LOOKING TO MAINTAIN PEAK PERFORMANCE IN YOUR SMARTWATCH?

RUN mXTEND™ (FR01-S4-224) – AN for a Smartwatch WIFI/BLUETOOTH (2400-2500 MHz)

Fractus Antennas specializes in enabling effective mobile communications by designing and manufacturing optimized antenna products that will make your wireless devices more competitive. Our mission is to transform our clients' product development processes with innovative components that accelerate time-to-market without compromising functionality.

RUN mXTEND™ antenna component

FR01-S4-224

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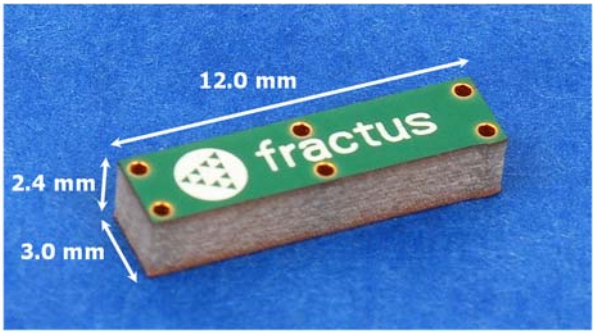
1. PRODUCT DESCRIPTION (FR01-S4-224)

Smartwatches are demanding innovation on various fronts. When performance is the driving factor, we recommend the RUN mXTEND™ solution. This solution reaches an 80% free-space efficiency as compared to most other solutions, which hover around 50% (or less). And while performance is the driver, the RUN mXTEND™ antenna component is still small in size but powerful when it comes to results.

The RUN mXTEND™ has been specifically designed to provide multiband performance in wireless devices, enabling worldwide coverage by operating costs across multiple communication standards including Bluetooth, ISM, WIFI, and WLAN. Based on Fractus Antennas' proprietary Virtual Antenna™ technology, the RUN mXTEND™ belongs to a new generation of antenna products focused on replacing conventional antenna solutions with miniature, off-the-shelf components that drive fast, intelligent design.

This breakthrough technology has been specifically designed to fit a diverse set of wireless applications – smartwatches is just one of the many environments where this tiny antenna can be transformational.

TOP



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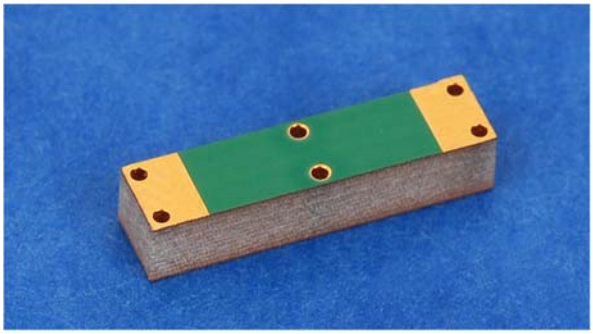

Material: The RUN mXTEND™ antenna component is built on glass epoxy substrate.

APPLICATIONS

- Smartwatch
- Wearables
- M2M
- IoT
- Modules
- Meters
- Remote Sensors

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)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 674491

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2. EVALUATION BOARD

The Evaluation Board provides a testing environment to determine how the RUN mXTEND™ antenna component will apply to a specific smartwatch design.

2.1. QUICK REFERENCE GUIDE

Technical features	2.4 – 2.5 GHz
Average Efficiency	> 75%
Peak Gain	2.2 dBi
VSWR	< 2:1
Radiation Pattern	Omnidirectional
Polarization	Linear
Weight (approx.)	0.19 g.
Temperature	-40 to + 85 ºC
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 (Figure 1).

2.2. EVALUATION BOARD (2.4-2.5 GHz)

This Evaluation Board integrates a coplanar grounded transmission line to connect the RUN mXTEND™ antenna component with the SMA connector. Overall dimensions make it suitable as an antenna system solution for smartwatches. The RUN mXTEND™ operates within a frequency band 2.4 GHz to 2.5 GHz, through a single input/output port.

