50Ω.

NOTE: The frequency range of the transmitter is divided into six bands as follows (RFA3 ANODE CIRCUIT):

525 - 600 kHz
600 - 720 kHz
720 - 940 kHz
940 - 1350 kHz
1350 - 1605 kHz

Frequency determining components are supplied to cover only that band in which the specified frequency lies.

1.3 Composition

The component units of the transmitter are as follows:-

Unit	Type	Prefix *
R.F. Drive and Modulator	5T60092	1
Control Panel	6P60095	2
R.F. Unit and H.T. Rectifier	4T60093	3
Crystal Oscillator	1T60099	4
Modulation Monitor (Accessory Item)	6A51921	5
Contactor Panel	3T60096	6

Composition Continued

Unit	Type	Prefix *
Mains Low Alarm Unit (Accessory Item)	1R56745	7
Directional Coupler	1R60098	10
Main H.T. Transformer	1L60486	
Main H.T. Regulator (Accessory Item)	Brown Boveri	

* In the simplified circuit diagram included in this Instruction Book, components located in different units may be shown on the same sheet. To facilitate identification, all components are prefixed by a number which indicates the unit to which the component belongs.

1.4 Valve and Crystal Complement

1.4.1 Detailed Valve Complement

The following list does not include the valves in the Modulation Monitor and Mains Low Alarm Unit. The valve complements for these units can be found in the Instruction Books for these units (appended to Volume 2).

Circuit Ref	Type	Function
1V1, 1V2	2B26	RFA1
1V3, 1V4	4-125A	RFA2
1V5, 1V6	3X3000F1	RFA3
1V7	6L6	RFA2
1V8	6156/4-250A	RFA3
1V9	OA3	Regulator
1V10	2D21	Starting Delay
1V11	2D21	Overload Cycling
3V8-3V9	5762	RFA4
4V1	6AK5	Crystal Oscillator
4V2	5763	Aperiodic Amplifier

1.4.2 Crystal Complement

2 off CRYSTALS, quartz, type 3R3535, heater pins horizontal.

1.5 Mechanical Construction

The transmitter consists of two heavy gauge aluminium cabinets mounted on two 4-inch steel wiring channels (ducts) which run the full width front and rear to form a base plinth.

The left hand cabinet contains the h.t. rectifiers and power output circuits while the right hand cabinet contains the exciter and modulator. When in position on the channels the cabinet are surmounted by a canopy with an ample exhaust vent containing the artificial aerial. (Accessory Item).

Each cabinet is divided into an upper and lower compartment by a shelf and each upper compartment is sub-divided into front and rear sections by partitions running parallel to the front. The lower compartments are fitted with flat cover panels which are aligned by locating pins and secured at the top by Oddie fasteners. The upper compartments are fitted front and rear with sliding doors which are fabricated from aluminium slats. Each of the slats is free-hinged to the next slat enabling the complete door to be roller mounted and to move in curved channelling around the outboard sides of the cabinet.

The frontal space between the cabinets is occupied by the main control panel, behind which is mounted the contactor panel. The control panel is hinged at the base to allow it to be dropped forward permitting access to the rear of the panel and to the contactor panel. When in position, the control panel is secured at the top by a large Oddie fastener; in the forward position it is supported by two chains.

The contactor panel is fitted behind the main control panel.

The heavy components of the transmitter (excluding the main h.t. transformer are mounted on the floors of the lower compartments with the remainder of the components disposed in the upper compartments. The disposition of the major components is summarised below.

(a) Left Hand Cabinet - Lower Compartment

Filament autotransformer (Stabilac) Accessory Item.
Filament voltage stabiliser (Stabilac) Accessory Item.
H.T. smoothing capacitors.
Blower.

(b) Left Hand Cabinet - Front Upper Section

Main h.t. rectifiers.
P.A. valves and filament transformers.
Cathode tuned circuits.

(c) Left Hand Cabinet - Rear Upper Section

P.A. stage anode tuning and loading capacitors and inductors
Directional coupler
Auxiliary h.t. supply

(d) Right Hand Cabinet - Lower Compartment

Modulation transformer
Modulation chokes
Modulation blocking capacitors
Blower

(e) Right Hand Cabinet - Front Upper Section

Crystal ovens
Exciter and driver valves
Modulator valves
Modulation monitor (Accessory Item)
Power contactors
Mains low alarm unit (Accessory Item)

(f) Right Hand Cabinet - Rear Upper Section

Bias supply
Timing circuit sub-assembly
Components associated with exciter and driver
Components associated with modulator
Relay set

All valves, meters and indicating lamps mounted inside the cabinets are visible through windows fitted to the sliding doors. Lights and power outlets are located in the upper compartments to facilitate maintenance.

The main h.t. transformer is located externally to the transmitter.

1.6 Dimensions and Weights

Height:	7 feet 3 inches (excluding canopy)
Width:	6 feet 10 inches
Depth:	3 feet 1.3/4 inches
Weight:	4000 lb (unpacked)
H.T. Transformer:	3 feet 6 inches x 1 foot 6 inches x 3 feet 6 inches
Weight:	1400 lb (approx).

1.7 Filament Voltage Stabiliser (Accessory Item)

The a.c. input to the filament transformers is regulated by a valve-controlled variable reactance voltage stabiliser which provides a single phase stabilised output of 415 volts.

A complete description of the unit (Stabilac SP3000/ANA) will be found in the maker's handbook supplied with the equipment.

1.8 Ventilation and Heating

The ventilation system is supplied by two motor-driven multivane fans mounted behind the control panel and extending into the two cubicles. One of the blowers forces air to the output and rectifier section and supplies cooling for both cabinets whilst the other supplies a forced air draught to the modulator and sub-modulator valves. The blowers are controlled and protected by Magnetic Motor starters which are fitted withreset buttons for re-connection of the blowers after overloads.

The heated air is exhausted through the canopy in which the artificial aerial (accessory item) is mounted.

Manometers are installed in each cabinet to provide an indication (in inches of water) of cabinet pressurisation. The normal reading for both cabinets is 2 inches nominal.

The crystal ovens are thermostatically controlled and are also connected to the ANCILLARY mains supply to permit pre-heating. Unless the transmitter is to be shut down for an extended period ANCILLARY mains should be left on permanently. In cold climates the ANCILLARY mains must be on for at least 2 hours prior to transmitter starting. Cabinet heaters are provided to prevent condensation within the transmitter during shut-down periods.

1.9 Power Control

The circuit breakers on the control panel are normally left ON, the transmitter being controlled by a push-button ON/OFF switch, an H.T. ON switch and an EMERGENCY OFF button. Provision is made for the remote connection of these switches and controls if required for desk or console operation.

A timing circuit consisting of two grid controlled thyratrons delays the application of the main H.T. until 60 seconds after switching on to allow the high power valves to attain the correct operating temperature.

Severe overloads are handled by thermal magnetic circuit breakers, whilst overload relays and a thyratron timing circuit deal with excessive current drains in the power amplifier or modulator valves, or aerial circuit faults.

The latter circuits provide for a momentary removal of the h.t. when an overload occurs. If the overload is of a transient nature, the h.t. is restored after a delay of approximately one second and transmission is automatically continued. If the fault persists, the h.t. is switched off and then on again. This cycling action repeats for a number of times depending on the setting of a pre-set control in the thyratron circuit, the normal adjustment being for three cycles. When the main h.t. is switched off in the last cycle, the second thyratron is triggered, producing a "lock-out". This means that the transmitter h.t. will remain off until some switching operation is carried out. In this case, the H.T. ON switch must be set to the OFF position and then switched ON again.

Overloads in the auxiliary h.t., sub-modulator and r.f. driver are handled by "one-shot" relays which produce a lock-out after one operation, and are re-set as above. A bias "no-volt" relay switches off the h.t. in the event of a bias failure.

A thermal delay contact is included in the control circuits to provide quick restart after short duration mains failures. Mains failures of duration longer than the delay time of this contactor produce full time delay restart.

All overloads are indicated by an associated lamp in the main control panel. The INDICATORS CLEAR button must be pressed to extinguish the overload pilots once the relay has operated even when this operation is not necessary to clear the lock-out produced. A gate switch interlock is provided to break the main h.t. control circuit while any of the doors remain open or any panel is not correctly in position. An indicator lamp and a selector switch, mounted on the control panel form a FAULT LOCATOR which may be used to determine rapidly which gate switch is unoperated. An INTERLOCK COMPLETE pilot lights when all gate switches are operated, and the INDICATORS CLEAR button must be pressed after all gate switches are closed, before any further switching will occur.

