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I.S.B. TRANSMITTER DRIVE UNIT S.T.C. TYPE A. 1406-B (PART OF RACK ASSEMBLIES A.M. TYPES 255, 255A, 7200, 277 & 277A)

GENERAL AND TECHNICAL INFORMATION

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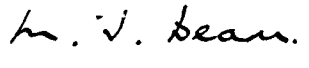

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I.S.B. TRANSMITTER DRIVE UNIT

S.T.C. TYPE A.1406-B

(PART OF RACK ASSEMBLIES A.M.
TYPES 255, 277 and 7200)

GENERAL AND TECHNICAL

INFORMATION

(S.T.C. Handbook 1055B. Issue 2)

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I.S.B. TRANSMITTER DRIVE UNITS

(S.T.C. TYPE A.1406B)

(S.T.C. TYPE A.1407B MONITOR UNIT AIR PUBLICATION AP2883ND)

TYPE 255 (188-IRE.2C) (A.1406B + A.1406B)	(1. Amplifying unit Type 607 (28-LRU.330A) (2. Oscillator unit Type 356 (16-LRU.192A) (3. Modulator unit Type 137 (17-LRU.67B) (4. Filter unit Type 418 (8-LRU.297A) (5. Modulator unit Type 139 (17-LRU.67A) (6. Modulator Unit Type 139A (17-LRU.67E) (7. Power unit Type 848 (94-LU.204A)
TYPE 255A (188-IRE.2L) *	(1. Amplifying unit Type 607A (28-LRU.330C) (2. Oscillator unit Type 356A (16-LRU.192C) Other items as Type 255 above.
TYPE 7200 (188-IRE.2G) *	Mobile version similar to Type 255A but comprising 1 - A.1406B only.
TYPE 277 (188-IRE.2D) (A.1406B + A.1407B)	(1. Amplifying unit Type 607 (28-LRU.330A) (2. Oscillator unit Type 356 (16-LRU.192A) (3. Modulator unit Type 137 (17-LRU.67B) (4. Filter Unit Type 418 (8-LRU.297A) (5. Modulator unit Type 139 (17-LRU.67A) (6. Modulator unit Type 139A (17-LRU.67E) (7. Power unit Type 848 (94-LU.204A) (8. Monitoring Equipment STC A.1407B (See Air Publication AP.2883 ND)
TYPE 277A (188-IRE.2N) *	(1. Amplifying unit Type 607A (28-LRU.330C) (2. Oscillator unit Type 356A (16-LRU.192C) Other items as Type 277 above.

* These rack assemblies incorporate a "voice operated gain adjusting device" (v.o.g.a.d.) which ensures that output from the equipment does not rise above a predetermined level when both input levels attain a peak at the same instant.

Printed in England by Standard Telephones & Cables Ltd.

LIST OF A.M. REFERENCE NOS.

A.M. Ref.	10D/18463	-	Rack assembly Type 255
	10D/19434	-	Rack assembly Type 255A
	10D/19414	-	Rack assembly Type 7200
	10D/19116	-	Rack assembly Type 277
	10D/19436	-	Rack assembly Type 277A
	10U/16860	-	Amplifying unit Type 607
	10U/16884	-	Amplifying unit Type 607A
	10V/16223	-	Oscillator unit Type 356
	10V/16233	-	Oscillator unit Type 356A
	10D/19122	-	Modulator unit Type 137
	10P/16162	-	Filter Unit Type 418
	10D/19127	-	Modulator unit Type 139
	10D/19439	-	Modulator unit Type 139A
	10K/17510	-	Power unit Type 848

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CHAPTER 1

INTRODUCTION

1.0 GENERAL

The type A.1406-B equipment is a low power, fixed frequency Independent Sideband Drive Unit, which can also be used for single or double sideband operation. The equipment is designed primarily for use with the S.T.C. transmitters type DS.12, DS.13 and DS.22; provided that similar circuit conditions prevail this drive equipment can well be used with transmitters of other manufacture.

Apparatus comprising the equipment is mounted on three individual chassis all of which are incorporated in a single cabinet with a jack panel, with or without other drive or monitor equipment according to the manufacturing group number.

Although reference must of necessity be made to the overall equipment, it should be understood that the purpose of this manual is to describe the drive apparatus only.

The Drive Unit will accept either one or two a.f. sideband signals each covering a range of approximately 100 to 6000 c/s. After a process of multiple modulation in conjunction with temperature-controlled, sealed crystal filters, two sidebands with a reduced carrier of 3.1 Mc/s are produced, the intelligence in one sideband being independent of that in the other. It should be noted that each sideband input could be composed of more than one speech or telegraph channel.

Two independent input signals (A & B) are each applied to a Line Amplifier and Modulator sub-unit and modulated on a 100 kc/s carrier. During this process the 100 kc/s carrier is mainly suppressed. The outputs from both balanced modulators are applied to crystal filters, with the result that one sideband only from each modulator is available. Thus Input A is contained in the upper sideband (U.S.B.) and Input B in the lower sideband (L.S.B.).

The two sidebands A & B are combined in a hybrid transformer and passed through a band-stop filter where the 100 kc/s signal is further suppressed. The signal then passes to the carrier modulator, where a low level 100 kc/s carrier signal is re-inserted and combined with the sideband signals. These combined signals are modulated on a 3 Mc/s carrier, which is suppressed in the process. The resulting sidebands, each approximately 12.0 kc/s wide and centred on 100 kc/s above and below the 3 Mc/s carrier, are applied to 3.1 Mc/s bandpass amplifier which passes the upper sideband only, i.e. 3.094 to 3.106 Mc/s.

Introduction

Cabinet including:-
A.1406B + A.1406B
(Code No. 188-LRE.2C or L)
725 lb (330 kg) approximately.

Cabinet including:-
A.1406B only.
(Code No. 188-LRE.2G)
475 lb (216 kg) approximately.

* NOTE: Line-up level is defined as the audio tone input level required to give the peak output power from the equipment.

CHAPTER 2a

GENERAL DESCRIPTION

1.0 CONSTRUCTION

All units comprising the A.1406-B equipment are incorporated in a single cabinet which is mounted on an undercut plinth. All wiring connections are maintained when a chassis is withdrawn. Power supplies are, however, isolated from each unit by means of a gate switch interlock circuit except the 75V A.C. crystal oven supply which remains "on" since it is obtained from a separate transformer connected directly accross the Mains. By inserting a shortening plug into the gate switch, the power supplies to each unit may be re-connected and the equipment operated while the chassis is removed from its normal position, the cable forms being housed in a conduit of "Duratuf" P.V.C. insulating material.

The units are retained in the cabinet by quick release spring catches fitted at each side of the front panel.

A window and hinged flap are provided on the Main Drive Unit for meter observation and access to controls.

When the equipment is used in a humid atmosphere, heaters can be supplied for mounting in the base of the cabinet to keep the equipment dry and at even temperature when it is switched off.

2.0 COMPOSITION OF EQUIPMENT.

As mentioned in Chapter 1, an ISB/DSB Transmitter Drive Equipment type A.1406B is normally fitted in a single cabinet (containing a terminal strip in the base for connection of external cabling) together with other apparatus, the complete assembly being allocated an overall code number. Typical assemblies are quoted below:-

(1) Two ISB/DSB Drive Units type A.1406B. The overall manufacturing code of this assembly is 18?-IRE.2C and the units are disposed (from top to bottom) in the cabinet as follows:-

Title	Code.
Filter Unit	8-IRU.297A
ISB/DSB Drive Unit	
ISB/DSB Drive Unit	
Jack Panel	87-IRU. 50B
Filter Unit	8-IRU.297A
Power supply	94-IRU.204A
Power Supply	94-IRU.204A

(2) ISB/DSB Drive Unit, type A.1406-B with Monitoring Equipment type A.1407B. This assembly has an overall manufacturing code 188-LRE.2D and units are disposed (from top to bottom) in the cabinet as follows:-

Title	Code
Filter Unit (Monitoring equipment)	8-LRU.297B
ISB/DSB Drive Unit	
Monitor Unit type A.1407B	
Jack Panel	87-LRU.50A
Filter Unit (drive equipment)	8-LRU.297A
Power Supply Unit (monitor equipment)	94-LRU.204A
Power Supply Unit (drive equipment)	94-LRU.204A

(3) One ISB/DSB Drive Unit type A.1406B. The overall manufacturing code of this assembly is 188-LRE.2G, and the units are disposed (from top to bottom) in the cabinet as follows:-

Title	Code
ISB/DSB Drive Unit	
Jack Panel	87-LRU.50E
Filter Unit	8-LRU.297A
Power Supply	94-LRU.204A

Two further assemblies, codes 188-LRE.2L and N, provide groups of equipment similar to those described in (1) and (2) above, with a different arrangement of the jack panel, the codes of these jack panels being 87-LRU.50K and H.

Details of Monitor Unit type A.1407B are given in an associated publication, AP.2383 ND.

3.0 OVERALL CIRCUIT DESCRIPTION

3.1 S.S.B. and I.S.B. Drive Circuits

Audio frequency signals (Input A and Input B) are independently applied to the A.F. Amplifier and Sideband Modulators via a transformer in each unit. The gain of the line amplifiers is such that an output of 0 dbm* may be obtained on the level meter for any input between -10 dbm to + 10 dbm. Output is indicated on a rectifier type output meter fitted on the front panel of the unit. The amplifiers are designed to give a sensibly level response from 100-6000 c/s.

* NOTE: 0 dbm in the Line Amplifier level meter is always referred to as the "line-up level", dbm means decibels referred to 1 mW in the impedance being used.

Each a.f. signal is applied to its associated balanced modulator stage through a 15 db pad which reduces the level to -15 dbm, this value being suitable for low level modulation. The signal is applied in antiphase to the control grids of valves V2 and V3, which operate in push-pull. Simultaneously, a 100 kc/s carrier generated by a crystal oscillator is applied in phase, via a transformer, to the two grids. The resultant modulation appearing across the secondary of the output transformer consists of sum and difference frequency components of the two applied signals, i.e. 100.1 kc/s to 106 kc/s and 94.0 kc/s to 99.9 kc/s and a low level 100 kc/s carrier leak due to any unbalance in the modulator. These signals are then fed by coaxial lines to the sideband filter unit. The filter (S-LU.139 BE and BF) associated with input B passes the lower sideband (94.0 kc/s to 99.9 kc/s) only and the filter (T-LU.139 BG and BH) associated with input A passes only the upper sideband (100.1 kc/s to 106 kc/s). The output level of the modulator with a single tone at correct line-up level is 0 dbm.

The two sidebands A & B are combined in a hybrid transformer in the filter unit and then passed through a bandstop filter where the 100 kc/s carrier is further suppressed. The u.s.b. and l.s.b. signals are applied through a coaxial cable to a zero gain amplifier in the 100 kc/s Oscillator Unit and thence to a further hybrid in the Carrier Modulator Unit; the 100 kc/s carrier re-insertion signal attenuated to its correct value is also applied to this hybrid transformer. The combined output is fed to the balanced modulator. This modulator is similar to that used in the Line Amplifier and Modulator Unit except that a carrier frequency of 3 Mc/s is injected. The resulting sidebands, each approximately 12 kc/s wide and centred on 100 kc/s above and below the 3 Mc/s carrier, are applied to a 3.1 Mc/s bandpass amplifier which passes the upper sideband only.

A VOGAD diode connected across the output circuit of the amplifier provides a negative potential from the signal peaks; this is applied as a controlling bias to the zero-gain amplifier mounted in the 100 kc/s Oscillator Unit.

One half of a double diode valve provides this facility, the second diode being used in a valve voltmeter circuit for metering purposes.

3.2 D.S.B. Operation

The A.1406B Drive Equipment can be used for generating a double-sideband signal, by applying the incoming signal to input "A" only. A switch on the Filter tray is moved to D.S.B. position and the CARRIER RE-INSERT switch is turned to D.S.B. The following functions are performed when this is done:-

The signal applied to input "A" is modulated, as before, on the 100 kc/s carrier, the carrier being suppressed. Both sidebands are now passed through a pad instead of a crystal filter and the carrier is re-inserted at such a level to give a d.s.b. signal modulated 80%. From this stage onwards, the signal is modulated at 3 Mc/s and the upper sideband selected at 3.1 Mc/s. Hence a 3.1 Mc/s d.s.b. signal is derived.

3.3 Power Supply Circuit

The general supplies required by the equipment are controlled by the mains On/Off switch S1 located on the Power Supply Unit; they are 270V D.C. unstabilised, 150V D.C. stabilised and 6.3V A.C. The 75V a.c. oven supply is obtained from a separate transformer connected directly across the mains.

The output leads from the Power Supply Unit are connected to a 12-pin Jones socket at the back of the tray. The supplies are then distributed to terminals on the S.S.B. Unit tray and Filter tray through "Duratuf" (P.V.C.) multiple conduits.

Two service sockets SK1 and SK2, wired independently for convenience, are mounted on the plinth to provide convenient points for plugging in either a soldering iron or an inspection lamp. Two Slydlok type fuses are included in this circuit.

CHAPTER 3

DETAILED DESCRIPTION OF UNITS

1.0 FILTER TRAY 8-LRU.297A

(Plate II; Fig.8)

This unit houses the following sealed crystal filters for sideband selection and carrier suppression:-

L.S.B. Filter 8-LU.139BE & BF (94-99.9 kc/s) Input B
U.S.B. Filter 8-LU.139BG & BH (100.1 kc/s - 106 kc/s) Input A
Bandstop Filter 8-LU.139AZ (100 kc/s)

They are maintained at an even temperature of approx. 60° by heating mats which are controlled by thermostats through a relay circuit. The relay is operated by D.C. obtained from a full-wave rectifier circuit in the oven supply (75V a.c.). A thermal cut-out is provided so that in the event of failure of the two thermostats, which are in series, the heaters are switched off and the indicator lamp goes out. The thermostats fitted to the filters are designed to operate at 60°C.

2.0 MAIN DRIVE UNIT

(Plates II, III, IV: Fig.1)

2.1 General

This unit contains five individual sub-units which together with the Filter Units provide i.s.b.; d.s.b. and s.s.b. drive facilities. Those sub-units mounted in the ISB/DSB Unit Tray 395-LRU.14A are (front left to right):-

(a) A.F. Amplifier and 100 kc/s Modulator (U.S.B.) Input A, 17-LRU.67A
(b) 3 Mc/s Oscillator and Carrier Modulator 17-LRU.67B.
(c) 3.1 Mc/s Bandpass Amplifier 28-LRU.330C
(d) 100 kc/s Oscillator 16-LRU.192C
(e) A.F. Amplifier and 100 kc/s Modulator (L.S.B.) Input B, 17-LRU.67E

2.2 A.F. Amplifier and 100 kc/s Modulators 17-LRU.67A, 17-LRU.67E

(Plates IV, VI; Fig.3)

These two sub-units are identical and each one comprises the following stages:-

1. A single stage audio amplifier using negative feedback
2. A balanced modulator using grid injection to two high slope pentode valves type 6AM6 operated in push-pull.

The audio frequency input is applied to the primary of input transformer T1, the latter matches the 600 ohm line impedance to the input impedance of V1 grid circuit. A switch-type potentiometer P1, across T1 secondary, is tapped in 2 db steps over a range of 40 db. In operation, P1 is set to attenuate the input signal to such a level that the audio output of V1 produces an indication of 0 db on the "LEVEL METER" M1. This output level is called the "line-up level ".

M1 is a rectifier-type meter switched by S1. For measurement of levels around 0 db the meter is connected directly in circuit; R7, R8, R9 form an attenuation network for readings at levels round +10 dbm and +20 dbm.

Negative feedback is arranged through C1, C15 and R1 and also across the un-bypassed cathode resistor R5. With C15 in circuit, S2 open (IN) less negative feedback is obtained at the lower audio frequencies, hence a rising response is obtained. In this way the circuit operates as an equalising network to compensate for the attenuation of lower frequencies in the crystal filters.

When S2 is closed (OUT), the amount of negative feedback is held substantially constant over the a.f. range, giving a flat response. This condition is used for d.s.b. operation when sideband filters are not used.

The output of the line amplifier is taken to the balanced modulator stage through a 15 db pad formed by R10, R11, R12, R13, R14. Audio signals are applied in antiphase to the control grids of V2 and V3, via transformer T3. Simultaneously, a 100 kc/s carrier is applied in phase to the control grids of V2 and V3 via the pad formed by R27, R28, R29, potentiometer R2 and transformer T4. The resultant modulation frequencies appearing across the secondary of the output transformer T5 are the sum and difference frequencies of the two applied signals, the 100 kc/s signal being balanced out in the modulator. C17 and C18 connected across the 15 db pad produce a rising response at the higher audio frequencies to compensate for attenuation in subsequent stages.

R18 is a common cathode bias resistor; R20 and R21 are meter shunts.

By careful adjustment of P3 and C8, the carrier leak may be reduced to a minimum and accurate balancing obtained.

2.3 3 Mc/s Oscillator and Carrier Modulator 17-LRU.67B

(Plates IV, VII; Fig.4)

The unit comprises the following stages:-

(1) a 3 Mc/s crystal oscillator using valve type 6AM6
(2) a 3 Mc/s buffer amplifier using valve type 6AM6
(3) a balanced modulator using grid injection on two type 6AM6 valves.

The outputs from the crystal filters and the carrier re-insertion networks are applied to this unit and modulated by injection of a 3 Mc/s signal from the 3 Mc/s oscillator to obtain a final output frequency of 3.1 Mc/s ± a.f. signal frequency.

The 3 Mc/s crystal oscillator is of a high stability type, the crystal being operated in an oven at 60°C. The crystal oven operates from a 75V a.c. supply obtained from a separate transformer T2 connected directly across the mains input and located in the Power Supply Unit.

The oven contains a preheater circuit in order to bring the oven rapidly to its working temperature after first switching on, and a normal heating circuit. Each circuit consists of a set of resistor and the oven is heat insulated by glass wool and controlled by two evacuated type thermostats. Heating and cooling cycles are indicated by two lamps located on the front panel of the Carrier Modulator Unit.

When the oven is first switched on, both thermostats are closed and the lamps are out. The thermostats TH1 in the preheater circuit opens at 40 ± 5°C and the associated red indicator lamp glows. The innermost part of the preheater compartment may have reached a temperature of about 65°C before this thermostat opens. The thermostat TH2 in the normal heating circuit opens at a temperature of 55 ± 5°C and the green indicating lamp in this circuit glows while the other lamp goes very dim and appears to be out. When the oven temperature begins to fall the thermostat in the normal heating circuit (TH2) closes and the lamps change over as described above, the thermostat in the preheater circuit TH1 remaining open all the time under normal conditions.

The 3 Mc/s signal from the crystal oscillator is applied to the buffer amplifier V3. A pi-network in the anode circuit of V3 matches the high output impedance of this stage to the 75 ohms of potentiometer P1. The 3 Mc/s signal is then applied in phase to the control grids of V1 and V2 via the potentiometer P1 and hybrid T3. (P1 enables the amplitude of the 3 Mc/s input to be adjusted to a suitable level.)

The signals from both modulators are applied to hybrid T1 of the Filter Unit, and the combined output passed through a bandstop crystal filter where the 100 kc/s signal is further attenuated. The u.s.b. and l.s.b. signals are then taken via SK.22 and a coaxial lead to the hybrid T1 on the Carrier Modulator Unit. The 100 kc/s carrier re-insertion signal attenuated to its correct value for s.s.b. working by A1 (or for i.s.b. working, by A1 and A2) is also applied to hybrid T1. The combined outputs are fed in antiphase to the control grids of V1 and V2.

Following modulation, the signals appearing at the output of T4 have the frequencies of:-

(a) 3094 to 3099.9 kc/s (L.S.B.)
3100.1 to 3106 kc/s (U.S.B.)
and a low level of 3100 kc/s

(b) 2899.9 to 2894 kc/s (L.S.B.)
2900.1 to 2906 kc/s (U.S.B.)
and a low level of 2900 kc/s.

Those only in (a) above will be passed by the 3.1 Mc/s Bandpass Filter.

Carrier leak may be reduced to a minimum by adjusting anode control C12, screen control P2 and grid balance control C8. This modulator is similar to that used in the channel modulator 17-LRU.67A, but in this case the injected carrier frequency is 3 Mc/s obtained from the 3 Mc/s oscillator.

2.4 3.1 Mc/s Bandpass Amplifier 28-LRU.330C

(Plates IV, VIII; Fig.6)

This unit is constructed from the following seven circuits:-

1. Input attenuator
2. Input tuned circuit, L1
3. First amplifier using type 6AM6 high slope miniature pentode valve.
4. Bandpass filter, L2 and L3
5. Second amplifier, V2 using power beam tetrode, valve type 5B/254M
6. Output tuned circuit, L4
7. Double Diode V3, Valve Voltmeter and Vogad, using valve 6AL5.

The group signal from the carrier modulator is connected by 75-ohm coaxial cable to the input attenuator which serves to isolate the tuned input circuit L1 from variations of reactance caused by adjustments in the Carrier Modulator Unit. Attenuator R4, R5, R6 is not normally used

but may be inserted in place of R1, R2, R3 to compensate for unit having low gain. A potentiometer R37 connected across the input circuit serves as a gain control.

The pi-network tuned input circuit correctly matches the 75-ohm input to the grid of the first amplifier valve V1, a damping resistance being added to reduce the Q to the correct value. V1 is a high slope miniature pentode type 6AM6.

A small amount of negative feedback is developed across the unbypassed cathode resistor R17. The output of V1 is applied to a band-pass filter L2 and L3, which is of the capacitance-coupled type.

Tetrode valve V2, type 5B/254M is employed in a linear amplifier stage. The screen is decoupled by R30 and C9. The output circuit, tuned to 3.1 Mc/s, matches the external load impedance of 75 ohms to the load impedance of the valve. Since the anode circuit (L4) of the valve is supplied with H.T. through the choke L5 into the low impedance end of the network, the inductance (1.5 mH) of L5 is not critical. The output from this stage is applied through a blocking condenser C7, and 75-ohm coaxial cable to the associated transmitter.

One diode of the double-diode valve, V3, type 6AL5, is used as a valve voltmeter, connected for measurement of sideband and carrier levels. Since the meter is also used for valve cathode current measurements, the scale is calibrated in milliamperes as well as in decibels.

The variable resistors R7, R8, R9, R10 are connected in the meter circuit and are adjusted for correct carrier and sideband levels. When the front panel switch is turned to position 2 (marked VI) the meter indicates correct cathode current of valve V1. When in position 3 (marked V2) however the meter indication for cathode current of valve V2 must be multiplied by 10 for correct value.

The other diode of V3 provides a VOGAD bias from a portion of the output of the amplifier. This is applied to V3 in the 100 kc/s Oscillator Unit which is connected in the common drive circuit following the band-stop filter. A delay voltage applied to the cathode ensures that the diode will not commence to operate until the incoming signal attains a level just less than its peak ($\frac{1}{2}$ watt) output.

2.5 100 kc/s Oscillator 16-LRU.192C

(Plates IV, IX; Fig.5)

The unit comprises three stages:-

Detailed Description of Units

1. The crystal oscillator using a D.T. cut (low frequency) crystal not contained in an oven and a miniature pentode valve type 6AM6.

2. A buffer amplifier using a type 6AM6 pentode valve.

3. A VOGAD controlled amplifier using pentode valve type 6AM6.

The function of stages 1 and 2 is to supply carrier frequencies to the upper and lower sideband modulators. The crystal oscillator uses a modified Colpitts circuit with a trimmer (C1) added to enable slight variations of frequency to be made. The crystal is not maintained at a constant temperature but the expected frequency drift from its nominal frequency at the calibrating temperature of 35°C, is ± 3.5 c/s over the temperature range 10°C to 50°C. The oscillator anode and screen supplies are obtained from a 150V stabilised supply.

