CONTENTS

LEADING PARTICULARS

Purpose of equipment

Homing equipment. Used in conjunction with aerials aircraft Type 7502, *the aircraft single or twin* 10*-channel v.h.f. transmitter-receiver installations, and suitable relay and switching units to provide homing indications on an electrical indicator Type* 7.

Frequency range

100 *to* 156 *Mc/s. Operates on spot frequencies within the range as selected by the transmitter-receiver. Will operate on either c.w., m.c.w. or R/T transmission.*

Operational range

Approximately 100 *nautical miles air-to-ground and* 200 *miles air-to-air at* 10,000 *ft. Satisfactory operation up to* 40,000 *ft.*

Facilities

Switching facilities provided by the control unit enable the transmitter-receiver installation to be used either with the homing equipment or for normal communication purposes. Provision is also made for coupling the homing equipment to an alternative transmitter-receiver where this is provided and, in certain installations, for switching the equipment from azimuth to elevation indications.

Power supplies

Power supplies for the equipment are taken from the AUX socket of the associated transmitter-receiver. The power requirements are as follows:—

H.T.	+270 *V*	40 *mA*
L.T.	+27 *V*	0.75*A*
G.B.	—50 *V*	15 *mA*

Installations

The following installations are in use:—

ARI.18044-twin 10-channel v.h.f. Indications both in azimuth and elevation.

ARI.18048-10-channel v.h.f. Azimuth only. Limited control of the meter sensitivity.

ARI.18049-twin 10-channel v.h.f. airborne relay. Azimuth only. Limited control of the meter sensitivity.

ARI.18085-twin 10-channel v.h.f. Indications both in azimuth and elevation. Limited control of the meter sensitivity.

ARI.18093-twin 10-channel v.h.f. Azimuth only. Limited control of meter sensitivity.

ARI.18142-twin 10-channel v.h.f. airborne relay. Azimuth only. Limited control of the meter sensitivity. Remote control by toggle switches on pilot's control panel.

ARI.18155-twin 10-channel v.h.f. Azimuth only. Limited control of meter sensitivity. Used in conjunction with ARI.18157.

Main items of installation

Item	Stores Ref.	Weight		Dimensions (in.)		
		lb.	oz.	Height	Width	Depth
Modulator unit Type 7087	10D/19221	4	13	6½	6½	7¾
Modulator unit Type 7747	10D/19783	4	13	6½	6½	7¾
Mounting Type 1034	10A/215		13	3	6½	9
Control unit Type 7086	10L/289		11½	3	4½	3
Control unit (remote) Type 7117	10L/290	1	4½	4½	4¾	2
Control unit (remote) Type 7746	10L/16309	1	4½	4½	4¾	2
Control unit (remote) Type 9959	10L/16342	1	3	4½	4¾	2
Box junction (aerial) Type 7089	10D/19223	3	13	6½	5¾	4¼
Box junction Type 169	10D/17999		6½	3¾	3½	2¼
Box junction Type 7372	10D/19276		6½	2¾	3½	2¼
Relay magnetic Type 1254	10F/16979		10	4	3	1½
Indicator electrical Type 7	10Q/61	1	7	3¼	3¼	4½

Chapter 1

INTRODUCTION AND GENERAL DESCRIPTION

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

INTRODUCTION

1. The installations are used in conjunction with the standard 10-channel VHF transmitter-receiver installations to provide homing indications on an indicator electrical Type 7. Indications can be obtained from any CW, MCW or R/T signal in the 100 to 156 Mc/s band to which the transmitter-receiver is tuned. In some applications, indications are provided both in azimuth and elevation, but not simultaneously; in others, only the azimuth indication facility is available.

2. The homing indication is derived from the phase difference between the signals produced in two separate aerials by the selected transmission. The signals from the aerials, mounted on the upper surface of the aircraft fuselage and spaced approximately 12 in. apart, are used for indications in azimuth. For indications in elevation, one of these aerials is used in conjunction with an aerial mounted on the underside of the fuselage.

3. Facilities are provided to enable the aircraft VHF transmitter-receiver to be used either with the homing equipment or as a normal VHF communication installation. Where installations include two transmitter-receivers, either one may be selected for use with the homing equipment. Normal communications signals can still be received by the transmitter-receiver used with the homing equipment. In installations where indication both in azimuth and elevation are required, switching facilities are provided to enable the operator to select the appropriate service.

General

4. A view of the units comprising the homing equipment other than the aerials and connecting

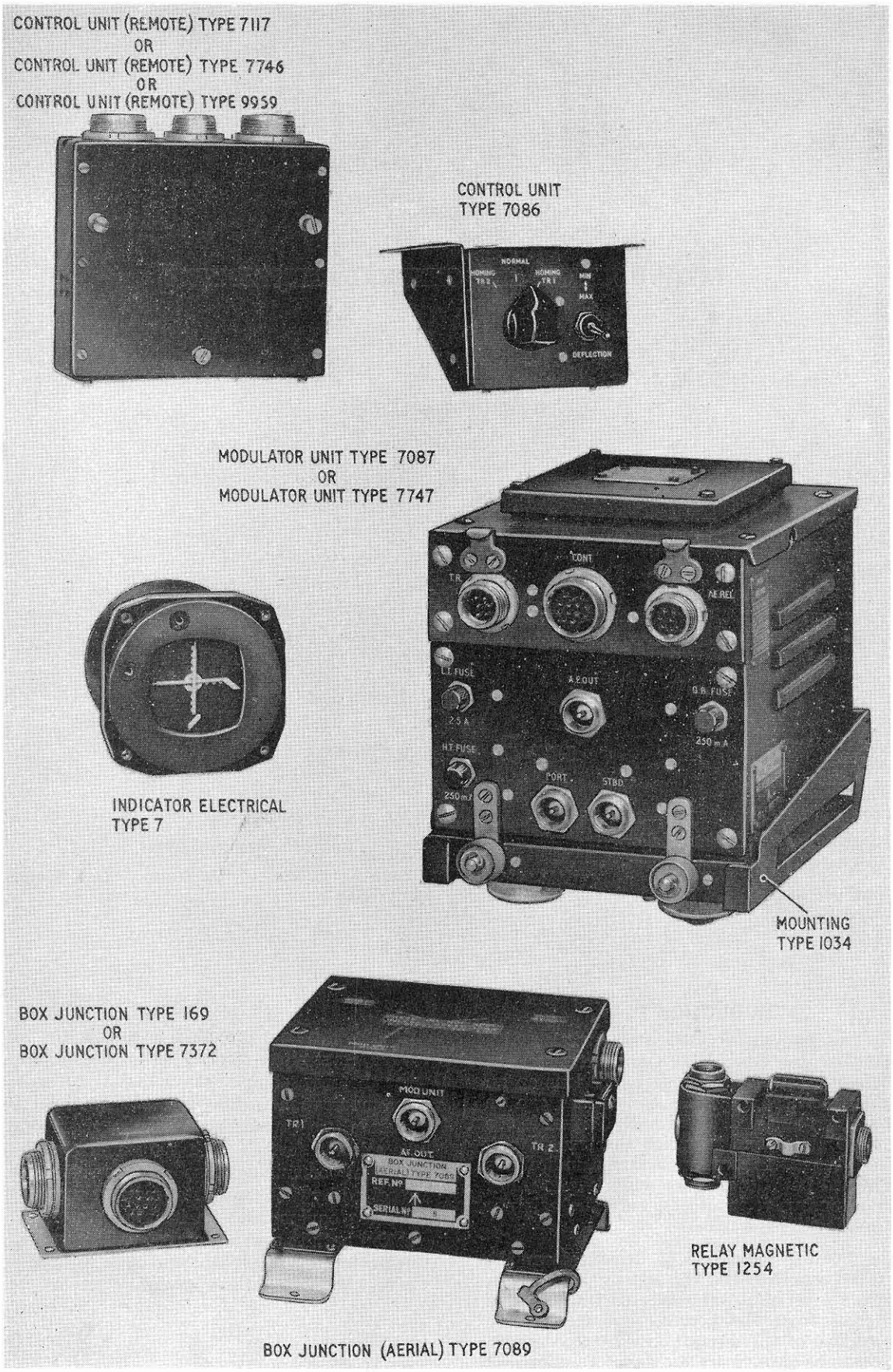


Fig. 1. Main items of the homing equipment

cables is shown in fig. 1. It consists of the following items:—

Item	*Stores Ref.*
Modulator unit Type 7087	10D/19221
or	
Modulator unit Type 7747	10D/19783
Mounting Type 1034	10AJ/215
Control unit Type 7086	10L/289
or	
Control unit (remote) Type 7117	10L/290
or	
Control unit (remote) Type 7746	10L/16309
Control unit (remote) Type 9959	10L/16342
Box junction (aerial) Type 7089	10D/19223
Box junction Type 169	10D/17999
Box junction Type 7372	10D/19276
Relay magnetic Type 1234	10F/16979
Aerials aircraft Type 7052	10B/16762
Indicator electrical Type 7	10Q/61
Suitable connector set	—

5. The transmitter-receivers with which the homing equipment may be used include the following:—

Item	*Stores Ref.*
TR.1934	10D/17693
TR.1935	10D/17694
TR.1936	10D/17695
TR.1985	10D/17937
TR.1986	10D/17938
TR.1987	10D/17939
TR.1997	10D/17978
TR.1998	10D/17980

Note . . .

Before they can be used with the homing equipment, certain of these transmitter-receivers must be modified:—

(1) *TR.*1934, *TR.*1935 *and TR.*1936 *to incorporate Modification No.* 2640/1 *and* 2641/1 *(Research Establishment Ref. No. R/A* 182*A and R/A* 183*A).*

(2) *TR.*1985, *TR.*1986 *and TR.*1987 *to incorporate Modification No.* 2640/1 *(Research Establishment Ref. No. R/A* 182*A).*

Modification

6. Some of the units to be described may have been supplied by the manufacturers in various stages of modification. Brief details of the modifications will be included in the text.

Operational range

7. The equipment will give satisfactory homing indications up to approximately 100 nautical miles air-to-ground at 10,000 ft. and up to 200 nautical miles air-to-air at this altitude.

Power Supplies

8. The power supplies are derived from the associated v.h.f. transmitter-receiver. The total power requirements are as follows:—

H.T.	+270 V	40 mA
L.T.	+27 V	0.75 A
G.B.	—50 V	15 mA

Airborne radio installations

9. Five types of airborne radio installations have been developed, namely:—

(1) ARI.18044 for use with twin 10-channel v.h.f. equipment. Indications both in azimuth and elevation.

(2) ARI.18048 for use with 10-channel v.h.f. equipment. Indications in azimuth only. Facilities for limited control of the meter sensitivity.

(3) ARI.18049 for use with twin 10-channel v.h.f. airborne relay equipment. Indications in azimuth only. Facilities for limited control of the meter sensitivity.

(4) ARI.18085 similar to ARI.18044 but with facilities for limited control of meter sensitivity.

(5) ARI.18093 for use with twin 10-channel v.h.f. equipment. Indications in azimuth only. Facilities for limited control of meter sensitivity.

(6) ARI.18142 for use with twin 10-channel v.h.f. airborne relay equipment. Indications in azimuth only. Facilities for limited control of the meter sensitivity. Remote control by toggle switches on the pilot's control panel.

(7) ARI.18155 for use with twin 10-channel v.h.f. equipment. Indications in azimuth only. Facilities for limited control of the meter sensitivity. Used in conjunction with ARI. 18157.

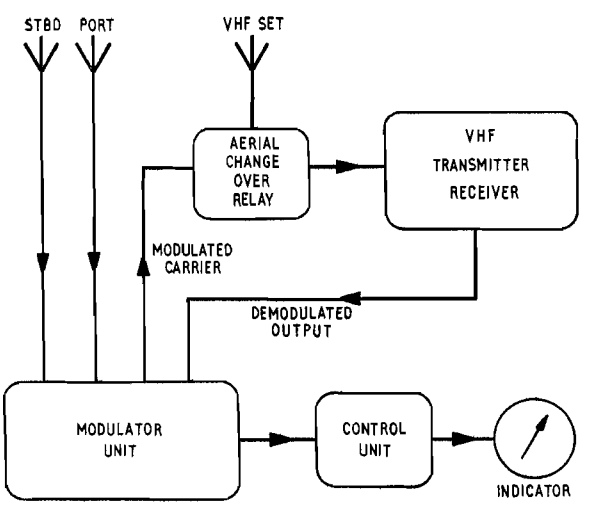


Fig. 2 Block diagram of typical installatiou

10. The function of a simple installation giving indications in azimuth only is shown in the block diagram fig. 2. With a selector switch in the control unit set to HOMING, the power supplies from the v.h.f. transmitter-receiver are applied to the modulator unit; at the same time the aerial changeover relay is energized thus disconnecting the normal v.h.f. transmitter-receiver aerial and connecting the modulated output from the modulator unit to the v.h.f. transmitter-receiver.

11. The modulator unit is a phase-measuring unit which converts the phase difference between the signals from the PORT and STBD aerials into an amplitude modulation of the carrier. The modulated carrier is then selected, amplified and demodulated in the v.h.f. receiver. The demodulated signal is fed back into the modulator unit where it is converted into a form suitable to operate the indicator pointer in the indicator electrical Type 7.

12. In installations which provide indications both in azimuth and elevation, an additional aerial relay is arranged to connect either the port or elevation aerial to the modulator unit. The phase difference between the port and starboard aerials is used for indications in azimuth and for elevation indications the starboard and elevation aerials are used.

Modulator unit Type 7087 and modulator unit Type 7747

13. The two modulator units only differ in very minor respects, the Type 7747 being a modified version of the Type 7087. The modifications will be described in the appropriate part of the text.

14. A block diagram of the modulator unit is given in fig. 3. The unit is wideband, designed to operate over the frequency range 100 to 156 Mc/s. A simplified circuit of the r.f. stage is shown in fig. 4. The vector diagram (*fig.* 5) illustrates the signals appearing at A and B of fig. 4.

15. The phase-shift network connected between the anodes of valves V1 and V2 (*fig.* 4) is arranged to introduce a signal phase-shift of approximately 90 deg. When the aircraft is on course, the signals in the two aerials will be in phase and of equal amplitude. With switch S in position 1, the voltage at A will consist of the output of V1 (Ep) plus the output of V2 (Es) after a phase change of approximately 90 deg. Similarly, with the switch S in position 2, the voltage at B will consist of the output of Es plus Ep after a phase change of 90 deg. In both cases the resultant amplitudes E_1 and E_2 will be the same.

16. In the case of off-course signals, the amplitude of the signals in the aerials will be the same but there will be a phase difference between them; the amount of phase difference will depend on the distance apart of the aerials and the actual bearing of the signal relative to the on-course signal.

17. When the signal is coming from the port side of the aircraft, the e.m.f. in the port aerial will lead the e.m.f. in the starboard aerial. With switch S in position 1 the voltage at A will consist of the output of V1 (Ep) plus the output of V2 (Es) which is already out of phase with Ep and which

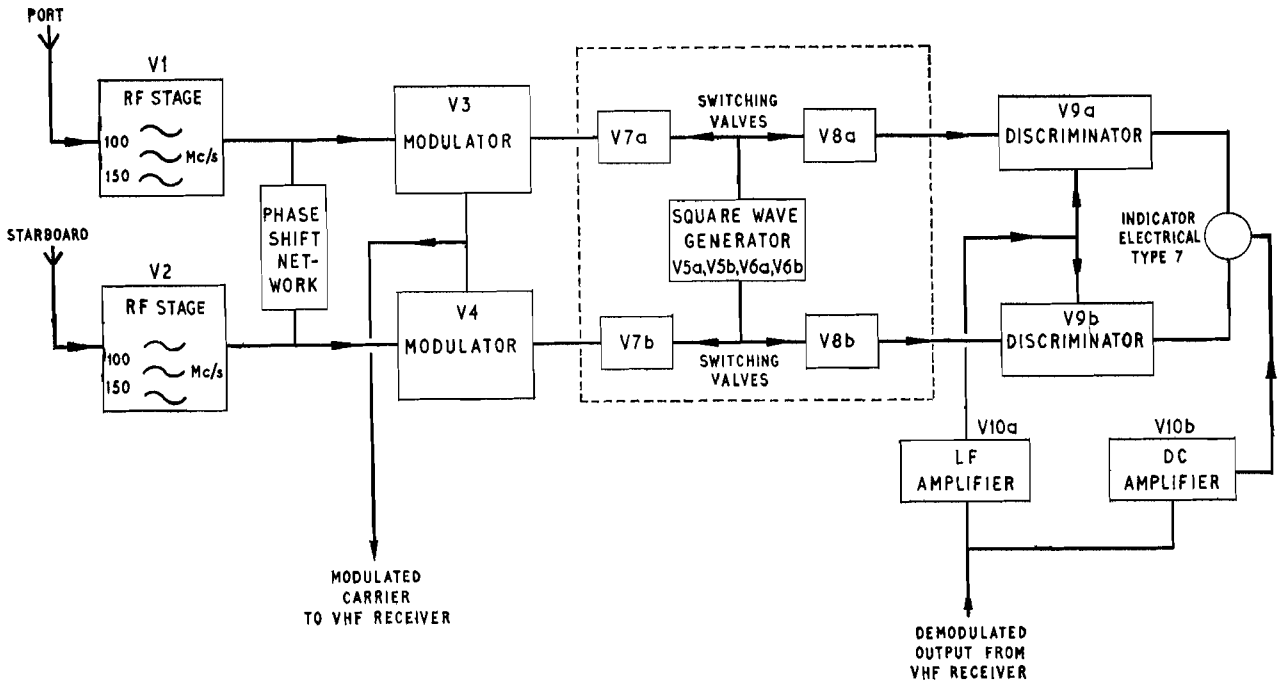


Fig. 3 Block diagram of modulator unit Type 7087

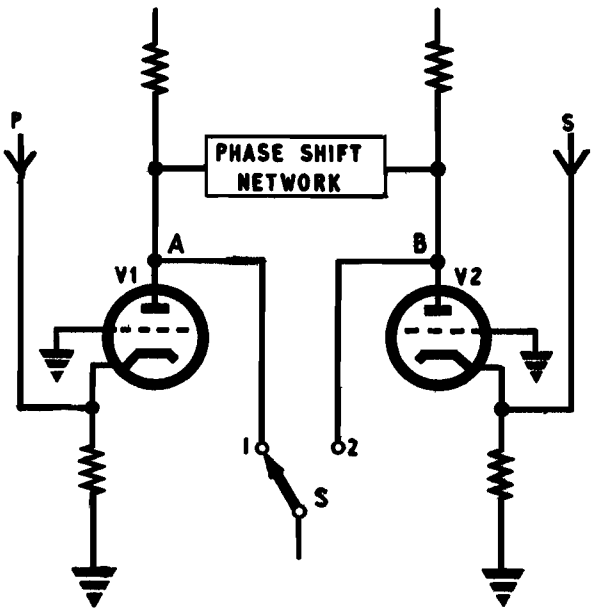


Fig. 4. Simplified RF circuit

now undergoes a phase change of 90 deg. The resultant amplitude E_1 in (b) of fig. 5 will be less than E_1 in (a) of fig. 5. With switch S in position 2 the voltage at B will consist of Es plus Ep which is leading Es and which now undergoes a phase change of 90 deg. The resultant amplitude E_2 in (b) of fig. 5 will be greater than E_2 in (a) of fig. 5. The resultant amplitudes of E_1 and E_2 for a signal from the starboard side of the aircraft are shown in (c) of fig. 5. The amplitudes of E_1 and E_2 are therefore, dependent on the normal amplitude of the signals (substantially independent of azimuth) and the phase difference between them.

18. The actual switching in the modulator unit is electronically actuated by a multivibrator at approximately 4·5 kc/s. The multivibrator is designed to give the very square waveform and the low impedance output required for this particular application.

SECRET

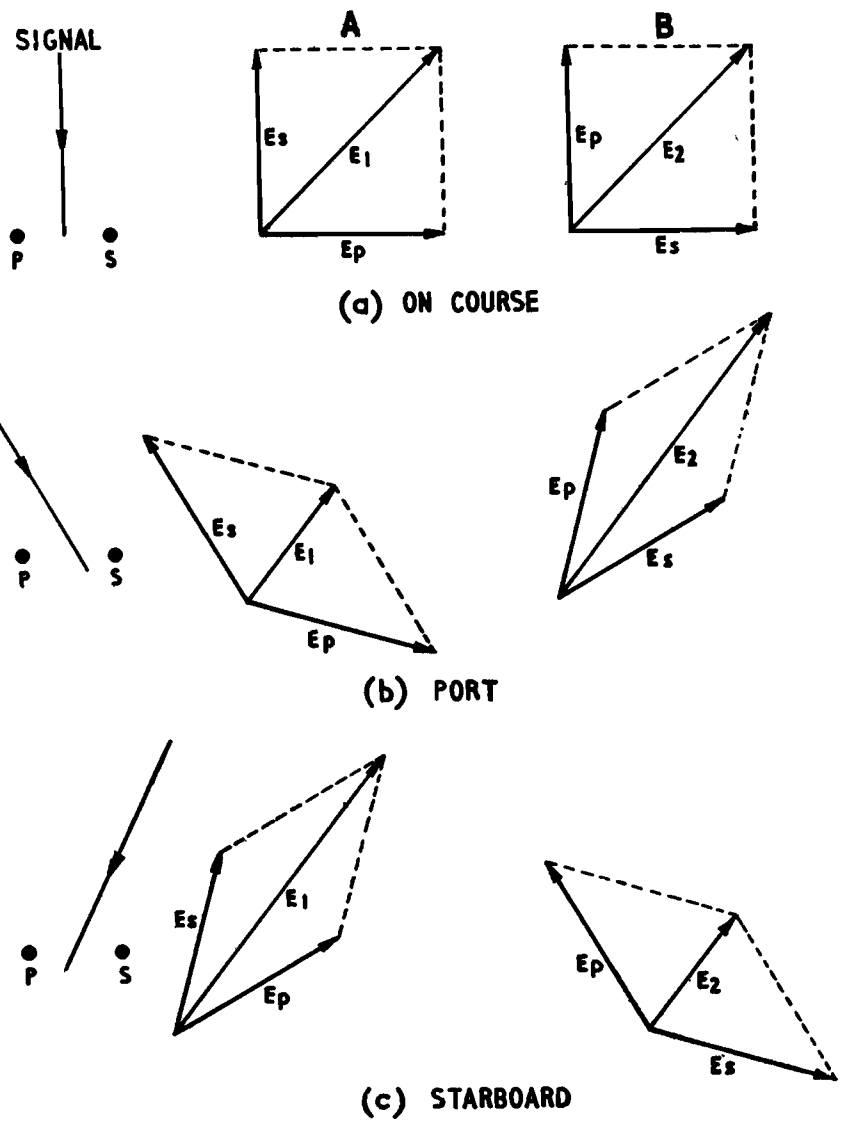


Fig. 5. RF stage vector diagram

19. The switching and signal waveforms are shown in fig. 6. The output voltages E_1 and E_2 from V1 and V2 are connected to the modulator valves V3 and V4 whose grids are switched by the electronic switch in such a manner that when one valve is conducting the other is completely cut off. On course, E_1 and E_2 will be equal and the output voltages at V3 and V4 anodes will also be equal; these will combine to give an unmodulated carrier as shown. When E_1 and E_2 are unequal, due to a signal from port or starboard, the output carrier will be modulated at the switching frequency. The depth of modulation will depend upon the difference in amplitudes of E_1 and E_2.

20. The modulated carrier is fed into the v.h.f. receiver where it is selected, amplified, and demodulated. The demodulated signal is then fed back into the modulator unit where, after removal of the d.c. component, it is amplified in the l.f. amplifier V10a (*fig.* 3) and applied to the grids of the discriminator valves V9a and V9b. The anode voltages of these valves are controlled by the multivibrator switch. The modulator and discriminator switching voltages are taken from the same source and are in phase.

◄ **21.** In the modulator unit Type 7747 the cathode-bias resistor in the l.f. amplifier is increased in value. This resistor is shunted by a resistor in the control unit when the meter sensitivity switch is set to MAX. In this position the sensitivity of the l.f. amplifier is the same as the l.f. amplifier in the modulator unit Type 7087. By removing the shunt resistor, *i.e.* setting the switch to MIN, the gain of the amplifier is reduced. ►

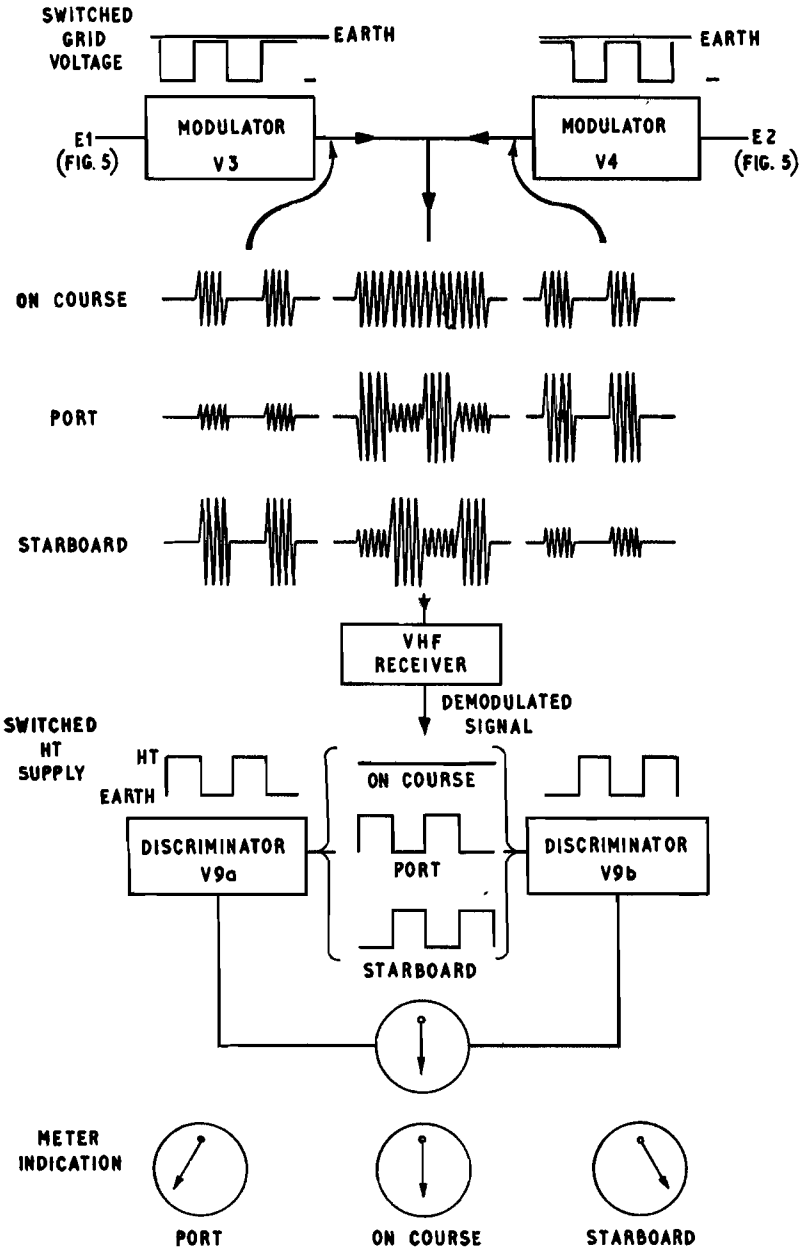


Fig. 6. Signal and switching waveforms

22. Fig. 6 also illustrates the operation of the discriminator. Because the on-course signal results in an unmodulated output carrier there will be no signal to apply to the grids of V9a and V9b. The average current taken by these valves will be the same and the indicator, a centre reading microammeter connected between the two cathodes, will give a zero or on-course reading.

23. The incoming waveform from a port signal applied to the grids of V9a and V9b will be in phase with the switched h.t. supply of V9a and out of phase with the h.t. supply of V9b, resulting in a decrease in current through V9b. The indicator will be deflected to port, the amount of deflection being controlled by the amplitude of the incoming waveform. Similarly with a starboard signal, V9b will pass more current than V9a and the meter will deflect to starboard.

24. The discriminator acts as an extremely narrow band filter. Any signal not in phase with the switching signal will affect both valves by an equal amount and will balance out as far as the indicator reading is concerned. As a result the system is equally effective on c.w., m.c.w. and R/T signals.

25. The d.g. voltage developed across the diode load of the v.h.f. receiver is applied to the d.c. amplifier (*fig.* 3) and is used to operate an indicator flag in indicator electrical Type 7. The flag will disappear when the magnitude of the incoming signal is strong enough to operate the homing equipment satisfactorily.

26. If the modulator units incorporate Modification No. 3279/1, the flag circuit will have been modified; in this case the flag will disappear as soon as the equipment is set to homing, i.e., is it not dependent on the incoming signal.

Aerials and aerial connectors

27. Vertical whip aerials (aerials aircraft Type 7052) are used with the equipment. Two aerials mounted on the top of the fuselage spaced approximately 12 in. apart on a line at right angles to the longitudinal axis of the fuselage, are used for indications in azimuth. In installations where indications in elevation are required, the starboard aerial is used in conjunction with another aerial mounted on the underside of the fuselage. As it is not possible to align accurately the latter two aerials, phase correction is introduced by the connector from the lower aerials. The length of the aerial connectors is extremely critical and it is important to use matched connectors for each installation.

Control units

28. The type of control unit required is dependent upon the particular installation. Switching facilities are provided to enable the v.h.f. transmitter-receiver installations to be used either with the homing equipment or for normal communication purposes. Provision is also made for coupling the homing equipment to alternative transmitter-receivers where such are provided and, in certain installations, for switching the equipment from azimuth to elevation indications. In installations where space is restricted, alternative control units are provided which are remotely operated by toggle switches on the pilot's control panel.

Indications

29. The indicator electrical Type 7 is a crossed pointer instrument. The vertical pointer pivots from the top and is used for indications in azimuth; the horizontal pointer pivots from the left-hand side and is used for indication in elevation. The zero positions of both pointers are along the lines of two rows of ten dots originating from the circle at the centre of the indicator.

30. Two flag movements incorporated in the indicator identify the service in use. One located at the bottom of the indicator is used for the azimuth and the other at the right-hand side is used for elevation. The flags in their normal position cover the tip of the associated indicator pointer. In the operate position the appropriate flag should disappear.

31. Fig. 7 is a graph of the indicator full-scale deflection plotted against the frequency of the incoming signal for both azimuth and elevation when the preset controls in the modulator unit are set to their normal positions and, in the installations using modulator unit Type 7747, with the meter sensitivity switch on the control unit set to the maximum position. The scaling of the indicator is linear, *i.e.* if full scale deflection is 5 deg. then each dot is 1 deg.

Note . . .

The sensitivity of the indicator can be adjusted to suit particular requirements, i.e., if the equipment is going to be used over a narrow band of the frequency range, but this adjustment must be made at second line workshops using the correct test equipment.

Test equipment

32. Special test equipment has been developed for servicing the homing equipment:—

(1) Test. oscillator Type 7049 (10S/16757)

(2) Test set Type 7144 (10S/16468)

(3) Test set Type 7748 (10S/16772)

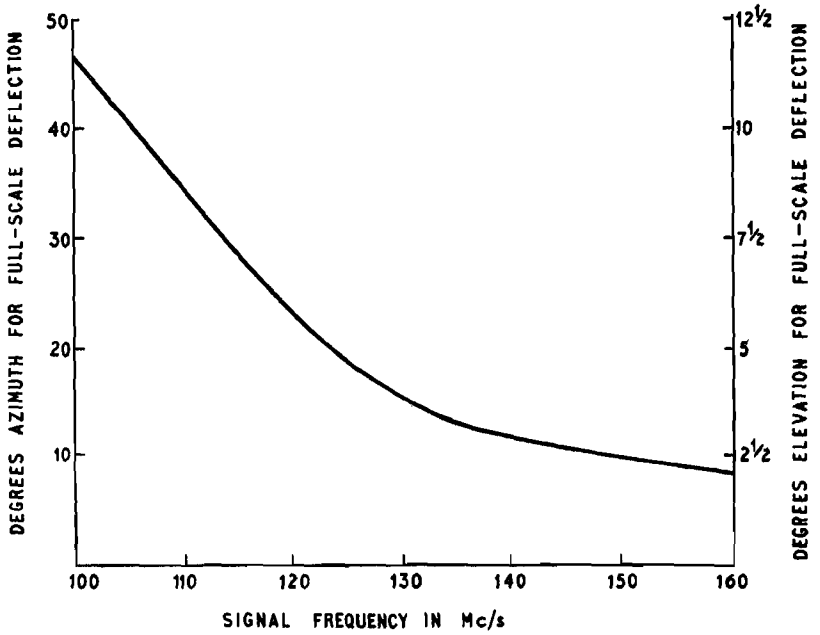


Fig. 7. Indicator full-scale deflection plotted against frequency

Test oscillator Type 7049

33. This oscillator is used for testing the airborne installations. The oscillator radiates a modulated crystal-control carrier at any one frequency channel in the v.h.f. band. The r.f. power output is sufficient to operate the equipment under test at distances not exceeding 40 ft from the aircraft aerials. The modulated carrier also enables the audio operation of the associated v.h.f. transmitter-receiver to be tested. Power for the test oscillator is provided by self-contained h.t. and l.t. batteries.

Test set Type 7144

34. For second and third lines of servicing of modulator unit Type 7087 test set Type 7144 is used. In addition, facilities are provided for testing the indicator electrical Type 7. Power supplies for the test set are derived from the associated v.h.f. transmitter-receiver.

Test set Type 7748

35. This test set is a modified version of test set Type 7144 and it is provided for testing the ◄ modulator unit Type 7747. ►

Chapter 2

INSTALLATION AND CONSTRUCTION

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

INSTALLATION

Introduction

1. There are seven types of wide-band homing installation for use in conjunction with the aircraft standard 10-channel VHF transmitter-receiver installations to provide homing indications in azimuth and, in some installations, azimuth or elevation.

Installation	*Used with*	*Indications*
ARI.18044	Twin 10-channel VHF	Azimuth and elevation
ARI.18048	Single 10-channel VHF	Azimuth only
ARI.18049	Twin 10-channel VHF airborne relay	Azimuth only
ARI.18085	Twin 10-channel VHF	Azimuth and elevation
ARI.18093	Twin 10-channel VHF	Azimuth only
◀ ARI.18142	Twin 10-channel VHF airborne relay	Azimuth only
ARI.18155	Twin 10-channel VHF used in conjunction with ARI.18157	Azimuth only ▶

2. When two VHF transmitter-receivers are used they are referred to in the following description and illustrations as VHF TR1 and VHF TR2 and may include two of the following:—

Item	*Stores Ref.*
TR 1934	10D/17693
TR 1935	10D/17694
TR 1936	10D/17695
TR 1985	10D/17937
TR 1997	10D/17978
TR 1998	10D/17980

Equipment

3. The following items comprise the homing equipment and the numbers off are tabulated for each ARI. They are normally supplied to the aircraft manufacturer for installation at the works. The items listed are required in addition to the existing VHF equipment.

(A.L.15, Nov. 57)

TABLE I

◀ List of equipment

Stores Ref.	Description	Weight lb.	Weight oz.	No. off ARI. 18044	18048	18049	18085	18093	18142	18155	Remarks
10B/16762	Aerial aircraft Type 7052	–	14	3	2	2	3	2	2	2	
5C/430	Blocks terminal	–	3				As required				Aircraft contractor to supply
10L/289	Control unit Type 7086	–	10	–	1	1	–	1	–	1	
10L/16342	Control unit (remote) Type 9959	1	3	–	–	–	–	–	1	–	
10L/16309	Control unit (remote) Type 7746	1	5	–	–	–	1	–	–	–	
10L/230	Control unit (remote) Type 7117	1	5	1	–	–	–	–	–	–	
10Q/61	Indicator electrical Type 7	1	7	1	1(2)	1	1	1(2)	1	–	ARI.155 uses indicator in ARI.18157
10D/17999	Junction box Type 169	–	7	–	–	2	–	–	–	–	
10D/19276	Junction box Type 7372	–	7	–	(1)	–	–	(1)	–	–	
10D/19223	Junction box Type 7089	3	13	1	–	1	1	1	1	1	
10D/19221	Modulator unit Type 7087	4	3	1	–	–	–	–	–	–	
10D/19783	Modulator unit Type 7747	4	3	–	1	1	1	1	1	1	
10AJ/215	Mounting Type 1034	–	13	1	1	1	1	1	1	1	
10F/16979	Relay magnetic Type 1254	–	10	1	1	–	1	–	–	–	
	Toggle switches			2	–	–	3	–	3	–	Aircraft contractor to supply

Quantity shown in brackets required when two indicators are fitted. ▶

Connectors

General

4. All connectors are service supply items bearing A.M. Ref. numbers; they are supplied to the aircraft manufacturers on embodiment loan and are fitted by them. If connectors are required for renewal these can be drawn from the Stores in the usual way. Cable lengths will vary according to the type of aircraft to be fitted. The basic type numbers and details of the connectors for each ARI. are shown in the following Tables 2 to 6 and in fig. 1 to 5 (at the end of the chapter).

Note . . .

It is of course, possible that aircraft will be fitted with the installation after it has left the manufacturer. In this event a complete connector set for the particular type of aircraft must be demanded, e.g. connector set Type ARI/18044/

TABLE 2

Connectors ARI.18044

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
1	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR1 existing aerial	Junction box (Aerial) Type 7089–AE TR1	Required for VHF installation fitted with separate aerials for the two transmitter–receivers—see fig. 1.
2	D267/50/	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR2 existing aerial	Junction box (Aerial) Type 7089–AE TR2	
3	D267/30	Uniradio 67	Socket Type 523—with flexible guard	Socket Type 703	VHF TR1 AE	Junction box (Aerial) Type 7089–MOD UNIT TR1	
4	D267/30	Uniradio 67	Socket Type 523—with flexible guard	Socket Type 703	VHF TR2 AE	Junction box (Aerial) Type 7089–MOD UNIT TR2	
5	D267/30	Uniradio 67	Socket Type 703	Socket Type 703	Mod. unit Type 7087–AE OUT	Junction box Aerial Type 7089–MOD UNIT AE OUT	
6	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052 STBD.	Mod. unit Type 7087–STBD	Refer to para 5 to 14.
7	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–PORT	Relay magnetic Type 1254–plug B	
8	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–ELEVATION	Relay magnetic Type 1254–plug C	
9	Connector phasing	Uniradio 67	Socket Type 703	Socket Type 703	Relay magnetic Type 1254–plug C	Mod unit Type 7087–PORT	

TABLE 2—*continued*

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
10	B11/20	Twelvevinmetsmall 2·5	Socket Mk. 4 12-way pos. 2	Socket Mk. 4 12-way pos. 1	VHF TR1 AUX	Junction box (Aerial) Type 7089–TR1-AUX	
11	B11/20	Twelvevinmetsmall 2·5	Socket Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 2	VHF TR2 AUX	Junction box (Aerial) Type 7089–TR2–AUX	
12	B7/30	Sextovinmetsmall 2·5	Plug Mk. 4 6-way pos. 0	Socket Mk. 4 6-way pos. 0	Mod. unit Type 7087–AE REL	Junction box (Aerial) Type 7089–MOD UNIT AE REL	
13	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Mod. unit Type 7087–CONT	Control unit (remote) Type 7117–plug A	
14	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Control unit (remote) Type 7117–socket C	Indicator electrical Type 7	
15		Sextovinmetsmall	Plug Mk. 4 6-way pos. 0	Free	Control unit (remote) Type 7117–socket B	Toggle switches on control panel	Item 15 and 16 to be supplied by the aircraft contractor.
16		Dupren	Free	Free	Junction box (Aerial) Type 7089–MOD UNIT RELAY 1254	Terminal block on relay 1254	

The above list applies to twin 10-channel VHF installations fitted with separate aerials for the transmitter–receivers. Where a common aerial is used in place of the two separate aerials the following items will be required in place of items 1 and 2.

