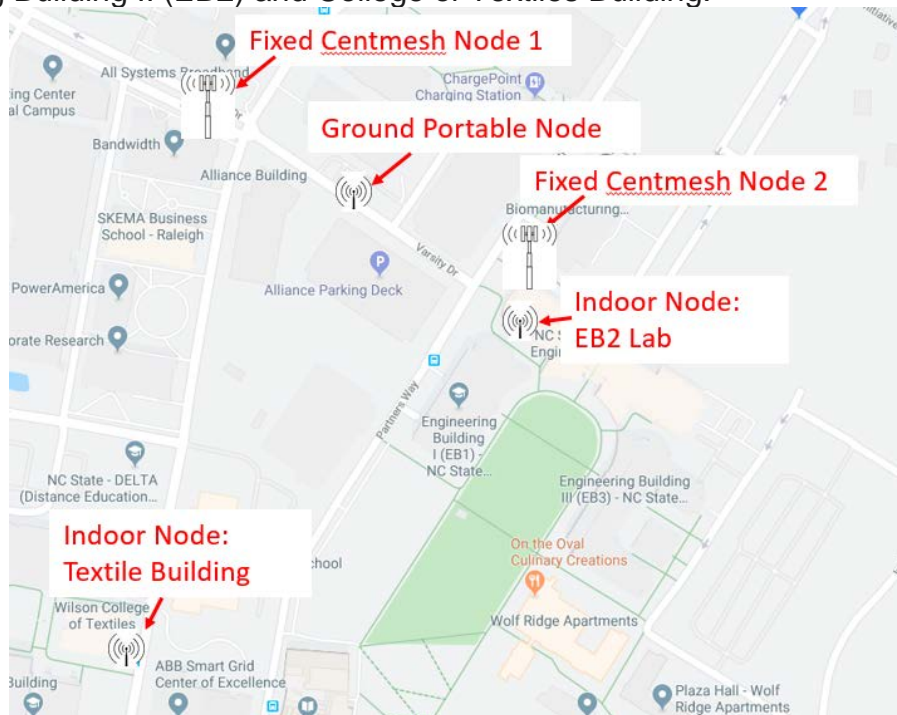


This FCC experimental license will be used to develop the project “Aerial Experimentation and Research Platform for Advanced Wireless (AERPAW)” funded by National Science Foundation (NSF). AERPAW is the platform under the “Platforms for Advanced Wireless Research (PAWR)” project. AERPAW will be a first-of-its-kind aerial wireless experimentation platform with the goal to accelerate the integration of UAS into the national air-space, and to enable new advanced wireless features for UAS platforms, such as flying base stations for hot spot wireless connectivity. As part of this effort, AERPAW will develop a software-defined, reproducible, and open-access advanced wireless platform with experimentation features spanning 5G technologies and beyond.

As part of AERPAW we are planning to obtain an innovation zone license. However, since it will take time to obtain the innovation zone license we are applying for this license for doing the groundworks for this project.

