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# ONE mXTEND<sup>™</sup> - Enabling 5G coverage.

APPLICATION NOTE

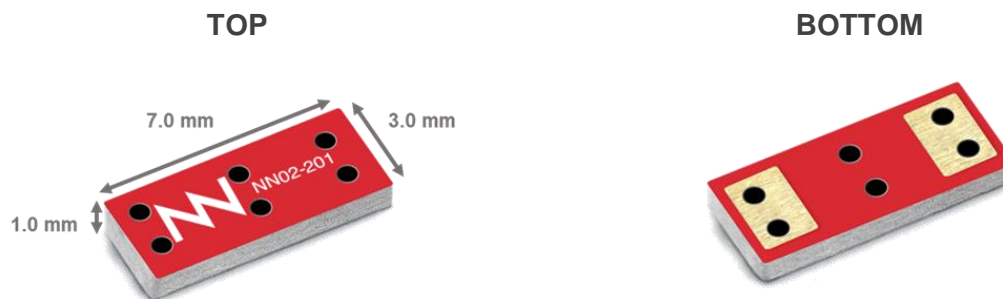
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# 1. HIGH-PERFORMANCE 5G DESIGNS WITH ONE mXTEND<sup>™</sup>

## 1.1. PRODUCT DESCRIPTION NN02-201

**ONE mXTEND<sup>™</sup> (NN02-201)** is the smallest Virtual Antenna<sup>®</sup> chip for both **cellular** and **unlicensed** IoT wireless devices. Featuring a size of 7 mm x 3 mm x 1 mm, this part number has been designed to fit just about every **IoT device**, particularly *small, light, entry level products*. **ONE mXTEND<sup>™</sup>** is enabled by Virtual Antenna<sup>®</sup> technology, thus featuring the unique properties of this class of products: versatile tunability within the broadest operating range in the market: 800 MHz up to 10600 MHz. This makes the perfect product for **multiband connectivity** at cellular IoT, including connectivity within several communication standards such as LTE, LTE-M, NB-IoT, and 5G bands, but also for other standards such as for instance WiFi-6E, BLE, and many more.



**Material:** The ONE mXTEND<sup>™</sup> antenna booster is built on glass epoxy substrate.

### APPLICATIONS

- Industrial IoT
- Asset Tracking & Logistics
- Wearables
- Consumer Electronics

### BENEFITS

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

## 1.2. EVALUATION BOARD FOR 5G (3300 – 5000 MHz)

### 1.2.1. QUICK REFERENCE GUIDE

Technical features	3300 MHz – 5000 MHz
Average Efficiency	> 70 %
Peak Gain	4.1
VSWR	< 2.5:1
Radiation Pattern	Omnidirectional
Polarization	Linear
Weight (approx.)	0.02 g.
Temperature	-40 to +125 °C
Impedance	50 Ω
Dimensions (L x W x H)	7.0 mm x 3.0 mm x 1.0 mm

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

### 1.2.2. EVALUATION BOARD

This evaluation board (part number: EB\_NN02-201-5G) is made with a coplanar grounded transmission line (trace on the PCB) to connect the ONE mXTEND™ antenna booster with the SMA connector. The ONE mXTEND™ provides operation in the frequency region from 3300 MHz to 5000 MHz, through a single input/output port.

