Honeywell

INSTALLATION MANUAL

BENDIX/KING®

KRA 405

RADAR ALTIMETER

MANUAL NUMBER 006-00104-0006
Revision 6, June 2003

WARNING

THE ENCLOSED TECHNICAL DATA IS ELIGIBLE FOR EXPORT UNDER LICENSE DESIGNATION NLR AND IS TO BE USED SOLELY BY THE INDIVIDUAL/ ORGANIZATION TO WHOM IT IS ADDRESSED. DIVERSION CONTRARY TO U.S. LAW IS PROHIBITED.

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BENDIX/KING

KRA 405

Radar Altimeter

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THIS PAGE RESERVED

SECTION I
GENERAL INFORMATION

LIST OF TABLES

SECTION II
INSTALLATION

LIST OF TABLES

LIST OF ILLUSTRATIONS

SECTION III
OPERATION

LIST OF ILLUSTRATIONS

SECTION I
GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains information relative to the physical, mechanical, and electrical characteristics of the Bendix/ King KRA 405. Installation and operating procedures are also included. Information relative to the maintenance and procurement of replacement parts may be found in Section IV, V, and VI of the KRA 405 Maintenance/ Overhaul Manual.

1.2 DESCRIPTION OF EQUIPMENT

The KRA 405 Radar Altimeter System provides the pilot with dependable, accurate AGL altitude information during the critical approach phase of a flight. The system has the capability of alerting the pilot when a predetermined altitude (decision height) is reached. The system also provides altitude information to the flight control system during the approach.

1.3 TECHNICAL CHARACTERISTICS

TABLE 1-1 KRA 405 Radar Altimeter Technical Characteristics

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	C87. DO-138 ENV CAT AG/A/NJ/AAAEXXXXX. DO-160A Altitude CAT F2.
PHYSICAL CHARACTERISTICS:	Refer to Figure 2-2, Dwg No 155-05153-0000.
WEIGHT:	Refer to Figure 2-2, Dwg No 155-05153-0000.
ALTITUDE:	55,000 ft (16,764 m) (Per DO-160A CAT F2).
ENVIRONMENTAL SPECIFICATIONS: Operating Temperature Range:	 -54 deg C to +71 deg C.
POWER REQUIREMENTS:	27.5 Vdc +/- 20% at 850 mA.
ANTENNA CABLES (2 Required): Length: Cable Type:	 Total Length 34 ft (10.36 m) max both cables combined. RG-393.
AIRCRAFT INSTALLATION DELAY (AID):	40 ft (12.19 m) recommended. 57 ft (17.37 m) available.

TABLE 1-1 KRA 405 Radar Altimeter Technical Characteristics

SPECIFICATION	CHARACTERISTIC
ALTITUDE TRIPS (Selectable):	
Three (shop adjustable):	
Adjustment Range #1 and #2:	0-1600 ft (0-487.68 m).
Adjustment Range #3:	0-2000 ft (0-609.60 m).
Factory Settings:	Trip #1 250 ft (76.20 m). Trip #2 500 ft (152.40 m). Trip #3 1200 ft (365.76 m).
ALTITUDE RANGE:	
Tracked:	-20 to 2,500 ft (-6.1 to 762.0 m).
ALTITUDE ACCURACY:	
System:	+/- 5 ft (1.5 m) or +/- 5% (whichever is greater) at 0 to 500 ft and +/- 7% at 500 to 2,000 ft.
KRA 405:	+/- 3 ft (0.91 m) or +/- 3% (whichever is greater) at 0 to 500 ft and +/- 5% at 500 to 2,000 ft.
ALTITUDE OUTPUT:	
Slope:	
Precision Equipment: (see note 1)	-20 to 2,500 ft (-6.1 to 762.0 m) -10 mv/ft (32.81 mv/m); Zero ft = 0.000 volts.
Auxiliary Output #1: (see note 2)	-20 to 500 ft (-6.1 to 152.4 m) +20 mv/ft (+65.62 mv/m); 500 to 2,500 ft (152.4 to 762.0 m) +3 mv/ft (9.84 mv/m); Zero ft = +0.400 volts.
Auxiliary Output #2: (see note 3)	-20 to 2,500 ft (-6.1 to 762.0 m) -4 mv/ft (13.12 mv/m); Zero ft = 0.000 volts.
Load Capability:	2 k ohms.
Off Scale Voltage:	
Precision Equipment Output:	-28 +/- 1.5 Vdc.
Auxiliary Output #1:	+17.3 +/- 0.5 Vdc.
Auxiliary Output #2:	-11.2 +/- 0.6 Vdc.
Time Constant:	
Precision Equipment Output:	0.1 second maximum.

TABLE 1-1 KRA 405 Radar Altimeter Technical Characteristics

SPECIFICATION	CHARACTERISTIC
TRANSMITTER OUTPUT:	
Power:	150 mW nominal, FMCW.
Center Frequency:	4300 +/- 15 MHz.
Modulation Frequency:	
Primary:	100 Hz nominal.
Secondary:	101 Hz nominal (in dual installation).
FM Deviation P-P:	100 MHz.
Type of Service:	Continuous.
WARNING SYSTEM:	
FCS Warn:	
Normal Operation:	+20 to +32 Vdc at not greater than 100 mA.
Warn Condition:	Less that 10 uA.
Altimeter Valid	
Normal Operation:	+30 V no load (10 k ohms source impedance).
Warn Condition:	+20 V or less no load.
ALTITUDE TRIPS:	
Tripped (Locked R/T):	Less than +0.5 Vdc at not greater than 100 mA.
Untripped (Unlocked R/T):	Less than 20 uA at not greater than +30 Vdc.
NOTES: 1. For Honeywell equipment refer to KDA 335, KPI 553A, KPI 553B, or KDI 573B manuals. 2. For Collins equipment refer to Collins manuals. 3. For Sperry equipment refer to Sperry manuals.	

TABLE 1-2 KNI 415, KNI 416 Indicator Technical Characteristics

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	DO-138 ENV CAT GAPAAAXXXXXX. DO-160A Altitude CAT F1, Temperature CAT F1.
PHYSICAL DIMENSIONS:	Refer to Figure 2-1, Dwg No 155-05160-0000.
WEIGHT:	Refer to Figure 2-1, Dwg No 155-05160-0000.
ALTITUDE:	55,000 ft (16,764 m) (Per DO-160A CAT F1).
ENVIRONMENTAL SPECIFICATIONS: Operating Temperature Range:	 -20 deg C to +71 deg C (Per DO-160A CAT F1).
POWER REQUIREMENTS: Primary Power: Panel Lamp Power: 28 V Units: 5 V Units:	 27.5 Vdc +/- 20% at 850 mA. 28 Vdc +/- 10% or 26 Vac +/- 10% at 120 mA. +5 Vdc +/- 10% or 5 Vac +/- 10% at 575 mA.
ALTITUDE RANGE: Displayed:	 -20 to 2,000 ft (-6.1 to 609.60 m).
ALTITUDE ACCURACY: 0 to 500 ft: 500 to 2,000 ft:	 +/- 4 ft (1.22 m) or +/- 4% (whichever is greater). +/- 5%.
DECISION HEIGHT: Altitude Range: Accuracy:	 0 to 2,000 ft (0 to 609.60 m) (pilot adjustable). +/- 5 ft (1.27 m) or 5%, whichever is greater.
EXTERNAL DECISION HEIGHT OUTPUT:	Isolated pair of relay contacts for switching external circuit. 110 mA at 28 Vdc, 3 W maximum continuous contact load.
VISUAL WARNING SYSTEM: Pilot Display Warning Flag: Normal Operation: Flag Condition: Indicator Needle: Over Altitude:	 Flag hidden from view. Power failure or altitude error. Needle hidden from view.

TABLE 1-3 KA 54 Antenna Technical Characteristics

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	C87. DO-138 ENV CAT AAAAAX
PHYSICAL CHARACTERISTICS:	Refer to Figure 2-4, Dwg No 155-05159-0000.
WEIGHT:	2 Required. Refer to Figure 2-4, Dwg No 155-05159-0000.
ALTITUDE:	55,000 ft (16,764 m).
ENVIRONMENTAL SPECIFICATIONS: Operating Temperature Range:	 -54 deg C to +71 deg C.
BEAMWIDTH: E-Plane: H-Plane:	 50 +/- 5 deg. 40 +/- 4 deg.
SIDELOBES:	Greater than 25 dB down.
VSWR:	4240 - 4360 MHz: 1.3:1 Maximum.
GAIN:	11.5 dB above isotopic.
POLARIZATION:	Linear.
POWER HANDLING:	100 W average, 1 kW Peak.
CROSS COUPLING:	20 in spacing - 80 dB max. 36 in spacing - 95 dB max.
INPUT IMPEDANCE:	50 ohms nominal.

TABLE 1-4 KA 54A Antenna Technical Characteristics

SPECIFICATION	CHARACTERISTIC
TSO COMPLIANCE:	C87. DO-160A ENV CAT D2AJXWFD
PHYSICAL CHARACTERISTICS:	Refer to Figure 2-7, Dwg No 071-01501-0000.
WEIGHT:	2 Required. Refer to Figure 2-7, Dwg No 071-01501-0000.
ALTITUDE:	60,000 ft (18,281 m).
ENVIRONMENTAL SPECIFICATIONS: Operating Temperature Range:	 -54 deg C to +85 deg C.
BEAMWIDTH: E-Plane: H-Plane:	 45 deg min. 40 deg min.
SIDELOBES:	Greater than -40 dB down.
VSWR:	4240 - 4360 MHz: 1.5:1 Maximum.
GAIN:	10 dB above isotopic.
POLARIZATION:	Linear.
POWER HANDLING:	1 W average, 10 W Peak.
CROSS COUPLING:	20 in spacing - 88 dB max. 36 in spacing - 95 dB max.
INPUT IMPEDANCE:	50 ohms nominal.

1.4 UNITS AND ACCESSORIES SUPPLIED

1.4.1 THE KRA 405 RADAR ALTIMETER SYSTEM COMPONENTS

1.4.1.A Bendix/King KRA 405 Radar Altimeter (R/T), P/N 066-01048-0000,-0002 (-0000 has been replaced by -0002).

1.4.1.B Bendix/King KNI 415 Radar Altimeter Indicator, P/N 066-03031-0000,-0001,-0002,-0003,-0004; or KNI 416 Radar Altimeter Indicator, P/N 066-03044-0000,-0001,-0002,-0003,-0004.

1.4.1.B.1 The indicator with a black faceplate and 5 volt lighting is P/N 066-03031-0000, P/N 066-03044-0000.

1.4.1.B.2 The indicator with a black faceplate and 28 volt lighting is P/N 066-03031-0001, P/N 066-03044-0001.

1.4.1.B.3 The indicator with a gray faceplate and 5 volt lighting is P/N 066-03031-0002, P/N 066-03044-0002.

1.4.1.B.4 The indicator with a gray faceplate and 28 volt lighting is P/N 066-03031-0003, P/N 066-03044-0003.

1.4.1.B.5 The indicator with a black faceplate and NVG lighting is P/N 066-03031-0004, P/N 066-03044-0004.

1.4.1.C Bendix/King KA 54A Radar Altimeter Antenna (2 each), P/N 071-01501-0000.

1.4.1.D Bendix/King KRA 405 Radar Altimeter R/T Installation Kit (050-01391-0000) which includes:

050-01391-0000 INSTALLATION KIT 3

SYMBOL	PART NUMBER	FIND NO	DESCRIPTION	UM	-0000
	030-02211-0000		CONNECTOR	EA	1.00
	057-02029-0007		LABEL	EA	1.00
	071-04003-0000		MTG RACK 3 INCH	EA	1.00

P/N 030-02211-0000, connector, vendor part numbers:

Cannon	KPT06B18-32SW
Burndy	BT06AC18-32SW
Array	PW06B18-32SW
Amphenol	PT06A18-32SW(SR)

1.4.1.E Bendix/King KNI 415, KNI 416 Radar Altimeter Indicator Installation Kit (either 050-01401-0000 for black units or 050-01401-0001 for gray units) which includes:

050-01401-0000 INSTL KIT BLK PLT AA
050-01401-0001 INSTL KIT GRY PLT AA

SYMBOL	PART NUMBER	FIND NO	DESCRIPTION	UM	-0000	-0001
	030-02210-0006		CONN 19P F Y OLV	EA	1.00	1.00
	057-02029-0008		LABEL	EA	1.00	1.00
	057-02029-0009		LABEL	EA	1.00	1.00
	073-00044-0001		PLATE MOORING	EA	1.00	1.00
	073-00045-0000		ADAPTOR PLATE	EA	1.00	.
	073-00045-0001		ADAPTOR PLATE	EA	.	1.00
	089-05115-0012		SCR, MACH, 6-32, F	EA	4.00	.
	089-06461-0012		SCR FHP 6-32X3/4	EA	.	4.00

P/N 030-02210-0006, connector, vendor part numbers:

Cannon	KPT06B14-19SY
Burndy	BT06AC14-19SY

Array PW06B14-19SY
Amphenol PT06A14-19SY(SR)

1.4.1.F Bendix/King KA 54A Radar Altimeter Antenna Installation Kit (050-02960-0000) which includes:

050-02960-0000 KA54A INSTALL KIT				0
SYMBOL	PART NUMBER	FIND NO DESCRIPTION	UM	-0000
	030-00108-0000	CONN TNC CA RG214	EA	4.00

P/N 030-00108-0000, connector RG393, vendor part number:
TED Manufacturing 5-10-43-2

1.5 ACCESSORIES REQUIRED, BUT NOT SUPPLIED

RG393 Cable, 34 ft (10.36 m), P/N 024-00075-0000, mil spec M17/127-RG393.

1.6 LICENSE REQUIREMENTS

The transmitter, as installed in the aircraft, requires an Aircraft Radio Station License. This license is obtained by filing FCC Form 404. The KRA 405 may be operated for up to 30 days without a station license, after filing the FCC Form 404 and while awaiting the receipt of the station license, if a copy of the FCC Form 404 is kept in the aircraft.

This equipment has been type accepted by the FCC and entered on their list of type accepted equipment as AlliedSignal KRA 405 and must be identified as AlliedSignal KRA 405 on your FCC Form 404, Aircraft Radio Station License Application.

1.7 CONTINUED AIRWORTHINESS

The instructions for continued airworthiness in the TC or STC approvals for this product supplements or supersedes the instructions for continued airworthiness in this manual.

This Bendix/ King product KRA 405 is designed and manufactured to allow on-condition maintenance. On-condition maintenance is described as follows. There are no periodic service requirements necessary to maintain continued airworthiness. No maintenance is required until the equipment does not properly perform its intended function. When service is required, a complete performance test must be accomplished following any repair action. Consult the appropriate section of the Maintenance Manual for complete performance test information.

