

## RUN mXTEND™ (FR01-S4-224) – A standard antenna solution for mobile frequency bands

Fractus Antennas specializes in enabling effective mobile communications. Using Fractus Antennas technology, we design and manufacture optimized antennas to make your wireless devices more competitive. Our mission is to help our clients develop innovative products and accelerate their time to market through our expertise in antenna design, testing and manufacturing.



RUN mXTEND™ antenna booster

FR01-S4-224

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

ISO 9001: 2015 Certified



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## 1. PRODUCT DESCRIPTION FR01-S4-224

The RUN mXTEND™ antenna booster has been specifically designed for providing multiband performance in wireless devices (in particular in mobile devices), enabling worldwide coverage by allowing operation in the communication standards GSM850, GSM900, GSM1800/DCS, GSM1900/PCS, UMTS, LTE850, LTE900, LTE1700, LTE1800, LTE1900, LTE2000, LTE2100, LTE2300, LTE2500, and LTE2600.



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

### APPLICATIONS

- Handsets
- Smartphones
- Tablets
- Phablets
- Laptop PCs
- Netbooks
- Modules
- Routers
- eBook readers

### BENEFITS

- High efficiency
- Small size
- Cost-effective
- Easy-to-use (pick and place)
- Multiband behaviour (worldwide standards)
- Off-the-Shelf Standard Product (no customization is required)

The RUN mXTEND™ antenna booster belongs to a new generation of antenna solutions based on the Virtual Antenna™ technology owned by Fractus Antennas. The technology is mainly focused on replacing conventional antenna solutions by miniature and standard components.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 674491



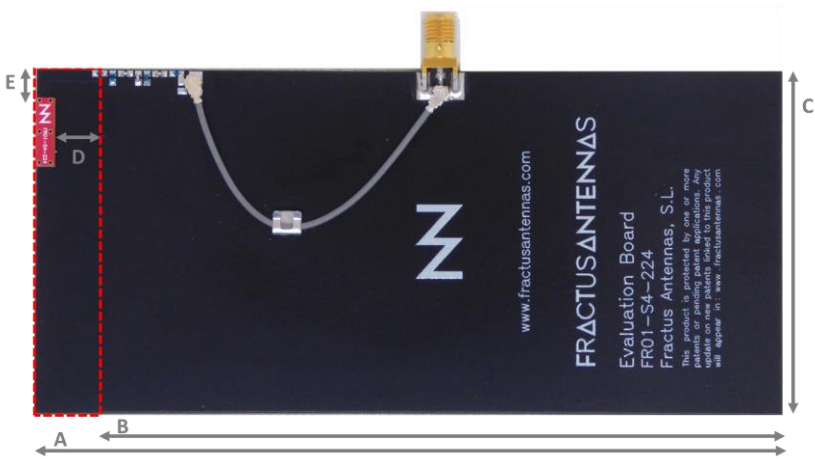
2. QUICK REFERENCE GUIDE

Technical features	824 – 960 MHz	1710 – 2690 MHz
Average Efficiency	> 65 %	> 70 %
Peak Gain	2.8 dBi	1.8 dBi
VSWR	< 3:1	
Radiation Pattern	Omnidirectional	
Polarization	Linear	
Weight (approx.)	0.19 g.	
Temperature	-40 to + 125 °C	
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. EVALUATION BOARD (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

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

Figure 1 – EB\_FR01-S4-224-1B-2RJ-1P. Evaluation Board providing operation from 824 MHz to 960 MHz and from 1710 MHz to 2690MHz.

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 [www.fractusantennas.com/virtual-antenna/](http://www.fractusantennas.com/virtual-antenna/).

3.1. MATCHING NETWORK

The specs of a Fractus Antennas standard product are measured in their evaluation board, which is an ideal case. In a real design, components nearby the antenna, LCD's, batteries, covers, connectors, etc. affect the antenna performance. This is the reason why 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. Do it in the ground plane area, not in the clearance area. This provides a degree of freedom to tune the RUN mXTEND™ antenna booster once the design is finished and taking into account all elements of the system (batteries, displays, covers, etc.).

