

# WLAN Antenna Pattern Measurement Test Report for GEN3 BC7 - HIGH



Report Reference: MDE\_HARMAN\_1702\_BC7\_High\_WLAN\_1\_RP  
Date: 24.03.2017

## Test Laboratory:

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## Note:

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## 1 Test Lab Declaration

All test results stated relate only to the device tested.

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- in the resulting document it's status (being an excerpt) is clearly stated and
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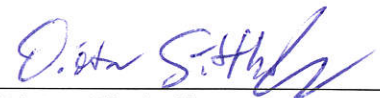
## 2 SIGNATURES

Responsible for  
Accreditation Scope:



Robert Machulec

Responsible  
for Test Report:



Dieter Sütthoff

### 3 Project and Result Summary

DUT	GEN3 BC7 - HIGH	DUT SN	SN039
Test lab	7layers GmbH Borsigstr. 11 40880 Ratingen Germany	Set up	free space
		Test start	03.03.2017
Customer	Harman International Industries, Inc. 3001 Cabot Drive Novi, MI 48377 USA	Report date	24.03.2017
		Report by	Dieter Sütthoff
		Approved by	Robert Machulec

HW Version	1.6.8
SW Version	2.17.02.00

WLAN 2.4 GHz, High Sample						
<b>RMS Detector, RBW 10 MHz</b>	<b>2412 MHz</b>	<b>2437 MHz</b>	<b>2462 MHz</b>	<b>2472 MHz</b>		
<b>Antenna Port Input Power (Conducted Sample)</b>	<b>6.3</b>	<b>6.1</b>	<b>6.6</b>	<b>7.2</b>		
Tot. Rad. Pwr. (dBm)	-5.7	-3.6	-1.6	-0.8		
Peak EIRP (dBm)	-0.8	1.1	2.8	3.4		
Directivity (dBi)	4.8	4.6	4.3	4.2		
Efficiency (dB)	-12.0	-9.7	-8.2	-8.0		
Efficiency (%)	6.4	10.8	15.2	15.9		
<b>Gain (dBi)</b>	<b>-7.1</b>	<b>-5.0</b>	<b>-3.8</b>	<b>-3.8</b>		
WLAN 5 GHz, High Sample						
<b>RMS Detector, RBW 10 MHz</b>	<b>5180 MHz</b>	<b>5220 MHz</b>	<b>5240 MHz</b>	<b>5600 MHz</b>	<b>5785 MHz</b>	<b>5825 MHz</b>
<b>Antenna Port Input Power (Conducted Sample)</b>	<b>13.8</b>	<b>14.3</b>	<b>14.4</b>	<b>13.5</b>	<b>13.4</b>	<b>13.2</b>
Tot. Rad. Pwr. (dBm)	10.2	11.0	10.9	9.3	9.0	9.0
Peak EIRP (dBm)	16.2	17.2	16.7	16.1	15.1	14.8
Directivity (dBi)	6.0	6.2	5.9	6.8	6.1	5.8
Efficiency (dB)	-3.6	-3.3	-3.5	-4.2	-4.4	-4.2
Efficiency (%)	44.0	46.5	44.3	38.3	36.2	38.3
<b>Gain (dBi)</b>	<b>2.4</b>	<b>2.9</b>	<b>2.3</b>	<b>2.6</b>	<b>1.7</b>	<b>1.6</b>

Tab. 1: Test result summary WLAN



Fig. 1: Photo of test setup.

## 4 Brief Description of Settings and Test Method

### 4.1 References and Standards Used

- [1] CTIA: "Test Plan for Wireless Device Over the Air Performance", Revision 3.6.1, 11/2016.
- [2] 3GPP TS 25.101: "User Equipment (UE) radio transmission and reception (FDD)", (Release 11), Version V11.2.0, June 2012.
- [3] 7 layers document: "Test Procedure for Over the Air Performance Estimation Applied by the OTA Test Lab at 7 layers Ratingen", Version January 2009.

### 4.2 Test Procedure TRP

The method of measurement for radiated RF power and receiver performance are based on the principals of the test standard CTIA: "Test Plan for Mobile Station Over the Air Performance" [1].

***In general the following approach is applied for TRP measurements:***

- For TRP measurement put OUT in a mode where it transmitting periodical RF energy.
- Rotate the OUT in all room directions with a angle grid of 15°.
- Gather power data for both, vertical and horizontal polarization.
- Calculate total radiated power by integrating over the whole sphere as outlined in [1].

The test setup was placed at the turning device inside a fully anechoic chamber. The object under test (OUT) was set to transmit permanently signal on specific frequencies  
The total radiated power (TRP) of the test setup was measured in all angle direction (3D) using a step width of 15° and using two measurement antenna polarizations (vertical and horizontal).

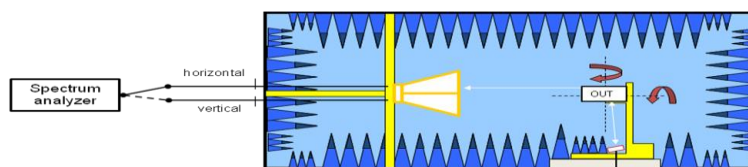


Fig. 1: Block diagram for TRP measurement

### 4.3 Definitions

3GPP	3 <sup>rd</sup> Generation Partnership Project
BER	Bit error rate or bit error ratio
BS	Base station
CTIA	Cellular Telecommunications & Internet Association
DUT	Device under test
FS	Free space
TP	Talk position (phone is situated at SAM = human head phantom)
TRP	Total Radiated Power
EIRP	Effective Isotropic Radiated Power
TRS	Total Radiated Sensitivity (same as TIS in CTIA), loss of link level
EIRS	Effective Isotropic Radiated Sensitivity

## 5 Detailed Radiated Test Results and Pattern

### 5.1 Equipment List

#### For TRP measurements:

Antenna:	Dual polarized horn ETS3164-03 by ETS	SN 00052619
Receiver:	FSIQ spectrum analyzer by R&S	SN 840061/005

#### Orientation of EUT compared to a standard device

For orientation of the EUT in the result pictures below the following photos illustrate the used orientation compared to a standard device:



Fig. 2: Photo orientation of DUT.



