Sagemcom Fast380ba

WiFi 7 Extender Proposal DVT

Update date: 2024/07/19

Agenda

- Specification & Block Diagram
- ME Outline, Dimensions and PCB placement
- Thermal Simulation Result
- Antenna Simulation Result (Updated)
- Appendix

Requirement of Antenna Design and Measurement

Requirements of Antenna Design

RF Function	Number of ANT	Frequency Band	Remark
Wi-Fi _ Dual Band	1	2400~2500MHz & 5150~5850MHz	PCB Antenna
Wi-Fi _ Dual Band	1	2400~2500MHz & 5150~5850MHz	Printing
Wi-Fi_6G	2	5925~7125MHz	PCB Antenna
Wi-Fi_6G	2	5925~7125MHz	Printing
BT	1	2400~2500MHz	Printing
Wi-Fi_5G	1	5150~5850MHz	PCB Antenna
Wi-Fi_5G	1	5150~5850MHz	Printing

Requirements of Measurement

Test Item	Specification	Result	
Efficiency	> 75%	75%~77%	Pass
Return Loss	< -15 dB	-15 dB ~ -34 dB	Pass
Isolation	2.4G < -20 dB ; 5G&6G < -30 dB	2.4G : -21 dB ~ -62dB 5G&6G : -30 dB ~ -82 dB	Pass
Peak Gain	2.4G < 4.5 dBi ; 5G&6G < 5.5 dBi	2.4G < 3.80 dBi 5G&6G < 5.47 dBi	Pass
ECC	0.2	< 0.104	Pass
Uncorrelated combined gain	Between -7 dB and 1 dB Maximum +/-15° apart vertical directions -3 dB	MAX : 0.75dB	Pass
Correlated combined gain	< 6 dB	< 6 dB	Pass

Conclusions

1. The Return Loss of all antennas are under 15dB.
2. All antenna isolation are meet requirement.
3. All antenna efficiency is around 75%~77%.
4. The Peak Gain of the BT1 antenna is about 2.52 to 2.75 dBi;

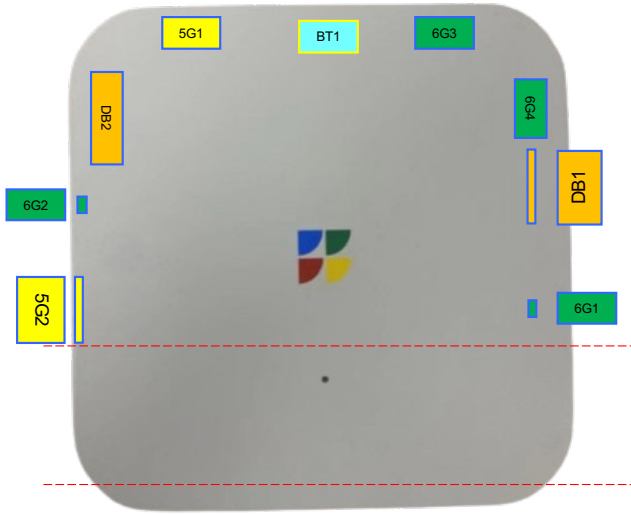
   The Peak Gain of the DB1 ~DB2 antenna is about 3.41 to 5.36 dBi;

   The Peak Gain of the 5G1~5G2 antenna is about 4.52 to 5.30 dBi;

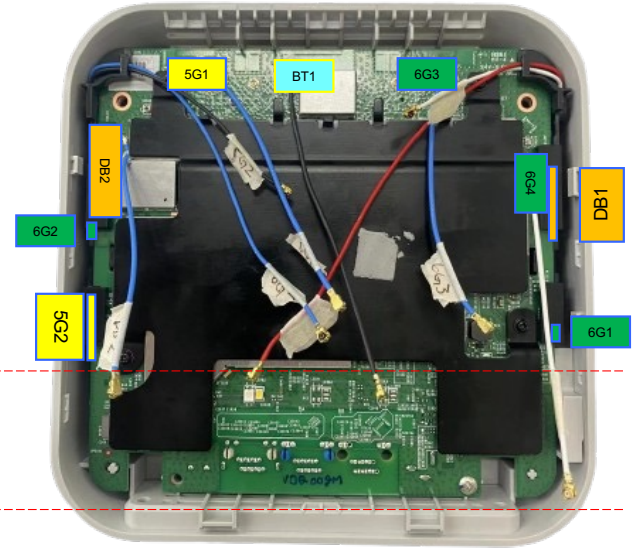
   The Peak Gain of the 6G1~6G4 antenna is about 4.37 to 5.47 dBi.
5. The ECC of all antennas is under 0.2.
6. The correlated gain is under 6 dBi.

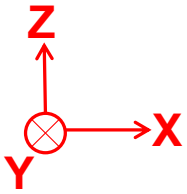
Product / Antenna Overview

Front



Front





5 cm

Antenna	Frequency (MHz)	Test Cable	Cable length	Antenna Size
DB1	2400-2500 5150-5850	phi=1.13mm,LLS I-PEX connector	163 mm	32mm X 17mm
5G2	5150-5850	phi=1.13mm,LLS I-PEX connector	144 mm	20mm X 10mm
6G1-6G2	5925-7125	phi=1.13mm,LLS I-PEX connector	130 / 167 mm	20mm X 10mm
DB2	2400-2500 5150-5850	phi=1.13mm,LLS I-PEX connector	NA	Printing
BT1	2400-2500	phi=1.13mm,LLS I-PEX connector	NA	Printing
5G1	5150-5850	phi=1.13mm,LLS I-PEX connector	NA	Printing
6G3-6G4	5925-7125	phi=1.13mm,LLS I-PEX connector	NA	Printing

Product / Antenna Overview

Front

Top

Back

Side

Antenna cable loss

Antenna	cable length	Frequency (MHz)	Cable loss (dB)
DB1	163 mm	2400	0.49
		2450	0.50
		2500	0.50
		5150	0.69
		5470	0.70
		5850	0.71
5G2	144 mm	5150	0.60
		5470	0.63
		5850	0.64

1

Antenna cable loss

Antenna	cable length	Frequency (MHz)	Cable loss (dB)
6G1	130 mm	5925	0.59
		7525	0.62
		7125	0.63
6G2	167 mm	5925	0.75
		7525	0.80
		7125	0.82

Antenna S-Parameter

Frequency (MHz)	BT	DB1	DB2	5G1	5G2
2400	15	16	17		
2450	17	19	24		
2500	15	16	19		
5150		19	16	16	15
5470		28	20	18	23
5850		25	15	15	28

Frequency (MHz)	6G1	6G2	6G3	6G4
5925	24	33	17	16
6525	34	20	25	18
7125	18	15	19	18

Antenna Isolation(1)

Frequency (MHz)	BT1 & DB1	BT1 & DB2	BT1 & 5G1	BT1 & 5G2	BT1 & 6G1	BT1 & 6G2	BT1 & 6G3	BT1 & 6G4
2400	31	27	26	37	39	33	23	23
2450	21	24	25	35	41	35	23	24
2500	23	24	23	33	42	36	22	25
5150	46	37	38	48				
5470	49	42	41	48				
5850	55	56	43	48				
5925					47	53	40	36
6525					47	45	33	37
7125					44	48	38	46

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Antenna Isolation(2)

Frequency (MHz)	DB1 & DB2	DB1 & 5G1	DB1 & 5G2	DB1 & 6G1	DB1 & 6G2	DB1 & 6G3	DB1 & 6G4
2400	24	27	39	22	44	35	26
2450	24	26	44	23	44	30	26
2500	26	25	46	26	41	30	30
5150	34	36	55	32	45	43	34
5470	41	72	45	35	45	34	35
5850	48	43	51	38	43	48	40
5925				38	43	51	38
6525				36	46	51	35
7125				32	50	39	32

1

Antenna Isolation(3)

Frequency (MHz)	DB2 & 5G1	DB2 & 5G2	DB2 & 6G1	DB2 & 6G2	DB2 & 6G3	DB2 & 6G4
2400	33	33	41	32	23	24
2450	31	31	38	33	26	29
2500	33	33	40	39	29	35
5150	34	35	36	41	42	31
5470	34	34	41	37	40	38
5850	32	36	42	32	35	35
5925			41	32	31	31
6525			48	32	36	34
7125			46	42	35	40

1

Antenna Isolation(4)

Frequency (MHz)	5G1 & 5G2	5G1 & 6G1	5G1 & 6G2	5G1 & 6G3	5G1 & 6G4
2400					
2450					
2500					
5150	31	47	32	33	31
5470	32	45	32	32	38
5850	47	57	35	42	34
5925		53	31	50	35
6525		45	45	39	35
7125		47	41	31	45

1

Antenna Isolation(5)

Frequency (MHz)	5G2 & 6G1	5G2 & 6G2	5G2 & 6G3	5G2 & 6G4
2400				
2450				
2500				
5150	33	30	42	52
5470	39	32	40	32
5850	50	36	44	35
5925	46	36	42	35
6525	39	35	47	36
7125	49	37	45	46

1

Antenna Isolation(6)

Frequency (MHz)	6G1 & 6G2	6G1 & 6G3	6G1 & 6G4	6G2 & 6G3	6G2 & 6G4	6G3 & 6G4
2400						
2450						
2500						
5150						
5470						
5850						
5925	38	48	36	57	44	34
6525	35	43	41	55	42	32
7125	45	34	36	46	51	35

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Efficiency and Peak Gain(1)

Frequency (MHz)	BT1		DB1		DB2		5G1		5G2	
	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)
2400	2.52	75.69	3.73	75.39	3.55	76.01				
2450	2.75	76.12	3.80	76.76	3.62	76.99				
2500	2.75	75.50	3.79	75.66	3.41	76.16				
5150			5.27	76.61	4.82	75.71	4.52	76.35	4.99	75.92
5470			5.36	76.85	5.31	76.11	4.62	76.17	5.30	76.44
5850			5.17	75.02	4.49	75.18	4.42	75.74	5.04	75.99

Efficiency and Peak Gain(2)

Frequency (MHz)	6G1		6G2		6G3		6G4	
	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)
5925	5.06	75.62	4.80	76.37	4.80	75.19	4.55	75.89
6525	5.47	76.77	4.91	76.48	5.28	77.16	5.12	76.65
7125	5.21	75.49	4.77	75.67	5.18	75.76	4.37	75.71

Correlated Gain and Uncorrelated Gain

Correlated signals

Any transmit beamforming mode, whether fixed or adaptive Examples: Phased arrays, Closed Loop MIMO, Transmitter Adaptive Antenna, Maximum Ratio Transmission (MRT), or Statistical Eigen Beamforming (EBF)

Cyclic Delay Diversity (CDD) modes Example: Legacy modes in 802.11n
Same digital data carried by each Tx antenna, but with different cyclic delays
Signals are highly correlated at any one frequency

Completely uncorrelated signals (if not combined with a correlated mode)

Space Time Block Codes (STBC) or Space Time Codes (STC) for which different digital data is carried by each Tx antenna during any symbol periodExample: WiMAX Matrix A (Alamouti coding)

Spatial Multiplexing MIMO (SM-MIMO) Example: WiMAX Matrix B; Matrix C, which adds diversity, is also uncorrelated
Independent data streams sent to each Tx antenna

Unequal antenna gain, equal transmit powers

For antenna gains = G_1 , G_2 , …, G_N dBi

If transmit signals are correlated, thenDirectional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 /N]$ dBi

If all transmit signals are completely uncorrelated, thenDirectional gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10})/N]$ dBi

Correlated Gain Table

Frequency (MHz)	2D XZ plane		2D YZ plane		2D XY plane	
	Peak Gain (dBi)	Average Gain (dBi)	Peak Gain (dBi)	Average Gain (dBi)	Peak Gain (dBi)	Average Gain (dBi)
2450	5.43	3.10	5.41	3.06	5.29	2.82
5470	5.54	2.88	5.71	3.34	5.41	2.74
6525	5.69	2.44	5.89	3.32	4.72	1.96

Uncorrelated Gain Table

Frequency (MHz)	2D XZ plane		2D YZ plane		2D XY plane	
	Peak Gain (dBi)	Average Gain (dBi)	Peak Gain (dBi)	Average Gain (dBi)	Peak Gain (dBi)	Average Gain (dBi)
2450	0.69	-1.40	0.75	-1.47	0.56	-1.85
5470	0.26	-2.27	0.06	-2.15	0.38	-2.48
6525	0.54	-2.89	0.54	-2.22	-0.63	-3.48

ECC Table(1)

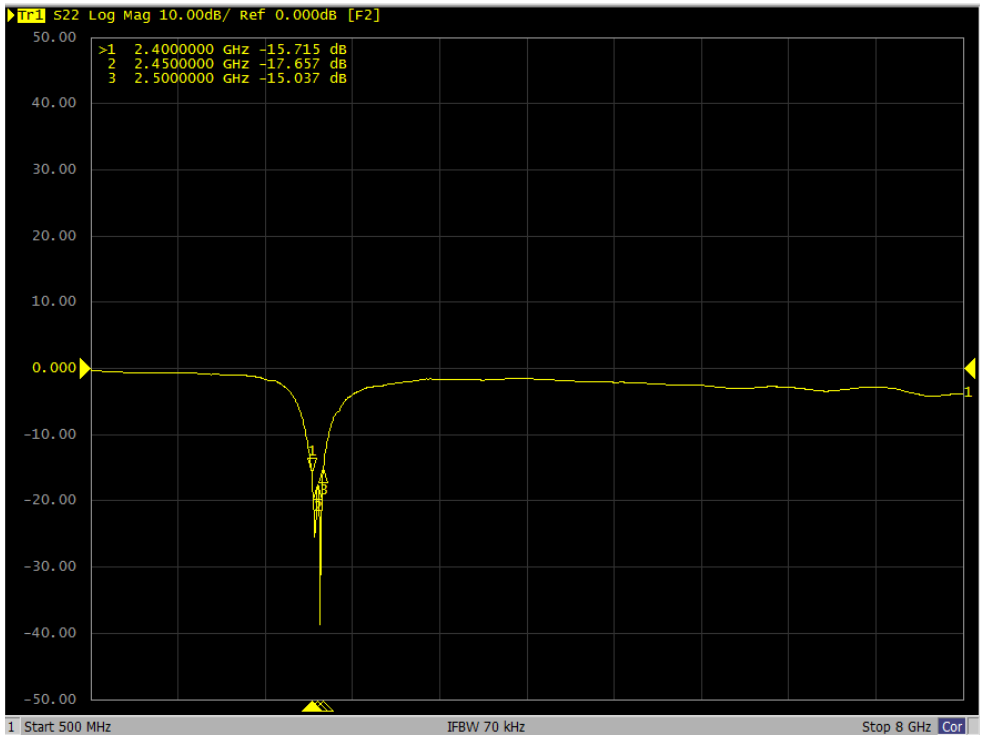
Frequency (MHz)	BT1 VS DB1	BT1 VS DB2	BT1 VS 5G1	BT1 VS 5G2	DB1 VS DB2	DB1 VS 5G1	DB1 VS 5G2	DB2 VS 5G1	DB2 VS 5G2	5G1 VS 5G2
2400	0.0204	0.0226	0.0823	0.0082	0.0124	0.0094	0.0182	0.0224	0.0172	0.0173
2450	0.0145	0.0325	0.0813	0.0093	0.0193	0.0083	0.0129	0.0168	0.0124	0.0184
2500	0.0102	0.0136	0.0882	0.0077	0.0193	0.0082	0.0188	0.0148	0.0174	0.0163
5150	0.0083	0.0182	0.0124	0.0062	0.0119	0.0142	0.0294	0.0758	0.0734	0.0535
5470	0.0136	0.0173	0.0129	0.0124	0.0038	0.0204	0.0228	0.0835	0.0692	0.0634
5850	0.0115	0.0193	0.0119	0.0193	0.0079	0.0284	0.0264	0.0783	0.0835	0.0619

ECC Table(2)

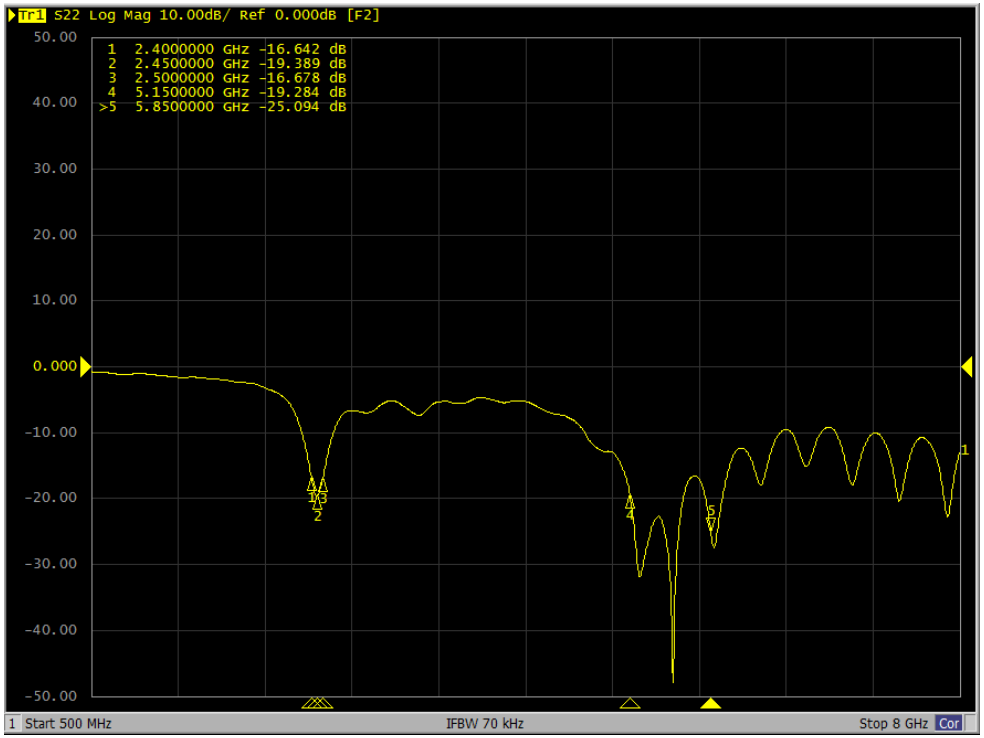
Frequency (MHz)	6G1 VS 6G2	6G1 VS 6G3	6G1 VS 6G4	6G2 VS 6G3	6G2 VS 6G4	6G3 VS 6G4
5925	0.0372	0.0235	0.104 3	0.0529	0.0526	0.0383
6525	0.0482	0.0184	0.0735	0.0503	0.0357	0.0433
7125	0.0411	0.0163	0.1502	0.0482	0.0284	0.0382