Please notice that different devices with different ground planes and different components nearby the RUN mXTEND™ antenna booster may need a different matching network. To ensure optimal results, the use of high Q and tight tolerance components is highly recommended (Murata components). If you need assistance to design your matching network beyond this application note, please contact [support@fractusantennas.com](mailto:support@fractusantennas.com), or try our free-of-charge **NN Wireless Fast-Track** design service, you will get your chip antenna design including a custom matching network for your device in 24h<sup>1</sup>. Other related to NN's range of R&D services is available at: <https://www.fractusantennas.com/rdservices/>

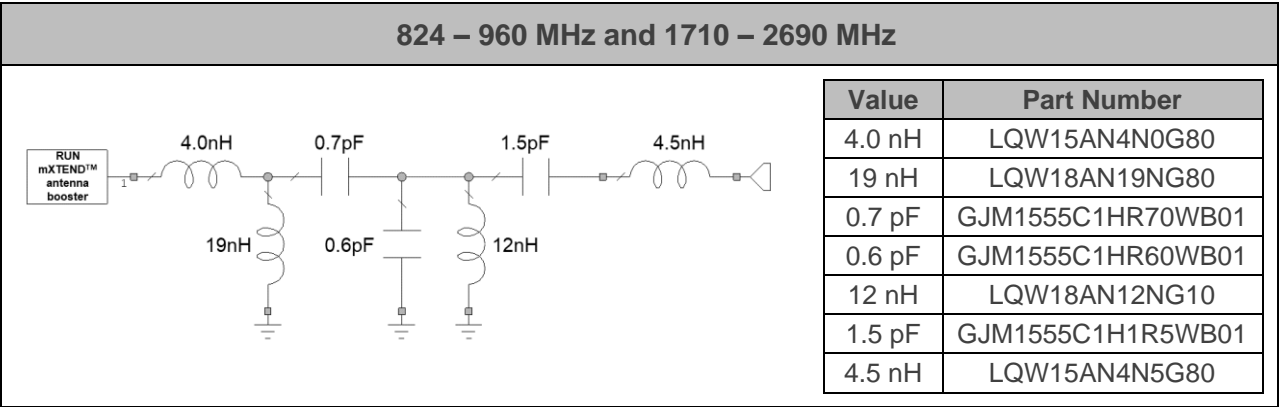
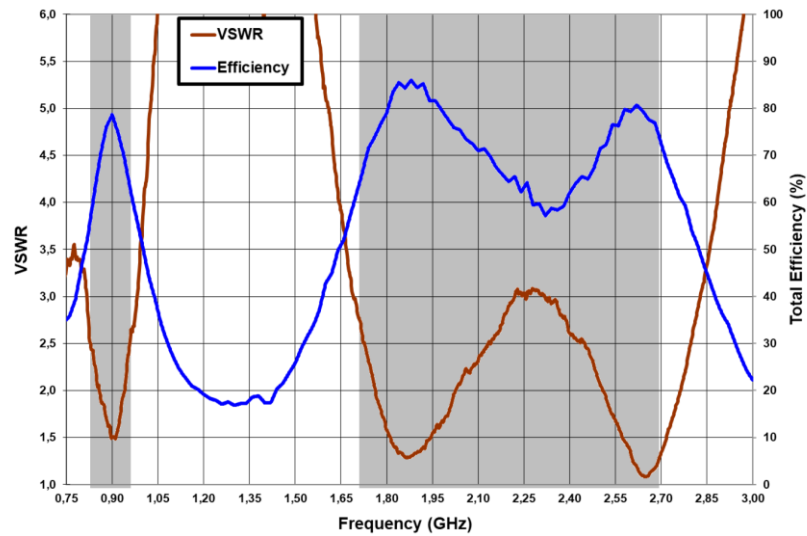


Figure 2 – Matching Network implemented in the evaluation board (Figure 1).

