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21111 N. 19th Avenue
Phoenix, Arizona 85027-2708
U.S.A.
CAGE: 58960
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Installation Manual

KTR 2280B Multi-Mode Digital Radio

Part Number	CAGE
62005555-0101	58960

Draft

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TRANSMITTAL INFORMATION

THIS IS AN INITIAL RELEASE OF KTR 2280B MULTI-MODE DIGITAL RADIO PUBLICATION No. D202502004686
ISSUED FOR USE IN SUPPORT OF THE FOLLOWING:

Table TI-1 shows the applicable components.

Table TI-1. Applicable Components

Component PN	Nomenclature
62005555-0101	KTR 2280B Multi-Mode Digital Radio

Revision History

Table TI-2 shows the revision history of this SIM.

Table TI-2. Revision History

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RECORD OF REVISIONS

For each revision, write the revision number, revision date, date put in the manual, and your initials in the applicable column.

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RECORD OF TEMPORARY REVISIONS

Instructions on each page of a temporary revision tell you where to put the pages in your manual. Remove the temporary revision pages only when discard instructions are given. For each temporary revision, put the applicable data in the record columns on this page.

Definition of Status column: A TR may be active, incorporated, or deleted. "Active" is entered by the holder of the manual. "Incorporated" means a TR has been incorporated into the manual and includes the revision number of the manual when the TR was incorporated. "Deleted" means a TR has been replaced by another TR, a TR number will not be issued, or a TR has been deleted.

Temporary Revision Number	Status	Page Number	Issue Date	Date Put In Manual	By	Date Removed From Manual	By
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Refer to Table INTRO-3 for other applicable service information documents not listed in the Service Bulletin List.

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INTRODUCTION

1. How to Use This Manual

A. General

- (1) This publication gives maintenance instructions for the equipment shown on the Title page.
- (2) Standard maintenance procedures that technicians must know are not given in this manual.
- (3) This publication is written in agreement with the ATA Specification.
- (4) Warnings, cautions, and notes in this manual give the data that follows:
 - A WARNING gives a condition or tells personnel what part of an operation or maintenance procedure, which if not obeyed, can cause injury or death.
 - A CAUTION gives a condition or tells personnel what part of an operation or maintenance procedure, which if not obeyed, can cause damage to the equipment.
 - A NOTE gives data, not commands. The NOTE helps personnel when they do the related instruction.
- (5) Warnings and cautions go before the applicable paragraph or step. Notes follow the applicable paragraph or step.

B. Observance of Manual Instructions

- (1) Make sure that you carefully obey all safety, quality, operation, and shop procedures for the unit.
- (2) All personnel who operate equipment and do maintenance specified in this manual must know and obey the safety precautions.

C. Symbols

- (1) The symbols and special characters are in agreement with IEEE Publication 260 and IEC Publication 27. Special characters in text are spelled out.
- (2) The signal mnemonics, unit control designators, and test designators are shown in capital letters.
- (3) The signal names followed by an "*" show an active low signal.
- (4) Some figures in this manual incorporate standard geometric characteristic symbols. Refer to Figure INTRO-1 for the geometric characteristic symbols.

CHARACTERISTIC SYMBOLS

	FLATNESS		PERPENDICULARITY
	STRAIGHTNESS		PARALLELISM
	CIRCULARITY		ANGULARITY
	CYLINDRICITY		CIRCULAR RUN OUT
	PROFILE OF A SURFACE		POSITION
	PROFILE OF A LINE		SYMMETRY
	CONCENTRICITY		

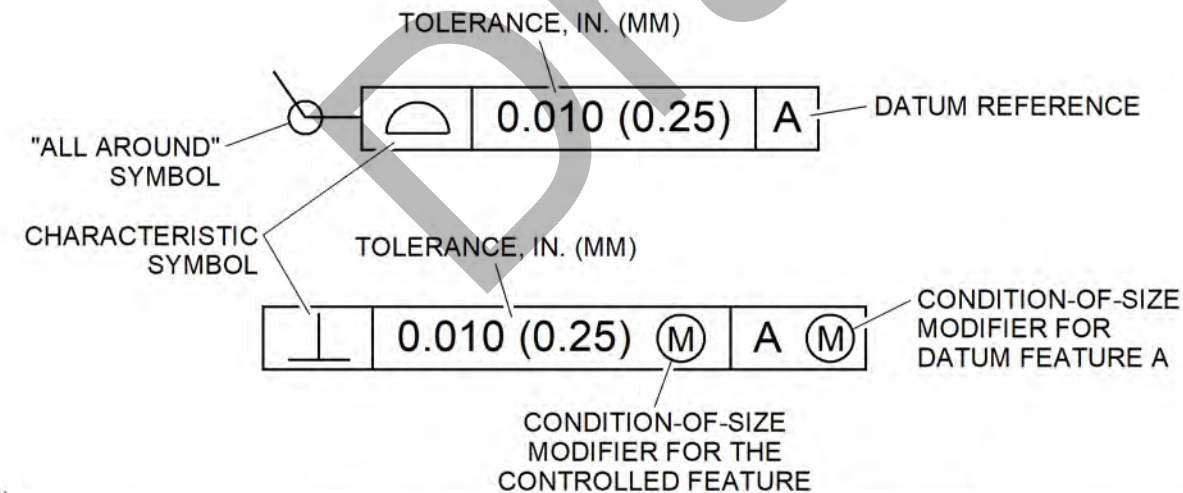
MODIFYING SYMBOLS

- (M) MAXIMUM MATERIAL CONDITION (MMC)
- (S) REGARDLESS OF FEATURE SIZE (RFS)
- (P) PROJECTED TOLERANCE ZONE

OTHER SYMBOLS

- DIAMETER
- NEGATIVE NOTATION

FEATURE CONTROL FRAME



EXCEPT WHEN THE DATUM(S) OR CONTROLLED FEATURE IS A PLANE SURFACE, A MODIFIER IS REQUIRED PER GENERAL RULE 1 OR MAY BE USED TO ALTER GENERAL RULE 2

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Figure INTRO-1. (Sheet 1 of 2) Geometric Tolerance Symbols

GENERAL RULES

1. POSITION (Φ) TOLERANCES AND THEIR RELATED DATUMS APPLY AT MMC OR RFS AS SPECIFIED IN THE FEATURE CONTROL FRAME.
2. EXCEPT FOR POSITION (Φ), ALL TOLERANCES AND THEIR RELATED DATUMS APPLY RFS UNLESS OTHERWISE SPECIFIED.
3. ALL GEOMETRIC TOLERANCES ARE SPECIFIED AS TOTAL VALUES (TOTAL DIAMETER, TOTAL THICKNESS, TOTAL WIDTH, OR TOTAL ON RADIUS).
4. WHEN TWO DATUM FEATURES ARE REFERENCED IN HYPHENATED FORM, $\boxed{A-B}$, A SINGLE DATUM IS ESTABLISHED BY THE TWO FEATURES.
5. WHEN TWO OR THREE DATUMS ARE REFERENCED IN SUCCEEDING FRAMES, $\boxed{A} \boxed{B} \boxed{C}$, THE ORDER OF PRECEDENCE IS LEFT TO RIGHT.

SAMPLE INTERPRETATIONS

$\boxed{-A-}$ THIS IS DATUM FEATURE A WHICH IS USED TO CREATE DATUM A IN THE PROCESSING EQUIPMENT.

$\boxed{\parallel} \boxed{0.010 (0.25)}$ THIS SURFACE MUST BE FLAT WITHIN 0.010 IN. (0.25 MM) TOTAL (MEETING EITHER SYSTEM WILL ACCEPT THE PART).

$\boxed{\parallel} \boxed{0.010 (0.25)} \boxed{B}$ THIS IS DATUM FEATURE C AND, RFS MUST BE PARALLEL TO DATUM B, RFS, WITHIN 0.010 IN. (0.25 MM) TOTAL.

$\boxed{\nearrow} \boxed{0.0005 (0.013)} \boxed{A-B}$ EACH CIRCULAR ELEMENT OF THIS FEATURE, RFS, MUST NOT RUN OUT MORE THAN 0.0005 IN. (0.013 MM) FIM, WITH RESPECT TO THE DATUM ESTABLISHED BY FEATURES A AND B, BOTH RFS.

$\boxed{\Phi} \boxed{\varnothing 0.010 (0.25)} \boxed{M} \boxed{A} \boxed{B} \boxed{M} \boxed{C} \boxed{M}$ THE AXIS OF THIS FEATURE, WHEN THIS FEATURE IS AT MMC, MUST BE LOCATED WITHIN 0.010 IN. (0.25 MM) DIAMETER OF THE TRUE (BASIC) LOCATION ESTABLISHED IN RELATION TO THE PRIMARY SURFACE DATUM A, SECONDARY DATUM B AT MMC, AND TERTIARY DATUM C AT MMC.

$\boxed{\perp} \boxed{\varnothing 0.010 (0.25)} \boxed{M} \boxed{A}$ THE AXIS OF THIS FEATURE, WHEN THIS FEATURE IS AT MMC, MUST BE PERPENDICULAR TO DATUM A, RFS, WITHIN A 0.010 IN. (0.25 MM) DIAMETER TOLERANCE ZONE PROJECTED 0.500 IN. (12.7 MM) ABOVE THE SURFACE.

$\boxed{\angle} \boxed{\parallel}$ THE ANGULAR ORIENTATION OF THIS FEATURE NEED NOT BE CONTROLLED WITH RESPECT TO ANY OTHER FEATURE.

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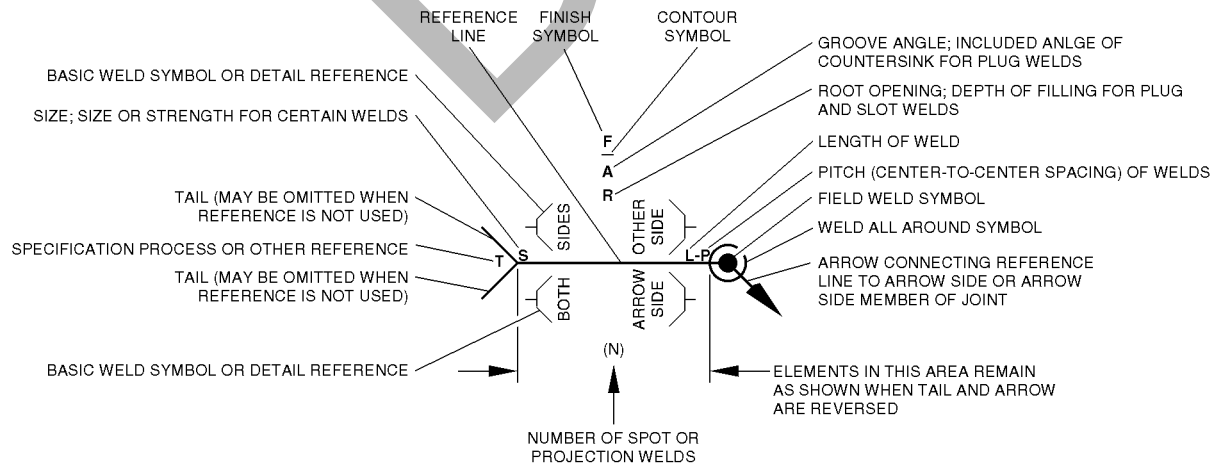
Figure INTRO-1. (Sheet 2 of 2) Geometric Tolerance Symbols

- (5) Some figures in this manual incorporate standard weld symbols. Refer to Figure INTRO-2 for the weld symbols.

BASIC WELD SYMBOLS AND THEIR LOCATION SIGNIFICANCE								
LOCATION SIGNIFICANCE	FILLET	PLUG OR SLOT	SPOT OR PROJECTION	SEAM	BACK OR BACKING	SURFACING	FLANGE	
							EDGE	CORNER
ARROW SIDE								
OTHER SIDE								
BOTH SIDES		NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
NO ARROW SIDE OR OTHER SIDE SIGNIFICANCE	NOT USED	NOT USED			NOT USED		NOT USED	NOT USED

BASIC WELD SYMBOLS AND THEIR LOCATION SIGNIFICANCE							
LOCATION SIGNIFICANCE	GROOVE (FLASH OR UPSET)						
	SQUARE	V	BEVEL	U	J	FLARE V	FLARE BEVEL
ARROW SIDE							
OTHER SIDE							
BOTH SIDES							
NO ARROW SIDE OR OTHER SIDE SIGNIFICANCE	NOT USED EXCEPT FOR FLASH OR UPSET WELDS	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED

SUPPLEMENTARY SYMBOLS					
WELD ALL AROUND	FIELD WELD	MELT-THRU	CONTOUR		
			FLUSH	CONVEX	CONCAVE



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Figure INTRO-2. Weld Symbols

(6) The symbols in Figure INTRO-3 show ESDS and moisture sensitive devices.

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ESDS



MOISTURE SENSITIVE

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Figure INTRO-3. Symbols

D. Units of Measure

- (1) Measurements, weights, temperatures, dimensions, and other values are expressed in the USMS followed by the appropriate SI metric units in parentheses. Some standard tools or parts such as drills, taps, bolts, nuts, etc. do not have an equivalent.

E. Page Number Block Explanation

- (1) The data in this manual is divided into sections. A standard page number block system is used. Page number blocks are shown in Table INTRO-1.

Table INTRO-1. Page Number Blocks

Section	Page Number Block
Section 1- General Information	1-1 thru 1-999
Section 2- Installation	2-1 thru 2-999
Section 3- Operation	3-1 thru 3-999

F. Electrostatic Discharge

- (1) Touch the items susceptible to electrostatic discharge in accordance with MIL-HDBK-263. Refer to MIL-STD-1686 for definition of the standards and conditions.

2. Customer Support

A. Honeywell Aerospace Online Technical Publications Website

- (1) Go to the Honeywell Online Technical Publications Website at <https://aerospace.honeywell.com/us/en/support-and-resources/contact-us>.
 - To download or see publications online
 - To order a publication
 - To tell Honeywell of a possible data error in a publication.

B. Honeywell Aerospace Contact Team

- (1) If you do not have access to the Honeywell Technical Publications Website, or if you need to speak to personnel about non-Technical Publication matters, the Honeywell Aerospace Contact Team gives 24/7 customer service to Air Transport & Regional, Business & General Aviation, and Defense & Space customers around the globe.

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3. References

A. Honeywell/Vendor Publications

- (1) ATA No. 20-00-03 (Pub. No. A09-1100-004), Standard Repair Procedures for Honeywell Avionics Equipment Instruction Manual.

B. Other Publications

- (1) These publications are standard references. Check for latest version of publication.
 - The United States GPO Style Manual (available at <http://www.gpo.gov/fdsys/pkg/GPOSTYLEMANUAL-2008/content-detail.html>)
 - IEEE Std 260.1, Standard Letter Symbols for Units of Measurement (available from the American National Standards Institute at <http://www.ansi.org>)
 - ASME Y14.38, Abbreviations for Use on Drawings and Related Documents (available from the American National Standards Institute at <http://www.ansi.org>)
 - ASME Y14.5, Dimensioning and Tolerancing (available from the American National Standards Institute at <http://www.ansi.org>)
 - ANSI/IEEE Std 91, Graphic Symbols for Logic Functions (available from the American National Standards Institute at <http://www.ansi.org>)
 - CAGE codes and manufacturer's addresses are available at <https://cage.dla.mil>.
 - IEEE 315/ANSI Y32.2, Graphic Symbols for Electrical and Electronics Diagrams (available from the American National Standards Institute at <http://www.ansi.org>)
 - MIL-HDBK-263, Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric) (available from any military standards database)
 - MIL-STD-1686, Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric) (available from any military standards database).

4. Acronyms and Abbreviations

A. General

- (1) The abbreviations are used in agreement with ASME Y14.38.
- (2) Acronyms and non-standard abbreviations used in this publication are as follows:

Table INTRO-2. List of Acronyms and Abbreviations

Term	Full Term
ACARS	Aircraft Communications Addressing and Reporting System
ADF	Automatic Direction Finder
AM	Amplitude Modulation
ANT	Antenna
AOA	Angle Of Attack
APM	Aircraft Personality Module
ARINC	Aeronautical Radio, Incorporated

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Table INTRO-2. List of Acronyms and Abbreviations (Cont)

Term	Full Term
ASME	American Society of Mechanical Engineers
ATA	Air Transport Association
ATN	Aeronautical Telecommunication Network
AWG	American Wire Gauge
BFO	Beat Frequency Oscillator
BIT	Built-in Test
CAGE	Commercial and Government Entity
CFR	Code of Federal Regulations
CMC	Central Maintenance Computer
CMF	Communications Management Function
COM	Communication
CPDLC	Controller/Pilot Data Link Communications
DEG	Degree
DME	Distance Measuring Equipment
EB	Engineering Bulletin
ELT	Emergency Locator Transmitter
ESDS	Electrostatic Discharge Sensitive
ETSO	European Technical Standard Order
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FMS	Flight Management System
GBAS	Ground Based Augmentation System
GLS	GBAS Landing System
GMT	Greenwich Mean Time
GND	Ground
GPO	Government Publishing Office
GPS	Global Positioning System
GS	Glidescope
Hz	Hertz
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IRS	Inertial Reference System
KTR	King Transceiver Radio

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Table INTRO-2. List of Acronyms and Abbreviations (Cont)

Term	Full Term
Kts.	knots
LOC	localizer
LPV	Localizer Performance with Vertical Guidance
LRU	Line Replaceable Unit
MHz	Megahertz
MIC	Microphone
MMDR	Multi-Mode Digital Receiver
NAV	Navigation
NDB	Non-Directional Beacon
No.	Number
PCF	Platform Configuration File
PN	part number
POA	Plain Old Aircraft communications addressing and reporting system
PRAIM	Predictive Receiver Autonomous Integrity Monitor
PTT	Push-To-Talk
PVT	Position, Velocity, and Time
PWR	Power
RAIM	Receiver Autonomous Integrity Monitor
RF	Radio Frequency
RTCA	Radio Technical Commission for Aeronautics
RX	Receiver
Rev	Revision
SBAS	Satellite Based Augmentation System
SI	International System of Units
STC	Supplemental Type Certificate
TR	temporary revision
TSO	Technical Standard Order
TX	Transmitter
USMS	United States Measurement System
UTC	Universal Time Coordinated
VDC	Volt Direct Current
VHF	Very High Frequency
VOR	Very High Frequency Omnidirectional Range

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Table INTRO-2. List of Acronyms and Abbreviations (Cont)

Term	Full Term
VSWR	Voltage Standing Wave Ratio
dB	Decibel
dBm	Decibel (Referenced to One Milliwatt)
kHz	Kilohertz
mA	Milliampere

5. Service Information Documents

A. **Applicable Service Information Documents**

- (1) Refer to Table INTRO-3 for other applicable service information documents not listed in the Service Bulletin List.

Table INTRO-3. Applicable Service Information

Document Type	Document Number/ Revision Number	Title	Date Put In Manual
Not applicable	Not applicable	Not applicable	Not applicable

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SECTION 1 – GENERAL INFORMATION

1. Introduction

- A. This manual contains information relative to the physical, mechanical, and electrical characteristics of the Honeywell KTR 2280B MMDR. Installation and check out procedures are also included. Information relative to the maintenance, alignment, and procurement of the replacement parts may be found in this KTR 2280B CMM, Publication No. D202502004686. Final design of the installation and airworthiness approval is incumbent upon the installer and their respective certification authority.

2. Equipment Description

- A. The MMDR is designed with Ethernet and ARINC-429 interfaces which are intended for usage in the aircraft to communicate with other systems. ARINC-429 interface is redundant to Ethernet interface and it will be used to interface to other systems where Ethernet bus is not supported and to interface to the systems where timing is critical to meet the requirements. ARINC-429 interface alone can be used without Ethernet based on the Aircraft architecture. It is also designed with RS-422 and RS-232 that will be used primarily for development and testing.
- B. The MMDR supports both the Honeywell proprietary MAC (Microphone, Audio and Control bus) digital audio bus and analog audio outputs. Analog audio outputs are provided as a redundant to digital audio, they can be used in addition to digital audio outputs to meet the safety requirements. Analog outputs alone can be used without digital audio based on the aircraft platform architecture. Time mark signals from GNSS are connected to external systems to indicate the time of applicability of measurements. Discrete inputs/outputs are also supported to meet the pilot interface, identify the unit position and test requirements.
- C. The eight receivers and their modes of operation are as follows. The NAV receiver operates in one of 3 modes as dynamically controlled by the system interface. These three modes are VOR, LOC, and VDB. The GS receiver operates in the Glideslope mode only. The ADF operates in the direction finding and AM modes. There are three COM receivers. The first COM is a traditional AM mode receiver with either 25 or 8.33 kHz channel spacing. The second AM COM receiver functions as a Guard Channel receiver with either 25 or 8.33 kHz channel spacing. The third COM receiver is capable of receiving either VDL Mode 2 (D8PSK) or VDL Mode A (MSK) signals. The COM transmitter is capable of AM, VDL Mode 2, or VDL Mode A modes. The MB receiver operates in the Marker Beacon mode only. The GNSS receiver operates in Navigation, SBAS or GBAS modes based on the mode selection and availability of the augmentation data.
- D. The KTR 2280B contains BIT so that the operational health of the unit is constantly monitored. When a critical fault is detected, the unit notifies the host system. The unit stores detected failures in non-volatile memory for later review. The unit also has a temperature sensor and a timer so that faults can be time stamped and temperature data can be collected and stored.

