



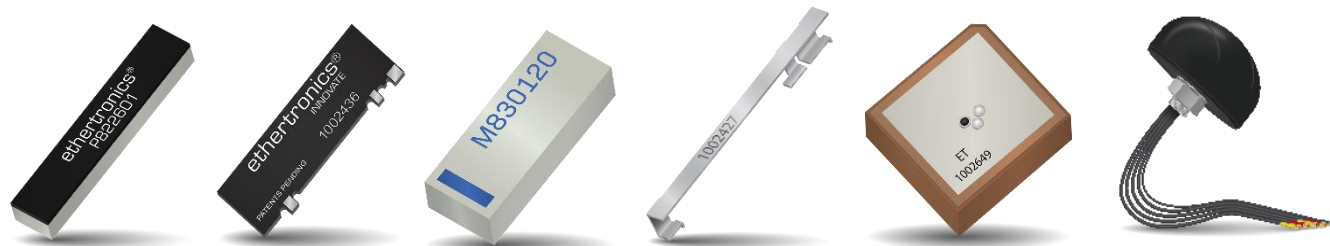
## **Antennas: Technologies & New Product Developments**

**Carmen Redondo**





## Antennas: Technologies & New Product Developments



# AVX ANTENNAS



AVX Antenna Design and R&D centers regularly anticipate needs and adapt and innovate products to support the explosive growth of next-generation technologies spanning smartphones and tablets to automotive and IoT devices



Internet of Things	Industrial	Automotive	Lighting
Narrow Band Internet of Things	Cellular 4G / 5G	Smart Homes & Cities	Infotainment & Navigation
Fleet & Asset Tracking	Smart Meters	DSRC / V2X	Security
Agriculture	Gateway Routers	Consumer	Medical

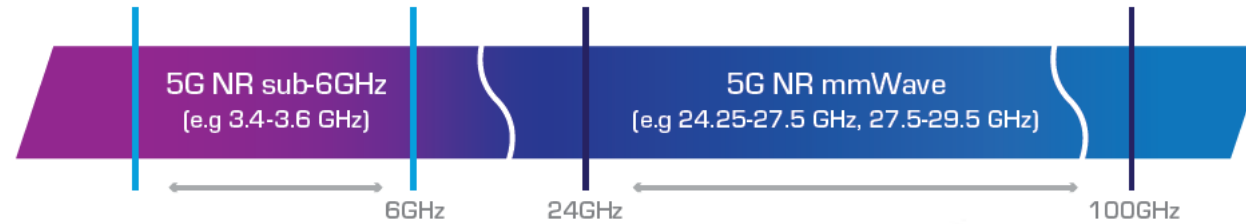
# TECHNOLOGIES



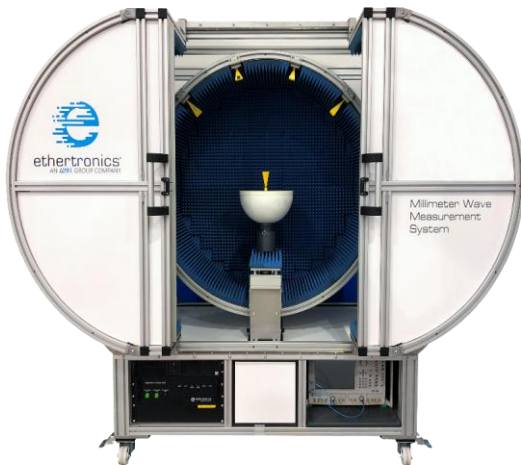
- ❑ 5G mmWave
- ❑ 5G sub-6 GHz
- ❑ NB-IoT, LTE-M
- ❑ UWB
- ❑ Multiband Antennas
- ❑ Other technologies: GNSS, Wi-Fi 6