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

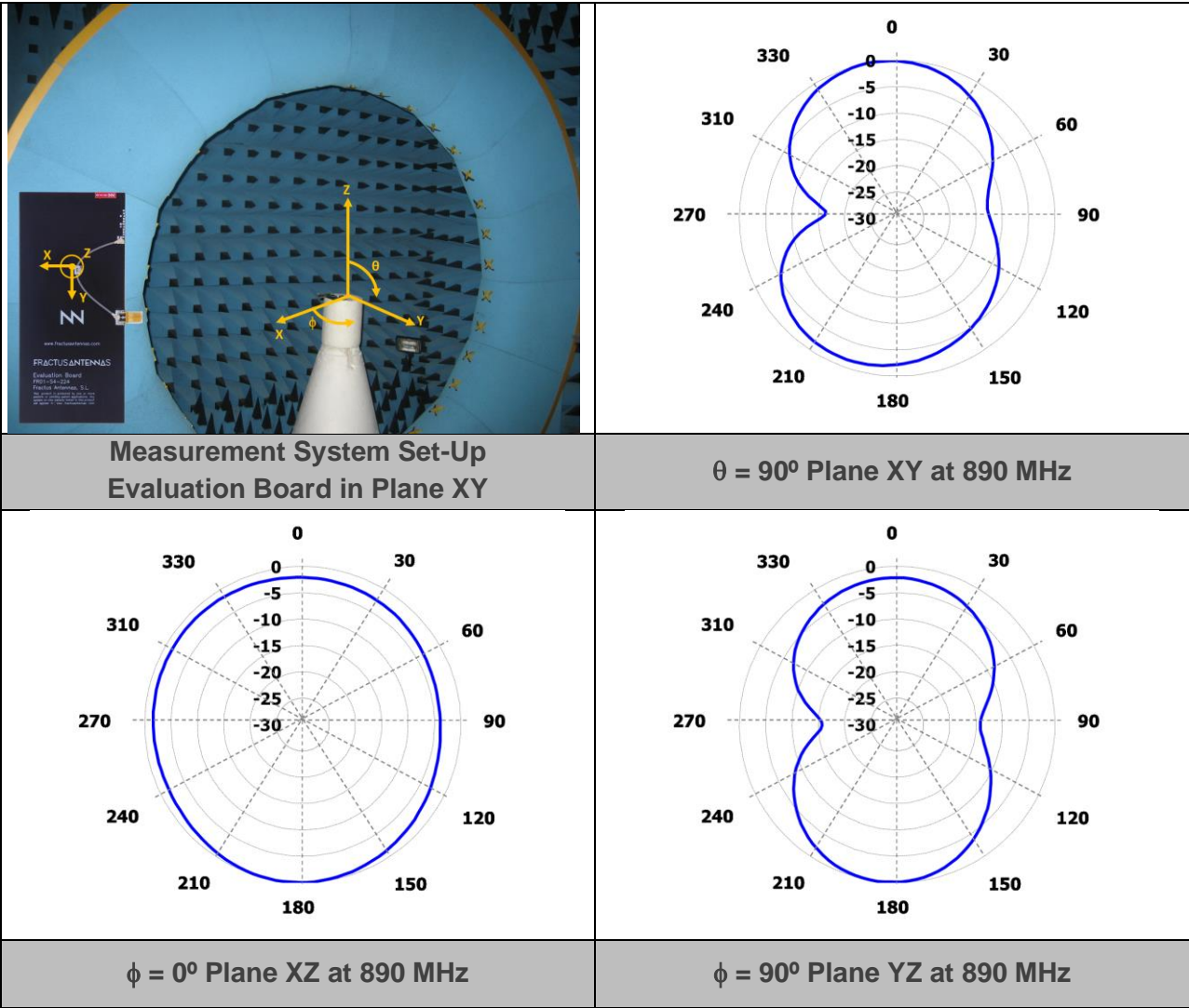
### 3.2. VSWR AND TOTAL EFFICIENCY

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



**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)).

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

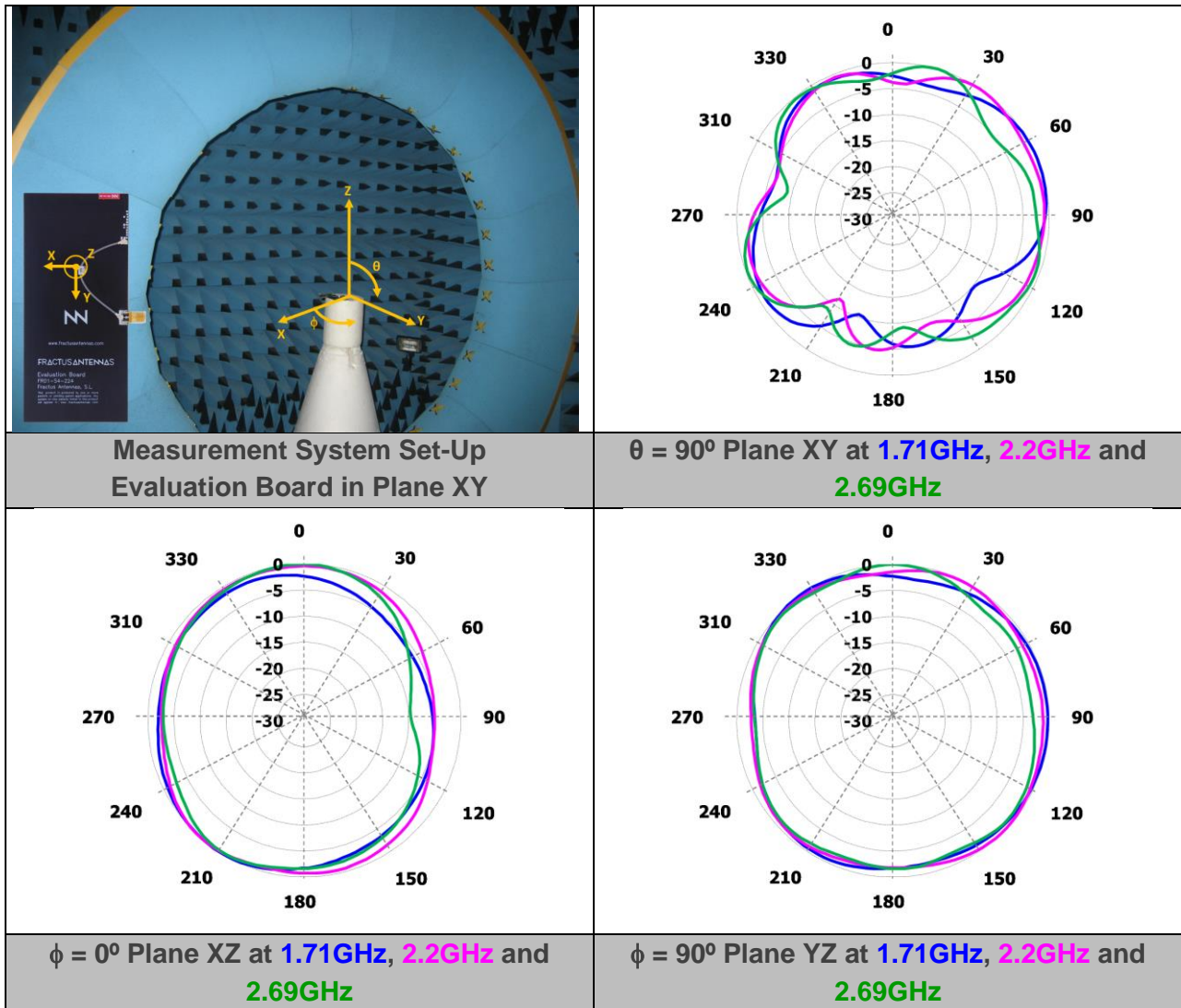


Gain	Peak Gain	2.8 dBi
	Average Gain across the band	1.9 dBi
	Gain Range across the band (min, max)	0.3 <--> 2.8 dBi
Efficiency	Peak Efficiency	78.6 %
	Average Efficiency across the band	69.9 %
	Efficiency Range across the band (min, max)	54.3 – 78.6 %

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.



