Datasheet

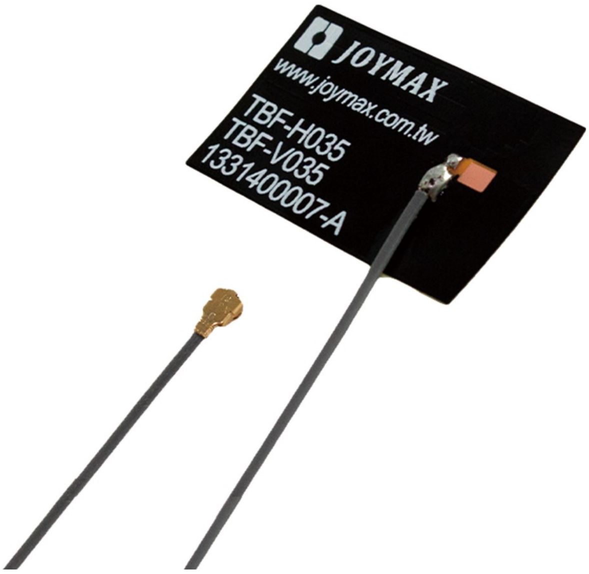
JOYMAX
EnJOY MAX Wireless®

TBF-H035cc3B

WiFi 7/6E Adhesive FPC antenna

The Joymax TBF-H035cc3B series antennas are adhesive-mount, flexible print circuit (FPC) board dipole antennas designed for use in 2.4 GHz, 5 GHz, 6 GHz bands supporting WiFi 7, WiFi 6E, and WiFi 6 applications.

The dipole antennas provide a ground plane independent 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 U.FL-type / MHF plug (female socket) connector.



Features

- Broad bandwidth 2.4 GHz to 7.125 GHz
- Performance at 2400 MHz to 2500 MHz
  - VSWR: ≤ 2.2
  - Peak Gain: 2.4 dBi
  - Efficiency: 60%
- Performance at 5150 MHz to 7125 MHz
  - VSWR: ≤ 2.7
  - Peak Gain: 7.1 dBi
  - Efficiency: 65%
- Ground plane independence dipole design
- Adhesive backing permanently adheres to non-metallic enclosure/chassis using 3M 467MP

Applications

- WiFi/WLAN applications:
  - WiFi 7 (802.11be)
  - WiFi 6E (802.11ax)
  - WiFi 6 (802.11ax)
  - WiFi 5 (802.11ac)
  - WiFi 4 (802.11n)
- 2.4 GHz ISM applications:
  - Bluetooth®
  - ZigBee®
  - Thread®
  - IEEE 802.15.4
  - IEEE 802.11b/g
- Internet of Things (IoT) devices

Ordering Information

Part Number	Cable Diameter	Cable Length	Connector
TBF-H035MP3B-W006	1.13 mm	60 mm	U.FL-Type / MHF1 Plug
TBF-H035MP3B-W012	1.13 mm	120 mm	U.FL-Type / MHF1 Plug
TBF-H035MP3B-W018	1.13 mm	180 mm	U.FL-Type / MHF1 Plug
TBF-H035MF3B-W006	1.13 mm	60 mm	MHF4 Plug
TBF-H035MF3B-W012	1.13 mm	120 mm	MHF4 Plug
TBF-H035MF3B-W018	1.13 mm	180 mm	MHF4 Plug

Available from Joymax Electronics and select distributors and representatives.

Table 1: Electrical Specifications

TBF-H035cc3B	WiFi / WLAN Band (MHz)		
Frequency Range	2400~2500	5150~5850	5925~7125
VSWR (Max)	2.2	2.1	2.7
Peak Gain (dBi)	2.4	4.4	7.1
Average Gain (dBi)	-2.2	-1.5	-2.1
Efficiency (%)	60	71	62
Polarization	Linear		
Radiation	Omni directional		
Max Power	1 W		
Wavelength	½-λ		
Electrical Type	Dipole		
Impedance	50 Ω		

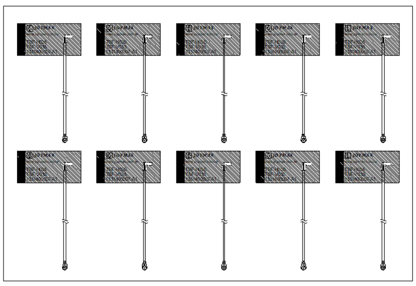
Electrical specifications and plots measured with the antenna adhere to an non-conductive plate with 120mm long coaxial cable.

