

5.7 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Requirement: FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 22.917(a)(b)

Test Method: ANSI/TIA-603-E-2016 & KDB 971168 D01v03r01

Limit:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB. The emission limit equal to -13 dBm.

Test Procedure:

The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range. b. Measuring frequency range is from 30 MHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Set RBW & VBW to 100 kHz for the measurement below 1 GHz, and 1 MHz for the measurement above 1 GHz.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

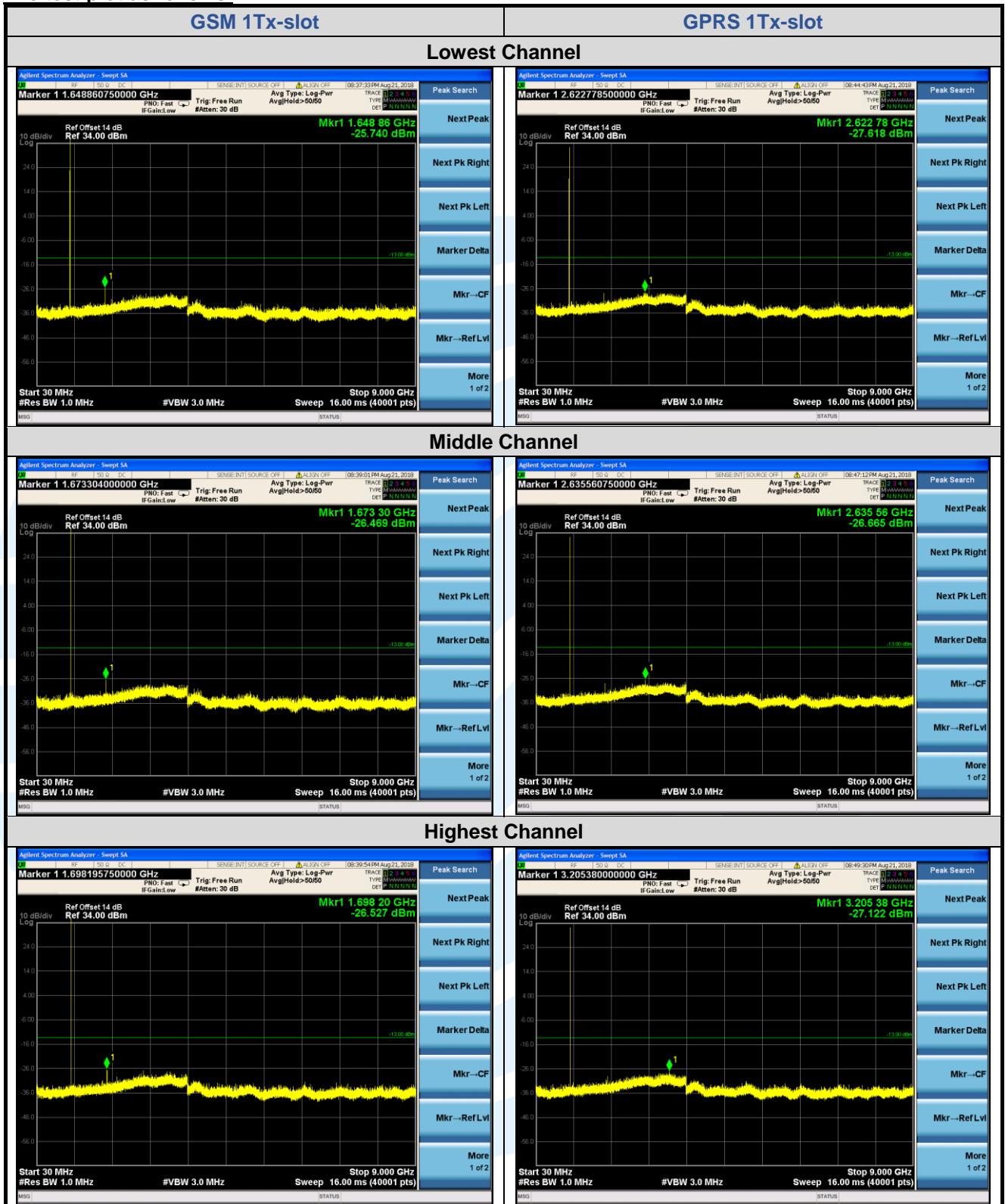
Test Setup: Refer to section 4.2.2 for details.

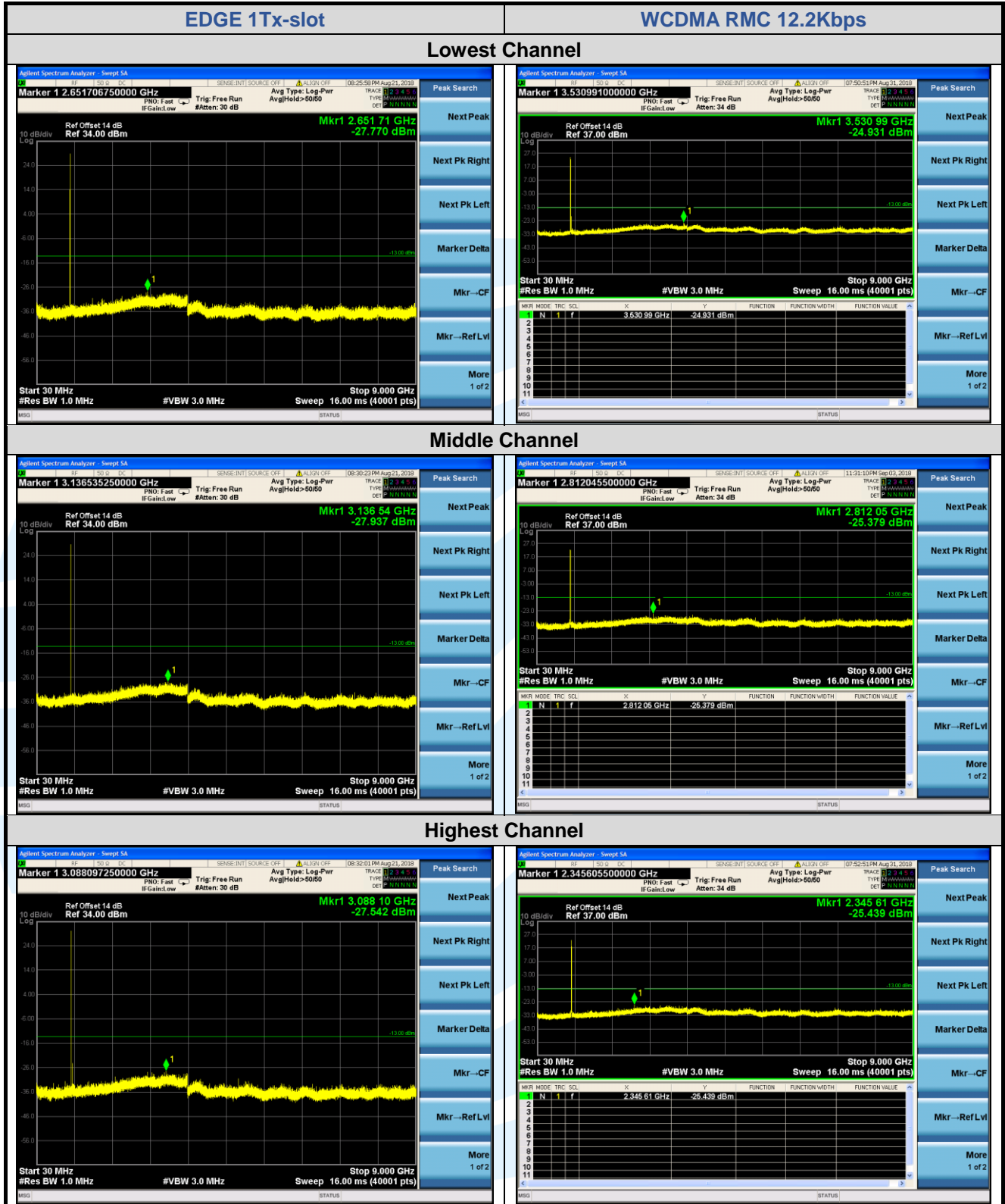
Instruments Used: Refer to section 3 for details

