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RUN mXTEND™ - Ensuring Reliable Cellular Connectivity

APPLICATION NOTE
RUN mXTEND™ (NN02-224)

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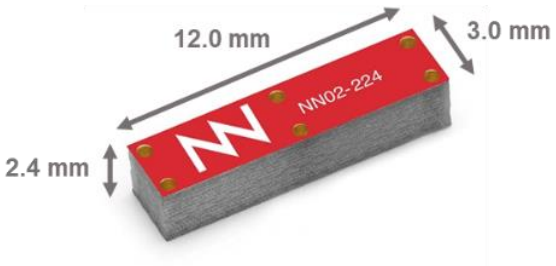
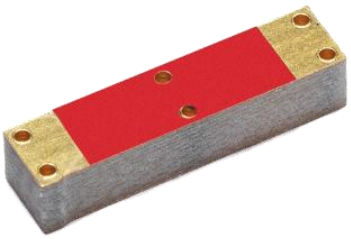
1. PRODUCT DESCRIPTION NN02-224

The RUN mXTEND™ (NN02-224) antenna booster has been specifically designed to provide multiband performance in IoT and mobile wireless devices, enabling worldwide coverage by supporting operation in nearly every sub-6 GHz band. This includes communication standards such as LTE, NB-IoT, 5G NR, Wi-Fi, Bluetooth, GNSS, and many more within the operating range of 698 MHz to 8000 MHz.

TOP



BOTTOM



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

APPLICATIONS

- Smart Metering
- Smart City & Smart Building
- Industrial IoT
- Asset Tracking & Logistics

BENEFITS

- High efficiency
- Small size
- Cost-effective
- Easy-to-use (pick and place)
- Multiband
- Off-the-Shelf Standard Product

2. QUICK REFERENCE GUIDE

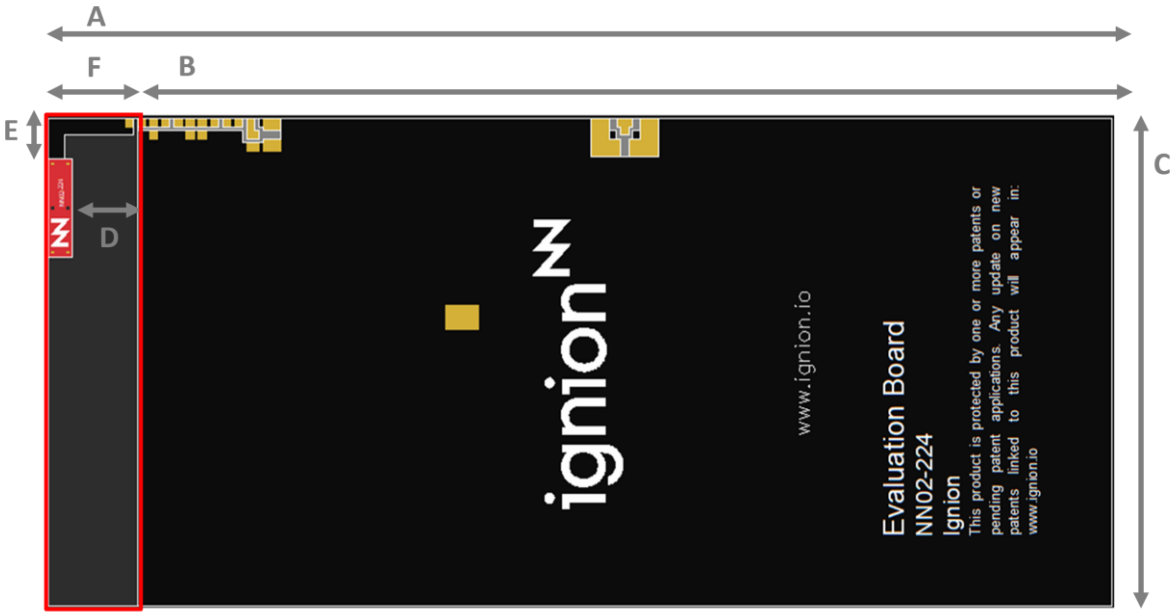
In this application note, it is demonstrated how the RUN mXTEND™ antenna booster (NN02-224) provides multiband performance in wireless devices across a wide range of frequencies from 824 MHz to 960 MHz and from 1710 MHz to 2690 MHz. This enables worldwide coverage and supports operation in multiple IoT-related communication standards, including any LTE band within this frequency range, NB-IoT, LTE-M, 5G-NR, and any other communication standards within the specified range.

Technical features	824 – 960 MHz	1710 – 2690 MHz
Average Efficiency	> 65 %	> 70 %
Peak Gain	1.8 dBi	1.9 dBi
VSWR	< 3:1	
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. Note that for obtaining comparable results, a ground plane length larger than 100 mm is recommended.

