

BASE AIR  
FEB 19 1974

T.O. IT-29A-2-11

See APP.  
T.O. IT-29A-2-11S

★  
**TECHNICAL MANUAL**  
**MAINTENANCE**

**RADIO AND COMMUNICATIONS**

**USAF SERIES**

**T-29A, B, C, AND D**

**AIRCRAFT**

AF 41(608)-29332  
F41608-72-D-1959

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*Title	1 Dec 73	58N	15 Apr 70	143 thru 148	15 Jan 65
*A	1 Dec 73	58P thru 58S	15 Apr 70	149	1 Sep 71
*i	1 Dec 73	58T Blank	15 Apr 70	150	Original
ii thru iv	Original	59 thru 62	1 Mar 72	151 thru 153	15 Jan 65
v	29 Nov 68	63	Original	154	15 Feb 67
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vii Added	10 Feb 67	67	Original	157 thru 160	Original
viii Blank	10 Feb 67	68	1 Mar 72	160A thru 160B	15 Jul 73
1	31 Oct 58	*69 thru 82A	1 Dec 73	161	Original
2 thru 2A	1 Mar 72	*82B Blank	1 Dec 73	162 thru 164	1 Mar 72
2B Blank	20 Sep 60	*82B-1 thru 82B-2		164A Deleted	1 Mar 72
3	1 Mar 72	Added	1 Dec 73	164B	20 Sep 60
4 thru 5	Original	82C thru 82M	20 Sep 60	165	Original
6 thru 10A	1 Mar 72	82N	1 Sep 71	166 thru 168	1 Mar 72
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11 thru 12	1 Mar 72	82S	1 Jul 73	Deleted	1 Mar 72
12A Added	15 Feb 67	82T thru 82W	1 Sep 71	174A thru 174B	20 Sep 60
12B Blank	15 Feb 67	82X thru 82AE	15 Jul 73	*175	1 Dec 73
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52 thru 53	Original	133	1 Sep 71	*200H Blank	1 Dec 73
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55	Original	138	15 Feb 67	*202	1 Dec 73
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58C thru 58H	20 Sep 60	141	1 Sep 71	204 Blank	Original
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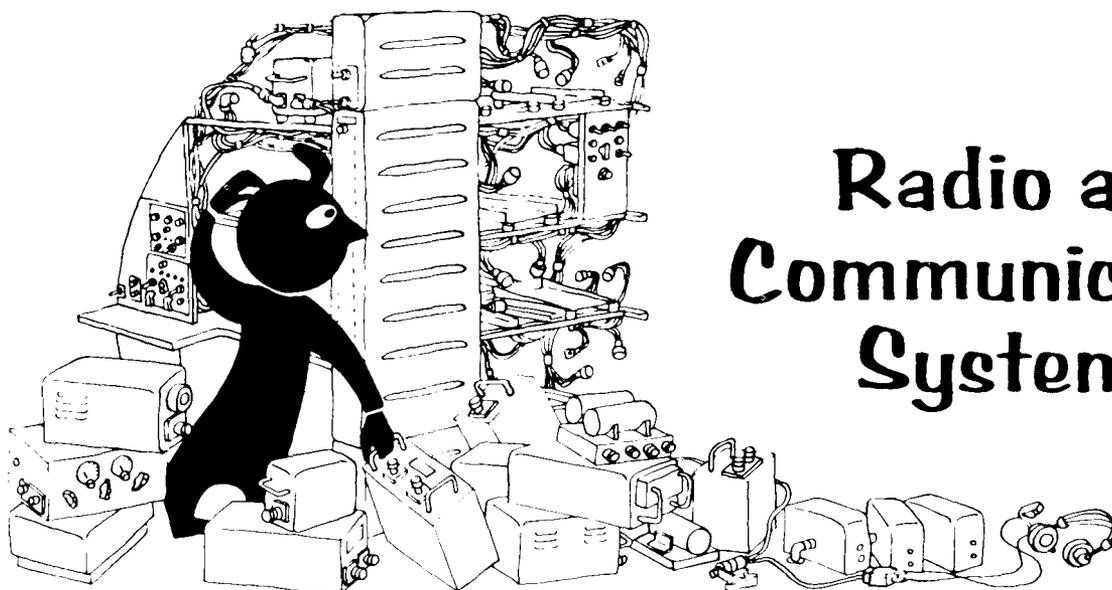
ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

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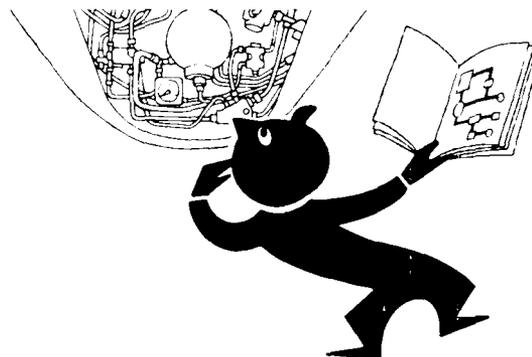
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# Radio and Communication Systems

## DESCRIPTION

This gives a functional description of the system, a list of all components, with their location, and their function. Each component listed is described, also included under this heading are brief functional descriptions of the integral sub-systems.

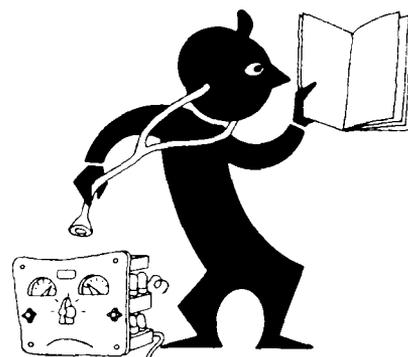


## OPERATIONAL CHECK-OUT

In this portion of each section are procedures for ground checking the system and its components. It provides a step-by-step operational check-out of the equipment or system to determine that the equipment or system so checked is functioning at its optimum operational capability.

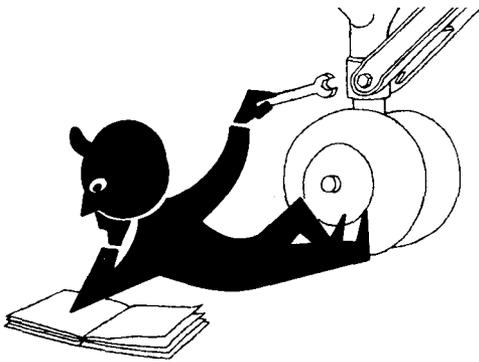
## SYSTEM ANALYSIS

Contained under this heading is a list of troubles which could develop within the system or in one of its components. The trouble shooting chart lists the possible cause of the malfunction, indicates the isolation procedure to direct the mechanic as easily as possible to the trouble area, and prescribes the remedial maintenance action.



**REPLACEMENT**

This part of each section contains removal and installation instructions, together with the list of tools and equipment required to accomplish replacement.



**ADJUSTMENT**

Incorporated under this heading are instructions for accomplishing adjustments on the system and/or its components; to maintain the systems performance at optimum operational standards.

**SERVICING**

These are servicing instructions for cleaning, draining, or lubricating the system and/or its components. This is work which must be accomplished by organizational maintenance personnel when performing work specified in previous portions of the section.



**MAINTENANCE**

This particular category will not be found in all Handbooks. This major heading will only be used when special maintenance is used which does not specifically meet the requirements under another heading.

# T-29 COMPARISON CHART



EQUIPMENT	T-29A	T-29B	T-29C	T-29D
TRAINING FACILITIES	10 Navigation Students and/or Instructor	10 Navigation Students and/or Instructor	10 Navigation Students and/or Instructor	2 Student Navigators 2 Student Nav-Bomb. 1 Instructor Navigator 2 Student Bombardiers 1 Instructor Bombardier
POWER PLANT	R2800-97W	R2800-97W	R2800-99W	R2800-99W
ENGINE FIRE EXT	2-shot CO <sub>2</sub>	1-shot DB	1-shot DB	1-shot DB
RH GENERATOR & #2 ALTERNATOR	Engine-driven	Hydraulic Motor-Driven	Hydraulic Motor-Driven	Hydraulic Motor-Driven
PRESS. CABIN	No	Yes	Yes	Yes
ASTRODOMES	3 Astrodomes (1 flat window for periscope sextant in place of forward astro-dome)	3 Astrodomes (1 flat window for periscope sextant in place of 1st or 2nd forward astro-dome)	0 or 2 Astrodomes (2 or 4 flat windows for periscope sextants in place of astrodomes.)	None (2 flat windows for periscope sextants)
LOOP ANTENNA	1 top 3 bottom	2 top 2 bottom	2 top 2 bottom	1 top 1 bottom
SERIAL NUMBERS	49-1910 to 49-1945 and 50-183 thru 50-194 incl.	51-3797 to 51-3816; 51-5114 to 51-5172, and 51-7892 thru 51-7917 incl.	52-1091 to 52-1175, and 53-3461 thru 53-3494 incl. except 52-1092 52-1096 thru 52-1098 incl. 52-1105 52-1106 52-1125 52-1128 52-1139 52-1142 which have been redesignated AT-29C aircraft	52-1176 to 52-1185; 52-5812 thru 52-5836; 52-9976 thru 52-9980 and 53-3495 thru 53-3546 incl.

# LIST OF T-29 SECTIONALIZED MAINTENANCE MANUALS

TITLE	TECHNICAL ORDER NUMBER
GENERAL AIRPLANE	1T-29A-2-1
GROUND HANDLING SERVICING AND AIRFRAME	1T-29A-2-2
HYDRAULIC SYSTEMS	1T-29A-2-3
UTILITY SYSTEMS	1T-29A-2-4
POWER PLANT SYSTEMS	1T-29A-2-5
FUEL AND OIL SYSTEMS	1T-29A-2-6
LANDING GEAR SYSTEMS	1T-29A-2-7
FLIGHT CONTROL SYSTEMS	1T-29A-2-8
INSTRUMENT SYSTEMS	1T-29A-2-9
ELECTRICAL SYSTEMS	1T-29A-2-10
COMMUNICATION SYSTEMS	1T-29A-2-11
NAVIGATION SYSTEMS	1T-29A-2-12
BOMBING AND RECONNAISSANCE SYSTEMS	1T-29A-2-13
CONFIDENTIAL SUPPLEMENT	1T-29A-2-13A
T-29A WIRING DATA	1T-29A-2-14
T-29B AND T-29C WIRING DATA	1T-29B-2-14
T-29D WIRING DATA	1T-29D-2-14

NOTE: FOR AT-29C AIRCRAFT, REFER TO APPLICABLE 1T-29A-2 SERIES SUPPLEMENTS

## SUPPLEMENTARY DATA

OPERATING INSTRUCTIONS	T.O. 1T-29A-1	Flight Manual
STRUCTURAL REPAIR DATA	T.O. 1T-29A-3 T.O. 1T-29D-3	Manual of Structural Repair Instructions
PARTS IDENTIFICATION AND BLUEPRINT NUMBERS	T.O. 1T-29A-4 T.O. 1T-29B-4 T.O. 1T-29D-4	Illustrated Parts Break-down
WEIGHT AND BALANCE DATA	T.O. 1T-29A-5 T.O. 1T-29B-5 T.O. 1T-29D-5	Basic Weight Check List and Loading Data
OFFICIAL INSPECTION REQUIREMENTS	T.O. 1T-29A-6	Manual of Inspection Requirements
AIRCRAFT AND EQUIPMENT PUBLICATIONS	T.O. 1T-29A-01	List of Applicable Publications

For detailed information on how to use this series of manuals, refer to T.O. 1T-29A-2-1, T-29 General Airplane Manual, Introduction.

**LIST OF TIME COMPLIANCE TECHNICAL ORDERS**

T.O. 1T-29-599



## Section I

### GENERAL INFORMATION

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#### DESCRIPTION

#### 1-1. GENERAL.

##### CAUTION

Only qualified personnel will operate or perform maintenance on installed radio equipment.

The radio communications equipment consists basically of an interphone and public address system, a command radio system, and a liaison radio system. The interphone and public address system is the distribution medium of transmission and reception for all other communications facilities. Each crew and student station in the airplane is provided with a microphone, headset, and interphone control panel. The control panels are varied to include switches to cover the individual functions carried out at each station, but each panel has a

volume control and a jack selector switch. The control panels provide partial control of the radio sets required at each station, providing the radio sets are turned on and properly adjusted for the function desired. Direct control over some of the communications equipment is confined to the radio operator's station at the radio equipment rack. A radio junction box — also located on the radio equipment rack — routes the airplane's dc electrical power to the various systems. Additional power requirements are met by dynamotors which are integral parts of the systems.

##### NOTE

*On T-29B (serial No. 52-1156 and subsequent) model airplanes, there is no provision for a radio operator's position.*

Refer to paragraph 1-2 for the types of equipment installed on the various models of T-29 airplanes.

#### 1-2. LIST OF RADIO AND COMMUNICATION EQUIPMENT.

TYPE AND DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
Interphone, USAF combat, on T-29A and T-29B (except serial No. 51-5144) model airplanes.	To provide inter-communication between all stations on airplane.	Internal only.	At each crew and student station.
Interphone, AN/AIC-10, on T-29B (serial No. 51-5144), T-29C, and T-29D model airplanes.	To provide inter-communication between all airplane stations.	Internal only.	At each crew and student station.

## 1-2. LIST OF RADIO AND COMMUNICATION EQUIPMENT (CONT).

TYPE AND DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
VHF command radio set, AN/ARC-3, on T-29B model airplanes.	To provide receiver and transmitter for voice and CW communication from plane-to-plane or plane-to-ground.	Frequency range 100 to 156 mc—line of sight distances.	Pilots' overhead switch panel.
UHF command radio set, AN/ARC-27.	To provide receiver and transmitter for voice communication from plane-to-plane or plane-to-ground.	Frequency range 225.0 to 399.9 mc—line of sight distances.	Pilots' overhead switch panel.
HF Liaison Radio Set Collins 18S-4 on T-29C airplanes incorporating TCTO 1T-29C-508.	To provide receiver and transmitter for voice and CW communication from plane-to-plane or plane-to-ground.	Frequency range 2.0 to 18.5 mc.	Pilots' overhead switch panel and code key at radio operator's position.
Liaison radio set, AN/ARC-8, on T-29A and T-29B (except serial No. 50-184, 51-5168, 51-7897 and 51-7914.	To provide receiver and transmitter for voice and CW communication, On T-29B (serial No. 51-5124 and subsequent) model airplanes, also to transmit distress signals; plane-to-plane or plane-to-ground.	Frequency 2000 to 24,000 kc — long range.	Pilots' overhead switch panel and master control at radio operator's position.
Transponder Set, AN/APX-25.	To provide transponder for automatic selective identification of the aircraft to ground, shipboard, or airborne IFF recognition installations.		Pilots' overhead switch panel.

## 1-2. LIST OF RADIO AND COMMUNICATION EQUIPMENT (CONT).

TYPE AND DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
Transponder Set, AN/APX-72	Provides automatic radar identification, identification of position, emergency signals, and attitude reporting of the craft on which it is located to all suitably equipped interrogating facilities within operational range of the system.	Line of sight.	Pilots overhead control panel.
HF Liaison Radio Set 618T-3 (SSB) on T29A & T29B serial No. 50-184, 51-5168, 51-7897, and 51-7914.	To provide receiver and transmitter for voice communication from plane to plane or plane to ground.	Frequency range 2.0 to 30. MC.	Pilots overhead switch panel and radio rack.
VHF Command Radio Set Wilcox 807A, (used on selected T-29A, B, C, D, and E aircraft.	To provide receiver and transmitter for voice communication from plane to plane or plane-to-ground.	Frequency range from 116.0 MHz through 149.975 MHz line of sight distance.	Pilots overhead switch panel.

## 1-3. INTERPHONE, USAF COMBAT.

See figures 1-1 and 1-2. This interphone system provides intercommunication between each crew member and student station on the airplane. Connections for microphone and headset in the nose and main landing gear wheel wells are provided to facilitate ground maintenance operations. The normal interphone system operates through an amplifier which is connected to all stations. There is also a navigator interphone circuit which includes an amplifier with automatic gain control to compensate for the loss of input (speech) with changes of altitude. This circuit is provided for communication between any crew member and student, while the other crew members and students can still use the normal system. A third limited interphone system, radar interphone, provides communication between the radio operator, the camera operator, and the radar stations. This circuit, working with an automatic gain control amplifier, can be used while the rest of the crew and students are using either the normal or the navigator interphone system. A call system is provided which enables any station to interrupt reception of all stations. Four loudspeakers are tied into the interphone system for public address purposes.

## 1-4. INTERPHONE, AN/AIC-10.

See figures 1-1 and 1-2. This interphone system provides high intelligibility communication in all conditions, and at any operating altitude, between each crew member and student station on the airplane. Each station has a microphone and headset, and a control panel; each control panel is fitted with a plug-in type amplifier. For standby listening without headset, the pilot, copilot, and master radar control stations are fitted with interphone loudspeakers. Each loudspeaker has an associated amplifier. The control panel at each station permits interphone selection, mix, and volume control to that crew member and includes selection of the necessary radio signals, provided the radio equipment is turned on and tuned into the function desired. A call system is provided which enables any station to interrupt reception of all stations. An emergency provision is made on each control panel to enable the station to listen to the interphone system at line level. A separate channel is provided for communication between the pilot, copilot, crew chief, navigator instructor, and students



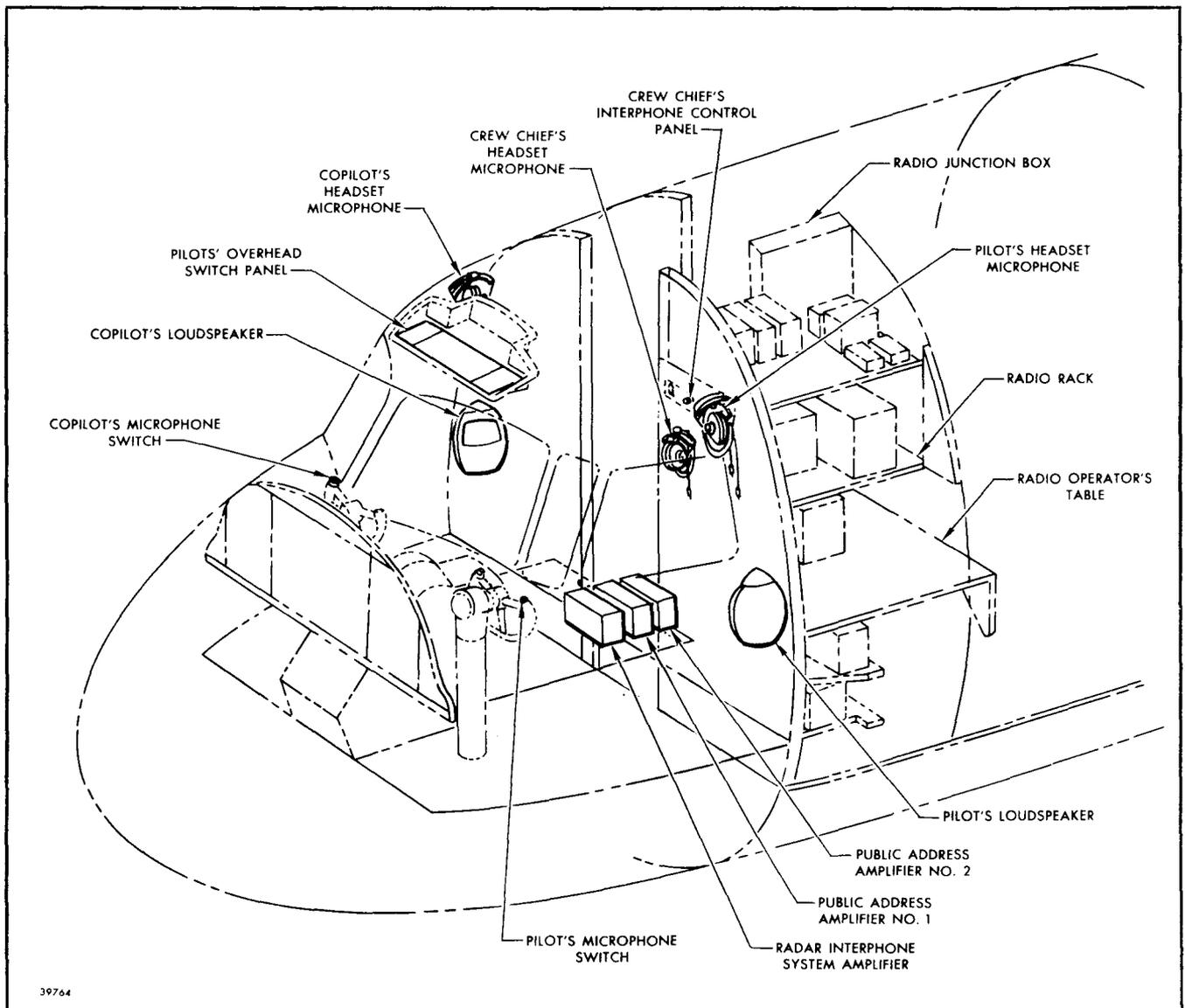


Figure 1-1. Radio and Communications Equipment, Nose Section, Typical

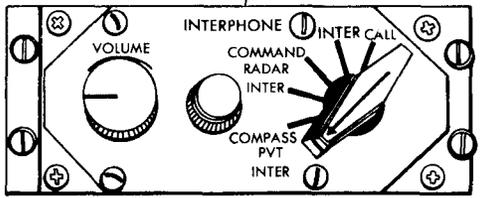
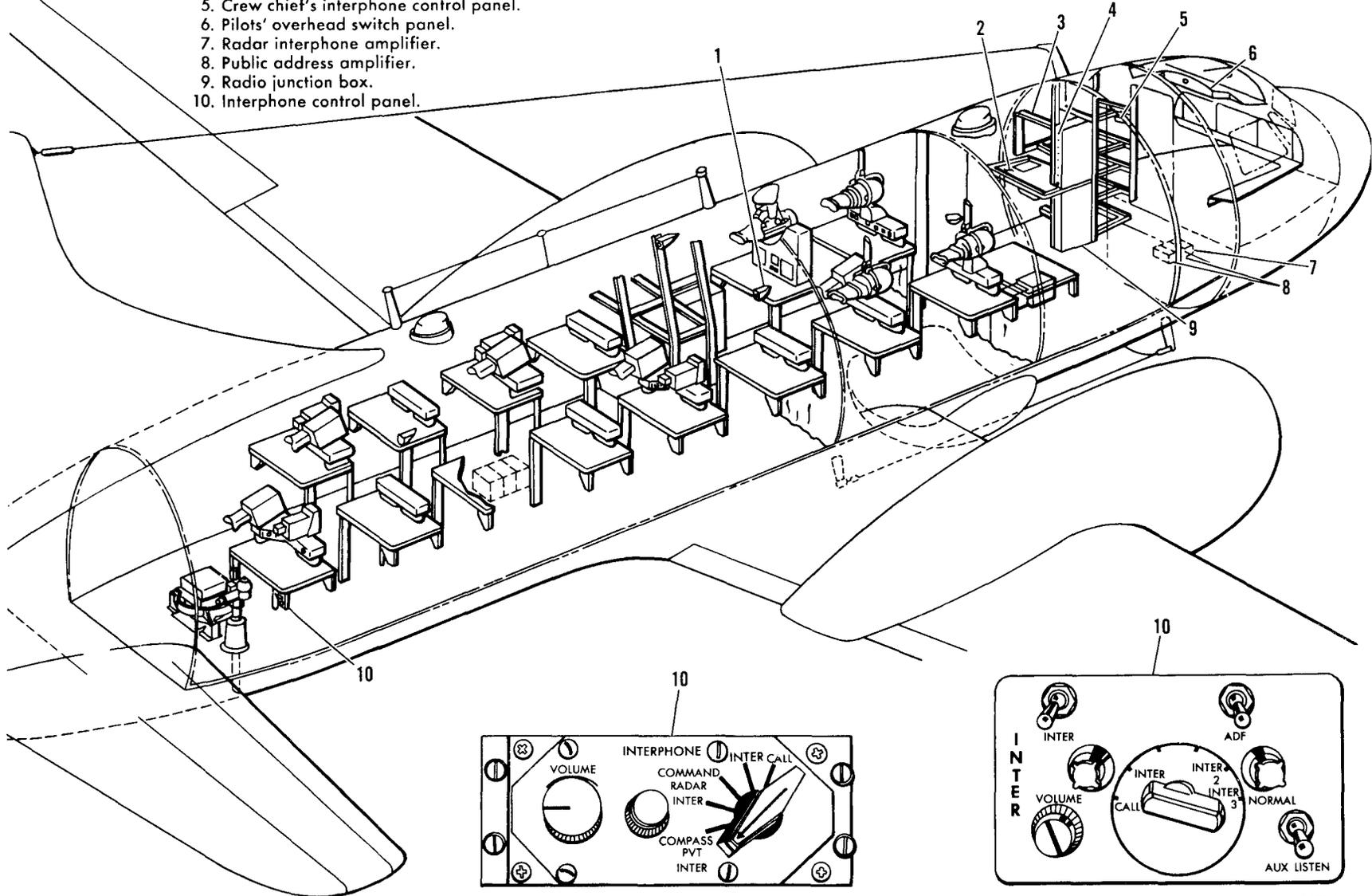
without interrupting the normal interphone system. A third channel permits communication between the master radar operator, pilot, copilot, navigator instructor, radar instructor, and students without interrupting the normal interphone system. Refer to Section III for detailed information on the interphone and public address systems.

#### 1-5. UHF COMMAND RADIO SET, AN/ARC-27.

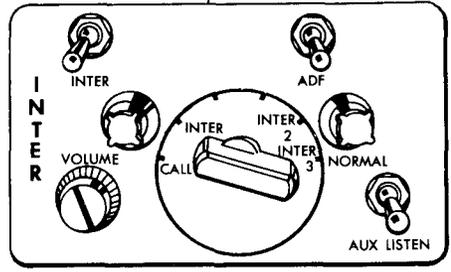
See figures 1-3 through 1-5. The UHF command radio system AN/ARC-27 is installed on all T-29 model airplanes. The system provides a means of voice communication from plane-to-plane or plane-to-ground, over line of sight distances and within a frequency range of 225.0 to 399.9 mc. The receiver/transmitter is amplitude-modulated and operated on any one of twenty preset frequencies in its frequency range. An auxiliary

function of the system is to receive direction finding signals from the direction finding antenna, amplify and demodulate the signals, and apply them to the AN/ARA-25 direction finding equipment; refer to T.O. 1T-29A-2-12. An additional function is provided in conjunction with the radar tone scoring for phantom bombing; refer to T.O. 1T-29A-2-13. The tone scoring is switched into the command set for transmission to the ground to enable ground monitors to determine the accuracy of the bombing practice. The pilots have command of the bomb scoring function and can assume command by means of a switch selection on the pilots' overhead switch panel. The major components of the system are a receiver-transmitter, a pilots' control panel, a main control panel, and a flush-type antenna. On T-29B model airplanes, a transfer relay, operated by a transfer switch on the pilots' overhead switch panel, enables the pilots to transfer command radio to the

1. Public address loudspeaker.
2. Radio operator's station.
3. Radio equipment rack.
4. Radio circuit breaker panel.
5. Crew chief's interphone control panel.
6. Pilots' overhead switch panel.
7. Radar interphone amplifier.
8. Public address amplifier.
9. Radio junction box.
10. Interphone control panel.



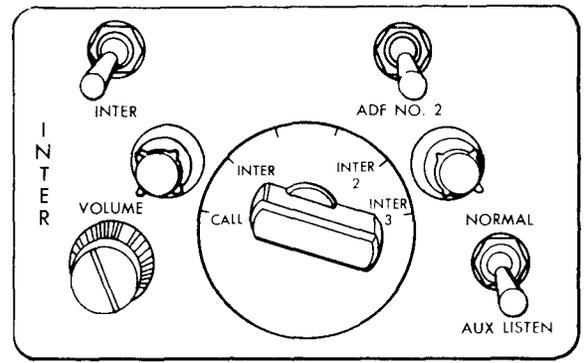
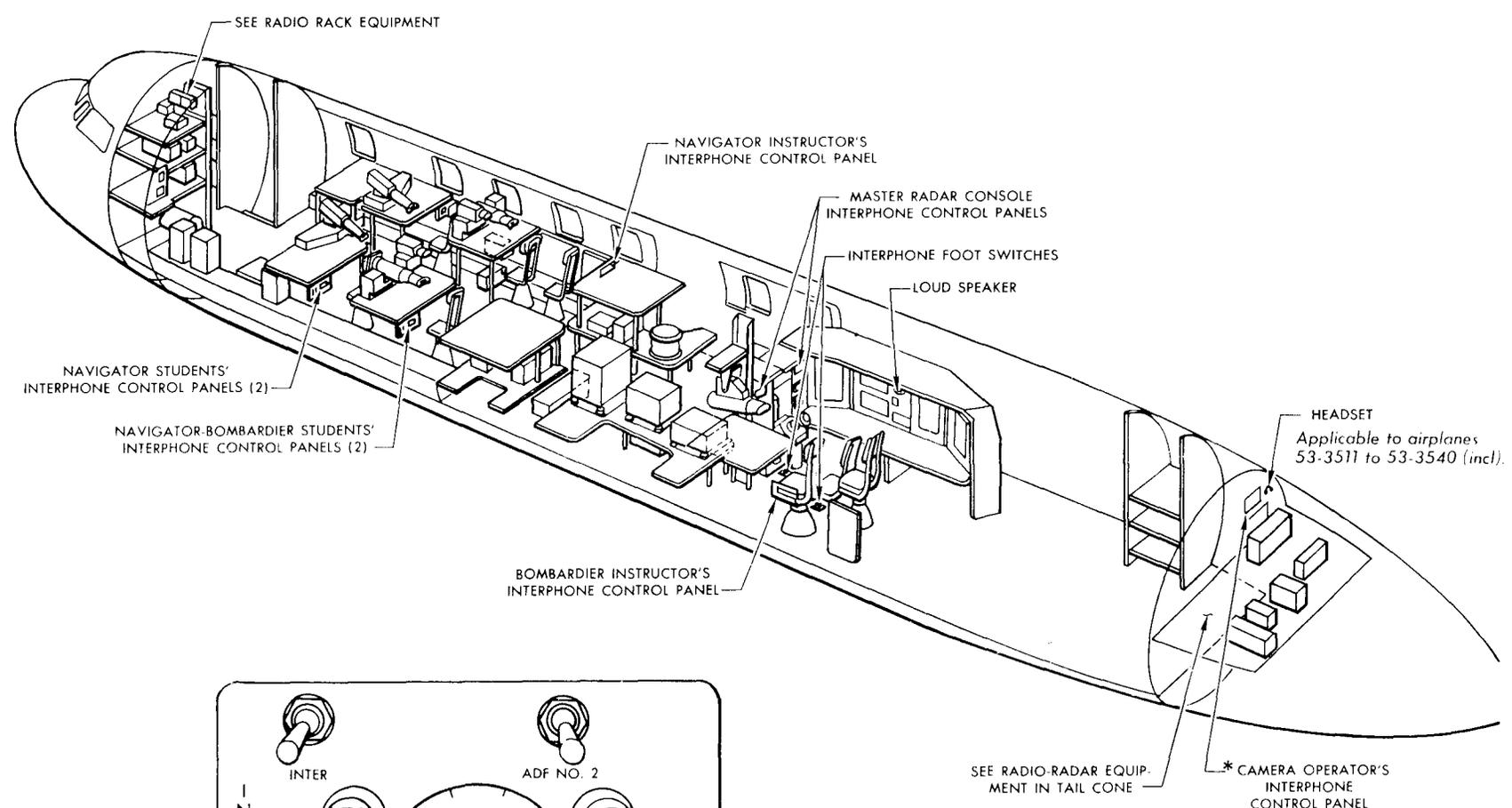
T-29A AND T-29B INTERPHONE CONTROL PANEL



T-29C INTERPHONE CONTROL PANEL, TYPICAL

Figure 1-2. Radio and Communications Equipment, Cabin Section, Typical (Sheet 1 of 2)

Figure 1-2. Radio and Communications Equipment, Cabin Section, Typical (Sheet 2 of 2)



INTERPHONE CONTROL PANEL, TYPICAL

\*Applicable to airplanes 53-3511 to 53-3540 (incl.)

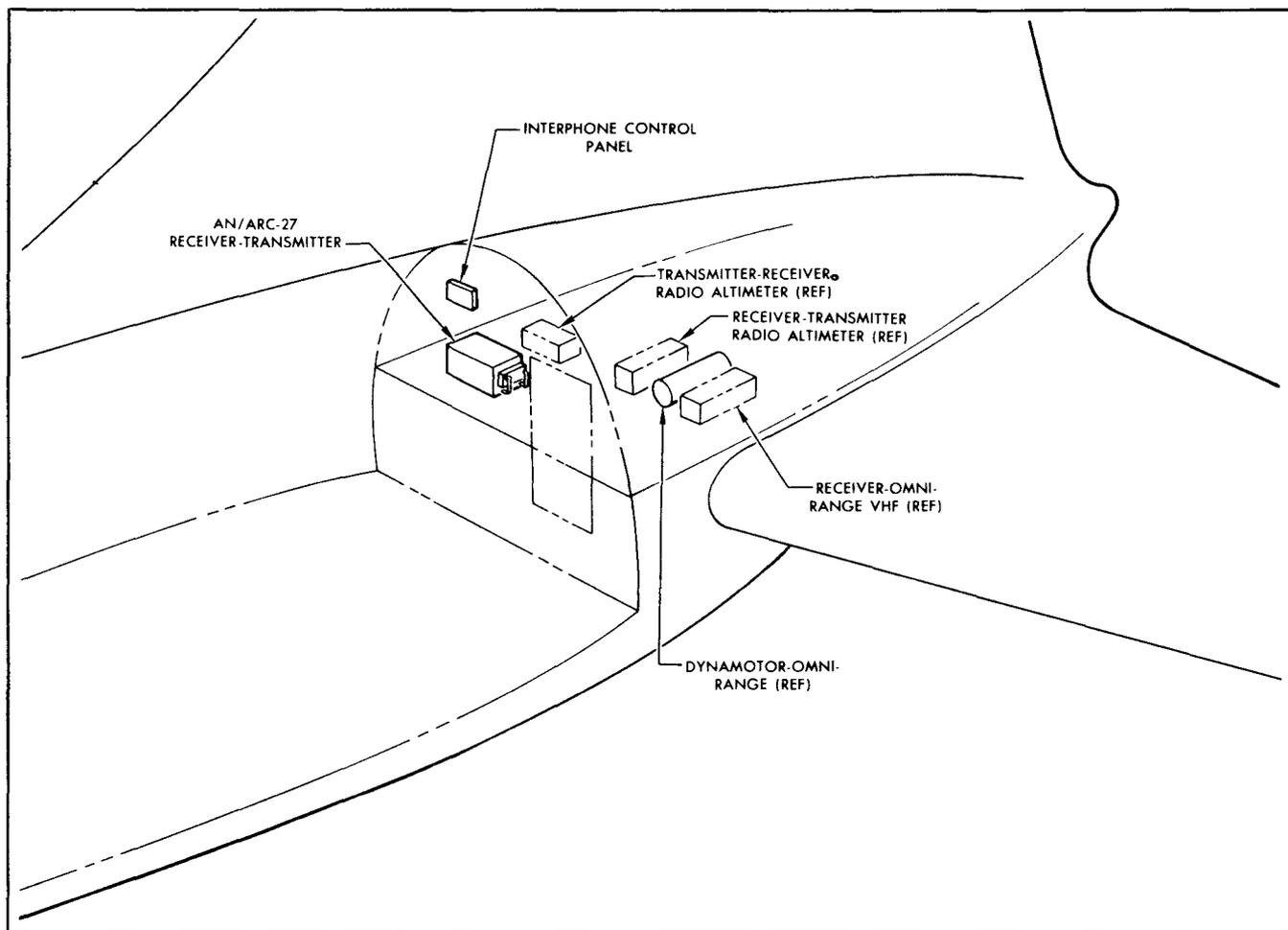


Figure 1-3. Radio and Communications Equipment, Tail Cone, Typical

VHF radio installation in the event of failure of the UHF. Refer to Section V for detailed information on the UHF command radio set.

#### 1-5A. HF LIAISON RADIO SET, COLLINS 18S-4.

The HF liaison radio set is installed on *T-29C model airplanes incorporating TCTO 1T-29C-508*. The system provides AM radio telephone and CW communication from plane-to-plane or plane-to-ground in the 2.0 to 18.5 megacycle range. The system includes a receiver-transmitter, an antenna tuner, a control panel, a code key, and an antenna. Transmission and reception are on the same frequency and a total of 20 frequencies may be preset. Refer to Section V-A for detailed information on the HF liaison radio set.

#### 1-6. VHF COMMAND RADIO SET, AN/ARC-3.

See figures 1-1 thru 1-5. The AN/ARC-3 radio system is installed on *all T-29B model airplanes*. The system is designed for receiving and transmitting voice and MCW communications over a frequency range of 100 to 156 megacycles, from plane-to-plane or plane-to-ground. Average communicating

distances are approximately 30 miles at an altitude of 1,000 feet and 135 miles at 10,000 feet. These distances may be increased or decreased depending on atmospheric conditions. The system consists of a receiver, a transmitter, a power junction box, a control panel, and an antenna. The equipment is designed to operate in extremely humid conditions and in a wide range of temperatures. The system is remotely controlled from the pilots' overhead switch panel. The receiver and transmitter are coordinated to tune simultaneously to the selected channel. There are eight preset crystal-controlled channels. Refer to Section IV for detailed information on the AN/ARC-3 radio set.

#### 1-7. LIAISON RADIO SET, AN/ARC-8.

See figures 1-4 and 1-5. This radio system is designed for long range use and operates on frequencies of from 2,000 to 24,000 kc. The main components are a receiver, a transmitter, a dynamotor, a pilots' control panel, a code key, and a wire type antenna. The receiver is interconnected with the transmitter for break-in operations. The interconnection of the transmitter with the receiver

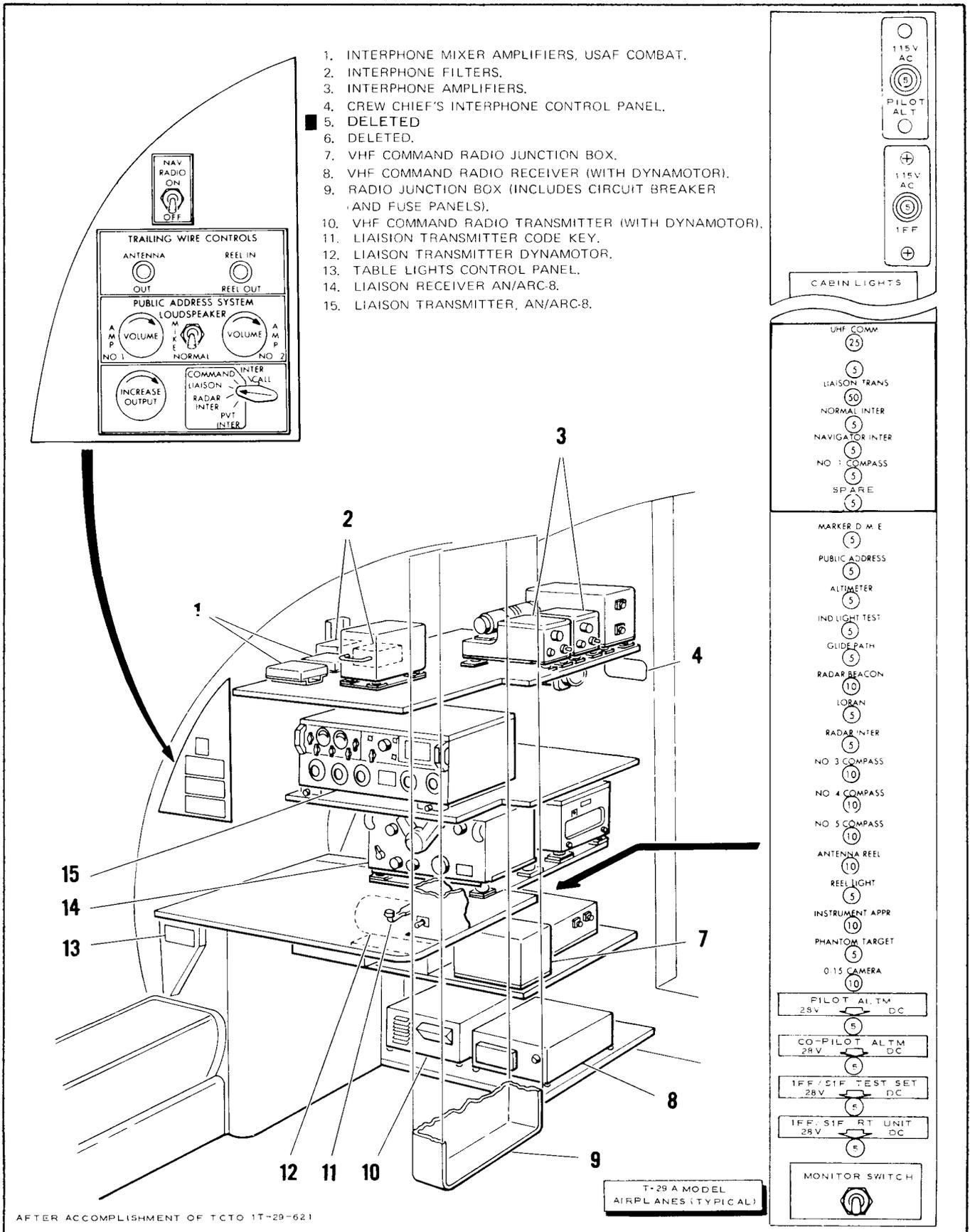
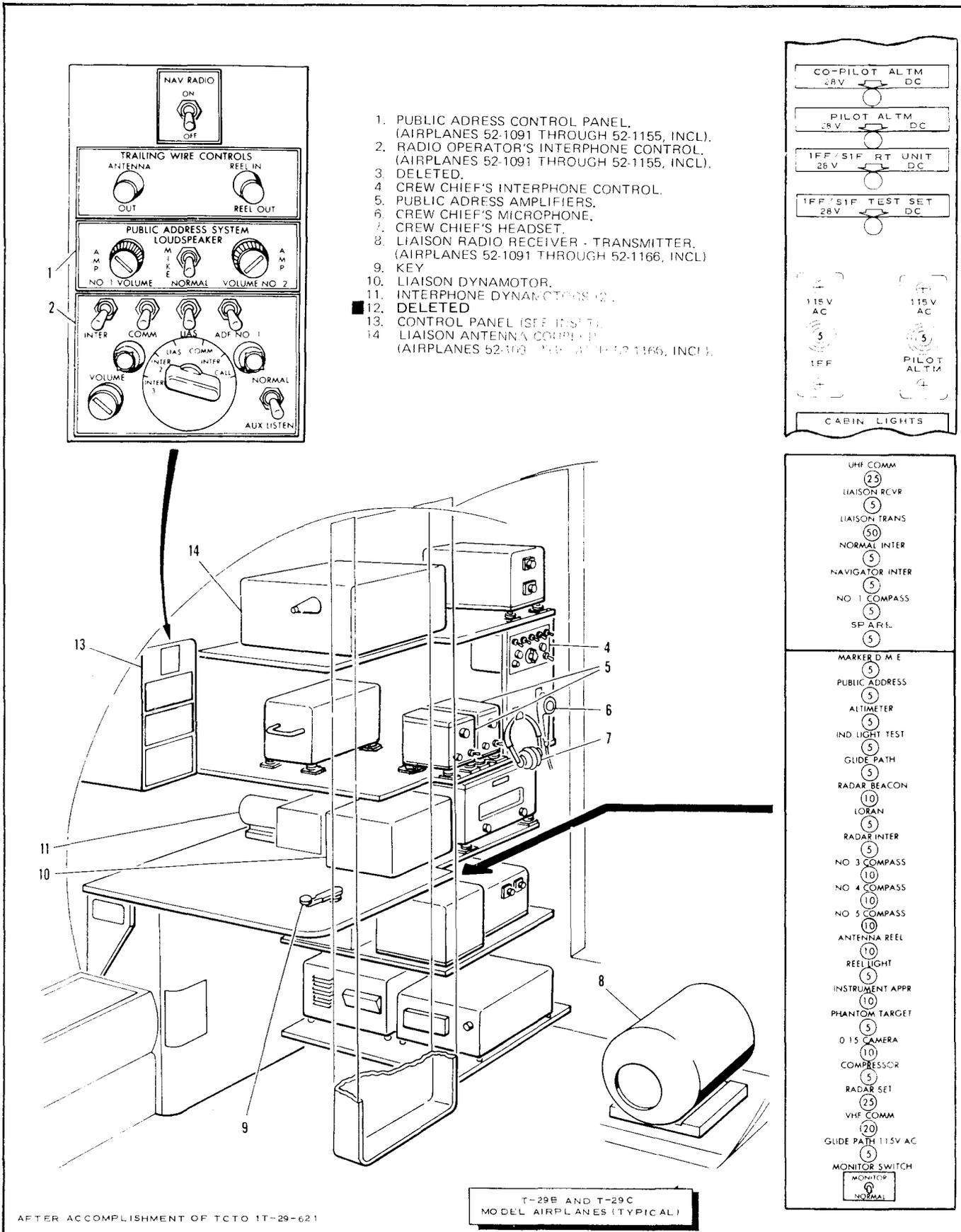


Figure 1-4. Radio and Communications Equipment, Radio Rack, Typical (Sheet 1 of 3)



1. PUBLIC ADDRESS CONTROL PANEL, (AIRPLANES 52-1091 THROUGH 52-1155, INCL).
2. RADIO OPERATOR'S INTERPHONE CONTROL, (AIRPLANES 52-1091 THROUGH 52-1155, INCL).
3. DELETED.
4. CREW CHIEF'S INTERPHONE CONTROL.
5. PUBLIC ADDRESS AMPLIFIERS.
6. CREW CHIEF'S MICROPHONE.
7. CREW CHIEF'S HEADSET.
8. LIAISON RADIO RECEIVER - TRANSMITTER, (AIRPLANES 52-1091 THROUGH 52-1166, INCL)
9. KEY
10. LIAISON DYNAMOTOR.
11. INTERPHONE DYNAMOTORS (2).
12. DELETED
13. CONTROL PANEL (SEE INSET).
14. LIAISON ANTENNA COMPACT (AIRPLANES 52-1091 THROUGH 52-1166, INCL).

T-29B AND T-29C MODEL AIRPLANES (TYPICAL)

Figure 1-4. Radio and Communications Equipment, Radio Rack, Typical (Sheet 2 of 3)

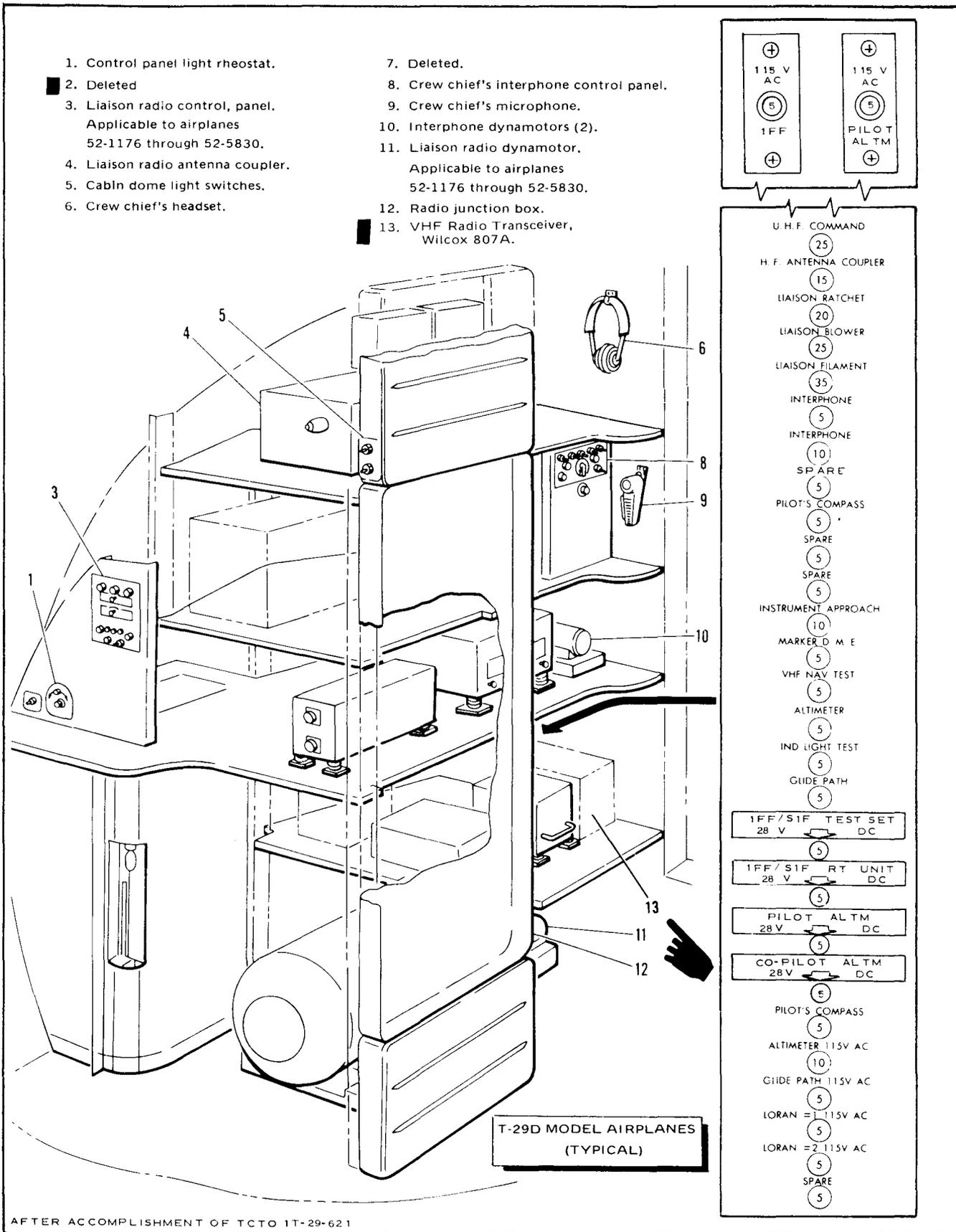
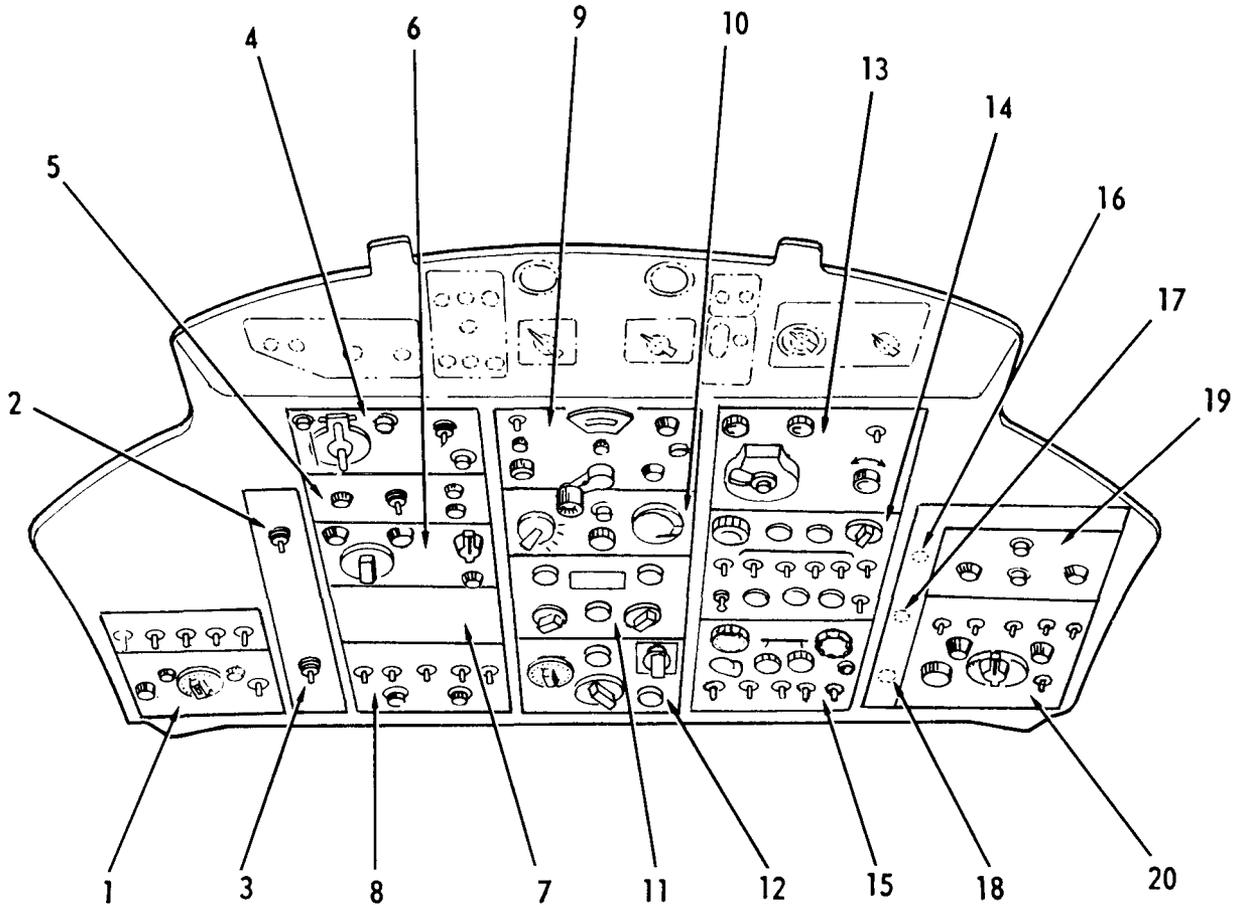


Figure 1-4. Radio and Communications Equipment, Radio Rack, Typical (Sheet 3 of 3)



- |                                    |                           |
|------------------------------------|---------------------------|
| 1. A/C INTERPHONE                  | 11. VHF, WILCOX 807       |
| 2. COMPASS AUDIO                   | 12. UHF, ARC-27 ■         |
| 3. LOUDSPEAKER                     | 13. VOR NO. 2             |
| 4. VOR NO. 1                       | 14. IFF/SIF CONTROL       |
| 5. INSTRUMENT SELECT SWITCH        | 15. HF 714E-2             |
| 6. TACAN, ARN-21A                  | 16. COMPASS AUDIO         |
| 7. BLANK                           | 17. FASTEN SEAT BELTS     |
| 8. COMMAND TRANSFER AUDIO SWITCHES | 18. NO SMOKING            |
| 9. ADF, C-1514/A                   | 19. IFF/SIF CAUTION PANEL |
| 10. RADAR, C-4881                  | 20. A/C INTERPHONE        |

T-29A AND T-29B AIRPLANES (TYPICAL)

AFTER ACCOMPLISHMENT OF TCTO 1T-29-621

Figure 1-5. Pilots' Overhead Switch Panel, Typical (Sheet 1 of 2)

forms a complete liaison radio set. The receiver is manually controlled by the radio operator, but the transmitter can be controlled from either the pilots' overhead switch panel or the radio operator's station. The receiver can be operated with the transmitter either on or off if neither the code key nor microphone switch is depressed. A monitor switch, on the radio circuit breaker panel, makes it possible to monitor the transmitted signal through the receiver and removes the transmitter side-tone from the interphone circuit. A green light, on the pilots' control panel, indicates that the transmitter is ready for remote control.

#### 1-8. VHF RADIO SET, WILCOX 807A.

The Wilcox 807A radio system is installed in selected T-29A, B, C, D, and E model airplanes. The system is designed for receiving and transmitting voice communications over a frequency range of 116.000 MHz. through 149.975 MHz, from plane-to-plane and plane-to-ground. The system consists of a transceiver, control panel and antenna. The transceiver is remotely controlled from the pilots' overhead switch panel. Refer to section IV-A for detailed information on the Wilcox 807A VHF radio set.

#### 1-8A. TRANSPONDER SET, AN/APX-25.

The AN/APX-25 transponder set provides automatic selective identification of the aircraft in which it is installed to ground, shipboard, or airborne IFF recognition installations. The system includes a pulse-type receiver-transmitter, a transponder set coder, two control panels on the pilots' overhead switch panel, and an omnidirectional receiving and transmitting antenna. Tuning of the equipment is performed at the receiver-transmitter by turning manually operated counters to predetermined settings. Refer to section VII-A for detailed information on the AN/APX-25 transponder set.

#### 1-8B. LIAISON RADIO SET 618T-3 (SSB).

The Collins HF103 communications system is used for long range radio telephone communications. The system provides either conventional amplitude modulation (AM) or single side band (SSB) modes of operation. The SSB mode, which concentrates more power into the sideband and suppresses the carrier, may be used to communicate with stations having SSB capability. The AM mode provides less side band power but enables communications with stations not having SSB capability. Any one of 28,000 frequency channels can be selected from the control panel. The channels are spaced at 1-kilohertz (KHZ) intervals in the frequency range of 2.00 to 29.999 megahertz (MHZ). The system is designated HF No. 2. Each system is protected by two 28-volt dc circuit breakers (one 35 ampere and one 10 ampere) and one 115 VAC 5 ampere circuit breaker. Main components of the system are: Receiver - Transmitter 618T-3, Automatic Antenna Tuner 180L-3, Control Panel 714E-2, HF Antenna. Components of the HF communication system are shown in figure 5B-1. The transceiver is located in rack shelf assembly No. 2 in radio equipment section. Antenna coupler is located in the electrical equipment rack. Control panel is located in the overhead console. The operation of the system is controlled from the remote control panel located in the overhead console. A rotary switch is used to energize the system and select type of operation. An off position de-energizes the system. In the USB (upper sideband) position the system operates as an SSB carrier suppressed system using only the upper sideband. In the AM position, the upper sideband and carrier are used to provide a signal which is equivalent of an AM signal. Four dials control the frequency selection for either SSB or AM operation. A direct digital readout of the operating frequency is provided in a window above the dials. The frequencies between 2.00 and 29.999 MC can be selected. AN RF SENS (sensitivity) control varies the gain of the RF amplifiers in the receiver. The receiver audio output is applied to the interphone system.

#### 1-8C. TRANSPONDER SET, AN/APX-72.

The AN/APX-72 transponder set receives signals on 1030 MC and transmits on 1090 MC. The system has four MARK X (SIF) operational modes which consist of mode 1, mode 2, mode 3/A and mode C. In addition to the MARK X modes, the decoder also decodes mode 4 interrogations. The system includes a receiver-transmitter, computer-transponder, test set and lobing switch located in the tail-cone area, a pilots and co-pilots altimeter, control panel and circuit breakers in the flight compartment and two antennas. Refer to Section VII-B for detailed information on the AN/APX-72 transponder set.



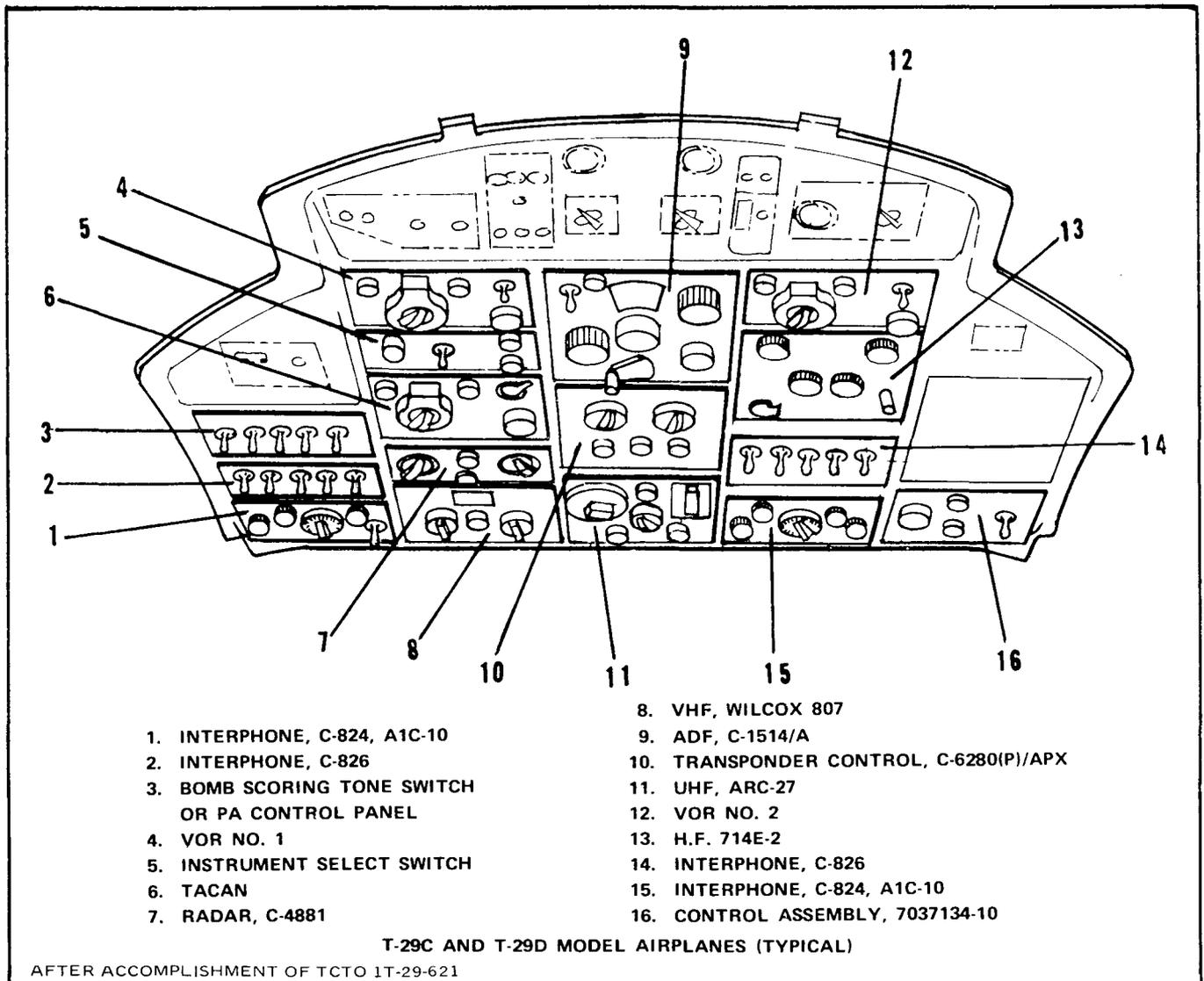


Figure 1-5. Pilot's Overhead Switch Panel, Typical (Sheet 2 of 2)

### 1-9. POWER SOURCES FOR RADIO EQUIPMENT.

## WARNING

Operation of radio and communication equipment involves the use of high voltages which are dangerous to life. Personnel must at all times observe safety precautions. Do not replace components of the system with the power on. Under certain conditions, because of charges retained by capacitors, a dangerous voltage may exist in some circuits even when the power supply is off. To avoid casualties, always ground any circuits prior to handling.

The direct current for the radio systems is drawn from the airplane essential or nonessential dc system; refer to T.O. 1T-29A-2-10. The following equipment draws

power from the 28-volt dc essential bus:

Interphone USAF Combat.  
 Interphone, AN/AIC-10.  
 UHF command radio, AN/ARC-27.  
 Liaison radio set, AN/ARC-8.

HF liaison radio set, Collins 18S-4.

Transponder set, AN/APX-72.

Liaison radio set, 618T-3 (SSB)

The VHF command radio, AN/ARC-3, public address, and radar interphone systems draw power from the 28-volt dc nonessential bus.

### NOTE

Power to the nonessential dc bus in the radio rack is controlled by the navigation radio switch, located on the radio operator's panel. This switch must be on before any equipment being powered from the nonessential bus can be operated.

Power for all radio equipment is directed through the radio junction box to the radio circuit breaker panel, then to the equipment. High voltage dc power for the radio equipment tubes is supplied by dc driven dynamotors integral with each system. In each case, the dynamotors take their dc power through the circuit breakers, for the radios, on the radio circuit breaker panel. The dynamotor for each part of the radio equipment is located on the radio rack or is an integral part of the component which it powers. Emergency dc power for the radio circuits is provided by the two airplane batteries. In the event that the two airplane generators become inoperative, the only source of power is the batteries. Use of the radio equipment in the event of a dc power failure will rapidly deplete the battery power. Malfunction of either or both of the generators automatically operates the load monitor relay which cuts off the 28-volt dc nonessential bus from which some radio equipment takes its power. Provision is made for overriding the load monitoring relay in an emergency, by means of a switch on the pilots' pedestal. Placing the switch in OVERRIDE position re-engages the load monitoring relay, allowing operation of the nonessential equipment.

#### 1-10. POWER FOR OPERATIONAL CHECK-OUT ON GROUND.

Refer to T.O. 1T-29A-2-10 for cautions to be observed and procedure for connecting external electrical power.

##### NOTE

Use an external power source for all radio operational tests when the airplane is on the ground. If equipment is to be operated which takes its power from the dc nonessential bus, the load monitor switch on the pilots' pedestal must be in OVERRIDE position and the navigation radio switch must be ON.

##### CAUTION

Before energizing any radio system, visually inspect the installation of that system to ensure that all connections are correctly made and that the equipment is properly installed and bonded.

#### 1-11. GENERAL INSTRUCTIONS FOR REMOVAL AND INSTALLATION OF EQUIPMENT.

Radio communication and navigation equipment on the forward radio equipment rack is shock mounted to the shelves. Connections to most of the equipment is made by means of electrical connectors, which have knurled locking rings to maintain firm connections. Each radio unit is held in place by slide fasteners, wing nuts, thumb screws, or other types of quick-disconnect fasteners. Each unit can be removed or reinstalled without the use of tools and without disturbing other units. Some units

incorporate electrical receptacles as integral parts of the mounting bases. Use caution in removing and reinstalling the units to maintain pin alignments. The use of excessive force may result in serious damage to contact components. Most cable-to-rack units terminate at plug-type connectors which incorporate knurled nuts. The connectors are designed to maintain safe connections when installed finger tight. Units on racks have individually shock mounted bases. Sufficient slack is provided in cables, flexible drives, and antenna leads to allow full action of the shock mounts when the equipment is installed.

##### NOTE

All electronic equipment will be safety wired if:

- a. It is not readily accessible in flight.
- b. It is not shock mounted.
- c. It is fastened to mount with snap locks.
- d. It is not normally under surveillance, and may constitute a safety of flight and/or a personnel hazard, if it accidentally slipped out of its mount, or became disconnected.

#### 1-12. COAXIAL CABLE INSTALLATION.

Coaxial cables that connect the radio set to its antenna require special attention during maintenance work.

##### WARNING

The HF communication radio antenna lead carries high voltage at high power which is dangerous to human life. If working on these leads, all power must be off. Properly maintain the antenna lead-in shields to minimize the possibility of accidental contact with high power leads. Never use the shelves of the radio rack for stowage of tools and equipment.

Since the routing of coaxial cables in the airplane is determined by the necessity of avoiding radio interference, these cables must always be reinstalled in exactly the original routing, with all connectors secured, and with ground or bonding straps replaced. Because damage to coaxial cables results in distorted reception or serious transmission loss, care should be taken to avoid sharp bends, pinches, kinks or stretching. Clamps must be used to prevent shifting or vibration, but must

not be installed in such a way as to dent or flatten the cable. Check all cables for frayed or broken insulations.

**NOTE**

When working with or near coaxial cables, care must be taken not to step on or put any weight on the cable. Do not place tools, tool boxes or equipment on the cables. Do not pull cables aside roughly to get at equipment. Even apparent slight distortions, dents, or flatness of the cable can result in serious transmission

losses. Do not pull on coaxial cables where there is any possibility of loosening the connection in the connectors. Always check to see that the insulation connections are in perfect condition.

**1-13. RADIO NOISE AND INTERFERENCE REDUCTION.**

Aircraft radio communication and navigation systems are subject to many types of noise which interfere with



reception. The airplane electrical systems are designed and installed to function with the minimum of radio noise. Radio noise filters are installed on all electric motors and equipment which may cause a radio noise problem. Bonding and ground straps installed on radio equipment prevent these units from acquiring electrical charges which cause static interference; parts not bonded to the general airframe carry separate static charges which contribute to radio noise. Static is discharged from the airframe through the static discharge wicks; refer to T.O. 1T-29A-2-10. Parts not bonded to the airframe do not discharge through the wicks, thus they create a radio interference. Frequent preventive maintenance will minimize noise interference. Refer to paragraphs 1-14 through 1-17, for the preventive items which should be checked at frequent intervals.

#### NOTE

Correct each item as discovered. Otherwise diagnosis of further trouble will not be possible.

#### 1-14. ANTENNA MAINTENANCE.

Refer to WARNING note in paragraph 1-12 and see figure 1-6. To improve radio reception, inspect and repair the antenna frequently. Check for each of the following where applicable:

- a. Insecure mounting for fastening masts, couplers, and relays.
- b. Cracked insulators on wires, or other parts.
- c. Loose bonding or ground wires.
- d. Loose lead-in connections.
- e. Corroded surfaces where grounded.
- f. Corroded lead-in connections.
- g. Loose, corroded, or damp coaxial cable and electrical cable connectors.
- h. Damaged wire or insulation, loose or broken strands.
- i. Crushed, flattened, or kinked coaxial cable.

#### NOTE

The transmission characteristics of coaxial cable may be seriously affected by seemingly slight kinking or flattening.

- j. Loose or missing coaxial and/or electrical cable clamps; worn clevis pins.

#### NOTE

Paint, grease, oil or other foreign material must be carefully cleaned from flush antenna covers.

#### 1-15. RADIO AND ELECTRICAL CABLE MAINTENANCE.

Cables moved during maintenance work and not replaced in their original position are a common source of hum and other radio interference. Interference is caused by radio cables being too close to ac circuits and from cross talk between audio circuits, particularly when grounding or bonding straps are omitted during installation of new equipment. Grease, oil, fuel, hydraulic fluid, water, or cleaning solvents may injure insulation of cables. Electrical wiring and components must be protected at all times from fluid materials.

#### 1-16. MICROPHONE AND HEADSET MAINTENANCE.

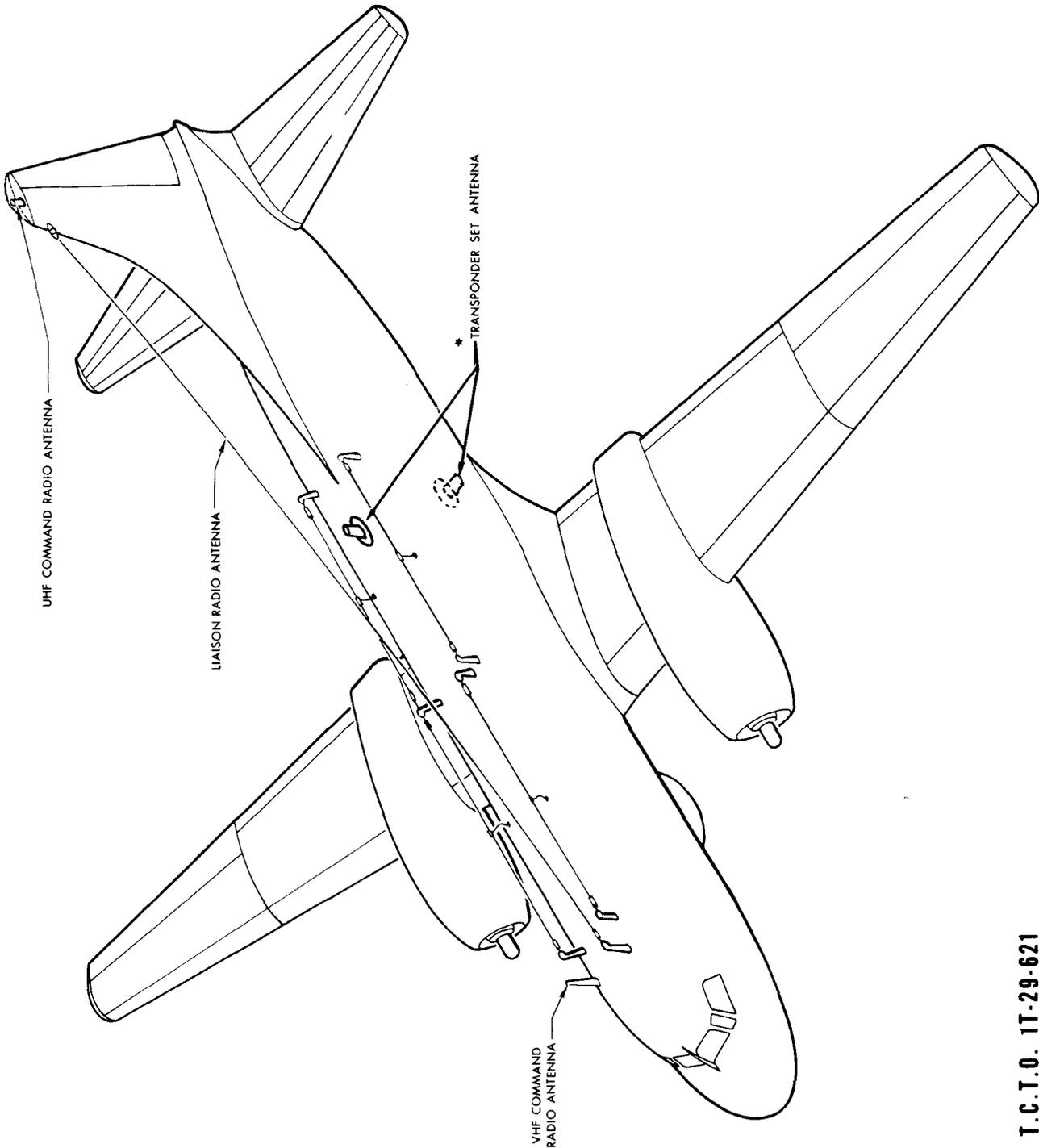
To improve radio reception, inspect and repair the microphone and headsets frequently. Check for each of the following where applicable:

- a. Frayed or worn cords.
- b. Plugs with distorted, worn, or dirty parts.
- c. Moisture in microphones.
- d. Cracked insulation or other obvious mechanical damage.
- e. Loose diaphragms or other internal parts. Tap microphone gently while listening to headset — this should result in normal noise.
- f. Changeable output; make comparison test with unit of known serviceability. Refer to Sections II and III for operation of interphone systems.

#### 1-17. RADIO AND ELECTRICAL COMPONENT MAINTENANCE.

To improve radio reception, inspect and repair radio and electrical components frequently. Check for each of the following where applicable:

- a. Security of mounting.
- b. Security of connector plugs, bonding, or grounding straps and wires.
- c. Security of flexible drive cable connections.
- d. Smooth operation of controls — jerky controls often cause radio noise.
- e. Microphonic vacuum tubes. Tap the case while listening with the headset. Ringing or stuttering sounds indicate a microphonic tube, or a tube with loose elements.
- f. Loose panel light connections.
- g. Defective panel light filaments; a loose or vibrating filament can cause excessive interference.



\* T.C.T.O. 1T-29-621

Figure 1-6. Radio and Communications Antenna Perspective, Typical

## Section II

# USAF COMBAT INTERPHONE SYSTEM

<i>Contents</i>	<i>Page</i>
Description .....	15
Operational Check-Out .....	20
System Analysis .....	20
Replacement .....	22
Adjustment .....	22
Servicing .....	22

### DESCRIPTION

#### 2-1. GENERAL.

See figure 2-1. The USAF combat interphone and public address system is installed on *T-29A and T-29B (except serial No. 51-5144) model airplanes*. This interphone and public address system provides communications, within the airplane, through interphone control panels and outlets for headset and microphone at each student and crew station. For ground maintenance operations, connections for a headset and microphone in the nose wheel well and in each nacelle permit communications between these points and any interphone facility inside the airplane. Although the control panels are varied to include switches to cover the individual functions carried out at each station, each has a VOLUME control and jack selector switch. Each interphone control panel contains the necessary connections and controls to permit use of the radio facilities required at that station, provided the radio facilities have been turned on and adjusted at their respective control panels. The interphone system is a combination of three separate systems—the normal interphone, navigator interphone, and radar interphone. Each system employs a separate amplifier to boost the voice or radio inputs to each station. The normal and navigator interphone systems provide separate channels of communication between all crew and student stations. These systems can be used simultaneously, by different groups of students and/or crew members, without interfering with each

other. The radar interphone system provides an additional communication channel between the radio operator and the four radar stations—student stations 4, 5, 6, and 7 (master radar). This circuit enables the radio operator to communicate with any or all of the radar stations while the other crew members and students are using either the normal or the navigator systems. A call system enables any station to interrupt reception at all other stations regardless of the individual selector switch positions. Certain training and operational functions require more than one signal to be received at one time. This is accomplished by means of two interphone mixer amplifiers which enable the pilot and or copilot to mix command radio, radio compass, interphone, marker beacon, and omnidirectional range audio reception into one output. The public address system consists basically of two amplifiers and four loudspeakers, with control switch provisions on the pilots' overhead switch panel and on the radio operator's left switch panel. Each amplifier energizes two loudspeakers in the cabin. On *T-29B (serial No. 51-3807 to 51-7917 incl) model airplanes*, the interphone control panel, at student station 7 (master radar), has provisions for use of the public address system. The normal and navigator interphone systems take their power from the 28-volt dc essential bus, and the circuit is protected by two 5 ampere circuit breakers placarded NORMAL INTER and NAVIGATOR INTER on the radio circuit breaker

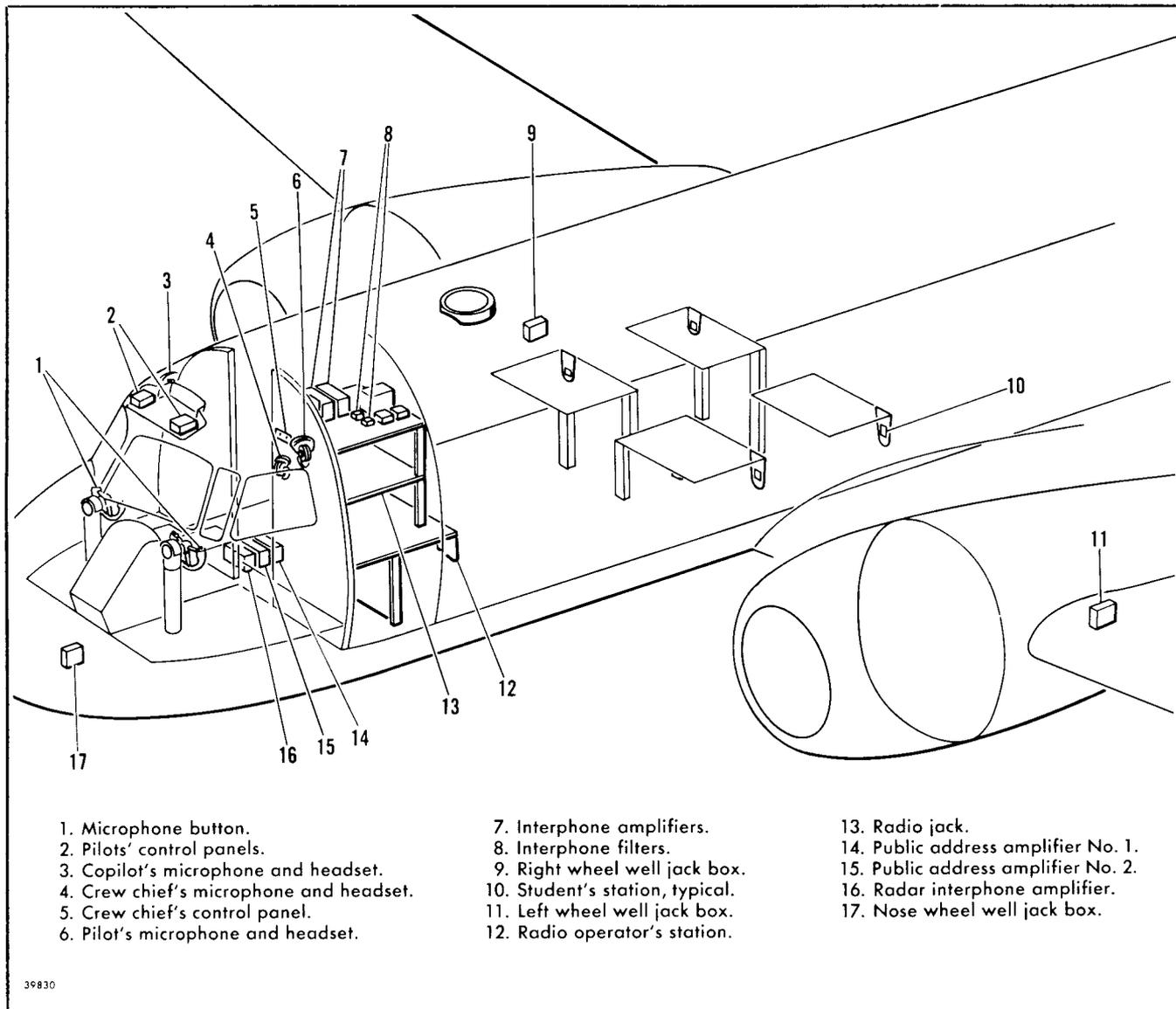


Figure 2-1. USAF Combat Interphone System Equipment Perspective

panel. The radar interphone and public address systems operate on power from the 28-volt dc nonessential bus, in the radio junction box. These circuits are protected by two 5 ampere circuit breakers, placarded PUBLIC

ADDRESS and RADAR INTER, on the radio circuit breaker panel. High voltage dc power for the amplifiers is supplied by integral dynamotors on each of the amplifiers, except the mixer amplifiers.

