

# Honeywell

TO: HOLDERS OF PRIMUS® 400SL COLORADAR™ SYSTEM DESCRIPTION AND INSTALLATION  
MANUAL, PUB. NO. IB8023130

SUPERSEDED, DATED 1 DECEMBER 1989

## HIGHLIGHTS

This manual is being replaced by System Description and Installation Manual, Pub. No. IB8029076, dated 1 December 1989.

Because of similarities between the PRIMUS® 400 and 400SL Radar Systems, the information for both systems was incorporated into one manual. Discard the manual in your possession and refer to Pub. No. IB8029076.



IB8023130

# PRIMUS-400SL ColoRadar™

DIGITAL MULTI-COLOR WEATHER RADAR

(Formerly Manufactured by RCA)

## system description and installation manual

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AVIONICS DIVISION, 8500 BALBOA BLVD., P.O. BOX 9028, VAN NUYS, CA 91409



## FOREWORD

This instruction manual provides information for the installation, operation, and maintenance of the PRIMUS-400SL ColoRadar Digital Multi-Color Weather Radar System. The maintenance instructions are suitable for use by line-maintenance personnel while the aircraft is on the ground. For servicing instructions normally performed by shop personnel after the equipment has been removed from the aircraft, refer to the applicable service manuals listed below:

<u>PRIMUS-400SL UNIT</u>	<u>SERVICE MANUAL</u>
Receiver-Transmitter, RT-4001	IB8029077
Digital Indicator, DI-4002	IB8023129
Antenna Pedestal, AP-4001	IB8029079

This equipment was tested and inspected before delivery to the carrier. It should be inspected immediately upon arrival. If any part of the shipment is missing or damaged, be sure the bill of lading or express receipt carries a notation to that effect before you sign it. Should concealed damage be discovered later after delivery has been taken, file a written "Request for Inspection" with the carrier within 15 days of delivery. Save the carton, packing materials, wrapping, etc., for inspection by the carrier's agent.

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February 1981

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## **SECTION 1**

### **DESCRIPTION**

#### **A. GENERAL**

The line replaceable units of the PRIMUS-400SL ColoRadar System are shown in Figure 1-1. These units make up a lightweight, X-band, alphanumeric digital radar designed for weather location and analysis and for ground mapping. The system meets the requirements of FAA TSO C63b for airborne weather radar equipment, except for the alphanumeric and color display and the freeze mode. No requirements currently exist in FAA C63b for alphanumeric and color display or freeze mode.

#### **B. PURPOSE OF SYSTEM**

The system detects storms along the flight path and gives the pilot a visual indication of storm intensity. In weather detection mode, target returns are displayed at one of four video levels (0, 1, 2, or 3), with 0 represented by a dark screen because of weak or no returns, and with levels 1, 2, 3 represented by green, yellow, and red to show progressively stronger returns. In ground mapping mode, the video levels are displayed as dark, cyan, yellow, and magenta.

#### **C. DESCRIPTION OF UNITS**

The system consists of three line-replaceable units (LRU's):

Receiver-Transmitter RT-4001

Digital Indicator DI-4002

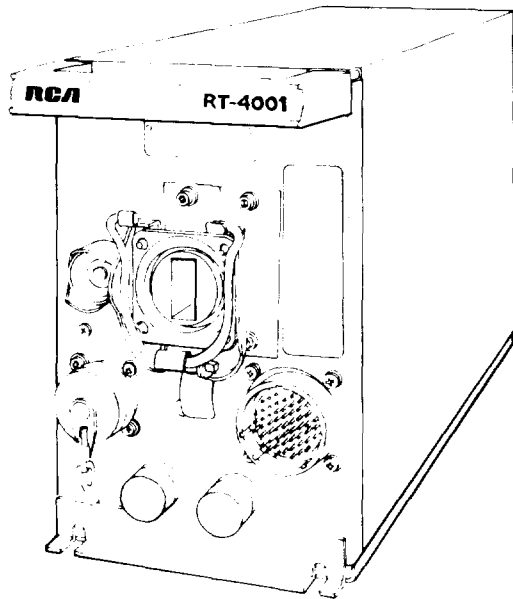
Antenna Pedestal AP-4001

##### **1. Receiver-Transmitter**

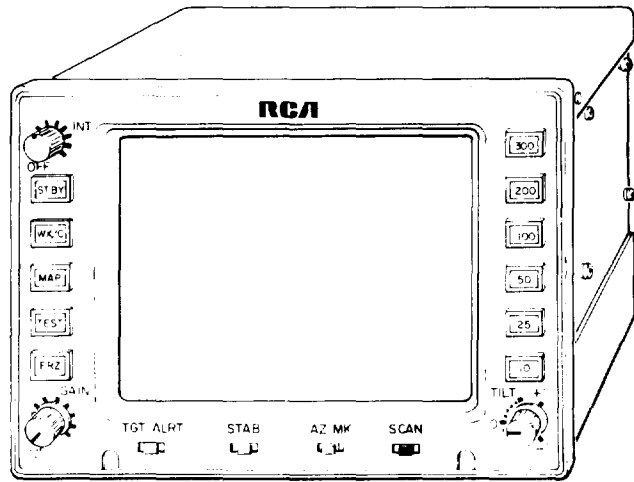
The R-T is housed in a short 1/2-ATR case that can be mounted in any convenient location in the aircraft; however, it should be mounted as close as possible to the antenna. To ease replacement and removal, a hard-mounting tray is available. The major assemblies in the R-T are the power supply, IF/video amplifier, programmer, modulator, magnetron, circulator, local oscillator, mixer, T/R limiter, and stabilization amplifier.

##### **2. Digital Indicator**

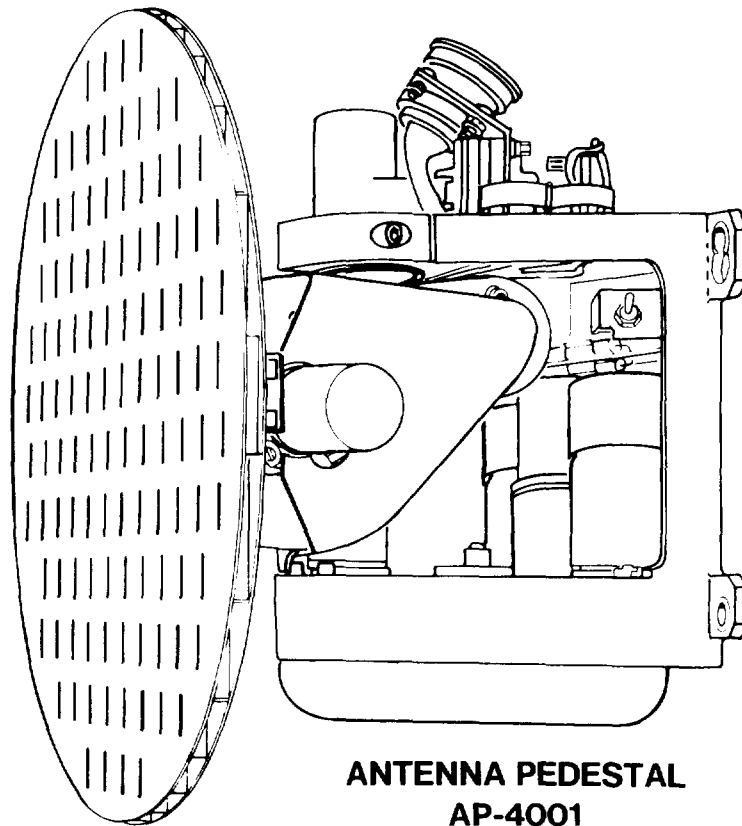
The Digital Indicator (DI) is designed for instrument-panel mounting. All of the pilot's operating controls are mounted on the front panel of the DI. Target returns are displayed on a rectangular 5-inch (12,7 cm) CRT together with range and mode alphanumerics to facilitate evaluation of the picture. Panel lighting at 5 VAC/DC or 28 VDC is selectable by a switch at the rear of the DI. The major assemblies in the DI are the power supply, video deflection, logic and memory, interface logic, and operating controls.



**RECEIVER-TRANSMITTER  
RT-4001**



**DIGITAL INDICATOR  
DI-4002**



**ANTENNA PEDESTAL  
AP-4001**

Figure 1-1. PRIMUS-400SL ColoRadar System

### 3. Antenna Pedestal

The Antenna Pedestal (AP) is designed for cantilever mounting on the aircraft bulkhead behind a radome. The AP is normally equipped with a 12-inch flat-plate phased-array radiator, but an 18-inch radiator and antenna base extension is available as an option. All scan and elevation electromechanical drive components are mounted on the pedestal, with a switch provided to stop antenna scanning during testing. The AP provides line-of-sight stabilization. Two pedestal configurations are available: one with the waveguide mating flange and main connector on the upper side of the pedestal, the other with the flange and connector on the bottom of the pedestal.

#### D. MAXIMUM PERMISSIBLE EXPOSURE LEVEL

Heating and radiation effects of weather radar can be hazardous. Personnel should remain at a distance greater than "R" (see Figure 1-2) from the radiating Antenna in order to be outside of the envelope in which radiation exposure levels equal or exceed  $10 \text{ mW/cm}^2$ , the limit recommended in FAA Advisory Circular AC No. 20-68B, August 8, 1980, Subject: "Recommended Radiation Safety Precautions for Airborne Weather Radar." The radius, R, to the maximum permissible exposure level boundary is calculated for the radar system on the basis of radiator diameter, rated peak-power output, and duty cycle. This is a far-field distance calculation, based on the recommendations outlined in AC No. 20-68B. The near-field to far-field intersection distances are less than the safe distances listed here. The advisory circular is reproduced without Appendix 1 in Appendix A of this manual.

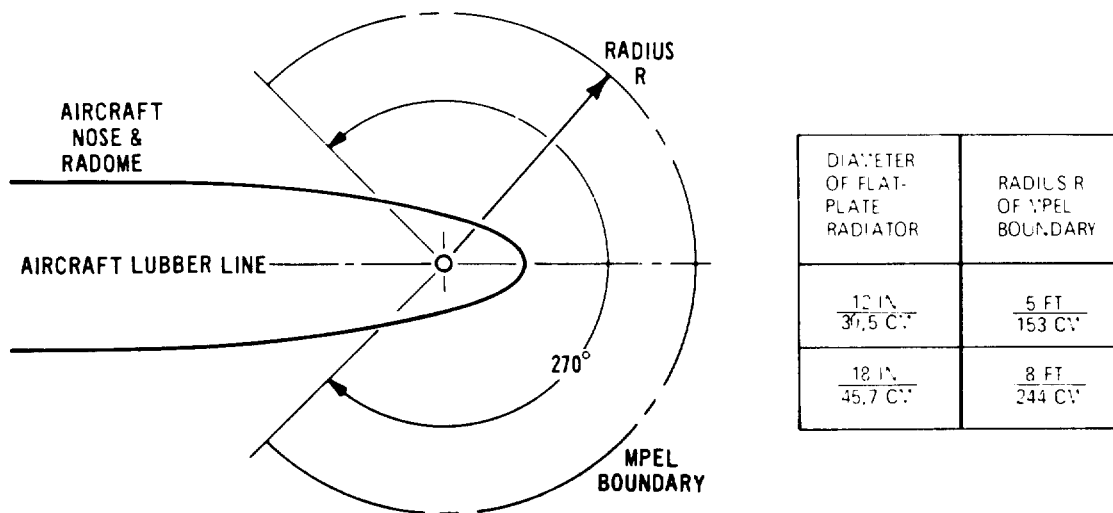


Figure 1-2. MPEL Boundary

Figure 1-2. MPEL Boundary

**E. LEADING PARTICULARS**

The leading particulars of the system are listed below:

Units in System	Receiver-Transmitter RT-4001 Digital Indicator DI-4002 Antenna AP-4001
Circuitry	All solid-state except R-T magnetron tube and Indicator CRT
Ranges (NM)	10, 25, 50, 100, 200, 300
TSO Operating Conditions	C63b (DO-160), Class 7
Receiver-Transmitter RT-4001	Category D2AJXXXXXXXXCBBBB
Digital Indicator DI-4002*	Category/A1B1/AKXXXXXXXXABBBB
Antenna AP-4001	Category D2AJXXXXXXXXABBBB
Operating Frequency	X-Band, 9345 ± 30 MHz
System Performance:	
Pulse Width	1 usec in MAP, 10, 25, and 50-mile ranges; 3.5 usec on all other ranges and modes
System Noise Figure	7 dB nominal
R-T Power Output	10 kW nominal
PRF	120 PPS
Self-Test	Momentary depression of TEST pushbutton provides color pattern and noise band presentation on 100-nm range
Power Requirement	27.5 Vdc at 5.6 amps nominal 115 Vac, 400 Hz, 35 VA Nominal
Color Display	
Weather Mode	0 Level Black 1 Level Green 2 Level Yellow 3 Level Red

\*Except alphanumeric and color display and freeze mode, functions should be evaluated under the type certificate procedures when installation approval is sought (FAA Handbook 8150.1, paragraph 13.6.3)

Map Mode	0 Level Black 1 Level Cyan 2 Level Yellow 3 Level Magenta
Panel Lighting	28 Vdc or 5 Vac/dc, selected by switch at rear of Digital Indicator

**F. EQUIPMENT SUPPLIED**

System units and associated equipment furnished by Sperry are listed in Table 1-1. The mating connectors supplied in the mating connector kit are useful not only in the installation of the radar in the aircraft, but also in making the bench test setup.

TABLE 1-1. EQUIPMENT SUPPLIED

MASTER ITEM NUMBER	DESCRIPTION	OUTLINE AND MOUNTING DATA
MI-585200	Receiver-Transmitter RT-4001	Figure 6-8
MI-585010	Receiver-Transmitter Mounting Tray	Figure 6-8
MI-585343	Digital Indicator DI-4002, Gray Panel	Figure 6-9
MI-585343-1	Digital Indicator DI-4002, Black Panel	Figure 6-9
MI-585219	Indicator Mounting Tray	Figure 6-9
MI-585202	Antenna Pedestal AP-4001 (Waveguide flange and mating connector on top) Less Radiator	Figure 6-10
MI-585202-1	Antenna Pedestal AP-4001 (Waveguide flange and mating connector on bottom) Less Radiator	Figure 6-10
MI-585041	Flat-Plate Phased-Array Radiator 12-inch (30,5 cm) Diameter	N/A
MI-585041-1	Flat-Plate Truncated 12-inch (30,5 cm diameter)	N/A
MI-585066	*Flat-Plate Phased-Array Radiator 18-inch (45,7 cm) Diameter	N/A
MI-585014	System Mating Connector	N/A

\*Receiver-Transmitter STC is factory-adjusted for use with a 12-inch (30,5 cm) antenna radiator. Refer to IB8029077, Section 2, for recommended STC adjustments for use with an 18-inch (45,7 cm) antenna radiator.

TABLE 1-1. EQUIPMENT SUPPLIED (Cont)

MASTER ITEM NUMBER	DESCRIPTION	OUTLINE AND MOUNTING DATA
MI-585053	Waveguide Pressurization Kit	Figure 6-4
MI-585215	Flexible Waveguide 6-inch Cover/Cover	N/A
MI-585215-1	Flexible Waveguide 6-inch Cover/Choke	N/A
MI-585216	Flexible Waveguide 12-inch Cover/Cover	N/A
MI-585216-1	Flexible Waveguide 12-inch Cover/Choke	N/A
MI-585187	Flexible Waveguide 18-inch Cover/Cover	N/A
MI-585187-1	Flexible Waveguide 18-inch Cover/Choke	N/A
MI-585188	Flexible Waveguide 24-inch Cover/Cover	N/A
MI-585188-1	Flexible Waveguide 24-inch Cover/Choke	N/A
MI-585189	Flexible Waveguide 36-inch Cover/Cover	N/A
MI-585189-1	Flexible Waveguide 36-inch Cover/Choke	N/A
MI-585190	Flexible Waveguide 48-inch Cover/Cover	N/A
MI-585190-1	Flexible Waveguide 48-inch Cover/Choke	N/A

## SECTION 2

### SYSTEM FUNCTIONAL DESCRIPTION

#### A. GENERAL

In this section the basic operating principles of the PRIMUS-400SL ColoRadar system are described with reference to a block diagram shown in Figure 2-1. The radar system consists of the Receiver-Transmitter (R-T), the Digital Indicator (DI), and the Antenna Pedestal (AP).

#### B. RECEIVER-TRANSMITTER

The Magnetron in the R-T generates 9345-MHz electromagnetic radiation pulses of about 10-kW peak power and feeds them to the Circulator. In the transmit mode, the Circulator channels most of the Magnetron energy to the Antenna; and in the receive mode, most of the return signal energy to the receiver circuits. A T/R Limiter isolates the receiver circuits from transmitter energy that leaks through the Circulator. In the Balanced Mixer, the 9285-MHz clockwise signal from a Local Oscillator is mixed with the 9345-MHz signal thereby generating a 60-MHz intermediate frequency (IF).

The Automatic Frequency Control (AFC) circuit samples the IF frequency from the mixer during the transmit pulse and develops a positive or negative DC error voltage depending upon whether the frequency is greater or less than 60 MHz. The error voltage controls the DC voltage applied to the 9285-MHz Local Oscillator (VCO) causing its frequency to change as required to remain 60 MHz removed from the Magnetron Frequency. In this way, the receiver tracks Magnetron drift.

The return signals are passed by the Circulator and T/R Limiter to the Balanced Mixer and converted to a 60 MHz IF signal which is fed to the IF and Video Amplifiers. The resultant analog radar video is quantized by the Indicator into four discrete levels (0, 1, 2, 3) for display.

The Programmer of the R-T receives a 120-Hz trigger signal from the Indicator Timing and Control Logic. The Programmer (1) delays operation of the Magnetron until the warm-up period has expired, (2) triggers the modulator at a 120-Hz rate, and (3) provides the IF Amplifier with the Blanking Gate. The Blanking Gate disables the receiver to prevent video resulting from the transmitter pulse from being displayed. It also generates the Sensitivity Time Control (STC) function which lowers the IF Amplifier sensitivity at close ranges and allows it to increase gradually at longer ranges, reaching a maximum sensitivity at a range of approximately 32 nautical miles for a 12-inch reflector. This action causes targets at varying distances from the Antenna to be displayed at their correct level. The amount of STC required is a function of Antenna gain; therefore, adjustments are provided to increase the STC depth and range (approximately 48 NM) when the higher gain 18-inch reflector is used.

The Modulator when triggered by the Programmer, triggers the magnetron with either 3.5-microsecond or 1.0-microsecond pulses depending on the range and mode selected.

The R-T also provides all power to operate the Antenna and Digital Indicator.

### C. DIGITAL INDICATOR

Upon receipt of the analog video information from the R-T, the Digital Indicator digitizes, synchronizes, correlates, stores, and displays the receiver signals on the CRT. The CRT presents an offset plan-position indicator (PPI) with a 60 or 120-degree sector display. The rho-theta radar data is converted to an X-Y data format, stored in a solid state digital memory, and displayed on the CRT in an X-Y interlaced raster. The raster consists of 472 interlaced horizontal lines (236 data lines); each line is made up of 240 cells, each of which can display 4 states (black or one of three colors). The Solid State memory stores the target data between antenna scans, thereby allowing the high contrast CRT to be refreshed at a 60 Hz rate, producing a flicker-free non-fading image. Because of the brightness and high contrast of the display, no viewing hood is needed. The Indicator contains Timing and Control Logic which controls the solid-state memory and all other functions associated with acquiring and displaying the digital data. The distance of a target from the aircraft may be determined by referring to the range marks (equally spaced on each range setting). As an aid in locating a target with respect to aircraft heading, the pilot may select azimuth-marks which appear 30 degrees apart in the scanned area.

