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Your innovation.
Accelerated.

RUN mXTEND™

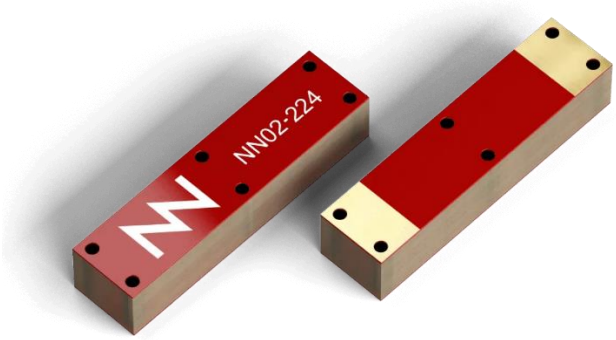
NN02-224

USER MANUAL

RUN mXTEND™: Highly versatile and powerful.

The small, versatile RUN mXTEND™ (NN02-224) is the perfect solution for devices where **volume and cost are constrained but maximum performance is desired**.

Thanks to its dimensions and tuneability, the antenna easily adapts to almost every wireless device and to any radio technology within the 698-8000 MHz frequency range.



RUN mXTEND™ component (NN02-224)

Most used industries.

- **Asset Tracking & Logistics.**
- **Smart Metering.**
- **Fleet Management.**
- **IoT Sensors and Modules.**
- **Industrial IoT.**

RUN mXTEND™ benefits.

- **Top performance**: Top multiband IoT performance.
- **Ultra-compact form factor:** 12.0 mm x 3.0 mm x 2.4 mm.
- **Global reach:** Multiband performance compatible with global standards.
- **Fast time to market** – build a digital prototype using Oxion™ platform.
- **Simple manufacturing:** Off-the-Shelf standard component mounted with pick-and-place.

Operation bands summary.

LTE/LTE-M/NB-IoT, GSM, UMTS, 4G, 5G, GNSS, Bluetooth, Wi-Fi, and many more within the frequency range of 698 MHz to 8000 MHz.

CHAPTER INDEX

1 SOLUTION OVERVIEW

The RUN mXTEND™ is a versatile antenna component that can be easily tuned to operate at any wireless frequency. Table 1 provides an overview of a few examples of configurations of the RUN mXTEND™ component for popular wireless frequencies, including cellular LTE/LTE-M, NB-IoT, ISM, Bluetooth, GNSS, and Wi-Fi dual band.

SOLUTION	Frequency range	Frequency Regions
CELLULAR IoT	824 – 960 MHz & 1710 – 2690 MHz	2
ISM	863 – 928 MHz	1
ISM + BLUETOOTH	863 – 928 MHz & 2400 – 2500 MHz	2
GNSS	1561 MHz, 1575 MHz & 1598 – 1606 MHz	3
BLUETOOTH	2400 – 2500 MHz	1
Wi-Fi	2400 – 2500 MHz & 4900 – 5875 MHz	2

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

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

Technical Features	RUN mXTEND™ (NN02-224)
Radiation Pattern	Omnidirectional
Polarization	Linear
Weight (approx.)	0.19 g
Temperature	-40 to + 125 ºC
Impedance	50 Ω

Table 2 - Technical features for the RUN 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 IoT

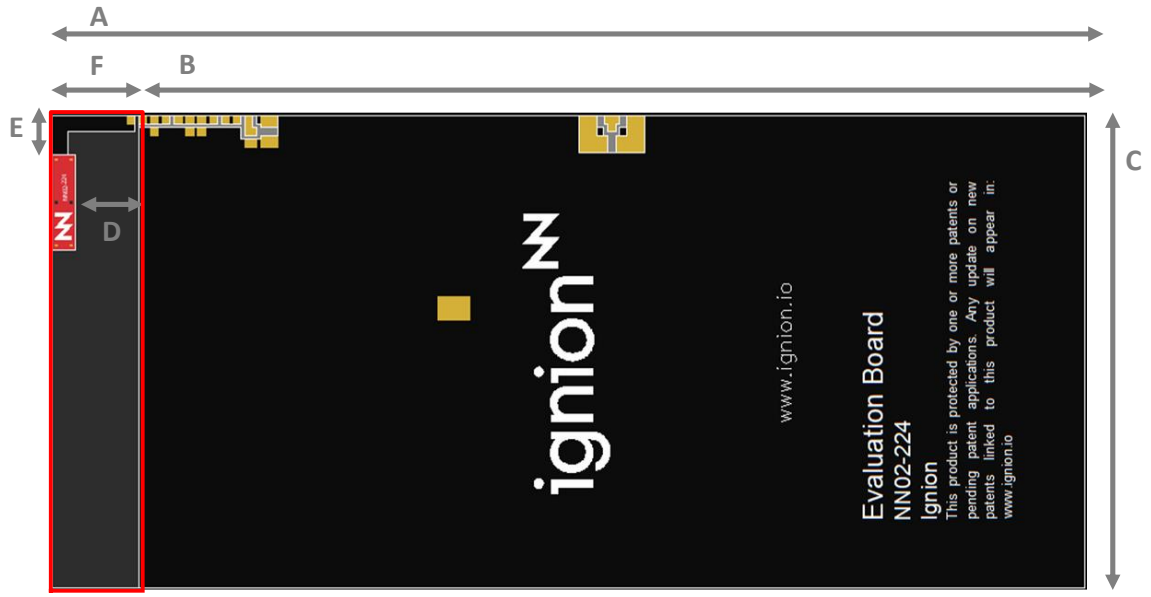
RUN mXTEND™ is designed to cater to a wide range of wireless communication standards, including LTE CAT 1, LTE CAT-M and NB-IoT. It provides reliable operation across multiple frequency bands, ensuring a reliable path to passing cellular certification.

