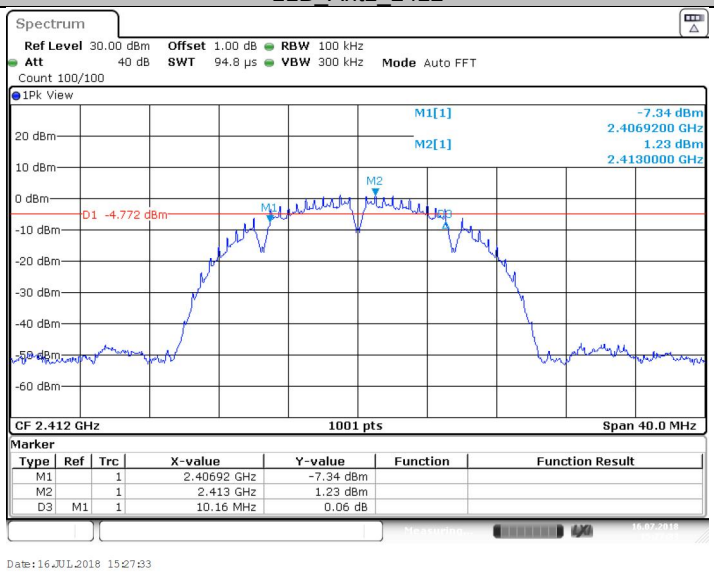
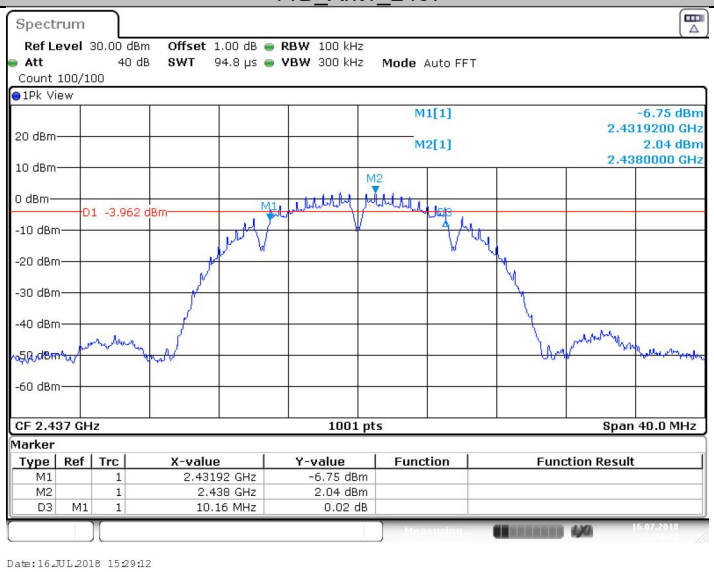
Test Graphs

11B_Ant1_2412



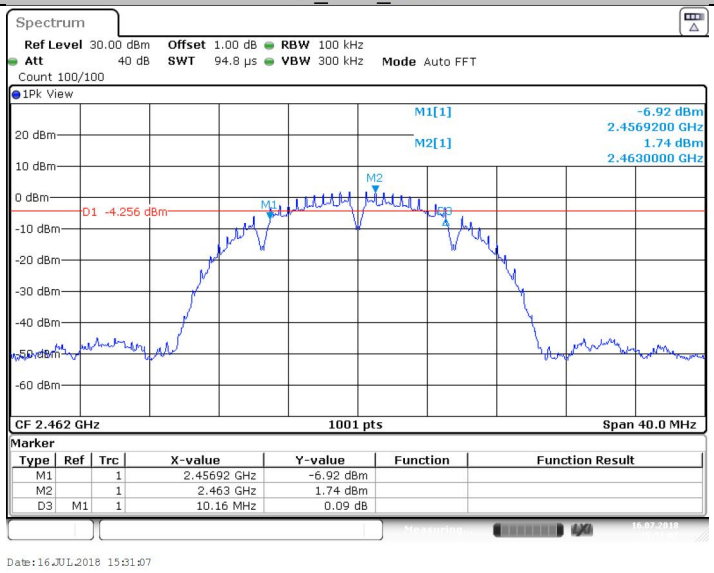
Date:16.JUL.2018 15:27:33

11B_Ant1_2437



Date:16.JUL.2018 15:29:12

11B_Ant1_2462



Date:16.JUL.2018 15:31:07

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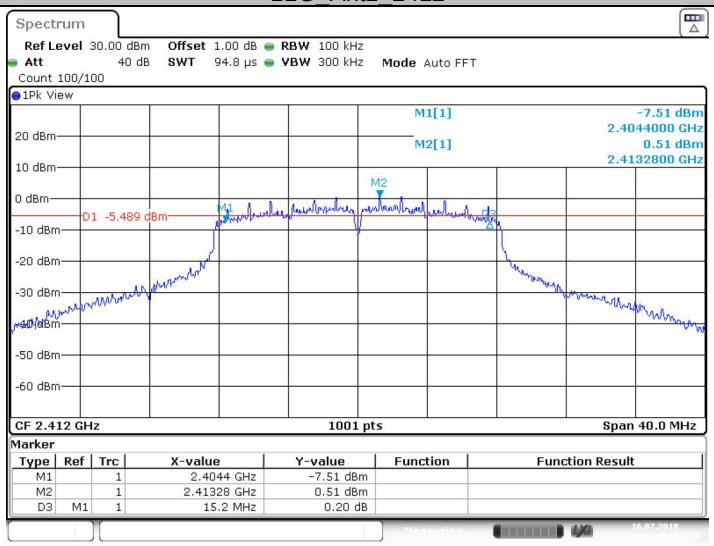
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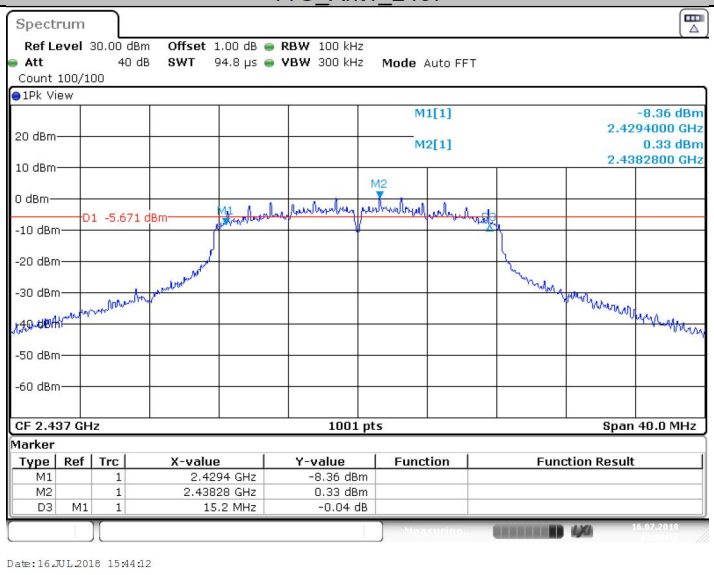
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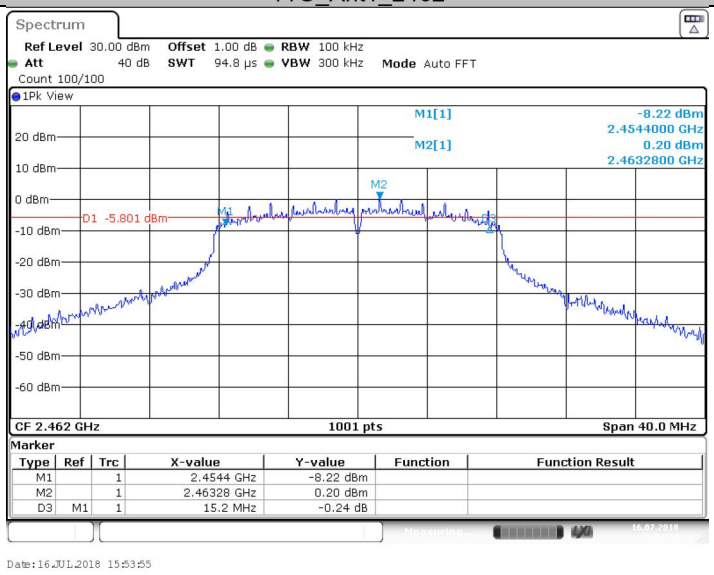

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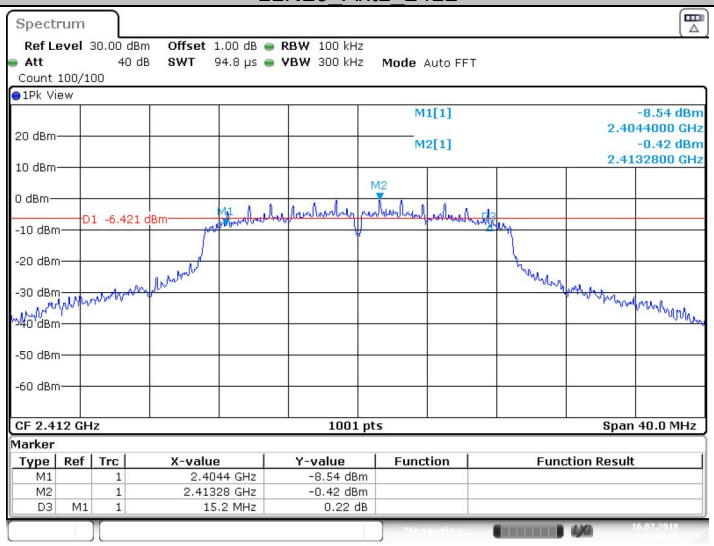
11N20_Ant1_2412

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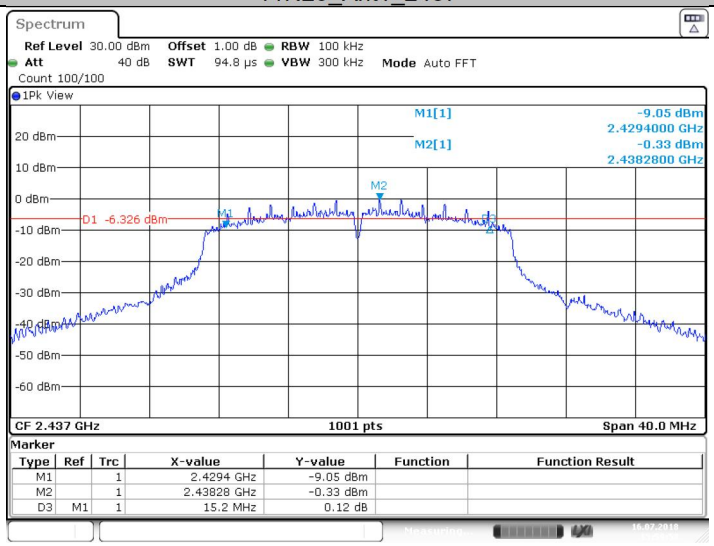
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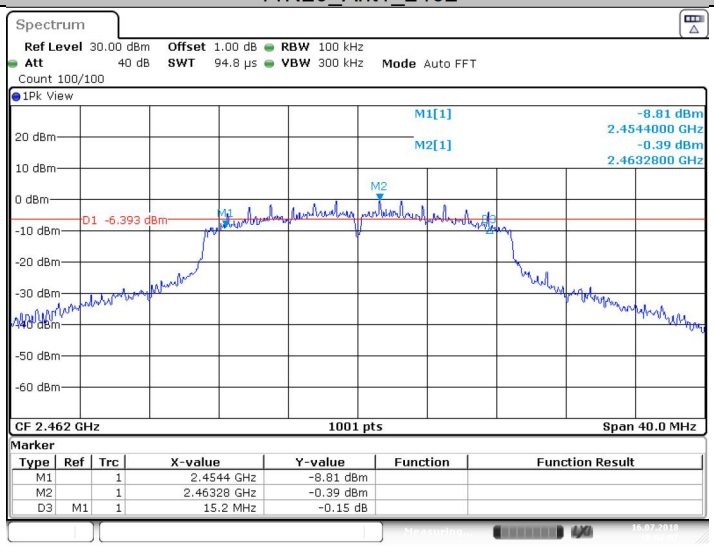

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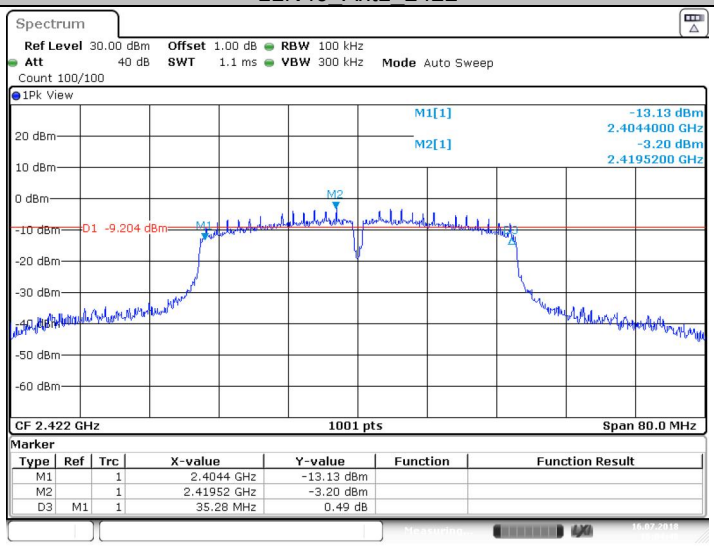
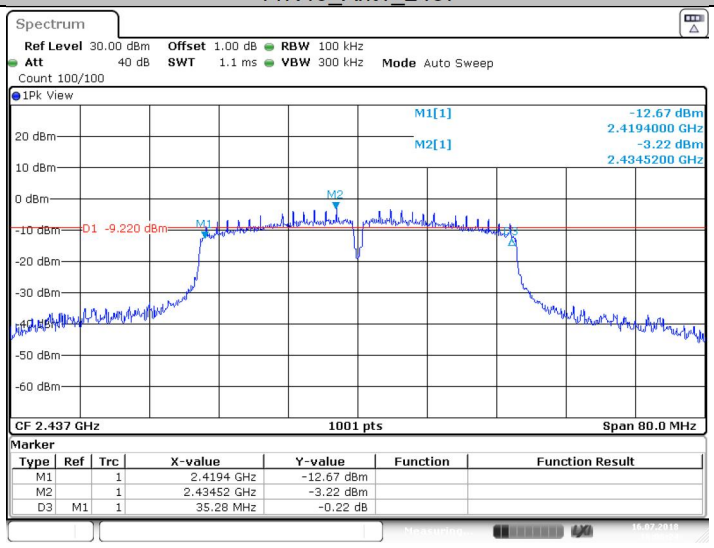
11N40_Ant1_2422



