



Version: TNP-21061_UBN2310BA00/U10G177.00

Released Date: 2023/04/27

Test Date: 2023/04/27

Tested By: Zhu-Wei

Reviewed By: Daniel

Confidential

- Revised History
- Specification
- Antenna Placement & Condition
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- Return Loss, S-parameters Test
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- 2D Radiation Patterns
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- Results Summary (Return Loss, S-parameters, Peak Gain, Efficiency)
- Conclusion & Comments

Revision History

Released Date	Version	Revised Records
2021/10/26	V1.0	• Antenna evaluation report
2021/11/18	V1.1	• Change Antenna Type
2021/12/06	V1.2	• Change Antenna Size
2021/12/18	V1.3	• Antenna evaluation with new specification
2021/12/29	V1.4	• Change ANT2 placement & frequency (dual band)
2021/12/30	V1.5	• Antenna evaluation report
2022/01/04	V1.6	• Change antenna Cable length
2022/06/22	V1.7	• Change ANT2 Cable direction
2022/07/01	V1.8	• Change ANT2 Cable Routing (p.7)
2022/09/27	V1.9	• Change ANT2 cable length (L=80mm)
2023/02/13	V2.0	• Update model name U10H175.00/U10G177.00 as customer request
2023/03/10	V2.1	• Update anechoic chamber information (p.20)
2023/04/27	V2.2	• Change Antenna Cable routing (p.6~7)

Requirements of Antenna Design

RF Function	Number of ANT	Frequency Band	Remark
Wi-Fi (2.4/5G)	2	2400-2500 / 5050-5825 MHz	ANT1, 2
Wi-Fi (5G)	2	5050-5825 MHz	ANT3, 4

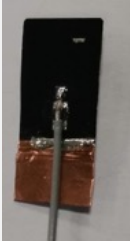
Requirements of Measurement

Test Item		Specification	Remark
Return Loss		-10dB Max @2400-2500 / 5050-5825 MHz	
Isolation		<-25dB	
Peak Gain	2.4GHz (Dual Band)	<3.5 dBi	
	5GHz (Dual Band)	<4.0 dBi	
	5GHz	<3.5 dBi	
Efficiency	2.4GHz	≥70% @2400-2500 MHz	
	5GHz	≥70% @5050-5825 MHz	
Radiation Pattern		Scale: +5 - -45 dBi, Angle step size: 5 degree	

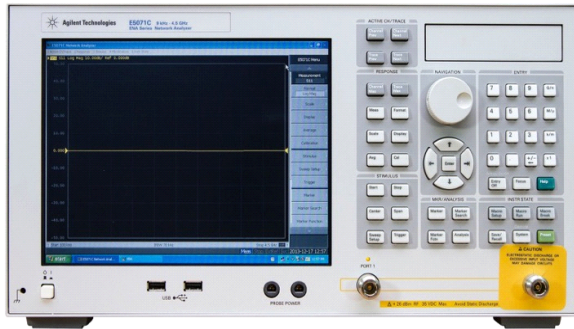
1M Cable Loss (unit: dB)									
	1GHz	2GHz	2.45GHz	3GHz	4GHz	5GHz	5.2GHz	5.8GHz	6GHz
1.13mm	≤2.2	≤3.1	≤3.45	≤3.8	≤4.4	≤4.9	≤5.0	≤5.3	≤5.4

Antenna	Cable Length (mm)	Cable Loss (unit: dB)	
		2.4GHz	5GHz
ANT1	230 mm	0.7935	1.1270
ANT2	80 mm	0.2723	0.3868
ANT3	135 mm	/	0.6615
ANT4	105mm	/	0.5145

Antenna Placement & Solution

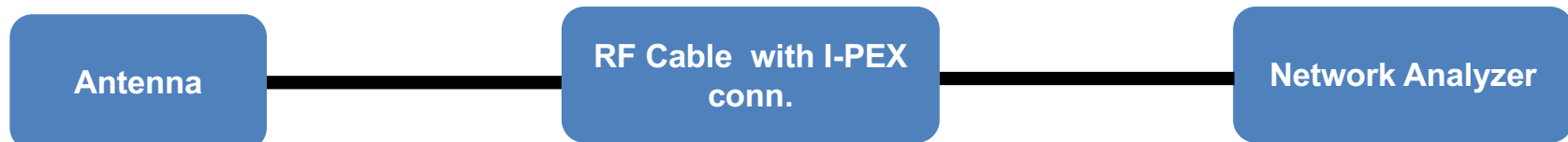
Antenna	Previous Version	Current Version
ANT1		
ANT2		
ANT3		
ANT4		

Test Setup for Return Loss Test



Equipment	Brand	Model	S/N
Network Analyzer	Keysight	E5071C	MY46417759

Calibration date : 2022/12/28



Test Steps for Return Loss

Step 1

Configure the Network Analyzer

- Turn on the network analyzer
- Perform initialization
- Setting the appropriate frequency range and measurement parameters.

Step 2

Calibrate the Network

- Before starting the test, calibrate to eliminate the inherent response of the test system.
- Perform full open, full short, and full load calibration, as well as calibration of the reference plane.

Step 3

Set the Test Parameters

- Set the desired test parameters on the network analyzer. This typically includes selecting the desired S-parameter type (e.g., S11, S21, etc.), frequency range, and power level.

Step 4

Connect the Antenna

- Properly connect the antenna to the test port of the network analyzer.
- Ensure a secure connection and use suitable adapters and cables to minimize signal loss.

Step 5

Perform the Test

- Begin the S-parameter test of the antenna. This will measure the reflection and transmission characteristics of the antenna within the selected frequency range.

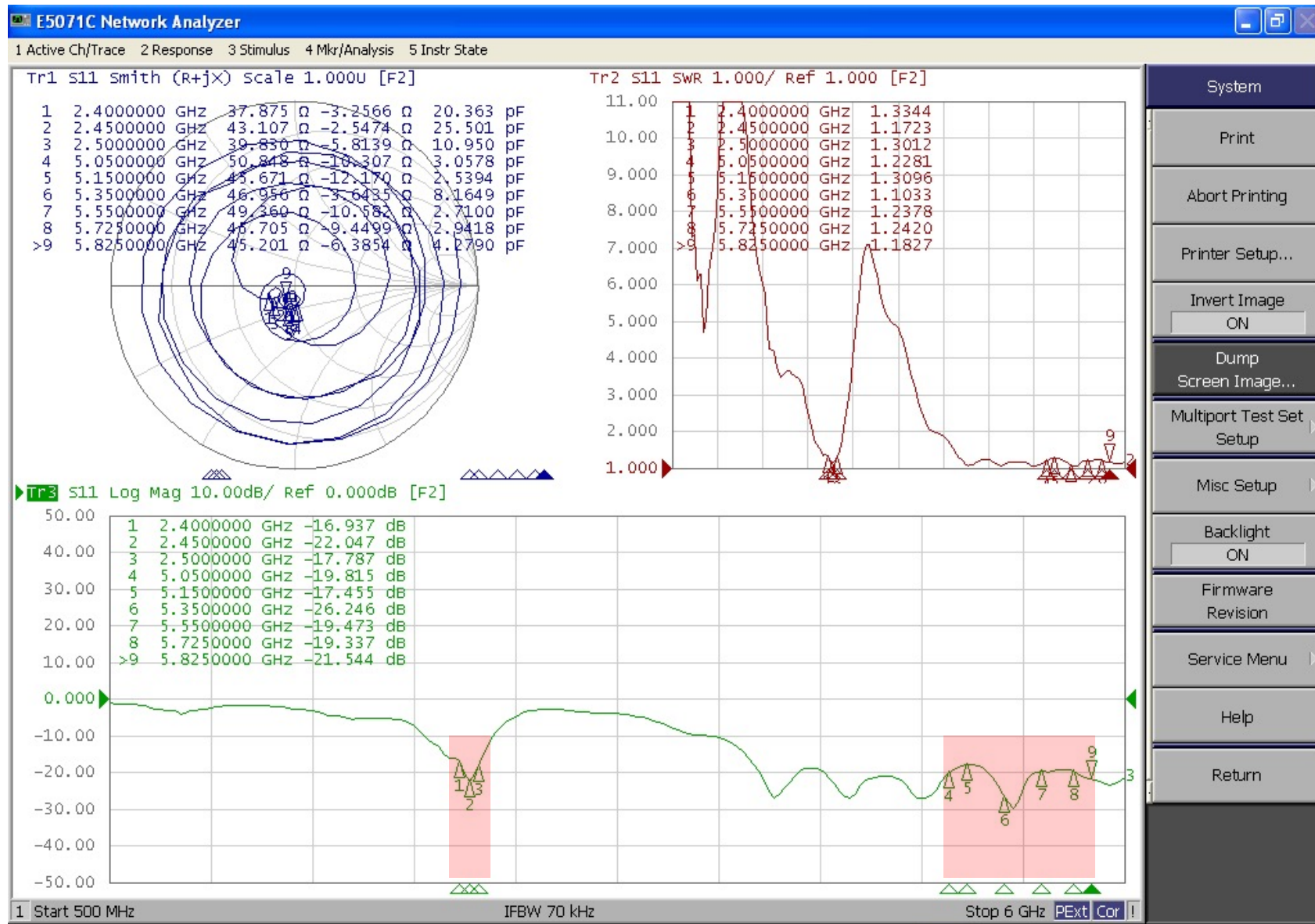
Step 6

Record the Results

- Once the test is completed, record the measurement results. These results are usually presented in the form of graphs or tables for further analysis and comparison.

