

ONE mXTEND™: 5G coverage in the smallest antenna ever

- **Antenna component:** ONE mXTEND™ NN02-201
- **Dimensions:** 7.0 mm x 3.0 mm x 1.0 mm
- **Frequency regions:** 2500 MHz to 5000 MHz



5G worldwide coverage in the ultra slim and smallest chip antenna

The **smallest volume antenna** ever is here to cover **worldwide 5G** in your next wireless design.

The ONE mXTEND™ antenna booster, with a tiny volume of only **21mm³**, is designed to provide **5G cellular IoT connectivity** in a miniature and ultra slim antenna component avoiding the usual problem with size restrictions. The antenna and its super reduced size covers **2G, 3G, 4G** and **5G** all in one antenna package.

The new ONE mXTEND™ **ultra slim antenna** booster, only 7.0 x 3.0 x 1.0 mm, can fit in about any IoT wireless design and offers **5G** connectivity to IoT and mobile devices in the easiest way. It's **tiny, slim, multiband** and it can be assembled into the PCB with a pick and place machinery as any other component.

5G is taking on the challenge given by the upcoming wireless market that requires connectivity with a high level of adaptability to **many different multiband devices**, and this challenge needs an **easy antenna**, already designed, that enables a **fast, quick** and **cheap time to market**.

ONE mXTEND™: 5G made simple

INDEX OF CHAPTERS

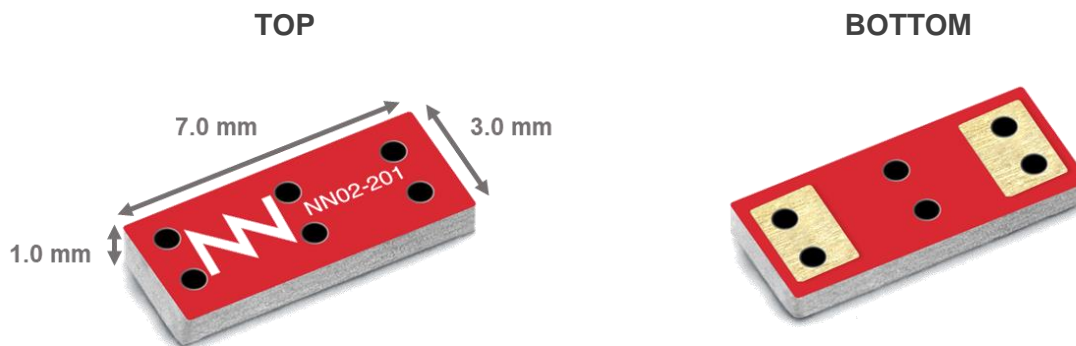
| | |
|--|----|
| 1. PRODUCT DESCRIPTION NN02-201..... | 4 |
| 2. EVALUATION BOARD (5G) | 5 |
| 3. CAPABILITIES AND MEASUREMENT SYSTEMS..... | 9 |
| 4. MECHANICAL CHARACTERISTICS NN02-201..... | 10 |
| 5. ASSEMBLY PROCESS..... | 11 |
| 6. PACKAGING | 14 |

TABLE OF CONTENTS

| | | |
|------|--|----|
| 1. | PRODUCT DESCRIPTION NN02-201..... | 4 |
| 2. | EVALUATION BOARD (5G) | 5 |
| 2.1. | QUICK REFERENCE GUIDE | 5 |
| 2.2. | EVALUATION BOARD..... | 5 |
| 3. | CAPABILITIES AND MEASUREMENT SYSTEMS..... | 9 |
| 4. | MECHANICAL CHARACTERISTICS NN02-201..... | 10 |
| 4.1. | DIMENSIONS, TOLERANCES, AND RoHS | 10 |
| 4.2. | COLOR RANGE FOR THE INK..... | 10 |
| 4.3. | RECOMMENDED FOOTPRINT FOR THE NN02-201 | 11 |
| 5. | ASSEMBLY PROCESS..... | 11 |
| 6. | PACKAGING | 14 |

1. PRODUCT DESCRIPTION NN02-201

The ONE mXTEND™ antenna booster has been specifically designed for providing multiband performance in wireless devices with small space requirements. It is a miniature antenna capable of being adapted, with a high level of flexibility, to the designer needs. Featured by an extremely reduced package, the ONE mXTEND™ is a versatile product capable of enabling 2G, 3G, 4G, and 5G coverage through the same single antenna package. The configuration presented herein illustrates how to tune the antenna component to provide worldwide 5G coverage in the new radio 5G frequency bands n77, n78, n79 and n90.



