

Report No.: SEWA2204000011RG05

Rev.: 01

Page: 1 of 310



TEST REPORT

Application No.: SEWA2204000011RG
Applicant: Quectel Wireless Solutions Co., Ltd.
Address of Applicant: Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Manufacturer: Quectel Wireless Solutions Co., Ltd.
Address of Manufacturer: Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
EUT Description: Multi-mode Smart LTE Module
Model No.: SC690A-NA
Trade Mark: Quectel
FCC ID: XMR2022SC690ANA
Standards: FCC 47 CFR Part 2, Subpart J
FCC 47 CFR Part 15, Subpart E
Date of Receipt: 2022/08/05
Date of Test: 2022/08/15 to 2022/09/14
Date of Issue: 2022/09/15

Test Result :	PASS *
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* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Authorized Signature:

Panta Sun

Panta Sun
Wireless Laboratory Manager



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1 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2022/09/15		Original

Prepared By	
	(Tizzy Song) / Test Engineer
Checked By	
	(Well Wei) / Reviewer



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2 Test Summary

Test Item	Band ^[1]	FCC rules No.	Test Requirements	Test Result	Result
Antenna Requirement	--	15.203/15.407 (a)	--	Clause 4.1	PASS
26dB Emission Bandwidth	Band I	15.407(a)(1)	No limit.	Clause 4.5	Reporting only
	Band II-A	15.407(a)(2)			
	Band II-C	15.407(a)(2)			
6dB Emission Bandwidth	Band III	15.407(e)	≥ 500 kHz.	Clause 4.6	PASS
99% Occupied Bandwidth	Band I	KDB 789033 D02§ D	No limit.	Clause 4.7	Reporting only
	Band II-A				
	Band II-C				
	Band III				
Duty Cycle	Band I Band II-A Band II-C Band III	--	No limit.	Clause 4.3	Reporting only
Maximum Conducted Output Power	Band I	15.407(a)	< 250mW	Clause 4.4	PASS
	Band II-A	15.407(a)(2)	<MIN{250mW,11dBm+10*lg(EBW)}		
	Band II-C		< 1W		
	Band III	15.407(a)(3)			
Maximum Power Spectral Density	Band I	15.407(a)	<11dBm/MHz	Clause 4.8	PASS
	Band II-A	15.407(a)(2)	<11dBm/MHz		
	Band II-C		<30dBm/500KHz		
	Band III	15.407(a)(3)			
Unwanted Emissions that fall Out of the Restricted Bands (Radiated)	Band I	15.209 15.407(b)	F<1GHz: §15.209/§7.2.5 limit (QP). F≥1GHz & out-restricted: <-27dBm/MHz PK e.i.r.p. (exl. 5.15-5.35 GHz). F≥1GHz & in-restricted: §15.209/§7.2.5 limit (AV&PK).	Clause 4.9	PASS
	Band II-A	15.407(b) 15.209	F<1GHz: §15.209/§7.2.5 limit (QP). F≥1GHz & out-restricted: <-27dBm/MHz PK e.i.r.p. (exl. 5.25-5.35 GHz). F≥1GHz & in-restricted: §15.209/§7.2.5 limit (AV&PK).		PASS
	Band II-C	15.407(b) 15.209	F<1GHz: §15.209/§7.2.5 limit (QP). F≥1GHz & out-restricted: <-27dBm/MHz PK e.i.r.p. (exl. 5.47-5.725 GHz). F≥1GHz & in-restricted: §15.209/§7.2.5 limit (AV&PK).		PASS
	Band III	15.407(b) 15.209	F<1GHz: §15.209/§7.2.5 limit (QP) F≥1GHz &out-restricted:(QP)		PASS



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			a) 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges; b) 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges; c) 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and d) -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges. F≥1GHz & in-restricted: §15.209/§7.2.5 limit (AV&PK).		
Unwanted Emissions in the Restricted Bands (Radiated)	Band I Band II-A Band II-C Band III	15.209	---	Clause 4.10	PASS
AC Power Line Conducted Emissions	Band I Band II-A Band II-C Band III	15.207	---	Clause 4.2	PASS
Dynamic Frequency Selection	Band II-A Band II-C	15.407	Channel Move Time:10 Seconds	Clause 4.11	PASS
Frequency Stability	Band I Band II-A Band II-C Band III	15.407(g)	Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual	N/A	N/A
Note 1: Band I: 5150-5250MHz Band II-A: 5250-5350MHz Band II-C: 5470-5725MHz Band III: 5725-5850MHz					



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3 General Information

3.1 Details of Client

Applicant:	Quectel Wireless Solutions Co., Ltd.
Address of Applicant:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Manufacturer:	Quectel Wireless Solutions Co., Ltd.
Address of Manufacturer:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

3.2 Test Location

Company:	SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.
Address:	South of No. 6 Plant, No. 1, Runsheng Road, Suzhou Industrial Park, Suzhou Area, China (Jiangsu) Pilot Free Trade Zone
Post code:	215000
Test engineer:	Lves Cheng, Tizzy Song

3.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **A2LA (Certificate No. 6336.01)**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6336.01.

• **Innovation, Science and Economic Development Canada**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0120.

IC#: 27594.

• **FCC –Designation Number: CN1312**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized as an accredited testing laboratory.

Designation Number: CN1312.

Test Firm Registration Number: 717327



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3.4 General Description of EUT

EUT Description:	Multi-mode Smart LTE Module	
Model No.:	SC690A-NA	
Trade Mark:	Quectel	
Hardware Version:	R1.0	
Software Version:	SC690ANAPAR02A02	
IMEI:	RF Conducted	867269050014144
	RSE & AC power line	867269050012684 867269050012692
WLAN Mode Supported:	802.11a:	20 MHz channel bandwidth
	802.11n:	20 MHz / 40 MHz channel bandwidth
	802.11ac:	20 MHz / 40 MHz / 80 MHz channel bandwidth
Operation Frequency:	5150MHz to 5250MHz 5250MHz to 5350MHz 5470MHz to 5725MHz 5725MHz to 5850MHz	
Modulation Type:	802.11a:	OFDM (BPSK, QPSK, 16QAM, 64QAM)
	802.11n:	OFDM (BPSK, QPSK, 16QAM, 64QAM)
	802.11ac:	OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
Channel Spacing:	20MHz:	802.11a/n(HT20)/ac(VHT20)
	40MHz:	802.11n(HT40)/ac(VHT40)
	80MHz:	802.11ac(VHT80)
Antenna Type:	External Antenna	
Antenna Gain:	5150MHz to 5250MHz: -0.67dBi; 5250MHz to 5350MHz: -0.19dBi; 5470MHz to 5725MHz: 1.28dBi; 5725MHz to 5850MHz: 1.1dBi;	
	Note: The antenna gain are derived from the gain information report provided by the manufacturer.	
Smart System:	☒ SISO	802.11a/n/ac
	☐ MIMO	CDD: 802.11a/n/ac/ax: Tx & Rx
		STBC: 802.11n/ac/ax: Tx & Rx
		TXBF: 802.11n/ac/ax: Tx & Rx
DFS Function:	☐ Diversity	802.11a: Tx & Rx
	☐ Master	
RF Cable:	☐ Slave with radar detection	☒ Slave without radar detection
	1.5dB	



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Remark:

In FCC 15.31, for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table, and the selected channel to perform the test as below:

Frequency Range of Operation Operating Frequency Range (in each Band)	Number of Measurement Frequencies Required	Location of Measurement Frequency in Band of Operation
1 MHz or less	1	centre
1 MHz to 10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near centre

For UNII Band I:

Mode	Channel	Frequency(MHz)
IEEE 802.11a/n/ac 20MHz	The Lowest channel	5180
	The Middle channel	5200
	The Highest channel	5240
IEEE 802.11n/ac 40MHz	The Lowest channel	5190
	The Highest channel	5230
IEEE 802.11ac 80MHz	The Middle channel	5210

For UNII Band II-A:

Mode	Channel	Frequency(MHz)
IEEE 802.11a/n/ac 20MHz	The Lowest channel	5260
	The Middle channel	5280
	The Highest channel	5320
IEEE 802.11n/ac 40MHz	The Lowest channel	5270
	The Highest channel	5310
IEEE 802.11ac 80MHz	The Middle channel	5290



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For UNII Band II-C:		
Mode	Channel	Frequency(MHz)
IEEE 802.11a/n/ac 20MHz	The Lowest channel	5500
	The Middle channel	5580
	The Highest channel	5700
IEEE 802.11n/ac 40MHz	The Lowest channel	5510
	The Middle channel	5550
	The Highest channel	5670
IEEE 802.11ac 80MHz	The Lowest channel	5530
	The Highest channel	5610

For UNII Band III:		
Mode	Channel	Frequency(MHz)
IEEE 802.11a/n/ac 20MHz	The Lowest channel	5745
	The Middle channel	5785
	The Highest channel	5825
IEEE 802.11n/ac 40MHz	The Lowest channel	5755
	The Highest channel	5795
IEEE 802.11ac 80MHz	The Middle channel	5775

Frequency Band	Channel	Freq.(MHz)	Channel	Freq.(MHz)
TDWR Channel	118*	5590	124	5620
	120	5600	126*	5630
	122 [#]	5610	128	5640

Note:

1. The above Frequency and Channel in “*” were 802.11n HT40 and 802.11ac VHT40.
2. The above Frequency and Channel in “[#]” were 802.11ac VHT80.



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3.5 Test Environment and Mode

Environment Parameter	101.0 kPa Selected Values During Tests	
Relative Humidity	44-46 % RH Ambient	
Value	Temperature(°C)	Voltage(V)
NTNV	22~23	3.8
Remark: NV: Normal Voltage NT: Normal Temperature		

3.6 Description of Support Units

Description	Manufacturer	Model No.
Mother board	Quectel	SMART-EVB-G5
Adaptor	Something High Innovation (B.V.I.) Co., Ltd	P12F050200
Remark: all above the information of table are provided by client.		

3.7 Worst-case configuration and mode

Low data rate was used to test on antenna port conducted tests and radiated spurious emissions since it has the highest maximum power. Following are the worst-case data rates set for test:

Modulation Type	SISO - Data Rate	MIMO - Data Rate
802.11a	6 Mbps	/
802.11n (HT 20)	MCS0 (6.5 Mbps)	/
802.11n (HT 40)	MCS0 (13.5 Mbps)	/
802.11ac (VHT 20)	MCS0 (6.5 Mbps)	/
802.11ac (VHT 40)	MCS0 (13.5 Mbps)	/
802.11ac (VHT 80)	MCS0 (29.3 Mbps)	/



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4 Test results and Measurement Data

4.1 Antenna Requirement

Standard requirement:	47 CFR Part 15 Section 15.203
The antenna is External antenna on the main PCB and no consideration of replacement. The best case gain of the antenna is 5150MHz to 5250MHz: -0.67dBi; 5250MHz to 5350MHz: -0.19dBi; 5470MHz to 5725MHz: 1.28dBi; 5725MHz to 5850MHz: 1.1dBi;.* <i>*Note:</i> The antenna gain are derived from the gain information report provided by the manufacturer. <i>Remark:</i> As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.	



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4.2 AC Power Line Conducted Emissions

Test Requirement:	47 CFR Part 15 Section 15.407(b)		
Test Method:	ANSI C63.10: 2013 Section 6.2		
Test Frequency Range:	150kHz to 30MHz		
Receiver Setup:	RBW = 9kHz, VBW = 30kHz		
Limit:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
* Decreases with the logarithm of the frequency.			
Test Procedure:	1) The mains terminal disturbance voltage test was conducted in a shielded room. 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded. 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2. 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.		



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Test Setup:	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates at lowest, middle and highest channel.
Final Test Mode:	Refer to section 3.7 for details. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 6 for details.
Test Results:	Pass



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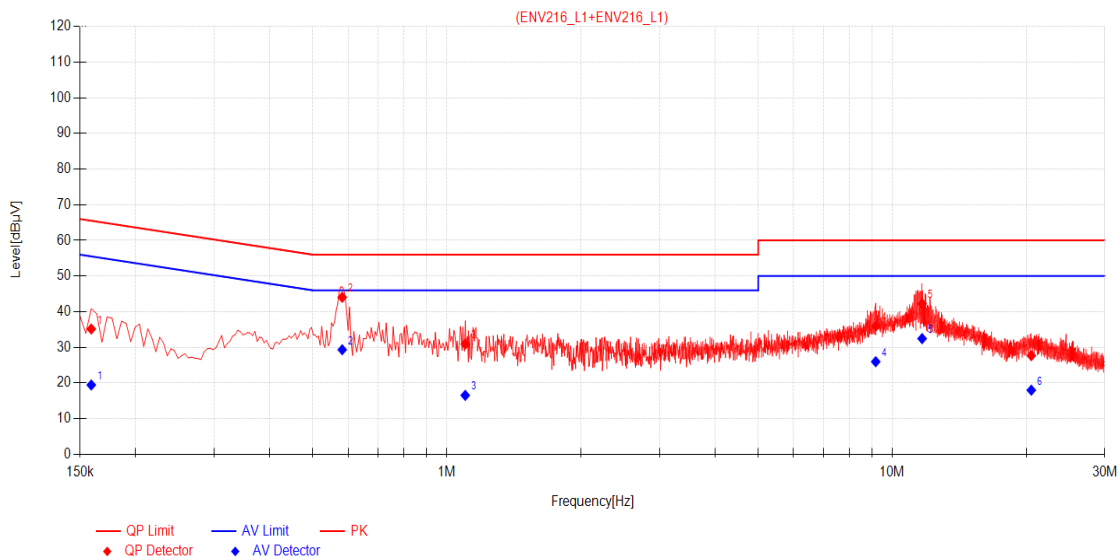
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Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Phase: Line



Final Data List

NO.	Frequency [MHz]	Factor [dB]	QP Reading [dBμV]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Reading [dBμV]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Verdict
1	0.1590	10.67	24.49	35.16	65.52	30.36	8.78	19.45	55.52	36.07	PASS
2	0.5820	10.52	33.53	44.05	56.00	11.95	18.81	29.33	46.00	16.67	PASS
3	1.0995	10.64	20.28	30.92	56.00	25.08	5.90	16.54	46.00	29.46	PASS
4	9.1815	10.66	25.28	35.94	60.00	24.06	15.32	25.98	50.00	24.02	PASS
5	11.6700	10.59	31.63	42.22	60.00	17.78	21.86	32.45	50.00	17.55	PASS
6	20.5215	10.40	17.27	27.67	60.00	32.33	7.59	17.99	50.00	32.01	PASS

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Value = Reading[dBμV] + Factor(Lin factor[dB] + cable loss[dB]).
3. Margin = Limit[dBμV] – Value[dBμV]



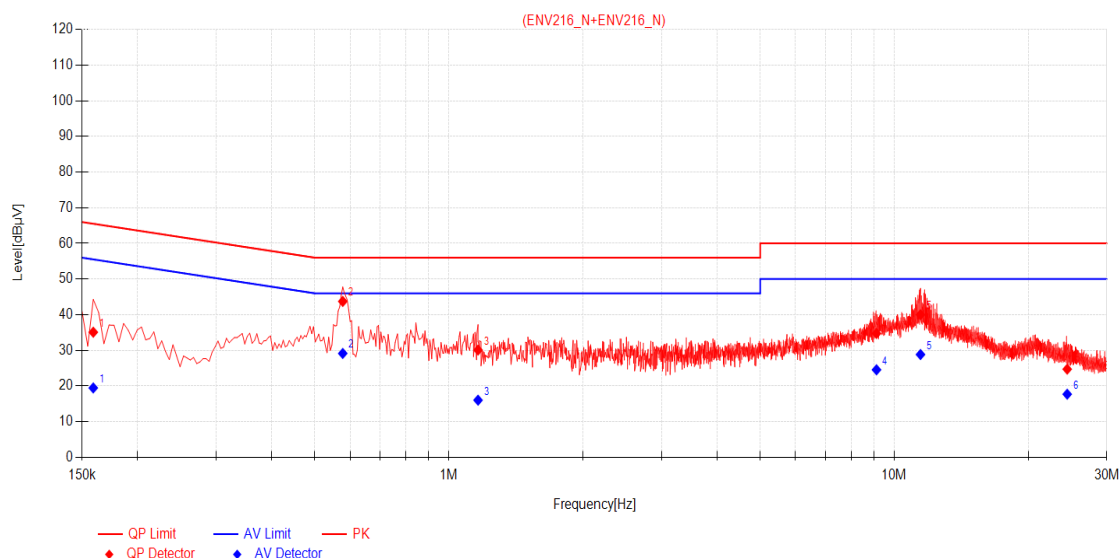
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Phase: Neutral