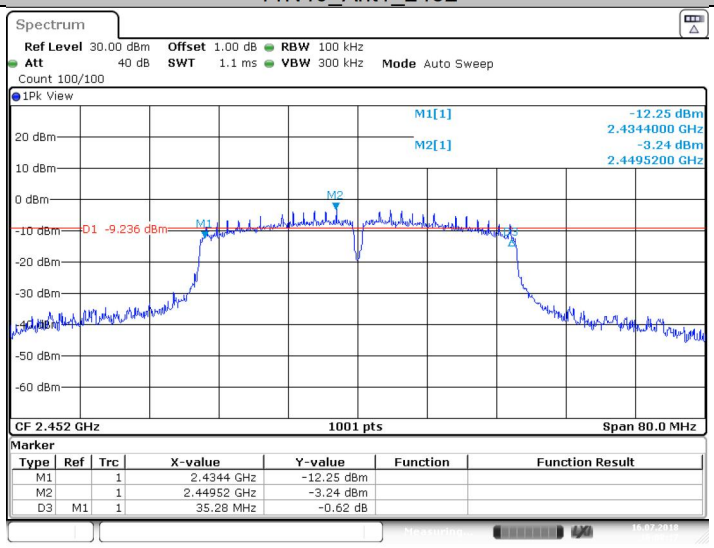
Date:16.JUL.2018 16:04:49

11N40_Ant1_2437



Date:16.JUL.2018 16:06:24

11N40_Ant1_2452



Date:16.JUL.2018 16:08:18

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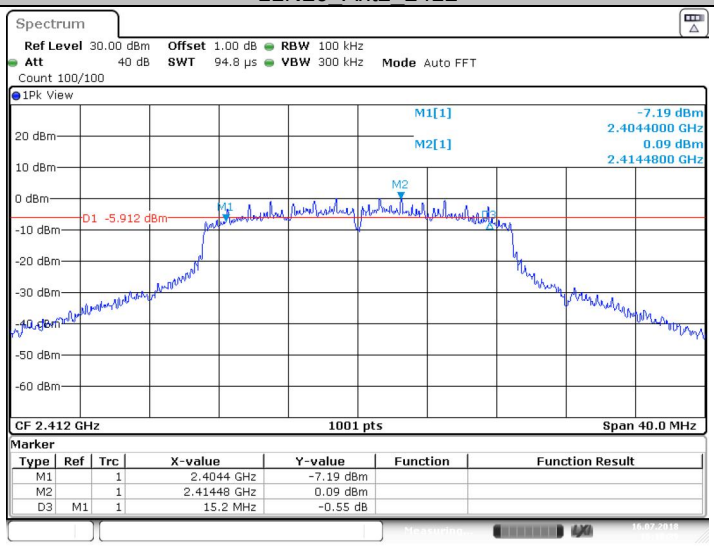
11N20_Ant2_2412

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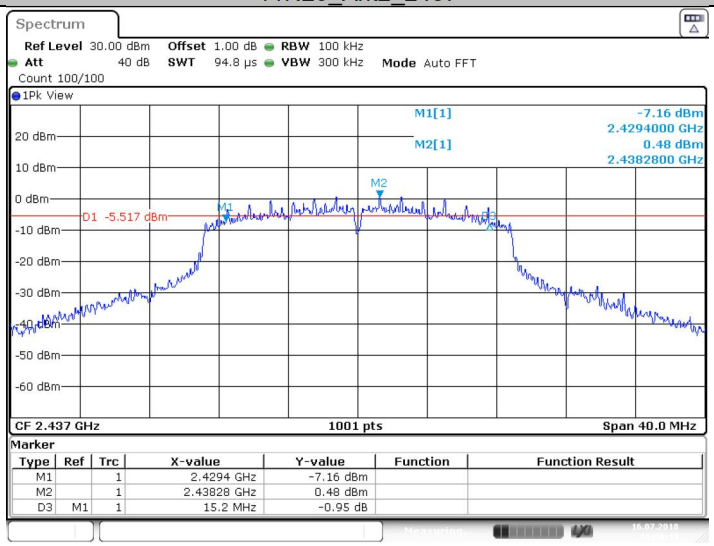
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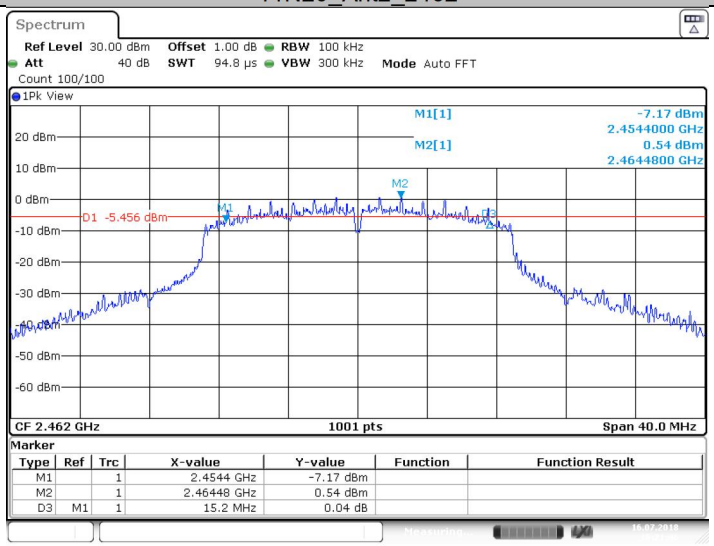

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9.5 Spurious RF conducted emissions

Test Method

1. Connect EUT test port to spectrum analyzer.
2. Establish a reference level by using the following procedure:
   a. Set RBW=100 kHz. VBW≥3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
   b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
3. Use the maximum PSD level to establish the reference level.
   a. Set the center frequency and span to encompass frequency range to be measured.
   b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
4. Repeat above procedures until other frequencies measured were completed.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

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Spurious RF conducted emissions

Test Result

TestMode	Antenna	Channel (MHz)	FreqRange (MHz)	RefLevel (dBm)	Result (dBm)	Limit (dBm)	Verdict
11B	Ant1	2412	Reference	1.34	1.34	---	PASS
		2412	30~1000	1.34	-69.42	-18.66	PASS
		2412	1000~26500	1.34	-46.73	-18.66	PASS
		2437	Reference	1.90	1.90	---	PASS
		2437	30~1000	1.90	-69.17	-18.1	PASS
		2437	1000~26500	1.90	-49.59	-18.1	PASS
		2462	Reference	1.55	1.55	---	PASS
		2462	30~1000	1.55	-68.51	-18.45	PASS
		2462	1000~26500	1.55	-48.72	-18.45	PASS
11G	Ant1	2412	Reference	0.51	0.51	---	PASS
		2412	30~1000	0.51	-69.05	-19.49	PASS
		2412	1000~26500	0.51	-53.08	-19.49	PASS
		2437	Reference	0.26	0.26	---	PASS
		2437	30~1000	0.26	-68.73	-19.74	PASS
		2437	1000~26500	0.26	-52.43	-19.74	PASS
		2462	Reference	0.15	0.15	---	PASS
		2462	30~1000	0.15	-69.21	-19.85	PASS
		2462	1000~26500	0.15	-52.97	-19.85	PASS
11N20	Ant1	2412	Reference	-0.55	-0.55	---	PASS
		2412	30~1000	-0.55	-68.36	-20.55	PASS
		2412	1000~26500	-0.55	-52.5	-20.55	PASS
		2437	Reference	-0.30	-0.30	---	PASS
		2437	30~1000	-0.30	-68.73	-20.3	PASS
		2437	1000~26500	-0.30	-53.42	-20.3	PASS
		2462	Reference	-0.35	-0.35	---	PASS
		2462	30~1000	-0.35	-68.78	-20.35	PASS
		2462	1000~26500	-0.35	-52.3	-20.35	PASS
11N40	Ant1	2422	Reference	-3.51	-3.51	---	PASS
		2422	30~1000	-3.51	-69.17	-23.51	PASS
		2422	1000~26500	-3.51	-52.66	-23.51	PASS
		2437	Reference	-3.56	-3.56	---	PASS
		2437	30~1000	-3.56	-69.04	-23.56	PASS
		2437	1000~26500	-3.56	-53.4	-23.56	PASS
		2452	Reference	-3.22	-3.22	---	PASS
		2452	30~1000	-3.22	-67.93	-23.22	PASS
		2452	1000~26500	-3.22	-52.93	-23.22	PASS
11N20	Ant2	2412	Reference	0.06	0.06	---	PASS
		2412	30~1000	0.06	-69.13	-19.94	PASS
		2412	1000~26500	0.06	-52.7	-19.94	PASS
		2437	Reference	0.58	0.58	---	PASS
		2437	30~1000	0.58	-68.96	-19.42	PASS
		2437	1000~26500	0.58	-52.97	-19.42	PASS
		2462	Reference	0.52	0.52	---	PASS
		2462	30~1000	0.52	-68.78	-19.48	PASS
		2462	1000~26500	0.52	-53.17	-19.48	PASS

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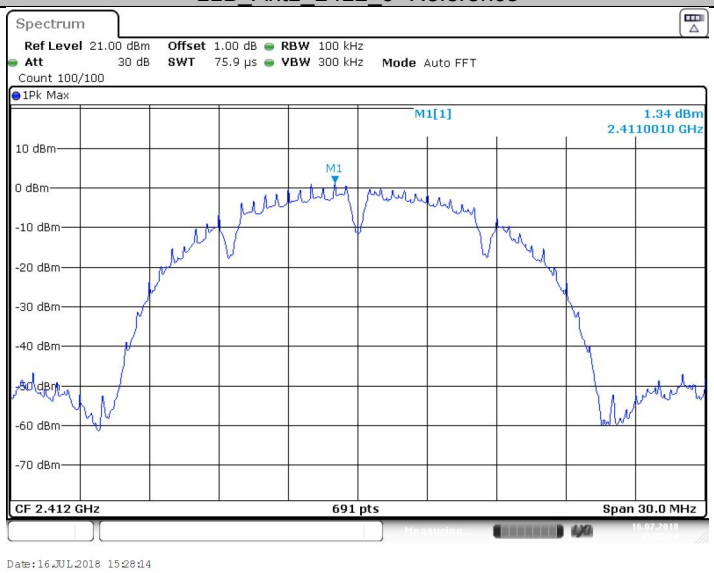
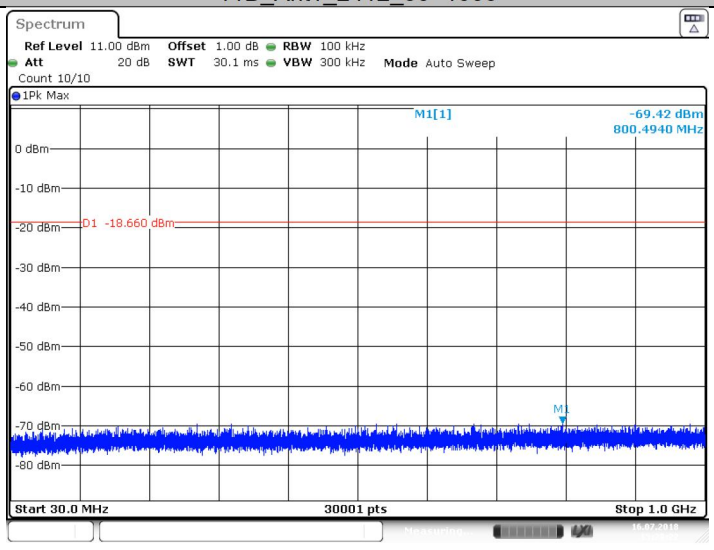
Test Graphs

11B_Ant1_2412_0~Reference



Date:16.JUL.2018 15:28:14

11B_Ant1_2412_30~1000



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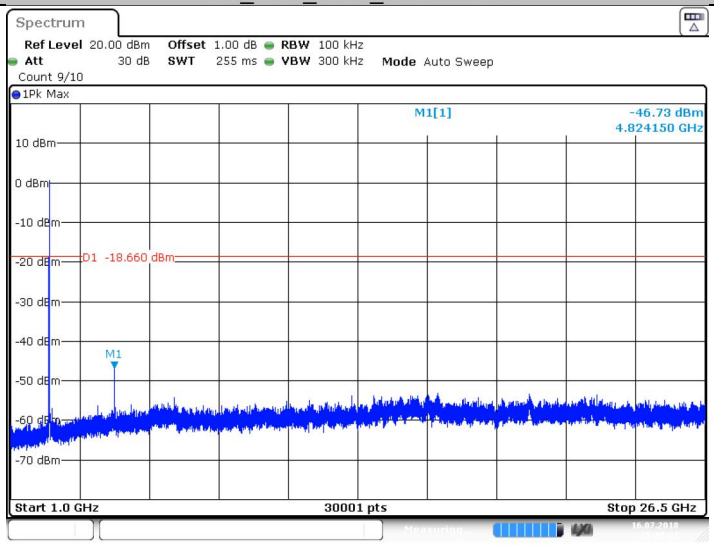
11B_Ant1_2412_1000~26500



Date:16.JUL.2018 15:28:34

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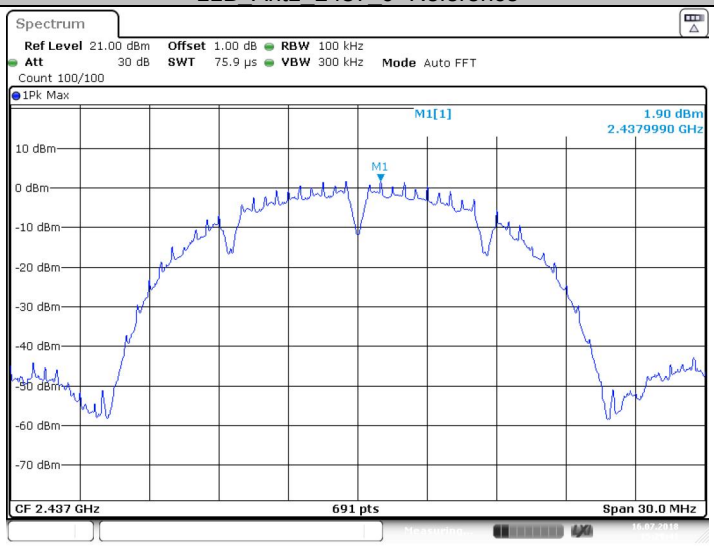
11B_Ant1_2437_0~Reference



Date:16.JUL.2018 15:29:41

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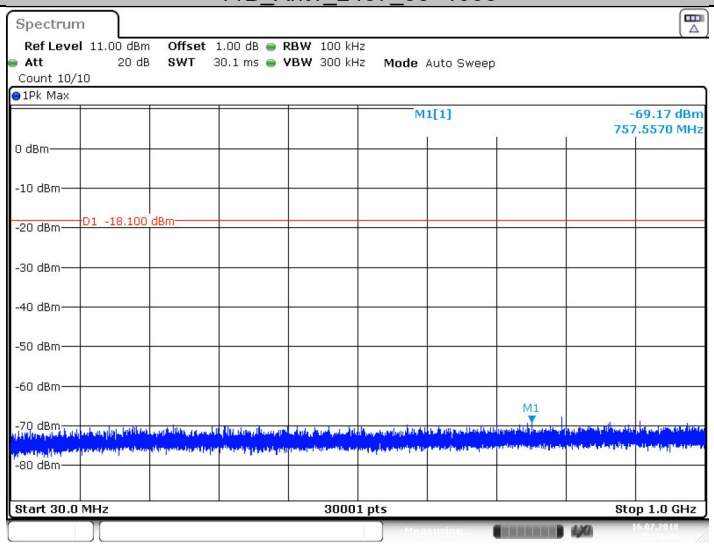

