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WSS 4G System Base-Station

Installation Manual

Document Number 750-00004-00



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:

Remote Radio Head (RRH)	Part Number 001-00303-10
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Service Bulletin History

Mod Level	Service Bulletin Number	Service Bulletin Date	Reason for Modification

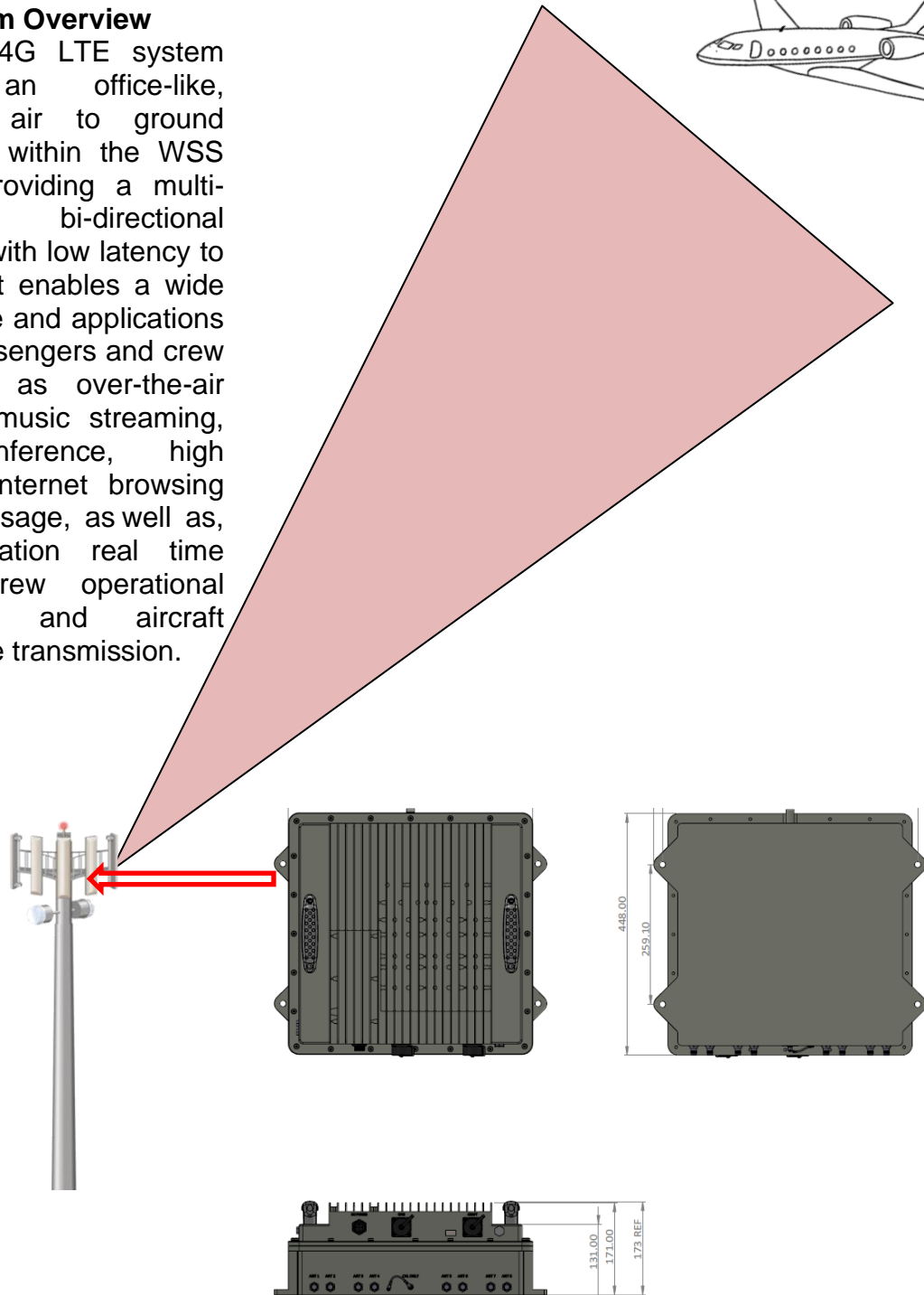
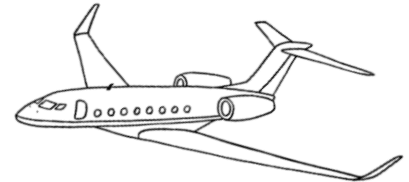
1.0 GENERAL DESCRIPTION

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.






