WHA YU INDUSTRIAL CO., LTD.(HEAD OFFICE)

DONGGUAN AEON TECH CO.,LTD.(CHINA)

SPECIFICATION FOR APPROVAL

CUSTOMER:	*星縱智能*	
PART NAME:	*RF Antenna Assembly*	
PART NO.:	*23.005.000000*	*REVISION:*
W. Y. P/NO.:	*C4254-690053-A(SSR2000418)*	*REV.: X1*

	MANUFACTURER SIGNATURE	CUSTOMER SIGNATURE
APPROVED BY :		
DATE :		

WHA YU GROUP

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RF Antenna Assembly

Specification

1. Electrical Properties : With housing/LORA

1.1	Frequency Range	863~870 ,902~928MHz
1.2	Impedance	50Ω Nominal
1.3	VSWR	≤ 3.0：1 Max.
1.4	Return Loss	6.0dB Min.
1.5	Radiation	Omni-directional
1.6	Peak Gain	863~870MHz < 3.69dBi 902~928MHz <3.81dBi
1.7	Cable Loss	0.44 dB Max.
1.8	Polarization	Linear
1.9	Cable	1.13mm Low loss cable
1.10	Connector	I-PEX MHF 4L Connector

3. Physical Properties :

2.1	Operating Temp.	-10℃ ~ +60℃
2.2	Storage Temp.	-10℃ ~ +70℃

RF Antenna Assembly

Specification

1. Electrical Properties : With housing/LTE

1.1	Frequency Range……	703~960 ,1710~2170,2300~2700MHz
1.2	Impedance ……	50Ω Nominal
1.3	VSWR ……	≤ 3.0：1 Max.
1.4	Return Loss……	6.0dB Min.
1.5	Radiation ……	Omni-directional
1.6	Peak Gain……	703~960MHz < 1.17dBi
		1710~2170MHz <4.41dBi
		2300~2700MHz <4.69dBi
1.7	Cable Loss……	0.62 dB Max.
1.8	Polarization……	Linear
1.9	Cable……	1.13 Coaxial Cable
1.10	Connector……	I-PEX MHF Connector

2. Physical Properties :

2.1	Operating Temp. ……	-10℃ ~ +60℃
2.2	Storage Temp. ……	-10℃ ~ +70℃

RF Antenna Assembly

Specification

1. Electrical Properties : With housing/Wi-Fi

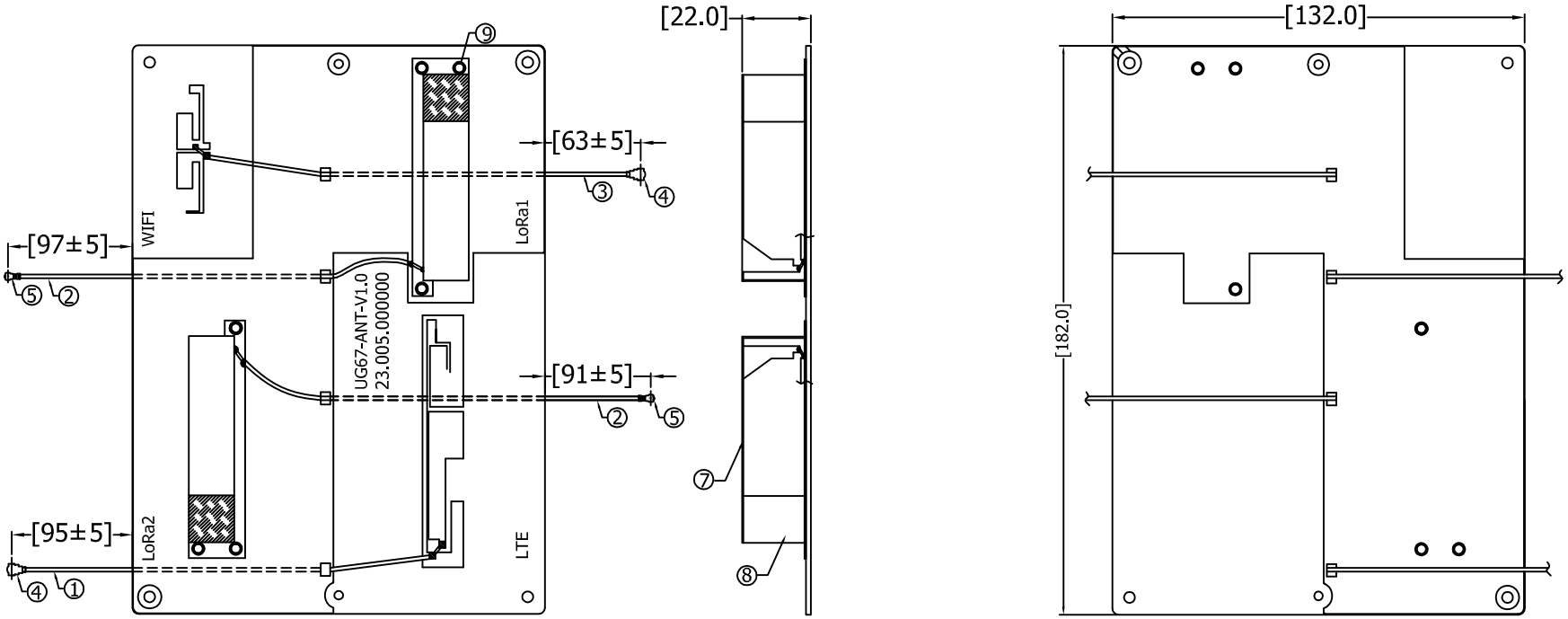
1.1	Frequency Range	2400~2500MHz
1.2	Impedance	50Ω Nominal
1.3	VSWR	≤1.92：1 Max.
1.4	Return Loss	10 dB Min.
1.5	Radiation	Omni-directional
1.6	Peak Gain	6.04dBi
1.7	Cable Loss	0.56 dB Max.
1.8	Polarization	Linear
1.9	Cable	1.13 Coaxial Cable
1.10	Connector	I-PEX MHF Connector

2. Physical Properties :

2.1	Operating Temp.	-10℃ ~ +60℃
2.2	Storage Temp.	-10℃ ~ +70℃

CG-

REV	DATE	DESCRIPTION
X1	12/29-2020	New Issue



NOTE:詳細包裝參見SOP

NO		DESCRIPTION	Q'TY	REMARK
9	RIVET	Aluminum 5052	6	
8	泡棉雙面背膠	EVA+G4000	2	
7	PIFA	SUS430,Plated Ni,T=0.4mm	2	
6	PCB	FR4;64mil;1/2oz,Black	1	
5	Connector	I-PEX MHF 4L Plug	2	
4	Connector	I-PEX MHF Plug	2	
3	CABLE	⌀1.13mm cable ; Color :White[白色]	1	
2	CABLE	⌀1.13mm Low loss cable ; Color :Gray[灰色]	2	
1	CABLE	⌀1.13mm cable ; Color :Black[黑色]	1	

XX.	±5.0	APPROVED	CUSTOMER:	星縱智能		
X.	±3.0	Spring	PART NO :	23.005.000000		
.X	±1.0	CHECKED	PART NAME:	RF Antenna Assembly		
.XX	±0.5		W.Y P/NO :	C4254-690053-A		
.XXX	±0.2	DRAWING	REV	UNIT	FILE :	SSR2000418
		shuhua	X1	mm	SHEET :	1/1

CUSTOMER'S SINGATURE

M.gear Wha Yu Group

TNP-20010
Antenna Test Report

Version: v 1.4
Released Date: 2020/10/08
Prepared By: James
Reviewed By: Daniel

M.gear
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Contents

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- Conclusion & Comments
- Specification
- Antenna Placement & Solution
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- VSWR Results
- Isolation Results
- Test Setup for Radiation Pattern Measurement
- 2D Radiation Pattern Results
- 3D Radiation Pattern Results
- Results Summary (VSWR, isolation, peak gain, efficiency)

Revision History

Released Date	Version	Revised Records
2020/04/30	1.0	Antenna Test Report
2020/06/12	1.1	Antenna tuning with new clearance area
2020/06/17	1.2	Improve gain, efficiency and isolation of LORA antenna
2020/10/08	1.3	Change lora-1 direction
2021/01/08	1.4	Change lora-2 direction

Summary & Comments

Antenna Performance Summary

- VSWR, peak gain and efficiency of antenna meet specification.
- Gain and radiation efficiency of LORA Antenna were enhanced in v1.4

Comments for Further Improvement

To be confirmed by the customer

Specification

Requirements of Antenna Design

RF Function	Number of ANT	Frequency Band	Remark
LORA	2	863~870 / 902~928 MHz	
LTE	1	703~960 / 1710~2170 / 2300~2700MHz	
Wi-Fi	1	2400~2500 MHz	

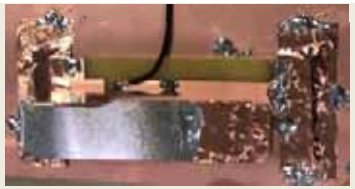
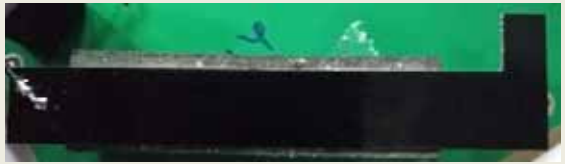
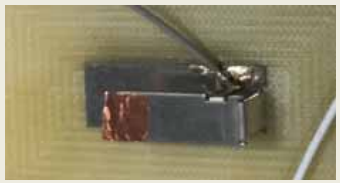
Requirements of Measurement

Test Item		Specification	Remark
VSWR	LORA	≤ 3.0	
	LTE	≤ 3.0	
	Wi-Fi	≤1.92	
Isolation		≤ -15dB	
Peak Gain		TBD	
Efficiency		TBD	
Radiation Pattern			

Antenna Placement & Solution

Antenna	ANT Type	Size (L * W * H)	Cable Length (mm)	Cable Type
LORA_ANT1	PIFA	66*20*15.3mm	200mm	Φ=1.13
LORA_ANT2	PIFA	66*20*15.3mm	200mm	Φ=1.13
LTE_ANT1	PCB	80.6*15*1.6mm	200mm	Φ=1.13
2G_ANT1	PCB	40*10.5*1.6mm	180mm	Φ=1.13

Antenna Placement & Solution

Antenna	Previous Version	
LORA_ANT1		
LORA_ANT2		
LTE_ANT1		
2G_ANT1		

Antenna Placement & Solution

Antenna	Previous Version	Previous Version	Current Version
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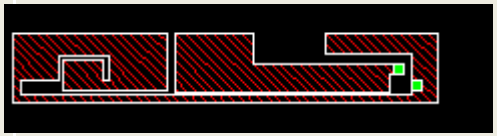
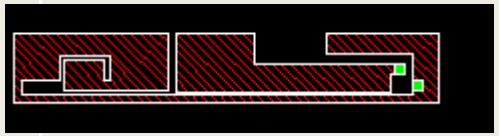
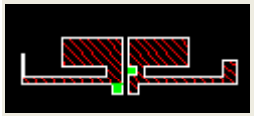
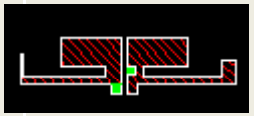
LORA_ANT2			
LTE_ANT1			
2G_ANT1			

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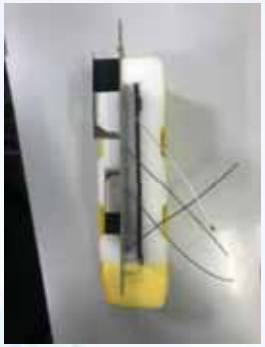
Test Setup for S-parameter Measurement

