



# 2.4 & 5 GHz SELECTION GUIDE

WIFI | WLAN | BLUETOOTH | BLE | WIFI 6 | ISM  
ZIGBEE | 802.11a / b / g / n / ac / ax | V2X | DSRC





KYOCERA AVX is a leading supplier of active and passive antenna solutions for industrial, commercial, automotive, and medical applications with prototyping facilities in the United States, France & Taiwan, China and manufacturing sites in South Korea, Vietnam, and China. KYOCERA AVX antennas offer a competitive advantage in the market by providing enhanced throughput speed, spectral efficiency, reliability and performance.

Our ever-evolving portfolio consists of antennas, antenna technologies, RF chipsets, antenna systems, and measurement systems for both active and passive antenna solutions.

### KYOCERA AVX STATE-OF-THE-ART MANUFACTURING CAPABILITIES

- Stamping
- LTCC
- Plastic injection molding
- Heat-staking
- Plasma treatment
- FR4 and Composite material
- Acoustic module design and testing (THD, SPL)
- Flexible printed circuit
- PAD printing, painting
- Laser Direct Structuring (LDS)
- Cable assemblies
- RF testing
- HTC ceramic
- Chemical plating
- Wired antenna forming



**2.5B**

Antenna solutions sold and shipped to market



**212**

Patents and continued IP portfolio growth



**3000**

Platforms designed with leading customers



**300**

Active and passive antenna products



**5**

Global Design Centers



**24**

Antenna Measurement Systems



**1<sup>st</sup>**

World's Leading Automotive Test Chamber

KYOCERA AVX antennas are designed for a wide array of applications. Whether the antenna is embedded, internal, external, or outdoor, KYOCERA AVX uses its worldwide manufacturing capabilities to provide state of the art antenna technology. The KYOCERA AVX Antenna Design team helps customers select the best antenna for the application.



Internet of Things



Industrial



Automotive



Lighting



Narrow Band  
Internet of Things



Cellular  
4G / 5G



Smart Homes  
& Cities



Infotainment &  
Navigation



Electric Vehicles  
& Stations



Payment  
Terminals



Fleet & Asset  
Tracking



Satellite  
Communications



Near Field  
Communication



Smart Meters



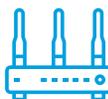
DSRC / V2X



Security



Agriculture



Gateway Routers



Consumer



Medical





### 1 | CONSULTATION

- Definition of critical electrical/mechanical performance requirements
- Feasibility study and CAD/board layout review
- Recommendations on antenna technology, placement and orientation



### 2 | DESIGN

- Antenna Selection: Standard vs. Custom, Active vs. Passive, etc.
- Reference design integration experience
- Mechanical engineering optimization
- RF simulations
- Design for industrialization



### 3 | PROTOTYPING

- Prototyping tools (3D printers, LPKF machines, fully equipped workshops)
- Mock-ups to validate technical offering
- Samples



### 4 | TEST & OPTIMIZATION

- Pre-Certification testing reports for FCC, PTCRB, EMI, Noise issues
- Available tests: VNA & Anechoic Chamber Testing, Octobox Chamber Measurements, Device Simulation, Test House Measurements, Benchmark Testing & Competitive Analysis



### 5 | MANUFACTURING

- Quality documentation available
- 4 antenna manufacturing locations
- More than 2.5Bn antennas in the market

Connectivity is key in today's world and devices in the market require strong signal strength to allow for peak performance. Integrating an antenna is not trivial, whether it is an off-the-shelf product or a highly customized solution, and should not be an afterthought.

The KYOCERA AVX Antenna Design Team strongly recommends considering the antenna design and/or the antenna integration process as early as possible, ideally during the product design and the radio module selection. A perfect match between the radio and the antenna will ensure all wireless connectivity needs are met.

Working with the KYOCERA AVX Antenna Design Team is simple and straight forward. The team will ask relevant questions to determine if a standard, off-the-shelf antenna or a customized antenna is the best technology solution.