17	D267/50	Uniradio 67	Socket Type 703	Socket Type 703	Relay magnetic Type 1254–plug B	Junction box (Aerial) Type 7089–AE TR1	Relay magnetic Type 1254 is part of the existing VHF installation.
18	D267/50	Uniradio 67	Socket Type 703	Socket Type 703	Relay magnetic Type 1254–plug C	Junction box (Aerial) Type 7089–AE TR2	

Table 3

Connectors ARL18048

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
1	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft 226, 228 or 229	Relay magnetic Type 1254–plug B	
2	D267/51	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	Trans. Recv. aerial	Relay magnetic Type 1254–plug A	
3	D267/30	Uniradio 67	Socket Type 703	Socket Type 703	Mod. unit Type 7747–AE OUT	Relay magnetic Type 1254–plug C	
4	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–PORT	Mod. unit Type 7747–PORT	Refer to para. 5 to 14.
5	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–STBD.	Mod. unit Type 7747–STBD.	
6	B11/30	Twelvevinmetsmall 2·5	Plug Mk. 4 12-pole pos. 0	Socket Mk. 4 12-pole pos. 0	Mod. unit Type 7747–CONT	Control unit Type 7086–MOD. UNIT	
7	B11/30	Twelvevinmetsmall 2·5	Plug Mk. 4 12-pole pos. 2	Socket Mk. 4 12-pole pos. 0	Control unit Type 7086–IND.	Indicator electrical Type 7	Single indicator installation only
8	B21/42	Duvinmetsmall 2·5	Plug Mk. 4 6-pole pos. 0	Free	Mod. unit Type 7747–AE REL	Terminal block	Blue—pin A Red—pin B
9	B7/30	Sextovinmetsmall 2·5	Socket Mk. 4 6-pole pos. 0	Plug Mk. 4 12-pole pos. 0	Mod. unit Type 7747–TR	VHF TR AUX	6-way A to 12-way J; B K; C L; D G; E E Pin F of 6-way and pins A, B, C, D and F of 12-way—blank.
10	B11/30	Twelvevinmetsmall 2·5	Plug Mk. 4 12-pole pos. 0	Plug Mk. 4 12-pole pos. 0	Control unit Type 7086–IND	Junction box Type 7372–CONT	Required when two indicators electrical Type 7 are used.
11	B11/30	Twelvevinmetsmall 2·5	Socket Mk. 4 12-pole pos. 0	Socket Mk. 4 12-pole pos. 0	Indicator Electrical Type 7, No. 1	Junction box Type 7372–IND 1	
12	B11/30	Twelvevinmetsmall 2·5	Socket Mk. 4 12-pole pos. 0	Plug Mk. 4 12-pole pos. 0	Indicator Electrical Type 7, No. 2	Junction box Type 7372–IND 2	

Table 4

Connectors ARI.18049

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
◄ 1	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR1 Existing aerial	Junction box (Aerial) Type 7089–AE TR1	
2	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR2 Existing aerial	Junction box (Aerial) Type 7089–AE TR2	
3	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR1 AE	Junction box (Aerial) Type 7089–MOD UNIT TR1	►
4	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR2 AE	Junction box (Aerial) Type 7089–MOD UNIT TR2	
5	D267/30	Uniradio 67	Socket Type 703	Socket Type 703	Junction box (Aerial) Type 7089–MOD UNIT AE OUT	Mod. unit Type 7747–AE RELAY	
6	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–PORT	Mod. unit Type 7747–PORT	Refer to para. 5 to 14.
7	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–STBD.	Mod. unit Type 7747–PORT	Refer to para. 5 to 14.
8	B11/20	Twelvevinmetsmall 2·5	Socket Mk. 4 12-way pos. 0	Plug Mk. 4 12-way pos. 0	Junction box (Aerial) Type 7089–VHF TR1 AUX	Junction box Type 169–HOMING	
9	B11/20	Twelvevinmetsmall 2·5	Socket K.4 12-way pos. 0	Plug Mk. 4 12-way pos. 0	Junction box (Aerial) Type 7089–VHF TR2 AUX	Junction box Type 169–HOMING	
10	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 1	Junction box Type 169–REL UNIT	Relay unit Type 123–plug EB	
11	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 2	Junction box Type 169–REL UNIT	Relay unit Type 123–plug EF	
12	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	VHF TR1–AUX	Junction box Type 169–TR AUX	
13	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	VHF TR2–AUX	Junction box Type 169–TR AUX	

RESTRICTED

TABLE 4—*continued*

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
14	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Mod. unit Type 7747–CONT.	Control unit Type 7086–MOD. UNIT	
15	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Control unit Type 7086–IND	Indicator electrical Type 7	
16	B7/10	Sextovinmetsmall 2·5	Socket Mk. 4 6-way pos. 0	Plug Mk. 4 6-way pos. 0	Junction box (Aerial) Type 7089–MOD. UNIT AE RELAY	Mod. unit Type 7747–AE RELAY	
17	B7/30	Sextovinmetsmall 2·5	Plug Mk. 4 6-way pos. 0	Socket Mk. 4 6-way pos. 0	Junction box (Aerial) Type 7084–MOD. UNIT TR	Mod. unit Type 7747–TR	

TABLE 5

Connectors ARI.18065

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
1	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR1 existing aerial	Junction box (aerial) Type 7089–AE TR1	Required for use with VHF installations fitted with separate aerials for the two VHF transmitter-receivers.
2	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR2 existing aerial	Junction box (aerial) Type 7089–AE TR2	
3	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR1–AE	Junction box (aerial) Type 7089–MOD. UNIT TR1	
4	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR2–AE	Junction box (aerial) Type 7089–MOD. UNIT TR2	
5	D267/30	Uniradio 67	Socket Type 703	Socket Type 703	Mod. unit Type 7747–AE OUT	Junction box (aerial) Type 7084–MOD. UNIT AE OUT	
6	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–STBD.	Mod. unit Type 7747–STBD.	Refer to para. 5 to 14.
7	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–PORT	Relay magnetic Type 1254–plug B	
8	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–ELEVATION	Relay magnetic Type 1254–plug C	

TABLE 5—*continued*

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
9	Connector phasing	Uniradio 67	Socket Type 703	Socket Type 703	Relay magnetic Type 1254–plug A	Mod. unit Type 7747–PORT	Refer to para. 5 to 14.
10	B11/20	Twelvevinmetsmall 2·5	Socket Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 1	VHF TR1–AUX	Junction box (aerial) Type 7089–TR1 AUX	
11	B11/20	Twelvevinmetsmall 2·5	Socket Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 2	VHF TR1–AUX	Junction box (aerial) Type 7089–TR2 AUX	
12	B7/20	Sextovinmetsmall 2·5	Plug Mk. 4, 6-way pos. 0	Socket Mk. 4 6-way pos. 0	Mod. unit Type 7747–AE RELAY	Junction box (aerial) Type 7089–MOD. UNIT AE RELAY	
13	—	Dupren	Free	Free	Junction box (aerial) Type 7089–MOD. UNIT RELAY 1254	Terminal block on relay 1254	To be supplied by the aircraft contractor.
14	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Mod. unit Type 7747–CONT.	Control unit (remote) Type 7746–plug A	
15	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Control unit (remote) Type 7746–socket C	Indicator electrical Type 7	
16	—	Sextovinmetsmall 2·5	Plug Mk. 4 6-way pos. 0	Free	Control unit (remote) Type 7746–socket B	Toggle switches of pilots control panel	To be supplied by the aircraft contractor.

The above list applies to twin 10-channel VHF installations fitted with separate aerials for the transmitter-receivers. Where the two aerials are replaced with a common aerial the following items will be required in place of items 1 and 2.

17	D267/50	Uniradio 67	Socket Type 703	Socket Type 703	Relay magnetic Type 1254–plug B	Junction box (aerial) Type 7089–AE TR1	Relay magnetic Type 1254 is part of the existing VHF installation.
18	D267/50	Uniradio 67	Socket Type 703	Socket Type 703	Relay magnetic Type 1254–plug C	Junction box (aerial) Type 7089–AE TR2	

TABLE 6

Connectors ARI.18093

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
1	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR1 existing aerial	Junction box (aerial) Type 7089–AE TR1	
2	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR2 existing aerial	Junction box (aerial) Type 7089–AE TR2	
3	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR1–AE	Junction box (aerial) Type 7089–MOD. UNIT TR1	
4	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR2–AE	Junction box (aerial) Type 7089–MOD. UNIT TR2	
5	D267/30	Uniradio 67	Socket Type 703	Socket Type 703	Junction box (aerial) Type 7089–MOD. UNIT AE OUT	Mod. unit Type 7747–AE RELAY	
6	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–PORT	Mod. unit Type 7747–PORT	Refer to para. 5 to 14.
7	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–STBD.	Mod. unit Type 7747–STBD.	Refer to para. 5 to 14.
8	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	VHF TR1–AUX	Junction box (aerial) Type 7089–TR1 AUX	
9	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	VHF TR2–AUX	Junction box (aerial) Type 7089–TR2 AUX	
10	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Mod. unit Type 7747–CONT.	Control unit Type 7086–MOD. UNIT	
11	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Control unit Type 7086–IND	Indicator electrical Type 7	Single indicator installation only.
12	B11/30	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Control unit Type 7086–IND	Junction box Type 7372–CONT	Required when two indicators electrical Type 7 are used. Not shown in fig. 5.
13	B11/30	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Junction box Type 7372–IND 1	Indicator electrical Type 7, No. 1	
14	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Junction box Type 7372–IND 2	Indicator electrical Type 7, No. 2	
15	B7/10	Sextovinmetsmall 2·5	Socket Mk. 4 6-way pos. 0	Plug Mk. 4 6-way pos. 0	Junction box (aerial) Type 7089–MOD UNIT AE RELAY	Mod. unit Type 7747–AE RELAY	
16	B7/30	Sextovinmetsmall 2·5	Plug Mk. 4 6-way pos. 0	Socket Mk. 4 6-way pos. 0	Junction box (aerial) Type 7089–MOD UNIT TR	Mod. unit Type 7747–TR	

◀ TABLE 7

Connectors ARI.18142

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
1	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR1 Existing aerial	Junction box (aerial) Type 7084–AE TR1	
2	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR2 Existing aerial	Junction box (aerial) Type 7084–AE TR2	
3	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR1–AE	Junction box (aerial) Type 7084–MOD UNIT TR1	
4	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR2–AE	Junction box (aerial) Type 7089–MOD UNIT TR2	
5	D267/30	Uniradio 67	Socket Type 703	Socket Type 703	Junction box (aerial) Type 7089–MOD. UNIT AE OUT	Mod. unit Type 7747–AE RELAY	
6	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–PORT	Mod. unit Type 7747–PORT	Refer to para. 5 to 14.
7	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–STBD.	Mod. unit Type 7747–PORT	Refer to para. 5 to 14.
8	B11/20	Twelvevinmetsmall 2·5	Socket Mk. 4 12-way pos. 0	Plug Mk. 4 12-way pos. 0	Junction box (aerial) Type 7089–VHF TR1 AUX	Junction box Type 169–HOMING	
9	B11/20	Twelvevinmetsmall 2·5	Socket Mk. 4 12-way pos. 0	Plug Mk. 4 12-way pos. 0	Junction box (aerial) Type 7089–VHF TR2 AUX	Junction box Type 169–HOMING	
10	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 1	Junction box Type 169–REL UNIT	Relay unit Type 123–plug EB	
11	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 2	Junction box Type 169–REL UNIT	Relay unit Type 123–plug EF	
12	B11/20	Twelveinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	VHF TR1– AUX	Junction box Type 169–TR AUX	
13	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	VHF TR2–AUX	Junction box Type 169–TR AUX	
14	B7/10	Sextovinmetsmall 2·5	Socket Mk. 4 6-way pos. 0	Plug Mk. 4 6-way pos. 0	Junction box (aerial) Type 7089–MOD. UNIT AE RELAY	Mod. unit Type 7747–AE RELAY	
15	B7/30	Sextovinmetsmall 2·5	Plug Mk. 4 6-way pos. 0	Socket Mk. 4 6-way pos. 0	Junction box (aerial) Type 7084–MOD. UNIT TR	Mod. unit Type 7747–TR ▶	

◀ TABLE 8
Connectors ARI.18155

Item (1)	Basic Type (2)	Cable (3)	Terminations End A (4)	Terminations End B (5)	Destination sleeves End A (6)	Destination sleeves End B (7)	Remarks (8)
1	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR1 existing aerial	Junction box (aerial) Type 7089–AE TR1	
2	D267/50	Uniradio 67	Cable eye and ferrule	Socket Type 703	VHF TR2 existing aerial	Junction box (aerial) Type 7089–AE TR2	
3	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR1–AE	Junction box (aerial) Type 7089–MOD. UNIT TR1	
4	D267/30	Uniradio 67	Socket Type 523 with flexible guard	Socket Type 703	VHF TR2–AE	Junction box (aerial) Type 7089–MOD. UNIT TR2	
5	D267/30	Uniradio 67	Socket Type 703	Socket Type 703	Junction box (aerial) Type 7089–MOD. UNIT AE OUT	Mod. unit Type 7747–AE RELAY	
6	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–PORT	Mod. unit Type 7747–PORT	Refer to para. 5 to 14.
7	Connector phasing	Uniradio 67	Cable eye and ferrule	Socket Type 703	Aerial aircraft Type 7052–STBD.	Mod. unit Type 7747–STBD.	Refer to para. 5 to 14.
8	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	VHF TR1–AUX	Junction box (aerial) Type 7089–TR1 AUX	
9	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	VHF TR2–AUX	Junction box (aerial) Type 7089–TR2 AUX	
10	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Mod. unit Type 7747–CONT.	Control unit (remote) Type 9959 plug A	
11	B11/20	Twelvevinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Socket Mk. 4 12-way pos. 0	Control unit Type 9959 socket C	Junction box (homing) Type 11143	Part of ARI.18157
13	—	Sextovinmetsmall 2·5	Plug Mk. 4 12-way pos. 0	Free	Control unit (remote) Type 9959 socket B	Toggle switches on pilot's control	To be supplied by the aircraft contractor
14	B7/10	Sextovinmetsmall 2·5	Socket Mk. 4 6-way pos. 0	Plug Mk. 4 6-way pos. 0	Junction box (aerial) Type 7089–MOD. UNIT AE RELAY	Mod. unit Type 7747–AE RELAY	
15	B7/30	Sextovinmetsmall 2·5	Plug Mk. 4 6-way pos. 0	Socket Mk. 4 6-way pos. 0	Junction box (aerial) Type 7089–MOD. UNIT TR	Mod. unit Type 7747–TR	

Phasing connectors

5. The homing equipment is dependent on the phase difference between the EMF picked up by the aerial being transferred accurately to the modulator unit by the radio frequency connectors. This means that the connectors from the aerials to the modulator unit must have the same electrical length. The electrical length of a cable, is by definition, the physical length of an identical cable with an air dielectric. For uniradio cable 67 and uniradio 81 the electrical length at VHF is between 1·48 and 1·52 times the physical length. Due to this spread in the velocity ratio it is not sufficient to match feeders by their physical lengths. The phasing connectors are therefore manufactured to an electrical length. The electrical lengths are calculated making due allowance for any socket, changeover relay, bulkhead adapter, etc. that may be connected in circuit.

6. To avoid differential effects due to temperature and stress, it is important to run the two connectors from the azimuth aerials together wherever possible.

7. In installations providing elevation indications allowance must be made for the fore and aft displacement (if any) of the elevation aerial (*para.* 13, *sub-para.* (4)).

8. To obtain the correct electrical length to maintain the phase difference at the modulation unit, the physical length of the connectors may, of necessity, be longer than required for a direct run. The excess cable should be carefully stowed.

9. Under no circumstances must the phasing connectors be altered in length or their terminations changed. Care should be taken in handling, and bends of radius less than 6 inches should be avoided.

10. The following example is used to illustrate the calculations and importance of phasing connector matching. It is based on an aircraft using ARI.18044 (*fig.* 2). Four phasing connectors are required and an allowance must be made for the displacement of the elevation aerial. The physical dimensions shown in Table 9 are those which could have been submitted by an aircraft manufacturer for a cable run and they are used as a basis to calculate the correct lengths to be supplied. The elevation aerial is 168 cm. forward of the azimuth aerials.

TABLE 9

Phasing connectors

Item	Description	Physical length in cm.
1	Starboard aerial to modulator unit	508·0
2	Relay magnetic 1254 to modulator unit	46·0
3	Port aerial to relay magnetic 1254	442·0
4	Elevation aerial to modulator unit	206·0

11. For correct operation of the equipment two sets of conditions must be met. Firstly, the electrical length of item 1 must be equal to the sum of the electrical lengths of items 2 and 3, secondly, the electrical length of item 1 must equal the sum of items 2 and 4. In both cases allowances must be made for the electrical lengths of the socket Type 703 and of the relay magnetic Type 1254.

12. Assuming that items 1 and 2 are supplied to the physical lengths required then items 3 and 4 can be calculated to fulfil the conditions of para. 11. The minimum calculated physical length of the connectors must be equal to or exceed that specified in Table 9.

13. Since the phasing connectors have to be accurately measured for correct electrical length, the calculated length must allow for the largest error due to variation in the velocity ratio of the cable and the factor 1·52 is used in the following calculations. The electrical length of the socket Type 703 is assumed to be 6·5 cm. and that of the relay magnetic 11 cm.

(1) Maximum electrical length of item 1 is 508·0 × 1·52 cm., plus 6·5 cm. (allowance for one socket 703) giving total 778·6 cm.

(2) Maximum electrical length of item 2 is 46·0 × 1·52 cm., plus 13·0 (two sockets 703) giving total 82·9 cm.

(3) Hence item 3 should have an electrical length of 778·6 cm. minus 82·9 cm., minus 11 cm. (the electrical length of the relay magnetic) giving total of 684·7 cm. The minimum physical length of item 3 should be 684·7 minus 6·5 cm. (socket 703) divided by 1·52 giving total 446·2 cm. This is 4·2 cm. longer than asked for (Table 9) and is therefore satisfactory.

(4) The connector to the elevation aerial, item 4, must include the 168 cm. allowance due to the aerial displacement; hence from para. 11 the electrical length of item 4 should be 168 cm. plus 778·6 cm. minus 82·9 cm. minus 11 cm. (due to relay magnetic) giving a total of 852·7 cm. The minimum physical length of item 4 should be 852·7 cm. minus 6·5 (socket 703) divided by 1·52 giving total of 556·6 cm. This is much larger than asked for, mainly due to the allowance for the aerial displacement, and the excess length must be carefully stowed, preferably in the radio bay of the aircraft.

Note . . .

The displacement allowance for the elevation aerial is positive for the forward displacement and negative for aft. The electrical length is the same as the physical length.

14. In the preceding calculations items 1 and 2 were fixed to the required length (*para.* 12) and the calculated items 3 and 4 are longer than asked for, if however items 2 and 3, or 2 and 4 had been fixed the lengths of the remaining items would have been too short and therefore useless.

Modulator units Type 7087 and Type 7747

15. The modulator units must be mounted upright. They may either rest in the mounting Type 1034 or be suspended from it; appropriate clips and spigot holes being provided on the modulator units for both forms of mounting. The unit should be installed preferably in the aircraft radio bay, close to the VHF transmitter-receivers for ease of cabling. Sufficient clearance must be left to enable the unit to be withdrawn from the mounting and for it to move freely on the shock absorbers. Provision must be made for the cable run to the front of the unit.

Mounting Type 1034

16. The mounting for the modulator unit is fitted with cup-type shock absorbers which are secured to the airframe by bolts. The earthing strap on the mounting should be connected to the airframe or the bonding system.

Junction box Type 169 and Type 7372

17. The boxes may be fitted in any convenient position and attitude; shock absorbers are not required. Adequate clearance must be allowed for the connector terminations.

◀ **Control units (remote) Type 7117, Type 7746, Type 9959 and associated toggle switches**

18. The remote units are provided for installations where space on the pilot's control panel is restricted. They may be fitted in any attitude without shock mounting.

19. Two toggle switches, one two-pole and one single-pole are required for use with the 7117 unit and one two-pole and two single-pole for use with each of the 7746 and 9959 units. The switches must be fitted within easy access of the operator and must carry identification labels. The labels should be marked as follows:—

Control unit	*Switch*	*Label marking in switch position*	
		Open	*Closed*
7717	Two-way	NORMAL	HOMING
	Single way	AZIMUTH	ELEVATION
7746	Two-way	NORMAL	HOMING
	Single way	AZIMUTH	ELEVATION
	Single way*	MIN.	MAX.
9959	Two-way	NORMAL	HOMING
	Single way	TR1	TR2
	Single way*	MIN.	MAX.

* Min–Max switch to have word DEFLECTION adjacent to switch. ▶

Control unit, Type 7086

20. The control units should be installed in such a position as to give the operator access to the controls without moving from his station. They are normally provided suitably assembled for bulkhead mounting. They can be adapted for the standard Air Ministry console system by interchanging the fixing brackets. No form of shock absorber is necessary.

21. Sufficient clearance must be left for connector entry, the amount being dependent on the type of connector termination either angle or straight.

Junction box (aerial) Type 7089

22. This box is used as a radio frequencies and power supply junction box between the VHF transmitter-receiver and the modulator unit and should be positioned as close as possible to those units. It may be installed in any attitude. Shock absorbers are provided on brackets fitted to the box. The earthing strap should be connected to the airframe or bonding system.

Relay magnetic, Type 1254

23. The relay is used to switch the aerial from the VHF transmitter-receiver to the modulator unit or to switch in the elevation aerial and should be installed in the radio bay or cable run. It does not require shock mounting and may be fitted in any attitude. The relay may be mounted on the junction box (aerial) Type 7089; hank bushes for fixing are provided on the top cover.

Indicator

24. The indicator should be fitted in the pilot's cockpit and must be shock mounted. It should be positioned so that the 'set zero' adjusting screws are at 9 o'clock and 12 o'clock.

Aerials

Azimuth facility

25. Two whip aerials Type 7052 are required for the azimuth facility. Details of the aerial installations are shown in fig. 6. They must be mounted athwartships (*fig.* 6) symmetrically space about the fore and aft centre line on the aircraft. The rods must be parallel, spaced 12 in. plus or minus 1 in. apart and should be in a vertical plane parallel to the fore and aft centre line of the aircraft. The aerials may be raked back in the fore and aft plane at an angle not greater than 20 deg. to the vertical.

26. It may be found that the best position for the aerials in order to fulfil the requirements of the installation is on the underside of the aircraft slightly forward of the mid section, so that they are clearly visible from the ground at all azimuths when the aircraft is in flight.

27. Other positions on the aircraft, for example on the top of the fuselage or above or below the wings may satisfy the requirements. The location should be clear of blisters and no other aerial either protruding or suppressed should be within 3 feet of the aerials in the fore and aft direction.

28. The correct mounting and bonding of the aerials are of the greatest importance. A whip aerial installation is a two terminal network, one terminal is the thread of the aerial rod and the other the skin of the aircraft in the immediate vicinity of the hole through which the rod projects. The braid of the phasing connector should be electrically connected to the aricraft skin by the shortest path which should not exceed 2½ in. The point of connection to the skin should be as near as

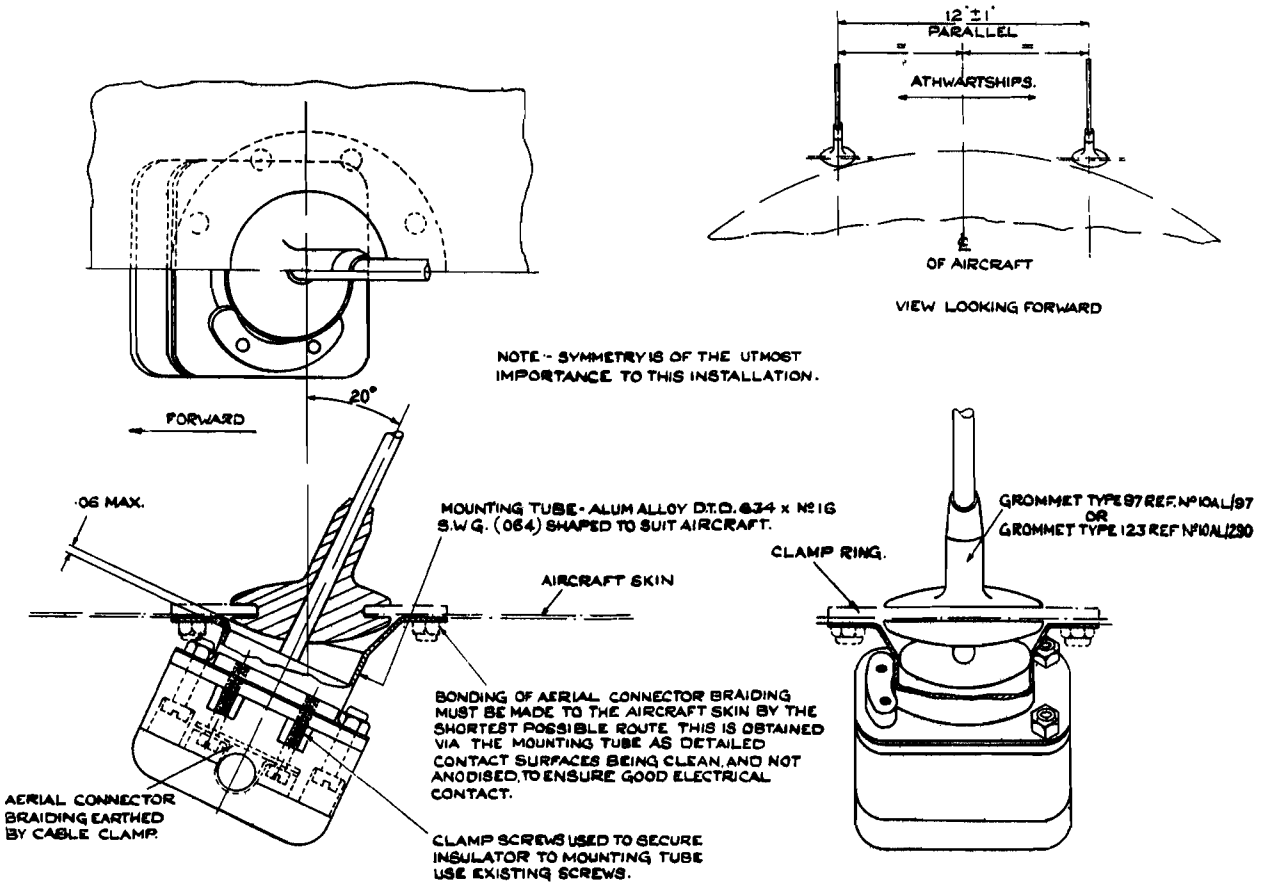


Fig. 6. Installation of aerial Type 7052

practicable to the centre of the hole. The terminations to the two aerials should be symmetrical.

29. The length of the aerial projecting inside the aircraft should be kept as small as possible and should not exceed 2½ in. To meet this requirement a special aerial mounting may have to be engineered.

Elevation facility

30. A third aerial Type 7052 is required for the elevation facility. It is used in conjunction with the starboard azimuth aerial. It should be mounted above or below the azimuth aerials depending on whether they are in turn mounted below or above the fuselage or wing. Preferably it should be in the vertical plane mid-way between the azimuth aerials but may be offset athwartships so as to lie in the vertical plane of the starboard aerial.

31. The elevation aerial may be positioned fore or aft of the azimuth aerials but its longitudinal displacement from the azimuth aerial should not exceed 6 feet.

CONSTRUCTION

Modulator units Type 7087 and Type 7747

32. The modulator units only differ in very minor respects, the Type 7747 being a modified version of the Type 7087. The description which follows is applicable to both units. The overall dimensions of the units are height 6½ in. width 6¼ in., depth 7¾ in.

33. The components which comprise the modulator unit are housed in a light alloy case (*Chap.* 1, *fig.* 1). The case is provided with ventilating louvres on the back and two sides, and has removable top and bottom covers each secured by Dzus fasteners. The bottom cover is perforated to admit cooling air and the top cover is provided with a ventilator which also serves to house the spare fuses. Access to the fuses is by removing the complete top cover.

34. The modulator unit when installed in the mounting Type 1034 (*fig.* 7) is secured by two locating spigots at the rear and two knurled nuts at the front which clamp on two brackets. Additional spigot holes and brackets are provided so that the unit may be fitted in an inverted mounting.

35. The modulator unit is constructed as two separate sub-units which are interconnected with a miniature eight-pin Jones plug and socket.

36. The larger of the sub-units referred herein as the LF assembly has not been referenced as a separate item in the modulator unit Type 7087; in the modulator unit Type 7747 it is known as the multivibrator unit Type 7755, Stores Ref. 10V/675. The smaller unit is the RF unit Type 7088 Stores Ref. 10D/19222.

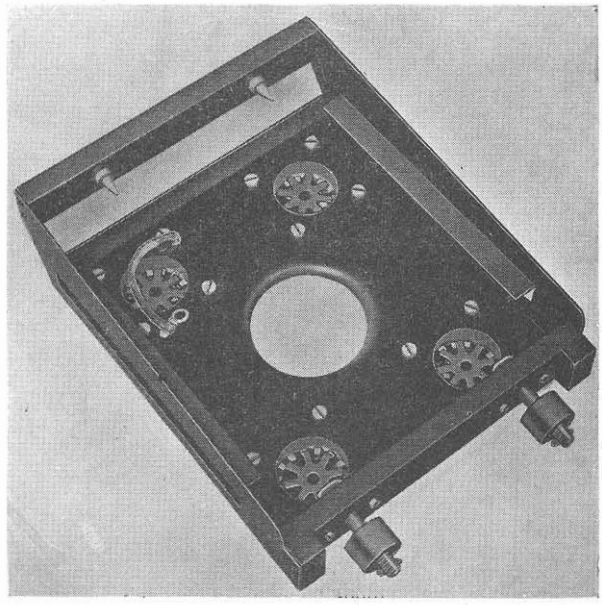


Fig. 7. Mounting Type 1034

37. The l.f. assembly (*fig.* 8 and 9) is the main body of the unit and includes the valves and components of the electronic switch, discriminator, l.f. amplifier and d.c. amplifier. These items are assembled partly on the main chassis which is spot welded to the case at approximately one third of its height and partly on another small chassis.

38. The small chassis is secured by two screws and lock-nuts to the sides of the case; the rear of the chassis is fixed by two captive screws to two pillars supported on the main chassis. This construction allows the small chassis to pivot on the side screws for ease of servicing when the two captive fixing screws are released. The two preset controls METER GAIN and METER BALANCE are fitted on the small chassis and are arranged so that they can be adjusted when the top cover is removed.

39. A narrow panel fitted to the front of the l.f. assembly carries two Mk. 4 sockets and one Mk. 4 plug for interconnection to other items of the homing equipment. This panel is secured to the assembly by four screws and lock-nuts and it is not normally detached from it.

40. Three cartridge type fuse holders are fitted in the lower flanges of the case. Two on the left for l.t. and h.t. fuses and one on the right for the g.b. fuse.

41. The r.f. unit shown in fig. 10 consists of a small chassis fitted to a panel which is secured to

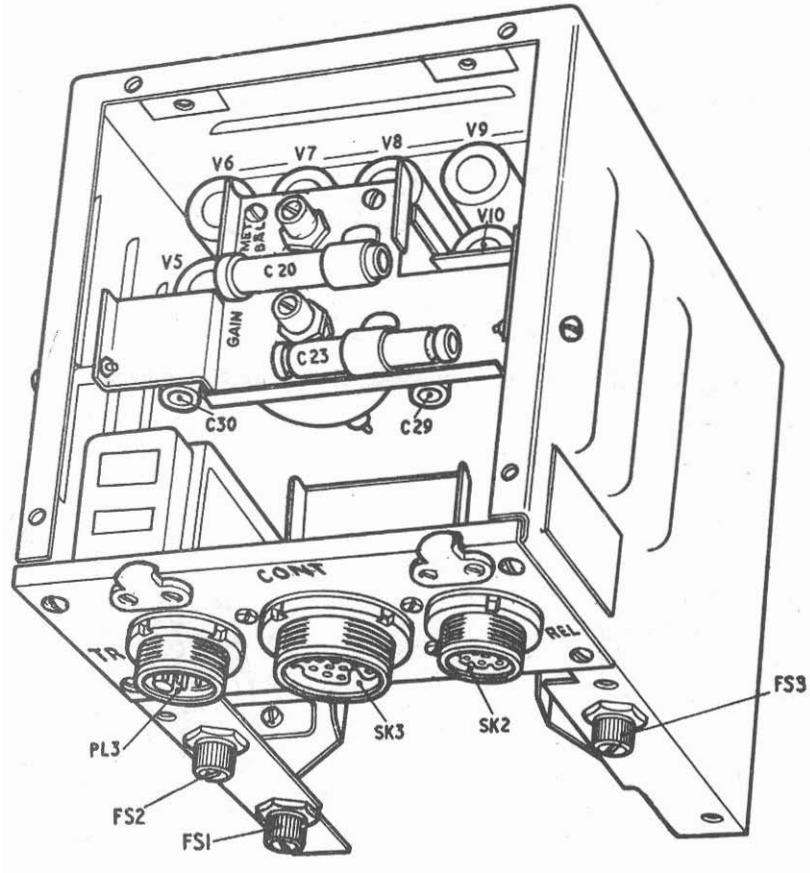


Fig. 8. L.F. assembly top view (covers removed)

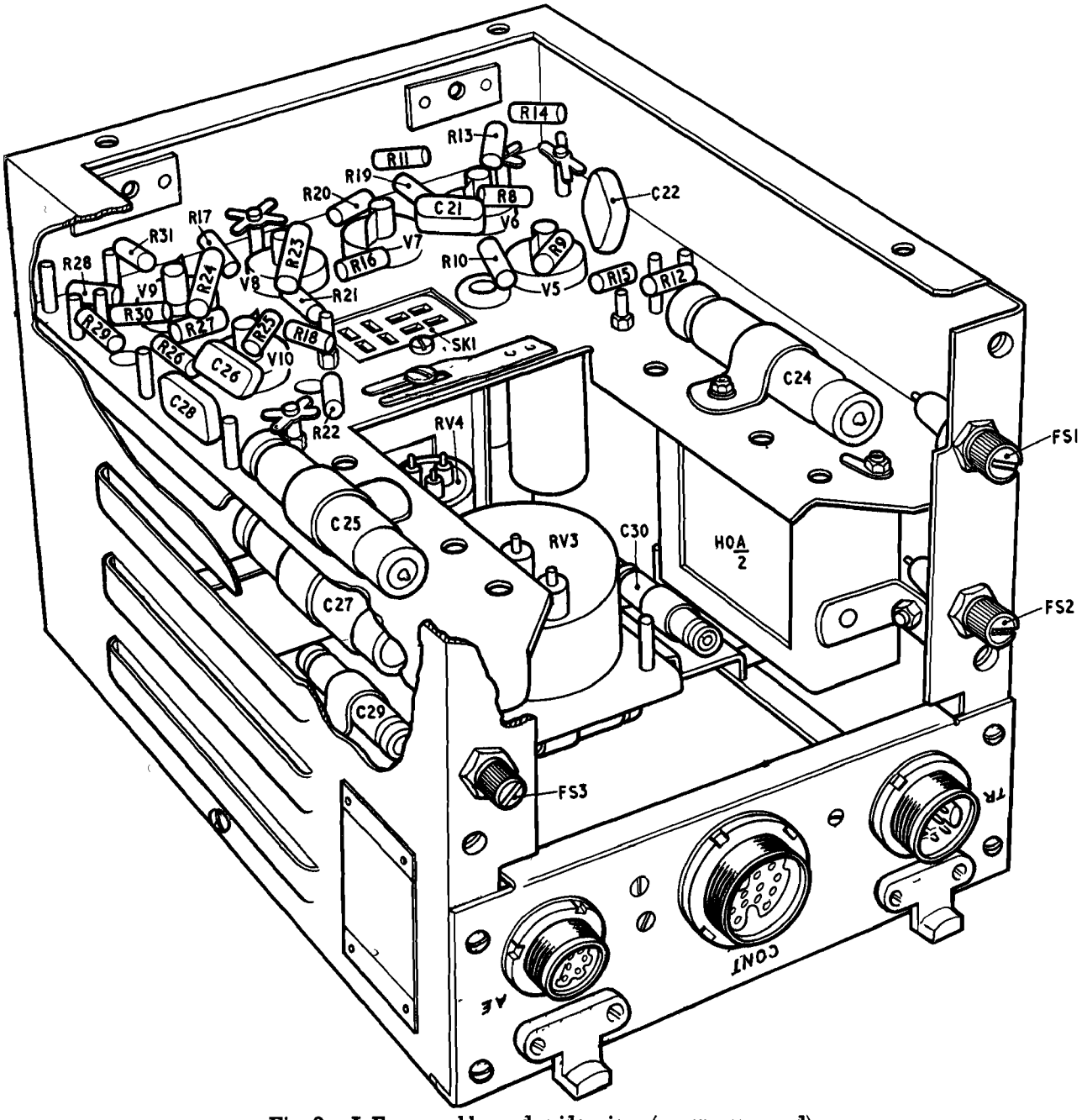


Fig. 9. L.F. assembly underside view (covers removed)