3. Technical Characteristics

A. KTR 2280B Technical Characteristics

Table 1-1. KTR 2280B Technical Characteristics

Functionality	TSO, ETSO Standard	RTCA, EUROCAE Standard
COM Transmitter	TSO-C169a, ETSO-2C169a	DO-186B & ED-23C for Transmitter Classes 3 & 5
COM Receive	TSO-C169a, ETSO-2C169a	DO-186B for Receiver Classes C, D, E & ED-23C for Receiver Classes C, D, E & H2

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Table 1-1. KTR 2280B Technical Characteristics (Cont)

Functionality	TSO, ETSO Standard	RTCA, EUROCAE Standard
VDL Mode 2	TSO-C160a	DO-281C & ED-92C for Class YF7
VOR	TSO-C40c, ETSO-2C40c	DO-196 & ED-22B
Localizer	TSO-C36e, ETSO-2C36f	DO-195 for Receiver Class B & ED-46B for Automatic Landing
VDB	TSO-C162b	DO-253D Change 1 Class A
Glideslope	TSO-C34e, ETSO-2C34f	DO-192 & ED-47B
ADF	TSO-C41d, ETSO-2C41d	DO-179 for Receiver Class A & ED-51
Stuck Microphone	TSO-C128a, ETSO-2C128	DO-207 & ED-67
Marker Beacon	TSO-C35d, ETSO-2C35d	DO-143 Class A & EUROCAE 1/WG7/70
GPS/SBAS (LPV)	TSO-C145e/C146e	DO-229E Beta-3/Delta-4
GPS/GBAS (GLS)	TSO-C161b	DO-253D Change 1 GAEC C
ARINC Mode A Data Transceiver	Non-TSO Function	A618/A750

B. KTR 2280B Environmental Requirements

Table 1-2. KTR 2280B Environmental Requirements

DO-160G and ED-14G Section	Title	Category	Description
4	Temperature and Altitude	A1F1	
4.5.1	Ground Survival Low Short Term Operating Low		-67°F (-55°C) -40°F (-40°C)
4.5.2	Operating Low Temp ⁽¹⁾		-40°F (-40°C)
4.5.3	Ground Survival High Short Term Operating High		185°F (85°C) 158°F (70°C)
4.5.4	Operating High Temp ⁽²⁾		158°F (70°C)
4.5.5	In-Flight Loss of Cooling	X	Not Required
4.6.1	Altitude Test	A1/F2	Altitude 55,000ft for fixed wing, 15,000ft for helicopter
4.6.2	Decompression Test	A2	4kft to 55kft
4.6.3	Overpressure Test	A2	1800mbar
5	Temperature Variation	B	5 deg/ minute
6	Humidity	C	
7	Shock and Crash Safety	B	

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Table 1-2. KTR 2280B Environmental Requirements (Cont)

DO-160G and ED-14G Section	Title	Category	Description
8	Vibration	Fixed S	Curve C & M Fan Blade Off (FBO) Vibration Test Ram Air Turbine (RAT) Vibration Test
		Helicopter U2	Curve F, F1
		HR	High level short duration for engine failures
			Ram Air Turbine (RAT)
9	Explosion Atmosphere	H	
10	Waterproofness	W	
11	Fluids Susceptibility	F	
12	Sand and Dust	D	
13	Fungus Resistance	F	
14	Salt Spray	S	
15	Magnetic Effect	Z	<.3 m
16	Power Input Essential/ Critical ⁽³⁾	ZXI	Momentary power interruptions (DC) tested to >50ms with radio reset allowed. Momentary power interruptions (DC) tested to <=50ms with no radio reset allowed. Emergency voltage will be 16.0 V instead of 18.0 V.
17	Voltage Spike (Essential/ Critical)	A	
18	Audio Frequency Conducted Susceptibility- Power Inputs	Z	
19	Induced Signal Susceptibility	CCX	
20	Radio Frequency Susceptibility	RR	20 V/M
21	Emission of Radio Frequency Energy	M	
22	Lightning Induced Transient Susceptibility	B2K2L2 and A3J3L3	
23	Lightning Direct Effects	X	Not Required
24	Icing	X	Not Required

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Table 1-2. KTR 2280B Environmental Requirements (Cont)

DO-160G and ED-14G Section	Title	Category	Description
25	Electrostatic Discharge (ESD)	A	
26	Flammability	C	

NOTES:

- (1) To meet Canadian airworthiness standards, Operating Low Temperature test will be performed for -40°F (-40°C) instead of A1F1 (A1's 5°F (-15°C) or F1's -4°F (-20°C)).
- (2) To meet product specific requirement, Operating High Temperature test will be performed for 158°F (70°C) instead of A1F1 (A1's 131°F (55°C) or F1's 131°F (55°C)).
- (3) The passing criterion is to return to pre-interruption operating condition and continue to operate normally after aircraft power is restored. Another pass criterion is to perform normally during any interrupt of duration less than or equal to 50 ms. The emergency voltage will be 16.0 V instead of 18.0 V. The KTR 2280B is not required to operate during Engine Starting Under Voltage Operation but will return to normal operation when nominal operating voltage is reapplied.

4. KTR 2280B Power Requirements

Receive (Nominal)	22 Watt (0.8 A at 27.5 V)
Receive (Nominal) W/10% Transmit	35 Watt (1.27 A at 27.5 V) - Average
Receive (Nominal) W/100% Transmit	150 Watt (5.45 A at 27.5 V)
Receive (Maximum)	28 Watt (1.02 A at 27.5 V)
Receive (Maximum) W/10% Transmit	45 Watt (1.64 A at 27.5 V) - Average
Receive (Maximum) W/100% Transmit	180 Watt (6.55 A at 27.5 V)
Power Input	16 to 33VDC (Nominal Voltage 27.5 VDC)

NOTE: 100% transmit is specified for short-term operation only

5. Licensing Requirements

- A. The KTR 2280B MMDR meets CFR Title 47, Part 2, 15 and 87 (FCC Approvals) for all radio equipment. For non-US registered aircraft, follow applicable licensing requirements as required.
- B. This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:
 - This device cannot cause interference.
 - This device must accept any interference, including interference that can cause undesired operation of the device.

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SECTION 2 – INSTALLATION

1. General Information

- A. This section contains general suggestions and information to consider before installation of the KTR 2280B. Close adherence to these suggestions will assure optimum performance from the equipment.

NOTE: The conditions and test required for the TSO/ETSO approval of this article are minimum performance standards. Those installing this article, on or within a specific type or class of aircraft, are responsible for determining that the aircraft installation conditions are suitable for the TSO/ETSO article. TSO/ETSO articles must have separate approval for installation in an aircraft. The article can be installed only if performed under article 14 CFR part 43 or the applicable airworthiness requirements.

NOTE: Per AC 23.1309-1E, the probability of total loss of navigation and communication (a Hazardous failure) must be less than $1E-7$ (Part 23 Class III or Class IV) per flight hour and only dual installation of KTR 2280B can support this probability requirement without the installation of additional navigation or communication equipment. Additionally, other installation considerations must be analyzed (e.g. electrical wiring and interconnect, power distribution, RF cabling and antennas) to determine the acceptability.

2. Equipment Installation

A. Avionics Cooling Requirements

- (1) The unit is cooled by a fan internal to the unit. During installation, do not block any holes in the unit cover(s) which would restrict air flow.

B. Equipment Location

- (1) The following paragraphs contain information pertaining to the initial installation of the KTR 2280B MMDR, including instructions concerning the location and mounting of the supporting antenna(s).
- (2) The equipment must be installed in the aircraft in a manner consistent with acceptable workmanship and engineering practices and in accordance with the instructions set forth in this publication. To ensure that the system has been properly and safely installed in the aircraft, the installer make a thorough visual inspection and conduct an overall operational check of the system on the ground prior to flight.
- (3) The installation must be in accordance with standards established by the customer's installing agency and existing conditions as to unit location and type of installation; however, the following must be considered before installing the system in order to assure a more satisfactory performance from the equipment.

NOTE: The TSO identifies the minimum performance standards, tests, and other conditions applicable for issuance of design and production approval of the article. The TSO applicant is responsible for documenting all limitations and conditions suitable for installation of the article. An applicant requesting approval for installation of the article within a specific type or class of product is responsible for determining environmental and functional compatibility.

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- (4) Care must be exercised to avoid mounting components near equipment operating with high pulse current or high rf power outputs such as radar and satellite communications equipment. In general, the equipment must be installed in a location convenient for operation, inspection, and maintenance, and in an area consistent with the TSO environmental limits. Determine the mounting location for system components following the guidelines below
- (5) Mounting Tray Location(s)
- (a) The KTR 2280B MMDR mounting tray can be installed in any convenient location. KTR 2280B MMDR can be installed with the two mounting options (Tray mount or Bracket Mount) based on the accessibility for the installation and maintenance. Refer to paragraph 2.C for details. Installer can choose the mounting method and place an order for the corresponding installation kit.
- (6) Antenna(s)
- (a) The antenna(s) must be well removed from other antenna projections, the engine(s), and propeller(s). It must also be well removed from landing gear doors, access doors, or other openings which will break the ground plane for the antenna(s). On metal skinned aircraft, the antenna(s) must be bonded to the surface of the aircraft in a fore to aft location that provides the flattest ground plane. On composite aircraft, the antenna(s) must be located at the center of a conductive ground plane, contoured to the shape of the aircraft, having dimensions of at least 2 feet by 2 feet. The antenna penetration must be designed such that the structural integrity of the fuselage is not compromised. The antenna(s) need to be within 5 degrees of the centerline.
- (b) When installing the system antennas, the mounting area should supply a solid mechanical base for the antenna, as well as clearance for the connector. A doubler plate is usually necessary when the antenna is mounted on an unsupported large skin area. Refer to the aircraft manufacturer's specifications; reinforcements for antennas are often built in. Doubler plates or shims, if used, must be metallic and shaped to interface the antenna base to the aircraft contour. All antenna installations should be in accordance with manufacturer installation instructions.
- (c) Where practical, plan the antenna location(s) to keep cable lengths as short as possible and avoid sharp bends in the cable to minimize the VSWR. Avoid running other cables or wires near the antenna cable(s).
- (d) On pressurized aircraft, the antenna(s) must be sealed using an approved sealant, such as RTV No. 3145 (016-01082-0000) or equivalent, around the connector and mounting hardware.
- (e) The antenna edge and mounting hardware recesses must be sealed from the outside for moisture protection using RTV or equivalent.
- (f) Mount the antenna(s) in as clean an environment as possible, away from exhaust gases and oils. The antenna(s) must be kept clean. If left dirty (oil covered), the antenna performance can be affected.
- (g) The antennas should be TSO approved for their intended operation and not supplied with the KTR 2280B MMDR. 50-ohm coaxial antenna interfaces are provided on the front panel for the following installer supplied antennas:

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- VHF communications antenna (for Voice, Mode A, and Mode 2 transmission and reception)
- VOR/LOC antenna (for VOR, LOC, and VDB reception)
- Glideslope antenna (for glide slope reception)
- Marker beacon antenna (for marker beacon reception)
- GNSS antenna (for GNSS reception)
- ADF antenna (for ADF reception)

C. KTR 2280B Mechanical Installation

- (1) The mounting tray for the KTR 2280B MMDR must be mounted using the dimensions specified in the outline and mounting drawing, KTR 2280B MMDR can be installed with the below two mounting options (Tray mount or Bracket Mount) based on the accessibility for the installation and maintenance.

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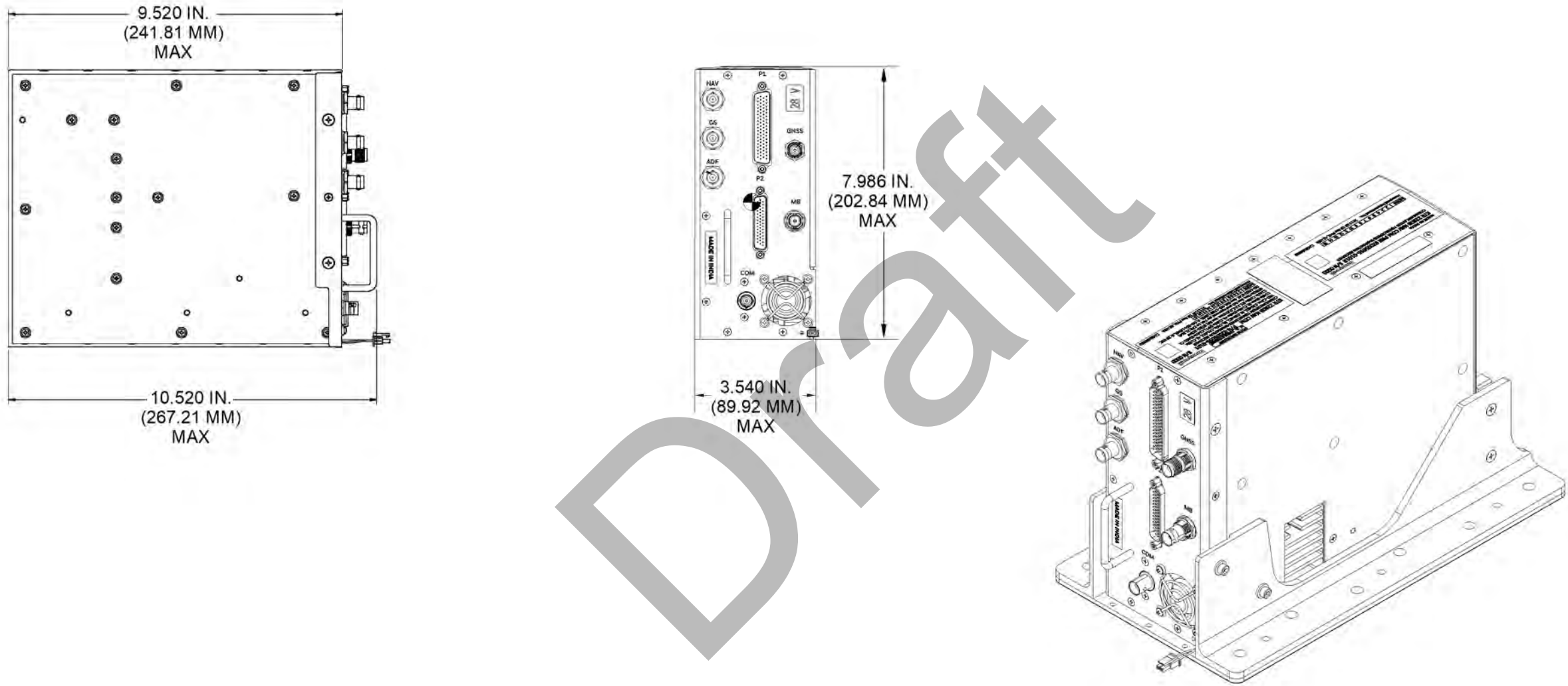
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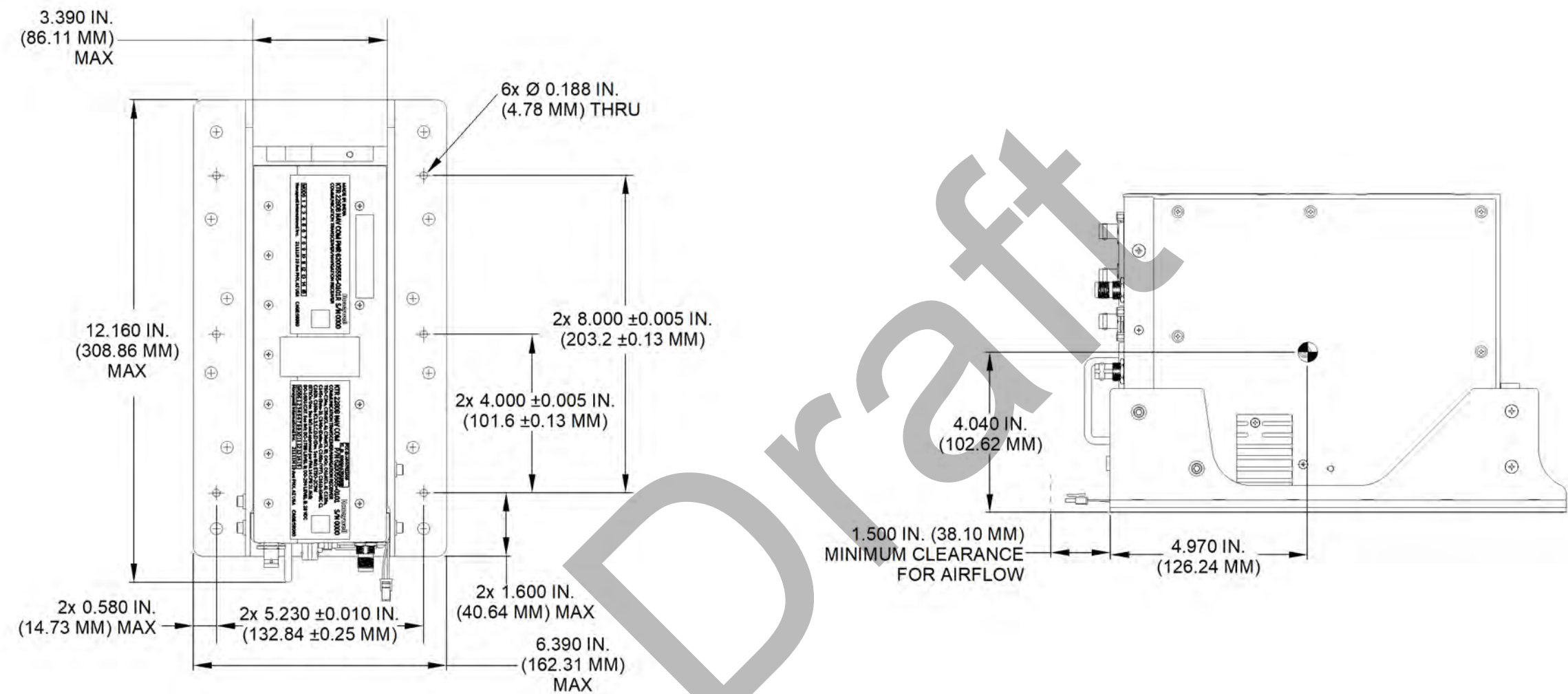
Figure 2-1. (Sheet 1 of 4) Outline and mounting drawing (62005484-101, Tray Mount)

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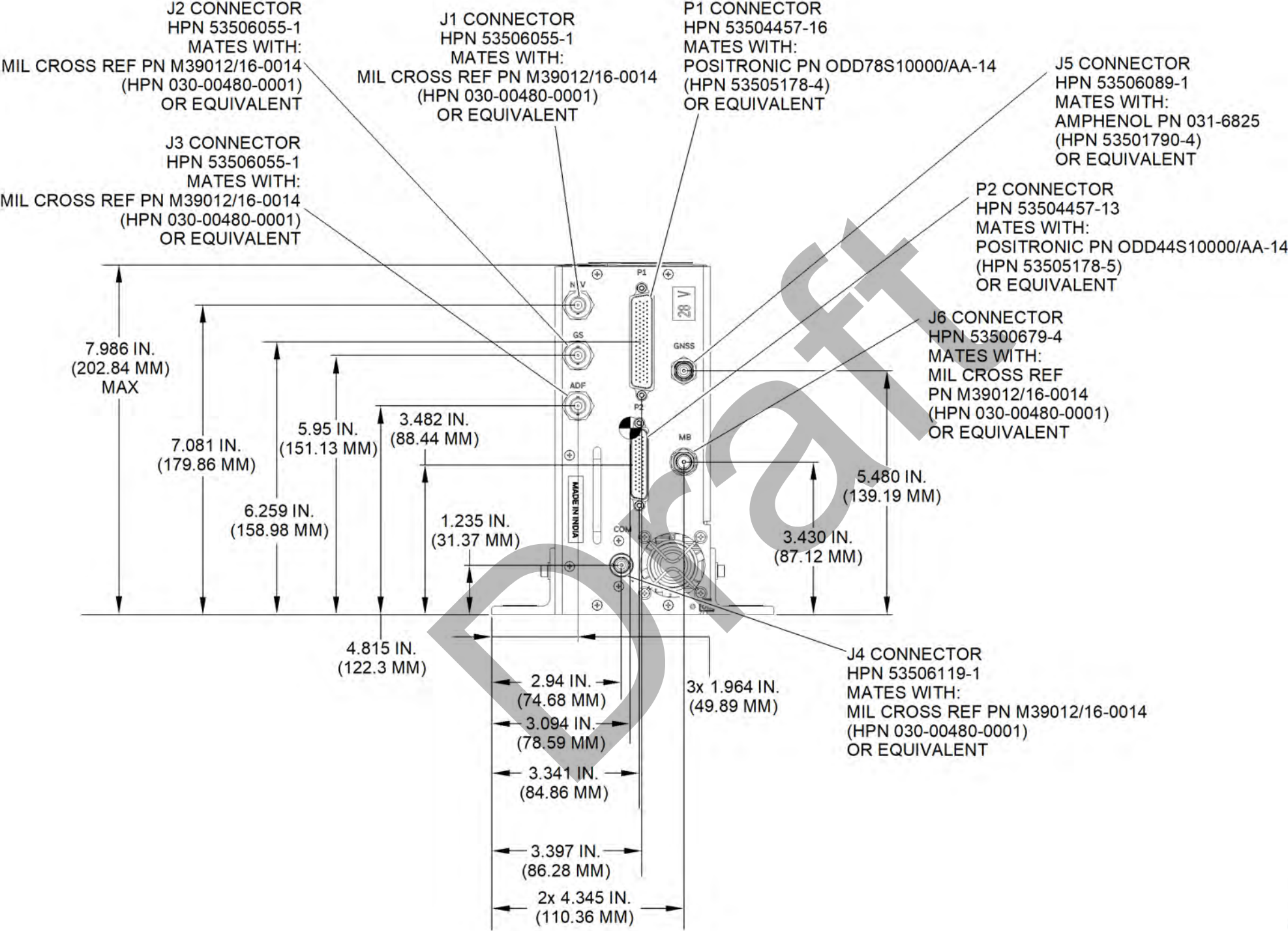


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Figure 2-1. (Sheet 2 of 4) Outline and mounting drawing (62005484-101, Tray Mount)

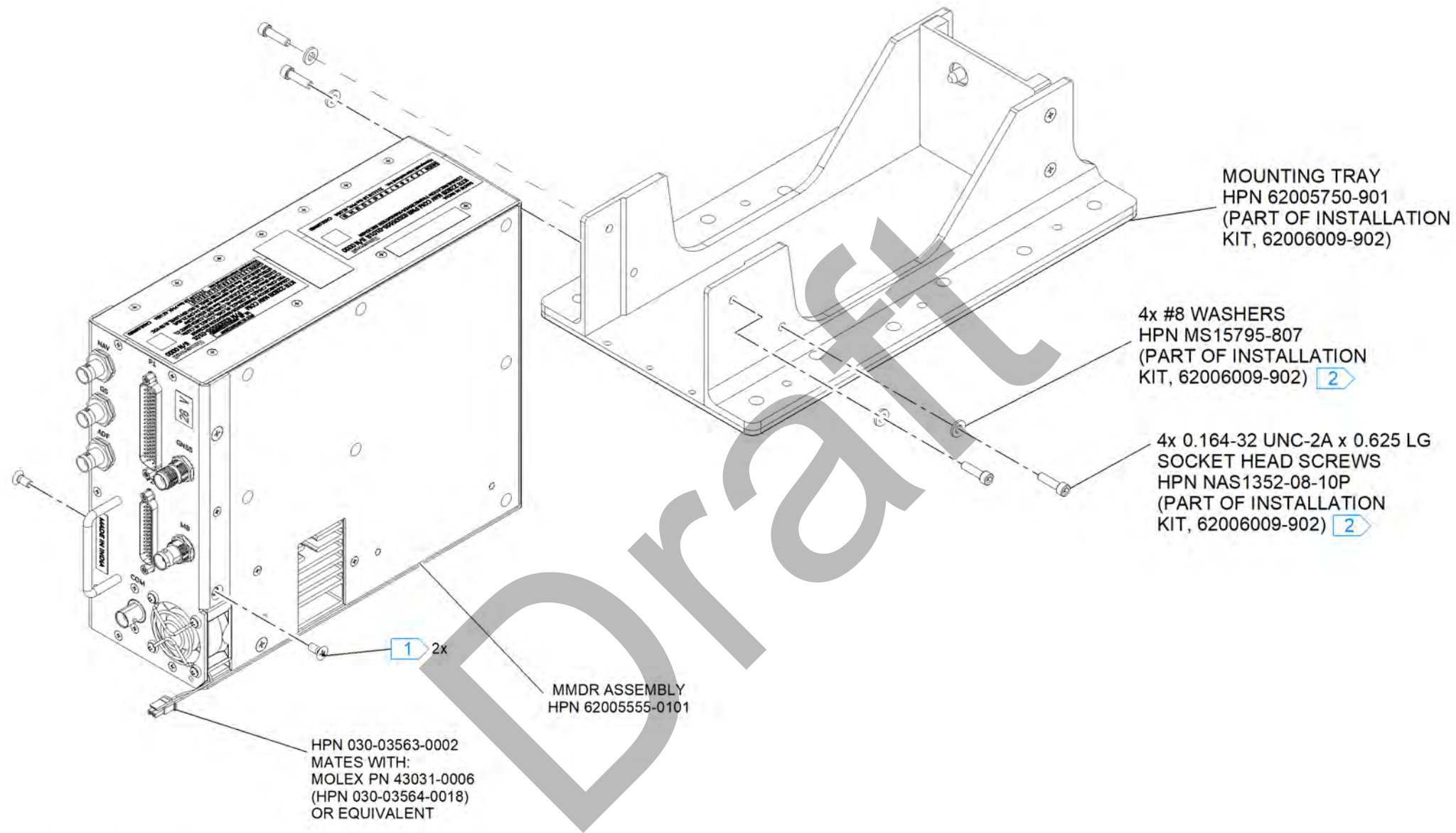
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Figure 2-1. (Sheet 3 of 4) Outline and mounting drawing (62005484-101, Tray Mount)



NOTES:

- 1 REMOVE 2 SCREWS INDICATED FROM MMDR UNIT PRIOR TO TRAY INSTALLATION.
- 2 USING MOUNTING KIT, 62006009-902, MOUNT MMDR TO TRAY USING THE (4) WASHERS AND 0.164-32 SOCKET HEAD SCREWS INCLUDED WITH KIT. TORQUE SCREWS TO 16 ±1 IN-LB (1.81 ± 0.11 NM).

