Datasheet

JOYMAX
EnJOY MAX Wireless®

ZHF-HA04cc2G

5G Rugged Burial antenna

The Joymax ZHF-HA04cc2G series antennas are rugged, burial-mount, dipole antennas designed for use in 5G New Radio FR1, LTE, and Cellular IoT (LTE-M, NB-IoT) applications with broad bandwidth coverage from 617 MHz to 5000 MHz. The antenna also supports CBRS (3550 MHz to 3700MHz), Public Safety (4940 MHz to 4990 MHz), and a growing number of C-band applications.

The dipole antenna provides a ground plane independent rugged antenna solution to be buried on ground, roadways and etc. Connection is made to the radio via a coaxial cable terminated in an TNC plug connector.

Features

- Bandwidth 617 MHz and 5000 MHz
- Performance at 617 MHz to 960 MHz
  - VSWR: ≤ 4.0
  - Peak Gain: 1.9 dBi
  - Efficiency: 38%
- Ground plane independence dipole design
- IK10 rated, rugged design burial to ground
- IP67 rated, waterproof design
- TNC plug (male pin) connector

Applications

- 5G NR FR1, 4G, 3G, 2G, CBRS
- Cellular IoT: LTE-M (Cat-M1), NB-IoT
- CBRS Private Network (3550 to 3700MHz)
- C-Band applications (3700 to 4200MHz)
- Public Safety networks (4940 to 4990MHz)
- Low-power, wide-area (LPWA) applications
  - LoRaWAN®
  - Sigfox®
  - Weightless-P®
  - WiFi HaLow™ (802.11ah)
- Roadway Monitoring Device

Ordering Information

Part Number	Description
ZHF-HA04TC2G-Q100	5G Rugged Antenna with TNC Plug (male pin), RG58/U coaxial cable, L=1000mm
ZHF-HA04TC2G-Q200	5G Rugged Antenna with TNC Plug (male pin), RG58/U coaxial cable, L=2000mm
ZHF-HA04TC2G-B300	5G Rugged Antenna with TNC Plug (male pin), J195 coaxial cable, L=3000mm
ZHF-HA04TC2G-B200	5G Rugged Antenna with TNC Plug (male pin), J195 coaxial cable, L=2000mm

Available from Joymax Electronics and select distributors and representatives.
Custom cable lengths are available for OEM volume inquiry.

Table 1: Electrical Specifications

ZHF-HA04cc2G	5G NR / LTE Bands (MHz)			
Frequency Range	617~960	1710~2690	3300~4200	4400~5000
VSWR (Max)	4.0	3.5	3.7	4.9
Peak Gain (dBi)	1.9	4.3	2.1	2.0
Average Gain (dBi)	-4.3	-3.9	-4.9	-5.3
Efficiency (%)	38	41	32	30
Polarization	Linear			
Radiation	Omni directional			
Max Power	1 W			
Wavelength	½-λ			
Electrical Type	Dipole			
Impedance	50 Ω			

Electrical specifications measured with the antenna hanging free with 2 meter long RG58 coaxial cable and TNC plug connector.

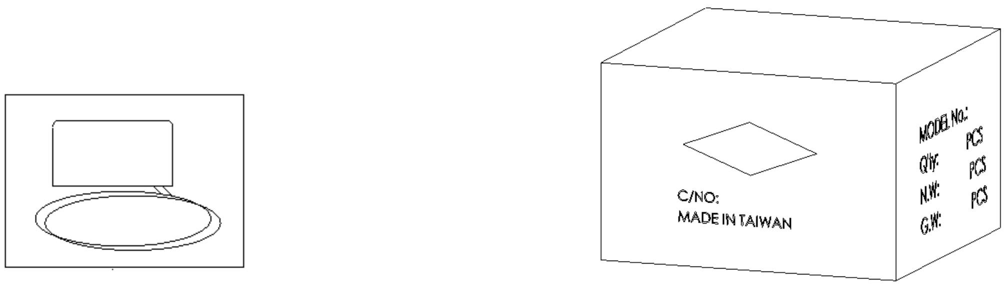
ATTENUATION FIGURES - 5 MM (0.195 INCH) DIAMETER CABLES									
Frequency Range (MHz)	698	960	1710	2650	3300	4400	5000	5850	7125
Cable Attenuation (dB/M)	< 0.4	< 0.5	< 0.6	< 0.8	< 0.9	< 1.1	< 1.2	< 1.3	< 1.7

Table 2: Mechanical Specifications

Parameter	Value
Connection	TNC Plug (male pin)
Operating Temp.	-40˚C to +85˚C
Weight	1000mm cable— 503g; 2000mm cable—538g
Dimension	⌀100.0 mm x 55.0 mm
Antenna Color	Grey
Ingress Protection	IP67
IK Rating	IK10

Packaging Information

The ZHF-HA04cc2G antennas are individually packed into a box as shown in **Figure 1**. 10 pcs per carton, 320 mm x 250 mm x 230 mm (16.5 in x 12.2 in x 10.2 in), total weight 6.4 kgs (16.3 lb). Distribution channels may offer alternative packaging options.