SECTION II
INSTALLATION

2.1 GENERAL INFORMATION

2.1.1 INTRODUCTION

This section contains general suggestions and information to consider before installation of the KRA 405. Close adherence to these suggestions will assure optimum performance from the equipment.

The conditions and test required for the TSO and MOPS approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or with a specified type or class of aircraft to determine that the aircraft installation conditions are within the TSO and MOPS standards. These articles must have separate approval for installation in an aircraft. Any features in this equipment outside the requirements of this applicable TSO and MOPS must be evaluated and approved as part of the installation approval. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

2.1.2 UNPACKING AND INSPECTING EQUIPMENT

Exercise extreme care when unpacking the equipment. Make a visual inspection of the unit for evidence of damage incurred during shipment. If a claim for damage is to be made, save the shipping container to substantiate the claim. The claim should be promptly filed with the transportation company. It would be advisable to retain the container and packaging material after all the equipment has been removed in the event that equipment storage or reshipment should become necessary.

2.2 AVIONICS COOLING REQUIREMENTS FOR PANEL MOUNTED EQUIPMENT

The greatest single contributor to increased reliability of modern day avionics is to limit the maximum operating temperature of the individual units whether panel mounted or remote mounted. While modern day individual circuit designs consume much less electrical energy, watts per cubic inch dissipated within the avionics unit remains much the same due to the high density packaging techniques utilized. Consequently, the importance of providing cooling to the avionics stack is still with us today.

While each individual unit may or may not require forced air cooling, the combined heat load of several units operating in a typical avionics location will significantly degrade the reliability of the avionics if provisions for cooling are not incorporated in the initial installation. Failure to provide cooling to the equipment will lead to increased avionics maintenance costs and may also void the Honeywell warranty.

2.3 ALTITUDE TRIP ADJUSTMENT

2.3.1 FACTORY SETTING

Three altitude trips are provided in the KRA 405 Radar Altimeter R/T (P/N 066-01048-0002) and set at 250, 500 and 1200 feet. Should the customer elect to have these altitudes changed, the installing agency should follow the steps in paragraph 2.3.2.

2.3.2 RESETTING THE ALTITUDE TRIPS

2.3.2.A. Equipment Required

TABLE 2-1 Altitude Trip Set Test Equipment (Audio Generator)

TYPE	CHARACTERISTICS	REPRESENTATIVE MODELS
Audio Signal Generator		Hewlett Packard 200CD or equivalent.
Digital Voltmeter (DVM)		Eldorado 1820A or equivalent
Power Supply	28 V @ 1.5 amps	

2.3.2.B. Procedure

NOTE: All test points and adjustment points are shown in Figure 2-11.

2.3.2.B.1 Remove the R/T cover by turning the two (2) quick connect screws one-half turn counterclockwise.

2.3.2.B.2 Place a 50 ohm termination on the transmitter antenna connector (lower TNC connector).

2.3.2.B.3 Connect +27.5 Vdc to Pin L and ground Pin N on the front connector.

2.3.2.B.4 Connect a DVM to TP 506. The DVM should indicate -28 +/- 1.5 Vdc.

2.3.2.B.5 Connect an audio frequency generator to TP 201. Adjust the frequency of the generator to 3,000 Hz. Adjust the level of the generator until -8.01 +/- 1.5 Vdc is present at TP 207.

2.3.2.B.6 Adjust the frequency until the voltage at TP 506 indicates the desired altitude trip voltage according to the formula: V = A x (-0.01 V/ft),

Where: V = Voltage in volts at TP 506
A = Desired altitude trip level in feet

Example: 100 ft = 100 ft x (-0.01 V/ft) = -1 Vdc

2.3.2.B.7 To adjust Altitude Trip #1, connect the DVM to TP 605. Adjust R616 counter-clockwise until -8 +/- 1.5 Vdc is present at TP 605. Then slowly rotate R616 clockwise until the voltage at TP 605 switches to +28 +/- 1.5 Vdc.

2.3.2.B.8 To adjust Altitude Trip #2, follow the procedures in steps 4 through 7 above using TP 607 and R622 in step 7.

2.3.2.B.9 To adjust Altitude Trip #3, follow the procedures in steps 4 through 7 above using TP 613 and R653 in step 7.

2.3.2.B.10 Verify the trip adjustments by the following:

2.3.2.B.10.a Adjust the signal generator until the voltage at TP 506 is at least 1.50 volts above the highest trip point.

2.3.2.B.10.b Connect the DVM to TP 605. Slowly decrease the frequency until the DVM switches to +28 +/- 1.5 Vdc. The voltage at TP 506 should indicate the desired trip voltage +/- 10%.

2.3.2.B.10.c Repeat steps 10.a and 10.b with the DVM connected to TP 607.

2.3.2.B.10.d Repeat steps 10.a and 10.b with the DVM connected to TP 613.

2.4 KRA 405 SYSTEM INSTALLATION

NOTE: Figure 2-13 shows an external sonalert installation.

2.4.1 KRA 405 R/T

2.4.1.A Select the KRA 405 R/T location in the equipment bay. The unit may be mounted rigid, but if shock mounting is desired, allow adequate sway space. In either case allow one inch of free air space around the top and rear of the unit. Avoid mounting the unit near a high heat source.

2.4.1.B Refer to Figure 2-2 for the KRA 405 R/T mounting dimensions. Mark, punch, then drill mounting holes, being careful not to damage adjacent equipment or cables.

2.4.1.C Using four (4) #6-32 screws, secure the mounting tray in the position selected. The fluted knob should face in a direction to provide easy access.

2.4.1.D Slide the KRA 405 R/T into the rack. Secure the unit in place by hooking the triangular keeper over the front lip of the unit and tightening the fluted knob.

2.4.2 KNI 415, KNI 416 INDICATOR

2.4.2.A Plan a location on the aircraft panel that is clearly visible to the pilot with the least deviation from his normal scan pattern while in an approach.

2.4.2.B Avoid mounting the unit close to heater vents or other high heat sources.

2.4.2.C Make certain that clearance is available between units so that normal vibration does not cause the unit to strike adjacent equipment cases.

2.4.2.D Allow clearance behind the unit for installation of the cables and connectors.

2.4.2.E If an instrument hole that meets the installation requirements is not available, cut a 3 inch ATI hole per Figure 2-1. The unit may be mounted in front of or behind the panel. Secure the unit with mounting ring provided and four (4) 1/2 inch long 5-32 instrument screws.

2.4.3 ANTENNAS

2.4.3.A Approved Antennas

The KRA 405 Radar Altimeter System requires two antennas for a single system installation. Since the system is CW, one antenna is used to transmit the signal and the other is used to receive the reflected signal. In order to meet the requirements of TSO C87, the KRA 405 system must use TSO'd antennas with the characteristics listed in Paragraph 1.3. Approved antennas are listed in the table below:

TABLE 2-2 Approved Antennas

FIG	UNIT	MANUFACTURER	MANUFACTURER PART NUMBER
2-4	KA 54	Dorne and Margolin	DMPN 3-3/A
2-5		UB Corporation	AD 43013-1
2-5		Comant Industries	01-34-04531
2-6		Dorne and Margolin	DMPN 3-4/A
2-7	KA 54A	Sensor Systems Inc.	S67-2002

The UB Corporation, Sensor Systems and Comant Industries antennas can be purchased directly from the respective manufacturers:

UB Corporation
9829 Wilsky Blvd.
Tampa, FL 336144
Telephone: 813-884-1463

Comant Industries Inc.
3021 Airport Ave.
Santa Monica, CA 90405
Telephone: 213-390-6694
Telex: 69-1583

Sensor Systems, Inc.
8929 Fulbright Ave.
Chatsworth (Lax), CA 91311
Telephone: 818-341-5366

2.4.3.B Planning the Antenna Installation

Many factors are important when planning an optimum antenna installation for use with a radar altimeter system. Careful planning and attention to detail are absolutely necessary. Failure to install the antennas correctly will cause degradation in system performance.

2.4.3.B.1 ANTENNAS SHOULD BE MOUNTED NEAR POINT OF AIRCRAFT ROTATION. This reduces the effect of pitch and roll attitude in altitude readings during approach and landing.

2.4.3.B.2 ANTENNAS MUST BE MOUNTED CLOSE ENOUGH TO THE R/T SO THAT THE ANTENNA CABLE LENGTH DOES NOT EXCEED 17 FEET. Use of cables longer than 17 feet will decrease system sensitivity.

2.4.3.B.3 ANTENNAS SHOULD BE POINTING STRAIGHT DOWN WITHIN +/- 6 DEGREES WHEN THE AIRCRAFT IS IN A LEVEL FLIGHT ATTITUDE. Antennas mounted more than 6 deg off the vertical will exhibit erratic operation on the ground. See Figure 2-3 for examples of this type of installation.

2.4.3.B.4 ANTENNAS MAY BE MOUNTED IN LINE OR SIDE-BY-SIDE, the former being the best choice of the two. When using side-by-side installations, the antennas should be mounted on a flat surface of the aircraft. The angle between the antenna centerlines should be less than 6 deg. Failure to do so will result in erratic operation on the ground, i.e., the needle will fluctuate as much as 20 feet, dependent upon the angle between centerlines. Airborne operation will be satisfactory.

2.4.3.B.5 DUAL INSTALLATION: Two (2) receive and two (2) transmit antennas are required for a dual installation, one pair for each system. The transmit antenna of one system must be located as far as possible from the receive antenna of the other system in order to avoid interference between the two systems (see Figure 2-3).

2.4.3.B.6 ANTENNAS SHOULD BE MOUNTED NO LESS THAN 20 INCHES APART (measure from center to center) in order that leakage between the antennas remains at a tolerable level. The pointer may not stow above 2500 feet if the leakage between the antennas is too great.

2.4.3.B.7 ANTENNAS SHOULD NOT BE SEPARATED BY A DISTANCE GREATER THAN THE ANTENNA HEIGHT ABOVE THE TERRAIN AT TOUCHDOWN. If the antennas are separated by more than this distance, sufficient terrain ares is not illuminated for ground level operation. The antennas should be mounted closer than the antenna height above the terrain (but no less than 20 inches) if the angle between the antennas is greater than 6 deg.

2.4.3.B.8 ANTENNA LOCATIONS SHOULD PROVIDE 120 DEGREE CLEARANCE CONES - no aircraft projection or other antenna should lie within these cones. A fixed object in the cone could cause the altimeter to lock on to a single altitude while a moving projection (gear, flaps, etc.) could cause erratic operation.

2.4.3.B.9 SURFACE AREA BETWEEN ANTENNAS SHOULD BE FREE FROM SEAMS OR OTHER DISCONTINUITIES. Never mount an antenna directly on a seam. If antennas must be separated by a seam, make sure the two pieces of aircraft skin are electrically bonded together by adding bonding straps (i.e., have multiple straps across seam separating the two antennas). Follow rule C.1 when bonding the straps. Failure to bond properly can cause loss in system sensitivity and/or cause the pointer to momentarily come into view above 2500 feet AGL (this phenomena is commonly called “peaking”).

2.4.3.B.10 ANTENNA MUST NOT BE LOCATED IN AREAS WHERE EXCESS WATER CAN ACCUMULATE. Water between the antenna flange and aircraft skin will cause loss of system sensitivity and peaking.

2.4.3.B.11 CONNECTORS ON ANTENNAS SHOULD BE MOUNTED PERPENDICULAR TO A LINE DRAWN THROUGH THE TWO ANTENNAS. The antennas are so designed that minimum coupling occurs when mounted as above. Any other mounting may cause the altimeter to lock on to erroneous altitudes when flying above 2500 feet AGL.

2.4.3.C Implementing the Antenna Installation

2.4.3.C.1 ANTENNA AND AIRFRAME SURFACES MUST BE FREE OF PAINT OR OTHER INSULATING MATERIALS, INCLUDING CHROMATE. Apply Alumi-

prep #33 (P/N 016-01127-0000) to cleanse the metal of any residue left after removing paint or insulating material. Protect bare aluminum surfaces with Alodine 1001 (P/N 016-01128-0000) or equivalent prior to mounting antennas or bonding straps.

2.4.3.C.2 RF/AIR SEALING GASKETS ARE TO BE INSTALLED BETWEEN KA 54A MOUNTING FLANGES AND AIRCRAFT SKIN.

2.4.3.C.3 RF ANTENNA CABLES SHOULD BE PREPARED ACCORDING TO PARAGRAPH 2.4.4 of the KRA 405 Installation Manual, using the 40 foot AID, if possible.

2.4.3.C.4 MAXIMUM ALLOWABLE LENGTH FOR EACH RF CABLE (RECEIVE AND TRANSMIT) IS 17 FEET. System sensitivity suffers when cables longer than 17 feet are used.

2.4.3.C.5 MAKE SURE THE CABLE ARE TIGHT INSIDE THE CABLE CONNECTORS.

2.4.3.C.6 AVOID THE USE OF RIGHT ANGLE OR BULKHEAD COAX CONNECTORS. SWRs are greater on these types of connectors and therefore can cause problems. If right angle or bulkhead connectors must be used, extreme care should be exercised in assembly and the tests in paragraph 2.5 should be performed.

2.4.3.C.7 MINIMUM RECOMMENDED BEND RADIUS OF RG 393/U COAX IS 5 INCHES. Bends less than 5 inches in radius can significantly increase VSWR.

2.4.3.C.8 EXCESS CABLE LENGTHS SHOULD BE LASHED SECURELY BUT NOT TO THE POINT OF CUTTING OR DISTORTING THE CABLE INSTALLATION. Cutting the coax shield causes an altitude return and affects system operation.

2.4.3.C.9 TIGHTEN ALL ANTENNA COAX CONNECTORS SLIGHTLY MORE THAN FINGER TIGHT.

2.4.3.C.10 DO NOT PAINT ANTENNA: Operation and/or accuracy may suffer.

2.4.4 ANTENNA CABLES

2.4.4.1 General

The KRA 405 Radar Altimeter System is designed to read an altitude of zero (0) feet at touchdown by adjustment of antenna cable length and selection of the proper Aircraft Installation Delay (AID). Depending upon the minimum length of cable required and the antenna height above the ground at touchdown, the proper AID can be selected.

2.4.4.2 Minimum Cable Length Required

After the location of the antennas has been determined (paragraph 2.4.3), a minimum length of antenna cable required for the installation can be determined. Measure the distance from the R/T to each antenna adding enough extra length to avoid obstructions in the cable path and to allow for connection to the antenna connector.

2.4.4.3 Antenna Height

The antenna height above ground at touchdown is determined by information obtained in the aircraft manual or by actually measuring the height of the antenna when the aircraft is in touchdown configuration. The measurement cannot be made on a parked aircraft since the landing gear is loaded. A simulated touchdown can be obtained by jacking up the aircraft until the landing gear is unloaded as long as pitch attitude is also taken into account.