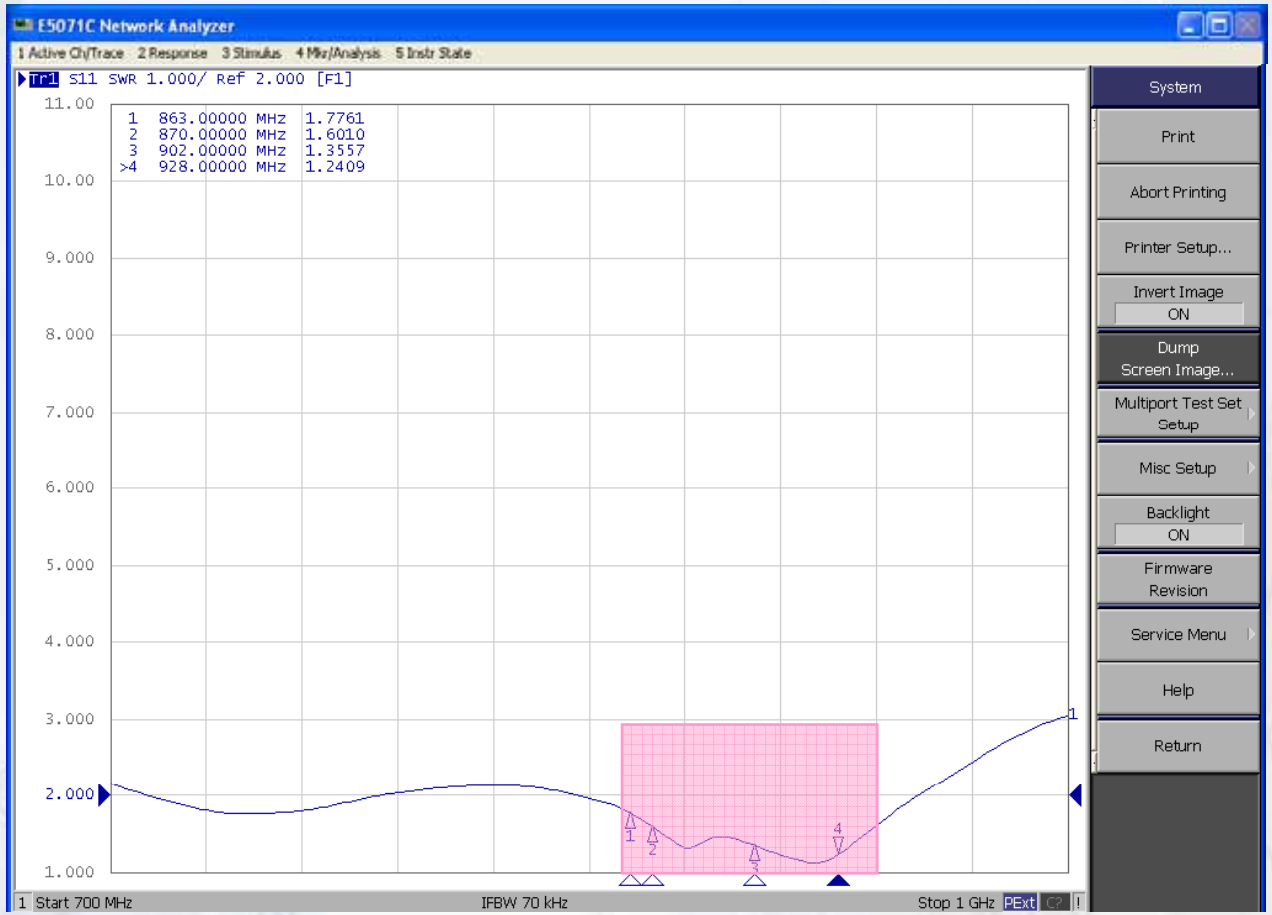
Equipment	Brand	Model
Network Analyzer	Keysight	E5071C



Antenna — RF Cable (1.13mm) with MHF Conn. — Network Analyzer

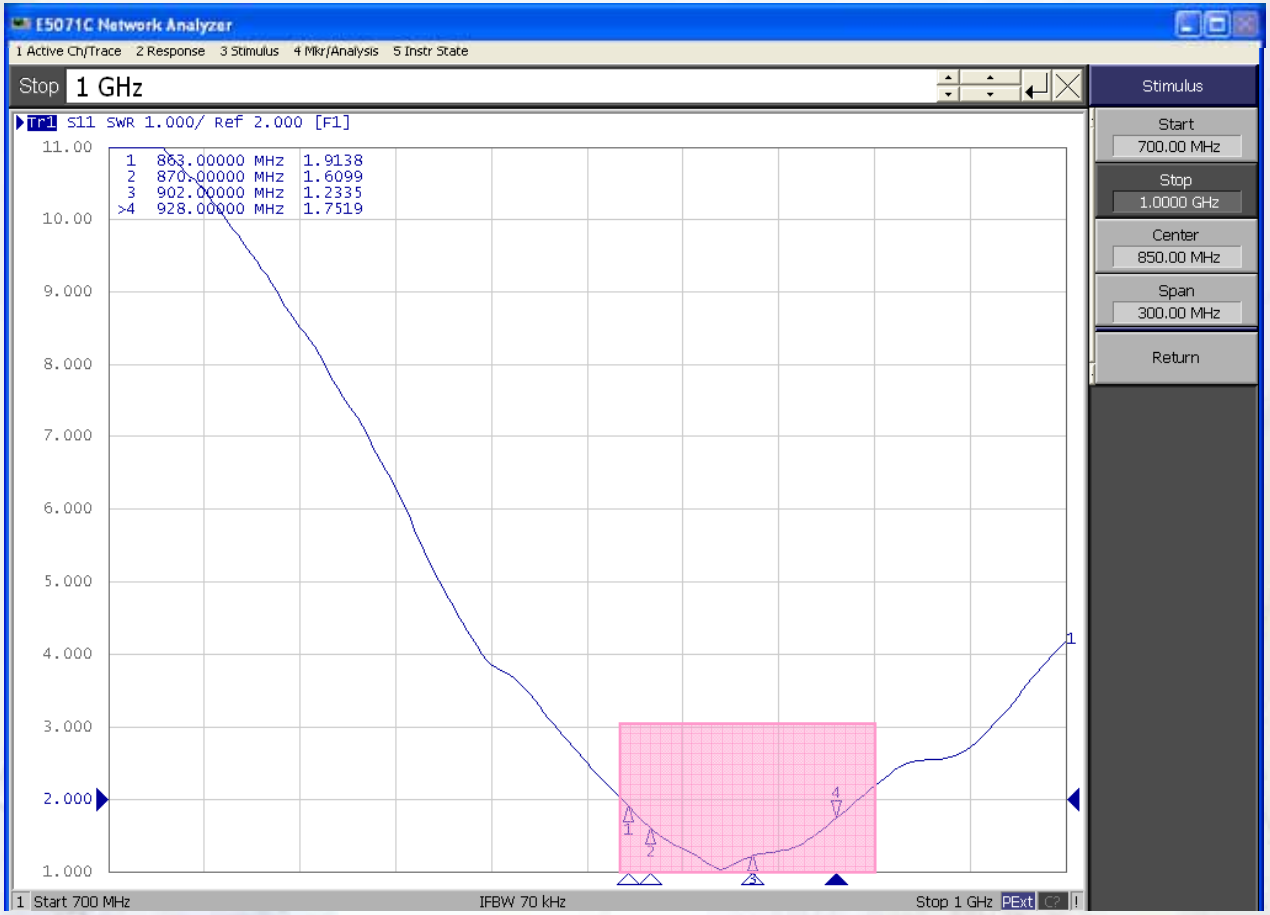
VSWR Results

LORA_ANT1 (868-870/902-928MHz) (Criterion: ≤3.0)



VSWR Results

LORA_ANT2 (868-870/902-928MHz) (Criterion: ≤3.0)



VSWR Results

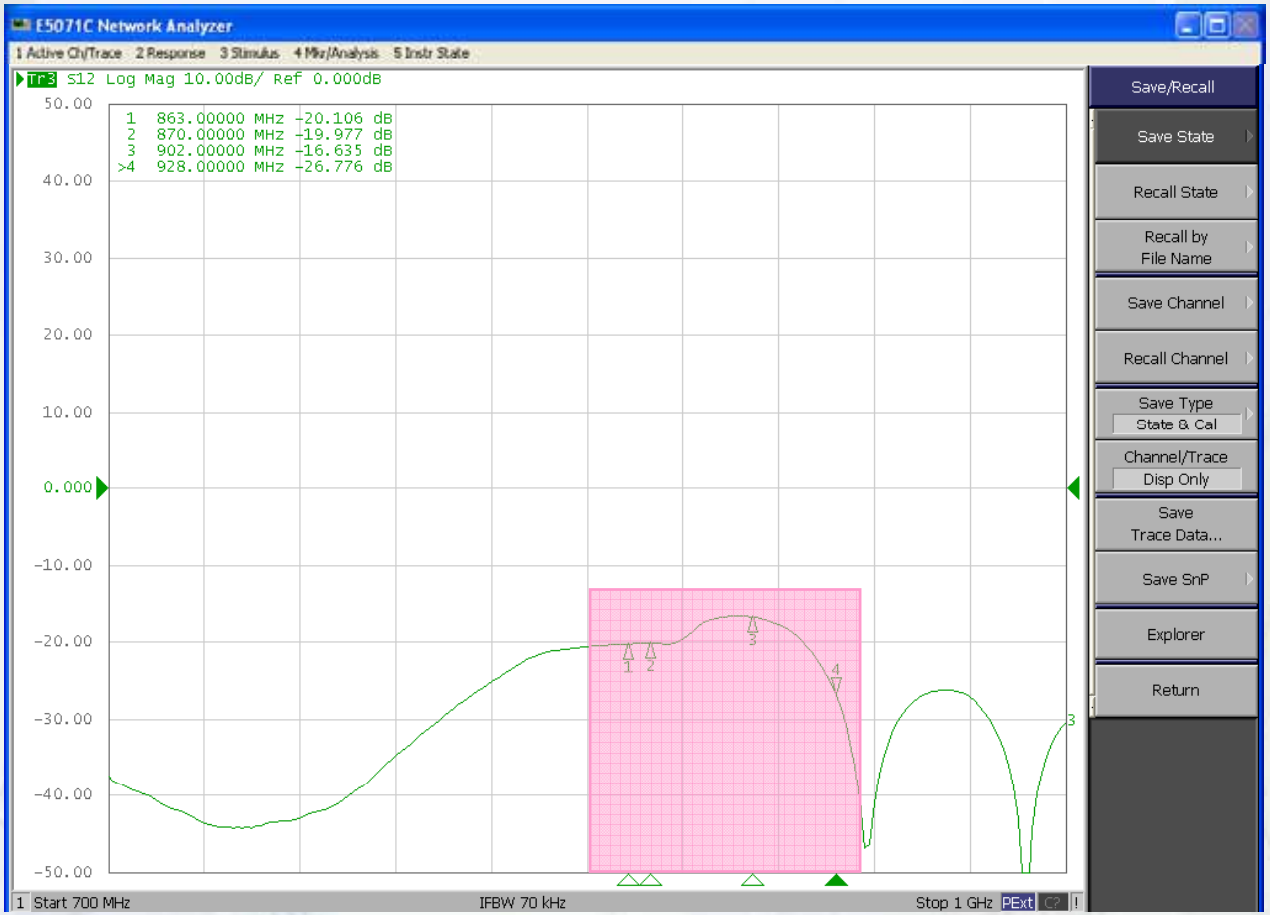
LTE_ANT1 (703~960 / 1710~1880 / 1920~2170 / 2300~2700 MHz) (Criterion: ≤3.0)

VSWR Results

2G_ANT1 (2400-2500MHz) (Criterion: ≤1.92)

