BAR mXTEND™ (FR01-S4-232) – 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.

BAR mXTEND™ Antenna Booster

FR01-S4-232

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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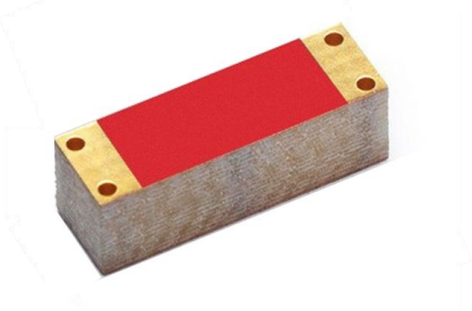
1. PRODUCT DESCRIPTION FR01-S4-232

The BAR 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, LTE700, LTE800, LTE850, LTE900, LTE1700, LTE1800, LTE1900, LTE2000, LTE2100, LTE2300, LTE2500, and LTE2600.

TOP

BOTTOM



Material: The BAR mXTEND™ Antenna Booster 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 BAR mXTEND™ Antenna Booster belongs to the 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.

2. EVALUATION BOARD 3 PORTS (698-798MHz, 824-960MHz, 1710-2690MHz)

2.1. QUICK REFERENCE GUIDE

Technical features	698 – 798 MHz	824 – 960 MHz	1710 – 2690 MHz
Average Efficiency	> 45.0 %	> 40.0 %	> 75.0 %
Peak Gain	1.3 dBi	0.3 dBi	3.8 dBi
VSWR	< 3:1		
Radiation Pattern	Omnidirectional		
Polarization	Linear		
Weight (approx.)	0.21 g		
Temperature	-40 to + 85 ºC		
Impedance	50 Ω		
Dimensions (L x W x H)	10.0 mm x 3.2 mm x 3.2 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 BOARD 3 PORTS

This Evaluation Board (part number: EB_FR01-S4-232-UFL3R) integrates UFL cables to connect the BAR mXTEND™ Antenna Boosters with the SMA connector. It works from 698 MHz to 798 MHz, from 824 MHz to 960 MHz, and from 1710 MHz to 2690 MHz.

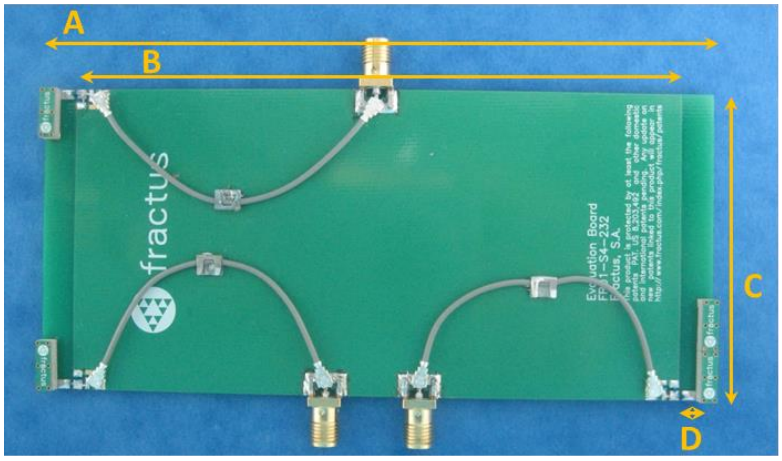


Figure 1 – EB_FR01-S4-232-UFL3R. Evaluation Board providing operation in 3 frequency ranges, 698 MHz to 798 MHz, 824 MHz to 960 MHz, and 1710 MHz to 2690 MHz.

Measure	mm
A	133
B	120
C	60
D	3.3

Tolerance: ±0.2 mm

D: Distance between the BAR mXTEND™ Antenna Booster and the ground plane.

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

This product is protected by at least the following patents PAT. US 8,203,492, PAT. US 8,736,497 and other domestic and international patents pending. Any update on new patents linked to this product will appear in www.fractusantennas.com/virtual-antenna/.

Comments:

- Note that in this case the Evaluation Board (Figure 1) integrates two BAR mXTEND™ Antenna Boosters that are placed together to provide operation at LTE700 (698 – 798 MHz). Please see Figure 10 for the recommended footprint.
- The efficiency measures (Figure 3) are shown from 700 MHz due to the minimum frequency specifications of the Satimo STARGATE 32 anechoic chamber.

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 to place 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 BAR 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 BAR 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).

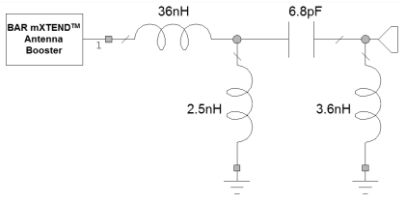
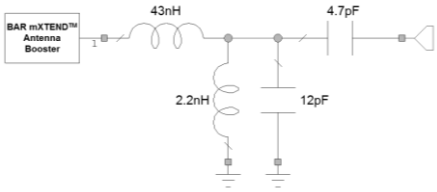
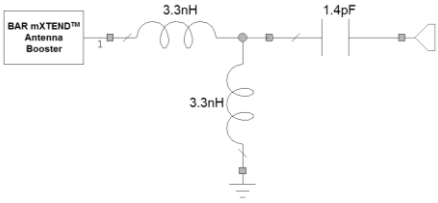
	Matching network for the Evaluation Board	
698 – 798 MHz		**Value** / **Part Number** **36 nH** LQW18AN36NG00 **2.5 nH** LQW15AN2N5B80 **6.8 pF** GJM1555C1H6R8WB01 **3.6 nH** LQW15AN3N6B80
824 – 960 MHz		**Value** / **Part Number** **43 nH** LQW18AN43NG00 **2.2 nH** LQW15AN2N2B80 **12 pF** GJM1555C1H120FB01 **4.7 pF** GJM1555C1H4R7WB01
1710 – 2690 MHz		**Value** / **Part Number** **3.3 nH** LQW15AN3N3B80 **3.3 nH** LQW15AN3N3B80 **1.4 pF** GJM1555C1H1R4WB01

Figure 2 – Matching networks implemented in the Evaluation Board 3 ports (Figure 1).

These matching networks apply to this Evaluation Board. Other configurations would require a matching network adjustment. Please contact info@fractusantennas.com for more information related to the antenna booster matching service.