Return Loss

BT1

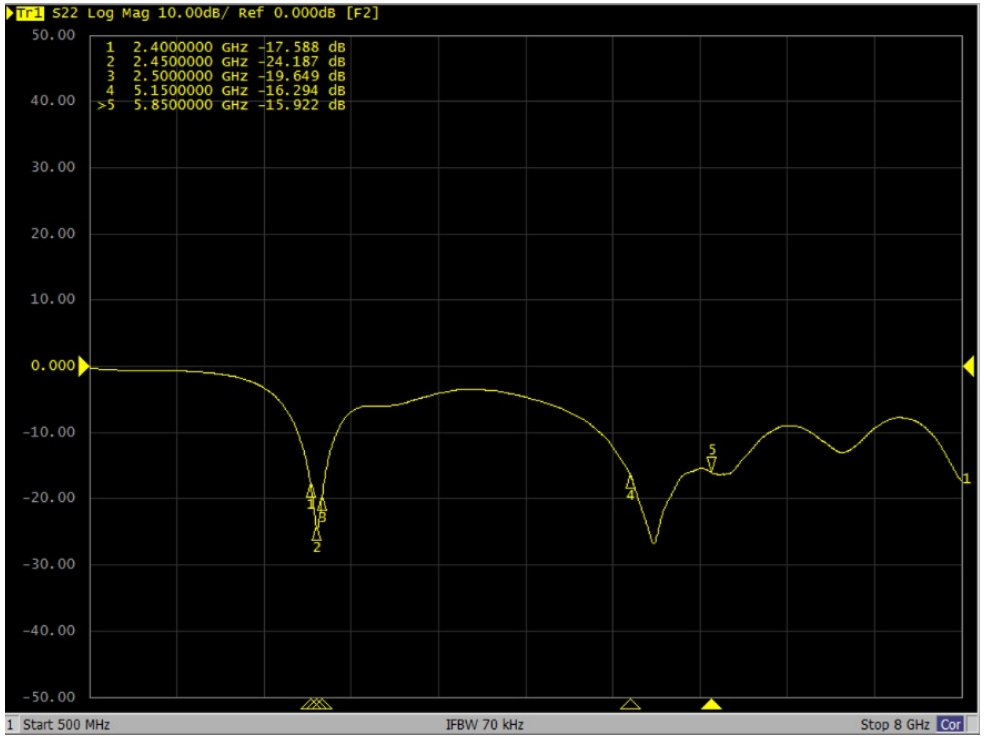


DB1

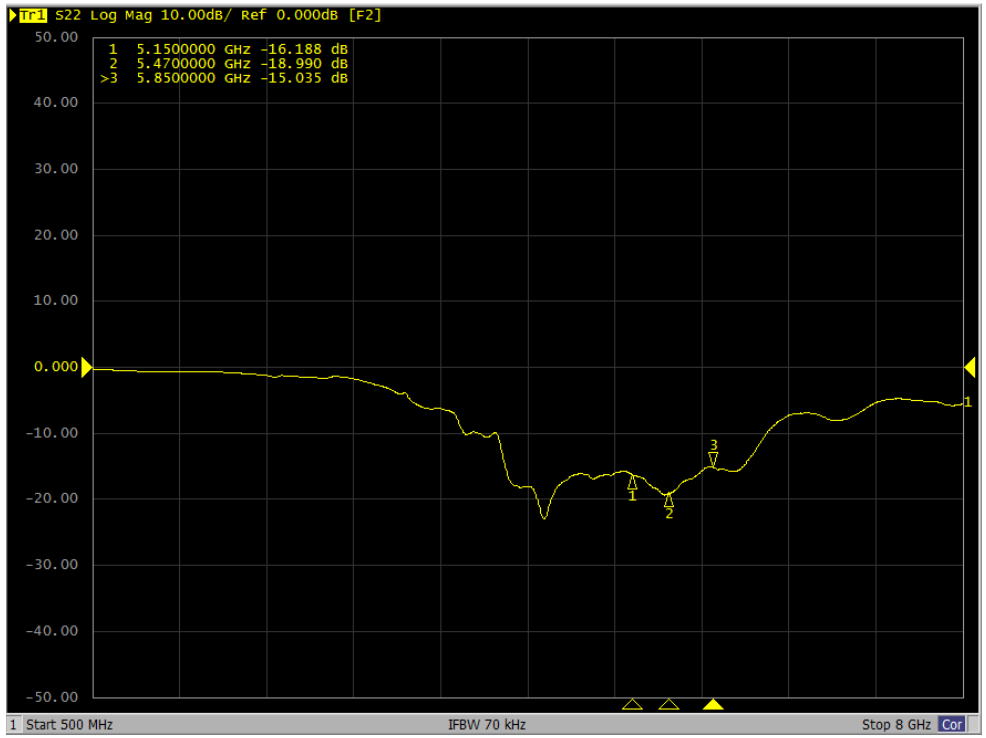


Return Loss

DB2

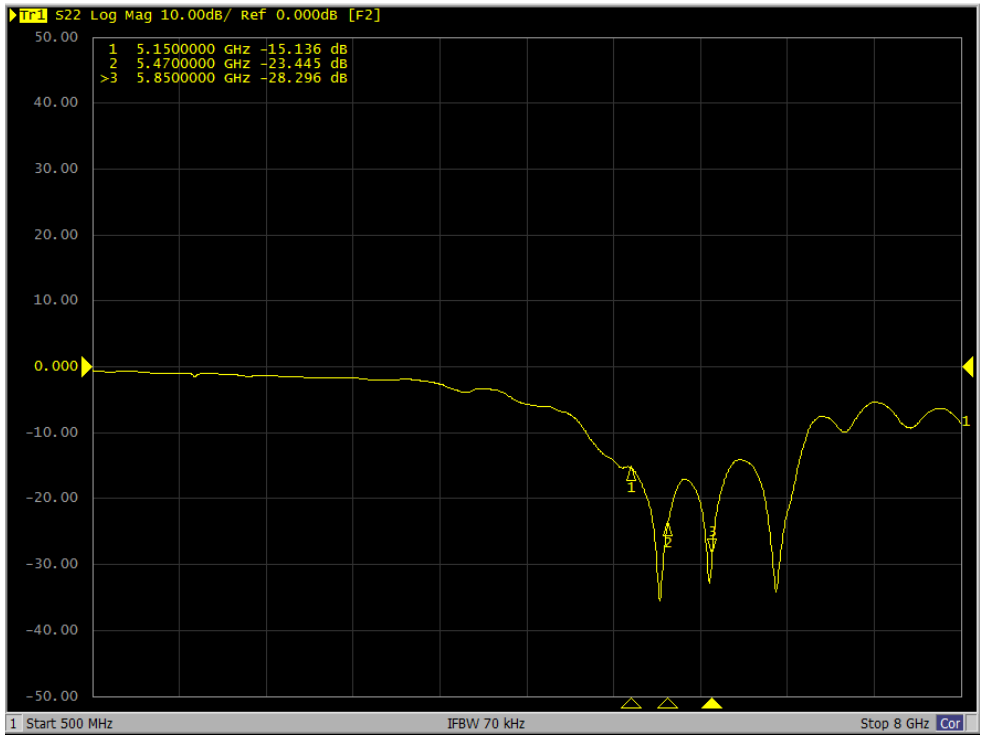


5G1

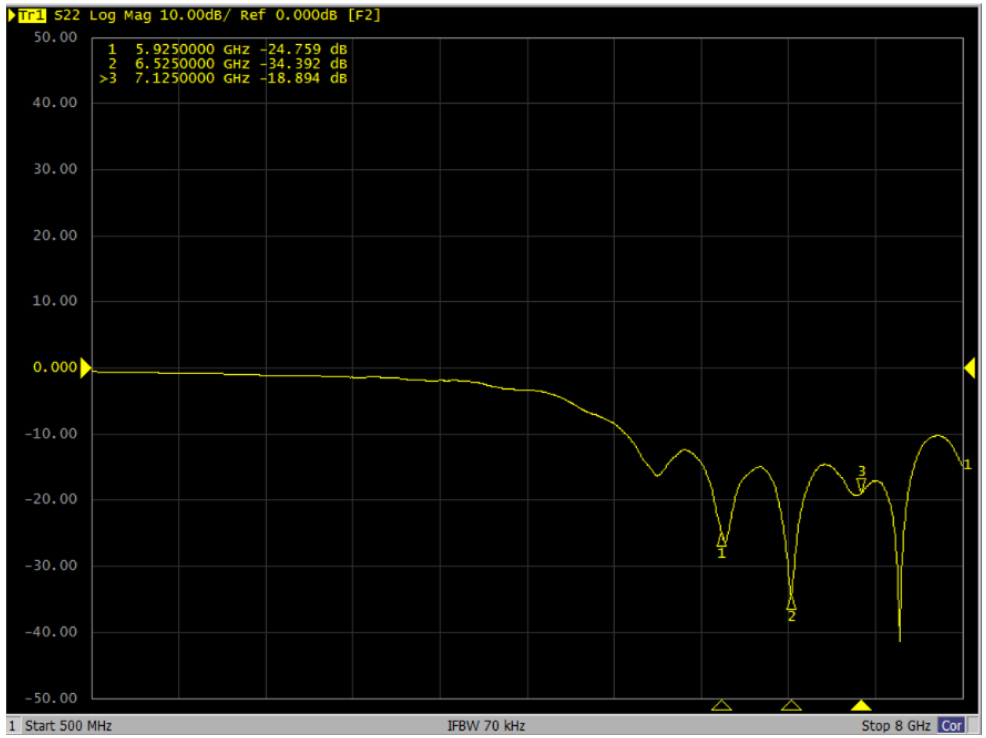


Return Loss

5G2

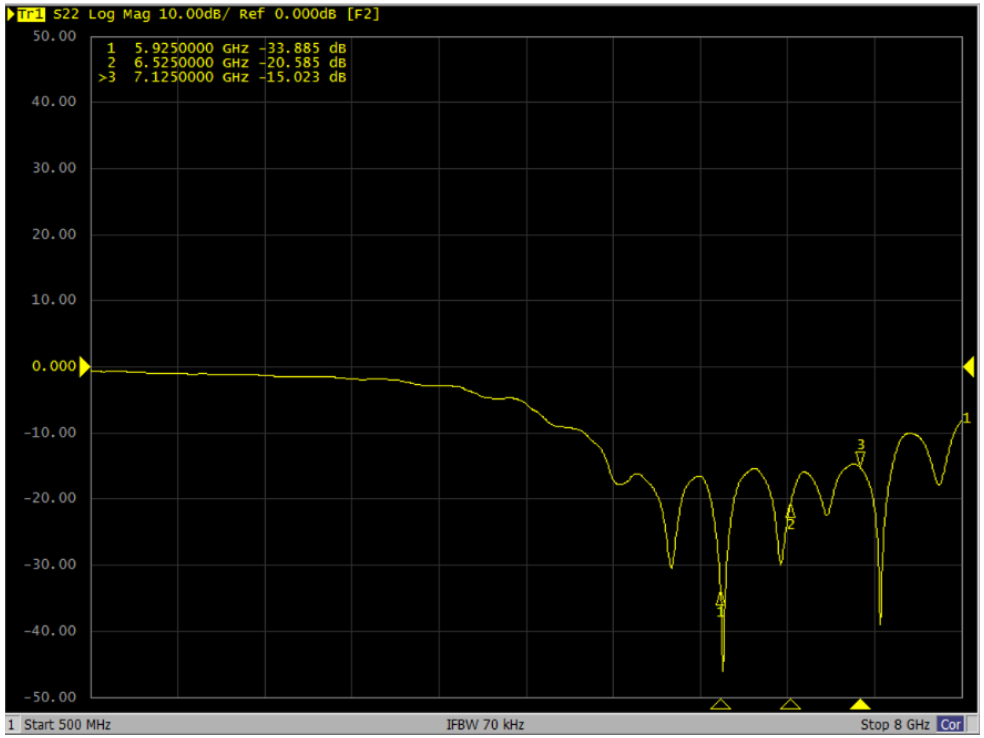


6G1



Return Loss

6G2



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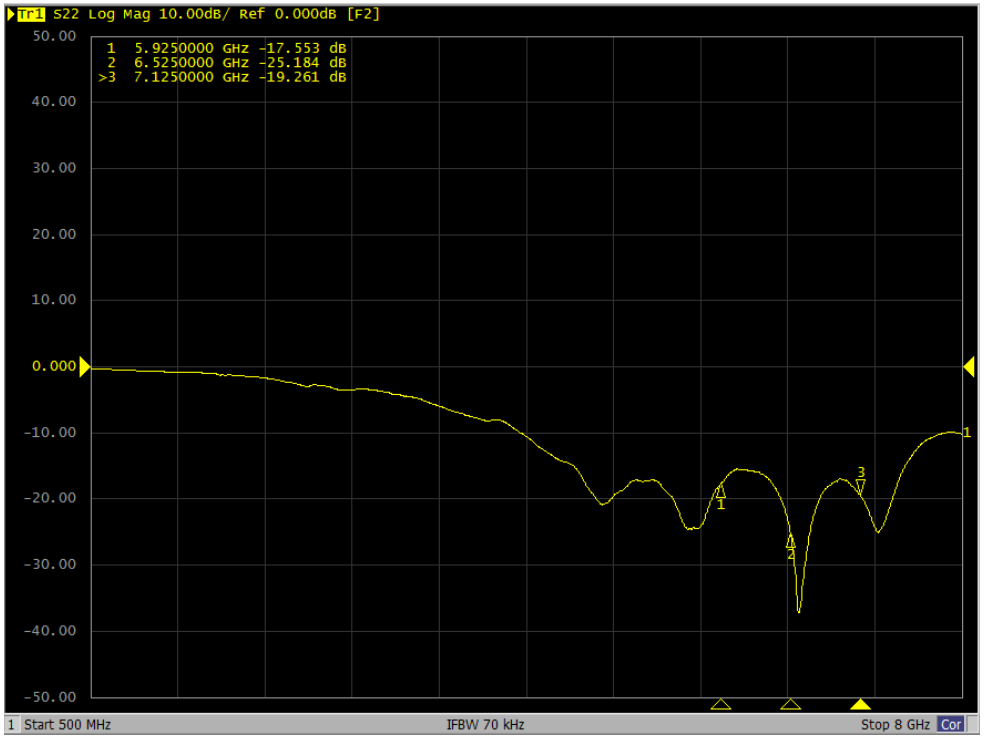
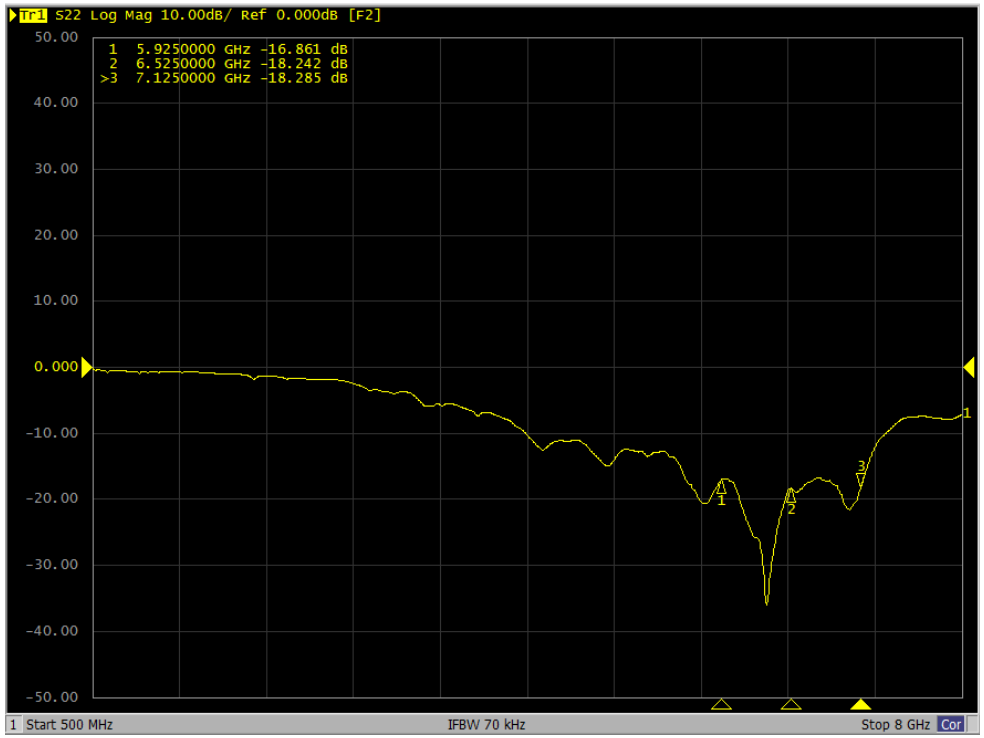