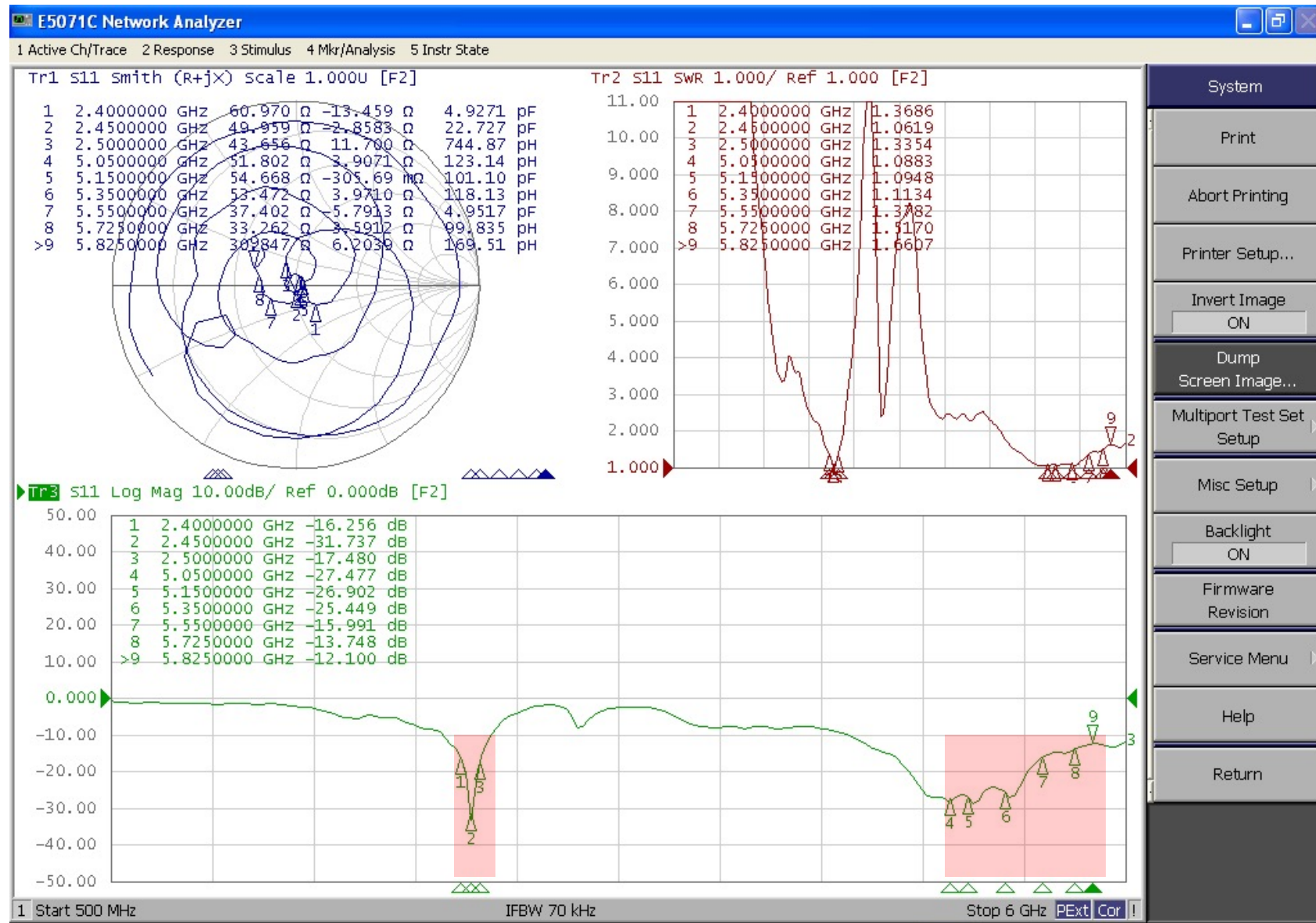
Return Loss Test

ANT1 (2400-2500 / 5050-5825 MHz) (Criterion: < -10 dB)



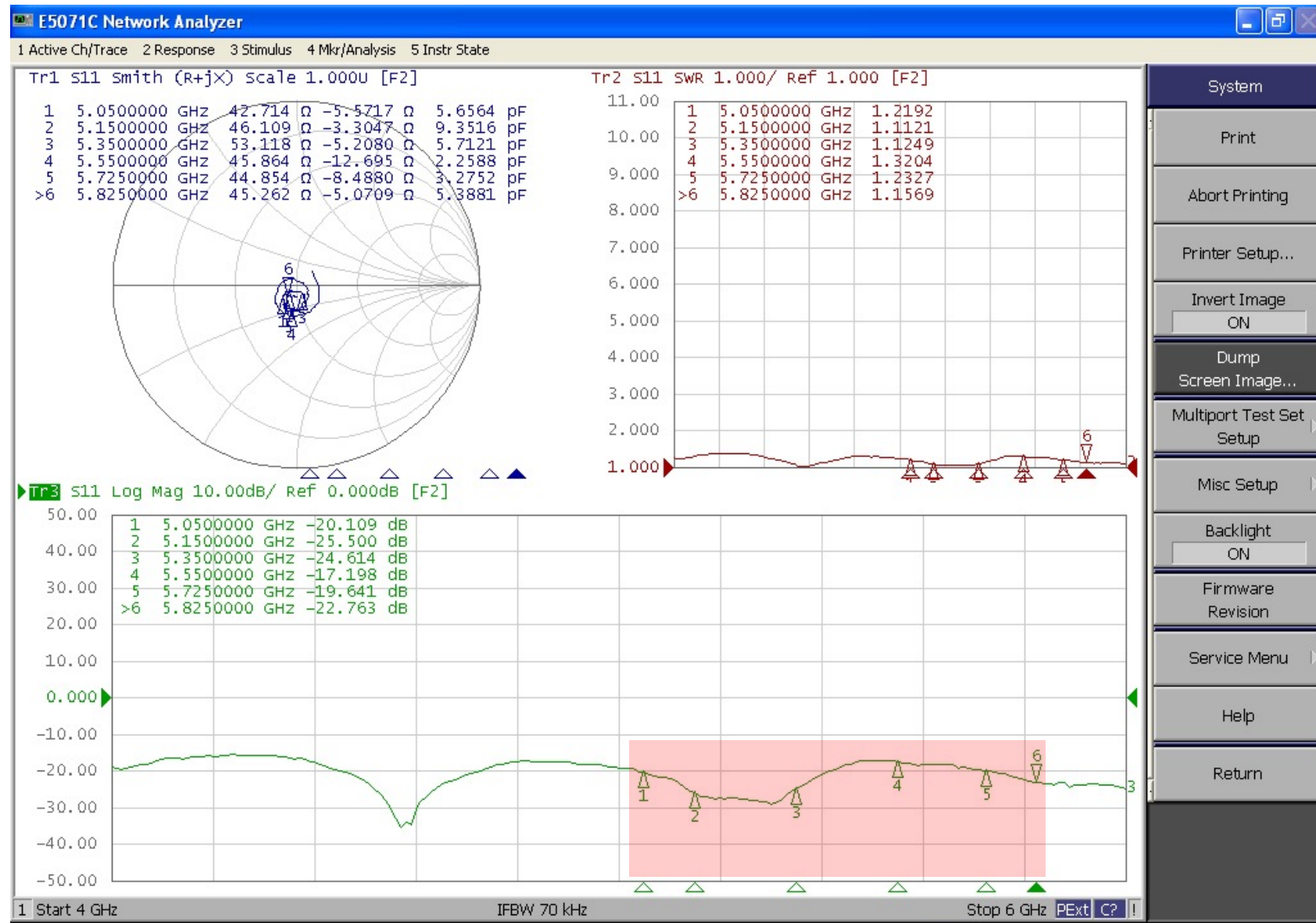
Return Loss Test

ANT2 (2400-2500 / 5050-5825 MHz) (Criterion: < -10 dB)



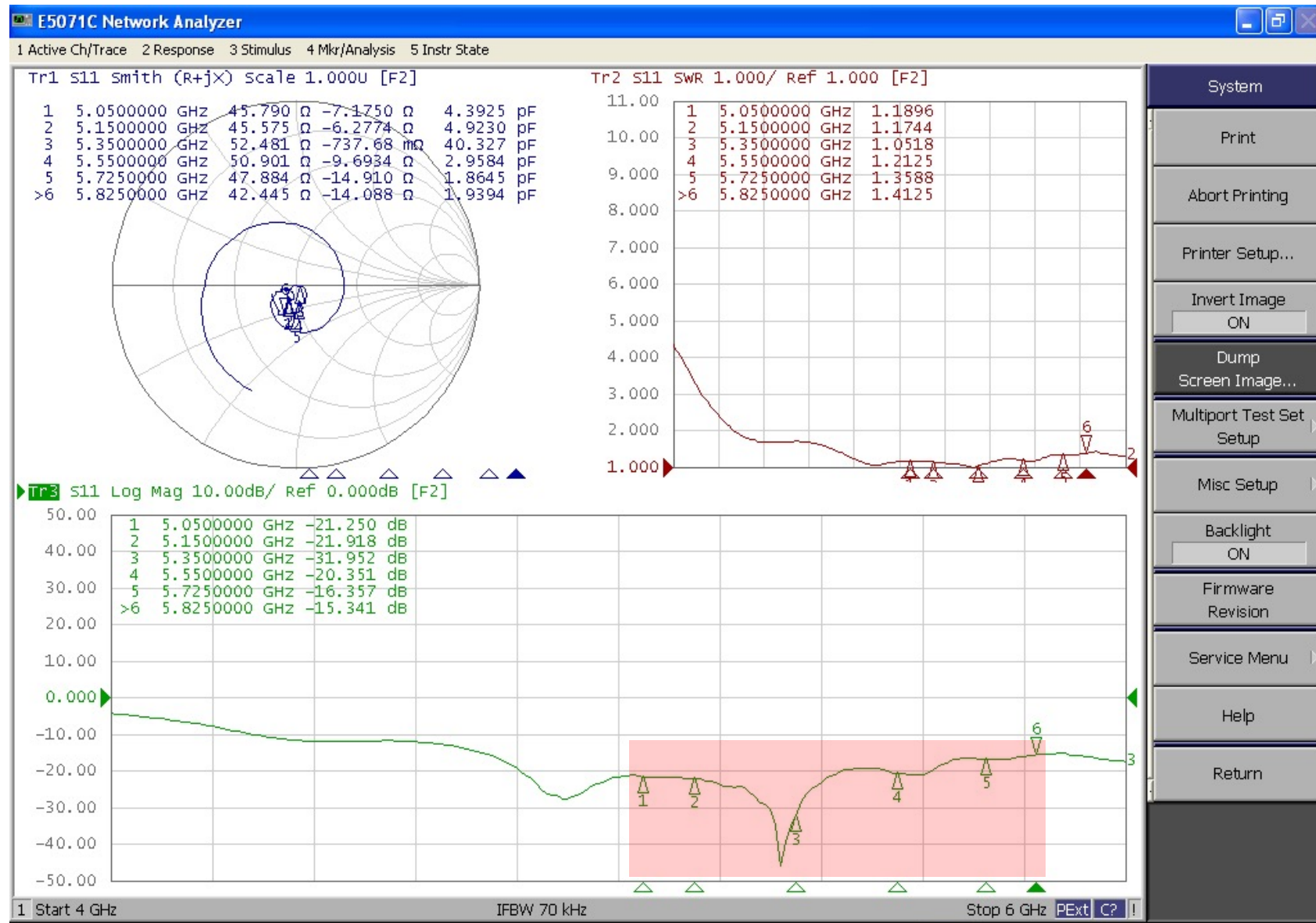
Return Loss Test

ANT3 (5050-5825 MHz) (Criterion: < -10 dB)