2-2. USAF COMBAT INTERPHONE AND PUBLIC ADDRESS SYSTEM, LIST OF COMPONENTS.

ITEM	LOCATION	FUNCTION
Amplifier, 26A/AIC (3); on T-29A model airplanes. Amplifier AM-300/AIC (3) on T-29B (except serial No. 51-5144) model airplanes.	Two on radio equipment rack, top shelf; one on cabin floor, right side, aft of flight compartment bulkhead.	To amplify voice or radio signals.
Amplifier, public address, AM-300/AIC (2).	On cabin floor, right side, aft of flight compartment bulkhead.	To amplify voice for public address system.

ITEM	LOCATION	FUNCTION
Mounting, MT-677/AIC, or MT-677A/AIC (5).	At base of each interphone and public address amplifier.	To provide a shock proof mount for interphone and public address amplifiers.
Amplifier, mixer, AM-142-2S (2).	Radio equipment rack, top shelf.	To permit reception of more than one signal simultaneously.
Mounting plate, MT-556/AIC.	At base of each mixer amplifier.	To provide a shock proof mount for mixer amplifier.
Filter, pilots' interphone, F-21/-ARA-9 (2).	Radio equipment rack, top shelf.	To filter out unwanted signals on reception of more than one signal.
Control panel, interphone, C-695/-AIC (2).	Pilots' overhead switch panel.	To control volume and selection.
Control panel, interphone, C-699/-AIC (10).	Student stations 8, 10, 11, 12, 13, 14, 15, 16, 17, and 18.	To control volume and selection.
Control panel, interphone, C-701/-AIC.	Radio equipment rack (crew chief's).	To control volume and selection.
Control panel, interphone, C-703/-AIC.	Radio operator's control panel.	To control volume and selection.
Control panel, interphone, C-704/-AIC (5).	Student stations 4, 5, 6, 7 (master radar), and camera operator's station.	To control volume and selection.
Plug, U-92/U (2).	Adjacent to pilot and copilot.	To make microphone and headset connections.
Plug, U-94/U (17).	Radio operator's station, master radar console, student stations 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and camera operator's station.	To make microphone and headset connections.
Jack, J-139A/AIC (3).	One in each nacelle; one in nose landing gear wheel well.	To make microphone and headset connection for ground crew.
Loudspeaker, public address, (4).	Right side of cabin near student stations 5, 8, and 14. Left side of cabin near student station 11.	Loudspeaker for public address system.
Headset — Microphone H-78/AIC (19).	All stations on T-29A and B model airplanes.	To originate and listen to interphone signals.
Switch, hand-operated (2).	Pilot's and copilot's control wheels (outboard horn).	To control microphone.
Switch, public address address control AN 3023-8.	Pilot's overhead switch panel.	To control public address system.
Circuit breaker, 5 ampere, NORMAL INTER.	Radio circuit breaker panel, aft of radio rack.	To protect normal interphone system from circuit faults.
Circuit breaker, 5 ampere, NAVIGATOR INTER.	Radio circuit breaker panel, aft of radio rack.	To protect navigator interphone system circuit.
Circuit breaker, 5 ampere, RADAR INTER.	Radio circuit breaker panel, aft of radio rack.	To protect radar interphone system circuit.
Circuit breaker, 5 ampere, PUBLIC ADDRESS.	Radio circuit breaker panel, aft of radio rack.	To protect public address system circuit.

### 2-3. INTERPHONE AND PUBLIC ADDRESS SYSTEM AMPLIFIERS.

The interphone system employs three amplifiers, one each for the normal, the navigator, and the radar interphone systems. Two additional amplifiers are installed for use with the public address system. Essentially the amplifiers are alike, consisting of a four-tube, two-stage, audio amplification unit incorporating an automatic gain control which adjusts the amplification of the amplifier. This adjustment is in steps, at altitudes of approximately 10,000, 20,000, and 30,000 feet, to provide a volume level normally suitable for the altitude at which the airplane is flying. An integral dynamotor fitted on each amplifier supplies high voltage dc power for the plate voltage of each tube. The AM-26A/AIC amplifier differs from the AM-300/AIC amplifier in that it incorporates a manual gain control in addition to the automatic gain control. The manual control is safety-wired in position 1 and should not be disturbed under ordinary circumstances. Each amplifier can be controlled by an ON-OFF switch (on the front of the amplifier) which is safety-wired in the ON position for normal operations.

### 2-4. MIXER AMPLIFIER.

The pilot's and copilot's interphones are each fitted with a mixer amplifier to allow reception of more than one signal at a time. These units are single tube, push-pull amplifiers housed in an aluminum box. A four-wire receptacle is used for all electrical connections. Each amplifier feeds only one headset and is operated at maximum gain. It has no gain control and does not require any operating adjustments. Placing the function selector switch in the MIX. SIG. & COMMAND position enables the pilots to listen to as many as five audio channels simultaneously.

### 2-5. PILOTS' CONTROL PANEL.

See figure 2-2. The pilot and copilot positions are provided with interphone control panels which incorporate, in addition to the normal interphone channel, two specialized features. The first of these features is a PVT. INTER channel which is connected to all stations. The second is a mixed signals facility which is provided for the pilots only. They may individually mix command radio, radio compass, interphone, marker beacon, and omnidirectional range audio signals into one output. A selector switch, placarded PVT. INTER-COMPASS-LIAISON-MIX. SIG. & COMMAND-INTER-CALL, provides for the selection of the desired type of operation. PVT. INTER position selects the navigator interphone system. COMPASS position selects the AN/ARN-6 radio compass system. LIAISON position selects the pilots' liaison radio operation. MIX. SIG. &

COMMAND position makes it possible to mix the various audio signals simultaneously: Four toggle switches over the MIX. SIG. & COMMAND position are placarded INTER-COMP-MARKER-LOCALIZ. If any one or all four of the switches are placed in the up (on) position, corresponding signals will be heard along with those of the command radio set. INTER position selects communications within the airplane. CALL position is used to interrupt any transmission or reception on the interphone system and to call stations to answer on the INTER position. When the CALL position is desired, the pilot must hold the switch in this position—when the switch is released, it will spring back to the INTER position. A filter switch, placarded RANGE ONLY-VOICE ONLY-NORMAL USE, reduces the output of the signals at the headset when placed in RANGE ONLY or VOICE ONLY as required. During normal operations, ensure that the filter switch is in the NORMAL USE position.

### 2-6. CREW AND STUDENT CONTROL PANELS.

See figure 2-2. Interphone control panels located at the crew chief's station, radio operator's station, radar and camera operator's station, student stations, and student station 7 (master radar) are essentially alike. Each control panel has in common a VOLUME control, and CALL-INTER-PVT. INTER selector positions. The crew chief, radio operator, and student station 7 (master radar) control panels have a COMMAND selection; the crew chief and radio operator control panels have a LIAISON selection; the crew chief, student station 7 (master radar), camera operator, and navigation student stations have a COMPASS selection; the radio operator, student radar stations, camera operator, and student station 7 (master radar) have a RADAR INTER selection; and student station 7 (master radar) control panel has LOUD SPKR selection. The functions of these selector positions allow each station so equipped to perform the necessary operations with the use of the interphone system.

### 2-7. EXTERNAL INTERPHONE FACILITIES.

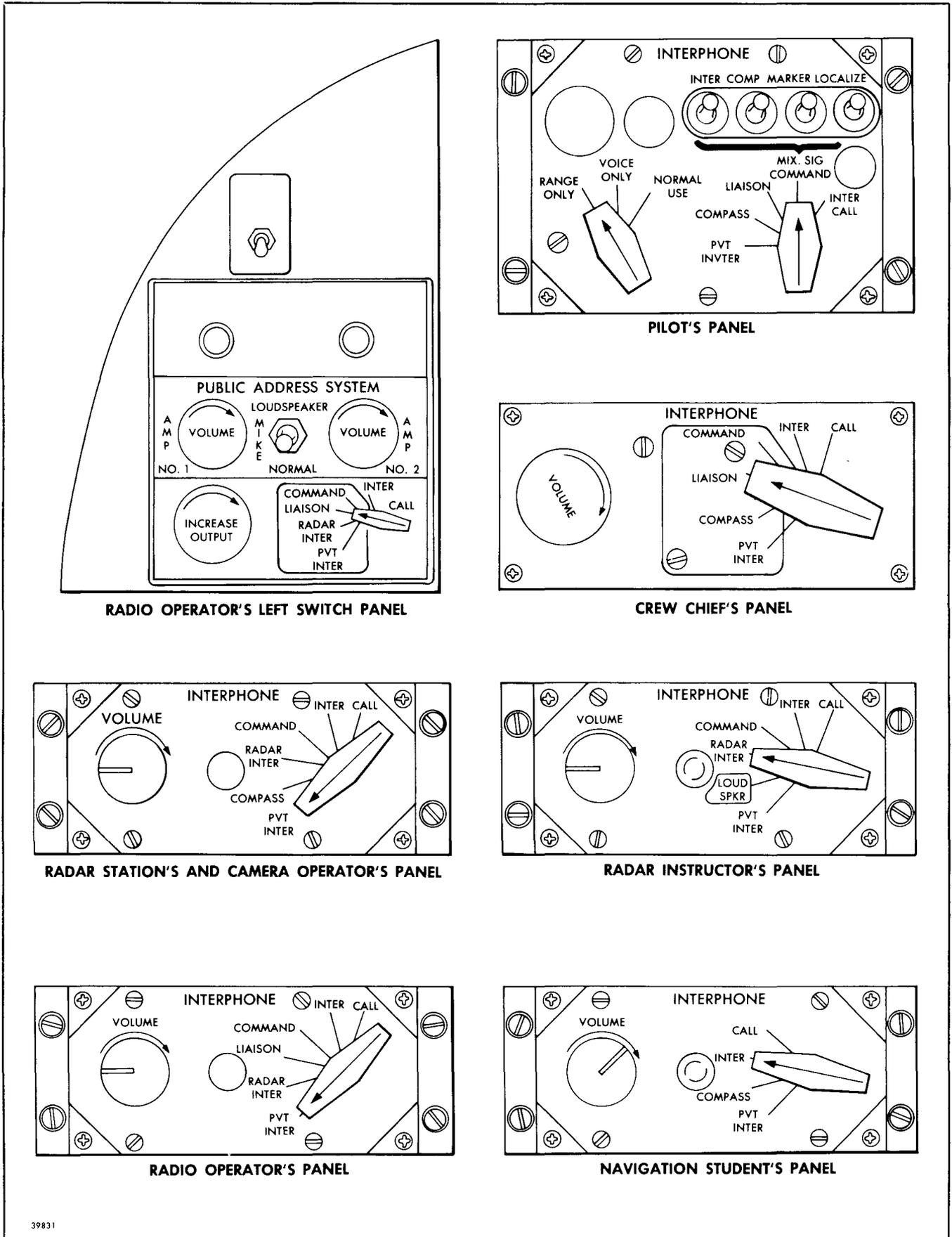
Phone jacks are installed in the nose wheel well and in each nacelle to provide ground crew facilities for intercommunication during operational check-out procedures, repair, and maintenance operations. The jacks provide headset and microphone connections. For intercommunication between a station and any one or all of the three external facilities, the function selector switch on the appropriate control panel is placed in INTER position. With the system energized, the external stations may communicate with the internal interphone stations by depressing the microphone switch, and listen to the headset. No other controls are provided at the external stations.

2-7A. INTERPHONE HEADSET-MICROPHONE,  
H-78/AIC.

Headset-Microphone set H-78/AIC consists of headset H-70/AIC and microphone M-33/AIC. The two components are electrically wired together to use one jack

for plugging into the interphone system, and are linked together by a wire frame mounting assembly for hand-free use. The microphone does not have a press-to-talk switch.





RADIO OPERATOR'S LEFT SWITCH PANEL

PILOT'S PANEL

CREW CHIEF'S PANEL

RADAR STATION'S AND CAMERA OPERATOR'S PANEL

RADAR INSTRUCTOR'S PANEL

RADIO OPERATOR'S PANEL

NAVIGATION STUDENT'S PANEL

39831

Figure 2-2. USAF Combat Interphone System Control Panels

**OPERATIONAL CHECK-OUT**

**2-8. TEST EQUIPMENT REQUIRED.**

None.

**2-9. USAF COMBAT INTERPHONE SYSTEM, OPERATIONAL CHECK-OUT.**

a. Connect external power source to airplane; refer to T.O. 1T-29A-2-10.

b. Place selector switch, on pilots' overhead switch panel, in INTER position and adjust volume control for maximum output.

**NOTE**

The volume control on the interphone panels is effective for all positions of the selector switch. Set this control at or near the maximum position and adjust the volume controls on the various radio sets to provide the proper headset levels. This procedure is necessary in order to prevent compass course reversal, radio receiver overload, distortion, etc. due to having the volume control on the interphone panel set at minimum output and the control on the radio set adjusted for maximum output.

c. It is necessary to tune in required radio facility independently. Refer to the applicable section in this handbook and T.O. 1T-29A-2-12 for the proper tuning procedure of the desired radio set.

d. Speak into microphone, while depressing microphone button on control wheel, and listening in on headset. Spoken sounds will be heard loudly and clearly in headset. Repeat this process with another man listening, then replying from other stations in return.

e. On T-29A model airplanes, remove safety wire from manual gain control of normal interphone amplifier, and switch manual gain control from position 1 to

positions 2, 3, and 4, while speaking softly into pilot's microphone. Listen to output of headset and make sure there is a noticeable increase in volume for each successive position of gain control.

f. Return gain control to position 1.

g. Select RADAR INTER position on radio operator's selector switch. Increase gain control of radar amplifier from 1 to 4 as outlined in step e. There should be a noticeable increase in volume from headset for each successive position. Return gain control to position 1, and safety-wire.

h. Repeat step g. for PVT. INTER position of radio operator's selector switch, using gain control on navigator interphone amplifier. Safety-wire manual gain control in position 1.

i. Check CALL facility by placing pilot's interphone selector switch in CALL position and speaking into pilot's microphone while another man listens from another station. Signal from pilot's position should be received loud and clear and should interrupt any other reception.

j. Repeat step i. from all interphone control panels and check that a signal is received at all stations.

k. Place pilot's selector switch in MIX. SIG. & COMMAND position and check mixing facility. Refer to T.O. 1T-29A-2-12 for operation of COMP, MARKER, and LOCALIZ facilities, and to Section V for command radio.

l. Operate liaison radio with selector switch in LIAISON position; refer to Sections VI and VII for operation of liaison radio. Liaison signals should be received loud and clear.

m. Disconnect source of external power from airplane.

**SYSTEM ANALYSIS**

**2-10. USAF COMBAT INTERPHONE SYSTEM, TROUBLE SHOOTING.**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>INTERMITTENT OR NO OUTPUT</b>	<b>FROM INTERPHONE SYSTEM.</b>	
No 28-volt dc power supply	Check to see that other dc operated equipment is functioning, and that circuit breakers are closed, that plugs on front of amplifier are secure, and that the switch on front of amplifier is ON.	Correct power supply failure; refer to T.O. 1T-29A-2-10. Close circuit breakers; secure plug; place switch ON.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>INTERMITTENT OR NO OUTPUT FROM INTERPHONE SYSTEM (cont).</b>		
Dynamotor or amplifier defective.	Check to see that other radio equipment is functioning normally; refer to paragraph 2-9. Exchange amplifier with one known to be functioning normally.	Replace amplifier; refer to paragraph 2-13.
Control panel or panels defective.	Check to see that output is normal from other control panels; refer to paragraph 2-9. Check defective panel for dirt or moisture across terminals and connections.	Clean off dirt and moisture. Replace panel; refer to paragraph 2-12.
Jack box defective.	Check to see that output is normal from other jack boxes. Check continuity in jack box wiring with a multimeter.	Replace jackbox; refer to paragraph 2-12.
Headset or cord defective.	Check headset at a station known to be operating. Check cord for frayed insulation or broken wires.	Replace headset.
<b>INTERMITTENT OR NO OUTPUT FROM INTERPHONE OR RADIO WHEN PILOT OR COPILOT IS USING FILTER.</b>		
Filter defective.	Exchange filter with one known to be functioning normally.	Replace filter; refer to paragraph 2-12.
<b>GAIN OF AMPLIFIER DOES NOT CHANGE WITH ALTITUDE.</b>		
Automatic gain control in amplifier defective.	Replace amplifier with one known to be functioning normally.	Replace amplifier; refer to paragraph 2-13.
<b>NO RADIO OUTPUT ON MIX SIG. AND COMMAND POSITION OF PILOT'S SELECTOR SWITCH.</b>		
Mixer amplifier defective.	Check that COMMAND radio and interphone are functioning normally; refer to paragraph 2-9. Recheck with mixer amplifier known to be functioning normally.	Replace mixer amplifier; refer to paragraph 2-13.
<b>ANY STATION FAILS TO OPERATE ON TALK BUT IS SATISFACTORY ON LISTEN.</b>		
Microphone defective.	Check microphone at other stations.	Replace microphone.
<b>ANY STATION FAILS TO OPERATE FOR LISTEN ONLY WITH SELECTOR IN ANY POSITION.</b>		
Headset defective.	Check headset at other stations known to be operating.	Replace headset.
Control panel defective.	Check to see that other control panels in system are functioning normally; refer to paragraph 2-9.	Replace defective control panel; refer to paragraph 2-12.
<b>NO OUTPUT FROM PUBLIC ADDRESS SYSTEM.</b>		
Public address amplifier defective.	Exchange amplifier with one known to be functioning normally.	Replace amplifier; refer to paragraph 2-13.
Public address loudspeaker defective.	Listen to broadcast from other functioning loudspeakers.	Replace loudspeaker.

## REPLACEMENT

### WARNING

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must at all times observe safety precautions. Turn power off prior to replacing components of this equipment. Under certain conditions, a dangerous voltage may exist in some circuits, even when the power supply is off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

#### 2-11. SPECIAL TOOLS REQUIRED.

None.

#### 2-12. GENERAL INSTRUCTIONS FOR REMOVAL AND REPLACEMENT OF EQUIPMENT.

Refer to Section I.

#### 2-13. USAF COMBAT INTERPHONE SYSTEM AMPLIFIERS, REMOVAL.

To remove any amplifier in the interphone system proceed as follows:

a. Open NORMAL INTER, NAVIGATOR INTER, RADAR INTER, and PUBLIC ADDRESS circuit breakers on radio circuit breaker panel.

b. Remove electrical connector on front of amplifier. Tape electrical connector to amplifier surface to permit easy access.

c. Unfasten quick-release fitting holding amplifier to shock mounted base plate.

d. Remove amplifier.

#### 2-14. USAF COMBAT INTERPHONE SYSTEM AMPLIFIERS, INSTALLATION.

To install any amplifier in the interphone system proceed as follows:

a. On amplifiers that have an ON-OFF switch, place switch in OFF position.

b. Install amplifier on shock mounted base plate.

c. Connect electrical connector.

d. Gently shake amplifier to see that it is properly shock mounted.

e. Place amplifier ON-OFF switch in ON position. Safety-wire switch in ON position.

f. Close NAVIGATOR INTER, RADAR INTER, and PUBLIC ADDRESS circuit breakers on radio circuit breaker panel.

g. Perform operational check; refer to paragraph 2-9.

## ADJUSTMENT

#### 2-15. USAF COMBAT INTERPHONE SYSTEM, ADJUSTMENT.

No adjustment is required.

## SERVICING

#### 2-16. USAF COMBAT INTERPHONE SYSTEM, NOISE REDUCTION.

Refer to Section I.

## Section III

### AN/AIC-10 INTERPHONE SYSTEM

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Description .....	23
Operational Check-out .....	29
System Analysis .....	30
Replacement .....	32
Adjustment .....	34
Servicing .....	34

#### DESCRIPTION

#### 3-1. GENERAL.

See figures 3-1 and 3-2. The AN/AIC-10 interphone system is installed on T-29B (serial No. 51-5144 only), T-29C, and T-29D model airplanes. This system provides a method of communication between each crew member and student station on the airplane. The interphone system is designed for high intelligibility communication under all conditions and at any operating altitude. Each station has a control panel with an integral plug-in amplifier, headset and microphone. On T-29B (serial No. 51-5144), and T-29C model airplanes, the pilot, copilot, and radio operator are provided with loudspeakers for standby listening without headsets. On T-29D model airplanes, the pilot, copilot, and master radar console positions are equipped with loudspeakers

for standby listening. Power for the system is drawn from the 28-volt dc essential bus at the radio circuit breaker panel. Two dynamotors, energized by 28-volt dc power, provide filtered output of 170-volt dc for each amplifier in the system. On T-29B (serial No. 51-5144), and T-29C (serial No. 52-1091 to 52-1155 incl) model airplanes, a public address system is installed in conjunction with the interphone system. The system is controlled from a panel on the pilots' overhead switch panel.

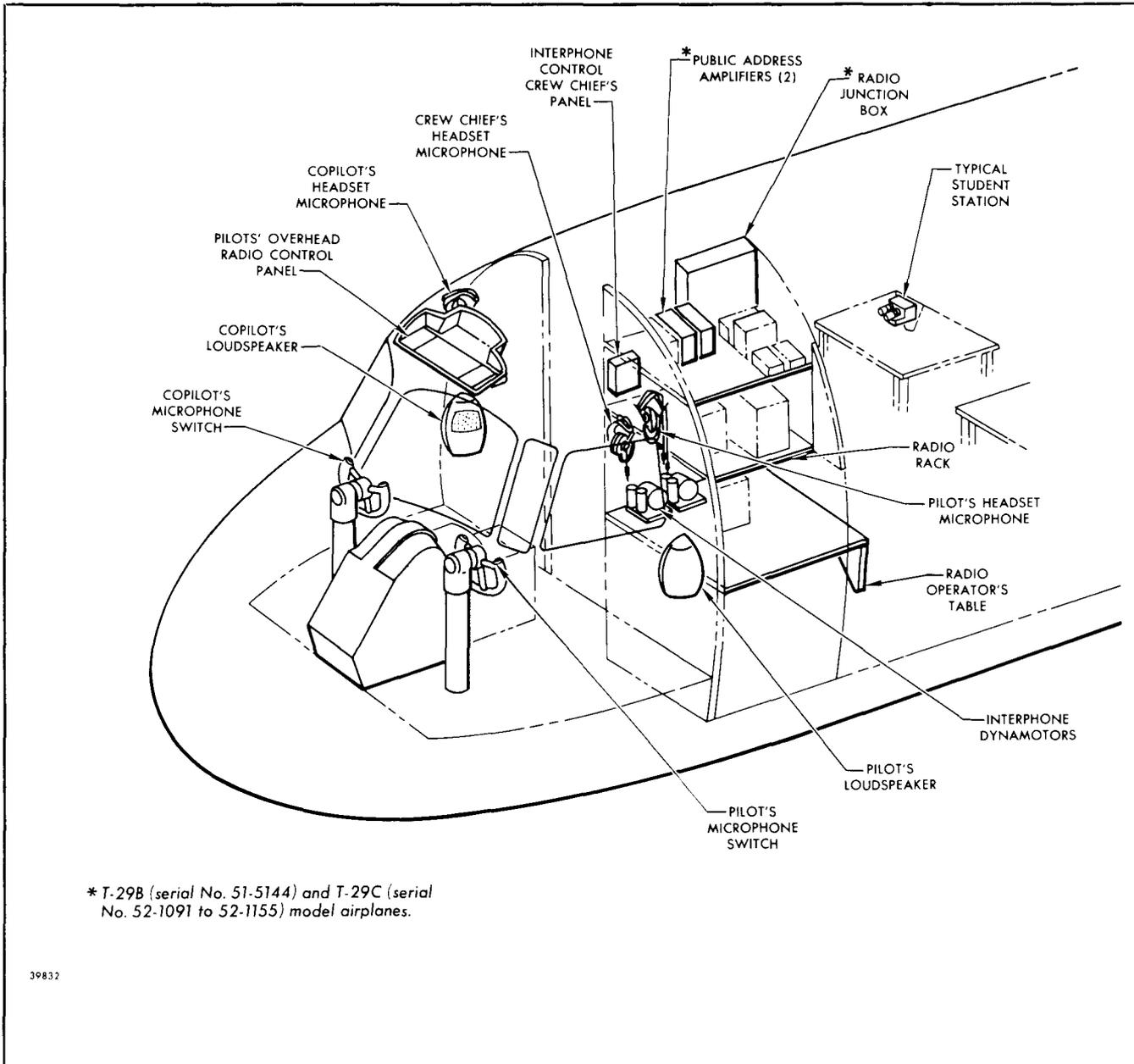
#### NOTE

The AN/AIC-10 interphone system installed on these airplanes provides three different channels of communication. Refer to paragraph 3-2 for details of the airplane positions interconnected by the different channels.

#### 3-2. AN/AIC-10 INTERPHONE SYSTEM, INTERCONNECTIONS CHART.

On T-29B (serial No. 51-5144), and T-29C (serial No. 52-1092 to 52-1095 incl) model airplanes:

CHANNEL	INTERPHONE STATIONS CONNECTED
CALL	All stations.
Normal interphone, INTER.	All stations.
Navigator interphone, INTER 2.	All stations.
Radar interphone, INTER 3.	Pilot, copilot, radio operator, student stations 4, 5, 6, 7, 8 (instructor only), 9, and camera operator.



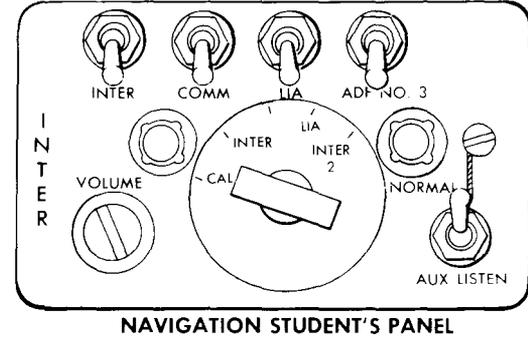
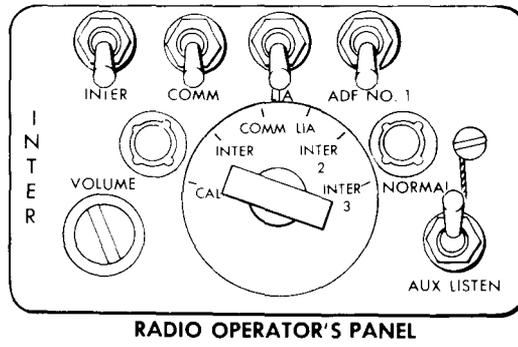
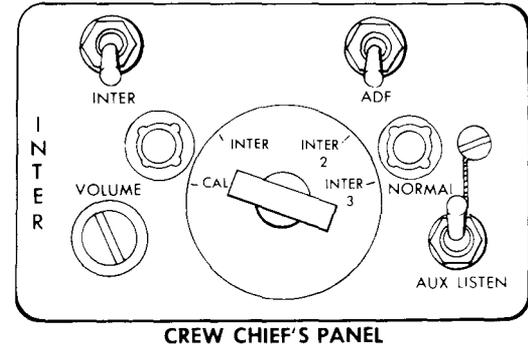
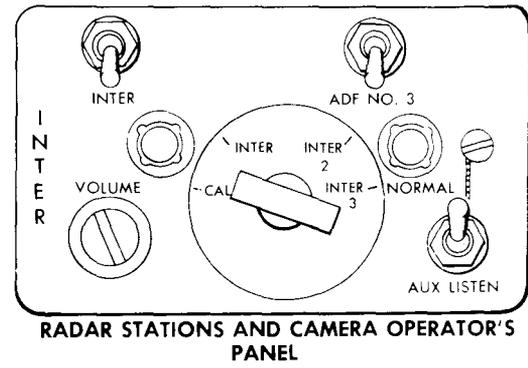
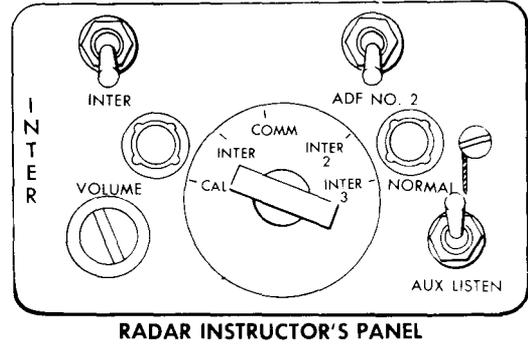
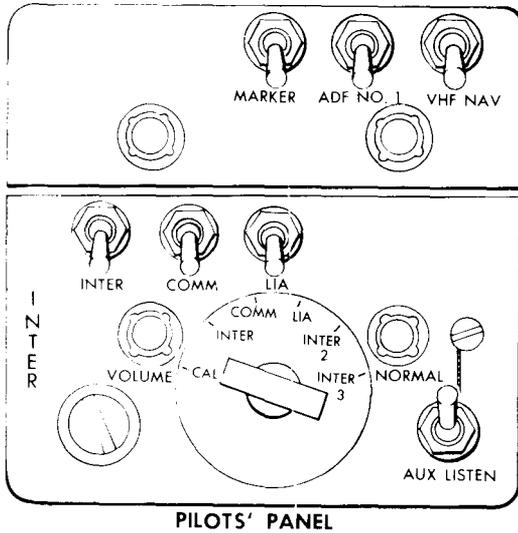
\* T-29B (serial No. 51-5144) and T-29C (serial No. 52-1091 to 52-1155) model airplanes.

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Figure 3-1. Interphone (AN/AIC-10) Equipment Perspective, Typical

On T-29C (serial No. 52-1091, 52-1096 and subsequent) model airplanes:

CHANNEL	INTERPHONE STATIONS CONNECTED
CALL	All stations.
Normal interphone, INTER.	All stations.
Navigator interphone, INTER 2.	All stations.
Radar interphone, INTER 3.	Pilot, copilot, radio operator, student stations 4, 5, 7, 8 (instructor only), and camera operator.



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Figure 3-2. Interphone (AN AIC-10) Control Panels, Typical

**3-2. AN/AIC-10 INTERPHONE SYSTEM, INTERCONNECTIONS CHART (CONT).***On T-29D model airplanes:*

CHANNEL	INTERPHONE STATIONS CONNECTED
CALL	All stations.
Normal interphone, INTER.	All stations.
Navigator interphone, INTER 2.	Pilot, copilot, crew chief, student stations 4, 5, 6, 7, 8, and 11.
Radar interphone, INTER 3.	Pilot, copilot, student stations 4, 5, 6, 7, 8, 9, and 11.

**3-3. AN/AIC-10 INTERPHONE SYSTEM, LIST OF COMPONENTS.**

ITEM	LOCATION	FUNCTION
Control panel, interphone, C824/AIC-10.	<p><i>On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1092 to 52-1095 incl) model airplanes, pilot, copilot, radio operator, crew chief, camera operator, instructor at student station 5, and student stations 4 to 18 (20).</i></p> <p><i>On T-29C (serial No. 52-1091, 52-1096 and subsequent) model airplanes, pilot, copilot, crew chief, radio operator, camera operator, instructor at student stations 5 and 8, and student stations 4 to 18 (21).</i></p> <p><i>On T-29D model airplanes, pilot, copilot, crew chief, and student stations 4 to 11 (11).</i></p>	To control volume, mixing and selection.
Control panel, interphone, C826/AIC-10 (2).	Pilots' overhead switch panel.	To control mix.
Control panel, public address.	<i>On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1091 to 52-1155 incl) model airplanes, pilots' overhead switch panel.</i>	To provide loudspeaker control.
Amplifier, public address, AM-300/AIC (2).	<i>On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1091 to 52-1155 incl) model airplanes, radio equipment rack.</i>	To amplify public address signals.
Loudspeaker, public address, MN-15B (4).	<i>On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1091 to 52-1155 incl) model airplanes, in cabin ceiling approximately above student station 4, student station 8 (two loudspeakers) and student station 16.</i>	To listen to public address.

ITEM	LOCATION	FUNCTION
Loudspeaker, interphone, LS-184/-AIC-10 (3).	<i>On T-29B (serial No. 51-5144) and T-29C model airplanes, pilot's, copilot's, and radio operator's stations.</i>	For standby listening without headsets.
	<i>On T-29D model airplanes, pilot, copilot, and master radar console.</i>	
Dynamotor, interphone, DY-76/-AIC.	Radio equipment rack.	To supply high voltage power for interphone system amplifiers.
Mount, dynamotor, MT-1059/U.	Radio equipment rack.	To provide a shock proof mounting for dynamotor.
Dynamotor, interphone, DY-77/-AIC.	Radio equipment rack.	To supply high voltage power for interphone system amplifiers.
Mount, dynamotor, MT-1060/U.	Radio equipment rack.	To provide a shock proof mounting for dynamotor.
Headset-microphone, H-78/AIC.	<i>On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1092 to 52-1095 incl) model airplanes, pilot, copilot, camera operator, instructor at student stations 5 and 8, and 4 to 18 (19).</i>	To originate and listen to interphone signals.
	<i>On T-29C (serial No. 52-1091, 52-1096 and subsequent) model airplanes, at pilot, copilot, camera operator, radio operator, instructor at student stations 5 and 8, and 4 to 18 (20).</i>	
	<i>On T-29D model airplanes, pilot, copilot and student stations 4, 5, 6, 7, 9, and 11 (8).</i>	
Microphone, interphone, M-34/-AIC.	<i>On T-29B (serial No. 51-5144) and T-29C model airplanes, pilot, copilot, radio operator, and crew chief stations (4).</i>	To originate voice signals.
	<i>On T-29D model airplanes, pilot, copilot, and crew chief stations (3).</i>	
Headset, interphone, H-70/AIC.	<i>On T-29D model airplanes, at crew chief's station.</i>	To listen to all signals.
Foot switch, 8911K525 (3).	<i>On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1092 to 52-1095 incl) model airplanes, student stations 5, 6, and 7.</i>	To control microphone.
	<i>On T-29C (serial No. 52-1091, 52-1096 and subsequent) model airplanes, student stations 4, 5, and 6.</i>	
Foot switch, SA-47A/AIC (2).	<i>On T-29D model airplanes, master radar station 9, and radar instructor station 11.</i>	To control microphone.

**3-3. AN/AIC-10 INTERPHONE SYSTEM, LIST OF COMPONENTS (CONT).**

ITEM	LOCATION	FUNCTION
Circuit breaker, 5 ampere, INTERPHONE.	Radio circuit breaker panel.	To protect circuit from overload.
Circuit breaker, 10 ampere, INTERPHONE.	Radio circuit breaker panel.	To protect circuit from overload.

**3-4. INTERPHONE CONTROL PANEL, C824/AIC-10.**

See figure 3-2. The control panel consists of a panel with a six position rotary channel selector switch, a NORMAL-AUX LISTEN switch safetied to NORMAL, a volume control, and provisions for five toggle monitoring switches. Panel lighting is provided by two small lights which back-light the engraving on the face of the panel. Integral with each panel is a plug-in type amplifier with three stages of amplification and automatic gain control. The plug-in feature assists in rapid removal when an amplifier becomes inoperative. The channel selector switch on each control panel provides six selections, not all of which are in use at various stations, but each station has adjacent CALL and INTER provisions. The CALL position allows the user to interrupt the reception and transmission of all interphone stations to arrange a channel for conversation. When released from the CALL position, the switch returns to INTER. Three interphone channels—INTER, INTER 2, and INTER 3—are available to the pilot, copilot, and certain other stations. Refer to paragraph 3-2 for the interphone station interconnections. The toggle switches on the panel enable the user to select and mix radio facilities with the channel selected on the rotary selector switch, providing the facility desired is operating and tuned correctly. MARKER, ADF No. 1, ADF No. 2, ADF No. 3, VHF NAV, INTER, LIA, and COMM selections are available to the stations fitted with the corresponding toggle switches. The NORMAL-AUX LISTEN switch, when placed in the AUX LISTEN position, allows restricted operation of the station if the amplifier for the station becomes inoperative. In the AUX LISTEN position, one channel at a time can be monitored, the volume control is inoperative, and the station cannot transmit over the interphone system. The volume control adjusts the audible volume the user hears in the headset during normal operations.

**NOTE**

CALL signals are received at all stations at full volume and are not reduced in strength by the volume control setting.

The amplifier used in the control panel is a compactly constructed plug-in assembly using subminiature tubes and components. Three stage amplification, with peak-clipping automatic gain control, gives sufficient output for all phases of operation. Compensation for loss of output at high altitude is obtained by barometric switches which increase amplification by short circuiting resistors at preset altitude settings.

**3-5. INTERPHONE CONTROL PANEL, C826/AIC-10.**

See figure 3-2. Control panel C826/AIC-10 is used in conjunction with control panel C824/AIC-10 at the pilots' positions, and consists of five toggle switches and two panel lights. Only three of the five toggle switches are used on *T-29 model airplanes*. They allow the pilots to monitor MARKER, ADF No. 1, and VHF NAV radio sets, providing these facilities are operating and are tuned correctly.

**3-6.** Deleted.

**3-7.** Deleted.

**3-8. PUBLIC ADDRESS SYSTEM.**

On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1091 to 52-1155 incl), model airplanes, a public address system is installed. The system is controlled from a panel, placarded LOUDSPEAKERS, on the pilots' overhead switch panel. The panel contains a single switch marked ON and OFF. Transmission over the public address system is accomplished by means of the interphone system microphone circuit and four loudspeakers in the cabin. The four public address loudspeakers are not connected to the interphone loudspeakers.

**NOTE**

Certain T-29 aircraft have been modified for specific purposes and do not contain the public address system.

**3-9. PUBLIC ADDRESS AMPLIFIERS, AM-300/AIC.**

On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1091 to 52-1155 incl) model airplanes, two identical amplifiers are installed for the public address system. Each amplifier consists of four tubes arranged in a push-pull audio-amplifying circuit. A special automatic gain, which varies the gain for changes in altitude, is included. An integral dynamotor supplies plate voltage for the tubes. An ON-OFF switch mounted on the front of the amplifier controls the 28-volt dc power supply to the amplifier. Each public address amplifier supplies power for two loudspeakers.

**3-10. INTERPHONE LOUDSPEAKERS, LS-184/AIC-10.**

A loudspeaker assembly is installed at the pilot and copilot positions for standby listening without headsets. The speakers function all the time the interphone system is operating. Each speaker assembly incorporates an amplifier with an ON-OFF switch. CALL signals will be heard from the interphone loudspeakers even with the ON-OFF switch in the OFF position.

**NOTE**

On T-29B serial No. 51-5144, and T-29C (serial No. 1091 to 1155 incl) model airplanes, an interphone loudspeaker is also installed at the radio operator's position. On T-29D model airplanes, an interphone speaker is also installed at the master radar console.

**3-11. INTERPHONE DYNAMOTORS, DY-76/AIC-10 AND DY-77/AIC-10.**

Two dynamotors, DY-76/AIC-10 and DY-77/AIC-10, provide 170-volt filtered dc power for the plate voltages of the interphone system plug-in amplifiers. Both dynamotors serve the same function but the DY-76/AIC-10 is capable of serving more interphone stations. Power for the DY-76/AIC-10 dynamotor is taken from the 28-volt dc essential bus and is protected by a ten ampere circuit breaker, INTERPHONE, on the radio circuit breaker panel. Power for the DY-77/AIC-10 dynamotor is taken from the 28-volt dc essential bus and is protected by a five ampere circuit breaker, INTERPHONE, on the radio circuit breaker panel. The dynamotors are attached to fixed mountings attached to the radio equipment rack.

**3-12. INTERPHONE MICROPHONE, M-34 AIC.**

The microphone is a hand held-type with a built in press-to-talk switch. The microphone is designed for close contact use. The press-to-talk switch must be pressed in for use and released when listening.

**3-13. INTERPHONE HEADSET-MICROPHONE, H-78/AIC.**

Headset-microphone set H-78/AIC consists of headset H-70/AIC and microphone M-33/AIC. The two components are electrically wired together to use one jack for plugging into the interphone system, and are linked together by a wire frame mounting assembly for hand-free use. The microphone does not have a press-to-talk switch.

**OPERATIONAL CHECK-OUT****3-14. TEST EQUIPMENT REQUIRED.**

None.

**3-15. AN/AIC-10 INTERPHONE SYSTEM, OPERATIONAL CHECK-OUT.**

a. Connect external power source to airplane; refer to T.O. 1T-29A-2-10.

**NOTE**

The interphone system is energized whenever the airplane 28-volt dc power supply system is energized.

b. Set interphone control panel volume controls at about ten o'clock position. If system is operating properly, signal received at any station should be clearly audible.

**NOTE**

The maximum interphone volume is obtained when the VOLUME control is set at the 5 o'clock position.

c. Select CALL on pilot's control panel; depress switch on pilot's microphone, then speak into microphone. Signal should be heard distinctly from standby

loudspeakers in flight compartment, at radio operator's position, and at master radar console, where applicable.

d. Check that CALL signal from pilot's position is clearly heard from every other interphone position on airplane.

e. On T-29B (serial No. 51-5144) and T-29C (serial No. 52-1091 to 52-1155 incl) model airplanes, place LOUDSPEAKER switch, on pilots' overhead switch panel, in ON position. Speak into pilot's microphone with microphone switch depressed. Signal should be clearly audible from four public address loudspeakers in cabin.

f. Select CALL at each station on airplane in turn and check that a voice signal from each station is clearly audible from standby loudspeakers and pilots' headsets.

g. Place channel selector switch on pilot's control panel in INTER position. Speak into pilot's microphone with microphone switch depressed and check that a signal is clearly heard at all other interphone positions with channel selector switches in INTER position.

**NOTE**

To receive any intercommunications, except for CALL signals, the listening stations' channel selector must be in the same position as the transmitting station channel selector or the corresponding mixer switch must be on.

Reply from station being checked to make sure that both talk and listen facilities are functioning normally.

h. Cover pilot's microphone so there is no sound input into microphone. With microphone switch depressed, listen in headset. When microphone switch is operated there should be distinct clicking sound in headset. Dynamotor whine and tube hiss should be

barely heard. There should be no high level frying noise or oscillation.

i. Turn volume control on pilot's control panel to 12 o'clock. Listen to pilot's headset. Dynamotor whine and tube hiss should be barely heard. There should be no high level frying noise or oscillation. Turn volume control to full gain. Tube hiss and dynamotor whine should increase. Return volume control to about ten o'clock position.

j. Repeat steps h. and i. at every interphone station.

k. Place channel selector switch on pilot's control panel in INTER #2 position, depress switch on pilot's microphone, then speak into microphone. Check that the signal is clearly heard at all stations with INTER #2 position. Reply from station being checked to make sure that both talk and listen facilities are functioning normally.

l. Repeat step k. using INTER #3 position of channel selector switch.

m. Check pilot's mixing facility by placing toggle switch for facility desired in up position. Tune in desired facility; refer to Sections III through VII, as applicable. Facility selected should be clearly heard on selected interphone channel. Check each facility.

n. Repeat step m. for every interphone control panel with mixing facilities provided.

o. Check AUX LISTEN operation of each control panel in turn by breaking safety wire at NORMAL-AUX LISTEN switch and placing switch in AUX LISTEN position. Turn volume control to twelve o'clock position. Listen to an interphone conversation on a selected channel. Conversation should be audible but lower strength than with switch in NORMAL position. Safety wire switch to NORMAL position.

**SYSTEM ANALYSIS**

**3-16. AN AIC-10 INTERPHONE SYSTEM, TROUBLE SHOOTING.**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>ENTIRE SYSTEM INOPERATIVE—NO PANEL ILLUMINATION.</b>		
INTERPHONE circuit breakers open.	Check to see that INTERPHONE circuit breakers are closed.	Close INTERPHONE circuit breakers. If interphone circuit breakers will not remain closed, carry out wiring circuit check with multimeter; refer to applicable wiring data section.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>ENTIRE SYSTEM INOPERATIVE — NO PANEL ILLUMINATION (cont).</b>		
Power source faulty.	Check external dc power connection. Check for 28 volts on dc voltmeter, and on generator control panel.	Correct power supply malfunction; refer to T.O. 1T-29A-2-10.
<b>ENTIRE SYSTEM INOPERATIVE, PANELS ARE ILLUMINATED.</b>		
Dynamotor defective, or shorted dynamotor power supply line.	Exchange dynamotor for one known to function correctly. With multimeter, check cable to see that pin B is not shorted to ground or to other pins.	Replace dynamotor; repair defect; refer to paragraph 3-18.
<b>A STATION FAILS TO OPERATE ON TALKING AND LISTENING BUT OPERATES IN AUX LISTEN.</b>		
Amplifier defective.	Exchange amplifier for one known to function correctly.	Replace amplifier; refer to paragraph 3-20.
<b>ANY STATION FAILS TO OPERATE ON TALKING BUT IS SATISFACTORY ON LISTENING.</b>		
Microphone talk switch defective.	Check microphone for operation at station known to be operating normally. Check talk switch for continuity with multimeter.	Replace microphone or separate talk switch, as applicable.
<b>ANY STATION FAILS TO OPERATE FOR LISTENING ONLY, INCLUDING IN "AUX LISTEN" POSITION.</b>		
Headset or control panel defective.	Exchange headset for one known to be functioning normally.	If headset is defective, replace headset; if headset is not defective, replace control panel; refer to paragraph 3-20.
<b>STANDBY LOUDSPEAKER DOES NOT OPERATE FOR "CALL," BUT STATION IS OPERATING.</b>		
Loudspeaker amplifier defective, power supply to speaker open, or defective loudspeaker unit.	Recheck with loudspeaker unit known to function correctly. With multimeter, perform continuity check on loudspeaker cable; refer to applicable wiring data section.	Replace loudspeaker unit; refer to paragraph 3-24. Repair defect in cable.
<b>STATION FAILS TO OPERATE PROPERLY WITH SWITCHES SET FOR A PARTICULAR FACILITY.</b>		
Switch defective, or wire open in cable to control panel.	Check that facility is operating properly by attempting to operate on another station. Check selector switch and wiring for continuity, using a multimeter.	Replace control panel; refer to paragraph 3-20. Repair defective wiring; refer to applicable wiring data section.
<b>SYSTEM OPERATES PROPERLY BUT ONE OR BOTH PANEL LIGHTS ARE EXTINGUISHED.</b>		
Lamp or lamps defective.	Check lamp bulbs.	Replace bulbs.
<b>SYSTEM OSCILLATES OR IS NOISY WHEN ANY STATION IS TALKING.</b>		
Dynamotor defective.	Exchange dynamotor for one known to function correctly.	Replace dynamotor; refer to paragraph 3-18.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>SYSTEM OSCILLATES WHEN A PARTICULAR STATION IS TALKING.</b>		
Ground at station talking defective.	With multimeter check for resistance between control panel cable pin X and ground; refer to applicable wiring data section.	Repair defective ground.
Wires in cables to control panel open.	With multimeter, perform continuity check of cables; refer to applicable wiring data section.	Repair defective cable.
<b>ONE STATION OSCILLATES WHEN LISTENING.</b>		
Control panel defective.	Exchange control panel for one known to function correctly.	Replace control panel; refer to paragraph 3-20.
<b>SYSTEM IS NOISY (DYNAMOTOR WHINE).</b>		
Dynamotor brushes or commutator worn.	Exchange dynamotor for one known to function correctly.	Replace dynamotor; refer to paragraph 3-18.
Dynamotor ground poor.	With multimeter, check for resistance between pin A of dynamotor cable and ground.	Repair defective ground.
<b>ONE STATION APPEARS WEAK AND DISTORTED FOR EITHER TALKING OR LISTENING.</b>		
Plug-in amplifier in control panel defective.	Exchange plug-in amplifier for one known to function correctly.	Replace amplifier; refer to paragraph 3-20.
<b>EXCESSIVE CROSSTALK BETWEEN CHANNELS.</b>		
Output volume too high from radio receiver used on MIX facility.	Compare output volume of radio receiver with normal interphone volume.	Reduce output from radio receiver by adjusting volume control; refer to applicable section for details of radio facility volume controls.
Control panel defective.	Exchange suspected control panel for one known to function normally.	Replace defective control panel; refer to paragraph 3-20.

## REPLACEMENT

### WARNING

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must at all times observe safety precautions. Do not replace components of the system with the power supply on. Under certain conditions, a dangerous voltage may exist in some circuits, even when power is

off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

#### **3-17. SPECIAL TOOLS REQUIRED.**

None.

#### **3-18. GENERAL INSTRUCTIONS FOR REMOVAL AND INSTALLATION OF EQUIPMENT.**

Refer to Section I.

**3-19. CONTROL PANEL C824/AIC-10, AMPLIFIER, REMOVAL.**

- a. Open two INTERPHONE circuit breakers on radio circuit breaker panel.
- b. Remove panel from fastener receptacle strip by loosening four Dzus fasteners.
- c. Open two Camloc studs on top dust cover. Turn studs  $\frac{1}{4}$  turn and release; remove top dust cover.
- d. Remove bottom dust cover as directed in steps b. and c.
- e. Open three Camloc studs from top side of amplifier panel.
- f. Turn center (inner) stud  $\frac{1}{4}$  turn and press against Camloc fastener socket.
- g. Repeat step f. on two outer studs to loosen amplifier.
- h. Lift amplifier out of panel.

**3-20. CONTROL PANEL, C824/AIC-10, AMPLIFIER, INSTALLATION.**

- a. Set amplifier in control panel, and line up locating pins with locating bushings on panels—press amplifier firmly in place.
- b. Turn studs  $\frac{1}{4}$  turn to tighten three Camloc studs in Camloc sockets.
- c. Install bottom and top dust covers by tightening two Camloc studs as in step b.
- d. Mount panel in receptacle and tighten four Dzus fasteners. No adjustments are required.
- e. Close two INTERPHONE circuit breakers on radio circuit breaker panel.

**3-21.** Deleted.**3-22.** Deleted.**3-23. STANDBY LOUDSPEAKER UNIT, LS-184/AIC-10, REMOVAL.**

- a. Open two INTERPHONE circuit breakers on radio circuit breaker panel.
- b. Remove speaker switch retaining nut.
- c. Remove single screw on front cover adjacent to switch.
- d. Remove three screws attaching speaker cover to airplane structure, and two screws holding cover to speaker side clip.
- e. Remove electrical connector to speaker.
- f. Remove three bolts attaching speaker assembly to airplane structure, and detach speaker.
- g. If speaker is to be replaced, remove back mounting bracket from speaker by unfastening three screws, then remove two screws holding front plate and detach plate.

**3-24. STANDBY LOUDSPEAKER UNIT, LS-184/AIC-10, INSTALLATION.**

- a. Attach plate assembly to bottom of speaker cone assembly, using two screws; torque to a value of 12 to 15 inch-pounds.
- b. Attach back mounting bracket to speaker assembly with three screws and lockwashers; torque to a value of 20 to 25 inch-pounds.
- c. Attach complete assembly to airplane structure with three bolts; torque to a value of 20 to 25 inch-pounds.
- d. Attach electrical connector to speaker.
- e. Align cover with speaker and attach with three screws; torque to a value of 12 to 15 inch-pounds.
- f. Attach side of cover to speaker side clip with two screws; torque to a value of 12 to 15 inch-pounds.

- g. Attach front of cover with single recessed-head screw; torque to a value of 12 to 15 inch-pounds.
- h. Secure front switch with switch retaining nut.
- i. Close two INTERPHONE circuit breakers on radio circuit breaker panel.

**3-25. CONTROL PANEL LAMPS, REPLACEMENT.**

To replace a lamp in any control panel, turn the lamp holder counterclockwise until it is unscrewed from the panel. Pull the lamp from the holder. Insert new lamp; replace holder in panel, turning clockwise.

**ADJUSTMENT****3-26. AN/AIC-10 INTERPHONE SYSTEM, ADJUSTMENT.**

No adjustment is required.

**SERVICING****3-27. AN/AIC-10 INTERPHONE SYSTEM, NOISE REDUCTION.**

Refer to Section I.

## Section IV

### VHF COMMAND RADIO SET AN/ARC-3

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#### DESCRIPTION

#### NOTE

*This section is applicable to T-29B model airplanes. Wiring and antenna provisions for the AN/ARC-3 command radio set are incorporated in T-29C (serial No. 52-1091 to 52-1155 incl) model airplanes, but the equipment is not installed.*

#### 4-1. GENERAL.

See figure 4-1. The AN/ARC-3 command radio set is designed to provide voice and mcw communications from airplane to airplane or airplane to ground. This equipment transmits and receives through a single antenna within the frequency range of 100 to 156 megacycles. Frequencies of this range are characterized by line of sight distances — that is, average communicating distances are approximately 30 miles at an altitude of 1000 feet and 135 miles at 10,000 feet. These distances may be increased or decreased, depending on atmospheric conditions. Remote operation of the equipment

on any of eight preset crystal-controlled channels is accomplished by selecting the desired channel on a control panel. The transmitter and receiver are coordinated with the control panel, through a power junction box, to tune the selected channel simultaneously within seconds. On all T-29B (except serial No. 51-5144) model airplanes, the army combat interphone system is used in operation of the AN/ARC-3 radio set. On T-29B (serial No. 51-5144) model airplanes, the AN/AIC-10 interphone system is used. The AN/ARC-3 command radio set is constructed to withstand long periods of high humidity and will operate satisfactorily at temperatures ranging from  $-55^{\circ}\text{C}$  ( $-67^{\circ}\text{F}$ ) to  $50^{\circ}\text{C}$  ( $122^{\circ}\text{F}$ ). The VHF command radio set is supplied 28-volt dc power from the nonessential bus. This circuit is protected by a 20 ampere circuit breaker placarded VHF COMM on the radio circuit breaker panel. Additional power required to operate the set is supplied by two dynamotors, one for the transmitter and one for the receiver, both mounted on the power junction box.

#### 4-2. VHF COMMAND RADIO SET, AN/ARC-3, LIST OF COMPONENTS.

ITEM	LOCATION	FUNCTION
Transmitter, T-67 ARC-3, T-67-A/ARC-3, or T-67B ARC-3.	Radio equipment rack, bottom shelf.	To transmit command radio signals.
Mounting, MT-238A ARC-3.	Radio equipment rack, bottom shelf.	To provide a shock proof mounting for transmitter.

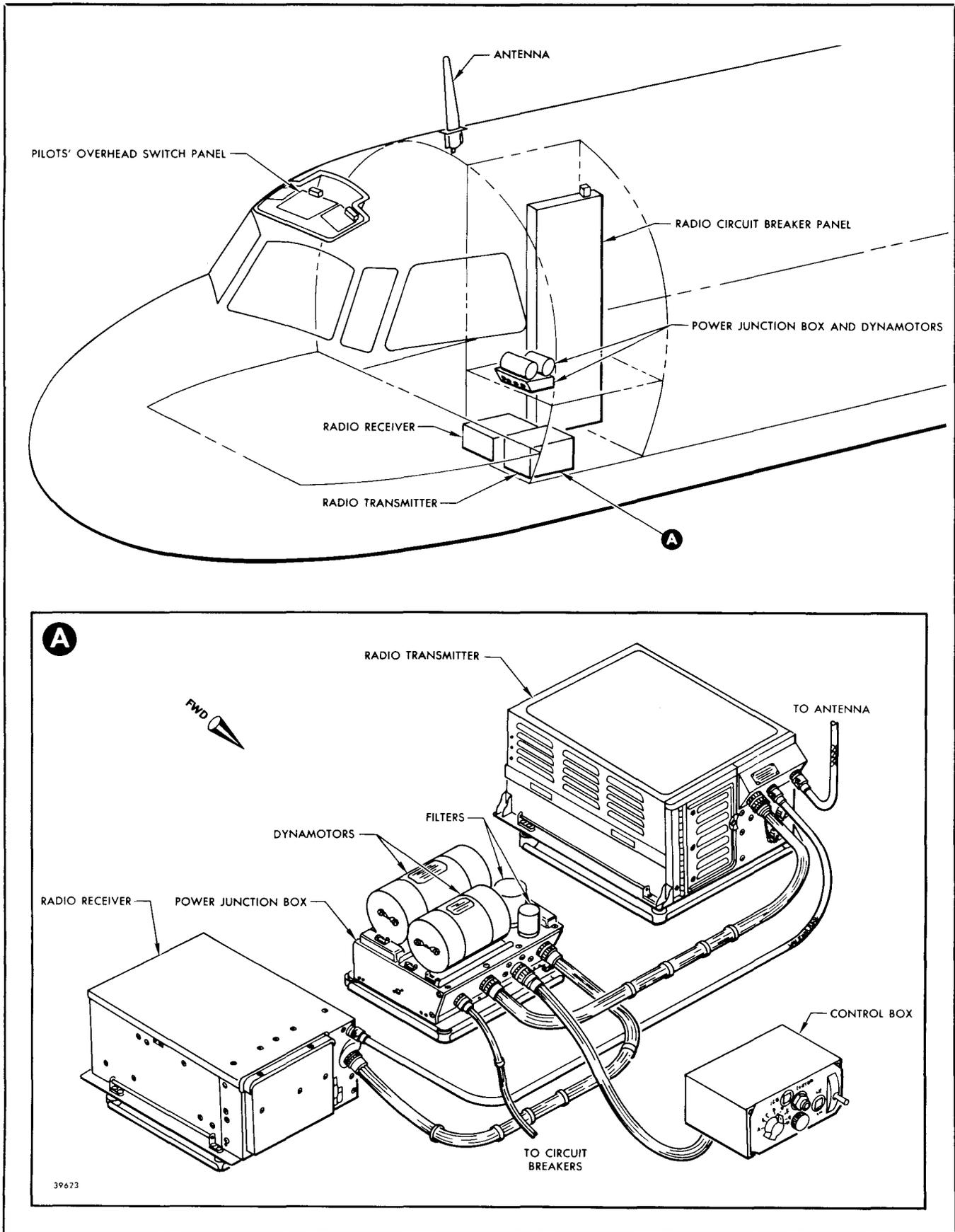


Figure 4-1. VHF Command Radio Perspective

ITEM	LOCATION	FUNCTION
Dynamotor, DY-21/ARC-3.	Mounted on power junction box.	To supply additional power to transmitter.
Receiver, R-77/ARC-3, R-77A/ARC-3, or R-77B/ARC-3.	Radio equipment rack, bottom shelf.	To receive command radio signals.
Mounting, MT-237A/ARC-3.	Radio equipment rack, bottom shelf.	To provide a shock proof mounting for receiver.
Dynamotor, DY-22/ARC-3.	Mounted on power junction box.	To supply additional power to receiver.
Power junction box, J68/ARC-3.	Radio equipment rack, second shelf above floor.	To coordinate operation of transmitter, receiver, and control panel. Contains all interconnections between components.
Control panel, C-404A/A.	Pilots' overhead switch panel.	To remotely control channel selection of AN/ARC-3 set.
Command transfer relay, AN-3303-1.	Radio equipment rack.	To cut out either VHF or UHF command radio operation.
Command transfer switch, COMMAND TRANSFER VHF, UHF.	Pilots' overhead switch panel.	To select VHF or UHF command radio facilities.
Antenna mast, AN104-B.	Top right surface of fuselage nose section.	To receive or transmit command radio signals.
Circuit breaker, 20 ampere, VHF COMM.	Radio circuit breaker panel.	To protect command radio circuit.
Circuit breaker, 5 ampere, NORMAL INTER.	Radio circuit breaker panel.	To protect command transfer relay circuit.

#### 4-3. VHF COMMAND RADIO TRANSMITTER.

See figure 4-1. The radio transmitter contains nine tubes and provides a crystal-controlled rf power output of approximately 8 watts on any one of eight preselected channels. Provisions are made in the radio transmitter for voice and mcw transmission. The entire transmitter, with the exception of its power supply, is housed in a metal cabinet with a removable bottom and wrap around top. Entrance to the crystal compartment is through a metal door on the front panel. Sockets for installing crystals are on the composition strip inside this compartment. Louvers in the sides, and back of the cabinet supply adequate ventilation. Receptacles for making external connections to the transmitter are mounted on the front panel. Receptacles and plugs are as following: U-15-U is for the power line connection from power junction box J-68 ARC-3; RECEIVER PL-259 is for connection to radio receiver R-77/ARC-3, R-77A ARC-3, or R-77B ARC-3; PL-259 ANTENNA is for connection to the antenna mast; PL-151 is for connection to the interphone system; and PL-152 is for making connection to a test unit

for alignment purposes. The radio transmitter receives power from the airplane 28 volt dc nonessential bus and from the dynamotor (DY-21/ARC-3 which is a part of the AN ARC-3 radio set). When the remote control panel selector switch is positioned for the desired channel, and the control panel ON-OFF switch is placed in ON, the power junction box is energized and, in turn, routes power to energize the transmitter and receiver. The transmitter then automatically tunes to operate and transmit signals on the frequency selected, but remains in a standby condition until a microphone switch button is depressed.

#### 4-4. VHF COMMAND RADIO RECEIVER.

See figures 4-1 and 4-2. The receiver is a 17 tube crystal controlled superheterodyne. This receiver operates on any preselected channel within the frequency range of the equipment—100 to 156 megacycles. The various channels are automatically selected by an electrically operated channel-selecting mechanism which is an integral part of the receiver. When the remote control panel selector switch is positioned for the desired channel, and the control panel ON-OFF switch is placed in

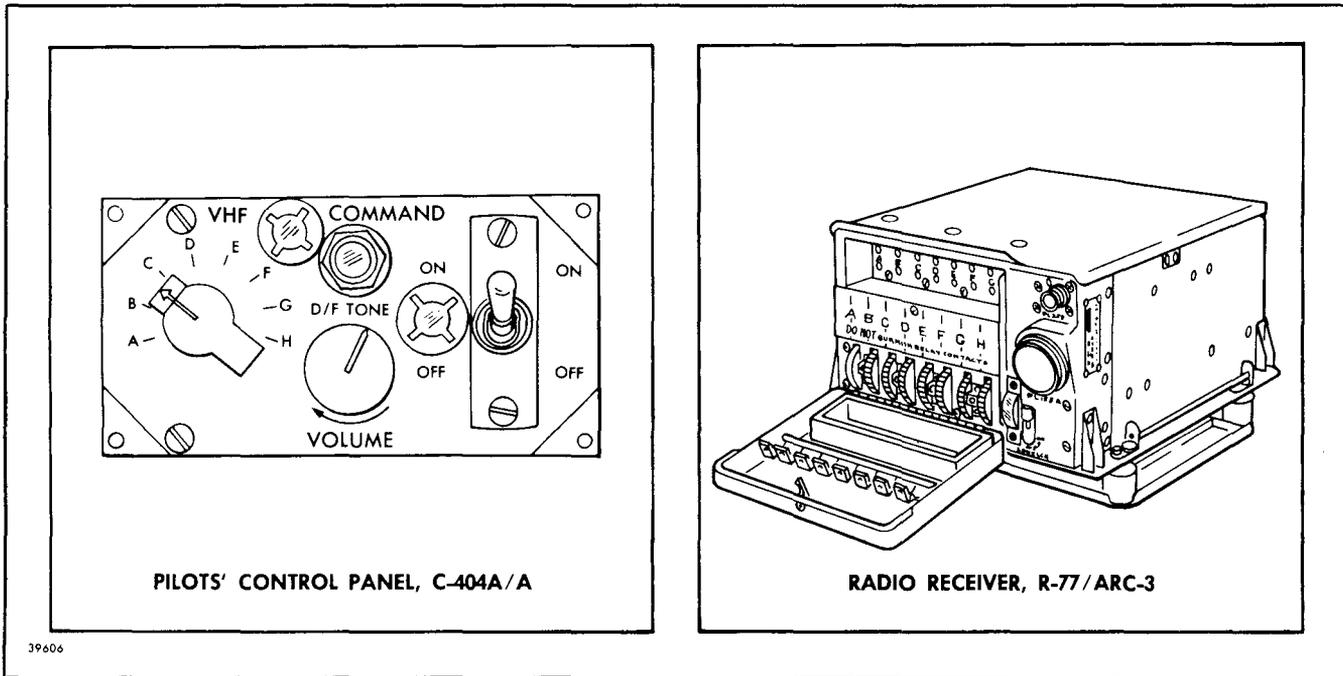


Figure 4-2. VHF Command Radio Control Panel and Receiver Perspective

ON, the power junction box is energized and, in turn, routes power to energize the transmitter and receiver. The receiver then automatically tunes to operate and receive signals on the frequency selected. The receiver monitors the selected channel continuously except during periods of transmission, at which time the receiver is shut off and the modulating signal is heard in the headset. Except for its power supply, the entire receiver is housed in a metal cabinet. The crystals are housed in the compartment extending across the top of the front panel. Located directly below this crystal compartment are eight thumbwheels calibrated in megacycles—They are for selecting the correct harmonic frequencies for each channel or groups of channels. Access to the crystal compartment and the thumbwheels is gained by releasing the latch on the hinged metal cover on the front panel. Sockets for installing crystals are mounted on the composition strip in this compartment. On the front panel is a frequency indicator dial. This dial, covered by a plastic window, indicates the channel frequency to which the receiver is tuned. A SQUELCH, ON-OFF, adjustment is located to the right of the frequency indicator dial. Plug, PL-153-A, is for the power connection from the power junction box; ANT PL-259 is for the antenna connection.

#### 4-5. VHF COMMAND RADIO CONTROL PANEL.

See figure 4-2. The VHF command radio control panel contains an ON-OFF switch, channel selector switch, VOLUME control, and a D F TONE button. The ON-OFF switch energizes and deenergizes the VHF

command radio set. The channel selector switch, with its eight channel positions (A through H), controls the transmitter and receiver automatic tuning circuits. The VOLUME control varies the audio level feed to the headset. The D/F TONE button is used as a key when mcw operation of the equipment is desired. Two light caps provide control panel illumination through a plastic lighting panel whenever the pilots' overhead switch panel lights are turned on.

#### 4-6. VHF COMMAND RADIO POWER JUNCTION BOX.

See figure 4-1. The VHF command radio power junction box performs two functions: it serves as a mounting for the dynamotor unit, and it coordinates operation of the control panel, transmitter, and receiver so that they will operate simultaneously. When the ON-OFF switch on the remote control panel is turned ON, the power junction box is energized from the airplane's 28-volt dc electrical system. The junction box, through a system of relays and coils, routes power to the receiver dynamotor and to the receiver and transmitter. When a microphone button or the D F TONE button is depressed, the power junction box routes power to the transmitter dynamotor. Two fuses in the power junction box protect the transmitter and receiver dynamotor output circuits. These fuses, along with spares, are located in fuse clips adjacent to the corresponding dynamotors. Covers over the fuses are attached by snap-slide fasteners for easy accessibility.

**4-7. DYNAMOTOR, DY-21/ARC-3.**

See figure 4-1. This dynamotor is the larger of the two dynamotors located on top of the power junction box. It supplies additional power for the operation of the VHF command radio transmitter. Power connections are made through a three-pin socket on the bottom of the dynamotor base; when the dynamotor unit is in position, the socket engages a plug on the chassis of the power junction box. The larger of the two metal cans on top of the power junction box contains a filter choke for this dynamotor. The transmitter dynamotor operates only when a microphone button or the D/F TONE button is depressed.

**4-8. DYNAMOTOR, DY-22/ARC-3.**

See figure 4-1. This dynamotor DY-22 ARC-3 is the smaller of the two dynamotors located on top of the power junction box. It supplies additional power for the operation of the VHF command radio receiver. Power connections are provided through a three-pin socket, on the bottom of the dynamotor base, which engages a plug on the chassis of the power junction box. The smaller of the two cans mounted on top of the power junction box contains a filter choke for this dynamotor. When the ON-OFF switch is in the ON position, the receiver dynamotor operates continuously.

**OPERATIONAL CHECK-OUT**

**4-9. TEST EQUIPMENT REQUIRED.**

None.

**4-10. VHF COMMAND RADIO SET, AN/ARC-3, OPERATIONAL CHECK-OUT.**

**WARNING**

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must at all times observe safety precautions. Turn power off prior to working on equipment, and disconnect power from the airplane. Do not replace components of the system with the power supply on. Under certain conditions, a dangerous residual voltage may exist in some circuits, even when the power supply is off, because of charges retained by capacitors. To avoid casualties always ground any circuit prior to handling.

a. Check to see that the static ground cable on left main landing gear is in contact with ground; with external power connected to airplane, check to see that VHF COMM and NORMAL INTER circuit breakers on radio circuit breaker panel are closed.

**NOTE**

No transmission will be made on emergency distress frequency channels except for emergency purposes. For testing, demonstration, or drill purposes, radio equipment will be operated into a non-radiating dummy load instead of an antenna.

b. Place ON-OFF switch, on control panel, in ON position. Set channel selector switch to desired channel. Equipment will tune automatically to selected channel.

**NOTE**

Check to see that COMMAND TRANSFER, VHF-UHF switch, on pilots' overhead switch panel, is in VHF position.

c. Turn interphone control panel selector switch, on pilots' overhead switch panel, to MIX. SIG. and COMMAND.

d. Allow 30 to 45 seconds for tubes in equipment to reach normal operating temperature. During the latter portion of this period, an audio tone will be heard in headset. When this tone stops, receiver and transmitter have tuned to selected channel and reception will then be possible.

e. Close microphone press-to-talk button and speak into microphone. Speech (sidetone), which modulates transmitter will be audible in headset.

f. Release microphone button to restore receiver operation. Receiver will monitor selected channel continuously except during periods of transmission, at which time receiver is shut off and modulating signal is heard in headset.

g. Adjust SQUELCH, ON-OFF, control, located on receiver panel, for least background noise level consistent with operating conditions; refer to paragraph 4-21.

h. Check mcw operation by pressing D F TONE button on control panel. A continuous tone will be heard in headset as long as D F TONE button is depressed.

i. Establish two-way radio communication with another airplane or with control tower.

j. Check transmission and reception on as many channels as are available to testing facility (tower or other airplane). Transmitter and receiver should automatically tune to each selected channel simultaneously. Approximately two seconds are required to select channels. An audio tone will be heard in headset while equipment is tuning.

**NOTE**

If either the receiver or transmitter tune incorrectly on a particular channel, select another

channel and then reselect the desired channel. If repeated mistuning occurs, refer to paragraph 4-11.

k. Vibrate equipment on mounting bases during receiving and transmitting periods to check for intermittent operation. There should be no interruption in reception or transmission.

l. Place ON-OFF switch on control panel in OFF position; disconnect external power source.

<b>SYSTEM ANALYSIS</b>
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**4-11. VHF COMMAND RADIO SET, AN/ARC-3, TROUBLE SHOOTING.**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>NO TRANSMISSION, TUNING SYSTEM STOPS AT HIGH END OF FREQUENCY BAND.</b>		
Crystal faulty.	Check transmission on another frequency.	Replace faulty crystal; refer to paragraph 4-16.
Tube defective.	If there is no transmission on any frequency, tube is probably defective.	Replace transmitter; refer to paragraph 4-13.
<b>NO TRANSMISSION, MOTOR DOES NOT START.</b>		
Circuit breaker open.	Check to see if VHF COMM circuit breaker on radio circuit breaker panel is open.	Close VHF COMM circuit breaker.
Loose connection or short in circuit.	Check circuit continuity; refer to applicable wiring data section.	Tighten loose connection or repair short; refer to applicable wiring data section.
Dynamotor, DY-21/ARC-3, faulty.	If circuit continuity check is satisfactory, check to see if dynamotor runs when microphone button is depressed.	Replace dynamotor; refer to paragraph 4-18.
<b>NO TRANSMISSION, TUNING MOTOR DOES NOT RUN.</b>		
Tuning motor faulty.	After 30 to 45 seconds warm up period, transmitter will not tune.	Replace transmitter; refer to paragraph 4-13.
<b>NO RECEPTION.</b>		
Antenna loose.	Check antenna for proper securing; refer to paragraph 4-15.	Secure antenna properly; refer to paragraph 4-15.
Tube defective.	If receiver has power but no sound, tube is probably faulty.	Replace receiver; refer to paragraph 4-13.
Relay contacts dirty.	Check circuit continuity; refer to applicable wiring data section.	Replace receiver; refer to paragraph 4-13.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>NO RECEPTION, TUNING SYSTEM STOPS AT PROPER FREQUENCY.</b>		
Tube faulty.	Check frequency tuning for at least three channels.	Replace receiver; refer to paragraph 4-13.
<b>NO RECEPTION, TUNING SYSTEM STOPS AT WRONG FREQUENCY.</b>		
Thumbwheel set improperly.	Check settings of thumbwheels on front panel of receiver.	Properly set thumbwheels; refer to paragraph 4-23.
Crystal relay contacts dirty.	If thumbwheel setting is correct, check to see that reception on other frequency channel is satisfactory.	Replace receiver; refer to paragraph 4-13.
<b>NO RECEPTION, DYNAMOTOR WILL NOT START.</b>		
Fuse blown.	Check condition of receiver dynamotor fuse on power junction box.	Replace blown fuse with spare fuse in fuse clip adjacent to dynamotor.
Loose connection or short in circuit.	Check circuit continuity; refer to applicable wiring data section.	Tighten loose connection or repair short in circuit; refer to applicable wiring data section.
Circuit breaker open.	Check to see if VHF COMM circuit breaker on radio circuit breaker panel is open.	Close VHF COMM circuit breaker.

## REPLACEMENT

### WARNING

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must at all times observe safety precautions. Turn power off prior to working on equipment, and disconnect power from the airplane. Do not replace components of the system with the power supply on. Under certain conditions, a dangerous residual voltage may exist in some circuits, even when the power supply is off, because of charges retained by capacitors. To avoid casualties always ground any circuit prior to handling.

#### 4-12. SPECIAL TOOLS REQUIRED.

None.

#### 4-13. VHF COMMAND RADIO SET, AN ARC-3, MAJOR COMPONENTS, REPLACEMENT.

Refer to Section I for the general instructions for removal and installation of radio equipment.

#### 4-14. VHF COMMAND RADIO ANTENNA, REMOVAL.

- a. Loosen knurled locking ring of antenna cable connector and detach coaxial antenna cable from antenna.
- b. Remove nut and bolt from structural antenna clamp in flight compartment overhead.
- c. Remove six screws from outside fuselage skin, seal, and grounding straps.
- d. Lower antenna down through structural clamp into flight compartment.

#### 4-15. VHF COMMAND RADIO ANTENNA, INSTALLATION.

See figure 4-3.

#### 4-16. VHF COMMAND RADIO SET, AN/ARC-3, CRYSTAL, REMOVAL.

- a. Open crystal compartment door on front panel of transmitter or receiver.
- b. Remove desired crystal from lettered socket.

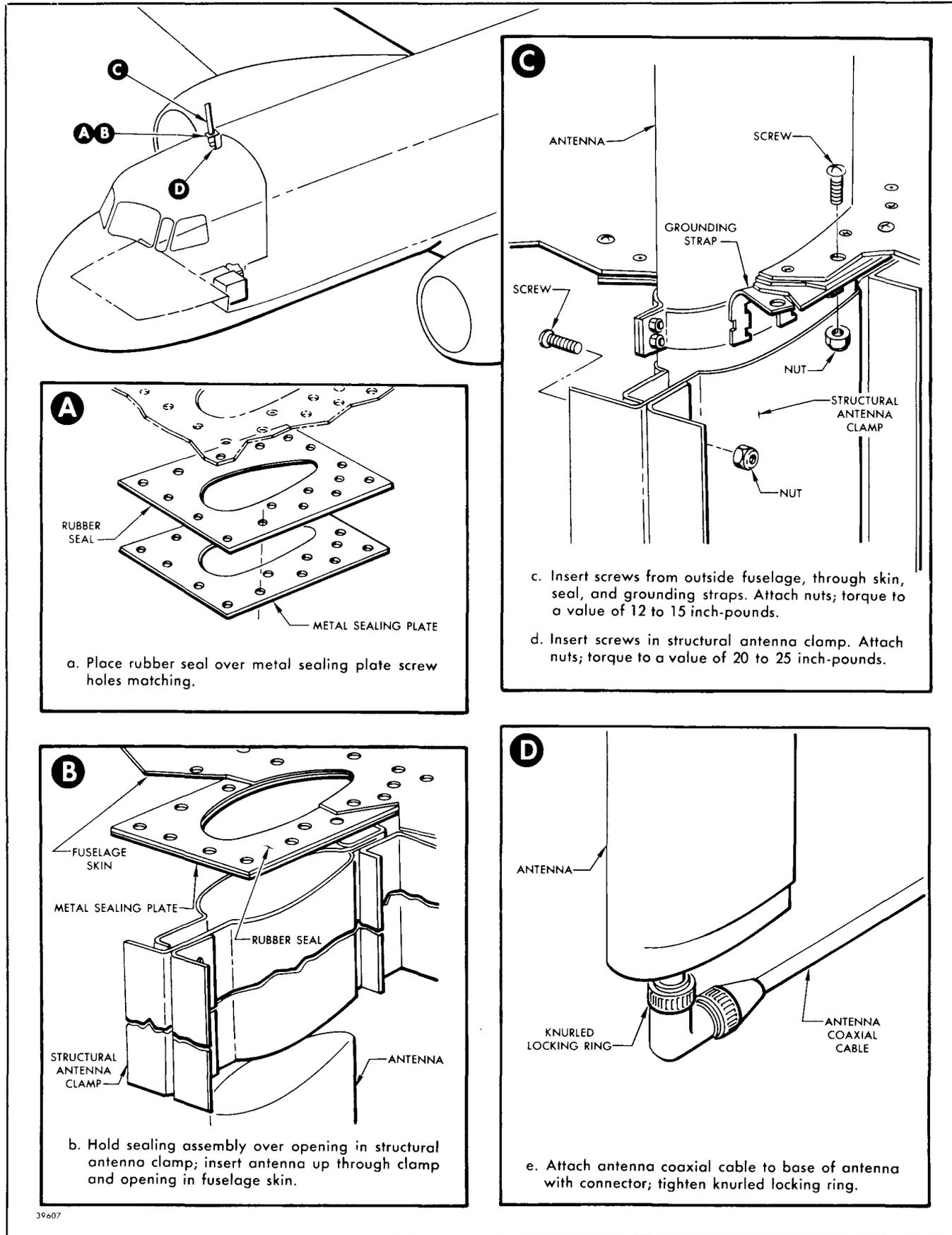


Figure 4-3. VHF Command Radio Antenna Installation

**4-17. VHF COMMAND RADIO SET, AN/ARC-3, CRYSTAL, INSTALLATION.**

- a. Insert selected crystals in properly lettered sockets; refer to paragraphs 4-22 and 4-23 for selection and adjustment of crystals.
- b. On receiver, set thumbwheel below selected crystal to designated operating frequency for that particular channel; refer to paragraph 4-23 for adjustment procedure.
- c. Close crystal compartment door and fasten door to hold crystals in place.

**4-18. VHF COMMAND RADIO SET, AN/ARC-3, DYNAMOTOR, REMOVAL.****NOTE**

The removal and installation of both dynamotors is essentially the same, therefore the following two paragraphs apply to both dynamotors, DY-21/ARC-3, and DY-22/ARC-3.

- a. With external power source disconnected, open VHF COMM and NORMAL INTER circuit breakers on

radio circuit breaker panel. Insure that left main landing gear static ground cable is in contact with ground.

- b. Remove safety wire from four snap-slide fasteners on base of dynamotor.
- c. Pull back four snap-slide fasteners and lift dynamotor unit from power junction box.

**4-19. VHF COMMAND RADIO SET, AN/ARC-3, DYNAMOTOR, INSTALLATION.**

a. Align socket on dynamotor base with socket on power junction box; two extra holes in base of dynamotor slip over guide pins on chassis of power junction box and eliminate possibility of mounting dynamotor in a reversed position. Install dynamotor in place on power junction box.

- b. Connect four snap-slide fasteners; safety-wire.
- c. Close VHF COMM and NORMAL INTER circuit breakers on radio circuit breaker panel.
- d. Perform operational check-out; refer to paragraph 4-10.

**ADJUSTMENT****4-20. TEST EQUIPMENT REQUIRED.**

None.

**4-21. VHF RECEIVER SQUELCH CONTROL, ADJUSTMENT.**

Background noise in the receiver can be effectively reduced by adjustment of the squelch circuit.

- a. Slide SQUELCH, ON-OFF, cover, located just to right of frequency indicating dial on receiver front panel, to one side to gain access to screwdriver adjustment.
- b. To increase squelch action, rotate control shaft in counterclockwise direction with screwdriver.
- c. To decrease squelch action, rotate control shaft in clockwise direction with screwdriver.

**NOTE**

Do not set the squelch action higher than necessary to reduce the background noise level to a tolerance level, as an increase in squelch action also prevents weak signal reception.

**4-22. VHF TRANSMITTER CRYSTAL SELECTION.**

To select the proper transmitter crystal for a particular channel, divide the desired operating frequency by 18. The crystal frequency in kilocycles is stamped on each crystal nameplate. To determine the proper crystal, use the following formula:

$$fc = \frac{fo}{18}$$

The  $fc$  equals crystal frequency and  $fo$  equals desired operating frequency.

Example:

To set up a 100-megacycle operating frequency:

$$fc = \frac{100}{18} = 5555.55 \text{ kilocycles.}$$

Install a crystal with 5555.55 kilocycles stamped on the nameplate. No other adjustment is necessary to the transmitter. The transmitter will then automatically tune to the desired frequency when the corresponding channel is selected at the control panel.