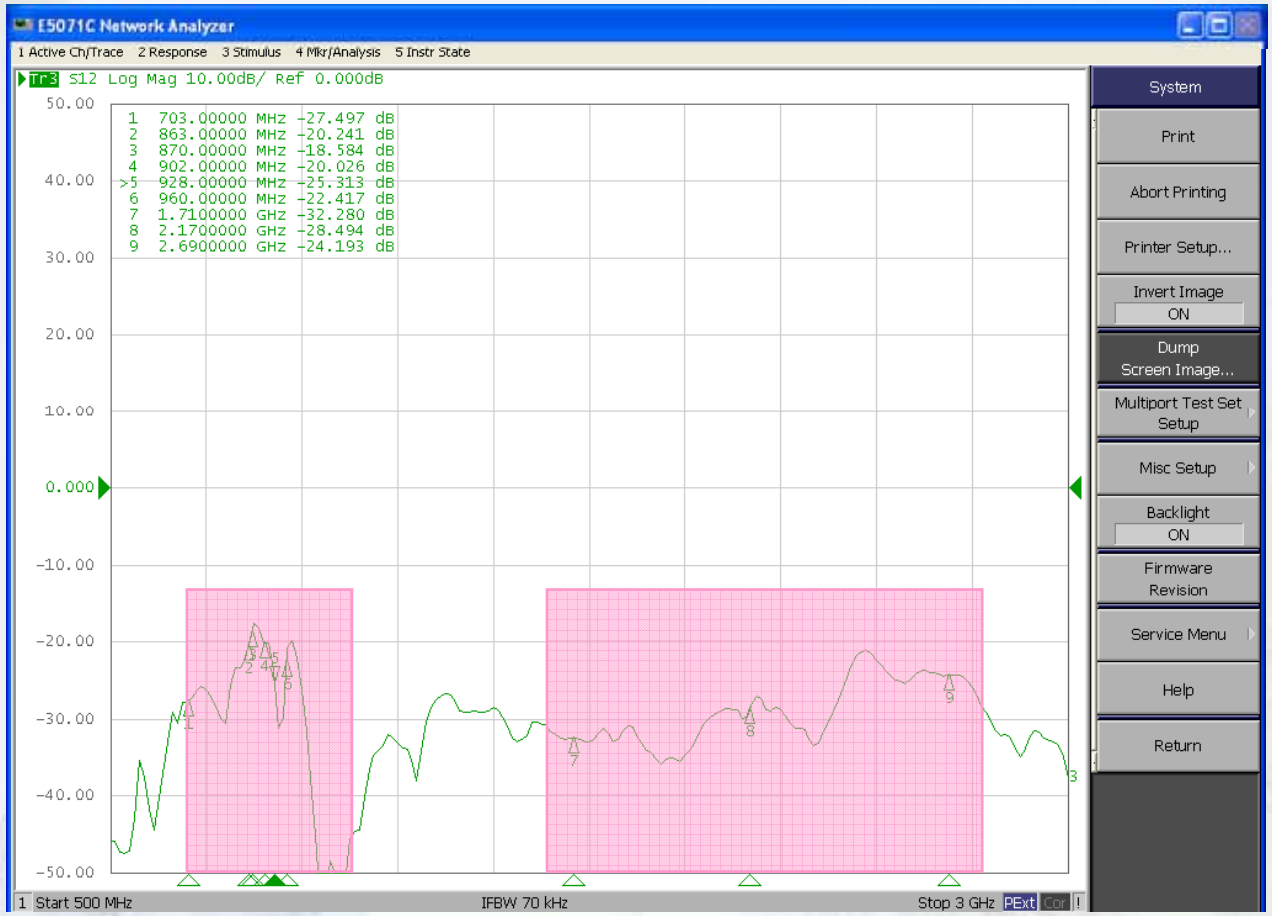
Isolation Results

LORA_ANT1 & LORA_ANT2 (Criterion: ≤ -15dB)



Isolation Results

LORA_ANT1 & LTE_ANT1 (Criterion: ≤ -15dB)

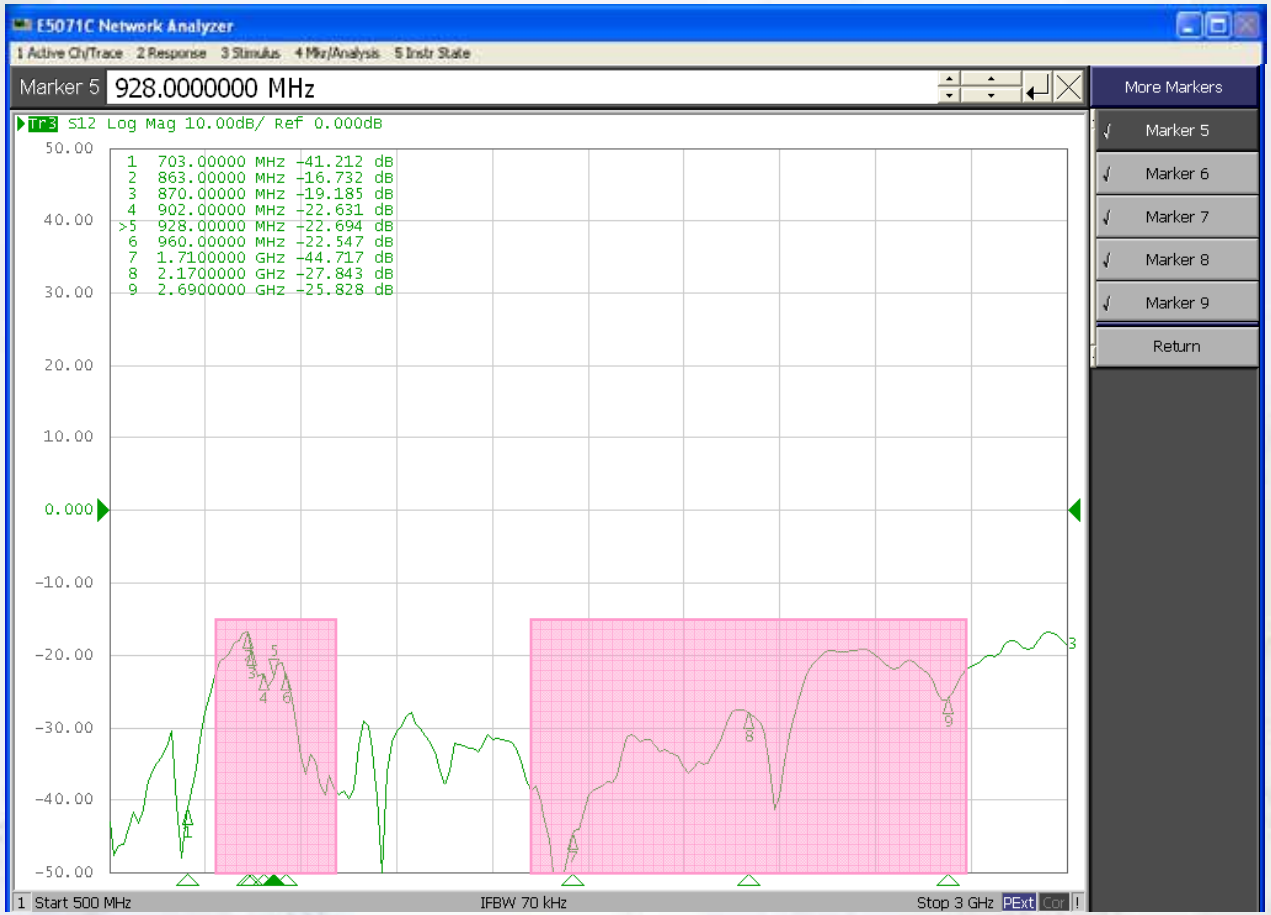


Isolation Results

LORA_ANT1 & 2G_ANT1 (Criterion: ≤ -15dB)

Isolation Results

LORA_ANT2 & LTE_ANT1 (Criterion: ≤ -15dB)

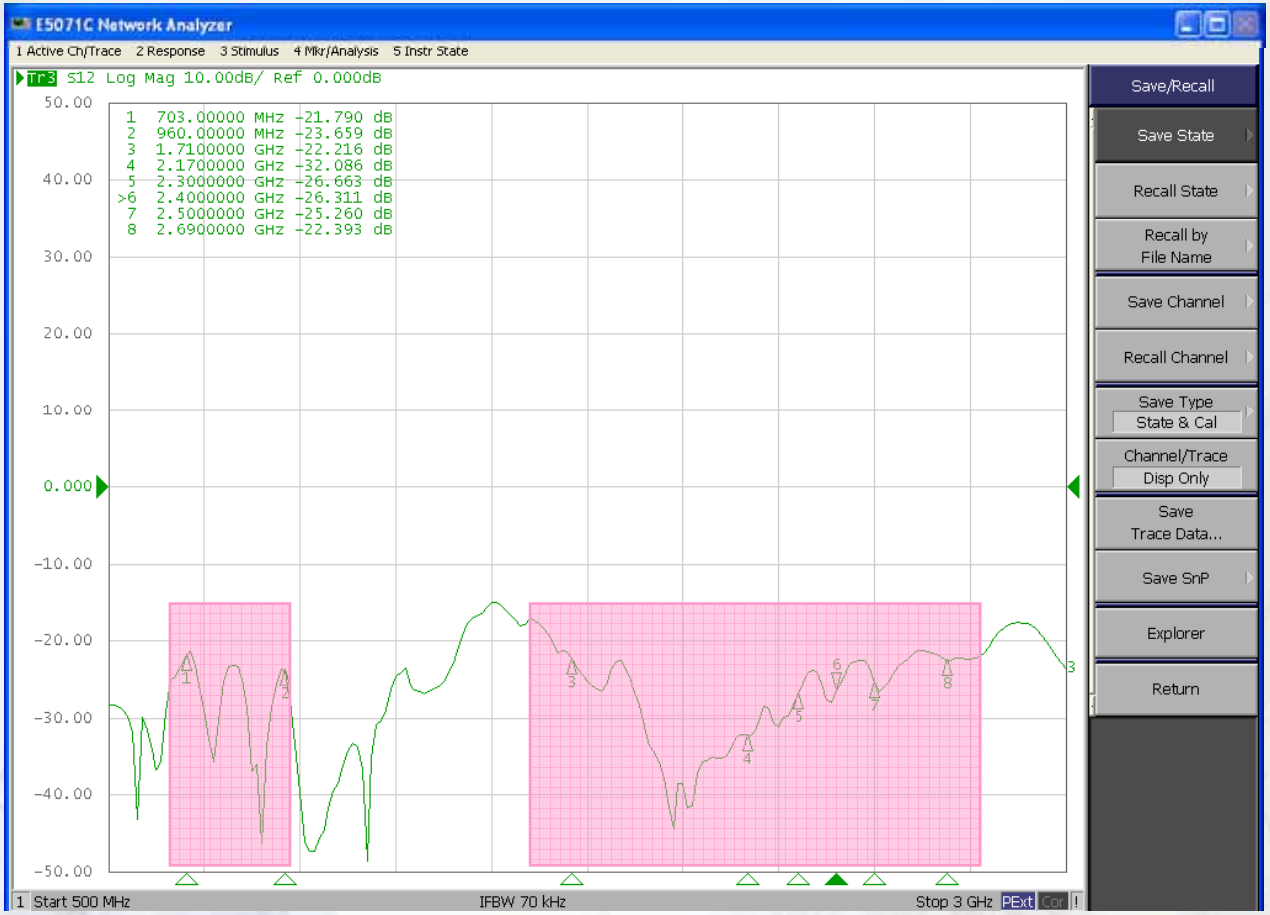


Isolation Results

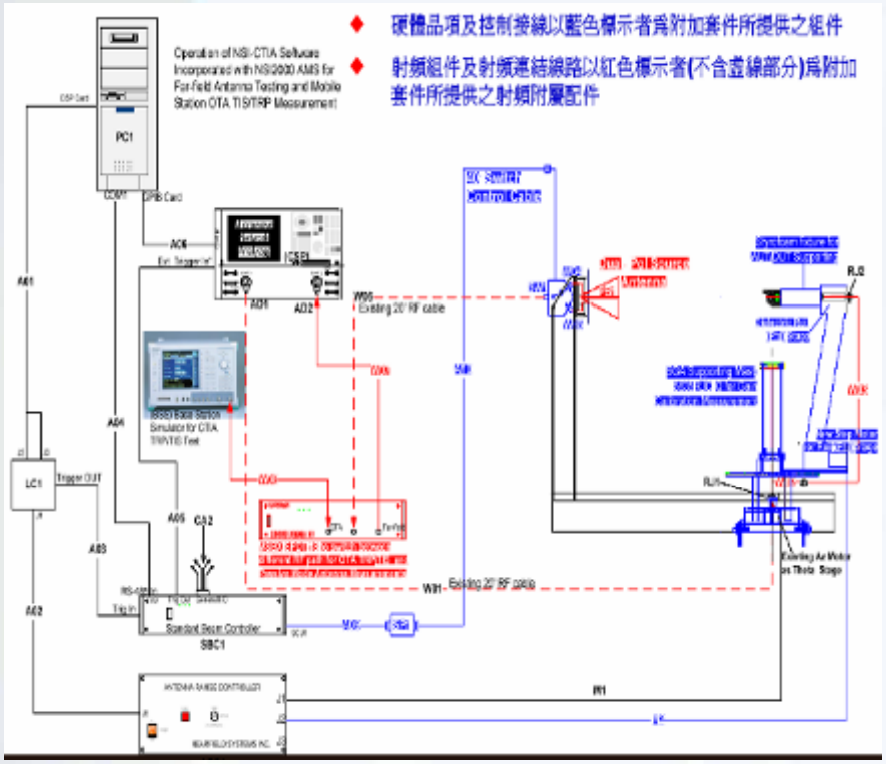
LORA_ANT2 & 2G_ANT1 (Criterion: ≤ -15dB)

