Chapter 2

RADAR INSTALLATION

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF APPENDICES

Introduction

1. This chapter contains a description of the aircraft's radar installation and includes information on the servicing necessary to maintain the installation in an efficient condition, also the recommended procedures for removing the equipment from the aircraft. Complete descriptive and servicing information on the equipment used is given in A.P.116B-0304-1 and 2.

DESCRIPTION

General

2. The aircraft radar installation consists of an A.R.I.18107 Tacan navigational aid which, when tuned to a ground or surface beacon, provides distance and bearing information indicating the position of the aircraft relative to the beacon to which the aircraft's equipment is tuned. This information is fed electronically to the indicator on the centre instrument panel.

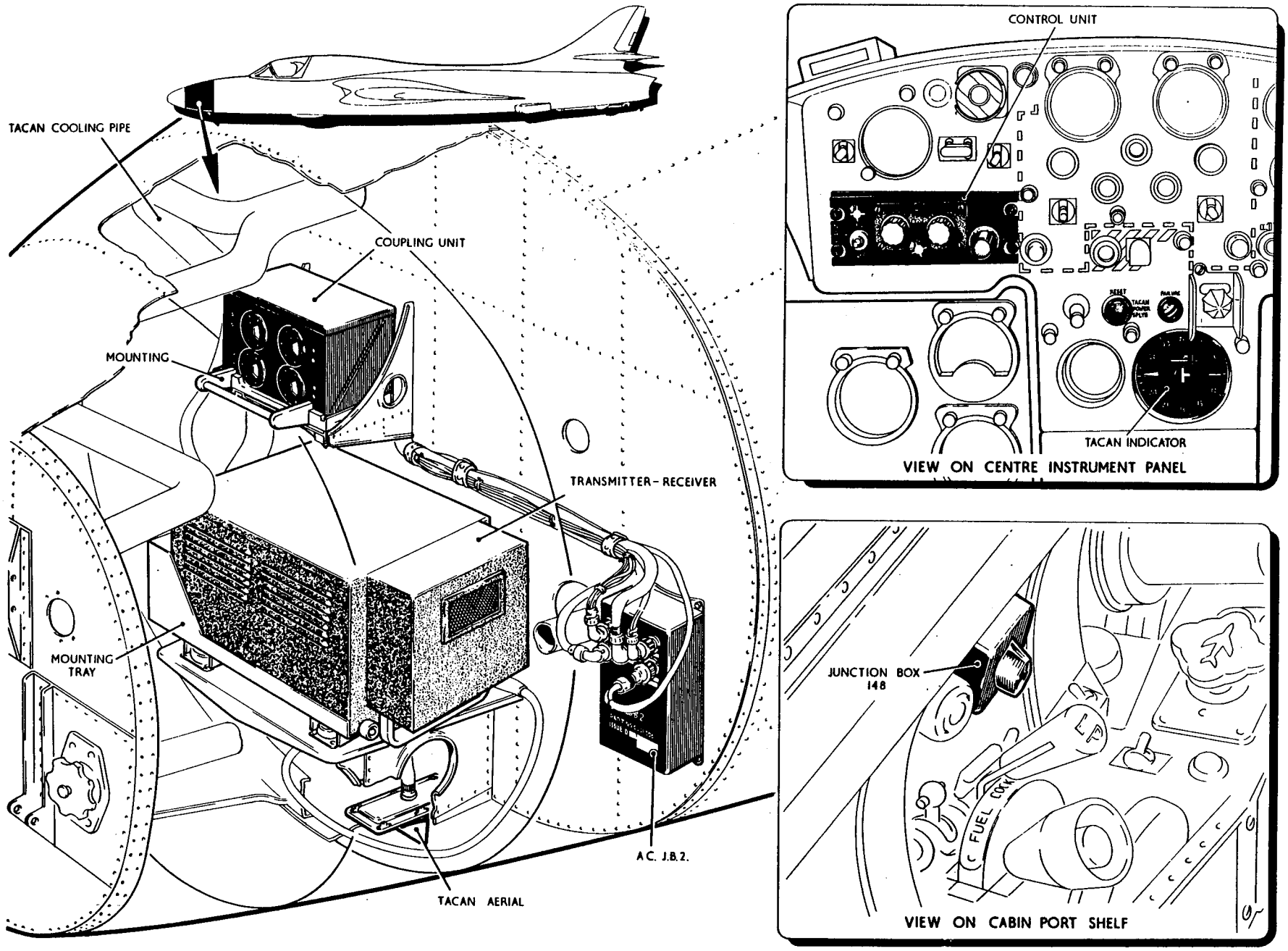

Fig. 1. Tacan installation – location

TP(E) 25820

Coded identification signals which are transmitted at intervals by the beacon are fed via a Type 148 junction box to the crew's telephones in the U.H.F. radio installation (Chap.1).

3. The equipment comprises a transmitter-receiver RT–220/ARN–21, carried on a mounting tray Type 9274, a coupling unit *(indicator)* Type 11920 carried on a Type 9545 mounting; a Type C-866/ARN-21 control unit; and an aerial Type 100A. The transmitter-receiver and the coupling unit are carried in the nose wheel bay; the aerial projects downwards from the underside of the aircraft, and is attached to a mounting panel between frames 2 and 3. The control unit is mounted on the centre instrument panel, in the cabin. The units are interconnected as illustrated in fig.2.

4. The power supplies for the Tacan installation are taken from the aircraft a.c. circuit, and through a Type 26B control panel supplied by a Type 108 inverter mounted on the a.c. supply panel, as described in Sect.5, Chap.1, Group H.1. Both supplies are routed to power supply relays on the transmitter-receiver mounting tray via a.c. junction box, No.2, from which an a.c. supply is also fed to the coupling unit. A supply for the control unit illuminating lamps is provided from the cabin lighting circuit *(Sect.5, Chap.1, Group F.1)*. The operating frequency of the transmitter is in the frequency range of 1025 to 1150 Mc/s., and the receiver operates in the 962 to 1024 and 1151 to 1213 Mc/s frequency ranges.

Transmitter-receiver and mounting tray

5. The transmitter-receiver is secured to the rear of the mounting tray by two locating spigots, and at the front by two wing nuts which engage into fittings on the transmitter-receiver. On the rear of the transmitter-receiver, a 45-pin connector mates with a 45-pin socket connector on the mounting tray; the rear of which serves as a junction box. A housing across the rear of the tray carries two power control relays, and also carries the connectors by which the cables from the control unit, the coupling unit, and the power supplies are connected with the transmitter-receiver. The aerial connection is made at the front of the transmitter-receiver.

6. Cooling air for the transmitter-receiver is provided from the cabin air discharge valve *(Book 1, Sect.3, Chap.8)*. A fan in the transmitter-receiver draws the cooling air through a polythene cloth air filter which is fitted to the base of the mounting tray; the air is exhausted through louvres in the dust cover that encloses the transmitter-receiver. To protect the equipment from unwanted radiations picked up in the control unit and power supply cables, filter units are housed in the mounting tray. The mounting tray is secured to the aircraft mounting structure by anti-vibration mounts.

Coupling unit (indicator) and mounting

7. The coupling unit, which couples the Tacan installation to the indicator, is contained in a box which is carried in a Type 9545 mounting fitted with a detachable backplate. Plugs on the rear of the coupling unit fit into mating sockets on the backplate, which is attached to the mounting by screws that fit into captive nuts fixed to the mounting. Two dowel locating pins are fitted to the backplate, and a lever-operated quick releasing device holds the coupling unit in the mounting which is secured to the aircraft structure by anti-vibration mounts.

8. On the face of the coupling unit, two pairs of indicating dials are mounted, and are used for setting up purposes. One pair indicates bearing, the other indicates distance. The upper bearing dial reads 0-360 degrees; the lower, a Vernier dial, reads 0-40 degrees. Similarly, the upper distance dial reads 0-200 miles, and the Vernier dial 0-20 miles. Two independent gear trains are housed inside the unit, one for the bearing section, the other for the distance section. In each section a motor control *(servo)*, supplied from the transmitter-receiver, drives gear assemblies that drive the dials and also drive the rotors of their associated torque transmitters, potentiometers, and resolvers. In the bearing section, a navigational resolver, energized from the navigation display system, is coupled to a sin. cos. potentiometer which provides an output voltage to the navigation display.