The Timing and Control Logic is the heart of the Indicator logic circuits. Precise counting and timing referenced to a 10.08 MHz crystal controlled oscillator make it possible for all of the other Indicator logic circuits to function.

One of the outputs from the Timing and Control Logic is a signal to the Antenna Control Logic which, in turn, sends two drive signals, A and B, to the Antenna. Depending upon the phase relationship of these signals, a leading or trailing B, the Antenna Azimuth Drive Stepper Motor is driven either clockwise or counterclockwise, driving the Antenna, in turn, either right or left. The Antenna angle (or azimuth) information is provided to the Scan Converter along with the Conversion Clock signal from the Timing and Control Logic. On the basis of these inputs, the Scan Converter converts data acquired in rho-theta format (the pattern of normal Antenna scan) to an X-Y raster like that used in a conventional television monitor. For each and every rho-theta position of acquired radar data, there is a commensurate X-Y coordinate for the display of that data upon the screen. The rho-theta position and the X-Y raster coordinates are brought into proper relation by the Scan Converter which puts out an Update Address to the Memory.

If the Memory is envisioned as an X-Y matrix in which each address, or cell, is described by a vertical and a horizontal value, it can be seen that the Update Address selects the vertical and horizontal value so that the new data will be stored in the proper cell. Just as the cell is selected, a Write Enable signal from the Timing and Control Logic signals the Memory to update the selected Memory cell with data from the Data Correlator.

The Range/Azimuth Mark and Alphanumeric Generators, each operating in conjunction with a read-only memory, also generate displays on the basis of the Timing and Control Logic. The Alphanumeric Generator changes output on the basis of signals from the Control Panel. Although not shown on the block diagram, the Azimuth Mark Generator is always actively generating azimuth marks, but the marks are displayed only when they are called up at the Control Panel.

The Timing and Control Logic also generates the signals by which the Video Deflection Circuits synchronize the start of the X-Y raster trace on the screen

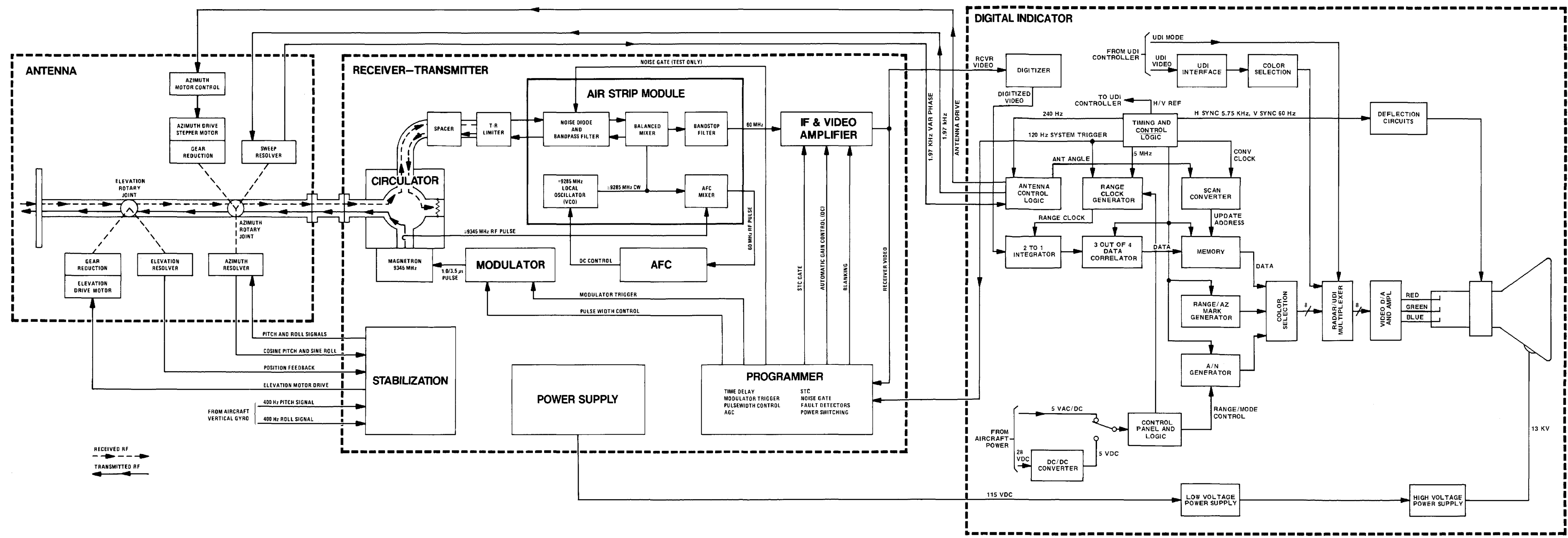


Figure 2-1. System Block Diagram 2-3/4

Several 8-bit codes to the Video Digital-to-Analog Converter select colors, some for weather, some for groundmapping, some for alphanumeric display. Still other codes are available for use the Universal Digital Interface (UDI). Digital Indicator DI-4002 is equipped with the UDI, thereby extending its utilization to include display of many other types of information, such as aircraft checklists, area navigation symbology, etc.

The High-Voltage Power Supply uses magnetic components similar to those used in conventional television sets; however, the High-Voltage Power Supply is not associated with horizontal deflection, as it would be in a television set. A sample of the high voltage is used to control a closed-loop feedback path that provides the regulation (1 percent) required to maintain the stable display sizes required by the Indicator. The operating frequency of the High-Voltage Power Supply is locked to the horizontal sweep rate (15.75 kHz) to prevent asynchronous noise from appearing on the screen.

#### **D. ANTENNA PEDESTAL**

Two Rotary Joints (Elevation and Azimuth) enable the Antenna pedestal to scan on both elevation and azimuth. Through a Gear Reduction, the Azimuth Drive Stepper Motor drives the Antenna in azimuth in approximately 0.1-degree increments in response to timing signals from the Indicator. The Antenna scans 120 degrees and is stepped 1024 times in each direction. Two 120-Hz square waves (Antenna Drive A and B) are received from the Indicator. Depending upon the phase relationship of these two signals, the Azimuth Drive Stepper Motor is driven either clockwise or counterclockwise.

The Antenna utilizes a full line-of-sight stabilization system, and it thus makes use of an Azimuth Resolver to modify beam elevation during aircraft pitch and roll when the Antenna is not looking dead ahead.

Pitch, roll, and tilt control signals are processed by stabilization circuits in the R-T into elevation drive signals for the Antenna Pedestal.

**SECTION 3**  
**OPERATION**

**A. GENERAL**

The weather radar system is used to detect and locate various storms along the flight path and to give the pilot a visual indication of intensities. After evaluating the storms, the pilot can plan avoidance. The radar system performs only the functions of weather detection and ground-mapping.

**WARNING**

**WEATHER RADAR SHOULD NOT BE USED OR RELIED UPON FOR PROXIMITY WARNING OR FOR ANTICOLLISION PROTECTION.**

For the purposes of weather avoidance, users are strongly urged to familiarize themselves with FAA Advisory Circular AC 00-24A (6-23-78), subject: "Thunder storms."

**B. CONTROLS AND DISPLAY FEATURES**

All controls used to operate the radar system are located on the Indicator front panel. These controls and the display features are indexed and identified in Figures 3-1 and 3-2 and described in Table 3-1.

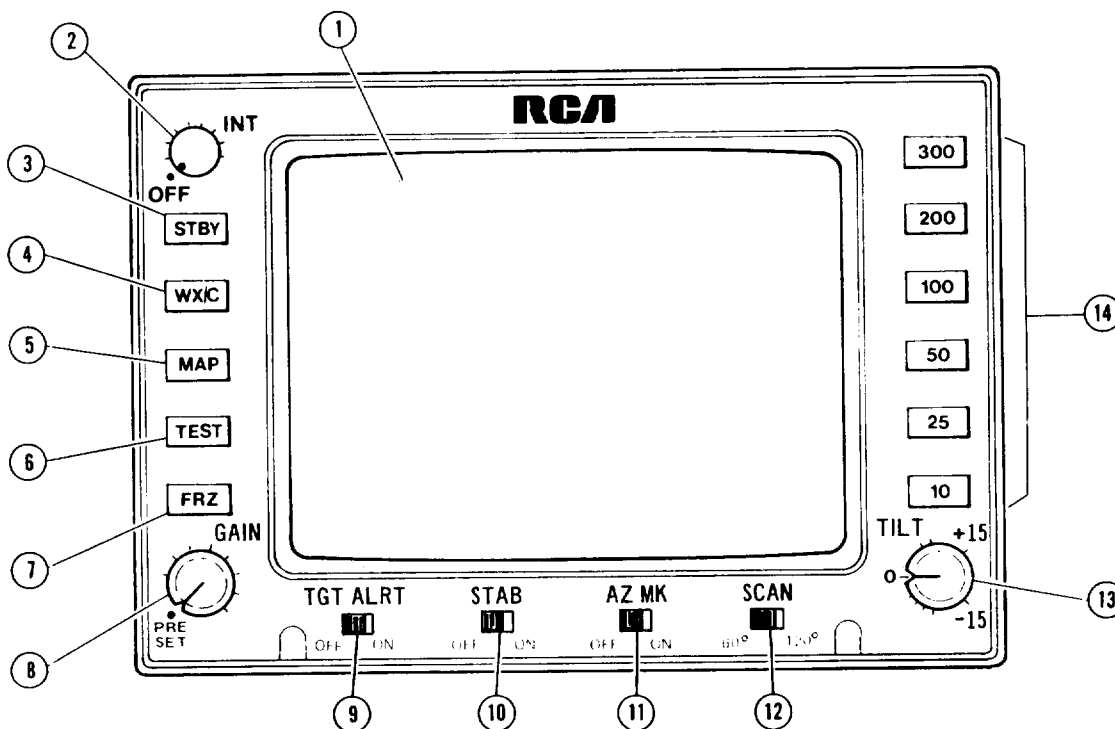


Figure 3-1. Indicator Controls

TABLE 3-1. INDICATOR CONTROLS

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<b>1</b>	Display area (see Figure 3-2 for explanation of alphanumeric display)
<b>2 INT/OFF</b>	Rotary control used to turn system on and off, and to adjust brightness (intensity) of display. At initial turn-on, system will be in standby and STBY will be displayed.
<b>3 STBY</b>	Momentary pushbutton used to select standby after radar has been used in an operating mode; e.g., WX or TEST. Standby is useful for keeping radar in ready state while taxiing, loading, etc. In standby, antenna does not scan, transmitter is not enabled, display memory is erased. STBY is displayed in Mode Field, and 100 is displayed as the selected range numeric.
<b>4 WX/C</b>	Alternate action momentary pushbutton used to select weather detection operation. If WX/C or MAP is selected prior to end of warm-up period, WAIT will be displayed until RT warms up (approximately 60 seconds). After initial turn-on and warm up, first depression of WX/C selects basic weather operation; WX is displayed.  Second depression of pushbutton selects cyclic weather display; CYC is displayed. Displayed red targets flash on and off once per second; gain is automatically set to preset level.
<b>5 MAP</b>	Momentary pushbutton used to select ground mapping display; MAP is displayed.
<b>6 TEST</b>	Momentary pushbutton used to select a special test pattern to allow verification of system operation; 100 mile range is automatically selected; TEST is displayed.
<b>7 FRZ</b>	Momentary pushbutton used to turn freeze function on or off with alternate depressions. When freeze is selected, display is not updated with incoming target return data. To alert pilot, FRZ label is displayed and is flashed on and off once each second. FRZ is automatically deactivated whenever selection of different control settings dictate a change in displayed data. At system turn-on, FRZ is automatically off.

TABLE 3-1. INDICATOR CONTROLS (Cont)

---

<b>8</b>	<b>GAIN</b>	Rotary control with one fixed-gain detented position PRESET. Used to adjust sensitivity of radar receiver, primarily to resolve nearby strong target signals while ground mapping. Sensitivity increases with clockwise rotation. Full counterclockwise rotation to detent sets gain at preset level. When control is not in detented position, VAR is displayed unless preset gain has been automatically selected.
<b>9</b>	<b>TGT ALERT</b>	Slide control used to turn target alert function on or off. When enabled, letter T in red rectangle is displayed to identify that target alert function is active. Target alert is active only when radar gain is calibrated; i.e., in WX with GAIN PRESET and in CYC or TEST. The SYMBOL TGT▲ in a red rectangle is displayed and flashes once each second whenever a red-level target is detected within the target alert sector (range from 60 to 160 nm and within $\pm 7.5$ degrees of aircraft flight path). Target alert is deactivated automatically if MAP is selected or if variable GAIN is used, but is reactivated automatically when operating controls are restored to valid alert settings.
<b>10</b>	<b>STAB</b>	Slide control used to turn antenna stabilization on or off.
<b>11</b>	<b>AZ MK</b>	Slide control used to either display or not display azimuth markers at 30-degree intervals.
<b>12</b>	<b>SCAN</b>	Slide control used to select an antenna scan sector of either 60 or 120 degrees.
<b>13</b>	<b>TILT</b>	Rotary control used to select tilt angle of antenna beam with relation to earth plane (with stabilization on) or with relation to airframe (with stabilization off). Clockwise rotation tilts beam upward 0 to 15 degrees; counterclockwise rotation tilts beam downward 0 to 15 degrees.
<b>14</b>	<b>10/25/50/100/200/300</b>	Momentary pushbuttons used to select one of six ranges. For each selected range, five range marks are displayed. At system turn-on, 100 mile range is automatically selected. Internal memory for range pushbuttons is always active.

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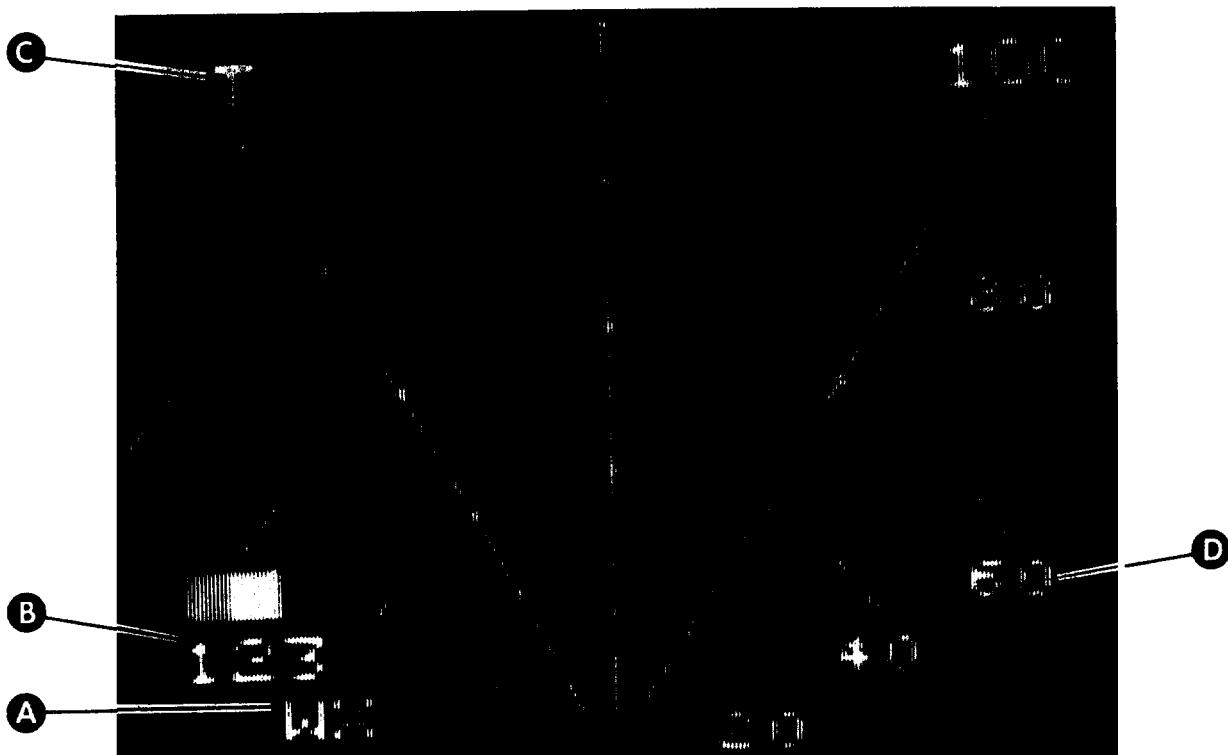


Figure 3-2. Alphanumeric Display

TABLE 3-2. ALPHANUMERIC DISPLAY

<p><b>A</b> Mode Field</p>	<p>Selected function is displayed as STBY, WX, CYC, MAP, or TEST.</p> <p>WAIT is displayed until the initial RT warmup period has expired and the Indicator and Antenna are synchronized.</p> <p>ANT is displayed as a blinking word, when the Indicator and Antenna become unsynchronized (e.g., because of Antenna failure).</p>
<p><b>B</b> Auxiliary Field</p>	<p>Color bar relates displayed colors to signal reflectivity levels 1, 2, 3 displayed beneath color bar.</p> <p>For WX, CYC, and TEST, color bar is green, yellow, and red. For MAP, color bar is cyan, yellow, and magenta.</p> <p>VAR replaces 1, 2, 3 in WX and MAP when GAIN control is not in detented PRESET position.</p> <p>FRZ is displayed as a blinking word when freeze function is selected. Active in all modes.</p>

TABLE 3-2. ALPHANUMERIC DISPLAYED (Cont)

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<b>C Target Field</b>	Blank unless target alert is enabled causing letter T in red rectangle to be displayed. Flashing alert symbol TGT ▲ in a red rectangle is displayed when red-level target is detected within the target alert sector.
<b>D Range Mark Numerics</b>	Five labelled range marks are displayed on each range. The fifth range mark label is larger serving to identify the selected range. Range and azimuth marks and numerics are displayed in cyan for WX, CYC, and TEST; in green for MAP.

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**C. OPERATION**

The following paragraphs contain procedures for operating the radar.

**1. Preliminary Control Settings**

Place the system controls in the following positions before applying power from the aircraft electrical system:

<b>INT/OFF</b>	<b>Fully counterclockwise in OFF (detent) position.</b>
<b>GAIN</b>	<b>Fully counterclockwise in PRESET (detent) position.</b>
<b>TILT</b>	<b>Fully clockwise to +15 position.</b>
<b>TGT ALRT</b>	<b>OFF</b>
<b>STAB</b>	<b>ON</b>
<b>AZ MK</b>	<b>OFF</b>
<b>SCAN</b>	<b>120</b>

## 2. Precautions

If radar is to be operated in any mode other than STBY while the aircraft is on the ground:

- (a) Direct nose of aircraft such that antenna scan sector is free of large metallic objects such as hangars or other aircraft for a distance of 100 feet (30 meters) and tilt antenna fully upwards.
- (b) Avoid operation during refueling of aircraft or other refueling operations within 100 feet (30 meters).
- (c) Avoid operation if personnel are standing too close in the 270-degree forward sector of the aircraft (see paragraph D in Section 1, Maximum Permissible Exposure Level).

## 3. Self-Test

A distinctive test pattern is displayed when the TEST function is selected. Perform the following procedures to verify the operational status of the radar after installation and before each flight.