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

APPLICATIONS

- Asset Tracking
- Fleet Management
- Modules
- IoT
- Routers
- Handsets and smartphones
- Tablets and PCs
- Digital cameras
- Sensors
- Smartwatches and wearables

BENEFITS

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

The ONE mXTEND™ antenna booster belongs to a new generation of antenna solutions based on Virtual Antenna™ technology owned by FRACTUS ANTENNAS. This technology enables replacing conventional and custom antenna solutions by a new class of so-called antenna boosters, delivered in the form of a new range of miniature and off-the-shelf chip antenna components. These new chip antennas are by nature multiband and multipurpose, so they fit in a variety of wireless platforms to provide a wireless link at many different communication services. By using a Virtual Antenna™ component the design becomes more predictable compared to a custom solution, making the whole process **faster, cheaper and easier**.

2. EVALUATION BOARD (5G)

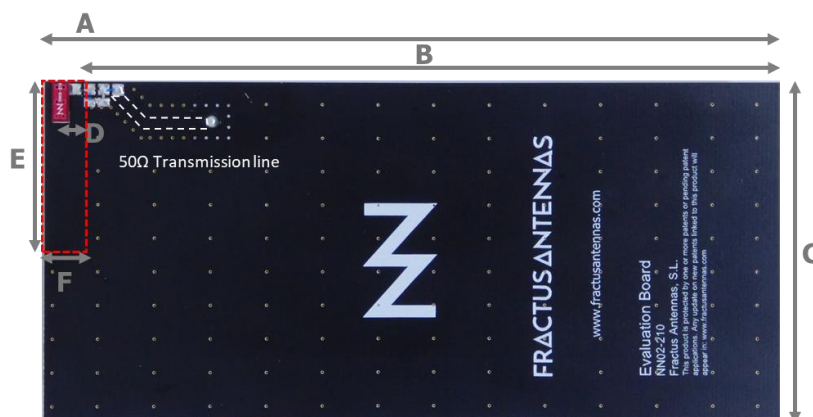
2.1. QUICK REFERENCE GUIDE

| Technical features | 2500 MHz – 5000 MHz |
|------------------------|--------------------------|
| Average Efficiency | > 65 % |
| Peak Gain | 4.1 |
| VSWR | < 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 (Figure 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 2500 MHz to 5000 MHz, through a single input/output port.



| Measure | mm |
|---------|-------|
| A | 131 |
| B | 124.5 |
| C | 60 |
| D | 2.5 |
| E | 30 |
| F | 6.5 |

Tolerance: ±0.2 mm

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

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

Clearance Area: 30 mm x 6.5 mm (ExF)

Figure 1 – EB_NN02-201-5G. Evaluation board providing operation at 5G bands (from 2500 MHz to 5000 MHz).

This product and its use are protected by at least one or more of the following [patents and patent applications](#) PAT. US 9,130,259 B2; US 16/731755; EP 18736916.0 and other domestic and international patents pending. Additional information about patents related to this product is available at www.fractusantennas.com/virtual-antenna/.

2.2.1. MATCHING NETWORK

ONE mXTEND™ antenna booster needs a matching network to connect to your 5G receiver. This section describes a suitable matching network (Figure 2) for ONE mXTEND™ 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™ antenna booster is a versatile product, bringing a broadband solution able to cover the 5G frequency bands n77, n78, n79 and n90. 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@fractusantennas.com, or try our free-of-charge¹ **NN Wireless Fast-Track** design service, you will get your chip antenna design including a custom matching network for your device in 24h¹. Other information related to NN's range of R&D services is available at: <https://www.fractusantennas.com/rdservices/>

