

Rev A1
July -30
2020

Document:
WSS 4G Aircraft Installation Manual 750-
00003-00 Rev a1.Docx



Document Number: 750-00003-00
Revision: A1

WSS 4G System Aircraft

Installation Manual

Document Number 750-00003-00



Wireless Systems Solutions
630 Davis Dr. Suite 250
Morrisville, NC 27560

The information contained in this manual is applicable to systems utilizing the following Aircraft Base Radio Part Numbers:

Aircraft User Equipment Base Radio (ABR)	Part Number 001-00300-10
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1.0 GENERAL DESCRIPTION

1.1 Introduction

This document provides guidance for the installation of the WSS 4G LTE System. It describes the physical, mechanical and electrical characteristics for the installation of the WSS system. The System is intended for In-Flight Entertainment (IFE). IFE includes Electronic Flight Bag (EFB) advisory information only and does not include any flight-critical data.

1.2 System Overview

The WSS 4G LTE system provides an office-like, broadband air to ground connectivity within the WSS Network. Providing a multi-megabit, bi-directional throughput with low latency to each aircraft enables a wide range of use and applications for both passengers and crew alike such as over-the-air video and music streaming, video conference, high bandwidth internet browsing and email usage, as well as, next generation real time weather, crew operational applications and aircraft maintenance transmission.



The core system components include:

- One WSS Aircraft Radio (noted herein as “Airborne User Equipment Base Radio” (ABR) or “Radio”) which is typically mounted on the electronics or avionics shelf of the aircraft, (however the radio may be mounted in other locations inside or outside the aircraft’s pressure vessel)
- One High Performance Blade (HPB) Rx Aircraft active antenna.
- One Full-Duplex Quad (FDQ) Tx/Rx Aircraft active antenna.

Equipment not provided, but required for the installation and operation of the System include:

- Network Router/Cabin Wireless Access Point (CWAP). The WSS system is designed to connect to an FAA approved network wireless router (not included). A multi-function connector on the radio provides Ethernet connectivity to the router over a 4-pair wired-Ethernet 1000BASE-T interface. Reference Section 6.6 –Router



Configuration, for details regarding Routers approved for use with the WSS 4G System

NOTE: *It is the responsibility of the installer to obtain FAA approval for the router installation and for providing the aircraft owner/operator with evidence that the critical aircraft systems are not susceptible to RFI/EMI interference from portable electronic devices (i.e. “Wi-Fi immunity” or “PED/T-PED tolerance”).*

1.3 Related Documentation

The following documents are referenced within the body of this Installation Guide:

WSS SmartCart Operations Manual – Document Number 750-000XX-00 Cabin Guide – Document Number 750-000XX-00

RTCA DO-313 “Certification Guidance for Installation of Non-Essential, Non-Required Aircraft Cabin Systems and Equipment.”

FAA Advisory Circular 43.13-2B “Acceptable Methods, Techniques, and Practices – Aircraft Alterations”

FAA Advisory Circular 43.13-1B “Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair”

FAA Advisory Circular AC 20-168 “Non-Essential Cabin Systems Certification Guidance”

Code of Federal Regulations (CFR) Title 47, Part 2, Subpart J

Code of Federal Regulations (CFR) Title 47, Part 15

RTCA DO-160G “Environmental Conditions and Test Procedures for Airborne Equipment”

RTCA DO-178C “Software Considerations in Airborne Systems and Equipment Certification”

RTCA DO-254 “Design Assurance Guidance for Airborne Electronic Hardware”

National Electrical Manufacturers Association (NEMA) WC 27500 “Standard for Aerospace and Industrial Cable” and/or SAE AS22759

1.4 Unpacking and Inspecting Equipment

Upon receipt of the WSS equipment in shipping boxes, inspect them for damage. If shipment is determined to be damaged, take photographs of the damage, and notify the

carrier and file a claim. If the boxes are intact, carefully unpack the equipment and make a visual inspection of the unit for evidence of damage incurred during shipment. If the unit is damaged, take photographs of the damage, and notify the carrier and file a claim.

When provided, locate the shock sensor on the exterior of the shipping container and inspect for any indicators as shown in Figure 1.4-1.



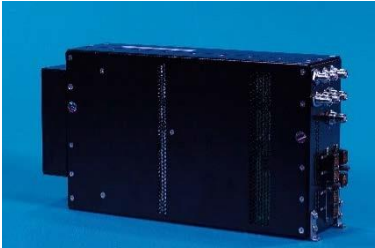


Figure 1.4-1 Shock Sensors

To justify a claim, save the original shipping container and all packing materials. Do not return the unit until the carrier has authorized the claim. Retain the original shipping containers for storage. If the original containers are not available, a separate cardboard container should be prepared that is large enough to accommodate sufficient packing material to prevent movement.

1.5 WSS 4G System Components

1.5.1 WSS Provided Equipment Shipset

Table 1.5.1-1 contains the quantity, depiction, description and part numbers for the WSS 4G System components that should be ordered from Wireless Systems Solutions for the installation.

Table 1.5.1-1 WSS 4G System Components			
Quantity	Depiction	Description	Part Number (P/N)
1		Airborne User Equipment Base Radio (ABR)	001-00300-10
Quantity	Depiction	Description	Part Number (P/N)
1		High Performance Blade (HPB) Antenna	AT2450-1 or AT2450-5*
1		Full-Duplex Quad (FDQ) Antenna	AT2450-2_E
<p><i>* Note- HPB Antenna AT2450-5 may be used if antennas are installed in reversed configuration. See section 3.5 Mounting Considerations for additional details.</i></p>			

1.5.2 Optional Provided Material

Table 1.5.1-2 contains the quantity, depiction, description and part numbers for the WSS 4G System components that can be ordered from Wireless Systems Solutions or procured by the installer.



Table 1.5.2-2 Optional WSS Provided Material

Quantity	Description	Part Number
1	ABR P2 CONNECTOR KIT	765-00033-22
	(1) TE Connectivity/Deutsch 4-Bay DMC Harness Housing (P2)	<i>DMC-M 80-01</i>
	(3) TE Connectivity/Deutsch DMC Chimney, Non-rotation	<i>732-8052-18A</i>
	(3) TE Connectivity/Deutsch 20x22 GA Socket Module Insert Kit (P2-A, P2-C, P2-D)	<i>DMC-M 20-22SN</i>
	(1) TE Connectivity DMC Harness EMI Backshell, 4-Bay (P2)	<i>732-8052-10 A</i>
	(1) TE Connectivity/Deutsch DMC Blank Chimney (P2)	<i>732-8052-13A</i>
1	ABR P1 CONNECTOR KIT	765-00034-22
	(1) TE Connectivity/Deutsch 12 GA Socket Module Insert (P1-A)	<i>DMC-M 04-12SN</i>
	(1) TE Connectivity/Deutsch 20x22 GA Socket Module Insert Kit (P1-B)	<i>DMC-M 20-22SN</i>
	(1) TE Connectivity/Deutsch DMC Harness EMI Backshell, 2-Bay (P1)	<i>732-8052-14A</i>
	(2) TE Connectivity/Deutsch DMC Chimney, Non-rotation (P1)	<i>732-8052-18A</i>
	(1) TE Connectivity/Deutsch 2-Bay DMC Harness Housing (P1)	<i>DMC-M 40-01</i>

1.5.3 Installer-Provided Material

Table 1.5.3-1 contains additional material needed for WSS 4G LTE System installation which are not provided and are the responsibility of the installer for their unique aircraft installation. Refer to Section 3.4 for any special tooling required for installation.

Table 1.5.2-3 Installer-Provided Material

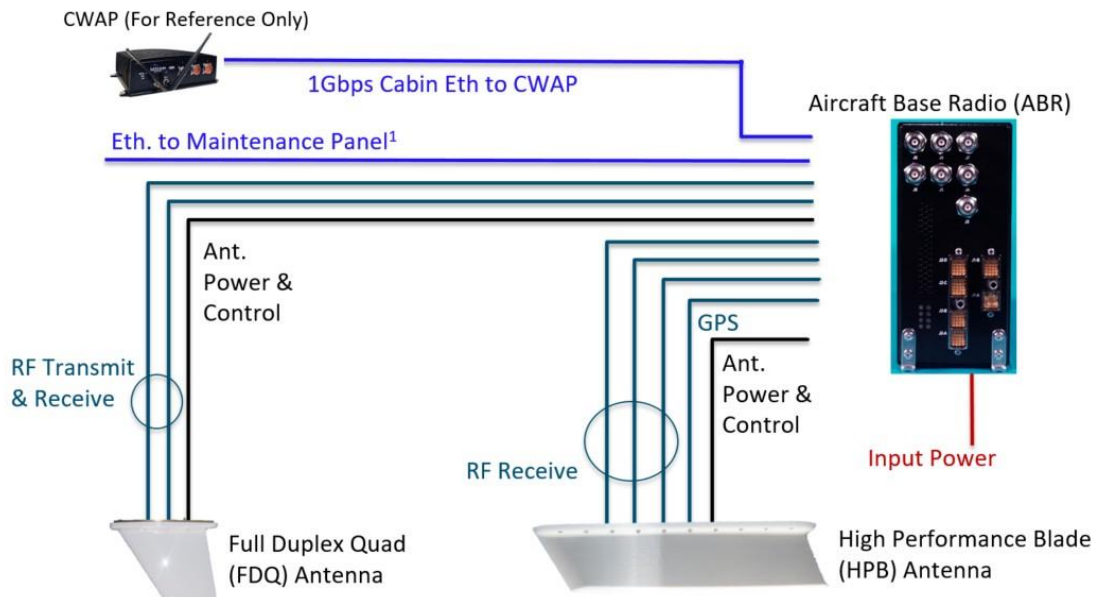
Quantity	Description	Part Recommendations
1	3/8 ATR Mounting Tray (For Aircraft Base Radio installation)	B/E Aerospace MT4-3333
1	50 Ohm RF Terminator (To be Installed on ABR Connector Panel)	Bracket Mfg. BM11037 or Equivalent
18	Tie-down Straps	600-057
2	Boot Seal	HSB-2-1 or equivalent
2	TE Connectivity Solder Sleeve (.275IDXx .750LG)	M83519/1-5

HPB/FDQ Circular Antenna Connectors		
2	Mil Circular Connector (Mates with MIL-DTL-26482 Series 1, C58-533723-10P for FDQ and HPB Antennas)	MIL-C-26482 Series I, Size 12, Insert 12-10, with 10 ea. #20 socket contacts. Ex: Amphenol PT06SE-12-10S (crimp)
2	M85049/8x-12xxx EMI Backshell for Size 12 Mil Circular Connector (Straight or angled)	M85049/8x-12xxx EMI Backshell Isodyne: ISODJ150NF1202-S EMI Backshell 90° or equivalent
FDQ/HPB Antenna Gasket		
1	Av-deHi-Tak Polyurethane Conductive HPB Gasket	AG247000-35
1	Av-deHi-Tak Polyurethane Conductive FDQ Gasket	AG924000-09
Wire Harness Insulation and Sleeving (quantity as required)		
A/R	Insulation Sleeving (.375)	M23053/4-104-0 or equivalent
A/R	Insulation Sleeving (.500-.195DIA)	M23053/4-105-0 or equivalent
A/R	Insulation Sleeving (.750-.313)	M23053/4-106-0 or equivalent
A/R	Insulation Sleeving (.063-.031)	M23053/5-102-0 or equivalent
A/R	Tubular Braid Wire 0.500-inch diameter	AA59569R36T0500 or equivalent

1.6 Interface Summary

The WSS 4G System requires multiple RF, power and control cable connections. Figure 1.6-1 shows the basic system, and a simplified aircraft cabling diagram. In addition to the radio-antenna cables, connection to the aircraft +28 V_{DC} power bus is required.

Figure 1.6-1 System Interfaces / Overview



¹ Ethernet connection routed to suitable location within aircraft and terminated at equipment maintenance panel or stowed for in-flight maintenance access.



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2.0 TECHNICAL SPECIFICATIONS

Table 2-1 presents Technical Specifications of the WSS 4G System.

Table 2-1 Technical Specifications	
Aircraft Base Radio (ABR)	
Parameter	Specification
FCC Identification Number	2AWXX-ABR0385CRM
Operating frequency range	2.4GHz ISM Band - 2400 to 2483.5 MHz
Power Input	22 to 32VDC, 10.7 Amps Maximum at 28Vdc Nominal Voltage
RF Power Output	+34dBm +/- 1dB at radio Tx output port
Form Factor	ARINC-404 3/8 ATR Chassis. See Figure 2.3.1-1
ABR Chassis Weight	11 lbs.
ABR Chassis Ventilation Requirements	3.0-inch Clearance Required behind ABR Fan and 0.25" Clearance Required from the sides of the Chassis
High Performance Blade (HPB) Antenna	
Parameter	Specification
Frequency	2445.7 to 2475.7 MHz
VSWR	<2:1
Polarization	Vertical
Impedance	50 ohms
Form Factor	See Figure 2.3.2-1 or Figure 2.3.2-2
Center of Gravity	See Figure 2.3.2-1 or Figure 2.3.2-2
Weight	13.5 lbs. Max
Max Speed Rating	*0.99 Mach/KCAS 400 @ Altitude 28,250 ft.
Full-Duplex Quad (FDQ) Antenna	
Parameter	Specification
Frequency	2407.8 to 2437.8 MHz Tx Band 2445.7 to 2475.7 MHz Rx Band
VSWR	< 2:1
Polarization	Vertical
Impedance	50 ohms
Form factor	See Figure 2.3.2-3
Center of Gravity	See Figure 2.3.2-3
Weight	6.5 lbs. Max
Max Speed Rating	*0.99 Mach/KCAS 400 @ Altitude 28,250 ft.

**These calculations are based on the International Standard Atmosphere (ISA) & U.S. Standard Atmosphere of 1976 and are subject to the same 32,000 [m] limitation.*

FCC Compliance: This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



2.1 Environmental DO-160G

Testing is accomplished in accordance with DO-160G, Environmental Conditions and Test Procedures for Airborne Equipment. The following DO-160G categories and test conditions are based on the design of the ABR and the aircraft antennas for the intended installation inside or outside of the pressure vessel. The Radio contains no lithium battery. The ABR is designed to operate in airframe areas that meet the environmental conditions outlined in the DO-160G Table 2.1-1 below. It is the responsibility of the installer to ensure the selected location meets the environmental conditions. The ABR and antennas are not designed to be installed in wings or wheel well areas.

See Table 2.1-1 and 2.1-2 for the applicable WSS System DO-160 requirements.

