RADIO TRANSCEIVER MANUAL

FOR INTERNAL USE ONLY

POLAR REMOTE CONTROLS **PART NUMBERS 600-682-01**
MODEL NUMBERS: 60068201, 60068203
DIVISION OF ATLAS POLAR COMPANY LTD. **REV. #1**

60 NORTHLINE RD. **December 2020**

TORONTO ONTARIO M4B 3E5

Please note:

This manual will only discuss the conditions governing regulations, not the overall system. To understand the complete unit package, installation, operation and maintenance, ALL equipment manuals should be read thoroughly.

POLAR RADIO REMOTE SYSTEM

This device complies with Part 15 of FCC & RSS-Gen of IC 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.

Le present appareil est conforme aux CNR d'Industrie Canada applicable aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

CAUTION : Changes or modifications not expressly approved by Atlas polar Company Ltd., could void the users authority to operate this equipment.

NOTE: This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

RSS-Gen Notices for Transmitter Antenna

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter (IC: 6272A-60068201) has been approved by Industry Canada to operate with the antenna types listed in this document with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this document, having a gain greater than the maximum gain indicted for that type, are strictly prohibited for use with this device.

Conformément à la réglementation d’Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d’une type et d’un gain maximal (ou inferieur) approuvé pour l’émetteur par Industire Canada. Dans le but de réduire les risques de brouillage radioélectrique à l’intention des autres utilisateurs, il faut choisir le type d’antenne et son gain de sorte que la puissance istrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l’intensité nécessaire à l’établissement d’une communication satisfaisante.

Le présent émetteur radio (IC: 6272A-6006820) a été approuvé par Industrie Canada pur fonctionner avec les types d’antenne énumérés ci-dessous et ayant un gain admissible maximal et l’impédance requise pour chaque type d’antenne. Les types d’antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l’exploitation de l’émetteur.

ATLAS POLAR COMPANY LIMITED

POLAR 9900R TECHNICAL DATA

SYSTEM

Frequency:	902-924 MHz Frequency Hopping Spread Spectrum
Operating Temperature	-25®C to +50®C
Transmission Range	122 m or 400 feet
Data Transmission	11 bytes including Identity and CRC error values
Addressing	Programmable. 65,500 unique addresses
Approved by	Pending
Operating Licensing	Not required

INTRODUCTION

The Polar Radio Remote Control System consists of a wireless transceiver that is connected to the Polar 2100B/4100/5200 actuator (purchased separately). All communicated information between the transceiver is in a digital format and works on the 900 MHz frequency.

FREQUENCY HOPPING DESCRIPTION

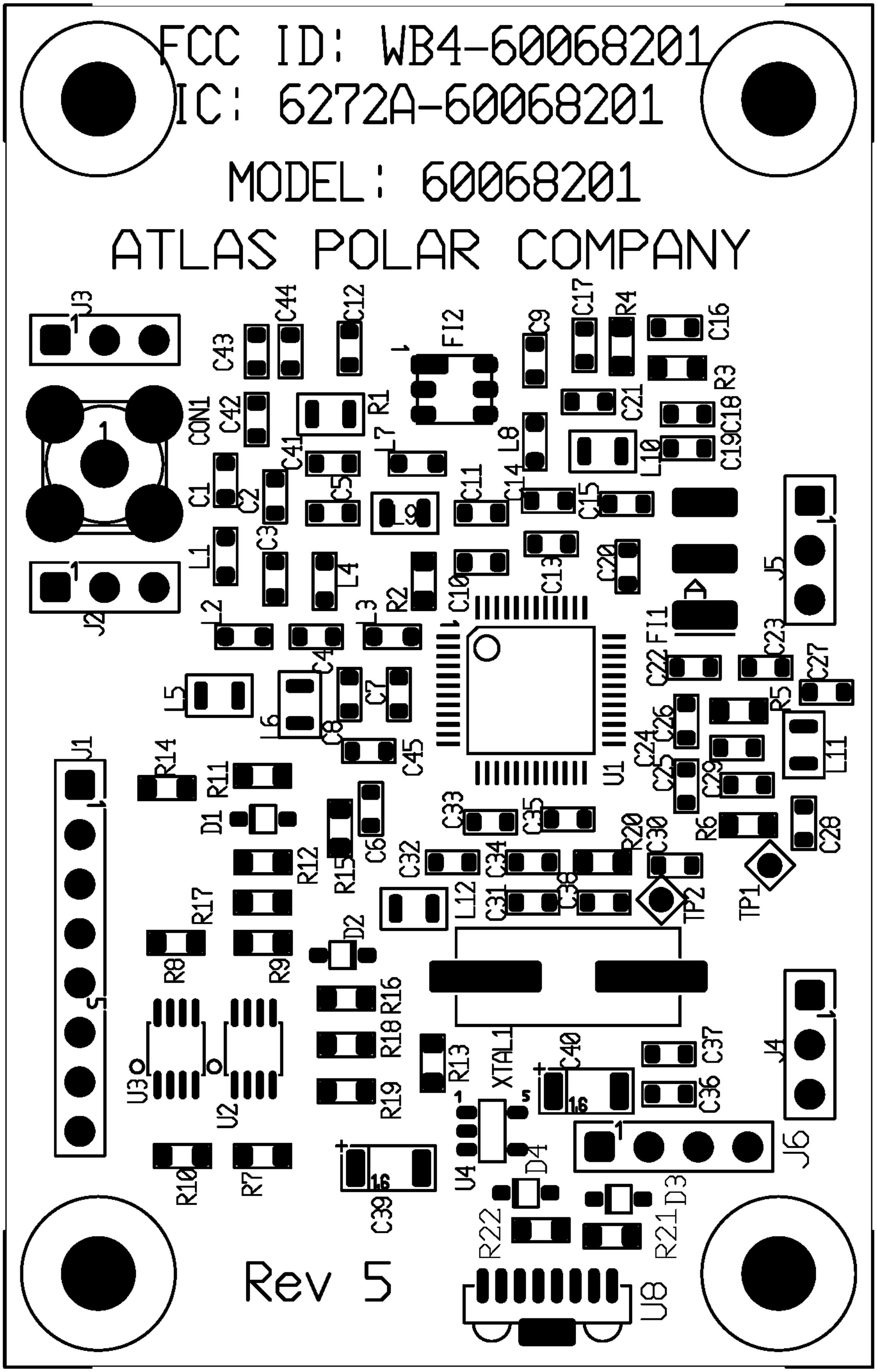
The transceiver use 50 equally spaced frequencies (902 TO 928 MHz). The transceiver has a stored unique random stepping sequence throughout the 50 channels. The random stepping sequence will utilize all 50 channels, and continue to repeat the same sequence during its communication.

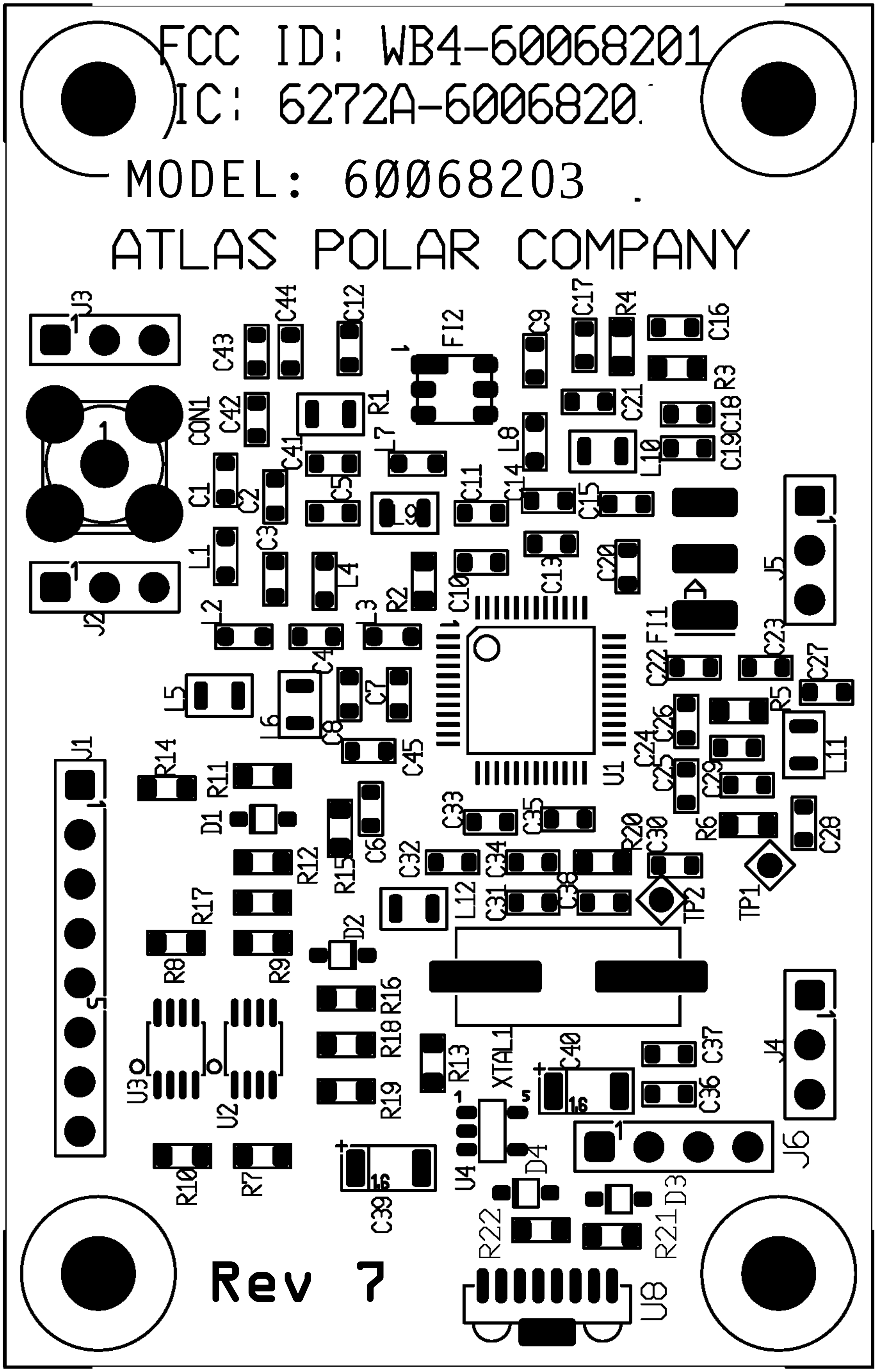
The transceiver communicates on a frequency hopping, spread spectrum algorithm. The hopping sequence is unique for each transceiver and therefore the communication link is immune to interference from other radios. There is a setup procedure that is required to establish the hopping sequence between the transceiver. This allows the ability of swapping transmitters, receivers, or programming multiple transmitters for use with one receiver. Once the communication link between one transceiver is established, another tuned transmitter cannot interfere unless the first link (other transmitter) is disconnected.