2.4.4.4 Aircraft Installation Delay (AID) Selection and Calculation of Actual Antenna Cable Length

Figure 2-8 is a graph used to determine the AID selection and the actual cable lengths used in the installation. The cable lengths shown depend upon the AID used and antenna height. The graph assumes the use of RG 393/U RF cable having a propagation constant of 0.7. Cable lengths are critical and must be measured accurately. The following formula was used to produce the AID and installation cable length graph.

$$L = (AID-2H)B$$

Where: L = Total length in feet in RF antenna cable required for the installation (L must be greater or equal to the minimum cable length determined in paragraph 2.4.4.2.)

AID = Aircraft Installation Delay in feet (20, 40, and 57 feet)

H = Antenna height in feet

B = Cable propagation constant

NOTE: For equivalent types of 50 ohm coaxial cable other than RG 393/U, the above equation must be used in order to determine the length of cable and AID to be used.

The graph in Figure 2-8 and the formula above yield the total length of cable to be used in the installation (i.e., the length of cable used from R/T to the transmit antenna plus the length of cable from the R/T to the receive antenna). The cables need not be equal in length. Excess cable should be coiled and secured to the aircraft. The transmit and receive cables must be continuous with no intervening connections or breaks. Figure 2-9 contains instructions for assembly of TNC connectors to RG 393/U cable. Careful construction of the coax connectors is extremely important in a Radar Altimeter installation.

NOTE: Maximum length allowed for each cable is 17 feet (34 feet for both).

2.4.4.5 Aircraft Installation Delay (AID) Selection

Optimum performance of the KRA 405 system results using the 40 foot AID. It is recommended that for all installations where it is practical, the installer select the 40 foot AID and calculate the cable lengths (paragraph 2.4.4.4) based upon this AID. Excess cable can be coiled and secured to the air frame.

After selection of the AID, the proper pins on the KRA 405 R/T connector must be jumpered.

2.4.4.5.A 40 foot AID: Jumper pins a and J.

2.4.4.5.B 57 foot AID: No jumpers are necessary.

2.4.4.6 Example Using Figure 2-8 to Determine AID and Cable Length

2.4.4.6.A Assume that the antenna location (paragraph 2.4.3) has been selected and that the minimum cable length required (paragraph 2.4.4.2 transmit plus receive) is 12 feet.

2.4.4.6.B The measured antenna height (paragraph 2.4.4.3) is 2.5 feet.

2.4.4.6.C Entering the graph in Figure 2-8 with an antenna height of 2.5 feet, the 40 foot AID yields 23.2 feet and the 57 foot AID yields 34.4 feet (greater than the maximum 34 feet allowed). Therefore, the 40 foot AID should be used as recommended in paragraph 2.4.4.5. If equal lengths are desired, the length of each cable would be 11.5 feet.

2.4.5 WIRING HARNESS

Figure 2-10 shows the KRA 405 mating connector pin connections and the KNI 415, KNI 416 mating connector pin locations. Figure 2-14 is the system interconnection drawing.

During preparation of the wiring harness, observe the following precautions:

2.4.5.A Bond and shield all parts of the aircraft electrical system such as generators and ignition systems.

2.4.5.B Keep the cables away from circuits carrying heavy current, pulse-transmitting equipment, 400 Hz circuits, and other sources of interference.

2.4.5.C Make all external connections of the equipment through designated connectors listed on the diagram.

2.4.5.D Wire size is specified on the interconnect diagram.

2.4.5.E Leave slack in cables to allow for free sway of the equipment.

2.4.5.F After installation of the cables in the aircraft and before installation of the equipment, a check should be made to ensure that the aircraft power is applied only to the pins specified.

2.5 POST INSTALLATION TESTS

2.5.1 GENERAL

In most cases altimeter installations that closely follow the suggestions of paragraph 2.4.3 will need no special equipment to check the integrity of the system, and the first 5 steps of paragraph 2.5.2 are sufficient to determine proper altimeter operation. However, if more than one of the suggestions in paragraph 2.4.3 cannot be complied with, the probability increases that an installation problem will exist. In order to determine whether an altimeter installation problem does exist, the tests in paragraphs 2.5.2 and 2.5.3 can take the place of a flight test. Agencies that install many altimeter systems (including other manufacturers' equipment) will find these test procedures quite helpful. For the majority of installation problems encountered, the procedures in paragraph 2.5.2 should prove sufficient.

2.5.2 KRA 405 RADAR ALTIMETER POST INSTALLATION TEST PROCEDURE USING MICROWAVE ABSORBER

2.5.2.A Purpose of Test

The most common complaint (from an operational standpoint) against the KRA 405 Radar Altimeter System is that the indicator needle does not always stow behind the mask after the test button is pressed and released, while flying above 2,500 feet AGL. This problem is usually attributed to any one of several possible installation deficiencies, whereby an RF leakage path allows the 4.3 GHz transmitter output to bleed into the system's receiver, bypassing the normal antenna-to-ground-to-antenna path. The following procedure duplicates a flight altitude greater than 2,500 feet AGL in order to find these RF leakage paths.

2.5.2.B Required Equipment

The items listed below, or their electrical equivalent, may be used to conduct the tests in this paragraph.

TABLE 2-3 RF Leakage Test Equipment (Microwave Absorber)

QTY	TYPE	CHARACTERISTICS	REPRESENTATIVE MODELS
2	Microwave Absorber	1 ft square	Anlon ML 74
2	TNC Female Barrel		Americon 3180-0000
2	TNC Male Load		Microlab FXR TA-SMT

2.5.2.C Test Procedures

2.5.2.C.1 Turn on aircraft primary power.

2.5.2.C.2 Adjust the DH knob on the indicator to set the DH bug to 25 feet.

2.5.2.C.3 Depress the test button on the indicator. The altitude indicated should be 50 +/- 5 feet and the DH lamp should be out.

2.5.2.C.4 Slowly advance the DH but until the DH lamp lights. The bug should be set at 50 +/- 5 feet at this time. Continue increasing the DH but setting. The DH lamp should stay lit.

2.5.2.C.5 Release the test button. The indicated altitude should now be 0 +/- 5 feet.

NOTE: In some installations, the tolerances given here may be greater, due to antenna location and a difference between aircraft touch down attitude and parked attitude.

2.5.2.C.6 Place a one (1) foot square piece of the microwave absorber over each KRA 405 Altimeter antenna. The pointer should go clockwise behind the mask.

NOTE: It may be necessary to remove the aircraft from the hanger, away from other aircraft and/or other sources of reflection in order to achieve an un-lock condition (pointer behind mask) with the microwave absorber.

Complete steps 2 through 4. Release the test switch. The pointer should again go behind the mask.

2.5.2.C.7 If the pointer did not stow in step 6 above, first exchange the antenna coaxes at the R/T. Repeat step 6. If the pointer still does not stow, disconnect the antenna cable from the R/T unit receiver or upper coax connector (transmitter input, lower coax connector), and terminate the R/T with a 50 ohm load. The pointer should stow. If it does not, place the microwave absorber over the transmit (receiver) antenna. If the pointer still does not stow, disconnect the antenna coax from the transmit (receiver) antenna and connect a 50 ohm microwave load to the antenna coax. Rebond the antenna if the pointer is now stowed. If not, terminate the transmit (receiver) port of the R/T. Check the items in paragraph 2.4.3 pertaining to the antenna coax if the pointer is stowed. If not, the R/T unit should be bench tested.

2.5.2.C.8 Repeat step 7 terminating the transmit port of the R/T and reconnecting the receiver coax and antenna. Use the instructions in parentheses.

2.5.3 KRA 405 RADAR ALTIMETER POST INSTALLATION TEST PROCEDURE USING SIMULATED ALTITUDES

The procedures in paragraph 2.5.3.1 simulate an actual altitude and, therefore, test the RF portion of the altimeter. The procedures in paragraph 2.5.3.2 test all circuit functions except the RF portion.

2.5.3.1 Test Method 1

KRA 405 Radar Altimeter Post Installation Test Procedures using 1000 Foot Delay Line

2.5.3.1.A Purpose of Test

This test simulates an actual altitude of 1000 feet AGL with various return signal strengths. Low power output, poor coax cables, poor connectors and poor R/T performance can be found using this method.

2.5.3.1.B Required Equipment

The items listed below, or their electrical equivalent, may be used to conduct the tests in this section.

TABLE 2-4 RF Output Test Equipment (Delay Line)

QTY	TYPE	CHARACTERISTICS	REPRESENTATIVE MODELS
1	Delay Line	1000 ft.	Teledyne M7421B
1	Attenuator, Variable	0-40 dB, 4-8 GHz.	Narda 794-FM
2	Attenuator, Fixed	20 dB, 3-6 GHz.	Narda 773-20
2	Adapter N_F to SMA		P/N 030-00123-0000, Americon 2082-2300.
2	Adapter N_M to TNC_F		Amphenol 78800
1	Adapter N_M to TNC_M		Amphenol 78875
1	RG393/U cable with TNC_M Connectors.	6 ft.	P/N 024-00075-0000, mil spec M17/127-RG393

2.5.3.1.C Test Procedure

2.5.3.1.C.1 Connect the test equipment as shown in Figure 2-12, replacing the antennas in the installation.

2.5.3.1.C.2 Adjust the variable attenuator to 0 dBm (this setting yields approximately 65 dB loop loss). The KNI 415, KNI 416 should indicate 900 to 1100 feet.

2.5.3.1.C.3 Slowly increase the variable attenuator until the KNI 415, KNI 416 pointer goes clockwise behind the mask. During this operation, the pointer should continue to indicate the previous altitude +/- 10 feet. After the pointer stows, the total attenuation in the line should be 102 dB minimum (40 dB + atten. in delay line + variable atten.).

2.5.3.1.C.4 Pointer movement while adjusting the variable attenuator in step 3 indicates a possible problem in the antenna coax. Connect the test equipment directly to the R/T transmitter port and connect to the receiver port via the 6 foot test cable. Try step 3 again. Pointer movement while adjusting the variable attenuator indicates a possible R/T problem. The R/T should be bench tested to insure proper operation.

2.5.3.1.C.5 When step 3 attenuates a level of less than 102 dB to unlock the system, this can be an indication of possible low TX power output. Reconnect the equipment as in step 4. The pointer should stow at an attenuation of 110 dB minimum (40 dB + atten. in delay line + variable atten.). Should the unit now exhibit proper operation, check the antenna cables for total length greater than 34 feet (remember, RG 393/U attenuation per foot at 4.3 GHz is 0.20 dB, therefore, length greater than 34 feet may hurt system performance).

2.5.3.2 Test Method 2

KRA 405 Radar Altimeter Post Installation Test Procedures using audio generator.

2.5.3.2.A Purpose of Test

This test simulates altitudes of 0 to 2,500 ft to the IF and altitude processor. This test does not check the RF output, but may indicate poor coax cables and connectors.

2.5.3.2.B Required Equipment

The items listed below or their electrical equivalent may be used to conduct the tests in this section.

TABLE 2-5 IF and Altitude Processor Test Equipment (Audio Generator)

QTY	TYPE	CHARACTERISTICS	REPRESENTATIVE MODELS
1	Audio Generator	100 Hz to 250 kHz minimum range	Hewlett Packard 200CD
1	Audio Attenuator	0-12 dB in 1 dB steps	Hewlett Packard 355C
1	Audio Attenuator	0-120 dB in 10 dB steps	Hewlett Packard 355D
1	RMS Voltmeter		Ballatine 310B
2	Microwave Absorber	1 ft square	Anlon ML 74
2	TNC Female Barrel		Americon 3180-0000
2	TNC Male Load		Microlab FXR TA-SMT

2.5.3.2.C Test Procedure

2.5.3.2.C.1 Connect the equipment as shown in Figure 2-12

NOTE: It may be necessary to remove the aircraft from the hanger, away from the other aircraft and/or sources of reflections in order to achieve an unlock condition with the microwave absorber.

2.5.3.2.C.2 Set the attenuators to maximum. Adjust the output level at the terminals of the audio oscillator for 226 mV (0 dBm into a 50 ohm load). The attenuation in the line then represents the input signal level. Readjust the oscillator each time the frequency range is changed.

2.5.3.2.C.3 Apply each of the following frequencies to TP 201 and then by slowly increasing the attenuation, determine the input signal level at which the unit unlocks. The minimum attenuation level and the displayed altitude are listed below.

TABLE 2-6 Indicated KNI 415, KNI 416 Altitude (+/- 7%)

(+/- 1%)	MINIMUM ATTENUATION	40 ft AID	57 ft AID
100920	74	2500 ft	2491.5 ft
98920	75	2450 ft	2441.5 ft
88920	74	2200 ft	2191.5 ft
78920	73	1950 ft	1941.5 ft
68920	72	1700 ft	1961.5 ft
58920	71	1450 ft	1441.5 ft
46920	69	1150 ft	1141.5 ft
38920	67	950 ft	941.5 ft
28920	65	700 ft	691.5 ft
16920	61	400 ft	391.5 ft

2.5.3.2.C.4 If the above altitudes or attenuation levels are in error, load the transmit and receiver ports of the R/T and complete Step 3 again. Successful completion of the tests indicates a problem in the antennas, coax, connectors, or simply that the absorber was not properly applied. Make sure that the unit is unlocked (pointer behind mask) with no external signal applied. Failure to complete this step satisfactorily indicates a unit malfunction; the unit should be bench tested using the procedures in the maintenance manual.