Technical Features	824 – 960 MHz	1710 – 2690 MHz
Average Efficiency	> 65 %	> 70 %
Peak Gain	1.8 dBi	1.9 dBi
VSWR	< 3:1	

Table 3 - Performance of RUN mXTEND™ configured for Cellular IoT on evaluation board (131 mm x 60 mm x 1 mm).

EVALUATION BOARD FOR CELLULAR IoT

This Evaluation Board EB_NN02-224-1B-2RJ-1P integrates a UFL cable to connect the RUN mXTEND™ antenna booster with the SMA connector. The RUN mXTEND™ is tuned for operation in two frequency regions, from 824 MHz to 960 MHz and from 1710 MHz to 2690 MHz, through a single input/output port. For further technical information, please check the links for the application notes listed in Table 1.



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.

1.2. ISM 868/915

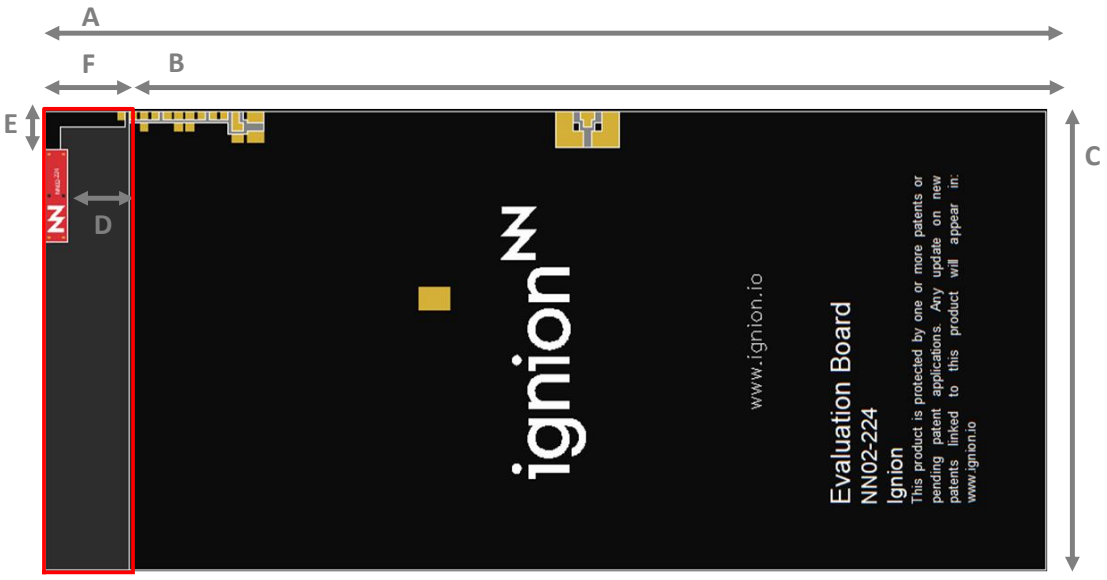
RUN mXTEND™ delivers exceptional performance in the ISM 868 and 915 bands. This configuration ensures optimal performance, small form factor, and cost-effectiveness in devices using wireless standards like LoRa, Sidewalk, ZigBee, Z-Wave, and Wi-SUN.

Technical features	863 – 870 MHz	902 – 928 MHz	863 – 928 MHz
Average Efficiency	> 85 %	> 85 %	> 85 %
Peak Gain	2.1 dBi	2.1 dBi	2.2 dBi
VSWR	< 2:1	< 2:1	< 2:1

Table 4 - Performance of RUN mXTEND™ configured for ISM on evaluation board (131 mm x 60 mm x 1 mm).