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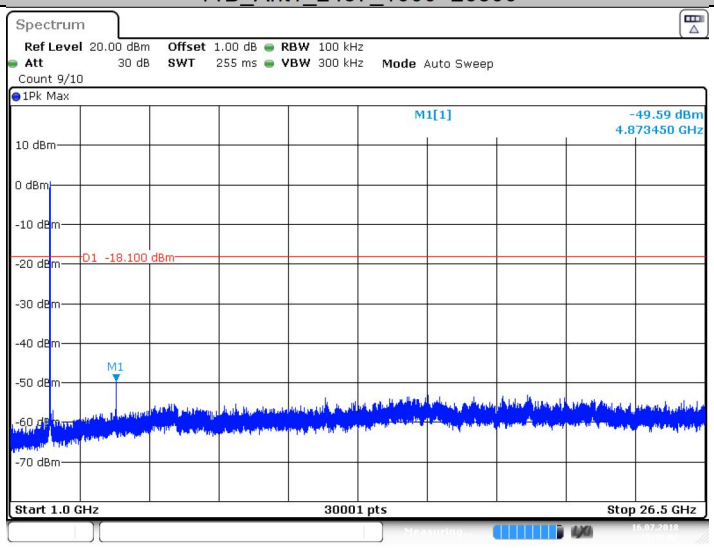
11B_Ant1_2437_1000~26500



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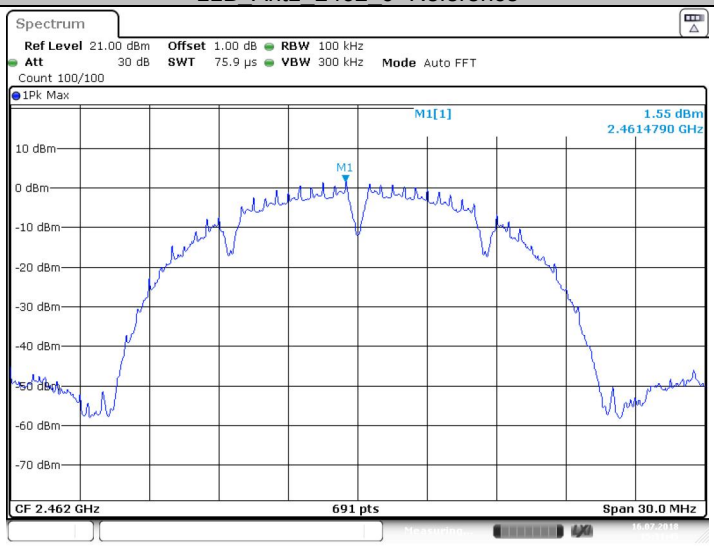
11B_Ant1_2462_0~Reference

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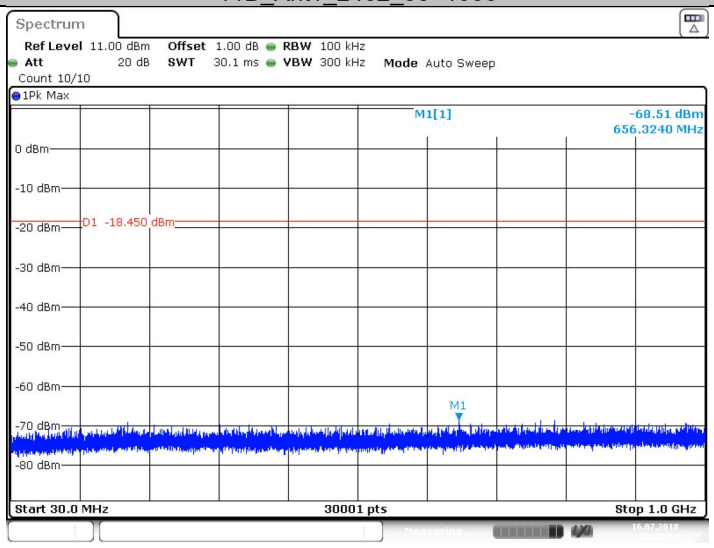
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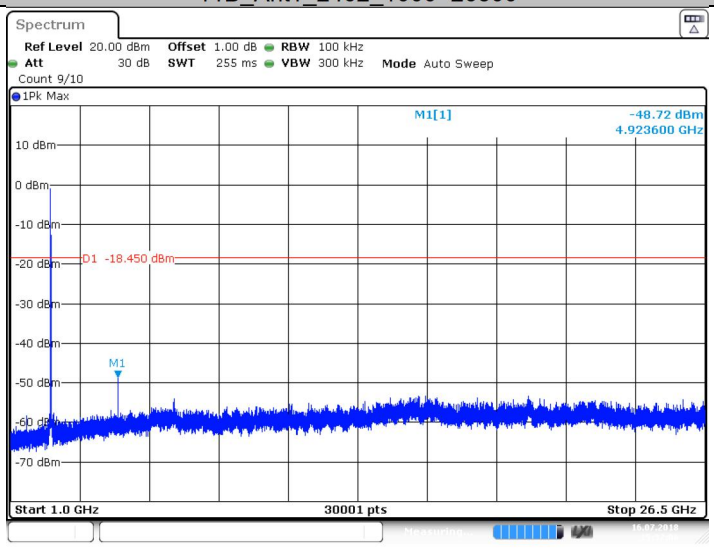

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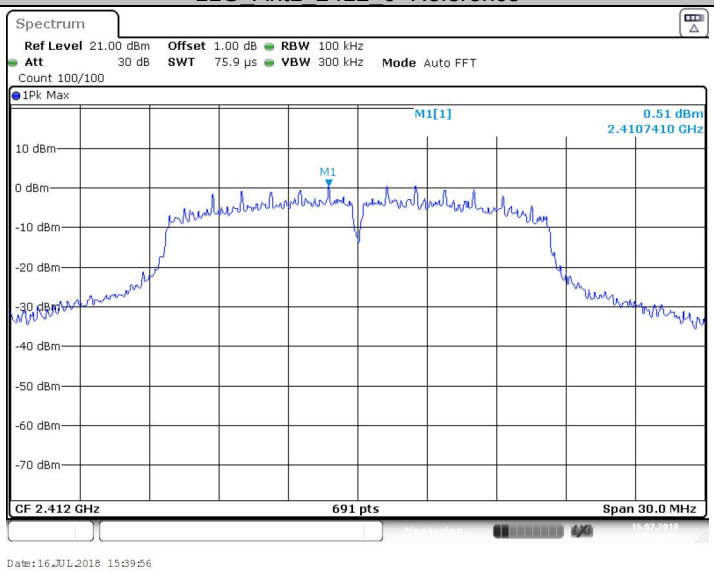
11G_Ant1_2412_0~Reference

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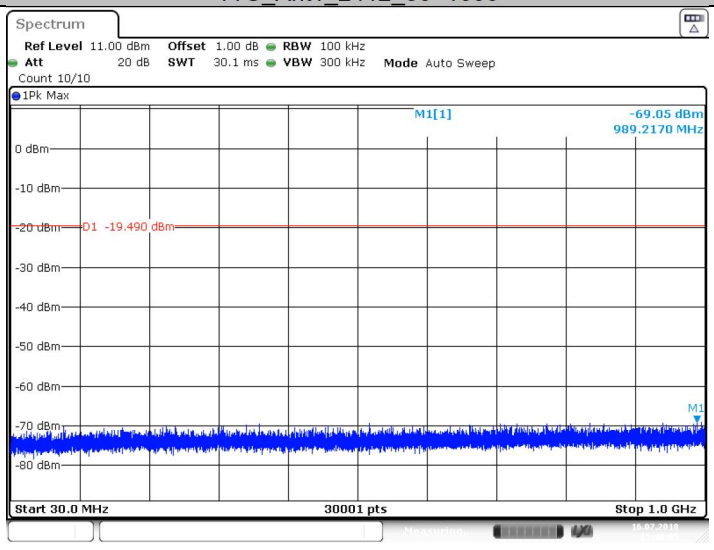
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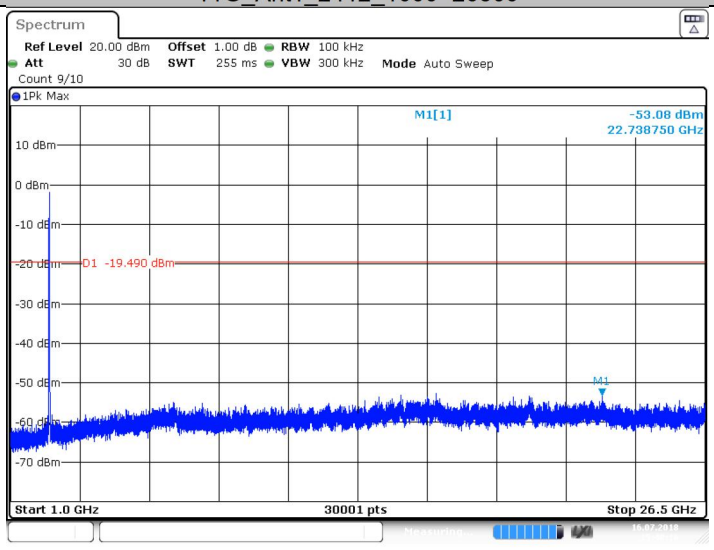

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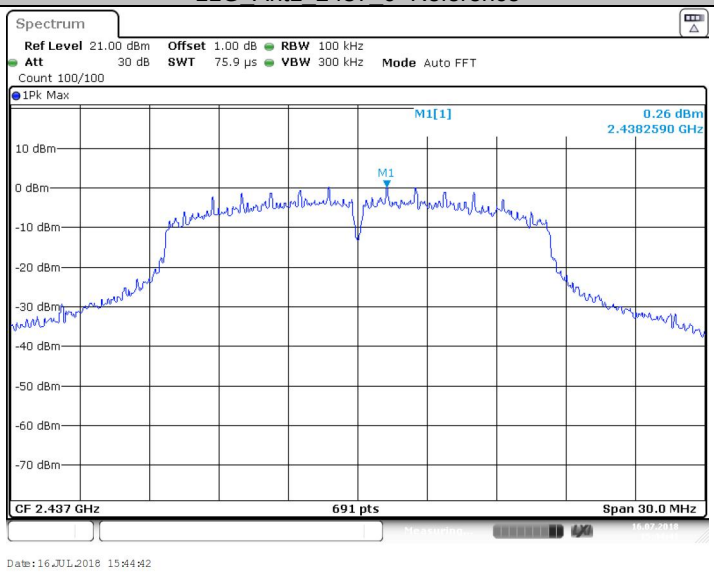
11G_Ant1_2437_0~Reference

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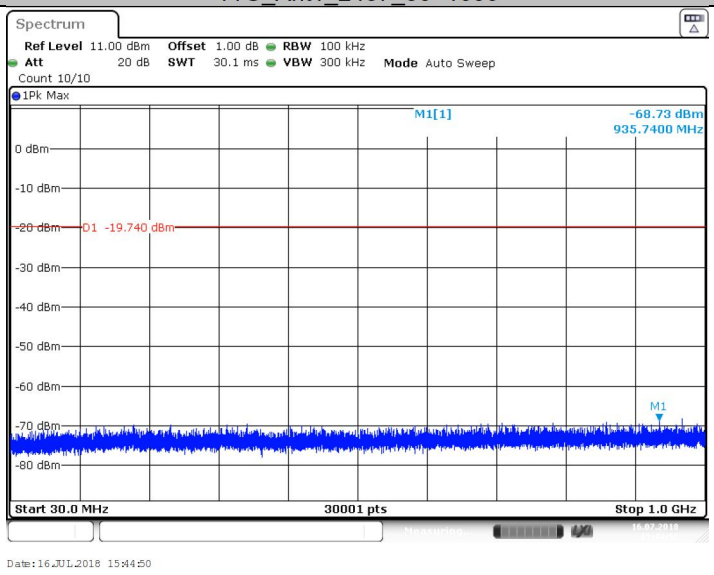
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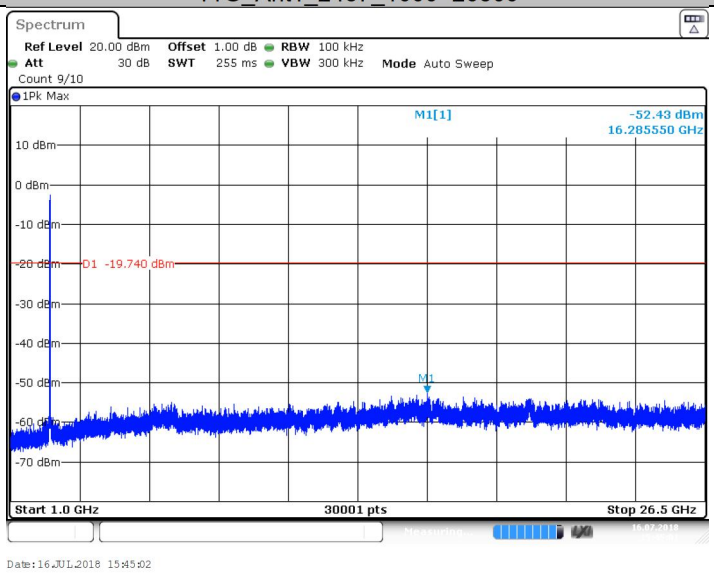

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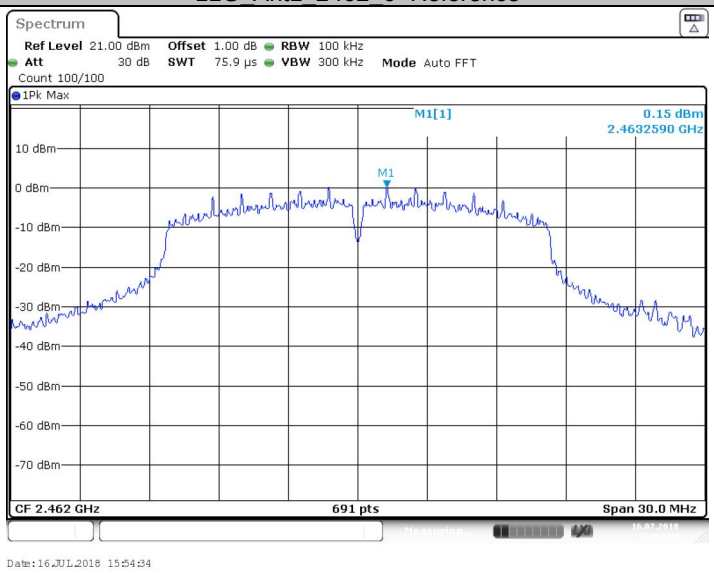