1 pc antenna/ 1 PE bag

10 pcs antenna/ 1 Carton

Figure 1. Antenna Packaging

Product Dimensions

Figure 2 provides dimensions of the ZHF-HA04cc2G in mm measurement unit. The antenna permanently mounts with burial to ground, roadways etc. Connection is made to the radio via a coaxial cable terminated in a TNC plug (male pin) connector.

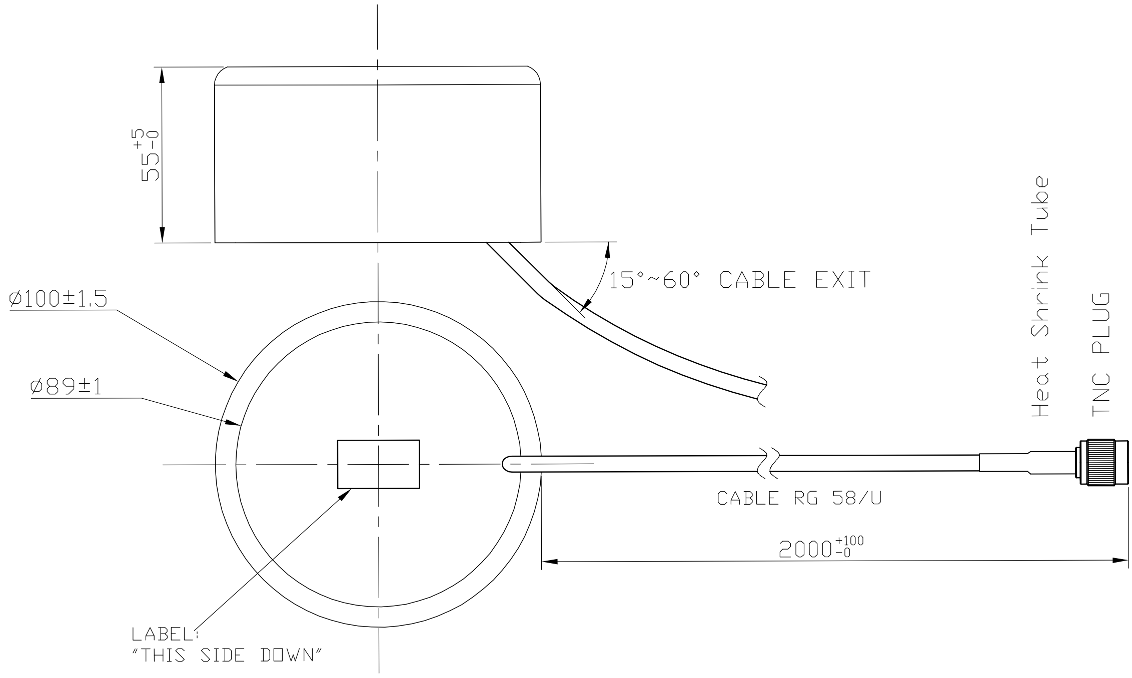


Figure 2. Antenna Dimensions

Antenna Test Setup

The ZHF-HA04cc2G is tested with antenna hanging free in the space as shown in **Figure 3.** The charts on the following pages represent data taken with the antenna with 2 meter long RG58 coaxial cable and TNC plug connector.

Figure 3. Antenna Test Orientation

VSWR

Figure 4 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR is a function of the reflection coefficient, which 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.