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Figure 2-1. (Sheet 4 of 4) Outline and mounting drawing (62005484-101, Tray Mount)

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(2) Installation Kit - Multi Mode Digital Radio - Tray Mount (MMDR) (62006009-902)

(a) The KTR 2280B MMDR Tray Mount Installation Kit Honeywell PN 62006009-901 contains the following parts

Symbol	Part Number	FIND NO	DESCRIPTION	UM	Qty
	62005750-901	001	TRAY ASSEMBLY - KTR2280B	EA	1
	MS15795-807	002	WASHER, FLAT, METAL, ROUND, GENERAL PURPOSE	EA	4
	NAS1352-08-10P	003	SCREW, CAP, SOCKET HEAD	EA	4

(b) The KTR 2280B MMDR Tray Assembly Honeywell PN 62005750-901 contains the following parts

Symbol	Part Number	FIND NO	DESCRIPTION	UM	Qty
	62005667-901	001	BRACKET, TRAY	EA	1
	62005666-901	002	BLOCK, SUPPORTING	EA	1
	MS24693-C50	003	MS24693, SCREW, FLH, 100 DEG, CROSS-RECESSED, CRES, .164-32UNC-2A X .500 L	EA	6
	016-01007-0009	0701	LOCTITE 243	EA	A/R

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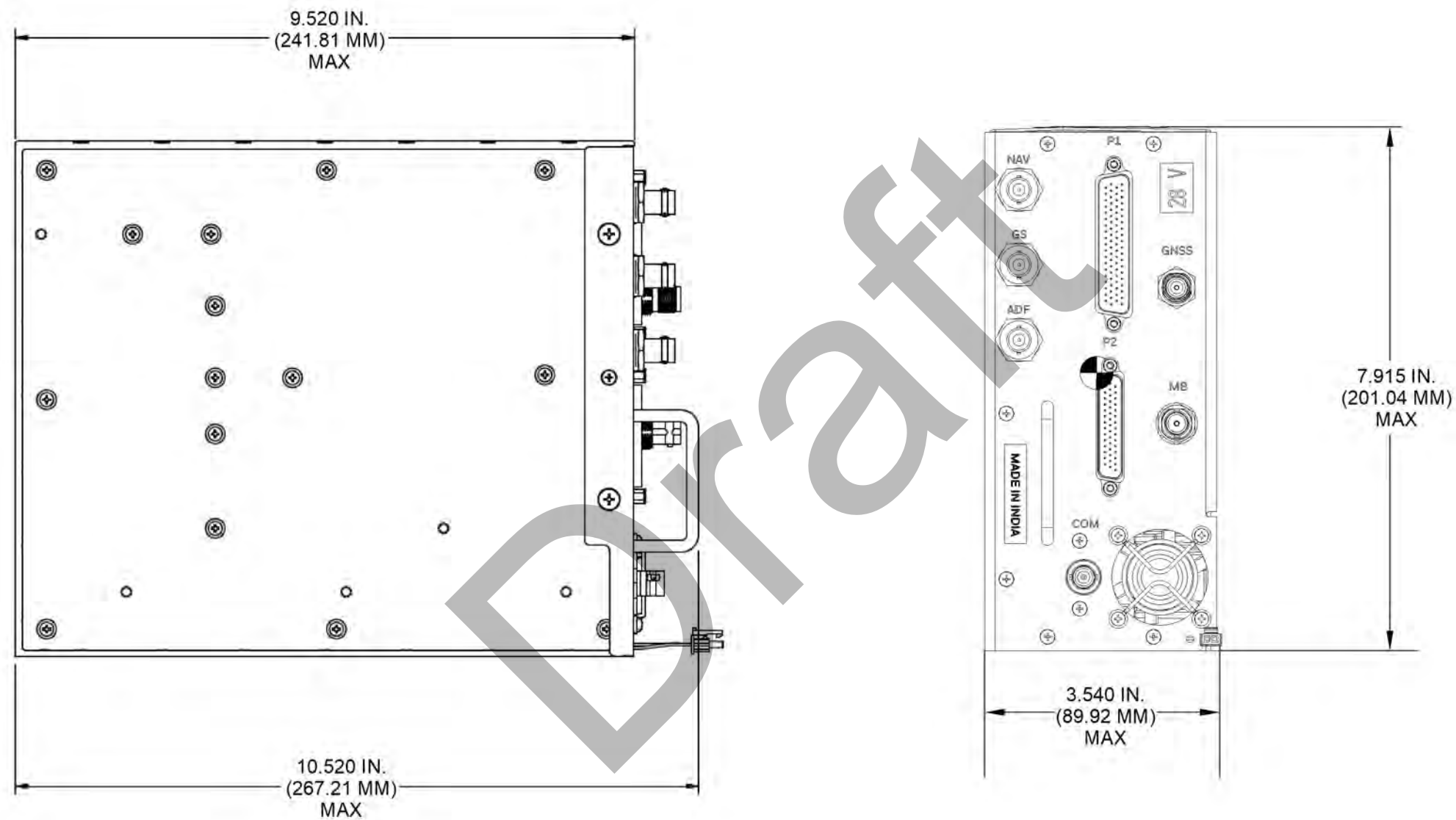
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Figure 2-2. (Sheet 1 of 4) Outline and mounting drawing (62005751-101, Bracket Mount)

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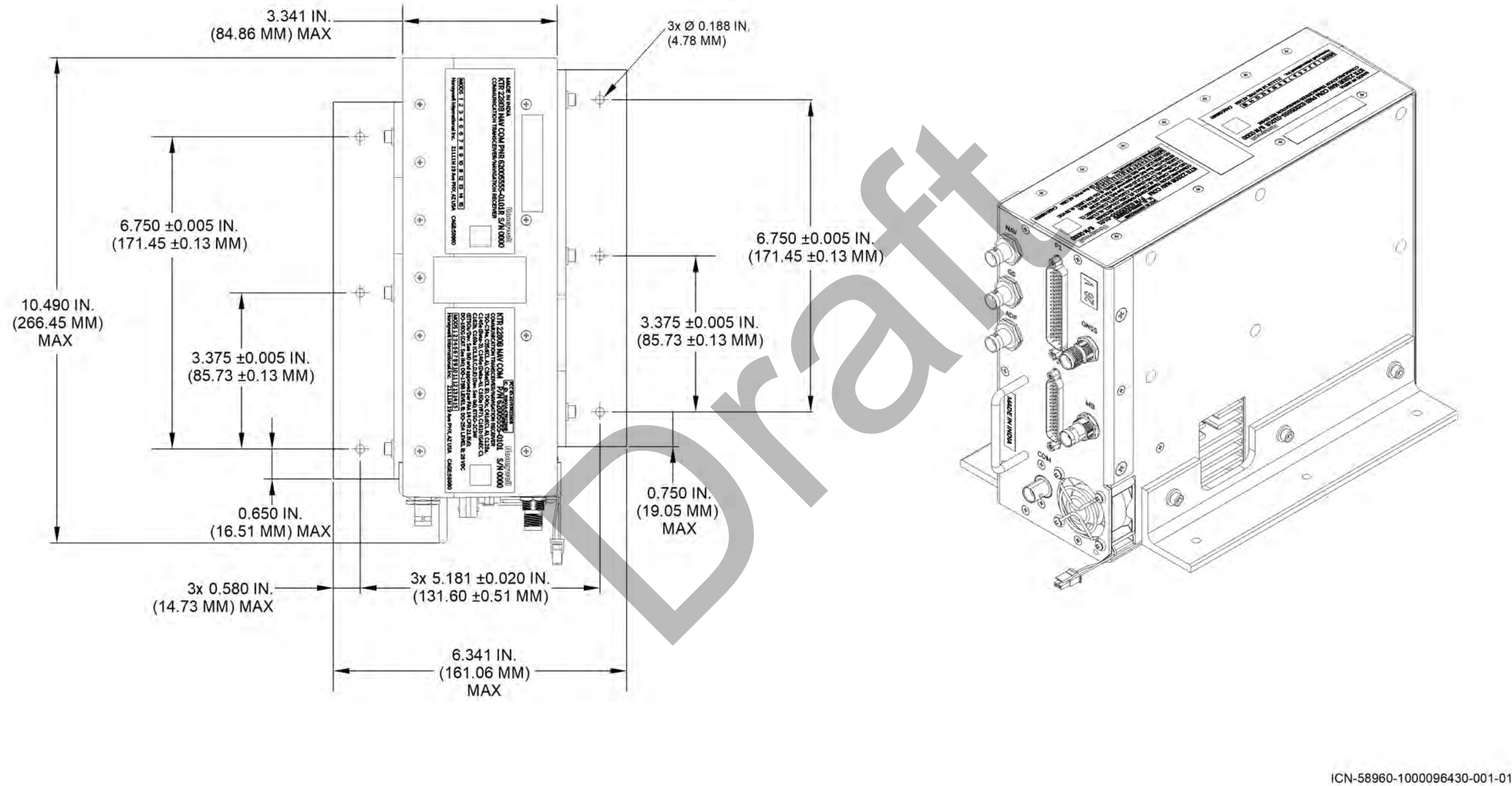


Figure 2-2. (Sheet 2 of 4) Outline and mounting drawing (62005751-101, Bracket Mount)

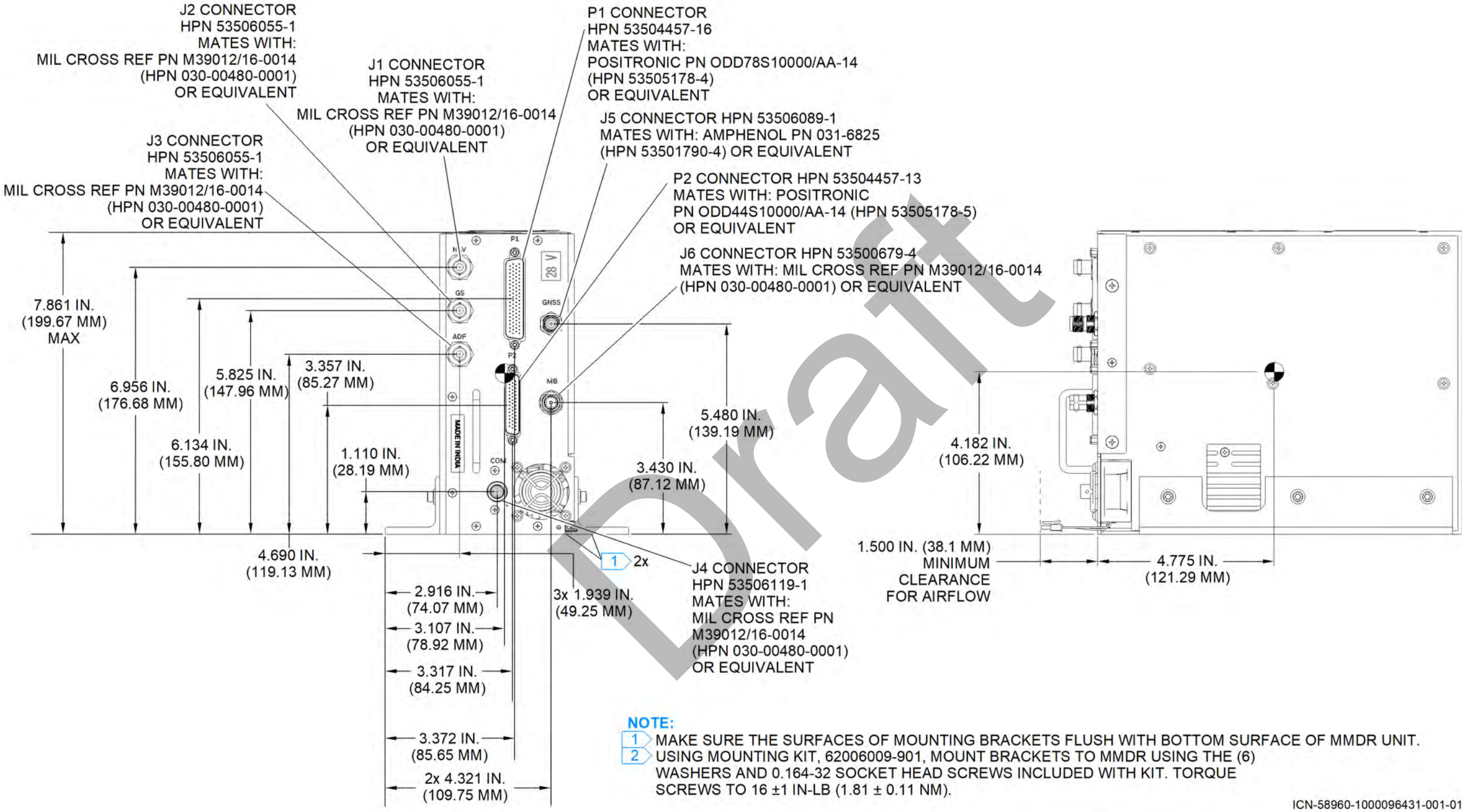
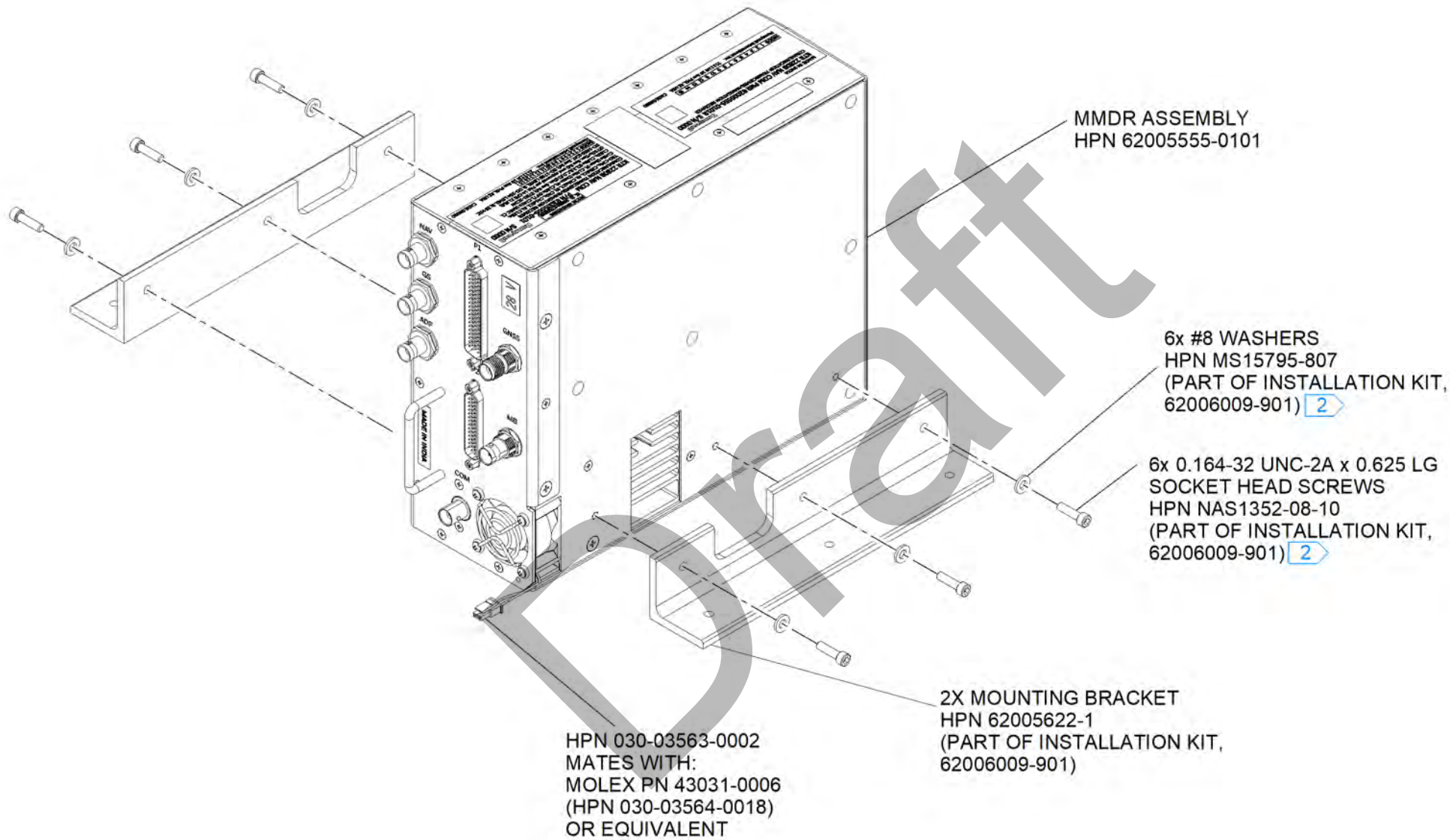


Figure 2-2. (Sheet 3 of 4) Outline and mounting drawing (62005751-101, Bracket Mount)



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Figure 2-2. (Sheet 4 of 4) Outline and mounting drawing (62005751-101, Bracket Mount)

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(3) Installation Kit - Multi Mode Digital Radio - Bracket Mount (MMDR) (62006009-901)

(a) The MMDR Bracket Mount Installation Kit Honeywell PN 62006009-901 contains the following parts.

Symbol	Part Number	FIND NO	DESCRIPTION	UM	Qty
	62005622-1	001	BRACKET, MOUNT, KTR2280B	EA	2
	MS15795-807	002	WASHER, FLAT, METAL, ROUND, GENERAL PURPOSE	EA	6
	NAS1352-08-10P	003	SCREW, CAP, SOCKET HEAD	EA	6

D. Antenna Mechanical Installation

(1) VHF COM Antennas

- (a) The VHF COM antenna must be mounted as far away as possible (8 feet, minimum) from other similar antennas and the vertical stabilizer. Mounting the COM antenna as far away as possible from the navigation antenna will help reduce COM to NAV interference. The COM antenna must also be mounted as far away as possible from an ELT antenna to prevent distortion of the radiated pattern and to prevent radiated broadband noise from the ELT when excited by the COM transmissions. Radiated broadband noise from an ELT is a common cause of COM-to-COM and COM-to-NAV interference. Mounting one antenna on top of the fuselage at the highest location to ensure a good radiation pattern and the other on the bottom of the fuselage offers good separation with a minimum of interaction.
- (b) It is recommended that one COM transceiver be connected to the top antenna for good ground communication and that the other COM transceiver be connected to the bottom antenna to provide good airborne communications. If mounting antennas on the same side of the aircraft is unavoidable, maintain the minimum allowable separation (8 feet).
- (c) The antenna must be mounted on a section of the aircraft that is horizontal during cruise flight. The base of the antenna must be well bonded to the metal aircraft skin. Remove any paint from around the mounting holes to ensure a good connection between the antenna and the skin. The metal aircraft skin at the base of the antenna must extend a minimum of 24 inch (610 mm) in every direction. This provides the ground plane required for the antenna. Any less metallized area will result in reduced communication range at some bearings around the aircraft and can increase interference to and from other systems.

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- (d) Mounting a COM antenna on an aircraft with fabric, fiberglass, or composite skins require special antenna mounting techniques. Most antenna installations on these materials requires a metal doubler plate to be installed inside the aircraft skin to support the antenna and to supply the necessary 24 inch (610 mm) ground plane. If this is impractical, it can be possible to cement metal foil inside the skin to extend the ground plane to 24 inch (610 mm). The foil extension must be well bonded to the doubler plate to be effective.
 - (e) The COM transceiver performance depends heavily on the integrity of the electrical bonding to the airframe and also the electrical integrity of the aircraft structure. If the electrical resistance between an antenna and the aircraft or between adjacent skin panels change intermittently, noisy communications can result.
 - (f) Connect the antenna to the COM unit with 50-ohm coaxial cable, keeping the cable length to a minimum and avoiding sharp bends in the cable. Keep the COM antenna cable as far away from other antenna cables as possible and do not bundle several cables together.
 - (g) Any antenna which meets the TSO requirements can be used as the VHF communications antenna. It is vertically polarized and operates in the frequency range of 118 to 137 or 118 to 152 MHz as appropriate with a maximum VSWR of 2:1. It has an omni-directional radiation pattern and an impedance of 50 ohms. Antenna should withstand minimum power of 25 Watts.
 - (h) Use Dow-Corning DC-4, or equivalent, on both inside and outside of the connector and its mate as an effective barrier against moisture and to prevent corrosion.
- (2) VOR/LOC/VDB/Glideslope Antennas
- (a) The NAV antenna must be well removed from other antennas, projections, engines, or propellers. It must have a clear line of sight area if possible. The antenna must be mounted symmetrically with the center line of the aircraft. Avoid running other coaxial cables and wires near the NAV antenna cable.
 - (b) The VOR/LOC antenna with Glideslope is a two-piece dipole with one part mounted on each side of the vertical stabilizer. It must be installed on the upper section of the vertical stabilizer of single finned aircraft and be at least 28 inches (711.2 mm) (measured vertically) from the horizontal stabilizer.
 - (c) On dual VOR/ILS installations, it is recommended that a splitter be used to divide signals from a single VOR/LOC antenna into two or more receivers. Use double shielded cables to reduce interference to the receivers.
 - (d) Any antenna which meets the TSO requirements can be used as the VOR/LOC antenna. The antenna is horizontally polarized and operates in the frequency range of 108 to 118 MHz. The antenna has a radiation pattern, which is omni-directional. Antenna impedance is 50 ohms.
 - (e) For systems that support VDB operation (TSO- C162b) the minimum aircraft implementation loss (including antenna gain, cable loss, connector loss, etc) must be no less than 5 dB.
 - (f) Any antenna which meets the TSO requirements can be used as the glideslope antenna. The antenna is horizontally polarized and operates in the frequency range of 329 to 335 MHz. It has a hemispherical radiation pattern and an impedance of 50 ohms.

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(3) ADF Antennas

- (a) KTR 2280B MMDR is compatible with KA-44B ADF antenna. The KA 44B, 071-1234-00/01, is a low profile ADF Antenna which contains both loop and sense antennas, preamplifiers, and modulators which combine the antenna signals into a single RF signal which is output to the KTR 2280B through a quadaxial cable of non-critical length. The KA 44B is supplied with a backing plate for 155-05334-0000 (Refer to Figure 2-3) and the KA 44B is supplied with a grounding ring for 155-05334-0010 (Refer to Figure 2-4).

CAUTION: KEEP THE ANTENNA AT LEAST 4 FEET AWAY FROM DME OR TRANSPONDER ANTENNAS TO MINIMIZE L-BAND INTERFERENCE. THE ANTENNA MUST BE MOUNTED WELL CLEAR OF THE AIRCRAFT GENERATOR/ALTERNATOR AND WELL CLEAR OF ANY GENERATOR/ALTERNATOR CABLES.

CAUTION: DO NOT ROUTE THE CABLES ALONG WITH HIGH POWER LEVEL TRANSMITTING CABLES. DO NOT ROUTE THE CABLES WITH OR NEAR ALTERNATOR OR 400HZ CABLES. MAKE SURE THAT THE CABLES DO NOT INTERFERE WITH ANY OF THE AIRCRAFT CONTROL CABLES.