2.2.2. VSWR and TOTAL Efficiency

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

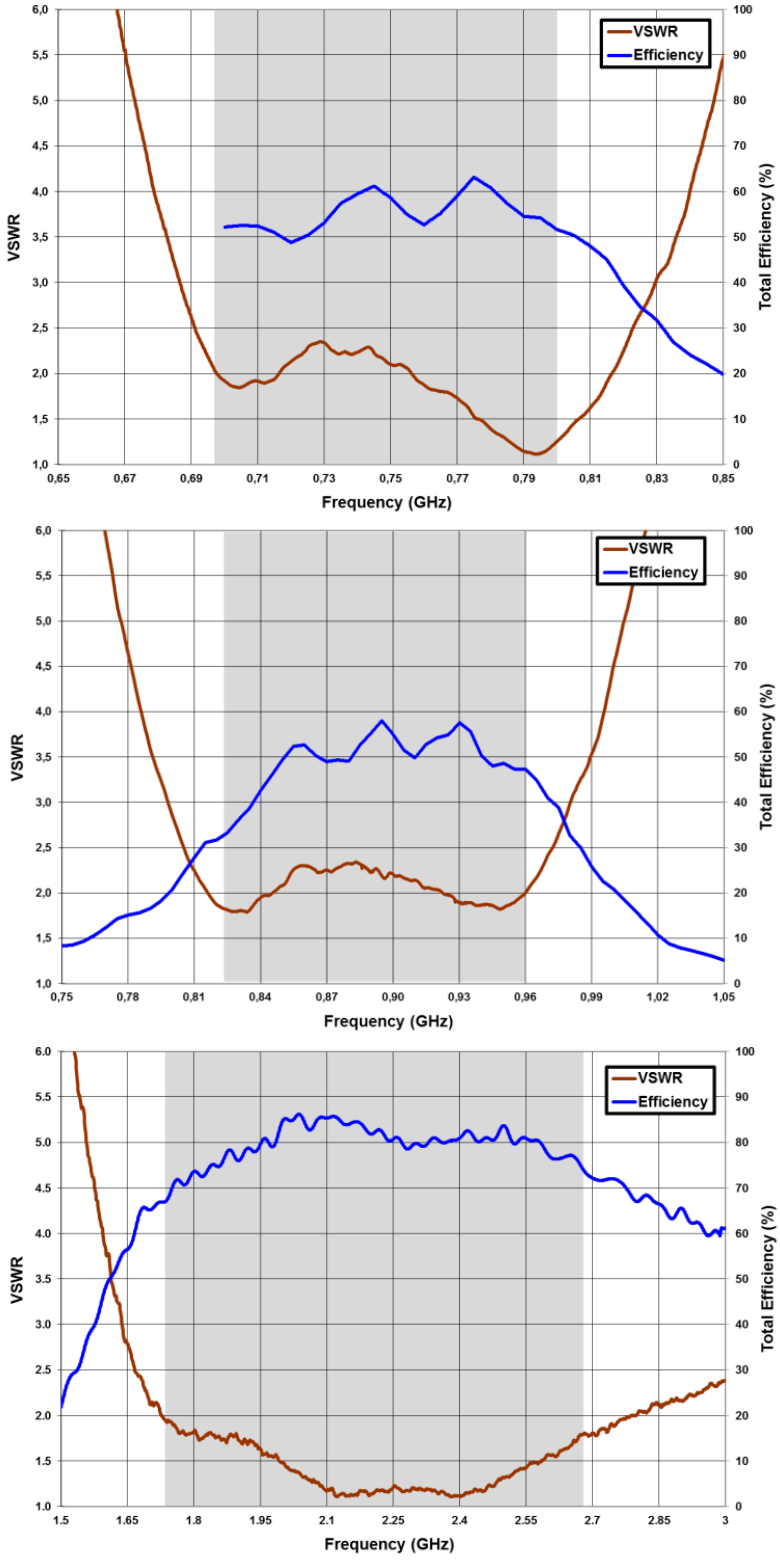


Figure 3 – VSWR and Total Efficiency for the 698 – 798 MHz range, for the 824 – 960 MHz range, and for the 1710 – 2690 MHz range from the Evaluation Board 3 ports (Figure 1).

2.2.3. Transmission coefficient

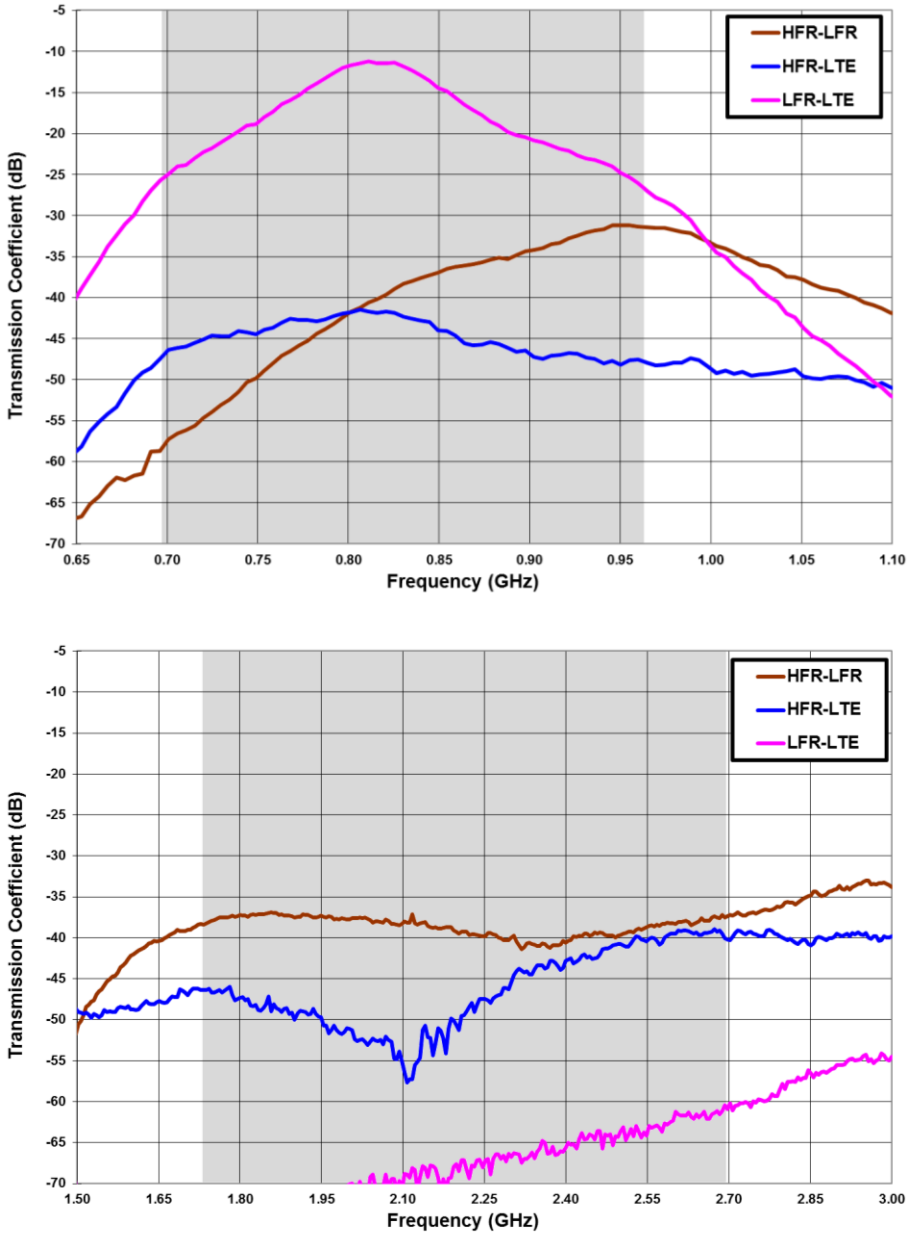
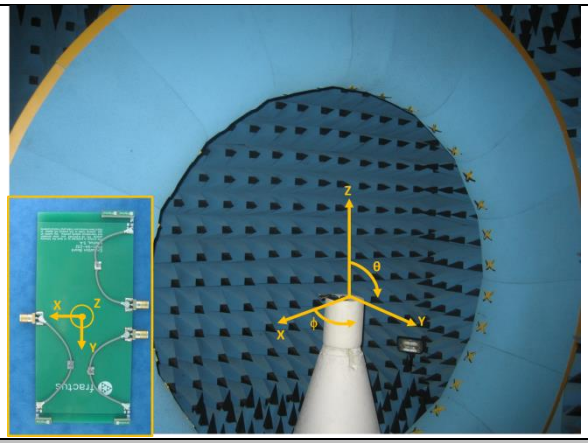
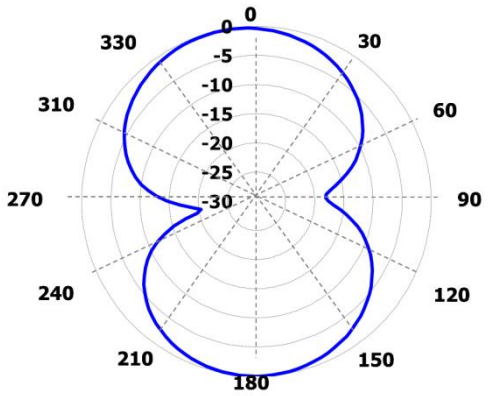