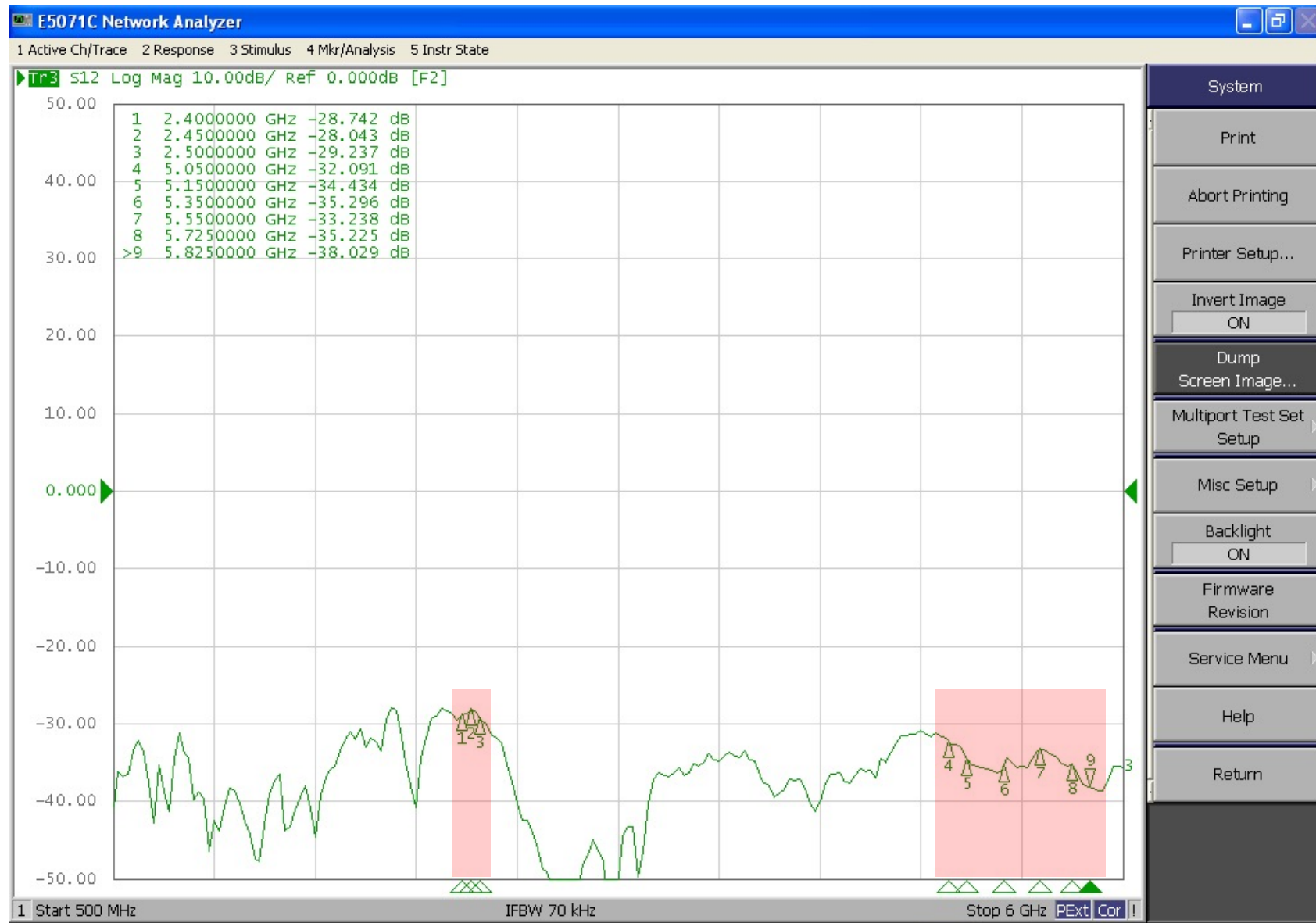
Return Loss Test

ANT4 (5050-5825 MHz) (Criterion: < -10 dB)



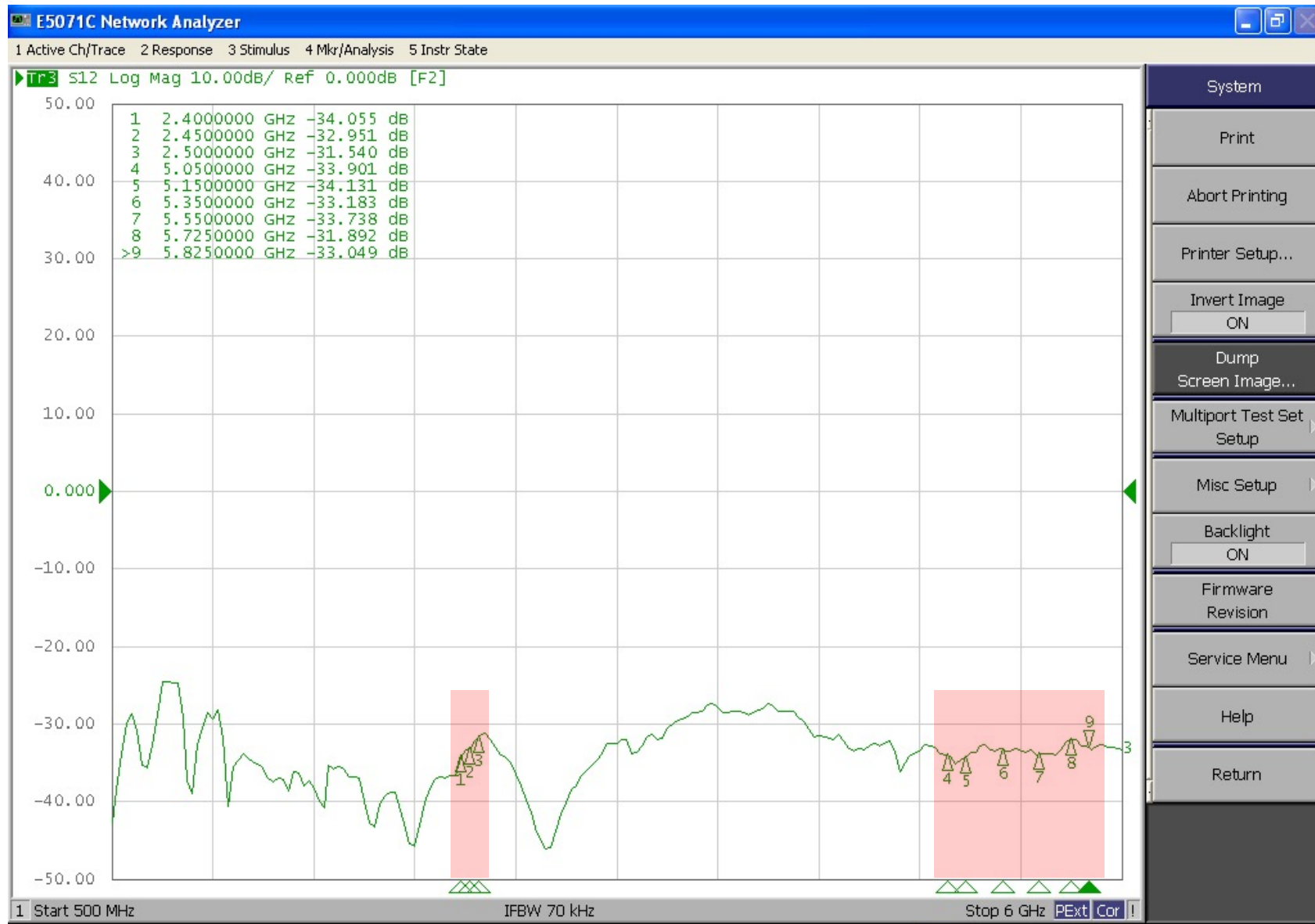
Isolation Test

ANT1 & ANT2 (Criterion: $< -25\text{dB}$)



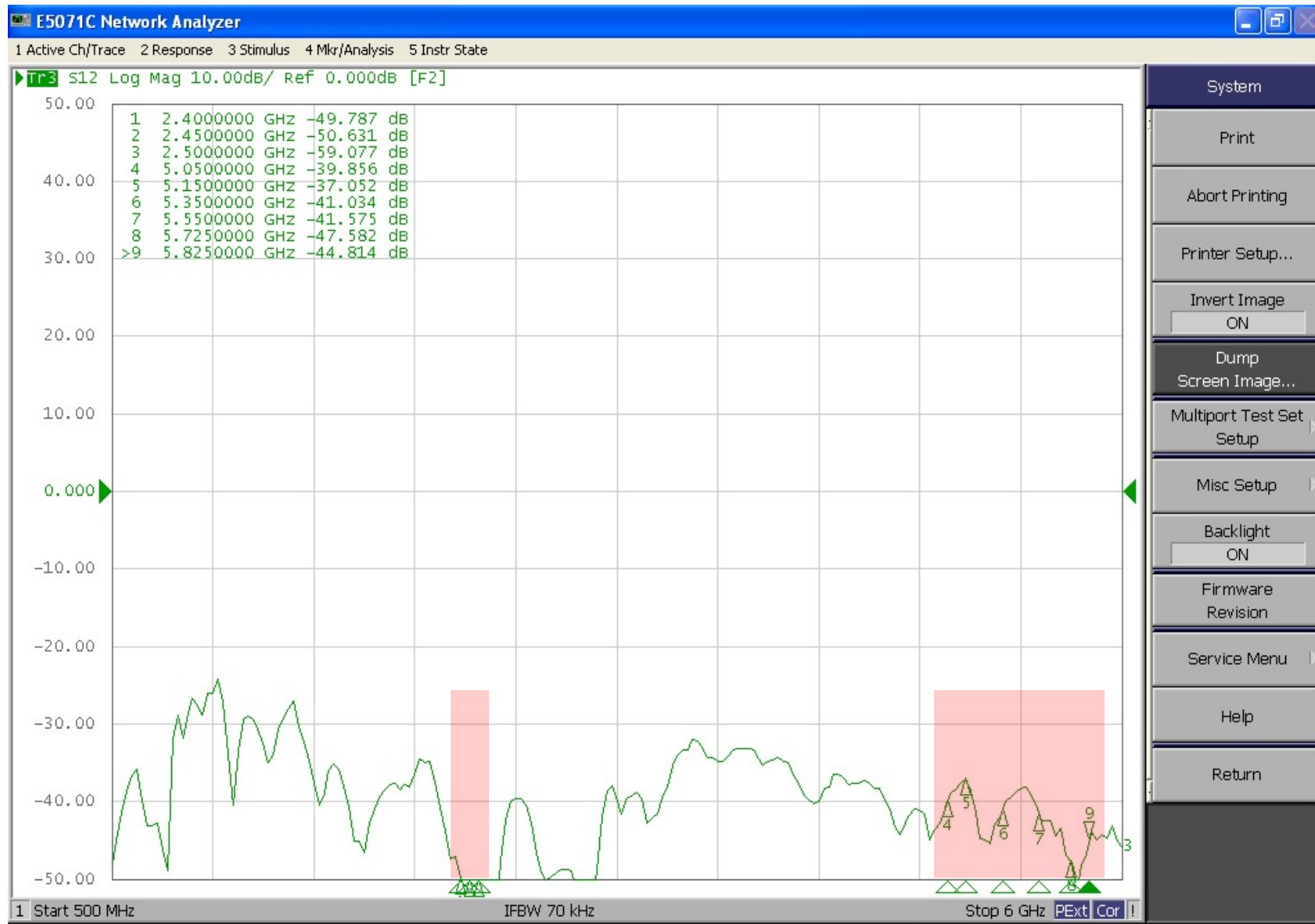
Isolation Test

ANT1 & ANT3 (Criterion: $< -25\text{dB}$)