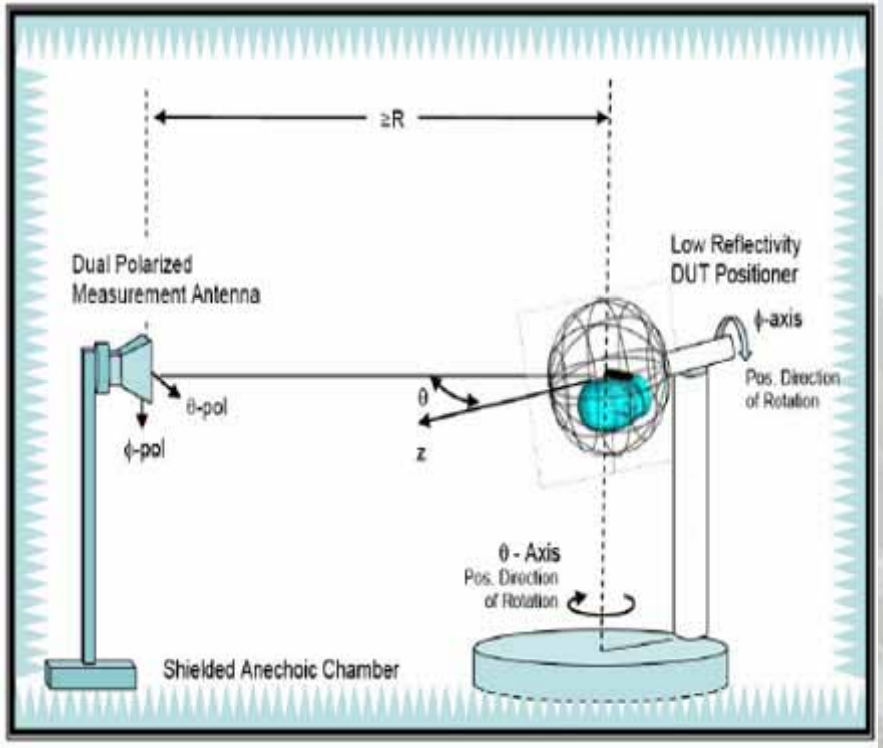
Isolation Results

LTE_ANT1 & 2G_ANT1 (Criterion: ≤ -15dB)



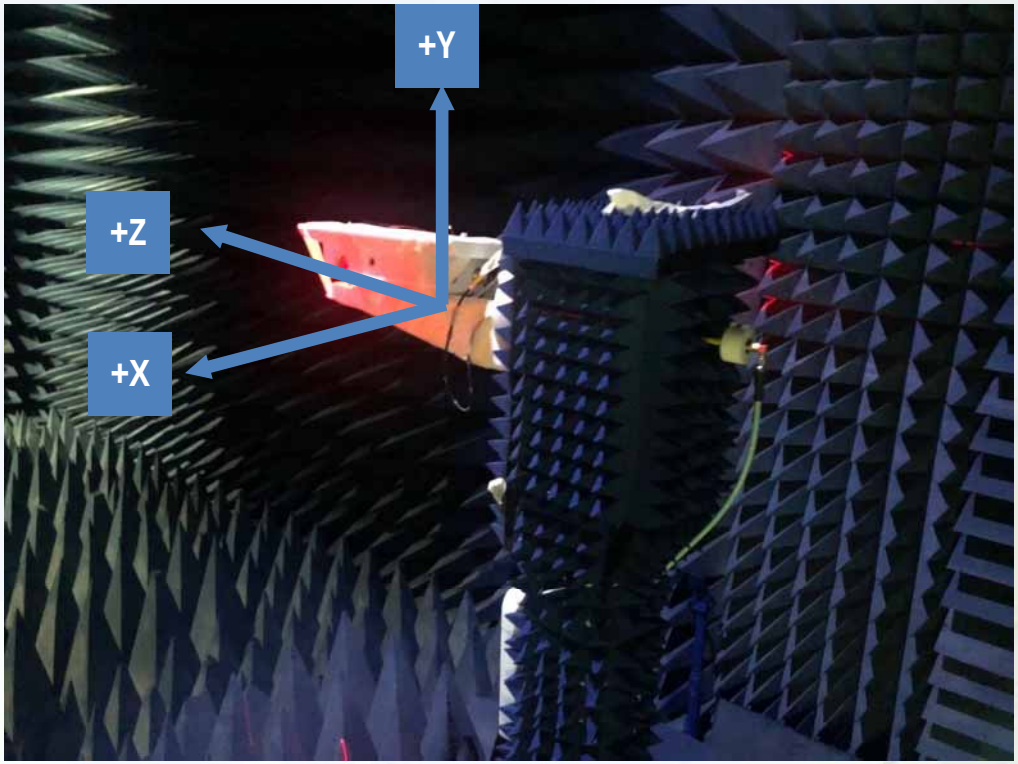
Chamber Information



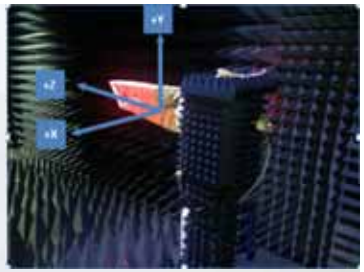


Chamber	Brand	Model	Location
WavePro	WavePro	FFC-700	China, Dongguan

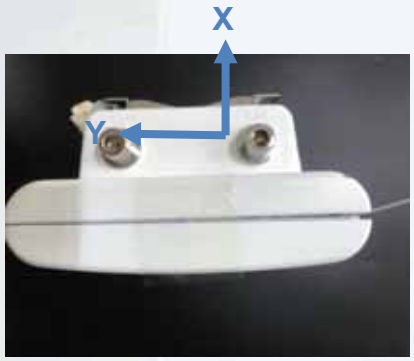
Test Setup for Radiation Pattern Measurement

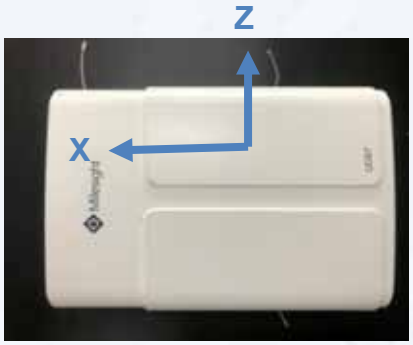


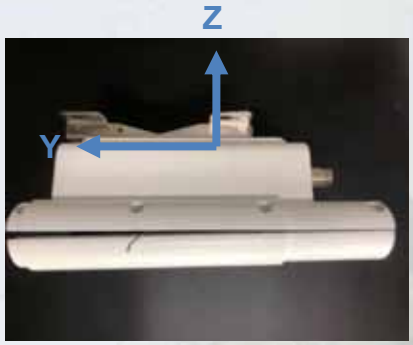
2D Radiation Pattern Results



LORA_ANT1







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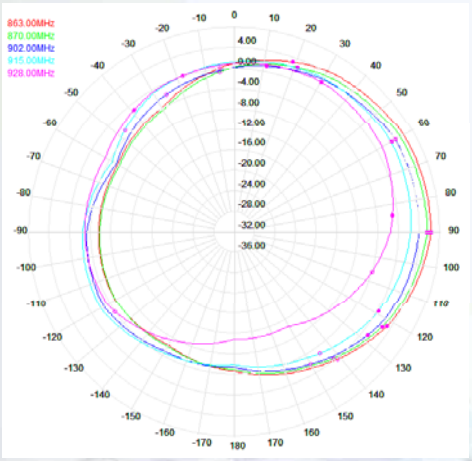

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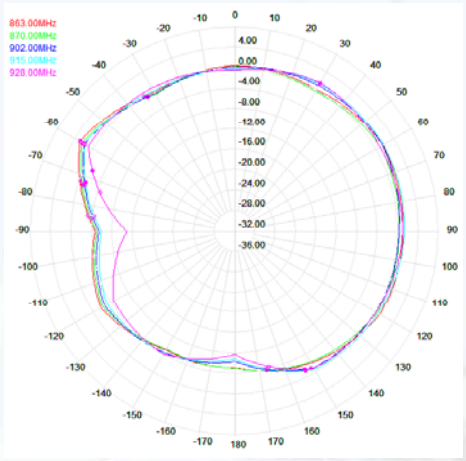

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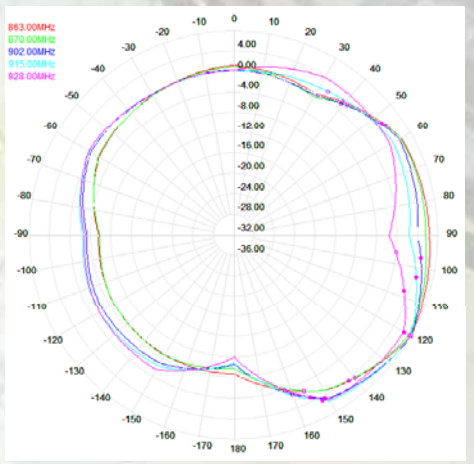

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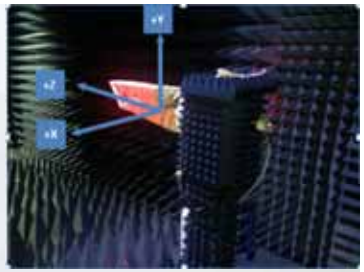
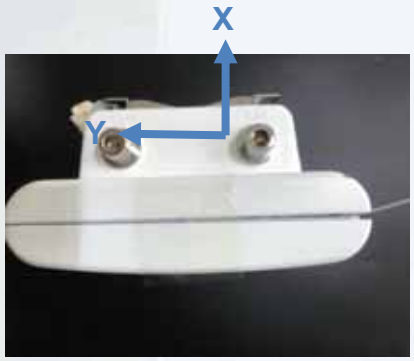
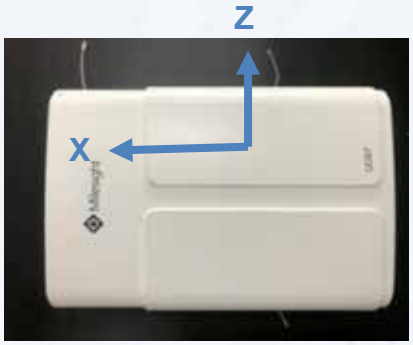
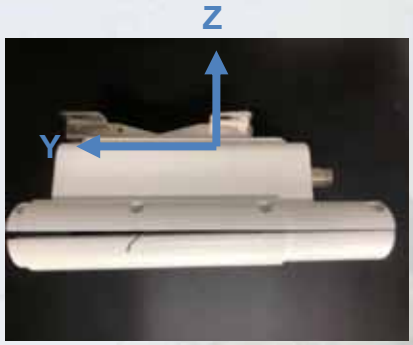
2D Radiation Pattern Results



LORA_ANT2







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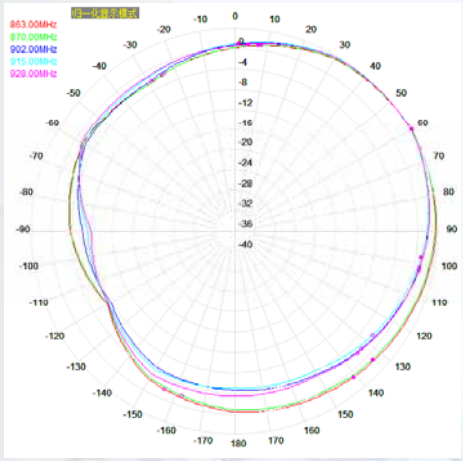

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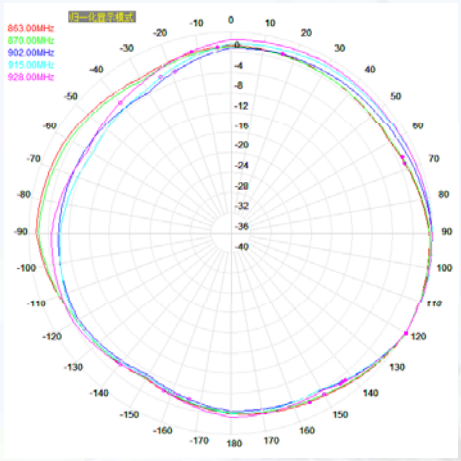

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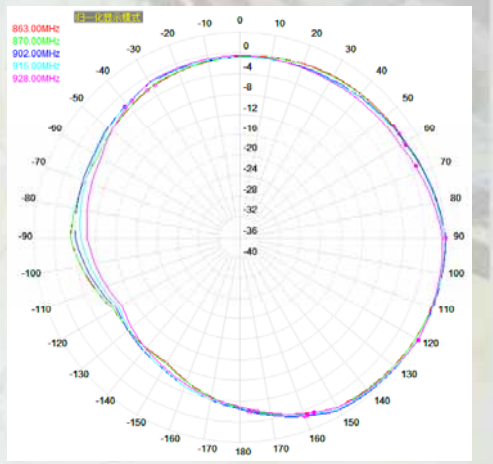