1.10 Tuning

Tuning is carried out by a combination of selecting fixed capacitors and inductor tappings in the grid and anode circuits of the r.f. stages. The output circuit is a double pi-network, arranged to cover the frequency band in a similar manner, except that only the frequency-determining capacitors for a limited band including the specified frequency are supplied.

When coarse selection has been made, fine tuning is carried out in the driver and p.a. anode circuits. The driver is tuned by a sliding shorted turn in the anode inductor, whilst the p.a. anode circuit is tuned by a variable vacuum type capacitor.

Both these drives are brought to the front door jamb of the cabinets, the driver control to the left-hand side of the R.F. Drive and Modulator cabinet and the p.a. control to the right-hand side of the R.F. Unit and Rectifier cabinet. They are coupled to counter-type dials having recessed hexagon heads, into which a miniature chromium plated crank handle is inserted when adjustment of these controls is desired.

A TUNE/NORMAL switch, located on the control panel provides for a reduced main h.t. being applied to the transmitter during tuning adjustments of the r.f. driver and output stages. A TUNE/WORK switch is also provided in the upper front compartment of the right hand cabinet to permit the application of the auxiliary h.t. without the main h.t. being connected, when lower level stages are being tuned.

For detailed tuning instructions refer to Section 4.

1.11 Supervisory Facilities

Visual indication of transmitter operating and fault conditions is provided by pilot lamps operating from a 6.3V a.c. supply. These lamps indicate the steps in the starting sequence of the transmitter and also give an indication of the location of the fault conditions. The colours of the lamp bezels provide an indication of the lamp functions as follows:-

GREEN	-	Normal operating conditions
AMBER	-	Non-urgent alarm conditions
RED	-	Urgent alarm conditions

An aural alarm is given when the mains voltage falls below a pre-determined level for a given time. (If Accessory Mains Low Alarm Unit is Fitted)

1.12 Metering

Metering of mains input voltages, h.t. voltages and valve voltages and currents is provided, together with indications of forward and reflected aerial power and valve filament hours.

The various meters in the transmitter are listed below.

Circuit Ref.	Indication	Location
1M12	Oscillator (4V1) Cathode	Immediately above crystal ovens in upper front compartment of R.F. Drive and Modulator cabinet.
1M13	Amplifier (4V2) Cathode	
1M5	AFA1 (1V1) Cathode	Mounted on panel in upper front compartment of R.F. Drive and Modulator cabinet.
1M6	AFA1 (1V2) Cathode	
1M7	AFA2 (1V3) Cathode	
1M8	AFA2 (1V4) Cathode	
1M9	RFA2 (1V7) Grid	Mounted on control panel in upper front compartment of R.F. Drive and Modulator cabinet.
1M10	RFA2 (1V7) Cathode	
1M11	RFA3 (1V8) Grid	
1M14	RFA3 (1V8) Screen	
5M1	Set Carrier	
5M2	% Modulation	
1M1	Mains Voltmeter	Top panel of R.F. Drive and Modulator cabinet.
1M2	Bias Voltage	
1M3	AFA3 (1V5) Anode	
1M4	AFA3 (1V6) Anode	
3M3	RFA4 (3V8) Cathode	Mounted on panel in upper front compartment of R.F. Unit and H.T. Rectifier cabinet.
3M4	RFA4 (3V9) Cathode	
3M1	RFA4 (3V8, 3V9) Grid	Top panel of R.F. Unit and H.T. Rectifier cabinet.
3M2	RFA4 (3V8, 3V9) Anode	
3M5	Main H.T. Voltage	
3M6	RFA3 (1V8) Anode	
2M1	Filament Hours	Mounted on Main Control Panel.
2M2	Filament Voltage	
2M4	Switched Voltmeter:	
	Control Voltage	
	Auxiliary H.T.	
	RFA2 Screen	
	RFA2 Screen	
	Crystal Oscillator	
	AFA1 Screen	
2M5	Aerial Power (reflected)	
2M6	Aerial Power (forward)	
2M7	Carrier Fail Meter Relay	
2M8	Aerial Fault Meter Relay	

1.13 Artificial Aerial (Accessory Item)

The artificial aerial is fitted in the exhaust duct of the transmitter, and is made up of resistance units to the power capability required. An L-network is provided to allow the artificial aerial to be matched to exact impedance required. The network is not supplied in transmitters intended for parallel operation .

Each unit is constructed of nichrome resistance strip, insulated with mica, and wound in and out of stacked steel cooling plates, the method of winding being designed to minimise the inductance. The required number of resistance units are then mounted on insulators in a metal framework and connected in series to form the artificial load.

1.14 Inspection Lights and Power Outlets

Inspection lights are fitted to the upper front and rear compartments of the cabinets, for use when making adjustments and servicing. A power outlet is also provided in each cabinet for operating test equipment or other portable apparatus.

The power outlets are alive when the AUXILIARY MAINS circuit breaker is closed, but the operation of the LIGHTS switch on the control panel is also necessary to switch on the inspection lights.

1.15 Remote Control Facilities

Facilities have been provided for the connection of remote control and supervisory units. These units carry all the necessary controls for operation of the transmitter from remote switching units or consoles.

1.16 Modulation Monitor (Accessory Item)

The transmitter can be fitted with a Modulation Monitor type 6A51921 which provides continuous monitoring of the transmitter output. The two meters associated with the modulation monitor are located on the control panel.

A full description of the modulation monitor will be found in Volume 2, Appendix 1.

1.17 Mains Low Alarm Unit (Accessory Item)

The Mains Low Alarm Unit type [illegible] is a self-contained unit and can be located in the upper front compartment of the R.F. Drive and Modulator cabinet. The unit is arranged to give aural indication should the mains voltage on any phase drop below 85% of nominal.

A full description of the mains low alarm unit will be found in Volume 2, Appendix 2.

- End of Part -

2. INSTALLATION

2.1 Preparation of the Station Building

It is assumed that the station building has been properly prepared with an adequate concrete floor space and wiring trenches. The disposition of the external wiring will depend on the location of the external units and the incoming mains supply.

2.2 Unpacking

All packing cases are identified by the unit reference number of the component parts which they contain. For transport, the transmitter is broken down into the following sections (The degree of break-down depends to some extent on the mode of transport):

1. The base wiring channels with the wiring laced inside.
2. The two cabinets, from which the heavier and the fragile components have been removed. Doors and covers are also packed separately.
3. The top canopy, which contains the artificial aerial, dismantled for economy of packing space.
4. The control panel.
5. Two end panels which cover the outer sides of the cabinet, and the cover panel for the rear of the control panel.
6. Heavy components, such as the modulation transformers, chokes, filament transformers and main h.t. smoothing components.
7. The main h.t. transformer.
8. The filament voltage stabiliser.
9. Meter panels.
10. Meters, valves, crystals, vacuum capacitors, etc.

2.3 Assembly

All electrical components and hardware items of the transmitter are tagged to facilitate both assembly and re-wiring. Where two parts are to be bolted together, the mating bolt-holes are identified with duplicated labels, ensuring correct assembly. The following assembly instructions are therefore only included as a guide, since the system of labelling is normally sufficient in itself, in conjunction with the drawings provided, to enable re-assembly of the transmitter.

Basically, re-assembly consists of locating the cabinets and control panel in position on the wiring channels, fitting the cover pieces and canopy, installing the component parts of the transmitter, and re-connection of the wiring. The necessary external connections are given in Sub-Section 2.4.

The R.F. Drive and Modulator cabinet is located at the right, the R.F. Unit and H.T. Rectifier cabinet on the left, the Control Panel occupying the space remaining between them on the base wiring channels.

The general method of assembly is as follows:-

WARNING: When re-assembling, do not lift or otherwise handle the cabinets by the roller door channels or their supporting brackets, as this can cause the door to seize. If, after installation, the doors do not run freely, tap down the lower channel brackets with a rubber mallet.

1. Check that the mounting site is level. Place the base channels (wiring ducts) in position on the floor, with the duct covers facing outwards. Space them the correct distance apart, then level all channels, using packing pieces where necessary, to ensure the upper surfaces are level with each other. It is important to ensure a level plane for the cubicles to rest on, so that the transmitter can be re-assembled without straining of the cabinets or dividing walls. Take care that there is adequate support for the channels between the packing pieces, where used.

2. Mark out the positions of both channels, then remove the front channel and packing pieces, marking the latter to ensure correct replacement when needed. Bolt the rear channel to the floor, or secure it in such a way that it will not move when the cabinets are manoevred into position.

3. Identify the right hand cabinet (R.F. Drive and Modulator) and place it in position with the rear channel supporting the rear of the cabinet. The wiring cut-outs should be aligned with those in the rear channel.

