Datasheet

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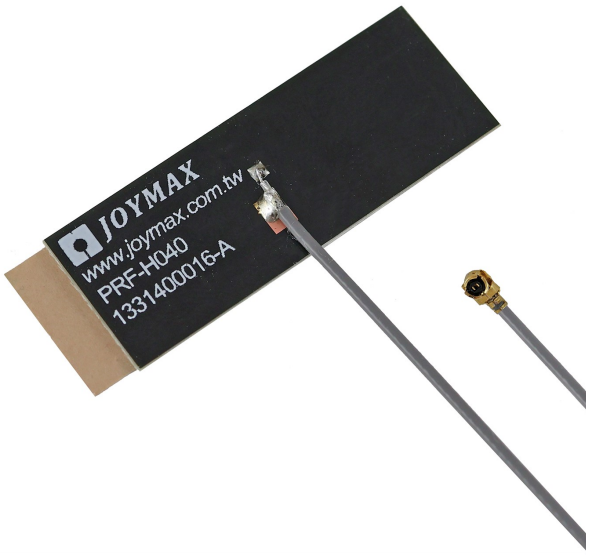
PRF-H040cc4B

GNSS L1 L2 L5 Adhesive PCB antenna

The Joymax PRF-H040cc4B series antenna is an adhesive-mount, print circuit board (PCB) dipole antenna designed for use in 1176.45 MHz, 1227.6 MHz and 1559 to 1608 MHz frequency bands supporting Global Navigation Satellite System (GNSS) including GPS (L1, L2, L5), GALILEO (E1, E5a, E5b), GLONASS (G1, G3), BeiDou/Compass (B1, B1C, B2a, B2b), QZSS (L1, L2, L5) and IRNSS (NavIC) for Navigation, Location, Timing applications.

The PCB antenna provides an internal/embedded antenna solution to easily mount in RF transparent (e.g. plastic) enclosures, enabling environmental sealing and for protection from antenna damage. Connection is made to the radio via a coaxial cable terminated in an MHF plug connector.



Features

- Bandwidth 1176 MHz, 1227 MHz, 1575 MHz
- Performance at 1176.45 MHz (L5, NavIC)
  - VSWR: ≤ 1.9
  - Peak Gain: 0.6 dBi
  - Efficiency: 38%
- Omnidirectional radiation
- Adhesive backing permanently adheres to non-metallic enclosure/chassis using 3M 467MP

Applications

- Global Navigation Satellite System (GNSS)
  - GPS (L1, L2, L5)
  - GALILEO (E1, E5a)
  - GLONASS (G1)
  - BeiDou/Compass (B1, B1C, B2a)
  - IRNSS/NavIC (L5)
  - QZSS (L1, L2, L5)
- Navigation, Timing, Location

Ordering Information

Part Number	Cable Diameter	Cable Length	Connector
PRF-H040MP4B-W006	1.13 mm	60 mm	U.FL-Type / MHF1 Plug
PRF-H040MP4B-W012	1.13 mm	120 mm	U.FL-Type / MHF1 Plug
PRF-H040MP4B-W018	1.13 mm	180 mm	U.FL-Type / MHF1 Plug
PRF-H040MF4B-W006	1.13 mm	60 mm	MHF4 Plug
PRF-H040MF4B-W012	1.13 mm	120 mm	MHF4 Plug
PRF-H040MF4B-W018	1.13 mm	180 mm	MHF4 Plug

Available from Joymax Inc. and select distributors and representatives.

Table 1: Electrical Specifications

PRF-H040cc4B	GNSS L1, L2, L5 Band (MHz)				
Frequency Range	1176.45 (L5)	1227.6 (L2)	1561 (B1)	1575.42 (L1)	1602 (G1)
VSWR (Max)	1.9	2.3	1.6	1.4	1.9
Peak Gain (dBi)	0.6	0.7	1.0	1.3	1.1
Average Gain (dBi)	-4.3	-4.1	-4.2	-4.0	-4.1
Efficiency (%)	38	39	38	40	39
Polarization	Linear				
Radiation	Omni directional				
Max Power	1 W				
Wavelength	½-λ				
Electrical Type	Dipole				
Impedance	50 Ω				

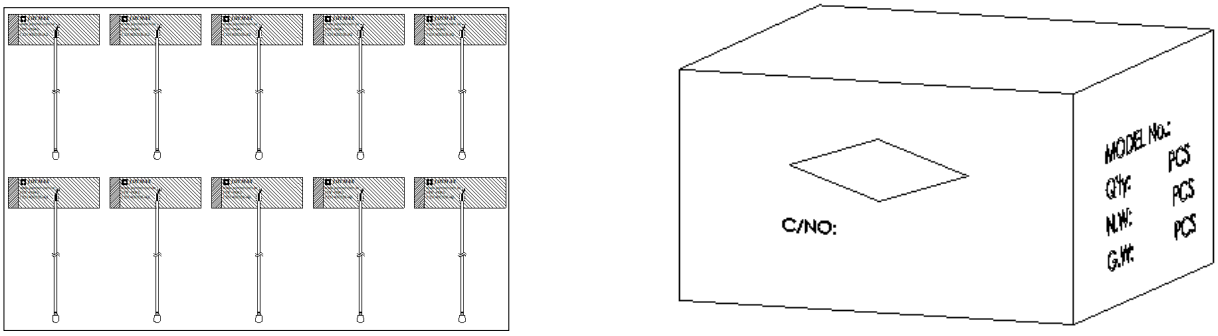
Electrical specifications and plots measured with the antenna adhere to an 150 mm x 150 mm non-conductive plate.