**4-23. VHF RECEIVER CRYSTAL SELECTION AND ADJUSTMENT.**

The frequency of the correct receiver crystal to be used can be found by using the following formula:

$$f_c = \frac{f_o - 12}{H}$$

The  $f_c$  equals crystal frequency,  $f_o$  equals the frequency to which the receiver is to be tuned, and H equals harmonic. The correct value of H is given in the following table:

Frequency ( $f_o$ )	Receiver crystal harmonic (H)
100-108 .....	11
108-116 .....	12
116-124 .....	13
124-132 .....	14
132-140 .....	15
140-148 .....	16

Frequency ( $f_o$ )	Receiver crystal harmonic (H)
148-156 .....	17
156 .....	18

No crystals below 8000 kilocycles, or above 8727 kilocycles should be used:

Example:

To select a proper crystal for a 100-megacycle channel,  $f_c = \frac{100 - 12}{11} = 8000$  kilocycles.

Select a crystal with 8000 kilocycles stamped on the nameplate. After the proper crystal has been inserted in its socket, adjust the thumbwheels on the front of the receiver panel to the proper frequency. The receiver has eight thumbwheels, calibrated in kilocycles, designated from A through H. The kilocycle calibration on each thumbwheel should agree with the crystal and the frequency desired for each channel.

**SERVICING**

**4-24. VHF COMMAND RADIO SET, AN/ARC-3, SERVICING.**

**NOTE**

Cables are often moved during servicing work and not replaced in their original position. This is a common source of hum and other interference. Interference is caused by proximity to ac circuits, particularly when grounding or bonding straps are omitted during installation of new equipment. Grease, oil, fuel, hydraulic fluid, water, or cleaning solvents may injure insulation. Electrical wiring and components must be protected at all times from fluid materials.

To prevent radio noise and interference, check for the following as applicable:

- a. Security of mounting.
- b. Security of connector plug, bonding or grounding straps and electrical wiring.
- c. Security of flexible turning cable connections.
- d. Smooth operation of controls—jerky controls often cause radio noise.
- e. Microphonic vacuum tubes. Tap the case while listening with headset. Ringing or stuttering sounds indicate a microphone tube with loose elements.

## Section IV-A

### VHF COMMUNICATIONS SYSTEM WILCOX 807A

#### 4A-1. GENERAL.

The Wilcox 807A VHF communications system is installed on selected T-29A, B, C and D airplanes. The transceiver transmits and receives voice communications in the very-high-frequency (vhf) range from 116.000 through 149.975 megacycles (mc). In addition, when used with auxiliary equipment, the transceiver is capable of transmitting and receiving communications intelligence for an Air Traffic Control Signaling System (ATCSS).

#### 4A-3. TRANSCEIVER.

The transceiver is constructed of aluminum and is divided into five basic sections: front panel, bottom deck, receiver chassis, center chassis, and rear panel. Screws with self-locking nuts are used to join the sections together to insure a rigid frame. Two aluminum side covers completely enclose the equipment. These covers are easily removed by releasing the quick-action fasteners which secure them to the frame. Mounted on the front panel are a rotary switch and a meter for the selection and monitoring of voltage and

#### 4A-2. VHF COMMUNICATIONS SYSTEM, WILCOX 807A, LIST OF COMPONENTS.

ITEM	LOCATION	FUNCTION
Series 807A VHF Transceiver, Wilcox type No. 97607-101.	Radio equipment rack, bottom shelf.	To provide VHF communications system.
Radio Set Control, Wilcox type No. 97733-100.	Pilots' overhead control panel.	Provides remote frequency, volume, power, and communi- cations test control.
Antenna.	Top right surface of nose section.	Radiates and receives VHF communications signals.

current at various points in the unit; two jacks, designated MIKE and PHONE; a time totalizing meter (when supplied); two hold-down hooks; and a standard front panel handle. All electrical connections to the unit are made through a dual connector on the rear panel, which is a formed heat sink with mounting facilities for three transistors. The receiver chassis extends the full length of the unit at the left side and is attached to the rear panel by hinges and to the front panel and center chassis by quick-release fasteners. When the fasteners are released, the receiver chassis swings out from the side of the unit to provide access to the rear of the receiver chassis and to the left side of the center chassis. Components and circuitry located on the receiver chassis are as follows: the bias tuning and switching matrix, all frequency conversion circuits, bandpass filters, and the receiver circuits. Components and circuits located on the left side of the center chassis are as follows: an assembly containing transmitter excitation circuits, a

transient suppression transistor, filtering components, and the high-voltage assembly. Components and circuitry located on the right side of the center chassis are as follows: an assembly containing two stages of rf drive, a tube-type power amplifier, a blower for cooling, and a positioning motor; two transistors (modulator driver/amplifier); and two printed circuit boards. The printed circuit boards are mounted back-to-back and are hinged at the bottom and secured at the top with two quick-release fasteners. Components and circuitry mounted on the boards are as follows: modulator input amplifiers, sidetone amplifiers, transient suppression circuits, and the power and motor control circuits. Power transformers and associated filtering are mounted on the bottom deck. Transistors are employed in all transceiver circuits except for the tube used as the transmitter power amplifier. Extensive use is made of printed circuit techniques in the equipment design and all small-signal transistors are of the plug-in type.

#### 4A-4. EQUIPMENT CHARACTERISTICS.

CHARACTERISTIC	SPECIFICATION
<b>OVER-ALL CHARACTERISTICS</b>	
Power input	+27.5 volts dc, -20 to +10 percent; 11 amperes max.
Power consumption	
Receive	2.0 amperes
Transmit	7.5 amperes, carrier only
	10.5 amperes, carrier with 100 percent modulation
Frequency range	116.000 through 149.975 megacycles
Number of channels	1360 selectable channels spaced 25 kc apart on receive and transmit. However, supplied filters FL106 and FL301 in the receiver provide a bandpass of 40 kc for 50-kc channel spacing. Alternate filters can be supplied which provide a receiver bandpass of 20 kc for 25-kc channel spacing.
Channeling time	Less than 4 seconds
Frequency selection	Two-out-of-five (2x5) system
Environmental requirements	
Temperature	
Continuous operation	-54°C to +55°C (-65°F to +131°F)
Intermittent operation (30 minutes maximum)	-54°C to +71°C (-65°F to +160°F)
Power removed	-62°C to +71°C (-79.6°F to +160°F)
Humidity	95 to 100 percent at 50°C (122°F) for 48 hours with moisture condensation on the equipment once each hour
Altitude	45,000 feet, maximum

## 4A-4. EQUIPMENT CHARACTERISTICS (Cont.)

CHARACTERISTIC	SPECIFICATION
<b>OVER-ALL CHARACTERISTICS</b>	
Environmental requirements (cont.)	
Vibration	
Shockmounted	0.030 inch constant excursion from 10 to 55 cps with maximum acceleration of 5g. Constant acceleration of 5g from 55 to 500 cps
Rigid mount	0.020 inch constant excursion from 5 to 37 cps with maximum acceleration of 3g. Constant acceleration of 1.5g from 37 to 500 cps
Shock	
Shockmounted	6g operating; 15g impact (10 milliseconds duration)
<b>RECEIVER CHARACTERISTICS</b>	
Input impedance	52 ohms, coaxial
Sensitivity	A maximum signal of 3 (hard) microvolts, modulated 30 percent at 1000 cps, is required to achieve 6-db signal-plus-noise-to-noise ratio
Selectivity	
<i>Normal</i> (using supplied 50-kc filters 44266-1 and 38179-2 in positions FL106 and FL301)	±15 kc wide minimum at 6 db down; ±31.5 kc wide maximum at 60 db down
<i>Sharp</i> (using optional 25-kc filters 44266-2 and 38179-2 in positions FL106 and FL301)	±6 kc wide minimum at 6 db down; ±18 kc wide maximum at 60 db down
All spurious responses	At least 60 db down
Audio output impedance	
Receiver	500 ohms nominal; accommodates output loads from 200 ohms to infinity
ATCSS	100 ohms
Audio output	
Receiver	100 milliwatts into an external 200- or 500-ohm resistive load for 100 percent modulation
ATCSS	0.50 volts into an open circuit for a 1000-microvolt signal, modulated 30 percent at 1000 cps
Audio distortion	Less than 7.5 percent at normal rated output for a signal modulated 30 percent at 1000 cps
Audio response	Less than 6 db total variation from 300 to 3750 cps

---

RECEIVER CHARACTERISTICS (Cont.)

---

Agc	Receiver output will not vary more than 3 db over the range of signal input levels from 5 to 100,000 microvolts, and not more than 6 db over the range of signal input levels from 5 to 500,000 microvolts. Receiver will not overload with 1-volt input signal
Squelch threshold	3 microvolts or less, internally and externally adjustable

---

TRANSMITTER CHARACTERISTICS

---

Output impedance	52 ohms, coaxial
Power output	25 watts minimum; 40 watts nominal
Frequency stability	Better than 0.005 percent
Type of emission	Carrier plus modulation (A3)
Type of modulation	Amplitude, high level
Modulation system	Internal modulator capable of modulating the transmitter 100 percent with a voltage of 0.25 rms at 1000 cps applied to a 100-ohm input circuit. Over-all distortion will not exceed 10 percent at 100 percent modulation at 1000 cps. Audio system flat within 6 db from 300 to 3000 cps
Audio input impedance	
Microphone	100 ohms
ATCSS	100 ohms
0 dbm	500 ohms, center tapped
Audio input	
Microphone	0.25 volts, 1000 cps
ATCSS	1.0 volt, 1000 cps
0 dbm	1 milliwatt, 1000 cps
Sidetone output impedance	500 ohms nominal; accommodates output loads from 200 ohms to infinity
Sidetone output	100 milliwatts into an external 200- or 500-ohm resistive load for 100 percent modulation

---

4A-5. OPERATIONAL CHECKOUT.

a. Test Operation of Wilcox 807A.

(1) Connect external power source to airplane and place VHF and interphone circuit breakers to ON position.

(2) Place control unit VHF COMM OFF/PWR switch to PWR. Dial light should glow.

NOTE

Command Transfer, VHF, UHF switch on pilot's overhead panel should be in VHF position.

(3) Set transceiver meter switch to V position. The transceiver meter should indicate approximately 27 volts. Place transceiver meter switch to REG SUP position. The meter should indicate approximately 20 volts.

(4) Place the VHF COMM frequency selector on the control panel to a frequency at which no signal is obtained in the headset. Press the COMM TEST switch. This disables the receiver squelch circuit and background noise should be heard in the headset. Place the transceiver meter switch to AGC position. The meter should show approximately 0.05 (1 scale division).

(5) Place the VHF COMM frequency selector on the control panel to the frequency of the Airfield Control

Tower. Operate the microphone push-to-talk (PPT) switch contact, the control tower or another airplane and check the the transceiver for the following:

(a) The transmitted message is received clear and audible by the control tower or aircraft.

(b) The received message is clear and audible. The VOL (Volume) control on the control panel varies the audio level.

(c) The indications listed in Table 4A-1 for MOD I, DRIVER V, DRIVER I, PA GRID I, PA B+, PA CATH I AND PWR OUT positions of transceiver meter switch are obtained on receiver meter.

(6) Set control unit, VHF COMM/PWR switch to OFF position.

(7) Remove external power from aircraft.

TABLE 4A-1. TRANSCEIVER FRONT PANEL METER INDICATIONS

Position Switch S1902	Typical Indication Meter M1
OFF	Open circuit
LINE V	27 volts, approximate
REG SUP	20 volts
AGC	*No signal applied, 0.05 (1 scale div); signal applied, 0.05 (1 scale div) to 0.80 (16 scale div), depending upon level of input signal
MOD I	**3.5 amperes maximum; 2.0 to 2.5 amperes typical
DRIVER V	***33 volts, $\pm 15$ percent
DRIVER I	*** Depends on frequency of operation; 0.06 amperes minimum; 0.5 amperes maximum; 0.15 to 0.3 amperes typical
PA GRID I	*** Depends on frequency of operation; zero milliamperes minimum; 40 milliamperes maximum; 15 to 25 milliamperes typical
PA B+	***400 volts, $\pm 15$ percent
PA CATH I	***Depends on frequency of operation; 0.3 amperes maximum; 0.15 to 0.2 amperes typical
PWR OUT	*** 25 watts minimum
Notes:	
*Meter scale for AGC position of switch S1902 is an <i>uncalibrated</i> indication of AGC action (not voltage or current).	
**Microphone PTT button depressed and speaking into microphone in a normal voice.	
***Test panel PTT switch S1 set to ON.	



## SECTION IV-B

### COLLINS VHF-101 COMMUNICATIONS SYSTEM

#### 4B-1. GENERAL.

a. The Collins VHF 101 Communications System provides Voice Communication from aircraft to aircraft or aircraft to ground. The frequency range is from 116.00 to 149.95 megacycles in 50 kilocycle steps, giving a total of 680 available frequencies or channels. Any of the 680 crystal controlled channels may be selected by Radio Set Control 614U-6. Channel selection tuning, and loadings are performed electronically. Pressing the microphone push-to-talk switches operates the transmitter.

b. Since the transmitter operates only at very high frequencies, its effective range generally is limited to line-of-sight distances, as determined by the height of the aircraft. Average communicating distances from aircraft to ground stations are 30 miles at 1000 feet and 135 miles at 10,000 feet.

#### 4B-2. TRANSMITTER.

The transmitter, 17L7A, is designed for rack installation in aircraft. It operates in a frequency range J 116.00 to 149.95 megacycles. There are 680 crystal controlled channels available for selection by a Collins Autopositioner system controlled by a remote frequency control unit. The power output is 25 watts. The emission is amplitude modulated (Class A3).

4B-3. Receiver 51 X 2B is an airborne, crystal-controlled, double conversion receiver that operates in the frequency range from 116.00 to 151.95 megacycles in 50 kilocycle steps when receiver is used with control 614U-6, and transmitter 17L7A. The receiver is a rack mounted item.

#### 4B-4. CONTROL 614U-6.

Control is designed for panel mounting and is cable connected to VHF Communications Transmitter 17L7A, and Receiver 51 X 2B. The frequency range of the 614U-6 is from 116.00 to 149.95 megacycles, and is controlled by two frequency selector switches. The course frequency switch provides one megacycle switching steps and the fine frequency switch provides 50 kilocycle switching steps.

#### 4B-5. CHECKOUT PROCEDURES.

##### NOTE

Be sure the interphone system is operating properly. Audio input and output for the radio equipment are obtained through the interphone system utilizing the same headphones and microphones for reception and transmission as are used for intercommunication in the airplane.

##### NOTE

Check to see that COMMAND TRANSFER, VHF-UHF switch on pilot's overhead switch panel is in VHF position.

a. Check out procedures for Collins VHF-101 communications system.

(1) Connect external power source to airplane and place VHF and interphone circuit breakers in the ON position.

(2) Place VHF power switch on 614U-6 control panel to ON position. Allow 15 minutes for warm up.

(3) Set the SQUELCH control on the 614U-6 and 51X-2B equipment fully clockwise.

(4) Select several frequencies known to be active and within the reception capabilities of the 51 X 2B receiver.

(5) Set the SQUELCH adjust control on the front panel of the 51 X 2B so that it just opens the receiver on the weakest of the signals found in Step 4.

(6) Determine whether or not the audio of the output receiver is sufficient for good reception. If inadequate, check interphone system. If interphone signals (transmission) are adequate, remove 51 X 2B from its mount and advance the AURAL level control, R18. Replace the 51 X 2B into its mount, and repeat the audio output check.

(7) Select several strong stations to determine if AGC is functioning properly. Check to see that the audio does not overload.

(8) Operate the system through all the megacycle setting and then through 20 of the 50-KC channels. Compare the frequency indication on the 614U-6 control with the frequency indication on the 51 X 2B receiver and the 17L7A transmitter.

(9) Adjust the SQUELCH control on front panel of the 51 X 2B so that squelch control on the 614U-6 control has proper control of the squelch threshold.

(10) Select a channel that may be used for test transmissions.

(11) Key the 17L7A transmitter and observe the meter indication at each position of the meter switch. Compare with values in Table 4B-1.

(12) Make a test transmission and observe the modulation indication on the meter with the meter switch set to MOD-E.

(13) Check level of the sidetone.

(14) If receiver, 51 X 2B, transmitter, 17L7A or 614U-6, control, does not operate properly, remove and replace with a like item that has been bench checked and then repeat complete check.

(15) When system operates normally, place 614U-6 panel power switch to the OFF position.

(16) Disconnect external power source for aircraft.

(17) The operating controls in the VHF-101 system are identified in Table 4B-1. The 17L7A has a frequency indicator, a circuit meter, a meter switch, and a microphone jack. The normal indications on the circuit meter for each position of the meter switch are listed in Table 4B-1.

**4B-6. OPERATING CONTROLS.**

The operating controls in the VHF-101 system are identified in Figure 4B-1. The 17L7A has a frequency indicator, a circuit meter, a meter switch, and a microphone jack. The normal indications on the circuit meter for each position of the meter switch are listed in Table 4B-1.

TABLE 4B-1. TYPICAL METER INDICATIONS FOR VHF TRANSMITTER 17L7A

METER SWITCH POSITION	TYPICAL INDICATIONS WITH 25 WATTS OUT
ANT	0 0.4-0.6
PA-G	0.4-1.0
DR-G	0.3-1.0
MOD-E	0-0.8*
BAT	0.7
LV	0.7
HV	0.7
PA-P	0.7

\*This indication depends on modulation percentage.

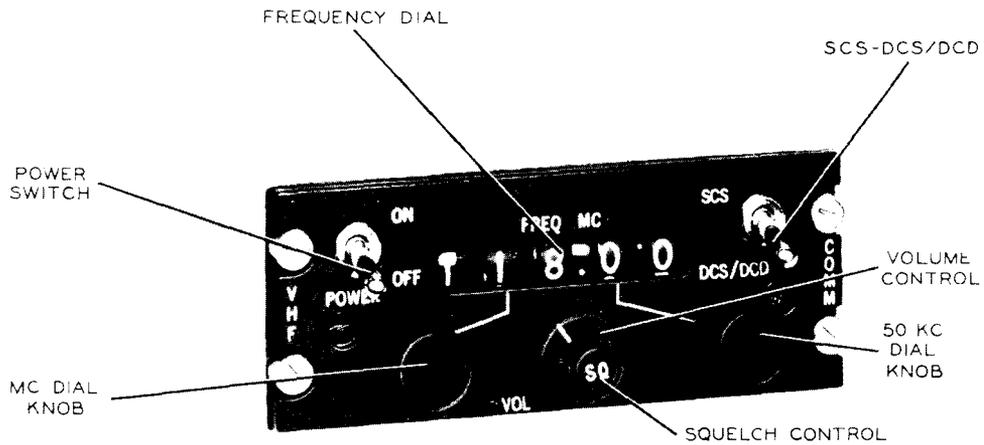
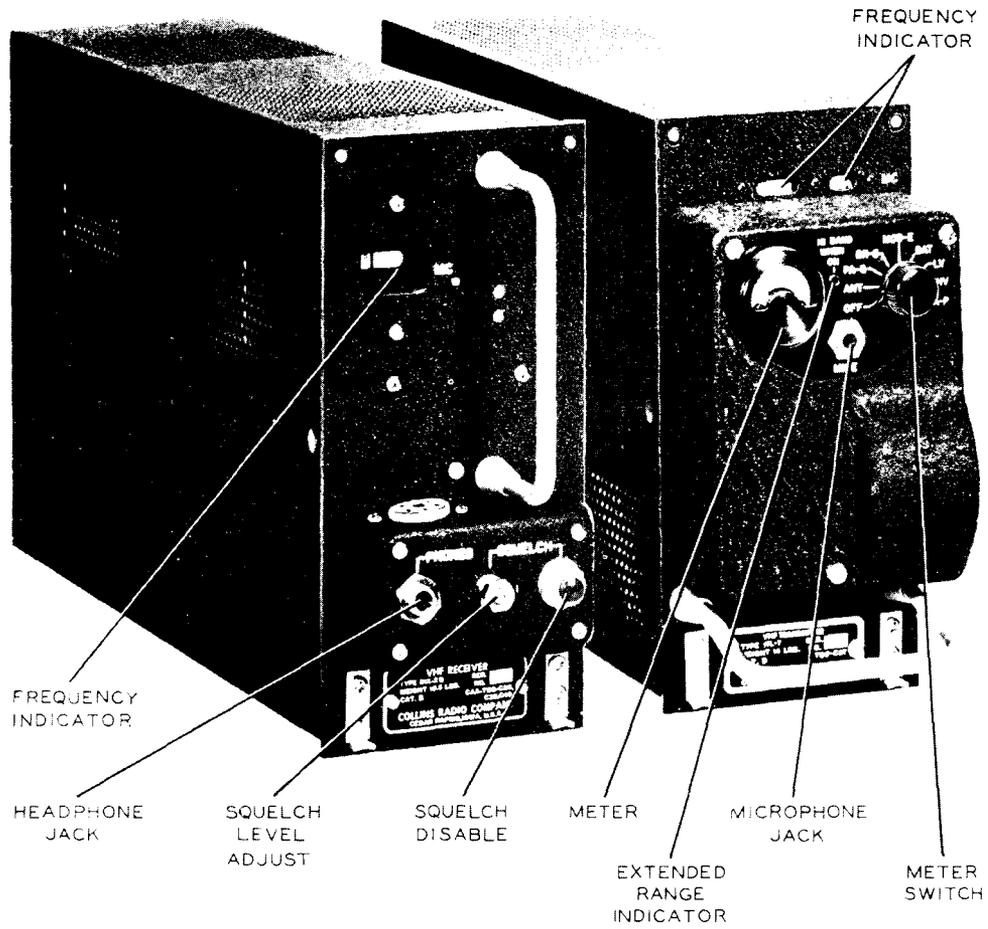
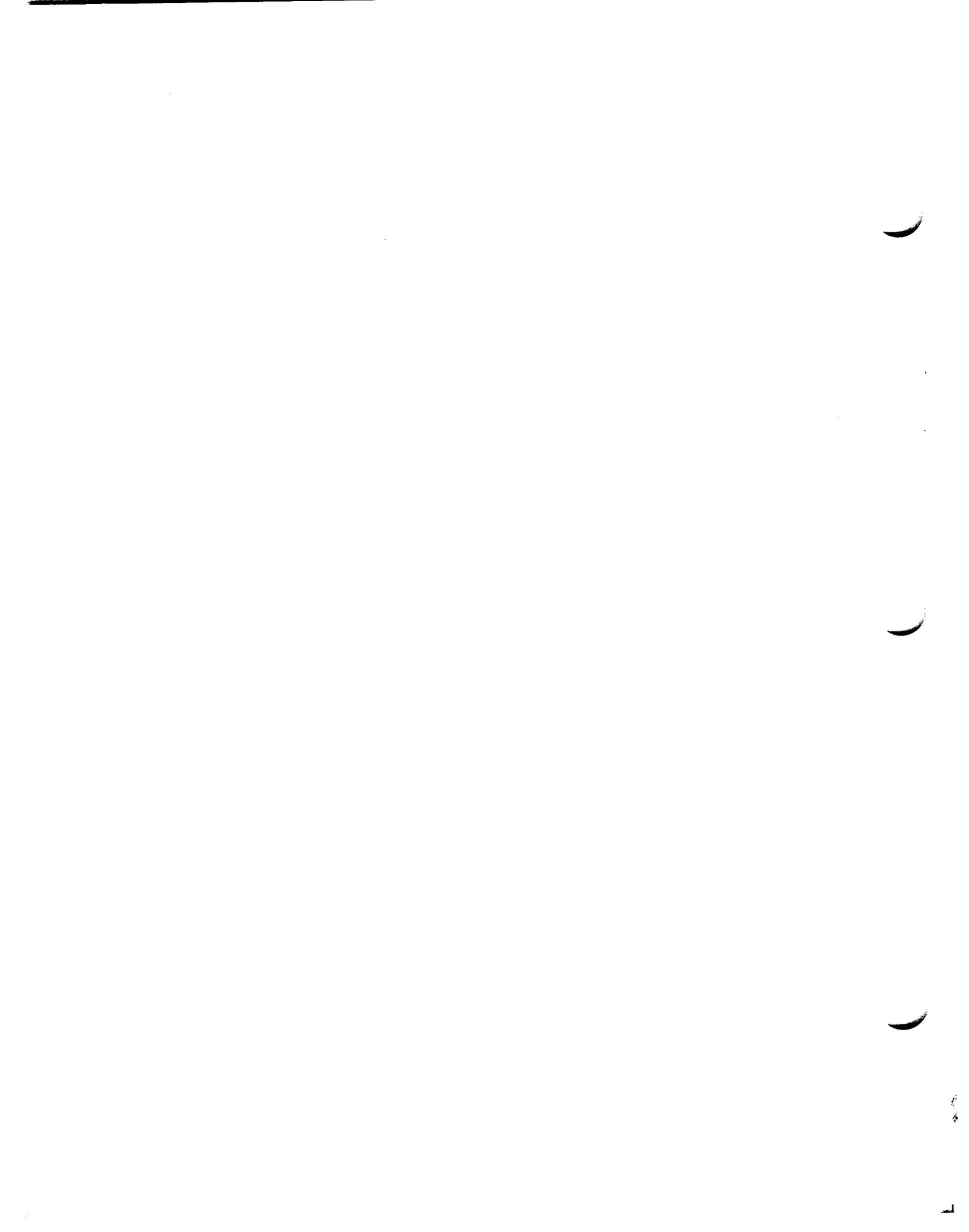


Figure 4B-1. Operating Controls for Communications System VHF-101



## Section V

### UHF COMMAND RADIO AN/ARC-27

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#### DESCRIPTION

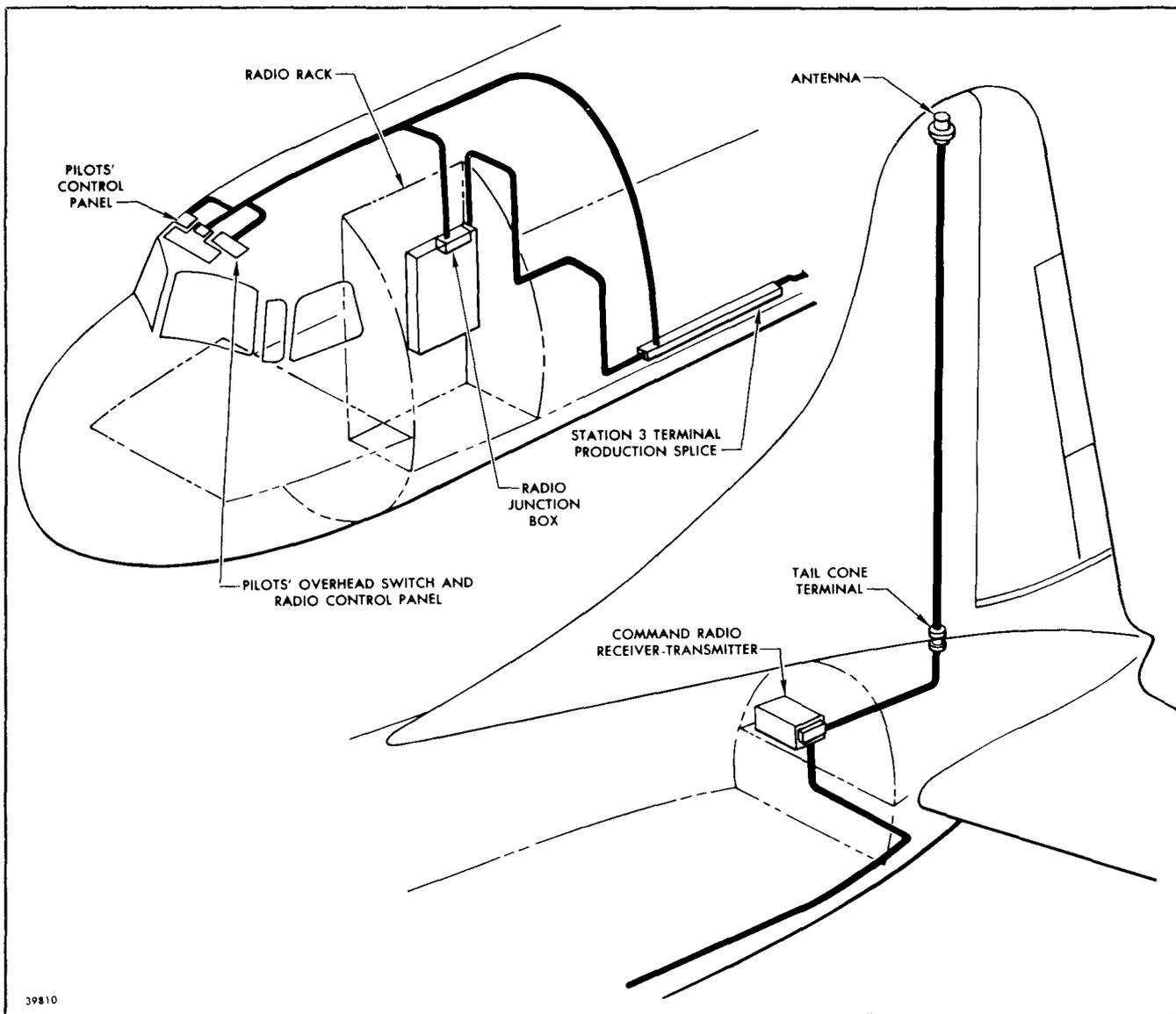
#### 5-1. GENERAL.

See figures 5-1 and 5-2. The UHF command radio set, AN/ARC-27, is installed *in all T-29 model airplanes*. It provides two-way amplitude-modulated voice radio telephone communication between airplane and airplane, airplane and ship, and airplane and ground. The set is capable of providing transmission and reception from a single antenna, on any one of 1750 frequency channels, spaced 100 kilocycles apart, in the band of 225.0 to 399.9 megacycles. It is also possible to monitor one predetermined frequency, known as a guard channel, located in the 238.0 to 248.0 megacycle band. The control units associated with the equipment permit the manual selection of any frequency within the frequency range, or the automatic selection of any one of 20 preset channels. The transmitter portion of the radio set can be tone modulated with a 1020 cps continuous tone signal, generated within the equipment, for emergency or direction finder purposes. *On T-29C (serial No. 53-3461 and subsequent) and T-29D (serial No. 53-3495 and subsequent) model airplanes*, the UHF command radio set may be used in conjunction with the AN/ARA-25 direction finder equipment for ADF

(automatic direction finding) and homing operations. When used for automatic direction finding (ADF), the receiver-transmitter receives radio frequency signals from the direction finding antenna, amplifies and demodulates the signals, and delivers the low-frequency modulation components to the direction finder amplifying and indicating equipment. Audio input and output for the equipment are obtained through the interphone system, utilizing the same headphones and microphones for reception and transmission as are used for intercommunication in the airplane. The command radio is also used for tone bomb scoring. The BOMB SCORING TONE switch, on the pilots' overhead switch panel, and three relays, on the master radar console, provide the interconnection necessary for the command radio to perform the scoring function. Operational check of the tone bomb scoring system is made during check of the command radio system; refer to paragraph 5-13. *On T-29B model airplanes*, a transfer relay and transfer panel enable the pilot to use either the UHF or VHF command radio set. Power to the UHF command radio AN/ARC-27 is from the 28-volt dc essential bus, and the circuit is protected by a 25 ampere UHF COMM circuit breaker.

#### 5-2. UHF COMMAND RADIO, AN/ARC-27, LIST OF COMPONENTS.

ITEM	LOCATION	FUNCTION
Receiver-transmitter, RT-178/ARC-27.	Radio rack in tail cone section.	To transmit and receive UHF command radio signals.



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Figure 5-1. UHF Command Radio (AN/ARC-27) Perspective, Typical

ITEM	LOCATION	FUNCTION
Pilots' control panel, C-1904/ARC27.	Pilots' overhead switch panel.	To control remotely selection of channel frequencies of UHF command radio and UHF direction finding group.
Antenna relay, RE-120/ARA-25, on T-29C (serial No. 53-3461 and subsequent) and T-29D (serial No. 53-3495 and subsequent) model airplanes.	Radio rack in tail cone.	To switch from UHF command antenna to ADF antenna.

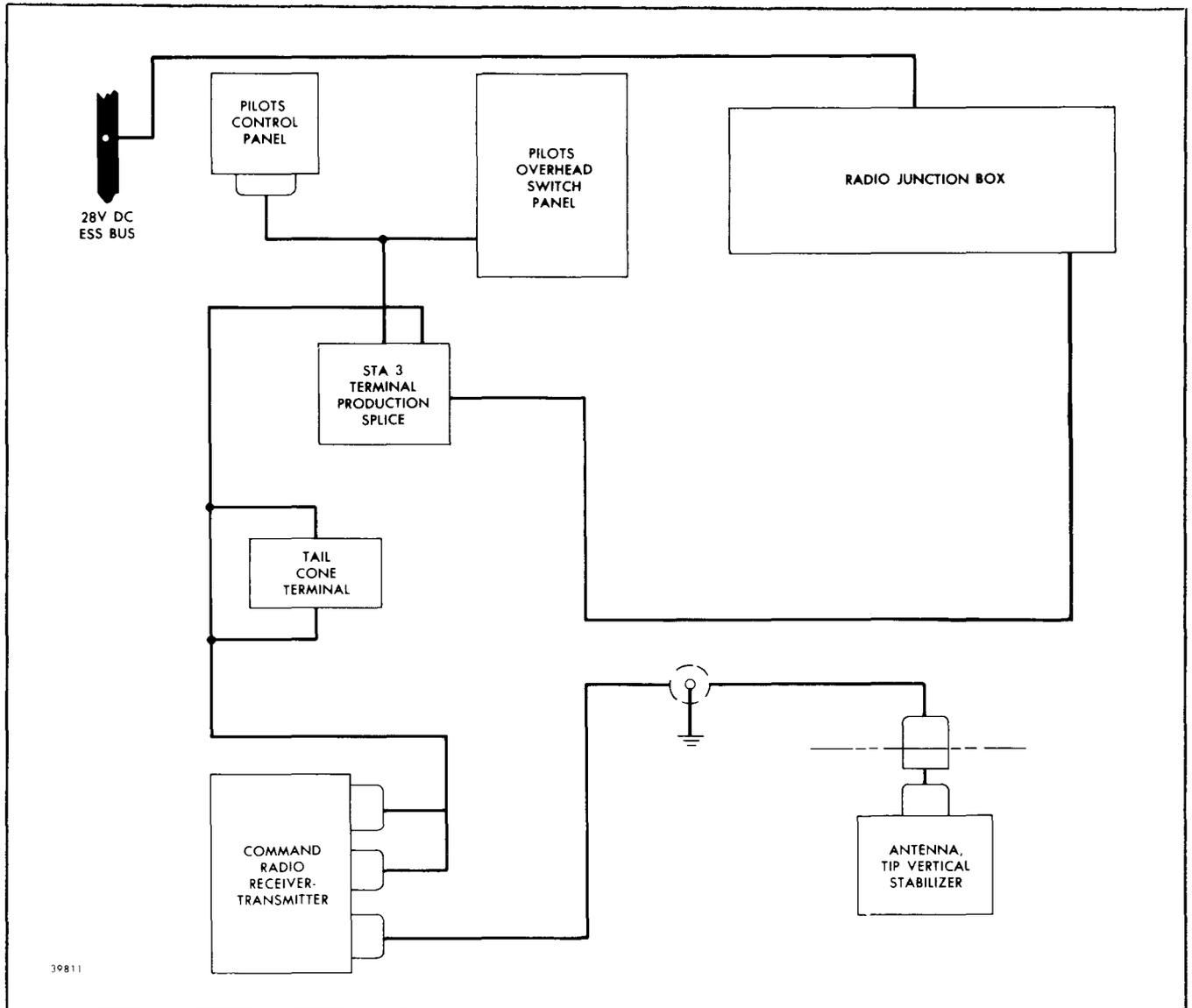


Figure 5-2. UHF Command Radio (AN/ARC-27) Block Diagram

ITEM	LOCATION	FUNCTION
Command transfer panel, T-29B and T-29C (serial No. 52-1091 to 52-1155 incl) model airplanes.	Pilots' overhead switch panel.	To select either UHF or VHF command radio facilities.
Transfer relay, T-29B model airplanes.	Radio equipment rack.	To transfer to either UHF or VHF command radio facilities.
Antenna, flush type, AT-256/ARC or AT-256A/ARC.	Top of vertical stabilizer.	To receive or transmit UHF command radio signals.
Circuit breaker, 25 ampere, UHF COMM.	Radio circuit breaker panel.	To protect UHF radio command circuit.
Mounting base, MT-822/ARC-27 or MT-822A/ARC-27.	Radio rack in tail cone.	To provide a shock mounting for receiver-transmitter.

### 5-3. UHF COMMAND RADIO RECEIVER-TRANSMITTER.

The receiver-transmitter consists of ten separate sub-assemblies mounted on a main chassis. The ten sub-assemblies are as follows:

- Guard channel receiver.
- Spectrum amplifier.
- Mechanical drive.
- Bias relay.
- R-F power amplifier.
- Spectrum oscillator.
- Main receiver.
- I-F and audio.
- Modulator.
- 20 to 30 MC i-f amplifier.

The main chassis, and subassemblies, and an integral dynamotor are enclosed in a sealed, pressurized aluminum case. The individual subassemblies are designed as plug-in units and use multiple contact connectors to make electrical connection to the main chassis cable wiring. The subassemblies are held in position mechanically by captive screws. The front control panel of the

receiver-transmitter contains a separate sensitivity and squelch control for both the main receiver and the guard receiver. The control panel also contains a meter jack and meter selector switch to check the operation of the important circuits of the equipment. A headset and microphone jack are provided to facilitate local testing of the receiver-transmitter. All external connection to receiver-transmitter are made through pressure-sealed connectors mounted on the front panel of the unit. The aluminum case of the receiver-transmitter is constructed so that an air passage exists between the outer and inner shells. The inner shell of the case is used to form the pressurizing seal with the front panel of the unit. A blower motor, mounted on the front panel, utilizes two rotor fans to force outside air along the passage between the outer and inner shells of the case to provide adequate ventilation.

### 5-4. RECEIVER-TRANSMITTER FRONT PANEL CONTROLS.

The functions of the controls on the front panel of the receiver-transmitter are as follows:

CONTROL	FUNCTION
SENS (GUARD REC).	Controls sensitivity of guard receiver.
SQ OFF (GUARD REC).	Cuts out guard channel receiver squelch circuit.
SENS (MAIN REC).	Controls sensitivity of main receiver.
SQ OFF (MAIN REC).	Cuts out main receiver squelch circuit.
PHONE jack.	Connects monitoring headset to receiver.
MIC jack.	Connects test microphone to transmitter.
METER jack.	Connects test meter to selector test points.
METER switch.	Selects meter test points in circuit.

### 5-5. DELETED.

**5-6. PILOTS' CONTROL PANEL.**

- See figure 5-3. The pilots' control panel is connected to the main control panel. The CHANNEL selector switch, on the pilots' control panel, permits individual
- selection of the 20 channels preset in the main control panel. In addition, the selector switch includes a guard

position (G), permitting operation of the main receiver and the transmitter on that frequency. An audio VOLUME control is also provided to adjust the volume from the receiver. Panel lighting is provided by two small lamps in red holders set in a plastic lighting panel. A single function selector switch has positions as follows:

CONTROL	POSITION	FUNCTION
Function selector switch.	OFF.	To remove all power from UHF command radio.
	T R.	To permit operation of transmitter and main receiver.
	T/R+G.	To permit operation of transmitter and main receiver while monitoring guard receiver.
	ADF.	To energize direction finder group and main receiver.

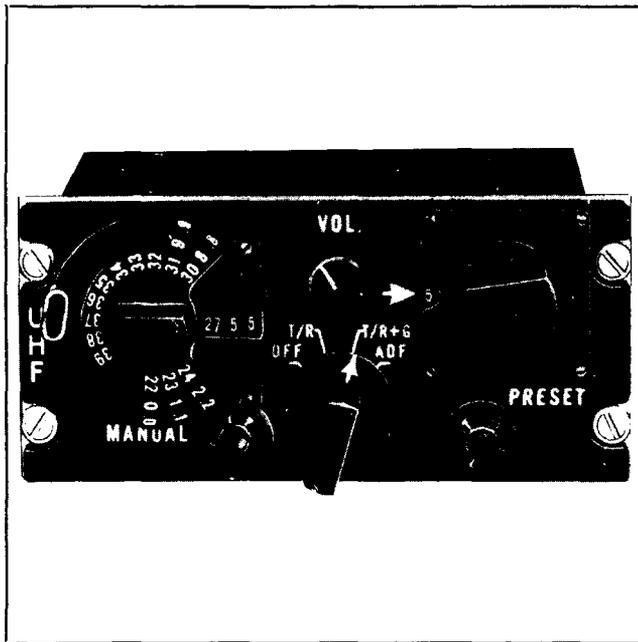


Figure 5-3. Pilots' Control Panel (C-1904/ARC-27)

#### 5-7. ANTENNA RELAY.

This antenna relay is part of the AN/ARA-25 direction finder equipment. Its purpose is to disconnect the UHF command radio receiver-transmitter from its communications antenna and connect it to the direction finder antenna. The antenna relay is energized when the function switch, on the pilots' UHF command radio control panel, is placed in the ADF position. Refer to T.O. 1T-29A-2-12 for detailed information on the direction finder group.

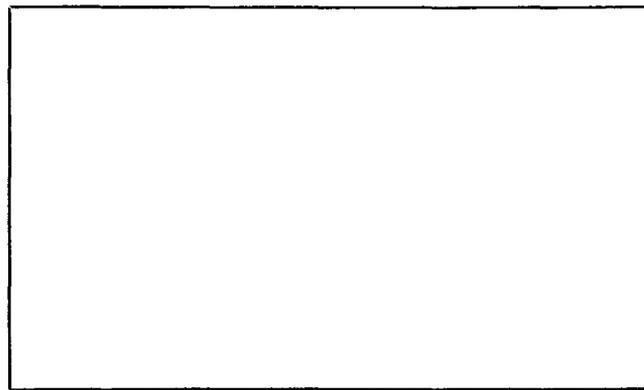


Figure 5-4. Deleted.

#### 5-8. COMMAND TRANSFER PANEL.

The command transfer panel provides a means of selecting either UHF or VHF command radio facilities when both are installed. This operation is accomplished by a two-position transfer switch placarded UHF and VHF. An indicating light illuminates when the transfer switch is placed in the VHF position.

#### 5-9. COMMAND TRANSFER RELAY.

The command transfer relay is controlled by the switch on the command transfer panel. When the switch is in the UHF position, only the UHF command radio set can be operated. When the switch is in the VHF position, the transfer relay is energized for VHF operation and power is cut off from the UHF set. For further information on the VHF command radio set refer to Section IV.

## OPERATIONAL CHECK-OUT

#### 5-10. TEST EQUIPMENT REQUIRED.

None.

#### 5-11. UHF COMMAND RADIO, PREPARATION FOR OPERATIONAL CHECK-OUT.

a. Make sure the static ground cable on the left main landing gear is installed properly and is touching the ground. Plug in external dc power source connector to external dc power receptacle located forward of main entrance door.

#### CAUTION

When using external power, the battery switch on the pilots' pedestal must remain in the

OFF position to prevent power transfer between the external power source and the airplane battery.

b. Place LOAD MONITOR switch, on pilots' pedestal, in OVERRIDE position.

c. Place DC VOLTMETER SELECTOR switch, on pilots' pedestal, in MAIN BUS position and check for 28 volts.

d. Check to see that UHF COMM and INTERNORMAL circuit breakers on radio circuit breaker panel are closed.

e. Place function selector switch, on pilots' overhead control panel, in T/R position to energize system (allow one minute for equipment warm-up).

f. Turn CHANNEL selector switch, on pilots' control panel, to desired channel.

g. Turn VOLUME control to desired level. The set is now ready to be operated from normal (pilots') position.

h. Deleted.

#### 5-12. DELETED.

#### 5-13. UHF COMMAND RADIO RECEIVER, OPERATIONAL CHECK-OUT.

a. Energize system; refer to paragraph 5-11.

b. At pilots' control panel, place function selector switch in T/R position and CHANNEL selector switch in position 1.

#### NOTE

Steps c., d., and e. require a second man in the tail cone section to depress the SQ OFF button on the receiver-transmitter front panel.

c. Allow one minute for set to warm up. Have man in tail cone section depress SQ OFF MAIN REC button. If receiver is operating normally, a hiss — characteristic of set noise — should be heard in headset.

d. Rotate CHANNEL selector switch through remaining channels being used, including position G, and check for receiver noise on each channel.

e. Turn function selector switch T/R+G and allow one minute for set to warm up. Check operational channels again, including guard channel.

f. Place function selector switch in OFF position; deenergize dc system and disconnect external power source.

#### 5-14. UHF COMMAND RADIO TRANSMITTER AND TONE BOMB SCORING, OPERATIONAL CHECK-OUT.

#### NOTE

No transmission will be made on emergency distress frequency channels except for emergency purposes. For testing, demonstrations, or drill purposes, radio equipment will be operated into a non-radiating dummy load instead of an antenna.

a. Energize system; refer to paragraph 5-11.

b. At pilots' control panel, place function selector switch in T/R position and CHANNEL switch in position 1.

c. When conditions permit, establish radio contact (with control tower, local radio station, or another airplane) on each channel being used. Press microphone switch to operate transmitter. Sidetone should be heard in headset whenever microphone switch is depressed.

d. Place function selector switch in T/R+G position and repeat step c.

e. Contact radio station and arrange a check for the tone bomb scoring system.

f. Energize the tone bomb scoring system; refer to T.O. 1T-29A-2-13.

g. Place function selector switch in T/R position and the BOMB SCORING TONE switch in the ON position — radio station must indicate when the continuous tone is interrupted.

h. Place function selector switch in OFF position; deenergize the dc system and disconnect external power source.

## SYSTEM ANALYSIS

### WARNING

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must at all times observe safety precautions. Turn power off prior to working

on equipment, and disconnect power from the airplane. Do not replace components of the system, with the power supply on. Under certain conditions a dangerous voltage may exist in some circuits, even when the power supply is off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

#### 5-15. TEST EQUIPMENT REQUIRED.

FIGURE & INDEX NO.	NAME	DESIGNATION	ALTERNATE	USE AND APPLICATION
None.	Milliammeter.	TS-80/U or equivalent.	ME-29/U.	To check voltage and amperage.
None.	Wattmeter, basic.	7CAC-979564-5.		To measure power.
None.	Element, 25 watts, 200 to 500 mc range.	7CBE-425020-41.		To use as element for wattmeter.
None.	Element, 50 watts, 200 to 500 mc range.	7CBE-425020-42.		To use as element for wattmeter.
None.	Gage, air.	MK-20A-UP.		To check pressure in sealed unit of receiver-transmitter.

#### 5-16. TRANSMITTER POWER OUTPUT TEST.

##### NOTE

To perform this check, the Bird Model 43 wattmeter requires one of several plug-in elements according to the power and frequency range under test. These items are stocked under separate numbers and only one item is obtained under each number; refer to paragraph 5-15. Check receiver-transmitter pressure — must not be more than 2 pounds at sea level.

- a. Connect thru-line wattmeter at point A of figure 5-5. It is imperative that test cable not be defective.
- b. Turn wattmeter plug-in elements so that arrow points toward transmitter line leading to antenna.
- c. Key transmitter and read transmitted power.
- d. Reverse wattmeter plug-in element so that arrow points toward transmission line leading to transmitter.
- e. Key transmitter and read reflected power.

- f. Compute power ratio as:

$$\text{Power Ratio} = \frac{\text{Transmitted Power, from Step c.}}{\text{Reflected Power, Step e.}}$$

- g. If power ratio is ten or greater and transmitter power is less than eight watts, replace receiver-transmitter unit.

##### NOTE

The power output specification for the receiver-transmitter unit is nine watts, the eight watt figure is given here to allow a margin for input voltage variations, reflected antenna troubles, etc.

- h. If power ratio is ten or greater, antenna system is satisfactory and no further tests are required.
- i. If power ratio is less than ten, proceed to check antenna and cable assembly for faults.

#### 5-17. CABLE ASSEMBLY TEST.

##### NOTE

Make this test on an unused frequency in the range of 350 to 400 megacycles.

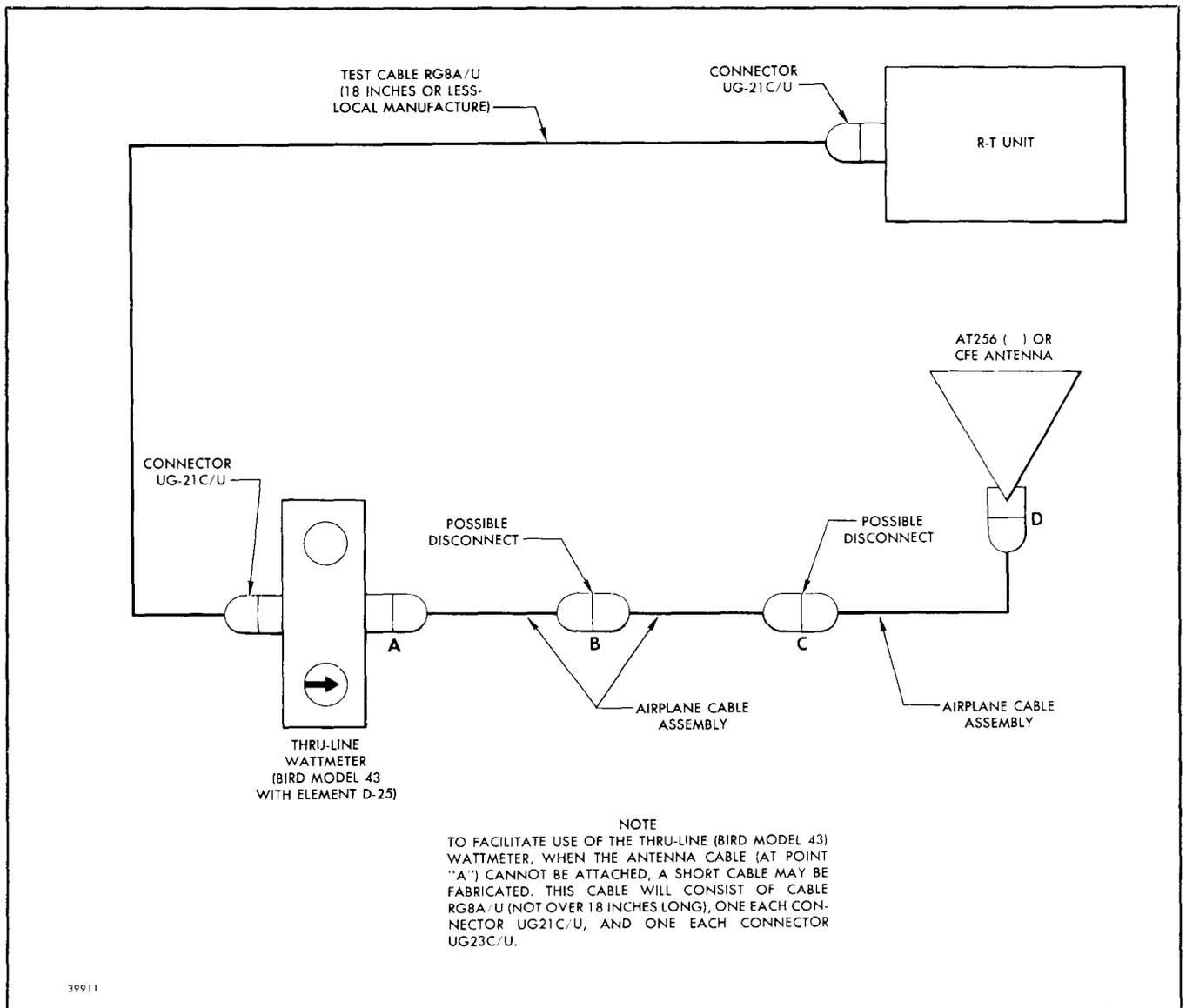


Figure 5-5. Antenna and Power Transmitter Elements, Test Hookup

a. Insert wattmeter at antenna, point D of figure 5-5, using test cable, and, with arrow pointed to antenna, read transmitted power.

b. Power delivered to antenna shall be not less than values listed:

Length of cable RG-8A/U or RG87A U	Percent power delivered as compared to reading at point A, figure 5-5.
100 ft	25%
50 ft	50%
25 ft	75%
10 ft	90%

c. If power delivered is less than that listed, a portion of cable is defective.

d. Other readings, if any, at various disconnects, will determine defective portion of cable.

#### 5-18. ANTENNA TEST.

a. Insert wattmeter at point D of figure 5-5, using test cable connected to antenna.

b. Key transmitter and read:

Transmitter power, arrow pointed at antenna.

Reflected power, arrow pointed at R T unit.

c. Compute power ratio; refer to paragraph 5-16, step f.

d. If power ratio is seven or greater, antenna is satisfactory.

e. If power ratio is less than seven, antenna is defective and should be replaced.

**5-19. UHF COMMAND RADIO SYSTEM, TROUBLE ISOLATION.**

See figure 5-6.

- a. Connect milliammeter to test jacks on transmitter-receiver face.
- b. Energize system; refer to paragraph 5-11.
- c. Place function selector switch, on pilots' control panel, in T/R+G position.
- d. Check voltage and amperage as indicated in following table.

**NOTE**

This test is designed to aid maintenance personnel in locating major sources of trouble. It is to be used as an aid in locating faulty units and vacuum tubes. Replacement of units is preferable when possible. If voltages do not agree with those listed in the following table, refer to paragraph 5-20 for details of trouble shooting and remedies.

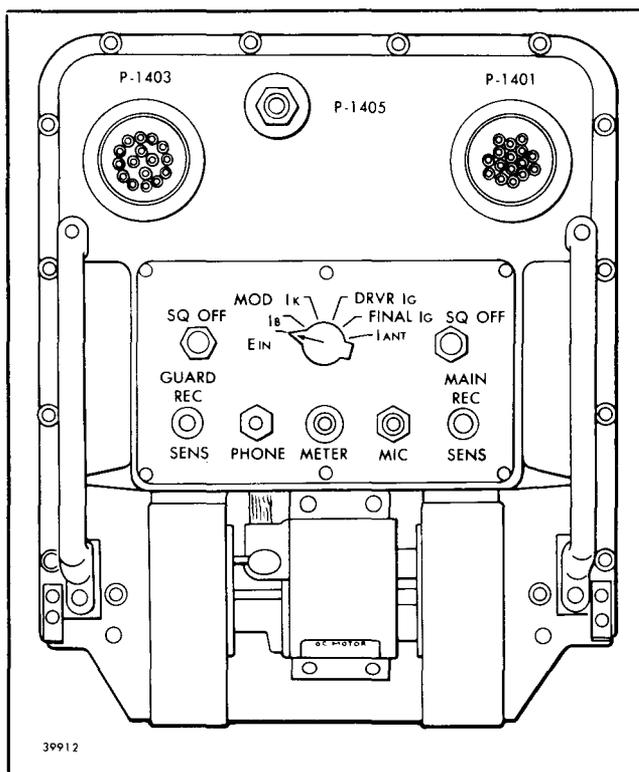


Figure 5-6. Receiver-Transmitter Front Panel

METER SWITCH POSITION	MULTIPLIER	RECEIVER METER READING	VALUE	TRANSMITTING METER READING	VALUE
Ein	50 volts	0.44-0.56	27.5v	0.54-0.56	27.5v
Ib (guard off)	1000 ma	0.24-0.28	240-280 ma	0.4 - 0.54	400-540 ma
(guard on)	1000 ma	0.30-0.34	300-340 ma	- - - -	- - - -
MOD Ik (un-modulated)	200 ma	0	0	0.25-0.4	50-80 ma
(modulated)	200 ma	0	0	0.5 - 0.7	100-140 ma
DRIVER Ig	50 ma	0	0	0.3 - 0.8	15-40 ma
FINAL Ig	50 ma (approx)	*	*	0.4 - 1.0	20-50 ma (approx)
Iant	25 watts (approx)	0	0	0.3 - 0.95	10-25 watts (approx)

\* A residual current will be read here because of a voltage divider in the final power amplifier stage. This reading does not indicate grid current through the tube.

**5-20. UHF COMMAND RADIO SYSTEM, TROUBLE SHOOTING.****NOTE**

Refer to paragraph 5-19 for isolation procedure required to locate trouble indicated in the following chart.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>SWITCH AT EIN, METER READS HIGH.</b>		
Defective power source.	Check power supply.	Repair power supply.
<b>SWITCH AT IB POSITION, METER READS LOW.</b>		
Defective dynamotor.	None.	Replace receiver-transmitter.
Open in plate supply.	None.	Replace receiver-transmitter.
Defective tube(s).	Test tubes.	Replace defective tube(s).
Disconnected sub-assembly.	Examine receiver-transmitter.	Tighten sub-assembly.
<b>SWITCH AT IB POSITION, METER READS HIGH.</b>		
Short in plate circuit supply wiring.	None.	Replace receiver-transmitter.
Short in internal component.	None.	Replace receiver-transmitter.
<b>SWITCH AT IK POSITION, METER READS LOW.</b>		
Faulty plate supply.	None.	Replace receiver-transmitter.
<b>SWITCH AT IK POSITION, METER READS HIGH.</b>		
Faulty bias supply.	None.	Replace receiver-transmitter.
<b>SWITCH AT DRVR IG POSITION, METER READS LOW.</b>		
Insufficient excitation.	None.	Replace receiver-transmitter.
<b>SWITCH AT FINAL LG POSITION, METER READS LOW (ASSUMING NORMAL AT PRECEDING TEST).</b>		
Defective driver plate circuit.	None.	Replace receiver-transmitter.
<b>SWITCH AT IANT POSITION, METER READS LOW (ASSUMING NORMAL AT PRECEDING TEST).</b>		
Defective final plate circuit.	None.	Replace receiver-transmitter.
<b>NO TRANSMISSION.</b>		
Open circuit breaker.	Check UHF COMM circuit breaker on radio circuit breaker panel.	Close UHF COMM circuit breaker.
Opening in circuit.	Check circuit continuity; refer to applicable wiring data section.	Repair or connect opening in circuit; refer to T.O. 1T-29A-2-10.
Receiver-transmitter inoperative.	Check to see that circuit breaker is closed and circuit continuity checks satisfactorily.	Replace receiver-transmitter; refer to paragraph 5-22.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>NO TRANSMISSION OR RECEPTION USING MASTER CONTROL PANEL.</b>		
Master control panel inoperative.		Replace master control panel; refer to paragraph 5-22.

**REPLACEMENT**

**5-21. SPECIAL TOOLS REQUIRED.**

None.

**5-22. GENERAL INSTRUCTIONS FOR REMOVAL AND REPLACEMENT OF RADIO EQUIPMENT.**

Refer to Section I for removal and installation of radio equipment.

**5-23. UHF COMMAND RADIO ANTENNA, REMOVAL.**

See figure 5-7.

- a. With external power source disconnected open

UHF COMM circuit breaker on radio circuit breaker panel.

- b. Remove attaching screws holding UHF command radio antenna cover in place on vertical stabilizer; remove cover.

- c. Remove antenna mounting nuts and screws.

- d. Lift antenna from support structure; remove coaxial antenna lead by backing off knurled locking ring.

**5-24. UHF COMMAND RADIO ANTENNA, INSTALLATION.**

See figure 5-7.

5-25. DELETED.

5-26. DELETED.

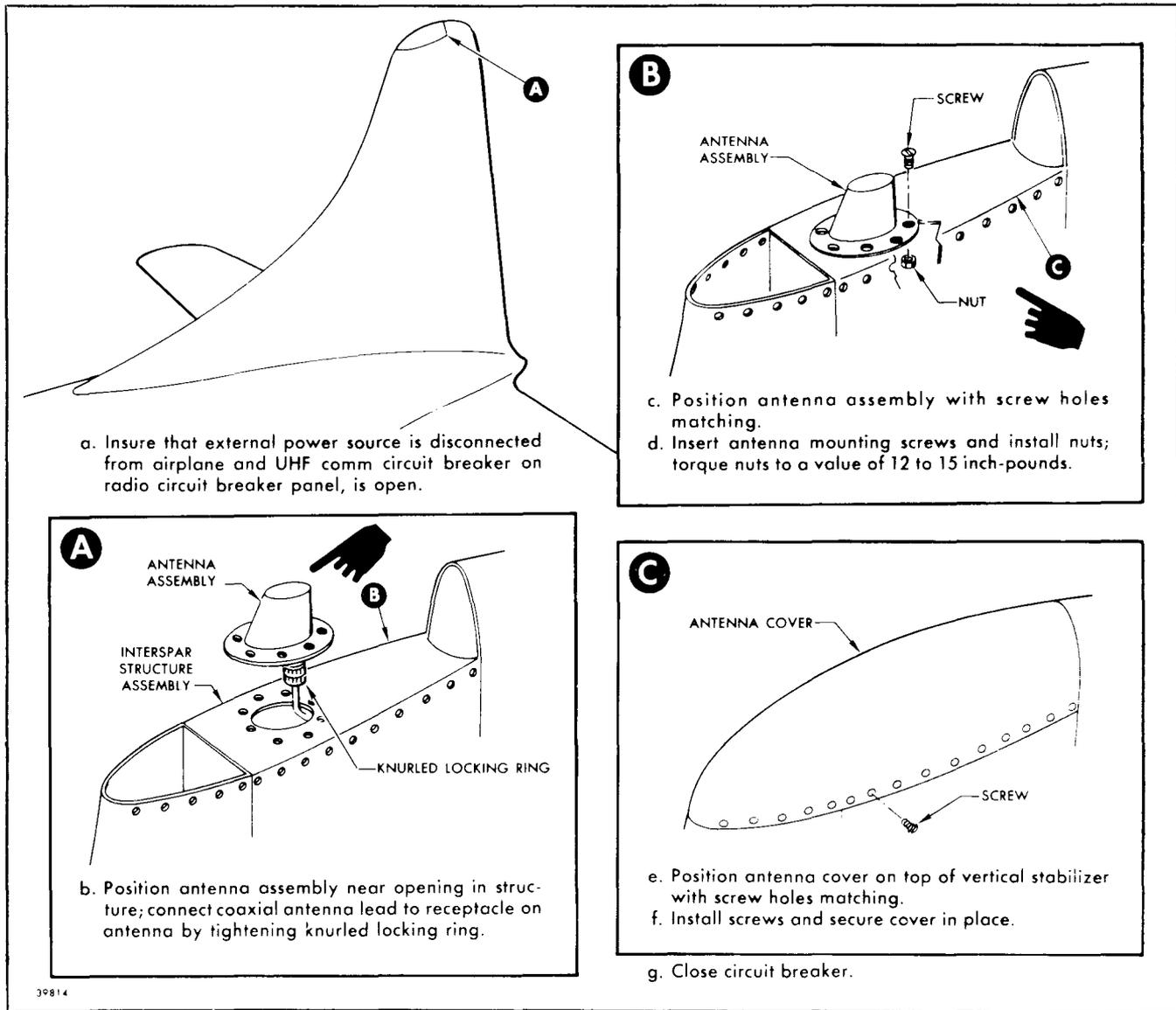


Figure 5-7. UHF Command Radio Antenna Installation

**5-27. UHF COMMAND RADIO RECEIVER-TRANSMITTER SENSITIVITY, ADJUSTMENT.**

See figure 5-6. The front panel of the receiver-transmitter contains a separate sensitivity control for the main channel receiver and the guard channel receiver. The sensitivity controls must be set in the following manner:

- a. Equipment must be in a normal operating condition; perform operational check-out; refer to paragraphs 5-13 and 5-14.
- b. Adjust MAIN REC SENS control to a point just

below position at which squelch opens on highest gain channel of all channels to be used. This frequency channel should be in vicinity of 280 to 360 megacycles. If MAIN REC SENS control is set too high, receiver noise will operate squelch, and a hissing sound, characteristic of thermal noise, will be heard in headset.

- c. Place T/R-T/R+G-ADF switch, located on main control panel, in T/R-G position.

- d. Adjust GUARD REC SENS control to a point just below position at which squelch opens.

**SERVICING**

**5-28. UHF COMMAND RADIO SET SERVICING.**

Refer to Section I for information on radio equipment servicing.

## Section V-A

### HF LIAISON RADIO SET COLLINS 18S-4

<i>Contents</i>	<i>Page</i>
Description .....	58A
Operational Check-Out .....	58F
System Analysis .....	58H
Replacement .....	58J
Adjustment .....	58K
Servicing .....	58K

#### DESCRIPTION

#### 5A-1. GENERAL.

See figures 5A-1 and 5A-2. The HF liaison radio set Collins 18S-4 is installed in *T-29C Model Airplanes incorporating TCTO IT-29C-508*. Radio set 18S-4 provides AM radio telephone (A-3) and CW (A-1) communication between aircraft and ground stations, or between aircraft. Radio telephone service may be used on any one of 10 preselected channels in the frequency range 2.0 to 18.5 megacycles. CW service may be used down to 3.5 megacycles. A total of 20 frequencies may be preset by using two crystals in each channel, provided the crystals in a given channel are not more than one percent apart in basic frequency. The pilot and copilot can select frequencies and class of service. Receiver primary power

and a transmitter filament "keep alive" circuit are controlled from the pilots' radio set control panel. Transmission and reception are on the same frequency at any given time, and both the receiver and the transmitter utilize a single antenna. An antenna tuner matches the output circuit of the transmitter to the antenna. Power to the 18S-4 radio set is supplied by the 28-volt dc essential bus and by the 115-volt, 400 cycle ac regulated system. Installation of radio set 18S-4 results in the relocation of AN/APN-70 (LORAN) antenna couplers No. 1, 2, and 5. The existing radio code key, type J-37 located on the radio operator's table, is utilized in the HF liaison radio set installation.

#### 5A-2. HF LIAISON RADIO SET, COLLINS 18S-4, LIST OF COMPONENTS.

ITEM	LOCATION	FUNCTION
Receiver-transmitter, Collins 18S-4.	Cabin floor, between stations 109 and 131, right-hand side.	To transmit and receive HF radio signals.
Mounting, 350C-5.	Cabin floor, between stations 109 and 131, right-hand side.	To provide vibration isolation and power connections for transmitter-receiver.
Antenna Tuner, 180L-2.	Radio equipment rack, top shelf.	To automatically match antenna to 52-ohm output circuit of the transmitter.

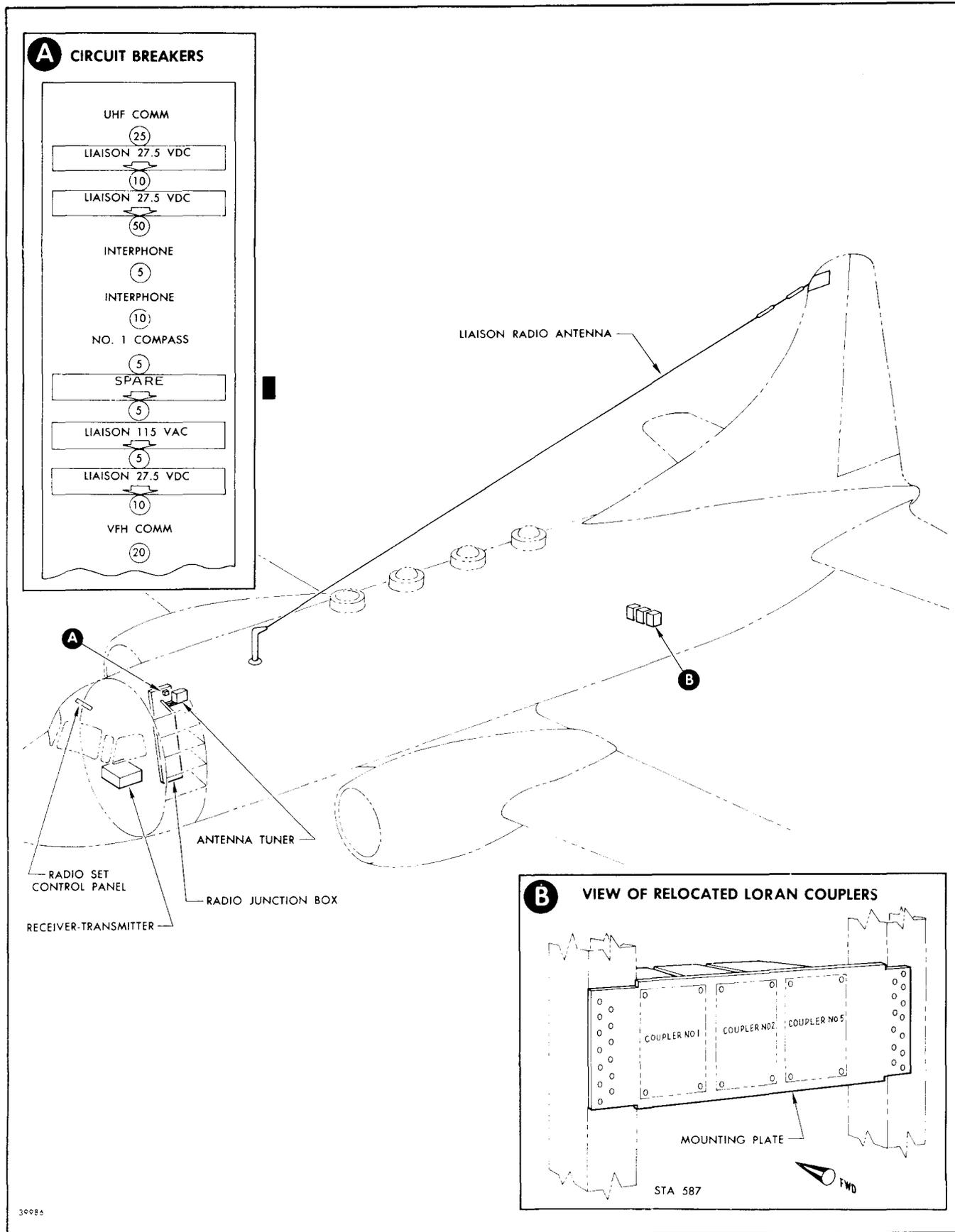


Figure 5A-1. HF Liaison Radio Set, Collins 185-4, Perspective

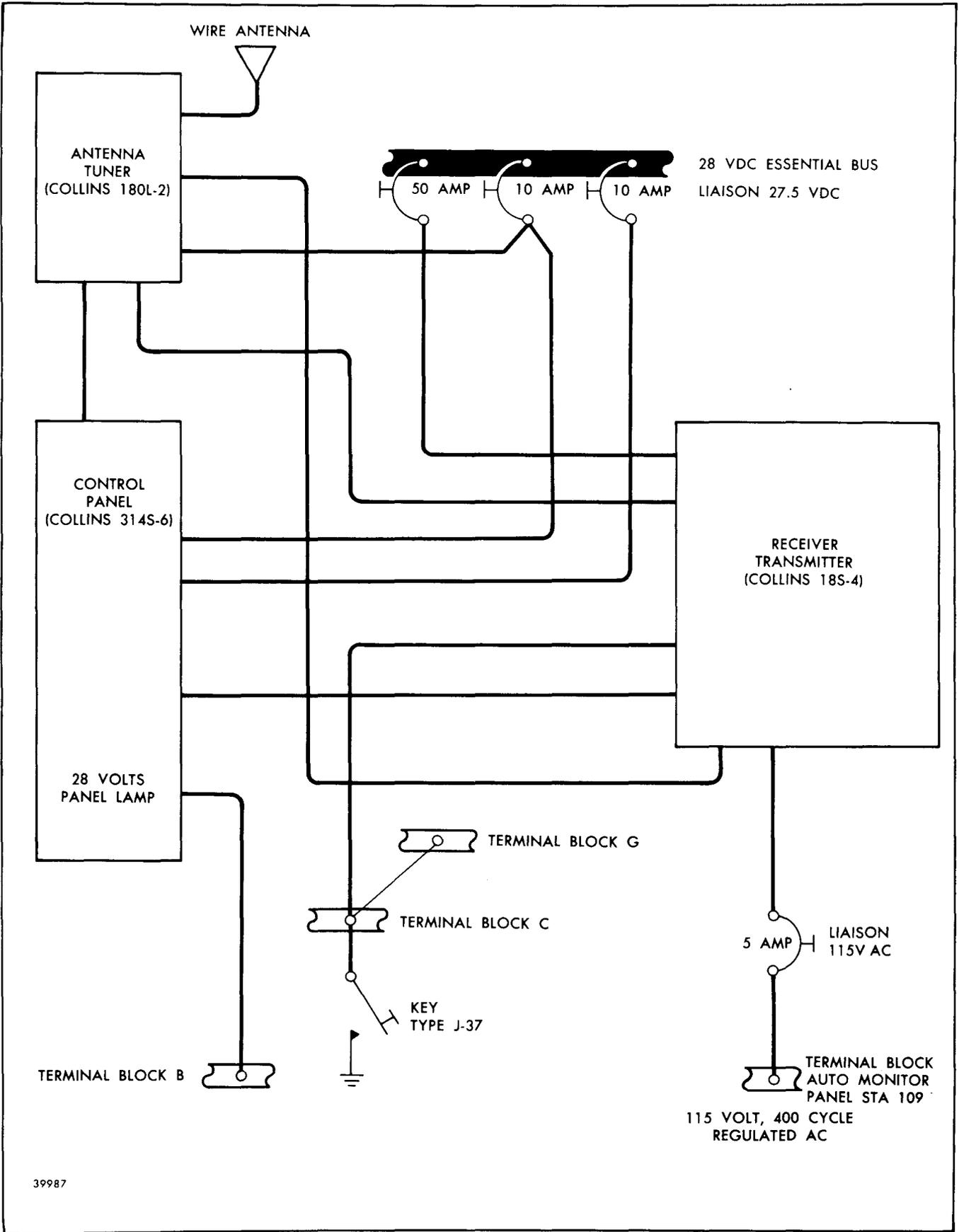


Figure 5A-2. HF Liaison Radio Set (Collins 185-4) Block Diagram

**5A-2. HF LIAISON RADIO SET, COLLINS 185-4, LIST OF COMPONENTS (Cont).**

ITEM	LOCATION	FUNCTION
Mounting 350D-3.	Radio equipment rack, top shelf.	To provide vibration isolation for antenna tuner.
Radio set control panel 314S-6.	Pilots' overhead switch panel.	To provide power control, selection of service, channel selection, and volume and tone control.
Circuit Breaker, 50 ampere, LIAISON 27.5V DC.	Radio circuit breaker panel.	To protect circuit from overload.
Circuit Breakers (2), 10 ampere, LIAISON 27.5V DC.	Radio circuit breaker panel.	To protect circuit from overload.
Circuit Breaker, 5 ampere, LIAISON 115V AC.	Radio circuit breaker panel.	To protect circuit from overload.

**5A-3. HF LIAISON RADIO SET RECEIVER-TRANSMITTER.**

The HF radio set receiver-transmitter provides AM radio telephone (A-3) and CW (A-1) communication between aircraft and ground stations, or between aircraft. The receiver and transmitter sections are contained in a single case and are mounted on a single main chassis. Other major components of the receiver-transmitter are the exciter unit, selector switch assembly, and the dynamotor which are removable as individual units. The front panel contains the RF output connection, a removable dust cover which houses the final amplifier tuning capacitors and network switches, a multipurpose meter, microphone and headset jacks, and a meter selection switch. Handles are provided at the sides of the receiver-transmitter to aid in removing and carrying the assembly. The receiver-transmitter case is secured by two Dzus fasteners at the rear of the assembly. The dynamotor is held in position by a flexible strap that is secured by captive screws. A felt ring closes the gap between the dynamotor air intake and a vented area of the main case to provide efficient cooling. The center dust cover is removable after actuating four snapslide fasteners.

**5A-4. HF LIAISON RADIO RECEIVER-TRANSMITTER MOUNTING.**

See figure 5A-3. The HF radio receiver-transmitter mounting (Collins 350C-5) provides shock vibration isolation and main power and control connections. Four shock vibration isolators and ground straps are provided on the bottom side of the mounting. The mounting includes a main power and control cable terminal strip in a rear enclosure and side access plates for other power and control cables. Two multicontact connectors are located on the rear frame to mate with fixed plugs on the receiver-transmitter. A "keep-alive" resistor on the top

of the rear enclosure maintains the transmitter filaments in a partly energized condition during standby. Two compression-ejection levers at the front of the mounting fit over the receiver-transmitter carrying handles in the compression position and are secured by safety wire pins. Two knurled fasteners fit over lugs on the bottom of the receiver-transmitter to secure it to the mounting.

**5A-5. HF LIAISON RADIO SET ANTENNA TUNER.**

See figure 5A-4. The HF radio set antenna tuner matches the output circuit of the transmitter to the aircraft antenna at selected frequencies. Power and control connections to the antenna tuner are made through a multi-contact fixed plug which extends through the front panel. An antenna connector, 52-ohm RF line connector, and SWR indicator also are installed in the front panel.

**5A-6. HF LIAISON RADIO SET ANTENNA TUNER MOUNTING.**

See figure 5A-4. The HF radio set antenna tuner mounting provides four vibration isolators and ground straps. Knurled fasteners at the front of the mounting tighten adjustable clamps into a flange on the base plate of the antenna tuner against fixed flanges at the rear of the base plate and mounting.

**5A-7. HF LIAISON RADIO SET CONTROL PANEL.**

See figure 5A-5. The HF radio set control enables the pilot or copilot to select service and channels and to control pitch of received CW signals, signal strength, and application of primary power to the receiver and the transmitter "keep-alive" filament circuits. The functions of the panel controls are as follows:

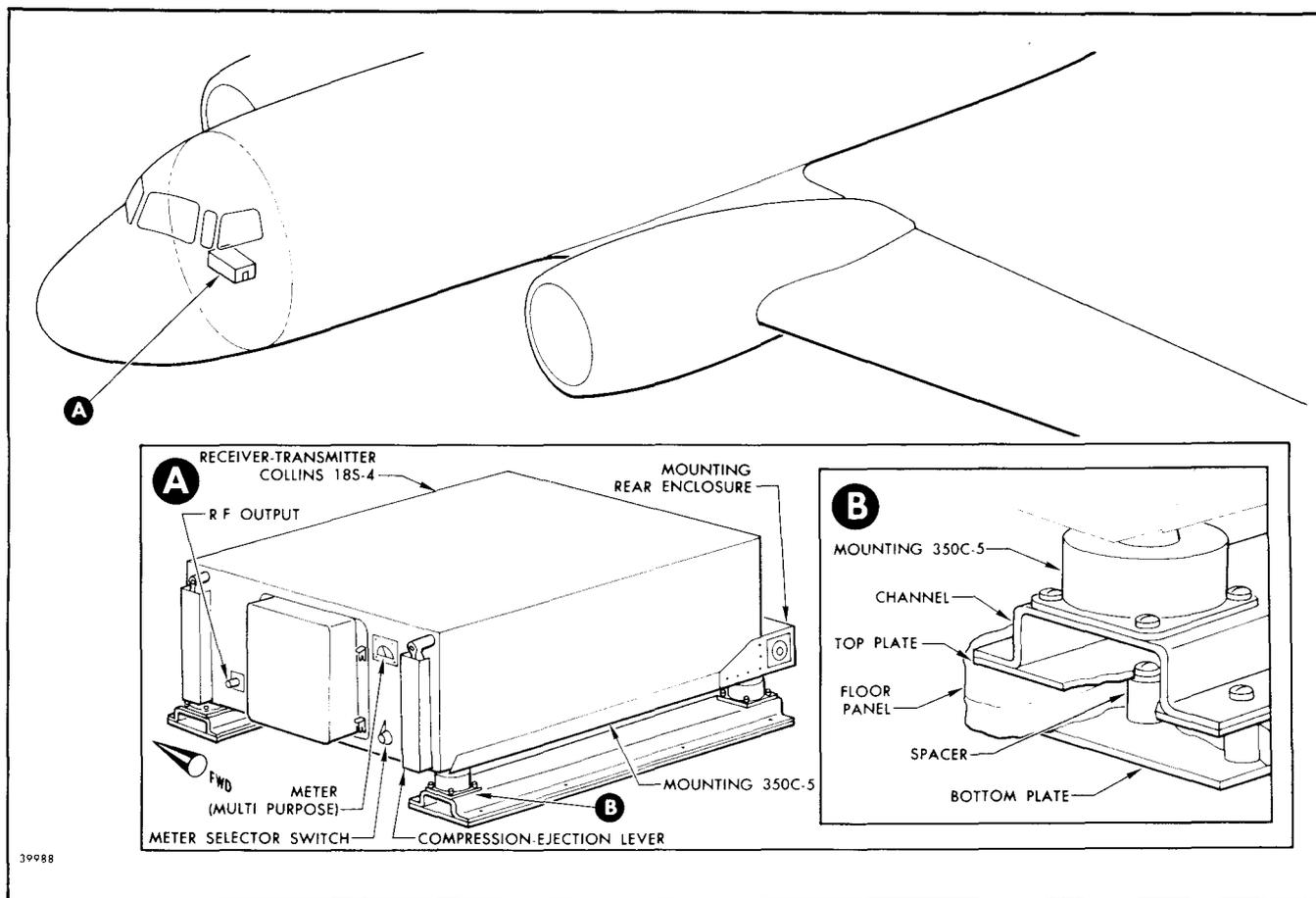


Figure 5A-3. HF Liaison Radio Receiver-Transmitter, Collins 185-4, Perspective

5A-7. HF LIAISON RADIO SET CONTROL PANEL (Cont).