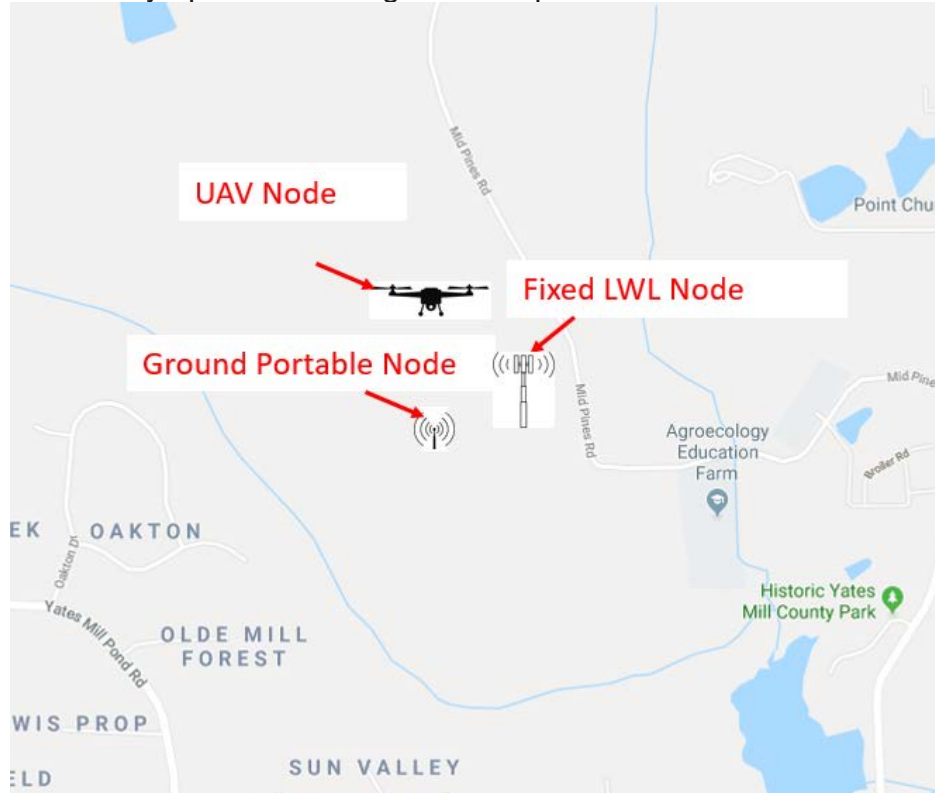
Experiment Scenarios

NCSU Centennial Campus: The map below shows two fixed “Centmesh” Nodes that will transmit to each other. We will have mobile nodes in the ground level (not a UAV) as well. This is our main test scenario. Fixed node and portable nodes will be tested indoors before any outdoor experiments are performed. Two indoor locations that we will be conducting our experiments are also shown in the map below that are inside Engineering Building II (EB2) and College of Textiles Building.



Lake Wheeler: The map below shows the fixed Lake Wheeler Node, that will communicate with Ground Portable Node and/or UAV node. The mobile portable node

as well as the UAV node will be within 300 feet radius of the fixed node. The pilot controlled UAV will fly up to 50 feet high at low speeds.



Experiment description: We plan to transmit 4G and 5G waveforms as well as other narrowband waveforms and unmodulated tones. The waveforms will be first tested at indoor locations. Then, we will be testing the waveforms at fixed and portable nodes.

Transmission frequency range: The frequencies we request for the experimental license are 2500-2690 MHz and 3550-4200 MHz. The reason for this broad frequency range is because these frequencies are also planned for the innovation zone license. The transmission frequency for UAVs are also the same frequency range 2500-2690 MHz and 3550-4200 MHz. We plan to test our waveforms between the fixed/portable nodes and UAV nodes or between two UAV nodes. UAV nodes will communicate with the LWL fixed node or the ground portable node as shown in the second map. The max bandwidth that we will transmit is 40 MHz with a maximum 20 dBm EIRP.

Antenna information and Drawings:

UAV and Ground Portable Nodes: We will test Mobile Mark RM-WB1-DN-BLK Omni Antenna and Octane SA-1400-5900 Omni Antenna for the UAV and ground portable node.

Fixed centmesh node 1: This is a light pole. We will test MA-WO-UWB antenna from Mars Antennas & RF Systems LTD. This node may also use the antennas used on portable nodes above.

Fixed centmesh node 2 and LWL Nodes: Fixed centmesh node 2 is a rooftop node. LWL node is a tower. For these two nodes, we will test VVSSP-360S-F antenna from CommScope. This node may also use antennas used in fixed centmesh node 1 and portable nodes.

Indoor Node: At indoor node, we will be testing all the antennas used at the portable nodes and fixed nodes.

The drawings for both of these antennas are attached.