Figure 4 – Transmission coefficient for the 698-798 MHz range (LTE), for 824 – 960 MHz range (LFR), and for the 1710 – 2690 MHz range (HFR) (from the Evaluation Board 3 ports) (Figure 1).

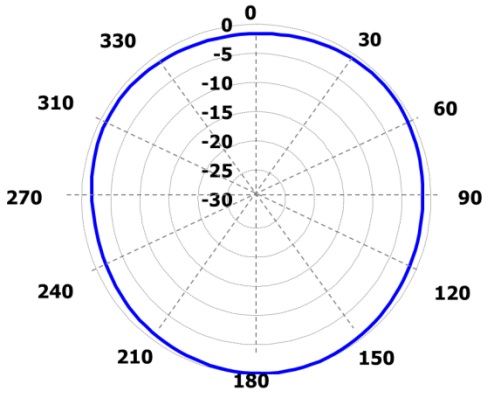
2.2.4. RADIATION PATTERNS (698-798 MHz), GAIN, AND EFFICIENCY



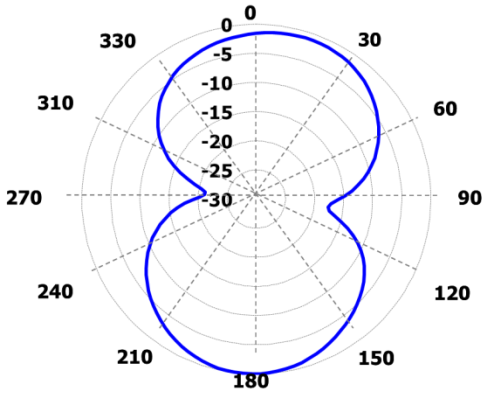
Measurement System Set-Up
Evaluation Board in Plane XY



θ = 90º Plane XY at 750 MHz



ϕ = 0º Plane XZ at 750 MHz

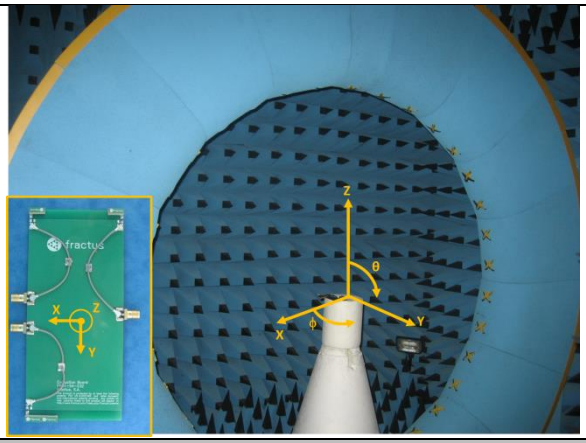


ϕ = 90º Plane YZ at 750 MHz

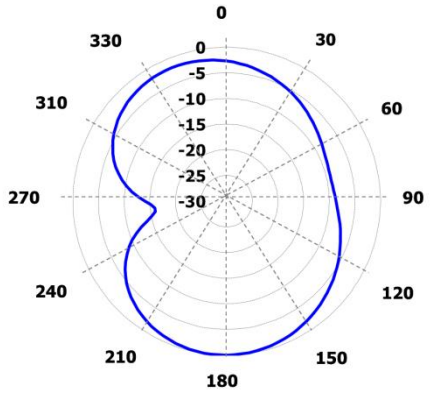
Gain	**Peak Gain**	1.3 dBi
	Average Gain across the band	0.3 dBi
	Gain Range across the band (min, max)	-0.6 <–> 1.3 dBi
Efficiency	**Peak Efficiency**	63.1 %
	Average Efficiency across the band	55.5 %
	Efficiency Range across the band (min, max)	48.8 – 63.1 %

Table 2 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 1) within the 698 – 798 MHz range. Measures made in the Satimo STARGATE 32 anechoic chamber.

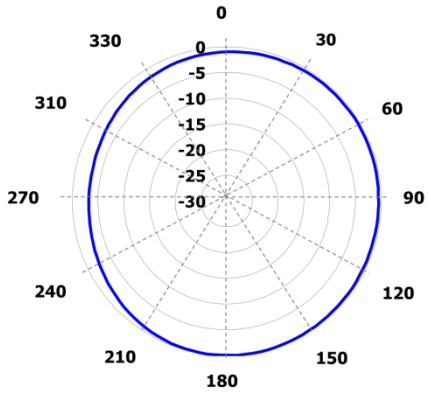
2.2.5. RADIATION PATTERNS (824-960 MHz), GAIN, AND EFFICIENCY



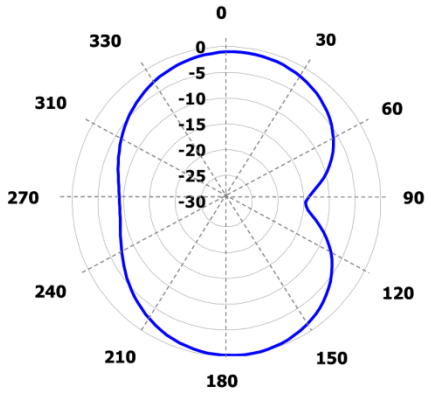
Measurement System Set-Up Evaluation Board in Plane XY