Table 2.1-1 ABR Radio DO-160G Categories

DO-160G Section	Description	Sub Section Description	WSS Test Conditions	
			ABR Radio	
4	Temperature and Altitude	4.5.1 Ground Survival Low Temp 4.5.1 Operating Low Temp 4.5.2 Ground Survival High Temp 4.5.3 Operating High Temp 4.6.1 Altitude 4.6.2 Decompression	F2	-55 °C -55 °C +85 °C +70 °C 55,000 ft. 50,000 ft.
5	Temperature Variation		B	-55 °C/min to +70°C max (5 °C/min)
6	Humidity		B	Cat B: 95% relative humidity at 65 °C (55 °C for Cat C)
7	Operational Shocks and Crash Safety		B	Normal Operational, 6G, 11 msec, 3 axes, sawtooth Crash Safety (Impulse), 20G, 11 msec, 3 axes, sawtooth (Non-Operational) Crash Safety (Sustained), 18G (Non-Operational)
8	Vibration		Cat S; Curve C	4.12Grms
9	Explosive Atmosphere		E	Non-ignition
10	Waterproofness		Y	Condensing water test



DO-160G Section	Description	Sub Section Description	WSS Test Conditions	
			ABR Radio	
11	Fluids Susceptibility	NA	X	NA
12	Sand and Dust		D	
13	Fungus Resistance	Fungus resistance test (destructive)	F	
14	Salt Fog	Salt Fog (corrosive atmosphere) test	S	
15	Magnetic Effect		A	
16	Power Input		Z*	* Category B for Abnormal Surge, 16.6.2.4
17	Voltage Spike		A	
18	Audio Frequency Conducted Susceptibility		Z	
19	Induced Signal Susceptibility		ZCX	
20	Radio Frequency Susceptibility (Radiated and Conducted)		S	
21	Emission of Radio Frequency Energy		M	
22	Lightning Induced Transient Susceptibility		A3H3L3	
23	Lightning Direct Effects		X	
24	Icing	Icing Test	B	
25	Electrostatic Discharge (ESD)		A	
26	Fire, Flammability	Flammability test (destructive)	C	

Table 2.1-2 Antenna DO-160G Categories

DO-160G Section	Description		WSS Test Conditions	
			Antennas (FDQ and HPB)	
4	Temperature and Altitude	4.5.1 Ground Survival Low Temp 4.5.1 Short time Operating Low Temp 4.5.2 Operating Low Temp 4.5.3 Ground Survival High Temp 4.5.3 Short time Operating High Temp	F2	-55 °C -55 °C -55 °C +85 °C +70 °C



DO-160G Section	Description		WSS Test Conditions	
			Antennas (FDQ and HPB)	
		4.5.4 Operating High Temp 4.6.1 Altitude 4.6.2 Decompression 4.6.3 Overpressure 4.5.5 In Flight Loss of Cooling		+70 °C 55,000 ft. 55,000 ft. -15,000 ft. Not Required
5	Temperature Variation		A	
6	Humidity		C	
7	Operational Shocks and Crash Safety		B	
8	Vibration		Cat R; Curves C, C1, E, E1 Cat Z; Curves R, P	
9	Explosive Atmosphere		H	
10	Waterproofness		S	
11	Fluids Susceptibility		F	Skydrol De-icing
12	Sand and Dust		S	
13	Fungus Resistance		F	
14	Salt Fog		S	
15	Magnetic Effect		A	
16	Power Input		A	
17	Voltage Spike		A	
18	Audio Frequency Conducted Susceptibility		Z	
19	Induced Signal Susceptibility		ZCX,ZWX	
20	Radio Frequency Susceptibility (Radiated and Conducted)		R,R	
21	Emission of Radio Frequency Energy		H	
22	Lightning Induced Transient Susceptibility		A3Z3XX	



DO-160G Section	Description	WSS Test Conditions		
		Antennas (FDQ and HPB)		
23	Lightning Direct Effects	2A2A		
24	Icing	A		
25	Electrostatic Discharge (ESD)	A		
26	Fire, Flammability	X		

2.2 Guidance Documentation

Table 2.2-1 includes a list of applicable guidance documentation.

Table 2.2-1 Guidance Documentation	
Guidance	Applicable Document
Radio Frequency Devices	CFR Title 47 Part 15 (15.247)
Equipment Authorization Procedures	CFR Title 47 Part 2, Subpart J
Unit Software compliance	RTCA DO-178C Level E
Unit Complex Electronic Hardware compliance	RTCA DO-254 Level E
Applicable Certification guidance	RTCA DO-313

2.3 Physical Characteristics

This section presents the physical characteristics of the WSS 4G System, including the Aircraft Base Radio (ABR), Full Duplex Quad (FDQ) Antenna, and High- Performance Blade (HPB) Antenna.

2.3.1 WSS Aircraft Base Radio

The WSS 4G radio system utilizes one radio.

Reference Figure 2.3.1-1 which depicts the Radio Form Factor.

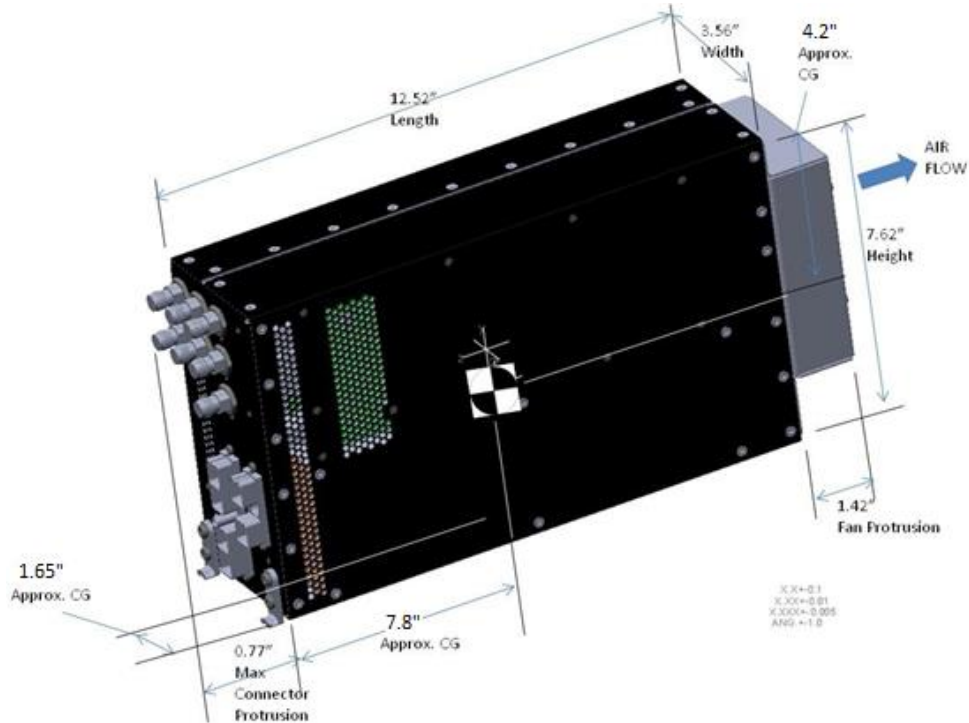


Figure 2.3.1-1 Aircraft Base Radio Form Factor

The ABR is mounted into an ATR Tray, shown in Figure 2.3.1-2. The tray is first mounted in the aircraft (i.e. avionics bay) in the location identified to meet the environmental requirements in Section 2.1.

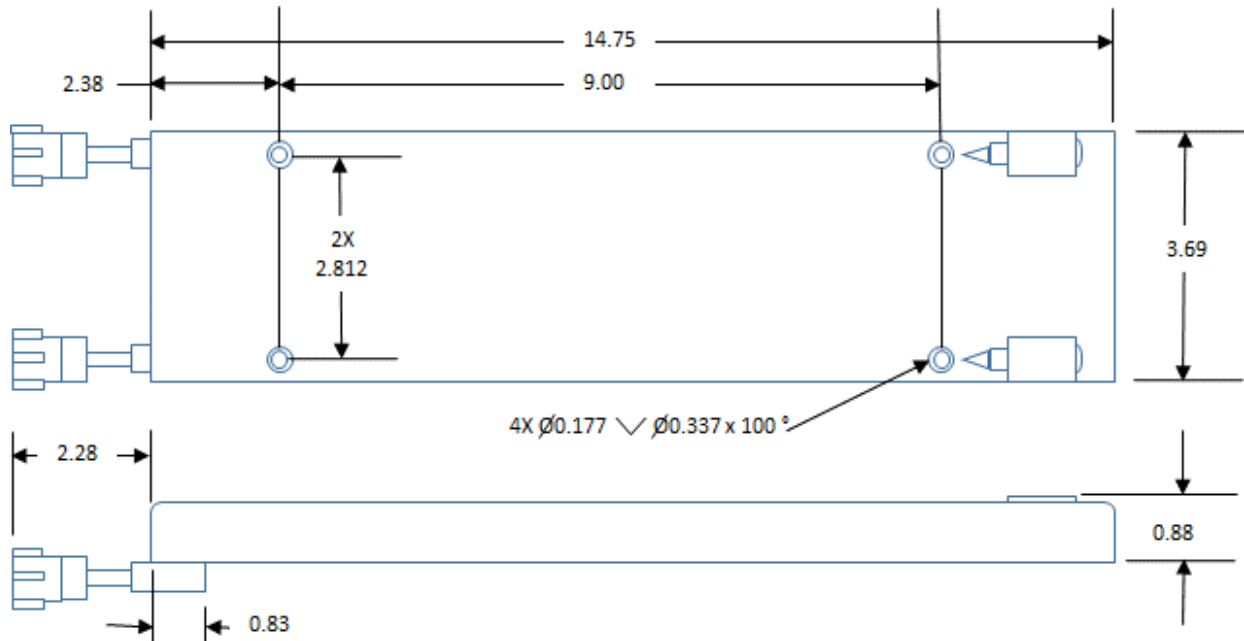


Figure 2.3.1-2 ABR Installation Tray

2.3.2 Antenna Mechanical Definition

The WSS 4G LTE system utilizes one Full-Duplex Quad (FDQ) antenna and one High Performance Blade (HPB) antenna. The HPB used will depend on the location it will be installed on the aircraft. See Section 3.5 Mounting Considerations for more details.

See Figure 2.3.2-1 for HPB antenna (Rear Mount).

See Figure 2.3.2-2 for HPB antenna (Front Mount).

See Figure 2.3.2-3 for FDQ antenna.

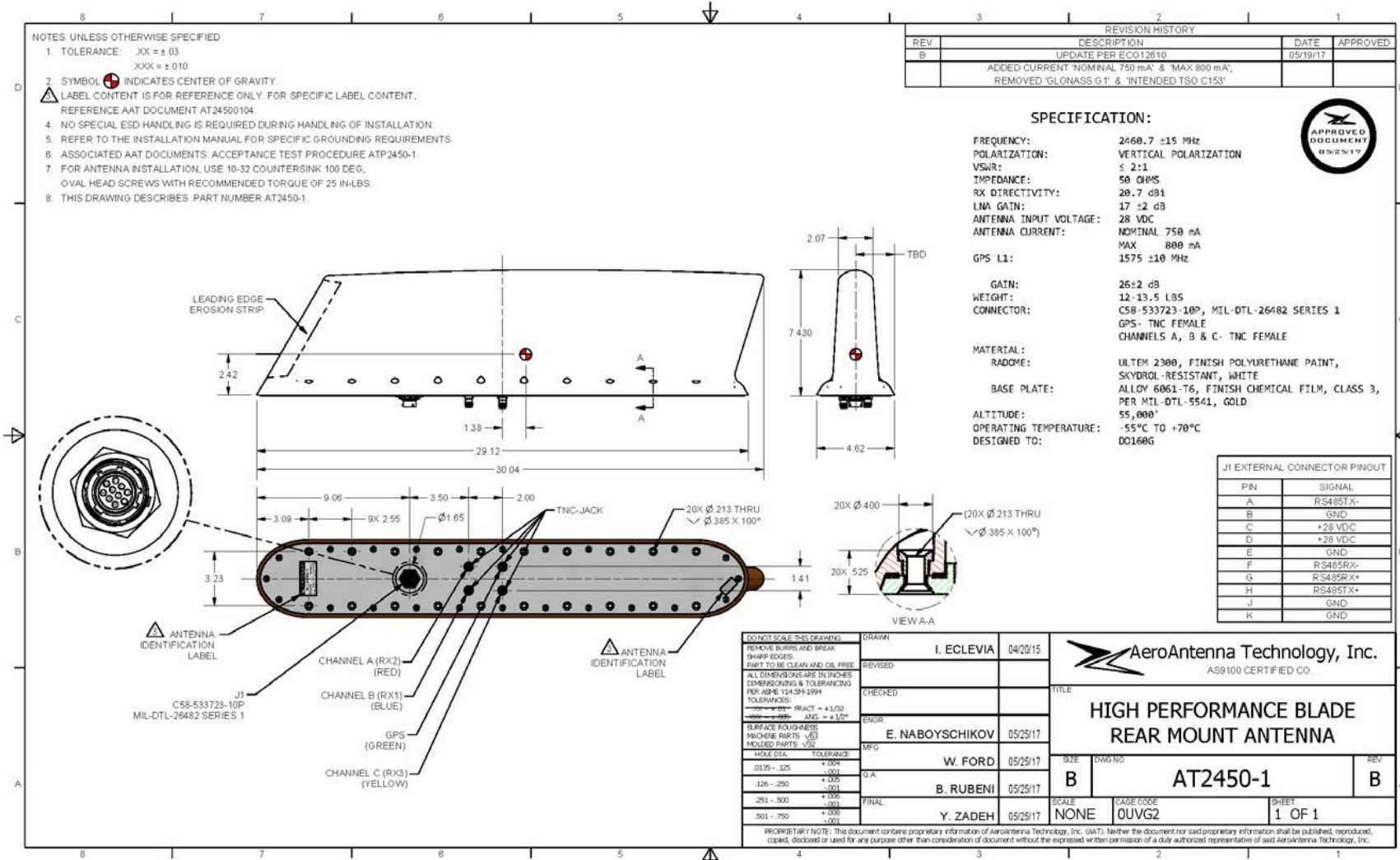


Figure 2.3.2-1 High Performance Blade (HPB) Antenna Detail (Rear Mount)

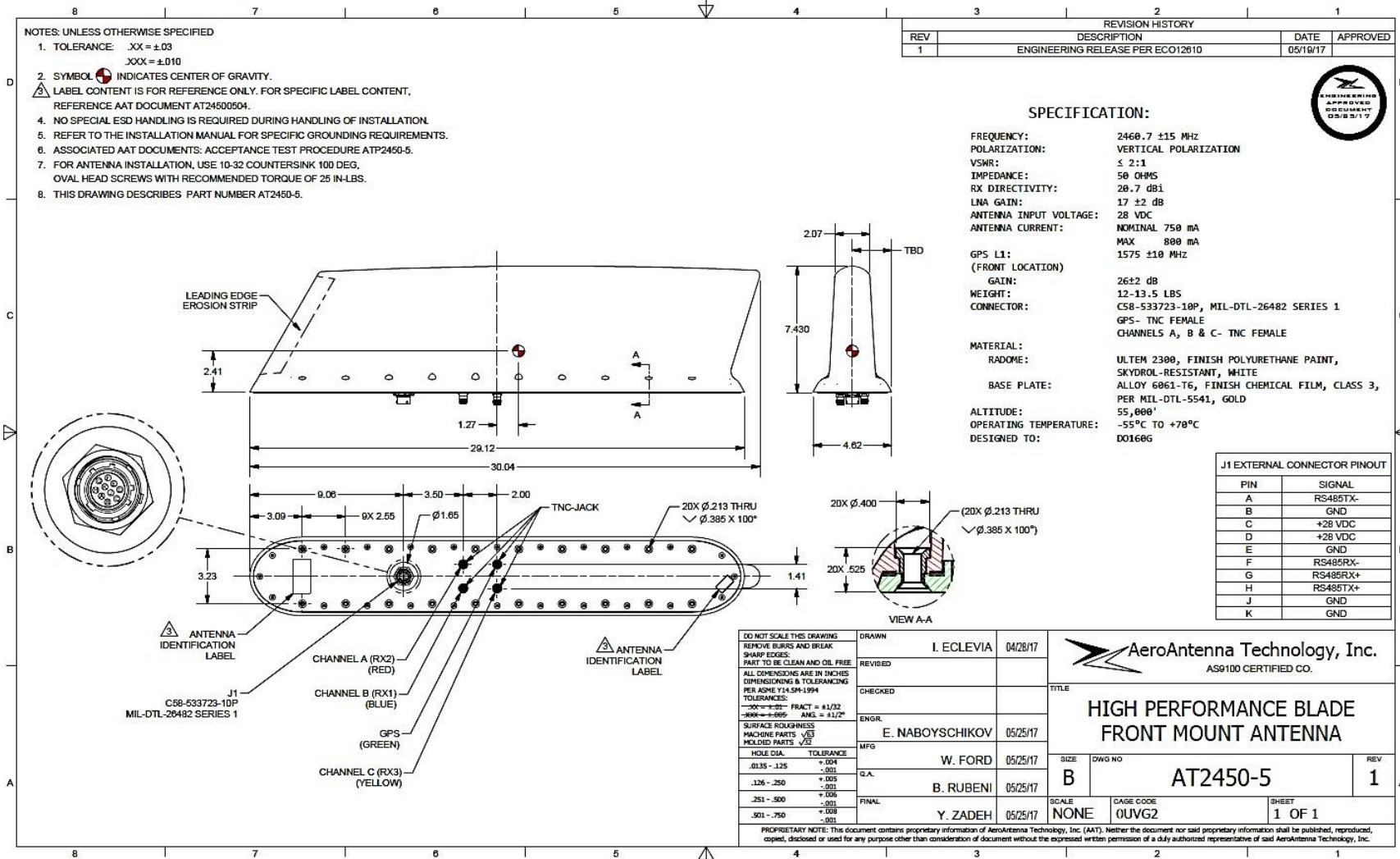


Figure 2.3.2-2 High Performance Blade (HPB) Antenna Detail (Front Mount)