Table 2: Mechanical Specifications

Parameter	Value
Connection	U.FL-type / MHF Plug (female socket)
Operating Temp.	-40˚C to +85˚C
Weight	1.54 g (0.05 oz) – 120 mm cable
Dimension	40.0 mm x 15.0 mm x 0.8 mm
Antenna Color	Black
Ingress Protection	N/A
Adhesive Backing	3M 467MP™

Packaging Information

The PRF-H040cc4B are bulk packaged into a clear plastic bag of 100 pcs as shown in **Figure 1**. 2000 pcs per carton, 330 mm x 180 mm x 130 mm (13.0 in x 7.1 in x 5.1 in) with total weight 3.9 kgs (8.6 lb). Distribution channels may offer alternative packaging options.



100 pcs antenna / 1 PE Bag 2000 pcs antenna /1 Carton

Figure 1. Antenna Packaging

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GNSS Constellations and Frequency Bands

As of 2025, there are 4 Global Navigation Satellite System (GNSS) in operation as shown in **Figure 2**. United States' GPS (Global Positioning System), European Union's Galileo system, Russia's Glonass and China's BeiDou/Compass system. Satellite-Based Augmentation System (SBAS) are designed to enhance the accuracy of GPS, including Japan's QZSS (Quasi-Zenith Satellite System), India's GAGAN and European EGNOS. IRNSS (Indian Regional Navigation Satellite System) operationally also known as NavIC is a stand alone Regional Navigation Satellite System (RNSS).

GNSS Frequency Bands										
GPS	L1 ✓ 1575.42 MHz		L2 ✓ 1227.6 MHz		L5 ✓ 1176.45 MHz					
Galileo	E1 ✓ 1575.42 MHz		E5a ✓ 1176.45 MHz		E5b ✓ 1207.14 MHz		E6 1278.75 MHz			
Glonass	G1 ✓ 1602 MHz		G2 1246 MHz		G3 ✓ 1202 MHz					
BeiDou (Compass)	B1 ✓ 1561 MHz		B1C ✓ 1575.42 MHz		B2a ✓ 1176.45 MHz		B2b ✓ 1207.14 MHz		B3 1268.52 MHz	
QZSS	L1 ✓ 1575.42 MHz		L2 ✓ 1227.6 MHz		L5 ✓ 1176.45 MHz		L6 1278.75 MHz			
SBAS	L1/E1/B1C ✓ 1575.42 MHz		L5/E5a/B2a ✓ 1176.45 MHz		G1 ✓ 1602 MHz		G2 1246 MHz		G3 ✓ 1202 MHz	
IRNSS (NavIC)	L5 ✓ 1176.45 MHz									

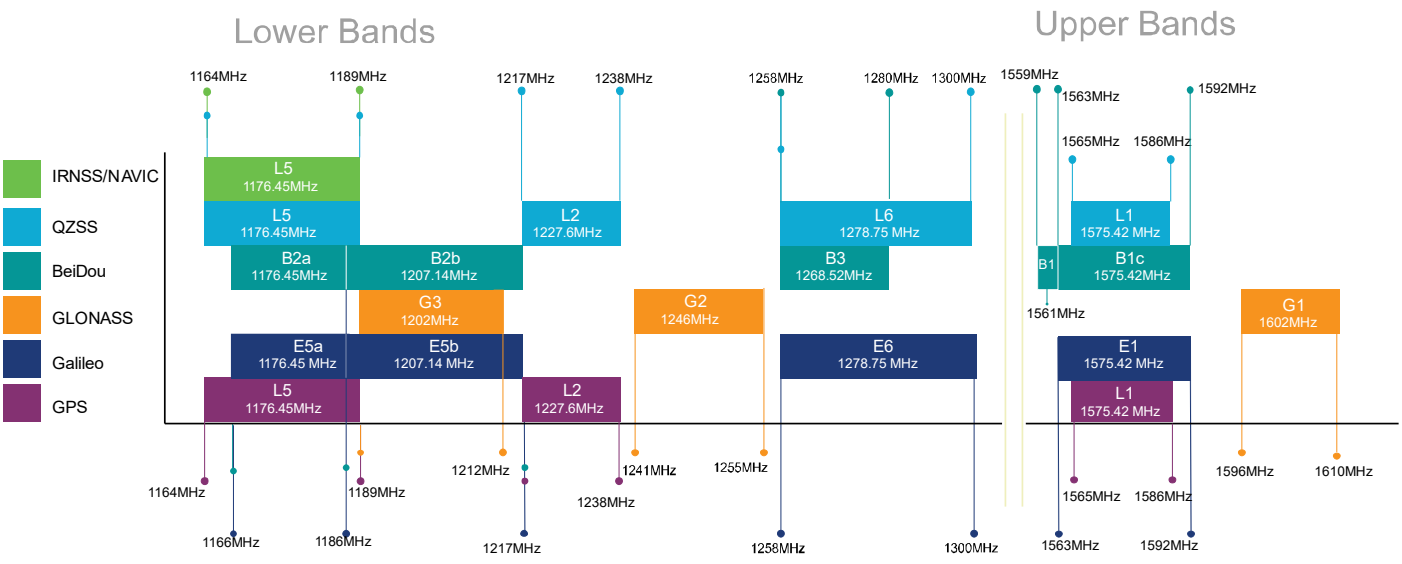

Figure 2. GNSS Frequency Bands

Product Dimensions

Figure 3 provides dimensions of the PRF-H040cc4B in mm measurement unit. The adhesive backing is 3M 467MP™, which provides outstanding adhesion to high surface energy plastics.