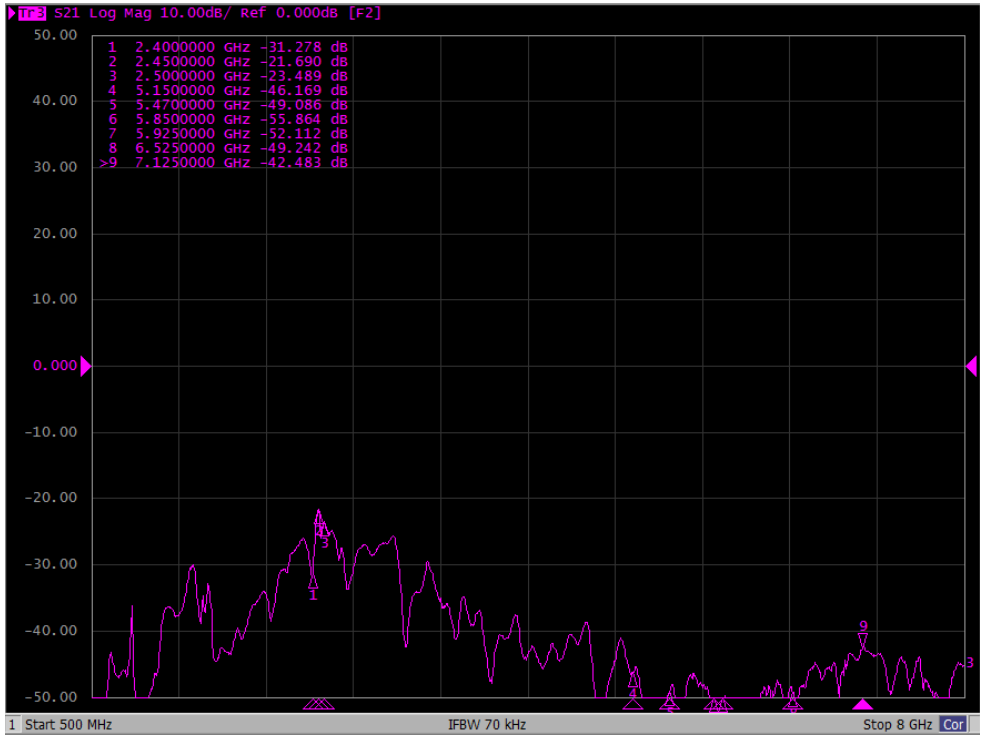
Return Loss

6G4

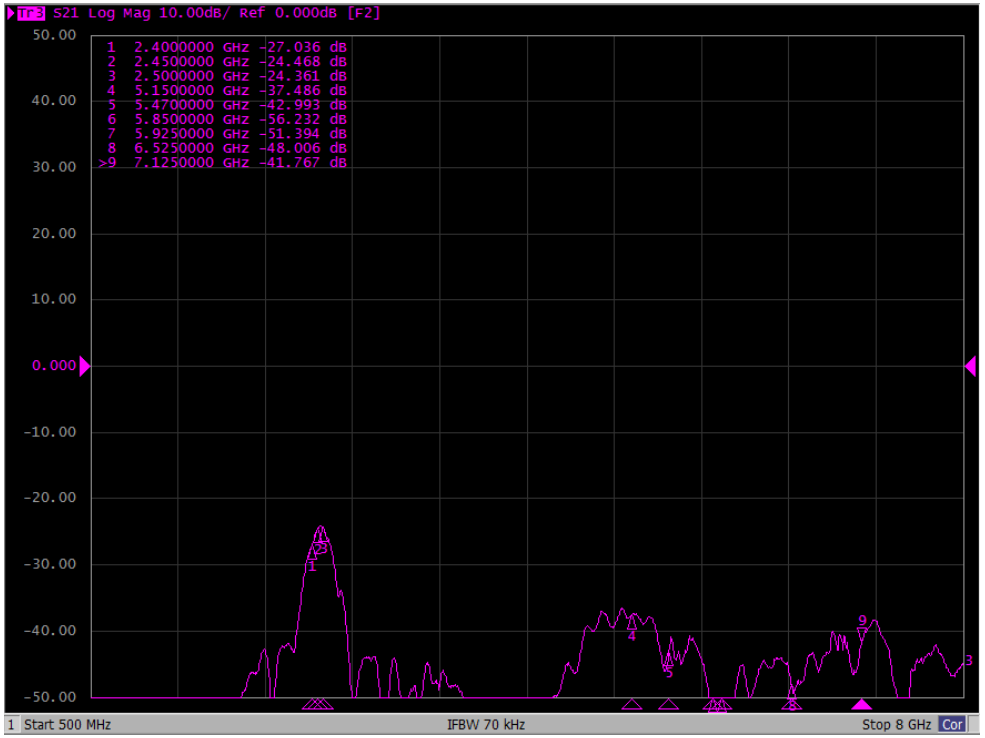


Isolation

BT1_DB1

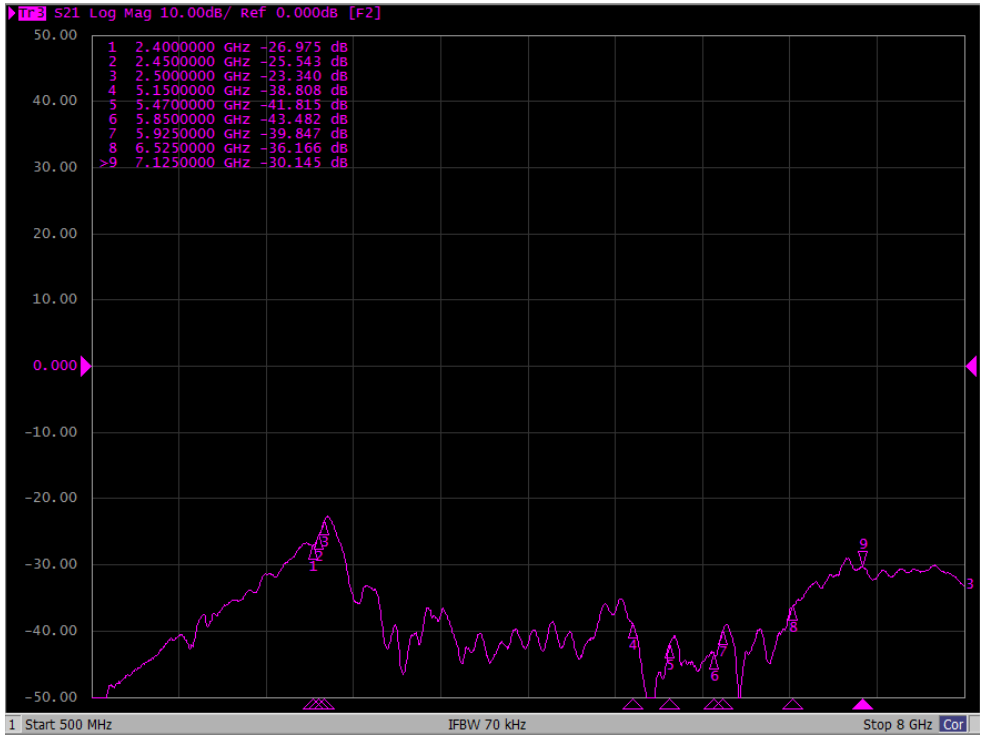


BT1_DB2

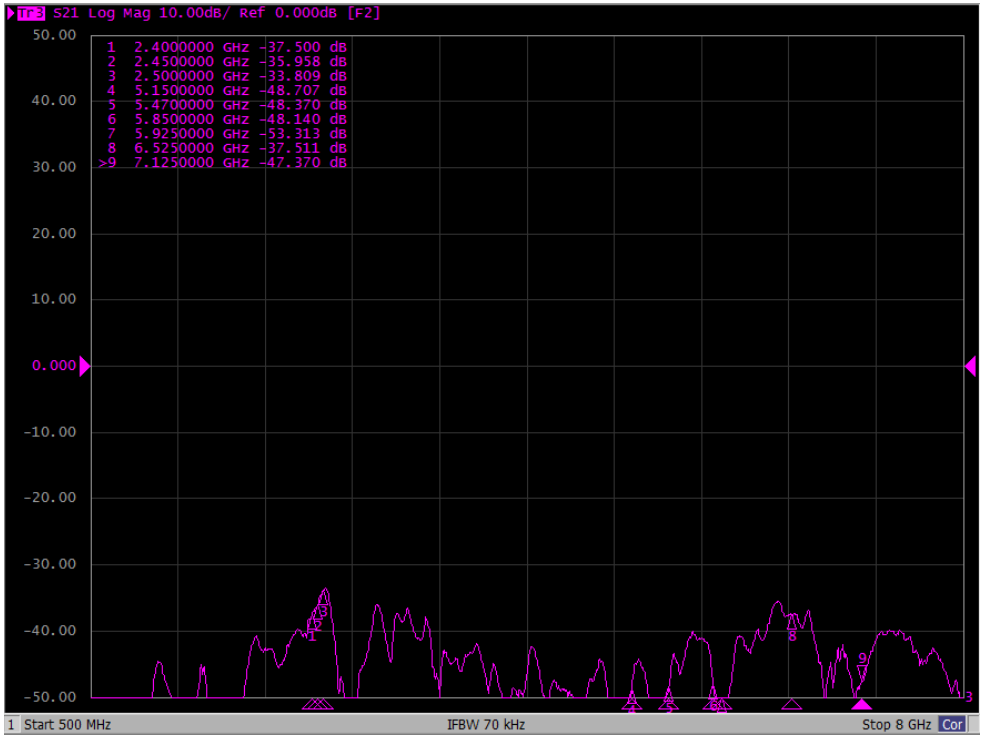


Isolation

BT1_5G1

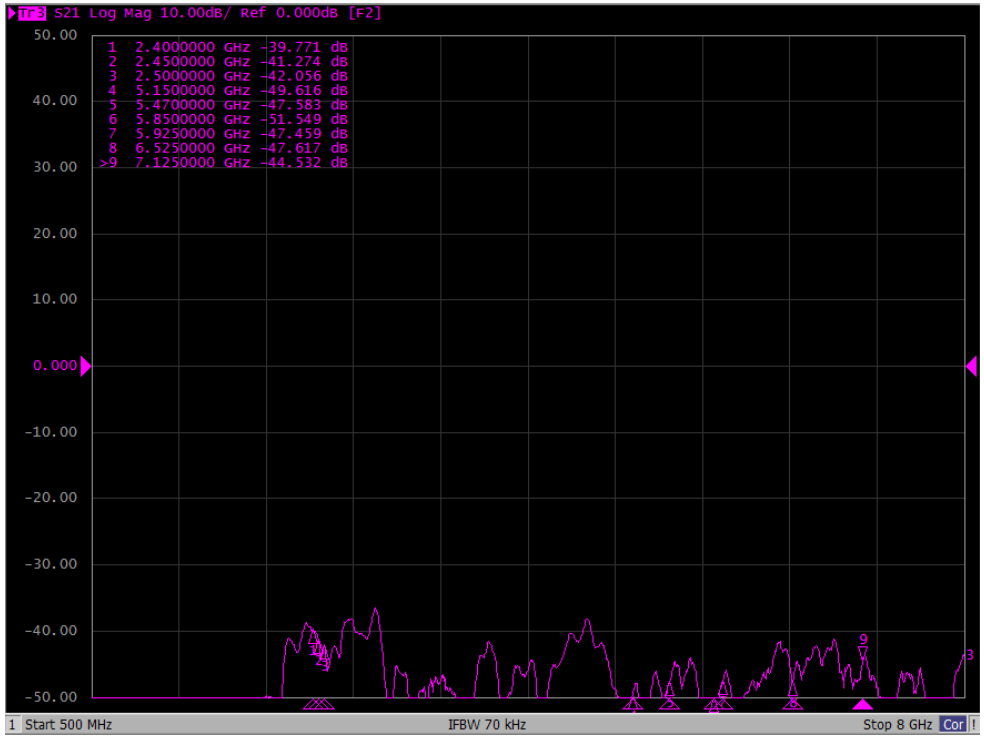


BT1_5G2

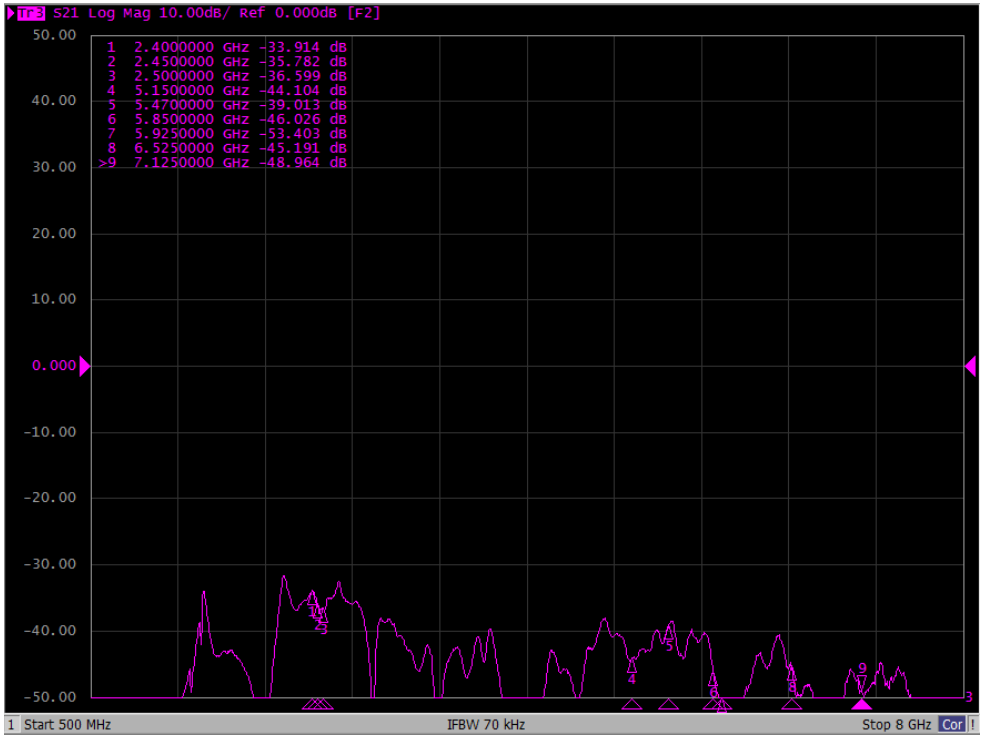


Isolation

BT1_6G1

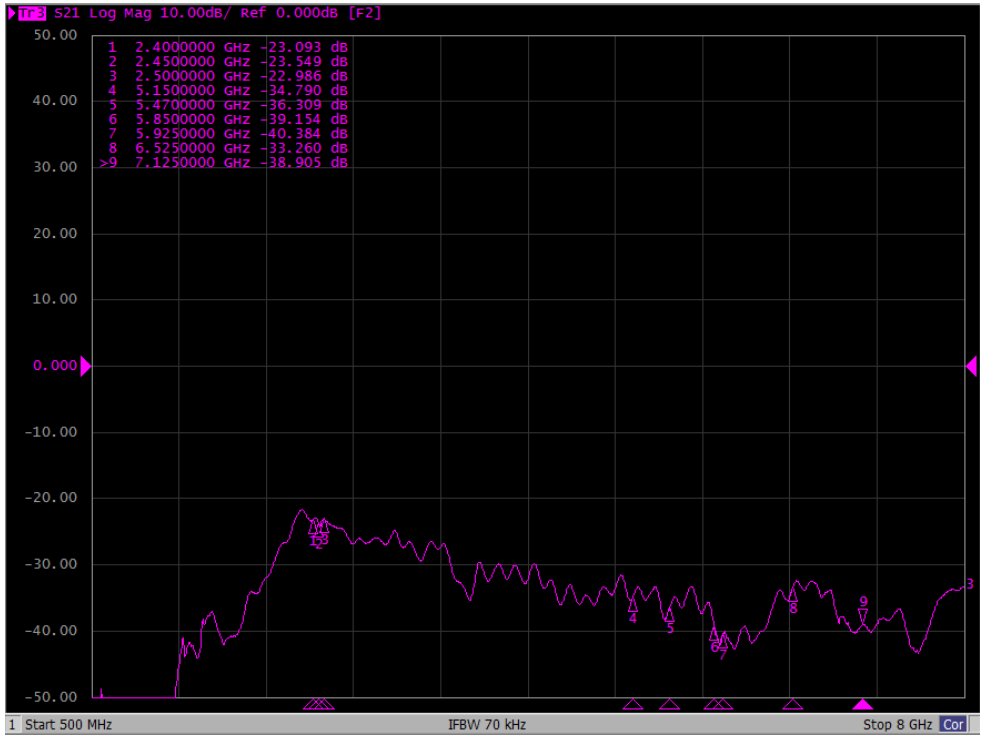


BT1_6G2

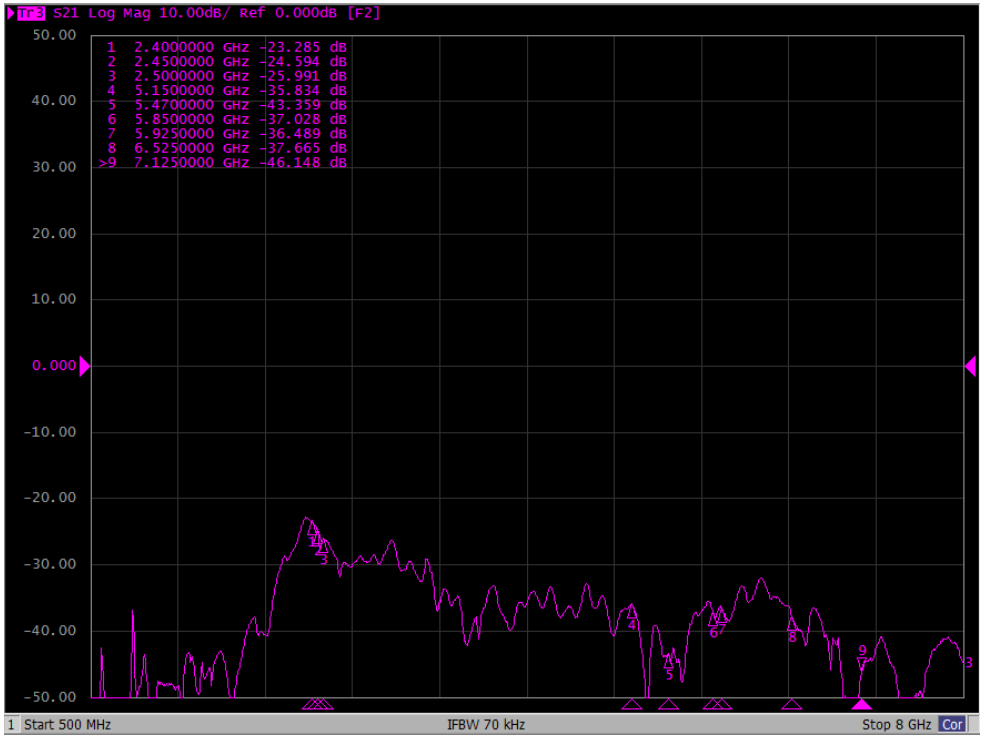


Isolation

BT1_6G3

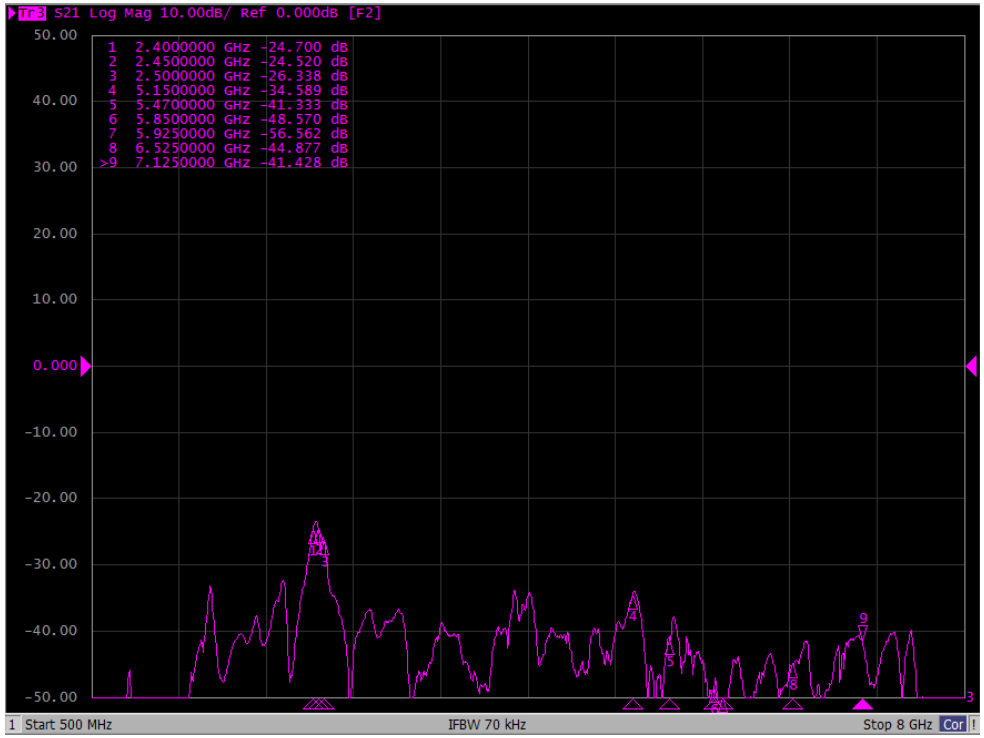


BT1_6G4

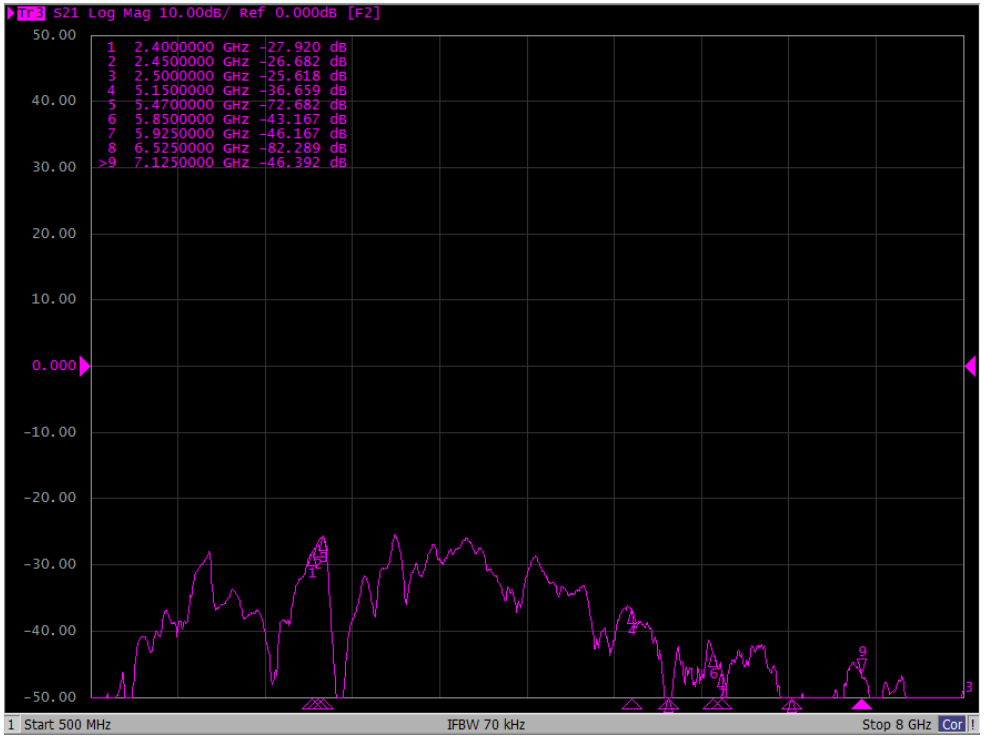


Isolation

DB1_DB2