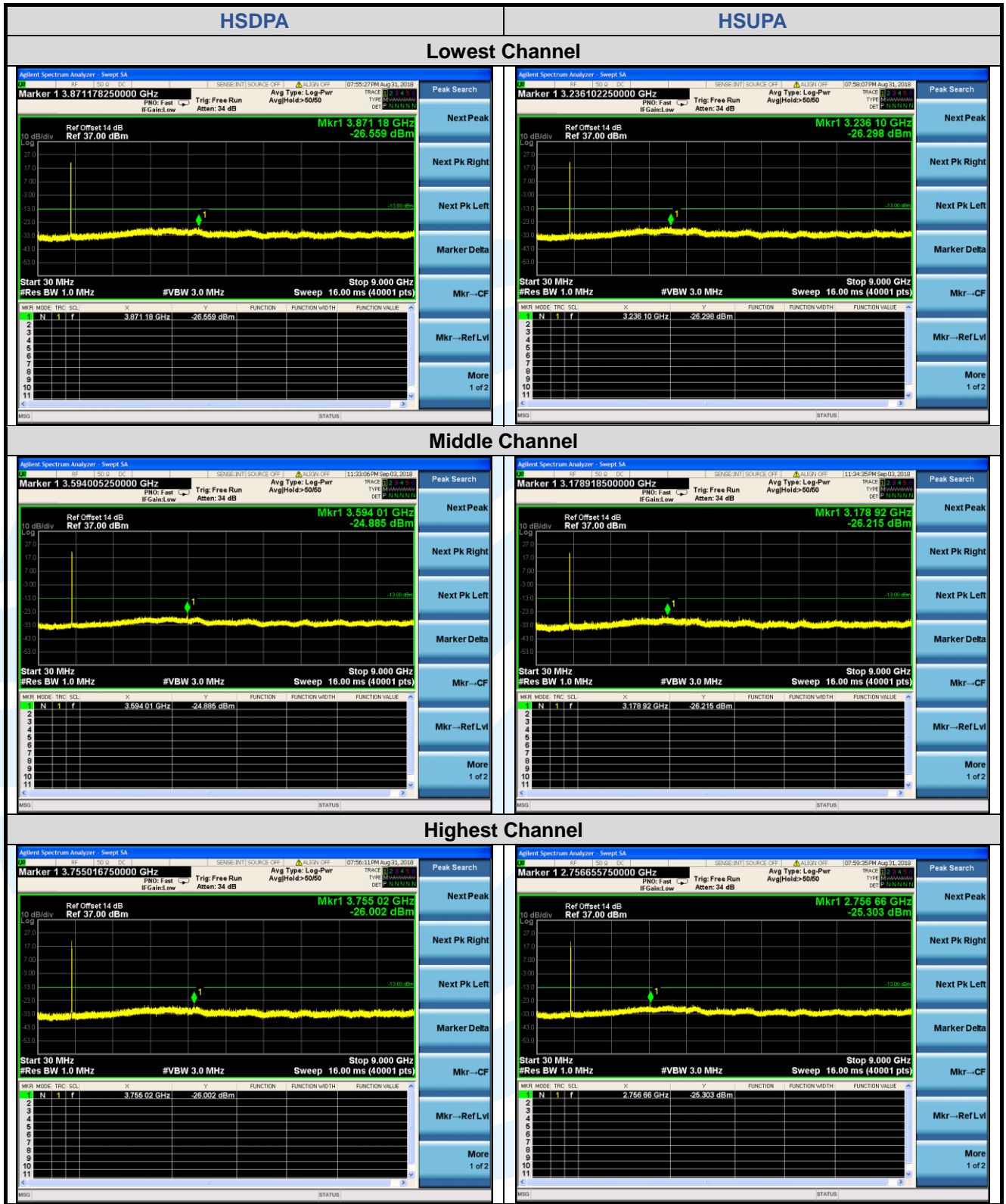
Test Mode: Link mode

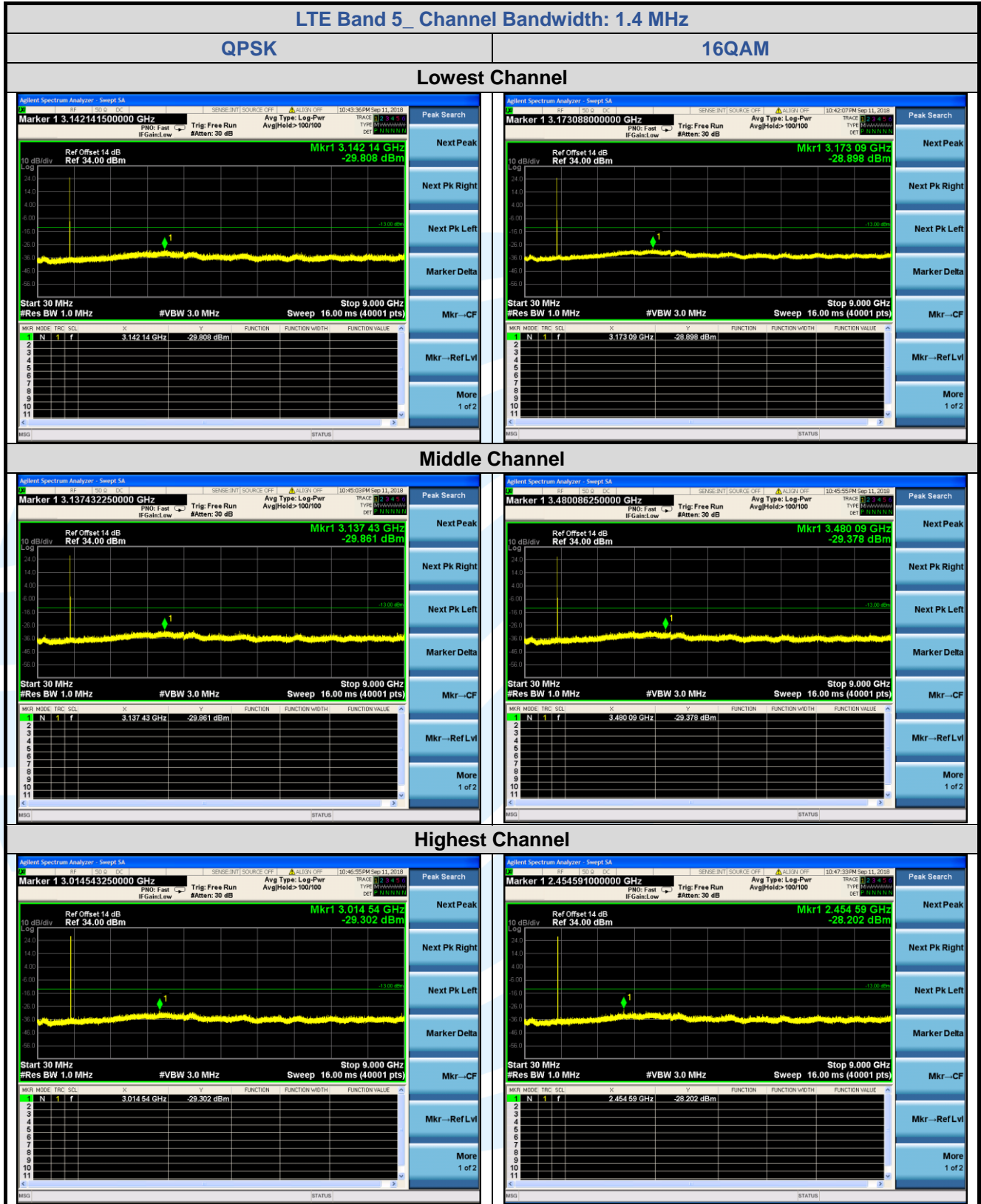
Test Results: Pass

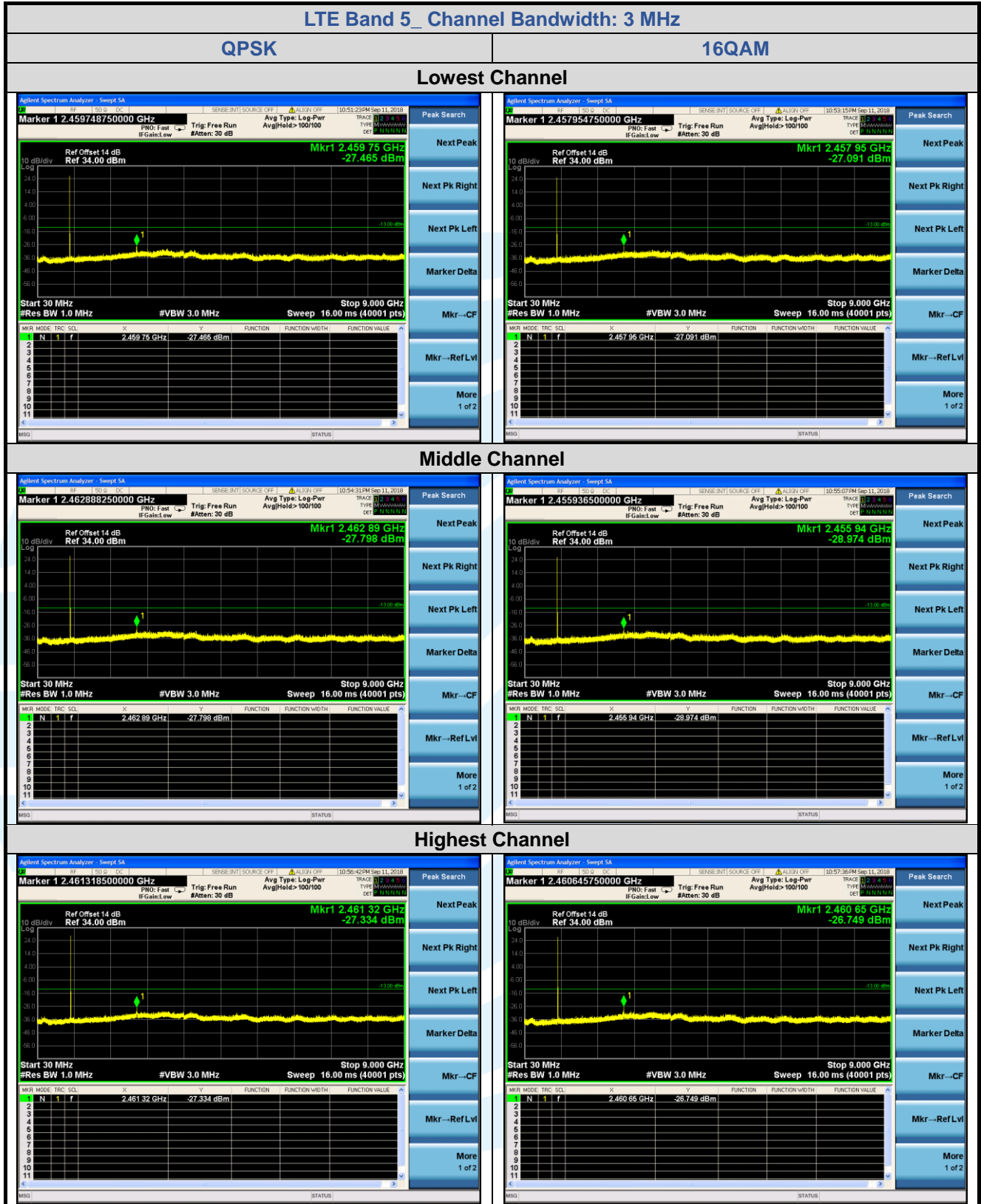
The test plot as follows:

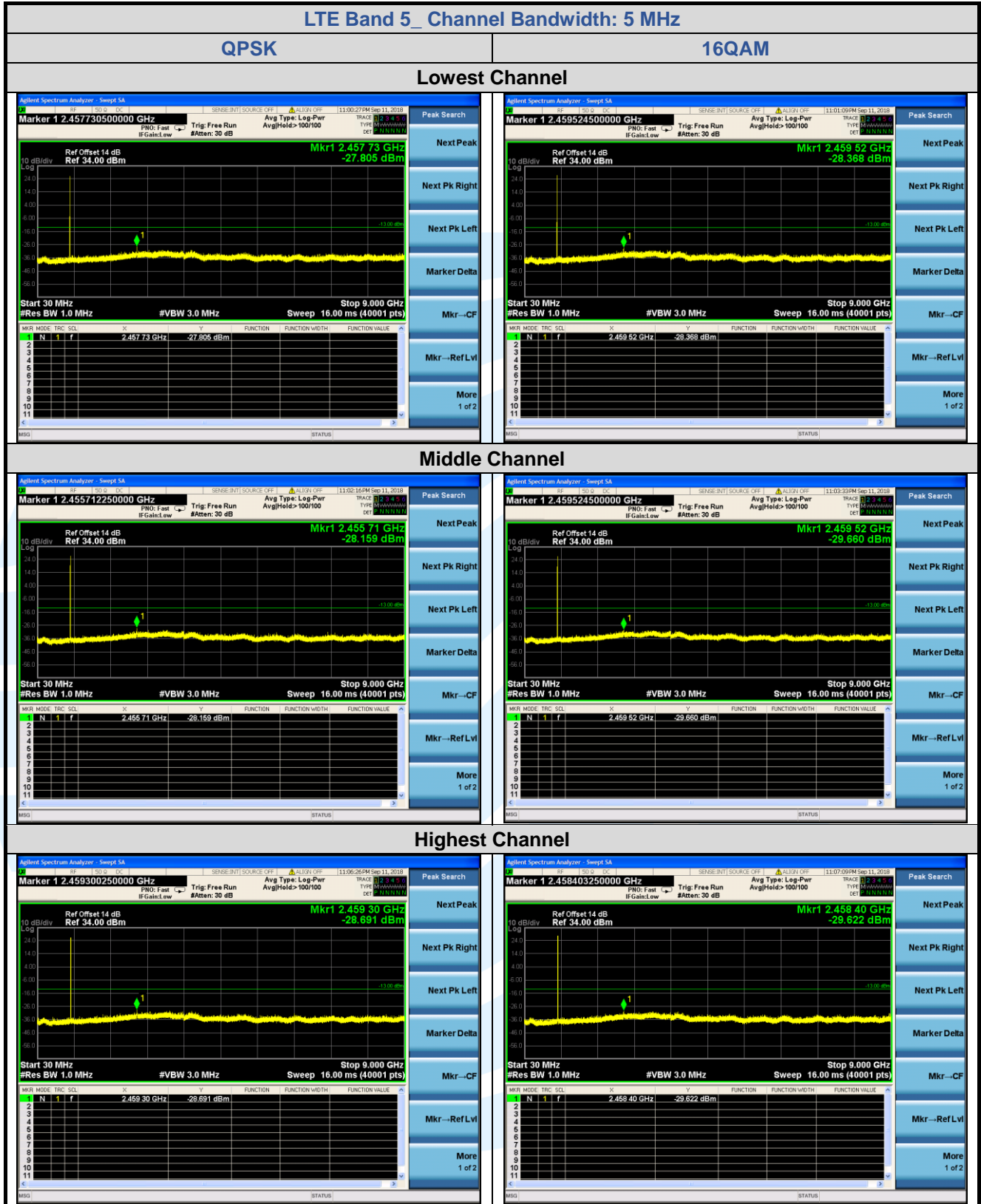


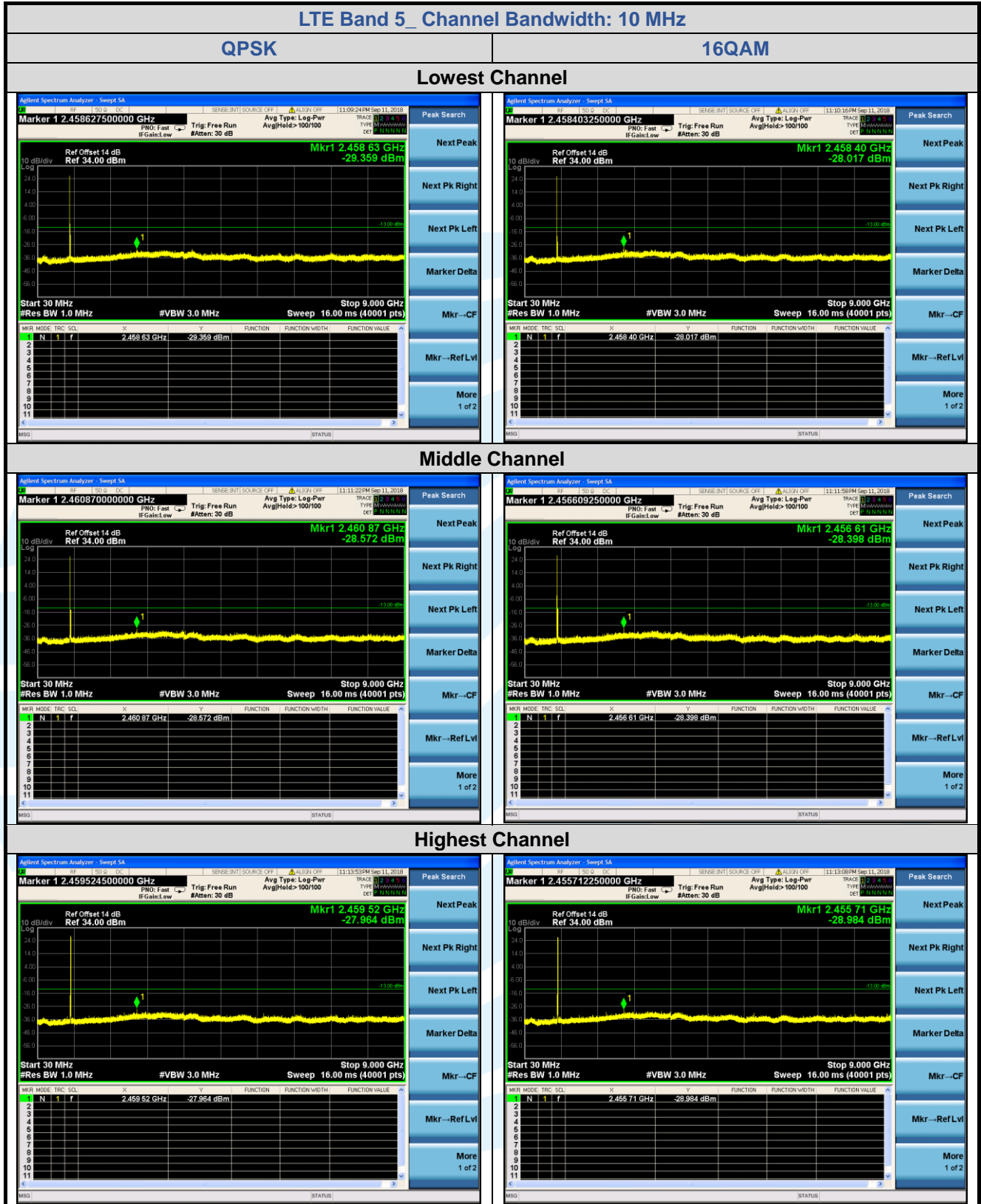












5.8 FIELD STRENGTH OF SPURIOUS RADIATION

Test Requirement: FCC 47 CFR Part 2.1053 & FCC 47 CFR Part 22.917(a)(b)

Test Method: ANSI/TIA-603-E-2016 & KDB 971168 D01v03r01

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009 MHz-30 MHz	Peak	10 kHz	30 KHz	Peak
30 MHz-1 GHz	Quasi-peak	100 kHz	300 KHz	Peak
Above 1 GHz	Peak	1 MHz	3 MHz	Peak

Limits:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB. The emission limit equal to -13 dBm.

Test Setup: Refer to section 4.2.1 for details.

Test Procedures:

1. Scan up to 10th harmonic, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.

Test procedure as below:

- 1) The EUT was powered ON and placed on a 0.8/1.5m high table at a 3 meter semi/fully Anechoic Chamber. The antenna of the transmitter was extended to its maximum length. Modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.
- 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 disturbance of the transmitter was maximized on the test receiver display by raising and lowering from 1m to 4m the receive antenna and by rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
- 4) Steps 1) to 3) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
- 5) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
- 6) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 3) is obtained for this set of conditions.
- 7) The output power into the substitution antenna was then measured.
- 8) Steps 6) and 7) were repeated with both antennas polarized.
- 9) Calculate power in dBm by the following formula:

$$ERP(\text{dBm}) = Pg(\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dBd)}$$

$$EIRP(\text{dBm}) = Pg(\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dBi)}$$

$$EIRP = ERP + 2.15\text{dB}$$

where:

Pg is the generator output power into the substitution antenna.

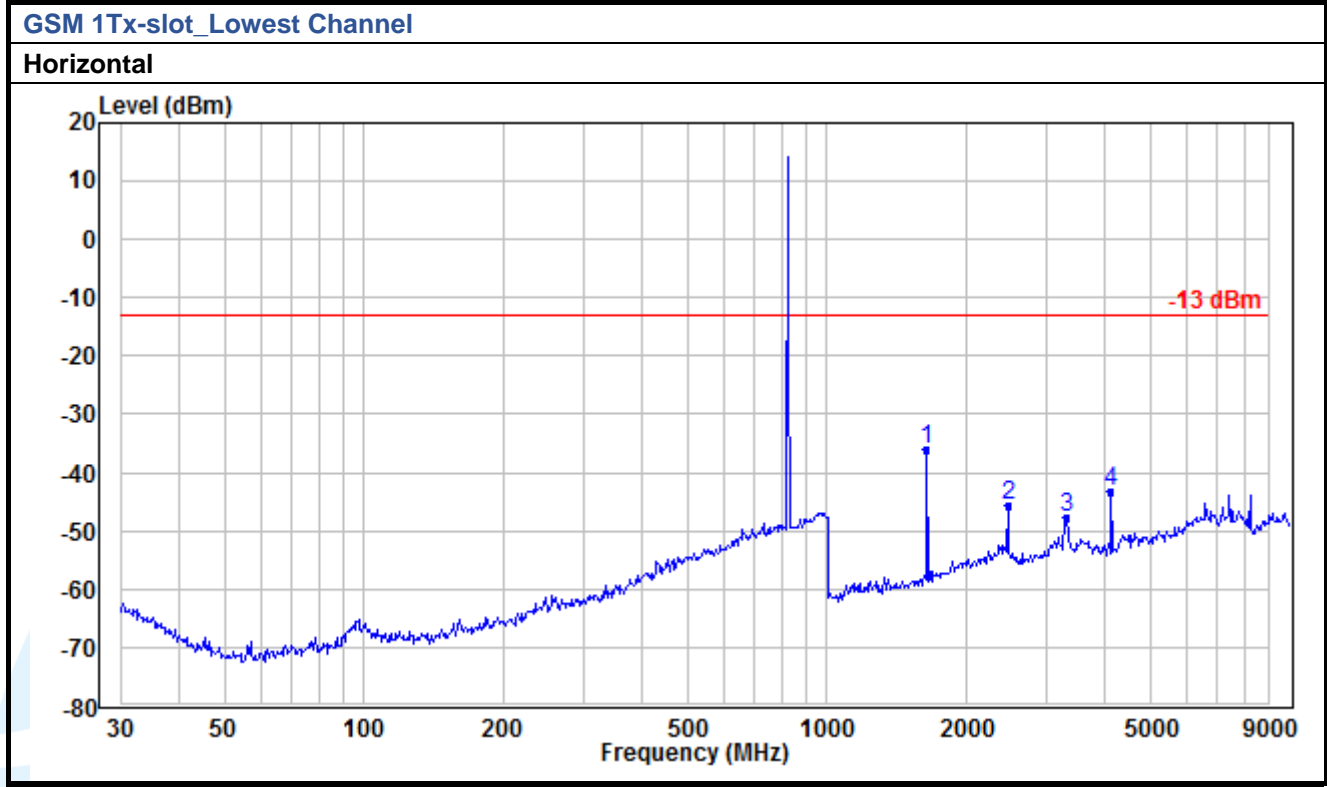
- 10) Test the EUT in the lowest channel, the middle channel the Highest channel
- 11) The radiation measurements are performed in X, Y, Z axis positioning for EUT operation mode, and found the Y axis positioning which it is worse case.
- 12) Repeat above procedures until all frequencies measured was complete.

Equipment Used: Refer to section 3 for details.