The receiver has a safety algorithm to protect against undesirable interference. The safety algorithm not only brings all functions to a neutral state but also closes the safety dump valve, ensuring no unwanted movement of the crane.

The receiver must be powered up before the transmitter. When the transmitter is powered, there will be a 1 second delay before communication. This is to allow transceiver to synchronization.

When the communication task is completed, the transmitter should be turned off with the E-stop engaged to preserve battery power. If the communication has been stopped due to pressing of an E-Stop, powering down, or loss of range, the communication may be resumed by cycling the E-stop.


FCC ID: WB4-60068201
IC: 6272A-60068201
MODEL: 60068201
ATLAS POLAR COMPANY
Rev 5


FCC ID: WB4-60068201
IC: 6272A-6006820
MODEL: 60068203
ATLAS POLAR COMPANY
Rev 7

ELECTRICAL INTERFACE

1. Connectors:

Connector J1	**Pin description**
Pin 1	Serial Instruction Enable
Pin 2	Serial Instruction Clock
Pin 3	Data Rx
Pin 4	Data Tx
Pin 5	Read/Write Data Message
Pin 6	Read/Write Serial Instruction
Pin 7	Serial Instruction Data
Pin 8	Supply Voltage

Connector J2	**Pin description**
Pin 1	Ground
Pin 2	Ground
Pin 3	Ground

Connector J3	**Pin description**
Pin 1	Ground
Pin 2	Ground
Pin 3	Ground

Connector J4	**Pin description**
Pin 1	Ground
Pin 2	Ground
Pin 3	Ground

Connector J5	**Pin description**
Pin 1	Ground
Pin 2	Ground
Pin 3	Ground

Connector J6	**Pin description**
Pin 1	IR Transmit
Pin 2	IR Receive
Pin 3	Not used
Pin 3	IR Shut down

2. DC Characteristics:

Parameter	Min	Typ	Max	Unit	Comment
Supply Voltage	3.5	5	6.5	Volts	
Voltage to any Serial Instruction line	3.5	5	6.5	Volts	Should not exceed supply voltage
Data Tx voltage	3.5	5	6.5	Volts	Should not exceed supply voltage
Data Rx voltage					Vcc
Tx/Rx data rate	9.6k	19.2k	20k	Bits/second	

3. Carrier Frequency, Frequency deviation and hopping sequence Selection:

The register values for the carrier frequency, of the receiver, high and low deviation carrier frequency for transmitter registers and hopping patterns are found in the arrays contained in the files “RF_Tables.C”. These tables must be included in the mother board operating code to load the values into the RF module. Below is a list of the function calls and a brief description of the function and variables that are required.

Function call	Description
void Next_channel(void)	Loads a hopping channel index from the random table
void Take_Reg_TX(int NbChannel)	Loads the transmitter register frequency values (carrier plus deviation and carrier minus deviation) with the hopping channel value
void Take_Reg_RX(int NbChannel)	Loads the receiver register frequency values with the receiver hopping channel value.

The communication of the register values to the RF module must comply with the timing as indicated in the AT86RF211S data sheet.

Once these registers are loaded with the parameter values, the Data Tx and/or Data Rx can be read or written directly as a data stream to the Data Tx, Data Rx pins. The mother board must supply the data buffering.

The serial number entered into the ROM memory of the mother board provides an index to the random table so there will be a hopping pattern uniqueness to the transmitter/receiver pair if they contain the same serial number. The serial number also must become part of the packet for data identification. The data packet must also include a CRC value for data verification.

4. Antenna:

The only antennas that are permitted for use with the 60068201 RF module are the Linx ANT-916-CW-QW, Linx ANT-916-CW-RCL, and 3.0” solid wire. The only antennas that are permitted for use with the 60068203 RF module are the Linx ANT-916-CW-RCL, and Laird EXC902BNX.

Datasheet

CW-RCL Series
916 MHz Right-Angle Whip Antenna

The 916-CW-RCL antenna is designed for sub-1 GHz and low-power, wide-area (LPWA) applications including LoRaWAN® and ISM band applications in the 902 MHz to 930 MHz band.

The right-angle rotating design of the 916-CW-RCL antenna allows for the antenna to be positioned for optimum performance.

The 916-CW-RCL is available with an SMA plug (male pin) or RP-SMA plug (female socket) connector for FCC Part 15 compliant applications.

Features

- Performance at 902 MHz to 930 MHz
  - VSWR: ≤ 1.8
  - Peak Gain: 4.2 dBi
  - Efficiency: 72%
- Compact size
  - 97.7 mm x 18.7 mm x 10.5 mm
- Rotating base allows for optimal positioning
- SMA plug (male pin) or RP-SMA plug (female socket)

Applications

- Low-power, wide-area (LPWA) applications
  - LoRaWAN®
  - WiFi HaLow™
- Internet of Things (IoT) devices
- Smart Home networking
  - Security systems
  - Home weather stations
- Remote sensing, monitoring and control
  - Security systems
  - Industrial machinery
  - AMR (automated meter reading)

Ordering Information

Part Number	Description
ANT-916-CW-RCL-SMA	916 MHz right-angle whip antenna with SMA plug (male pin)
ANT-916-CW-RCL	916 MHz right-angle whip antenna with RP-SMA plug (female socket)

Available from Linx Technologies and select distributors and representatives.

Electrical Specifications

ANT-916-CW-RCL	916 MHz
Frequency Range	902 MHz to 930 MHz
VSWR (max)	1.8
Peak Gain (dBi)	4.2
Average Gain (dBi)	-1.5
Efficiency (%)	72
Polarization	Linear
Radiation	Omnidirectional
Max Power	5 W
Wavelength	1/4-wave
Electrical Type	Monopole
Impedance	50 Ω
Connection	SMA plug (male pin) or RP-SMA plug (female socket)
Operating Temperature Range	-20 °C to +85 °C
Weight	12.5 g (0.44 oz)
Dimensions	97.7 mm x 18.7 mm x 10.5 (3.80 in x 0.74 in x 0.41 in)

Electrical specifications and plots measured with a 102 mm x 102 mm (4.0 in x 4.0 in) reference ground plane.

Packaging Information

The CW-RCL series antennas are packaged, 50 pcs in a clear plastic bag, 500 pcs per inner box, and 2000 pcs per export box. Distribution channels may offer alternative packaging options.

Product Dimensions

Figure 1 provides dimensions of the ANT-916-CW-RCL. The rotating base allows for continuous positioning through 360 degrees even while installed.

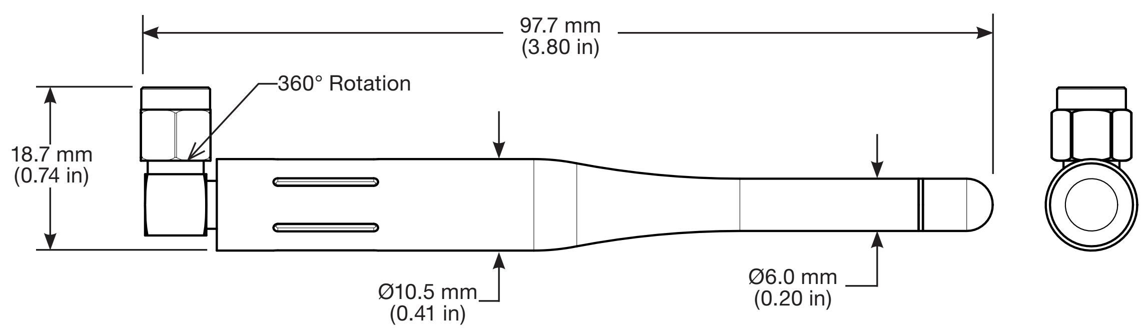


Figure 1. ANT-916-CW-RCL Antenna Dimensions

Counterpoise

1/4-Wave monopole antennas require an associated ground plane counterpoise for proper operation. The size and location of the ground plane relative to the antenna will affect the overall performance of the antenna in the final design. When used in conjunction with a ground plane smaller than that used to tune the antenna, the center frequency typically will shift higher in frequency and the bandwidth will decrease. The proximity of other circuit elements and packaging near the antenna will also affect the final performance.

