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Cover GPS, GLONASS and BeiDou in one L1 antenna port under 12×3×2.4 mm

APPLICATION NOTE
RUN mXTEND™ (NN02-224)

Navigate globally with RUN mXTEND™

- **Antenna Component:** RUN mXTEND™ NN02-224
- **Dimensions :** 12.0 mm x 3.0 mm x 2.4 mm
- **Frequency regions:** 1561 MHz, 1575 MHz, and 1598 MHz to 1606 MHz

With more than **80% of efficiency**, the new **RUN mXTEND™** chip antenna component covers the frequency ranges used for operating at the global navigation systems: **GPS**, **GLONASS** and **BeiDou**.

This new reference design illustrates a full satellite navigation performance, tested in two different evaluation board sizes, that allows location signal usability anywhere in the world.

The **miniature size** (12.0mm x 3.0mm x 2.4 mm) and the **high level of flexibility** of the standard component makes this solution one of the best options for any application to be developed where global navigation systems are involved. The RUN mXTEND™ provides operation in three frequency regions: **1561 MHz** (BeiDou E1 band), **1575 MHz** (GPS L1 band) and from **1598 MHz to 1606 MHz** (GLONASS L1 band).

The RUN mXTEND™ chip antenna component and other Ignion products based on its proprietary Virtual Antenna® technology are protected by one or more of the following Ignion patents.

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Ignion is an ISO 9001:2015 certified company. All our antennas are lead-free and RoHS and REACH compliant.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement Nº 674491

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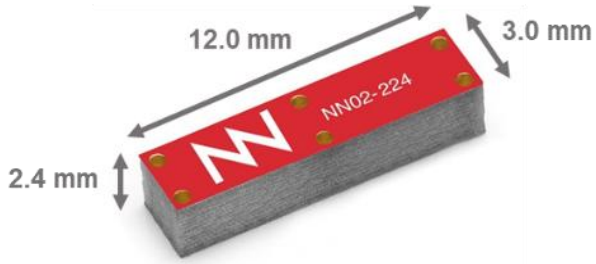
1. PRODUCT DESCRIPTION NN02-224

The RUN mXTEND™ antenna booster has been specifically designed for providing multiband performance in wireless devices enabling worldwide coverage. It is a multipurpose antenna solution capable of being adapted, with a high level of flexibility, to the antenna designer needs. The same antenna part can be used to cover different frequency ranges, since it offers the antenna designer the flexibility of selecting the frequency regions to operate through just the customization of the matching network. In particular, this application note illustrates how to use it for operating the global navigation systems: GPS, GLONASS and BeiDou.

TOP



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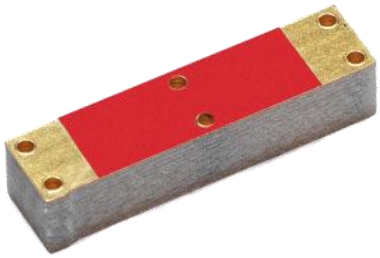


Material: The RUN mXTEND™ antenna booster is built on glass epoxy substrate.

APPLICATIONS

- GPS/GLONASS/BeiDou modules
- Navigators
- Track systems
- Handsets and Smartphones
- Tablets
- Digital Cameras
- Smart Watches

BENEFITS

- High efficiency
- Small size
- Cost-effective
- Easy-to-use (pick and place)
- Off-the-Shelf Standard Product (no customization is required)

The RUN mXTEND™ antenna booster belongs to a new generation of antenna solutions based on the Virtual Antenna® technology owned by Ignion. The technology is mainly focused on replacing conventional antenna solutions by miniature and standard components.