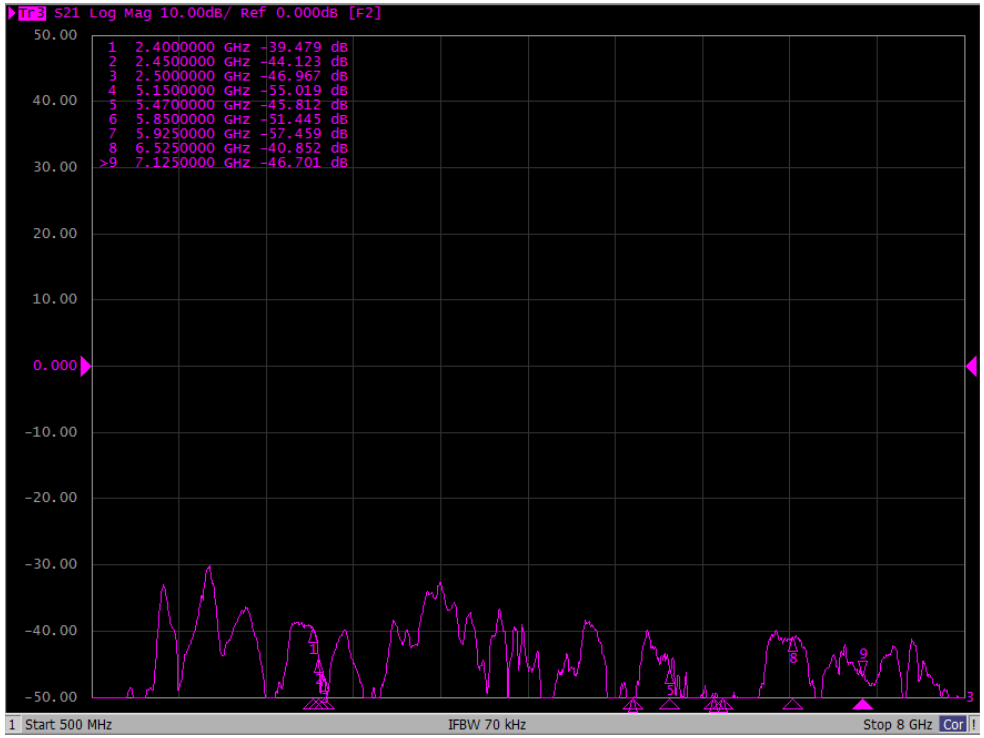


DB1_5G1

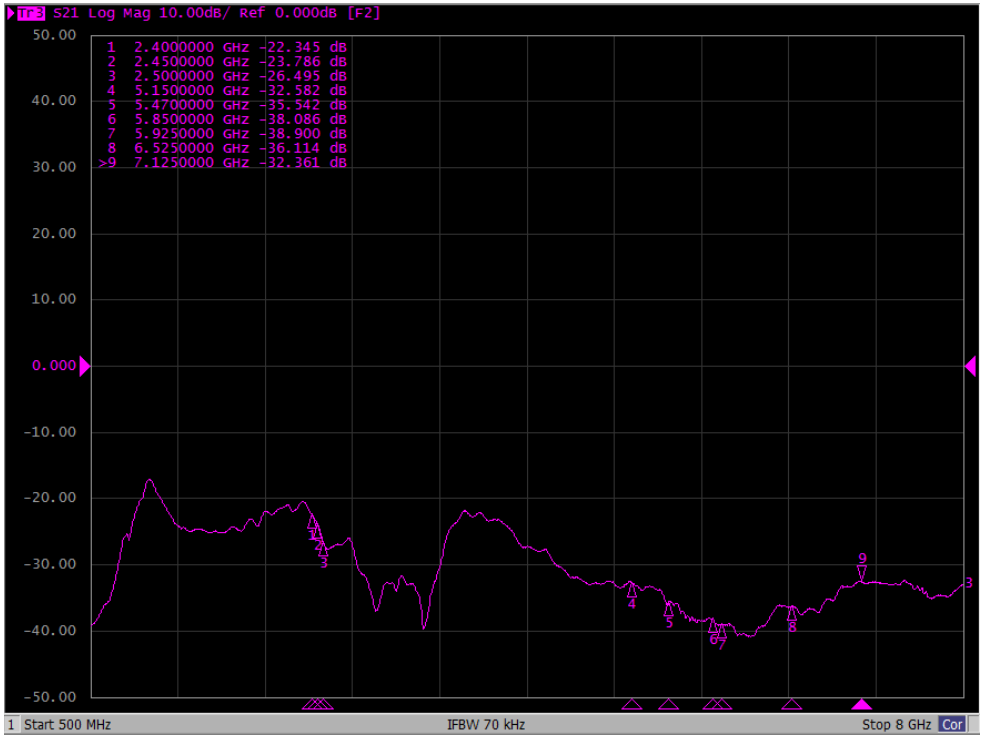


Isolation

DB1_5G2

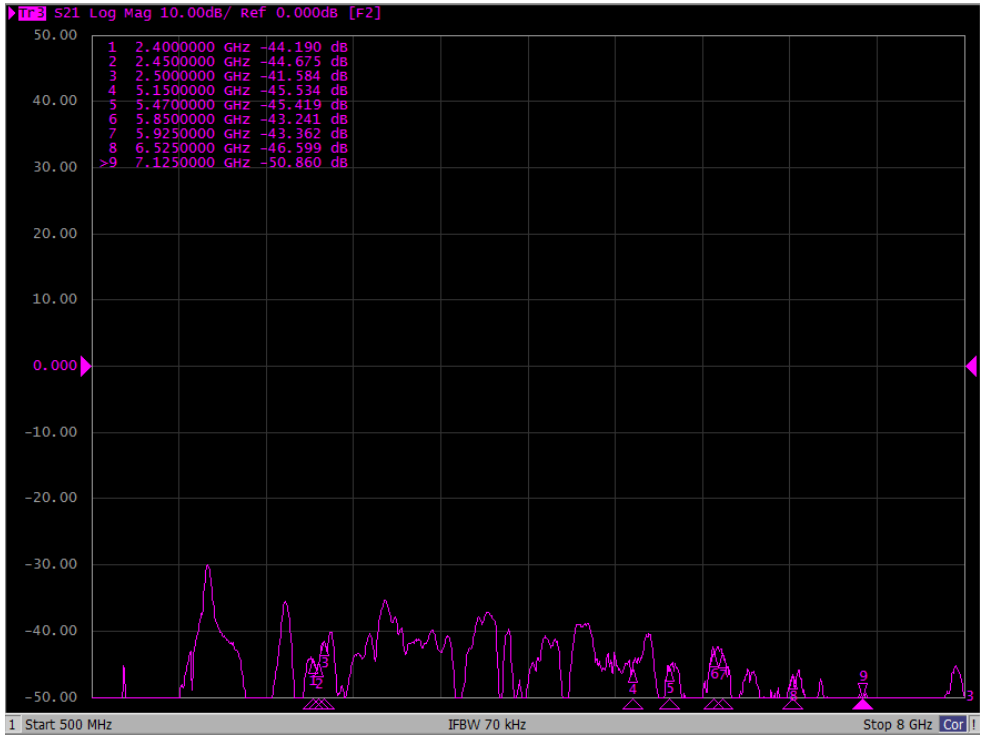


DB1_6G1

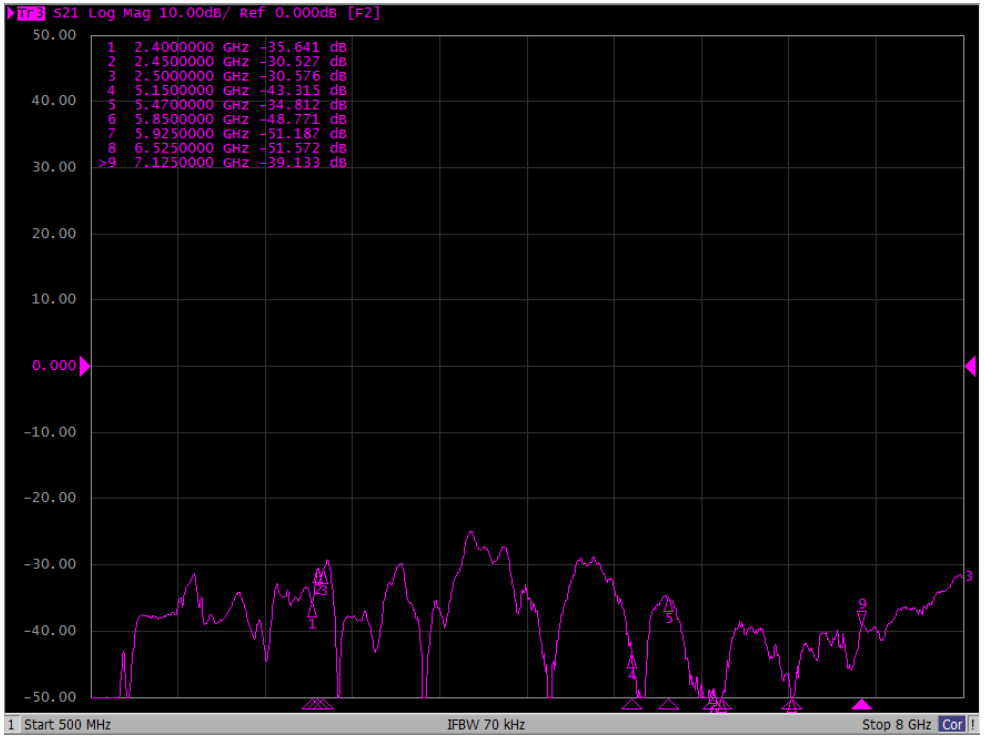


Isolation

DB1_6G2

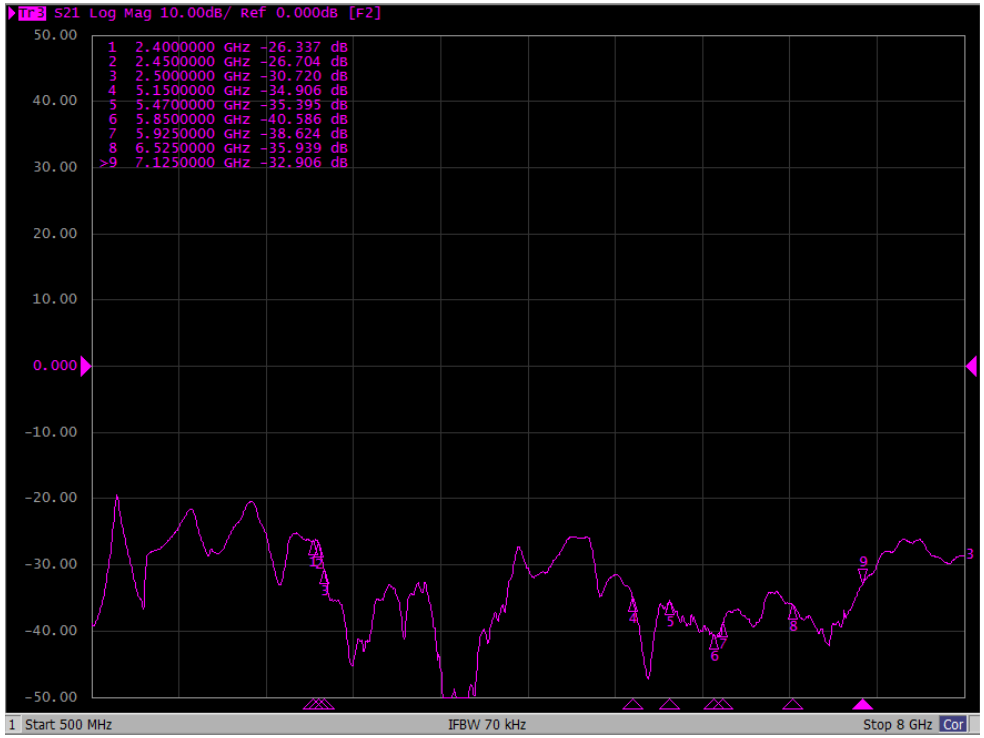


DB1_6G3

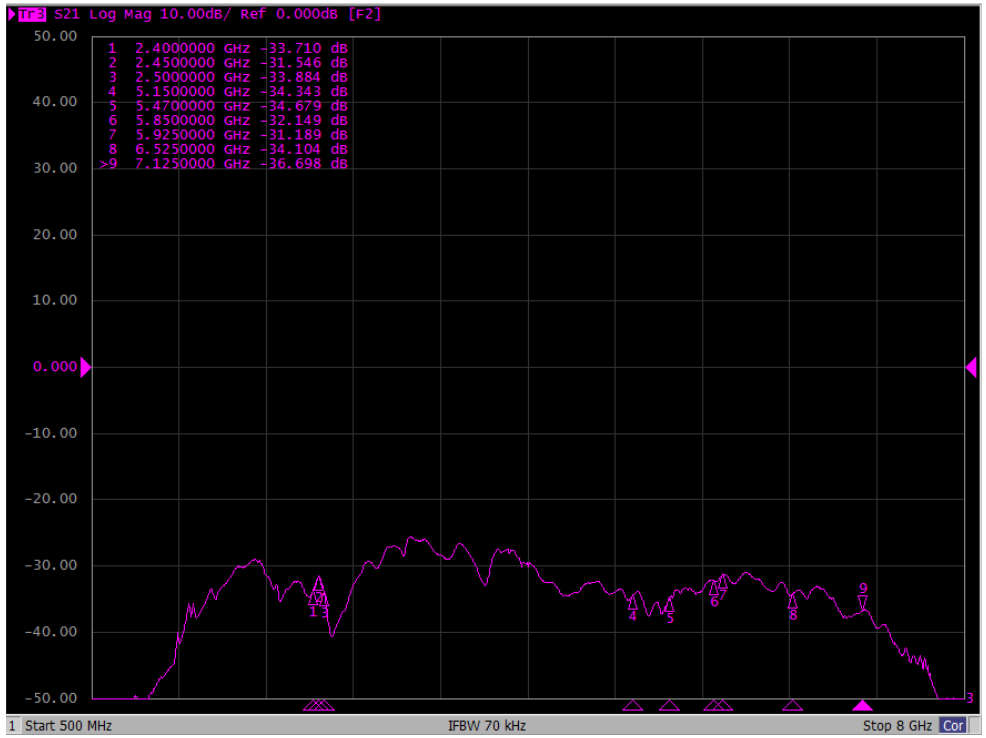


Isolation

DB1_6G4

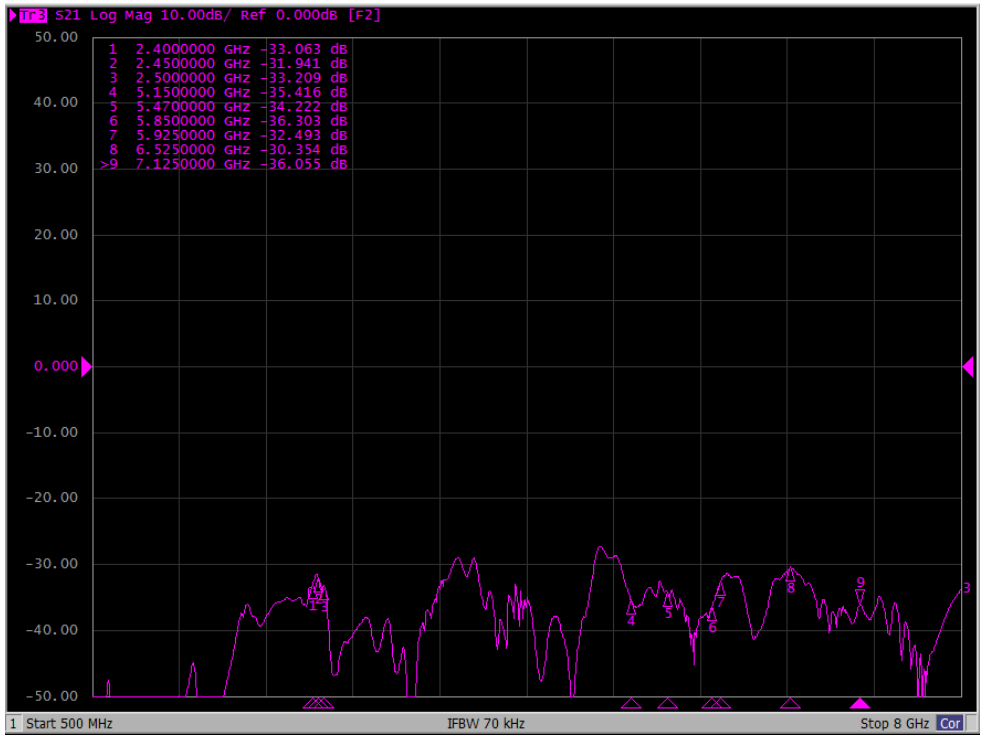


DB2_5G1

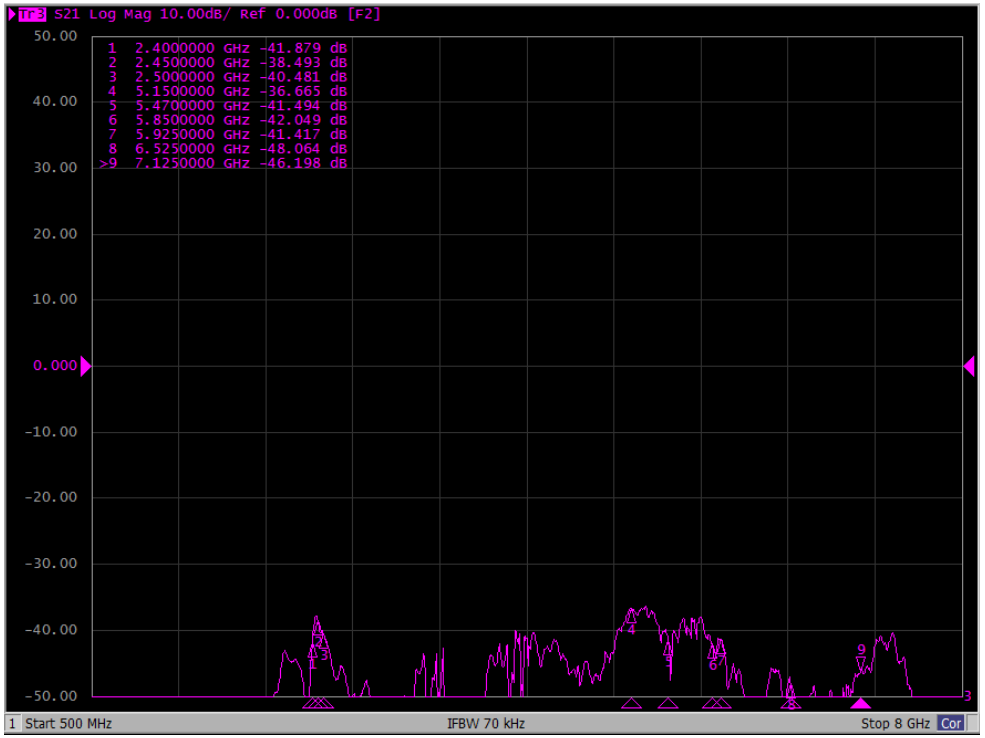


Isolation

DB2_5G2

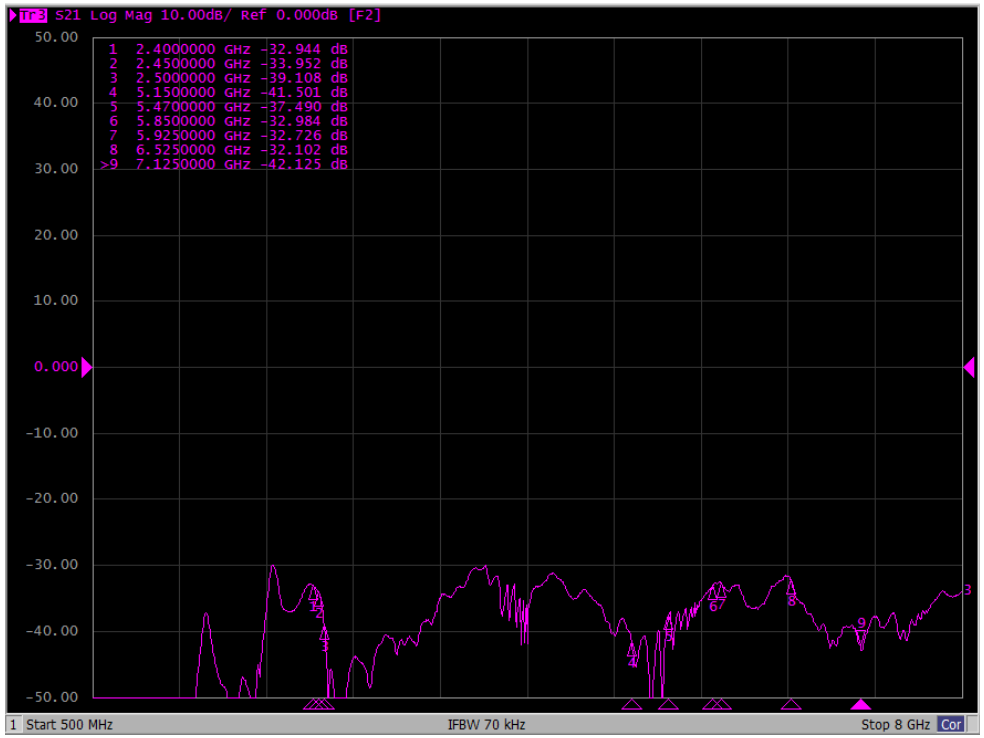


DB2_6G1

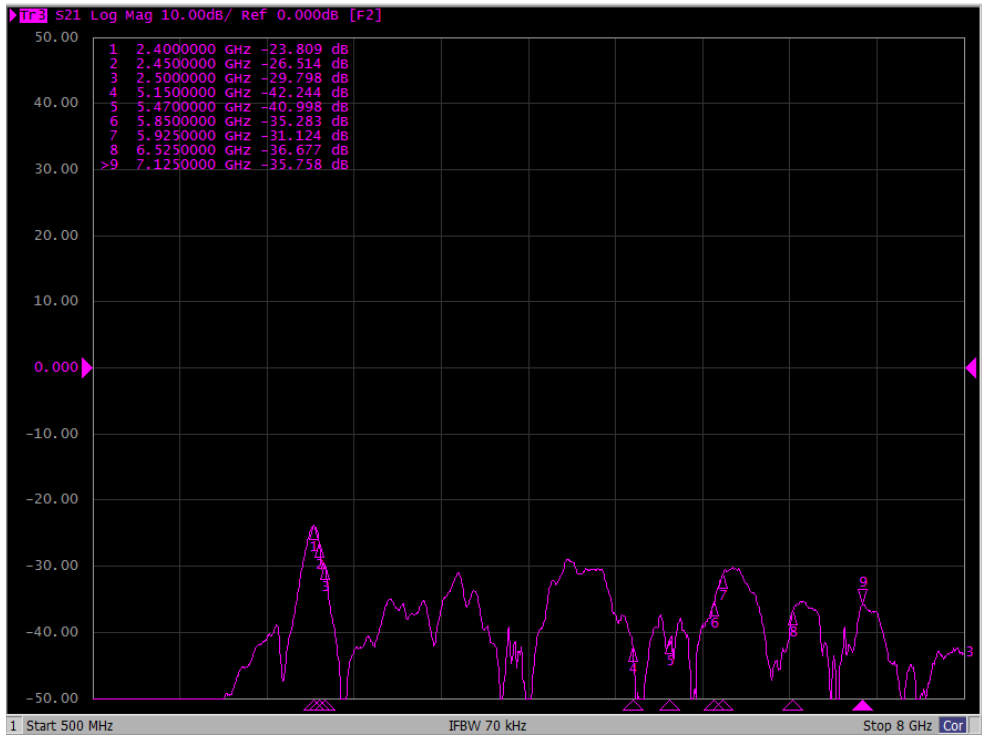


Isolation

DB2_6G2

