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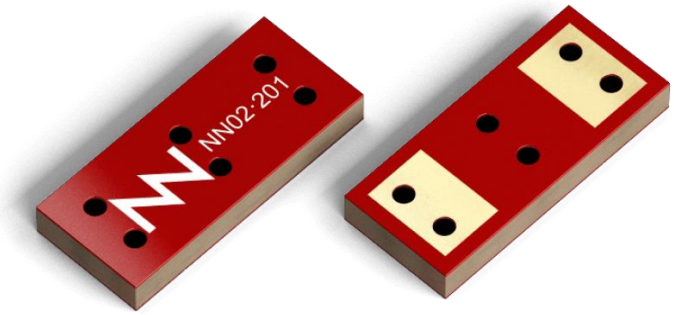
ONE mXTEND™

NN02-201

USER MANUAL

ONE mXTEND™: Highly versatile and powerful.

ONE mXTEND™ is the smallest Virtual Antenna® chip for both **cellular** and **unlicensed** IoT wireless devices (ISM). Featuring a size of 7 x 3 x 1mm, this antenna chip has been designed to fit just about every **IoT device**, particularly *small, light, entry-level products*. **ONE mXTEND™** is enabled by Virtual Antenna® 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 **2G**, **3G**, **4G,** and **5G** bands, but also for unlicensed regions of the spectrum such as for instance the entire range of **WiFi-6E**.



ONE mXTEND™ component (NN02-201)

Most used industries.

- **Asset Tracking & Logistics**
- **Industrial IoT**
- **Smart Home & Buildings**
- **Wearables & Hearables**
- **Smart Metering**

ONE mXTEND™ benefits.

- **Smallest volume:** Multiband cellular/ISM IoT performance in the smallest volume form factor: 7.0 mm x 3.0 mm x 1.0 mm.
- **Multiband:** 2G/3G, NB-IoT/LTE-M, 5G, ISM and Wi-Fi 6E applications.
- **Wide reach:** Multi regional product (compatible with multiple regional standards).
- **Reliability:** Off-the-Shelf standard product, no antenna part customization (electronic optimization).
- **Use cases:** Wi-Fi 6E devices and IoT entry level products such trackers, IoT sensors, wearables and alike.

Operation bands summary.

LTE/LTE-M/NB-IoT, GSM, UMTS, 4G, 5G, Bluetooth, Wi-Fi 7, and many more within the frequency range of 800 MHz to 10600 MHz.

CHAPTER INDEX

1 CONFIGURATION OVERVIEW

The ONE mXTEND™ antenna booster, with a **volume of only 21mm³**, is one of the smaller chip of the Virtual Antenna® family. This miniature, multipurpose, and ultra slim component is designed to provide multi-band connectivity at **cellular IoT**, including connectivity within several 2G, 3G, 4G and 5G bands, but also for other regions of the spectrum, such as **Wi-Fi 6E**.

Configuration	Frequency range	Frequency Regions
CELLULAR (2G/3G-EU)	880 – 960MHz, 1710 – 2170MHz	2
CELLULAR (2G/3G-USA)	824 – 894MHz, 1850 – 2170MHz	2
5G	3300 – 5000 MHz	1
Wi-Fi 6E	2400 – 2500MHz, 5170 – 5835MHz, 5925 – 7125 MHz	3

Table 1 - List of communication standards included in this user manual sorted by frequency range.

The following table presents the technical specifications of the ONE mXTEND™ antenna booster, including its radiation pattern, polarization, weight, temperature range, impedance, and dimensions. These features make the ONE mXTEND™ antenna booster a highly versatile and durable component that can be easily integrated into a wide range of wireless applications.

Technical Features	ONE mXTEND™ (NN02-201)
Radiation Pattern	Omnidirectional
Polarization	Linear
Weight (approx.)	0.02 g
Temperature	-40 to + 125 ºC
Impedance	50 Ω

Table 2 - Technical features for the ONE mXTEND™.