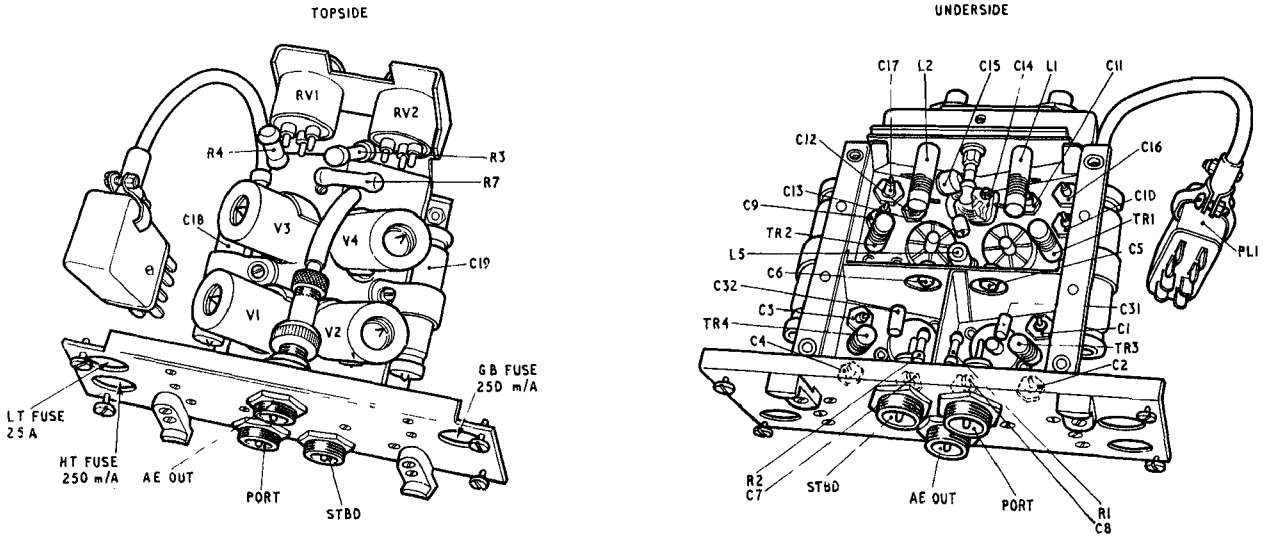
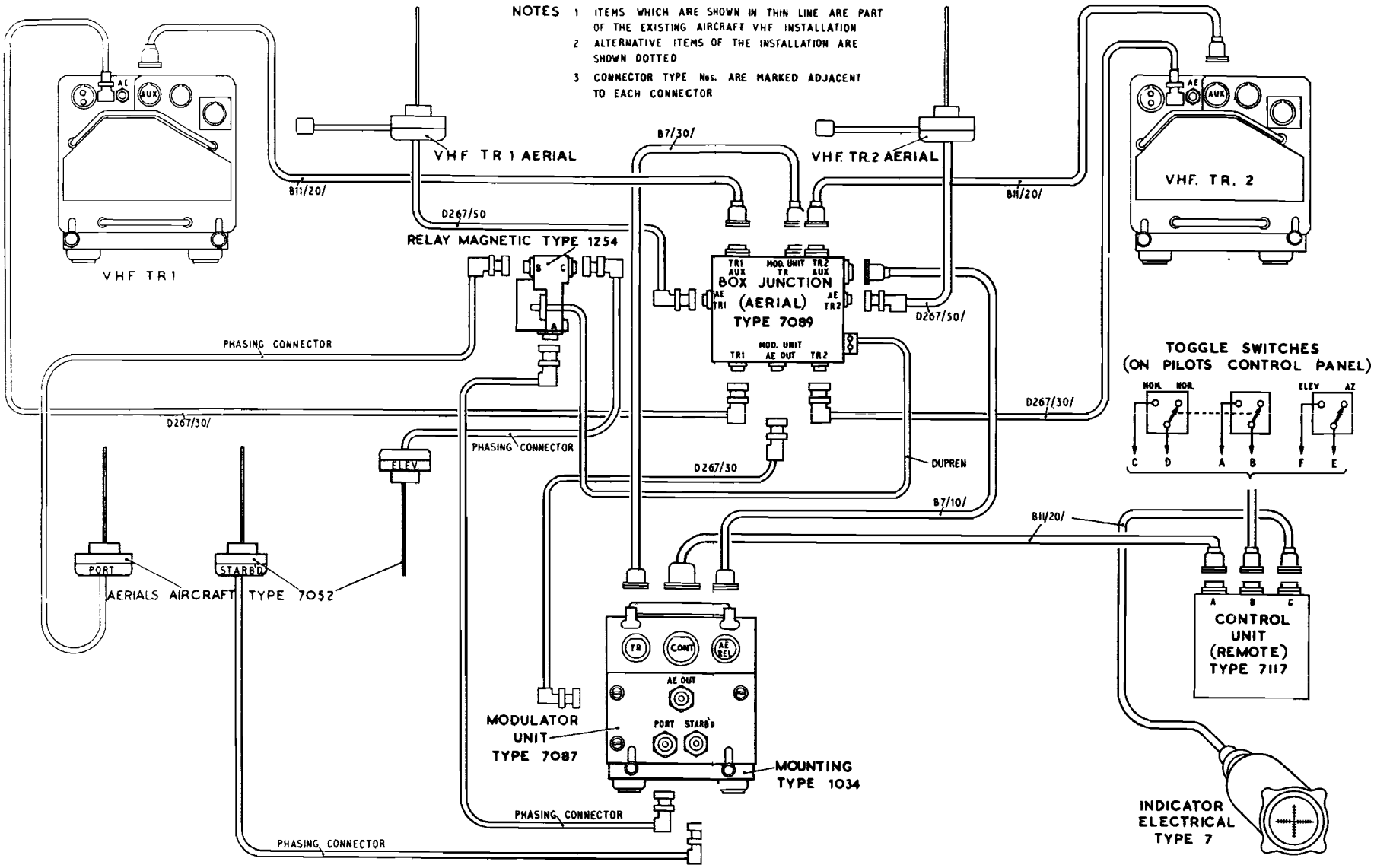


Fig. 10. R.F. unit



AIR DIAGRAM
6 07E MIN

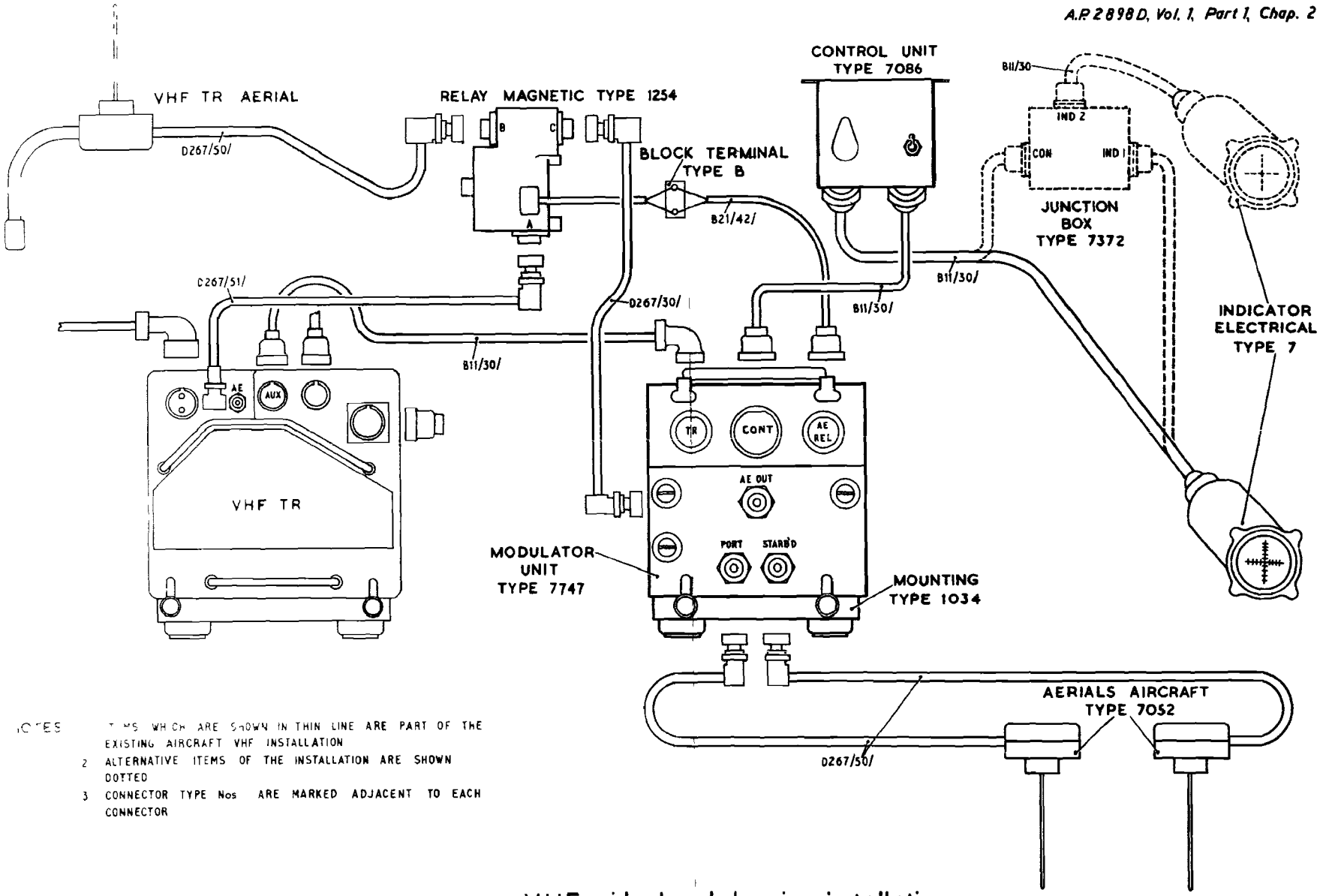
VHF wide-band homing installations - ARI. 18044 interconnections

Fig. 1.

PP8825 568718/4951 2/61 1000 C & P Gp 924 (4)

RESTRICTED

(A.L.10, Dec. '55)



NOTES

1. ITEMS WHICH ARE SHOWN IN THIN LINE ARE PART OF THE EXISTING AIRCRAFT VHF INSTALLATION
2. ALTERNATIVE ITEMS OF THE INSTALLATION ARE SHOWN DOTTED
3. CONNECTOR TYPE Nos ARE MARKED ADJACENT TO EACH CONNECTOR

AIR DIAGRAM
6107F/MIN

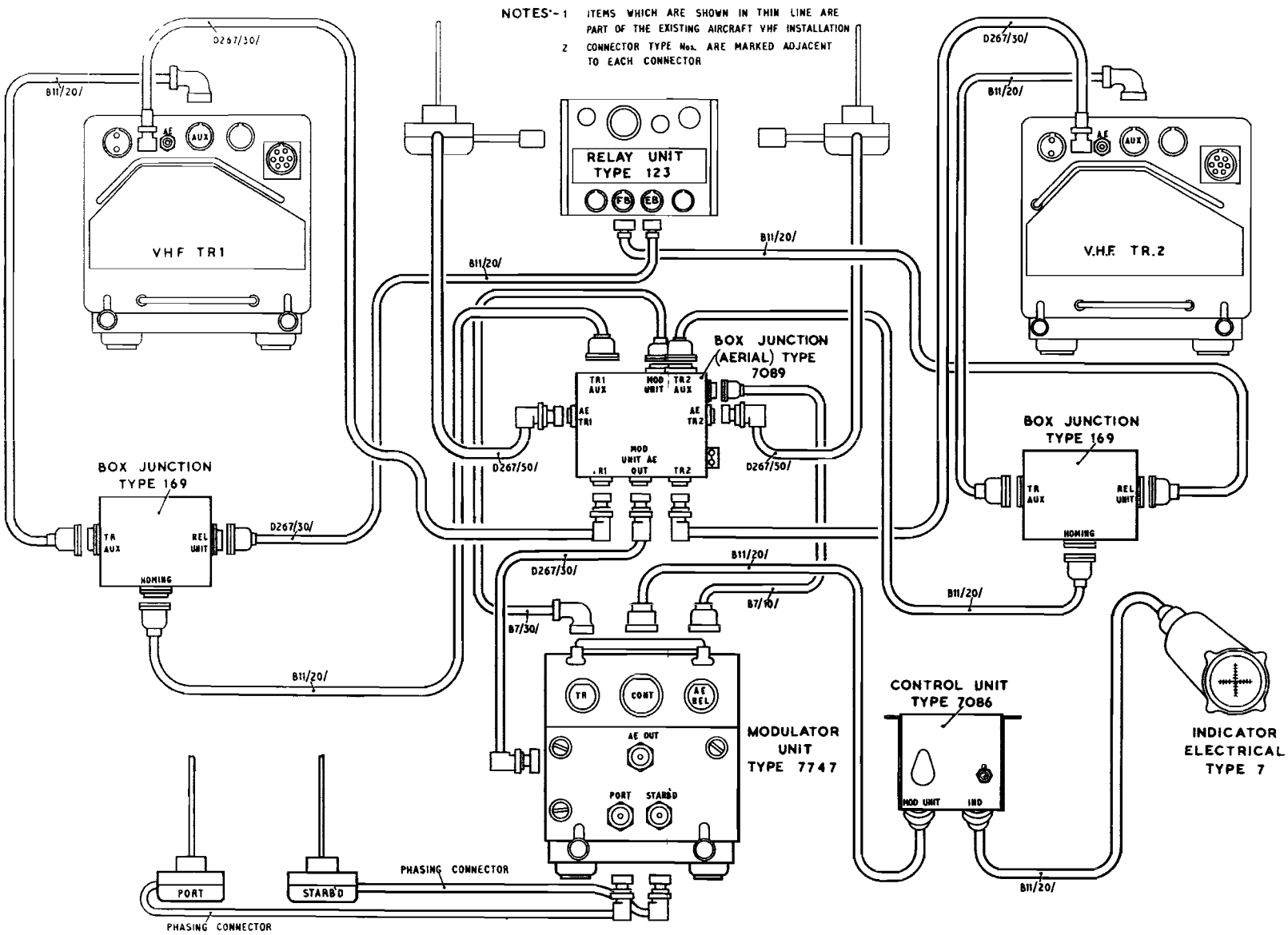
PP8825 S68718 4951 2/61 1000 C & P Gp 924 (4)

VHF wide-band homing installation
ARI. 18048 interconnection

Fig. 2

RESTRICTED

(A.L/O, Dec '55)



AIR DIAGRAM
6107G/MIN
ISSUE 1 PREPARED BY M.N. TA. OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

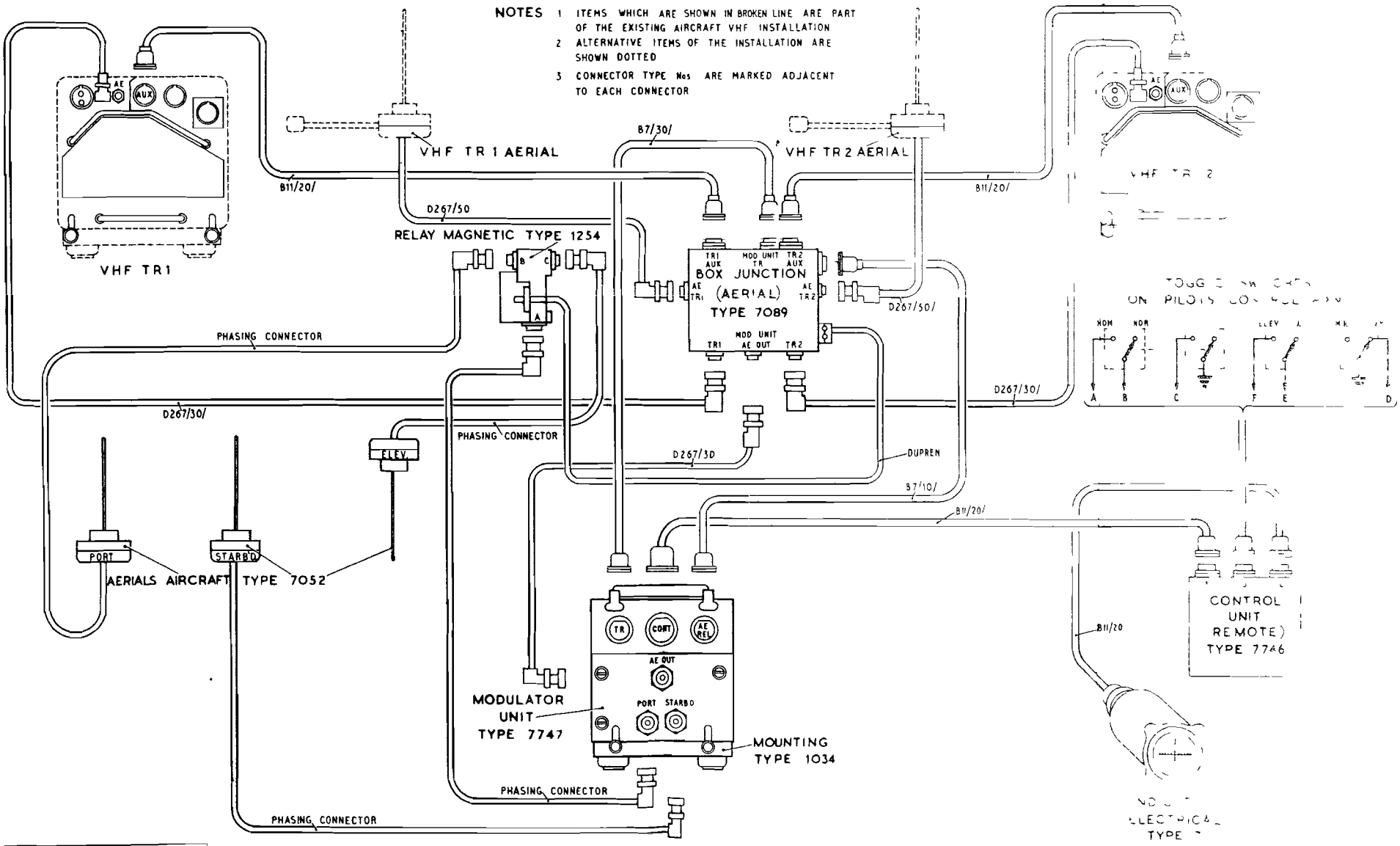
PP8825 568718/4951 2/61 1000 C & P Gp. 924 (4)

VHF wide-band homing installation ARI 18049 interconnection

Fig. 3

RESTRICTED

(A L 10, Dec. '55)



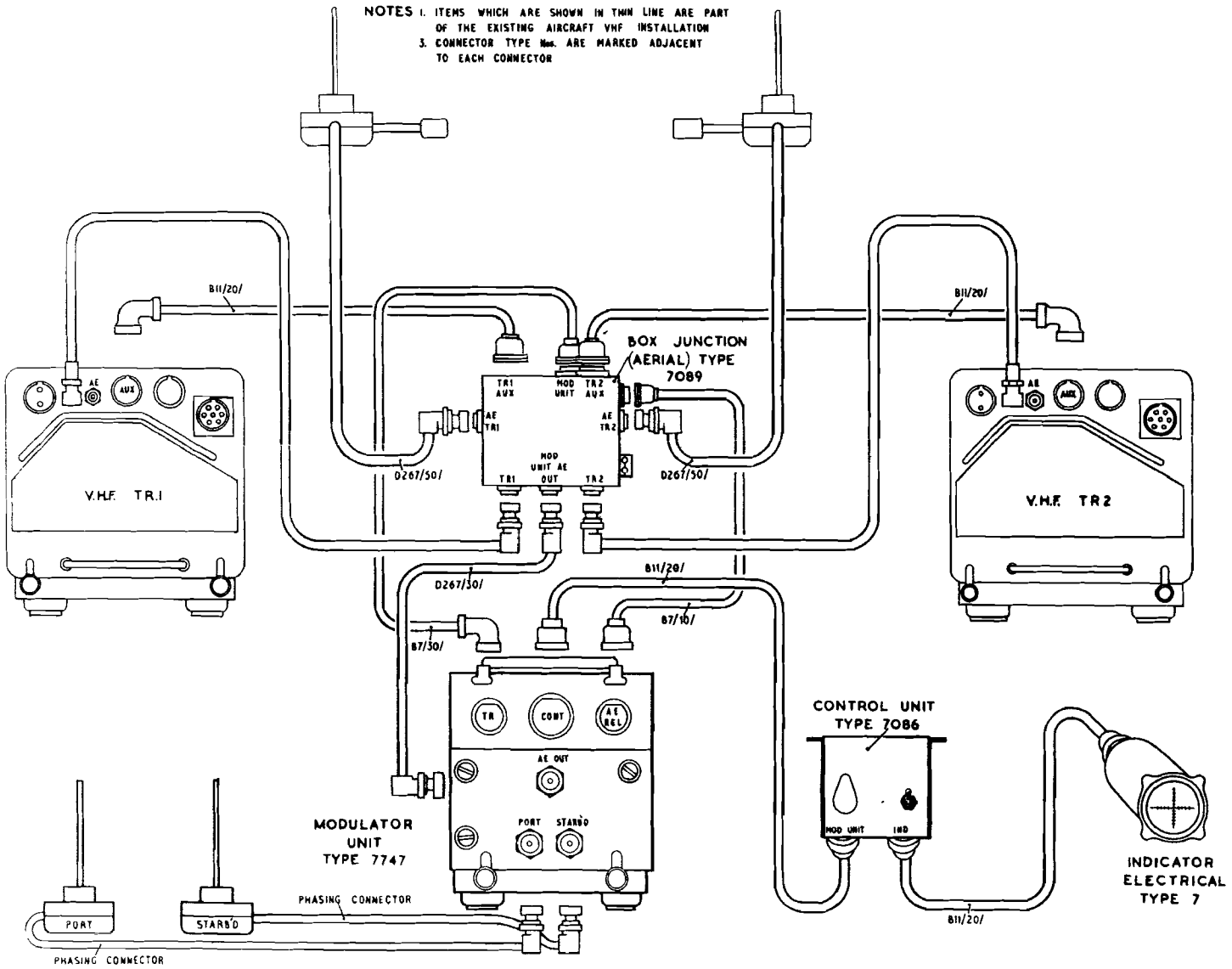
AIR DIAGRAM
6107L /MIN

ISSUE 2. | PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY ADMIRALTY

VHF wide-band homing installation—ARI. 18085 interconnections

RESTRICTED

PPB301 252897/8066 1 58 2000 C&P Gp 959 (4)



AIR DIAGRAM 6107M/MIN.
ISSUE 1

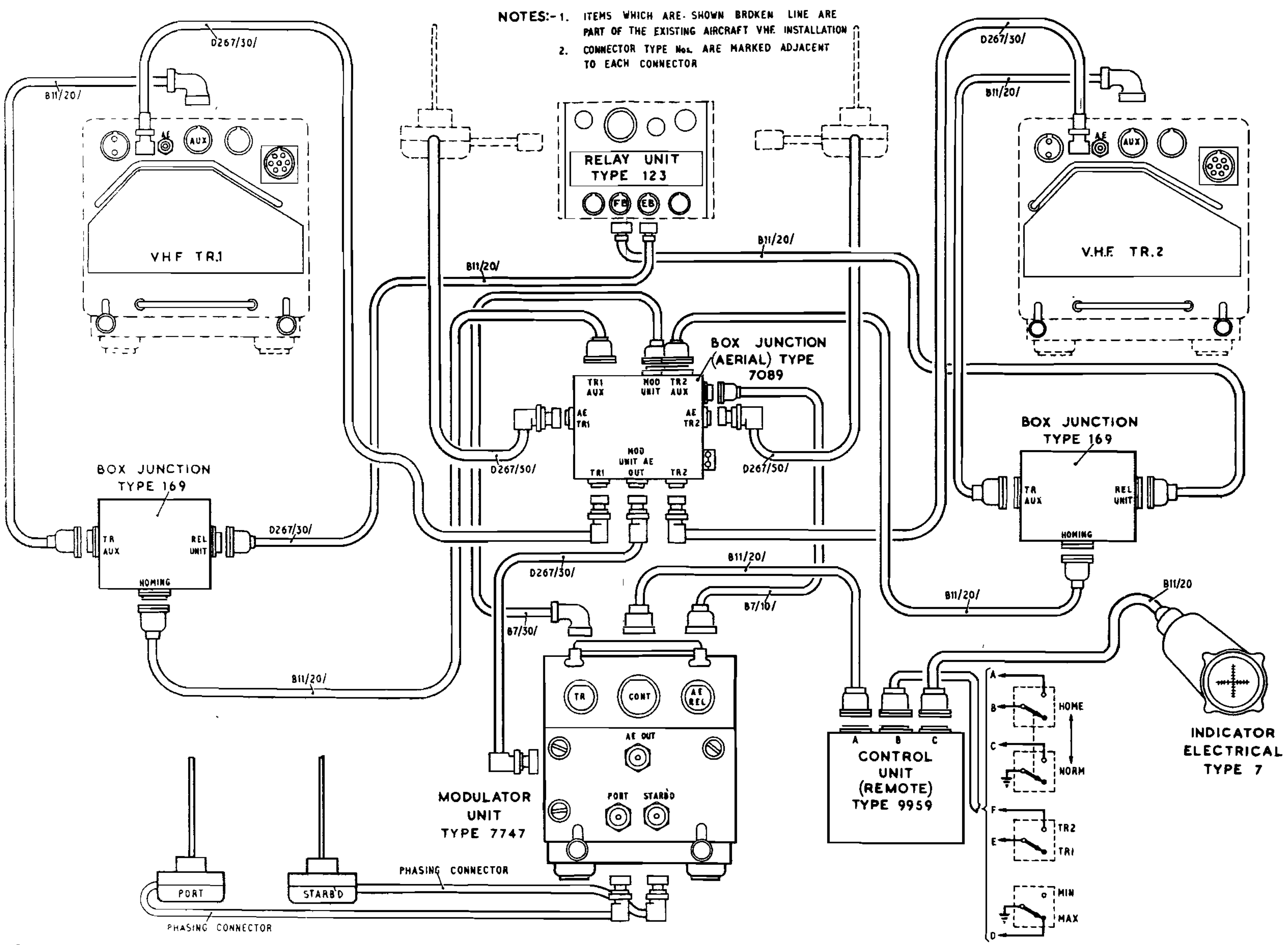
VHF wide-band homing installation - ARI. 18093 interconnection

Fig. 5

RESTRICTED

(A.L.10, Dec. '55)

PP7831 S71556/5200 1/56 1875 C & P Cp. 959 (1)



AIR DIAGRAM
6107X/MIN.
ISSUE 1.
PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY ADMIRALTY

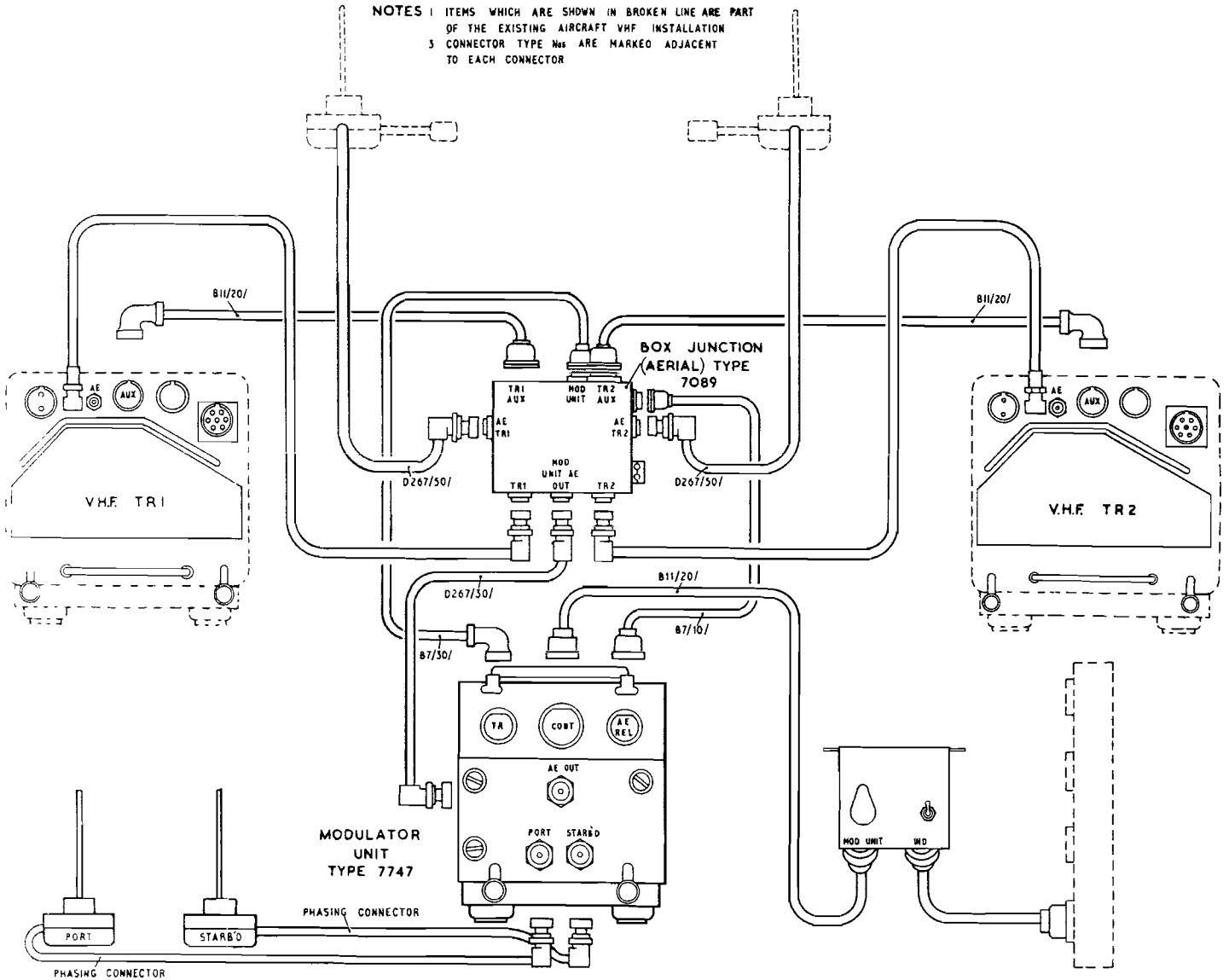
VHF wide-band homing installation ARI 18142: interconnections

Fig.13

RESTRICTED

(A.L.15, Nov. 57)

PP.n301 252897/8066 1/58 2000 C & P Gp. 959 (4)



AIR DIAGRAM
6107V/MIN.

PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY [illegible]

PP8301 253897 8066 1/58 2000 C & P Gp 959 (4)

VHF wide-band homing installation - ARI. 18155: interconnections

Fig.14

RESTRICTED

(A.L.15, Nov. 57)

Chapter 3

SETTING-UP AND OPERATION

LIST OF CONTENTS

SETTING-UP

1. The modulator units Type 7087 and Type 7747 should be set-up on the test bench to the instructions given in Part 2, Chapter 4 and 5, prior to installation in the aircraft.

2. The aircraft homing installation should be checked with a test oscillator Type 7049. Where two transmitter-receivers are installed the homing equipment should be checked in both the HOMING 1 and HOMING 2 positions.

Setting-up the test oscillator Type 7049

3. The test oscillator may be set-up in the workshops using a VHF transmitter-receiver on the bench, or near to the aircraft using the aircraft VHF transmitter-receiver. The procedure is as follows:—

(1) Slacken-off the two Dzus fasteners and remove the cover.

(2) Insert a crystal unit Type 10X/ — — — or Type 10XJ/ — — — of 1/18th of the selected test frequency.

(3) Observing the correct polarity, connect a testmeter Type F (or similar meter), set to 0 to 2 mA DC range, to the TEST points adjacent to the tuning dials.

(4) Extend the oscillator aerial.

(5) Set the knob marked CRYSTAL to the selected test frequency and press the ON/OFF button. Adjust the dial for maximum meter reading. (This should be between 0·2 and 0·45mA dependent on the frequency and activity of the crystal).

Note . . .

As it is possible to tune to the incorrect crystal harmonic it is most important that the dial calibration is correctly adhered to.

(6) Using the VHF receiver tuned to the selected test frequency (i.e. 18 times the test oscillator crystal frequency) adjust the knob marked OUTPUT for maximum modulated signal in the headphones.

(7) Lock the dials, replace the dust cover and tighten up the Dzus fasteners.

Checking azimuth indications

4. There are two methods of using the test oscillator for checking the azimuth indications in the homing installations. The first requires an operator for the test oscillator and an observer in the aircraft. For this the procedure is as follows:—

(1) Set the aircraft VHF receiver to the channel to which the test oscillator has already been adjusted.

(2) Set the control unit to AZIMUTH and HOMING 1 or HOMING 2 as appropriate.

(3) With the telescopic aerial fully extended the test oscillator should be positioned between 6 to 8 ft. to the port of the port aerial and to the starboard of the starboard aerial, in turn.

Note . . .

It is extremely important that the oscillator is held with the aerial in the vertical position.

(4) The observer in the cockpit should note that when the test oscillator switch is depressed:—

(*a*) The lower flag on the indicator electrical Type 7 disappears.

(*b*) The L/R pointer moves to the left when the oscillator is on the port side of the aircraft and conversely to the right with the oscillator on the starboard side.

(*c*) The 1,000 c/s modulation note is present in the headphones.

5. The second, and more favoured method is that in which the observer in the cockpit holds the test oscillator at arm's length on the port and starboard sides of the aircraft in turn, at the same time noting the meter pointer deflections and audio signal in his headphones.

Note . . .

If modification No. 3279/1 has been incorporated in the modulator units the flag will disappear as soon as the equipment is switched to HOMING.

6. Incorrect bearing indications may be obtained if the aircraft is in a hangar or on an aircraft carrier or near large masses of metal. In view of this, the first method outlined should be used only when the aircraft is in a flying attitude and in an open space.

Checking elevation indications

7. The elevation indications cannot be checked satisfactorily on the ground and should be tested for correct indication in the air by homing onto an airborne VHF transmitter.

OPERATION

8. All switching of the homing installation is carried out at a point remote from the modulation unit with the aid of a control unit. The facilities available depend on the particular installation and may include the following:—

(1) Homing in azimuth.
(2) Homing in elevation.
(3) Selection of the appropriate transmitter-receiver in a dual installation.
(4) Limited control of the meter sensitivity.

Homing in azimuth

9. Set the control unit to AZIMUTH and HOMING 1 or HOMING 2 as appropriate, check that the azimuth flag disappears and turn the aircraft to give an ON COURSE reading on the indicator electrical Type 7.

10. Ahead and astern indications are indistinguishable ON COURSE but can easily be resolved by turning the aircraft a few degrees, which is sufficient to produce a needle deflection which, when followed, turns the aircraft towards the homing transmitter.

11. When homing on two stations transmitting on the same frequency, the strongest received signal takes over control.

12. "On top" indications are clearly indicated by a gentle oscillation of the needle from side to side.

Homing in elevation

13. Having set the aircraft to the correct ON COURSE in azimuth the elevation can be checked by setting the control unit switch to ELEVATION and noting the position of the horizontal needle. The elevation reading will not be ambiguous if the aircraft has already been tuned to the correct ON COURSE position in azimuth.

14. When switching from the AZIMUTH to the ELEVATION positions the azimuth flag should re-appear and the elevation flag should disappear.

MIN/MAX switch

15. Limited control of the meter deflection can be obtained by setting the meter deflection switch to the appropriate position.

Duel VHF transmitter-receiver installations

16. In some installations the two VHF transmitter-receivers are switched on simultaneously to avoid delay, due to the warm-up period when switching from one transmitter-receiver to the other. When control units Type 7085 and 7086 are used with these installations, the modulator unit is connected to the appropriate transmitter-receiver by the operation of the HOMING 1–HOMING 2 switch. If control units Type 7117 and 7746 are used, however, the modulator unit is normally connected to No. 2 transmitter-receiver, and if No. 1 is required No. 2 must be switched off. The modulator unit will then be automatically connected to No. 1 transmitter-receiver.

Transmitter-receiver over-riding

17. When the VHF transmitter is switched on by the PRESS–TO–TRANSMIT button the homing equipment is rendered inoperative and the indicator flag will re-appear.

Press-to-mute

18. If the PRESS–TO–MUTE switch associated with the VHF transmitter-receiver installation is operated when the equipment is set to HOMING, no AGC signal will be applied to the modulator unit and the flag in the indicator will re-appear indicating that the homing equipment is inoperative.

Note . . .

If modification No. 3279/1 has been incorporated in the modulator unit the flag circuit will be energized from the HT line and the flag will not re-appear when the PRESS–TO–MUTE *switch is operated.*

Chapter 4

DETAILED CIRCUIT DESCRIPTION

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

INTRODUCTION

1. It is assumed in this chapter that the reader is familiar with the operating principle of the homing equipment described in detail in Chapter 1 of this publication.

2. A separate circuit description is given of the modulator unit. Circuit detail of other items of equipment are dealt with in the functional circuit descriptions of the installations in which they occur.

3. Power supplies for the equipment are derived from the associated VHF transmitter-receivers.

4. Some of the units may have been supplied by the manufacturers in various stages of modification. Brief details of the modifications will be included in the text.

MODULATOR UNITS

General

5. Modulator unit Type 7087 and modulator unit Type 7747 only differ in very minor respects, the Type 7747 being a modified version of the Type 7087. The circuit description which follows is applicable to both units.

6. A block diagram of the modulator unit is given in fig. 3 of Chapter 1. Reference should be made to this as necessary in addition to the figure numbers quoted in the following paragraphs. The complete circuit diagrams of the modulator units are shown in fig. 1 and 2 (at the end of the chapter).

7. The modulator unit consists of two parts namely:—

(1) RF unit Type 7086 (*Stores Ref.* 10D/19222) which houses the RF and modulator stages.

(2) The main chassis assembly, which houses the electronic switch, phase discriminator, LF amplifier and DC amplifier. For the purpose of this description this assembly will be called the LF unit.

The two units are interconnected by an eight-pole Jones plug PL5 and socket SK1 (fig. 1 and 2).

Note

The LF assembly in the modulator unit Type 7087 has not been given a separate Type and Ref. No. In the modulator unit Type 7747 this assembly is called the multivibrator unit Type 7755 Stores Ref. 10V/675.

RF UNIT

RF Stage

8. This stage is wideband covering the frequency range 100–156 Mc/s. The EMF's induced into the two aerials are isolated by means of two grounded-grid amplifiers V1 and V2, so that any subsequent interconnection between them has no retroactive effect.

9. The signals are fed from the aerials by coaxial feeders of 52-ohm characteristic impedance. The feeders are matched to the cathode impedance of V1 and V2 by capacitors C31, C32 and the tertiary windings of RF transformers TR3 and TR4. The primary and secondary windings of these transformers maintain the associated valve heaters at the same RF potential as their cathodes.

10. Connected between the anodes of V1 and V2, from an RF point of view, is a π network consisting of inductor L5 and the input and output capacitances of the two valves. This can be seen more clearly in the equivalent circuit shown in fig. 3. The π network is terminated with resistors R1 and R2 (anode loads of V1 and V2) which are equal to the nominal characteristic impedance of the network (150 ohms at 125 Mc/s).