3. AN EVALUATION BOARD FOR IoT DEVICES (824-960 MHz and 1710-2690MHz)

This Evaluation Board integrates a UFL cable to connect the RUN mXTEND™ antenna booster with the SMA connector. The RUN mXTEND™ provides operation in two frequency regions, from 824 MHz to 960 MHz and from 1710 MHz to 2690 MHz, through a single input/output port.



Measure	mm
A	131
B	120
C	60
D	8.0
E	5.0
F	11.0

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.

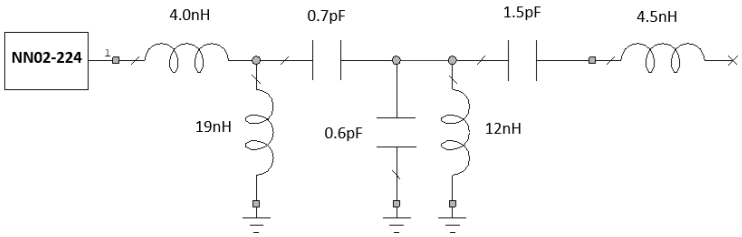
Clearance Area: 60 mm x 11 mm (CxF).

Figure 1 – EB_NN02-224-1B-2RJ-1P. Evaluation Board providing operation from 824 MHz to 960 MHz and from 1710 MHz to 2690MHz.

3.1. MATCHING NETWORK AND PERFORMANCE

The matching network and value components for this device and PCB size is provided below, together with the resulting total radiation efficiency. While the RUN mXTEND™ antenna booster remains the same for these frequency bands, the matching network topology and value of its components might be adapted to every different PCB size for an optimum performance. The specs of a Ignion standard product are measured in a reference evaluation board, to isolate the antenna performance from other system elements. However, when incorporating into real designs, nearby components such as LCD's, batteries, covers and connectors may affect the antenna performance. For this reason, placing pads compatible with 0402 and 0603 SMD components for a matching network as close as possible to the feeding point is highly recommended. The matching network should be implemented in the ground plane area rather than the clearance area, this will provide a degree of freedom for tuning the RUN mXTEND™ antenna component once the design is finished, considering all the elements of the system (batteries, displays, covers, etc.). To ensure optimal results, the use of high Q and tight tolerance components is highly recommended (Murata components).

824 – 960 MHz and 1710 – 2690 MHz



Value	Part Number
4.0 nH	LQW15AN4N0G80
19 nH	LQW18AN19NG80
0.7 pF	GJM1555C1HR70WB01
0.6 pF	GJM1555C1HR60WB01
12 nH	LQW18AN12NG10
1.5 pF	GJM1555C1H1R5WB01
4.5 nH	LQW15AN4N5G80