Table 2: Mechanical Specifications

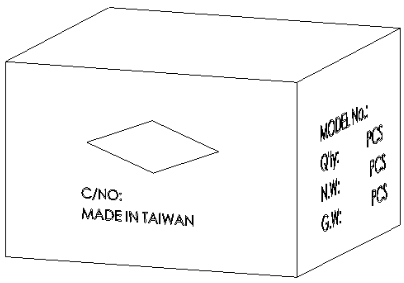
Parameter	Value
Connection	U.FL-type / MHF Plug (female socket)
Operating Temp.	-40˚C to +85˚C
Weight	60 mm cable—0.48 g; 120 mm cable—0.66 g; 180 mm cable—0.78 g
Dimension	35.0 mm x 20.0 mm x 0.25 mm
Antenna Color	Black
Ingress Protection	N/A

Packaging Information

The TBF-H035cc3B antennas are bulk packaged into a clear plastic bag of 50 pcs. **Figure 1**. 2000 pcs per carton, 330 mm x 180 mm x 180 mm (13.0 in x 7.9 in x 7.9 in), total weight 2.3 kgs (5.1 lb) Distribution channels may offer alternative packaging options.



50 pcs antennas/1 PE Bag



2000 pcs antenna/1 Carton

Figure 1. Antenna Packaging

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Product Dimensions

Figure 2 provides dimensions of the TBF-H035cc3B in mm measurement unit. The adhesive backing is 3M 467MP™, which provides outstanding adhesion to high surface energy plastics.

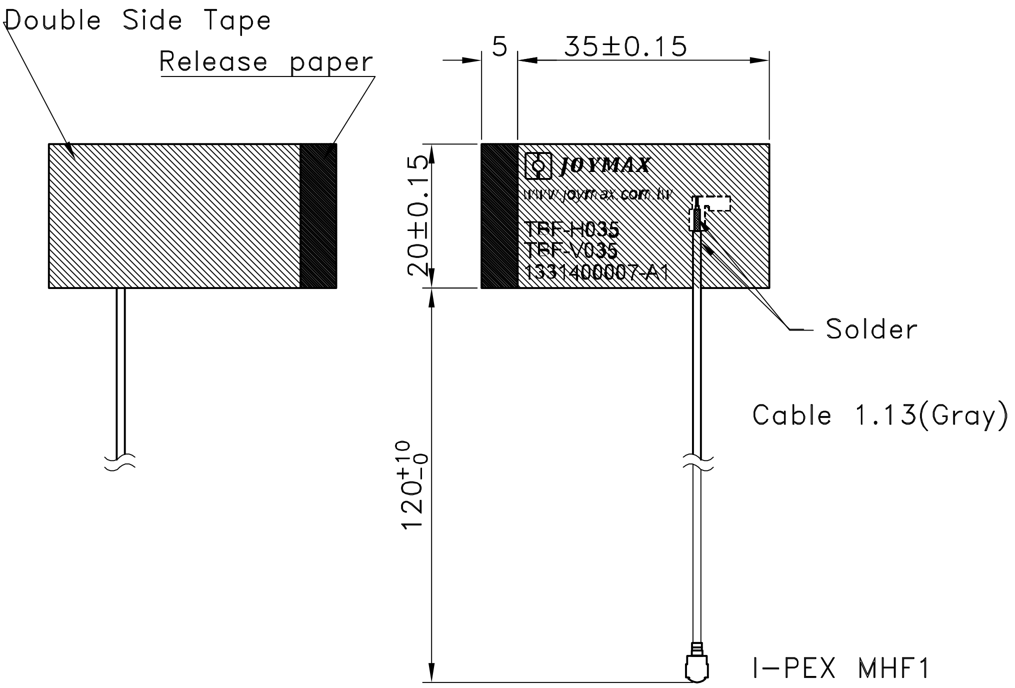


Figure 2. Antenna Dimensions

Antenna Installation

The TBF-H035cc3B antenna is designed for chassis-mount installation as shown in **Figure 3**. 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.

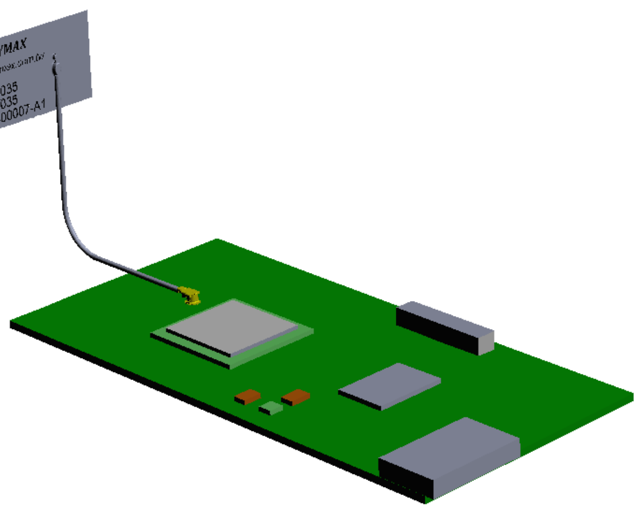


Figure 3. Antenna Installation

Antenna Test Orientation: 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 4**. Connection is made to the radio via a coaxial cable terminated in an U.FL-type / MHF plug (female socket) connector.