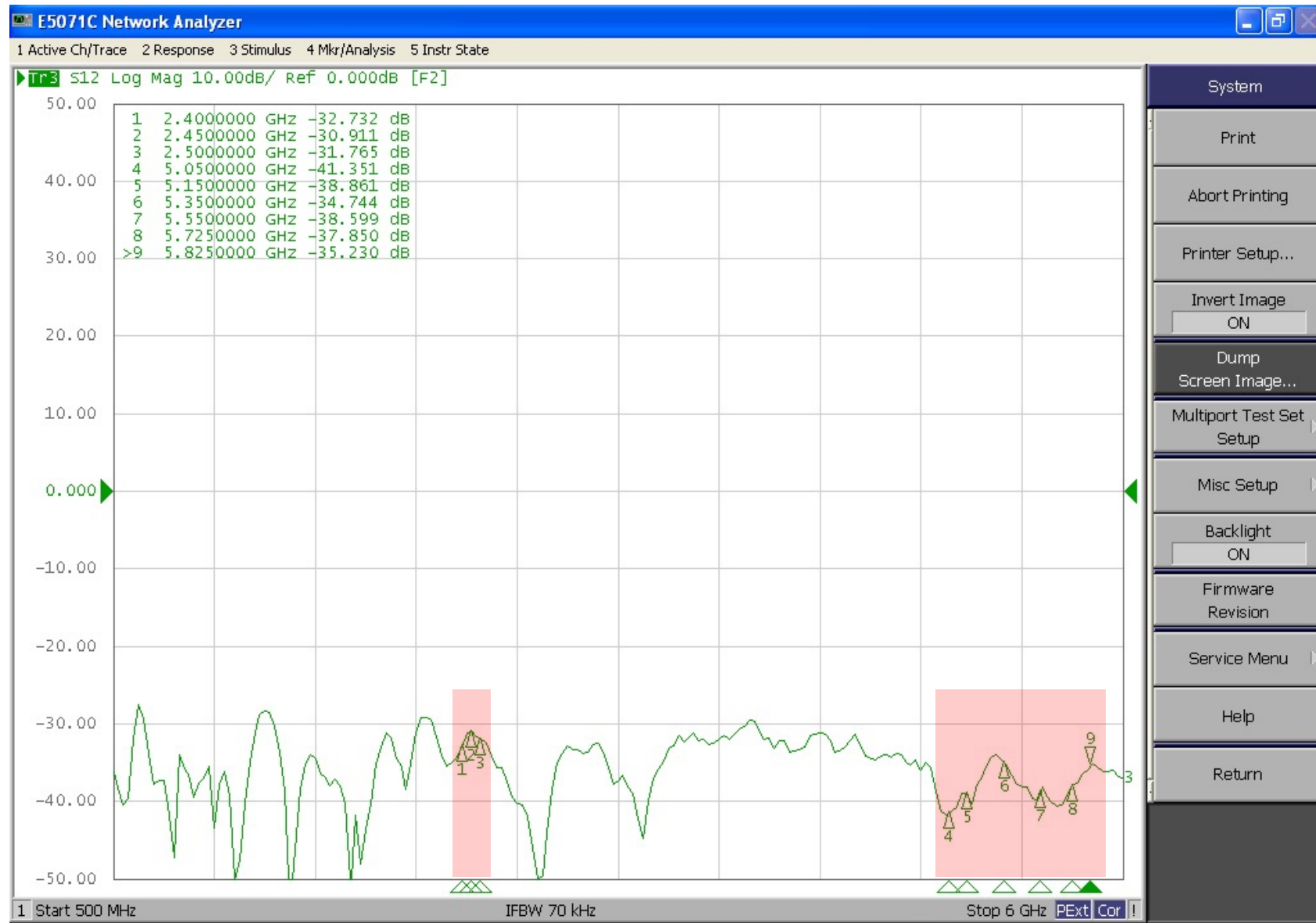
Isolation Test

ANT1 & ANT4 (Criterion: $< -25\text{dB}$)



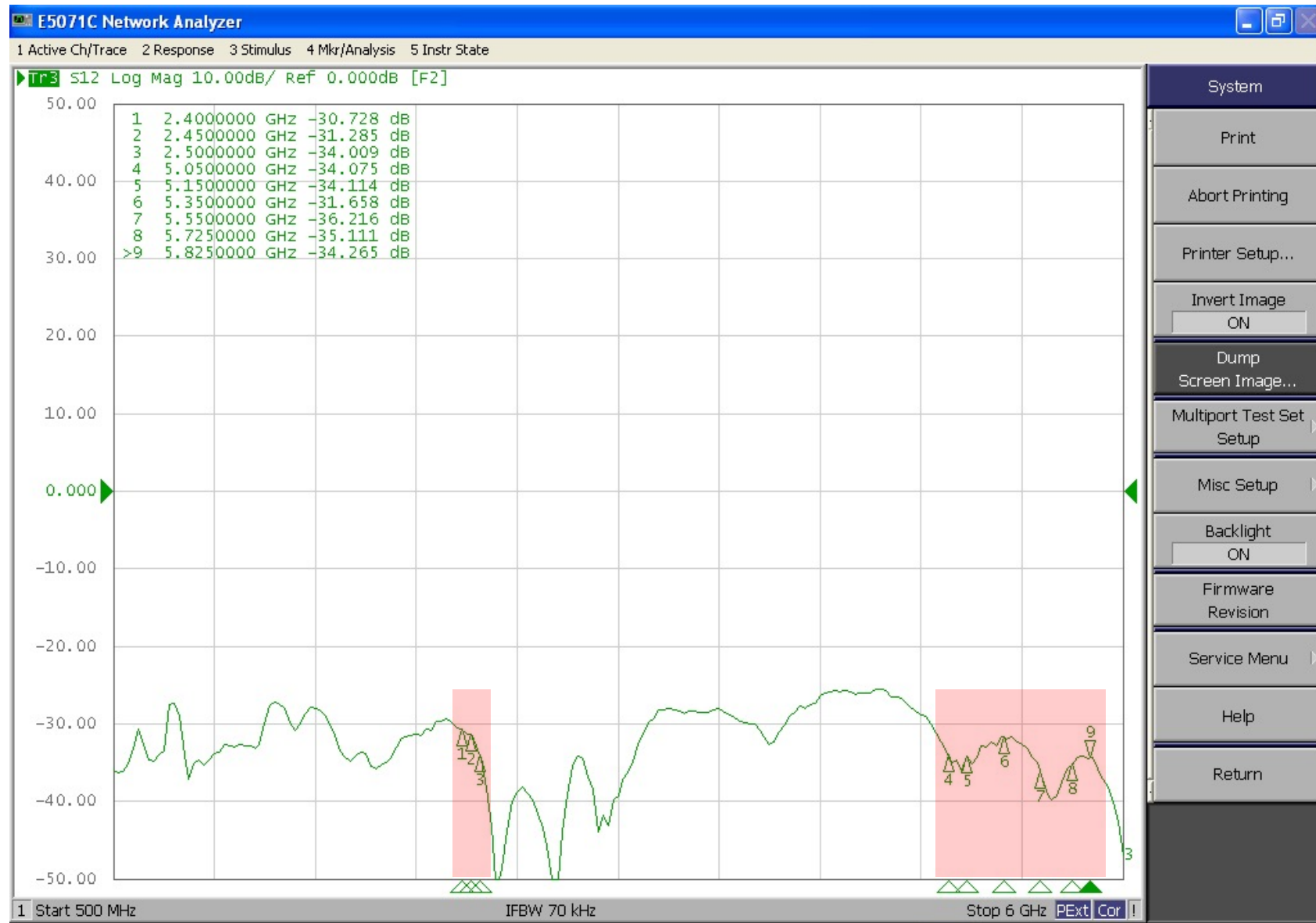
Isolation Test

ANT2 & ANT3 (Criterion: $< -25\text{dB}$)



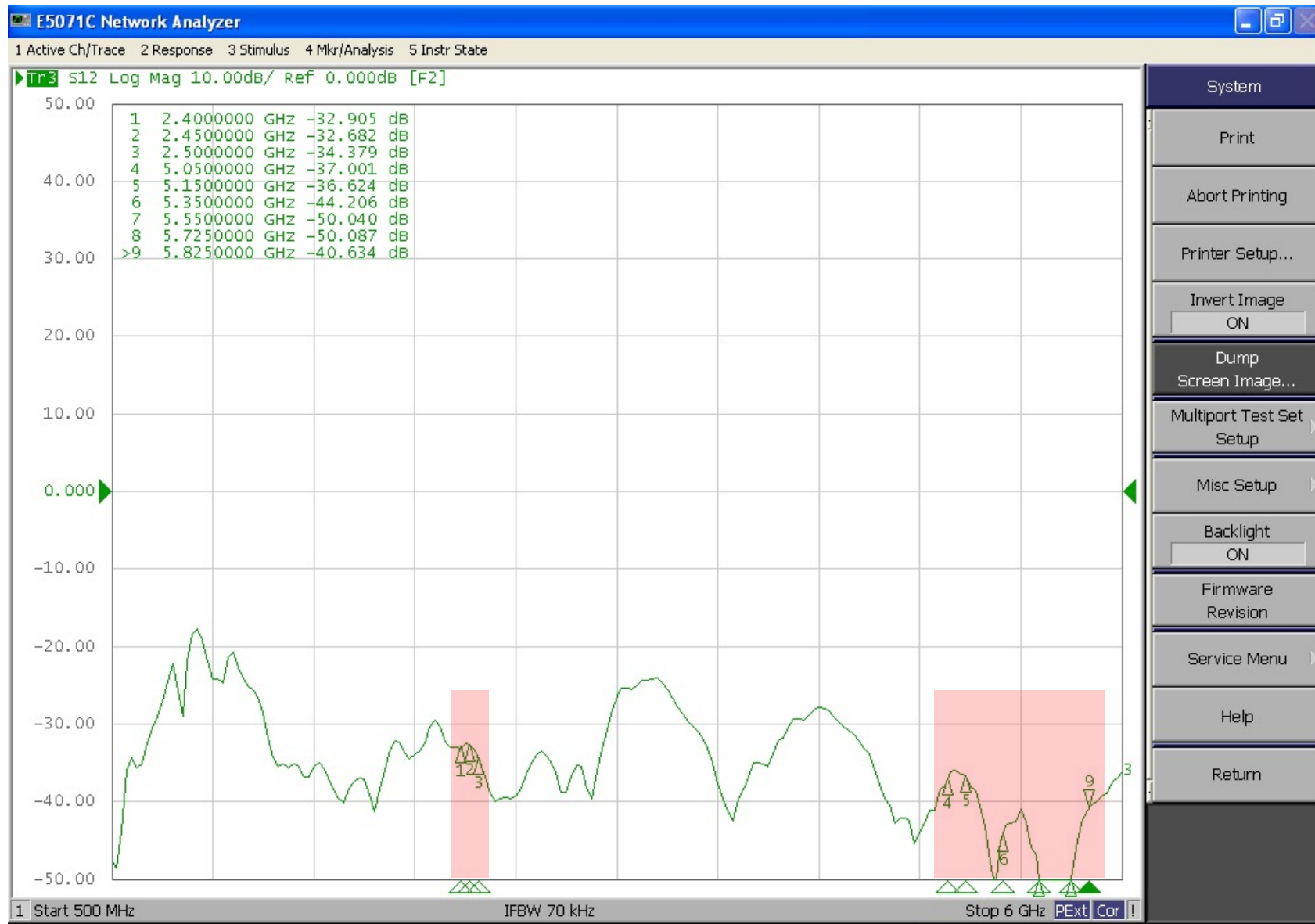
Isolation Test

ANT2 & ANT4 (Criterion: $< -25\text{dB}$)