MA-WO-UWB

138-6000 MHz Ultra Wide Band OMNI Directional Antenna

MARS MA-WO-UWB is an Ultra Wide Band OMNI Directional Antenna covering continuously all the bands from 138 MHz up to 6 GHz in a single antenna radome.

Perfect matching in all bands with small ground plane.

Excellent OMNI Directional coverage.

The antenna is PIM certified, thus making it suitable for all multi-carrier systems.



Specifications

Electrical

Frequency Range	Gain, typ.	Optimum Ground Plane Size	VSWR
138-174 MHz	3dBi	400x400 mm, 15.7"x15.7" (MG-400)	1.5:1 typ. (3:1 max)
380-450 MHz	4dBi	370x370 mm, 14.56"x14.56" (MG-370)	1.5:1 typ. (2.5:1 max)
450-512 MHz	5dBi	165x165 mm, 6.5"x6.5" (MG-165)	1.5:1 typ. (2.8:1 max)
698-746 MHz	6dBi	165x165 mm, 6.5"x6.5" (MG-165)	1.5:1 typ. (2.5:1 max)
746-806 MHz	7dBi	165x165 mm, 6.5"x6.5" (MG-165)	1.5:1 typ. (2.5:1 max)
806-960 MHz	7dBi	165x165 mm, 6.5"x6.5" (MG-165)	1.7:1 typ. (2.5:1 max)
1200-2700 MHz	8dBi	Not Required	1.3:1 typ. (2.0:1 max)
3300-3800 MHz	10dBi	Not Required	1.3:1 typ. (1.7:1 max)
4100-6000 MHz	11dBi	Not Required	1.5:1 typ. (2.0:1 max)
Polarization	Linear ,Vertical		
Pattern	OMNI Directional		
PIM, 3rd order, 2X20W	<-155 dBc		
Input Power, max	50 Watts		
Input Impedance	50 Ohm		

Mechanical

Dimensions (DxH)	40mm diameter (base diameter 72mm) x 540mm height 1.57" diameter (base diameter 2.8") x 21" height
Weight	350 gr.
Connector	N-Type, Female
Mounting	2" Pole Mount
Radom	UV Protected Plastic
Ground Plane	See Ordering Options & MG-XXX datasheet for the Optimum Ground Plane as specified above

Environmental

Operating Temp. Range	-40°C to +70°C
Vibration	According to IEC 60721-3-4
Wind Load	200 Km/h (Survival)
Flammability	UL94
Water Proofing	IP-65
Humidity	ETS 300 019-1-4, EN 302 085 (Annex A.1.1)
Salt Fog	According to IEC 68-2-11

Ordering Options

MA-WO-UWB	Antenna for 1200-6000 MHz
MA-WO-UWB & MG-400	Antenna for 138-174 MHz with plate 400x400 mm and accessories
MA-WO-UWB & MG-370	Antenna for 380-450 MHz with plate 370x370 mm and accessories
MA-WO-UWB & MG-165	Antenna for 450-960 MHz with plate 165x165 mm and accessories
MA-WO-UWB & MG-400M	Antenna for 138-174 MHz with plate 400x400 mm and accessories and mount
MA-WO-UWB & MG-370M	Antenna for 380-450 MHz with plate 370x370 mm and accessories and mount
MA-WO-UWB & MG-165M	Antenna for 450-960 MHz with plate 165x165 mm and accessories and mount

MARS Antennas & RF Systems proprietary information

MARS reserves the right to make technical changes or modifications to any of its products and specifications without prior notice and without implementing such changes to prior supplied products. Product images are representative and indicative only. Warranty terms and general conditions of sale are applicable on any purchase of any product, available on MARS website.