If a standard antenna is necessary, please refer to the links below for integration documentation:

- Datasheets: <http://www.kyocera-avx.com/antennas>
- Application Notes, DXF files & ME-FIT (3D CAD) (*found under specific individual antenna product pages*)
- Stock check: [www.kyocera-avx.com/resources/distributor-stock-check](http://www.kyocera-avx.com/resources/distributor-stock-check)

**If a customized passive or active antenna is necessary**, the KYOCERA AVX Antenna Design Team will contact and work with the key partners (distribution, sales, design, FAE, etc.) to fully understand the overall challenge and offer the best technology solution.

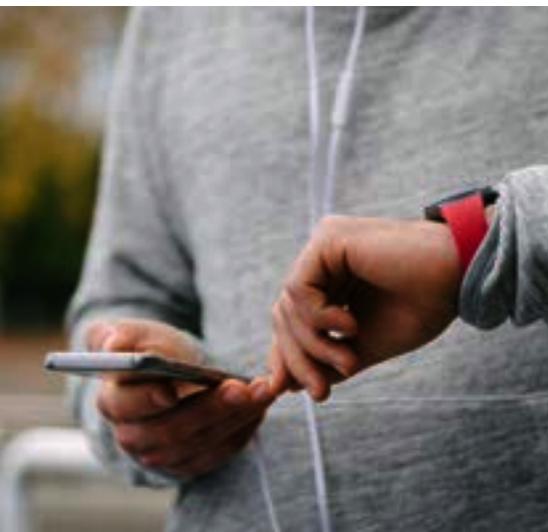
For questions and additional information about our solutions, please contact the KYOCERA AVX Antenna Design Team.



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### IS THIS A NEW DEVICE OR AN EXISTING DEVICE TO BE IMPROVED?

Are the mechanics frozen or flexible? Is the antenna location, shape and interconnect solution frozen? Standard antennas have a quicker time to market compared to custom designs making it easier to integrate them into projects, while minimizing redesign cycle time and eliminating design fees. A custom design can be developed to match required electrical and mechanical specifications.

### WHAT TYPE OF ANTENNA IS REQUIRED?

- Embedded (on board the device PCB) • Internal (inside device, but not surface mounted)
- External (outside device) • Outdoor (IP67)

### WHAT ARE THE MAIN CHALLENGES FOR THIS PROJECT?

KYOCERA AVX offers testing, debugging, designing, and manufacturing to solve challenges including:

- RF specifications • ME specifications • Design layout • Antenna integration • Surrounding interference, etc.

### IS A SPECIFIC STANDARD REQUIRED?

- Automotive (PPAP and IATF16949) • High reliability (MIL-PRF, T-Space, SRC9000, etc.)
- IP rating • UL rating • Plenum rating, etc.

### WHAT ARE THE ANTENNA SURROUNDINGS?

- Metallic components (heat sink, connectors, battery, big cap) • Additional antennas • Wires • Flexible FPC
- Audio components (speaker, microphone, earpiece) • High speed digital traces • Specific ground layout
- Shield boxes • Material loading close • Human body (hand, head, body worn device) • Potting material
- Nearby power components • 50 Ohms line to antenna

### WHAT IS THE DESIRED FREQUENCY RANGE, MAXIMUM VOLUME AND LOCATION?

Are the electrical and mechanical specifications available, and what is the selected antenna module? When a bigger antenna volume is available, better performances can be expected. The KYOCERA AVX Antenna Design Team will suggest the most optimized antenna shape, dimensions, and location based on the product to be developed.

### WHAT TYPE OF MOUNTING IS REQUIRED?

- RF cable & connector • SMT • Mag mount • Adhesive mount • Screw mount • Off-board • Pogo pin
- C-clips (spring contacts) • One-ended soldered cable

### WHAT TYPE OF CONNECTOR IS REQUIRED?

- SMA • RP-SMA • TNC • RP-TNC • U.fl • W.fl • Fakra • MMCX • BNC • N • NMO

### WHAT TYPE OF CABLE IS REQUIRED?

- Micro coaxial 0.8mm, 1.13mm, or 1.37mm diameter • RG58 • RG174 • RG316 • LMR200 • LMR400
- LMR195 • LMR240

### FOR AN EMBEDDED SOLUTION, IS PCB CLEARANCE POSSIBLE?

Is the PCB layout available to optimize the distance between the radio and the antenna, and the space from any threatening surroundings?