Control unit

9. The control unit, mounted on the centre instrument panel, carries on its face

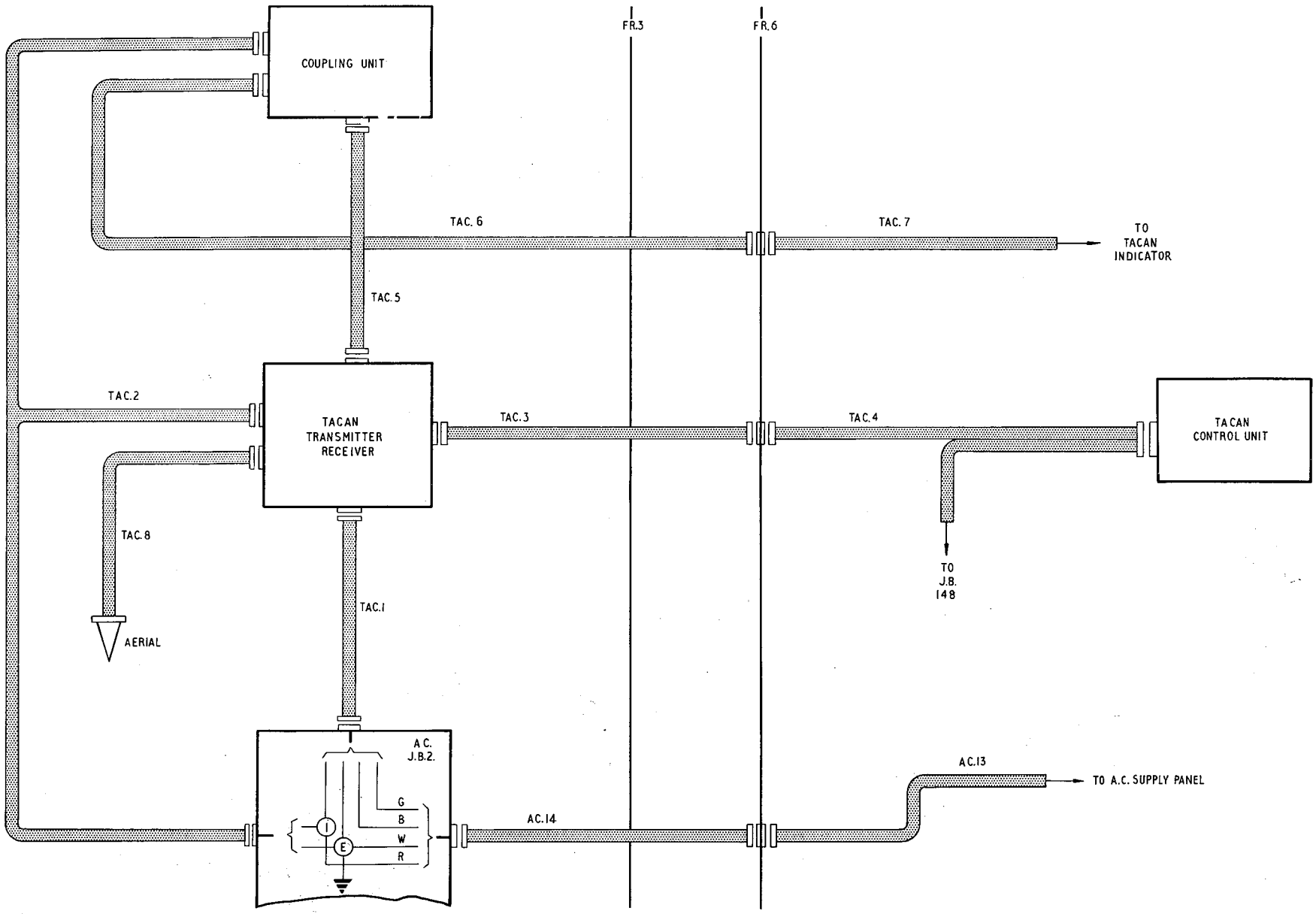

Fig. 2. Tacan installation - interconnection

RESTRICTED

two rotary channel selector knobs marked CHAN: a volume control knob marked VOL; and a three-position toggle switch marked T/R, REC, and OFF which controls the power supply to the equipment. With the switch at the position T/R, the equipment is energized so that both bearing and distance information is indicated. In the REC position, the equipment is switched on to receive bearing information only, and in the OFF position all the equipment is switched off.

10. Any one of the 126 channels available can be selected by turning the two knobs marked CHAN so that the number of the required channel appears in the window in the face-plate. The right-hand knob controls the 'units' figure of the channel number; the left-hand knob controls the 'hundreds' and 'tens'. The figures are illuminated by interior lamps, supplied from the cabin lighting circuit *(Sect.5, Chap.1, Group F.1)*. When the Tacan audio output is connected to the crew's telephones, the volume control knob on the control unit can be used to regulate the level of the audio signals.

Operation

General

11. When the aircraft's a.c. and d.c. power supply services are operating, the Tacan equipment can be switched on by use of the power control toggle switch on the control unit. In the REC position, the switch completes the energizing circuit of a power relay on the mounting tray; the relay supplies the transmitter-receiver equipment so that it operates to receive bearing information from the beacon. In the coupling unit, the bearing train motor is supplied from the transmitter-receiver in such a manner that the reading on the bearing dials coincides with the bearing of the Tacan beacon from the aircraft. The navigational resolver rotates synchronously with the 360 degree dial, and transmits signals proportional to the sine and cosine of the angle shown on the dial to the indicator. A video decoder unit in the transmitter-receiver provides audio identity tone signals which pass via the control unit volume control and the Type 148 junction box to the crew's telephones.

12. With the control unit toggle switch in the T/R position, a further power relay on the mounting energizes, and supplies the transmitter-receiver equipment so that it transmits interrogating pulse signals. These signals are detected by the beacon, which transmits distance reply signals. In the aircraft, range circuits measure the time which elapses between the transmission of the interrogating pulses and the reception of the reply signals. Other circuits convert this time difference into nautical miles, and figures representing these are displayed on the indicator. Power from the transmitter-receiver drives the distance train motor so that the distance dials on the coupling unit indicate the correct slant line distance from the aircraft to the beacon.

SERVICING

General

13. Information on the full servicing procedures for the Tacan installation is given in A.P.2534N, Vol.1, Any units suspected of being unserviceable should first be carefully checked in situ and, if found to be faulty, removed from the aircraft and taken into the workshop for rectification action as necessary. The servicing in the aircraft consists of the normal tests for security and serviceability, as described in the following paragraphs.

Power supply

14. If a fault is reported in the radar installation the power supply should first be checked in conjunction with the routeing and theoretical diagrams given in Sect.5, Chap.1, Group H.1, to ensure that the fault is not located in the aircraft's electrical system. The voltage, both on and off load, must be tested and a check made to ensure that the connectors carrying the supply to the equipment are correctly assembled.

Cables and connectors

15. Servicing of the cables and connectors consists of the standard continuity and insulation resistance tests and of periodical examination throughout their entire length for signs of damage and deterioration of the insulation. If any signs of these defects are found, the complete cable or connector must be replaced. All the clips and straps securing the connectors to the structure must also be examined

for signs of looseness and any defects rectified as necessary to prevent chafing. All the plug and socket connections must also be checked to ensure that they are fitted properly and that the fixings are tightened securely.

Security and serviceability check

16. The transmitter-receiver and mounting tray should be inspected to ensure that they are well secured and that all the connectors are tight. The space below the mounting should be clear, to allow free circulation of air up through the air filter in the mounting tray. The coupling unit, backplate, and mounting tray should be well secured, and all the connectors fully mated. The aerial and the control unit should also be inspected to ensure that they are secure. The control unit lamps should be checked by use of the aircraft dimmer switch in the cabin to ensure that they are not burnt out. The VOL control knob should operate smoothly, without binding, and the two CHAN controls should snap into place as they are rotated through each number.

Final check

17. After servicing the radar installation, ensure that the equipment is left switched OFF and that all access doors and panels, which were removed to gain access are correctly replaced and secured.

REMOVAL AND ASSEMBLY

General

18. The recommended procedure for removing the components of the Tacan installation is given in the following paragraphs. In general, the method of reassembly is a reversal of the removal procedure, but when there is any special feature it is covered by a note in the appropriate paragraph. Before removing or replacing a component the aircraft must be rendered electrically safe, as described in Sect.5, Chap.1, Group A.1.

Tacan transmitter-receiver

19. The recommended method of removing the Tacan transmitter-receiver is as follows:-

(1) Render the aircraft electrically safe, as described in Sect.5, Chap.1, Group A.1.

(2) Disconnect the aerial connector from the front of the transmitter-receiver, fit an approved cap and cover to the plug and socket, and stow the aerial plug clear of the transmitter-receiver.

(3) Remove the locking wire from the two wing nuts at the front of the mounting tray and unscrew the nuts until they are clear of the retaining catches on the transmitter-receiver.

(4) Disengage the rear of the transmitter-receiver from the spring-loaded dowels on the mounting tray by using the handle to withdraw the transmitter-receiver along the tray. Still using the handle, carefully remove the transmitter-receiver from the aircraft.

Transmitter-receiver mounting tray

20. The recommended method of removing the transmitter-receiver mounting tray is as follows:-

(1) Render the aircraft electrically safe, as described in Sect.5, Chap.1, Group A.1.

(2) Disconnect the connectors from the rear of the mounting tray, fit approved caps and covers to the plugs and sockets, and stow the cables clear of the mounting tray.

(3) The tray can now be removed after unscrewing the bolts that secure it to the aircraft mounting structure.

Coupling unit

21. The coupling unit can be removed as follows:-

(1) Render the aircraft electrically safe, as described in Sect.5, Chap.1, Group A.1.

(2) The unit is released by means of the quick-release lever underneath the Type 9545 mounting tray: by pulling the lever outwards and to the right, the coupling unit is free to be lifted out.

Note . . .

When replacing the coupling unit, the quick-release lever must be pushed sideways and to the left over the dead centre

portion of the linkage, to hold the unit rigidly in the mounting.