PURCHASE EVALUATION BOARD THROUGH DISTRIBUTOR

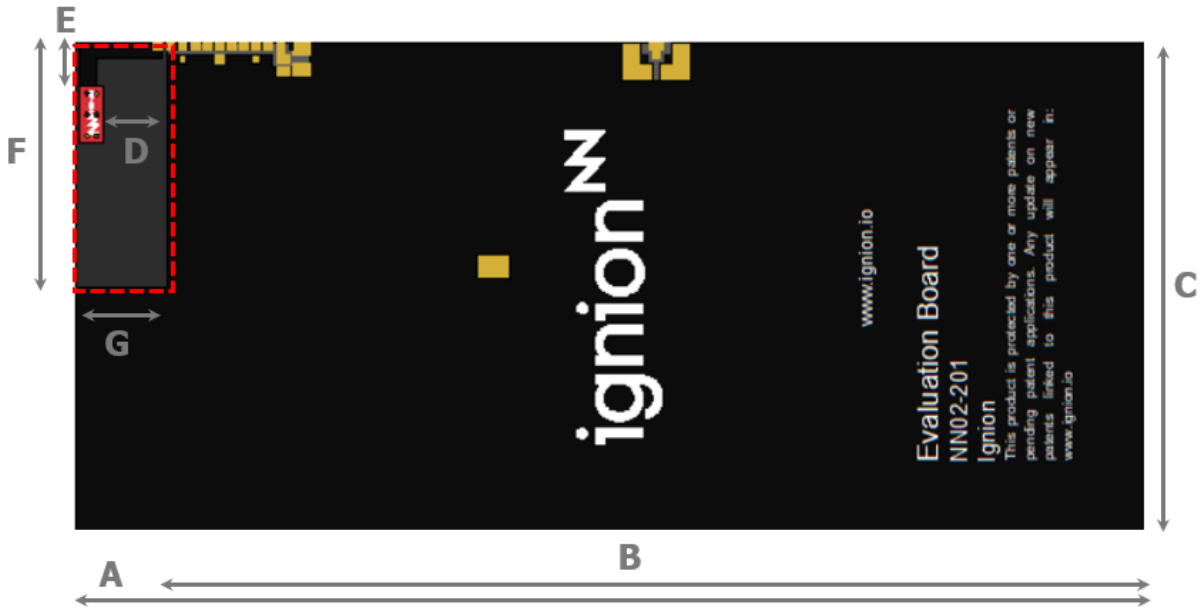
Any of the evaluation boards shown in this document can be purchased through our main distributors, find them here: https://ignion.io/distributors/.

1.1. CELLULAR 2G/3G EUROPE SOLUTION

Technical Features	880 – 960MHz	1710 – 2170MHz
Average Efficiency	> 55%	> 65%
Peak Gain	1.3 dBi	1.7 dBi
VSWR	< 3:1	

Table 3 - Performance of ONE mXTEND™ configured for **CELLULAR 2G/3G EUROPE** on evaluation board (131 mm x 60 mm x 1 mm).

This evaluation board (part number: EB_NN02-201-2G/3G-Europe) integrates a UFL cable to connect the ONE mXTEND™ antenna booster with the SMA connector. The ONE mXTEND™ provides operation in two frequency regions, from 880 MHz to 960 MHz and from 1710 MHz to 2170 MHz, through a single input/output port.



Measure	mm
A	131
B	120
C	60
D	8.0
E	5.0
F	30
G	11

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 8.0 mm (FxG)