Final Data List

NO.	Frequency [MHz]	Factor [dB]	QP Reading [dBμV]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Reading [dBμV]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Verdict
1	0.1590	10.72	24.37	35.09	65.52	30.43	8.74	19.46	55.52	36.06	PASS
2	0.5775	10.71	33.02	43.73	56.00	12.27	18.43	29.14	46.00	16.86	PASS
3	1.1625	10.75	19.35	30.10	56.00	25.90	5.28	16.03	46.00	29.97	PASS
4	9.1230	10.62	24.11	34.73	60.00	25.27	13.93	24.55	50.00	25.45	PASS
5	11.4540	10.65	29.35	40.00	60.00	20.00	18.18	28.83	50.00	21.17	PASS
6	24.4545	10.52	14.21	24.73	60.00	35.27	7.19	17.71	50.00	32.29	PASS

Remark:

- The following Quasi-Peak and Average measurements were performed on the EUT:
- Value = Reading[dBμV] + Factor(Lin factor[dB] + cable loss[dB]).
- Margin = Limit[dBμV] – Value[dBμV]



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4.3 Duty Cycle

The detailed test data see: **Appendix**



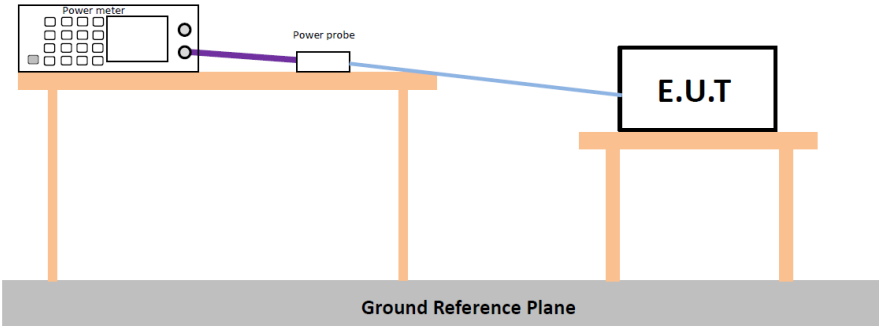
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4.4 Conducted Output Power

Test Requirement:	47 CFR Part 15 Section 15.407(a)	
Test Method:	ANSI C63.10 :2013 Section11.9.2.3	
Test Setup:	 * Test with power meter (Detector function: Average)	
Test Instruments:	Refer to section 6 for details.	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates	
Final Test Mode:	Refer to section 3.7 for details.	
Limit:	Frequency Band	Limit
	5150-5250MHz	Not exceed 250mW(24dBm)
	5250-5350MHz	The lesser of 250mW(24dBm) or 11+ 10logB
	5470-5725MHz	The lesser of 250mW(24dBm) or 11+ 10logB
	5725-5850MHz	Not exceed 1W(30dBm)
	*Where B is the 26dB emission bandwidth in MHz	
Test Results:	Pass	
The detailed test data see: Appendix		



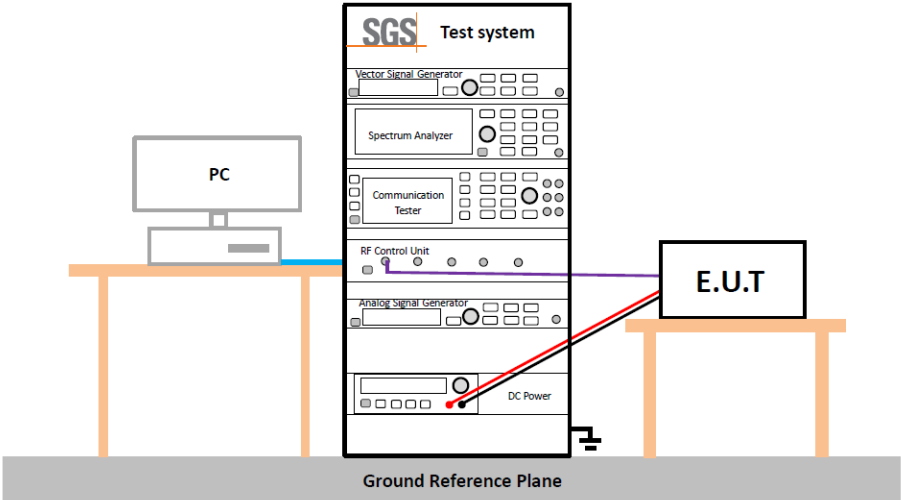
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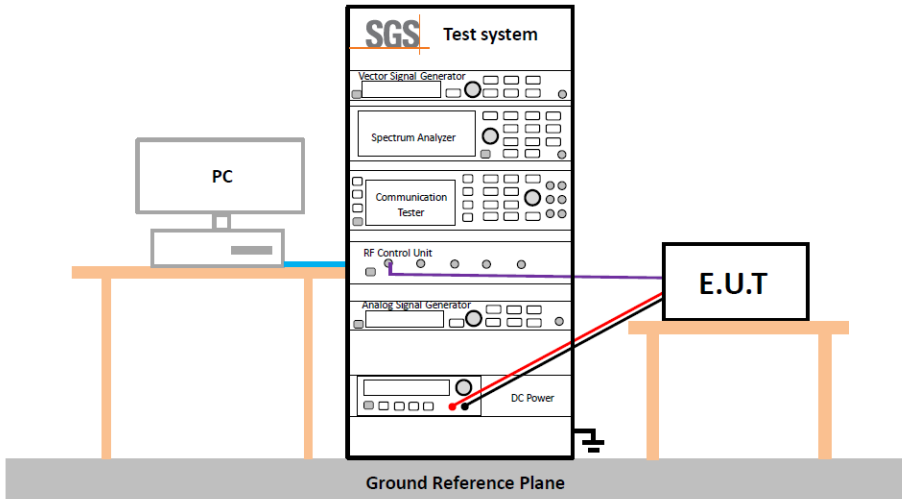
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4.5 26dB Emission Bandwidth

Test Requirement:	47 CFR Part 15 Section 15.407(a), KDB 789033 D02& C
Test Method:	ANSI C63.10: 2013 Section 11.8 Option 2
Test Setup:	
Instruments Used:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	No restriction limits
Test Results:	Pass
The detailed test data see: Appendix	

4.6 6dB Emission Bandwidth

Test Requirement:	47 CFR Part 15 Section 15.407(e)	
Test Method:	ANSI C63.10: 2013 Section 11.8 Option 2	
Test Setup:		
Test Instruments:	Refer to section 6 for details.	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates	
Final Test Mode:	Refer to section 3.7 for details.	
Limit:	Frequency Band	Limit
	5725-5850MHz	At lease 500kHz
Test Results:	Pass	
The detailed test data see: Appendix		



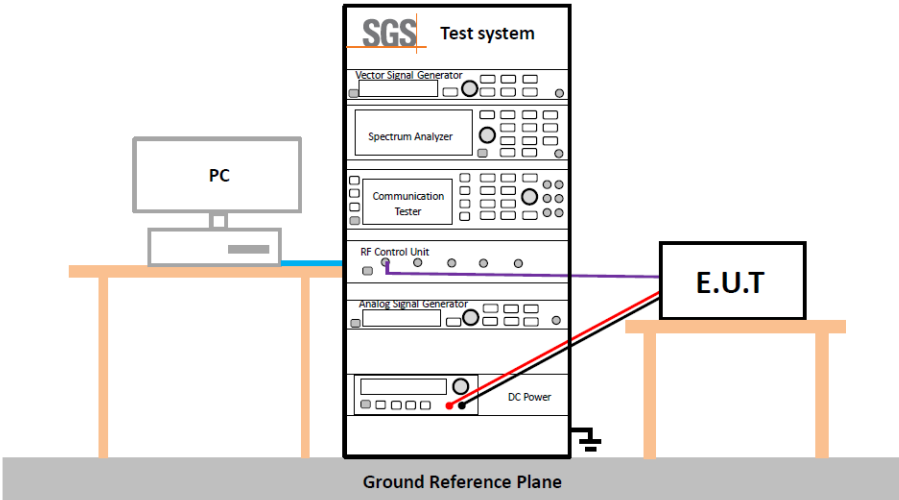
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4.7 99% Occupied Bandwidth

Test Requirement:	KDB 789033 D02§ D
Test Method:	ANSI C63.10: 2013 Section 6.9.3
Test Setup:	
Instruments Used:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	No restriction limits
Test Results:	Pass
The detailed test data see: Appendix	



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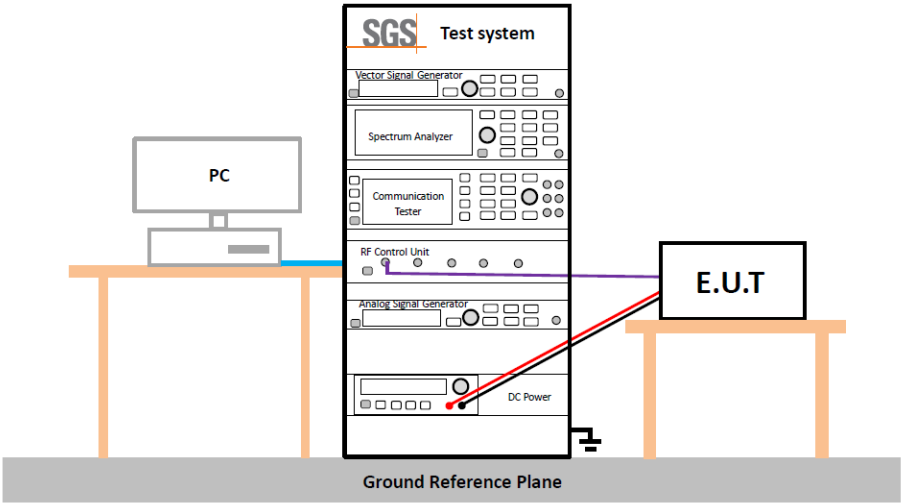
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4.8 Power Spectral Density

Test Requirement:	47 CFR Part 15 Section 15.407(a)		
Test Method:	ANSI C63.10: 2013 Section 11.10.2 KDB 789033 D02 v02r01, Section F.		
Test Setup:			
Instruments Used:	Refer to section 6 for details.		
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates		
Final Test Mode:	Refer to section 3.7 for details.		
Limit:	Frequency Band	Limit	
	5150-5250MHz	The power spectral density less than 11dBm/1MHz	
	5250-5350MHz	The power spectral density less than 11dBm/1MHz	
	5470-5725MHz	The power spectral density less than 11dBm/1MHz	
	5725-5850MHz	The power spectral density less than <30dBm/500KHz	
Test Results:	Pass		
The detailed test data see: Appendix			



4.9 Radiated Spurious Emissions

Test Requirement:	47 CFR Part 15 Section 15.205 and 15.209
Test Method:	ANSI C63.10: 2013 Section 6.4 / 6.5 / 6.6
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)
Test frequency:	9kHz ~ 40GHz(or 10 Harmonic)

Test Setup:

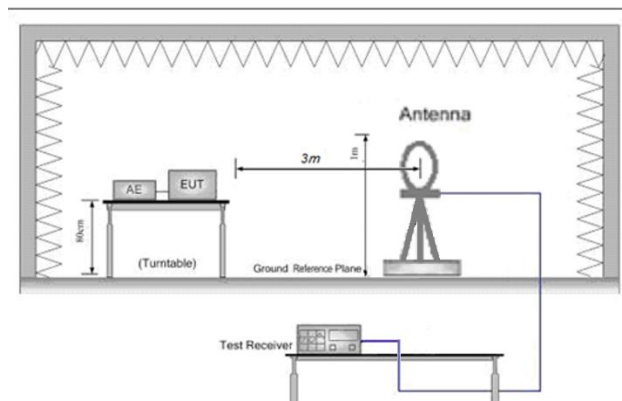


Figure 1. 9kHz to 30MHz

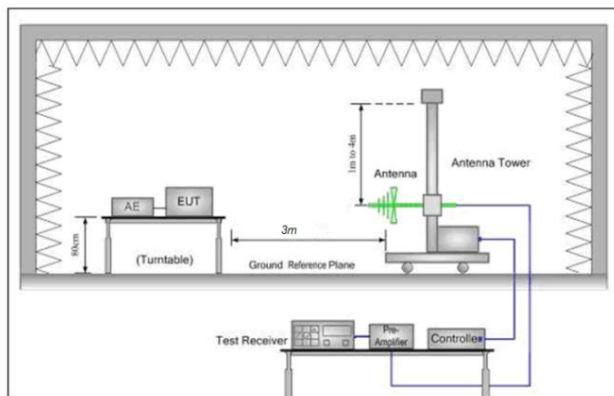


Figure 1. 30MHz to 1GHz

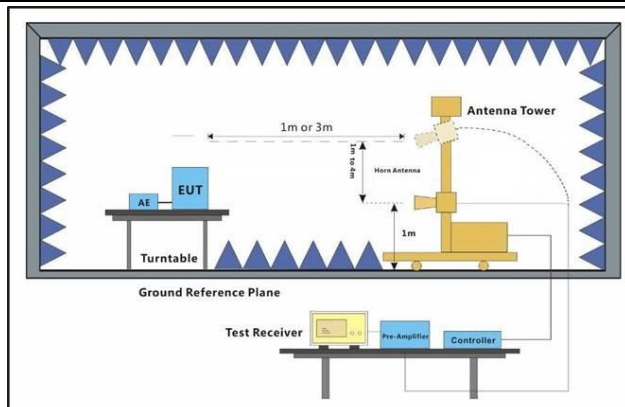


Figure 2. Above 1 GHz

Test Procedure:

- For below 1GHz test, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz test, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. (Distance from antenna to EUT is 1m for measurements >18GHz).
- The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and

	then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. Test the EUT in the outermost channels. h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is worse case. i. Repeat above procedures until all frequencies measured was complete. j. The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported k. The disturbance above 18GHz was very low, and the harmonics were the highest point could be found when testing, so only the harmonics had been displayed. l. At a measurement distance of 1 meter the limit line was increased by $20 \cdot \text{LOG}(3/1) = 9.54 \text{ dB}$.
Test Configuration:	Measurements Below 1000MHz • RBW = 120 kHz • VBW = 300 kHz • Detector = Peak • Trace mode = max hold Peak Measurements Above 1000 MHz • RBW = 1 MHz • VBW $\geq 3 \text{ MHz}$ • Detector = Peak • Sweep time = auto • Trace mode = max hold Average Measurements Above 1000MHz • RBW = 1 MHz • VBW $\geq [3 \cdot \text{RBW}]$ • Detector = RMS (power averaging), if $\text{span} / (\# \text{ of points in sweep}) \leq (\text{RBW} / 2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak. • Sweep time = auto • Perform a trace average of at least 100 traces.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates.
Final Test Mode:	Refer to section 3.7 for details.
Instruments Used:	Refer to section 6 for details.
Test Results:	Pass
The detailed test data see: Appendix	



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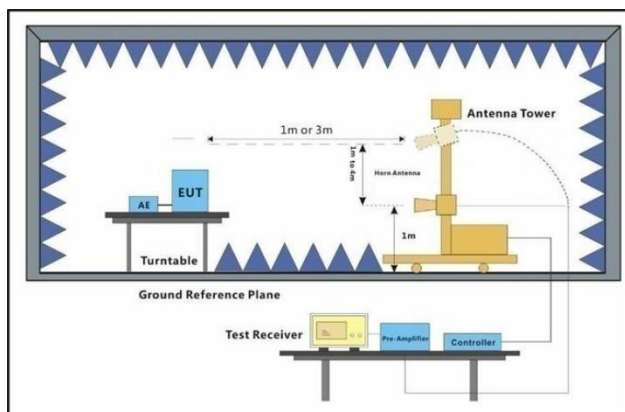
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4.10 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15 Section 15.407(b)		
Test Method:	ANSI C63.10: 2013 Section 11.12		
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)		
Limit:	Frequency	Limit (dBuV/m)	Remark
	30MHz-88MHz	40.0	Quasi-peak
	88MHz-216MHz	43.5	Quasi-peak
	216MHz-960MHz	46.0	Quasi-peak
	960MHz-1GHz	54.0	Quasi-peak
	Above 1GHz	54.0	Average Value
		74.0	Peak Value