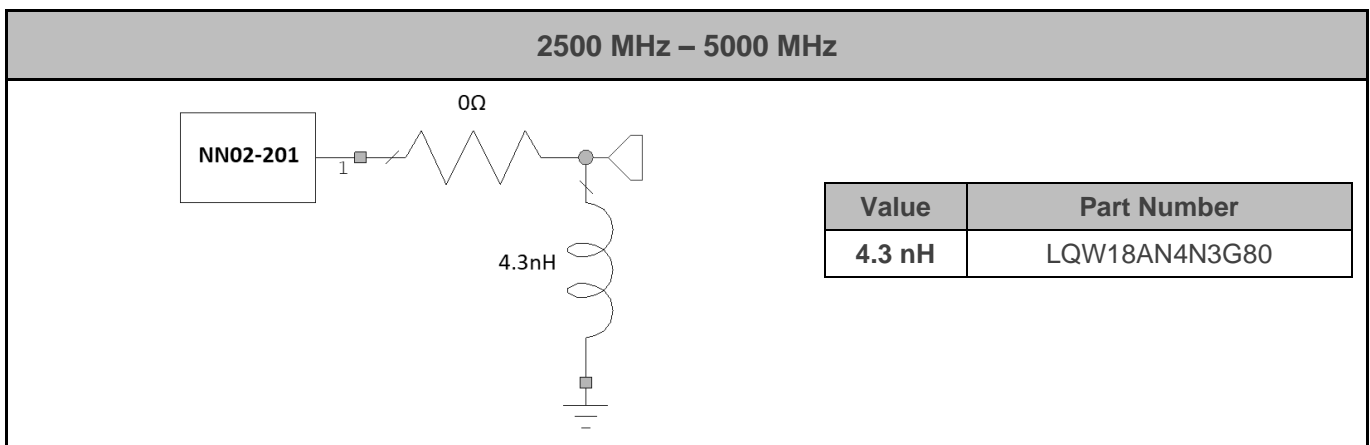


Figure 2 – Matching network implemented in the evaluation board (Figure 1).

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.

¹ See terms and conditions for a free NN Wireless Fast-Track service in 24h at: <https://www.fractusantennas.com/fast-track-project/>