# 5G mmWAVE ANTENNAS

## 5G SUB-6GHZ and MMWAVE

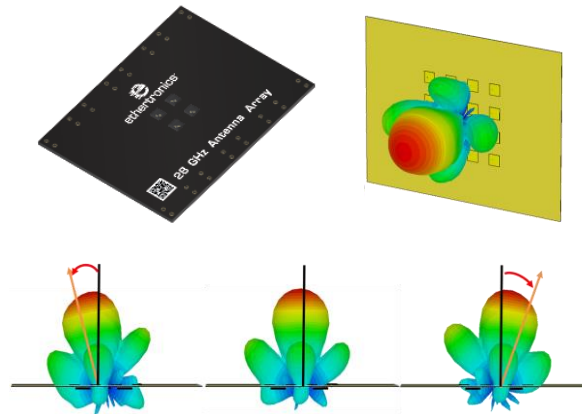


## Measurement Systems

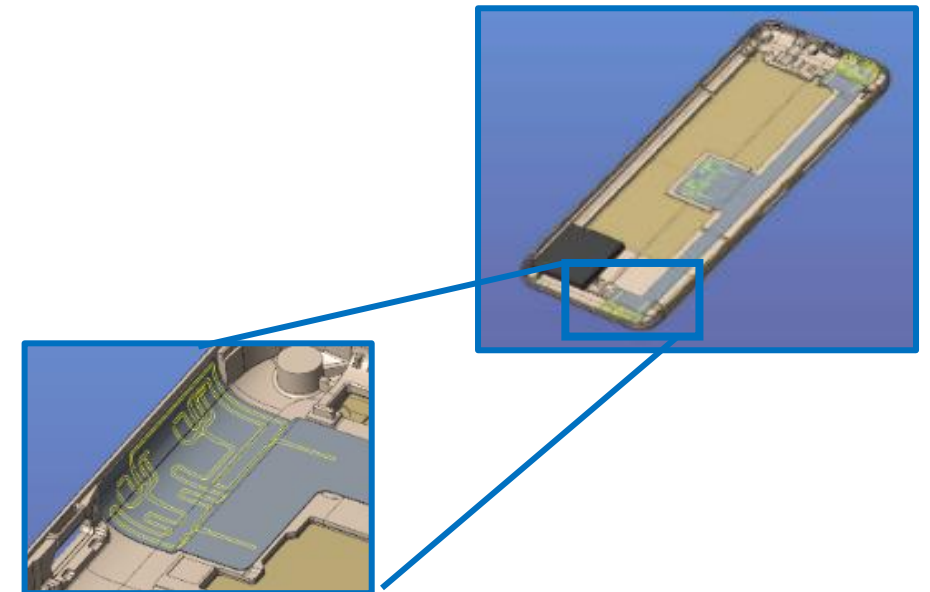


[mmWave Measurement System](#)

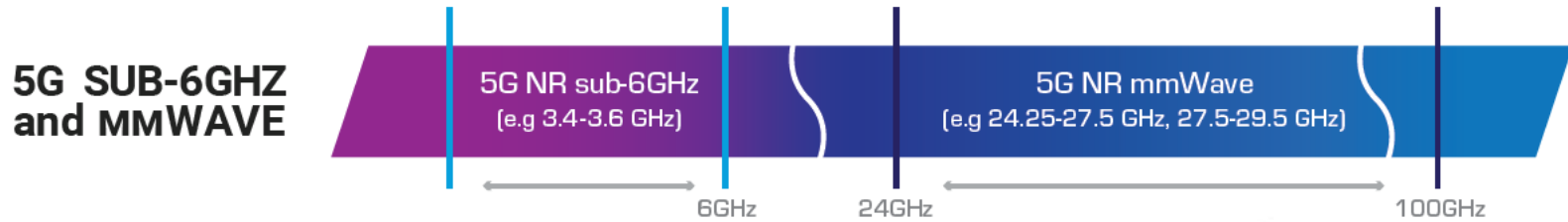
## High Gain Antennas (28 GHz and 60 GHz)






## Low-Cost Embedded Antenna Array Solution (28 GHz and 60 GHz)





# SUB-6GHz 5G ANTENNAS



## On-Board Antennas

	<p><b>1004795 / 1004796*</b> PCB Antenna (617-960) + (1710-2700) MHz</p>
	<p><b>1000146</b> Embedded Stamped Metal Antenna (3300-3800) MHz</p>
	<p><b>P822601 / P822602*</b> PCB Antenna (698-960) + (1710-2700) + (3300-3800) MHz</p>

## Off-Board Antennas

	<p><b>1005392F0</b> COMBO LTE / 5G &amp; Wi-Fi FPC + 2 Cable (LTE / 5G 600MHz - 5GHz) (Wi-Fi 2.4Hz &amp; 5GHz)</p>
	<p><b>1005460F0</b> LTE/5G FPC + Cable (LTE/5G 600MHz - 5GHz)</p>