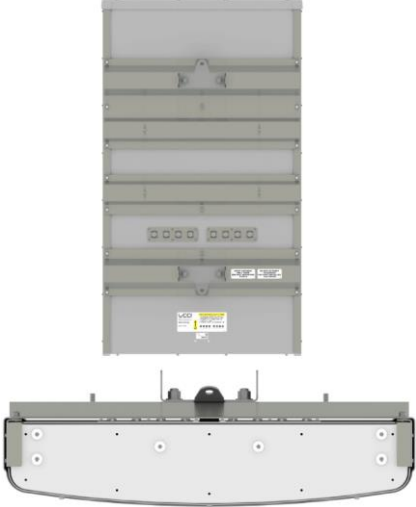
1.3 Unpacking and Inspecting Equipment

Upon receipt of the 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. 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.

1.4 WSS 4G System Components

1.4.1 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		Remote Radio Head (RRH)	001-00303-10
Quantity	Depiction	Description	Part Number (P/N)
1		Beam Forming Antenna	BFA8F- A5A

1.4.2 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	RRH CONNECTOR KIT	765-00043-22
1	RRH CABLE KIT	765-00044-22

1.4.3 Installer-Provided Material

Table 1.5.3-1 contains additional material needed for the 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.

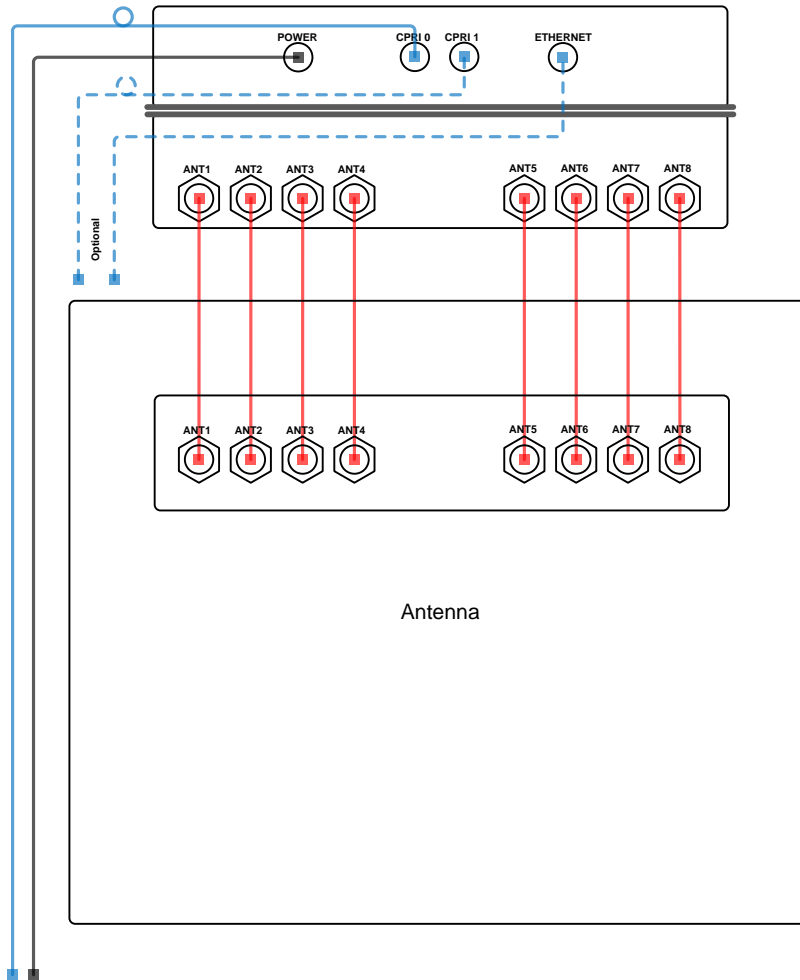
Table 1.5.2-3 Installer-Provided Material

Quantity	Description	Part Recommendations
1		
1		

1.5 Interface Summary

The WSS 4G System requires 8 phase-matched RF cables, power and fiber cable connections. Figure 1.6-1 shows the basic system, and a simplified cabling diagram. In addition to the radio-antenna cables, connection to the +28 VDC power line is required.

