Logitech
Antenna Under Test (AUT)
Report

Model Name: Y-R0035

Equipment Type: Wireless Keyboard

Manufacturer: Logitech Technology (Suzhou) Co., Ltd

Test Location: Suzhou, China No.3 Song Shan Road, New District

Tested by: Test Personnel

Report Date: 2023.12.07

Report Release History

Report version	Description	Date Issued
Y-R0035 AUT Report	Original release	2023/12/07

Table of Contents

1. EUT Antenna Information

1) Antenna Material : PCB on board
2) Antenna Type : Printed loop antenna
3) Antenna Dimension:42 x 3 mm
4) Operating Frequency : 2.4 GHz - 2.4835 GHz
5) Input Impedance : 50 Ω
6) Standing-Wave Ratio : 2:1

2. Measured Values and Calculation of Antenna Gains

Measure peak horizontal/vertical EIRP on each x-y, y-z, x-z plane. The highest measured values will be used to calculate the antenna peak gain.

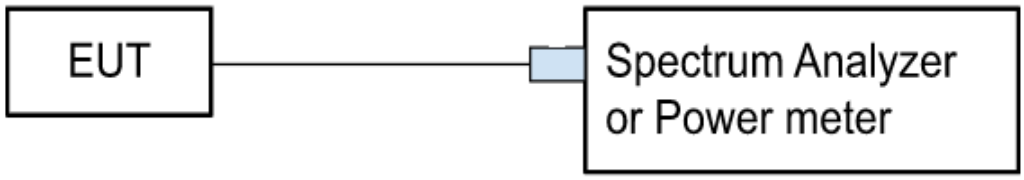
Antenna Peak Gain (dBi) = Max EIRP(dBm) - Conducted Power (dBm)

Frequency	X-Y Plane ϕ=0~360°, θ=90°		X-Z Plane ϕ=0°, θ=0~360°		Y-Z Plane ϕ=90°, θ=0~360°		Max Peak EIRP (dBm)	Conducted Power (dBm)	Antenna Peak Gain (dBi)
	Ver. Peak EIRP (dBm)	Hori. Peak EIRP (dBm)	Ver. Peak EIRP (dBm)	Hori. Peak EIRP (dBm)	Ver. Peak EIRP (dBm)	Hori. Peak EIRP (dBm)			
2405	-13.02	1.01	0.96	-2.10	-3.09	-1.37	1.01	-4.61	5.62
2444	-12.77	-0.40	-0.21	-2.28	-3.24	-1.40	-0.40	-4.91	4.51
2474	-12.91	-0.88	-1.30	-2.68	-3.89	-1.39	-0.88	-5.41	4.53

Test Date: 2023.12.07

3. Conducted Power Measurement

3.1 Test Setup



3.2 Test Instruments

Description	Model No.	Serial No.	Last Calibration
Spectrum Analyzer Keysight	N9020B	MY60110508	2023.7.25
RF signal cable Woken	Huber+suhner 10844497	276	2023.01.28

Note: The calibration interval of the above test instruments is 12 months

3.3 Test Procedure

A spectrum analyzer or Power meter was used to perform output power measurement, setting the detector to average and configuring EUT continuously transmitting power(100% duty cycle).