θ = 90º Plane XY at 890 MHz



ϕ = 0º Plane XZ at 890 MHz

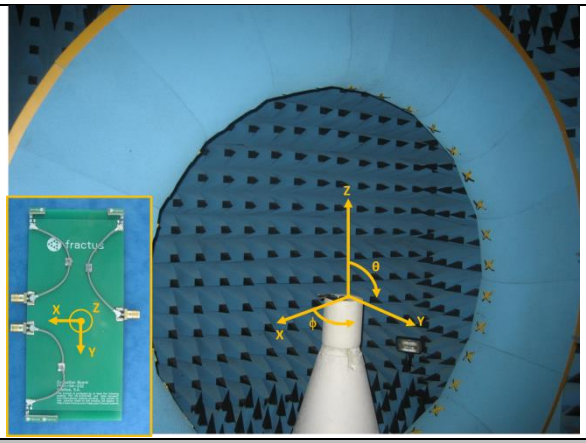


ϕ = 90º Plane YZ at 890 MHz

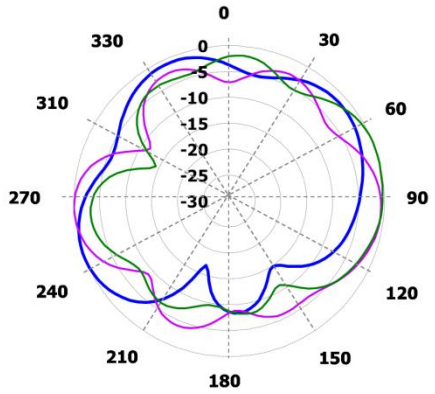
Gain	**Peak Gain**	0.3 dBi
	Average Gain across the band	-0.3 dBi
	Gain Range across the band (min, max)	-2.2 <–> 0.3 dBi
Efficiency	**Peak Efficiency**	58.0 %
	Average Efficiency across the band	49.8 %
	Efficiency Range across the band (min, max)	33.0 – 58.0 %

Table 3 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 1) within then 824 – 960 MHz range. Measures made in the Satimo STARGATE 32 anechoic chamber.

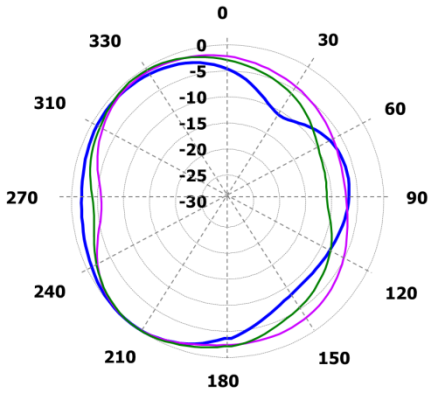
2.2.6. RADIATION PATTERNS (1710-2690 MHz), GAIN, AND EFFICIENCY



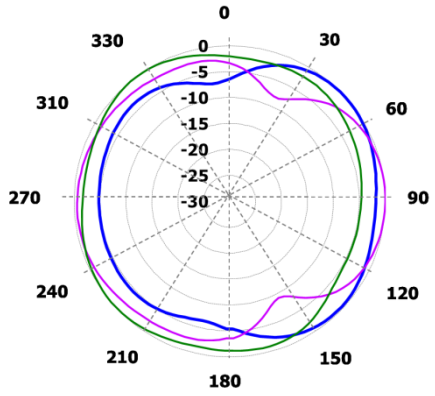
Measurement System Set-Up Evaluation Board in Plane XY



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**	3.8 dBi
	Average Gain across the band	3.1 dBi
	Gain Range across the band (min, max)	1.9 <–> 3.8 dBi
Efficiency	**Peak Efficiency**	87.9 %
	Average Efficiency across the band	79.3 %
	Efficiency Range across the band (min, max)	65.9 – 87.9 %

Table 4 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 1) within the 1710 – 2690 MHz range. Measures made in the Satimo STARGATE 32 anechoic chamber.

3. EVALUATION BOARD 1 PORT (824-960MHz and 1710-2690MHz)

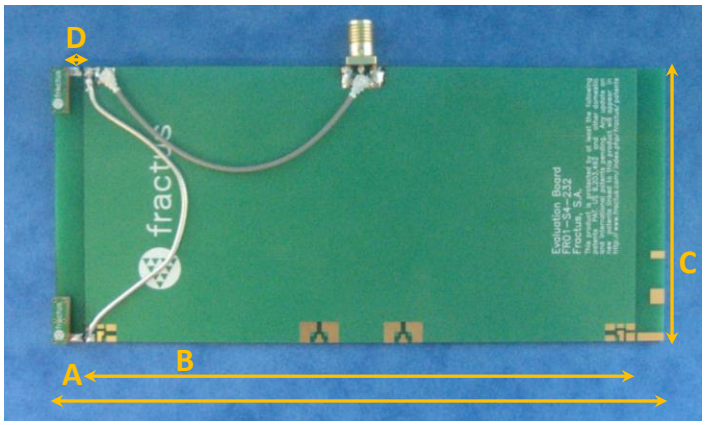
3.1. QUICK REFERENCE GUIDE

Technical features	824 – 960 MHz	1710 – 2690 MHz
Average Efficiency	> 50.0 %	> 65.0 %
Peak Gain	0.7 dBi	2.9 dBi
VSWR	< 3:1	
Radiation Pattern	Omnidirectional	
Polarization	Linear	
Weight (approx.)	0.21 g.	
Temperature	-40 to + 85 ºC	
Impedance	50 Ω	
Dimensions (L x W x H)	10.0 mm x 3.2 mm x 3.2 mm	

Table 5 – Technical Features. Measures from the Evaluation Board. See Figure 5. Note that for obtaining comparable results, a ground plane length larger than 100 mm is recommended.

3.2. EVALUATION BOARD 1 PORT (824-960 MHz and 1710-2690 MHz)

This Evaluation Board (part number: EB_FR01-S4-232-UFL2R-1P) integrates two BAR mXTEND™ Antenna Boosters to provide operation in two frequency regions, from 824 MHz to 960 MHz and from 1710 MHz to 2690 MHz. The two BAR mXTEND™ Antenna Boosters are connected between them through a 50 ohms impedance transmission line, in such a way that a single input/output port is provided. A UFL cable connects this single input/output port to the SMA connector.



Measure	mm
A	133
B	120
C	60
D	3.3

Tolerance: ±0.2 mm

D: Distance between the BAR mXTEND™ Antenna Booster and the ground plane.

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

Figure 5 – EB_FR01-S4-232-UFL2R-1P. Evaluation Board 1 port providing operation in 2 frequency ranges, 824 – 960MHz and 1710 – 2690MHz.

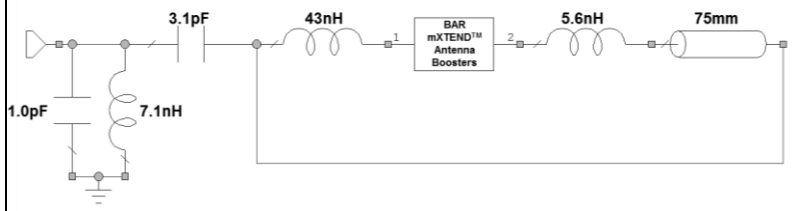
This product is protected by at least the following patents PAT. US 8,203,492, PAT. US 8,237,615 and other domestic and international patents pending. Any update on new patents linked to this product will appear in www.fractusantennas.com/virtual-antenna/.

3.2.1. 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 BAR 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 BAR 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).