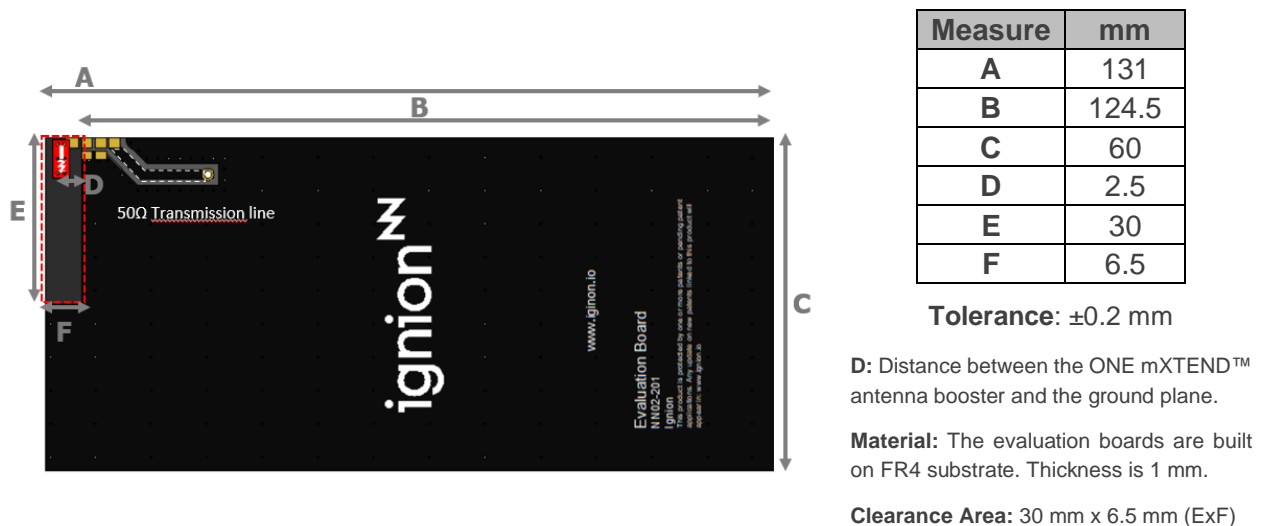


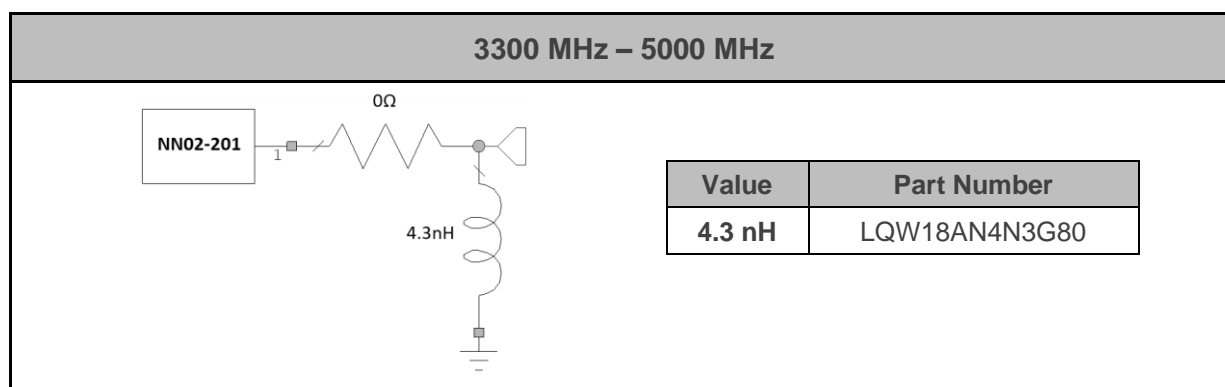
Figure 1 – EB\_NN02-201-5G. Evaluation board providing operation at 5G bands (from 3300 MHz to 5000 MHz).

This product and/or its use is protected by at least one or more patents and patent applications. Please check related patent information at: [ignion patents](#).

### 1.2.3. MATCHING NETWORK

ONE mXTEND<sup>™</sup> antenna booster needs a matching network to connect to your 5G receiver. This section describes a suitable matching network (Figure 8) for ONE mXTEND<sup>™</sup> and the resulting product specs when measured in the reference evaluation board (EB\_NN02-201-5G) (Figure 1). Please note that different devices with different form factors, ground planes, and nearby components may need a different matching network.

ONE mXTEND<sup>™</sup> antenna booster is a versatile product, bringing a broadband solution able to cover the 5G frequency bands n77, n78 and n79. This solution can easily be changed to operate in a more specific 5G band, optimizing the performance of the antenna booster. If you need assistance to design your matching network beyond this application note, please contact [support@ignion.io](mailto:support@ignion.io), or if you are designing a **different device size** or a **different frequency band**, we can assist you in less than 24 hours. Please, try our free-of-charge [Oxion<sup>™</sup>](#), which will get you a complete design report including a custom matching network for your device in 24h. Additional information related to Ignion's range of R&D services is available at: <https://ignion.io/rdservices/>.