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

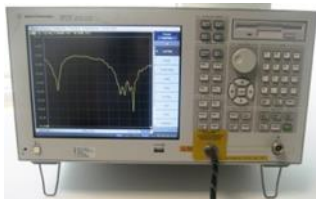


Gain	Peak Gain	1.8 dBi
	Average Gain across the band	1.1 dBi
	Gain Range across the band (min, max)	-0.2 <-> 1.8 dBi
Efficiency	Peak Efficiency	86.0 %
	Average Efficiency across the band	72.3 %
	Efficiency Range across the band (min, max)	57.2 – 86.0 %

**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.

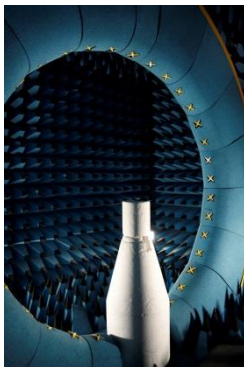
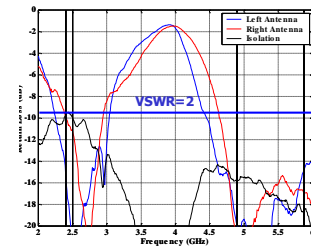
## 4. CAPABILITIES AND MEASUREMENTS SYSTEMS

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 requirement 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.