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

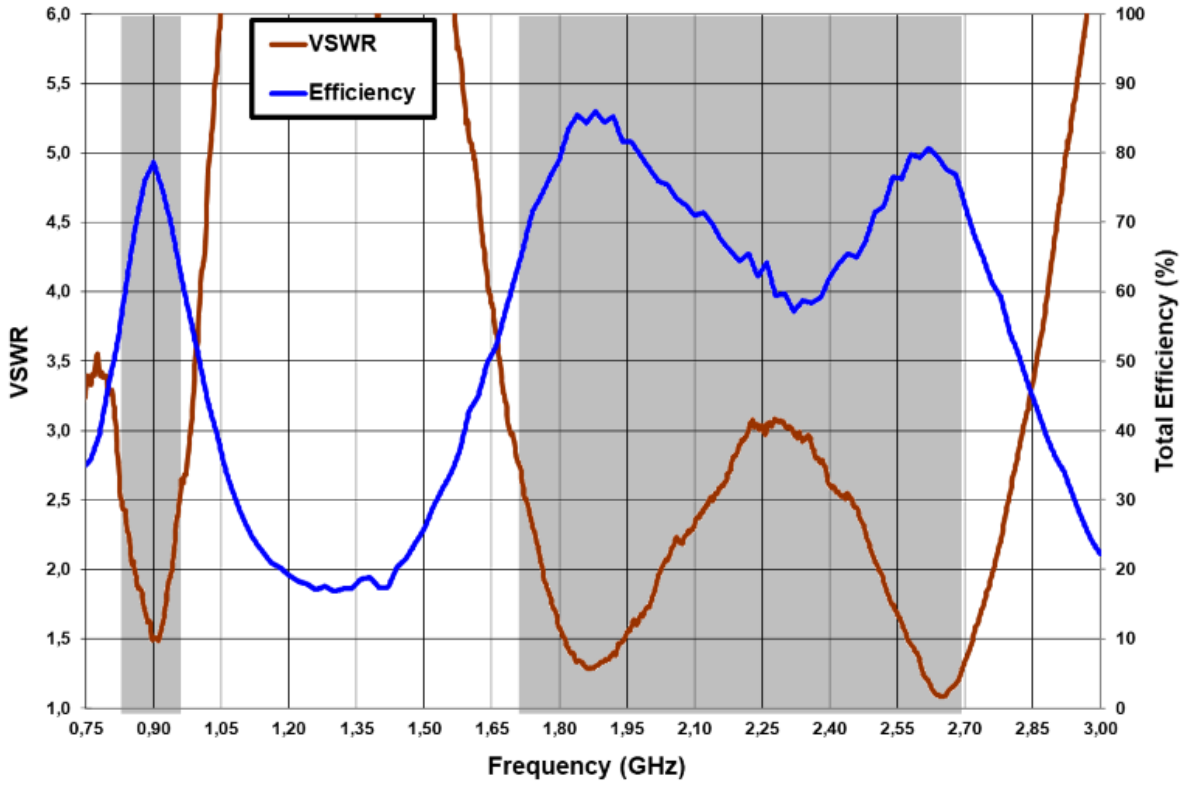


Figure 3 – VSWR and Total Efficiency for the 824 – 960 MHz frequency range and for the 1710 – 2690 MHz frequency range (from the evaluation board (**Figure 1**)).

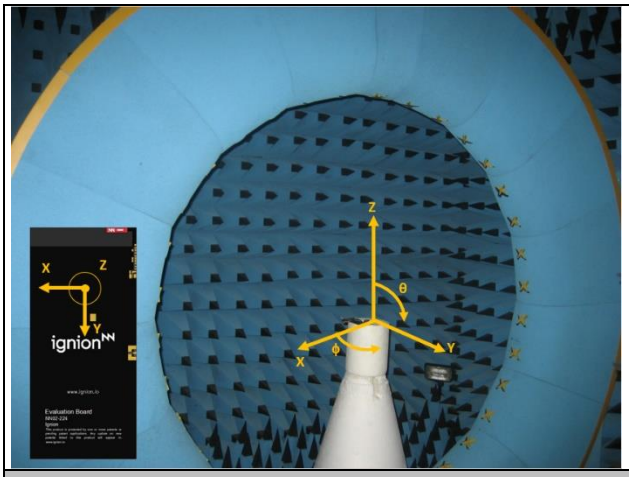
Please notice that different devices with different ground planes and different components nearby the RUN mXTEND™ antenna component may require a fine tuning of the matching network.

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

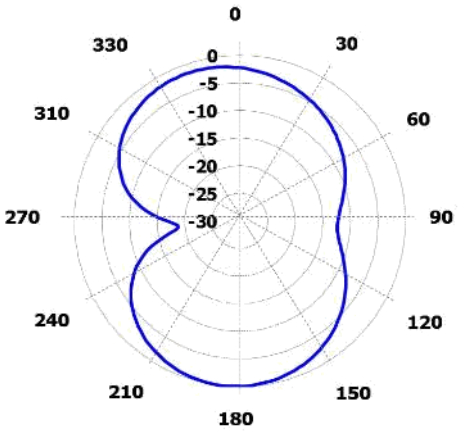
If you are designing a device with a different size or operating frequency than shown above, you can assess the performance of this configuration using our free-of-charge Oxion™ platform. This platform provides a complete design report, including expected performance and tailored design guide, within 24 hours. For additional information about Ignion's range of R&D services, please visit: https://ignion.io/resources-support/technical-center/engineering-support/. If you require further assistance, please contact support@ignion.io.

Purchase this or other evaluation boards through our main distributors by visiting the following link: https://ignion.io/distributors/.

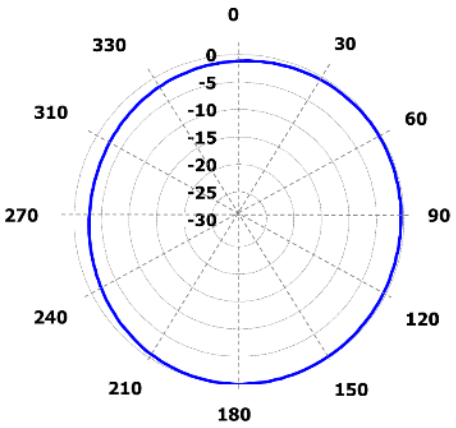
3.2. RADIATION PATTERNS (824-960 MHz), GAIN AND EFFICIENCY