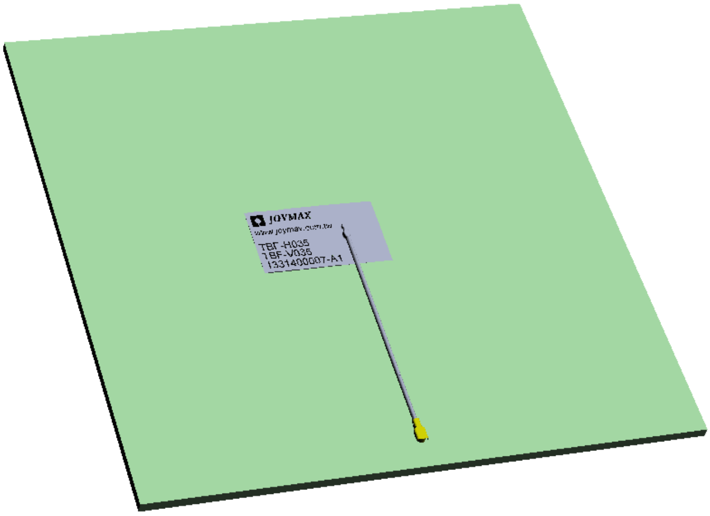


Figure 4. Chassis Mount, ground plane independent

VSWR

Figure 5 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.

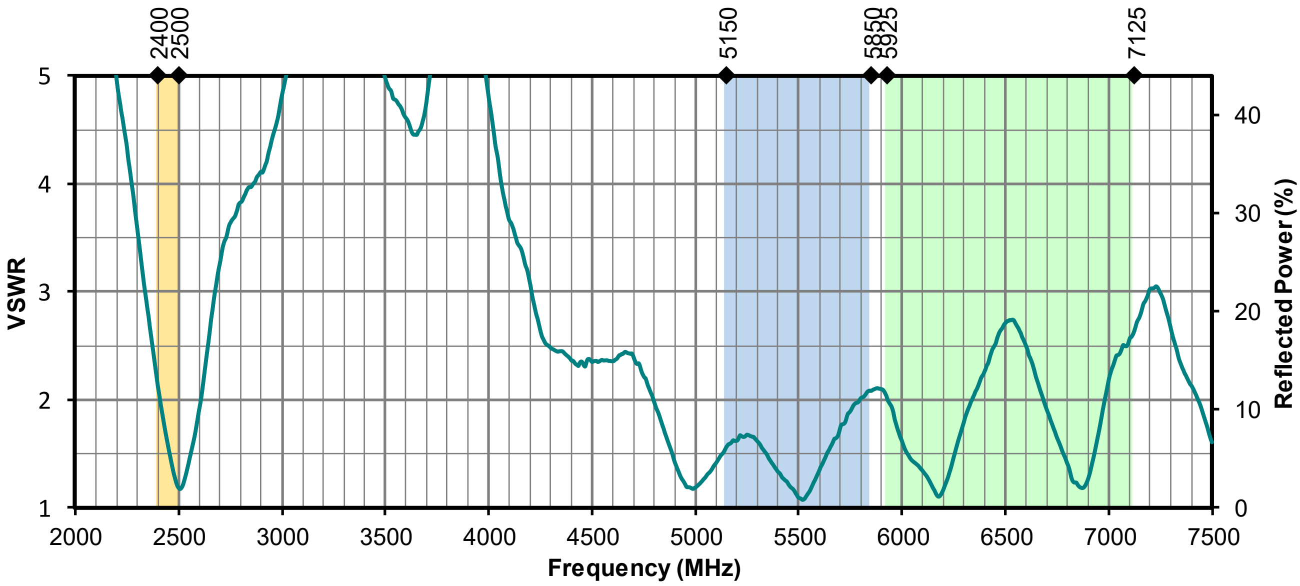


Figure 5. Antenna VSWR, No ground plane

Return Loss

Return loss (**Figure 6**), 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.