2.2.2. VSWR AND TOTAL EFFICIENCY

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

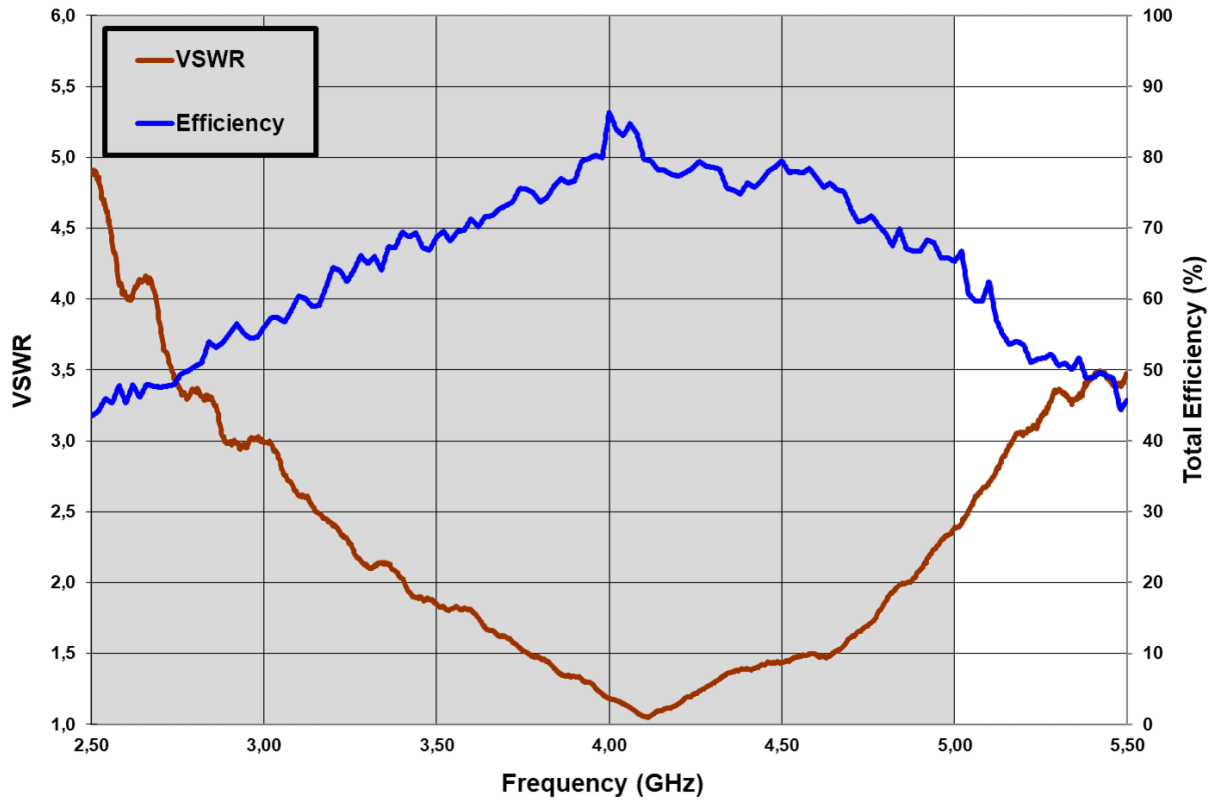
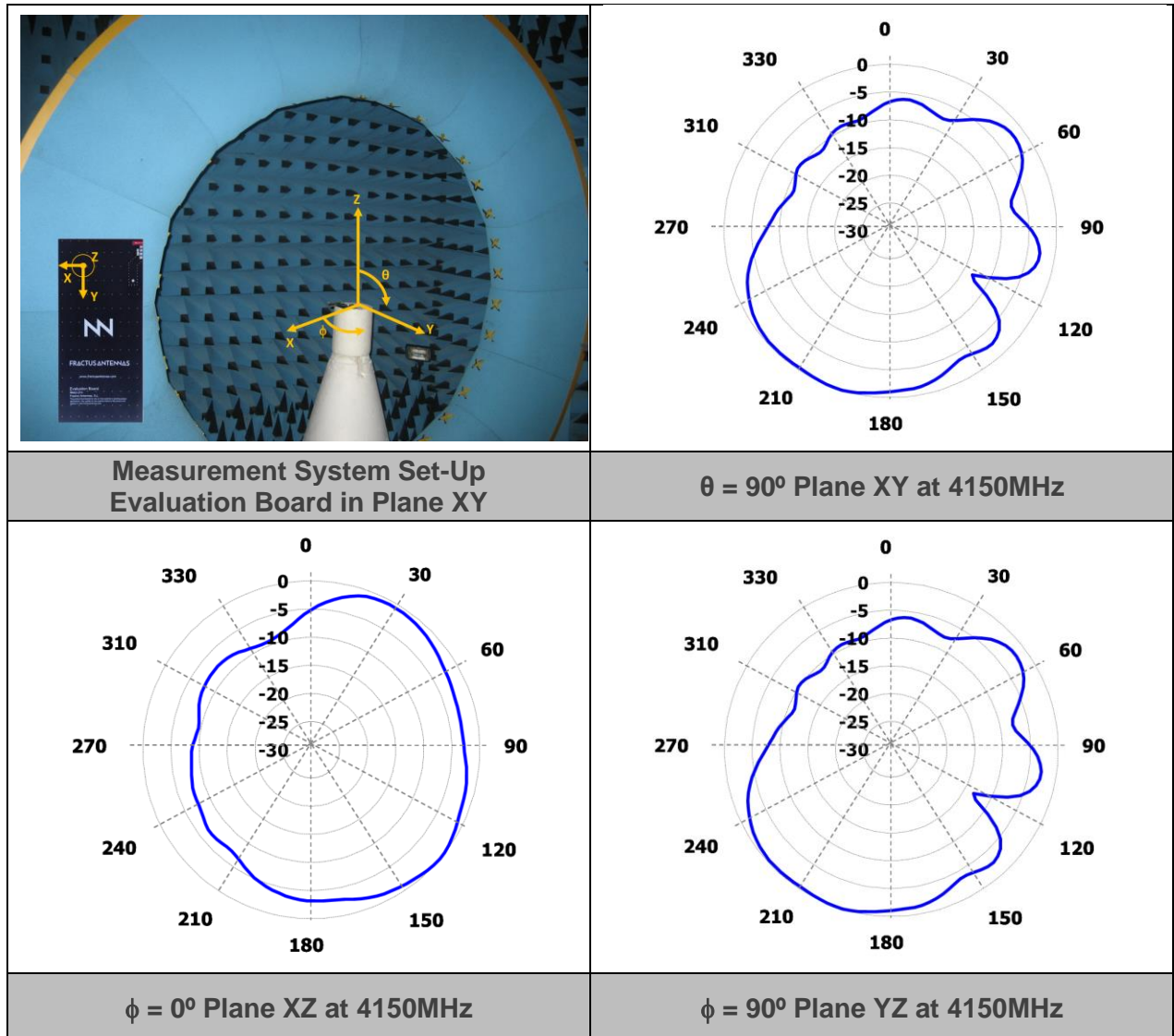


Figure 3 – VSWR and Total Efficiency at 5G bands (2500 MHz – 5000 MHz) (from the evaluation board) (Figure 1).