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

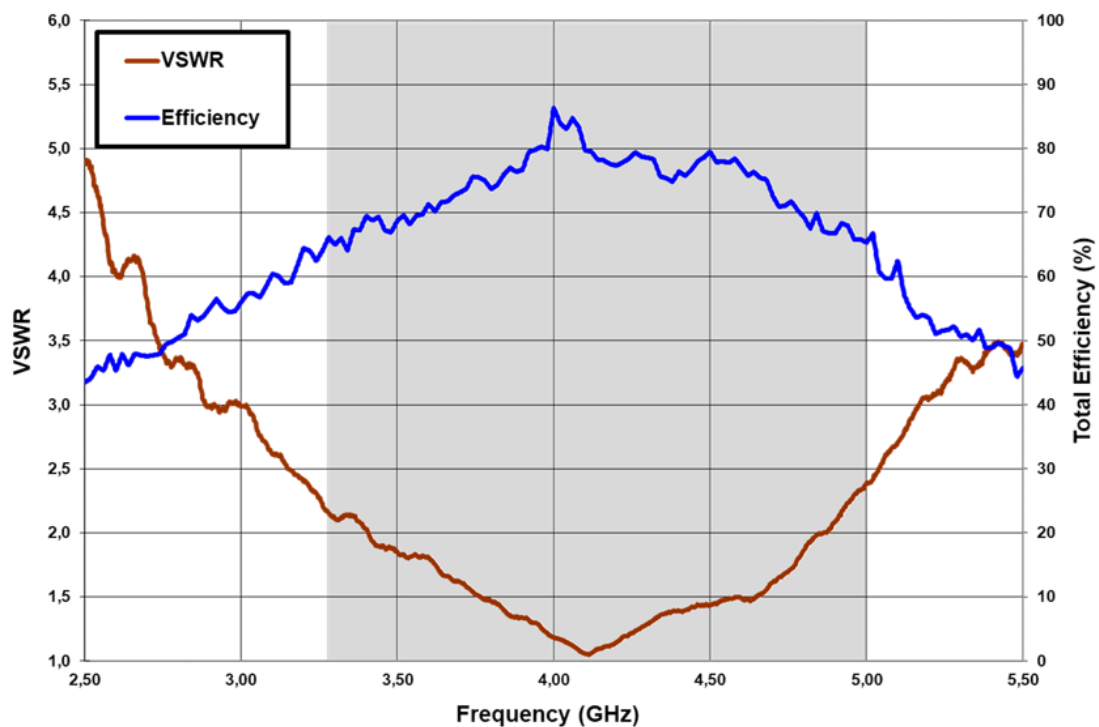
To ensure optimal results, the use of high-quality factor (Q) and tight tolerance components is highly recommended (e.g. Murata components with part numbers as in Figure 2). The antenna performance is always conditioned by its operating environment so that different devices with different printed circuit board sizes, components nearby the antenna, LCD's, batteries, covers, connectors, etc. affect the antenna performance. Accordingly, 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 of the antenna element. Do it in the ground plane area, not in the clearance area. By tuning the matching network in your final design with your final surrounding components (batteries, displays, covers, etc.) you will be able to optimize the antenna performance without changing the antenna part.

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

#### 1.2.4. VSWR AND TOTAL EFFICIENCY

**VSWR** (Voltage Standing Wave Ratio) is defined as the relation of transmitted and reflected standing waves of voltage in a radio frequency (RF) electrical transmission system. In other words, VSWR or Return Loss is directly related to the coverage. If these values are not optimal, the communication will be dropped and there will be a poor signal.