### **WARNING**

**TRANSMITTER OUTPUT POWER IS RADIATED THROUGHOUT THIS CHECKOUT PROCEDURE.**

- (a) Verify that the preliminary control settings have been made; then rotate INT/OFF control to mid-point to turn system on. Verify that STBY is displayed in Mode field and that 100 is displayed as selected range.
- (b) Momentarily press WX/C pushbutton and verify that WAIT is displayed in Mode field.


### **NOTE**

**A time delay circuit prevents the transmitter from operating and maintains the data memory erased until the magnetron has warmed up. If either the WX/C, TEST, or MAP pushbutton is pressed just after initial turn-on, the radar will display WAIT and will be in standby for the one minute warm-up period, then automatically become operational in the selected mode.**

### **NOTE**

**If none of the pushbuttons has been depressed, the radar will display STBY and will remain in the standby mode.**

- (c) Press TEST pushbutton and, when the test pattern appears, verify operation of the intensity control and adjust to desired viewing level.

- (d) Observe the display; verify that TEST is displayed in the Mode field and that test pattern exhibits the following characteristics as shown in Figure 3-3:
  - o range marks and alphanumerics are displayed in cyan
  - o color bar and 1 2 3 are displayed in auxiliary field
  - o the colors of the first three target bands are green, yellow, and red
  - o the color of the fourth target band (65 to 75 nm) is red
  - o the two red target bands flash on and off approximately once each second
  - o the 10 nm wide noise band between 85 and 95 nm is predominately green but may contain some yellow and red dots, and extends unbroken across the full display.
- (e) Observe the noise band and the line where the noise is changing in synchronism with the antenna scan. When this line in the noise band is at either edge of the display, slide TGT ALRT control to ON and verify that the letter T in a red box appears in the target alert field. As the line in the noise band passes the dead-ahead position, observe that the T is replaced by a flashing TGT  label. Slide TGT ALRT control to OFF to disable the function.
- (f) Verify that 100 (nm) is displayed in the upper right-hand corner and that the first four range marks are labelled with the correct numerics.
- (g) Slide AZ MK control to ON and verify that azimuth marks are displayed in cyan at 30-degree intervals. Slide AZ MK control to OFF to remove azimuth marks.
- (h) Slide SCAN SCAN control to 60<sup>o</sup> and verify that the displayed scan reduces to a 60-degree sector with a scan rate of approximately 1 sweep each 2 seconds. Slide SEC SCAN control to 120<sup>o</sup> to restore the 120-degree scan with a scan rate of approximately 1 sweep each 4 seconds.
- (i) Momentarily press WX/C pushbutton to erase display, then press TEST pushbutton. After approximately two seconds, momentarily press FRZ and verify that the 1 2 3 display beneath the color bar is replaced by a flashing FRZ label. Verify that only a portion of the test pattern is displayed and there is no further updating. Momentarily press FRZ pushbutton and verify that the display begins updating starting at the current scan position.
- (j) Press 10 (nm) range pushbutton and verify that the test pattern is momentarily blanked and then restored to the previous display.
- (k) Momentarily press WX/C pushbutton and verify that WX appears in the Mode field and 10 appears as the selected range. Verify correct range numerics.
- (l) Press each range pushbutton in succession (25/50/100/200/300) and verify that range numerics change appropriately with each selection.
- (m) With 300 (nm) range selected, verify display of noise dots between 60 and 300 nm.

- (n) Momentarily press WX/C pushbutton and verify that CYC is displayed in the Mode field and that display of noise dots does not change.
- (o) Rotate GAIN control just out of PRESET and verify that 1 2 3 remains in the auxiliary field and the average display of noise dots remains the same.
- (p) Momentarily press WX/C pushbutton and verify that WX is displayed in the mode field, that VAR replaces 1 2 3 in auxiliary field and that noise dots disappear. Then, rotate GAIN control slowly to maximum clockwise position, and verify that noise display increases until a solid display of multi-color noise appears between 120 and 300 nm.
- (q) Momentarily press MAP pushbutton and verify that MAP is displayed in the Mode field and that the display of noise dots increases slightly. Verify that the color of the noise dots is cyan and the color of the range marks and alphanumeric is green.
- (r) Momentarily press STBY pushbutton to return radar to non-transmitting state. Return GAIN control to PRESET.

#### 4. WX or MAP Operation

##### **WARNING**

**TRANSMITTER OUTPUT POWER IS RADIATED THROUGHOUT THIS PROCEDURE.**

- (a) Rotate INT/OFF control clockwise to mid-position and allow warmup period of approximately 1 minute.

##### **Note**

**A time delay circuit prevents the transmitter from operating until the magnetron has warmed up. If the radar is switched directly from OFF to WX, CYC, or MAP, it will remain inoperative and display WAIT until the warmup period has expired.**

- (b) After warmup period, press TEST pushbutton.
- (c) Adjust INT/OFF control until display brightness is at desired viewing level.
- (d) Observe 4-color test pattern display shown in Figure 3-3. If the noise band between 85 and 95 nm is broken or missing, it is indicative of problems in the radar system.
- (e) Press WX/C pushbutton, set RANGE switch to desired range, and continue operation in weather-detection mode. A typical weather display is shown in Figure 3-4.
- (f) If ground-mapping operation is desired, press MAP pushbutton, set RANGE switch to desired range, and continue operation in ground-mapping mode. A typical ground mapping display is shown in Figure 3-5.

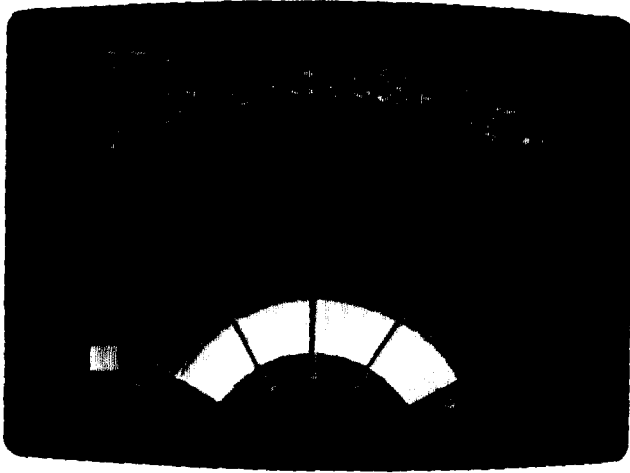


Figure 3-3. Test Pattern

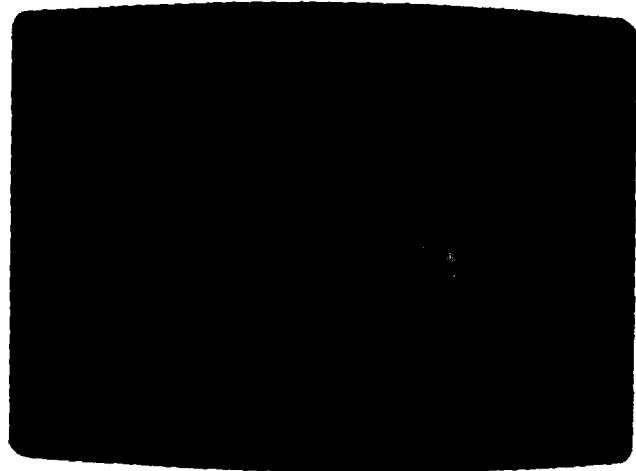


Figure 3-4. Weather Display



Figure 3-5. Ground Mapping Display

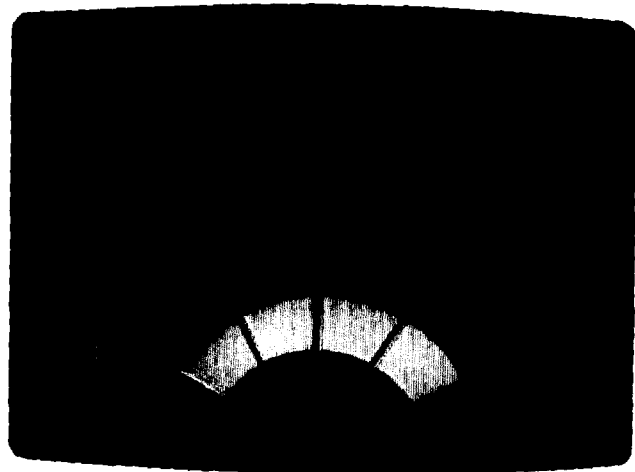


Figure 3-6. Fault Display

## 5. Fault Displays

Operation of the radar system is monitored by fault circuits which warn the pilot if abnormal operation occurs. Visual fault displays are provided for three types of monitored faults; display colors, transmitter and receiver integrity, and antenna synchronization.

Display colors are continuously monitored by the color bar and 1 2 3 legend in the auxiliary field. If a fault causes a change to unfamiliar colors, the severity level denoted by the faulty color(s) is directly coded by the 1 2 3 legend.

Transmitter and receiver integrity are monitored by the noise band in the test pattern. If the noise band is not continuous; i.e., broken up or appears periodically, the local oscillator or transmitter is faulty (see Figure 3-6). If the band is missing completely, the most likely cause is poor receiver sensitivity.

If the antenna scan becomes unsynchronized with the Indicator, the display is blanked to prevent erroneous or misleading azimuth target locations. Also, the word ANT will blink in the Mode field. Resynchronization will occur automatically, if possible; and proper operation will be restored within a few seconds.

Other circuits continuously monitor performance, loading, and temperature of system power supplies. A fault resulting in operation outside of preset limits will cause the system to shut down. Because all system power is removed, the only evidence of this shut down will be a blank display. For an overtemperature fault, the system will recycle ON automatically (if INT/OFF control remains in the ON position) after several minutes; but for other monitored faults the system will remain "latched" off. Should this occur, perform the following procedure to recycle the system:

- o Rotate INT/OFF control to OFF.
- o Verify aircraft power circuit breakers are ON (both DC and AC).  
Note: if the AC is off, fault will occur.
- o After a few seconds, rotate INT/OFF control to mid-point and press TEST pushbutton.

If the fault was of transient nature the system may operate satisfactorily; if not, it will automatically cycle OFF.

**SECTION 4**

**TROUBLESHOOTING**

**A. GENERAL**

The following troubleshooting procedures allow the operator to determine which LRU is at fault. A list of malfunctions is presented in Table 4-1, along with suggested corrective action. For detailed troubleshooting procedures for each LRU, refer to the applicable component maintenance manual.

Before attempting to use these procedures, make certain that the system units are properly connected to the aircraft interconnection wiring. Check the waveguide connections between the R-T and Antenna. Check that the aircraft supply voltages are present and within tolerance.

TABLE 4-1. SYSTEM MALFUNCTIONS AND SUGGESTED CORRECTIVE ACTION

MALFUNCTION	CORRECTIVE ACTION
Blower in Receiver-Transmitter does not go on	<ol style="list-style-type: none"> <li>1. Check Aircraft circuit breakers</li> <li>2. Check aircraft wiring</li> <li>3. Replace Receiver-Transmitter</li> <li>4. Replace Digital Indicator</li> </ol>
Blower in Receiver-Transmitter starts, but there is no presentation on Digital Indicator	<ol style="list-style-type: none"> <li>1. Check Digital Indicator INT control setting</li> <li>2. Check aircraft wiring</li> <li>3. Replace Digital Indicator</li> <li>4. Replace Receiver-Transmitter</li> </ol>
Digital Indicator displays "WAIT" continuously after normal warm-up period (approximately one minute after WX/C, MAP, or test pushbutton has been depressed)	<ol style="list-style-type: none"> <li>1. Check aircraft wiring</li> <li>2. Replace Digital Indicator</li> <li>3. Replace Receiver-Transmitter</li> </ol>
Continuous display of flashing "ANT" after normal warm-up period	<ol style="list-style-type: none"> <li>1. Check that antenna SCAN ON/OFF switch is in ON position</li> <li>2. Check aircraft wiring</li> <li>3. Replace Digital Indicator</li> <li>4. Replace Antenna</li> <li>5. Replace Receiver-Transmitter</li> </ol>
Solid colored bands of test pattern are not correct	Replace Digital Indicator
Red bands of test pattern not flashing	Replace Digital Indicator

TABLE 4-1. SYSTEM MALFUNCTIONS AND SUGGESTED CORRECTIVE ACTION (Cont)

MALFUNCTION	CORRECTIVE ACTION
Test pattern noise band is weak, broken or missing	<ol style="list-style-type: none"> <li>1. Replace Receiver-Transmitter</li> <li>2. Replace Digital Indicator</li> <li>3. Check aircraft wiring</li> </ol>
Range marks displayed are incorrect (number, spacing or labels)	Replace Digital Indicator
Azimuth lines not displayed	<ol style="list-style-type: none"> <li>1. Check AZ MK switch position</li> <li>2. Replace Digital Indicator</li> </ol>
Target alert not operational; "T" not displayed in upper left corner of indicator	<ol style="list-style-type: none"> <li>1. Check TGT ALRT switch position</li> <li>2. Replace Digital Indicator</li> </ol>
Freeze mode not operational	Replace Digital Indicator
60° scan not selectable	Replace Digital Indicator
GAIN control ineffective when operating in WX mode	<ol style="list-style-type: none"> <li>1. Replace Receiver-Transmitter</li> <li>2. Replace Digital Indicator</li> <li>3. Check aircraft wiring</li> </ol>
Antenna stabilization inoperative	<ol style="list-style-type: none"> <li>1. Check STAB switch position</li> <li>2. Replace Receiver-Transmitter</li> <li>3. Replace Antenna</li> <li>4. Check gyro</li> <li>5. Check aircraft wiring</li> </ol>
Weak or no targets displayed	<ol style="list-style-type: none"> <li>1. Replace Receiver-Transmitter</li> <li>2. Replace Digital Indicator</li> <li>3. Replace Antenna</li> <li>4. Check aircraft wiring and waveguide</li> </ol>
No Tilt control	<ol style="list-style-type: none"> <li>1. Replace Receiver-Transmitter</li> <li>2. Replace Antenna</li> <li>3. Replace Digital Indicator</li> <li>4. Check aircraft wiring</li> </ol>

**SECTION 5**

**SERVICING**

**A. GENERAL**

The radar system requires no servicing while installed in the aircraft beyond those procedures recommended under Inspection/Check and Cleaning/Painting.

**B. LUBRICATION AND SERVICING**

Instructions for applying lubricants and sealing and staking components to the appropriate parts and assemblies are supplied in the applicable components maintenance manual for each of the line-replaceable units.

## SECTION 6

### REMOVAL/INSTALLATION

#### A. GENERAL

Plan the installation in two stages. First, determine the location of the LRU's in the aircraft. Second, plan the length of the RF and electrical interconnections for the selected locations. The system installation wiring diagram is shown in Figure 6-7. Figure 6-6 shows the locations of connector contacts. The outline and mounting diagrams for the LRU's are shown in Figures 6-8 through 6-10.

#### CAUTION

**BEFORE ATTEMPTING TO INSTALL OR REMOVE ANY UNITS, TURN SYSTEM OFF BY MEANS OF INT/OFF CONTROL ON INDICATOR FRONT PANEL, AND VERIFY THAT AIRCRAFT 27.5 VDC AND 115 VDC TO RADAR ARE SWITCHED OFF.**

#### CAUTION

**DO NOT CONNECT NOR DISCONNECT ANTENNA WITHOUT FIRST TURNING SYSTEM OFF; OTHERWISE, DAMAGE TO ANTENNA AND INDICATOR CIRCUITS COULD RESULT.**

#### B. LOCATION

It is desirable to keep the waveguide run between the R-T and the Antenna as short as possible to minimize RF losses. For the same reason, it is best to avoid sharp bends, or any more bends than necessary, in the waveguide. The 90-degree twist, which is required in the waveguide, may be located wherever convenient.

In selecting the location of the R-T, remember that moisture and dirt are harmful to the equipment and that equipment failure rates increase rapidly with increases in temperature. The R-T should be emplaced with clearance so that the cooling air intake (bottom of unit) and the exhaust (rear of unit) are not blocked. For best reliability, the ambient temperature at the R-T location should be less than +40°C during operation.

Low-frequency navigational aids such as the ADF, along with their connecting leads, should be separated as far as possible from the R-T to minimize interference.

The Indicator should be installed in the instrument panel where there is easy access to the controls and a good view of the display. Since the Indicator can be installed and removed from the instrument panel with access only to the front of the panel, it is essential that sufficient slack be allowed in the cable to permit the Indicator to be pulled far enough out to disconnect the connector. Approximately 15 to 18 inches (38 to 46 cm) of slack will be sufficient.

The Antenna outline and installation diagram, Figure 6-10, shows the dimensions of the Antenna tilt and scan excursions. Check these excursions against your installation plans to be sure that the radiator will not strike any portion of the radome or airframe at tilt and scan extremes.

**CAUTION**

**USE CARE IN EXERCISING TILT OR SCAN EXCURSIONS BY HAND AS DAMAGE TO ANTENNA AZIMUTH AND ELEVATION DRIVES OR TO FLATPLATE RADIATOR COULD RESULT.**

The circuit breaker between the aircraft 27.5-VDC power supply and the radar system is not shown in the installation wiring diagram as this circuit breaker is normally part of the airframe electrical system. Before installing or working on the interconnection wiring, verify that this circuit breaker is in the off position.

Recommended equipment for installation (not supplied by Sperry) is listed in Table 6-1.

**C. REMOVING RECEIVER-TRANSMITTER**

- (a) Release R-T quick-disconnect, then remove waveguide-run flange from R-T waveguide.
- (b) Disconnect aircraft mating connector P201.
- (c) Place protective covers over R-T and aircraft waveguide flanges.
- (d) Remove safety wire, loosen hold-down clamps, and pull R-T out of mounting tray.

**D. REMOVING INDICATOR**

- (a) Turn two screws (access holes are near lower edge of Indicator front panel) counterclockwise to disengage two locking pawls holding Indicator to mounting tray.
- (b) Slide Indicator out of instrument panel, and disconnect aircraft connector P101 from Indicator.

**E. REMOVING ANTENNA**

- (a) Release Antenna quick-disconnect; then remove waveguide-run flange from Antenna waveguide. Carefully remove pressure or O-ring seal if waveguide is pressurized.
- (b) Disconnect aircraft connector P301 from Antenna.
- (c) Place protective covers over Antenna and aircraft mating waveguide flanges.
- (d) Remove and retain four socket-head cap screws and associated washers holding flat-plate phased-array radiator to Antenna (support radiator while these screws are being removed), then remove radiator.
- (e) Place protective covers over Antenna and radiator waveguide mating flanges.
- (f) Support Antenna pedestal, and remove and retain hardware holding pedestal to aircraft bulkhead. Remove Antenna pedestal.