Test Setup:



Test Procedure:

- The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel
- Test the EUT in the outermost channels.
- The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, And found the X axis positioning which it is worse case.

	i. Repeat above procedures until all frequencies measured was complete.
Test Configuration:	Measurements Below 1000MHz • RBW = 120 kHz • VBW = 300 kHz • Detector = Peak • Trace mode = max hold Peak Measurements Above 1000 MHz • RBW = 1 MHz • VBW ≥ 3 MHz • Detector = Peak • Sweep time = auto • Trace mode = max hold Average Measurements Above 1000MHz • RBW = 1 MHz • VBW ≥ [3 *RBW] • Detector = RMS (power averaging), if span / (# of points in sweep) ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak. • Sweep time = auto • Perform a trace average of at least 100 traces.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates.
Final Test Mode:	Refer to section 3.7 for details.
Instruments Used:	Refer to section 6 for details.
Test Results:	Pass
The detailed test data see: Appendix	



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4.11 Dynamic Frequency Selection

4.11.1 DFS Overview

Table 1: Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
<i>Non-Occupancy Period</i>	Yes	Not required	Yes
<i>DFS Detection Threshold</i>	Yes	Not required	Yes
<i>Channel Availability Check Time</i>	Yes	Not required	Not required
<i>U-NII Detection Bandwidth</i>	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
<i>DFS Detection Threshold</i>	Yes	Not required
<i>Channel Closing Transmission Time</i>	Yes	Yes
<i>Channel Move Time</i>	Yes	Yes
<i>U-NII Detection Bandwidth</i>	Yes	Not required
Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
<i>U-NII Detection Bandwidth and Statistical Performance Check</i>	All BW modes must be tested	Not required
<i>Channel Move Time and Channel Closing Transmission Time</i>	Test using widest BW mode available	Test using the widest BW mode available for the link
<i>All other tests</i>	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		



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4.11.2 DFS Detection Thresholds

**Table 3: DFS Detection Thresholds for Master Devices
and Client Devices with Radar Detection**

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP $\geq$ 200 milliwatt	-64 dBm
EIRP $<$ 200 milliwatt and power spectral density $<$ 10 dBm/MHz	-62 dBm
EIRP $<$ 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	



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4.11.3 RADAR TEST WAVEFORMS

Table 5 – Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A	Roundup $\left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \right\}$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					



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Table 5a - Pulse Repetition Intervals Values for Test A

Pulse Repetition Frequency Number	Pulse Repetition Frequency (Pulses Per Second)	Pulse Repetition Interval (Microseconds)
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

The aggregate is the average of the percentage of successful detections of Short Pulse Radar Types 1-4. For example, the following table indicates how to compute the aggregate of percentage of successful detections.

Radar Type	Number of Trials	Number of Successful Detections	Minimum Percentage of Successful Detection
1	35	29	82.9%
2	30	18	60%
3	30	27	90%
4	50	44	88%
Aggregate $(82.9\% + 60\% + 90\% + 88\%) / 4 = 80.2\%$			



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Table 6 – Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 7 – Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

4.11.4 Response Requirements

Table 4: DFS Response Requirement Values

Parameter	Value
<i>Non-occupancy period</i>	Minimum 30 minutes
<i>Channel Availability Check Time</i>	60 seconds
<i>Channel Move Time</i>	10 seconds See Note 1.
<i>Channel Closing Transmission Time</i>	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
<i>U-NII Detection Bandwidth</i>	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.

Note 1: *Channel Move Time* and the *Channel Closing Transmission Time* should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.

Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate a *Channel* move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

The detailed test data see: **Appendix**



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5 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	$\pm 0.54\text{dB}$
2	RF power density, conducted	$\pm 1.03\text{dB}$
3	Spurious emissions, conducted	$\pm 0.54\text{dB}$
4	Radio Frequency	$\pm 1.0\%$
5	Duty Cycle	$\pm 0.37\%$
6	Occupied Bandwidth	$\pm 1.0\%$
7	Conduction Emission	$\pm 2.90\text{dB}$ (150kHz to 30MHz)
8	Radiated Emission	$\pm 3.13\text{dB}$ (9k -30MHz)
		$\pm 4.80\text{dB}$ (30M -1GHz)
		$\pm 4.80\text{dB}$ (1GHz to 18GHz)
		$\pm 4.80\text{dB}$ (Above 18GHz)

Remark:

The U_{lab} (lab Uncertainty) is less than $U_{\text{CISPR/ETSI}}$ (CISPR/ETSI Uncertainty), so the test results

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.



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6 Equipment List

RF Test Equipment					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Shielding Room	Brilliant-emc	N/A	SUWI-04-01-06	2021/05/08	2024/05/07
Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-07	2022/02/16	2023/02/15
Signal Analyzer	ROHDE&SCHWARZ	FSV3030	SUWI-01-02-02	2022/05/17	2023/05/16
Measurement Software	Tonscend	JS1120-3 Test System V3.1.55	SUWI-02-09-09	NCR	NCR
Signal Analyzer	ROHDE&SCHWARZ	FSW43	SUWI-01-02-04	2022/05/28	2023/05/27
DC Power Supply	HYELEC	HY3005B	SUWI-01-18-01	2022/02/15	2023/02/14
Power meter	Anritsu	ML2495A	SUWI-01-31-01	2021/12/04	2022/12/03
Pulse power sensor	Anritsu	MA2411B	SUWI-01-32-01	2021/12/04	2022/12/03
Temperature Chamber	ESPEC	SU-242	SUWI-01-13-01	2022/02/15	2023/02/14
Wideband Radio Communication Tester	ROHDE&SCHWARZ	CMW500	SUWI-01-16-05	2022/02/14	2023/02/13
MXG Vector signal genitor	KEYSIGHT	N5182B	SUWI-01-38-01	2022/02/14	2023/02/13
Router	ASUS	GT-AXE11000(FCC ID MSQ-RTAXJF00)	SUWI-03-14-02	NCR	NCR

CE Test System					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Shielding Room	Brilliant-emc	N/A	SUWI-04-03-01	2021/05/08	2024/05/07
Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-01	2022/02/16	2023/02/15
Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-02	2022/02/16	2023/02/15
Measurement Software	Tonscend	JS32-CE V4.0.0.2	SUWI-02-09-05	NCR	NCR
Test receiver	ROHDE&SCHWARZ	ESR7	SUWI-01-10-01	2022/02/16	2023/02/15
Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-06	2022/02/16	2023/02/15



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RSE Test System					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date (yyyy/mm/dd)	Cal Due Date (yyyy/mm/dd)
Semi-Anechoic Chamber	Brilliant-emc	N/A	SUWI-04-02-01	2021/05/08	2024/05/07
Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-05	2022/02/16	2023/02/15
Signal Analyzer	ROHDE&SCHWARZ	FSW43	SUWI-01-02-04	2022/05/28	2023/05/27
Signal Analyzer	KEYSIGHT	N9020A	SUWI-01-02-05	2021/12/04	2022/12/03
Test receiver	ROHDE&SCHWARZ	ESR7	SUWI-01-10-01	2022/02/19	2023/02/18
Receiving antenna	SCHWRZBECK MESS- ELEKTRONIK	VULB 9163	SUWI-01-11-01	2021/05/16	2023/05/15
Receiving antenna	SCHWRZBECK MESS- ELEKTRONIK	BBHA 9120D	SUWI-01-11-02	2021/05/16	2023/05/15
Receiving antenna	SCHWRZBECK MESS- ELEKTRONIK	BBHA 9170	SUWI-01-11-03	2021/05/14	2023/05/13
Amplifier	Tonscend	TAP9K3G40	SUWI-01-14-01	2022/02/14	2023/02/13
Amplifier	Tonscend	TAP01018050	SUWI-01-14-02	2022/02/14	2023/02/13
Amplifier	Tonscend	TAP18040048	SUWI-01-14-03	2022/02/19	2023/02/18
Active Loop Antenna	SCHWRZBECK MESS- ELEKTRONIK	FMZB 1519B	SUWI-01-21-01	2021/06/10	2023/06/09
Measurement Software	Tonscend	JS32-RSE V4.0.0.0	SUWI-02-09-06	NCR	NCR



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7 Photographs - Setup Photos

Refer to Appendix A.2 WLAN Setup Photos.



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Emission Bandwidth Test Result

TestMode	Antenna	Frequency[MHz]	26dB EBW [MHz]	FL[MHz]	FH[MHz]	Verdict
11a	Ant1	5180	22.88	5168.92	5191.80	Reporting only
		5220	23.12	5208.72	5231.84	
		5240	22.28	5228.80	5251.08	
		5260	23.00	5248.76	5271.76	
		5300	23.04	5288.72	5311.76	
		5320	23.04	5308.76	5331.80	
		5500	23.00	5488.76	5511.76	
		5580	23.16	5568.68	5591.84	
		5700	23.64	5688.20	5711.84	
		5745	23.12	5733.64	5756.76	
		5785	22.84	5773.64	5796.48	
		5825	23.04	5813.68	5836.72	
11n20SISO	Ant1	5180	23.52	5168.28	5191.80	
		5220	24.32	5208.16	5232.48	
		5240	23.44	5228.44	5251.88	
		5260	23.40	5248.44	5271.84	
		5300	23.28	5288.56	5311.84	
		5320	23.80	5308.04	5331.84	
		5500	24.08	5488.20	5512.28	
		5580	24.00	5568.36	5592.36	
		5700	23.20	5688.60	5711.80	
		5745	23.80	5733.00	5756.80	
		5785	24.52	5773.04	5797.56	
		5825	24.64	5812.40	5837.04	
11n40SISO	Ant1	5190	41.76	5169.20	5210.96	
		5230	42.32	5208.80	5251.12	
		5270	41.52	5249.44	5290.96	
		5310	41.60	5289.12	5330.72	
		5510	41.44	5489.36	5530.80	
		5550	41.84	5528.88	5570.72	
		5670	41.84	5648.96	5690.80	
		5755	41.68	5734.12	5775.80	
11ac20SISO	Ant1	5795	42.24	5773.80	5816.04	
		5180	23.64	5168.12	5191.76	
		5220	23.36	5208.52	5231.88	
		5240	23.44	5228.44	5251.88	
		5260	23.80	5248.24	5272.04	
		5300	23.20	5288.56	5311.76	
		5320	23.76	5308.00	5331.76	
		5500	23.28	5488.56	5511.84	
		5580	23.64	5568.24	5591.88	
		5700	23.48	5688.36	5711.84	
		5745	23.64	5733.16	5756.80	
		5785	23.72	5773.08	5796.80	
11ac40SISO	Ant1	5825	23.48	5813.28	5836.76	
		5190	41.20	5169.52	5210.72	
		5230	41.36	5209.44	5250.80	
		5270	41.52	5249.36	5290.88	
		5310	41.68	5288.96	5330.64	
		5510	41.60	5489.20	5530.80	
		5550	41.60	5529.20	5570.80	
		5670	41.28	5649.44	5690.72	



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11ac80SISO	Ant1	5755	41.84	5733.96	5775.80
		5795	41.76	5774.20	5815.96
		5210	84.00	5168.08	5252.08
		5290	84.32	5247.92	5332.24
		5530	83.84	5488.24	5572.08
		5610	84.48	5567.76	5652.24
		5775	84.16	5732.92	5817.08



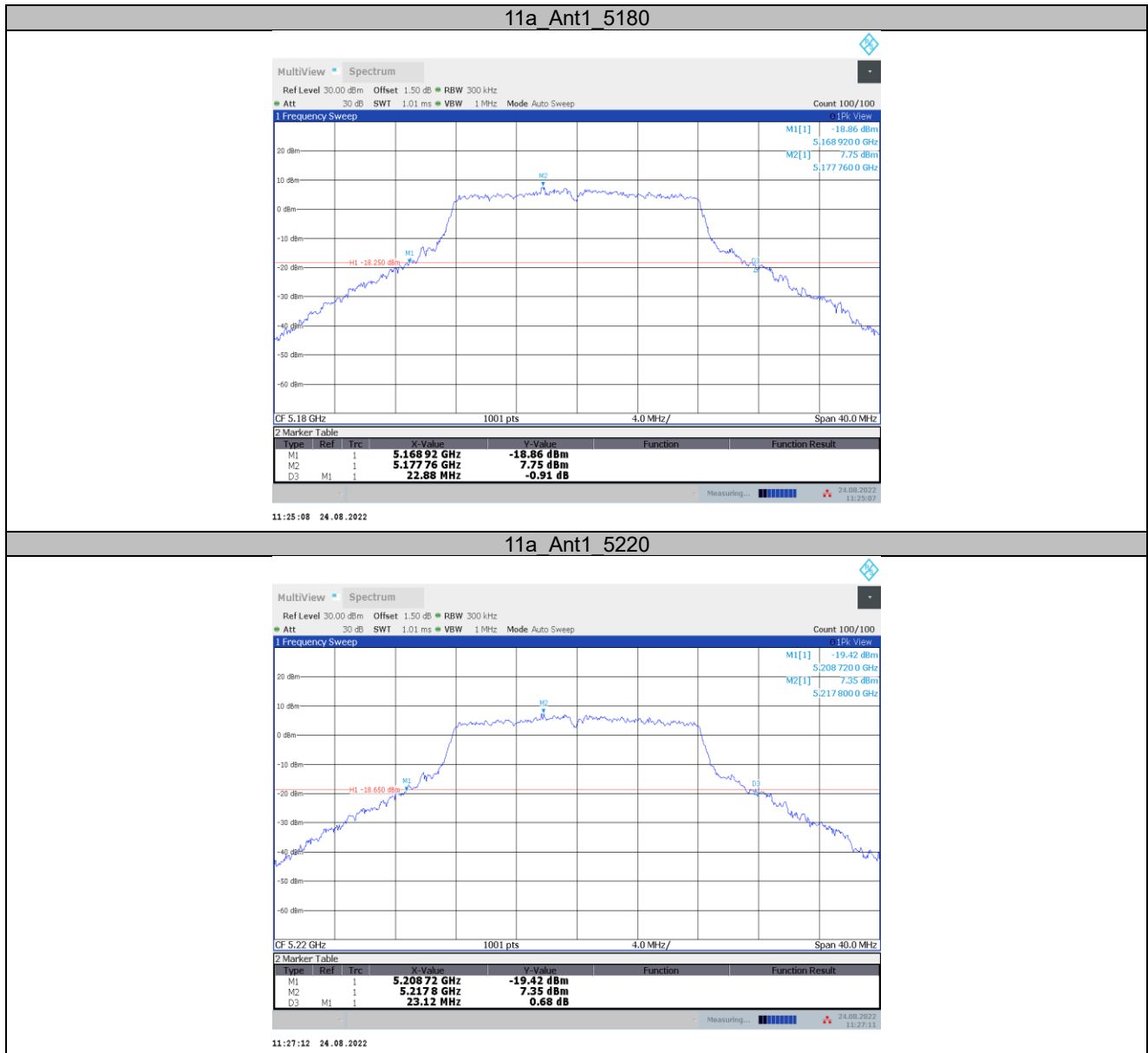
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Test Graphs