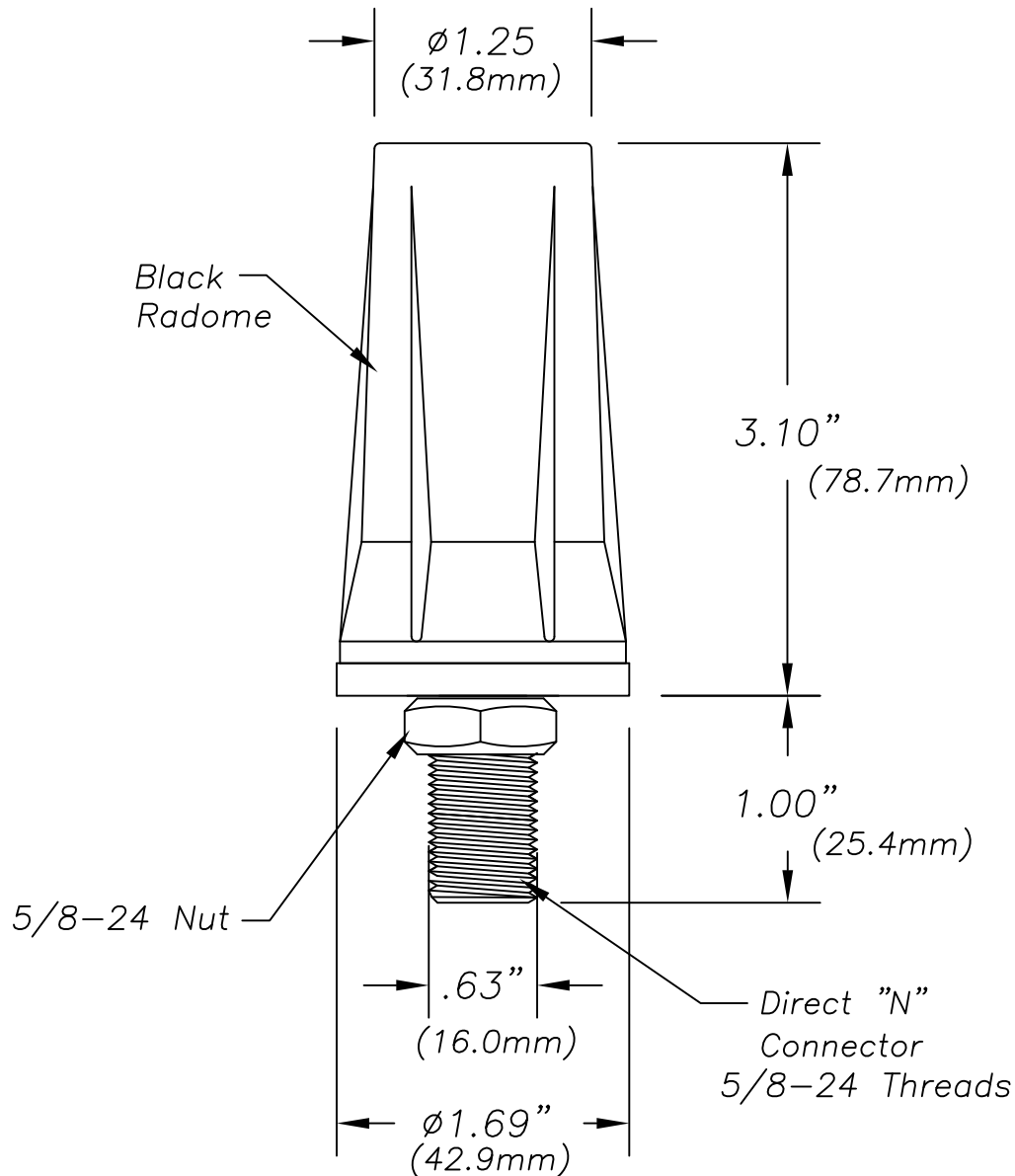
3 Hamanor st. Holon 5886103, P.O.Box 1852 Holon 5811801, Israel

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Source: <https://mars-antennas.com/wp-content/uploads/2018/04/MA-WO-UWB.pdf> (Date: 12/2/2019)