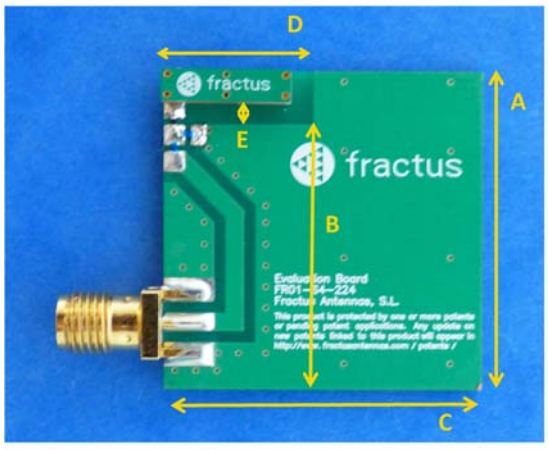

Figure 1 – EB_FR01-S4-224-SW-2400. Evaluation Board providing operation from 2.4 GHz to 2.5 GHz.

Measure	mm
A	30
B	25
C	30
D	14
E	2.0

Tolerance: ±0.2 mm

E: Distance between the RUN mXTEND™ antenna component and the ground plane.

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

This product and its use are protected by at least one or more of the following patents US 9,130,259 B2; US 9,276,307 B2 and patent applications US62/328073, http://www.fractusantennas.com/patents. Additional information about patents related to this product is available at www.fractusantennas.com/virtual-antenna/.

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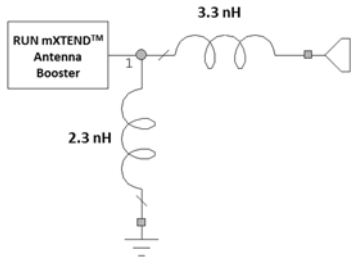
2.3. MATCHING NETWORK

The specifications of a Fractus Antennas standard product are measured in an Evaluation Board to create an ideal case. However, when incorporating into real design, nearby components such as LCD's, batteries, covers and connectors may affect the antenna performance. For this reason, placing pads compatible with 0402 and 0603 SMD components for a matching network as close as possible to the feeding point is highly recommended. Create this matching network in the ground plane area rather than the clearance area – this will provide a degree of freedom for tuning the RUN mXTEND™ antenna component once the design is finished, 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 component may require a different matching networks. To ensure optimal results, the use of high Q and tight tolerance components is highly recommended (Murata components).

If you need assistance, contact info@fractusantennas.com for more information related to the RUN mXTEND™ antenna component matching service.

2.4 – 2.5 GHz



Value	Part Number
2.3 nH	LQW15AN2N3B80
3.3 nH	LQW15AN3N3B80

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

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2.4. VSWR AND TOTAL EFFICIENCY

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

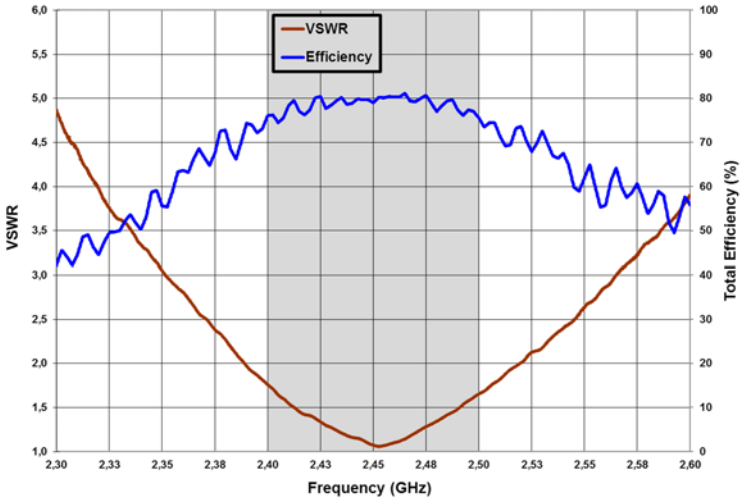

Figure 3 – VSWR and Total Efficiency for the 2.4 – 2.5 GHz frequency range (from the Evaluation Board (Figure 1)).