2. EVALUATION BOARD GPS/GLONASS/BeiDou

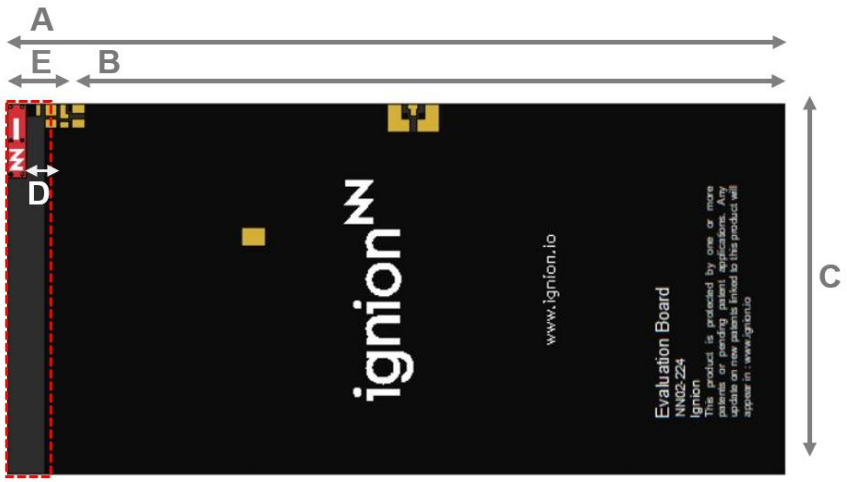
2.1. QUICK REFERENCE GUIDE

Technical features	1561 MHz	1575 MHz	1598 – 1606 MHz
Average Efficiency	> 75 %		> 80 %
Peak Gain	2.9 dBi	3.0 dBi	3.3 dBi
VSWR	< 1.5:1		
Radiation Pattern	Omnidirectional		
Polarization	Linear		
Weight (approx.)	0.19 g		
Temperature	-40 to +125 ºC		
Impedance	50 Ω		
Dimensions (L x W x H)	12.0 mm x 3.0 mm x 2.4 mm		

Table 1 – Technical Features. Measures from the Evaluation Board. See Figure 1.

2.2. EVALUATION BOARD

This Evaluation Board EB_NN02-224-1561-1606 integrates a UFL cable to connect the RUN mXTEND™ antenna booster with the SMA connector. The RUN mXTEND™ provides operation in three frequency regions, 1561MHz (BeiDou E1 band), 1575 MHz (GPS L1 band) and from 1598 MHz to 1606 MHz (GLONASS L1 band), through a single input/output port.



Measure	mm
A	126.5
B	120
C	60
D	2.5
E	6.5

Tolerance: ±0.2 mm

D: Distance between the RUN mXTEND™ antenna booster and the ground plane.

Material: The evaluation board is built on FR4 substrate. Thickness is 1 mm.

Clearance Area: 6.5 mm x 60 mm (E x C)

Figure 1 – EB_NN02-224-1561-1606. Evaluation Board providing operation at BeiDou E1 band (1561 MHz), GPS L1 band (1575 MHz) and for GLONASS L1 band (from 1598 MHz to 1606 MHz).

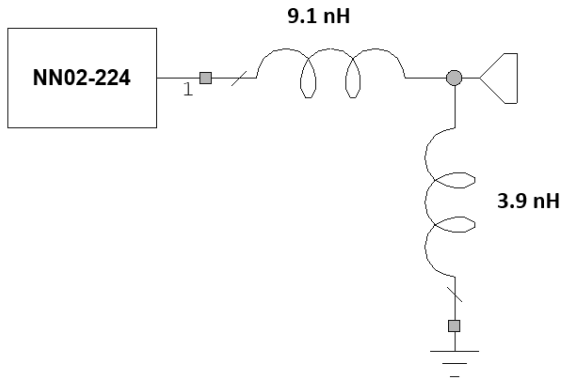
This product and its use are protected by at least one or more of the following patents PAT. US 9,130,259 B2; PAT. US 8,237,615 B2. Other domestic and international patents pending. Additional information about patents related to this product is available at www.ignion.io/virtual-antenna/.