For further discussion and guidance on the importance of the ground plane counterpoise, please refer to Linx Application Note, *AN-00501: Understanding Antenna Specifications and Operation*.

Antenna Orientation

The ANT-916-CW-RCL is characterized on the edge of a 102 mm x 102 mm ground plane as shown in Figure 2. This orientation, represents the most common orientation in end-product use.

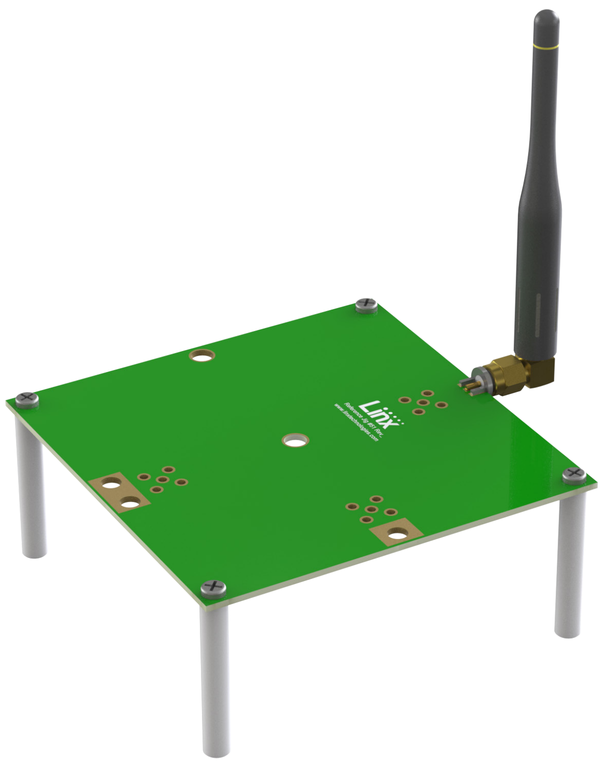


Figure 2. ANT-916-CW-RCL on Evaluation PCB

VSWR

Figure 3 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR describes the power reflected from the antenna back to the radio. A lower VSWR value indicates better antenna performance at a given frequency. Reflected power is also shown on the right-side vertical axis as a gauge of the percentage of transmitter power reflected back from the antenna.

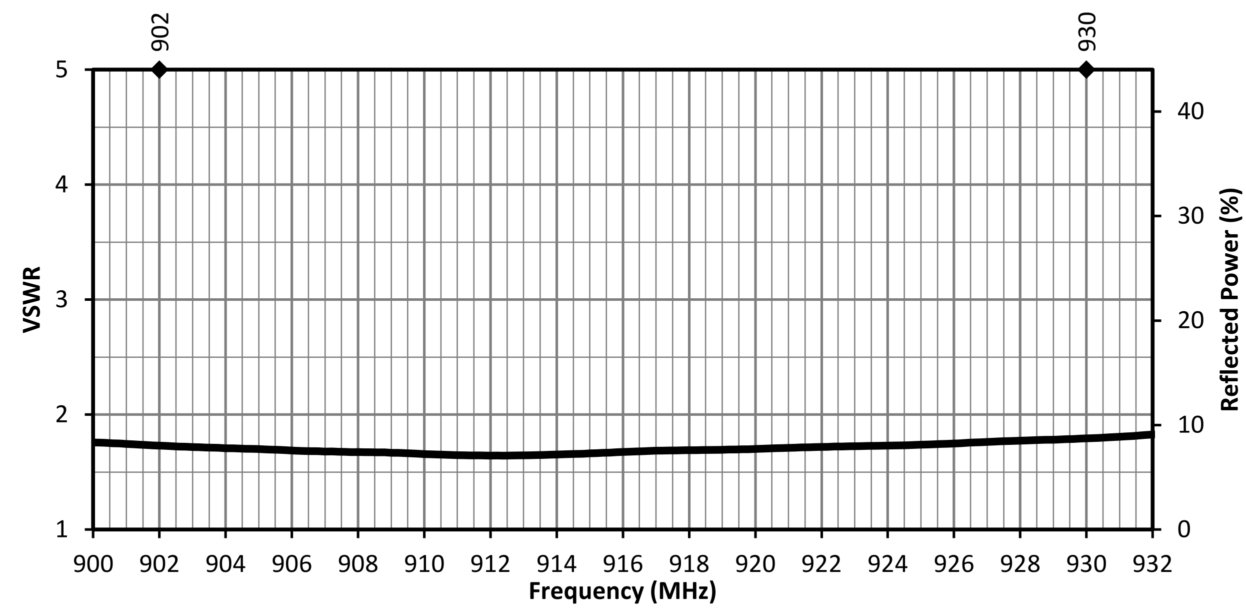


Figure 3. ANT-916-CW-RCL VSWR

Return Loss

Return loss (Figure 4), represents the loss in power at the antenna due to reflected signals. Like VSWR, a lower return loss value indicates better antenna performance at a given frequency.

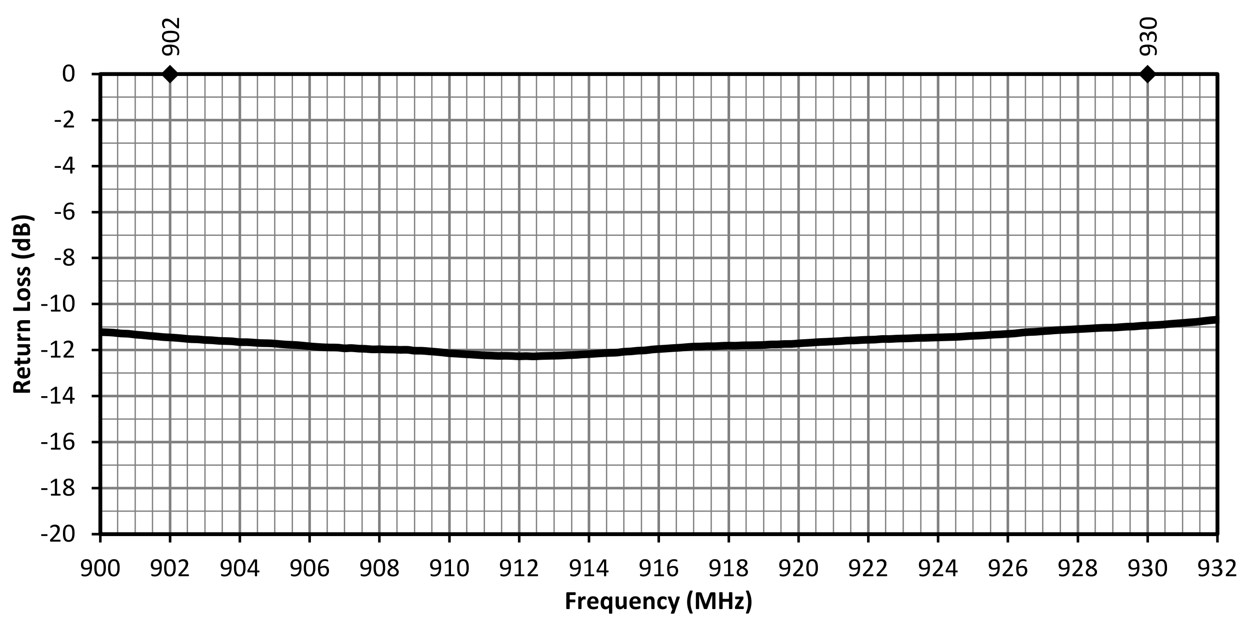


Figure 4. ANT-916-CW-RCL Return Loss

Peak Gain

The peak gain across the antenna bandwidth is shown in Figure 5. Peak gain represents the maximum antenna input power concentration across 3-dimensional space, and therefore peak performance at a given frequency, but does not consider any directionality in the gain pattern.