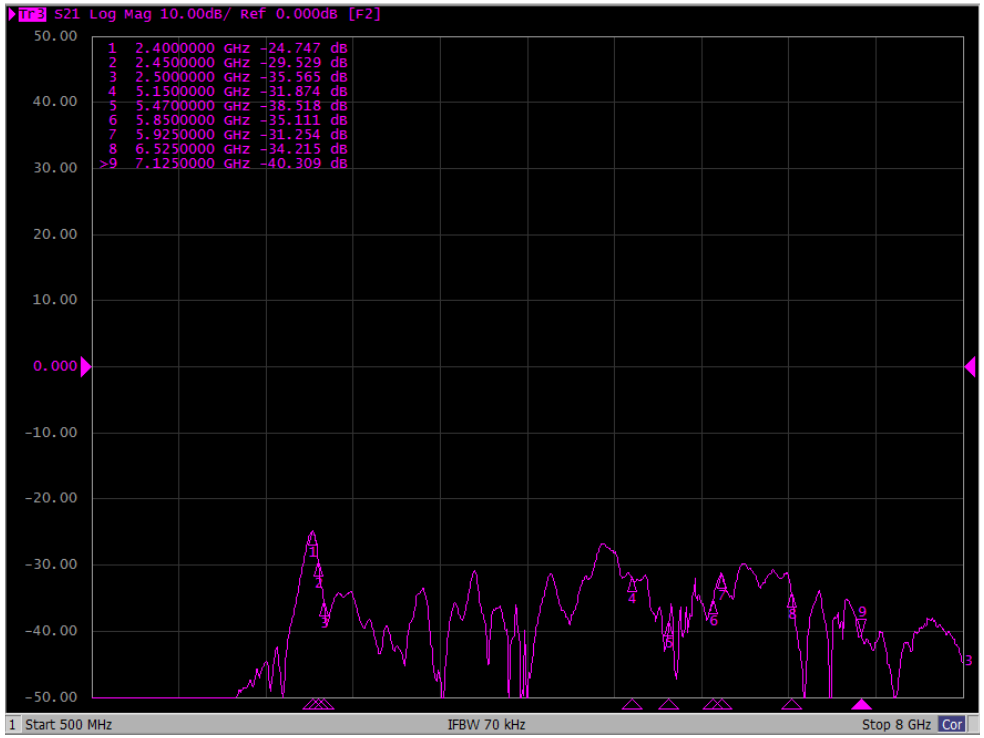


DB2_6G3

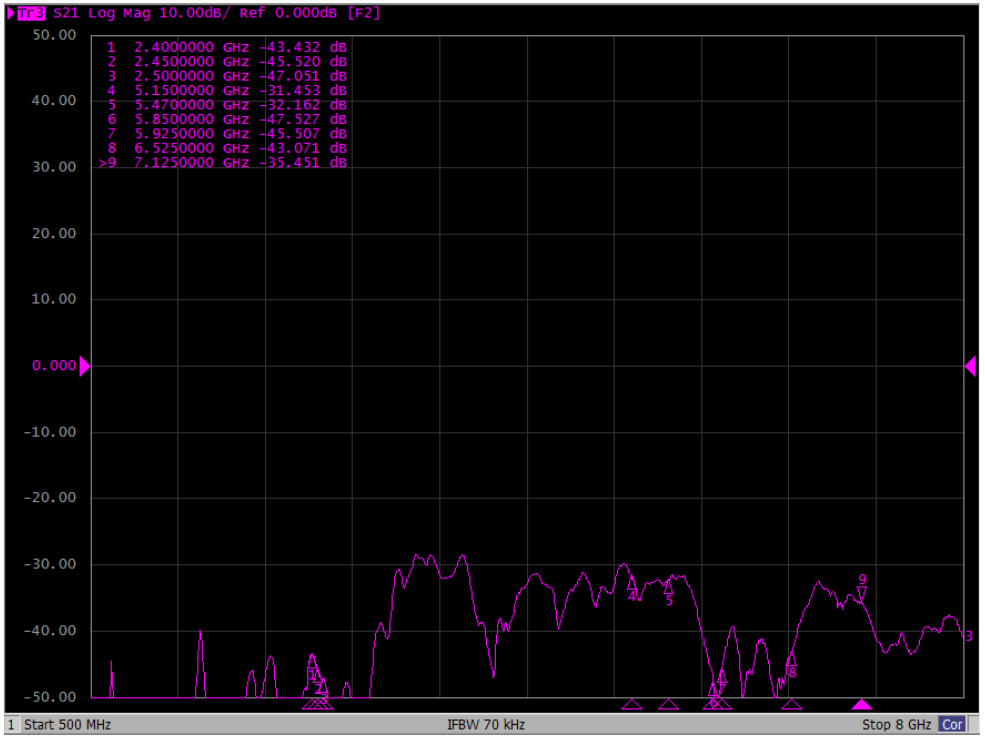


Isolation

DB2_6G4

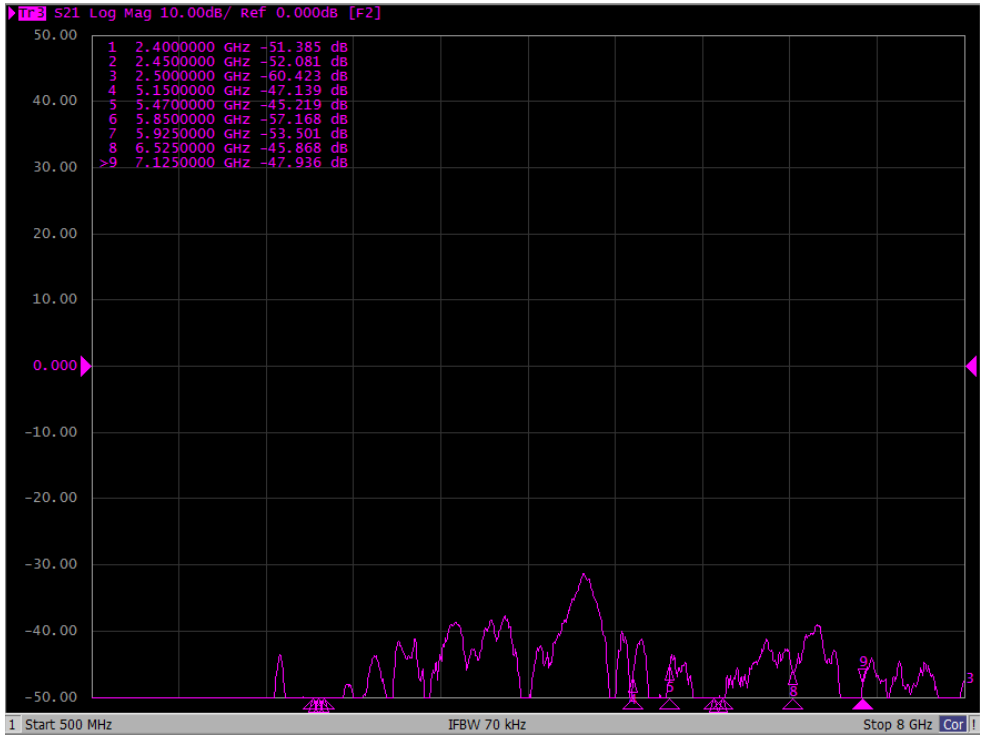


5G1_5G2



Isolation

5G1_6G1



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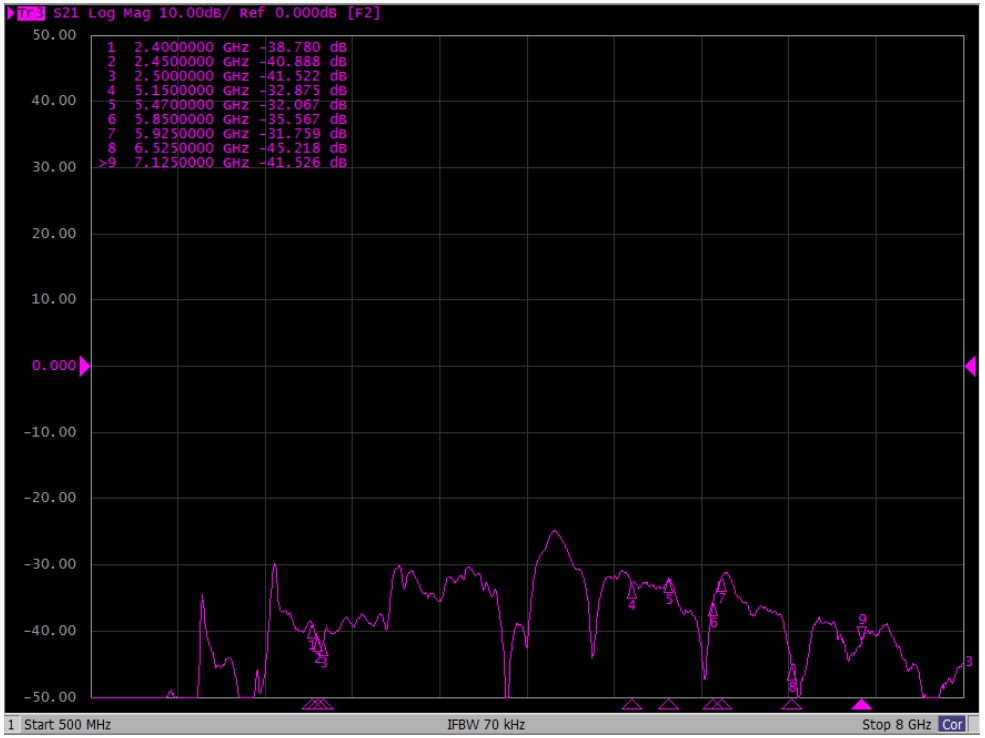
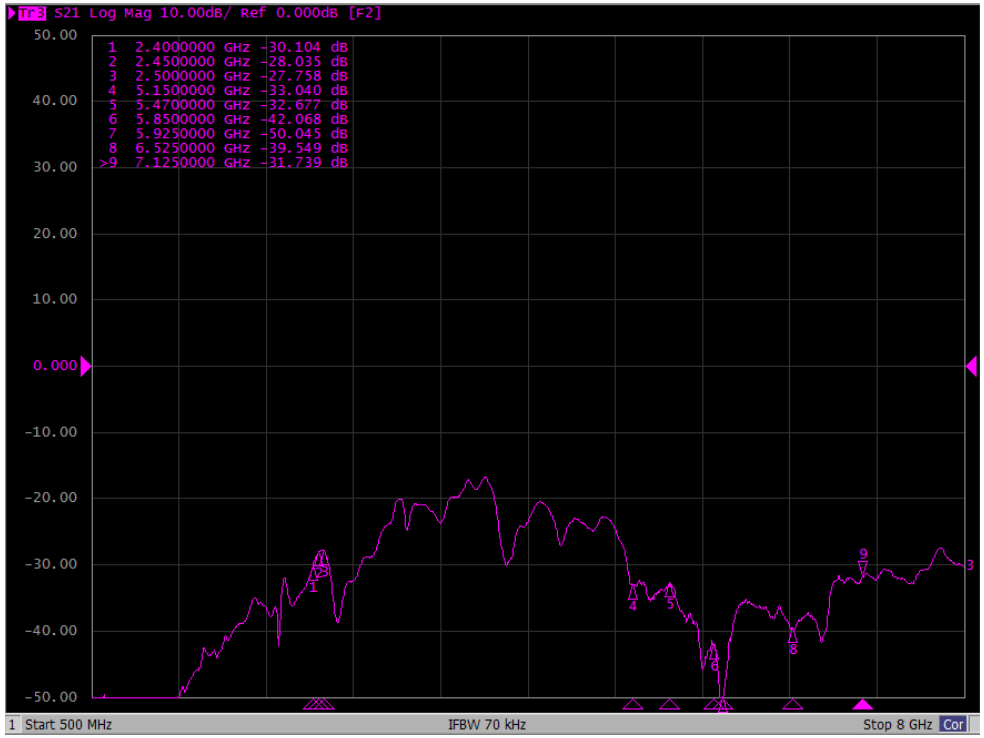
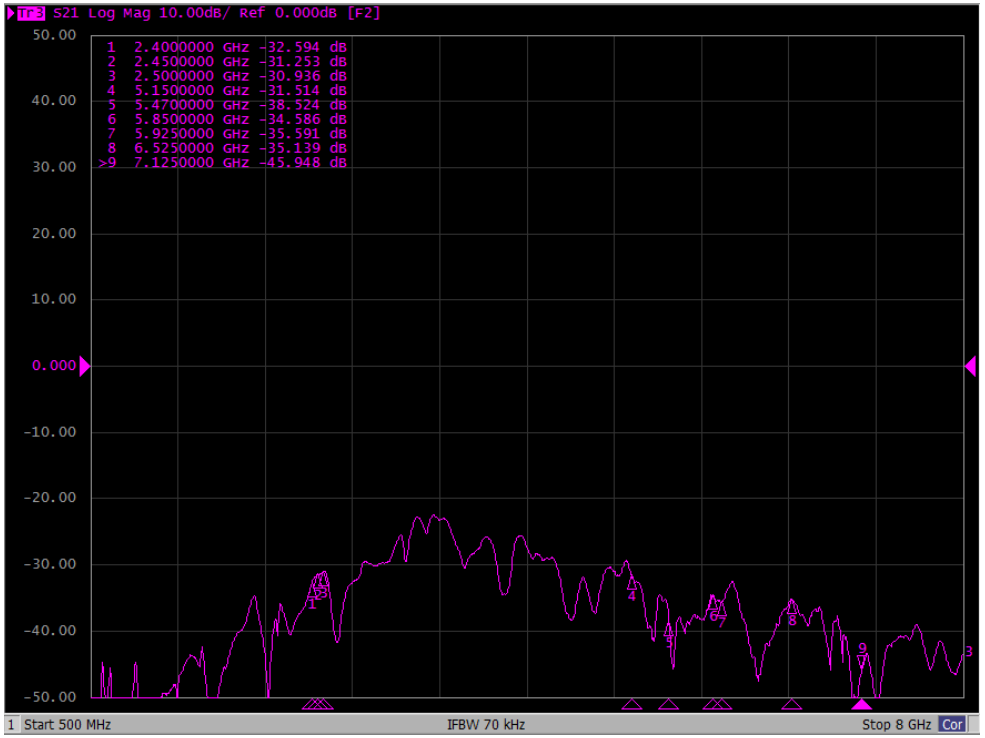


Isolation

5G1_6G3



5G1_6G4



Isolation

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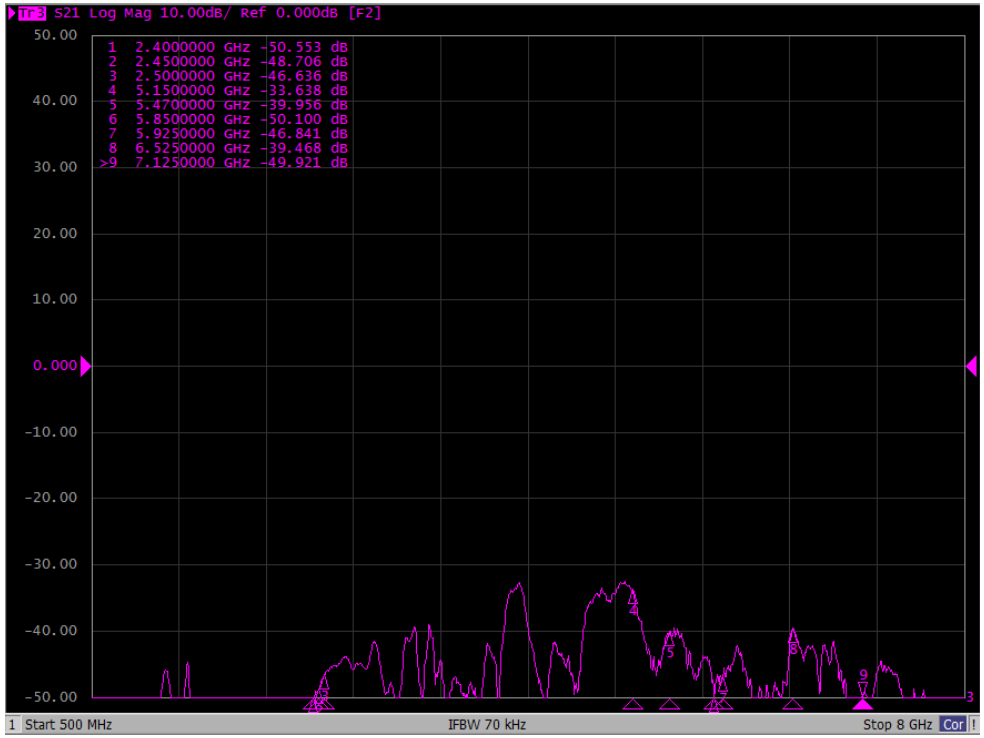
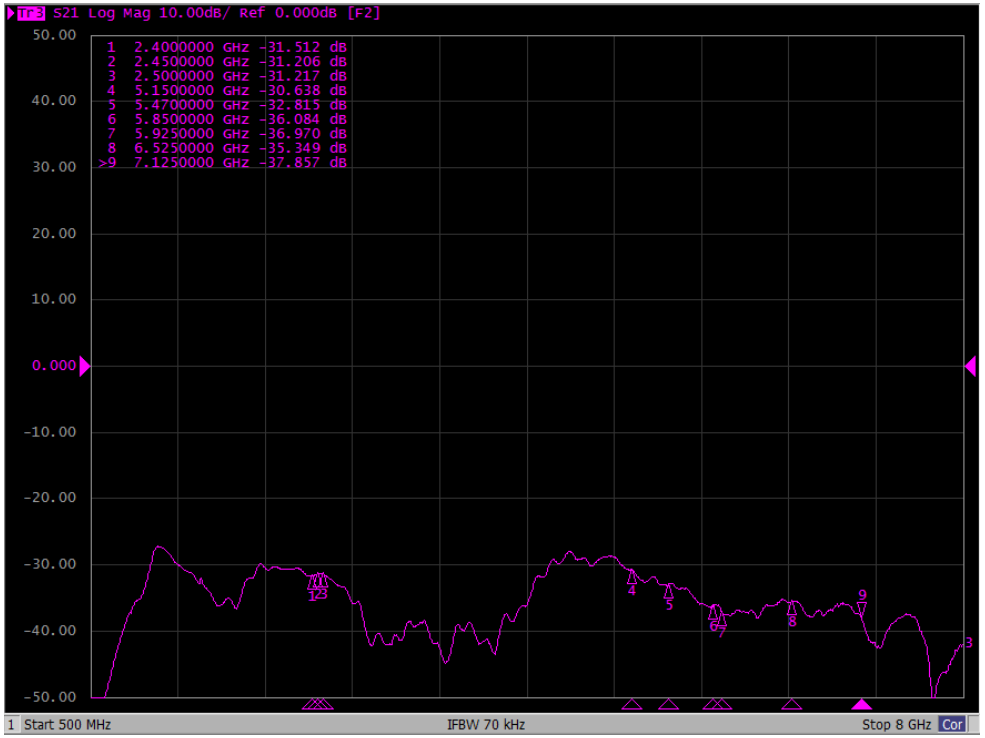
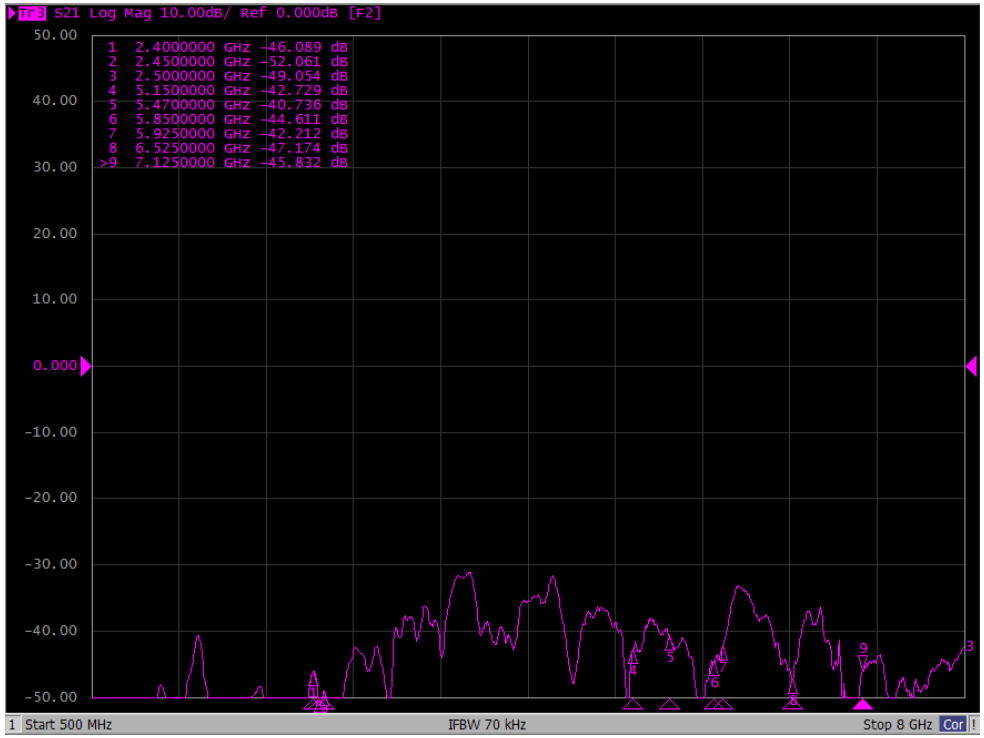