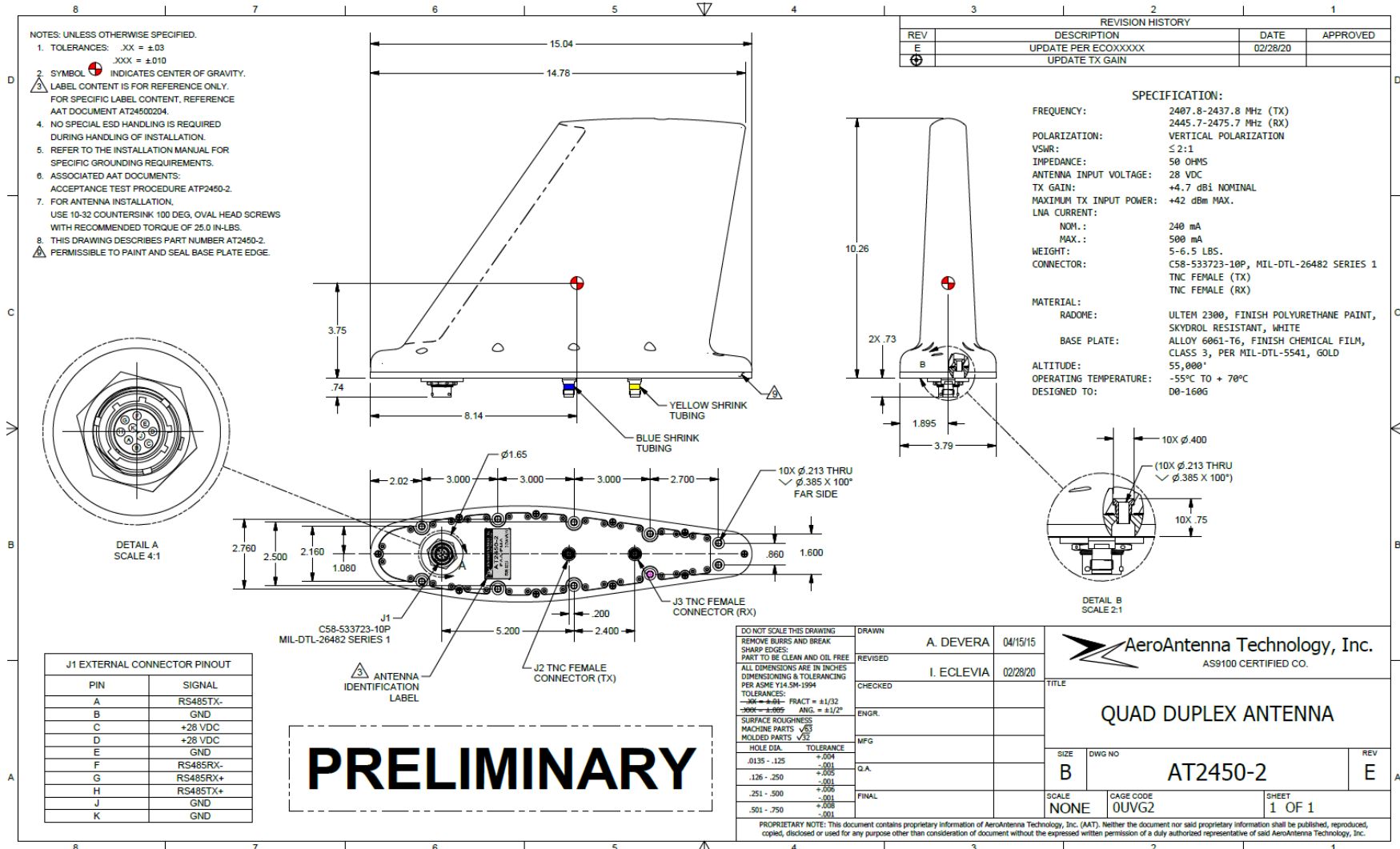


Figure 2.3.1-3 Full-Duplex Quad (FDQ) Tx/Rx Blade Antenna Detail




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3.0 PLANNING THE INSTALLATION

3.1 Introduction



Installation should take place in an area authorized for such activity; the installer will need to consider the location of the aircraft during the installation. The aircraft should be located outside of the hanger for post-installation system verification to reduce the amount of 2.4 GHz Wi-Fi interference from nearby sources and to maximize GPS reception.

3.2 Safety Precautions, Warnings, and Advisories

WARNINGS:  are provided before potentially dangerous procedures, materials, methods, and processes and must be followed precisely to avoid injury.

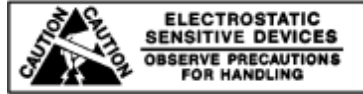
CAUTIONS:  are provided before procedures, materials, methods, and processes and must be followed precisely to avoid equipment damage.

NOTES: are provided after applicable procedural steps, when necessary, to highlight or clarify information.

	OBSERVE STANDARD SAFETY PRECAUTIONS AND WEAR SAFETY GLASSES AND OTHER PROPER SAFETY GEAR TO PREVENT PERSONAL INJURY DURING INSTALLATIONS.
	TURN OFF POWER BEFORE DISCONNECTING ANY COMPONENT FROM WIRING. DISCONNECTING THE COMPONENT WITHOUT TURNING POWER OFF MAY CAUSE VOLTAGE TRANSIENTS THAT CAN DAMAGE THE COMPONENT.



WHILE THE ABR SYSTEM IS NOT CLASSIFIED AS A STATIC SENSITIVE DEVICE, GOOD SHOP PRACTICES SHOULD BE FOLLOWED WHEN HANDLING AND INSTALLING ALL EQUIPMENT. USE OF GROUNDED CONDUCTIVE SURFACES AND ANTISTATIC MATERIALS IS RECOMMENDED.



THE FOLLOWING PRECAUTIONS SHOULD BE FOLLOWED WHILE INSTALLING THE 001-00300-10:

- De-energize or disconnect all power and signal sources and loads before installing the 001-00300-10.
- Place the component on a grounded, conductive surface.
- Ground the installer through a conductive wrist strap or other device using a 470-kilohm or 1-megohm series resistor to protect the equipment.
- Ground any electrical tools, such as soldering equipment that will contact the component. Contact with the operator's hand provides sufficient ground for tools that are otherwise electrically isolated.
- Install cables away from power outlets, uninterruptible power supplies, and other sources of strong electromagnetic interference.
- Ensure adequate shielding or protection is included if aircraft radio is installed where it may come in contact with fluids.



The ABR does not contain any user-serviceable parts. Unauthorized modifications or repairs could result in permanent damage to the 001-00300-10, void warranty and authority to operate this device under FAA, FCC and other applicable regulations. Repairs may only be performed by authorized service centers.

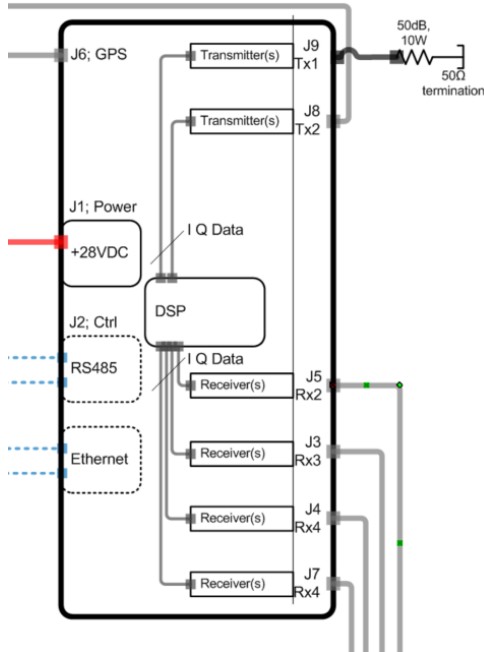


RF EXPOSURE STATEMENTS

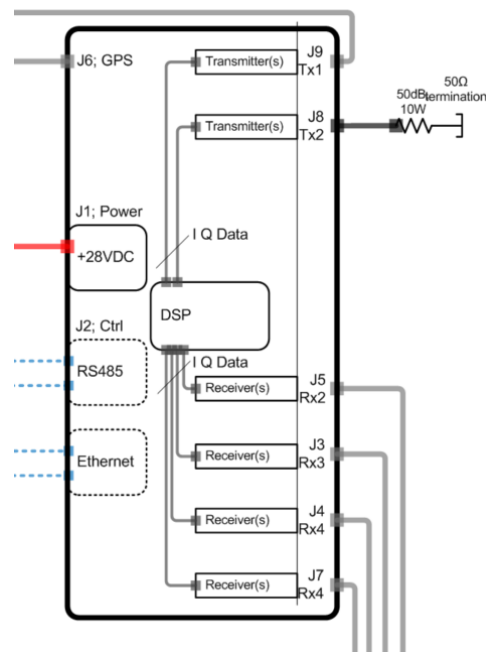
Exposure to radio frequency during wireless operation: Based on the FCC RF exposure compliance requirements, the separation distance between a wireless antenna and any person's body must be at least 6 inches [15.3 cm].

To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of 6 inches [15.3 cm] from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

NOTE: The ABR has two transmitters and only one transmitter is operational and connected to the antenna when the other transmitter is terminated with 50Ω and software disabled. The purpose of that is PA redundancy.



Tx2 (J8) is connected and enabled
 Tx1 (J9) is terminated and disabled



Tx1 (J9) is connected and enabled
 Tx2 (J8) is terminated and disabled

NOTE: The ABR has two identical transceivers (AD9375) from Analog Devices.



3.3 Installation Approval

This guide is not FAA approved installation data and only provides guidance to STC/TC applicants seeking installation approval for this equipment. The STC/TC holder provides FAA-Certified equipment and antenna location details. Installation guidance for the WSS radio is in accordance with RTCA document DO-313 (“Certification Guidance for Installation of Non-Essential, Non-Required Aircraft Cabin Systems and Equipment”). The WSS 4G LTE system is intended for entertainment and advisory purposes and is not designed to interoperate with Flight Critical Systems. Any required foreign approvals would be the responsibility of the STC Holder.

NOTE: *It is the responsibility of the installer to obtain FAA approval for the router installation and for providing the aircraft owner/operator with evidence that the critical aircraft systems are not susceptible to RFI/EMI interference from portable electronic devices (i.e. “Wi-Fi immunity” or “PED/T-PED tolerance”).*

NOTE: *Testing of the WSS system can only be performed within WSS network coverage. Please consult with Wireless Systems Solutions regarding coverage and availability.*

3.4 Special Tooling

3.4.1 Installation Tools

An optional special tool is recommended to mate and de-mate the TNC connectors on the front panel of the ABR chassis, as these connectors are tightly spaced. The tool is

an Ideal Industries Tool, Connector Removal; BNC/TNC; 12-inch, Mfr. Part#: 35-042, or equivalent, as depicted in Figure 3.4-1.

For the assembly of the DMC connector, the following tools are required; a) Insertion Tool (long Version) 057-0699-00A/(EN4165TS), and b) Extraction Tool (long Version) 057-0289 A/(EN4165TN). These are not pin insertion tools but module insertion and extraction tools. They are depicted in Figure 3.4-2 and Figure 3.4-3, for the Insertion and Extraction, respectively. Additionally, a 3mm hexagonal screwdriver is needed for securing the DMC connectors to the ABR.



Figure 3.4-1 TNC Connector Tool



Figure 3.4-2 Insertion Tool

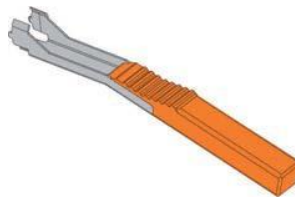


Figure 3.4-3 Extraction Tool

3.4.2 Post-Installation Tools

The SmartCart Test System is used for the ground test of the WSS 4G LTE System after it has been installed on the aircraft. The SmartCart Test System includes all the equipment necessary to perform a Connectivity / Traffic Test and Max Power Test. See Section 6.2.4 of this manual for more information.

3.5 Mounting Considerations

3.5.1 Antenna Site Selection

The system configuration consists of a full-duplex quad (Tx/Rx) blade antenna (FDQ) and a high-performance (Rx) blade antenna (HPB) mounted on the underside of the aircraft. A typical configuration is depicted Figure 3.5.1-1.

However, the antennas may be mounted in the reverse orientation as required provided the antenna installation guidance within this section is followed. HPB Antenna PN AT2450-5 w/ front mount GPS is recommended in place of PN AT2450-1 for optimal performance.

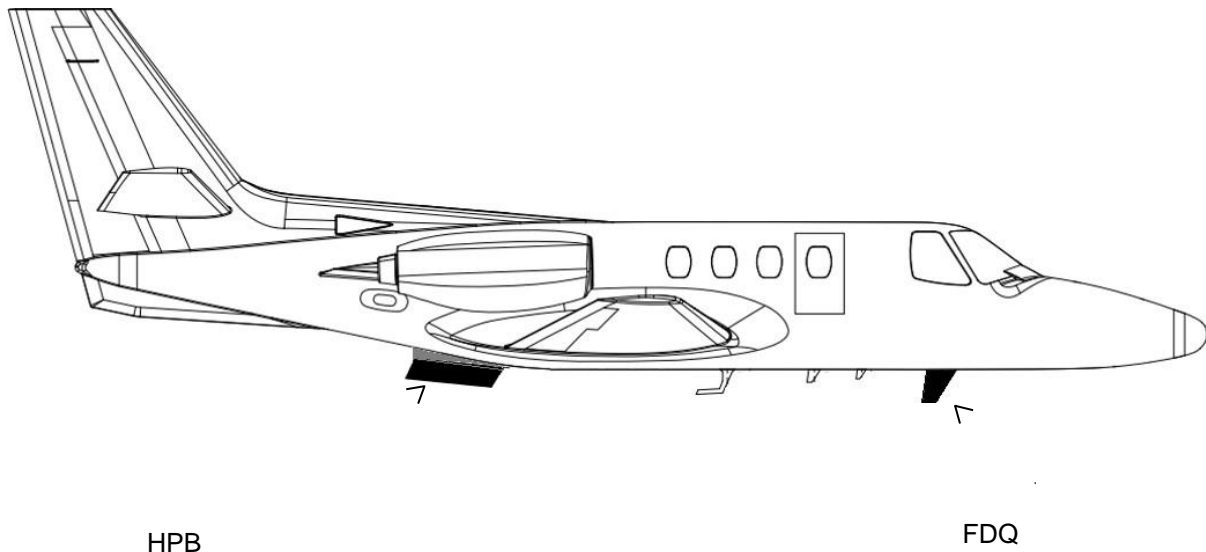
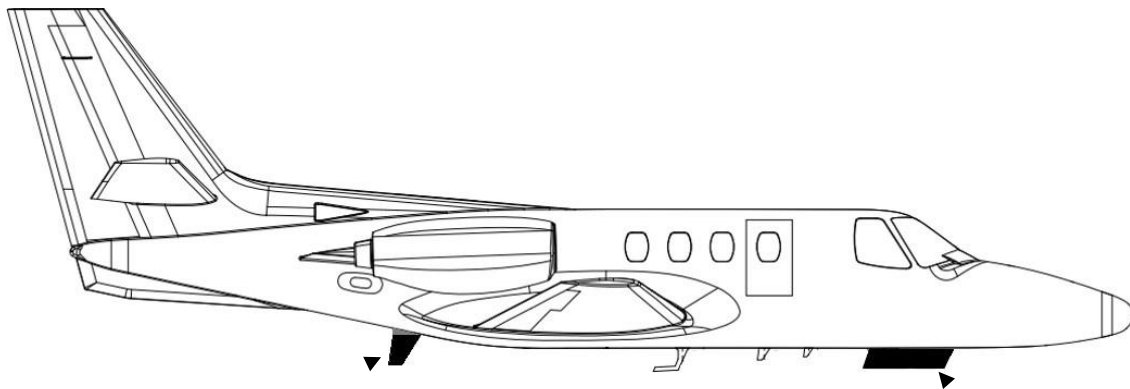


Figure 3.5.1-1 Typical Antenna Mounting



FDQ
(PN AT2450-2)

HPB
(PN AT2450-5)

Figure 3.5.1-2 Reverse Antenna Mounting Configuration

Once the antenna locations have been identified, determine the cable length required between the mounted ABR chassis, and the antenna fixtures. Select the appropriate cable to use based upon the guidance in Section 3.6.4.