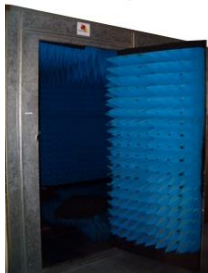
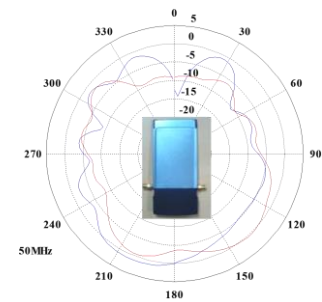
Agilent E5071B

VSWR  
&  
S Parameters



SATIMO STARGATE 32

Radiation  
Pattern  
&  
Efficiency



Anechoic chambers and full equipped in-house lab

5. MECHANICAL CHARACTERISTICS FR01-S4-224

5.1. DIMENSIONS, TOLERANCES AND RoHS

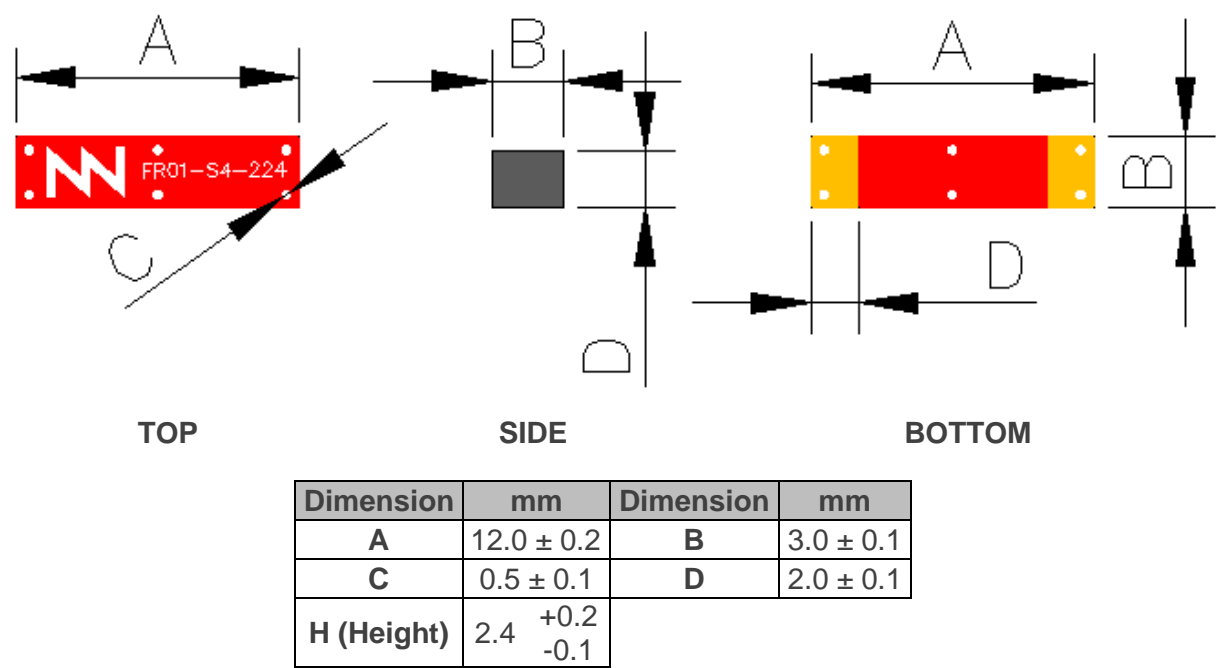


Figure 4 – RUN mXTEND™ antenna booster dimensions and tolerances.

The 2 pads are fully symmetrical to mount it on the PCB. See Figure 6.

The RUN mXTEND™ antenna booster FR01-S4-224 is compliant with the restriction of the use of hazardous substances (RoHS).

The RoHS certificate can be downloaded from [www.fractusantennas.com](http://www.fractusantennas.com).

5.2. COLOUR RANGE FOR THE INK

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



5.3. RECOMMENDED FOOTPRINT FOR THE FR01-S4-224

Assuming that the RUN mXTEND™ antenna booster FR01-S4-224 is placed in the clearance area of the PCB, see below the recommended footprint dimensions.