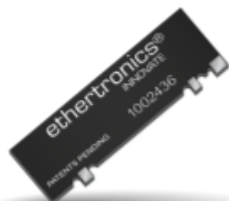
# NB-IoT, LTE-M ANTENNAS

**1004795 / 1004796** | Embedded Broadband LTE/Cellular FR4 Antenna



**SMD, Small Footprint**

**1002436** | Vertical Wideband FR4 Embedded LTE/Cellular Antenna



**Narrow Footprint**

**1002289** | LTE/Cellular Wide Band FPC Off-Board Antenna

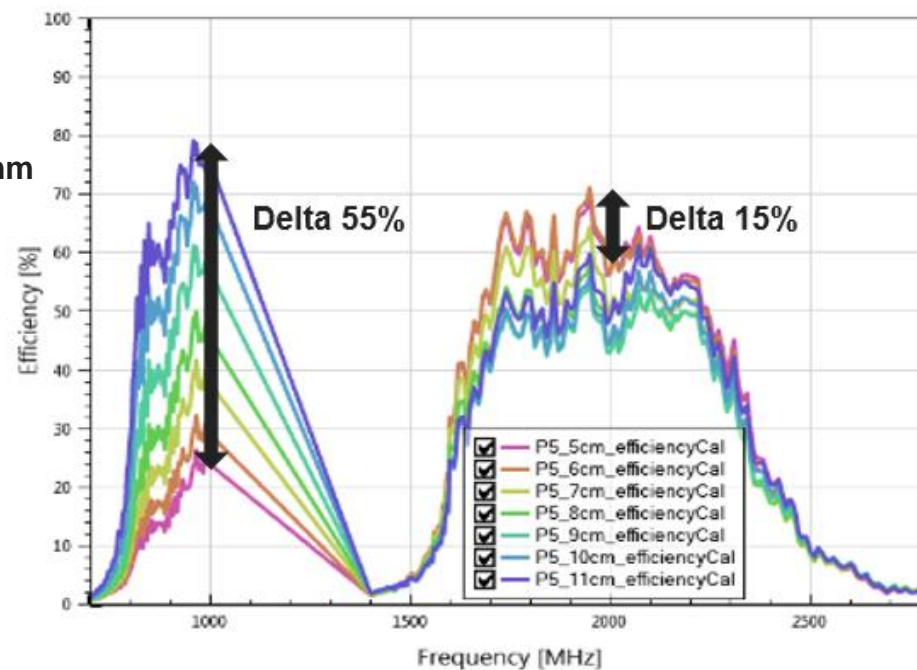


**Off Board**

**X9001248-4GMSMB1000R** | External Mag Mount LTE/Cellular Antenna



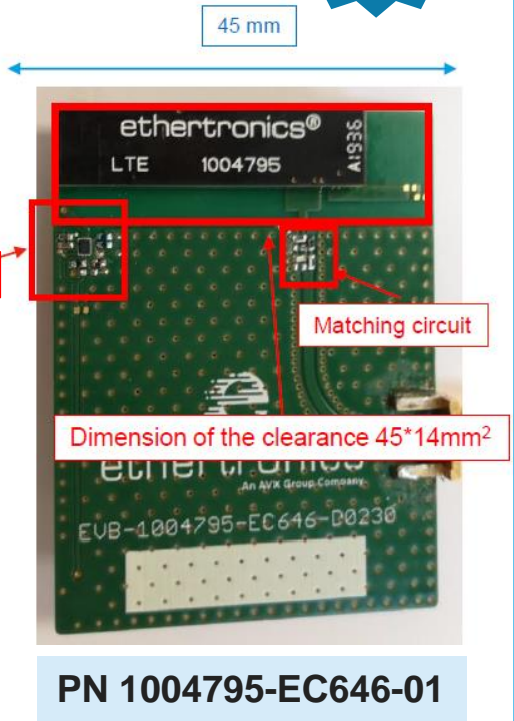
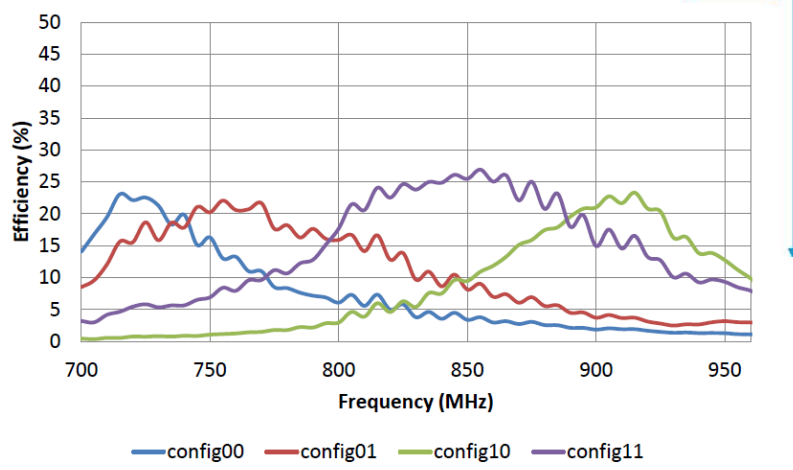
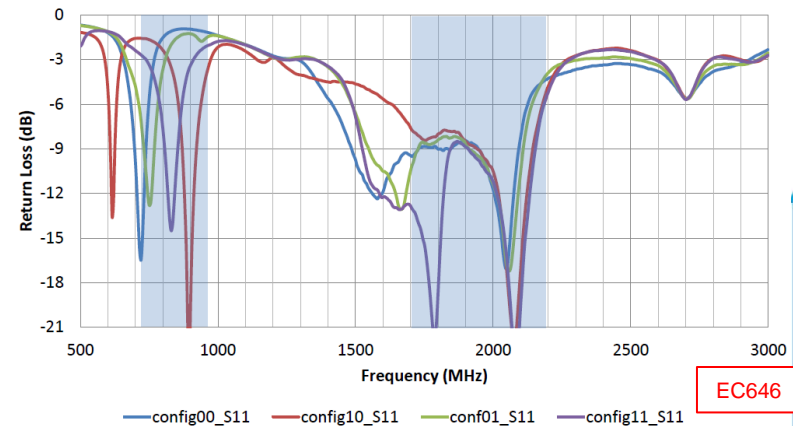
**External**