### ARE THE PCB LAYOUTS & 3D GERBER FILES AVAILABLE?

Helps to define a better antenna placement based on the surroundings and the PCB/product structure

	PART NUMBER	DESCRIPTION	FREQUENCY BANDS
2.4GHz &/OR 5GHz	1003468	Ceramic Patch 18x18x4 – On Board	2.4GHz
	1001013	FR4 – SMT	
	W1 Family	FR4/FPC – Off Board	
	1003893PT / 1003893FT	FR4/FPC – Off Board (Tunable)	
	1001312	LTCC – SMT	
	M310220		
	M830320		
	1002427	Stamped Metal – SMT	
	1002295	Stamped Metal – SMT Vertical Polarization	
	1002298	Stamped Metal – SMT Vertical Polarization	2.4GHz & 5GHz
	1000146	Stamped Metal – SMT	
	M830520	LTCC – SMT	
	1000423	Stamped Metal – On Ground	
	1000418	Stamped Metal – Off Board	
	1001932FT / 1001932PT	FR4/FPC – Off Board (Tunable)	
	1001435M0	Stamped Metal – Off Board	
	WX Family (A, B, C)	FR4/FPC – Off Board 3 types of radiation patterns	
	X9001091-W3DSMW	External – Indoor	
	X9000294-W3DRMB		
	1001388 / 1001430	Stamped Metal (L & R) – SMT	5GHz
	1004292PT	FR4 – Off Board (Tunable)	
	1004369PT	FR4 – Off Board (Mixed Polarization HP/VP)	
	W2 Family	FR4/FPC – Off Board	5GHz & 6GHz
	5.925 – 7.125GHz		
W3 Family	2.4GHz & 5.925 – 7.125GHz		
	2.4GHz & 5 GHz & 6GHz		

	PART NUMBER	DESCRIPTION	FREQUENCY BANDS
V2X	9001118	Ceramic Patch 13x13x4 – On Board	5.9 GHz
DSRC	1002298	Stamping – On Board Vertical Polarization	

	SMT ON BOARD				OFF BOARD			EXTERNAL
	FR4	STAMPED METAL	LTCC	CERAMIC PATCH	FR4	FPC	STAMPED METAL	INDOOR
<b>2.4 GHz SINGLE BAND</b>	1001013	1002295 1002427	M830320 M310220 1001312	1003468	W1P Series 1003893PT	W1F Series 1003893FT		
<b>2.4 &amp; 5GHz DUAL BAND</b>		1000146 1002298	M830520		W3P Series WAP Series WBP Series WCP Series 1001932PT 1003893PT	W3F Series 1001932FT	1000418 1000423 1001435M0	X9001091- W3DSMW  X9000294- W3DRMB
<b>5GHz</b>		1001388 1001430			W2P Series 1004292PT 1004369PT	W2F Series		
<b>WIFI 6</b>					W2P Series W3P Series	W2F Series W3F Series		
<b>V2X DSRC</b>		1002298		9001118				

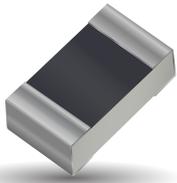


802.11 a/b/g/n/ac/ax / WIFI / WLAN / BLUETOOTH / BLE / WIFI 6 / ZIGBEE APPLICATIONS



**1001013** | Embedded Single Band SMT On/Off Ground Antenna

Frequency (GHz)	Mounting	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	Off Ground	2.6	76%	< 1.5:1	15.0 x 3.2 x 3.3	70 x 50
	On Ground	0.7	48%	< 1.8:1		



**1001312** | Embedded LTCC Single Band Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	1.88	62%	< 1.8:1	2.00 x 1.20 x 0.55	55 x 25