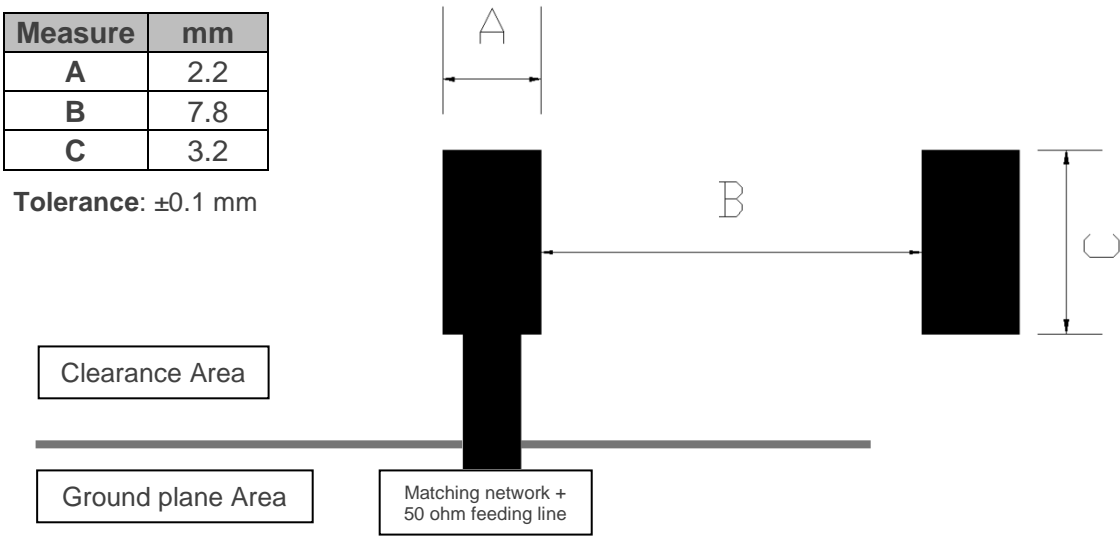
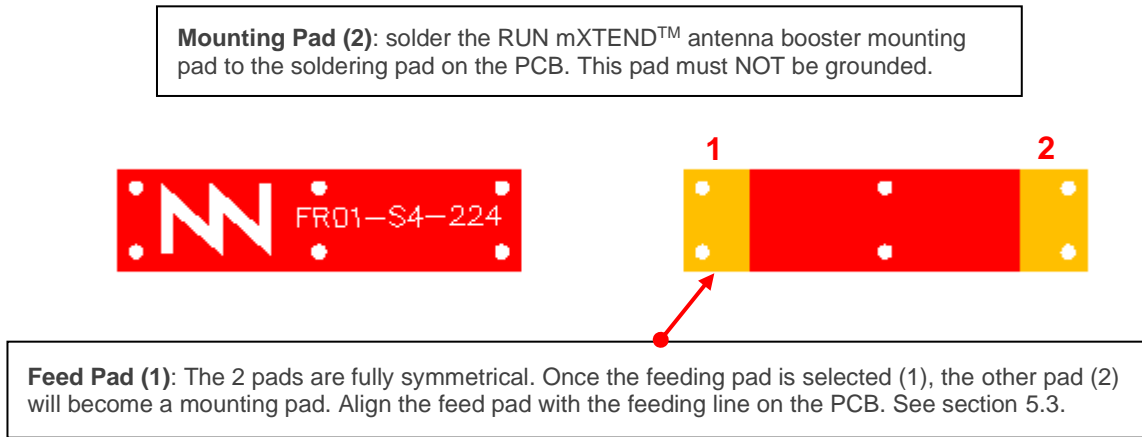


Figure 5 – Footprint dimensions for the single booster.

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

## 6. ASSEMBLY PROCESS

Figure 6 shows the back and front view of the RUN mXTEND™ antenna booster FR01-S4-224. Due to the symmetry in the product configuration, the feeding pad can be any of the 2 pads.

