

Chapter 3 HF (SSB) INSTALLATION

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Introduction

1. This Chapter contains descriptive, operational and servicing information on the long-range communications installation embodied in the aircraft. A list of components giving their Type or Part No., identification, location, access panel and associated A.P. is included in Sect.8 of the SDM.

Modification standard

2. This Chapter includes Mod 777A, B, C, D and E.

General

3. The HF (SSB) system — ARI 23090/5 — provides multi-channel, long-range voice communication with ground stations or other aircraft. Although the transmitter-receiver is capable of operating on any one of 28000 frequency channels within the range 2 MHz to 30 MHz, the aerial system restricts the operation of the installation within the range 2.8 MHz to 25 MHz.

4. The system is connected into the CASS (*Chap. 2, this Section*) and HF can be selected on both pilot's and observer's station boxes, which also connect the set to their associated mic./tel. and press-to-transmit lines. The HF set is operated from a control unit on the observer's starboard console. The transmitter-receiver and associated units are in the radio bay and the aerial is in the dorsal fin.

DESCRIPTION AND OPERATION

General

5. The components are located and the

wiring is routed as shown in the associated diagrams in Sect.8 of the SDM.

Power supplies (fig 1-1a)

6. 28 V d.c. is supplied from fuse D12 while 200 V, 3-phase, 400 Hz a.c. is fed via fuses 2A5, 2B5 and 2C5 in distribution box R-A in the radio bay. Power is available to the installation when the mode selector switch (*para 9*) is selected to any one of three operative communication modes. A warm-up period of one minute is required after selection of a mode before receiving facilities are available, and five minutes must elapse before attempting transmission. No provision is made for alternative power supplies to the installation.

Control unit

7. The control unit, A, on the observer's starboard console (panel C-M), accommodates frequency and mode selectors and an RF gain control. Illumination of the control unit is provided by two integral lamps controlled by the observer's instrument lighting circuit (*Cover 1, Sect. 6, Chap. 9B*).

8. Four rotary switches (MHz, 100 kHz, 10 kHz and 1 kHz) control frequency selection. The switches are mechanically coupled to a digital display with a range of 2 MHz to 30 MHz in 1 kHz increments, but the operating frequency range is limited to 2.8 MHz to 25 MHz (*para 3*).

9. The mode selector is a six position rotary switch marked as follows:-

- (1) OFF.
- (2) USB. Upper sideband mode for voice communication

- (3) LSB. Lower sideband mode for voice communication
- (4) AM. Amplitude modulation for voice communication
- (5) DATA. Auxiliary data equipment mode. (Not in use.)
- (6) CW. Continuous wave communication. (Not in use.)

10. The rotary control marked RF SENS provides variable control of the RF gain of the transmitter-receiver, and of the audio level in the crew's headphones. The control is used in conjunction with the HF push-switch on the CASS station boxes (*para 27*).

Transmitter-receiver

11. The transmitter-receiver is on the port side of the radio bay and identified R-BA. The unit fits into a mounting tray, locating two spigots at the rear and is retained by two wing nuts and washers which locate two catch plates on the front of the unit. The mounting tray is modified to suit the installation and is rigidly bolted to the shelf structure.

12. Forced cooling air is supplied from a blower mounted on the port upper side of the radio bay, which mixes bay air with air from an adjacent cooling duct nozzle and delivers it to the unit via a flexible hose. The blower runs whenever power is available at the a.c. busbars. The transmitter-receiver is capable of accepting an integral blower but it is not fitted in this installation. A description of the radio bay blower installation is in *Cover 1, Sect. 6, Chap. 8A*, while that of the bay air conditioning system is in *A.P.101B-1202-1A, Cover 2, Sect. 3, Chap. 8*.

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13. Electrical connection of the unit is automatic. Two halves of a 60-pole electrical connector mate as the back of the unit is pushed home. Four multi-pole plug and socket connectors on the rear of the mounting tray connect the tray assembly to other parts of the system. Sockets for the aerial (ANT) and for an auxiliary receiver aerial (AUX RCVR ANT, unused in this installation) are on the front of the unit.

14. The front panel of the unit contains a meter and a five-position meter selector switch. The first three positions monitor 28 V, 130 V and 1500 V supply voltages in the unit. The fourth position, PA MA, monitors the power amplifier plate current and the fifth position, CAL TONE, is used to check the frequency accuracy. Two jack sockets, adjacent to the meter, are labelled PHONE and MIC and enable the unit to be tested without the necessity of connecting it to the CASS.