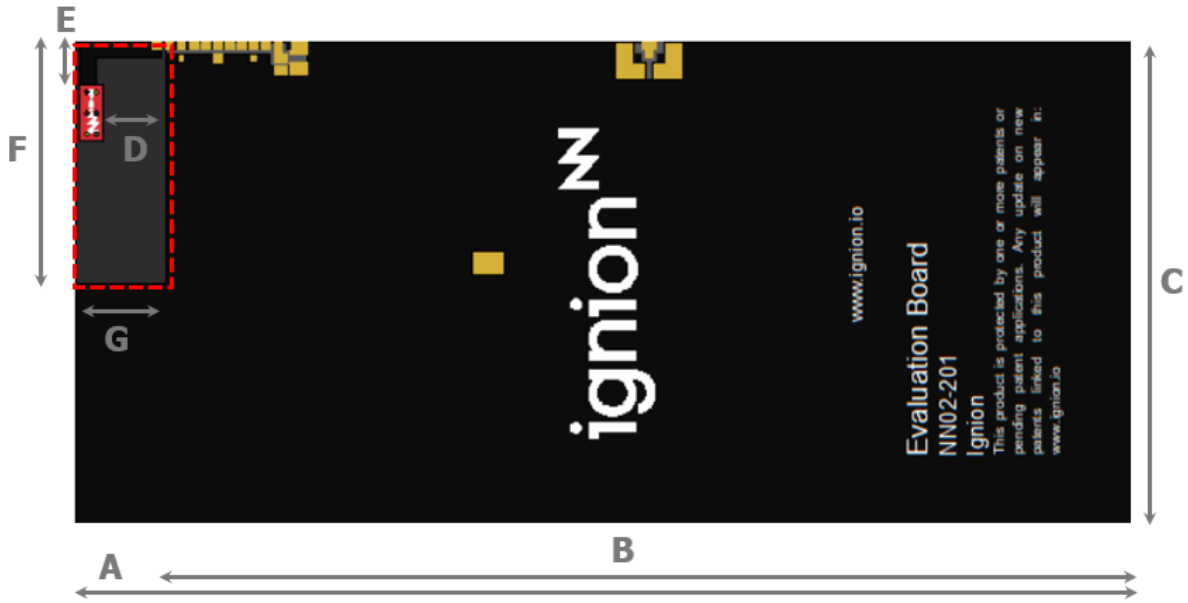
Figure 1 – EB_NN02-201-2G_3G-Europe. Evaluation board providing operation at 2G/3G-Europe band (880 – 960 MHz and 1710 – 2170 MHz).

1.2. CELLULAR 2G/3G USA SOLUTION

Technical Features	824 – 894MHz	1850 – 2170MHz
Average Efficiency	> 65%	> 70%
Peak Gain	1.9 dBi	2.0 dBi
VSWR	< 3:1	

Table 4 - Performance of ONE mXTEND™ configured for **CELLULAR 2G/3G USA** on evaluation board (131 mm x 60 mm x 1 mm).

This evaluation board (part number: EB_NN02-201-2G/3G-USA) integrates a UFL cable to connect the ONE mXTEND™ antenna booster with the SMA connector. The ONE mXTEND™ provides operation in two frequency regions, from 880 MHz to 894 MHz and from 1850 MHz to 2170 MHz, through a single input/output port.



Measure	mm
A	131
B	120
C	60
D	8.0
E	5.0
F	30
G	11

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 8.0 mm (FxG)

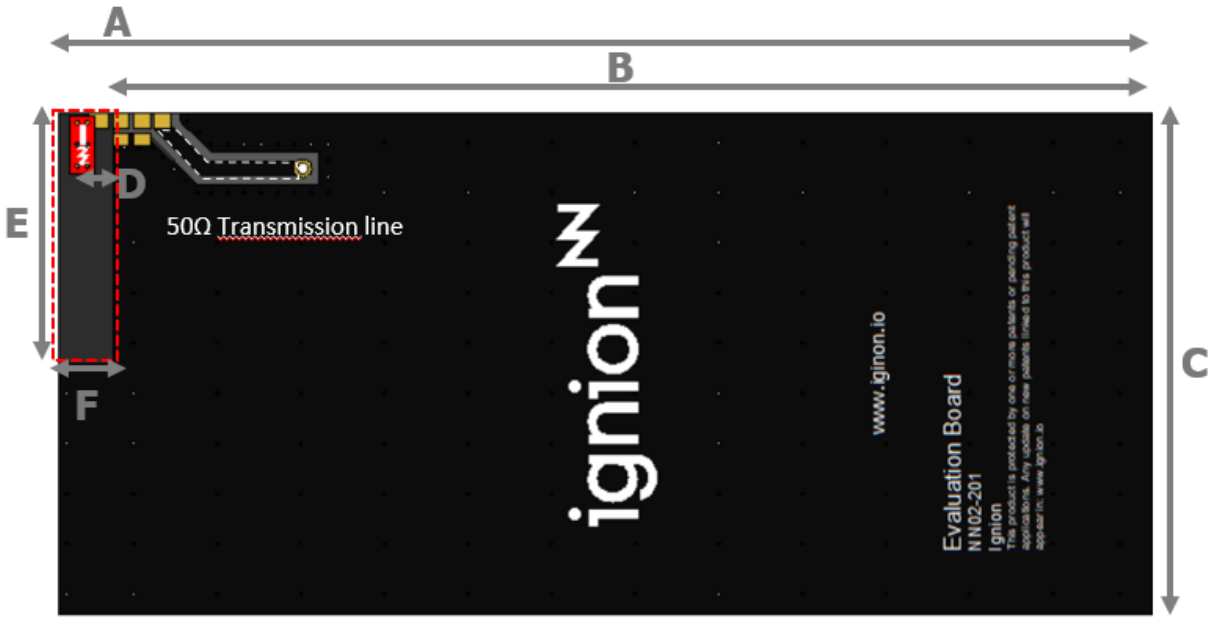
Figure 2 – EB_NN02-201-2G/3G-USA evaluation board providing operation at 2G/3G-USA band (824 – 894 MHz and 1850 – 2170 MHz).

