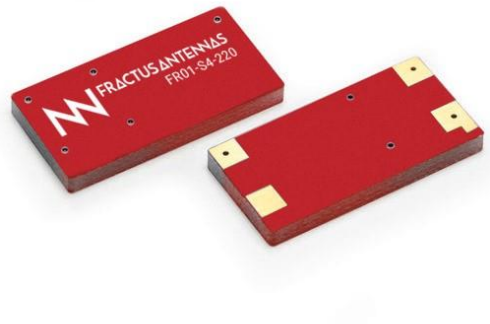
ALL mXTEND™ (FR01-S4-220) – A standard antenna solution for mobile frequency bands

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.



ALL mXTEND™ chip antenna component

FR01-S4-220

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

ISO 9001: 2015 Certified

INDEX OF CHAPTERS

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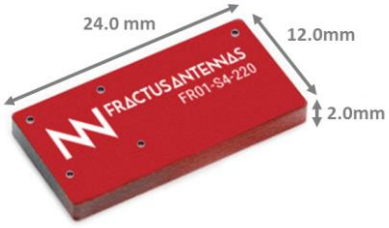
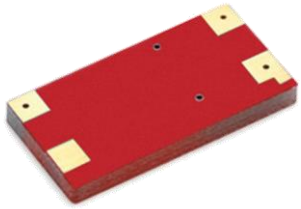
1. PRODUCT DESCRIPTION FR01-S4-220

The ALL mXTEND™ chip antenna component 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, LTE700, LTE800, LTE850, LTE900, LTE1700, LTE1800, LTE1900, LTE2000, LTE2100, LTE2300, LTE2500, and LTE2600.

TOP



BOTTOM



Material: The ALL mXTEND™ chip antenna component is built on glass epoxy substrate.

APPLICATIONS

- Handsets
- Smartphones
- Tablets
- Phablets
- Laptop PCs
- Netbooks
- Modules
- Routers
- eBooks

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 ALL mXTEND™ chip antenna component 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 Nº 674491

2. EVALUATION BOARDS 1 PORT (698-960MHz and 1710-2690MHz)

2.1. QUICK REFERENCE GUIDE

Technical features	698 – 960 MHz	1710 – 2690 MHz
Average Efficiency	> 55 %	> 75 %
Peak Gain	2.3 dBi	3.1 dBi
VSWR	< 3:1	
Radiation Pattern	Omnidirectional	
Polarization	Linear	
Weight (approx.)	1.23 g.	
Temperature	-40 to + 85 ºC	
Impedance	50 Ω	
Dimensions (L x W x H)	24.0 mm x 12.0 mm x 2.0 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.

2.2. EVALUATION BOARDS 1 PORT (698-960 MHz and 1710-2690 MHz)

This Evaluation Board (part number: EB_FR01-S4-220-1B-2R-1P) integrates one ALL mXTEND™ chip antenna component to provide operation in two frequency regions, from 698 MHz to 960 MHz and from 1710 MHz to 2690 MHz. A UFL cable connects this single input/output port to the SMA connector.

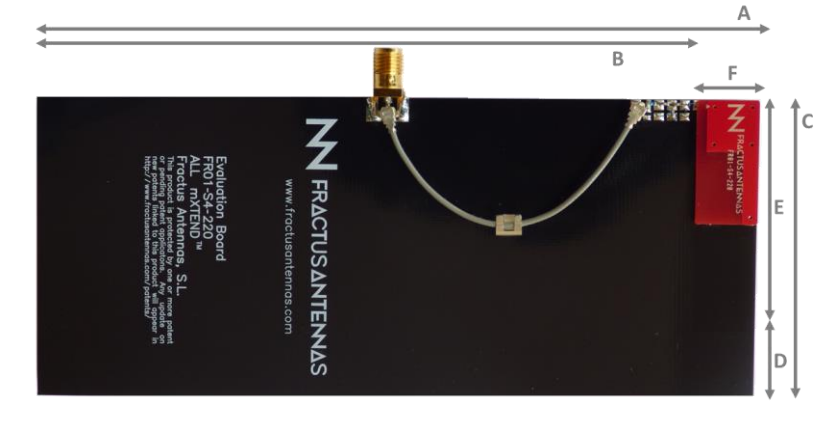


Figure 1 – EB_FR01-S4-220-1B-2R-1P. Evaluation Board 1 port providing operation in 2 frequency ranges, 698 – 960MHz and 1710 – 2690MHz.