4. Identify the centre base plate, and place it in position on the left side of the cabinet, so that the rear is supported by the rear channel.

5. Identify the left hand cabinet (R.F. Unit and H.T. Rectifier) and place into position so that the inside lower edge of the cabinet is up against the left hand edge of the centre base plate.

6. Tilt the cubicles back, and pack up the front edges with packing pieces. Pack the front of the centre base plate to the same height, then return the front wiring duct to its position.

   Align the cut-outs on the channel to those in the cubicles. Remove the packing pieces supporting the front edges, and bring the cabinets and the centre base plate to rest on the channels.

7. Assemble and fit the sliding doors. These are labelled, but may be readily identified by the fact that the front doors are fitted with seven windows, the rear doors with five. In addition, the catchblock assembly is positioned below centre, which enables identification of the cubicles to which they belong.

The tops of the doors run on nylon ball pivoted on spigots, which locate into the hinges between adjacent slats. The lower edge of the doors run in the door channels in a similar manner, except that every third nylon ball and spigot is replaced by a roller assembly, containing three rollers. The first spigots (catchblock end of door) locate in a groove milled in the leading edge of the first slat, the last spigots being fitted to a socket clamped permanently to the trailing edge of the door.

The rear door must be fitted first as it runs in the inner door channel. To fit it, the door must be held in position with the catchblock edge vertical at the front of the door channel bracket. Insert a spigot and nylon ball into the groove at the top of the leading edge of the catchblock slat, and a roller assembly into the bottom. Feed the first slat in between the door channel brackets. Before the hinge has passed between the brackets, fit a nylon ball and spigot to both top and bottom of the hinge. Continue to fit the rollers whilst feeding the slats one by one in between the door channel brackets, guiding the leading edge into the inner door channel. REMEMBER TO FIT A ROLLER ASSEMBLY TO THE LOWER EDGE OF THE DOOR FOR EVERY TWO NYLON BALLS.

The fitting of the front door is simpler, and follows the same sequence as above, except that the door can be fed directly into the channel. This permits the fitment of all the top nylon balls and spigots before fitting the door, and only the lower rollers must be fitted one by one whilst the door is being fed into the channel.

Fit the catchblock and ensure the doors operate smoothly, checking the operation of the gate switches by listening for a click as each door closes.

8. Loosely bolt the centre baseplate to the right-hand cabinet.

9. Identify the contactor panel, and bolt it to the vertical angle bracket on the right hand cabinet. Do not tighten the bolts at this stage.

10. Adjust the position of the left hand cabinet, if necessary, to align the holes in the contactor panel and in the base plate to the corresponding holes in the cabinet and in the contactor panel bracket. Bolt the base plate and the contactor panel to the left hand cabinet, and when it is certain that the cabinets are vertical and correctly aligned in all directions, tighten the bolts securely.

Bolt the bracket, which secures the upper end of the control panel, between the upper front adjacent corners of the two cabinets.

11. Fit the long cover strips that run along the top of the assembled transmitter, front, sides and rear. Fit the side covers over the door channel sides of both cabinets.

12. Place the canopy sections in position, with the aerial insulators to the rear and assemble. Install the artificial aerial (if supplied).

13. Fit the meter panels that locate at the front top of each cabinet. Mount the aerial insulator and the earth stud, and make the necessary connections between them and the cabinets.

14. Remove the covers from the wiring ducts and pass the free ends of the cableforms and coaxial cables through the nearest cutouts in the undersides of the cabinets. Make the tagged connections to the units and connect the coaxial cables (where applicable).

NOTE: All cableforms are labelled with the identification of the terminals to which they connect, and the use of bakelite fanning strips insures correct connection of individual wires. While the duct covers are removed make all external connections.

15. Identify and fit the control panel. This panel is hinged to the centre base plate, the hinge being bolted to it. Chain stays, secured at one end to the cabinet walls and at the other end of the inner lips at the edges of the control panel, are provided to enable the panel to be dropped forward for maintenance or testing purposes. When in position, it is held in place by a large chrome Oddie fastener. Connect the cable-form according to the tagged strips.

16. Install the h.t. filter capacitors in the lower front section of the left hand cabinet. These are not bolted down, and merely stand on the base of the cabinet. Connect the terminals of these components according to the tags.

17. Install the modulation transformers and inductor in the lower section of the right hand cabinet, as in the above, making all required connections. Capacitors [illegible], [illegible] and [illegible] are also fitted in this compartment.

18. Install the modulator coupling capacitors in the upper rear compartment of the right hand cabinet, and connect into circuit.

19. Install the filament stabiliser and autotransformer (if supplied) at the rear of the lower compartment of the left hand cabinet, and make the connections according to the tags.

20. Replace all remaining large components that have been removed from the various shelves or walls of the cabinets, according to the stencilled identifying labels adjacent to their location in the cabinet.

NOTE: The vacuum capacitors are fitted latter.

21. Fit the meters to the main meter panels above the cabinet doors and wire as indicated. Fit the meter panel containing the four small meters in the upper front section of the right-hand cabinet. Install the small meters 3M3 and 3M4 in position in the upper front compartment of the left-hand cabinet, and replace all the meters in the control panel. Wire all meters as indicated on the wiring tags.

22. Position the main h.t. transformer and wire to the external wiring. This wiring, together with the recommended wire size and coverings, is listed in sub-section 2.4.

23. Replace the glass-enclosed capacitors.

The variable capacitors fit into retaining clips which bolt on to the same wall, the capacitor protruding through to the front. Before fitting, set the capacitor to the position of minimum capacity by rotating the drive shank as far as possible in a clockwise direction. Insert the shank into the mounting hole, guiding it into the universal coupling of the drive. Tighten the retaining clip when in position. Turn the crank handle of the tuning control fully clockwise, tighten the coupling and check for smooth operation.

24. Insert the cabinet lights.

25. Check all relays.

26. Install the mains low alarm unit (if supplied) in the front section centre shelf of the right-hand cabinet, and make the necessary connections.

27. Check all wiring to ensure that all wires are connected, and that all components are installed in the correct position.

NOTE: ALL [illegible] INSTALLED DURING THE PRELIMINARY TESTS [illegible] CARRIED OUT AFTER INSTALLATION.

2.4 External Connections

Trenches should be provided for the external wiring where possible, the location of which will depend on the disposition of the external units and the incoming mains supply and circuit breaker. The wiring may be arranged to leave the ducts in any convenient position, remembering that all external wiring terminates in in the left-hand cabinet or the control panel.

The cable, if not in floor trenches, should be protected along the whole length of run, and should be terminated by soldered lugs corresponding in size to the current-carrying capacity of the circuit and the size of the terminal to which it is connected.

Before making the external connections, ensure that the mains circuit breaker is off, and all transmitter switches and circuit breakers are in the OFF position. Measure the necessary lengths of cable, terminate as required and lay in position in the wiring duct, passing the transmitter ends up through the duct cut-outs in the nearest position to the terminals to which they connect.

Connect the wiring as follows:-

Terminals	Wire Size	Current Rating	Function
6PHA1 LOAD - TQ50U 6PHA2 LOAD - TQ50V 6PHA3 LOAD - TQ50W 2N - TQ50N	7/.064 7/.064 7/.064 162/.0076	65A) 65A) 65A) 25A)	Voltage Regulator *
TQ50 u - 6PHB1 LINE TQ50 v - 6PHB2 LINE TQ50 w - 6PHB3 LINE	7/.064 7/.064 7/.064	65A 65A 65A	Tune/Normal Switching
6PHB1 LOAD - TR1 a4 6PHB2 LOAD - TR1 b4 6PHB3 LOAD - TR1 c4	7/.064 7/.064 7/.064	65A) 65A) 65A)	Tune/Normal switching (For other than 415V mains see diagram on transformer).
TR1 A - 3W TR1 B - 3X TR1 C - 3Y TR1 N - 3Z	16/.012(6600V) 16/.012(6600V) 16/.012(6600V) 16/.012(6600V)	7A) 7A) 7A) 7A)	Main H.T. Transformer to Rectifier.
Mains Active - 2a1 Mains Neut. - 2a2 Mains Earth - 2a3	7/.064 7/.064 7/.064	65A) 65A) 65A)	Single-phase mains input to ancillary Mains circuits
Mains Phase 1 - 2(CBA) Mains Phase 2 - 2(CBA) Mians Phase 3 - 2(CBA) Neutral - 2(n)	7/.064 7/.064 7/.064 162/.0076	65A 65A 65A 25A	3-Phase mains input to Transmitter.