3.5.1.1 WSS Antenna Site Selection and Separation

WSS provides dedicated engineering resources to work with the installer in the antenna placement process on all STC projects. WSS's cutting edge modeling tools provide insight into the antenna performance as mounted on a particular aircraft model. The below guidelines provide generic guidance on antenna placement; however, the actual antenna location per airframe will be determined through a joint effort of WSS and the STC partner.

Consideration should be given to mount the antenna in a location that provides the best performance versus accessibility to mounting of the antenna. Figures 3.5.1-2 and 3.5.1-3 show installations on representative aircraft to provide best performance; areas indicated in Green are permissible areas to mount antennas; areas indicated in Red should be avoided.

Figure 3.5.1-2 Antenna Location Preferences – Learjet 45 Example
(green) and keep-out areas (red) for Aircraft with Ventral Fins



Figure 3.5.1-3 Antenna Location Preferences – Citation Sovereign Example
(green) and keep-out areas (red) for Aircraft without Ventral Fins



The FDQ antenna is a transmit and receive antenna and should be mounted in a location with visibility to all directions when in flight. Optimal performance is often achieved between 10-20 inches from the centerline between the front landing gear and the main wing section. Alternatively, the FDQ can be placed along the centerline aft of the wings such that the base of the antenna aligns with the underside of the wings. The FDQ is the primary transmit and receive antenna in the forward, port, starboard, and aft directions.

The HPB antenna is a receive-only antenna which provides supplementary coverage to the port and starboard sides of the aircraft. Generally, the HPB should not be mounted underneath the wings due to pattern distortion from the wing surfaces. The HPB antenna should be mounted close to the centerline underneath the aircraft.



Figure 3.5.1-4 Antenna Off-Centerline Mounting

The FDQ antenna may be mounted 10-20 inches off centerline (depending on the curvature of the plane). The HPB antenna should generally be centered but may be mounted up to 12 inches off centerline if required.

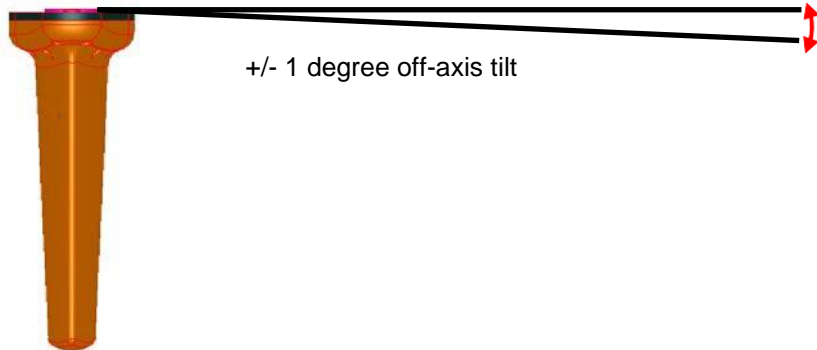


Figure 3.5.1-5 Antenna Off-Centerline Tilt

The antennas must be mounted with no more than +/- 1 degree of tilt from vertical, using the aircraft water line as reference.



Figure 3.5.1-6 FDQ Fore-Aft Tilt

The FDQ must be mounted with fore-aft tilt within +/-1 degree of longitudinal level, using the aircraft water line as reference.



Figure 3.5.1-7 HPB Fore-Aft Tilt

The HPB antenna may be mounted with a fore-aft up-tilt angle of up to 10 degrees, using the aircraft water line as reference.

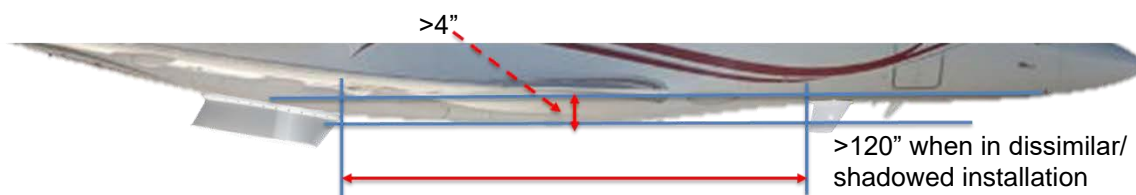


Figure 3.5.1-8 HPB and FDQ Antenna Separation

In situations where antennas are shadowed from each other by the aircraft fuselage a reduced separation of no less than 120" edge to edge is permissible as shown in Figure 3.5.1-8.

The edge-to-edge separation of the antennas must be greater than 168 inches in same antenna plane installation, meaning when positioned fore and aft along a flat fuselage surface. Please consult with WSS in each situation to ensure performance degradation risk is assessed.

3.5.1.2 Antenna Separation from Existing Antennas and Obstructions

The following is intended to provide general guidance to the installer when analyzing antenna placement options on the aircraft and describes minimum edge-to-edge separation criteria from existing antennas or obstructions such as drain masts. It is strongly recommended that the Installer always consult with WSS Product Support during this analysis phase to help in determining the most suitable locations and to discuss any deviations from this guidance that may be necessary. The following provides physical recommendations based upon antenna physical characteristics. Please consult with WSS Product Support regarding any additional, specific separation requirements that may need to be considered based upon RF interference for aircraft operations systems.

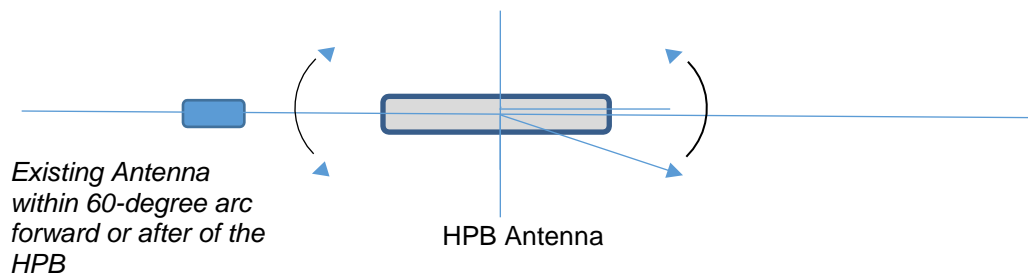
Table 3.5.1.2-1 Antenna Separation Guidelines

Installed Aircraft Antenna	FDQ Separation Distance	HPB Separation Distance
Antenna or Obstruction ≤ 4" High	12 inches edge-to-edge	12 inches edge-to-edge
Antenna or Obstruction > 4" High	18 inches edge-to-edge	18 inches edge-to-edge

NOTE - All distances as measured directly between the baseplate of the antennas against the aircraft fuselage.

Where possible it is recommended that the HPB antenna be installed such that the closest antennas and obstructions are located within a 60-degree area Forward or Aft of the HPB antenna as shown in Figure 3.5.1.2-2, top down view of antenna locations. For installations where a deviation must be considered, please contact WSS Product Support for assistance in evaluating other locations for consideration.

Figure 3.5.1.2-2 HPB Separation Placement Considerations





3.5.1.3 Antenna Ground Plane Requirements

The WSS 4G system antennas may be mounted to any electrically conductive airframe panels, such as aluminum or composite-carbon fiber airframe panels, without the need for additional ground planes to be installed.

Installation of ground planes will be required when mounting to non-conductive fiberglass panels. Please consult with WSS for ground plane requirements when mounting antennas on non-conductive surfaces.

3.5.2 ABR Site Selection

Consideration must be given for both the physical mounting location of the chassis, and the assurance that the chassis will be provided with a suitable airflow around it for cooling purposes as defined below.

To ensure that the ABR remains within its thermal limits, clearances of approximately 3 inches from the front, 3 inches from the back, and 4 inches from the top should be maintained. Clearance of at least ¼ inch should be maintained along the sides of the ABR chassis. Note that there is a fan mounted on the rear surface of the chassis (opposite side relative to the connector plane) and 3.0 inches of clearance needs to be maintained to the rear of the fan housing to support air flow and proper thermal performance of the chassis enclosure.

When selecting a location for the ABR installation, the installer must factor adequate spacing to accommodate coaxial cable connectors and bend radiuses for cable routing in all directions from the front panel of the ABR. Please refer to coaxial manufacture for maximum bend radius specifications and connector dimensions.

3.6 Cabling and Wiring

Reference Section 5, System Interconnects for RF, Power / Control and Ethernet connectivity diagram and connector assembly instructions.

3.6.1 General

An Electrical Load Analysis must be accomplished by the installer to determine that the electrical limits of the specific aircraft are not exceeded. The Electrical Load Analysis, Functional Hazard Assessment and other certification requirements for the aircraft must remain in compliance.

It is strongly advised that the following criteria be adhered to:

- Ensure that routing of the wiring does not come in contact with sources of heat, RF or EMI interference.
- Route wiring a safe distance from aircraft control cables.

- Check that there is ample space for the cabling and mating connectors. Avoid sharp bends in cabling. Refer to the manufacturer's minimum bend radius recommendations.
- When routing antenna cables, observe the following precautions:
 - All cable routing should be kept as short and direct as possible.
 - Avoid routing cables near power sources (e.g., 400 Hz generators, trim motors, etc.) or power or ballasts for fluorescent lighting.
 - Avoid routing cable near ADF antenna cable.
 - Avoid routing cables near the aircraft's GPS system antenna or power cables.
 - Avoid routing cables near the aircraft's transponder and DME system

3.6.2 DC Power (Radio and Antennas)

Installers should select the appropriate capacity circuit breaker to provide full rated current to the system as defined in Table 2-1. Reference Section 5.1.3 for DC Power wiring definitions. For additional guidance, refer to applicable FAA regulatory requirements and guidance for circuit protective devices.



Caution: Verify proper wiring and pins for 28 VDC Power and Ground from ABR to FDQ and HPB Antennas. Reverse polarity of the DC power connection will damage ABR.

3.6.3 Control and Network Cabling

All network and control cabling should to be shielded, controlled-impedance twisted pairs to ensure signal integrity and reject noise. Pair twist should be maintained to within a maximum recommended distance of 0.5" to the connector module entry points to minimize crosstalk between pairs.

Note that two pairs are crisscross arranged through the connector body. This minimizes crosstalk between the pairs while passing through the connector. Special attention must be paid to the wire pairing at both ends of the cable for digital signals. Failure to maintain wire pairing will result in high crosstalk in the cabling. Pin numbering in the diagrams conforms to industry standard TIA-568B pairs: 1-2, 3-6, 4-5, 7-8

3.6.3.1 Antenna Control Connections

Shielded two-pair (4-conductor) 100-ohm twisted pair cable such as PIC Wire and Cable Datamates E10424 or equivalent (Figure 3.6.3.1-1) is recommended for the control connection between the ABR and each antenna. Reference Section 5.1.3 for wiring information and 5.2.3 for connector shielding requirements.

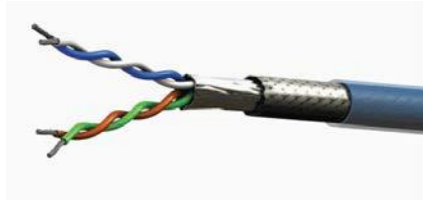


Figure 3.6.3.1-1 Example 2-pair Twisted, Shielded Cable

3.6.3.2 Network Connection

Shielded four-pair (8-conductor) 100-ohm twisted-pair cable such as PIC Wire and Cable Datamates E50824 or equivalent (Figure 3.6.3.2-1) is recommended for the 1000BASE-T Ethernet connection between the ABR and the Network Router and for the Maintenance Ethernet port connection. Shields should be grounded to the connector backshell at the ABR, and to the RJ-45 shield at the router end. If the network cable is required to penetrate the pressure vessel, an appropriate bulkhead feedthrough which preserves signal and shield integrity should be used. Reference Section 5.1.3 for wiring information and 5.2.5 for connector shielding information.



Figure 3.6.3.2-1 Example 1000BASE-T Ethernet Cable

3.6.4 RF Cabling

3.6.4.1 Coax Cable

Any Triple-shielded coaxial cable, which meets or exceeds burn requirements per Federal Aviation Regulations 14 CFR Part 25.869(a) (4) Amendment 25-113, Appendix F Part I(a)(3), and which is manufactured with materials that, when subjected to flames or high temperatures, will not outgas deadly hydrogen chloride (such as is produced by conventional PVC cables) is acceptable for the installation. The cable must also meet or exceed RF performance characteristics for the length selected.

NOTE: Receive (RX) coaxial cables between the Aircraft radio and the HPB should be equal in length within 12 inches.



Extreme care should be taken with cable assembly, as minor defects in cable termination can greatly increase VSWR and/or attenuation of cable assemblies and compromise system performance. Cable assemblies should be tested after assembly, and again after installation in the airframe to ensure no installation handling damage has occurred. It is recommended that the VSWR of the installed cabling system be less than 1.5:1, and attenuation be no greater than the maximum specified below. The 'cabling system' is defined as the connector-terminated cables, and any in-line bulkhead connector(s) required.

Table 3.6.4-1 Coax Cable Requirements

Characteristics	Specification
Cable Impedance	50 Ω
Operating Temperature Range	-55°C to 125°C
Velocity of Propagation (vp)	85% [± 5%]
Shielding of Effectiveness	> 90dB through 18 GHz
Maximum Attenuation / dB Loss (including connectors)	<ul style="list-style-type: none"> • ABR to FDQ/HPB Rx coax cables: < 6.0 dB @ 2.483 GHz • ABR to FDQ Tx coax cable: < 3.0 dB @ 2.483 GHz. • ABR to HPB embedded GPS: < 10.0 dB @ 1.5 to 1.6 GHz.
Maximum VSWR (including connectors)	1.5:1
Flammability	Federal Aviation Regulations 14 CFR Part 25.869(a) (4) Amendment 25-113, Appendix F Part I(a)(3)

Table 3.6.4-2 Recommended Coax Cable Compliance

Condition	Compliance Standard
Vapor Leakage	MIL-STD-202 Method 112E, paragraph 5, test condition C, procedure IV
Temperature Shock	MIL-STD-810, Method 503.2
Vibration	MIL-STD-810, Method 514.3, Procedure I
Power Handling Capability	MIL-T-81490, paragraph 4.7.13
Flexure	MIL-T-81490, paragraph 4.7.15



Tensile Load	MIL-T-81490, paragraph 4.7.17
Concentrated Load	MIL-T-81490, paragraph 4.7.18
Abrasion	MIL-T-81490, paragraph 4.7.19
Sand and Dust	MIL-STD-810, Method 510.2, Procedure I
Humidity	MIL-STD-810, Method 507
Condition	Compliance Standard
Salt Fog	MIL-STD-810, Method 509, Exposure \geq 96 hours
Dielectric Withstanding Voltage	MIL-STD-202, Method 301
Icing/Freezing Rain	MIL-STD-810, Method 521.0
Fungus Resistance	MIL-STD-810, Method 508.3
Rain - Drip	MIL-STD-810, Method 506.2, Procedure II
Rain – Blowing Rain	MIL-STD-810, Method 506.2, Procedure I
Corona Extinction Voltage	MIL-C-17, paragraphs 3.7.5 and 4.8.6

3.6.4.2 TNC Connector

TNC Male Connectors used for coaxial cable termination should ensure proper RF and environmental performance at the operating frequencies and environmental conditions. Soldered connectors should comply with J-STD-001 Solder Standards. All connectors will be torqued in accordance with manufacturer specifications.