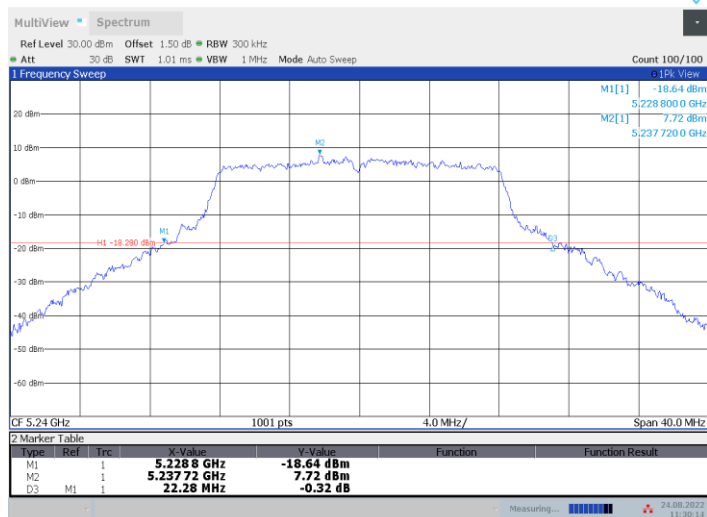
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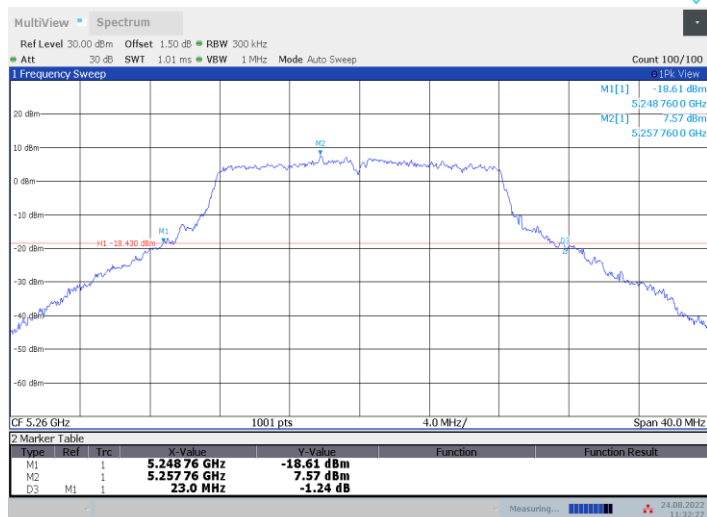
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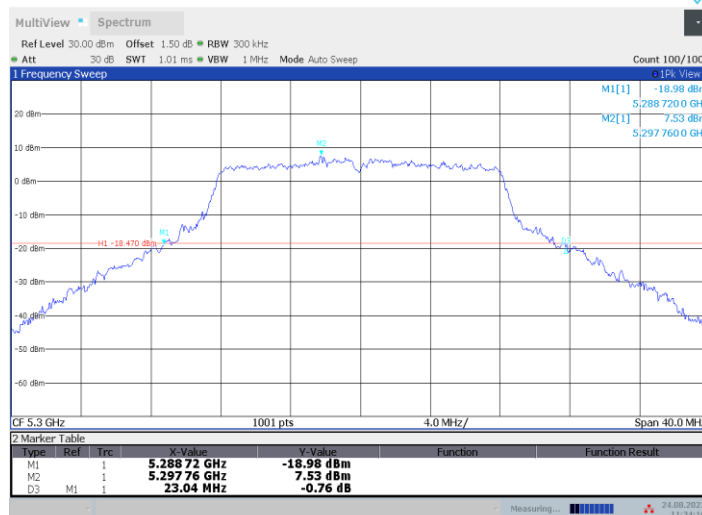
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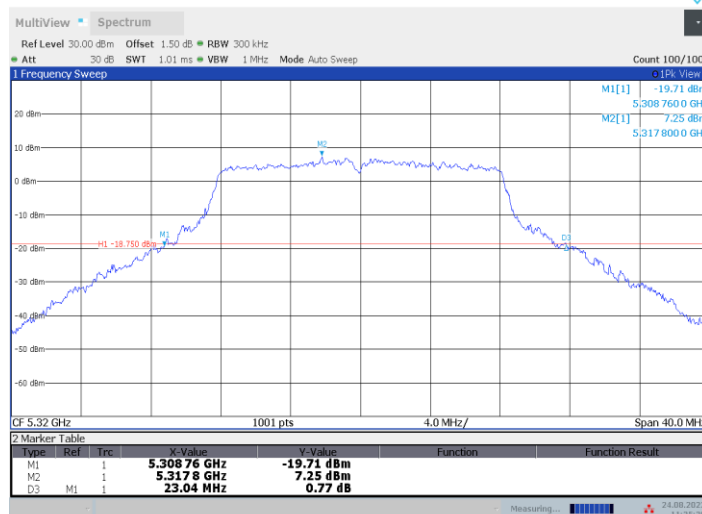
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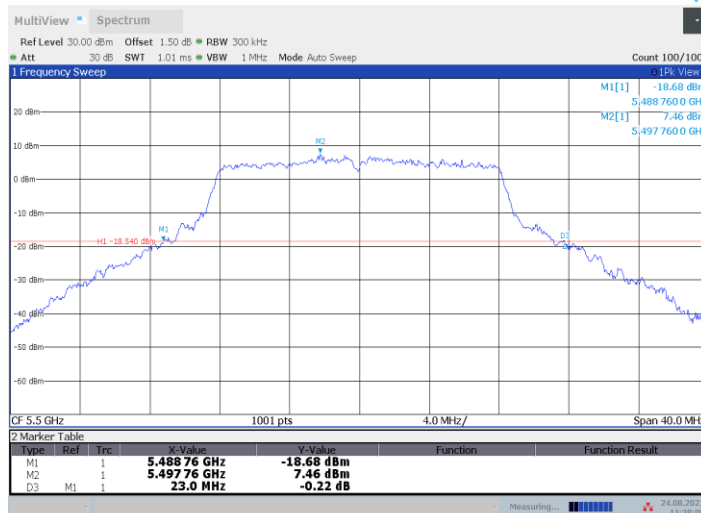