EVALUATION BOARD FOR ISM 868/915

This Evaluation Board EB_NN02-224-868-915 integrates a UFL cable to connect the RUN mXTEND™ antenna booster with the SMA connector. The RUN mXTEND™ is tuned for operation in the frequency region which covers from 863 MHz to 928 MHz, through a single input/output port. For further technical information, please check the links for the application notes listed in Table 1.



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 2 – EB_NN02-224-868-915. Evaluation Board providing operation from 863 MHz to 928 MHz.

1.3. GNSS

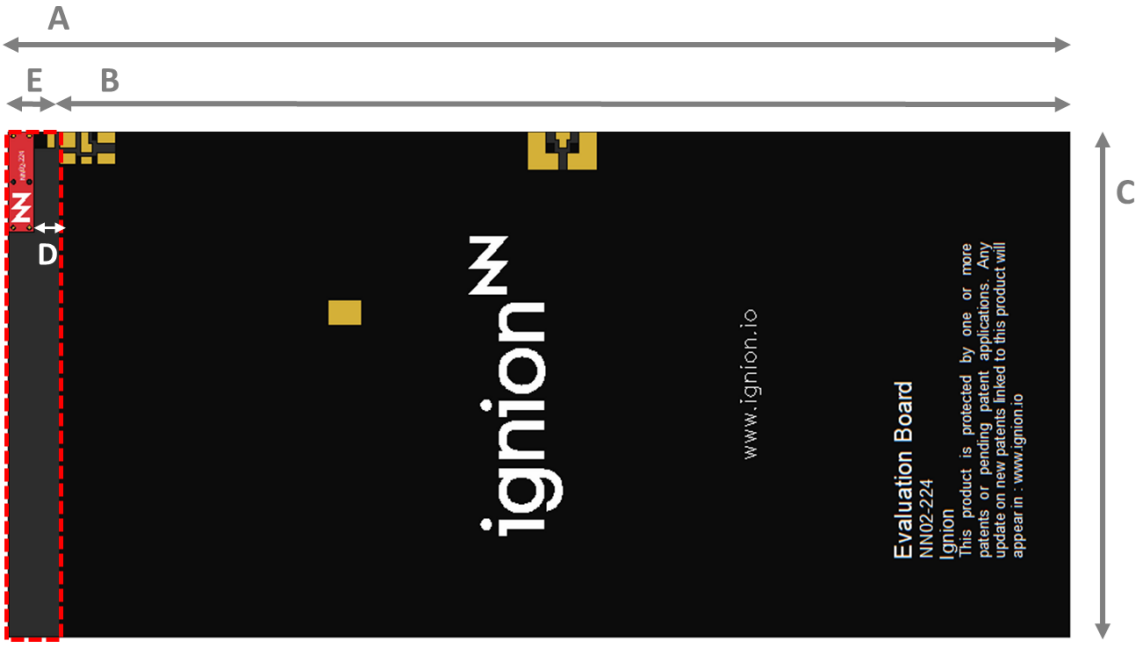
The RUN mXTEND™ can easily be tuned for global navigation systems and the below configuration provides operation in three GNSS frequency regions: **1561 MHz** (BeiDou E1 band), **1575 MHz** (GPS L1 band) and from **1598 MHz to 1606 MHz** (GLONASS L1 band).

Technical features	1561 MHz	1575 MHz	1598 – 1606 MHz
Average Efficiency	> 75 %	> 75 %	> 80 %
Peak Gain	2.9 dBi	3.0 dBi	3.3 dBi
VSWR	< 1.5:1		

Table 5 - Performance of RUN mXTEND™ configured for GNSS on evaluation board (126.5 mm x 60 mm x 1 mm).

EVALUATION BOARD FOR GNSS

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™ is tuned for 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. For further technical information, please check the links for the application notes listed in Table 1.



Measure	mm
A	126.5
B	120
C	60
D	3.5
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 3 - EB_NN02-224-1561-1606. Evaluation Board providing GNSS operation at BeiDou E1 band (1561 MHz), GPS L1 band (1575 MHz) and for GLONASS L1 band (from 1598 MHz to 1606 MHz).