**M310220** | Embedded Single Band LTCC Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	1.7	67%	< 2.0:1	3.00 x 1.50 x 1.08	60 x 40



**M830320** | Embedded Single Band LTCC Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	1.4	78%	< 2.0:1	8.0 x 3.0 x 1.3	60 x 40



**M830520** | Embedded Dual Band LTCC Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	1.0	62%	< 2.1:1	8.0 x 3.0 x 1.3	80 x 40
4.900 – 5.825	2.6	56%	< 2.8:1		



**1002298** | Embedded Dual Band Stamped Metal Antenna (Vertical Polarization)

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	3.6	78%	< 2.0:1	17.95 x 16.1 x 10.55	75 x 75
4.900 – 5.825	5.1	70%			

802.11 a/b/g/n/ac/ax / WIFI / WLAN / BLUETOOTH / BLE / WIFI 6 / ZIGBEE APPLICATIONS



**1002295** | Embedded Single Band Stamped Metal Antenna (Vertical Polarization)

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	4.4	79%	< 2.0:1	16.1 x 15.7 x 10.6	75 x 75



**1002427** | Embedded Single Band Stamped Metal Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.450	3.4	61%	< 2.0:1	31.2 x 2.3 x 3.9	110 x 55



**1001388 / 1001430** | Embedded 5 GHz Stamped Metal Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
5.150 – 5.825	3.5 to 4.5 (Based on location)	72%	< 2.0:1	8.75 x 4.05 x 2.01	75 x 75



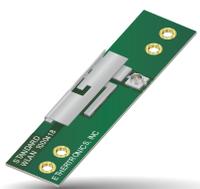
**1000146** | Embedded Dual Band Stamped Metal Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	1.5	80%	< 1.5:1	17.9 x 6.9 x 4.3	180 x 120
4.900 – 5.825	2.6	72%	< 1.6:1		



**1000423** | Off Board Embedded Dual Band Stamped Metal Antenna (On Ground)

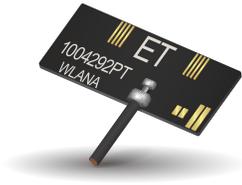
Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	Ref. Coax Length (mm)
2.400 – 2.485	0.6	57%	< 2.5:1	40.0 x 15.0 x 6.4	100
4.900 – 5.825	4.5	75%			



**1000418** | Off Board Embedded Dual Band Stamped Metal Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)
2.400 – 2.485	4.0	70%	< 2.0:1	45 x 11.3 x 5.1
5.150 – 5.825	4.2			

### 802.11 a/b/g/n/ac/ax / WIFI / WLAN / BLUETOOTH / BLE / WIFI 6 / ZIGBEE APPLICATIONS



**1004292PT** | Tunable Off Board Single Band FR4 5 GHz Dipoles

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	Other
5.150 – 5.850	4.8	70%	< 2.0:1	22.0 x 8.0 x 0.4	Diameter 1.13mm; u.fl compatible connector; Length 100mm using adhesive 3M468



**1004369PT** | Mixed VP/HP Polarized Tunable Off Board Single Band FR4 5 GHz Dipoles

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	Other
5.150 – 5.850	3.7	76%	< 2.0:1	18.0 x 12.4 x 0.4	Diameter 1.13mm; u.fl compatible connector; Length 100mm using adhesive 3M468



**1001932FT** | Tunable Off Board FPC Dual Band Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	Other
2.400 – 2.485	2.5	60%	< 2.0:1	35.2 x 8.5 x 1.6	Diameter 1.13mm; u.fl compatible connector; Length 100mm using adhesive 3M468
5.150 – 5.825	4.4	71%			

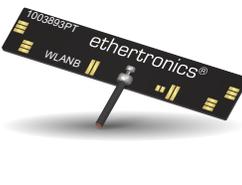
Ideal for last minute tuning in the device by using predefined tuning pads