## 5.2 Radiation Pattern TRP WLAN 2412 MHz

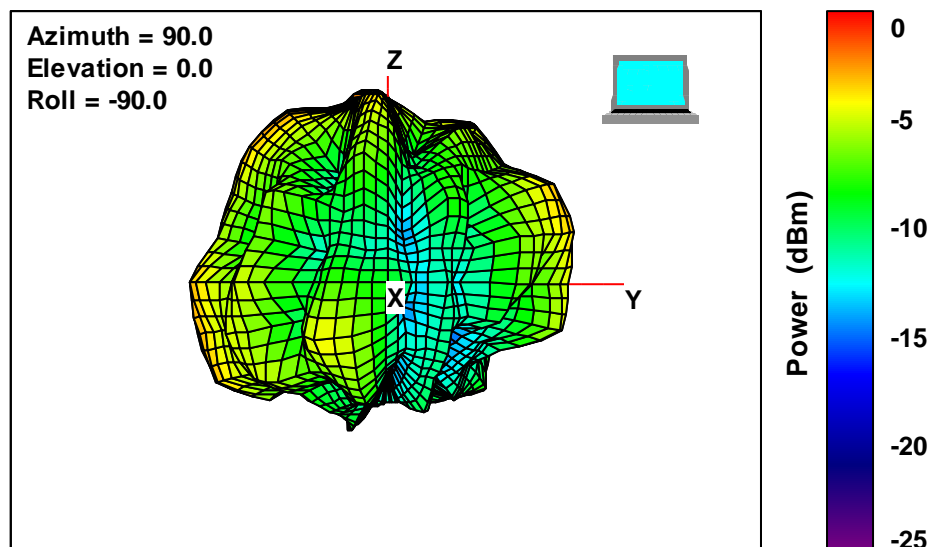
WLAN 2.4 GHz b-Mode TRP

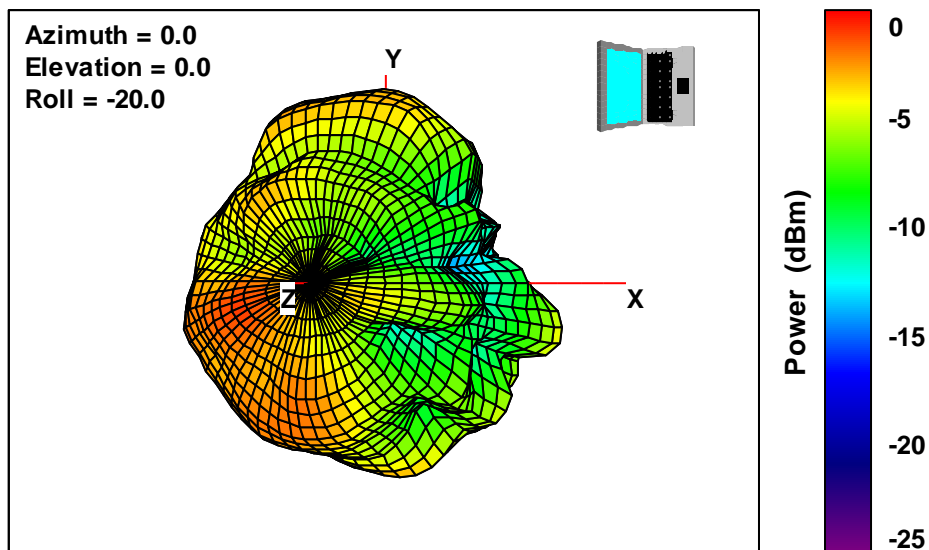
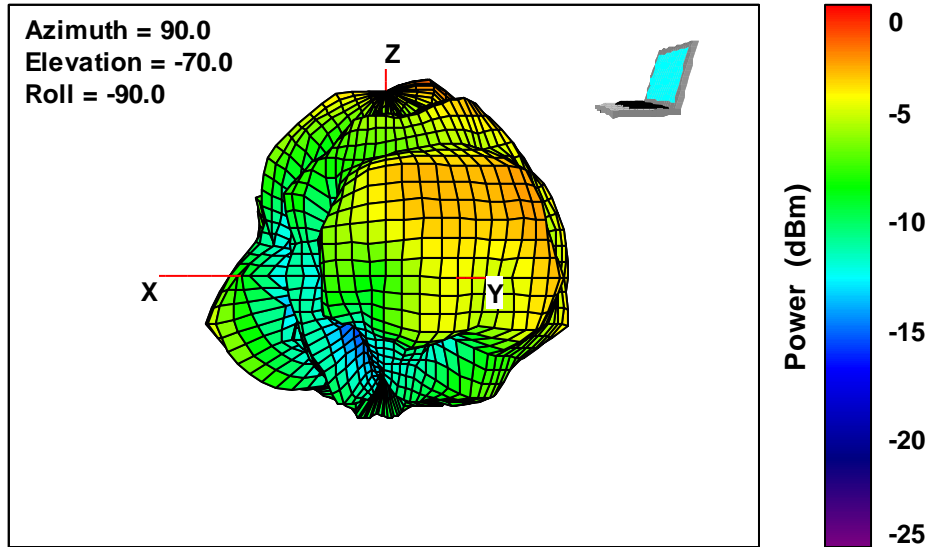
Temperature: 23.5

Humidity: 28.0

Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	-5.67
Peak EIRP (dBm)	-0.83
Directivity (dBi)	4.85
NHPRP $\pm\pi/4$ (dBm)	-6.89
NHPRP $\pm\pi/6$ (dBm)	-8.19
Boresight Phi ( $^{\circ}$ )	203.8
Boresight Th. ( $^{\circ}$ )	15