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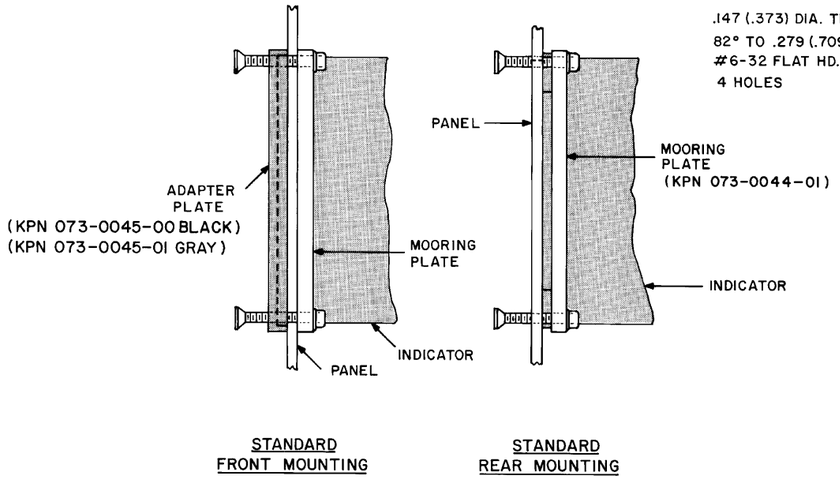
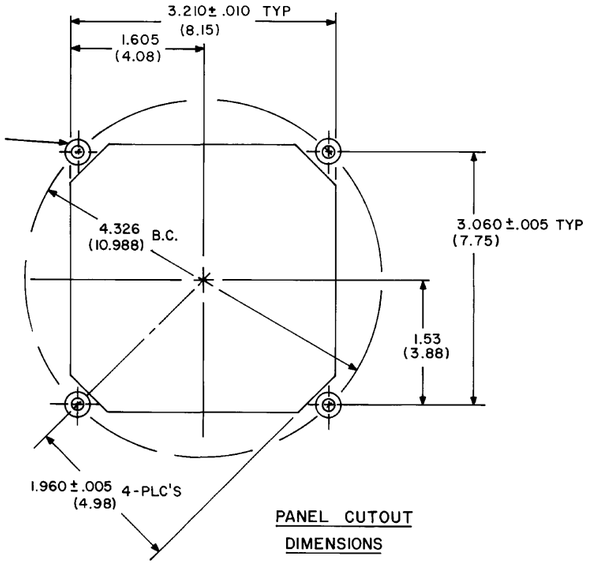


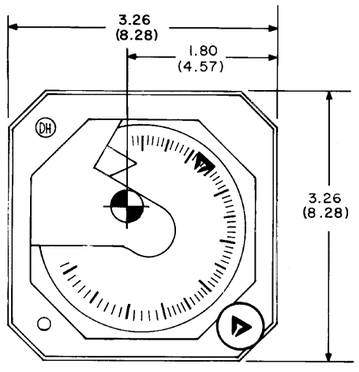
STANDARD FRONT MOUNTING

STANDARD REAR MOUNTING



PANEL CUTOUT DIMENSIONS

NOTES:
1. DIMENSIONS IN PARENTHESIS ARE IN CENTIMETERS.
2. WEIGHT: 1.7LBS (.77KG)
3. USE: GREENLEE PUNCH NO. 071-6038-00
FILE TEMPLATE NO. 071-6039-00



Dwg 155-05160-0000 Rev 1

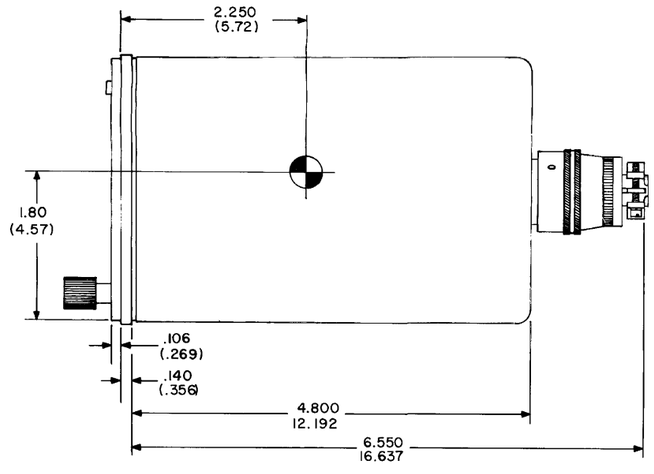
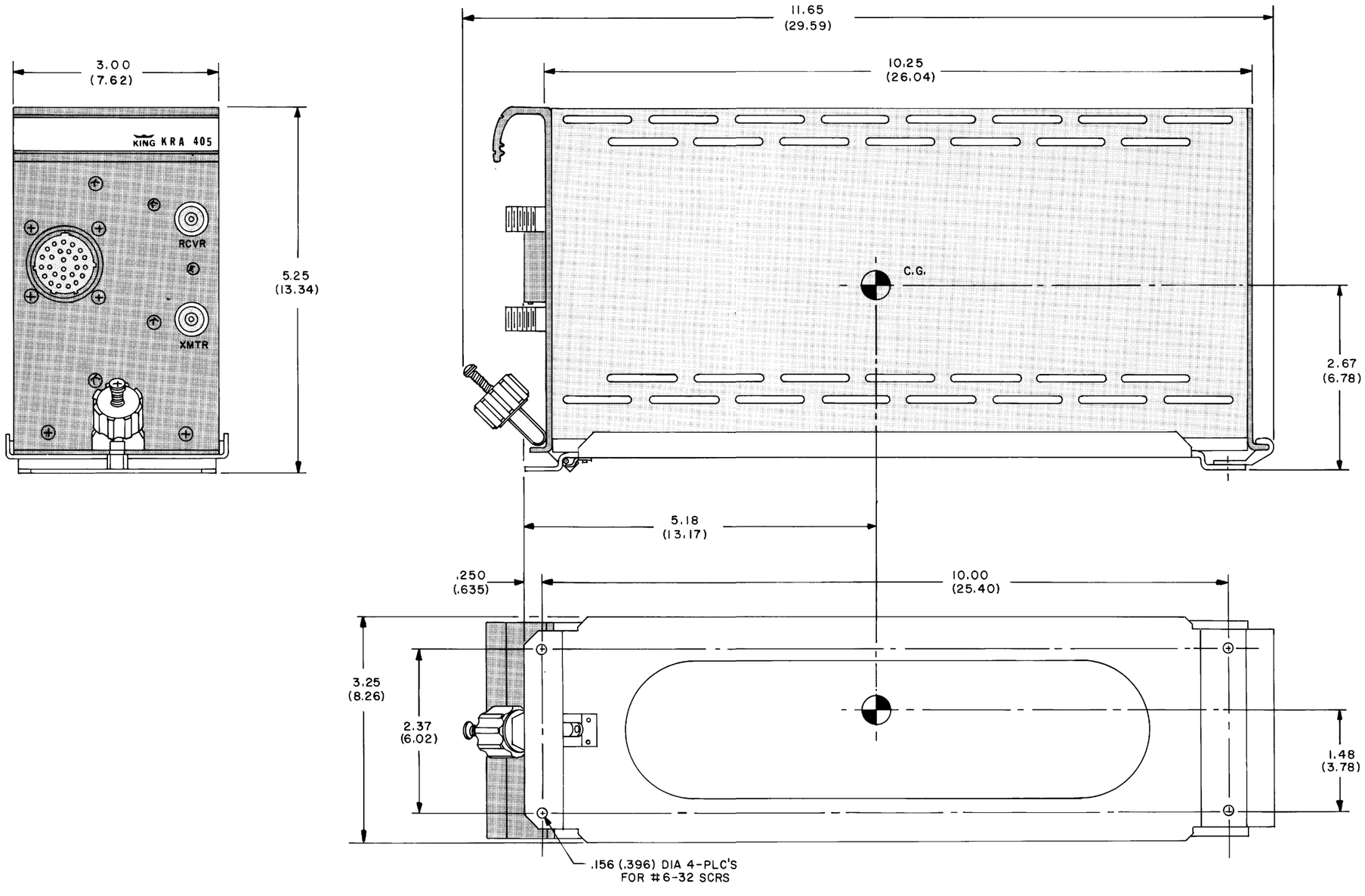


FIGURE 2-1 KNI 415, KNI 416 Installation Drawing (Dwg No 155-05160-0000, Rev 1)



NOTES:

1. DIMENSIONS IN PARENTHESIS ARE IN CENTIMETERS.
2. WEIGHT WITH MOUNTING RACK: 6.3 LBS.(2.86 Kg).

Dwg 155-05153-0000 Rev 1

FIGURE 2-2 KRA 405 Installation Drawing
(Dwg No 155-05153-0000, Rev 1)

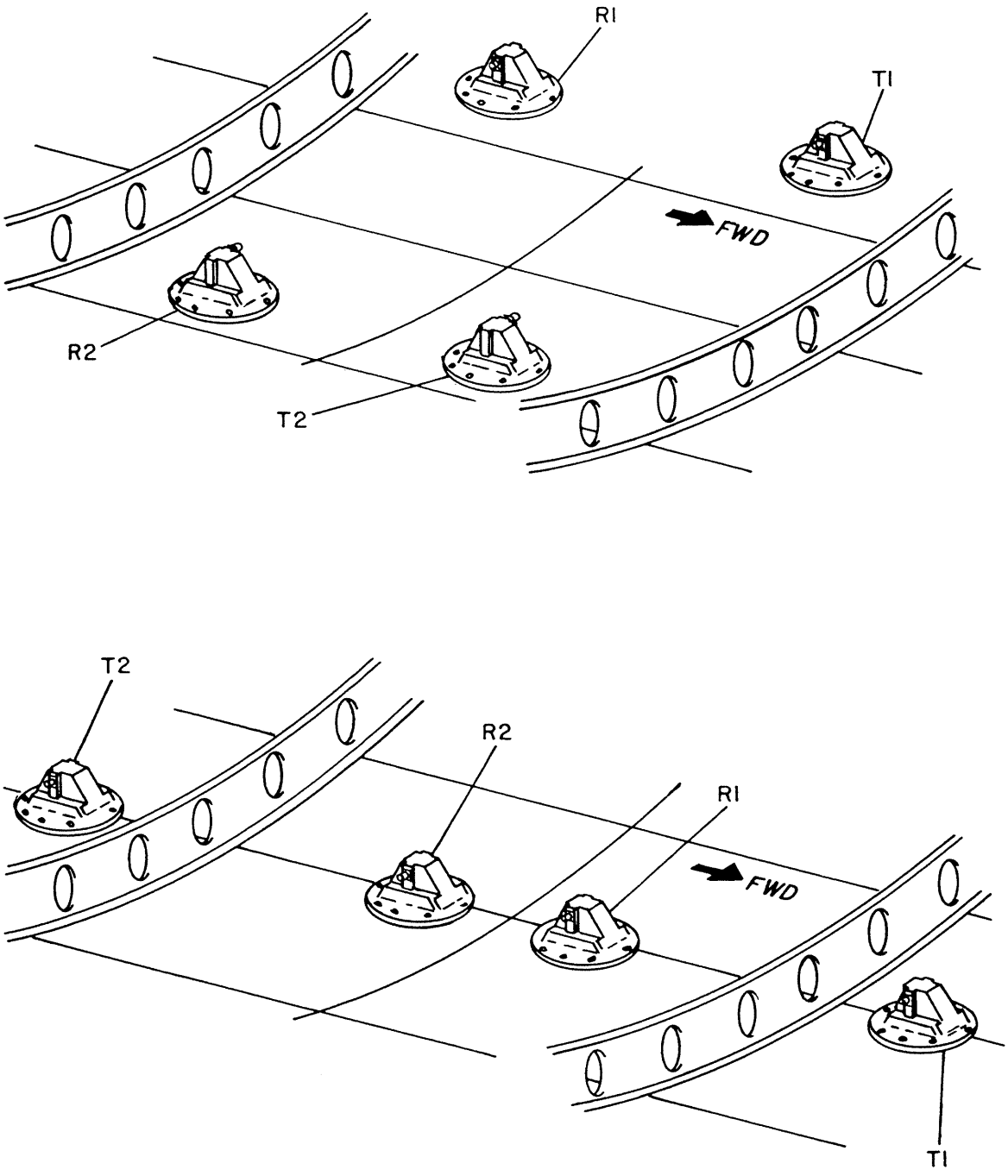
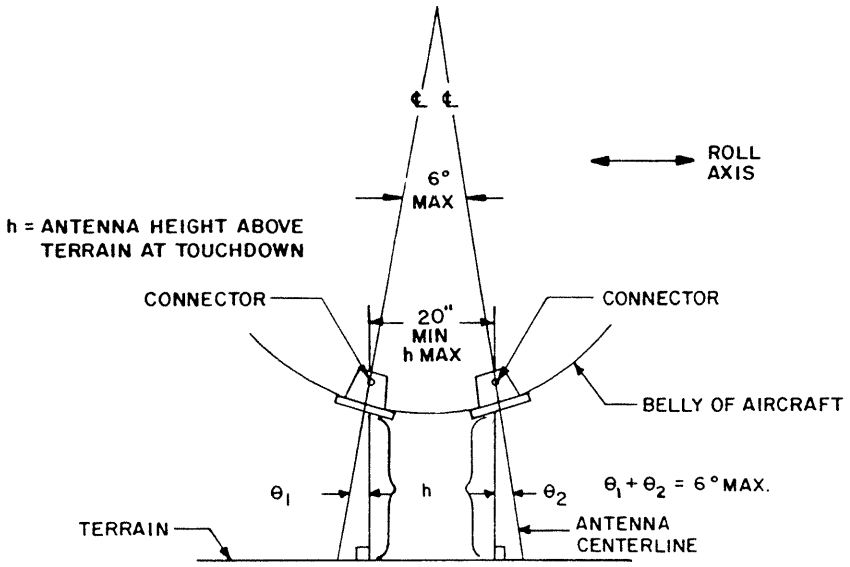
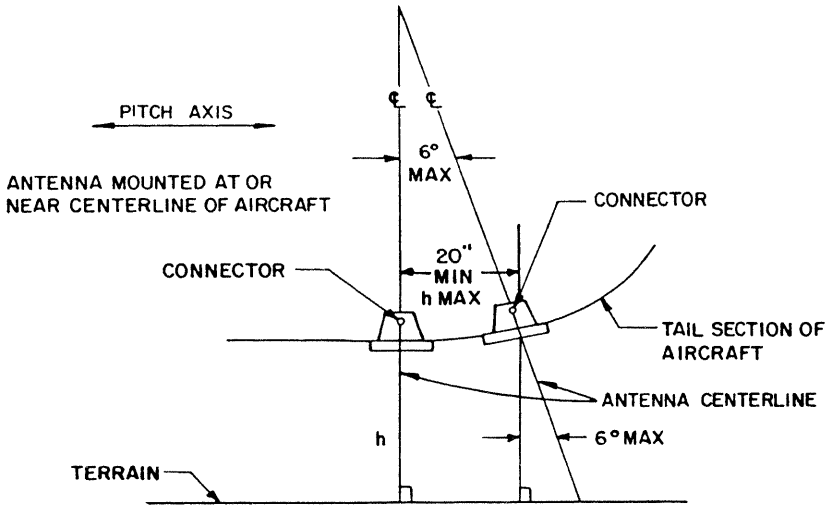


FIGURE 2-3 Typical Antenna Installation For a Dual Radar Altimeter System
(Sheet 1 of 2)