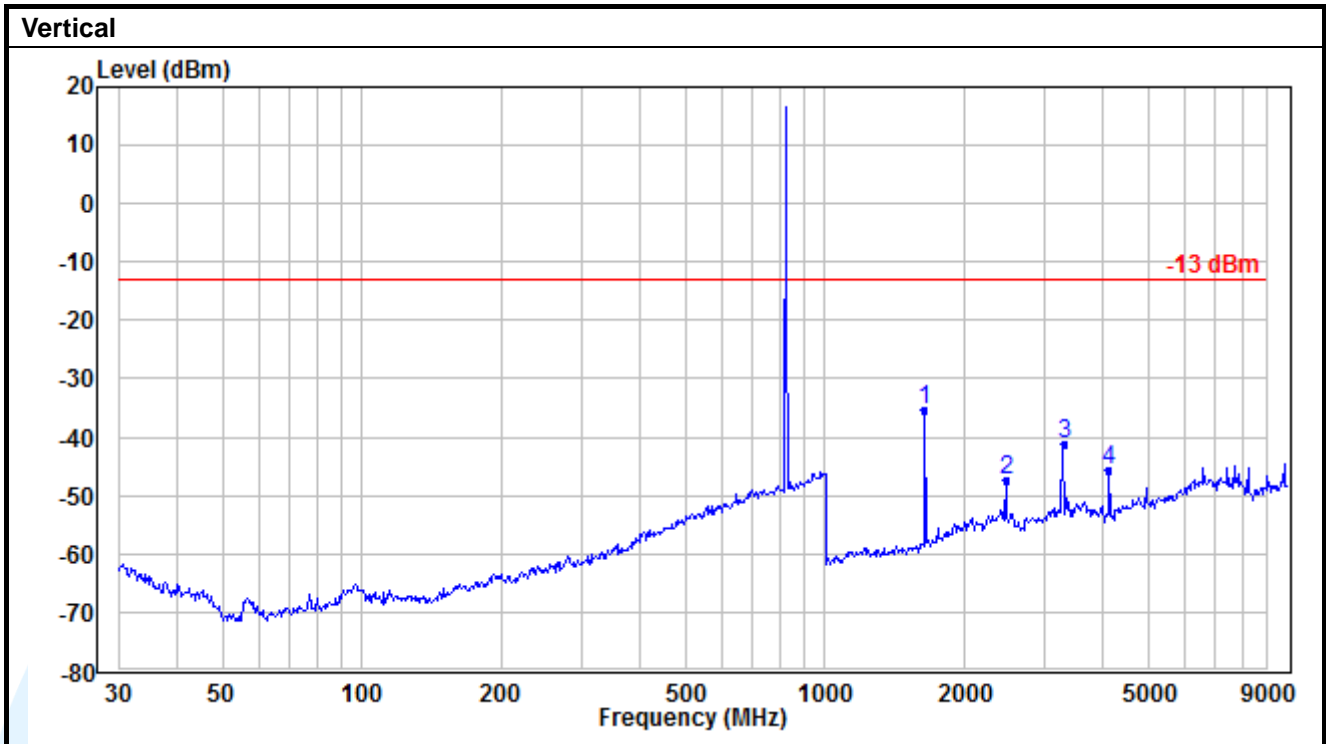
Test Result: Pass

The measurement data as follows:

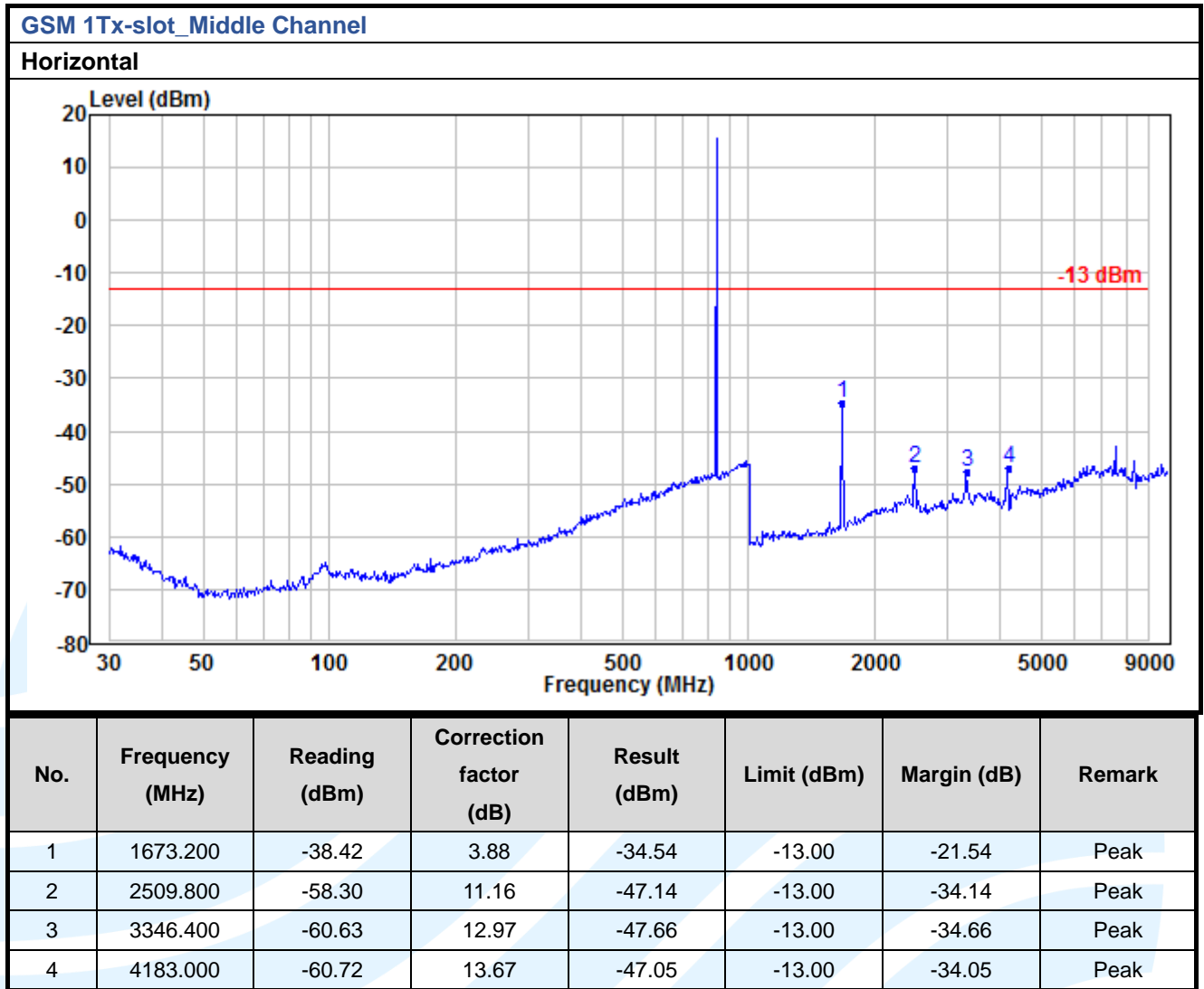
Radiated Emission Test Data

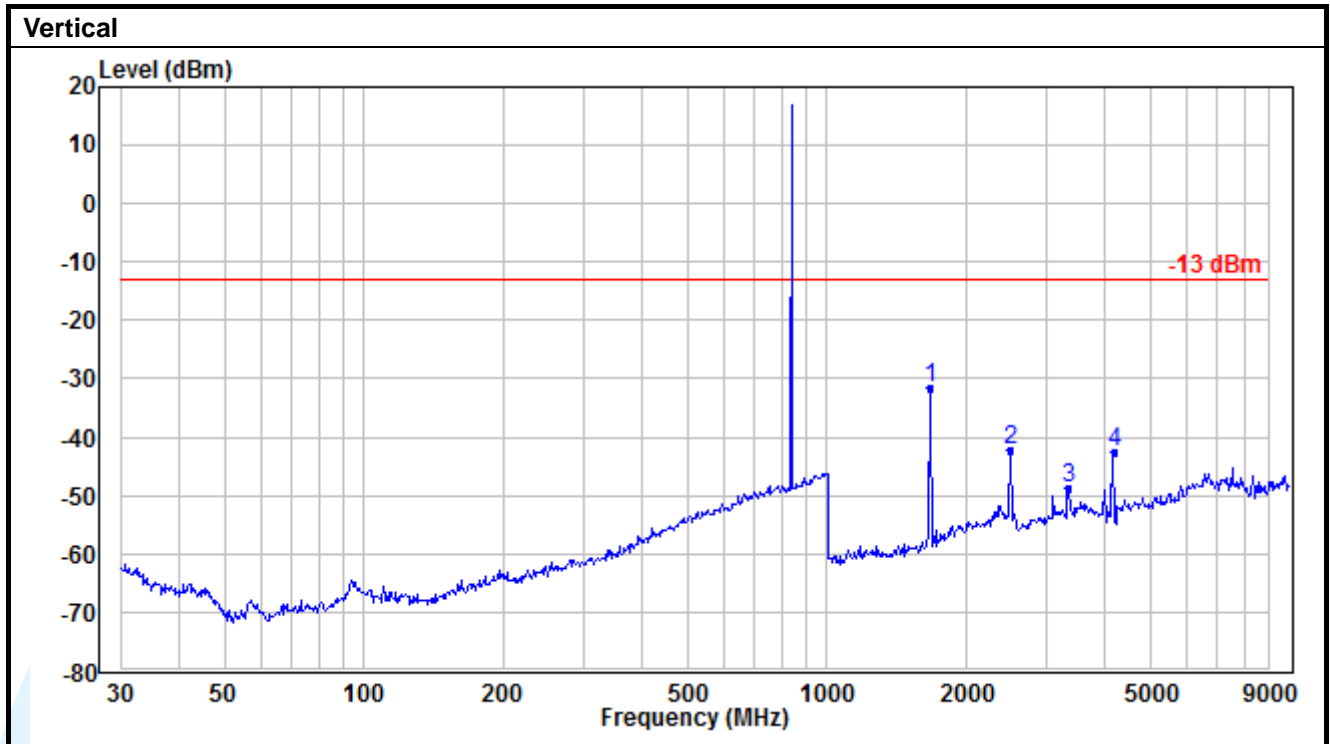


No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1648.400	-39.48	3.59	-35.89	-13.00	-22.89	Peak
2	2472.600	-56.86	11.19	-45.67	-13.00	-32.67	Peak
3	3296.800	-60.47	12.82	-47.65	-13.00	-34.65	Peak
4	4121.000	-56.71	13.43	-43.28	-13.00	-30.28	Peak

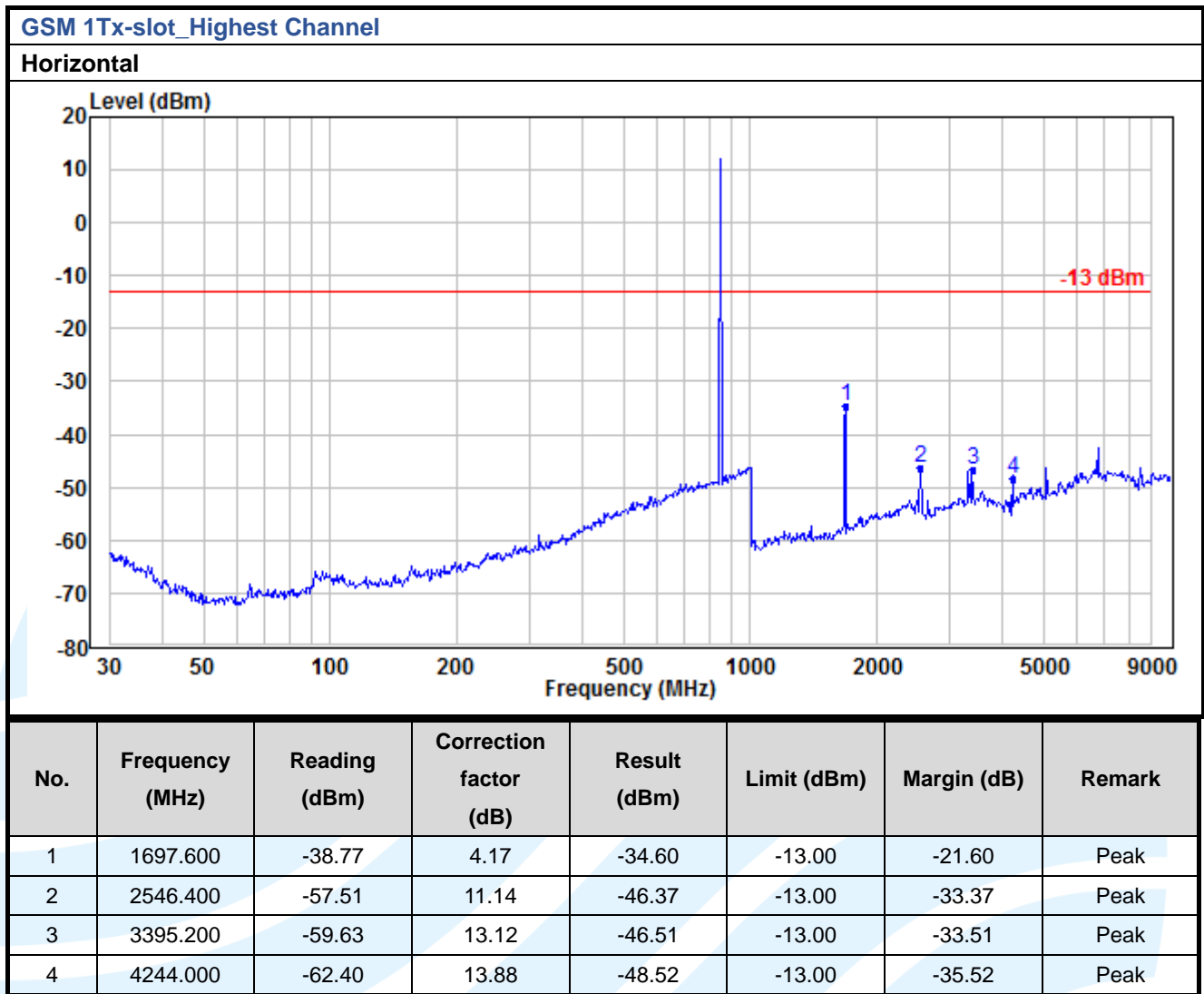


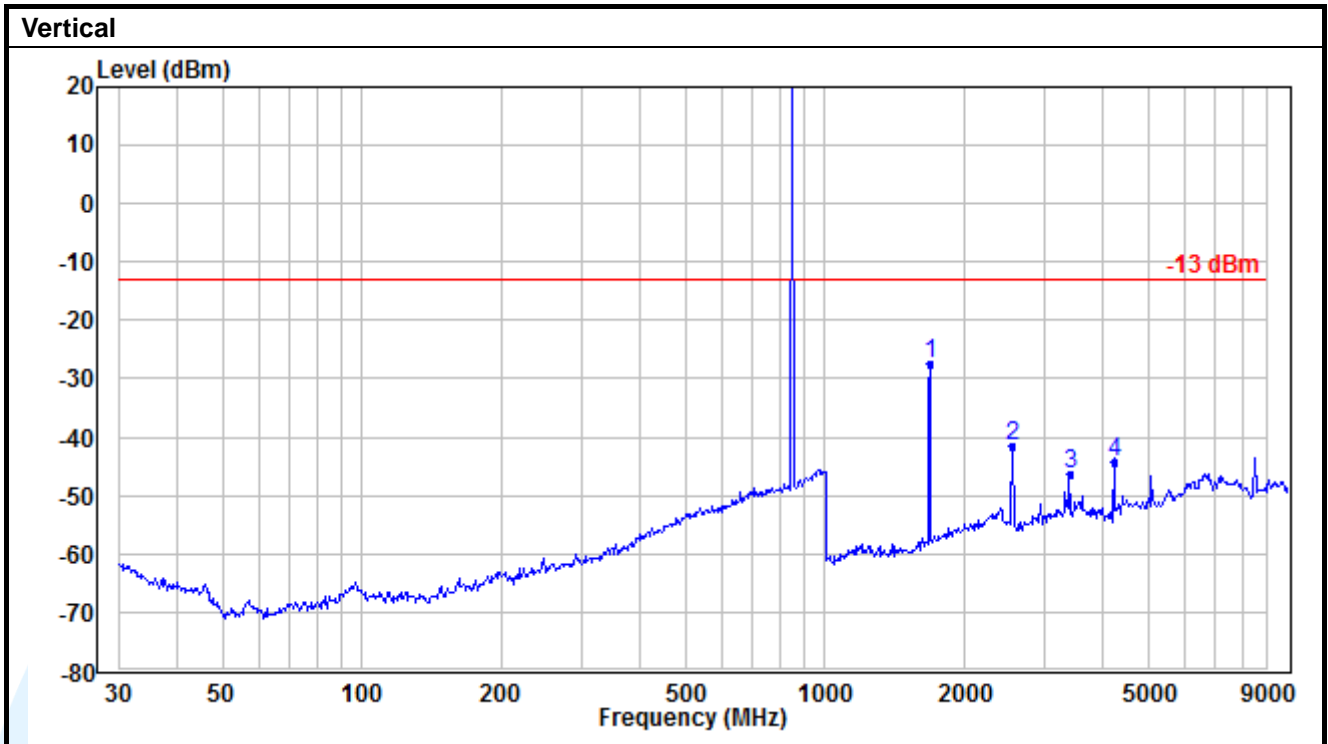
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1648.400	-38.78	3.59	-35.19	-13.00	-22.19	Peak
2	2472.600	-58.65	11.19	-47.46	-13.00	-34.46	Peak
3	3296.800	-53.93	12.82	-41.11	-13.00	-28.11	Peak
4	4121.000	-58.91	13.43	-45.48	-13.00	-32.48	Peak