2.2.3. RADIATION PATTERNS (2500 MHz – 5000 MHz), GAIN, AND EFFICIENCY



| | | |
|------------|---|---------------------|
| Gain | Peak Gain | 3.9dBi |
| | Average Gain across the band | 2.6dBi |
| | Gain Range across the band (min, max) | -0.4dBi <--> 3.9dBi |
| Efficiency | Peak Efficiency | 86.3% |
| | Average Efficiency across the band | 67.7% |
| | Efficiency Range across the band (min, max) | 43.5 – 86.3% |

Table 2 – Antenna Gain and Total Efficiency from the evaluation board (Figure 1) 5G bands (2500 MHz – 5000 MHz). Measures made in the Satimo STARGATE 32 anechoic chamber.

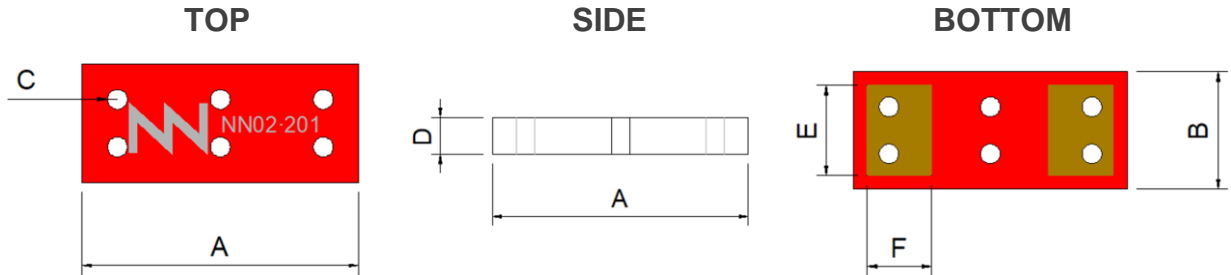
3. CAPABILITIES AND MEASUREMENT SYSTEMS

FRACTUS ANTENNAS specializes in designing and manufacturing optimized antennas for wireless applications and providing our clients with RF expertise. We offer turn-key antenna products and antenna integration support to minimize your time requirements and maximize your return on investment during your product development efforts. We also provide our clients with the opportunity to leverage our in-house testing and measurement facilities to obtain accurate results quickly and efficiently.



4. MECHANICAL CHARACTERISTICS NN02-201

4.1. DIMENSIONS, TOLERANCES, AND RoHS



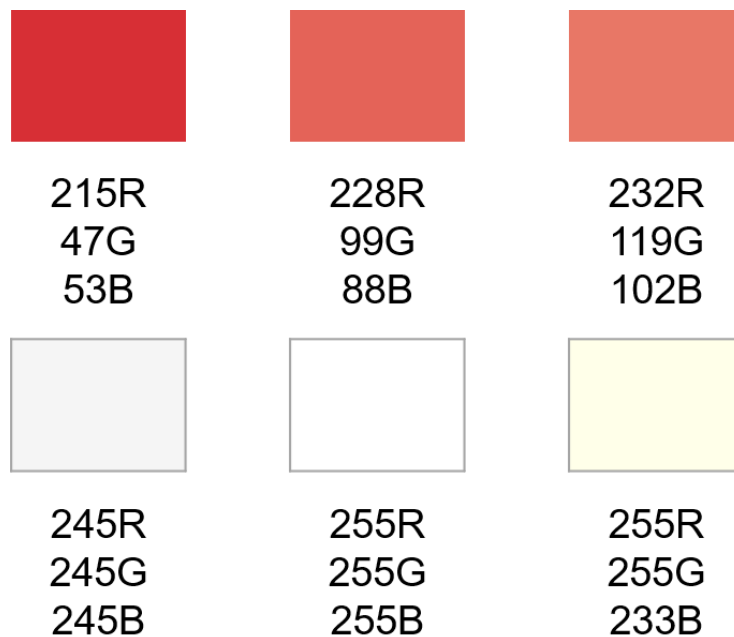
| Dimension | mm | Dimension | mm |
|-----------|-----|-----------|------|
| A | 7.0 | B | 3.0 |
| C | 0.5 | D | 1.0 |
| E | 2.3 | F | 1.65 |

Figure 4 – ONE mXTEND™ antenna booster dimensions and tolerances.

The ONE mXTEND™ antenna booster NN02-201 is compliant with the restriction of the use of hazardous substances (RoHS). For more information, please contact info@fractusantennas.com.

4.2. COLOR RANGE FOR THE INK

Next figure shows the range of the colors in the ONE mXTEND™ antenna booster:



Acceptable color range

4.3. RECOMMENDED FOOTPRINT FOR THE NN02-201

See below the recommended footprint dimensions for the ONE mXTEND™ antenna booster NN02-201.