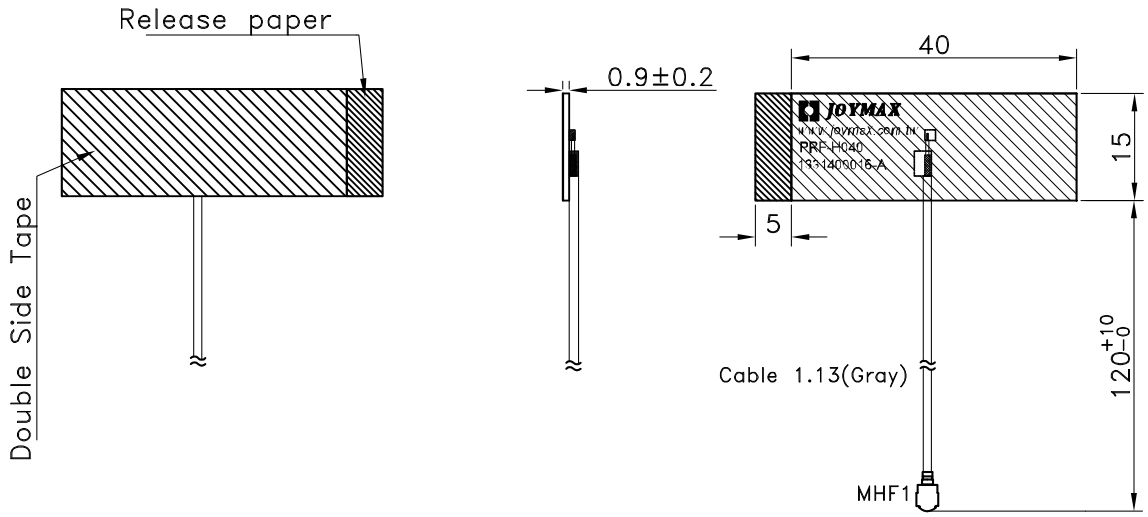

Figure 3. Antenna Dimensions

Antenna Installation

The PRF-H040cc4B antenna is designed for chassis-mount installation as shown in **Figure 4**. The integration of inner mount allows the antenna to be less affected from external pressure and intensive wavering, guaranteeing the state-of-art performance through inner side enclosure installation. The antenna should never be bent to the point of creating a crease or allowing the angle of the bend to fall below 90 degrees (i.e. become acute) as this will impair function and may cause permanent damage.

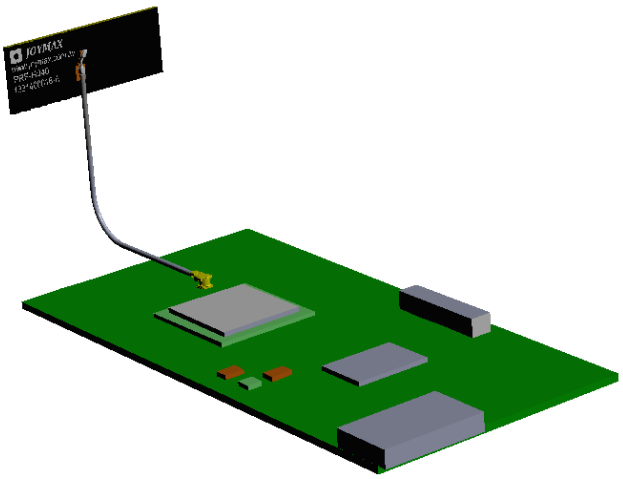

Figure 4. Antenna Installation

Antenna Test Setup: CHASSIS MOUNT, GROUND PLANE INDEPENDENT

The charts on the following pages represent data taken with the antenna adhere to a 150 mm x 150 mm non-conductive plate as shown in **Figure 5**. Connection is made to the radio via a 120 mm long coaxial cable terminated in an U.FL-type / MHF plug (female socket) connector.

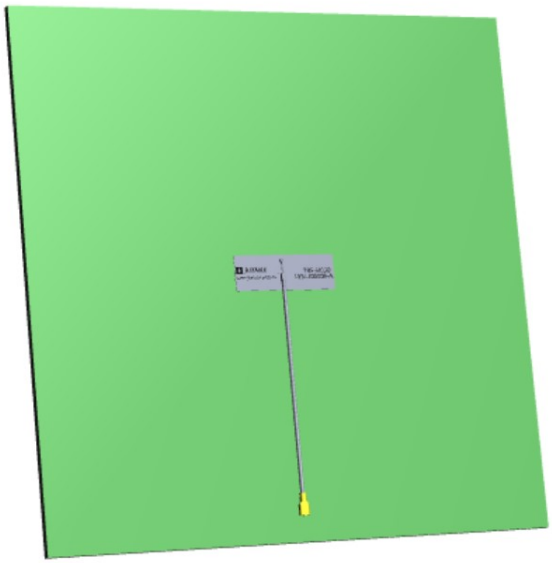

Figure 5. Chassis mount, adhere to 150 mm x 150 mm non-conductive plate

VSWR

Figure 6 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.