1.3. 5G SOLUTION

Technical Features	3300 – 5000MHz
Average Efficiency	> 70%
Peak Gain	4.1 dBi
VSWR	< 3:1

Table 5 - Performance of ONE mXTEND™ configured for **5G** band on evaluation board (131 mm x 60 mm x 1 mm).

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.



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)

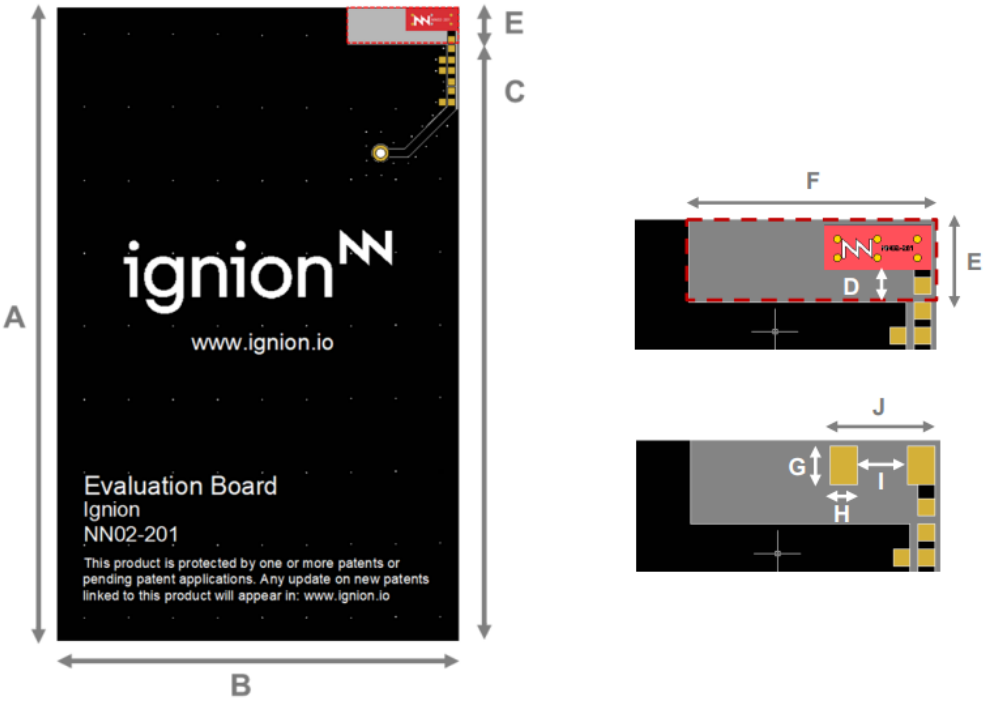
Figure 3 – EB_NN02-201-5G. Evaluation board providing operation at 5G bands (from 3300 MHz to 5000 MHz).

1.4. Wi-Fi 6E SOLUTION

Technical Features	2400 – 2500MHz	5170 – 5835MHz	5925 – 7125MHz
Average Efficiency	> 80%	> 85%	> 85%
Peak Gain	3.2 dBi	3.3 dBi	5.0 dBi
VSWR	< 2.5:1		

Table 6 - Performance of ONE mXTEND™ configured for **Wi-Fi 6E** on evaluation board (86 mm x 54 mm x 1 mm).