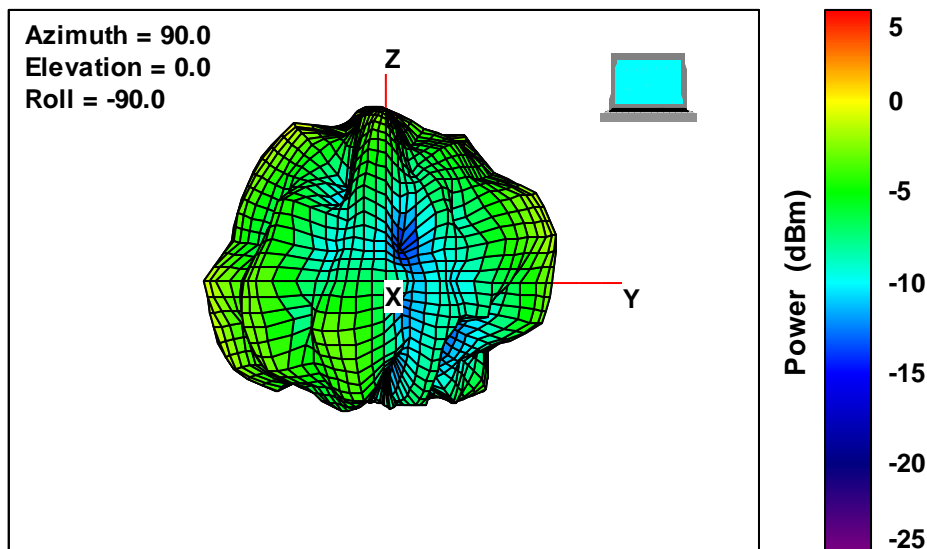


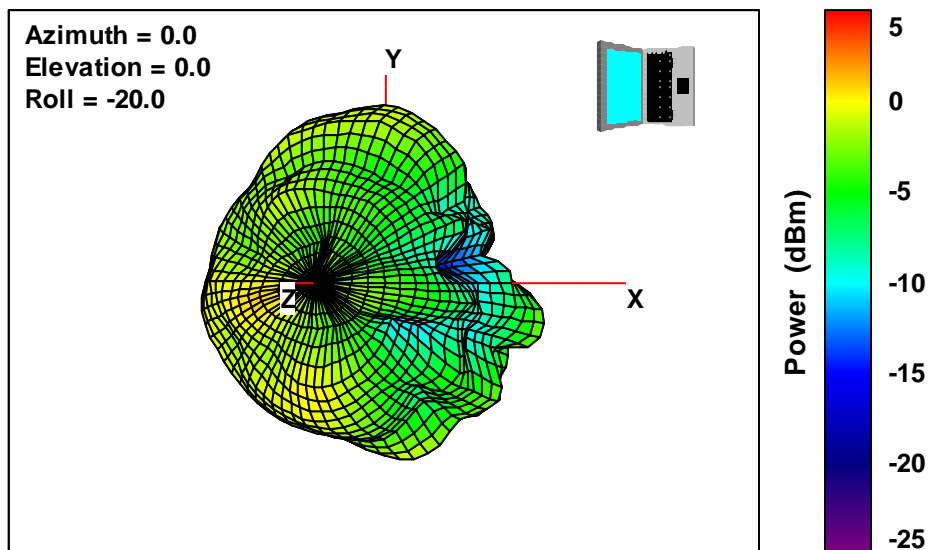
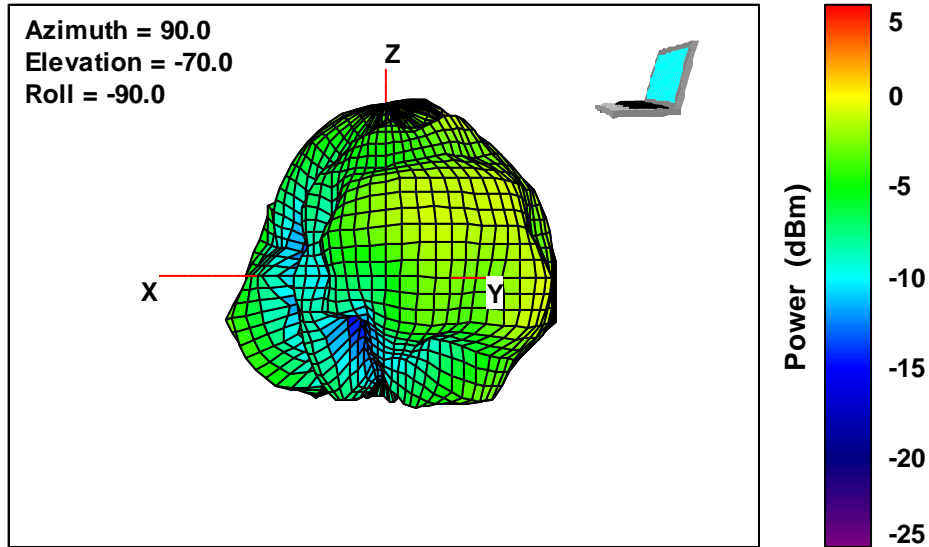
### 5.3 Radiation Pattern TRP WLAN 2437 MHz

WLAN 2.4 GHz b-Mode TRP

Temperature: 23.5  
 Humidity: 28.0  
 Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	-3.57
Peak EIRP (dBm)	1.08
Directivity (dBi)	4.65
NHPRP $\pm\pi/4$ (dBm)	-4.76
NHPRP $\pm\pi/6$ (dBm)	-6.04
Boresight Phi ( $^\circ$ )	199.7
Boresight Th. ( $^\circ$ )	15



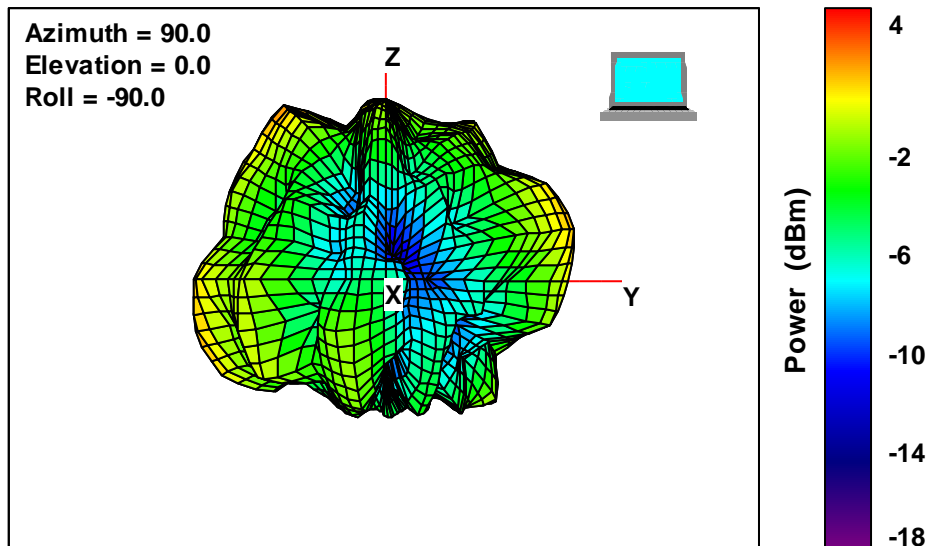


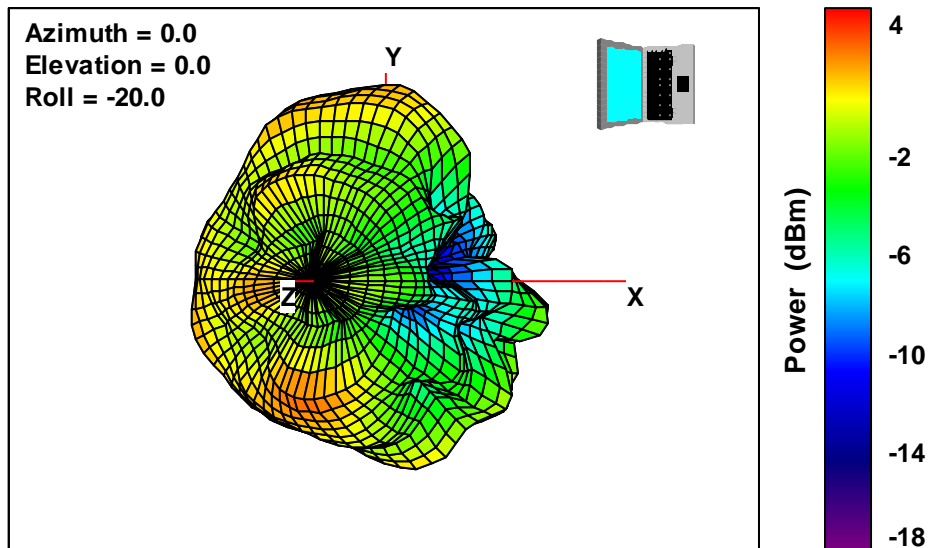
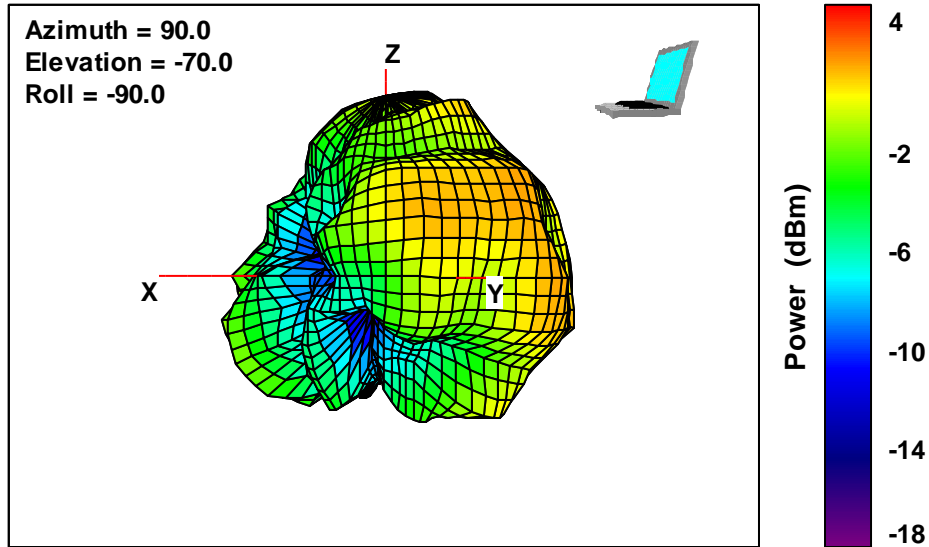
### 5.4 Radiation Pattern TRP WLAN 2462 MHz