**1001932PT** | Tunable Off Board FR4 Dual Band Antenna

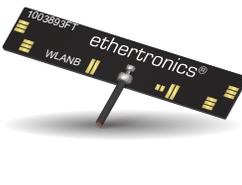
Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	Other
2.400 – 2.485	2.5	60%	< 2.0:1	35.2 x 8.5 x 1.8	Diameter 1.13mm; u.fl compatible connector; Length 100mm using adhesive 3M468
5.150 – 5.825	4.4	71%			

Ideal for last minute tuning in the device by using predefined tuning pads



**1003893FT** | Tunable High Performance Off Board FPC Single Band Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	Other
2.400 – 2.485	3.3	87%	< 1.5:1	40.0 x 8.0 x 0.4	Diameter 1.13mm; u.fl compatible connector; Length 100mm using adhesive 3M468



**1003893PT** | Tunable High Performance Off Board FR4 Single Band Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	Other
2.400 – 2.485	3.3	87%	< 1.5:1	40.0 x 8.0 x 0.4	Diameter 1.13mm; u.fl compatible connector; Length 100mm using adhesive 3M468

802.11 a/b/g/n/ac/ax / WIFI / WLAN / BLUETOOTH / BLE / WIFI 6 / ZIGBEE APPLICATIONS

### W1 FAMILY | Off Board Single Band 2.4 GHz Dipole Antenna



Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR (dB)	Size L x W x H (mm)
2.400 – 2.485	2.8	70%	< 1.5:1	35.2 x 8.5 x 0.4
Types	Tuning Versions	Connectors	Cable Lengths (mm)	Mounting Options
PCB FPC	Plastic wall Foam on plastic wall Ribs	u.fl w.fl MHF4	50; 100; 150; 200	Adhesive 3M468MP Adhesive 3M9448A Adhesive 3M467

### W2 Family | Off Board Single Band 5 GHz & 6 GHz Dipole Antenna



Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR (dB)	Size L x W x H (mm)
5.150 – 5.850	4.3	70%	< 2.1:1	15.9 x 7.6 x 0.4
5.925 – 7.125	3.9		< 2.5:1	
Types	Tuning Versions	Connectors	Cable Lengths (mm)	Mounting Options
PCB FPC	Plastic wall Foam on plastic wall	u.fl w.fl MHF4	50; 100; 150; 200	Adhesive 3M468MP Adhesive 3M9448A Adhesive 3M467

### W3 Family | Off Board Dual Band 2.4 GHz, 5 GHz, & 6 GHz Dipole Antenna



Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR (dB)	Size L x W x H (mm)
2.400 – 2.485	2.3	70%	< 1.5:1	35.2 x 8.5 x 0.4
5.150 – 5.825	5.0	60%	< 2.0:1	
5.925 – 7.125	2.5	65%	< 3.0:1	
Types	Tuning Versions	Connectors	Cable Lengths (mm)	Mounting Options
PCB FPC	Plastic wall Foam on plastic wall	u.fl MHF4	50; 100; 150; 200	Adhesive 3M468MP Adhesive 3M9448A Adhesive 3M467

### WX FAMILY | Off Board Dual Band 2.4 GHz & 5 GHz Dipole Antenna



Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR (dB)	Size L x W x H (mm)
2.400 – 2.485	3.0	65%	< 2.1:1	30.0 x 15.5 x 0.8
5.150 – 5.850	6.7	61%		
Types	Tuning Versions	Connectors	Cable Lengths (mm)	Mounting Options
PCB	Plastic wall	u.fl MHF4	50; 100; 150; 200	Adhesive 3M468MP

This antenna is ideal to rotate the radiation patterns with a single mechanical outline, slightly to the left (WA), to the right (WB) and straight aligned with Z axis (WC), which allows to maximize system throughput and migrate peak gain issues.