CONTROL	POSITION	FUNCTION
Function Selector Switch.	CW.  STDBY.  PH.	To supply power to receiver-transmitter, so that receiver produces CW signal reception when key is open.  To maintain receiver on for reception of CW.  To maintain receiver-transmitter on for voice reception with push-to-talk button of microphone not depressed. Operation of push-to-talk button closes transmitter relays, applies full filament voltages, starts dynamotor to provide transmitter high voltage, and transfers antenna to transmitter.
CHANNEL Selector Switch.	1 to 20.	To select any one of 20 possible operating frequencies.
POWER ON-OFF Switch.	ON-OFF.	To control primary power to the receiver-transmitter and to the "keep-alive" filament circuits.

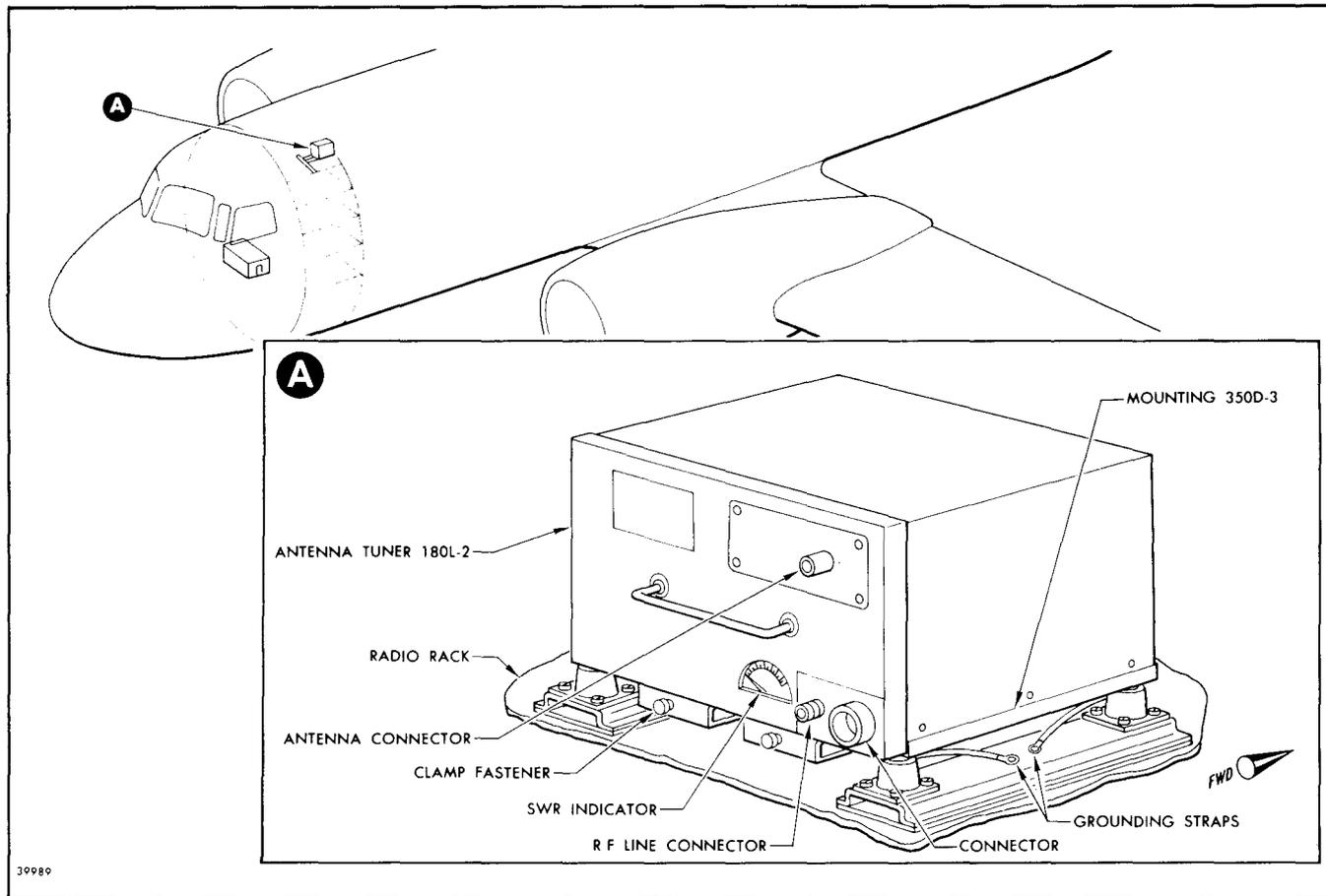


Figure 5A-4. HF Liaison Radio Set Antenna Tuner, Perspective

**5A-7. HF LIAISON RADIO SET CONTROL PANEL (Cont).**

CONTROL	POSITION	FUNCTION
BFO Control.	Knob.	To adjust pitch of receiver CW signals.
VOL Control.	Knob.	To adjust signal strength.

**5A-8. HF LIAISON RADIO SET ANTENNA.**

See figure 5A-1. The HF radio set utilizes the liaison radio antenna which has been modified to remove the

automatic shorting relay from the vertical stabilizer. Both the receiver and the transmitter utilize the single antenna.

**OPERATIONAL CHECK-OUT**

**5A-9. TEST EQUIPMENT REQUIRED.**

None.

**5A-10. HF LIAISON RADIO SET COLLINS 185-4, PREPARATION FOR OPERATIONAL CHECK-OUT.**

a. Make certain that the static ground cable on the left-hand main landing gear is installed properly and is touching the ground.

b. Connect an external dc power source to the airplane as instructed in T.O. 1T-29A-2-10 and observe all applicable precautions.

c. Energize ac regulated power system as instructed in T.O. 1T-29A-2-10 and observe all applicable precautions.

d. Verify that the three LIAISON 27.5V DC and the LIAISON 115V AC circuit breakers are closed.

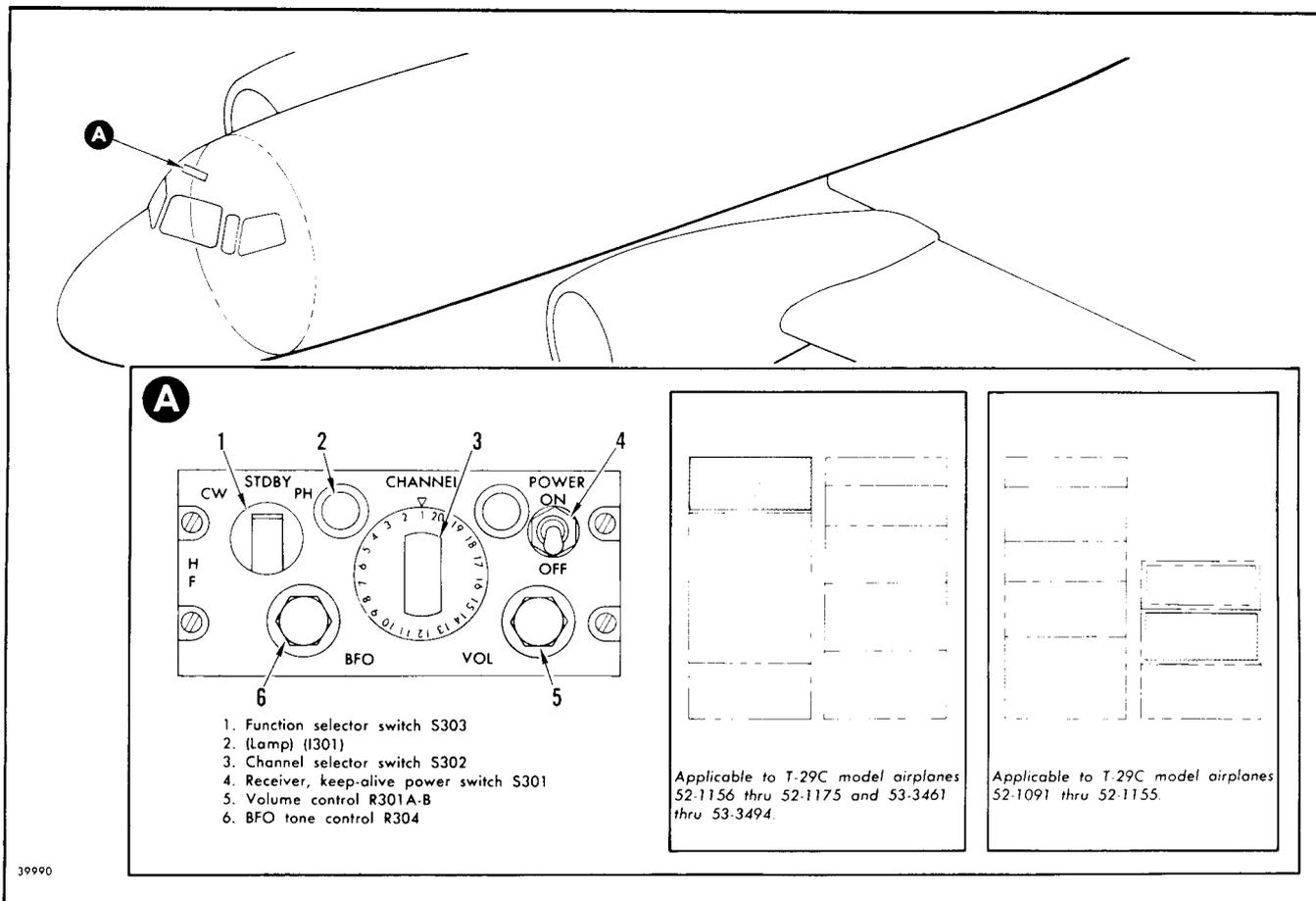


Figure 5A-5. HF Liaison Radio Set Panel Control

e. Check security of antenna and terminal connections at the antenna tuner.

f. Check security of receiver-transmitter and antenna tuner mountings. Verify that mountings are grounded properly.

g. Check cable connectors and tighten locking rings by hand if necessary. Inspect cables for broken wires or loose connections at terminals.

h. Verify that microphones, headset, and key cords are securely in place.

#### 5A-11. HF LIAISON RADIO SET, COLLINS 18S-4, OPERATIONAL CHECK-OUT.

a. Locate the airplane outside hangar during actual transmission and reception tests.

b. Perform operations outlined in paragraph 5A-10.

c. Set CW-STDBY-PH switch to STDBY and place POWER ON-OFF switch ON at control panel. Allow time for equipment to warm up.

d. Set BATTERY VOLTAGE-P.A. GRID-P.A. PLATE switch on the receiver-transmitter front panel to BATTERY VOLTAGE. The meter on the panel should indicate in the red area of its scale.

e. Set CW-STDBY-PH switch to STDBY and operate

CHANNEL switch on panel control to appropriate frequencies. Allow 5 to 15 seconds for channel selector mechanisms to operate. Listen for CW signals on appropriate frequencies. Regulate pitch and volume with BFO and VOL controls on panel control.

f. Set CW-STDBY-PH switch to CW. Operate the BATTERY VOLTAGE-P.A. GRID-P.A. PLATE switch to P.A. GRID and P.A. PLATE positions alternately, pressing the key while the switch is in each position. The dynamotor should operate continuously. The panel meter should indicate in the red area of its scale each time the key is pressed. Operate CHAN selector switch to all appropriate frequency selection positions and repeat current indication tests. CW signal sidetone should be reproduced in headsets.

g. Set CW-STDBY-PH switch to PH. Repeat current indication tests given in step d. Operate push-to-talk button of a microphone to operate the transmitter. Conduct tests over the entire appropriate frequency range.

#### NOTE

Cycling indication sidetone should be produced in the headsets during the automatic antenna tuning cycle.

**CAUTION**

The maximum duty cycle of the antenna tuner is five minutes "RF ON", followed by five minutes "RF OFF". Do not exceed this cycle during the operational test.

h. The SWR indicator on the panel of the antenna tuner may vary in indication during channel selection cycles, but the indicator should remain at 3.5 or lower when transmitting on any channel and generally will drop to an indication of 2 or lower.

i. When tactical restrictions permit, check the complete system by two-way communication with a ground station or with another aircraft.

j. Make certain that the transmitter can be controlled by microphone and key at the pilot's station.

k. Deenergize ac regulated power system as instructed in T.O. 1T29A-2-10 and observe all applicable precautions.

l. Disconnect external dc power source from airplane as instructed in T.O. 1T-29A-2-10 and observe all applicable precautions.

**SYSTEM ANALYSIS**

**WARNING**

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must observe safety precautions at all times. Turn power off prior to working on equipment and disconnect power from the airplane. Do not replace components of the system with the power supply on. Under certain

conditions dangerous voltages may exist in some circuits, even when the power supply is off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

**5A-12. SYSTEM TROUBLE ANALYSIS.**

System trouble analysis frequently can be performed without removing the radio set components from the airplane. If trouble becomes apparent during the operational check-out, the nature of the fault may be determined by checking the troubleshooting chart, paragraph 5A-13.

**5A-13. HF LIAISON RADIO SET, COLLINS 185-4, TROUBLESHOOTING.**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>NO SIGNAL OUTPUT FROM RECEIVER.</b>		
No primary power.	Check power supply.	Repair power supply.
Defective headset.	Test with operative headset.	Replace headset.
Broken cabling, loose connectors.	Inspect cabling.	Repair or replace cables.
Antenna short-circuited.	Test circuit.	Repair circuit.
Defective tubes.	Test tube.	Replace tube.
Defective crystal.	Test crystal.	Replace crystal.
<b>WEAK SIGNAL OUTPUT FROM RECEIVER.</b>		
Low plate voltage.	Check power supply.	Repair power supply.
Defective tube.	Test tube.	Replace tube.
<b>RECEIVER NOISY.</b>		
Loose connections.	Inspect connections.	Repair connections.

**5A-13. HF LIAISON RADIO SET, COLLINS 185-4, TROUBLESHOOTING (Cont).**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
Defective tube.	Test tube.	Replace tube.
<b>RECEIVER OSCILLATES DURING VOICE RECEPTION.</b>		
Broken ground connection.	Inspect ground connection.	Repair connection.
Defective tube.	Test tube.	Replace tube.
<b>CHANNEL SELECTOR SYSTEM INOPERATIVE.</b>		
Low primary power.	Check power supply.	Repair power supply.
Broken cabling, loose connectors.	Inspect cables.	Repair or replace cables.
Defective motor.	Test motor.	Repair or replace motor.
Defective channel selector switch.	Test switch.	Replace switch.
<b>DYNAMOTOR INOPERATIVE.</b>		
Low primary power.	Check power supply.	Repair power supply.
Defective brushes.	Inspect brushes.	Replace brushes.
Open winding.	Test winding.	Replace tube.
<b>EXCESSIVE PA PLATE CURRENT.</b>		
Defective crystal.	Test crystal.	Replace crystal.
Defective oscillator, power amplifier tube.	Test tube.	Replace tube.
<b>ABNORMAL PA PLATE CURRENT WITH NORMAL PA GRID CURRENT.</b>		
Antenna open, short-circuited.	Test circuit.	Repair circuit.
<b>NO PA GRID CURRENT.</b>		
Defective crystal.	Test crystal.	Replace crystal.
Defective oscillator tube.	Test tube.	Replace tube.
PA grid circuit open.	Test circuit.	Repair circuit.

**REPLACEMENT****WARNING**

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must observe safety precautions at all times. Turn power off prior to working on

equipment, and disconnect power from the airplane. Do not replace components of the system with the power supply on. Under certain conditions, a dangerous residual voltage may exist in some circuits, even when the power supply is off, because of charges retained by capacitors. Always ground any circuit prior to handling components of the circuit.

**5A-14. SPECIAL TOOLS REQUIRED.**

None.

**5A-15. HF LIAISON RADIO SET COLLINS  
18S-4, MAJOR COMPONENTS, REPLACEMENT.**

Refer to Section I for the general instructions for removal and installation of radio equipment.

**5A-16. HF LIAISON RADIO SET  
RECEIVER-TRANSMITTER, REMOVAL.**

See figure 5A-3.

- a. Remove safety wire pins from compression-ejection levers.
- b. Loosen the two knurled locking nuts on the forward beam of the mounting.
- c. Open locking levers by pulling down from receiver-transmitter carrying handles.
- d. Disconnect plug from J-105 on receiver-transmitter.
- e. Slide the receiver-transmitter forward, disengaging the two multiconnector plugs, and carefully remove the unit from the mounting.

**5A-17. HF LIAISON RADIO SET RECEIVER-  
TRANSMITTER, INSTALLATION.**

See figure 5A-3.

**5A-18. HF LIAISON RADIO SET ANTENNA  
TUNER, REMOVAL.**

See figure 5A-4.

- a. Disconnect two plugs and antenna connector from antenna tuner.
- b. Loosen the two knurled fasteners at the forward edge of the mounting base plate until the clamps are disengaged.
- c. Lift the antenna tuner from the mounting base plate.

**5A-19. HF LIAISON RADIO SET ANTENNA  
TUNER, INSTALLATION.**

See figure 5A-4.

- a. Set the rear flange of the antenna tuner under the rolled edge at the rear of the mounting.
- b. Tighten the two knurled fasteners on the clamps at the forward edge of the mounting base plate until the clamps are fully engaged in the front flange of the unit. Install lockwire in the knurled fasteners.
- c. Connect two plugs and antenna connector to the antenna tuner.

**5A-20. LIAISON RADIO SET ANTENNA,  
REMOVAL AND INSTALLATION.**

See figure 5A-6. After installing antenna wire, tighten wire from 40 to 60 pounds tension by means of the antenna tension unit.

**ADJUSTMENT**

**5A-21. HF LIAISON RADIO SET, COLLINS  
18S-4, ADJUSTMENT.**

No adjustments should be made to the HF liaison radio set, Collins 18S-4, by organizational personnel.

**SERVICING**

**5A-22. HF LIAISON RADIO SET, COLLINS  
18S-4, SERVICING.**

Refer to Section I for servicing requirements of radio equipment.

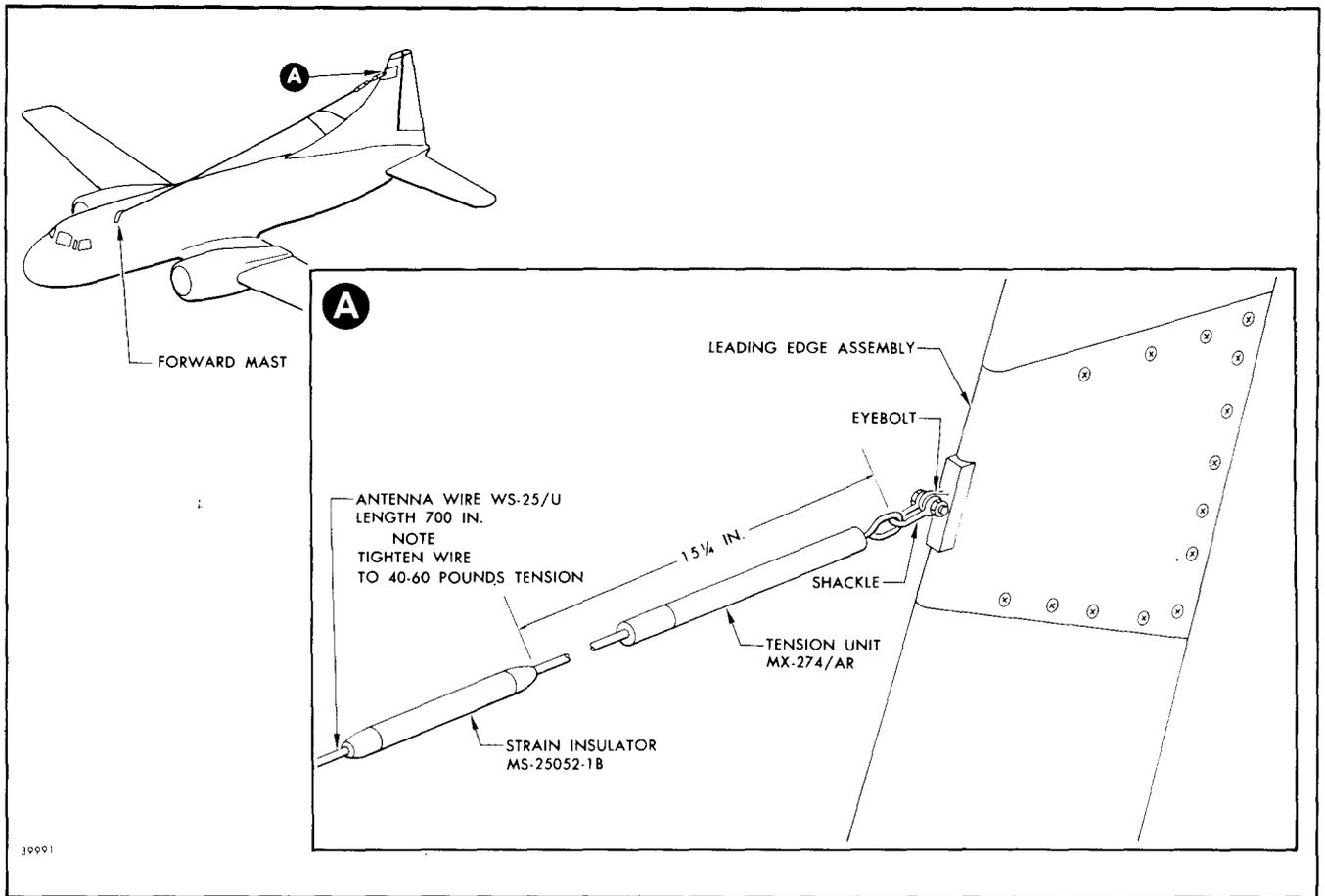
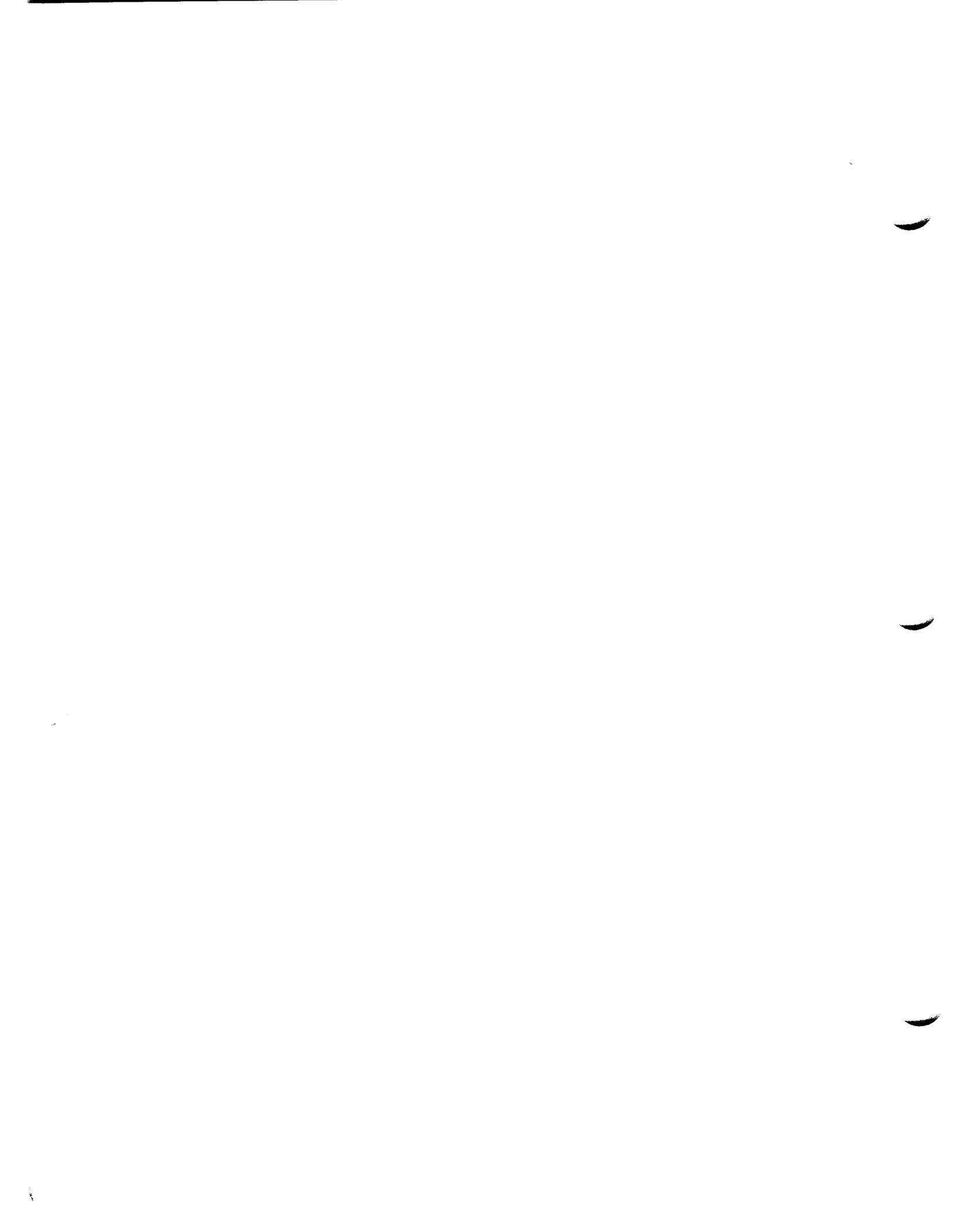


Figure 5A-6. HF Liaison Radio Set Antenna



**SECTION VB****COLLINS HF 103 COMMUNICATIONS SYSTEM****5B-1. GENERAL DESCRIPTION AND LEADING PARTICULARS.**

5B-2. Collins HF103 communications system is used for long range radio telephone communications. The system provides either conventional amplitude modulation (AM) or single side band (SSB) modes of operation. The SSB mode, which concentrates more power into the sideband and suppresses the carrier, may be used to communicate with stations having SSB capability. The AM mode provides less side band power but enables communications with stations not having SSB capability. Any one of 28,000 frequency channels can be selected from the control panel. The channels are spaced at 1-kilohertz (KHZ) intervals in the frequency range of 2.00 to 29.999 megahertz (MHZ). The system is designated HF No. 2. Each system is protected by two 28-volt dc circuit breakers (one 35 ampere and one 10 ampere) and one 115 VAC 5 ampere circuit breaker. Main components of the system are: Receiver - Transmitter 618T-3, Automatic Antenna Tuner 180L-3, Control Panel 714E-2, and HF Antenna. Components of the HF communication system are shown in figure 5B-1. The transceiver is located in rack shelf assembly No. 2 in radio equipment section. Antenna coupler is located in the electrical equipment rack. Control panel is located in the overhead console.

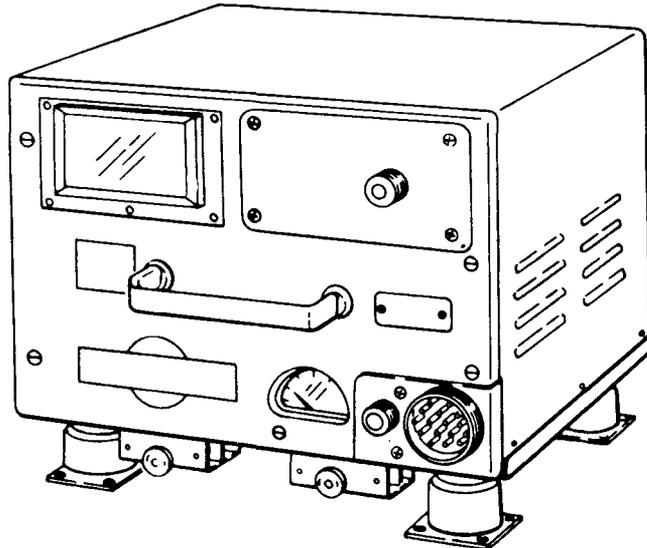
5B-3. SYSTEM OPERATION. The operation of the system is controlled from the remote control panel located in the overhead console. A rotary switch is used to energize the system and select type of operation. An off position de-energizes the system. In the USB (upper sideband) position the system operates as an SSB carrier suppressed system using only the upper sideband. In the AM position, the upper sideband and carrier are used to provide a signal which is equivalent of an AM signal. Four dials control the frequency selection for either SSB or AM operation. A direct digital readout of the operating frequency is provided in a window above the dials. The frequencies between 2.00 and 29.999 MC can be selected. AN RF SENS (sensitivity) control varies the gain of the RF amplifiers in the receiver. The receiver audio output is applied to the interphone system.

5B-4. OPERATIONAL CHECKOUT. The operational checkout of the HF communications system will require two men.

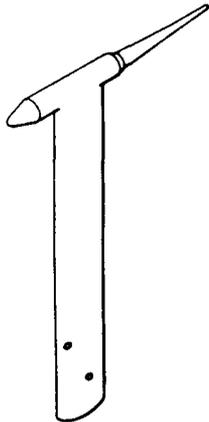
**NOTE**

Reception and transmission on the HF communications system is dependent on the inter-communications system. Therefore, perform this check during or after the operational checkout of the inter-communication system.

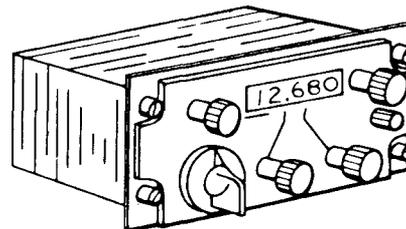
- a. Connect an external dc power source to aircraft.
- b. Position load-monitor-override switch to override, inverter switch to main.
- c. Close HF receiver, HF transmitters, HF Liaison, and interphone circuit breakers on radio junction box.
- d. Position Photo Intercomm Switch to inter and liaison.
- e. Rotate the HF function selector switch to AM on the HF control panel. Allow 3 to 5 minutes warmup.
- f. Adjust the frequency selector knob on the HF control panel to obtain a digital readout of 2 MC.
- g. Depress microphone button to talk; release microphone button to listen.
- h. Key transmitter, VSWR meter on HF Automatic tuner should read less than 2. The VSWR meter may vary in reading during tuning cycles but should rest at 2 or lower during transmission.
- i. Repeat steps (f) through (h) for frequencies of 8, 13, 18, and 24 MC.
- j. Rotate the HF function selector switch to USB.
- k. Select a minimum of 16 stations at points representing the entire band; eight with the selector switch in the USB position and eight with the switch in the AM position.



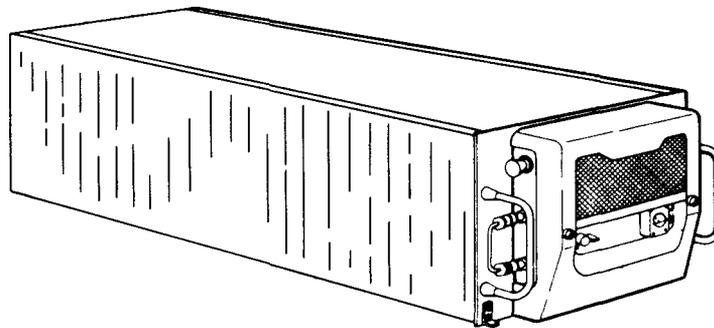
AUTOMATIC ANTENNA TUNER 180L-3



HF ANTENNA MAST



714E2-CONTROL



618T-3 TRANSCEIVER

Figure 5B-1. HF (618T-3SSB) Command Communication Equipment Location Diagram.

RESULT. The receiver will tune to each of the above stations, in turn, as noted by background noise in the receiver (RF SENS control rotated to the maximum clockwise position).

l. Rotate the function selector switch on the HF control to the AM position. Select a channel that may be heard for testing transmissions and contacting an available HF radio station.

RESULT. Speech (sidetone) should be heard in pilot's headset during transmission. Reception should be clear.

m. At the radio equipment rack, while HF transmitter is transmitting, turn the test meter selector switch on the transceiver to each of the following positions and observe the test meter readings.

SWITCH POSITION	TYPICAL READINGS
28V	Red Area
130V	Red Area
PAMA	300 MA
1500V	Red Area

n. Repeat step (l) with HF control selector switch in the USB position.

o. Turn all switches off.

p. Disconnect external power.

5B-5. REMOVAL AND REPLACEMENT. All HF-2 communications systems are mounted with conventional hardware and interconnected with standard hardware (except for the antenna) and require no special removal and replacement instructions. Be careful to align mating connectors before seating components in their mounting racks. Make sure that electrical bonding straps are reconnected and connectors safety wire is replaced when components are installed.

**5B-6. TROUBLESHOOTING HF COMMAND COMMUNICATIONS EQUIPMENT (618T3).**

5B-7. To receive and transmit on the HF communication system, the aircraft intercommunication system must be energized and operating properly. Power is supplied to the HF communication system through three circuit breakers located on the radio junction box circuit breaker panel.

**5B-8. TROUBLESHOOTING PROCEDURES.**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>ENTIRE SYSTEM INOPERATIVE</b>		
HF circuit breaker(s) open	Check circuit breakers	Close circuit breaker(s)
Fault in intercommunication system	Check reception and transmission at the transceiver using phone and M/C jack provided	Repair fault in intercommunication system
Defective transceiver	Check transceiver test meter for correct reading (see step m paragraph 5B-4) Select other transceiver channels to see if set operates properly on any channel.	Replace transceiver.
Defective Antenna Coupler	Check for proper indications of VSWR meter on coupler as shown in step h paragraph 5B-4.	

## 5B-8. TROUBLESHOOTING PROCEDURES (CONT)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
RECEPTION NORMAL BUT NO TRANSMISSION.		
Fault in intercommunication system	Check transmission at the transceiver using MC jack as provided.	Repair fault in intercommunication system.
Defective transceiver	Check transceiver test meter for correct reading. (see step m paragraph 5B-4) Select other transceiver channels to see if set operates properly on any channel.	Replace transceiver
Defective antenna coupler.	Check for proper indications of VSWR meter on coupler as shown in step h paragraph 5B-4.	Replace antenna coupler.
TRANSMISSION NORMAL BUT NO RECEPTION.		
Fault in intercommunication system	Check reception at the transceiver using phone jack provided	Repair fault in intercommunication system
Defective transceiver	Check transceiver test meter for correct reading (see step m paragraph 5B-4) Select other transceiver channels to see if set operates properly on any channel.	Replace transceiver
Defective antenna coupler.	Check for proper indications of VSWR meter on coupler as shown in step h paragraph 5B-4.	

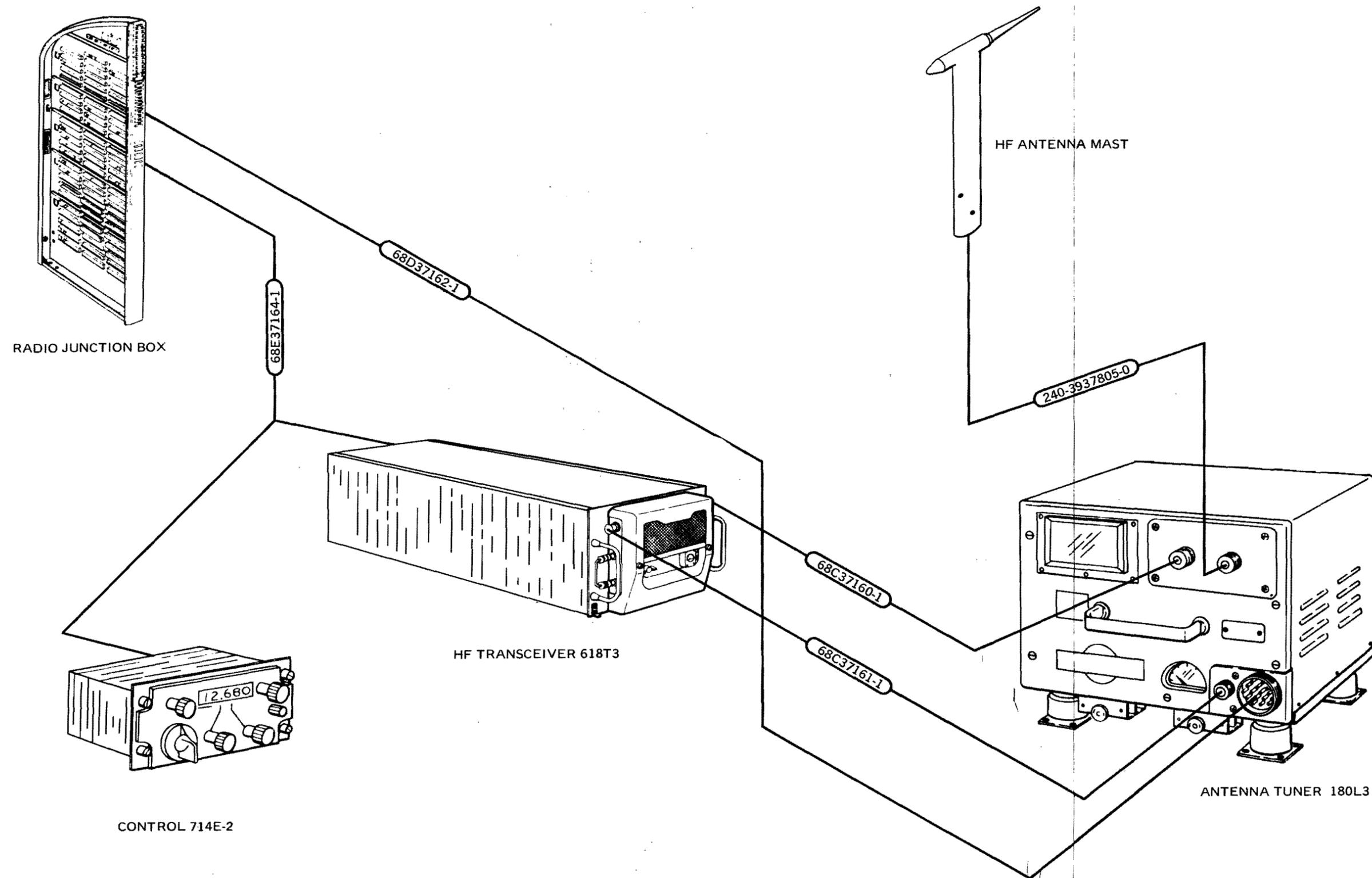


Figure 5B-2. HF(618T-3 SSB) Communications Cabling Diagrams

## Section VI

### LIAISON RADIO SET AN/ARC-8

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#### DESCRIPTION

#### NOTE

*This section is applicable to all T-29A and T-29B model airplanes except serial No. 51-5144.*

#### 6-1. GENERAL.

See figures 6-1 and 6-2. The pilots' liaison radio set AN ARC-8 is composed of a receiver, a transmitter, and accessory equipment for high frequency, long-range, two-way radio communication. The set provides voice, modulated continuous wave (mcw) telegraphy, or continuous wave (cw) telegraphy. Although the receiver and transmitter are separate units, they are interconnected by a monitor switch which makes it possible to monitor transmitted signals through the receiver. The interconnection of the receiver and the transmitter

forms a complete liaison radio set. The receiver is manually controlled by the radio operator, but the transmitter can be controlled from the pilots' overhead switch panel or at the transmitter itself. The receiver can be operated with the transmitter either on or off, if neither the key nor a microphone switch is depressed. Audio input and output for the equipment are obtained through the airplane interphone system and utilize the same headphones and microphone for reception and transmission as are used for intercommunication in the airplane. Refer to Section II for complete details of the interphone system.

#### 6-2. LIAISON RADIO SET, AN/ARC-8, LIST OF COMPONENTS.

ITEM	LOCATION	FUNCTION
Transmitter, T-47(A) ART-13.	Radio equipment rack.	To transmit liaison radio signals.
Mounting, MT-284 ART-13.	Radio equipment rack.	To provide a shock mounting for transmitter.
Receiver, BC-348.	Radio equipment rack.	To receive liaison radio signals.
Mounting, FT-154.	Radio equipment rack.	To provide a shock mounting for receiver.

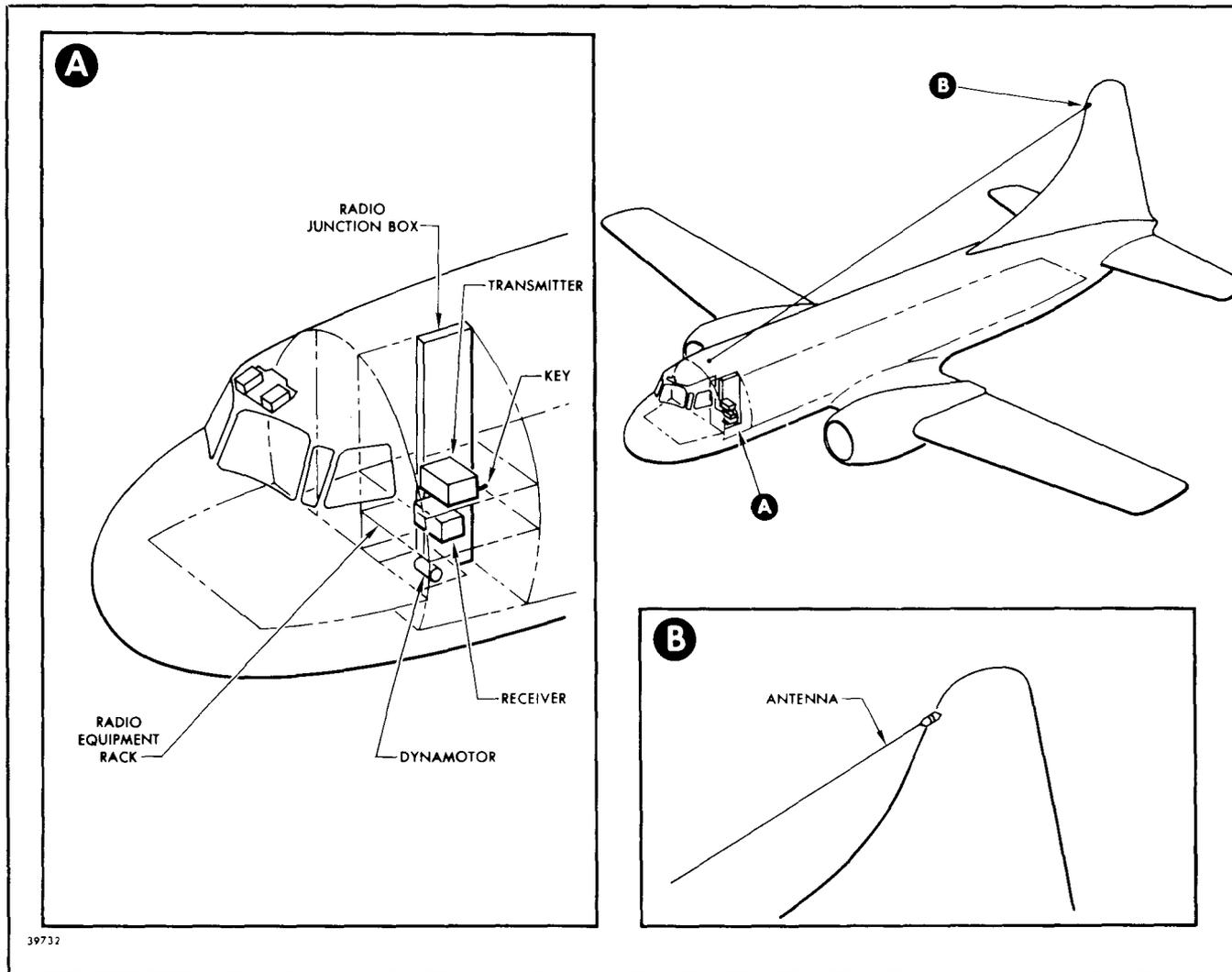
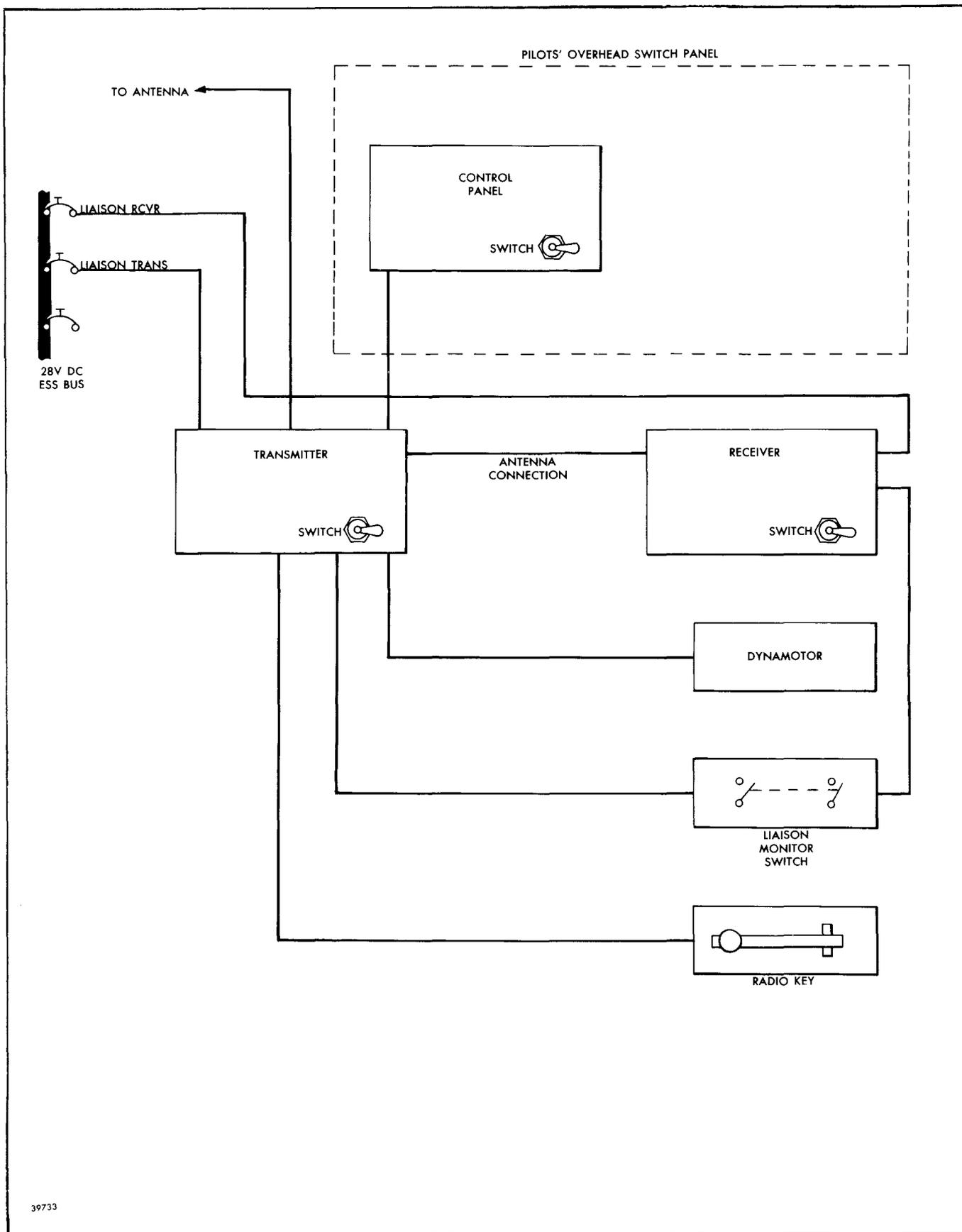


Figure 6-1. Liaison Radio Set (AN ARC-8) Perspective

ITEM	LOCATION	FUNCTION
Switch, MONITOR SWITCH, MONITOR-NORMAL.	Radio circuit breaker panel.	To monitor transmitted signals through receiver.
Dynamotor, DY-17/ART-13(A).	Radio equipment rack.	To provide high voltage to radio transmitter.
Mounting, MT-164/ART-13.	Radio equipment rack.	To provide a shock mounting for dynamotor.
Key.	Top of radio operator's table.	To send I.M.C. signals.
Control panel, C-405A/A.	Pilots' overhead switch panel.	To control liaison radio transmitter.



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Figure 6-2. Liaison Radio Set (AN/ARC-8) Block Diagram

ITEM	LOCATION	FUNCTION
Liaison wire antenna.	Top of fuselage to vertical stabilizer.	To receive and transmit signals.
Circuit breaker, 50 ampere, LIAISON TRANS.	Radio circuit breaker panel (essential equipment).	To protect transmitter set circuit.
Circuit breaker, 5 ampere, LIAISON RCVR.	Radio circuit breaker panel (essential equipment).	To protect receiver set circuit.

### 6-3. TRANSMITTER, T-47(A)/ART-13.

See figure 6-3. The transmitter provides transmission frequencies in the range of from 2000 to 18,100 kilocycles, using a variable frequency oscillator. The low frequency and high frequency oscillators are electron-coupled with no provision made for crystal control of the frequency of either oscillator. Therefore, a crystal controlled frequency standard has been incorporated in the equipment for the calibration of the variable frequency oscillators. Calibration tables are required to calibrate the transmitter. Refer to T.O. 12R2-2ART-13-1 for calibration tables. The transmitter includes components which provide radio transmission of voice, modulated continuous wave telegraphy (mcw), or continuous wave telegraphy (cw). Using VFO (variable frequency oscillator) operation, shifting from one transmission frequency to another can be accomplished by the conventional method of hand positioning the controls (with CHANNEL selector in MANUAL) or by using the built-in automatic shifting mechanism—known as the Autotune. Autotune operation, either local or remote, is available for ten preselected frequencies in the range of 2000 to 18,100 kilocycles. When the transmitter is in use at altitudes over 20,000 to 25,000 feet, the power is automatically reduced by about one-half to prevent arcing or flashover. A 28-volt dc power source is required for operation of the transmitter. Voltages as low as 24 volts can be used but reduction in power output and increased time for Autotune operation will result.

### 6-4. DYNAMOTOR.

See figure 6-4. The dynamotor unit is the power source used for the operation of the radio transmitter. The unit contains a dynamotor, barometric switch, control and overload relays, filters and fuse for overload protection of the plate and screen voltage supply circuits

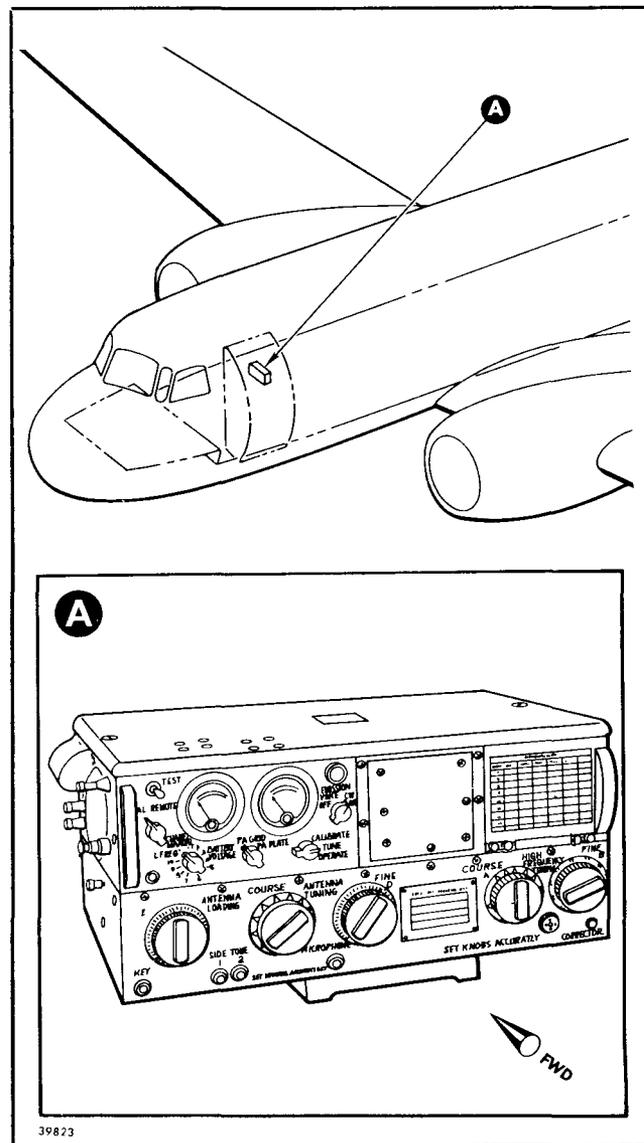


Figure 6-3. Radio Transmitter (T-27A/ART-13)  
Perspective

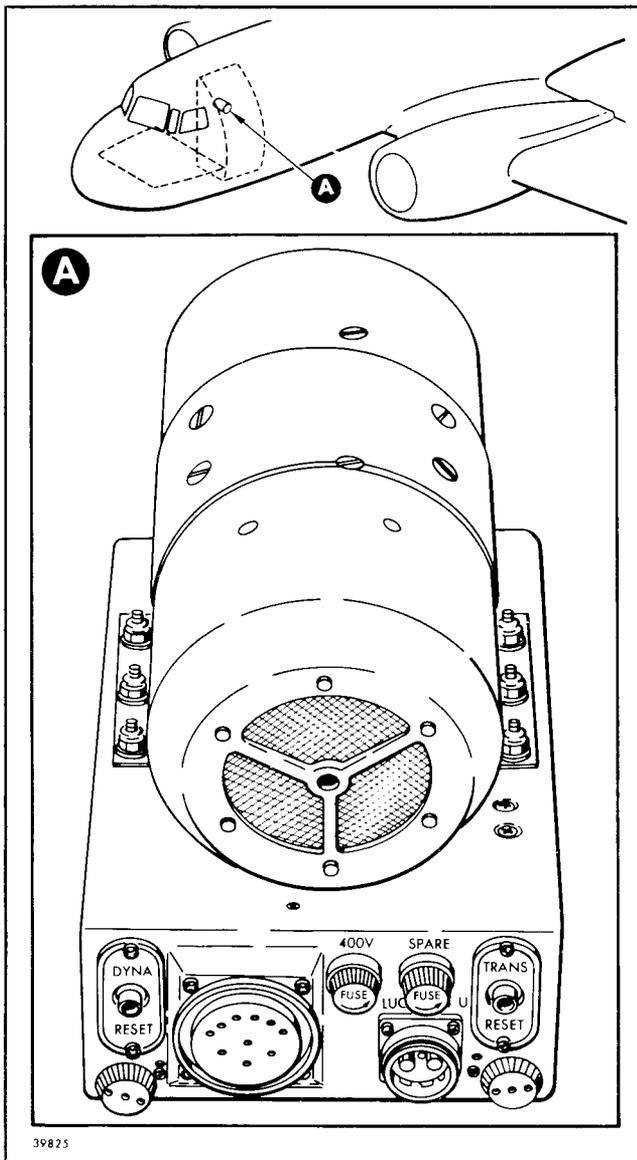


Figure 6-4. Dynamotor Unit (DY-17/ART-13A) Perspective

of the low power stages. A 28-volt dc power source is required for operation of the dynamotor as well as for the circuits in the transmitter.

**6-5. RECEIVER, BC-348.**

See figure 6-5. On T-29A model airplanes, receiver BC-348R or Q is used, and on T-29B model airplanes, receiver BC-348R, B, C, M, O, P, or Q is used. These models are essentially alike; therefore reference will be made throughout this section to receiver BC-348. The receiver is a locally controlled eight-tube, six band superheterodyne receiver which receives power from the 28-volt dc essential bus. No features are provided for remote operation. The receiver is capable of voice, tone, and cw reception with manual or automatic volume control. All coils and high voltage power supply

units are built into the receivers. The total power consumed by the receiver is 56 watts. A dowel pin fastened to the receiver chassis prevents accidental installation of a 14-volt dynamotor in this 28-volt receiver. The following panel items are mounted on the front of the panel: antenna and ground binding posts; an antenna alignment control marked ANT ALIGN; dial lights rheostat control marked DIAL LIGHTS; a tuning control marked TUNING; a band switch control marked BAND SWITCH; a dial window housing which covers the dial lights; a beat frequency control marked BEAT FREQ; a crystal filter control marked OUT-CRYSTAL-IN; a volume control marked INCREASE VOL; a volume control selector switch marked AVC-OFF-MVC; a C.W. OSC control; and two telephone jacks marked TEL. The entire receiver cabinet is attached to a mounting by means of studs and snapslides. The receiver covers the frequency range from 0.2 to 0.5 megacycles (200 to 500 kilocycles) and from 1.5 to 18.0 megacycles. These frequencies are covered by six bands, which are under control of a band change switch. The frequency range for each of the six bands is as follows:

Band	Frequency Range
1	0.2 to 0.5 MC
2	1.5 to 3.5 MC
3	3.5 to 6.0 MC
4	6.0 to 9.5 MC
5	9.5 to 13.5 MC
6	13.5 to 18.0 MC

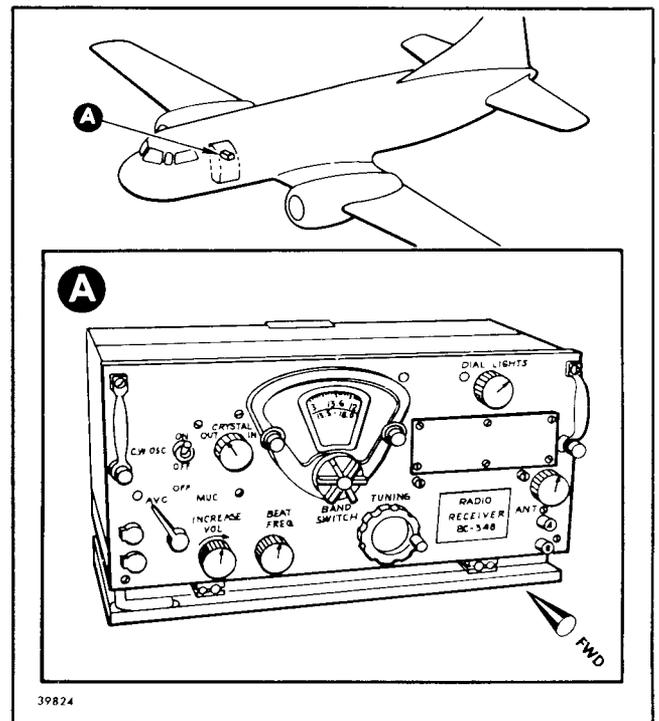


Figure 6-5. Radio Receiver (BC-348) Perspective

**6-6. LIAISON MONITOR SWITCH.**

A liaison monitor switch makes it possible to monitor the transmitted signals through the receiver, and removes the transmitter sidetone from the interphone circuit when monitoring. The interconnection of the transmitter with the receiver, by means of the monitor switch, forms a complete liaison radio set.

**6-7. KEY.**

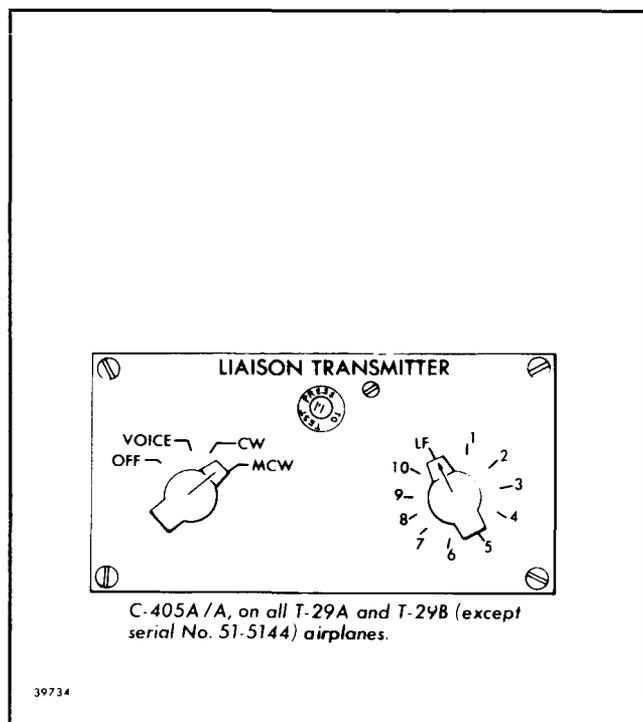
A liaison radio code key is provided for transmission of I.M.C. signals. With the transmitter set in either CW or MCW, operation of the key will effect transmission of signals through the transmitter.

**6-8. CONTROL PANEL, C-405A/A.**

See figure 6-6. The control panel, C-405A/A, used with radio transmitting set AN/ART-13, provides control of the transmitter from the pilots' overhead switch panel when the transmitter LOCAL-REMOTE switch is in REMOTE. One knob on the control panel permits the power supply to be turned on or off and selects the type of emission (VOICE, CW, MCW). A second knob

operates the Autotune and permits selection of any one of ten preset frequency channels. A pilot lamp on the control panel operates when the emission selector switch is in any position other than OFF. The pilot lamp will light only when control is from the remote position. If Autotune is in process of changing the transmission frequency, the pilot lamp will remain off until the Autotune cycle is completed.

6-9. DELETED.



6-10. DELETED.

Figure 6-6. Liaison Transmitter Control Panel (C-405A/A)

## OPERATIONAL CHECK-OUT

### 6-11. TEST EQUIPMENT REQUIRED.

None.

### 6-12. PREPARATION OF SYSTEM FOR OPERATIONAL CHECK-OUT.

#### WARNING

Operation of this equipment involves the use of voltages which are dangerous to life. Personnel must at all times observe safety precautions. Do not replace components of the system with the power supply on. Under certain conditions, a dangerous residual voltage may exist in some circuits, even when the power supply is off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

To energize the airplane dc electrical circuits with external power for ground operation, proceed as follows:

a. Ensure that the static ground cable on the left main landing gear is touching the ground. Connect an external power source to the external dc power receptacle, located forward of the main entrance door.

#### CAUTION

When using external power, the battery switch on the pilots' pedestal must remain in the OFF position to prevent power transfer between the external power source and the airplane battery.

b. Place DC VOLTMETER SELECTOR switch, on pilots' pedestal, to MAIN BUS, and check voltmeter for 28 volts.

c. Check to see that following circuit breakers on radio circuit breaker panel are closed; *on T-29A model airplanes*, LIAISON REC and LIAISON TRANS; *on T-29B model airplanes*, LIAISON RCVR and LIAISON TRANS.

#### NOTE

Some bases may have regulations relating to radio silence. These regulations must be checked before any transmission is permitted. These regulations will not affect the receiver checks.

### 6-13. GENERAL SYSTEM, PRE-OPERATIONAL CHECK.

a. Inspect interconnections for conformity to mock-up of particular installation.

b. Check knurled knobs on front of transmitter and dynamotor unit, microphone selector switch, and all connector plug locking rings, for presence of safety wiring.

c. Inspect antenna for proper security and tension—antenna must be taut.

d. Check connections to receiver, antenna ground and loading unit, making certain spring connector terminals are making good contact with wires.

e. Check all components for security of mounting.

### 6-14. RECEIVER, BC-348, OPERATIONAL CHECK-OUT.

a. Prepare for operational check-out; refer to paragraph 6-12.

b. Plug headset into radio operator's jack box. Place switch of jack box in liaison position.

c. Set receiver OFF-AVC-MVC switch in MVC position—dynamotor should start.

d. After a 30-second warm-up period, advance INCREASE VOLUME until a slight background noise is heard.

e. Set band switch to frequency band on which test signals are available and tune in desired signal.

#### NOTE

All tuning should be done with the OFF-AVC-MVC switch in the MVC position and with the INCREASE VOLUME control advanced only enough to give the desired signal strength. In the absence of a signal, the setting of the volume control can be determined by the loudness of the background noise. With the OFF-AVC-MVC switch in the MVC position, very strong signals will block the receiver and intelligible signals cannot be received.

f. Set OFF-AVC-MVC switch to AVC position—desired signal should still be heard.

g. Set CW OSC switch to ON position and set BEAT FREQ oscillator control with arrow pointing upward. An audible beat note should be heard which changes in pitch as BEAT FREQ dial is rotated.

h. Switch on all auxiliary equipment drawing power from radio receiver, BC-348. Repeat steps b through g., for one frequency band—radio receiver should operate with slightly reduced output.

**6-15. TRANSMITTER, AN/ART-13,  
OPERATIONAL CHECK-OUT.****NOTE**

No transmission will be made on emergency distress frequency channels except for emergency purposes. For testing, demonstration, or drill purposes, radio equipment will be operated into a non-radiating dummy load instead of an antenna.

a. Prepare system for operational check-out; refer to paragraph 6-12.

b. Check LOCAL-REMOTE switch on transmitter panel to make sure it is in proper position, according to whether operation is desired from transmitter panel or from pilots' overhead switch panel.

c. Turn on liaison receiver; place AVC-OFF-MVC switch in AVC position.

d. Place transmitter EMISSION switch on VOICE with antenna selector switch on FIXED ANT. Make sure the microphone selector switch is in position corresponding to type of microphone to be used. Place meter switch on P.A. PLATE and power level switch on OPERATE.

e. Place CHANNEL switch in a position corresponding to one of frequencies desired for testing. Normal frequency change by Autotune should be accomplished in less than 25 seconds, depending on temperature and power supply.

f. When cycle is completed, check settings of controls A, B, C, D, and E against readings on transmitter chart with the zero line of vernier scale on control B previously set so that it is directly above dial.

g. Place EMISSION switch on CW and close TEST switch. Plate current should indicate in area marked CW.

h. Place meter switch on P.A. GRID. Meter should indicate in area marked P.A. GRID. Release TEST switch and place meter switch on P.A. PLATE.

i. Place EMISSION switch on MCW.

j. Listen in sidetone circuit and close TEST switch. Receiver hiss should stop and sidetone signal should be heard. Plate current should be in or near area marked MCW. Release TEST switch.

k. Place EMISSION switch on VOICE. Press microphone button. Plate current should indicate about 20 or 30 higher than on CW. Speak or whistle into microphone. Plate current should read near area marked MCW and may read full scale on loud signals.

l. Check control settings against chart, P.A. GRID, and P.A. PLATE current on CW for each of other channels it is desired to check.

m. Check operation of Autotune on each of channels not set up by cycling Autotune into each in turn and making sure controls turn properly.

n. If remote operation is provided in installation, check operation of Autotune from it by cycling each channel in turn and checking setting of controls against transmitter chart for each channel set up. Check to see that controls turn properly on other channels. Check key on CW, and proper operation on MCW and VOICE from remote control unit on one channel.

o. Cycle transmitter into one of frequencies set up in high frequency range. Tune receiver for CW operation on that frequency. Set NORMAL-MONITOR switch on MONITOR position and turn power level switch on transmitter to CALIBRATE position. It should be possible to hear a beat note and to tune beat note to zero by rotating receiver dial. Return power level switch to OPERATE and NORMAL-MONITOR switch to NORMAL position.

p. Place CHANNEL switch on MANUAL and let Autotune cycle. All controls should move freely. Set control C on position 1, control A on 2, control B on 1910. Set power level switch on CALIBRATE position and listen in sidetone circuit. A beat note should be heard and it should be possible to tune it to zero by rotating control B. Replace power level switch on OPERATE position.

q. Return CHANNEL switch to position it was on originally and let Autotune cycle.

r. Turn transmitter and receiver off.

**6-16. DELETED.**

<b>SYSTEM ANALYSIS</b>
------------------------

**6-17. TRANSMITTER, T-47 ART-13, TROUBLE SHOOTING.**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>EQUIPMENT WILL NOT OPERATE WHEN TURNED ON.</b>		
Dynamotor brushes worn out.	If red indicator light is on, press DYNA-RESET button on front of dynamotor.	If dynamotor does not start, replace dynamotor.
Dynamotor overload relay open.	Press DYNA-RESET button on front of dynamotor.	Replace dynamotor if necessary.
LOCAL-REMOTE switch set on REMOTE position.	Check position of LOCAL-REMOTE switch.	Place LOCAL-REMOTE switch to LOCAL position.
Transmitter overload relay open.	Press TRANS. RESET button on dynamotor unit.	Replace transmitter if necessary.
Loose connections on AN/ART-13A equipment.	Check other equipment on same power source for operation.	Tighten loose connections.
Broken wire or loose connection in interconnecting cable.	Check circuit continuity; refer to applicable wiring data section.	Repair or replace faulty cable or connection; refer to applicable wiring data section.
<b>PILOTS' OVERHEAD CONTROL WILL NOT OPERATE EQUIPMENT.</b>		
LOCAL-REMOTE switch on transmitter in LOCAL position.	Check position of LOCAL-REMOTE switch. Switch must be in REMOTE position to operate.	If switch is in REMOTE position, replace control panel C-405A A.
Wiring defective.	Replace remote control panel.	Test and repair wiring; refer to applicable wiring data section.
<b>DYNAMOTOR STARTS MOMENTARILY WHEN DYNA-RESET BUTTON IS PRESSED.</b>		
Excessive current due to faulty part or short circuit in control panel C-405A/A.	Check transmitter operation with LOCAL-REMOTE switch in LOCAL.	Replace control panel C-405A A.
Short circuit in transmitter.	Check LIAISON TRANS. circuit breaker on radio circuit breaker panel.	Replace transmitter.
<b>NO RF POWER OUTPUT ON ANY FREQUENCY RANGE.</b>		
Control C is set between two numbered positions.	Unlock dial and rotate it back and forth through a small range while holding TEST switch closed.	Set carefully so that numbered position lines up with index line.
Fuse in 400 volt plate and screen supply is blown.	With power off, and circuit grounded, remove fuse from front of dynamotor power unit.	Replace fuse.
<b>ARCING OCCURS AT ALTITUDE HIGHER THAN 20,000 TO 25,000 FEET.</b>		
Pressure-operated switch in dynamotor not operating.	Use cw emission and hold telegraph key closed. At some altitude between 20,000 and 25,000 feet, marked reduction in antenna current should be noted.	Replace dynamotor unit.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>ARCING OCCURS AT ALTITUDE HIGHER THAN 20,000 TO 25,000 FEET (cont).</b>		
Defective insulation or improper spacing between parts.	With power off and circuit grounded, check area where arcing occurred for sharp pointed projections.	Replace transmitter.
<b>NO RF POWER OUTPUT ON ONE FREQUENCY RANGE; OPERATION ON OTHER FREQUENCY RANGES IS SATISFACTORY.</b>		
Control A or control C not set correctly.	Check alignment of numbered position lines with index lines.	Unlock dial and set controls correctly.
CALIBRATE-TUNE-OPERATE switch is not in operate position.	Check switch position.	Place switch in OPERATE position to obtain full rf power output.
VFO-XTAL switch improperly set.	Check switch position.	Place switch in XTAL position.
<b>AUTOTUNE SYSTEM WILL NOT OPERATE.</b>		
LOCAL-REMOTE switch is in wrong position.	Check switch position for applicable control being used.	Place LOCAL-REMOTE switch in proper position according to transmitter control or remote control.
Telegraph key, microphone switch, or TEST switch is closed.	Check positions of each key and switch.	Open switch or release key for Autotune to operate.
Overload relay on dynamotor power unit open.	Press RESET button labeled TRANS. RESET.	If overload relay continues to open, replace dynamotor.
Autotune mechanism.	Perform above checks. Autotune does not operate after above checks.	Replace transmitter.

**6-18. RECEIVER, BC-348, TROUBLE SHOOTING.**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>WEAK OR NO SIGNALS ALL BANDS RECEIVER.</b>		
Tripped circuit breaker.	Check circuit breaker LIAISON RCVR on radio circuit breaker panel for closed position.	Close circuit breaker.
Dynamotor not supplying sufficient power.	Check dynamotor power supply.	Replace dynamotor if power supply is normal.
Ground or short in circuit.	Check circuit for ground or short; refer to applicable wiring data section.	Repair circuit; refer to applicable wiring data section.
<b>WEAK OR NO SIGNALS ANY ONE BAND.</b>		
Faulty heterodyne oscillator in receiver unit.	Check circuit for grounds or shorts; refer to applicable wiring data handbook.	Replace receiver unit.

**6-19. DELETED.**

**REPLACEMENT****6-20. GENERAL INSTRUCTIONS FOR REMOVAL AND REPLACEMENT OF EQUIPMENT.**

Refer to Section I for general instructions for removal and replacement of equipment.

**ADJUSTMENT****6-21. TEST EQUIPMENT REQUIRED.**

None.

set AN/ARC-8 by organizational maintenance personnel.

**6-22. LIAISON RADIO SET, AN/ARC-8, ADJUSTMENT.**

No adjustments should be made to the liaison radio

6-23. DELETED.

**SERVICING****6-24. LIAISON RADIO SET, AN/ARC-8, SERVICING.**

Refer to Section I for servicing requirements of radio equipment.

**SECTION VII**  
**WEATHER RADAR SET AN/APN-158**

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**DESCRIPTION**

**NOTE**

This section applicable only to aircraft incorporating TCTO 1T-29D-531.

**7-1. GENERAL.**

Weather Radar (AN/APN-158) presents a weather map of the general sky area of approximately 120° around the nose of the aircraft and extending to a distance of 30, 60, or 150 nautical miles. The weather map, displayed as a visual presentation on the screen of the indicator, shows the location of potentially dangerous areas, such as thunderheads and hailstorms, in terms of distance and azimuth with respect to the aircraft. The radar set also provides a visual presentation of lakes, streams, cities, shorelines and mountains.

7-2. The R/T unit generates RF energy in the 9,375 mc region (X-Band). The RF energy is applied to the antenna which radiates the energy in a beam. The beam is scanned in a 120° pattern ahead of the aircraft at a rate of 60 scans per minute. Thunderstorms in the path of the radiated energy reflect part of the energy back to the antenna. This energy, received by the antenna, is coupled to the receiver portion of the R/T unit. The R/T unit and the synchronizer amplify and detect the RF energy and apply it to the indicator. The display on the indicator gives the pilot and co-pilot a visual indication of thunderstorms ahead of the aircraft. The location of the weather radar components are shown in figure 7-1.

**7-3. TABLE OF COMPONENTS.**

Each of the various components of Radar Set AN/APN-158 (figure 7-2) is identical with the corresponding component of Weather Radar System (Type WP-103) manufactured by Collins Radio Company. The major assemblies of Radar Set AN/APN-158, their location and function are listed below:

COMPONENT	LOCATION	FUNCTION
Receiver-Transmitter RT-711/APN-158	Radome Area	To transmit and receive the radar signals for display on the Azimuth-Range Indicator.
Synchronizer, Electrical SN-358/APN-158	Radome Area	To generate sweep signals synchronous with antenna azimuth, provide line-of-sight stabilization and range marker signals.
Indicator, Azimuth-Range IP-724/APN-158	Pilot's Instrument Panel	To present returned signals on PPI scope and indicate azimuth and range.
Antenna, AS-1520/APN-158 or AS-1642/APN-158	Radome Area	To transmit the pulses of RF energy and receive the returned target signals.
Control, Radar Set C-4881/APN-158	Radio Remote Control Panel	To provide the pilot a means of operating the radar from the cockpit.

**Table 7-1. Radar Set AN/APN-158 Components**

## 7-3. TABLE OF COMPONENTS. (CONT)

COMPONENT	LOCATION	FUNCTION
Mount, Receiver-Transmitter, MT-3068/APN-158	Radome Area	To provide a means of shockmounting the Receiver-Transmitter in the aircraft.
Mount, Synchronizer MT-3069/APN-158	Radome Area	To provide a means of shockmounting the Synchronizer in the aircraft.

Table 7-1. Radar Set AN/APN-158 Components (Continued)

## 7-4. RECEIVER-TRANSMITTER, RT-711/APN-158.

See figure 7-3. The R/T unit consists of a magnetron oscillator, a klystron local oscillator, a trigger generator, a mixer-duplexer, fault sensing circuits; a positive 250-volt power supply, a positive 27.5-volt power supply, a negative 27.5-volt power supply and a negative 700-volt power supply. The magnetron modulator employs ac charging of the pulse forming network and is used to trigger the magnetron. The trigger generator furnishes the trigger pulse for the thyatron in the magnetron modulator and furnishes a timing pulse for all other circuits in the radar system. The trigger generator receives a synchronizing signal from the modulator charging current, supplied by the 115-volt, 400 cps power source. A ferrite circulator and crystal protector,

which comprise part of the mixer-duplexer assembly, are used to protect the receiver crystals during transmitter pulse. In the receiver, the IF output of the balanced signal mixer is amplified in the IF preamplifier and applied to the IF amplifier in the synchronizer. An RF switch on the front of the unit removes high voltage from the modulator while furnishing input power to the trigger generator for test purposes.

## 7-5. SYNCHRONIZER ELECTRICAL SN-358/APN-158.

See figure 7-4. The IF signal received from the R/T unit is further amplified and detected in the synchronizer. The detected signal (video information) is amplified in the video amplifier module and applied to the indicator. The output

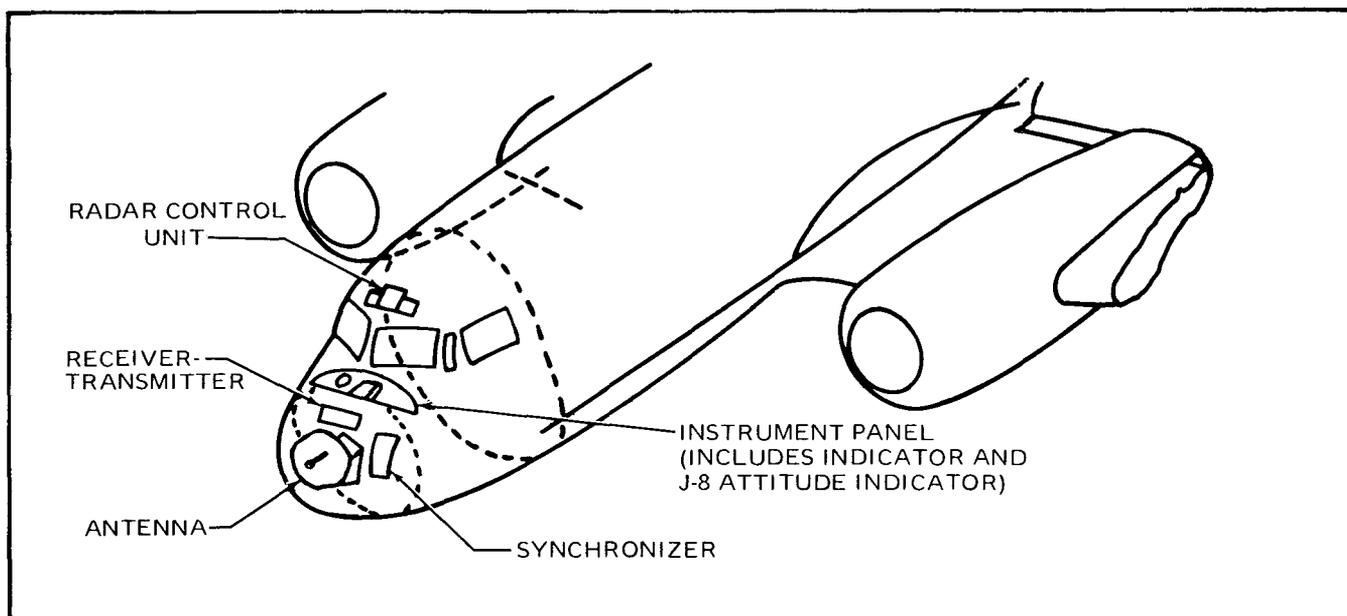


Figure 7-1. Location of Radar Set (APN-158) Components (Typical).

of the receiver local oscillator is also mixed with a portion of the output of the transmitter section of the R/T unit. This produces IF signals of about 30 mc. This IF signal is amplified in the synchronizer and applied to a 30 mc discriminator. The output of the discriminator is the automatic frequency control (AFC) signal which is applied back to the receiver portion of the R/T unit and keeps the local oscillator frequency exactly 30 mc above the transmitter frequency. A trigger pulse from the R/T unit is applied to the gate generator in the synchronizer. The gating pulse produced by the gate generator turns on the indicator tube during trace time and also turns on the synchronizer sweep generator. The signal produced by the synchronized sweep generator is applied to the deflection circuits in the indicator.

#### 7-6. AZIMUTH-RANGE INDICATOR.

See figure 7-5 and 7-6. The azimuth-range indicator is located on the instrument panel for viewing by both the pilot and co-pilot. The indicator receives video information from the synchronizer and displays this information on a long persistence cathode-ray tube in terms of azimuth and range. The indicator has four control knobs, the RANGE switch, which provides 30-, 60- or 150-mile sweep, the BACKGROUND switch, for adjustment of background noise level, the DIM tab, for dimming display for night viewing and the RED tab, for changing display to deep red for night viewing.

#### 7-7. ANTENNA.

See figure 7-8. The antenna is driven in azimuth  $60^\circ$  either side of dead ahead by the antenna azimuth drive motor. Azimuth sweep information is obtained from a resolver that is mechanically connected to the azimuth drive motor and applied to the synchronizer. The synchronizer amplifies and converts the azimuth sweep information to a sweep signal that produces the azimuth scan on the indicator tube. Pitch and roll signals, applied to the synchronizer from the aircraft gyro, are amplified in the synchronizer and applied to a resolver in the antenna. The resolver combines the pitch and roll signals into a composite stabilization signal. The tilt signal is applied to the synchro in the control unit and added to the manual tilt signal. The composite stabilization and tilt signals are combined in the synchronizer and amplified. The amplified tilt signal is then applied to the tilt motor in the antenna, which positions the antenna to compensate for aircraft pitch and roll.

#### 7-8. RADAR CONTROL UNIT.

The radar control unit controls three functions of the radar set: mode of operation, receiver gain and antenna tilt. The mode of operation is set by the RDR switch. Ground for the standby and operate relays in the R/T unit, radar and gyro power relays, and contour circuit (CTR) in the synchronizer is provided by the RDR switch on the control unit. The GAIN control on the control unit provides an adjustable bias voltage that controls the gain of the receiver preamplifier tubes in the R/T unit. Antenna tilt is

controlled by a synchro in the radar control unit: the synchro, in series with the tilt signal from the antenna, can tilt the antenna  $\pm 15^\circ$  with respect to the horizontal axis of the aircraft.