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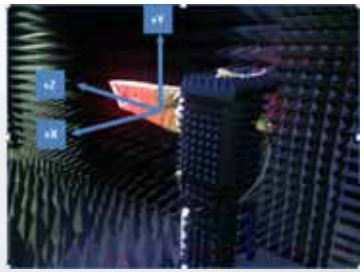
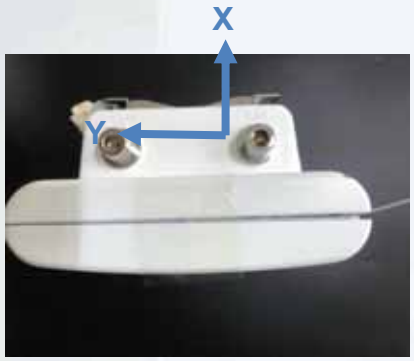
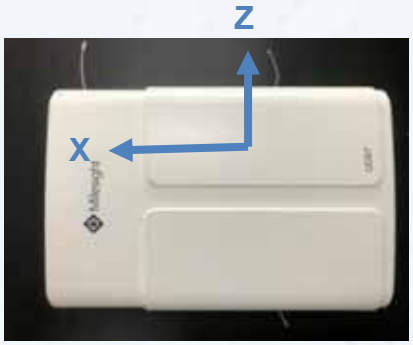
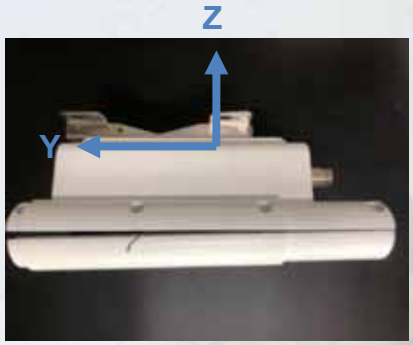
2D Radiation Pattern Results



LTE_ANT1







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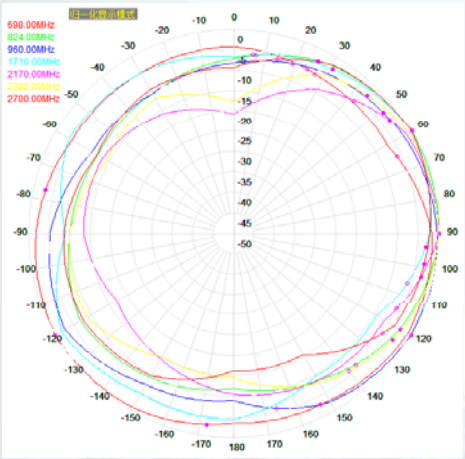

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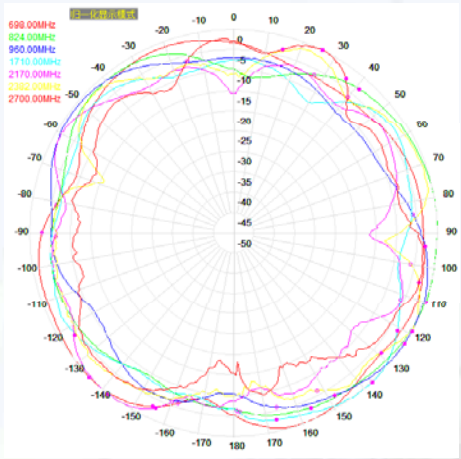

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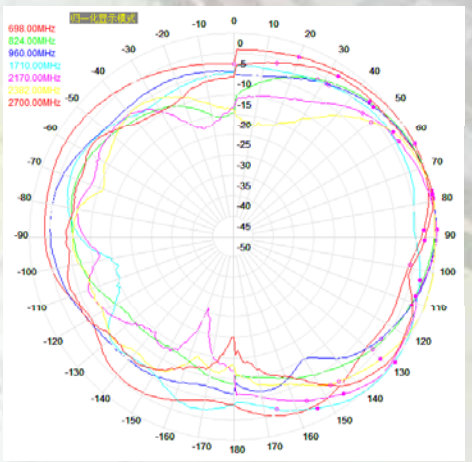
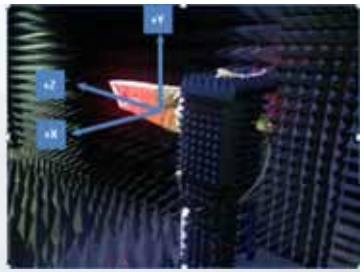
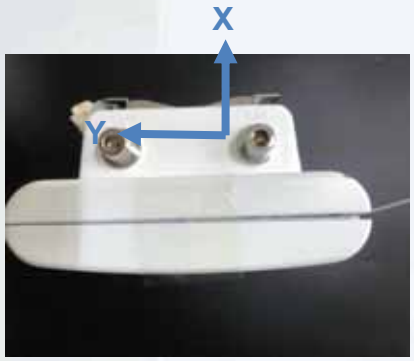
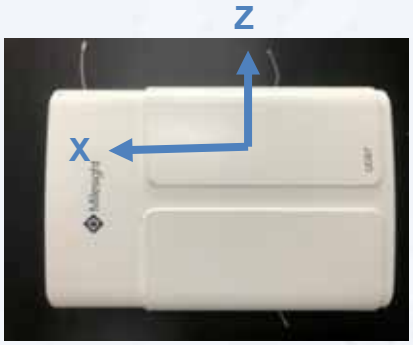