Programme - 2C1, 2C2, 2C3 (2C2 earth) PVC Screened RG covered 5/.0076

* If a.v.r. voltage regulator is not used link -

6PHA1 load - 6PHB1 line
6PHA2 load - 6PHB2 line
6PHA3 load - 6PHB3 line

2.5 Remote Control Connections

Where remote control of the transmitter is required, the following connections from the transmitter to the remote control point are necessary:-

Terminals	Function
2B1	ON/OFF (active)
2B2	ON
2B3	OFF
2B5-8	Emergency OFF
2B9-10	Aerial Changeover
2B11	Lockout Pilot
2B12	Carrier Fail Pilot
2C4-11	Power Meters
2C12	6.0V, 50 c/s Supply (from transmitter)
2T1	Alarm Bell

2.6 Air Pressure Manometers

The manometers are emptied before delivery and must be refilled at this stage.

To fill:- Remove both the air vent plug at the top of the glass tube and the plug at the top of the lower rear body casting. Use a pipette filled with the special unity specific gravity oil supplied to fill the manometer via the entry point at the top of the glass tube. Fill until the oil level reaches "0" on the gauge. Replace the two plugs after first ensuring that the small vent hole in the top plug has not become blocked during transit.

2.7 Transformer Adjustment Taps

Transformers not connected to the output of voltage regulators are provided with voltage adjustment tappings which must be set to the local mains voltage. These taps are detailed on the schematic circuit diagrams in which the relevant transformer is shown. A list of these transformers is given below:-

Circuit Ref. No.	Function	Drg. No.	Location
1TR6	Bias Rectifier	60090A5)	
1TR9	Control Rectifier	60090A5)	R.F. Drive and Mod-
1TR10	Crystal Heaters	60090C7)	ulator cabinet.
1TR11	Thyratron Filaments	60090A5)	
3TR11	Auxiliary H.T.	60090A5)	R.F. Unit and Rectifier cabinet.

2.8 Index of Preset Controls and Adjustable Compcnents

The preset controls and adjustable components in the transmitter are tabulated below. The function of each control or component is given, together with the book reference to the final adjustment procedures. It may be convenient to check off each item against the list during the post installation tests and tuning adjustments to ensure that all componets have been correctly adjusted.

Circuit Ref. No.	Function	Reference Volume/Section
(a)	Chokes	
1L8	Modulation Peaking (RFA4)	1/5.3
1L11	Modulation Peaking (RFA3)	1/5.3
(b)	Inductors	
1L6	RFA2 π-Circuit	1/4.1
1L9	RFA3 π-Circuit	1/4.1
1L12	RFA3 π-Circuit	1/4.1
3L5	RFA4 π-Circuit	1/4.3
3L6	RFA4 π-Circuit	1/4.3
3L13	RFA4 Harmonic Trap	1/4.4
3L14	RFA4 Harmonic Trap	1/4.4
3L15	RFA4 Harmonic Trap	1/4.4
3L16	RFA4 Harmonic Trap	1/4.4
(c)	Capacitors	
3C16	RFA4 Neutralisation	1/4.7
3C24	RFA4 Anode Tune	1/4.3
3C31	RFA4 Harmonic Trap	1/4.4
4C1	Frequency Trim - Crystal 1	1/4.3
4C2	Frequency Trim - Crystal 2	1/4.3
10C3	Directional Coupler - Pick-up Balance	2/2.7
10C4	Directional Coupler - Pick-up Balance	2/2.7

Circuit Ref. No.	Function	Reference Volume/Section
(d)	Variable Resistors	
1RV1	AFA1 Screen Voltage Adjust	1/4.6
1RV2	AFA2 Screen Voltage Adjust	1/4.6
1RV3	AFA3 (1V5) Bias Adjust	1/4.6
1RV4	AFA3 (1V6) Bias Adjust	1/4.6
1RV5	Bias Bleed	1/3.12 *
1RV6	AFA1 Bias Adjust	1/4.6
1RV7	1V9 Standing Current Adjust	1/3.7
1RV8	Overload Cycle Adjust	1/3.9
1RV9	RFA2 Screen Voltage Adjust	1/4.2
1RV10	Crystal Oscillator H.T. Adjust	1/4.2
1RV11	AFA2 (1V3) Bias Adjust	1/4.6
1RV12	AFA2 (1V4) Bias Adjust	1/4.6
1RV13	Starting Delay Adjust	1/3.9
1RV14	Bias Voltage Adjust	1/3.12 *
1RV15	Aux. H.T. Overload Adjust	1/3.8
1RV16	AFA2 Overload Adjust	1/3.8
1RV17	RFA3 Overload Adjust	1/3.8
1RV18	AFA3 Overload Adjust	1/3.8
1RV19	RFA4 Overload Adjust	1/3.8
1RV20	8 db Pad Adjust (if fitted)	3/App.1
1RV25	1V5 Filament Voltage Adjust	1/3.10 **
1RV26	1V6 Filament Voltage Adjust	1/3.10 **
2RV1	Forward Power Meter Shunt	1/4.5
2RV2	Reflected Power Meter Shunt	1/4.5
3RV1	Surge Limiting (Aux. H.T.)	1/3.13 ø
3RV2	3V3 Filament Voltage Adjust	1/3.10 **
3RV3	3V9 Filament Voltage Adjust	1/3.10 **
(e)	Thermal Delay Switch	
1THA	Thermal Delay	1/3.13

* See also Sub-Section 4.6

** See also Sub-Section 5.4

ø See also Sub-Section 5.5

- End of Part -

3. PRELIMINARY TESTS AND ADJUSTMENTS

3.1 General

The transmitter has been thoroughly tested, and operated for an extended period before delivery. If re-assembly, and re-connection of all circuits has been carried out correctly, the transmitter should function without further tests.

However, it is always desirable to check the accuracy of the connections, and it may occur that some of the preset controls have become disturbed during transit or installation. For these reasons, the following postinstallation test and adjustments have been given, and it is recommended that they are carried out before placing the transmitter into service.

It is advised that a thorough knowledge of the transmitter should be gained by reference to the circuit descriptions and diagram, before attempting to switch on for the first time.

The equipment offers complete protection to operating and servicing personnel. Gate switches and grounding switches are provided for personnel protection and no attempt should be made to interfere with or override these devices.

No attempt should be made to operate the transmitter with any door open or the access covers removed.

The preliminary tests and adjustments detailed hereafter can be performed with all doors closed and all access covers in position.

Before attempting to check, measure or adjust any component within the transmitter, the transmitter must be completely disconnected from the mains supply.

The tests should be performed in the order detailed below.

3.2 Ancillary Mains

1. ENSURE THAT ALL CIRCUIT BREAKERS AND SWITCHES ARE IN THE OFF POSITION.

2. Set the ANCILLARY MAINS circuit breaker to ON, and check that 240V a.c. is present on outlets 1CNA and 3CNA, in the right-hand and left-hand cabinets respectively. With the earth pin down, the active should be the left-hand contact of the socket.

3. Set the LIGHTS switch to ON, and check that the cabinet lights work.

4. Set 2SWC (CAB HEATERS) to ON. Check that cabinet heaters are heating.

   Check for approximatley 120V a.c. across each of the resistors 1R126, 1R127, 1R128, 1R129 and 3R19, 20, 21, 22.

   Operate by hand contacts 6PLA and check that all cabinet heaters are off.

5. Check for approximately 16V a.c. on pins 1 and 7 of both the crystal oven sockets.

6. Switch OFF.

3.3 Emergency Off Facility

1. Open the centre rear access cover and latch the contactor 6PLA by hand. Close the access cover.

2. Press the MECHANICAL TRIP button and check that the contactor is released.

3. Set the DISTRIBUTION circuit breaker to ON.

4. Press the EMERGENCY OFF button and check that the DISTRIBUTION circuit breaker is tripped.

5. Set the DISTRIBUTION and MAIN H.T. circuit breakers to ON, press the EMERGENCY OFF button, and check that both circuit breakers are tripped.

6. Repeat step (5) for the REMOTE EMERGENCY OFF if this facility is provided.

7. Reset the DISTRIBUTION and MAIN H.T. circuit breaker. Operate relay 3CR1 mechanically and check that the MAIN H.T. circuit breaker trips.

3.4 Mains Voltmeter

1. Set the DISTRIBUTION circuit breaker to ON.

2. Check operation of MAINS voltmeter and associated MAINS VOLTMETER switch. The voltage should read approximately 415 volts (or particular supply voltage being used) on each phase-to-phase position.

3.5 L.T. Switching and Blowers

1. Set LOCAL/REMOTE switch to LOCAL and press ON button.

2. Check that contactor 6PLA is energised and latches and that the blower motors start. Check that static pressure, as measured on air pressure manometers is approximately 2 inches.