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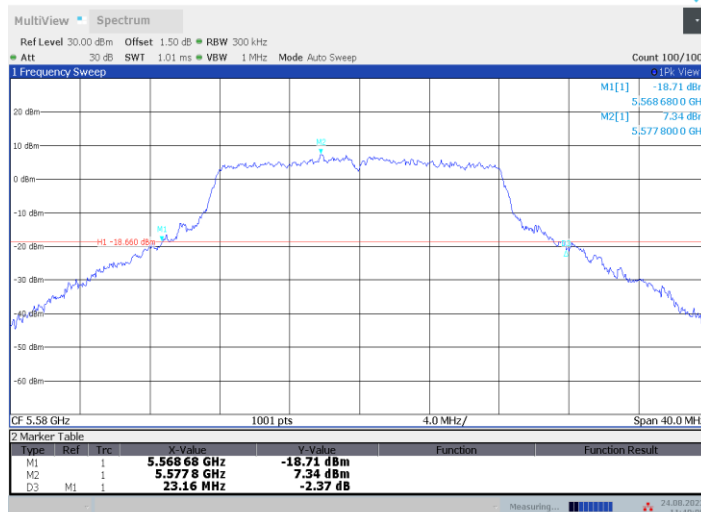
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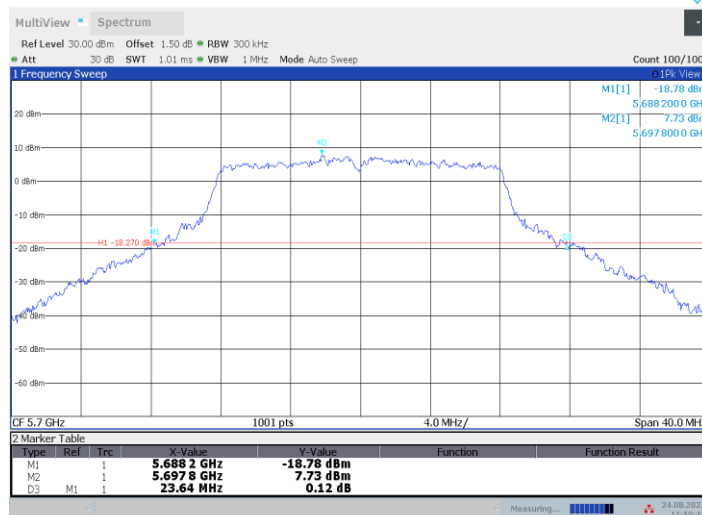
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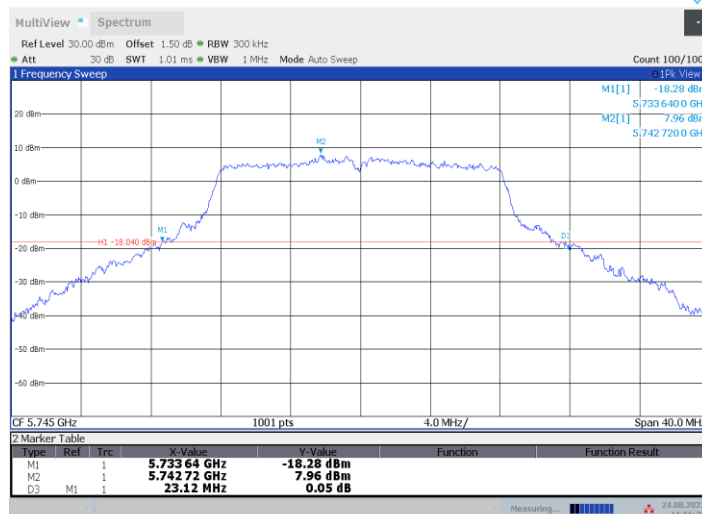
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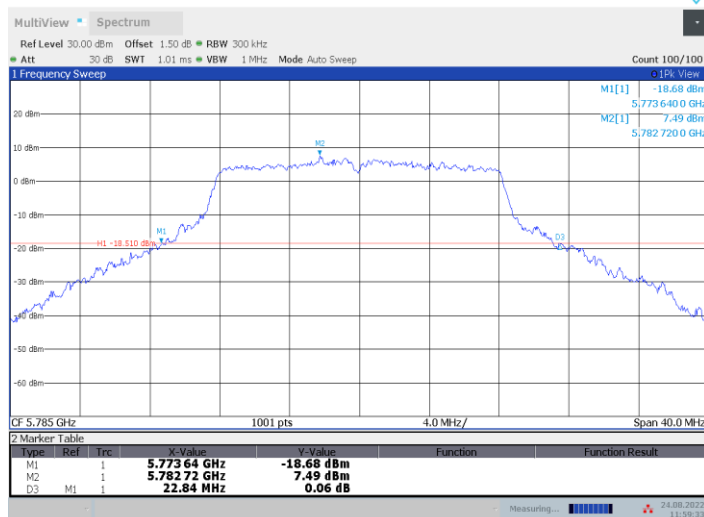
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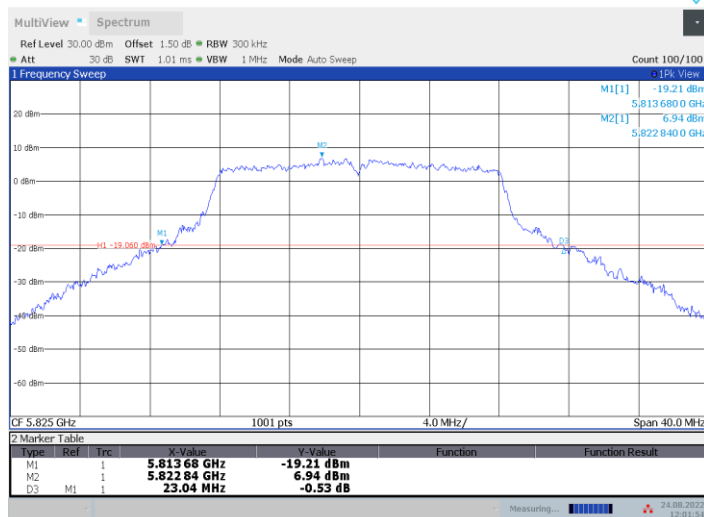
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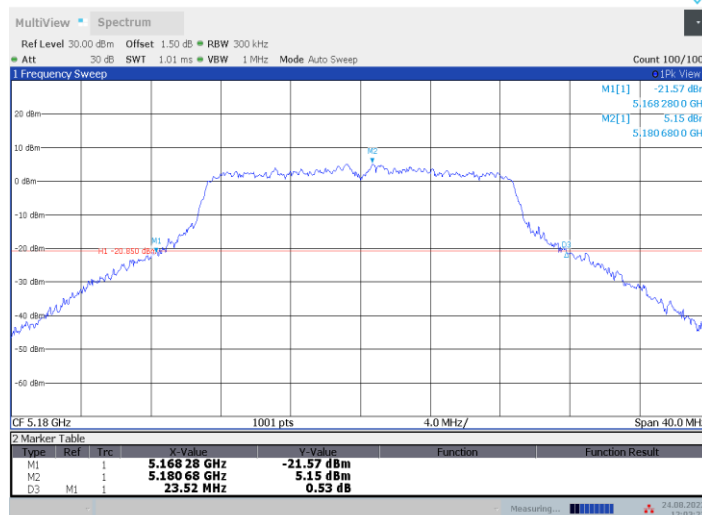
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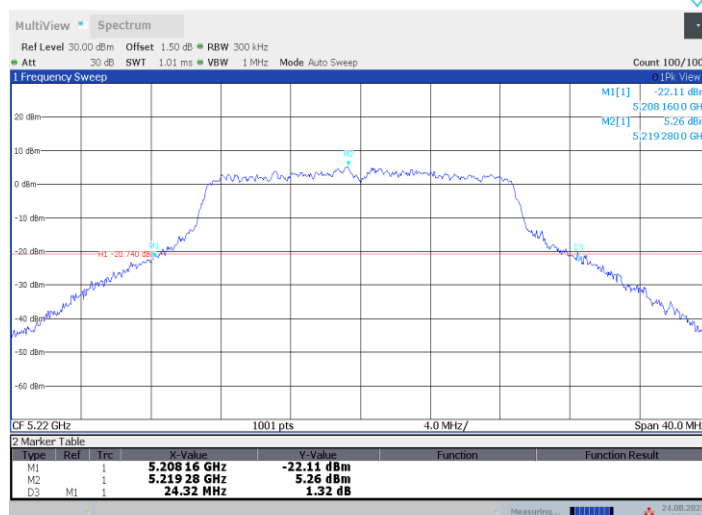
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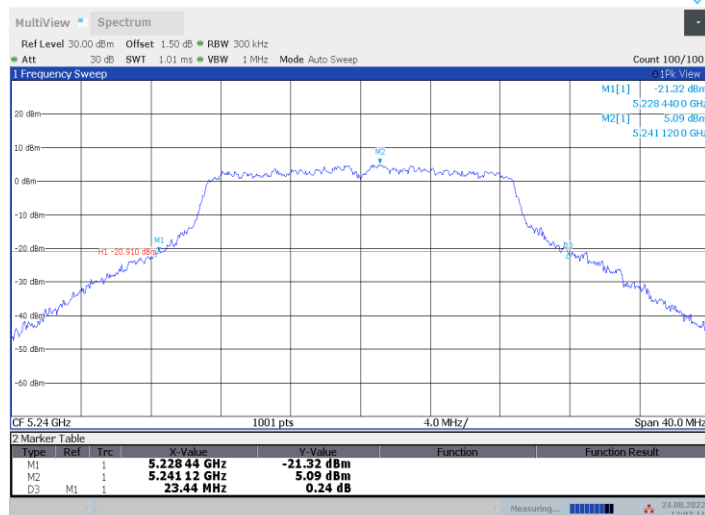
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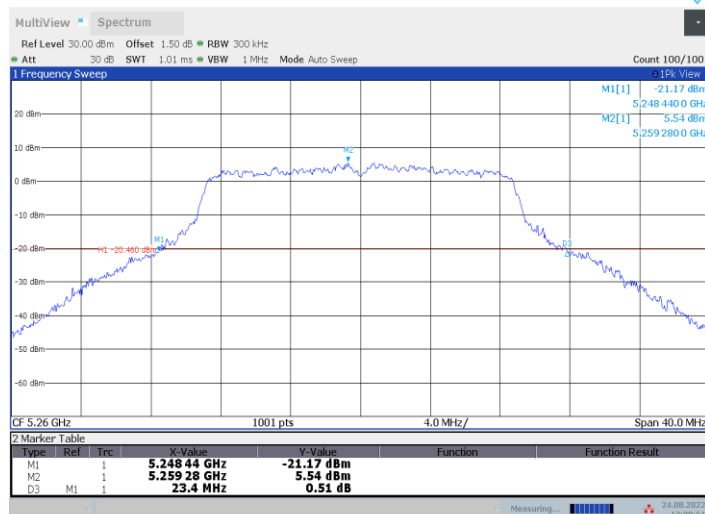
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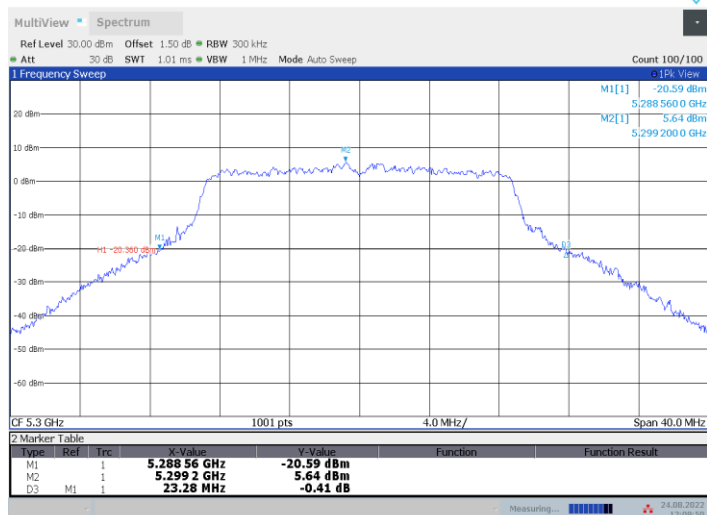
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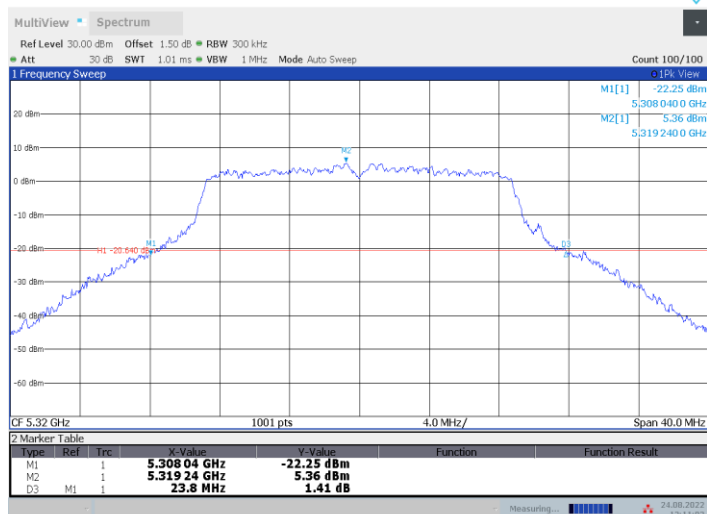
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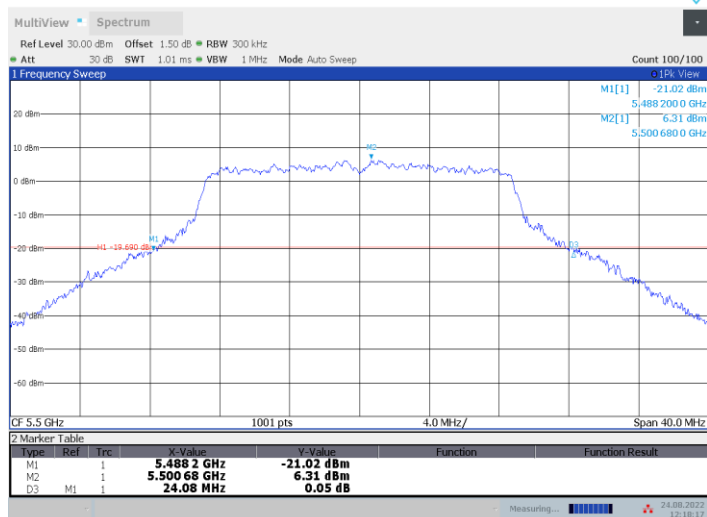
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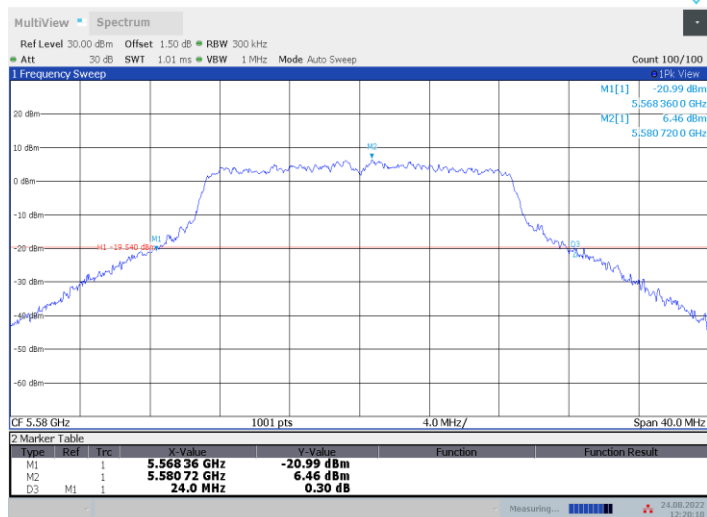
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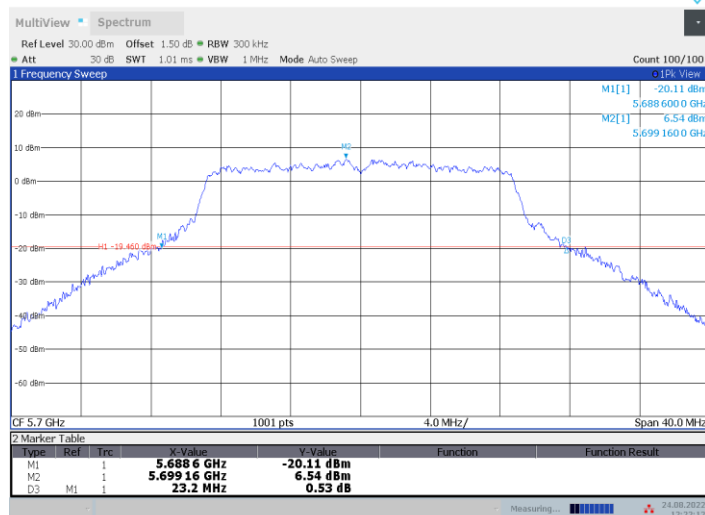
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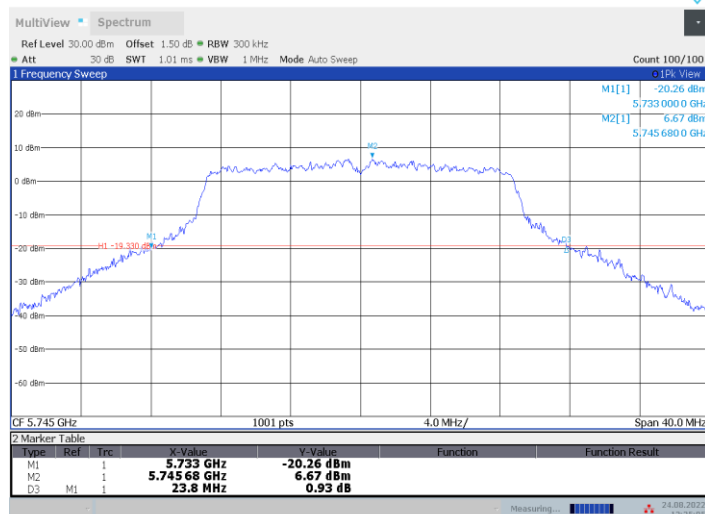
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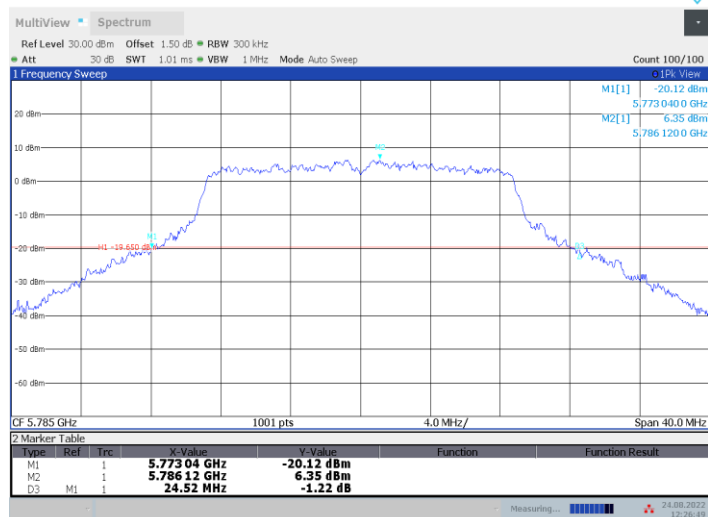
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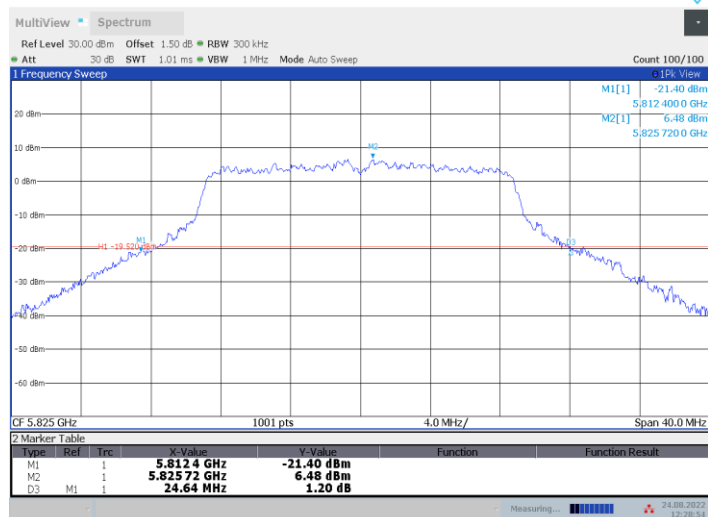
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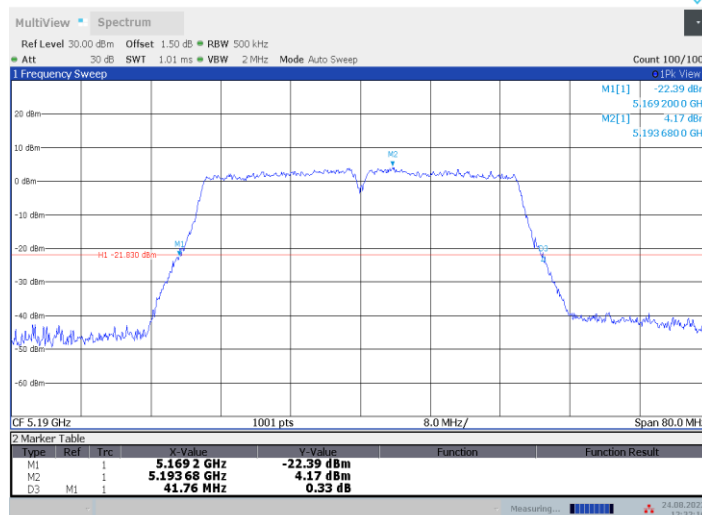
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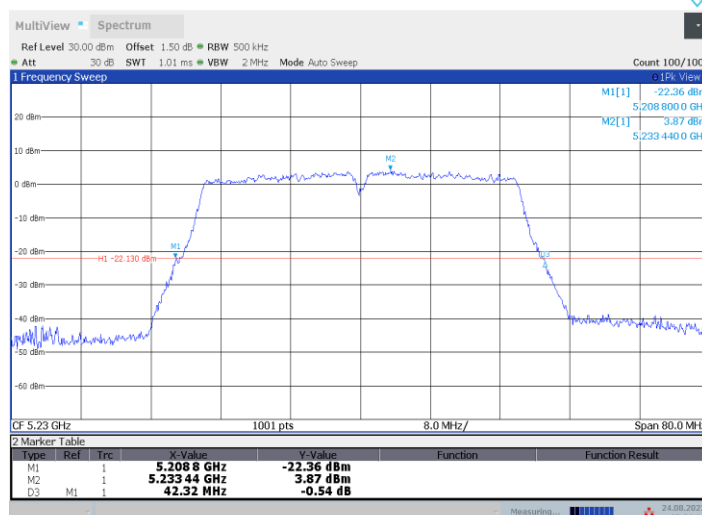
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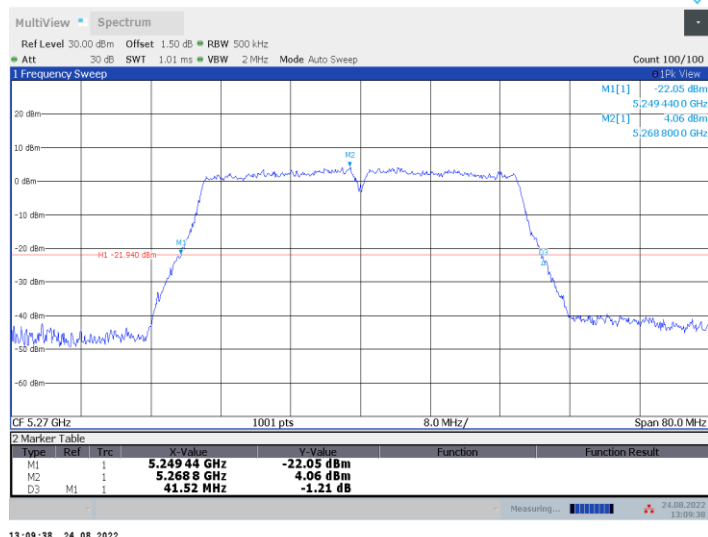
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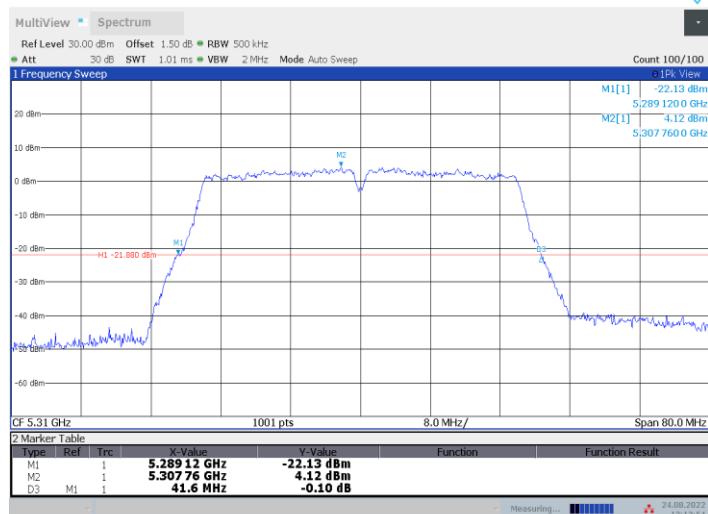
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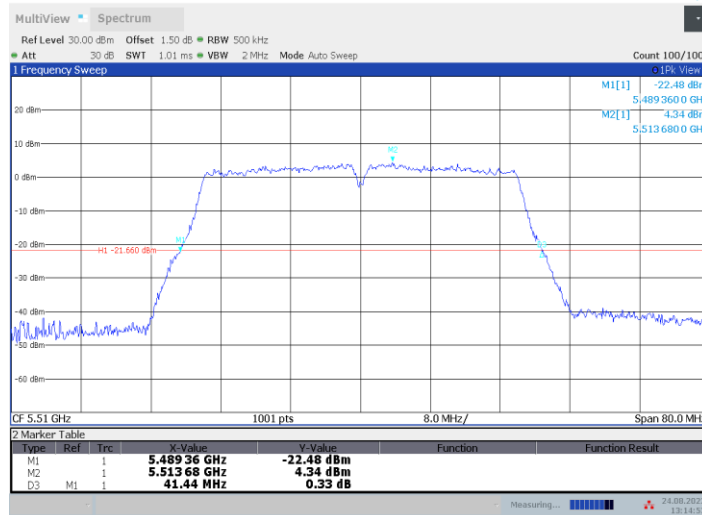
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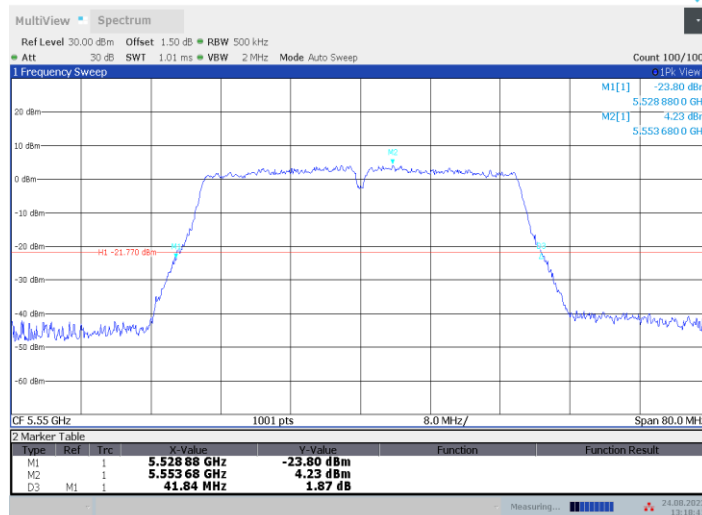
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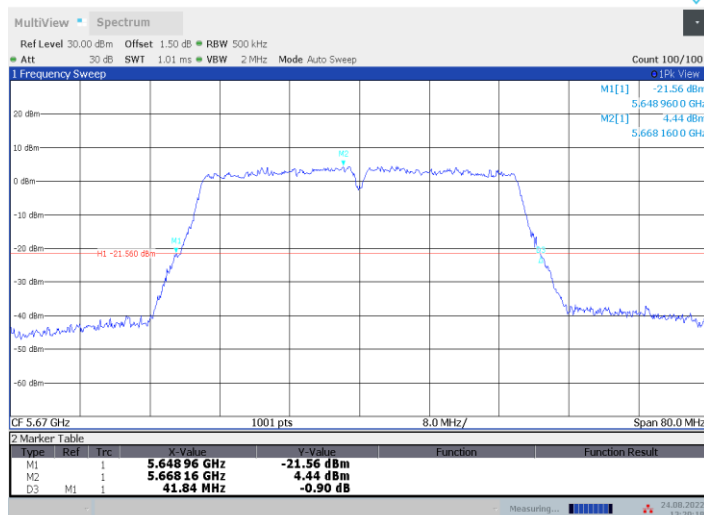
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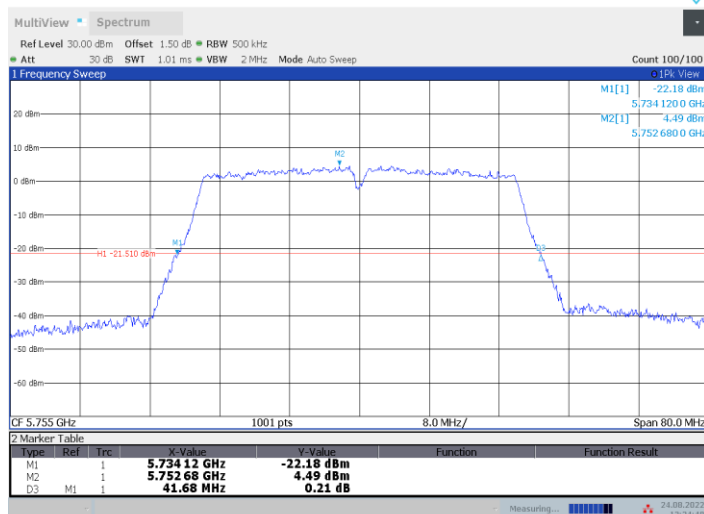
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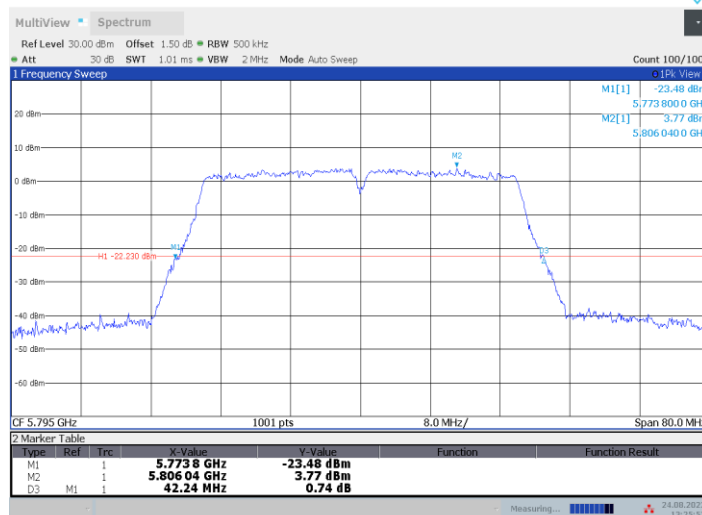
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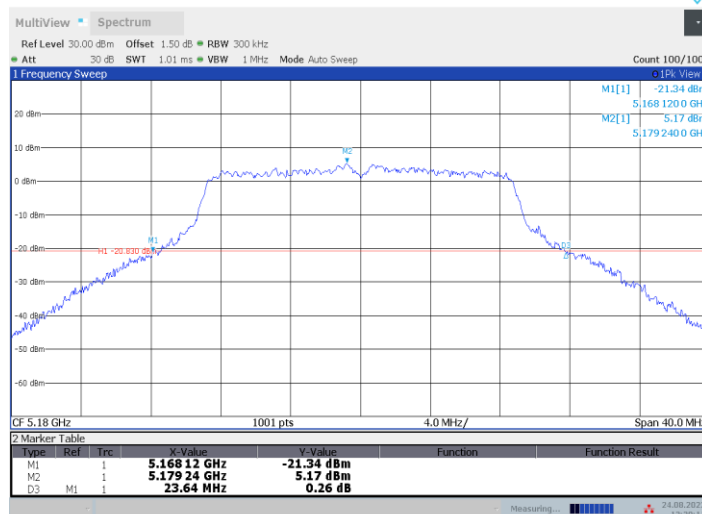
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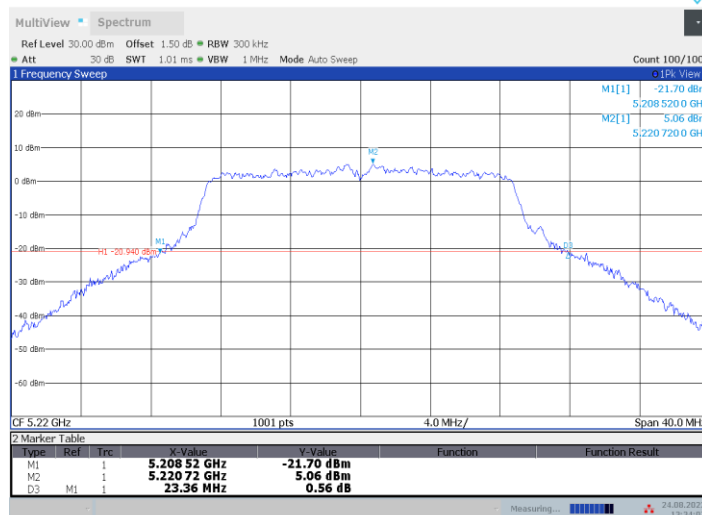
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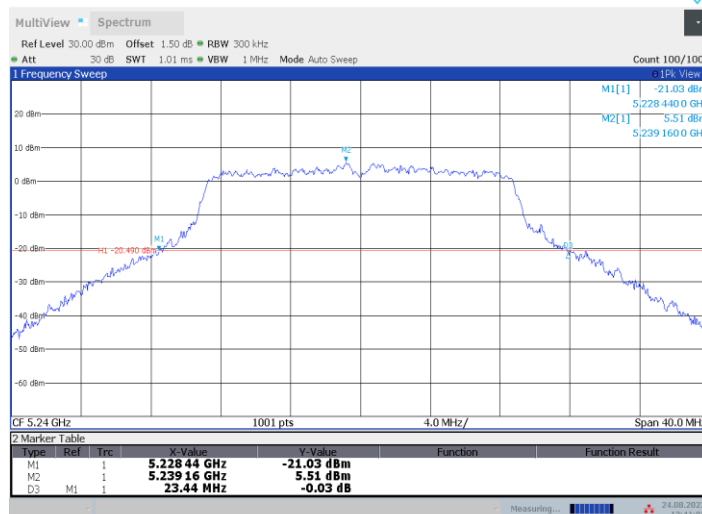
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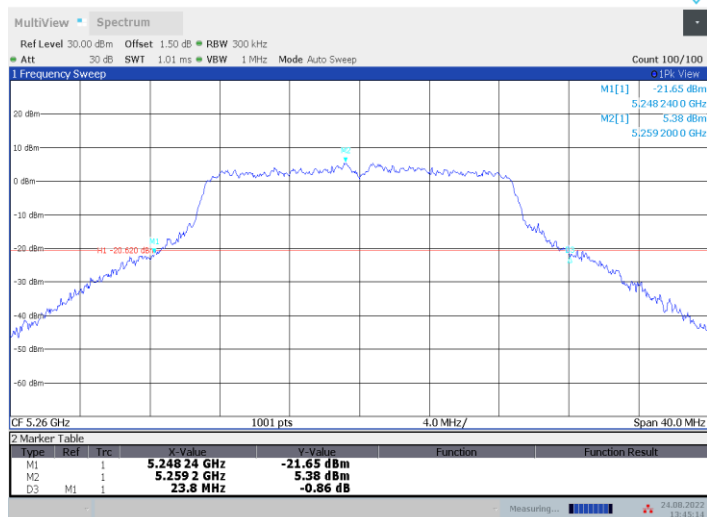
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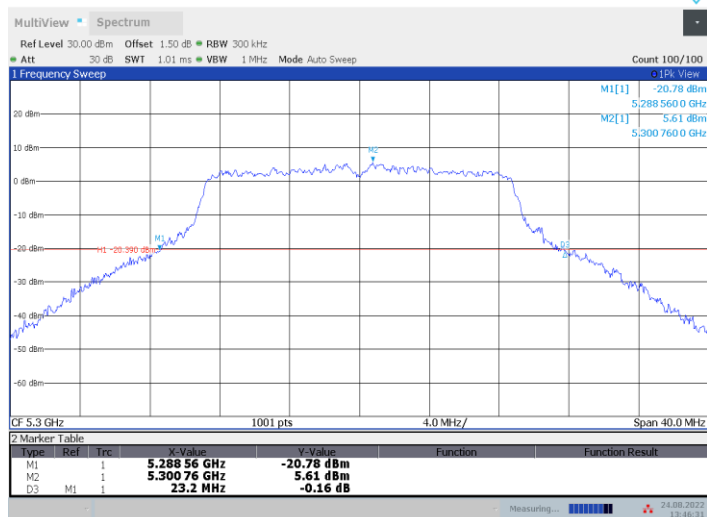
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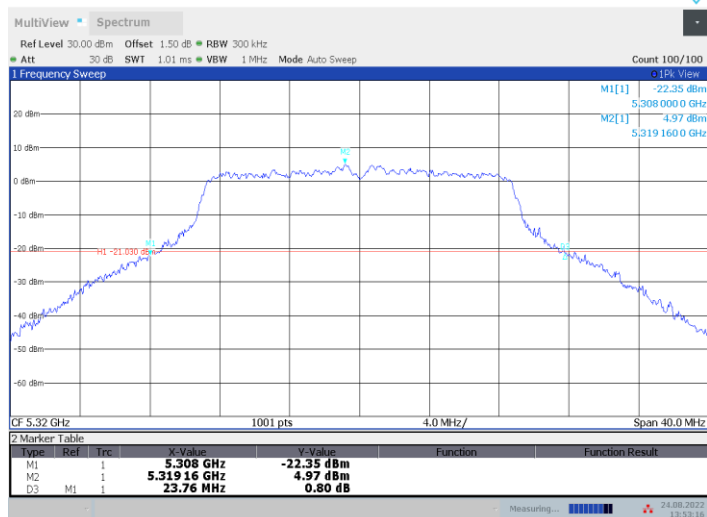
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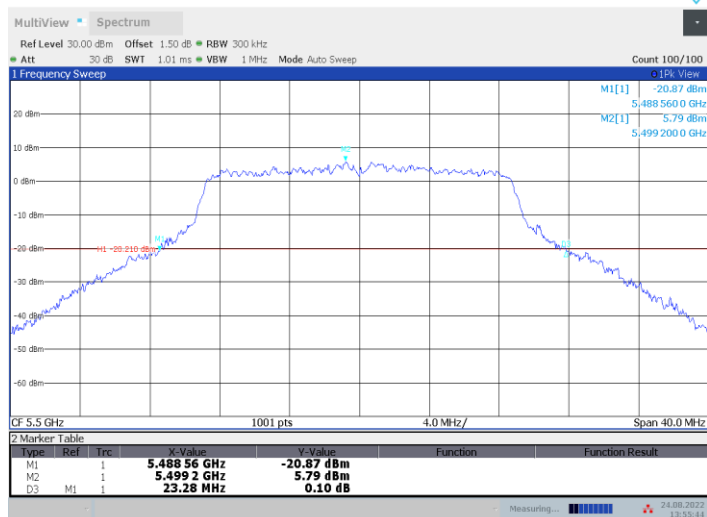
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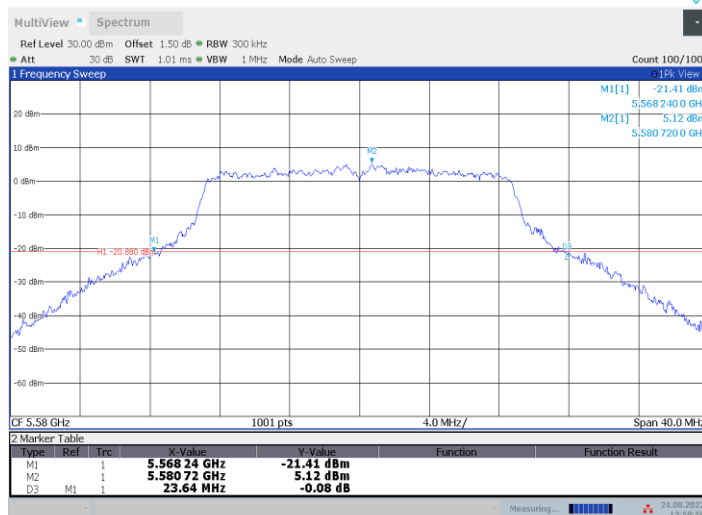
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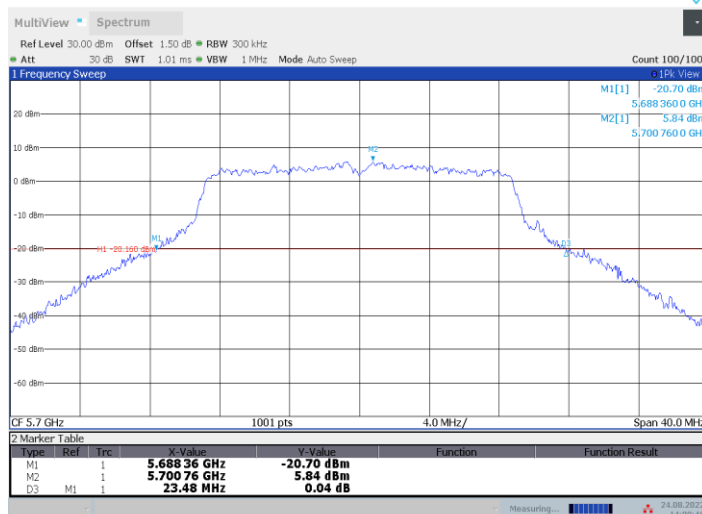
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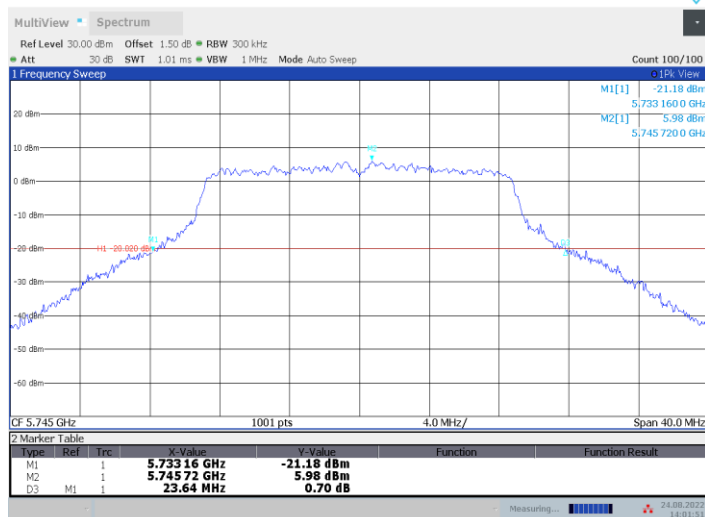
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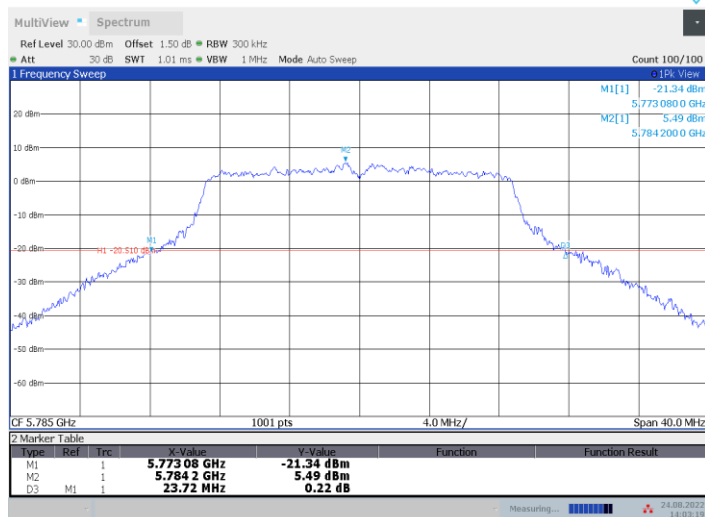
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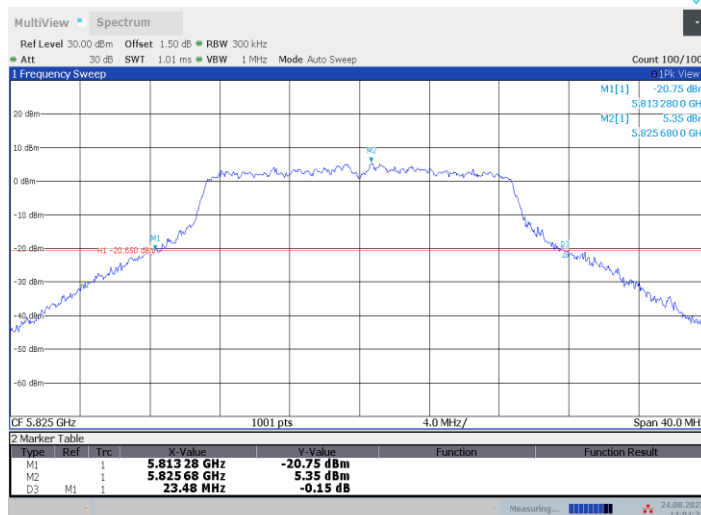
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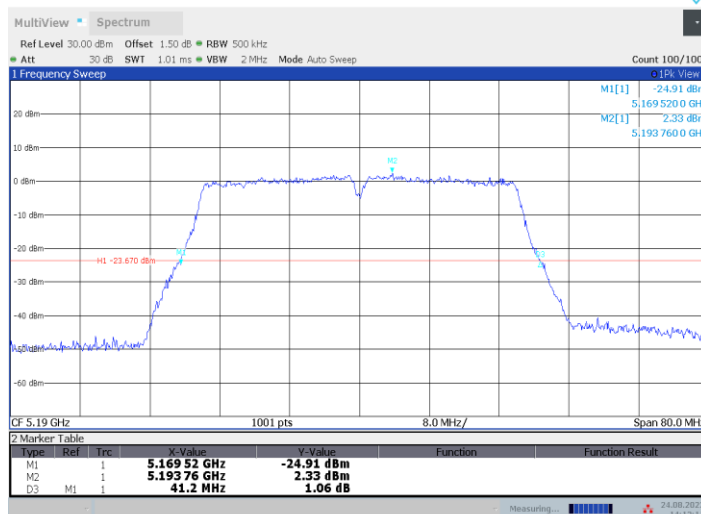
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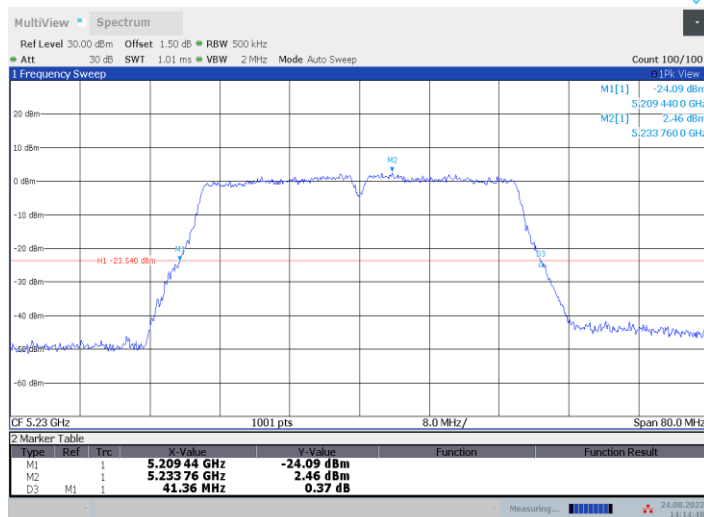
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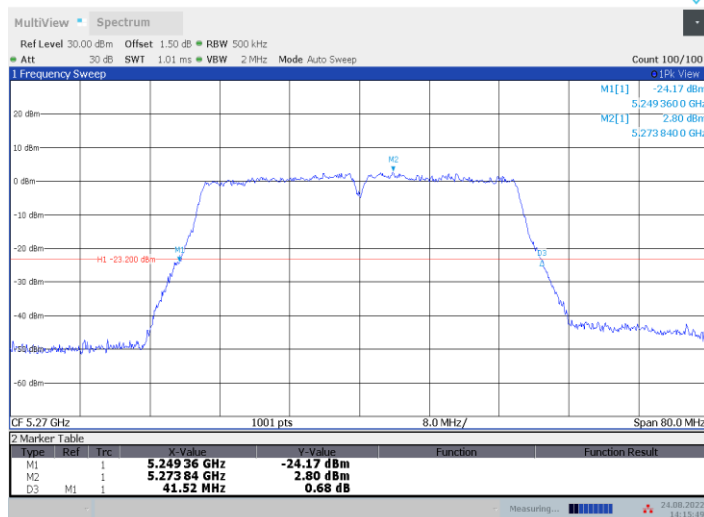
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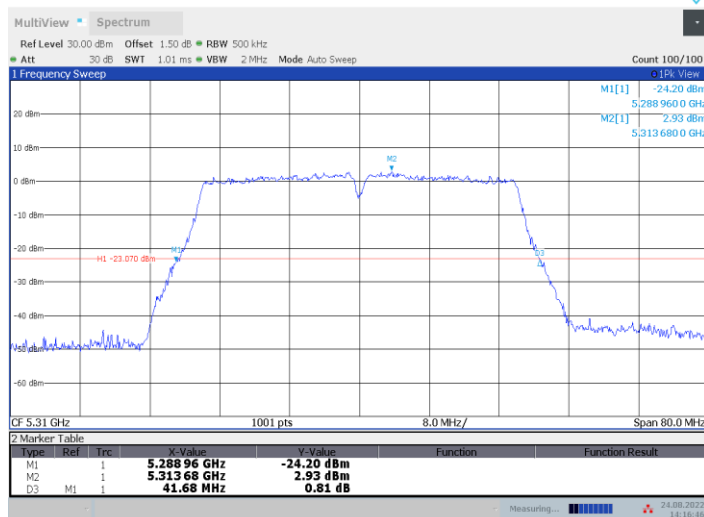
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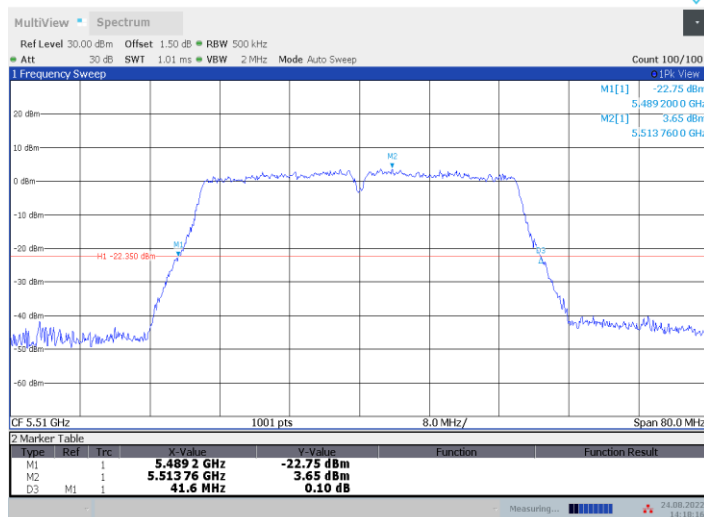
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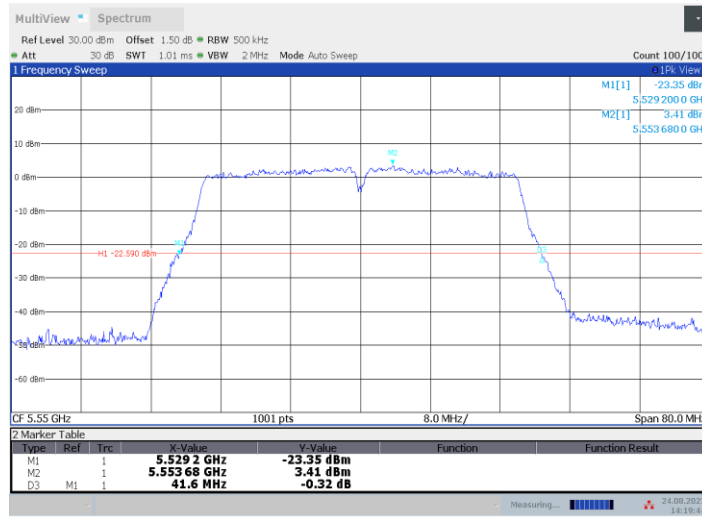
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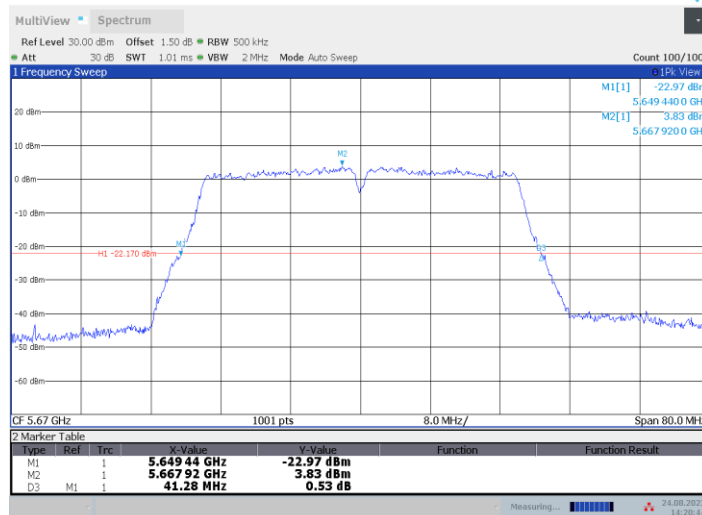
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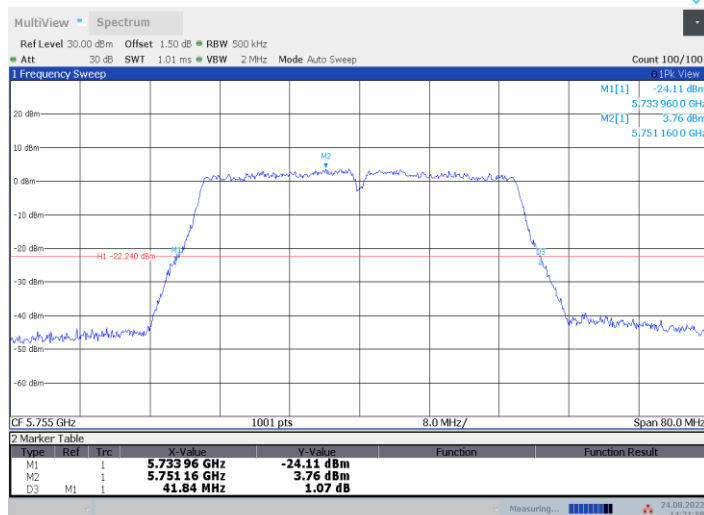
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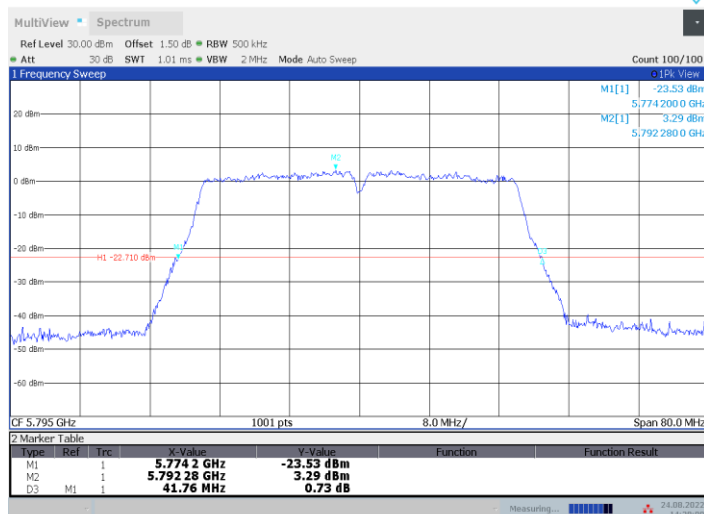
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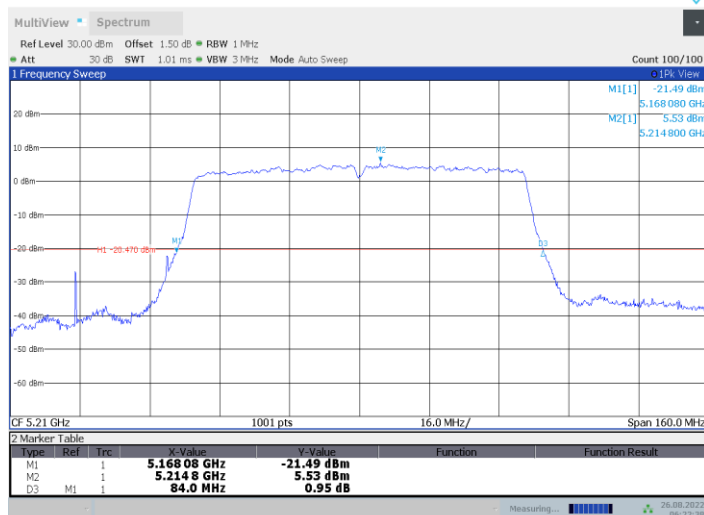
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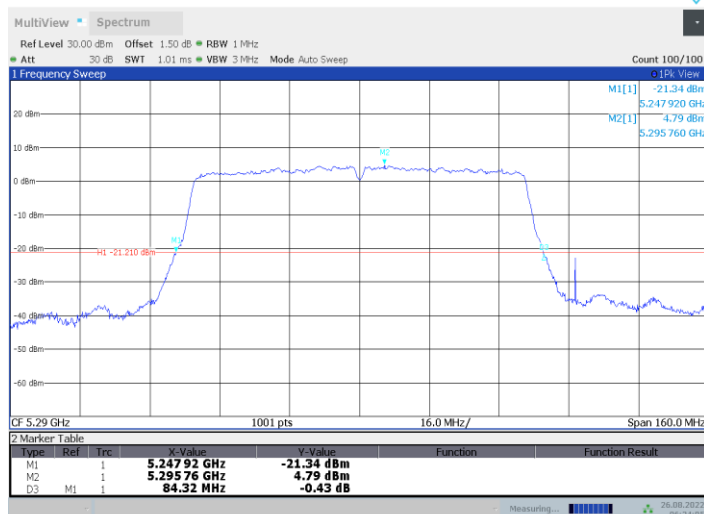
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11ac80SISO Ant1 5210