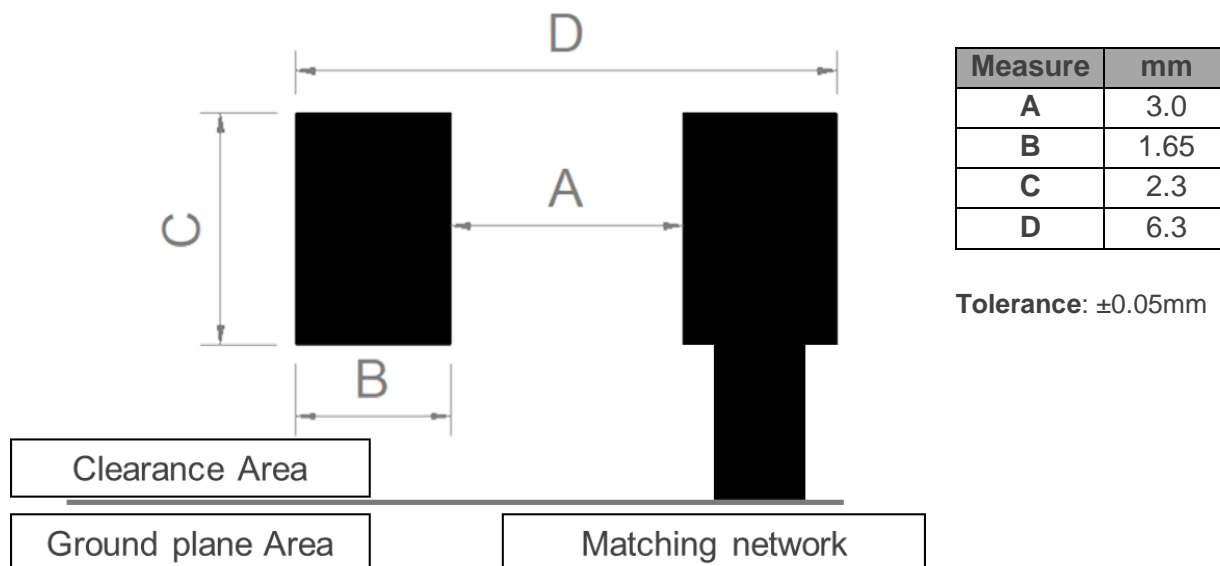


Figure 5 – Footprint dimensions for the the ONE mXTEND™ (NN02-201) antenna booster.

For additional support in the integration process, please contact support@fractusantennas.com

5. ASSEMBLY PROCESS

Figure 6 shows the back and front views of the ONE mXTEND™ antenna booster (NN02-201).

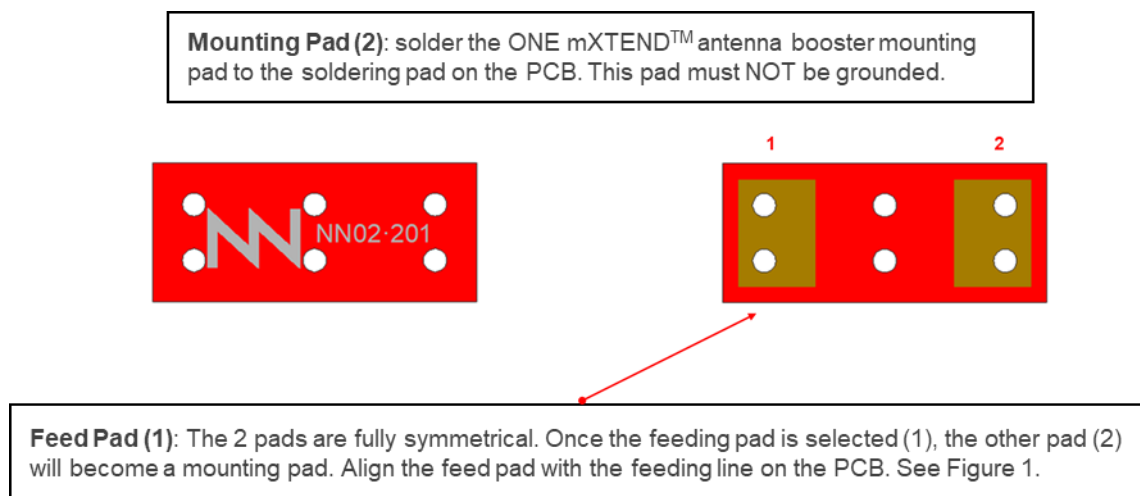


Figure 6 – Pads of the ONE mXTEND™ antenna booster NN01-201.