3.4 Test Result of RF conducted Power

Frequency	Conducted Power (dBm)
2405	-4.61

Frequency	Conducted Power (dBm)
2444	-4.91
2474	-5.41

Test Date: 2023.12.07

4. 2D Radiation Pattern Measurement

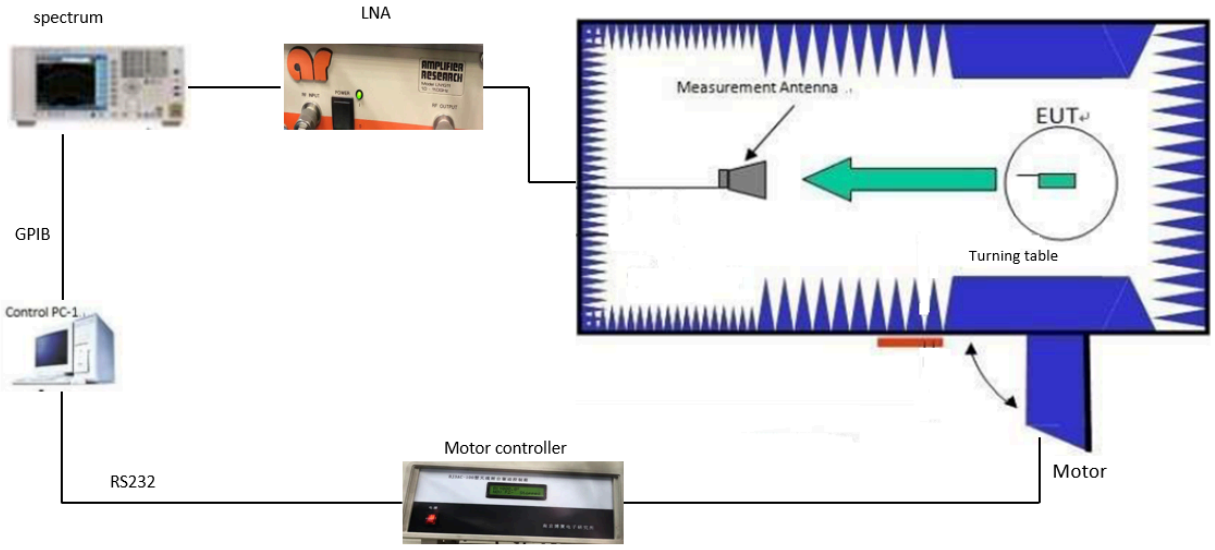
4.1 Test Location

2D radiation pattern measurement in Logitech China SZ 2.4GHz FAC anechoic chamber.

4.2 Description of the anechoic chamber

Chamber specification
Length: 5.0m
Width: 2.8m
Height: 2.8m
Turntable height: 1.4m
Measurement antenna height: 1.4m

Block diagram to show the chamber and test equipment.



4.3 Test Instruments

Description	Model No.	Serial No.	Last Calibration
Spectrum Analyzer	N9010A	MY49061163	2023.7.25

Keysight			
Horn Antenna ETS	BBHA 9120 D(1201)	D69250	2023.01.28
RF signal cable	SUCOFLEX104	SN293270/4	2023.01.28
Software	FAC-Radio Measurement System	Version 1.1.0.7	N/A
Turntable controller	BJ3AC-100	N/A	2023.01.28
LNA	LN1G11	321282	2023.01.28

Note: The calibration interval of the above test instruments is 12 months

4.4 Test Procedure

i. Connect the EUT to Spectrum Analyzer and record the power setting of EUT and the measured conducted power.
ii. Fasten the EUT in the center of the turntable, record the coordinates and take pictures.
iii. Configuring EUT continuously transmitting power(100% duty cycle).
iv. Make sure the transmit signal is stable and at the maximum RF power level.
v. Setup the channel power function by spectrum analyzer.
vi. Read the channel power level on the spectrum analyzer and record in the following positions.
    1. The turntable is then stepped between 0 to 360 degrees along the horizontal plane in 15-degree increments.
    2. Data is recorded using the spectrum analyzer for both theta and phi polarizations at each position.
vii. Rotate the EUT with 90 degrees and repeat step f.1 and step f.2 until all 3 planes(X-Y,X-Z,Y-Z) were measured.
viii. According to substitution techniques, a substitution horn antenna is substituted for EUT at the same position and the signal generator exports the CW signal to the substitution antenna via a TX cable. Rotated the turntable and moved the receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a value of spectrum reading equal to “Raw Value" gotten from step vii. Record the power level of S.G.

$$EIRP = P_{SigGen} + G_T - L_C$$

where:

P_{SigGen} = power setting of the signal generator that produces the same received power reading as the DUT, in dBm;