Pre-amplifier

15. A pre-amplifier, identified R-BB, is bolted to the port shelf adjacent to the transmitter-receiver. It increases the level of the microphone signals to that required by the transmitter. The unit is integral with a cable assembly that connects to the rear of the transmitter-receiver mounting tray.

Aerial system

16. This is a notch-excited system whereby radiation is effected by tuning a suppressed notch to the radio frequency in use (2.8 MHz to 25 MHz) by a variable capacitor connected across the 'open end' of the notch. The transmitter is coupled into the notch via a multi-tapped impedance matching transformer, joined to the capa-

citor by a radio frequency connector, so that during transmission a circulating current is set up in the notch; currents are thereby induced in the wings and fuselage which set up a radiation field.

17. The location of the suppressed notch is a section cut away from the dorsal fin between stations 488.6 and 520. It is approximately 32 in. long and has a mean depth of 17 in., the contour of the aircraft is maintained by a moulded fibre glass cover. The aerial system comprises the following units:-

Aerial selector unit

Selector unit junction box

Junction box

Impedance matching unit

RF tuner unit

RF connector

RF load

Tumbler switch

18. The aerial selector unit, R-BC, on the starboard side of the radio bay, fits into a mounting tray, locating a multi-pole electrical connector on the selector unit junction box, which is bolted to the rear of the mounting tray. The selector unit is retained by two nut and washer assemblies which locate catch plates on the front of the unit. The mounting tray is rigidly bolted to an a.v. mounted platform assembly which it shares with the RF load. The front panel of the unit contains a meter and a test lamp.

19. Cooling air is supplied from an air distribution pipe (A.P.101B-1202-1A,

Cover 2, Sect. 3, Chap. 8) which exhausts onto the starboard face of the unit. An upstream branch pipe also blows cooling air upwards just below the front of the RF load.

20. Electrical connection of the unit is automatic. Two halves of an 80-pole electrical connector mate as the back of the unit is pushed home in the selector unit junction box and mounting tray. Two multi-pole plug and socket connections are made on the selector unit junction box, and are routed to junction box R-BG.

21. Junction box R-BG is on the starboard side of the radio bay, rigidly bolted to the shelf. Four multi-pole plugs lead cables to other parts of the system.

22. The RF load, R-BF, is secured by three bolts to an a.v. mounted platform assembly that it shares with the aerial selector unit. Electrical connections are made by one six-pole and two co-axial sockets. Cooling air is supplied as described in para 19.

23. A single-pole switch, C-AF, marked HF RADIO SILENCE, NORMAL-SILENCE, located on the observer's starboard console, prevents the one-second transmission for fine tuning of the aerial (para 29), provided SILENCE is selected. No transmission can take place when the switch is at SILENCE.

24. The impedance matching unit, D-AM, is bolted to the forward bulkhead of the dorsal fin notch. The unit is a ferrite-cored, multi-ratio transformer providing switched

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tappings for matching the output impedance of the transmitter to the notch. Electrical connections are made by two sockets, one 26-pole, the other co-axial.

25. The RF tuner unit, D-AN, is bolted to the aft bulkhead of the notch and electrical connections are made by a 17-pole socket. The unit contains a motor controlled variable capacitor and three fixed capacitors. At the lower frequencies the fixed capacitors are brought into circuit as required.

26. The RF connector connects the impedance matching unit to the RF tuner unit. It is twisted into the shape of a one turn coil and its function is to complete the tuned circuit around the notch.

Operation

WARNING...

When the HF radio installation is used on the ground all ground personnel and equipment must be well clear of the aircraft, owing to the high voltages in the airframe structure during transmissions.

27. With a.c. and d.c. supplies available the HF radio equipment is switched on by selecting the mode required at the control unit, and after a 1 minute warm-up period the receive facility will be available to either crew member on depression of the HF push-button at his CASS station box. 30 sec after switching on, the required operating frequency may be selected, when the transmitter first tunes itself and then supplies a signal to re-tune the aerial (*para 28*). Tuning takes up to 15 sec, during which time a 1 kHz note is fed to the headphones. Should the required frequency be already selected when the equipment is switched on, the 10 kHz selector should be rotated one step off

frequency and then returned to the operating frequency to allow the fine tuning circuit to operate. The audio level in the headphones is adjusted as desired by rotating the HF push-button in conjunction with the RF SENS control on the control unit; a proper balance is indicated when background noise is just audible and a weak signal is raised to a comfortable listening level. The transmit facility is available when the TRANS & REC switch on the CASS station box is selected to HF, and switching details are included in Chapter 2 of this Section.