Backplate

22. To remove the backplate from the Type 9545 mounting, remove the coupling unit as described in paragraph 21, and then proceed as follows:-

(1) Render the aircraft electrically safe, as described in Sect.5, Chap.1, Group A.1.

(2) Disconnect the connectors from the backplate, fit approved caps and covers, and stow the cables clear of the backplate.

(3) Release the backplate by unscrewing the 12 screws which secure it to the Type 9545 mounting.

Aerial

23. To remove the Tacan aerial proceed as follows:-

(1) Render the aircraft electrically safe, as described in Sect.5, Chap.1, Group A.1.

(2) Disconnect the connector from the socket on the aerial, fit an approved cap and cover to the plug and socket, and stow the cable clear of the aerial.

(3) Unscrew the six aerial securing bolts from the nut plate, withdrawing them through the mounting block.

(4) Inside the nose wheel bay, remove the nut plate, bend the bonding strips clear, and lift out the aerial.

(5) Replace the bonding strips and nut plate in position on the mounting block and retain them thus by replacing the fixing bolts; securing the latter into the nut plate only sufficiently to hold the nut plate and bonding strips securely.

Note . . .

When re-assembling the aerial, ensure good electrical bonding by checking that all the mating surfaces are absolutely clean, and making perfect contact.

Control unit

24. To remove the control unit proceed as follows:-

(1) Render the aircraft electrically safe, as described in Sect.5, Chap.1, Group A.1.

(2) Disengage the four Dzus fasteners on the face of the control unit. Withdraw the unit from the instrument panel.

(3) Disconnect the connector from the rear of the control unit, and remove the unit from the aircraft.

Appendix 1. MOD 1372 & 1378

(IFF/SSR 1520 – ARI 23134/3)

CONTENTS

Introduction

1. This appendix contains a description of the ARI 23134/3 (IFF/SSR – Identification Friend or Foe/secondary Surveillance Radar) introduced by Mod 1372 and the affect on this installation of the companion modification, Mod 1378 – to introduce automatic height encoding equipment. Servicing, removal and assembly instructions are given, together with illustrations of equipment location and interconnection, pulse forms and codes. The power supply to the installation is described in Sect.5, Chap 1, Group H 1 , App 2. The height encoding equipment is described in Sect.5, Chap 2, Group 3 A, App 1. Further information on the equipment may be obtained from the publications listed in Table 1.

DESCRIPTION

General

2. The ARI 23134/3 is the airborne equipment which forms part of an IFF/SSR system. The purpose of the system is to enable the aircraft to identify itself rapidly and automatically when challenged by suitably equipped ground

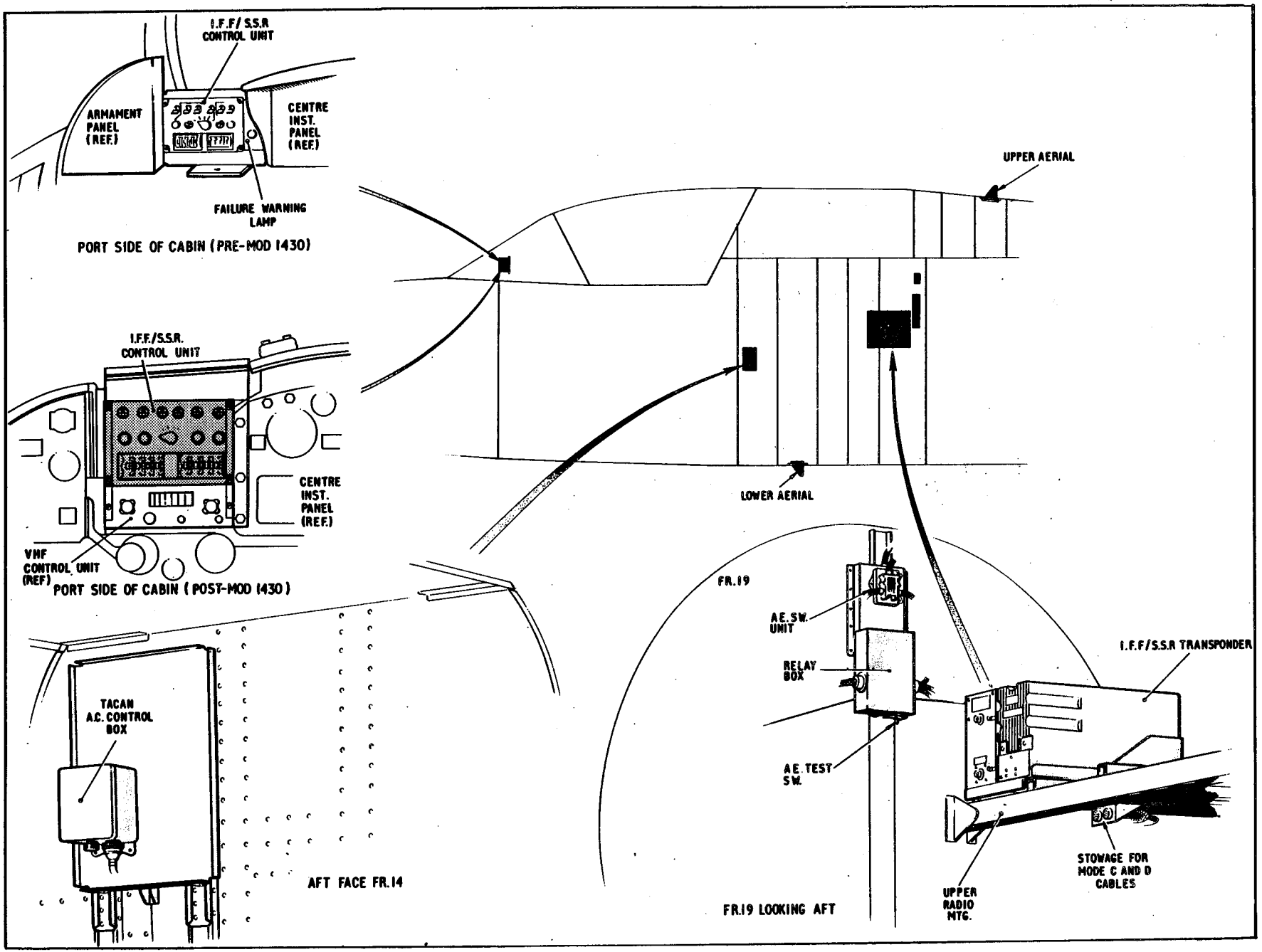

Fig.1 Location of equipment

▶ (Mod 1430 added) ◀

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stations. When interrogated by a military (IFF) or a civilian (SSR) ground radar station the airborne equipment will respond by transmitting the appropriate signal. The ARI 23134/3 is designed for spot frequency operation on the two separate frequencies within the 950 MHz to 1150 MHz bands allocated to the system. One channel is employed for reception of the interrogating signals and the other for transmitting replies.

3. The interrogating signal pulse from the ground radar station is fed to the aircraft transponder transmitter. The resultant transmission or reply pulse is received by the ground radar station and shown on a read-out scale and displayed with the radar echo on the C.R.T. but it appears at a slightly greater range due to a delay introduced by both the interrogating equipment and the aircraft transponder. The interrogating pulses are selectively coded and the transponder will decode these pulses and reply with the appropriate code. One operating mode provides the means whereby the aircraft altitude is transmitted by the airborne equipment. This facility is available only when Mod.1378 is embodied.

Aircraft Equipment

General

4. The aircraft equipment comprising the IFF/SSR installation is the transmitter receiver (transponder), aerial switching unit, two Type 100B aerials, control unit and failure warning lamp/switch. A relay box is also fitted in the system which contains the control relay for the a.c. and d.c. supplies, the aerial test switch and a 1 amp fuse in the a.c. supply circuit.

Transmitter/receiver (transponder)

5. The transponder, on a shock absorber mounting, is positioned on the upper radio mountings on the starboard side of the fuselage forward of frame 19. Electrical connection is by a 98 way multi-pin plug and socket connection and a co-axial connector to the aerial switching unit. On the front of the transponder are the manual selection switches for setting Mode 2 (para.10). The transponder is designed to operate within the temperature range -55 deg.C to ±125 deg.C at altitudes up to 100 000ft. and is pressurized with nitrogen or dry air to 4lb/in^2. Two CHARGE/CHECK/PURGE valves on the front panel are provided for this purpose. The 98 way connector and cable assemblies in addition to providing interconnection with the IFF/SSR installation incorporates two connectors identified NSM 3050–R3 MODE C and NSM 3050–R4 MODE D. These two connectors are secured to a bracket below the transponder shelf. Connector R3–MODE C provides interconnection with the height encoding equipment. Connector R4 – MODE D is not used and is covered with a dust cap.

Aerial switching unit

6. This unit is mounted above and aft of the transponder on the forward face of frame 19 in the radio bay. It contains solid state circuits which alternately switch the upper or lower aerial to the transponder. The switching operation is controlled by the selection on the aerial test switch. Inter-connection to aerials and supply is by plug and socket connectors.

Note...

Failure of the d.c. supply, or a failure of the driver circuit, renders the switching action of the aerial switching unit inoperative. The transponder will then remain connected to the aerial socket marked UPPER. If one or both switching diodes fail, the transponder remains connected to the LOWER socket.