3. Press the OFF button, and check that 6PLA is released and the blower motor stops. As the blower motors slows down, check the direction of rotation, and reverse if necessary. This may be done by reversing any two of the three-phase mains wires at the terminal block of the blower motor.

4. Set the LOCAL/REMOTE switch to REMOTE, and check remote operation (if this facility is provided) as in step (2) and (3) above, using the remote ON and OFF button.

5. Check that with the LOCAL/REMOTE switch to REMOTE, the blowers can be stopped by the OFF button, and that with the switch on LOCAL, the blowers cannot be started by the remote ON button, but can be stopped by the remote OFF button.

6. Switch OFF completely.

3.6 Control Supply

NOTE: At this stage it is necessary to cover the holes supplying air to the airflow switches 1SNG and 3SNB. This permits the adjustment of relays without the treatment plant being switched fully on, as it prevents the operation of contactor 6PLB. The holes must not be uncovered until described in these instructions.

1. Cover the holes supplying air to the airflow switches.

2. Close the CONTROL and DISTRIBUTION circuit breakers, and press the ON button.

3. Check for approximately -50V in the CONTROL VOLTAGE position of the meter switch 2SMJ and VOLTS meter.

4. Using a jumper or other convenient means, set the anode current of VR3 1V9 (OA3 cold cathode stabiliser) to between 3 and 5mA by adjusting preset control 1RV7.

5. Check that relays 1CSL and 1HTB have operated.

6. Operate the manual switch and check that relay 1HTB operates when the switch is set to position 2.

7. Press the RESET and INDICATORS CLEAR button and check that 1PCL operates.

3.7 Overload Relay Setting

1. Close the CONTROL and DISTRIBUTION circuit breakers, and press the ON button.

2. Using a relay setting power supply (or other suitable current source) adjust the relays as shown in the table below.

Relay to operate:	1AHO	1DOA	1DOR	1MOA	1FOA
Pilot to light:	AUX.H.T.	AFA2	RFA3	AFA3	RFA4
Connect + to:	Earth	1R20	3R42	1R25-27	3R46
Connect - to:	3R51	Earth	Earth	Earth	Earth
Adjust Resistor:	1RV15	1RV16	1RV17	1RV18	1RV19
Set current to:	1.1A	200mA	500mA	3.5A	3A
Manually operate HTA:	Yes	Yes	Yes	No	No
Check TCL operates:	No	No	No	Yes	Yes
Clear pilot - release HTA:	Yes	Yes	Yes	No	No
Clear pilot - button 28WK:	No	No	No	Yes	Yes

3. Set the contact arm of the AERIAL FAULT meter relay back towards zero until the relay operates. Check that 1LFA and 1TOL operate and that 1LFX loads on. Check that the AERIAL pilot lights.

4. Release the meter relay by moving the contact arm fur ards and check that the AERIAL pilot remains alight. Clear the pilot by pressing the INDICATORS CLEAR button.

5. Manually release relay 1HTB and prevent it from operating.

6. Set the contact arm of the CARRIER FAIL meter relay towards mid-scale so that the arm touches the pointer. Check that 1CFA pulses and continues to pulse as the contact arm is moved towards zero where contact with the pointer is broken. Check that while 1CFA is pulsating, the CARRIER pilot blinks and that the alarm bell rings intermittently (ALARM switch must be set to ON). Check also the operation of the remote [illegible] pilot and alarm bell.

3.8 Timing and Overload Setting

1. Insert valves 1V11 and 1V1[illegible] 1D22 and disconnect filament regulator.

2. REMOVE AIR BLOCKS from [illegible].

3. Set DISTRIBUTION and CONTROL circuit breakers to ON, and press the ON button.

4. Check that when the blower comes up to running speed, the air switches operate, 6PLB is energised and the PILS pilot lights.

5. Check that 1V10 and 1V11 commence to heat, and that after approximately 10 seconds from switching on, relay 1TDA operates.

6. Check that after a further 50 to 60 seconds, 1TDB pulses and 1TDC locks in. This time may be adjusted by the STARTING DELAY preset potentiometer 1RV13.

7. Set H.T. switch to ON, and check that 1HTA operates.

8. Set LOCAL/REMOTE switch to REMOTE and check that 1HTA releases. Operate remote H.T. switch and check that 1HTA operates. Return LOCAL/REMOTE switch to LOCAL.

9. Operate 1MOA momentarily and check that 1TDA and 1TOL operate and then release.

10. Repeat step (9) several times until 1TDB operates. Set 1RV8 (O/L CYCLE) so that 1TDB operates after 3 cycles of operation of 1MCA. Clear 1TDB by OFF/ON action of the H.T. switch.

11. Check that when 1TDB operates, the LOCKOUT pilot lamp lights.

12. Set the H.T. switch to OFF, and check that 1TDB releases, and the LOCKOUT pilot is extinguished.

13. Switch OFF completely.

3.9 Filament Switching

1. Insert all valves, reconnect filament regulator, switch the DISTRIBUTION and CONTROL circuit breakers to ON, and press the ON button.

2. Check that the FILAMENT HOURS meter starts to run, and check that the FIL. VOLTS meter reads 415V true (refer test report for actual reading). Adjust (if necessary) the filament stabiliser to give this voltage.

3. Measure the filament voltages of all valves and check that the voltages are within the following limits:-

Circuit Ref.	Type	Nominal Voltage (V)	Maximum Voltage (V)	Minimum Voltage (V)
1V1, 1V2	2E26	6.3	6.93	5.67
1V3, 1V4	A-125	5.0	5.5	4.75
1V5, 1V6	3E3000F1	7.5	7.5	7.12
1V7	6146	6.3	6.93	5.67
1V8	A-250A	5.0	5.5	4.75
1V10, 1V11	2D21	6.3	6.9	5.7

Circuit Ref.	Type	Nominal Voltage(V)	Maximum Voltage(V)	Minimum Voltage(V)
3V8, 3V9	5762	12.6	12.6	12.0
4V1	6AK5	6.3	6.93	5.67
4V2	5763	6.0	6.63	5.4

If the filament voltages of the modulator and p.a. valves are not within the limits specified above, adjustment should be made to the 5% taps in the primary of the filament transformers and/or the preset resistors in the transformer primary circuits as follows:-

1V5: Adjust 1TR4 and 1RV25
1V6: Adjust 1TR5 and 1RV26

3V8: Adjust 3TR8 and 3RV2
3V9: Adjust 3TR9 and 3RV3

Refer also to sub-section 3.2

4. Prevent one of the airflow switches from operating, and check that the relay 1RS releases and all filaments are extinguished.

5. Repeat step (4) for the other airflow switch.

6. Switch OFF completely.

3.10 Safety Switches and Fault Locator

1. Remove all covers except centre rear access cover, and open all doors. Rotate the FAULT LOCATOR switch on the control panel starting from position 1 (left-hand front top) and check that on all positions except the last (right-hand rear bottom) the FAULT pilot lamp lights. The I/L COMPLETE pilot should remain extinguished until ALL gate switches are closed.

2. Replace the right rear bottom cover and rotate the FAULT LOCATOR switch from position 1 to 2. Check that on the last position the FAULT pilot is extinguished.

3. Repeat step (2) for all remaining covers and gates with the exception of the left-hand top gate.

4. Close the left-hand cabinet front top gate and check that the FAULT pilot lights for all positions of the FAULT LOCATOR switch.

5. Press the INDICATORS CLEAR button and check that contactor 1RS releases. Check also that 1RS operates and the I/L COMPLETE pilot lights.

NOTE: As the FAULT INDICATOR may be of some use in those tests from this stage onwards, it is advised that reference be made to Sub-Section 5.2 which gives full instructions relating to the method of using this circuit for locating open gate switches.

3.11 Bias Switching

1. Set 1RV14 to maximum resistance.

2. Set 1RV3 and 1RV4 to maximum anti-clockwise position.

3. Set the BIAS circuit breaker to ON and press the ON button. Check that the BIAS meter reads approximately 1200 volts.

4. Check that relay 1BKV has operated and that the BIAS pilot is alight.

5. Adjust the shorting slider on 1RV5 so that the BIAS meter reads 1000 volts.

6. Check that bias voltage is present at the grids of 1V5 and 1V6.

3.12 Main and Auxiliary H.T. Switching

1. Set the sliders of 1RV1, 1RV2, 1RV9 and 1RV10 near the earthy end. Adjust 3RV1 for approximately half value.

2. Disconnect the wires to the modulator from the h.t. terminals 3Z and 3Y to prevent h.t. from being applied to the transmitter.