TABLE 6-1. REQUIRED EQUIPMENT FOR INSTALLATION

NOMENCLATURE	DISCRIPTION
AC Power Source	115 VAC $\pm$ 5%, 380 to 420 Hz, 0.5 ampere
	<p><b><u>NOTE</u></b></p> <p><b>This power must be obtained from the same source as the gyro reference phase; otherwise, antenna stabilization will not function properly.</b></p>
DC Power Source	27.5 VDC $\pm$ 1-%, negative ground, 10 amperes
Vertical Gyroscope	<p>Roll input: aircraft left bank produces voltage in phase with excitation (pin d to pin A, Figure 6-7).</p> <p>Pitch input: aircraft with nose down produces voltage in phase with excitation (pin b to pin A, Figure 6-7).</p> <p>For other settings, see servo amplifier gain adjustment procedure in Antenna Pedestal maintenance manual IB8029079.</p> <p>The two-wire pitch and roll stabilization signals to be provided by the vertical gyroscope (or other reference system) should have an amplitude of <math>(E/2300) \pm 2\%</math> per degree of displacement measured across a 10,000-ohm load where E is the voltage of the nominal 115-VAC, 400-Hz reference phase. The stabilization signal phase should lead the reference phase power by 8 (+4, -2) degrees. The residual signal and noise output at zero pitch and roll should not exceed 0.5 millivolt. The verticality error should not exceed <math>\pm 0.25</math> degree. The stabilization signal should meet the performance requirements for all loads from 10,000 to 40,000 ohms.</p>
Contact-Insertion Tool	MS24256-A20*
Contact-Removal Tool	MS24256-R20*
Waveguide	RG67/U and flexible X-band waveguide between R-T and Antenna should be as short as possible.
Waveguide Flanges	<p>At R-T mounting tray: UG135/U cover flange</p> <p>At Antenna: UG135/U cover flange</p>

\* Available from: Astro Tool Col., Inc., 3941 W. 139th St., Hawthorne, CA 90250  
 Buchanan Crimp Tool Products, 1065 Flora Avenue, Union, NJ 07083  
 Sperry Avionics Systems, Replacement Parts, 8500 Balboa Blvd., Van Nuys, CA 91409

## F. INSTALLING RECEIVER-TRANSMITTER

### CAUTION

**BEFORE INSTALLING R-T, CHECK STC IDENTIFIER TAB ON FRONT PANEL. THE NUMBER SHOWING (12 OR 18) MUST CORRESPOND WITH THE SIZE OF ANTENNA RADIATOR BEING INSTALLED. IF NECESSARY, REFER TO IB8029077, SECTION 2.D, FOR RECOMMENDED STC SETTINGS AND ADJUSTMENT PROCEDURES.**

- (a) Align four holes of mounting tray with mounting holes in aircraft, and fasten mounting tray in place. Secure one end of ground strap to airframe.
- (b) Slide R-T into mounting tray until it is hooked under curved hold-down end of tray. Position, hand-tighten, and safety-wire hold-down clamps in front.
- (c) Remove protective cover from R-T waveguide flange. Check flange for dents or foreign matter. Connect waveguide run by means of quick-disconnect clamp (MI-585214). Connect aircraft interconnection wiring to R-T connector J201, after first inspecting P201 and J201 for loose, bent or damaged pins.

## G. INSTALLING INDICATOR

- (a) Turn two screws (access holes are near lower edge of Indicator front panel) counterclockwise so that locking pawls will travel rearmost.
- (b) Locate slide switch between heat-sink fins on rear of Indicator. Use tip of small flat screwdriver to slide switch up or down--up if aircraft panel-lighting voltage is 28 VDC--down if voltage is 5 VAC/VDC. For switch location see Figure 6-9.
- (c) Connect Indicator to aircraft mating connector P101. If used, connect UDI mating connector P102.
- (d) Slide Indicator, connector-end first, into tray, and engage two spring-loaded guide pins at rear.
- (e) Turn locking-pawl screws clockwise until pawls engage tray (through rectangular cutouts).

### CAUTION

**USE ONLY HAND PRESSURE TO SEAT INDICATOR INTO PANEL. DO NOT USE THE LOCKING-PAWL SCREWS TO "SCREWJACK" THE INDICATOR INTO PLACE.**

- (f) Push Indicator into panel with one hand until springs in guide pins are depressed, hold in place and tighten locking-pawl screws.

## H. INSTALLING ANTENNA

- (a) Align Antenna mounting holes with four holes in aircraft bulkhead, then fasten Antenna in place with appropriate hardware. (Antenna using 18-inch radiator needs an extension on base of Antenna to allow clearance for radiator excursions.)
- (b) Remove protective covers from Antenna and aircraft mating waveguide flanges. Check flanges for dents or foreign matter. Connect waveguide to Antenna by means of quick-disconnect clamp (if waveguide is pressurized, install pressure window and RF gasket between waveguide and Antenna). Connect aircraft interconnection wiring to Antenna connector J301.
- (c) Remove protective cover from radiator waveguide flange. Check flange for dents or foreign matter.
- (d) Position flat-plate radiator so mounting holes are aligned with holes in Antenna waveguide flange and legend on radiator reads right-side up (logo should be below legend), then fasten radiator to Antenna using four socket-head cap screws and associated flat and lockwashers furnished.
- (e) Set SCAN ON/OFF switch to ON.

## I. ANTENNA CONVERSION, WAVEGUIDE FLANGE UP/DOWN

If necessary, MI-585202 (waveguide connecting flange up) may be converted to the configuration of MI-585202-1 (waveguide connecting flange down), or vice versa. The conversion requires the interchange of several electrical leads, as indicated by the schematic diagram, Figure 6-11.

## J. INSTALLING WAVEGUIDE

In the installation of the waveguide, the primary objective is an efficient two-way transmission of RF energy between the R-T and the Antenna. A mismatched or damaged waveguide will result in a high voltage standing wave ratio (VSWR) and arcing. The higher the VSWR, the greater the transmission loss. Arcing, on the other hand, is seen by the radar as a dead short that could cause damage to the receiver crystals or to the transmitter magnetron or modulator.

The polarity of the waveguide at the R-T is rotated 90 degrees with respect to that of the Antenna; thus somewhere in the waveguide run between the Antenna and R-T a piece of 90-degree twist waveguide (twistable or rigid) will be required.

In planning the waveguide run, give preference to the use of rigid rather than flexible or twistable waveguide (where feasible) because it has lower transmission losses, lends itself better to pressurization, and withstands abuse better than flexible or twistable waveguide.

When installing flexible or twistable waveguide, do not flex or twist it any more than necessary for the installation. If a click is heard, or felt, when a piece of twistable waveguide is twisted, it may be considered as evidence of damage. With flexible or twistable waveguide, avoid making bends in the H-plane. In making E-plane bends, keep the bend radius at 2- $\frac{1}{2}$  inches or greater. Specify waterproof coatings for twistable waveguide for pressurization purposes and to keep out water.

Losses due to VSWR can also result from contamination and damage. The flanges of unconnected waveguide should be capped or taped shut to keep out water, dust, loose hardware, etc. A loose screw in the waveguide, for example, would act in the same manner as a misplaced shorting stud used for waveguide tuning. It would cause an unpredictable VSWR each time it rolled to a new location. Sometimes waveguide is dropped and dented or someone steps on it, or a drill bit inadvertently chews through it. Sometimes an installer is tempted to tug at rigid waveguide to force it into better alignment with the R-T or Antenna, and worse yet, sometimes the screws used to join the cover and choke flanges are used to screw-jack misaligned waveguide into a final fit, with the result that the cover or choke flange is literally forced off the end of the waveguide.

The proper method of mating waveguide flanges is to mate a cover flange to a choke flange for minimum VSWR between flange couplings (see Figure 6-1). The R-T and the Antenna each present a UG136B/U choke flange to the UG135/U cover flange on the aircraft interconnecting waveguide. These choke flanges have tapped screw holes for convenience in joining cover flanges to them. No washers are used between the flanges. For a pressure seal of the waveguide, an O-ring must be inserted between the flanges.

If a cover flange is mated directly to another cover flange, or if a choke flange is joined to another choke flange, a mismatch condition occurs in which RF energy is lost or in which arcing results. If an emergency makes it necessary to mate two cover flanges, a special conductive RF gasket (Sperry 1712519-1) should be used between the flange surfaces to prevent high-power arcing. This RF gasket has the correct resilience to form a pressurization seal at the joint. No. 8 lock and flat washers along with No. 8-32 nuts will be needed to secure 8-32 screws used to join the cover flanges. If two choke flanges must be mated, a metallic wafer approximately 0.050 inch thick and constructed of the same material as the flange should be inserted between the flanges. The wafer dimensions should match the flange, including the X-band aperture. In addition, the Sperry MS90064-13 O-ring seal should be placed on either side of the wafer to preserve pressurization. The tapped holes of one of the choke flanges must be drilled out, preferably with a No. 16 drill (0.173-inch) so as to pass the threads of the No. 8-32 screws.

Notwithstanding these emergency measures, it is best to use proper mating flanges. A better solution to the emergency connections described in the preceding paragraph would be to insert a short piece of waveguide in the waveguide run terminated with cover flanges for mating chokes or terminated with choke flanges for mating covers.

The basic building blocks for waveguide installations are shown in Figure 6-2. Manufacturers can normally furnish rigid waveguide in custom lengths. Elbows are available with either E- or H-plane bends; typical dimensions for these elbows are given in Figure 6-2. All waveguide used with Sperry X-band radar is referred to as "small X-band."

The following paragraphs contain procurement sources for waveguide products:

- o Sperry Avionics Systems  
8500 Balboa Boulevard  
Van Nuys, CA 91409

Telephone: (213) 894-8111

Sperry supplies flexible waveguide (see Table 1-1 for available lengths and MI part numbers).

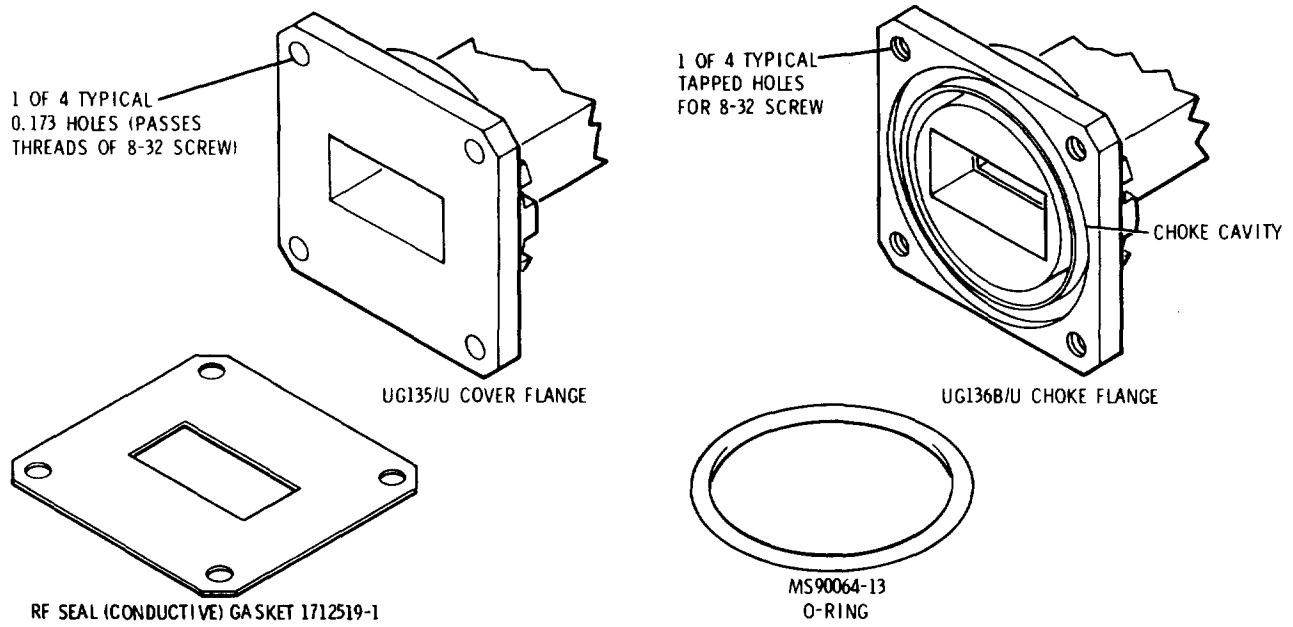


Figure 6-1. Typical Mating Choke and Cover Flanges

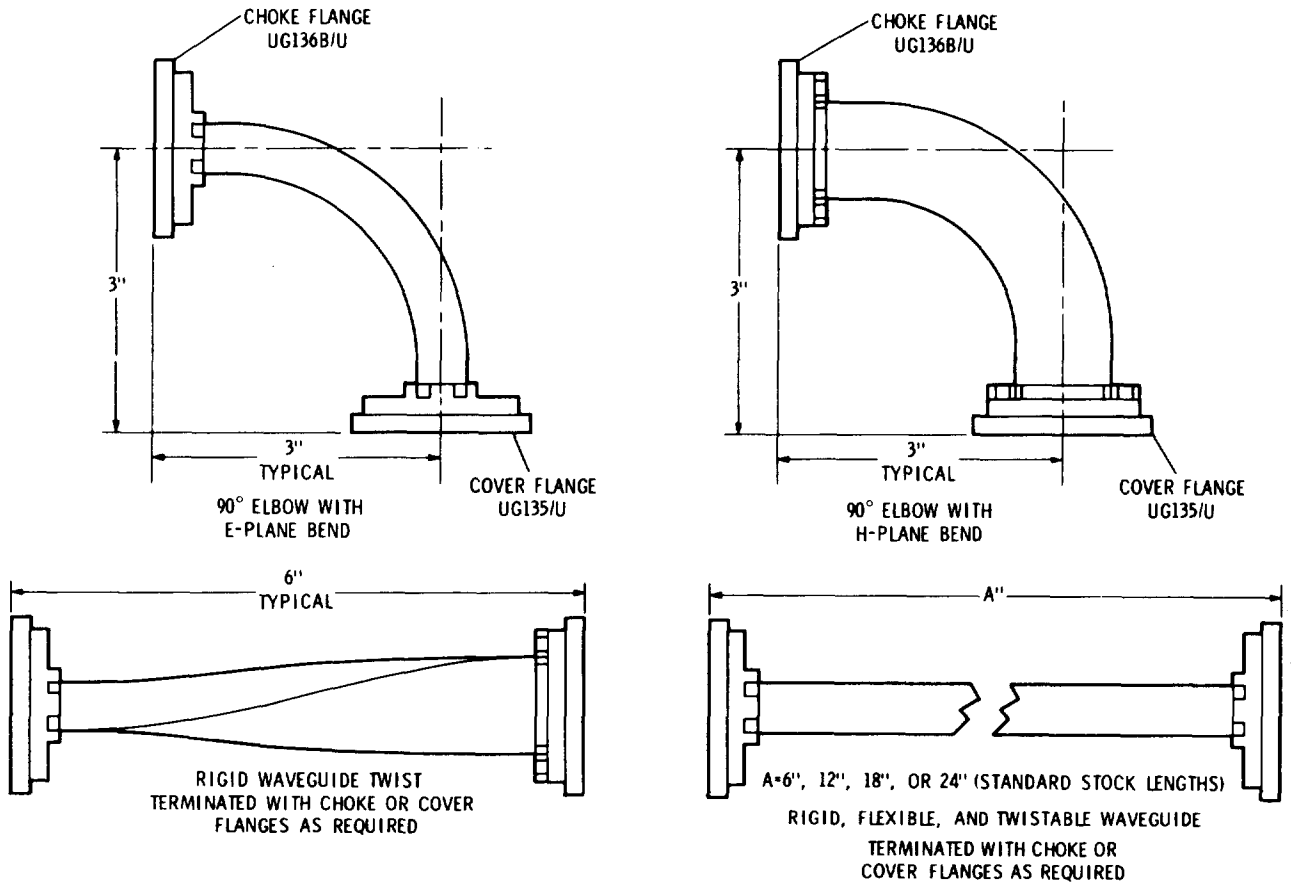


Figure 6-2. Waveguide Building Blocks

o Andrew California Corporation Telephone: (714) 626-3505  
771 East Maryland Avenue  
Claremont, CA 91711

o Airtron (Division of Litton Telephone: (201) 539-5500  
Industries, Inc.)  
200 East Hanover Avenue  
Morris Plains, NJ 07950

Airtron supplies a complete line of waveguide equipment. Airtron also supplies tool kit and stock components for fabricated flexible-twistable waveguide to length in field. This field-fabricated waveguide section is not recommended, however, for permanent or pressurized installations.

o Tech System Corp Telephone: (203) 283-5801  
Technical Division  
401 Watertown Road  
Thomastom, CT 96787

o Tech System Corp Telephone: (213) 651-5050  
c/o Fetty/Schoenduve, Inc.  
7407 Melrose Avenue  
Los Angeles, CA 90046

o Waveguide Engineering and Telephone: (213) 882-1999  
Manufacturing Co., Inc.  
20729 Dearborn Street  
Chatsworth, CA 91311

o Guide Microwave, Inc. Telephone: (213) 767-2620  
11845 Wicks Street Telex: (910) 498-2707  
Sun Valley, CA 91352

If the R-T waveguide is to be unpressurized, use of the pressure-seal O-rings at waveguide joints is optional. Figure 6-3 shows a typical unpressurized waveguide installation. However, moisture can collect in unpressurized waveguide, resulting in degradation of radar performance. It is good practice to pressurize the waveguide to reduce the collection of moisture. It is also a good practice to drill a 1/8-inch (3, 1-mm) drain hole in the lowest point of the waveguide so that trapped moisture can escape. Although such a hole is easy to provide for an unpressurized system, it may not be practical with a pressurized system, unless the hole can be located in a pressurized part of the aircraft. The drain hole should be located dead center of either the wide or narrow dimension of the waveguide to avoid affecting electrical characteristics. Drill the hole close to a connecting flange so that the inside surface of the waveguide around the hole can be polished free of burrs and cleaned of metallic particles produced by the drill.