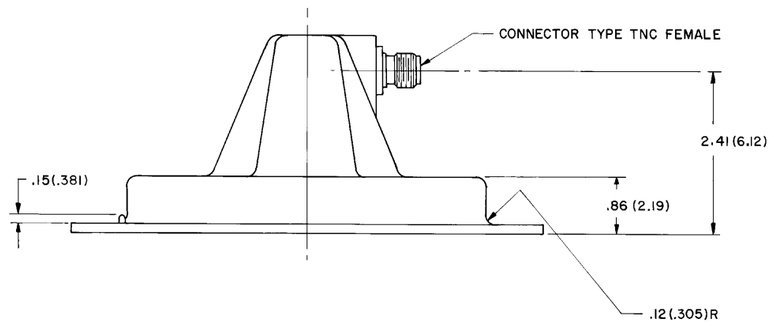


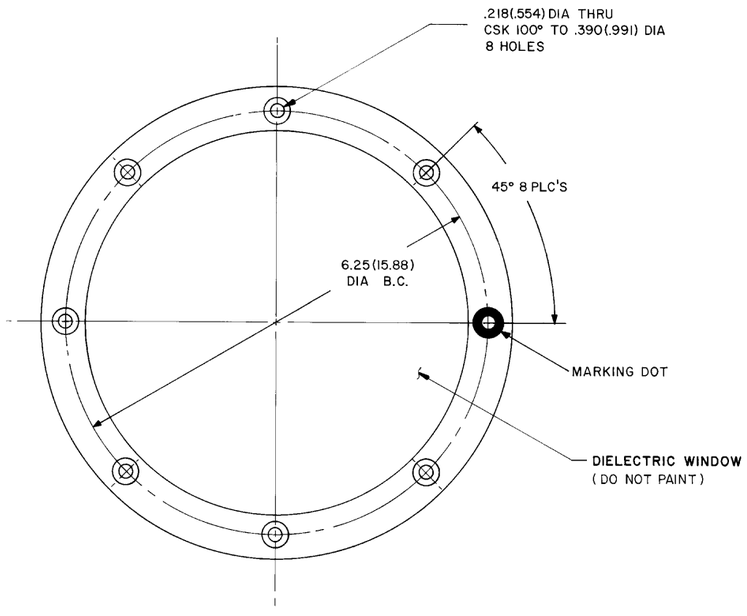
SIDE-BY-SIDE INSTALLATION

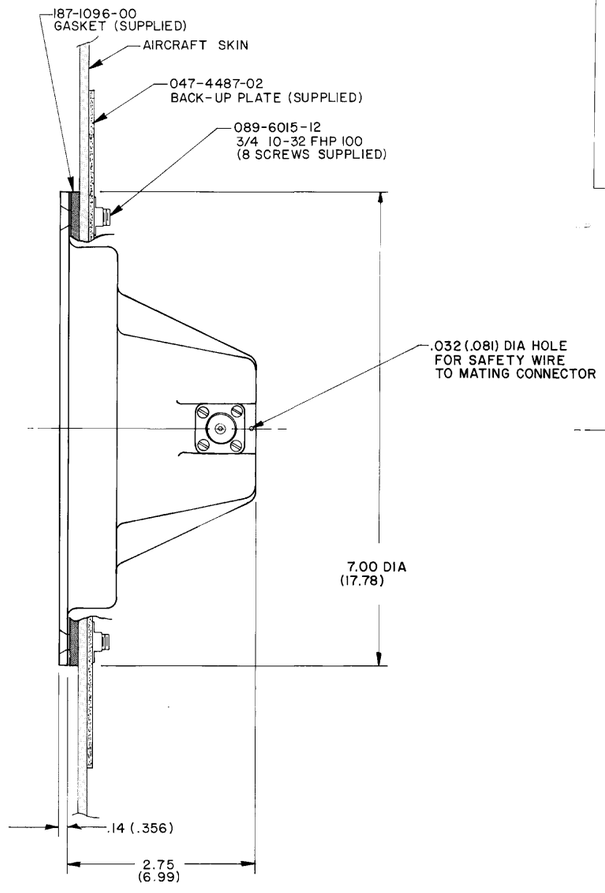


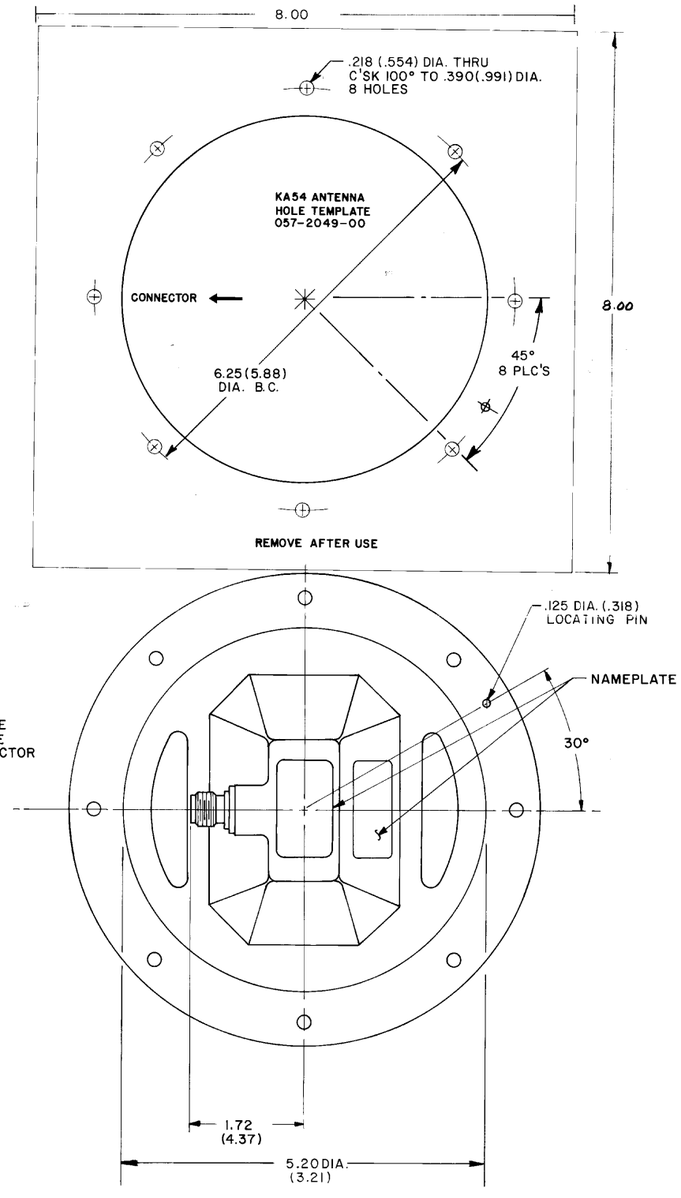
INLINE INSTALLATION (a flat surface is preferred)

FIGURE 2-3 Typical Antenna Installation For a Dual Radar Altimeter System
(Sheet 2 of 2)





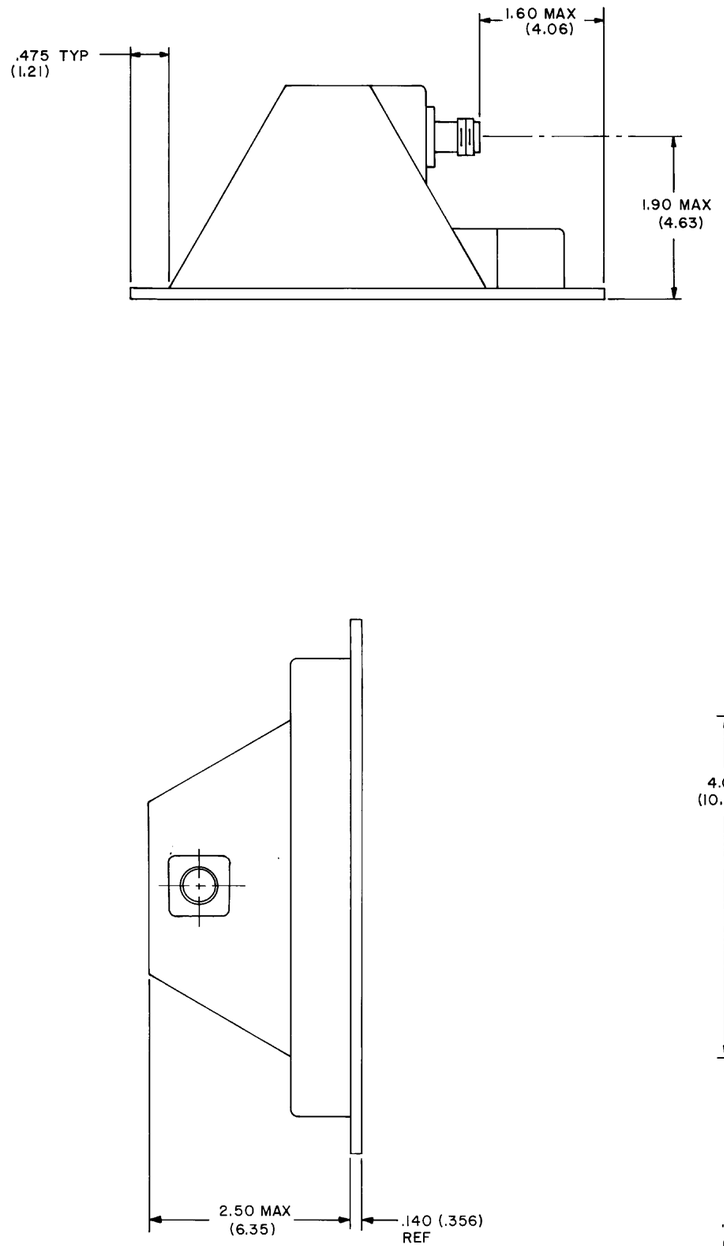




Dwg 155-05159-0000 Rev 1

NOTES:
1. DIMENSIONS IN ( ) ARE IN CENTIMETERS.
2. WEIGHT: LBS. (KG).
3. —CAUTION—
   DO NOT USE BACK-UP PLATE AS A TEMPLATE
   USE TEMPLATE 057-2049-00 SUPPLIED IN THE
   INSTALLATION KIT — REMOVE AFTER USE —
4. GASKETS 187-1096-00 (SUPPLIED) SHOULD BE USED
   IN EACH INSTALLATION.
5. BACK-UP PLATE, IF USED, SHOULD BE INSTALLED IN
   ACCORDANCE WITH ACCEPTED FAA STANDARDS.
6. SEE KRA 405 INSTALLATION MANUAL 006-0104-0X
   FOR COMPLETE ANTENNA MOUNTING INSTRUCTIONS.

FIGURE 2-4 KA 54 (Dorne Margolin Type DMPN 3-3/A) Antenna Outline and Mounting Drawing (Dwg No 155-05159-0000, Rev 1)

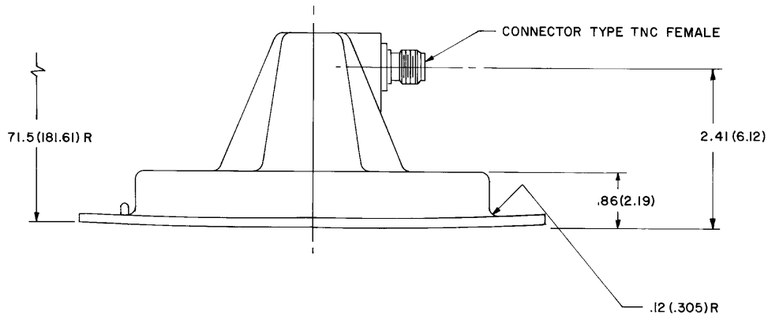


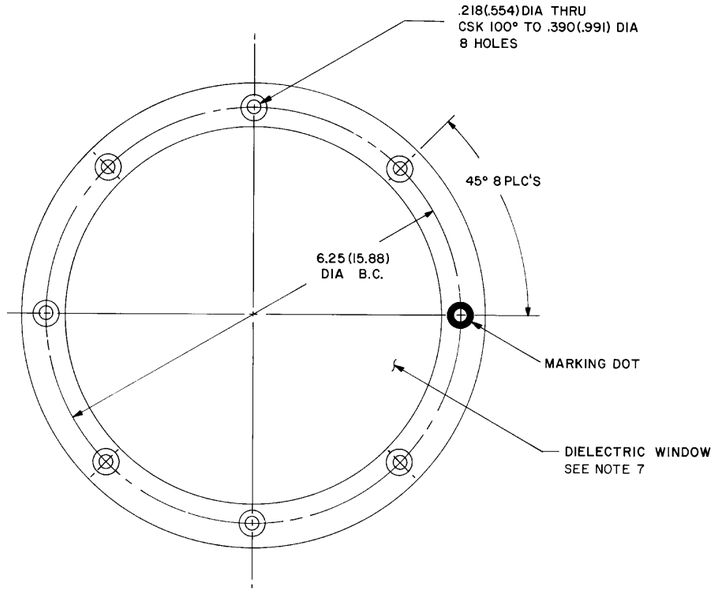
NOTES:

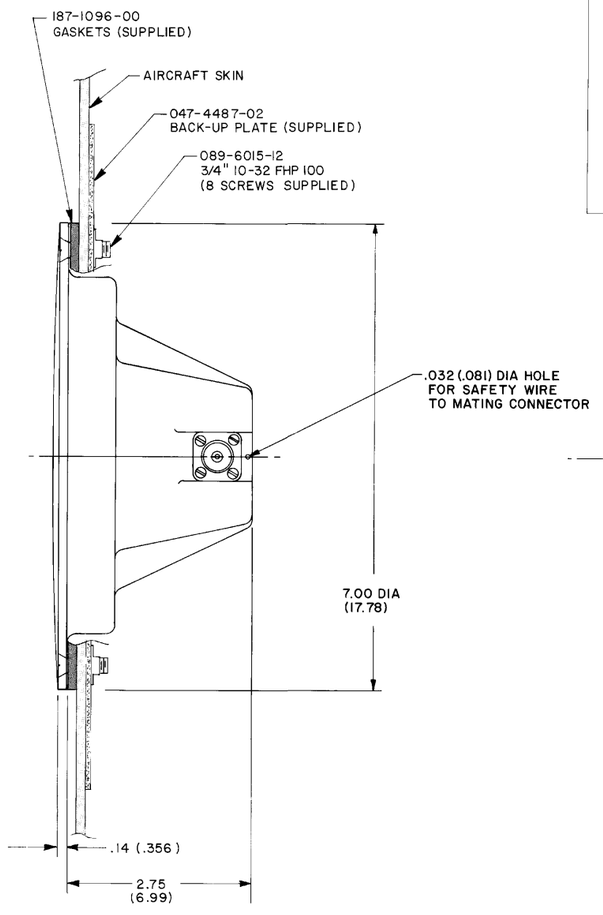
1. DIMENSIONS IN ( ) ARE IN CENTIMETERS.
2. WEIGHT:
   UBC 43013-1: 1LB (.454 Kg)
   COMANT 01-34-04531: .81LB (.368Kg)