#### 7-9. MOUNT, RECEIVER-TRANSMITTER.

See figure 7-3. The R/T unit shockmount contains four shock isolators, a mating flange and a mating connector. The mating flange provides for connection between the R/T waveguide flange and the waveguide leading to the antenna mating flange. The mating connector provides for connection between the R/T electrical connector and the interconnecting cable harness.

#### 7-10. MOUNT, SYNCHRONIZER.

See figure 7-4. The synchronizer shockmount contains four shock isolators and a mating connector. The mating connector provides for connection between the synchronizer electrical connector and the interconnecting cable harness.

#### 7-11. PRIMARY POWER AND CONTROL CIRCUITS.

Primary power (28 VDC) is obtained from the essential dc bus located below the floor on left hand side at station 187. Primary power is applied to the inverters through the inverter ON/OFF switch located on the pilot's pedestal. The inverter output (115 VAC, 400 cps) is applied to the R/T unit through the radar control panel. Pitch and roll signals are applied to the synchronizer thru the impedance matching transformers located in the Autopilot Junction Box.

#### 7-12. RADAR POWER DISTRIBUTION.

Operating dc power for the radar set is generated in the R/T unit. Regulated power supplies, located in the R/T unit, provide +28, -28 and +250 volts. The regulated dc voltages are applied to the various components of the radar set. Operate and standby power (115 VAC, 400 cps), obtained from the inverters, is applied to the various components of the radar set through the operate and standby relays located in the R/T unit.

### OPERATIONAL CHECKOUT .

#### 7-13. TEST EQUIPMENT.

Before performing an operational checkout, refer to list of required test equipment below.

#### TEST EQUIPMENT REQUIRED

NAME	USE
Gyro Tilt Table	For pitch and roll axis stabilization check.
Multimeter ME-26A/U	As null indicator during stabilization checks.
Protractor-Level	Angle measurements during stabilization checks.

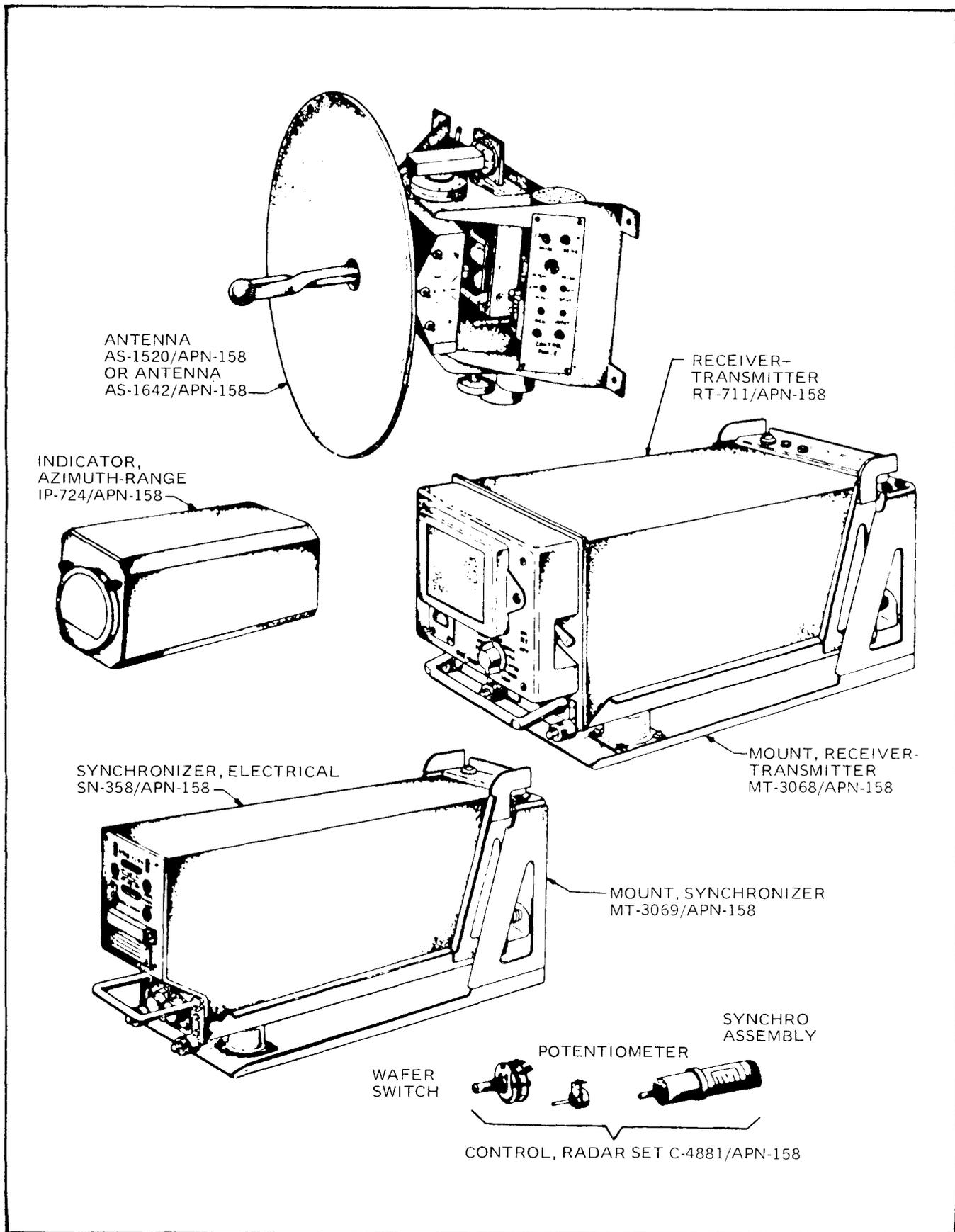


Figure 7-2. Radar Set AN/APN-158.

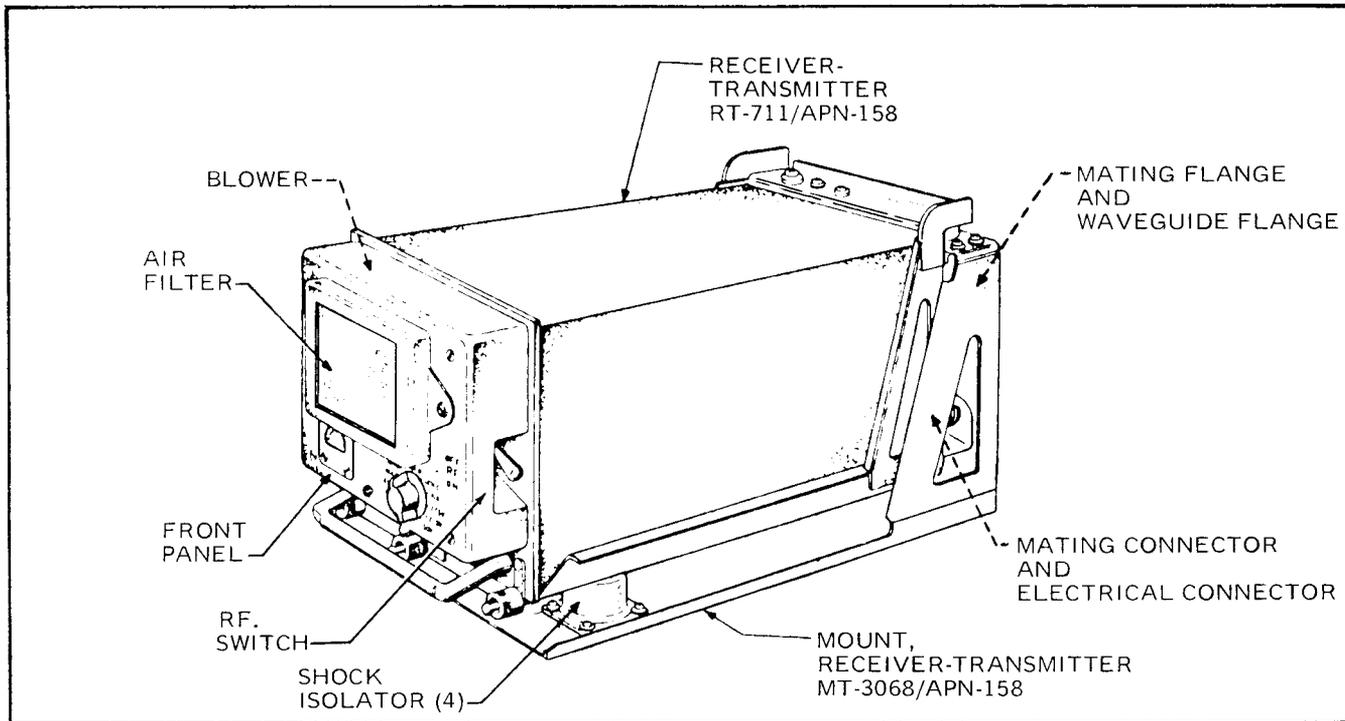


Figure 7-3. Receiver-Transmitter RT-711/APN-158 Installed in Mount, Receiver-Transmitter MT-3068/APN-158.

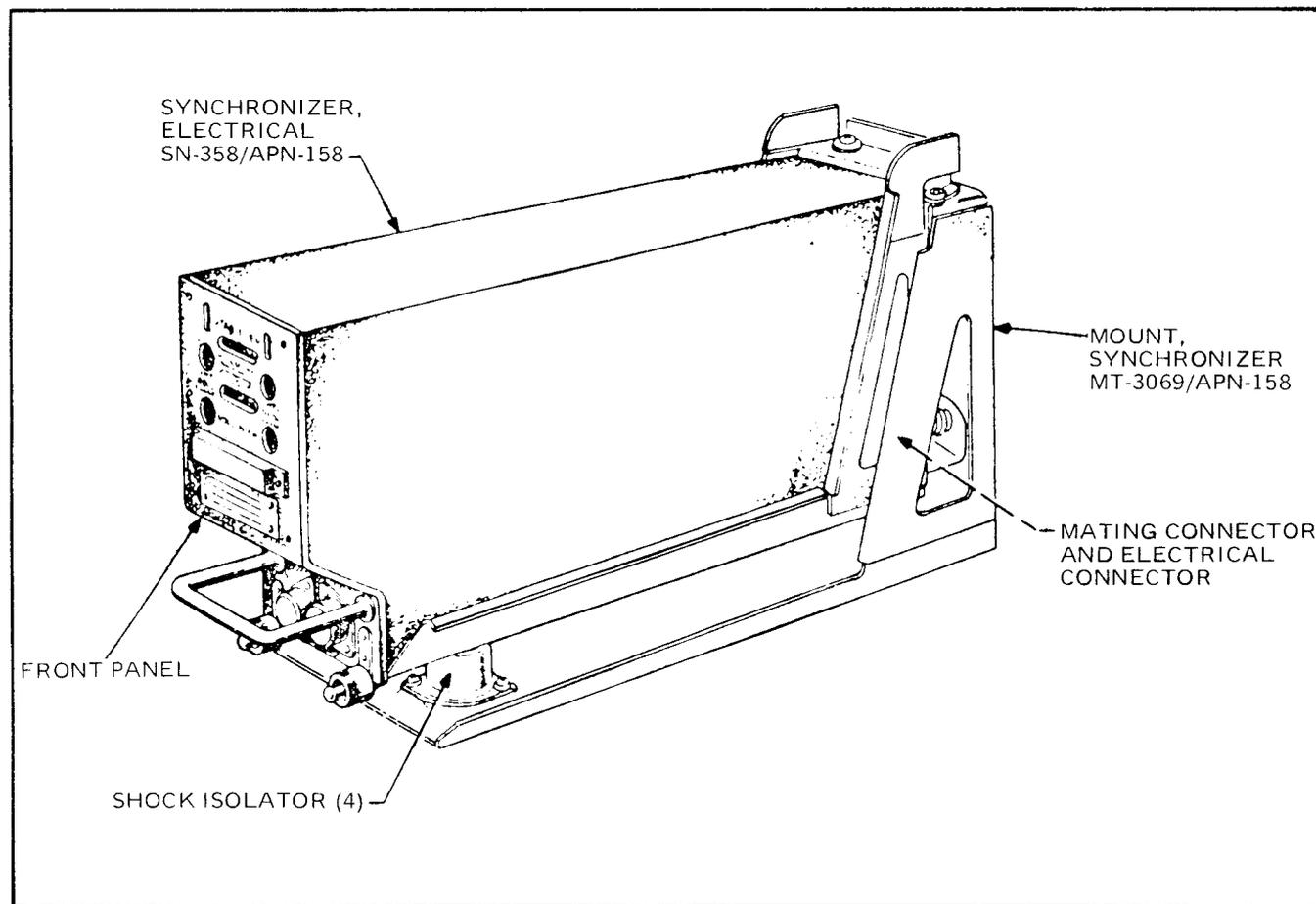


Figure 7-4. Synchronizer, Electrical SN-358/APN-158 Installed in Mount, Synchronizer MT-3069/APN-158.

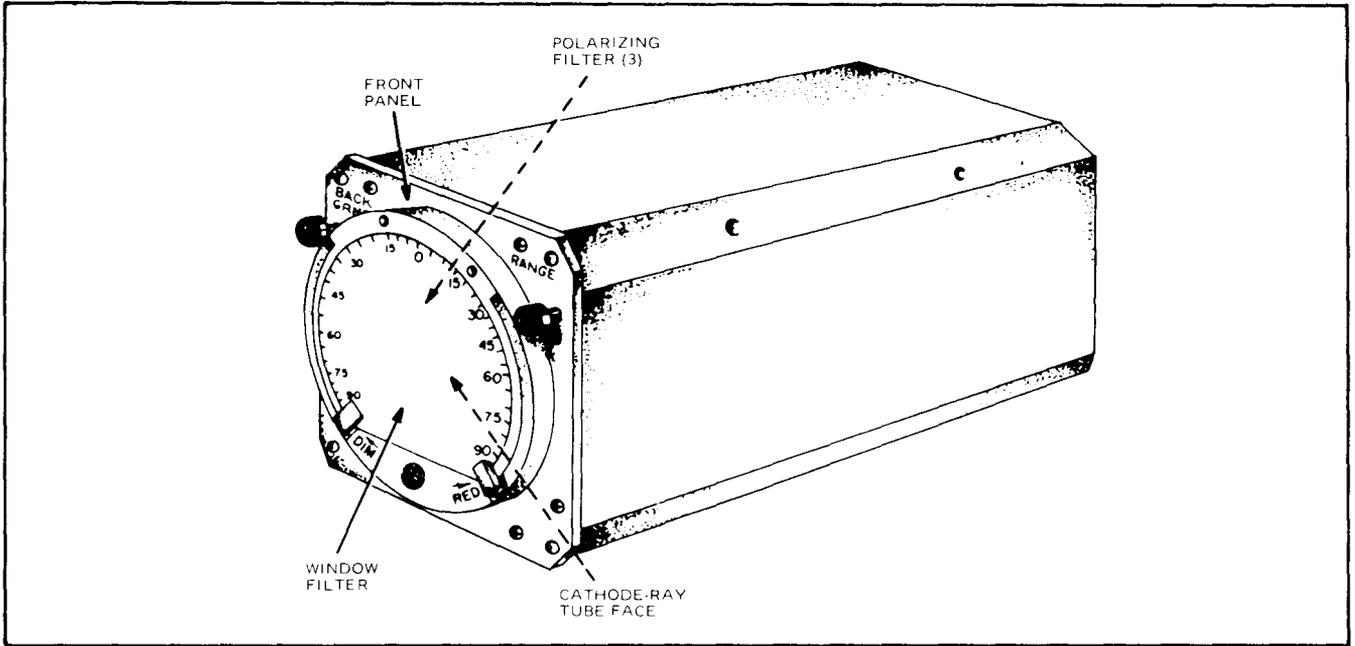


Figure 7-5. Indicator, Azimuth-Range IP-724/APN-158, Front Three-Quarter View.

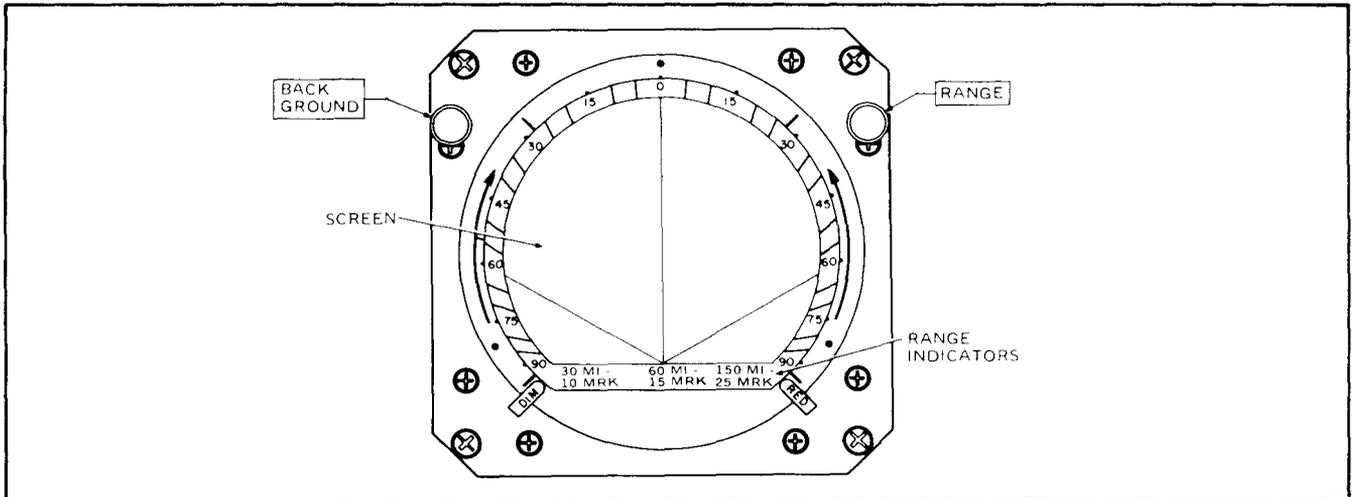


Figure 7-6. Azimuth-Range Indicator, Front View, Showing Location of Controls and Screen.

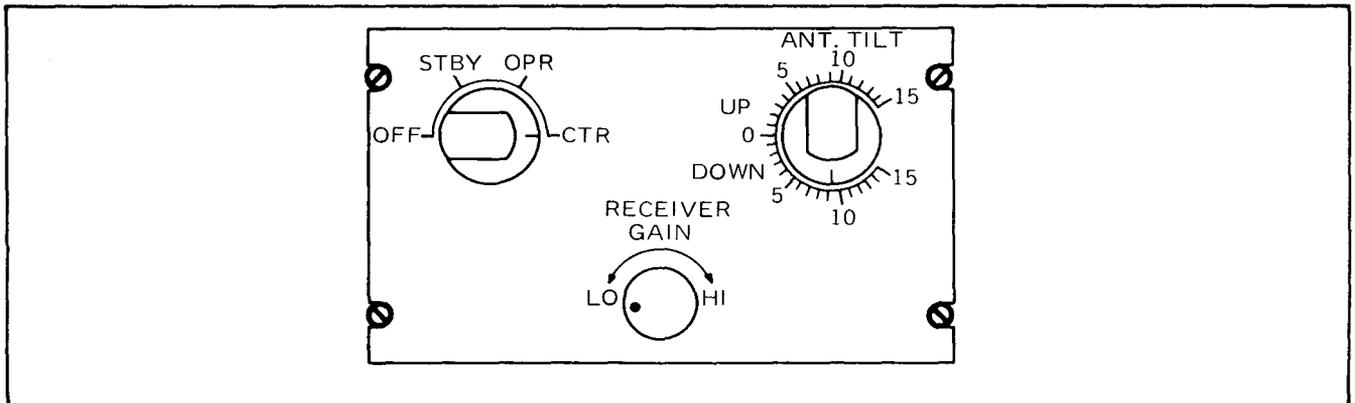
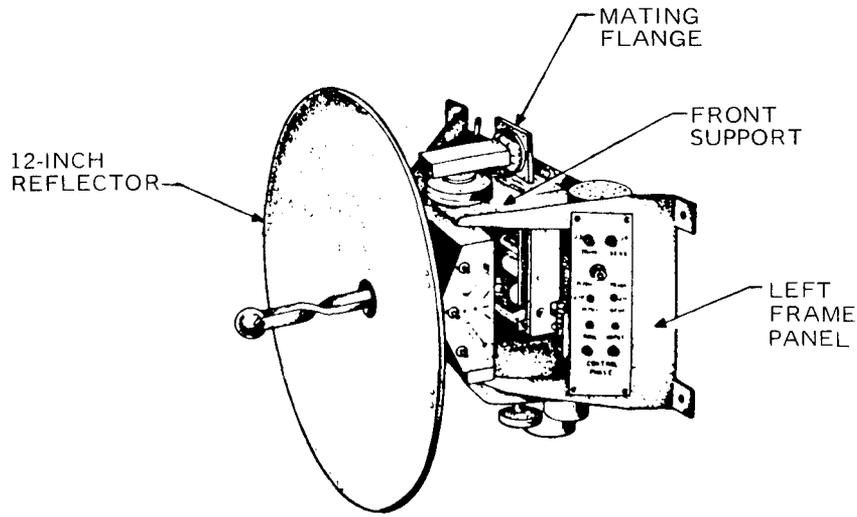
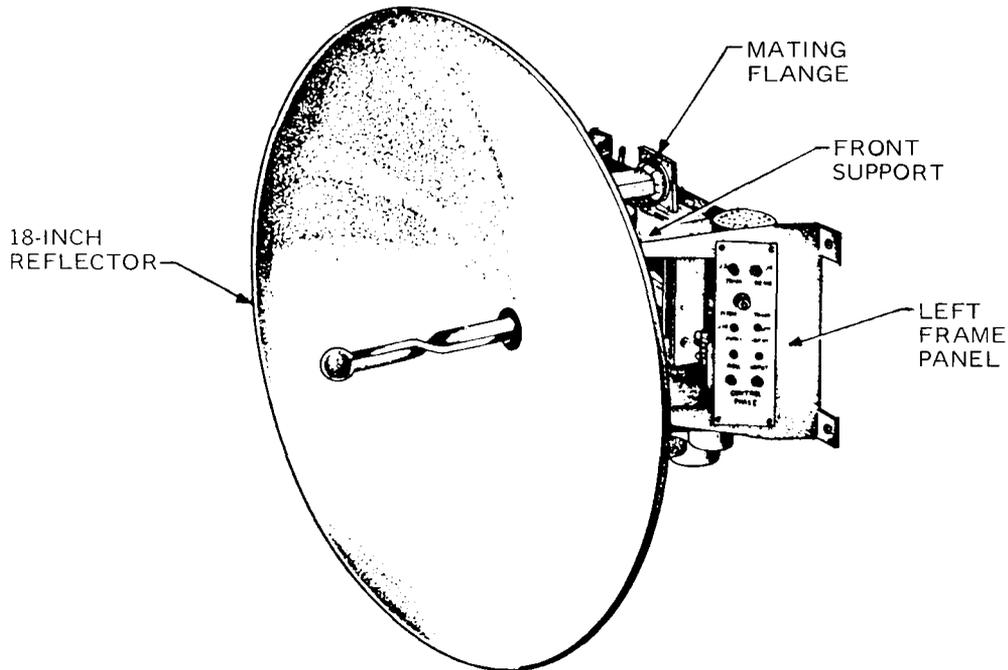


Figure 7-7. Cockpit Control Panel, Front View, Showing Typical Location of Controls.



A. ANTENNA AS-1520/APN-158



B. ANTENNA AS-1642/APN-158

Figure 7-8. Antenna AS-1520/APN-158 and Antenna AS-1642/APN-158 (Typical).

**NOTE**

Perform this check without engines running. To prevent excessive drain on aircraft batteries, use external power source. External power receptacle is provided on the right side of fuselage at station 109.

**7-14. PRELIMINARY SETTINGS.**

Proceed as follows:

- a. Set BATTERY MASTER switch on pilots pedestal to OFF.
- b. Set INVERTER SELECTOR SWITCH to OFF.
- c. Connect external dc power source to aircraft.
- d. Depress MAIN INVERTER and RADAR GEN A, GEN B and GEN C circuit breakers on main circuit breaker panel.
- e. Set LOAD MONITOR switch on the pilot's pedestal to the OVER-RIDE position.
- f. Raise the radome on the nose of the aircraft and secure it.
- g. Set switches and controls to the positions indicated in Table 7-2.
- h. Allow a five minute warmup period before proceeding with paragraph 7-15.

SWITCH OR CONTROL	LOCATION	POSITION
SCAN	Antenna (figure 7-8)	ON
RF	R/T Unit (figure 7-3)	ON
BACK GND	Indicator (figure 7-6)	Fully CCW
ANT	Radar Control Unit (figure 7-7)	0°
RDR	Radar Control Unit	STBY

**Table 7-2. Preliminary Control Settings**

**7-15. TEST PROCEDURE.**

Refer to paragraph 7-14 for preliminary control settings prior to accomplishing the following procedure.



Position the aircraft to prevent the radar from scanning any large, close by, metallic surfaces

during testing. Scanning such surfaces within approximately 50 feet may damage the receiver crystals.

**NOTE**

If the operational check results are not as indicated in steps 2 through 8 below, refer to the trouble shooting procedure, paragraph 7-19.

- a. Set the switches and controls to the position indicated in Table 7-3.

SWITCH OR CONTROL	LOCATION	POSITION
RANGE	Indicator	30 MI - 10 MRK
GAIN	Radar Control Unit	Fully CCW
RDR	Radar Control Unit	OPR

**Table 7-3. Operating Control Settings**

- b. Adjust the GAIN and BACKGRD controls until a good presentation is obtained.
- c. Set the RANGE switch to the 60 MI and 150 MI positions and note that the trace brightness does not change.
- d. Vary the antenna elevation with radar control unit ANT control. Observe that ground clutter is visible on the indicator when the antenna is in the down position and that target strength varies as the antenna tilt control is moved through its 30° arc.
- e. Observe that the erase circuit is operating and that display persistence is satisfactory.
- f. If there is a thunderstorm target available, adjust the ANT control for a maximum target return.
- g. Set the RDR switch to CTR and note the presentation on the indicator. If the target contains heavy precipitation, a hole or black core will appear in the target presentation.
- h. If the target appears on the indicator as a black core, reduce the setting of the GAIN control and note that the core gradually disappears as the GAIN is reduced.
- i. After the preceding tests have been satisfactorily completed, stabilization checks should be performed in accordance with paragraphs 7-16 through 7-18. If stabilization checks are not to be performed turn RDR switch to OFF and position the other switches and controls as indicated in Table 7-2.

**7-16. PITCH AXIS STABILIZATION.**

If not previously accomplished, raise and secure the nose radome and refer to paragraph 7-14 for preliminary control settings prior to accomplishing the following stabilization checks:

- a. Place the RF switch on the R/T unit and the SCAN switch on the antenna to OFF.
- b. Place the RDR switch on the radar control panel to OPR.



Do not attempt to position the antenna by applying pressure to the reflector. Use MANUAL SWEEP ADJ on the bottom of antenna (figure 7-9) for moving the antenna in azimuth and the ANT control on radar control unit (figure 7-7) for moving antenna in elevation.

- c. Position the antenna, by use of the MANUAL SWEEP ADJ on the bottom of the antenna for  $0^\circ$  azimuth by aligning the pointer with the  $0^\circ$  mark on the azimuth gimbal.
- d. Position the antenna, by use of the ANT control on the radar control panel, for  $0^\circ$  elevation by aligning the pointer with the  $0^\circ$  mark on the elevation gimbal.
- e. Connect the multimeter (30 VAC range) between the PITCH HI and LO test points on the synchronizer.
- f. Adjust the pitch axis of the gyro tilt table for a null indication on the multimeter.
- g. Connect the multimeter (30 VAC range) between the ROLL HI and LO test points on the synchronizer.
- h. Adjust the roll axis of the gyro tilt table for a null indication on the multimeter.
- i. Connect the multimeter to test points J8 and J9 on the antenna.
- j. Tilt the gyro tilt table on its roll axis to a  $20^\circ$  right wing down attitude and check to see that a null exists at test points J8 and J9, with the azimuth pointer on the antenna still aligned with the  $0^\circ$  mark. If not, loosen the three mounting screws holding the pitch-roll resolver (B3) and rotate the resolver body to the nearest null and retighten the mounting screws. Return the gyro table to the conditions specified in steps f through i.
- k. Insure that the elevation pointer on the antenna is aligned with the  $0^\circ$  mark. Measure the angle between the antenna reflector and the horizontal axis using the protractor-level (figure 7-10). Carefully note and record the angle.

- l. Reset the protractor-level for an upward change of  $5^\circ$ .

- m. Adjust the gyro table for a  $10^\circ$  nose down attitude from the reference level determined in step f.
- n. Adjust the PITCH AMPL control (R10 on the synchronizer front panel) until the antenna assumes a position that egress with the preset protractor-level.
- o. Connect the multimeter between STAB HI - ELEV HI test points on the synchronizer and adjust the PITCH PHASE control (R8) for a null indication.
- p. Recheck steps l thru o and readjust if necessary.

**NOTE**

The antenna reflector movement is only one-half that of the gyro movement and in the opposite direction.

**7-17. ROLL AXIS STABILIZATION.**

- a. Position the antenna, by use of the MANUAL SWEEP ADJ on the bottom of the antenna, for  $0^\circ$  azimuth by aligning the pointer with the  $0^\circ$  mark on the azimuth gimbal.
- b. Set the ANT control on the radar control panel to  $0^\circ$ .
- c. Level the gyro in both pitch and roll in accordance with paragraph 7-16, steps f through i.
- d. Ensure that the elevation pointer on the antenna is aligned with the center mark and then position the antenna, by use of the MANUAL SWEEP ADJ, to  $60^\circ$  right.

**NOTE**

The antenna has alignment marks on the azimuth gimbal at  $0^\circ$ ,  $45^\circ$  and  $60^\circ$  in both left and right position.

- e. Measure the angle between the antenna reflector and the horizontal using the protractor-level. Carefully note and record the angle.
- f. Reset the protractor-level for an upward change of  $5^\circ$ .
- g. Adjust the gyro tilt table for a  $12^\circ$  right wing down attitude from the reference determined in step e.
- h. Adjust the ROLL AMPL control (R7) on the synchronizer front panel until the antenna assumes a position that egress with the preset protractor-level.

**NOTE**

The antenna roll correction is one-half the actual roll angle times the sine of the antenna azimuth angle. The direction of correction is always opposite that of the gyro movement.

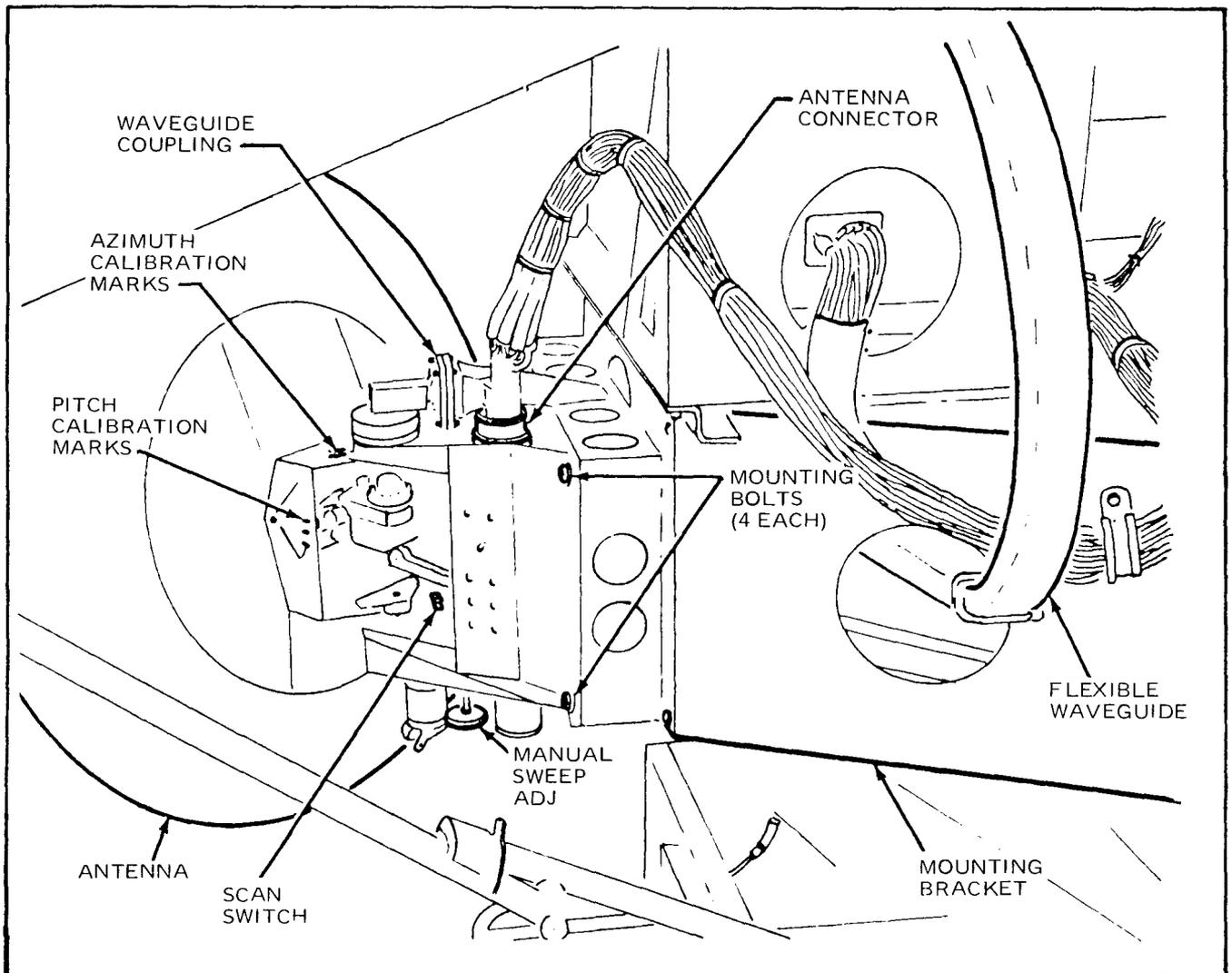


Figure 7-9. Location of Radar Set Antenna Manual Control and Alignment Marks.

i. Connect the multimeter between the STAB HI - ELEV HI test points on the front panel of the synchronizer and adjust the ROLL PHASE control (R5) for null indication.

j. Recheck steps d through h and readjust if necessary.

#### 7-18. FINAL STABILIZATION.

Accomplish final stabilization checks after performing paragraphs 7-16 and 7-17.

a. Reinstall the attitude indicator in the aircraft.

b. Position the antenna, by use of the MANUAL SWEEP ADJ, for  $0^{\circ}$  azimuth by aligning the pointer with the  $0^{\circ}$  mark on the azimuth gimbal.

c. Set the ANT control, on the radar control unit, to  $0^{\circ}$ .

d. Connect a jumper wire between J8 and J9 on the antenna (this removes stabilization signals) and ensure that

the antenna elevation pointer is still aligned with the center mark.

e. Measure the angle between the antenna reflector and horizontal using the protractor-level. Carefully note and record the angle.

f. Reset the protractor-level to the angle exactly one-half that measured in step e.

g. Remove the jumper wire between J8 and J9 and adjust the PITCH TRIM (R7) on the antenna until the antenna reflector angle agrees with the preset protractor level.

h. Set the RDR switch on the radar control unit to OFF.

i. Set the antenna SCAN and R/T unit RF switches to ON.

j. Lower and secure the radome.

**TROUBLE-SHOOTING PROCEDURE**

**7-19. TEST EQUIPMENT, TOOLS AND MATERIAL.**

A multimeter ME-26A/U or equivalent, common hand tools and 22 gage safety wire are the only requirements for accomplishing the following procedure.

7-20. Before performing trouble-shooting procedure listed in Table 7-5, take the following preparatory steps:

a. Position the aircraft to prevent the antenna from scanning any large, close-by metallic surfaces. Scanning such surfaces with 50 feet may damage the receiver crystals.

b. Raise the nose radome and secure it.

c. Set switches and controls to the positions indicated in Table 7-4.

d. Conduct performance checks (Table 7-5) using an external power source.

e. Upon completion of performance checks, return switches and controls to the positions indicated in Table 7-4. Lower and secure the nose radome.

CONTROL	LOCATION	POSITION	FIGURE NO.
RDR	Radar Control Unit	OFF	7-7
ANT	Radar Control Unit	0°	7-7
GAIN	Radar Control Unit	Fully CCW	7-7
BACKGRD	Indicator	Fully CCW	7-6
RANGE	Indicator	150-25	7-6
RF	R/T Unit	ON	7-3
Meter Switch	R/T Unit	GEN C	7-3
SCAN	Antenna	ON	7-9

**Table 7-4. Control Positions**

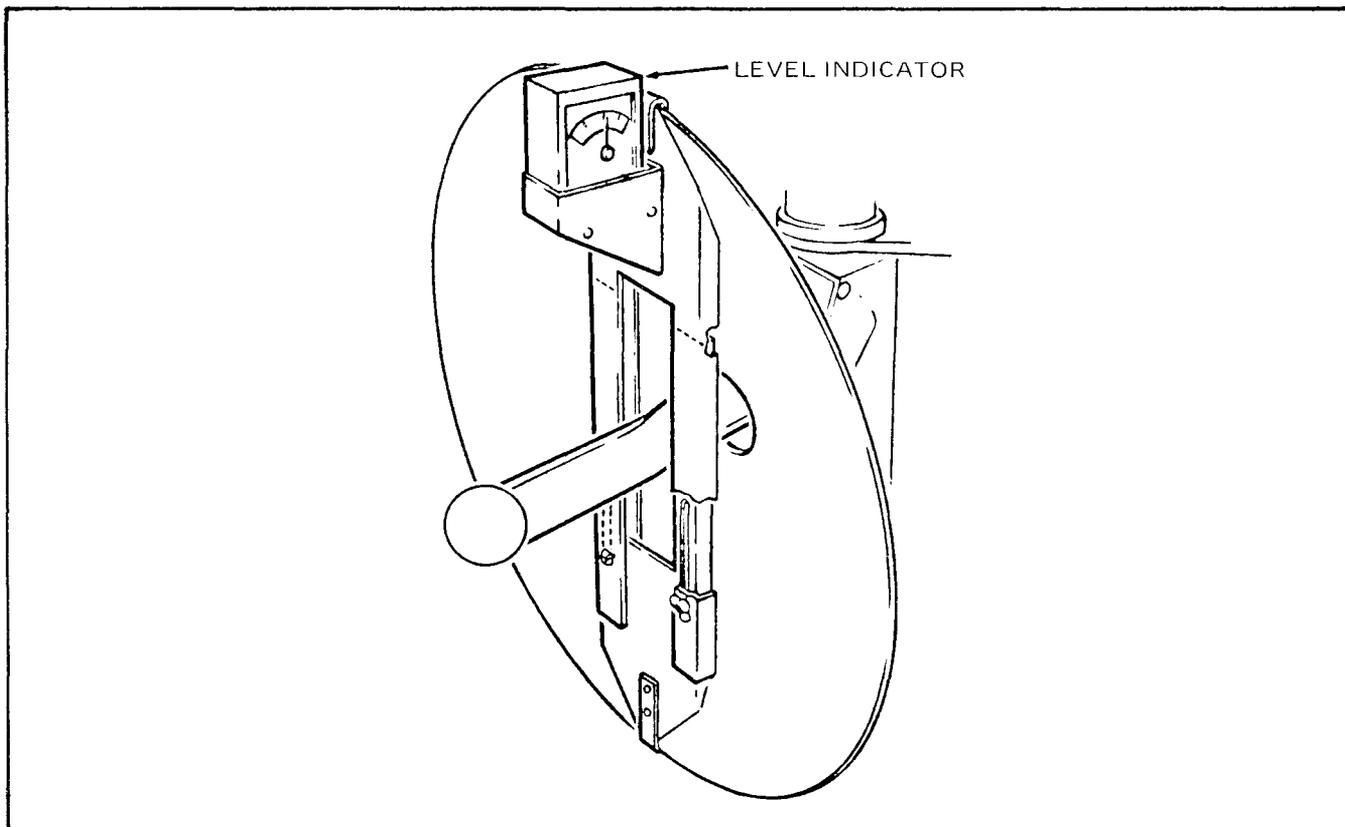


Figure 7-10. Protractor-Level for Measuring Antenna Angle.

UNIT	ACTION	NORMAL INDICATION	CORRECTIVE MEASURES
Radar Control Unit	Set RDR switch to STBY. Wait 4 minutes before switching to OPR.	Radar inverter operates, blower motor in R/T unit operates, and meter on R/T unit indicates between 8 and 10.	Check to see that POWER, SW, A, B, and C circuit breakers on WEATHER RADAR power panel are pushed in. Replace R/T unit. Replace radar control unit.
R/T Unit	Set meter switch to GEN B.	Meter on R/T unit indicates within one division of center scale.	Replace R/T unit.
Radar Control Unit	Set RDR Switch to OPR.	Antenna starts scanning (check visually) and magnetron operates (check by setting meter switch on R/T unit to MAG and look at meter for midscale indication).	Insure the RF switch on R/T unit and the scan switch on the antenna are on. If antenna does not scan, check for 115 volts between pins L and K of P1 on antenna. If 115 volts is present, replace antenna. If 115 volts is not present, replace R/T unit. If magnetron does not operate, replace R/T unit. Replace radar control unit.
R/T Unit	Set meter switch to GEN A.	Meter on R/T unit indicates $5 \pm 1$ .	Replace R/T unit.
R/T Unit	Set meter switch to + 250 V.	Meter on R/T unit indicates $5 \pm 1$ .	Replace R/T unit.
R/T Unit	Set meter switch to + 27.5 V.	Meter on R/T unit indicates $5 \pm 1$ .	Replace R/T unit.
R/T Unit	Set meter switch to - 27.5 V.	Meter on R/T unit indicates $5 \pm 1$ .	Replace R/T unit.
R/T Unit	Set meter switch to KA.	Meter on R/T unit indicates $5 \pm 1$ .	Replace R/T unit.
R/T Unit	Set meter switch to MAG.	Meter on R/T unit indicates $5 \pm 1$ .	Replace R/T unit.
R/T Unit	Set meter switch to REV.	Meter on R/T unit indicates $5 \pm 1$ .	Replace synchronizer. If trouble still exists, replace R/T unit.
R/T Unit	Set meter switch to FWD.	Meter on R/T unit indicates $5 \pm 1$ .	Replace synchronizer. If trouble still exists, replace R/T unit.
R/T Unit	Set meter switch to AFC.	Meter on R/T unit indicates $5 \pm 1$ .	Replace synchronizer. If trouble still exists, replace R/T unit.
Indicator	Turn BACKGRD control cw.	Sweep appears on indicator.	If sweep or bright dot is not visible, check for 115 volts between N and M and between L and K of P1 on indicator. Also check for + 250 volts between pins P and E. If voltages are present, replace indicator. If bright dot only is visible, replace synchronizer. If trouble still exists, replace indicator.

Table 7-5. Trouble Shooting the Radar Set

UNIT	ACTION	NORMAL INDICATION	CORRECTIVE MEASURES
Indicator	Set RANGE switch to all three ranges (150-25, 60-15, and 30-10).	Sweep is present on all ranges.	If sweep is not present on all ranges, replace synchronizer. If trouble still exists, replace indicator. If sweep appears bent or folded over, replace synchronizer. If sweep does not begin at proper position (center bottom of screen), replace indicator.
Indicator	Set RANGE switch to 150-25, 60-15 and 30-10.	Range marks are present on all ranges.	If last range mark is missing, replace synchronizer. If range marks appear wavy or chopped, replace synchronizer. If trouble still exists, replace R/T unit.
Radar Control Unit	Turn GAIN control fully cw. Adjust ANT control until targets appear on indicator.	Presentation of targets and rangemarks with maximum targets at one setting of ANT control.	If rangemarks are present but targets are not, replace synchronizer. If trouble still exists, replace R/T unit. If targets are present but range marks are not, replace synchronizer. If targets do not vary as ANT control is turned, check antenna and radar control unit.
Radar Control Unit	Set RDR switch to CTR	Dark holes appear in areas of very strong target return (If no strong target returns are present, dark holes will not appear.).	Replace synchronizer. Replace radar control unit.

Table 7-5. Trouble Shooting the Radar Set ( Cont)

**7-21. WIRING DIAGRAMS.**

The wiring diagram for the Weather Radar Set facility are contained in Section VIII, figure 8-13.

**REMOVAL AND REPLACEMENT.****7-22. LOCATION OF COMPONENTS.**

The synchronizer, R/T unit and antenna are mounted on bulkhead at station 9.000 in the nose of the aircraft. The indicator and attitude indicator are located on the instrument panel. The control unit is mounted on the overhead radio remote control panel.

**7-23. REMOVAL OF SYNCHRONIZER.**

- Insure that the power is OFF.
- Cut the safety wire and unscrew the retainer thumb nuts until they are loose enough to drop down.
- Pull the synchronizer forward to free the rear locating pins and electrical connectors.
- Lift the synchronizer from the shock mount.

**7-24. REPLACEMENT OF SYNCHRONIZER.**

- Slide the synchronizer into the shock mount; be careful that the electrical connector in the rear mates correctly with the receptacle on the mounting.

- Ensure that the locating pins are correctly positioned; then tighten the retainer thumb nuts.

- Jar the synchronizer slightly and check to see that the retainer thumb nuts are tightened fully. Lock the retainer thumb nuts with safety wire.

**7-25. REMOVAL OF R/T UNIT.**

- Insure that the power is OFF.
- Cut the safety wire and unscrew the retainer thumb nuts until they are loose enough to drop down.
- Unscrew the retractor nut until the electrical and waveguide connectors on the R/T unit are free of the electrical and waveguide receptacles on the mounting.
- Lift the R/T unit from the shock mount.

**7-26. REPLACEMENT OF R/T UNIT.**

- Slide the R/T unit into the shock mount; be careful that the electrical and waveguide connectors in the rear mate correctly with the electrical and waveguide receptacles on the mounting.
- Insure that the locating pins are correctly positioned and that the front panel of the R/T unit is positioned on the

retractor. Tighten the retractor nut until the rear of the R/T unit is snug against the mounting. Tighten the retainer thumb nuts.

c. Jar the R/T unit slightly and check to see that the retainer thumb nuts are tightened fully. Lock the retainer thumb nuts with safety wire.

#### 7-27. REMOVAL OF ANTENNA.

a. Insure that the power is OFF.

b. Disconnect the waveguide and electrical connector from the antenna.

c. Remove the four bolts that hold the antenna to the mounting bracket and carefully lower the antenna.

#### 7-28. REPLACEMENT OF ANTENNA.

a. Position the antenna against the mounting bracket and secure with four bolts.

b. Connect the waveguide and electrical connector to the antenna.

#### 7-29. REMOVAL OF RADAR CONTROL UNIT.

a. Insure that the power is OFF.

b. Loosen the two Dzus fasteners.

c. Withdraw the radar control unit sufficiently to reach the electrical connector at the rear.

d. Disconnect the connector and lift the radar control unit free from the console.

#### 7-30. REPLACEMENT OF RADAR CONTROL UNIT.

a. Connect the connector on the radar control unit.

b. Slide the radar control unit into the console and secure with the two Dzus fasteners.

#### 7-31. REMOVAL OF INDICATOR.

a. Loosen the fastener at the top of the indicator and remove the two screws at the upper corners.

b. Slide the indicator aft on the support fixture until it is free the panel.

c. Disconnect the connector at the rear of the indicator.

d. Remove the four countersunk screws from the tray support on the bottom of the indicator. Remove the tray support.

#### 7-32. REPLACEMENT OF INDICATOR.

a. Install the tray support on the bottom of the indicator and secure it with four countersunk screws.

b. Connect the connector on the rear of the indicator.

c. Slide the indicator into the support fixture. Ensure that the rear portion of the tray support slips under the lip of the flange of the support fixture.

d. Position the fastener at the top of the indicator and tighten and reinstall the two screws in the upper corners.



## Section VII-A

### TRANSPONDER SET AN/APX-25

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Operational Check-Out .....	82J
System Analysis .....	82L
Replacement .....	82M
Adjustment .....	82M
Servicing .....	82M

### DESCRIPTION

#### 7A-1. GENERAL.

See figures 7A-1 and 7A-2. Transponder set AN/APX-25 is a pulse-type transponder set which provides automatic selective identification of the aircraft in which it is installed to ground, shipboard, or airborne IFF recognition installations. The equipment receives and decodes challenging radio signals originated and beamed by either of two IFF interrogating systems: Mark X or Selective Identification Feature (SIF). The principal units of the transponder set are a pulse-type receiver-transmitter and a coder connected to a common omnidirectional receiving and transmitting antenna. The

transponder set control permits turning on the equipment and selecting the various modes of operation. Coder group control permits selection of reply codes (generated in the coder) to two modes of operation and switches on the coder to permit selection of the reply code to the third mode. Tuning of the equipment is performed at the receiver-transmitter by turning manually operated counters to predetermined settings. The transponder set receives primary power from the 28-volt dc essential bus through a 5-ampere circuit breaker and from the 115-volt 400-cycle ac-regulated power system through a 5-ampere circuit breaker.

#### 7A-2. TRANSPONDER SET, AN/APX-25, LIST OF COMPONENTS.

ITEM	LOCATION	FUNCTION
Transponder set receiver-transmitter, RT-279/APX or RT-279A/APX.	Tail section, station 766, right-hand side.	To receive and decode interrogation pulse-pairs and to transmit coded replies.
Transponder set receiver-transmitter mounting, MT-362A/A or HT-1439/A.	Tail section, station 766, right-hand side.	To furnish adequate support and vibration insulation.
Transponder set receiver-transmitter filter, F-245/APX-25.	Tail section, station 766, right-hand beneath receiver-transmitter.	To filter 115-volt ac and 28-volt dc supply voltages for RT-279/APX-receiver-transmitter.
Transponder set coder, KY-95/APX or KY-95A/APX.	Tail section, station 782, center-line.	To generate a train of pulses to modulate the transmitter of the receiver-transmitter.

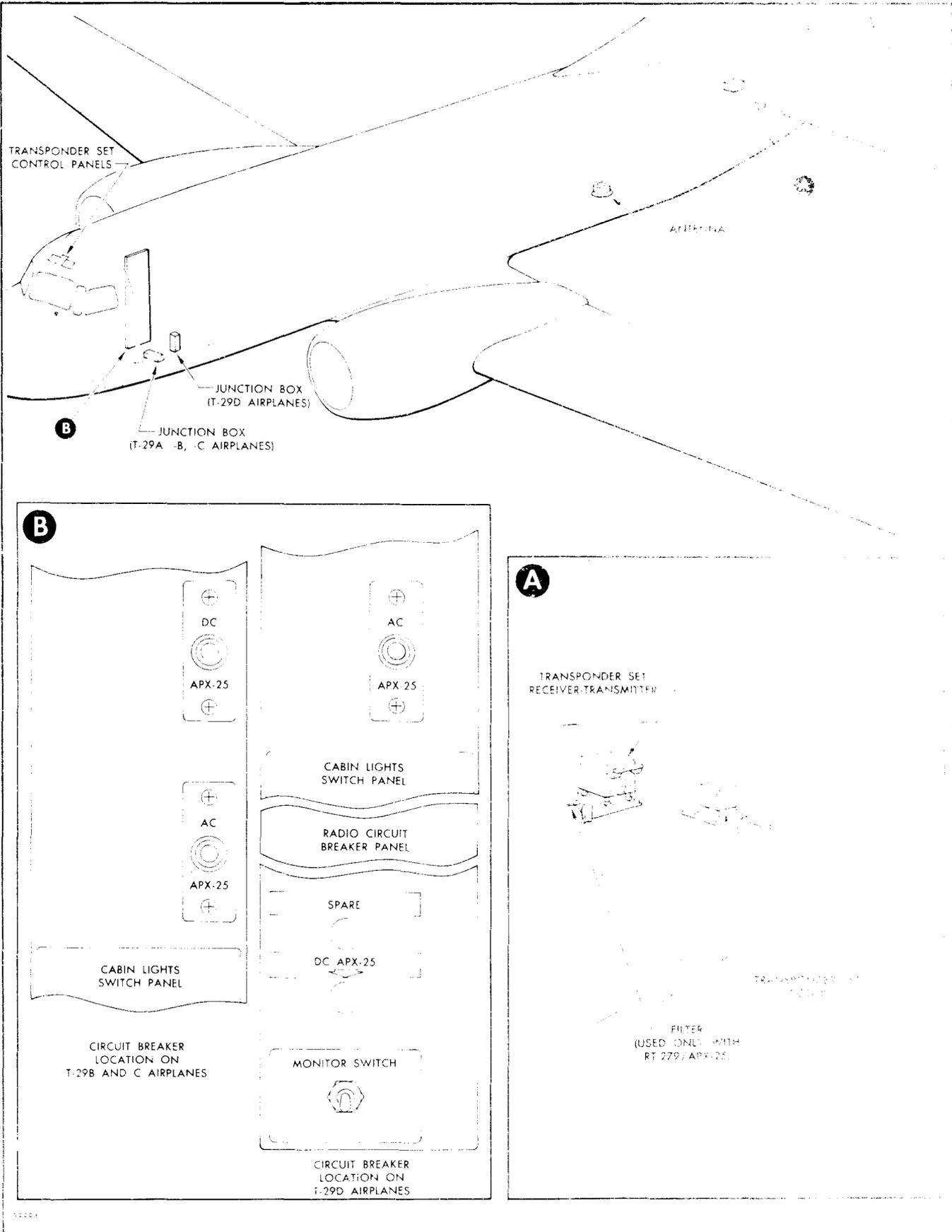


Figure 7A-1. Transponder Set (AN/APX-25) Perspective

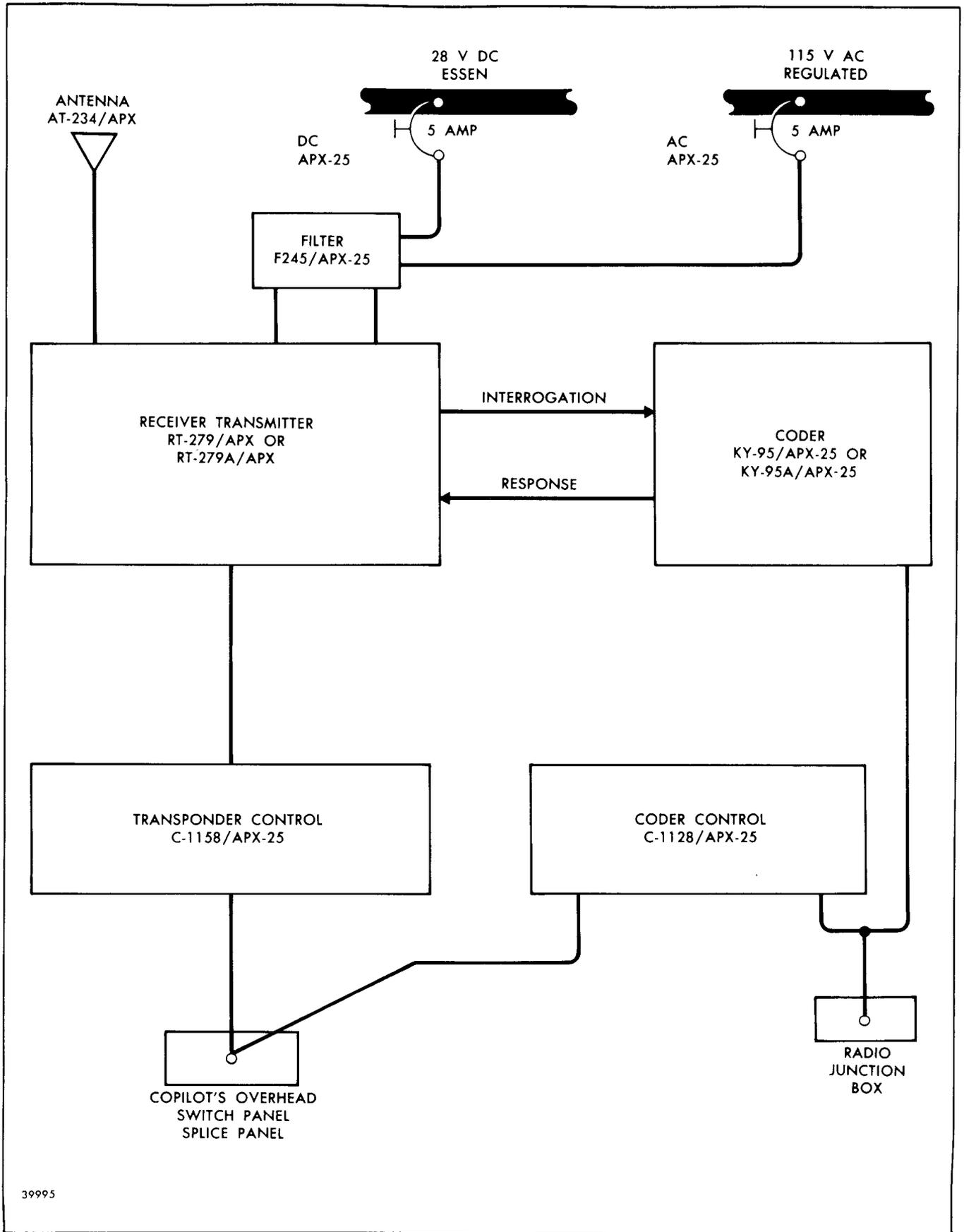


Figure 7A-2. Transponder Set (AN/APX-25) Block Diagram

**7A-2. TRANSPONDER SET, AN/APX-25, LIST OF COMPONENTS (Cont).**

ITEM	LOCATION	FUNCTION
Transponder set coder mounting, MT-1151/APX-25.	Tail section, station 782, centerline.	To furnish adequate support and vibration insulation.
Transponder set antenna, AT-234/APX.	Station 644 centerline, fuselage bottom skin.	To provide for omnidirectional reception and transmission for the transponder set.
Transponder set control, C-1158/APX-25.	Pilots' overhead switch panel.	To provide all operating controls except code selectors.
Coder group control, C-1128/APX-25.	Pilots' overhead switch panel.	To provide control for SIF operation.
Transponder set junction box.	Station 131, left-hand side ( <i>T-29A, B, and C airplanes</i> ). Station 149, left-hand side ( <i>T-29D airplanes</i> ).	To provide for inter-connection of transponder set components.
Circuit breaker, 5-ampere, DC APX-25.	Radio junction box.	To protect transponder set circuit.
Circuit breaker 5-ampere, AC APX-25.	Radio junction box.	To protect transponder set circuit.

**7A-3. TRANSPONDER SET RECEIVER-TRANSMITTER.**

See figure 7A-3. The transponder set receiver-transmitter RT-279/APX contains circuits which enable it to receive and decode properly coded interrogation pulse-pairs, depending upon the mode of operation selected, and to transmit various coded replies modulated either from its own reply-pulse generator or from the coder unit. This unit is composed of three major assemblies. The front panel assembly includes the r-f head and tuning mechanism, a frequency calibration chart, the ANTENNA and CODER receptacles and two test adjustment receptacles. The panel assembly is hinged at the bottom, so that by loosening six captive screws, the entire panel may be swung down to permit access to tubes. Opening the front panel opens one of two interlock switches in the primary power line; removing the rear cover operates the other interlock. The second major assembly, the IF strip, which also includes the detector and two video stages, is mounted across the top of the front panel assembly so that its dust cover projects about 1.5 inches from the front surface of the unit. Finally, the rear chassis assembly includes the decoder, reply pulse generator, modulator, and power supply circuits. The NORM-MOD switch (a screwdriver adjustment is on this assembly) is accessible when the rear cover is removed. The other preset adjustments are exposed when a cover plate on the right-hand side of the wrap-around cabinet is removed. Ventilation for the entire component is provided by a blower assembly. The receiver-transmitter RT-279A/APX is similar to

RT-279/APX with the following major differences. The RF head of RT-279A/APX is enclosed in a pressurized case to prevent arcing between high voltage points at high altitudes. The tuning mechanism includes three screwdriver slotted adjustment disks for adjusting frequencies.

**7A-4. RECEIVER-TRANSMITTER MOUNTING.**

See figure 7A-3. The receiver-transmitter mounting MT-362A/A or MT-1439A includes four rubber vibration mounts with grounding jumpers to furnish adequate support and vibration insulation for the receiver-transmitter. Two hold-down lugs at the lower front and two tapered pins at the rear of the receiver-transmitter secure this component to the mounting.

**7A-5. RECEIVER-TRANSMITTER FILTER.**

See figure 7A-3. The filter F-245/APX-25 is used only with RT-279/APX receiver-transmitter to filter both the 115-volt ac and 28-volt dc supply voltages. A pi-type filter is used for the 115-volt ac line and a L-type filter is used for the 28-volt dc line.

**7A-6. TRANSPONDER SET CODER.**

See figure 7A-3. The transponder set coder contains the reply coding circuits used in SIF operation. Two multi-conductor receptacles on the front panel provide connection to the remote MODE 1 and MODE 3 code

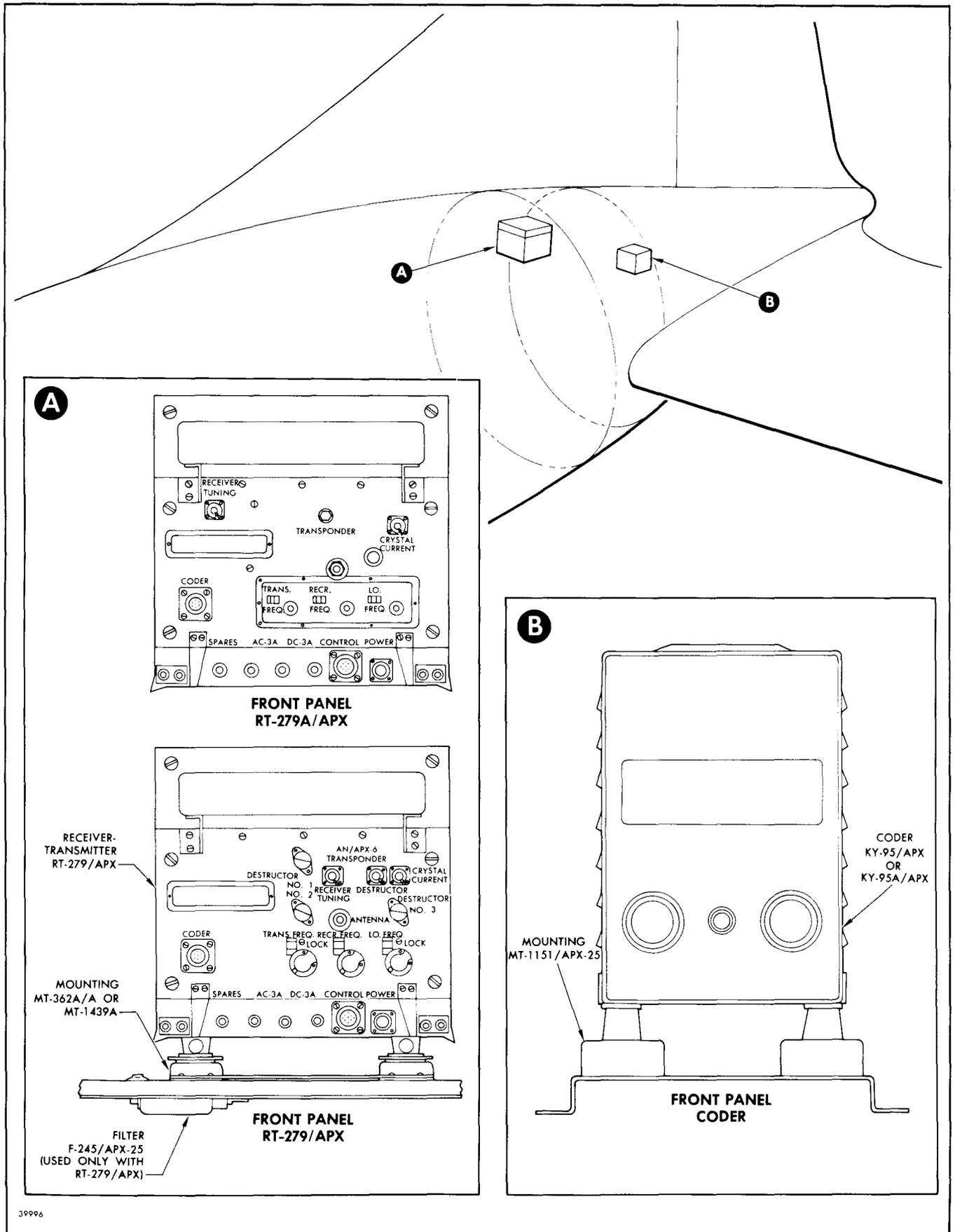


Figure 7A-3. Transponder Set Receiver-Transmitter and Coder, Perspective

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selectors, and primary power line and signal connection to the receiver-transmitter. A coaxial receptacle is provided for use with auxiliary equipment. Also on the front panel under a hinged cover on the KY-95/APX-25 are the MODE 2 CODE SELECTORS, 12 toggle switches in two vertical rows of six each, on the KY-95A/APX-25, a MODE 2 CODE SELECT switch array contains four wheels and a locking device. On KY-95/APX-25, the chassis can be removed from the case by removal of two screws, one at the top and one at the rear of the cabinet. On KY-95A/APX-25, the chassis can be removed by removing six screws, two on either side, two on the top, and one Dzus fastener at the rear. All tubes and the preset adjustments then are accessible.

#### 7A-7. TRANSPONDER SET CODER MOUNTING.

See figure 7A-3. The coder mounting MT-1151/APX-25 includes four rubber vibration mounts with grounding jumpers to provide adequate support and vibration insulation. Lip protrusions at the bottom (front and rear)

of the coder enable it to be firmly clamped to the mounting. A single wingnut holds a clamp over the front lip of the coder.

#### 7A-8. TRANSPONDER SET ANTENNA.

See figure 7A-4. The antenna AT-234/APX is a circular, flush-mounted unit that is used both for reception and transmission by the transponder set. The antenna is omnidirectional.

#### 7A-9. TRANSPONDER SET CONTROL.

See figure 7A-5. The control C-1158/APX contains all of the operating controls other than code selectors. The MASTER five-position rotary switch turns on the transponder set and enables EMERGENCY code operation. Three toggle switches enable operation in MODE 2 or 3, and I/P code transmission. The control has red-filtered edgelifighting. The control functions are as follows:

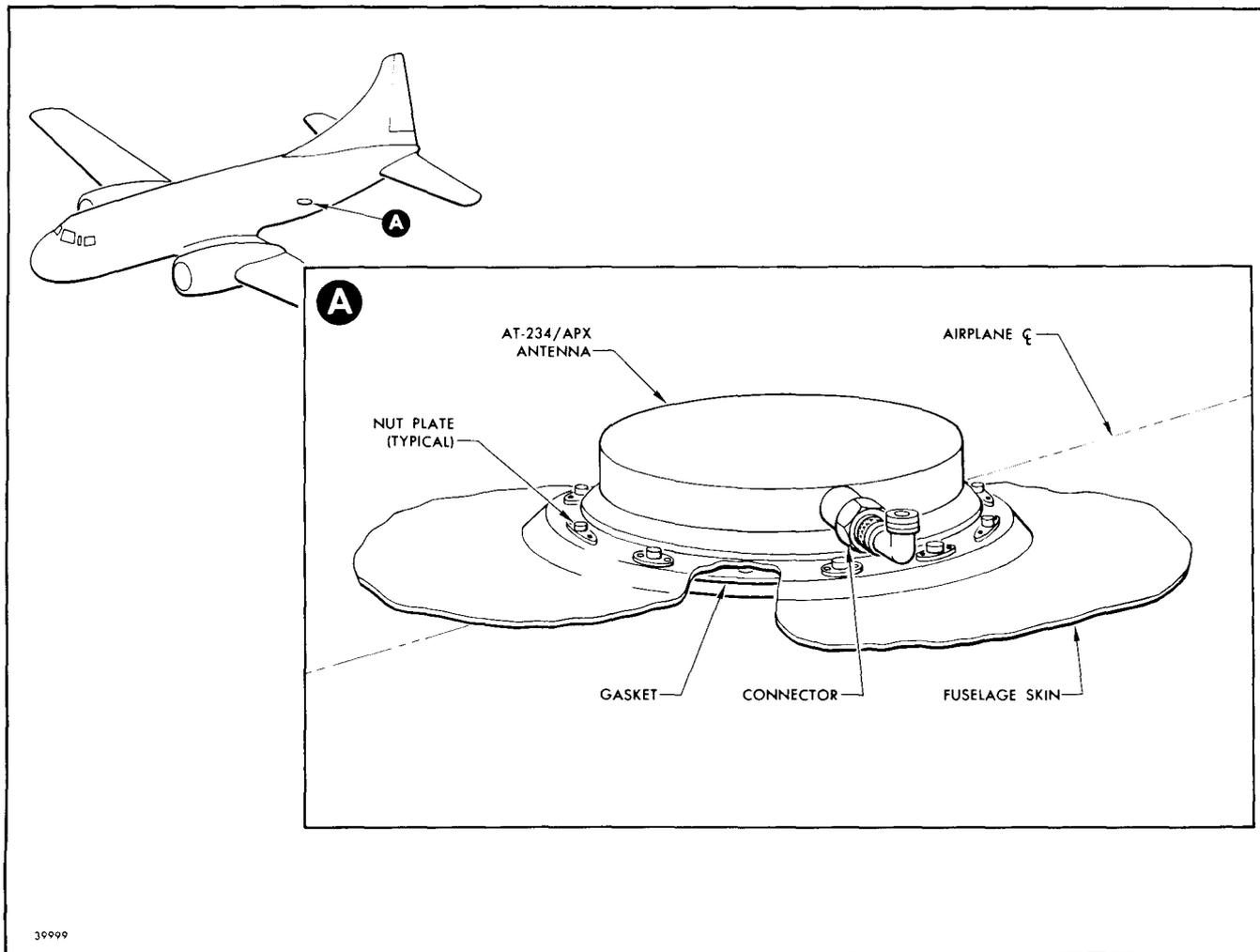


Figure 7A-4. Transponder Set Antenna (AT-234/APX) Perspective

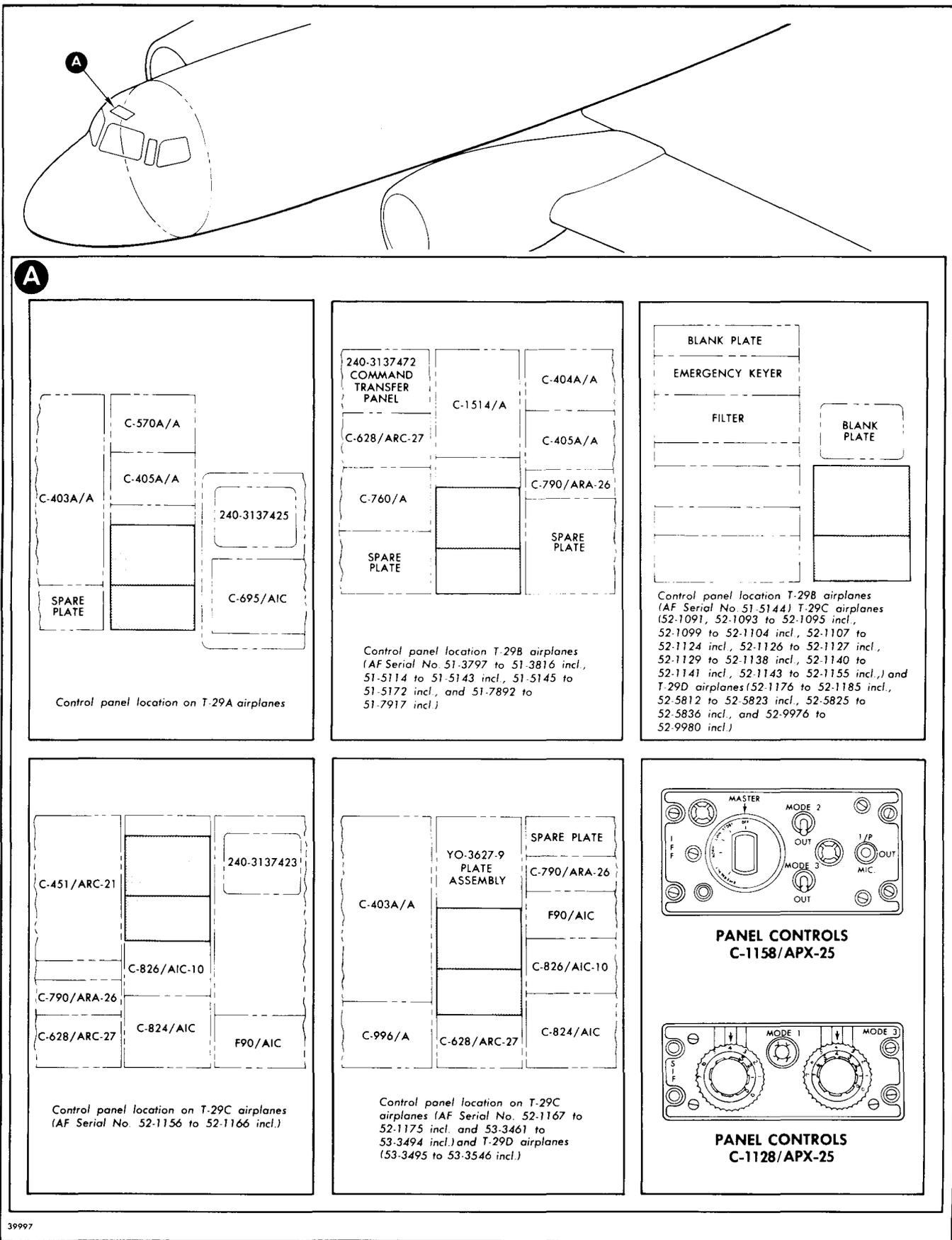


Figure 7A-5. Transponder Set (AN/APX-25) Controls Perspective

**7A-9. TRANSPONDER SET CONTROL, C-1158/APX (Cont).**

CONTROL	POSITION	FUNCTION
MASTER	OFF	No primary power is applied to the equipment.
	STDBY	All primary power is turned on. Tubes are heated and after a delay of approximately one minute, are ready for operation; receiver is desensitized to prevent operation.
	LOW	Receiver is partially sensitive and the equipment operates only in the presence of strong interrogations.
MASTER	NORM	Receiver operates at full sensitivity and provides maximum performance.
	EMERGENCY	Receiver operates at full sensitivity and replies to any mode of interrogation.  <b>NOTE</b> A push button dial stop is located to the left of the MASTER control to prevent accidental EMERGENCY operation.
MODE 2-OUT	OUT	Equipment transmits normal Mode 1 replies to Mode 1 interrogations, but does not respond to Mode 2 interrogations.
	MODE 2	Normal Mode 1 operation is retained, and in addition normal Mode 2 replies to Mode 2 interrogations are transmitted.
MODE 3-OUT	OUT	Equipment operates in Mode 1.
	MODE 3	Normal Mode 1 operation is retained, and in addition normal Mode 3 replies to Mode 3 interrogations are transmitted.
I/P-OUT-MIC	I/P	Equipment responds to Mode 2 interrogations with Mode 2 replies.
	OUT	Equipment operates as controlled by the mode switches.
	MIC	I/P replies are transmitted while pilot's microphone switch is closed.

**7A-10. CODER GROUP CONTROL.**

See figure 7A-5. The control C-1128/APX-25 is effective only in SIF operation. Two dual concentric selector knobs establish the Mode 1 and 3 response coding.

The left-hand MODE 1 controls consist of an eight-position and a four-position rotary switch. The right-hand MODE 3 controls consist of 2 eight-position rotary switches. The control has red-filtered edge lighting. The control functions are as follows:

CONTROL	POSITION	FUNCTION
MODE 1 (Outer)	0 to 7	Controls selection of first three internal pulses available in Mode 1 codes.
MODE 1 (Inner)	0 to 3	Controls selection of last two internal pulses available in Mode 1 codes.
MODE 3 (Outer)	0 to 7	Controls selection of first three internal pulses available in Mode 3 codes.
MODE 3 (Inner)	0 to 7	Controls selection of last three internal pulses available in Mode 3 codes.

**7A-11. TRANSPONDER SET JUNCTION BOX.**

See figure 7A-1. The transponder junction box is provided for interconnection of AN/APX-25 components.

The junction box cover includes a connection diagram for the junction box wiring.

**OPERATIONAL CHECK-OUT**
**7A-12. TEST EQUIPMENT REQUIRED.**

FIGURE AND INDEX NO.	NAME	DESIGNATION	ALTERNATE	USE AND APPLICATION
NONE	Coder-Decoder Group	AN/UPA-39		Line or bench testing.
NONE	Radar Test Set	AN/UPM-6A/B		Line testing in SIF.

**7A-13. PREPARATION OF TRANSPONDER SET AN/APX-25 FOR OPERATIONAL CHECK-OUT.**

- a. Make certain that the static ground cable on the left-hand main landing gear is installed properly and is touching the ground.
- b. Connect an external dc power source to the airplane as instructed in T.O. 1T-29A-2-10 and observe all applicable precautions.
- c. Energize ac regulated power system as instructed in T.O. 1T-29A-2-10 and observe all applicable precautions.
- d. Verify that the D.C. APX-25 and A.C. APX-25 circuit breakers are closed.
- e. Check that cable connections are firmly seated; tighten by hand the locking rings on cable plugs.
- f. Check mountings of all components to see that they are secure and undamaged; tighten locking devices and inspect shock mounts.
- g. Check for usable fuses in all fuse holders.
- h. Test to see that connecting cables and other equipment do not interfere with free movement of the receiver-transmitter on its shock mounts.
- i. Check that REC-FREQ, LO-FREQ, and TRANS-FREQ dials are set and locked at the assigned frequency.

- j. Set AN/APX-25 controls as follows:

Turn MASTER to OFF  
Turn MODE 2-OUT to OUT  
Turn MODE 3-OUT to OUT  
Turn I/P-OUT-MIC to OUT

**7A-14. PRELIMINARY CONNECTIONS AND CONTROL SETTINGS OF AN/UPA-39 AND AN/UPM-6A/B TEST EQUIPMENT.**

- a. Interconnection of AN/UPA-39 Coder-Decoder Group and AN/UPM-6A/B Radar Test Set.
  1. Connect "S-G OUT" to "S-G IN" using jumper cable W-401.
  2. Connect "TRIGGER OUT" on AN/UPA-39 to "SYNC IN" on AN/UPM-6A/B. (If oscilloscope is being used, use "T" adapter and connect to sync input on oscilloscope also.)
  3. Connect "VIDEO OUT" on AN/UPM-6A/B to "VIDEO IN (-)" on AN/UPA-39. (If oscilloscope is being used to monitor code trains, use "T" adapter and connect to signal input on oscilloscope also.)
  4. Connect "OUTPUT" on AN/UPA-39 to "VIDEO IN" on AN/UPM-6A/B.
  5. Connect "test hat" to "R-F IN", or (if direct connection is to be made) connect cable W-703 to "H-P IN", with adapter E-701 on other end.

6. Connect terminating plug E-401 at "H-P IN" or "R-F IN", whichever is unused.
- b. Control settings on AN/UPA-39 Coder-Decoder Group.
  1. Set "SYNC" to "INTERNAL".
  2. Set "CODER INT SYNC OFF" to "OFF".
  3. Set "CODE-DECODE" to "DECODE".
  4. Set "I/P-NORMAL-EMERGENCY" to "NORMAL".
- c. Control Settings on AN/UPM-6A/B Radar Test Set.
  1. Set "NORMAL — SIF" to "NORMAL" (if AN/UPM-6A/B is modified).
  2. Set "SYNC" to "EXT".
  3. Set "OUTPUT LEVEL" to "120" (minimum signal).
  4. Set "TRANSPONDER DELAY" to "O".

5. Set "WAVEMETER INPUT" to "OFF".
6. Set "PULSE GROUPING" to "OUT".
- d. Final Preparation of Transponder Set and Test Equipment.
  1. Ground the test equipments and connect them to suitable power source (115 volts, 50 to 1000 cps) and energize power supply of transponder.
  2. Set "POWER" to "ON" on AN/UPM-6A/B, AN/UPA-39 and oscilloscope. Set "MASTER" to "STDBY" on AN/APX-25. Allow ten minutes warmup period if time permits.
  3. Clamp "test hat" over antenna (or connect adapter E-701 to "ANTENNA" on receiver-transmitter, or electrical test panel).
  4. Adjust "INPUT VOLTAGE" so that "INPUT VOLTAGE" meter reads in the green region of the scale.

**7A-15. AN/APX-25 PREFLIGHT OPERATIONAL CHECK FOR SIF (AN/UPM-6A/B and AN/UPA-39).**

**NOTE**

Adjust all controls as outlined in paragraphs 7A-13 and 7A-14.