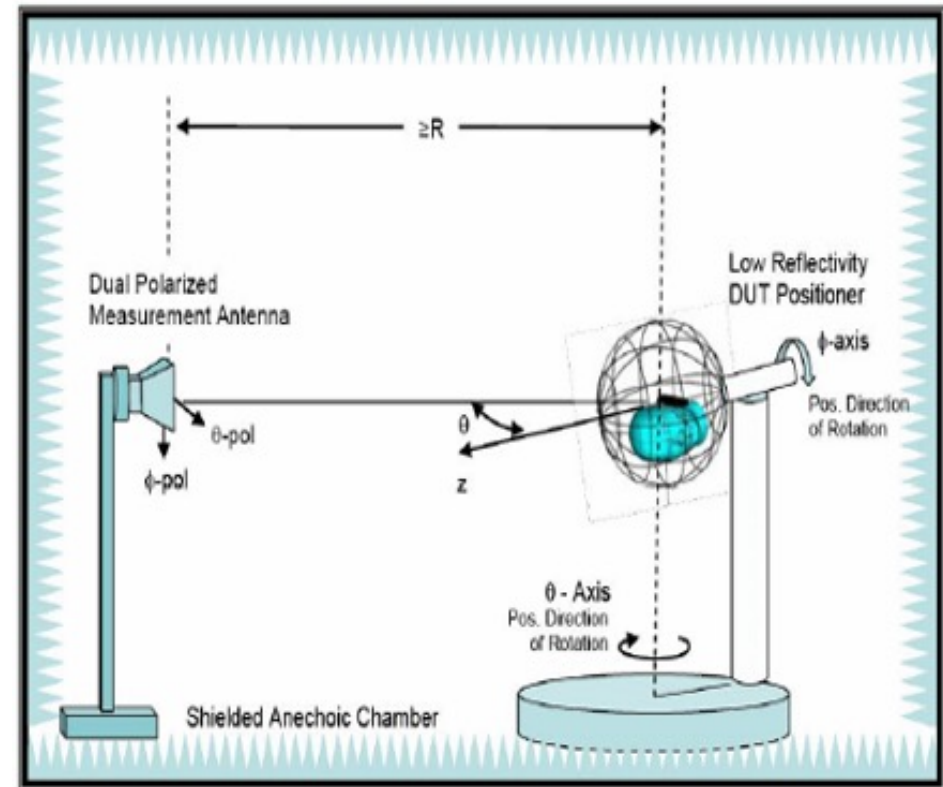
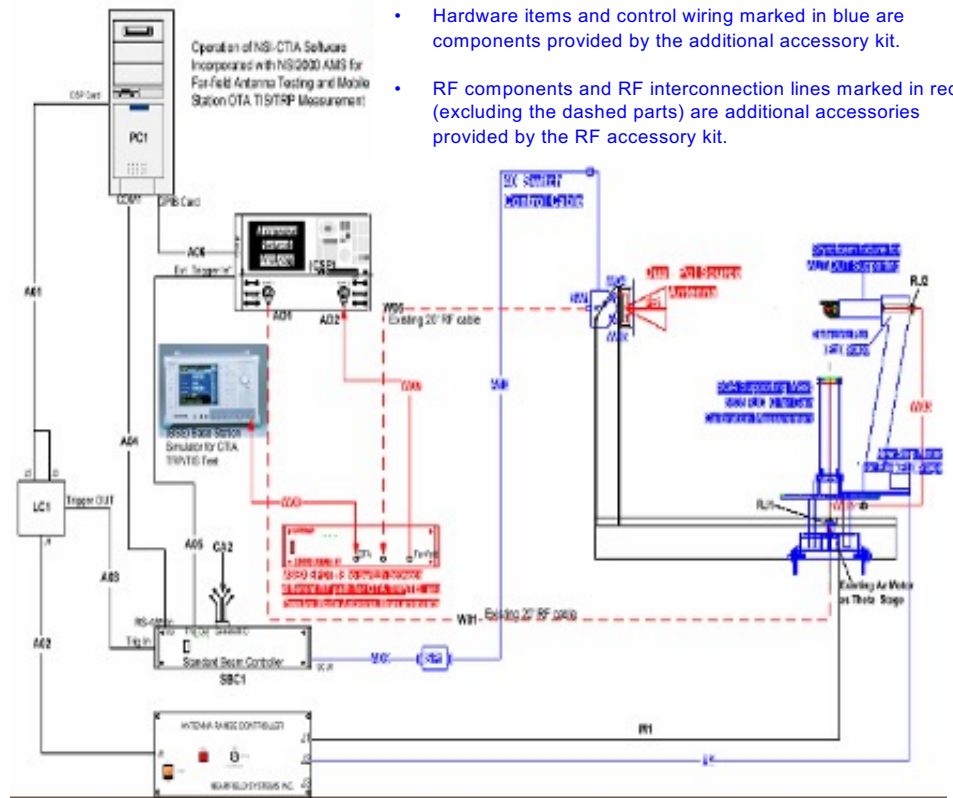


Isolation Test

ANT3 & ANT4 (Criterion: $< -25\text{dB}$)



Chamber Information

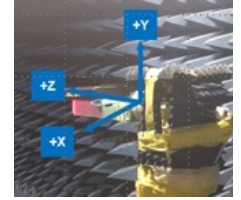


Test software: AnTestpro99
Calibration date: 2023/02/13

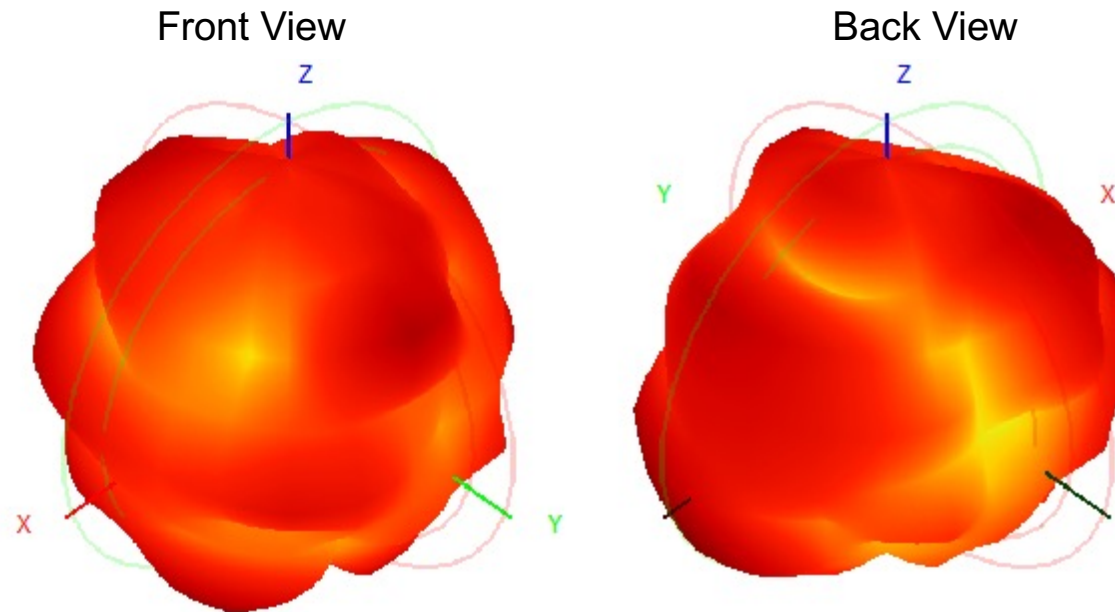
Chamber	Brand	Model	Serial No.	Date	Dimension	Freq. Range	Function	Location
Single-probe	WavePro	FFC-700	WP-C07-003	2007/10/24	3.25*3.25*7M	0.4 ~ 6 GHz	- Gain and Efficiency 3D Radiation pattern - TRP & TIS: 2G/3G/4G LTE/802.11 a/b/g/n/NB-IOT/BT	China, Dongguan