### 802.11 a/b/g/n/ac/ax / WIFI / WLAN / BLUETOOTH / BLE / WIFI 6 / ZIGBEE APPLICATIONS



**X9001091-W3DSMW / X9001091-W3DSMB** | External Dual Band Hinged Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x Diameter	Other
2.400 – 2.485	1.8	75%	< 1.5:1	84.00mm x 9.35mm	SMA male connector Performance in free space
5.150 – 5.850	4.0	80%	< 2.0:1		



**X9000294-W3DRMB** | External Dual Band Hinged Blade Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x Diameter	Other
2.400 – 2.485	3.2	75%	< 1.7:1	157.50mm x 17.65mm	RP-SMA male connector Performance in free space
5.150 – 5.850	4.5	60%	< 2.1:1		



**1003468** | 2.4 GHz Ceramic Patch

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
2.400 – 2.485	3.83	74%	< 2.0:1	18 x 18 x 4	50 x 50



**1001435M0** | Off Board Dual Band On/Off Ground Stamped Metal Antenna

Frequency (GHz)	Mounting	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	Other
2.400 – 2.485	Off Ground	4.2	82%	< 2.0:1	41.1 x 14.6 x 9.5	GND plane: 150x150mm Diameter: 1.13mm Length: 70mm u.fl connector
	On Ground	4.7	87%			
2500 – 2700	Off Ground	6.4	80%			
	On Ground	6.0	75%			

### V2X / DSRC APPLICATIONS



**9001118** | Embedded V2X Ceramic Patch Antenna

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Polarization	Size L x W x H (mm)	GND Plane Size (mm)
5.850 – 5.925 GHz	4	55%	< 1.5:1	RHCP	13 x 13 x 4	70 x 70



**1002298** | Embedded V2X Stamped Metal Antenna (Vertical Position)

Frequency (GHz)	Peak Gain (dBi)	Efficiency	VSWR	Size L x W x H (mm)	GND Plane Size (mm)
5.850 – 5.925	5.1	70%	< 2.0:1	17.95 x 16.1 x 10.55	75 x 75

KYOCERA AVX PART NUMBER	MODULE	MODULE MANUFACTURER	MODULE MANUFACTURER DISTRIBUTOR
EC477; EC624	Broadcom 4366E	BROADCOM 4x4 MIMO dual band with off-board active steering antennas	
1001932PT; 1001932FT	ConnectCore 6®	DIGI® International	Mouser, DigiKey, Arrow, Avnet
1000146	ConnectCore® 6UL SBC Express board	DIGI® International	Mouser, DigiKey, Arrow, Avnet
1001932PT; 1001932FT	ConnectCore® 6UL SBC Express board	DIGI® International	Mouser, DigiKey, Arrow, Avnet
1000423	ThermoFisher Scientific W1001 Module	Fisher Scientific™	ThermoFisher Scientific
1000146	Laird™ WB45NBT	Laird™	Mouser, DigiKey, Arrow, Avnet
1000146	Laird™ 60-SIPT	Laird™	Mouser, DigiKey, Arrow, Avnet
1000418	Extron Transceiver 20-2052-01LF	Extron	Extron
M830520	Lantronix Premier Wave SE1000	Lantronix	Mouser, Symmetry, Arrow
M830520	Lantronix Premier Wave EN	Lantronix	Mouser, Symmetry, Arrow
1001077; 1000668	Lantronix xPICO	Lantronix	Mouser, Symmetry, Arrow
1000423	TI WL1835MOD	Texas Instruments	Mouser, Avnet, DigiKey, Arrow
1000423	TI WL1831MOD	Texas Instruments	Mouser, Avnet, DigiKey, Arrow
1000423	TI WL1805MOD	Texas Instruments	Mouser, Avnet, DigiKey, Arrow
1000423	TI WL1801MOD	Texas Instruments	Mouser, Avnet, DigiKey, Arrow
1000423	TI WL1837MOD	Texas Instruments	Mouser, Avnet, DigiKey, Arrow
1000423	TI WL1807MOD	Texas Instruments	Mouser, Avnet, DigiKey, Arrow
M830520	TI Simplelink CC3225MOD	Texas Instruments	Mouser, Avnet, DigiKey
M830520	TI Simplelink CC3235MOD	Texas Instruments	Mouser, Avnet, DigiKey
1001312	Telit WE866C3-I	Telit	Rutronik, Arrow
M830120	Telit SL876Q5-A	Telit	Rutronik, Arrow
M830520	Premier Wave 2050	Lantronix US	Mouser
M830520	Midatronics	Sharky Pro Italy	Midatronics

The Active Steering™ antenna systems boost wireless connectivity significantly. This patented technology continually optimizes the antenna's direction in real-time on a per millisecond basis, creating multiple radiation patterns around the same antenna and then selects the ideal pattern to hit its targeted device with best signal.