Measure	mm
A	142
B	130
C	60
D	15
E	45
F	12

Tolerance: ±0.2 mm

Material: The Evaluation Boards are built on FR4 substrate. Thickness is 1 mm.

Clearance Area: 45 mm x 12 mm

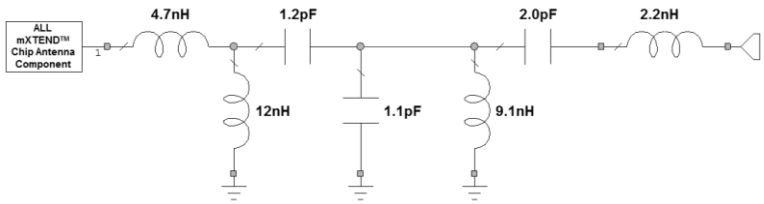
This product and its use are protected by at least one or more of the following patents and patent applications PAT. US 9,130,259 B2; PAT. US 8,237,615 B2; and other domestic and international patents pending. Additional information about patents related to this product is available at www.fractusantennas.com/virtual-antenna/.

2.2.1. MATCHING NETWORK

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 ALL mXTEND™ chip antenna component 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 ALL mXTEND™ chip antenna component may need a different matching network. To ensure optimal results, the use of high Q and tight tolerance components is highly recommended (Murata components).

698 MHz – 960 MHz and 1710 MHz – 2690 MHz



Value	Part Number
4.7 nH	LQW15AN4N7B80
12 nH	LQW15AN12NG00
1.2 pF	GJM1555C1H1R2WB01
1.1 pF	GJM1555C1H1R1WB01
9.1 nH	LQW15AN9N1G00
2.0 pF	GJM1555C1H2R0WB01
2.2 nH	LQW15AN2N2B80

Figure 2 – Matching network implemented in the Evaluation Board 1 port (Figure 1).

This matching network applies to this Evaluation Board. Other configurations would require a matching network adjustment. Please contact info@fractusantennas.com for more information related to the matching service for a chip antenna component.