3.6.4.3 Recommended Coax Cable Assembly

WSS recognizes that there are many sources for coaxial cable within the marketplace. While a specific manufacturer and type is not mandatory, to meet WSS Network’s aim of providing a high-performance, high-reliability system for long term Customer satisfaction, it is strongly recommended that coaxial cables meeting all of the stated environmental and installation requirements is selected. For reference purposes, the following are examples of such cables:



Table 3.6.4-2 RF Coax Cable Example

	Typical Cable Attenuation	Max Cable Attenuation	Max Cable Outer Diameter	Min. Bend Radius	Nominal Cable Weight
Aviation Industry Coax Example #1	0.324 dB/ft @ 18 GHz per 100ft	0.363 dB/ft @ 18 GHz per 100ft	0.212"	1"	0.42 lb/ft
Aviation Industry Coax Example #2	0.191 dB/ft @ 18 GHz per 100ft	0.209 dB/ft @ 18 GHz per 100ft	0.338"	2"	0.10 lb/ft



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4.0 INSTALLATION PROCEDURE

This section provides the necessary information for successful installation of the WSS 4G System. Guidance for the installation of the WSS ABR is provided by RTCA Standard DO-313, "Certification Guidance for Installation of Non-Essential, Non-Required Aircraft Cabin Systems and Equipment," and FAA Advisory Circulars AC 43.13-1B, AC43.13-2B, and AC20-168.

4.1 Antenna Installation

An example antenna drawing for the HPB antenna is shown in Figure 2.3.2-1/2 and for the FDQ antenna is shown in Figure 2.3.2-3. Refer to the manufacturer's drawings for the antenna mounting screw torque values required to install the antennas to the aircraft. The STC applicant will need to determine if the recommended torque values need to be modified based on material mounting, such as honeycomb, skin/shim, etc. The following guidance is provided for installation. See AC 43.13-1B for additional guidance on antenna installation.

1. Bonding- Antennas mounted on composite aircraft panels must provide an electrical bond of 10.0 milliohms or less to the airframe ground. Bonding of the antenna may be accomplished through the mounting hardware, attached to an internal doubler plate with a suitable ground strap between the doubler plate and the airframe provide that the resistance between the antenna and airframe meets the requirements of this section. Antennas mounted on sheet metal aircraft panels must provide an electrical bond of 2.5 milliohms or less to the airframe ground. Refer to Advisory Circular 43.13-1b chapter 15 for additional guidance.
2. Apply an electrical bonding agent between the antenna and the fuselage skin using Av-DEC or equivalent gaskets or appropriate conductive paste.
3. All interface surfaces of antenna doublers and edges of the antenna fillet areas and feed-through holes for the antennas are to be sealed with PRC DeSoto Pro-Seal 870 or equivalent.
4. Seal the antenna attaching screw holes with RTV 162 sealant or equivalent and contour to match the antenna.
5. DO NOT PAINT ANTENNA RADOME. Painting the antenna's radome will degrade the performance of the system and may void warranty. If touch-up is required, use Polyurethane MIL-PRF-85285, Color number 27875.
6. The edge of the FDQ antenna's aluminum baseplate can be painted if desired.

NOTE: For both FDQ and HPB antenna installation, it is acceptable to use 10-32 countersunk 100-degree flat screw head as an alternative to 10-32 countersunk 100-degree oval screw head. Recommended torque for both is 25 in-lbs.

4.2 ABR Cable Installation

Run the coaxial and control cable harnesses through the aircraft as planned by the installer. Ensure that bend radii are greater than the values specified by the manufacturer, the cables are protected from sharp airframe structural components, and are routed appropriately to address the unique routing locations/environment of the

aircraft per industry best practice. Secure the cable to the aircraft structure at FAA-compliant intervals. Use approved lacing tape, or equivalent, to secure any length of cable otherwise unsupported, such as the 1000BASE-T Maintenance Port using industry best practice.

NOTE: Prior to connecting to the aircraft antennas, refer to Section 6.1 Installation Verification.

4.3 ABR Chassis Installation

After the cable harness installation has been completed, mount the chassis tray to the aircraft avionics rack in a manner consistent with the mounting requirements described in Section 3.5.2 of this manual.

Guide the ABR into the tray with the connector panel facing out, lining up the guide pins in the back, and securing the front swing-bolts to the mounting feet on the ABR box. Install swing bolt lower part onto the mounting hooks, and hand tighten by turning the knob clockwise until fully seated. No tool is required for installation and a measurement of torque is not required.

Connect the cables to the ABR per Section 5.0 System Interconnects guidance.

Bonding- The electrical bond between the installed ABR, mounting tray and airframe ground should not exceed 2.5 milliohms. Refer to Advisory Circular 43.13-1b chapter 15 for additional guidance.



Caution: Verify proper wiring and pins for 28 VDC Power and Ground from ABR to FDQ and HPB Antennas. Reverse polarity of the DC power connection may damage the ABR.



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5.0 SYSTEM INTERCONNECTS

5.1 Connector List and Descriptions

This section details the system interconnect requirements for proper cabling and interconnection of the WSS System.

The J1 and J2 connectors for the ABR are keyed for proper alignment with the ABR receptacle. When assembling the connectors, ensure that the keyways are installed so that the keyway opening is in the 12 o'clock position between the numbers '1' and '6' etched on the connector housing. See figure 5.1.1-1 below for proper alignment.



The assembly of the plug keying component on the cabling harness does not require the use of any tools. If the plug keying component p/n 732-8020-10 is incorrectly installed in the connector cavity, it must be broken to be removed. Use caution when assembling the ABR connectors. See figures below for keying alignment reference.



Figure 5.1.1-1 ABR Connector Keying Alignment Reference

5.1.1 ABR Front Panel

Figure 5.1.1-2 Aircraft Base Radio Front Panel View





Figure 5.1.1-2 Aircraft Base Radio Connector Pin Definition Chart

GIGABIT ETHERNET (CWAP)			
J2-D			
5 BI_DD+	10 BI_DC-	15 NC	20 NC
4 BI_DC+	9 BI_DD-	14 NC	19 NC
3 NC	8 NC	13 NC	18 NC
2 BI_DB+	7 BI_DA-	12 NC	17 NC
1 BI_DA+	6 BI_DB-	11 NC	16 NC

DC POWER OUT TO FDQ/HPB ANTENNA			
J1-B			
5 FDQ FILTERED +28 VDC	10 FDQ FILTERED RTN	15 SP FILTERED +28VDC	20 SP FILTERED RTN
4 FDQ FILTERED +28 VDC	9 FDQ FILTERED RTN	14 SP FILTERED +28VDC	19 SP FILTERED RTN
3 HPB FILTERED +28VDC	8 HPB FILTERED RTN	13 SP FILTERED +28VDC	18 SP FILTERED RTN
2 HPB FILTERED +28VDC	7 HPB FILTERED RTN	12 SP FILTERED +28VDC	17 SP FILTERED RTN
1 RESERVED	6 RESERVED	11 RESERVED	16 RESERVED

MAINTENANCE PORT			
J2-C			
5 NC	10 NC	15 BI_DD+	20 BI_DC-
4 NC	9 NC	14 BI_DC+	19 BI_DD-
3 NC	8 NC	13 NC	18 NC
2 NC	7 NC	12 BI_DB+	17 BI_DA-
1 NC	6 NC	11 BI_DA+	16 BI_DB-

AIRCRAFT POWER	
J1-A	
2 +28VDC	4 GND RTN
1 +28VDC	3 GND RTN

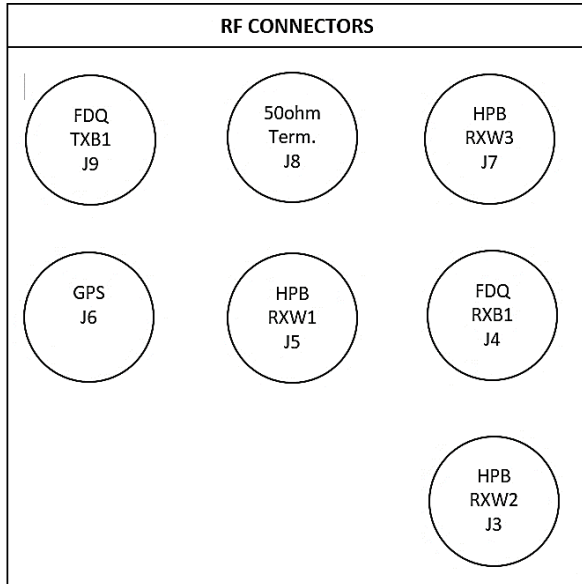


Figure 5.1.1-2 Cont.

RESERVED			
J2-B			
5 RESERVED	10 RESERVED	15 RESERVED	20 RESERVED
4 RESERVED	9 RESERVED	14 RESERVED	19 RESERVED
3 RESERVED	8 RESERVED	13 RESERVED	18 RESERVED
2 RESERVED	7 RESERVED	12 RESERVED	17 RESERVED
1 RESERVED	6 RESERVED	11 RESERVED	16 RESERVED

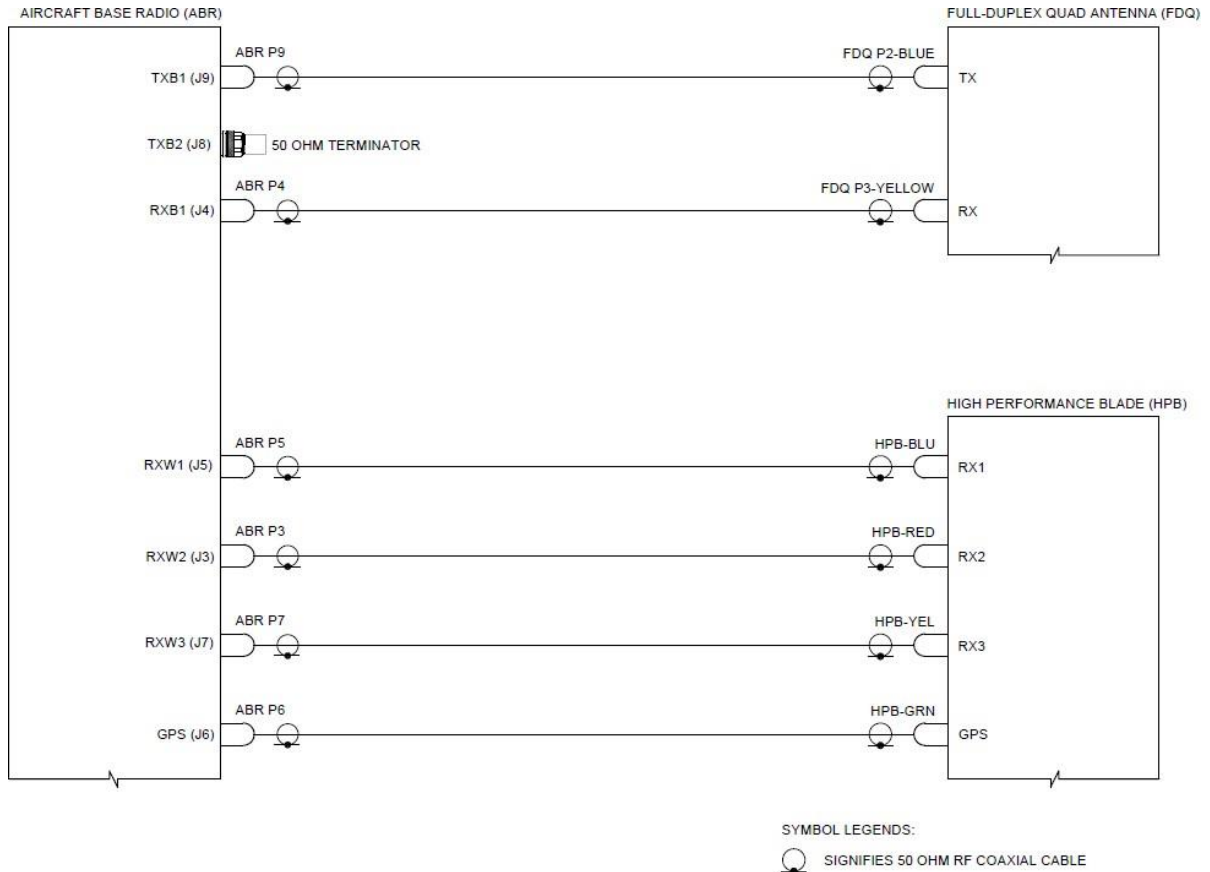
ANTENNA CONTROL			
J2-A			
5 RESERVED	10 RESERVED	15 HPB RS-485 RX+	20 HPB RS-485 TX-
4 RESERVED	9 RESERVED	14 HPB RS-485 TX+	19 HPB RS-485 RX-
3 RESERVED	8 RESERVED	13 RESERVED	18 RESERVED
2 RESERVED	7 RESERVED	12 FDQ RS-485 RX+	17 FDQ RS-485 TX-
1 RESERVED	6 RESERVED	11 FDQ RS-485 TX+	16 FDQ RS-485 RX-

Figure 5.1.1-2 Cont.



5.1.2 RF Interconnects

Figure 5.1.2-1 ABR to Antennas Connectivity



5.1.3 Power and Data Interconnects and Connectors

Ethernet Electrical Characteristics: The Ethernet port conforms to IEEE 802.3 for 1000BASE-T using CAT-6 shielded cable with metalized connector plugs (for Shield Grounding). Note that Power over Ethernet (PoE) is NOT supported.