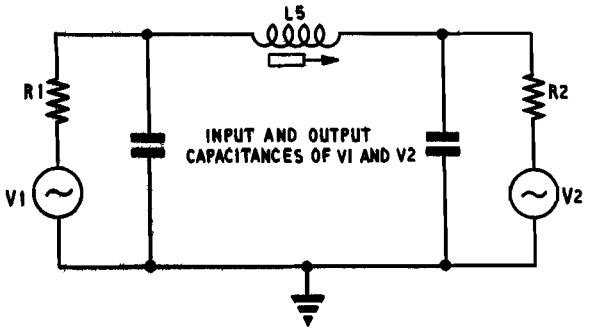


Fig. 3. RF stage, equivalent circuit

11. Ideally the network should introduce a phase shift of 90 deg. in the signal output from V2 that appears at the anode of V1 and vice versa. In practice, however, the amount of phase shift varies with the frequency of the incoming signal:—

Frequency Mc/s	*Phase shift deg.*
100	70
113	80
125	90
138	100
156	110

12. Two variable preset controls are provided in the RF stage:—

(1) Potentiometer RV1 (fig. 1 and 2) which enables V1 and V2 to be balanced.

(2) An adjustable core in the inductor L5 which allows the π network to be adjusted to the correct setting-up frequency.

Modulator Stage

13. The signal outputs from the RF stage are applied to the cathode of V3 and V4 via capacitors C5 and C6. Transformers TR1 and TR2 provide the necessary RF loads and maintain the heaters at the same RF potential as their associated cathodes. The circuit around V3 and V4 is arranged so that they work at full gain with their grids at negative 5 volts. Their control grids are connected to the electronic switch via the feed-through decoupling capacitors C11 and C12. The switching voltages are arranged so that when one valve is conducting the other is cut-off.

14. A simplified circuit of the modulator stage is shown in fig. 4. Inductors L1, L2 and variable capacitor C14, together with the anode-grid capacitances of V3 and V4, form a tuned circuit. This circuit has a very flat response and, when tuned to 121·5 Mc/s, will accept signals in the range 100–156 Mc/s.

15. The combined signal output from V3 and V4 is matched into a short length of 43-ohm coaxial feeder by capacitor C15 (fig. 1 and 2). This feeder is terminated with a socket SK4 which is connected to plug PL4 fitted to the front panel of the RF unit. The signals are fed into the VHF receiver where they are selected, amplified and demodulated.

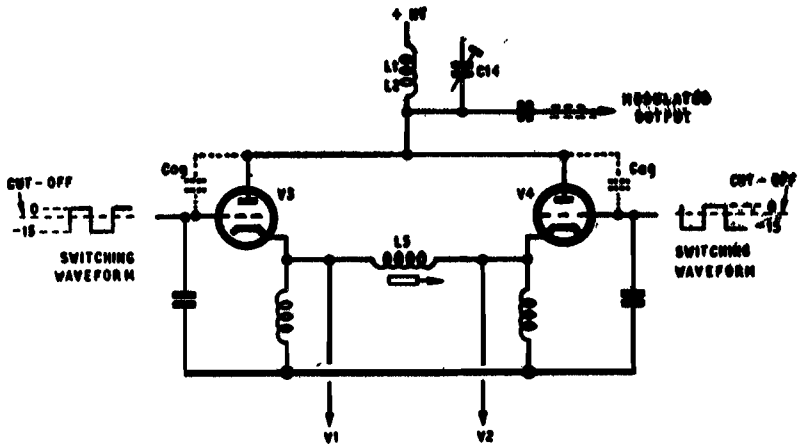


Fig. 4. Modulator stage, simplified circuit

16. The DC voltages at the anodes of V3 and V4 are isolated from each other by C13. RV2 (MODULATION BALANCE) adjusts these voltages; it compensates for slight differences in the valve characteristics.

LF Unit

Electronic Switch

17. The electronic switching requirements are as follows:—

(1) Extremely square symmetrical waveform with the minimum delay between the positive-going and negative-going pulses.

(2) The fundamental switching frequency to be high enough to enable the equipment to be used simultaneously for homing and communication purposes, i.e., the switching frequency will be superimposed on the normal audio frequencies.

(3) Low impedance output to switch the modulator and discriminator stages. This is necessary because the grids of V3 and V4 are decoupled to earth by C11 and C12 and they will present a low impedance path to the high harmonics of the switching frequency.

These requirements are fulfilled by the use of an anode-grid coupled multivibrator incorporating cathode-followers in the coupling. The fundamental frequency of the circuit is approximately 4·5 kc/s.

18. To obtain the extremely square waveform at the frequency required, the circuit must be capable of generating frequencies at least up to the 10th harmonic, i.e., up to 45 kc/s. In the case of the normal multivibrator shown in fig. 5, the higher harmonics are suppressed by the stray capacitances and the "Miller effect" (represented in fig. 5 by C3 and C4). As a result the waveform becomes

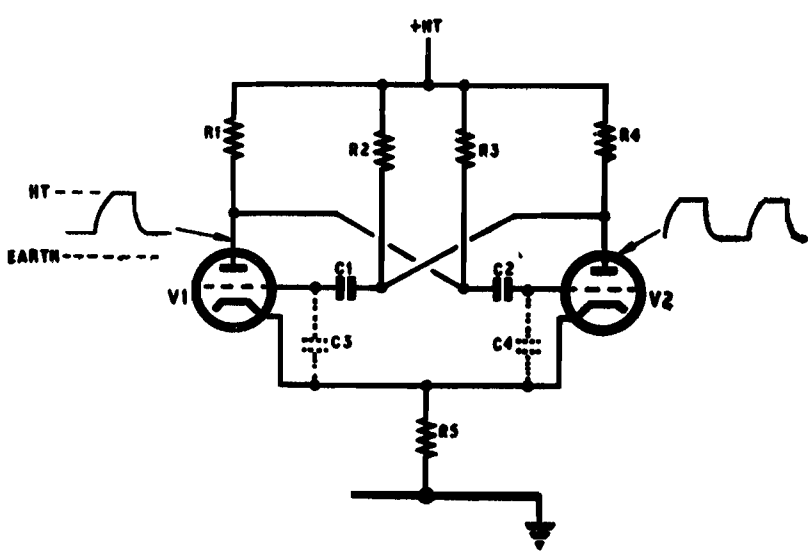


Fig. 5. Normal multivibrator circuit

distorted as shown. Further, since the multivibrator is required to switch the modulator and discriminator stages, the added load imposed would increase this distortion.

19. The improved circuit shown in fig. 6 eliminates these drawbacks. Cathode followers V6a and V6b are connected in series with the coupling capacitors C21 and C22. The advantages of the cathode followers are:—

(1) High input resistance

(2) Low input capacitance

(3) Low output resistance

(1) and (2) enable the square waveform to be obtained and (3) provides the output required.

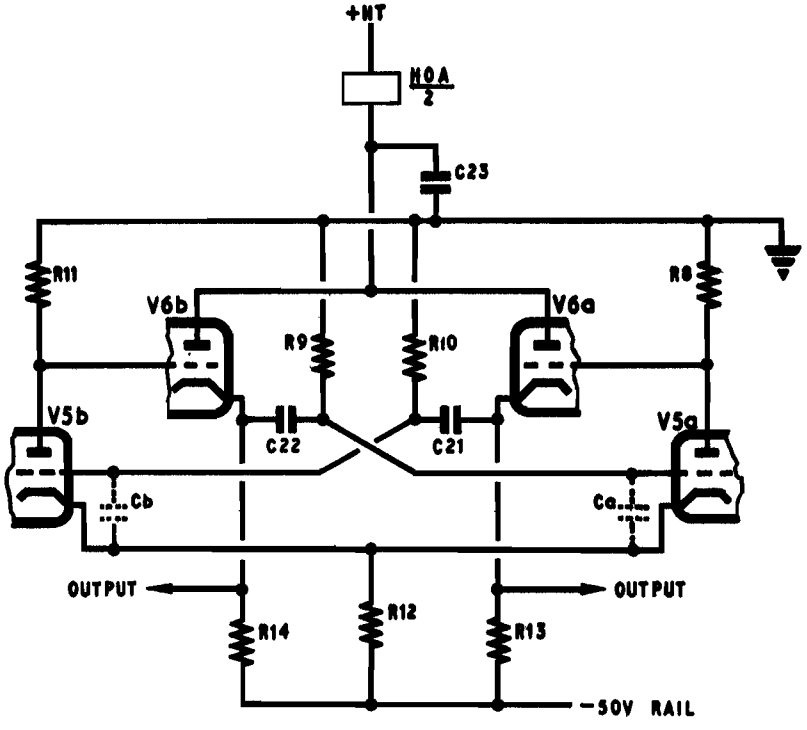


Fig. 6. Improved multivibrator circuit

Since this output resistance is small the time-constants formed by it, the stray capacitances and the "Miller effect" (Ca and Cb) now become negligible. The waveforms that appear at various points of the electronic switch are illustrated in fig. 7.

20. The circuit (fig. 6) is designed to multivibrate approximately 2V above earth and 15V below earth. The anodes of V5a and V5b are connected to earth via load resistors R8 and R11; their cathodes are taken to the -50V rail (pin E of socket SK3 fig. 1 and 2) via a common bias resistor R12. The -50V supply is connected when a switch in the appropriate control is set to HOMING. Resistor R15 connected across pins E and G of socket SK3 provides a high resistance DC path between cathode and grid in the non-operate position. The frequency of oscillation of the circuit is controlled by the time constants of C21–R10 and C22–R9 together with the inter-electrode and stray capacitances.

21. The anodes of the cathode-followers V6a and V6b are connected to the +HT supply via the energizing coil of relay HOA/2. The cathodes of these valves go to the -50 volt rail via separate load resistors R13 and R14. When R15 (fig. 1 and 2) is shorted out (By a switch in the control unit), V6a and V6b conduct and relay HOA/2 is energized. Contacts HOA1 connect the +HT supply to V1, V2, V3, V4, V8a, V8b, V9a, V10a and V10b. Contacts HOA2 connect the 28V supply to pin B of socket SK2.

22. For the correct operation of the modulator stage, V3 and V4 grids require to be switched between zero and negative 5V. This is effected by connecting the diodes V7a and V7b (triodes strapped as diodes) between the cathode followers and V3 and V4. The diodes will only conduct when their cathodes are at a lower potential than their anodes. The waveforms at the cathodes of V7a

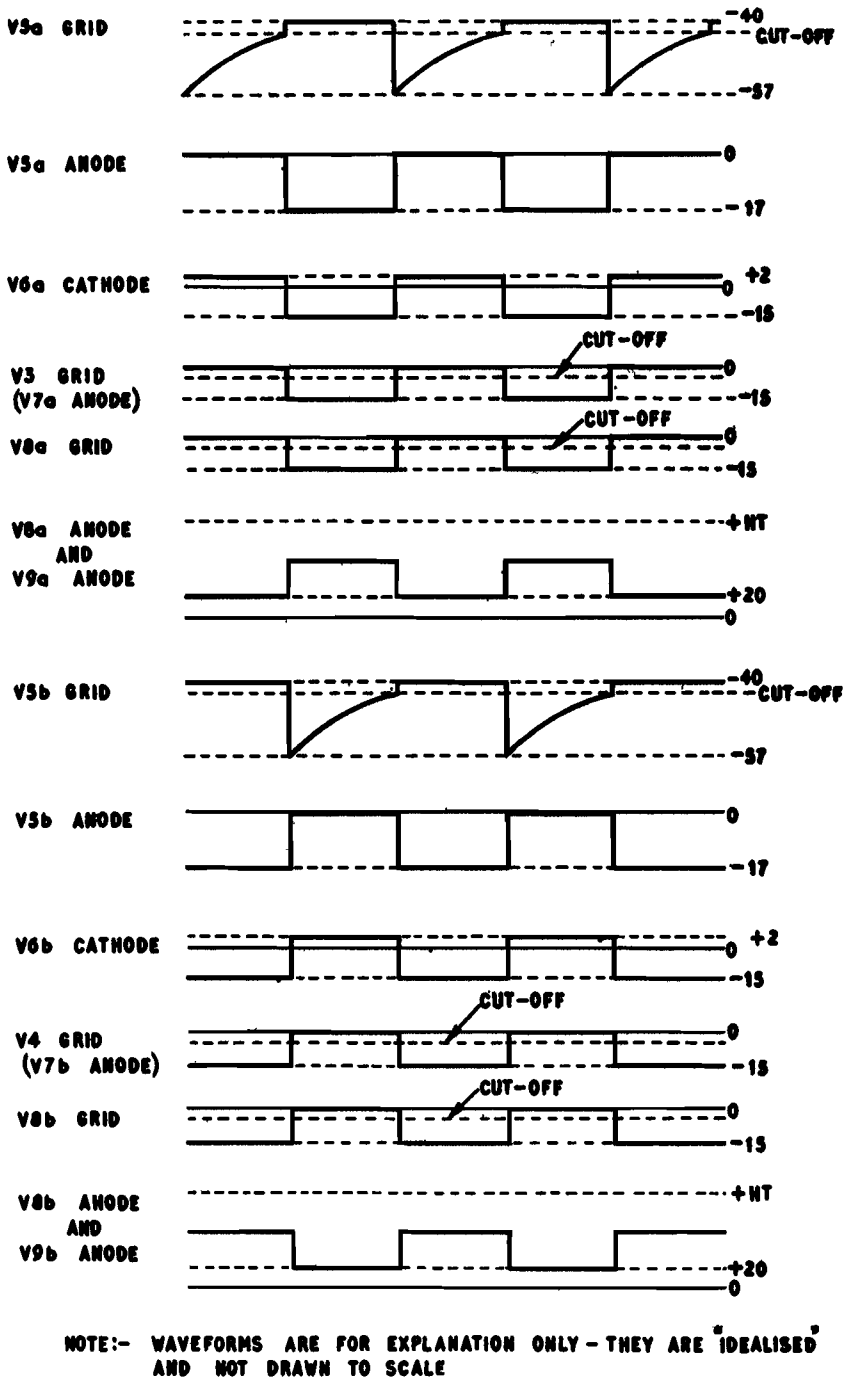


Fig. 7. Electronic switch, waveforms

and V7b and across the diode loads R19 and R20 are shown in fig. 7.

23. At the same time as the modulator valves are being switched it is necessary to switch the discriminator valves V9a and V9b. This is achieved by connecting the switching voltages to the grids of the two intermediate valves V8a and V8b and taking the HT supply for V9a and V9b via the same anode loads as V8a and V8b, i.e., R23 and R24.

24. The waveforms appearing at the grids and anodes of V8a and V8b are shown in fig. 7. The switching voltages are applied to V8a and V8b via the limiting resistors R16 and R17. The cathodes of these valves are taken directly to earth. During the positive-going pulses grid current flows,

limited by R16 and R17, and the anode potentials drops to approximately +20V. During the negative-going pulses V8a and V8b are completely cut-off.

25. When V8a is conducting the anode supply to V9a is reduced to +20V and, since its cathode is connected to the +24V supply, via bias resistor R39 and potentiometer RV4, it will be completely inoperative during the period the positive-going pulse is applied to V8a. Similarly V9b is inoperative when V8a is conducting.

Discriminator

26. The demodulated signal from the VHF receiver via the LF amplifier is applied simultaneously to the control grids of V9a and V9b via stopper resistor R28. The pointer movement of the indicator is connected between the two cathodes. When the aircraft is "on course" there will be no input signal to V9a and V9b; the average current taken by the two valves will be the same and the indicator will read zero. When the input waveform is in phase with the switched HT supply to V9a there will be an increase in current through V9a and a decrease in current through V9b, and vice versa when the input waveform is in phase with V9b HT supply. The meter will deflect to the right or left accordingly, the amount of deflection varying with the amplitude of the signal applied.

27. Damping of the indicator movement is provided by capacitors C29 and C30 in conjunction with the cathode bias resistors R30, R31 and potentiometer RV4 (METER BALANCE). This potentiometer is used to balance the two valves, i.e., zero the indicator, when pin C of plug PL3 is shorted to earth.

LF Amplifier

28. The output of the VHF receiver is fed into the modulator unit via pin C of plug PL3. This output consists of the demodulated signal and the DC component from the receiver AVC network. The DC component is isolated from the LF amplifier V10a by C26. Negative feedback is provided by omitting the capacitor across the bias resistor R27. The output from the anode load potentiometer RV3 (METER GAIN) is fed into the discriminator valves V9a and V9b.

29. In the modulator unit Type 7747 the cathode-bias resistor in the LF amplifier is increased in value. This resistor is shunted by a resistor in the control unit when the meter sensitivity switch is set to MAX. In this position the gain of the LF amplifier is the same as the LF amplifier in the modulator unit Type 7087. By removing the shunt resistor i.e., setting the switch to MIN. the gain of the amplifier is reduced.

DC Amplifier

30. The VHF receiver output is also fed into a directly-coupled amplifier V10b. The LF component is removed by the low-pass filter R22–C25. The DC component, which will vary between +70V under no signal conditions to —15V under full AVC conditions, is applied to the grid of V10b. The cathode of this valve is connected to the 24V tap on the valve heater chain. The indicator flag movement is connected to the anode and cathode of V10b via R18 and pins C and D of socket SK3. The circuit values are arranged so that the flag will disappear when the voltage applied to the grid is approximately 2V less than the nominal 24V LT supply.

Note

Modification No. 3279/1 which applies to both Types of modulator unit modifies the flag indicator circuit. The grid of V10b is connected to earth and since the cathode is at +24V the valve is biased beyond cut-off. As soon as the HT supply is switched on the flag will operate, i.e., it is not dependent on the incoming signal.

Heater Supplies

31. Connections to the valve heaters are shown in fig. 1 and 2. Supplies to the valves in the RF unit are via feed-through decoupling capacitors. The heater circuit is completed only when the LF and RF units are interconnected.

ARI.18044

General

32. This installation is used in certain R.A.F. aircraft which are fitted with twin 10-channel VHF transmitters. It provides indications both in azimuth and elevation.

33. A functional block interconnection diagram of ARI.18044 is given in fig. 8. The facilities provided, selected by the remote switches are as follows:—

(1) Normal—the two VHF transmitter-receivers are used for their normal communication functions.

(2) Homing in azimuth, using the appropriate VHF transmitter-receiver.

(3) Homing in elevation using the appropriate VHF transmitter-receiver.

Normal

34. With the remote control switch set to NORMAL and No. 1 VHF transmitter-receiver switched ON circuit conditions are as follows:—

(1) Relay TRC/4 in the junction box (aerial) Type 7089 is de-energized. The power supplies and the LF signal output from No. 1 transmitter-receiver are connected to the modulator unit via relay contacts TRC1; TRC2; TRC3 and TRC4.

(2) Relay HOA/2 in the modulator units is de-energized. Contacts HOA2 disconnect the 24V supply to relays HOB/1 and HOC/1.

(3) The communication aerials are connected via relay contacts HOB1 and HOC1 to the transmitter-receivers.

35. When No. 2 transmitter-receiver is switched ON relay TRC/4 is energized; the power supplies and the LF signal output from No. 2 transmitter-receiver are connected to the modulator unit. Conditions detailed in sub-para. 31(2) and (3) apply.

Note . . .

In some aircraft the VHF transmitter-receivers are switched on simultaneously to avoid delay due to the warm-up period when switching from one transmitter-receiver to the other. In these installations relay TRC/4 will be energized and the modulator unit will be connected to No. 2 transmitter-receiver.

Homing in azimuth

36. With the remote switches set to HOMING and AZIMUTH and with No. 1 transmitter-receiver switched ON the following circuit changes are made:—

(1) The −50V supply is connected to the cathode-followers in the modulator unit and relay HOA/2 is energized. Contacts HOA1 connect the +HT supply to the other stages in the modulator unit; contacts HOA2 connect the 24V supply to relays HOB/1 and HOC/1 in the junction box (aerial) Type 7089.

(2) Relay HO/2 in the control unit, is de-energized. Contacts HO1 complete the 24V supply to relay HOB/1, contacts HOB1 connect the VHF output from the modulator unit (PL4) to No. 1 transmitter-receiver. Contacts HO2 are not used.

(3) Relay ELV/4, in the control unit, is de-energized. The vertical pointer and the associated flag in the indicator electrical Type 7 are connected to the modulator unit by contacts ELV3 and ELV4.

(4) The aerial changeover relay Type 1254 is de-energized and the port aerial is connected to the modulator unit.

37. When No. 2 transmitter-receiver is switched ON, the circuit changes are as follows:—

(1) Relay TRC/4 is energized; the power supplies and the LF signal output from No. 2 transmitter-receiver are connected to the modulator unit.

(2) Relay HOA/2 is energized and relay HOC/1 is operated via contact HO1. Contacts HOC1 connect the VHF output from the modulator unit to No. 2 transmitter-receiver.

Note . . .

In installations where the two transmitter-receivers are switched on simultaneously the modulator unit will be connected to No. 2 transmitter-receiver. If No. 1 transmitter-receiver is required No. 2 must be switched off. The modulator unit will then be connected automatically to No. 1 transmitter-receiver.

Homing in elevation

38. The circuit for this facility is similar to that for homing in azimuth described in para. 36 and 37 with the exception of sub-para. 33 (3) and (4). The circuit differences are:—

(1) Relay ELV/4 is energized. The horizontal pointer and the associated flag in the indicator electrical Type 7 are connected to the modulator unit by contacts ELV3 and ELV4.

(2) The aerial changeover relay Type 1254 is energized via contact ELV1 and the elevation aerial is connected to the modulator unit.

Transmitter over-riding conditions

39. When either of the transmitters is switched on by the press-to-transmit button the following circuit changes are made:—

(1) The +HT supply to the modulator unit is disconnected.

(2) Relay HOA/2 in the modulator unit is de-energized. Contact HOA2 disconnects the +24V supply to relays HOB/1 and HOV/1.

(3) Contacts HOB1 and HOC1 re-connect the communication aerials to the transmitter-receiver.

Press-to-mute

40. If the press-to-mute switch associated with the VHF transmitter-receiver is operated when the equipment is set to HOMING, no AGC signal will be applied to the modulator unit. The flag in the indicator will re-appear, indicating that the equipment is inoperative.

ARI.18048

General

41. This installation is used in certain R.A.F. and Naval aircraft which are fitted with a single 10-channel VHF transmitter-receiver.

42. A functional block interconnection diagram of ARI.18048 is given in fig. 9. The facilities provided, selected by control unit Type 7086, are as follows:—

(1) Normal—the transmitter-receiver is used for its normal communication function.

(2) Homing in azimuth.

In addition limited control of the meter sensitivity is provided by a toggle switch which can be set to MAX and MIN positions (*para.* 29).

Note . . .

The control unit Type 7086 must incorporate modification No. 3179/1 before it can be used with this installation. This modification provides for the additional switch SWB and associated resistor R2 required to control the meter sensitivity.

43. Control unit Type 7086 is also used in ARI.18049 and facilities are provided for two transmitter-receivers. When used with ARI.18048 the homing facility is operative when the control unit is set either to HOMING 1 or HOMING 2.

44. The press-to-mute conditions are the same as for ARI.18044 in para. 40.

Normal

45. With the control unit set to NORMAL and the transmitter-receiver switched ON, circuit conditions are as follows:—

(1) Power supplies and the LF signal ouput from the transmitter-receiver are connected to the modulator unit.

(2) Relay HOA/2 in the modulator unit, is de-energized and contacts HOA2 disconnect the +24V supply to the aerial changeover relay Type 1254.

(3) The VHF communication aerial is connected directly to the transmitter-receiver.

Homing in azimuth

46. With the control unit set to HOMING 1 or HOMING 2 and with the transmitter-receiver switched ON, the following circuit changes are made:—

(1) The −50V supply is connected to the cathode-followers in the modulator unit and relay HOA/2 is energized. Contacts HOA1 connect the +HT supply to the other stages in the modulator unit; contacts HOA2 connect the +24V supply to the aerial change-over relay.

(2) The VHF output from the modulator unit (PL4) is connected to the transmitter-receiver.

Transmitter over-riding conditions

47. When the transmitter is switched on by the press-to-transmit button the following circuit changes are made:—

(1) The +HT supply to the modulator unit is disconnected.

(2) Relay HOA/2 is de-energized. Contacts HOA2 disconnect the +24V supply to the aerial changeover relay and the communication aerial is reconnected to the transmitter-receiver.

General

48. This installation is used in certain Naval aircraft which are fitted with twin 10-channel VHF airborne relay equipment (ARI.5491).

49. A functional block interconnection diagram of ARI.18049 is given in fig. 10. The facilities provided, selected by control unit Type 7086, are as follows:—

(1) Normal—the airborne relay equipment functions normally.

(2) Homing in azimuth, using either No. 1 or No. 2 transmitter-receiver.

In addition limited control of the meter sensitivity is provided by a toggle switch which can be set to MAX and MIN positions (*para.* 29).

Note . . .

(1) *The control unit Type* 7086 *must incorporate modification No. 3179/1 before it can be used with this installation. This modification provides for the additional switch SWB and associated resistor R2 required to control the meter sensitivity.*

(2) *Modification No.* 4021/2 *to the control unit Type* 7086 *has been introduced to enable the homing aerials to be automatically retracted when the control unit switch is set to* NORMAL. *The spare contact on switch SWA(b) is connected to pin L of PL*1. *The modification is applicable to RN only.*

50. The homing facility can only be used when the control unit Type 383 in ARI.5491 is set to RT1, RT2 or DUAL with the control unit Type 7086 set to HOMING 1 or HOMING 2 as appropriate.

51. The transmitter over-riding and the press-to-mute conditions are the same as for ARI.18044 described in para. 39 and 40.

Normal

52. With control unit Type 7086 set to NORMAL and control unit Type 383 set to RT1, RT2, DUAL or REL, the circuit conditions are as follows:—

(1) Relay TRC/4 is energized. The power supplies and the LF signal output from No. 2 transmitter-receiver are applied to the modulator unit via relay contacts TRC1, TRC2, TRC3 and TRC4.

(2) Relay HOA/2 is de-energized, contacts HOA2 disconnect the +24V supply to relay HOB/1 and HOC/1.

(3) The communication aerials are connected via contacts HOB1 and HOC1 to the transmitter-receivers.

Note . . .

The homing equipment is on stand-by when control unit Type 383 is set to REL *but the homing facility cannot be used in this position.*

Homing in azimuth

53. With control unit Type 7086 set to HOMING 1 and with control unit Type 383 set to RT1 or DUAL, the following circuit changes are made:—

(1) The +24V supply to relay TRC/4 is disconnected and the relay is de-energized. The power supplies and LF signal output from No. 1 transmitter-receiver are applied to the modulator unit.

(2) The −50V supply is connected to the cathode-followers in the modulator unit via switch SWAc and relay HOA/2 is energized. Contacts HOA1 connect the +HT supply to the other stages of the modulator unit; contacts HOA2 connect the +24V supply to relay HOB/1 and HOC/1.

(3) The +24V supply to relay HOB/1 is completed by switch SWAb. Contacts HOB/1 connect the VHF output from the modulator unit to No. 1 transmitter-receiver.

54. With control unit Type 7086 set to HOMING 2, and with control unit Type set 383 to RT2 the following circuit changes are made:—

(1) Relay TRC/4 is energized; the power supplies and the LF signal output from No. 2 transmitter-receiver are connected to the modulator unit.

(2) Relay HOA/2 in the modulator unit is energized. The +24V supply is connected to relay HOC/1 via contacts HOA1 and switch SWAC.

(3) Contacts HOC1 connect the VHF output from the modulator unit to No. 2 transmitter-receiver.

ARI.18085

General

55. This installation is similar to ARI.18044 except that it provides for limited control of the meter sensitivity. A functional block interconnection diagram is given in fig. 11. The circuit description of ARI.18044 para. 33 to 39 is applicable to this installation.

◀ **Note . . .**

To enable the warm-up facility to be used with No. 2 transmitter-receiver, modification No. 4240/2 to junction box Type 7089 has been introduced. The wiring to relay TRC/4 is re-routed and brought out to an additional terminal block which is connected to the selector switch in the VHF control unit. When this modification is incorporated it is not necessary to switch off No. 2 transmitter when No. 1 is required (para. 37). ▶

Control units

56. Control unit (remote) Type 7746 is a modified version of control unit (remote) Type 7117. The modification provides for resistor R1 and minor wiring changes so that the pilot can have control of the meter sensitivity.

ARI.18093

General

57. ARI.18093 is used in conjunction with a twin 10-channel VHF installation. A functional block interconnection diagram is given in fig. 12.

58. The facilities provided, selected by control unit Type 7086 are as follows:—

(1) Normal—the two VHF transmitter-receivers are used for their normal communication functions.

(2) Homing in azimuth using the appropriate transmitter-receiver.

In addition limited control of the meter sensitivity is provided by a toggle switch which can be set to MIN and MAX positions.

59. The transmitter over-riding and the press-to-mute conditions are the same as for ARI.18044 described in para. 39 and 40.

Normal

60. With control unit set to NORMAL, circuit conditions are as follows:—

(1) Relay TRC/4 in the junction box (aerial) Type 7089 is energized. The power supplies and the LF signal output from No. 2 transmitter-receiver are applied to the modulator unit via the relay contacts TRC1, TRC2, TRC3 and TRC4.

(2) Relay HOA/2 in the modulator unit is de-energized, contacts HOA2 disconnect the +24V supply to relays HOB/1 and HOC/1.

(3) The communication aerials are connected via relay contacts HOB1 and HOC1 to the transmitter receivers.

Homing in azimuth

61. With control unit Type 7086 set to HOMING 1 the following circuit changes are made:—

(1) Relay TRC/4 is de-energized; the power supplies and the LF signal output from No. 1 transmitter-receiver are connected to the modulator unit.

(2) The −50V supply is connected to the cathode of the cathode followers in the modulator unit via switch SWAc in the control unit and relay HOA/2 is energized. Contacts HOA1 connect the + HT supply to the other stages in the modulator unit; contacts HOA2 connect the +24V supply to relays HOB/1 and HOC/1 in the junction box (aerial) Type 7089.

(3) The +24V to relay HOB/1, is completed by switch SWAb in the control unit. Contacts HOB1 connect the VHF output from the modulator (PL4) to No. 1 transmitter-receiver.

62. With control set to HOMING 2, the following circuit changes are made:—

(1) Relay TRC/4 is energized; the power supplies and the LF signal output from No. 2 transmitter-receiver are connected to the modulator unit.

(2) Relay HOA/2 in the modulator unit is energized. The +24V supply is connected to relay HOC/1 via contacts HOA1 and switch SWAc.

(3) Contacts HOC1 connect the VHF output from the modulator unit to No. 2 transmitter-receiver.

ARI.18142

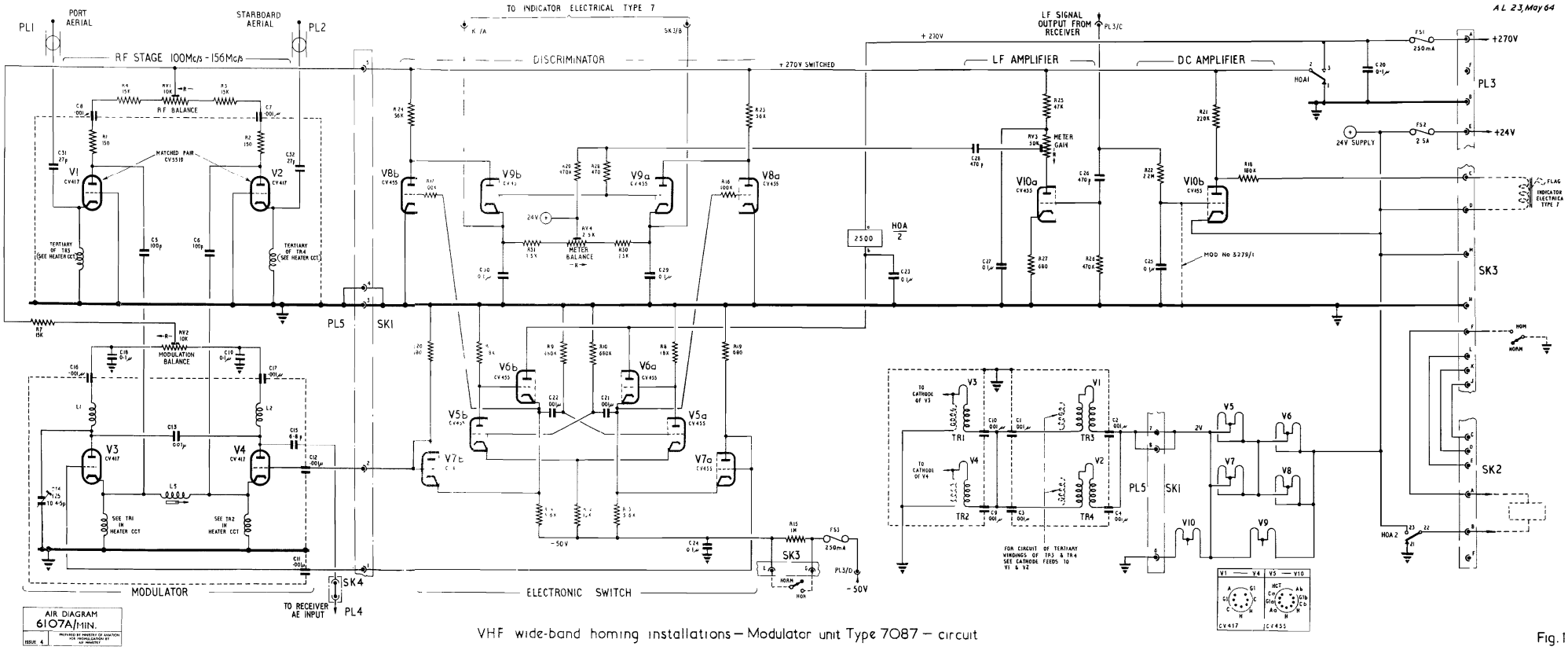
General

63. ARI.18142 is used in conjunction with twin 10-channel VHF airborne relay equipment. A functional block interconnection diagram is given in fig. 13. This installation is used in aircraft where space on the pilot's control panel is restricted and the control unit Type 7086 (ARI.18093) cannot be used. Control unit (remote) Type 9959, in conjunction with toggle switches on the pilot's control panel, provides the same function as the control unit Type 7086. The circuit description of ARI. 18093 (*para.* 57 *to* 62), relating the function of the control unit Type 7086 to those of the toggle switches, can be applied to this installation.

ARI.18155

General

64. A functional block interconnection diagram of ARI.18155 is given in fig. 14. This installation is similar to ARI.18093 except that an indicator electrical Type 7 is not supplied; it uses instead the indicator in ARI.18157.



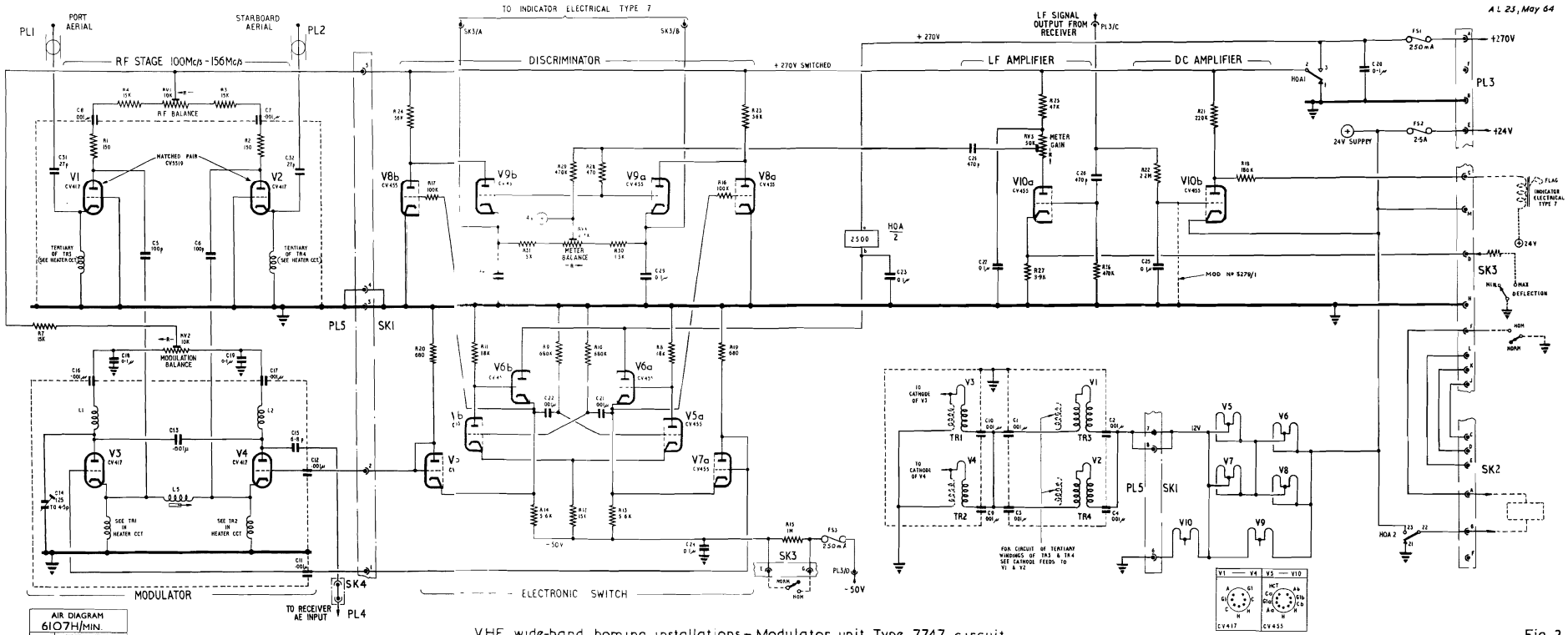
AIR DIAGRAM 6107A/MIN.
ISSUE 4

243/372621/19/5/64 J. T. & S.