No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1673.200	-35.58	3.88	-31.70	-13.00	-18.70	Peak
2	2509.800	-53.27	11.16	-42.11	-13.00	-29.11	Peak
3	3346.400	-61.63	12.97	-48.66	-13.00	-35.66	Peak
4	4183.000	-56.36	13.67	-42.69	-13.00	-29.69	Peak

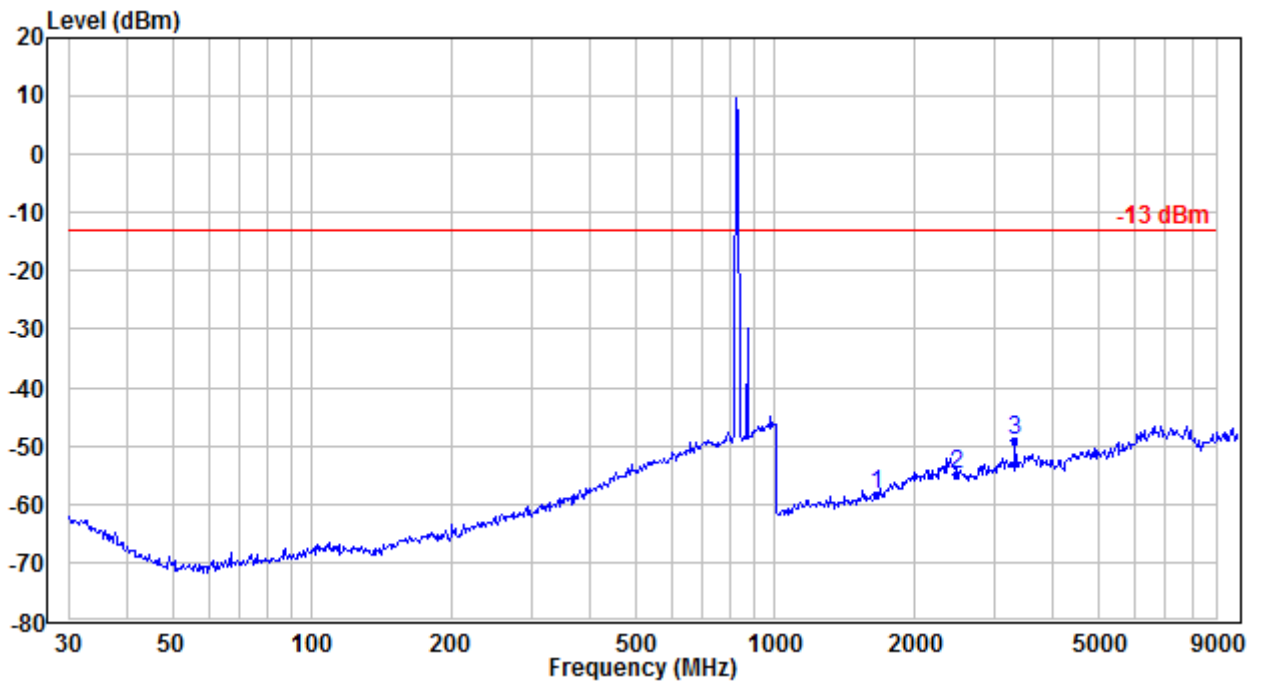




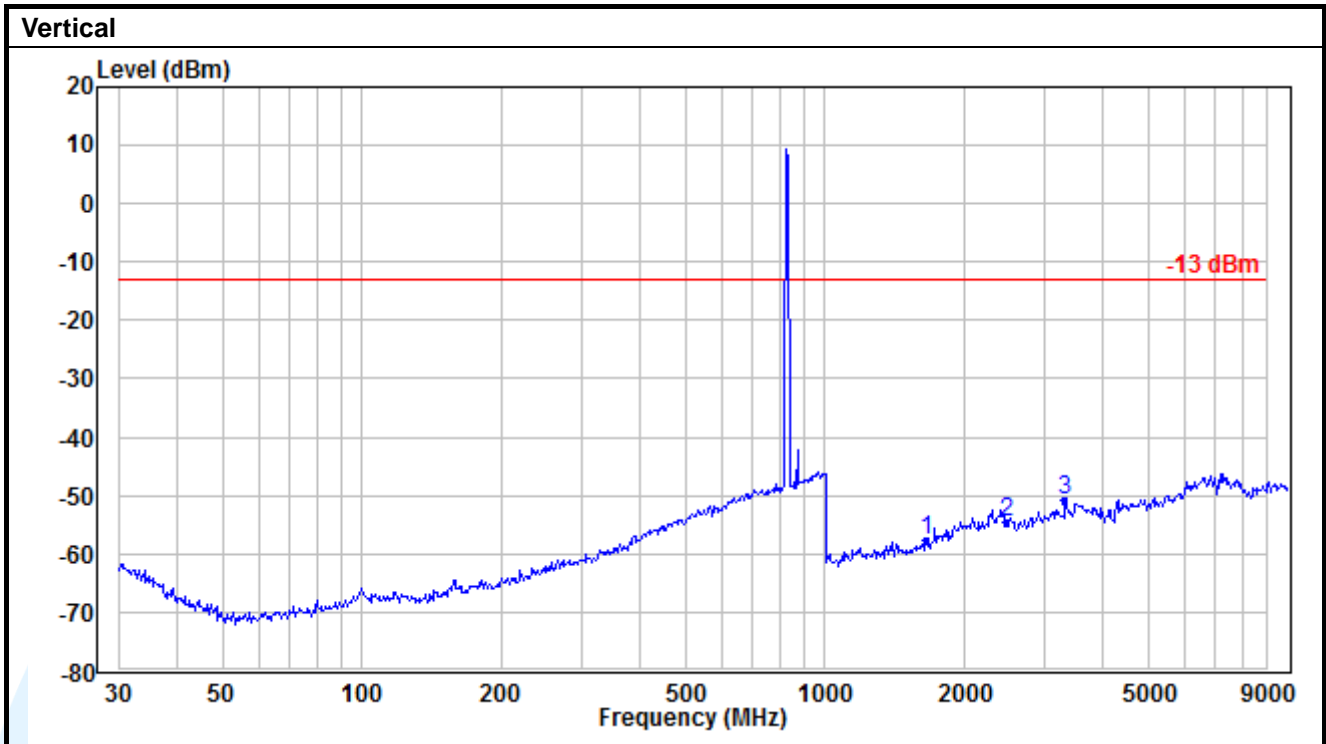
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1697.600	-31.65	4.17	-27.48	-13.00	-14.48	Peak
2	2546.400	-52.71	11.14	-41.57	-13.00	-28.57	Peak
3	3395.200	-59.28	13.12	-46.16	-13.00	-33.16	Peak
4	4244.000	-58.22	13.88	-44.34	-13.00	-31.34	Peak

WCDMA RMC 12.2Kbps_Lowest Channel

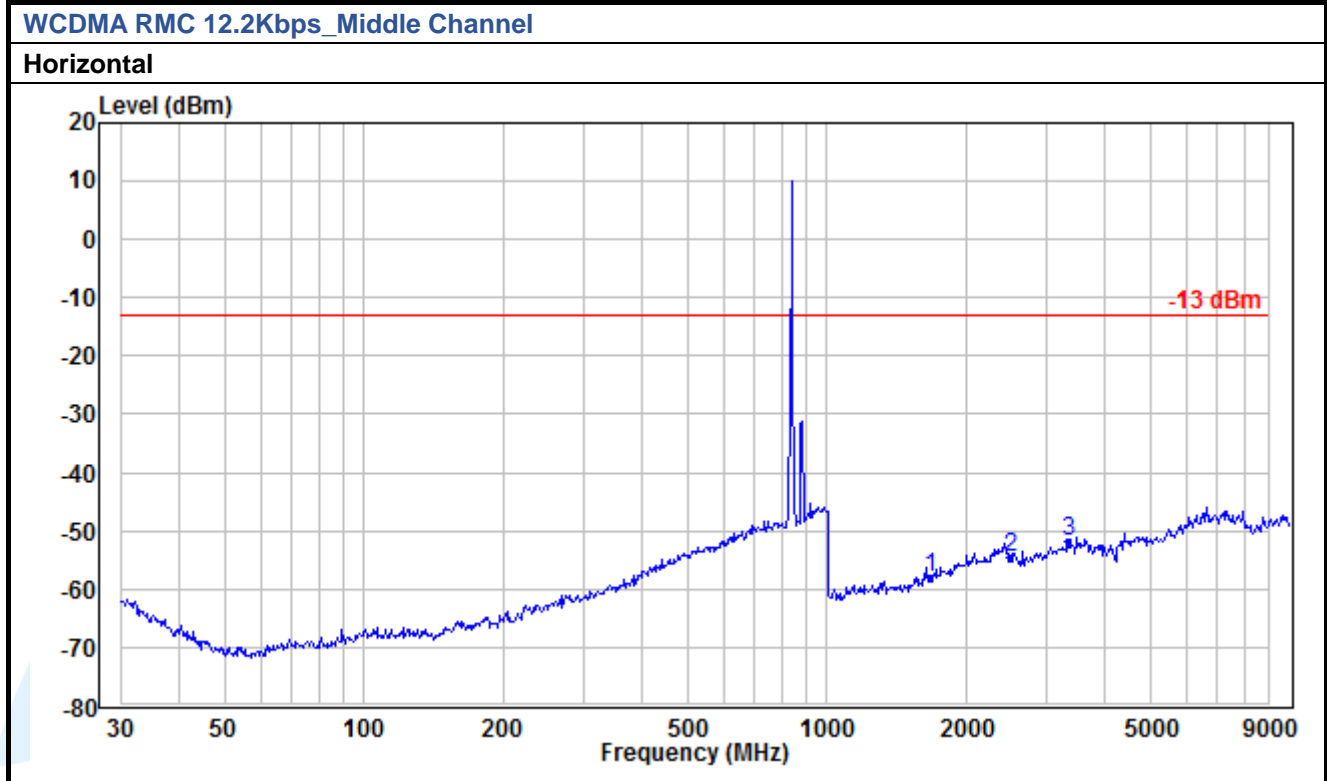
Horizontal



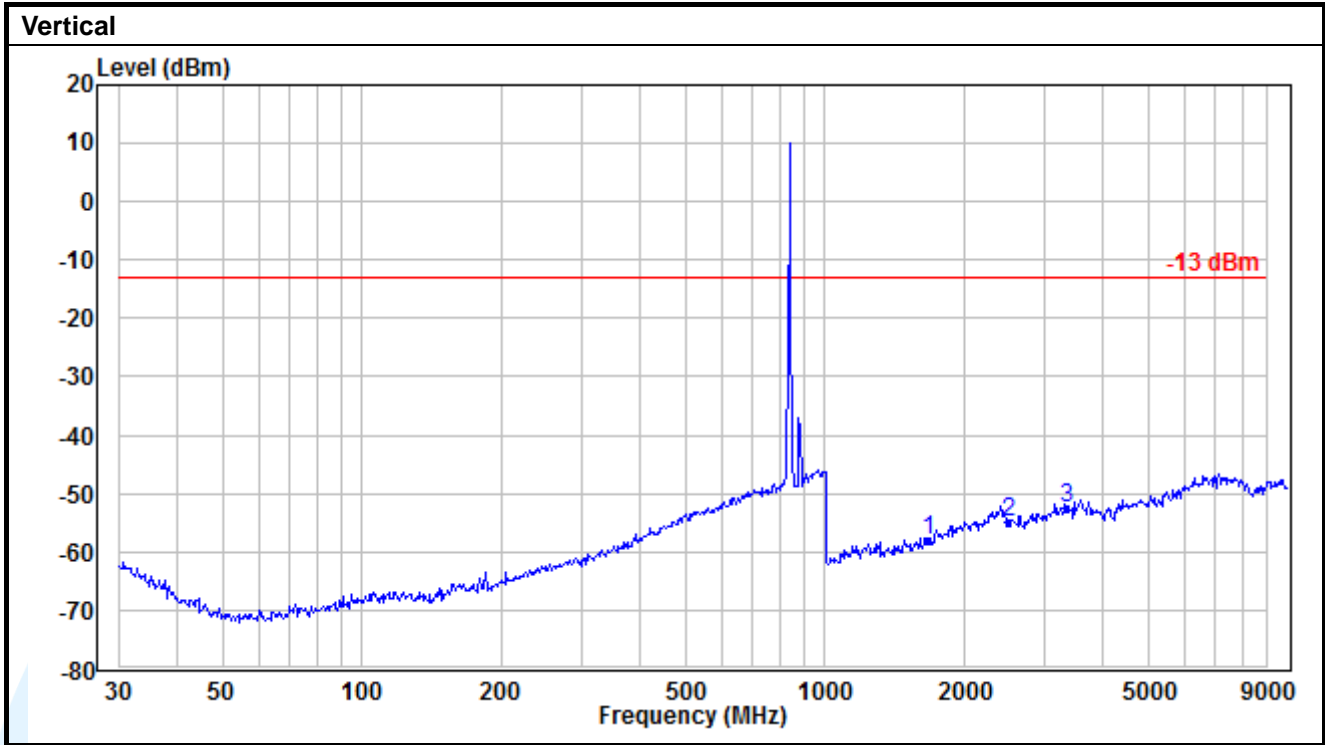
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1652.800	-62.12	3.64	-58.48	-13.00	-45.48	Peak
2	2479.200	-66.15	11.18	-54.97	-13.00	-41.97	Peak
3	3305.600	-61.93	12.84	-49.09	-13.00	-36.09	Peak



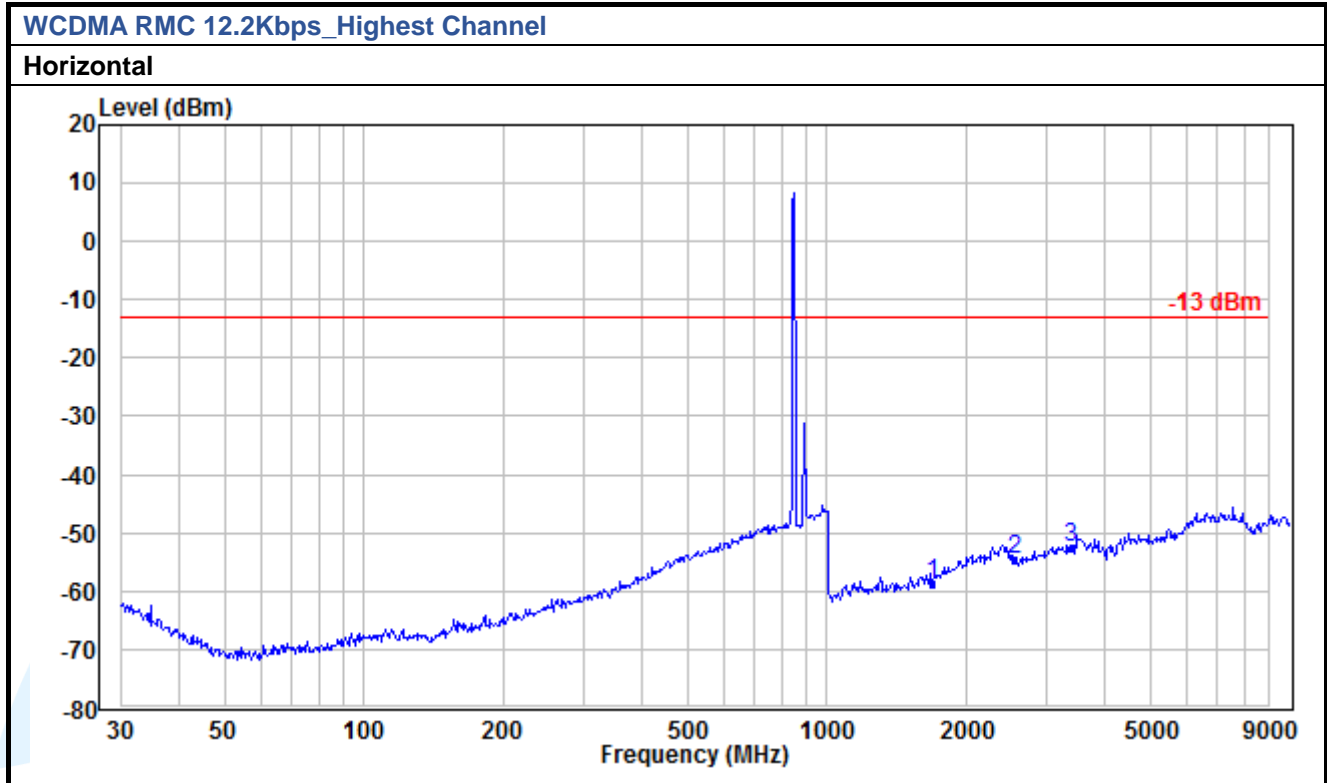
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1652.800	-61.42	3.64	-57.78	-13.00	-44.78	Peak
2	2479.200	-65.77	11.18	-54.59	-13.00	-41.59	Peak
3	3305.600	-63.67	12.84	-50.83	-13.00	-37.83	Peak