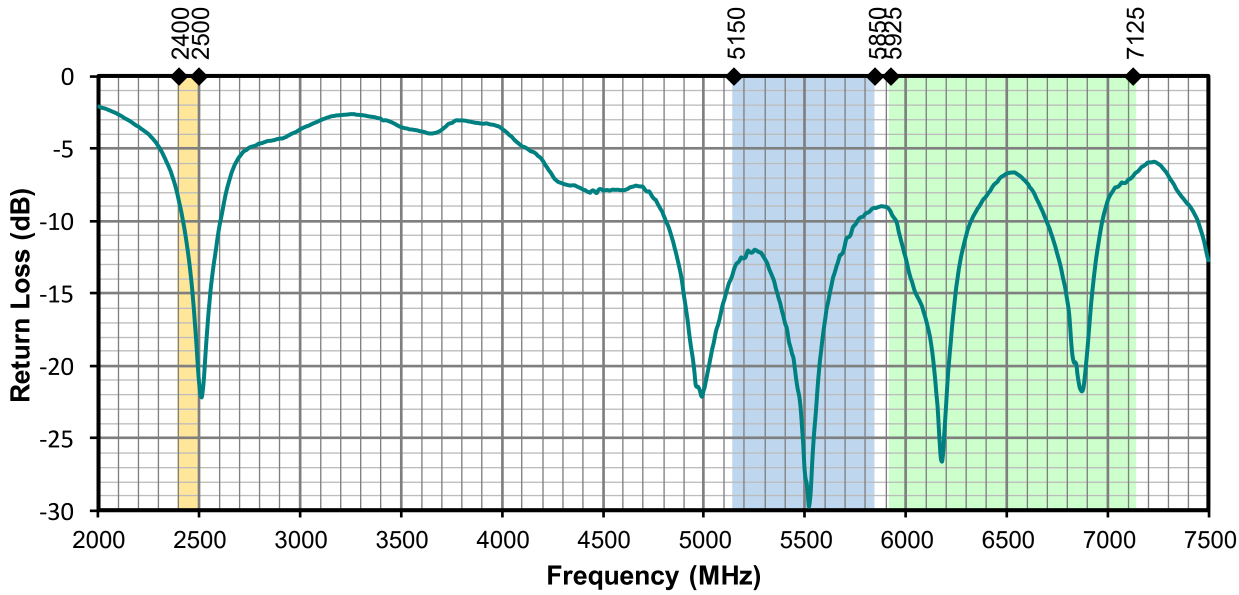


Figure 6. Antenna Return Loss, No ground plane

Peak Gain

The peak gain across the antenna bandwidth is shown in **Figure 7**. 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.

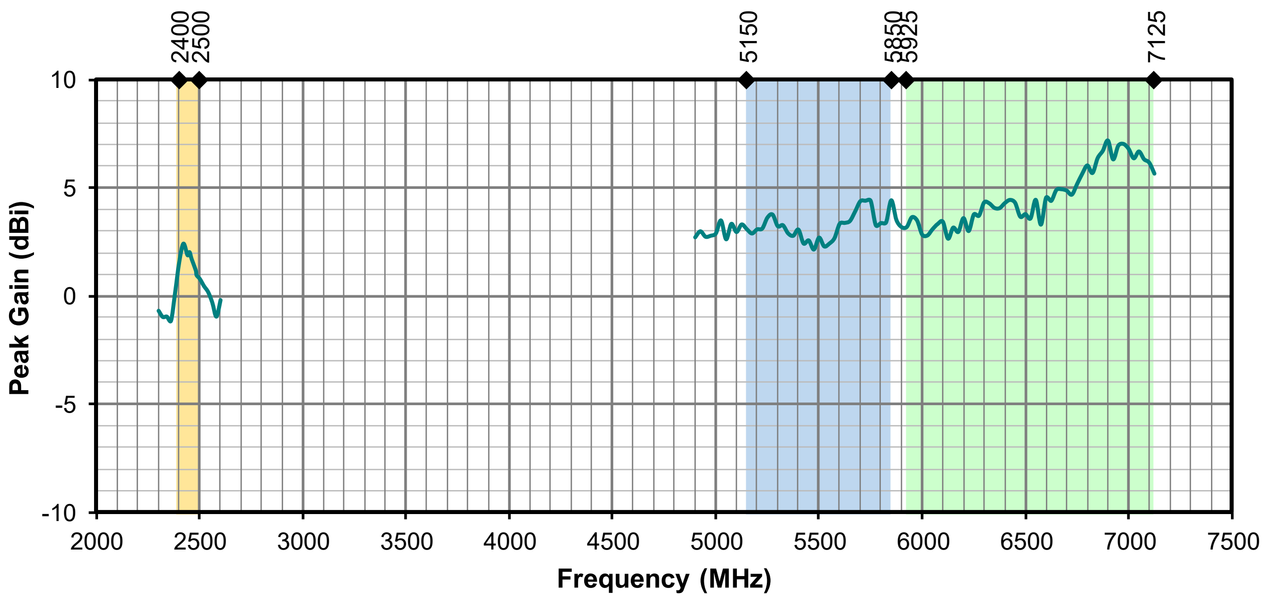


Figure 7. Antenna Peak Gain, No ground plane

Average Gain

Average gain (**Figure 8**), is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