VHF wide-band homing installations — Modulator unit Type 7087 — circuit

RESTRICTED

Fig. 1



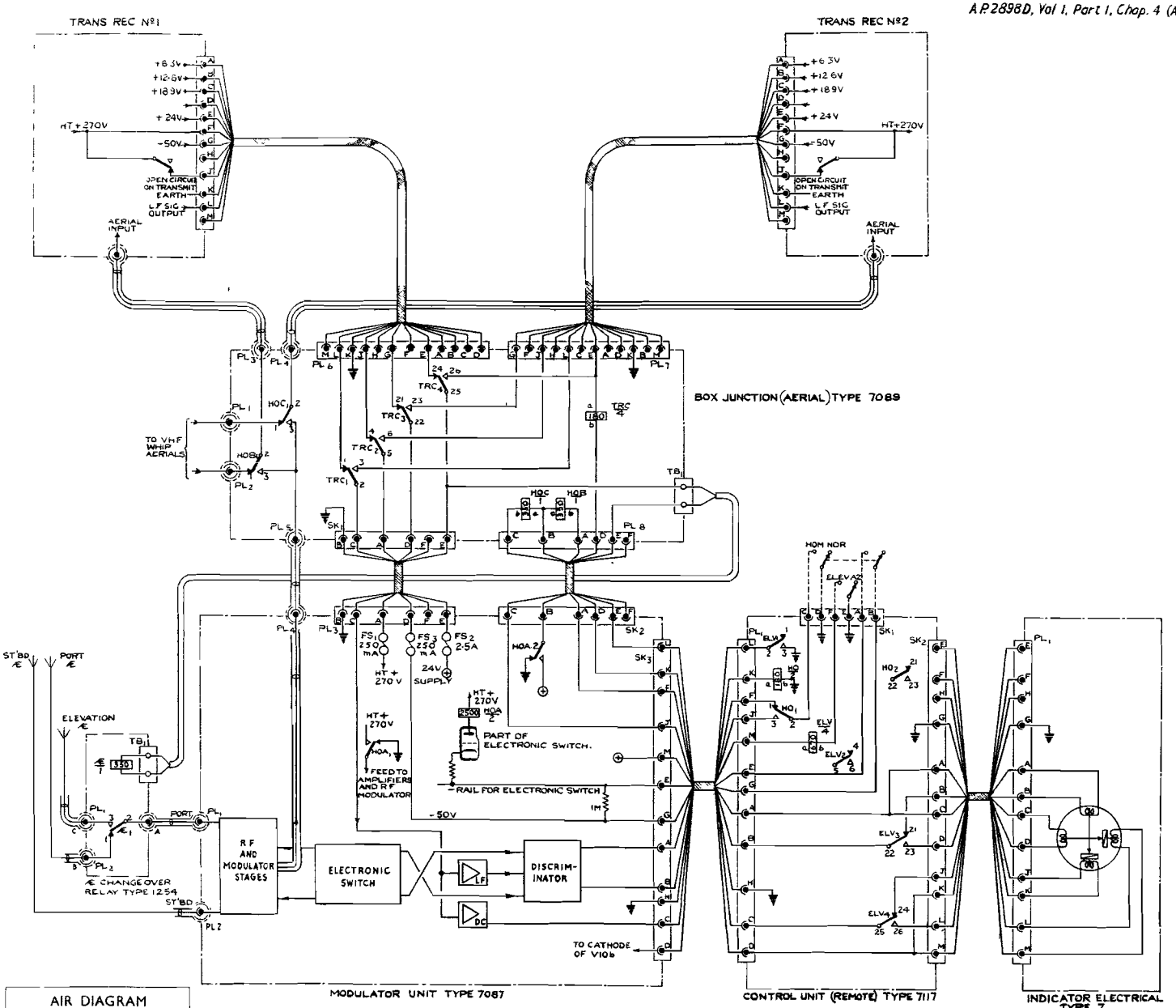
AIR DIAGRAM 6107H/MIN. ISSUE 3

Fig. 2

VHF wide-band homing installations – Modulator unit Type 7747 – circuit

RESTRICTED

243/372621/19/5/64 J T. & S.



AIR DIAGRAM 6107B/MIN.	
ISSUE 3.	PREPARED BY THE MINISTRY OF SUPPLY FOR REPRODUCTION BY AIR MINISTRY ADMIRALTY

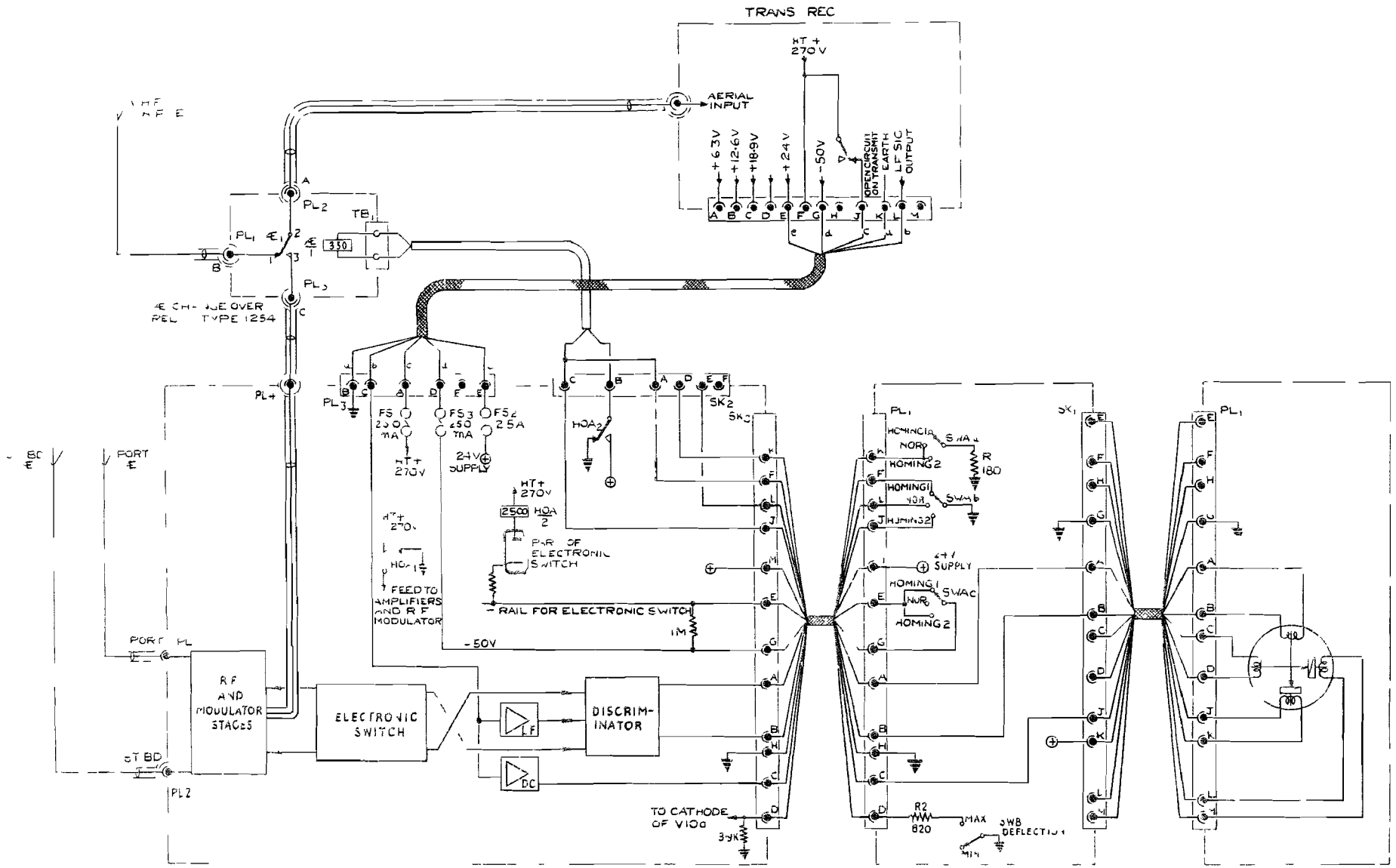
VHF wide-band homing installations–ARI. 18044 functional diagram

Fig. 8

PP8745 543483/7227 9/60 250 C & P Gp. 924 (4)

RESTRICTED

(A.L.18, Aug. 58)



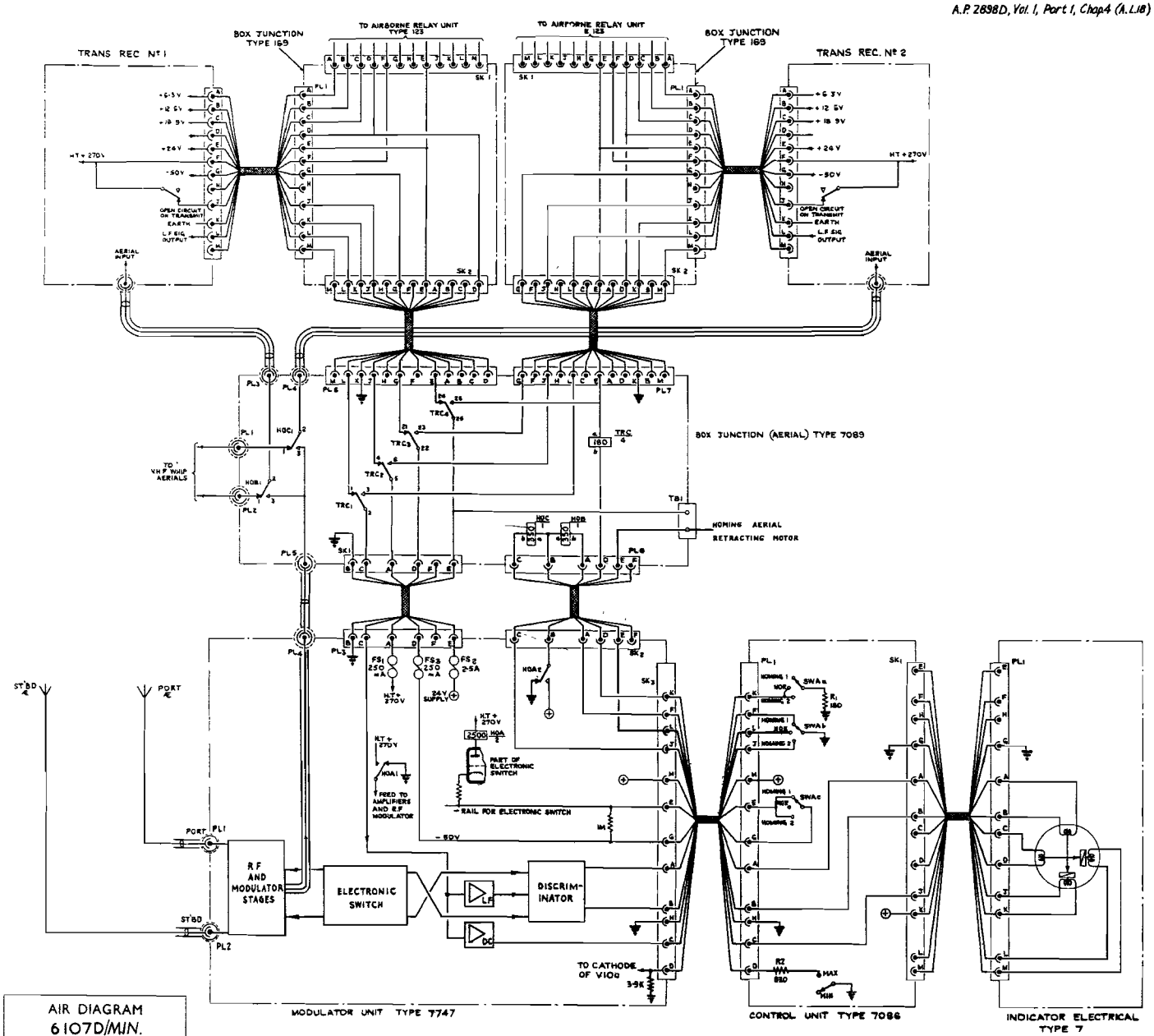
AIR DIAGRAM
6107C/MIN

VHF wide band homing installations - ARI 18048 functional diagram

Fig 9

RESTRICTED

(ALJ8, Aug 58)



AIR DIAGRAM 6107D/MIN.	
ISSUE 3.	PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY ADMIRALTY

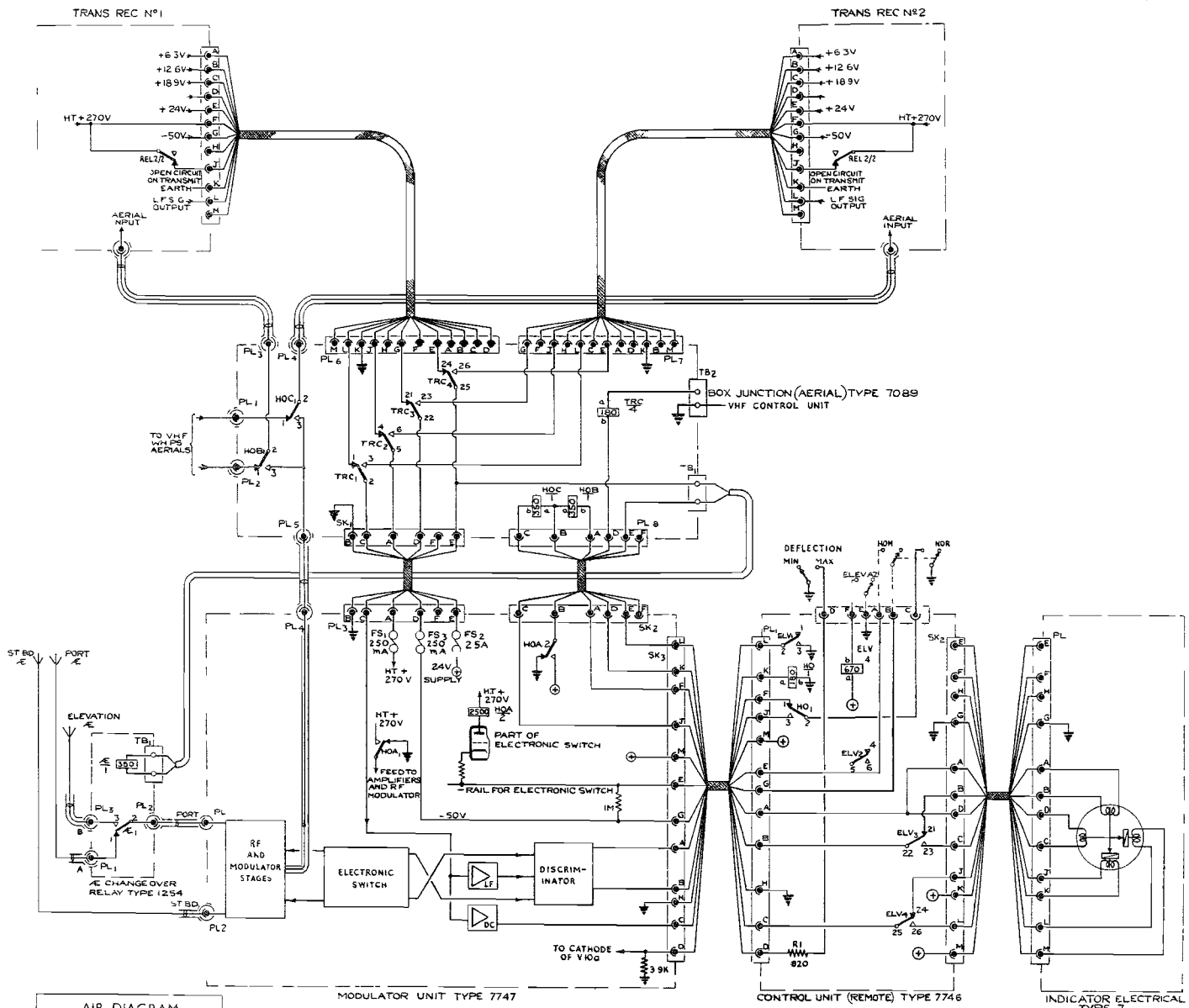
VHE wide-band homing installation – ARI 18049 functional diagram

Fig. 10

PP8745 543483/7227 8/60 250 C & P Gp. 924 (4)

RESTRICTED

(A.L.18, Aug. 58)



AIR DIAGRAM
6107J/MIN

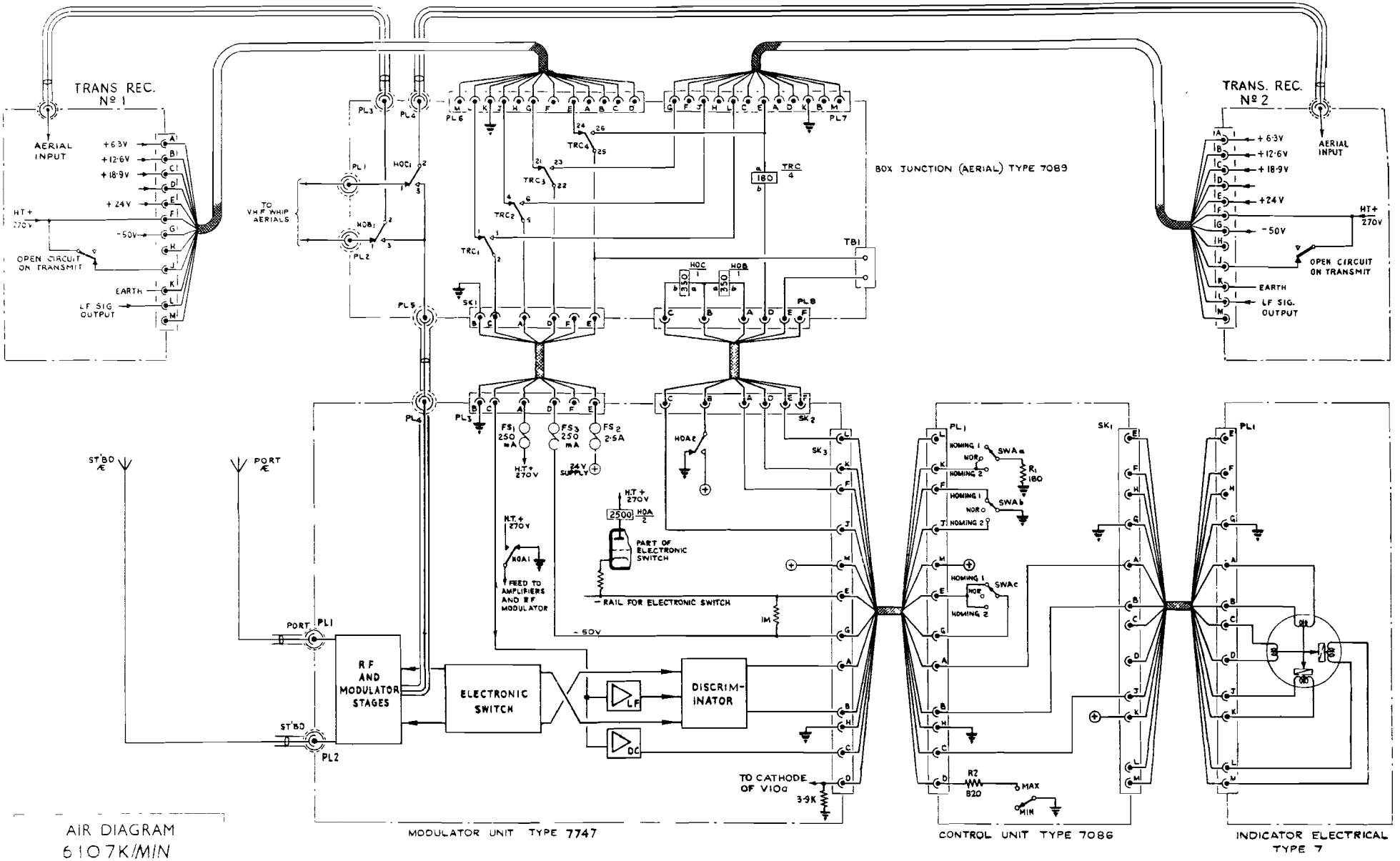
ISSUE 3

PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY THE MINISTRY ADMIRALTY

VHF wide-band homing installations – ARI 18085 functional diagram

Fig 11

PP8745 543483/7227 8/60 250 C & P Gp 924 (4)



AIR DIAGRAM
6107K/MIN

ISSUE 2

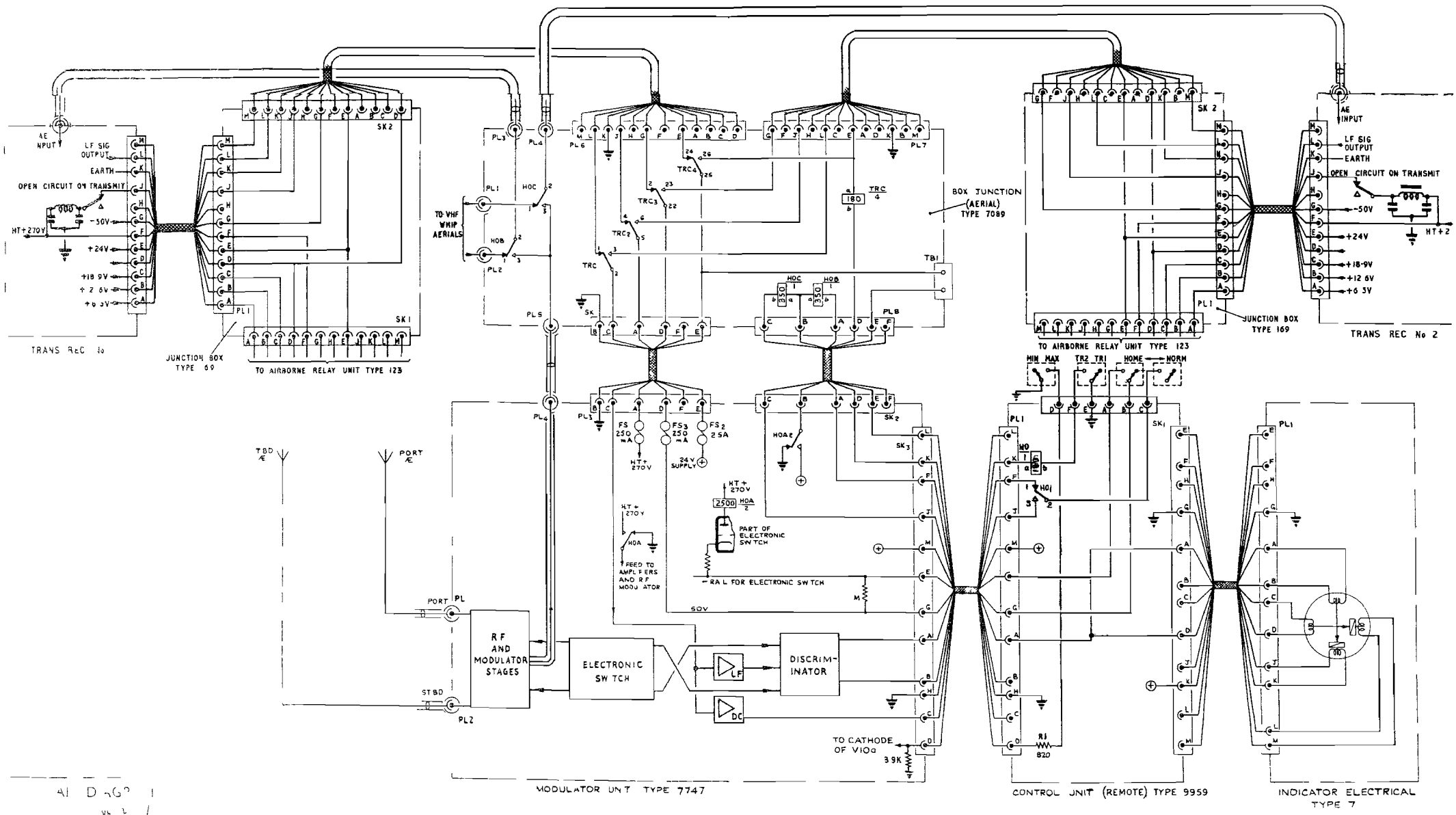
PRINTED BY M.N.A.T. OF SUPPLY FOR PROMULGATION BY AIR MINISTRY ADMIRALTY

PP8745 543483/7227 8,60 250 C & P Gp. 924 (4)

VHF wide-band homing installation – ARI 18093 functional diagram

Fig. 12

RESTRICTED

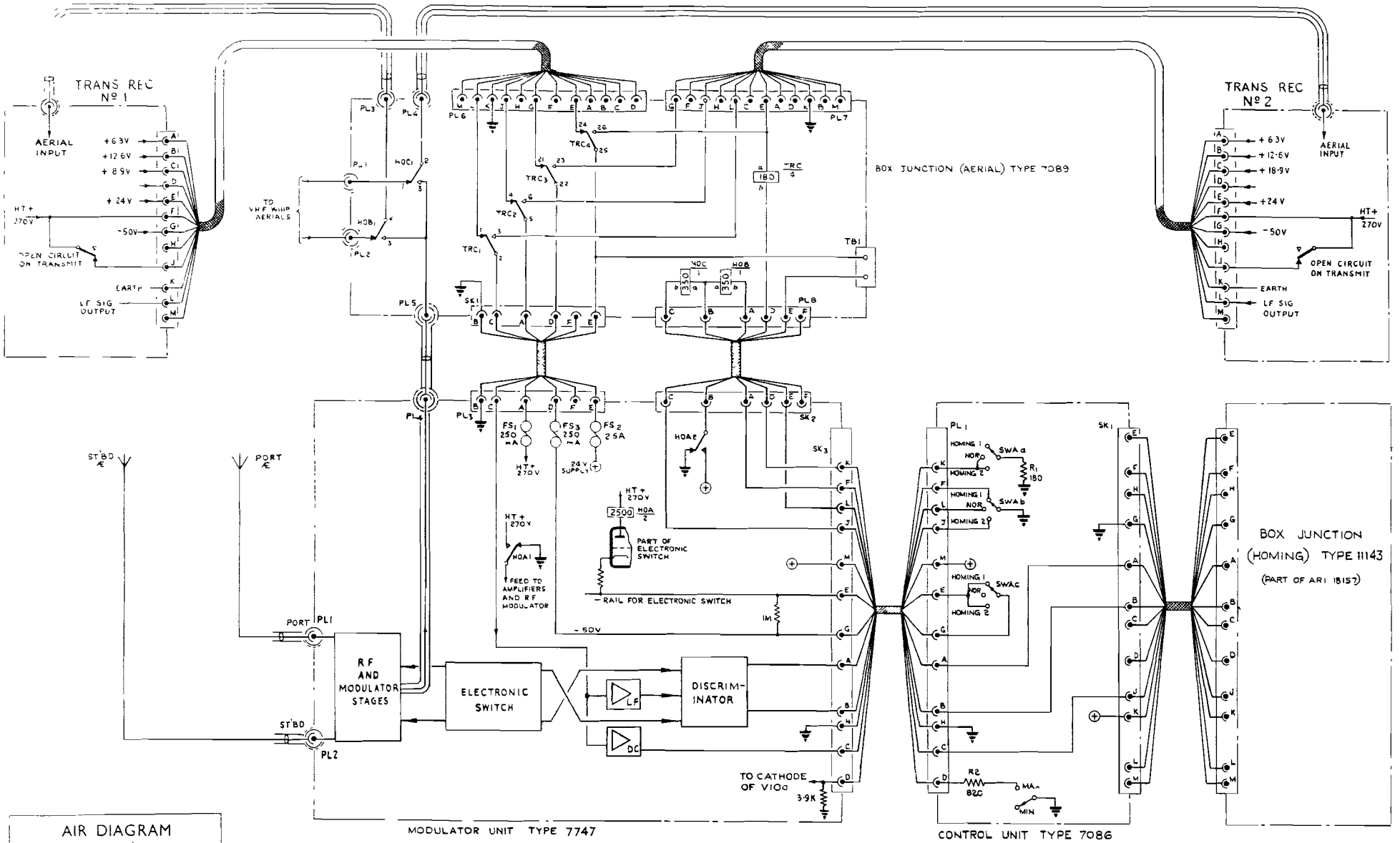


VHF wide-band homing installation - ARI 18142 functional diagram

Fig

RESTRICTED

(AL 18 Aug



AIR DIAGRAM
6107U/MIN.
ISSUE 2

PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY ADMIRALTY

PP3745 S43483 7227 8/60 250 C & P Gp 924 (4)

VHF wide-band homing installation – ARI 18155 functional diagram

Fig. 14

RESTRICTED

(A.L.18, Aug.58)

Chapter 1

GENERAL SERVICING INFORMATION

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

DISMANTLING AND RE-ASSEMBLY

Introduction

1. Before attempting to dismantle any unit, reference should be made to the description and illustrations in Part 1, Chap. 2.

Modulator units Type 7087 and ◄ Type 7747 ►

2. The modulator units differ only in very minor respects, ◄ the Type 7747 being a modified ► version of the Type 7087. The dismantling instructions which follow are applicable to both units.

To remove the RF unit Type 7088

3.

(1) Slacken off the Dzus fasteners on the modulator unit and remove the top and bottom covers.

(2) Disconnect the 8-pole Jones plug.

(3) Disengage the red-painted spring-loaded captive screw located in front of the 8-pole Jones socket. Ensure that this screw is completely disengaged from the r.f. chassis.

(4) Disengage the four, red-painted, mushroom-head screws adjacent to the fuse-holders.

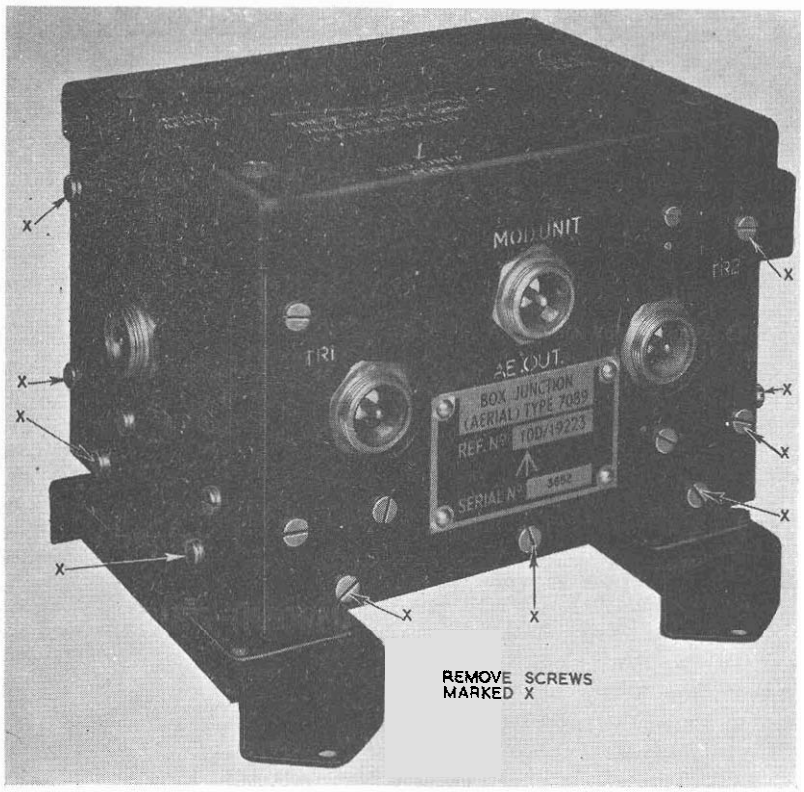


Fig. 1. Dismantling junction box (aerial) Type 7089

(5) Carefully withdraw the r.f. unit ensuring that the small cable-form is not caught up on the l.f. unit chassis.

4. The components in the underside of the r.f. unit are protected by a perforated cover plate which can be removed after disengaging the four captive screws.

Junction box (aerial) Type 7089

5. For ease of servicing, the junction box has been designed so that it can be dismantled in two parts; the parts being interconnected by a cable-form. The procedure is as follows:—

(1) Disengage the red-painted captive screws and remove the top cover.
(2) Remove the ten 4 B.A. cheese-head screws identified in fig. 1.
(3) Remove the two cheese-head screws adjacent to the flexible mounting on the underside of the box.
(4) Gently disengage the two-parts of the box.

All components are now accessible for repair or replacement as required.

Control units

6. The components in the control units are readily accessible when the covers are removed.

Re-assembling

7. The re-assembly of the units is the reverse of the routine outlined for dismantling. When replacing the RF unit Type 7088, ensure that the cableform on the top-side of the unit is not trapped between the fixing flange and the l.f. unit chassis.

MINOR SERVICING

Renewing valves

8. The valves on the r.f. unit can be renewed after the unit has been removed from the l.f. unit. Matched pairs of valves should be used in positions V1, V2 and V3, V4.

9. To renew the valves in the l.f. unit proceed as follows:—

(1) Remove the top cover from the modulator unit.
(2) Disengage the two red-painted captive screws located on either side of the METER BALANCE control.
(3) The small sub-chassis, on which the preset controls are mounted, is now free to pivot on the side fixing bolts and can be moved out of the way to provide access to the valves.

Coaxial plugs

10. To repair or renew the coaxial plugs on the front panel of the r.f. unit, the following procedure should be adopted:—

(1) Disconnect the flying lead from the back of the AE OUT plug.
(2) Unsolder capacitors C31 and C32 and disengage them from the pins of PL1 and PL2.
(3) Remove the cheese-head screws adjacent to the PORT and STBD aerial plugs.
(4) Withdraw the front panel complete with co-axial plugs.

Defective relay HO2/2

11. To renew defective relay HO2/2:—

(1) Remove the top and bottom covers of the modulator unit.
(2) Remove the RF unit Type 7088.
(3) Remove the three cheese-head screws on the left-hand side of the modulator unit.
(4) Unsolder the leads to the relay tag-board.
(5) Remove the two screws securing the fixing bracket to the main chassis.
(6) The relay complete with tagboard and fixing bracket can now be removed.

12. The relay tagboard connections are as follows:—

Pin	*Colour*	*Destination*
a	Red	H.T. fuse and relay HOA pin 3
b	Black	Capacitor C23
1, 21	Black	Plug PL3 pin B and Earth
2	Orange	Socket SK1 pole 5
3	Red	Capacitor C20 and relay HOA pin a
22	Brown	Socket 2 pole B
23	Brown	L.T. fuse and resistor RV4 centre pin

Defective relay TRC/4

13. Dismantle the junction box (aerial) Type 7089 using the procedure detailed in para. 5. Details of the wiring to the tag panel are as follows:—

Pin	*Colour*	*Destination*
a	Black	Plug 7 Pin E and relay TRC/4 pin 26
b	Yellow	Plug 8 pin D
1	Green	Plug 6 pin 1
2	Green	Socket 1 pole 6
3	Green	Plug 7 pin L
4	Red	Plug 6 pin J
5	Red	Socket 1 pole A
6	Red	Plug 7 pin J
21	White	Plug 6 pin G
22	White	Socket 1 pole D
23	White	Plug 7 pin G
24	Brown	Plug 6 pin E
25	Brown	Socket 1 pole E
26	Black	Relay TRC/4 pin a

Relay tag board

14. The tagboards for relays HO2/2 and TRC/4 are tagboards Z.560011 which have been specially modified for this equipment. The modified boards are not available from stores.

15. The procedure for replacing the tagboards is as follows:—

(1) Dismantle the relays in the modulator unit or junction box (aerial) as detailed in para. 12 and 13.
(2) Unsolder the leads to the relay tagboard.
(3) Remove the tagboard. Retain the special fixing screws and washers.
(4) Obtain a tagboard Z.560011 and enlarge the existing fixing holes to $\frac{1}{4}$ in. diameter.

(5) Cut back the spills on the tagboard to $\frac{1}{16}$ in.
(6) Fit modified tagboard to relay bracket and secure with special screws and washers.

Fuses

16. Ensure that the spare and active fuses are serviceable and of the correct rating. Details of the fuses are as follows:—

	Nomenclature	*Stores Ref.*	*Rating*	*Colour code*
LT	Fuse Type 173	10H/19881	2·5A	Yellow and Purple
◄ HT and GB	Fuse links	5920–99–059–0136	250mA	Brown ►

Chapter 2

(Completely revised)

TEST SET TYPE 7144 AND TEST SET TYPE 7748

LIST OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF ILLUSTRATIONS

INTRODUCTION

1. Test set Type 7144 (Ref. No. 10S/16468) is provided for testing and aligning modulator unit Type 7087. In addition, facilities are provided for checking the operation of the indicator electrical Type 7. Views of the test set are shown in fig. 1 and 2. The test set Type 7748 is a modified version of test set Type 7144 and it is provided for testing modulator unit Type 7747. Details of the modifications are given in Appendix 1.

2. All the necessary connectors to make the required tests are provided with the test set, suitable provision being made for their stowage when not in use.

3. Power supplies for both the test set and the modulator unit are derived from the associated VHF transmitter-receiver.

4. The operation of the test set is described in Part 2, Chap. 4.

GENERAL DESCRIPTION

Function

5. The test is designed to check the correct operation of:—

(1) The LF assembly of modulator unit Type 7087.

(2) The complete modulator unit.

(3) Functional tests of indicator electrical Type 7.

6. Three monitoring sockets are provided to enable the switching waveforms to be examined with an oscilloscope. These are the two output waveforms from the multi-vibrator SWITCHING WAVEFORM 1 (SK2) (*fig.* 1), SWITCHING WAVEFORM 2 (SK 1) and the input waveform to the LF amplifier stage INPUT WAVEFORM (SK 3).

7. A three-position switch SELECT INPUT (SWA) provides the following alternative inputs to the LF amplifier stage:—

Position 1 EARTH—LF amplifier earthed (used to check the METER BALANCE control in the LF assembly of the modulator unit).

Position 2 LOCAL—internal input from the modulator unit multivibrator (used to check the GAIN control in the LF assembly of the modulator unit).

Position 3 TR—output from the VHF receiver (used to check the MODULATION BALANCE and the RF BALANCE controls in the RF unit).