824 – 960 MHz and 1710 – 2690 MHz



Value	Part Number
43 nH	LQW18AN43NG00
5.6 nH	LQW15AN5N6B80
3.1 pF	GJM1555C1H3R1WB01
7.1 nH	LQW15AN7N1G80
1.0 pF	GJM1555C1H1R0WB01

Figure 6 – Matching network implemented in the Evaluation Board 1 port (Figure 5).

Please note that the matching network includes a 50 ohms impedance micro coaxial transmission line having a length of 75 mm. To ensure optimal results, good grounding between the transmission line shielding and the ground plane is highly recommended. 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 antenna booster matching service.

3.2.2. VSWR and TOTAL Efficiency

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

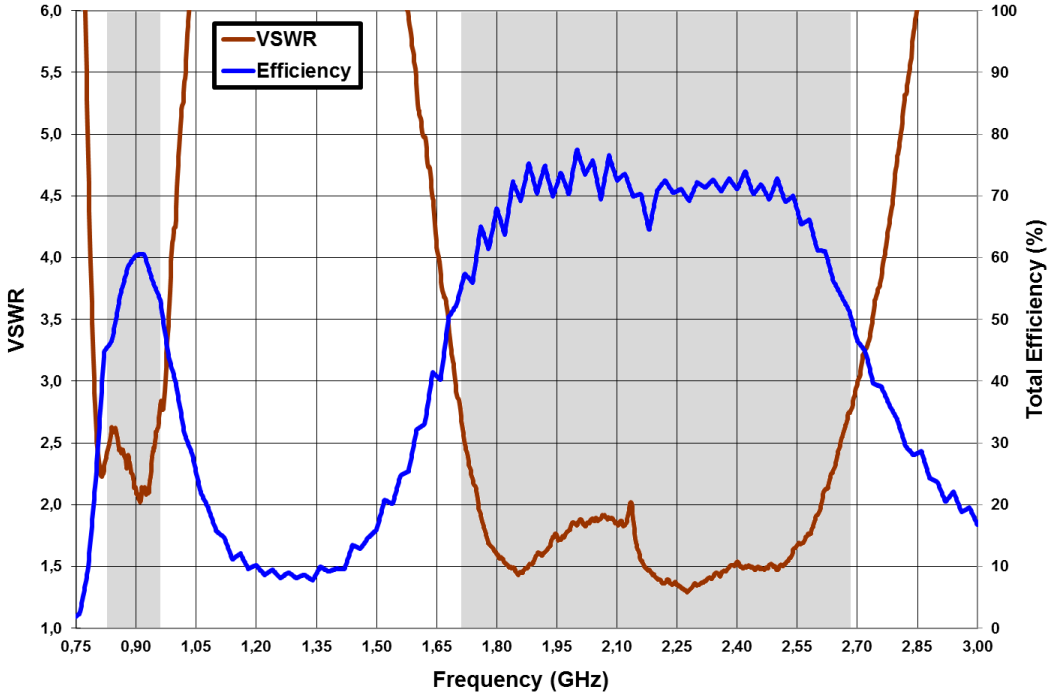
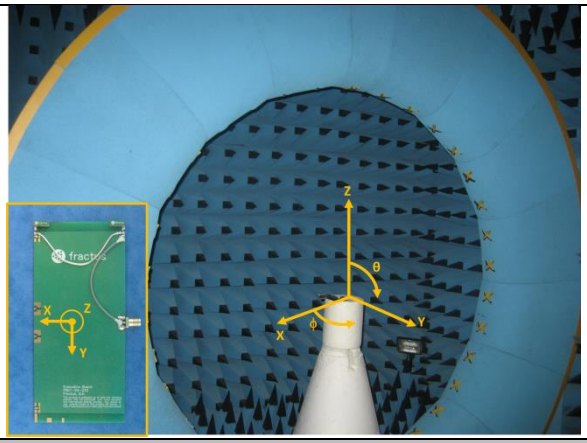
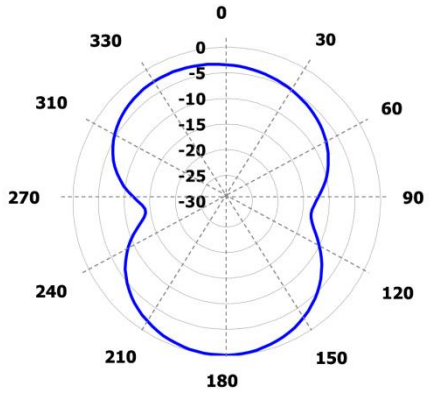


Figure 7 – VSWR and Total Efficiency for the 824 – 960 MHz frequency range and for the 1710 – 2690 MHz frequency range (from the Evaluation Board) (Figure 5).

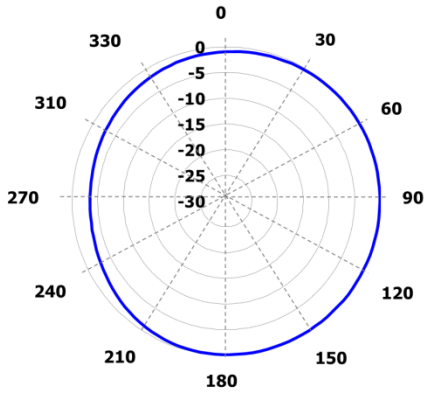
3.2.3. RADIATION PATTERNS (824-960 MHz), GAIN, AND EFFICIENCY



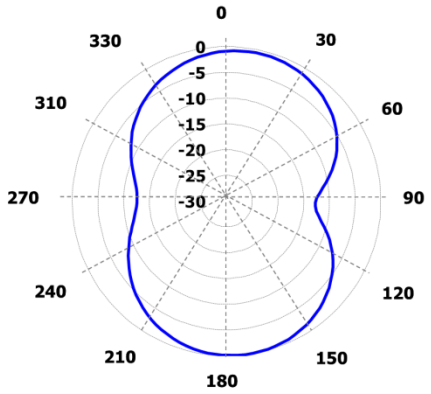
Measurement System Set-Up
Evaluation Board in Plane XY



θ = 90º Plane XY at 890 MHz



ϕ = 0º Plane XZ at 890 MHz

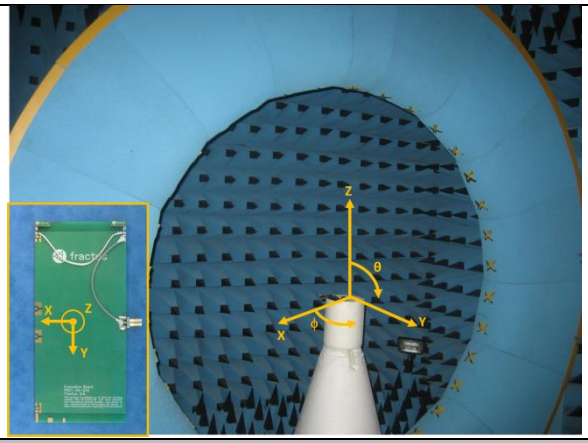


ϕ = 90º Plane YZ at 890 MHz

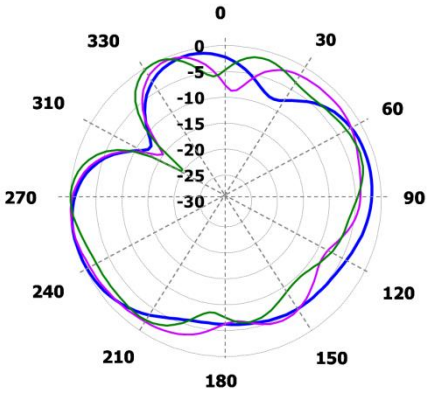
Gain	**Peak Gain**	0.7 dBi
	Average Gain across the band	0.3 dBi
	Gain Range across the band (min, max)	-0.5 <–> 0.7 dBi
Efficiency	**Peak Efficiency**	60.6 %
	Average Efficiency across the band	55.3 %
	Efficiency Range across the band (min, max)	45.1 – 60.6 %

Table 6 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 5) within the 824 – 960 MHz frequency range. Measures made in the Satimo STARGATE 32 anechoic chamber.