2.2.2. VSWR AND TOTAL EFFICIENCY

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

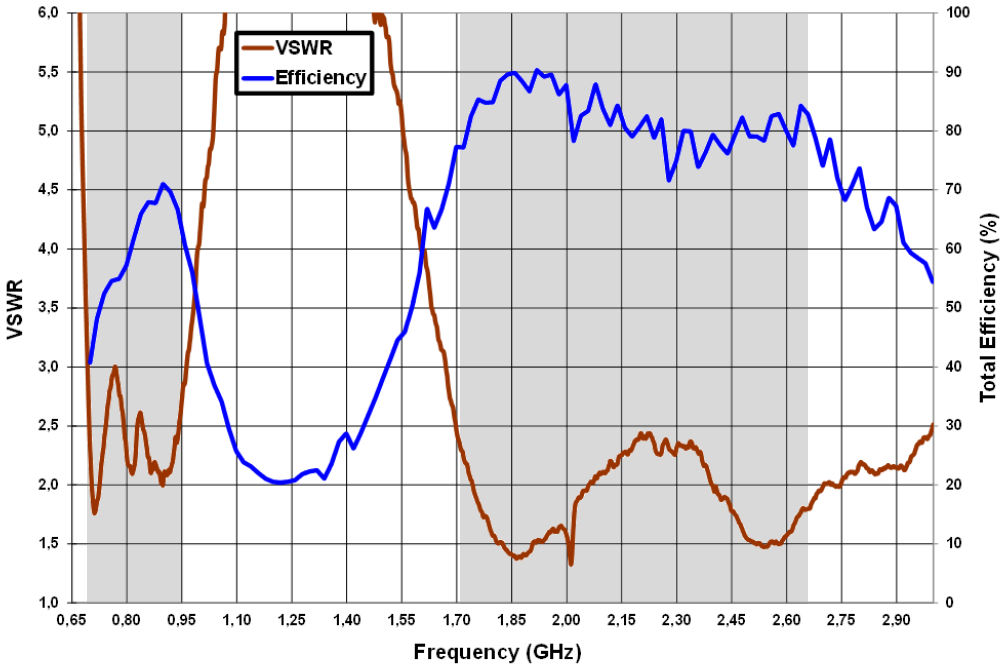
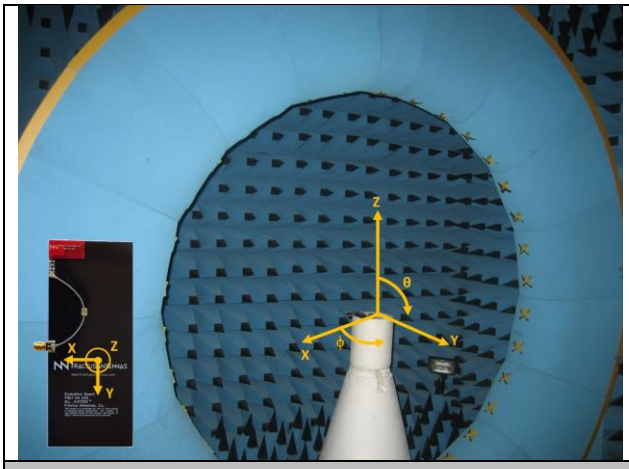
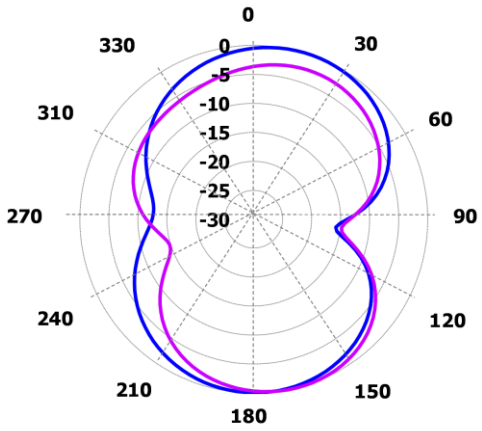


Figure 3 – VSWR and Total Efficiency for the 698 – 960 MHz frequency range and for the 1710 – 2690 MHz frequency range (from the Evaluation Board) (Figure 1).

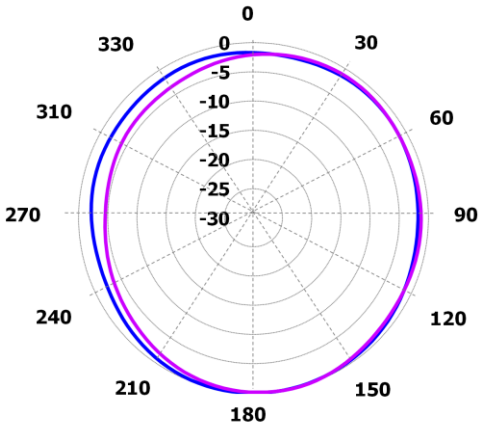
2.2.3. RADIATION PATTERNS (698-960 MHz), GAIN AND EFFICIENCY



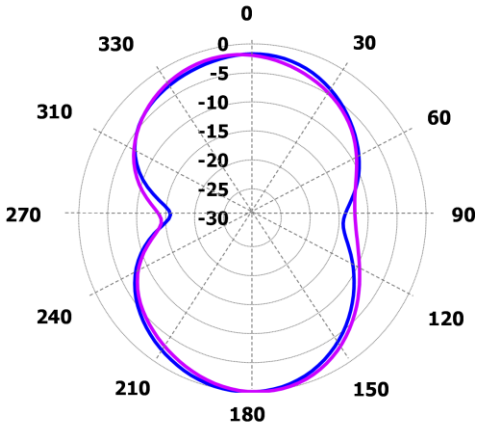
Measurement System Set-Up
Evaluation Board in Plane XY