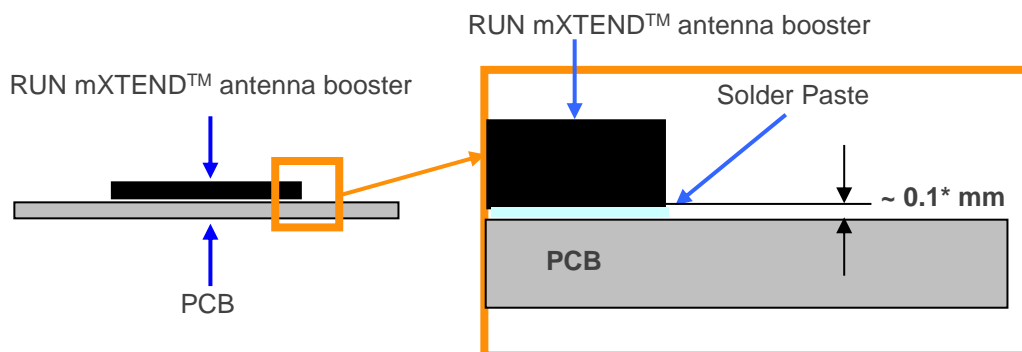


**Figure 6** –Pads of the RUN mXTEND™ antenna booster FR01-S4-224.

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 4, Figure 8.
3. After soldering the RUN 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 RUN mXTEND™ antenna booster FR01-S4-224 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 (T <sub>smax</sub> to T <sub>p</sub> )	3 °C / second (max.)
PREHEAT	- Temperature Min (T <sub>smin</sub> ) - Temperature Max (T <sub>smax</sub> ) - Time (t <sub>smin</sub> to t <sub>smax</sub> )	150 °C 200 °C 60-180 seconds
REFLOW	- Temperature (T <sub>L</sub> ) - Total Time above T <sub>L</sub> (t <sub>L</sub> )	217 °C 60-150 seconds
PEAK	- Temperature (T <sub>p</sub> ) - Time (t <sub>p</sub> )	260 °C 20-40 seconds
RAMP-DOWN	Rate	6 °C/second max
Time from 25 °C to Peak Temperature		8 minutes max

Table 4 – Recommended soldering temperatures.

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

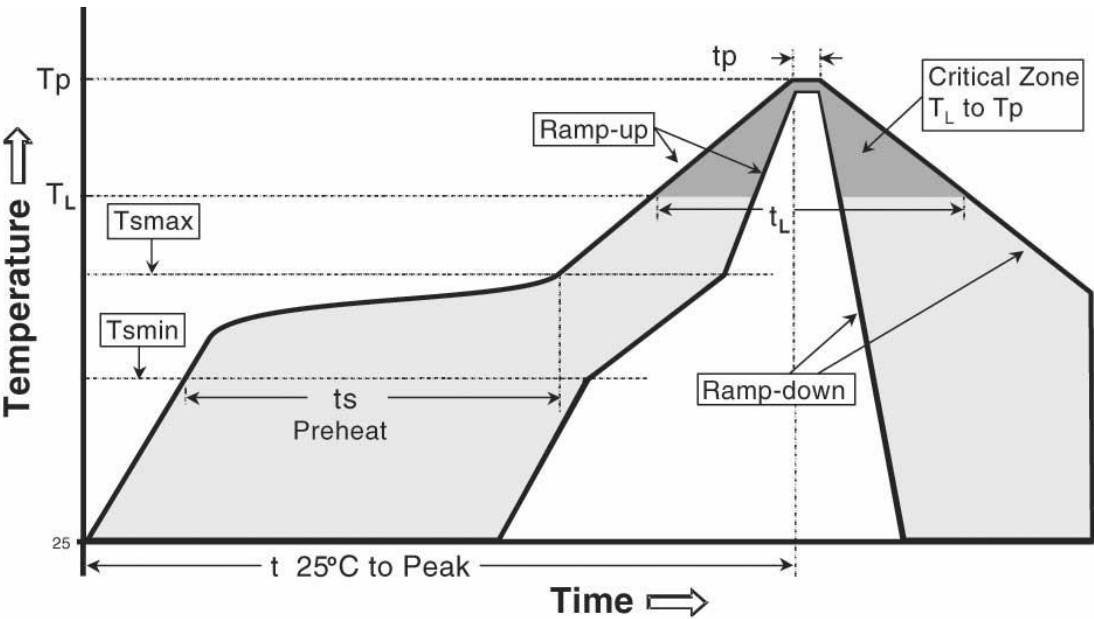


Figure 8 – Temperature profile.