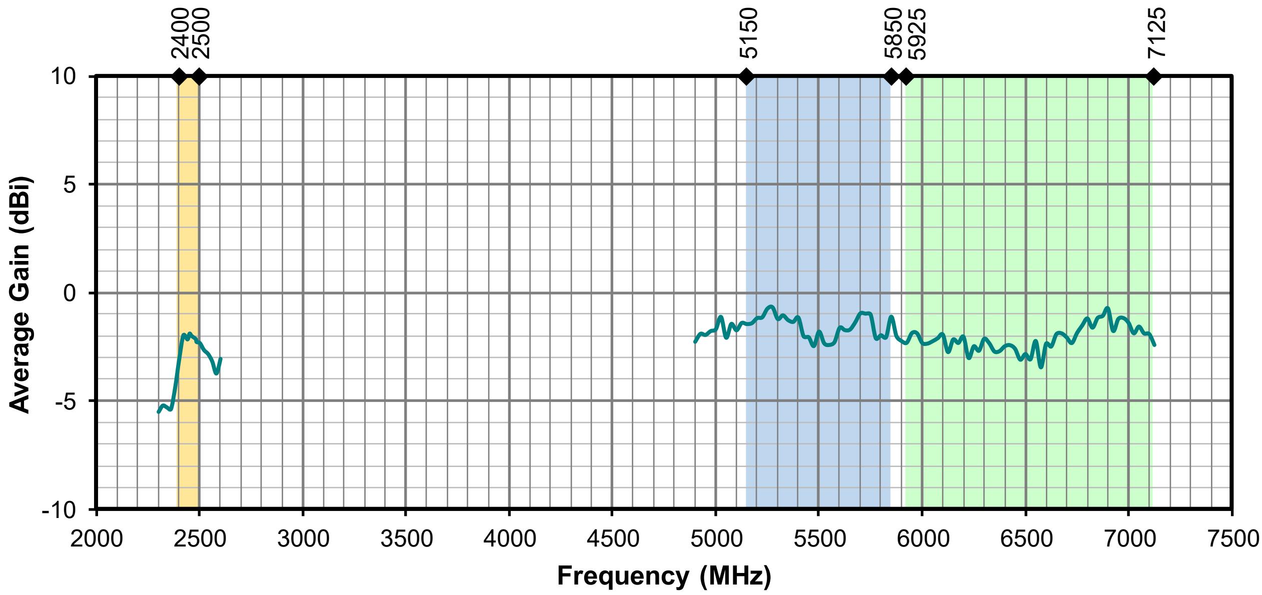


Figure 8. Antenna Average Gain, No ground plane

Radiation Efficiency

Radiation efficiency (**Figure 9**), 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.

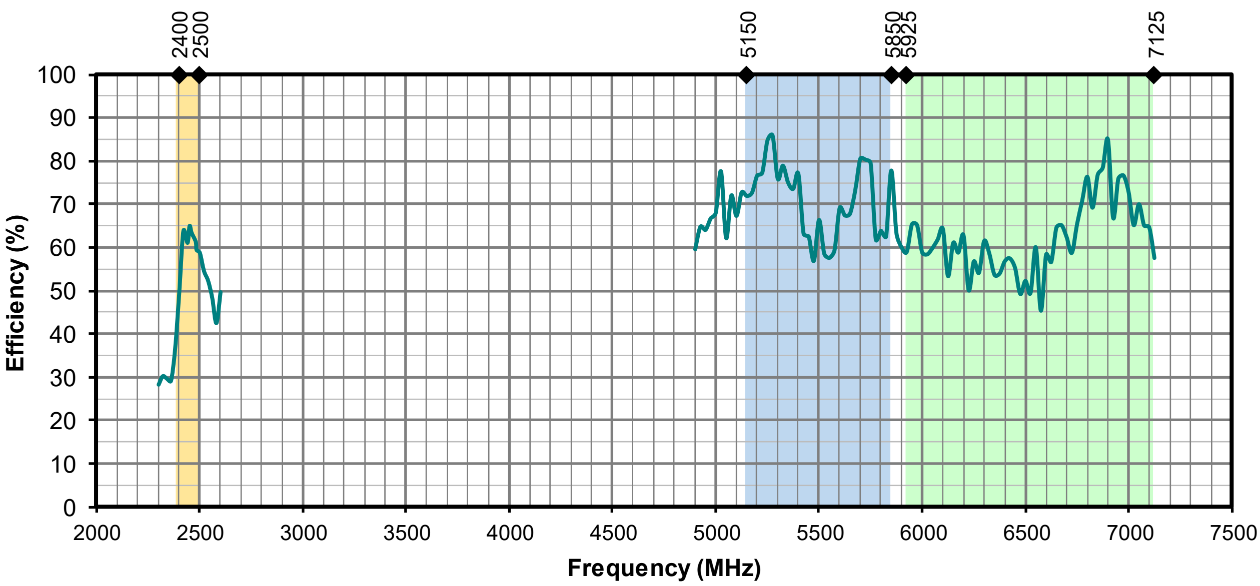
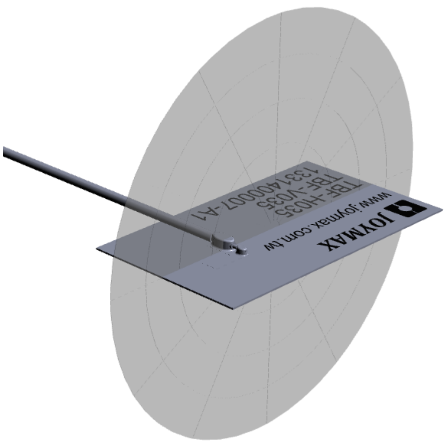