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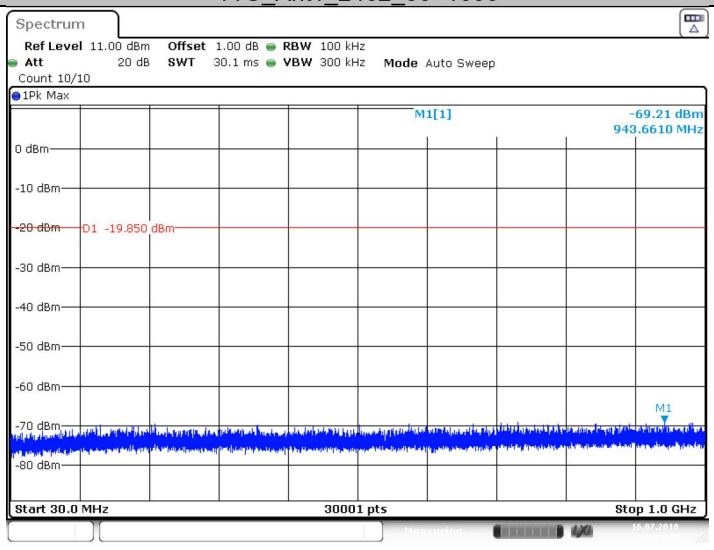

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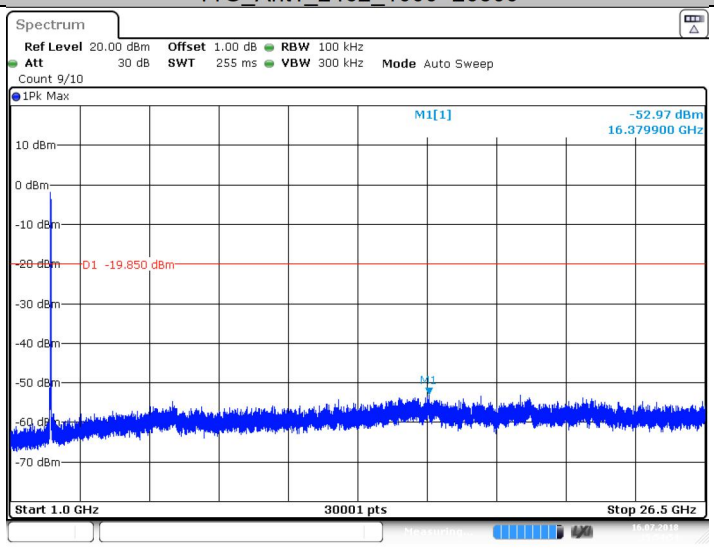

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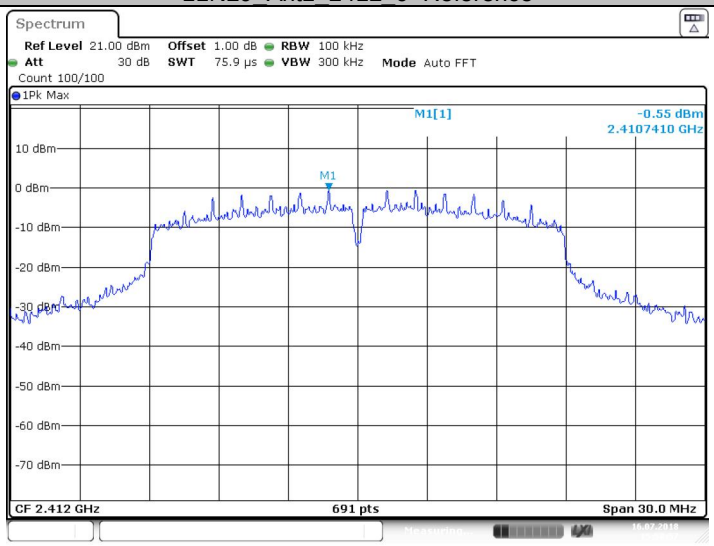
11N20_Ant1_2412_0~Reference

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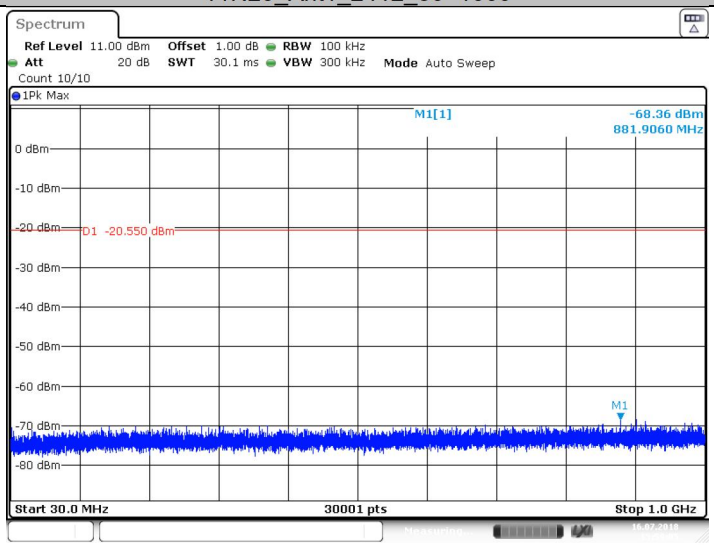
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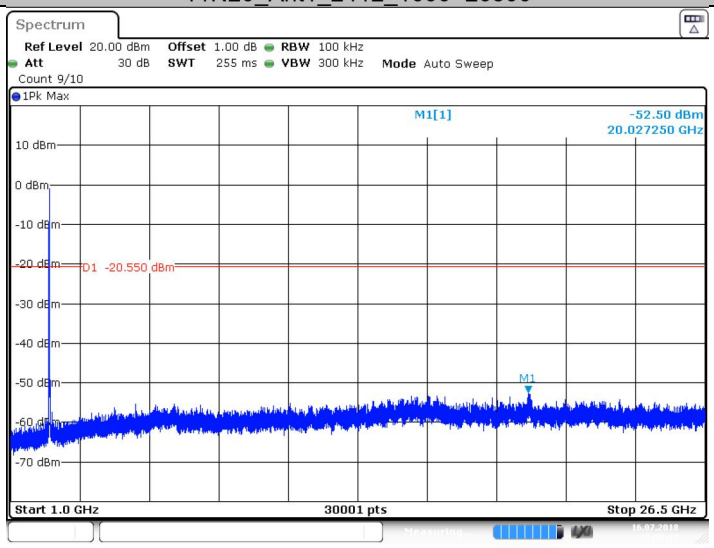

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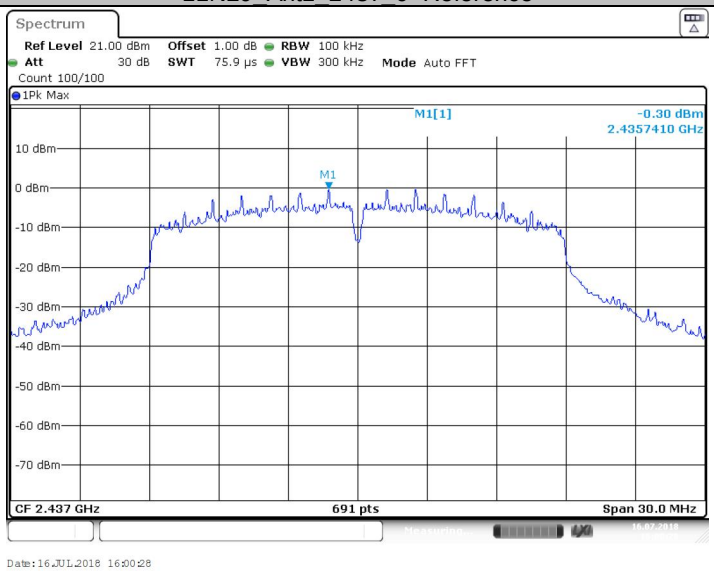
11N20_Ant1_2437_0~Reference

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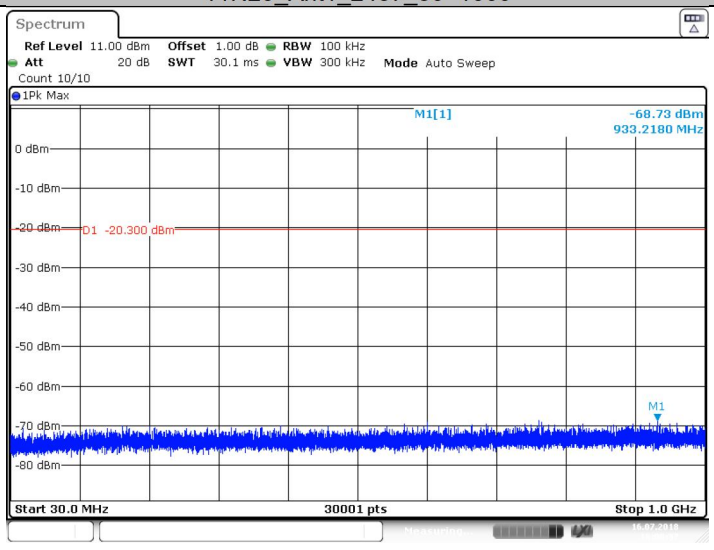
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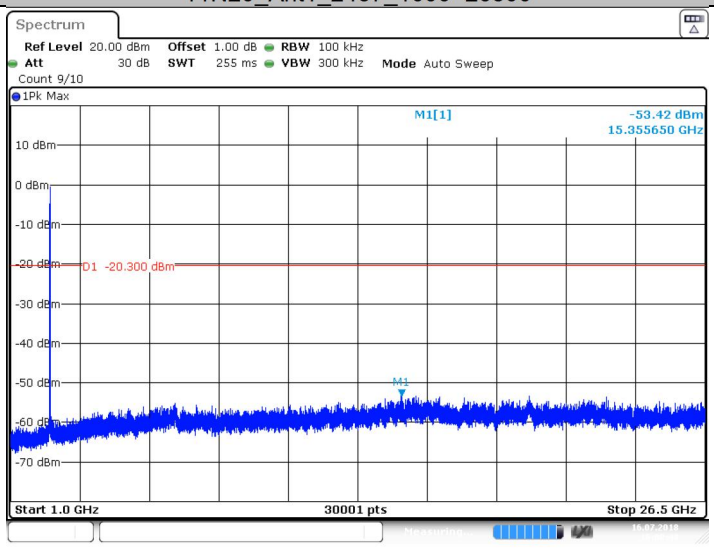

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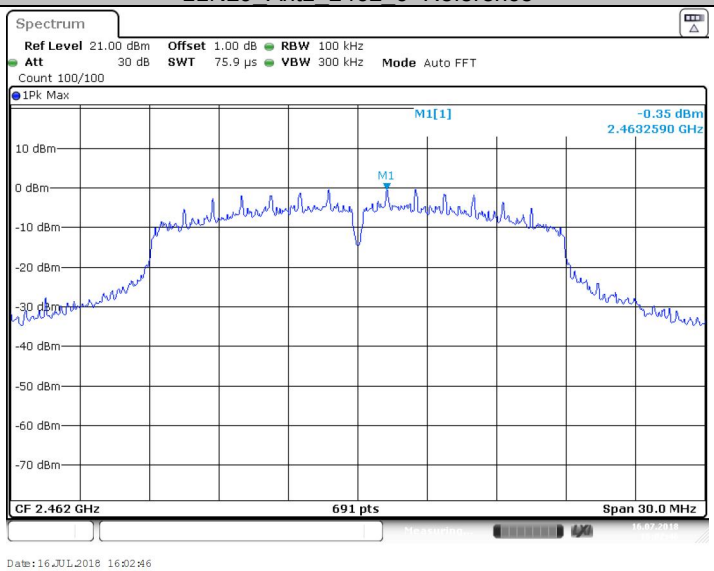
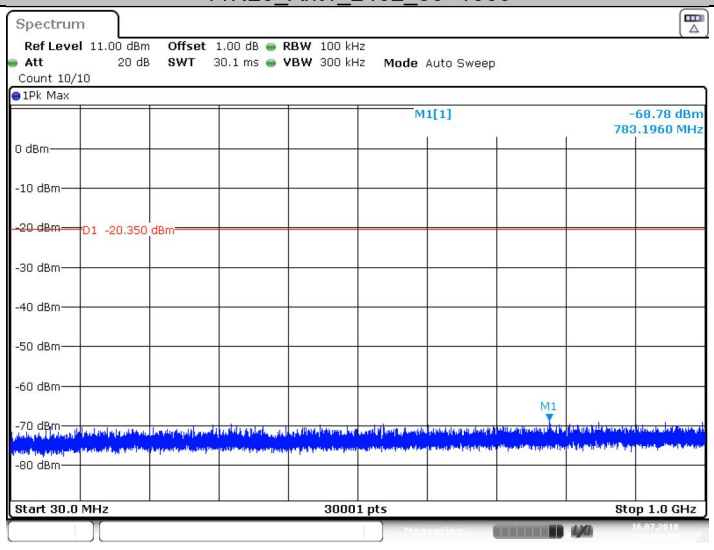
11N20_Ant1_2462_0~Reference



11N20_Ant1_2462_30~1000



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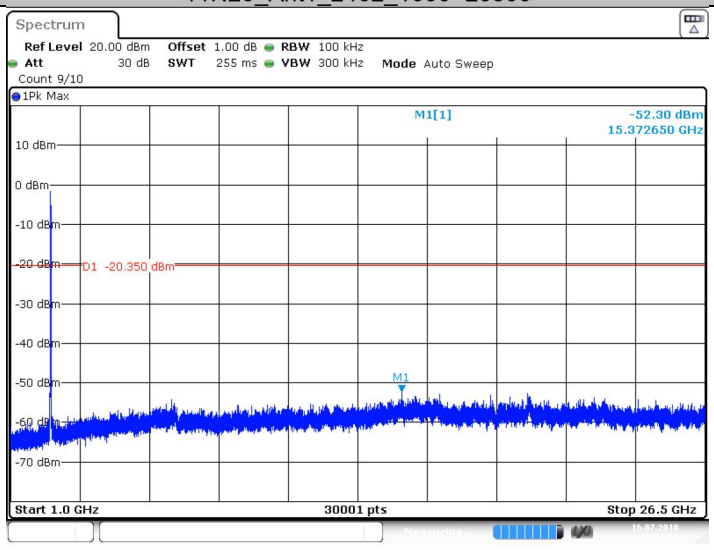