1.4. BLUETOOTH

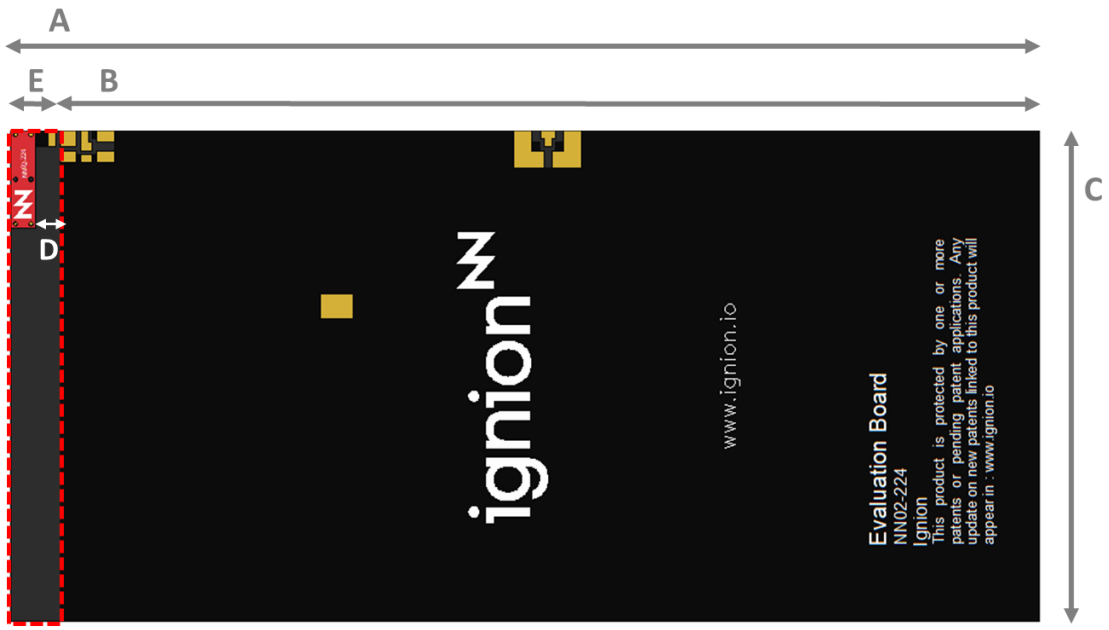
Unleash high 2.4GHz performance by using the RUN mXTEND™ configured for standards like Bluetooth, Zigbee, Thread and Wi-Fi single band. Designed for optimal signal strength and range.

Technical features	2400 – 2500MHz
Average Efficiency	> 75%
Peak Gain	4.2 dBi
VSWR	< 1.5:1

Table 6 - Performance of RUN mXTEND™ configured for Bluetooth on evaluation board (126.5 mm x 60 mm x 1 mm).

EVALUATION BOARD FOR BLUETOOTH

This Evaluation Board EB_NN02-224-2400 integrates a UFL cable to connect the RUN mXTEND™ antenna booster with the SMA connector. The RUN mXTEND™ is tuned for operation in the frequency region which covers from 2.4 GHz to 2.5 GHz, through a single input/output port. Further technical information, check the links for the App Notes listed in Table 1.



Measure	mm
A	126.5
B	120
C	60
D	3.5
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 4 – EB_NN02-224-2400. Evaluation Board operation from 2.4 GHz to 2.5 GHz.

1.5. Wi-Fi

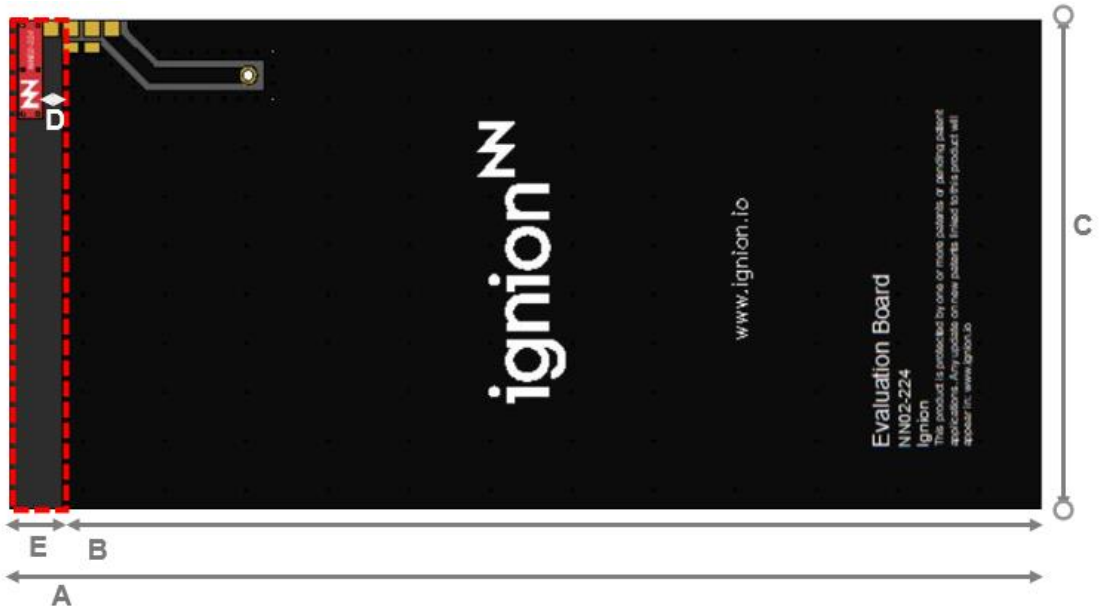
The RUN mXTEND™ can be configured for multiband operation, here maximizing performance in any Wi-Fi standard for 2.4 GHz and 5 GHz.