Relay box

7. This box is mounted below the aerial switching unit on the forward face of frame 19 with electrical connection by two multi-pin and socket connectors. It contains the supply relay, the aerial test switch and the 1 amp fuse in the a.c. supply line to the transponder. The three-position toggle of the aerial test switch protrudes through the lower face of the relay box so that it can be operated externally. The switch is normally locked in the FLIGHT position by its spring loaded guard but may be selected to UPPER or LOWER during testing or servicing

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
Transponder Type 16928 Control unit Type 16929 Aerial switching unit Type 16941 Aerials Type 100B (Ref.No.10B/20275)	A.P.114J-0101-16

operations. These two latter selections refer to the aerial which is connected to the transponder. In the FLIGHT position switching of the aerials is controlled by the aerial switching unit.

Note...

The aerial test switch will not select the upper or lower aerial if the power supply is disconnected or if the aerial switching unit is faulty.

Aerials

8. Two fuselage mounted Type 100B blade aerials are used by the IFF/SSR installation. The position of these aerials is shown in Fig.1 and electrical connection in each case is by a single co-axial connector.

Control unit and failure warning lamp

9. On pre-Mod 1430 aircraft, these two units are installed on a common mounting between the centre instrument panel and the port arch panel in front of the pupil pilot. The control unit is held in position by four quick release fasteners and the amber failure warning lamp is attached to the mounting inboard of the control unit. When Mod 1430 is embodied, the control unit is positioned to enable a VHF control unit to be fitted below it, whilst the failure warning lamp is located on the lower left hand side of the centre instrument panel. Electrical connection to the control unit is by a multi-pin socket connector and to the failure warning lamp by terminal connections. Illumination of the control unit is by ten internal lamps, two red which illuminate the facia and eight white for the switch rockers. The lighting is controlled and dimmed by the port side lamps dimmer switch. The control unit front panel is illustrated in Fig. 2.

10. This paragraph describes the function of all switches on the IFF/SSR control unit.

(1) FUNCTION CONTROL switch

The in-flight operation of the IFF/SSR installation is controlled by this switch which has a rotary action and five positions. The positions and functions of these positions are as follows:–

(i) OFF – Installation inoperative.

(ii) SBY – With this position selected, the IFF/SSR control relay is energized and supply from the IFF/SSR fuses is passed to the aerial switching unit and if the Tacan inverter is on line a.c. supply is passed to the transponder. The transponder will now accept interrogations only. After approximately one minute warming up time, the transponder is ready to transmit information when switched to NORM.

(iii) LOW – With this position selected, the transponder accepts selected interrogations and transmits information but the receiver sensitivity is reduced. This selection may be requested by ground radar to reduce clutter from long range replies.

(iv) NORM – In this position the transponder accepts selected interrogations and transmits information.

(v) EMGY/PUSH – (The switch is pushed and turned to this position). In this position the transponder accepts Modes 1, 2, 3A or 3B interrogations irrespective of their selection. Emergency transmissions are made of the selected code, followed by three repeats of the frame pulses. When switched from OFF to EMGY/PUSH the transponder immediately attempts emergency transmissions but 50 seconds should be allowed for the transmitter to warm up. The amber failure lamp will flash until replies are transmitted.

(2) The equipment can reply to three military Modes numbered 1, 2 and 3 and four civil Modes lettered A, B, C and D. Modes 3 and A are identical.

(i) MODE 1 – This is selected by a two position toggle switch, which when selected up enables the transponder to accept Mode 1 interrogations and to transmit information selected on the control unit Mode 1 selection switches.

(ii) MODE 2 – Selection is by a two position toggle switch which when selected up enables the transponder to accept Mode 2 interrogations and transmit information selected by the code selection switches on the front of the transponder. (These switches are not accessible in flight).

(iii) MODE 3A – OFF – B This is a three position rotary switch. Position 3A enables the transponder to accept Mode 3A interrogations and to transmit information replies selected on the control unit Mode 3 code selection switches. Position B enables the transponder to accept Mode B interrogations and to transmit information selected on the control unit Mode 3 code switches. In the OFF position the transponder will not accept interrogations of Mode 3A or 3B.

(iv) MODE C – Selection is by a two position toggle switch which when selected up permits the transponder to accept MODE C interrogations and transmit altitude information using data received from the Mk. 30A encoding altimeter.

(v) MODE D – Selection is by a two position switch but operation of this

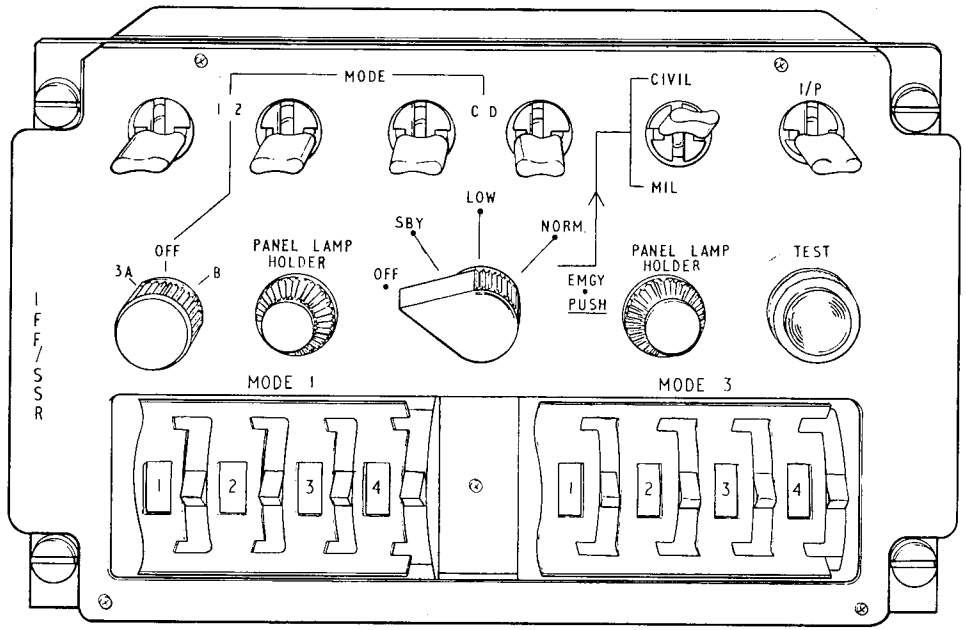


Fig. 2 Control unit

Mode requires a separate coding unit which is not fitted.

(3) Code information may be selected on the control unit panel for Mode 1 and Mode 3A and B. Four switches are available on each of these Modes, providing code settings of 0000 to 7777, resulting in a combination of 4096 codes.

(i) MODE 1 – Code switches provide selection of Mode 1 information for transmission.

(ii) MODE 3 – Code switches provide selection of Mode 3A or 3B code information for transmission, depending upon which Mode is selected.

(4) MODE 2 – This information is pre-set before flight by switches on the transponder and is allocated for the particular aircraft to which it is fitted.

(5) THE CIVIL-MIL switch operates only with the function control switch in the EMGY/PUSH position.

(i) CIVIL – In this position the transponder is automatically selected as code 7700 followed by three repeats of the frame pulses and operates only in the Mode 3A or B.

(ii) MIL – In this position the transponder's reply in Modes 1, 2, and 3A is the selected code followed by three repeats of the framing pulse.

(6) The I/P switch operates the IDENTIFICATION of POSITION facility in the transponder and will be requested by a ground station. The switch is biased to the central OFF position. On selecting the switch to the up position the I/P facility operates and is timed to continue for twenty seconds after the switch returns to the central position.

(7) TEST – The test button is a combined push switch and lamp incorporating a double filament with a green filter. When depressed, with the equipment operating, the self test facility of the transponder checks the receiver sensitivity, the transmitter power output level and the Mode serviceability.

Operation

General

11. With 28V d.c. power available at the busbar and the Tacan inverter on the line, selection of the FUNCTION control switch on the control unit from OFF to SBY will provide an earth return for the coil of the control relay which will close and complete the circuit to supply 115v, single phase a.c. from the Tacan inverter to power the transponder. It will also complete the d.c. circuit to the aerial switching unit. The IFF FAIL lamp will glow but after an initial 50 sec. warming up period, will go out if the installation circuits are working properly, and the IFF/SSR is ready for use.

Interrogation and reply

12. Interrogating pulses are transmitted in pairs by the ground station at a radiated frequency of 1030 MHz. The time interval between the interrogating pulses is set to a particular value at the ground station. Six

separate time intervals are used and these are defined as MODES. These modes are shown in Table 2.

13. The interrogating pulses initiate a coded pulse train reply from the transponder at a frequency of 1090 MHz. The replies are known as CODES, which are pre-set on selector switches on the control unit and on the transponder. Every transponder reply contains two framing pulses spaced at 20·3 μs apart. Between these are twelve information pulse positions. The presence or absence of any of the information pulses is determined by the setting of the code selector switches. Up to 4096 different codes can be permutated from the twelve positions.

Identification pulse

14. An additional pulse is provided 4·35 μs after the second framing pulse. This pulse is transmitted only when the I/P switch on the control panel is operated at the request of the ground control.