2.3. MATCHING NETWORK

The specs of a Ignion standard product are measured in their evaluation board, which is an ideal case. In a real design, components nearby the antenna, LCD's, batteries, covers, connectors, etc. affect the antenna performance. This is the reason why it is highly recommended placing pads compatible with 0402 and 0603 SMD components for a matching network as close as possible to the feeding point. Do it in the ground plane area, not in the clearance area. This provides a degree of freedom to tune the RUN mXTEND™ antenna booster once the design is finished and taking into account all elements of the system (batteries, displays, covers, etc.).

Please notice that different devices with different ground planes and different components nearby the RUN mXTEND™ antenna booster may need a different matching network. To ensure optimal results, the use of high Q and tight tolerance components is highly recommended (Murata components). Please, if you need assistance contact support@ignion.io for more information related to the antenna booster matching service.

1561 MHz, 1575 MHz and 1598 – 1606 MHz



Value	Part Number
9.1 nH	LQW18AN9N1G80
3.9 nH	LQW15AN3N9B80

Figure 2 – Matching Network implemented in the evaluation board (Figure 1).

For additional information, please visit www.ignion.io or contact info@ignion.io.

If you need help designing your matching network beyond this application note, contact support@ignion.io or run your device through Oxion™ at https://oxion.ai, Ignion's free-of-charge[1] AI-powered antenna integration platform, for a custom matching network and a complete design report in 24h. Ignion's engineering services: https://ignion.io/design-center/engineering-support/

1 See terms and conditions for the free-of-charge Oxion™ service at: https://oxion.ai

2.4. VSWR AND TOTAL EFFICIENCY

VSWR (Voltage Standing Wave Ratio) and Total Efficiency versus Frequency (GHz).

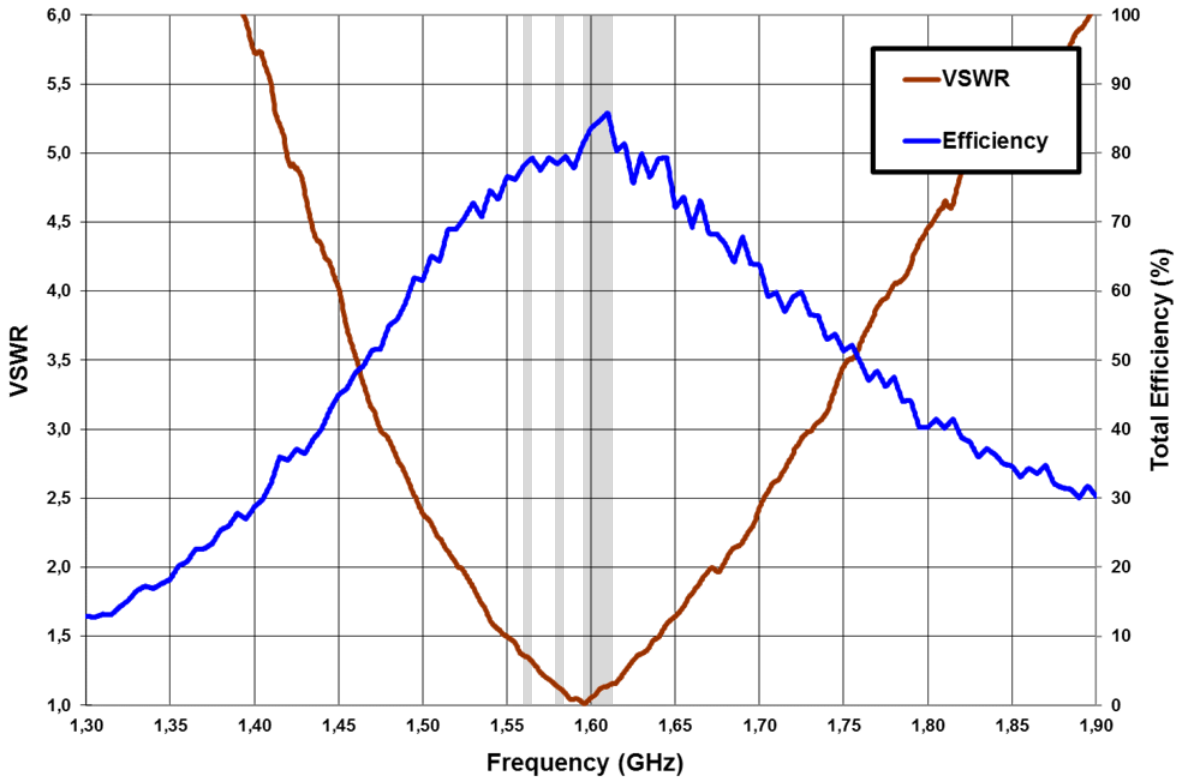
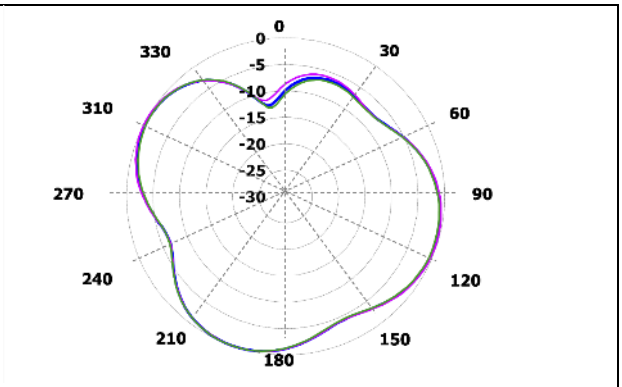