If the waveguide installation is to be pressured, it is recommended that Waveguide Pressurization Kit MI-585053 be used (see Figure 6-4). Figure 6-5 shows a typical pressurized-waveguide installation. A waveguide pressurization-port adapter must be installed between the waveguide cover flange and the input/output choke flange on the R-T so that cabin air can bleed into

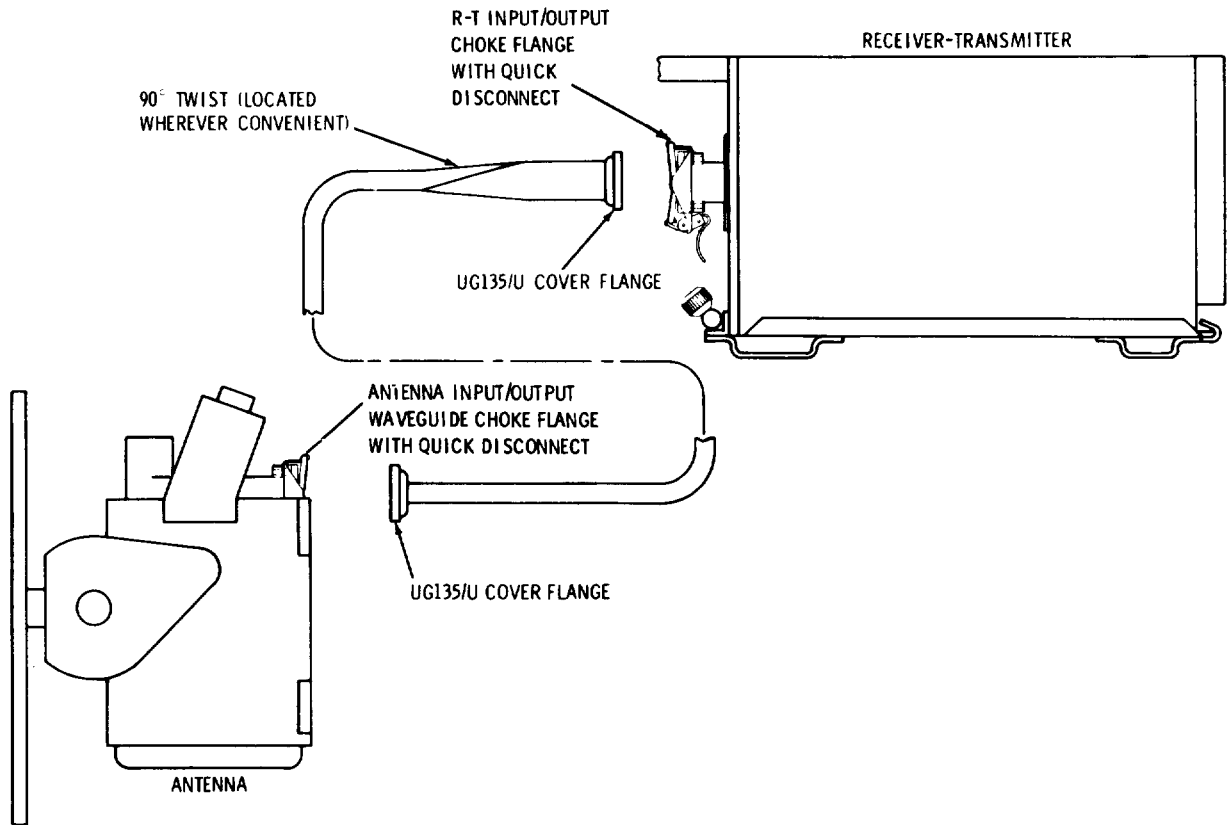


Figure 6-3. Typical Unpressurized Waveguide Installation

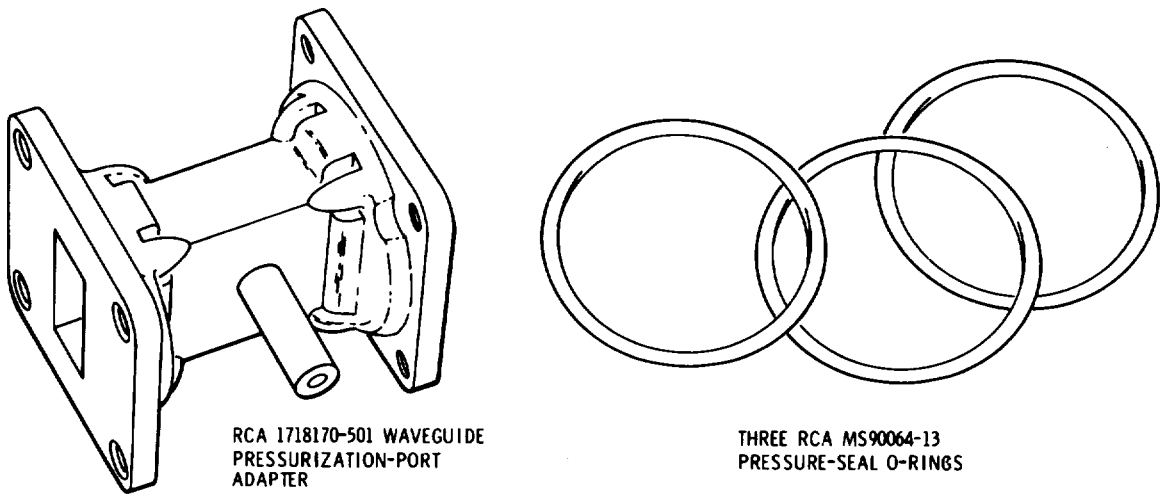


Figure 6-4. Waveguide Pressurization Kit MI-585053



the waveguide in order to maintain the waveguide at cabin pressure. The air source should be able to sustain a leakage rate of up to 18 cubic inches per minute (300 cubic cm per minute). If both the R-T and the waveguide pressurization-port adapter are to be installed in a pressurized area (same pressure as the cabin), the installation is the same as that for installation in an unpressurized part of the aircraft, except that the bleed tube is not needed.

#### **K. RADOMES**

THE RADOME IS AN EXCEPTIONALLY IMPORTANT PART OF THE RADAR INSTALLATION. A POOR RADOME CAN DEGRADE THE PERFORMANCE OF THE RADAR SYSTEM. IT IS RECOMMENDED THAT THE RADOME HAVE AN AVERAGE ONEWAY POWER TRANSMISSION OF NOT LESS THAN 90 PERCENT. USE POLYURETHANE, POLYESTER, OR LACQUER-BASE PAINTS. METALLIC PAINTS OR UNDERCOATING SHOULD NOT BE APPLIED TO THE RADOME. MAXIMUM PROTECTION FROM RAIN EROSION CAN BE OBTAINED BY FOLLOWING THE RADOME MANUFACTURER'S PAINTING PROCEDURES. RADOME DAMAGE SHOULD BE REPAIRED ONLY BY AN AUTHORIZED RADOME-REPAIR FACILITY.

FAA Advisory Circular 43-14, pertaining to radomes, is included in Appendix A.

One source of radome is:

Norton Company  
Plastics and Synthetics Division  
Aero Product Operations  
P.O. Box 350  
Akron, OH 44309

Telephone: (216) 633-3224

Sources of anti-static, anti-erosion radome paints are:

Prestic  
Synres Chemical Corp  
Kestin Department  
1211 North Olive Street  
Anaheim, CA 92803

Telephone: (714) 776-9872  
(213) 722-1834

Astrocoat  
Sterline Lacquer Manufacturing Co.  
3150 Brannan Avenue  
St Louis, MO 63139

Telephone: (314) 776-4450

Cat-a-Last  
Bostik-Finch, Inc.  
20846 S. Normandie Avenue  
Torrance, CA 90502

Telephone: (213) 320-6800

PRIMUS-400SL ColoRadar System IB8023130

It may occasionally be necessary to install RF absorption material in various locations around the bulkhead or on portions of the Radome to minimize side-lobe effects. A source of absorption material is:

Emerson & Cuming and Company  
604 West 182nd Street  
Gardena, CA 90248

Telephone: (213) 321-6650

If an erosion shoe is required, two sources are:

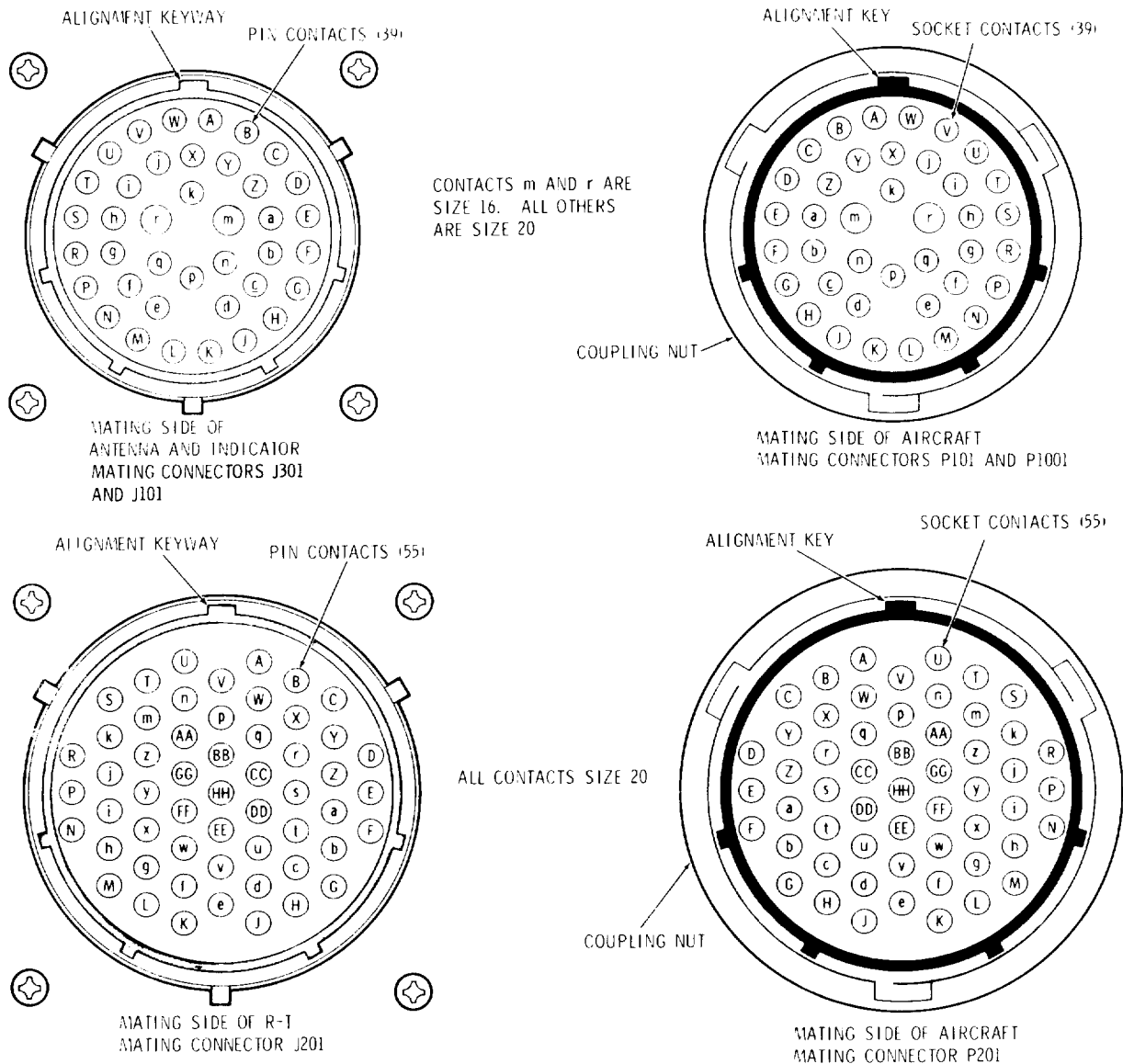
B. F. Goodrich Engineered  
Systems Company  
Department 0750, Building 24-B  
500 South Main Street  
Akron, Ohio 44318

Telephone: (216) 379-3201

Gaco  
Gates Engineering Company, Inc.  
100 Southwest Street  
Wilmington, DE 19899

Telephone: (302) 656-9951

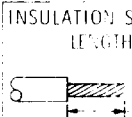

**PRIMUS-400SL ColoRadar System IB8023130**



**LEADING PARTICULARS ON CONTACTS**

WIRE SIZE AWG	INSULATION STRIPPING (SEE INSET FIGURE)	CONTACT SIZE	CONTACT TYPE	RCA OR ITT CANNON PART NUMBER
20, 22, 24	0.187 inch 4.75 mm	20	Socket	MS3193A20A
20, 22, 24	0.187 inch 4.75 mm	20	Pin	MS3192A20A
16, 18, 20	0.250 inch 6.35 mm	16	Socket	MS3193-16A
16, 18, 20	0.250 inch 6.35 mm	16	Pin	MS3192-16A

INSULATION STRIPPING LENGTH	WIRE CONTACT SIZE	HOLE-FILLER DETAILS
 0.187 inch 4.75 mm	20	COLOR RCA OR ITT CANNON CODE PART NUMBER Red MS3187A20
 0.250 inch 6.35 mm	16	Blue MS3187-16

TO INSERT OR REMOVE CONNECTOR CONTACTS, THE FOLLOWING TOOLS WILL BE USEFUL:

- CONTACT-INSERTION TOOL MS24256-A20
- CONTACT-REMOVAL TOOL MS24256-R20
- CRIMP TOOL M22520-1-01 WITH TURRET M22520-1-02

THESE TOOLS AVAILABLE FROM:

- ASTRO TOOL CO INC  
3941 W 139TH ST  
HAWTHORNE, CA 90250
- BUCHANAN CRIMP TOOL PRODUCTS  
1065 FLORAL AVE  
UNION, NJ 07083
- RCA AVIONICS SYSTEMS  
REPLACEMENT PARTS  
8500 BALBOA BLVD  
VAN NUYS, CA 91409

**Figure 6-6. System Mating Connectors, Pin Layouts (Sheet 1 of 2)**

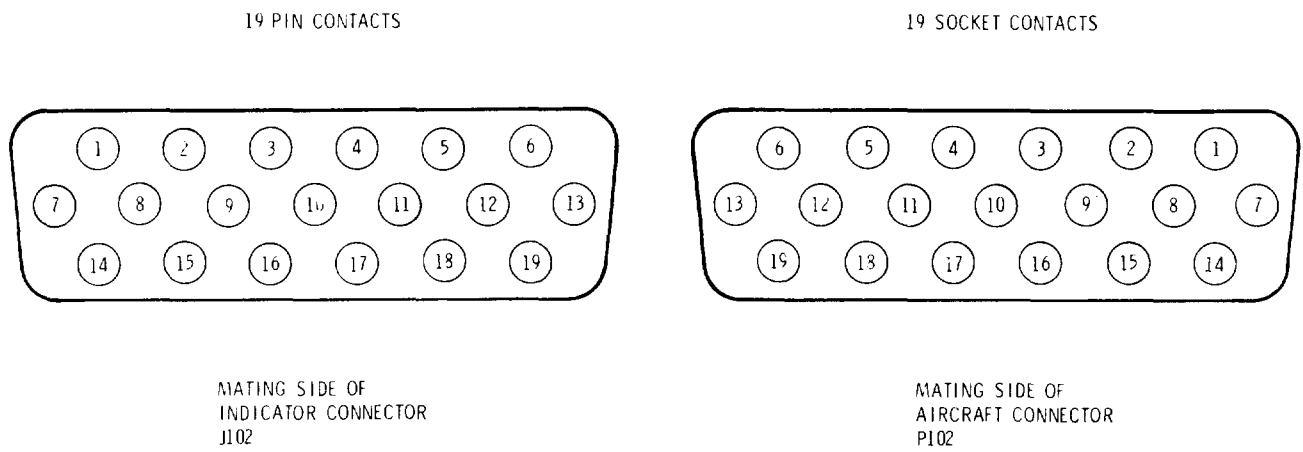
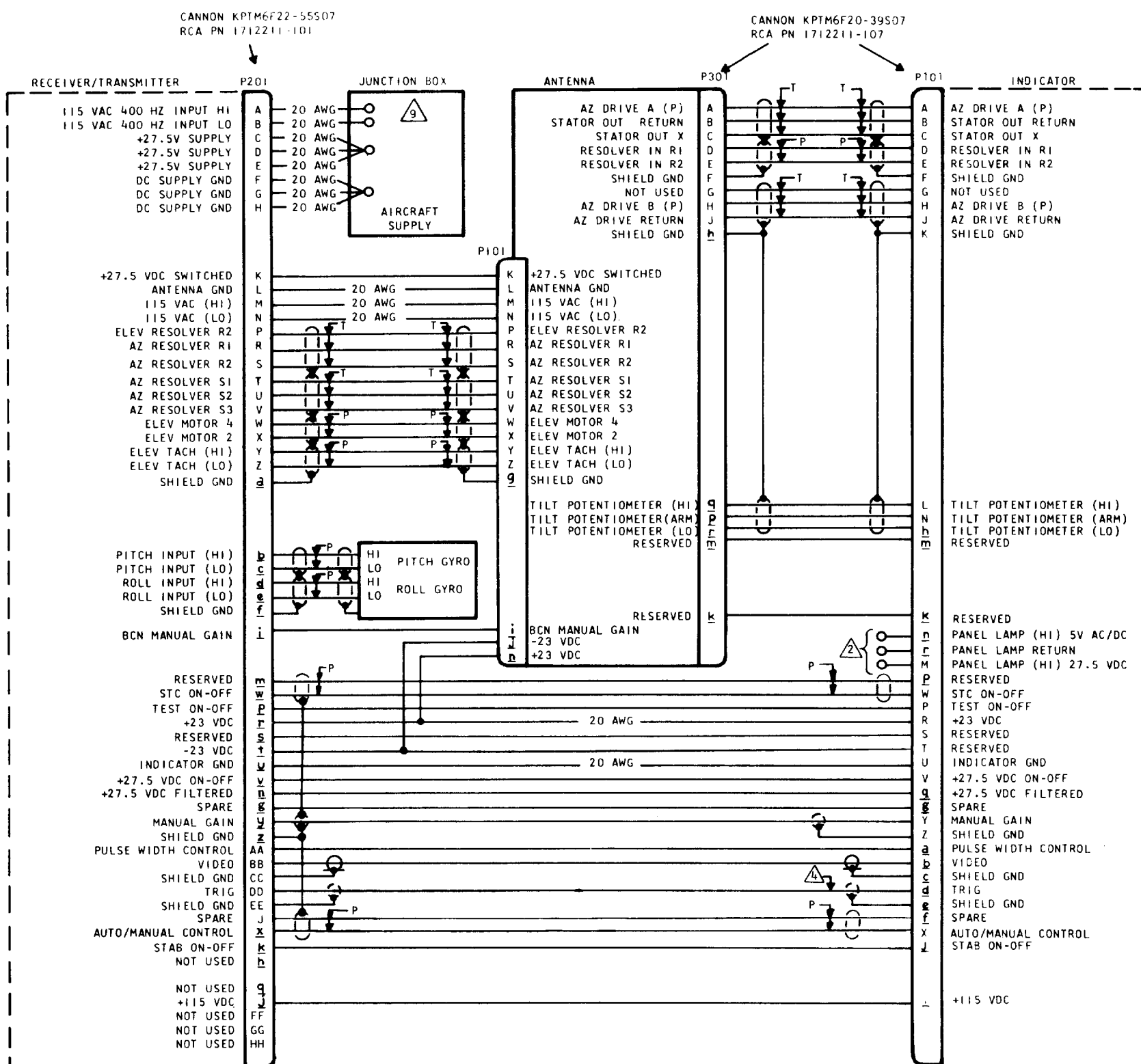


Figure 6-6. System Mating Connectors, Pin Layouts (Sheet 2 of 2)

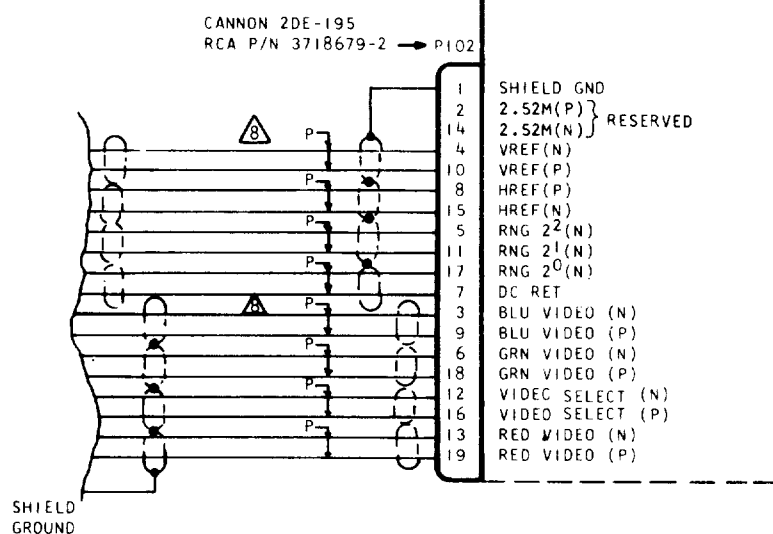


9. THE 115 VAC 400 HZ POWER MUST BE PROVIDED FROM THE SAME SOURCE USED FOR THE GYRO REFERENCE PHASE.
8. CABLE SHALL MEET CHARACTERISTICS OF TABLE 1. SEE TABLE 2 FOR CABLE AVAILABLE FROM RCA.
7. ALL UNDERLINED LETTERS ARE LOWER CASE (x).
6. MATING CONNECTORS ARE FURNISHED AS MATING CONNECTOR KIT MI-585014. (P102 NOT INCLUDED)
5. MAXIMUM CURRENT FOR PANEL LIGHTING AT 5V IS 1.0 AMP. MAXIMUM CURRENT FOR PANEL LIGHTING AT 27.5 VDC IS 0.26 AMP.
4. CABLE CAPACITANCE FOR THIS LINE SHALL NOT EXCEED 2000 PICOFARADS.
3. SYMBOLS INDICATE AS FOLLOWS:
- = SHIELDED TWISTED PAIR
  - = SHIELDED TWISTED TRIPLE
  - = SHIELDED SINGLE
  - = RG188A/U COAX

2. P1001-b AND P1001-r ARE TO BE CONNECTED TO THE AIRCRAFT 5-VOLT PANEL-LAMP DIMMER-CONTROLLED SUPPLY. ON AIRCRAFT USING 28 VDC PANEL-LAMP SYSTEM. P1001-m AND P1001-r ARE CONNECTED TO THE AIRCRAFT 28 VDC PANEL-LAMP DIMMER-CONTROLLED SUPPLY. WIRES TO b, r, AND m ARE TO BE NUMBER 20 AWG.