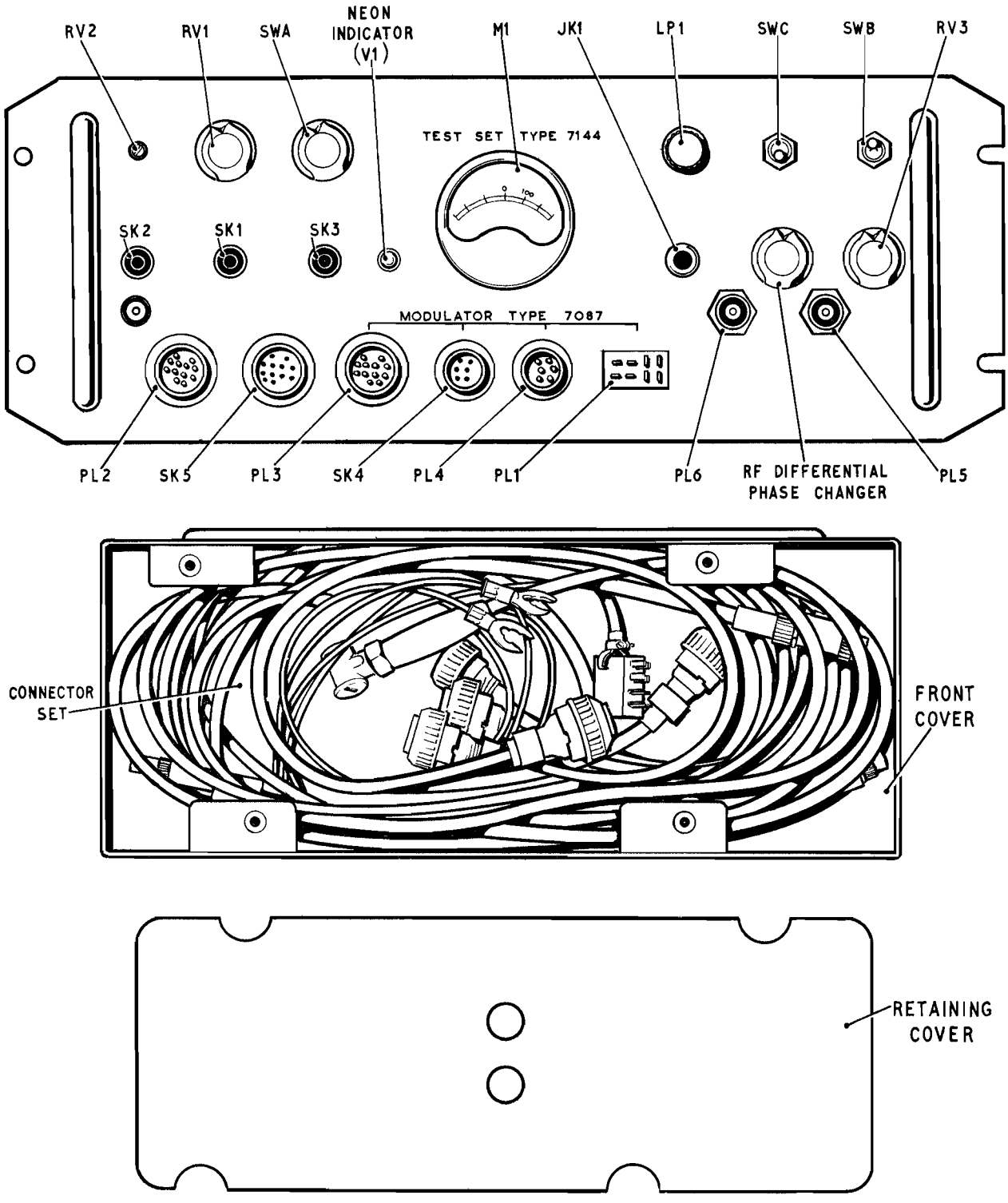


Fig. 1. Test set Type 7144—front view

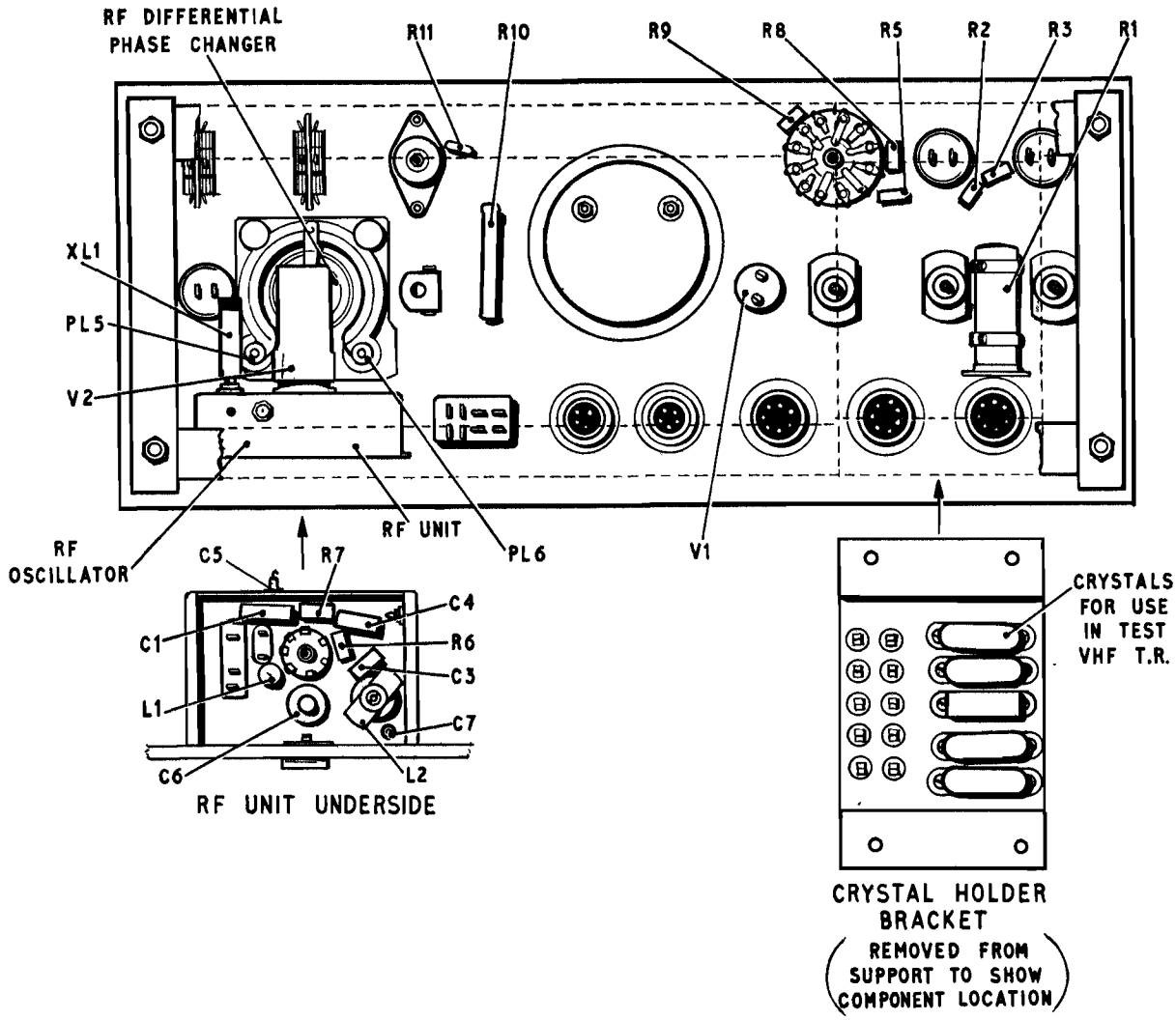


Fig. 2. Test set Type 7144—rear view

Additional contacts are provided on this switch to test the indicator electrical Type 7. The switch functions applicable to the indicator tests are marked in red.

8. The LOCAL INPUT control (RV1) is used to vary the signal applied to the LF amplifier when the SELECT INPUT switch (SWA) is set to LOCAL.

9. A crystal controlled harmonic generator using a crystal unit Type 10XJ/5670 is incorporated in the test set to provide an RF signal at all the harmonics within the band 100-156 Mc/s. The HT supply to the generator is via the XTAL OSC HT ON/OFF switch (SWB).

10. The output from the harmonic generator is fed into a RF differential phase changer. This control introduces a phase difference in the signal output applied to the RF SIGNAL output plugs PORT (PL5) and STBD (PL6) as follows:—

Fully counter clockwise—Target azimuth 30 deg. port.

Centre position—Target on course.

Fully clockwise—Target azimuth 30 deg. starboard.

11. Bearing indications are displayed on a centre-zero microammeter 250-0-250 μA instead of the pointer movements of an indicator electrical Type 7 used in the ARI's. The operation of the AVC of the associated VHF receiver is indicated by a small neon lamp (V1).

12. The sensitivity of the meter circuit can be adjusted by the METER SENSITIVITY control (RV3). With the control fully counter-clockwise full-scale deflection is obtained from a signal at 102.06 Mc/s (18th harmonic of harmonic generator) 30 deg. to port or starboard. With the control fully clockwise full scale deflection is obtained from a signal at

TABLE 1

List of connectors

Item	Type No.	Stores Ref.	No. off	Length ft.	Length in.	Type of Cable	Functions (denoted by sleeve marking)
1	B8/20A/23	10HA/14845	1	4	6	Sexto vinmet small 2.5	Test set AE RELAY to Mod unit AE RELAY
2	B8/20A/24	10HA/14846	1	4	6	Sexto vinmet small 2.5	Test set TR to Mod unit TR
3	B12/20A/22	10HA/14843	1	4	0	Twelvevinmet small 2.5	Test set CONT to Mod unit CONT
4	B12/20A/21	10HA/14842	1	6	0	Twelvevinmet small 2.5	Test set AUX to AUX TR AUX
5	B12/20A/23	10HA/14844	1	2	0	Twelvevinmet small 2.5	Test set TEST IND to INDICATOR
6	10062	10HA/14068	1	3	6	Dupren 4	Test set HT CURRENT to testmeter
7	10186	10HA/14847	1	1	6	Twelvevinmet small 2.5	Test set LF UNIT to Mod unit
8	D267/30A/1	10HA/14052	2	6	3	Uniradio 67	Test set RF SIGNALS to Mod unit
9	D267/32C/2	10HA/14848	1	6	0	Uniradio 67	Mod unit AE OUT to VHF TR AE
10	D267/21B/1	10HA/14850	1	0	6	Uniradio 67	Sig. gen to adaptor

153.09 Mc/s (27th harmonic) 30 deg. to port or starboard.

13. The NORMAL/HOMING switch (SWC) and the indicator lamp (LP1) are used to check the operation of the relay in the modulator unit.

14. The HT current break-jack (JK1) is provided in order to measure the total HT current drawn by the modulator unit.

15. The TEST IND socket (SK5) is used in conjunction with the three-position switch TEST INDICATOR to check the pointer and flag movement of the indicator electrical Type 7.

Connectors

16. A list of connectors supplied with the test set is shown in Table 1. The electrical length of the RF connectors, item 8, is 290 mm. plus or minus 3 mm. (the physical length is approximately two-thirds this figure). This length is carefully measured by the manufacturers. If one of these connectors is damaged in any way, it should be replaced with a new one from Stores.

Constructional details

17. The general layout of the test set may be seen in fig. 1 and 2. It is designed for mounting in a standard 19 in. rack. The front view (*fig.* 1) shows the controls on the front panel. A deep metal front cover provides accommodation for the connectors which are secured in position during transit by the retaining cover. The front cover is secured to the test set with four captive screws.

18. The rear view (*fig.* 2) shows the disposition of the components. The majority of the components are mounted on the back of the front panel. A small chassis houses the RF harmonic generator, the components on the underside of this chassis are screened and protected by a small plate.

19. The RF differential phase changer is a special assembly which has been developed for the test set. It consists of a 270 deg. segment of silver-plated brass strip supported on a rigid base plate by means of two insulating pillars and the pins of the two RF plugs PL5 and PL6. The spacing between the strip and the base plate is arranged so that the characteristic impedance of the assembly is 50 ohms. The output of the harmonic generator is applied to an insulating moving arm in contact with the strip.

20. Crystal holders, fitted to a small panel secured to two cross members at the rear of the test set, are provided for stowage of the five crystals required for use with the test VHF transmitter-receiver. The crystals, which are supplied with the test set, are:—

Frequency in kc/s	*Stores Ref.*
5130	10XJ/5130
5760	10XJ/5760
6390	10XJ/6390
7020	10XJ/7020
7650	10XJ/7650

CIRCUIT DESCRIPTION

Introduction

21. The complete circuit of the test set is shown in fig. 3. The circuit is described under three main headings each assuming that the test set is connected up as it would be in use.

Testing LF assembly of modulator unit Type 7087

22. Plugs PL1, PL3, PL4 and socket SK4 are connected to the modulator unit under test with the appropriate connectors. Plug PL2 is connected to the v.h.f. transmitter-receiver.

23. The power supplies from the v.h.f. transmitter-receiver are connected via plug PL2 and socket SK4 to the modulator unit. The h.t. current drawn by the modulator unit can be measured with a meter (test set Type F) connected into the break jack JK1.

24. To enable the l.f. section to be tested without the r.f. unit, the heater supply is completed via pins 7 and 8 of plug PL1 and a load resistor R1, equivalent to the r.f. unit heater load.

25. The output from the electronic switch is applied via pins 1 and 2 of plug PL1 to the potentiometer chain R2, RV1 (LOCAL INPUT), RV2 (BAL) and R3. The test sockets SK1 and SK2 enable the switching waveforms to be monitored with an oscilloscope.

26. When switch SWA is set to LOCAL the output waveform from the traveller of RV1 is applied via pole C of socket SK4 to the l.f. amplifier in the modulator unit. This waveform can be monitored at SK3.

27. The meter output from the modulator unit is applied via pins A and B of plug PL3 and the variable resistor RV3 (METER SENSITIVITY) to the microammeter M1. The neon indicator V1 (FLAG) is connected via pins C and D of plug PL3 to the modulator unit to check the operation of the flag circuit.

28. If, when switch SWC is set to HOMING, the relay in the modulator unit operates, the 24V supply is connected via a relay contact, pin B of plug PL4, and limiting resistor R11 to the indicator lamp LP1. The other side of LP1 is connected via pin A of plug PL4 through the modulator unit back to pin F of plug PL3 and switch SWC to earth.

Testing complete modulator unit

29. Plug PL1 is disconnected from the l.f. assembly and the test set. The modulator unit is reassembled and the coaxial plugs PL5 (PORT) and PL6 (STBD) on the test set are connected to the modulator unit with the special r.f. connectors provided.

30. The harmonic generator required for these tests consists of a crystal-controlled valve oscillator the anode circuit of the valve being approximately tuned to the centre of the v.h.f. band (125 Mc/s). The control grid, screen grid and cathode of valve V2 function as a triode oscillator; inductance L1 together with stray capacities form the tuned anode load. The output from the anode of V2 is connected via capacitor C6 to the moving arm of the differential phase changer.

31. The phase of the signal applied to the coaxial plugs PL5 (PORT) and PL6 (STBD) can be adjusted relative to each other by varying the position of the phase changer control.

32. When switch SWA is set to t.r. the demodulated output from the v.h.f. receiver is connected from pin L of plug PL2 to pin C of socket SK4; the resulting output from the modulator unit being displayed on microammeter M1.

Testing indicator electrical Type 7

33. The indicator is connected to socket SK5 with the special connector provided. The two pointer movements are connected to points A, B, C and D. Current is applied from +24V supply to the two pointer movements connected in parallel via resistor R8, switch wafers SWAc and SWAd and R9 to earth. The direction of the current through the movements is reversed when SWA is switched from LEFT to RIGHT.

34. The two flag movements are also tested in parallel through points J, K, L and M, resistors R4 and R5 and switch wafer SWAb.

Appendix 1

TEST SET TYPE 7748

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Conversion details

1. Test set Type 7748, reference No. 10S/16772 is a modified version of test set Type 7144 and it is used for testing modulator unit Type 7747. Details of the circuit changes involved are given in fig. 1.

2. The meter circuit in the test set Type 7144 is modified by replacing the variable resistor RV3 (fig. 3) with a fixed resistor R12 in order to simulate more closely the indicator circuit in the homing installations.

3. In the space vacated by RV3, a two-position switch SWD (fig. 1) is fitted and is used, in conjunction with the additional resistor R13, to simulate the two-position control of indicator deflection provided in ARI.18048, 18049, 18085 and 18093.

4. The wiring of plug PL3 is re-arranged to line up with wiring of socket SK3 (CONT.) of modulation unit Type 7747.

5. The operation of the test set Type 7748 is described in Part 2, Chap. 5.

Note . . .
Test set Type 7748 must not be used with modulator unit Type 7087.

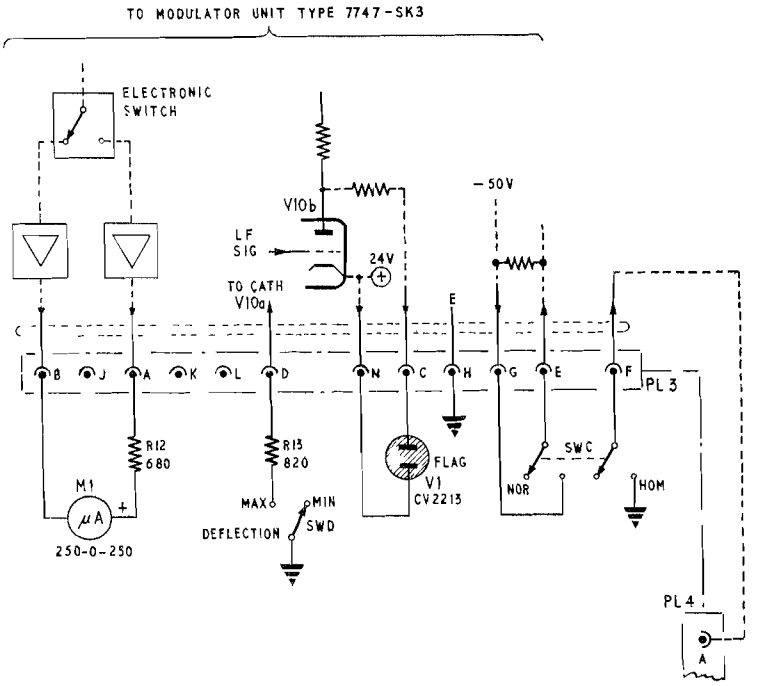


Fig. 1. Circuit changes required to convert test set Type 7144 to test set Type 7748

Chapter 3

TEST OSCILLATOR TYPE 7049

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Stores Ref. No.	◀ 10S/16757 ▶
Function	A crystal controlled MCW transmitter of very small RF power designed to check the operation of VHF navigational aid equipment installed in aircraft.
Frequency range	VHF 100–150 Mc/s, crystal controlled using 10X/.....or 10X// .....crystals.
Output power	30–150 microwatts.
Modulation	1·1 kc/s ± 200 c/s amplitude modulated.
Power supplies	Batteries:— HT 67·5V—Battery, dry No. 1 (Stores Ref. 5J/3239). LT 1·5V—Battery, dry No. 2 (Joint-Service Cat.No.6135-101102) OR Cell, dry 1·5 volts (Stores Ref. 5J/2000).
Dimensions	Width 5 in. Height 5 in. Depth 3¼ in.
Weight	3 lb. 12 oz. (including batteries).

Introduction

1. The test oscillator Type 7049, shown in fig. 1, is a crystal controlled MCW transmitter of very small RF power designed to check the operation of VHF navigational aid equipment.

2. It is a hand-held battery-operated unit which provides an amplitude-modulated signal at any frequency within the range 100 to 156 Mc/s.

General

3. Crystal units Type 10X/ - - - or 10XJ/ - - - ($\frac{1}{16}$ of the RF signal frequency required) are used in the test oscillator. The total RF power output is not less than 30 microwatts and not more than 150 microwatts dependent upon the frequency and activity of the crystal.

4. The carrier is modulated to a depth of between 20 and 60 per cent. at approximately 1 kc/s.

5. Power is supplied from self-contained HT and LT batteries as follows —

HT 67·5V—Battery, dry No. 1 (*Ref.* No. 5J/3739) at 10mA.

LT 1·5V—Battery, dry No. 2 (*Joint-Service Cat No.* 6135–101102) at 0·33A; OR

Cell, dry 1·5 volts (*Ref.* No. 5J/2000).

The oscillator will function satisfactorily with the HT down to 45 volts and the LT down to 1·25 volts.

6. Three controls are provided:—

(1) Two preset variable capacitors CRYSTAL and OUTPUT which are used to set up the oscillator to the required frequency.

(2) A spring-loaded on/off switch which is connected in series with the LT supply.

Constructional details

7. The main constructional features of the test oscillator can be seen in the views shown in fig. 1, 2, 3 and 4. It is housed in a metal case measuring 5 in. by 5 in. by 3½ in. deep and weight, complete with batteries, approximately 3 lb. 12 oz.

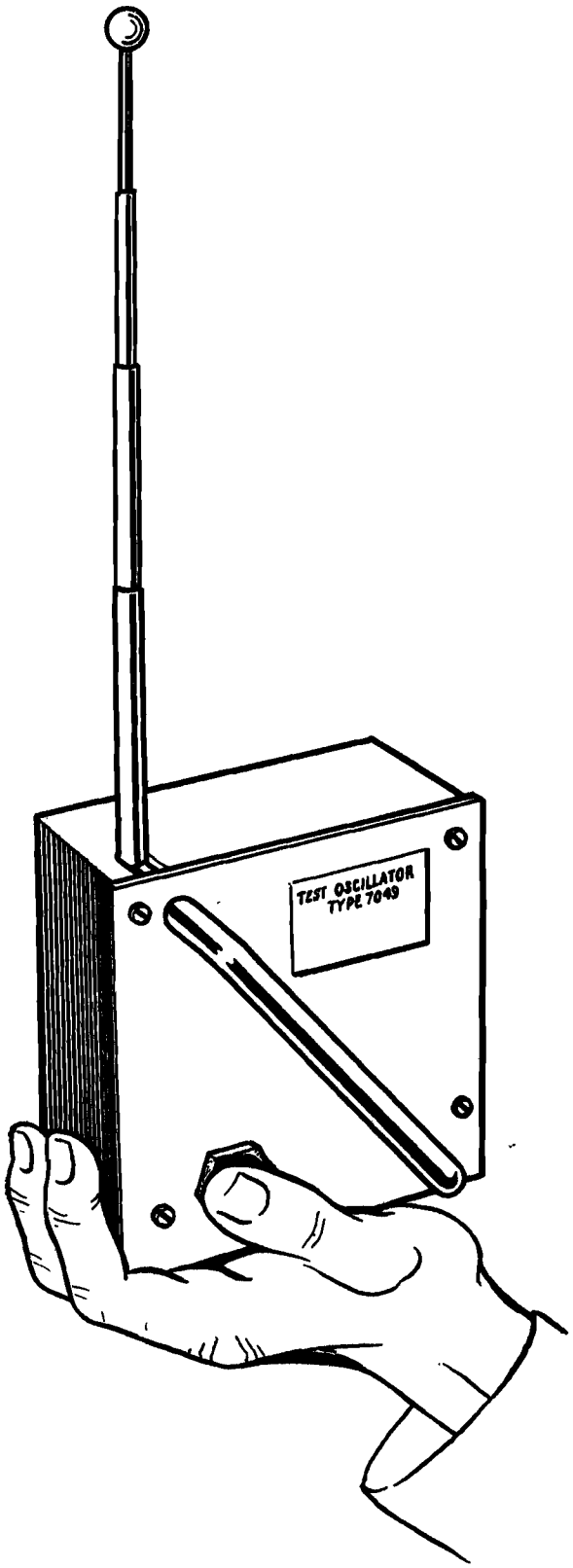


Fig. 1. Test oscillator Type 7049, general view

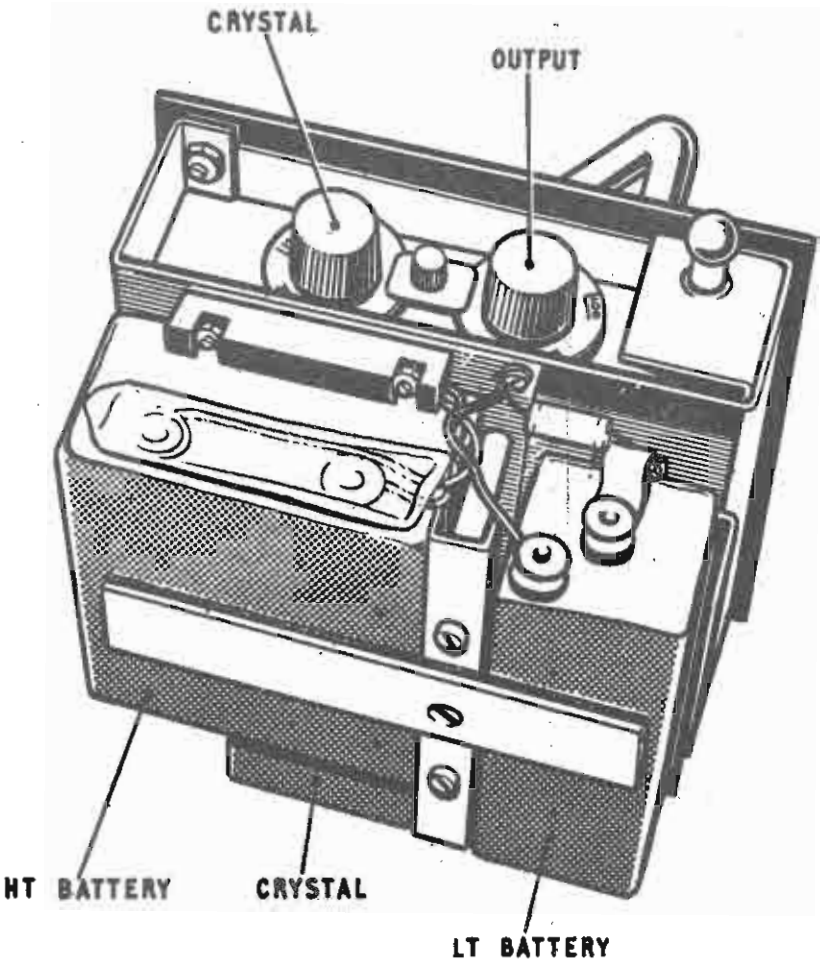


Fig. 2. Test oscillator Type 7049, rear view, cover removed

8. It is designed so that it can be held in one hand and operated with the thumb on the spring-loaded on/off switch (*fig.* 1). A four section telescopic rod aerial is incorporated. A handle on the front panel is provided for transportation.

9. The preset controls and batteries (*fig.* 2) are accessible by removing the dust cover which is secured by two Dzus fasteners. Two test points, adjacent to the controls, are provided for use during the setting-up and alignment of the test oscillator.

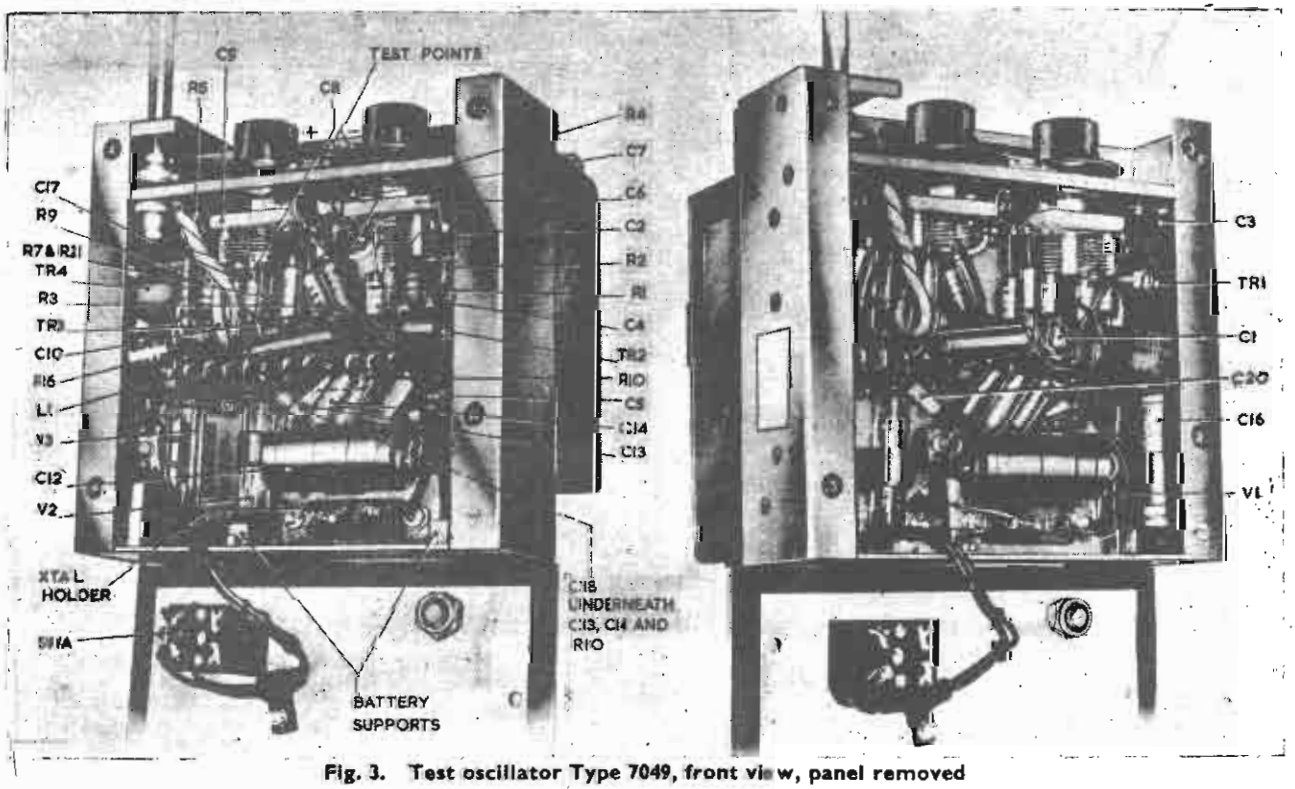


Fig. 3. Test oscillator Type 7049, front view, panel removed

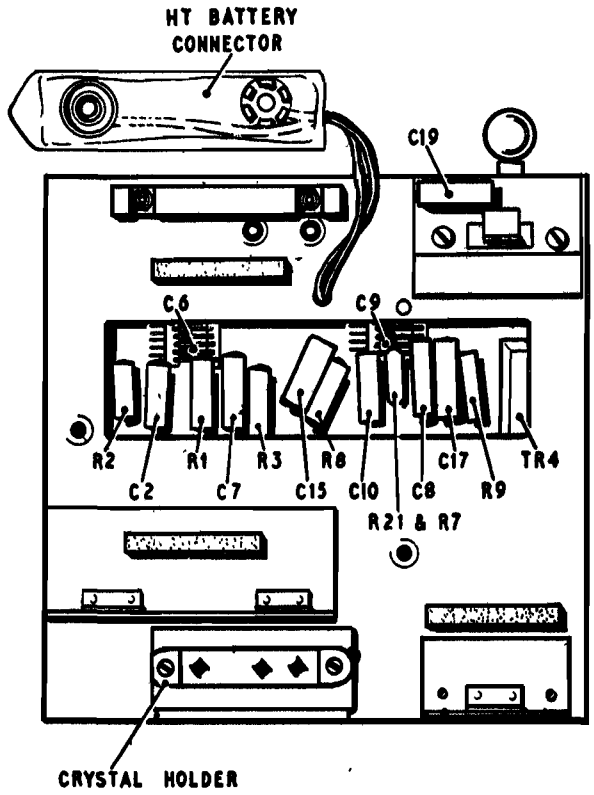


Fig. 4. Test oscillator Type 7049, rear view batteries removed

10. The majority of the components are mounted in a small box chassis (*fig.* 3) which is secured to the front panel with four screws. The crystal holder is designed to accommodate 10X/ - - - or 10XJ/ - - - Type crystal units. A slot in the rear of the chassis (*fig.* 4) provides access to the components secured to the tag strip fitted behind the variable capacitors C6 and C9.

11. A bracket fitted to the back of the chassis covers the slot and accommodates the two batteries which are locked in position by a clamp.

12. Provision is made for two alternative LT batteries (*fig.* 5). The test oscillator will normally be supplied to accommodate the rectangular battery (cell, dry 1·5 volt). To fit the cylindrical battery (battery, dry No. 2) proceed as follows:—

(1) Remove the two countersunk screws which secure the insulating block holding the LT positive connector.

(2) Remove the connector from the block taking care not to damage the capacitor C19.

(3) Invert the block and refix the connector using the lower fixing holes.

(4) Refix the block (in the inverted position) to the chassis.

(5) Remove the two curved supports from their stowage position inside the chassis (*fig.* 3) and fit one to the small cover plate and the other to the chassis (*fig.* 5).

(6) Insert the cylindrical battery and secure in position with clamp. Anchor the solder tag on the flying lead under the top clamp fixing screw.

Circuit description

13. The circuit of the test oscillator is shown in fig. 6. The pentode valve V1 is used as a combined oscillator and trebler. The control-grid, screen-grid and filament are used as a triode crystal controlled Colpitts oscillator, self bias is provided by resistor R1. The filament is maintained at the required RF potential by means of the transformer TR1 and capacitors C2 and C6. The anode load of V1, comprising the primary winding of TR2 and the variable capacitor C6, is tuned to the third harmonic of the crystal.

14. The voltage developed across the secondary winding of TR2 is applied to the control-grid of V2. Standing grid-bias for this valve is derived from voltage drop across the resistor R8 connected between the negative HT supply line and earth. Additional bias is provided by the voltage derived from the grid current passing through resistors R3, R4 and R8.

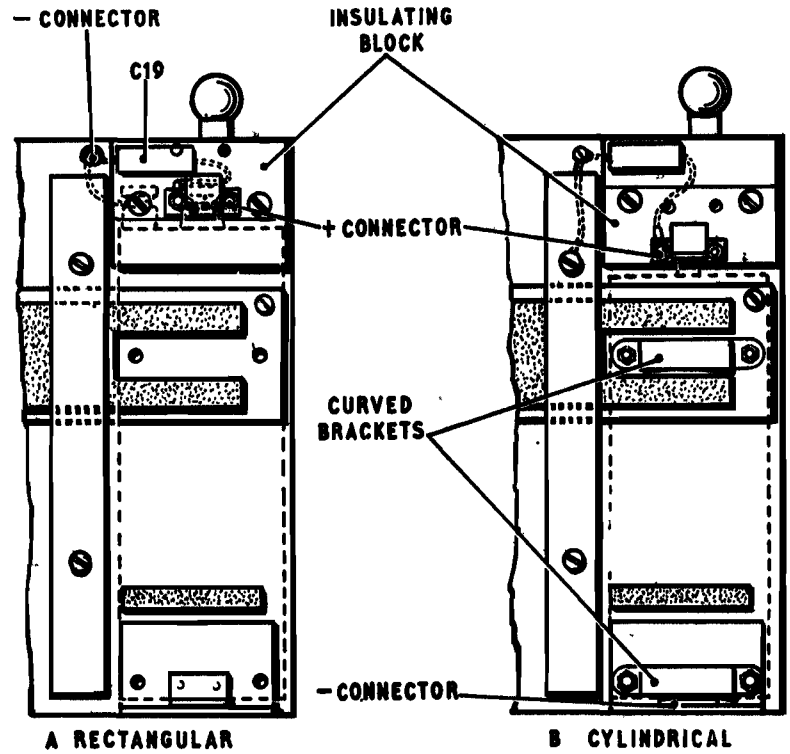


Fig. 5. Fitting alternative LT batteries

15. Since the amplitude of the bias is dependent on the drive from V1, a meter connected to the TEST POINTS (across R4) can be used to indicate the correct tuning position of C6.

16. The primary winding of TR3 and capacitor C9 provide the anode load for V2. The load is tuned to the 6th harmonic of the drive voltage *i.e.* the 18th harmonic of the crystal. The secondary winding of TR3, consisting of one turn of insulated wire, is connected to the telescopic rod aerial.

17. In order to obtain the required minimum of 20 per cent modulation over the frequency band 100–156 Mc/s a combination of control-grid screen grid and anode modulation is applied to V2.

18. A modulation frequency of approximately 1 kc/s is derived from V3. A Hartley oscillator circuit is used, the frequency of which is controlled by the inductance of the tapped l.f. choke TR4 and the capacity of C13, self bias is provided by R6.

19. The h.t. supply to the anode and screen of V2 is fed through a winding on TR4 and is therefore varying at the modulation frequency. R.F. decoupling is provided by the inductor L1 and capacitors C10 and C11.

20. A modulation voltage opposite in phase to that of the anode, is taken from the top end of TR4 and applied to the control grid of V2 via C18 and R10. This resistor limits the modulation voltage and in conjunction with C7, provides the necessary r.f. decoupling.

Setting-up

21. The setting up procedure is as follows:—

(1) Slacken off the two Dzus fasteners and remove the cover.

(2) Insert a crystal unit Type 10X/ – – – or 10XJ/ – – – of $\frac{1}{18}$th of the selected test frequency.

(3) Insert the l.t. and h.t. batteries in the spaces provided, and fit the clamp and connectors.

(4) Connect a test meter Type F (or similar meter) set to the 0 to 2 mA d.c. range, to the test points adjacent to the tuning dials, observing the correct polarity.

(5) Extend the test oscillator aerial.

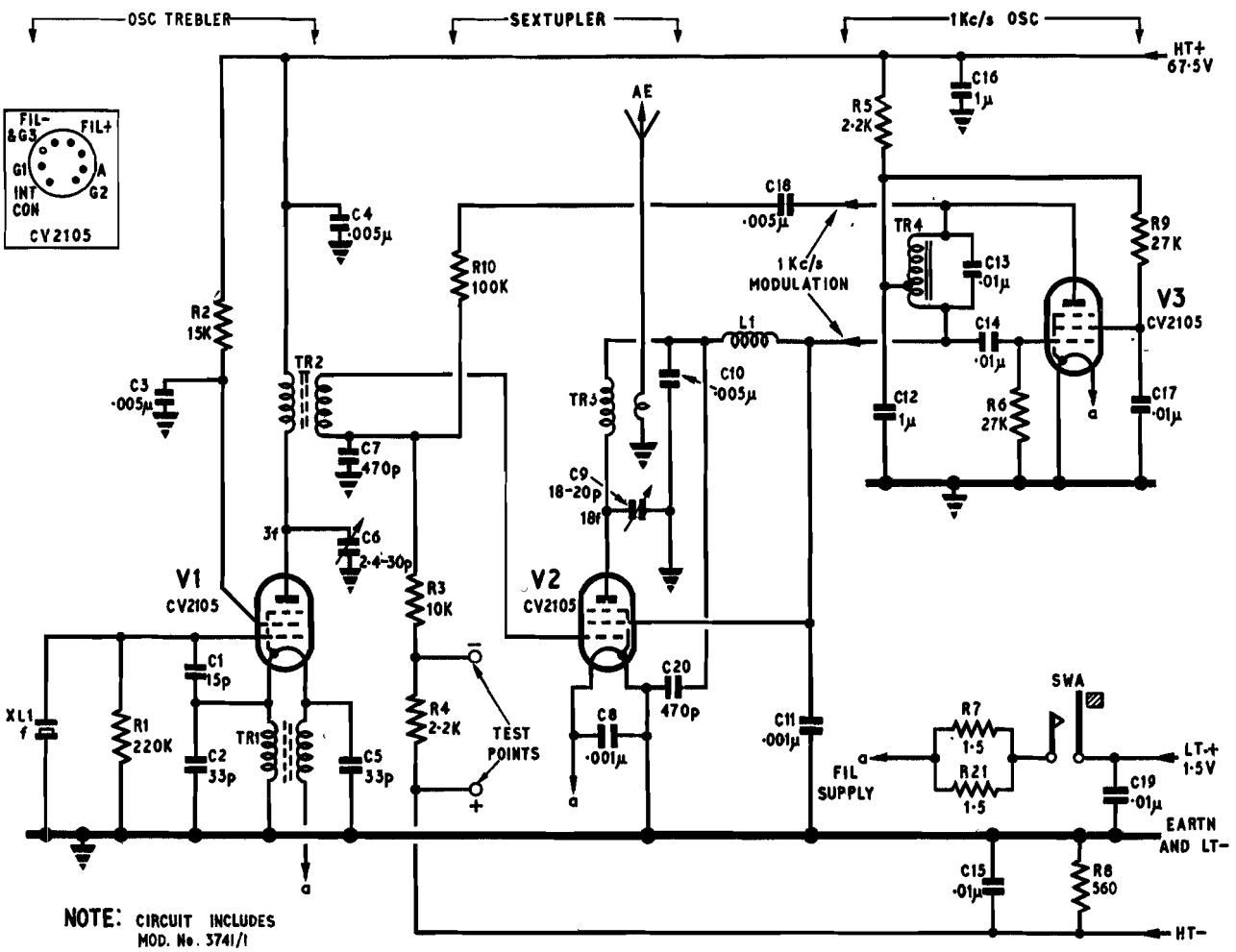


Fig. 6. Test oscillator Type 7049, circuit

F.S./3

(6) Set the knob marked "CRYSTAL" to the selected test frequency and press the l.t. on/off switch. Adjust this dial for maximum meter reading. (This should be between 0·2 and 0·45 mA dependent on the frequency and activity of the crystal).