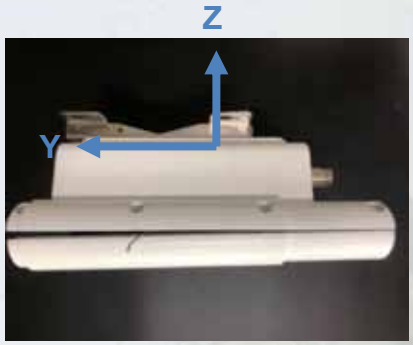
2D Radiation Pattern Results



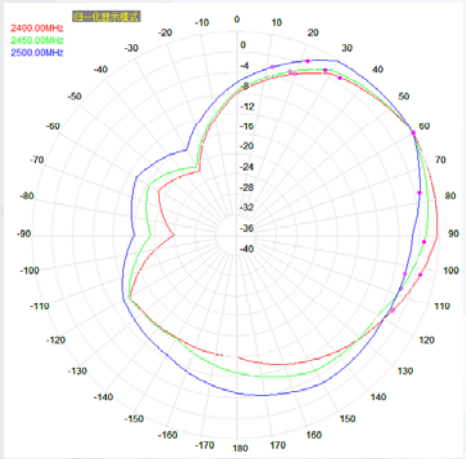
2G_ANT1



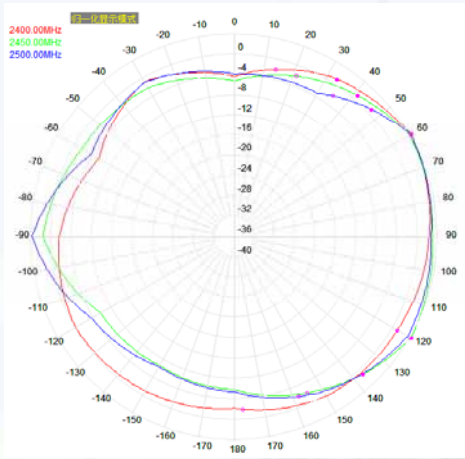




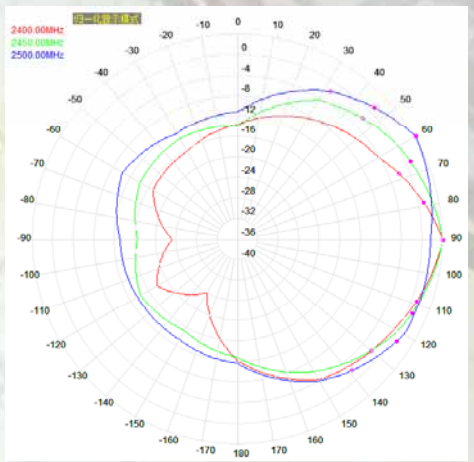
XY



XZ



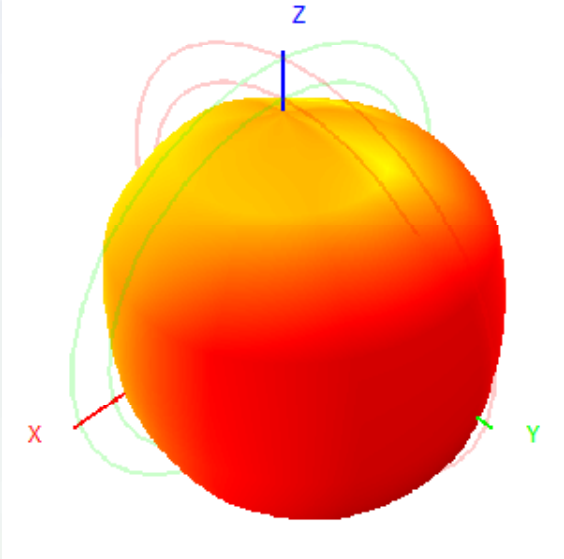
YZ



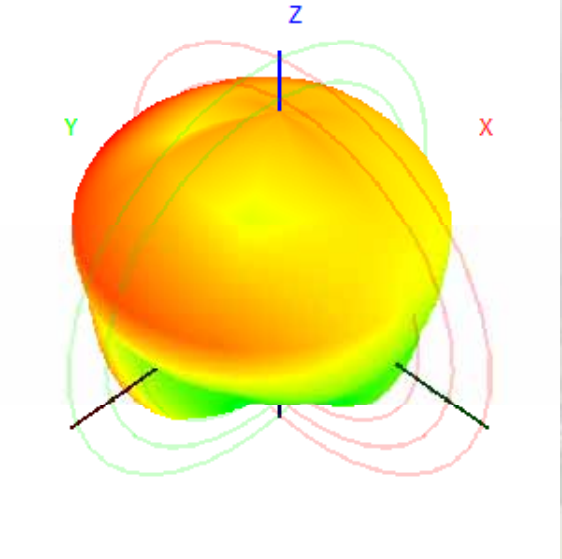
3D Radiation Pattern Results

LORA_ANT1, 863 MHz

Front View



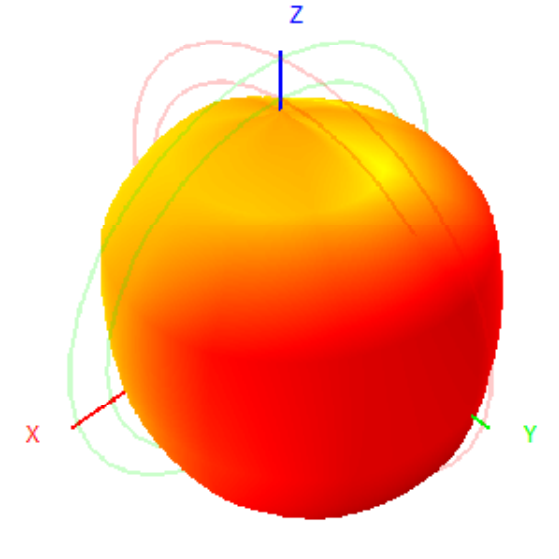
Back View



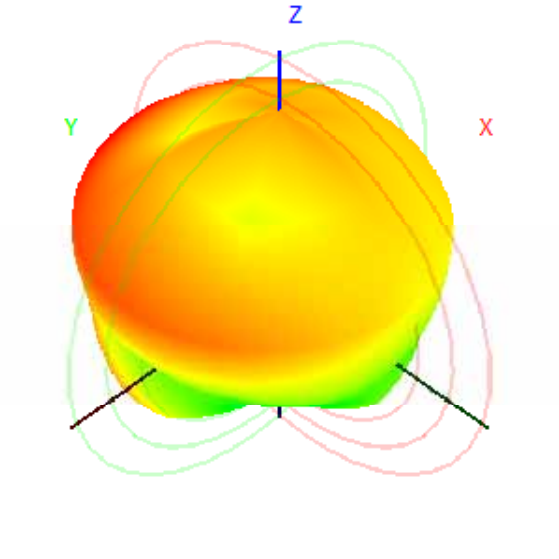
3D Radiation Pattern Results

LORA_ANT1, 870 MHz

Front View



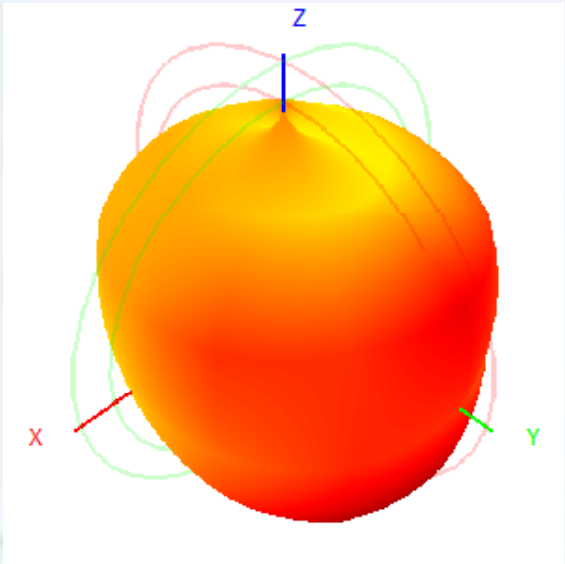
Back View



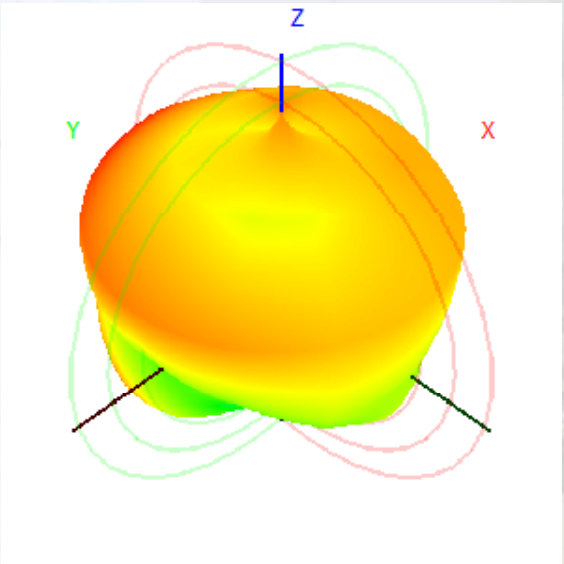
3D Radiation Pattern Results

LORA_ANT1, 902MHz

Front View



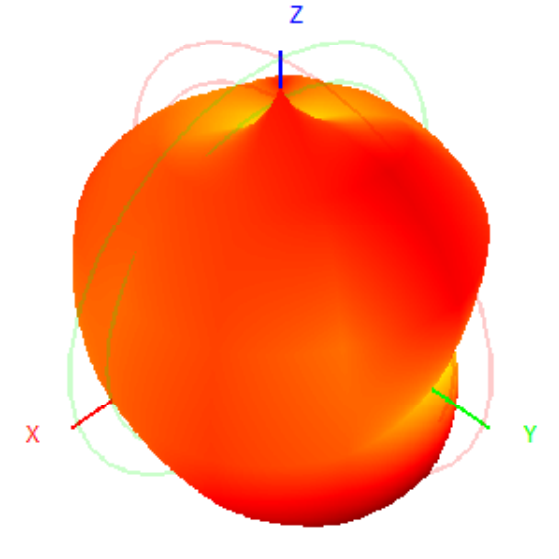
Back View



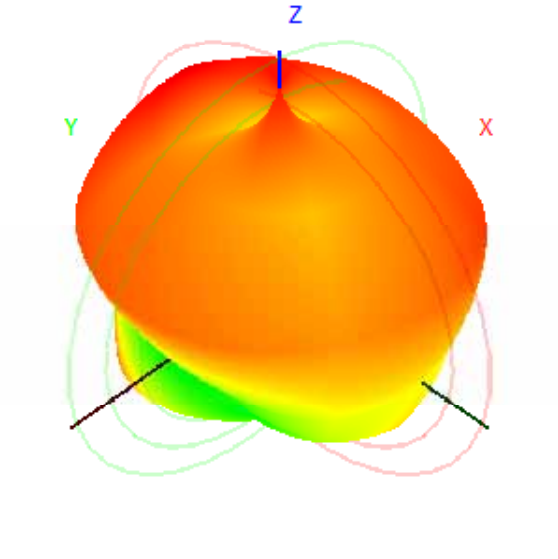
3D Radiation Pattern Results

LORA_ANT1, 928 MHz

Front View



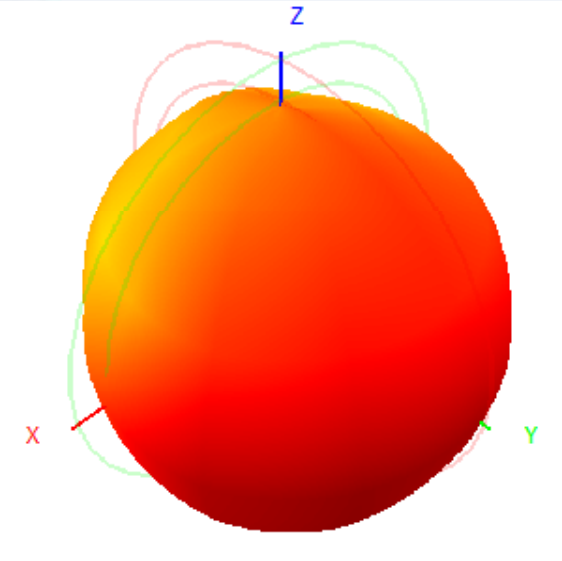
Back View



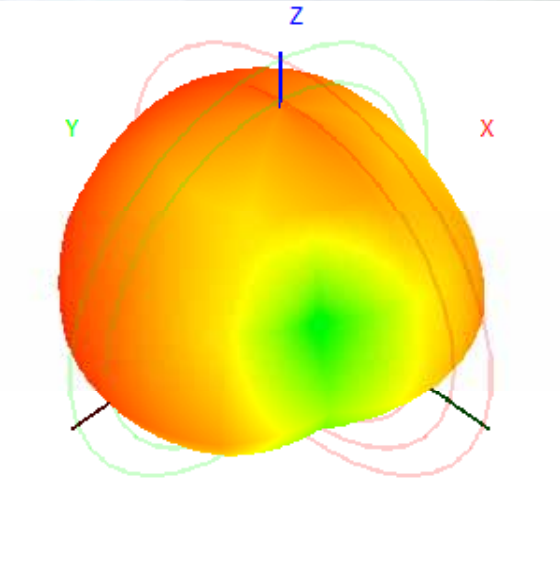
3D Radiation Pattern Results

LORA_ANT2, 863MHz

Front View



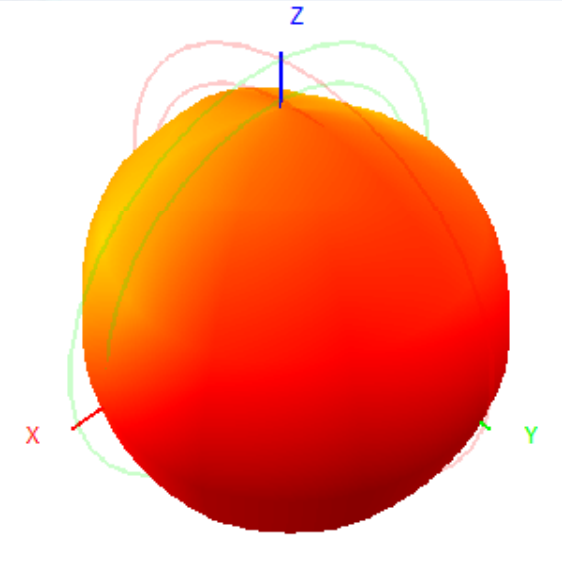
Back View



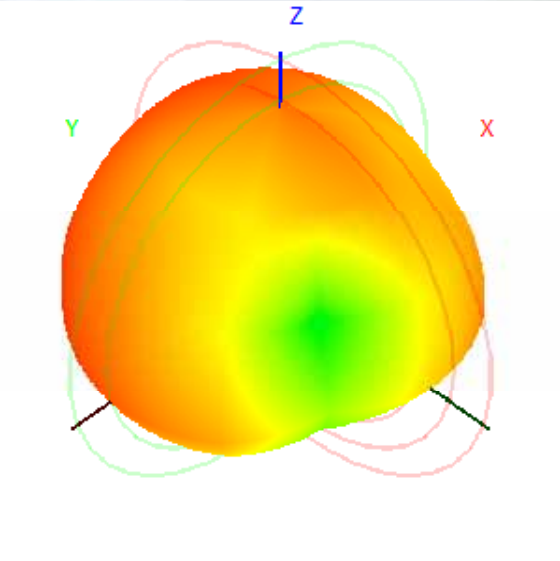
3D Radiation Pattern Results

LORA_ANT2, 870 MHz

Front View



Back View



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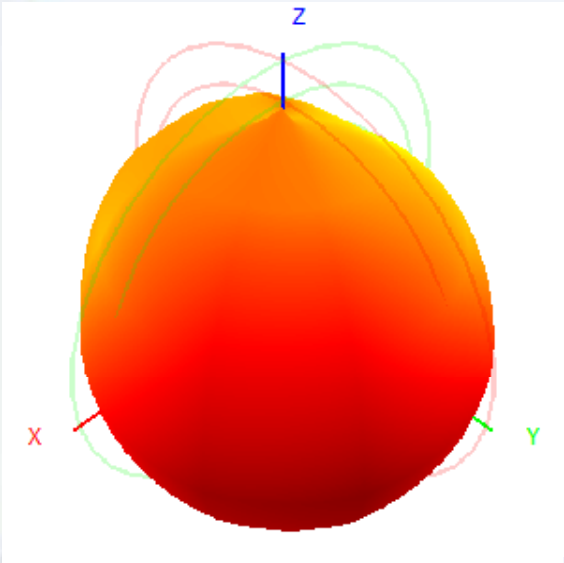
Website : www.whayu.com
E-mail : market@whayu.com