The output of the oscillator is applied to the buffer amplifier through a small capacitor (C6);. the anode load of the amplifier being a tuned transformer having a 75-ohm output winding which feeds hybrid coil T1. This in turn feeds hybrids T2 and T3 which between them provide four outputs at 75-ohms, two for application to the sideband modulators, one for carrier re-insertion and one for monitoring. The use of hybrids in this circuit reduces direct inter-channel crosstalk and provides a simple method of obtaining a 100 kc/s carrier for re-insertion. The amplitude of the re-inserted carrier can be adjusted by potentiometer R13. R14 varies the phase of the reinserted carrier relative to that of the u.s.b. modulator carrier to give correct phase relationships between sidebands and carrier for d.s.b. working.

The buffer amplifier is operated from the unregulated h.t. supply, and cathode current metering of oscillator and amplifier valves is effected by a switch and milliammeter.

In stage 3, a pentode valve V3 operates as a zero gain amplifier. It is connected in circuit immediately following the band-stop filter and is controlled by the VOGAD diode in the 3.1 Mc/s Bandpass Amplifier.

Output from the band stop filter, 94 - 106 kc/s, is applied to transformer T5 and thence to the control grid of V3 via C14, R16. The anode load T6 provides output which is fed through a 20 db pad, R23, R24, R25 to the Carrier Modulator. Stage gain is approximately 20 db and the pad in the anode circuit effectively reduces this gain to zero.

A controlling bias generated from a portion of the output of the 3.1 Mc/s Bandpass Amplifier can be applied to V3 via the VOGAD On/Off switch S2 and R15.

The VOGAD circuit is arranged to operate and provide a controlling bias just before the output of the 3.1 Mc/s amplifier reaches peak power (i.e. $\frac{1}{2}$ watt) and the circuit of V3 is arranged so that the bias provides a complete gain control over the stage and hence over the output of the equipment, to the extent that for an increase of 10 db above the 0 db line up level the output rises only 2 db.

3.0 POWER SUPPLY UNIT 94-LRU.204A

(Plates II, V; Fig. 7)

H.T. power supply circuits for the Main Drive Unit employ a full wave, hard valve rectifier type 53KU with a two stage choke-input filter. D.C. output voltage is approximately 270V and ripple content in the output is at least 60 db down. A voltage stabiliser circuit employing a G180/2M neon stabiliser supplies H.T. at 150V for 100 kc/s and 3 Mc/s oscillators., Transformer input tappings (in 10V steps) are provided for connection to an a.c. supply within one of the ranges 100-120V and 200-250V. Valve heaters are also supplied from l.t. windings on the main transformer T1.

A separate transformer T2 connected directly to the Mains provides 75V a.c. for the crystal oven heaters. D.C. at 75V for operating a relay and gate switch interlock circuit is also supplied by this winding on T2 in conjunction with a small bridge-connected selenium rectifier.

The transformer and chokes are oil-filled and hermetically sealed.

NOTE: The h.t. and l.t. supplies come on together when the equipment is switched on. The oven circuit is permanently connected.

CHAPTER 3a

DETAILED DESCRIPTION OF UNITS.

1.0 FILTER TRAY 8-LRU.297A

(Plate II; Fig. 8)

This unit houses the following sealed crystal filters for sideband selection and carrier suppression:-

L.S.B. Filter 8-LU.139BE & BF (94-99.9 kc/s) Input B
U.S.B. Filter 8-LU.139BC & BH (100.1 kc/s - 106 kc/s) Input A
Bandstop Filter 8-LU.139AZ (100 kc/s)

They are maintained at an even temperature of approx. 60° by heating mats which are controlled by thermostats through a relay circuit. The relay is operated by D.C. obtained from a full-wave rectifier circuit in the oven supply (75V a.c.). A thermal cut-out is provided so that in the event of failure of the two thermostats, which are in series, the heaters are switched off and the indicator lamp goes out. The thermostats fitted to the filters are designed to operate at 60°C.

2.0 MAIN DRIVE UNIT

(Plates II, III, IV: Fig. 1)

2.1 General

This unit contains five individual sub-units which together with the Filter Units provide i.s.b.; d.s.b. and s.s.b. drive facilities. Those sub-units mounted in the ISB/DSB Unit Tray 395-LRU.14A are (front left to right):-

(a) A.F. Amplifier and 100 kc/s Modulator (U.S.B.) Input A, 17-LRU.67A
(b) 3 Mc/s Oscillator and Carrier Modulator 17-LRU.67B.
(c) 3.1 Mc/s Bandpass Amplifier 28-LRU.330C
(d) 100 kc/s Oscillator 16-LRU.192C
(e) A.F. Amplifier and 100 kc/s Modulator (L.S.B.) Input B, 17-LRU.67E

2.2 A.F. Amplifier and 100 kc/s Modulators 17-LRU.67A. 17-LRU.67E

(Plates IV, VI: Fig.3)

These two sub-units are identical and each one comprises the following stages:-

Detailed Description of Units

1. A single stage audio amplifier using negative feedback
2. A balanced modulator using grid injection to two high slope pentode valves type 6AM6 operated in push-pull.

The audio frequency input is applied to the primary of input transformer T1, the latter matches the 600 ohm line impedance to the input impedance of V1 grid circuit. A switch-type potentiometer P1, across T1 secondary, is tapped in 2 db steps over a range of 40 db. In operation, P1 is set to attenuate the input signal to such a level that the audio output of V1 produces an indication of 0 db on the "Level Meter" M1. This output level is called the "line-up level".

M1 is a rectifier-type meter switched by S1. For measurement of levels around 0 db the meter is connected directly in circuit; R7, R8, R9 form an attenuation network for readings at levels round +10 dbm and +20 dbm.

Negative feedback is arranged through C1, C15 and R1 and also across the un-bypassed cathode resistor R5. With C15 in circuit, S2 open (IN) less negative feedback is obtained at the lower audio frequencies, hence a rising response is obtained. In this way the circuit operates as an equalising network to compensate for the attenuation of lower frequencies in the crystal filters.

When S2 is closed (OUT), the amount of negative feedback is held substantially constant over the a.f. range, giving a flat response. This condition is used for d.s.b. operation when sideband filters are not used.

The output of the line amplifier is taken to the balanced modulator stage through a 15 db pad formed by R10, R11, R12, R13, R14. Audio signals are applied in antiphase to the control grids of V2 and V3, via transformer T3. Simultaneously, a 100 kc/s carrier is applied in phase to the control grids of V2 and V3 via the pad formed by R27, R28, R29, potentiometer R2 and transformer T4. The resultant modulation frequencies appearing across the secondary of the output transformer T5 are the sum and difference frequencies of the two applied signals, the 100 kc/s signal being balanced out in the modulator. C17 and C18 connected across the 15 db pad produce a rising response at the higher audio frequencies to compensate for attenuation in subsequent stages.

R18 is a common cathode bias resistor; R20 and R21 are meter shunts.

By careful adjustment of P3 and C8, the carrier leak may be reduced to a minimum and accurate balancing obtained.

2.3 3 Mc/s Oscillator and Carrier Modulator 17-LRU.67B.

(Plates IV, VII; Fig. 4)

The unit comprises the following stages:-

(1) a 3 Mc/s crystal oscillator using valve type 6AM6
(2) a 3 Mc/s buffer amplifier using valve type 6AM6
(3) a balanced modulator using grid injection on two type 6AM6 valves.

The outputs from the crystal filters and the carrier re-insertion networks are applied to this unit and modulated by injection of a 3 Mc/s signal from the 3 Mc/s oscillator to obtain a final output frequency of 3.1 Mc/s ± a.f. signal frequency.

The 3 Mc/s crystal oscillator is of a high stability type, the crystal being operated in an oven at 60°C. The crystal oven operates from a 75V a.c. supply obtained from a separate transformer T2 connected directly across the main input and located in the Power Supply Unit.

The oven contains a preheater circuit in order to bring the oven rapidly to its working temperature after first switching on, and a normal heating circuit. Each circuit consists of a set of resistor and the oven is heat insulated by glass wool and controlled by two evacuated type thermostats. Heating and cooling cycles are indicated by two lamps located on the front panel of the Carrier Modulator Unit.

When the oven is first switched on, both thermostats are closed and the lamps are out. The thermostats TH1 in the preheater circuit opens at 40 + 5°C and the associated red indicator lamp glows. The innermost part of the preheater compartment may have reached a temperature of about 65°C before this thermostat opens. The thermostat TH2 in the normal heating circuit opens at a temperature of 55 + 5°Cand the green indicating lamp in this circuit glows while the other lamp goes very dim and appears to be out. When the oven temperature begins to fall the thermostat in the normal heating circuit (TH2) closes and the lamps change over as described above, the thermostat in the preheater circuit TH1 remaining open all the time under normal conditions.

The 3 Mc/s signal from the crystal oscillator is applied to the buffer amplifier V3. A pi-network in the anode circuit of V3 matches the high output impedance of this stage to the 75 ohms of potentiometer P1. The 3 Mc/s signal is then applied in phase to the control grids of V1 and V2 via the potentiometer P1 and hybrid T3. (P1 enables the amplitude of the 3 Mc/s input to be adjusted to a suitable level.-)

The signals from both modulators are applied to hybrid T1 of the Filter Unit, and the combined output passed through a bandstop crystal filter where the 100 kc/s signal is further attenuated. The u.s.b. and l.s.b. signals are then taken via SK.22 and a coaxial lead to the hybrid T1 on the Carrier Modulator Unit. The 100 kc/s carrier re-insertion signal attenuated to its correct value for s.s.b. working by A1 (or for i.s.b. working, by A1 and A2) is also applied to hybrid T1. The combined outputs are fed in antiphase to the control grids of V1 and V2.

Following modulation, the signals appearing at the output of T4 have the frequencies of:-

(a) 3094 to 3099.9 kc/s (L.S.B.)
3100.1 to 3106 kc/s (U.S.B.)
and a low level of 3100 kc/s

(b) 2899.9 to 2894 kc/s (L.S.B.)
2900.1 to 2906 kc/s (U.S.B.)
and a low level of 2900 kc/s.

Those only in (a) above will be passed by the 3.1 Mc/s Bandpass Filter.

Carrier leak may be reduced to a minimum by adjusting anode control C12, screen control P2 and grid balance control C8. This modulator is similar to that used in the channel modulator 17-LRU.67A, but in this case the injected carrier frequency is 3 Mc/s obtained from the 3 Mc/s oscillator.

2.4 3.1 Mc/s Bandpass Amplifier 28-LRU.330C

(Plates IV, VIII; Fig. 13)

This unit is constructed from the following seven circuits:-

1. Input attenuator
2. Input tuned circuit, L1
3. First amplifier using type 6AM6 high slope miniature pentode valve.
4. Bandpass filter, L2 and L3
5. Second amplifier, V2 using power beam tetrode, valve type 5B/254M
6. Output tuned circuit, L4
7. Double Diode V3, Valve Voltmeter and Vogad, using valve 6AL5.

The group signal from the carrier modulator is connected by 75-ohm coaxial cable to the input attenuator which serves to isolate the tuned input circuit L1 from variations of reactance caused by adjustments in the Carrier Modulator Unit. Attenuator R4, R5, R6 is not normally used

but may be inserted in place of R1, R2, R3 to compensate for unit having low gain. A potentiometer R37 connected across the input circuit serves as a gain control.

The pi-network tuned input circuit correctly matches the 75-ohm input to the grid of the first amplifier valve V1, a damping resistance being added to reduce the Q to the correct value. V1 is a high slope miniature pentode type 6AM6.

A small amount of negative feedback is developed across the unbypassed cathode resistor R17. The output of V1 is applied to a band-pass filter L2 and L3, which is of the capacitance-coupled type.

Tetrode valve V2, type 5B/254M is employed in a linear amplifier stage. The screen is decoupled by R30 and C9. The output circuit, tuned to 3.1 Mc/s, matches the external load impedance of 75 ohms to the load impedance of the valve. Since the anode circuit (L4) of the valve is supplied with H.T. through the choke L5 into the low impedance end of the network, the inductance (1.5 mH) of L5 is not critical. The output from this stage is applied through a blocking condenser C7, and 75-ohm coaxial cable to the associated transmitter.

One diode of the double-diode valve, V3, type 6AL5, is used as a valve voltmeter, connected for measurement of sideband and carrier levels. Since the meter is also used for valve cathode current measurements, the scale is calibrated in milliamperes as well as in decibels.

The variable resistors R7, R8, R9, R10 are connected in the meter circuit and are adjusted for correct carrier and sideband levels. When the front panel switch is turned to position 2 (marked VI) the meter indicates correct cathode current of valve V1. When in position 3 (marked V2) however the meter indication for cathode current of valve V2 must be multiplied by 10 for correct value.

The other diode of V3 provides a VOGAD bias from a portion of the output of the amplifier. This is applied to V3 in the 100 kc/s Oscillator Unit which is corrected in the common drive circuit following the band-stop filter. A delay voltage applied to the cathode ensures that the diode will not commence to operate until the incoming signal attains a level just less than its peak ($\frac{1}{2}$ watt) output.

2.5 100 kc/s Oscillator 16-LRU.1920

(Plates IV, IX; Fig. 12)

The unit comprises three stages:-

Detailed Description of Units.

1. The crystal oscillator using a D.T. cut (low frequency) crystal not contained in an oven and a miniature pentode valve type 6AM6.

2. A buffer amplifier using a type 6AM6 pentode valve.

3. A VOGAD controlled amplifier using pentode valve type 6AM6.

The function of stages 1 and 2 is to supply carrier frequencies to the upper and lower sideband modulators. The crystal oscillator uses a modified Colpitts circuit with a trimmer (C1) added to enable slight variations of frequency to be made. The crystal is not maintained at a constant temperature but the expected frequency drift from its nominal frequency at the calibrating temperature of 35°C, is ± 3.5 c/s over the temperature range 10°C to 50°C. The oscillator anode and screen supplies are obtained from a 150V stabilised supply.

The output of the oscillator is applied to the buffer amplifier through a small capacitor (C6); the anode load of the amplifier being a tuned transformer having a 75-ohm output winding which feeds hybrid coil T1. This in turn feeds hybrids T2 and T3 which between them provide four outputs at 75-ohms, two for application to the sideband modulators, one for carrier re-insertion and one for monitoring. The use of hybrids in this circuit reduces direct inter-channel crosstalk and provides a simple method of obtaining a 100 kc/s carrier for re-insertion. The amplitude of the re-inserted carrier can be adjusted by potentiometer R13. R14 varies the phase of the reinserted carrier relative to that of the u.s.b. modulator carrier to give correct phase relationships between sidebands and carrier for d.s.b. working.

The buffer amplifier is operated from the unregulated h.t. supply, and cathode current metering of oscillator and amplifier valves is effected by a switch and milliammeter.

In stage 3, a pentode valve V3 operates as a zero gain amplifier. It is connected in circuit immediately following the band-stop filter and is controlled by the VOGAD diode in the 3.1 Mc/s Bandpass Amplifier.

Output from the band stop filter, 94 - 106 kc/s, is applied to transformer T5 and thence to the control grid of V3 via C14, R16. The anode load T6 provides output which is fed through a 20 db pad, R23, R24, R25 to the Carrier Modulator. Stage gain is approximately 20 db and the pad in the anode circuit effectively reduces this gain to zero.

A controlling bias generated from a portion of the output of the 3.1 Mc/s Bandpass Amplifier can be applied to V3 via the VOGAD On/Off switch S2 and R15.

The VOGAD circuit is arranged to operate and provide a controlling bias just before the output of the 3.1 Mc/s amplifier reaches peak power (i.e. ½ watt) and the circuit of V3 is arranged so that the bias provides a complete gain control over the stage and hence over the output of the equipment, to the extent that for an increase of 10 db above the 0 db line up level the output rises only 2 db.

3.0 POWER SUPPLY UNIT 94-LRU.204A

(Plates II, V; Fig. 7)

H.T. power supply circuits for the Main Drive Unit employ a full wave, hard valve rectifier type 53KU with a two stage choke-input filter. D.C. output voltage is approximately 270V and ripple content in the output is at least 60 db down. A voltage stabiliser circuit employing a G180/2M neon stabiliser supplies H.T. at 150V for 100 kc/s and 3 Mc/s oscillators. Transformer input tappings (in 10V steps) are provided for connection to an a.c. supply within one of the ranges 100-120V and 200-250V. Valve heaters are also supplied from l.t. windings on the main transformer T1.

A separate transformer T2 connected directly to the Mains provides 75V a.c. for the crystal oven heaters. D.C. at 75V for operating a relay and gate switch interlock circuit is also supplied by this winding on T2 in conjunction with a small bridge-connected selenium rectifier.

The transformer and chokes are oil-filled and hermetically sealed.

NOTE: The h.t. and l.t. supplies come on together when the equipment is switched on. The oven circuit is permanently connected.

CHAPTER 4

INSTALLATION

1.0 THE SHIPPING SPECIFICATION

1.1 Description

The Shipping Specification is a booklet listing, in classified form, all items into which the equipment is broken down for shipment. It will naturally vary according to the method of transport adopted for different projects and is therefore not supplied as part of this Manual. Two copies of the specification are packed with the equipment and two copies are despatched by mail.

The specification comprises four parts as follows:-

(a) A cover sheet
(b) A sheet of explanatory notes
(c) A sheet giving a summarised breakdown of the equipment
(d) A series of sheets giving the detailed breakdown

The first two of the above sheets (a) and (b) do not require any particular comment. The third or "Classification Sheet" is an index showing the principal sections into which the equipment has been divided as considered from the shipping and re-erection points of view. It contains four columns, the first two of which refer to manufacturing codes and titles of main parts. The third column shows arbitrary designation letters assigned to the above parts and these letters correspond to Classification Letters on the top right hand side of each detailed "breakdown" sheet. The fourth column shows the number of detailed sheets which should be present.

The detailed "breakdown" sheet lists every item which forms a separate entity package. Each sheet contains eleven columns titled as follows:-

1. Unit References

This is a letter corresponding with that marked on the layout and other drawings. It thus indicates the part of the floor on which the item will stand when finally erected. The unit reference letter should not be confused with the Classification Letter, which is purely a shipping "breakdown" indication.

2. Specification) For manufacturer's use only
3. Item No.

4. Remarks

Notes for assembly and installation.

5. M.S.T.

The job M.S.T. number and serial number of equipment shipped.

6. & 7. Class and Item No.

The letter S denotes that the article is a shipping item; the following letter is the Section Classification letter as given in the Classification Sheet. The item number is the shipping item number under the above classification.

8. Case No.

Shows the number of the case in which the item will be found. This number is stencilled on the outside of the case.

9, 10 & 11. Quantity, Code, Description — Describe the articles, and state how many make up each package or item.

1.2 How to use the Shipping Specification

(a) Decide which part of the erection programme is to be done first, by studying the information given later in this chapter.

(b) From the third, or "Classification Sheet" of the Shipping Specification, find the Section Classification Letter of the apparatus required.

(c) Turn to the detailed breakdown sheets bearing the appropriate classification letter and find the case number for the items wanted.

(d) Unpack the items and identify by means of labels on them.

(e) Note from the "Unit Reference" on the detailed breakdown sheets and the layout drawings, where items should go on the floor.

(f) Check, from the detailed breakdown sheets, that nothing is missing.

(g) Proceed with erection and assembly.

1.3 Special Packing

When cabinets are packed with chassis, etc., in position, it is the practice of the Shipping Department to secure the chassis by means of wooden supports. These are fitted inside the cabinets, between the chassis runners and side panels. In a similar way, to keep certain components in position during transit, various item brackets etc., (painted yellow) may be used. These, together with the wooden supports, should be removed during the course of installation.

2.0 PREPARATION OF SITE

Since rear access to units is not required the equipment may be positioned comparatively close to walls in the transmitter building. All cables can be arranged to enter the base or roof of the cabinet. If floor entry is used, suitable ducts must be cut in the building and covers manufactured.

The measurements of fixing holes in the base of the cabinet should be noted and 7/16" (fixing holes on plinth are $\frac{1}{2}$" dia.) diameter Rigifix inserts inserted in the floor at appropriate points. The inserts must be accurately located and squarely set.

3.0 ERECTING THE EQUIPMENT

The following is a general description of the procedure to be adopted. No specific instructions for any one group of equipment are given.

(1) Remove the units or blank panels from the lowest positions in the cabinet.

(2) Place the cabinet in its allocated position on the station floor and secure it.

(3) Connect up power, coaxial and audio lines to the terminal block in the base of the cabinet. In this respect the following table shows the types of cable to be used, and Figs. 12 and 13 show methods of termination of coaxial cable type Uniradio 32.

Purpose	Type of Cable
Mains Supply Oven Supply Cabinet heater supply, if required	3/.029 V.I.R.
Audio Inputs A and B	Any 600 ohm twin screened cable such as 1/.036 twin, lead covered
Output and Monitor	Uniradio 32

(4) Set mains transformer tappings to suit the Mains supply, See Section 4.0.

4.0 MAINS TRANSFORMER TAPPINGS AND CONNECTIONS

Code Number	Primary Terminals	Mains Voltage 50-60 c/s	Remarks
U.46149-23	2, 3	100V	
	1, 3	110	
	3, 5	120V	
	2, 4	200	
	1, 4	210	
	2, 5	220	
	1, 5	230	
	2, 6	240	
	1, 6	250	
Oven Trans-former AB.46151-3	2, 3	100	Short 2, 6 and 3, 7
	1, 3	110	Short 1, 5 and 3, 7
	1, 4	120	Short 1, 5 and 4, 8
	2, 7	200	Connect 3, 6
	1, 7	210	As for 200V
	1, 7	220	Connect 3 to 5
	2, 7	230	Connect 4 to 5
	1, 7	240	Connect 4 to 5
	2, 8	250	Connect 4 to 5
	1, 8	260	Connect 4 to 5

CHAPTER 5

LINING UP AND PUTTING INTO SERVICE

WARNING

1. Throughout the following procedure all meter switches must be left in the OFF position except when a reading is actually being taken.

2. The Level switch on the Bandpass Amplifier should NEVER be turned to a carrier position unless the audio inputs are disconnected or removed.

1.0 INITIAL TESTS

It is assumed for the purposes of these tests that the equipment has been installed and all valves are fitted, cables connected etc., and power is available. Before putting the equipment into service, however, it is advisable that the equipment is tested in the following manner. If for any reason the results obtained are unsatisfactory, the procedure detailed in the relevant parts of Chapter 8 should be carried out. It should be noted at this juncture that if any adjustments are made which affect the overall gain of the equipment, the gain control R37, of the 3.1 Mc/s Bandpass amplifier should be adjusted accordingly.

1.1 Test Equipment Required

One calibrated valve voltmeter.

1.2 Serviceability Check

Refer to Plate IV for disposition of units.

(1) Switch on the Mains supply to the equipment but not the Mains switch in the cabinet. The Oven Lamp on the Filter Unit and the Oven Supply lamp on the Power Unit should be illuminated immediately. After a short delay period (up to 2 minutes) the red lamp on the Carrier Modulator should be illuminated. Check that as the ovens attain their working temperatures, the indicator lamp in the Filter Unit goes dim, and the lamps in the Carrier Modulator change over, i.e. the green lamp becomes illuminated.

Pull forward the Filter Tray and insert a thermometer through test hole in the Filter Assembly cover so that the thermometer bulb is suspended about the centre of the oven but not touching the upper

mounting plate. Allow sufficient time for the oven to reach its operating temperature (three to four hours). The registered temperature should be 50°C ± 2°C. If this is not correct refer to Chapter 7 section 5.1.1 to re-set the oven thermostats. Restore the Filter Tray to the cabinet.

(2) After the ovens have been on for four hours, set the Mains switch on the equipment to ON and immediately check that no valve currents are excessive. Allow a warm-up period of not less than ½ hour. During the latter part of this period the valve currents may be checked against the figures given in Appendix 1 of this volume.