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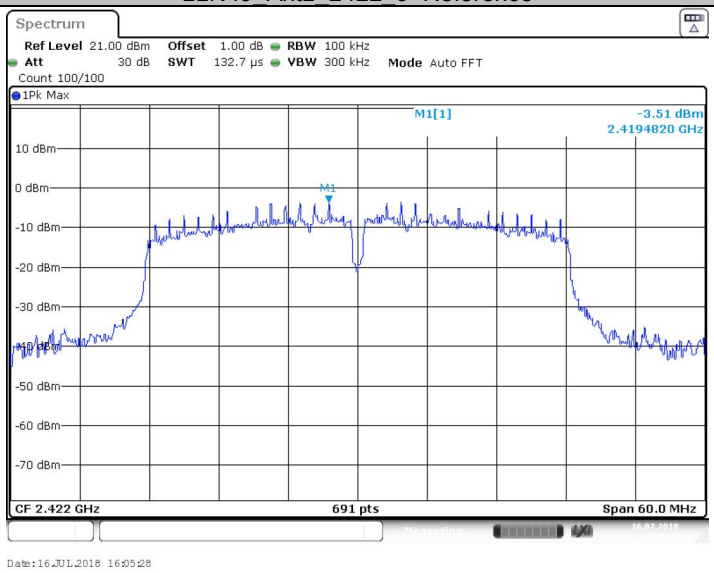
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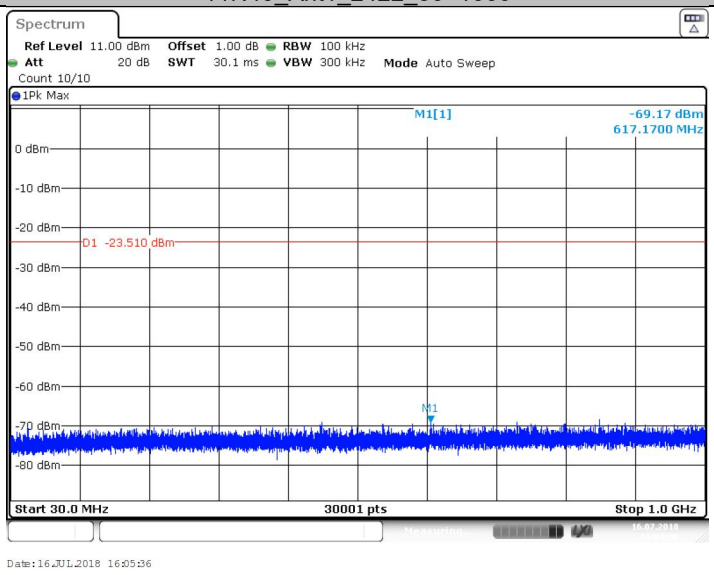
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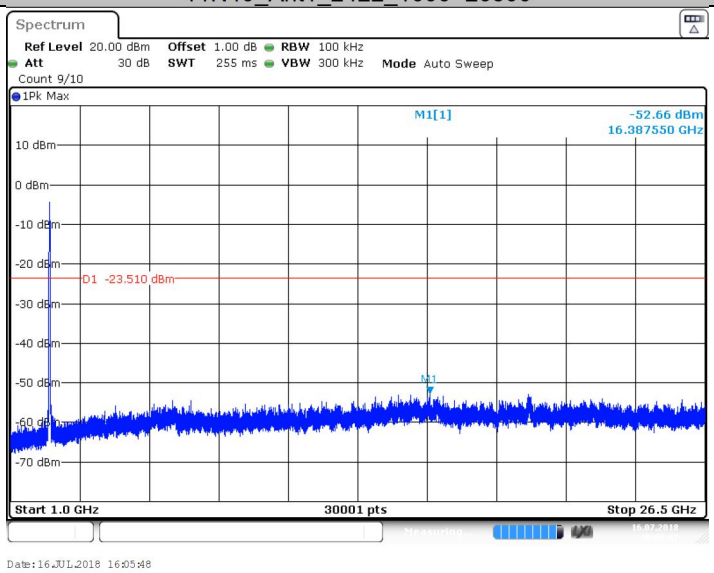

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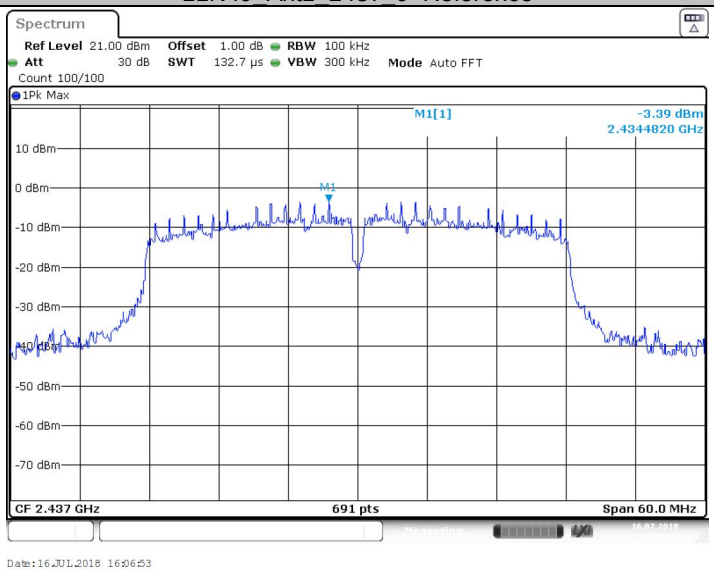
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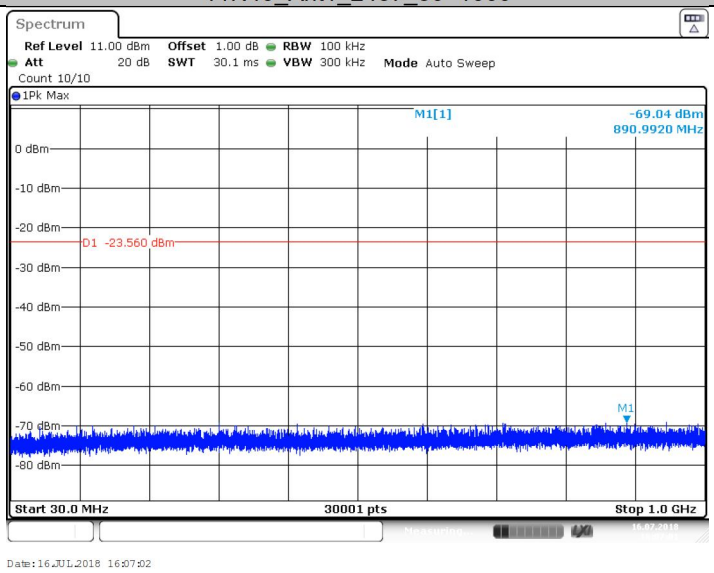
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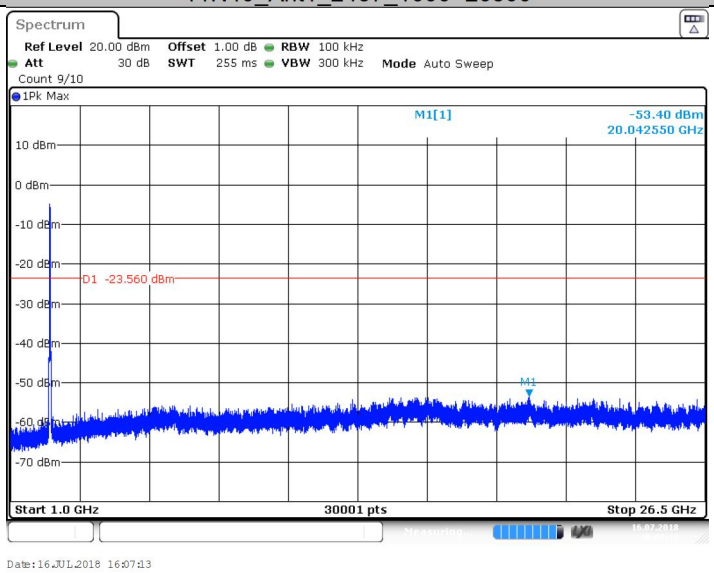

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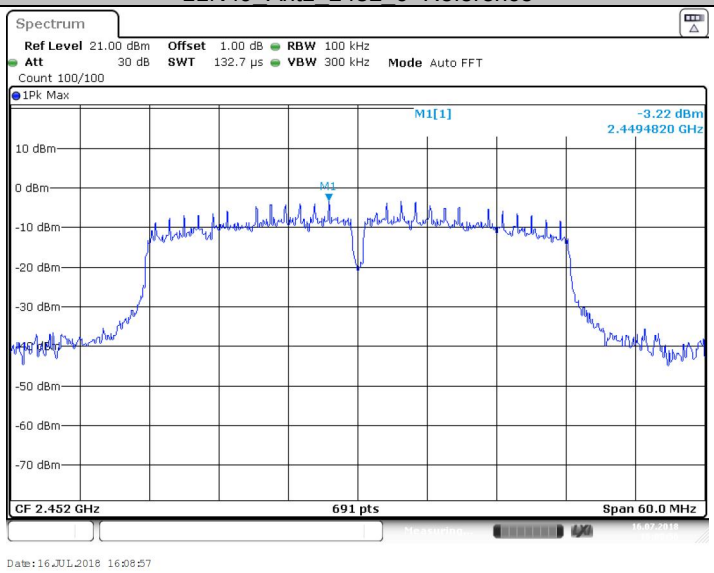
11N40_Ant1_2452_0~Reference

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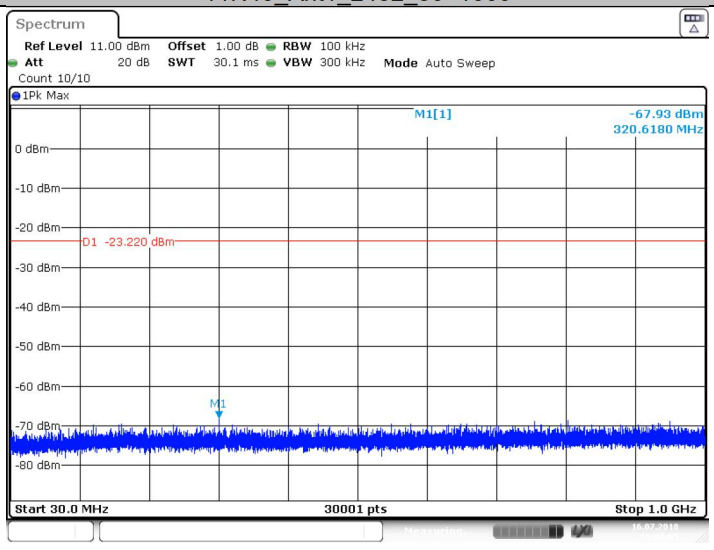
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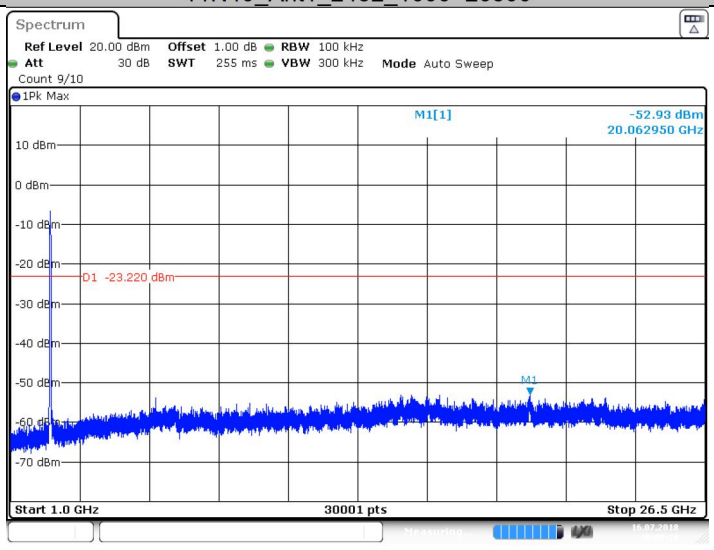

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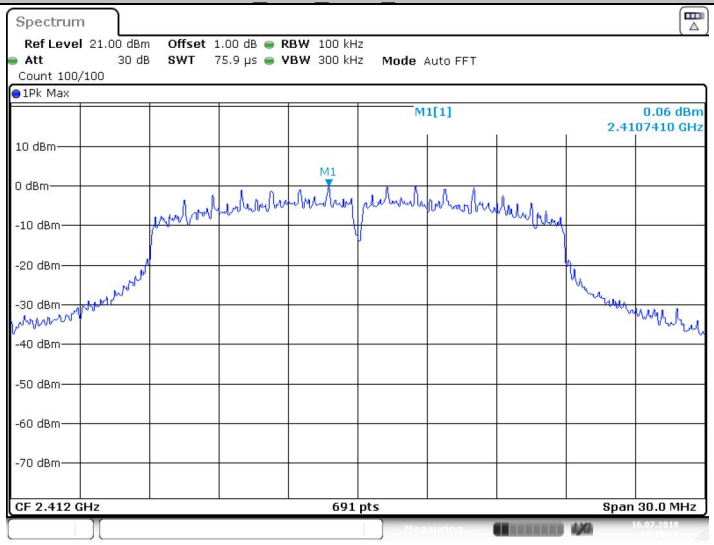
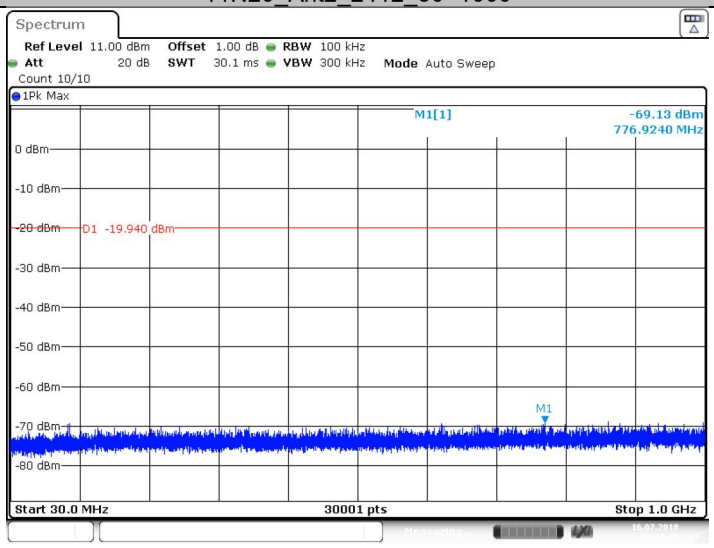
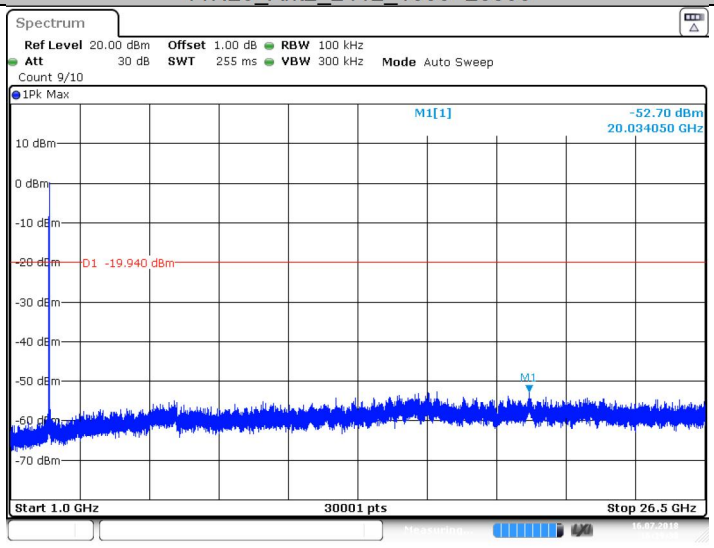
11N20_Ant2_2412_0~Reference