Suppression pulse

15. While the transponder is transmitting a reply to an interrogation a suppression pulse is emitted to inhibit the Tacan installation, which operates in the same frequency band. Conversely, when the Tacan installation is transmitting, a pulse from the Tacan suppresses the IFF/SSR installation.

Emergency

16. Two transponder codes are reserved for emergency use:–

Code 77 – Emergency
Code 76 – Loss of communication

When either code is set and the EMGY/PUSH switch operated, a special read-out and alarm is given on the ground controller's display.

Sidelobe suppression

17. Because of the configuration of the ground equipment transmitting aerial, the transponder in the aircraft may be triggered by spurious sidelobes in addition to the interrogator beam. This effect is overcome by one of two methods. The methods are known as 2 pulse sidelobe suppression and 3 pulse sidelobe suppression. In the 2 pulse method it is arranged that the two interrogating pulses are transmitted on separate aerials, the interrogator aerial and the control aerial. A comparator circuit in the transponder compares the relative strengths of the pulses and either replies or not, according to the relative signal strengths. In the 3 pulse method the interrogating pulses P1 and P3 are transmitted on the interrogator aerial and a third pulse, P2, is transmitted on the control aerial and two microseconds after the P1 signal. The signal strengths of P1 and P3 are compared with that of P2 and the transponder will reply or not according to the relative signal strengths.

Failure warning lamp

18. During operation of the installation the amber failure warning lamp will glow in the following cases:–

(1) Function selector switch set to OFF.
(2) Function selector switch set to SBY and the transponder being interrogated (warning lamp will flash).
(3) If a fault occurs within the transponder.
(4) If the features of the self test check are not fulfilled.

Self test lamp

19. Correct functioning of the warmed-up equipment may be checked by use of the self test lamp/switch on the IFF/SSR control panel in the following manner:–

(1) On the control unit select 1, 2, C and D switches down.
(2) Select 1 and 3 code switches to 0000 and the CIVIL/MIL switch to MIL.
(3) With the function control switch at SBY, depress the TEST lamp and it should remain out. The amber FAIL WARN lamp should flash.
(4) Select the function selector to LOW. Depress the TEST lamp and it should glow. The amber FAIL lamp should flash.

TABLE 2

Modes of operation

Mode	Time interval	Function
1	3 μ sec.	Military identification
2	5 μ sec.	Military identification
3A	8 μ sec.	Civil/Military identification
B	17 μ sec.	Civil identification
C	21 μ sec.	Automatic altitude
D	25 μ sec.	–

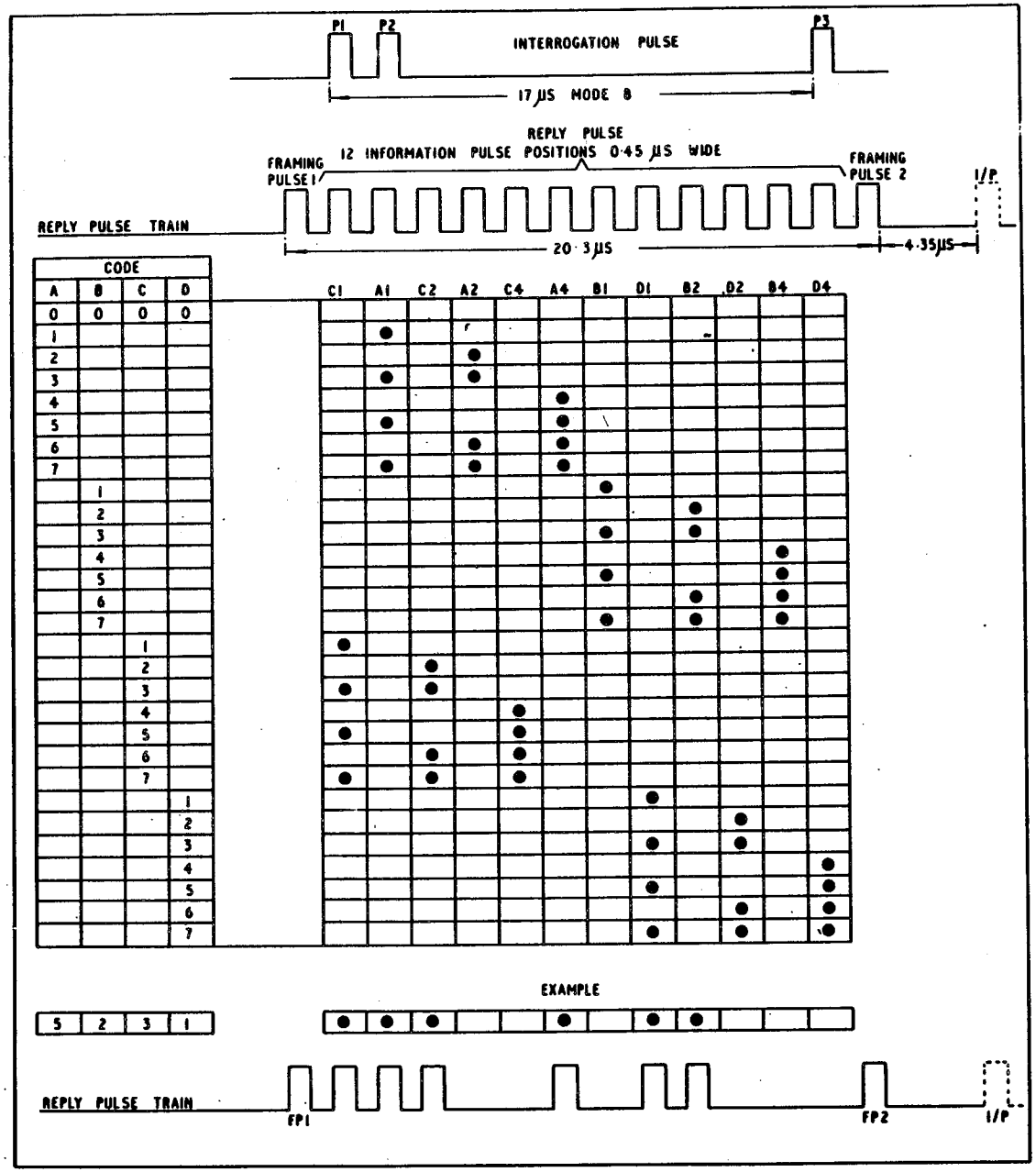


Fig. 3 Interrogation and reply pulse wave forms and codes

Should the amber lamp remain steady this is not a failure indication in the LOW selection.

(5) Select the function selector to NORM. Depress the TEST lamp and it should glow. The amber lamp should remain out.

(6) Select the function selector to EMGY/PUSH. Depress the TEST lamp and it should glow. The amber lamp should remain out.

(7) Select the function selector switch to OFF and note that the amber warning light comes on.

SERVICING

General

20. Servicing of the IFF/SSR installation is given in A P 114J-0101-16. Any units suspected of being unserviceable should be carefully checked in situ, both for source of supply power and individual serviceability, before removal. Ensure every unit is secure and the plugs and sockets are properly mated and securely tightened. Cables and connectors should be examined along their entire length for signs of damage or deterioration. All clips securing the cables to the aircraft structure must be inspected for signs of looseness. Insecure slips should be tightened as necessary to prevent chafing.

Aerial switching unit

21. The aerial switching unit contains solid state components and it is therefore not possible to check the continuity and operation of this