WLAN 2.4 GHz b-Mode TRP

Temperature: 23.5  
 Humidity: 28.0  
 Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	-1.57
Peak EIRP (dBm)	2.75
Directivity (dBi)	4.32
NHPRP $\pm\pi/4$ (dBm)	-2.74
NHPRP $\pm\pi/6$ (dBm)	-4.00
Boresight Phi ( $^{\circ}$ )	262.45
Boresight Th. ( $^{\circ}$ )	30





### 5.5 Radiation Pattern TRP WLAN 2472 MHz

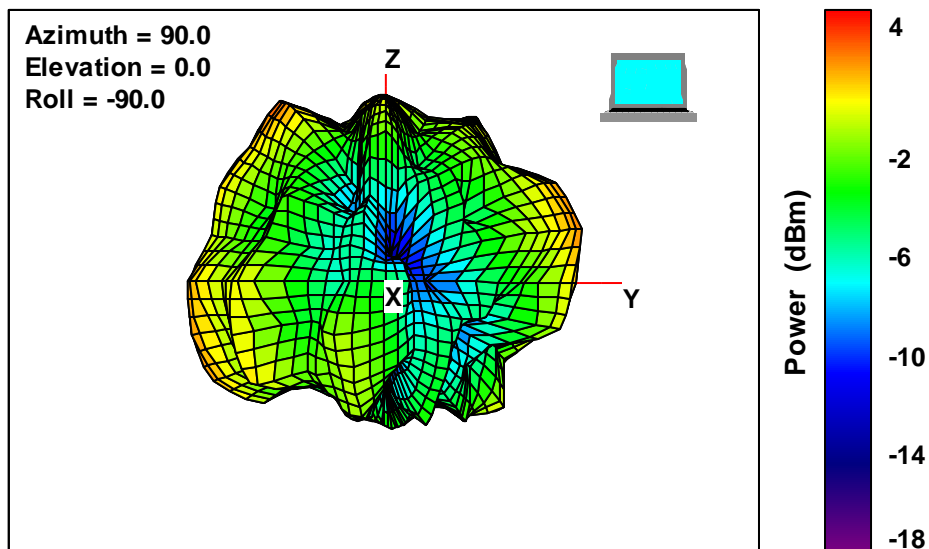
WLAN 2.4 GHz b-Mode TRP

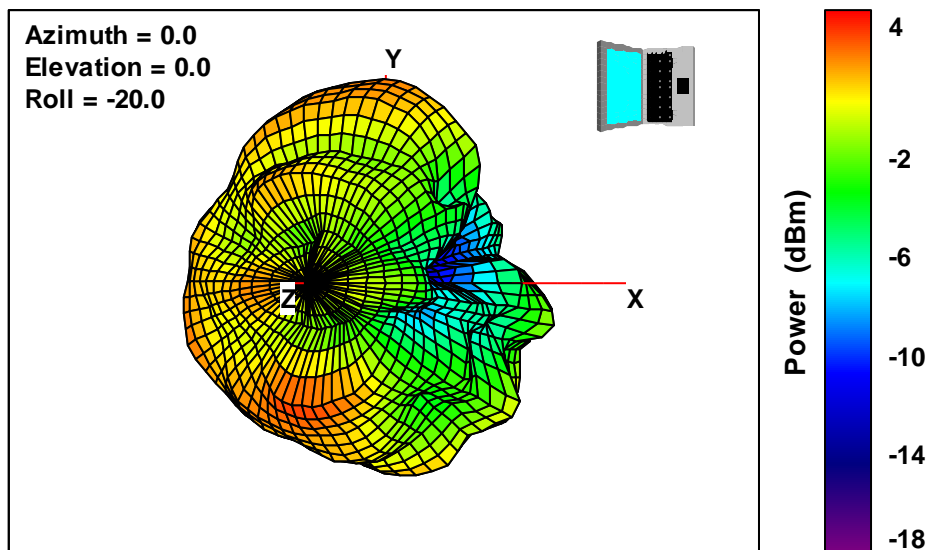
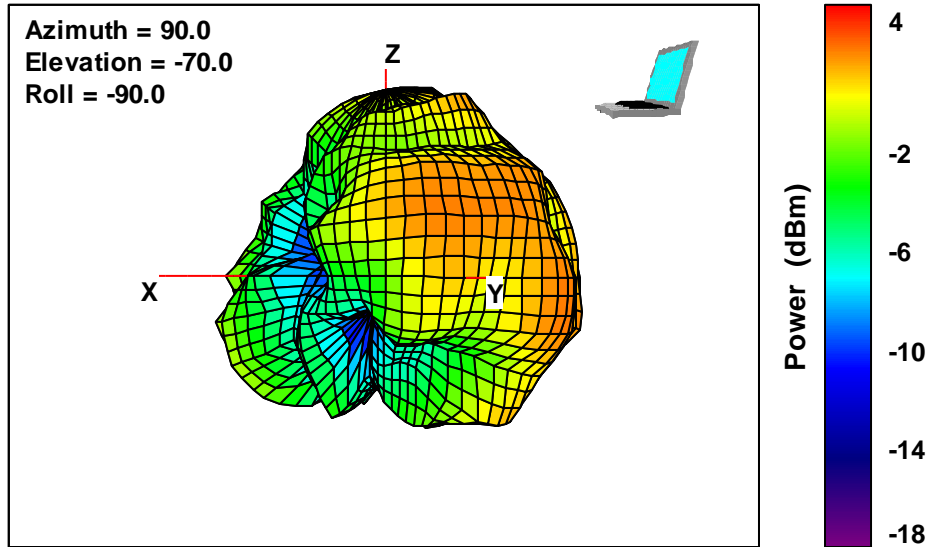
Temperature: 23.5