θ = 90º Plane XY at 750 MHz and 890 MHz



ϕ = 0º Plane XZ at 750 MHz and 890 MHz

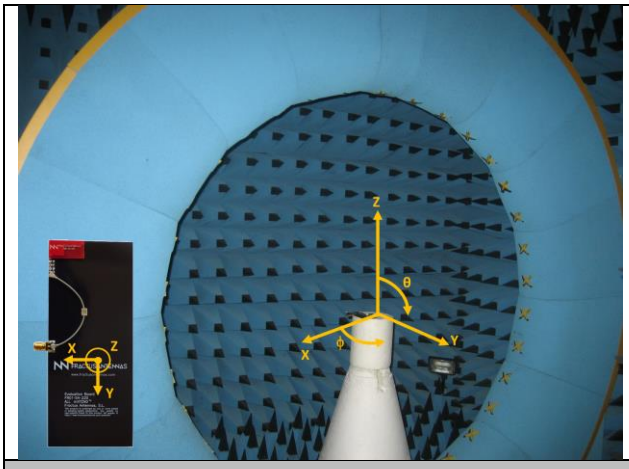


ϕ = 90º Plane YZ at 750 MHz and 890 MHz

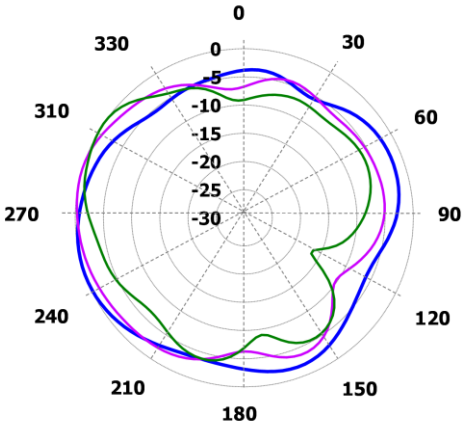
Gain	**Peak Gain**	2.3 dBi
	Average Gain across the band	0.8 dBi
	Gain Range across the band (min, max)	-0.8 <–> 2.3 dBi
Efficiency	**Peak Efficiency**	71.1 %
	Average Efficiency across the band	60.7 %
	Efficiency Range across the band (min, max)	40.2 – 71.1 %

Table 2 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 1) within the 698 – 960 MHz frequency range. Measures made in the Satimo STARGATE 32 anechoic chamber.

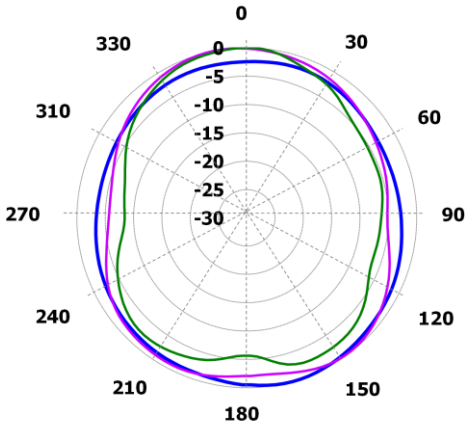
2.2.4. RADIATION PATTERNS (1710-2690 MHz) GAIN, AND EFFICIENCY



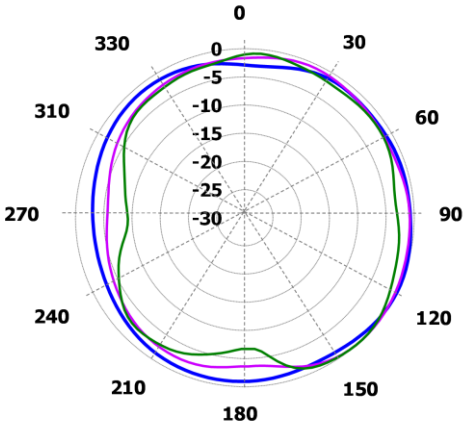
Measurement System Set-Up Evaluation Board in Plane XY



θ = 90º Plane XY at 1.71 GHz, 2.2 GHz and 2.69 GHz



ϕ = 0º Plane XZ at 1.71 GHz, 2.2 GHz and 2.69 GHz



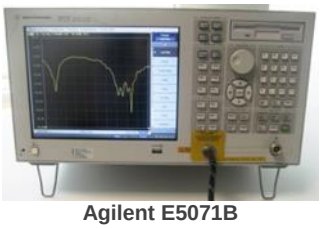
ϕ = 90º Plane YZ at 1.71 GHz, 2.2 GHz and 2.69 GHz

Gain	**Peak Gain**	3.1 dBi
	Average Gain across the band	2.5 dBi
	Gain Range across the band (min, max)	1.6 <–> 3.1 dBi
Efficiency	**Peak Efficiency**	90.3 %
	Average Efficiency across the band	82.1 %
	Efficiency Range across the band (min, max)	71.6 – 90.3 %

Table 3 – Antenna Gain and Total Efficiency for the Evaluation Board (Figure 1) within the 1710 – 2690 MHz frequency range. Measures made in the Satimo STARGATE 32 anechoic chamber.