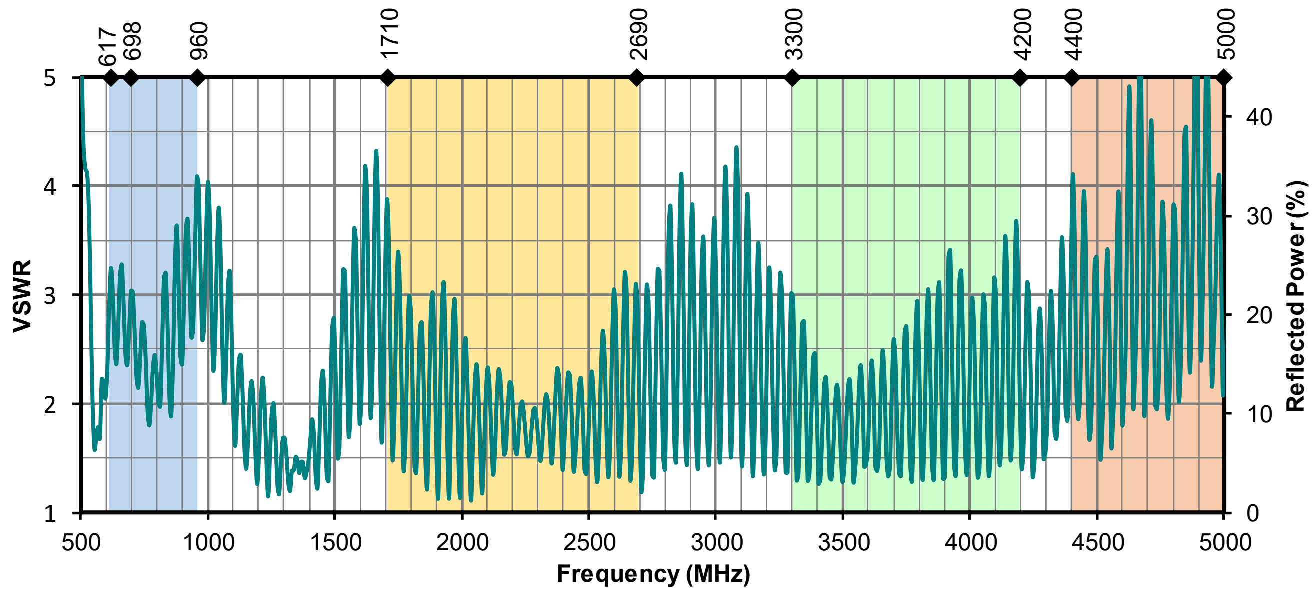


Figure 4. Antenna VSWR, hanging free

Return Loss

Return loss (**Figure 5**), 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.

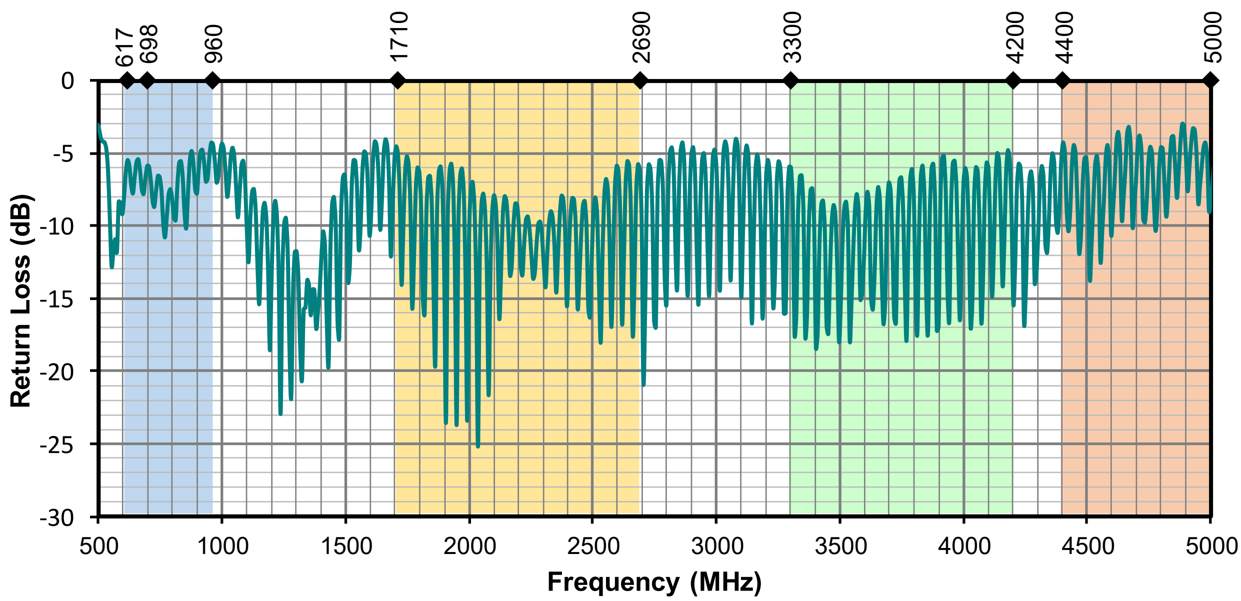


Figure 5. Antenna Return Loss, hanging free

Peak Gain

The peak gain across the antenna bandwidth is shown in **Figure 6**. 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.