As a surface mount device (SMD), the ONE mXTEND™ antenna booster is compatible with industry standard soldering processes. The basic assembly procedure for the ONE mXTEND™ antenna booster is as follows:

1. Apply a solder paste on the pads of the PCB. Place the ONE mXTEND™ antenna booster on the board.
2. Perform a reflow process according to the temperature profile detailed in Table 3, Figure 8.
3. After soldering the ONE mXTEND™ antenna booster to the circuit board, perform a cleaning process to remove any residual flux. FRACTUS ANTENNAS recommends conducting a visual inspection after the cleaning process to verify that all reflux has been removed.

The drawing below shows the soldering details obtained after a correct assembly process:

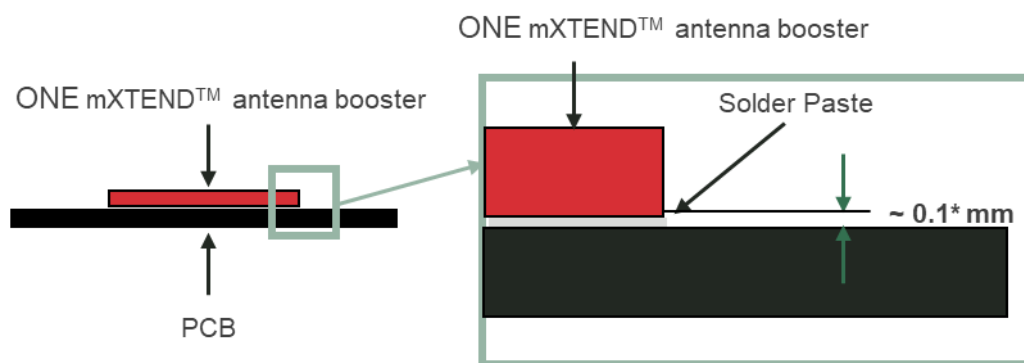


Figure 7 – Soldering Details.

NOTE(*): Solder paste thickness after the assembly process will depend on the thickness of the soldering stencil mask. A stencil thickness equal or larger than **127 microns (5 mils)** is required.

The ONE mXTEND™ antenna booster (NN02-201) can be assembled following the Pb-free assembly process. According to the Standard **IPC/JEDEC J-STD-020C**, the temperature profile suggested is as follows:

| Phase | Profile features | Pb-Free assembly (SnAgCu) |
|--|--|------------------------------------|
| RAMP-UP | Avg. Ramp-up Rate (T _{smax} to T _p) | 3 °C / second (max.) |
| PREHEAT | - Temperature Min (T _{smin}) - Temperature Max (T _{smax}) - Time (t _{smin} to t _{smax}) | 150 °C 200 °C 60-180 seconds |
| REFLOW | - Temperature (T _L) - Total Time above T _L (t _L) | 217 °C 60-150 seconds |
| PEAK | - Temperature (T _p) - Time (t _p) | 260 °C 20-40 seconds |
| RAMP-DOWN | Rate | 6 °C/second max |
| Time from 25 °C to Peak Temperature | | 8 minutes max |

Table 3 – Recommended soldering temperatures.

Next graphic shows temperature profile (grey zone) for the ONE mXTEND™ antenna booster assembly process reflow ovens.