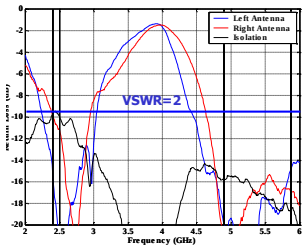
3. CAPABILITIES AND MEASUREMENT SYSTEMS

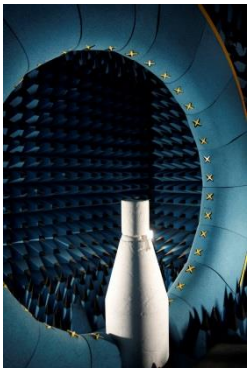
Fractus Antennas specializes in designing and manufacturing optimized antennas for wireless applications and providing our clients with RF expertise. We offer turn-key antenna products and antenna integration support to minimize your time requirement and maximize your return on investment during your 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

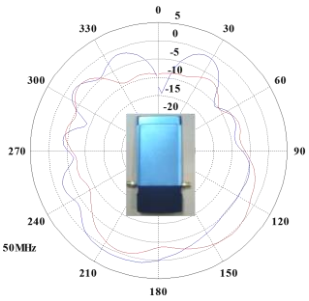
VSWR
&
S Parameters





SATIMO STARGATE 32

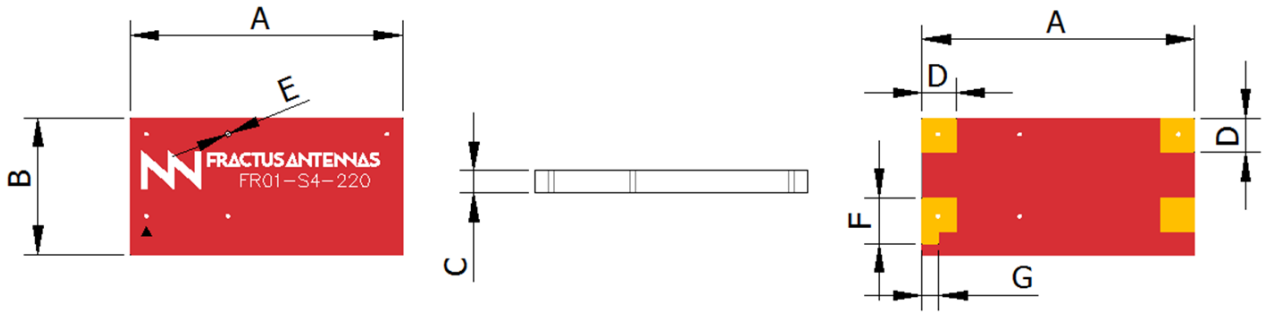
Radiation
Pattern
&
Efficiency



Anechoic chambers and full equipped in-house lab

4. MECHANICAL CHARACTERISTICS FR01-S4-220

4.1. DIMENSIONS, TOLERANCES, AND RoHS



TOP **SIDE** **BOTTOM**

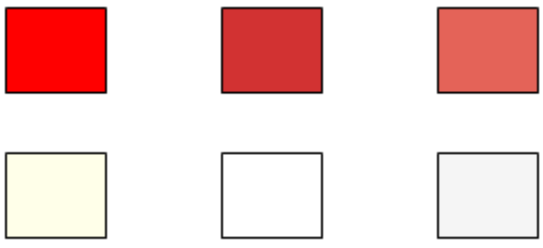
Dimension	mm	Dimension	mm
A	24.0 ± 0.15	**B**	12.0 ± 0.15
C (height)	2.0 + 0.2 - 0.1	**D**	3.0 ± 0.05
E	0.5 ± 0.05	**F**	4.0 ± 0.05
G	1.5 ± 0.05		

Figure 4 – ALL mXTEND™ chip antenna component dimensions and tolerances.