(3) Pull forward the Drive Unit tray and restore the power supplies by shorting the gate socket with the plug provided.

(4) Set the switch on the Filter Unit to I.S.B.

(5) On the Drive Unit Tray disconnect SK.27. (NOTE: The top-cap of V2 in the 3.1 Mc/s Bandpass Amplifier is at h.t. potential.) With the LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier at SET ZERO, adjust the ZERO SET control for 0 on the cathode current scale of the associated LEVELS meter.

(6) Check that the CARRIER RE-INSERT switch on the 3 Mc/s Oscillator and Carrier Modulator Unit is OFF, then replace SK.27. There should be little or no reading in the LEVELS meter. This reading, if any, is caused by carrier leak in the Carrier Modulator. If a reading of more than 0.25 mA is observed, the Carrier Modulator must be re-balanced. (Chapter 8, Section 4.4.2 or 6.1).

(7) Set the LEVELS meter switch to SSB/ISB SIDEBAND LEVEL. Disconnect sockets SK.19, SK.22 and SK.35, and connect SK.19 and SK.22 together by means of a co-axial patch cord. The LEVELS meter should now provide a reading of less than 0.25 mA. Repeat with patchcord connected between sockets SK.35 and SK.22 (SK.19 must be left disconnected) and a similar reading should be obtained. This is carrier leak from the 100 kc/s modulators. If these readings are not obtained the 100 kc/s modulators must be rebalanced (Chapter 8, Section 4.2.2, or 6.0). Replace SKs.19, 22 and 35.

(8) Disconnect SK.28 and connect a 75 ohm load across it. Arrange an audio input (1000 c/s) of level between -10 and +10 dbm, to input A or input B. Adjust the INPUT ATTENUATOR for 0 db on the relevant Line Amplifier Unit with switch on METER DIRECT. Check that the Levels meter indicates 0 db on the black scale. If this does not occur, ascertain that the VOGAD switch on the 100 kc/s Oscillator is OFF, then connect a valve voltmeter across the load on SK.28 and adjust, R.37 in the 3.1 Mc/s Bandpass Amplifier for a reading of 6.1 Volts. Check that the levels meter now reads 0 db on the black scale. If this does not occur, realignment of the 3.1 Mc/s Bandpass Amplifier must be carried out (Chapter 8, Section 4.5.).

(9) Set the VOGAD switch on the 100 kc/s Oscillator to ON and check that the output level, as indicated in the Levels meter, decreases by 1 db (valve voltmeter reading 5.7V). If this does not occur adjust R34 in the 3.1 Mc/s Bandpass Amplifier for the correct conditions.

(10) Disconnect the audio input then set the CARRIER RE-INSERT switch to D.S.B. Set the LEVELS switch to D.S.B. CARRIER and adjust the CARRIER LEVEL control for an indication of 0 db on the RED scale of the Levels meter. The valve voltmeter, connected as described in (8) should read 3.05 volts. Set the CARRIER RE-INSERT switch to I.S.B. and the LEVELS switch to I.S.B. carrier. The Levels meter should still indicate 0 db (± 1 db) on the RED scale and the valve voltmeter should read 0.3 volts. Set the CARRIER RE-INSERT switch to S.S.B. and the LEVELS switch to S.S.B. carrier, the meter should again indicate 0 db on the RED scale, and the valve voltmeter should indicate 0.96 volts.

(11) Check that when these readings are taken the CARRIER LEVEL control is set approximately to the reference line. If not, release the knob by the locking grub screw, and re-set. (Remove the unit to do this).

(12) Check the overall frequency response in the following manner:-

(a) Arrange a constant level of input to Input A. Set the equalising switch S2 on the Input A Line Amplifier and 100 kc/s Modulator to IN. (This is located immediately behind the front panel of the unit.) Set the meter switch on the 3.1 Mc/s Bandpass Amplifier to SSB/ISB SIDEBAND LEVEL.

(b) Set the input frequency to 1000 c/s, the switch on the Filter Unit to I.S.B. and adjust the input attenuator associated with Input A for 0 db in the relevant Line Amplifier meter (meter switch to METER DIRECT). The LEVELS meter on the 3.1 Mc/s Bandpass Amplifier should indicate 0 db on the black scale.

(c) Set the a.f. input to each of the following frequencies in turn, maintaining the level constant (do not use the Line Amplifier meter for this purpose) and note the level indicated by the LEVELS meter in the 3.1 Mc/s Bandpass Amplifier, at each one.

100 c/s	1000 c/s	4000 c/s
300 c/s	2000 c/s	5000 c/s
500 c/s	3000 c/s	6000 c/s
800 c/s		

The indication given by the Levels meter should not vary by more than 3 db overall.

(d) Repeat this test using Input B.

(e) If results prove unsatisfactory refer to Chapter 3 sub-section 2.2 and Chapter 7 section 7.0.

This completes the initial testing of the equipment and, if all tests are proved satisfactory, the equipment is ready for service.

CHAPTER 5a.

LINING UP AND PUTTING INTO SERVICE.

WARNING.

1. Throughout the following procedure all meter switches must be left in the OFF position except when a reading is actually being taken.

2. The Level switch on the Bandpass Amplifier should NEVER be turned to a carrier position unless the audio inputs are disconnected or removed.

1.0 INITIAL TESTS

It is assumed for the purposes of these tests that the equipment has been installed and all valves are fitted, cables connected etc., and power is available. Before putting the equipment into service, however, it is advisable that the equipment is tested in the following manner. If for any reason the results obtained are unsatisfactory, the procedure detailed in the relevant parts of Chapter 8a should be carried out. It should be noted at this juncture that if any adjustments are made which affect the overall gain of the equipment, the gain control R37, of the 3.1 Mc/s Bandpass amplifier should be adjusted accordingly.

1.1 Test Equipment Required

One calibrated valve voltmeter.

1.2 Serviceability Check

Refer to Plate IV for disposition of units.

(1) Switch on the Mains supply to the equipment but not the Mains switch in the cabinet. The oven Lamp on the Filter Unit and the Oven Supply lamp on the Power Unit should be illuminated immediately. After a short delay period (up to 2 minutes) the red lamp on the Carrier Modulator should be illuminated. Check that as the ovens attain their working temperatures, the indicator lamp in the Filter Unit goes dim, and the lamps in the Carrier Modulator change over, i.e. the green lamp becomes illuminated.

Pull forward the Filter Tray and insert a thermometer through test hole in the Filter Assembly cover so that the thermometer bulb is suspended about the centre of the oven but not touching the upper

mounting plate. Allow sufficient time for the oven to reach its operating temperature (three to four hours). The registered temperature should be 50°C ± 2°C. If this is not correct refer to Chapter 7a section 5.1.1 to re-set the oven thermostats. Restore the Filter Tray to the cabinet.

(2) After the ovens have been on for four hours, set the Mains switch on the equipment to ON and immediately check that no valve currents are excessive. Allow a warm-up period of not less than ½ hour. During the latter part of this period the valve currents may be checked against the figures given in Appendix 1 of this volume.

(3) Pull forward the Drive Unit tray and restore the power supplies by shorting the gate socket with the plug provided.

(4) Set the switch on the Filter Unit to I.S.B.

(5) On the Drive Unit Tray disconnect SK.27. (NOTE: The top-cap of V2 in the 3.1 Mc/s Bandpass Amplifier is at h.t. potential.) With the LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier at SET ZERO, adjust the ZERO SET control for 0 on the cathode current scale of the associated LEVELS meter.

(6) Check that the CARRIER RE-INSERT switch on the 3 Mc/s Oscillator and Carrier Modulator Unit of OFF, then replace SK.27. There should be little or no reading in the LEVELS meter. This reading, if any, is caused by carrier leak in the Carrier Modulator. If a reading of more than 0.25 mA is observed, the Carrier Modulator must be re-balanced. (Chapter 8a Section 4.4.2 or 6.1).

(7) Set the LEVELS meter switch to SSB/ISB SIDEBAND LEVEL. Disconnect sockets SK.19, SK.22 and SK.35, and connect SK.19 and SK.22 together by means of a co-axial patch cord. The LEVELS meter should now provide a reading of less than 0.25 mA. Repeat with patchcord connected between sockets SK.35 and SK.22 (SK.19 must be left disconnected) and a similar reading should be obtained. This is carrier leak from the 100 kc/s modulators. If these readings are not obtained the 100 kc/s modulators must be rebalanced (Chapter 8a Section 4.2.2, or 6.0). Replace SKs.19, 22 and 35.

(8) Disconnect SK.28 and connect a 75 ohm load across it. Arrange an audio input (1000 c/s) of level between -10 and +10 dbm, to input A or input B. Adjust the INPUT ATTENUATOR for 0 db on the relevant Line Amplifier Unit with switch on METER DIRECT. Check that the Levels meter indicates 0 db on the black scale. If this does not occur, ascertain that the VOGAD switch on the 100 kc/s Oscillator is OFF, then connect a valve voltmeter across the load on SK.28 and adjust, R.37 in the 3.1 Mc/s Bandpass Amplifier for a reading of 6.1 Volts. Check that the levels meter now reads 0 db on the black scale. If this does not occur, realignment of the 3.1 Mc/s Bandpass Amplifier must be carried out (Chapter 8a, Section 4.5.).

(9) Set the VOGAD switch on the 100 kc/s Oscillator to ON and check that the output level, as indicated in the Levels meter, decreases by 1 db (valve voltmeter reading 5.7V). If this does not occur adjust R34 in the 3.1 Mc/s Bandpass Amplifier for the correct conditions.

(10) Disconnect the audio input then set the CARRIER RE-INSERT switch to D.S.B. Set the LEVELS switch to D.S.B. CARRIER and adjust the CARRIER LEVEL control for an indication of 0db on the RED scale of the Levels meter. The valve voltmeter, connected as described in (8) should read 3.05 volts. Set the CARRIER RE-INSERT switch to I.S.B. and the LEVELS switch to I.S.B. carrier. The Levels meter should still indicate 0 db (± 1 db) on the RED scale and the valve voltmeter should read 0.3 volts. Set the CARRIER RE-INSERT switch to S.S.B. and the LEVELS switch to S.S.B. carrier, the meter should again indicate 0 db on the RED scale, and the valve voltmeter should indicate 0.96 volts.

(11) Check that when these readings are taken the CARRIER LEVEL control is set approximately to the reference line. If not, release the knob by the locking grub screw, and re-set. (Remove the unit to do this).

(12) Check the overall frequency response in the following manner:-

(a) Arrange a constant level of input to Input A. Set the equalising switch S2 on the Input A Line Amplifier and 100 kc/s Modulator to IN. (This is located immediately behind the front panel of the unit.) Set the meter switch on the 3.1 Mc/s Bandpass Amplifier to SSB/ISB SIDEBAND LEVEL.

(b) Set the input frequency to 1000 c/s, the switch on the Filter Unit to I.S.B. and adjust the input attenuator associated with Input A for 0 db in the relevant Line Amplifier meter (meter switch to METER DIRECT). The LEVELS meter on the 3.1 Mc/s Bandpass Amplifier should indicate 0 db on the black scale.

(c) Set the a.f. input to each of the following frequencies in turn, maintaining the level constant (do not use the Line Amplifier meter for this purpose) and note the level indicated by the LEVELS meter in the 3.1 Mc/s Bandpass Amplifier, at each one.

100 c/s	1000 c/s	4000 c/s
300 c/s	2000 c/s	5000 c/s
500 c/s	3000 c/s	6000 c/s
800 c/s		

The indication given by the Levels meter should not vary by more than 3 db overall.

(d) Repeat this test using Input B.

(e) If results prove unsatisfactory refer to Chapter 3a sub-section 2.2 and Chapter 7a section 7.0

This completes the initial testing of the equipment and, if all tests are proved satisfactory, the equipment is ready for service.

CHAPTER 6

OPERATION

WARNING:

1. Throughout the following procedure all meter switches must be left in the OFF position except when a reading is actually being taken.

2. The LEVEL meter switch on the 3.1 Mc/s Bandpass Amplifier should never be turned to a carrier position without first removing the audio input(s) to the equipment.

3. Allow the equipment to warm up for at least ½ hour before making adjustments. Ovens should have been on for at least 4 hours. If the equipment is in daily use the ovens should be left on continuously.

1.0 SETTING UP

1.1 General

In the course of the following instructions, reference is made to the planning level of the system. It should be noted that this refers to the test-tone level at the drive unit input socket; speech peaks will in general be higher than this, for example, 8 db higher for the TOP.10 to TOP.12.

This is important since, if the transmitter is set up to peak output power with a planning level input, when speech peaks occur the transmitter will be overrun with subsequent damage.

The A.1406 equipment is set up, in the first instance, to peak power levels and then input is reduced, by means of the input attenuators, to provide the correct operating levels.

1.2 S.S.B. Operation

(a) Set CARRIER RE-INSERT Switch to OFF. Set switch on Filter Unit (8-LRU.297A) to I.S.B. Set the equaliser switch S2 on the A.F. Amplifiers and Modulators to IN, thereby introducing a rising response at the lower audio frequencies to compensate for the characteristics of the crystal filter.

(b) Obtain from the system terminal equipment a steady tone (approximately 1000 c/s) on Input A, at planning level for the system.

(c) Adjust Input "A" Attenuator on the A.F. Amplifier and Modulator Unit for an output level of 0 db as indicated on the front panel meter with meter switch set to METER DIRECT. This level corresponds to peak output power of the transmitter.

(d) Set LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier to SSB/ISB Sideband position and check that the Levels meter indicates 0 db $\pm \frac{1}{2}$ db on the black scale.

(e) Remove the 1000 c/s tone, set the CARRIER LEVEL control on the 100 kc/s Oscillator Unit to the reference line, then set the CARRIER REINSERT switch to S.S.B.

(f) Set the LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier to S.S.B. CARRIER position and, if necessary, adjust the CARRIER LEVEL control until the indication on the LEVELS meter is 0 db on the Red scale. Set the LEVELS switch back to SSB/ISB SIDEBAND.

(g) Re-apply the 1000 c/s tone and check that the equipment is still at 0 db line up level. Set VOGAD switch to ON. The indication in the LEVELS meter should decrease by 1 db.

(h) Reduce the input, by means of the Input Attenuator on Input A Line Amplifier and 100 kc/s Modulator, by the amount that the Speech peaks exceed the planning level (in TOP.10 or 12 8 db). The equipment can now be put to traffic.

1.3 I.S.B. Operation

(a) Set CARRIER RE-INSERT switch to OFF, the LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier to SSB/ISB - SIDEBAND LEVEL, the VOGAD switch to OFF, and the equalising switches S2 located behind the front panel of each Line Amplifier and 100 kc/s Modulator Unit to IN.

(b) Obtain from system terminal equipment a steady tone (approximately 1000 c/s) at planning level for the system and apply it to Input A.

(c) Set switch on the Line Amplifier to METER DIRECT, and adjust the Input Attenuator of Input A for a level of 0 db as indicated on the front panel meter of the Input A Line Amplifier and 100 kc/s Modulator Unit.

(d) Check that the LEVELS meter in the 3.1 Mc/s Bandpass Amplifier indicates 0 db ($\pm \frac{1}{2}$ db).

(e) Remove the 1000 c/s tone and set the CARRIER LEVEL control to the reference line. Set the CARRIER RE-INSERT control to I.S.B.

(f) Set the LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier to I.S.B. CARRIER and adjust the CARRIER LEVEL control for an indication of 0 db on the RED scale of the LEVELS meter. Return LEVELS meter switch to SSB/ISB SIDEBAND LEVEL.

(g) Apply 1000 c/s tone (planning level) to Input "B" and adjust the input attenuator for 0 db on meter in Line Amplifier and 100kc/s Modulator and the LEVELS meter in the 3.1 Mc/s Bandpass Amplifier.

Owing to slight difference in the gains of the 100 kc/s modulators and their associated crystal filters, it may not be possible to obtain output levels of 0 db on the 3.1 Mc/s Bandpass Amplifier LEVEL meter for both Input A and Input B. In order to ensure balance therefore, first line up Input A for a reading of 0 db on the LEVEL meter as outlined in 1.3C above. Then line up Input B as detailed in (g). Note the difference in readings and if it is greater than 1 db adjust gain control R37 so that the difference in levels is equally shared.

E.g. Input A reading on LEVEL meter = 0 db
Input B " " " " = +2 db

Final adjustment should be such that:

Input A reading becomes -1 db
Input B " " +1 db

(h) Set VOGAD switch to ON, this reading should decrease by 1 db.

(j) Reduce the input, by means of the Input Attenuator on Input B Line Amplifier and 100 kc/s Modulator by the amount that the speech peaks exceed the planning level.

(k) Re-apply 1000 c/s tone to input A and reduce as detailed in (j). The equipment is now ready for traffic.

For s.s.b. and i.s.b. operation when the A.1406 is used in conjunction with Terminal Equipment type TOP.10 or TOP.12 see Appendix 2.

1.4 D.S.B. Operation

(a) Set the LEVELS meter switch to D.S.B. CARRIER. Set th4 switch on the Filter Tray to D.S.B. and the equalising switch S2 on the Input A Line Amplifier and 100 kc/s Modulator to "OUT".

(b) Set the CARRIER RE-INSERT switch on the Carrier Modulator to D.S.B. and adjust the CARRIER LEVEL control for 0 db on the red scale of the LEVELS meter.

(c) Arrange a steady tone (approximately 1000 c/s), from the Terminal Equipment, at planning level, to Input 'A' and reduce the input, by means of the Input Attenuator on Input A Line Amplifier and 100 kc/s Modulator, by the amount that the speech peaks exceed the planning level (8 db for the TOP.10 or TOP.12).

(d) Set VOGAD switch to ON and the equipment is then ready for traffic.

This method of operation provides d.s.b. signals with a modulation depth of 85% on speech peaks.

CHAPTER 6a

OPERATION

WARNING:

1. Throughout the following procedure all meter switches must be left in the OFF position except when a reading is actually being taken.

2. The LEVEL meter switch on the 3.1 Mc/s Bandpass Amplifier should never be turned to a carrier position without first removing the audio input (s) to the equipment.

3. Allow the equipment to warm up for at least $\frac{1}{2}$ hour before making adjustments. Ovens should have been on for at least 4 hours. If the equipment is in daily use the ovens should be left on continuously.

1.0 SETTING UP

1.1 General

In the course of the following instructions, reference is made to the planning level of the system. It should be noted that this refers to the test-tone level at the drive unit input socket; speech peaks will in general be higher than this, for example, 8 db higher for the TOP.10 to TOP.12.

This is important since, if the transmitter is set up to peak output power with a planning level input, when speech peaks occur the transmitter will be overrun with subsequent damage.

The A.1406 equipment is set up, in the first instance, to peak power levels and then input is reduced, by means of the input attenuators, to provide the correct operating levels.

1.2 S.S.B. Operation

(a) Set CARRIER RE-INSERT Switch to OFF. Set switch on Filter Unit (8-IRU.297A) to I.S.B. Set the equaliser switch S2 on the A.F. Amplifiers and Modulators to IN, thereby introducing a rising response at the lower audio frequencies to compensate for the characteristics of the crystal filter.

(b) Obtain from the system terminal equipment a steady tone (approximately 1000 c/s) on Input A, at planning level for the system.

(c) Adjust Input "A" Attenuator on the A.F. Amplifier and modulator Unit for an output level of 0 db as indicated on the front panel meter with meter switch set to METER DIRECT. This level corresponds to peak output power of the transmitter.

(d) Set LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier to SSB/ISB Sideband position and check that the Levels meter indicates 0 db ± ½ db on the black scale.

(e) Remove the 1000 c/s tone, set the CARRIER LEVEL control on the 100 kc/s Oscillator Unit to the reference line, then set the CARRIER REINSERT switch to S.S.B.

(f) Set the LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier to S.S.B. CARRIER position and, if necessary, adjust the CARRIER LEVEL control until the indication on the LEVELS meter is 0 db on the Red scale. Set the LEVELS switch back to SSB/ISB SIDEBAND.

(g) Re-apply the 1000 c/s tone and check that the equipment is still at 0 db line up level. Set VOGAD switch to ON. The indication in the LEVELS meter should decrease by 1 db.

(h) Reduce the input, by means of the Input Attenuator on Input A Line Amplifier and 100 kc/s Modulator, by the amount that the Speech peaks exceed the planning level (in TOP.10 or 12 8 db). The equipment can now be put to traffic.

1.3 I.S.B. Operation

(a) Set CARRIER RE-INSERT switch to OFF, the LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier to SSB/ISB - SIDEBAND LEVEL, the VOGAD switch to OFF, and the equalising switches S2 located behind the front panel of each Line Amplifier and 100 kc/s Modulator Unit to IN.

(b) Obtain from system terminal equipment a steady tone (approximately 1000 c/s) at planning level for the system and apply it to Input A.

(c) Set switch on the Line Amplifier to METER DIRECT, and adjust the Input Attenuator of Input A for a level of 0 db as indicated on the front panel meter of the Input A Line Amplifier and 100 kc/s Modulator Unit.

(d) Check that the LEVELS meter in the 3.1 Mc/s Bandpass Amplifier indicates 0 db (± ½ db).

(e) Remove the 1000 c/s tone and set the CARRIER LEVEL control to the reference line. Set the CARRIER RE-INSERT control to I.S.B.

(f) Set the LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier to I.S.B. CARRIER and adjust the CARRIER LEVEL control for an indication of 0 db on the RED scale of the LEVELS meter. Return LEVELS meter switch to SSB/ISB SIDEBAND LEVEL.

(g) Apply 1000 c/s tone (planning level) to Input "B" and adjust the input attenuator for 0 db on meter in Line Amplifier and 100 kc/s Modulator and the LEVELS meter in the 3.1 Mc/s Bandpass Amplifier.

Owing to slight difference in the gains of the 100 kc/s modulators and their associated crystal filters, it may not be possible to obtain output levels of 0 db on the 3.1 Mc/s Bandpass Amplifier LEVEL meter for both Input A and Input B. In order to ensure balance therefore, first line up Input A for a reading of 0 db on the LEVEL meter as outlined in 1.3C above. Then line up Input B as detailed in (g). Note the difference in readings and if it is greater than 1 db adjust gain control R37 so that the difference in levels is equally shared.

E.g. Input A reading on LEVEL meter = 0 db
Input B " " " " = +2 db

Final adjustment should be such that:

Input A reading becomes -1 db
Input B " " +1 db

(h) Set VOGAD switch to ON, this reading should decrease by 1 db.

(j) Reduce the input, by means of the Input Attenuator on Input B Line Amplifier and 100 kc/s Modulator by the amount that the speech peaks exceed the planning level.

(k) Re-apply 1000 c/s tone to input A and reduce as detailed in (j). The equipment is now ready for traffic.

For s.s.b. and i.s.b. operation when the A.1406 is used in conjunction with Terminal Equipment type TOP.10 or TOP.12 see Appendix 2.

1.4 D.S.B. Operation

(a) Set the LEVELS meter switch to D.S.B. CARRIER. Set the switch on the Filter Tray to D.S.B. and the equalising Switch S2 on the input A Line Amplifier and 100 kc/s Modulator to "OUT".

(b) Set the CARRIER RE-INSERT switch on the Carrier Modulator to D.S.B. and adjust the CARRIER LEVEL control for 0 db on the red scale of the LEVELS meter.

(c) Arrange a steady tone (approximately 1000 c/s), from the Terminal Equipment, at planning level, to Input 'A' and reduce the input, by means of the Input Attenuator on Input A Line Amplifier and 100 kc/s Modulator, by the amount that the speech peaks exceed the planning level (8 db for the TOP.10 or TOP.12).

(d) Set VOGAD switch to ON and the equipment is then ready for traffic.

This method of operation provides d.s.b. signals with a modulation depth of 85% on speech peaks.