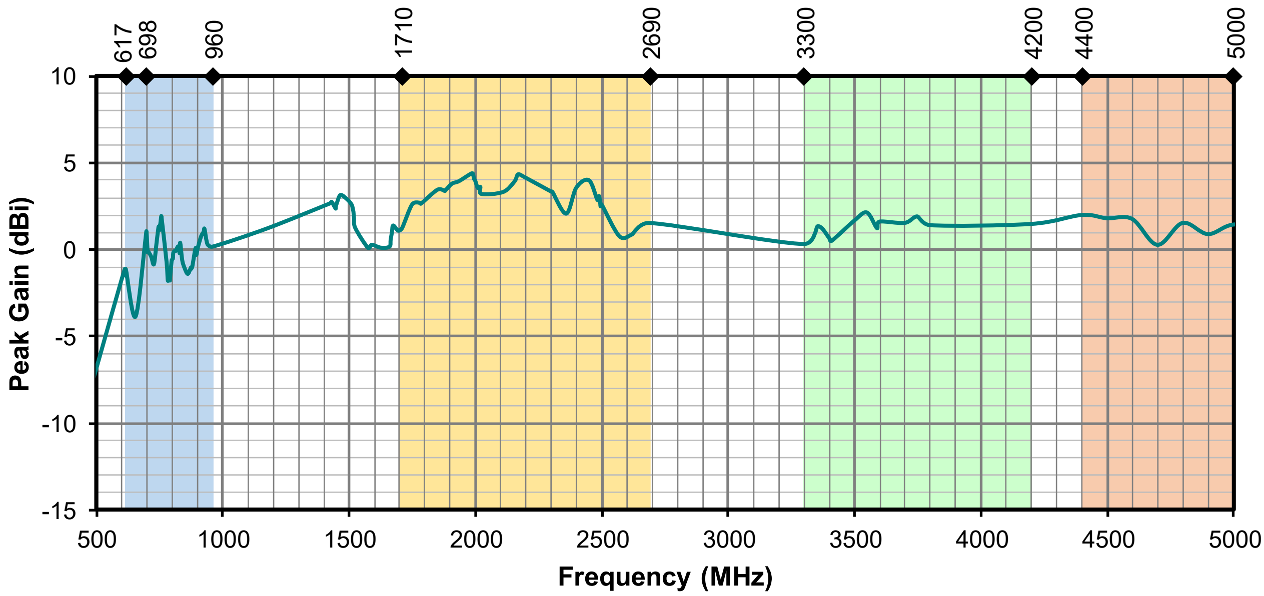


Figure 6. Antenna Peak Gain, hanging free

Average Gain

Average gain (**Figure 7**), is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

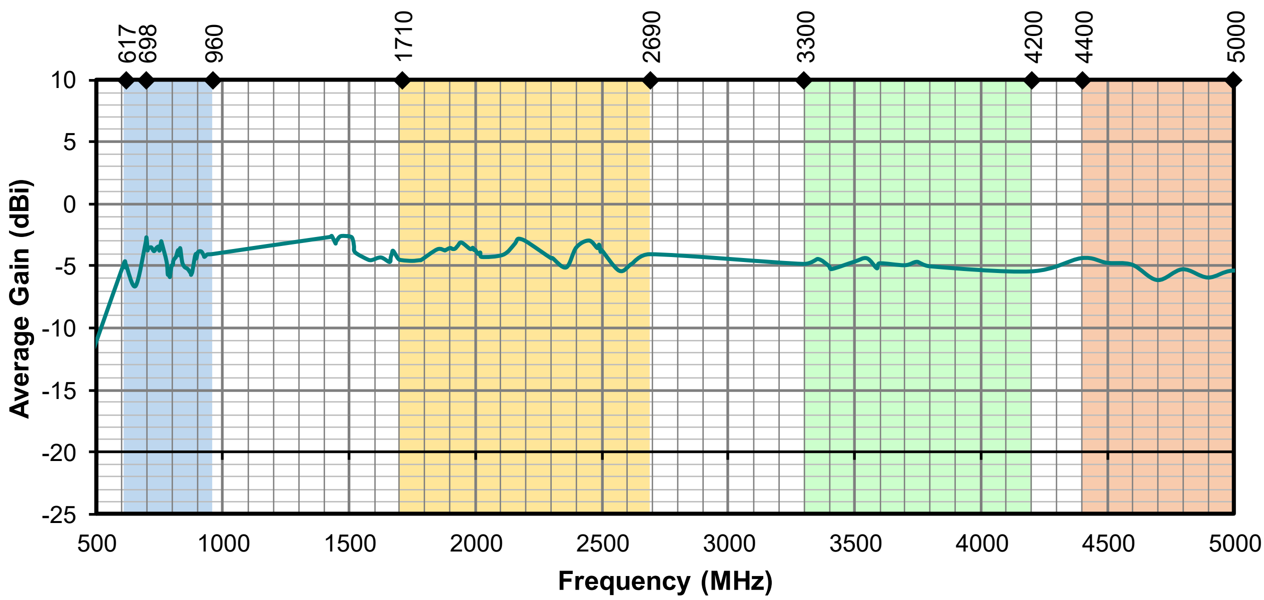


Figure 7. Antenna Average Gain, hanging free

Radiation Efficiency

Radiation efficiency (**Figure 8**), shows the ratio of power radiated by the antenna relative to the power supplied to the antenna, expressed as a percentage, where a higher percentage indicates better performance at a given frequency. An ideal antenna has 100% efficiency. But in really world, usually an external antenna radiates only 50~60% of power supplied to it.