3D Radiation Pattern

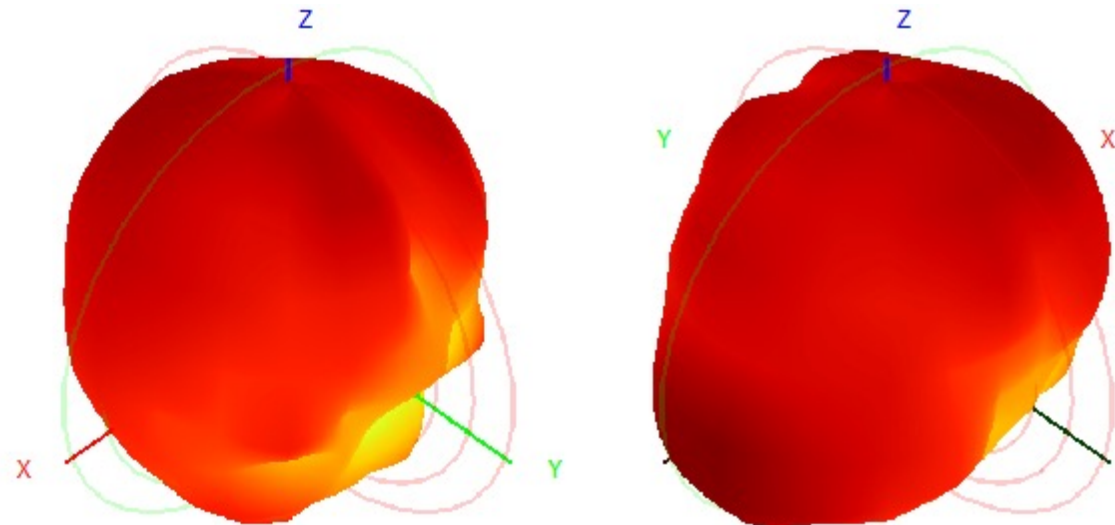
ANT1



2450 MHz

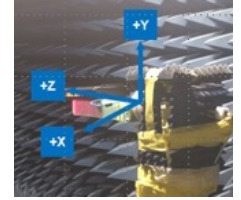


5050 MHz

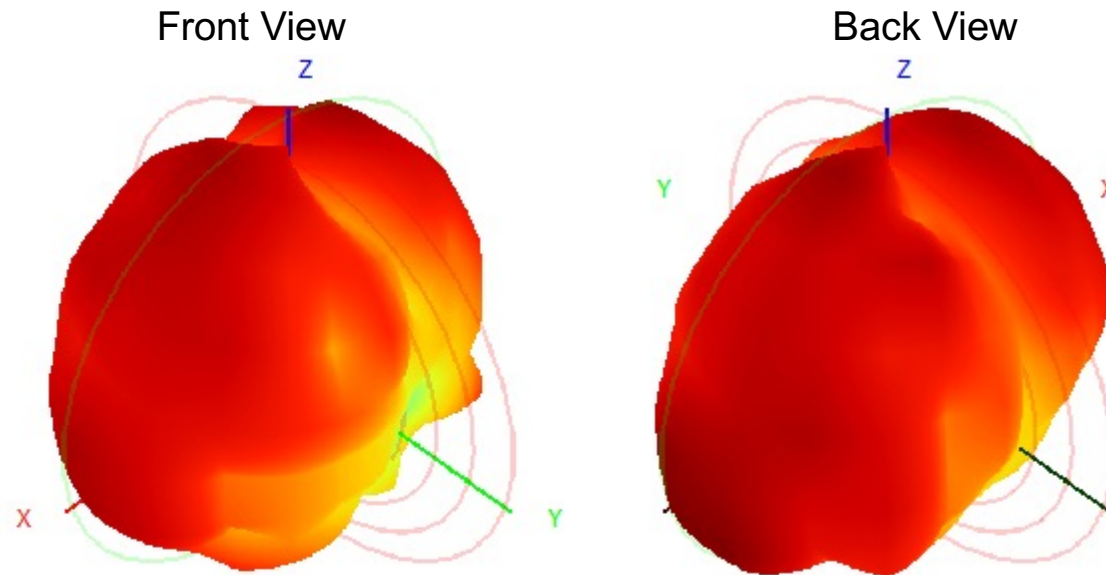


3D Radiation Pattern

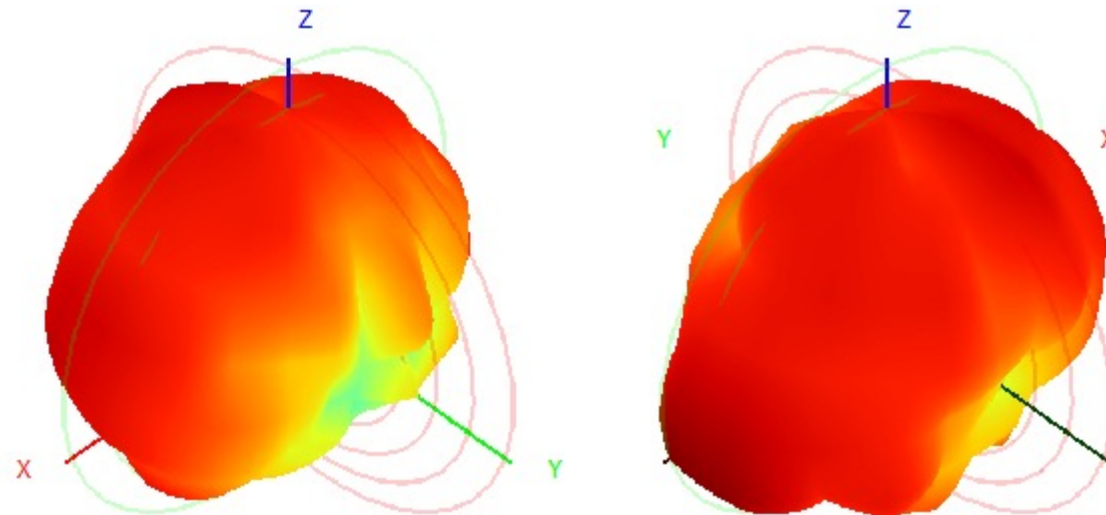
ANT1



5350 MHz

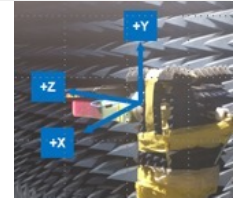


5825 MHz

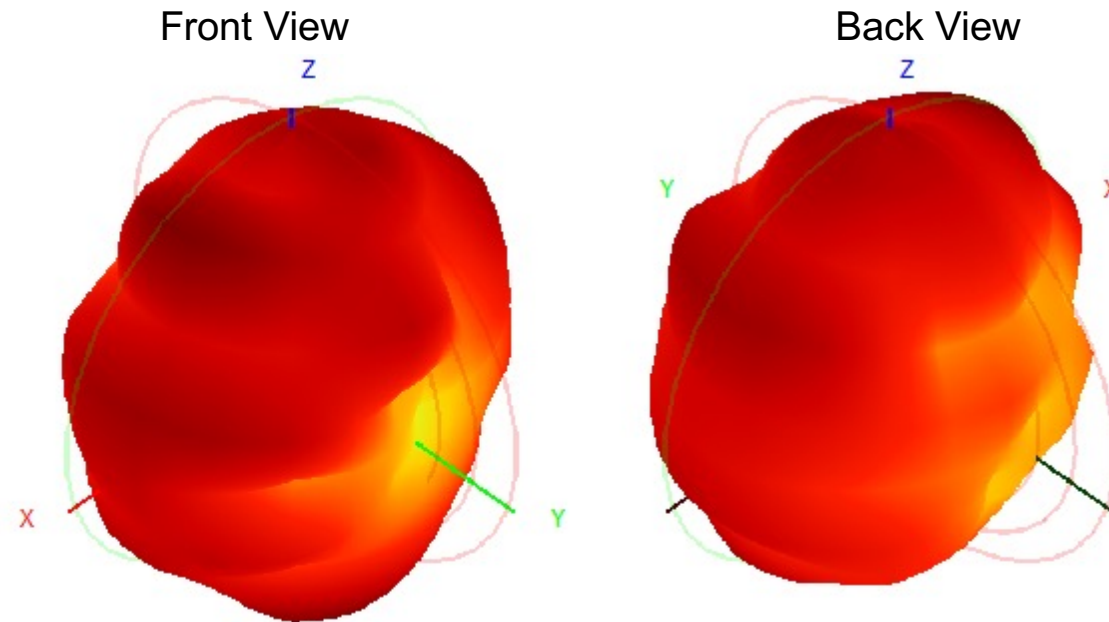


3D Radiation Pattern

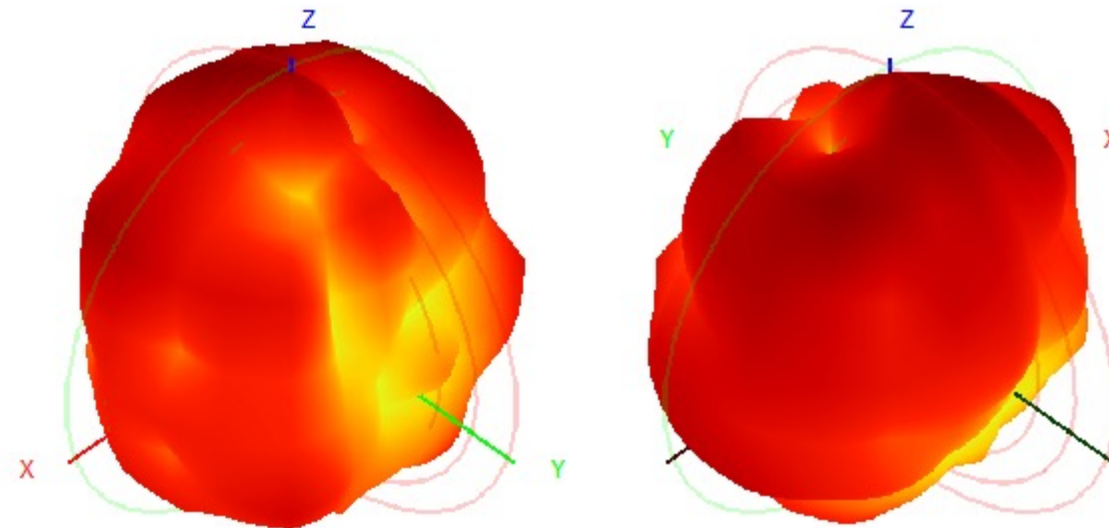
ANT2



2450 MHz

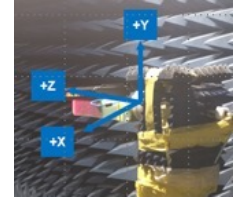


5050 MHz

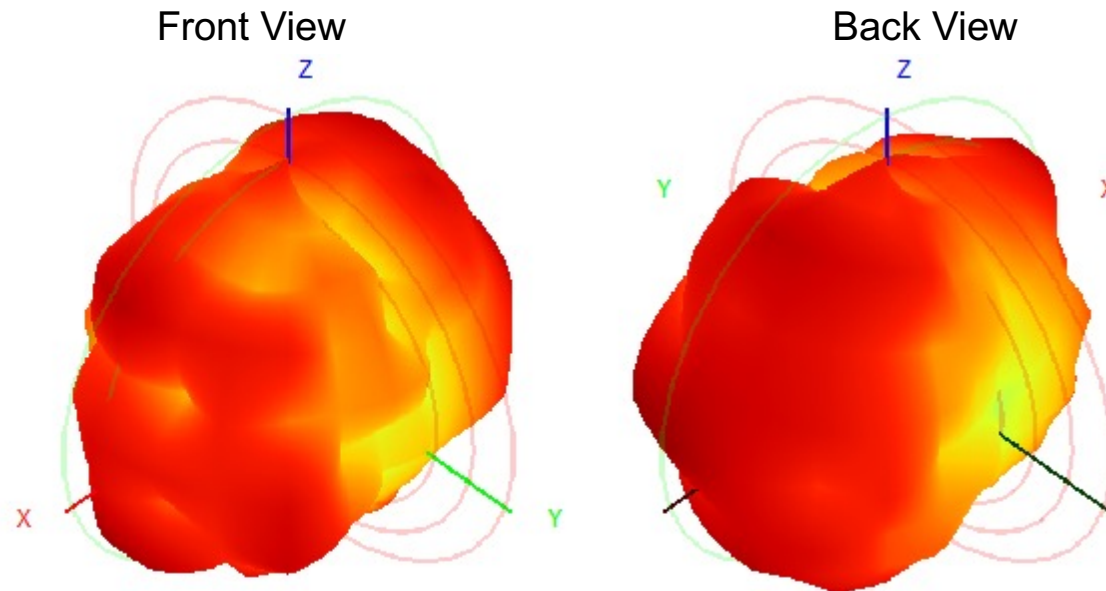


3D Radiation Pattern

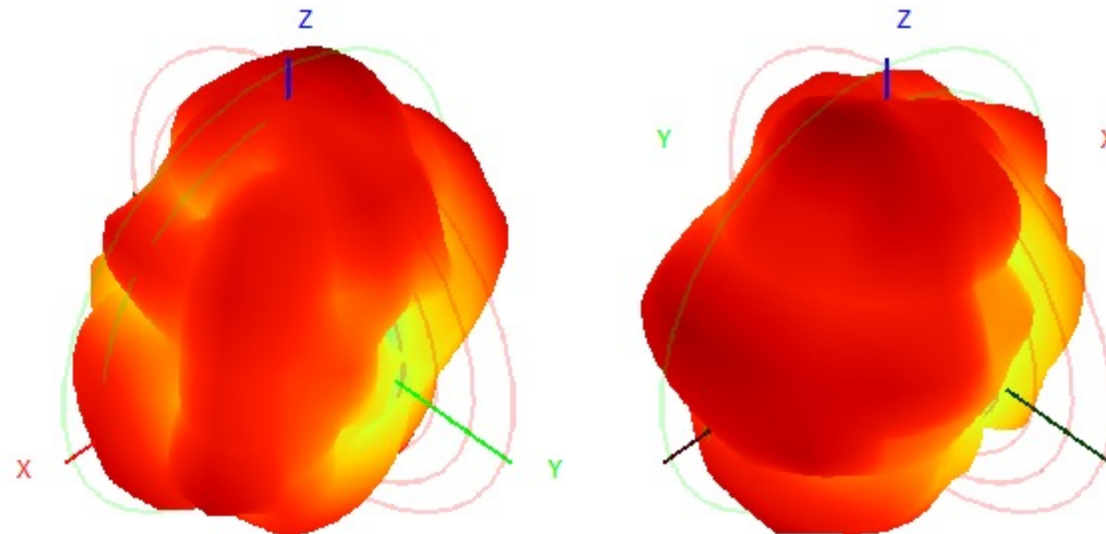
ANT2



5350 MHz

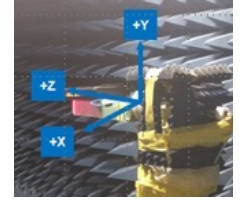


5825 MHz

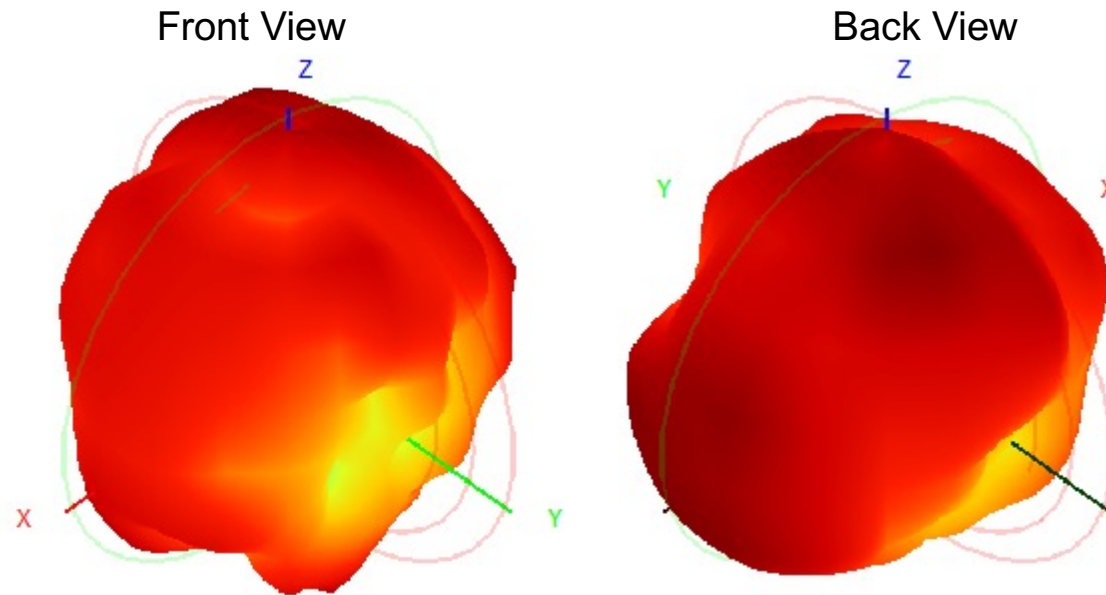


3D Radiation Pattern

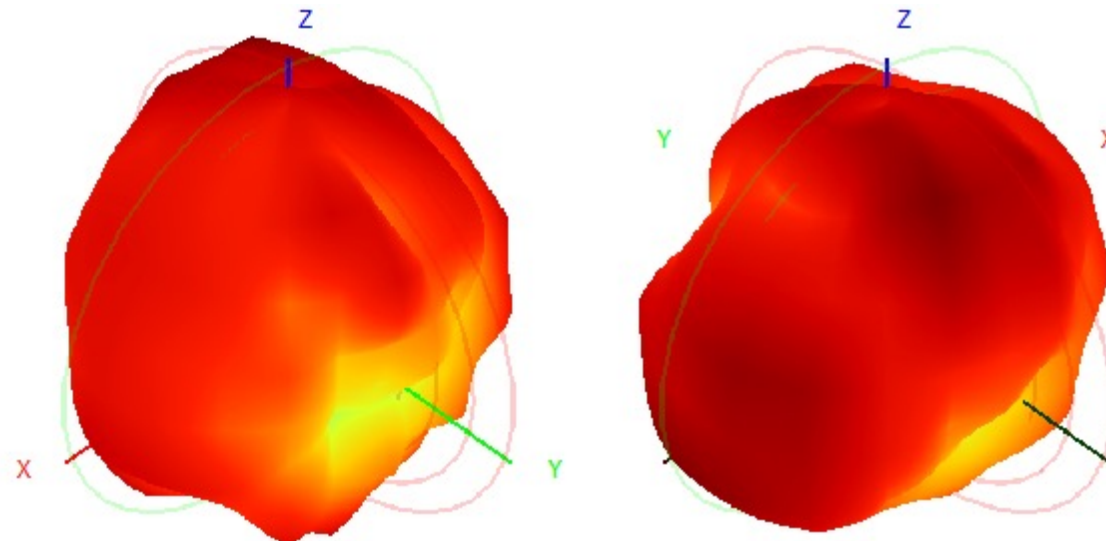
ANT3



5050 MHz

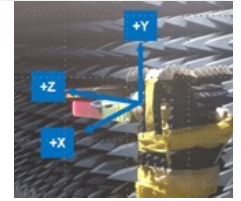


5150 MHz

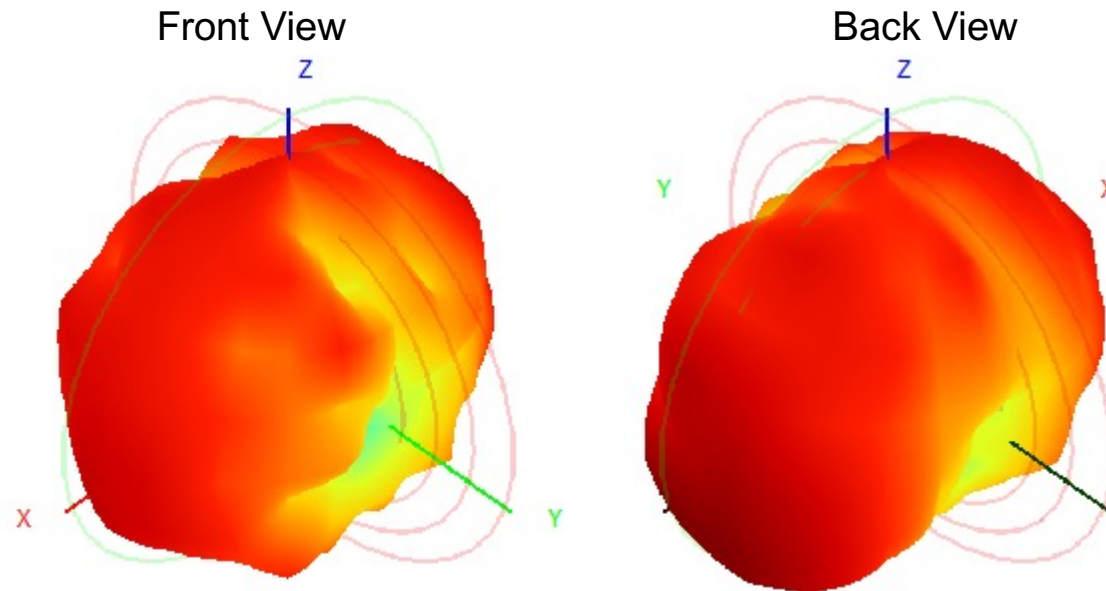


3D Radiation Pattern

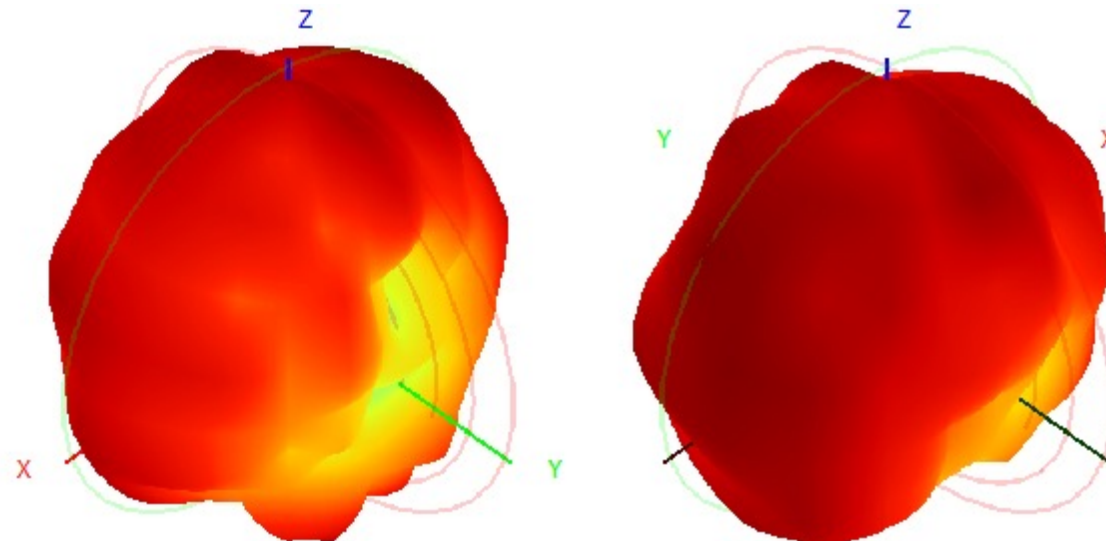
ANT3



5350 MHz

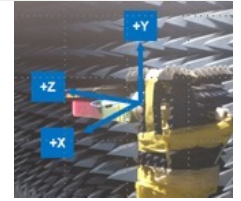


5825 MHz

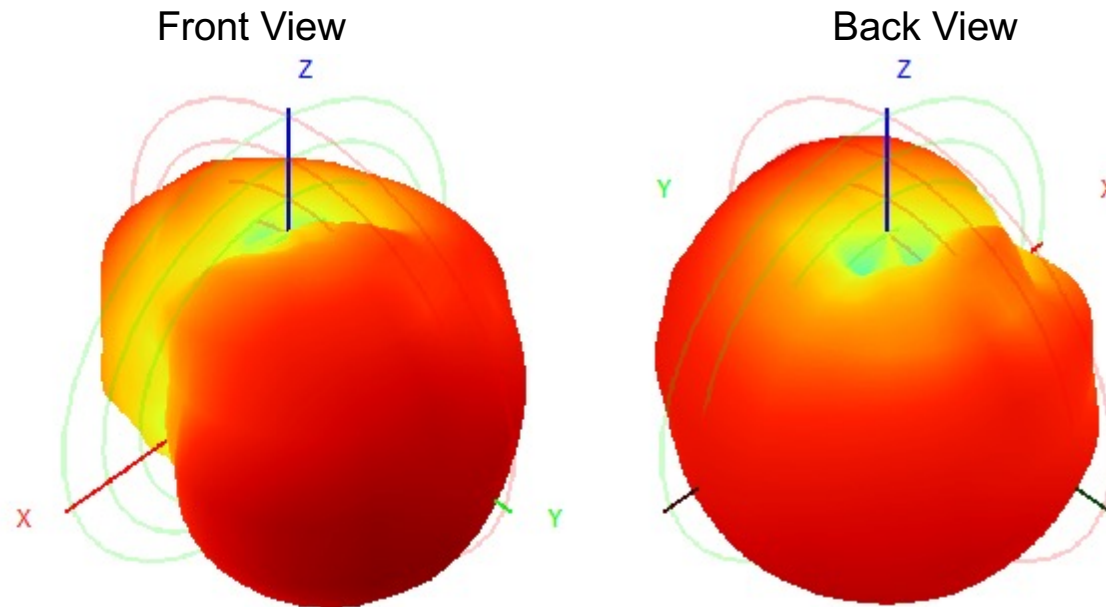


3D Radiation Pattern

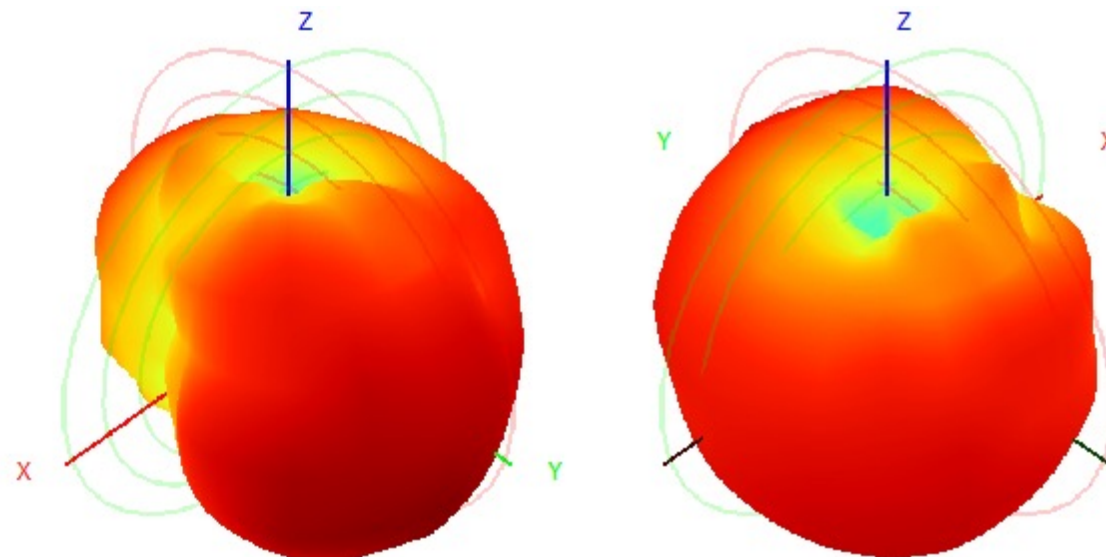
ANT4



5050 MHz

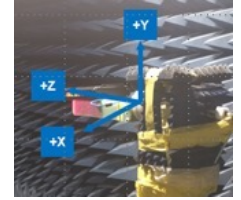