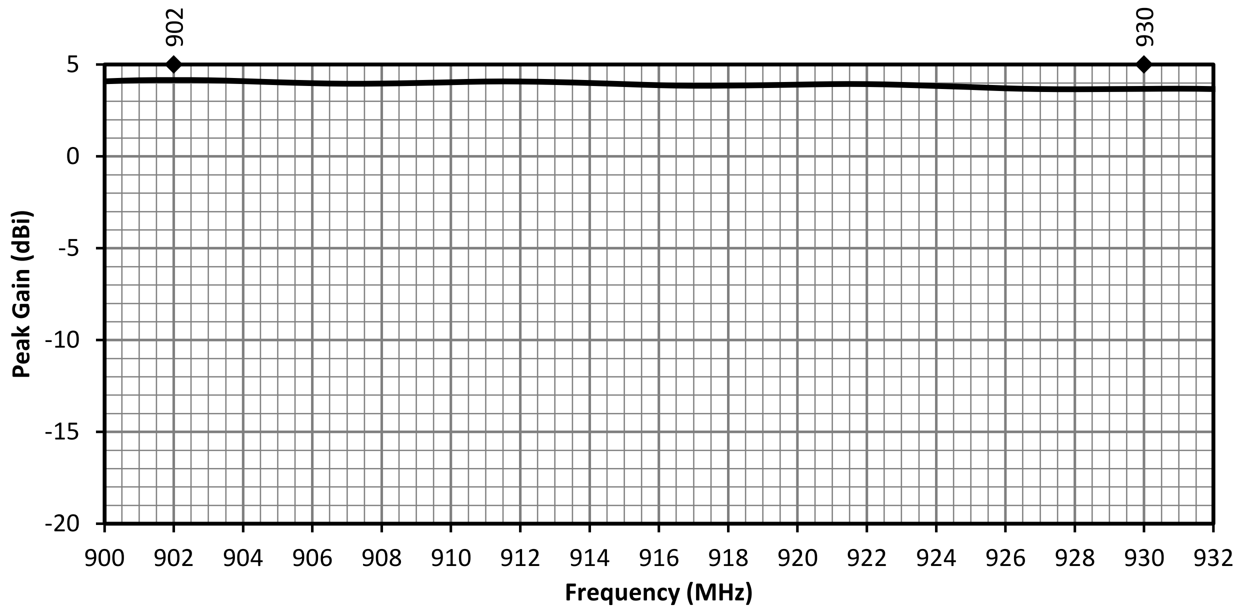


Figure 5. ANT-916-CW-RCL Peak Gain

Average Gain

Average gain (Figure 6), is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

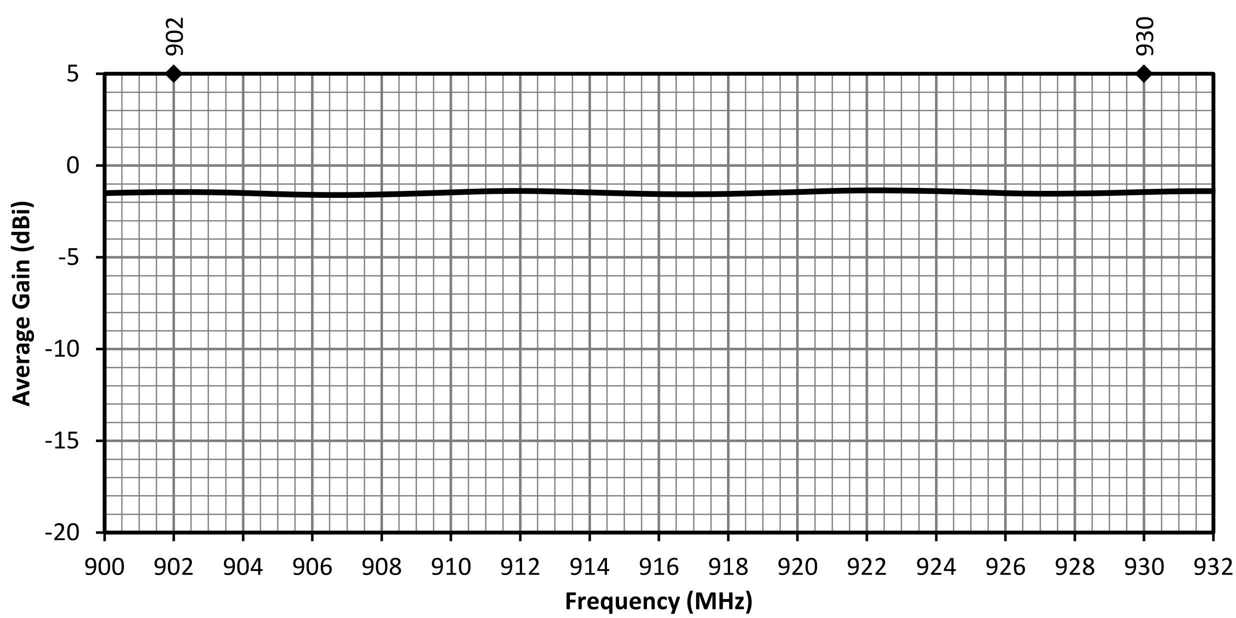


Figure 6. ANT-916-CW-RCL Antenna Average Gain

Radiation Efficiency

Radiation efficiency (Figure 7), shows the ratio of power delivered to the antenna relative to the power radiated at the antenna, expressed as a percentage, where a higher percentage indicates better performance at a given frequency.

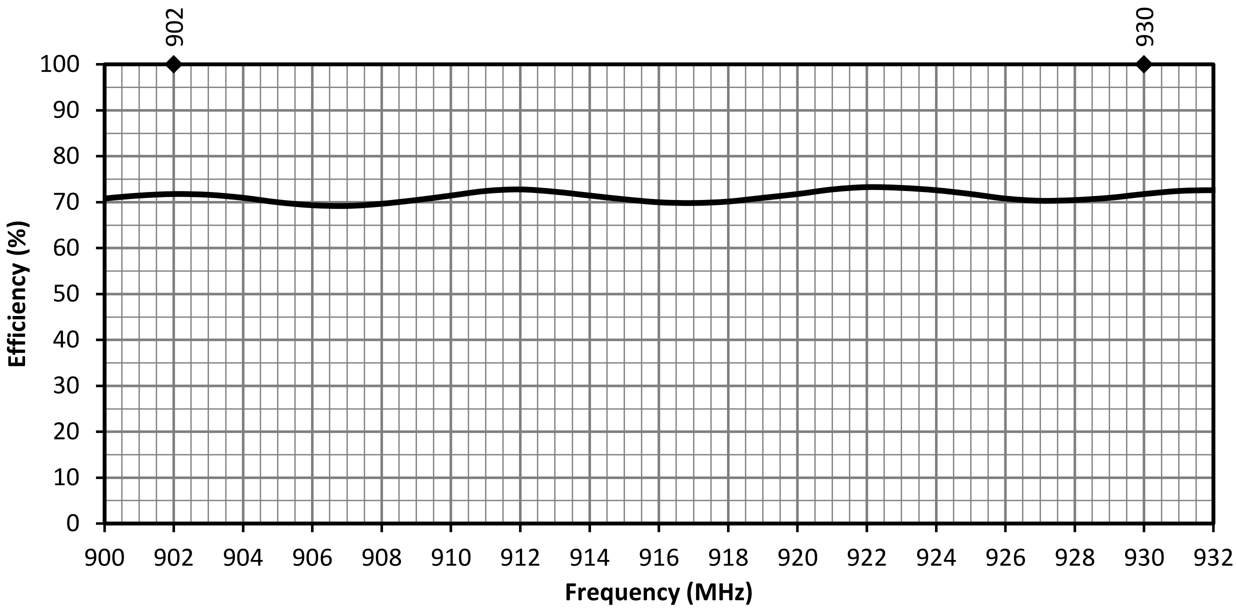
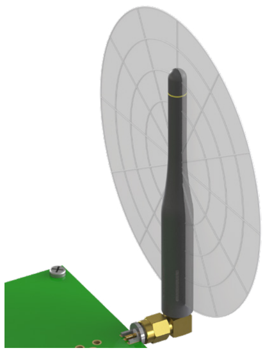


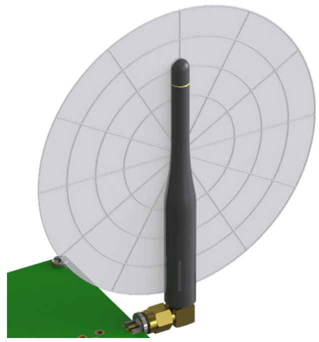
Figure 7. ANT-916-CW-RCL Antenna Radiation Efficiency

Radiation Patterns

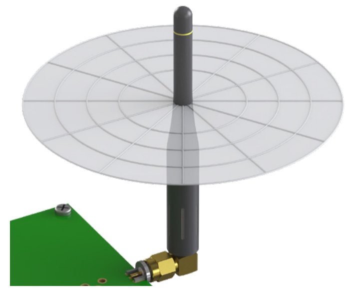
Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. Antenna radiation patterns are shown in Figure 8 using polar plots covering 360 degrees. The antenna graphic at the top of the page provides reference to the plane of the column of plots below it. Note: when viewed with typical PDF viewing software, zooming into radiation patterns is possible to reveal fine detail.