Figure 5.1.3-1 ABR Power and Ethernet Connectivity

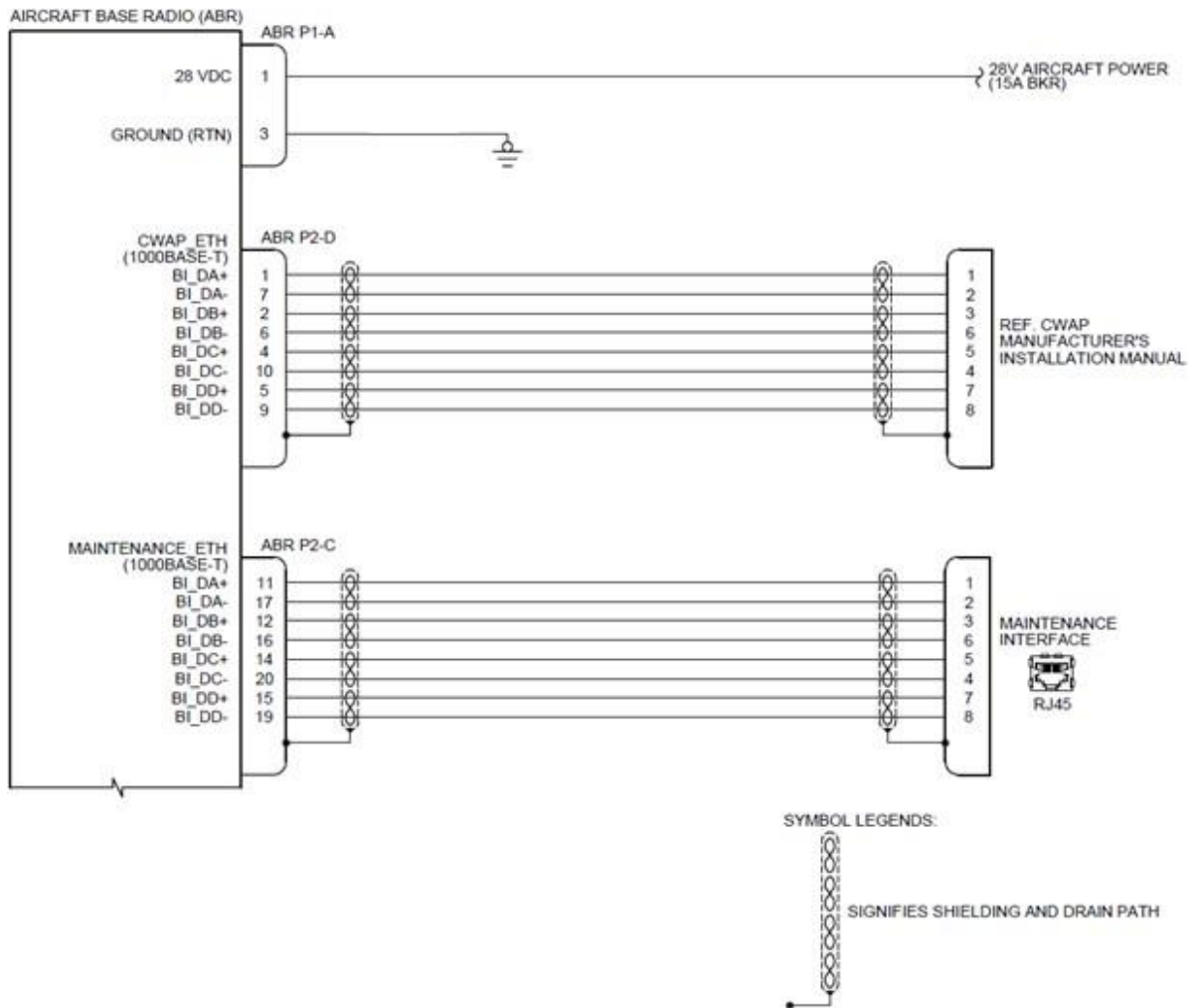
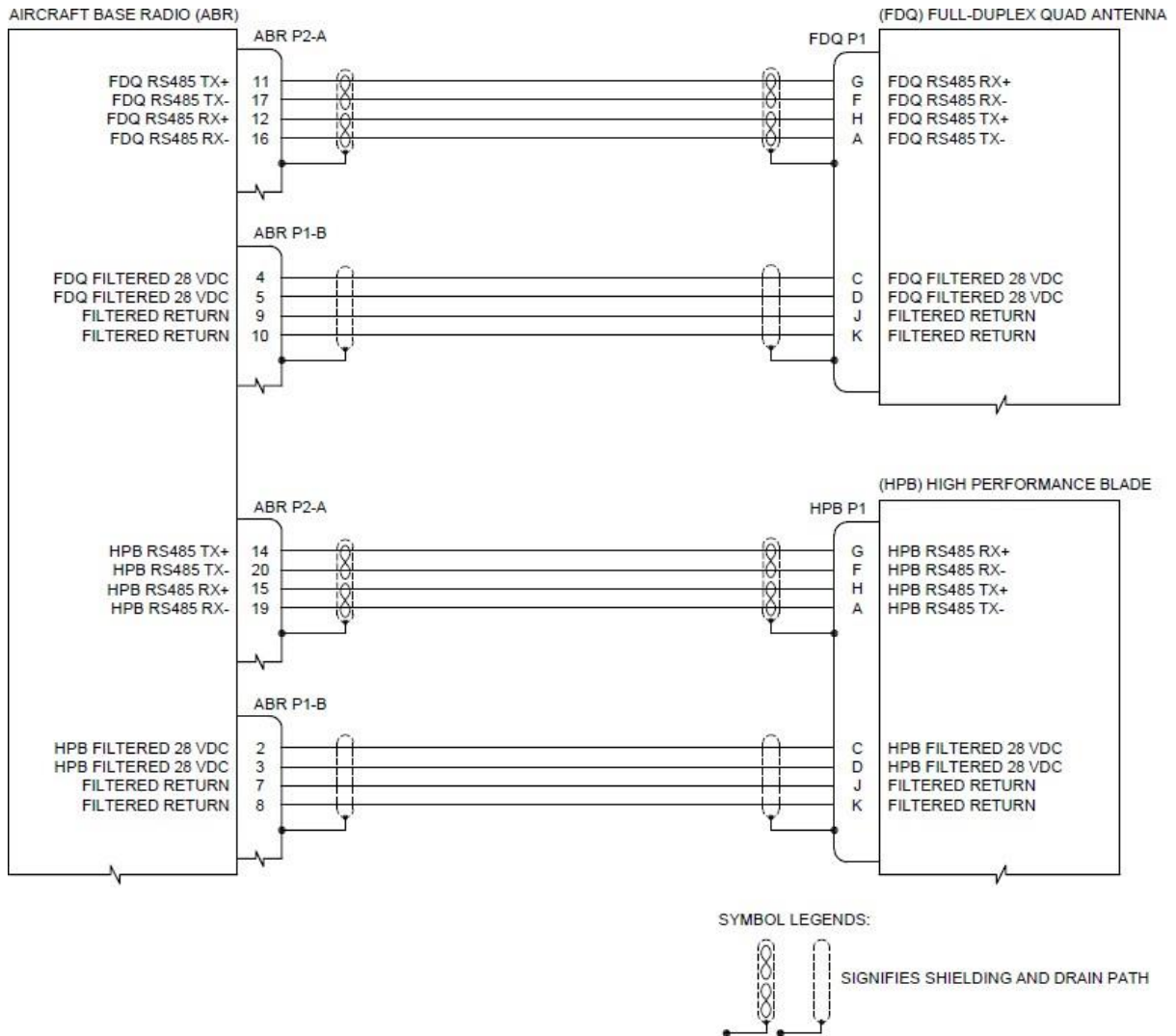


Figure 5.1.3-2 ABR to Antenna Power and Control Connectivity



Caution: Verify proper wiring and pins for 28 VDC Power and Ground from ABR to FDQ and HPB Antennas. Reverse polarity of the DC power connection may damage ABR.

5.2 Connector Parts Lists and Construction

The following provides guidance on the specific parts and connector make up that should be observed when constructing the cables for the ABR and antennas.

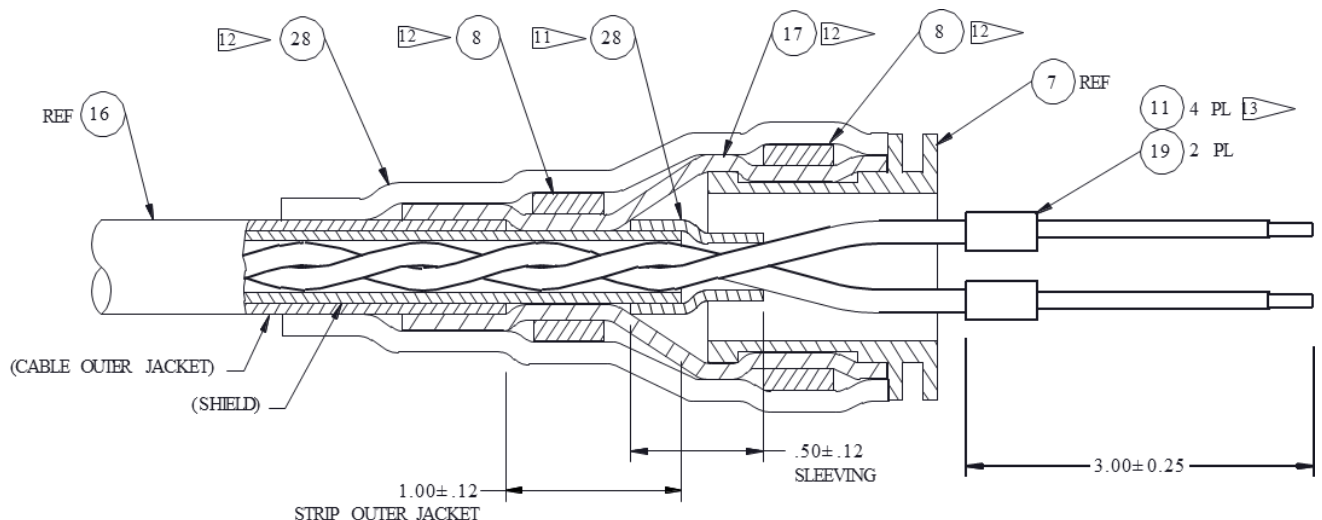
5.2.1 ABR Power Input (P1-A)

The P1-A connection is used for aircraft power to the ABR.

Table 5.2.1-1 P1-A Parts List

Quantity	Manufacturer & Description	Part Number	Drawing Item Number (IN)
A/R	Power Cable 14 AWG, Single Conductor	M27500-14TG2T14 or equivalent	11
2	TE Connectivity Solder Sleeve (.275IDx .750LG)	M83519/1-5	19
1	TE Connectivity/Deutsch DMC Chimney	732-8052-18A	7
2	GlenAir Tie-down Strap	600-057 or equivalent	8
1	Braid Wire (36AWG, .500DIA)	AA59569R36T0500 or equivalent	17
A/R	Insulation Sleeving (.375DIA)	M23053/4-104-0 or equivalent	27
A/R	Insulation Sleeving (.500-.195DIA)	M23053/4-105-0 or equivalent	28
A/R	Insulation Sleeving (.750- .313)	M23053/4-106-0 or equivalent	29
A/R	Power Cable, 2 COND	To be determined by installer	16

Figure 5.2.1-1 P1-A Shield Terminations





Note 11: After stripping cable outer jacket, secure ends of braided shield and foil shield using insulation sleeving indicated.

Note 12: Fit a length of braid wire, IN (ITEM NUMBER) 17, such that it covers the cable outer jacket, the exposed cable shield, and the connector chimney or back-shell.
Secure one end of IN 17 on the cable shield using IN 8 and secure the other end of IN 17 to the connector chimney or back-shell, again using IN 8. Completely cover IN 17 using boot seal, IN 18, or sleeving, IN 27, 28 as indicated.

Note 13: Splice 2 conductors, IN 11, 3.00-in long, using IN 19. Install sleeving, IN 27, over splice, not shown.

NOTE: Wire listed is for reference only. Wires used for the installation are to be determined by the installer as applicable to the aircraft.

5.2.2 ABR Antenna Power Output (P1-B)

The P1-B connection is used for 28VDC for both the FDQ and the HPB.

Table 5.2.2-1 P1-B Parts List

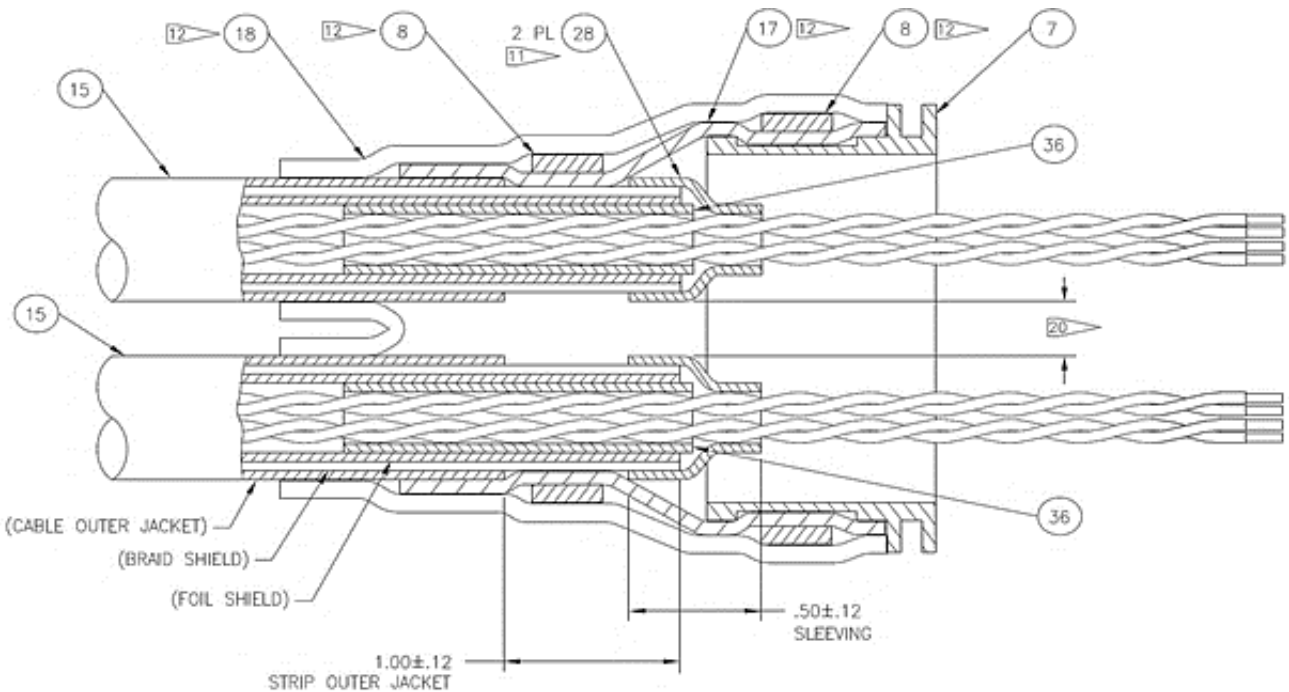
Quantity	Manufacturer & Description	Part Number	Drawing Item Number (IN)
1	TE Connectivity/Deutsch DMC Chimney	732-8052-18A	7
2	GlenAir Tie-down Strap	600-057 or equivalent	8
1	Braid Wire (36AWG, .500DIA)	AA59569R36T0500 or equivalent	17
A/R	Insulation Sleeving (.375DIA)	M23053/4-104-0 or equivalent	27
A/R	Insulation Sleeving (.500-.195DIA)	M23053/4-105-0 or equivalent	28
A/R	Insulation Sleeving (.063- .031)	M23053/5-102-0 or equivalent	36
1	Boot Seal	HSB-2-1 or equivalent	18
A/R	Cable, 22AWG/4 COND	M27500-22TG4T14 or equivalent	15

5.2.3 ABR Antenna Control Output (P2-A)

The P2-A connection is used for antenna control for both the FDQ and the HPB.

Figure 5.2.3-1 ABR P2-A Shield Terminations

Table 5.2.3-1 ABR P2-A Parts List							
Quantity	Manufacturer & Description	Part Number	Drawing Item Number (IN)				
1	TE Connectivity/Deutsch DMC Chimney	732-8052-18A	7				
2	GlenAir Tie-down Strap	600-057 or equivalent	8				
1	Braid Wire (36AWG, .500DIA)	AA59569R36T0500 or equivalent	17				
A/R	Insulation Sleeving (.375DIA)	M23053/4-104-0 or equivalent	27				
A/R	Insulation Sleeving (.500-.195DIA)	M23053/4-105-0	28				
1	Boot Seal	HSB-2-1 or equivalent	18	A/R	Cable, 24AWG/4 COND	E10424 or equivalent	12
A/R	Cable, 24AWG/4 COND	E10424 or equivalent	12				



Note 11: After stripping cable outer jacket, secure ends of braided shield and foil shield using insulation sleeving indicated.



Note 12: Fit a length of braid wire, IN (ITEM NUMBER) 17, such that it covers the cable outer jacket, the exposed cable shield, and the connector chimney or back-shell.
Secure one end of IN 17 on the cable shield using IN 8 and secure the other end of IN 17 to the connector chimney or back-shell, again using IN 8.
Completely cover IN 17 using boot seal, IN 18, or sleeving, IN 27, 28 as indicated.

Note 20: Cables are cinched together when IN 8 is crimped.

NOTE: Wire listed is for reference only. Wires used for the installation are to be determined by the installer as applicable to the aircraft.