7. PACKAGING

The RUN mXTEND™ antenna booster FR01-S4-224 is delivered in tape and reel packaging.

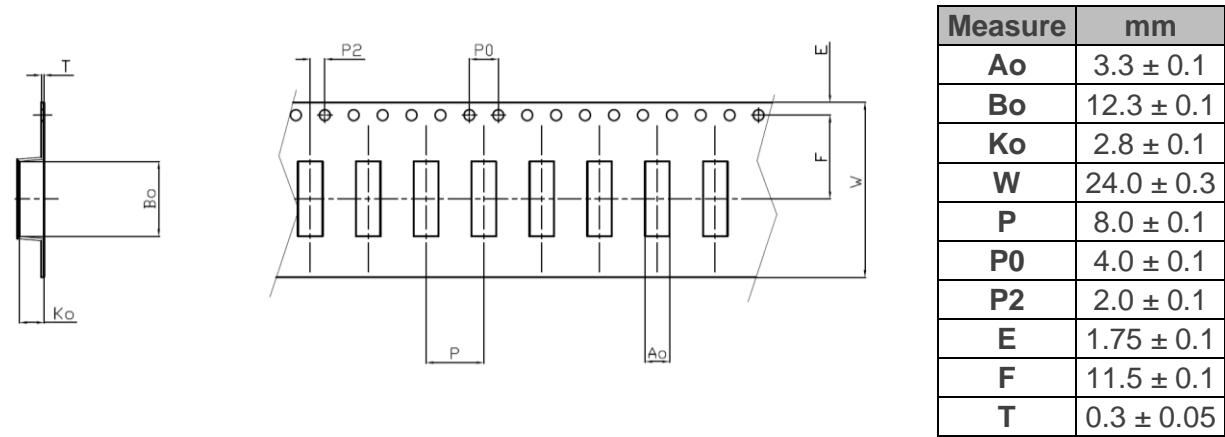
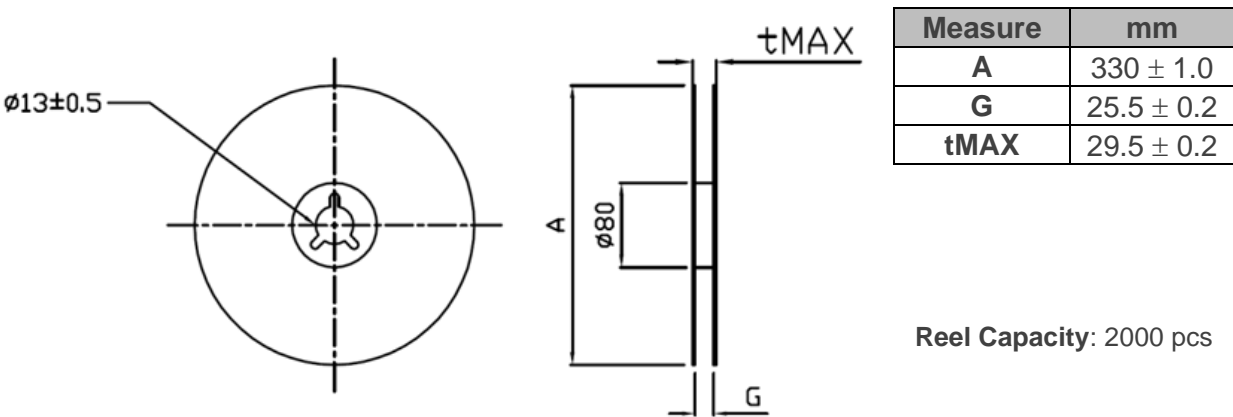


Figure 9 – Tape dimensions and Tolerances.



Reel Capacity: 2000 pcs

Figure 10 – Reel Dimensions and Capacity.

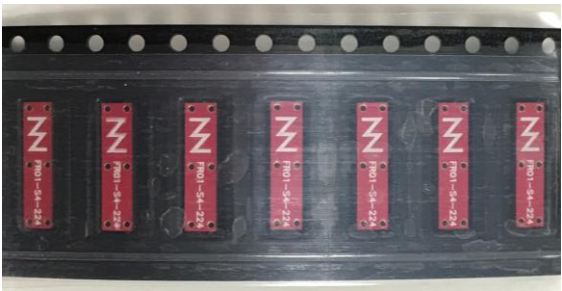


Figure 11 – Image of the tape.