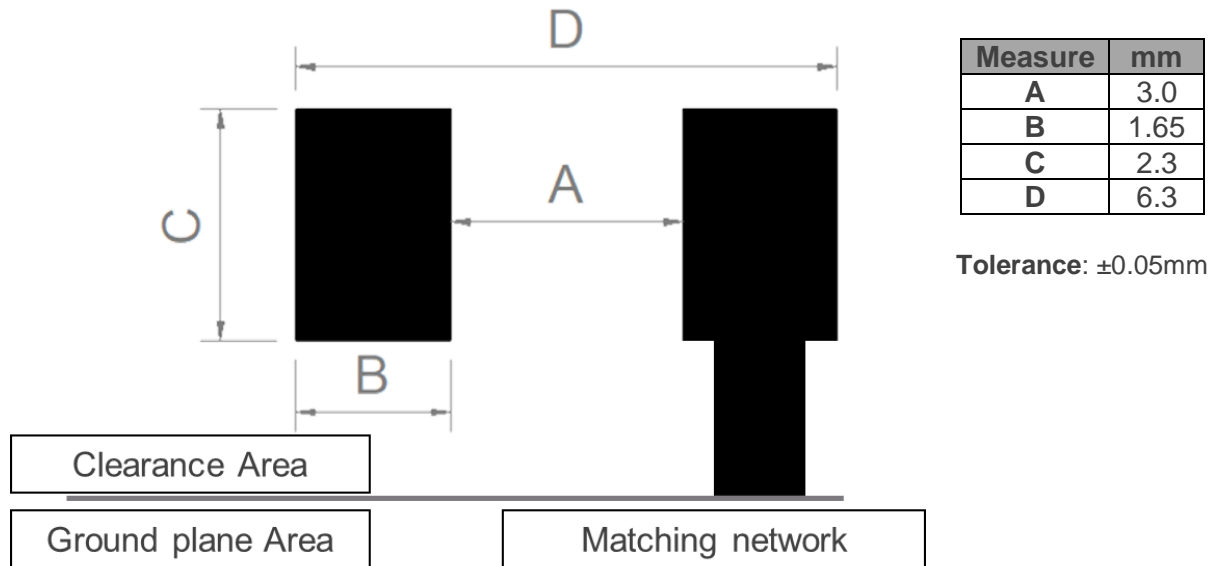
**Total Efficiency** is a term used to measure the ratio between the power supplied to the antenna and the radiated power of the system. Power is supplied to the antenna by the RF module and then, a part of that power is radiated to space and the other is transformed into losses (reflection due to decoupling between the transmission line and the antenna, loss during conduction, heat losses, etc.). Total Efficiency measures the quantity of power from the RF module that is effectively radiated to the space.



**Figure 3** – VSWR and Total Efficiency at 5G bands (3300 MHz – 5000 MHz) (from the evaluation board) (Figure 1).

**1.2.5. RECOMMENDED ANTENNA FOOTPRINT FOR THE ONE mXTEND<sup>™</sup> (NN02-201)**

See below the recommended footprint dimensions for the ONE mXTEND<sup>™</sup> (NN02-201) antenna booster.