RM-WB1-DN-BLK

Sub6 Omnidirectional Antenna Body Mount "Bus" Antenna with Direct "N" Termination 617-960 MHz & 1700-6000 MHz



Antenna Specifications:

Frequency:	617-960/1700-6000MHz
Gain:	3 dBi peak
VSWR:	2:1
Radome Material:	Black ABS Plastic
Impedance:	50 Ohm Nominal
Maximum Input Power:	10 Watts
Connector:	Direct "N"
Water Ingress:	IPX7 when properly mounted
Operational Temperature:	-40° to +85°C
Weight:	6.5 oz (184g)
Mounting:	5/8 Dia.(15.8mm) feed thru, 1" lg (25.4mm) thread up to 1/4" (6.35mm) thk.metal

8/7/19

() METRIC DIMENSIONS
IN PARENTHESIS



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VISIT OUR WEBSITE AT WWW.MOBILEMARK.COM

L-, S-, and C-band Stub Antenna



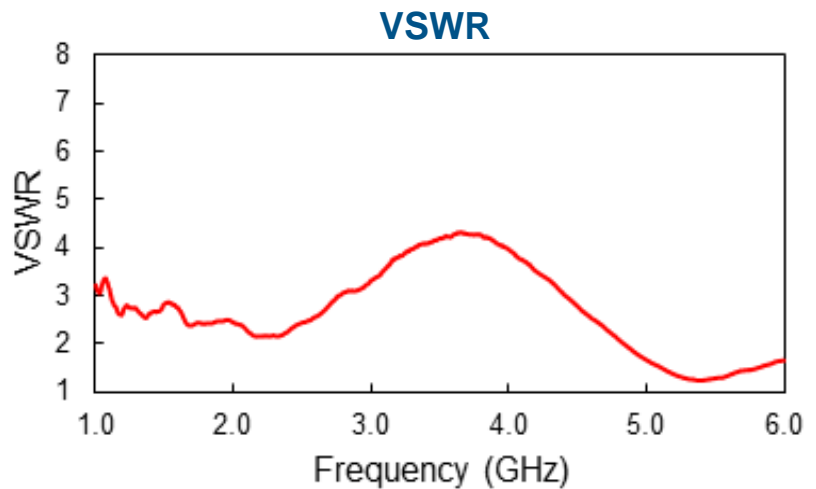
Model Shown: SA-1400-5900

Characteristics

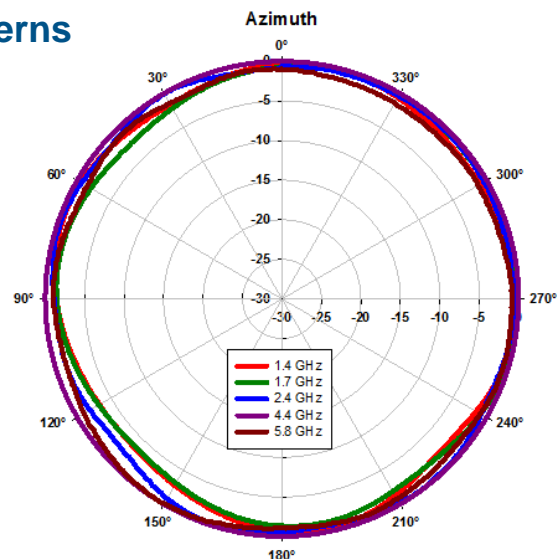
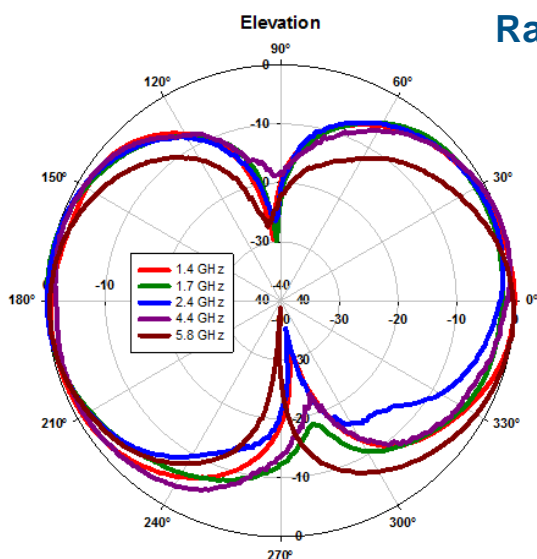
Model	SA-1400-5900
Frequency	1400 - 5900 MHz
Gain	0.3 dBi @ 1400 MHz 0.5 dBi @ 1700 MHz 1.0 dBi @ 2400 MHz 0.7 dBi @ 4400 MHz 1.3 dBi @ 5800 MHz
VSWR	< 3:1 over relevant bands
Pattern	Near Omnidirectional in Azimuth
Polarization	Vertical
Power	0.5 W
Size	2.65" × 0.52"
Weight	0.35 oz
Connector Type	SMA Male