Humidity: 28.0

Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	-0.79
Peak EIRP (dBm)	3.38
Directivity (dBi)	4.17
NHPRP $\pm\pi/4$ (dBm)	-1.94
NHPRP $\pm\pi/6$ (dBm)	-3.21
Boresight Phi (°)	257.6
Boresight Th. (°)	30







## 5.6 Radiation Pattern TRP WLAN 5180 MHz

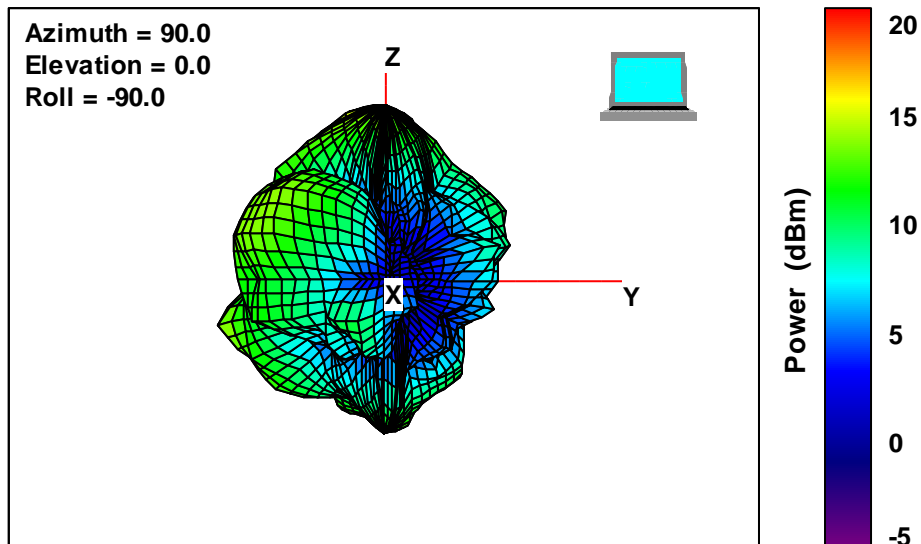
WLAN 5 GHz a-Mode TRP

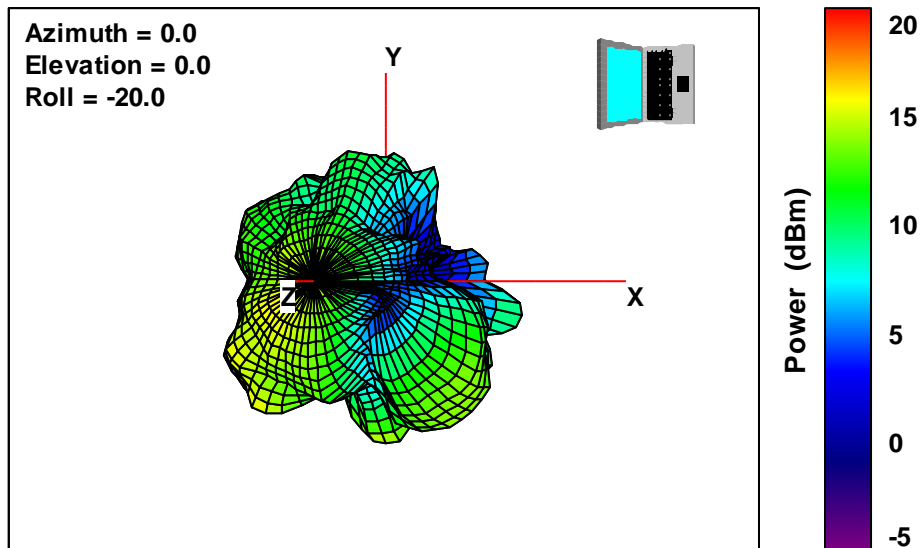
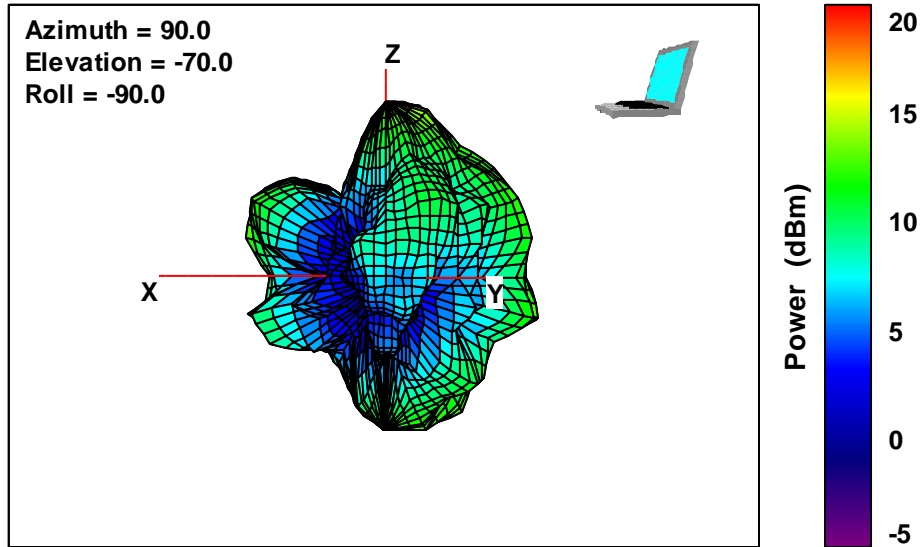
Temperature: 23.5

Humidity: 28.0

Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	10.24
Peak EIRP (dBm)	16.22
Directivity (dBi)	5.98
NHPRP $\pm\pi/4$ (dBm)	8.70
NHPRP $\pm\pi/6$ (dBm)	7.29
Boresight Phi (°)	230.3
Boresight Th. (°)	60