CHAPTER 7

MAINTENANCE

1.0 GENERAL

Under normal conditions the operating levels and values of valve currents may be checked by careful observation of the meters in the drive unit.

Periodical checks, however, must be made to ensure that the crystal and main filter ovens are operating at their correct temperatures; that the three balanced modulators are adjusted for minimum carrier leak, and any variations in operating levels corrected.

The procedure to be adopted when a valve is replaced is included at the end of this chapter.

2.0 DAILY ROUTINE

2.1 Check of Ovens and Valves

(a) It is assumed that the ovens have been left switched on permanently. Check that the OVEN LAMP on the Filter Unit is changing from dim to bright.

(b) Check that the lamps, located on either side of the front panel meter of the Carrier Modulator Unit, are changing over at regular intervals. Those lamps are in the crystal oven heater circuit.

(c) Switch on the a.c. supply to the Power Unit by means of the main switch and after about five minutes check all valve currents. (See Appendix 1).

(d) By keeping a daily record of meter readings against valve life, any falling off in emission will be detected and the valve can be replaced before it becomes quite useless, thus avoiding possible break in transmission. For these records to serve a useful purpose, it is important that the conditions of measurement remain constant in respect to supply voltage.

2.2 Check of Output Levels

In order to eliminate the possibility of false readings on the front panel meters due to effects of feedback, ensure that all control switches, other than those directly required, are switched off.

(a) Set meter switch on 3.1 Mc/s Bandpass Amplifier to ISB/SSB SIDEBAND LEVEL. Apply 1000 c/s line-up tone to each Line Amplifier in turn and adjust INPUT ATTENUATOR for a reading of 0 db on front panel meter of this Unit. Check that Sideband output level is 0 db on black scale of Levels meter on 3.1 Mc/s Bandpass Amplifier Unit. Set VOGAD switch to ON, check that indication in Levels meter decrease by 1 db. Disconnect 1000 c/s source.

(b) Set CARRIER RE-INSERT switch, on Carrier Modulator Unit, to S.S.B. position and the switch on 3.1 Mc/s Amplifier, to S.S.B. Carrier Level. Check that carrier level on red scale of this meter is 0 db when carrier level control is on reference line.

(c) Set meter switch on 3.1 Amplifier to I.S.B. Carrier, and Carrier Re-insert switch to I.S.B. Check that I.S.B. carrier level is 0 db on Red scale of levels meter.

3.0 WEEKLY ROUTINE

Reset gain control (R37) on the 3.1 Mc/s Bandpass Amplifier Unit for correct output and check all output levels as in 2.2.

4.0 MONTHLY ROUTINE

Check balance of the 3 Modulators as described in Chapter 8, Sections 4.2.2 and 4.4.2 or 6.0.

5.0 BI-MONTHLY ROUTINE

5.1 Checking the Operation of Sideband Filter Oven Thermostats

NOTE: As a safety precaution, two thermostats are fitted in series on the oven assembly in this equipment. Accordingly, if for any reason one thermostat fails to function the second one will operate and ensure that the oven heater circuit opens. It is important therefore to check, periodically, that both are capable of functioning and, in this connection, the procedure detailed below should be followed. This check can be carried out during normal operating time.

(a) Pull out Filter Tray Unit.

(b) Insert a thermometer into the test hole in top cover of filter oven and allow about $2\frac{1}{2}$" of bulb to project inside oven.

(c) Allow oven to warm up and note the temperature at which is stabilises. This should be $50^{\circ}C \pm 2^{\circ}C$.

(d) Wait for oven indicator lamp, on front panel of unit, to go dim.

(e) Short test points A and B on tag board and note that indicator lamp becomes brightly illuminated. If this is not the case remove short from AB and connect test points BC. Note that lamp now becomes bright.

(f) As soon as above result is obtained, note time and observe indicator lamp. The latter should, within a period (8 minutes) revert to "dim" condition, i.e. the oven should be operating normally, the lamp alternately going dim and bright. Now check with the other test points shorted and the oven should operate as above.

(g) If, for any reason, the time period for the correct functioning of the thermostat is greatly exceeded, or the lamp remains permanently bright or the temperature is not maintained within limits given in (c), the thermostats will require attention. In this event it will be necessary to remove the cover from the chassis, detach the thermostat assembly complete with its metal mounting plate and wiring to test points, and fit a replacement.

NOTE: Take care that the thermometer is removed before pushing the Filter Tray back into the cabinet.

5.1.1 Adjustment of Thermostats

When the thermostats are replaced by new or reconditioned ones, the replacements will require adjustment. The method of carrying out these adjustments is as follows:-

(1) Switch on the Mains supply to the equipment and allow 4 hours for the ovens to stabilise before commencing adjustments. During this period, insert a thermometer through the test hole in the filter oven cover so that the thermometer bulb is suspended in the centre of the oven, but not touching the upper mounting plate. Short circuit TH1 by linking terminals A and B on the test strip (located on the right of the Filter Unit chassis).

(2) Check operating temperature. If this is not $50^{\circ} \pm 1^{\circ}C$, remove thermometer and oven cover, then adjust TH2. This operation should be performed as rapidly as possible and the oven cover replaced immediately in order to preserve the operating conditions of the oven.

It should be noted that a $\frac{1}{4}$ turn on the thermostat adjusting screw provides a variation in temperature of approximately $4^{\circ}C$. Further, clockwise adjustment increases the operating temperature and anticlockwise the reverse.

(3) Allow a further 20 minutes for the oven conditions to stabilise (with thermometer in the test hole), and, if necessary re-adjust TH2.

(4) Repeat (2) and (3) until the oven temperature stabilises at $50^{\circ} \pm 1^{\circ}C$.

(5) Remove the link between A and B and connect it between B and C.

(6) After approximately 20 minutes check over temperature, then, if necessary, adjust TH1 in the manner described in (2), (3) and (4) for an oven operating temperature of $50^{\circ} \pm 1^{\circ}C$.

(7) Remove thermometer and link between B & C and return Filter Unit to cabinet.

5.2 Re-setting the Thermal Cut-Out

Fig.10.

If both oven thermostats fail to operate, the oven temperature will rise to approximately 75° when the thermal cut-out will operate to disconnect supplies to the heater element and indicator lamp.

The cut-out operates by virtue of a very low melting-point alloy, Woods Metal, which runs at $72\text{-}75^{\circ}C$.

Instructions for re-setting are given on the diagram (Fig.10), but it is again made clear that a clean (free of normal solder) iron must be used.

A supply of Woods metal is provided with each equipment. Additional supplies can be obtained from Standard Telephones and Cables Limited. Quote Woods Metal, Stock No. 907858 and the quantity required.

6.0 VALVE CHANGES

Unit	Valve	Procedure
17-LRU.67A and E	V1 V2 & V3	No adjustment needed Re-balance Modulator (Chapter 8: Section 4.2.2)
17-LRU.67B	V1 or V2 V3 V4	Re-balance Modulator (Chapter 8: Section 4.4.2) Adjust C2 and L3 for maximum output in SK.25 (Chapter 8: Section 4.4.1) Adjust C2 for maximum output in SK.25 (TMS set to LOSS) (Chapter 8: Section 4.4.1)

Unit	Valve	Procedure
28-LRU.330C	V1	No adjustment
	V2	Adjust T4 for maximum at SK.33 (Chapter 8: Section 4.1)
	V3	Adjust T6 for maximum at SK.37 (Chapter 8: Section 4.4.2)
28-LRU.330C	V1	Re-trim CC3a for maximum output, use re-inserted carrier With normal line up tone (1000 c/s) applied to input of A.F. Amplifier Unit, re-adjust gain control (R.37) on 3.1 Mc/s B.P. Filter Unit for 0 db output.
	V2	Re-trim CC3a, CC14a, and CC16a re-adjust gain control for 0 db output
	V3	Re-adjust ZERO SET and check LEVEL meter reading against a standard valve voltmeter and load (see Chapter 8: Section 4.4.2) Re-adjust VOGAD operating level (see Chapter 8: Section 4.4.3)

7.0 FILTER CHANGES

1. Carrier Stop Filter 8-LU.139AZ:- no realignment required

2. Bandpass Filters 8-LU.139BE, BF or BG, BH. These filters are designed to work in pairs, e.g. if it is required to fit a new "BE" filter, the corresponding "BF" filter must also be fitted.

In the event of such a change the overall frequency response of the equipment should be measured on the relevant sideband by connecting a constant level a.f. input to Input A or B as required and noting the output level variations at SK.28 for a.f. input frequencies between 100 and 6000 c/s. Refer to Chapter 5, sub-section 1.2(ii).

Before carrying out this test, filter ovens should be allowed at least 4 hours warming up and the rest of the equipment at least 1 hour.

The response should lie between two lines 3 db apart. If necessary the response at the lower audio frequencies can be adjusted by selecting equalising condensers C.15 or C.15 and C.16 in parallel in the Line Amplifier Unit. The response at the higher audio frequencies can similarly be adjusted by connecting C.17 and C.18 to the alternative positions as shown on the Line Amplifier schematic.

CHAPTER 7a.

MAINTENANCE.

1.0 GENERAL.

Under normal conditions the operating levels and values of valve currents may be checked by careful observation of the meters in the drive unit.

Periodical checks, however, must be made to ensure that the crystal and main filter ovens are operating at their correct temperatures; that the three balanced modulators are adjusted for minimum carrier leak, and any variations in operating levels corrected.

The procedure to be adopted when a valve is replaced is included at the end of this chapter.

2.0 DAILY ROUTINE

2.1 Check of Ovens and Valves

(a) It is assumed that the ovens have been left switched on permanently. Check that the OVEN LAMP on the Filter Unit is changing from dim to bright.

(b) Check that the lamps, located on either side of the front panel meter of the Carrier Modulator Unit, are changing over at regular intervals. These lamps are in the crystal oven heater circuit.

(c) Switch on the a.c. supply to the Power Unit by means of the main switch and after about five minutes check all valve currents. (See Appendix 1).

(d) By keeping a daily record of meter readings against valve life, any falling off in emission will be detected and the valve can be replaced before it becomes quite useless, thus avoiding possible break in transmission. For these records to serve a useful purpose, it is important that the conditions of measurement remain constant in respect to supply voltage.

2.2 Check of Output Levels

In order to eliminate the possibility of false readings on the front panel meters due to effects of feedback, ensure that all control switches, other than those directly required, are switched off.

(a) Set meter switch on 3.1 Mc/s Bandpass Amplifier to ISB/SSB SIDEBAND LEVEL. Apply 1000 c/s line-up tone to each Line Amplifier in turn and adjust INPUT ATTENUATOR for a reading of 0 db on front panel meter of this Unit. Check that Sideband output level is 0 db on black scale of Levels meter on 3.1 Mc/s Bandpass Amplifier Unit. Set VOGAD switch to ON, check that indication in Levels meter decrease by 1 db. Disconnect 1000 c/s source.

(b) Set CARRIER RE-INSERT switch, on Carrier Modulator Unit, to S.S.B. position and the switch on 3.1 Mc/s Amplifier, to S.S.B. Carrier Level. Check that carrier level on red scale of this meter is 0 db when carrier level control is on reference line.

(c) Set meter switch on 3.1 Amplifier to I.S.B. Carrier, and Carrier Re-insert switch to I.S.B. Check that I.S.B. carrier level is 0 db on Red scale of levels meter.

3.0 WEEKLY ROUTINE

Reset gain control (R37) on the 3.1 Mc/s Bandpass Amplifier Unit for correct output and check all output levels as in 2.2.

4.0 MONTHLY ROUTINE

Check balance of the 3 Modulators as described in Chapter 8a Sections 4.2.2. and 4.4.2 or 6.0

5.0 BI-MONTHLY ROUTINE

5.1 Checking the Operation of Sideband Filter Oven Thermostats

NOTE: As a safety precaution, two thermostats are fitted in series on the oven assembly in this equipment. Accordingly, if for any reason one thermostat fails to function the second one will operate and ensure that the oven heater circuit opens. It is important therefore to check, periodically, that both are capable of functioning and, in this connection, the procedure detailed below should be followed. This check can be carried out during normal operating time.

(a) Pull out Filter Tray Unit.

(b) Insert a thermometer into the test hole in top cover of filter oven and allow about 2½" of bulb to project inside oven.

(c) Allow oven to warm up and note the temperature at which it stabilises. This should be 50°C + 2°C.

(d) Wait for oven indicator lamp, on front panel of unit, to go dim.

(e) Short test points A and B on tag board and note that indicator lamp becomes brightly illuminated. If this is not the case remove short from AB and connect test points BC. Note that lamp now becomes bright.

(f) As soon as above result is obtained, note time and observe indicator lamp. The latter should, within a period (8 minutes) revert to "dim" condition, i.e. the oven should be operating normally, the lamp alternately going dim and bright. Now check with the other test points shorted and the oven should operate as above.

(g) If, for any reason, the time period for the correct functioning of the thermostat is greatly exceeded, or the lamp remains permanently bright or the temperature is not maintained within limits given in (c), the thermostats will require attention. In this event it will be necessary to remove the cover from the chassis, detach the thermostat assembly complete with its metal mounting plate and wiring to test points, and fit a replacement.

NOTE: Take care that the thermometer is removed before pushing the Filter Tray back into the cabinet.

5.1.1 Adjustment of Thermostats

When the thermostats are replaced by new or reconditioned ones, the replacements will require adjustment. The method of carrying out these adjustments is as follows:-

(1) Switch on the Mains supply to the equipment and allow 4 hours for the ovens to stabilise before commencing adjustments. During this period, insert a thermometer through the test hole in the filter oven cover so that the thermometer bulb is suspended in the centre of the oven, but not touching the upper mounting plate. Short circuit TH1 by linking terminals A and B on the test strip (located on the right of the Filter Unit chassis).

(2) Check operating temperature. If this is not 50° ± 1°C, remove thermometer and oven cover, then adjust TH2. This operation should be performed as rapidly as possible and the oven cover replaced immediately in order to preserve the operating conditions of the oven.

It should be noted that a ¼ turn on the thermostat adjusting screw provides a variation in temperature of approximately 4°C. Further, clockwise adjustment increases the operating temperature and anticlockwise the reverse.

(3) Allow a further 20 minutes for the oven conditions to stabilise (with thermometer in the test hole) and, if necessary re-adjust TH2.

(4) Repeat (2) and (3) until the oven temperature stabilises at 50° ± 1°C.

(5) Remove the link between A and B and connect it between B and C.

(6) After approximately 20 minutes check oven temperature, then, if necessary, adjust TH1 in the manner described in (2), (3) and (4) for an oven operating temperature of 50° ± 1°C

(7) Remove thermometer and link between B & C and return Filter Unit to cabinet.

5.2 Re-setting the Thermal Cut-Out

Fig.10.

If both oven thermostats fail to operate, the oven temperature will rise to approximately 75° when the thermal cut-out will operate to disconnect supplies to the heater element and indicator lamp.

The cut-out operates by virtue of a very low melting-point alloy, Woods Metal, which runs at 72-75°C.

Instructions for re-setting are given on the diagram (Fig.10) but it is again made clear that a clean (free of normal solder) iron must be used.

A supply of Woods metal is provided with each equipment. Additional supplies can be obtained from Standard Telephones and Cables Limited. Quote Woods Metal, Stock No. 907858 and the quantity required.

6.0 VALVE CHANGES

Unit	Valve	Procedure
17-LRU.67A and E	V1	No adjustment needed
	V2 & V3	Re-balance Modulator (Chapter 8a: Section 4.2.2)
17-LRU.67B	V1 or V2	Re-balance Modulator (Chapter 8a: Section 4.2.2)
	V3	Adjust C2 and L3 for maximum output in SK.25 (Chapter 8a: Section 4.4.1)
	V4	Adjust C2 for maximum output in SK.25 (TMS set to LOSS) (Chapter 8a: Section 4.4.1

Unit	Valve	Procedure
28-LRU.330C	V1	No adjustment
	V2	Adjust T4 for maximum at SK.33 (Chapter 8a: Section 4.1
	V3	Adjust T6 for maximum at SK.37 (Chapter 8a (Section 4.4.2)
28-LRU.330C	V1	Re-trim CC3a for maximum output, use re-inserted carrier With normal line up tone (1000c/s) applied to input of A.F. Amplifier Unit, re-adjust gain control (R.37) on 3.1 Mc/s B.P. Filter Unit for 0 db output
	V2	Re-trim CC3a, CC14a, and CC16a re-adjust gain control for 0 db output
	V3	Re-adjust ZERO SET and check LEVEL meter reading against a standard valve voltmeter and load (see Chapter 8a: Section 4.4.2) Re-adjust VOGAD operating level (see Chapter 8a: Section 4.4.3)

7.0 FILTER CHANGES

1. Carrier Stop Filter 8-LU.139AZ:- no realignment required

2. Bandpass Filter 8-LU.139BE, BF or BG, BH. These filters are designed to work in pairs, e.g. if it is required to fit a new "BE" filter, the corresponding "BF" filter must also be fitted.

In the event of such a change the overall frequency response of the equipment should be measured on the relevant sideband by connecting a constant level a.f. input to Input A or B as required and noting the output level variations at SK.28 for a.f. input frequencies between 100 and 6000 c/s. Refer to Chapter 5a, sub-section 1.2 (ii).

Before carrying out this test, filter ovens should be allowed at least 4 hours warming up and the rest of the equipment at least 1 hour.

The response should lie between two lines 3 db apart. If necessary the response at the lower audio frequencies can be adjusted by selecting equalising condensers C.15 or C.15 and C.16 in parallel in the Line Amplifier Unit. The response at the higher audio frequencies can similarly be adjusted by connecting C.17 and C.18 to the alternative positions as shown on the Line Amplifier schematic.

CHAPTER 8

RE-ALIGNMENT

1.0 GENERAL

The procedure outlined in this chapter for complete re-alignment of individual units should only be carried out after a major repair or replacement has been carried out. A Transmission Measuring Set is required but if this is not available an accurately calibrated valve voltmeter can be used. When the latter is used it should, in measurements across a co-axial socket, be terminated in 75 ohms. Figures which should be indicated in a valve voltmeter are given in parenthesis where possible.

Reference should be made to the level diagram Fig.2 and original test sheets for the equipment while carrying out re-alignment.

2.0 APPARATUS REQUIRED

T.M.S.:	S.T.C. Type 74602C if available
Audio Oscillator:	Range 100 - 10,000 c/s
Valve Voltmeter:	Range 0 - 25V. Accurately calibrated up to 10 volts.
Multi-range meter:	(suggested type, Avo, model 7)
Frequency Standard:	Accuracy .0001% if available
Thermometer:	0 - 100°C or 0 - 212°F
Resistors:	1 - 100K ohms ½ watt carbon or non-inductive type
	3 - 75 ohms ¼ watt " " " "
	1 - 75 ohms 1 watt " " " "
Capacitor:	8 or 10 uF 350V d.c. working
Trimming Tool:	Of non-ferrous material

WARNING:

1. Throughout the following procedure, all meter switches must be left in the OFF position except when a reading is actually being taken.

2. The LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier should NEVER be turned to a CARRIER position without first disconnecting the audio input.

3. Allow equipment to warm up for at least ½ hour before making adjustments. The ovens should be on for at least 4 hours.

3.0 POWER SUPPLY UNIT

3.1 Check of Output Voltages and Ripple

(a) Pull forward the Drive Unit tray, restore power supplies by inserting a shorting plug in gate switch, then disconnect plug P.21.

(b) Set the Mains switch to ON and measure voltages between pins of SK.21 with test meter as follows:

Pins	Voltage
6 and 1	150 ± 3 volts d.c.
4 and 5	6.3 ± 0.2 volts a.c.
3 and 2	80 ± 5 volts a.c.

(c) By means of a spare Painton plug connect an 8 or 10 uF capacitor in series with a 100,000ohm resistor between pins 8 and 1 (earth) of socket SK.21.

(d) Connect a valve voltmeter across the 100,000ohm resistor and adjust the range switch to measure the ripple voltage. This should be less than 250mV.

(e) Measure the voltage between pins 8 and 1.
This should be 270V ± 10V D.C.

(f) Remove spare Painton plug and replace P.21.

4.0 ALIGNMENT OF UNITS IN THE DRIVE UNIT TRAY

The following instructions should be carried out sequentially in the order in which the units are detailed.

4.1 100 kc/s Oscillator

4.1.1 Check of Output Levels

(a) Check cathode currents of all valves in the unit.
See Appendix 1.

(b) Remove sockets SK.30, 31, 32 and 33. Terminate each of them, except SK.30, with a 75-ohm resistor.

(c) Connect T.M.S. (set to LEVEL) or valve voltmeter, to SK.33 across the 75 ohms resistor. Adjust the core of T4 for maximum output which should be +4 dbm ± 1 db (0.43V ± 0.5V).

(d) Check the level at SK.31 and 32 for a similar indication.

(e) Check level at SK.30 with R.13 (Carrier Level control) set to maximum. Output level should be +4 dbm (0.43V) with T.M.S. set to LEVEL, or valve voltmeter connected directly across the socket. Switch T.M.S. to LOSS (terminate valve voltmeter in 75 ohms) and adjust R13 for a level of -4 dbm (0.178V).

(f) Remove loads and replace sockets.

4.1.2 Frequency Check

A frequency check can be carried out if a frequency standard accurate to 0.0001% is available. If this is available, allow the unit to warm up for at least 1 hour, then adjust trimmer C1 for a frequency of 100 kc/s ± 1 c/s at SK.33. If not, leave C1 as set at the factory.

NOTE: If a frequency standard is not available and a new crystal is fitted the grinding accuracy of the crystals is such that satisfactory operation can be obtained with C1 set mid-way.

4.2 A.F. Amplifier and 100 kc/s Modulators

4.2.1 Check of Amplifier Gain

(a) Set meter switch on front panel to AUDIO LEVEL DIRECT, the equalising switch S2 (on chassis immediately behind front panel) to OUT, and the Input Attenuator to 40.

(b) Connect a 1000 c/s tone source to Input A or B as required.

(c) Withdraw SK.19 (or SK.35) and connect to the T.M.S., set to LOSS. If a valve voltmeter is used, terminate SK.19 or SK.35 with 75 ohms but do not connect valve voltmeter yet.

(d) Adjust audio input level to -10 dbm (.245V) across 600 ohms, and move the Input Attenuator towards 0.

(e) Check that the front panel meter indication is better than 0 db when the Input Attenuator reaches 0.

(f) Set input attenuator P1 to 40 and adjust the audio input to +10 dbm (2.45V across 600 ohsm).

(g) Adjust P1 for indication by front panel meter of 0 db. Check that level at SK.19 (or SK.35) is approximately 0 dbm. (.274 volts). Refer to test sheets and level diagram Fig.2.

(h) Switch off 1000 c/s source.

4.2.2 Balancing the 100 kc/s Modulator

If a T.M.S. is available this operation can be carried out at this stage. If not, balancing of all modulators must be left until the 3.1 Mc/s Bandpass Amplifier has been aligned. Refer to sub-section 4.5 and proceed from there.

(a) Connect a valve voltmeter probe to the test point in the grid circuit of V2 and V3.

(b) Ensure that there is no a.f. input then adjust P.2 for carrier level of 2.5V in valve voltmeter. Lock this control.

(c) With T.M.S. (set to LOSS) connect to SK.19, or SK.35 are appropriate, adjust P.3 and C.8 alternately for a minimum in the T.M.S. This should be approximately -20 dbm. Lock P3 and C8, ensuring that balance does not alter.

NOTE: If, when balance is obtained, P3 is found to be very close to one end of its traverse, check V2 and V3.

4.2.3 Checking Frequency Response

This check is provided for completeness and for use when the frequency response of the unit is suspect. It should be noted that the unit is wired at the factory for use with a specific crystal filter. If the filter is changed or adjusted, the response of the filter must be obtained and the frequency response of both Line Amplifier and 100 kc/s Modulators adjusted accordingly.