The ALL mXTEND™ chip antenna component FR01-S4-220 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 ALL mXTEND™ chip antenna component:



Acceptable color range

4.3. RECOMMENDED FOOTPRINT FOR THE FR01-S4-220

Assuming that the ALL mXTEND™ chip antenna component FR01-S4-220 is placed in the clearance area of the PCB, see below the recommended footprint dimensions.

Measure	mm
A	18.0
B	4.0
C	3.1
D	3.1

Tolerance: ±0.05mm

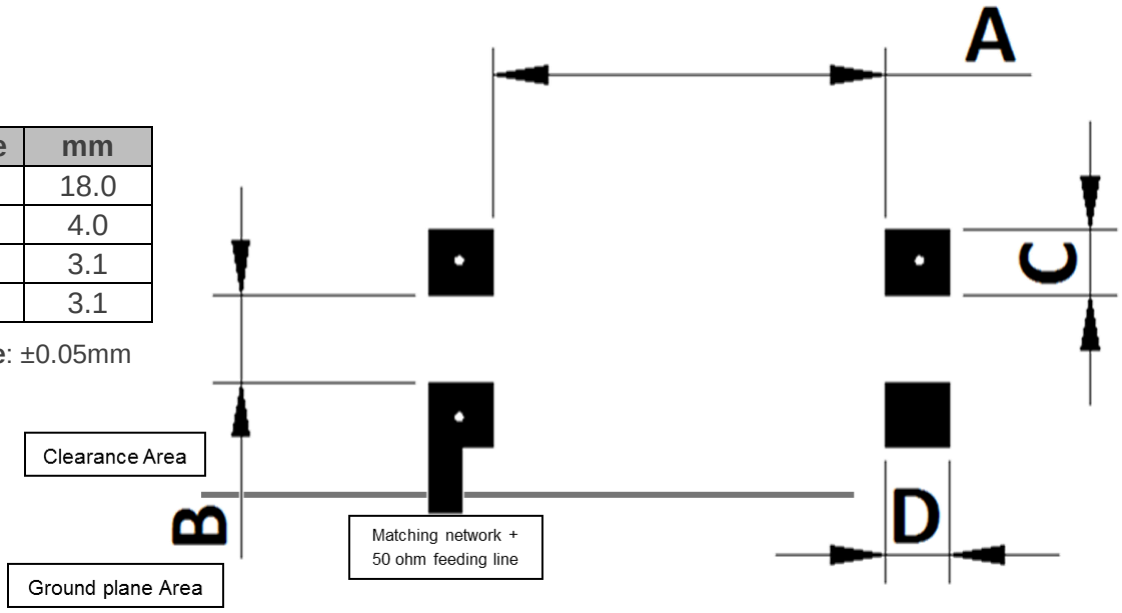


Figure 5 – Footprint dimensions for the single chip antenna component.

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

5. ASSEMBLY PROCESS

Figure 6 shows the back and front views of the ALL mXTEND™ chip antenna component FR01-S4-220. Due to the product configuration, the feeding pad can only be the pad 1.