- (b) The antenna installation will determine, to a large extent, whether the ADF will give optimum performance as required. The KA 44B ADF Antenna contains both the loop and sense antennas. The following considerations must be taken into account before selecting a location for the antenna:
- Mount the antenna on the center line of the aircraft fuselage. Failure to do so can result in excessive Q.E. error.
 - If the antenna is to be top mounted, select a location where shadowing from the wings, etc., is minimized.
 - The antenna must be well removed from any projections such as engines and propellers, as well as landing gear doors, access doors or other openings which will break the ground plane for the antenna.
 - Use the template included in the installation kit to mark the mounting holes on the aircraft fuselage.
 - Drill and/or punch the required holes.
 - Use a piece of fine sandpaper or emery cloth to sand the area on the fuselage skin on which the backup plate is to be mounted.
 - Apply Alumiprep No. 33, 016-01127-0000, to both the inside area of the fuselage and the back of the doubler plate, following the directions on the container to cleanse the metal of any residue.
 - Apply Alodine No. 1001, 016-00128-0000, to both locations following the directions on the container. This is used to ensure good bonding and prevent oxidation.
 - Refer to the installation manual and mount the antenna as shown. First rivet the doubler plate in place. It is imperative that the doubler plate make a good ground plane contact with the inside of the aircraft skin.
 - Prepare the ADF RF cable as shown in paragraph 2.E. Step(1)(g) Quadaxial Cable Preparation. Note that the cable provided can be cut to length as required for the installation.

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(4) KA 44B Technical Characteristics

Table 2-1. KA 44B Technical Characteristics

Specification	Characteristic
Environmental Specifications	Refer to APPENDIX A
Physical Dimensions	Refer to APPENDIX A
Physical Dimensions	Refer to Figure 2-3 and Figure 2-4 for Outline and Mounting Drawing
Physical Dimensions	Refer to Figure 2-3 and Figure 2-4 for Outline and Mounting Drawing
Physical Dimensions	8.5 $\pm$ 0.5 VDC at 100 mA max (supplied by KTR 2280B)

(a) KB 44B Antenna and Cable Assembly Installation Kit

- 1 The KA 44B antenna installation kit Honeywell PN 050-01756-0020 contains the following parts

PN	Description	Rev
050-01756-0020	INSTALL KIT 48 FT MMDR KA 44B DO-160D	C

Symbol	Part Number	FIND NO	DESCRIPTION	UM	Qty
	030-00101-0000		PANEL MNT PLUG	EA	1.00
	057-02259-0000		ANT MTG TEMPLATE	EA	1.00
	057-05944-0074		ANT MTG TEMPLATE	EA	1.00
	076-01042-0001		FERRULE W/F	EA	1.00
	090-00019-0007		RING RTNR .438	EA	1.00
	091-00031-0005		NY CA CLAMP .312	EA	1.00
	155-05334-0000		INST DWG KA44B	RF	1.00
	200-02586-0020		ANT CBL ASSY 48FT KA 44B DO-160D	RF	1.00

- 2 The KA 44B antenna cable assembly Honeywell PN 200-02586-0020 contains the following parts

PN	Description	Rev
200-02586-0020	ANT CBL ASSY 48FT KA 44B DO-160D	G

Symbol	Part Number	FIND NO	DESCRIPTION	UM	Qty
	025-00001-0000		WIRE, HOOKUP, PTFE, 26 (7/34) AWG SPC, BLK	IN	3.9

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Symbol	Part Number	FIND NO	DESCRIPTION	UM	Qty
	025-05120-0000		WIRE, TIN PLTD CU SHLD, 5-24 (19/36) AWG TPC COND	IN	578
	026-00029-0000		WIRE, CU, 22AWG, TINNED	IN	3
	030-01157-0011		SOCKET CRMP 20G	EA	9
	030-01171-0000		CONN SUB-D HSG 9S (FEMALE PINS)	EA	1
	030-02351-0000		HOOD/LVR ASSY ST E	EA	1
	150-00024-0010		TUBING SHRINK 10G	IN	2
	150-00049-0010		SHRINK TUBING WHT	IN	0.75
	150-00052-0010		SHRNK TUBING WHT	IN	4.5
	300-02586-0020		ANTENNA CABLE INTERCONNECT KA 44B DO-160D	EA	REF
	53001150-1		CABLE, QUADRAXIAL, 50 ±2 OHMS, TEMPERATURE RANGE: -67 to 392°F (-55 TO +200°C)	FT	48.17
	025-00003-0008		WIRE 22 GRY	IN	4.3
	710-H4T5		HEAT SHRINK, 1/4, PRNTABLELABL	EA	1

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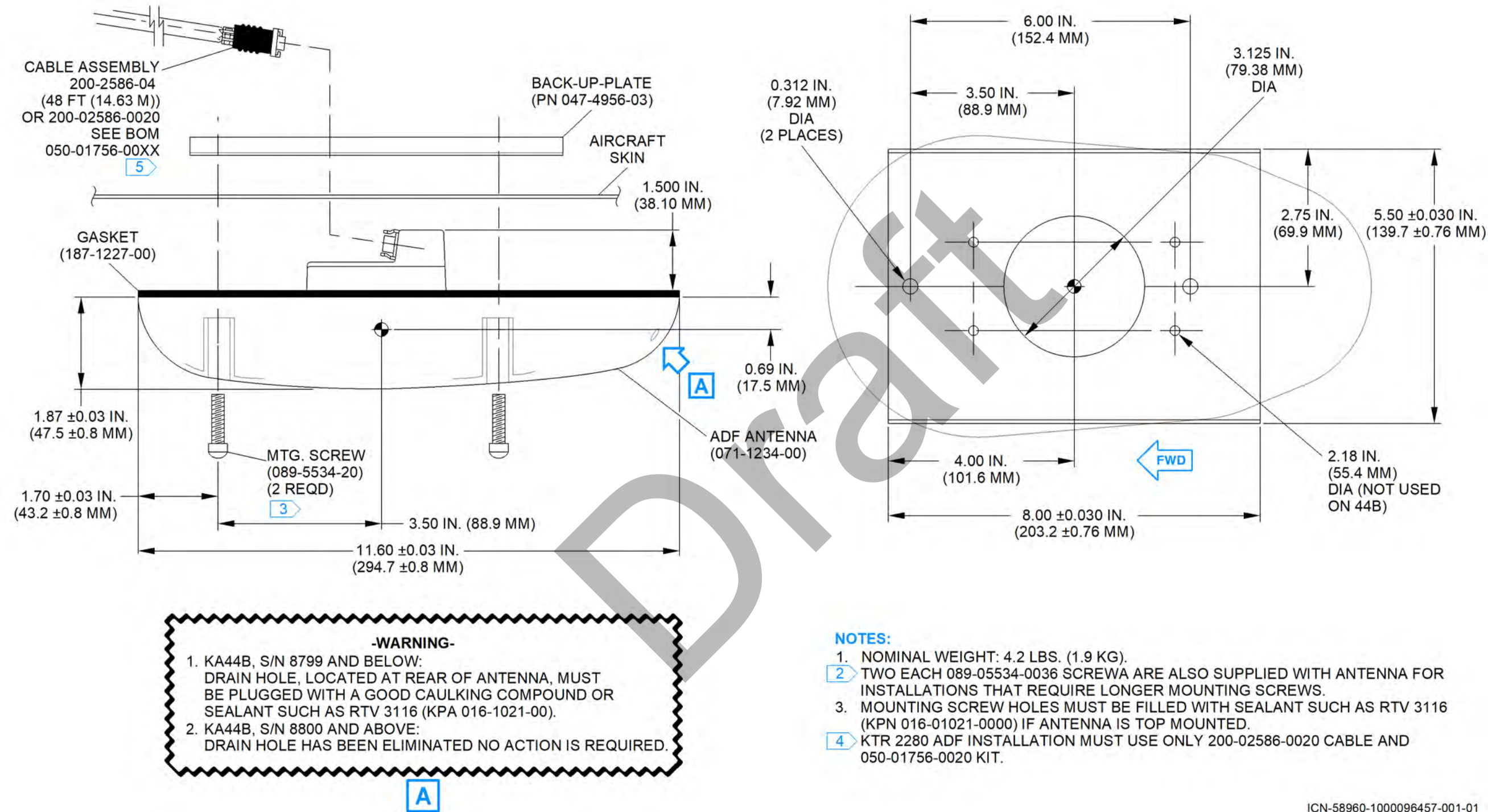


Figure 2-3. KA 44B Outline and Mounting Drawing (Dwg No 155-05334-0000 Rev AC)

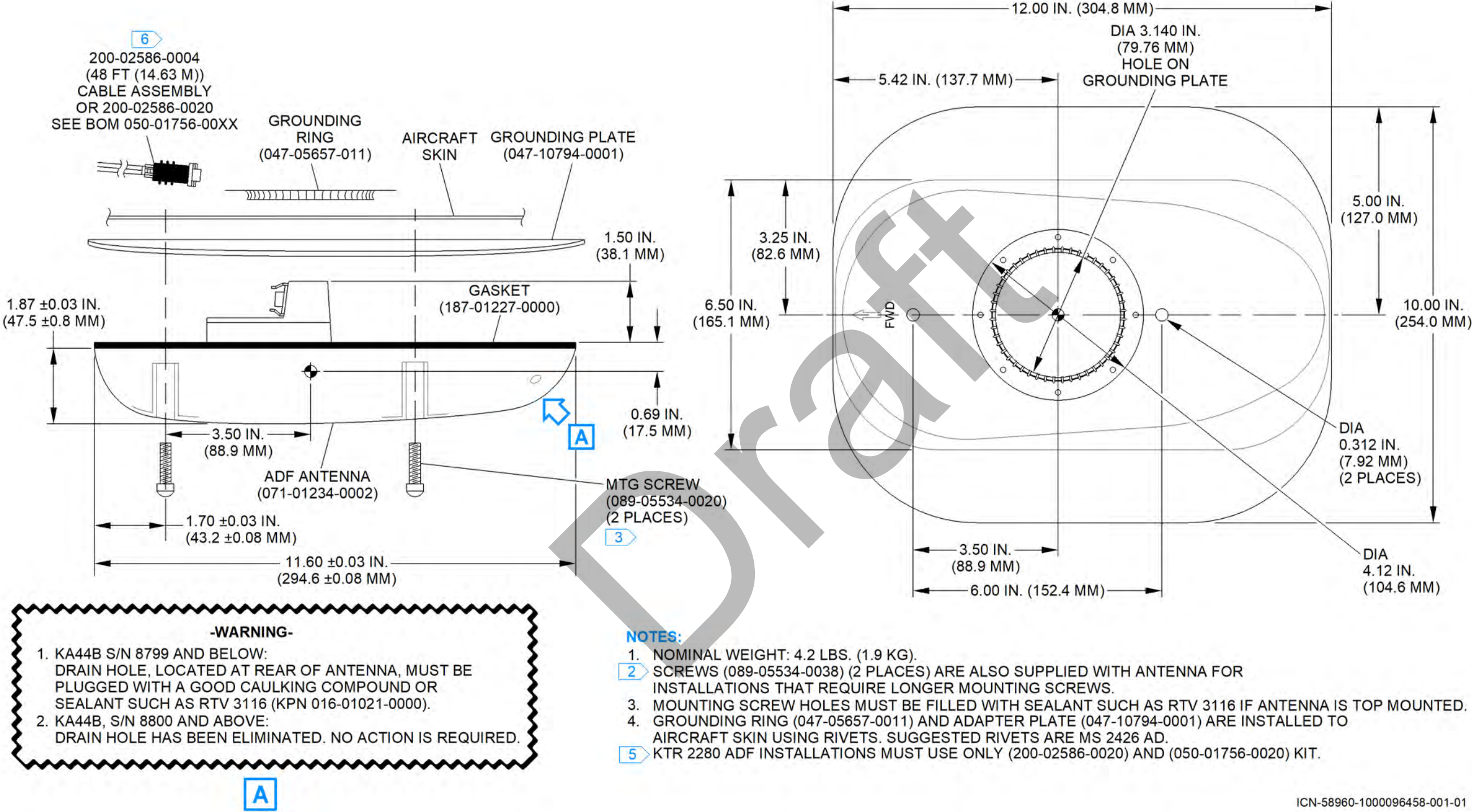


Figure 2-4. KA 44B Outline and Mounting Drawing (Dwg No 155-05334-0010 Rev AD)

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(5) GNSS Antenna

- (a) The antenna(s) should be mounted a minimum of 30 inches (762 mm) away from the transponder, TCAS or DME antennas and three feet from the UHF or VHF communication antennas.
- (b) Mount on top of aircraft per manufacturers specifications. Mount near centerline to give balanced horizontal pattern coverage. In a dual GPS antenna installation, 10 inches (254 mm) minimum center to center spacing is recommended.

NOTE: The total losses in the coaxial cable run and interconnects between the antenna(s) and the KTR 2280B MMDR must not be outside the parameters given in Table 2-2. Refer to Table 2-2 .

NOTE: The antenna cabling information noted in this section, in particular by Figure 2-13 and Figure 2-14, is provided as possible antenna connection solutions and is provided for reference only. While the options noted in the figures will be applicable to many installations, adherence to the following sub-sections will ensure that the total cable/interconnection losses are within specification.

- 1 Consult manufacturer's coaxial cable data sheet specifications. Using the length of the top and/or bottom antenna cables and the manufacturer specified dB loss for each foot of cable type, select a particular type or types of cable that meet the top and bottom cable loss limitations. In anticipation of aging factors, it is advisable to select a cable type that has an insertion loss that when combined with interconnect losses will equal a dB loss significantly lower than 2 dB.

Table 2-2. Compatible GPS Active Antennas

Characteristic	Specification
GPS Antenna Approved Types:	The MMDR works with the following GPS antenna types:
Non-SBAS acceptable antenna types	Sensor Systems S67- 1575- 132
	Sensor Systems S67- 1575- 232
SBAS/GBAS acceptable antenna types	All antennas listed below may be used
	Honeywell KA96 (071- 01620- 0001)
	Honeywell KA97 (57000228- 001)
	Sensor Systems S67- 1575- 146
	AeroAntenna AT575- 343H
Alternate Antenna Specifications:	The installed GPS antenna must meet the following requirements:
Non SBAS antennas	TSO Approved for TSO- C129
SBAS/GBAS antennas	TSO Approved for TSO- C190 meeting RTCA DO- 301 with additional G/T requirement of - 28.6 dB/K
Antenna power supplied by RX	+ 8.0 VDC +/- 10% at 60 mA max. (Antenna In- rush current draw must be less than 480 mA during the first 1.2 msec from power on)
Antenna + Amplifier Gain required	+26.5 to + 32.5 db at 1575.42 MHz
Cable/connector loss allowed	2.5 to 12.0 db at 1575.42 MHz

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Table 2-2. Compatible GPS Active Antennas (Cont)

Characteristic	Specification
Antenna gain pattern	Elevation Angle Minimum Gain > 15 degrees - 2 dBic 10 degrees - 3 dBic 5 degrees - 4.5 dBic
	Horizontal pattern = Omnidirectional, Gain not greater than + 7 dBic at any angle

Table 2-3. KA 96 Active GPS Antenna Technical Characteristics

Specification	Characteristic
TSO COMPLIANCE:	TSO-C190
ENVIRONMENTAL CATEGORIES:	Refer to Figure 2-7
PHYSICAL DIMENSIONS:	Refer to Figure 2-5
AIRSPEED RATING:	600 Kts. TAS
OUTPUT IMPEDANCE:	50 Ohms (Nominal)
DC VOLTAGE:	4.5 to 15 Volts
DC CURRENT:	35mA (Nominal), 40mA (Maximum) at 4.7 VDC

Table 2-4. KA 97 Active GPS Antenna Technical Characteristics

Specification	Characteristic
TSO COMPLIANCE:	TSO-C190
ENVIRONMENTAL CATEGORIES:	Refer to Figure 2-10
PHYSICAL DIMENSIONS:	Refer to Figure 2-8
AIRSPEED RATING:	600 Kts. TAS
OUTPUT IMPEDANCE:	50 Ohms (Nominal)
DC VOLTAGE:	4.5 to 15 Volts
DC CURRENT:	35mA (Nominal), 40mA (Maximum) at 4.7 VDC

Table 2-5. KA 96 Installation Kit (050-03729-0000)

Sl.No	Part No	Description	Qty
1	047-10735-0002	ANT DBLR COMPLETE	1

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Table 2-5. KA 96 Installation Kit (050-03729-0000) (Cont)

Sl.No	Part No	Description	Qty
2	155-06085-0000	KA 96 INSTALL DRAWING	REF
3	187-01989-0001	KA 96 GASKET	1

NOTE: The KA 97 antenna does not have an installation kit since there is no gasket required and the o-ring is provided with the antenna.

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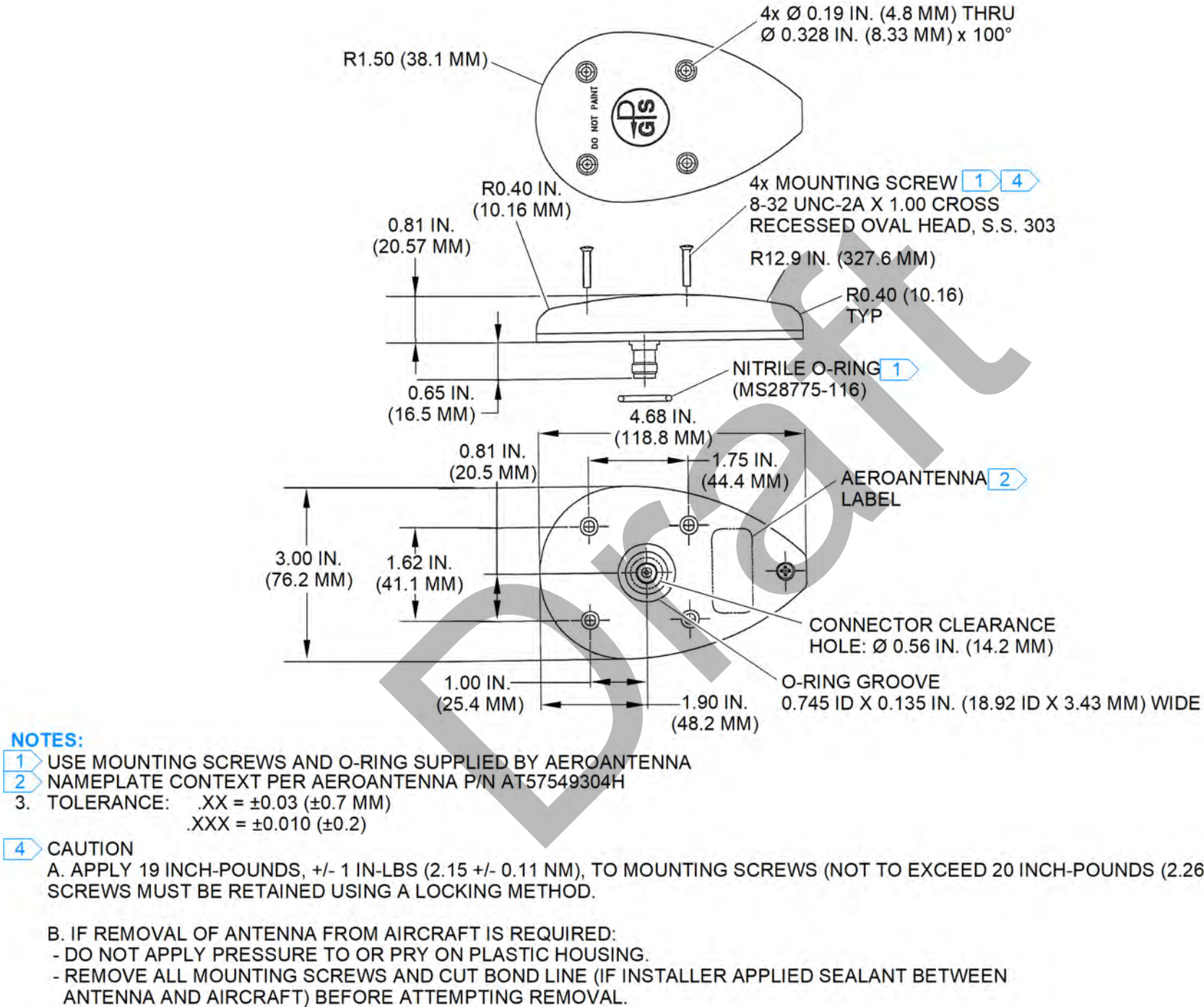
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Figure 2-5. (Sheet 1 of 2) KA 96 Outline (071-01620-0000, Rev D)

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SPECIFICATION:

FREQUENCY: 1575.42 $\pm$ 10.23 MHz
POLARIZATION: RIGHT HAND CIRCULAR
AXIAL RATIO: 3 dB MAX AT BORE SIGHT

RELATIVE RADIATION
COVERAGE:

Elevation Angle (degrees)	Gain [dBic]
0	-5
5	-3.5
10	0
20	2
30	2
30 < Elev. $\leq$ 75	2.5
> 75	3.0

AMPLIFIER:

GAIN: 29 $\pm$ 2 dB OVER TEMPERATURE
NOISE FIGURE: 1.9 dB MAX. @ 77°F (25°C), 2.5 dB MAX.
IMPEDANCE: 50 OHMS
VSWR (DRY): $\leq$ 1.5:1
VSWR (RAIN): $\leq$ 2.0:1
POWER HANDLING: 1 WATT
VOLTAGE: 4.5-15 VDC
CURRENT: 40 mA NOMINAL, 45 mA MAX @ 4.7 VDC

FINISH: WEATHERABLE POLYMER

CONNECTOR: TNCF

WEIGHT: 7.5 OZ MAX.

ALTITUDE: 55,000'

OPERATING TEMP: -67 TO +158°F (-55 TO +70°C)

STORAGE TEMP: -67 TO +185°F (-55 TO +85°C)

DESIGNED TO: DO-160E,

ENV CAT: F2-AB[BD][S(CLMY)U(FF1)]X[SY]FSXSZXXX[ZCZW]YH[A4J44][2A]CAC

TSO: C190 (RTCA/DO-301)

DESIGNED TO: HONEYWELL P/N: 071-01620-0001

ICN-58960-1000096434-001-01

Figure 2-5. (Sheet 2 of 2) KA 96 Outline (071-01620-0000, Rev D)

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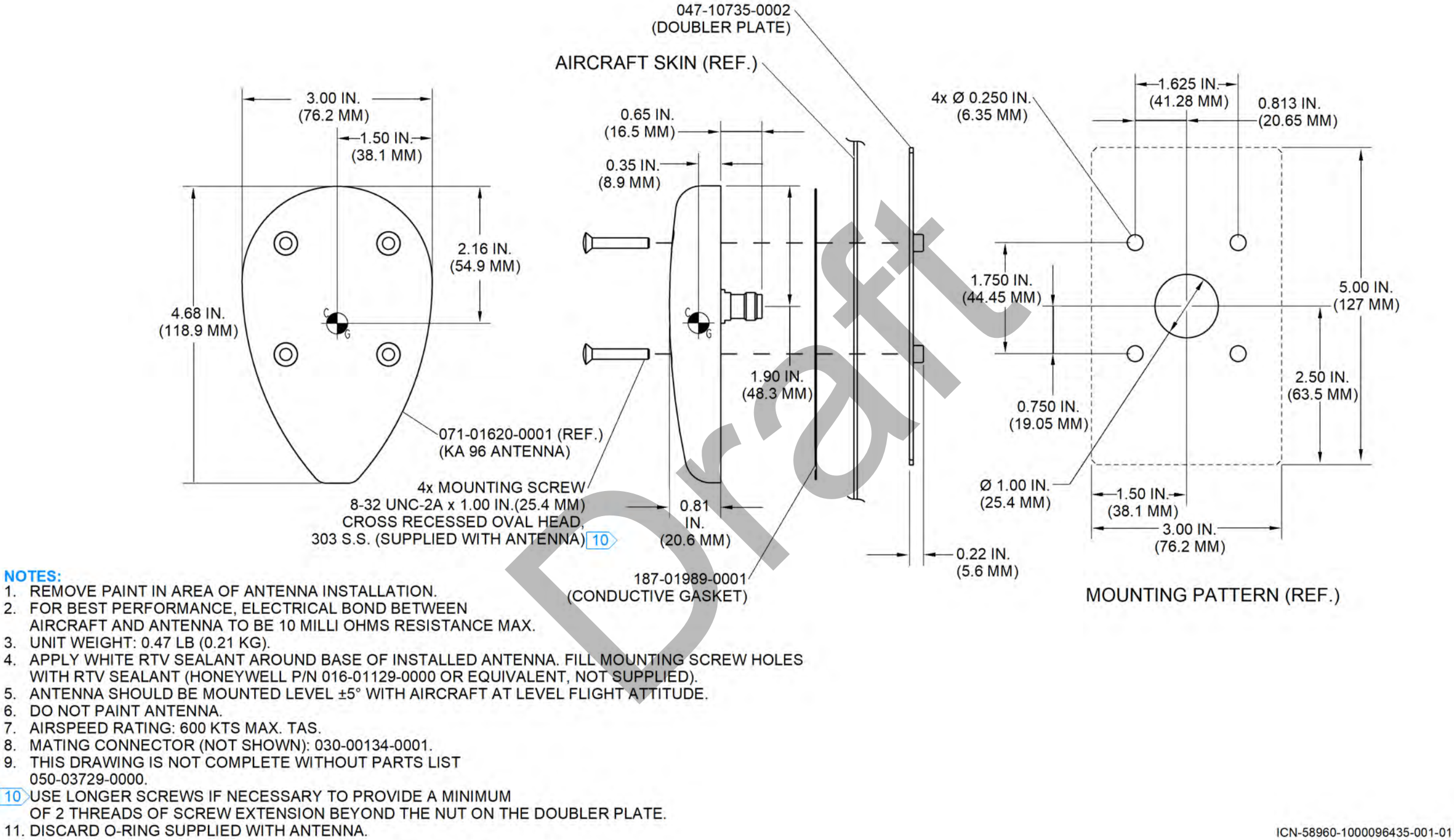


Figure 2-6. KA 96 Installation Drawing (155-06085-0000, Rev -)

RTCA/DO-160E

ENVIRONMENTAL QUALIFICATION FORM

NOMENCLATURE: KA96 GPS Antenna

PART NUMBER: 071-01620-0001

TSO NUMBER: TSO-C190 (RTCA/DO-301)

MANUFACTURER'S SPECIFICATION: 071-01620-0000

MANUFACTURER: AeroAntenna Technology, Inc.