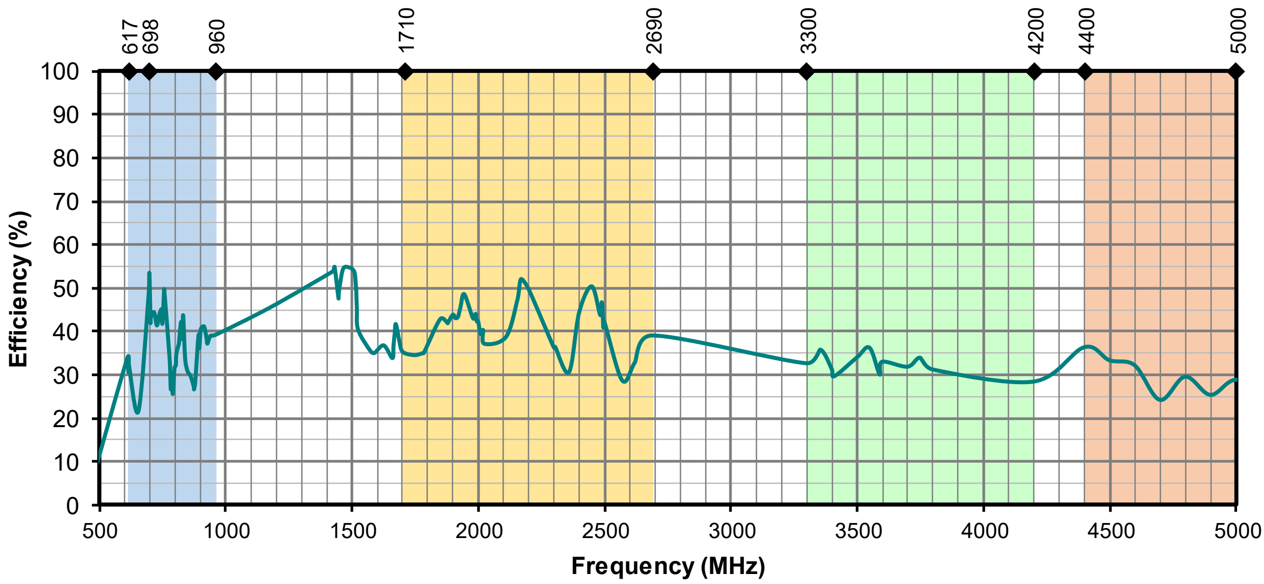
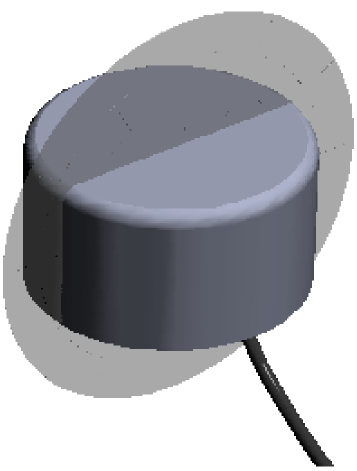


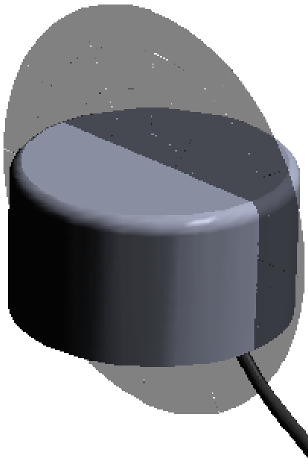
Figure 8. Antenna Efficiency, hanging free

Radiation Patterns

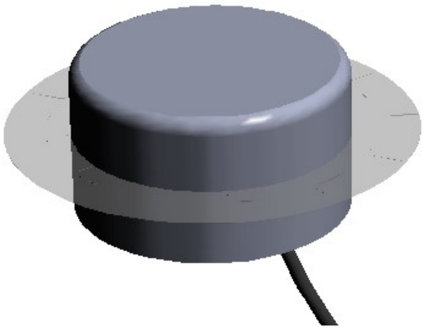
Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. Antenna radiation patterns are shown in **Figure 9** using polar plots covering 360 degrees. The antenna graphic at the top of the page provides reference to the plane of the column of plots below it.



XZ-Plane Gain

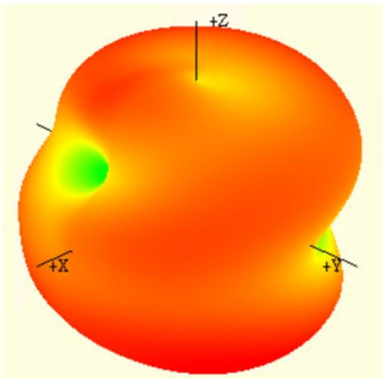


YZ-Plane Gain

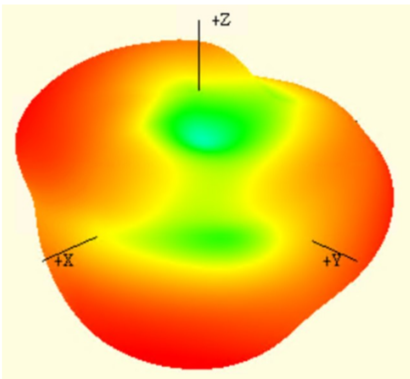


XY-Plane Gain

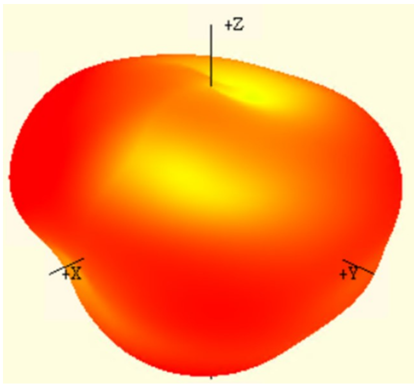
617 MHz to 960 MHz (778 MHz)