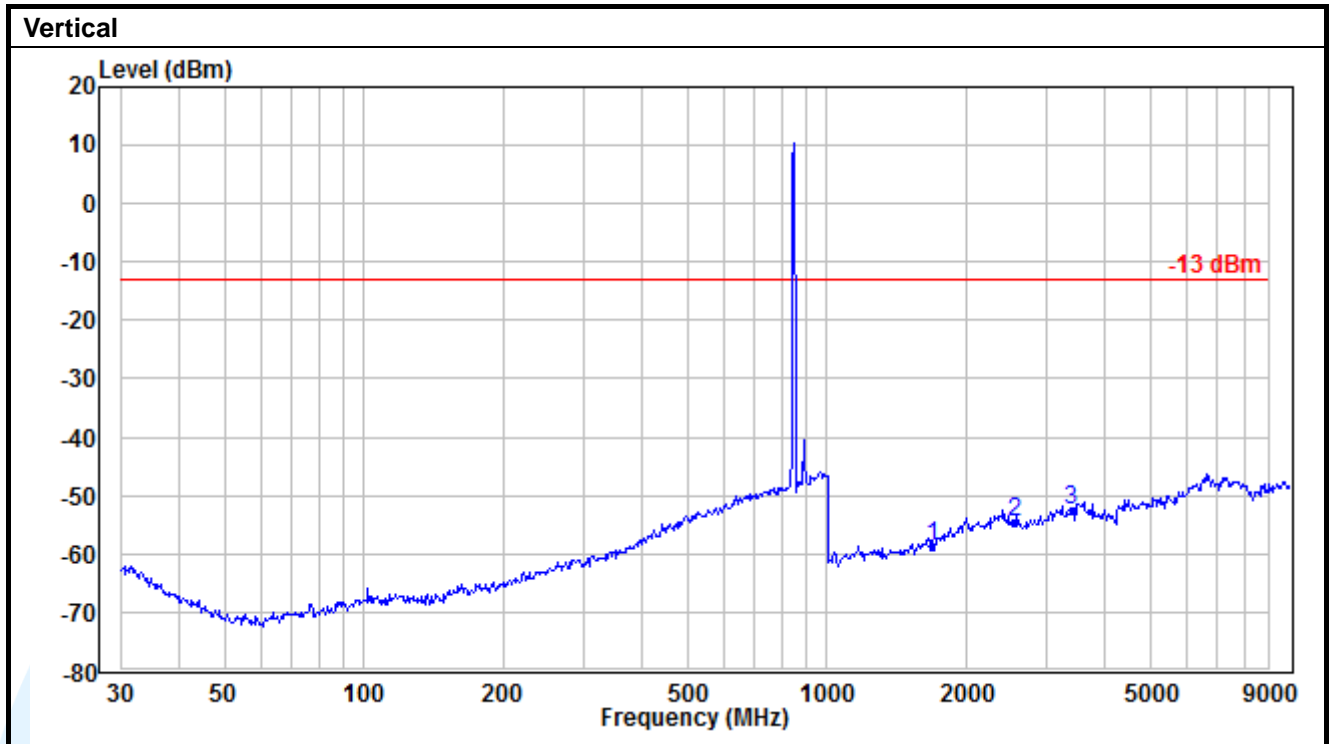
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1672.800	-61.86	3.88	-57.98	-13.00	-44.98	Peak
2	2509.200	-65.75	11.16	-54.59	-13.00	-41.59	Peak
3	3345.600	-64.86	12.97	-51.89	-13.00	-38.89	Peak



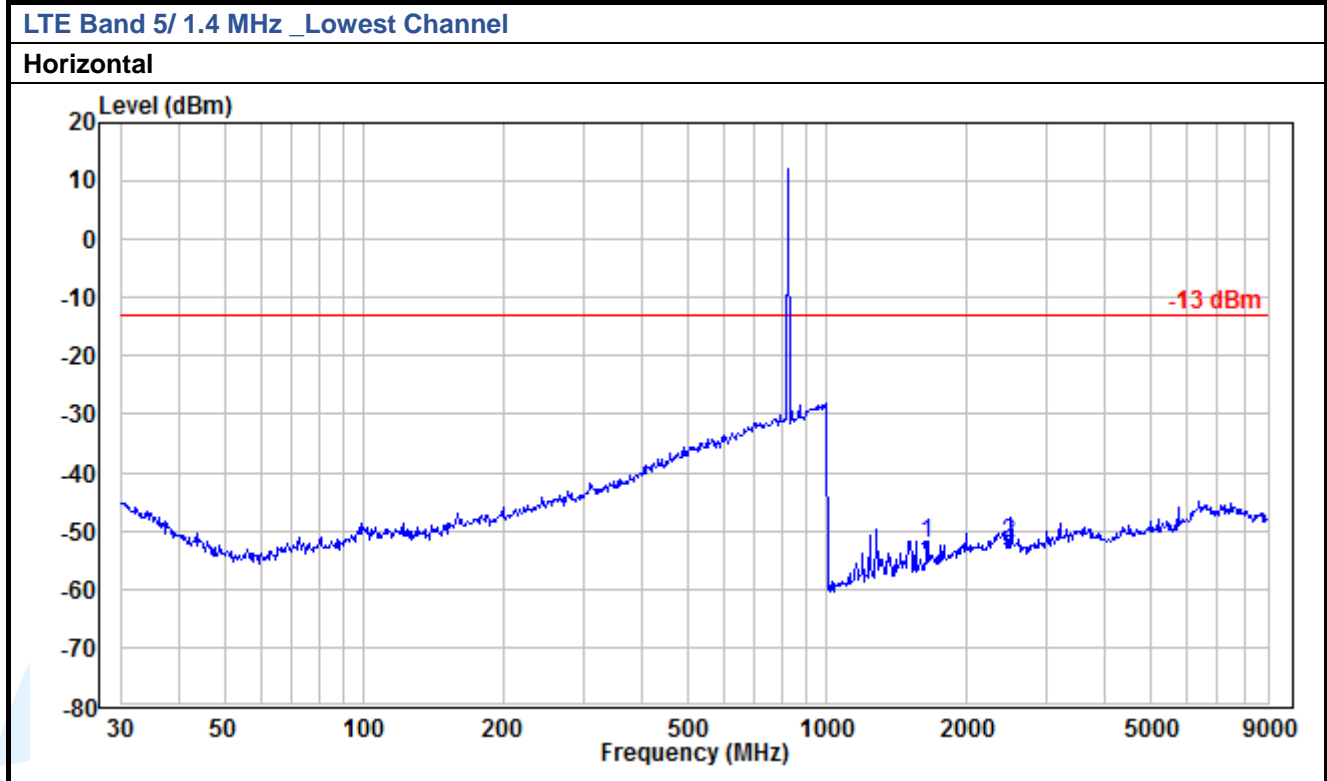
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1672.800	-61.96	3.88	-58.08	-13.00	-45.08	Peak
2	2509.200	-66.11	11.16	-54.95	-13.00	-41.95	Peak
3	3345.600	-65.48	12.97	-52.51	-13.00	-39.51	Peak



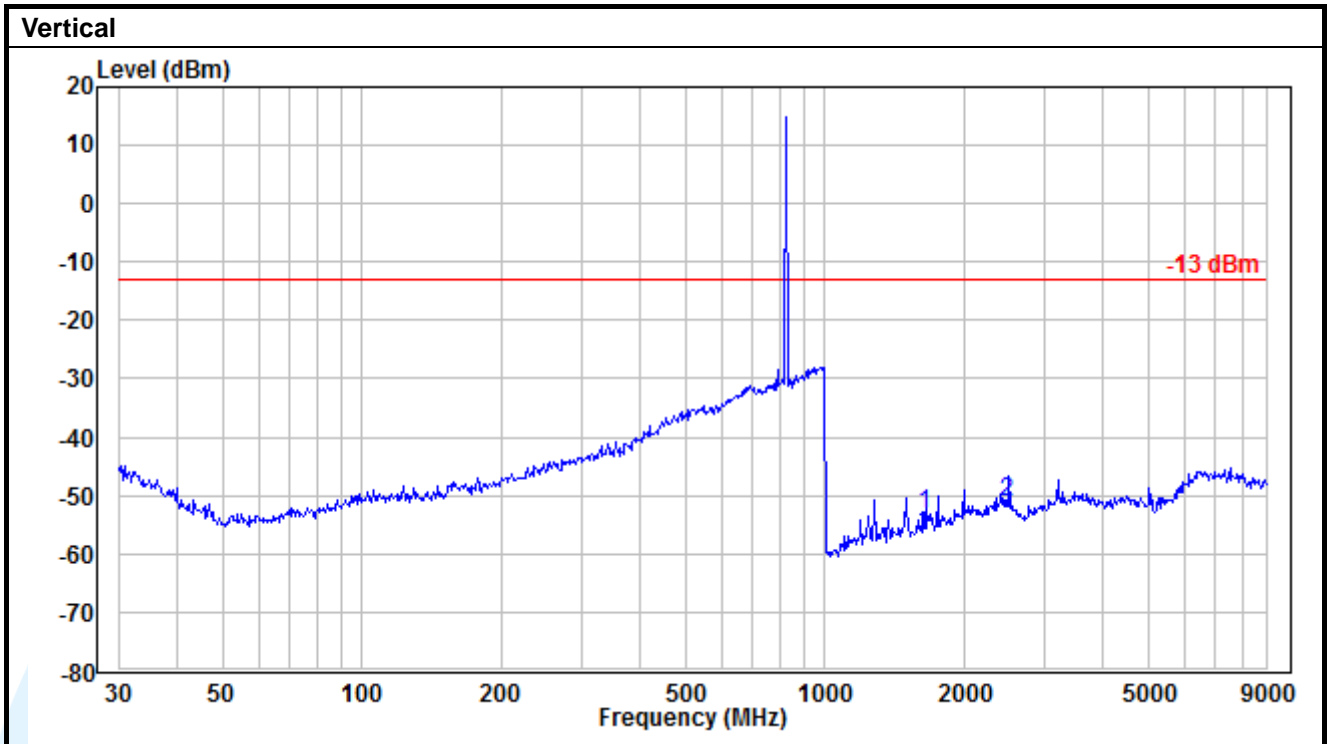
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1693.200	-62.72	4.11	-58.61	-13.00	-45.61	Peak
2	2539.800	-65.59	11.14	-54.45	-13.00	-41.45	Peak
3	3386.400	-65.71	13.08	-52.63	-13.00	-39.63	Peak



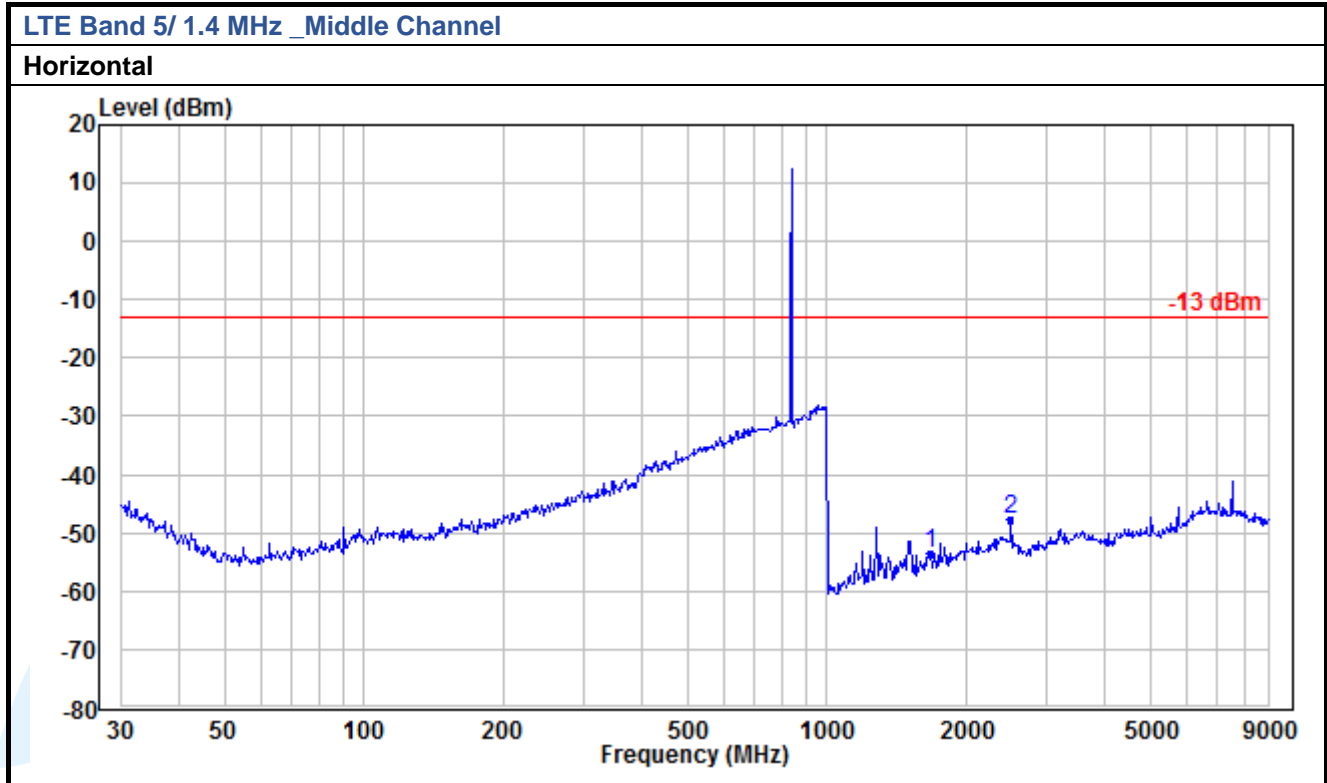
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1693.200	-62.94	4.11	-58.83	-13.00	-45.83	Peak
2	2539.800	-65.76	11.14	-54.62	-13.00	-41.62	Peak
3	3386.400	-65.42	13.08	-52.34	-13.00	-39.34	Peak