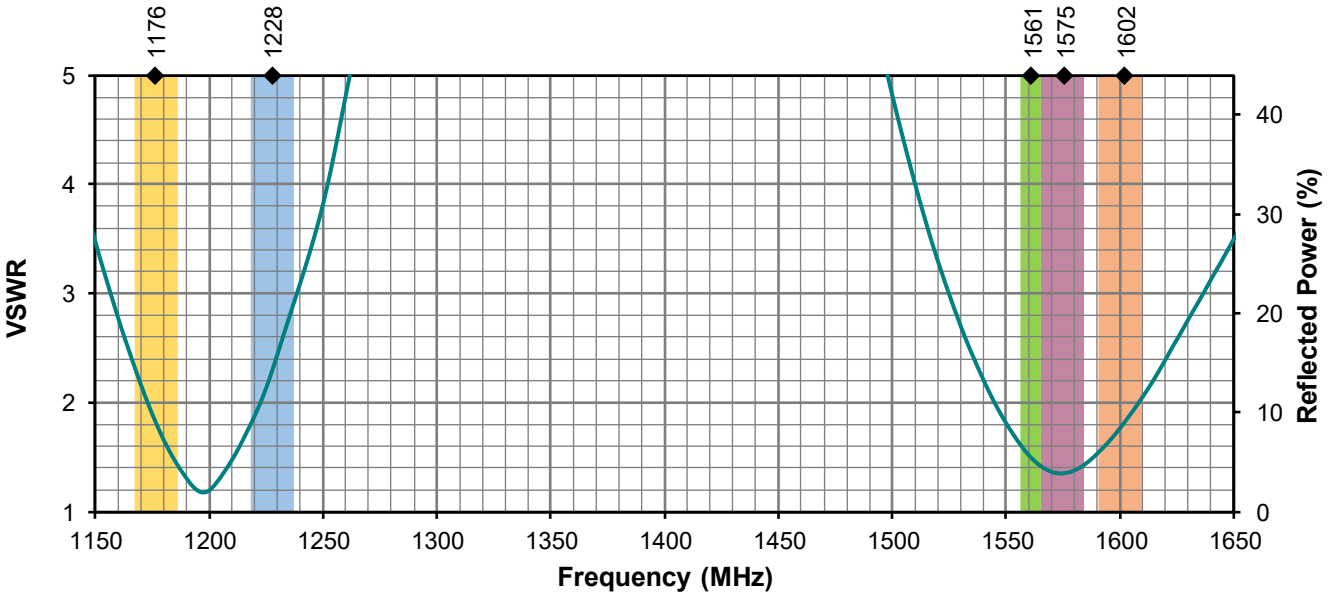

Figure 6. Antenna VSWR

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Return Loss

Return loss (**Figure 7**), 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.

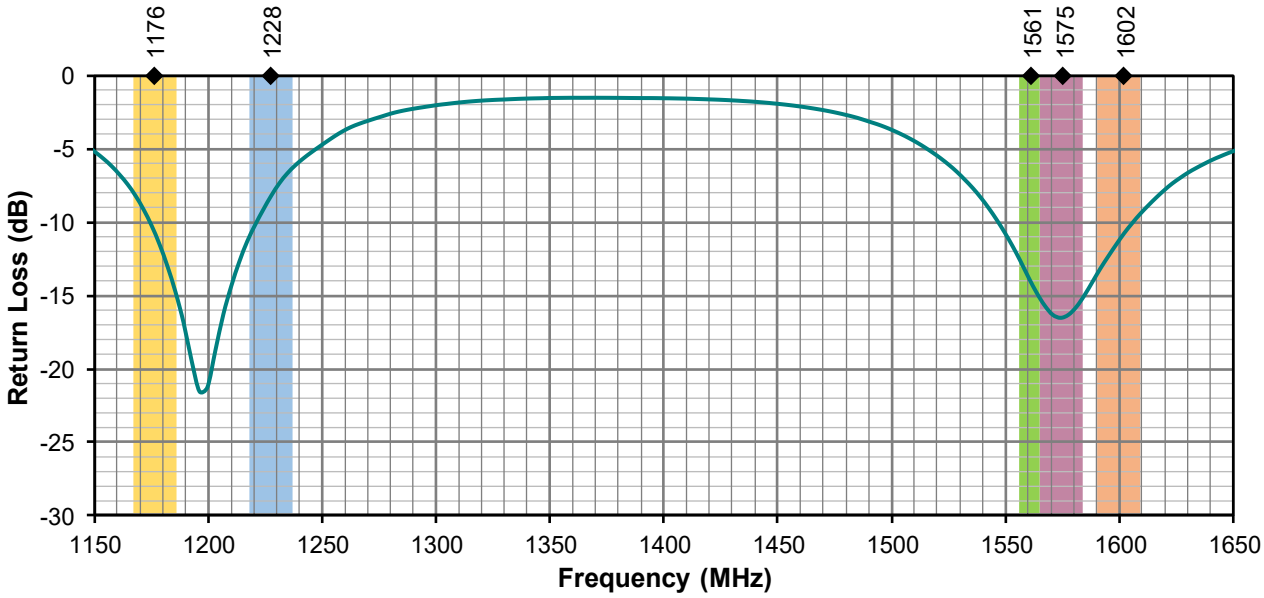


Figure 7. Antenna Return Loss

Peak Gain

The peak gain across the antenna bandwidth is shown in **Figure 8**. 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.