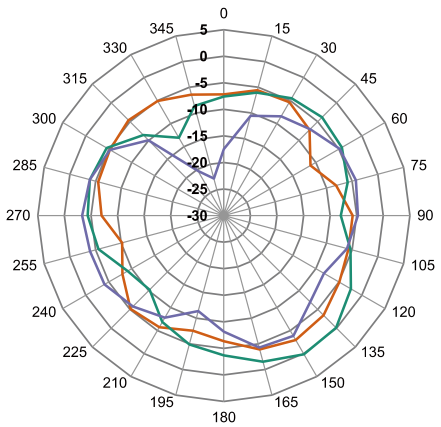
617 MHz



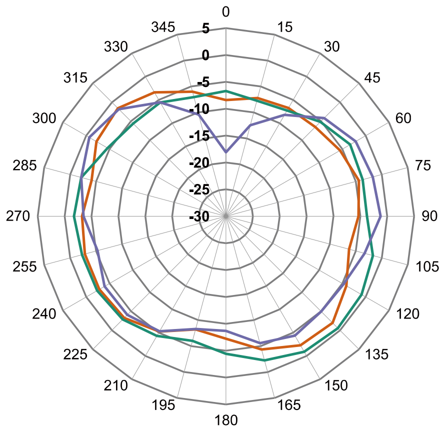
778 MHz



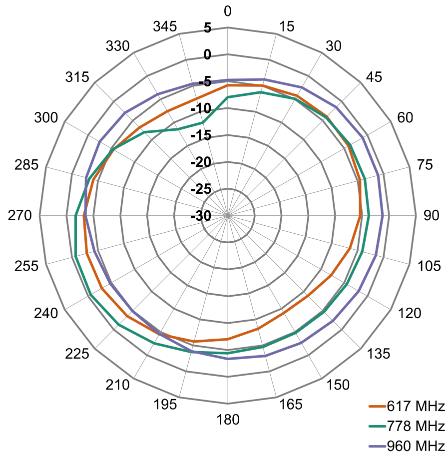
960 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

Figure 9-1. Antenna Radiation Patterns, with 2 Meter long RG58 coaxial cable

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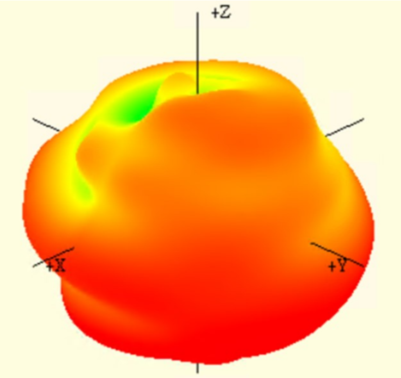
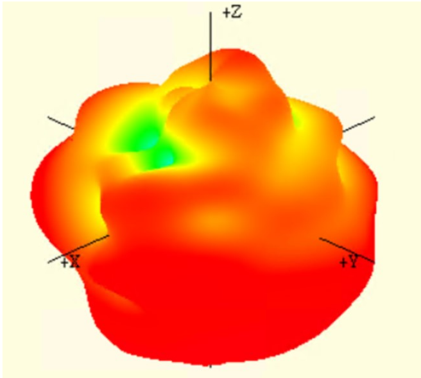
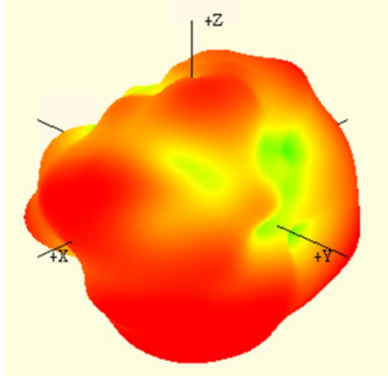
1710 MHz to 2700 MHz (2200 MHz)