Note . . .

As it is possible to tune the trebler stage to the incorrect crystal harmonic it is most important that the dial calibration should be strictly adhered to.

(7) Using a v.h.f. receiver tuned to the selected test frequency (*i.e.* 18 times the test oscillator crystal frequency) adjust the knob marked "OUTPUT" for maximum modulated signal in the headphones.

(8) Lock dials, replace the dust cover and tighten the Dzus fasteners.

Operation

22. There are two proposed methods of use when checking the azimuth indications in the 10-channel v.h.f. homing installations. The first requires an operator for the test oscillator and an observer in the aircraft cockpit. For this the procedure is as follows:—

(1) Set the aircraft v.h.f. receiver to the channel to which the test oscillator has already been adjusted.

(2) Set the control unit to AZIMUTH and HOMING 1 or HOMING 2 as appropriate.

(3) With the telescopic aerial fully extended the test oscillator should be held in a vertical position between 6 and 8 feet to the port of the port aerial and to the starboard of the starboard aerial in turn. The observer in the cockpit should note that when the test oscillator switch is depressed:—

(*a*) the lower flag on the indicator, electrical Type 7 disappears.

(*b*) the L/R pointer moves to the left when the oscillator is in the port side of the aircraft and conversely to the right with the oscillator on the starboard side.

(*c*) the 1000 c/s modulation note is present in the headphones.

23. The second, and more favoured, method is that in which the observer in the cockpit holds the test oscillator at arm's length on the port and starboard sides of the aircraft in turn, at the same time noting the meter pointer deflections and audio signal in his headphones.

24. Incorrect bearing indications may be obtained if the aircraft is in a hanger or on an aircraft carrier or near large masses of metal. In view of this, the first method outlined should be used only when the aircraft is in a flying attitude and in an open space.

Servicing

25. To assist in servicing the test oscillator a list of typical voltages and currents is provided:—

Voltage across the l.t. battery on load = 1·5V

◀ Voltage across the filaments on load = 1·15V–1·35V

Total l.t. current = 0·30A–0·36A

Voltage across h.t. battery on load = 63V–65V

Total h.t. current, crystal inserted and C6 tuned = 9mA–11·5mA ▶

Chapter 4

INSTRUCTIONS FOR TESTING AND ALIGNING MODULATOR UNIT TYPE 7087 USING TEST SET TYPE 7144

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

TEST EQUIPMENT

1. In addition to the test set Type 7144, which is described in Chapter 2 of this Part, the following items of Service equipment will be required:—

Nomenclature	No. off	Stores Ref.	Remarks
Signal generator Type 61	1	10S/16315	Part of test kit Type 7
or			
Signal generator Type 62	1	10S/16318	
Oscilloscope Type 13A	1	10S/831	
or			
Oscilloscope Type 13	1	10S/825	
or			
Oscilloscope Type 10	1	10SB/110	
Test meter Type Y	1	10S/16379	
or			
0—100 microammeter	1	—	Internal resistance to be approximately 250 ohms
Test meter Type F	1	10S/1	Used on 0—10 and 0—100 mA d.c. ranges only
or similar			
VHF transmitter-receiver Type TR 1997	1	10D/17978	
or			
VHF transmitter-receiver Type 1998	1	10D/17980	
Mounting assembly Type 873/2	1	10AJ/82	

Nomenclature	No. off.	Stores Ref.	Remarks
Control unit Type 382	1	10L/246	
Connector Type B12/30/B1	1	10HA/9005	Part of test rig Type 35
Connector Type 2981/1	1	10HA/4919	
Crystal unit Type 10XJ/	1	10XJ/6210	For use in the v.h.f. TR in addition to those supplied with test set Type 7144

Connectors required, other than those listed above, are supplied with the test set Type 7144 or with the relevant test equipment.

2. To cover the frequency range 100–156 Mc/s in the event of TR.1997 or TR.1998 being unobtainable, a combination of two of the v.h.f. transmitter-receivers listed below may be used.

Nomenclature	*Freq. range Mc/s*	*Stores Ref.*
TR.1934	100–125	10D/17693
TR.1935	124·5–156	10D/17694
TR.1985	106–125	10D/17937
TR.1986	124·5–156	10D/17938

Note . . .

Before they can be used for these tests:—

(1) *TR.*1934 *and TR.*1935 *must incorporate Modification No.* 2640/1 *and* 2641/1 (*Research Establishment Ref. No. R/A*182A *and R/A* 183*A*).

(2) *TR.*1985 *and TR.*1986 *must incorporate Modification No.* 2640/1 (*Research Establishment Ref. No. R/A*182A).

General

3. Connect the 28V supply and the control unit Type 382 to v.h.f. transmitter-receiver. Using the crystal units provided with the test set Type 7144 and the additional crystal unit Type 10XJ/6210 (*para.* 1) tune the receiver section of the v.h.f. transmitter-receiver as follows:—

Control unit Type 382 *position*	*Receiver frequency*	*Crystal unit Type* 10*XJ/*
A	102·06	5130
B	113·4	5760
C	124·74	6390
D	136·08	7020
E	147·42	7650
F	121·5	6210

4. Where two v.h.f. transmitter-receivers are required it will be necessary to change over the appropriate connectors during the tests.

5. The v.h.f. transmitter-receivers should be checked periodically to ensure that they meet the requirements for receiver sensitivity and the signal to noise ratio specified in the relevant Air Publication.

6. Circuit references in the text refer to fig. 1, Chap. 4, Part 1 of this volume.

TESTING THE LF ASSEMBLY OF THE MODULATOR UNIT

Initial preparation

7. Remove the r.f. unit Type 7088 from the modulator unit as follows:—

(1) Slacken off the eight Dzus fasteners and remove the top and bottom covers.

(2) Unscrew the four captive screws retaining the front panel of the r.f. unit.

(3) Upturn the modulator unit and unscrew the captive screw located in front of the Jones plug.

(4) Remove the Jones plug and withdraw the r.f. unit.

8. Connect the l.f. assembly to the test equipment as shown in fig. 1.

H.T. current consumption and relay operation

9. The h.t. current used by the l.f. assembly can be measured with the test meter Type F when it is connected into the HT CURRENT break jack. The operation of the relay in the l.f. assembly can also be checked in this test. The procedure is as follows:—

(1) Select channel D on the control unit Type 382.

(2) With the NORMAL/HOMING switch on the test set set in the NORMAL position and with the XTAL OSC HT switched to OFF the current, with the test meter Type F on the 10mA d.c. range, should be less than 1 mA.

(3) Set the test meter to the 100mA d.c. range.

(4) With the NORMAL/HOMING switch to HOMING the current should be between 16 and 21mA and, if the relay in the assembly has operated, the red indicator lamp on the test set should light.

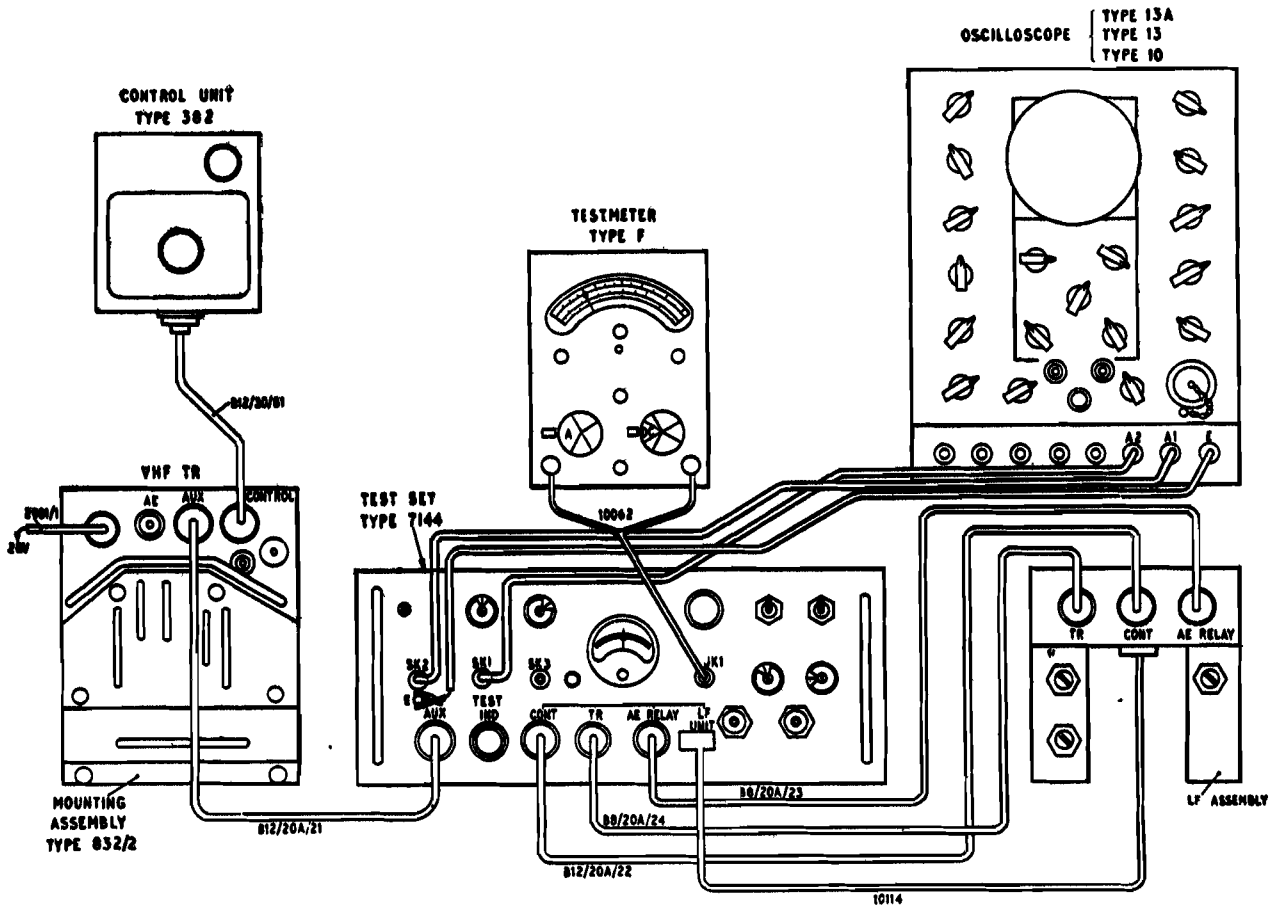


Fig. 1. Testing the L.F. assembly

Meter balance

10. The discriminator is balanced with the METER BALANCE control (RV4). To avoid errors due to extraneous pick-up the control is adjusted with the LF amplifier input earthed. Balance conditions are indicated on the microammeter in the test set. The procedure is as follows:—

(1) Set the SELECT INPUT switch on the test set to EARTH.

(2) Adjust the METER BALANCE control in the LF assembly for zero reading on the test set meter

Electronic switch waveform

11. The waveforms from the electronic switch which are normally applied to the RF unit can be examined with an oscilloscope. The procedure using the oscilloscope Type 13A, is as follows:—

(1) Connect A1 and A2 sockets of the oscilloscope to the SWITCHING WAVEFORM 1 (SK2) and SWITCHING WAVEFORM 2 (SK1) sockets on the test set.

(2) Connect the EARTH socket of the oscilloscope to the earth terminal on the test set.

(3) With A1 and A2 gain controls of the oscilloscope set to maximum in turn each waveform should cover at least 3·2 cm (i.e. greater than 4V peak-to-peak). The waveforms should be square with a mark to space ratio not greater that 1·2 to 1.

Meter gain control

12. The switching waveforms (*para.* 11) are fed back into the LF amplifier and are used to set the METER GAIN control (RV3) in the LF assembly to a predetermined level. The waveforms are applied to the LOCAL INPUT control in the test set. The output from this control can be varied to simulate a signal from port or starboard or in the BAL position to simulate an "on course" signal. The signal output can be monitored with the oscilloscope at the INPUT WAVEFORM test socket SK3.

13. To compensate for slight differences in waveform shape and amplitude the BAL preset control on the test set is adjusted for a zero reading on the meter when the LOCAL INPUT control is set to BAL.

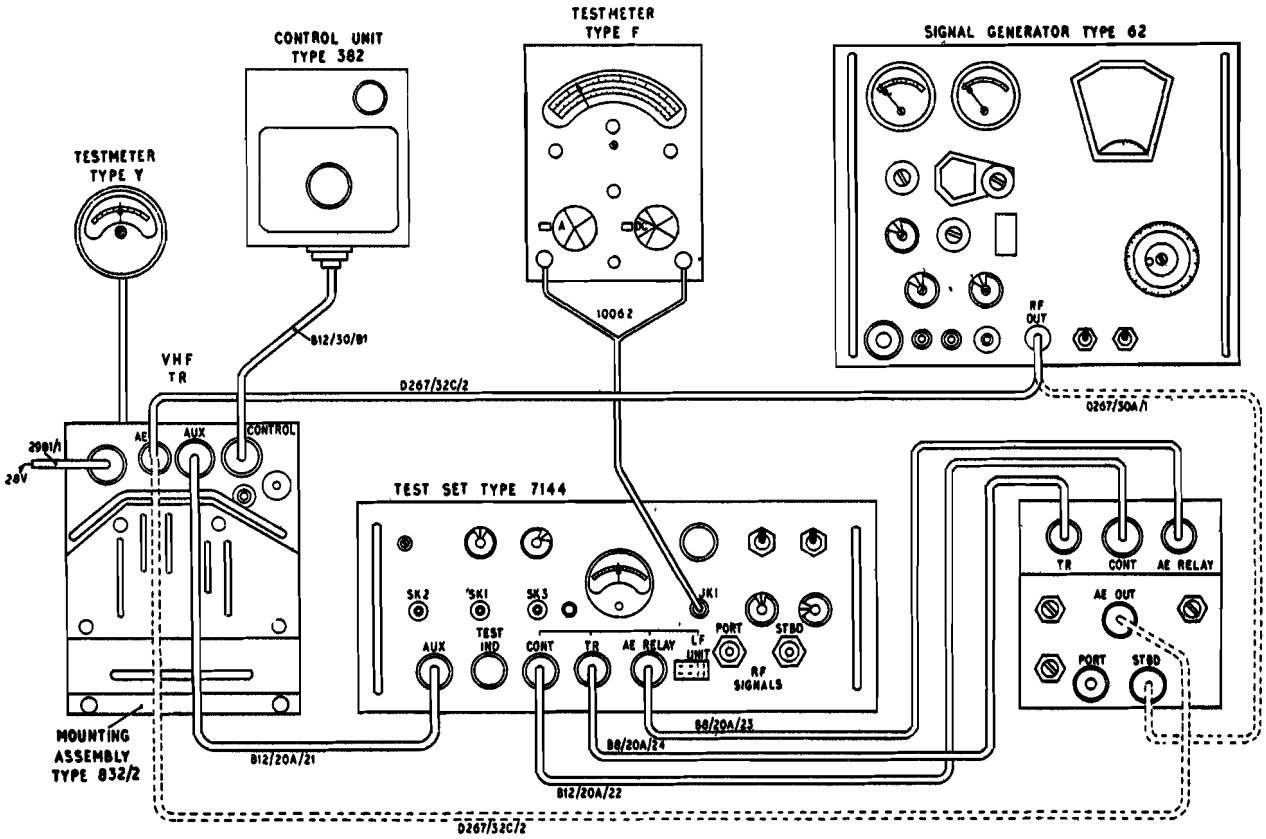


Fig. 2. Insertion loss test

14. The procedure for adjusting the METER GAIN control is as follows:—

(1) Adjust the METER SENSITIVITY control on the test set to maximum (fully clockwise position).

(2) Set the LOCAL INPUT control on the test set to BAL and the SELECT INPUT switch to LOCAL.

(3) Adjust the BAL control on the test set with a screwdriver for a zero reading on the test set meter.

(4) Set the LOCAL INPUT control to maximum in the direction of "L" and set the METER GAIN control (RV3) on the LF assembly for a reading of 200 on the test set meter.

Note...

In some modular units it is possible to get an incorrect setting of RV3 due to overloading the discriminator stage. To ensure that the correct reading is obtained RV3 should be turned fully counter-clockwise and then readjusted.

(5) Set the LOCAL INPUT control on tests set to maximum in the direction of "R". The test set meter should read between 180 and 220 microamps.

(6) Switch off the VHF transmitter-receiver.

TESTING THE COMPLETE MODULATOR UNIT

15. Remove the connector Type 10114 (*fig.* 1) and reconnect the RF unit to the LF assembly but do not reassemble the two units. This allows the RF unit to be orientated in any position and so provides easy access to the preset controls.

HT current consumption

16.

(1) Select channel D on the control unit Type 382.

(2) Set the test set controls as follows:—

(a) NORMAL/HOMING switch to HOMING
(b) SELECT INPUT switch to EARTH
(c) THE XTAL OSC HT switch to OFF

(3) The current measured with the test meter Type F should be between 40 and 50mA DC.

Insertion loss

17. To ascertain the decrease in signal strength due to the insertion of the modulator unit in the aircraft VHF receiver system the test set-up shown in fig. 2 is used. Signal generator Type 61 may be used in place of the Type 62. In this event the special adaptor connector Type D267/21B/1 provided with the test set Type 7144 should be used in conjunction with either connector Type D267/32C/2 or D267/30A/1 to make the necessary RF connections. Full operations instructions for signal generator Type 62 will be found in A.P.2563BN and for signal generator Type 61 in A.P.2538JJ.

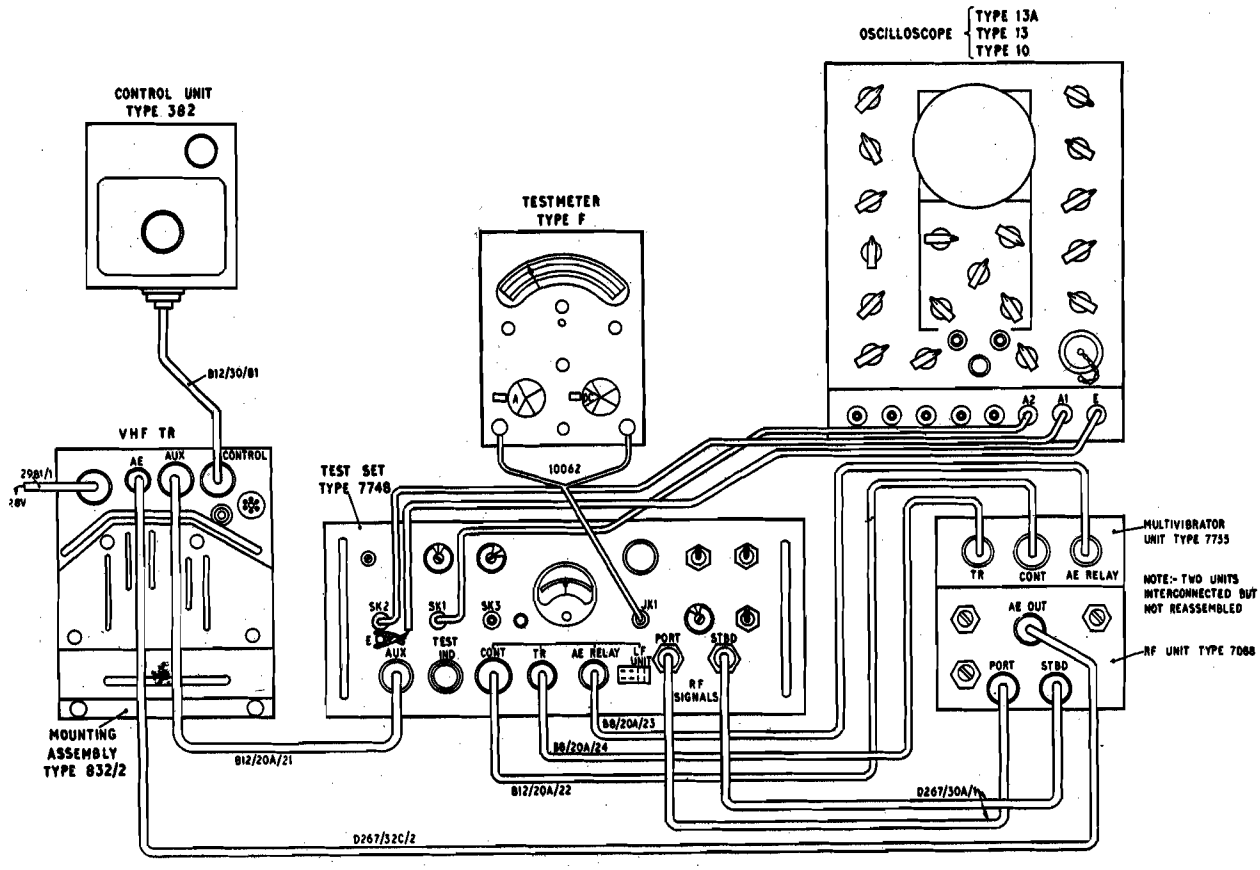


Fig. 3. Testing the complete modulator unit

18. The insertion loss test is checked at a frequency of 121·5 Mc/s. The procedure is as follows:—

(1) Set the local tune switch situated on the extreme left of the VHF transmitter-receiver channel change mechanizing to REC (mid-way position).

(2) Connect the test meter Type Y (or the 0—100 microammeter) to the 2-pole plug IP2 on the IF amplifier chassis of the VHF transmitter-receiver.

(3) Connect the signal generator RF OUTPUT to the VHF transmitter-receiver AERIAL socket by means of the connector Type B267/32C/2.

(4) Select channel F (121·5 Mc/s) on the control unit Type 382 and set the NORMAL/HOMING switch on the test set to HOMING.

(5) Set the signal generator to 121·5 Mc/s on CW operation and adjust the ATTENUATOR for a reading of 40 on the test meter Type Y. Ensure that the SIG GEN TUNE control is adjusted for peak output readjusting the ATTENUATOR if necessary. Note the ATTENUATOR reading.

(6) Transfer the connector Type D267/32C/2 from the signal generator to the AE OUT socket on the modulator unit.

(7) Connect the signal generator RF OUTPUT to the PORT aerial socket of the modulator unit by means of connector Type D267/30A/1.

(8) Adjust the signal generator ATTENUATOR for a reading of 20 on the test meter Type Y.

(9) Adjust capacitor C14 on the modulator unit for peak reading on the test meter Type Y (the slotted shaft of C14 is accessible with a small screwdriver through a hole adjacent to V3 on the top side of RF unit chassis).

(10) Ensure that the signal generator SIG GEN TUNE control is tuned correctly and readjust the ATTENUATOR for a reading of 40 on the test meter Type Y. The ATTENUATOR reading should be within —3 dB of the value obtained in sub-para. (5).

(11) Transfer the connector Type D267/30A/1 to the STBD aerial socket of the modulator unit and repeat sub-para. (10).

(12) Set the control unit Type 382 to OFF and restore the VHF transmitter-receiver local tune switch to OFF (fully in position).

◀ **Note . . .**

Insertion losses greater than 3 dB are to be expected at frequencies other than 121·5 Mc/s these being greater at the extreme limits of the VHF band. This is acceptable provided that insertion loss tests details in para. 18 are met. ▶

(A.L.15, Nov. 57)

RF unit preset controls

19. The preset controls in the RF unit are adjusted under signal conditions using the harmonic generator in the test set Type 7144 as a signal source. The test equipment is connected up as shown in fig. 3. The RF unit is connected to but not re-assembled in the LF assembly.

Modulation balance

20. Variable inductor L5 and the MODULATION BALANCE control (RV2) are used in conjunction to balance the modulator stage. The connector Type D267/30A/1 connected to the STBD aerial sockets on the test set and the modulator unit must be removed. The test procedure is as follows:—

(1) Connect the oscilloscope as follows:—

(a) The SYNC socket to cathode of V6a on the modulator unit

(*b*) A1 socket to SK3 on the test set

(c) E socket to E terminal on the test set.

(2) Select channel D on the control unit Type 382.

(3) Set the XTAL OSC HT switch on the test set to ON, the NORMAL/HOMING switch to HOMING and the SELECT INPUT switch to TR.

(4) Adjust the METER GAIN control (RV3) to approximately 90 deg. from its fully counter-clockwise position.

(5) Using the connector Type D267/30P/1 join the PORT aerial socket on the test set to the PORT aerial socket on the modulator unit.

(6) Adjust the controls on the oscilloscope until two cycles of modulation waveform can be seen. Note the amplitude of the waveform.

Note . . .

Amplitude modulation of the carrier is introduced in this test resulting in "spikes" appearing on the trace at a repetition frequency of twice the switching frequency. The "spikes" should be ignored during the balancing adjustments.

(7) Remove the connector from the PORT aerial socket on the modulator unit and connect it to the STBD socket. The amplitude waveform should be the same as that in para. 6.

(8) If the two waveforms are not equal adjust the MODULATION BALANCE control (RV2) and again observe the trace on the oscilloscope when the RF connector is connected to the PORT and STBD aerial in turn. Repeat as necessary until the amplitudes are equal.

(9) Having adjusted the MODULATION BALANCE control, adjust L5 (accessible through the centre hole in the bottom over the RF unit) until the horizontal lines between the spikes are co-linear when the connection is connected to both the PORT and STBD positions in turn.

RF balance

21.

(1) Using both the RF connectors Type D267/30A/1 connect the test set and modulator unit aerial sockets PORT to PORT and STBD to STBD.

(2) Select channel B on the control unit Type 382.

(3) Set the RF differential phase changer to the ON COURSE position.

(4) Adjust the RF BALANCE control (RV1) on the modulator unit for a zero reading on the test set meter.

(5) It is possible for a slight error to be introduced in this adjustment due to small differences in the electrical characteristics of the two connectors Type D267/30A/1. This should be checked as follows:—

(a) Interchange the connectors Type D267/30A/1 ensuring that PORT is connected to PORT and STBD to STBD.

(b) If the meter does not read zero, note the reading and adjust RV1 for half this value.

(c) Restore the connectors to their original positions. The meter should read the same value in the opposite sense, e.g. Meter reading (b) 16 microamps to PORT, adjust RV1 until meter reads 8 microamps to PORT. Meter (c) should read 8 microamps to STBD.

Note . . .

If the reading in (b) is greater than 20 microamps the connectors should be considered suspect and should be replaced with new ones from stores.

Overall performance

22. Reassemble the RF unit in the LF assembly but do not replace the top and bottom covers. With the modulator connected as in fig. 3, proceed as follows:—

(1) Set the METER SENSITIVITY control on the test set to mid-way position.

(2) Select channel A on the control unit Type 382.

(3) Set the RF differential phase-changer to the fully PORT and fully STBD positions in turn and observe the meter readings.

(4) Adjust the METER GAIN control (RV3) in the modulator unit until the larger of the two readings is 150 microamps.

(5) Set the RF differential phase-changer to the ON COURSE fully PORT and fully STBD positions in turn on channels A to E and record the meter readings.

The meter readings should conform to following values:—

Channel	ON COURSE limits Plus or minus	Fully PORT and fully STARBOARD. Minimum change from observed ON COURSE readings
A	40	120
B	20	130
C	120	*160
D	120	*190
E	150	*200

* The meter indications are non-linear above 200 due to the limiting action of the meter circuit in the modulator unit and it is possible that these requirements cannot be met when the ON COURSE reading is not approximately zero. In these cases provided that the reading in the opposite sense to the ON COURSE reading meets the requirements, the modulator unit can be considered satisfactory, e.g. if the ON COURSE reading for channel D is 80 microamps to PORT the reading for the fully STBD position should be not less than 110 i.e. 80 + 110 equals 190 microamps.

Note . . .

Although the ON COURSE *tolerances seem rather large in actual bearing indications they represent an error of approximately* 8 *degrees on each frequency channel.*

23. Having completed all the adjustments to the modulator unit:—

(1) Lock the preset controls RV1, RV2, RV3 and RV4.

(2) Ensure that there is a full complement of serviceable spare fuses stowed in top cover.

(3) Replace the top and bottom covers.

TESTING INDICATOR ELECTRICAL TYPE 7

24. The indicator to be tested is connected to the TEST IND socket of the test set Type 7144 as shown in fig. 4. The two indicators movements and the two flag movements are tested simultaneously as follows:—

(1) Select channel A on control unit Type 382.

(2) Set the TEST INDICATOR switch on the test set to L. The two flags should disappear and the two indicator movements should deflect between half and full scale to the left and ◄ downwards respectively. ►

(3) Set the TEST INDICATOR switch to R. The two flags should disappear and the two indicator movements should deflect between ◄ half and full scale to the right and upwards respectively. ►

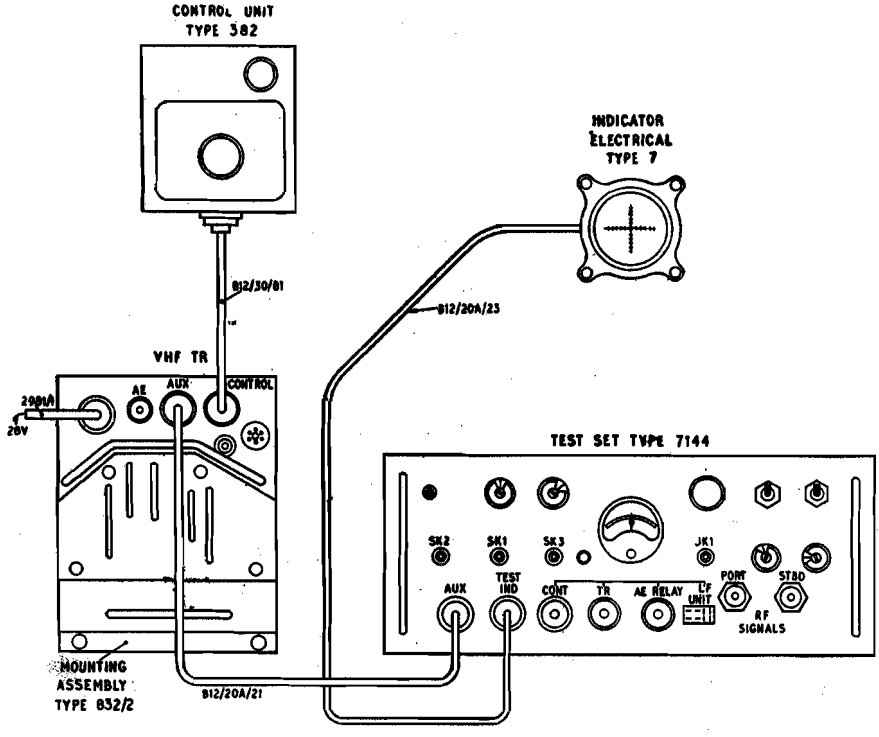


Fig. 4. Testing the indicator electrical Type 7

Chapter 5

INSTRUCTIONS FOR TESTING AND ALIGNING MODULATOR UNIT TYPE 7747 USING TEST SET TYPE 7748

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

TEST EQUIPMENT

1. In addition to the test set Type 7748, which is described in Chapter 2 of this Part, the following items of Service equipment will be required:—

Nomenclature	No. off	Stores Ref.	Remarks
Signal generator Type 61	1	10S/16315	Part of test kit Type 7
or			
Signal generator Type 62	1	10S/16318	
Oscilloscope Type 13A	1	10S/831	
or			
Oscilloscope Type 13	1	10S/825	
or			
Oscilloscope Type 10	1	10SB/110	
Test meter Type Y	1	10S/16379	
or			
0—100 microammeter	1	—	Internal resistance to be approximately 250 ohms
Test meter Type F	1	10S/1	Used on 0–10 and 0–100 mA d.c. ranges only
or similar			
VHF transmitter-receiver Type TR.1997	1	10D/17978	
or			
VHF transmitter-receiver Type TR.1998	1	10D/17980	
Mounting assembly Type 873/2	1	10AJ/82	
Control unit Type 382	1	10L/246	
Connector Type B12/30/B1	1	10HA/9005	Part of test rig
Connector Type 2981/1	1	10HA/4919	Type 35
Crystal unit Type 10XJ/	1	10XJ/6210	For use in the VHF TR in addition to those supplied with test set Type 7748.

Connectors required, other than those listed above, are supplied with the test set Type 7748 or with the relevant test equipment.

2. To cover the frequency range 100–156 Mc/s in the event of TR.1997 or TR.1998 being unobtainable a combination of two of the v.h.f. transmitter-receivers listed below may be used:—

Nomenclature	*Freq. range Mc/s*	*Stores Ref.*
TR.1934	100–125	10D/17693
TR.1935	124·5–156	10D/17694
TR.1985	100–125	10D/17937
TR.1986	124·5–156	10D/17938

Note . . .

Before they can be used for these tests:—

(1) *TR.*1934 *and TR.*1935 *must incorporate Modification No.* 2640/1 *and* 2641/1 *(Research Establishment Ref. No. R/A* 182*A and R/A* 183*A).*

(2) *TR.*1985 *and TR.*1986 *must incorporate Modification No.* 2640/1 *(Research Establishment Ref. No. R/A* 192*A).*

General

3. Connect the 28V supply and the control unit Type 382 to v.h.f. transmitter-receiver. Using the crystal units provided with the test set Type 7748 and the additional crystal unit Type 10XJ/6210 (*para.* 1) tune the receiver section of the v.h.f. transmitter-receiver as follows:—

Control unit Type 382 position	*Receiver frequency*	*Crystal unit Type 10XJ/*
A	102·06	5130
B	113·4	5760
C	124·74	6390
D	136·08	7020
E	147·42	7650
F	121·5	6210

4. Where two v.h.f. transmitter-receivers are required it will be necessary to change over the appropriate connectors during the tests.

5. The v.h.f. transmitter-receivers should be checked periodically to ensure that they meet the requirements for receiver sensitivity and signal to noise ratio specified in the relevant Air Publication.

6. Circuit references in the test refer to fig. 10, Chapter 4, Part 1 of this Volume.

TESTING THE MULTIVIBRATOR UNIT TYPE 7755

Initial preparation

7. Remove the r.f. unit Type 7088 from the multivibrator unit as follows:—

(1) Slacken off the eight Dzus fasteners and remove the top and bottom covers.

(2) Unscrew the four captive screws retaining the front panel of the r.f. unit.

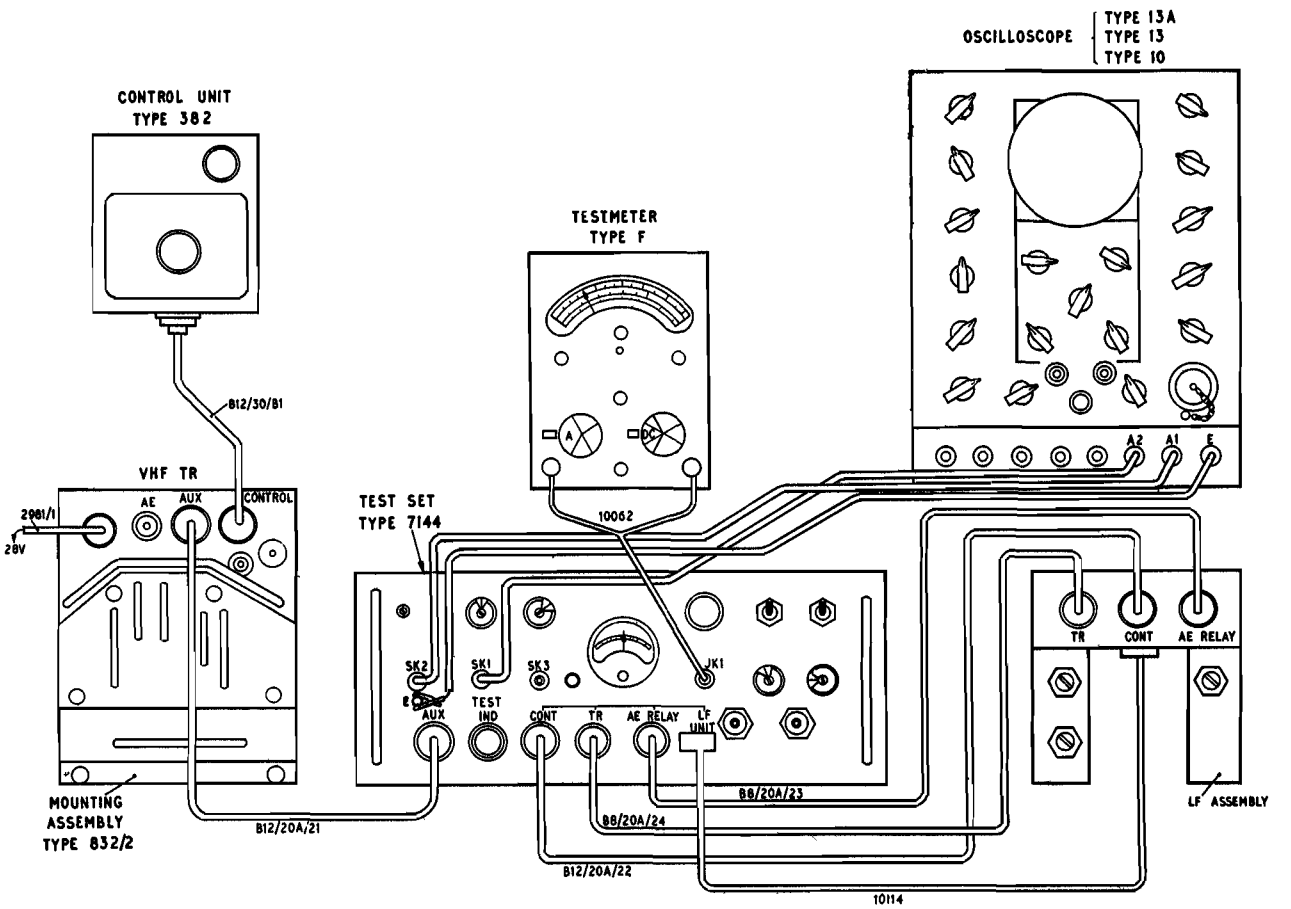


Fig. 1. Testing the multivibrator unit Type 7755

(3) Upturn the modulator unit and unscrew the captive screw located in front of the Jones plug.

(4) Remove the Jones plug and withdraw the r.f. unit.

8. Connect the multivibrator unit to the test equipment as shown in fig. 1.

H.T. current consumption and relay operation

9. The h.t. current used by the multivibrator unit can be measured with the test meter Type F when it is connected into the H.T. CURRENT break jack. The operation of the relay can also be checked in this test. The procedure is as follows:—

(1) Select channel D on the control unit Type 382.

(2) With the NORMAL/HOMING switch on the test set in the NORMAL position and with the XTAL OSC H.T. switch to OFF, the current, with the test meter Type F on the 10 mA d.c. range, should be less than 1 mA.

(3) Set the test meter to the 100 mA d.c. range.

(4) With the NORMAL/HOMING switch to HOMING the current should be between 16 and 21 mA and if the relay in the multivibrator unit has operated, the red indicator lamp on the test set should light.

Meter balance

10. The discriminator is balanced with the METER BALANCE control (RV4). To avoid errors due to extraneous pick-up, the control is adjusted with the l.f. amplifier input earthed. Balance conditions are indicated on the microammeter in the test set. The procedure is as follows:—

(1) Set the SELECT INPUT switch on the test set to EARTH.