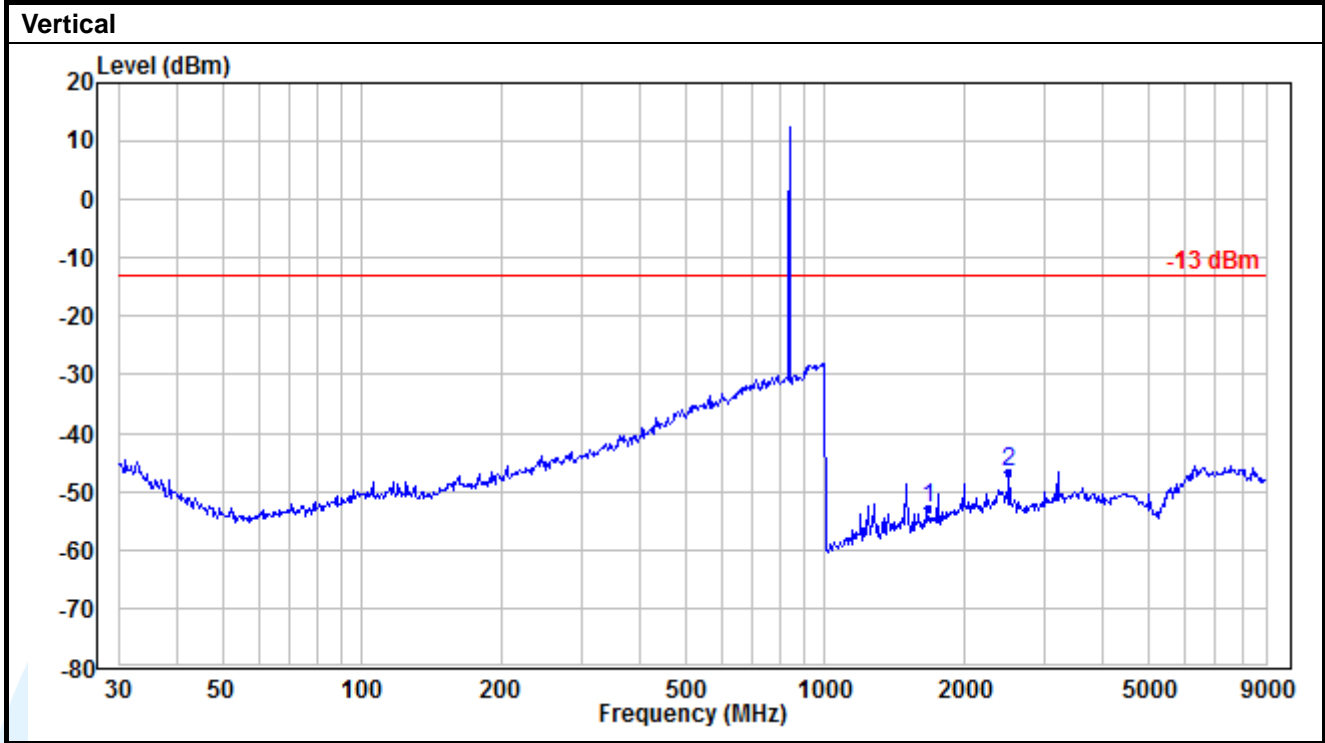
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1649.400	-55.63	3.61	-52.02	-13.00	-39.02	Peak
2	2474.100	-63.25	11.18	-52.07	-13.00	-39.07	Peak



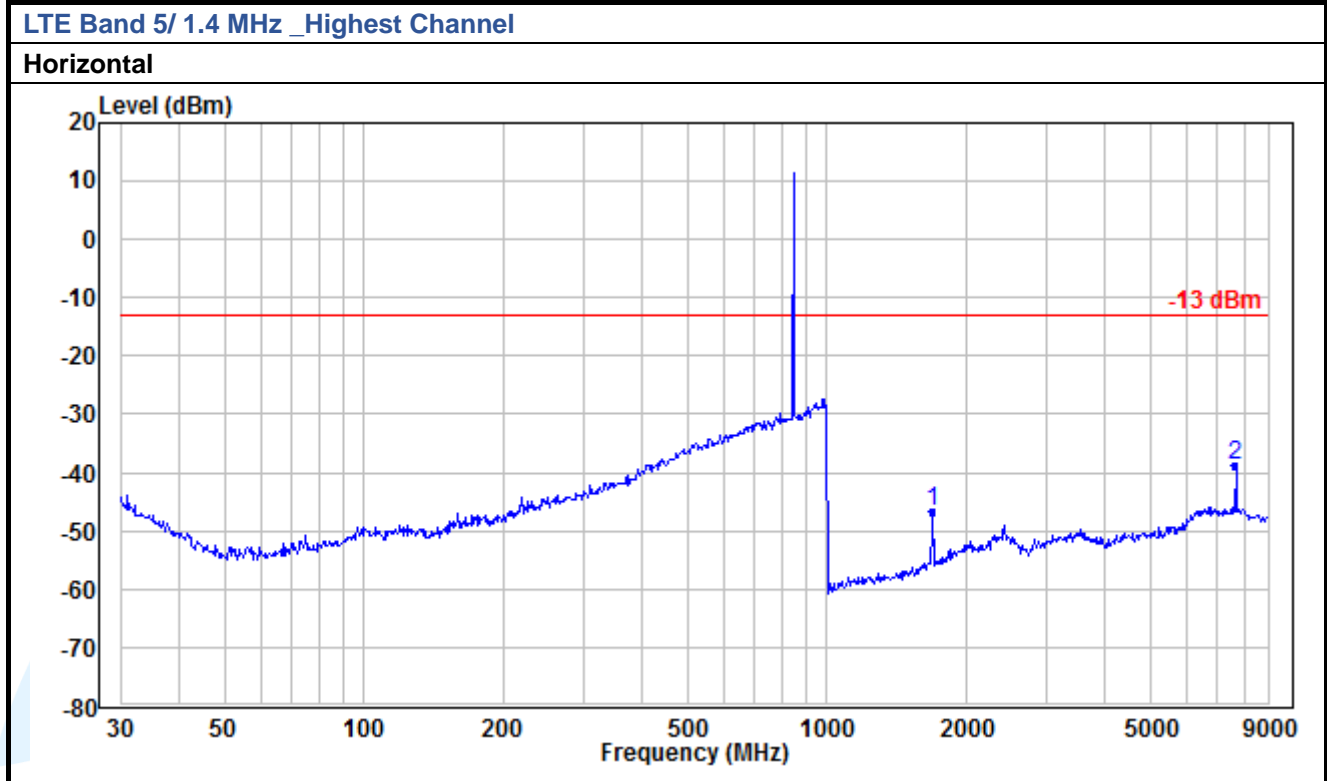
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1649.400	-56.88	3.61	-53.27	-13.00	-40.27	Peak
2	2474.100	-62.16	11.18	-50.98	-13.00	-37.98	Peak



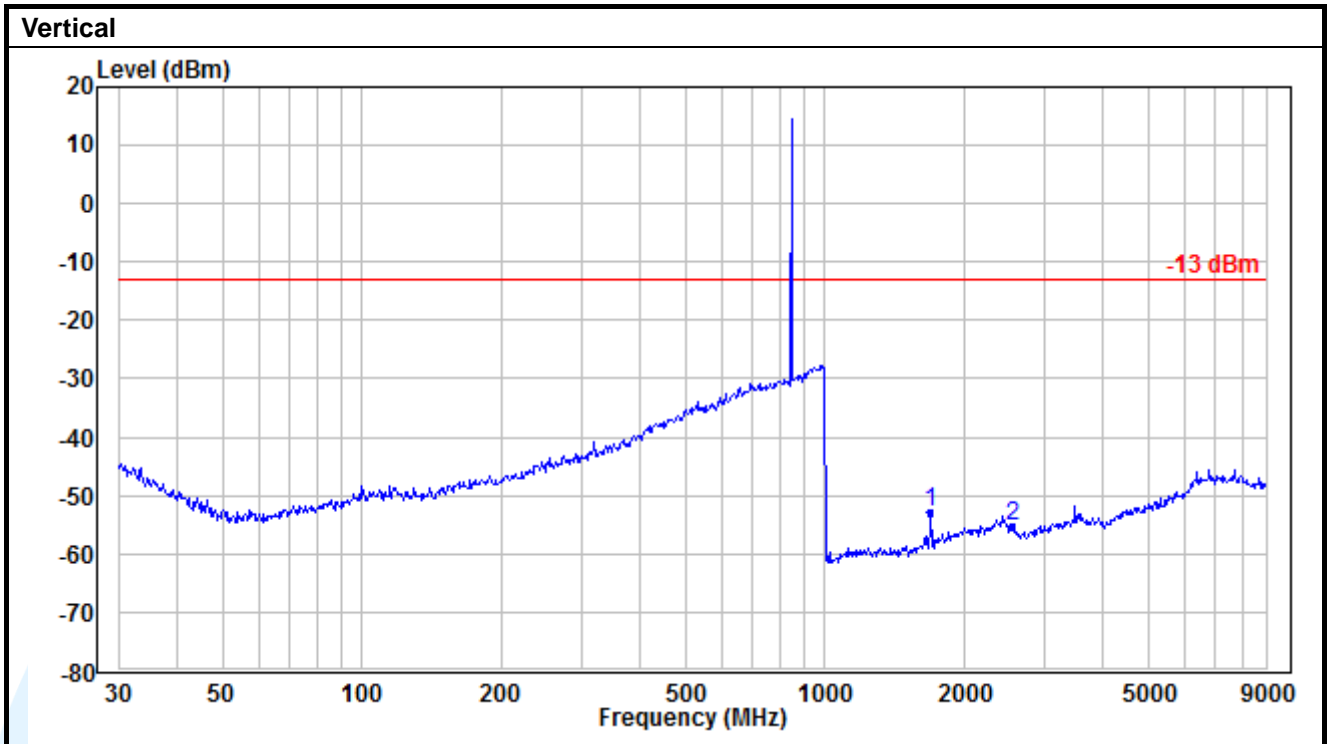
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1673.000	-57.33	3.88	-53.45	-13.00	-40.45	Peak
2	2509.500	-58.71	11.16	-47.55	-13.00	-34.55	Peak



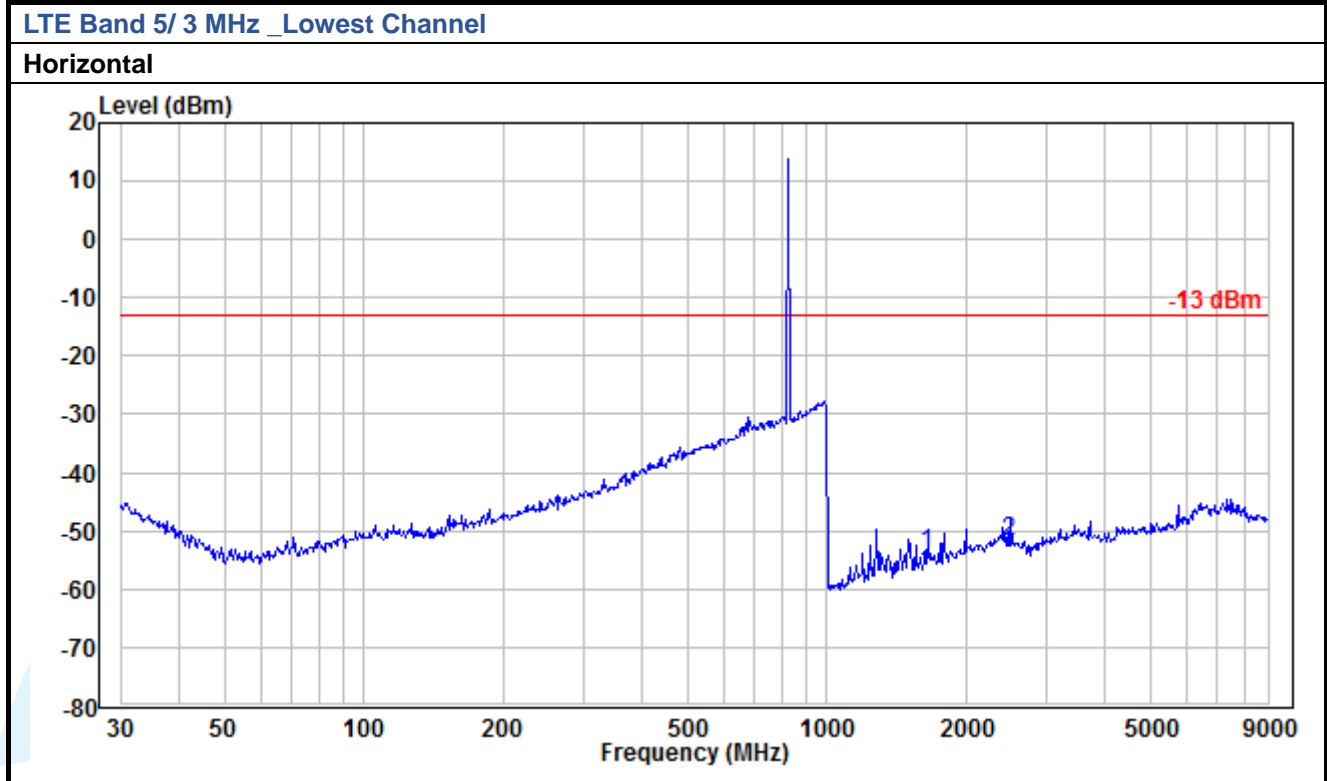
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1	1673.000	-56.67	3.88	-52.79	-13.00	-39.79	Peak
2	2509.500	-57.80	11.16	-46.64	-13.00	-33.64	Peak



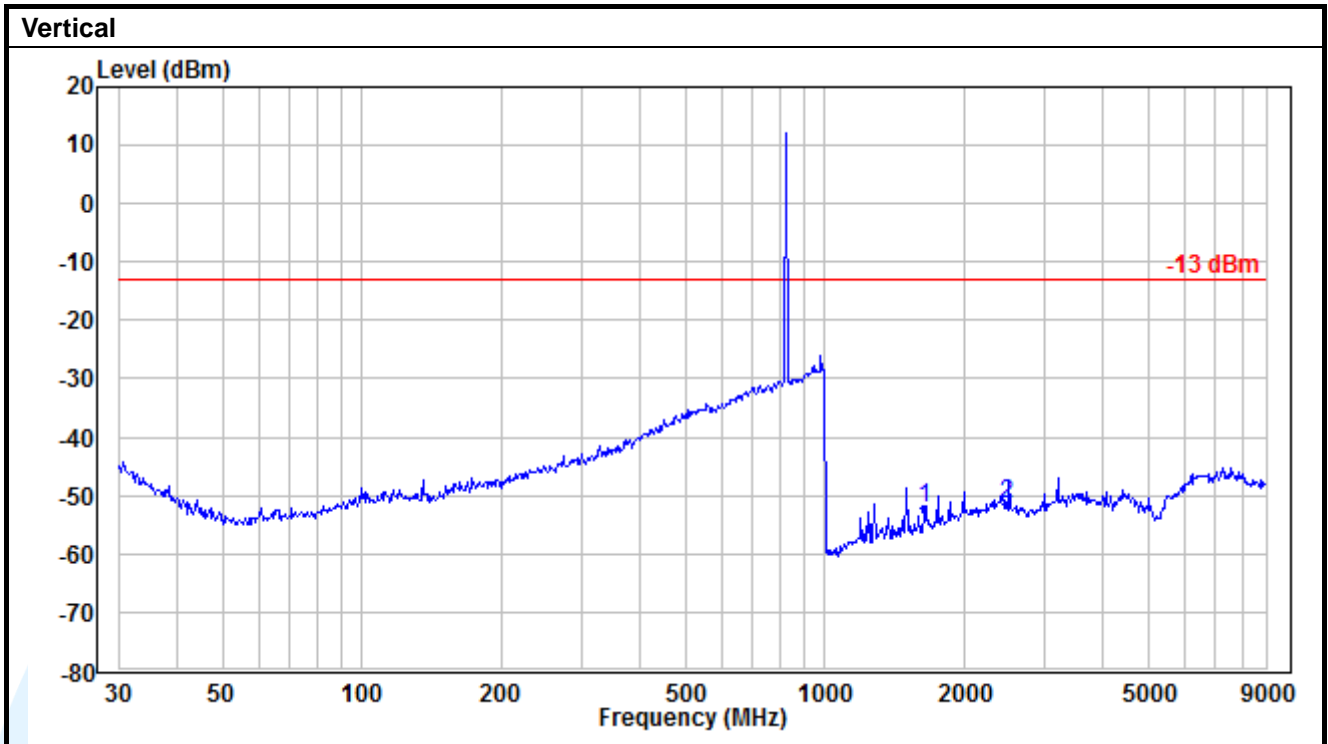
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1696.600	-51.00	4.16	-46.84	-13.00	-33.84	Peak
2	7634.700	-57.04	18.40	-38.64	-13.00	-25.64	Peak