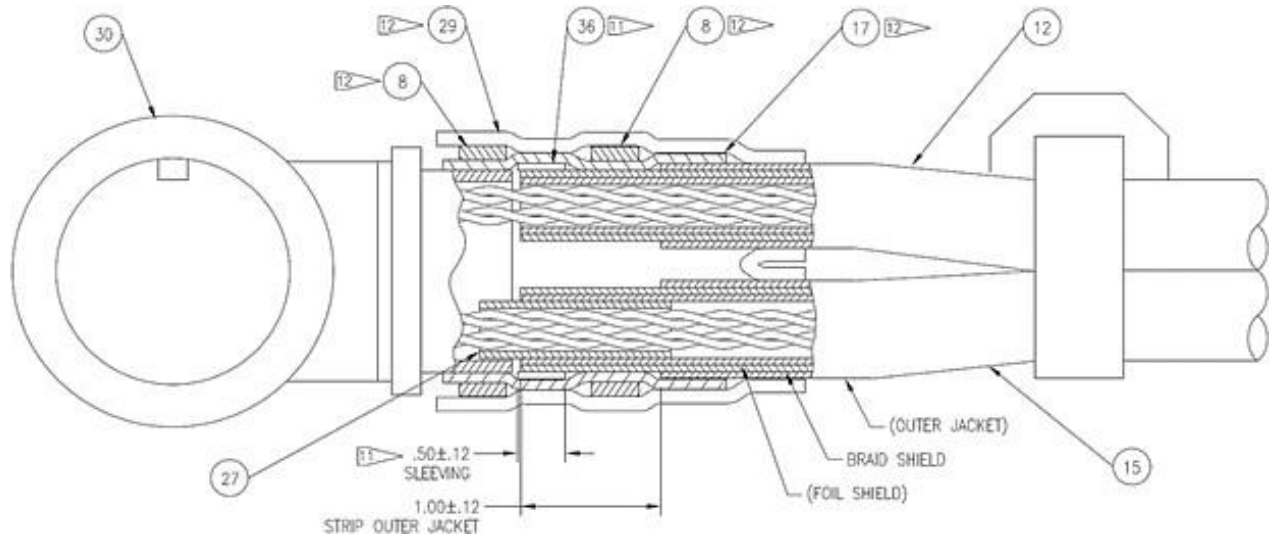
5.2.4 Antenna Power & Control input – (FDQ P1) & (HPB P1)

The FDQ P1 connector is used on the FDQ antenna.
The HPB P1 connector is used on the HPB antenna.

Table 5.2.4-1 FDQ P1 and HPB P1 Parts List

Quantity	Manufacturer & Description	Part Number	Drawing Item Number (IN)
A/R	Cable, 22AWG/4 COND	M27500-22TG4T14 or equivalent	15
A/R	Cable, 24AWG/4 COND	E10424 or equivalent	12
1	Braid Wire (36AWG, .500DIA)	AA59569R36T0500 or equivalent	17
4	GlenAir Tie-down Strap	600-057 or equivalent	8
A/R	Insulation Sleeving (.063- .031)	M23053/5-102-0	36
A/R	Insulation Sleeving (.750- .313)	M23053/4-106-0	29
A/R	Insulation Sleeving (.375)	M23053/4-104-0	27
A/R	Insulation Sleeving (.500-.195DIA)	M23053/4-105-0	28
2	Amphenol Circular MIL Spec Connector 26482 Size 12	MS3126E12-10S	30

Figure 5.2.4-1 FDQ P1 and HPB P1 Shield Terminations



Note 11: After stripping cable outer jacket, secure ends of braided shield and foil shield using insulation sleeving indicated.

Note 12: Fit a length of braid wire, IN (ITEM NUMBER) 17, such that it covers the cable outer jacket, the exposed cable shield, and the connector chimney or back-shell. Secure one end of IN 17 on the cable shield using IN 8, and secure the other end of IN 17 to the connector chimney or back-shell, again using IN 8. Completely cover IN 17 using boot seal, IN 18, or sleeving, IN 27, 28 as indicated.

NOTE: Wire listed is for reference only. Wires used for the installation are to be determined by the installer as applicable to the aircraft.



Caution: Verify proper wiring and pins for 28 VDC Power and Ground from ABR to FDQ and HPB Antennas. Reverse polarity of the DC power connection will damage ABR.

5.2.5 ABR CWAP & Maintenance Eth. Outputs (P2-C & P2-D)

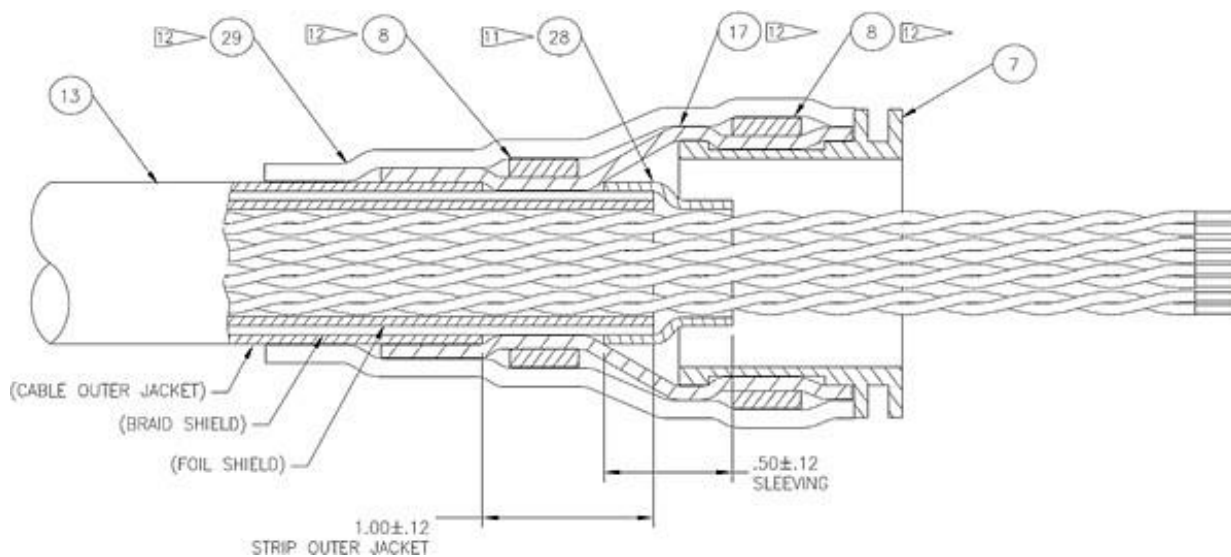
The P2-C connection is used for the Maintenance port which is a 1000Base-T connection.

The P2-D connection is used for the CWAP port which is a 1000Base-T connection.

Table 5.2.5-1 P2-C and P2-D Parts List

Quantity	Manufacturer & Description	Part Number	Drawing Item Number (IN)
2	TE Connectivity/Deutsch DMC Chimney, Non-rotation	732-8052-18A	7
4	GlenAir Tie-down Strap	600-057 or equivalent	8
1	Braid Wire (36AWG, .500DIA)	AA59569R36T0500 or equivalent	17
A/R	Insulation Sleeving (.500-.195DIA)	M23053/4-105-0 or equivalent	28
A/R	Insulation Sleeving (.750- .313)	M23053/4-106-0 or equivalent	29
A/R	Cable, 24AWG/8 COND	E50824 or equivalent	13

Figure 5.2.5-1 P2-C and P2-D Shield Terminations



Note 11: After stripping cable outer jacket, secure ends of braided shield and foil shield using insulation sleeving indicated.

Note 12: Fit a length of braid wire, IN (ITEM NUMBER) 17, such that it covers the cable outer jacket, the exposed cable shield, and the connector chimney or back-shell. Secure one end of IN 17 on the cable shield using IN 8, and secure the other end of IN 17 to the connector chimney or back-shell, again using IN 8. Completely cover IN 17 using boot seal, IN 18, or sleeving, IN 27, 28 as indicated.

NOTE: Wire listed is for reference only. Wires used for the installation are to be determined by the installer as applicable to the aircraft.



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6.0 POST INSTALLATION

This section provides the necessary information for successful post-installation verification and test recommendations for the WSS 4G System. This process is intended to be a one-time process for the initial installation of the system. This process may need to be repeated only if the WSS 4G System fails, if components of the system are replaced, or if the aircraft undergoes significant modification that may have an impact to system operation.

6.1 Installation Verification

After successful installation of the WSS 4G system is complete, verification of the installation and commissioning of the system should take place. The following tables provide an overview of the recommended steps to accomplish this verification.

Post-installation verification overview. Reference Section 6.1.1 for additional instructions:

	Step	Process
1	Coaxial Cable verification	Verification of RF coaxial cable installation to eliminate potential issues from cable runs and connector terminations. This is recommended but not mandatory.
2	Visual inspection	Inspect that all components have been installed and secured and that all connectors are in place and tight

6.1.1 Post-installation Verification Instructions

6.1.1.2 RF Coaxial Cable Verification

Once the installation of system cabling is complete and have been terminated, it is recommended that all coaxial cables are tested to confirm no cable shorts, breaks or connector issues have occurred. WSS strongly recommends coax cables be tested post-installation.

To facilitate these tests a capacitance measuring meter should be utilized.

1. Identify the Coaxial cable type and the capacitance per foot indicated within the coaxial cable specification.
2. Calculate the expected total capacitance for the length of coaxial cable installed.
3. Disconnect the coaxial cable from the Aircraft Radio (ABR) and the applicable antenna.



4. Using a capacitance meter, or suitable Digital Meter, measure the capacitance between outer and inner conductor
5. Verify that the result is in line with the calculated value and reconnect the cable at both ends.
6. If the value is not as expected, further troubleshooting to determine the cause of the error may be required.
7. Repeat this measurement for each coaxial cable.

6.1.1.3 VISUAL VERIFICATION

Upon completion of all installation work, it is recommended that a final verification is performed to ensure that all components have been installed, mounted and secured correctly and that all connectors and fasteners are tight prior to applying system power.

6.2 Ground Test

After installation verification of the WSS 4G system is complete, ground testing should take place. The following tables provide an overview of the recommended steps to accomplish this verification.

Refer to Section 3.4, Special Tooling, for the equipment necessary to perform the following functional checks and calibration procedures.

Ground Test Process Overview. Reference Section 6.2.1 for additional instructions:

	Step	Process
1	Power On Self-Test	Application of power to system and Aircraft Radio POST verification.
2	GPS Verification	Verification of the System GPS reception
3	WSS 4G Service Activation & Commissioning	Service Activation and commissioning for operation within the Network.
4	System traffic test	System traffic test to WSS Network utilizing SmartCart
5	System power test	System power test to validate transmit power utilizing SmartCart



6.2.1 ABR Power On Self-Test (POST)

At power up, the ABR automatically runs a Power On Self-Test (POST) in order to perform basic system level tests. The system status LED's on the front of the ABR will begin a flash sequence indicating that the ABR is cycling through the self-test process. Upon completion of a successful POST, the system is ready for operation and the status LED's will illuminate according to the diagram shown in Figure 7.2.2-1 below. In the event the POST is unsuccessful, consult Section 7 – Troubleshooting for additional guidance.

6.2.2 GPS Verification

The WSS 4G system requires no connection to the onboard avionics to assist with aircraft location information. System position is derived from the system GPS, embedded within the HPB antenna. The built-in GPS is verified during POST and monitored thereafter by the ABR monitoring software.

- 1) Locate the aircraft outside and away from hangers and other obstructions with a clear view of the horizon.
- 2) Apply power to the ABR and allow the POST to complete (approximately 180 seconds)
- 3) Verify the status of the Digital Card LEDs on the front panel of the ABR as indicated below:

PASS: Digital Card Yellow LED – Off

FAIL: Digital Card Yellow LED – Flashing

A flashing Yellow fault indicates that a GPS lock could not be established at that time.

In the event this test fails, consult Section 7 – Troubleshooting for additional guidance.

6.2.3 Service Activation

The WSS 4G system requires activation of service prior to flight testing and after system installation. System activation must also be performed after Aircraft Base Radio (ABR) exchange as unique system details will need to be updated for continued service. Satcom Direct provides Service activation and billing support for WSS's Business Aviation Customers and should be contacted directly to discuss options and to setup a Customer Service Agreement.

Please contact your specific Service Provider as applicable for other market segments.

Each ABR contains a unique, fixed Subscriber Identity Module (SIM) card and the International Mobile Equipment Identity (IMEI). This identifier is tracked by ABR Serial number which will be required for provisioning and activation.



NOTE: *While every effort will be made to activate service as quickly as possible, it is recommended that the activation process is started as early as possible during system installation to ensure any potential delays are minimized prior to aircraft delivery.*

For service activation under OEM or Dealer:

1. Identify the ABR Serial Number, located on the front panel of the unit.
2. Contact the Satcom Direct Activations team at Activations@satcomdirect.com and provide the following information:
 - Owner / Operator details
 - Aircraft Tail Number
 - Aircraft Type and Serial Number
 - ABR Serial Number
 - Location of Installation
 - Any available details regarding timing for completion of the installation and intended flight testing schedule

For service activation under End Customer:

1. Identify the ABR Serial Number, located on the front panel of the unit.
2. Contact the Satcom Direct inside sales team to complete the customer service activations form at +1 (321) 777-3000 or via insidesales@satcomdirect.com and provide the following information:
 - Owner / Operator details
 - Aircraft Tail Number
 - Aircraft Type and Serial Number
 - ABR Serial Number
 - Location of Installation
 - Any available details regarding timing for completion of the installation and intended flight testing schedule

Current Satcom Direct Customers can find additional activations support online at <https://csa.satcomdirect.com/>

3. Satcom Direct will coordinate the necessary commissioning and activation steps with the Installation Partner and Wireless Systems Solutions Product Support team for the ABR and provide notification of completion.
4. Upon completion of these steps, the Installation Center may proceed with flight testing in accordance with flight test procedures to validate service has been activated. It is recommended that the Installation Center remain coordinated with the Satcom Direct and WSS Product Support teams prior to and throughout flight testing to provide guidance and system monitoring as needed.
5. Once flight testing is complete, please notify Satcom Direct of test completion and aircraft entry / return to service date.



6.2.4 System Traffic and Power tests

The following sections provide an overview of the steps required to perform a system traffic test and system power test utilizing the WSS SmartCart ground test equipment.

For full details regarding setup, configuration and test requirements, please refer to the SmartCart Operations Manual, PN 600-00336-000.

	Step	Process
1	Setup SmartCart	Setup test equipment for the Traffic Test in accordance to SmartCart Operations Manual, PN 750-000XX-00.
2	Perform Traffic Test	Execute Traffic Test to verify end-to-end data connectivity from the aircraft cabin to WSS core network.
3	Download test report	Using the SmartCart user interface, download and email the successful test report to support@wireless2.com . See SmartCart Operational Manual for more information.
4	Setup SmartCart	Setup test equipment for the Max Power Test in accordance to SmartCart Operations Manual, PN 750-000XX-00.
5	Perform Max Power Test	Execute Max Power Test to verify the WSS 4G System is transmitting at maximum power from the port side beam of the FDQ antenna
6	Repeat Max Power Test	Repeat Max Power Test x3 to verify max power from aft, starboard and forward beams of the FDQ antenna. See SmartCart Operational Manual for more information.

6.3 Flight Test

The Ground Test Process has been designed to validate the system installation, provisioning & activation and network connectivity. Should the Installer require system specific flight validation of the system’s operation after conducting ground testing, the following provides guidance for in-flight user validation of the system.

NOTE: *This testing can only be performed within WSS network coverage. Please consult with Wireless Systems Solutions regarding coverage and availability, and suitable flight planning. The following provides an overview of the validation steps.*



	Step	Process
1	Establish network connection	Confirmation of initial system attach within network coverage.
2	End-to-end device connection	Verification of data connection from onboard user device and internet access.

6.3.1 Flight Test Planning

It is recommended that prior to commencing flight testing, the Installer consult with Wireless Systems Solutions to determine the most suitable flight path to ensure network coverage during testing.

A flight plan should be optimized to provide the aircraft with operation within the available WSS network coverage to establish a connection, provide time in flight to perform end user device testing and allow enough maneuverability to validate a continuous connection throughout the flight per the following sections.