11N20_Ant2_2412_30~1000



11N20_Ant2_2412_1000~26500



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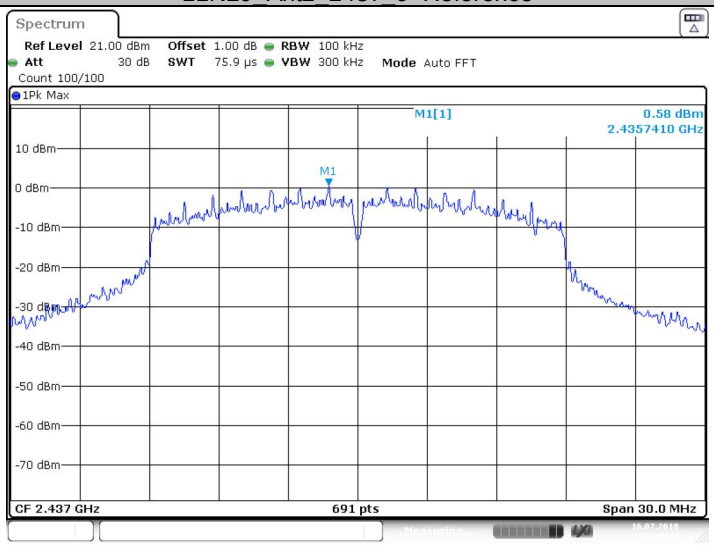

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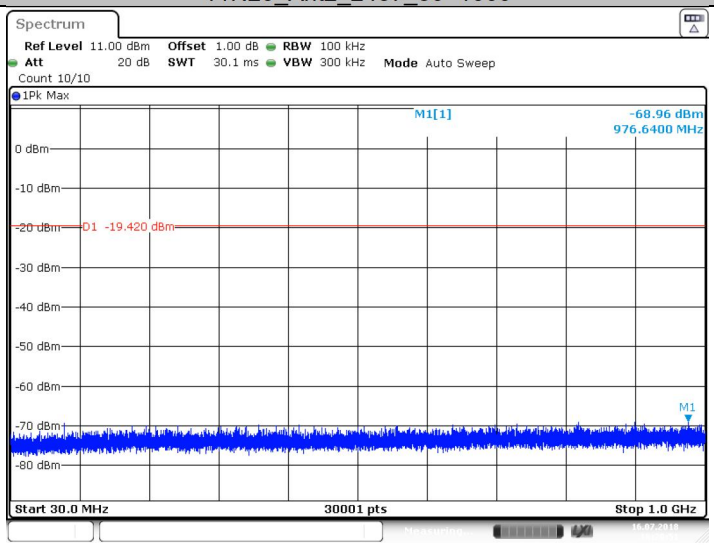
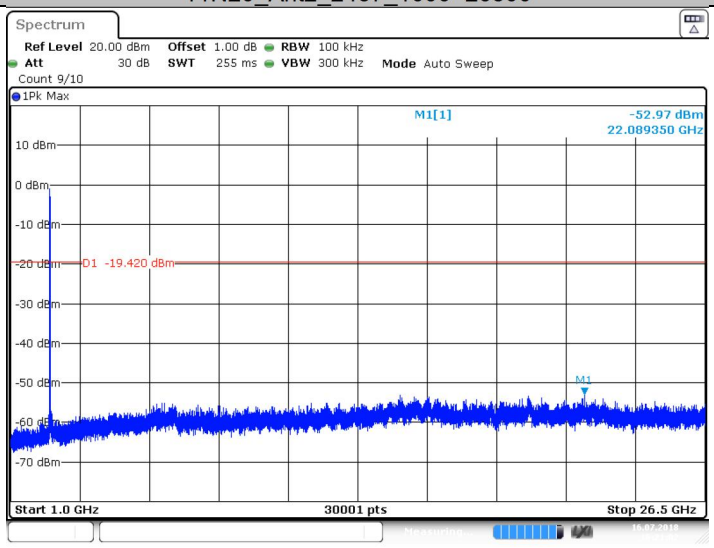


11N20_Ant2_2437_1000~26500



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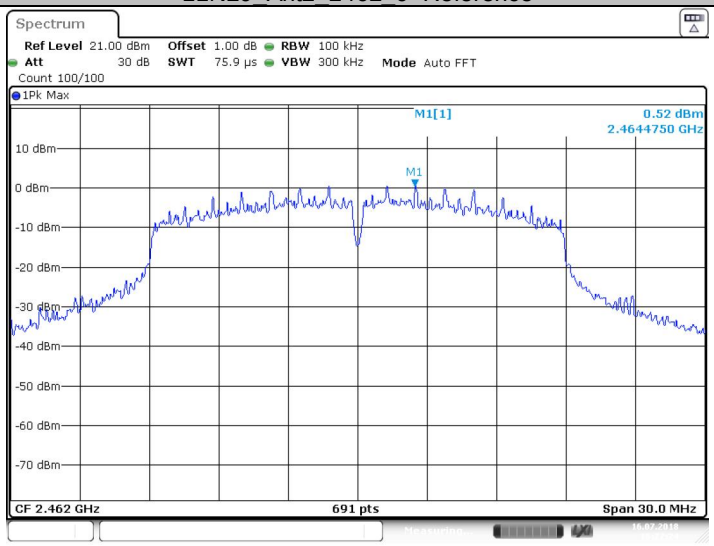
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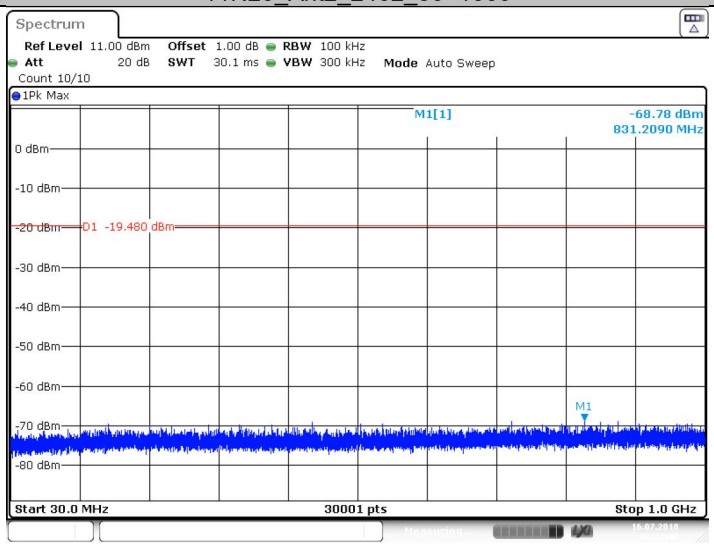
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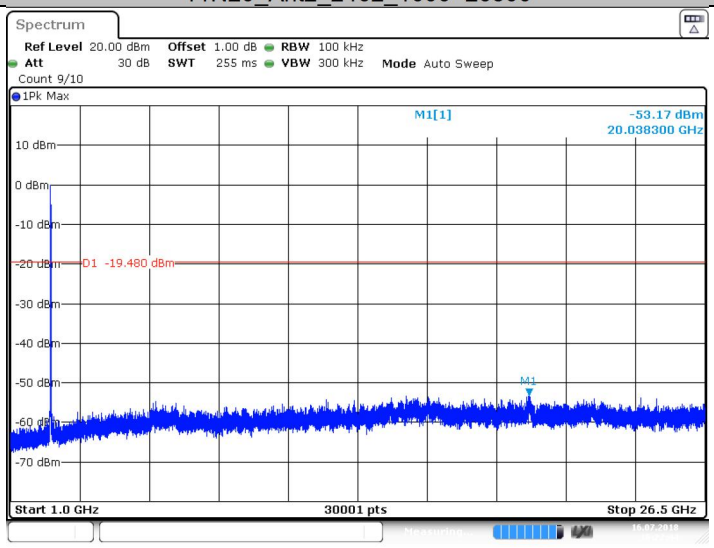

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9.6 Band edge testing

Test Method

1. Connect EUT test port to spectrum analyzer.
2. Set spectrum analyzer setting as below:
   Set RBW ≥ 1% of the span, VBW ≥ RBW.
   Set Sweep = auto. Set Detector function = peak. Allow the trace to stabilize.
   Set Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
3. Repeat above procedures until all frequencies measured were complete.

Limit:

Frequency Range MHz	Limit (dBc)
30-25000	-20

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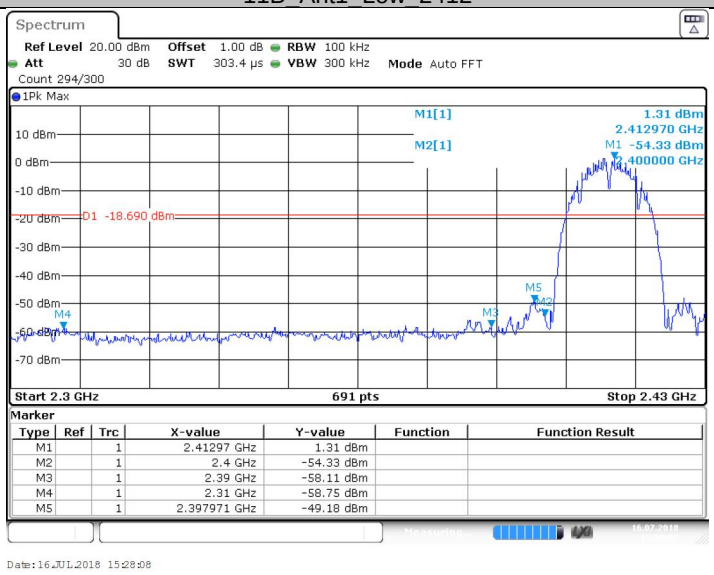
Band edge testing

Test result

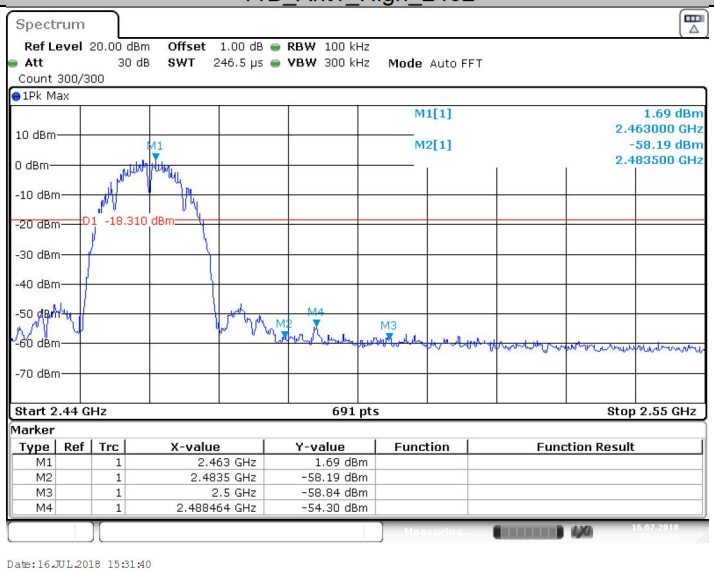
TestMode	Antenna	ChName	Channel (MHz)	RefLevel (dBm)	Result (dBm)	Limit (dBm)	Verdict
11B	Ant1	Low	2412	1.31	-49.18	-18.69	PASS
		High	2462	1.69	-54.3	-18.31	PASS
11G	Ant1	Low	2412	0.58	-30.07	-19.42	PASS
		High	2462	0.14	-48.06	-19.86	PASS
11N20	Ant1	Low	2412	-0.71	-28.97	-20.71	PASS
		High	2462	-0.41	-43.35	-20.41	PASS
11N40	Ant1	Low	2422	-3.30	-35.82	-23.3	PASS
		High	2452	-3.19	-38.92	-23.19	PASS
11N20	Ant2	Low	2412	-0.10	-29	-20.1	PASS
		High	2462	0.43	-47.2	-19.57	PASS

Test Graphs

11B_Ant1_Low_2412



11B_Ant1_High_2462



11G_Ant1_Low_2412

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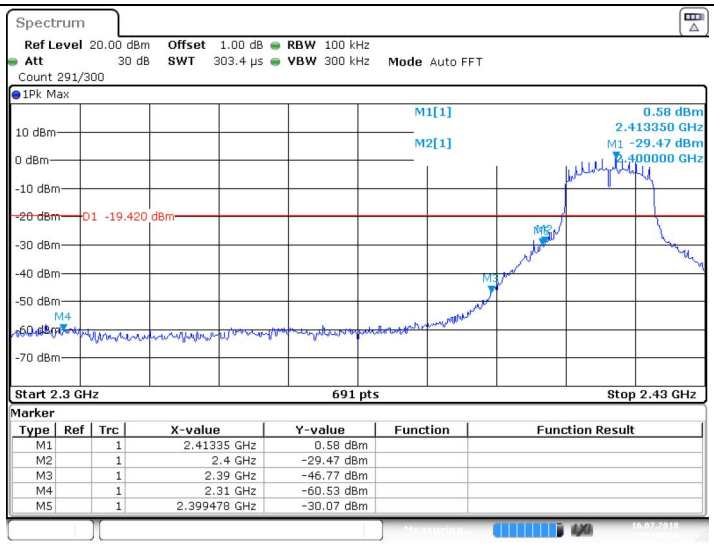
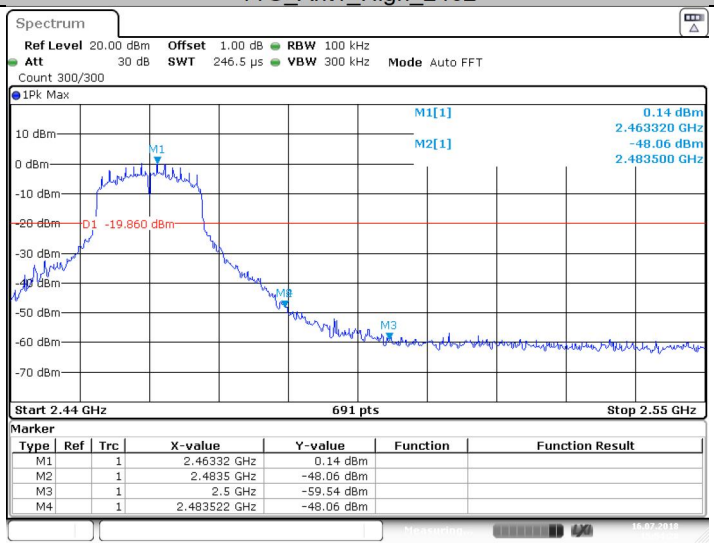
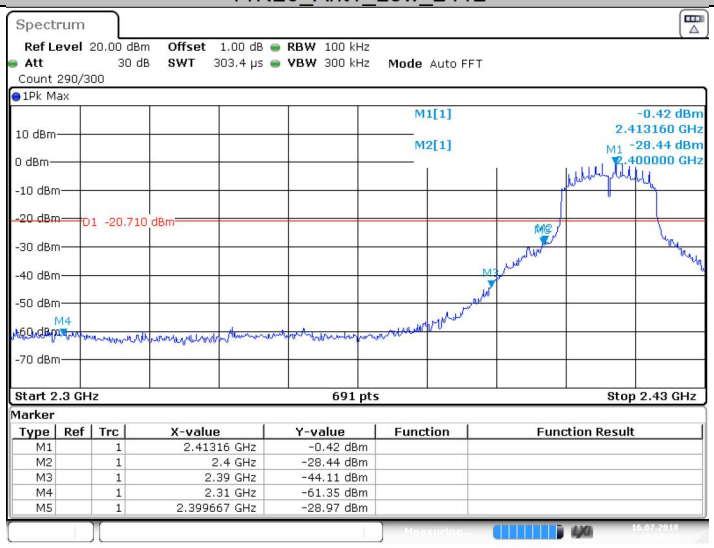