# NB-IoT, LTE-M ANTENNAS

## ACTIVE BAND SWITCHING

**NEW!**



## LASER DIRECT STRUCTURING (LDS)

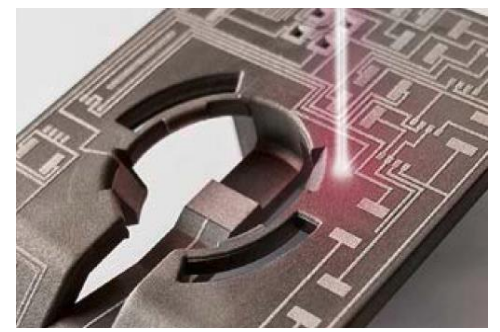





Image Courtesy of LPKF Laser & Electronics

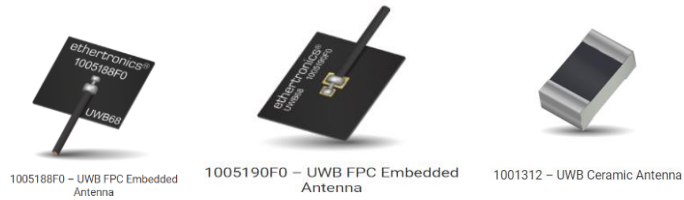
**LDS prototyping capabilities in Europe (France)**

-  Flexibility for design optimization
-  Faster time-to-market
-  Quicker sample availability

**NEW!**

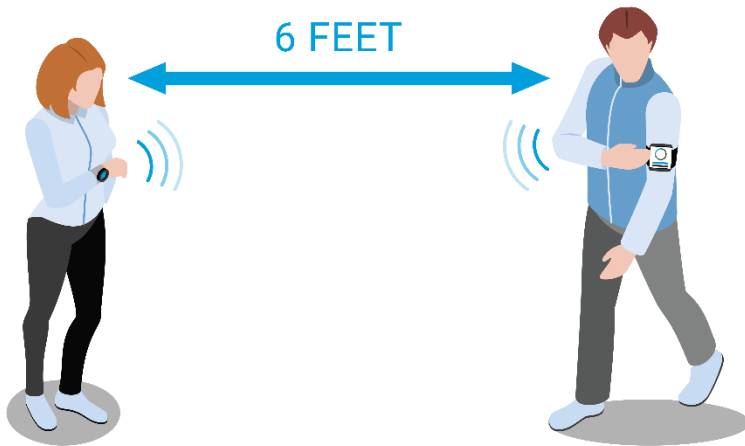


# UWB ANTENNAS



[UWB Antennas](#)

## SOCIAL DISTANCING



**UWB technology** enables high accuracy (< 15cm error margin) in distance measurement.

**Typical application:** Wearable devices using UWB is able to measure the exact distance with high accuracy and the system can alarm the users when a minimum safety distance is not respected.

## Anechoic Chambers Upgraded with Phase Variation Measurement Capabilities

**NEW!**

Improve your system accuracy by optimizing:

- Fidelity Factor
- Group Delay

It can be used not only for UWB, but also for BLE 5.2!

*Roadmap: Pair of Antennas or Design for Anchors to maximize power reception*



# MULTIBAND EXTERNAL ANTENNAS

## Multiband X-in-1 Antennas



### X1005324-LWS5SX10A2

LTE MIMO / GNSS (Active) / Wi-Fi MIMO 5-in-1 External Antenna  
(698-960 • 1710-2170 • 2300-2690) + (1561/1575/1602) MHz +  
(2400-2500 • 5150-5850) MHz

## Multiband 2-in-1 Antennas



### X1005243-LGA2SA10A1

GPS/GLONASS (Active) / LTE 2-in-1 External Antenna  
(1575/1602) MHz  
(698-960 • 1710-2170 • 2300-2690) MHz



### X1005244-LWA3SX10A2

GNSS (Active) / LTE / Wi-Fi  
3-in-1 External Antenna  
(1561/1575/1602) MHz +  
(698-960 • 1710-2170 •  
2300-2690) MHz +  
(2400-2500 • 5150-5850) MHz