(a) Connect the T.M.S., set to LOSS, or valve voltmeter, to SK.19 or 35 as appropriate.

(b) Arrange a tone input and adjust for 0 db line up level. The T.M.S. should now indicate 0 db (0.274V).

(c) Connect a valve voltmeter across the audio input and, maintaining the input level constant at this point, vary the input frequency between 100 c/s and 6000 c/s. The following response should be obtained in the T.M.S. With equalising switch S2 set to IN and C15 alone in circuit: 6 db (approx.) lift between 100 and 500 c/s (0.54V).

With equalising switch S2 set to IN and C15, C16 connected in parallel: 4 db (approx.) lift between 100 and 500 c/s (0.43V). With equalising switch S2 set to OUT the response should be flat between 100 and 6000 c/s unless the 15 db pad is bridged by C17, C18, when a lift of approximately 1.4 db (0.32V) should occur towards the higher frequencies.

4.3 Aligning the Zero Gain Amplifier

This stage is located on the 100 kc/s Oscillator Unit, but since it forms a separate entity, alignment must be carried out separately.

(a) On the 100 kc/s Oscillator Unit, disconnect socket SK.37 and connect to the T.M.S. (set to loss).

(b) Arrange a 1000 c/s tone to Input A or B and adjust input attenuator for 0 db on the front panel meter of the Line Amplifier and 100 kc/s Modulator and check that the Vogad switch is set to OFF.

(c) Adjust the core of T6 in the oscillator unit for maximum indication in the T.M.S. This should be at least -25 dbm.

(d) Remove audio input. Remove T.M.S. and reconnect SK.37.

4.4 3 Mc/s Oscillator and Carrier Modulator

4.4.1 Aligning the 3 Mc/s Oscillator

(a) Connect T.M.S., set to LOSS to SK.25 and adjust L3 and C2 for maximum. This should be 14 dbm ± 1 db (1.4V ± 0.15V).

(b) Check the frequency at SK.25 against a frequency standard (accuracy at least 0.0001%) and adjust to 3 Mc/s ± 5 c/s by means of C1. If a frequency standard is not available, leave C1 at factory setting.

NOTE: If a frequency standard is not available, the grinding accuracy of the crystals is such that satisfactory operation with a replacement crystal can be obtained with C1 set mid-way.

4.4.2 Balancing the Carrier Modulator

If a T.M.S. is not available refer to section 4.5 of this chapter and continue alignment from that point.

(a) Remove Unit from tray and set C8 to mid-position. Replace unit, connect up but leave sockets SK.22 and SK.23 disconnected.

(b) Connect a valve voltmeter, set to 5V range between test point and earth.

(c) Adjust C11 for maximum indication, then adjust P1 for an indication of 2.5V in the valve voltmeter. This is 3.0 Mc/s carrier injection. Remove valve voltmeter.

(d) Connect T.M.S., set to LOSS to SK.24. Adjust T.M.S. range switch for an indication on the meter, then adjust P2 and C12 for a minimum indication in the T.M.S. with C8 set to mid-way. Increase the sensitivity of the T.M.S. until the most accurate balance is obtained. Decrease T.M.S. sensitivity.

(e) Replace SK.23, set Carrier Re-insert switch to D.S.B. Turn Carrier Level control to obtain a definite indication then adjust C.17 for maximum output at SK.24. Disconnect SK.23.

(f) Turn T.M.S. to OFF and check level of 3 Mc/s carrier at the test point. This may have changed due to variation in C8. Adjust level to 1.5V and lock P1.

(g) Check balance of modulator again and, when carrier leak is less than -36 dbm lock C12 and P2. Recheck balance after locking. Replace all sockets.
NOTE: C12 and C17 are interdependent.

4.4.3 Check Gain of Carrier Modulator

(a) Connect T.M.S. (set to LOSS) to P.22. Switch on 1000 c/s tone to input A or B and line up to 0 db on meter in Line Amplifier. Note that level on T.M.S. is approximately -25 dbm. (Refer to sub-section 4.3). Disconnect T.M.S. and replace SK.22.

(b) Connect T.M.S. (set to LOSS) to SK.24 and check that output level is -16 dbm ± 1 db.
Leave T.M.S. connected to SK.24 for subsequent test.

4.4.4 Check Levels of 100 kc/s Re-inserted Carrier

(a) Disconnect 1000 c/s tone.

(b) Set the Carrier Re-insert switch on the Carrier Modulator to S.S.B. and set the carrier level control on the 100 kc/s Oscillator to the reference line. The level indicated on the T.M.S. at SK.24 should be -32 dbm ± 1 db.

If not, adjust the Carrier Level control for this reading then reset the knob on its spindle.

(c) Set the Carrier Re-insert switch to I.S.B. D.S.B., in turn, and check that T.M.S. indications of -42 dbm ± 1 db and -21 dbm ± 1 db are obtained. Reconnect SK.24. NOTE: The reading obtained for I.S.B. may be masked by 3 Mc/s carrier leak.

4.5 3.1 Mc/s Bandpass Amplifier

WARNING:

1. Always return LEVELS meter switch to OFF except when taking a reading.

2. Never set the LEVELS meter switch to a carrier position when a tone is present.

4.5.1 Lining Up

(a) Disconnect socket SK.28 and connect a 75 ohm 1 watt resistor across it. Connect a valve voltmeter across this load resistor.

(b) Set the CARRIER RE-INSERT switch to D.S.B. and turn the Carrier Level control for an indication in the valve voltmeter. Adjust for a convenient level below 5 volts.

(c) Set R37 to maximum and adjust the trimmers of L1 to L4 for maximum indication by the valve voltmeter, at the same time adjusting R37 to maintain this indication below 5V. Retrim several times to obtain exact settings.

(d) Re-trim the Zero Gain Amplifier by means of T6 in the 100 kc/s Oscillator Unit, again for maximum in the valve voltmeter at SK.28.

4.5.2 Setting Up the LEVELS meter

(a) Disconnect input socket SK.27.

(b) Set the LEVELS meter switch S2 to the SET ZERO position and adjust the ZERO SET control for a zero indication on the milliamp scale of the LEVELS meter. Set the Levels meter switch to ISB/SSB SIDEBAND and replace SK.27.

(c) Apply a 1000 c/s tone to Input A or B and adjust Input Attenuator for 0 db in the Line Amplifier meter.

(d) Increase the output of the 3.1 Mc/s Amplifier by means of R.37 until the valve voltmeter across SK.28 reads 6.1V.

(e) Check that the Levels meter now reads 0 db on the black scale. If not, adjust R7 to obtain this indication. Lock R7 and R.37 and disconnect 1000 c/s tone.

(f) Set the LEVELS meter switch to D.S.B. CARRIER and the CARRIER RE-INSERT switch to D.S.B.

(g) Adjust the CARRIER LEVEL control to give an indication in the valve voltmeter of 3.05V.

(h) Check that the levels meter indicates 0 db on the RED scale. If not adjust R8 to obtain this indication. Lock R8.

(j) Check that the Carrier level control is set approximately to the reference line.

(k) Set the CARRIER RE-INSERT switch to I.S.B. and the LEVELS meter switch to I.S.B. Carrier. Valve voltmeter should indicate 0.3V and the levels meter 0 db on the Red scale. If these readings are not obtained adjust the Carrier Level control for the correct indication in the Valve voltmeter then adjust R10 to give correct Levels meter indication. Lock R.10.

(l) Set LEVELS meter switch to SSB Carrier and CARRIER RE-INSERT switch to S.S.B. Valve voltmeter should read 0.96V and the Levels meter 0 db on the Red scale. Adjust carrier level control to give correct reading in valve voltmeter, then adjust R9 to obtain the correct Levels meter indication. Lock R9.

4.5.3 Adjustment of VOGAD Operating Level

(a) Set Carrier Re-insert switch to OFF and the LEVELS meter switch to ISB/DSB SIDEBAND.

(b) Apply a 1000 c/s tone and adjust for 0 db line up level.

(c) Set Vogad switch to ON and adjust R.34 for an indication of -1 db on the LEVELS (a decrease of 1 db) meter.

5.0 ADJUSTMENT OF CARRIER PHASE FOR D.S.B. OPERATION

(a) Set up the equipment for d.s.b. operation. (Chapter 6 sub-section 1.4) and connect the output of the 3.1 Mc/s Bandpass Amplifier, SK.28, to a d.s.b. monitoring equipment, or alternatively, to a cathode-ray oscillograph.

(b) Adjust the oscillograph to obtain a steady picture then adjust R.14 in the 100 kc/s Oscillator for minimum distortion. On the oscillograph the distortion will be apparent as humps in the modulation envelope.

6.0 BALANCING THE MODULATORS, ALTERNATIVE METHOD

This alternative method of balancing the modulators is made available for use when a T.M.S. is not available. As stated in sub-section 4.2.2. the 3.1 Mc/s Amplifier must be aligned first (section 4.5) and the signal path through the equipment must be proved.

6.1 Balancing the 3.0 Mc/s Carrier Modulator

(a) To prevent the carrier leak of the 100 kc/s Modulators providing false readings, disconnect sockets SK.19, SK.35.

(b) Set Carrier Re-insert switch to OFF and Levels meter switch to S.S.B. Carrier.

(c) The Levels meter should now give an indication of carrier leak. If a more suitable indication is required set Levels meter switch to I.S.B. Carrier.

(d) On the 3 Mc/s Oscillator and Carrier Modulator check that C8 is set mid-way then adjust C.12 and P2 for a minimum indication in the Levels meter, increasing the meter sensitivity by setting the Levels meter switch to SET ZERO.

(e) Connect a valve voltmeter between test point and earth and adjust P1 to give a reading of exactly 1.5V with C.11 tuned for maximum. Disconnect valve voltmeter.

(f) Repeat adjustments of C.12 and P2 as detailed in (d). These controls are inter-dependent, therefore it is essential to check them with care. The absolute minimum indication in the Levels meter should correspond approximately with zero on the milliamp scale of the meter, with switch at Zero Set.

(g) Return Levels meter switch to ISB/SSB SIDEBAND LEVEL
This completes the balancing of the 3.0 Mc/s Modulator.

6.2 Balancing the 100 kc/s Modulators

(a) Disconnect SK.22 and connect, by means of a co-axial patch cord to either SK.19 or SK.35 as required. Ensure that there is no audio input, preferably by shorting the input lines.

(b) Set the Levels meter switch on the 3.1 Mc/s Bandpass Amplifier to S.S.B. Carrier. Check that the Carrier Re-insert switch is set to OFF. An indication should now be obtained in the Levels meter. If not increase its sensitivity by switching to I.S.B. carrier on Zero Set. This reading is carrier leak from one of the 100 kc/s Modulators.

(c) Adjust the balance controls C8, P3 on the appropriate 100 kc/s Modulator for a minimum indication in the Levels meter. These controls are very sensitive and great care must be taken to obtain the final accurate adjustment.

(d) Connect a valve voltmeter between test point and earth and adjust P2 to give a reading of exactly 1.5V. Remove valve voltmeter and re-check balance (c).

CHAPTER 8a

RE-ALIGNMENT

1.0 GENERAL

The procedure outlined in this chapter from complete re-alignment of individual units should only be carried out after a major repair or replacement has been carried out. A Transmission Measuring Set is required but if this is not available an accurately calibrated valve voltmeter can be used. When the latter is used it should, in measurements across a co-axial socket, be terminated in 75 ohms. Figures which should be indicated in a valve voltmeter are given in parenthesis where possible.

Reference should be made to the level diagram Fig. 2 and original test sheets for the equipment while carrying out re-alignment.

2.0 APPARATUS REQUIRED

T.M.S.	S.T.C. Type 74602C if available
Audio Oscillator:	Range 100 - 10,000 c/s
Valve Voltmeter:	Range 0 - 25V. Accurately calibrated up to 10 volts.
Multi-range meter:	(suggested type, Avo, model 7)
Frequency Standard:	Accuracy .0001% if available
Thermometer:	0 - 100°C or 0 - 212°F
Resistors:	1 - 100K ohms ½ watt carbon or non-inductive type
	3 - 75 ohms ¼ watt " " " "
	1 - 75 ohms 1 watt " " " "
Capacitor:	8 or 10 µF 350V d.c. working
Trimming Tool:	Of non-ferrous material

WARNING:

1. Throughout the following procedure, all meter switches must be left in the OFF position except when a reading is actually being taken.

2. The LEVELS meter switch on the 3.1 Mc/s Bandpass Amplifier should NEVER be turned to a CARRIER position without first disconnecting the audio input.

3. Allow equipment to warm up for at least ½ hour before making adjustments. The ovens should be on for at least 4 hours.

3.0 POWER SUPPLY UNIT

3.1 Check of Output Voltages and Ripple

(a) Pull forward the Drive Unit tray, restore power supplies by inserting a shorting plug in gate switch, then disconnect plug P.21.

(b) Set the Mains switch to ON and measure voltages between pins of SK.21 with test meter as follows:

Pins	Voltage
6 and 1	150 ± 3 volts d.c.
4 and 5	6.3 ± 0.2 volts a.c.
3 and 2	80 ± 5 volts a.c.

(c) By means of a spare Painton plug connect an 8 or 10 /uF capacitor in series with a 100,000 ohm resistor between pins 8 and 1 (earth) of socket SK.21.

(d) Connect a valve voltmeter across the 100,000 ohm resistor and adjust the range switch to measure the ripple voltage. This should be less than 250 mV.

(e) Measure the voltage between pins 8 and 1.
This should be 270V ± 10V D.C.

(f) Remove spare Painton plug and replace P.21.

4.0 ALIGNMENT OF UNITS IN THE DRIVE UNIT TRAY

The following instructions should be carried out sequentially in the order in which the units are detailed.

4.1 100 kc/s Oscillator

4.1.1 Check of Output Levels

(a) Check cathode currents of all valves in the unit.
See Appendix 1.

(b) Remove sockets SK.30, 31, 32 and 33. Terminate each of them, except SK.30, with a 75-ohm resistor.

(c) Connect T.M.S. (set to LEVEL) or valve voltmeter, to SK.33 across the 75 ohms resistor. Adjust the core of T4 for maximum output which should be +4 dbm ± 1 db (0.43V ± 0.05V)

(d) Check the level at SK.31 and 32 for a similar indication.

(e) Check level at SK.30 with R.13 (Carrier Level control) set to maximum. Output level should be +4 dbm (0.43V) with T.M.S. set to LEVEL, or valve voltmeter connected directly across the socket. Switch T.M.S. to LOSS (terminate valve voltmeter in 75 ohms) and adjust R13 for a level of -4 dbm (0.178V).

(f) Remove loads and replace sockets.

4.1.2 Frequency Check

A frequency check can be carried out if a frequency standard accurate to 0.0001% is available. If this is available, allow the unit to warm up for at least 1 hour, then adjust trimmer C1 for a frequency of 100 kc/s ± 1 c/s at SK.33. If not, leave C1 as set at the factory.

NOTE: If a frequency standard is not available and a new crystal is fitted the grinding accuracy of the crystals is such that satisfactory operation can be obtained with C1 set mid-way.

4.2 A.F. Amplifier and 100 kc/s Modulators.

4.2.1 Check of Amplifier Gain

(a) Set meter switch on front panel to AUDIO LEVEL DIRECT, the equalising switch S2 (on chassis immediately behind front panel) to OUT, and the Input Attenuator to 40.

(b) Connect a 1000 c/s tone source to Input A or B as required.

(c) Withdraw SK.19 (or SK.35) and connect to the T.M.S., set to LOSS. If a valve voltmeter is used, terminate SK.19 or SK.35 with 75 ohms but do not connect valve voltmeter yet.

(d) Adjust audio input level to -10 dbm (.245V) across 600 ohms, and move the Input Attenuator towards 0.

(e) Check that the front panel meter indication is better than 0 db when the Input Attenuator reaches 0.

(f) Set input attenuator P1 to 40 and adjust the audio input to + 10 dbm (2.45V across 600 ohms).

(g) Adjust P1 for indication by front panel meter of 0 db. Check that level at SK.19 (or SK.35) is approximately 0 dbm. (.274 volts). Refer to test sheets and level diagram Fig.2.

(h) Switch off 1000 c/s source.

4.2.2 Balancing the 100 kc/s Modulator

If a T.M.S. is available this operation can be carried out at this stage. If not, balancing of all modulators must be left until the 3.1 Mc/s Bandpass Amplifier has been aligned. Refer to sub-section 4.5 and proceed from there.

(a) Connect a valve voltmeter probe to the test point in the grid circuit of V2 and V3.

(b) Ensure that there is no a.f. input then adjust P.2 for carrier level of 2.5V in valve voltmeter. Lock this control.

(c) With T.M.S. (set to LOSS) connect to SK.19 or SK.35 as appropriate, adjust P.3 and C.8 alternately for a minimum in the T.M.S. This should be approximately -20 dbm. Lock P3 and C8, ensuring that balance does not alter.

NOTE: If, when balance is obtained, P3 is found to be very close to one end of its traverse, check V2 and V3.

4.2.3 Checking Frequency Response

This check is provided for completeness and for use when the frequency response of the unit is suspect. It should be noted that the unit is wired at the factory for use with a specific crystal filter. If the filter is changed or adjusted, the response of the filter must be obtained and the frequency response of both Line Amplifier and 100 kc/s Modulators adjusted accordingly.

(a) Connect the T.M.S., set to LOSS, or valve voltmeter, to SK.19 or 35 as appropriate.

(b) Arrange a tone input and adjust for 0 db line up level. The T.M.S. should now indicate 0 db (0.274V).

(c) Connect a valve voltmeter across the audio input and, maintaining the input level constant at this point, vary the input frequency between 100 c/s and 6000 c/s. The following response should be obtained in the T.M.S. With equalising switch S2 set to IN and C15 alone in circuit: 6 db (approx.) lift between 100 and 500 c/s (0.54V).

With equalising switch S2 set to IN and C15, C16 connected in parallel: 4 db (approx.) lift between 100 and 500 c/s (0.43V). With equalising switch S2 set to OUT the response should be flat between 100 and 6000 c/s unless the 15 db pad is bridged by C17, C18, when a lift of approximately 1.4 db (0.32V) should occur towards the higher frequencies.

4.3 Aligning the Zero Gain Amplifier

This stage is located on the 100 kc/s Oscillator Unit, but since it forms a separate entity, alignment must be carried out separately.

(a) On the 100 kc/s Oscillator Unit, disconnect socket SK.37 and connect to the T.M.S. (set to loss).

(b) Arrange a 1000 c/s tone to Input A or B and adjust input attenuator for 0 db on the front panel meter of the Line Amplifier and 100 kc/s Modulator and check that the Vogad switch is set to OFF.

(c) Adjust the core of T6 in the oscillator unit for maximum indication in the T.M.S. This should be at least -25 dbm.

(d) Remove audio input. Remove T.M.S. and reconnect SK.37.

4.4 3 Mc/s Oscillator and Carrier Modulator

4.4.1 Aligning the 3 Mc/s Oscillator

(a) Connect T.M.S., set to LOSS to SK.25 and adjust L3 and C2 for maximum. This should be 14 dbm ± 1 db (1.4V +_ 0.15V).

(b) Check the frequency at SK.25 against a frequency standard (accuracy at least 0.0001%) and adjust to 3 Mc/s ± 5 c/s by means of C1. If a frequency standard is not available, leave C1 at factory setting.

NOTE: If a frequency standard is not available, the grinding accuracy of the crystals is such that satisfactory operation with a replacement crystal can be obtained with C1 set mid-way.

4.4.2 Balancing the Carrier Modulator

If a T.M.S. is not available refer to section 4.5 of this chapter and continue alignment from that point.

(a) Remove Unit from tray and set C8 to mid-position. Replace unit, connect up but leave sockets SK.22 and SK.23 disconnected.

(b) Connect a valve voltmeter, set to 5V range between test point and earth.

(c) Adjust C11 for maximum indication, then adjust P1 for an indication of 2.5V in the valve voltmeter. This is 3.0 Mc/s carrier injection. Remove valve voltmeter.

(d) Connect T.M.S., set to LOSS to SK.24. Adjust T.M.S. range switch for an indication on the meter, then adjust P2 and C12 for a minimum indication in the T.M.S. with C8 set to mid-way. Increase the sensitivity of the T.M.S. until the most accurate balance is obtained. Decrease T.M.S. sensitivity.

(e) Replace SK.23, set Carrier Re-insert switch to D.S.B. Turn Carrier Level control to obtain a definite indication then adjust C.17 for maximum output at SK.24. Disconnect SK.23.

(f) Turn T.M.S. to OFF and check level of 3 Mc/s carrier at the test point. This may have changed due to variation in C8. Adjust level to 1.5V and lock P1.

(g) Check balance of modulator again and, when carrier leak is less than -36 dbm lock C12 and P2. Recheck balance after locking. Replace all sockets.

NOTE: C12 and C17 are interdependent.

4.4.3 Check Gain of Carrier Modulator

(a) Connect T.M.S. (set to LOSS) to P.22. Switch on 1000 c/s tone to input A or B and line up to 0 db on meter in Line Amplifier. Note that level on T.M.S. is approximately -25 dbm. (Refer to sub-section 4.3). Disconnect T.M.S. and replace SK.22.

(b) Connect T.M.S. (set to LOSS) to SK.24 and check that output level is -16 dbm ± 1 db.
Leave T.M.S. connected to SK.24 for subsequent test.

4.4.4 Check Levels of 100 kc/s Re-inserted Carrier

(a) Disconnect 1000 c/s tone.

(b) Set the Carrier Re-insert switch on the Carrier Modulator to S.S.B. and set the carrier level control on the 100 kc/s Oscillator to the reference line. The level indicated on the T.M.S. at SK.24 should be -32 dbm ± 1 db.

If not, adjust the Carrier Level control for this reading then reset the knob on its spindle.

(c) Set the Carrier Re-insert switch to I.S.B. D.S.B., in turn, and check that T.M.S. indications of -42 dbm ± 1 db and -21 dbm ± 1 db are obtained. Reconnect SK.24. NOTE: The reading obtained for I.S.B. may be masked by 3 Mc/s carrier leak.

4.5 3.1 Mc/s Bandpass Amplifier

WARNING:

1. Always return LEVELS meter switch to OFF except when taking a reading.

2. Never set the LEVELS meter switch to a carrier position when a tone is present.

4.5.1 Lining Up

(a) Disconnect socket SK.28 and connect a 75 ohm 1 watt resistor across it. Connect a valve voltmeter across this load resistor.

(b) Set the CARRIER RE-INSERT switch to D.S.B. and turn the Carrier Level control for an indication in the valve voltmeter. Adjust for a convenient level below 5 volts.

(c) Set R37 to maximum and adjust the trimmers of L1 to L4 for maximum indication by the valve voltmeter, at the same time adjusting R37 to maintain this indication below 5V. Retrim several times to obtain exact settings.

(d) Re-trim the Zero Gain Amplifier by means of T6 in the 100 kc/s Oscillator Unit, again for maximum in the valve voltmeter at SK.28.

4.5.2 Setting Up the LEVELS meter

(a) Disconnect input socket SK.27.

(b) Set the LEVELS meter switch S2 to the SET ZERO position and adjust the ZERO SET control for a zero indication on the milliamp scale of the LEVELS meter. Set the Levels meter switch to ISB/SSB SIDEBAND and replace SK.27.

(c) Apply a 1000 c/s tone to Input A or B and adjust Input Attenuator for 0 db in the Line Amplifier meter.

(d) Increase the output of the 3.1 Mc/s Amplifier by means of R.37 until the valve voltmeter across SK.28 reads 6.1V.

(e) Check that the Levels meter now reads 0 db on the black scale. If not, adjust R7 to obtain this indication. Lock R7 and R.37 and disconnect 1000 c/s tone.