Features

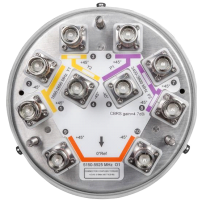
- Operation over video receiver bands
 - L-band: 1.7 – 1.85 GHz
 - S-band: 2.2 – 2.5 GHz
 - C-band: 4.4 – 4.95 GHz
5.25 – 5.85 GHz
- Small form factor and lightweight
- Easily fits on small radios



Radiation Patterns



VVSSP-360S-F



10-port small cell antenna, 4x 1695–2690, 4x 3400–3800 and 2x 5150–5925 MHz. 360° Horizontal Beamwidth, fixed tilt.

Electrical Specifications

Frequency Band, MHz	1695–1920	1920–2180	2300–2690	3400–3800	5150–5925
Gain, dBi	6.6	7.3	8.2	4.9	5.1
Beamwidth, Horizontal, degrees	360	360	360	360	360
Beamwidth, Vertical, degrees	21.9	19.1	15.6	39.0	22.4
Beam Tilt, degrees	7	7	7	0	0
USLS (First Lobe), dB	14	14	12	19	9
Isolation, Cross Polarization, dB	25	25	25	25	25
Isolation, Inter-band, dB	28	28	28	28	28
VSWR Return Loss, dB	1.5 14.0	1.5 14.0	1.5 14.0	1.5 14.0	1.5 14.0
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-150		
Input Power per Port, maximum, watts	125	125	125	35	5
Polarization	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	1695–1920	1920–2180	2300–2690	3400–3800	5150–5925
Gain by all Beam Tilts, average, dBi	6.3	7.1	7.9	4.7	4.4
Gain by all Beam Tilts Tolerance, dB	±0.6	±0.5	±0.5	±0.3	±1.1
Beamwidth, Vertical Tolerance, degrees	±2	±2.3	±1.5	±5.7	±6.5

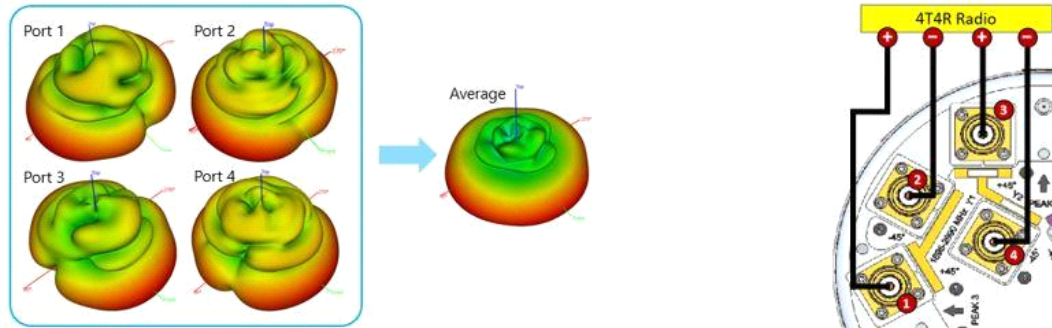
* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, [download the whitepaper Time to Raise the Bar on BSAs](#).