XZ-Plane Gain

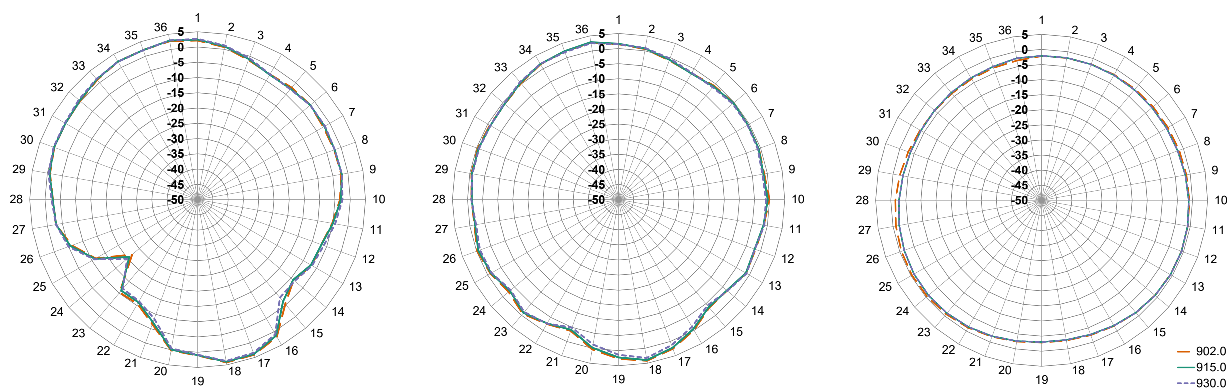


YZ-Plane Gain



XY-Plane Gain

902 MHz to 930 MHz (916 MHz)

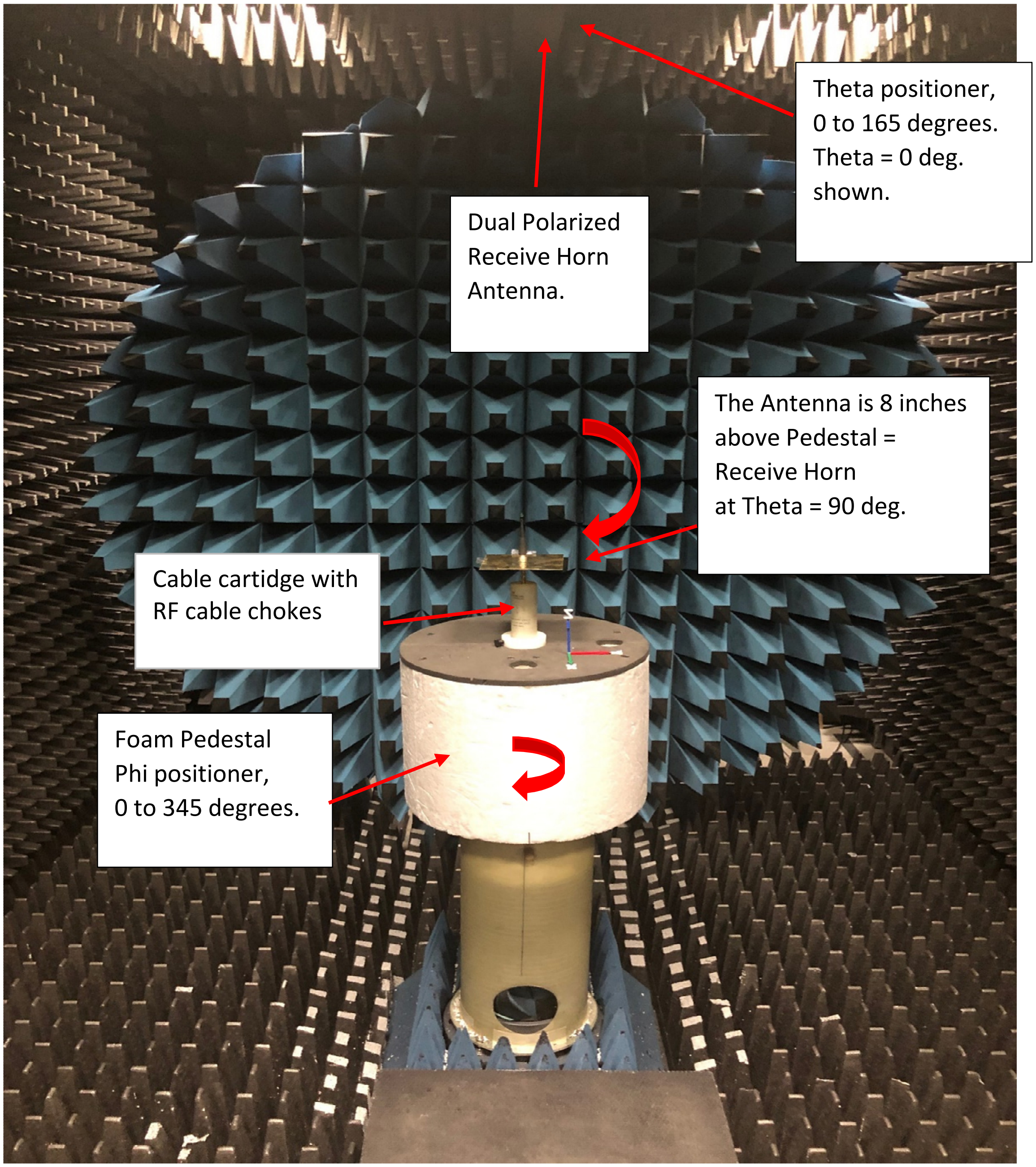


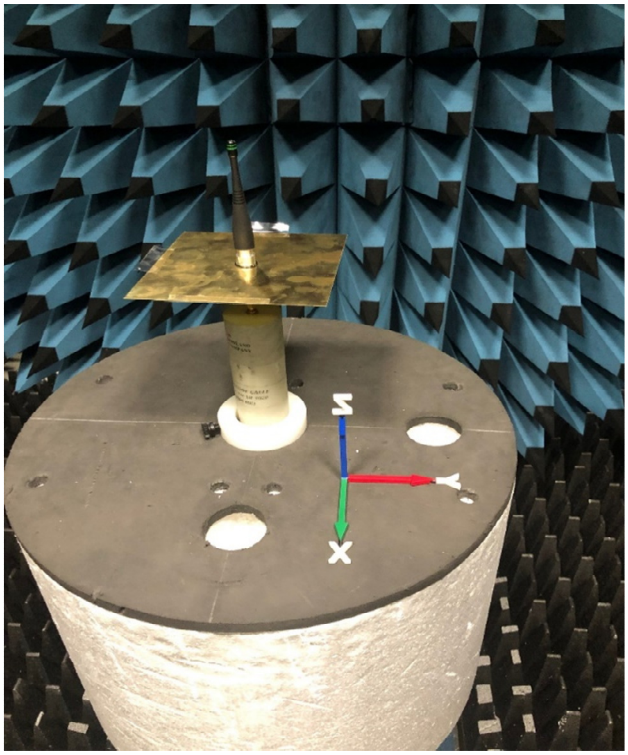
XZ-Plane Gain YZ-Plane Gain XY-Plane Gain

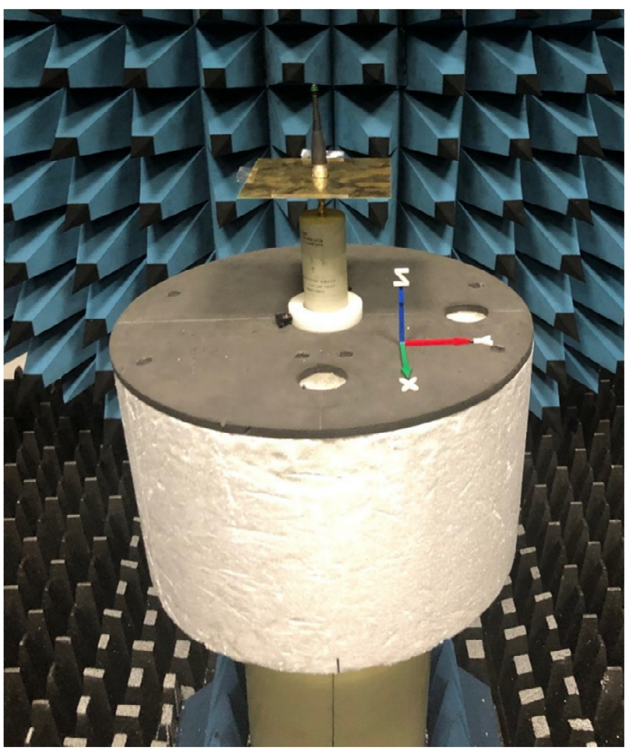
Figure 8. ANT-916-CW-RCL Radiation Patterns

Website: http://linxtechnologies.com
Linx Offices: 159 Ort Lane, Merlin, OR, US 97532
Phone: +1 (541) 471-6256
E-MAIL: info@linxtechnologies.com

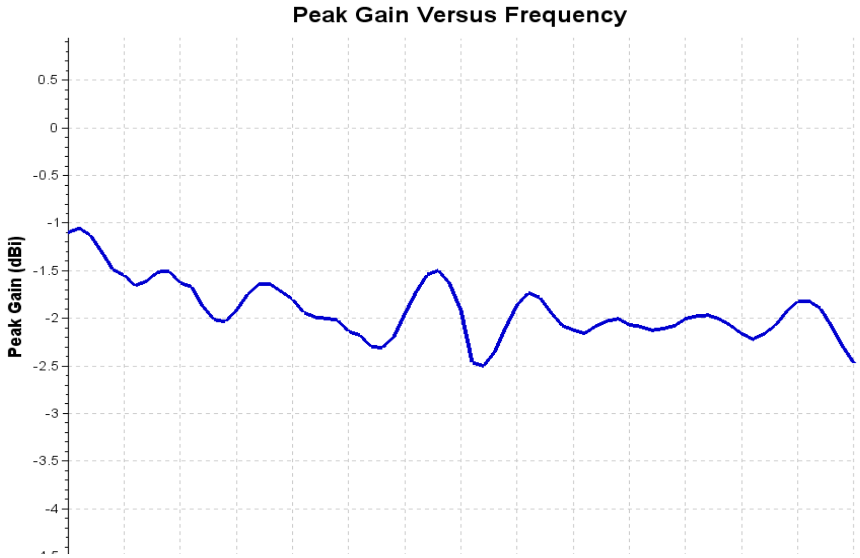
An Anechoic Antenna chamber using the Howland 3100 Dual Positioner System was used.
The Theta positioner rotates from 0 to 165 degrees in 15 degree increments.
For each value of Theta, the Phi positioner rotates from 0 to 345
Antenna was mounted a 6'' Square ground plane.