STEP	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION
1	MASTER to STDBY.	Blower motor starts.
2	MASTER to NORM, MODE 1 to 00. Mode selector to 1. A, B, C, and D code selectors to 0000.	DECODING INDICATOR lights, bracket pulses appear on scope.
3	Mode Selector to 2 and 3.	DECODING INDICATOR does not light, pulses do not appear.
4	Mode selector to 1, MODE 1 code selector to 73. A and B code selectors to 73.	DECODING INDICATOR lights, all internal Mode 1 pulses appear in code train.
5	Adjust PEAK VOLTAGE meter to full scale. While depressing PULSE GROUPING set I/P-OUT-MIC to I/P and release; to MIC and key pilot's microphone momentarily.	Meter reads 35 percent full scale in each case. This indication should last for 30 seconds after release of switch, then meter reads 20 percent.
6	MASTER to EMERGENCY. Depress PULSE GROUPING.	Meter reads 50 percent of full scale.
7	MASTER to NORM. MODE 2 - OUT to MODE 2. Mode selector to 2. A, B, C, and D code selectors to the assigned Mode 2 reply code for the aircraft.	DECODING INDICATOR lights, Mode 2 code train appears on scope.
8	Mode selector to 3.	DECODING INDICATOR does not light, no pulses on scope.
9	Mode selector to 2. All MODE 2 code selectors OFF. A, B, C, and D selectors to 0000.	DECODING INDICATOR lights, only bracket pulses appear on scope.
10	Turn on all MODE 2 code selectors. A, B, C, and D code selectors to 7777.	DECODING INDICATOR lights, all Mode 2 pulses appear in code train.
11	Mode selector to 3. MODE 2 - OUT to OUT. MODE 3 - OUT to MODE 3. MODE 3 code selector to 00. A, B, C, and D code selectors to 0000.	DECODING INDICATOR lights, bracket pulses appear on scope.
12	Mode selector to 2.	DECODING INDICATOR lights, no pulses appear on scope.
13	Mode selector to 3, MODE 3 code selector to 77. A and B code selectors to 77.	DECODING INDICATOR lights, all internal Mode 3 pulses appear in code train.

## SYSTEM ANALYSIS

### WARNING

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must observe safety precautions at all times. Turn power off prior to working on equipment and disconnect power from the airplane. Do not replace components of the system

with the power supply on. Under certain conditions a dangerous voltage may exist in some circuits, even when power supply is off, because of charges retained by capacitors. To avoid casualties always ground any circuit prior to handling.

#### 7A-16. TEST EQUIPMENT REQUIRED.

Refer to paragraph 7A-12.

#### 7A-17. TRANSPONDER SET, AN/APX-25, TROUBLESHOOTING.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>BLOWER MOTOR DOES NOT OPERATE (Step 1, paragraph 7A-15).</b>		
Defective fuse.	MASTER to OFF. Check fuse.	Replace fuse.
Defective power supply, cabling, or filter F-245/APX-25.	Connect dc voltmeter (50-volt range) to test point, DC-3A should indicate $27.5 \pm 1.5$ volts.	Repair power supply or cabling, or replace filter.
Defective transponder set control.	Substitute test C-1158/APX.	If blower motor starts, replace C-1158/APX control.
Receiver-transmitter blower circuit.	Test blower circuit.	Repair.
<b>DECODING INDICATOR DOES NOT LIGHT (Step 2, paragraph 7A-15).</b>		
Defective power supply.	MASTER to STDBY, connect ac voltmeter (250-volt range) to test point AC-3A should indicate $115 \pm 2$ volts.	Repair power supply.
Defective coder.	Disconnect plug from CODER receptacle. MASTER to STDBY indication should be $115 \pm 2$ volts.	Test and replace coder.
Defective receiver-transmitter.	If preceding step was not $115 \pm 2$ volts, defective receiver-transmitter is indicated.	Test and replace receiver-transmitter.
<b>DECODING INDICATOR DOES NOT LIGHT (Step 3, paragraph 7A-15).</b>		
Defective receiver-transmitter (transmitter section)	Connect VIDEO IN (+) to test point (coder output).	If DECODING INDICATOR lights, test and replace receiver-transmitter.
Defective coder.	Connect TRIGGER OUT to test point (coder input, Mode 1).	If DECODING INDICATOR lights, test and replace coder.
Defective transponder set control.	Repeat first check with test control C-1158/APX.	If DECODING INDICATOR lights, test and replace control C-1158/APX.

**REPLACEMENT****WARNING**

Operation of electronic equipment involves the use of voltages which are dangerous to life. Personnel must observe safety precautions at all times. Turn power off prior to working on equipment and disconnect power from the airplane. Do not replace components of the system with the power supply on. Under certain conditions, a dangerous residual voltage may exist in some circuits, even when the power supply is off, because of charges retained by capacitors. To avoid casualties, always ground any circuit prior to handling.

**7A-18. SPECIAL TOOLS REQUIRED.**

None.

**7A-19. TRANSPONDER SET, AN/APX-25, MAJOR COMPONENTS, REPLACEMENT.**

Refer to Section I for the general instructions for removal and installation of radio equipment.

**7A-20. TRANSPONDER SET ANTENNA, REMOVAL.**

- a. Disconnect coaxial cable from antenna.
- b. Remove screws that attach antenna and gasket to fuselage skin and remove antenna from airplane.

**7A-21. TRANSPONDER SET ANTENNA, INSTALLATION.**

See figure 7A-4.

**ADJUSTMENT****7A-22. TRANSPONDER SET, AN/APX-25, ADJUSTMENT.**

No adjustments should be made to transponder set AN/APX-25 by organizational maintenance personnel.

**SERVICING****7A-23. TRANSPONDER SET, AN/APX-25, SERVICING.**

Refer to Section I for servicing requirements of radio equipment.

## AIM SYSTEM

### Section VII-B

## TRANSPONDER SET AN/APX-72; ALTITUDE ENCODER AAU-21/A; TEST SET TS-1843 AND TRANSPONDER COMPUTER KIT-1A/TSEC

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### DESCRIPTION

#### 7B-1. General.

The AIM System (figures 7B-1 and 7B-2) is a complete system which includes interrogation equipment and provides altitude and identification information from an aircraft to an interrogating station. The three basic functions provided by AIMS are an interrogation (question) function, a transponder (answer) function and an intelligence input function (altitude and IFF/SIF equipment). The interrogation and reply functions are accomplished through the Air Traffic Control Radar Beacon System (ATCRBS) portion of the AIM System. The ATCRB system consists of the target aircraft transponder system and the ground interrogator. On receipt of an interrogation pulse-group from the interrogator-transmitter unit at a ground station, the airborne transponder is triggered, causing a multi-pulse reply group to be transmitted. These replies are received by the ground in-

terrogator-receiver and, after video processing decoding, etc. are displayed to the ground control operator. The nature of the multiple pulse replies provides individualized information pertaining to the responding aircraft as to identification and altitude. The intelligence input function of the AIM system is accomplished through the operation of the IFF/SIF equipment and the altitude reporting equipment. The IFF/SIF (identification, friend or foe/selective identification feature) system provides the in-flight aircraft with positive identification if challenged by a ground or airborne IFF recognition installation (RI). On the receipt of an RI challenge, the system decodes the interrogating signal, encodes a reply, then automatically transmits the coded reply back to the RI where it is visually displayed on an indicating device such as a search radar plan position indicator. The system receives and transmits in MARK X and MARK XII IFF Systems.

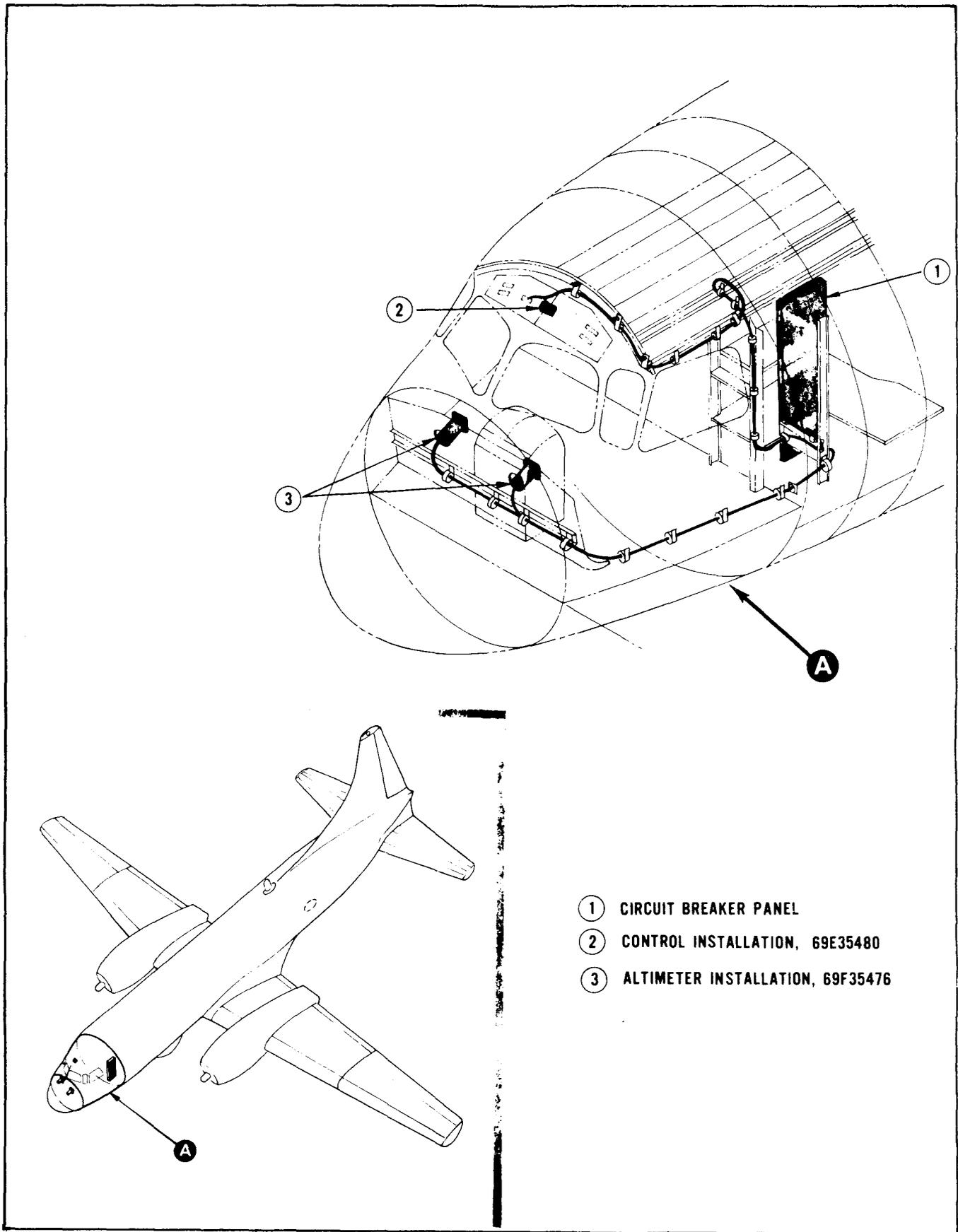


Figure 7B-1. Transponder Set (AN/APX-72) Controls Perspective

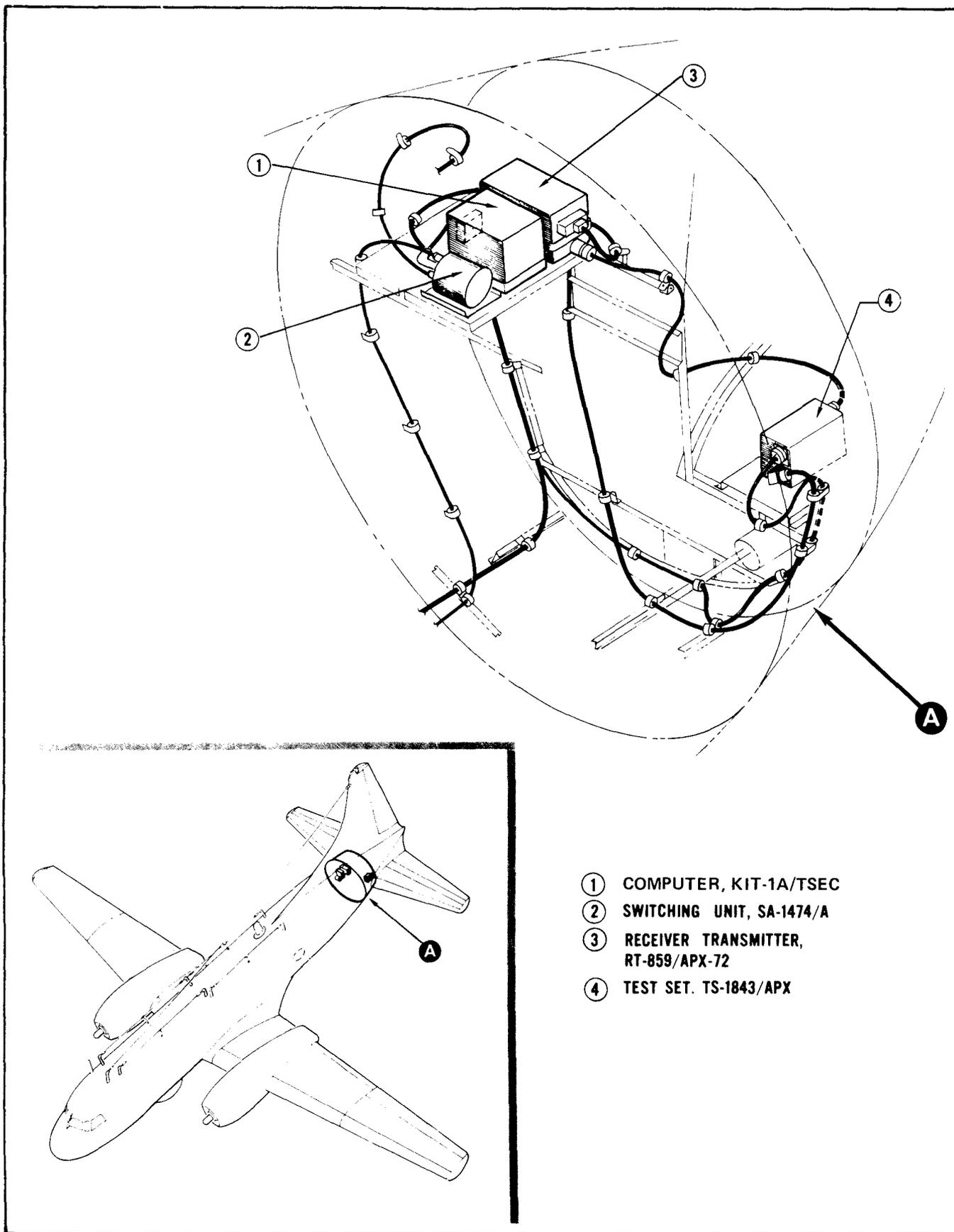


Figure 7B-1A. Transponder Set (AN/APX-72) Tailcone Perspective

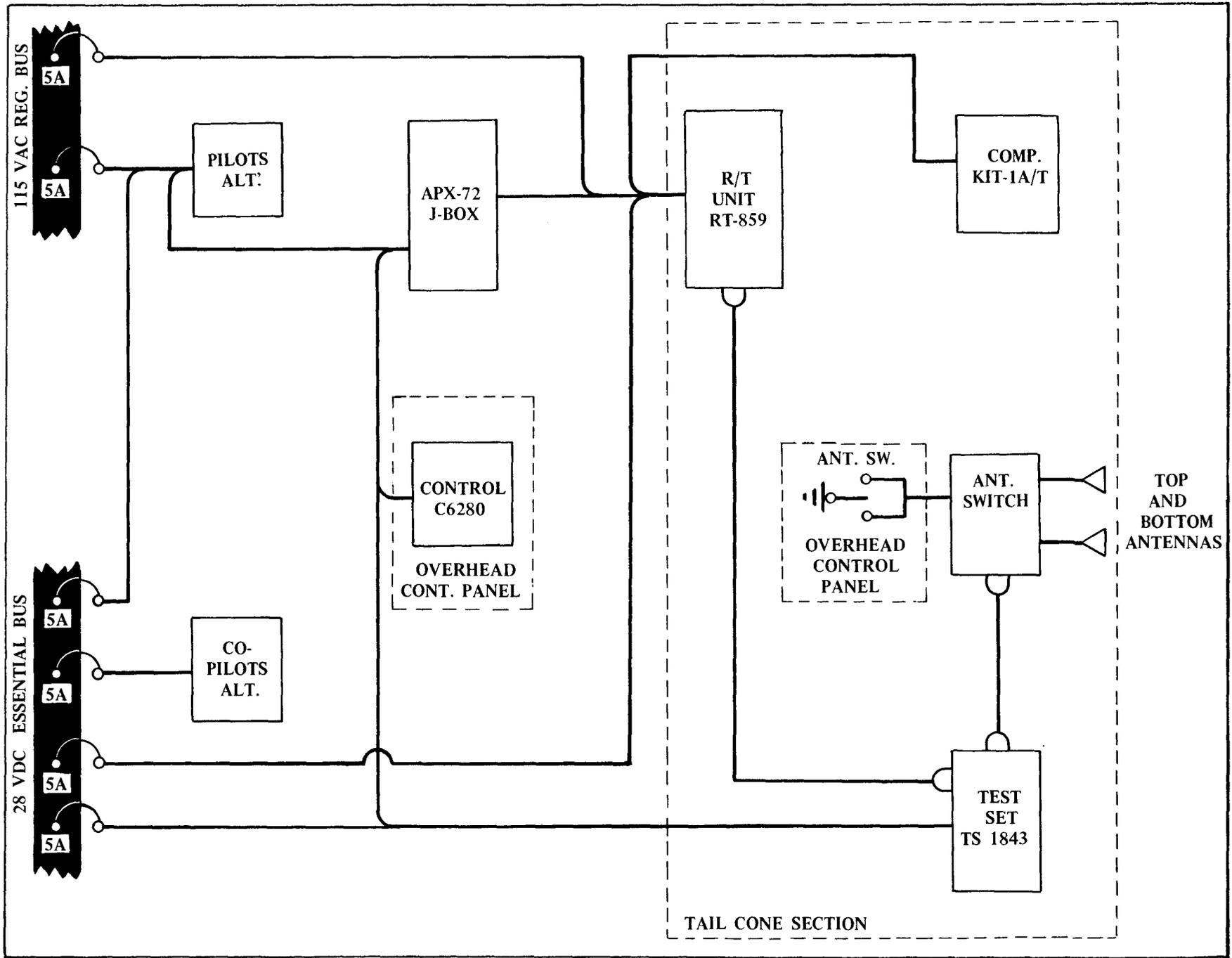


Figure 7B-2. Transponder Set (AN/AP X-72) Block Diagram

## 7B-2. TRANSPONDER SET, AN/APX-72, LIST OF COMPONENTS.

ITEM	LOCATION	FUNCTION
Transponder Set, Receiver-Transmitter, RT859/APX-72.	Tailcone section.	To receive and decode multi-pulse signals and to transmit coded replies.
Mount MT3809/APX-72 Receiver Transmitter RT859 mount.	Tailcone section.	To furnish adequate support for the receiver transmitter unit.
Test Set, TS1843/APX-72 Transponder.	Tailcone section.	To test and monitor the transponder system.
Mount Test Set MT3513/APX-72.	Tailcone section.	To furnish adequate support for the test set.
Antenna Switching Unit SA1474-A/APX-72 with Mount MT1948/U.	Tailcone section.	To alternately select top and bottom antenna of APX-72 system.
Mount, Computer MT4578/U for Kit-1A/SEC	Tailcone section.	To furnish adequate support for Kit-1A/SEC.
Computer, Transponder Kit-1A/T.	Tailcone section.	Process Mode 4 interrogations and causes the transponder to generate appropriately coded reply signals.
Control C6280AP/APX-72.	Pilots overhead control panel.	To provide all operating controls.
Circuit breaker, 5 ampere dc, TS1843 test set.	Radio junction box.	To protect test set circuit.
Circuit breaker, 5 ampere dc, APX-72.	Radio junction box.	To protect APX-72 circuit.
Circuit breaker, 5 ampere dc, AAU-21/A altimeter.	Radio junction box.	To protect altimeter.
Circuit breaker, 5 ampere dc, AAU-27/A altimeter.	Radio junction box.	To protect altimeter.
Circuit breaker, 5 ampere ac, APX-72.	Radio junction box.	To protect APX-72 circuit.
Circuit breaker, 5 ampere ac, AAU21/A altimeter.	Radio junction box.	To protect altimeter.
Altimeter, AAU21/A with Encoder.	Pilots instrument panel.	Furnishes altitude information to transponder set.
Antenna (2) AT741/A.	STA 549 upper. STA 651 lower.	To provide omnidirectional reception and transmission of signals for the transponder set.

7B-3. Control C6280. The IFF/SIF master control knob (7, figure 7B-3) is a five position, rotary switch. The knob is labeled MASTER and it controls the following functions: the OFF position removes power from the set; the STBY position applies power but does not enable the receiver; the LOW position, selected only upon order of a controlling agency, enables the receiver with reduced sensitivity so that only strong, local interrogations are answered; the NORM position enables the receiver with full sensitivity so that reply may be made at maximum range. The EMER position is selected by pulling out on the knob before rotating. When actuated, this mode automatically squawks an emergency reply to interrogation of Mode 1, 2, and 3/A. To disable EMER rotate the knob out of EMER position. The rotary master knob must be pulled out and rotated to OFF to remove power from set.

MODES 1, 2, 3/A and C have three-position toggle switches (2, 4, 6, and 8), with an OUT, a center ON, and a spring loaded TEST position. Placing one of these switches in the ON position will activate the mode associated with the switch. Proper operation of a mode is indicated when the test lamp illuminates while the mode enable/test switch is held in the TEST position. Mode C (Altitude Reporting) enables the APX-72 to report the aircraft pressure altitude to the interrogating agency.

The MODE 1 code select wheels (13), are used to set the desired two digit mode 1 reply code. The wheels are labeled MODE 1.

The MODE 3/A code select wheels (11), are used to set the desired four digit mode 3/A reply code. The wheels are labeled MODE 3/A.

The switch labeled IDENT-OUT-MIC (10), is a three position toggle switch. OUT position disables the ident feature. At the request of the controlling agency, this switch is momentarily pressed to the IDENT position. The switch spring returns to the OUT position but the set will initiate a special identification reply for 15 to 30 seconds on the MODE and CODES selected.

With the switch in the MIC position, the set will initiate the special identification on the MODE and CODES selected each time the UHF transmitter button is depressed. MODES C and 4 are not affected by this switch.

#### NOTE

In the event the IP/MIC switch is in the MIC position and the UHF transmitter is keyed, the transmitter (APX-72) may continue sending after the key is released. Should this occur, the IP/MIC switch should be manually moved to the OUT position to cease transmission.

The switch labeled RAD TEST-OUT-MON (9), is a three position toggle switch. The OUT position disables all functions of this switch. The MON position causes the test indicator light to illuminate when a reply is made to an interrogation of any selected mode. The RAD TEST position is used for ground test operation and requires additional equipment.

The Test Indicator Light (5), is labeled TEST and illuminates to indicate proper operation of the IFF/SIF modes when a mode enable switch is held at TEST. This light also illuminates when the radar test/monitor switch is at MON, the master switch is at NORM and the set is replying to an interrogation of any selected MODE. It is a green press-to-test type light that may be dimmed for night operation.

MODE 4 is a military secure MODE. Controls and indicators for MODE 4 are located on the left side and top of the APX-72 control unit (1, 3, 14, and 15), outlined by a white line. MODE 4 interrogation is received by a special transponder-computer which encodes and triggers a proper identification response signal. The master rotary switch controls transponder action in all MODES. When the MODE 4 enable switch is selected ON, MODE 4 will operate normally in either NORM or EMER position of the master control knob and at a reduced receiver sensitivity in LOW. MODE 4 is inoperative in either STBY or OFF position of the master control knob. To operate MODE 4, the MODE 4 enable switch must be in the ON position, special codes must be inserted into the system, and code A or B selected. Should MODE 4 fail to reply to a valid interrogation, the IFF caution light will illuminate.

The amber colored IFF caution light is located on the pilot's overhead control panel. It illuminates to alert the pilot that the APX-72 has failed to reply to a valid MODE 4 interrogation provided: (1) the aircraft power is ON and (2) the IFF master control knob is not OFF. The IFF caution light circuitry monitors for: (1) MODE 4 codes zeroized, (2) transponder failure to reply to proper interrogation, and (3) automatic self-test function of the computer reveals a computer malfunction. Should the IFF caution light illuminate, check IFF master control knob in NORM, MODE 4 enable switch is ON, and MODE 4 code selector knob in proper A or B code position for current code time period. If light remains illuminated, avoid operation in a known MODE 4 interrogating environment or if already in one, take appropriate corrective or emergency action as operationally directed for this condition (inoperative MODE 4).

The MODE 4 enable switch (14), is provided for control of MODE 4 operation. It is labeled ON and OUT. It is a positive action switch which may be pulled out to be placed OFF.

The MODE 4 reply indication select switch (15), is a three position toggle switch with a LIGHT, an OUT (center) and

AUDIO position. When the switch is placed in the LIGHT position, only the reply light (3), of MODE 4 is enabled. The AUDIO position enables both the reply light and the aural indication. With the switch in AUDIO, an aural signal indicates MODE 4 interrogations are being received and illumination of the MODE 4 reply light indicates replies are transmitted. In the OUT position, both light and audio indications are inoperative. This switch must be in either the AUDIO or LIGHT position when operating MODE 4.

A green MODE 4 reply indicator light (3), is provided to indicate MODE 4 replies are being transmitted when the MODE 4 reply indication select switch is either in the AUDIO or LIGHT position. The reply light will not illuminate when pressed-to-test unless the MODE 4 reply indicator light is on the AUDIO or LIGHT position.

The MODE 4 code selector is a four position (HOLD, A, and ZERO) rotary knob (1). A and B codes are preset daily as operationally directed by the single insertion of a code changer key. A is the present CODE and B is the next succeeding CODE thereby enabling the set to properly reply to any valid MODE 4 interrogation during a given time period. The ZERO position zeroizes the code setting. Both codes are normally zeroized when the master switch is turned to OFF after the aircraft has landed. If a second flight is anticipated during the proper time periods, the code settings may be retained by selecting the HOLD position of the knob. The HOLD position is spring loaded to return to the A position. To hold codes, the knob must be held momentarily (2-3 seconds) to the HOLD position before power is removed from the transponder. Allow transponder power to remain on for at least 15 seconds after the knob is released, and then turn OFF as desired. The code setting is now mechanically latched and will be retained when aircraft power is turned off.

To hold the code setting, the aircraft's weight must be on the landing gears. The HOLD feature will remain in effect until the aircraft's weight is off the landing gears.

If power is removed from the transponder less than 15 seconds after selecting HOLD, either by turning the transponder OFF or by turning OFF aircraft electrical power, the code setting will zeroize when transponder power is lost.

Both A and B codes may be zeroized any time the aircraft has electrical power ON and the APX-72 Master Knob is in any position except OFF by placing the code selector knob to the zero position. The code selector must be pulled out before it can be turned to the ZERO position. Any time (in flight or on the ground) the IFF master control knob is placed in the OFF position, the A and B codes are zeroized unless the HOLD function has been properly actuated. Use Code A or Code B as operationally directed.

#### **7B-4. TRANSPONDER TEST SET, T1843.**

The test set is used to indicate continued satisfactory performance of the IFF/SIF system on a GO-NO-GO basis.

When the transponder test set is operated in the self-test MODE by placing one of the MODE 1, 2, 3A, or C switches on the control in the TEST position, it generates interrogation pulse pairs for the desired MODE. These interrogations are applied to the transponder to check for proper receiver frequency, sensitivity, and decoding. The test set analyzes the resulting replies for bracket spacing, frequency, power, and antenna circuit VSWR and provides a GO-NO-GO indication to the operator in the form of an illuminating lamp for a GO condition and an extinguished lamp for NO-GO conditions. The lamp is located on the control panel. The self-test modes will operate only if the master switch on the control panel is set to NORMAL position.

In monitor operations, the transponder test set indicates transponder performance by detecting transponder replies that are generated to external interrogation signals. The test lamp on the control panel will illuminate for a GO indication and will be extinguished for a NO-GO indication.

The APX-72 system can operate without the test set and its absence will not effect the normal operation of the other components. However, the absence of the test set deprives the operator of all test capabilities. In lieu of the test set, a bypass connector or cable can be installed in the antenna line between the antennas and the transponder.

#### **7B-5. Transponder Set AN/APX-72 Receiver-Transmitter, RT-859.**

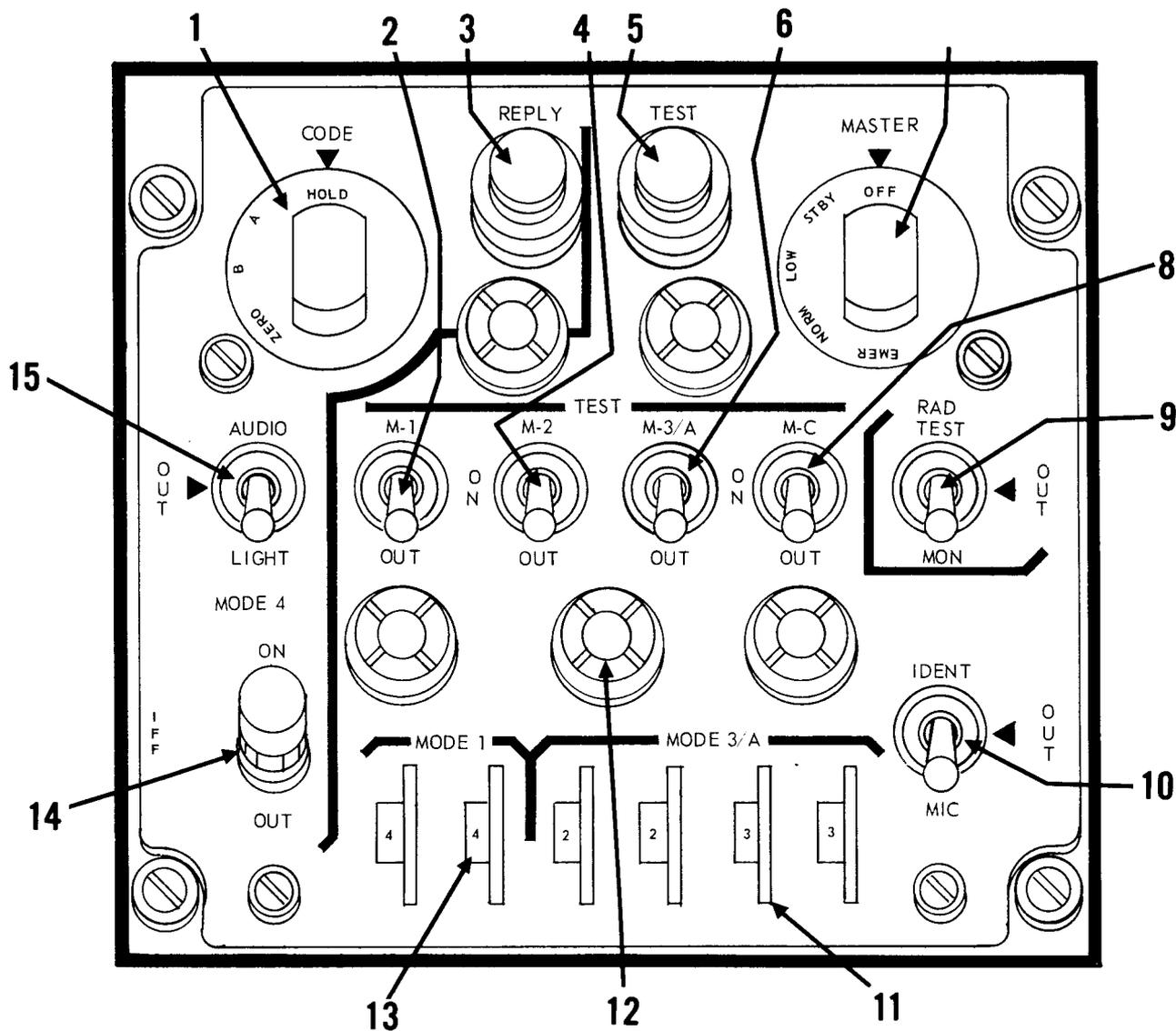
The RT-859/APX-72, when used with auxiliary equipment listed in paragraph 7B-2, provides automatic radar identification, identification of position, emergency signals, and altitude reporting of the craft on which it is located to all suitably equipped interrogating facilities within the operational range of the system. The RT-859/APX-72 receives, decodes and replies to the characteristic interrogations of operational MODES 1, 2, 3/A, C and 4. Specially coded identification of position (I/P) and emergency signals can be transmitted to interrogating stations when conditions warrant. The absence of auxiliary equipment, computer Kit-1A/TSEC and altimeter AAU-21/A, will not affect operation of the RT-859/APX-72 except in MODES 4 and C.

#### **7B-6. ALTIMETER-ENCODER AAU-21/A.**

The AAU-21/A altimeter-encoder combines a conventional pneumatic altimeter (counter-drum-pointer display) and an altitude-reporting encoder in one self-contained unit. The 10,000 and 1,000 foot counters and the 100 foot drum provide a direct digital output and readout of altitude in increments of 100 feet, from -1000 to 38,000 feet. The digital output is referenced to 29.92 in. hg. and is not affected by changes of barometric setting. The pointer repeats the indications of the 100 foot drum, and serves both as a vernier for the drum and as a quick indication of the rate and sense of altitude changes. Two methods may be used to read indicated altitude on the counter-drum-pointer altimeter: (1)

# IFF/SIF Radar Systems Control Panel

AN/APX-72



- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>1. MODE 4 CODE SELECTOR KNOB</li> <li>2. MODE 1 ENABLE/TEST SWITCH</li> <li>3. REPLY INDICATOR LIGHT</li> <li>4. MODE 2 ENABLE/TEST SWITCH</li> <li>5. TEST INDICATOR LIGHT</li> <li>6. MODE 3/A ENABLE/TEST SWITCH</li> <li>7. IFF/SIF MASTER CONTROL KNOB</li> <li>8. MODE C ENABLE/TEST SWITCH</li> <li>9. RADAR TEST/MONITOR ENABLE SWITCH</li> </ul> | <ul style="list-style-type: none"> <li>10. IDENTIFICATION OF POSITION ENABLE SWITCH</li> <li>11. MODE 3/A CODE SELECT WHEELS</li> <li>12. PANEL LAMPS</li> <li>13. MODE 1 CODE SELECT WHEELS</li> <li>14. MODE 4 ENABLE SWITCH</li> <li>15. MODE 4 REPLY INDICATION SELECT SWITCH</li> </ul> |
|--|--|

Figure 7B-3. Control Panel C 6280/APX-72

read the counter drum window, without reference to the pointer, as a direct digital readout in thousands and hundreds of feet, or (2) read the thousands of feet on the two counter indicators, without referring to the drum, and then add the 100 foot pointer indication.

The self-contained servo driven encoder provides altitude encoded in 100 foot increments for automatic transmission when the AIMS transponder is interrogated on MODE C. In case of power loss to the encoder servo system, a CODE OFF flag will appear automatically in a window in the upper left portion of the display, indicating that altitude information is no longer being transmitted to the ground. In this condition, the instrument continues to function as a normal barometric altimeter.

The altimeter setting is entered by use of a normally operated barometric set knob in the lower left front of the instrument case. The altimeter setting appears on counters in the window in the lower right of the display and has a range of settings from 28.1 to 31.0 in. hg.

An internal vibrator operates continuously whenever aircraft dc power is turned ON. The vibrator minimizes internal mechanical friction, enabling the instrument to provide a smoother display during changing altitude conditions. Should vibrator failure occur, the altimeter will continue to function pneumatically, but a less-smooth movement of the instrument display will be evident with changes in altitude.

**7B-9. The APX-72 components utilize the following power sources.**

NOMENCLATURE	POWER	DECAL
Transponder	28vdc ESS 115vac REG	IFF/SIF RT Unit 115VAC IFF
Test set	28vdc ESS	IFF/SIF Test Set
Altimeter (Copilot's)	28fdc ESS	Copilot's Altm DC
Altimeter (Pilot's)	28fdc ESS 115vac REG	Pilot's Altm DC Pilot's Altm AC

**7B-10. COMPUTER, TRANSPONDER (KIT-1A/TSEC)**

The IFF MARK X system becomes the IFF MARK XII system through the addition of a MODE 4 capability to the basic IFF (SIF) equipment. The MODE 4 function of this system provides for a secure (encrypted) IFF capability

## WARNING

If the altimeter's vibrator is inoperative due to either internal failure or dc power failure, the 100 foot pointer may momentarily hang up when passing through "0" (12 o'clock position). If the vibrator has failed, the 100 foot pointer hang up can be minimized by tapping the case of the altimeter. Pilots should be especially watchful for this failure when their minimum approach altitude lies within the 800-1000 foot part of the scale (1800-2000 feet, 2800-3000 feet, etc.), and should use any appropriate altitude back-up information available.

**7B-7. Altimeter - AAU-27/A.**

The co-pilot's AAU-27/A altimeter provides the same pneumatic capabilities as the pilot's AAU-21/A. But it does not have the altitude encoder. The face display of the AAU-27/A is the same as that of the AAU-21/A.

**7B-8. Antenna Switching Unit.**

a. The antenna switching unit is a solid state lobe which provides coverage from antennas located on the fuselage top and bottom. It continually switches at the rate of 38 cps between the two antennas. The unit is remotely controlled by a switch on the pilot's overhead panel. The three position toggle switch (TOP, BOT, and BOTH) is located beside the MODE 4 caution light and is used to select either the top, bottom, or both antennas.

b. The MODE 2 code select wheels on the transponder are used to set the assigned four digit identity code.

through use of a KIR-1A/TSEC computer with the interrogator and a KIT-1A/TSEC computer with the transponder. With the KIT-1A operational in the aircraft, the computer processes MODE 4 interrogations and causes the transponder to generate appropriately coded reply signals.

**7B-11. Antenna (AT-741/A).**

The antennas used in the APX-72 system are vertically polarized and omnidirectional. The bottom antenna is located

on the aircraft center line at approximately station 651. The top antenna is located on the aircraft center line at approximately station 549.

**OPERATIONAL CHECKOUT PROCEDURES**

**7B-12.** The operational checkout procedures are divided into three parts. Paragraph 7B-13 provides a system self-test utilizing the aircraft installed TS-1843 test set. Paragraph 7B-14 provides a GO-NO-GO procedure utilizing the radiation method, and paragraph 7B-15 provides a complete system checkout utilizing the antenna insertion test jacks.

**7B-13. AN/APX-72 Self-Test Procedure.****NOTE**

To perform this operational checkout, test set TS-1843/APX, must be installed in the aircraft. Refer to figure 7B-3 for control settings.

- a. Turn aircraft power ON.
- b. Engage AN/APX-72 circuit breakers.
- c. Select STDBY position on MASTER switch (7) to NORM.
- d. Wait five minutes then place MASTER switch (7) to NORM.
- e. Select OUT position on M-2(4), M-3/A(6) and M-C(8) MODE selector switches.
- f. Move and hold the M-1 switch (2) to test position. A green indicator light (5) will ILLUMINATE, indicating that the set is operational in MODE 1.
- g. The MODE select switches are spring-loaded in test position and must be held in test position to perform the self-test function. In test position only the two framing pulses are generated. If the green light comes ON, then this MODE of operation is acceptable.
- h. Move the M-1 switch (2) to OUT position. The OUT position disables the MODE. The ON position is used for normal operation. In normal operation, reply codes are selected by code select switches.
- i. Repeat step f. for M-2 (4), M-3/A (6) and M-C (8).
- j. Upon completion of steps a. through i. and reception of acceptable indications, the system is acceptable as operational. To perform the system code tests, the equipment should be checked in accordance with paragraphs 7B-15 and 7B-16.

**7B-14. Test Procedure - GO-NO-GO.****7B-15. Test Equipment Required.**

- a. KIR-1A/TSEC interrogator computer.
- b. KIK-18/TSEC keyer and keying material.
- c. ST-21 test set.
- d. KIT-1A/TSEC transponder computer.
- e. TTU-205B/E pressure-temperature test set.
- f. AN/APM-123(V) transponder test set.
- g. CN1088/U 50DB attenuator or CN1088A/U 55DB attenuator.
- h. UG564/U adapter.

**7B-16. Coding and Decoding.****NOTE**

The following procedure provides a rapid GO-NO-GO system check of the AN/APX-72 including the antenna elements. If correct results are not obtained using this procedure, the procedures in paragraph 7B-17 should be accomplished to isolate the malfunction.

- a. Apply external power to aircraft.
- b. Engage AN/APX-72 circuit breakers.
- c. Place inverter switch to MAIN and load monitor switch to OVERRIDE.

**NOTE**

To differentiate between the control setting of the transponder set from those of the test set, the control of the transponder set will be identified by its identifying number ( ), reference figure 7B-3. The GO-NO-GO lights on the AM/APM-123(V) test set indicate the following:

- (1) ACCEPT (White) indicates acceptable transponder set performance or satisfactory self-test.

(2) REJECT (Red) indicates transponder or self-test failure.

d. Set master switch (7) to STDBY, and RAD TEST-OUT-MON switch (9) to OUT.

e. After 5 minutes, place master switch (7) to NORMAL.

f. Position the AN/APM-123(V) test set within an area 50 ±10 feet from the aircraft antenna. Do not have any obstruction between the test set and the aircraft antenna.

g. Set up the AN/APM-123(V) test set for the radiation function, direct the arrow on the test set antenna toward the aircraft transponder set antenna.

h. Connect external power to the AN/APM-123(V) and place POWER switch in the appropriate position (115vac or 28vdc) for power source being used.

i. Place function switch to self test position.

j. Place the press to test switch in LOCK position. The ACCEPT indicator should light and the REJECT indicator should remain OFF in MODES 1,2,3/A, and 3/A,CJ test if the test set is operating properly. MODE 4 does not have a self test function.

k. Place SIDE LOBE SUPPRESSION switch to ON, ACCEPT indicator should remain lighted. Return SIDE LOBE SUPPRESSION switch to OFF.

l. Set M-2 (4), M-3/A, M-C (8) switches to OUT and M-1(2) switch to ON. Set MODE 1 code selector (13) to 73 and MODE 3/A code selector (11) to 0077. Set antenna select switch to UPPER.

m. Set MODE 2 code selectors on receiver-transmitter to the reply code assigned to the aircraft or 7777.

n. Set code selector on test set to 7300.

o. Place MODE switch to position 1 and the DIR-RAD switch to RAD.

p. Place function switch to SYSTEM position.

q. Place the press to test switch in the LOCK position. The ACCEPT indicator should light indicating acceptable receiver-transmitter performance. The REJECT indicator should not light. If ACCEPT indicator does not light and REJECT indicator is ILLUMINATED, perform the following checks to determine the probable cause:

#### NOTE

Adjust the antenna on the AN/APM-123 if necessary, to obtain an ACCEPT light.

(1) Release press to test switch from LOCK position.

(2) Place function switch to self test position and depress the press to test switch. ACCEPT indicator should light if test set is operating properly.

(3) If step (2) checks satisfactorily, place function switch in FREQ-POWER position and depress the press to test switch. If the ACCEPT indicator ILLUMINATES, the coder function of the transponder is the probable cause of the reject. (In FREQ-POWER position, the test set evaluates overall transponder set performance excluding the coder function.)

#### NOTE

During the following tests, conduct a self test of the test set periodically and whenever necessary to verify an indicated transponder set failure. Accomplish by placing FUNCTION switch to self test and depressing press to test switch if not already in the LOCK position. ACCEPT indicator should light.

#### NOTE

Do not set MODE 3/A to Code 7600 or 7700 for a radiated test. Confine these settings to closed loop testing. Code 7600 signifies a communications failure and Code 7700 signifies an aircraft in distress.

#### NOTE

On the transponder set control the two code selector wheels for MODE 1 correspond to codes A and B on the test set and the four code selector wheels for MODE 3/A correspond to codes A, B, C, and D, reading from left to right. The A, B, C, and code numbers are the sum of the respective pulses; i.e.,  $A_1 + A_2 + A_4$  pulses are generated when code A7 is selected. Set codes C and D on the test set to 00 for MODE 1 Code selections.

r. Place press to test switch to LOCK position.

s. Rotate antenna select switch to all three positions (UPPER, LOWER and BOTH). ACCEPT indicator should remain illuminated.

t. Actuate ISLS switch to ON. ACCEPT indicator should extinguish and REJECT indicator should illuminate. Return ISLS switch to OFF.

u. Check MODE 1 using codes 43, 33, 22, and 11 on the control panel code selector (13) and 4300, 3300, 2200, and 1100 on the AN/APM-123 test set.

v. Set M1 (2) to OFF.

w. Set M2 (4) to ON. Set code selectors on receiver-transmitter and AN/APM-123 to 7777. Set MODE switch to 2. ACCEPT indicator should illuminate and REJECT indicator should extinguish.

x. Repeat steps s. through t. above.

y. Repeat step w. above using codes 4444, 3333, 2222, and 1111.

z. Set M-2 (4) to OFF.

aa. Set M-3/A(6) to ON and MODE 3/A code selector (11) to 0077.

ab. Set code selector on test set to 0077 and MODE switch to 3/A. ACCEPT indicator should illuminate and REJECT indicator should extinguish.

ac. Repeat steps s. through t. above.

ad. Place MODE switch to test. Place RAD TEST-OUT-MON switch (9) to RAD-TEST. ACCEPT indicator should ILLUMINATE and REJECT indicator shall extinguish.

ae. Place MODE switch to 3/A, and RAD TEST-OUT-MON switch (9) to OUT.

af. Repeat steps aa. through ab. above using codes 7777,4444, 3333, 2222, and 1111.

ag. I/P MODE (Ident) test.

(1) Set MODE 3/A code selector (11) to 7777. On the AN/APM-123 set code selector to 7777.

(2) Place function switch on test set to IDENT (IP).

(3) Energize the UHF communications system.

(4) Place IDENT-OUT-MIC switch (10) to IDENT position, hold for approximately one second and release. Note time of release. Observe that the ACCEPT light remains illuminated for 15 to 30 seconds after release and then extinguishes.

(5) Switch pilot's and co-pilot's interphone control to COMMAND position.

(6) Place IDENT-OUT-MIC switch (10) to MIC position. One at a time, actuate the pilot's and co-pilot's microphone switch for approximately one second and release. Note time of release. Results should be the same as for step (4) above.

ah. Emergency MODE test.

(1) Place IDENT-OUT-MIC switch (10) to OUT.

(2) Conduct Emergency MODE test first in MODE 1, code 73 then MODE 2, code 7777 and MODE 3/A, code 7700. For MODE 3/A check, select code 7700 on the test set and verify that a correct reply can be obtained regardless of the code setting at the transponder set control. Do not dwell in emergency MODE.

(3) Place function switch on test set to EMER position.

(4) Place master switch (7) to EMER position. (Knob must be lifted to rotate switch.) ACCEPT indicator should light for each emergency MODE check.

(5) Return master switch (7) to NORM and FUNCTION switch to SYSTEM.

ai. MODE C (Altitude Reporting) test.

**CAUTION**

The TTU-205B/E test set requires 115vac, 400 Htz power source. Observe all normal precautions to preclude damaging the airspeed indicator or altimeter.

(1) Engage PILOT'S and CO-PILOT'S ALTM circuit breakers.

(2) Assure proper test set-up has been accomplished per preceding paragraphs and apply power to TTU-205B/E.

(3) Connect the TTU-205B/E to the pilot's pitot static system and perform a leak test. All leaks must be repaired before continuing with MODE C test.

**NOTE**

Pitot input pressure must be connected and the TTU-205B/E airspeed input must be maintained at 50 knots for all test altitudes.

(4) Assure master switch (7) is still in NORM position and function switch is in SYSTEM position.

(5) Place M-C switch (8) to the ON position.

(6) Observe that the CODE OFF flag is not in view on the AAU-21/A encoder and the vibrator is operating. This indicates the encoder system is being supplied with 115vac power.

(7) Set the AAU-21/A encoder barometric scale to 29.92.

(8) Place MODE switch on AN/APM-123(V) to C.

(9) Place the press to test switch in LOCK position.

(10) Apply pressure to the altimetry system until the TTU-205 altimeter indicates the altitudes listed in Column A figure 7B-4. Set in the corresponding code listed in Column I, figure 7B-4 in the code selector on the AN/APM-123(V). ACCEPT light should ILLUMINATE. AAU-21/A should read within values listed in Column H, figure 7B-4.

(11) Repeat step (10) for all test altitudes.

(12) If the ACCEPT light fails to ILLUMINATE, accomplish a self test on the AN/APM-123(V). If self test of the test set is satisfactory, remove the AAU-21/A from aircraft and return to shop for bench check.

(13) Disconnect TTU-205B/E from the pilot's pitot static system and reconnect to the co-pilot's pitot static system. Apply pressure to the system for 1000, 5000, and 20,000 feet, the AAU-27/A altimeter should read the value in Column A with tolerance as listed in Column H of figure 7B-4.

- (14) Disconnect TTU-205B/E test set from aircraft.
- (15) Disengage Pilot's and Co-Pilot's altimeter circuit breakers.

aj. MODE 4 test procedure.

- (1) Place the master switch (7) to STDBY and function switch to self test.
- (2) Assure that MODE 4 VER BIT 1 and 2 and the SIDE LOBE SUPPRESSION switches are OFF.
- (3) Set the switches on the Transponder Control as follows:

<u>SWITCH</u>	<u>POSITON</u>
MASTER	NORMAL
M-1, M-2, M-3/A, M-C	OUT
AUDIO/LIGHT	AUDIO
CODE	A
MODE 4	OUT

- (4) Set the Controls on the AN/APM-123(V) as follows:

<u>SWITCH</u>	<u>POSITION</u>
FUNCTION	SYSTEM
MODE	4
CODE A/B	A
PRESS TO TEST	LOCK
DIR-RAD	RAD

- (5) Connect the KIR-1A computer to the MODE 4 connector on AN/APM-123(V) using cable CX-12216/APM-123(V). ZEROIZE light on AN/APM-123(V) should ILLUMINATE.
- (6) Using the KIK-18, key the KIR-1A and close access door. ZEROIZE light on AN/APM-123 should extinguish.
- (7) Install the KIT-1A computer in the aircraft.
- (8) Observe the following results:
  - (a) REJECT light on test set shall ILLUMINATE.
  - (b) Audio tone should be heard in the head set.
  - (c) IFF CAUTION light shall ILLUMINATE.

(9) Using the KIK-18, key the KIT-1A and close access door. Results should be the same as step 8 above.

(10) Release the press to test switch from the LOCK position and place MODE 4 switch (14) to ON.

(11) Briefly depress the press to test switch and observe the following:

**NOTE**

Press to test switch may have to be depressed 4 or 5 times in order for ACCEPT indicator to ILLUMINATE.

- (a) Audio tone should be heard in the headset.
- (b) REPLY light (3) shall ILLUMINATE.
- (c) IFF CAUTION light shall extinguish.
- (d) ACCEPT light on test set shall ILLUMINATE.

(12) Place AUDIO-OUT-LIGHT switch (15) to LIGHT and repeat step 11 above. Observe same results except audio tone shall not be heard.

(13) Place MODE 4 code A/B switch to B and briefly depress the push to test switch, REJECT light shall ILLUMINATE. Place CODE switch (1) to B. Briefly depress the press to test switch. ACCEPT indicator shall ILLUMINATE, REJECT indicator shall extinguish.

(14) Return MODE 4 code A/B switch and CODE switch (1) to A.

(15) Place the MODE 4 VER BIT 1 switch to 1 and briefly depress the press to test switch. REJECT light shall ILLUMINATE.

(16) Return the MODE 4 VER BIT 1 switch to OFF.

(17) Place the MODE 4 VER BIT 2 switch to 2 and briefly depress the press to test switch. REJECT light shall ILLUMINATE.

(18) Return MODE 4 VER BIT 2 switch to OFF.

(19) Place the SIDE LOBE SUPPRESSION switch to ON and briefly depress the press to test switch. REJECT light shall ILLUMINATE.

(20) Return the SIDE LOBE SUPPRESSION switch to OFF.

(21) Depress the squat switch on the left main landing gear and hold for 15 seconds and release. (This simulates gear up and gear down.)

(22) Place MODE 4 code switch (1) to HOLD for 2 seconds then return to A.

INPUT TEST POINTS		AAU-21/A OUTPUTS AND TOLERANCES	
A ALTITUDE	C a/s (KTS)	H FLIGHT LINE TOL. ± FT.	I AN/APM-123 (V) MODE C CODE OUTPUTS
0	50	60	0660 0620 0630
1000	50	70	0360 0320 0330
5000	50	100	4260 4220 4230
10000	50	130	6560 6544 6510 6520 6530
20000	50	190	7760 7740 7710 7720 7730
30000	50	230	1640 1460 1440 1410 1420 1430 1010
35000	50	250	5514 5164 5144 5114 5124 5134 1144

Figure 7B-4. Mode C Altitude Test Points

(23) Wait at least 15 seconds and turn master switch (7) to OFF.

(24) Wait at least 15 seconds and turn master switch (7) to STDBY and after 15 seconds to NORM.

(25) Briefly depress the press to test switch on the test set. ACCEPT light shall ILLUMINATE. REPLY light (3) shall ILLUMINATE.

(26) Repeat steps 21, 23, and 24 above but do not repeat step 22.

(27) Briefly depress press to test switch several times and observe the following:

(a) REJECT light on test set shall ILLUMINATE.

(b) IFF caution light shall ILLUMINATE.

(28) Using the KIK-18, key the KIT-1A. Close the access door. Briefly depress the press to test switch and observe the following:

(a) ACCEPT indicator shall ILLUMINATE.

(b) REPLY light (3) shall ILLUMINATE.

(c) IFF caution light shall extinguish.

(29) Place MODE 4 code switch (1) to ZERO and the AUDIO-OUT-LIGHT switch (15) to AUDIO.

(30) Place the press to test switch in the LOCK position and observe the following:

(a) REJECT light on test set shall ILLUMINATE.

(b) Audio tone shall be heard in the headset.

(c) IFF CAUTION light shall ILLUMINATE.

(d) Reply light shall extinguish.

ak. Test procedure - TS-1843 test set.

#### NOTE

Do not change any of the bench set adjustments on the TS-1843 test set.

(1) Place function switch to self test and MODE switch to 1.

(2) Press the test light (5) and check that the light ILLUMINATES.

(3) Place the RAD TEST -OUT- MON switch (9) to OUT position.

(4) Place MODE switches M-1 (2), M-2 (4), M-3/A (6), and M-C (8) to test position one at a time and observe that the green test light (5) displays a steady light as each switch is actuated. This indicates the airborne test set (TS-1843) is interrogating and the receiver-transmitter has

responded with a "GO" evaluation for system performance, including receiver sensitivity and frequency, transmitter power output and frequency, decoding; reply framing pulse spacing and antenna system VSWR. If the test light (5) does not ILLUMINATE, the TS-1843 is probably faulty since previous tests would have detected a defective receiver-transmitter.

#### NOTE

Power must be applied to the altitude encoder to obtain a "GO" indication with MODE C switch (8) in the test position.

(5) Place function switch to SYSTEM.

(6) Place RAD TEST-OUT-MON switch (9) in MON position. Place M-2 (4), M-3/A (6) and M-C (8) switches to the OUT position and M-1 (2) to ON. Place press to test switch on AN/APM-123 to LOCK position.

(7) Place MODE selector to 1. Test light (5) should ILLUMINATE.

(8) Place M-1 switch (2) to OUT and M-2 switch (4) to ON.

(9) Rotate MODE selector to 2. Test light (5) should ILLUMINATE. Repeat this procedure for MODE 3/A and C.

#### NOTE

When not being properly interrogated by the AN/APM-123, the test light (5) may blink at a slow steady rate when the RAD TEST-OUT-MON switch (9) is in MON. This is normal and does not indicate a failure. No light or a random flickering light indicates a malfunction.

(10) Return the RAD TEST-OUT-MON switch (9) to OUT and master switch (7) to OFF.

(11) Remove power from all test equipment and disconnect all test cables.

(12) Place inverter switch to OFF.

(13) Disconnect external power from aircraft.

#### NOTE

After completion of checkout procedure, be sure connector on KIT-1A/TSEC harness on MT-4578/U is protected.

**7B-17. Test Procedure - Complete System.**

**7B-18. GENERAL.**

The following procedure is designed to provide a complete transponder system check using the test signal insertion provisions provided for both the upper and lower antennas. The AN/APM-123 will be connected to the appropriate test receptacle in lieu of connecting to the antenna cable.

**NOTE**

Test equipment required is the same for the radiation test and listed in paragraph 7B-14.

a. Test equipment hookup.

(1) Locate the test set AN/APM-123 in the aft section of the aircraft.

(2) Connect the AN/APM-123 to either 115vac, 400 cycle or 28vdc power source.

(3) Disconnect the RF cable from probe jack on the AN/APM-123 test set and attach the CG 409G/U cable to the probe jack.

(4) Disconnect the aircraft antenna cable from the RT859 receiver transmitter and connect the attenuator CN1088/U or CN1088A/U to the receiver transmitter.

(5) Connect the CG 409G/U cable from the AN/APM-123 test set to the attenuator.

(6) Apply external power to aircraft.

(7) Engage AN/APX-72 circuit breakers (6 each).

(8) Place inverter switch to MAIN and load monitor switch to OVERRIDE.

(9) Place the DIR-RAD switch on test set AN/APM-123 to DIR.

b. Test procedure for RT859 receiver transmitter. With the test set AN/APM-123 connected to check point 1 as shown in figure 7B-5 perform operational check out as described in paragraphs 7B-15 and 7B-16.

c. Test procedure for test set TS1843 and associated wiring. With the test set AN/APM-123 connect to check point 2 as shown in figure 7B-5, perform operational check out as described in paragraphs 7B-15 and 7B-16.

d. Test procedure for antenna lobing switch, upper antenna. With the test set, AN/APM-123, connected to check point 3 as shown in figure 7B-5, and the antenna select switch in UPPER, perform the operational check out as described in paragraphs 7B-15 and 7B-16.

e. Test procedure for antenna lobing switch, lower antenna. With the test set, AN/APM-123, connected to check point 4 as shown in figure 7B-5, and the antenna select switch in LOWER, perform the operational check out as described in paragraphs 7B-15 and 7B-16.

f. Test procedure for test receptacle, upper antenna. With the test set, AN/APM-123, connected to check point 5 as shown in figure 7B-5, and the antenna select switch in UPPER, perform the operational check out as described in paragraphs 7B-15 and 7B-16.

g. Test procedure for test receptacle lower antenna. With the test set, AN/APM-123 connected to check point 6 as shown in figure 7B-5, and the antenna select switch in LOWER, perform the operational check out as described in paragraphs 7B-15 and 7B-16.

**7B-19. Removal of C-6280/APX-72 Control.**

a. Turn OFF electrical power.

b. Unfasten four dzus fasteners and pull control from the stationary panel.

c. Disconnect the electrical connections and remove from aircraft.

**7B-20. Installation of C-6280/APX-72 Control.**

c. Checkout the control. (Refer to paragraph 7B-13.)

d. Checkout test set. (Refer to paragraph 7B-13.)

**7B-21. Removal of RT859/APX-72 Transponder.**

- a. Turn OFF electrical power.
- b. Remove electrical connectors.
- c. Loosen 2 lock bolts.
- d. Pull transponder from mounting base and remove from aircraft.

**7B-22. Installation of RT859/APX-72 Transponder.**

- a. Set transponder in mount.
- b. Secure 2 lock bolts.
- c. Secure electrical connectors.
- d. Checkout transponder. (Refer to paragraph 7B-13.)

**7B-23. Removal of TS-1843/APX Test Set.**

- a. Turn OFF electrical power.
- b. Unfasten two dzus fasteners.
- c. Disconnect electrical connector and two coax connectors.
- d. Lift up on front of the unit and pull from mount.

**7B-24. Installation of TS-1843/APX Test Set.**

- a. Slide unit into mount.
- b. Fasten two dzus fasteners.
- c. Connect electrical connector and two coax connectors.

**7B-25. Removal of SA1474 Lobing Switch.**

- a. Turn OFF electrical power.
- b. Disconnect three antenna coax connectors and wire bundle.
- c. Unfasten two quick-disconnect fasteners at forward end of switch.
- d. Slide switch from mount.

**7B-26. Installation of SA1474 Lobing Switch.**

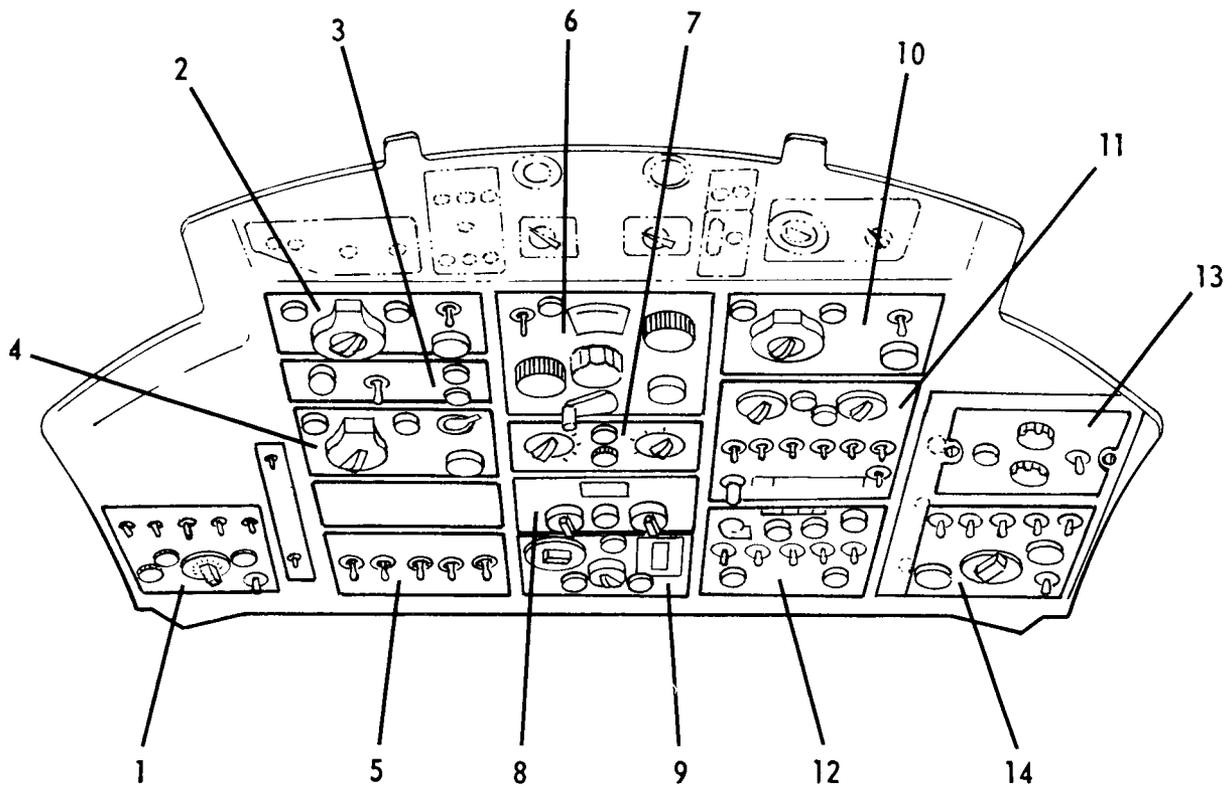
- a. Slide switch into mount.
- b. Fasten two quick-disconnect fasteners at forward end of mount.
- c. Connect three coax connectors and wire bundles.

**7B-27. Removal of AT-741/A Antenna.**

- a. Turn OFF electrical power.
- b. Disconnect antenna coax.
- c. Remove six mounting screws and remove antenna from aircraft.

**7B-28. Installation of AT-741/A Antenna.**

- a. Orientate antenna to mounting position and align mounting holes.
- b. Install six mounting screws.
- c. Connect antenna coax.



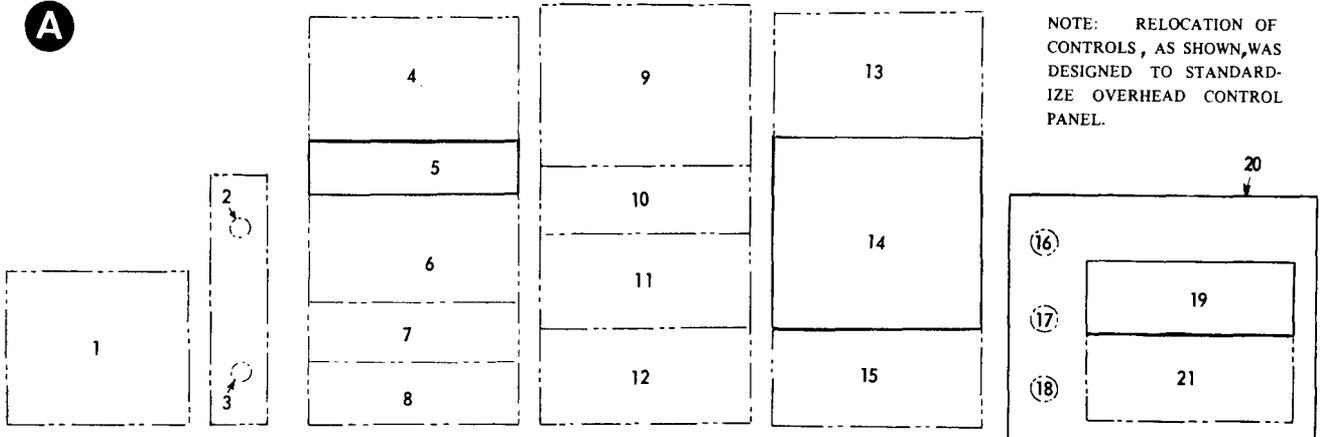
- |                                    |                           |
|------------------------------------|---------------------------|
| 1. A/C INTERPHONE                  | 8. VHF, WILCOX 807        |
| 2. VOR NO. 1                       | 9. UHF, ARC-27            |
| 3. INSTRUMENT SELECT SWITCH        | 10. VOR NO. 2             |
| 4. TACAN, ARN-21A                  | 11. IFF/SIF CONTROL PANEL |
| 5. COMMAND TRANSFER AUDIO SWITCHES | 12. HF, 714E-2            |
| 6. ADF, C-1514/A                   | 13. IFF/SIF CAUTION PANEL |
| 7. RADAR, C-4881                   | 14. INTERPHONE, A/C       |

T-29A AND T-29B MODEL AIRPLANES (TYPICAL)

Figure 7B-5. Overhead Control Panel Perspective (Sheet 1 of 2)



**A**

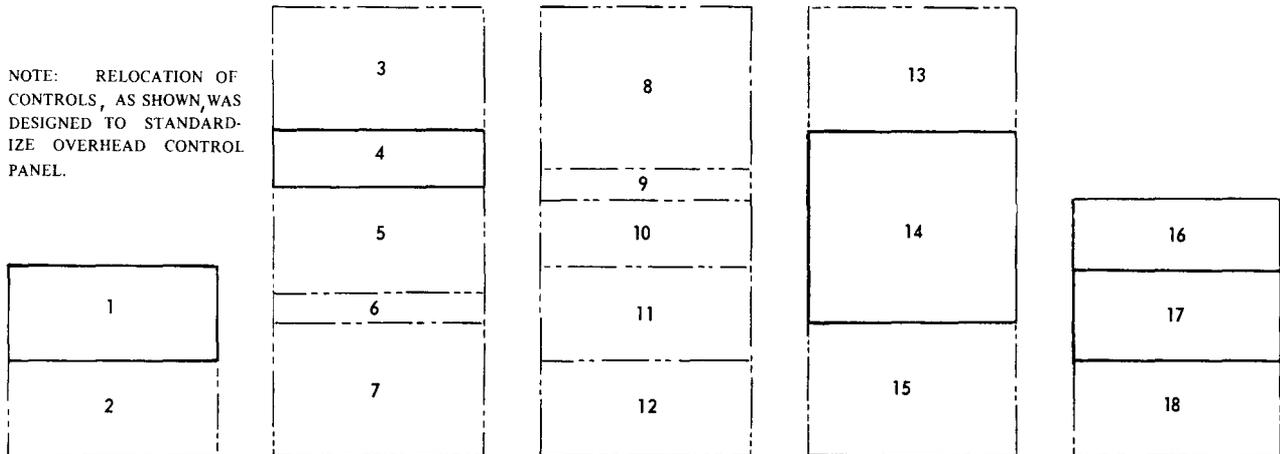


NOTE: RELOCATION OF CONTROLS, AS SHOWN, WAS DESIGNED TO STANDARDIZE OVERHEAD CONTROL PANEL.

- |                                    |   |
|------------------------------------|---|
| 1. A/C INTERPHONE                  | 12. UHF ARC-27                              |
| 2. COMPASS AUDIO                   | 13. # 2 VOR                                 |
| 3. LOUDSPEAKER                     | 14. TRANSPONDER CONTROL, C-6280 ( ) (P)/APX |
| 4. # 1 VOR                         | 15. HF 714E-2                               |
| 5. INST. SEL. SWITCH               | 16. COMPASS AUDIO                           |
| 6. TACAN ARN-21A                   | 17. FASTEN SEAT BELT                        |
| 7. BLANK                           | 18. NO SMOKING                              |
| 8. COMMAND TRANSFER AUDIO SWITCHES | 19. 1FF/SIF CAUTION PANEL                   |
| 9. ADF C-1514/A                    | 20. PANEL, 7140343-10                       |
| 10. RADAR C-4881                   | 21. A/C INTERPHONE                          |
| 11. VHF WILCOX 807                 |   |

**-1 CONTROLS INSTL. -T-29A, B (SINGLE ADF MODELS) VIEW LOOKING AT COCKPIT OVERHEAD PANEL**

NOTE: RELOCATION OF CONTROLS, AS SHOWN, WAS DESIGNED TO STANDARDIZE OVERHEAD CONTROL PANEL.



- |   |   |
|---|---|
| 1. INTERPHONE C-826                             | 10. RADAR C-4881                            |
| 2. BOMB SCORING TONE SWITCH OR PA CONTROL PANEL | 11. VHF WILCOX 807                          |
| 3. # 1 VOR                                      | 12. UHF ARC-27                              |
| 4. INST. SEL. SWITCH                            | 13. # 2 VOR                                 |
| 5. TACAN ARN-21A                                | 14. TRANSPONDER CONTROL, C-6280 ( ) (P)/APX |
| 6. BLANK  | 15. INTERPHONE C-824 A1C-10                 |
| 7. INTERPHONE C-824 A1C-10                      | 16. CONTROL ASSEMBLY, 7037134-10            |
| 8. ADF C-1514/A                                 | 17. INTERPHONE C-826                        |
| 9. BLANK  | 18. H.F. 714E-2                             |

**-3 CONTROLS INSTL., T-29C, D (EARLY MODELS) VIEW LOOKING AT COCKPIT OVERHEAD PANEL**

Figure 7B-5. Overhead Control Panel Perspective (Sheet 2 of 2)

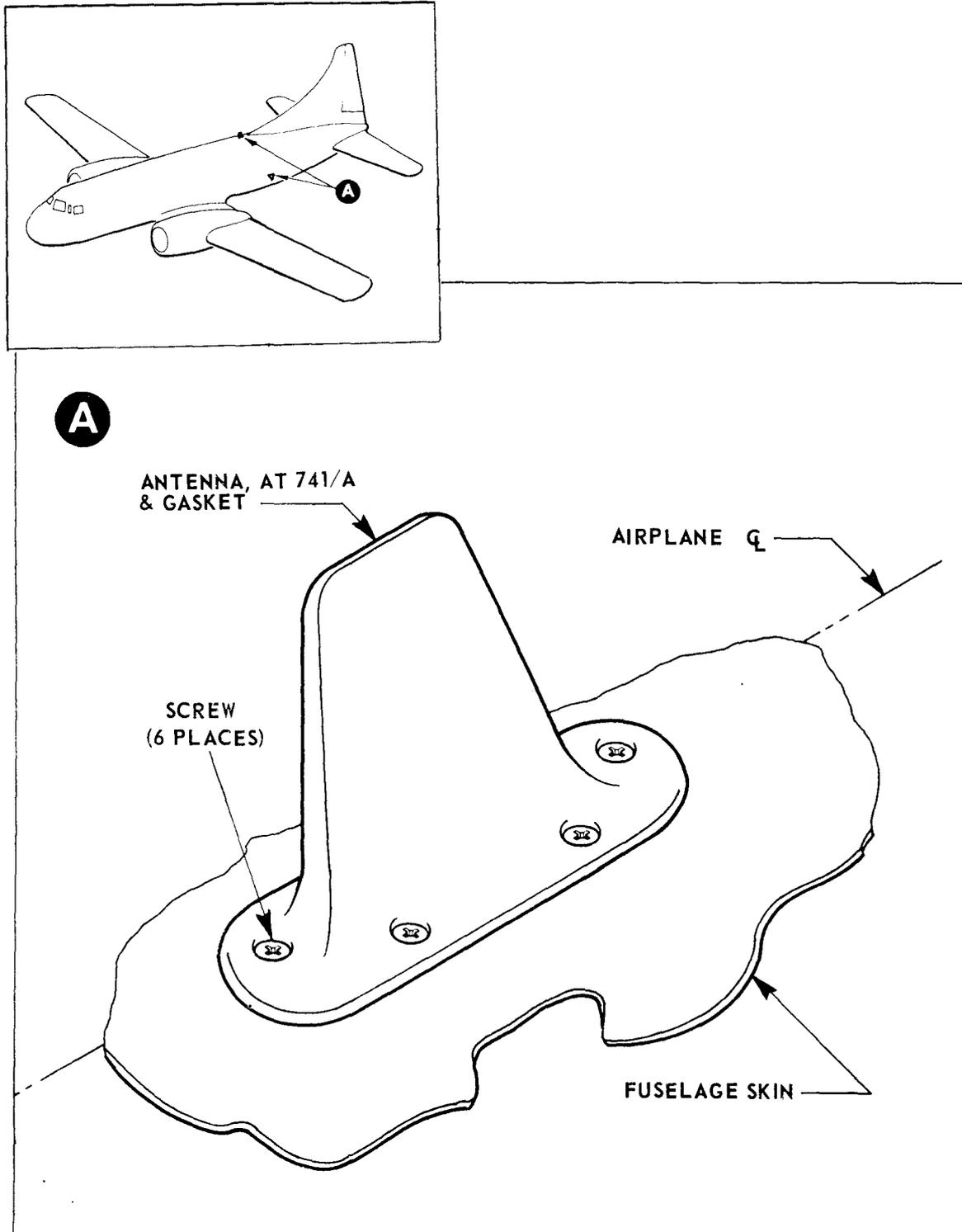


Figure 7B-6. Transponder Set Antenna (AT741/A) Perspective

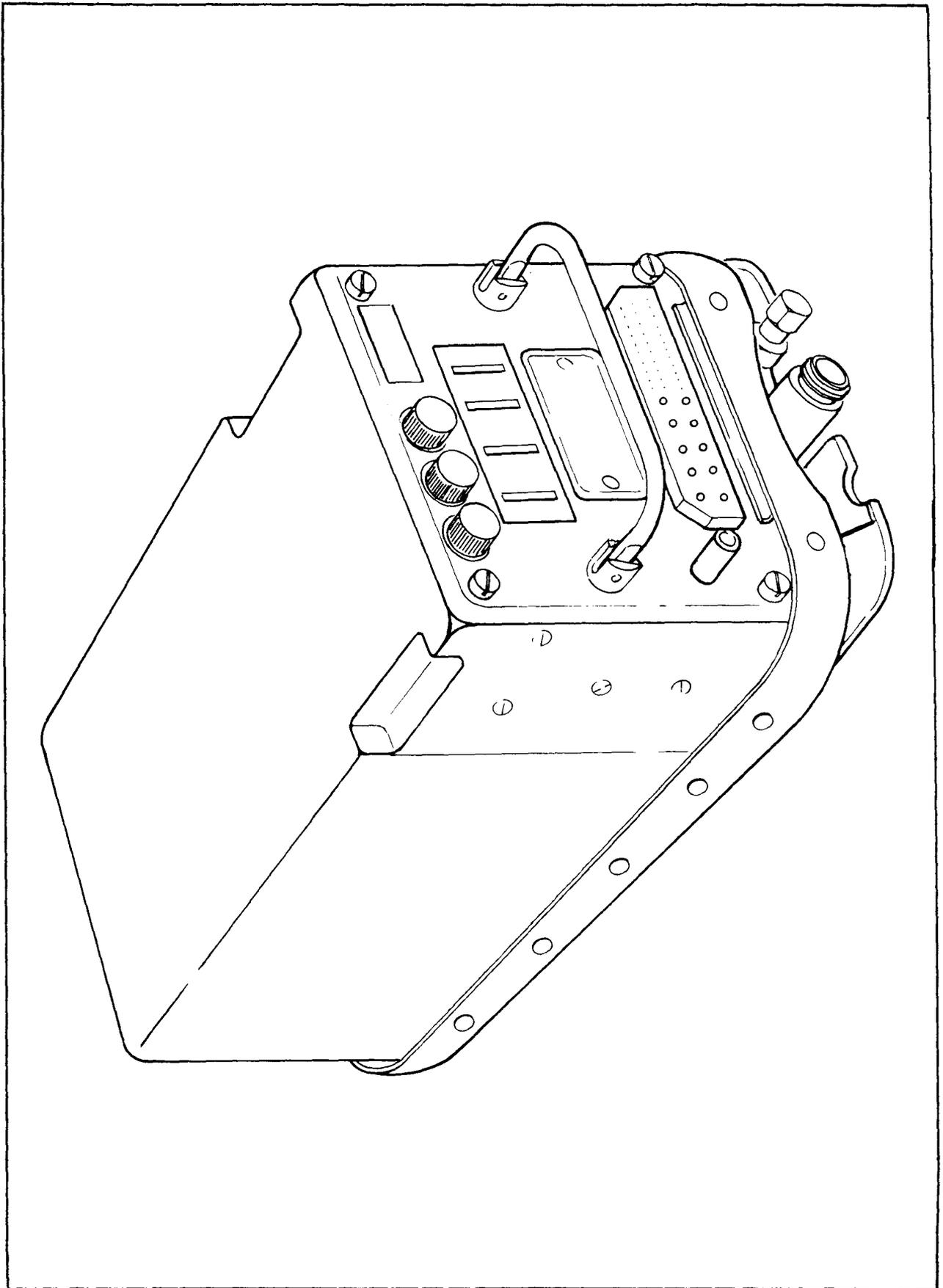


Figure 7B-7. Receiver-Transmitter RT-859/APX-72

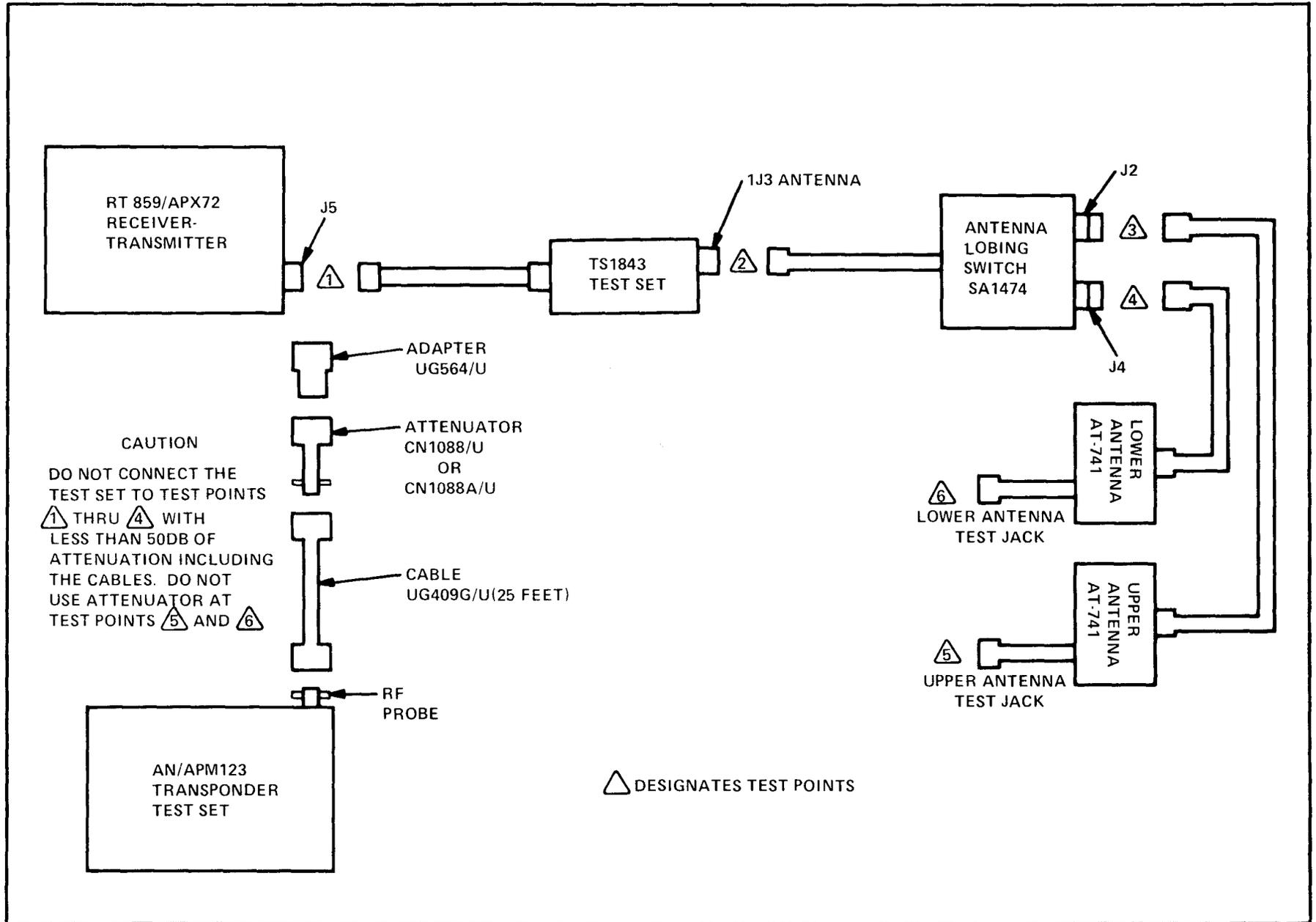


Figure 7B-8. Block Diagram, Complete AN/APX-72 Systems Test, Direct Method

## Section VIII

# GENERAL WIRING INFORMATION

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Description .....	83
Wire Maintenance .....	86
Trouble Shooting Electronic Systems .....	90
General Maintenance Notes .....	91

**DESCRIPTION**

### 8-1. GENERAL.

This section contains information in the use of wiring diagrams, coding and specifications of aircraft wiring, and wire selection and routing. Included in the latter paragraphs is a general discussion of wire maintenance and trouble shooting. Sections IX, X, and XI contain the wiring diagrams for the radio communications systems on the T-29A, T-29B, T-29C, and T-29D airplanes, respectively.