The result is a major increase in range, reliability and speed between devices living on the fringes of a network or hidden behind walls and hard-to-reach spaces. Connection dead spots are reduced as the KYOCERA AVX processor, the active steering chip and the antenna are designed together, which allows a more flexible antenna system placement.

The link optimization is in real time based on the WIFI radio link performance. A 3dB improvement can be rapidly observed on the radio link using a low latency adaptation patented algorithm. Its Data-Over-Coax (DOC) interface drives the whole system and allow any combination of active and passive antennas in the system design.



**Passive Omni Directional Antennas**  
Are not 100% Omni Directional



**Passive Antennas**  
Have "null" areas of low emissions



**Active Antennas**  
Eliminate nulls by "steering" the emission in real-time by using intelligent algorithms and flexible antenna structure



### ACTIVE ANTENNAS

#### EC624 | Active Steering Antenna Switch



The EC624 supports the DOC interface, which allows Active Steering signaling on the same physical cable as the primary RF feed without impacting the main WIFI radio signal. The DOC interface eliminates the need for custom connectors and cables, which reduces the system bill of materials, enables easier placement of off-PCB antennas, and provides seamless integration of any combination of active and passive antennas into the device designs. EC624 can support up to 8x8 MIMO systems, and comes in a 16-pin FC LGA package in a 2.0mm x 2.0mm package size.

#### EC477 | Active Steering Processor

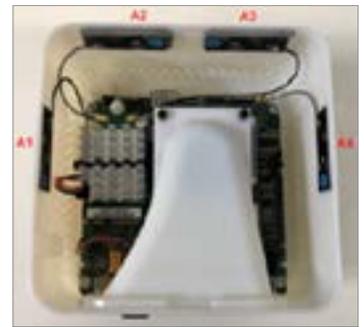


The EC477 combines a high-performance processor with a cost-optimized antenna control interface to deliver the proven "2x" performance and coverage benefits of WIFI Active Steering in a flexible and cost reduced system. This product works in conjunction with the EC624 Active Steering Switch to provide greater throughput and longer range for access points, gateways, smart appliances, extenders, bridges, streaming devices, set top boxes, and other client application products. It comes in a 24-pin QFN package in a 3.5mm x 3.5mm package size.

### REFERENCE DESIGN | 802.11AC 4X4 MIMO BROADCOM BCM4366E

The reference design based on Broadcom BCM4366E fully utilizes the capabilities of the combination EC477 processor and the EC624 active steering antenna switch.

A complete solution has been built using 4 active steering antennas. The solution is able to combine 256 radiation patterns (improving the total system composite gain), and offers up to 3dB in RSSI improvement and up to 40% throughput improvement in any multipath environment (non-line-of-sight).