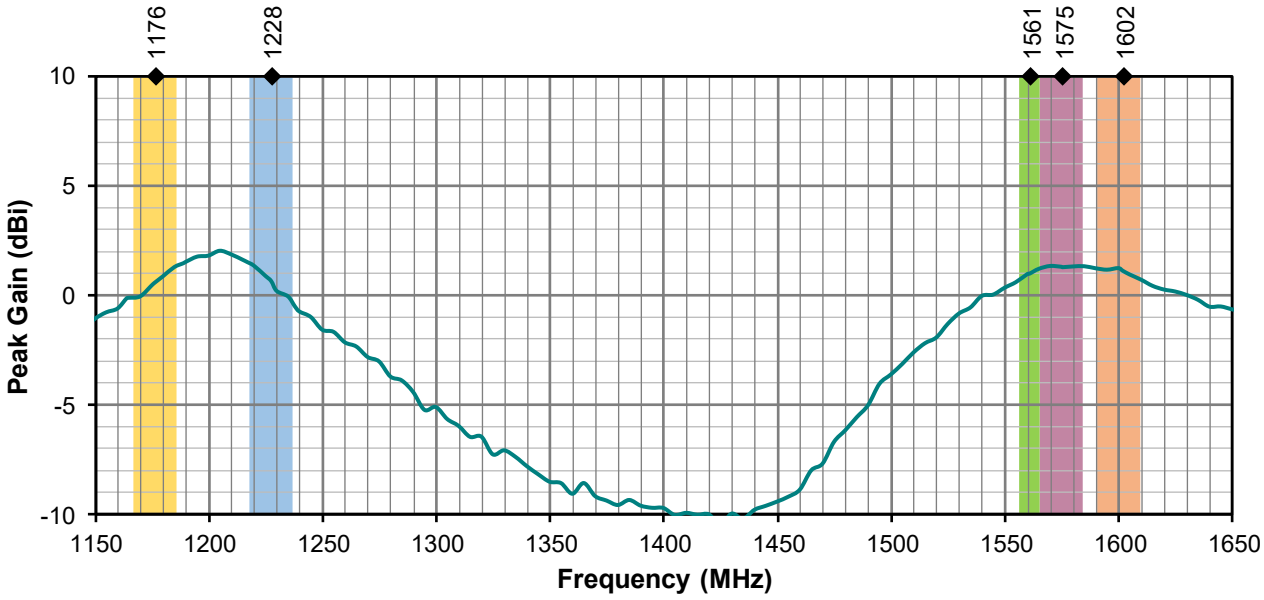


Figure 8. Antenna Peak Gain

Average Gain

Average gain (**Figure 9**), is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

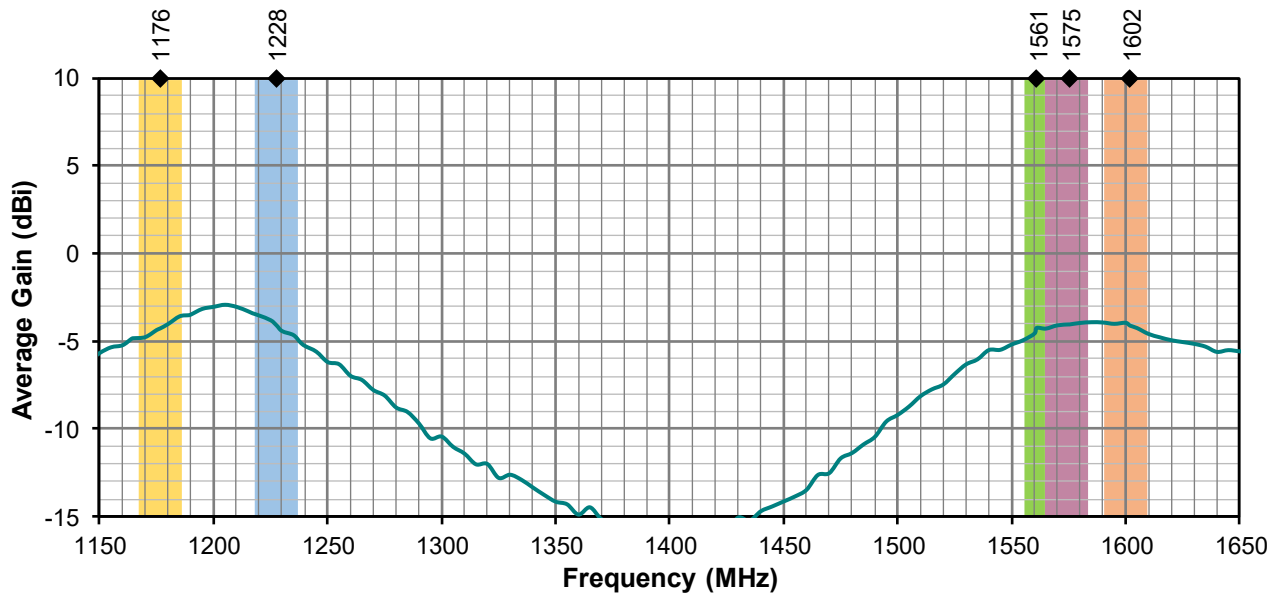


Figure 9. Antenna Average Gain

Radiation Efficiency

Radiation efficiency (**Figure 10**), 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.