3. Set H.T. switch to ON. Check that contactor 6PHA operates and relay 1HTB releases.

4. Set the TUNE/NORMAL switch to NORMAL and check that 6PHB operates. Check that the thermal delay 1THA is heating and that after approximately 9–11 seconds terminal 1F1 becomes earthy.

5. Set the LOCAL/REMOTE switch to REMOTE. Set the remote H.T. switch to on, and check that 6PHA and 6PHB operate in that order irrespective of the position of the TUNE/NORMAL switch. Return the switch to NORMAL.

6. Return the LOCAL/REMOTE switch to LOCAL and set the H.T. switch to OFF.

7. Set the TUNE/NORMAL switch (on the shelf in the modulator cabinet) to TUNE.

8. Close the MAIN H.T. and AUX. H.T. circuit breakers and press the ON button.

9. Check that the AUX. H.T. reads approximately 650V on the switched meter on the control panel. Check for some reading on all other positions of the switch except AFA2 SCREEN.

10. Set the TUNE/NORMAL switch to TUNE and check that terminal 1F1 becomes open circuit to earth after 9-11 seconds. If necessary adjust the screw on top of 1THA to give this delay ensuring that 1THA is fully heated before making any adjustments.

11. Check that cathode current is flowing in the following stages:

4V1	-	meter 1M12
4V2	-	meter 1M13
RFA2	-	meter 1M10
1V1	-	meter 1M5
1V2	-	meter 1M6

12. Set the H.T. switch to ON and check that the MAIN H.T. meter reads approximately 5kV. Check that the MAIN H.T. pilot is alight.

13. Set the TUNE/NORMAL switch to NORMAL and check that the reading on the MAIN H.T. meter increases slightly.

14. Set the H.T. switch to OFF and check that the reading on the MAIN H.T. meter falls rapidly to zero. Return the H.T. switch to ON.

15. Arrange to mechanically operate relays 1DOA, 1AHC and 1DCR in turn and check, in each instance, that h.t. is removed and can only be reapplied by OFF/ON operation of the H.T. switch.

16. Arrange to mechanically operate relays 1FOA and 1MOA momentarily in turn and check, in each instance, that 1TOL operates and the h.t. is removed. Check that h.t. is reapplied when the overload relay is released.

17. Arrange to mechanically operate either 1FOA or 1MOA and hold the relay in until 1TDB operates. Check that 1TDB locks in and that h.t. is removed.

- End of Part -

4. TUNING

4.1 Preliminary

1. Arrange the linking between 1C55 and 1C56 to give either 1240, 620 or 130pF in circuit depending on operating frequency as shown on the Tuning Chart (Drg 6009009).

2. Set the shorting tap on 1L6 as indicated on the Tuning Chart (Drg 6009009).

3. Set the 1V8 grid tap on 1L6 approximately 1/4 up the non-shorted section of the coil from the earthy (1C58) end.

4. Set the shorting taps on 1L9 and 1L14 as indicated on Tuning Chart (Drg 6009009).

5. Connect capacitors 1C69 through 1C86 according to the following table.

Frequency	π-Circuit Capacitance	
	Input	Output
535 - 750 kHz	1000pF	3000pF
620 - 850 kHz	750pF	2000pF
740 - 1010 kHz	500pF	1000pF
1010 - 1300 kHz	250pF	500pF
1300 - 1605 kHz	125pF	400pF

NOTE: The capacitance values listed above are approximate only and may need adjustment to obtain correct tuning and loading of RFA3.

6. Consult the Transmitter Test Report to ensure that the correct capacitors are installed in the p.a. output circuit.

7. Install the crystal oven in OVEN 1 position and set the CRYSTAL switch to position 1.

4.2 Tuning of Early R.F. Stages

1. Set the TUNE/WORK switch to TUNE and bring the transmitter on to the stage where bias is available.

2. Ensure that the H.T. switch is OFF and that the MAIN H.T. circuit breaker is closed.

3. Adjust the slider of 1RV9 to give 80-100V in the RFA2 SCREEN position of the meter switch.

4. Adjust the slider of 1RV10 to give 150-170V in the CRYSTAL OSC. position of the meter switch.

5. Check for approximately 1mA grid current in the RFA2 GRID meter.

6. Adjust the shorting tap on 1L6 to give minimum anode current in the RFA2 CATHODE meter.

7. Adjust the 1V8 grid tap on 1L6 to give approximately 50mA (or more) in the RFA3 GRID meter. Readjust the shorting tap for resonance.

8. Check that the RFA2 CATHODE current is between 40 and 50mA.

9. Set the CRYSTAL switch to position 2 and check that grid current is not evident in the RFA2 GRID meter. Return the CRYSTAL switch to position 1.

10. Install the second crystal oven (if supplied) in the OVEN 2 position and check for current in the RFA2 GRID meter when the CRYSTAL switch is set to position 2.

11. Set the TUNE/WORK switch to WORK.

12. Disconnect h.t. feed to 3L4.

13. Bring h.t. on in the TUNE condition.

14. Adjust the slug of 1L9 (front panel control on R.F. Drive and Modulator Cabinet) for a dip in RFA3 ANODE current.

15. Check that at least 600mA is indicated on RFA4 GRID meter.

4.3 R.F. Tuning

1. Connect the transmitter to the aerial system or artificial aerial.

2. Switch H.T. off and replace h.t. feed to 3L4.

3. Re-apply h.t. in the TUNE condition and adjust 3C24 (front panel control on the R.F. Unit and H.T. Rectifier Cabinet) for a dip in RFA4 ANODE current

4. Check all meter readings against the following tabulation.

RFA2 GRID	1-2mA
RFA2 ANODE	40-50mA
RFA3 GRID	20-30mA
RFA3 ANODE	200mA approximately)
RFA4 GRID	400mA approximately)
RFA4 ANODE	1.2A approximately)

5. Neutralise the p.a. as detailed in Sub-Section 4.7.

6. If the conditions detailed in step (4) above do not exist after neutralisation, adjust the relevant inductor taps or capacitors and retune. The following general rules will assist in determining the changes which are necessary.

   (a) If RFA2 GRID current is too low increase the h.t. on the crystal oscillator to a maximum of 250V, (adjust 1RV10).

   (b) If RFA2 GRID current is too high, decrease the h.t. on the crystal oscillator to a minimum of 150V.

   (c) Provided RFA3 GRID current is within limits, a lower than normal reading on RFA2 CATHODE can be neglected. If RFA2 CATHODE current is much greater than 45mA, the shorting tap on 1L6 is probably not adjusted for resonance. If the stage is in resonance and the current still high, reduce the screen voltage on RFA2 (adjust 1RV9). This may necessitate shifting the coupling tap on 1L6 to maintain correct current in RFA3 GRID. After shifting the coupling tap on 1L6, check that the shorting tap is set as close as possible to resonance.

   (d) If RFA3 ANODE current will not dip through resonance, adjustment of the shorting taps on 1L9 and 1L14 is necessary. If resonance is approached with the movable short-circuited turn (front panel control) right out of the coil, more inductance is required in either 1L9 or 1L14.

   (e) If the dip in RFA3 ANODE is below 200mA, the stage requires heavier loading. Increase the value of the output capacitance (3C31-36) in the π-circuit and retune.

   (f) A lower than normal reading for RFA4 GRID current also indicates that heavier loading is required in RFA3. Note however, that if RFA3 is heavily overloaded, RFA4 GRID current will be lower than normal.

   (g) If RFA4 ANODE dips below 1A, the loading on the p.a. stage should be increased by decreasing the number of turns in circuit of 3L5. For small loading changes decrease the value of capacitance (3C36-42). Loading can also be changed by adjusting the number of turns in circuit of 3L6; more turns gives heavier loading.

7. The second π-circuit (3L6 inductive element) should not require any adjustment, but if the tuning of this circuit is to be checked, proceed as follows:-

   (a) Short out 3L6.

(b) Reload the stage using as much inductance as possible in 3L5 and by selecting capacitors from those supplied in the groups 3C36-46. Note the value of this capacitance and call this value XpF.

(c) Select from group 3C36-46 a value of capacitance, the reactance of which equals the line impedance at the operating frequency. Call this value YpF.

(d) Select from group 3C36-42 a capacitance equal to (X + Y)pF.

(e) Progressively increase the inductance of 3L6 from zero until the original loading figures are obtained.