ADDRESS: Chatsworth, CA USA

DO-160E Section	Title	Category	Description
4	Temperature and Altitude	F2	
4.5.1	Ground Survival Low Temperature Test (GSLTT)		-55°C (EUT not operating)
	Short-Time Operating Low Temperature Test (STOLLT)		-55°C (EUT operating)
4.5.2	Operating Low Temperature Test (OLTT)		-55°C (EUT operating)
4.5.3	Ground Survival High Temperature Test (GSHTT)		+85°C (EUT not operating)
	Short-Time Operating High Temperature Test (STOHTT)		+70°C (EUT operating per MPS)
4.5.4	Operating High Temperature Test (OHTT)		+70°C (EUT operating per MPS)
4.5.5	In-Flight Loss of Cooling Test	X	No external or internal cooling required
4.6.1	Altitude Test		55,000 feet MSL
4.6.2	Decompression Test		8,000 to 55,000 ft MSL in ≤15 seconds
4.6.3	Overpressure Test		-15,000 feet
5	Temperature Variation	A	10°C/min
6	Humidity	B	Severe Humidity
7	Operational Shocks and Crash Safety	BD	Standard Op Shock and Crash Safety
8	Vibration	S	Fixed Wing, Curves C,L,M,Y (Zones 1 and 2)
		U	Helicopter, Curves F, FI (Zones 1a and 2)
9	Explosion Proofness	X	Not Tested
10	Waterproofness	SY	Continuous stream proof and condensing water proof
11	Fluids Susceptibility	F	Fluids
12	Sand and Dust	S	Sand
13	Fungus Resistance	X	Not Tested
14	Salt Fog	S	Spray test
15	Magnetic Effect	Z	Deflection of < 1° for a distance < 0.3m
16	Power Input	X	28 VDC powered unit. Momentary power interruptions up to 200ms (Category A). Category Z surge tests.
		X	High degree of spike protection
17	Voltage Spike	X	
18	Audio Frequency Conducted Susceptibility - Power Inputs	X	
19	Induced Signal Susceptibility	ZCZW	Equipment is Level B
20	Radio Frequency Susceptibility (Radiated and Conducted)	Y	Equipment is Level B
21	Emission of Radio Frequency Energy	H	
22	Lightning Induced Transient Susceptibility	A4J44	Equipment is Level B
23	Lightning Direct Effects	2A	Outside aircraft
24	Icing	C	External, non-temperature controlled
25	Electrostatic Discharge (ESD)	A	10 pulses in each polarity at 15kV/pulse
26	Fire, Flammability	C	Flamability

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Figure 2-7. KA 96 Environmental Qualification form (004-02403-4800, Rev -)

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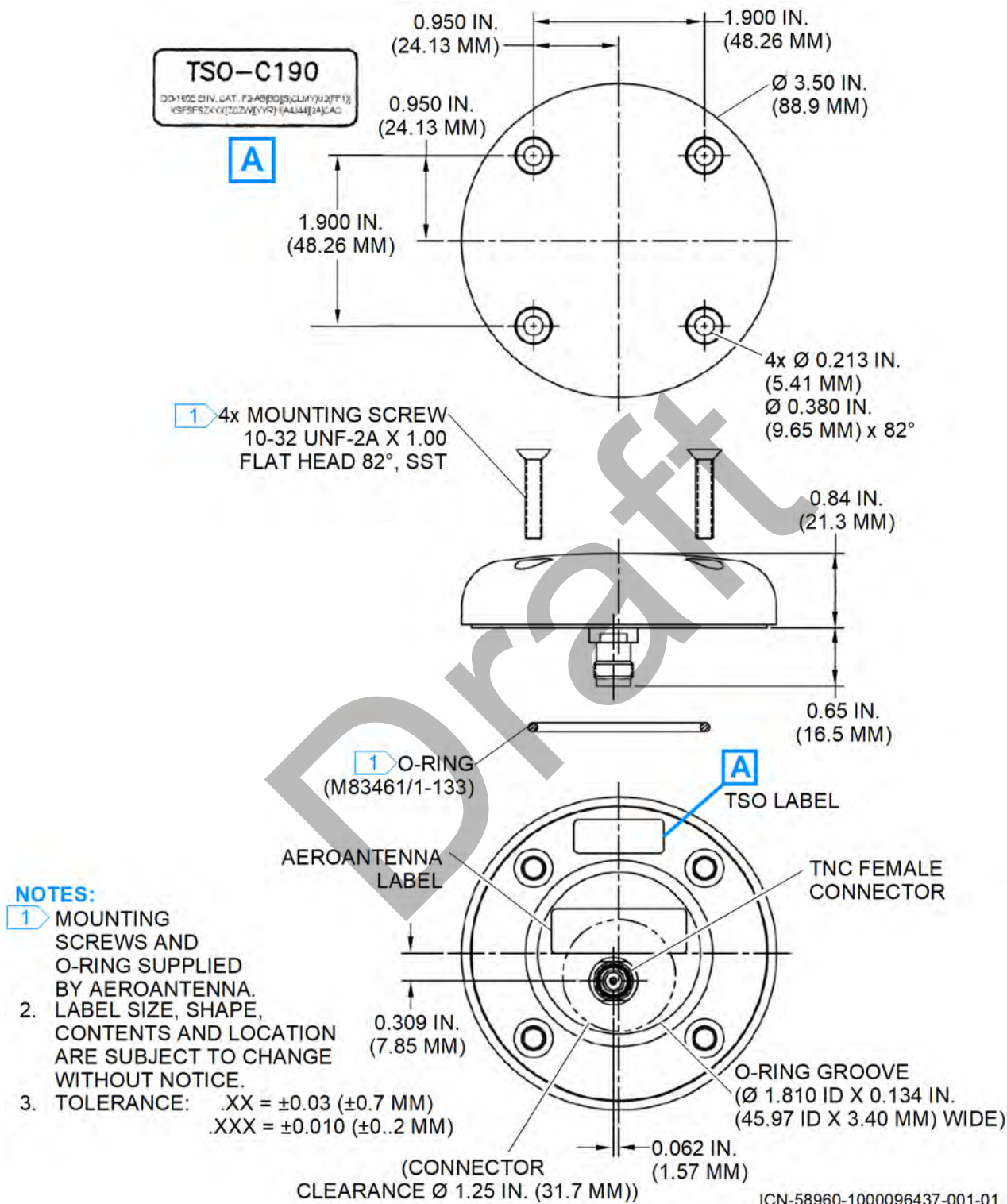


Figure 2-8. (Sheet 1 of 2) KA 97 Outline (57000228-000, Rev C)

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SPECIFICATION:

FREQUENCY: 1575.42 $\pm$ 10.23 MHz
POLARIZATION: RIGHT HAND CIRCULAR
AXIAL RATIO: 3 dB MAX AT BORE SIGHT

RELATIVE RADIATION
COVERAGE:

Elevation Angle (degrees)	Gain [dBic]
0	-5
5	-3.5
10	0
20	2
30	2
30 < Elev. $\leq$ 75	2.5
> 75	3.0

AMPLIFIER:

GAIN: 29 $\pm$ 2 dB OVER TEMPERATURE
NOISE FIGURE: 1.9 dB MAX. @ 77°F (25°C), 2.5 dB MAX.
IMPEDANCE: 50 OHMS
VSWR (DRY): $\leq$ 1.5:1
VSWR (RAIN): $\leq$ 2.0:1
POWER HANDLING: 1 WATT
VOLTAGE: 4.5-15 VDC
CURRENT: 40 mA NOMINAL, 55 mA MAX @ 4.7 VDC

FINISH: WEATHERABLE POLYMER
CONNECTOR: TNCF
WEIGHT: 8 OZ MAX.
ALTITUDE: 55,000'
OPERATING TEMP: -67 TO +158°F (-55 TO +70°C)
STORAGE TEMP: -67 TO +185°F (-55 TO +85°C)
DESIGNED TO: D0-160E,
ENV CAT: F2-AB[BD][S(CLMY)U2(FF1)]XSFSFSZXXX[ZCZW][YYR]H[A4J44][2A]CAC
RTCA/D0-301
TSO: C190
DESIGNED TO: HONEYWELL P/N: 57000228-001

ICN-58960-1000096438-001-01

Figure 2-8. (Sheet 2 of 2) KA 97 Outline (57000228-000, Rev C)

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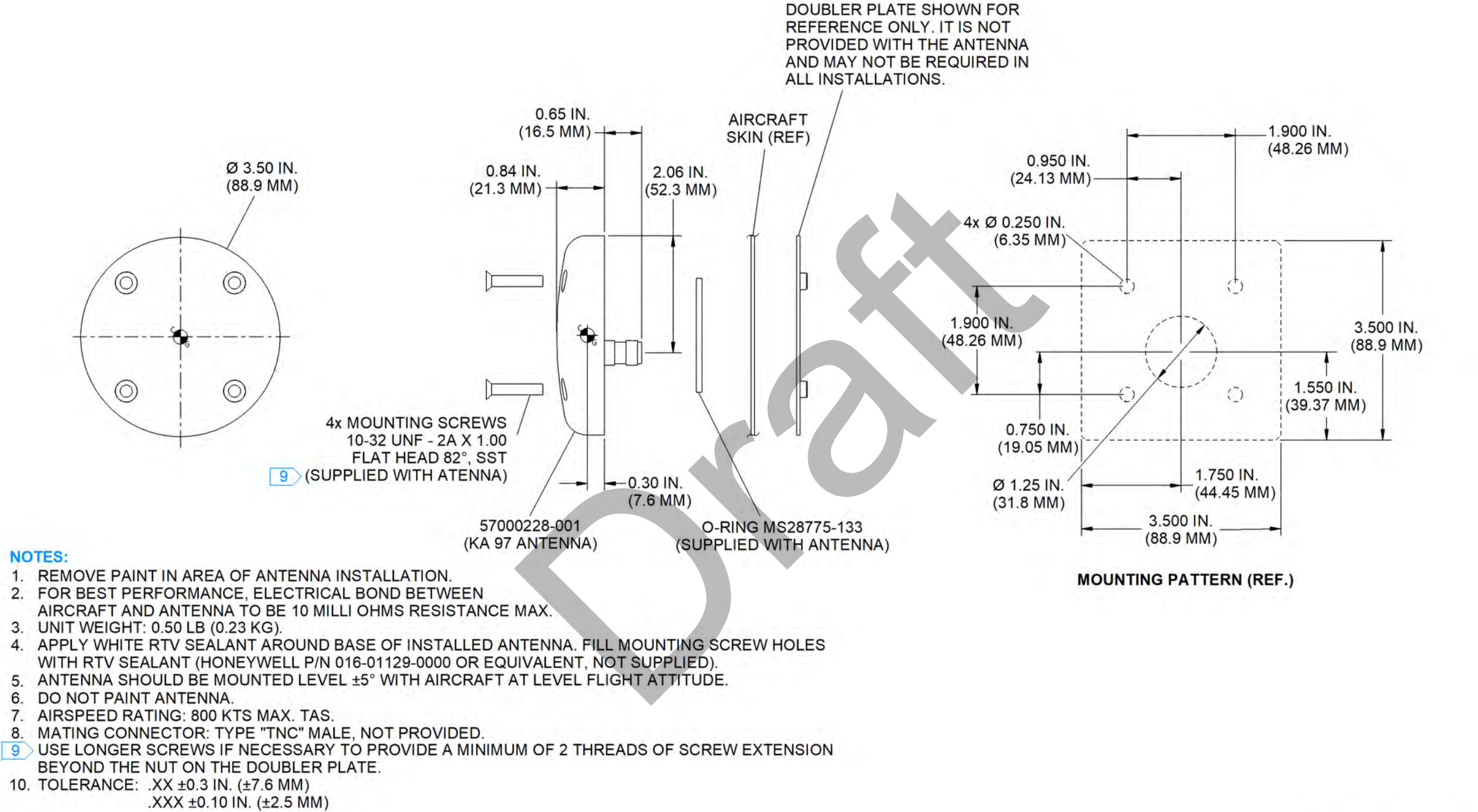
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ICN-58960-1000096439-001-01

Figure 2-9. KA 97 Installation Drawing (57000234-000, Rev -)

ENVIRONMENTAL QUALIFICATION FORM

NOMENCLATURE: KA97 GPS Antenna
PART NUMBER: 57000228-001
TSO NUMBER: TSO-C190 (RTCA/DO-301)
MANUFACTURER'S SPECIFICATION: 57000228-000
MANUFACTURER: AeroAntenna Technology, Inc.
ADDRESS: Chatsworth, CA USA

DO-160E Section	Title	Category	Description
4	Temperature and Altitude	F2	
4.5.1	Ground Survival Low Temperature Test (GSLTT)		-55°C (EUT not operating)
	Short-Time Operating Low Temperature Test (STOLLT)		-55°C (EUT operating)
4.5.2	Operating Low Temperature Test (OLTT)		-55°C (EUT operating)
4.5.3	Ground Survival High Temperature Test (GSHTT)		+85°C (EUT not operating)
	Short-Time Operating High Temperature Test (STOHTT)		+70°C (EUT operating per MPS)
4.5.4	Operating High Temperature Test (OHTT)		+70°C (EUT operating per MPS)
4.5.5	In-Flight Loss of Cooling Test	X	No external or internal cooling required
4.6.1	Altitude Test		55,000 feet MSL
4.6.2	Decompression Test		Not tested
4.6.3	Overpressure Test		Not tested
5	Temperature Variation	A	10°C/min
6	Humidity	B	Severe Humidity
7	Operational Shocks and Crash Safety	BD	Standard Op Shock and Crash Safety
8	Vibration	S	Fixed Wing. Curves C,L,M,Y (Zones 1 and 2)
		U2	Helicopter. Curves F, F1 (Zones 1a, 1b, and 2)
9	Explosion Proofness	X	Not Tested
10	Waterproofness	S	Continuous stream proof
11	Fluids Susceptibility	F	Fluids - the following fluids were analyzed or spray tested Jet Fuel, Regular Gasoline, Hydraulic Fluid, Motor Oil, Isopropanol, Ethanol, 100% Antifreeze, Propylene Glycol, Phenol (saturated solution), Ethylene Glycol, Skydrol
12	Sand and Dust	S	Sand
13	Fungus Resistance	F	Fungus
14	Salt Fog	S	Spray test
15	Magnetic Effect	Z	Deflection of < 1° for a distance < 0.3m
16	Power Input	X	Not tested
17	Voltage Spike	X	Not tested
18	Audio Frequency Conducted Susceptibility - Power Inputs	X	Not tested
19	Induced Signal Susceptibility	ZCZW	Equipment is Level B
20	Radio Frequency Susceptibility (Radiated and Conducted)	YYR	Equipment is Level B
21	Emission of Radio Frequency Energy	H	
22	Lightning Induced Transient Susceptibility	A4J44	Equipment is Level B
23	Lightning Direct Effects	2A	Outside aircraft
24	Icing	C	External, non-temperature controlled
25	Electrostatic Discharge (ESD)	A	10 pulses in each polarity at 15kV/pulse
26	Fire, Flammability	C	Flamability

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Figure 2-10. KA 97 Environmental qualification form (004-02413-4800, Rev -)

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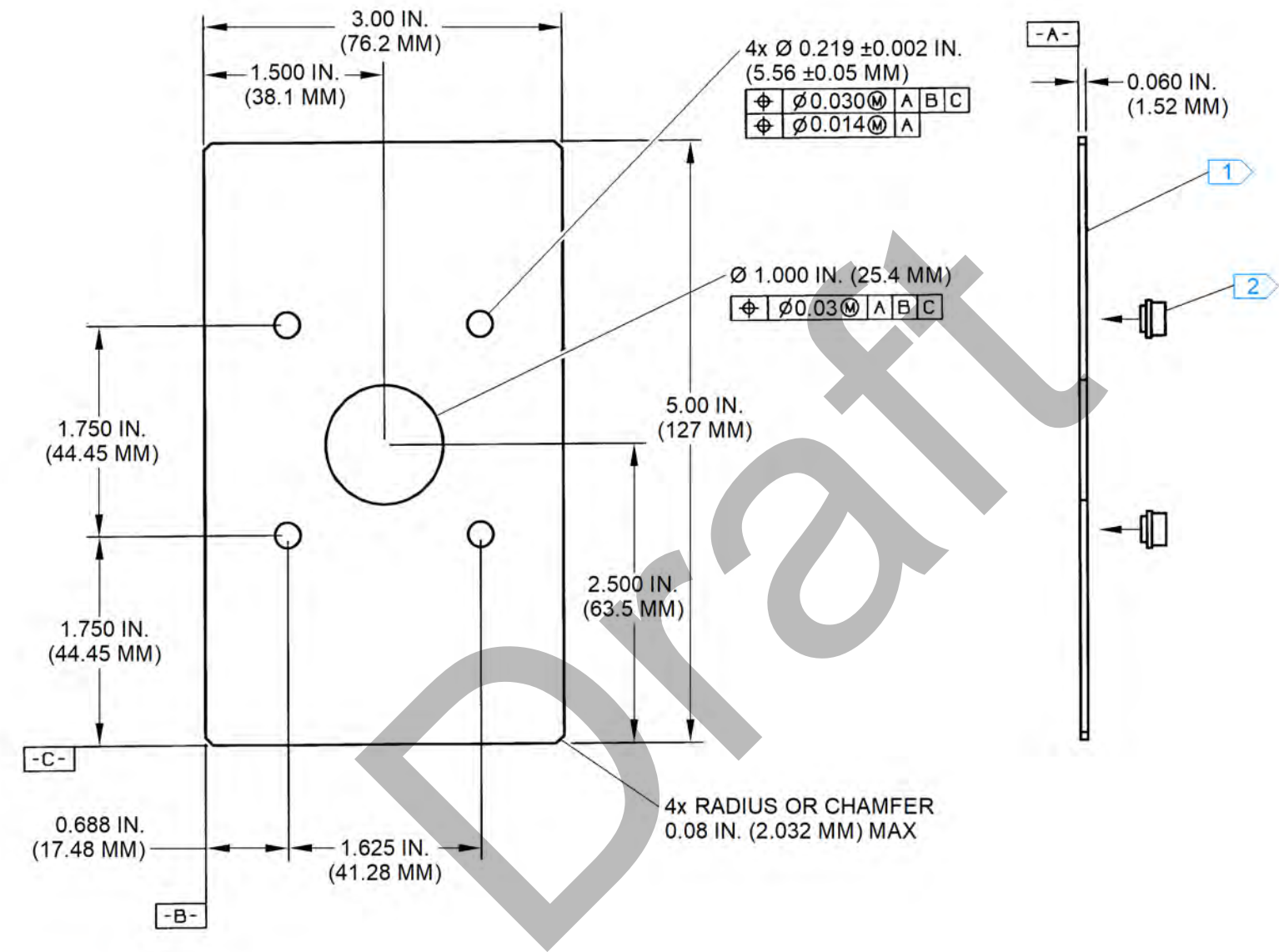
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Figure 2-11. KA 96/KA 97 Antenna Doubler Plate (047-10735-0000, Rev 1)

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Export Classification: EAR (7E994)

(6) Marker Beacon Antenna

- (a) When selecting a marker beacon antenna, the aerodynamics of the aircraft is considered. A low profile and low drag antenna, or a flush mounted antenna is used. Any antenna which meets the TSO requirements and operates at 75 MHz with a VSWR of less than 2:1 can be used as the marker beacon antenna. It has an impedance of 50 ohms and a hemispherical radiation pattern which consists of a single downward lobe. The antenna is polarized parallel to the axis of the fuselage.
- (b) The antenna should be mounted on the underside of the aircraft fuselage. This supplies a broad, single-lobed pattern directed downward for the reception of the 75 MHz marker signals. On dual VOR/ILS installations, if it is impractical to install two marker antennas a power divider can be used with some loss in sensitivity and reliability. Double shielded coax cable is recommended.

E. KTR 2280B Wiring and Cable Installation

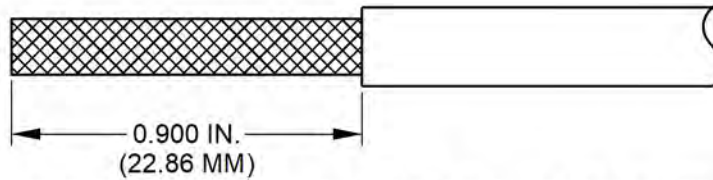
(1) KTR 2280B Interconnection and Cable Harness Fabrication

- (a) The KTR 2280B MMDR receives primary power from the aircraft power source. Aircraft specific interfaces are provided in separate EB or Installation Drawings, or Installation Drawings.
- (b) The length of the wires to parallel pins must be approximately the same length, so that the best distribution of current can be effected. Honeywell recommends that all wires, including spares, as provided with the interconnect definition information be included in the fabrication of the wiring harness. However, if full wiring is not desired, the installer must ensure that the minimum wiring requirements for the features and functions to be used have been incorporated.
- (c) When cables are installed in the aircraft, they must be supported firmly enough to prevent movement and must be carefully protected against chafing. Additional protection must also be provided in all locations where the cable can be subjected to chafing.
- (d) In wire bundles, the cabling must not be tied tightly together as this tends to increase the possibility of noise pickup and similar interference. When routing cables through the aircraft the cables must cross high-level RF lines at right angles.
- (e) Prior to installing any equipment, make a continuity check of all wires and cables associated with the system. Then apply power and check for proper voltages at system connectors, and then remove power before completing the installation.
- (f) The following guidelines are recommended:
 - 1 The installing facility will supply and fabricate all external cables. Refer Step C. for the recommended mating connectors.
 - 2 The unit must be kept a minimum of three feet from the antenna. Additionally, the antenna coax cable must not be bundled with the other wiring harnesses to the unit.