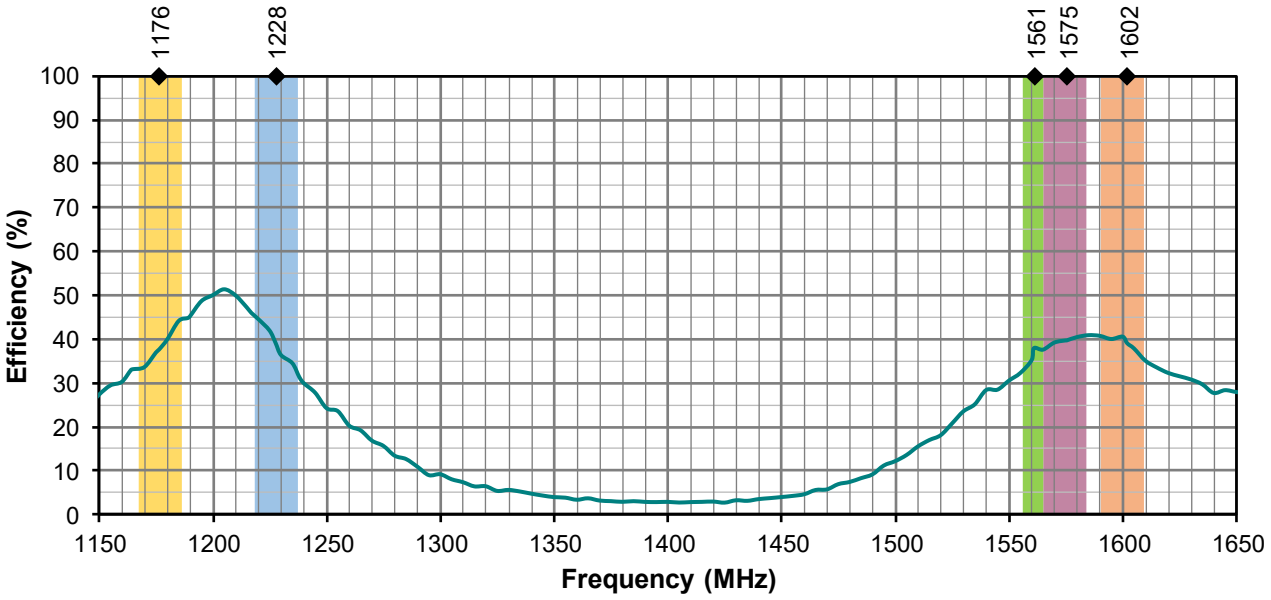
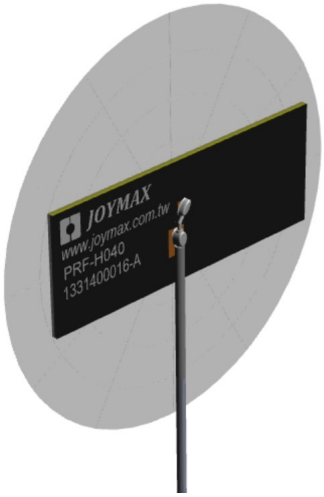


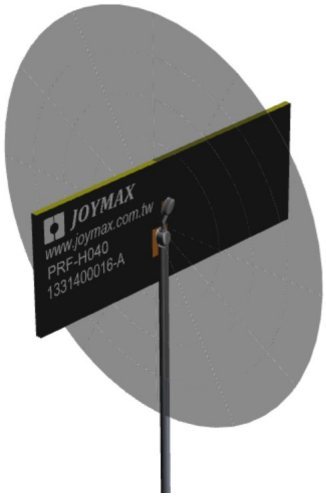
Figure 10. Antenna Efficiency

Radiation Patterns

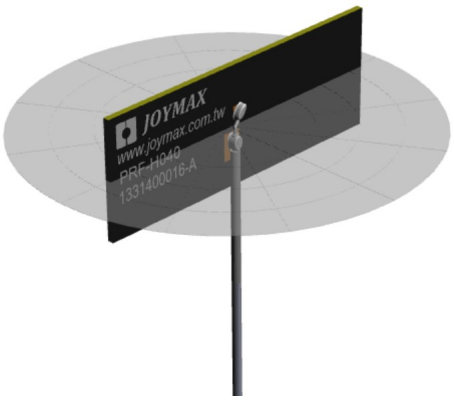
Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. Antenna radiation patterns are shown in **Figure 11** using polar plots covering 360 degrees. The antenna graphic at the top of the page provides reference to the plane of the column of plots below it.



XZ-Plane Gain

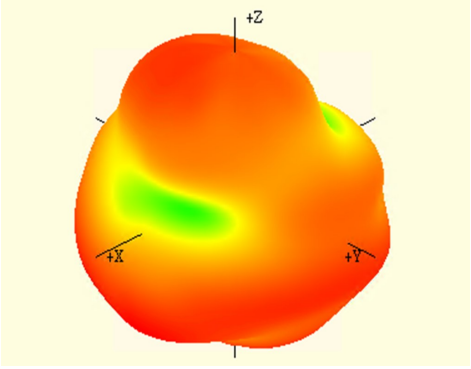


YZ-Plane Gain

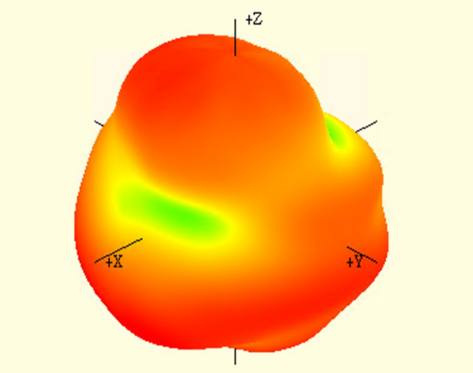


XY-Plane Gain

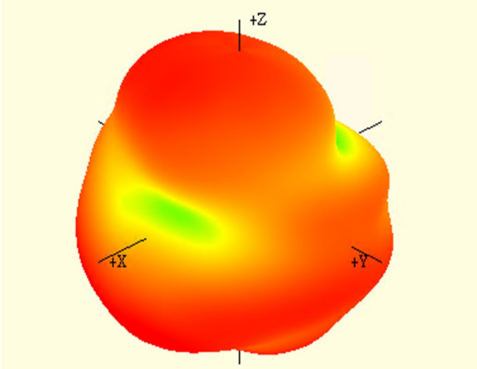
L5: 1164 MHz to 1189 MHz (1176.45 MHz)