TEST	MEASUREMENT	OUTPUT
<b>WTS-001</b> VNA & Anechoic Chamber Testing	Full passive characterization, measurement & analysis of device antenna performance	2D & 3D Radiation Pattern Plots & Composite Maps: <ul style="list-style-type: none"> <li>• Efficiency</li> <li>• Return Loss</li> <li>• ECC</li> <li>• Peak Gain</li> <li>• Composite Gain</li> <li>• Isolation</li> </ul>
<b>WTS-002</b> Octobox Chamber Measurements	Throughput system characterization in a controlled lab environment	Rate vs Range Plots  Two tests: One device configuration, two bands
<b>WTS-003</b> Device Simulation	Indoor propagation simulations for WIFI	Propagation model using a full 3D Ray Tracing Engine  Analyze spatial heat maps showing device performance in an indoor environment: <ul style="list-style-type: none"> <li>• Coverage</li> <li>• Throughput</li> <li>• MCS</li> <li>• RSSI</li> </ul>
<b>WTS-004</b> WIFI Test House Measurements	Real-world OTA WIFI system & throughput measurements within one of 3 fully furnished test houses located in France & USA	Benchmark Testing  4 Throughput Tests: One device configuration, two house positions, two bands
<b>WTS-005</b> Benchmark Testing & Competitive Analysis	Wireless performance analyzed based on throughput data rates, RSSI, spectral efficiency (bps/Hz)	Rate vs Range Analysis Benchmark Testing Comparative Analysis Mapping of performance across test locations
<b>WTS-006</b> RF Simulations	EM simulation for antenna design	Full antenna characterization in a given environment based on customer request <ul style="list-style-type: none"> <li>• Parametric study</li> <li>• Body loading</li> <li>• Antenna placement</li> <li>• Antenna tuning</li> </ul>
<b>WTS-007</b> Automotive In-Car Measurement	Full passive characterization, measurement & analysis of device antenna performance	2D & 3D Radiation Pattern Plots & Composite Maps: <ul style="list-style-type: none"> <li>• Efficiency, Return Loss, ECC</li> <li>• Peak Gain, Isolation</li> <li>• MIMO Multipath Interference</li> </ul>
<b>WTS-008</b> 5G mmWave Measurement Chamber	Non-Signaling Active Testing, Signaling Active Testing &/or Passive Testing	2D & 3D Radiation Pattern Plots <ul style="list-style-type: none"> <li>• Efficiency</li> <li>• TRP, TIS</li> </ul>



## UPCOMING PRODUCT RELEASES

By continuing to invest heavily in R&D and submitting several new patent applications every year, KYOCERA AVX continues to further expand the company's strong technology base with newly innovative, next-generation product solutions. Below is a list of products currently in development for release.

### SAMPLE KITS

- FPC antennas
- LTE Cat-M / NB-IoT
- UWB

### 5G ANTENNAS & FEMs

- 28 GHz full front end module
- 28 GHz passive antenna array
- Sub-6 GHz passive antenna array
- Subgiga 5G bands (FPC and FR4)

### COMBO ANTENNAS (INTERNAL TYPES)

- MIMO 2x2 WIFI & WIFI 6 dual band FPC and 2 cables
- MIMO 3x3 WIFI & WIFI 6 dual band FPC and 3 cables
- MIMO 4x4 WIFI & WIFI 6 dual band FPC and 4 cables
- MIMO 2x2 4G and GPS, FPC with 3 cables
- MIMO 2x2 4G and WIFI, FPC with 3 cables
- ISM 868/915 + GPS + WIFI FPC with 3 cables
- ISM 868/915 + GPS + 4G FPC with 3 cables
- 600 MHz side and middle cable FPC type
- All bands LTE blade antenna with TNC

### ISM ANTENNAS

- 915 MHz patch
- 868 MHz patch
- 433 MHz external directive antenna

### SATCOM ANTENNAS

- S-band antenna
- L-band antenna patch antenna (non-ceramic)
- Stacked patches (L1/L2)
- Multi-band GNSS active antenna (L1/L2/L5)
- 400MHz CP low orbit antenna

### MULTIBAND EXTERNAL ANTENNAS (IP67)

- 1 inch thickness, 6-in-1 (2x4G, 3x WIFI, 1x GNSS), 6 cables
- High performance, 6-in-1 (2x4G, 3xWIFI, 1xGNSS), 6 cables
- Cost efficient rugged mag mount 4G antenna
- Cost efficient rugged mag mount MIMO 2x2 4G antenna
- Sharkfin antenna
- Fiberglass LTE antenna
- Fiberglass 2.4 GHz antenna
- Fiberglass LTE antenna
- Fiberglass 2.4 GHz antenna

### UWB ANTENNAS

- FPC 6.5-8.5GHz with cable (side & middle cable)
- Ceramic-based UWB

For the most up-to-date product releases and product information, please visit [www.kyocera-avx.com](http://www.kyocera-avx.com)

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