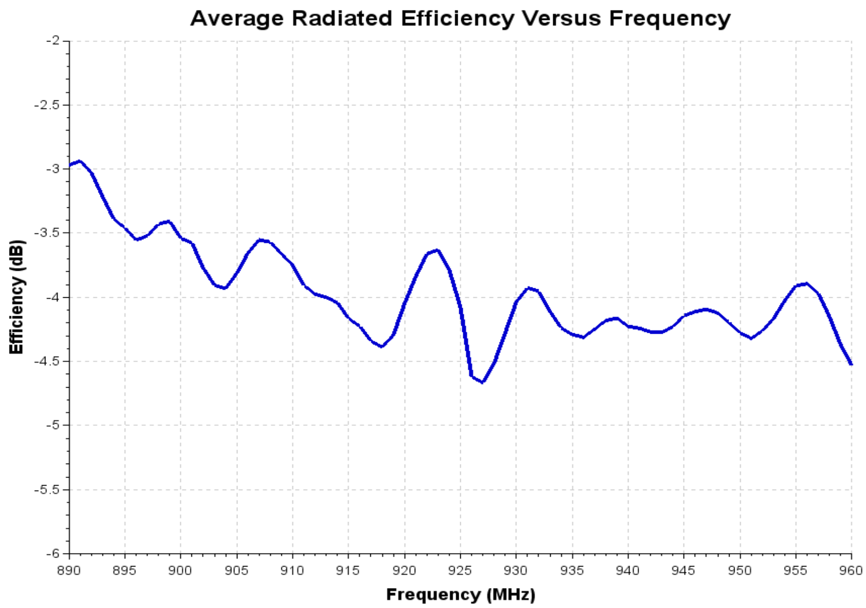



Z
Y
X

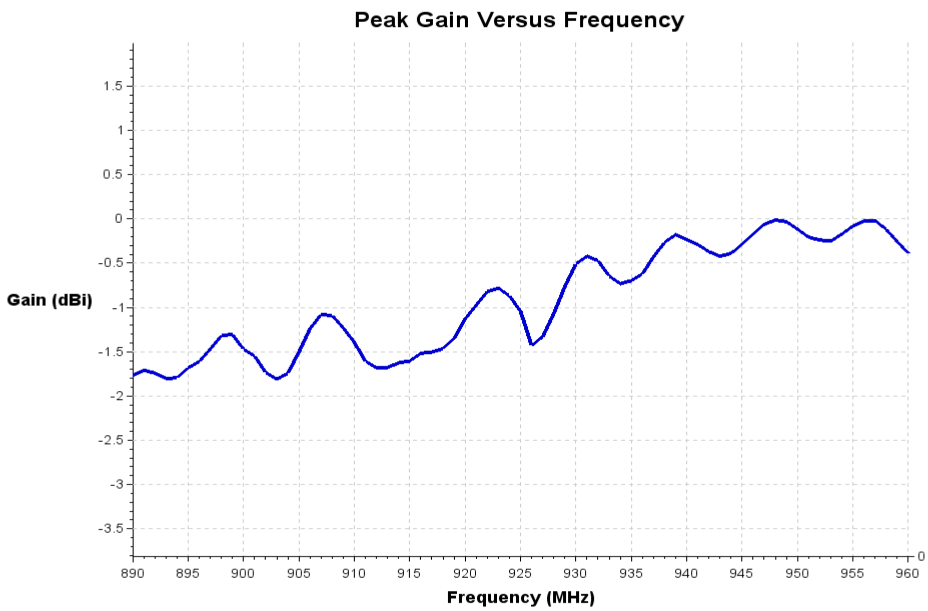

Z
Y
X

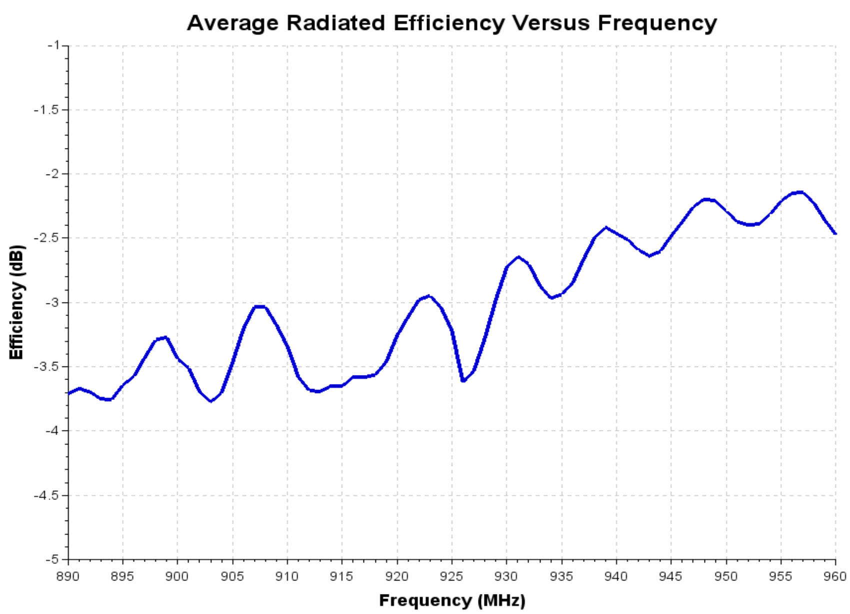
Antenna 1


Peak Gain Versus Frequency
Peak Gain (dBi)
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4

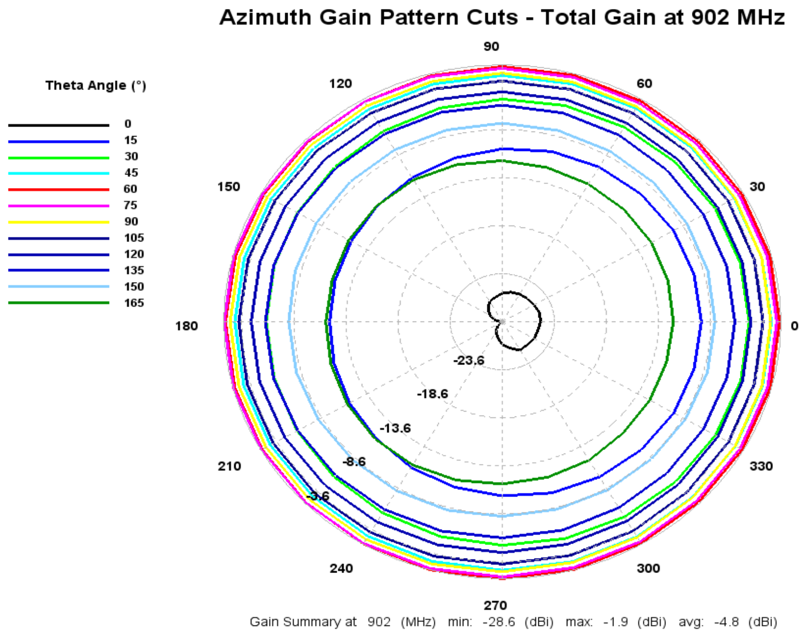

Average Radiated Efficiency Versus Frequency
Efficiency (dB)
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
890
895
900
905
910
915
920
925
930
935
940
945
950
955
960
Frequency (MHz)

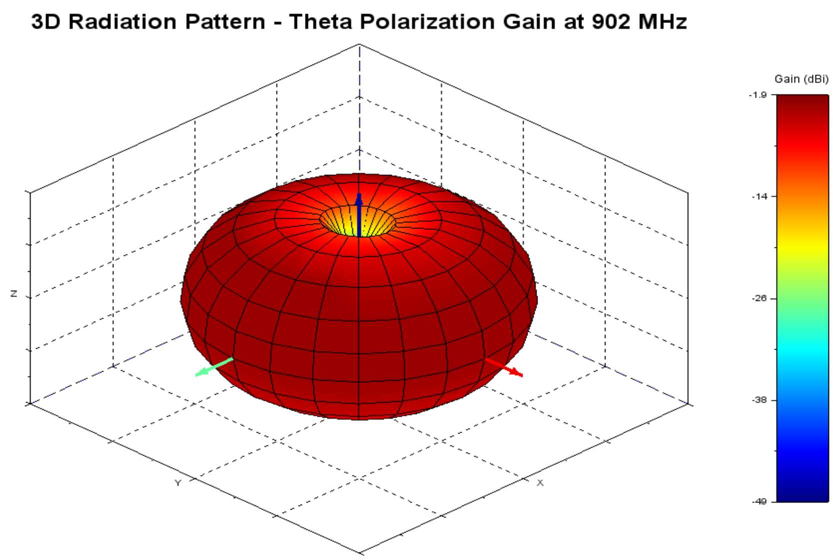
Antenna 2


Peak Gain Versus Frequency
Gain (dBi)
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
0
890
895
900
905
910
915
920
925
930
935
940
945
950
955
960
Frequency (MHz)

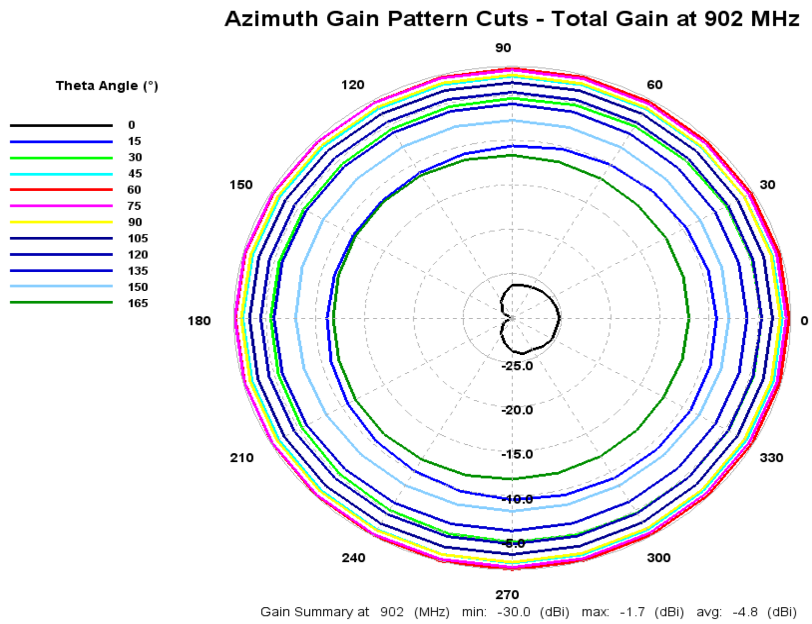

Average Radiated Efficiency Versus Frequency
Efficiency (dB)
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
890
895
900
905
910
915
920
925
930
935
940
945
950
955
960
Frequency (MHz)