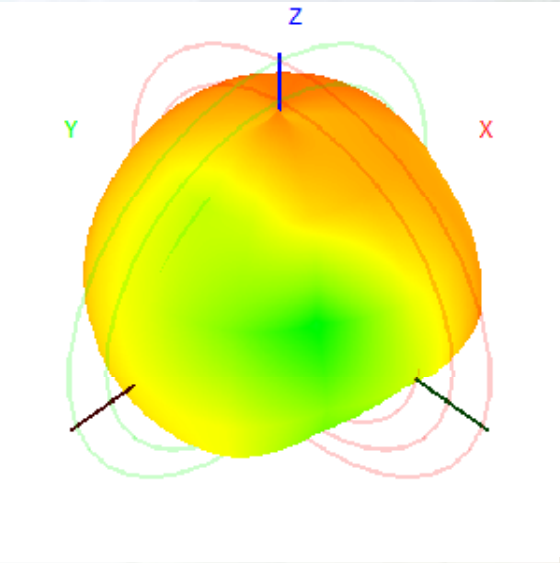
3D Radiation Pattern Results

LORA_ANT2, 902MHz

Front View



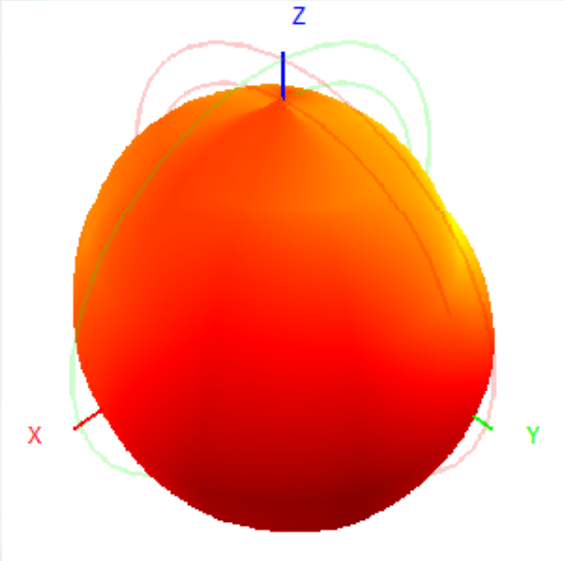
Back View



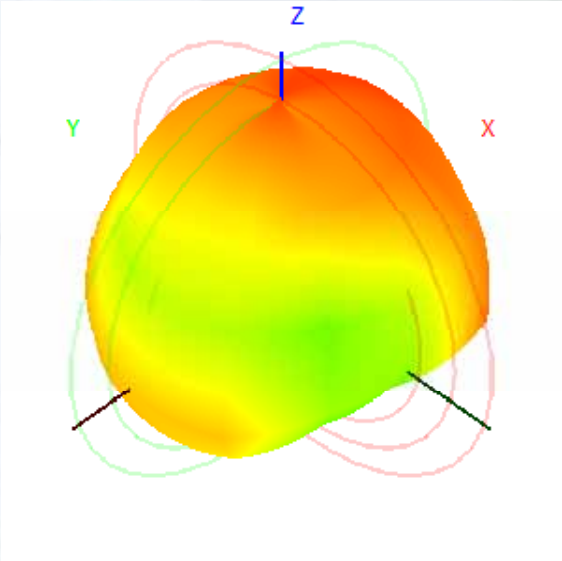
3D Radiation Pattern Results

LORA_ANT2, 928 MHz

Front View



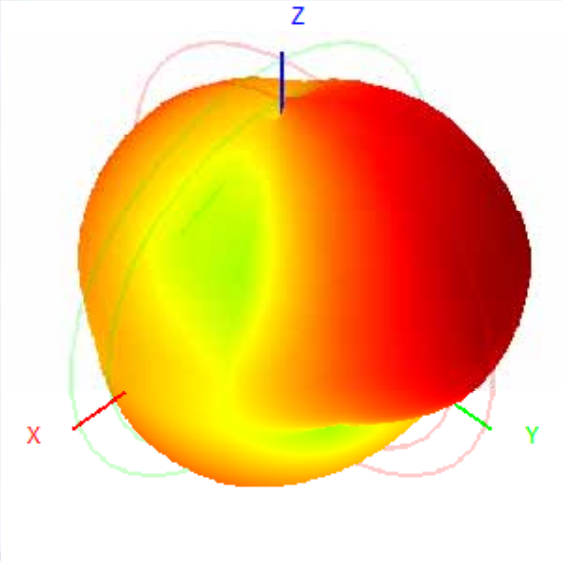
Back View



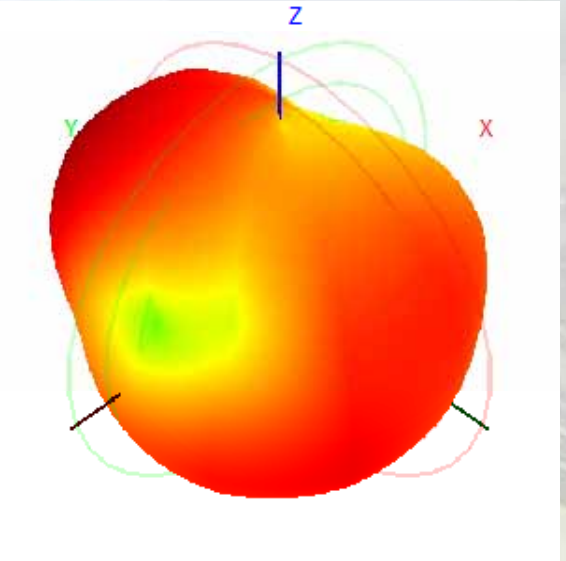
3D Radiation Pattern Results

LTE_ANT1, 703MHz

Front View



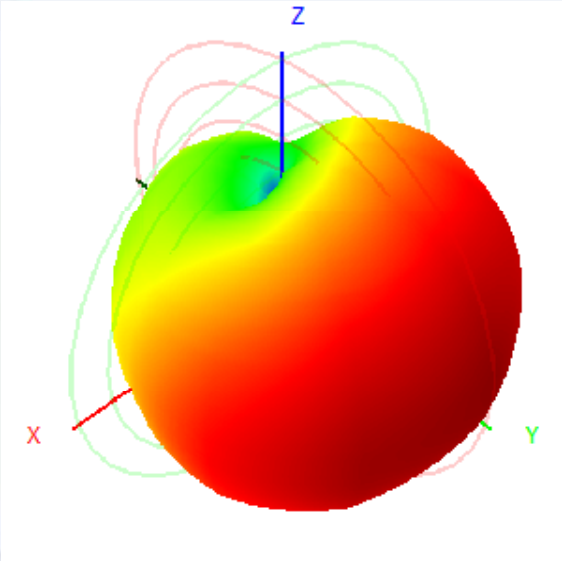
Back View



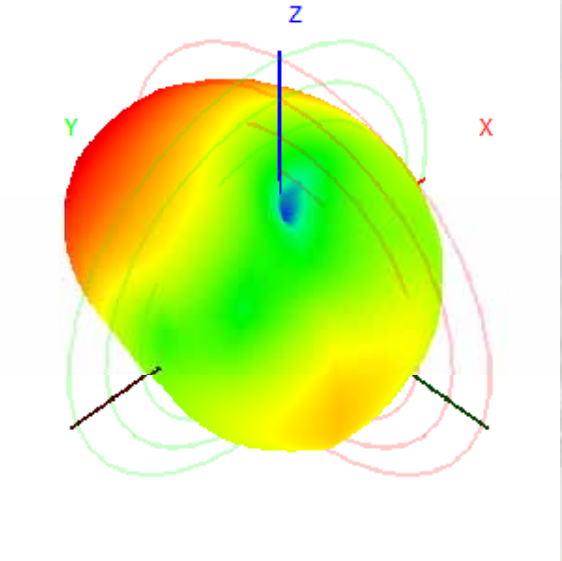
3D Radiation Pattern Results

LTE_ANT1, 824MHz

Front View



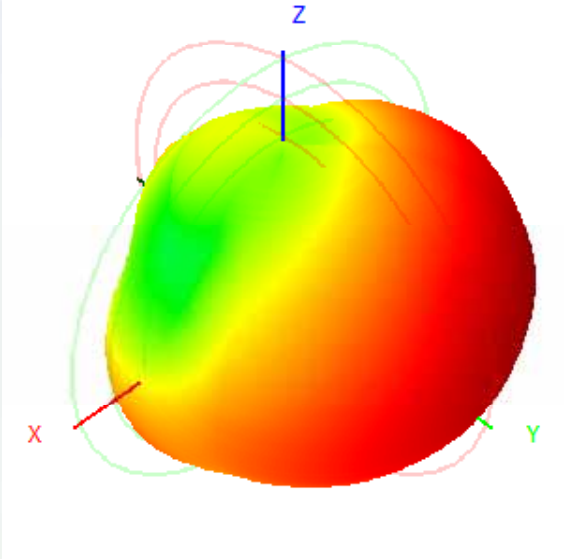
Back View



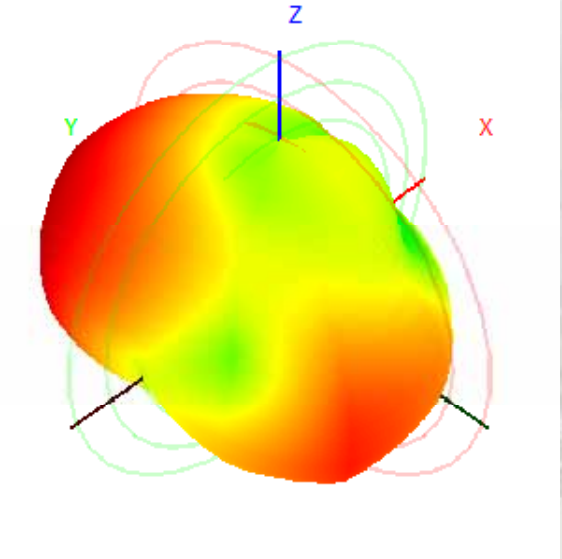
3D Radiation Pattern Results

LTE_ANT1, 960 MHz

Front View



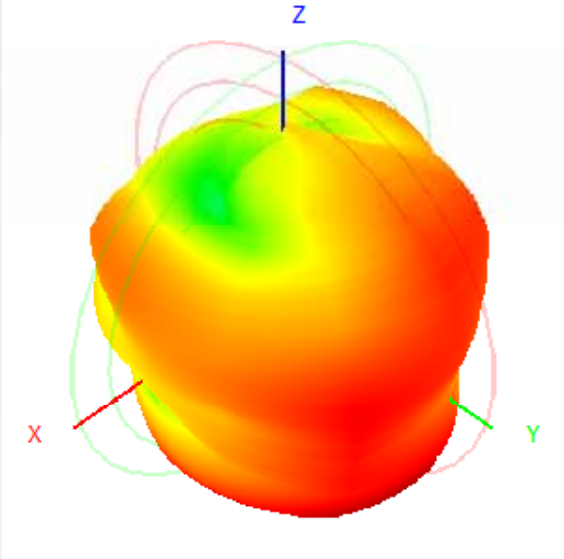
Back View



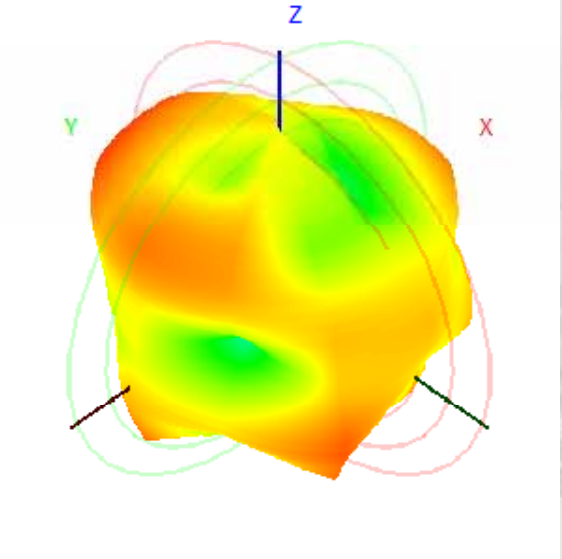
3D Radiation Pattern Results

LTE_ANT1, 1710MHz

Front View



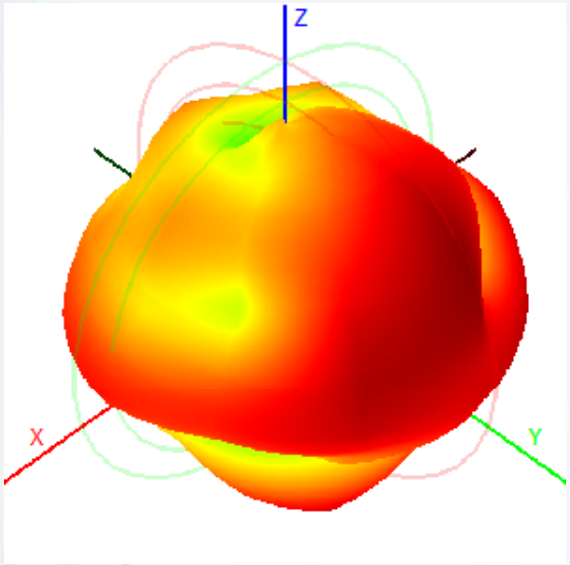
Back View



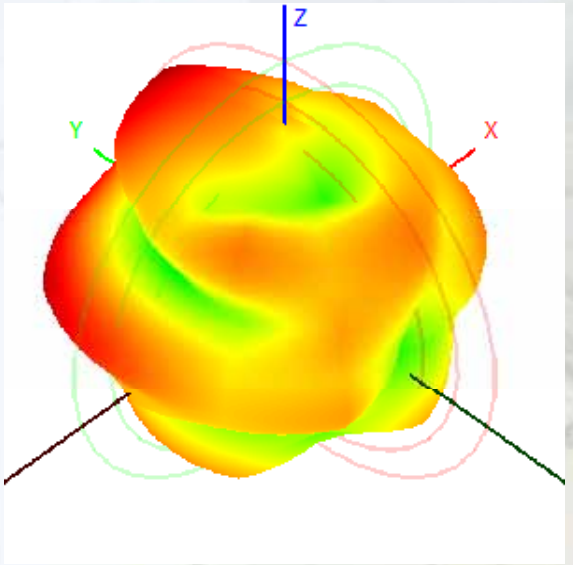
3D Radiation Pattern Results

LTE_ANT1, 2170 MHz

Front View



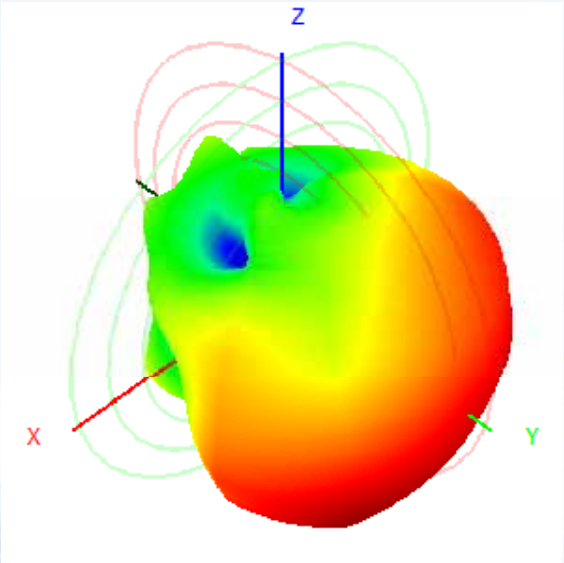
Back View



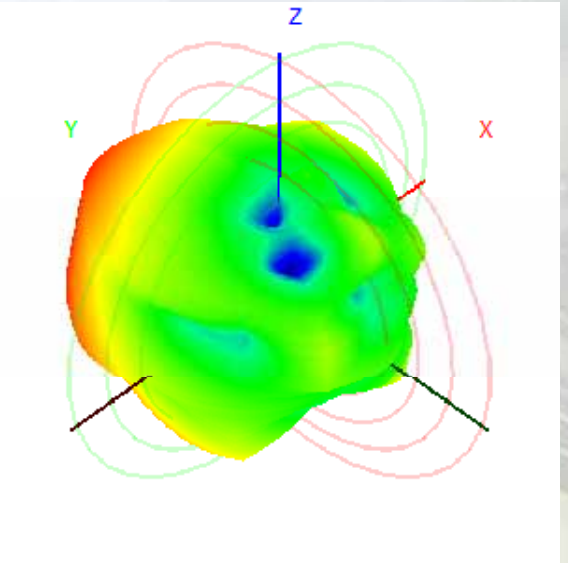
3D Radiation Pattern Results

LTE_ANT1, 2300 MHz

Front View



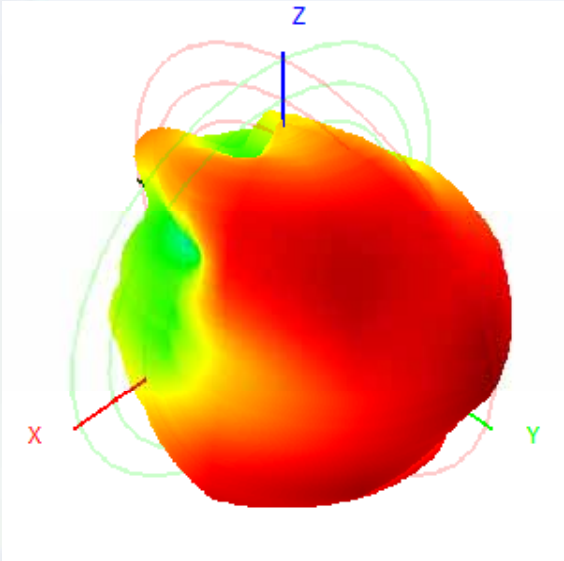
Back View



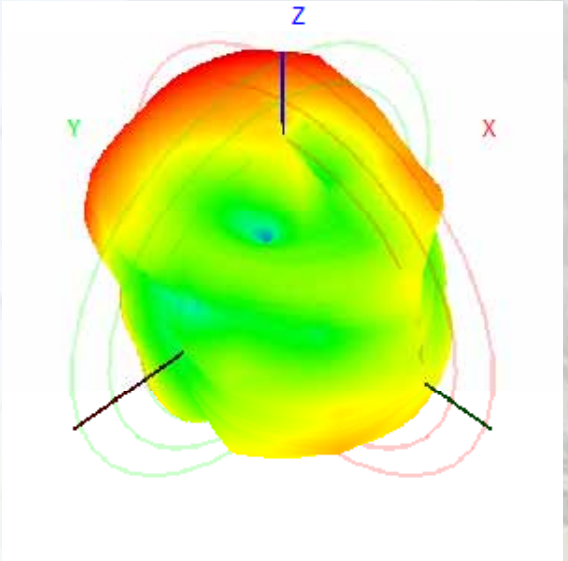
3D Radiation Pattern Results

LTE_ANT1, 2700 MHz

Front View



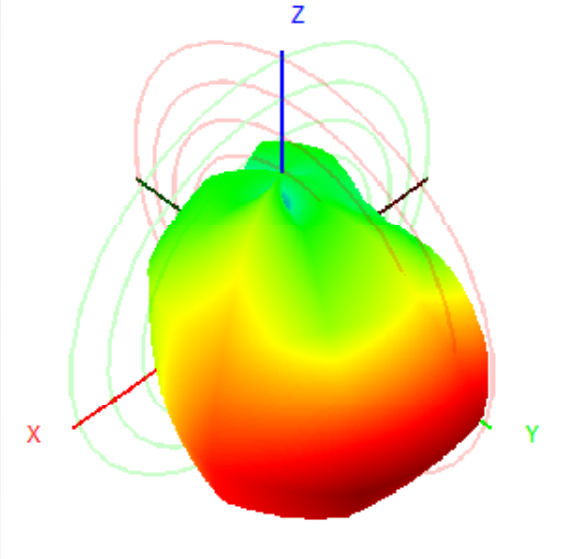
Back View



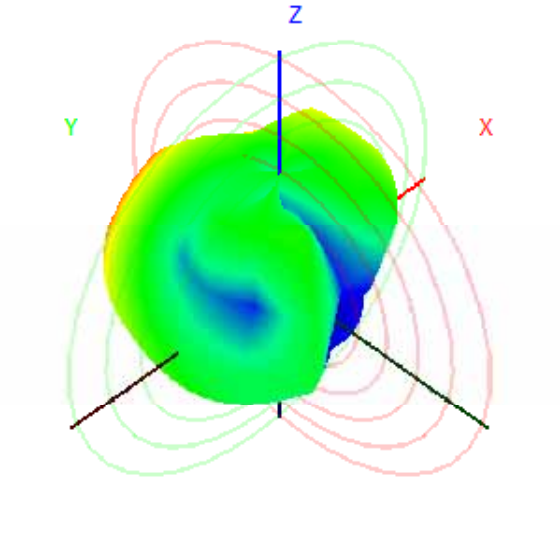
3D Radiation Pattern Results

2G_ANT1, 2400 MHz

Front View



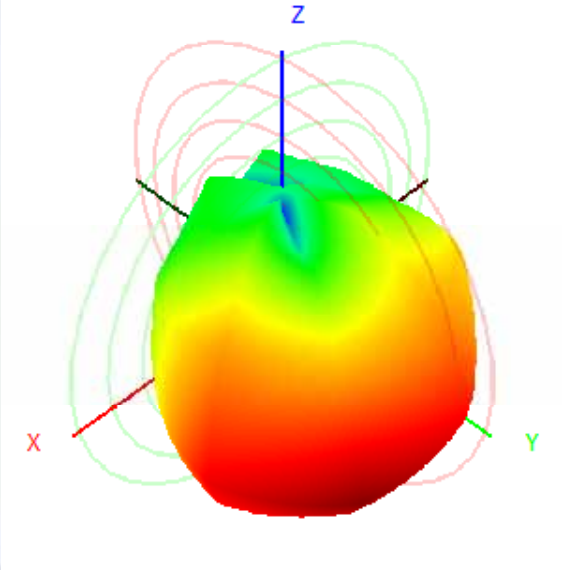
Back View



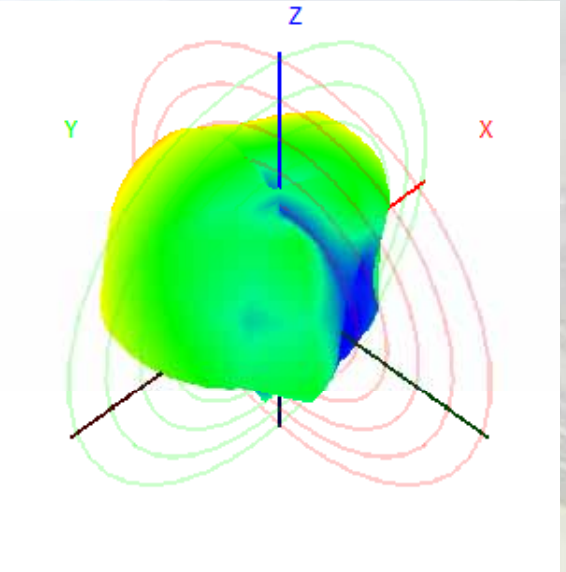
3D Radiation Pattern Results

2G_ANT1, 2450 MHz

Front View



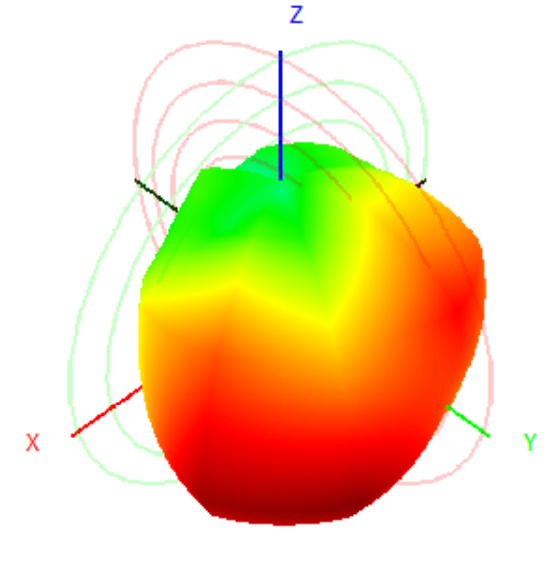
Back View



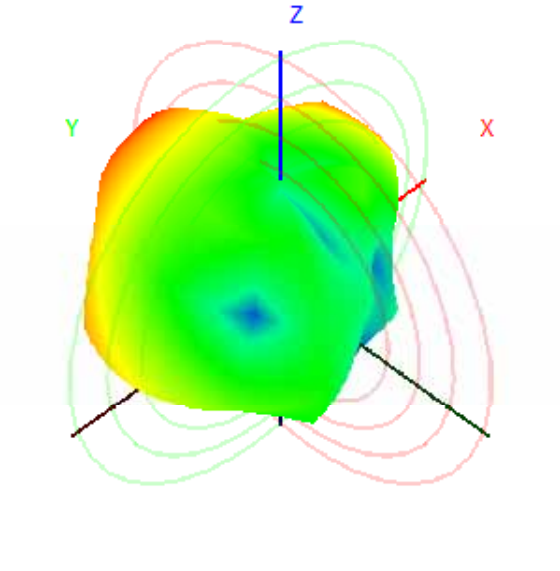