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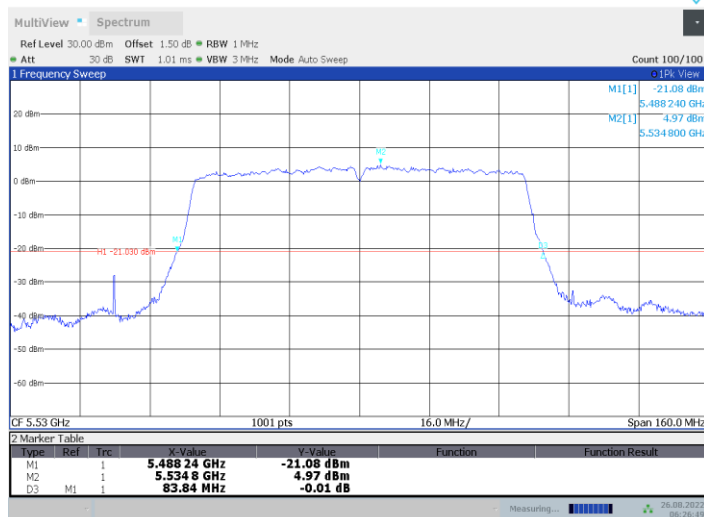
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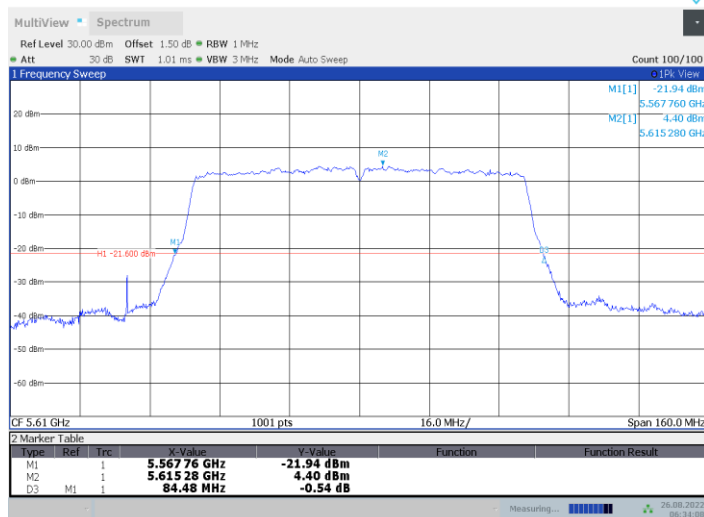
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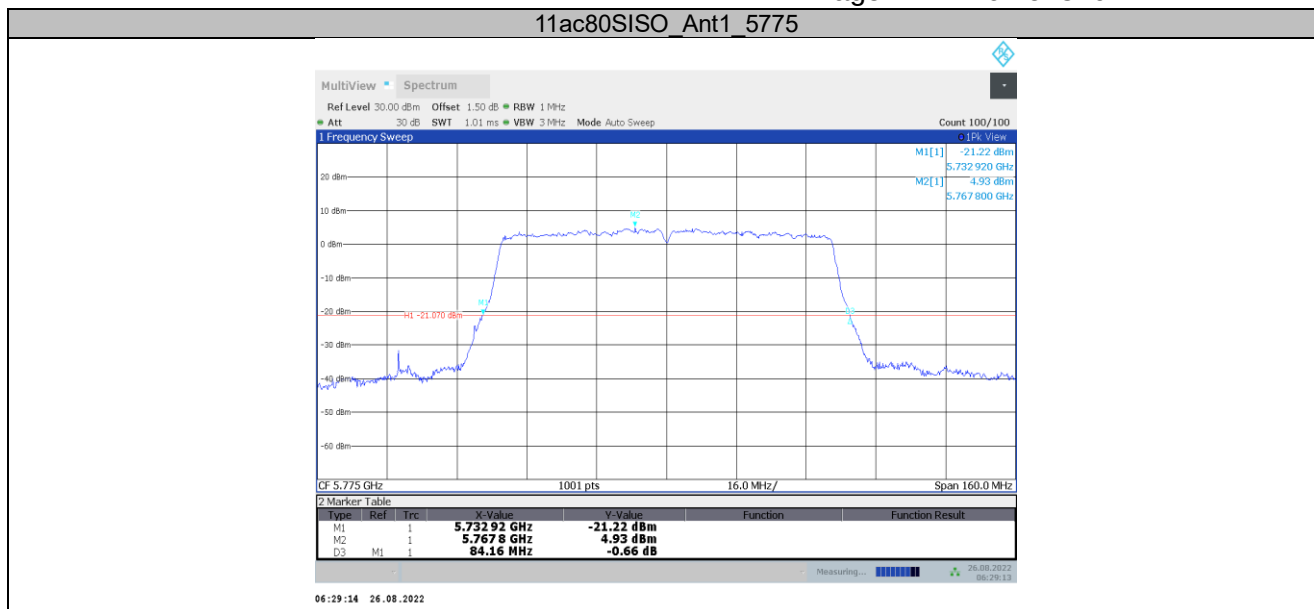
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Occupied channel bandwidth Test Result

TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Verdict
11a	Ant1	5180	17.076	5171.452	5188.529	Reporting only
		5220	17.033	5211.488	5228.522	
		5240	17.053	5231.463	5248.516	
		5260	17.028	5251.461	5268.489	
		5300	17.056	5291.453	5308.509	
		5320	17.029	5311.460	5328.489	
		5500	17.043	5491.457	5508.499	
		5580	17.066	5571.459	5588.524	
		5700	17.117	5691.418	5708.535	
		5745	17.116	5736.417	5753.533	
		5785	17.113	5776.403	5793.517	
		5825	17.08	5816.420	5833.500	
11n20SISO	Ant1	5180	18.192	5170.926	5189.117	
		5220	18.229	5210.916	5229.146	
		5240	18.259	5230.884	5249.143	
		5260	18.185	5250.933	5269.118	
		5300	18.24	5290.877	5309.116	
		5320	18.209	5310.909	5329.118	
		5500	18.22	5490.918	5509.138	
		5580	18.225	5570.902	5589.126	
		5700	18.227	5690.891	5709.119	
		5745	18.276	5735.861	5754.137	
		5785	18.225	5775.890	5794.115	
		5825	18.273	5815.869	5834.142	
11n40SISO	Ant1	5190	36.63	5171.775	5208.405	
		5230	36.606	5211.813	5248.419	
		5270	36.596	5251.794	5288.390	
		5310	36.595	5291.758	5328.353	
		5510	36.607	5491.783	5528.390	
		5550	36.626	5531.766	5568.392	
		5670	36.622	5651.779	5688.402	
		5755	36.589	5736.752	5773.342	
11ac20SISO	Ant1	5795	36.617	5776.749	5813.366	
		5180	18.228	5170.900	5189.128	
		5220	18.244	5210.894	5229.139	
		5240	18.215	5230.927	5249.142	
		5260	18.209	5250.919	5269.128	
		5300	18.225	5290.901	5309.126	
		5320	18.216	5310.905	5329.121	
		5500	18.226	5490.915	5509.142	
		5580	18.207	5570.911	5589.118	
		5700	18.21	5690.904	5709.114	
		5745	18.229	5735.886	5754.116	
		5785	18.224	5775.882	5794.106	
		5825	18.222	5815.885	5834.107	
11ac40SISO	Ant1	5190	36.535	5171.764	5208.299	
		5230	36.528	5211.811	5248.339	
		5270	36.526	5251.801	5288.327	
		5310	36.506	5291.770	5328.276	
		5510	36.526	5491.792	5528.318	
		5550	36.542	5531.762	5568.304	
		5670	36.517	5651.792	5688.309	