5150 MHz

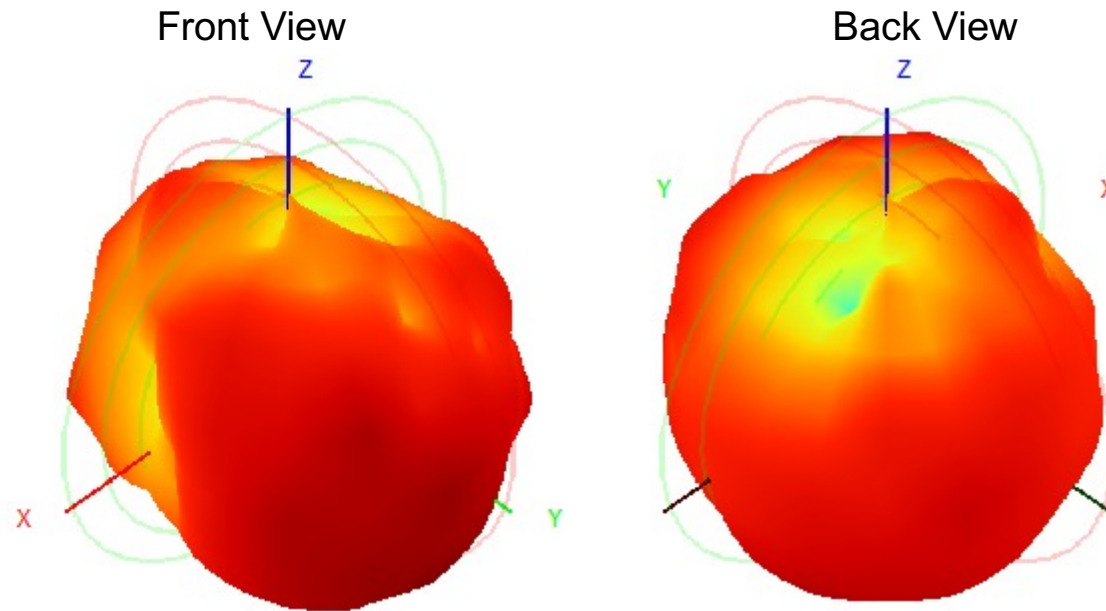


3D Radiation Pattern

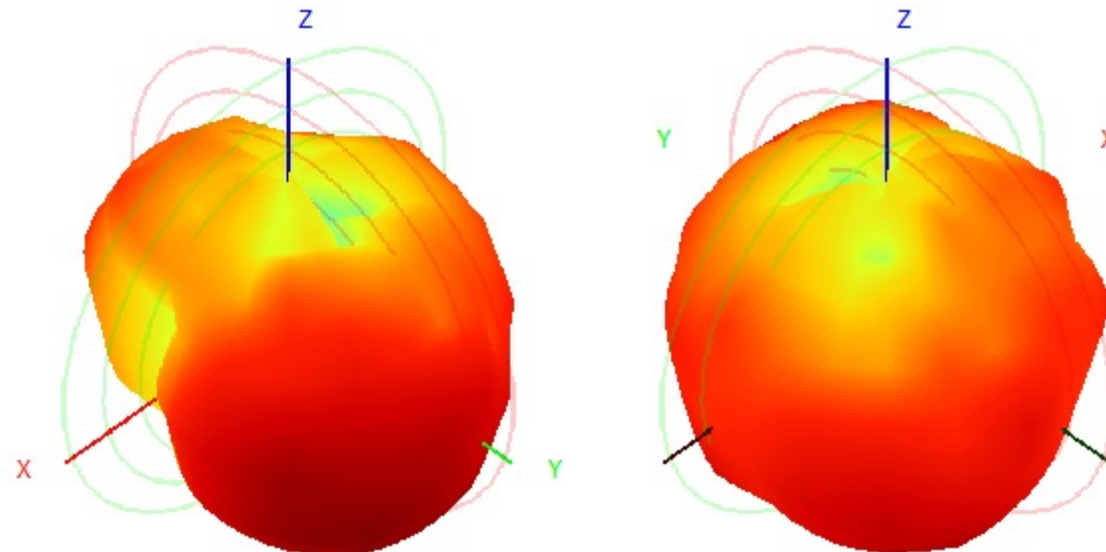
ANT4



5350 MHz



5825 MHz



Results Summary

Return Loss

(2400-2500 / 5050-5825 MHz) (Criterion: <-10dB)

Frequency (MHz)	ANT1	ANT2	ANT3	ANT4
2400	-16	-16	/	/
2450	-22	-31	/	/
2500	-17	-17	/	/
5050	-19	-27	-20	-21
5150	-17	-26	-25	-21
5350	-26	-25	-24	-31
5550	-19	-15	-17	-20
5725	-19	-13	-19	-16
5825	-21	-12	-22	-15

Results Summary

Isolation (Criterion: <-25dB)

Frequency (MHz)	ANT1 & ANT2	ANT1 & ANT3	ANT1 & ANT4	ANT2 & ANT3	ANT2 & ANT4	ANT3 & ANT4
2400	-28	-34	-49	-32	-30	-32
2450	-28	-32	-50	-30	-31	-32
2500	-29	-31	-59	-31	-34	-34
5050	-32	-33	-39	-41	-34	-37
5150	-34	-34	-37	-38	-34	-36
5350	-35	-33	-41	-34	-31	-44
5550	-33	-33	-41	-38	-36	-50
5725	-35	-31	-47	-37	-35	-50
5825	-38	-33	-44	-35	-34	-40

Results Summary

Antenna Peak Gain (Criterion: 2.4GHz for dual band < 3.5dBi)
2.4GHz Wi-Fi Antennas

Frequency (MHz)	ANT1 (dBi)	ANT2 (dBi)
2400	3.12	3.02
2450	3.14	3.10
2500	3.09	3.07
Average	3.11	3.06

Results Summary

Antenna Peak Gain (Criterion: 5GHz < 3.5dBi, 5GHz for dual band < 4dBi)
5GHz Wi-Fi Antennas