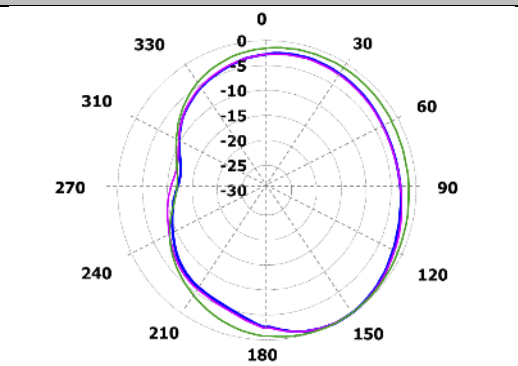
Figure 3 – VSWR and Total Efficiency for BeiDou E1 band (1561 MHz), GPS L1 band (1575 MHz) and GLONASS L1 band (1598 – 1606 MHz) (from the evaluation board (Figure 1)).

2.5. RADIATION PATTERNS (1561, 1575 and 1598-1606 MHz), GAIN AND EFFICIENCY

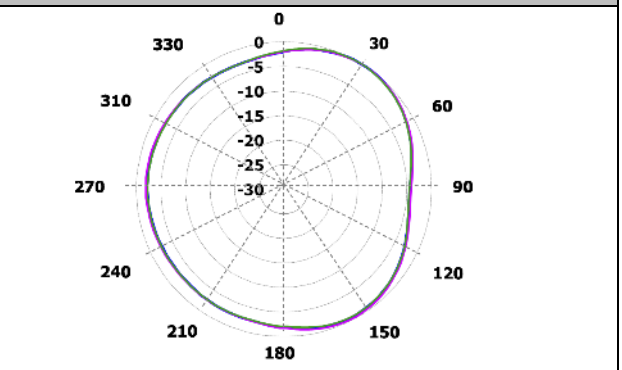
Measurement System Set-Up Evaluation Board in Plane XY