### 8-2. WIRING DIAGRAMS.

Wiring diagrams furnish the detailed information required for replacing or rewiring the items of electronic equipment. Wiring in the airplane is numbered and connected exactly as shown on the wiring diagrams. Interconnection between electronic circuits is indicated on the diagrams by reference to the manufacturer's drawing number — to find this reference, refer to the CROSS REFERENCE INDEX. A study of the applicable diagram will clarify the make-up and function of each power, control, and instrument circuit, and will guide the mechanic in tracing each circuit. The diagrams also aid in continuity checking, and general and specific trouble shooting on inoperative or defective circuits. Wiring diagrams are the most important tool in trouble shooting electronic systems.

### 8-3. HOW TO READ A WIRING DIAGRAM.

See figure 8-1.

### 8-4. HOW TO USE A WIRING DIAGRAM.

See figures 8-1 and 8-2. Wiring diagrams are used for general familiarization of a system, and are used, in conjunction with trouble shooting lists, in locating shorted or open circuits. As every wire in a circuit is marked exactly as noted on the diagram, and routing is shown through the various plugs and other connection points, reference to the diagram will locate any circuit in the airplane. After the circuit has been located, the trouble shooting list is again referred to for complete testing and isolation of the trouble. Each electronic wire is identified by a coded wire number fastened to both ends of the wire, and at intervals along the wire. The wire number on the wiring diagram verifies the number on the actual wire in the airplane, for positive identification of a particular circuit, and location within the circuit. Figure 8-2 shows an example of typical wire number. The broken number "2" indicates there is a duplicate item of equipment having the same wire identification. The "H" indicates the electrical wire is used in the Heating, Ventilating, and De-Icing circuit. The "R" indicates the wire is in the electronic Radio circuit, and the "L" that it is in Radio Liaison. The numbers "215" and "85" are the wire numbers. "A" and "F" indicate the wires are in the first and sixth segment from the source of power. Segment numbers are designated by the letters of the alphabet: A for 1, B for 2, etc. The letter "I" is not used. The broken "N" indicates that these wires complete the circuit to the ground network. If more complete information on a component is desired, make reference to the equipment list, using the equipment

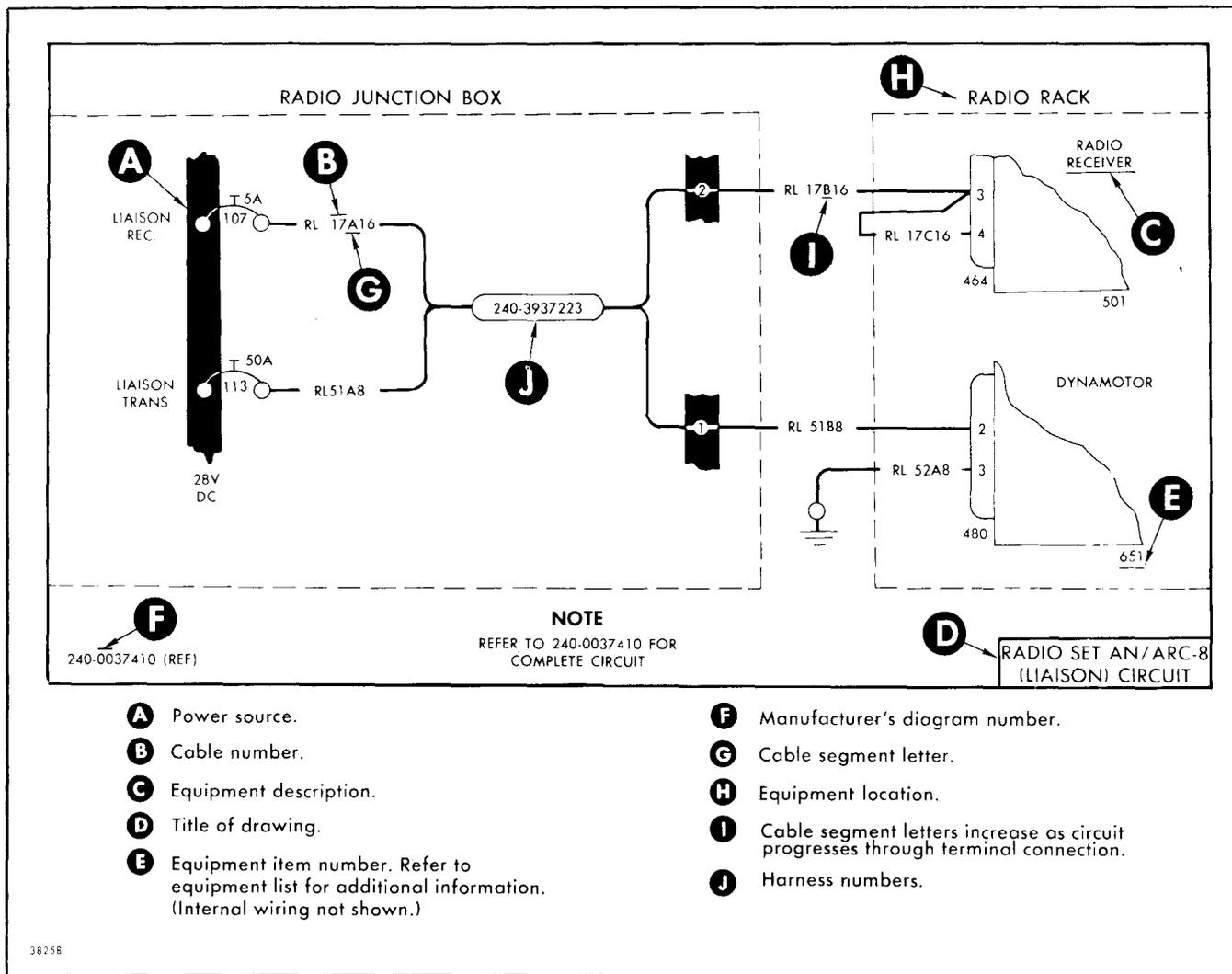


Figure 8-1. How To Read A Wiring Diagram

item number noted on the wiring diagram. When it is desired to order a component, reference to the noted manufacturer's drawing number may be made.

**8-5. LOCATION OF WIRING DIAGRAMS.**

For location of the wiring diagrams, refer to Section IX, X, and XI.

**8-6. SYSTEM WIRE CODES.**

See figure 8-2.

LETTER	SYSTEM
A	Armament
B	Photographic
C	Surface Controls
D	Instruments (other than flight or engine instruments).

LETTER	SYSTEM
E	Engine Instruments
F	Flight Instruments
G	Landing Gear
H	Heating, Ventilating, and De-Icing
J	Ignition
K	Engine Controls
L	Lighting
M	Miscellaneous
P	DC Power
Q	Fuel and Oil
RA	Radio Instrument Landing
RL	Radio Liaison
RM	Radio Marker Beacon

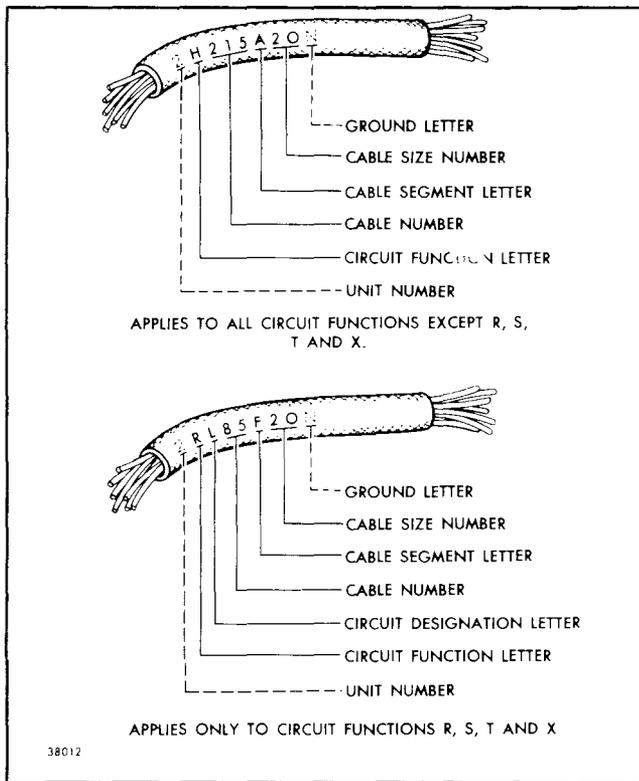


Figure 8-2. Wire Identification Code

LETTER	SYSTEM
RN	Radio Navigation
RU	Radio Command UHF
RV	Radio Command VHF
RZ	Interphone and Public Address
SA	Radio Altimeter
SN	Radar Navigation
SQ	Radar Bombing
SS	Radar Search
W	Warning and Emergency
XA	Three-phase Power
XB	Three-phase Power
XC	Three-phase Power
XN	AC Power Neutral or Ground
XP	Inverter or Alternator DC Power or Control
XV	Inverter or Alternator AC Power or Control
Fe	Iron Wire (black insulation — used in thermocouple leads)
Cn	Constantan Wire (yellow insulation — used in thermocouple leads)

**8-7. IDENTIFICATION CODE.**

See figure 8-2.

a. **UNIT NUMBER.** Where two or more identical items of equipment are installed in the same airplane, the unit numbers — 1, 2, 3, 4, — may be prefixed to differentiate between wires where it is desired that the equipment have the same wire identification. This requirement is mandatory for equipment listed under circuit function letters R, S, and T. In order to facilitate interchangeability requirements, identical wiring located in left and right wings, nacelles, and major interchangeable structural assemblies may have the same wire identification and the unit number is not required.

b. **CIRCUIT FUNCTION LETTER.** The circuit function letter is used to identify the circuit function specified in paragraph 8-6. Where a wire is used for more than one circuit function, the circuit function letter of that circuit which is functionally predominant shall apply.

c. **CIRCUIT DESIGNATION LETTER.** The circuit designation letter provides a refinement of the circuit function specified in paragraph 8-6, and shall be used only with circuit function letters R, S, T, and X. All other circuit functions shall not have a circuit designation letter.

d. **WIRE NUMBER.** The wire number, which shall consist of one or more digits, is used to differentiate between wires in a particular circuit. A different number shall be used for wires not having a common terminal or connection. Wire numbers 1,000 to 1,999 inclusive shall be reserved for use by the procuring agency to identify wires installed by service modifications.

e. **WIRE SEGMENT LETTER.** A wire segment is a wire between two terminals or connections. The wire segment letter is used to differentiate between wire segments in a particular circuit. A different letter shall be used for wire segments having a common terminal or connection. As a design objective, wire segments should be lettered in alphabetical sequence, and the letter "A" should identify the first segment of each circuit starting at the power source.

f. **WIRE SIZE NUMBER.** The wire size number is used to identify the AN or AL size of the wire.

g. **GROUND LETTER.** Ground wire letter "N" is used as a suffix to the wire identification code to identify any wire that completes the circuit to the ground network. Any such wire shall be capable of being connected to the ground network of the airplane electrical system without causing malfunctioning of the circuit.

**8-8. HOW TO FIND A WIRE NUMBER.**

a. Identify the system code letter; refer to paragraph 8-6.

b. Check the alphabetical index in Section IX, X, or XI for the figures that would be applicable to the identified system.

c. Check each applicable wiring diagram for the desired wire number.

d. When the wire serial number is found on a wiring diagram; find the desired segment number.

### 8-9. WIRE SELECTION.

The wires in a circuit must be of gage specified on the wiring diagram, and should not be kinked, frayed, or ruptured. General purpose low tension copper wiring, conforming to specification AN-J-C-48, is used in the airframe electrical installations, whether as individual wires, wire bundles, or routed through flexible or rigid conduit.

### 8-10. WIRE GAGES.

The size (gage) of the wire is designated in the American Wire Gage number (A.W.G.) — this system uses even numbers. The larger the number, the smaller the wire. The ampere rating, or current rating, of the wire is the amount of continuous duty current a wire will handle without appreciable heating. The fuse capacity of any wire is the maximum current the wire will carry without causing the strands to fuse together. When a wire is chosen for a particular installation, the wire size selected is one having a current rating equal to, or higher than, the maximum current the wire must carry. For example, a certain size wire will carry a load compatible with its heating effect tolerance, but because of its *length* there is the danger of an excessive voltage drop. To overcome this, a larger wire with a higher current rating would be used. In a 28-volt dc circuit, the allowable voltage drop for a continuous-duty current is 1-volt. If it is intermittent-duty current, a 2-volt drop is permitted. Intermittent operation may be defined as full loading of a circuit for not more than 3 minutes out of 20 minutes.

WIRE SIZE	RESISTANCE OF WIRE (OHMS PER 1000 FEET AT 20° C.)	BUNDLE RATING (AMPERES)	FUSE CAPACITY (AMPERES)
20	10.25	7.5	5
18	6.44	10.0	15
16	4.76	13.0	20
14	2.99	17.0	30
12	1.88	23.0	35
10	1.10	33.0	50
8	0.70	46.0	70
6	0.436	60.0	100
4	0.274	80.0	125
2	0.179	100.0	175
0	0.114	150.0	250
0	0.090	175.0	300

### 8-11. WIRE ROUTING.

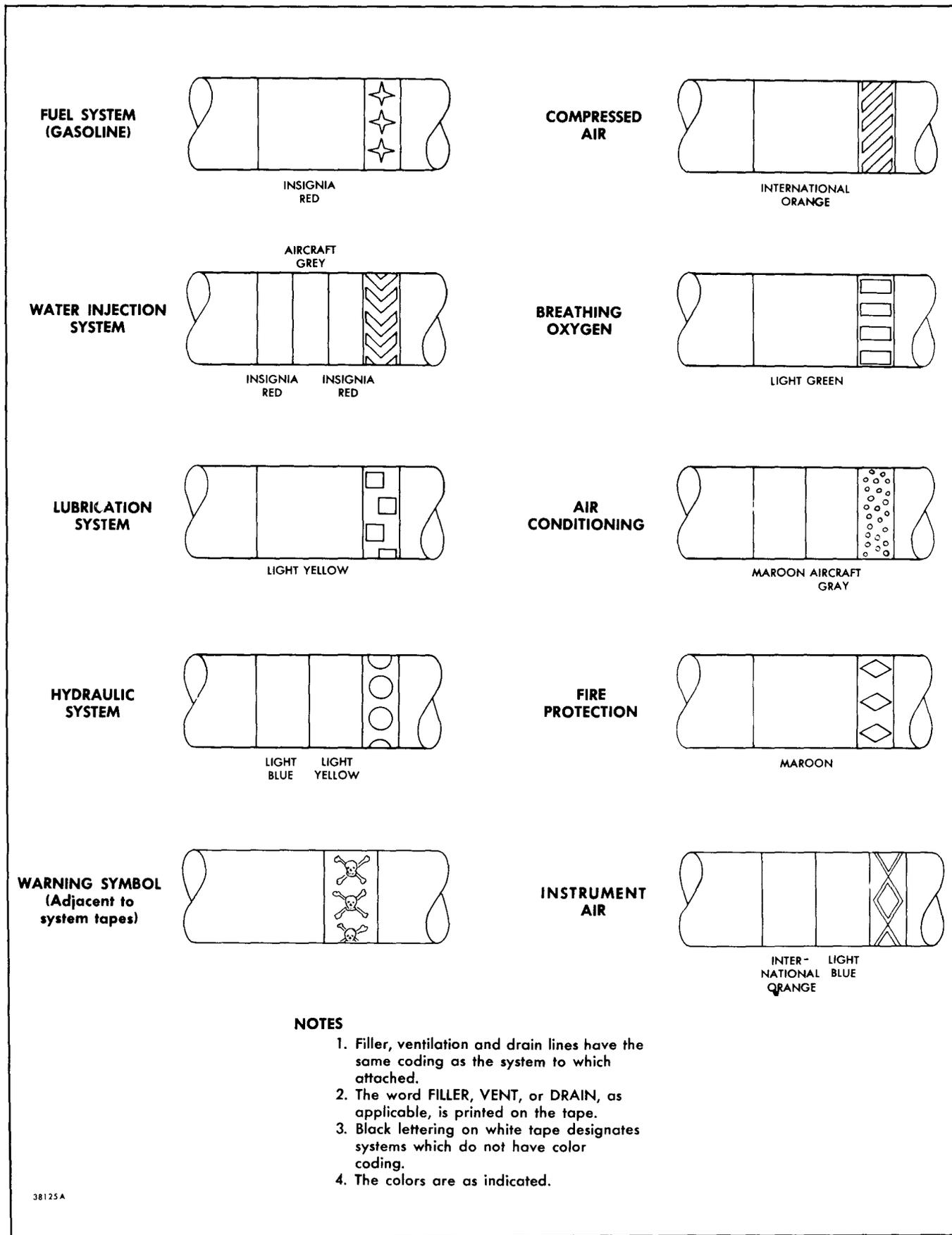
See figure 8-3. When a wire is replaced, it must be installed the way it was originally; that is, at least tied along the same bundle (harness). There must not be any shortcuts, short wires, an excess of slack, or an excess in tension in the replaced wires or individual wire. Wires must not be routed where an abrasion might occur, or where damage from battery acid fumes, fluids, exposure, or excessive heat would impair their reliability. When it is necessary to install wires in critical areas, they must be carefully insulated and correctly tied. All wires and clips, conduits, etc., must be kept a minimum of 2 inches from tubing containing combustible fluids — fuel, oil, hydraulic fluid, alcohol, and oxygen. A minimum of 12 inches must be maintained between wiring and oxygen lines in the vicinity of tubing containing combustible fluids. The referenced figure shows color and symbol coding found on the airplane tubing. In any event, wires shall not be attached to these lines or equipment.

## WIRE MAINTENANCE

### 8-12. GENERAL.

When installing and/or maintaining components or wiring, general security and condition of adjacent installations should be observed. Check terminal strips for surface cracks or breaks and security of connections; bonding and grounding jumpers for fraying, deterioration, or presence of corrosion. Wiring must not be attached to flexible conduits for support. Wiring may be spliced by use of a sta-kon connector. Emergency repairs may be accomplished by soldering wires

together, but all soldered connections will be replaced with an appropriate size connector as soon as possible. Splices must be covered with transparent insulating tubing extending at least 0.5 inch over each end and tied securely. Splices shall be staggered to prevent shorts due to puncturing of the insulation and to prevent excessive enlargement of the bundle. Permanent splices can not be used for salvaging short lengths of wire. Where wrapping type insulation is required for protection of wiring, use only plastic tape (Scotch Number 33) or vinyl tape. Other insulating tapes may



**NOTES**

1. Filler, ventilation and drain lines have the same coding as the system to which attached.
2. The word FILLER, VENT, or DRAIN, as applicable, is printed on the tape.
3. Black lettering on white tape designates systems which do not have color coding.
4. The colors are as indicated.

38125A

Figure 8-3. Tube Color Coding Chart

be used in emergencies, but will be replaced as soon as possible.

**CAUTION**

Use of friction tape is strictly prohibited, as it contains certain materials that are destructive to some wiring insulation.

**8-13. WIRE DAMAGE LIMITS.**

Wire damage to the extent shown on the following list does not seriously affect conductivity. If damage exceeds these limits however, the wire must be replaced, or repaired by installing a permanent splice; refer to paragraph 8-17. When cuts or nicks are discovered which do not require splicing or replacement, repair the defective insulation by wrapping with plastic or vinyl tape. Other insulating tapes may be used in emergencies, but must be replaced as soon as possible.

NUMBER OF STRANDS CUT OR NICKED		
WIRE SIZE (GAGE)	BETWEEN CONNECTION POINTS IN EACH SEGMENT	AT SEGMENT CONNECTION POINT
22 through 18 (7 strand)	1	None
22 through 10 (19 strand)	2	2
8 through 6	3	3
4 through 0	5	5

**8-14. TERMINALS.**

Terminals are installed at the ends of a conductor to make a firm, easy, dependable, and safer connection between the source of power and the unit to be operated. There are two general categories of terminals, the soldered and the solderless. The solderless is the most commonly used in aircraft. Terminals are never bent out of line with the wire unless absolutely necessary, and never past an angle of 60°.

**8-15. WIRE REPLACEMENT.**

Always replace damaged wires with wires of the same gage and composition as the original. In those instances where conduit installations occur before removing the damaged wire or wire group, secure a fish tape to one or more of the wires to be removed. By pulling the wire through the conduit and out the opposite end, the fish tape is threaded through the conduit and may be used to pull the new wire back through the conduit and into position. After a conduit repair has been completed, without the fish tape installed, the tape may be pushed through the conduit and used to pull the cable back through the conduit. If this method

fails, or if a tape or suitable equivalent is not available, the following procedure may be used:

- a. Place the knotted end of a cord a few inches within the conduit.
- b. Place a compressed air nozzle at the opening, and feed the cord into conduit while allowing the compressed air to blow the cord through, and out the opposite end. Work from the highest end of the conduit, so the cord will have the aid of gravity. Use the cord to pull a spare length of wire into the conduit which will in turn be used to pull the cable bundle into the conduit.
- c. With a series of half-hitches, lace the cable end so each terminal will be held close to the wire bundle; refer to paragraph 8-16.
- d. Align the wire bundle with the conduit and pull on the opposite end of the cord. If it is difficult to pull the wires through a long conduit, pull the wires out and rub the lacing and wires with paraffin.

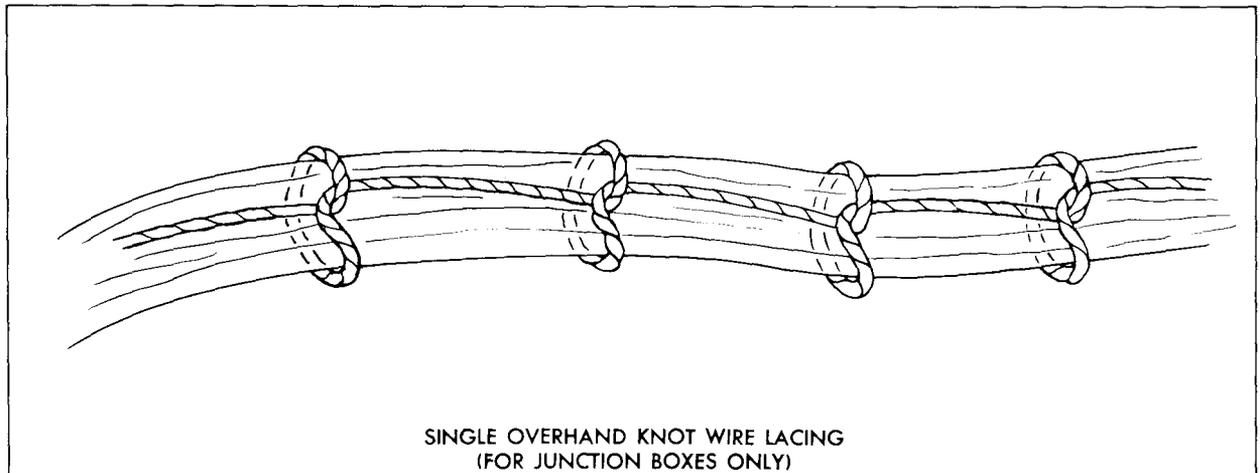
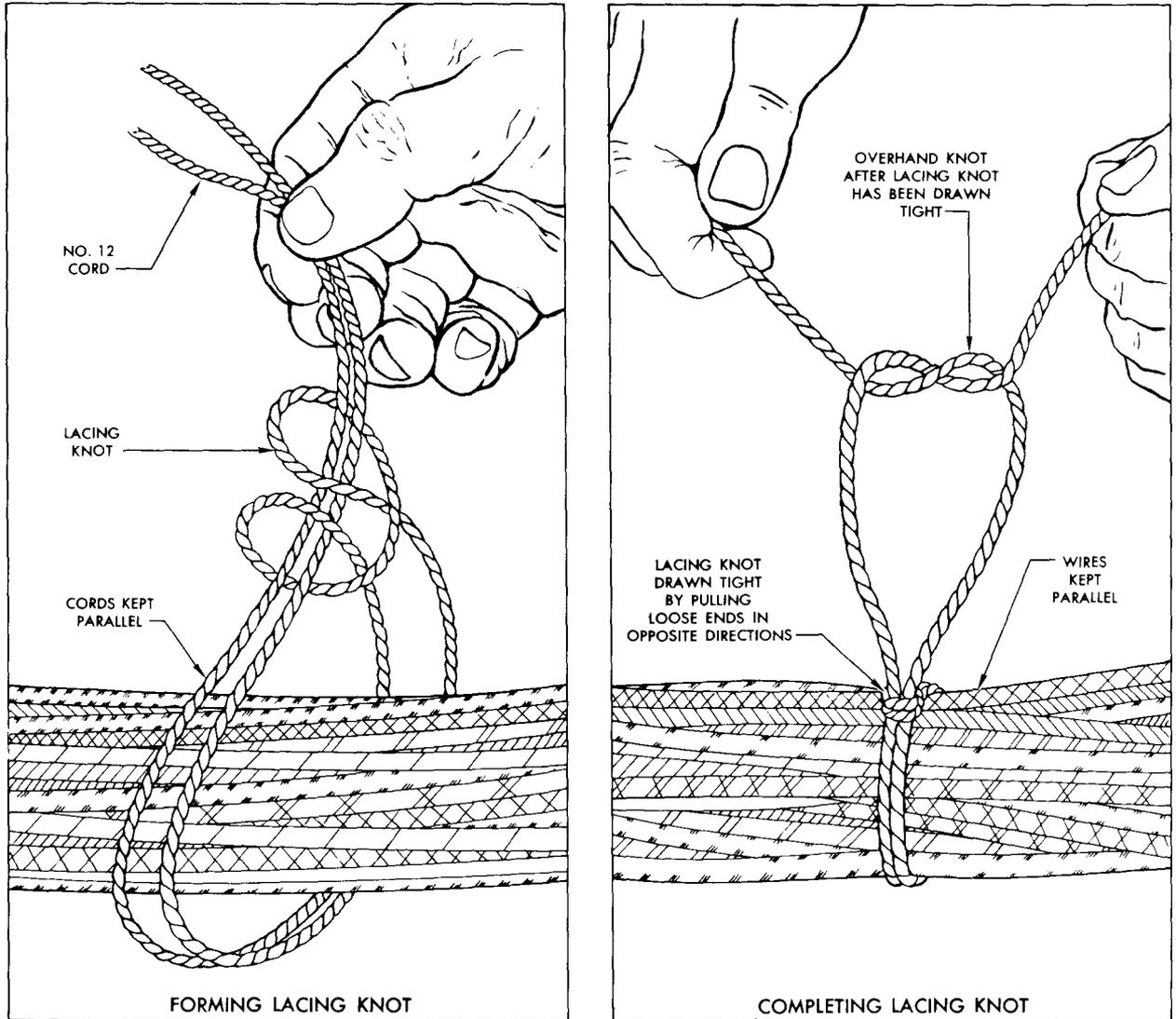
**8-16. WIRE LACING (SPOT-TYING).**

See figure 8-4. Lacing or spot-tying of wire groups and bundles is required within switch and junction boxes and on switch box covers. Where a number of wires enter a box, individual groups should be tied separately to facilitate wire removal and replacement. Use Specification MIL-C-5649, No. 12 cord for large wire bundles (12 or more wires) and No. 6 cord for small wire bundles, to spot-tie all long runs of wire every three inches. Be sure to spot-tie the wire bundle before each lead-off, regardless of the length of the run. Care must be taken to keep all wires within the bundle parallel and so arranged that the consecutive lead-off wire will be on the outside of the bundle. The most satisfactory method of lacing a wire group is with a wire-lacing knot as follows:

- a. Double a one-foot length of spot-tying cord and form a double loop on the closed end.
- b. Place the free end of the cord around the wire bundle and through the double loop.
- c. After making sure that all wires within the bundle are parallel, pull on the free ends of the cord until the double loop is pulled tight against the cords.
- d. Draw the lacing knot tight against the wire bundle by separating the two free strands and pulling them in opposite directions.
- e. Tie an overhand knot and draw it tight against the lacing knot. Trim the excess cord to within 0.25 inch of the knot.
- f. Coat knot with orange shellac or clear lacquer.

**NOTE**

Another method of lacing (for junction boxes only) is the use of a continuous series of single overhand knots. At the end of the series, this lacing can be secured by a double overhand (square) knot.



38014

Figure 8-4. Wire Lacing Knot, Typical

**8-17. REPAIR OF DAMAGED OR BROKEN WIRES.**

Damaged or broken wires may be spliced by removing the damaged area of the wire and attaching a two-way connector (AF Drawing No. 44A9215). Another type of repair is the use of the quick-disconnect splice. Where frequent removal of electrical or electronic equipment is required, this type of connection is generally used. It is also used in splicing wire bundles when a portion of the wire is installed in a prefabricated assembly, such as connecting the wire of a wing section to the wire of the fuselage or other connecting assemblies. Emergency repairs may be made by twisting and

soldering, taping and shellacking when a standard connector is not available. When this is done, the splice should be properly repaired at the first opportunity. Not more than two splices should be made per wire segment and these must be spaced at least four feet apart. Splices must not be made inside clamps or metallic conduit. Replacement wires must always be the same gage and composition as the original wire. Re-number replacement wires the same as the original wire. Do not use splices for salvaging short lengths of wire. In a harness containing a group of wires, 10 percent of the total number of wires in the harness can be spliced, provided that the splices are staggered sufficiently to prevent shorts due to puncturing of the insulation and to prevent excessive enlargement of the bundle.

<b>TROUBLE SHOOTING ELECTRONIC SYSTEMS</b>
--

**8-18. GENERAL.**

Failure of any electronic unit to operate when its control switch is turned to ON (or equivalent) requires that a check be made of the power lead to the unit, to determine that it is neither shorted to ground, nor open. A lead that is shorted to ground, to another electrical or electronic lead, or that has become overloaded due to fault within the operative electronic unit will cause the protective fuse to blow, or circuit breaker

to trip. An open circuit between an electronic unit and the power source will not cause the fuse to blow, or the circuit breaker to trip. After repairs or installation of electronic equipment, clear interiors of junction boxes and switch boxes of filings, cuttings, bits of solder, nuts, pieces of wire, and other foreign matter. Make sure that all terminals, terminal nuts, and conduit fittings and clamps are secure. Insofar as practicable, the electronic system and installation shall be restored to the original condition or as modified by official orders.

**8-19. TROUBLE SHOOTING MATERIAL SUPPLY INFORMATION.**

MATERIAL	SPECIFICATION
Cable, electric, low-tension aircraft.	MIL-W-5086
Cable, shielded, electric low-tension (for aircraft).	MIL-C-7078
Conduit, flexible, shielded.	MIL-C-6136
Connectors, electrical.	MIL-C-5015
Cord, cotton waxed.	MIL-C-5649
Cord, fiber glass. (Fiber glass cord will be used for spot-tying wire bundles in areas where high temperatures are encountered.)	
Tape, adhesive sealing rubber and cork composition.	MIL-T-6841
Terminal, electrical solderless.	MIL-T-5042
Tubing, aluminum, round, seamless.	Fed. WW-T-788
Tubing, aluminum, round, seamless.	Fed. WW-T-783
Tubing, extruded flexible vinyl plastic.	MIL-I-7444A (USAF)

### 8-20. ISOLATING TROUBLE IN ELECTRONIC CIRCUITS.

A short circuit will make the protective circuit breaker trip, or will make the limiter fuse blow. An overload, because of ground fault within an operating electronic unit, will do the same. A short may be caused by a lead that is shorted to ground, or to another electrical or electronic lead. The reason for a short circuit can usually be traced to moisture, direct contact with liquid seepage, punctured insulation, or chafing due to constant rubbing against another lead or against non-electronic components of the airplane. Some short circuits can be traced by visual inspection of the wire from the tripped circuit breaker throughout its entire length to the unit it connects to, for charring or discoloration of insulation and/or vinyl tubing. A continuity test light or bell unit, ohmmeter, or a voltmeter, may be used to verify that the trouble is isolated to the charred or discolored area—if there is no visible evidence, they may be used as positive method of isolating the trouble area. The foregoing instruments are also used to isolate an open circuit. An open circuit between an electronic unit and its power source will not cause a circuit breaker to trip, or a fuse to blow. Instead, the power will not be conducted at all; or if started, it may flow only partially through the circuit, and then directly back to the source.

### 8-21. CONTINUITY CHECK PROCEDURES.

Before making a continuity check, the wire being checked must be isolated electrically from any interconnecting circuit. When using either a continuity test light, bell (ring-out) unit, ohmmeter, or voltmeter, the same process of elimination and isolation is used—each

wire segment is progressively checked until an open or shorted area is found. With a continuity test light unit, the lamp will illuminate when there is a completed (shorted) circuit. It will fail to illuminate when there is an open or incomplete circuit. A test bell unit will ring or fail to ring, under the respective foregoing conditions. With a voltmeter being used as the test unit, a non-voltage (zero) reading during a continuity check will indicate a break in the circuit. In checking with an ohmmeter, the leads are connected across the circuit. A zero ohms reading will indicate circuit continuity. When using an ohmmeter, a dial reading is chosen (whether it reads R x 1, R x 10, or R x 10,000) which is estimated will contain the resistance of the element being measured. Generally, a resistance value in which the reading will fall midway, or somewhere in the upper half of the scale, should be selected.

#### CAUTION

When testing with a continuity tester, the test leads will be inserted at the segment connection points only. Under no circumstances will the insulation at intermediate points be pierced, with either the probes or a sharp instrument of any kind. Permanent damage will result if this is done. While making a circuit test with an ohmmeter, *never* attempt to check continuity or measure resistance in a circuit that is connected to a source of power. In addition, disconnect one end of an element when checking resistance, or the ohmmeter will read resistance for the parallel paths.

## GENERAL MAINTENANCE NOTES

### 8-22. BONDING.

Bonding is incorporated at various installations throughout the airplane to provide electrical conductivity between its metallic components. Maintenance of the bonding in good condition, to insure good electrical conductance, is of the utmost importance. The following general instructions will be adhered to when repairing and/or replacing bonding:

- a. Replacement bonding jumpers must be identical to the original bonding jumpers.
- b. Where self-locking type nuts are utilized for attachment of bonding, only the all-metal locking type nut will be used.

- c. Bonding jumpers must be installed so that vibration, expansion, contraction, or relative movement incidental to normal operation will not break the bonding connections, nor loosen them to such an extent that their electrical resistance will be affected.

#### CAUTION

Bonding jumpers must be installed in such a manner that normal operation of any movable component is not hindered, and so that bonding braid does not rub against other parts, particularly against sharp edges, as damage to the bonding and or to its adjacent components may result.

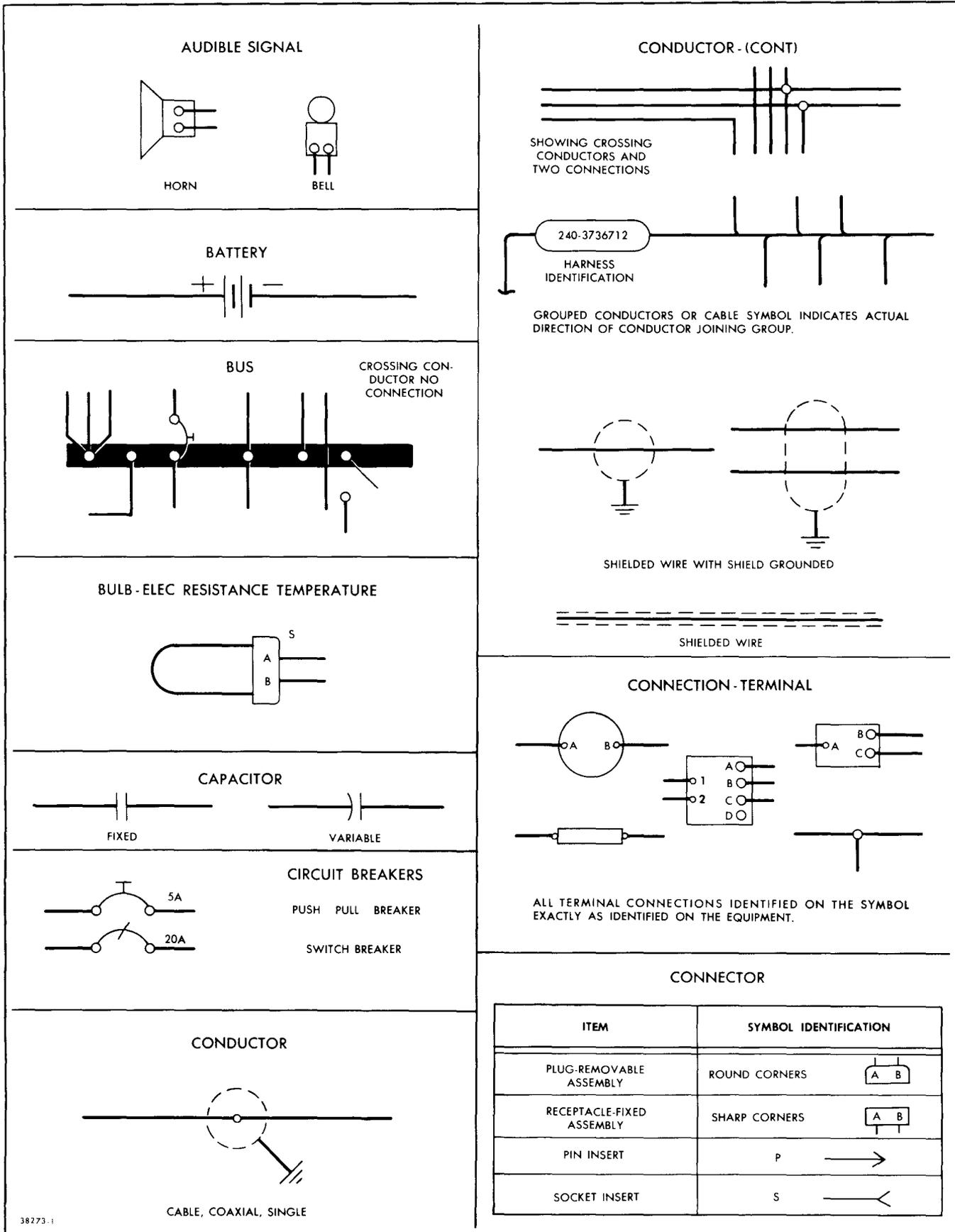
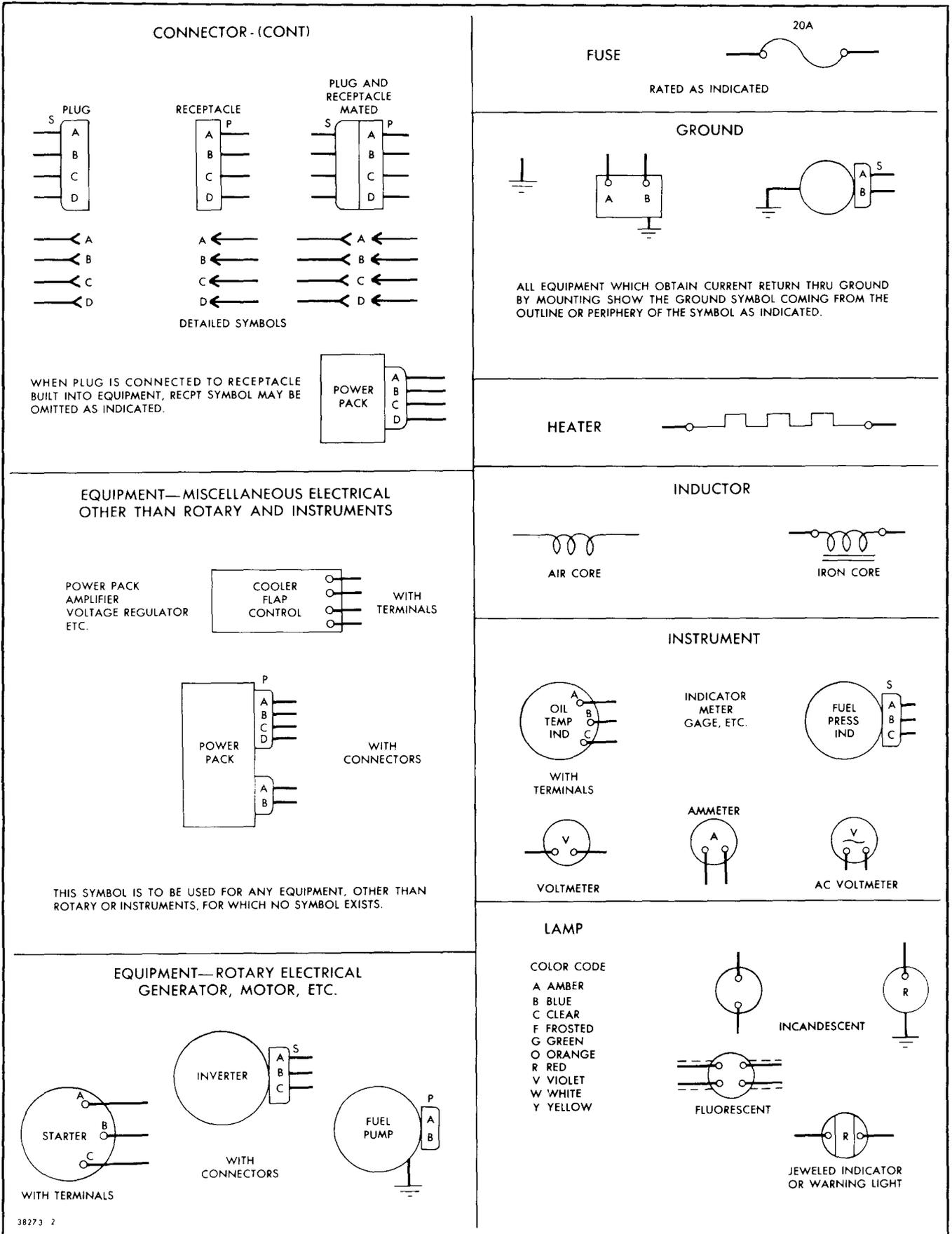


Figure 8-5. Electrical Symbols (Sheet 1 of 5)



38273 2

Figure 8-5. Electrical Symbols (Sheet 2 of 5)

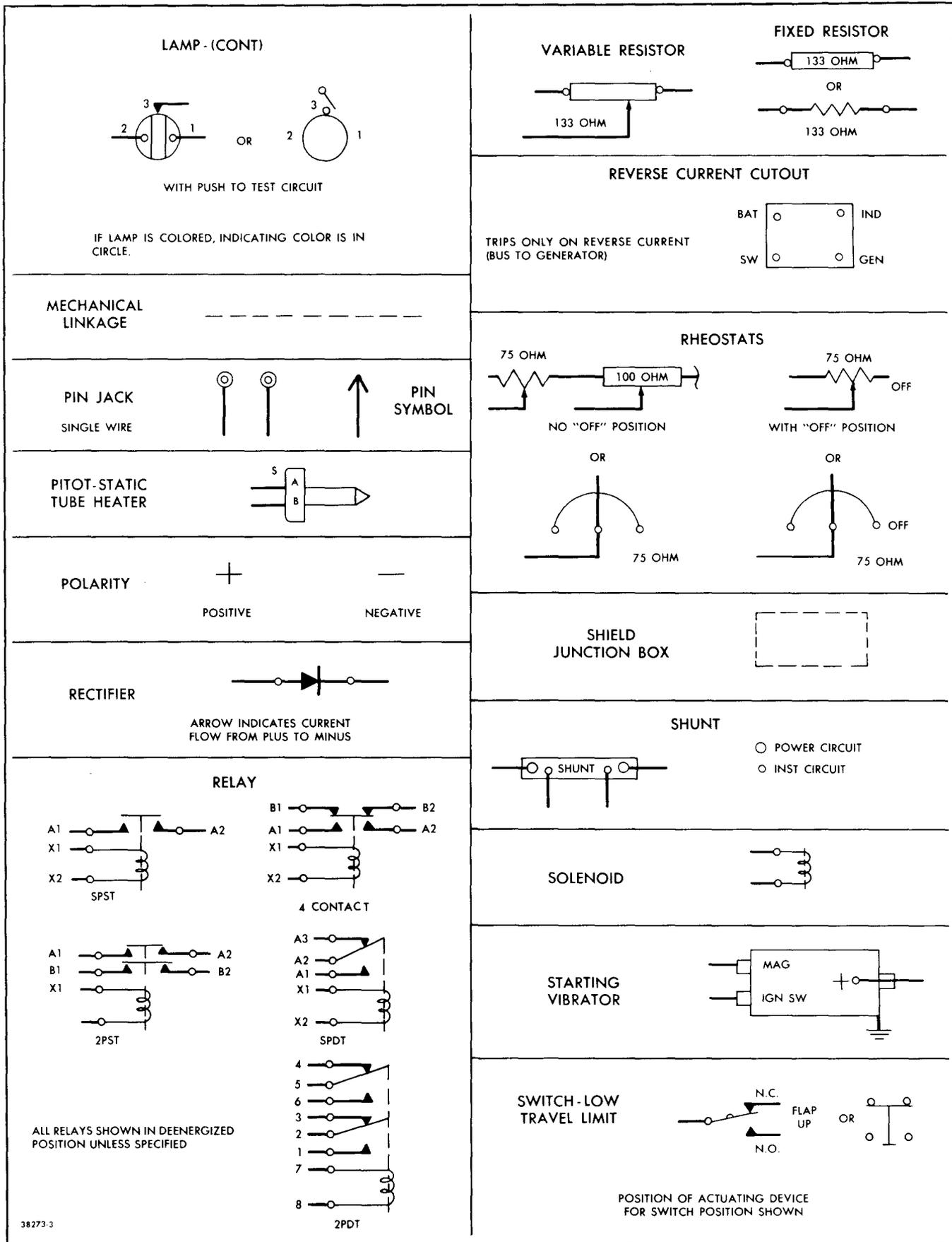


Figure 8-5. Electrical Symbols (Sheet 3 of 5)

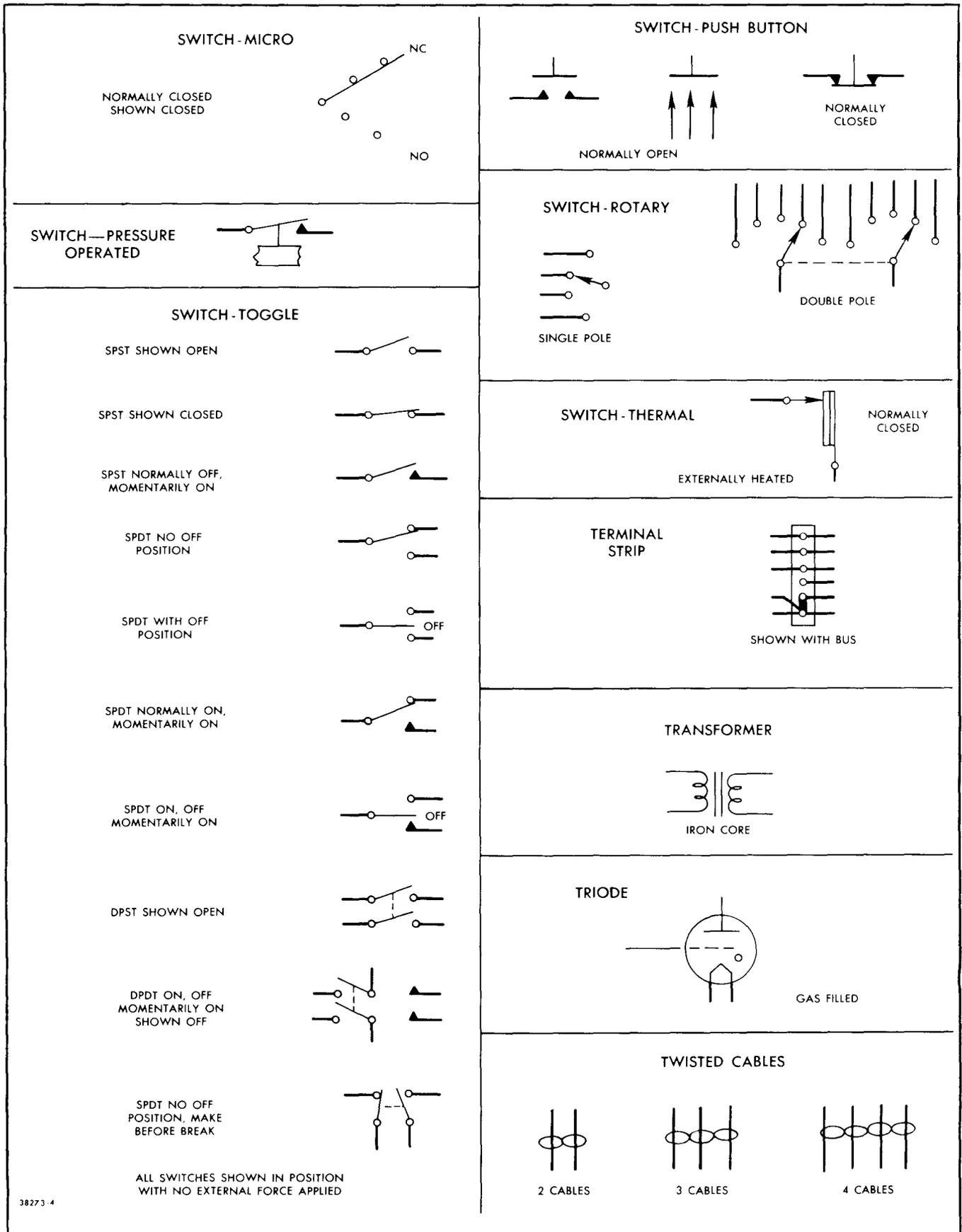


Figure 8-5. Electrical Symbols (Sheet 4 of 5)

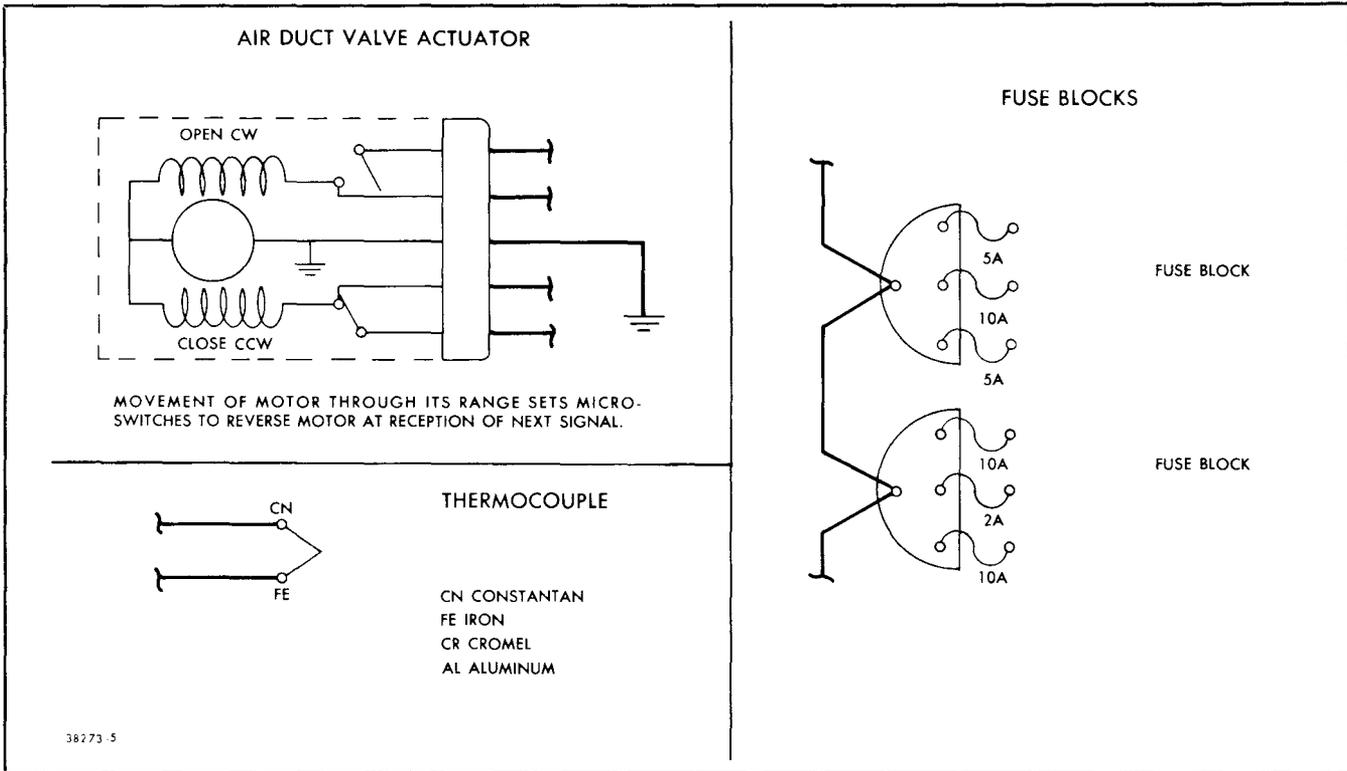


Figure 8-5. Electrical Symbols (Sheet 5 of 5)

d. To insure good electrical contact, bonding jumper terminal lugs and connection points must be clean prior to installation. Any paint, or other foreign matter, must be thoroughly removed from the contact area.

**8-23. CONNECTOR PLUG MAINTENANCE.**

When connecting plugs are inspected for condition, they should be checked for corrosion, indication of overheating, and for security of connections. To check for corrosion, the plug must be disconnected from its mating part. This is accomplished by breaking the safety wire, screwing the coupling ring off, and pulling the plug body straight out from its receptacle. The plug must not be disconnected from the receptacle by pulling it out by the attached wires. Corrosion may be found in either the female contact or on the surface of the male contact. Corrosion can be detected by its gray-white, powdery appearance. When corrosion is discovered, the contacts of the plug must be cleaned with a brush or clean rag which has been dipped into a non-corrosive solvent, or alcohol. Also check the plug for damaged

threads, and general condition, of the coupling ring. Prior to re-installation of the connector plug, the threads on the coupling ring must be lubricated with a thin coat of anti-seize compound, Federal Specification VV-P-236, or Dow Corning No. 4 compound, Specification MIL-L-8660. When installing the plug, the keyway and key must be mated properly, and the plug then pressed into the receptacle with a light hand pressure. The coupling ring is then engaged and tightened finger-tight. A strap wrench or other approved tool is then used to tighten the coupling ring approximately 0.125 inch beyond the finger-tight position, and new safety wire is installed.

**8-24. ELECTRICAL SYMBOLS.**

Electrical symbols are used to identify components of an electrical system on a wiring diagram. Application of these symbols will be found on all wiring diagrams and ability to recognize them will facilitate the mechanic in analyzing and understanding wiring diagrams; see figure 8-5.

## Section IX

### T-29A WIRING DATA

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Cross Reference List of Wiring Diagrams . . . . .	97
List of Equipment . . . . .	98
Wiring Diagrams . . . . .	100

#### 9-1. ALPHABETICAL INDEX OF WIRING DIAGRAMS.

TITLE	FIGURE NO.	APPLICABILITY SERIAL NO.
Interphone (USAF Combat) Circuit	9-1	All
Public Address Circuit	9-2	All
Public Address Control Panel, Typical	9-3	49-1910 to 49-1945 incl.
	9-4	50-183 and subsequent
Radio Set AN/APX-25 (Transponder) Circuit	9-9	All
Radio Set AN/ARC-8 (Liaison) Antenna Diagram	9-8	All
Radio Set AN/ARC-8 (Liaison) Circuit	9-7	All
Radio Set AN/ARC-27 (UHF Command) Antenna Diagram	9-6	All
Radio Set AN/ARC-27 (UHF Command) Circuit	9-5	All
Radio Set AN/APX-72 (Transponder) Circuit	9-10	All T-29A Airplanes incorporating TCTO 1T-29-621
Radio Set 618T-3 (SSB - Liaison) Circuit	9-11	50-184
Radio Set, Wilcox 807A (VHF COMMAND) Circuit	9-12	TCTO 1T-29-599
Radio, Collins VHF 101 Communications	10-9B	1T-29-624

#### 9-2. CROSS REFERENCE OF WIRING DIAGRAMS.

CONVAIR DRAWING NO.	TITLE	FIGURE NO.
240-0037317	Radio set AN/ARC-8 (Liaison) Antenna Diagram	9-8
240-0037317	Radio Set AN/ARC-27 (UHF Command) Antenna Diagram	9-6
240-0037402	Public Address Circuit	9-2
240-0037410	Radio Set AN/ARC-8 (Liaison) Circuit	9-7
240-0037415	Interphone (USAF Combat) Circuit	9-1
240-0037416	Radio Set AN/ARC-27 (UHF Command) Circuit	9-5
240-0037513	Radio Set AN/ARN-6 (No. 4 Compass) Circuit	T.O. 1T-29A-2-12
240-0037514	Radio Set AN/ARN-6 (No. 5 Compass) Circuit	T.O. 1T-29A-2-12
240-0037515	Radio Set AN/ARN-6 (No. 3 Compass) Circuit	T.O. 1T-29A-2-12
240-0067344	Table Lights Circuit	T.O. 1T-29A-2-14
240-0067352	Overhead Switch Panel Lights Circuit	T.O. 1T-29A-2-14
240-3937001	Public Address Control Panel, Typical	9-3
None	Radio Set AN/APX-25 (Transponder) Circuit	9-9
68E37081-1	Radio Set 618T3 (SSB - Liaison) Circuit	9-11
None	Radio Set AN/APX-72 (Transponder) Circuit	9-10
None	Radio Set, Wilcox 807A (VHF Command) Circuit	9-12

## 9-3. LIST OF EQUIPMENT.

ITEM NO.	NAME OF PART	MANUFACTURER	TYPE, MODEL, OR PART NO.
27	Amplifier	.....	AM-26A/A16
107	Circuit Breaker	.....	AN3161P5
113	Circuit Breaker	.....	AN3161P50
130	Control Panel	.....	C-405A/A
132	Control Panel	.....	C-699/AIC
133	Control Panel	.....	C-695/AIC
134	Control Panel	.....	C-701/AIC
135	Control Panel	.....	C-704/AIC
141	Control Panel—Pilots' Interphone	.....	C-383/AIC
146	Control Panel—Radio Operator's Interphone	.....	C-389/AIC
165	Dynamotor	.....	DY-17/ART-13A
172	Filter	.....	F-21/ARA-9
242	Jack	.....	JK-26
243	Jack	.....	JK-33A
244	Jack	.....	U-82/U
245	Jack	Utah Radio Products Co.	Type 34A
246	Jack Box	.....	J-139A/AIC
247	Key	.....	Type J-37
293	Loop Antenna—Radio Compass	.....	AS-313B/ARN-6
294	Loudspeaker	Racon Elec Co	MN-15B
464	Plug	.....	PL-Q103-A
466	Plug	.....	PL-55
470	Plug	.....	PL-152A
477	Plug	.....	U-7/U
478	Plug	.....	U-8/U
479	Plug	.....	U-9/U
480	Plug	.....	U-10/U
501	Receiver—Radio (Liaison)	.....	BC-348-R
532	Receptacle	.....	AN3102-20-27S
553	Relay	.....	AF-S49B6902
633	Switch	.....	AN3023-8
636	Switch	.....	AN3027-3
652	Switch	.....	SA-47A/AIC
657	Switch—Control	Convair	240-3160902-12
701	Transmitter—Radio (Liaison)	.....	T-47/ART-13
904	Amplifier	.....	AM-142/AIC
914	Control Panel	.....	C-1904/ARC-27
915	Control Panel	.....	C-703/AIC
919	Coupler	.....	AN753B1

## 9-3. LIST OF EQUIPMENT (CONT).

ITEM NO.	NAME OF PART	MANUFACTURER	TYPE, MODEL, OR PART NO.
931	Liaison Antenna	Convair	240-3037804-0
932	Jack	.....	U-61/U
950	Plug	.....	AN3108M22-14S
952	Plug	.....	AN3108M24-7S
953	Plug	.....	AN3108M24-20P
959	Receiver-Transmitter—Radio	.....	RT-178/ARC-27
966	Switch	.....	AN3023-3
967	Switch	.....	SA-26/U
973	Tip	.....	AN753A1
980	Control	.....	C-626/ARC-27
986	Plug	.....	UG-21C/U
989	Insulator	Isolantite, Inc.	434
1013	Antenna	.....	AT-256/ARC
1022	Filter	Bendix Aviation Corp	SC-D-8157
1034	Terminal	Burndy Engineering Co, Inc	YAV8C-L3
1038	Light Assy	.....	AN3502-1
1041	Resistor 4300 Ohms	Ohmite Mfg Co	RC20BG432K
1042	Resistor 270 Ohms	Ohmite Mfg Co	RC20BG271K
1043	Resistor 100 Ohms	Ohmite Mfg Co	RC30BG101K
1044	Resistor 22,000 Ohms	Ohmite Mfg Co	RC20BG223K
1045	Potentiometer	Ohmite Mfg Co	RV4ANFD103E
1046	Condenser	.....	CP53B1EB105K
1047	Condenser	Cornell-Dubilier Elec Corp	CE63 C500G
1068	Mounting Base	.....	MT28/ARN-5
1192	Relay	.....	S49B6902
1193	Plug	.....	AN3108M-24-5P
1194	Adapter	.....	UG27B/U
1195	Jack	.....	UG-160A/U
1601	Receiver-Transmitter—Transponder Set	.....	RT-279/APX
1602	Filter	.....	F-245/APX-25
1603	Coder—Transponder Set	.....	KY-95/APX
1604	Antenna—Transponder Set	.....	AT-234/APX
1605	Control—Transponder Set	.....	C-1158/APX-25
1606	Control—Coder Group	.....	C-1128/APX-25
1607	Transceiver	Wilcox	97607-101
1608	Control Panel	.....	97733-100
1609	Shockmount	.....	88245
1618	Transceiver	Collins	618T-3
1619	Control (HF)	Collins	714E-2
1620	Antenna Tuner	.....	180L-3
1621	Connector	.....	PL-259/U
1622	Connector	.....	UG-88/U
1623	Adapter	.....	UG-201/U
1624	Adapter	.....	UG-27/U
1625	Connector	.....	UG-1185/U
1626	Mount	.....	390J-1
1627	Connector	.....	GP3108E-28-15S

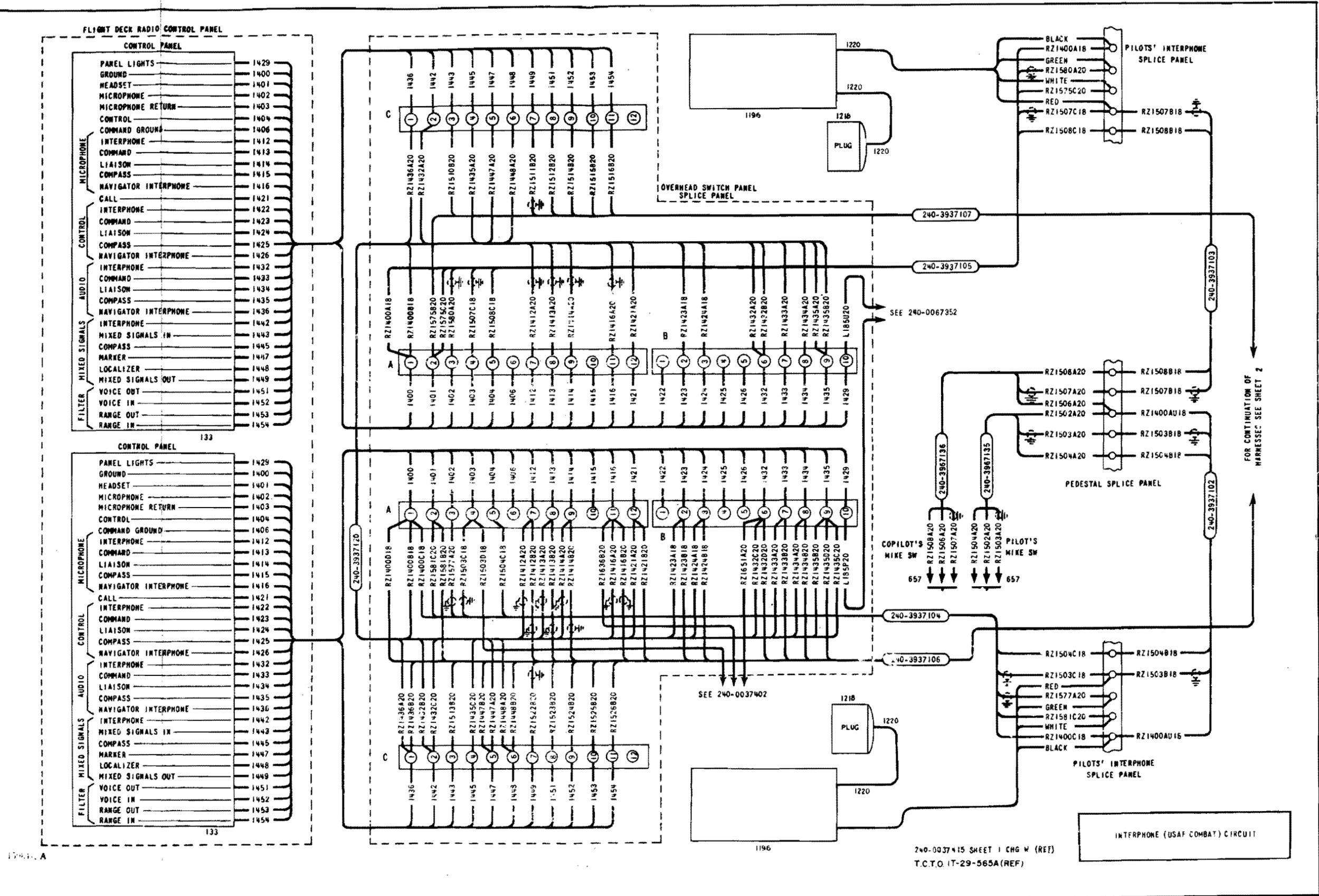
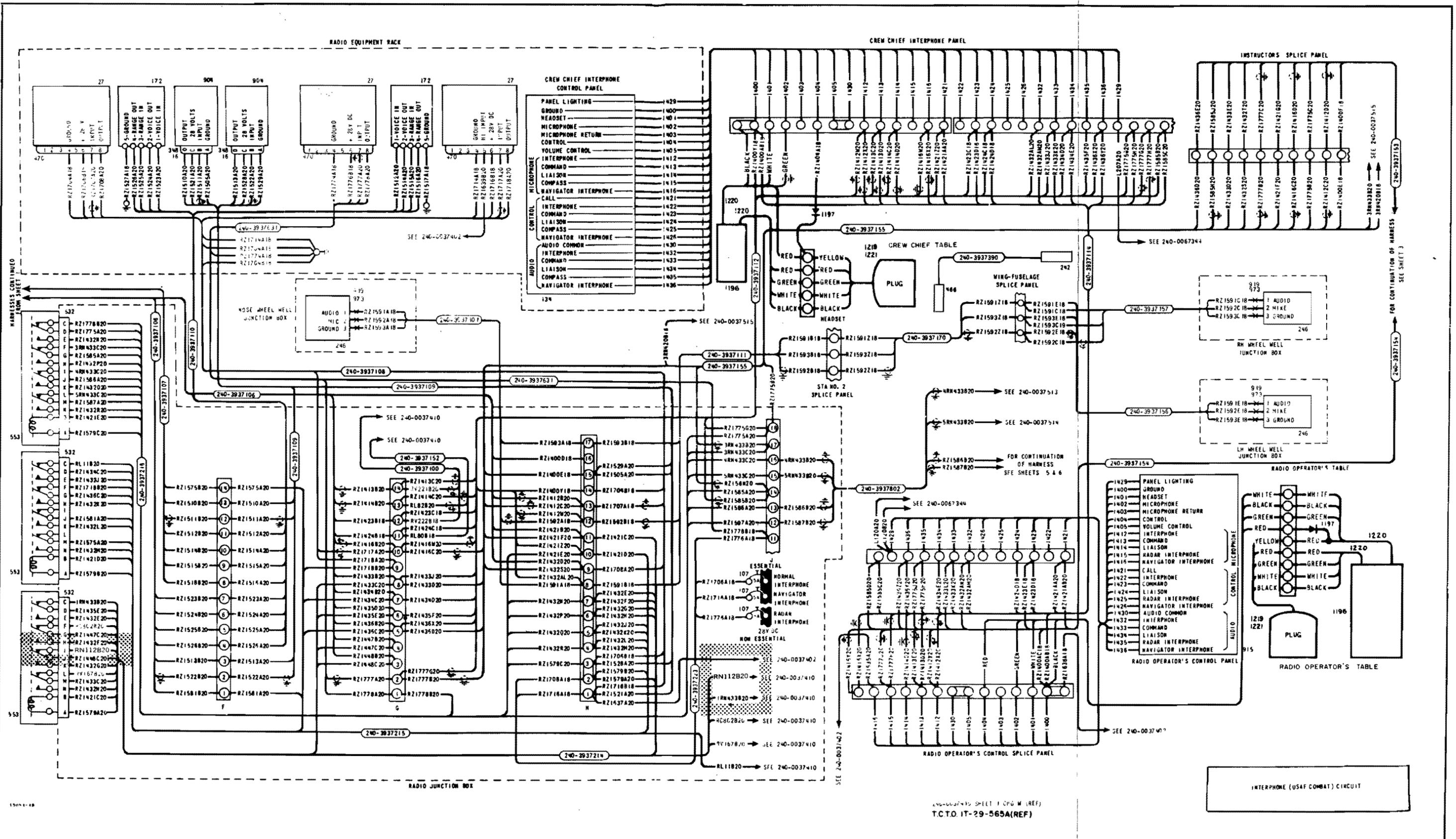


Figure 9-1. Interphone (USAF Combat) Circuit (Sheet 1 of 7)



240-0037410 SHEET 1 OF 6 (REF)  
 T.O. 1T-29-565A(REF)

Figure 9-1. Interphone (USAF Combat) Circuit (Sheet 2 of 7)

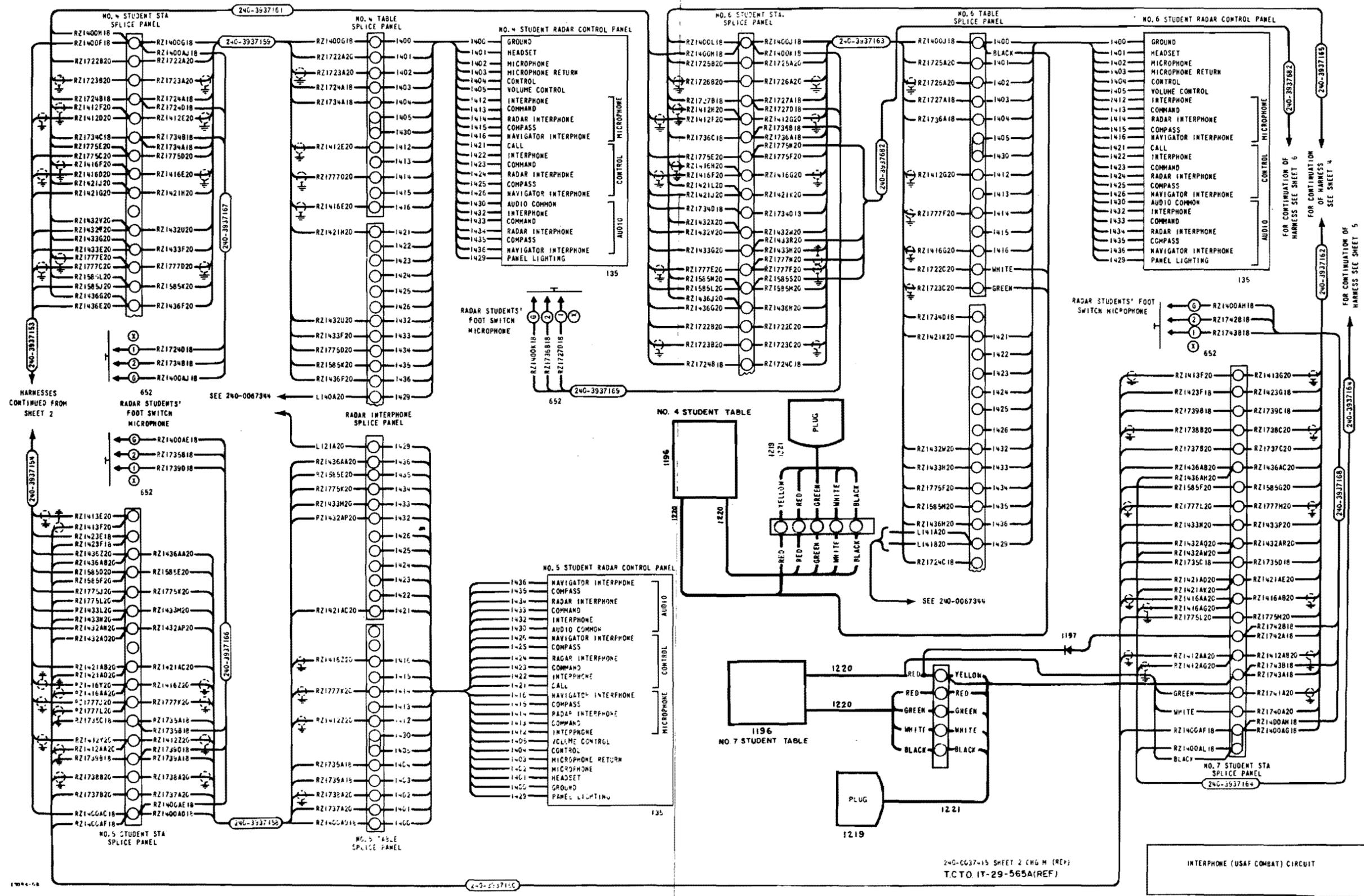
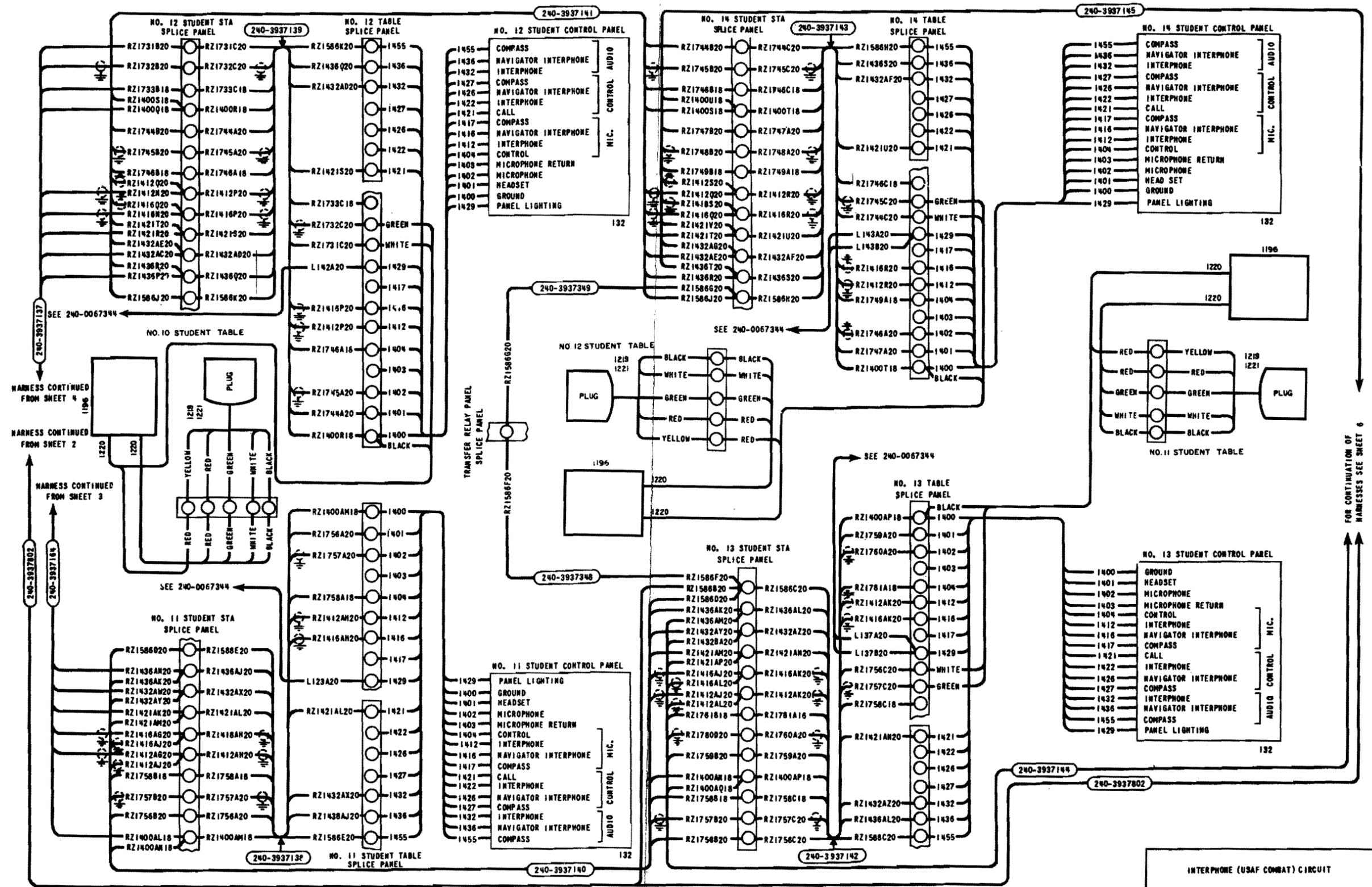


Figure 9-1. Interphone (USAF Combat) Circuit (Sheet 3 of 7)





240-0037415 SHEET 3 CHG K (REF)  
T.C.T.O. 1T-29-565A(REF)

Figure 9-1. Interphone (USAF Combat) Circuit (Sheet 5 of 7)