(f) Set the LEVELS meter switch to D.S.B. CARRIER and the CARRIER RE-INSERT switch to D.S.B.

(g) Adjust the CARRIER LEVEL control to give an indication in the valve voltmeter of 3.05V.

(h) Check that the levels meter indicates 0 db on the RED scale. If not adjust R8 to obtain this indication. Lock R8.

(j) Check that the Carrier level control is set approximately to the reference line.

(k) Set the CARRIER RE-INSERT switch to I.S.B. and the LEVELS meter switch to I.S.B. Carrier. Valve voltmeter should indicate 0.3V and the levels meter 0 db on the Red scale. If these readings are not obtained adjust the Carrier Level control for the correct indication in the Valve voltmeter then adjust R10 to give correct Levels meter indication. Lock R.10.

(l) Set LEVELS meter switch to SSB Carrier and CARRIER RE-INSERT switch to S.S.B. Valve voltmeter should read 0.96V and the Levels meter 0 db on the Red scale. Adjust carrier level control to give correct reading in valve voltmeter, then adjust R9 to obtain the correct Levels meter indication. Lock R9.

4.5.3 Adjustment of VOGAD Operating Level

(a) Set Carrier Re-insert switch to OFF and the LEVELS meter switch to ISB/DSB SIDEBAND.

(b) Apply a 1000 c/s tone and adjust for 0 db line up level.

(c) Set Vogad switch to ON and adjust R.34 for an indication of -1 db on the LEVELS (a decrease of 1 db) meter.

5.0 ADJUSTMENT OF CARRIER PHASE FOR D.S.B. OPERATION

(a) Set up the equipment for d.s.b. operation. (Chapter 6a, sub-section 1.4) and connect the output of the 3.1 Mc/s Bandpass Amplifier, SK.28, to a d.s.b. monitoring equipment, or alternatively, to a cathode-ray oscillograph.

(b) Adjust the oscillograph to obtain a steady picture then adjust R.14 in the 100 kc/s Oscillator for minimum distortion. On the oscillograph the distortion will be apparent as humps in the modulation envelope.

6.0 BALANCING THE MODULATORS, ALTERNATIVE METHOD

This alternative method of balancing the modulators is made available for use when a T.M.S. is not available. As stated in sub-section 4.2.2. the 3.1 Mc/s Amplifier must be aligned first (section 4.5) and the signal path through the equipment must be proved.

6.1 Balancing the 3.0 Mc/s Carrier Modulator

(a) To prevent the carrier leak of the 100 kc/s Modulators providing false readings, disconnect sockets SK.19, SK.35.

(b) Set Carrier Re-insert switch to OFF and Levels meter switch to S.S.B. Carrier.

(c) The Levels meter should now give an indication of carrier leak. If a more suitable indication is required set Levels meter switch to I.S.B. Carrier.

(d) On the 3 Mc/s Oscillator and Carrier Modulator check that C8 is set mid-way then adjust C.12 and P2 for a minimum indication in the Levels meter, increasing the meter sensitivity by setting the Levels meter switch to SET ZERO.

(e) Connect a valve voltmeter between test point and earth and adjust P1 to give a reading of exactly 1.5V with C.11 tuned for maximum. Disconnect valve voltmeter.

(f) Repeat adjustments of C.12 and P2 as detailed in (d). These controls are inter-dependent, therefore it is essential to check them with care. The absolute minimum indication in the Levels meter should correspond approximately with zero on the milliamp scale of the meter, with switch at Zero Set.

(g) Return Levels meter switch to ISB/SSB SIDEBAND LEVEL
This completes the balancing of the 3.0 Mc/s Modulator.

6.2 Balancing the 100 kc/s Modulators

(a) Disconnect SK.22 and connect, by means of a co-axial patch cord to either SK.19 or SK.35 as required. Ensure that there is no audio input, preferably by shorting the input lines.

(b) Set the Levels meter switch on the 3.1 Mc/s Bandpass Amplifier to S.S.B. Carrier. Check that the Carrier Re-insert switch is set to OFF. An indication should now be obtained in the Levels meter. If not increase its sensitivity by switching to I.S.B. carrier on Zero Set. This reading is carrier leak from one of the 100 kc/s Modulators.

(c) Adjust the balance controls C8, P3 on the appropriate 100 kc/s Modulator for a minimum indication in the Levels meter. These controls are very sensitive and great care must be taken to obtain the final accurate adjustment.

(d) Connect a valve voltmeter between test point and earth and adjust P2 to give a reading of exactly 1.5V. Remove valve voltmeter and re-check balance (c).

VALVE COMPLEMENT

Unit	Designation	Type	CV. No.	Function
A.F. Amplifier and Channel Modulators 17-LRU.67A and E	V1	6AM6	CV.138	A.F. Amplifier
	V2, V3	6AM6	CV.138	Balanced modulator
3 Mc/s Oscillator and Carrier Modulator	V1, V2	6AM6	CV.138	Balanced modulator
	V3	6AM6	CV.138	Buffer amplifier
	V4	6AM6	CV.138	Oscillator
3.1 Mc/s Bandpass Filter and Amplifier	V1	6AM6	CV.138	R.F. Amplifier
	V2	5B/251M	CV.428	R.F. Power amplifier
	V3	6AL5	CV.140	Valve voltmeter x
100 Kc/s Oscillator	V1	6AM6	CV.138	Oscillator
	V2	6AM6	CV.138	Buffer Amplifier
	* V3	6AM6	CV.138	Zero Gain Amplifier
Power Supply Unit	V1	53KU	CV.378	Full-wave rectifier
	V2	G180-2M	CV.395	Stabiliser (Voltage)

* Oscillator 16-LRU-192C only

x Valve voltmeter and v.o.g.a.d. on 28-LRU-330C only.

VALVE CURRENTS

N.B. The figures given below are typical and intended only as a guide. For actual figures taken on the equipment, see Test Sheets supplied.

Unit	Valve No.	Cathode Current
A.F. Amplifier and 100 kc/s Modulators (17-LRU.67A and E)	V1 V2 V3	10.0 3.5 3.5
100 kc/s Oscillator (16-LRU.192A)	V1 V2	1.0 4.0
100 kc/s Oscillator (16-LRU.192C)	V1 V2 V3	1.0 4.0 6.5
3.1 Mc/s Bandpass Amplifier (28-LRU.330A)	V1 V2	4.0 * 40.0
3.1 Mc/s Bandpass Amplifier (28-LRU.330C)	V1 V2	9.0 65.0
3.0 Mc/s Oscillator and Carrier Modulator (19-LRU-67B)	V1 V2 V3 V4	3.5 3.5 7.5 4.0

* Depends on setting of gain control R18. With R18 set to max., cathode current should be 12 mA.

ORDERING SPARE COMPONENTS

When ordering spare components, the following information should be given.

(a) The equipment type number (e.g. A.1406) and serial number.

(b) The appropriate drawing reference number as given in the Drawing list.

(c) Component identification, if shown on this drawing, e.g. Resistor R6.

(d) The data given in the Components List.

(e) All data which may appear on a label affixed to an item not made by Standard Telephones & Cables Ltd.,

(f) Full Shipping Instructions.

APPENDIX 2

LINING UP PROCEDURE FOR OPERATION OF A.1406 EQUIPMENT IN CONJUNCTION WITH THE TOP.10 & TOP.12 TELEPHONE TERMINATING EQUIPMENTS.

LINE UP PROCEDURE FOR SSB AND ISB WORKING OF DS.12 AND DS.13 TRANSMITTERS, WITH A.1406 DRIVE EQUIPMENT OPERATED IN CONJUNCTION WITH TOP.10 AND TOP.12 TELEPHONE TERMINATING EQUIPMENTS

The following procedure should be adopted for Tone Line-up immediately prior to opening service:-

On A.F. Amplifier Unit set Audio Level switch to direct and equalization switch S2 to "in".

Set Filter Switch to ISB.

Set Meter Switch on the 3.1 Mc/s Bandpass Amplifier to ISB/SSB Sideband Level.

Set Reinserted Carrier switch to "OFF".

S.S.B.

1. Test tone is sent from the TOP.10 or TOP.12 equipment at the Radio-Telephone Terminal. This is applied to one sideband input to the A.1406 drive equipment.

2. The audio frequency gain of the sideband amplifier of the A.1406 is adjusted so that the volume indicator shows -6 db.

3. This level corresponds to an output of $\frac{1}{8}$W from the A.1406 which drives a DS.12 transmitter to 1 kW output power, or a DS.13 transmitter to 10 kW output power. In order to facilitate tuning of the transmitters the drive level control on the R.F. truck should be increased in setting as much as necessary in order to give convenient readings for tuning purposes. This may correspond, for example, to approx. 4 kW output power from the DS.12 or approx. 20 kW in the case of the DS.13.

4. Set Reinserted Carrier switch to S.S.B.
The carrier level which will obtain under these conditions is -16 db relative to PEP.

5. The audio frequency gain control on the Line amplifier is now reduced by 2 db and the equipment is now ready for telephone traffic. The effective level of speech replacing the test tone will now be -10 RTP.

I.S.B.

1. Set up each sideband independently as for ssb operation by connecting the test tone to input A and B in turn.

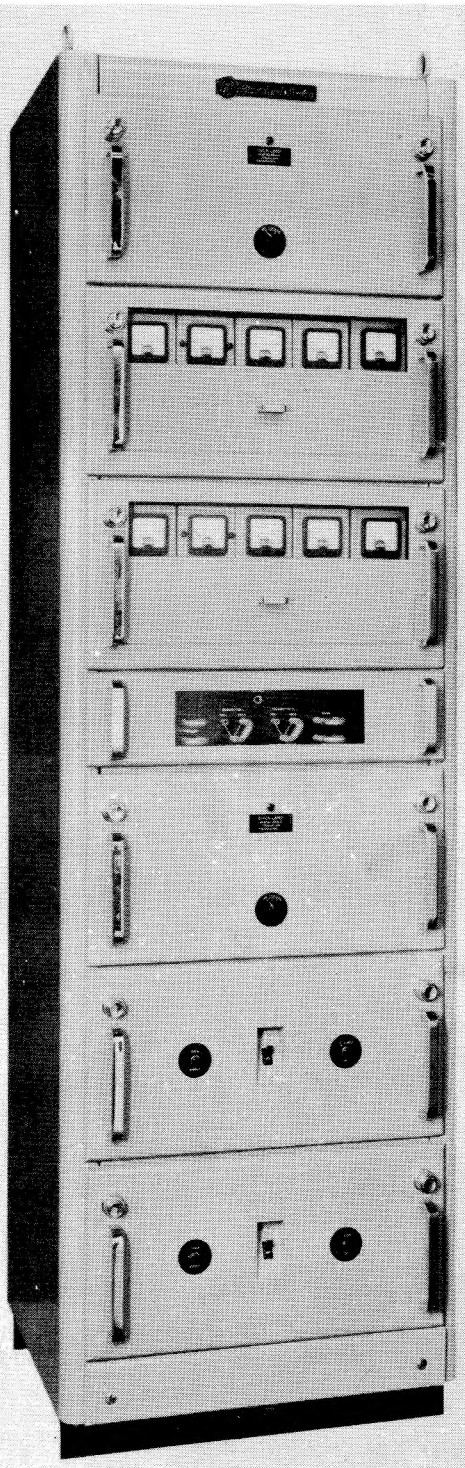
2. Set reinserted carrier switch to ISB i.e. carrier level is -26 db relative to P.E.P.

3. The audio frequency gain controls on the sideband amplifiers are now each reduced by 2 db, and the equipment is ready for telephone traffic. The effective speech level into each sideband input of the A.1406 will be -10 RTP.

NOTE: The above procedure is in agreement with the procedure used by the British Post Office wherein the relationship between test tone and speech is as follows:-

1 mW test tone gives $\frac{1}{4}$ power transmitter output
-10 RTP speech gives traffic loading condition.

The TOP.10 and TOP.12 terminating equipments give a slightly different relationship from that described above with an 8 db difference between speech and test tone as compared with the above described 10 db difference, and this discrepancy is allowed for in the above Line-up Procedure.

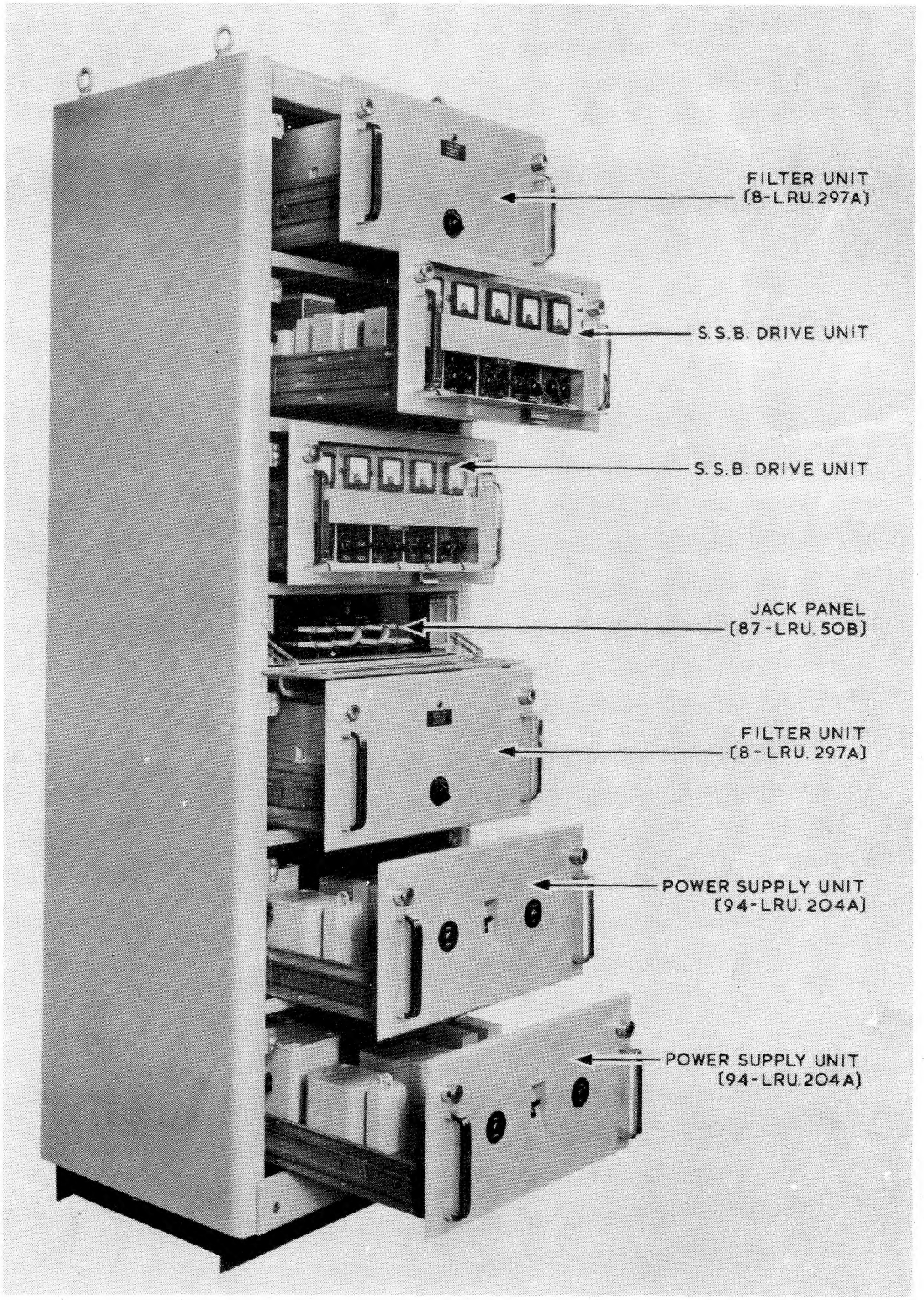


ISB/DSB TRANSMITTER DRIVE UNITS TYPE ~~A.1046.B.~~ A1406B

(ASSEMBLY CODE: 188-LRE.2C)

A2.1

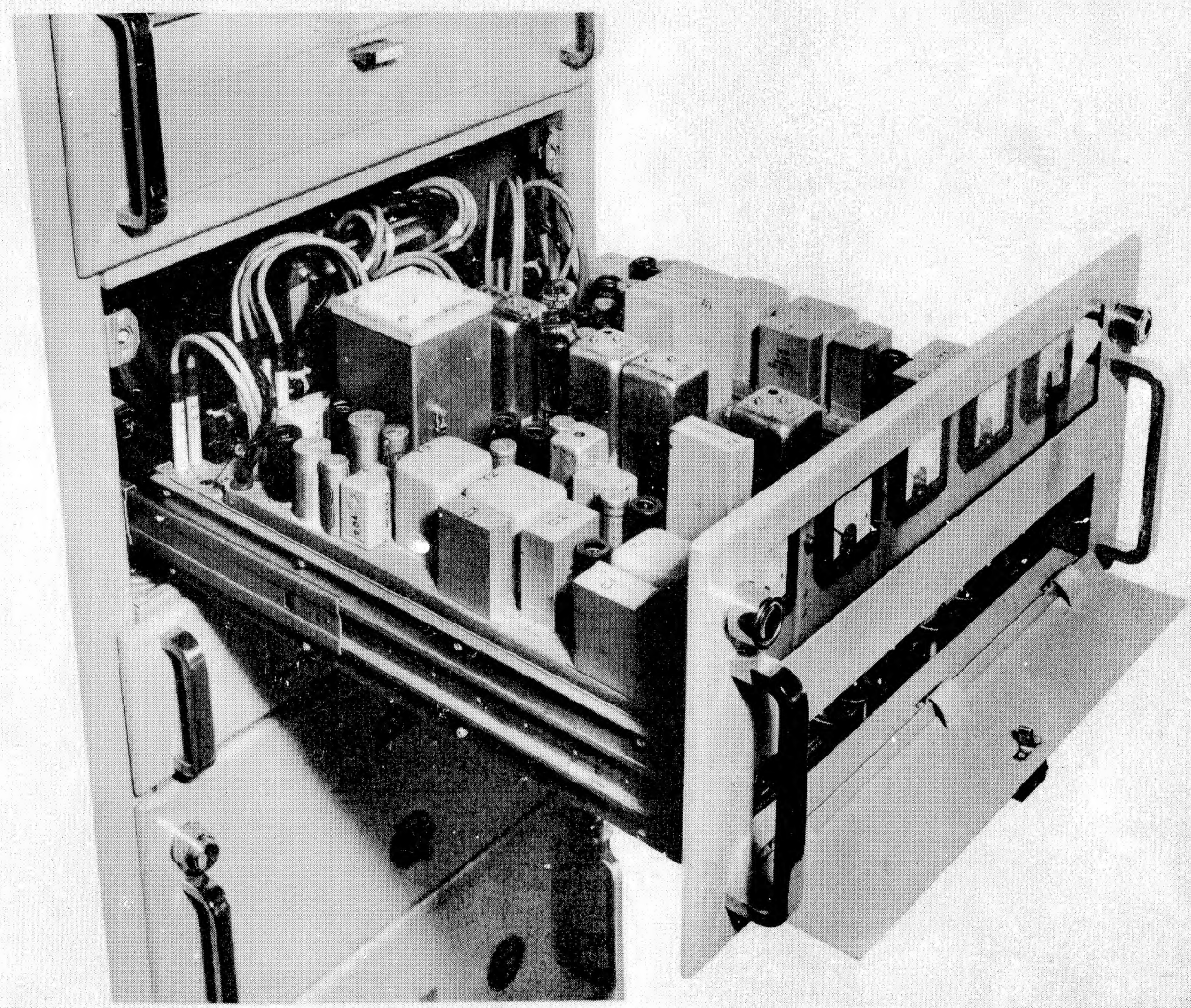
PLATE I



ISB/DSB TRANSMITTER DRIVE UNITS TYPE A.1406-B

(UNITS WITHDRAWN)

PLATE II



S.S.B. DRIVE UNIT (CHASSIS WITHDRAWN).