1. WIRING SHALL BE AWG SIZE 22. PIN TO PIN WIRING IS UNIVERSAL FOR MANY RCA RADAR SYSTEMS AND IS RECOMMENDED FOR ALL INSTALLATIONS TO FACILITATE DIRECT SUBSTITUTION OF OTHER SYSTEMS. WIRING NOMENCLATURE IS APPLICABLE TO PRIMUS-400 AND PRIMUS-400 SL.

NOTES: UNLESS OTHERWISE SPECIFIED.



*ELECTRICAL PROPERTIES. WIRE AWG 24. STRANDED TWISTED PAIR. SHIELDED.	
IMPEDANCE (PER MIL-C-915)	70 ± 7 OHMS
MUTUAL CAPACITANCE (PER MIL-C-915)	30 PF/FT MAX.
ATTENUATION AT 1 MHZ	1.4 DB/100 FT MAX.

\*EQUIVALENT TO RAYCHEM CORP. TWO CONDUCTOR, MULTIPLEX. DATA BUS. DRAWING NO. 10595. REV. C DATED 4-10-78 WHICH IS AVAILABLE FROM RCA PER TABLE 2.

TABLE 1

INSTALLATION CABLE (FOR USE WITH CONNECTOR KIT MI-585317)		
CABLE MI	*UNCUT LENGTH	FOR INSTALLATION RUN OF
MI-58529-4	40 FEET	5 FEET
MI-58529-4-1	90 FEET	10 FEET
MI-58529-4-2	120 FEET	15 FEET
MI-58529-4-3	160 FEET	20 FEET

\*CABLE AS SUPPLIED IS TWO CONDUCTOR SHIELDED WIRE AND FOR INSTALLATION MUST BE CUT INTO 8 PIECES.

TABLE 2

ONLY APPLICABLE TO DI-4002 IN NEW P-400SL SYSTEM

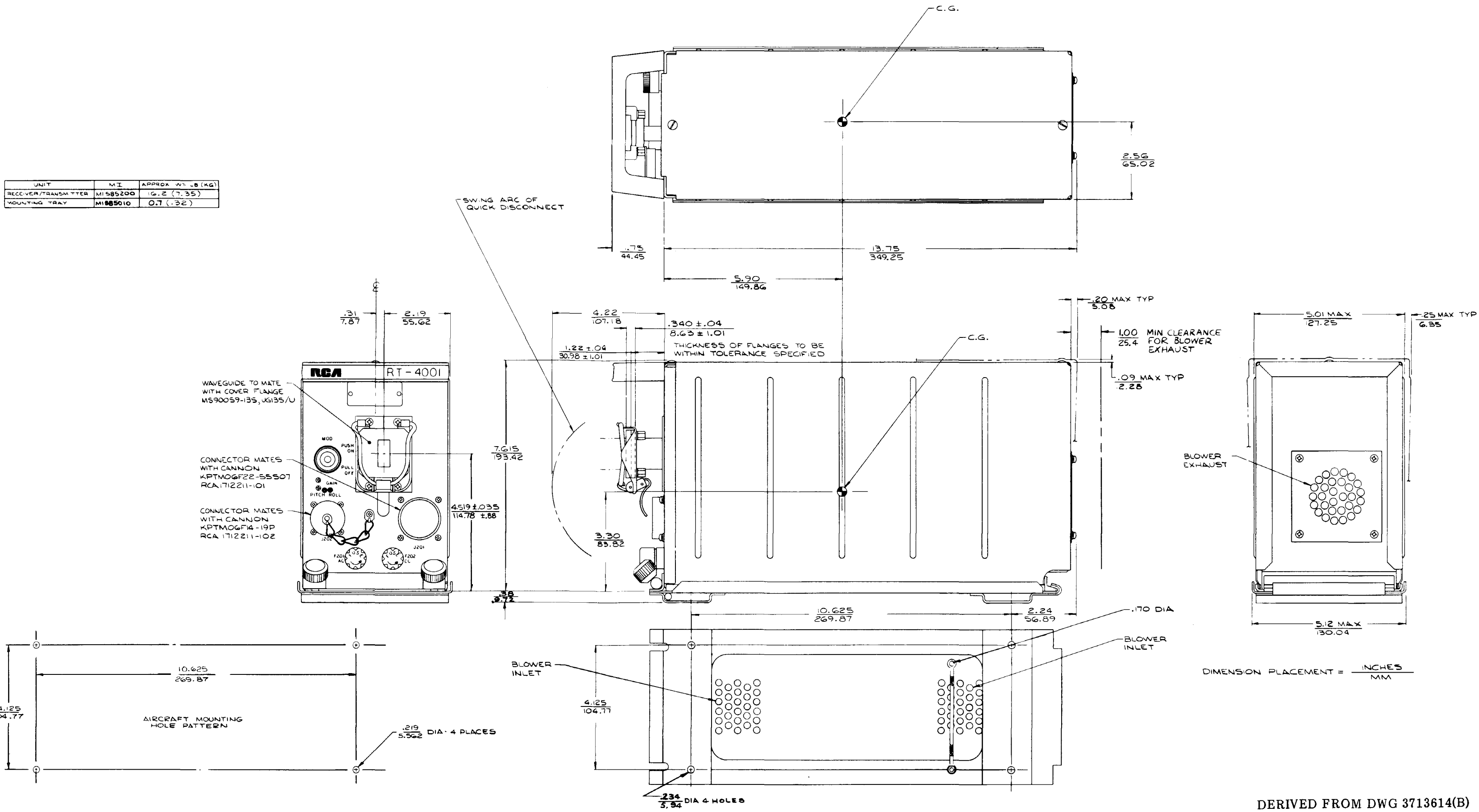
DERIVED FROM DWG 3713526(E)

Figure 6-7. System Installation Wiring Diagram (Sheet 1 of 2)

6-15/16

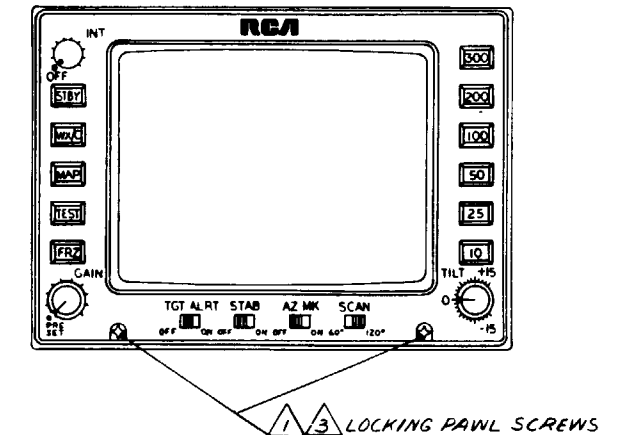
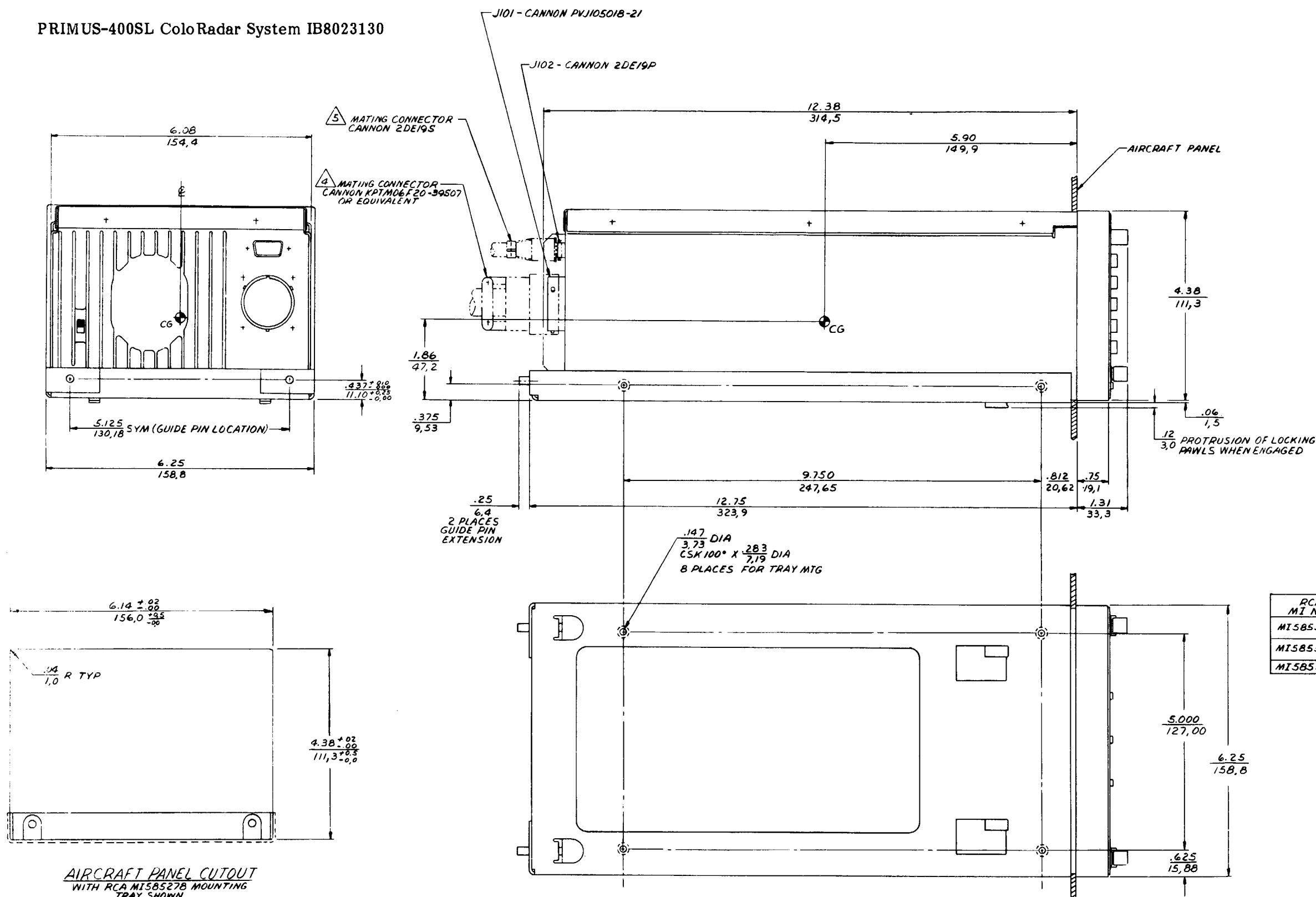


UNIT	MI	APPROX WT. LB (KG)
RECEIVER/TRANSMITTER	MI 985200	16.2 (7.35)
MOUNTING TRAY	MI 985010	0.7 (.32)



DERIVED FROM DWG 3713614(B)

Figure 6-8. Receiver-Transmitter Outline and Mounting Diagram  
6-19/20



RCA MI NO.	DESCRIPTION	WEIGHT	
		LB	KG
MI585343	INDICATOR ASSY. DIGITAL, GRAY PANEL, DI4002	10.8	4.90
MI585343-1	INDICATOR ASSY. DIGITAL, BLACK PANEL, DI4002	10.8	4.90
MI585278	MOUNTING TRAY ASSY	0.37	0.17

AIRCRAFT PANEL CUTOUT WITH RCA MI585278 MOUNTING TRAY SHOWN

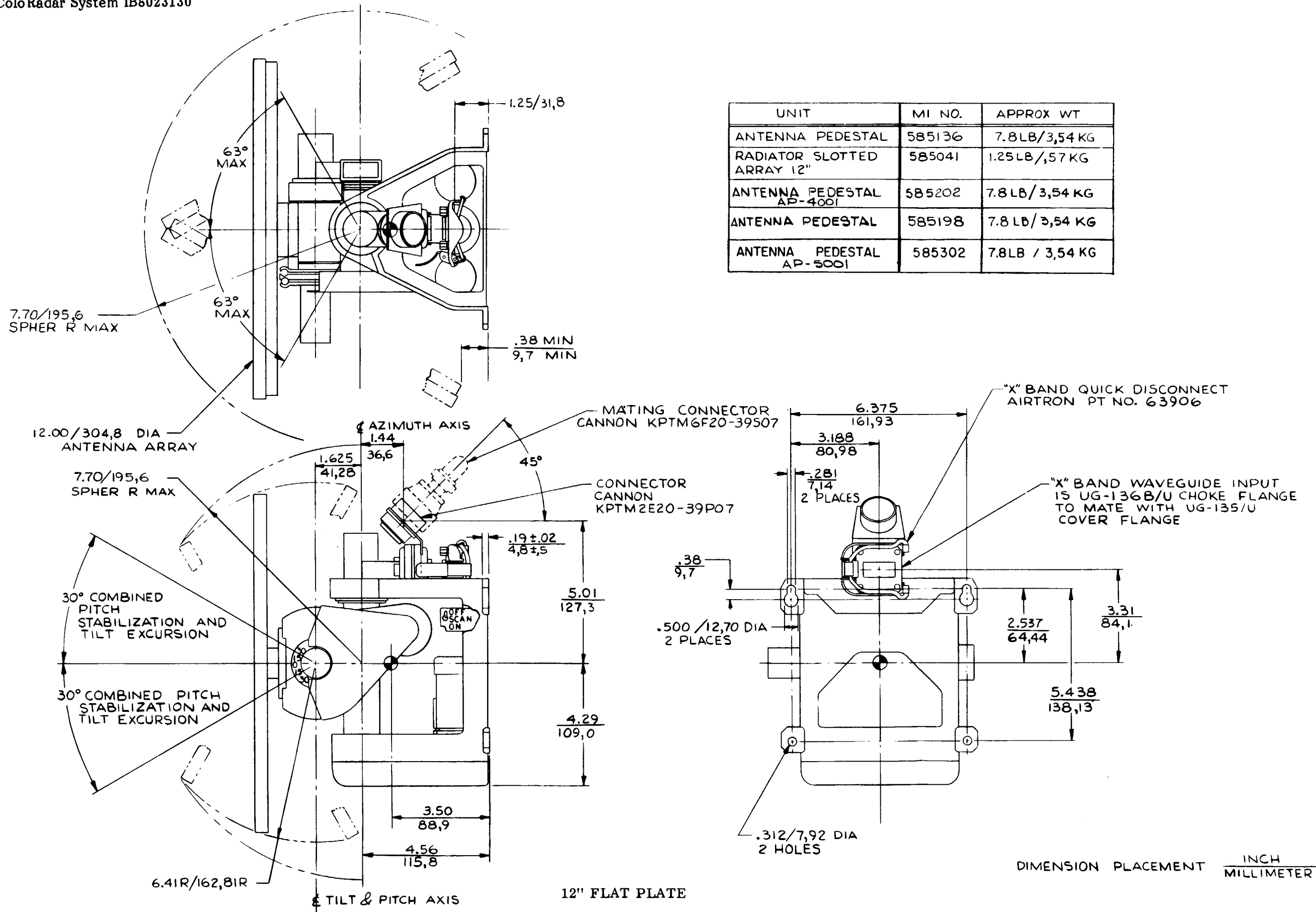
- 3 CAUTION: THE FOLLOWING REMOVAL PROCEDURE MUST BE USED TO AVOID DAMAGE TO INDICATOR. TURN EITHER LOCKING SCREW COUNTERCLOCKWISE UNTIL SLIGHT RESISTANCE IS FELT. THEN, WITH ONE HAND, APPLY SUFFICIENT FORCE TO INDICATOR FRONT PANEL TO HOLD IT AGAINST AIRCRAFT PANEL WHILE LOOSENING SECOND PANEL LOCKING SCREW. WHEN SLIGHT RESISTANCE IS FELT, RELEASE FORCE ON INDICATOR FRONT PANEL & SLIDE OUT OF MOUNTING TRAY.
2. DIMENSIONS GIVEN FOR CG ARE FOR UNIT & MOUNTING TRAY COMBINED.
- 1 TO LOCK INDICATOR IN POSITION, SLIDE UNIT INTO TRAY ENGAGING 2 PINS IN REAR. TURN LOCKING PAWL SCREWS CLOCKWISE UNTIL UNIT IS FIRMLY SECURED.
- NOTES.