Frequency (MHz)	ANT1 (dBi)	ANT2 (dBi)	ANT3 (dBi)	ANT4 (dBi)
5050	3.85	3.78	3.35	3.47
5150	3.77	3.80	3.38	3.42
5350	3.86	3.88	3.34	3.38
5550	3.94	3.91	3.45	3.42
5725	3.84	3.87	3.36	3.46
5825	3.76	3.79	3.44	3.39
Average	3.83	3.83	3.38	3.42

Results Summary

Antenna Efficiency (%) 2.4GHz Wi-Fi Antennas

Frequency (MHz)	ANT1 (%)	ANT2 (%)
2400	71	79
2450	73	77
2500	74	76
Average	72.6	77.3
Average Cable Loss Calibrated	87.2	82.3

Results Summary

Antenna Efficiency (%) 5GHz Wi-Fi Antennas

Frequency (MHz)	ANT1 (%)	ANT2 (%)	ANT3 (%)	ANT4 (%)
5050	72	77	74	74
5150	71	75	72	73
5350	71	74	72	73
5550	72	76	73	72
5725	72	75	73	74
5825	71	76	72	71
Average	71.5	75.50	72.7	72.8
Average Cable Loss Calibrated	92.7	82.5	84.6	82.0

Results Summary

ECC (Criterion: <0.15)

Frequency (MHz)	ECC
2400	0.09
2450	0.10
2500	0.07
5050	0.04
5150	0.09
5350	0.06
5550	0.07
5725	0.05
5825	0.06

Antenna Performance Summary

- VSWR, Isolation, peak gain and efficiency of 2.4/5G antenna meet specification.
- Due to the type current chamber is single probe, the device must lie down to accord with multi-probe chamber (top side of device towards +Z axis).

Comments for Further Improvement