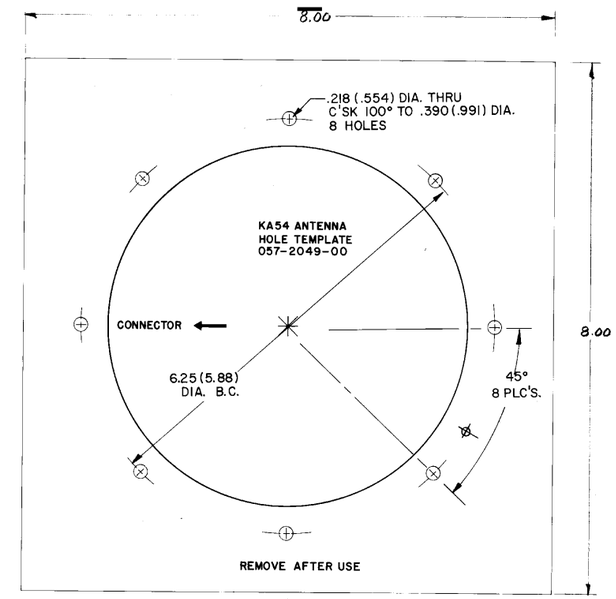
Dwg 155-05166-0000 Rev 0

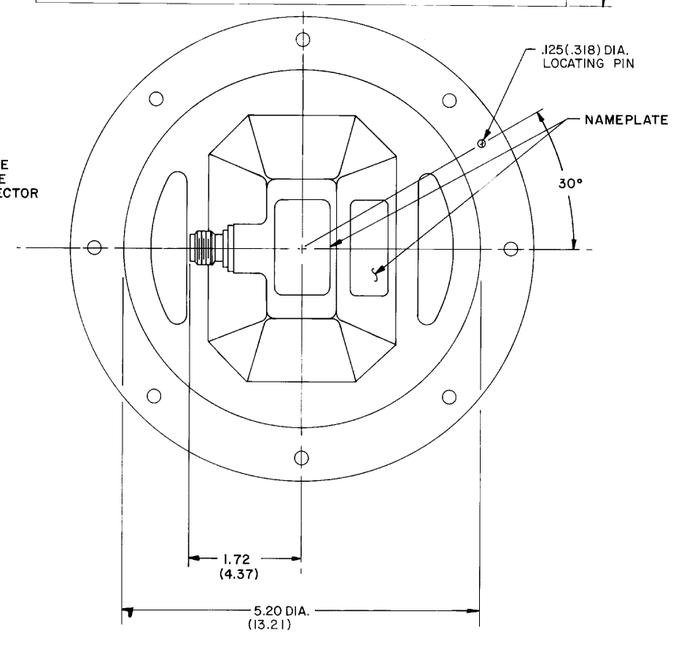
FIGURE 2-5 UBC (Type AD 43013-1) and Comant (Type 01-34-04531) Antenna Outline and Mounting Drawing (Dwg No 155-05166-0000, Rev 0)









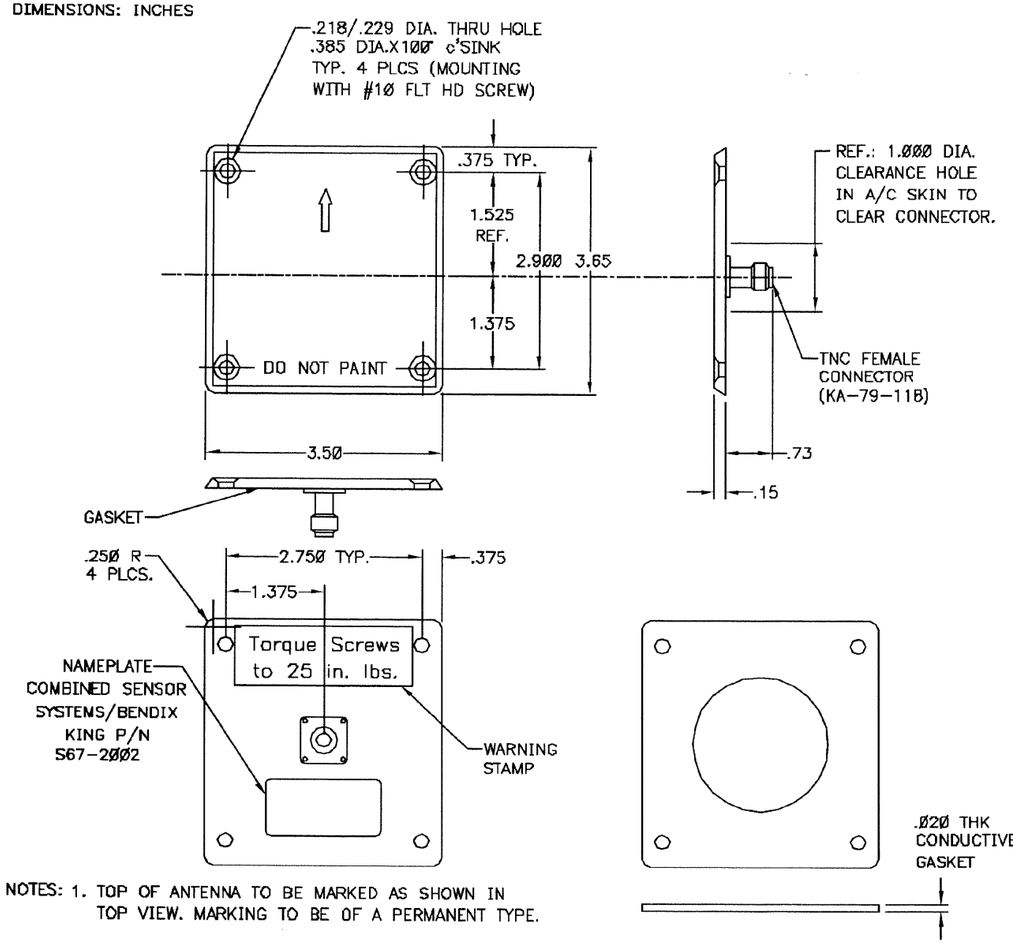


NOTES:
1. DIMENSIONS IN ( ) ARE IN CENTIMETERS.
2. WEIGHT: LBS. (KG)
3. —CAUTION—
   DO NOT USE BACK-UP PLATE AS A TEMPLATE
   USE TEMPLATE 057-2049-00 SUPPLIED IN THE
   INSTALLATION KIT — REMOVE AFTER USE —
4. GASKETS 187-1096-00(SUPPLIED) SHOULD BE USED
   IN EACH INSTALLATION.
5. BACK-UP PLATE, IF USED, SHOULD BE INSTALLED IN
   ACCORDANCE WITH ACCEPTED FAA STANDARDS.
6. SEE KRA 405 INSTALLATION MANUAL 006-0104-0X
   FOR COMPLETE ANTENNA MOUNTING INSTRUCTIONS.
7. DO NOT PAINT DIELECTRIC WINDOW.

Dwg 155-05167-0000 Rev 2

FIGURE 2-6 Dorne Margolin (Type DMPN 3-4/A) Antenna Outline and Mounting Drawing (Dwg No 155-05167-0000, Rev 2)

DIMENSIONS: INCHES



NOTES: 1. TOP OF ANTENNA TO BE MARKED AS SHOWN IN TOP VIEW. MARKING TO BE OF A PERMANENT TYPE.

Dwg 071-01501-0000 Rev AC

ELECTRICAL

FREQUENCY: 4200 to 4400 MHz.
VSWR: ≤2.0:1 4200 to 4400 MHz.
≤1.5:1 4275 to 4325 MHz.
IMPEDANCE: 50 OHM
POLARIZATION: LINEAR
BEAM WIDTH: ROLL PLANE 45° MIN (E)
PITCH PLANE 40° MIN. (H)
POWER HANDLING: 1 WATT (AVG)
10 WATT (PEAK)
SIDE LOBE LEVEL: -40 dB
GAIN: 9.5 dBi
LIGHTING PROTECTION: DC GROUNDED

MECHANICAL

WEIGHT: 3 Oz.
FINISH: SKYDROL RESISTANT EPOXY
ENAMEL COLOR GLOSS WHITE (-0000)
ENAMEL COLOR GLOSS BLACK (-0100)
BASE IRIDITE PER
MIL-C-5541B TYP. II
CONNECTOR: TNC FEMALE KA-79-118
MATERIAL: ALUM 6061-T6; TEFLON/ GLASS

ENVIRONMENTAL

OPERATING TEMPERATURE (REF.): -54°C to +85°C
STORAGE TEMPERATURE (REF.): -65°C to +85°C
ALTITUDE: -1,000 FT to 45,000 FT
VIBRATION: 10 G's
ENVIRONMENTAL CATEGORIES; DO-160A

FEDERAL AND MILITARY

FAA TSO C87 ARINC 707, 552°C
DESIGNED TO MIL-E-5400; MIL-E-5272C

ISOLATION H-PLANE

16° 80 dB
20° 88 dB
30° 90 dB
36° 95 dB

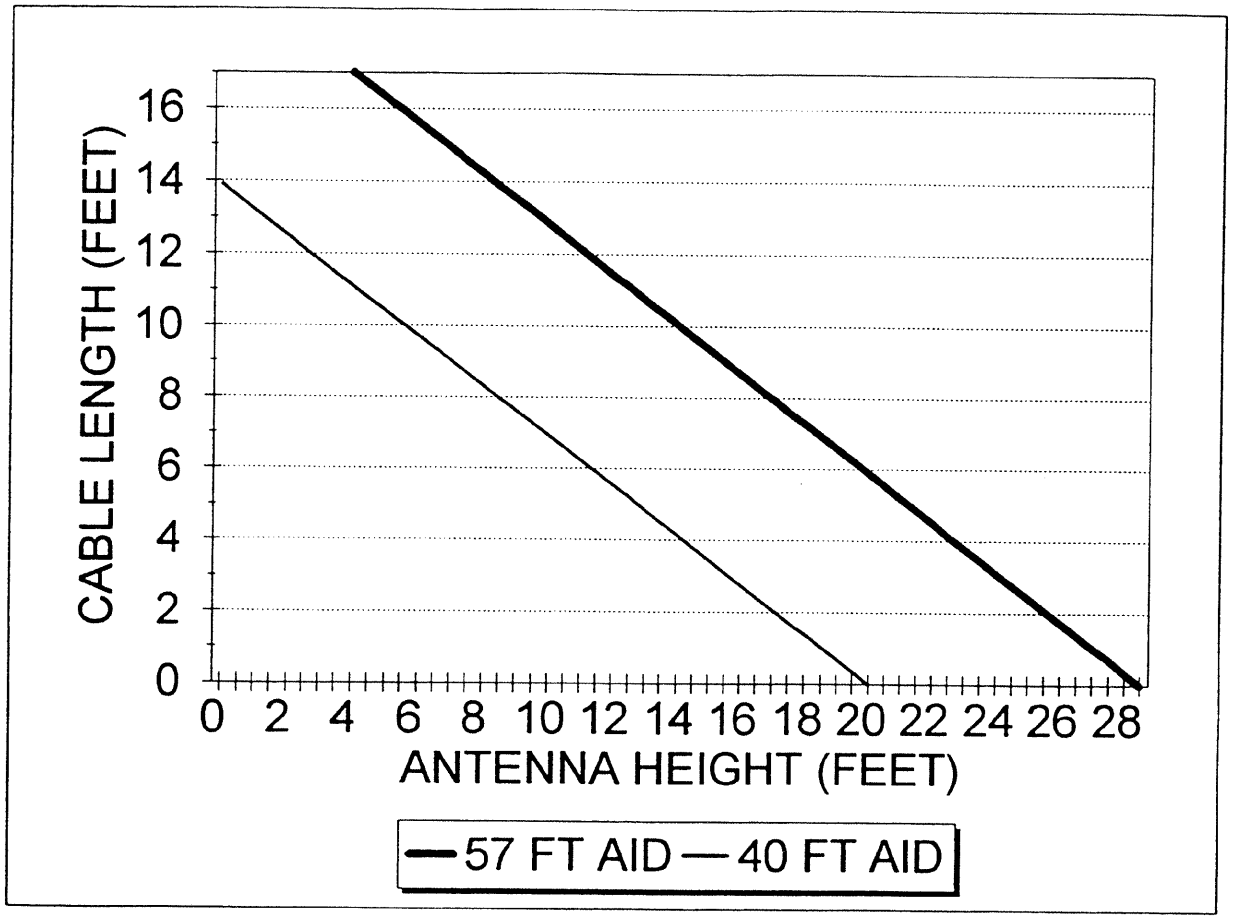
REFERENCE

HONEYWELL P/N 187-01753-0000 = VPN S67-200222
CONDUCTIVE GASKET .020 THK.

MS24693-C272 MOUTING SCREWS (4).

NOTES:
2. ELECTRICAL BOND BETWEEN A/C AND ANTENNA REQUIRED FOR BEST PERFORMANCE.
3. WHERE POSSIBLE REMOVE PAINT IN AREA BETWEEN SCREWS AND CONNECTOR OF AIRCRAFT SKIN.
4. VENDOR SERIAL NUMBER TAG MUST BE MARKED WITH THE FOLLOWING: TSO C87
5. PART WILL BE SUPPLIED WITH 4 MOUNTING SCREWS MS24693-C272 (#10 FLT HD SCREW) AND CONDUCTIVE GASKET AND INSTALLATION DRAWING.

FIGURE 2-7 KA 54A (Sensor Systems Type S67-2002) Antenna Outline and Mounting Drawing (Dwg No 071-01501-0000, Rev AC)

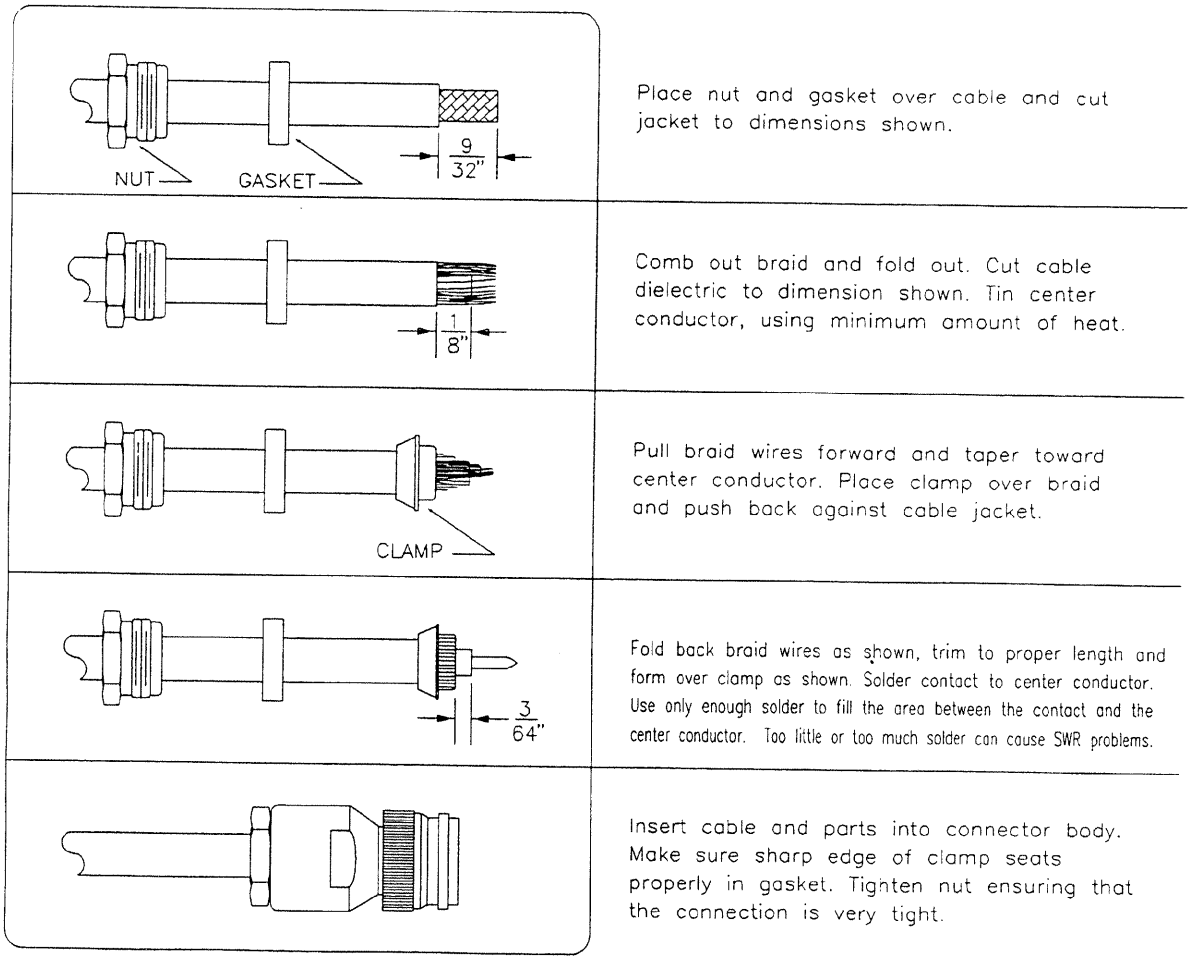


Notes:

1. Antenna height shown is the physical distance of the signal path from just one of the two antennas to ground with the aircraft in a touchdown configuration. This number is doubled in the formula when determining total cable length (XMT/RCV).
2. Cable length shown is for each cable when XMT and RCV cables of equal length are used, maximum length for one cable is 17.0 feet.
3. Cable length shown is the total of XMT and RCV cables. Total cable length cannot exceed 34.0 feet or 17.0 feet for each cable. Receive and transmit cables do not have to be of equal lengths.
4. Propagation Constant for cable types:

	Propagation Constant
RG 214	66%
RG 393	69.5%

FIGURE 2-8 Aircraft Installation Delay (AID) and Installation Cable Length Chart



Place nut and gasket over cable and cut jacket to dimensions shown.

Comb out braid and fold out. Cut cable dielectric to dimension shown. Tin center conductor, using minimum amount of heat.

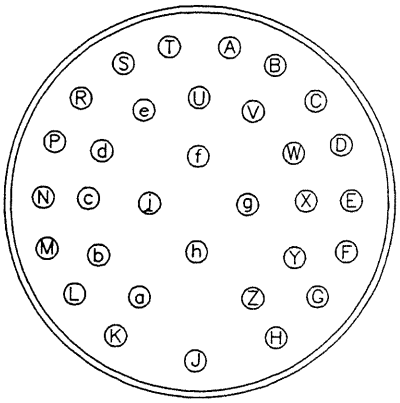
Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.

Fold back braid wires as shown, trim to proper length and form over clamp as shown. Solder contact to center conductor. Use only enough solder to fill the area between the contact and the center conductor. Too little or too much solder can cause SWR problems.

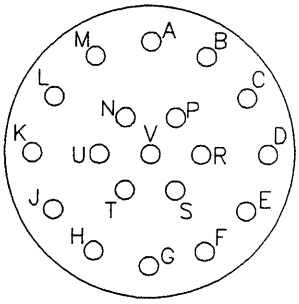
Insert cable and parts into connector body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut ensuring that the connection is very tight.

Note: Proper operation of a Radar Altimeter System depends upon the VSWR of the antenna cable. Therefore, extreme care must be exercised in assembling the TNC connector to the RG 393/U cable. Strict adherence to the above instructions will ensure a good VSWR of the antenna cables.

FIGURE 2-9 TNC Coax/ Connector Assembly (RG 393/U)
(P/N 030-00108-0004)



KRA 405 MATING CONNECTOR (P4051)
P/N 030-02211-0001



KRA 415/416 MATING CONNECTOR (P4151/P4161)
P/N 030-02210-0001

FIGURE 2-10 Connector Pin Locations

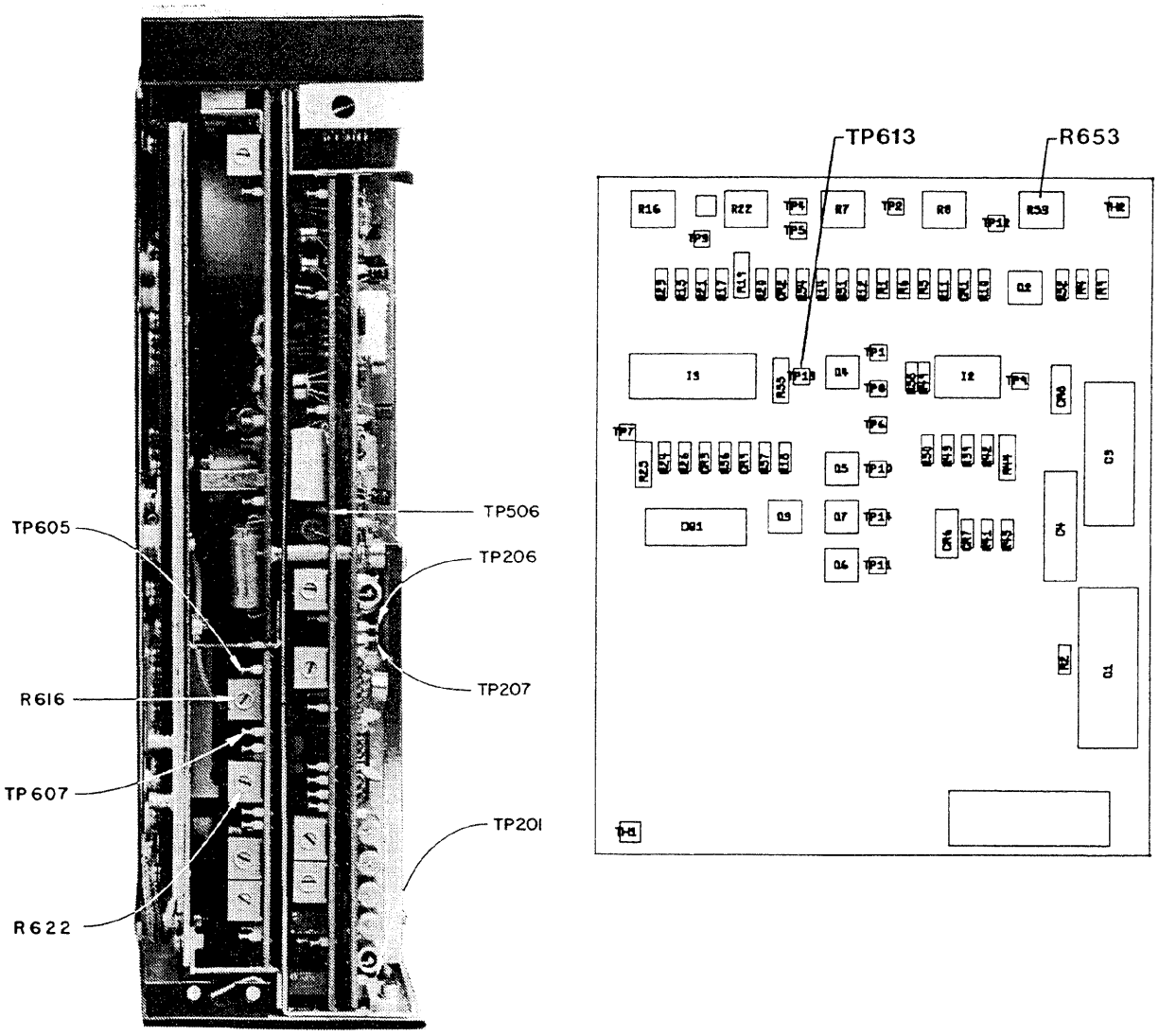
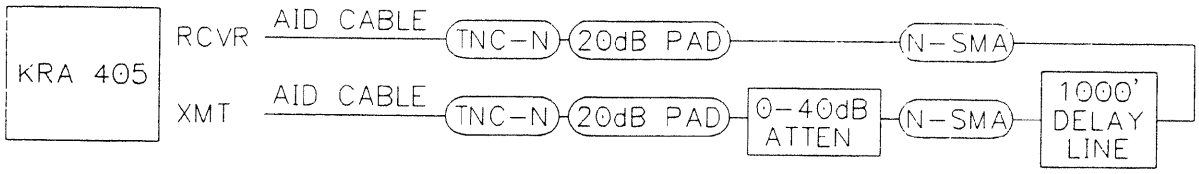
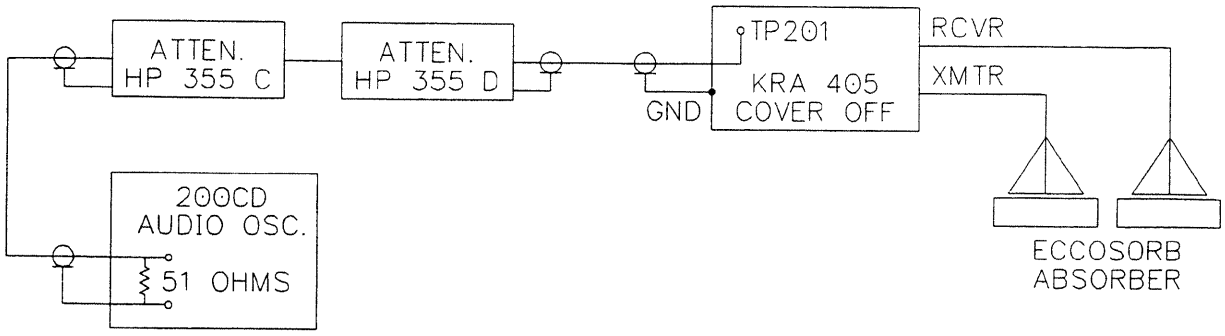


FIGURE 2-11 KRA 405 Altitude Trip Test Point and Adjustment Locations

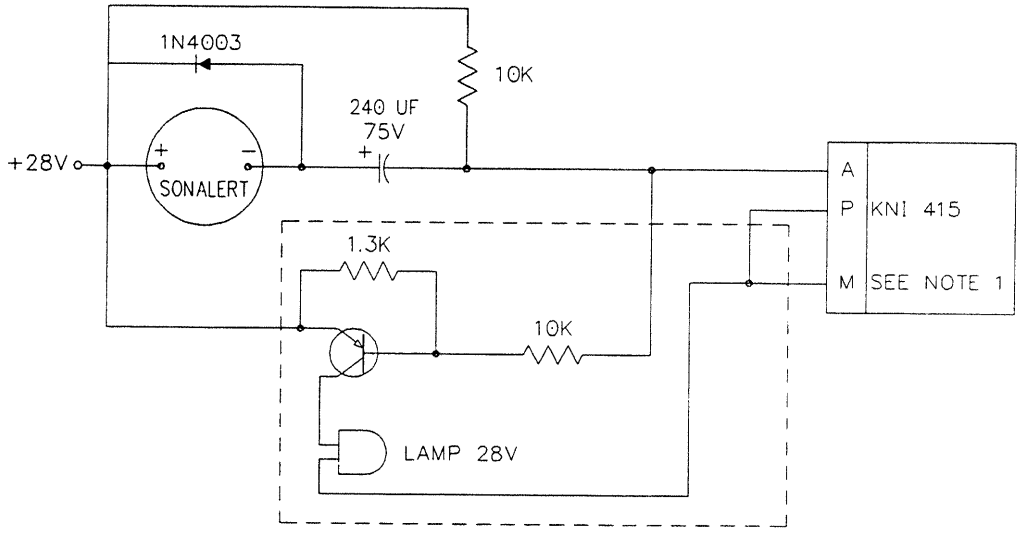


Test Method 1



Test Method 2

FIGURE 2-12 KRA 405 Test Equipment Setup



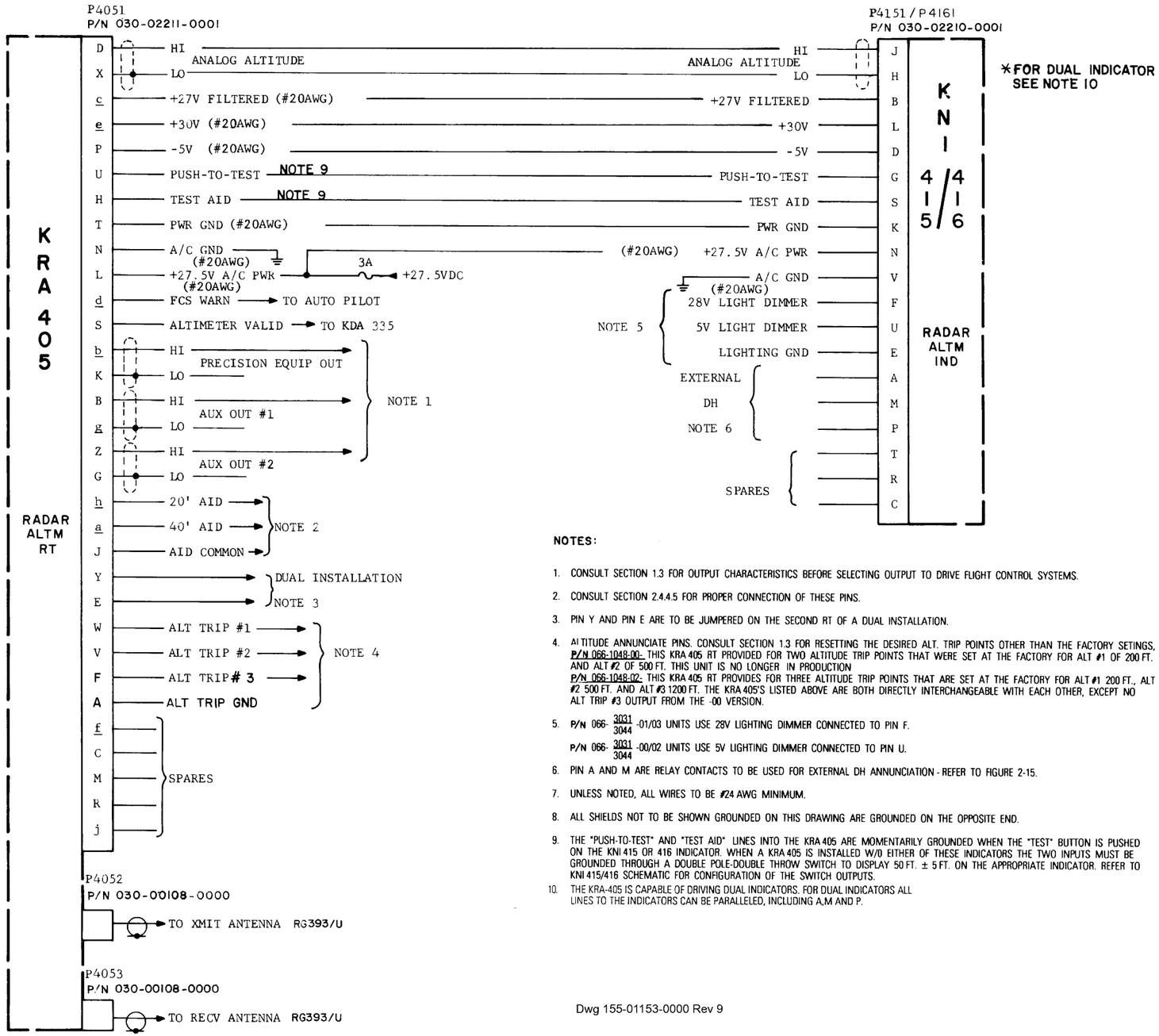
NOTE:

1. DH ENABLE RELAY "K201" (INTERNAL) OPENS GROUND TO PIN M ALLOWING LAMP TO EXTINGUISH 28V RELAY, 110 mA, 3W MAX.

PARTS LIST

PART NUMBER	DESCRIPTION
007-00161-0000	MPS A56 TRANSISTOR
007-06025-0000	DIODE 1N4003
038-00008-0000	SONALERT
096-05004-0006	CAP 240UF, 75V
131-00103-0023	RES. 10K QW 5%
131-00132-0023	RES. 1.3K QW 5%

FIGURE 2-13 External Sonalert w/ 15 Second DH Audio Fader



NOTES:

1. CONSULT SECTION 1.3 FOR OUTPUT CHARACTERISTICS BEFORE SELECTING OUTPUT TO DRIVE FLIGHT CONTROL SYSTEMS.
2. CONSULT SECTION 2.4.4.5 FOR PROPER CONNECTION OF THESE PINS.
3. PIN Y AND PIN E ARE TO BE JUMPERED ON THE SECOND RT OF A DUAL INSTALLATION.
4. ALTITUDE ANNUNCIATE PINS. CONSULT SECTION 1.3 FOR RESETTING THE DESIRED ALT. TRIP POINTS OTHER THAN THE FACTORY SETINGS.
   P/N 066-1048-00- THIS KRA 405 RT PROVIDED FOR TWO ALTITUDE TRIP POINTS THAT WERE SET AT THE FACTORY FOR ALT #1 OF 200 FT. AND ALT #2 OF 500 FT. THIS UNIT IS NO LONGER IN PRODUCTION
   P/N 066-1048-02- THIS KRA 405 RT PROVIDES FOR THREE ALTITUDE TRIP POINTS THAT ARE SET AT THE FACTORY FOR ALT #1 200 FT., ALT #2 500 FT. AND ALT #3 1200 FT. THE KRA 405'S LISTED ABOVE ARE BOTH DIRECTLY INTERCHANGEABLE WITH EACH OTHER, EXCEPT NO ALT TRIP #3 OUTPUT FROM THE -00 VERSION.
5. P/N 066-3031/3044 -01/03 UNITS USE 28V LIGHTING DIMMER CONNECTED TO PIN F.
   P/N 066-3031/3044 -00/02 UNITS USE 5V LIGHTING DIMMER CONNECTED TO PIN U.
6. PIN A AND M ARE RELAY CONTACTS TO BE USED FOR EXTERNAL DH ANNUNCIATION - REFER TO FIGURE 2-15.
7. UNLESS NOTED, ALL WIRES TO BE #24 AWG MINIMUM.
8. ALL SHIELDS NOT TO BE SHOWN GROUNDED ON THIS DRAWING ARE GROUNDED ON THE OPPOSITE END.
9. THE "PUSH-TO-TEST" AND "TEST AID" LINES INTO THE KRA 405 ARE MOMENTARILY GROUNDED WHEN THE "TEST" BUTTON IS PUSHED ON THE KNI 415 OR 416 INDICATOR. WHEN A KRA 405 IS INSTALLED W/0 EITHER OF THESE INDICATORS THE TWO INPUTS MUST BE GROUNDED THROUGH A DOUBLE POLE-DOUBLE THROW SWITCH TO DISPLAY 50 FT. ± 5 FT. ON THE APPROPRIATE INDICATOR. REFER TO KNI 415/416 SCHEMATIC FOR CONFIGURATION OF THE SWITCH OUTPUTS.
10. THE KRA-405 IS CAPABLE OF DRIVING DUAL INDICATORS. FOR DUAL INDICATORS ALL LINES TO THE INDICATORS CAN BE PARALLELED, INCLUDING A,M AND P.

Dwg 155-01153-0000 Rev 9

FIGURE 2-14 KRA 405 Radar Altimeter System Interconnect (Dwg No 155-01153-0000, Rev 9)

SECTION III
OPERATION

3.1 GENERAL

The KNI 415 and KNI 416 Radar Altimeter Indicators are shown in Figure 3-1 and 3-2 and are discussed below.

Altitude Scale: The KNI 415 scale gives accurate altitude indications from -20 to +2000 feet. From -20 to 500 feet each mark on the scale represents 10 feet. From 500 to 2000 feet, each mark represents 100 feet.

The KNI 416 scale gives accurate altitude indications from -10 to +2000 feet. From -10 to 200 feet each mark represents 5 feet, from 200 to 500 feet each mark represents 20 feet, and from 500 to 2000 feet each mark represents 100 feet.

Indicator Needle: The AGL altitude in feet is displayed beneath this needle. Needle will be clockwise behind mask when above 2000 feet.

Flag: Indicates invalid altitude information is being displayed or self test button is depressed.

Self Test Button: This button is used to test the Radar Altimeter R/T and indicator. When the button is depressed, the flag will come into view and 50 +/- 5 feet will be displayed.

DH Knob: This knob controls the DH (Decision Height) bug. By turning it clockwise, the DH bug will increase in altitude; counterclockwise, the bug will decrease in altitude.

DH Bug: Indicates altitude during an approach at which the DH lamp will light.

DH Lamp: This lamp lights when the Decision Height is reached. The lamp can be turned off by pushing the lamp in. The lamp can be turned on again, when below the decision height, by depressing the lamp a second time.

Once turned off, the DH lamp will be automatically armed upon climb out as the aircraft passes through the DH altitude. Pressing the self-test button will also turn on the DH lamp if the DH bug is set above 50 feet.

3.2 NORMAL OPERATION

3.2.1 PREFLIGHT

3.2.1.A Turn on primary aircraft power.

3.2.1.B Adjust the DH knob on the KNI 415, KNI 416 Radar Altimeter Indicator to set the DH but to 25 feet.

3.2.1.C Depress the TEST button. The indicated altitude should be 50 +/- 5 feet and the flag should come into view. The DH lamp should be out.

3.2.1.D With the TEST button depressed, slowly increase the DH bug until the DH lamp lights. The bug should be 50 +/- 5 feet. The lamp should be lit at all altitudes above 50 feet.

3.2.1.E Release the TEST switch. The warning flag should move out of view and the indicated altitude should be 0 feet, nominal.

3.2.2 TAXI

When taxiing to and from the ramp, the DH light is sometimes annoying. The light may be turned off by simply pressing the DH lamp. Once off, the lamp may be turned on again by pressing the DH lamp or pressing the TEST button, if the DH bug is set above 50 feet. Climbing past the decision height (indicated by the DH bug) arms the DH lamp so during the approach the lamp will light upon reaching the decision height.

3.2.3 IN FLIGHT OPERATION

At normal cruise altitudes above 2000 feet, the indicator pointer is behind the mask and the warning flag is hidden from view above 2,500 feet. A Flight Control System (FCS) warn is applied to the auto pilot or flight director system indicating that usable information is not available.

3.2.4 APPROACH

When the approach plates are reviewed prior to beginning the actual approach, the pilot should set the DH button to the decision height altitude, and check altimeter operation as follows:

3.2.4.A Depress the SELF TEST button and hold:

3.2.4.A.1 50 +/- 5 feet should be indicated.

3.2.4.A.2 The flag should come into view.

3.2.4.A.3 The DH lamp should light (if the DH setting is above 50 feet).

3.2.4.B Verify that the pointer comes on scale at 2000 feet AGL by using the barometric altitude as a reference.

3.2.4.C If the altimeter does not operate as specified above, refer to Emergency Operation, paragraph 3.3.

During the actual approach, the Radar Altimeter System provides altitude and altitude trip information to the flight control system. When the decision height is reached, the

DH lamp lights to alert the pilot that a decision is to be made. The DH lamp may then be turned off by pressing the lamp in.

3.3 EMERGENCY OPERATION

3.3.1 SELF TEST ERRORS

3.3.1.A If the altimeter does not indicate 50 +/- 5 feet when initiating self test, disregard to radar altimeter system.

3.3.1.B Should the flag not come into view but the indicated altitude is correct, the altimeter system may be used. Keep in mind that subsequent failures will not be indicated by the flag.

3.3.1.C Failure of the DH lamp to light during self test means the pilot must watch the indicator closely since the decision height will not be annunciated.

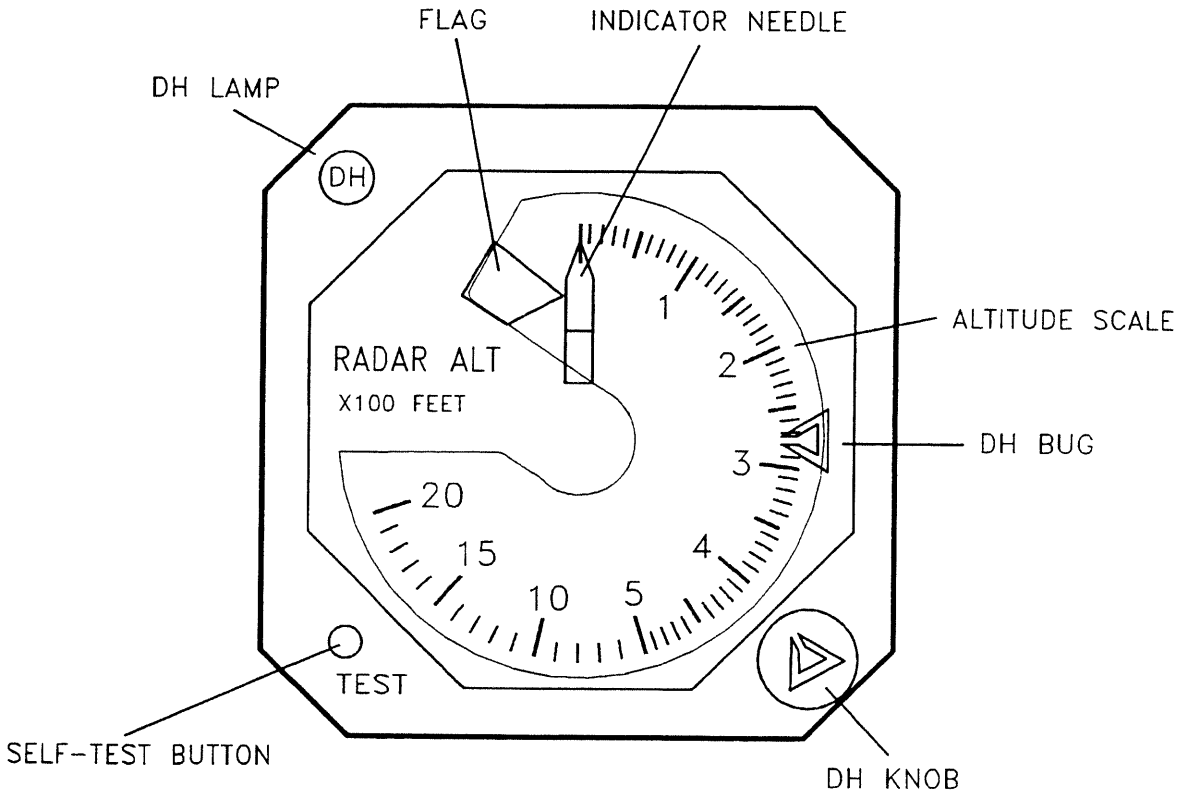


FIGURE 3-1 KNI 415 Control Functions

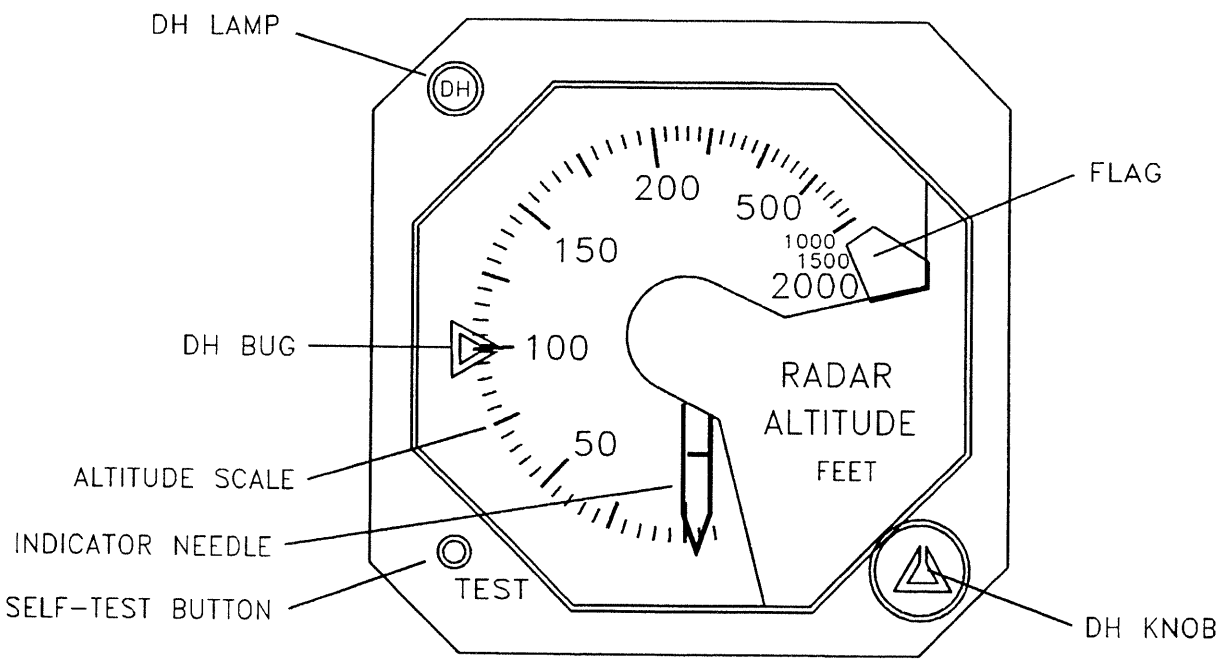


FIGURE 3-2 KNI 416 Control Functions

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