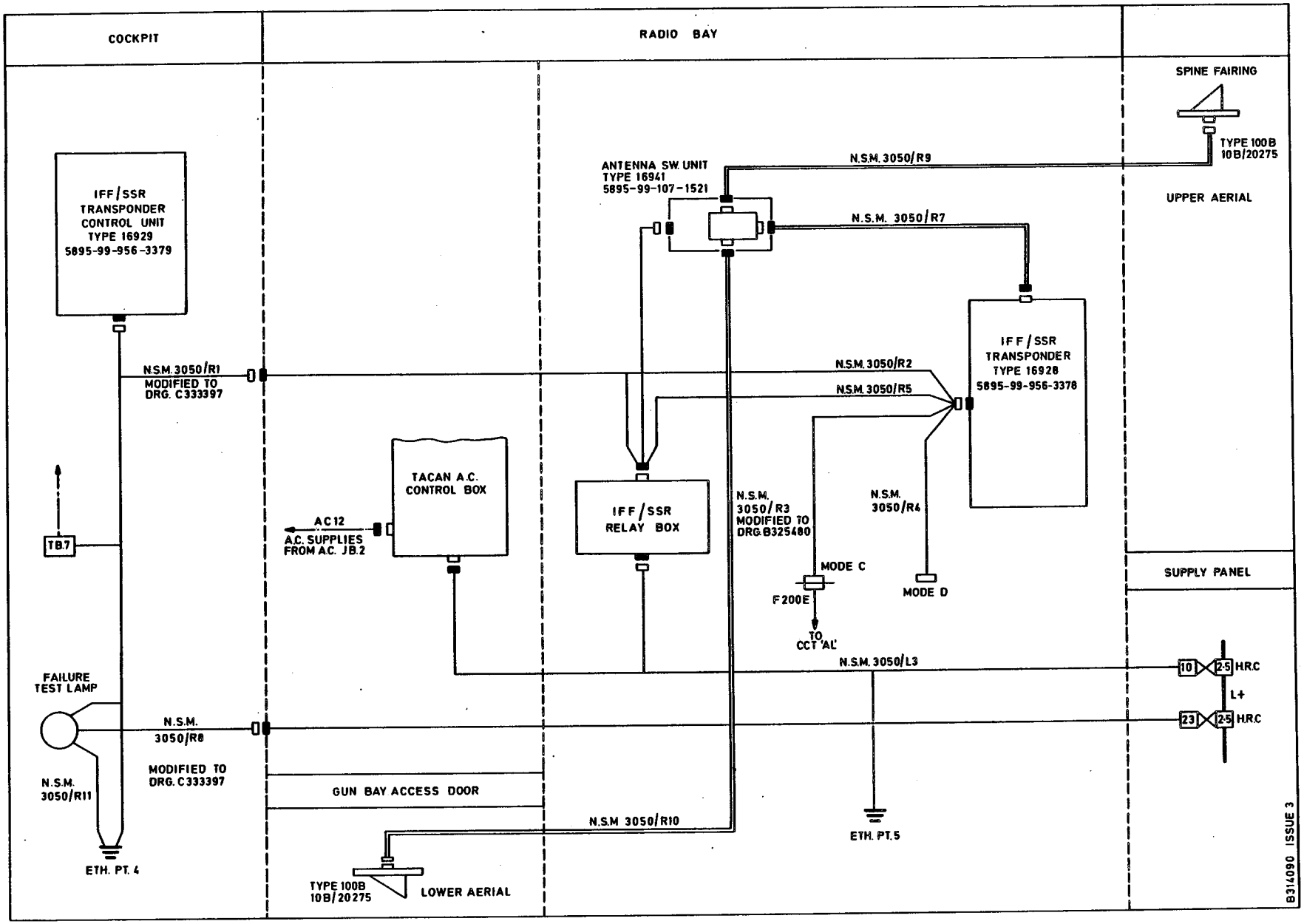
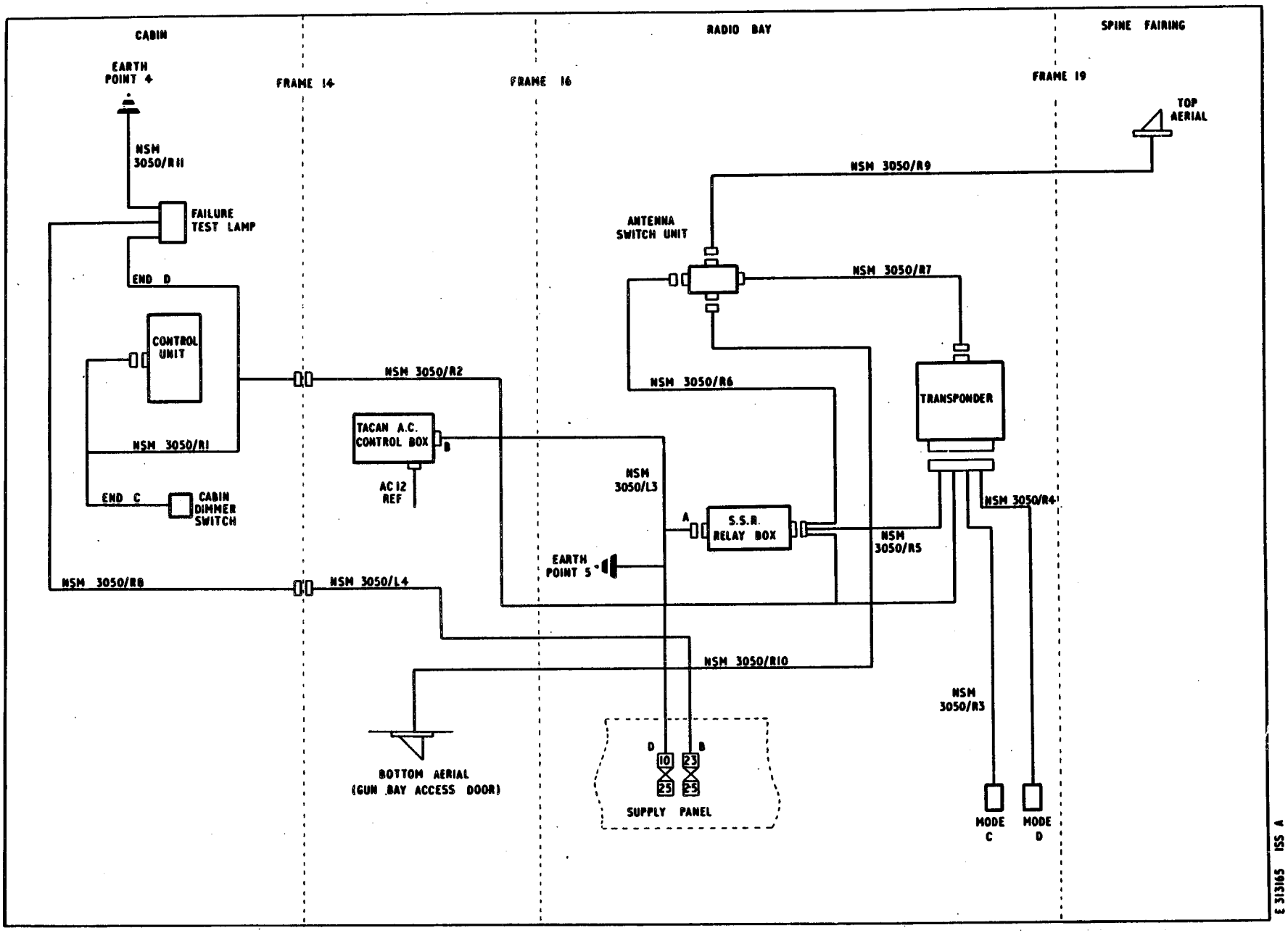


Fig.4 Equipment interconnections

▶ (Mod 1430 added) ◀



▶ Fig.4A Equipment interconnections – pre-Mod 1430 ◀

switch by d.c. or low frequency measurements. In particular the test unit used for aerial switches Type 6850 (A.R.I.5848) cannot be used to test this switching unit.

CAUTION...

Failure of the switching diodes in the aerial switching unit can occur if the peak R.F. voltage applied to the switch exceeds the diode breakdown voltage. It is essential therefore that R.F. power is applied to the switch only when the aerial terminals are correctly terminated either by a radiating aerial, or by a matched load.

Functional checks

22. A functional check of the installation can be made without special test equipment by using the built in self test equipment facility (para.19).

Test equipment

23. The ground test equipment required for testing the IFF/SSR 1520 airborne installation is listed in SRIM 3050. A performance test will require Cossor Test Set CRM 554. The performance test of the MODE C altitude reporting facility is given in Sect.5, Chap.2, Group 3.A, App.1.

REMOVAL AND ASSEMBLY

General

24. No difficulty should be experienced when removing any of the components comprising the IFF/SSR installation and the assembly is in general a reversal of removal but where there is any special feature it is covered by a note in the appropriate paragraph. Before removing or installing any components, the aircraft electrical system must be rendered safe as described in Sect.5, Group A.1., and on assembly ensure all bonding and earth connections are made good and all cables clipped and secured.

Transponder

25. The following is the recommended procedure for removing the transponder from the aircraft.

(1) Comply with safety regulations.
(2) Gain access to the radio bay.
(3) Remove electrical connectors from transponder and fit blanks. Stow cables clear of transponder.
(4) Undo and disengage the two knurled retaining catches at inboard end of transponder inboard until clear of mounting being careful to support unit as it comes clear.
(5) Fit approved blanking caps and covers.

Aerial switching unit

26. The recommended procedure for removing the aerial switching unit from the aircraft is as follows:–

(1) Comply with safety regulations.
(2) Gain access to the radio bay.
(3) Disconnect the four electrical connectors, fit blanks and stow clear of unit.
(4) Remove the three bolts securing the unit to its mountings and remove the unit.

Relay box

27. The recommended method of removing the relay box from the aircraft is as follows:–

(1) Comply with safety regulations.
(2) Gain access to frame 19 in the radio bay.
(3) Remove the two electrical connectors, fit approved blanks and stow cables.
(4) Undo the three bolts securing the relay box to its mounting assembly and remove the box from the aircraft.

Aerials Type 100B

28. Access to the upper aerial is gained via an access panel on the spine fairing between frames 21–22 and to the lower aerial by opening the gun bay access door on the bottom surface of the fuselage between frames 15–16. Once access is gained the removal procedure is the same in both cases and is as follows:–

(1) Comply with safety regulations.
(2) Undo co-axial connector, fit blank and stow clear.
(3) Undo the bolts securing the aerial assembly to the structure and pull assembly into the aircraft being careful not to damage aerial. Remove from aircraft.

Note...

On assembly make good electrical contact between aircraft skin and aerial mounting by ensuring that contact surfaces are clean and well mated.

Control unit

29. The recommended method of removing the control unit from its mounting in the cabin is as follows:–

(1) Comply with safety regulations.
(2) Undo electrical connection at rear of unit.
(3) Undo the four quick release fasteners securing the control unit to its mounting and remove control unit from aircraft.
(4) Fit approved blanks to control unit and cable end.