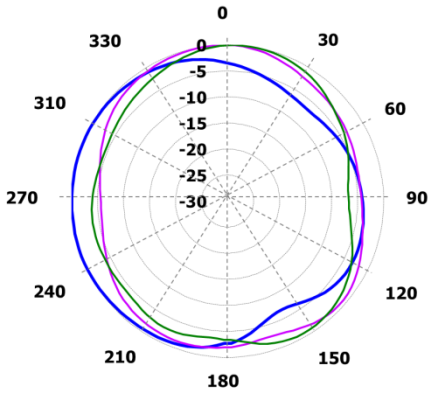
3.2.4. RADIATION PATTERNS (1710-2690 MHz), GAIN, AND EFFICIENCY



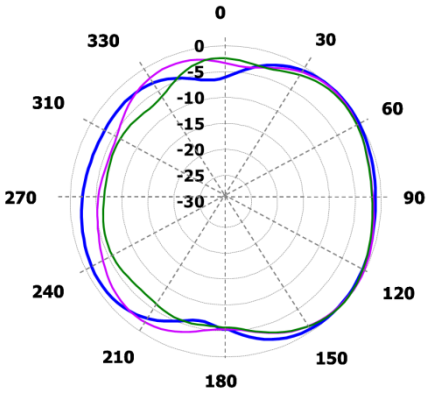
Measurement System Set-Up Evaluation Board in Plane XY



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



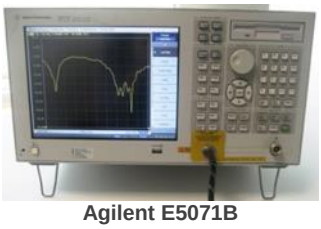
ϕ = 90º Plane YZ at 1.71 GHz, 2.2 GHz and 2.69 GHz

Gain	**Peak Gain**	2.9 dBi
	Average Gain across the band	2.3 dBi
	Gain Range across the band (min, max)	1.0 <–> 2.9 dBi
Efficiency	**Peak Efficiency**	77.5 %
	Average Efficiency across the band	68.7 %
	Efficiency Range across the band (min, max)	48.7 – 77.5 %

Table 7 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 5) within the 1710 – 2690 MHz frequency range. Measures made in the Satimo STARGATE 32 anechoic chamber.

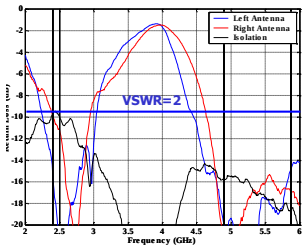
4. CAPABILITIES AND MEASUREMENT SYSTEMS

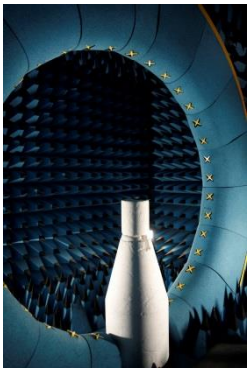
Fractus Antennas specializes in designing and manufacturing optimized antennas for wireless applications and providing our clients with RF expertise. We offer turn-key antenna products and antenna integration support to minimize your time requirement and maximize your return on investment during your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

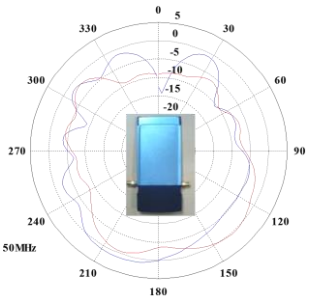
VSWR
&
S Parameters





SATIMO STARGATE 32

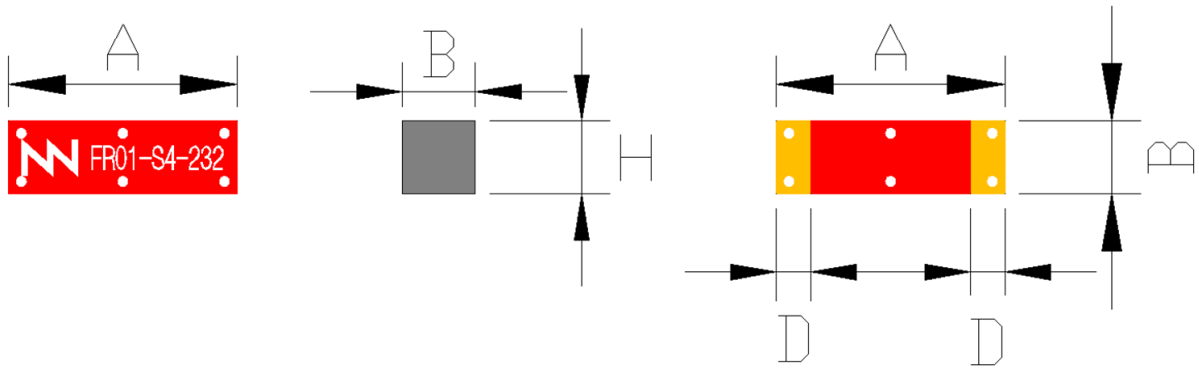
Radiation
Pattern
&
Efficiency



Anechoic chambers and full equipped in-house lab

5. MECHANICAL CHARACTERISTICS FR01-S4-232

5.1. DIMENSIONS, TOLERANCES, AND RoHS



TOP **SIDE** **BOTTOM**

Dimension	mm	Dimension	mm
A	10.0 ± 0.2	**B**	3.2 ± 0.2
C	0.5 ± 0.1	**D**	1.5 ± 0.1
H (Height)	3.2 +0.2 -0.1		

Figure 8 – BAR mXTEND™ Antenna Booster dimensions and tolerances.

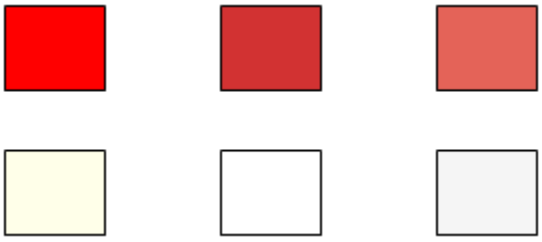
The 2 pads are fully symmetrical to mount it on the PCB. See Figure 11.

The BAR mXTEND™ Antenna Booster FR01-S4-232 is compliant with the restriction of the use of hazardous substances (**RoHS**).