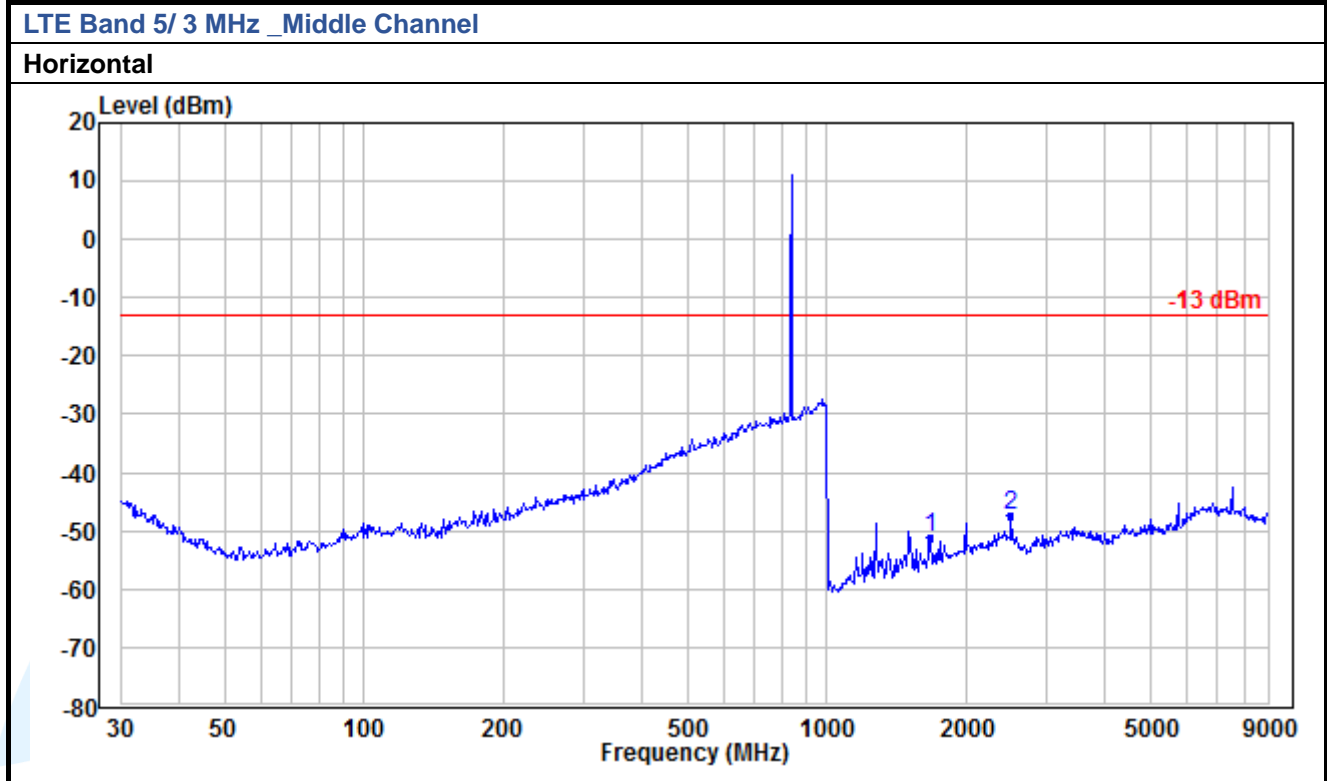
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1696.600	-56.86	4.16	-52.70	-13.00	-39.70	Peak
2	2544.900	-66.26	11.14	-55.12	-13.00	-42.12	Peak



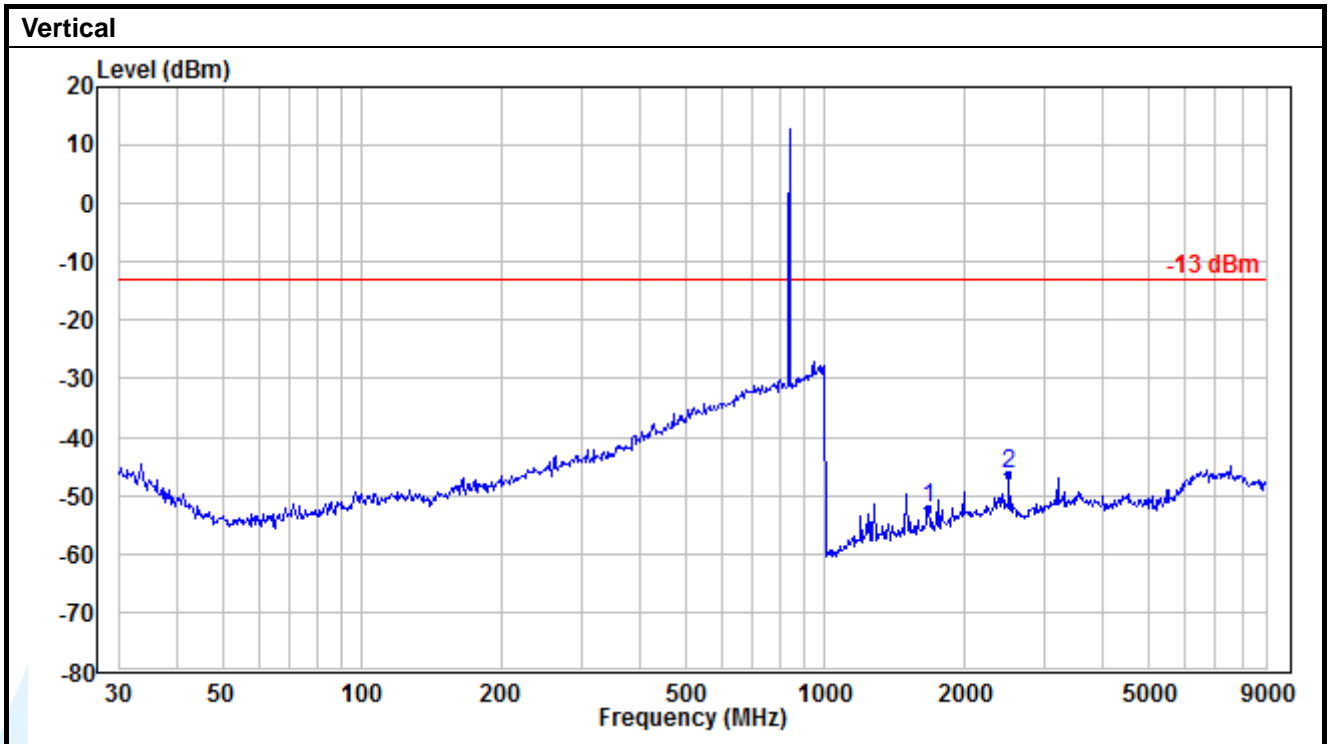
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1651.000	-57.47	3.62	-53.85	-13.00	-40.85	Peak
2	2476.500	-62.91	11.19	-51.72	-13.00	-38.72	Peak



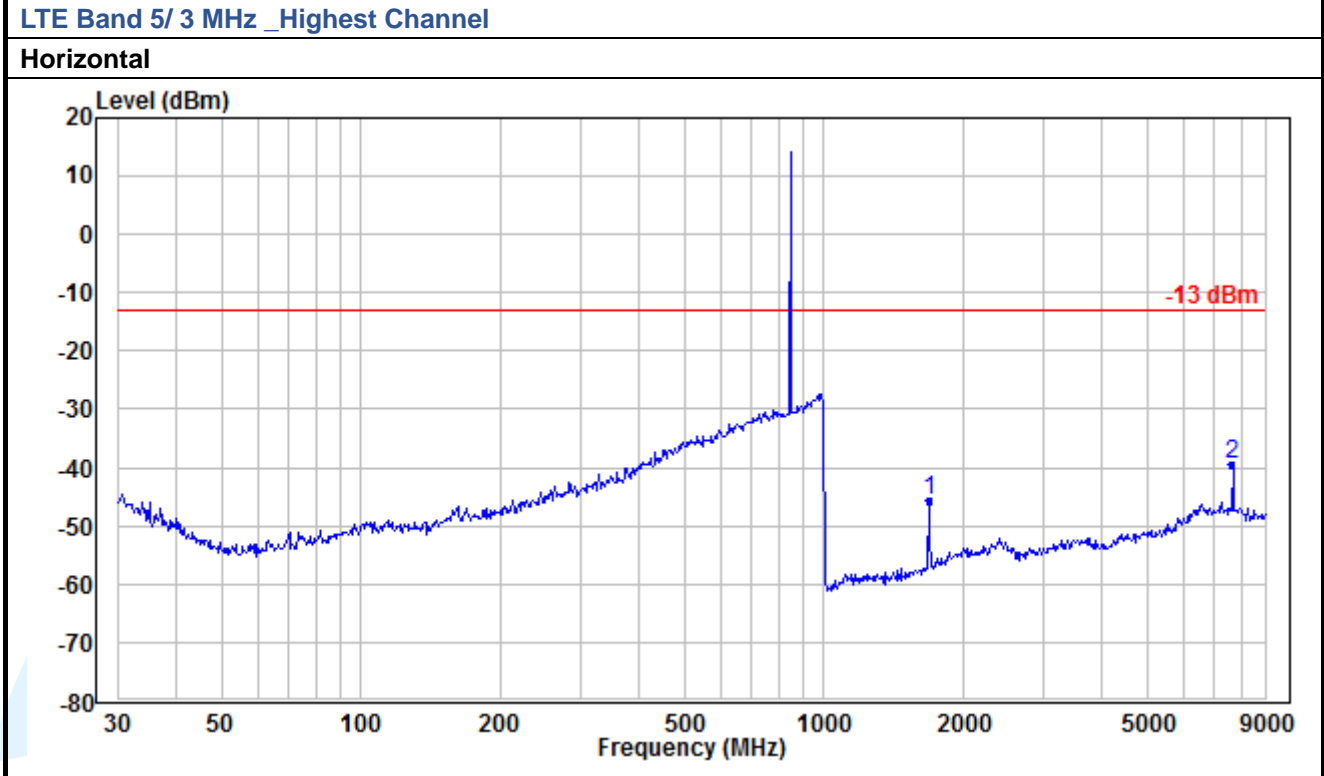
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1651.000	-55.64	3.62	-52.02	-13.00	-39.02	Peak
2	2476.500	-62.57	11.19	-51.38	-13.00	-38.38	Peak



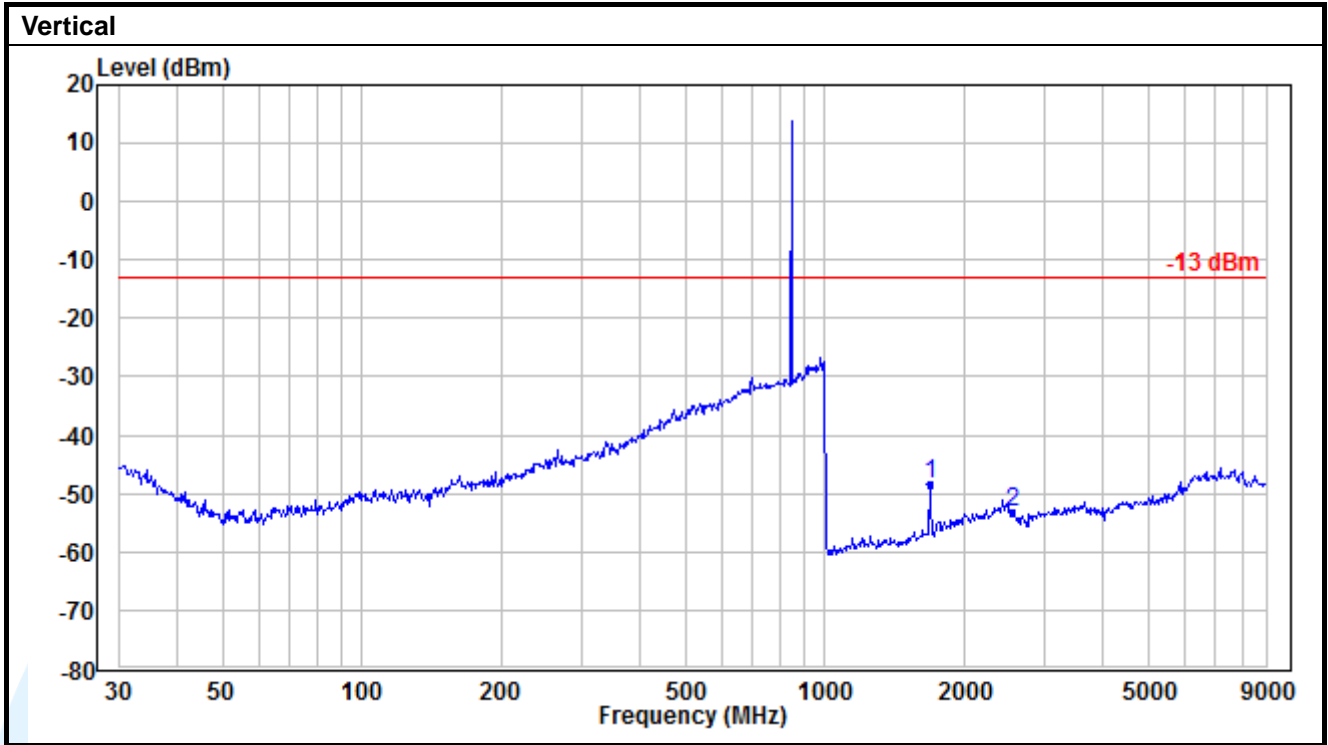
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1673.000	-55.18	3.88	-51.30	-13.00	-38.30	Peak
2	2509.500	-58.48	11.16	-47.32	-13.00	-34.32	Peak



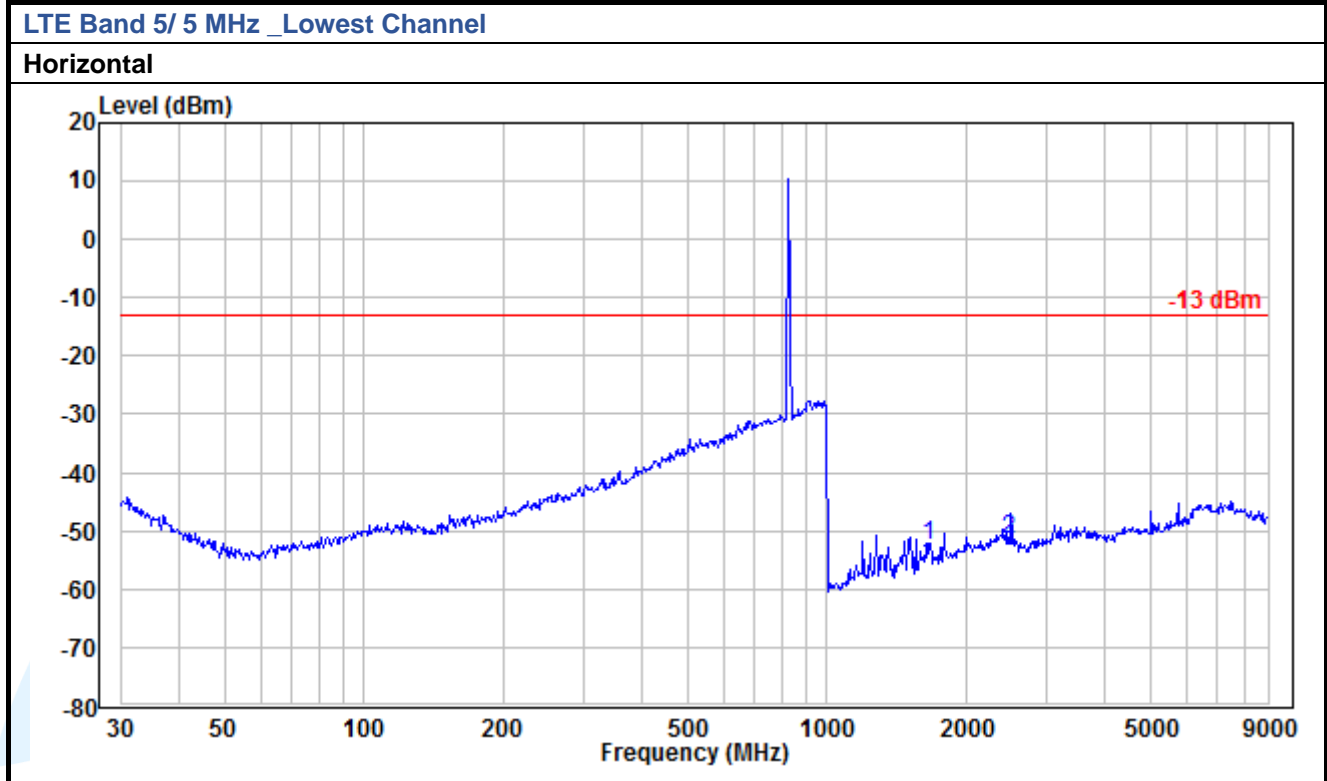
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1673.000	-55.95	3.88	-52.07	-13.00	-39.07	Peak
2	2509.500	-57.54	11.16	-46.38	-13.00	-33.38	Peak