Note...

Although reception on HF is possible after a 1 minute warm-up period, 5 minutes must elapse before transmitting.

Aerial tuning

28. To achieve some measure of radio-silence the transmitter-receiver adjusts the tuning of its power amplifier without radiation before being connected to the notch aerial. This is achieved by tuning into the RF load, which is of 50 ohms resistance. Three resistances are in the upper compartment of the cast box that forms the RF load case and the box top acts as a heat sink. Normally the resistances are in circuit for about 8 seconds. Selection of a frequency pre-tunes the notch aerial and allows the transmitter to tune into the RF load. The RF power is then transferred to the aerial system for a one second burst of transmission for fine tuning. The system then reverts to the receive condition with optimum reception facility. The aerial tuning system described above gives out only one second of detectable transmission.

29. Full radio silence can be achieved by setting the HF radio silence switch in the observer's cockpit to SILENCE (*para 23*). In this condition the aerial is only pre-tuned to one of 25 evenly spaced fre-

quencies and some loss of reception occurs on interpolated frequencies. Fine tuning of the aerial does not occur until the switch is returned to NORMAL, when the one second radiation takes place.

30. The aerial system is tuned within 8 seconds, including the one second of fine tuning; the average time is 4 seconds. When SILENCE is selected the maximum time of 7 seconds applies.

SERVICING

General

31. The complete installation may be tested as detailed in para 32 to 39 inclusive. It is a comprehensive test schedule, only part of which may be required to suit the particular circumstances. General servicing information on the ARI 23090 series and test equipment is detailed in A.P.116D-0102-6A.

Preparation for test

32. To test the HF installation the following equipment is required:-

- (1) 200 V, 3-phase, 400 Hz a.c. ground supply.
- (2) Mic./tel. headsets (3 off).
- (3) RF indicator, 6625-99-999-8550.
- (4) A wooden gantry to reach the notch aerial.

33. Three personnel are required to perform the tests, stationed as follows:-

- (1) One in the observer's cockpit to operate the controls.
- (2) One in the radio bay to observe the meters on the front of transmitter and aerial selector unit.

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- (3) One on the wooden gantry to observe the RF indicator on the notch.

34. The aircraft must not be on jacks, nor with any large metal structure adjacent to the notch. The wings must be spread.

- (1) Connect the a.c. ground supply to the aircraft (Cover 1, Sect. 6, Chap. 1).
(2) Ensure that the external cooling fan to the transmitter-receiver is blowing.

Transmitter-receiver performance test

35. (1) Plug a headset into the test socket in the observer's cockpit.
(2) Select HF on the observer's CASS box TRANS & REC rotary switch, and set the HF radio silence switch to NORMAL.
(3) Press the HF and I/C buttons on the CASS box and set each volume to a suitable level.
(4) Plug a headset into the radio bay socket and establish communication with the observer's cockpit.
(5) Switch the control unit mode selector switch to AM and turn the RF SENS control fully clockwise. A 1 kHz note will be heard in the headphones when the equipment has warmed up (up to 1 minute).
(6) Set the meter selector switch on the transmitter-receiver front panel to the 28 V position. The meter should indicate in the red area.
(7) Set the meter selector switch to 130 V. The meter should indicate in the red area.

- (8) Select a frequency on the control unit which will not cause undue interference; e.g. 4.732, 5.690 or 6.716 MHz. A tune tone will be heard for a period not exceeding 14 seconds; the system is tuned upon cessation.
(9) Set the meter selector switch to 1500 V. The meter should read zero. On depressing the P TO T switch the meter should indicate in the red area.
(10) Set the meter selector switch to PA MA. The meter should indicate zero.
(11) Disconnect the co-axial jumper lead from the 500 kHz STD plug on the right front panel of the transmitter-receiver. Depress the P TO T switch and the meter should indicate approximately 330 mA. Release the P TO T switch, and refit the co-axial jumper lead.
(12) Press the P TO T switch and the meter should indicate in the red area. With the P TO T switch still depressed, speak into the microphone and the meter should not vary. Release the P TO T switch.
(13) Switch the control unit mode selector to LSB. With the meter selector switch still at PA MA, the meter should indicate approximately 260 mA when the P TO T switch is depressed.
(14) Depress the P TO T switch and speak into the microphone and note that the meter varies with speech, peaking at approximately 600 mA, and that side-tone is present. Release the P TO T switch.
(15) Switch the mode selector to USB, and depress the P TO T switch. The meter should indicate approximately 260 mA. Repeat operation (14), above.