θ = 90º Plane XY at 1.561 GHz, 1.575 GHz and 1.602 GHz



ϕ = 0º Plane XZ at 1.561 GHz, 1.575 GHz and 1.602 GHz



ϕ = 90º Plane YZ at 1.561 GHz, 1.575 GHz and 1.602 GHz

BeiDou	**Gain**		2.9 dBi
	Efficiency		78.4%
GPS	**Gain**		3.0 dBi
	Efficiency		79.3 %
GLONASS	**Gain**	**Peak Gain**	3.3 dBi
		Average Gain across the band	3.2 dBi
		Gain Range across the band (min, max)	3.1 **<–>** 3.3 dBi
	Efficiency	**Peak Efficiency**	84.9 %
		Average Efficiency across the band	83.8 %
		Efficiency Range across the band (min, max)	82.7 – 84.9 %

Table 2 – Antenna Gain and Total Efficiency from the evaluation board (Figure 1) for BeiDou E1 (1561 MHz), GPS L1 (1575 MHz) and GLONASS L1 (1598 – 1606 MHz) bands. Measures made in the Satimo STARGATE 32 anechoic chamber.

3. EVALUATION BOARD CR80 GPS/GLONASS/BeiDou

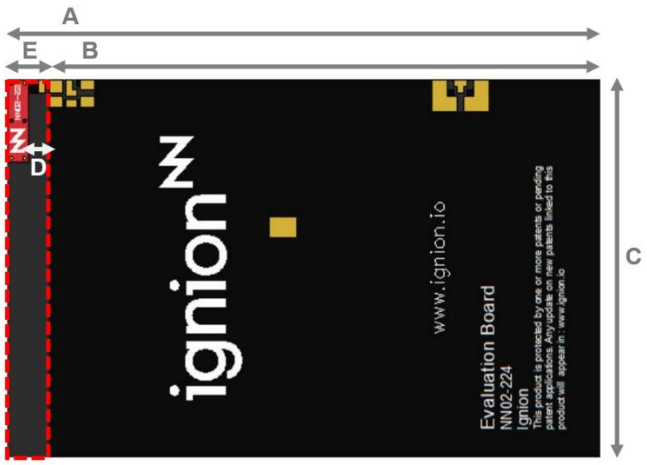
3.1. QUICK REFERENCE GUIDE

Technical features	1561 MHz	1575 MHz	1598 – 1606 MHz
Average Efficiency	> 80 %		> 85 %
Peak Gain	3.1 dBi	3.3 dBi	3.6 dBi
VSWR	< 1.5:1		
Radiation Pattern	Omnidirectional		
Polarization	Linear		
Weight (approx.)	0.19 g		
Temperature	-40 to +125 ºC		
Impedance	50 Ω		
Dimensions (L x W x H)	12.0 mm x 3.0 mm x 2.4 mm		

Table 3 – Technical Features. Measures from the Evaluation Board. See Figure 4.

3.2. EVALUATION BOARD

This Evaluation Board EB_NN02-224-CR80-1561-1606 integrates a UFL cable to connect the RUN mXTEND™ antenna booster with the SMA connector. The RUN mXTEND™ provides operation in three frequency regions, 1561 MHz (BeiDou E1 band), 1575 MHz (GPS L1 band) and from 1598 MHz to 1606 MHz (GLONASS L1 band), through a single input/output port.



Measure	mm
A	86
B	79.5
C	54
D	2.5
E	6.5

Tolerance: ±0.2 mm

D: Distance between the RUN mXTEND™ antenna booster and the ground plane.

Material: The evaluation board is built on FR4 substrate. Thickness is 1 mm.

Clearance Area: 6.5 mm x 54 mm (E x C)

Figure 4 – EB_NN02-224-CR80-1561-1606 in CR80 standard format. Evaluation Board providing operation for BeiDou E1 band (1561 MHz), GPS L1 band (1575 MHz) and for GLONASS L1 band (from 1598 MHz to 1606 MHz).