11G_Ant1_High_2462



11N20_Ant1_Low_2412



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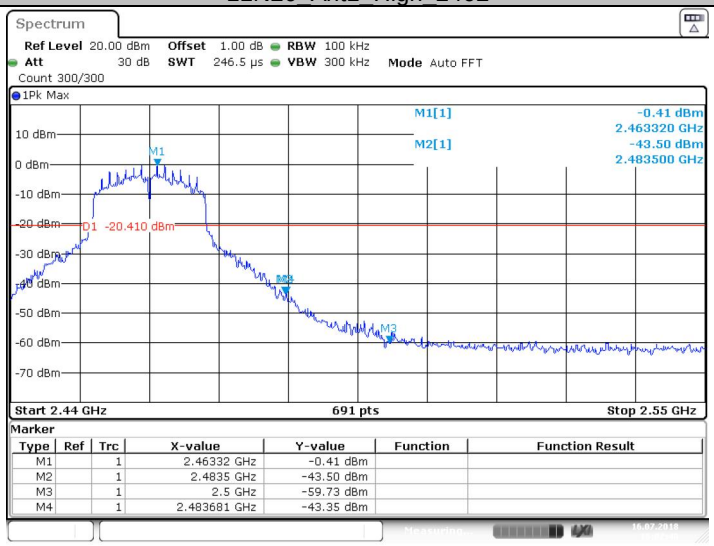
11N20_Ant1_High_2462

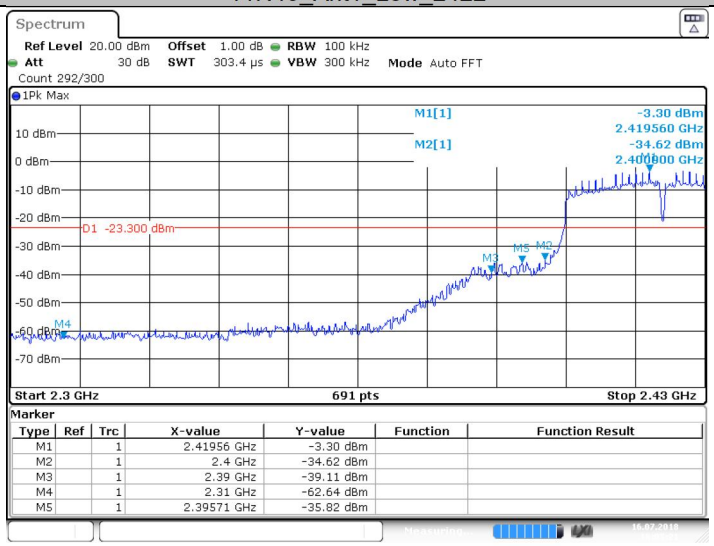


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46332 GHz	-0.41 dBm		
M2		1	2.4835 GHz	-43.50 dBm		
M3		1	2.5 GHz	-59.73 dBm		
M4		1	2.483681 GHz	-43.35 dBm		

Date:16.JUL.2018 16:02:40

11N40_Ant1_Low_2422

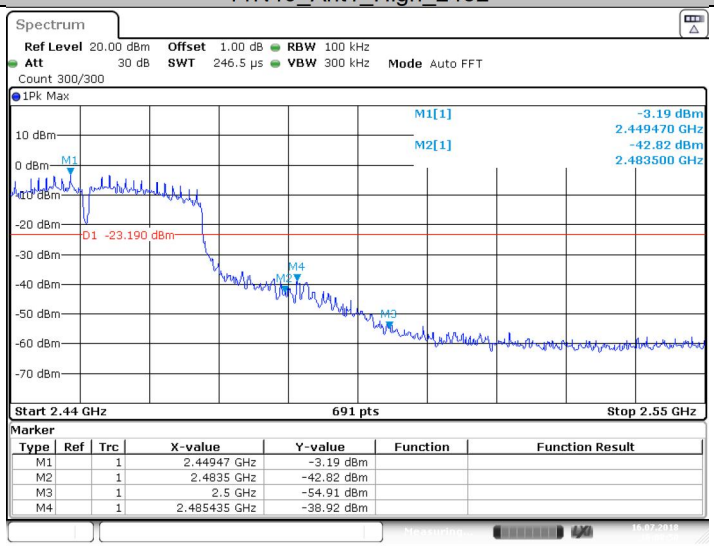


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41956 GHz	-3.30 dBm		
M2		1	2.4 GHz	-34.62 dBm		
M3		1	2.39 GHz	-39.11 dBm		
M4		1	2.31 GHz	-62.64 dBm		
M5		1	2.39571 GHz	-35.82 dBm		

Date:16.JUL.2018 16:05:22

11N40_Ant1_High_2452



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44947 GHz	-3.19 dBm		
M2		1	2.4835 GHz	-42.82 dBm		
M3		1	2.5 GHz	-54.91 dBm		
M4		1	2.485435 GHz	-38.92 dBm		

Date:16.JUL.2018 16:08:50

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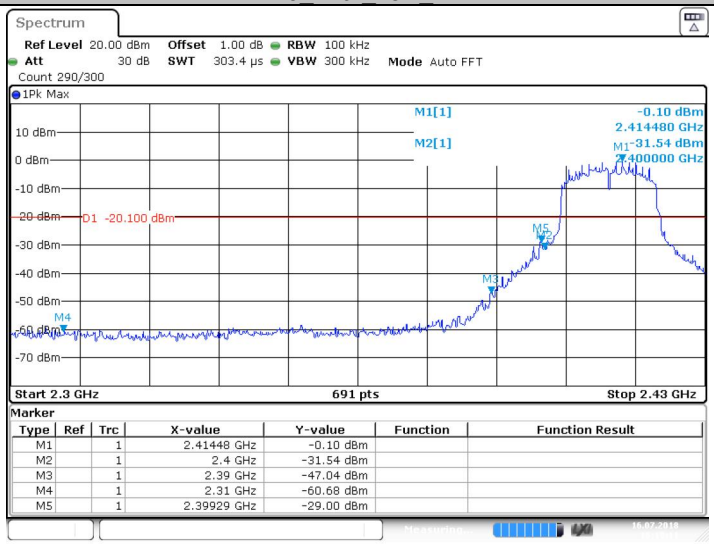
11N20_Ant2_Low_2412

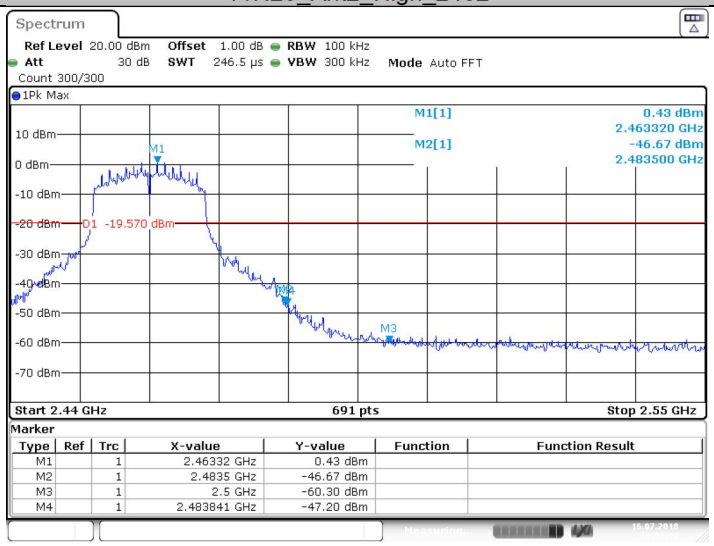


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41448 GHz	-0.10 dBm		
M2		1	2.4 GHz	-31.54 dBm		
M3		1	2.39 GHz	-47.04 dBm		
M4		1	2.31 GHz	-60.68 dBm		
M5		1	2.39929 GHz	-29.00 dBm		

Date:16.JUL.2018 16:19:12

11N20_Ant2_High_2462



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46332 GHz	0.43 dBm		
M2		1	2.4835 GHz	-46.67 dBm		
M3		1	2.5 GHz	-60.30 dBm		
M4		1	2.483841 GHz	-47.20 dBm		

Date:16.JUL.2018 16:22:18

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9.7 Spurious radiated emissions for transmitter

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3: The height of antenna 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.
4: 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.
5: Use the following spectrum analyzer settings According to C63.10:
For Below 1GHz
Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 KHz to 120KHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:
Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥RBW for peak measurement ,Sweep = auto, Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz

a) RBW = 1 MHz.
b) VBW \ [3 × RBW].
c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D,where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty

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cycle was 50%, then 3 dB shall be added to the measured emission levels.
2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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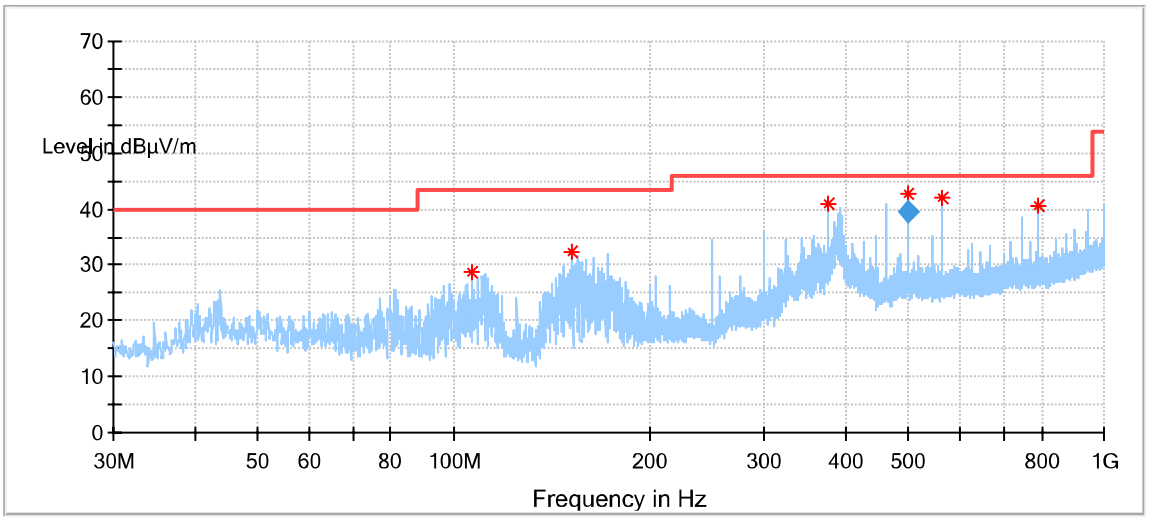
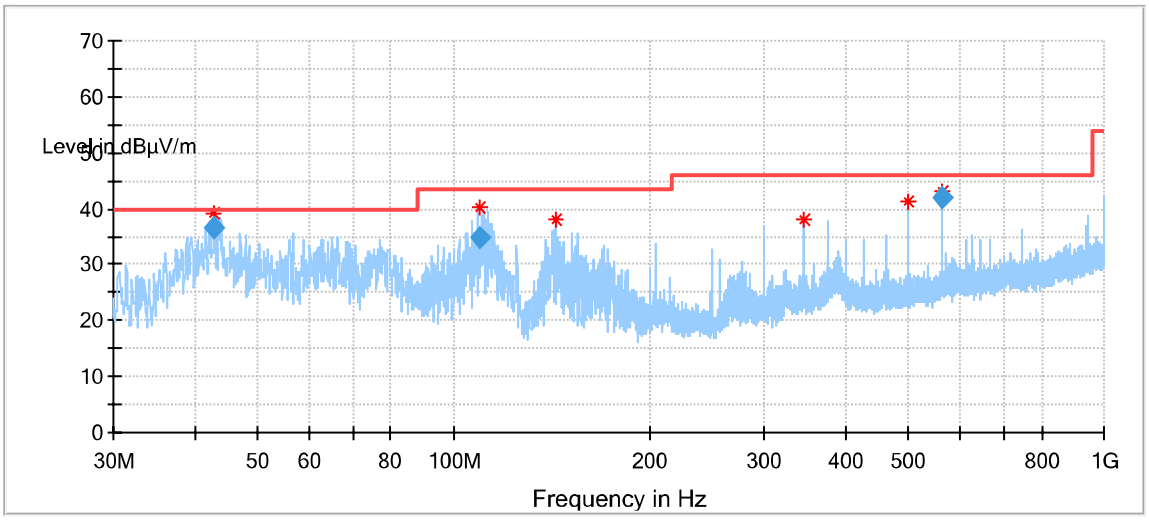
Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.
Pretest all modulation type, report the data of the worst case.
Transmitting spurious emission test result as below:
For model: D04011
Emission below 1GHz



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
499.999422	39.41	46.00	6.59	167.0	H	6.0	18.8



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
42.780733	36.56	40.00	3.44	104.0	V	2.0	13.7
109.385556	34.93	43.50	8.57	100.0	V	65.0	11.9
563.169867	42.06	46.00	3.94	105.0	V	203.0	20.1