8. Set the TUNE/NORMAL switch to NORMAL.

9. Check that all meter readings are within the limits given below.

RFA2 GRID	1-2mA
RFA2 ANODE	40-50mA
RFA3 GRID	10-15mA
RFA3 ANODE	350mA
RFA4 GRID	800mA
RFA4 ANODE	2.6-2.7A

10. Check that the RFA4 CATHODE currents do not differ by more than 15%.

11. Check the frequency of the transmitter in both positions of the CRYSTAL switch against a frequency sub-standard. Adjust 4C1 and 4C2 as necessary.

4.4 Adjustment of P.A. High Efficiency Circuits

1. Ensure that the transmitter is completely off and disconnect the filament leads to 3V8 and 3V9.

2. Connect the output of a signal generator tuned to the third harmonic of the operating frequency of the transmitter to the junction of 3C55/3L13 via a low value capacitor (about 10pF).

3. Connect a vacuum tube voltmeter to the same point and adjust the signal generator output to a convenient reference level.

4. Adjust slug in 3L13 for maximum reading on the v.t.v.m.

5. Repeat steps (2) to (4) inclusive for the remaining third harmonic traps using junctions 3C56/3L14, 3C57/3L15 and 3C58/3L16.

6. Reconnect the filament leads to 3V8 and 3V9.

7. Connect the signal generator and v.t.v.m. to the centre tap of 3V8 filament and adjust 3L13 and 3L14 for maximum reading on the v.t.v.m.

8. Transfer the signal generator and v.t.v.m. to the centre tap of 3V9 filament and peak 3L15 and 3L16.

9. Remove the signal generator and v.t.v.m.

10. Bring the transmitter on to full power and adjust 3C54 for maximum power output.

4.5 Power Measurement and Directional Coupler Calibration

If absolute r.f. power measuring equipment is available, the accuracy of the FORWARD and REFLECTED power meters can be checked as follows:-

1. With the transmitter correctly tuned as detailed above, accurately measure the actual power output into a non-reactive load of the correct resistance.

2. Adjust 2RV1 to make the FORWARD power meter read correctly. (2RV1 is located behind name plate on main control panel- temporarily remove nameplate).

3. Prevent the AERIAL FAULT meter relay (or 1FA) from operating and open circuit the output of the transmitter.

4. Bring the transmitter on to the TUNE condition.

5. Adjust 2RV2 until the REFLECTED power meter reading is equal to the FORWARD power meter reading.

6. Short circuit the load and bring the transmitter on to the TUNE condition.

7. Check that the FORWARD and REFLECTED power readings are equal but not necessarily of the same value as in step (5) above. If the readings are not equal, indications are that the directional coupler is not correctly aligned. Refer to Volume 2, Sub-Section 2.7 for alignment procedure.

4.6 Audio Adjustments

1. Set 1RV3 and 1RV4 to approximately mid-position.

2. Adjust 1RV1 to give 100-120V in the AFA1 SCREEN position of the meter switch.

3. Adjust the tap of 1RV2 to give 320-350V in the AFA2 SCREEN position of the meter switch.

4. Bring the transmitter on to full power.

5. Check that the BIAS meter reads approximately 1kV and that 1RV3, 1RV4 can be set so that 1V5 and 1V6 cathode currents are each 150mA. If necessary, adjust the shorting slider on 1RV5 and 1RV14.

6. Check that 1V1 and 1V2 cathode currents are each 10mA. Adjust 1RV6 if necessary.

7. Check that 1V3 and 1V4 cathode currents are between 50 and 70mA. If the currents are not substantially equal, adjust 1RV11 and 1RV12.

8. The transmitter is now ready for modulation checks to be made.

4.7 Neutralisation of P.A. Stage

A "cold" neutralisation procedure is adopted and should be performed during the initial tuning of the p.a. stage (see Sub-Section 4.3). The procedure is as follows:-

1. Switch h.t. off and remove feed to 3L4.

2. Connect a v.t.v.m. into the p.a. output circuit. (Either of the monitor outputs 3SKB, 3SKC are recommended).

3. Bring the transmitter h.t. on to the FULL condition.

4. Adjust 3C24 for maximum reading on the meter.

5. Adjust 3C16 for minimum reading on the meter.

6. Repeat steps (4) and (5) until the stage is neutralised.

7. Switch h.t. off and disconnect the v.t.v.m. Replace feed to 3L4.

8. Proceed with the p.a. tuning as detailed in Sub-Section 4.3.

- End of Part -

5. OPERATION

5.1 Normal Operation

Provided installation checks and tuning adjustments have been carried out as detailed in the preceding sections, the transmitter should require little attention under normal operating conditions. Regular meter readings should be taken so that any gradual dropping off in performance or adjustments can be readily seen. Regular maintenance as detailed in Volume 2 of this Instruction Book should also be practised. Although efficient air filters are used, there will be an accumulation of dust within the cabinets after long hours of constant use. The transmitter should be regularly cleaned and inspected.

It is important to note that the ANCILLARY MAINS should be left on even when the transmitter is not working. This ensures that the cabinet temperature will be slightly above ambient temperature thus preventing condensation within the cabinet.

For remote unattended operation, the transmitter is started up and closed down by the ON and OFF extended push buttons only, all time delays and switching sequence being automatic.

5.2 Operation of the Fault Locator

An interlock circuit is provided in the transmitter, which prevents the application of main, minor and auxiliary h.t. and of the bias supply voltage, if any of the gate switches are unoperated. These gate switches are fitted to the upper and lower, front and rear covers or doors on both of the transmitter cabinets, and serve as a safety device to protect the operating personnel. When all covers are in place, and all doors are closed, the interlock circuit is complete as all the gate switches will then be operated. An I/L COMPLETE pilot lamp is provided to indicate this.

In the event of the I/L COMPLETE pilot lamp not being alight, a check must be made to locate the open gate switch, and to facilitate this, a fault locating circuit has been incorporated, consisting of the FAULT LOCATOR switch and associated FAULT pilot lamp.

The 8-position switch is divided into two sections for the left hand and right hand cabinets, the individual gate switches being assigned initial letters indicating the front (F), rear (R), top (T) and bottom (B). In this way R.B. indicates the gate switches operated by the rear bottom cover.

If the I/L COMPLETE pilot is noticed to be extinguished, the following procedure should be followed:-

1. Set the FAULT LOCATOR switch fully anti-clockwise and rotate it in a clockwise direction, position by position, until the FAULT pilot lamp is extinguished. This position will indicate an unoperated gate switch.

2. Check the faulty door or cover and replace correctly, listening for the click which will be heard when the gate switch operates. If the I/L COMPLETE pilot lamp now is alight, proceed with the transmitter switching sequence. If the lamp is still not alight, this will indicate a further unoperated gate switch which must be located as detailed in step (1).

NOTE: Owing to the nature of the fault location circuit, the search for the unoperated gate switch must always be made commencing with the switch in the extreme anti-clockwise position. If two or more gate switches are unoperated only one of the faulty positions will be indicated during each search with the FAULT LOCATOR switch. Thus if two or more gate switches are open, the fact that the FAULT LOCATOR pilot is alight for any particular position of the switch does not necessarily indicate that the associated gate switch is operated. Searching with the switch should be concluded only when the I/L COMPLETE pilot lights, indicating that all gate switches have operated.

5.3 Prolongation of Performance

The following notes are presented as a guide to the remedial measures should the performance of the transmitter fall below that specified in Section 1.

It is again emphasised that a log of meter readings will serve to forewarn of valve failure or failing performance and will allow component replacement to be effected before interruption to service occurs.

(a) Response

The modulation peaking choke 1L11 provides control of the frequency response and modulator valve currents above approximately 3000 c/s. If the response at 10 kc/s is up, more sections of 1L11 should be brought into circuit. A choke (1L8) is also provided in the modulated feed to the r.f. driver stage the number of sections in circuit having an effect on the degree of pre-modulation at high audio frequencies. This latter choke therefore influences the response and distortion of the transmitter at high audio frequencies.

Should the response at low frequencies be down, the components in the feedback network should be checked. Open circuited or otherwise faulty components will modify the degree of feedback and hence upset the response.

(b) Distortion

Distortion and response are generally related and the correction of one usually corrects the other. The distortion at middle frequencies can be reduced by careful adjustment of the operating conditions of AFA1. The cathode resistor 1RV6 should be adjusted for minimum distortion at approximately 1000 c/s. Distortion at high audio frequencies can be corrected by modifying the operating conditions of AFA2. Increase in screen voltage above the normal figures laid down in Sub-Section 4.6 is permissible and some increase in gain and/or reduction in distortion may accrue from careful adjustment of the operating conditions for this stage.

(c) Noise

The main noise component in the transmitter originates in the filaments of the AFA2 valves. If the noise figure deteriorates, reversal of the filament connections to either or both valves will give an improvement in noise level.