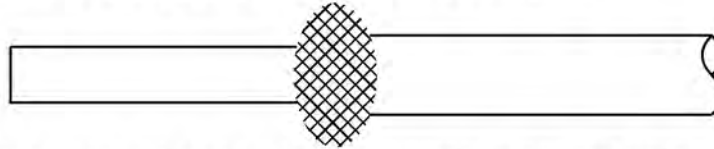
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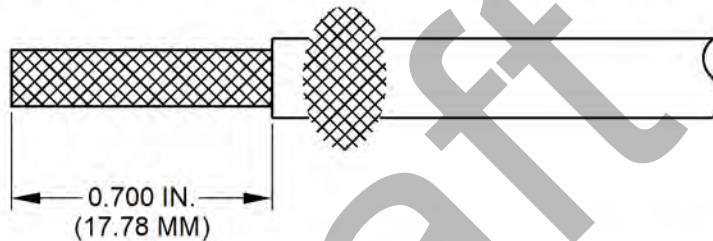
- 3 The length and routing of the external cables must be carefully planned before attempting the actual installation. Avoid sharp bends or locating the cable near aircraft control cables. The cables must be of a length to allow for a "maintenance loop". That is, the length must be adequate to access and extend the connectors aft of the panel for future maintenance purposes. Excess cabling must be secured and stowed by tie-wrapping until such maintenance is required.
 - 4 The cables must be supported firmly enough to prevent movement. They must be carefully protected wherever one can chafe against another or against some other object. Extra protection must be provided in all locations where the cables can be subject to chafe. Shields on shielded wires must be grounded in accordance with the system interconnection information.
 - 5 Shields must be carried through any obstruction through a thru-bulkhead connector. If shielding cannot be carried through by use of a bulkhead/connector pin, precautions must be taken to ensure each segment of the shielded lead be grounded at only one point. A ground connection of not more than two inches in length must be used. The preceding discussion does not apply to coaxial and quadraxial cable.
 - 6 Avoid routing cables near high noise and high-power sources.
- (g) Quadraxial Cable Preparation
- 1 For normal applications use RG142 or RG400, for low loss applications use RG393.



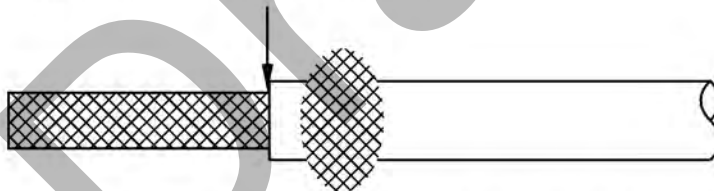
STEP 1. REMOVE THE OUTER INSTALLATION 0.900 INCH (22.86 MM) FROM THE END OF CABLE, EXPOSING THE OUTER SHIELD.



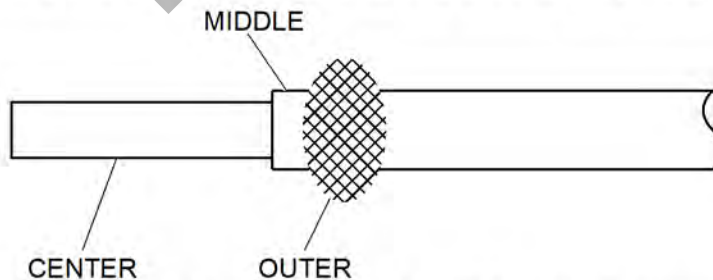
STEP 2. PUSH THE BRAID BACK AS FAR AS POSSIBLE. THIS WILL BE PULLED BACK UP LATER AND SOLDERED TO THE CONNECTOR BODY.



STEP 3. MEASURE BACK 0.700 INCH (17.78 MM) AND REMOVE THE OUTER INSULATION FROM THE MIDDLE SHIELD.



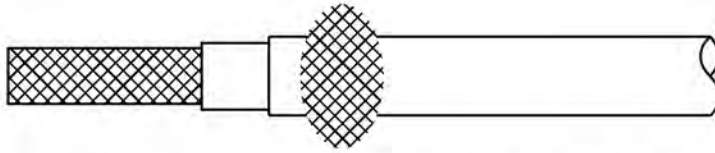
STEP 4. TIN THE EXPOSED SHIELD OF THE MIDDLE COAX. WITH A CUTTING TOOL, SCORE THE TINNED SHIELD AROUND THE ENTIRE CIRCUMFERENCE.



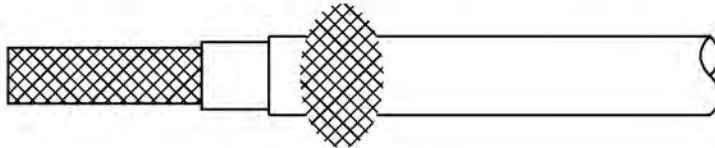
STEP 5. CAREFULLY BREAK LOOSE THE TINNED MIDDLE COAX SHIELD AND SLIDE IT OFF. THIS WILL EXPOSE THE CENTER COAX INSULATION.

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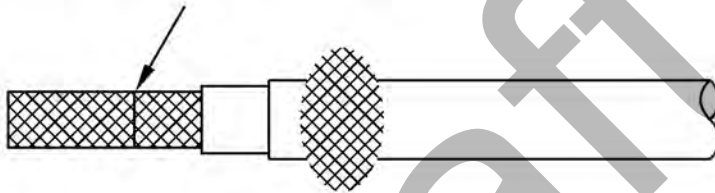
Figure 2-12. (Sheet 1 of 2) QuadraXial Cable Preparation



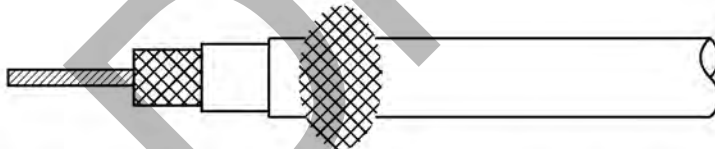
STEP 6. MEASURE BACK 0.500 INCH (12.70 MM) AND REMOVE THE INSULATION FROM THE CENTER SHIELD.



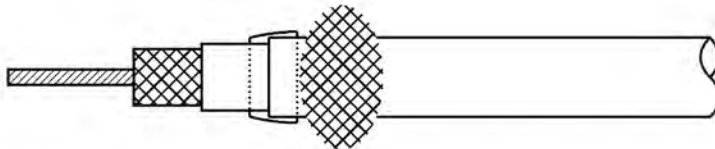
STEP 7. TIN THE SHIELD FOR THE CENTER COAX.



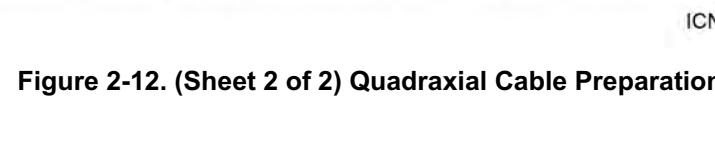
STEP 8. MEASURE BACK FROM THE END OF THE CABLE 0.30 INCH (7.6 MM) AND SCORE THE CENTER SHIELD WITH A CUTTING TOOL AROUND THE FULL CIRCUMFERENCE.



STEP 9. CAREFULLY BREAK THE SHIELD LOOSE. STRIP OFF THE INSULATION FROM THE CENTER CONDUCTOR.

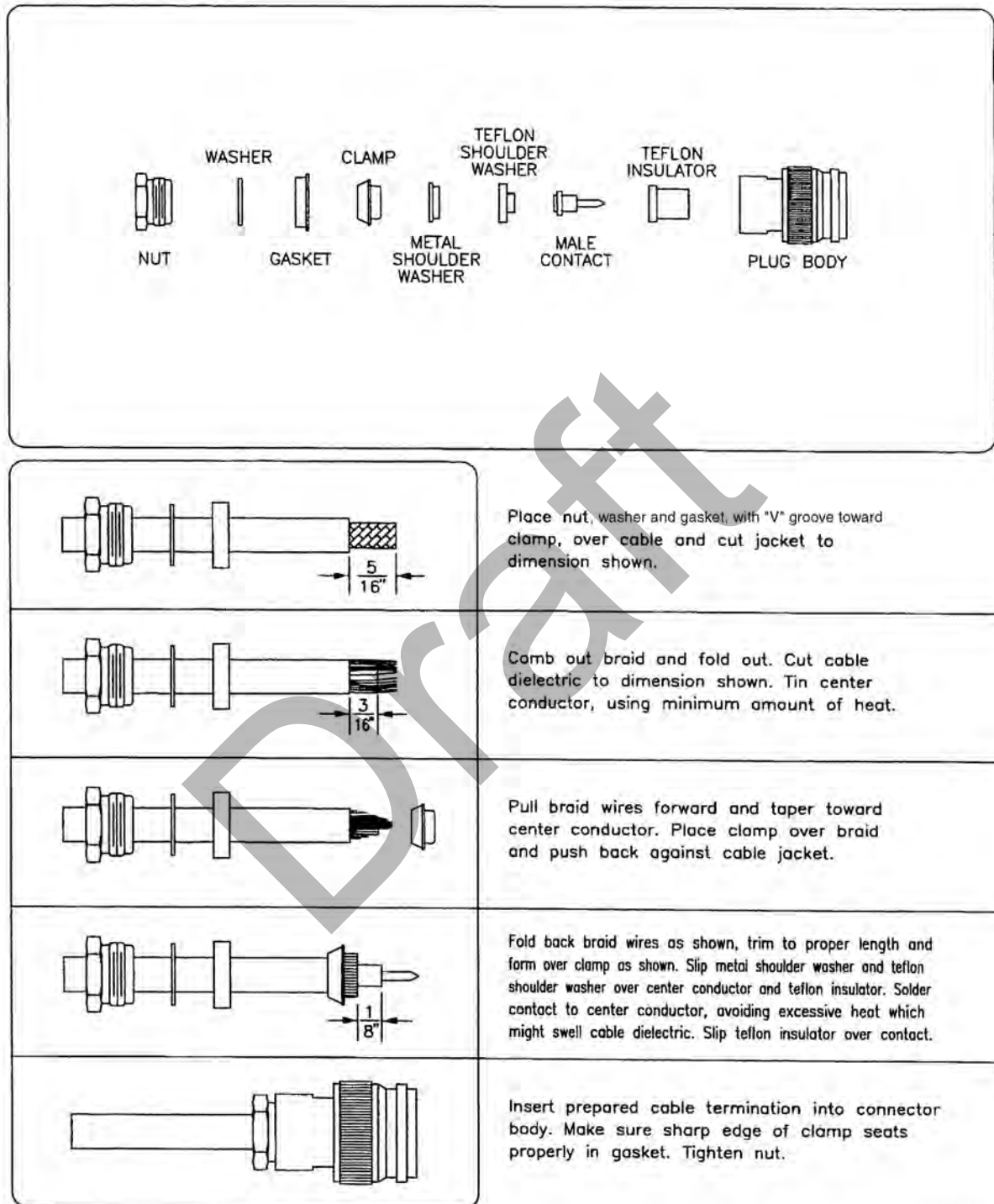


STEP 10. INSTALL 0.25 INCH (6.35 MM) LENGTH OF SHRINK TUBING OVER THE MIDDLE SHIELD STUB TO PREVENT POSSIBLE SHORTS TO THE OUTER SHIELD.



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Figure 2-12. (Sheet 2 of 2) Quadraxial Cable Preparation



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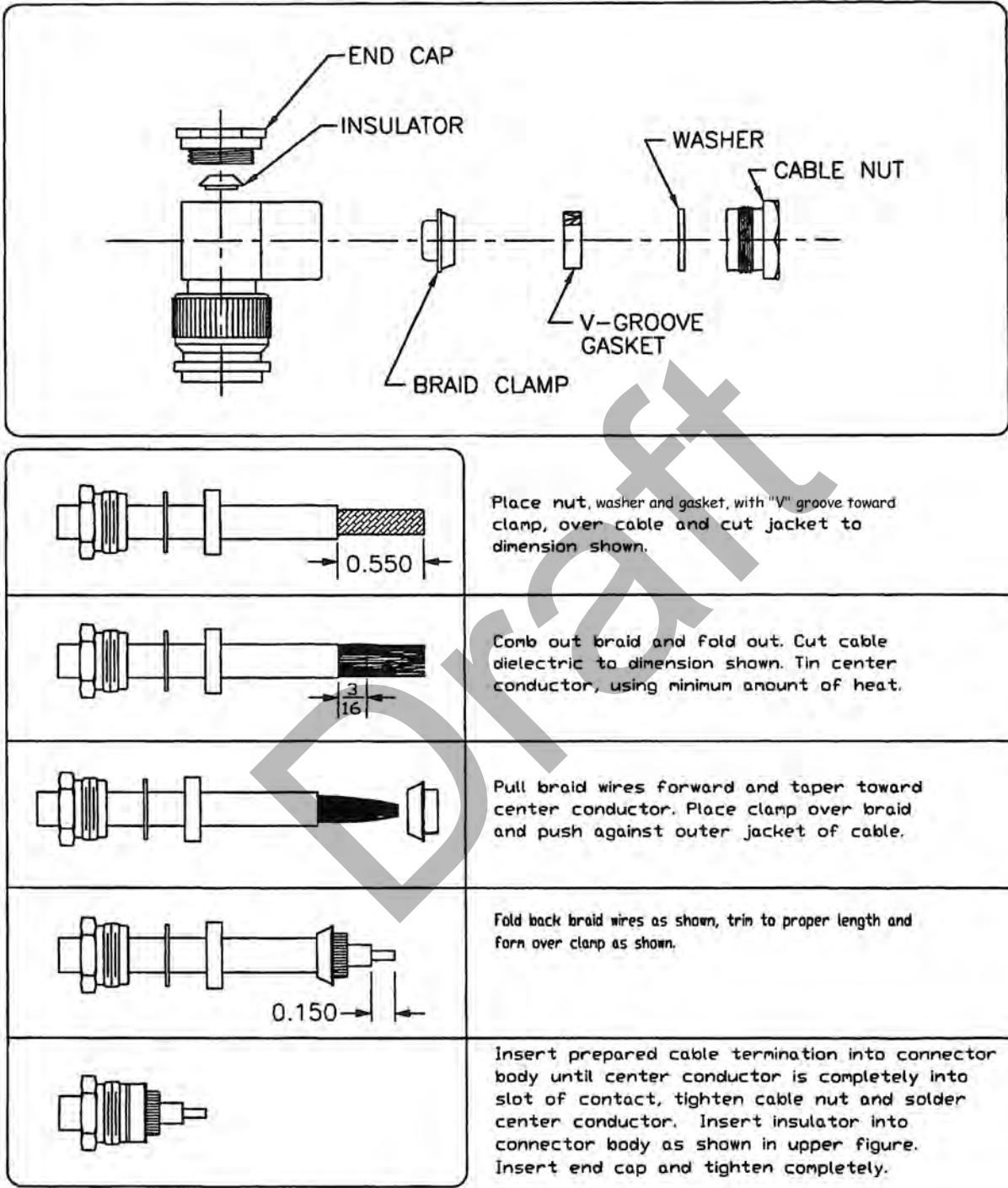
Figure 2-13. GNSS / Marker Beacon - TNC Antenna Coax with Straight Connector

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Figure 2-14. GNSS / Marker Beacon - TNC Antenna Coax with Right Angle Connector

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2 Primary Power and Circuit Breaker Requirements

- a The KTR 2280B MMDR receives primary power from the aircraft power circuit breakers. Power connections, wire sizes, and circuit breaker requirements can be found in the system installation manual and/or EB for a specific installation.

3 KTR 2280B MMDR Connectors

Table 2-6. KTR 2280B MMDR Connectors

Connector Name	Connector Type
Signal Connector (P1)	78 pin, Male, High Density, D-Subminiature
Signal Connector (P2)	44 Pin, Male, High Density, D-Subminiature
NAV Antenna (J1)	BNC, Female
GS Antenna (J2)	BNC, Female
ADF Antenna (J3)	BNC, Female
COM Antenna (J4)	BNC, Female
MB Antenna (J6)	BNC, Female
GNSS Antenna (J5)	TNC, Female

4 78 Pin Signal Connector

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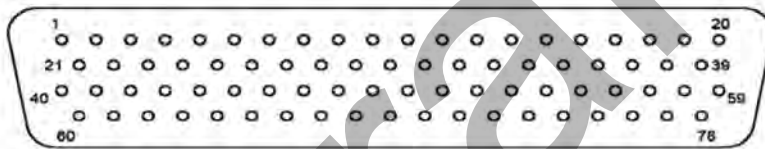
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Figure 2-15. 78 Pin Signal Connector Front View

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Table 2-7. 78 Pin Signal Connector Definition

PIN Number	PIN Name	Type	Function
1	DC Power 1 IN	Input	DC Power Input 1
2	Unit Pos PGM 1 ⁽¹⁾	Input	Used for LRU Identification
3	ADF ANT PWR OUT	Output	LRU and ADF antenna interface
4	RS-422 TX A	Output	RS-422 interface only used for testing purposes
5	RS-422 TX B	Output	RS-422 interface only used for testing purposes
6	Pgm Pin Common	Output	Provides ground path for LRU Identification pins
7	FAN 12V OUT	Output	To power the Internal fan (External Connector)
8	PGM3 ⁽¹⁾	Input	Used for LRU Identification
9	PGM6 ⁽¹⁾	Input	Used for LRU Identification
10	GND	Output	DC ground
11	GND	Output	DC ground
12	GND	Output	DC ground
13	GND	Output	DC ground
14	MAC_BUS_A1_LO	Input/Output	High speed serial time-multiplexed triplex bus used to transfer audio, control, and status information
15	MAC_BUS_A1_HI	Input/Output	High speed serial time-multiplexed triplex bus used to transfer audio, control, and status information
16	GND	Output	DC ground
17	GND	Output	DC ground
18	TEST ⁽¹⁾ IN	Input	Command to radio to enter Test mode
19	COM MIC Audio IN	Input	COM Tx Mic Audio input
20	COM MIC GND	Input	COM Tx Mic Ground
21	DC Power 2 IN	Input	DC Power Input 2
22	Unit Pos PGM 2 ⁽¹⁾	Input	Used for LRU Identification
23	ADF ANT PWR Return	Input	LRU and ADF antenna interface
24	RS-422 RX A	Input	RS-422 interface only used for testing purposes
25	RS-422 RX B	Input	RS-422 interface only used for testing purposes
26	PIO 0 TX (RS 232 - GNSS)	Output	RS-232 serial interface to allow the GNS receiver to output the PVT, measurement, and deviation data for test purpose.
27	A429 GNSS In #1 A	Input	GNSS ARINC 429 Input from FMS/IRS
28	PGM4 ⁽¹⁾	Input	Used for LRU Identification

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Table 2-7. 78 Pin Signal Connector Definition (Cont)

PIN Number	PIN Name	Type	Function
29	Ethernet 1 TX-	Output	LRU Ethernet Interface #1
30	Ethernet 1 TX+	Output	LRU Ethernet Interface #1
31	Ethernet 2 TX-	Output	LRU Ethernet Interface #2 (Growth)
32	Ethernet 2 TX+	Output	LRU Ethernet Interface #2 (Growth)
33	GND	Output	DC ground
34	GND	Output	DC ground
35	GND	Output	DC ground
36	MAC_BUS_B1_LO	Input/Output	High speed serial time-multiplexed triplex bus used to transfer audio, control and status information
37	MAC_BUS_B1_HI	Input/Output	High speed serial time-multiplexed triplex bus used to transfer audio, control and status information
38	COM MIC Key ⁽¹⁾ IN	Input	Command to enable COM Transmitter
39	COM TX Interlock ⁽¹⁾ IN	Input	Signifies that another COM Voice Tx has been keyed and own COM Rx needs to be desensitized
40	DC Return 1	Output	DC Power Return 1
41	Unit Pos Parity ⁽¹⁾	Input	Parity for the Unit position program pins
42	ADF MOD 0 OUT	Output	LRU and ADF antenna interface
43	A429 GNSS Out #1 A	Output	ARINC 429 GNSS Output
44	Time Mark Out #1 (A)	Output	GPS Time Mark, RS-422 serial output
45	Time Mark Out #1 (B)	Output	GPS Time Mark, RS-422 serial output
46	A429 GNSS Out #2 A	Output	ARINC 429 GNSS Output
47	A429 GNSS In #1 B	Input	GNSS ARINC 429 Input from FMS/IRS
48	PGM7 ⁽¹⁾	Input	Used for LRU Identification
49	GND	Output	DC ground
50	GND	Output	DC ground
51	GND	Output	DC ground
52	GND	Output	DC ground
53	MAC_BUS_A2_LO	Input/Output	High speed serial time-multiplexed triplex bus used to transfer audio, control and status information

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Table 2-7. 78 Pin Signal Connector Definition (Cont)

PIN Number	PIN Name	Type	Function
54	MAC_BUS_A2_HI	Input/Output	High speed serial time-multiplexed triplex bus used to transfer audio, control and status information
55	GND	Output	DC ground
56	GND	Output	DC ground
57	Download ⁽¹⁾ IN	Input	Command to radio to enter Download mode (Shop Load)
58	COM Audio/Sidetone HI OUT	Output	COM Audio and Sidetone Output
59	COM Audio/Sidetone LO OUT	Output	COM Audio and Sidetone Output
60	DC Return 2	Output	DC Power Return 2
61	ADF MOD 90 OUT	Output	LRU and ADF antenna interface
62	ADF Loop Enable OUT	Output	LRU and ADF antenna interface
63	A429 GNSS Out #1 B	Output	ARINC 429 GNSS Output
64	Time Mark Out #2 (A)	Output	GPS Time Mark, RS-422 serial output
65	Time Mark Out #2 (B)	Output	GPS Time Mark, RS-422 serial output
66	A429 GNSS Out #2 B	Output	ARINC 429 GNSS Output
67	PGM5 ⁽¹⁾	Input	Used for LRU Identification
68	Ethernet 1 RX-	Input	LRU Ethernet Interface #1
69	Ethernet 1 RX+	Input	LRU Ethernet Interface #1
70	Ethernet 2 RX-	Input	LRU Ethernet Interface #2 (Growth)
71	Ethernet 2 RX+	Input	LRU Ethernet Interface #2 (Growth)
72	GND	Output	DC ground
73	GND	Output	DC ground
74	GND	Output	DC ground
75	MAC_BUS_B2_LO	Input/Output	High speed serial time-multiplexed triplex bus used to transfer audio, control and status information
76	MAC_BUS_B2_HI	Input/Output	High speed serial time-multiplexed triplex bus used to transfer audio, control and status information

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Table 2-7. 78 Pin Signal Connector Definition (Cont)

PIN Number	PIN Name	Type	Function
77	Emergency Channel ⁽¹⁾ IN	Input	Command to change the COM channel to the emergency channel
78	VDL Interlock IN OUT ⁽¹⁾	Input/Output	Signifies that another COM Tx is transmitting in VDL or COM Voice Mode and own COM Rx needs to be desensitized

NOTE:

(1) indicates the Pin is active GND.