Figure 1.6-1 System Interfaces / Overview





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2.0 TECHNICAL SPECIFICATIONS

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

Table 2-1 Technical Specifications	
Remote Radio Head (RRH)	
Parameter	Specification
FCC Identification Number	2AWXX--ARRH04885CVT
Operating frequency range	2.4GHz ISM Band - 2400 to 2483.5 MHz
Power Input	48VDC, 4 Amps Maximum
Composite Maximum RF Power Output	+24dB +/- 1dB
Form Factor	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	2407.8 to 2437.8 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

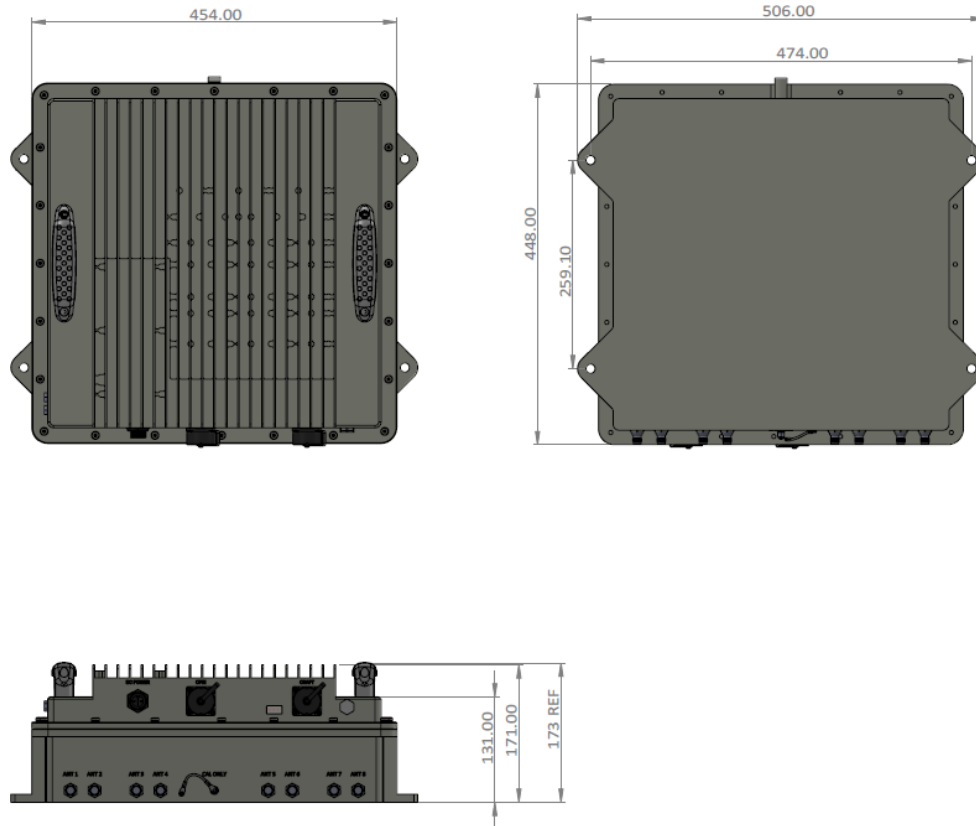
This section presents the physical characteristics of the WSS 4G System, including the Aircraft Base Radio (ABR), Full Duplex Quad (FDQ) Antenna, and High- Performance Blade (HPB) Antenna.

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 RRH is mounted on the back of the antenna, shown in Figure 2.3.1-2. The antenna mounting plate is first mounted in the tower in the location identified, see Section 2.1.