5 GHz Port Power Table

5 GHz FCC Power Requirements				
U-NII Band	U-NII 1	U-NII 2A	U-NII 2C	U-NII 3
Frequency (MHz)	5150 - 5250	5250 - 5350	5470 - 5725	5725 - 5850
Max Input power per port to align with FCC Title 47 Part 15 (Watts)	0.5	0.125	0.125	0.5

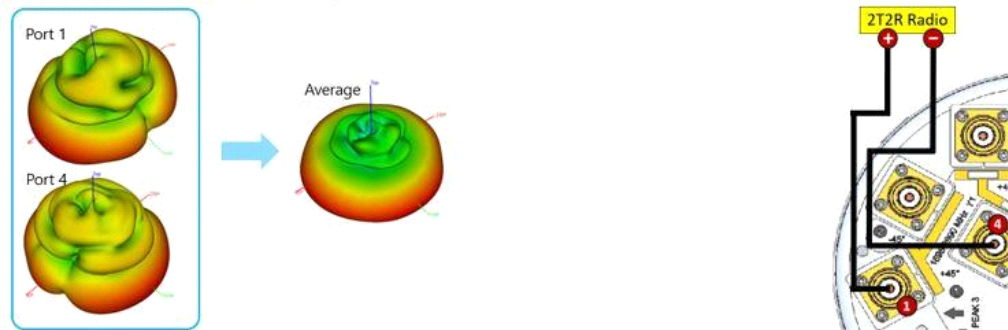
Port Configuration

4X Port Configuration:



- When using a 4T4R radio, use ports 1 – 4 of the pattern diversity antenna

2X Port Configuration:



- When using a 2T2R radio, use ports 1 & 4 of the pattern diversity antenna
- Using ports 2 & 3 yields the same result
- This ensures that both orientations and both polarizations are used
- When using this antenna in 2T2R, then this antenna does not have full polarization diversity

General Specifications

Operating Frequency Band	1695 – 2690 MHz 3400 – 3800 MHz 5150 – 5925 MHz
Antenna Type	Small Cell
Band	Multiband
Performance Note	Outdoor usage
Total Input Power, maximum	300 W @ 50 °C

Mechanical Specifications

RF Connector Quantity, total	10
RF Connector Quantity, high band	10
RF Connector Interface	4.3-10 Female
Grounding Type	RF connector inner conductor and body grounded to reflector and mounting bracket

VVSSP-360S-F

Radiator Material	Low loss circuit board
Radome Material	Fiberglass, UV resistant
Reflector Material	Aluminum
RF Connector Location	Bottom
Wind Loading, frontal	131.7 lbf @ 150 km/h 58.0 N @ 150 km/h
Wind Loading, maximum	13.0 lbf @ 150 km/h 58.0 N @ 150 km/h
Wind Speed, maximum	241 km/h 150 mph

Dimensions

Length	600.0 mm 23.6 in
Outer Diameter	200.0 mm 7.9 in
Net Weight, without mounting kit	7.0 kg 15.4 lb

Packed Dimensions

Length	850.0 mm 33.5 in
Width	320.0 mm 12.6 in
Depth	300.0 mm 11.8 in
Shipping Weight	9.6 kg 21.2 lb

Regulatory Compliance/Certifications

Agency

RoHS 2011/65/EU
ISO 9001:2015
China RoHS SJ/T 11364-2014

Classification

Compliant by Exemption
Designed, manufactured and/or distributed under this quality management system
Above Maximum Concentration Value (MCV)



* Footnotes

Performance Note Severe environmental conditions may degrade optimum performance