### X1005245-LSA3SA10A2

GNSS (Active) / LTE MIMO  
3-in-1 External Antenna  
(1561/1575/1602) MHz +  
(698-960 • 1710-2170 •  
2300-2690) MHz



### X1005248-GDA2SA10A2

GNSS (Active) / DSRC 2-in-1  
External Antenna  
(1561/1575/1602) MHz +  
(5850-5920) MHz

### X1005249-LGA2SA10A2

GPS/GLONASS (Active) / LTE  
2-in-1 External Antenna  
(1575/1602) MHz +  
(698-960 • 1710-2170 •  
2300-2690) MHz

## GNSS, LTE and Wi-Fi External Antennas



### X1005247-GNA1SA10A1

GNSS (Active) External Antenna  
(1561/1575/1602) MHz



### X1005246-4GA1SA10A1

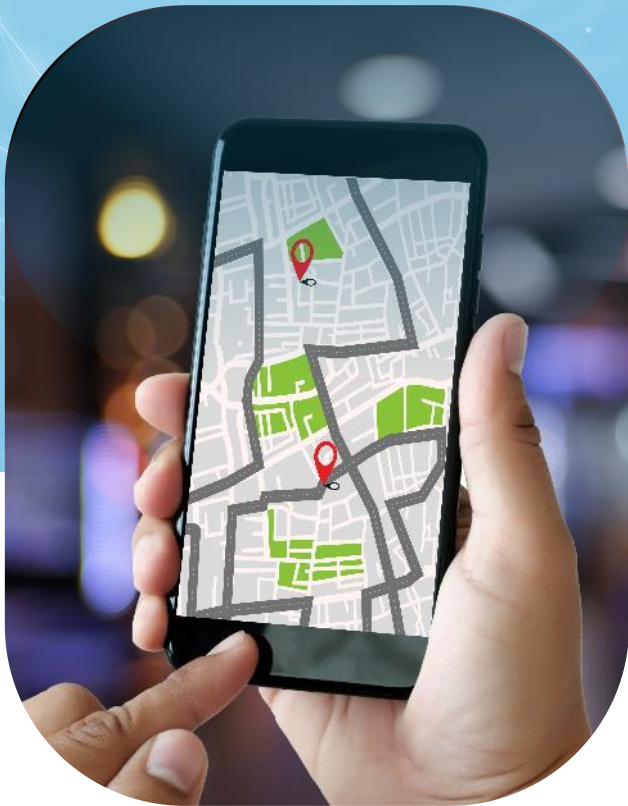
LTE External Antenna  
(698-960 • 1710-2170 •  
2300-2690) MHz

### X1005323-W3A1SA10A1

Wi-Fi External Antenna  
(2400-2500 • 5150-5850) MHz

# GNSS ANTENNAS

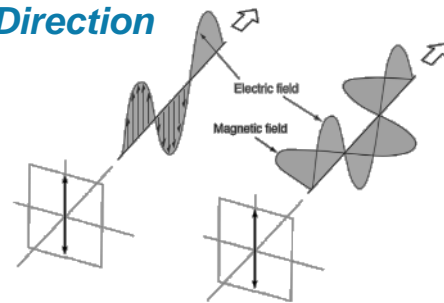
## Polarization of the Antenna



### GNSS Linear Polarized

Ceramic chip, metal stamping and PCB antennas for non-roof top applications

*Propagation Direction*



Off Board



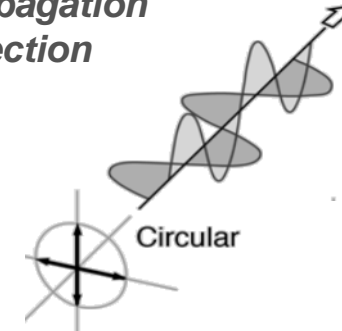
On Board



### GNSS Circular Polarized

Ceramic Patch antenna with different sizes for roof top applications

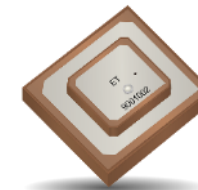
*Propagation Direction*



Single Feed



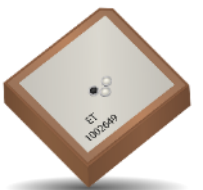
High Precision



Off Board



Dual Feed



# Wi-Fi 6 ANTENNAS



## W-family

Standard PCB/FPC + cable antennas

**W2 FAMILY** | 5GHz & 6GHz

**W3 FAMILY** | 2.4 / 5.0 / 6.0GHz



Frequency Band (GHz)	5.150 – 5.850	5.925 - 7.125
Return Loss	< -9.0dB	< -7.3 dB
Average Efficiency	70%	
Peak Gain	< 4.3 dBi	< 3.9 dBi
Feed Point Impedance	50 ohms unbalanced	