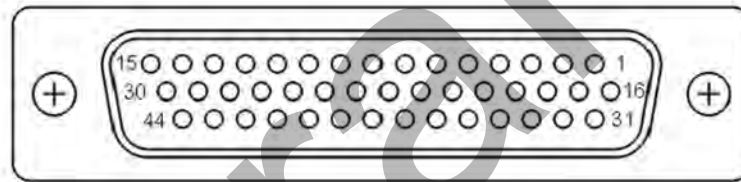
5 44 Pin Signal Connector

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Figure 2-16. 44 Pin Signal Connector Front View

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Table 2-8. 44 Pin Signal Connector Definition

PIN Number	PIN Name	Type	Function
1	NAV Audio HI OUT	Output	VOR/LOC Analog audio output
2	NAV Audio LO OUT	Output	VOR/LOC Analog audio output
3	GND	Output	DC ground
4	ADF Audio HI OUT	Output	ADF Analog audio output
5	ADF Audio LO OUT	Output	ADF Analog audio output
6	Spare	N/A	N/A
7	Spare	N/A	N/A
8	Spare	N/A	N/A
9	Spare	N/A	N/A
10	Spare	N/A	N/A
11	A429 Tuning In #2 B	Input	ARINC 429 Tuning Interface
12	A429 Tuning In #2 A	Input	ARINC 429 Tuning Interface
13	A429 CMU Out B	Output	ARINC 429 Datalink Interface
14	A429 Tuning Out B	Output	ARINC 429 Tuning Interface
15	A429 Tuning Out A	Output	ARINC 429 Tuning Interface
16	GND	Output	DC ground
17	GND	Output	DC ground
18	GND	Output	DC ground
19	GND	Output	DC ground
20	GND	Output	DC ground
21	Spare	N/A	N/A
22	Spare	N/A	N/A
23	Spare	N/A	N/A
24	Spare	N/A	N/A
25	GND	Output	DC ground
26	Spare	N/A	N/A
27	GND	Output	DC ground
28	A429 CMU Out A	Output	ARINC 429 Datalink Interface
29	GND	Output	DC ground
30	GND	Output	DC ground
31	MB Audio HI OUT	Output	MB Analog audio output
32	MB Audio LO OUT	Output	MB Analog audio output
33	GND	Output	DC ground

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Table 2-8. 44 Pin Signal Connector Definition (Cont)

PIN Number	PIN Name	Type	Function
34	AUX COM Audio HI OUT	Output	Auxiliary COM Analog audio output
35	AUX COM Audio LO OUT	Output	Auxiliary COM Analog audio output
36	Spare	N/A	N/A
37	Spare	N/A	N/A
38	Spare	N/A	N/A
39	A429 GNSS In #2 B	Input	GNSS ARINC 429 Input from FMS/IRS
40	A429 GNSS In #2 A	Input	GNSS ARINC 429 Input from FMS/IRS
41	A429 CMU In B	Input	ARINC 429 Datalink Interface
42	A429 CMU In A	Input	ARINC 429 Datalink Interface
43	A429 Tuning In #1 B	Input	ARINC 429 Tuning Interface
44	A429 Tuning In #1 A	Input	ARINC 429 Tuning Interface

6

KA 44B Mating Connector

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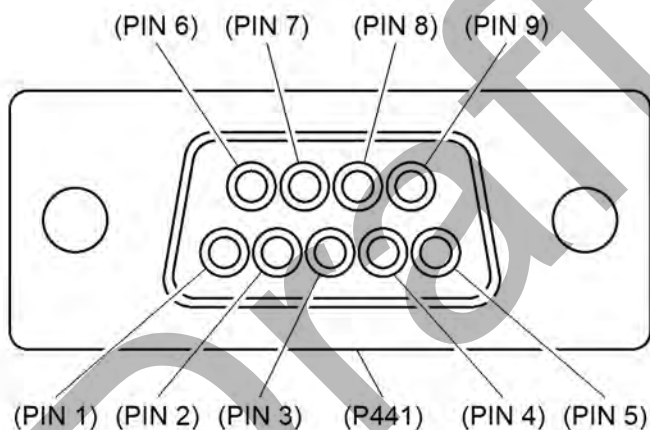
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Figure 2-17. KA 44B Mating Connector Front View

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Table 2-9. KA 44B Pin Functions

PIN	I/O	SIGNAL NAME
1	I	ANTENNA POWER
2	I	LOOP ENABLE
3	O	RF INPUT
4	I	ADF MOD 90 Out
5	I	ADF MOD 0 Out
6		NO CONNECTION
7		GROUND
8		INNER SHIELD
9		MIDDLE/OUTER SHIELD

3. Post-Installation Checks

A. **KTR 2280B MMDR Post-Installation Inspection and Ground Test**

(1) Inspection

- (a) Table 2-10 is a visual inspection/check procedure that must be performed after system installation as part of a system checkout. A post-installation test per Paragraph 3.A. Step (2) Ground Tests must be performed. In addition, the procedure must be used as a periodic maintenance inspection check.

Table 2-10. Inspection/Check Procedure

Equipment	Inspection/Check Procedure
KTR 2280B MMDR	A. Inspect external surface for damage.
	B. Check that the unit is securely installed and that retaining mechanism is securely tightened.
	C. Ensure that all connections in the mounting tray are properly mounted and secure.
Antennas	A. Inspect external surfaces for damage.
	B. Check that antenna is properly mounted and mounting screws are tight.
	C. Ensure that antenna coaxial cable connectors are properly mated and secure.

- (b) Perform the following inspections on the overall system:

- 1 Check that cables do not interfere with aircraft controls or other equipment.
- 2 Check cabling for proper routing and check security of tie-down points. Inspect and adjust cable runs to ensure that cables are not strained, kinked, or severely twisted and are not exposed to rough or sharp surfaces. To check the aircraft and MMDR system interconnections proceed as follows:

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(c) System Inter-wiring Check

- 1 To check the aircraft and MMDR system interconnections proceed as follows:
 - a Check that all cables and inter-wiring are installed in accordance with the inter-wiring and cable harness fabrication instructions (Refer to Paragraph 2.E. Step (1) KTR 2280B Interconnection and Cable Harness Fabrication).
 - b Using the applicable interconnection information, check wiring for proper destinations, opens and shorts.
 - c Check RF cables for insertion loss and VSWR.

(d) Visual Inspection

- 1 In conjunction with system installation, perform the inspection/check procedure. Refer to Table 2-10.

(2) Ground Tests

(a) Post-Installation Test (NAV/COM Functionality)

- 1 Perform a ground check of the installation before the flight test. Using a local frequency, confirm that the COM function can receive and transmit a modulated signal. Using a ramp tester, confirm that VOR, LOC, and GS needle deflections move in the correct direction, the To/From flag is the proper sense, and that the warning flags are functioning properly. Check all aircraft control movements to be sure no electrical cables interfere with their operation.

CAUTION: AS AN ADDED PRECAUTION BEFORE ANY FLIGHT TESTS, CHECK THE ANTENNA. VSWR MUST BE CHECKED WITH AN IN-LINE TYPE WATTMETER INSERTED IN THE COAXIAL TRANSMISSION LINE BETWEEN THE TRANSCEIVER AND THE ANTENNA. ANY PROBLEM WITH THE ANTENNA INSTALLATION WILL MOST LIKELY BE SEEN AS A HIGH REFLECTED POWER.

NOTE: Installed system transmitter power may show considerably less than the manufacturer's rating of 16 W (minimum). There are several reasons for this:

- 1 It is not uncommon for an installation to have up to as much as 1 dB of RF transmission line cable loss. This would reduce a 16 W transmitter output to 12.7 W.
- 2 RF power meter test equipment that has an accuracy of ± 0.3 dB would cause power reading variations as high as ± 1 W.
- 3 The effect of antenna VSWR in a given installation will affect the output power. The VSWR is a function of the antenna design itself, aircraft skin properties and proximate metallic features of the airframe, and the size of the metallic surface the antenna is bonded to. Note that the committees that wrote the Minimum Operation Performance Standards to which the VHF COM system

is TSO'd are aware of this characteristic. They have established that transmitter power for a 16 W (minimum) transmitter must not drop below 8.0 W into a 2:1 VSWR and 6.4 W into a 3:1 VSWR (Refer to RTCADO-186B and EUROCAE ED-23C).

(b) Post-Installation Test (ADF Functionality)

1 A quick preliminary check can be made by tuning to a local AM broadcast station or a strong NDB station. Check for satisfactory audio (this must be done where clear reception is possible, preferably outside of the hangar).

2 Quadrantal Error Adjustments

a The system has been factory adjusted to compensate for a typical airframe. Therefore, little or no compensation must be required. Nonetheless, the KTR 2280B provides soft-ware adjustment of Quadrantal Error (the average amount of quadrantal error (QE) that exists due to the shape of the airframe). The values for these alignments are stored within the aircraft system maintenance computer and downloaded to the KTR 2280B on power up. If this download does not occur the KTR 2280B uses the last values that were loaded. The KA 44B ADF antenna, like most modern ADF antennas, can have inherent errors at the quadrantal (45°, 135°, 225° and 315°) bearings relative to the antenna's bore site. The following procedure details the process for setting a KTR 2280B configuration parameter to allow the radio to automatically compensate for these inherent errors. It is very important that this procedure be followed exactly as stated to ensure these quadrantal bearings are properly compensated. This procedure can be carried out at any location, however care must be exercised to ensure that the chosen location is magnetically "clean". Usually an airfield's compass rose location is a good choice since magnetically "clean" is one of the criteria for establishing compass rose location.

NOTE: Ensure that QE = 0 is the value being fed or the last value that was fed to the KTR 2280B before performing this procedure.

b Point the nose of the aircraft directly at the emitter (NDB or AM broadcast radio station) being used for this purpose. Confirm this orientation by verifying the ADF indicator's bearing pointer is pointing directly to the lubber line (aircraft nose reference).

c Record the magnetic heading of the aircraft using the aircraft directional gyro or magnetic compass.

d Using the aircraft's directional gyro or magnetic compass as a guide, rotate the aircraft 45° to the left such that the aircraft magnetic heading is now 45° less than the value found in Step c.

e Record the number of degrees by which the ADF bearing has moved relative to the ADF indicator's lubber line. (This number must be a positive number and must be approximately 45°). Log this number as Bearing_45.

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- f Using the aircraft's directional gyro or magnetic compass as a guide, rotate the aircraft another 45° to the left so that the magnetic heading is now 90° less than the value found in Step c.
- g Record the number of degrees by which the ADF bearing indication has moved relative to the ADF indicator's lubber line. (This number must be a positive number and must be approximately 90°).
- h Confirm that the value in Step g is within $\pm 5^\circ$ of 90° . If not, the aircraft has a magnetic anomaly that precludes the ability to calculate an acceptable QE adjustment. The QE alignment process must terminate at this point and not resume until any aircraft related anomalies have been corrected.

NOTE: Problems with this step could also be due to the airfield location where the QE alignment procedure is being performed if that location is not magnetically "clean".

- i Using the aircraft's directional gyro or magnetic compass as a guide, rotate the aircraft another 45° to the left so that the magnetic heading is now 135° less than the value found in Step c.
- j Record the number of degrees by which the ADF bearing indication has moved relative to the ADF indicator's lubber line. (This number must be a positive number and must be approximately 135°). Log this number as Bearing_135.
- k Using the aircraft's directional gyro or magnetic compass as a guide, rotate the aircraft another 45° to the left so that the aircraft magnetic heading is now 180° less than the value found in Step c.
- l Record the number of degrees by which the ADF bearing indication has moved relative to the ADF indicator's lubber line. (This number must be a positive number and must be approximately 180°).
- m Confirm the value recorded in Step l is within $\pm 5^\circ$ of 180° . If not, the aircraft has a magnetic anomaly that precludes the ability to calculate an acceptable QE adjustment. The QE alignment process must terminate at this point and not resume until the aircraft related anomalies have been corrected.

NOTE: Problems with this step could also be due to the airfield location where the QE alignment procedure is being performed if that location is not magnetically "clean".

- n Using the aircraft's directional gyro or magnetic compass as a guide, rotate the aircraft another 45° to the left so the aircraft magnetic heading is now 225° less than the value found in Step c.
- o Record the number of degrees by which the ADF bearing indication has moved relative to the ADF indicator's lubber line.

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(This number must be a positive number and must be approximately 225°). Log this number as Bearing_225.

p Using the aircraft's directional gyro or magnetic compass as a guide, rotate the aircraft another 45° to the left so that the aircraft magnetic heading is now 270° less than the value found in Step c.

q Record the number of degrees by which the ADF bearing indicator has moved relative the ADF indicator's lubber line (This number must be a positive number and must be approximately 270°).

r Confirm the value recorded in Step q is within $\pm 5^\circ$ of 270°. If not, the aircraft has a magnetic anomaly that precludes the ability to calculate an acceptable QE adjustment. The QE alignment process must terminate at this point and not resume until the aircraft related magnetic anomalies have been corrected.

NOTE: Problems with this step could also be due to the airfield location where the QE alignment procedure is being performed if that location is not magnetically "clean".

s Using the aircraft's directional gyro or magnetic compass as a guide, rotate the aircraft another 45° to the left so that the aircraft magnetic heading is now 315° less than the value found in Step c.

t Record the number of degrees by which the ADF bearing indicator has moved relative to the ADF indicator's lubber line. (This number must be a positive number and must be approximately 315°). Log this number as Bearing_315.

u Using the following formulas, calculate the QE offset:

$QE_{45} = 45 - \text{Bearing}_{45}$ (This could be a negative number if Bearing_45 is > 45)

$QE_{135} = \text{Bearing}_{135} - 135$ (This could be a negative number if Bearing_135 is < 135)

$QE_{225} = 225 - \text{Bearing}_{225}$ (This could be a negative number if Bearing_225 is > 225)

$QE_{315} = \text{Bearing}_{315} - 315$ (This could be a negative number if Bearing_315 is < 315)

$QE = ((QE_{45}) + (QE_{135}) + (QE_{225}) + (QE_{315})) / (4)$

v Enter the value calculated in Step u into the KTR 2280B Parameter table in Paragraph 4

w Recheck the relative bearings and readjust the QE compensation as necessary to split the error at the quadrantal points (45°, 135°, 225° and 315°) to obtain the lowest possible error.

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3 Operational Checks

- a The following operational checks are to verify proper operation of the ADF function of the KTR 2280B and can be made with the aircraft in the parking area.

- (1) Place the ADF in the ANT mode and tune in several known stations. Verify that audio reception is satisfactory and that volume control operation is normal. Verify that the ADF indicator needle is parked at the 90-degree position relative to the noise of the aircraft. Place the unit in the ADF mode and verify that the needle points to the station.
- (2) Select the BFO function to enter the BFO mode and verify that the BFO tone is present in the receiver audio (if a keyed CW station is used the tone heard will be the coded identifier).
- (3) Post-Installation Test (GNSS Functionality)
 - (a) Satellite acquisition will be accomplished within 15 minutes.
 - (b) Check the system displays for valid GPS display to confirm unit is transmitting valid data.
 - (c) Confirm with secondary GPS unit that position is the same.

B. KTR 2280B Post-Installation Flight Tests

(1) COM Transceiver Flight Test

- (a)** To check the COM transceiver, maintain altitude of at least 1500 feet and contact a ground station facility at a range of at least fifty nautical miles. Contact a ground station close in. Disable the automatic squelch and listen for any unusual electrical noise which would reduce the COM receiver sensitivity by increasing the squelch threshold. If possible, verify the communications capability on both the high and low end of the VHF COM band. Ensure that the COM mode selector is capable of individually selecting all three modes (one mode at a time).

(2) NAV Receiver Flight Test

- (a)** To check the VOR/ILS system, select a VOR frequency within a forty nautical mile range. Listen to the VOR audio and ensure that no electrical interference such as magneto noise is present. Check the tone identifier filter operation. Fly inbound and outbound on a selected VOR radial and check for proper LEFT-RIGHT and TO-FROM indications. Check the VOR accuracy.

NOTE: VOR ground station scalloping may be present.

- (b)** To check the localizer and glideslope functions, select an appropriate ILS frequency and fly an approach to the proper runway. Check for proper LEFT-RIGHT and UP-DOWN indications.

(3) ADF Receiver Flight Test

- (a) Confirm that bearing indications to several local NDB facilities appear reasonable. Listen to the ADF audio and ensure that no unusual electrical interference is present.

4. KTR 2280A Installation Parameter Modifications

- A. The KTR 2280B has several parameters that can be adjusted during installation in order to conform the unit to a given installation. Parameter modifications must only be performed by a qualified avionics technician. Table 2-11 Unit Parameters, lists the KTR 2280B adjustments accessible by the technician to facilitate the unit installation.

NOTE: KTR 2280B units sent to the factory for repair will be returned to service with their factory defaults reset as shown in Table 2-11.

- B. The method for setting these parameters is a function of the specific installed system and the user interface used for personality module settings. Refer to the appropriate STC Installation Manual for specific instructions. The KTR 2280B responds to installed system personality module settings through high speed ARINC 429 labels 300, 301, 302, 303, 304 and 305. These labels occur periodically at a 1 Hz rate.

Table 2-11. Unit Parameters

Parameter	MMDR Factory Default	Minimum Setting	Maximum Setting	Resolution
COM Carrier Squelch (-dBm)	88	85	100	1
COM Emergency Freq. (MHz)	121.500	118.000	136.990	(1)
COM Emergency Volume (dB) ⁽²⁾	20	0	72	1
COM Sidetone Level (dB) ⁽²⁾	52	0	72	1
COM Squelch (SNR dB)	12	3	20	1
COM Microphone Gain ⁽³⁾	21	0	31	(4)
ADF QE Offset (degrees)	0	-20	+20	0.1
ADF Damping Value (Seconds) ⁽⁵⁾	0 (0.16 seconds)	0	10	1
VOR Damping Value (Seconds) ⁽⁶⁾	0 (0.96 seconds)	0	10	1
Localizer Damping Value (Seconds) ⁽⁷⁾	0 (0.96 seconds)	0	30	0.1
Glideslope Damping Value (Seconds) ⁽⁸⁾	0 (0.96 seconds)	0	30	0.1

NOTES:

(1) 8.33 kHz channel spacing

(2) This setting represents attenuation (in dB) relative to rated audio output level.

(3) This setting is a relative number only. Each numeric value represents a change of 1.5 dB. Nominal setting, which represents the level provided by typical microphones, is the default numeric value of 21. This control provides amplification (for unusually

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weak microphones) of up to 15 dB (setting of 31) or attenuation (for extra sensitive microphones) of up to 31.5 dB (setting of 0) relative to the default.

- (4) Each resolution increment is equivalent to 1.5 dB. Total range is -31.5 dB to 15.0 dB.
- (5) If ADF Damping Value of 0 is received, the MMDR will set the ADF damping to its factory default value of 0.16 seconds.
- (6) If VOR Damping Value of 0 is received, the MMDR will set the VOR damping to its factory default value of 0.96 seconds.
- (7) If Localizer Damping Value of 0 is received, the MMDR will set the Localizer damping to its factory default value of 0.96 seconds. Valid timing range is 0.5 - 3.0 seconds in 0.5 second resolution. Input will be divided by 10 and rounded to nearest 0.5 seconds.
- (8) If Glideslope Damping Value of 0 is received, the MMDR will set the Glideslope damping to its factory default value of 0.96 seconds. Valid timing range is 0.5 - 3.0 seconds in 0.5 second resolution. Input will be divided by 10 and rounded to nearest 0.5 seconds.

5. ARINC 429 Interface

- A. The KTR 2280B has four high speed ARINC 429 transmitters (A429 Tuning Out, A429 CMU Out, A429 GNSS Out #1 and A429 GNSS Out #2) and five high speed ARINC 429 receivers (A429 Tuning In #1, A429 Tuning In #2, A429 CMU In, A429 GNSS In #1 and A429 GNSS IN #2).

- (1) ARINC 429 tuning Inputs

Table 2-12. A429 Tuning In #1 / A429 Tuning In #2

Label	Function	Parameter Name	Expected interval (ms)
034	NAV	Set VOR/ILS Frequency	200
053	NAV	Set VOR/ILS Standby (Preset) Frequency	200
265	NAV	Set VOR/ILS Volume	200
030	COM	Set VHF COM Frequency	200
047	COM	Set VHF Aux/Guard COM Frequency	200
052	COM	Set VHF COM Standby (Preset) Frequency	200
266	COM	Set VHF COM Volume	200
263	COM	Set VHF Aux/Guard COM Volume	200
032	ADF	Set ADF Frequency	200
262	ADF	Set ADF Volume	200
150	CLOCK	GMT(UTC)	1000
260	CLOCK	Date	1000
151	CMC	Flight Leg	1000
300	APM	MMDR Configuration Options #1	1000
301	APM	MMDR Configuration Options #2	1000
302	APM	MMDR Configuration Options #3	1000
303	APM	MMDR Configuration Options #4	1000
304	APM	MMDR Configuration Options #5	1000
305	APM	MMDR Configuration Options #6	1000

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Table 2-12. A429 Tuning In #1 / A429 Tuning In #2 (Cont)

Label	Function	Parameter Name	Expected interval (ms)
227	CMC	CMC Command and Control	1000
276	VDL	VDR Mode Command	500
033	VDB	Landing Mode/Frequency	200
306	APM	MMDR Configuration Options #7	1000
312	Data load	Ground Speed	200

(2) ARINC 429 Tuning Outputs

Table 2-13. A429 Tuning Out

Label	Function	Parameter Name	Interval (ms)
034	NAV	VOR/ILS Frequency	200
053	NAV	VOR/ILS Standby (Preset) Frequency	200
265	NAV	VOR/ILS Volume	200
242	NAV	VOR/ILS Station Ident (Chars 1-2)	200
244	NAV	VOR/ILS Station Ident (Chars 3-4)	200
173	NAV	Localizer Deviation	100
174	NAV	Glideslope Deviation	100
222	NAV	VOR Bearing	100
030	COM	VHF COM Frequency	200
047	COM	VHF Aux/Guard COM Frequency	200
052	COM	VHF COM Standby (Preset) Frequency	200
266	COM	VHF COM Volume	200
263	COM	VHF Aux/Guard COM Volume	200
267	COM	VHF COM Status	200
032	ADF	ADF Frequency	200
262	ADF	ADF Volume	200
162	ADF	ADF Bearing	100
350	CMC	Member System Status	1000
352	CMC	MMDR System Fault Report	1000
377	CMC	Member System Identification	1000
033	VDB	Landing Mode/Frequency	200

(3) ARINC 429 CMF/CMU Inputs

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Table 2-14. A429 CMU In

Label	Function	Parameter Name	Expected Interval (ms)
172	VDL	System Address Label	1000
251	VDL	Williamsburg BOP VDR #1	Burst
252	VDL	Williamsburg BOP VDR #2	Burst
253	VDL	Williamsburg BOP VDR #3	Burst
270	VDL	Apex CMU Status Word 1	1000
276	VDL	Apex CMU Status Word 2	1000
214	VDL	Aircraft ICAO Address 1	1000
216	VDL	Aircraft ICAO Address 2	1000

(4) ARINC 429 CMU/CMF Outputs

Table 2-15. A429 CMU Out

Label	Function	Parameter Name	Interval (ms)
172	VDL	System Address Label (SAL)	1000
270	VDL	VDR Status Word	1000
304	VDL	Williamsburg BOP	Burst
377	VDL	VDR Equipment ID	1000

(5) ARINC 429 GNSS Inputs

Label (Oct)	Parameter	Signal Format	Rate (ms)
033	Landing Mode/Freq	(f)	333
040	Set Altitude	BCD	Paragraph (a)
041	Set Latitude	BCD	Paragraph (a)
042	Set Longitude	BCD	Paragraph (a)
045	Message Block Start	BLOCK	Paragraph (d)
046	Message Block Body	BLOCK	Paragraph (d)
125	UTC	BCD	667
143	Destination Longitude	BNR	Paragraph (b)
144	Destination Latitude	BNR	Paragraph (b)
146	Satellite Deselect #1	DISC	Paragraph (b)
150	UTC	BNR	160
152	Destination ETA	BNR	Paragraph (b)
157	Input Discretes	DISC	Paragraph (e)

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Label (Oct)	Parameter	Signal Format	Rate (ms)
167	Alt. Waypoint ETA	BNR	Paragraph (b)
170	Satellite Deselect #2	DISC	Paragraph (b)
203	Altitude	BNR	62.5
204	Baro Corrected Altitude	BNR	62.5
214	Alt. Waypoint Latitude	BNR	Paragraph (b)
216	Alt. Waypoint Longitude	BNR	Paragraph (b)
227	Command Word	DISC	Paragraph (c)
260	Date	BCD	800
304	Command Summary	Packed	Paragraph (c)
305	SBAS PA Mode & SP Selection	DISC	333
310	Latitude	BNR	100
311	Longitude	BNR	100
314	True Heading	BNR	40
324	Pitch Angle	BNR	40
325	Roll Angle	BNR	40
361	Altitude - Inertial	BNR	40

- (a) The GNS receiver shall accommodate these labels being transmitted in Burst mode in one of the following manners:
- four pairs with 250 ms between pairs
 - two per sec for 1 sec or 500 ms burst with 12 ms between successive labels
 - four pairs with 300 ms between bursts.