3D Radiation Pattern Results

2G_ANT1, 2500 MHz

Front View



Back View



Results Summary

VSWR (Criterion: ≤3.0)

Frequency (MHz)	LORA_ANT1	LORA_ANT2
863	1.7	1.9
870	1.6	1.6
902	1.3	1.2
928	1.2	1.7

Results Summary

VSWR (Criterion: ≤3.0)

Frequency (MHz)	LTE_ANT1
703	2.0
960	2.7
1710	2.1
2170	1.2
2300	1.1
2700	2.0

Results Summary

VSWR (Criterion: ≤1.92.0)

Frequency (MHz)	2G_ANT1
2400	1.5
2450	1.5
2500	1.7

Results Summary

Isolation (Criterion: ≤- 15dB)

Frequency (MHz)	LORA_ANT1 & LORA_ANT2
863	-20.1
870	-19.7
902	-16.6
928	-26.7

Results Summary

Isolation (Criterion: ≤-15dB)

Frequency (MHz)	LORA_ANT1 & LTE_ANT1	LORA_ANT2 & LTE_ANT1
703	-27.4	-41.1
863	-20.2	-16.7
870	-18.5	-19.1
902	-20.0	-22.6
928	-25.3	-22.6
960	-22.4	-22.6
1710	-32.2	-44.7
2170	-28.4	-27.8
2700	-24.1	-25.8

Results Summary

Isolation (Criterion: ≤- 20dB)

Frequency (MHz)	LORA_ANT1 & 2G_ANT1	LORA_ANT2 & 2G_ANT1
863	-21.7	-23.6
870	-26.2	-23.8
902	-20.8	-24.6
928	-26.5	-27.9
2400	-28.6	-30.4
2450	-30.5	-30.2
2500	-26.3	-29.3

Results Summary

Isolation (Criterion: ≤- 20dB)

Frequency (MHz)	LTE_ANT1 & 2G _ANT1
703	-21.7
960	-23.6
1710	-22.2
2170	-32.0
2300	-26.6
2400	-26.3
2500	-25.2
2700	-22.3

Results Summary

Peak Gain & Efficiency

Frequency (MHz)	LORA_ANT1		LORA_ANT2	
	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)
863	3.69	63.7	3.36	72.7
870	3.32	60.2	3.08	73.8
902	3.81	70.7	2.70	66.7
928	2.60	59.4	2.32	57.1

Results Summary

Peak Gain & Efficiency

Frequency (MHz)	LTE_ANT1	
	Peak Gain (dBi)	Efficiency (%)
703	-0.53	27.8
824	1.17	46.5
960	-0.22	30.5
1710	0.69	52.6
2170	4.41	53.4
2300	4.69	59.9
2500	4.05	60.4
2700	2.32	50.5

Results Summary

Peak Gain & Efficiency

Frequency (MHz)	2G_ANT1	
	Peak Gain (dBi)	Efficiency (%)
2400	5.38	56.4
2450	5.20	53.3
2500	6.04	52.1