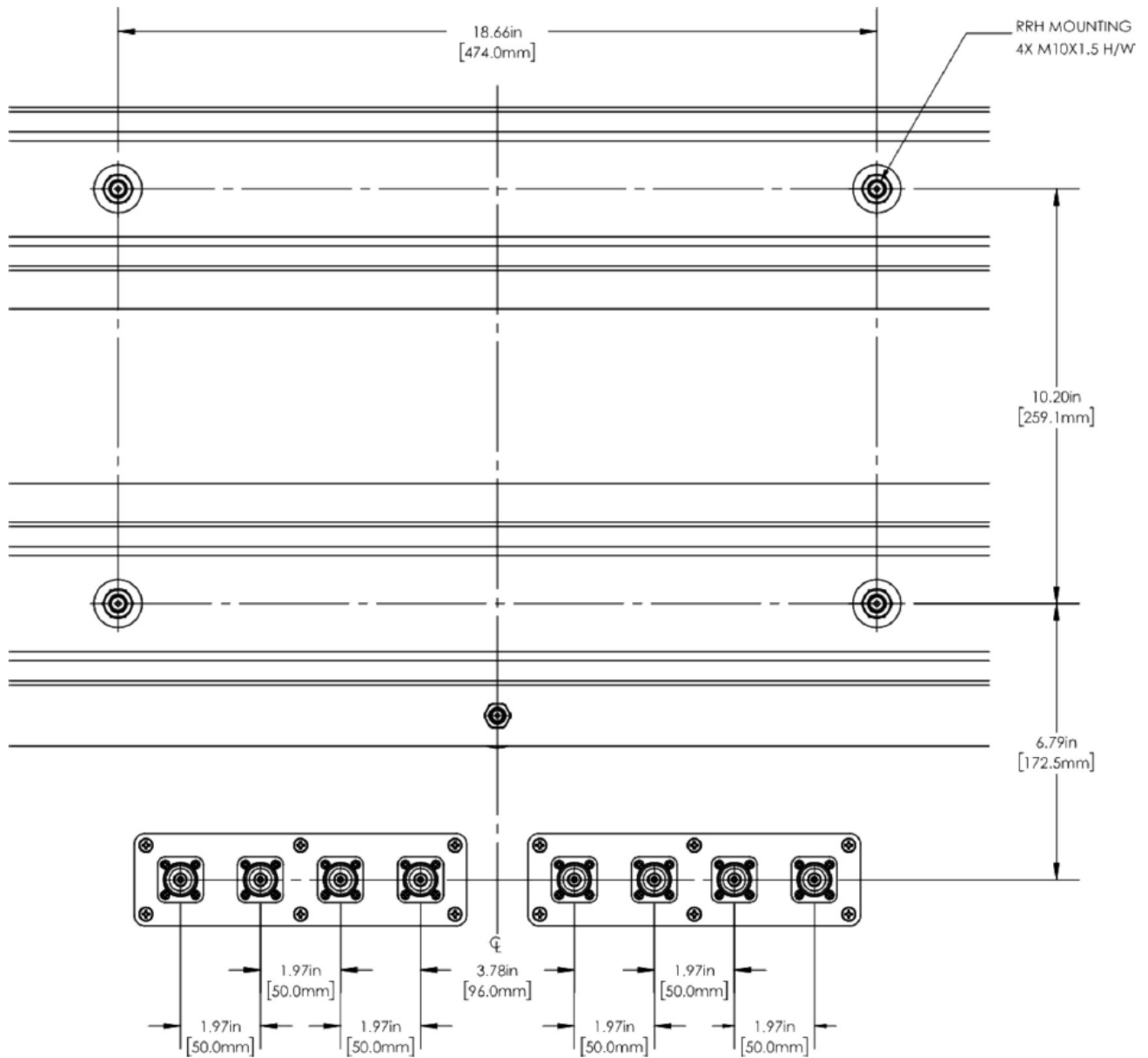


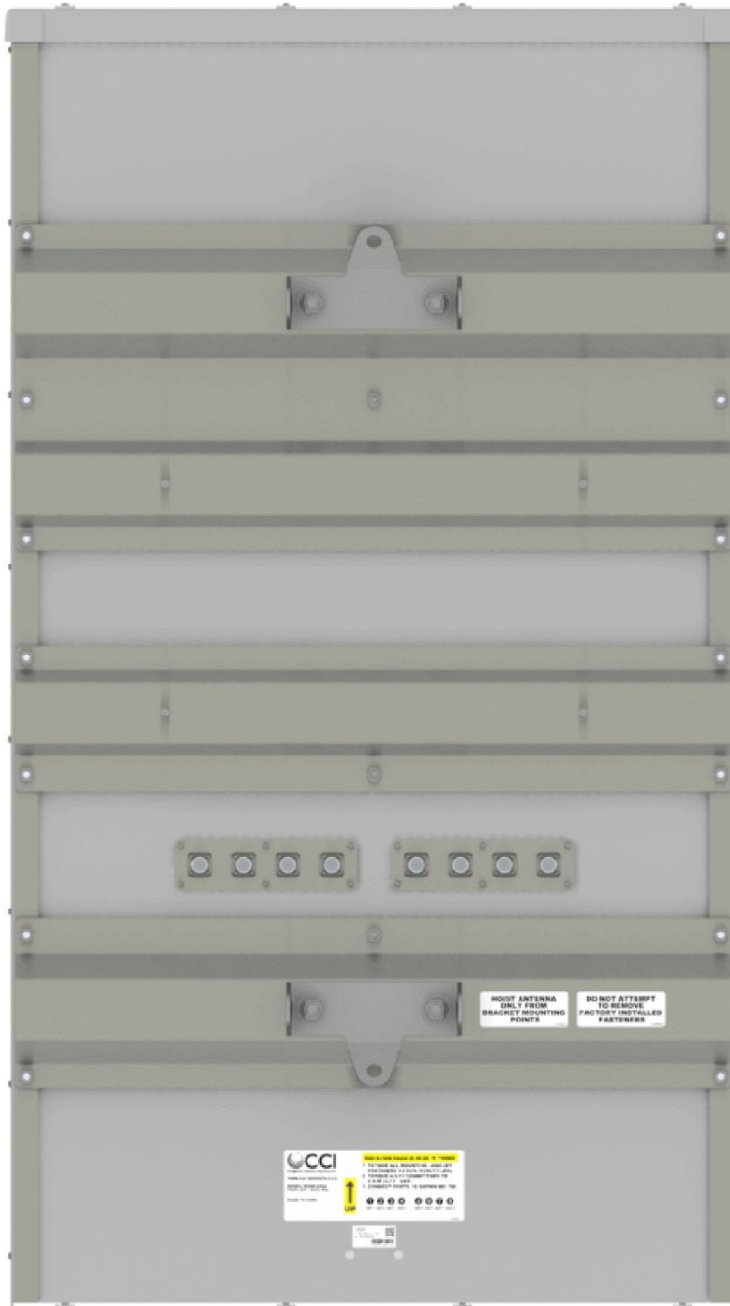
Figure 2.3.1-2 RRH Installation

2.3.2 Antenna Mechanical Definition

The WSS 4G LTE system utilizes one Full-Duplex Phase array antenna. See Section 3.5 Mounting Considerations for more details.

See Figure 2.3.2-1 for Beam Forming antenna

(Rear Mount).



**Figure 2.3.2-1 Beam Forming Antenna Detail
(Rear Mount)**



SPECIFICATIONS Beam Forming Antenna BFA8F-A5A

Electrical

Ports	8 Ports for 2407-2476 MHz
Frequency Range	2407-2476 MHz
Single Column Data	
Column Gain	18.0 dBi
Column Azimuth Beamwidth (-3dB)	71°
Column Elevation Beamwidth (-3dB)	5.8°
Column Elevation Uptilt (at Peak)	4.5°
Column Elevation Sidelobes (1st Upper)	< -28 dB
Column Cross-Polar Discrimination (at Peak)	> 30 dB
Column Front-to-Back Ratio @180°	> 30 dB
Column Port-to-Port Isolation	> 20 dB
Array Data*	
Array Gain	26.8 dBi
Array Azimuth Beamwidth (-3dB)	8.4°
Array Elevation Beamwidth (-3dB)	5.8°
Array Elevation Uptilt (at Peak)	4.5°
Array Elevation Sidelobes (1st Upper)	< -30 dB
Array Cross-Polar Discrimination (at Peak)	> 40 dB
Array Front-to-Back Ratio @180°	> 40 dB
Voltage Standing Wave Ratio (VSWR)	< 1.5:1
Passive Intermodulation (2x0.25 Watt)	≤ -144 dBc
Input Power Continuous Wave (CW)	50 watts
Polarization	Vertical
Input Impedance	50 ohms