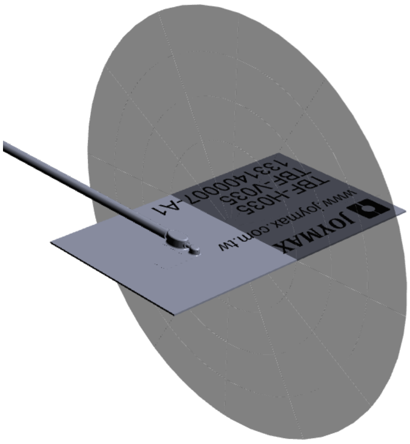
Figure 9. Antenna Efficiency, No ground plane

Radiation Patterns

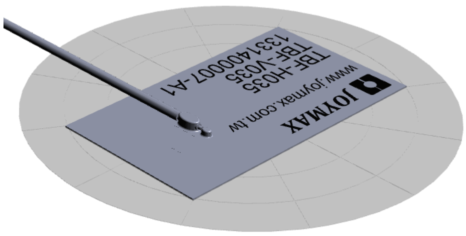
Radiation patterns provide information about the directionality and 3-dimensional gain performance of the antenna by plotting gain at specific frequencies in three orthogonal planes. Antenna radiation patterns for a straight orientation are shown in **Figure 10** using polar plots covering 360 degrees. The antenna graphic at the top of the page provides reference to the plane of the column of plots below it.



XZ-Plane Gain

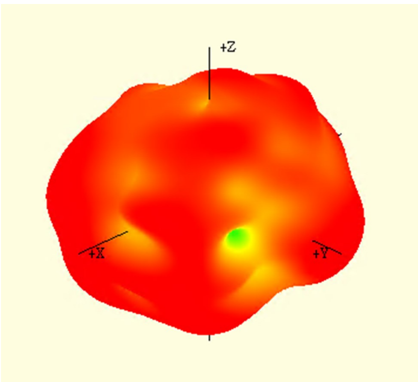


YZ-Plane Gain

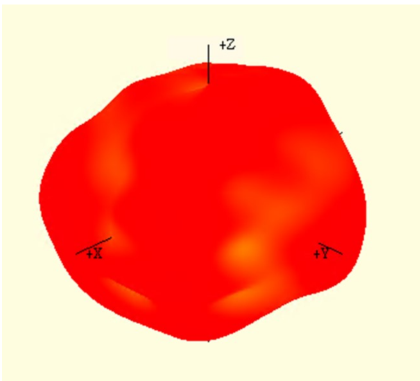


XY-Plane Gain

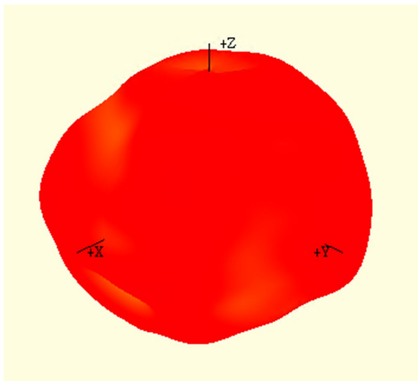
2400 MHz to 2500 MHz (2450 MHz)