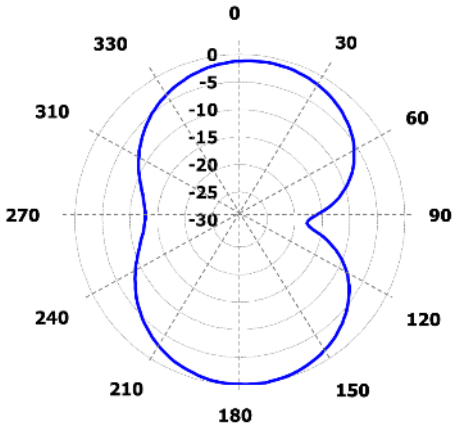
Measurement System Set-Up Evaluation Board in Plane XY



θ = 90º Plane XY at 890 MHz



ϕ = 0º Plane XZ at 890 MHz



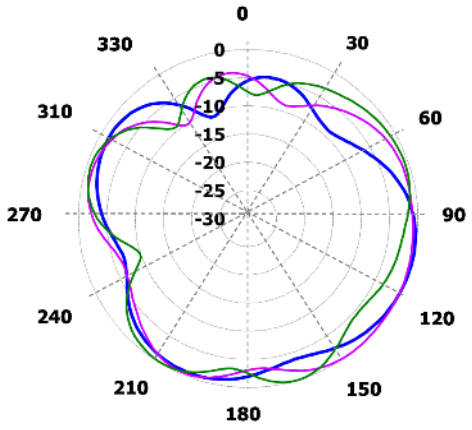
ϕ = 90º Plane YZ at 890 MHz

Gain	**Peak Gain**	1.8 dBi
	Average Gain across the band	1.1 dBi
	Gain Range across the band (min, max)	-0.2 **<–>** 1.8 dBi
Efficiency	**Peak Efficiency**	72.1 %
	Average Efficiency across the band	66.6 %
	Efficiency Range across the band (min, max)	49.8 – 72.1 %

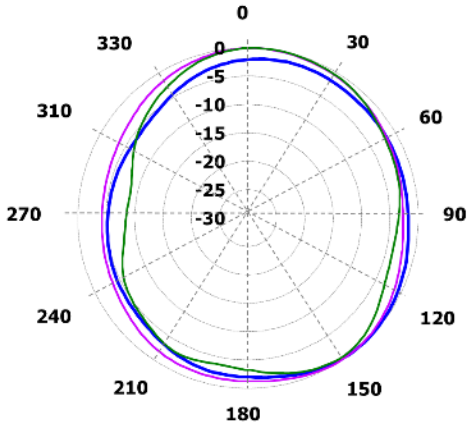
Table 2 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 1) within the 824 – 960 MHz frequency range. Measures made in the Satimo STARGATE 32 anechoic chamber.

3.3. RADIATION PATTERNS (1710-2690 MHz), GAIN AND EFFICIENCY

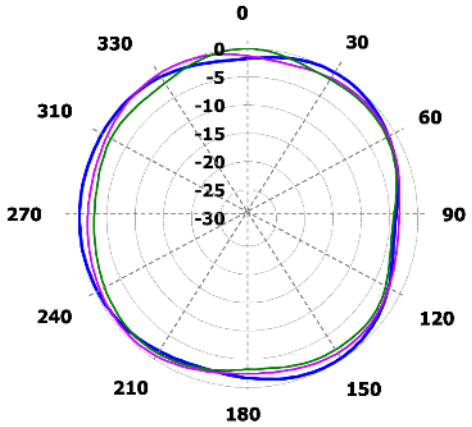
Measurement System Set-Up Evaluation Board in Plane XY



θ = 90º Plane XY at 1.71GHz, 2.2GHz and 2.69GHz



ϕ = 0º Plane XZ at 1.71GHz, 2.2GHz and 2.69GHz



ϕ = 90º Plane YZ at 1.71GHz, 2.2GHz and 2.69GHz

Gain	**Peak Gain**	1.9 dBi
	Average Gain across the band	1.3 dBi
	Gain Range across the band (min, max)	0.5 **<–>** 1.9 dBi
Efficiency	**Peak Efficiency**	80.7 %
	Average Efficiency across the band	72.7 %
	Efficiency Range across the band (min, max)	62.6 – 80.7 %

Table 3 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 1) within the 1710 – 2690 MHz frequency range. Measures made in the Satimo STARGATE 32 anechoic chamber.

This product and its use is protected by at least one or more of the following patents and patent applications **US 8,203,492**; **US 8,237,615**; **PCT/EP2013/064692**; **WO2014/012842**; **US 62/028,494**; **US 62/072,671**; and other domestic and international patents pending. Additional information about patents related to this product is available at https://ignion.io/virtual-antenna/

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