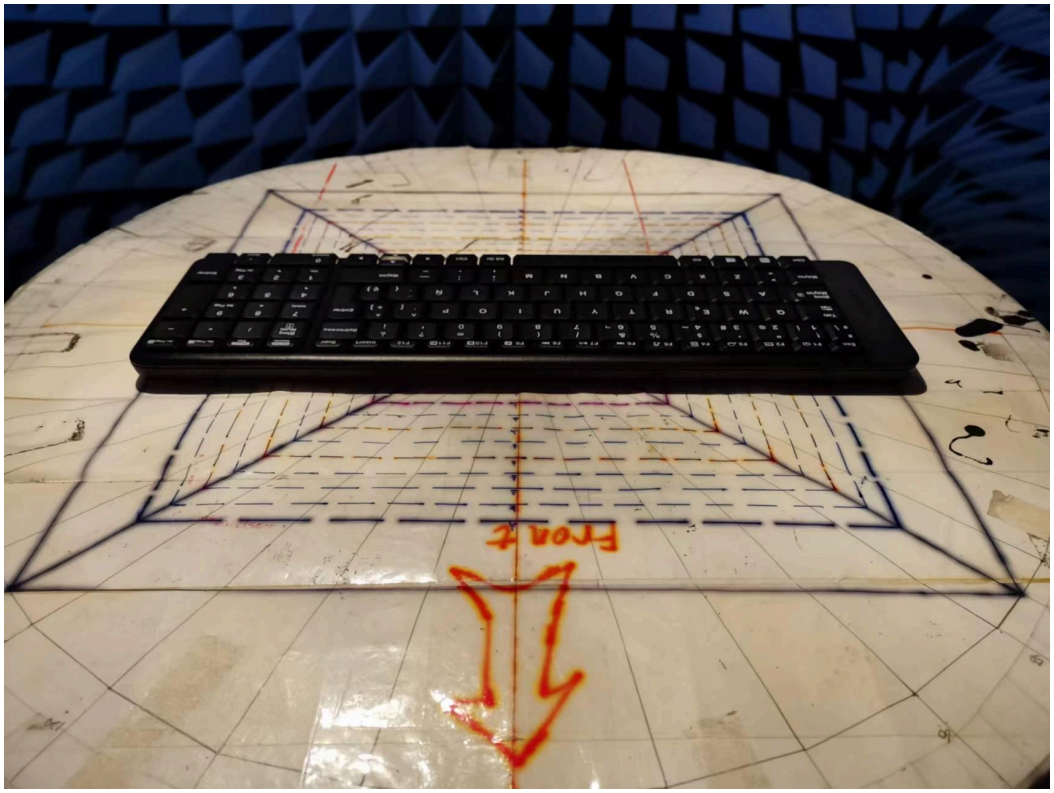
G_T = gain of the substitute antenna, in dBd (ERP) or dBi (EIRP);

L_C = signal loss in the cable connecting the signal generator to the substitute antenna, in dB

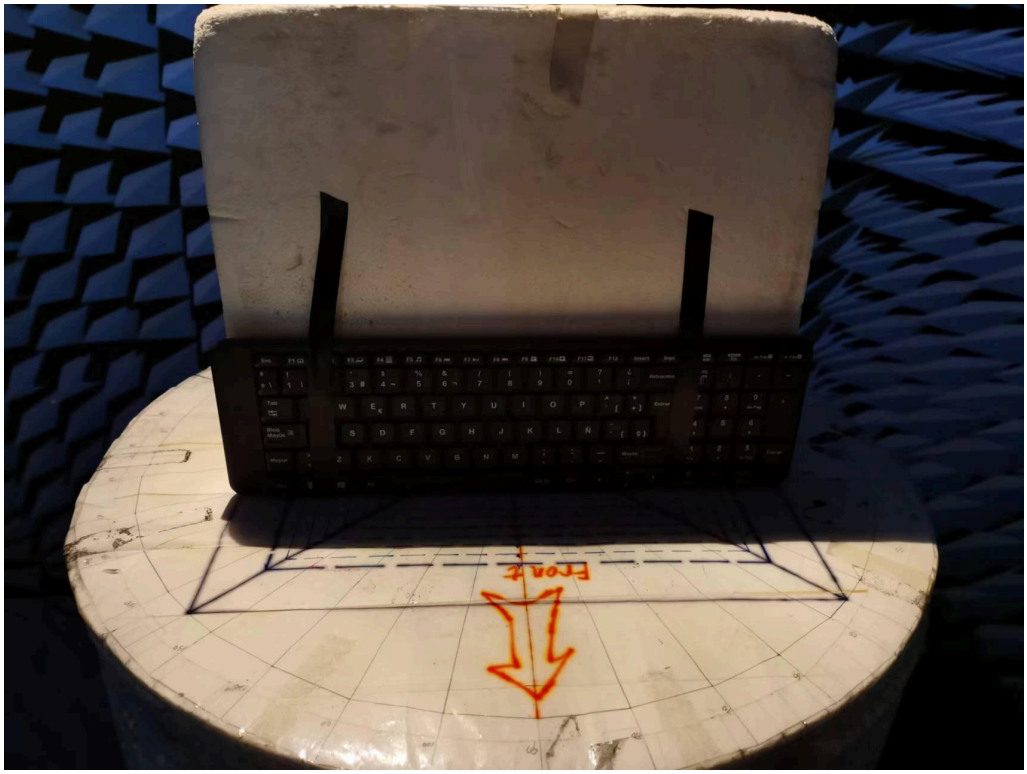
ix. Antenna Peak Gain (dBi) = Max EIRP(dBm) - Conducted Power (dBm)