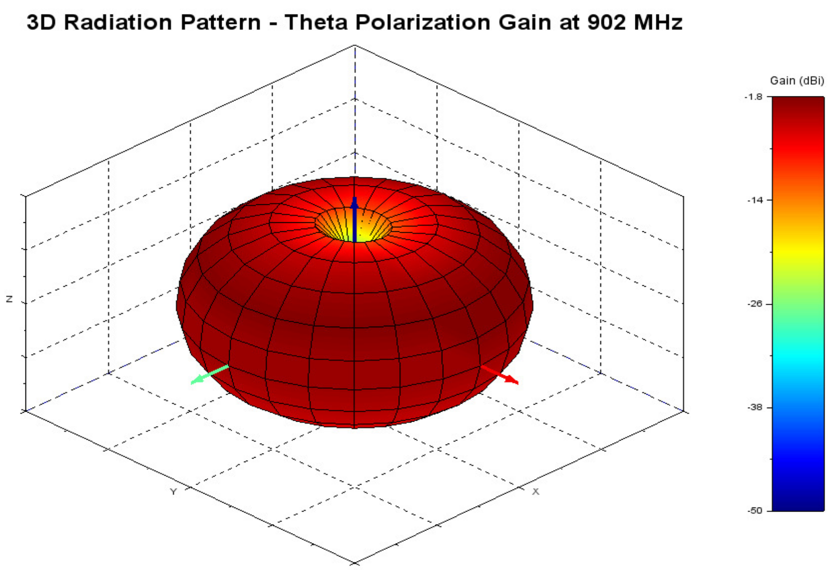
Antenna 1


Azimuth Gain Pattern Cuts - Total Gain at 902 MHz
Theta Angle (°)
0
15
30
45
60
75
90
105
120
135
150
165
90
120
60
150
30
180
0
210
330
240
300
270
-23.6
-18.6
-13.6
-8.6
-3.6
Gain Summary at 902 (MHz) min: -28.6 (dBi) max: -1.9 (dBi) avg: -4.8 (dBi)

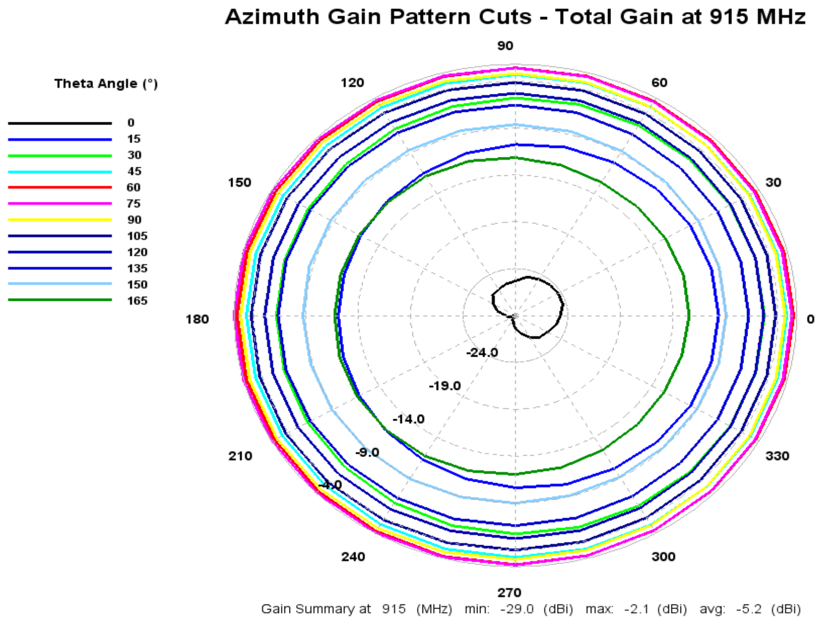

3D Radiation Pattern - Theta Polarization Gain at 902 MHz
Gain (dBi)
-1.9
-14
-26
-38
-49
Z
Y
X

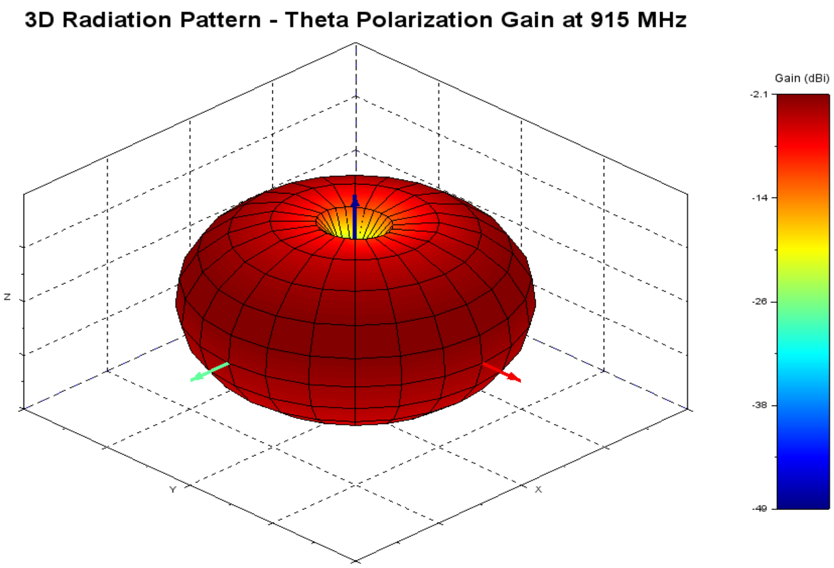
Antenna 2


Azimuth Gain Pattern Cuts - Total Gain at 902 MHz
Theta Angle (°)
0
15
30
45
60
75
90
105
120
135
150
165
90
120
60
150
30
180
0
210
330
240
300
270
-25.0
-20.0
-15.0
-10.0
-5.0
Gain Summary at 902 (MHz) min: -30.0 (dBi) max: -1.7 (dBi) avg: -4.8 (dBi)


3D Radiation Pattern - Theta Polarization Gain at 902 MHz
Gain (dBi)
-1.8
-14
-26
-38
-50
Z
Y
X

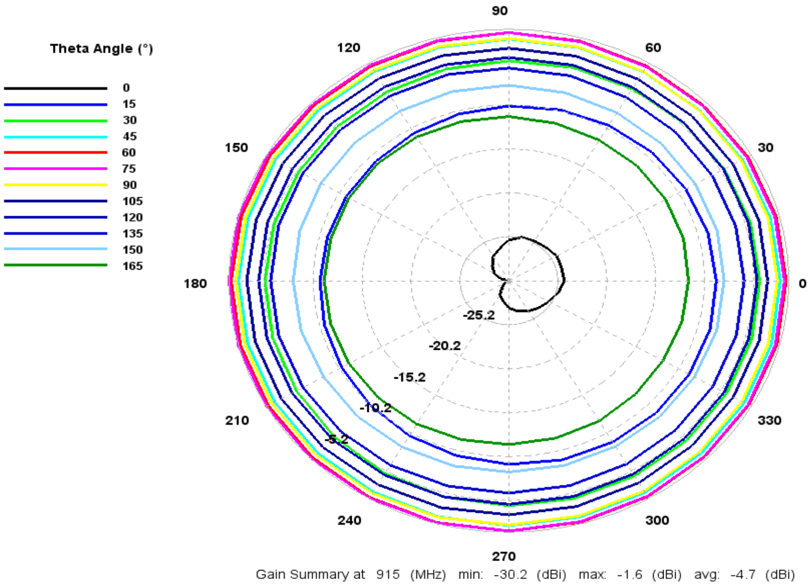
Antenna 1


Azimuth Gain Pattern Cuts - Total Gain at 915 MHz
Theta Angle (°)
0
15
30
45
60
75
90
105
120
135
150
165
90
120
60
150
30
180
0
210
330
240
300
270
-24.0
-19.0
-14.0
-9.0
-4.0
Gain Summary at 915 (MHz) min: -29.0 (dBi) max: -2.1 (dBi) avg: -5.2 (dBi)