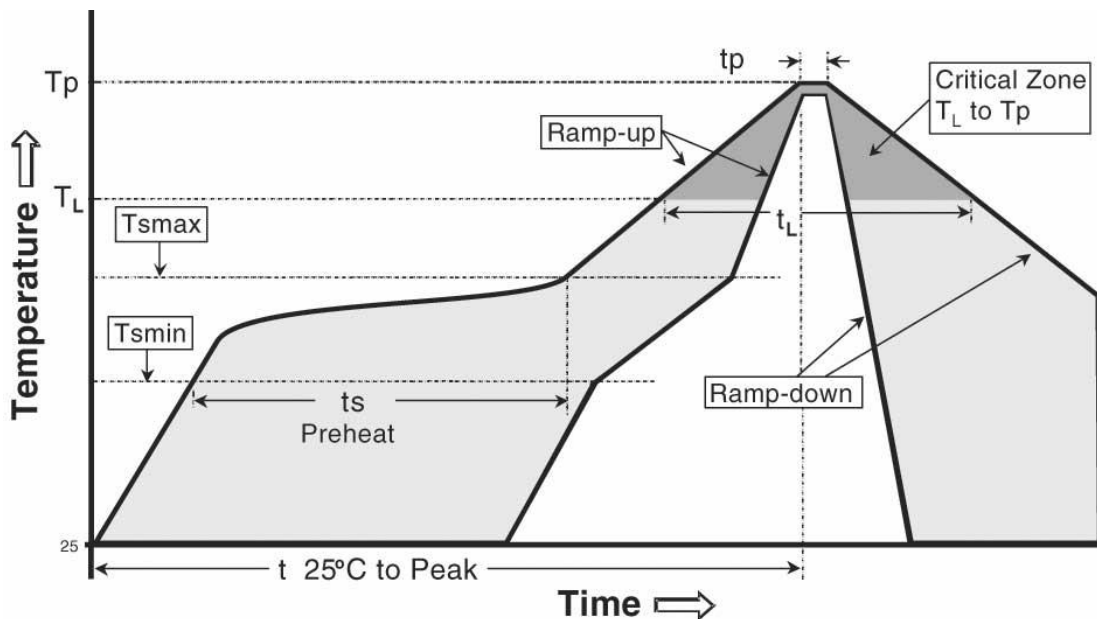
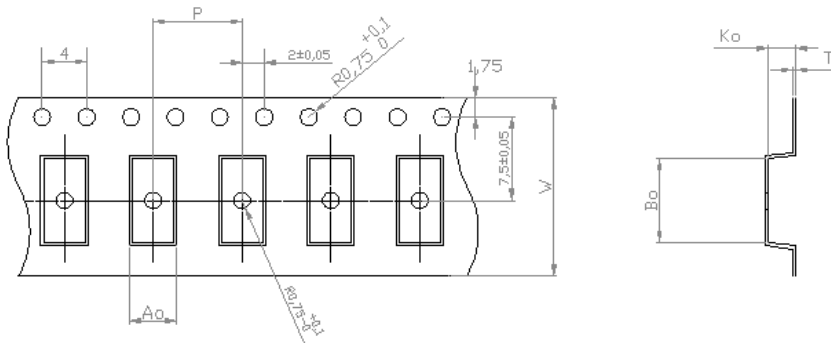


Figure 8 – Temperature profile.

6. PACKAGING

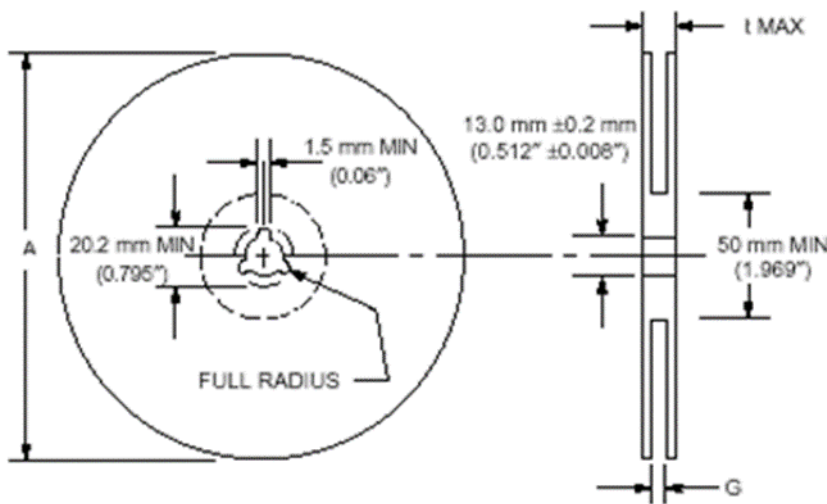
The ONE mXTEND™ antenna booster NN02-201 is delivered in tape and reel packaging.



| Measure | mm |
|---------|------------|
| A0 | 3.6 ± 0.1 |
| B0 | 7.5 ± 0.1 |
| K0 | 2.5 ± 0.1 |
| W | 16.0 ± 0.3 |
| P | 8.0 ± 0.1 |
| T | 0.3 ± 0.05 |

Figure 9 – Tape dimensions and tolerances.

REEL DIMENSIONS



| Measure | mm |
|---------|------------|
| A | 330 ± 1.0 |
| G | 16.4 ± 0.1 |
| t max | 20.4 ± 0.1 |

Reel Capacity: 2500 pcs

Figure 10 – Reel dimensions and capacity.

FRACTUS ANTENNAS products and solutions are protected by [Fractus Antennas patents](#).

All information contained within this document is property of FRACTUS ANTENNAS and is subject to change without prior notice. Information is provided “as is” and without warranties. It is prohibited to copy or reproduce this information without prior approval.

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

ISO 9001: 2015 Certified