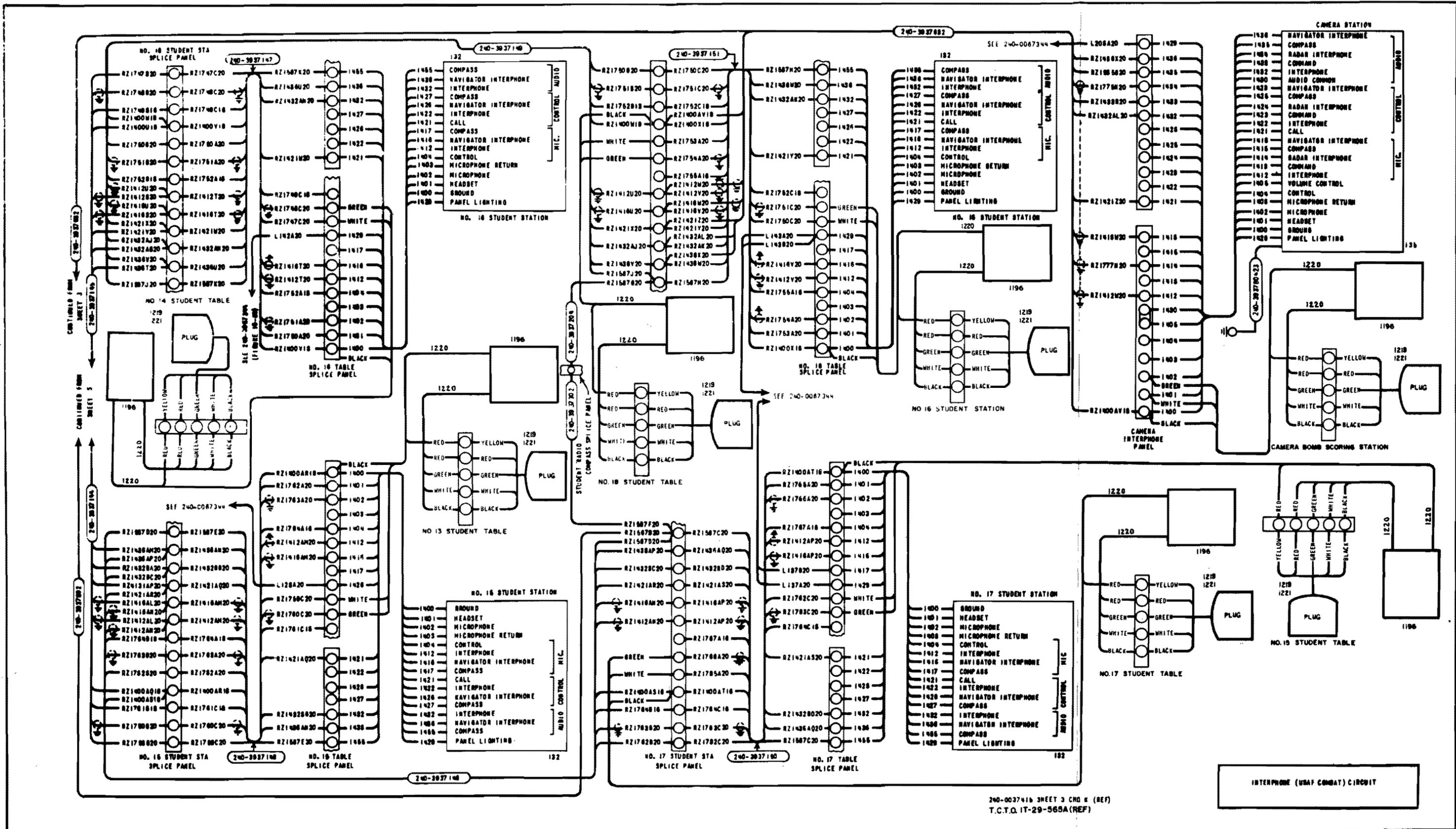


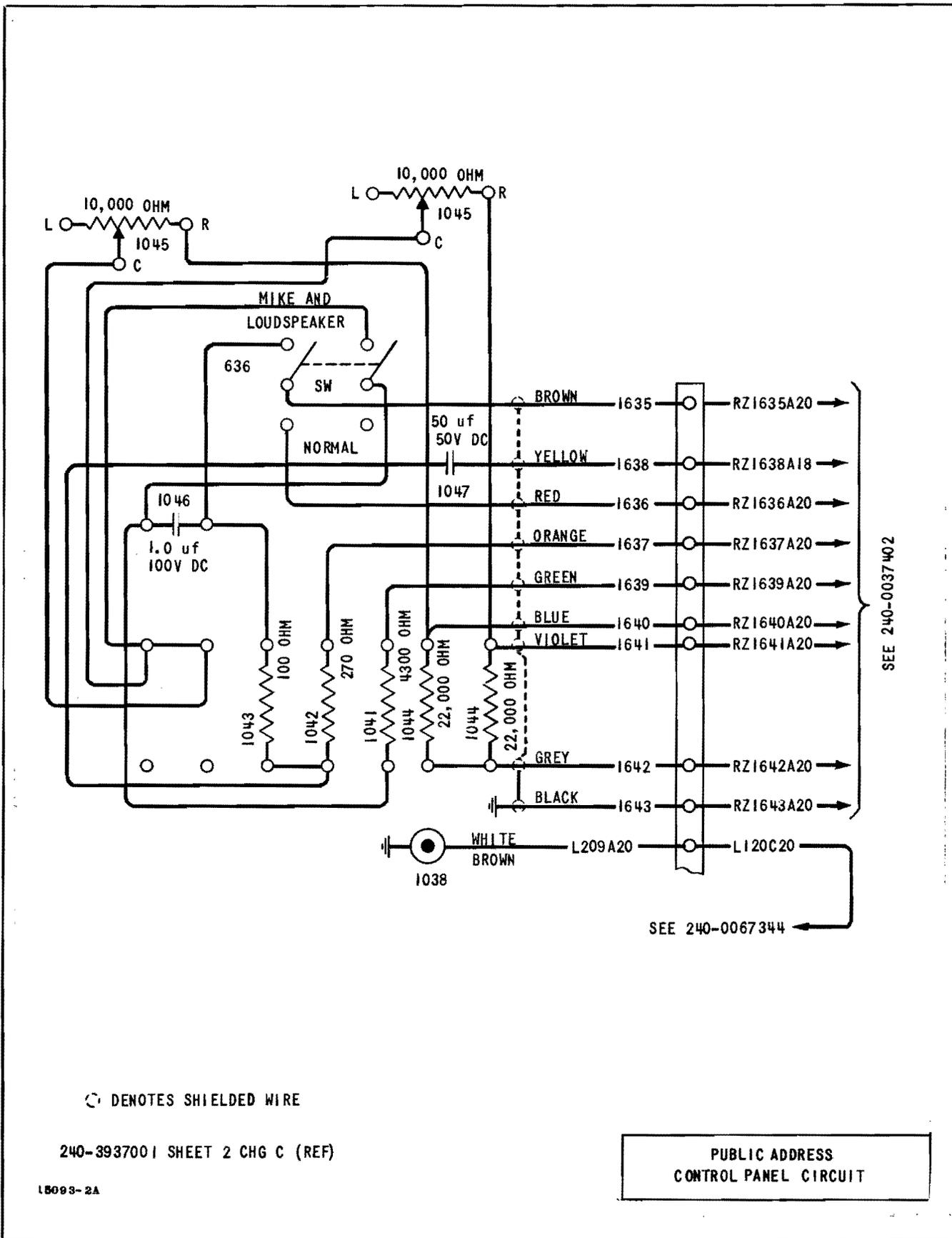
Figure 9-1. Interphone (USAF Combat) Circuit (Sheet 6 of 7)

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Figure 9-1. Interphone (USAF Combat) Circuit (Sheet 7 of 7)





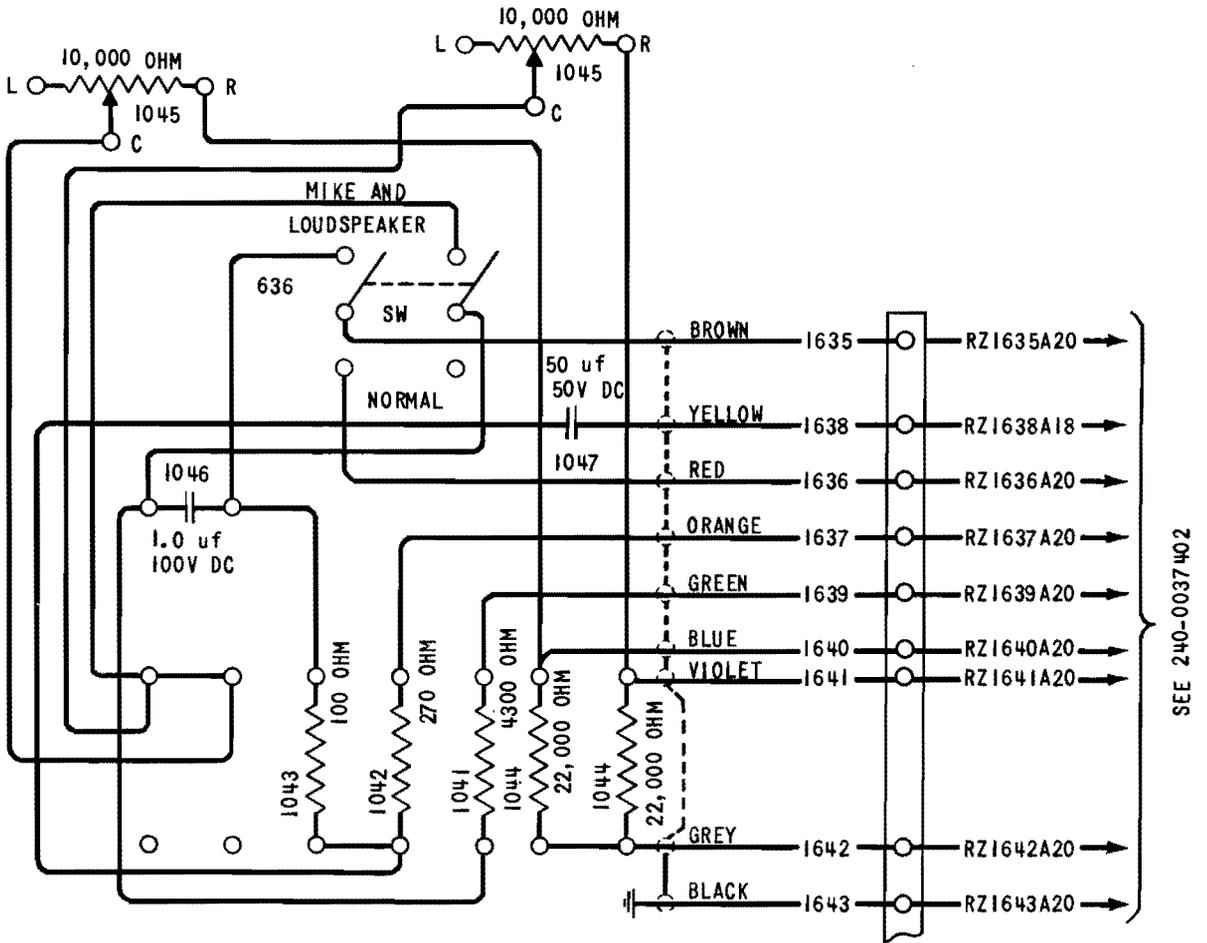
⊙ DENOTES SHIELDED WIRE

240-3937001 SHEET 2 CHG C (REF)

18093-2A

PUBLIC ADDRESS CONTROL PANEL CIRCUIT

Figure 9-3. Public Address Control Panel, Typical (Airplanes 49-1910 to 49-1945 Incl)



○ DENOTES SHIELDED WIRE

240-3937001 SHEET 1 CHG F (REF)

15093-4A

PUBLIC ADDRESS  
CONTROL PANEL CIRCUIT

Figure 9-4. Public Address Control Panel, Typical  
(Airplanes 50-183 and Subsequent)



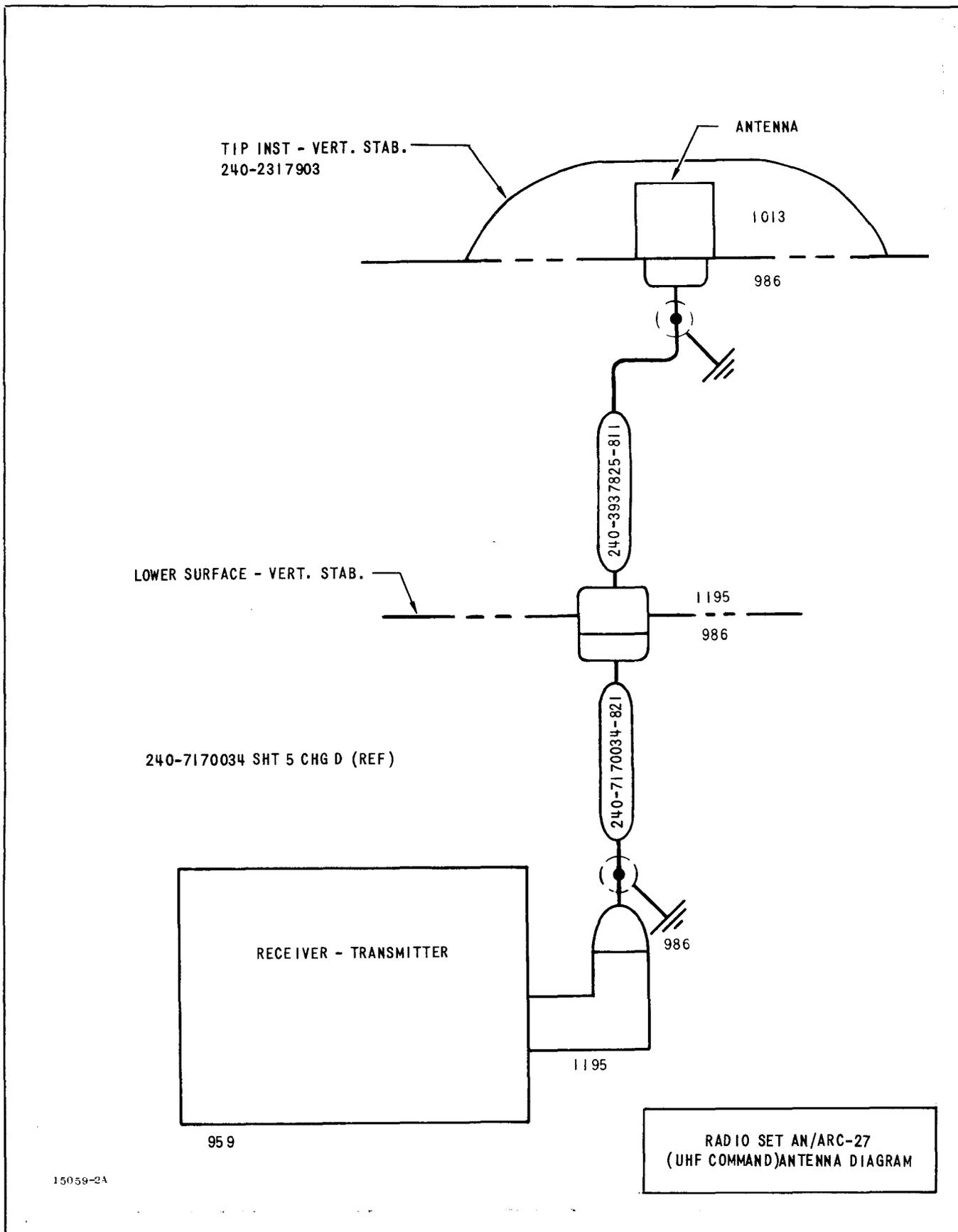


Figure 9-6. Radio Set AN/ARC-27 (UHF Command) Antenna Diagram



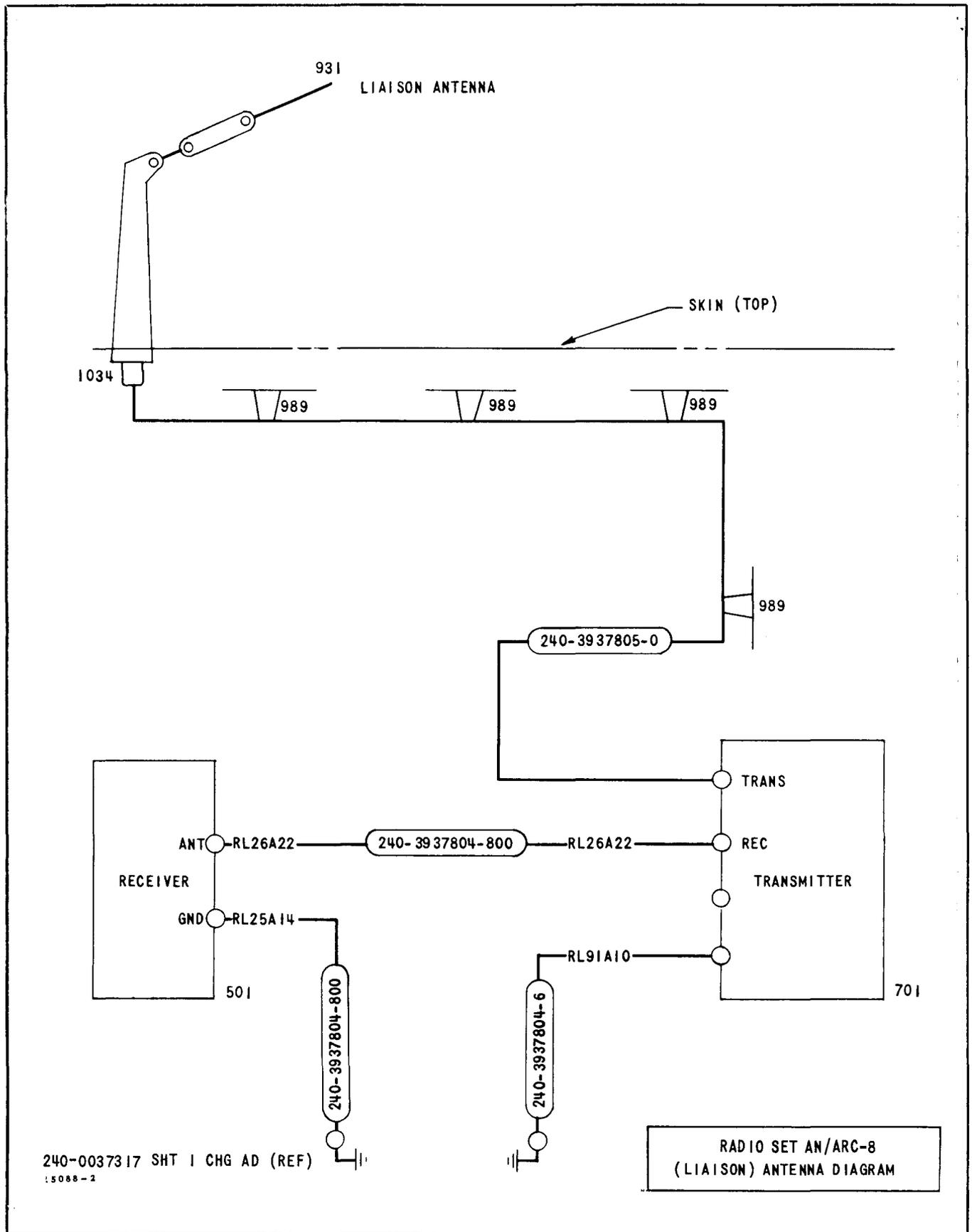


Figure 9-8. Radio Set AN/ARC-8 (Liaison) Antenna Diagram

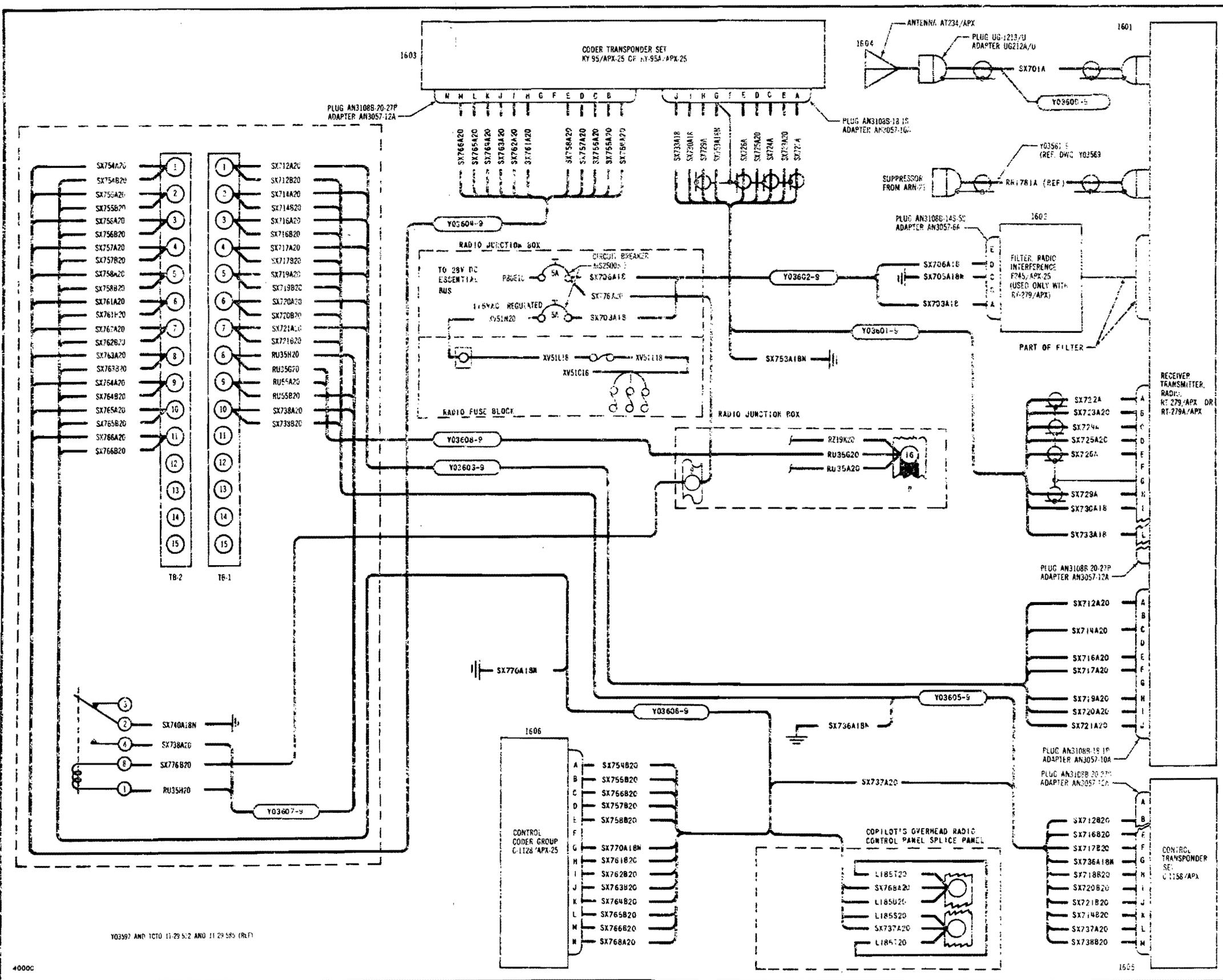


Figure 9-9. Transponder Set (AN/APX-25) Circuit



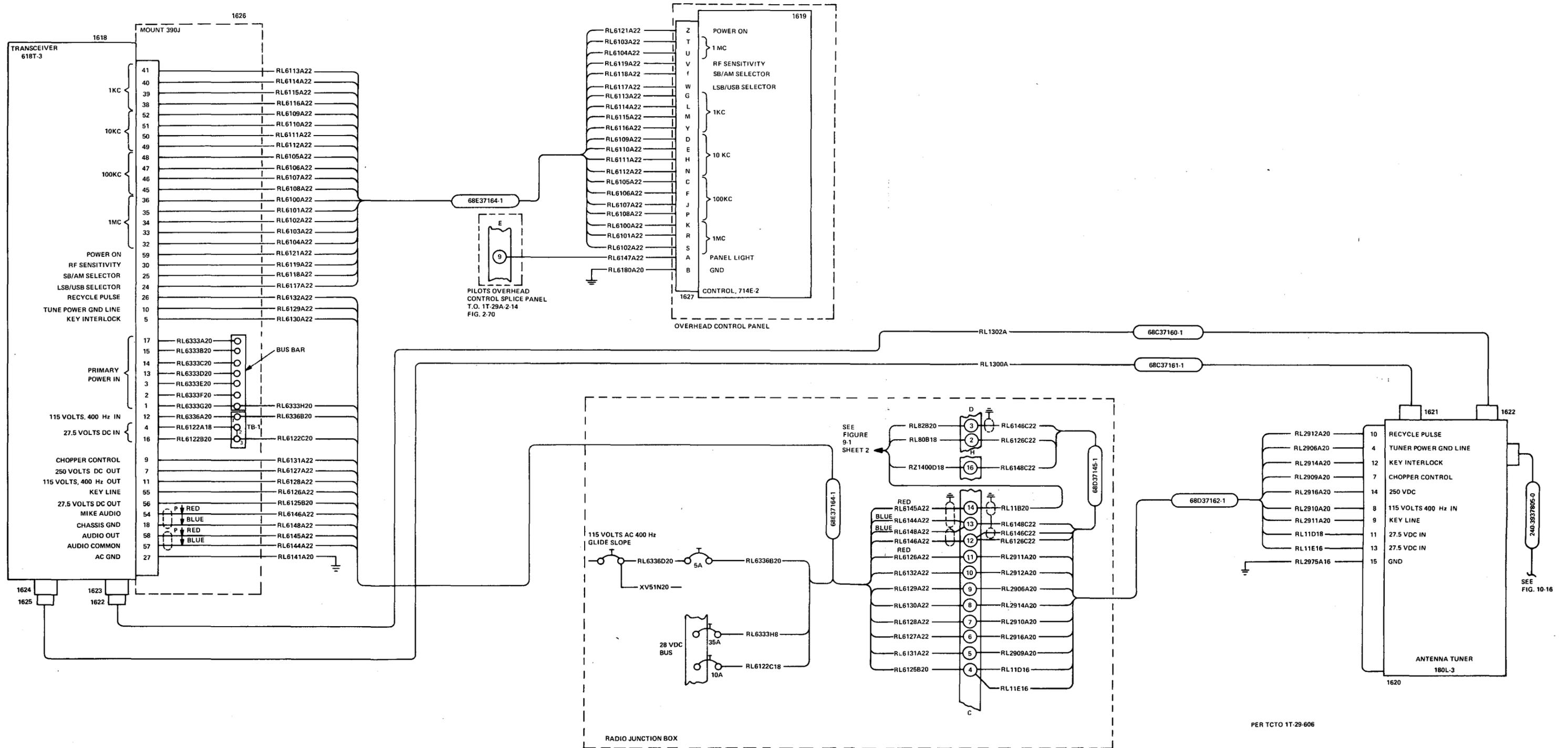


Figure 9-11. Radio Set 618T-3 HF SSB (Airplane 50-184)

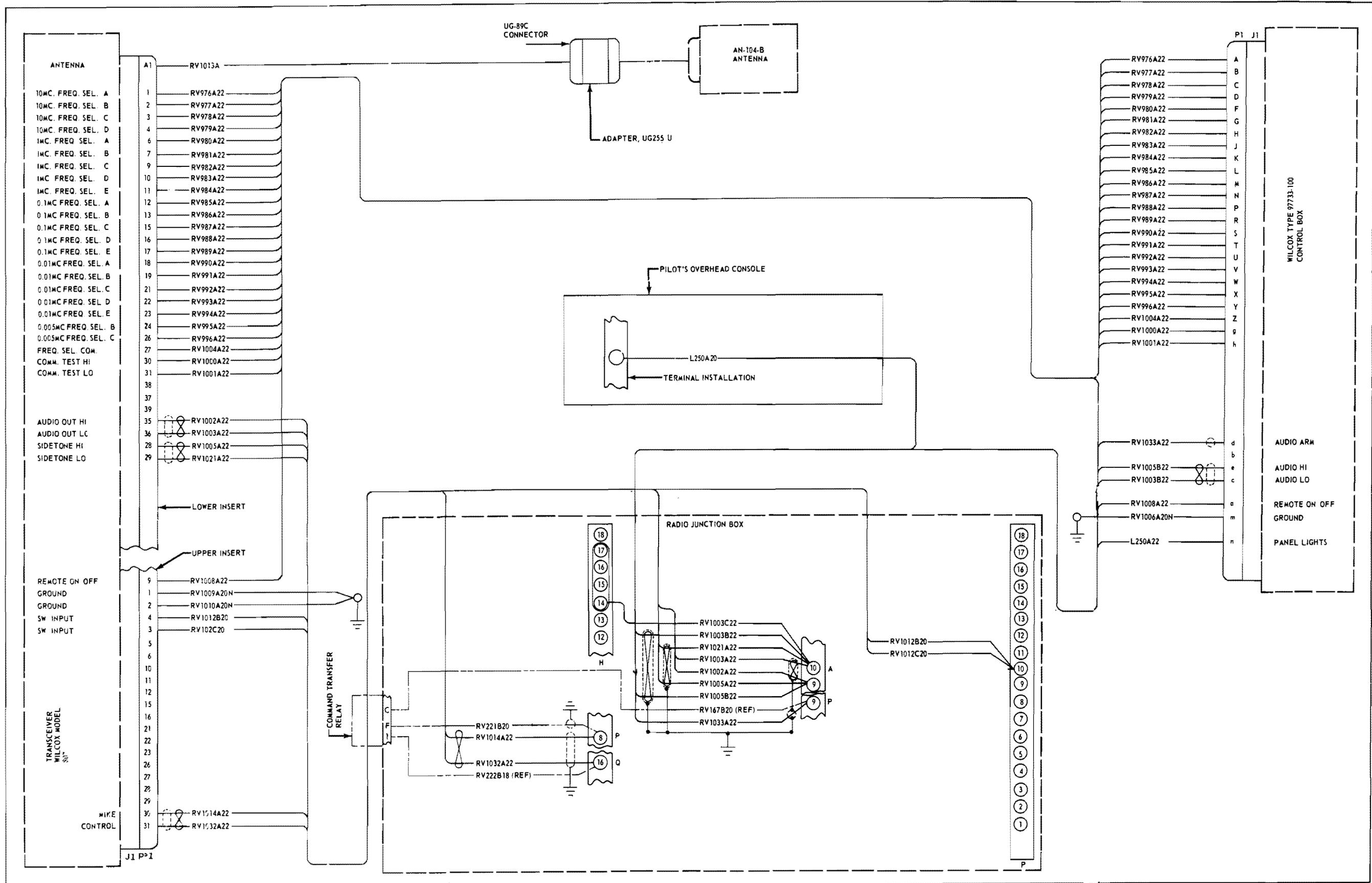


Figure 9-12. Wilcox 807 VHF Communications Transceiver Wiring Diagram

## Section X

### T-29B AND T-29C WIRING DATA

<i>Contents</i>	<i>Page</i>
Alphabetical Index of Wiring Diagrams . . . . .	115
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#### 10-1. ALPHABETICAL INDEX OF WIRING DIAGRAMS.

TITLE	FIGURE NO.	APPLICABILITY SERIAL NO.
Interphone (AN/AIC-10) Circuit	10-3	51-5144, 52-1092 to 52-1095 incl
	10-4	52-1091, 52-1096 to 52-1155 incl
	10-5	52-1156 and subsequent
Interphone (USAF Combat) Circuit	10-1	51-3797 to 51-3806 incl
	10-2	51-3807 to 51-5143, and 51-5145 to 51-7917 incl
Public Address Circuit	10-6	51-3797 to 51-5143 and 51-5145 to 51-7917 incl
	10-7	51-5144, 52-1091 and subsequent
Radio Set Collins 18S-4 (HF Liaison) Circuit	10-13B	Applicable to T-29C airplanes incorporating TCTO 1T-29C-508
Public Address Control Panel, Typical	10-8	All
Radio Set AN/APX-25 (Transponder) Circuit	10-21	51-3797 to 51-5123 incl
Radio Set AN/APX-25 (Transponder) Circuit	10-22	51-5124 and subsequent, and T-29C airplanes
Radio Set AN/APX-72 (Transponder Circuit)	9-10	All T-29A and B Airplanes except 51-5144
	11-10	All T-29C and D Airplanes and 51-5144
Radio Set AN/ARC-3 (VHF Command) Antenna Diagram	10-10	51-3797 to 51-7917 incl
Radio Set AN/ARC-3 (VHF Command) Circuit	10-9	51-3797 to 51-7917 incl
Radio Set Wilcox 807A (Command) Circuit	10-9A	All T-29B & C Airplanes Incorporating TCTO 1T-29-599
Radio, Collins VHF 101 Communications	10-9B	1T-29-624
Radio Set AN/ARC-8 (Liaison) Antenna Diagram	10-16	51-3797 to 51-5143 incl and 51-5145 to 51-7917 incl
Radio Set AN/ARC-8 (Liaison) Circuit	10-14	51-3797 to 51-5123
	10-15	51-5144, 52-1091 to 52-1155 incl
Radio Set AN/ARC-27 (UHF Command) Antenna Diagram	10-13	All

## 10-1. ALPHABETICAL INDEX OF WIRING DIAGRAM (CONT).

TITLE	FIGURE NO.	APPLICABILITY SERIAL NO.
Radio Set AN/ARC-27 (UHF Command) Circuit	10-11 10-12	51-3797 to 51-5143 and 51-5145 to 51-7917 incl 51-5144, 51-1091 and subsequent
Radio Set 618T-3 SSB (Liaison) Circuit	10-23	51-5168, 51-7877 and 51-7914

## 10-2. CROSS REFERENCE LIST OF WIRING DIAGRAMS.

CONVAIR DRAWING NO.	TITLE	FIGURE NO.
240-0037317	Radio Set AN/ARC-3 (VHF Command) Antenna Diagram	10-10
240-0037317	Radio Set AN/ARC-8 (Liaison) Antenna Diagram	10-16, 10-19, 10-20

**10-2. CROSS REFERENCE LIST OF WIRING DIAGRAMS (CONT).**

CONVAIR DRAWING NO.	TITLE	FIGURE NO.
240-0037317	Radio Set AN/ARC-27 (UHF Command) Antenna Diagram	10-13
240-0037402	Public Address Circuit	10-6, 10-7
240-0037403	Interphone (AN/AIC-10) Circuit	10-3, 10-4, and 10-5
240-0037415	Interphone (USAF Combat) Circuit	10-1, 10-2
240-0037416	Radio Set AN/ARC-3 (VHF Command) Circuit	10-9
240-0037416	Radio Set AN/ARC-8 (Liaison) Circuit	10-14, 10-15
240-0037416	Radio Set AN/ARC-27 (UHF Command) Circuit	10-11, 10-12
240-0037513	Radio Set AN/ARN-6 (No. 4 Compass) Circuit	T.O. 1T-29A-2-12
240-0037514	Radio Set AN/ARN-6 (No. 5 Compass) Circuit	T.O. 1T-29A-2-12
240-0037515	Radio Set AN/ARN-6 (No. 3 Compass) Circuit	T.O. 1T-29A-2-12
240-0067305	Wing and Tail Anti-Icing Circuit	T.O. 1T-29B-2-14
240-0067344	Table Lights Circuit	T.O. 1T-29B-2-14
240-0067352	Overhead Switch Panel Lights Circuit	T.O. 1T-29B-2-14
240-3937001	Public Address Control Panel, Typical	10-8
None	Radio Set Collins 18S-4 (HF Liaison) Circuit	10-13B
None	Radio Set AN/APX-25 (Transponder) Circuit	10-21 10-22
None	Radio Set AN/APX-72 (Transponder) Circuit	9-10, 11-10
68E37081-1	Radio Set 618T-3 SSB (Liaison) Circuit	10-23

**10-3. LIST OF EQUIPMENT.**

ITEM NO.	NAME OF PART	MANUFACTURER	TYPE, MODEL, OR PART NO.
16	Adapter	.....	AN3057-6
17	Adapter	.....	AN3057-8
19	Adapter	.....	AN3057-12
39	Antenna—Command (VHF)	.....	AN104B
80	Box—Power Jet	.....	J-68/ARC-3
107	Circuit Breaker	.....	AN3161P5
110	Circuit Breaker	.....	AN3161P20
111	Circuit Breaker	.....	AN3161P25
113	Circuit Breaker	.....	AN3161P50
130	Control Panel	.....	C-405A/A
132	Control Panel	.....	C-699/AIC
133	Control Panel	.....	C-695/AIC
134	Control Panel	.....	C-701/AIC
135	Control Panel	.....	C-704/AIC
141	Control Panel—Pilots' Interphone	.....	C-383/AIC
146	Control Panel—Radio Operator's Interphone	.....	C-389/AIC
165	Dynamotor	.....	DY-17/ART-13A



## 10-3. LIST OF EQUIPMENT (CONT).

ITEM NO.	NAME OF PART	MANUFACTURER	TYPE, MODEL, OR PART NO.
172	Filter	.....	F-21/ARA-9
242	Jack	.....	JK-26
243	Jack	.....	JK-33A
244	Jack	.....	U-82/U
245	Jack	Utah Radio Products Co	JK-34A
246	Jack Box	.....	J-139A/AIC
247	Key	.....	Type J-37
257	Lamp	.....	AN3140-327
276	Light Assy—Control Panel	.....	AN3502-2B
348	Plug	.....	AN3106-14S2S
358	Plug	.....	AN3106-16S1S
371	Plug	.....	AN3106-24-28S
415	Plug	.....	AN3108-14S5S
420	Plug	.....	AN3108-16S1S
423	Plug	.....	AN3108-18-1S
441	Plug	.....	AN3108-24-28S
464	Plug	.....	PL-Q103-A
466	Plug	.....	PL-55
468	Plug	.....	PL-148A
469	Plug	.....	PL-151A
471	Plug	.....	PL-153A
477	Plug	.....	U-7/U
478	Plug	.....	U-8/U
479	Plug	.....	U-9/U
480	Plug	.....	U-10/U
481	Plug	.....	U-15/U
482	Plug	.....	U-16/U
501	Receiver — Radio (Liaison)	.....	BC-348R or BC-348Q on airplanes 51-3797 to 51-7907 (incl) BC-348R, BC-348Q, or BC-348B, BC-348C, BC-348M, BC-348D, or BC-348P on airplanes 51-7908 and subsequent
502	Receiver — Command Radio (VHF)	.....	R-77A ARC-3
532	Receptacle	.....	AN3102-20-27S
533	Receptacle	.....	AN3102-20-29S
553	Relay	.....	AF S49B6902
628	Switch	.....	AN3021-2
633	Switch	.....	AN3023-8

## 10-3. LIST OF EQUIPMENT (CONT).

ITEM NO.	NAME OF PART	MANUFACTURER	TYPE, MODEL, OR PART NO.
636	Switch	.....	AN3027-3
652	Switch	.....	SA-47A/AIC
657	Switch — Control	Convair	240-3160902-12
701	Transmitter — Liaison Radio	.....	T-47A ART-13
702	Transmitter — Command Radio (VHF)	.....	T-67 ARC-3 or T-67A ARC-3 or T-67B ARC-3
725	Adapter (Right Angle)	.....	UG-306 U
767	Plug	.....	AN3106B24-7S
768	Plug	.....	AN3106B24-11S
771	Plug	.....	AN3106B36-7P
856	Plug	.....	AN3108B36-7P
904	Amplifier	.....	AM-145 AIC
905	Amplifier	.....	AM-300 AIC
914	Control Panel	.....	C-1904/ARC-27
915	Control Panel	.....	C-703 AIC
919	Coupler	.....	AN753B1
931	Antenna — Liaison Radio	Convair	240-3035802-15
932	Jack	Convair	JA-14
950	Plug	.....	AN3108M22-14S
951	Plug	.....	AN3108M24-5S
952	Plug	.....	AN3108M24-7S
953	Plug	.....	AN3108M24-20P
959	Receiver Transmitter — Radio	.....	RT-178 ARC-27
966	Switch	.....	AN3023-3
973	Tip	.....	AN753A1
981	Plug	.....	PL-259A
982	Adapter	.....	M-359A
986	Plug	.....	UG-21C U
989	Insulator	Convair	INS-7
999	Tee Connector	.....	UG-274 U
1004	Plug	.....	AN3108M24-5P
1012	Receptacle	.....	UG-160A U
1013	Antenna	.....	AT-256 ARC or AT-256A ARC
1022	Filter	Bendix Aviation Corp	SC-D-8157
1024	Plug	.....	AN3108M20-27S
1028	Receptacle	.....	AN3102-22-4S
1034	Terminal	Convair	TE-S-90
1038	Light Assy	.....	AN3502-1

## 10-3. LIST OF EQUIPMENT (CONT.).

ITEM NO.	NAME OF PART	MANUFACTURER	TYPE, MODEL, OR PART NO.
1041	Resistor 4300 ohms	Ohmite Mfg Co	RC20BG432K
1042	Resistor 270 ohms	Ohmite Mfg Co	RC20BG271K
1043	Resistor 100 ohms	Ohmite Mfg Co	RC30BG101K
1044	Resistor 22,000 ohms	Ohmite Mfg Co	RC20BG223K
1045	Potentiometer	Ohmite Mfg Co	RV4ANFD103E
1046	Condenser	.....	CP53B1EB105K
1047	Condenser	Cornell-Dubilier Elec Corp	CE63C500G
1054	Plug	.....	AN3106-20-27S
1069	Control Box	.....	C-404A/A
1072	Circuit Breaker	Mechanical Products Inc	MS25005-5
1077	Plug	.....	AN3108B16S-1S
1092	Transfer Panel	Convair	240-3137473
1096	Capacitor	Sangamo Elec Co	CP29A1DF103M
1119	Plug	.....	AN3108B20-27S
1136	Circuit Breaker, 5 amp	Mechanical Products Inc	80A-5
1139	Circuit Breaker, 20 amp	Mechanical Products Inc	83A-20
1140	Circuit Breaker, 25 amp	Mechanical Products Inc	84A-25
1177	Plug	.....	AN3108M-22-14P
1178	Plug	.....	AN3108M-14S-56
1196	Adapter	.....	VA-1646/AIC
1197	Diode	.....	1N40
1204	Amplifier	.....	AM-300A/AIC
1205	Mounting Base	.....	MT-677/AIC or MT677A/AIC
1206	Adapter	.....	AN3057-8A
1207	Resistor	.....	RC20AE682K
1208	<i>Deleted.</i>		
1209	Control Panel	.....	C-824/AIC-10
1210	Control Panel	.....	C-826/AIC-10
1211	Filter	.....	F-90/AIC
1212	Loudspeaker	.....	LS-184/AIC-10
1213	Dynamotor	.....	DY-76/AIC-10
1214	Dynamotor	.....	DY-77/AIC-10
1215	Mounting Base	.....	MT-1059/U
1216	Mounting Base	.....	MT-1060/U
1217	Microphone	.....	M-34/AIC
1218	Jack	.....	U-92/U
1219	Plug	.....	U-94/U
1220	Cord	.....	WF-14/U
1221	Cord	.....	WM-85/U
1222	Adapter	.....	AN3057-10A
1223	Adapter	.....	AN3057-12A
1224	Adapter	.....	AN3057-16A
1225	Receptacle	.....	AN3100C-22-19P
1226	Plug	.....	AN3106-16-10S
1227	Plug	.....	AN3106-22-19S

## 10-3. LIST OF EQUIPMENT (CONT).

ITEM NO.	NAME OF PART	MANUFACTURER	TYPE, MODEL, OR PART NO.
1228	Plug	.....	AN3108-22-14S
1229	Circuit Breaker	.....	MS25005-10
1230	Resistor-150 ohm	.....	RC20AE151J
1231	Resistor-330 ohm	.....	RC20AE331K
1232	Resistor-100 ohm	.....	RC30AE101J
1233	Resistor-150 ohm	.....	RC30AE151J
1234	Resistor-82 ohm	.....	RC30AE820J
1235	Headset-Mike	.....	H-78/AIC
1236	Plug	.....	AN3106-22-14S
1248	Switch, Control Wheel	Convair	240-3160902-12
1262	Plug	.....	UG-88B/U
1263	Plug	.....	UG-59A/U
1264	Plug	.....	UG-212A/U
1265	Antenna Coupler	.....	CU-145/ARC
1267	Relay	.....	RE-132/ARC
1268	Cable	.....	RG-8A/U
1269	Cable	.....	RG-58A/U
1273	Switch, Foot	Cutler Hammer	8911K525
1274	Capacitor	Sprague	TVA1413
1280	Control Panel	.....	C-455/ARC
1284	Plug	.....	AN3108-22-14P
1285	Plug	.....	AN3106B-24-28S
1286	Control Panel	.....	C-451/ARC-21
1288	Plug	.....	97-3108B-32-409P
1289	Plug	.....	97-3108B-28-425S
1290	Plug	.....	AN3106B-16-9S
1291	Plug	.....	97-3108B-28-425P
1292	Plug	.....	AN3106M-8S-1S
1293	Plug	.....	AN3108B-22-14S
1294	Adapter	.....	AN3057-4A
1295	Plug	.....	AN3106B-10SL-4P
1296	Receptacle	.....	AN3100C-10SL-4S
1325	Transformer	Triad	HS-66
1326	Resistor	Allen Bradley	GB3615
1327	Resistor	Allen Bradley	GB2715
1342	Plug	Convair	240-3935346
1343	Receptacle	.....	AN3101B24-28P
1359	Capacitor	.....	CP54B1EC205V
1360	Resistor	.....	RC21AE510K
1361	Resistor	.....	RC21AE101K
1362	Filter	.....	FA 1209
1403	Actuator	Lockheed	669157
1416	Light Assembly	Luminator Corp	L9515
1432	Light Assembly	Luminator Corp	L-10333

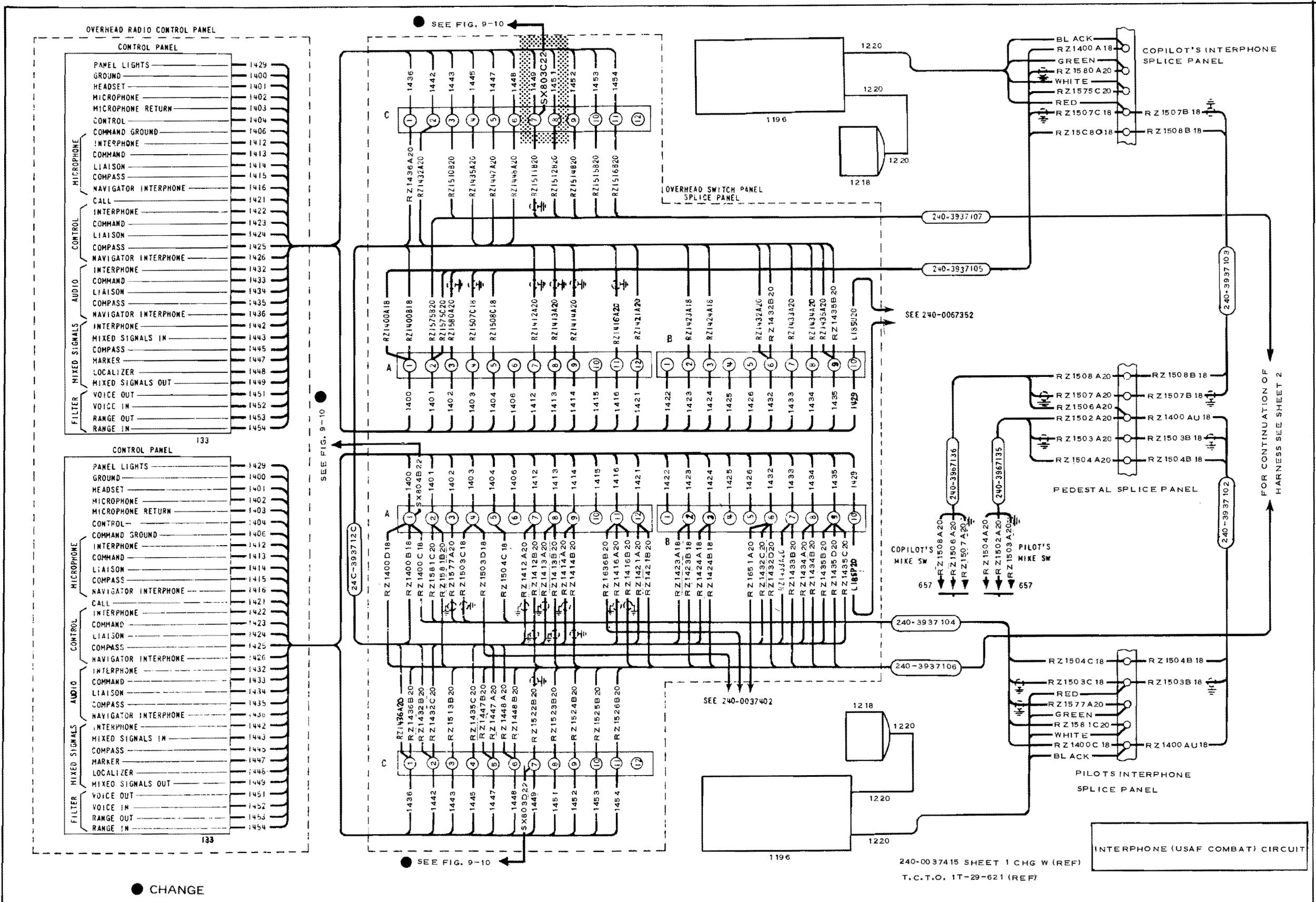
## 10-3. LIST OF EQUIPMENT (CONT).

ITEM NO.	NAME OF PART	MANUFACTURER	TYPE, MODEL, OR PART NO.
1601	Receiver-Transmitter—Transponder Set	.....	RT-279/APX
1602	Filter	.....	F-245/APX-25
1603	Coder—Transponder Set	.....	KY-95/APX
1604	Antenna—Transponder Set	.....	AT-234/APX
1605	Control—Transponder Set	.....	C-1158/APX-25
1606	Control—Coder Group	.....	C-1128/APX-25
1607	Junction Box—Transponder Set	.....	
1608	Circuit Breaker	.....	MS25005-5
1609	Circuit Breaker	.....	MS25005-5
1610	Receiver-Transmitter—HF Liaison	Collins Radio Co.	18S-4
1611	Mounting	Collins Radio Co.	350C-5
1612	Tuner—Antenna	Collins Radio Co.	180L-2
1613	Control Panel—HF Liaison Radio	Collins Radio Co.	314S-6
1614	Circuit Breaker—Liaison, 50 amps, 27.5 V dc	.....	
1615	Circuit Breaker—Liaison, 10 amps, 27.5 V dc	.....	
1616	Circuit Breaker—Liaison, 10 amps, 27.5 V dc	.....	
1617	Circuit Breaker—Liaison, 5 amps, 115 V dc	.....	
1618	Transceiver	Wilcox	97607-101
1619	Control Panel	.....	97733-100
1620	Shockmount	.....	88245
1621	Transceiver	Collins	618T-3
1622	Control	Collins	714E-2
1623	Antenna Tuner	.....	180L-3
1624	Connector	.....	PL-259/U
1625	Connector	.....	UG-88/U
1626	Adapter	.....	UG-201/U
1627	Adapter	.....	UG-27/U
1628	Connector	.....	UG-1185/U
1629	Mount	.....	390J-1
1630	Connector	.....	GP3108E-28-15S

**10-4. LIST OF T-29C AIRCRAFT MODIFIED IN ACCORDANCE WITH TCTO 1T-29C-532.**

52-1091, 52-1100, 52-1104, 52-1107, 52-1110 thru 52-1116, 52-1118 thru 52-1120, 52-1122, 52-1126, 52-1127, 52-1129 thru 52-1132, 52-1134 thru 52-1137, 52-1140, 52-1141, 52-1143 thru 52-1145, 52-1147 thru

52-1152, 52-1154 thru 52-1172, 52-1175, 53-3461 thru 53-3463, 53-3466, 53-3467, 53-3471 thru 53-3474, 53-3476 thru 53-3478, 53-3487 thru 53-3489.



● CHANGE

Figure 10-1. Interphone (USAF Combat) Circuit (Sheet 1 of 6) (Airlanes 51-3797 to 51-3806 Incl)

240-0037415 SHEET 1 CHG W (REF)  
T.C.T.O. 1T-29-621 (REF)

INTERPHONE (USAF COMBAT) CIRCUIT

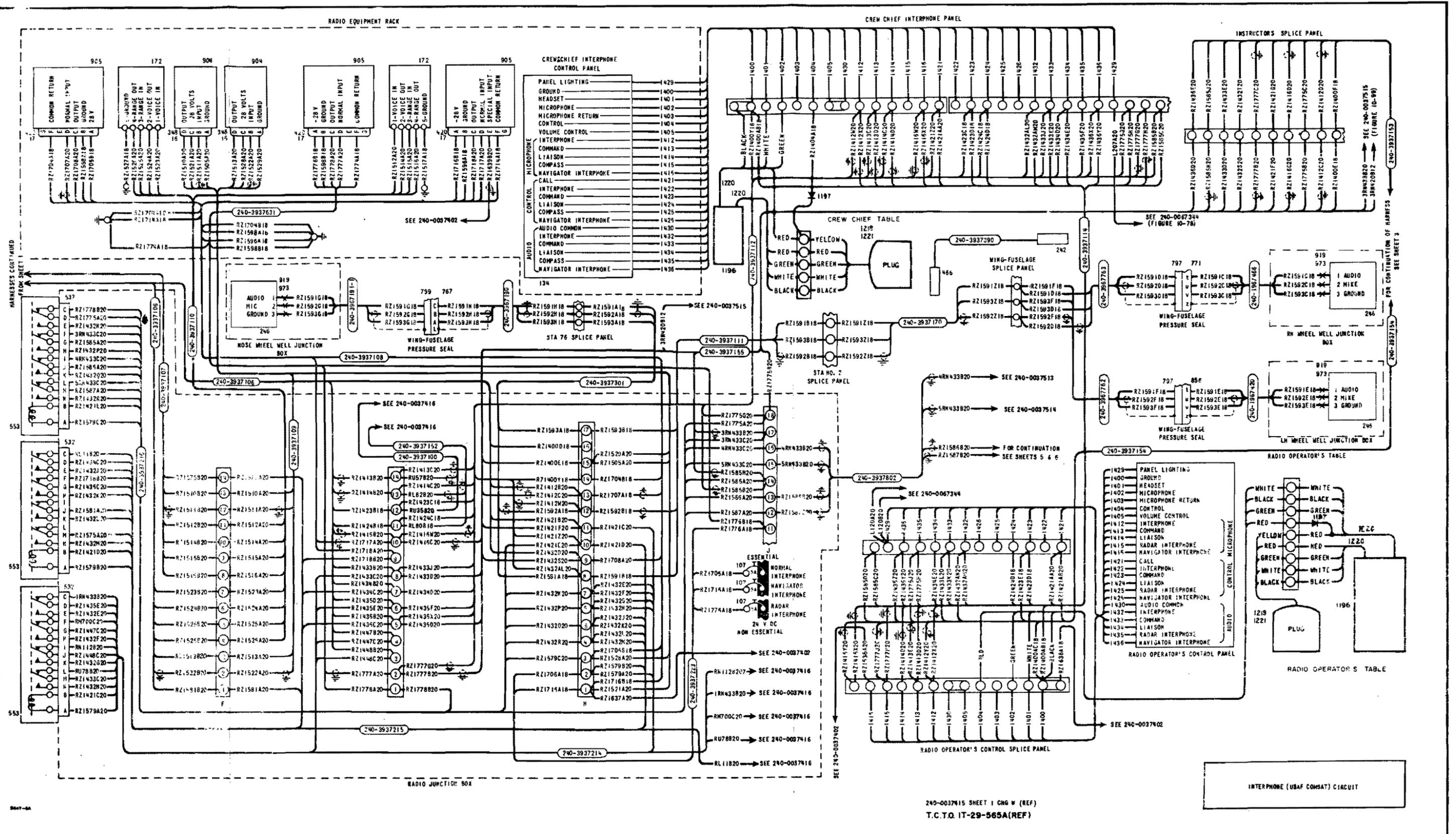


Figure 10-1. Interphone (USAF Combat) Circuit (Sheet 2 of 6) (Aircraft 51-3797 to 51-3806 Incl)

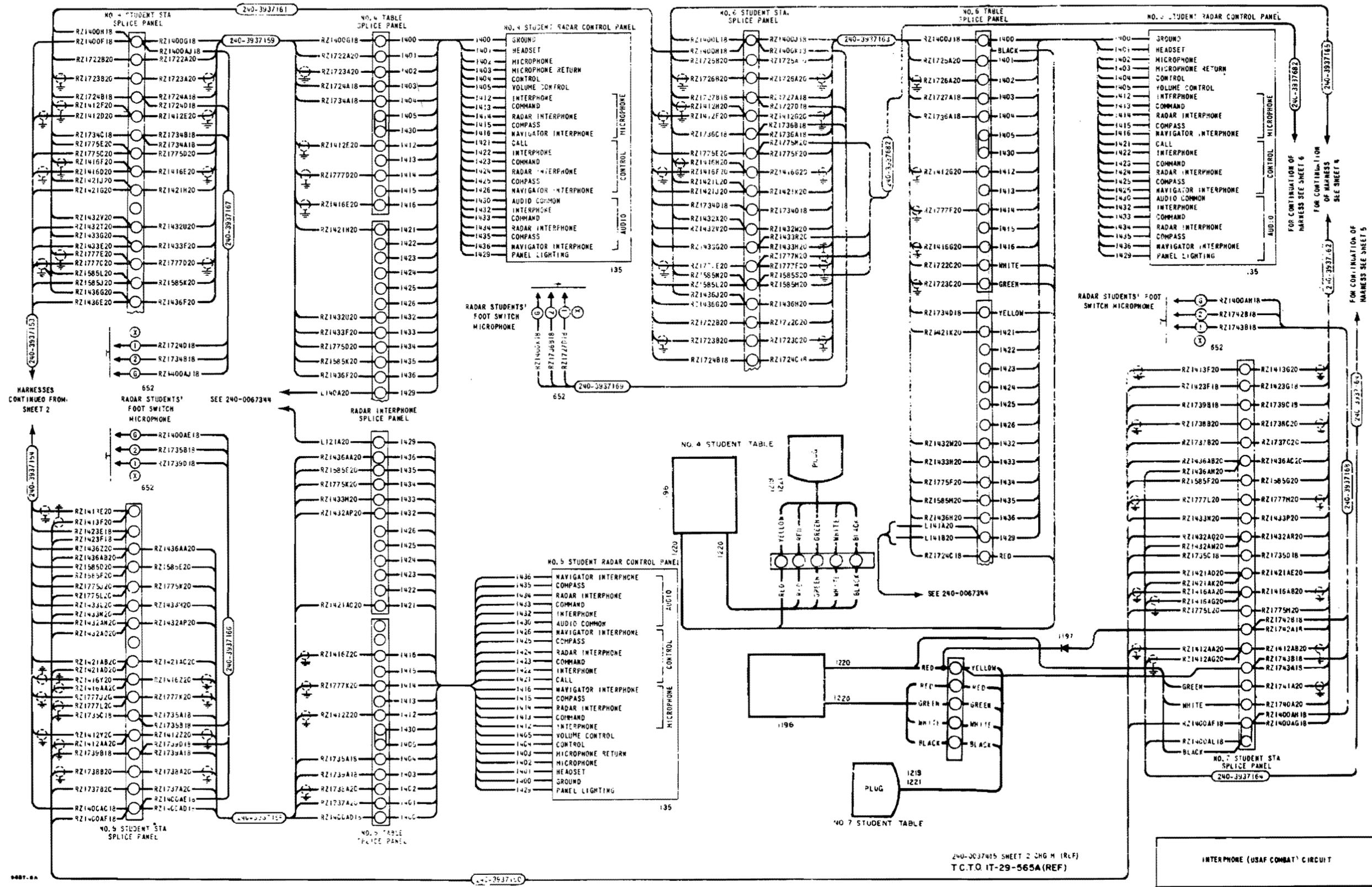


Figure 10-1. Interphone (USAF Combat) Circuit (Sheet 3 of 6) (Airplanes 51-3797 to 51-3806 Incl)

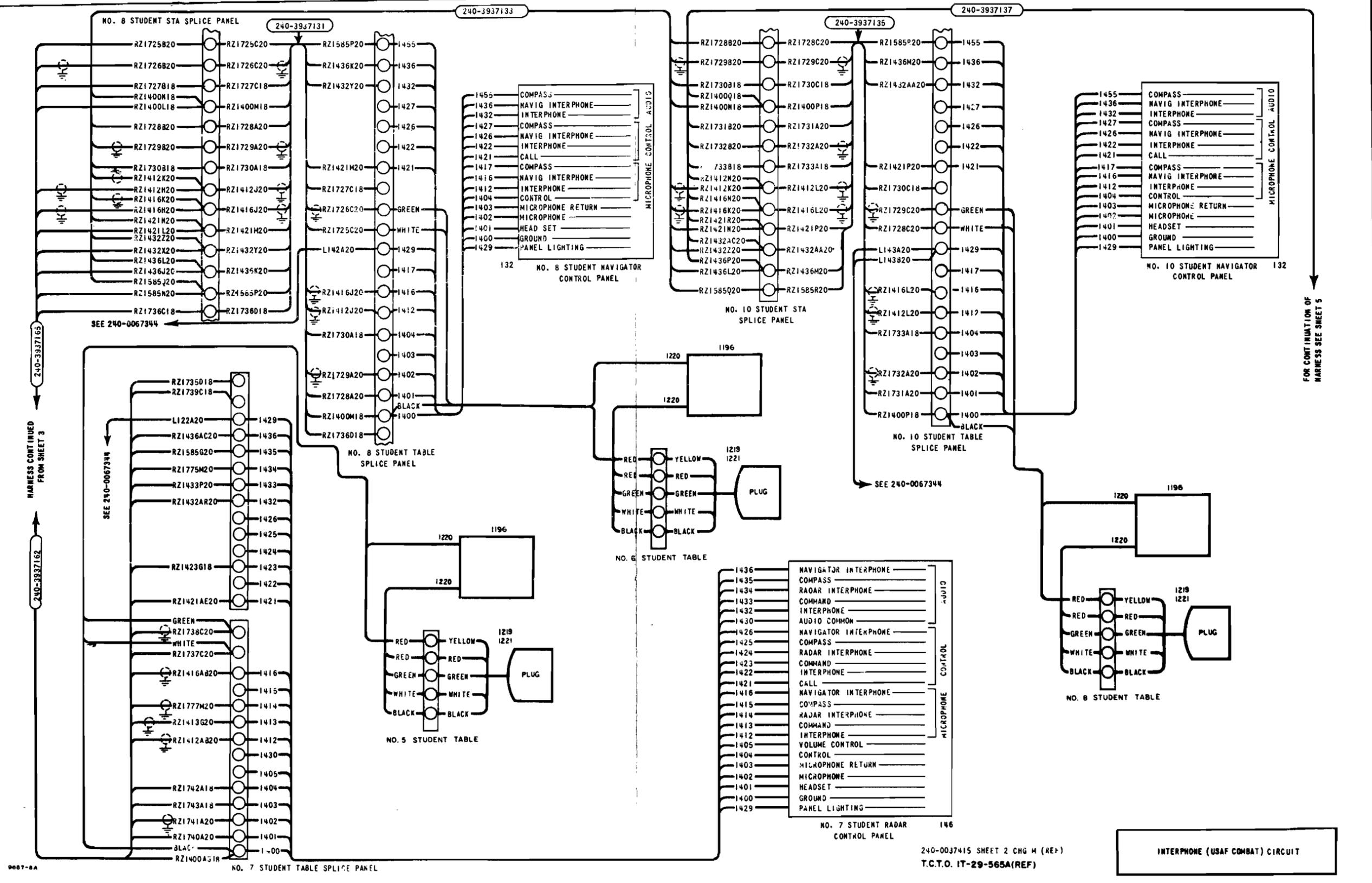


Figure 10-1. Interphone (USAF Combat) Circuit (Sheet 4 of 6) (Airlanes 51-3797 to 51-3806 Incl)

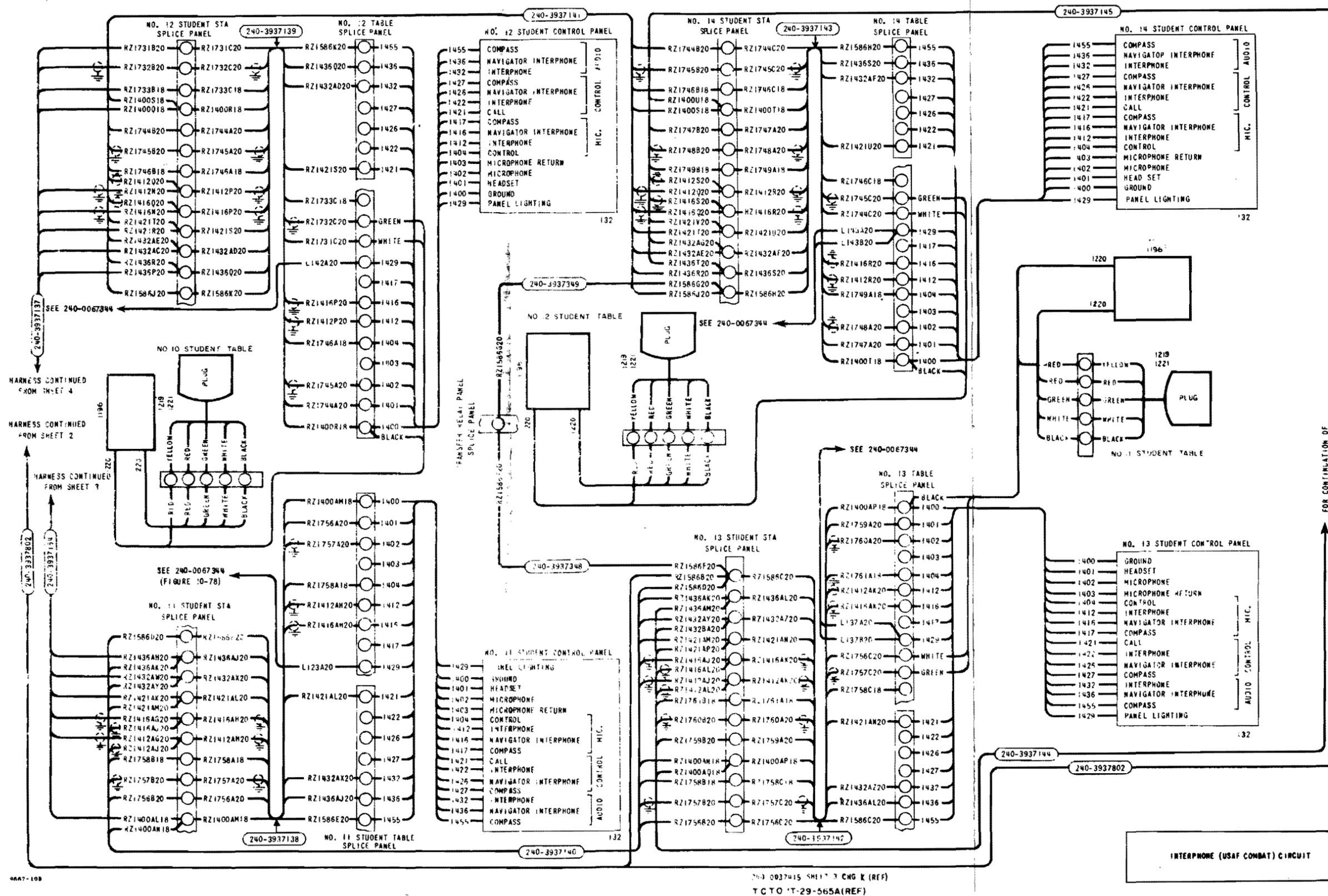


Figure 10-1. Interphone (USAF Combat) Circuit (Sheet 5 of 6) (Airlanes 51-3797 to 51-3806 Incl)

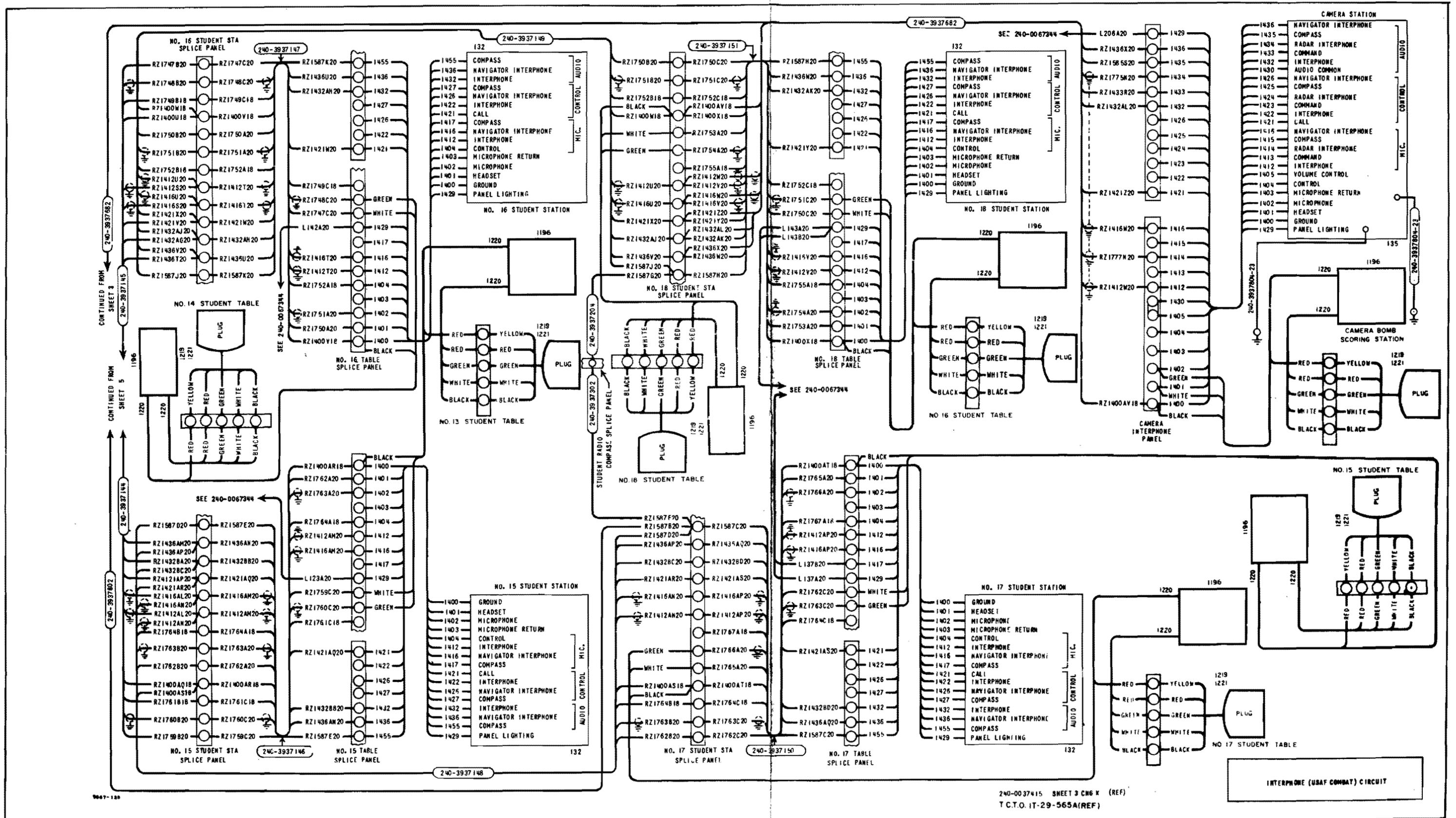


Figure 10-1. Interphone (USAF Combat) Circuit (Sheet 6 of 6) (Airplanes 51-3797 to 51-3806 Incl)

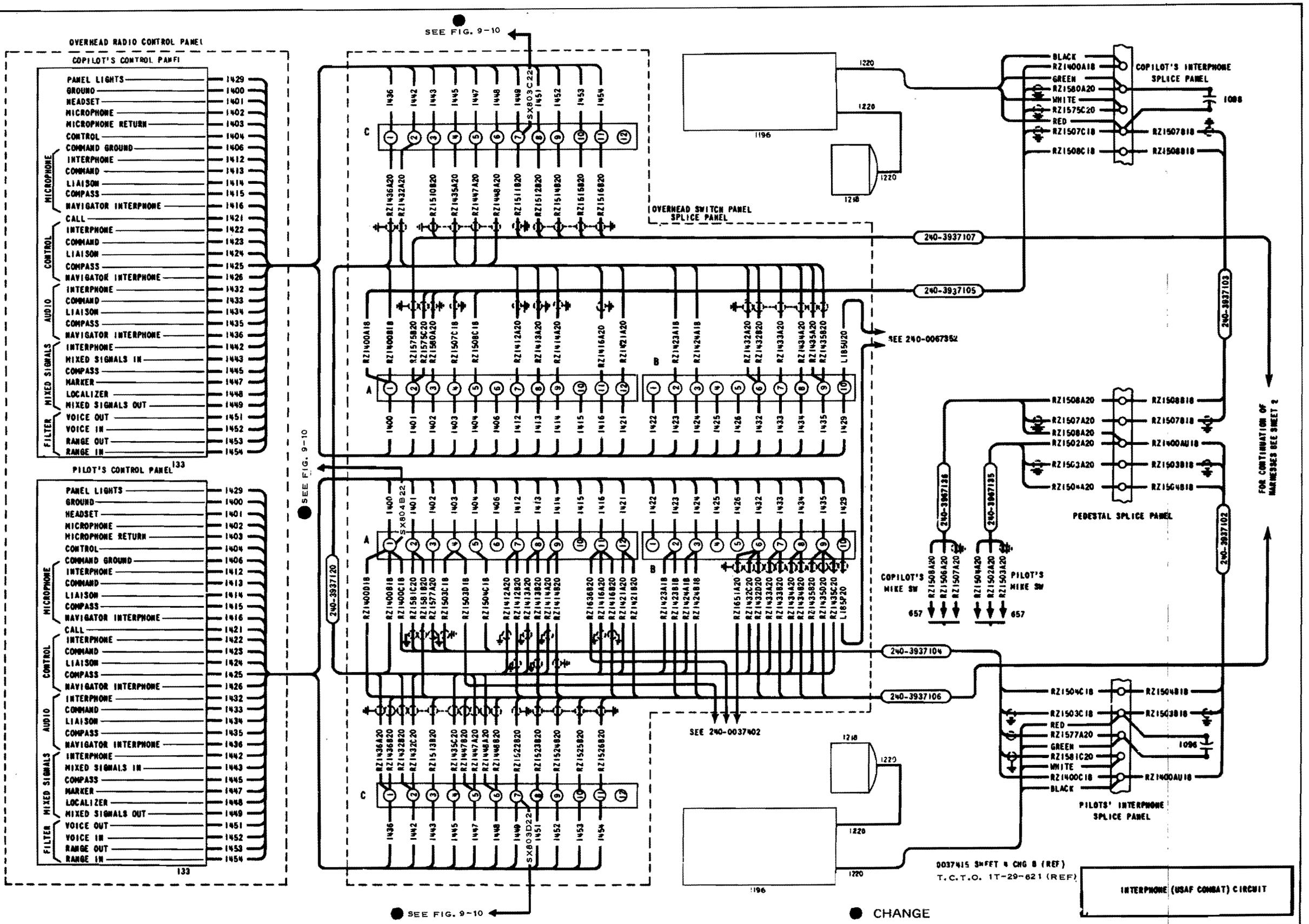


Figure 10-2. Interphone (USAF Combat) Circuit (Sheet 1 of 6) (Airplanes 51-3807 to 51-5143, and 51-5145 to 51-7917 Incl)

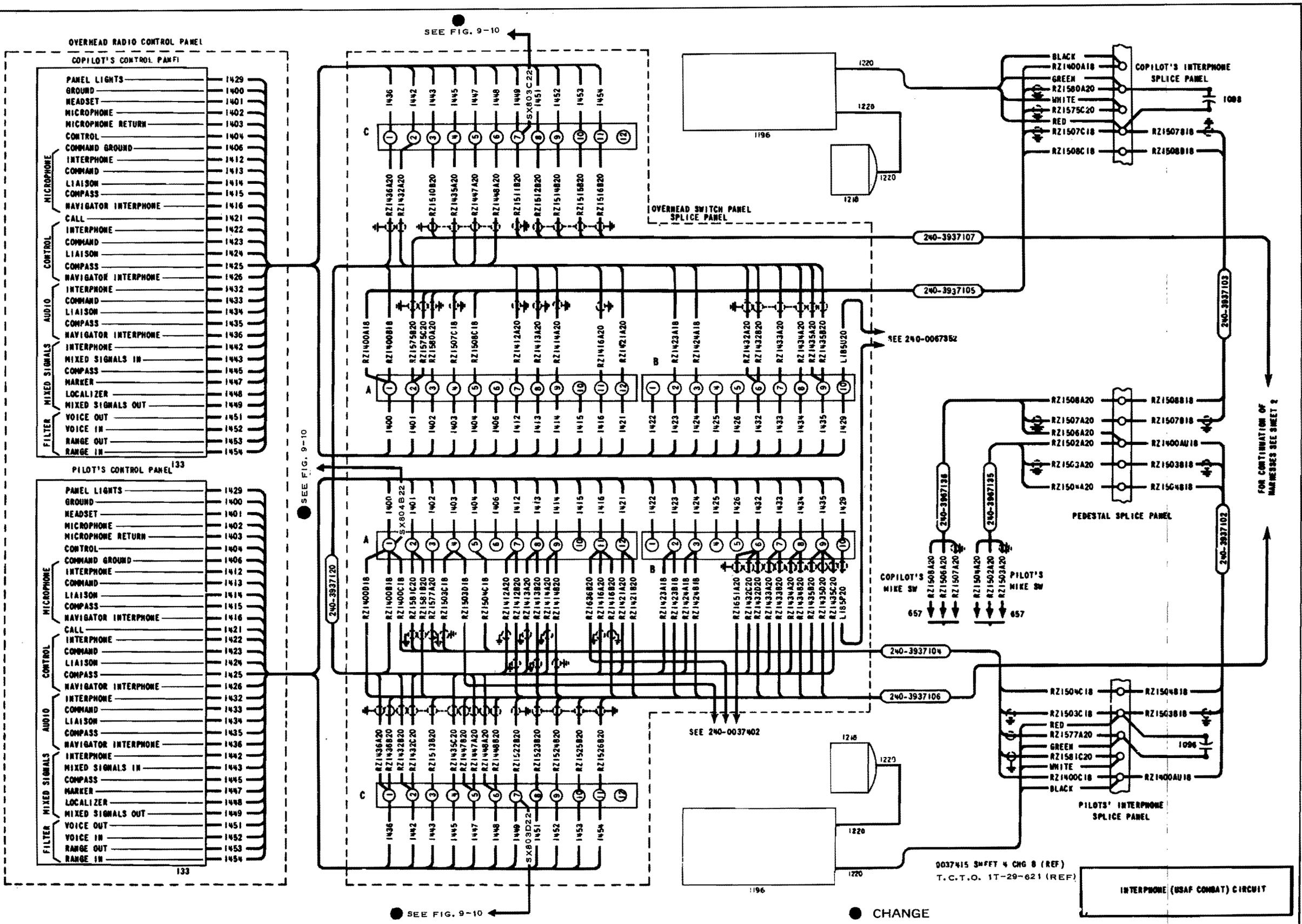


Figure 10-2. Interphone (USAF Combat) Circuit (Sheet 1 of 6) (Airplanes 51-3807 to 51-5143, and 51-5145 to 51-7917 Incl)



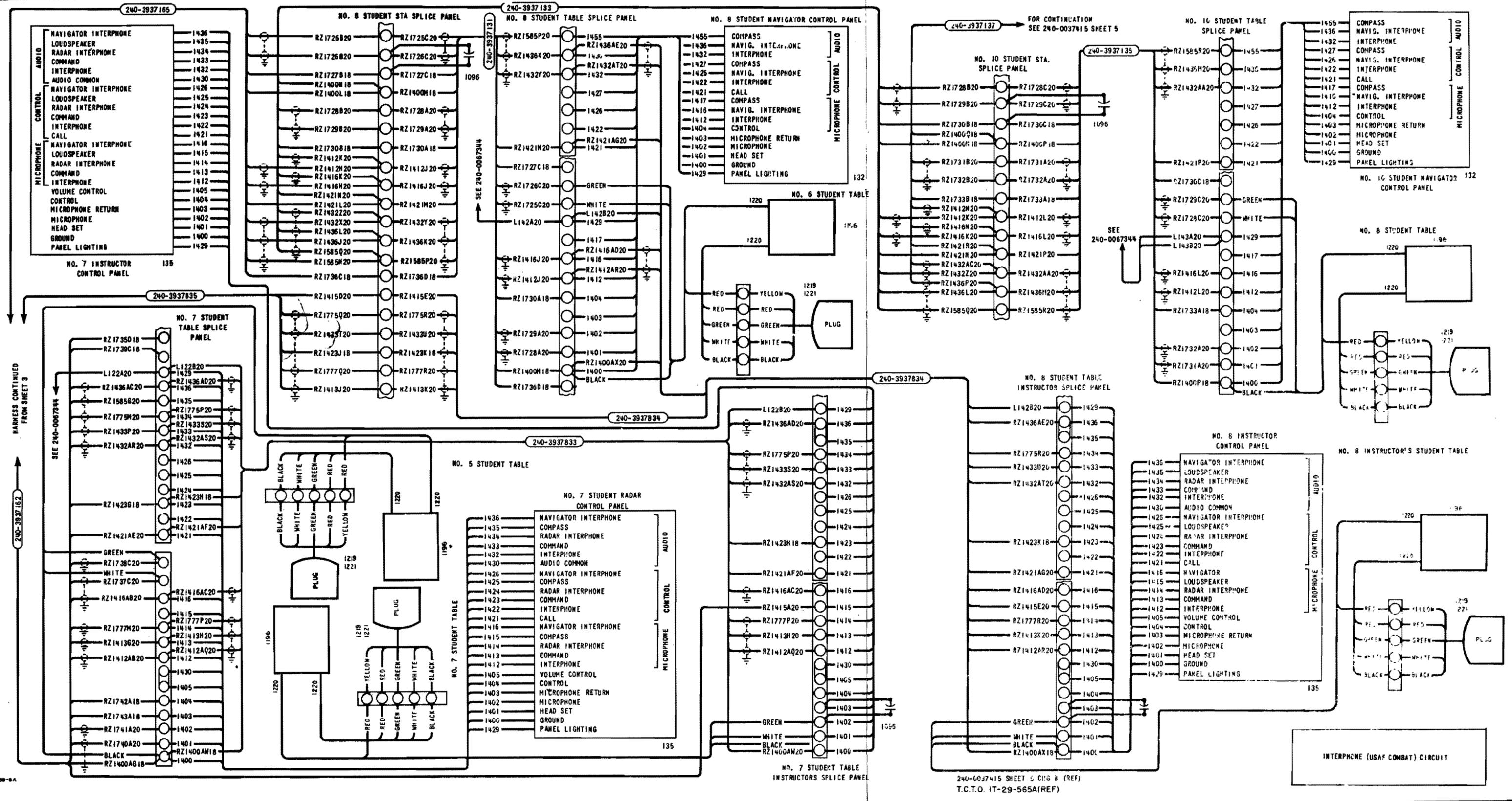


Figure 10-2. Interphone (USAF Combat) Circuit (Sheet 4 of 6) (Aircraft 51-3807 to 51-5143, and 51-5145 to 51-7917 Incl)