5.4 Modulator and P.A. Valve Life

The life expectancy of the modulator and p.a. valves may be extended by judicious operation at reduced filament voltage. The filament voltages can be reduced by adjustment of the primary taps on the filament transformers and/or adjustment of the preset resistors in the transformer primary circuits.

5.5 Auxiliary H.T. Overloads

Mains and switching surges may cause operation of the auxiliary h.t. overload relay causing an h.t. lockout. If this relay tends to operate during the sequential switching period, the shorting slider on 3RV1 should be moved to increase the effective value of the resistor.

- End -

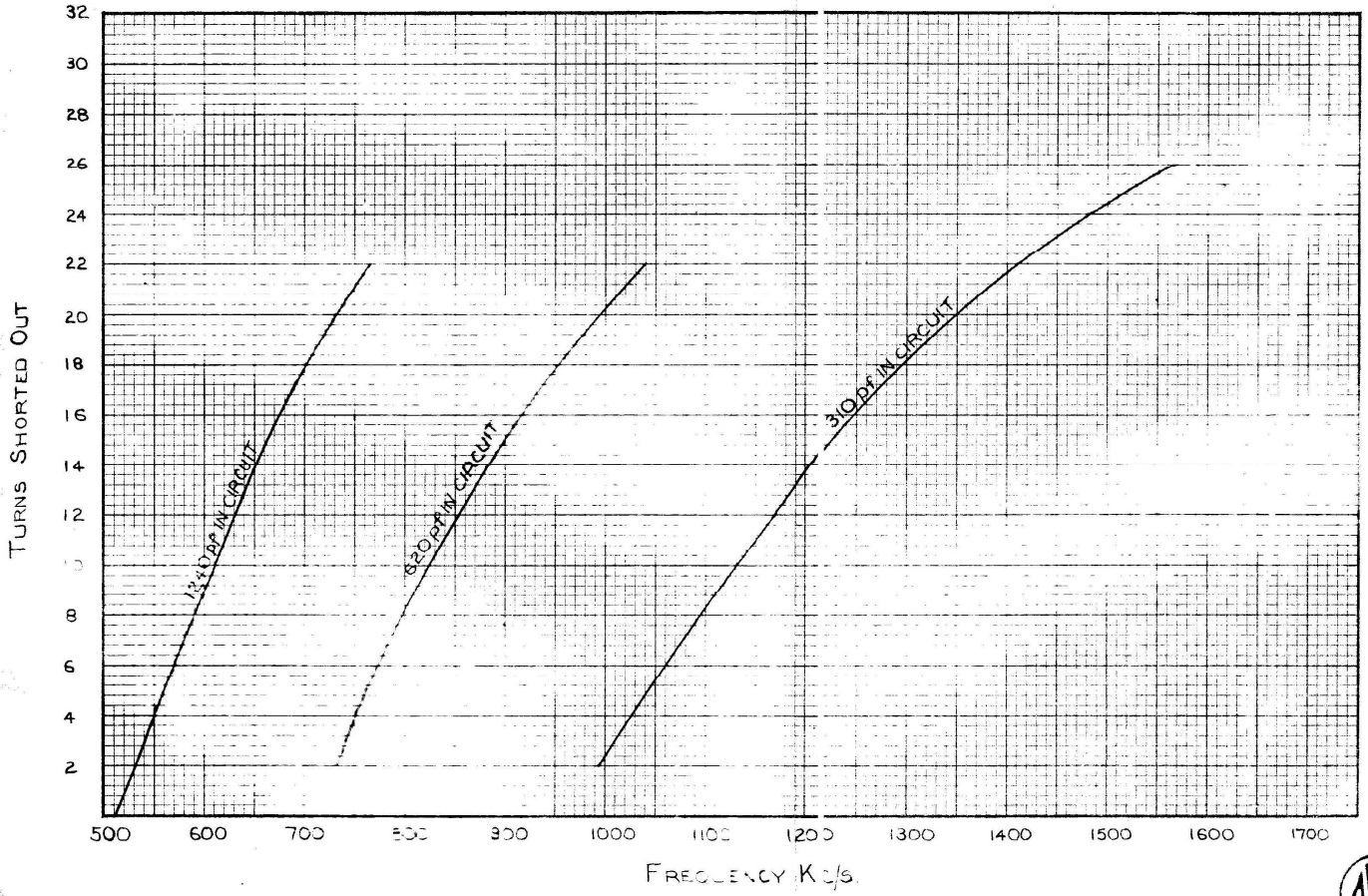

CHART FOR ... INDUCTORS IL6
10 K.W. TRANSMITTER BTM-C
TYPE 5J60090
DRG. 6009003

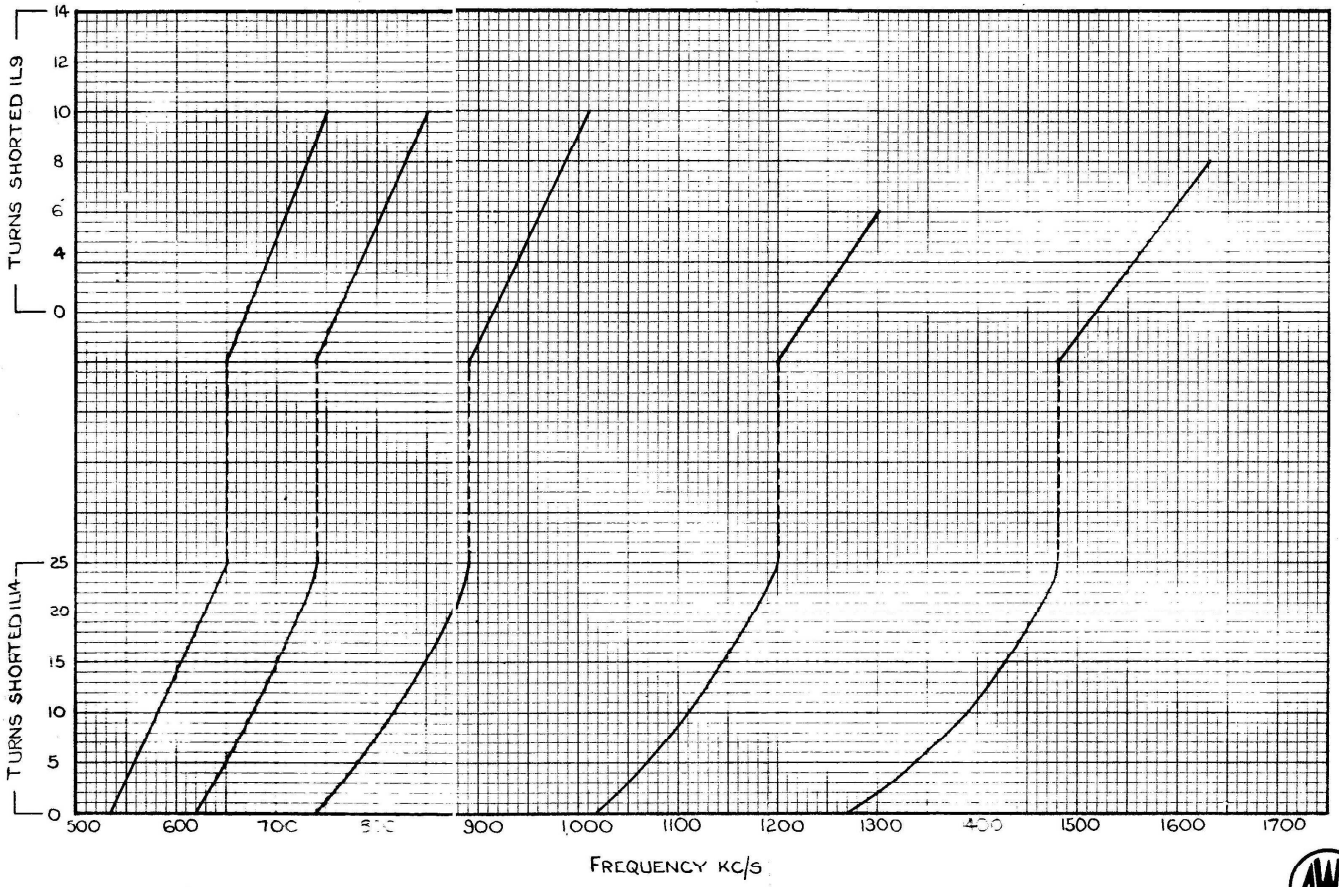

CHART FOR SETTING INDUCTORS IL9,

10K.W.M.F. BROADCAST TRANSMI

BTM-10K

TYPES 5J60090

DRG. 60090C10