The Evaluation Board EB-NN02-201-WiFi6E integrates the ONE mXTEND™ antenna booster to provide operation in the frequency region going from 2.400 GHz to 2.483 GHz, 5125 GHz to 5.835 GHz and 5.925 GHz to 7.125 GHz, through a single input/output port.



Measure	mm
A	86
B	54
C	81
D	2.0
E	5.0
F	15
G	2.3
H	1.65
I	3.0
J	6.3

Tolerance: ±0.2 mm

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

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

Clearance Area: 15 mm x 5.0 mm (FxE) (indicated in dashed red line)

Figure 4 – EB-NN02-201-WiFi6E. Evaluation board providing operation at Wi-Fi6E bands (from 2400 MHz to 2500 MHz, from 5170 MHz to 5835 MHz and from 5925 MHz to 7125MHz).

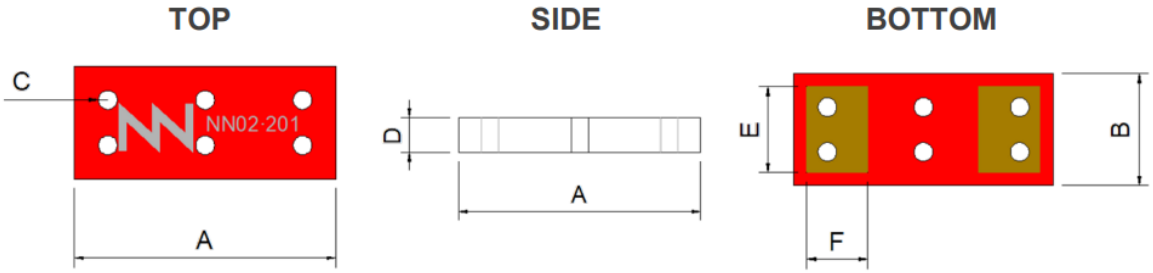
1.5. ASSESS YOUR OWN DEVICE REQUIREMENTS

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/.

2 MECHANICAL SPECIFICATIONS

2.1 DIMENSIONS, TOLERANCES, AND RoHS



Measure	mm
A	7.0
B	3.0
C	0.5
D	1.0
E	2.3
F	1.65

Figure 5 - 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).

The RoHS certificate can be downloaded from https://ignion.io/files/RoHS_NN02-201.pdf.

2.2 SPECIFICATIONS FOR THE INK

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

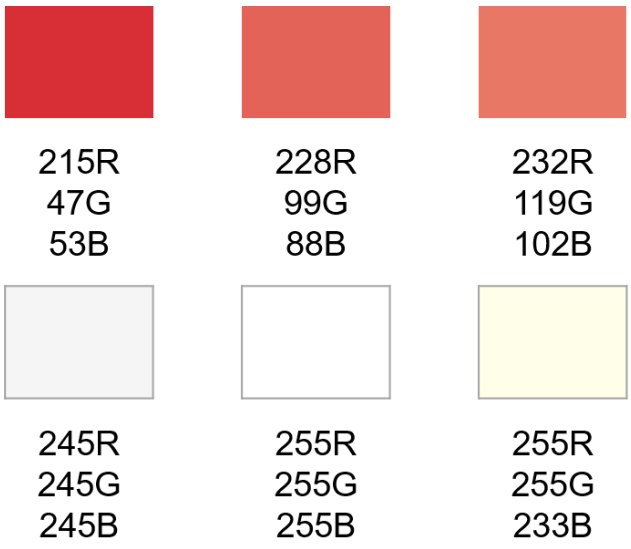


Figure 6 – Acceptable color range.

3 ASSEMBLY AND MANUFACTURING

Figure 7 shows the back and front views of the ONE mXTEND™ (NN02-201) antenna booster.