4.5 Test Setup photos

X-Y Plane:



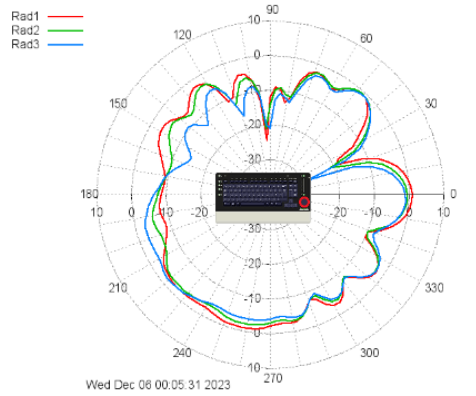
X-Z Plane:



Y-Z Plane:

4.6 2D Pattern Test Plot

X-Y Plane: Horizontal



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Radiation pattern #1:

Lantau_RadPatt_0201_A68_CH05_AnH_TX__yongju+changchunPCB_231206_0_CORR

Average power = **-5.29 dBm**
Front average power = **-6.56 dBm** (From 0 deg to 180 deg)

Min power = **-24.40 dBm** @ 93.00 deg
Max power = **1.01 dBm** @ 0.00 deg

Radiation pattern #2:

Lantau_RadPatt_0201_A68_CH44_AnH_TX__yongju+changchunPCB_231206_0_CORR

Average power = **-5.78 dBm**
Front average power = **-7.18 dBm** (From 0 deg to 180 deg)

Min power = **-20.95 dBm** @ 93.00 deg
Max power = **-0.40 dBm** @ 0.00 deg

Delta max power = **-1.41 dBm**
Delta average power = **-0.49 dBm**
Delta front average power = **-0.63 dBm**

Radiation pattern #3:

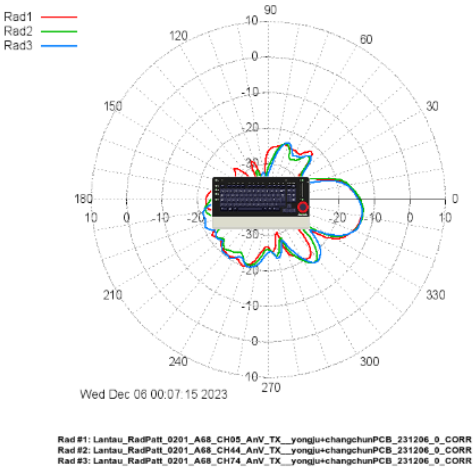
Lantau_RadPatt_0201_A68_CH74_AnH_TX__yongju+changchunPCB_231206_0_CORR

Average power = **-6.62 dBm**
Front average power = **-9.25 dBm** (From 0 deg to 180 deg)

Min power = **-28.45 dBm** @ 21.00 deg
Max power = **-0.88 dBm** @ -3.00 deg

Delta max power = **-1.89 dBm**
Delta average power = **-1.33 dBm**
Delta front average power = **-2.70 dBm**

X-Y Plane: Vertical



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Radiation pattern #1:

Lantau_RadPatt_0201_A68_CH05_AnV_TX__yongju+changchunPCB_231206_0_CORR

Average power = **-24.53 dBm**
Front average power = **-27.29 dBm** (From 0 deg to 180 deg)

Min power = **-47.73 dBm** @ 126.00 deg
Max power = **-13.02 dBm** @ -6.00 deg

Radiation pattern #2:

Lantau_RadPatt_0201_A68_CH44_AnV_TX__yongju+changchunPCB_231206_0_CORR

Average power = **-25.18 dBm**
Front average power = **-28.95 dBm** (From 0 deg to 180 deg)

Min power = **-42.64 dBm** @ 120.00 deg
Max power = **-12.77 dBm** @ -9.00 deg

Delta max power = **0.25 dBm**
Delta average power = **-0.65 dBm**
Delta front average power = **-1.66 dBm**

Radiation pattern #3:

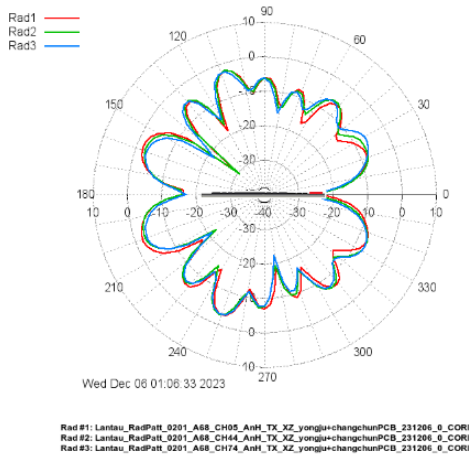
Lantau_RadPatt_0201_A68_CH74_AnV_TX__yongju+changchunPCB_231206_0_CORR

Average power = **-24.87 dBm**
Front average power = **-29.01 dBm** (From 0 deg to 180 deg)

Min power = **-40.32 dBm** @ 129.00 deg
Max power = **-12.91 dBm** @ -12.00 deg

Delta max power = **0.11 dBm**
Delta average power = **-0.34 dBm**
Delta front average power = **-1.72 dBm**

X-Z Plane: Horizontal



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Radiation pattern #1:

Lantau_RadPatt_0201_A68_CH05_AnH_TX_XZ_yongju+changchunPCB_231206_0_CORR

Average power = **-9.53 dBm**
Front average power = **-9.43 dBm** (From 0 deg to 180 deg)

Min power = **-29.02 dBm** @ 141.00 deg
Max power = **-2.10 dBm** @ 159.00 deg

Radiation pattern #2:

Lantau_RadPatt_0201_A68_CH44_AnH_TX_XZ_yongju+changchunPCB_231206_0_CORR

Average power = **-9.58 dBm**
Front average power = **-9.16 dBm** (From 0 deg to 180 deg)

Min power = **-30.57 dBm** @ 141.00 deg
Max power = **-2.28 dBm** @ 108.00 deg

Delta max power = **-0.17 dBm**
Delta average power = **-0.04 dBm**
Delta front average power = **0.27 dBm**

Radiation pattern #3:

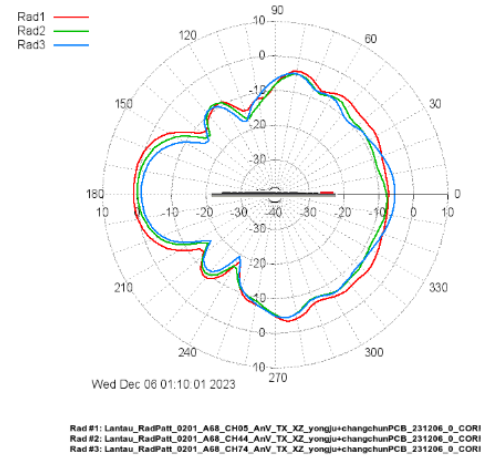
Lantau_RadPatt_0201_A68_CH74_AnH_TX_XZ_yongju+changchunPCB_231206_0_CORR

Average power = **-9.78 dBm**
Front average power = **-9.09 dBm** (From 0 deg to 180 deg)

Min power = **-27.46 dBm** @ 0.00 deg
Max power = **-2.68 dBm** @ 108.00 deg

Delta max power = **-0.57 dBm**
Delta average power = **-0.24 dBm**
Delta front average power = **0.34 dBm**

X-Z Plane: Vertical



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Radiation pattern #1:

Lantau_RadPatt_0201_A68_CH05_AnV_TX_XZ_yongju+changchunPCB_231206_0_CORR

Average power = **-6.70 dBm**
Front average power = **-6.96 dBm** (From 0 deg to 180 deg)

Min power = **-18.16 dBm** @ -117.00 deg
Max power = **0.96 dBm** @ 180.00 deg

Radiation pattern #2:

Lantau_RadPatt_0201_A68_CH44_AnV_TX_XZ_yongju+changchunPCB_231206_0_CORR

Average power = **-8.08 dBm**
Front average power = **-8.37 dBm** (From 0 deg to 180 deg)

Min power = **-16.85 dBm** @ 108.00 deg
Max power = **-0.21 dBm** @ 177.00 deg

Delta max power = **-1.17 dBm**
Delta average power = **-1.38 dBm**
Delta front average power = **-1.41 dBm**

Radiation pattern #3:

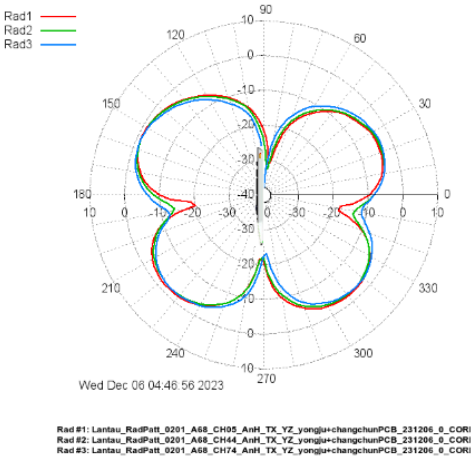
Lantau_RadPatt_0201_A68_CH74_AnV_TX_XZ_yongju+changchunPCB_231206_0_CORR