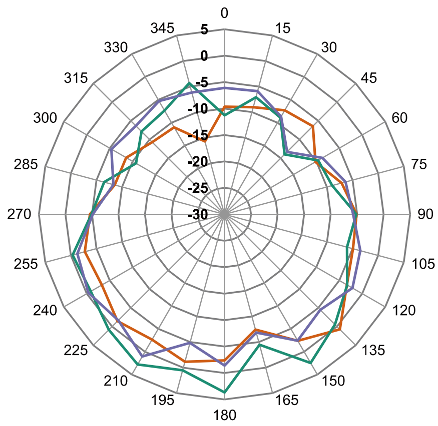
1710 MHz



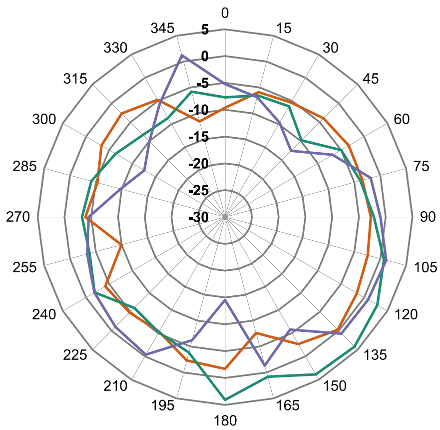
2200 MHz



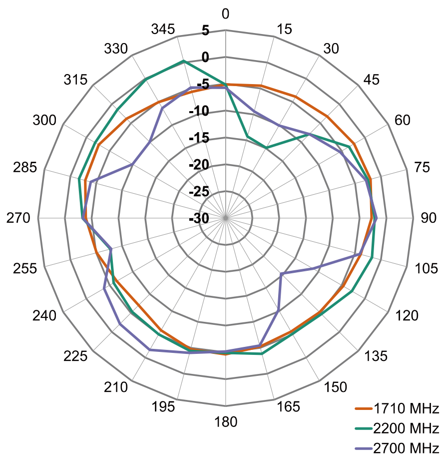
2700 MHz



XZ-Plane Gain

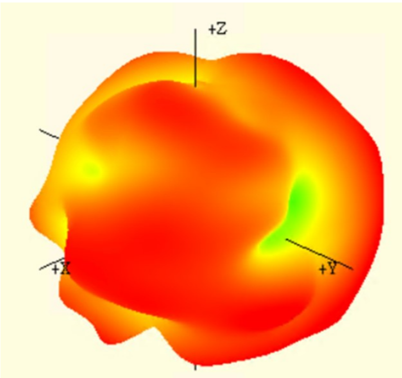


YZ-Plane Gain

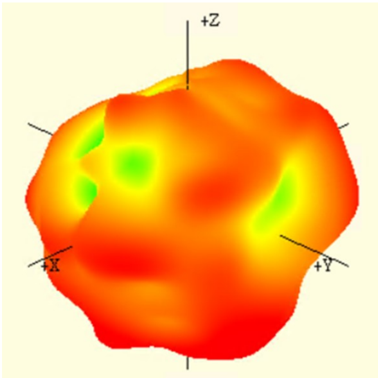


XY-Plane Gain

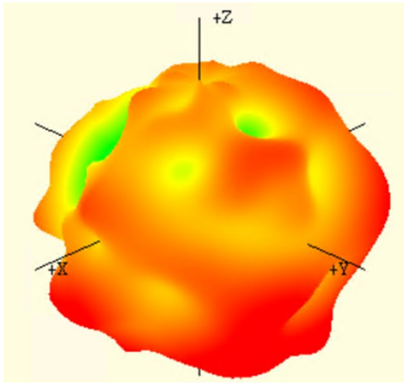
3300 MHz to 4200 MHz (3750 MHz)