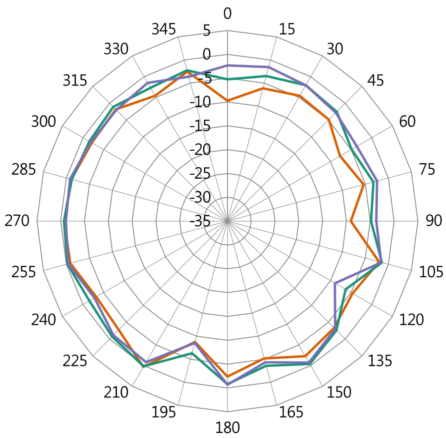
2400 MHz



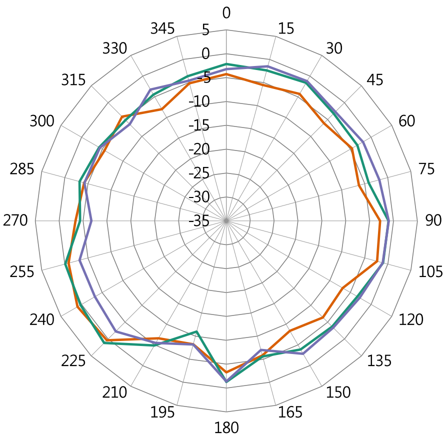
2450 MHz



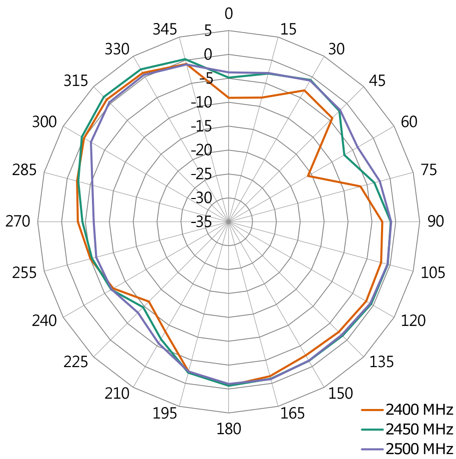
2500 MHz



XZ-Plane Gain



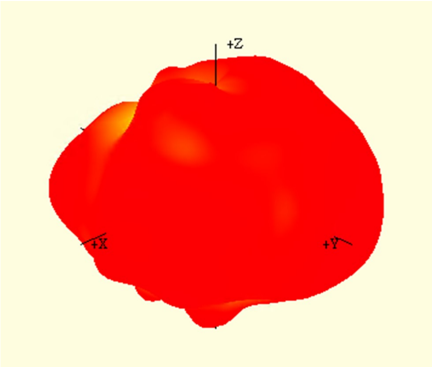
YZ-Plane Gain



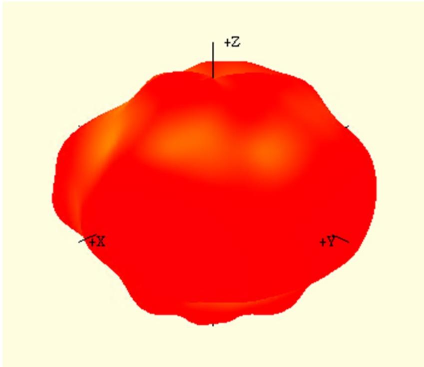
XY-Plane Gain

Figure 10. Antenna Radiation Patterns, No ground plane

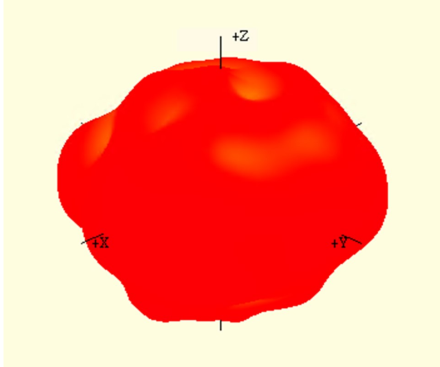
5150 MHz to 5850 MHz (5550 MHz)