The RoHS certificate can be downloaded from www.fractusantennas.com.

5.2. COLOUR RANGE FOR THE INK

Next figure shows the range of the colours in the BAR mXTEND™ Antenna Booster:



Acceptable color range

5.3. RECOMMENDED FOOTPRINT for the FR01-S4-232

Assuming that the BAR mXTEND™ Antenna Booster FR01-S4-232 is placed in the clearance area of the PCB, see below the recommended footprint dimensions.

Measure	mm
A	1.7
B	6.8
C	3.4

Tolerance: ±0.1 mm

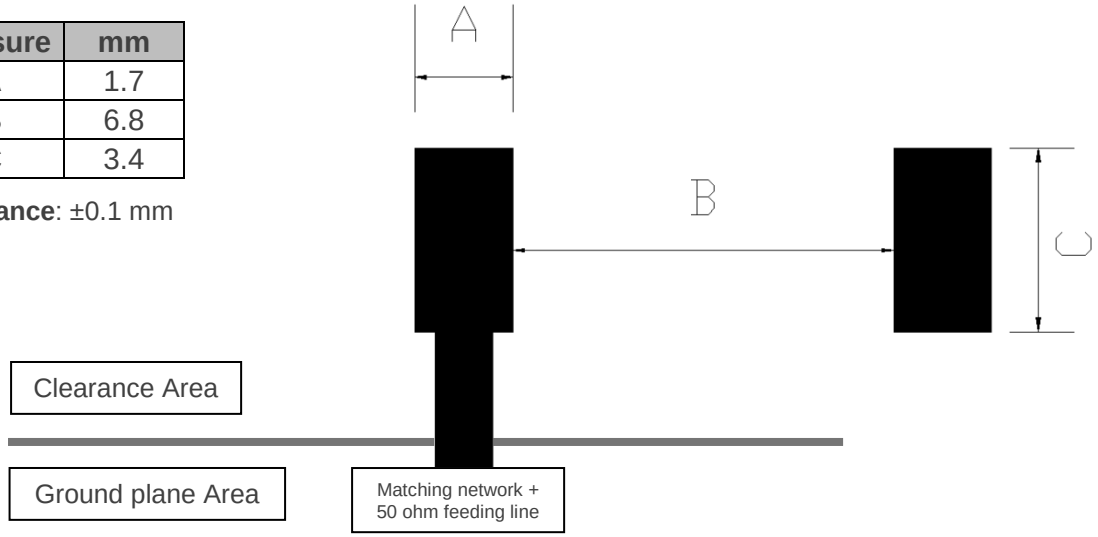


Figure 9 – Footprint dimensions for the single booster.

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

5.4. RECOMMENDED FOOTPRINT for the FR01-S4-232 double booster

Measure	mm
A	1.7
B	6.8
C	3.4
D	3.3

Tolerance: ±0.1 mm

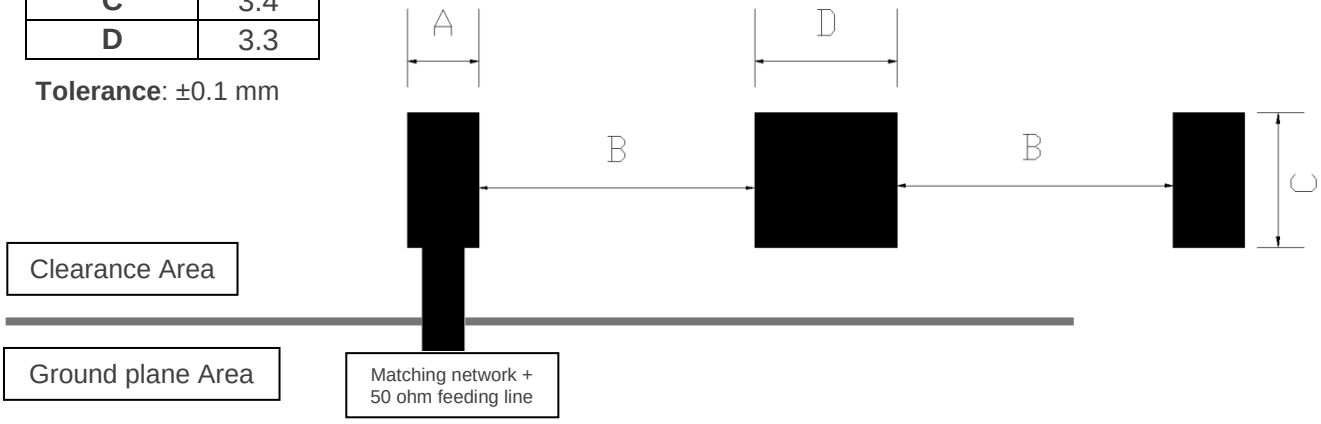


Figure 10 – Footprint dimensions for the double booster.

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

6. ASSEMBLY PROCESS

Figure 11 shows the back and front view of the BAR mXTEND™ Antenna Booster FR01-S4-232. Due to the symmetry in the product configuration, the feeding pad can be any of the 2 pads.

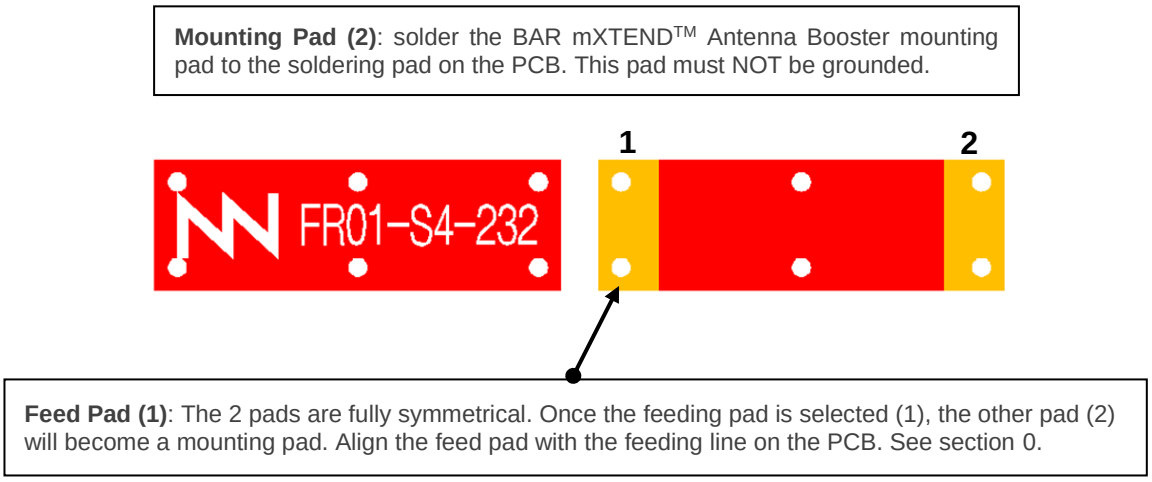


Figure 11 – Pads of the BAR mXTEND™ Antenna Booster FR01-S4-232.