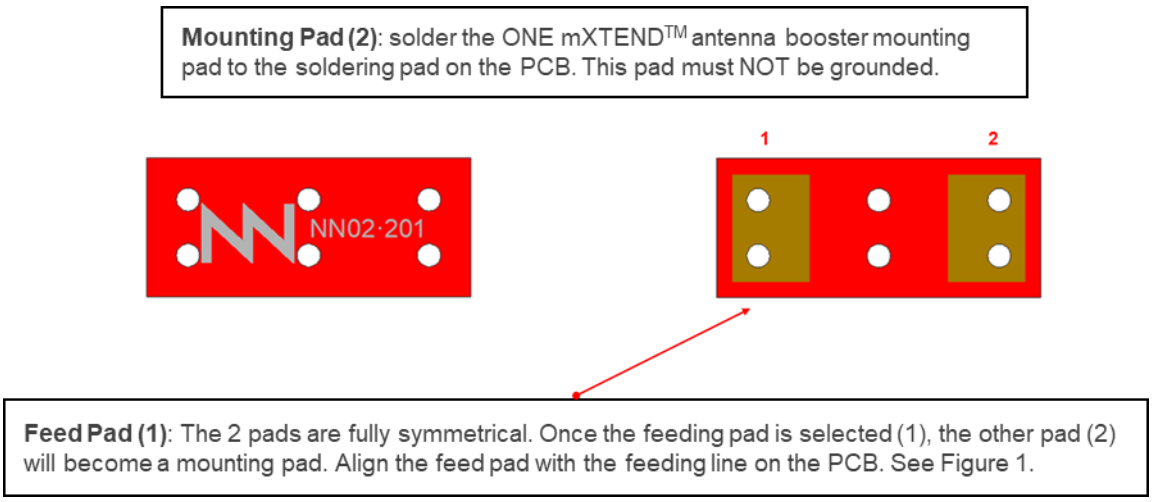


Figure 7 – Pads of the ONE mXTEND™ (NN02-201) antenna booster

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 Figure 9, Table 7.
3. After soldering the ONE mXTEND™ antenna booster to the circuit board, perform a cleaning process to remove any residual flux. Ignion 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:

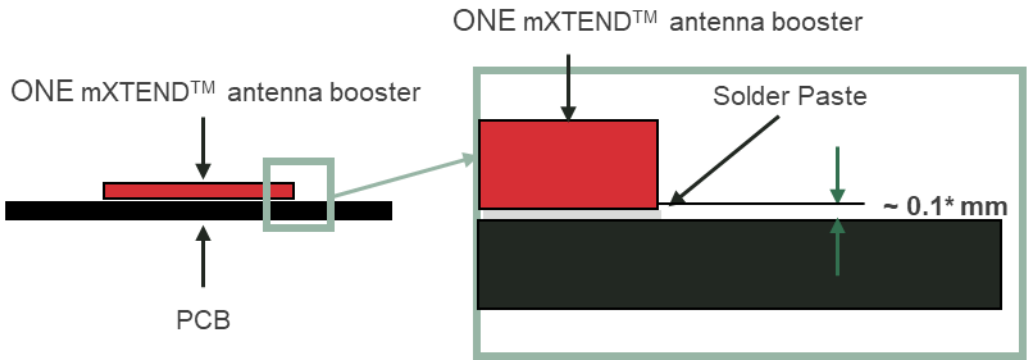


Figure 8 – Soldering Details.

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

Phase	Profile features	Pb-Free Assembly (SnAgCu)
RAMP-UP	Avg. Ramp-up Rate (Tsmax to Tp)	3 ºC / second (max.)
PREHEAT	- Temperature Min (Tsmin) - Temperature Max (Tsmax) - Time (tsmin to tsmax)	150 ºC 200 ºC 60-180 seconds
REFLOW	- Temperature (TL) - Total Time above TL (tL)	217 ºC 60-150 seconds
PEAK	- Temperature (Tp) - Time (tp)	260 ºC 20-40 seconds
RAMP-DOWN	Rate	6 ºC/second max
Time from 25 ºC to Peak Temperature		8 minutes max

Table 7 - Recommended soldering temperatures.