Technical features	2400 – 2500 MHz	4900 – 5875 MHz
Average Efficiency	> 70 %	> 70 %
Peak Gain	2.9 dBi	3.1 dBi
VSWR	< 2.5:1	

Table 7 - Performance of RUN mXTEND™ configured for Wi-Fi on evaluation board (126.5 mm x 60 mm x 1 mm).

EVALUATION BOARD FOR WI-FI

This Evaluation Board EB_NN02-224-2,4-5 is made with a coplanar grounded transmission line (trace on the PCB) to connect the RUN mXTEND™ antenna booster with the SMA connector. The RUN mXTEND™ is tuned for operation in the frequency regions, from 2.4 GHz to 2.5 GHz and from 4.9 GHz to 5.875 GHz, through a single input/output port. For further technical information, check the links for the App Notes listed in Table 1.



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 5 – EB_NN02-224-2,4-5. Evaluation Board operation from 2.4 GHz to 2.5 GHz and from 4.9 GHz to 5.875 GHz.

1.6. ISM 868/915 + BLUETOOTH

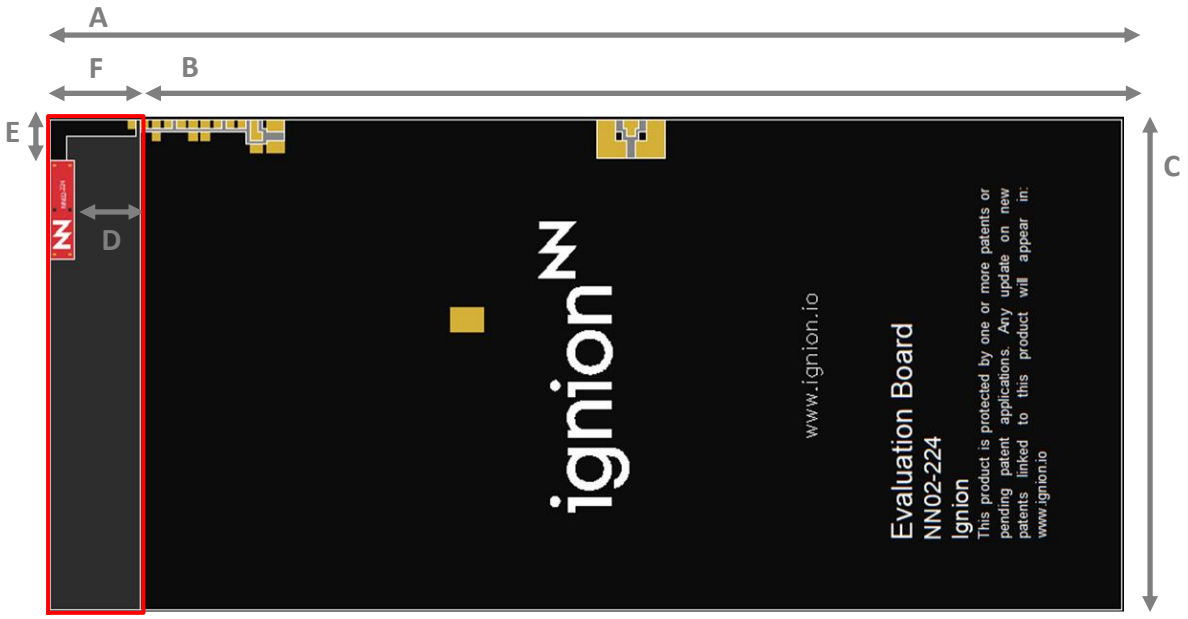
Ensuring small size, cost-effective and high performance in industrial, smart home and smart city applications, RUN mXTEND™ is configured to cover both 868/915 MHz and 2.4GHz in a single antenna solution for standards like LoRa, Sidewalk, ZigBee, Z-Wave, Wi-SUN combined with Bluetooth/Wi-Fi.

Technical features	863 – 870 MHz	902 – 928 MHz	863 – 928 MHz
Average Efficiency	> 75 %	> 75 %	> 75 %
Peak Gain	1.4 dBi	1.6 dBi	1.6 dBi
VSWR	< 2:1	< 2:1	< 2:1
Technical features	**2400 – 2500MHz**		
Average Efficiency	> 80 %		
Peak Gain	2.9 dBi		
VSWR	< 2:1		

Table 8 - Performance of RUN mXTEND™ configured for ISM+Bluetooth on evaluation board (131 mm x 60 mm x 1 mm).