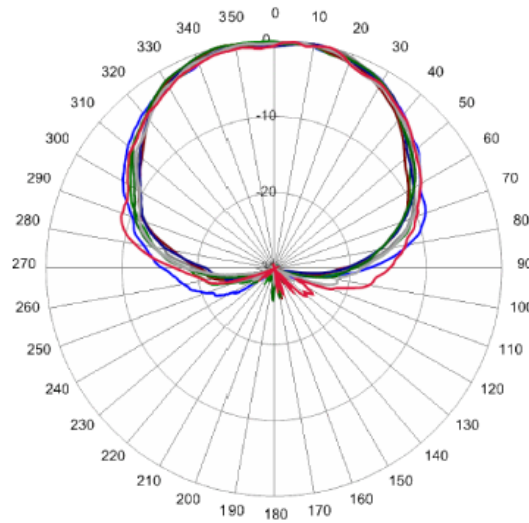
* Based on using equal weight analog beam former. Digital beam former with amplitude taper results in lower peak gain

Mechanical

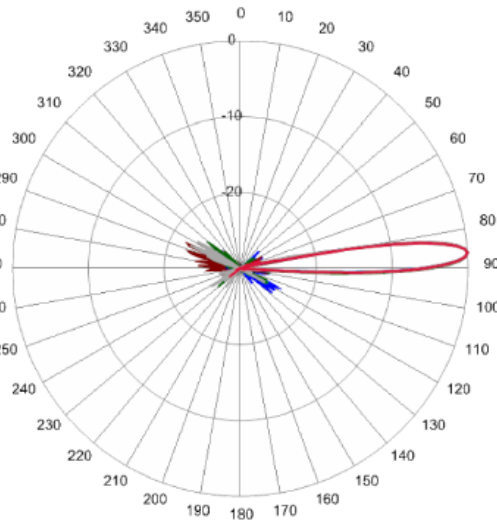
Dimensions (LxWxD)	57.8x32.4x6.8 in (1468x824x173 mm)
Survival Wind Speed	> 150 mph (> 241 kph)
Front Wind Load	400 lbs (1778 N) @ 100 mph (161 kph)
Side Wind Load	101 lbs (451 N) @ 100 mph (161 kph)
Equivalent Flat Plate Area	15.6 ft² (1.5 m²)
Weight *	84.7 lbs (38.4 kg)
Connector	8 x 4.3-10 female
Mounting Pole	2 to 5 in (5 to 12 cm)

* Weight excludes mounting kit

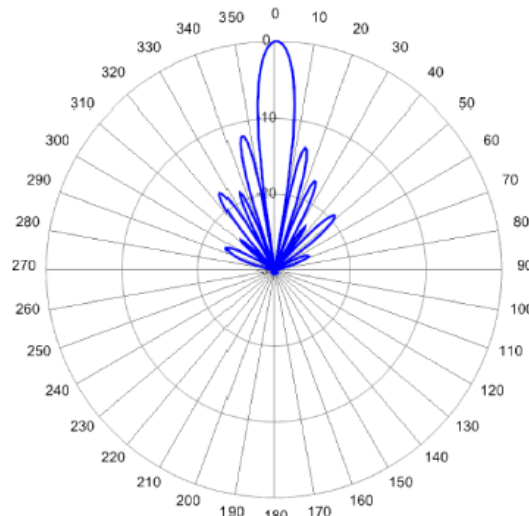
Figure 2.3.2-2 Beam Forming Antenna Detail



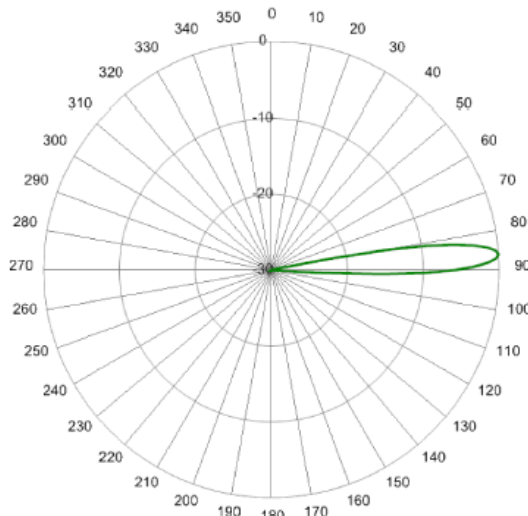
2442 MHz Column Azimuth (Ports 1 to 8)



2442 MHz Column Elevation 4° UpTilt (Ports 1 to 8)



2442 MHz Array Azimuth (Equal Weighting)



2442 MHz Array Elevation 4° (Uptilt)

Figure 2.3.1-3 Beam Forming Tx/Rx Antenna Detail




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3.0 PLANNING THE INSTALLATION

3.1 Introduction



Installation should take place in an authorized location for such activity; the installer will need to consider the location of the antenna.