- 5 CONNECTOR AVAILABLE AS PART OF SYSTEM MATING CONNECTOR KIT MI585220.
- 4 CONNECTOR AVAILABLE AS PART OF SYSTEM MATING CONNECTOR KIT MI585014

DIMENSION PLACEMENT =  $\frac{\text{INCH}}{\text{MM}}$

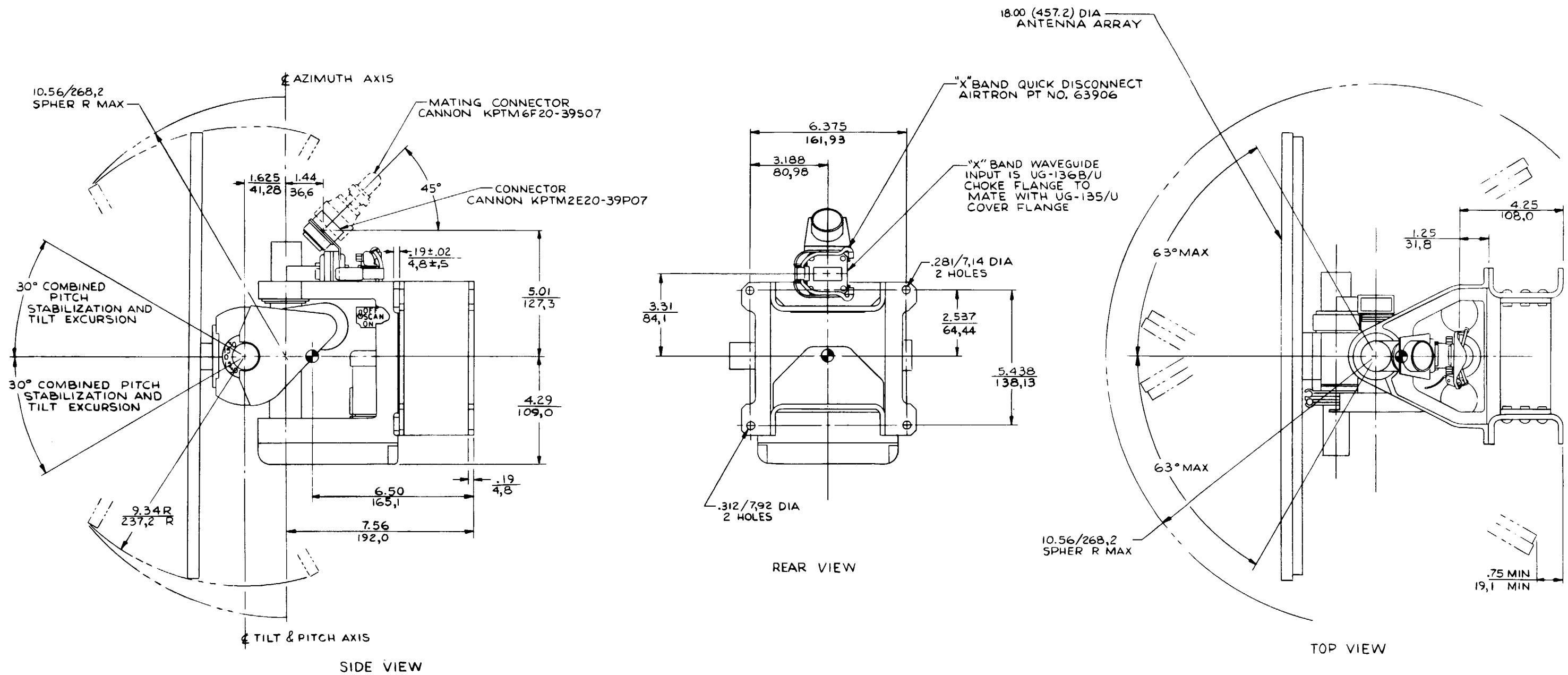
DERIVED FROM DWG 3715242(A)

Figure 6-9. Digital Indicator Outline and Mounting Diagram



DERIVED FROM DWG 1713860(F)

Figure 6-10. Antenna Outline and Mounting Diagram (Sheet 1 of 2)  
6-23/24



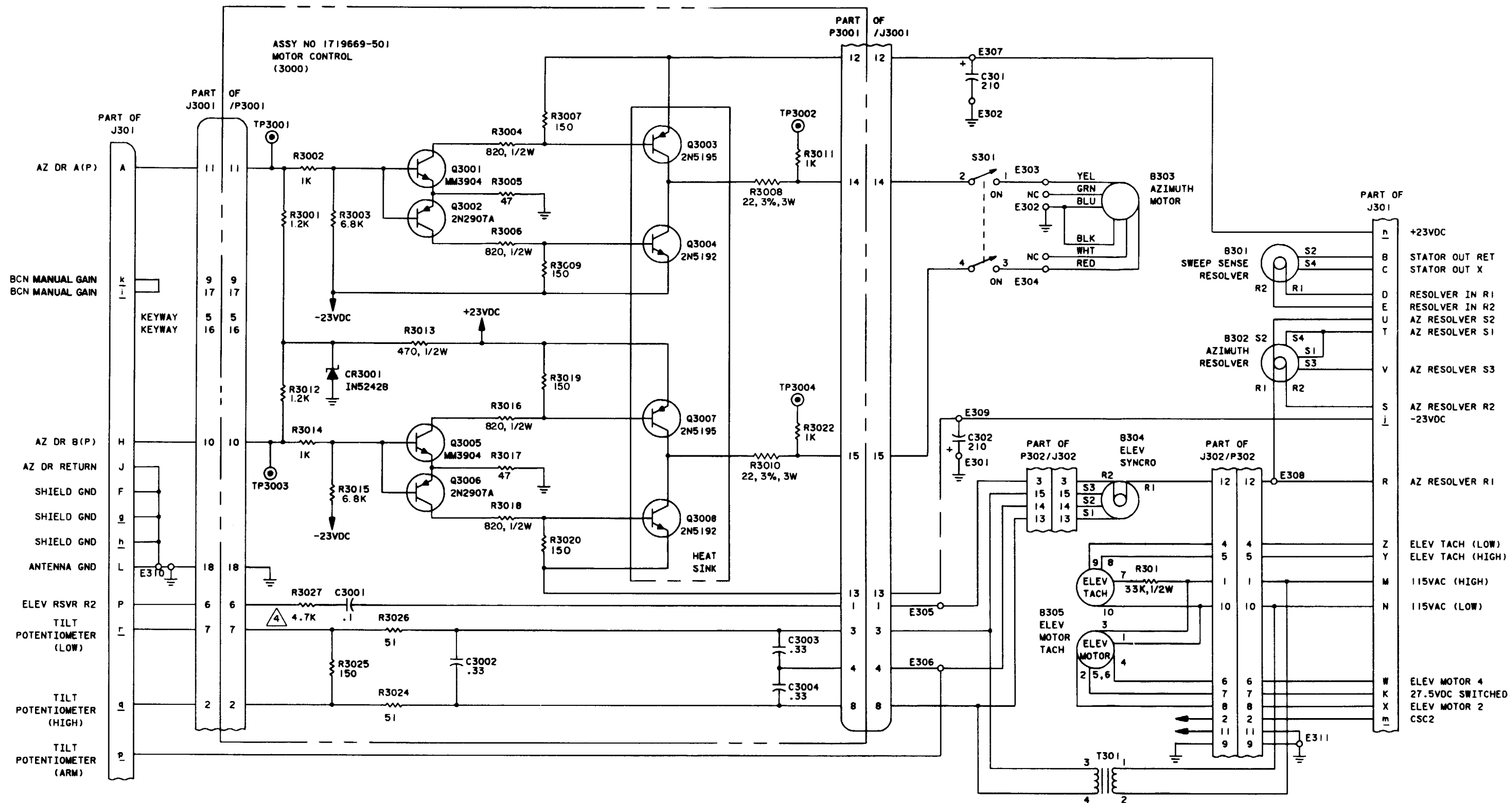
UNIT	MI NO.	APPROX WT
ANTENNA PEDESTAL	585136	7.8 LB/3.54 KG
RADIATOR SLOTTED ARRAY 18" & BASE EXTENSION	585066	3.94 LB/1.79 KG
ANTENNA PEDESTAL AP-4001	585202	7.8 LB/3.54 KG
ANTENNA PEDESTAL	585198	7.8 LB/3.54 KG
ANTENNA PEDESTAL AP-5001	585302	7.8 LB / 3.54 KG

DIMENSION PLACEMENT  $\frac{\text{INCH}}{\text{MILLIMETER}}$

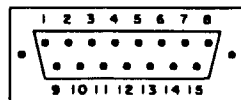
18" FLAT PLATE

DERIVED FROM DWG 1713860(F)

Figure 6-10. Antenna Outline and Mounting Diagram (Sheet 2 of 2)



▲ FACTORY SELECTED 1/4W, 1K TO 10K, ±2%, NOMINAL 4.7K.



3. TERMINAL DESIGNATION P302.

2. ALL CAPACITANCE VALUES ARE IN MICROFARADS.

1. ALL RESISTANCE VALUES ARE IN OHMS, ±2%, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATION TABLE			
LAST USED	OUT OF SEQ	ZONE	NOT USED
B301	C3004	C3001-C3004	
C301	CR3001	TP3002, TP3003	
R301	Q3008	Q3003-Q3006	
S301	R3027	R3002-R3027	
T301	TP3004		
	W3002		

WAVEGUIDE DOWN CONVERSION	
FROM	TO
J3001-7	J301-g
J3001-2	J301-f
B301-S2	J301-C
B301-S4	J301-B
B302-S2	J301-T
B302-S4	J301-U
B302-S2	B302-S1
S301-1	B303-E304
S301-3	B303-E303

DERIVED FROM DWG 1713858(H)

Figure 6-11. Antenna Pedestal Schematic Diagram

**SECTION 7**  
**ADJUSTMENT/TEST**

**A. GENERAL**

The following procedures are designed for checking the operation of the PRIMUS-400SL ColoRadar System and to verify the installation while the aircraft is on the ground.

**B. PRELIMINARY PROCEDURES**

- (1) Position aircraft so that no personnel or large metallic objects (hangars, fuel trucks, other aircraft, etc.) are within 120 degree area scanned by radar.
- (2) Verify that the units are properly connected to aircraft wiring. Check cable connections at R-T, Digital Indicator, and Antenna, and waveguide run between R-T and Antenna. In new installations, make a VSWR check of waveguide run.
- (3) The radar system required primary power of 27.5 Vdc  $\pm$  10 percent and 115 Vac  $\pm$  5 percent. Verify that the aircraft power voltages are within specified tolerance.
- (4) Prior to turning on radar, set Digital Indicator controls to following settings:

TILT:	15 up
INT/OFF:	OFF
GAIN:	GAIN PRESET
STAB:	ON
SCAN:	120 <sup>o</sup>
AZ MK:	OFF
TGT ALRT:	OFF

**C. SYSTEM CHECKOUT**

**WARNING**

**THE FOLLOWING STEPS CAUSES THE ANTENNA TO RADIATE RF ENERGY WHILE THE AIRCRAFT IS ON THE GROUND. POSITION AIRCRAFT SO THAT NO PERSONNEL OR LARGE MATALLIC OBJECTS (HANGARS, FUEL TRUCKS, OTHER AIRCRAFT, ETC.) ARE WITHIN 120 DEGREE AREA SCANNED BY RADAR.**

- (1) Verify that aircraft radar power-supply circuit breaker is energized.

- (2) On Digital Indicator, rotate INT/OFF control clockwise to desired viewing level. STBY and 100 should be displayed.
- (3) Depress TEST pushbutton, WAIT and 100 should be displayed until warmup period expired.
- (4) Verify that the test pattern displayed is correct (see Figure 3-3).
  - o If the noise band is missing, the receiver sensitivity is poor or the Video Analog-to-Digital Converter in the indicator is faulty.
  - o If the noise band is broken into segments (see Figure 3-4), the AFC is faulty.
- (5) Turn INT/OFF control both clockwise and counterclockwise. Verify that display brightens for clockwise rotation and dims for counterclockwise rotation.
- (6) Verify that the antenna scan is synchronized with updating of the noise band display.
- (7) Position TGT ALRT slide control to the on position and verify that a flashing (1/2 second on, 1/2 second off) TGT  $\uparrow$  is displayed. Reposition the TGT ALRT switch to the OFF position.
- (8) Position AZ MK slide control to the ON position and verify that 5 azimuth markers are displayed (see Figure 3-2).
- (9) Position SCAN slide control to the 60° position and verify that the antenna scan is  $\pm 30^\circ$  from dead ahead and that only three azimuth markers are displayed. Reposition SCAN switch to 120° position.
- (10) Depress FRZ pushbutton and verify that a flashing (1/2 second on, 1/2 second off) FRZ has replaced 123 in the Auxiliary field and that the noise band display is not being updated.
- (11) Depress WX/C pushbutton then depress the 10, 25, 50, 100, 200, and 300 pushbuttons in the sequence listed. Verify that the Range Marks are identified as follows:

RANGE SELECTED

<u>RANGE MARK</u>	<u>10</u>	<u>25</u>	<u>50</u>	<u>100</u>	<u>200</u>	<u>300</u>
1st	2	5	10	20	40	60
2nd	4	10	20	40	80	120
3rd	6	50	30	60	120	180
4th	8	20	40	80	160	240
5th	10	25	50	100	200	300

- (12) Rotate GAIN control clockwise just out of PRESET detent, verify that VAR has replaced 123 and that the number of noise spots being displayed has diminished. Rotate GAIN control clockwise to stop and verify that number of noise spots being displayed increases.
- (13) Depress WX/C pushbutton and verify that VAR has been replaced with 123, that WX has been replaced with CYC, and that the number of noise spots being displayed are the same with the GAIN control rotated fully clockwise to its stop as with the gain control rotated fully counterclockwise to the PRESET detent position.
- (14) Depress MAP pushbutton and verify that MAP has replaced CYC and that the number of noise dots being displayed has increased.
- (15) Depress STBY pushbutton and verify that only STBY and 100 are displayed and that antenna has stopped scanning.

#### **D. ANTENNA STABILIZATION CHECKS**

This procedure provides a method for adjusting the sensitivity of the radar stabilization amplifiers (in the Receiver-Transmitter) to correspond to the sensitivity of the vertical gyroscope in the individual aircraft. This procedure should be accomplished for each new installation, whenever stabilization problems are suspected, or after the stabilization system has been serviced.

##### **NOTE**

**As received from the factory, the Antenna synchros and resolvers are correctly aligned. For other than new installations, it is necessary for correct alignment of these items to be verified in accordance with applicable maintenance manual procedures.**

##### **NOTE**

**As received from the factory, the sensitivity of the stabilization amplifiers in the Receiver-Transmitter is adjusted for a gyro sensitivity of 50 millivolts per degree. If the gyro sensitivity is 200 millivolts per degree, refer to the R-T Maintenance Manual before proceeding.**

##### **WARNING**

**TO PREVENT RADIATION OF MICROWAVE ENERGY DURING THIS PROCEDURE, THE SYSTEM MUST BE OPERATED IN STBY MODE OR THE MODULATOR MUST BE DISABLED.**

## 1. Preliminary Checks

- (a) Level the pitch and roll reference axes of the aircraft relative to the earth's surface.

### **NOTE**

**It is preferable, but not an absolute necessity, for the aircraft axes to be leveled.**

- (b) Verify that the mounting surface of the Antenna is aligned to the pitch and roll reference axes of the aircraft within  $\pm 1/4$  degree.

### **NOTE**

**As an alternate to leveling the aircraft, the mounting surface of the antenna may be shimmed to align it perpendicular to the earth's surface.**

- (c) Place the Antenna SCAN switch in the OFF position.
- (d) Pull the MOD ON/OFF switch on the R-T front panel so as to disable the modulator and prevent microwave radiation.
- (e) If the aircraft or Antenna has not been leveled in accordance with steps (a) or (b), determine and record the pitch and roll angles of the aircraft relative to the mounting surface of the vertical gyroscope.
- (f) Rotate the INT/OFF control on the Indicator to mid-position and slide STAB control to OFF.

## 2. Pitch Compensation Check/Adjustment

- (a) Verify that STBY is displayed in the Mode field on the Indicator.
- (b) Manually position flat-plate phased-array radiator in dead-ahead position as indicated by Antenna azimuth scale.
- (c) Alternately turn TILT control to both  $15^{\circ}$  up and  $15^{\circ}$  down positions, and verify, by observing spirit level, that flat-plate phased-array radiator responds in same direction to  $15 \pm 1.5$  degrees.
- (d) Using Indicator TILT control, adjust Antenna pitch until the spirit level indicates it is vertical or equal to the angle recorded in step 1(e) (Preliminary Checks).
- (e) Loosen, or remove, as necessary, mounting hardware of aircraft vertical gyroscope. Lift it from mounting surface and level the gyroscope using protractor spirit level.

- (f) Slide Indicator STAB control to ON and verify that there is no change in the Antenna pitch angle.

**NOTE**

**If the Antenna pitch angle changes more than + 1/4 degrees, do not proceed until either the gyro, Antenna, or R-T deficiency is corrected. Refer to applicable maintenance manuals.**

- (g) Alternately displace aircraft vertical gyro in pitch axis 20 degrees up and 20 degrees down. Verify that flat-plate phased-array radiator elevates  $20 \pm 0.5$  degrees in opposite direction. If not, adjust PITCH GAIN on front panel of R-T to minimize any errors.

**NOTE**

**Do not displace gyroscope from its level position for more than a few seconds at a time; otherwise, precession may occur and introduce errors which prevent correct adjustment. After each displacement from level position, re-level the gyro for several minutes before proceeding to the next check.**

**3. Roll Compensation Check Adjustment**

- (a) Verify that STBY is displayed in the Mode field on the Indicator .
- (b) Verify that the MOD ON/OFF switch on the R-T front panel is pulled outward (OFF).
- (c) Manually position flat-plate phased-array radiator in dead-ahead position as indicated by Antenna azimuth scale.
- (d) Alternately turn TILT control to both  $15^{\circ}$  up and  $15^{\circ}$  down positions, and verify, by observing spirit level, that flat-plate phased-array radiator responds in same direction  $15 \pm 0.5$  degrees.
- (e) Using Indicator TILT control, adjust Antenna pitch until the spirit level indicates it is vertical or equal to the angle recorded in Step 1(e) (Preliminary Checks).
- (f) Verify that the gyroscope table is level in both the pitch and roll axes.
- (g) Alternately position aircraft vertical gyroscope in roll axis 20 degrees right and 20 degrees left (keeping it at 0 degree on pitch axis), and verify, by observing spirit level, that flat-plate phased-array radiator elevation changes  $17.5 \pm 0.5$  respectively from its initial position. If not, adjust ROLL GAIN on R-T front panel as necessary to compensate for any error.

**NOTE**

**Do not displace gyroscope from its level position for more than a few seconds at a time; otherwise precession may occur and introduce errors which prevent correct adjustment. After each displacement from level position, re-level the gyro for several minutes before proceeding to the next check.**

- (h) Manually position flat-plate phased-array radiator to 60 degree right position as indicated by Antenna azimuth scale.

Repeat step (g) and verify elevation logic of  $17.5 \pm 0.5$  degrees up and down respectively. If necessary, readjust ROLL GAIN on K-T front panel to minimize the observed deviations.

- (i) Rotate INT/OFF control on Indicator; place SCAN switch on Antenna in ON position, and push MOD ON PUSH/MOD OFF PULL switch on R-T to activate modulator.
- (j) Re-install vertical gyroscope in its aircraft mounting location.

**E. PRESSURIZATION CHECKS**

For those installations in which the waveguide is to be pressurized, conduct the following pressurization test after connecting the waveguide between the R-T and the Antenna.

- (1) Apply  $10 \text{ lbs/in}^2$  ( $0,7 \text{ Kg/cm}^2$ ) through waveguide bleeder.
- (2) Use flow meter to obtain leakage rate. Allowable leakage rate is up to  $18 \text{ in}^3/\text{min}$  ( $300 \text{ cm}^3/\text{min}$ ).

If a flow meter is not available for testing, the change in pressure with respect to time may be used for the same purpose.

- (1) Apply  $10 \text{ lbs/in}^2$  ( $0,7 \text{ Kg/cm}^2$ ) through waveguide bleeder.
- (2) Arrest air flow from pressure source into waveguide.
- (3) Observe time in seconds required for pressurization in waveguide to drop to  $5 \text{ lbs/in}^2$  ( $0,35 \text{ Kg/cm}^2$ ).

The time it will take for the pressure to drop to  $5 \text{ lbs/in}^2$  ( $0,35 \text{ Kg/cm}^2$ ) varies linearly with time versus waveguide length. For each foot ( $30,5 \text{ cm}$ ) of waveguide, the minimum allowable time is 5 seconds. Thus, for example, for 3 feet ( $91 \text{ cm}$ ) of waveguide, the minimum allowable time is 15 seconds.

**SECTION 8**  
**INSPECTION/CHECK**

**A. GENERAL**

The following inspection and check procedures are recommended for the PRIMUS-400SL ColoRadar System after it is installed in the aircraft.

**B. INSPECTION**

**CAUTION**

**BEFORE PREFORMING ANY OF THESE PROCEDURES, MAKE CERTAIN THAT THE INT/OFF CONTROL ON THE FRONT PANEL OF THE INDICATOR IS IN THE OFF POSITION.**

**1. Inspect Receiver-Transmitter**

- (a) Make visual inspection of all external surfaces for possible damage. Check dust cover air vents and external connectors for dust or damage.
- (b) Inspect external parts (waveguide connectors, hold-down hooks) for loose hardware.
- (c) Make visual check for lamps, circuits breakers, and pushbutton switches for damage.

**2. Inspect Digital Indicator**

- (a) Make visual examination of all external surfaces for possible damage. Check dust cover air vents and external connectors for dust or damage.
- (b) Inspect external parts (connectors, control knobs) for looseness or damage.
- (c) Check controls for smooth, positive action.
- (d) Check that Indicator is secure in mounting assembly (locking mechanism is engaged properly).

**3. Inspect Antenna (aircraft radome removed)**

- (a) Make visual examination of all external surfaces for possible damage.
- (b) Inspect gears for damaged teeth and check that they are lubricated adequately.
- (c) Inspect wiring, particularly at motors and resolvers, for breaks, burned areas, and damaged sleeving.
- (d) Check that antennma moves freely in azimuth, elevation, and roll, and rotary joints are not damaged.