PLATE III

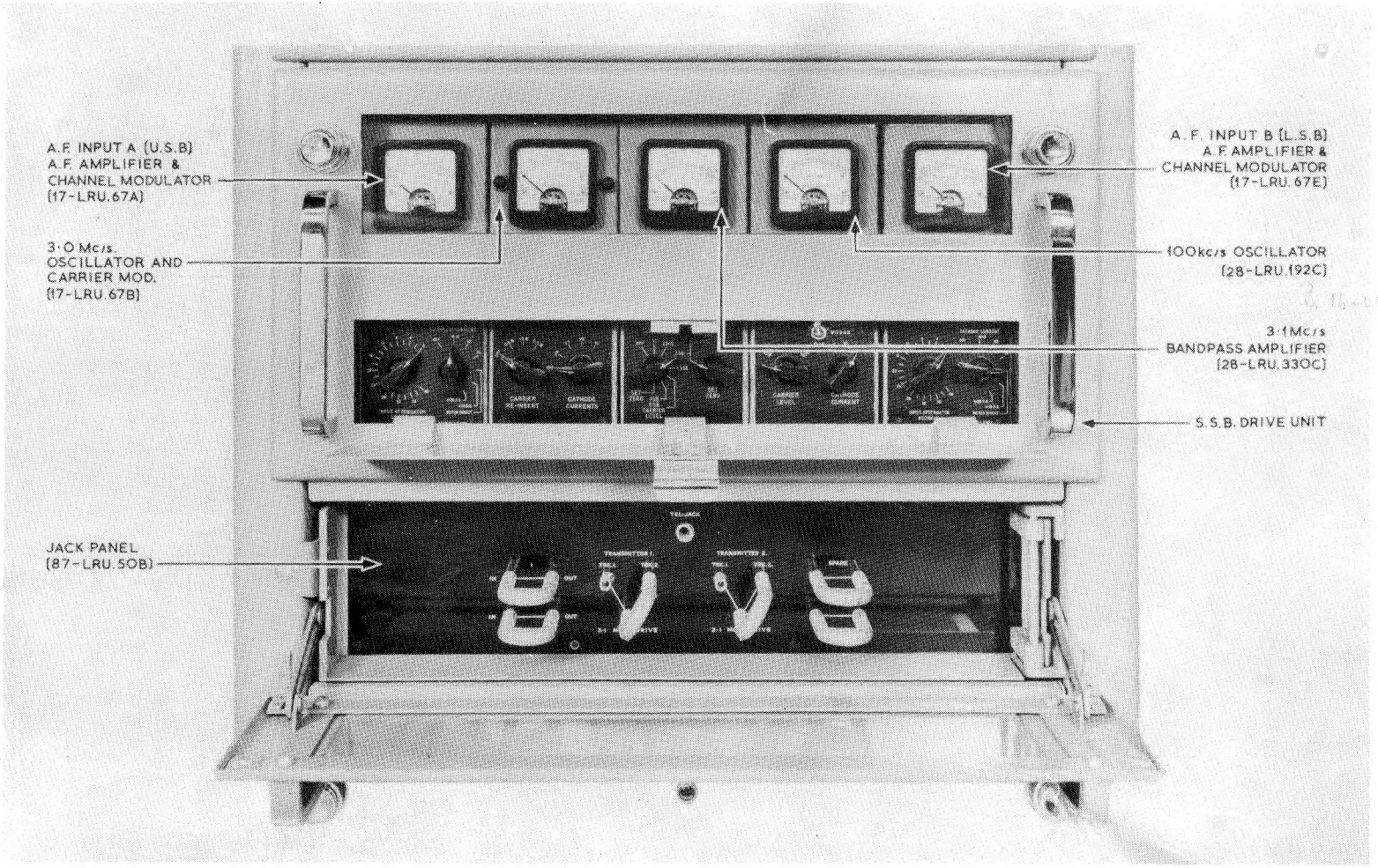


PLATE IV

S.S.B. DRIVE UNIT (SHOWING SUB UNITS AND CONTROLS) AND JACK PANEL

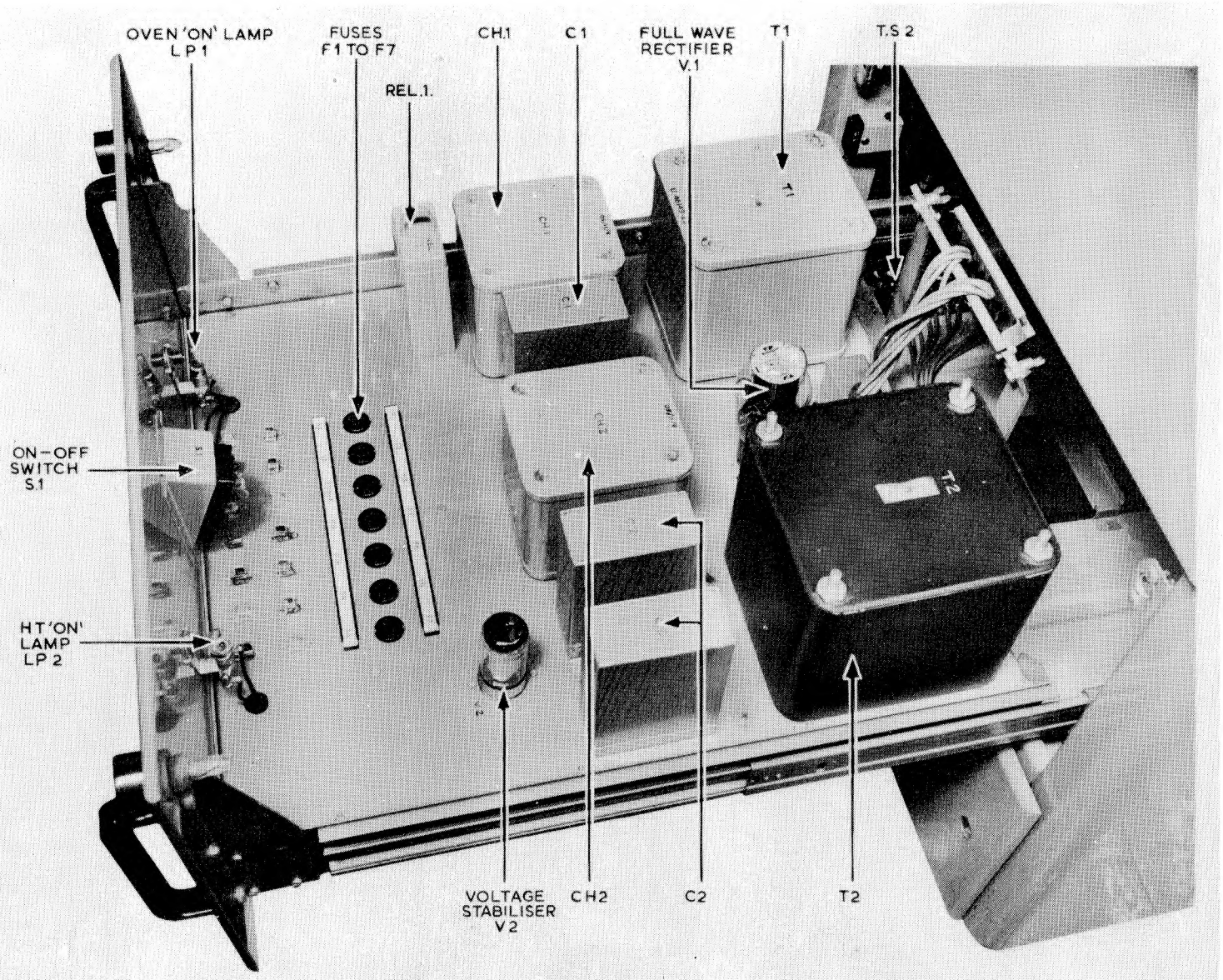
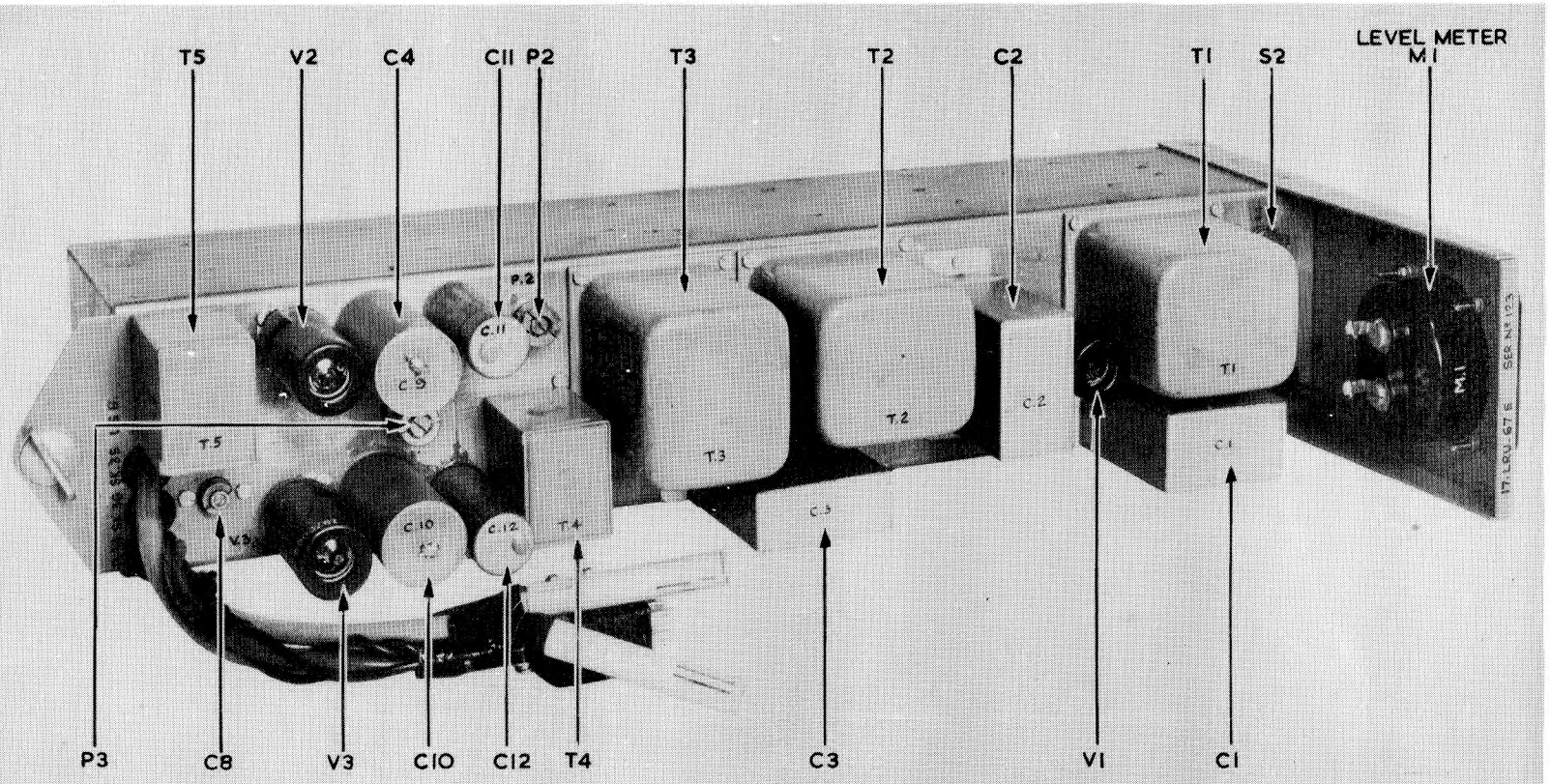


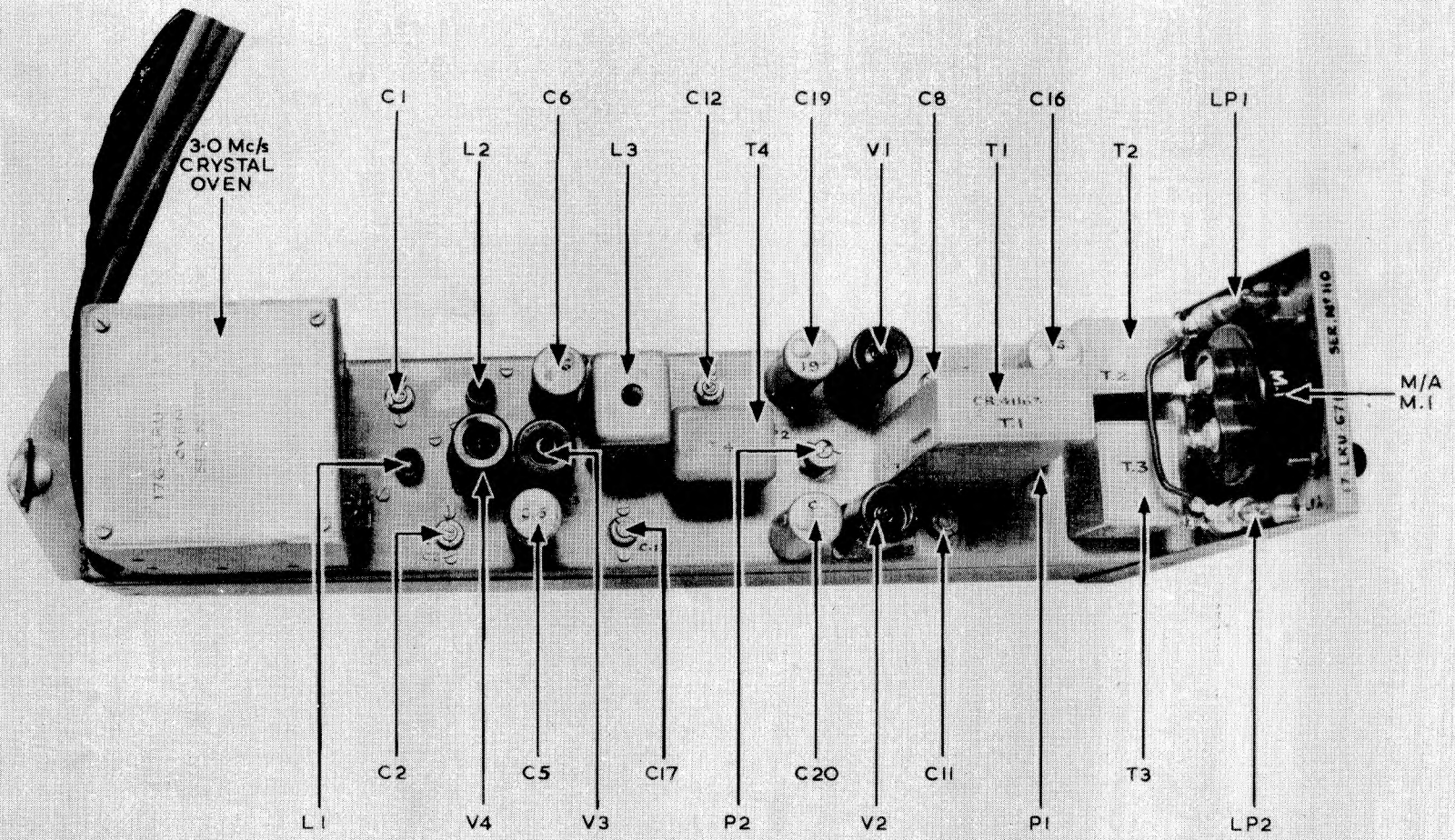
PLATE V

POWER SUPPLY UNIT (94-LRU-204A)



A.F. AMPLIFIER AND 100 KC/S MODULATOR (17-LRU67E)

PLATE VI



3·0Mc/s OSCILLATOR AND CARRIER MODULATOR (17-LRU.67B) (PLAN VIEW)

PLATE VII

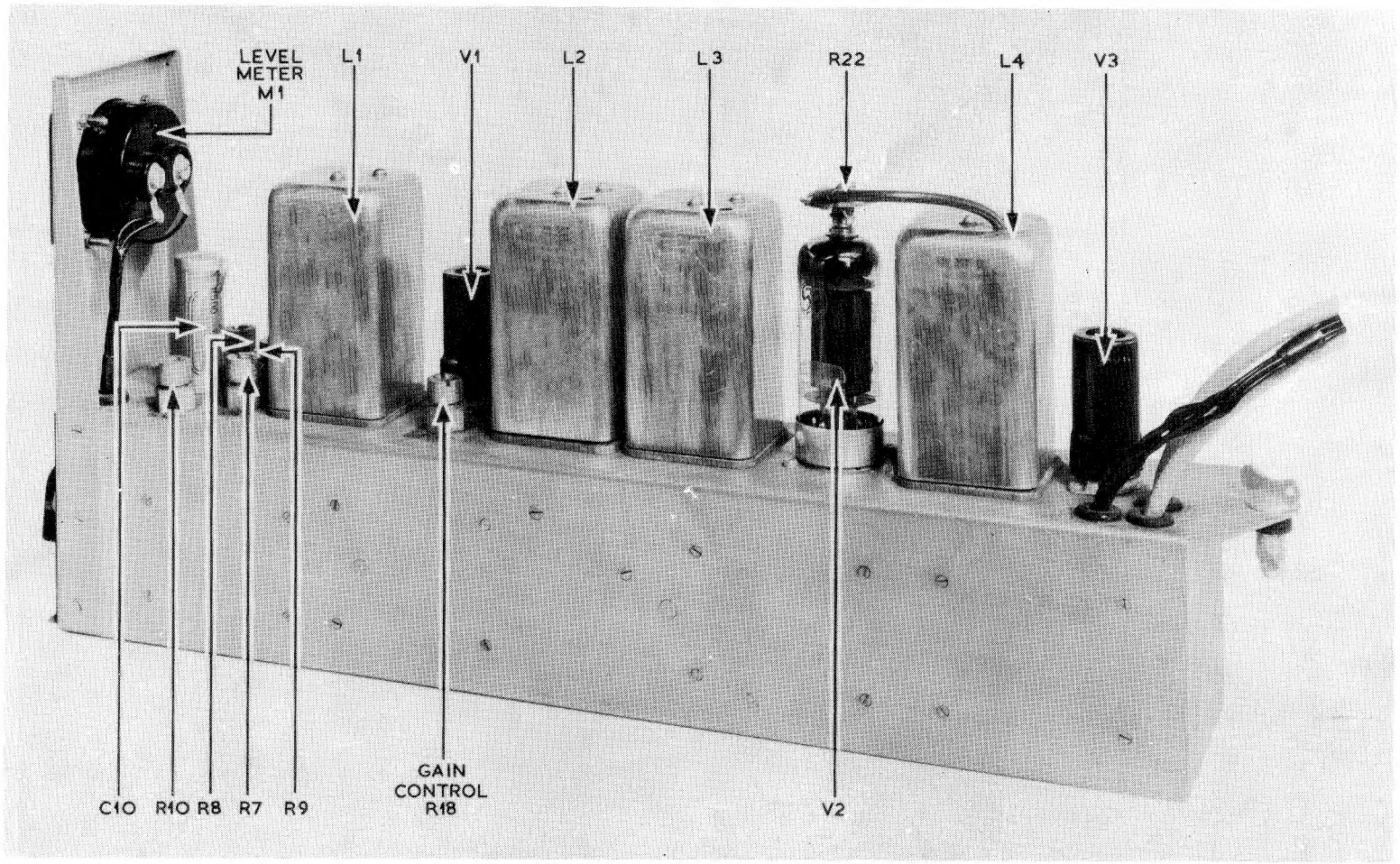


PLATE VIII

3·1 MC/S BANDPASS AMPLIFIER (28-LRU.330C)

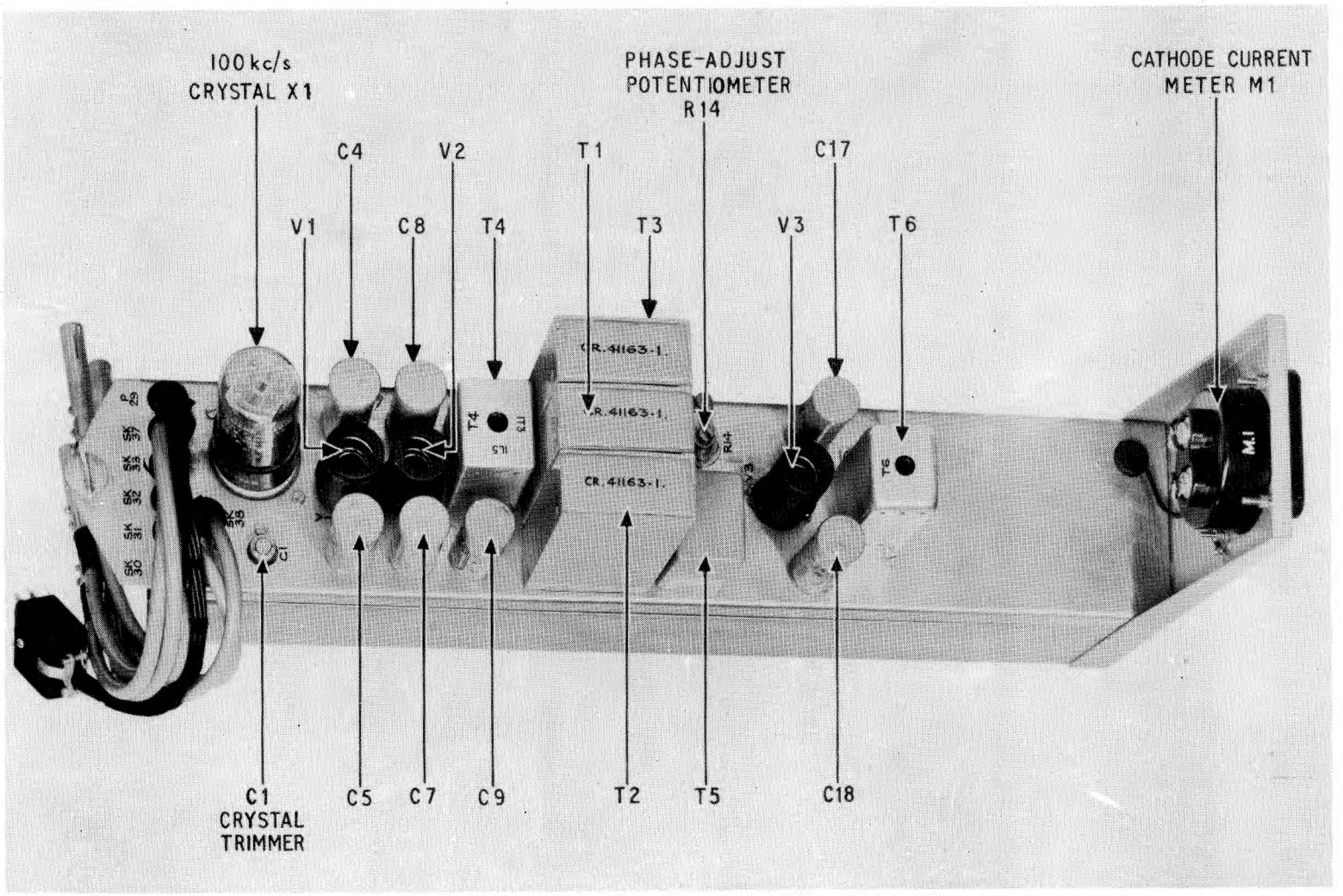


PLATE IX

100 KC/S OSCILLATOR (16-LRU.192C)

ISSUE A
3730
8/4/49.
P3 DELETED.

ISSUE B.
19-8-49.

ISSUE 1
27/50
ADD C15
" S2
MOD WIRING TO SW'T ADD NOTE RE R18 CH NOTE 4215

ISSUE 2
17-3-50
[illegible]
C/N 4215/19

ISS 3
11-4-51
R3 ADDED
C2 & C3 REVERSED
C/N 4215/28

ISS 5
R30 ADDED
C/N 4215-30

ISS 6
C18 & NOTE ADDED C/N 4215/32

ISSUE 7.
18 9 52
C17 & C18 WITH NOTE ADDED
C/N 4215/17986

ISSUE 8
24 10 52
[illegible]
MAT. ADDED
CH 4215/41/49

ISS. 9
131-12-52
SERIES RES & MAH WERE SHOWN AS SEPARATE UNITS
CH NO. 4215-43 JAB

ISSUE 10.
23 4 53
TEST POINT ADDED
CN 4215-49

ISS 11
6 1 54
CN 4215-48 AMD 2

ISS. 12
2 2 54

DIST. H
3736

(A.L.I. Nov. 61)

P18 U.S.B. (INPUT A)
P54 L.S.B. (INPUT B)

NOTE:- C17 & C18 NORMALLY CONNECTED TO POINTS 'A' FOR 18dB LIFT OR ALTERNATELY TO POINTS 'B' FOR FLAT RESPONSE.

NOTE: C16 IS CONNECTED ONLY WHEN REQD. ON FINAL TEST TO ADJUST EQUALISING CIRCUIT ACCORDING TO FREQUENCY RESPONSE OF CRYSTAL FILTER.

NOTE
EQUALIZATION OUT-S2 CLOSED
EQUALIZATION IN -S2 OPEN

AUDIO FREQUENCY INPUT

+250V.

TO CRYSTAL FILTER
U.S.B. SK.19 (INPUT A)
L.S.B. SK 35 (INPUT B)

FILS 6·3V.AC

100 KC/S OSCILLATOR
U.S.B. SK 20 (INPUT A)
L.S.B. SK 36 (INPUT B)

AP2883NB
FIG.3.

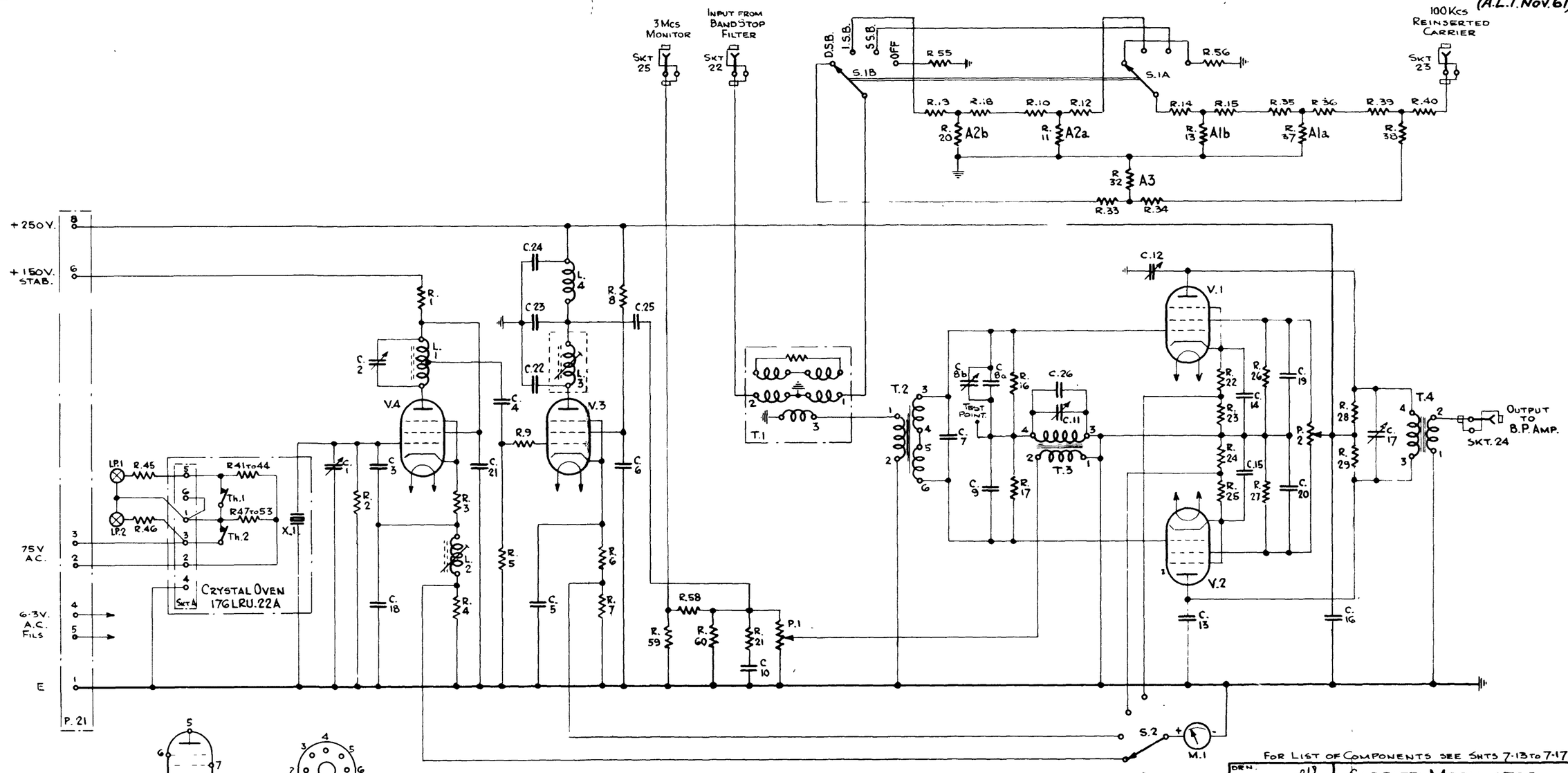
* V2 & V3 HAVE COMMON CATHODE RESISTOR - R.18.