Failure warning lamp

30. Removal of this item from its mounting beside the control unit is self evident.

APPENDIX 2 - MOD 1467

RADAR ALTIMETER - ARI 23232/17

LIST OF CONTENTS

TABLE 1

Equipment List

Equipment	Type	Air Publication
Transmitter-receiver	SMITHS 0101 HRA/1	AP116B-0215 SERIES
Radar altitude indicator	SMITHS 0201 KIR 01 Mod 01	AP116B-0215 SERIES
Aerials (2 off)	SMITHS 0301-HAA-04	
Tone generator	RACAL E 679/1	
Amplifier	RACAL A 691/5	

INTRODUCTION

1. This appendix contains a description of the ARI 23232/17 (Radar Altimeter) introduced by Mod 1467. The Radar Altimeter installation provides continuous indication of the altitude of the aircraft up to a height of 5000 ft above the nearest terrain. Main components of the installation are listed, together with type or part number, in the Equipment List (Table 1) and are located in the aircraft as shown in Fig 1. A theoretical diagram is in Fig 3. In addition to the following information, complete descriptive and servicing details of the equipment are available in AP116B-0215-1A.

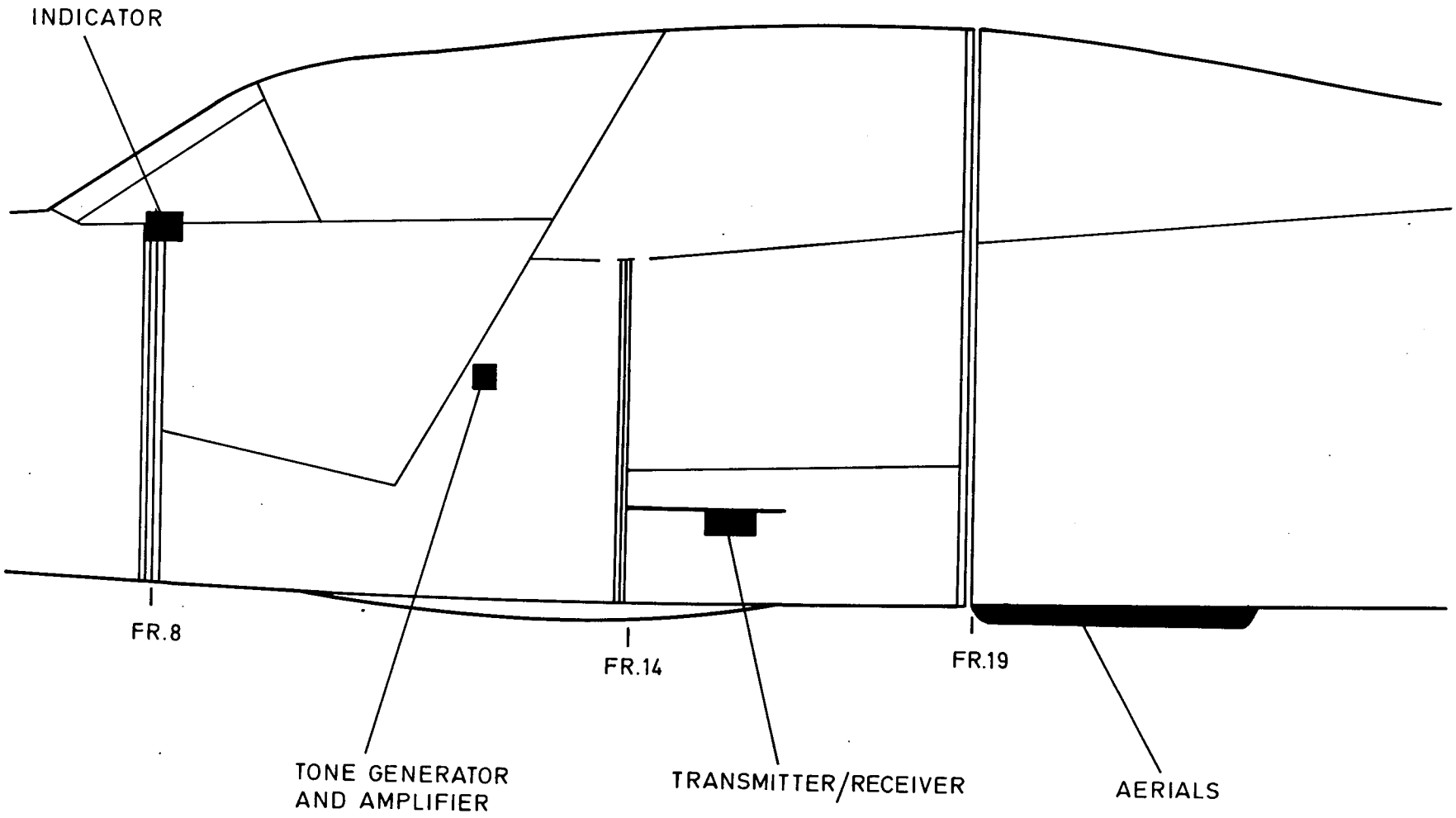


Fig. 1 Radar altimeter - location of equipment

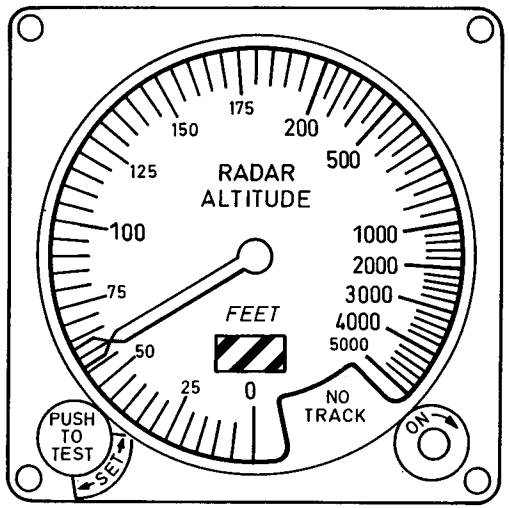


Fig 2 Radar Altimeter Indicator

DESCRIPTION

General

2.. The ARI 23232/17 is a high resolution, short pulse radar system with low-level terrain tracking and altitude sensing capabilities and will operate normally in temperatures ranging from -40 deg C to +71 deg C. The equipment will track terrain ahead of, or adjacent to, the aircraft when it is nearer than the terrain below, thus providing warning of rapid changes in altitude.

3. Altitude information is derived from measurement of the time lapse between transmission of a 4300 MHz pulse and the echo return pulse, which is processed to produce a standard analogue output voltage. This voltage (external range), varying from zero volts at ground level to +40 VDC at 5000 ft., is proportional to the altitude of the aircraft above the local terrain and is used to drive a servo device in the indicator which positions the indicator pointer. A switched output of the indicator is used to operate the peripheral LOW warning lights and the LYRE BIRD tone generation in the event of the aircraft descending below the height set on the index bug. The system incorporates a manually controlled built-in test facility which can be used to check correct operation of the transmitter-receiver and indicator prior to and during flight or for bay servicing purposes.

Power supplies

4. The system is supplied with 115 VAC from B phase of the AC distribution panel and with 28 VDC from the main fuse panel. The AC supply is routed via fuse 3 and the system master switch to the indicator. A separate DC supply is routed direct to the transmitter-receiver via fuse 43. A further DC supply is routed from fuse 44 to the tone generation panel and is used to power the tone generator and the amplifier. The supply for the instrument illumination is taken from fuse 31 which is used to supply the port shelf and engine anti-ice control lighting.

Transmitter-receiver

5. The transmitter-receiver is mounted on the port side of the radio bay just below the emergency UHF battery. The unit is secured in the rack by two screw clamps which engage fittings on the front panel and by a full width knife-edge wedge at the rear. A 26 pole plug J1 and two co-axial connectors J2 RCVR ANT and J3 XMTR ANT on the front panel, provide for connection of the unit into the system. A receptacle marked TEST J4 on this panel, provided for test purposes, is used for the connection of an external shorting plug. This shorting plug, which is attached by a flexible strap to the front panel, must always be fitted for the equipment to operate. Depending upon the modification standard of the transmitter- receiver, the front panel may also house an elapsed time indicator.

Indicator

6. The indicator is located in the armament control panel which is located on the port side of the pilots' main instrument panel. The indicator is secured by four screws and connected into the installation by a 19 pole plug on the back of the instrument case. In the front of the indicator is a circular dial with a peripheral scale and a centrally pivoted pointer. A triangular shaped marker (low altitude limit index), adjustable over the full indication range, is positioned on the outer edge of the scale and a fixed masking shield marked NO TRACK is positioned outside the scale extremities. An aperture in the lower centre of the dial displays a black and red striped failure flag. A low altitude warning indicator is mounted off the dial in the lower right corner of the case. A control knob at the lower left corner, marked PUSH TO TEST with SET position, serves as the setting control for the low altitude limit index and built-in test function switch. The ON-off function of the knob incorporated with the low altitude warning indicator is not used in this installation.

Aerials

7. The two aerials are mounted in a fairing on the underside of the centre fuselage on the aircraft centre-line between frames 19 and 24 and are connected by co-axial cables cables directly to the transmitter-receiver. The aerials do not require disconnecting in order to lower the fairing, which can be accomplished by releasing the four securing bolts and lowering it to the ground on the hinge fitted at the forward end.