### 5.7 Radiation Pattern TRP WLAN 5220 MHz

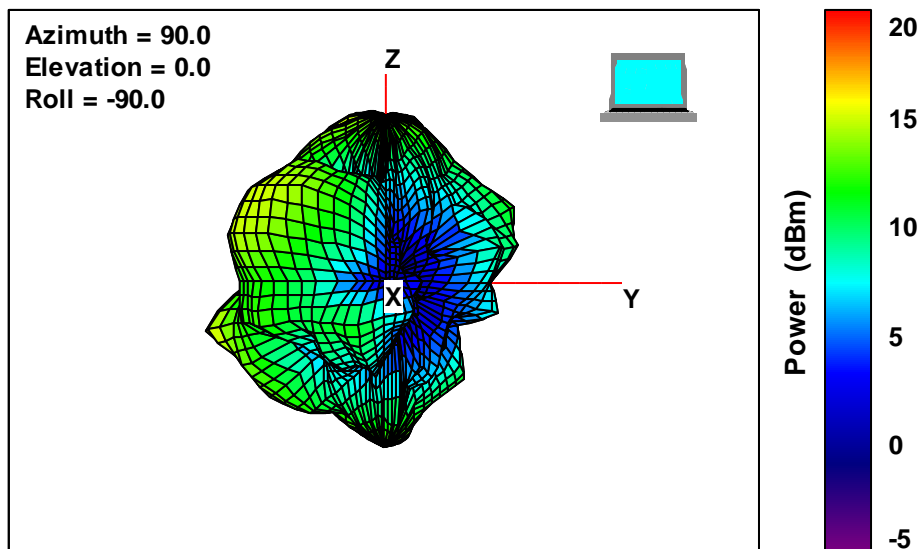
WLAN 5 GHz a-Mode TRP

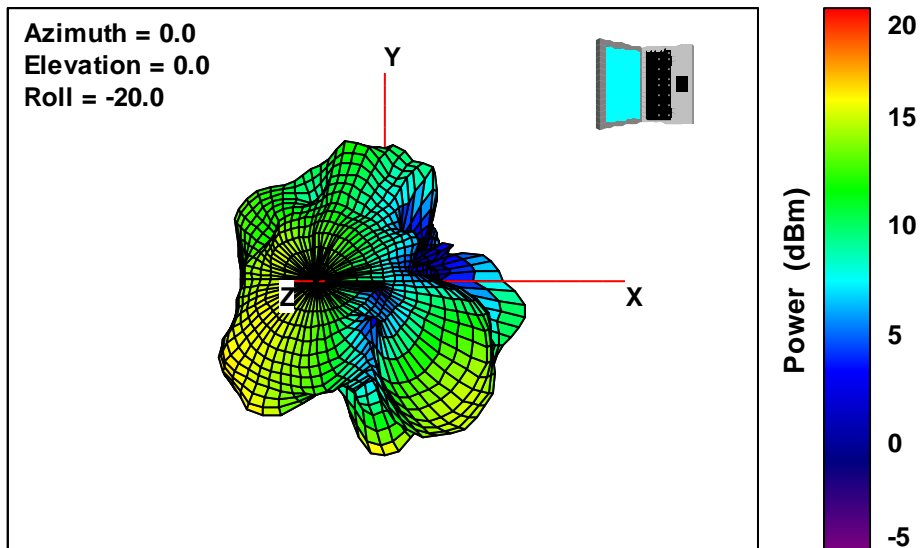
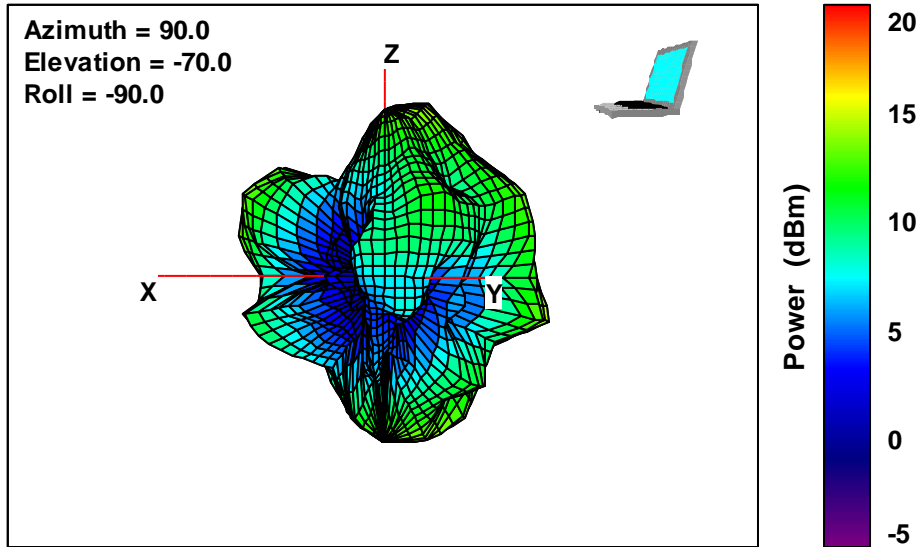
Temperature: 23.5

Humidity: 28.0

Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	10.97
Peak EIRP (dBm)	17.17
Directivity (dBi)	6.20
NHPRP $\pm\pi/4$ (dBm)	9.42
NHPRP $\pm\pi/6$ (dBm)	8.04
Boresight Phi ( $^\circ$ )	259.6
Boresight Th. ( $^\circ$ )	105