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

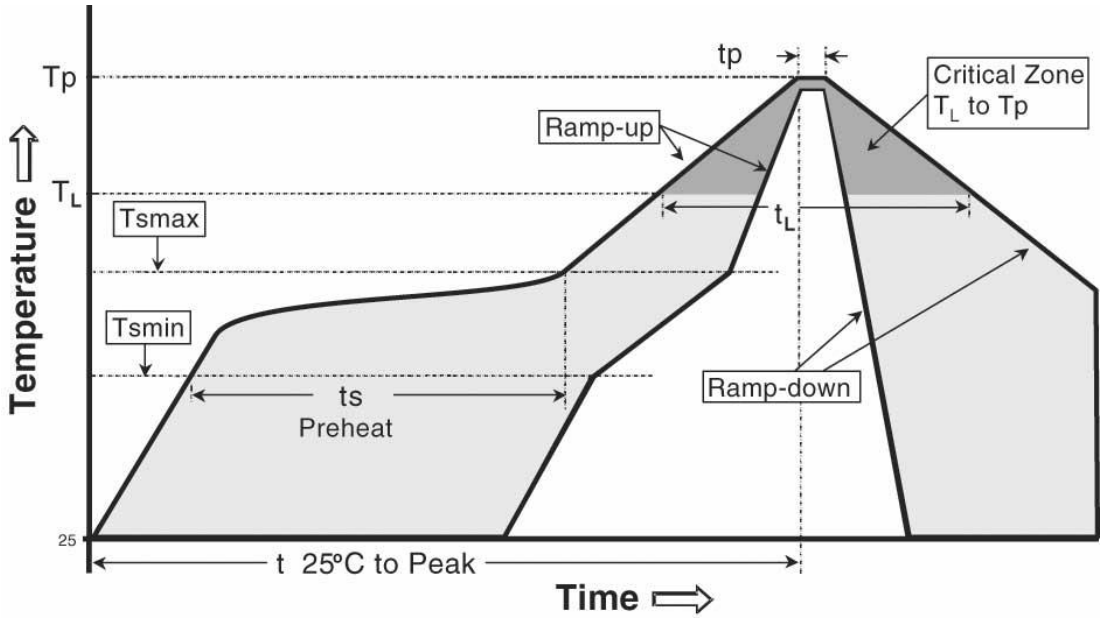
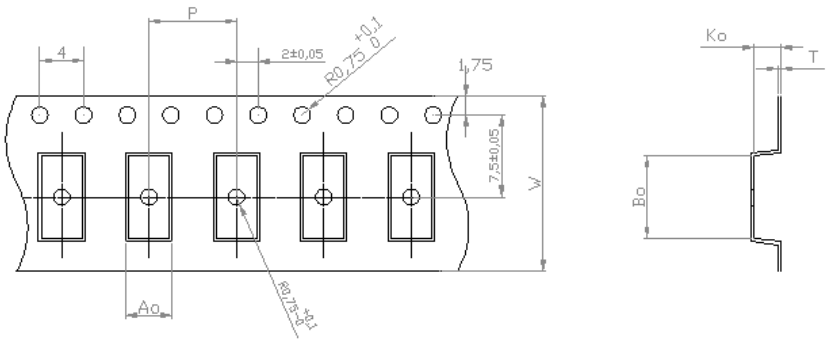


Figure 9 – Temperature profile.

4 PACKAGING

The ONE mXTEND™ (NN02-201) antenna booster is delivered in tape and reel packaging. Ambient room conditions according to Moisture Sensitivity Level (MSL1): Unlimited floor life at 30 °C/85%RH.



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 10 - Tape dimensions and tolerances.

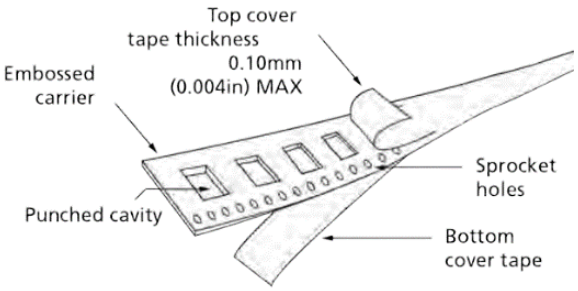
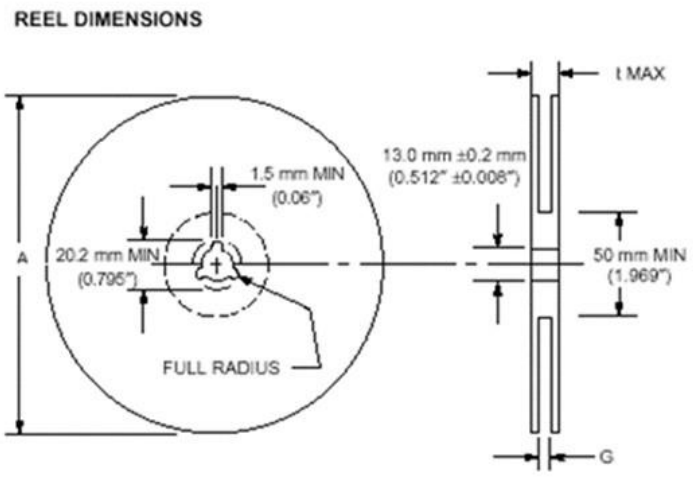