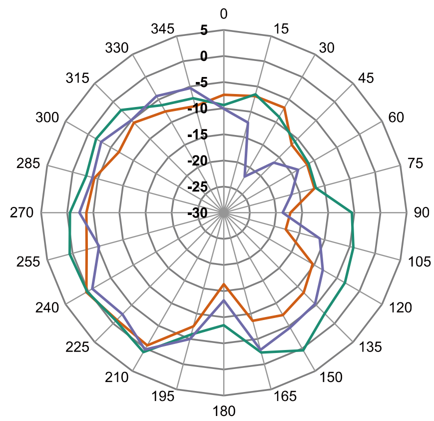
3300 MHz



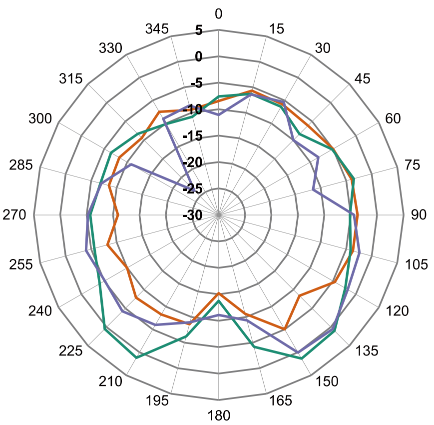
3750 MHz



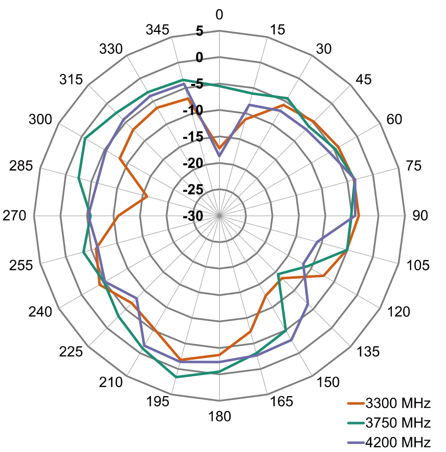
4200 MHz



XZ-Plane Gain

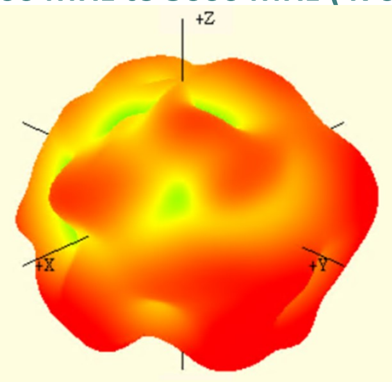


YZ-Plane Gain

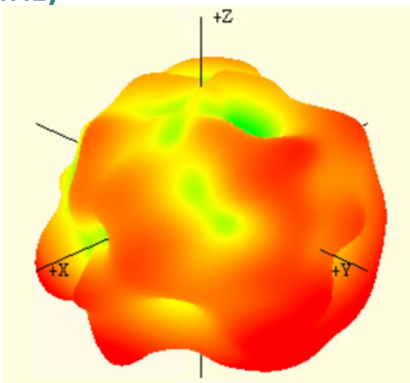


XY-Plane Gain

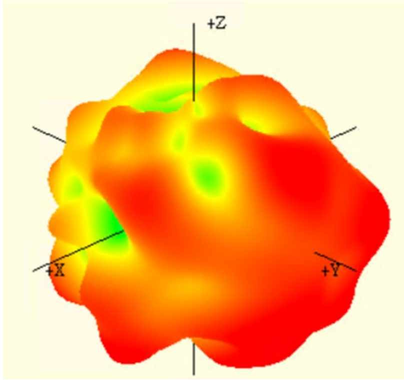
4400 MHz to 5000 MHz (4700 MHz)



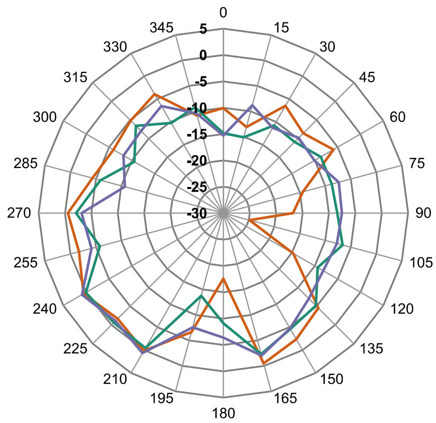
4400 MHz



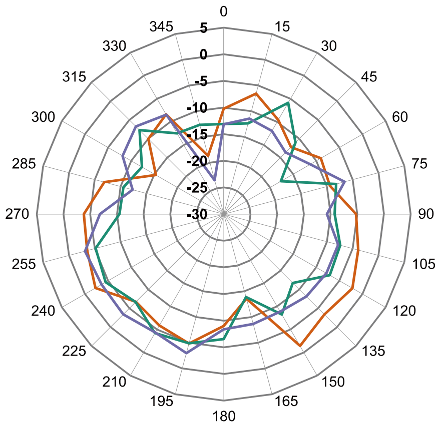
4700 MHz



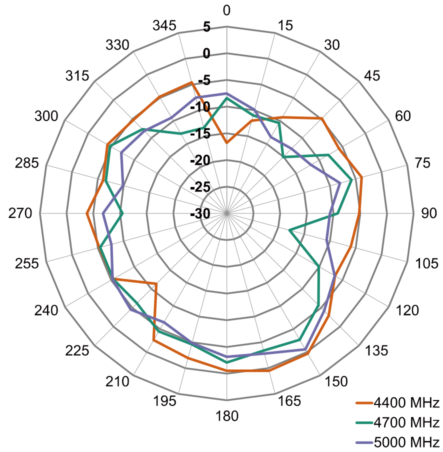
5000 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

Figure 9-2. Antenna Radiation Patterns, with 2 Meter long RG58 coaxial cable

Antenna FAQs

Q: What is an antenna?

An antenna is used for transmission or reception of radio signals in wireless communication.

Q: How do antennas work?

Electricity flowing into the transmitter antenna makes electrons vibrate up and down it, producing radio waves. The radio waves travel through the air at the speed of light. When the waves arrive at the receiver antenna, they make electrons vibrate inside it.

Q: Does antenna size matter?

A bigger antenna, properly designed, will always have more **gain** than a smaller one. And it will be the best kind of **gain**, much better than using a small antenna and simply over-amplifying it, because a small antenna just won't pull in truly weak signals like this gigantic one will.

Q: What is the advantage of external antennas?

External antennas usually offer **better bandwidth** and **high performance** due to the nature of their larger size. This often results in a higher rated **gain** (dBi) than their internal counterparts. Due to its smaller size, an internal antenna would not function well to support lower frequencies.

Ease of integration – an external antenna requires fewer design resources and shorter time to integrate to allow for a more rapid time-to-market. An internal antenna's performance is influenced by device environment – PCB ground plane, nearby metal part, and enclosure. That would require much more effort such as impedance matching network to complete antenna design.

Q: Why is most antenna impedance 50 Ohm?

50 Ohm is an industry standard of coax cables and power amplifiers. It was chosen as a tradeoff between maximum power handling for the transmit coax and the copper losses. The optimum would have been anyway in the range of **30 to 100 ohm** with average at 50 Ohm.

Q: Why does GNSS require RHCP (Right-hand-circularly-polarized) antennas?

Satellite's signal has a low power density, especially after propagating through the **atmosphere** (**ionosphere** affect radio wave). Polarized waves oscillate in more than one direction, which deliver satellite's signal to receiver on Earth surface more effectively.

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06/24 RevA

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