5G2_6G2



Isolation

5G2_6G3



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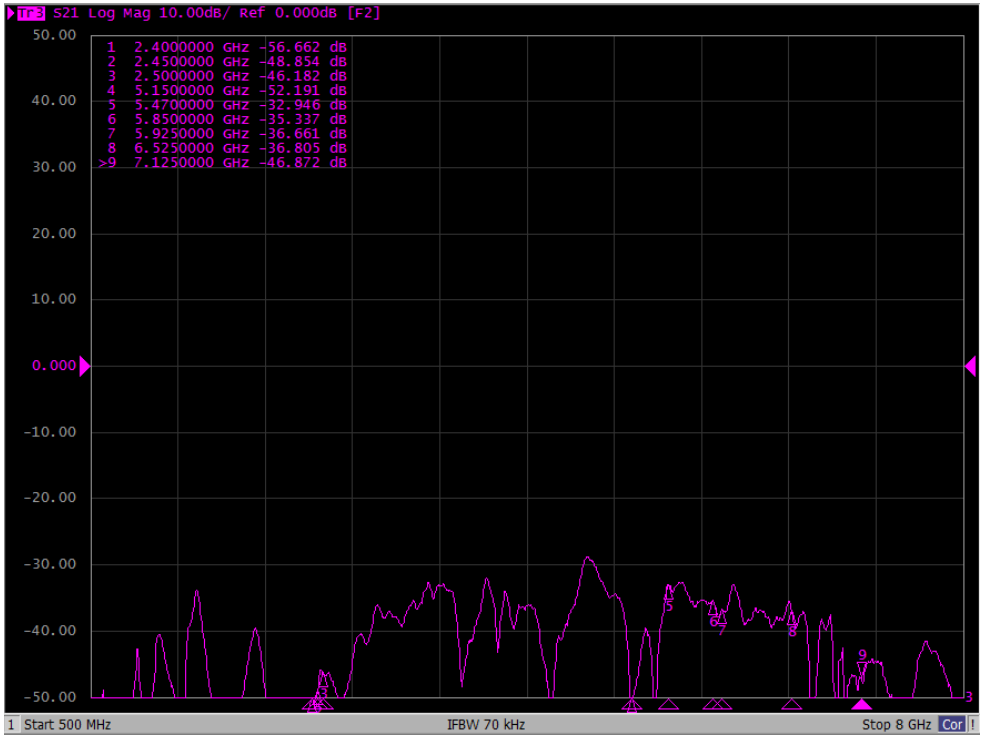
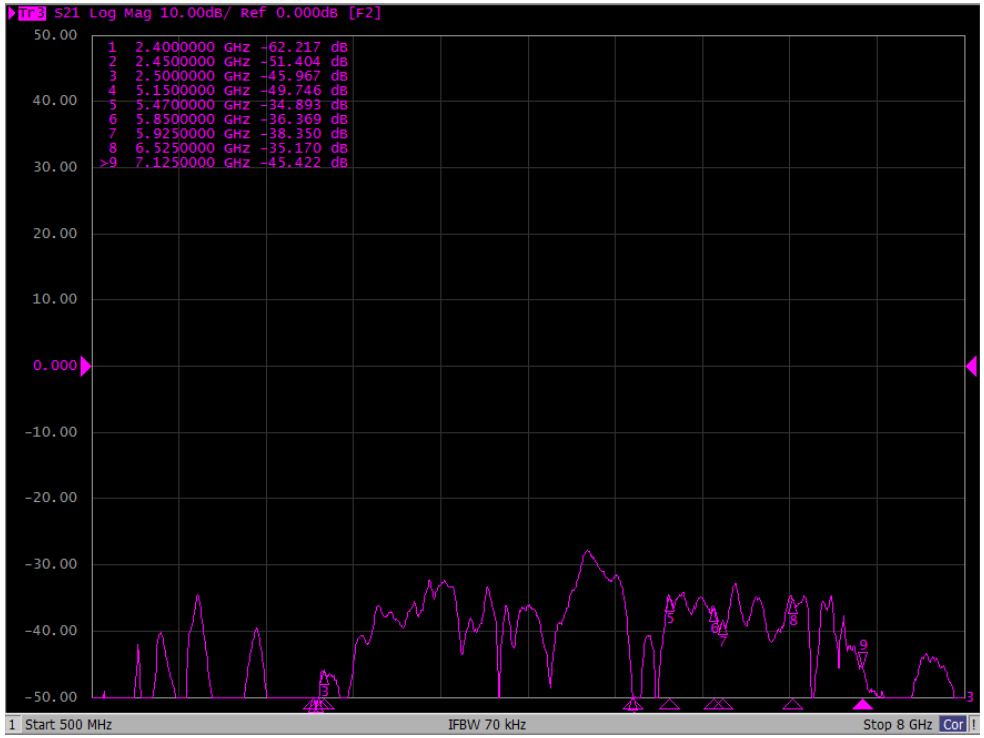


Isolation

6G1_6G2



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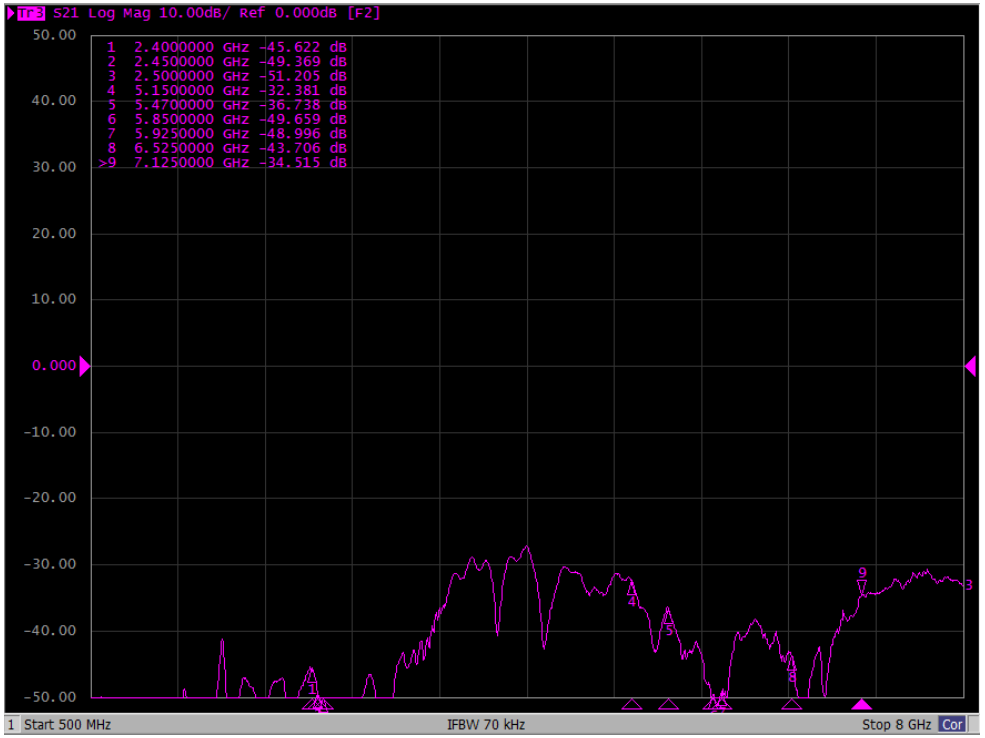
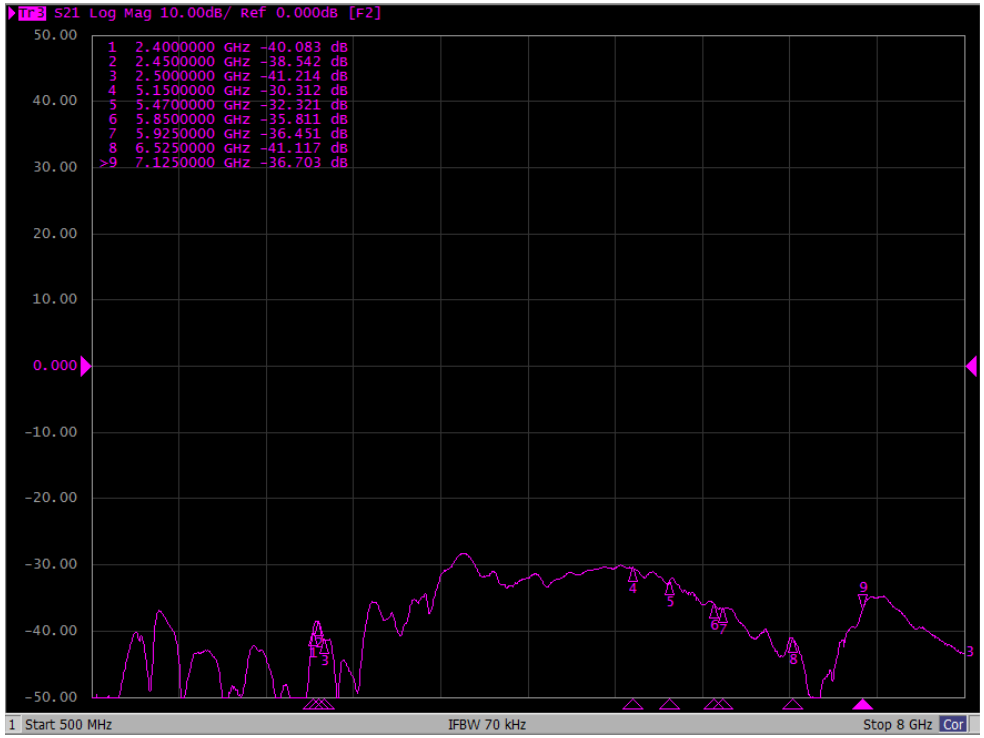


Isolation

6G1_6G4



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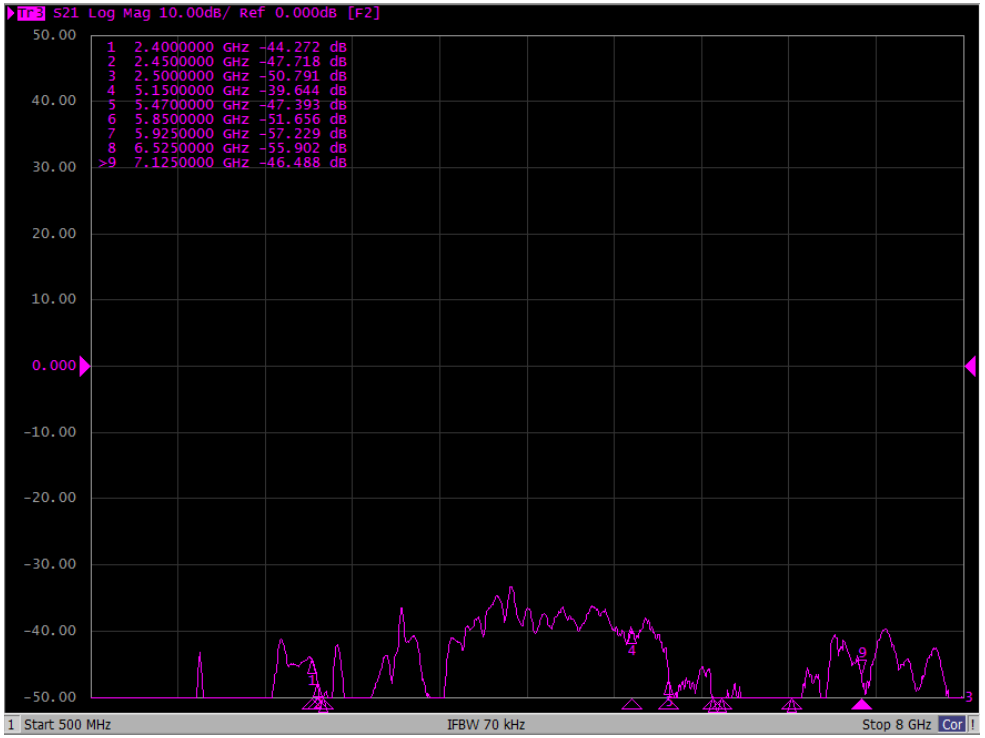
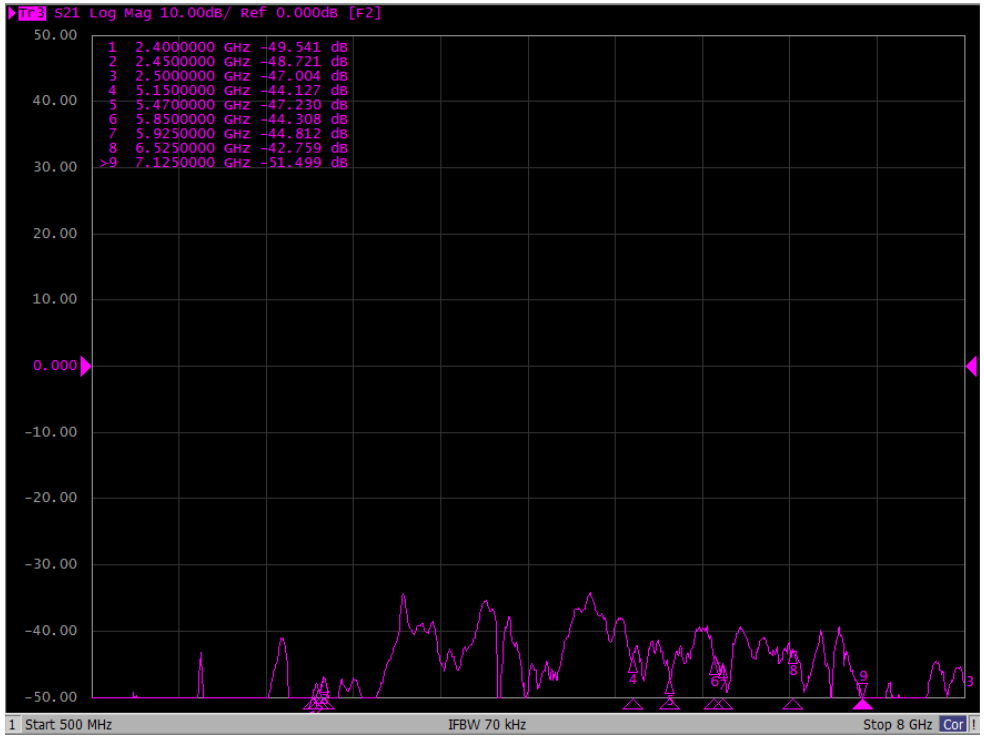
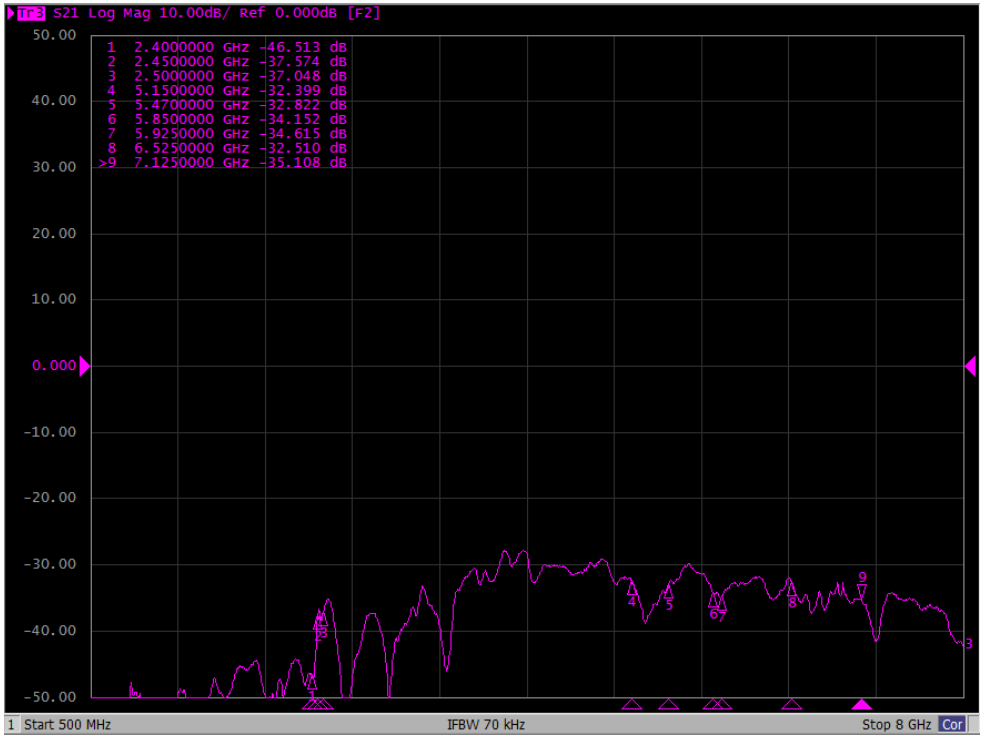


Isolation

6G2_6G4

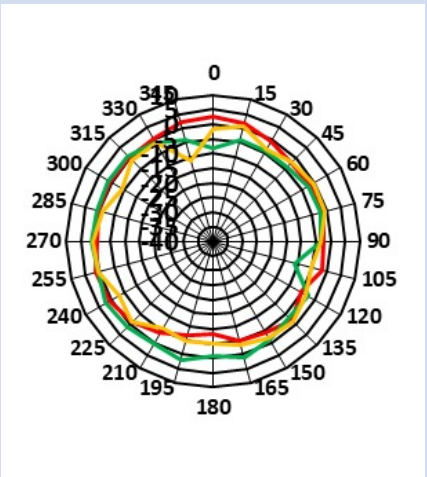
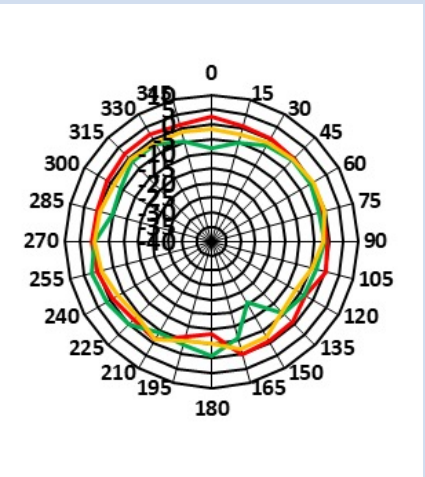
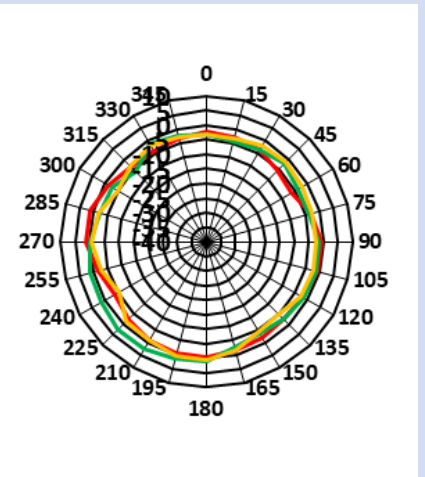


6G3_6G4



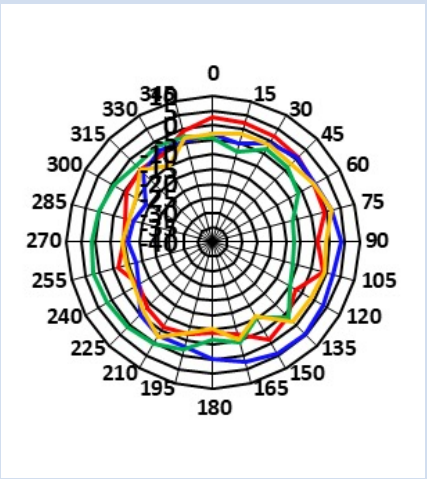
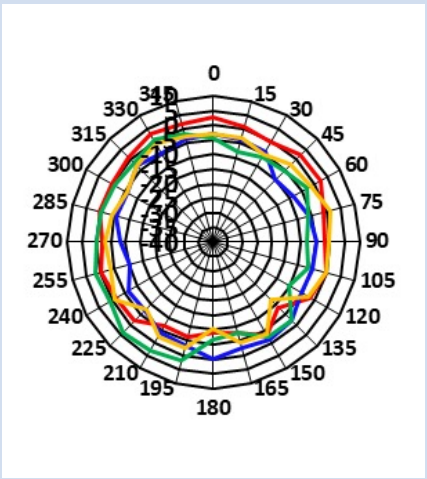
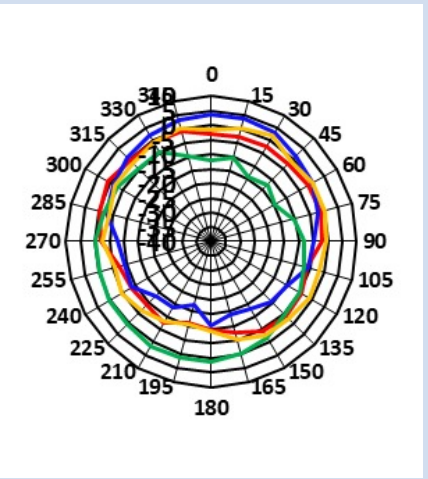
2D Radiation Pattern Coverage–2450MHz