(2) Adjust the METER BALANCE control in the multivibrator unit for zero reading on the test set meter.

Electronic switch waveforms

11. The waveforms from the electronic switch which are normally applied to the r.f. unit can be examined with an oscilloscope. The procedure using the oscilloscope Type 13A, is as follows:—

(1) Connect A1 and A2 sockets of the oscilloscope to the SWITCHING WAVEFORM 1 (SK2) and SWITCHING WAVEFORM 2 (SK1) sockets on the test set.

(2) Connect the EARTH socket of the oscilloscope to the earth terminal on the test set.

(3) With A1 and A2 gain controls of the oscilloscope set to maximum in turn each waveform should cover at least 3·2 cm (i.e., greater than 4V peak to peak). The waveforms should be square with a mark-to-space ratio not greater than 1·2 to 1.

Meter sense and amplitude test

12. The switching waveforms (*para.* 11) are fed back into the l.f. amplifier and are used to check that the meter readings are in the correct sense and that the deflections to the right and left are approximately equal. The waveforms are applied to the LOCAL INPUT control in the test set. The output from this control can be varied to simulate a signal from port or starboard, or in the BAL position, to simulate an "on course" signal. The signal output can be monitored with the oscilloscope at the INPUT WAVEFORM test socket SK3.

13. To compensate for slight differences in waveform shape and amplitude the BAL preset control on the test set is adjusted for a zero reading on the meter when the LOCAL INPUT control is set to BAL.

14. The procedure for this test is as follows:—

(1) Set the METER SENSITIVITY switch on the test set to MAX.

(2) Set the LOCAL INPUT control on the test set to BAL and the SELECT INPUT switch to LOCAL.

(3) Adjust the BAL control on the test set with a screwdriver for a zero reading on the test set meter.

(4) Set the LOCAL INPUT control to maximum in the direction of "L" and check that the meter deflects to the left.

(5) Adjust the METER GAIN control (RV3) in the multivibrator unit for a reading of 200 on the test set meter.

Note . . .

In some modulator units it is possible to get an incorrect setting of RV3 due to overloading the discriminator stage. To ensure that the correct reading is obtained RV3 should be turned fully counter-clockwise and then readjusted.

(6) Set the LOCAL INPUT control on test set to maximum in the direction of "R". The test set meter should deflect to the right and should read between 180 and 220 microamps.

(7) Switch off the v.h.f. transmitter-receiver.

TESTING THE COMPLETE MODULATOR UNIT

15. Remove the connector Type 10114 (*fig.* 1) and reconnect the r.f. unit to the multivibrator unit but do not re-assemble the two units. This allows the r.f. unit to be orientated in any position and so provides easy access to the preset controls.

H.T. current consumption

16.

(1) Select channel D on the control unit Type 382.

(2) Set the test set controls as follows:—

(a) NORMAL/HOMING switch to HOMING.

(b) SELECT INPUT switch to EARTH.

(c) The XTAL OSC H.T. switch to OFF.

(3) The current measured with the test meter Type F should be between 40 and 50 mA d.c.

Insertion loss

17. To ascertain the decrease on signal strength due to the insertion of the modulator unit in the aircraft v.h.f. receiver system the test set-up shown in fig. 2 is used. Signal generator Type 61 may be used in place of the Type 62. In this event the special adaptor connector Type D267/21B/1 provided with the test set Type 7748 should be used in conjunction with either connector Type

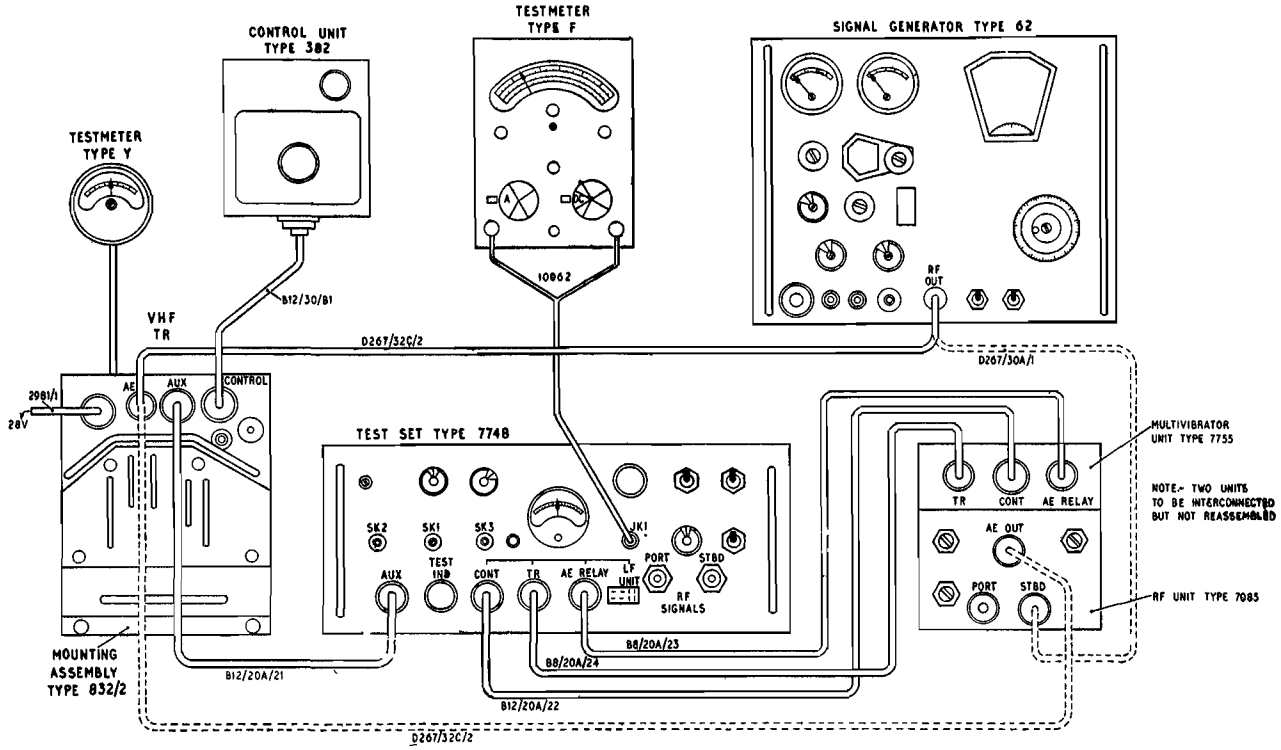


Fig. 2. Insertion loss test

D267/32C/2 or D267/30A/1 to make the necessary r.f. connections. Full operations instructions for signal generator Type 62 will be found in A.P. 2563BN and for signal generator Type 61 in A.P.2538JJ.

Note . . .

If the special adaptor connector Type D267/21B/1 is not available, an alternative connector can be made up using an adaptor bulkhead socket to socket (Z560047) and a short length of cable uniradio Type 67 terminated at one end with a socket Type 703 (10H/19608) and at the other with a socket Type 523 (10H/3931).

18. The insertion loss is checked at a frequency of 121·5 Mc/s. The procedure is as follows:—

(1) Set the local tune switch situated on the extreme left of the v.h.f. transmitter-receiver channel change mechanism to REC (mid-way position).

(2) Connect the test meter Type Y (or the 0–100 microammeter) to the 2-pin plug 1P2 on the i.f. amplifier chassis of the v.h.f. transmitter-receiver.

(3) Connect the signal generator R.F. OUTPUT to the v.h.f. transmitter-receiver AERIAL socket by means of the connector Type B267/32C/2.

(4) Select channel F (121·5 Mc/s) on the control unit Type 382 and set the NORMAL/HOMING switch on the test set to HOMING.

(5) Set the signal generator to 121·5 Mc/s on c.w. operation and adjust the ATTENUATOR for a reading of 40 on the test meter Type Y. Ensure that the SIG. GEN. TUNE control is adjusted for peak output, readjusting the ATTENUATOR if necessary. Note the ATTENUATOR reading.

(6) Transfer the connector Type D267/32C/2 from the signal generator to the AE OUT socket on the modulator unit.

(7) Connect the signal generator R.F. OUTPUT to the PORT aerial socket of the modulator unit by means of connector Type D267/30A/1.

(8) Adjust the signal generator ATTENUATOR for a reading of 20 on the test meter Type Y.

(9) Adjust the capacitor C14 on the modulator unit for peak reading on the test meter Type Y (the slotted shaft of C14 is accessible with a small screwdriver through a hole adjacent to V3 on the top side of r.f. unit chassis).

(10) Ensure that the signal generator SIG. GEN. TUNE control is tuned correctly and readjust the ATTENUATOR for a reading of 40 on the test set Type Y. The ATTENUATOR reading ◀ should be within—6 dB of the value obtained ▶ in sub-para. (5).

(11) Transfer the connector Type D267/30A/1 to the STBD aerial socket of the modulator unit and repeat sub-para. (10).

(12) Set the control unit Type 382 to OFF and restore the v.h.f. transmitter-receiver local tune switch to OFF (fully in position).

Note . . .

Insertion losses greater than 3 dB are to be expected at frequencies other than 121·5 Mc/s, these losses being greater at the extreme limits of the v.h.f. band. This is acceptable provided that insertion loss tests details in para. 18 are met.

R.F. unit preset controls

19. The preset controls on the r.f. unit are adjusted under signal conditions using the harmonic generator in the test set Type 7748 as a signal source. The test equipment is connected up as

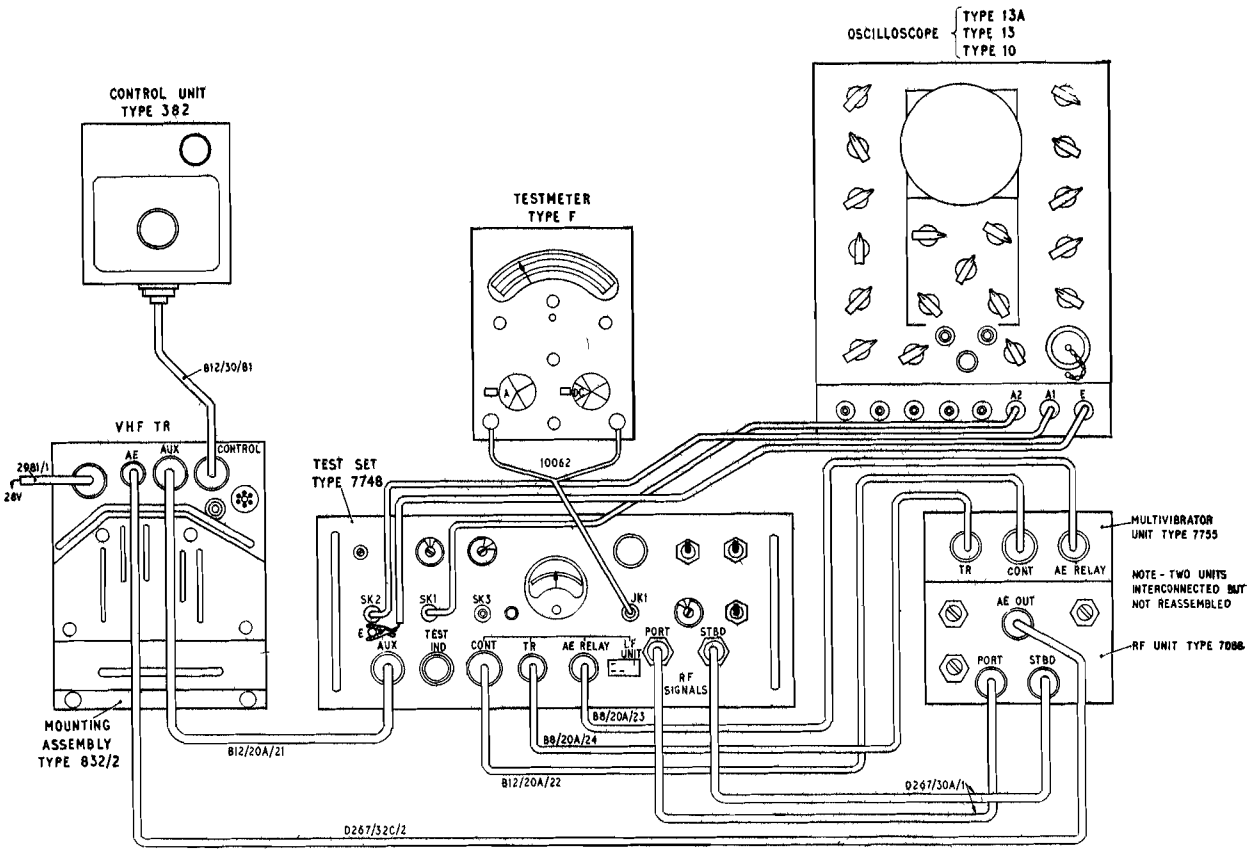


Fig. 3 Testing the complete modulator unit

shown in fig. 3. The r.f. unit is connected to but not reassembled in the multivibrator unit.

Modulation balance

20. Variable inductor L5 and the MODULATION BALANCE control (RV2) are used in conjunction to balance the modulator stage. The connector Type D267/30A/1 connected to the STBD aerial sockets on the test set and the r.f. unit must be removed. The test procedure is as follows:—

(1) Connect the oscilloscope as follows:—
  (*a*) The SYNC socket to cathode of V6a on the modulator unit
  (*b*) A1 socket to SK3 on the test set
  (*c*) E socket to E terminal on the test set.

(2) Select channel D on the control unit Type 382.

(3) Set the XTAL OSC H.T. switch on the test set to ON, the NORMAL/HOMING switch to HOMING and the SELECT INPUT switch to TR.

(4) Adjust the METER GAIN control (RV3) to approximately 90° from its fully counter-clockwise position.

(5) Using the connector Type D267/30P/1 join the PORT aerial socket on the test set to the PORT aerial socket on the modulator unit.

(6) Adjust the controls on the oscilloscope until two cycles of modulation waveform can be seen. Note the amplitude of the waveform.

Note . . .

Amplitude modulation of the carrier is introduced in this test resulting in "spikes" appearing on the trace at a repetition frequency of twice the switching frequency. The "spikes" should be ignored during the balancing adjustments.

(7) Remove the connector from the PORT aerial socket on the modulator unit and connect it to the STDB socket. The amplitude waveform should be the same as that in para. 6.

(8) If the two waveforms are not equal, adjust the MODULATION BALANCE control (RV2) and again observe the trace on the oscilloscope when the r.f. connector is connected to the PORT and STBD aerial in turn. Repeat as necessary until the amplitudes are equal.

(9) Having adjusted the MODULATION BALANCE control, adjust L5 (accessible through the centre hole in the bottom cover of the r.f. unit) until the horizontal lines between the spikes are co-linear when the connector is connected to both the PORT and STDB positions in turn.

R.F. balance

21. (1) Using both the r.f. connectors Type D267/30A/1 connect the test set and modulator unit aerial sockets PORT to PORT and STBD to STBD.

(2) Select channel B on the control unit Type 382.

(3) Set the r.f. differential phase changer to the ON COURSE position.

(4) Adjust the R.F. BALANCE control (RV1) on the modulator unit for a zero reading on the test set meter.

(5) It is possible for a slight error to be introduced in this adjustment due to small differences in the electrical characteristics of the two connectors Type D267/30A/1. This should be checked as follows:—

(*a*) Interchange the connectors Type D267/30A/1 ensuring that PORT is connected to PORT and STBD to STBD.

(*b*) If the meter does not read zero, note the reading and adjust RV1 for half this value.

(*c*) Restore the connectors to their original positions. The meter should read the same value in the opposite sense, e.g., meter reading (*b*) 16 microamps to PORT, adjust RV1 until meter reads 8 microamps to PORT, meter (*c*) should read 8 microamps to STBD.

Note . . .

If the reading in (*b*) *is greater than* 20 *microamps the connectors should be considered suspect and should be replaced with new ones from Stores.*

Overall performance

22. Reassemble the r.f. unit in the multivibrator unit but do not replace the top and bottom covers. With the equipment connected as in fig. 3 proceed as follows:—

(1) Set the METER SENSITIVITY switch on the test set to MAX.

(2) Select channel A on the control unit Type 382.

(3) Set the r.f. differential phase-changer to the fully PORT and the fully STBD positions in turn and observe the meter readings.

(4) Adjust the METER GAIN control (RV3) in the modulator unit until the larger of the two readings is 150 microamps.

(5) Set the r.f. differential phase-changer to the ON COURSE, fully PORT and fully STBD positions in turn on channels A to E and record the meter readings.

(6) Set the METER SENSITIVITY switch to MIN and repeat test sub-para. (5) for channels D and E only and check that the readings are less than those recorded.

The meter readings (5) should conform to the following values:—

Channel	ON COURSE limits Plus or minus	Fully PORT and fully STARBOARD. Minimum change from observed ON COURSE readings
A	50	120
B	◀ 25	130
C	85	*160
D	135	*190
E	170 ▶	*200

* The meter indications are non-linear above 200 due to the limiting action of the meter circuit in the modulator unit and it is possible that these requirements cannot be met when the ON COURSE reading is not approximately zero. In these cases, provided that the reading in the opposite sense to the ON COURSE reading meets the requirements, the modulator unit can be considered satisfactory, e.g., if the ON COURSE reading for channel D is 80 divisions to PORT the reading for the fully STBD position should be not less than 110, i.e. 80 + 110 equals 190 microamps.

Note . . .

Although the ON COURSE *tolerances seem rather large, in actual bearing indications they represent a channel error of approximately* 8 *degrees on each frequency.*

23. Having completed all the adjustments to the modulator unit:—

(1) Ensure that there is a full complement of serviceable spare fuses stowed in top cover.

(2) Replace the top and bottom covers.

TESTING THE INDICATOR ELECTRICAL TYPE 7

24. The indicator to be tested is connected to the TEST IND socket of the test set Type 7748 as shown in fig. 4. The two indicator movements and the two flag movements are tested simultaneouslv as follows:—

(1) Select channel A on control unit Type 382.

(2) Set the TEST INDICATOR switch on the test set to L. The two flags should disappear and the two indicator movements should deflect between half and full scale to the left and downwards respectively.

Set the TEST INDICATOR switch to R. The two flags should disappear and the two indicator movements should deflect between half and full scale to the right and upwards respectively.

Printed for H.M. Stationery Office by Herald Printing Works, York
(60994) Wt. 23110-242 1375 8/64 Gp. 375/8 (13-5-64 372620)

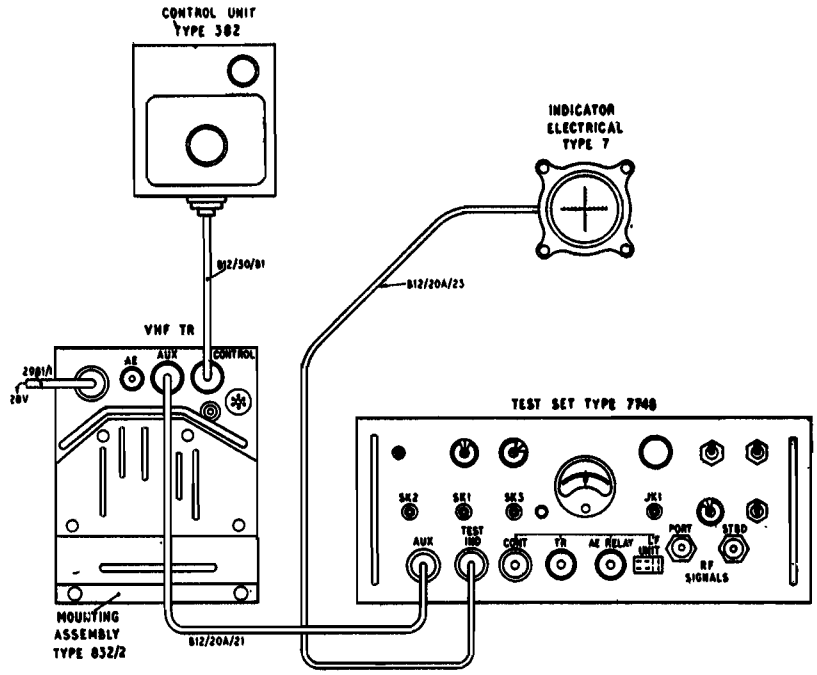


Fig. 4 Testing the indicator electrical Type 7

Chapter 1

GENERAL FAULT-FINDING INFORMATION

LIST OF CONTENTS

LIST OF TABLES

Introduction

1. The fault finding information given in this chapter is divided into two main categories.

(1) The location of faulty units in a complete installation.

(2) The location of faulty components in the individual units.

2. The first category is intended for use in the aircraft. A number of symptoms are listed in Tables 1, 2 and 3 together with certain tests which can be applied so that the faulty unit can be rapidly located.

3. In order to conduct the tests to locate the faulty components satisfactorily, the test equipment described in Part 2, Chapter 5 will be required. Faults that can be diagnosed using the test procedure are listed in Table 4.

Voltage tables

4. The figures given in Tables 5 and 6 are typical voltages for the units concerned. All voltages are relative to chassis potential under normal working conditions. Supply voltages were LT 26V; HT 270V and GB −50V. The readings were taken with a 20,000 ohms/volt meter (multimeter Type 1 is suitable). Variations of up to 20 per cent are not necessarily indicative of faults.

Valve selection

CV455 and CV4024

5. Valve CV455 is being replaced by CV4024, an equivalent valve in the reliable series. The characteristics of the two valves are not identical in the working conditions of position V5 of the multivibrator unit. Valves may have to be selected to meet the mark-to-space ratio test requirement.

6. In production models of the equipment the manufacturers were given a concession to increase the limits of the mark-to-space ratio to 1·6 to 1 when using a CV4024 in position V5.

CV417

7. Matched pairs of valves CV417 should be used in position V1 and V2 and also in positions V3 and V4 of the RF unit Type 7088. The RF balance test described in Part 2, Chap. 5, para. 21 can be used to select the valves.

8. Insert the CV417 valves to be selected, in turn, in position V1 of the RF unit. Allow time for the valve to warm up and stabilize. Record the reading on the test set meter. Valves which give readings within 10 μA of each other can be used as matched pairs.

(A.L.17, Mar. 58)

TABLE I

Fault diagnosis ARI.18044 and ARI.18085

Symptom	Possible cause	Test/Remedy
No signals received on No. 2 TR in the HOMING position when both TRs are switched on but signals received on No. 1 TR.	1. Defective relay TRC/4 in aerial junction box Type 7049.	1. Change the junction box.
	2. Defective relay in control unit Type 7117 or Type 7746.	2. Change the control unit.
	3. Defective wiring between cockpit control switch and the remote control unit Type 7117 or Type 7746.	3. Check wiring.
No signals received on No. 1 TR in the HOMING position when both TRs are switched on.	1. Normal operation.	1. Switch off No. 2 TR.
	2. Defective aerial change-over relay in junction box Type 7089.	2. Change the junction box.
Signals received in NORMAL position but not in the HOMING position.	1. No. HT supply to the modulator unit.	1. (*a*) Check HT fuse. (*b*) Test connector between the modulator unit and the aerial junction box.
	2. No. GB supply to the modulator unit.	2. Check GB fuse.
	3. No LT supply to the modulator unit.	3. Check LT fuse.
	4. Defective relay HOA/2 in the modulator unit.	4. Change the modulator unit.
Signals received in the HOMING position but no L/R indications on the indicator electrical Type 7 (using the test oscillator Type 7049) 5 kc/s switching signal cannot be heard in the phones.	1. Defective modulator unit.	1. Change the modulator unit.
Signals received in the HOMING position but no L/R indications on the indicator electrical Type 7 (using the test oscillator Type 7049). 5 kc/s switching signal can be heard in the phones.	1. Defective indicator electrical Type 7.	1. Change the indicator.
	2. Defective connector between the modulator unit and the indicator.	2. Change the connector.
	3. Defective modulator unit.	3. Change the modulator unit.
No change in deflection on the indicator when the switch on the cockpit control panel is changed from MAX to MIN and vice-versa.	1. Defective switch or defective wiring between switch and remote control unit.	1. Check wiring and switch.
	2. Defective wiring in the modulator unit.	2. Change modulator unit.

TABLE 2

Fault diagnosis ARI.18048

Symptom	Possible cause	Test/Remedy
No signals received on the VHF receiver when the switch on the control unit Type 7086 is set to HOMING 1 but signals received in the NORMAL and HOMING 2 positions. Similarly no signals in the HOMING 2 but signals in the HOMING 1 and NORMAL positions.	1. Defective switch in the control unit Type 7086.	1. Change the control unit.
No signals received on VHF receiver when the switch in the control unit is set to HOMING 1 or HOMING 2 but signals received in the NORMAL position.	1. No HT supply to the modulator unit.	1. (*a*) Check HT fuse. (*b*) Test connector between the modulator unit and the TR.
	2. No GB supply to the modulator unit.	2. Check GB fuse.
	3. No LT supply to the modulator unit.	3. Check LT fuse.
	4. Defective relay HOA/2 in the modulator unit.	4. Change the modulator unit.
	5. Defective aerial change-over relay Type 1254.	5. Change the relay Type 1254.
Signals received in the HOMING 1 and the HOMING 2 positions but no L/R indications (using test oscillator Type 7049) on the indicator electrical Type 7. The 5 kc/s switching signal cannot be heard in phones.	1. Defective modulator unit.	1. Change the modulator unit.
Signals received in HOMING 1 and HOMING 2. No L/R indications (using the test oscillator Type 7049). The 5 kc/s note can be heard in the phones.	1. Defective indicator electrical Type 7.	1. Change the indicator.
	2. Defective connector between modulator unit and the indicator.	2. Change the connector.
	3. Defective modulator unit	3. Change the modulator unit.
No change in deflection on the indicator when the switch on the control unit is changed from MAX to MIN and vice-versa.	1. Defective switch in control unit.	1. Test for 820 ohm resistance between pin D and E of PL1 on the control unit when switch is set to MAX.
	2. Defective connector between the control unit and modulation unit.	2. Change the connector.
	3. Defective wiring in the modulator unit.	3. Change the modulator unit.

TABLE 3
Fault diagnosis ARI.18049 and ARI.18093

Symptom	Possible cause	Test/Remedy
No signals received on the VHF receiver when the switch on the control unit Type 7086 is set to HOMING 1 but signals received in the NORMAL and HOMING 2 positions. Similarly no signals in the HOMING 2 but signals in the HOMING 1 and NORMAL position.	1. Defective switch in the control unit Type 7086.	1. Change the control unit.
Signals received in the HOMING 1 and NORMAL position but not in the HOMING 2 position.	1. Defective relay TRC/4 in the junction box Type 7089.	1. Change the junction box.
	2. Defective connector between:— (*a*) Control unit and the modulator unit. (*b*) Modulator unit and the junction box Type 7089. (*c*) Junction box Type 7089 to TR.	2. Test the connectors.
No signals received in the HOMING 1 or HOMING 2 position but signals received in the NORMAL position.	1. No HT supply to the modulator unit.	1. (*a*) Check HT fuse. (*b*) Test connector between the modulator unit and the TR.
	2. No GB supply to the modulator unit.	2. Check LT fuse.
	3. No LT supply to the modulator unit.	3. Check LT fuse.
	4. Defective relay HOA/2 in the modulator unit.	4. Change the modulator unit.
	5. Defective aerial change-over relay in the junction box Type 7089.	5. Change the junction box Type 7089.
Signals received in HOMING 1 and HOMING 2 positions but no L/R indications (using the test oscillator Type 7049) on the indicator electrical Type 7. The 5 kc/s switching signal cannot be heard in the phones.	1. Defective modulator unit.	1. Change the modulator unit.
Signals received in HOMING 1 and HOMING 2 positions but no L/R indications (using the test oscillator Type 7049). The 5 kc/s note can be heard in the phones.	1. Defective indicator electrical Type 7.	1. Change the indicator.
	2. Defective connector between the indicator and the modulator unit.	2. Change the connector.
	3. Defective wiring in the modulator unit.	3. Change the modulator unit.
No change in deflection on the indicator when the switch on the control unit is changed from MAX to MIN and vice-versa.	1. Defective switch in the control unit.	1. Test for 820 ohm resistance between pin D and E of PL 1 on the control unit when the switch is set to MAX.
	2. Defective connector between the control unit and the modulator unit.	2. Change the connector.
	3. Defective wiring in the modulator unit.	3. Change the modulator unit.

TABLE 4

Fault diagnosis on test bench

(Paragraph references in the Test column are to the test procedure detailed in Chapter 5 of Part 2).

Test	Symptom	Possible cause	Test/Remedy
HT current consumption (*para.* 9), NORMAL/HOMING switch in the test set switched to NORMAL.	HT current exceeding 1mA and/or red lamp on test set illuminated.	1. Defective capacitor C24	1. Renew C24.
		2. Defective resistor R15.	2. Renew R15.
		3. Defective capacitor C23.	3. Renew C23.
HT current consumption NORMAL/HOMING switch set to HOMING (*para.* 9).	Current exceeding 21 mA.	Many.	Check valve voltages listed in Table 5.
Meter balance (*para.* 10).	Unable to obtain balance.	1. V9 or V8 defective.	1. Renew V9 or V8.
		2. Capacitors C29 and C30 leaking.	2. Check valve voltages.
		3. Defective balance control RV4.	3. Test for resistance.
Switch waveforms (*para.* 11).	Unable to obtain 4V p to p.	1. V5, V6 or V7 defective.	1. Check valve voltages.
Mark space ratio (*para.* 11).	Ratio greater than 1·2 to 1.	1. V5a faulty or incorrect valve fitted.	1. Valves may require selection for this position (*refer to para.* 5).
Meter amplitude (*para.* 14).	The METER GAIN control RV3 cannot be adjusted to obtain the required 200 μA.	1. V10 defective.	1. Renew V10.
		2. C28 defective.	2. Check valve voltages. Defective C28 indicated by low anode voltage.
Meter amplitude (*para.* 14).	L and R indications differ by more than specified limits.	1. METER BALANCE control RV4 adjusted incorrectly.	1. Adjust as detailed in Part 2, Chap. 5, para. 10.
		2. V10 defective.	2. Renew V10.

Note . . .

The following tests are applicable to the assembled modulator unit. It is assumed that the multivibrator unit Type 7755 has been tested satisfactorily and that the fault will be in the RF unit Type 7088.

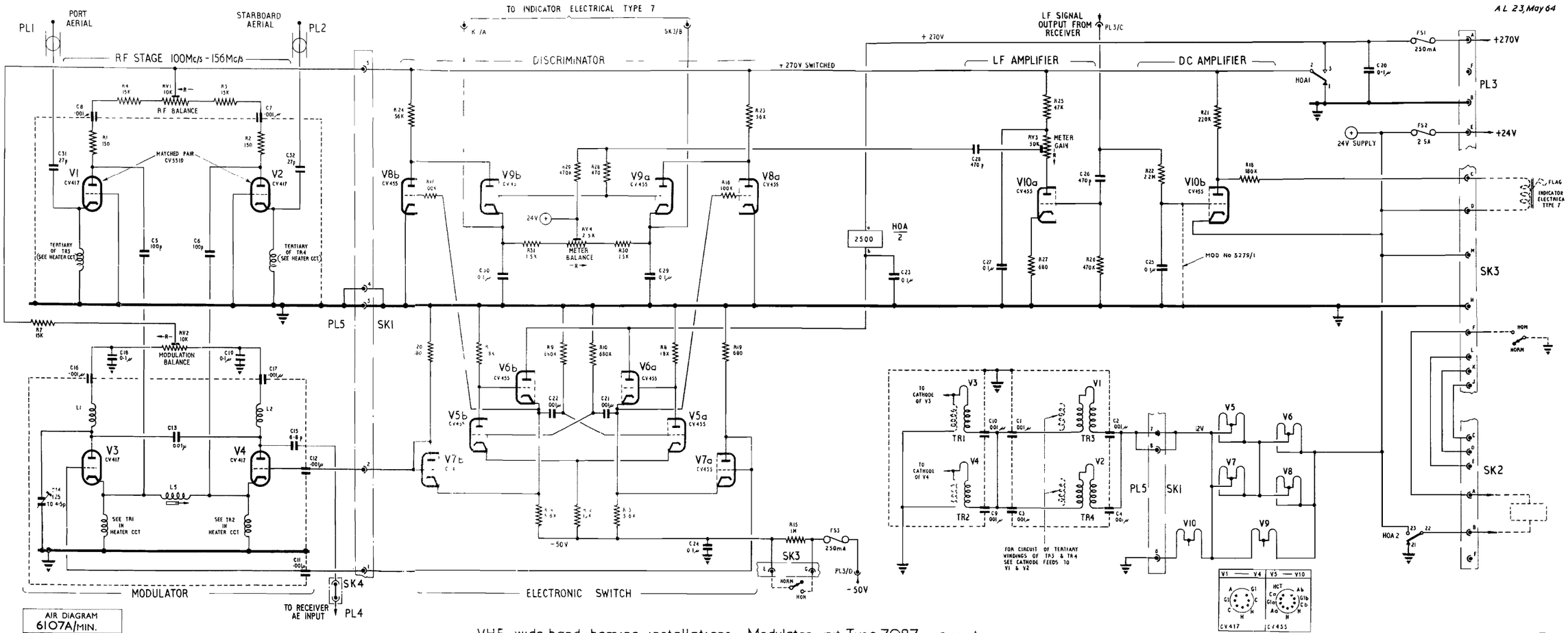
HT current consumption (*para.* 16)	HT current exceeds specified limits.	1. V1, V2, V3 or V5 defective.	1. Check valve voltages or renew valves.
Insertion loss (*para.* 18).	Loss exceeds specified limits.	1. V1 or V2 defective.	1. Check valve voltages or renew valves. (*Refer to para.* 7).
Modulation balance (*para.* 20).	Unable to obtain balance.	1. V3 or V4 defective.	1. Check valve voltages or renew valves. (*Refer to para.* 7).
RF balance (*para.* 21).	Unable to obtain balance within the specified limits.	1. V1 or V2 defective.	1. Check valve voltages or renew valves. *Refer to para.* 7).

TABLE 5
Valve voltages multivibrator unit Type 7755

Pin No.	1	2	3	4	5	6	7	8	9
Electrode	Ab	Glb	Cb	H	H	Aa	Cla	Ca	Hct
V5	−9·5	−35	−33	19·5	19·5	−9·5	−35	−33	13
V6	245	−9·5	−2·8	26	26	245	−9	−2·3	19·5
V7	−2·8	−2·8	−2·8	19·5	19·5	−2·6	−2·6	−2·3	13
V8	118	−2·5	0	26	26	118	−2·3	0	19·5
V9	118	13·8	28	26	13	118	13·8	28	19
V10	47	12·7	26	0	13	87	0	1·2	6·5

TABLE 6
Valve voltages RF unit Type 7088

Pin No.	1	2	3	4	5	6	7
Electrode	Gl	C	H	H	C	Gl	A
V1	0	0	13	6·5	0	0	72–104 varies with RV1 setting
V2	0	0	13	6·5	0	0	72–104 varies with RV1 setting
V3	−2·5	0	6·5	0	0	−2·5	95–130 varies with RV2 setting
V4	−2·5	0	0	6·5	0	0	95–130 varies with RV2 setting

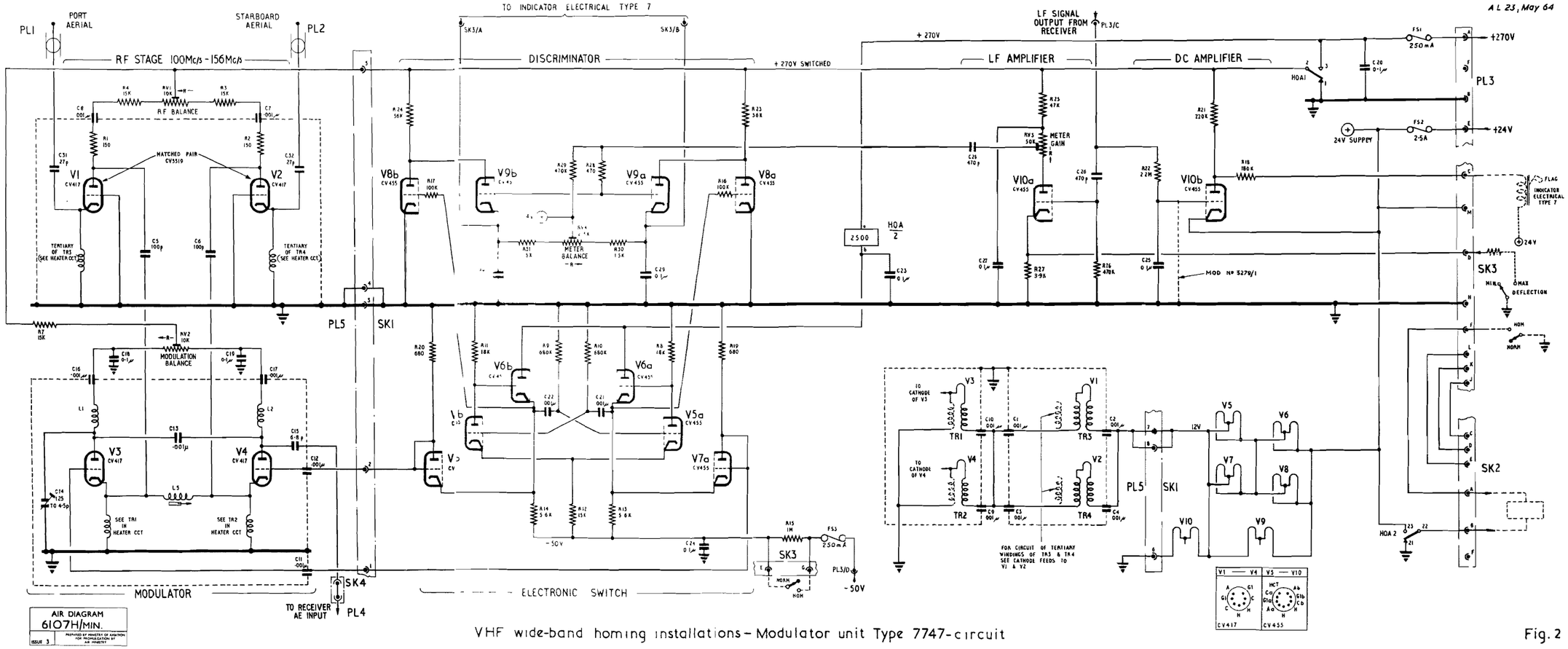


AIR DIAGRAM 6107A/MIN.
ISSUE 4
PREPARED BY MINISTRY OF AVIATION FOR PROMULGATION BY AIR MINISTRY

243/372621/19/5/64 J. T. & S.

VHF wide-band homing installations — Modulator unit Type 7087 — circuit

Fig. 1



AIR DIAGRAM 6107H/MIN. ISSUE 3

243/372621/19/5/64 J T. & S.

VHF wide-band homing installations – Modulator unit Type 7747-circuit

Fig. 2

RESTRICTED