EVALUATION BOARD FOR ISM 868/915 AND BLUETOOTH

This Evaluation Board EB_NN02-224-ISM-BT integrates a UFL cable to connect the RUN mXTEND™ antenna booster with the SMA connector. The RUN mXTEND™ is tuned for operation in the frequency region which covers from 863 MHz to 928 MHz and 2400 MHz to 2500 MHz, through a single input/output port. For further technical information, please check the links for the application notes listed in Table 1.



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 6 – EB_NN02-224-ISM-BT. Evaluation Board providing operation from 863 MHz to 928 MHz and from 2400 MHz to 2500 MHz.

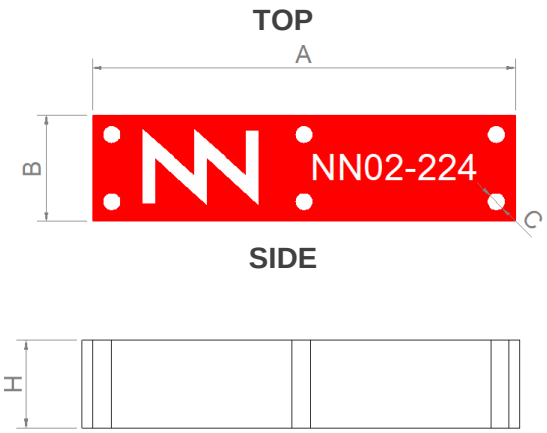
1.7. ASSESS YOUR OWN DEVICE REQUIREMENTS

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



Dimension	mm	Dimension	mm
A	12.0 ± 0.2	**B**	3.0 ± 0.1
C	0.5 ± 0.1	**D**	2.0 ± 0.1
H (Height)	2.4 +0.2 -0.1		

Figure 7 – RUN mXTEND™ antenna booster dimensions and tolerances.

The 2 mounting pads (bottom view) are fully symmetrical to mount it on the PCB.

The RUN mXTEND™ antenna booster NN02-224 is compliant with the restriction of the use of hazardous substances (**RoHS**).

The RoHS certificate can be downloaded from https://ignion.io/files/RoHS_NN02-224.pdf.

2.2 SPECIFICATIONS FOR THE INK

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

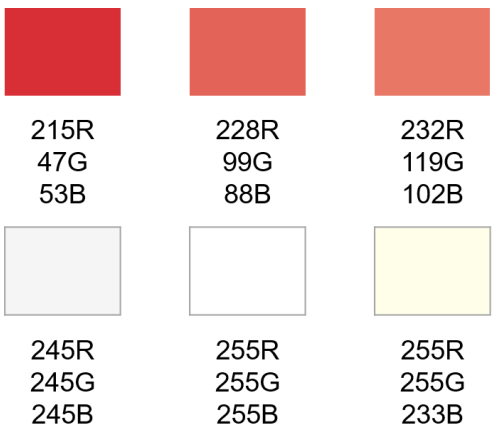


Figure 8 – Acceptable color range.

3 ASSEMBLY AND MANUFACTURING

Figure 18 shows the back and front view of the RUN mXTEND™ antenna booster NN02-224. Due to the symmetry in the product configuration, the feeding pad can be any of the 2 pads.

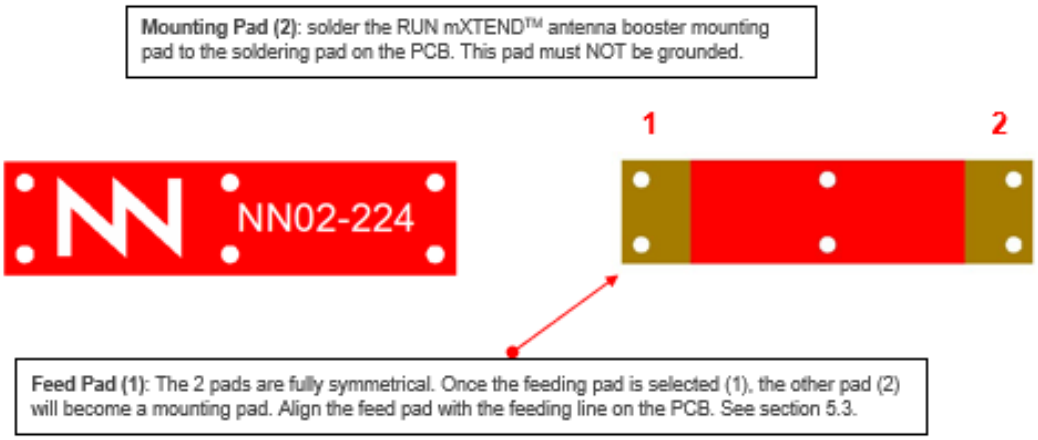


Figure 9 – Pads of the RUN mXTEND™ antenna booster NN02-224.