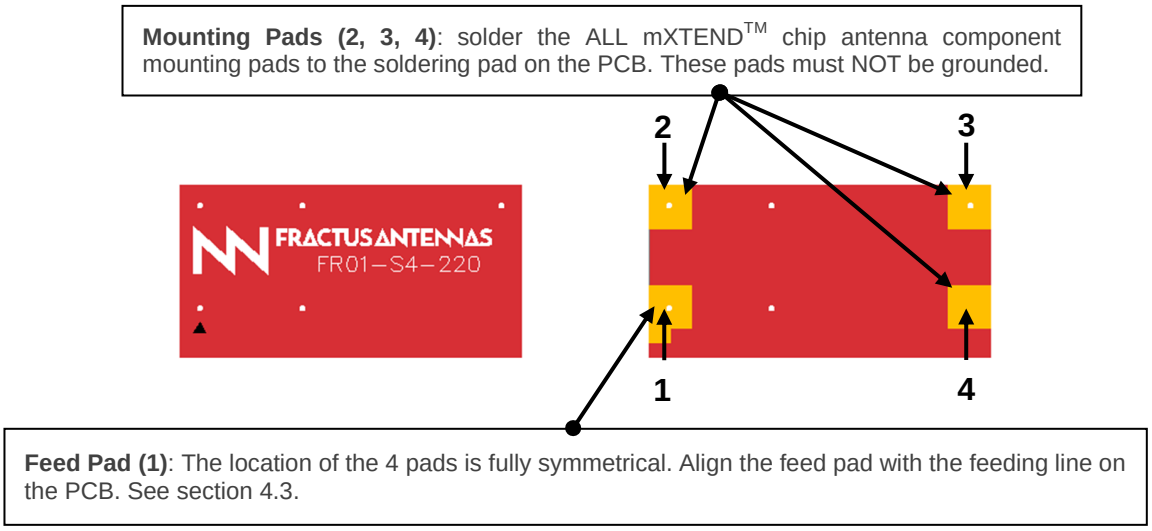


Figure 6 – Pads of the ALL mXTEND™ chip antenna component FR01-S4-220.

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

1. Apply a solder paste on the pads of the PCB. Place the ALL mXTEND™ chip antenna component on the board.
2. Perform a reflow process according to the temperature profile detailed in Table 4, Figure 8.
3. After soldering the ALL mXTEND™ chip antenna component 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:

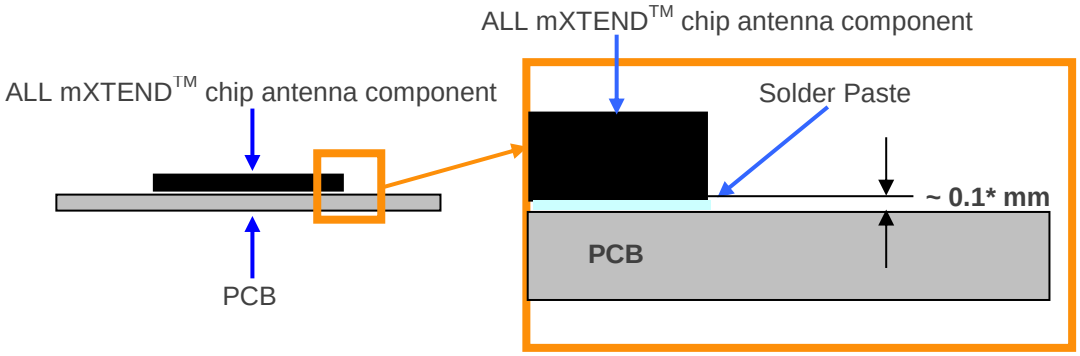


Figure 7 – Soldering Details.

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 ALL mXTEND™ chip antenna component FR01-S4-220 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 4 – Recommended soldering temperatures.

Next graphic shows temperature profile (grey zone) for the ALL mXTEND™ chip antenna component assembly process reflow ovens.