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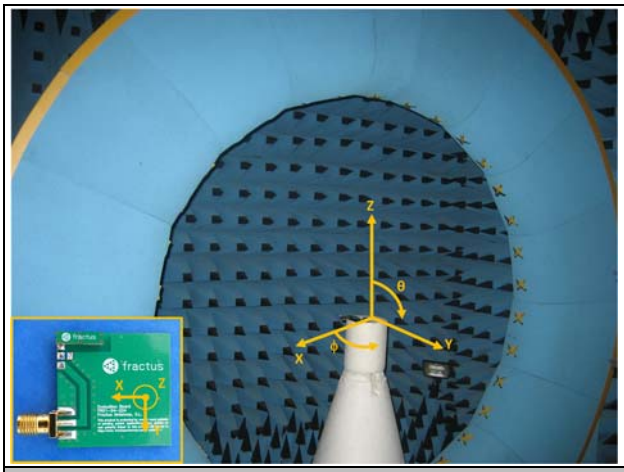
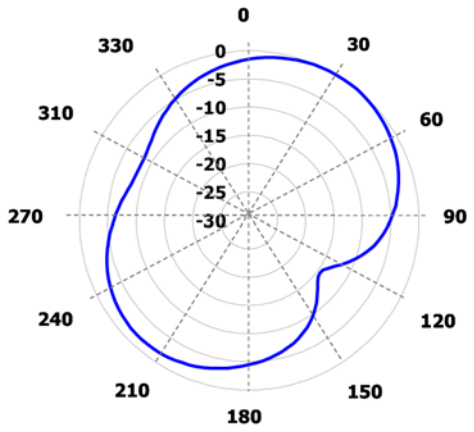
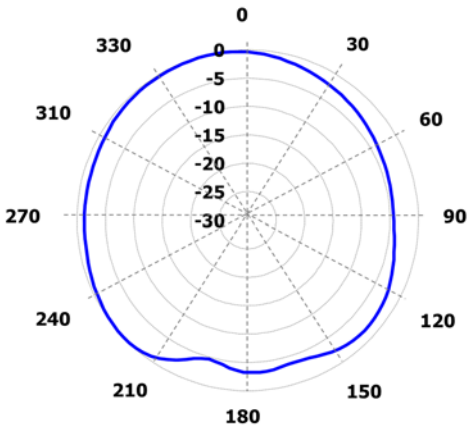
2.5. RADIATION PATTERNS, GAIN, AND EFFICIENCY



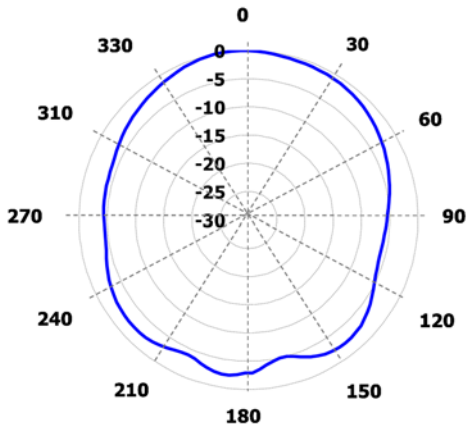
Measurement System Set-Up
Evaluation Board in Plane XY



θ = 90º Plane XY at 2.45 GHz



ϕ = 0º Plane XZ at 2.45 GHz



ϕ = 90º Plane YZ at 2.45 GHz

Gain	**Peak Gain**	2.2 dBi
	Average Gain across the band	1.9 dBi
	Gain Range across the band (min, max)	1.7 <–> 2.2 dBi
Efficiency	**Peak Efficiency**	81.2 %
	Average Efficiency across the band	78.6 %
	Efficiency Range across the band (min, max)	74.5 – 81.2 %

Table 2 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 1) within the 2.4 – 2.5 GHz frequency range. Measures made in the Satimo STARGATE 32 anechoic chamber.

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3. HUMAN HAND IMPACT

In general terms, the interaction between a human body and a radiating system affects performance by introducing efficiency decrements and detuning effects. In a smartwatch solution, this interaction is particularly strong given the device is set around the wrist of the human hand.

This section will analyze the impact of the human hand (Figure 4) over the Evaluation Board (Figure 1) on different distances at the frequency range of 2.4 GHz to 2.5 GHz.

Figure 4 – Phantom hand used to assess the performance of the evaluation board (Figure 1) when regarding the human hand interaction.

3.1. SET-UP

The evaluation board (Figure 1) is placed over a phantom hand emulating the electromagnetic properties of the human body at the frequency range of 2.4-2.5GHz at different distances (Figure 5).

a) 0mm

b) 3mm

c) 6mm

Figure 5 – Different distances between the phantom hand and the evaluation board that provide operation from 2.4GHz to 2.5GHz.

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3.2. MATCHING NETWORK

Please note that the matching network topology has been maintained for each configuration. The component values have been re-adjusted in each case for compensating the detuning effects introduced by the proximity of the phantom hand (Figure 5).