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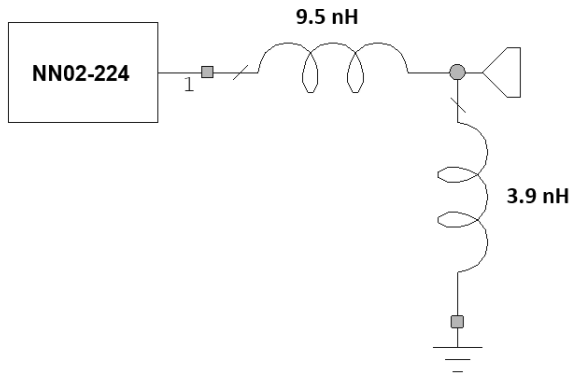
1561 MHz, 1575 MHz and 1598 – 1606 MHz



Value	Part Number
9.5 nH	LQW18AN9N5G80
3.9 nH	LQW15AN3N9B80

Figure 5 – Matching Network implemented in the evaluation board (Figure 4).

For additional information, please visit www.ignion.io or contact info@ignion.io.

If you need help designing your matching network beyond this application note, contact support@ignion.io or run your device through Oxion™ at https://oxion.ai, Ignion's free-of-charge[2] AI-powered antenna integration platform, for a custom matching network and a complete design report in 24h. Ignion's engineering services: https://ignion.io/design-center/engineering-support/

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3.4. VSWR AND TOTAL EFFICIENCY

VSWR (Voltage Standing Wave Ratio) and Total Efficiency versus Frequency (GHz).

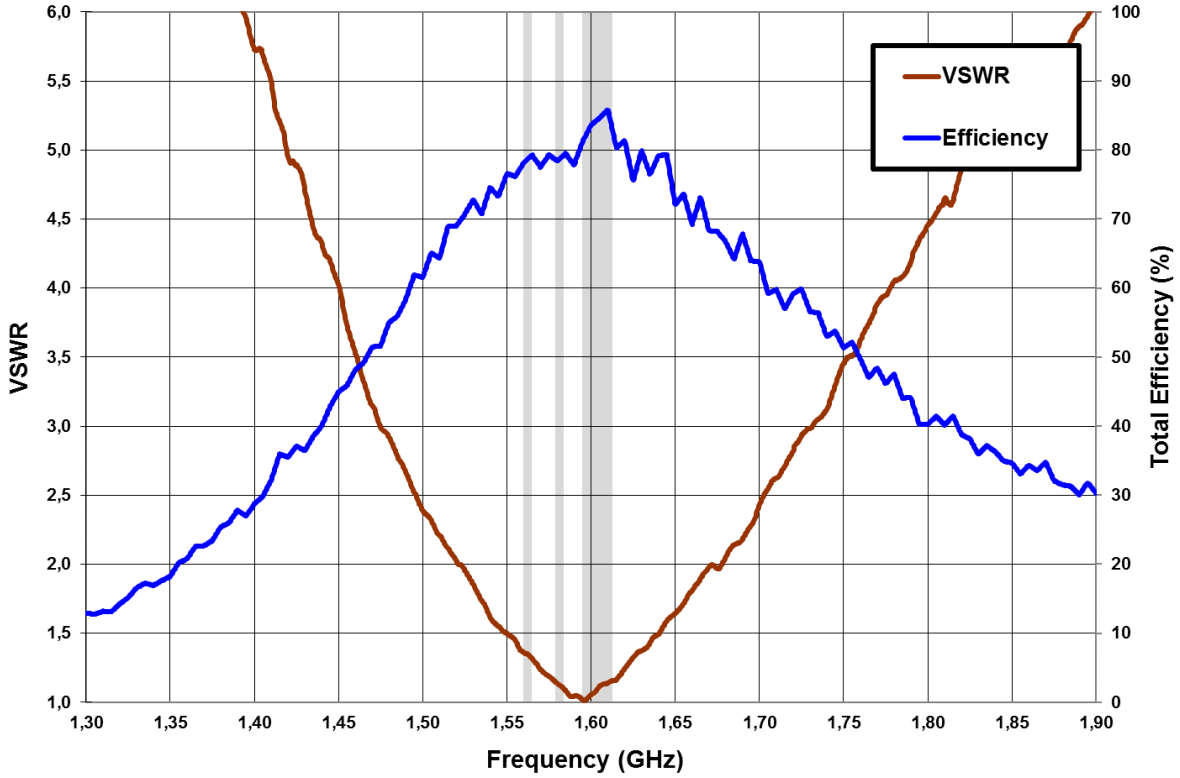
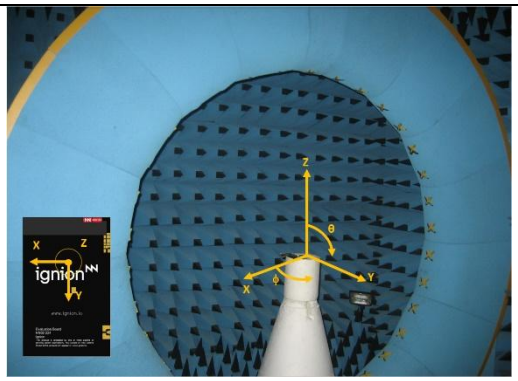