Frequency Band (GHz)	2.40 – 2.48	5.15 – 5.85	5.925 - 7.125
Return Loss	< -15 dB	< -10 dB	< -6 dB
Average Efficiency	70 %	60 %	65 %
Peak Gain	< 2.3 dBi	< 5 dBi	< 2.5 dBi
Feed Point Impedance	50 ohms unbalanced		

# MULTI-PATTERN Wi-Fi ANTENNAS

## WX-family

### Standard PCB + cable antennas

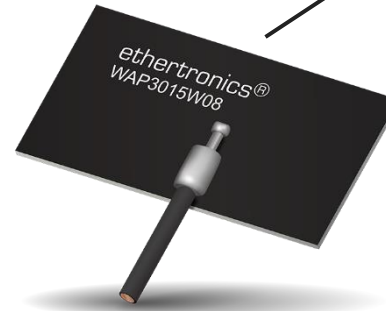
- Single mechanics – different radiation patterns flavors
- Easy fine tuning to maximize MIMO performance
- Maximize system throughput
- Mitigate peak gain issues

#### PN Nomenclature

PCB silk screen number

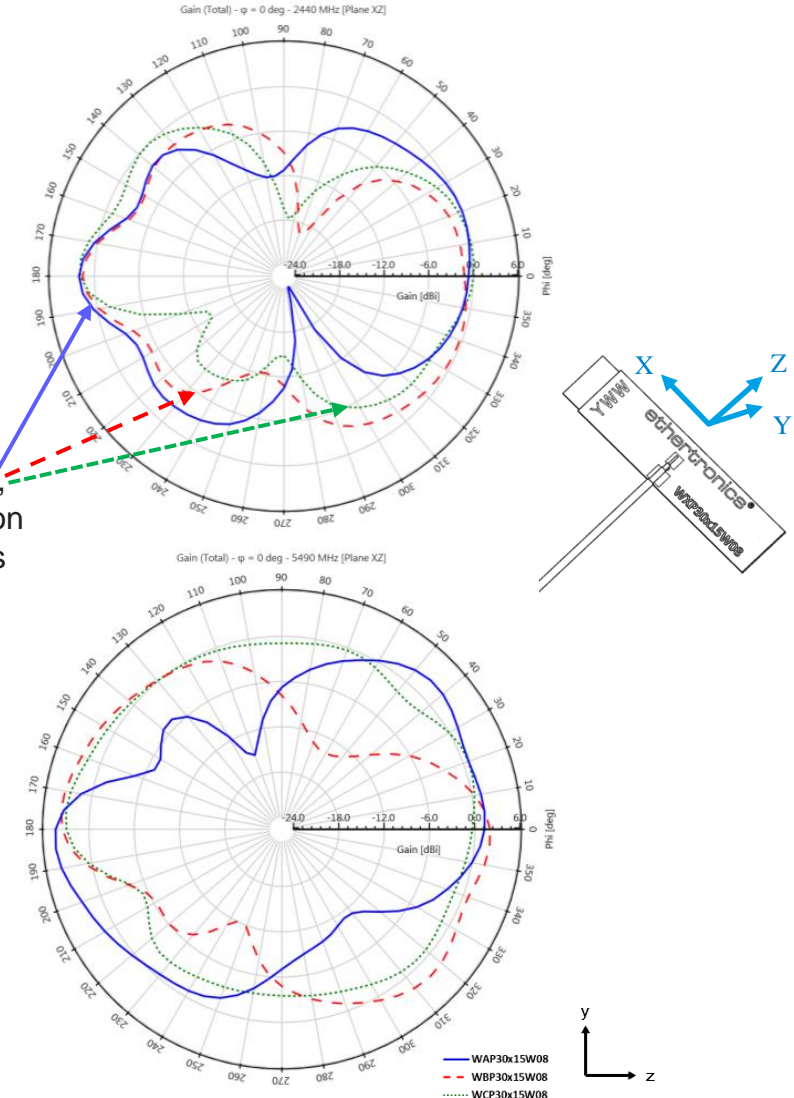
<b>W</b>	<b>A</b>	<b>P</b>	<b>3015</b>	<b>W</b>	<b>08</b>
Series	Rad. pattern orientation	Type	Size	Tuning version	PCB thickness
W = Wi-Fi Family	A = Slant to left (+x) B = Slant to right (-x) C = Straight (aligned with z-axis)	P = PCB	30x15 mm	W=Tuning on plastic wall	08 = 0.8 mm