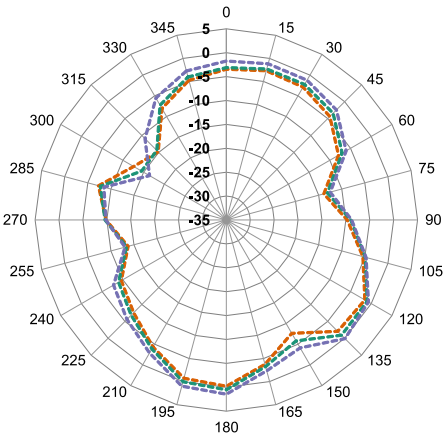
1164 MHz



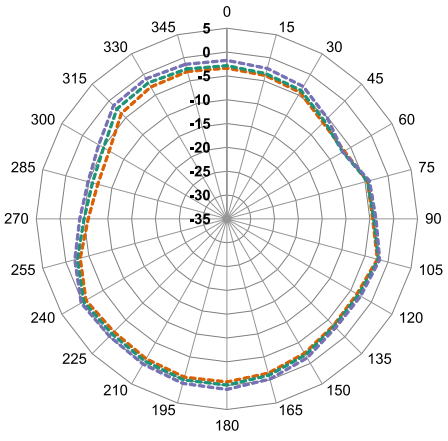
1176.45 MHz



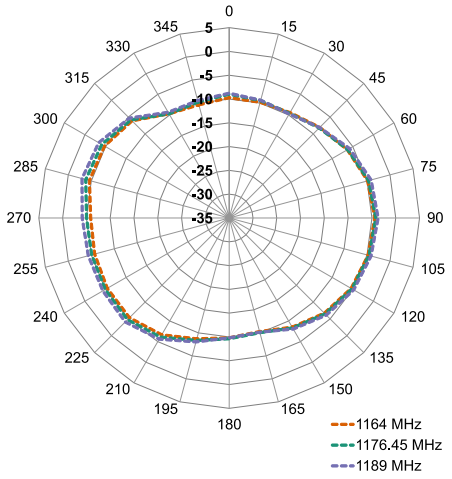
1189 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

Figure 11. Antenna Radiation Patterns

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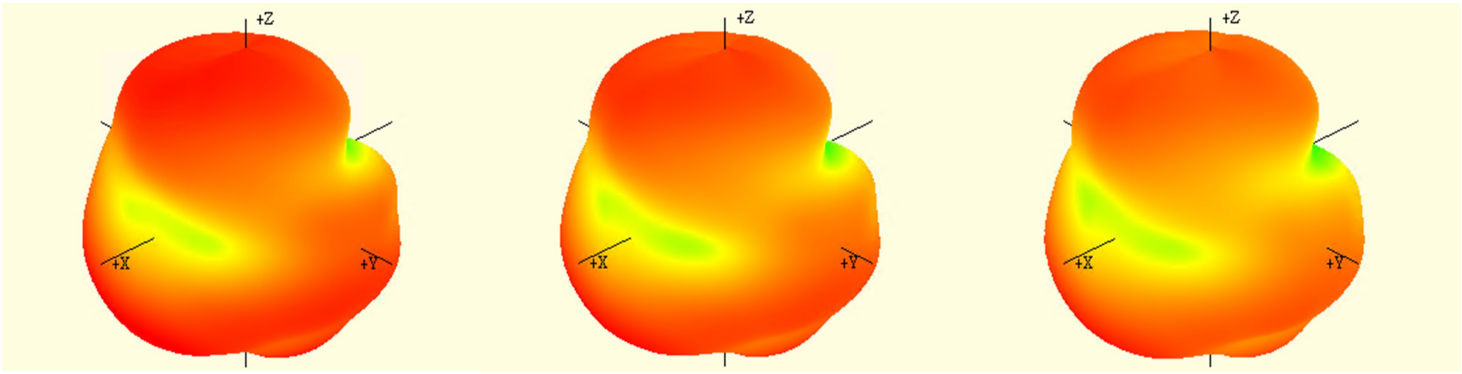
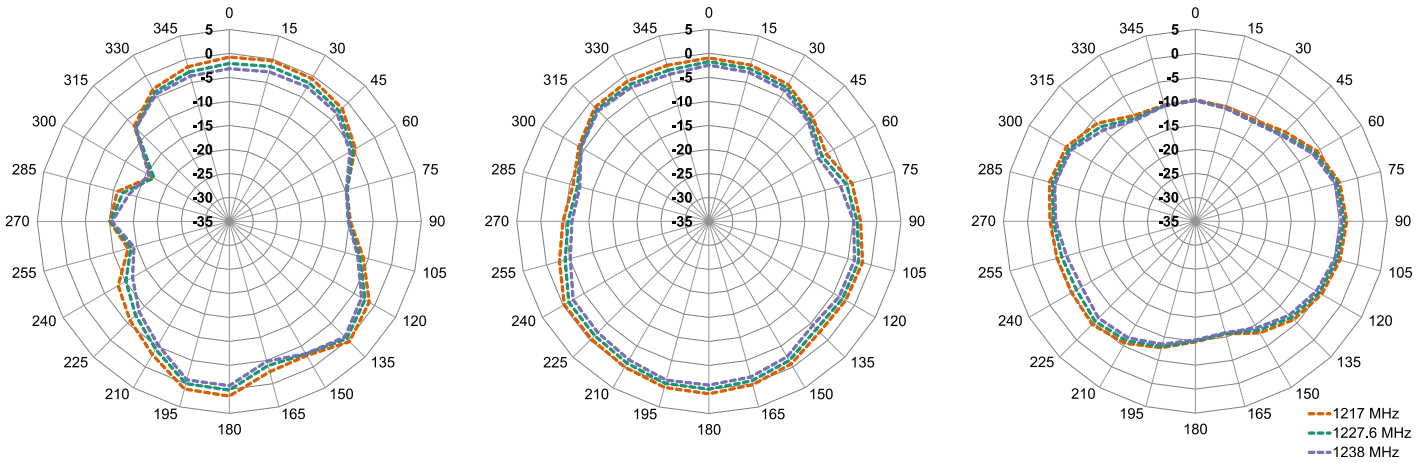
L2: 1217 MHz to 1238 MHz (1227.6 MHz)