NOTE: The algorithm used satisfies all burst modes defined by ARINC-743.

- (b) The GNS receiver shall accommodate these labels being transmitted in Burst mode in one of the following manners:
- three packets, 540 ms between packets, 3 ms between labels in the packet
 - three packets, 200 ms between packets, 3 ms between labels in the packet
 - burst rate of 1 sec for up to 3 sec or a burst of 500 ms with 12 ms between each label.
- (c) The GNS receiver shall accommodate these labels being transmitted at a 1 Hz rate or a Burst mode.
- (d) The GNS receiver shall accommodate acceptance of label 045 followed by a burst of several label 046.
- (e) The GNS receiver shall accommodate these labels being transmitted at a 5 Hz rate or a Burst mode.

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(6) ARINC 429 GNSS Outputs

- (a) GNSS A429 Outputs can be configured to Legacy 2PX Data Set, ARINC 743A Data Set or ILS Look- Alike Data Set in the platform configuration file. Based on the selected configuration labels are output as per the transmit rate defined in the below table.

Table 2-16. A429 GNSS Out #1 and A429 GNSS Out #2

Label (Oct)	Parameter	Signal Format	Legacy 2PX Data Set Transmit Rate (msec)	ARINC 743A Data Set Transmit Rate (msec)	ILS Look-Alike Data Set Transmit Rate (msec)
002	Time to Go	BCD	200		100
012	Velocity Made Good	BCD			100
017	Selected Runway Heading	BCD	200		200
033	Landing Mode/Frequency	DISC	200		200
034	VOR/ILS Frequency	BCD			100
035	DME Frequency	BCD			100
050	SBAS Approach Data ⁽¹⁾	DISC	200		100
050	Extended Measurement Status ⁽¹⁾	DISC	1000	1000	
051	Extended Measurement Block Header	DISC	1000	1000	
052	Supplementary Measurement Block Header	DISC	1000	1000	
053	Clock Correction	BNR	1000	1000	
054	Clock Correction Fine	BNR	1000	1000	
056	Standard Atmospheric Corrections	BNR	1000	1000	
057	User Range Accuracy	BNR	1000	1000	
060	Measurement Status	DISC	1000	1000	
061	Pseudo Range	BNR	1000	1000	
062	Pseudo Range Fine	BNR	1000	1000	
063	Range Rate ⁽¹⁾	BNR	1000	1000	
063	Raw Delta Range ⁽¹⁾	BNR	1000	1000	
064	Delta Range	BNR	1000	1000	
065	SV Position X	BNR	1000	1000	
066	SV Position X Fine	BNR	1000	1000	
070	SV Position Y	BNR	1000	1000	

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Table 2-16. A429 GNSS Out #1 and A429 GNSS Out #2 (Cont)

Label (Oct)	Parameter	Signal Format	Legacy 2PX Data Set Transmit Rate (msec)	ARINC 743A Data Set Transmit Rate (msec)	ILS Look-Alike Data Set Transmit Rate (msec)
071	SV Position Y Fine	BNR	1000	1000	
072	SV Position Z	BNR	1000	1000	
073	SV Position Z Fine	BNR	1000	1000	
074	UTC Measure Time	BNR	1000	1000	
076	GNSS Altitude (MSL)	BNR	200 - 1000	200 - 1000	
101	HDOP	BNR	200 - 1000	200 - 1000	
102	VDOP	BNR	200 - 1000	200 - 1000	
103	GNSS Track Angle	BNR	200 - 1000	200 - 1000	
105	Selected Runway Heading	BNR	200		200
110	GNSS Latitude	BNR	200 - 1000	200 - 1000	
111	GNSS Longitude	BNR	200 - 1000	200 - 1000	
112	GNSS Ground Speed	BNR	200 - 1000	200 - 1000	
114	Lateral Protection Level- Glide Path (LPLGP)	BNR	200		
115	Vertical Protection Level- Glide Path (VPLGP)	BNR	200		
116	Horizontal GLS Deviation (Rectilinear)	BNR	200		100
117	Vertical GLS Deviation (Rectilinear)	BNR	200		100
120	GNSS Latitude Fine	BNR	200 - 1000	200 - 1000	
121	GNSS Longitude Fine	BNR	200 - 1000	200 - 1000	
124	Digital Time Mark	DISC	1000	1000	1000
125	UTC	BCD	200 - 1000	200 - 1000	
127	Vertical Alarm Limit	BNR	200		
130	HIL	BNR	200 - 1000	200 - 1000	
133	VIL	BNR	200 - 1000	200 - 1000	
136	VFOM	BNR	200 - 1000	200 - 1000	
140	UTC Fine	BNR	200 - 1000	200 - 1000	
141	UTC Fine Fractions	BNR	200 - 1000	200 - 1000	
142	Vertical Velocity FOM	BNR	200 - 1000	200 - 1000	1000

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Table 2-16. A429 GNSS Out #1 and A429 GNSS Out #2 (Cont)

Label (Oct)	Parameter	Signal Format	Legacy 2PX Data Set Transmit Rate (msec)	ARINC 743A Data Set Transmit Rate (msec)	ILS Look-Alike Data Set Transmit Rate (msec)
143	Approach Area HIL	BNR	1000	1000	
144	Approach Area VIL	BNR	1000	1000	
145	Horizontal Velocity FOM	BNR	200 - 1000	200 - 1000	1000
147	UTC Leap Seconds	BNR	200-1000	200 – 1000	
150	UTC	BNR	200 - 1000	200 - 1000	
151	SBAS Pseudo Range Correction	BNR	1000	1000	
152	SBAS Sigma FLT and Air	BNR	1000	1000	
153	SBAS Ionospheric Correction	BNR	1000	1000	
153	Final Approach Course	BNR			200
154	SBAS Ionospheric Sigma	BNR	1000	1000	
155	Counter	BNR	200 - 1000	200 - 1000	
156	Approach Selection Status	DISC	200		200
157	Input Discrete Status	DISC	1000		
162	Destination ETA	BNR	333	333	
163	Alt. Waypoint ETA	BNR	333	333	
164	GBAS Tropospheric Correction	BNR	1000		
165	Vertical Velocity	BNR	200 - 1000	200 - 1000	
166	N/S Velocity	BNR	200 - 1000	200 - 1000	
167	Lateral Alarm Limit	BNR	200		
171	Vertical Proportional Deviations	BNR	200		100
173	Lateral Proportional Deviations	BNR	200		50
174	E/W Velocity	BNR	200 - 1000	200 - 1000	
174	Vertical Proportional Deviations	BNR			50
177	Distance to LTP/FTP (Threshold)	BNR	200		200
201	Distance to LTP/FTP	BCD			100
202	Slant Distance	BNR			100
206	GBAS B1 and B2	BNR	1000	1000	
207	GBAS B3 and B4	BNR	1000	1000	
213	GBAS Pseudo Range Correction	BNR	1000	1000	

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Table 2-16. A429 GNSS Out #1 and A429 GNSS Out #2 (Cont)

Label (Oct)	Parameter	Signal Format	Legacy 2PX Data Set Transmit Rate (msec)	ARINC 743A Data Set Transmit Rate (msec)	ILS Look-Alike Data Set Transmit Rate (msec)
214	Distance to LTP/FTP	BNR			100
215	GBAS Sigma GND and Air	BNR	1000	1000	
217	GBAS Sigma Tropo. and Iono.	BNR	1000	1000	
222	VOR Bearing	BNR			100
227	Command Word	DISC	On Call ⁽²⁾	On Call ⁽²⁾	
232	Airport ID #1	DISC	1000		
240	Selected Glide Path Angle	BNR	200		
241	Threshold Crossing Height	BNR	200		
242	VOR Ground Station ID #1	DISC			200
243	GLS Runway Select	DISC	1000		1000
244	VOR Ground Station ID #2	DISC			200
246	DME Ground Station ID #1	DISC			200
247	DME Ground Station ID #2	DISC			200
247	HFOM	BNR	200 - 1000	200 - 1000	
252	Time to Go	BNR	200		100
254	GBAS ID	DISC	1000		
255	GBAS ID / Airport ID	DISC	1000		
260	Date	BCD	200 - 1000	200 - 1000	
261	GPS Discrete Word #1	DISC	200		1000
263	Approach ID #1	DISC	200		200
264	Approach ID #2	DISC	200		200
273	GPS Sensor Status	DISC	200 - 1000	200 - 1000	200
274	GLS Status	DISC	1000		1000
276	Selected/Achieved GBAS Approach Service Type (GAST)	DISC	200		
300	DME Ground Station ID	DISC			200
305	SBAS PA Mode and SP Selection	DISC	200-1000	200-1000	200
306	CRC #1	DISC	200		200
307	CRC #2	DISC	200		200

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Table 2-16. A429 GNSS Out #1 and A429 GNSS Out #2 (Cont)

Label (Oct)	Parameter	Signal Format	Legacy 2PX Data Set Transmit Rate (msec)	ARINC 743A Data Set Transmit Rate (msec)	ILS Look-Alike Data Set Transmit Rate (msec)
341	Look-Ahead SBAS Horizontal Integrity	BNR	1000	1000	
342	Look-Ahead SBAS Vertical Integrity	BNR	1000	1000	
343	Destination HIL	BNR	333	333	
344	Destination VIL	BNR	333	333	
346	Alt. Waypoint VIL	BNR	333	333	
347	Alt. Waypoint HIL	BNR	333	333	
350	Command Response	DISC	1000	1000	
352	Maintenance Discrete 1	DISC	1000	1000	
353	GLS Maintenance Word	DISC	1000		
354	Counter	BNR	1000	1000	
355	GNSS Fault Summary	DISC	1000	1000	1000
370	GNSS Height (WGS-84)	BNR	200 - 1000	200 - 1000	200
371	Configuration ID (Equipment ID)	DISC	1000		1000
377	Configuration ID (Equipment ID)	DISC	1000	1000	

NOTES:

- (1) Transmission of these labels definition are dependent on the Platform Configuration File (PCF) configuration.
- (2) These labels are only output when requested by an input label 227.

(7) Ethernet Interface

- (a) KTR 2280B MMDR is configured to communicate with the external Systems on "Ethernet Interface #1".

(8) Ethernet Input Datagrams

Table 2-17. Ethernet Input Datagrams

Datagram ID	Datagram Name	Interval (msec) ⁽¹⁾	Length Type	Source
0x100	Radio Tuning	200	Fixed	FMS
0x101	MMDR APM Data	1000	Fixed	FMS
0x102	CMC Command	1000 ⁽²⁾	Fixed	CMC (OMS)
0x103	CMU Status	1000	Fixed	CMU

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Table 2-17. Ethernet Input Datagrams (Cont)

Datagram ID	Datagram Name	Interval (msec) ⁽¹⁾	Length Type	Source
0x104	CMU Message In	Burst	Variable	CMU
0x105	SOLO Word In	Burst	Fixed	CMU
0x120	GNSS Initialization - IRS Inputs #1	100	Fixed	IRS
0x121	GNSS Initialization - IRS Inputs #2	Burst ⁽³⁾	Fixed	IRS
0x122	Attitude	40	Fixed	IRS
0x123	Altitude - IRS Input	40	Fixed	IRS
0x124	GNSS Initialization - FMS Inputs #1	100	Fixed	FMS
0x125	GNSS Initialization - FMS Inputs #2	Burst ⁽³⁾	Fixed	FMS
0x126	Altitude - FMS Inputs	62.5	Fixed	FMS
0x127	GNSS PRAIM Destination Request	Burst ⁽⁴⁾	Fixed	FMS
0x128	GNSS PRAIM Alternate Waypoint Request	Burst ⁽⁴⁾	Fixed	FMS
0x129	GNSS LPV FAS Data	Burst	Fixed	FMS
0x12A	GNSS APD Block	Burst	Fixed	FMS
0x12B	UTC and Date	200	Fixed	FMS/IRS
0x12C	GNSS Honeywell PRAIM Destination Request	Burst ⁽⁴⁾	Fixed	FMS
0x12D	GNSS Honeywell PRAIM Alternate Waypoint Request	Burst ⁽⁴⁾	Fixed	FMS

NOTES:

- (1) The input datagram rates specified in the above table define the minimum range over which the LRU is required to operate correctly. The LRU is not required to explicitly detect datagrams received at a higher or lower rate than what is specified in the table.
- (2) Per document 701-00625-2200 (System Requirements Document for the Mercury2 PX Global Navigation System Sensor), the GNSS receiver sub-system expects producing system like OMS or CMC to transmit Command Word (label 227) and Command Summary (label 304) at 1 Hz rate or in Burst mode.
- (3) Per document 701-00625-2200 (System Requirements Document for the Mercury2 PX Global Navigation System Sensor), the GNSS receiver sub-system expects producing system like IRS or FMS to transmit Altitude (Label 040), Latitude (Label 041), Longitude (Label 042) in Burst mode in one of the following manners:
 - four pairs with 250 ms between pairs

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- two per sec for 1 sec or 500 ms burst with 12 ms between successive label
 - four pairs with 300 ms between bursts
- (4) Per document 701-00625-2200 (System Requirements Document for the Mercury2 PX Global Navigation System Sensor), the GNSS receiver sub-system expects producing system like FMS to transmit ARINC 743 Alternate Waypoint PRAIM request (labels 167, 214, 216, 146, and 170) , ARINC 743 Destination PRAIM request (labels 152, 144, 143, 146, and 170), Honeywell Alternate Waypoint PRAIM request (labels 135, 132, 131, 126, 127) , Honeywell Destination PRAIM request (labels 152, 144, 143, 126, 127) inputs in Burst mode in one of the following manners:
- three packets, 540 ms between packets, 3 ms between labels in the packet
 - three packets, 200 ms between packets, 3 ms between labels in the packet
 - burst rate of 1 sec for up to 3 sec or a burst of 500 ms with 12 ms between each label

(9) Ethernet Output Datagram

Datagram ID	Datagram Name	Interval (msec)	Length Type	Destination
0x200	MMDR Control Status	100	Fixed	FMS
0x201	Reserved	-	-	-
0x202	MMDR VDL Status	1000	Fixed	CMU
0x203	MMDR VDL Message Out	Burst	Variable	CMU
0x204	SOLO Word Out	Burst	Fixed	CMU
0x205	MMDR VDB Data Out	Burst	Fixed	Testing/External GNSS
0x220	GNSS Deviations Block	200	Fixed	FMS
0x221	GNSS Navigation Block	200	Fixed	FMS/IRS
0x222	GNSS Measurement Block	1000	Fixed	FMS/IRS
0x224	GNSS PRAIM Destination Response	333	Fixed	FMS
0x225	GNSS PRAIM Alternate Waypoint Response	333	Fixed	FMS
0x226	GNSS Look ahead RAIM	1000	Fixed	FMS
0x227	GNSS Approach Area RAIM	1000	Fixed	FMS
0x300	MMDR Maintenance	1000	Fixed	FMS/CMC (OMS)
0x301	MMDR Configuration	1000	Fixed	CMS
0x302	GNSS Maintenance	1000	Fixed	FMS/CMC (OMS)

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SECTION 3 – OPERATION

1. General

The KTR 2280B is a remote mounted radio. As such, the user interface is defined by controllers and displays unique to the particular system configuration. Refer to the appropriate pilot's guide or flight manual supplement for complete operating instructions.

The paragraphs below provide an overview of the controls and displays that are typically available in systems that provide full KTR 2280B functionality.

A. **VHF COM Controls and Displays**

- (1) Frequency Selectors: An active frequency (channel) and a standby frequency (channel) selector. A "swap" or "flip-flop" button may be available for swapping the active and standby frequencies. The KTR 2280B responds to high speed ARINC 429 labels 030 and 052 for the active and standby selections respectively. These labels appear only when a frequency (channel) change is made.
- (2) Volume Control: A rotational knob or up/down pushbutton to adjust the volume of the COM audio output. The KTR 2280B responds to high speed ARINC 429 label 266 for the COM volume control setting. This label appears only when a volume change is made.
- (3) RX/TX Annunciators: Some display means indicate when the radio is transmitting (TX Annunciator) and when the radio is receiving (RX Annunciator). This is keyed by the squelch status. The KTR 2280B outputs the RX status and TX status on the high speed ARINC 429 label 267, having a 5 Hz update rate.
- (4) Squelch Disable Control: Normally a pushbutton that cycles between Squelch Disable and Squelch Enable. The RX annunciator will be displayed during Squelch Disable. The KTR 2280B responds to high speed ARINC 429 label 266 for COM squelch disable (override). This label appears only when a status change is made.
- (5) Stuck Microphone Annunciator: Some display means to indicate when the Push-to-Talk (PTT) button has been held down beyond the 30 second transmitter time-out period. The KTR 2280B outputs the stuck microphone alert on high speed ARINC 429 label 267, having a 5 Hz update rate.
- (6) Emergency COM Control: Some means to channel the KTR 2280B transmitter and receiver to a pre-defined emergency frequency (channel) in the event of display and/or control failure. Pin 26 on main connector J1 is the discrete control for this function. Grounding this normally open pin places the unit into Emergency COM Mode.
- (7) AUX COM channel and volume controls are typically not available. These parameters can be adjusted through APM settings.

B. **VHF NAV Controls and Displays**

- (1) Frequency Selectors: An active frequency (channel) and a standby frequency (channel) selector. A "swap" or "flip-flop" button may be available for swapping the active and standby frequencies. The KTR 2280B responds to high speed ARINC 429 labels 034 and 053 for the active and standby selections respectively. These labels appear only when a frequency (channel) change is made.
- (2) Volume Control: A rotational knob or up/down pushbutton to adjust the volume of the NAV audio output. The KTR 2280B responds to high speed ARINC 429 label 265 for the volume control setting. This label appears only when a volume change is made.

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- (3) Ident Tone Control: A means to defeat the Ident Tone notch filter in the NAV audio so the 1020 Hz Ident Tone can be heard. The KTR 2280B responds to high speed ARINC 429 label 265 for ident filter control. This label only occurs when a status change is made.
- (4) The NAV Station Ident is Output on Label 242 and 244.
- (5) KTR 2280B responds to high speed ARINC 429 label 033 for VDB mode selection. This label only occurs when a mode change is made.

C. ADF Controls and Displays

- (1) Frequency Selectors: An active frequency (channel) and a standby frequency (channel) selector. A "swap" or "flip-flop" button may be available for swapping the active and standby frequencies. The KTR 2280B responds to high speed ARINC 429 label 032 for frequency selection. This label only occurs when a frequency (channel) change is made.
- (2) Volume Control: A rotational knob or up/down pushbutton to adjust the volume of the ADF audio output. The KTR 2280B responds to high speed ARINC 429 label 262 for volume setting. This label only occurs when a change is made.
- (3) Mode Control: A means to select the following ADF operating modes:
 - (a) ADF Mode - The normal ADF operating mode.
 - (b) ANT Mode - The mode in which ADF bearing information is defeated and receiver sensitivity and bandwidth are optimized for audio reception only.
 - (c) BFO Mode - The mode required in order to use first generation NDB facilities that used on/off carrier keying for identification.
- (4) The KTR 2280B responds to high speed ARINC 429 label 032 for mode selection. This label only occurs when a change is made.

D. VDL Mode A and VDL Mode 2

- (1) VDL Mode A
 - (a) Mode A allows the KTR 2280B to exchange downlink and uplink POA data messages with a CMF through a transmit/receive pair of 100 Kbps ARINC 429 digital interfaces. The downlink message data bits transferred to the KTR 2280B modulate the RF carrier at a rate of 2,400 bps using the DSB-AM MSK modulation scheme.
 - (b) The KTR 2280B also controls when to access the channel to transmit data. The data link channel selection is still controlled by the CMF, but channel selection messages are exchanged through the same high-speed ARINC 429 interface used to exchange AOA messages which simplifies wiring.
- (2) VDL Mode 2
 - (a) VDL Mode 2 is the term used to describe a suite of air/ground protocols that increases the data rate of the air/ground link to 31,500 bps.
 - (b) VDL Mode 2 allows the transition from character-oriented ACARS protocols for end-to-end delivery of messages to one that uses bit-oriented ATN protocols using the same VHF ground and aircraft radios. The KTR 2280B Mode 2 capability supports the transmission and reception of standard ACARS messages using a protocol referred to as AOA.
 - (c) The KTR 2280B Mode 2 capability also supports the transmission and reception of bit-oriented ATN application messages such as CPDLC. The set of VDL Mode

2 protocols consist of the physical layer protocol, channel access protocol, data link service and management protocol, and Mode 2 network access protocol. The physical layer protocol includes the modulation, data rate, and forward error correction techniques used to transmit data over the air/ground link.

- (d) The channel access protocol is the method that allows multiple aircraft to communicate with the ground stations on the same frequency. The data link service and management protocol includes procedures to establish, maintain and hand-off an air/ground link, and ensure error-free delivery of messages. The network access protocol is the interface between users and the Mode 2 air/ground link service providers. As in Mode A, only the physical layer and channel access protocols are performed by the KTR 2280B while the data link service and management, and the network access protocols are performed by the CMF.
- (e) The VDL Mode 2 physical layer protocol employs a bit transmission rate of 31,500 bps over the air/ground link on a single 25-kHz channel. The increased utilization of the 25-kHz channel is achieved by use of a bandwidth modulation scheme known as D8PSK. A D8PSK transmitter transmits a carrier whose phase is modulated by the data. The phase can be 0, 45, 90, 135, 180, 225, 270, or 315 degrees. The rate at which the carrier phase is changed is the modulation rate. The phase difference or D8PSK symbol between successive phase changes can be equal to 0, 45, 90, 135, 180, 225, 270, or 315 degrees. Since there are eight possible phase differences, each phase change (D8PSK symbol) represents three bits of information: 000, 001, 011, 010, 110, 111, 101, or 100.
- (f) For example, if the phase changes at a 10.5-kHz rate, the bit transmission rate is equal to 31.5 Kbps. The VDL Mode 2 D8PSK modulator uses the bits in the message, three at a time, to select the carrier phase change at a rate of 10,500 D8PSK symbols each second. A 10.5-kHz D8PSK phase modulation rate corresponds to a D8PSK bit transmission rate of 31.5 Kbps.
- (g) The VDL Mode 2 channel access protocol is CSMA modified to let all terminals to have equal chances to access the channel when multiple terminals have data to transmit. The ability to optimize the CSMA protocol is included in the VDL Mode 2 channel access protocol specification.
- (h) As in Mode A, the Mode 2 data link channel selection is controlled by the CMF through the same high-speed ARINC 429 interface used to exchange downlink and uplink AOA or ATN messages. The CMF also dynamically controls the switching between Mode A and Mode 2 operation subject to available coverage. Since the VDL Mode 2 data rate and modulation scheme differ from those used in Mode A, separate VHF frequencies and ground-based VHF equipment must be used to give POA and AOA/ATN service coverage. As a result, the availability of high-speed AOA service depends on the availability of ground stations.

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