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

1. Apply a solder paste on the pads of the PCB. Place the RUN mXTEND™ antenna booster on the board.
2. Perform a reflow process according to the temperature profile detailed in Table 9, Figure 11.
3. After soldering the RUN 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:

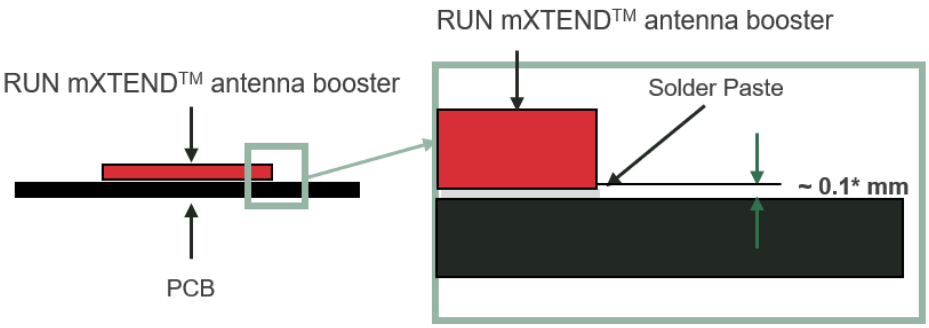


Figure 10 – Soldering Details.

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 RUN mXTEND™ antenna booster NN02-224 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 (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 9 - Performance of RUN mXTEND™ configured for ISM+Bluetooth on evaluation board (131 mm x 60 mm x 1 mm).

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

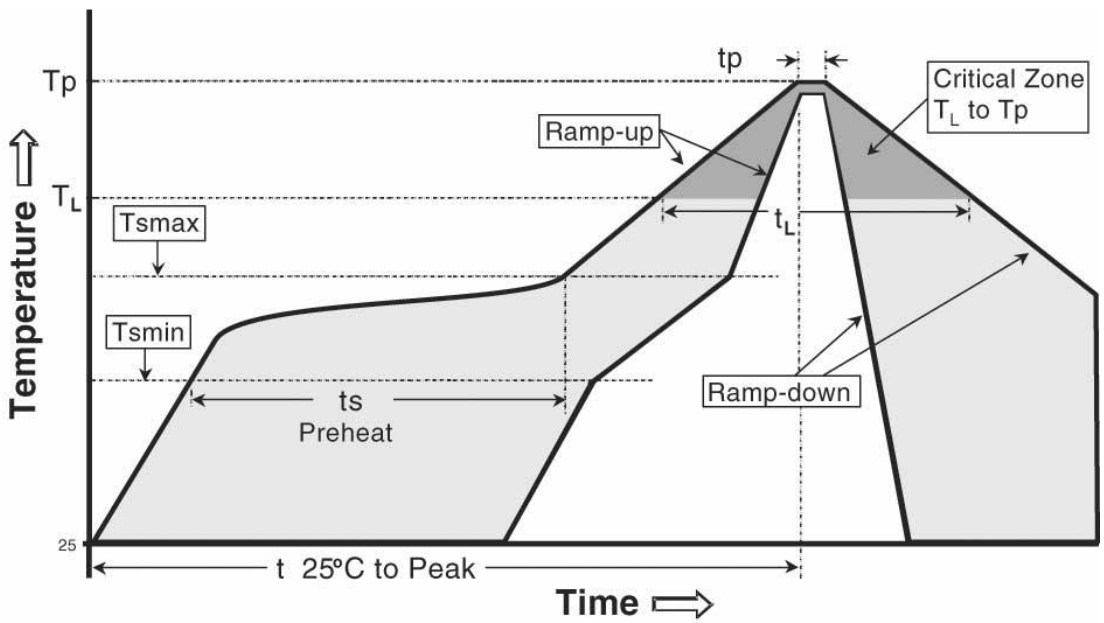
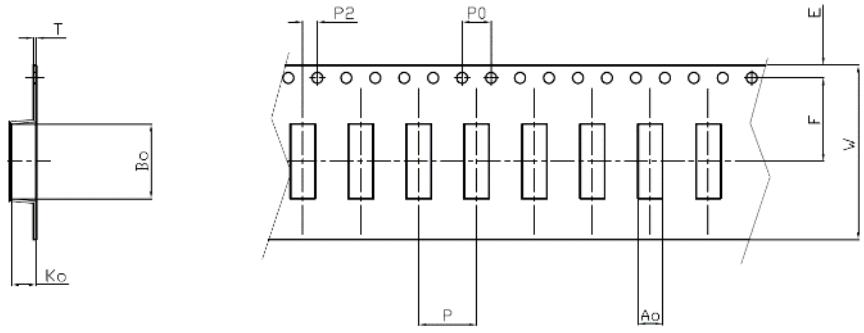


Figure 11 – Temperature profile.

4 PACKAGING

The RUN mXTEND™ antenna booster NN02-224 is delivered in tape and reel packaging. Ambient room conditions according Moisture Sensitivity Level (MSL1): Unlimited floor life at 30 °C/85%RH.