SWITCH NUMBERED CLOCKWISE VIEWED FROM REAR.

AF AMP & CHANNEL MODULATOR.

DRN	APP
CHK'D.	ENG

17-LRU-67 A E
SHT. 7·2


(A.L.I. Nov. 61)
3781
Iss. 6
22-8-52
RE-DRAWN
A2b INSERTED IN I.S.B. CCT.
CH. 4215-34
R.57 DELETED
R 58,59,60 ADDED
CH 4215-35
ISSUE. 7
17-10-52.
TEST 3 NOT ADDED
CH. 8
6 1 54
3 Mcs MONITOR
SKT 25
INPUT FROM BAND STOP FILTER
SKT 22
100 Kcs REINSERTED CARRIER
SKT 23
D.S.B.
I.S.B.
S.S.B.
OFF
S.1B
S.1A
R.55
R.56
R.13
R.18
R.10
R.12
R.14
R.15
R.35
R.36
R.39
R.40
R. 20 A2b
R. 11 A2a
R. 13 A1b
R. 37 A1a
R. 38
R. 32 A3
R.33
R.34
+250 V.
+150 V. STAB.
75 V A.C.
6·3 V. A.C. FILS
E
P. 21
C.24
C.23
C.22
L.4
L.3
L.2
L.1
R.8
C.25
C.2
R.1
V.4
V.3
C.4
R.9
C.6
C.1
C.3
C.21
R.2
R.3
R.5
R.6
R.7
R.4
C.5
C.18
R.58
R.59
R.60
R.21
C.10
P.1
LP.1
LP.2
R.45
R.46
R41 to 44
R47 to 53
Th.1
Th.2
X.1
CRYSTAL OVEN 17GLRU.22A
SKT A
T.1
T.2
C.8b
C.8a
TEST POINT
C.7
C.9
R.16
R.17
C.26
C.11
T.3
C.12
V.1
V.2
R.22
R.23
R.24
R.25
C.14
C.15
R.26
R.27
C.19
C.20
P.2
C.13
C.16
R.28
R.29
C.17
T.4
OUTPUT TO B.P. AMP.
SKT. 24
S.2
M.1
V.1 to V.4
CO AXIAL SOCKET
FOR LIST OF COMPONENTS SEE SHTS 7·13 to 7·17
DRN.
CHKD.
APP
ENG.
CARRIER MODULATOR
SCHEMATIC DIAGRAM
17 LRU 67
GROUP B
SHT. 7·12
AP 2883 NB
FIG. 4.
THIS DRAWING BELONGS TO STANDARD TELEPHONES & CABLES LIMITED & IS ISSUED ON CONDITION THAT IT IS NOT COPIED, RE-PRINTED OR OTHERWISE DISCLOSED TO A THIRD PARTY EITHER WHOLLY OR IN PART WITHOUT THE CONSENT IN WRITING OF STANDARD TELEPHONES & CABLES LIMITED

RESISTORS.

AP2883NB (A.L.K. Nov. 61)

SCHEM. NO.						
R1	24Ω.	5%		RCD240J.		ERIE CERAMIC.
R2	"	"		"		" "
R3	100Ω	"		RCJ101J		" "
R4	12 Ω	10%		RC7J		ERIE RMA9
R5	12 Ω	10%		RC7J		ERIE RMA9
R6	220Ω	10%		RC7J		ERIE RMA9
R7	100Ω	10%				COLVERN. CLR1106/12S
R8	200Ω	"				" " " "
R9	10.5Ω	"				" " " "
R10	3000Ω	"				" " " "
R11	47Ω	10%		RCJ470K		ERIE CERAMIC
R12						
R13	4.7K	10%		RCH472K.		ERIE CERAMIC
R14	1K	"		RCH102K		" "
R15	33Ω	10%		RCJ330K		" "
R16	"	"		" "		" "
R17	47Ω	10%		RCJ470K		" "
R18	3K	"				COLVERN. CLR.1106/12S.
R19	10400Ω	1%				S.T.C. TYPE 4034 BC.
R20	110Ω	2%		RCC111G		WELWYN A3623
R21	100Ω	10%		RCJ101K		
R22	100Ω	10%		RCJ.101K		ERIE CERAMIC
R23	10 Ω.	5%		RCE100J		WELWYN A3623.
R24	10400Ω	1%				S.T.C. 4034BC.
R25	30K	10%		RWH303L.		PAINTON. P302.
R26	2.2K	2%		RCC222G		WELWYN. A3623
R27	47K	5%		RCC473J		" "
R28	2000Ω					COLVERN. CLR.1106/12S.
R29	220Ω	±5%	1.5W	W.W.		5905-99-011-3239
R30	10K	±5%	3W	W.W.		5905-99-011-3344
R31	39K	±5%	4.5W	W.W.		5905-99-011-8248
R32	100K	10%		RC7J		ERIE RMA9

3735.

PRE. ISSUE A. 8-4-49. Addition & modn.

PRE ISS. B. 25-5-49 MODN & ADDN MADE.

ISS C 2-7-49

ISSUE 1 4-[illegible]-49 DELETE R12 RCJ.303J DELETE R21 RCJ561K R28 WAS 250Ω

ISSUE 2 [illegible] C/N 4182/12 ISS 3 C/N 4182/12

ISS 4 17-4-52. C/N 4182-20

ISS 5 17-7-52 C/N 4182/26

ISSUE 6. 18-11-52

DRN.	CHKD.
APPD.	ENG

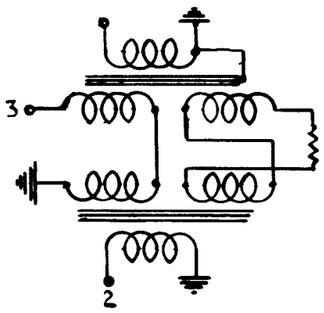
28LRU330A

SHT. 7-3

FOR CONTINUATION SEE SHT 7-4

(A.L.1. Nov. 61)

ISSUE 1 3735
24-11 53.



T1., T2., T3.

P29/6 + 150V STABILISED
P29/8 + 250V

C11a C11b CO-AXIAL SK.31
R14
C12a C12b CO-AXIAL SK 30
R13
T3
T1
T4
C10
CO-AXIAL SK 33
CO-AXIAL SK 32
T2

R7 R5 R12 R9
C5 C4 C9 C8
R6 C6
V1 V2

INPUT SK 38
T5
C14 R16
R15
C13 C17

C18 R21
T6
R23 R25 OUTPUT SK 37.
R22 R19 C16
R24
R20
V3

C1 C3 R1
R2
X1
C2
R3 R4
R8 C7 R10 R11
S1.
M1
S2
R17 C19 R18
P29/4 X 6.3V FILS
P29/5 X
P29/1 EARTH
P29/2 VOGAD BIAS.

100 KCS CRYSTAL & OSCILLATOR

OSCILLATOR UNIT TYPE 356A.

AP2883NB
FIG.12.

DRN JAF CHKD
ENGR APP

16-LRJ-192C
SHEET 7-20

SEE SHTS 7-21 7-22 7-23 FOR COMPONENTS

RESISTORS.

AP 2883 NB
(A.L.I. Nov. 61)

SCHEM Nº	VALUE	TOL.	RATING	RCSC CODING	SERVICE REF Nº	REMARKS
R1	470K	10%	½W	RCJ 474K		ERIE CERAMIC
R2	220Ω	10%	¾W	RCH 221K		" "
R3	10K	10%	¾W	RCH 103K		" "
R4	8·32Ω		10M/a			ETEI TYPE WE METER SHUNT
R5	10K	10%	¾W	RCH 103K		ERIE CERAMIC
R6	47K	10%	¾W	RCH 473K		" "
R7	100K	10%	¾W	RCH 104K		" "
R8	470K	10%	½W	RCJ 474K		" "
R9	10K	10%	¾W	RCH 103K		" "
R10	330Ω	10%	¾W	RCH 331K		" "
R11	8·32Ω		10M/a			ETEI TYPE W.E. METER SHUNT
R12	220K	10%	¾W	RCH 224K		ERIE CERAMIC
R13	75Ω					COLVERN CLR 1106-12S POT-METER
R14	250Ω					COLVERN CLR 1232-26B POT-METER
R15	10K	10%	¾W	RC7H 103K		ERIE CERAMIC
R16	100Ω	10%	½W	RC7J 101K		" "
R17	390Ω	10%	½W	RC7J		" "
R18	8·32Ω		10M/a			E.T.E.I TYPE W.E METER SHUNT
R19	10KΩ	10%	¾	RC7H 103K		ERIE CERAMIC
R20	100Ω	10%	¾	RC7H 101K		" "
R21	10K	10%	¾	RC7H 103K		" "
R22	27K	10%	¾	RC7H 273K		" "
R23	33Ω	5%	¾	RC2D		RC2D are rated 0.5 Watt
R24	68Ω	5%	¾	RC2D		
R25	33Ω	5%	¾	RC2D		

ISSUED BY - 3735

ISSUE 1
24·11·53
C.J 4193-32

ISS. 2.
6 / 54.
R.23 & 25. WERE 61Ω.
C.N. 4193/35

ISSUE. 3.
28·5·54.
R19 was 47KΩ
R23 R25 were 62Ω RC2C
224 was 15Ω RC2
C/S 4193-38

ISSUE. 4
4·1·55.

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16-LRU-192C

SHT. 7-21

FOR CONTINUATION SEE SHT 7-22

CONDENSERS

AP. 2883 N.B (A.L.I. Nov. 61)

SCHEM Nº	VALUE	TOL	RATING	R C & C CODING	SERVICE REF Nº	REMARKS
C1	100 pF			RCL 141·14		POLAR TRIMMER C803
C2	·001 µF	10%	350 V	RCL 130·23		TCC TYPE M3N CASE A
C3	100 pF	10%	350v	RCL 130·24M		DUBILIER S G35 OR DIC 401 SMP
C4	·1 µF	15%	500v			STC 4775A
C5	·1 µF	"	500v			STC 4775A
C6	330 pF	10%	350v	RCL 130·24M		DUBILIER SG35
C7	·1 µF	15%	500v			STC 4775A
C8	·1 µF	"	500v			" "
C9	·1 µF	"	500v			" "
C10	470 pF	10%	350v	RCL 130·24M		DUBILIER SG35
C11A	·01 µF	10%	350v	RCL 130·21		TCC M3N
C11B	·01 µF	10%	350v			TCC M3N
C12A	·01 µF	10%	350v			TCC M3N
C12B	·01 µF	10%	350v			TCC M3N
C13	360 pF	5%	350v			TCC SMWN
C14	270 pF	10%	750V	RCL 132		CMMIG
C15	·01 µF	20%	200v	RCL 131		CP 31C
C16	470 pF	5%		RCL 130·24M		DUBILIER 5635
C17	·1 µF	15%	500V			S.T.C. 4775A
C18	·1 µF	15%	500V			S.T.C 4775A
C19	0·1 µF			RCL 136		CPM. 26.

ISSUED BY - 3735

ISSUE 1 24. 11. 53. CH 2103/41

Iss. 2 3·4·56 C19 ADDED CH 4193/42

Iss. 3 25·5·56

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~~3955~~ 1
~~3[illegible]~~ 1
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APP | ENG

16-LRU-192c

SHT 7·22

FOR CONTINUATION SEE SHT 7.23

TRANSFORMERS.

AP2883NB (AL.1.Nov.61)

ISSUED BY - 3735

ISSUE 1 24-11-53

"TG" WAS NOT SHOWN. CH. 4193/42 gf

155.2 25-5-56

SCHEM Nº	SUPPLIER	SUPPLIERS CODE	R C S C CODING	SERVICE REF Nº	REMARKS
T1	STC	TYPE CR4116	3-1 HYBRID	Coil	
T2	"	" "	"	"	
T3	"	" "	"	"	
T4	"	" 20	LRU-226A		
T5	"				MO 42161/2. Transformer T3238 10K/17539
T6	"	" 20	LRU-226A		
			METER.		
M1	E.T.E	TYPE 225	To SPEC ZA 10B.		SCALE 0-10 M/AMPS
	F.S.D.	1M/AMP RES	75Ω MOVING COIL		
			CRYSTAL		
X1	STC				RL SPEC 7065-122D.
					100 KC/S
					TYPE D.T CUT (FOR UNOVENED USE
			SWITCHES		
S1	B.N.S.F.	MHC			RL SPEC. 7016-205B.
					SINGLE BANK TWO POLE
					THREE POSITIONS.
S2	B.N.S.F.		RCL 151 FIG. 2	Z 510504	TOGGLE DOUBLE POLE
					DOUBLE THROW.
			VALVES		
V1	BRIMAR	CAM6	(CV 138)		
V2	"	"	"		
V3	"	"	"		

[redacted]
DIST. H

DRN	CHKD.
APP	ENG

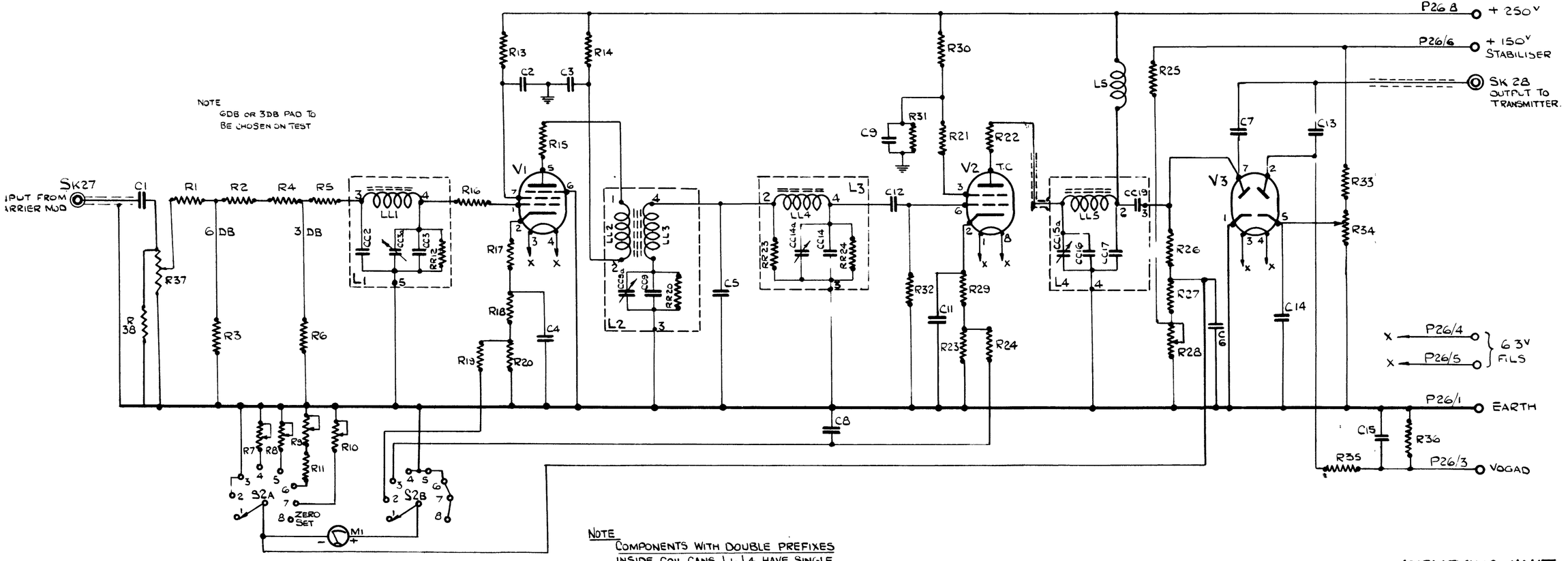
16-LRU-1920

SHT. 7-23

FOR CONTINUATION SEE SHT END.

(A.L.1. Nov. 61)

ISSUE 1 3
2/6 11-53.
CN. 4182/9
ISS 2
28 2



NOTE
COMPONENTS WITH DOUBLE PREFIXES INSIDE COIL CANS L1-L4 HAVE SINGLE PREFIXES ON 400-LRU-84 (e.g. CC17 = C17)

3·1 Mc/s B.P. FILTER AND AMPLIFIER

SEE SHTS 7.5, 7.7 & 7.8 FOR COMPONENTS

AMPLIFYING UNIT TYPE 607A.

AP2883
FIG.1

DRS CHK
APP ENG
28-LRU-3
SHEET 7

AP2883NB
(AL.1. Nov.61)

ISSUED BY 3735

PRE ISSUE A 1-11 49.

ISSUE 1. 14-11-49. C/N 4182-13

155.2 7-4-52 C/N 4182-20

155.3 17-4-52 C/N 4182/24

ISSUE.4 24-10-52

SCHEM Nº	VALUE	TOL	RATING	RCSC CODING	SERVICE REF Nº	REMARKS
RR.2	47K.	±10%		RC7J		ERIE RMA9
R.R.20	47K.	±2%				WELWYN A3622.
R.R.23	470Ω	± 10%		R.CJ471K.		ERIE CERAMIC.
R.R.24	33K	±10%		RC7J		ERIE RMA9
C.C.2	2,200 P.F.	±10%				CERAMICON. HI-K. STYLE M
C.C.3a	25 PF.					WINGROVE & ROGERS TRIMMER. CB-03
C.C.3	68 PF.	±5%				CERAMICON. N750. STYLE L
C.C.9a	25 PF.					WINGROVE & ROGERS TRIMMER. CB-03
C.C.9	75 PF.	± 5%				CERAMICON. N750. STYLE. L.
C.C.14a	25 PF.					WINGROVE & ROGERS TRIMMER. CB-03
C.C.14	56 PF.	±5%				CERAMICON N750. STYLE L.
C.C.16a	25PF					WINGROVE & ROGERS. TRIMMER. CB-03
C.C.16	56 PF.	±5%				CERAMICON N750. STYLE L
C.C.17	500PF.	± 2%				DUBILIER. TYPE S.G35.
C.C.19	10,000 PF.	±20%				T.C.C. C.P. 33S.
LL1	29 μH					
LL2	"					
LL3.	"					
LL4	"					
LL5	"					

DRN RP | CHKD.
APP | ENG.

28 LRU330A

SHT. 7·5

FOR CONTINUATION SEE SHT

RESISTORS.

AP 2883 NB
(A.L.I. Nov. 61)

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ISSUE 1
24-11-53.
CH A192/40

155.2
28.2.55.

SCHEM Nº	VALUE	TOL.	RATING	R C & C CODING	SERVICE REF Nº	REMARKS
R1	24 Ω	5%		RCD 240J		ERIE
R2	24 Ω	5%		RCD 240J		"
R3	100 Ω			RCJ 101J		"
R4	12 Ω	10%		RC7J		"
R5	12 Ω	10%		RC7J		"
R6	220 Ω	10%		RC7J		"
R7	100 Ω					COLVERN CLR 1106-125
R8	200 Ω					" " " "
R9	100 Ω					" " " "
R10	3000 Ω					" " " "
R11	22 Ω	±10%		RC7J		
R13	4·7K	10%		RCH 472K		ERIE
R14	1 K	10%		RCH 102K		ERIE
R15	33Ω	10%		RCJ 330K		"
R16	33Ω	10%		RCJ 330K		"
R17	47Ω	10%		RCJ 470K		"
R18	150 Ω	10%		RCJ 151K		"
R19	10400Ω	1%				STC 4034 BC
R20	110 Ω	2%		RCC 111G		WELWYN SA 3623
R21	100Ω	10%		RCJ 101K		ERIE
R22	100Ω	10%		RCJ 101K		"
R23	10Ω	5%		RCC 100G		WELWYN SA 3623
R24	10400Ω	1%				STC 4034 BC
R25	30K	10%		RWH 303K		PAINTON P302
R26	2·2K	2%		RCC 222G		WELWYN SA 3623
R27	47K	5%		RCC 473J		" "
R28	2000Ω					COLVERN CLR 1106-125
R29	120Ω	±5%	1·5W	W.W.		5905-99-011-3233
R30	10K	±5%	3W	W.W.		5905-99-011-3344
R31	39K	±5%	4·5W	W.W.		5905-99-011-8248
R32	100K	10%		RC7J		ERIE
R33	33K	10%		RC7H		"
R34	5K					COLVERN CLR 1106-125
R35	56K	10%		RC7J		ERIE
R36	470K	10%		RC7J		ERIE
R37	3K					COLVERN CLR 1106-125
R38	82Ω	10%		RC7J		ERIE

3781-1
3735-1
1ST. H

DRN	CHKD.
APP	ENG.

28-LRU-330C

SHT 7.7

FOR CONTINUATION SEE SHT 7.8.

CONDENSERS.

AP2883 N.B.
(A.L.I. Nov. 61)

ISSUED BY - 3735
ISSUE 1
24·11·53

SCHEM Nº	VALUE	SUPPLIERS CODE	RCSC CODING	SERVICE REF Nº	REMARKS
C1	·01 µF	TCC CP33S			
C2	4700 Pfd	ERIE CERAMICON	RCL 130·71M		
C3	"	"	"		
C4	"	"	"		
C5	6800 Pfd	DUBILIER S691W			
C6	·1 µF	TCC CP36H			
C7	·01 µF	TCC CP33S			
C8	"	"			
C9	·1 µF	TCC CP37N			
C11	"	TCC CP36H			
C12	18 Pfd.	ERIE N750K			
C13	4700 Pfd	ERIE CERAMICON			
C14	1·0 µF		RCL 136. CPM 2K1.		
C15	"		"	"	
			SWITCHES		
S1		BNSF MHC			RL 7016-207B 2-POSITION SINGLE BANK DOUBLE POLE
S2		BNSF MHC			RL 7016-208B 8-POSITION DOUBLE BANK SINGLE POLE
			METER		
M1		E.T.I. 225			RL 7003-43A.
			INDUCTANCES		
L1					400-LRU-84 J (SEE SHT 7.5)
L2					" K "
L3					" L "
L4					" M "
L5					LP115569.
			VALVES		
V1				CV 138	BRIMAR 6AM6
V2				CV 428	STC. 5B/254M
V3				CV 140	BRIMAR 6AL5

DIST° H

DRN | CHKD.
APP. | ENG

28-LRU-330C
SHT 7·8

FOR CONTINUATION SEE SHT 7.9