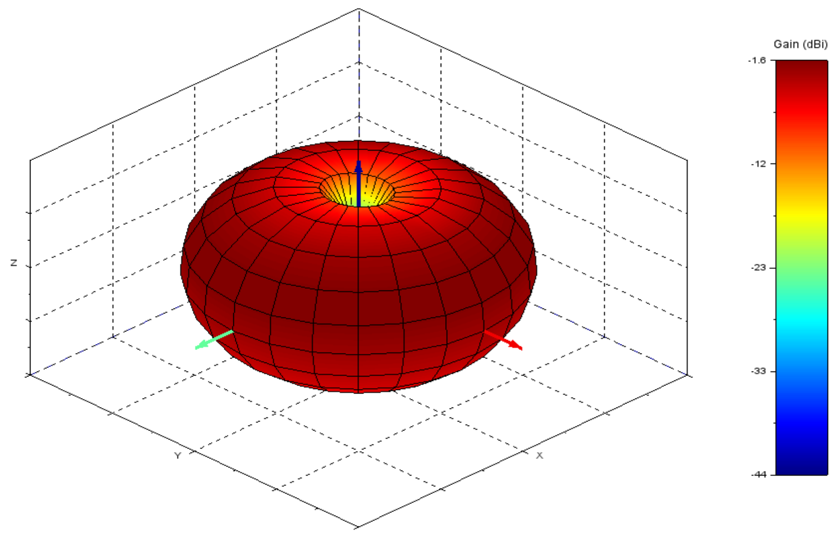

3D Radiation Pattern - Theta Polarization Gain at 915 MHz
Gain (dBi)
-2.1
-14
-26
-38
-49
Z
Y
X

Antenna 2

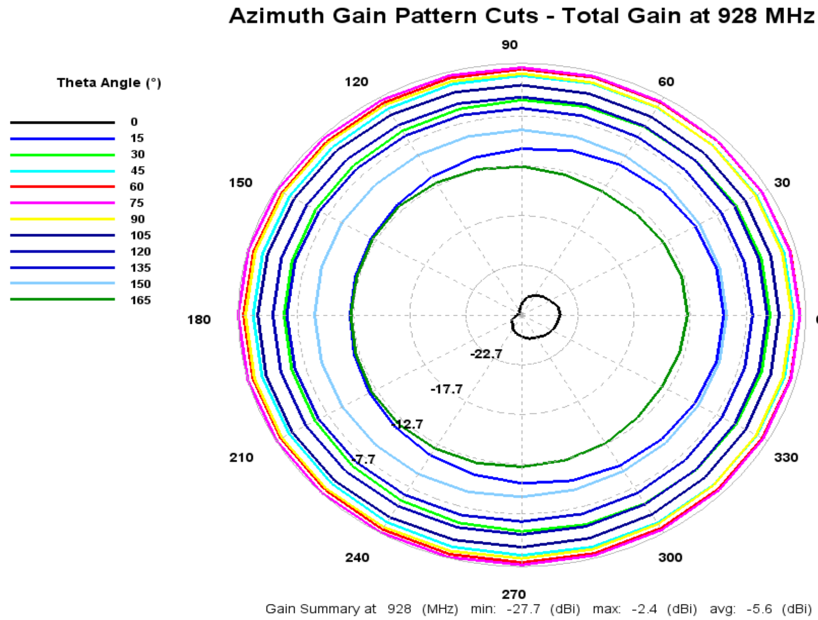
Azimuth Gain Pattern Cuts - Total Gain at 915 MHz

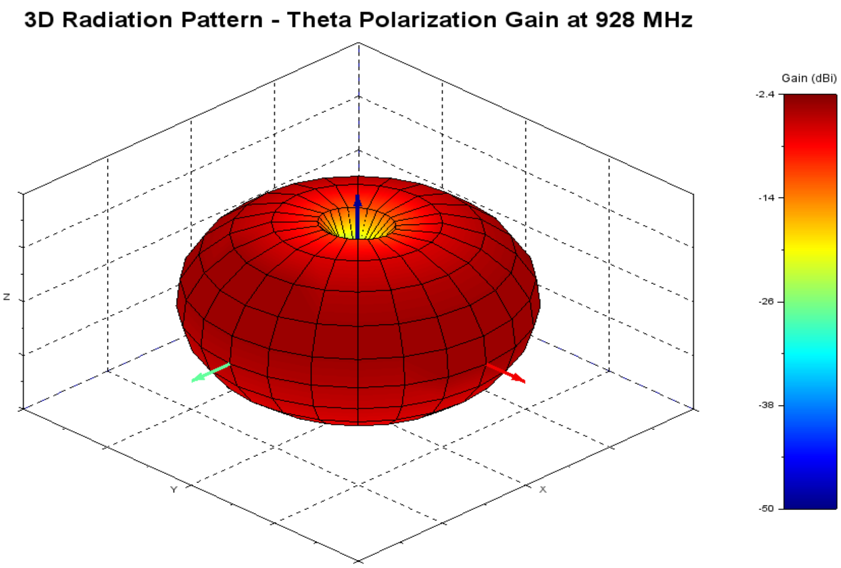


3D Radiation Pattern - Theta Polarization Gain at 915 MHz



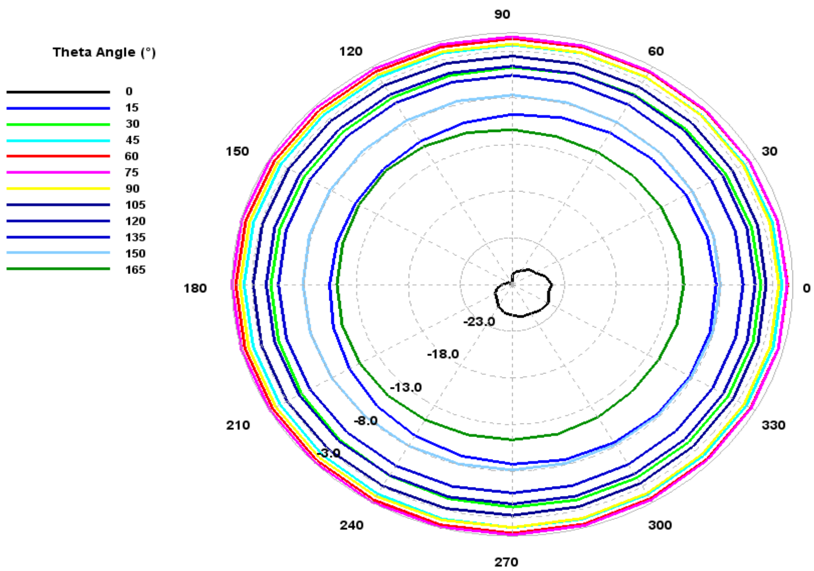
Antenna 1


Azimuth Gain Pattern Cuts - Total Gain at 928 MHz
Theta Angle (°)
0
15
30
45
60
75
90
105
120
135
150
165
90
120
60
150
30
180
0
210
330
240
300
270
-22.7
-17.7
-12.7
-7.7
Gain Summary at 928 (MHz) min: -27.7 (dBi) max: -2.4 (dBi) avg: -5.6 (dBi)


3D Radiation Pattern - Theta Polarization Gain at 928 MHz
Gain (dBi)
-2.4
-14
-26
-38
-50
Z
Y
X

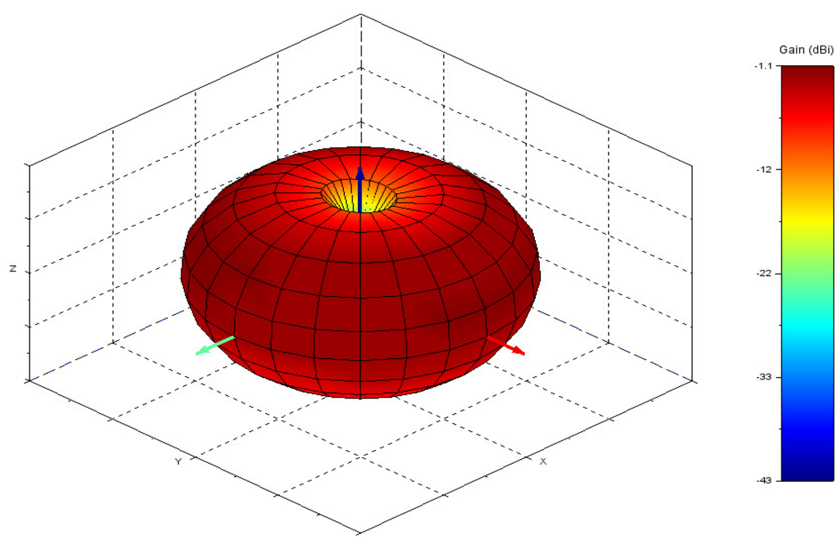
Antenna 2

Azimuth Gain Pattern Cuts - Total Gain at 928 MHz



Gain Summary at 928 (MHz) min: -28.0 (dBi) max: -1.1 (dBi) avg: -4.3 (dBi)

3D Radiation Pattern - Theta Polarization Gain at 928 MHz



5. Required Host System Labelling

FCC ID and Industry Canada ID on Host System
The integrator must affix the module's FCC ID and Industry Canada ID on the product, if the OMESH OPM15-E1 is installed inside the hose system and its FCC ID and Industry Canada ID may not be visible
. the FCC ID and Industry Canada ID label must appear on the outside of the host system visible to the user.

Example working to appear somewhere on the outside of the host system visible to the end user:

Contains "FCC ID: WB4-60068201" & :IC: "6272A-60068201"

OR

OPM15 Inside, FCC ID: WB4-60068201 IC: 6272A-60068201

6. Module currently used in the following Atlas polar Products:

- **a. 600-682-01 Rev. 5**
  - **i. PB926-T**
  - **ii. PB926-R**
- **b. 600-682-01 Rev. 7**
  - **i. HV900-60H**
  - **ii. HV900-60S**

7. The module and its antenna must be housed in an enclosure such that when operating, the clearance to people is great than 10 mm.

If this clearance cannot be assured additional compliance testing must be completed of SAR or a new certification may be required.