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

1. Apply a solder paste on the pads of the PCB. Place the BAR mXTEND™ Antenna Booster on the board.
2. Perform a reflow process according to the temperature profile detailed in Table 8, Figure 13.
3. After soldering the BAR 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:

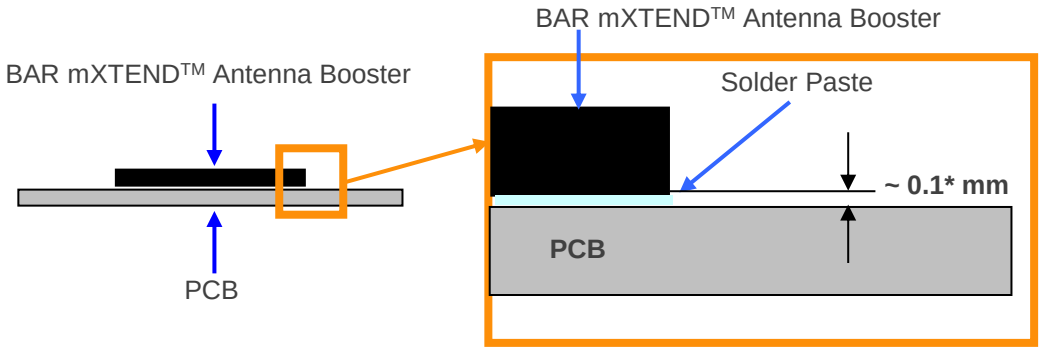


Figure 12 – Soldering Details.

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 BAR mXTEND™ Antenna Booster FR01-S4-232 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 8 – Recommended soldering temperatures.

Next graphic shows temperature profile (grey zone) for the BAR mXTEND™ Antenna Booster assembly process reflow ovens.

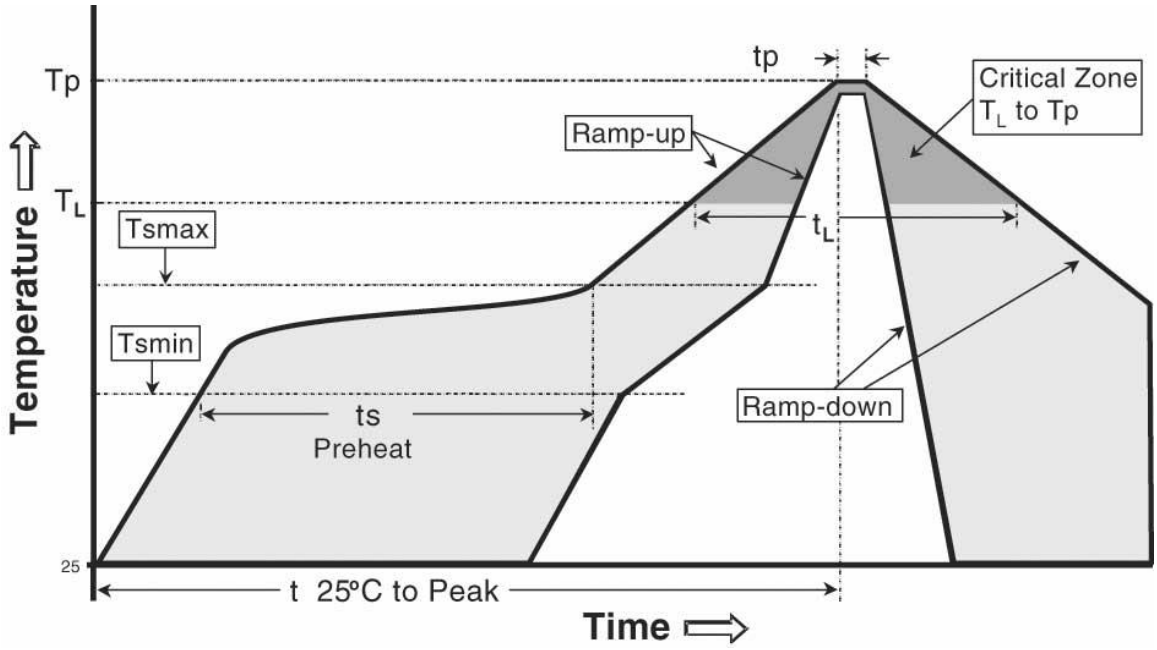
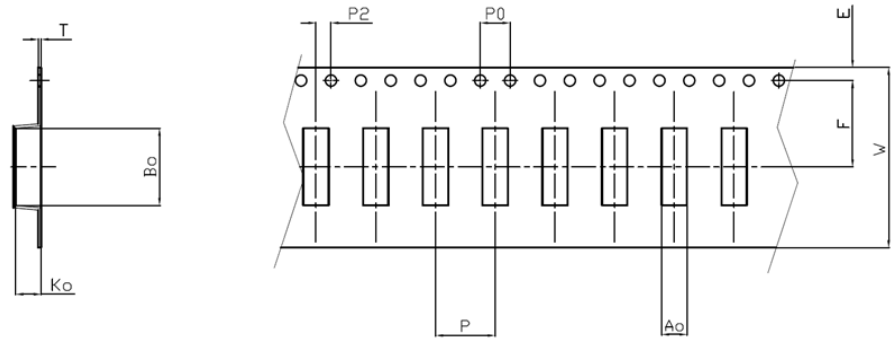


Figure 13 – Temperature profile.

7. PACKAGING

The BAR mXTEND™ Antenna Booster FR01-S4-232 is delivered in tape and reel packaging.



Measure	mm
Ao	3.4 ± 0.1
Bo	10.3 ± 0.1
Ko	3.4 ± 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	0.4 ± 0.05

Figure 14 – Tape dimensions and Tolerances.

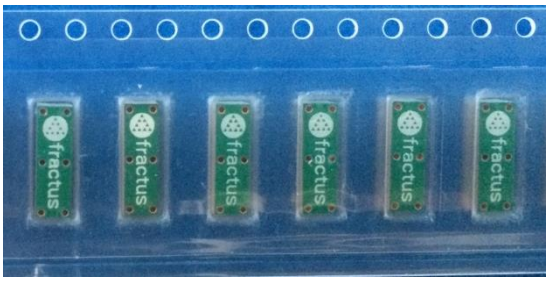
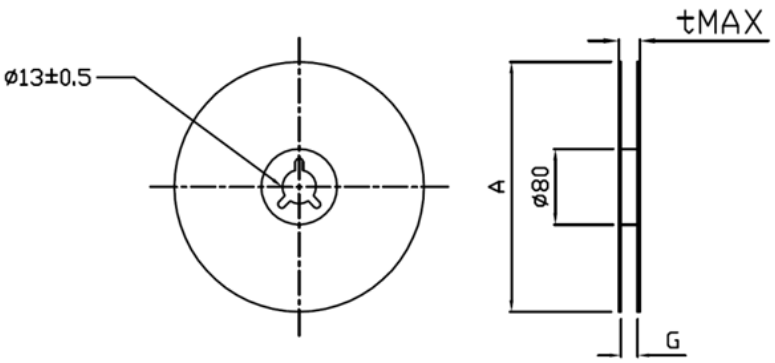


Figure 15 – Image of the tape.



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

Reel Capacity: 2000 pcs

Figure 16 – Reel Dimensions and Capacity.

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