1. The WSS network has been optimized for operation above 10,000 feet. The flight plan should ensure that all testing is conducted above this altitude to assure optimal operation.
2. The flight plan should plan for a circular or box flight plan to permit a full 360-degree rotation of the aircraft, in either direction, within the defined coverage area to demonstrate connectivity during any aircraft heading. Turns should be made within normal operational parameters.

6.3.2 Flight Test Execution

6.3.2.1 System Attach to Network

This section provides guidance on steps to validate an initial network connection (attach) once the aircraft flies into network coverage.

1. Prior to takeoff, confirm that the system is powered and ground test procedures have been completed.
2. Ensure that the cabin device intended to validate operation is connected to the system and is operational.
3. Once the aircraft is airborne, navigate to the defined waypoint for the start of testing, confirming that the aircraft has reached the minimum altitude for the test of 10,000 ft.
4. The system will automatically attach to the network once the aircraft enters coverage.
5. From the connected device, confirm the link has been established by validating that the device Wi-Fi connection has transitioned from indicating No Internet to Internet Access

6.3.2.2 End-to-End User Device Testing

This section provides guidance on steps to validate an end-to-end user connection(s) while aircraft is operating within network coverage.

While maintaining the flight plan previously initiated the following user test should be performed periodically to confirm a connection is maintained and the user experience is uninterrupted.

1. Using the User device, browse to a known operational website such as www.wireless2.com and confirm the expected web page is displayed.
2. Initiate a suitable user application such as Netflix or YouTube video streaming.
3. Once playback has begun, validate clear video and audio is present during the flight.

While not common, if a network connection is lost, the connection should typically re-establish with 60 seconds. Depending on the application type, a refresh or restart may be required.

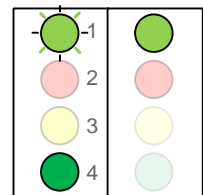
Should a connection not be established or fail to re-establish, refer to Section 7 for troubleshooting guidelines.

Note *the connection issues may be because of public internet issues or circumstances outside of Wireless Systems Solutions control. Please consult Product Support should this occur to fully diagnose the cause.*

6.4 Operation and Maintenance

The ABR is designed to be accessed wirelessly via CWAP or wired Ethernet maintenance port by an Installer or Certified Technician. The end user is not required to interact with the ABR in order to connect to the internet.

Upon initial power up (first power after initial installation) and after Boot / Configuration is complete at approximately 120 seconds, confirm that the ABR's Power-On Self-Test (POST) has executed successfully by illumination of the bottom-left Green LED, top-right Green LED, flash the top-right LED and no faults are present (Flashing Yellow or Red LEDs). [Figure 7.2.2-1] In the event of a fault condition, Product Support should be consulted to remotely troubleshoot the ABR, or directly connect the maintenance laptop for troubleshooting. Example faults include; Over-temperature, Antenna, Fan. Also, see Troubleshooting Guide, Section 7.



Any future software updates of the FAA-Approved application software are to be performed by an authorized avionics Certified Repair Station and are to be conducted on the ground (e.g. hangar). After the installation, the technician will verify the software update (e.g. checksums), software versions and hardware versions per the WSS release notification.



6.5 Recommendations for Eliminating Self-Wi-Fi Interference

This paragraph is to provide detailed instructions on recommendations for eliminating interference from Wi-Fi devices in the aircraft.

Configure the CWAP (Wi-Fi Router/Access Point) to 5.8 GHz band if possible. Routers and access points operating in the 2.4GHz band should be configured to operate on Channel 1 or Channel 6 (2.412 GHz or 2.437 GHz).

6.6 Router Configuration

WSS works closely with aircraft CWAP manufacturers to ensure that the WSS ABR and aircraft cabin router provide an integrated solution. CWAPs that are approved to work with the WSS ABR are required to develop interface support that will obtain ABR status information to learn the network state, IP address assignment, and signal quality. Unapproved CWAP solutions that do not meet these requirements will not function.

Note that the connection between the WSS Radio and the CWAP is a standard 10/100/1000BASE-T Ethernet Interface.

To ensure the proper level of capabilities, WSS has developed a checklist of minimal Compatibility Requirements in order to connect a CWAP to the WSS radio. For an overview, these minimum requirements include:

- Multiple SSIDs, 802.11n (5.8GHz and 2.4GHz), RADIUS authentication, Port and MAC address filtering, multiple VLANs, access security, and features normally supported in WAP devices.
- Minimum feature set does not require satellite or 3G/4G cellular connectivity.
- Mechanism to manage support and deliver fully functional Wi-Fi connectivity with each install

WSS adopts an open development environment with CWAP manufacturers, allowing the manufacturer to develop advanced features and support multiple connectivity solutions in the cabin such as Satellite and 3G/4G connectivity to supplement the high-throughput, low latency WSS Network.

STC activity and management for specific CWAP offerings will be accomplished by OEM/MRO/CWAP partners. With a range of options to suit multiple airframes, it is recommended that the OEM/MRO Installation Partners consult with Wireless Systems Solutions and the CWAP partners to determine which CWAPs are most suitable for each Operator's needs.



NOTE: *It is the responsibility of the installer to obtain FAA approval for the router installation and for providing the aircraft owner/operator with evidence that the critical aircraft systems are not susceptible to RFI/EMI interference from portable electronic devices (i.e. “Wi-Fi immunity” or “PED/T-PED tolerance”).*

For further information on current CWAP options, please contact the WSS CWAP team, via: info@wireless2.com



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7.0 TROUBLESHOOTING AND FAULT DIAGNOSIS

This section describes the troubleshooting and fault diagnosis processes for the WSS 4G system. It is always recommended that should an operational issue be suspected that you seek assistance with these procedures through Satcom Direct, details for which can be found below.

7.1 Product Support

If an issue is encountered or suspected, it is recommended that customers and technicians contact Satcom Direct or the applicable Service Provider.

Satcom Direct can be reached by telephone at **+1 (321) 777-3000** or email at support@satcomdirect.com

7.2 Troubleshooting Procedures

7.2.1 Diagnostic Access

There are two physical 1000BASE-T Ethernet ports on the Aircraft Base Radio (ABR):

1) connection to the Cabin Wireless Access Point (CWAP), which is a Wi-Fi router to connect the aircraft's Personal Electronic Devices (PEDs) and other Wi-Fi endpoints (e.g. sensors), to the WSS network

2) wired maintenance port which is recommended to be in an accessible location within the cabin for direct laptop connection to the ABR.

Both the ABR-CWAP Ethernet connection and the Maintenance Ethernet port are rated at 1000BASE-T.

Aboard the aircraft, while either on the ground (e.g. hangar) or during flight testing, the maintenance technician's primary interface to the ABR will be through the wireless CWAP rather than the wired connection to the ABR's maintenance Ethernet port. Since the ABR is an IP-addressable endpoint, maintenance technicians with the proper security credentials will be able to access the ABR for maintenance and diagnostic tasks, both wireless and hardwired. During ABR installation, ABR configuration (initial or replacement), or if for some reason the wireless access to the ABR via the CWAP is unavailable, the ABR hardwired maintenance Ethernet port may be used.

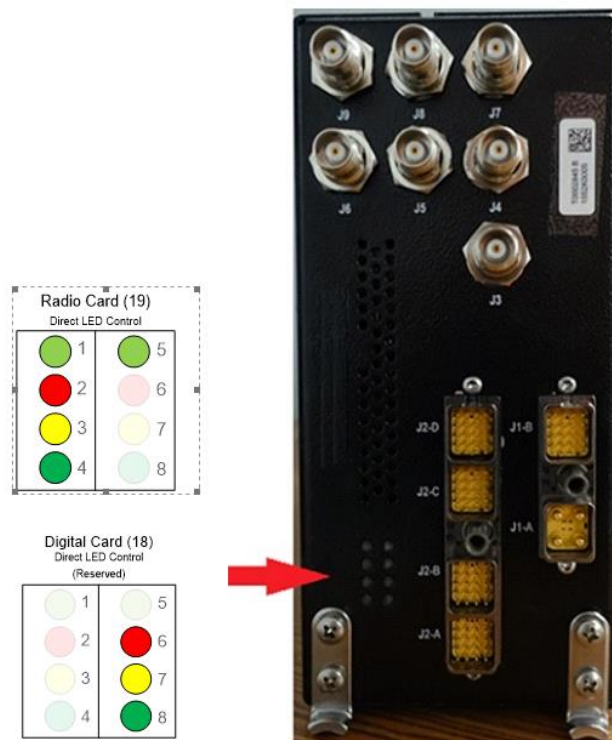
7.2.2 Aircraft Base Radio (ABR) Status Indicators

The following chart, Figure 7.2.2-1 describes the ABR Status LED conditions to be expected after the ABR POST is completed. Refer to section 7.2.3 for additional fault diagnostic procedures.

Figure 7.2.2-1 ABR Front Panel Indicators

ABR Front LEDs	Status
	<p>System Ready- [<180 Seconds]</p> <p>When the ABR has successfully completed POST and GPS signal acquisition, the Radio Card and Digital Card green LED's will be solid. The WSS System is ready for operation.</p>

Figure 7.2.2-2 ABR Front Panel





7.2.3 Fault Indicators

Table 7.2.3-1 ABR Indicators

LED #	State	Description
1	Blinking	Internal Eth Activity
2	Steady	18 or 19 POST/BIST failure
2	Blinking	19 DSP or Radio failure ¹
3	Steady	Loss of GPS
3	Blinking	Holdover
4	Steady	ABR functional
4	Blinking	Radio Initialization
5	Steady	PHY Power Good
6	Auxiliary	Reserved
7	Auxiliary	Reserved
8	Auxiliary	Reserved

A critical fault results in the ABR being non-functional. A non-critical fault would result in limited or degraded functionality.

NOTE: *The WSS 4G system is a non-critical, entertainment only system with no connection to critical aircraft systems. Failure of function or complete loss of the WSS 4G system has no impact to the safe operation of the aircraft.*

7.2.4 Fault Conditions and Diagnosis Steps

7.2.4.1 System Fails to Power Up

Fault Condition: No system status lights illuminated on front panel of the ABR

Recommendations:

1. Check 28Vdc power is present at ABR power input.
2. Check P1 and P2 cables are properly seated on ABR.
3. Contact Product Support for additional assistance in troubleshooting and ABR repair/replacement as needed.

7.2.4.2 Fan Failure

Fault Condition: Fan failure. When the temperature exceeds the critical level, the unit shuts down. A power cycle or a more involved maintenance action is required to restart the unit from a critical over temperature condition.

Recommendations:

1. Check for obstructions at the rear of ABR that might impede the fan from turning.
2. Clean the fan intake if there is any accumulation on dust or debris and checking for a foreign object jamming the fan.
3. Check 28Vdc power is present at the ABR power input.

¹ Respectively



4. Contact Product Support for additional assistance in troubleshooting and ABR repair/replacement as needed.

7.2.4.3 ABR Radio Card Non-Critical Fault Indicated

1. Additional information regarding this fault condition and recommended resolution steps will be further defined in a later revision of this document.
2. Contact Product Support for additional assistance in troubleshooting the System and repair/replacement as needed.

7.2.4.4 ABR Radio Card Critical Fault Indicated

Fault Condition:

Red LED Blinking (POST/BIST Failure) or Steady (Radio Fault)

Recommendation:

1. Check ABR unit is fully seated into installation tray
2. Power cycle ABR
3. Contact Product Support for additional assistance in troubleshooting and ABR repair/replacement as needed.

7.2.4.5 ABR Digital Card Non-Critical Fault Indicated

Fault Condition:

Yellow LED steady

Recommendation:

1. Check that P6 TNC on ABR is seated properly.
2. Check that Green TNC on the HPB is seated properly.
3. Check P1 and P2 cables are properly seated on ABR.
4. Power cycle ABR
5. Contact Product Support for additional assistance in troubleshooting and ABR repair/replacement as needed.

7.2.4.6 ABR Digital Card Critical Fault Indicated

Fault Condition:

Red LED Blinking (POST/BIST Failure) or Steady (DSP Fault)

Recommendation:

1. Check 28Vdc power is present at ABR power input.
2. Check P1 and P2 cables are properly seated on ABR.



3. Power cycle ABR
4. Contact Product Support for additional assistance in troubleshooting and ABR repair/replacement as needed.

7.2.4.7 Failure to Connect In-Flight

Fault Condition:

A User is unable to make a connection to the Internet or use the WSS System for similar applications over the network

Recommendations:

1. Verify that the aircraft is operating within the expected WSS 4G network coverage area and at a suitable altitude. Contact Service Provider for current coverage areas and network status.
2. Verify that the installed CWAP is operational and the User device is connected to the local cabin Wi-Fi network.
3. Where available, confirm the status of the WSS 4G network within the CWAP User interface connections information screen. Consult the CWAP manufacturer's documentation for additional details.
4. If installed, restart the system via the Power Interrupt switch.
5. Contact Product Support for additional assistance in troubleshooting this issue including account activation and network troubleshooting.

7.2.4.8 Intermittent connection In-Flight

Fault Condition:

A User is unable to establish a connection to the Internet or use the WSS System for similar applications over the network, however, the connection may be intermittent or lost.

Recommendations:

1. Verify that the aircraft is operating within the expected WSS 4G network coverage area and at a suitable altitude to remain in coverage during the session. Contact Service Provider for current coverage areas and network status.
2. Where available, confirm the status of the WSS 4G network within the CWAP User interface connections information screen. Consult the CWAP manufacturer's documentation for additional details.
3. Contact Product Support for additional assistance in troubleshooting this issue including network troubleshooting.



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8.0 MAINTENANCE AND REPAIR

8.1 General

This section provides troubleshooting, maintenance and repair guidance for the WSS 4G system.

8.2 Maintenance

The WSS 4G system requires no periodic routine maintenance.

8.3 Recommended Periodic Scheduled Servicing Tasks

Perform the following inspections at a minimum of once a year; during regularly scheduled maintenance, either 100 hour, annual, or other approved maintenance interval.

1. During any maintenance activities involving the WSS System perform a post-installation check as described within this Installation Manual.
2. Inspect the WSS radio system wire/bundle and coax cable routing for evidence of damage, chafing, grounding, security, bonding, integrity of shields, and connector backshell condition.
3. Visually inspect the ABR radio mechanical installation for any defects or damage to the aircraft structure or to the ABR radio.
4. Visually inspect the FDQ and HPB Antenna installation for any defects or damage to the aircraft structure or to the FDQ and HPB Antennas.
5. Verify that all mandatory Service Alerts and/or Service Bulletins for the ABR radio have been accomplished.

8.4 Repair

Please contact Satcom Direct or applicable Service Provider to initiate troubleshooting and issue resolution procedures.

Satcom Direct can be reached by telephone at **+1 (321) 777-3000** or email at support@satcomdirect.com

8.5 Hardware & Software Updates

Hardware and Software updates will be communicated through Service and Installation Partners. Please contact support@wireless2.com with questions regarding ABR updates at this time.



9.0 GLOSSARY

ABR	Aircraft User-Equipment Base Radio
AC	Advisory Circular
A/R	As Required
ARINC	Aeronautical Radio, Incorporated
ATR	Air Transport Radio
CG	Center of Gravity
CWAP	Cabin Wireless Access Point
DC	Direct Current
EFB	Electronic Flight Bag
EMI	Electromagnetic Interference
ESD	Electro Static Discharge
FAA	Federal Aviation Administration
FCC	Federal Communication Commission
FDQ	Full-Duplex Quad
GPS	Global Positioning System
HPB	High Performance Blade
IFE	In-Flight Entertainment
IMEI	International Mobile Equipment Identity
LTE	Long Term Evolution
NDA	Non-Disclosure Agreement
PED	Personal Electronic Device
P/N	Part Number
POST	Power On Self-Test
RF	Radio Frequency
RFI	Radio Frequency Interference
RTCA	Radio Technical Commission for Aeronautics
Rx	Receive
WSS	Wireless Systems Solutions
SIM	Subscriber Identity Module
STC	Supplemental Type Certificate
TC	Type Certificate
Tx	Transmit