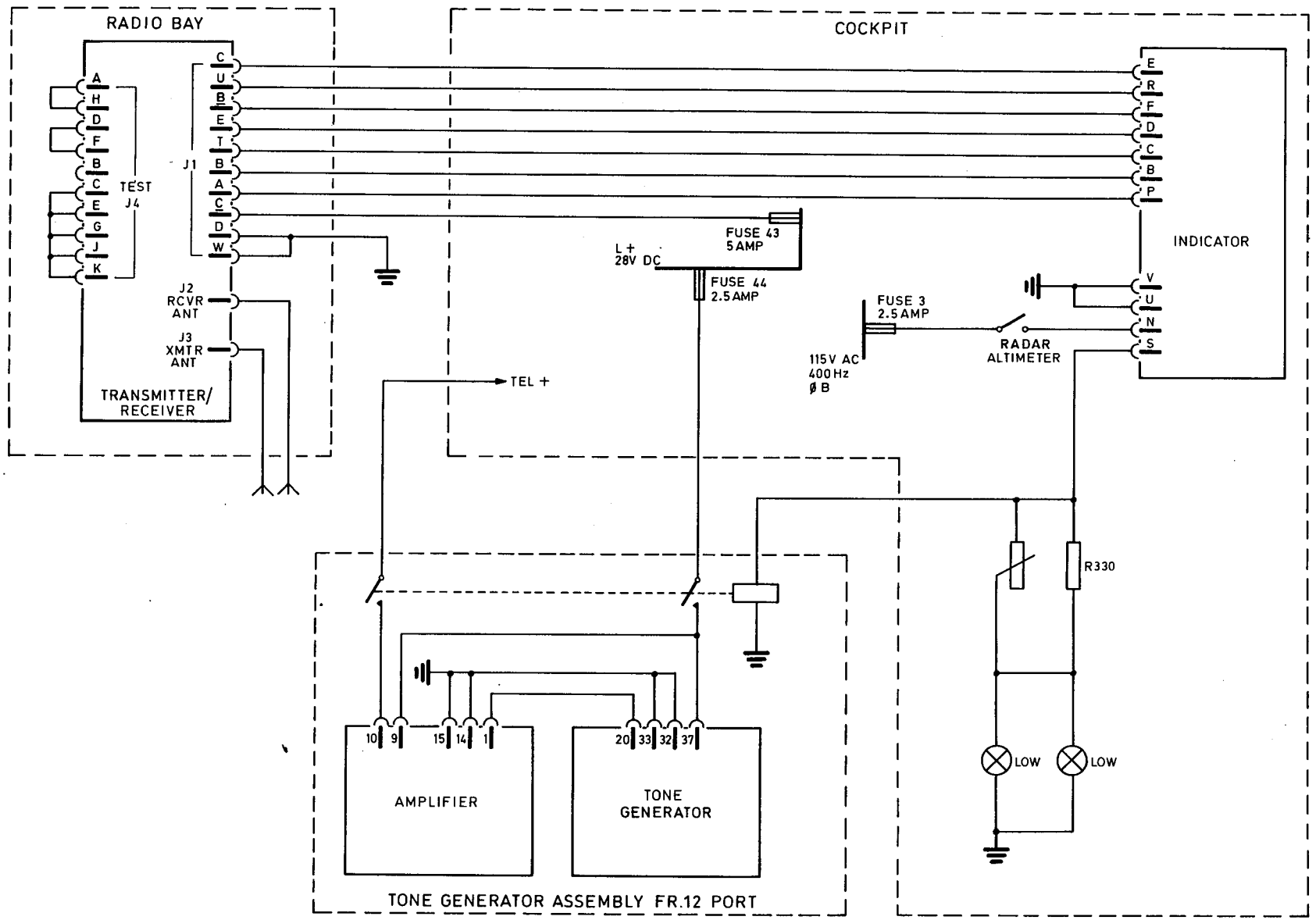


Fig. 3 Radar altimeter - theoretical

Warning light and tones

8. Two peripheral LOW warning lights, located in the pilots' line of sight, above the glare-shield, and a LYRE BIRD tone in the crew headset operates when the warning light located in the indicator is illuminated. They are designed to give extra warning when the aircraft descends below the setting of the low altitude index. The lights and the tone cancel automatically when the aircraft climbs above the index height. The intensity of the LOW lights can be controlled by the centre of the knob located adjacent to the indicator. The outer of the knob is used to control the lighting level of the indicator.

Tone generator and amplifier

9. The tone generator and amplifier are situated on a mounting plate on the forward face of frame 12 and adjacent to the port ejection seat.

OPERATION

General

10. The system is switched on by the operation of the RADAR ALTIMETER master switch from the OFF to the ON position. Clockwise rotation of the indicator SET knob will increase the height selected by the low altitude index to the desired low limit. Low altitude is indicated by the illumination of the amber light in the lower right hand corner of the instrument, which is activated by an internal transistor switch when indicated altitude falls below the pre- selected index. The circuit is arranged so that the warning will only appear when valid signals, indicated by the absence of the failure flag, are being received by the indicator. The failure flag is operated by a solenoid, controlled by a valid track signal from the transmitter-receiver, and is in view when the power is switched OFF, if the supply fails or loss of track occurs when the system is operating. Loss of track is further indicated by the pointer swinging behind the 'no track' mask.

11. The PUSH TO TEST function of the left control knob brings the self-test circuits into operation. With the system switched on, operation of the push- switch activates circuits in the transmitter-receiver which produce a simulated 100 ft. altitude signal. Use of this facility is detailed under Testing.

SERVICING

WARNING...
When servicing this equipment, personnel must observe the precautions detailed in Sect.2 Chap.4 regarding radio frequency hazards

General

12. Detailed servicing of the installation is covered in AP116B-0215-1A. Before any item of equipment suspected of being unserviceable as a result of system malfunction is removed from the aircraft, the installation should be examined and power supplies checked. Wiring continuity and insulation resistance should be checked, as required, using standard test equipment.

Examination

13. Ensure that all units of the installation are correctly fitted and that plug/socket connectors are correctly assembled and connected. Examine all units for damage and cables for signs of chafing. Ensure that cable clips are tight fitting and correctly fitted.

Testing

14. Testing the system in situ is limited to the use of the built-in test facility and functional checks as detailed in the following paragraphs.

15. Ensure that the area in the immediate vicinity of the aerials is clear of obstacles and that the aerial fairing is fitted correctly in the flight position.

16. With power available at the aircraft busbars and the RADAR ALTIMETER master switch in the OFF position, check that the failure flag is displayed and the pointer is in the 'no track' position.

17. Connect a headset to the socket provided on the ejection seat.

18. Test sequence.

(1) Operate the RADAR ALTIMETER master switch to ON position and allow the equipment to warm up.

(2) Rotate the SET knob to position the low altitude index at 50 ft. Observe that after approximately 1 minute the failure flag clears, the indicator reads +2 ft. to +3 ft. and the low altitude warning light on the indicator illuminates. Observe also the two LOW lights illuminate and that the LYRE BIRD tone can be heard in the headset.

(3) Operate the centre dimmer switch control knob, located adjacent to the indicator, through its entire range and check that the lights cannot be extinguished. Return to the full brilliance position.

(4) Operate the test push-switch (PUSH TO TEST) and hold. Observe indication of 100 ft +/- 10 ft. and that the low altitude warnings (light and audio) are cancelled as the pointer passes the index limit.

(5) Release the push-switch and observe that the pointer returns to between +2 ft. and +3 ft. and the low altitude warnings are reinstated.

(6) Set the RADAR ALTIMETER master switch to OFF position and observe that the low altitude warnings are cancelled, the pointer swings to the 'no track' position and the failure flag appears.

(7) Operate the instrument lighting dimmer switch (outer knob of dimmer switch located adjacent to radar altimeter indicator) and check that the lighting level varies with movement of the control.

(8) Remove headset on completion of tests.

REMOVAL AND INSTALLATION

General

19. Before an item of equipment is disconnected, the aircraft must be rendered electrically safe as described in Sect.5, Chap.1, Group A1. When an item of equipment is removed for servicing or repair, protective caps should be fitted to the receptacles on the unit and the free connectors on the aircraft should be suitably blanked or insulated and temporarily stowed.

Transmitter-receiver

20. To gain access to the radar altimeter transmitter-reciver remove the fuselage underside panels to the radio bay. The radar altimeter transmitter-receiver is located in an enclosure below the enmergency battery stowage.

Mounting rack

21. If the mounting rack is removed and refitted or replaced, ensure that the areas under the bolt holes and the securing bolts and nuts are cleaned free of paint to ensure good electrical bonding.

Aerials

22. It is essential when installing an acrial that mating surfaces are perfectly clean and flush fitting to ensure good electrical bonding. Also, the words 'DO NOT PAINT' must be on the starboard side of the forward aerial and on the port side of the aft aerial.

23. Inspect the seal between the aerial fairing and the fuselage for signs of damage and fuel contamination. Replace the seal if any signs of damage are evident.

FAULT DIAGNOSIS AND RECTIFICATION

General

24. With the exception of basic power and wiring continuity checks using standard test equipment, diagnosis and rectification of faults must be in accordance with detailed procedures and instructions in AP114J-1901-1.