Note...

If the transmitter-receiver is not operating properly as indicated in these tests, remove it, if necessary, for bay servicing. DO NOT ATTEMPT TO MAKE REPAIRS WHILE THE EQUIPMENT IS IN THE AIRCRAFT.

Aerial test

36. (1) Attach the RF indicator to the side of the notch aerial cover using the screws provided, and select the indicator selector switch to ARI 23090/5 (A.P.116D-0102-1C, Chap. 4).
(2) Plug a headset with extension lead into the wheel bay socket and establish communication with the radio bay and cockpit personnel.
(3) Select the observer's radio silence switch to SILENCE.
(4) Switch the control unit mode selector to AM and allow 1 minute to warm-up.
(5) Select HF on the observer's CASS box TRANS & REC rotary switch and press and release the HF push-button on the CASS box, turning it clockwise.
(6) Select any frequency between 2.8 MHz and 3.1 MHz. The tune tone will be heard in the headset for a period not exceeding 10 seconds. The aerial selector unit test lamp will illuminate for several seconds. The meter should not indicate. At the cessation of the tune note, receiver noise should be audible, controllable by the RF gain control. The RF indicator should not indicate.

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Note...

No tune tone will be heard if only the kHz knob is moved as the aerial is not retuned in this case. A break in noise is the only indication of movement of this control.

- (7) Select the radio silence switch to NORMAL. The aerial selector unit test lamp should illuminate for approximately 1 second and the meter should indicate a rapid rise and fall.
- (8) Depress the P TO T switch. The aerial selector unit meter should indicate less than 1 and the RF indicator should give a steady indication between 50 and 150. Release the P TO T switch.
- (9) Switch the mode selector to LSB or USB. Depress the P TO T switch and the meter reading should reduce, provided no speech is transmitted. The RF indicator should read near zero with no modulation.
- (10) Speak into the microphone and the meter reading should fluctuate up to a maximum of 1.5. The RF indicator will fluctuate widely with speech. Release the P TO T switch.
- (11) Switch the control unit mode selector to AM and depress the P TO T switch. The meter should steady at a low value after an initial rapid rise and fall. Release the P TO T switch.
- (12) Repeat operations (7) to (11) inclusive at frequencies within the following bands:- (3.2 to 3.8), 4.732, 5.690, 6.716, (8.5 to 10.0), 11.178, 15.080, 18.025 MHz.

Note...

During these tests, the steady meter readings at each frequency should be noted for future use. Any subsequent major difference may indicate either low

transmitter output, or a bad connection in the aerial system, etc.

- (13) Set the mode selector switch to OFF.
- (14) Remove the RF indicator from the notch.

Receiver test

37. (1) Set the radio silence switch to SILENCE.
- (2) Switch on the system and detailed in para 35, operations (1) (2) (3) and (5).
- (3) Select one of the GPO standard frequency transmissions. The tune tone will be heard for between 3 and 10 seconds. On cessation the receiver noise should be audible and the standard transmission heard. The volume is adjustable by the RF SENS control.

Note...

GPO (Rugby) call sign "MSF", transmits on 2.5, 5.0, 10.0 and 15.0 MHz; A1, A2 at 0.5 kW output; with the following programme:-

Mins past hour	Programme
0 - 5	Carrier and seconds pulse
5 - 9½	Silent
9½ - 10	Call sign and frequency off set, given three times in morse

The programme is repeated every 10 minutes.

- (4) If the transmission cannot be heard but background noise is present, select an alternative frequency. A check on two frequencies is sufficient.

- (5) Set the radio silence switch to NORMAL. The tune tone will return for several seconds as the aerial system corrects itself. Background noise and signals may increase on cessation.

Note...

Under circumstances of poor reception, such as the hangar doors being closed, etc., it will be necessary to perform this test outside the hangar.

- (6) Switch off as in para 39.

Transmission test

38. (1) Position the aircraft outside and clear of the hangar.
- (2) Perform operations (1) and (2) of para 34.
- (3) Set the radio silence switch to NORMAL.
- (4) Set the control unit mode selector to AM and turn the RF SENS control fully clockwise.
- (5) Select HF on the observer's CASS box rotary switch, press the HF and I/C buttons on the CASS box and set each volume to a suitable level.
- (6) Allow five minutes for the equipment to warm up.
- (7) Select the local airfield frequency on the control unit.

Note...