### 5.8 Radiation Pattern TRP WLAN 5240 MHz

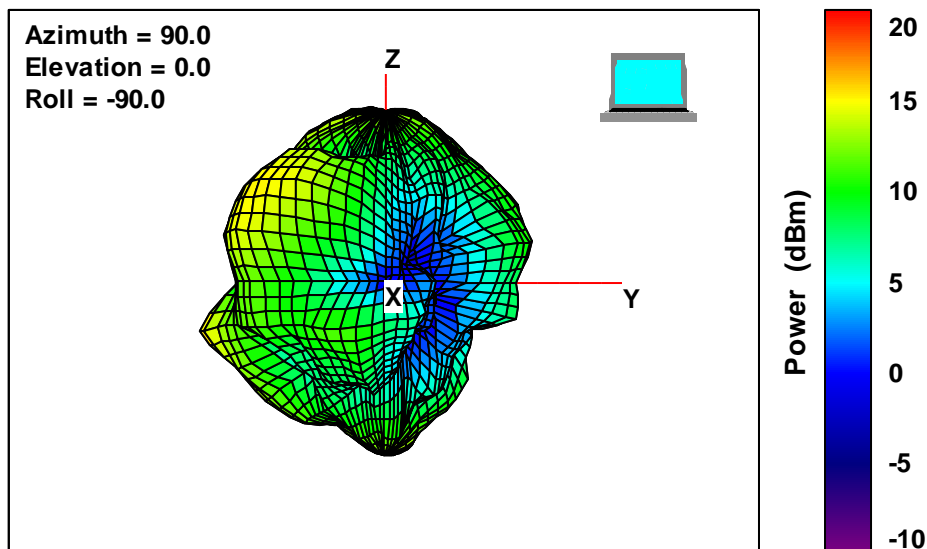
WLAN 5 GHz a-Mode TRP

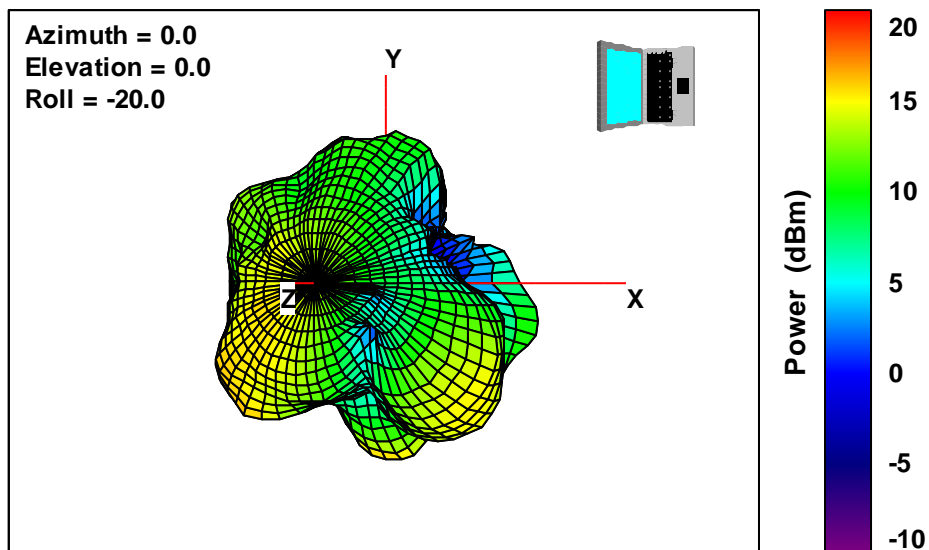
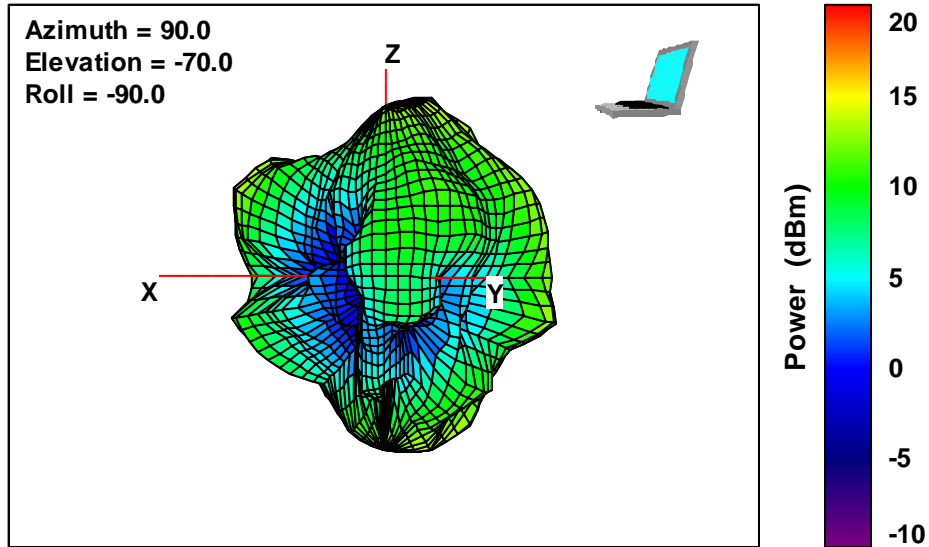
Temperature: 23.5

Humidity: 28.0

Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	10.86
Peak EIRP (dBm)	16.73
Directivity (dBi)	5.88
NHPRP $\pm\pi/4$ (dBm)	9.28
NHPRP $\pm\pi/6$ (dBm)	7.89
Boresight Phi ( $^\circ$ )	272.55
Boresight Th. ( $^\circ$ )	105





## 5.9 Radiation Pattern TRP WLAN 5600 MHz

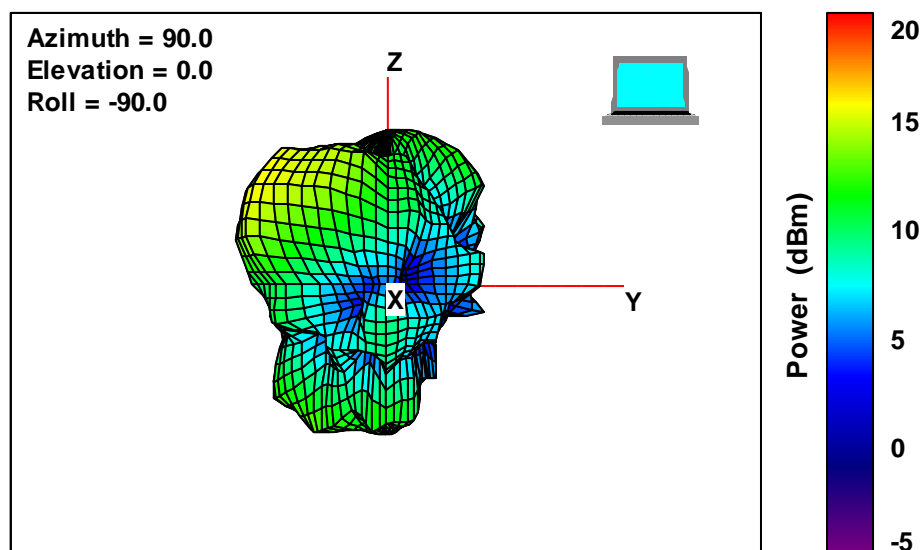
WLAN 5 GHz a-Mode TRP

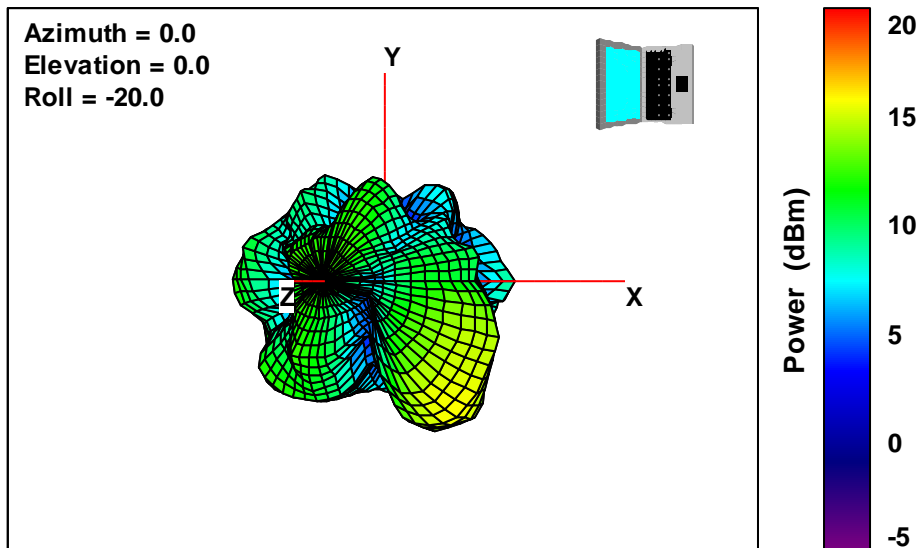
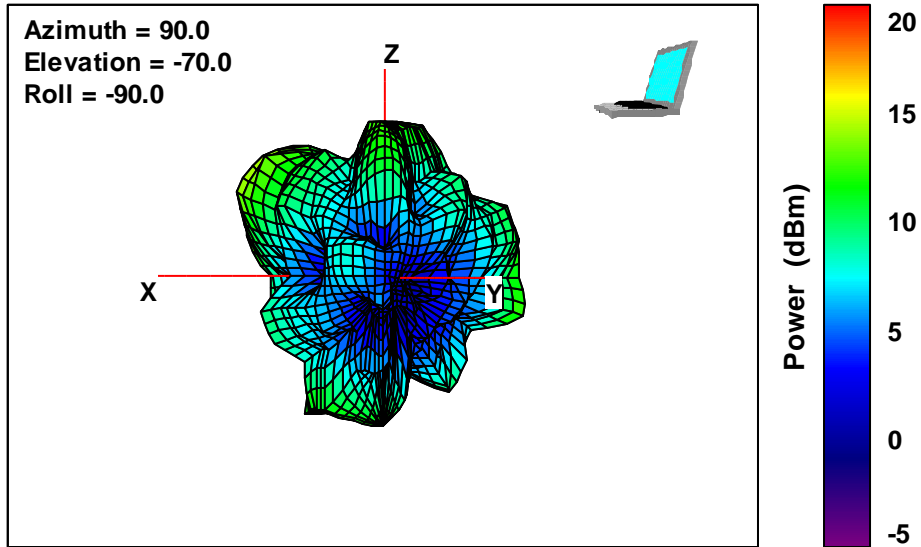
Temperature: 23.5