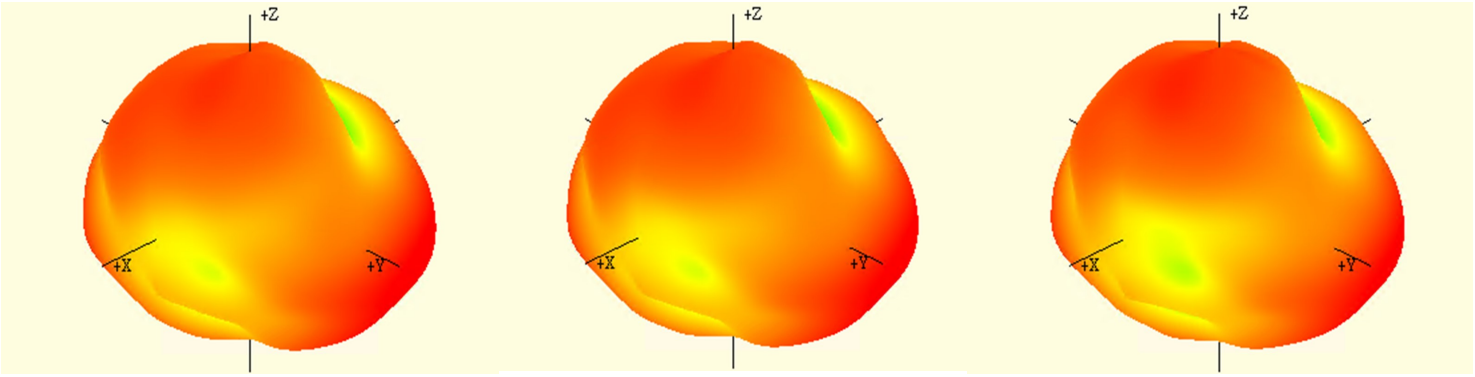


1217 MHz | 1227.6 MHz | 1238 MHz

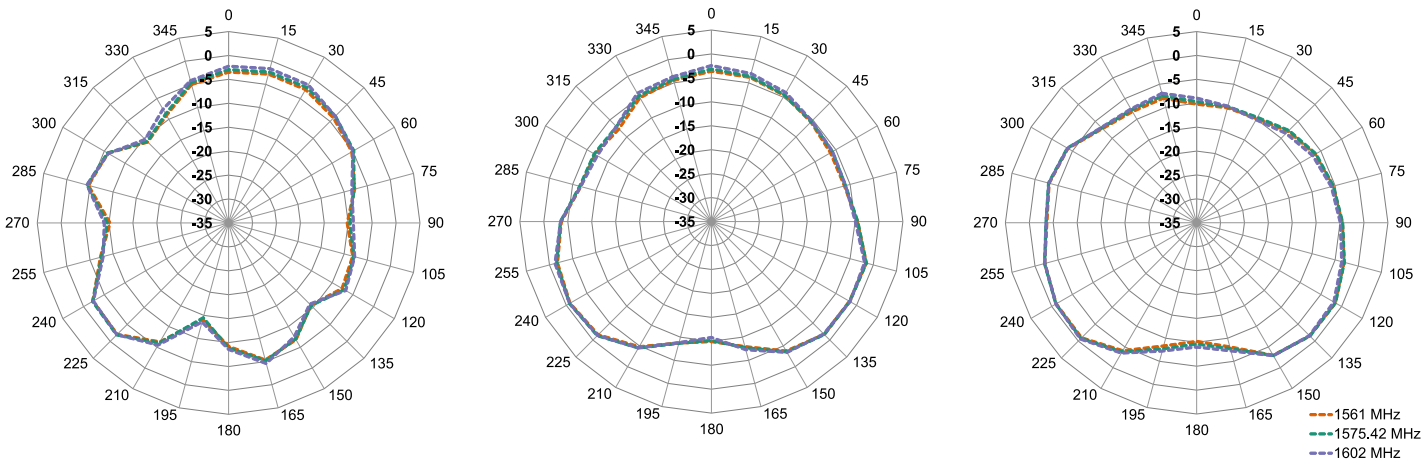


XZ-Plane Gain | YZ-Plane Gain | XY-Plane Gain

L1: 1561 MHz to 1602 MHz (1575.42 MHz)



1561 MHz | 1575.42 MHz | 1602 MHz



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

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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.

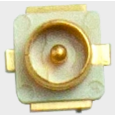
Q: Why is most antenna impedance 50 Ohm?

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.

MATING COMPONENTS: RF COAXIAL CONNECTOR

Part Number	Image	Connector 1 (Receptacle)	Connector 2 (Plug)	Cable Length		Cable Diameter (mm)
				mm	Inch	
CT-MFB01X		MHF4L Jack Male pin Straight	N/A	N/A	N/A	N/A
CT-MPB01X		MHF1 Jack Male pin Straight	N/A	N/A	N/A	N/A
ZX-012CP-00M						0.81
ZX-012CP-01M						1.37
ZX-003CP-00M						1.13

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