Measure	mm
Ao	3.3 ± 0.1
Bo	12.3 ± 0.1
Ko	2.8 ± 0.1
W	24.0 ± 0.3
P	8.0 ± 0.1
P0	4.0 ± 0.1
P2	2.0 ± 0.1
E	1.75 ± 0.1
F	11.5 ± 0.1
T	0.3 ± 0.05

Figure 12 - Tape dimensions and tolerances.

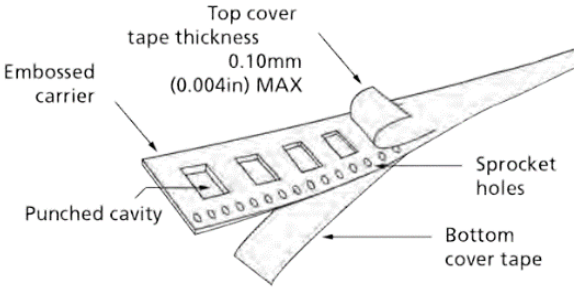
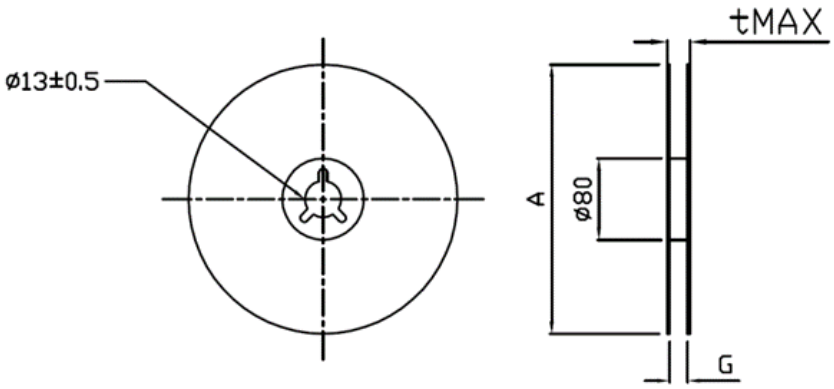


Figure 13 - Image of the tape.



Measure	mm
A	330 ± 1.0
G	25.5 ± 0.2
tMAX	29.5 ± 0.2

Reel Capacity: 2500 pcs

Figure 14 – 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 15 – 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 PRODUCT CHANGE NOTIFICATION

This document is property of Ignion,
Not to disclose or copy without prior written consent.

PCN Number: NN19100011

Notification Date: October 07th, 2019

Part Number identification:

Part Number changes, it will be applied in all the document of the company (User Manual, Data Sheet, …)

Previous Part Number	New Part Number
FR01-S4-224	NN02-224

Reason for change:

	Specs (electrical/mechanical)		Manufacturing location
	User Manual/Data Sheet		Quality/Reliability
	Material/Composition		Logistics
	Processing/Manufacturing	X	Other: Part Number

Change description:

1.- Part Number: From FR01-S4-224 FRACTUS to NN02-224 Ignion in the User Manual

OLD

NEW

Comments:

1.- Electrical and Mechanical specs remain the same

2.- Footprint in the PCB to solder the chip antenna remains the same

Identification method

1.- The part number on the antenna is different

User Manual	X	Available from: June 2020
Samples	X	Available from: June 2020

Ignion Contact:

Supply Chain
Name: Albert Vidal
Email: albert.vidal@ignion.io

7 ANNEX: LIST OF BANDS

7.1. Cellular IoT bands covered.

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
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	-
18	815 – 830	860 – 875	JAPAN
19	830 – 845	875 – 890	JAPAN
20	832 – 862	791 – 821	EMEA
23	2000 – 2020	2180 – 2200	NA
25	1850 – 1915	1930 – 1995	NA
26	814 – 849	859 – 894	NA
27	807 – 824	852 – 869	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

7.2. GNSS bands covered.

Bands	Frequency (MHz)	System
B1	1561.098 - 1591.7875	BeiDou
L1	1575.42	GPS
L1	1598.0625 - 1605.375	GLONASS
E1	1575.42 - 1602	Galileo

7.3. Bluetooth/Wi-Fi bands covered.

Comm. Standard	Frequency (MHz)	# band
Bluetooth/Wi-Fi	2400 - 2500	single band
Wi-Fi 4/5/6/6E/7	2400 – 2500 & 5150 - 7125	Multi band

7.4. ISM bands covered.

Bands	Protocol	Frequency (MHz)
ISM868	LoRa	863 - 870
	Wireless M-Bus	
	Wize	
	Zigbee	
	Wireless Hart	
Bands	**Protocol**	**Frequency (MHz)**
ISM915	LoRa	902 - 928
	Wireless M-Bus	
	Z-Wave	
	Thread	
	Wi-SUN	

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