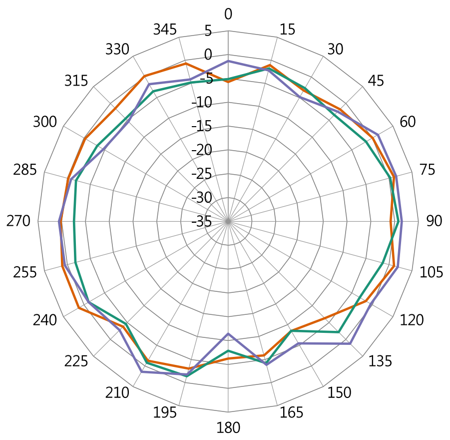
5150 MHz



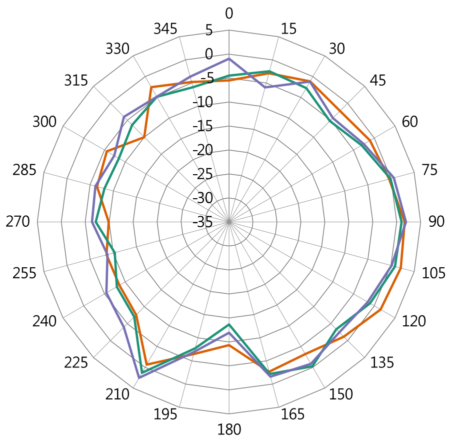
5550 MHz



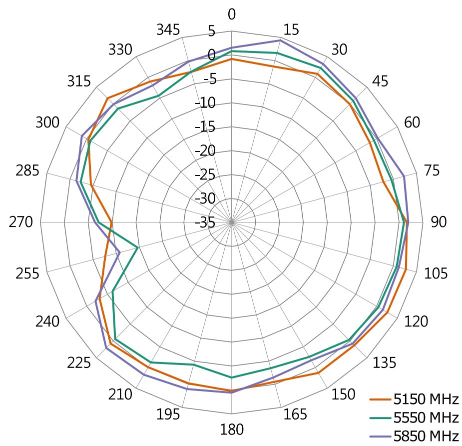
5850 MHz



XZ-Plane Gain

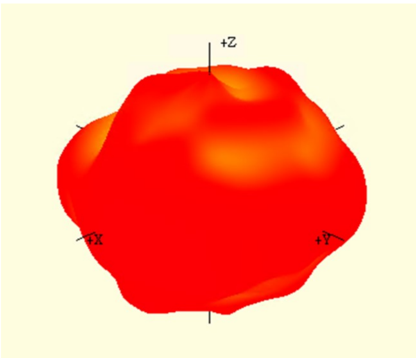


YZ-Plane Gain

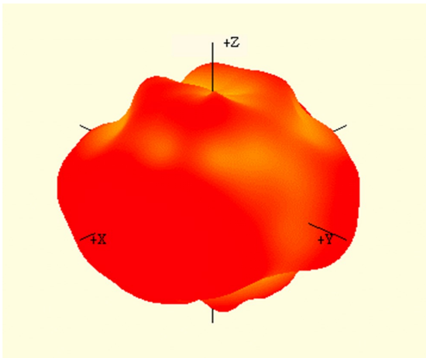


XY-Plane Gain

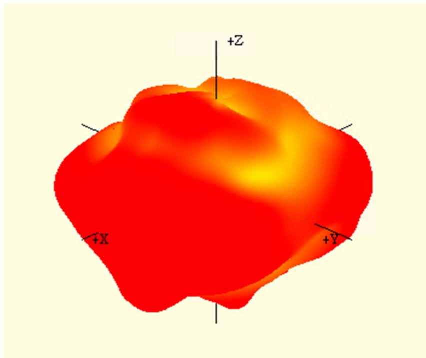
5925 MHz to 7125 MHz (6525 MHz)



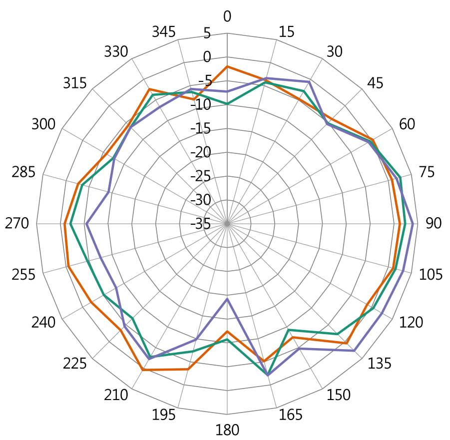
5925 MHz



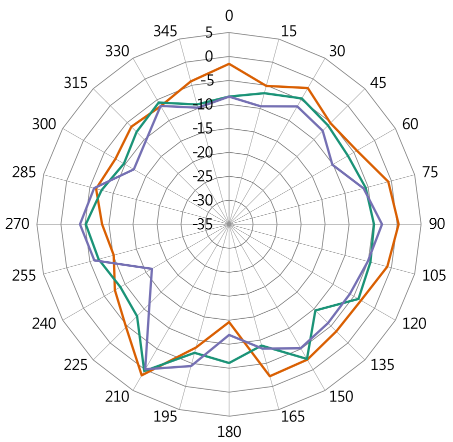
6525 MHz



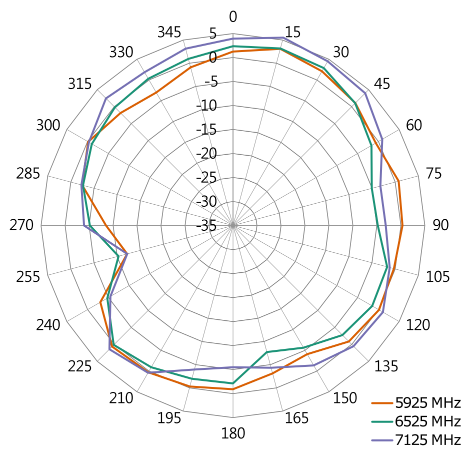
7125 MHz



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

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.

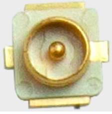
Q: Why is most antenna impedance 50 Ohm?

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

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