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.

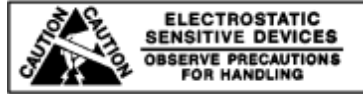
CAUTIONS:  are provided before procedures, materials, methods, and processes and must be followed precisely to avoid equipment damage.

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 RRH 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 001-00303-10.
- 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 RRH does not contain any user-serviceable parts. Unauthorized modifications or repairs could result in permanent damage to the 001-00303-10, void warranty and authority to operate this device and other applicable regulations. Repairs may only be performed by authorized service centers.



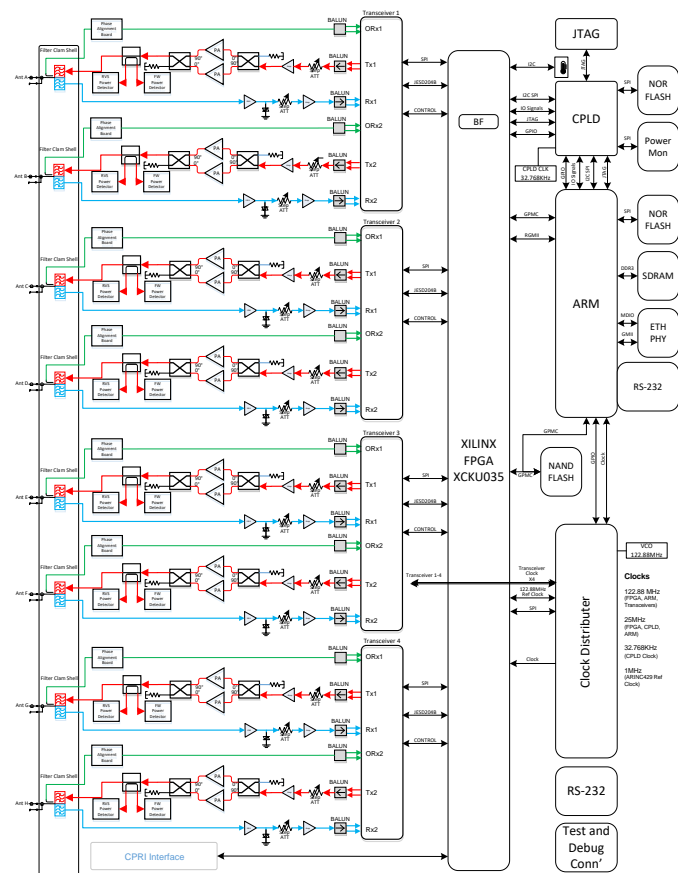
RF EXPOSURE STATEMENTS

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 21.26 inches [54 cm].

To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of 21.26 inches [54 cm] from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

NOTE: The RRH has eight transmitters operating at the same time and connected to all eight ports of the phased array antenna via phase matched coax cables.

NOTE: The RRH has four identical transceivers (AD9371) from Analog Devices.





3.3 Installation Approval

This guide is not approved installation data and only provides guidance to installation approval for this equipment.

NOTE: *It is the responsibility of the installer to obtain approval for the installation and for providing the owner/operator with evidence that the critical 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

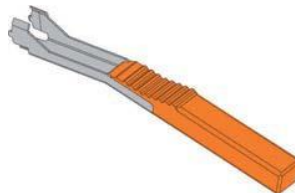


Figure 3.4-3 Extraction Tool

3.4.2 Post-Installation Tools

The Drone Test System is used for the ground test of the WSS 4G LTE System after it has been installed. The Drone 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 (Tx/Rx) beam forming antenna mounted on the top of the tower. 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.