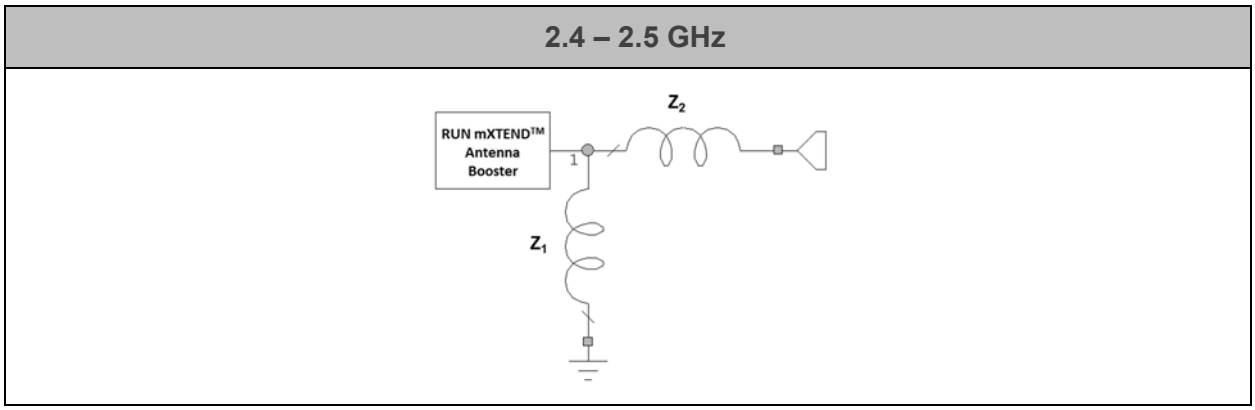

Figure 6 – Topology of matching network mounted at the different solutions.

Distance	Z_1	Z_2
0mm	1.5 nH	0 Ω
3mm	1.8 nH	3.3 nH
6mm	1.8 nH	3.4 nH

Table 3 – Values of the components for each distance.

Value		Part Number
Z1	1.5 nH	LQW15AN1N5C80
	1.8 nH	LQW15AN1N8C00
Z2	3.3 nH	LQW15AN3N3B80
	3.4 nH	LQW15AN3N4B80

Table 4 – Values and part numbers of the components used for the matching networks.

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3.3. VSWR AND TOTAL EFFICIENCY

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

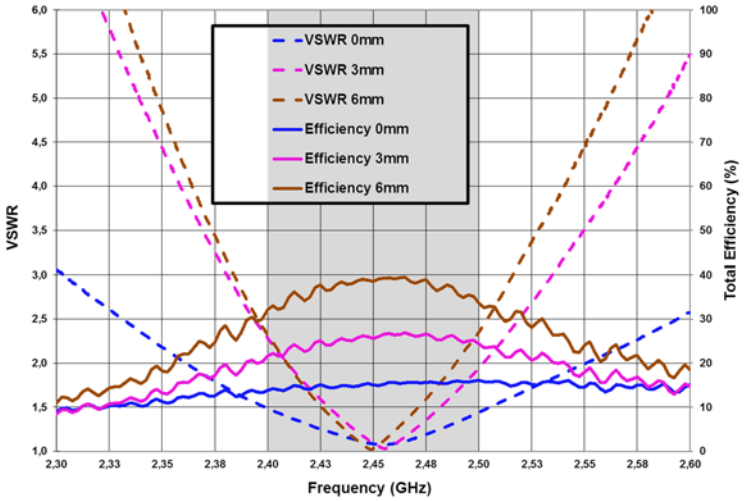

Figure 7 – VSWR and Total Efficiency for the 2.4 – 2.5 GHz frequency range (from the evaluation board (Figure 5)).

	VSWR	TOTAL EFFICIENCY (%)				
Distance	**2.4-2.5GHz**	**η_a[1] (2.4GHz)**	**η_a (2.5GHz)**	**η_a (min)**	**η_a (max)**	**η_a (average)**
Free Space	< 2:1	76.0	75.5	74.5	81.2	78.6
0mm	< 2:1	13.8	16.1	13.8	16.1	15.1
3mm	< 2.5:1	21.6	24.4	21.6	26.9	25.0
6mm	< 2.5:1	32.1	33.6	32.1	39.5	37.0

Table 5 – VSWR and Total Efficiency comparison considering the different distances.