BT1
DB1 2G
DB2 2G

	X-Z plane	Y-Z plane	X-Y plane
			

2D Radiation Pattern Coverage–5470MHz

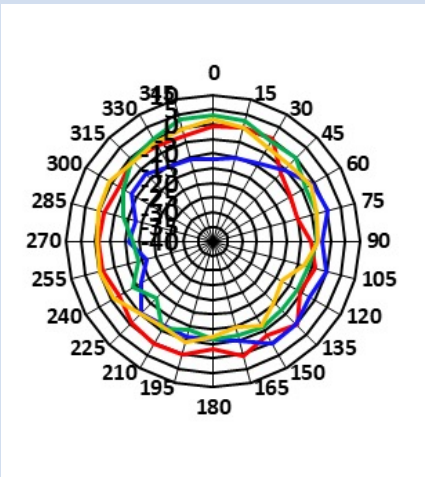
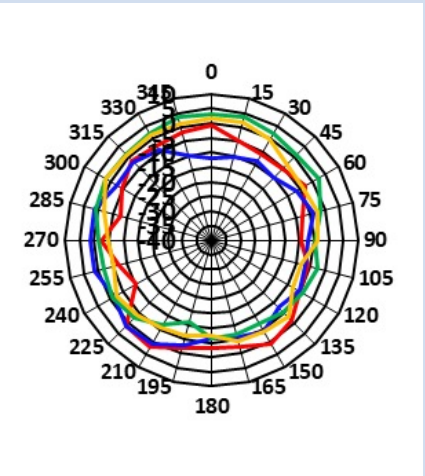
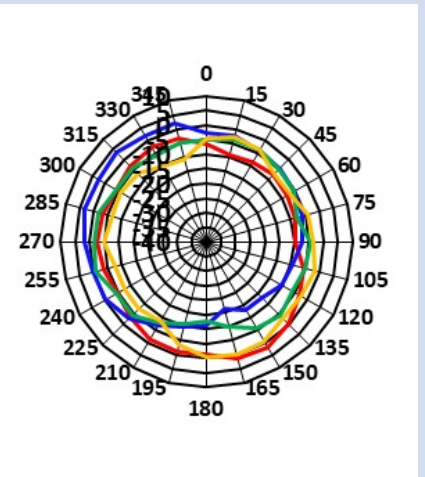
5G 1
5G 2
DB1 5G
DB2 5G

	X-Z plane	Y-Z plane	X-Y plane
			

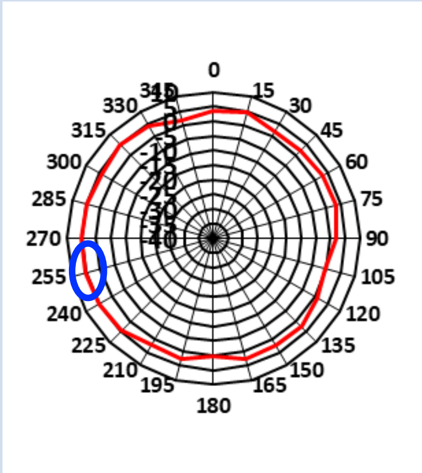
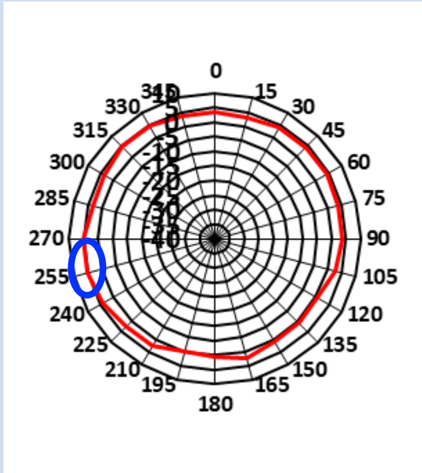
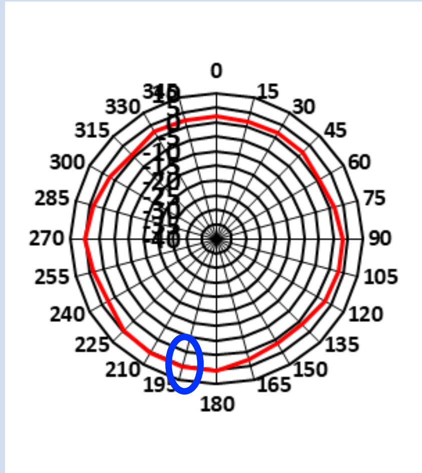
2D Radiation Pattern Coverage–6525MHz

工业富联

6G1
6G2
6G3
6G4

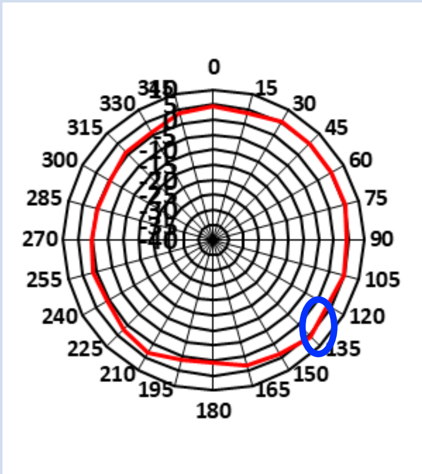
	X-Z plane	Y-Z plane	X-Y plane
			

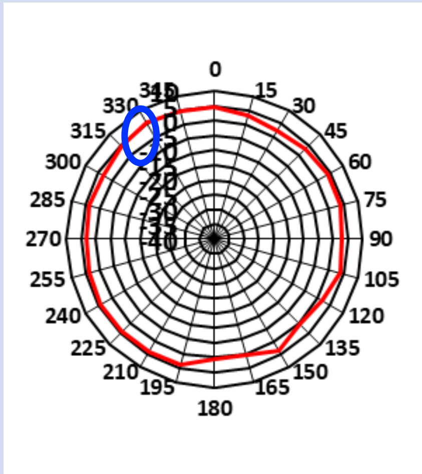
Correlated Radiation Pattern – 2.45GHz

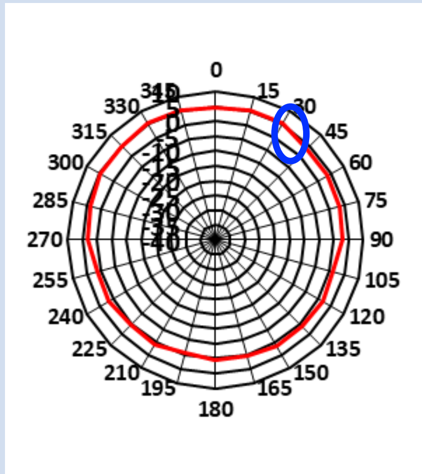
	X-Z plane	Y-Z plane	X-Y plane
			
	Max:5.43	Max:5.41	Max:5.29

Correlated Radiation Pattern – 5.47GHz

	X-Z plane	Y-Z plane	X-Y plane

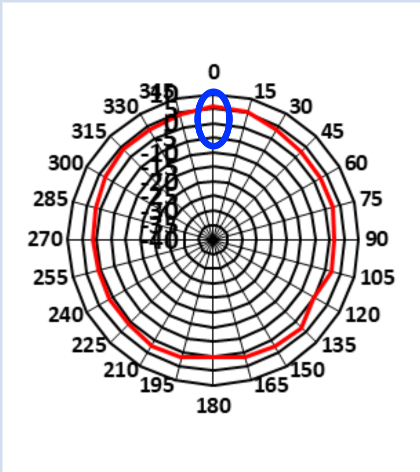
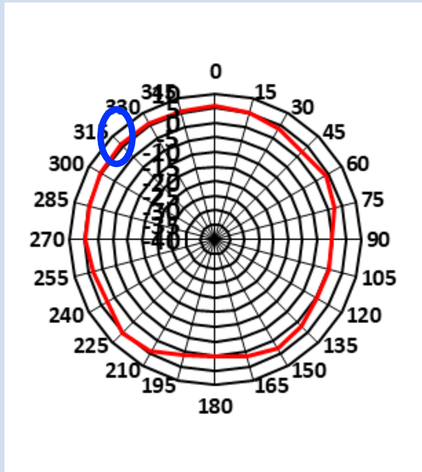
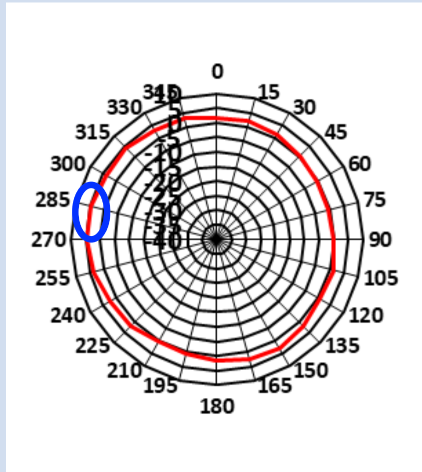




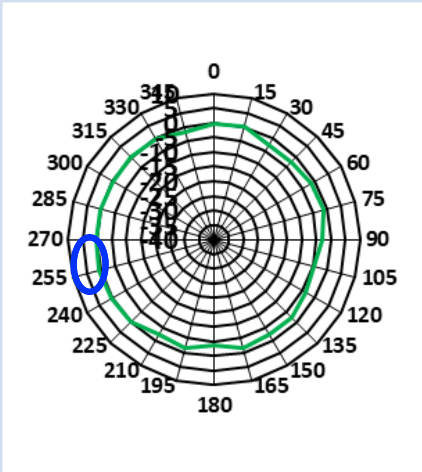
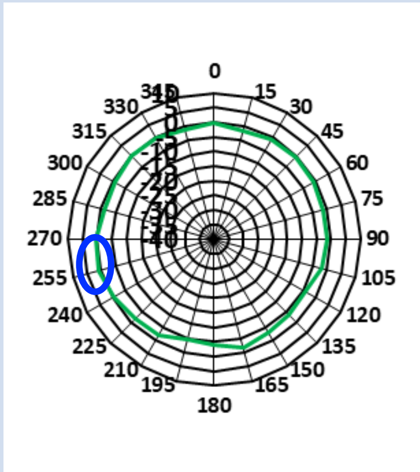
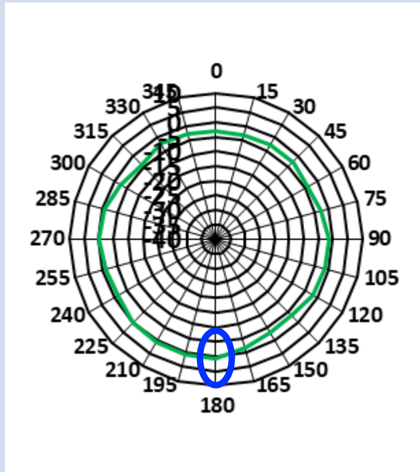


	X-Z plane	Y-Z plane	X-Y plane
	Max:5.54	Max:5.71	Max:5.41

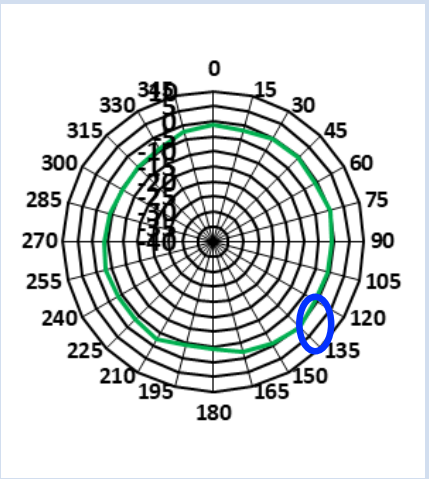
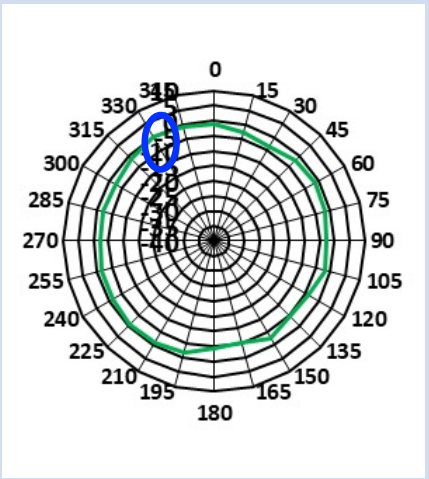
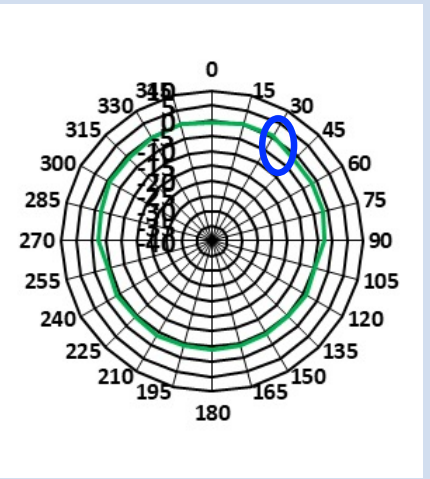
Correlated Radiation Pattern – 6.525GHz

	X-Z plane	Y-Z plane	X-Y plane
			
	Max:5.69	Max:5.89	Max:4.72

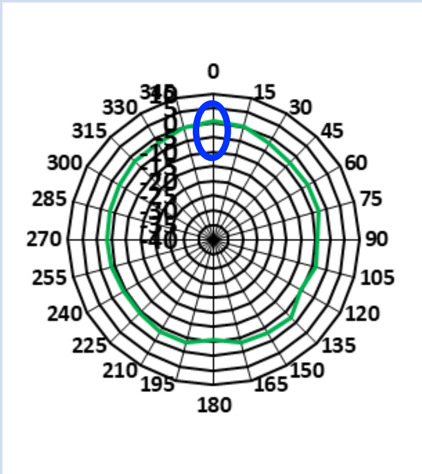
Uncorrelated Radiation Pattern – 2.45GHz

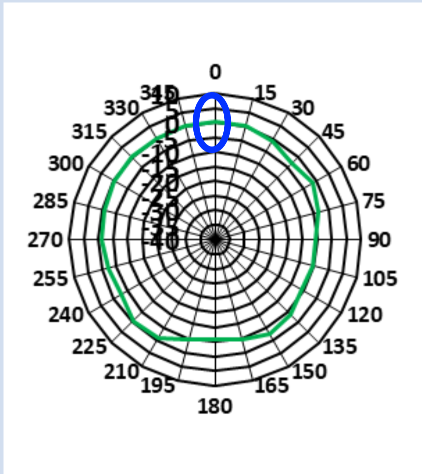
	X-Z plane	Y-Z plane	X-Y plane
			
	Max:0.69 Min:-4.61	Max:0.75 Min:-4.67	Max:0.56 Min:-4.01

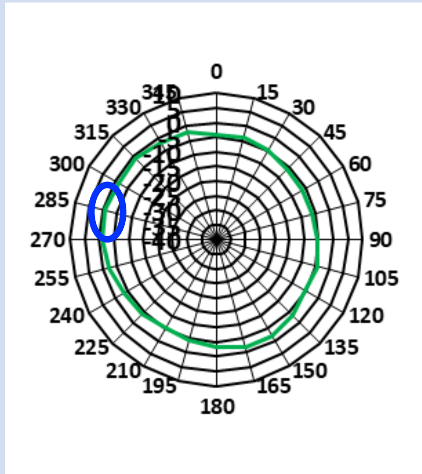
Uncorrelated Radiation Pattern – 5.47GHz

	X-Z plane	Y-Z plane	X-Y plane
			
	Max:0.26 Min:-5.35	Max:0.06 Min:-5.03	Max:0.38 Min:-4.55

Uncorrelated Radiation Pattern – 6.525GHz

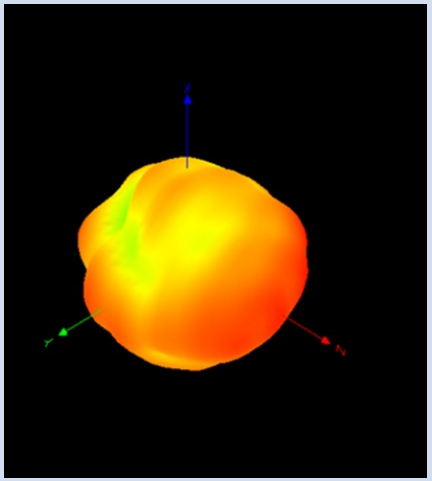
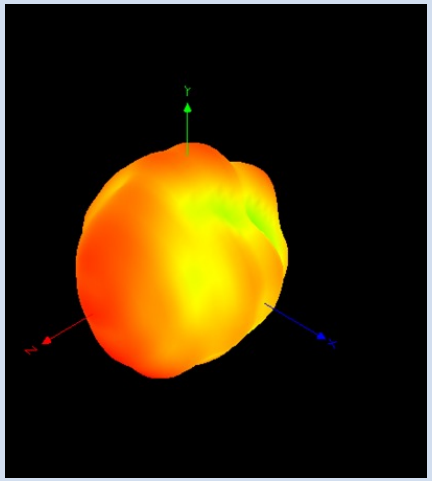
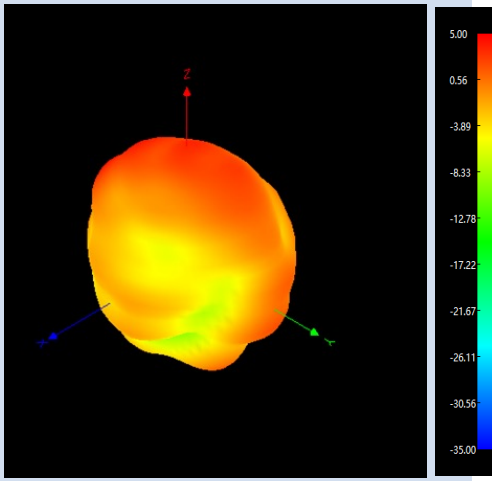




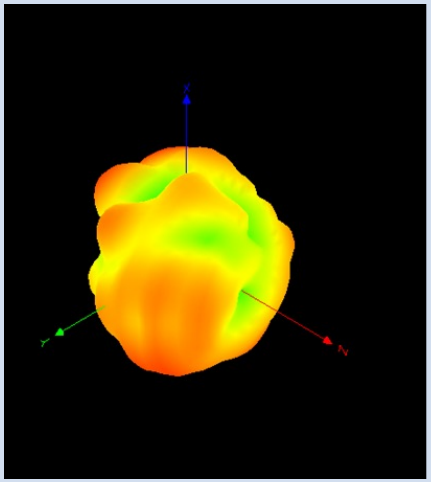
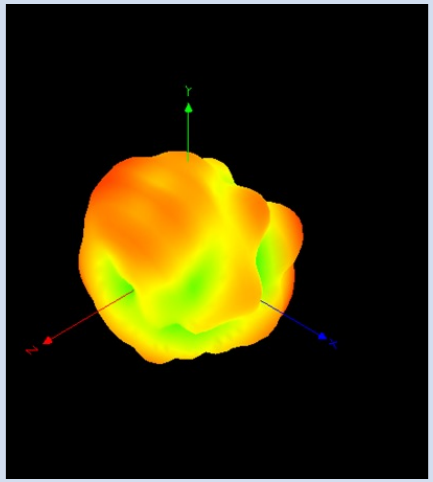
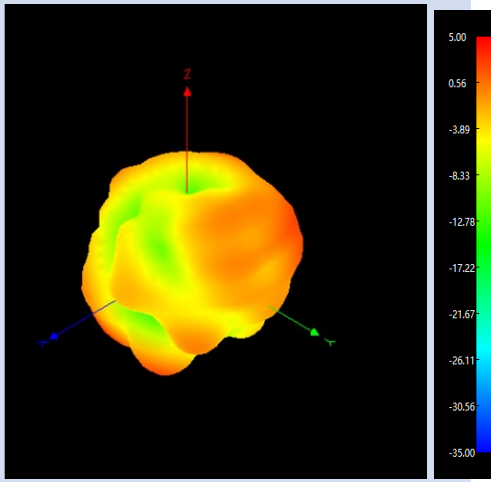