Humidity: 28.0

Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	9.33
Peak EIRP (dBm)	16.08
Directivity (dBi)	6.75
NHPRP $\pm\pi/4$ (dBm)	7.67
NHPRP $\pm\pi/6$ (dBm)	6.07
Boresight Phi ( $^{\circ}$ )	308
Boresight Th. ( $^{\circ}$ )	60







### 5.10 Radiation Pattern TRP WLAN 5785 MHz

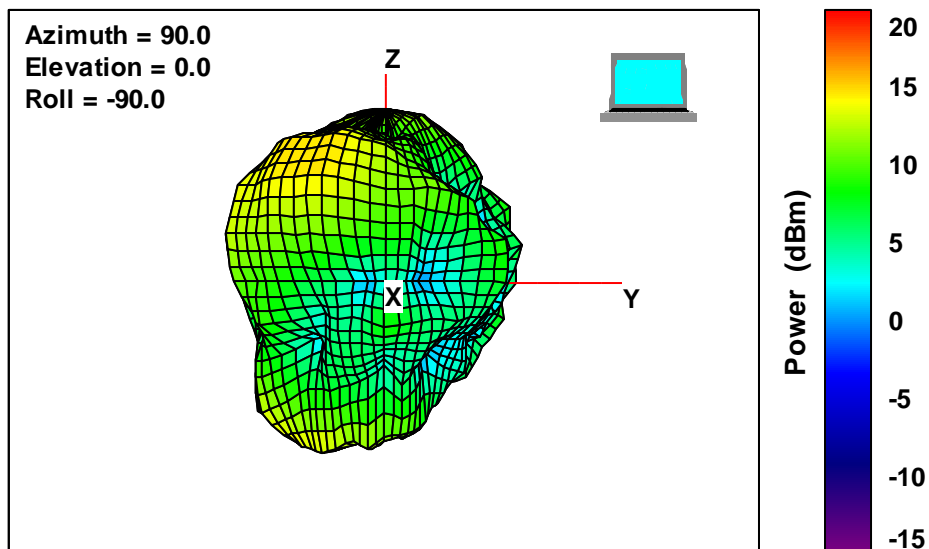
WLAN 5 GHz a-Mode TRP

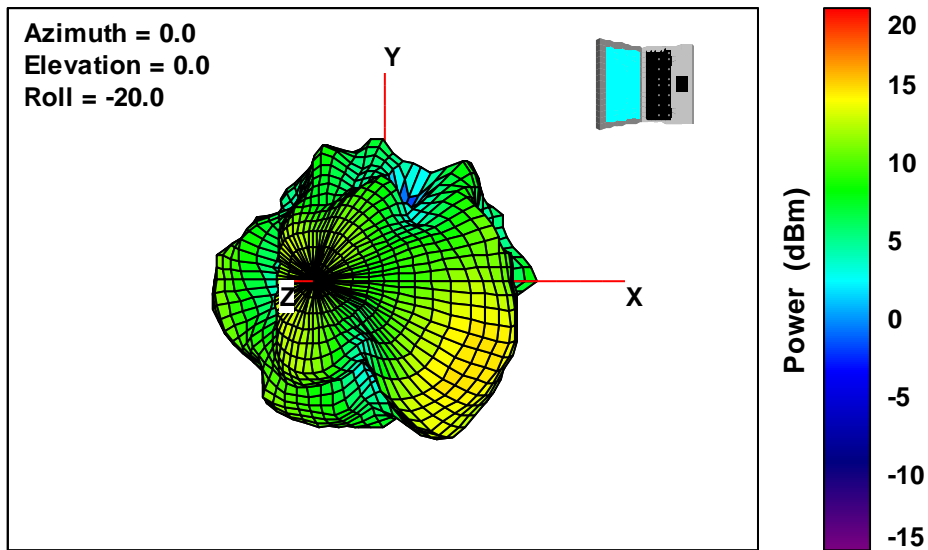
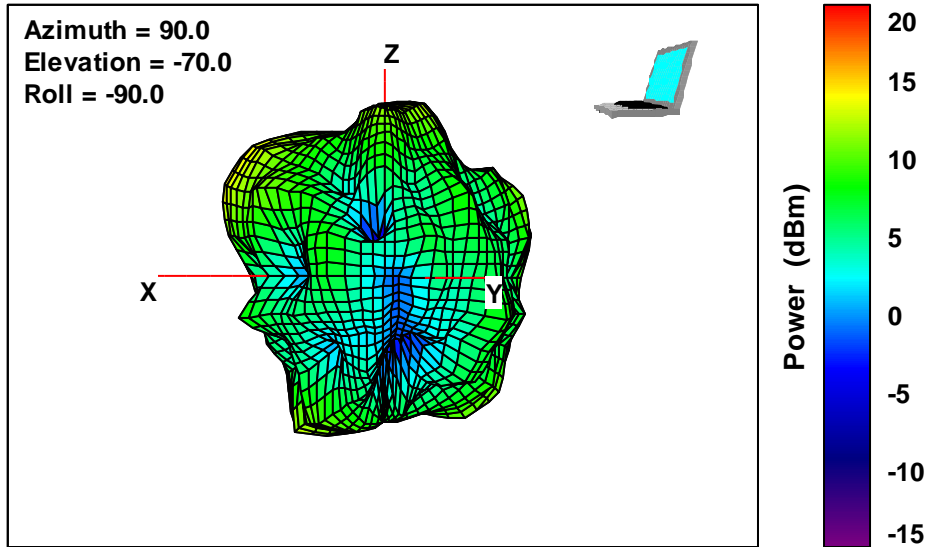
Temperature: 23.5

Humidity: 28.0

Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	8.99
Peak EIRP (dBm)	15.12
Directivity (dBi)	6.13
NHPRP $\pm\pi/4$ (dBm)	7.22
NHPRP $\pm\pi/6$ (dBm)	5.54
Boresight Phi ( $^\circ$ )	320
Boresight Th. ( $^\circ$ )	45





### 5.11 Radiation Pattern TRP WLAN 5825 MHz

WLAN 5 GHz a-Mode TRP

Temperature: 23.5

Humidity: 28.0

Test start: 03/10/2017

Tot. Rad. Pwr. (dBm)	9.03
Peak EIRP (dBm)	14.82
Directivity (dBi)	5.79
NHPRP $\pm\pi/4$ (dBm)	7.22
NHPRP $\pm\pi/6$ (dBm)	5.52
Boresight Phi ( $^{\circ}$ )	320
Boresight Th. ( $^{\circ}$ )	45