**SECTION 9**  
**CLEANING/PAINTING**

**A. GENERAL**

While the radar system is installed in the aircraft, cleaning is limited to the procedures given below. Painting and more extensive cleaning should be accomplished during overhaul when each LRU can be disassembled; detailed instructions are presented in the applicable maintenance manuals.

**B. EQUIPMENT AND MATERIALS**

Recommended cleaning agents and materials are:

- o Soft brush
- o Lint-free absorbent cloth
- o Solvent (denatured alcohol or commercial equivalent)
- o Mild glass cleaner
- o Compressed air--moderate pressure
- o No. 600 abrasive paper (nonconductive abrasive)

**C. CLEANING**

**1. Receiver-Transmitter and Mounting Tray**

- (a) Disconnect connector cable and waveguide, and remove unit from radio equipment rack or mounting tray.
- (b) Clean mounting tray with cloth or brush dampened in solvent; then dry with cloth or compressed air.
- (c) Clean all dust and foreign matter from front panel (waveguide part, connectors) and dust cover air vents, using either cloth or brush dampened in solvent; dry with cloth or compressed air. Clean corroded connector pins with abrasive paper.

**NOTE**

**It is important that air vents in dust cover be kept open to ensure proper circulation of cooling air.**

- (d) Check waveguide port on front of unit to be sure that there are no dirt or dust obstructions.
- (e) Replace Receiver-Transmitter, and reconnect cables and waveguide.

## **2. Digital Indicator and Mounting Tray**

- (a) Disconnect cable, and remove Digital Indicator from mounting tray.
- (b) Clean mounting tray with cloth or brush dampened in solvent; then dry with cloth or compressed air.
- (c) Clean all dust or foreign matter from dust cover air vents and rear connector with cloth or brush dampened in solvent; then dry with cloth or compressed air.
- (d) Clean front panel and face of Digital Indicator with mild glass cleaner and soft cotton cloth. Do not use abrasive or solvent-type cleaners.
- (e) Replace Digital Indicator, and reconnect cable.

## **3. Antenna**

- (a) Use cloth or brush dampened in solvent to clean flat-plate radiator; then dry with cloth or compressed air.
- (b) Use compressed air to blow away any visible dirt from Antenna pedestal.

## **4. Painting**

Except for minor retouching, painting should be accomplished after the equipment has been removed from the aircraft or during overhaul.

**SECTION 10**

**APPROVED REPAIRS**

Major repairs to the radar system are made only during overhaul when the equipment is removed from the aircraft. Detailed instructions for repair and adjustment of each of the LRU's are presented in the applicable maintenance manuals.

**SECTION 11**  
**ILLUSTRATED PARTS LIST**

**A. GENERAL**

This section lists the Master item numbers of LRU's that make up the PRIMUS-400SL ColoRadar system. The Master Items (MI) are illustrated in Figure 11-1 and are identified in Table 11-1.

**B. PARTS LISTING**

The illustrated parts list shows the Master Items used in this radar system. A detailed parts list for each of the Master Items, where applicable, is contained in the appropriate maintenance manual. If an item listed is preceded by a dash, it is not illustrated.

**C. ORDERING REPLACEMENT PARTS**

When ordering replacement units from Sperry Avionics Systems, specify the MI number and item description. Address all part orders to:

**Sperry Flight Systems**  
**Avionics Division**  
**Replacement Parts**  
**8500 Balboa Boulevard**  
**P.O. Box 9028**  
**Van Nuys, CA 91409**

Telephone **(213) 894-8411** or cable **COMAVSYS**, Los Angeles.

PRIMUS-400SL ColoRadar System IB8023130

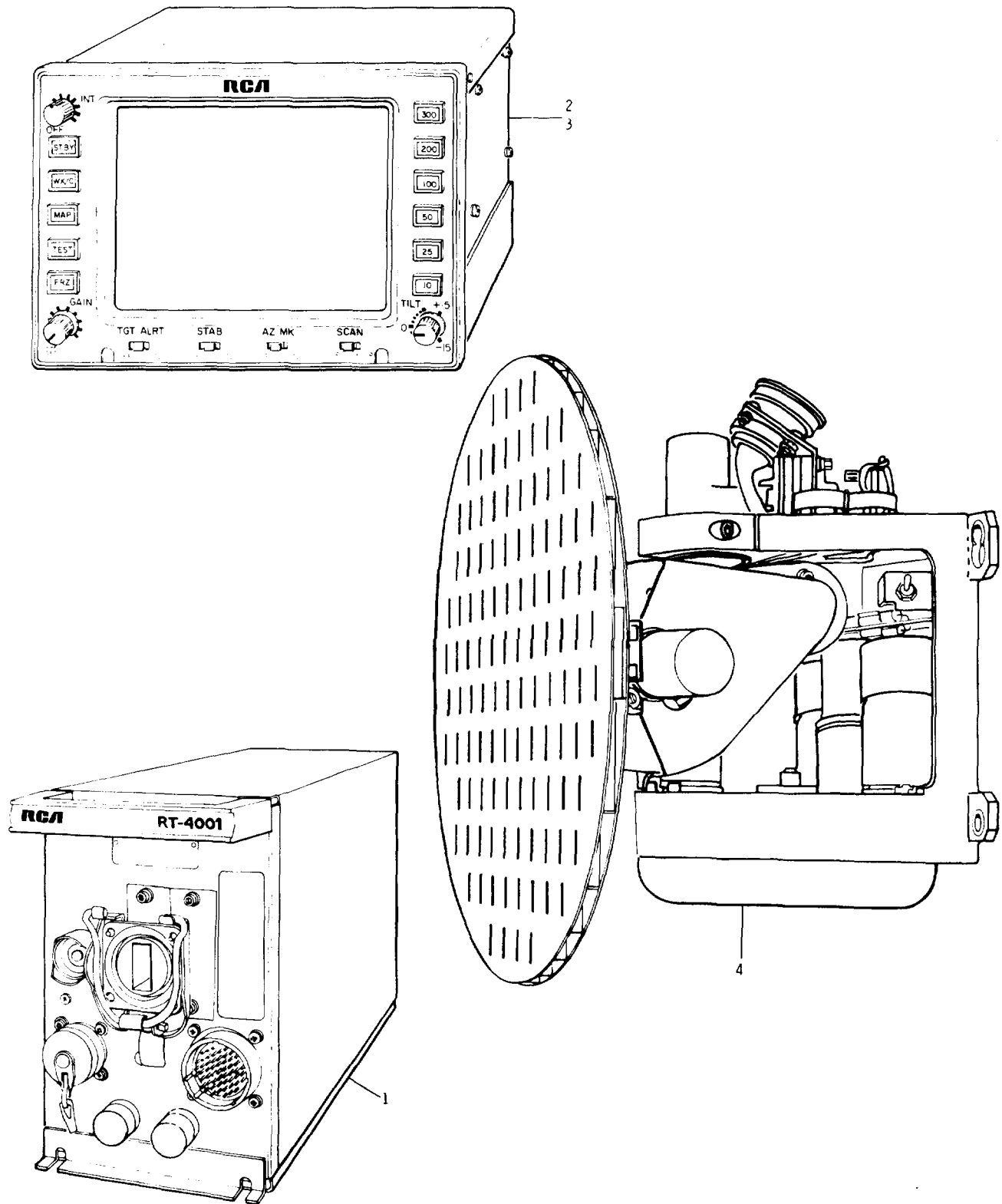


Figure 11-1. ColoRadar System Equipment (Sheet 1 of 2)

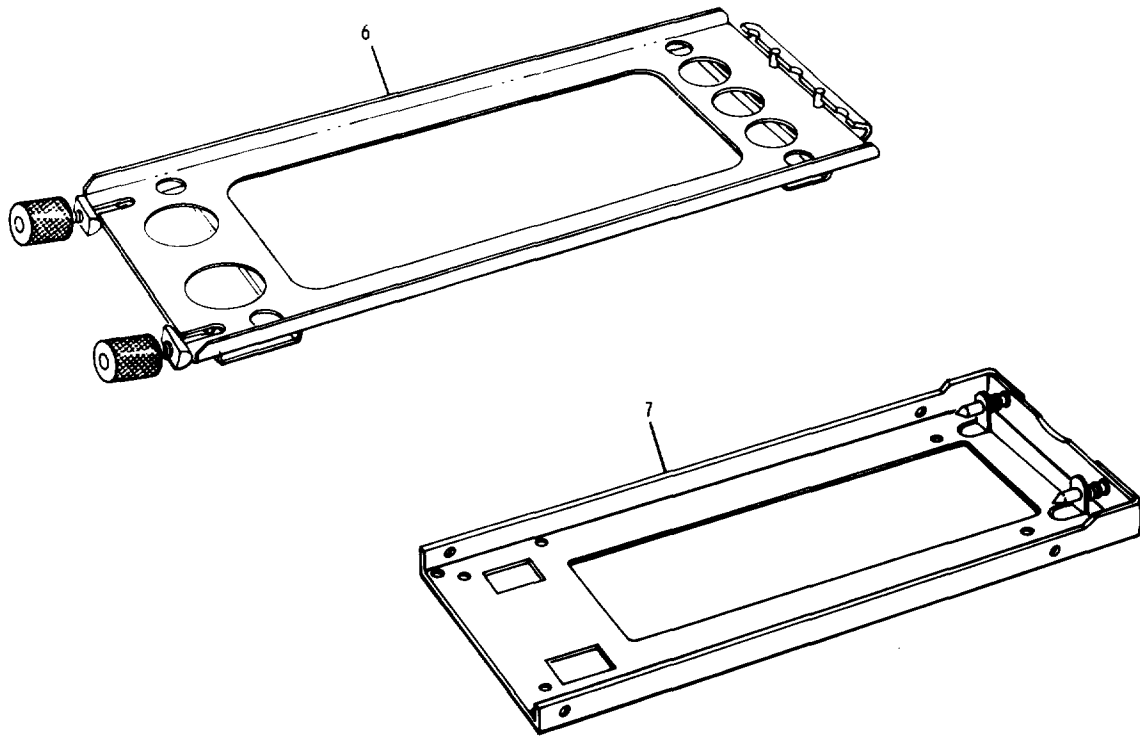


Figure 11-1. ColoRadar System Equipment (Sheet 2 of 2)

TABLE 11-1. SYSTEM EQUIPMENT

FIG. & ITEM NUMBER	PART NUMBER	NOMENCLATURE							EFFEC- TIVITY	UNITS PER ASSY
		1	2	3	4	5	6	7		
11-										
1	MI-585200	Receiver-Transmitter	RT-4001							1
2	MI-585343	Digital Indicator	DI-4002,							1
		Gray Panel								
3	MI-585343-1	Digital Indicator	DI-4002,							1
		Black Panel								
4	MI-585202	Antenna Pedestal	AP-4001 with							1
		flange up								
-5	MI-585202-1	Antenna Pedestal	AP-4001 with							1
		flange down								
6	MI-585010	Shock Mount, Receiver-Transmitter								1
7	MI-585278	Mounting Tray, Indicator								1

**APPENDIX A**  
**FAA ADVISORY CIRCULARS**

**This section provides FAA Advisory Circulars of  
interest to airborne weather radars.**

DATE 8/8/80

# ADVISORY CIRCULAR



DEPARTMENT OF TRANSPORTATION  
Federal Aviation Administration  
Washington, D.C.

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## RECOMMENDED RADIATION SAFETY PRECAUTIONS FOR GROUND OPERATION

**Subject:** OF AIRBORNE WEATHER RADAR

1. **PURPOSE.** This circular sets forth recommended radiation safety precautions to be taken by personnel when operating airborne weather radar on the ground.
2. **CANCELLATION.** AC 20-68A, dated April 11, 1975, is canceled.
3. **RELATED READING MATERIAL.**
  - a. Barnes and Taylor, Radiation Hazards and Protection (London: George Newnes Limited, 1963), p. 211.
  - b. U.S. Department of Health, Education and Welfare, Public Health Service, Consumer Protection and Environmental Health Service, "Environmental health microwaves, ultraviolet radiation and radiation from lasers and television receivers - An Annotated Bibliography," FS 2.300: RH-35, Washington, U.S. Government Printing Office, pp. 56-57.
  - c. Mumford, W. W., "Some technical aspects of microwave radiation hazards," Proceedings of the IRE, Washington, U.S. Government Printing Office, February 1961, pp. 427-447.
4. **BACKGROUND.** Dangers from ground operation of airborne weather radar include the possibility of human body damage and ignition of combustible materials by radiated energy. Low tolerance parts of the body include the eyes and testes.
5. **PRECAUTIONS.** Management and supervisory personnel should establish procedures for advising personnel of dangers from operating airborne weather radars on the ground. Precautionary signs should be displayed in affected areas to alert personnel of ground testing.
  - a. **General.**
    - (1) Airborne weather radar should be operated on the ground only by qualified personnel.

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Initiated by: AFO-512

8/8/80

(2) Installed airborne radar should not be operated while the aircraft is in a hangar or other enclosure unless the radar transmitter is not operating, or the energy is directed toward an absorption shield which dissipates the radio frequency energy. Otherwise, radiation within the enclosure can be reflected throughout the area.

b. Body Damage. To prevent possible human body damage, the following precautions should be taken:

(1) Personnel should never stand nearby and in front of a radar antenna which is transmitting. When the antenna is not scanning, the danger increases.

(2) A recommended safe distance from operating airborne weather radars should be established. A safe distance can be determined by using the equations in Appendix 1 or the graphs of figures 1 and 2. This criterion is now accepted by many industrial organizations and is based on limiting exposure of humans to an average power density not greater than 10 milliwatts per square centimeter.

(3) Personnel should be advised to avoid the end of an open waveguide unless the radar is turned off.

(4) Personnel should be advised to avoid looking into a waveguide, or into the open end of a coaxial connector or line connector to a radar transmitter output, as severe eye damage may result.

(5) Personnel should be advised that when high power radar transmitters are operated out of their protective cases, X-rays may be emitted. Stray X-rays may emanate from the glass envelope type pulser, oscillator, clipper, or rectifier tubes, as well as magnetrons.

c. Combustible Materials. To prevent possible fuel ignition, an installed airborne weather radar should not be operated while an aircraft is being refueled or defueled.

  
M. C. BEARD  
Director of Airworthiness

AC NO: 43-14

DATE: 2/24/77



# ADVISORY CIRCULAR

## DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

**SUBJECT:** MAINTENANCE OF WEATHER RADAR RADOMES

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1. PURPOSE. This advisory circular provides guidance material useful to repair facilities in the maintenance of weather radar radomes.
  2. CANCELLATION. AC 43-202, dated 6/11/65, and AC 90-20, dated 11/12/64, are cancelled.
  3. GENERAL. A radome is a covering whose primary purpose is to protect a radar antenna from the elements. It is a part of the airframe and, therefore, should have certain physical as well as electrical properties. Physically, a radome should be strong enough to withstand the airloads that it will encounter and it should be contoured to minimize drag. These properties vary with the shape, design speed, and size of the airplane on which it is to be installed. Electrically, a radome should permit the passage of the radar's transmitted signals and return echoes with minimum distortion and absorption. In order to do this, it should have a certain electrical thickness. The electrical thickness of a radome is related to the physical thickness, operating frequency, and the types of material and construction used. This relationship is defined by a number of complex mathematical equations which are of interest only to radome design engineers. These equations show that, for given physical properties, a radome should have a certain electrical thickness for a certain narrow range of operating frequencies. (This is the reason why C-band radomes will not give optimum performance with X-band radars and vice versa.) Also, a very small variation in physical thickness may cause a sizable variation in electrical thickness. Radar efficiency, definition, and accuracy of display depend upon a clear, nondistorted, reflection-free antenna view through the radome. Consequently, a radome should be precisely built for optimum performance.
  4. RADOME CHARACTERISTICS. There are two general types of radomes, the "thin wall" and "sandwich" types. Thin wall radomes are considered to be thin relative to the wavelength of the radar. They are generally useful when the radar frequency is low enough to permit a skin thickness which will satisfy the structural requirements. Sandwich radomes consist of two
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Initiated by: AFS-804

electrical performance can produce numerous problems which may appear to be symptoms of deficiencies in other units of the radar system. The following are examples of improper repair:

- (1) Use of wrong materials - not compatible with original radome materials.
- (2) Patches of different thickness.
- (3) Poor fabrication techniques.
- (4) Nonvoid-free patches.
- (5) Repairs overlapping.
- (6) Holes plugged with resin, screws, metal, wood, and plastic plugs.
- (7) Cuts or cracks simply coated with resin.
- (8) Tape (including electrical tape) over hole or crack and covered with resin.
- (9) Oversize patches.
- (10) Too much or too little resin.
- (11) Exterior coatings - too many coats, too thick, uneven thickness - metallic base paints.
- (12) Filled honeycomb cells.
- (13) Repairs made without removing moisture or moisture contamination from inside of radome wall.
- (14) Abrupt changes in cross-sectional areas.
- (15) Patches projecting above outside contour lines.
- (16) Improper cure.
- (17) Wrong size cells or density of honeycomb.
- (18) Excessive overlap in honeycomb joints.
- (19) Poor bonding of skin to core.
- (20) Gaps in honeycomb core.

or more plastic skins separated by a dielectric core. The core may consist of honeycomb plastic sections, hollow flutes, or foam plastic. The dielectric and separation of the skins will depend upon the wavelength of the radar frequency or frequencies.

5. RADOME DAMAGE. Probably the most frequent damage to radomes is holes in the structure caused by static discharges. These can be large holes that are readily apparent, or small pin holes that are almost imperceptible. Any hole, regardless of size, can cause major damage to a radome since moisture can enter the radome wall and cause internal delamination. If the moisture freezes, more serious damage may occur. If enough moisture collects, the radiation pattern will be distorted and the transmitted signals and return echoes seriously attenuated. Ram air through a hole can delaminate and break the inner surface of the radome and result in separation of the skins or faces of the material from the core, weakening the radome structure. Other types of damage are characterized as dents and scratches caused by impact with stones and birds and improper handling of the radome when it is removed for maintenance of the radar antenna. This type of damage is easily found by inspection.

6. MAINTENANCE.

- a. High performance radar radomes are very precisely constructed and sometimes the slightest change in their physical characteristics, such as excessive layers of paint, can adversely affect radar system performance. All repairs to radomes, no matter how minor, should return the radome to its original or properly altered condition, both electrically and structurally. The performance of proper maintenance to precision radomes requires special knowledge and techniques and the use of proper tools and materials. An improper minor repair can eventually lead to an expensive major repair. A radome having undergone major repairs should be tested to ascertain that its electrical properties have not been impaired. The testing of radomes requires test equipment that usually is found only in repair facilities specializing in radome maintenance. Even minor repairs may affect one or all of the following:

- (1) Transmissivity. Which is the ability of a radome to pass radar energy through it.
- (2) Reflection. Which is the return or reflection of the outgoing radar energy from the radome back into the antenna and waveguide system.
- (3) Diffraction. Which is the bending of the radar energy as it passes through the radome.

- b. These electrical properties, when altered by improper repair, may cause loss of signal, distortion and displacement of targets, and can clutter the display to obscure the target. Poor radome

2/24/77

7. RECOMMENDATION. Both the physical and electrical properties of radomes should be given careful consideration during repair operations. These properties are carefully controlled during manufacture and should not be altered by improper repairs.

*J. A. Ferrarese*  
J. A. FERRARESE

Acting Director, Flight Standards Service

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