[1] η_a refers to the total efficiency of the antenna system which considers both ohmic and impedance losses

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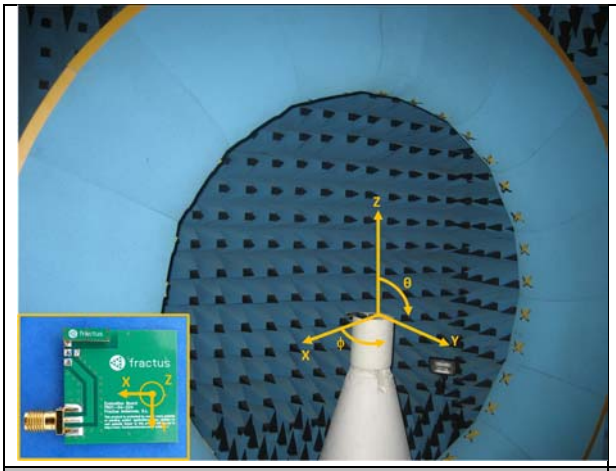
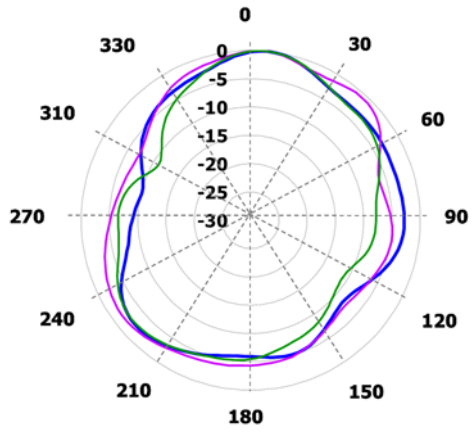
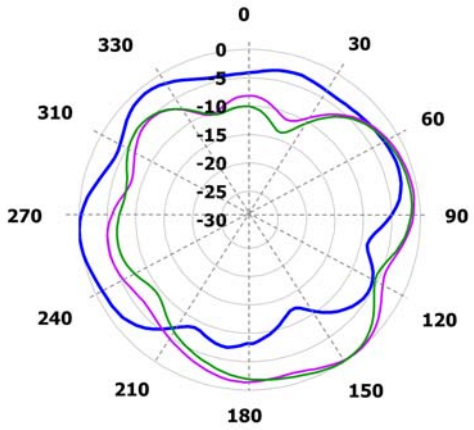
3.4. RADIATION PATTERNS, GAIN, AND EFFICIENCY



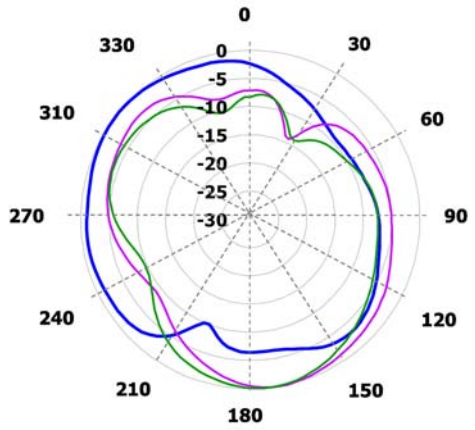
Measurement System Set-Up Evaluation Board in Plane XY



θ = 90º Plane XY at 2.45 GHz at 0mm, 3mm and 6mm



ϕ = 0º Plane XZ at 2.45 GHz at 0mm, 3mm and 6mm



ϕ = 90º Plane YZ at 2.45 GHz at 0mm, 3mm and 6mm

		0mm	3mm	6mm
Gain	Peak Gain	-3.5 dBi	0.3 dBi	3 dBi
	Average Gain across the band	-3.9 dBi	-0.3 dBi	2.6 dBi
	Gain Range across the band (min, max)	-4.5<–>-3.5 dBi	-1.2<–>0.3 dBi	1.7<–>3.0 dBi
Efficiency	Peak Efficiency	16.1 %	26.9 %	39.5 %
	Average Efficiency across the band	15.1 %	25.0 %	37.0 %
	Efficiency Range across the band (min, max)	13.8 – 16.1 %	21.6 – 26.9 %	32.1 – 39.5 %

Table 6 – Antenna Gain and Total Efficiency from the Evaluation Board (Figure 1) within the 2.4 – 2.5 GHz frequency range. Measures made in the Satimo STARGATE 32 anechoic chamber.

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