Figure 11 - Image of the tape.



Measure	mm
A	330 ± 1.0
G	16.4 ± 0.1
t MAX	20.4 ± 0.1

Reel Capacity: 5000 pcs

Figure 12 – Reel Dimensions and Capacity.

5 EASY DESIGN JOURNEY WITH VIRTUAL ANTENNA® TECHNOLOGY

This is the simple step by step design journey when designing with Virtual Antenna® technology. You can either do it yourself or you can leverage Ignion's comprehensive support. Our team of experts is available throughout every step, from feasibility to certification and can help ensure you get the antenna right.

Figure 13 – Virtual Antenna® design journey for a successful IoT solution.

Step 1 - Feasibility: The Oxion™ platform provides feasibility results on a bare PCB in terms of reflection coefficient, total efficiency, and design recommendations such as antenna placement and clearance area.

Step 2 - Build design file: Build the design files (Gerber files) with optimal antenna integration based on Ignion templates and design recommendations received from the Oxion™ platform.

Step 3 - EM simulation: Validation of the design files with an Electro-Magnetic (EM) simulation of the full device considering every component, ensuring project requirements are met. Further allowing evaluation of design changes and their impact to the antenna performance.

Step 4 - Final Gerber design file sanity check: Check done by Ignion free of charge, ensuring that the antenna, matching network layout and other design recommendations on the final Gerber file follows the design guidelines before manufacturing.

Step 5 - Produce prototype and test: Verify performance results are aligned with expectations, easily fine-tune matching network if needed.

Step 6 - Certification pre-test: Perform OTA tests to ensure the device is meeting certification requirements.

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

ISO 9001: 2015 Certified

6 ANNEX: List of bands

6.1 Cellular bands covered

Comm. Standard	Frequency (MHz)	# band
2G/3G-EU	880 – 960, 1710 – 2170	dual band
2G/3G-USA	824 – 894, 1850 – 2170	dual band
5G	3300 – 5000	single band

Bands	Uplink (MHz)	Downlink (MHz)	Region
1	1920 – 1980	2110 – 2170	GLOBAL
2	1850 – 1910	1930 – 1990	NA
3	1710 – 1785	1805 – 1880	GLOBAL
4	1710 – 1755	2110 – 2155	NA
5	824 – 849	869 – 894	NA
6	830 – 840	875 – 885	APAC
7	2500 - 2570	2620 - 2690	GLOBAL
8	880 - 915	925 - 960	GLOBAL
9	1749.9 - 1784.9	1844.9 - 1879.9	APAC
10	1710 – 1770	2110 – 2170	APAC
15	1900 – 1920	2600 – 2620	-
17	704 - 716	734 - 746	GLOBAL
18	815 – 830	860 – 875	JAPAN
19	830 – 845	875 – 890	JAPAN
23	2000 – 2020	2180 – 2200	NA
25	1850 – 1915	1930 – 1995	NA
26	814 – 849	859 – 894	NA
34	2010 – 2025	2010 – 2025	EMEA
37	1910 – 1930	1910 – 1930	NA
39	1880 – 1920	1880 – 1920	CHINA
65	1920 – 2010	2110 – 2200	GLOBAL
66	1710 – 1780	2110 – 2200	NA
70	1695 – 1710	1995 – 2020	NA

6.2 Wi-Fi 6E bands covered

Comm. Standard	Frequency (MHz)	# band
Wi-Fi 6E	2400 – 2500, 5170 – 5835, 5925 – 7125	multiband

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