Figure 6 – VSWR and Total Efficiency for BeiDou E1 (1561 MHz), GPS L1 band (1575 MHz) and GLONASS L1 band (1598 – 1606 MHz) (from the evaluation board (Figure 4)).

3.5. RADIATION PATTERNS (1561, 1575, and 1598-1606 MHz), GAIN AND EFFICIENCY



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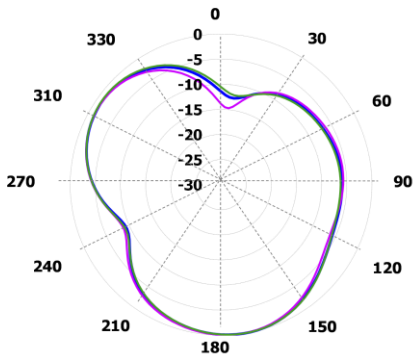

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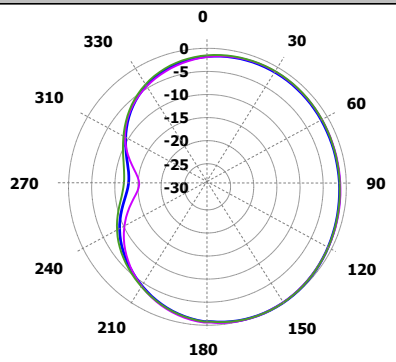
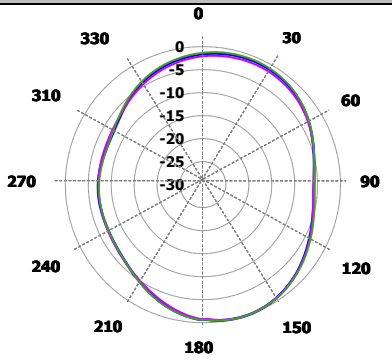


ϕ = 0º Plane XZ at 1.561 GHz, 1.575 GHz and 1.602 GHz



ϕ = 90º Plane YZ at 1.561 GHz, 1.575 GHz and 1.602 GHz

BeiDou		**Gain**	3.1 dBi
		Efficiency	84.7 %
GPS		**Gain**	3.3 dBi
		Efficiency	84.9 %
GLONASS	**Gain**	**Peak Gain**	3.6 dBi
		Average Gain across the band	3.5 dBi
		Gain Range across the band (min, max)	3.4 **<–>** 3.6 dBi
	Efficiency	**Peak Efficiency**	88.7 %
		Average Efficiency across the band	87.6 %
		Efficiency Range across the band (min, max)	86.4 – 88.7 %

Table 4 – Antenna Gain and Total Efficiency from the evaluation board (Figure 4) for BeiDou E1 (1561 MHz), GPS L1 (1575 MHz) and GLONASS L1 (1598 – 1606 MHz) bands. Measures made in the Satimo STARGATE 32 anechoic chamber.

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