Frequency (MHz)	2.4 – 2.48 GHz	5.15 – 5.85 GHz
Return Loss*	< -8 dB	< -7.9 dB
Average Efficiency*	64-68%	75-80%
Peak Gain*	<2.5 dBi	<6.1 dBi
Feed Point Impedance	50 ohms unbalanced	50 ohms unbalanced



30 x 15.2 x 0.8 mm

One fixed mechanic size, different radiation pattern options



# SELECTION TOOLS, TEST AND DESIGN SERVICES

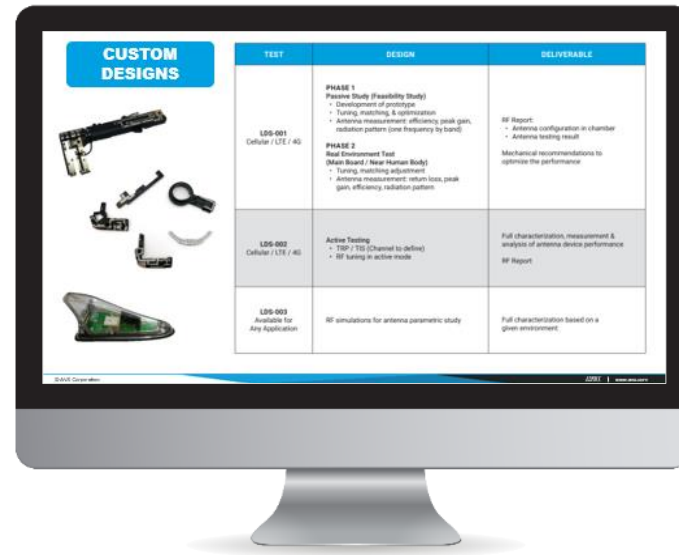
## Online Selection Tools & Antenna Selection Guide



## Test Services



## Custom Designs



To learn more, please visit:

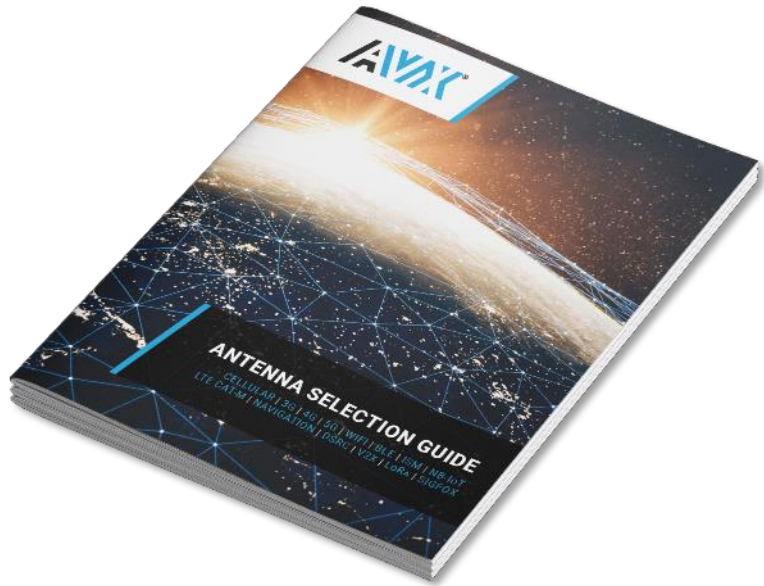
[Online Search Filter](#)

[Antenna Selection Guide](#)

[Application/Product Guides](#)

[Best Practices & Advises For Antenna Tuning](#)

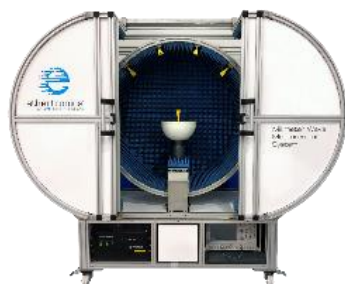
# ONLINE SELECTION TOOLS & ANTENNA SELECTION GUIDE



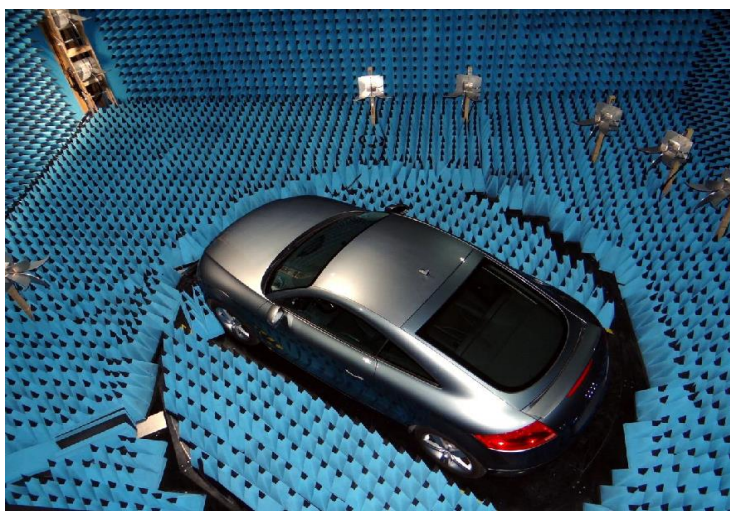
[Antenna Selection Guide](#)