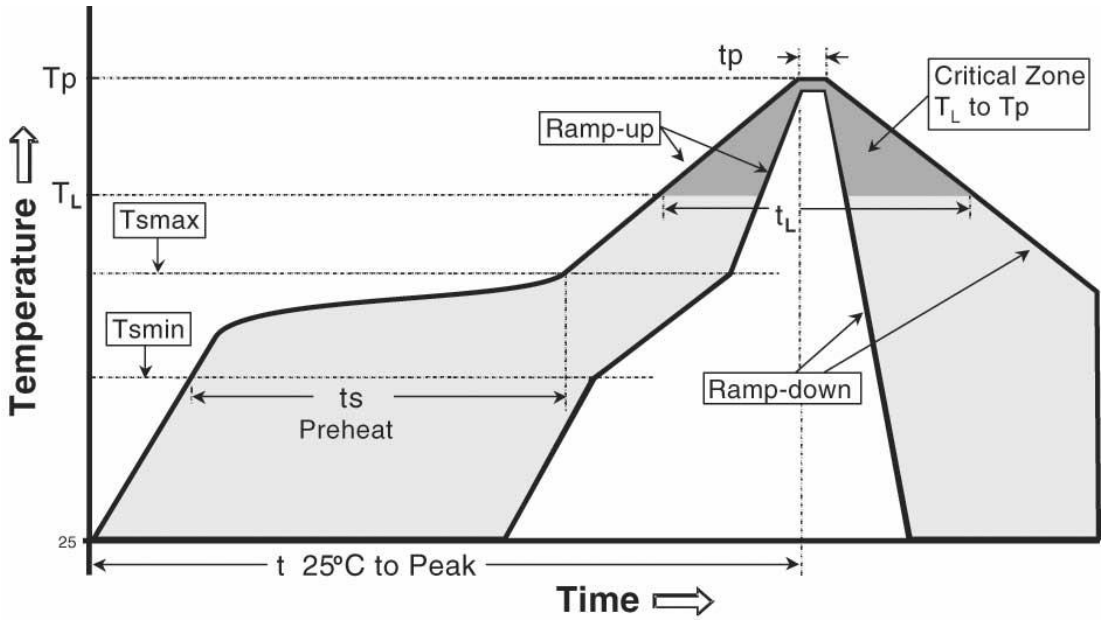
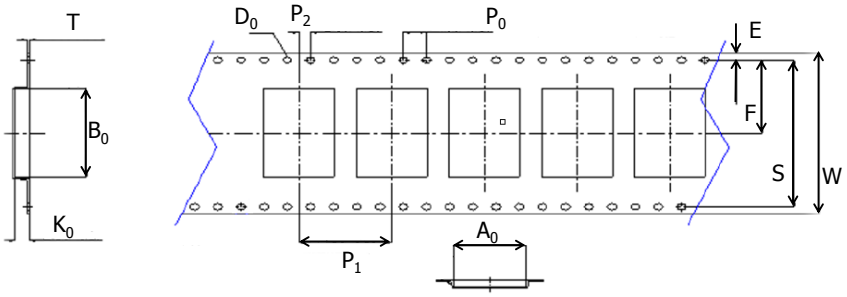


Figure 8 – Temperature profile.

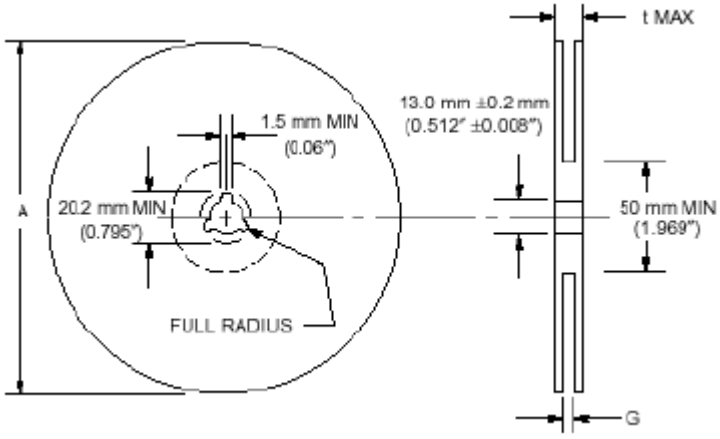
6. PACKAGING

The ALL mXTEND™ chip antenna component FR01-S4-220 is delivered in tape and reel packaging.



Measure	mm
Ao	12.3 ± 0.1
Bo	24.3 ± 0.1
Ko	2.5 ± 0.1
W	44.0 ± 0.3
D_0	1.55 ± 0.05
P_1	16.0 ± 0.1
P_0	4.0 ± 0.1
P_2	2.0 ± 0.1
E	1.75 ± 0.1
F	20.2 ± 0.1
S	40.4 ± 0.3
T	0.3 ± 0.05

Figure 9 – Tape dimensions and Tolerances.



Measure	mm
A	330 ± 1.0
G	17.5 ± 0.2
tMAX	21.5 ± 0.2

Reel Capacity: 1500 pcs

Figure 10 – Reel Dimensions and Capacity.

Figure 11 – Image of the reel.

Mouser Electronics

Authorized Distributor

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Ignion:

EB_FR01-S4-220-1B-2R-1P EB_NN02-220-1B-2R-1P