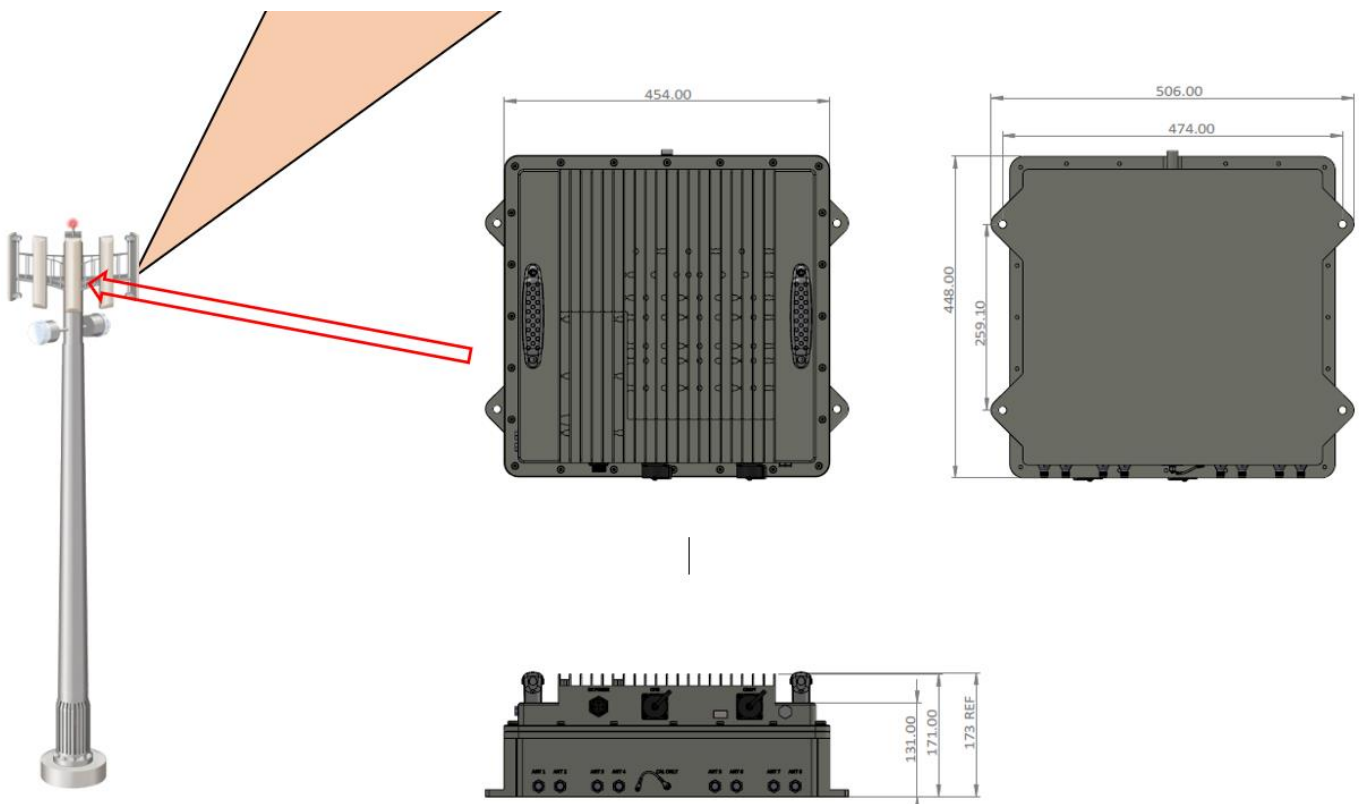


Figure 3.5.1-1 Typical Antenna Mounting





Once the antenna locations approved, the cable length required between the mounted and the antenna fixtures are fixed.

3.5.1.1 WSS Antenna Site Selection and Separation

WSS provides dedicated engineering resources to work with the installer in the antenna..



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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 unit 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 Drone
5	System power test	System power test to validate transmit power utilizing Drone



6.2.1 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.



6.2.2 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 Drone test equipment.

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

	Step	Process
1	Setup Drone	Setup test equipment for the Traffic Test in accordance to Drone 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 Drone user interface, download and email the successful test report to support@wireless2.com . See Drone Operational Manual for more information.
4	Setup Drone	Setup test equipment for the Max Power Test in accordance to Drone Operations Manual, PN 750-00004-00.
5	Perform Max Power Test	Execute Max Power Test to verify the WSS 4G System is transmitting at maximum power from the port.
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 Drone 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.

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 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 (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).

6.5 Router Configuration

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

7.2.2 Status Indicators

7.2.3 Fault Conditions and Diagnosis Steps

7.2.3.1 System Fails to Power Up



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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 RRH radio mechanical installation for any defects or damage to the aircraft structure or to the RRH radio.
4. Visually inspect the Beam Forming 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 RRH updates at this time.



9.0 GLOSSARY

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