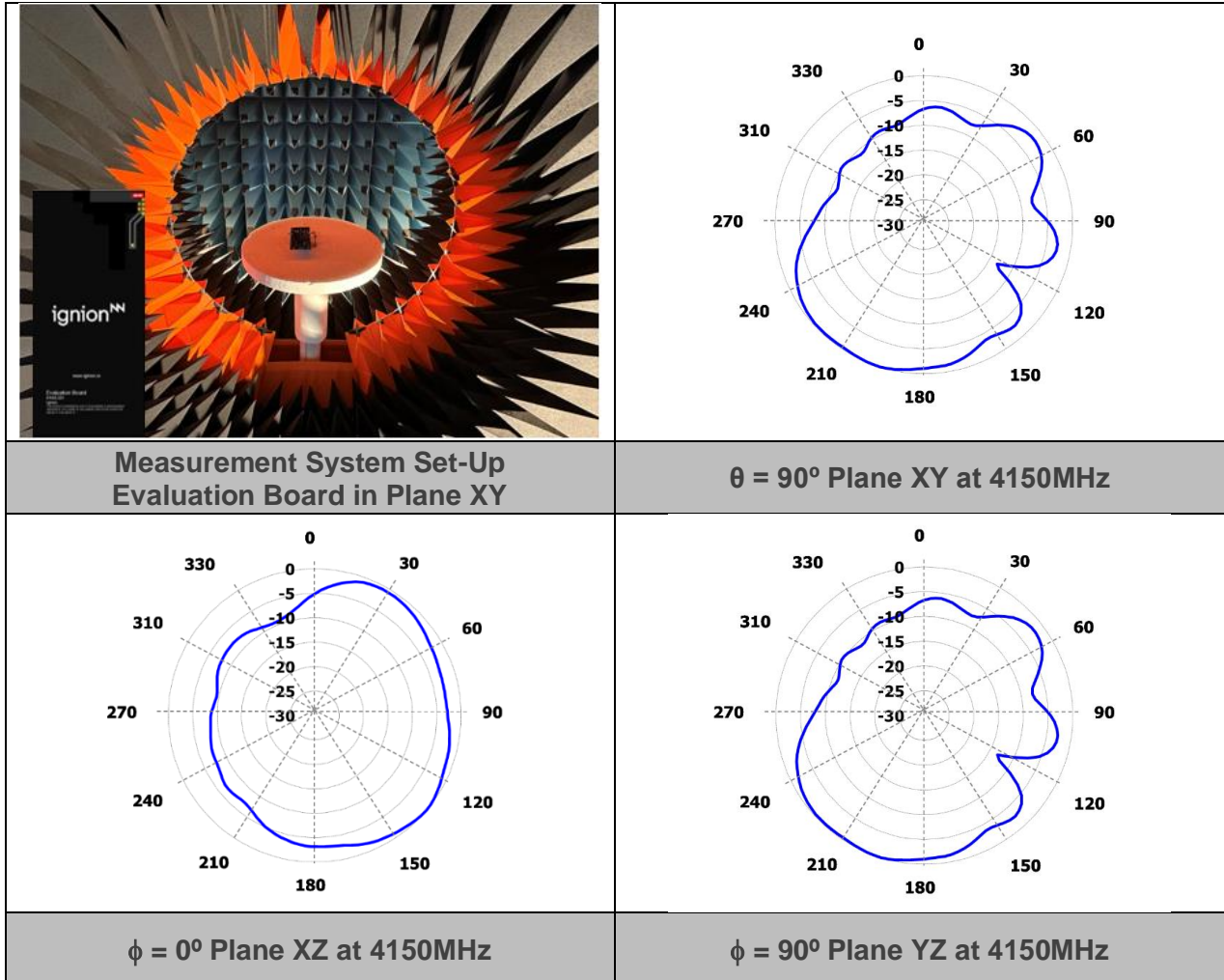


**Figure 4** – Footprint dimensions for the ONE mXTEND<sup>™</sup> (NN02-201) antenna booster.

For additional support in the integration process, please contact [support@ignion.io](mailto:support@ignion.io).

**1.2.6. RADIATION PATTERNS (3300 to 5000 MHz), GAIN, AND EFFICIENCY**

The radiation pattern of the 5G configuration of the ONE mXTEND<sup>™</sup> is shown below. The radiation pattern is the graphical representation of the radiation characteristics of an antenna, as a function of direction (azimuth and elevation coordinates). Among the characteristic parameters of a radiation pattern, the most important are gain and directivity. In this case, the radiation patterns are omnidirectional.



Gain	Peak Gain	4.1dBi
	Average Gain across the band	3.2dBi
	Gain Range across the band (min, max)	2.4dBi <-> 4.1dBi
Efficiency	Peak Efficiency	86.3%
	Average Efficiency across the band	74.1%
	Efficiency Range across the band (min, max)	64.0 – 86.3%

**Table 2** – Antenna Gain and Total Efficiency from the evaluation board (Figure 1) 5G bands (3300 MHz – 5000 MHz). Measures made in the Satimo STARGATE 32 anechoic chamber.



A promotional graphic for Oxion. It features the Oxion logo in white on a dark blue background with a light blue wave pattern. Below the logo, there are three lines of text: 'Try Oxion™ platform now and transform your ideas into real projects.', 'Get to market faster with no need for a physical prototype.', and 'Get a complete antenna design recommendation tailored for your PCB, including real-time performance tweaking.' At the bottom left is the website 'oxion.ai' and at the bottom right is a QR code.

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- 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 N° 674491.



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