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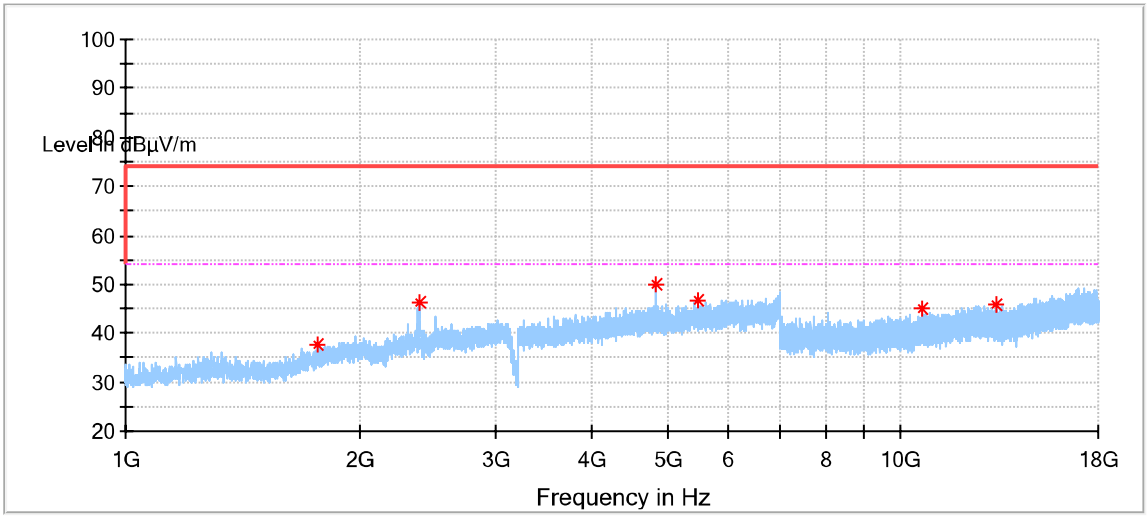
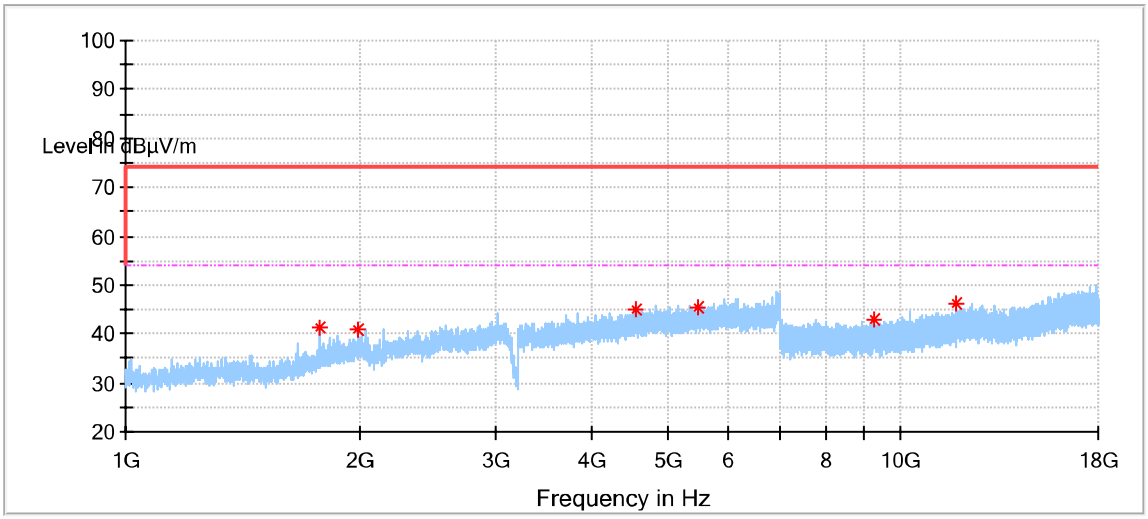
Emission between 1G-25GHz

802.11b Modulation:

2412MHz Test Result



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1766.500000	37.46	74.00	36.54	150.0	H	103.0	-6.6
2394.000000	46.28	74.00	27.72	150.0	H	282.0	-3.9
4824.500000	49.89	74.00	24.11	150.0	H	306.0	2.4
5469.500000	46.77	74.00	27.23	150.0	H	276.0	2.6
10640.000000	45.17	74.00	28.83	150.0	H	241.0	8.3
13259.500000	46.04	74.00	27.96	150.0	H	157.0	9.9



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1780.500000	41.18	74.00	32.82	150.0	V	239.0	-6.5
1993.000000	41.04	74.00	32.96	150.0	V	135.0	-5.2
4566.500000	45.06	74.00	28.94	150.0	V	105.0	2.8
5489.500000	45.54	74.00	28.46	150.0	V	138.0	2.7
9227.500000	42.89	74.00	31.11	150.0	V	152.0	7.0
11823.000000	46.07	74.00	27.93	150.0	V	65.0	9.3

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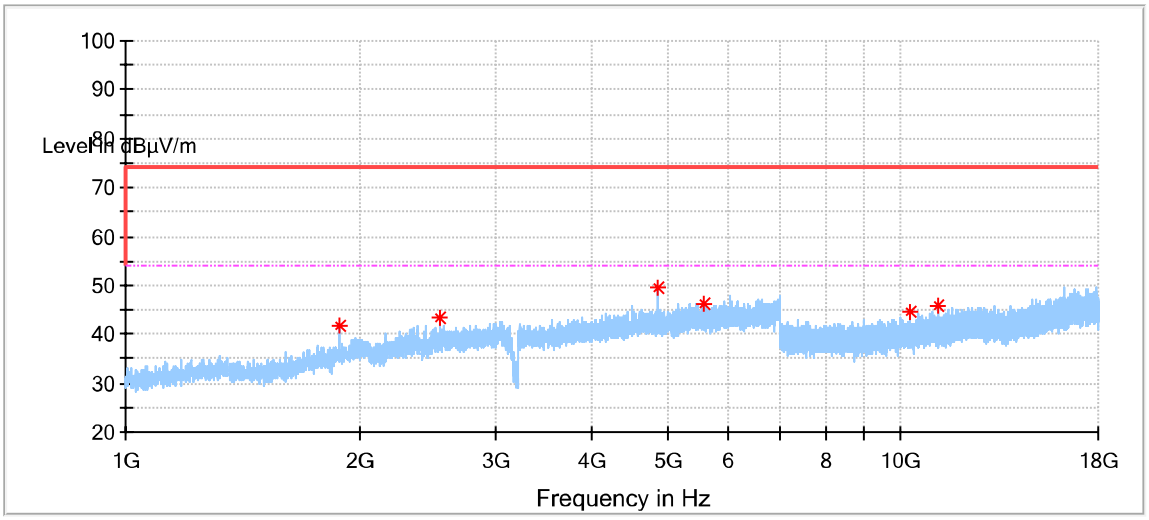
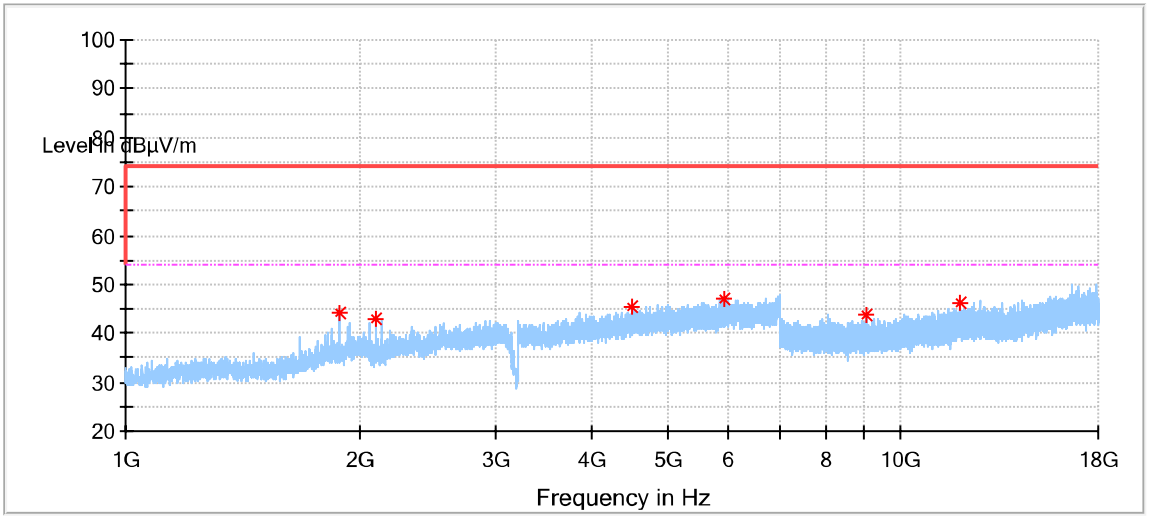
2437MHz Test Result



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1886.500000	41.59	74.00	32.41	150.0	H	71.0	-5.8
2542.500000	43.48	74.00	30.52	150.0	H	259.0	-3.2
4874.000000	49.51	74.00	24.49	150.0	H	329.0	2.4
5577.000000	46.13	74.00	27.87	150.0	H	220.0	2.9
10290.500000	44.50	74.00	29.50	150.0	H	314.0	7.9
11211.500000	45.95	74.00	28.05	150.0	H	92.0	8.3



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1886.000000	44.25	74.00	29.75	150.0	V	186.0	-5.8
2097.500000	42.87	74.00	31.13	150.0	V	186.0	-4.8
4516.000000	45.41	74.00	28.59	150.0	V	94.0	3.1
5930.000000	47.28	74.00	26.72	150.0	V	121.0	4.1
9009.000000	43.61	74.00	30.39	150.0	V	354.0	6.9
11925.000000	46.24	74.00	27.76	150.0	V	354.0	9.7

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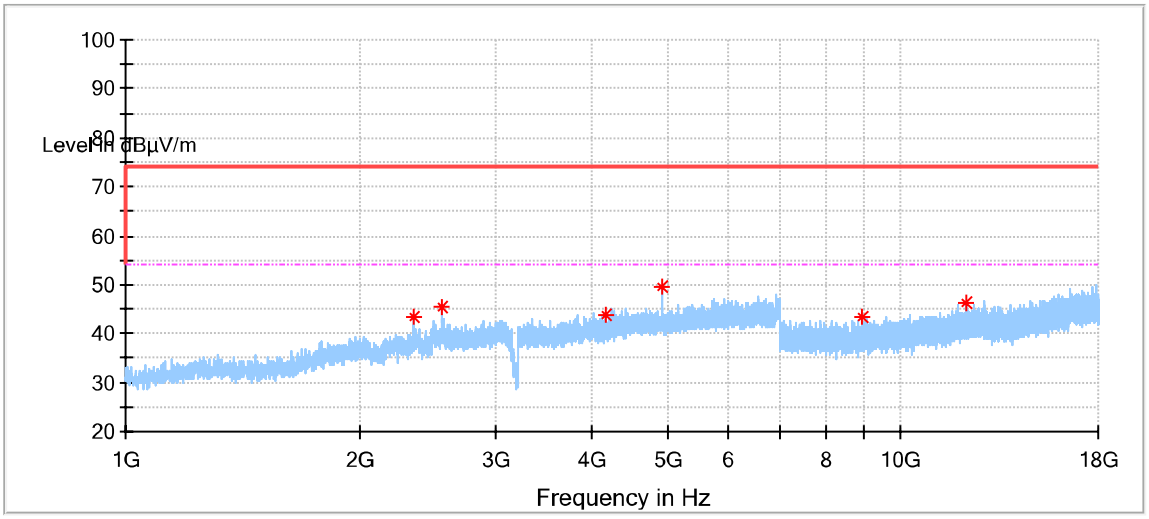
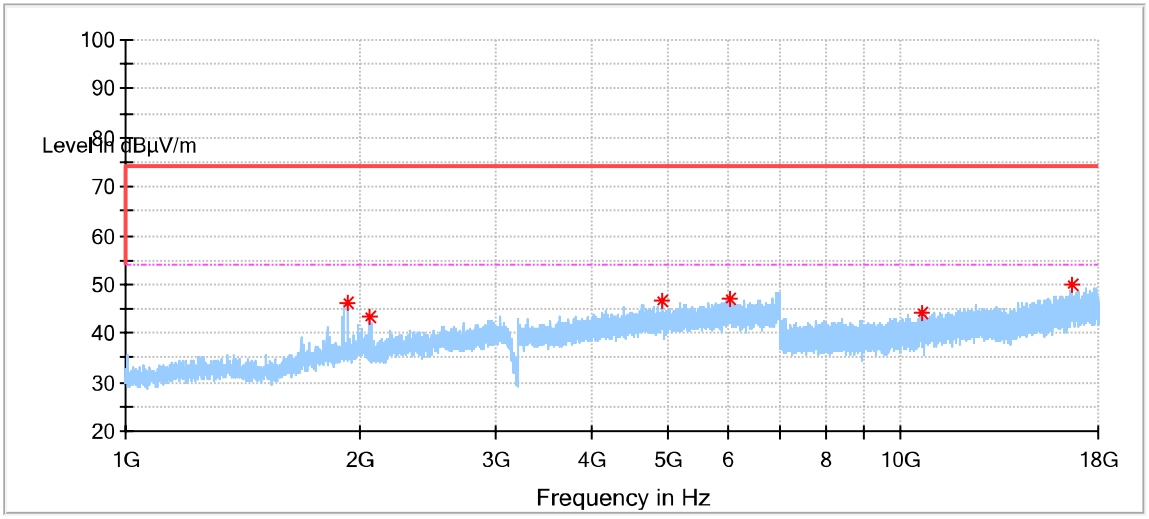
2462MHz Test Result



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2360.500000	43.41	74.00	30.59	150.0	H	285.0	-4.0
2563.500000	45.38	74.00	28.62	150.0	H	269.0	-3.2
4178.000000	43.68	74.00	30.32	150.0	H	128.0	1.8
4924.000000	49.53	74.00	24.47	150.0	H	98.0	2.3
8932.500000	43.21	74.00	30.79	150.0	H	18.0	6.9
12172.000000	46.14	74.00	27.86	150.0	H	46.0	9.6



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1933.500000	46.16	74.00	27.84	150.0	V	210.0	-5.5
2065.500000	43.50	74.00	30.50	150.0	V	176.0	-5.1
4923.500000	46.54	74.00	27.46	150.0	V	5.0	2.3
6023.500000	47.23	74.00	26.77	150.0	V	343.0	5.0
10642.500000	44.35	74.00	29.65	150.0	V	124.0	8.3
16701.500000	49.97	74.00	24.03	150.0	V	294.0	16.6

Remark:

(1) Data of measurement within frequency range 18Hz-26GHz are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
(2) Level=Reading Level + Correction Factor

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Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

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10 Test Equipment List

List of Test Instruments

Conducted Emission Test

Description	Manufacturer	Model no.	Serial no.	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2020-6-28
LISN	Rohde & Schwarz	ENV4200	100249	2020-6-28
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2020-6-28
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A

Radiated Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	101031	2020-6-28
High Pass Filter (HPF)	UCL	UCL-BPF1-7G	1504005103	2020-6-28
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2020-6-29
Horn Antenna	Rohde & Schwarz	HF907	102295	2020-6-22
Wideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	12827	2020-7-12
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2020-6-28
Pre-amplifier	Rohde & Schwarz	SCU 40A	100432	2020-7-16
Attenuator	Agilent	8491A	MY39264334	2020-6-28
3m Semi-anechoic chamber	TDK	9X6X6	----	2020-7-7
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

RF conducted test

DESCRIPTION	**MANUFACTURER**	**MODEL NO.**	**SERIAL NO.**	**CAL. DUE DATE**
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2020-6-28
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2020-6-28
Power Splitter	Weinschel	1580	SC319	2020-7-7
Vector Signal Generator	Rohde & Schwarz	SMBV100A	262825	2020-6-28
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2020-7-6
Test software	Tonscend	System for BT/WIFI	Version 2.6	N/A

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth
- 20dB bandwidth and 99% Occupied Bandwidth
- Carrier frequency separation
- Number of hopping frequencies
- Dwell Time
- Power spectral density
- Spurious RF conducted emissions
- Band edge

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.80dB; Vertical: 4.87dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.59dB; Vertical: 4.58dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6×10^{-7} or 1%
Uncertainty Evaluation for Power Spectral Density Conducted measurement	1.17dB
Uncertainty Evaluation for Spurious emissions Conducted measurement	1.43dB

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