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11ac80SISO	Ant1	5755	36.509	5736.758	5773.267
		5795	36.526	5776.744	5813.270
		5210	75.762	5172.323	5248.086
		5290	75.72	5252.282	5328.003
		5530	75.699	5492.337	5568.036
		5610	75.839	5572.157	5647.996
		5775	75.795	5737.149	5812.944



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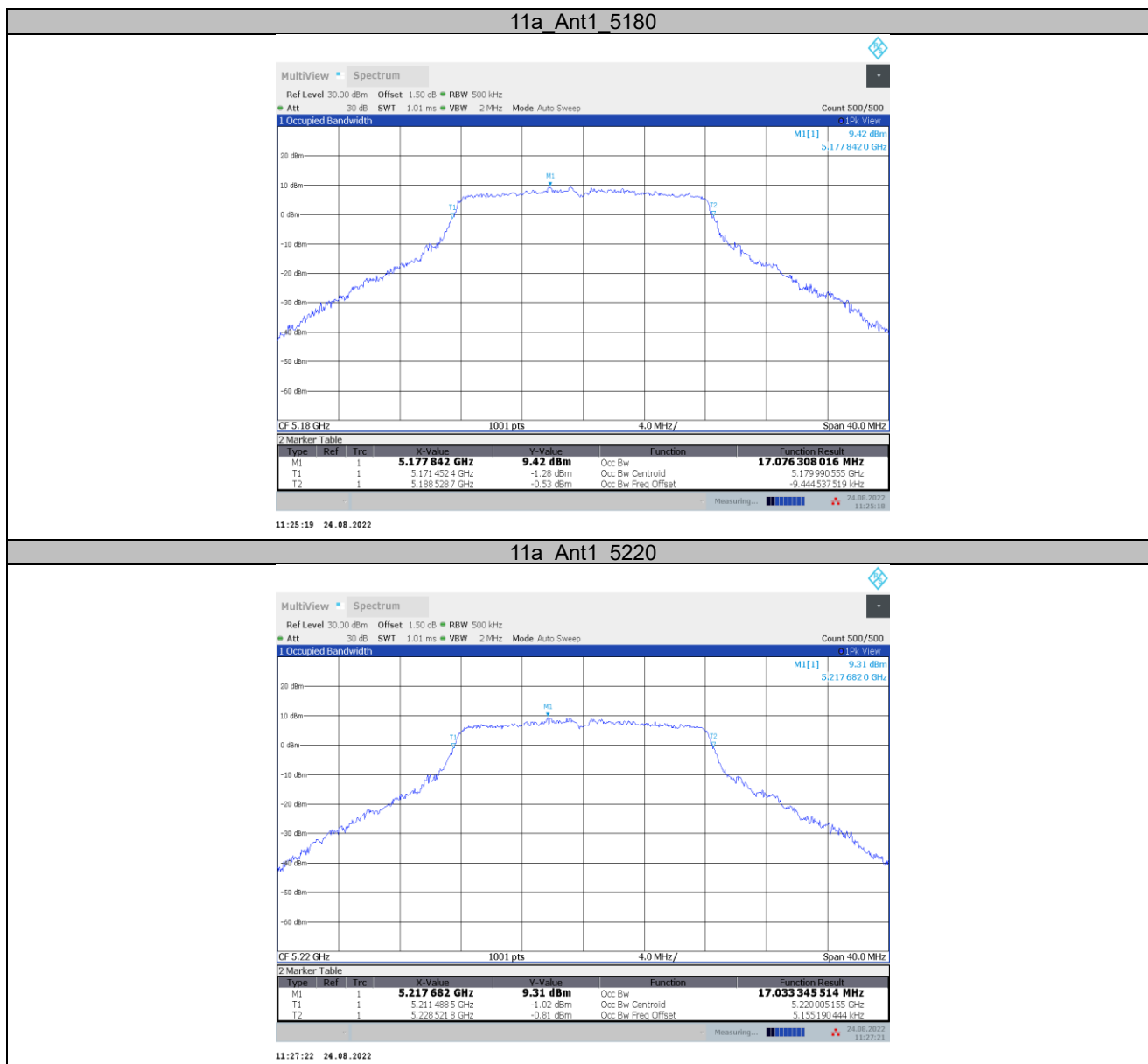
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Test Graphs



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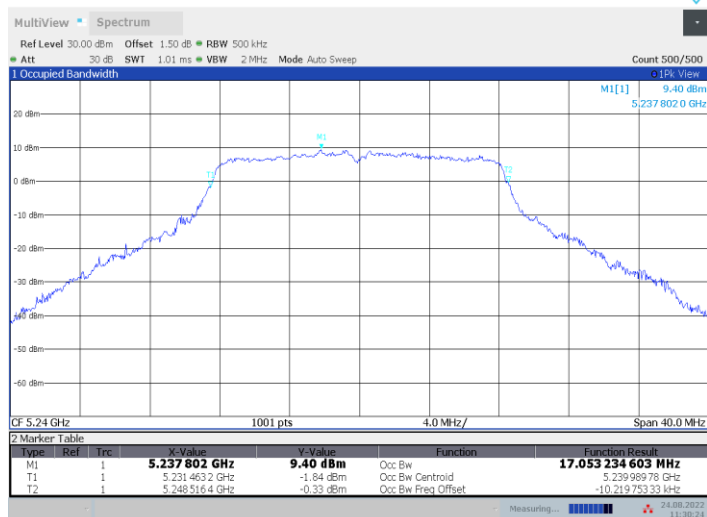
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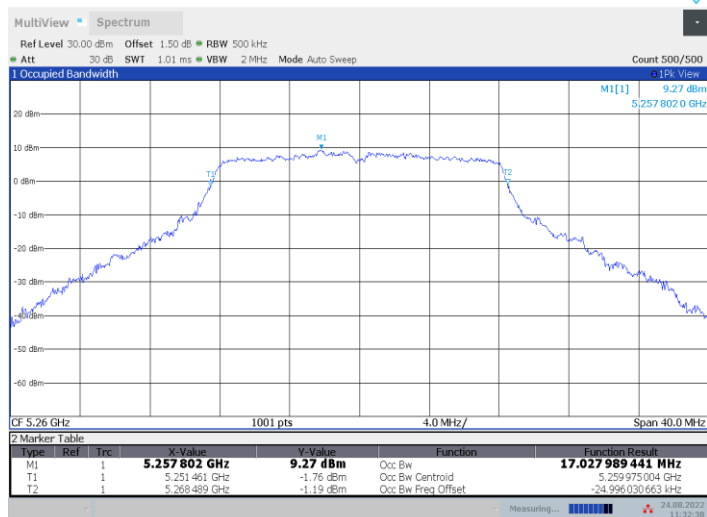
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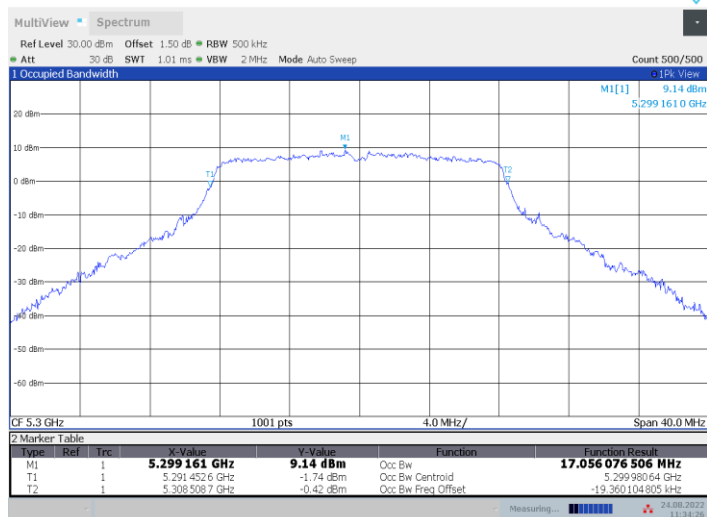
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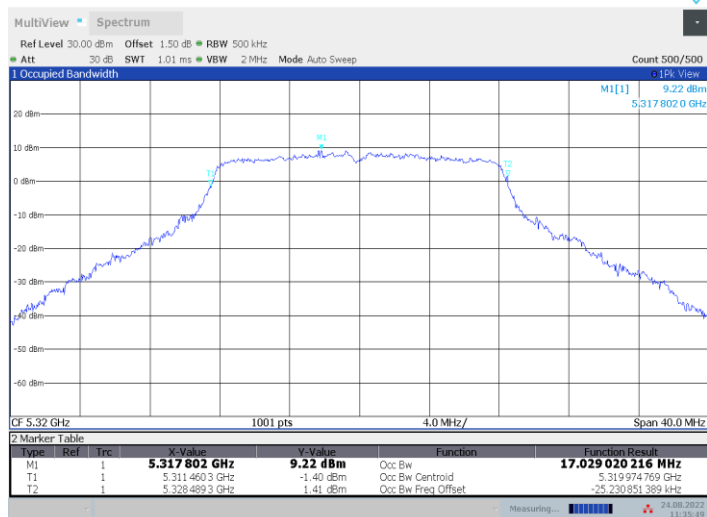
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