- (1) Before performing operation (8) ensure that no inconvenience will be caused to routine work.
- (2) Transmit period must not exceed five minutes followed by a receiving period of not less than five minutes. Continuous reception can take place.

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- (8) When the system is on tune, as indicated by the cessation of the 1 kHz tone, operate the P TO T switch and make a test call to ATC, giving aircraft call-sign. Check that voice quality is good on transmission and reception. It may be necessary to adjust the RF SENS or HF volume control.
- (9) Switch the mode selector switch to LSB and repeat operation (8).
- (10) Switch the mode selector switch to USB and repeat operation (8).
- (11) Repeat tests from operation (7) onwards using frequencies of 5.960, 6.716, 11.178, 15.080 and 18.025 MHz.

Note...

Notify the ground station of the proposed frequencies and allow time to change over, or until called by ground station.

Switching off

39. To switch off the HF system:-

- (1) Set the pilot's and observer's CASS box rotary switches to OFF.
- (2) Press and release the HF and I/C buttons on the CASS boxes.
- (3) Switch the mode selector switch on the control unit to OFF.
- (4) Disconnect the a.c. ground supply.

REMOVAL AND INSTALLATION**Transmitter-receiver and aerial selector units**

40. To remove either transmitter-receiver or aerial selector units:-

- (1) Remove the locking wire from the front retaining nuts and also, in the case of

the transmitter-receiver only, disconnect the co-axial aerial connection on the front of the unit, identified ANT.

- (2) Turn the nuts evenly anti-clockwise until free of the catch plates on the unit.
- (3) Grasp the handle(s) of the unit and draw it straight forward without lifting. When the spigots or connectors are clear of the holes at the rear of the unit, the unit can be lifted from the tray.

RF load

41. To remove the RF load:-

- (1) Disconnect the two co-axial plugs and the six-pole plug from the unit.
- (2) Remove the three 10 UNF bolts and washers from the attachment lugs and lift the unit clear.

Control unit

42. To remove the control unit from the observer's starboard console:-

- (1) Turn the four control unit retaining screws anti-clockwise until they disengage the console trap nuts.
- (2) Lift the control unit until the electrical connection in its base is exposed.
- (3) Turn the electrical plug clamp ring clockwise until it releases the connector threads.
- (4) Draw the plug away from the connector to disengage the units.

Pre-amplifier

43. To remove the pre-amplifier R-BB:-

- (1) Disengage the integral cable assembly at connector R-BA/4 on the transmitter-receiver.
- (2) Remove the two 8 UNF hexagon headed bolts which pick-up anchor nuts under the shelf.
- (3) Lift the unit clear.

Junction box

44. To remove the junction box R-BG:-

- (1) Disengage the three electrical plugs from the junction box.
- (2) Remove the two 10 UNF hexagon headed bolts which pick up anchor nuts under the shelf.
- (3) Lift the unit clear.

Aerial units**RF connector**

45. The RF connector terminates at each end with ball and sliding joints which are bridged with phosphor-bronze bellows. These joints must not be bent more than 10 deg from straight and it is important that the bellows are not twisted. Remove the RF connector as follows:-

- (1) Remove the locking wire at the forward connection.
- (2) Unscrew the $\frac{5}{16}$ in. UNF locking nut on the impedance matching unit.
- (3) Hold the bellows in a 1 in. UNF spanner (1.65 in. across flats) to prevent rotation and slacken the $\frac{5}{16}$ in. UNF union nut to finger tightness.

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- (4) At the RF tuner unit end remove five of the six 4 BA screws which secure the circular plate to the tuner unit.
- (5) Hold the RF connector by the loop and completely release the $\frac{5}{8}$ in. UNF nut, then the last 4 BA screw holding the circular plate. The RF connector is now free and may be lifted clear.

Impedance matching unit

46. The impedance matching unit is secured to the notch forward bulkhead by

six 10 UNF bolts. Disconnect the two plugs, remove the bolts and lift the unit clear.

RF tuner unit

47. The RF tuner unit is secured to the notch rear bulkhead by four $\frac{1}{4}$ in. UNF bolts. Disconnect the plug, remove the four bolts and lift the unit clear.

Installation of units

48. Installation of any of the units is the reverse of the removal procedure. The

mounting surfaces must be clean when fitting the impedance matching unit and the RF tuner unit, as the mounting surfaces form part of the notch bonding strip. When fitting the RF connector circular plate to the RF tuner unit, the synthetic rubber O-ring seal must be in position.

Note...

Immediately prior to installation of the RF connector, the 5/8 in. UNF union nut threads are to be lightly greased with grease XG-285.

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