	X-Z plane		Y-Z plane		X-Y plane	
	Max:0.54	Min:-5.52	Max:0.54	Min:-5.61	Max:-0.63	Min:-6.29

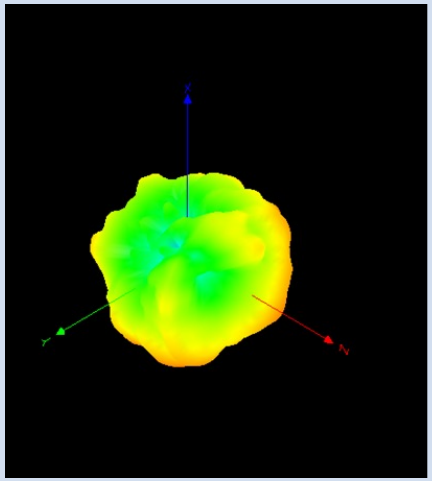
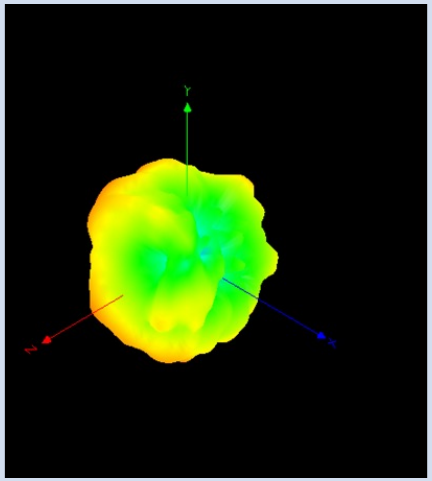
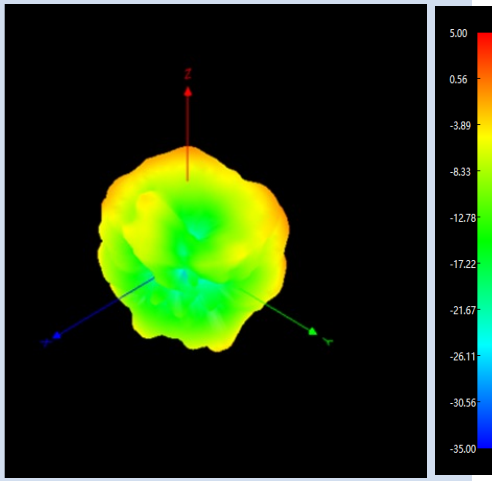
3D Radiation Pattern–BT

2450MHz			
			

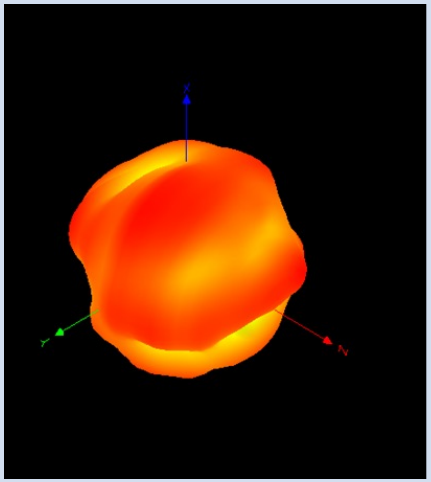
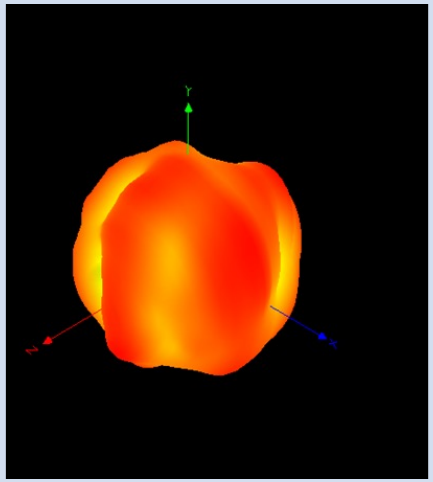
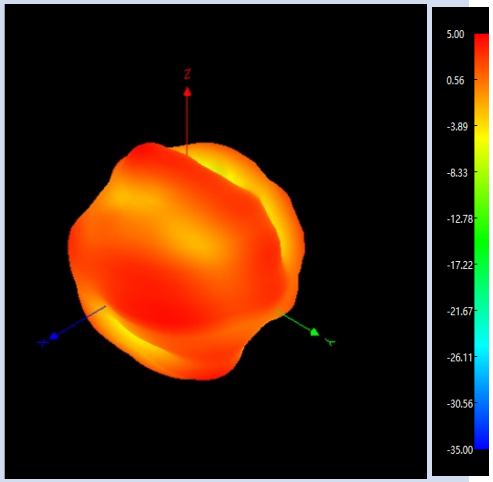
3D Radiation Pattern–DB1 2G

2450MHz			
			

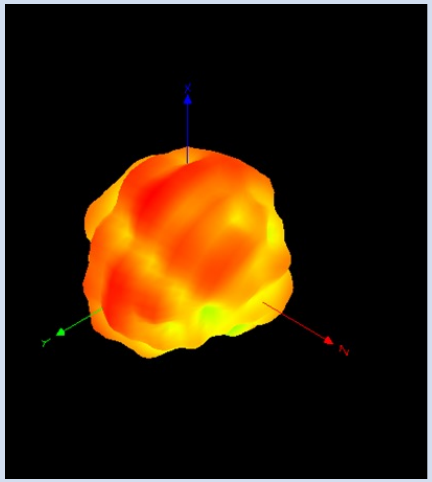
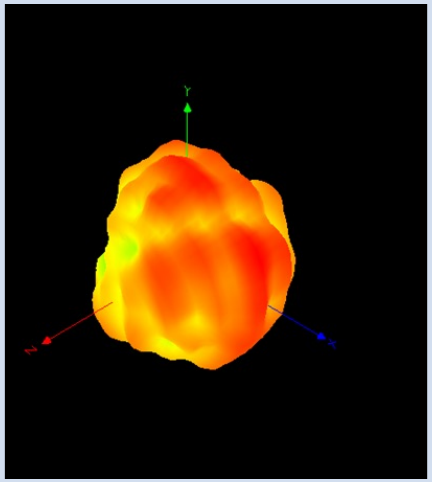
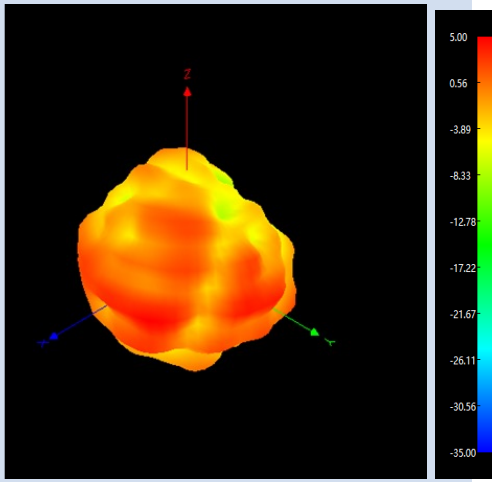
3D Radiation Pattern–DB1 5G

5470MHz			
			

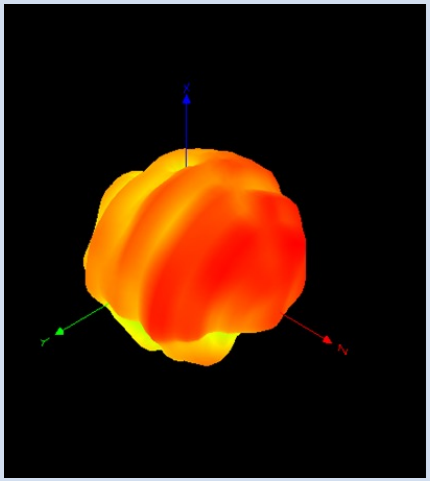
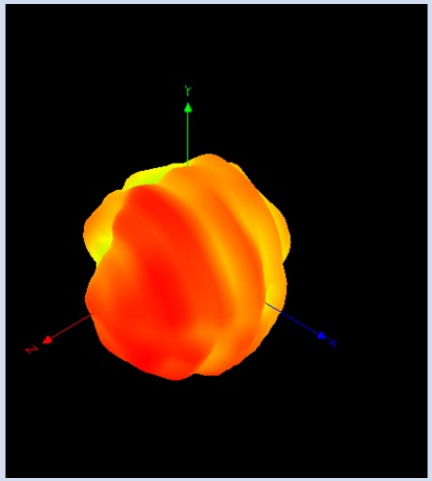
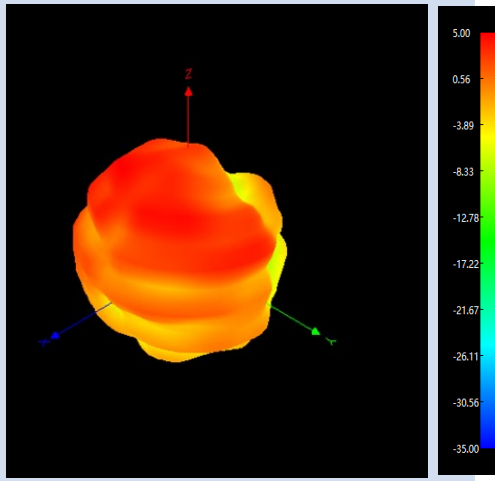
3D Radiation Pattern–DB2 2G

2450MHz			
			

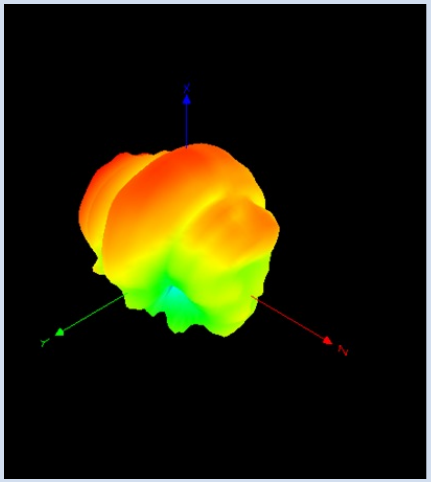
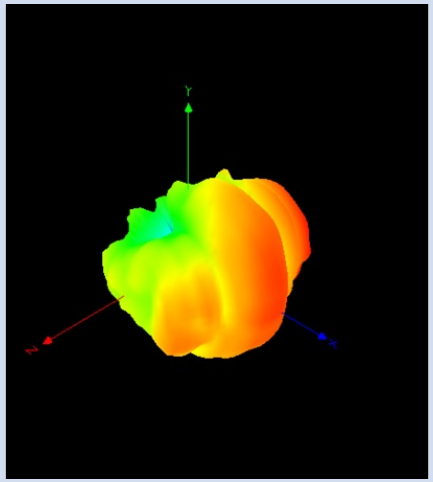
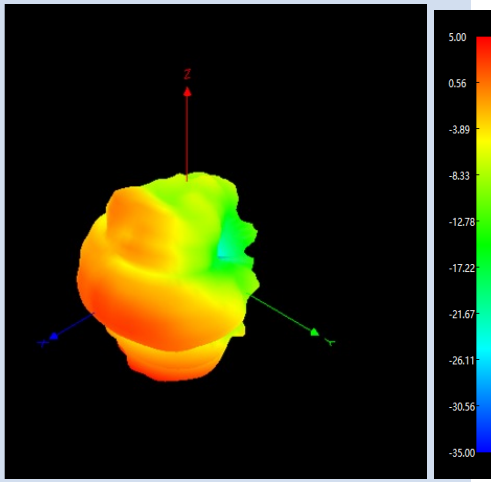
3D Radiation Pattern–DB2 5G

5470MHz			
			

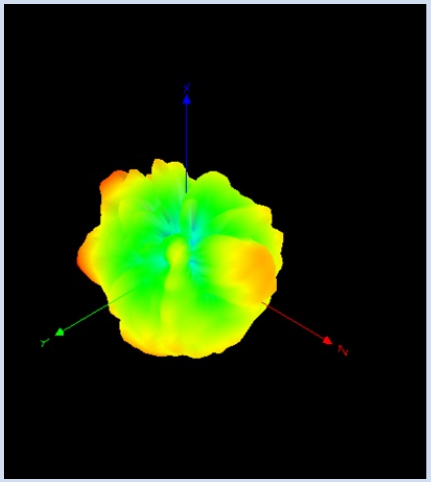
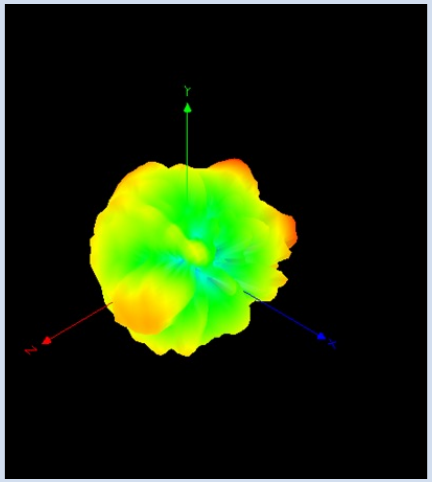
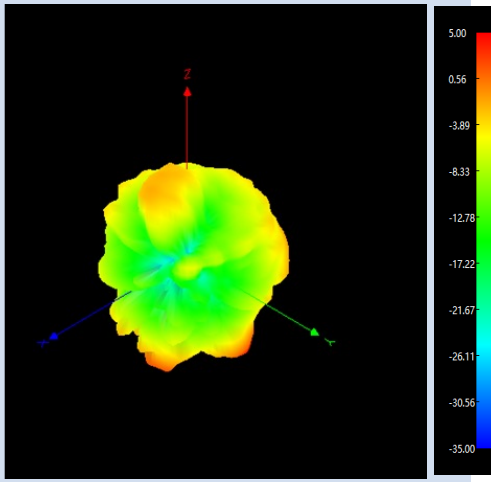
3D Radiation Pattern–5G1

5470MHz			
			

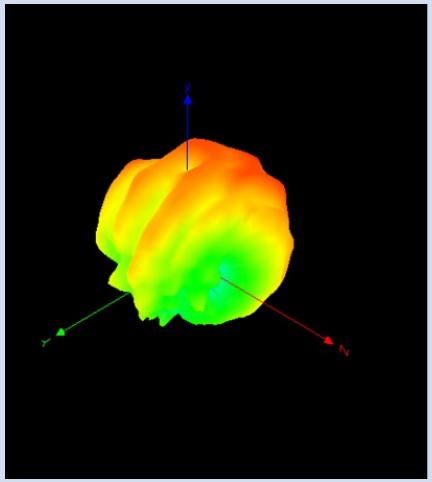
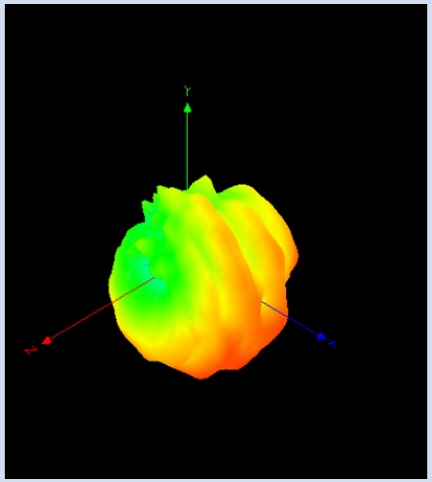
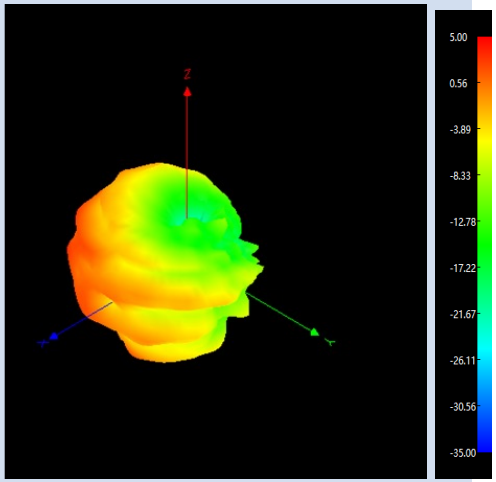
3D Radiation Pattern–5G2

5470MHz			
			

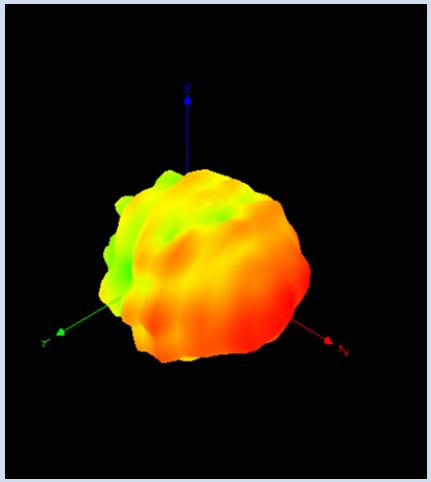
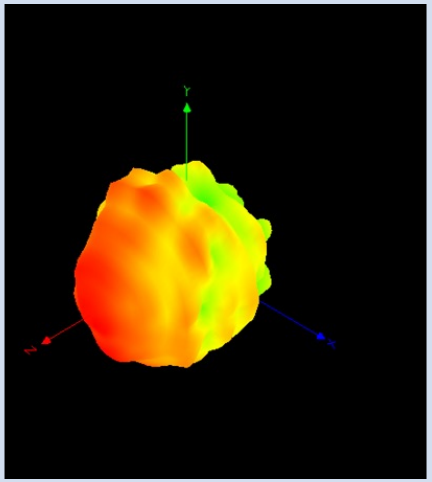
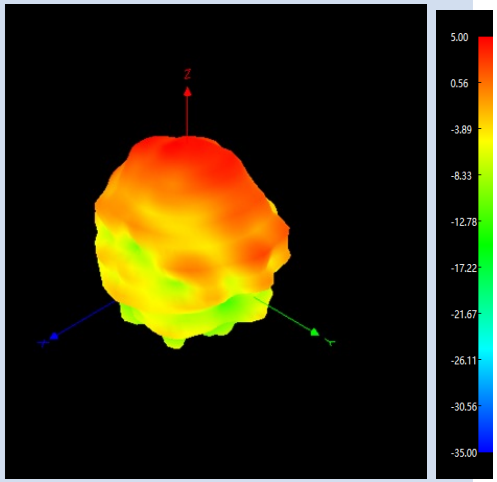
3D Radiation Pattern–6G1

6525MHz			
			

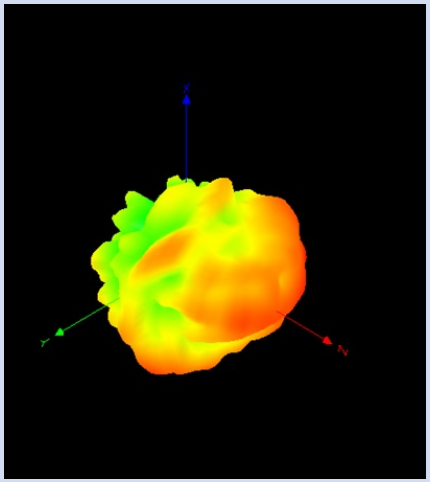
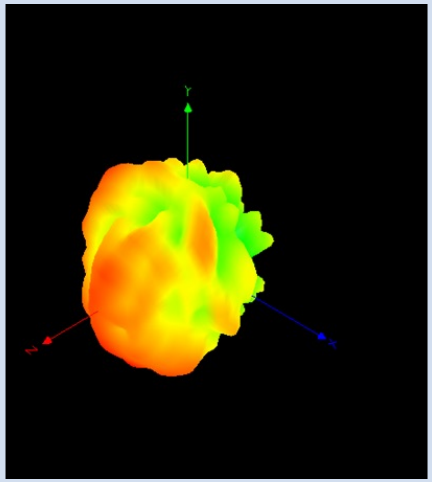
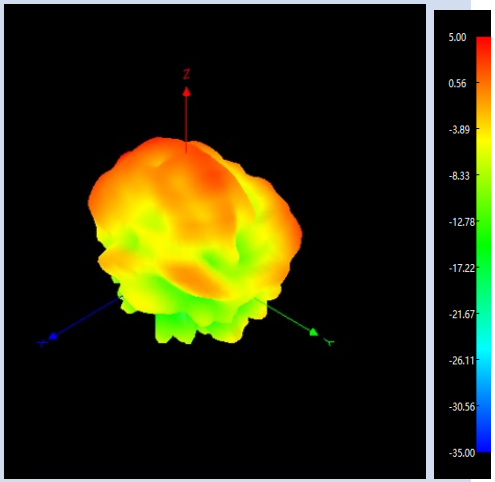
3D Radiation Pattern–6G2

6525MHz			
			

3D Radiation Pattern–6G3

6525MHz			
			

3D Radiation Pattern–6G4

6525MHz			
			

Thank you!