Average power = **-8.16 dBm**
Front average power = **-8.41 dBm** (From 0 deg to 180 deg)

Min power = **-19.42 dBm** @ -120.00 deg
Max power = **-1.30 dBm** @ 180.00 deg

Delta max power = **-2.26 dBm**
Delta average power = **-1.46 dBm**
Delta front average power = **-1.44 dBm**

Y-Z Plane: Horizontal



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Radiation pattern #1:

Lantau_RadPatt_0201_A68_CH05_AnH_TX_YZ_yongju+changchunPCB_231206_0_CORR

Average power = **-8.54 dBm**
Front average power = **-9.31 dBm** (From 0 deg to 180 deg)

Min power = **-31.24 dBm** @ 81.00 deg
Max power = **-1.37 dBm** @ 153.00 deg

Radiation pattern #2:

Lantau_RadPatt_0201_A68_CH44_AnH_TX_YZ_yongju+changchunPCB_231206_0_CORR

Average power = **-8.37 dBm**
Front average power = **-9.28 dBm** (From 0 deg to 180 deg)

Min power = **-32.68 dBm** @ 84.00 deg
Max power = **-1.40 dBm** @ 156.00 deg

Delta max power = **-0.03 dBm**
Delta average power = **0.17 dBm**
Delta front average power = **0.03 dBm**

Radiation pattern #3:

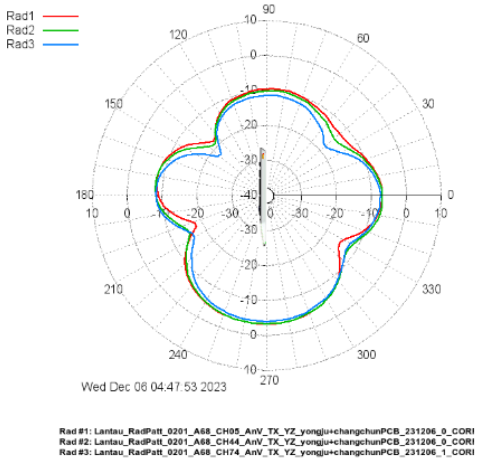
Lantau_RadPatt_0201_A68_CH74_AnH_TX_YZ_yongju+changchunPCB_231206_0_CORR

Average power = **-8.29 dBm**
Front average power = **-9.37 dBm** (From 0 deg to 180 deg)

Min power = **-42.29 dBm** @ 87.00 deg
Max power = **-1.39 dBm** @ 156.00 deg

Delta max power = **-0.02 dBm**
Delta average power = **0.25 dBm**
Delta front average power = **-0.06 dBm**

Y-Z Plane: Vertical



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Radiation pattern #1:

Lantau_RadPatt_0201_A68_CH05_AnV_TX_YZ_yongju+changchunPCB_231206_0_CORR

Average power = **-9.71 dBm**
Front average power = **-11.21 dBm** (From 0 deg to 180 deg)

Min power = **-18.23 dBm** @ 135.00 deg
Max power = **-3.09 dBm** @ -93.00 deg

Radiation pattern #2:

Lantau_RadPatt_0201_A68_CH44_AnV_TX_YZ_yongju+changchunPCB_231206_0_CORR

Average power = **-9.74 dBm**
Front average power = **-11.92 dBm** (From 0 deg to 180 deg)

Min power = **-19.28 dBm** @ 135.00 deg
Max power = **-3.24 dBm** @ -84.00 deg

Delta max power = **-0.15 dBm**
Delta average power = **-0.03 dBm**
Delta front average power = **-0.71 dBm**

Radiation pattern #3:

Lantau_RadPatt_0201_A68_CH74_AnV_TX_YZ_yongju+changchunPCB_231206_1_CORR

Average power = **-10.82 dBm**
Front average power = **-13.51 dBm** (From 0 deg to 180 deg)

Min power = **-22.51 dBm** @ 138.00 deg
Max power = **-3.89 dBm** @ -87.00 deg

Delta max power = **-0.80 dBm**
Delta average power = **-1.11 dBm**
Delta front average power = **-2.30 dBm**