[Online Selection Tools](#)

# TEST SERVICES



[mmWave Chamber](#)



[Automotive Chamber](#)

TEST	MEASUREMENT	DELIVERABLE
<p><b>LTS-001</b> Passive Testing in Anechoic Chamber</p> <p><b>LTS-001A</b> Passive Testing in Automotive Chamber</p>	<p>Full characterization, measurement &amp; analysis of passive performance</p> <p>Benchmark testing possible</p>	<p>RF Report:</p> <ul style="list-style-type: none"> <li>• 2D &amp; 3D Radiation Pattern Plots</li> <li>• Efficiency</li> <li>• Return Loss</li> <li>• Peak Gain</li> <li>• Isolation</li> </ul>
<p><b>LTS-002</b> Antenna Optimization &amp; Passive Testing in Anechoic Chamber</p> <p><b>LTS-002A</b> Antenna Optimization &amp; Passive Testing in Automotive Chamber</p>	<p>Antenna matching &amp; performance optimization</p> <p>Full characterization, measurement &amp; analysis of passive performance</p>	<p>Matching network for the antenna. PCB footprint. Mechanical recommendations.</p> <p>RF Report:</p> <ul style="list-style-type: none"> <li>• 2D &amp; 3D Radiation Pattern Plots</li> <li>• Efficiency</li> <li>• Return Loss</li> <li>• Peak Gain</li> <li>• Isolation</li> </ul>
<p><b>LTS-003</b> Active Testing in Anechoic Chamber</p> <p><b>LTS-003A</b> Active Testing in Automotive Chamber</p>	<p>Active tests of the full system</p> <p>Benchmark testing possible</p>	<p>RF Report:</p> <ul style="list-style-type: none"> <li>• TRP</li> <li>• TIS</li> </ul>
<p><b>LTS-004</b> Antenna Optimization &amp; Active Testing in Anechoic Chamber</p> <p><b>LTS-004A</b> Antenna Optimization &amp; Active Testing in Automotive Chamber</p>	<p>Active tests of the full system</p> <p>Benchmark testing possible</p>	<p>Recommendations for optimization</p> <p>RF Report:</p> <ul style="list-style-type: none"> <li>• TRP</li> <li>• TIS</li> </ul>
<p><b>LTS-005</b> RF Simulations</p>	<p>EM simulation for antenna design</p>	<p>Full antenna characterization in a given environment based on customer request</p> <ul style="list-style-type: none"> <li>• Parametric study</li> <li>• Body loading</li> <li>• Antenna placement</li> <li>• Antenna tuning</li> </ul>

Automotive testing chamber is recommended for vehicles and also large/heavy devices (e.g. washing machines or parking meters)



# CUSTOM DESIGNS



TEST	DESIGN	DELIVERABLE
<p><b>LDS-001</b> Cellular / LTE / 4G</p>	<p><b>PHASE 1</b> <b>Passive Study (Feasibility Study)</b></p> <ul style="list-style-type: none"> <li>• Development of prototype</li> <li>• Tuning, matching, &amp; optimization</li> <li>• Antenna measurement: efficiency, peak gain, radiation pattern (one frequency by band)</li> </ul> <p><b>PHASE 2</b> <b>Real Environment Test (Main Board / Near Human Body)</b></p> <ul style="list-style-type: none"> <li>• Tuning, matching adjustment</li> <li>• Antenna measurement: return loss, peak gain, efficiency, radiation pattern</li> </ul>	<p>RF Report:</p> <ul style="list-style-type: none"> <li>• Antenna configuration in chamber</li> <li>• Antenna testing result</li> </ul> <p>Mechanical recommendations to optimize the performance</p>
<p><b>LDS-002</b> Cellular / LTE / 4G</p>	<p><b>Active Testing</b></p> <ul style="list-style-type: none"> <li>• TRP / TIS (Channel to define)</li> <li>• RF tuning in active mode</li> </ul>	<p>Full characterization, measurement &amp; analysis of antenna device performance</p> <p>RF Report</p>
<p><b>LDS-003</b> Available for Any Application</p>	<p>RF simulations for antenna parametric study</p>	<p>Full characterization based on a given environment</p>

# THANK YOU.



**Carmen Redondo** | Global Marketing Manager, Antennas

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**RF SOLUTIONS**



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