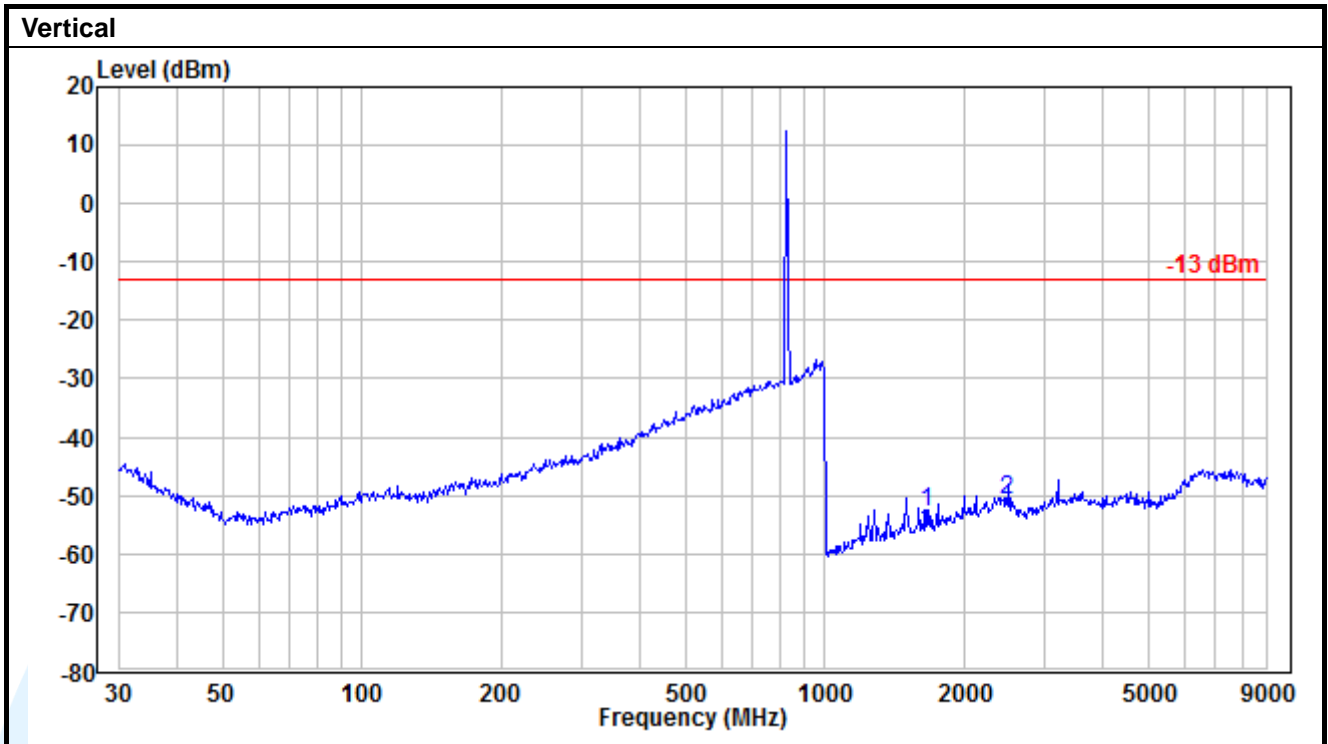
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1695.000	-49.64	4.15	-45.49	-13.00	-32.49	Peak
2	7627.500	-57.74	18.40	-39.34	-13.00	-26.34	Peak



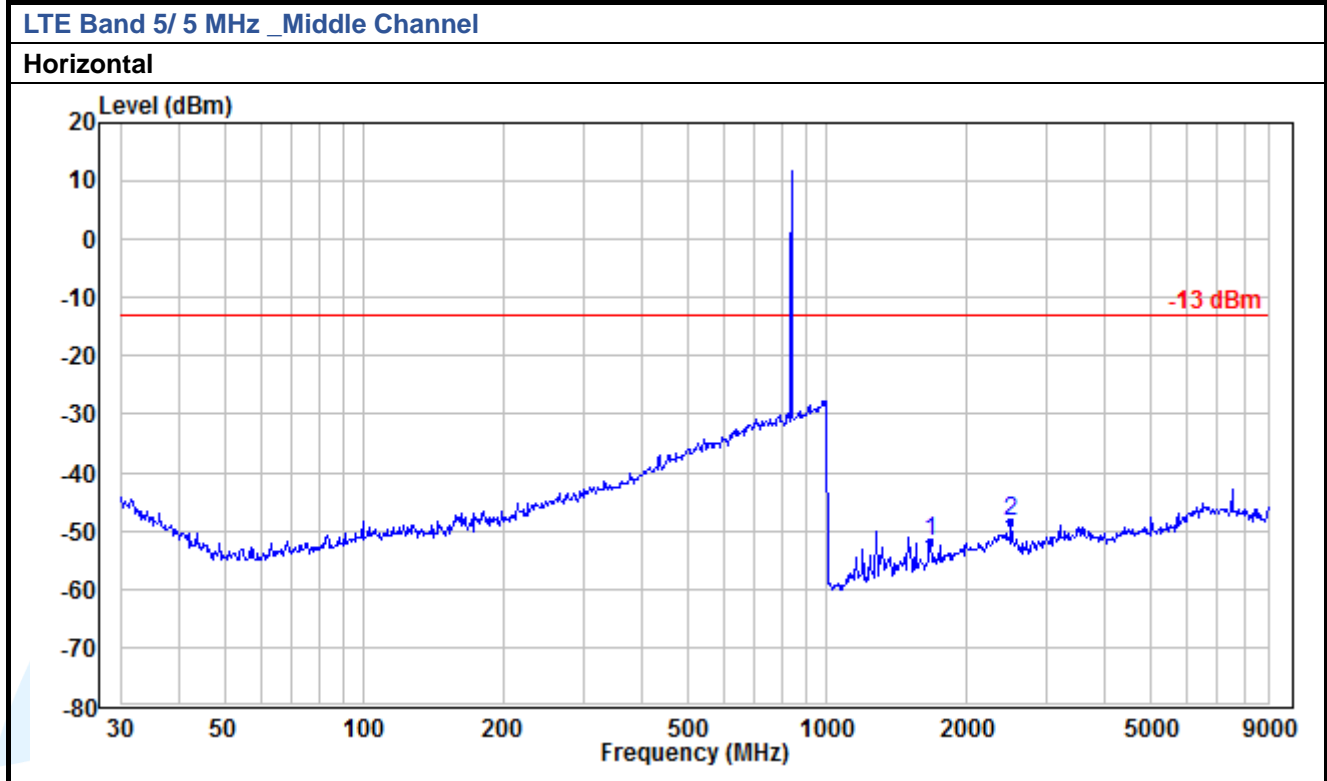
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1695.000	-52.59	4.15	-48.44	-13.00	-35.44	Peak
2	2542.500	-64.46	11.14	-53.32	-13.00	-40.32	Peak



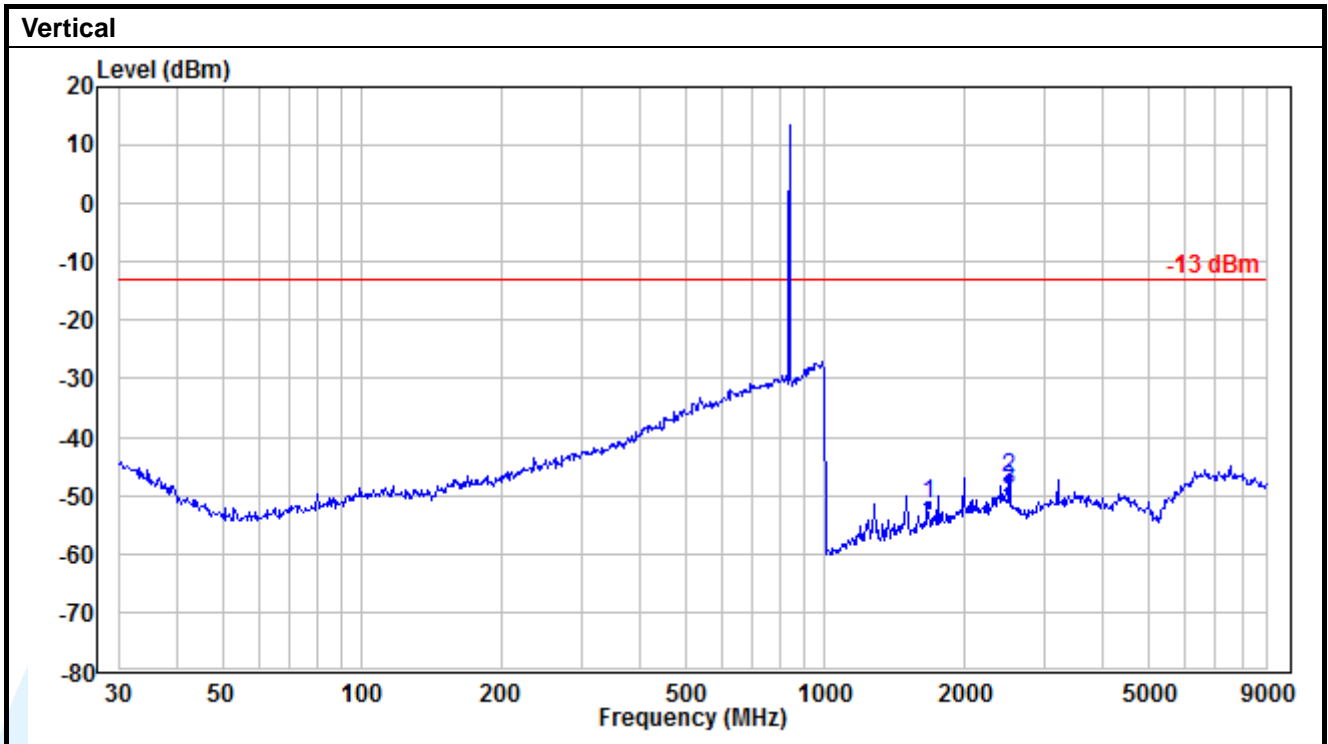
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1653.000	-56.04	3.64	-52.40	-13.00	-39.40	Peak
2	2479.500	-62.78	11.18	-51.60	-13.00	-38.60	Peak



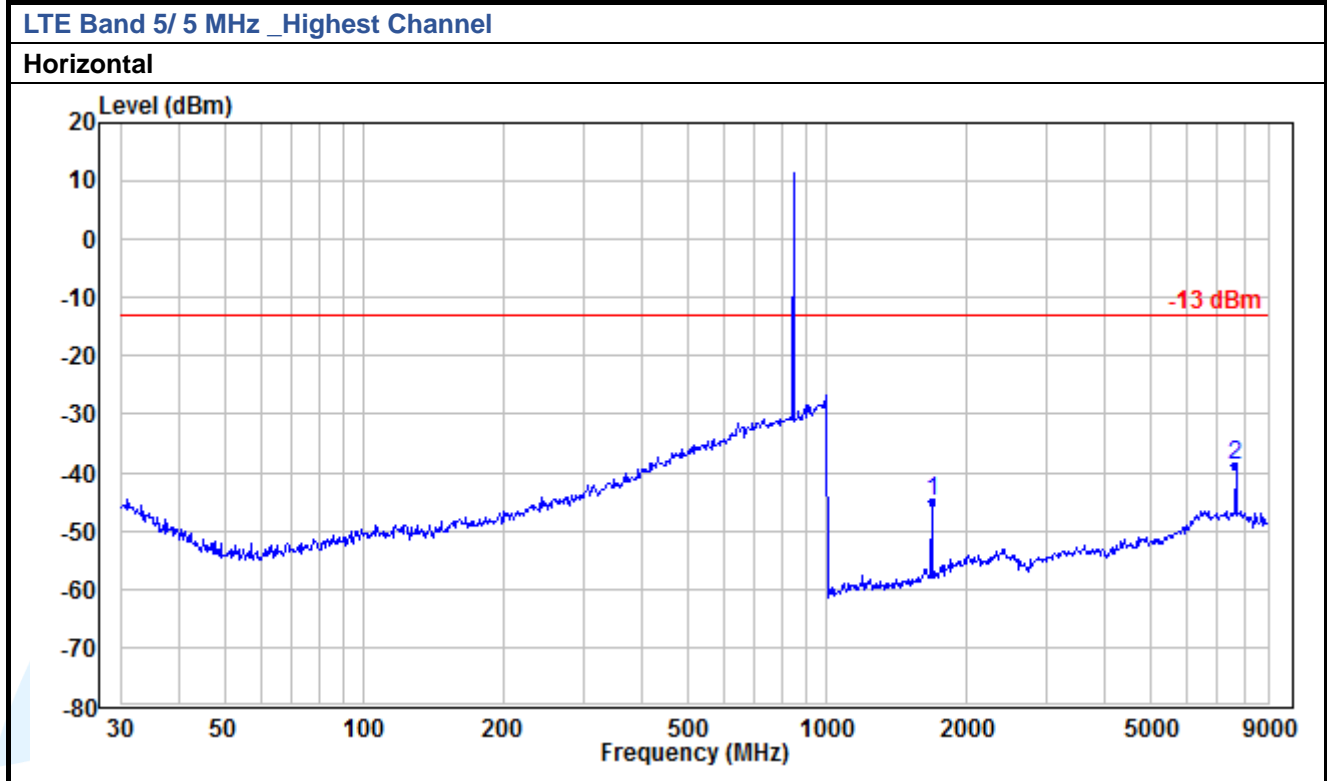
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1653.000	-56.39	3.64	-52.75	-13.00	-39.75	Peak
2	2479.500	-61.94	11.18	-50.76	-13.00	-37.76	Peak



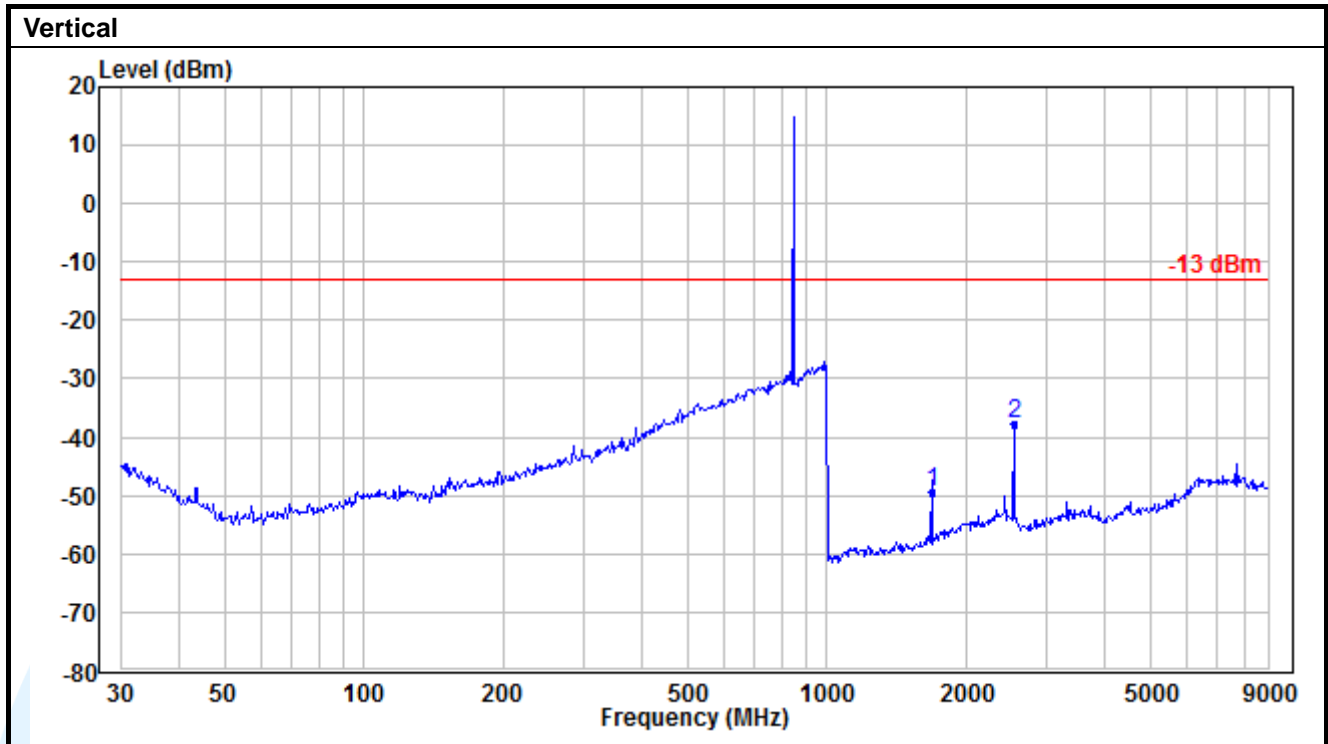
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1673.000	-55.68	3.88	-51.80	-13.00	-38.80	Peak
2	2509.500	-59.50	11.16	-48.34	-13.00	-35.34	Peak



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1673.000	-55.46	3.88	-51.58	-13.00	-38.58	Peak
2	2509.500	-58.28	11.16	-47.12	-13.00	-34.12	Peak
3	2509.500	-60.28	11.16	-49.12	-13.00	-36.12	Peak



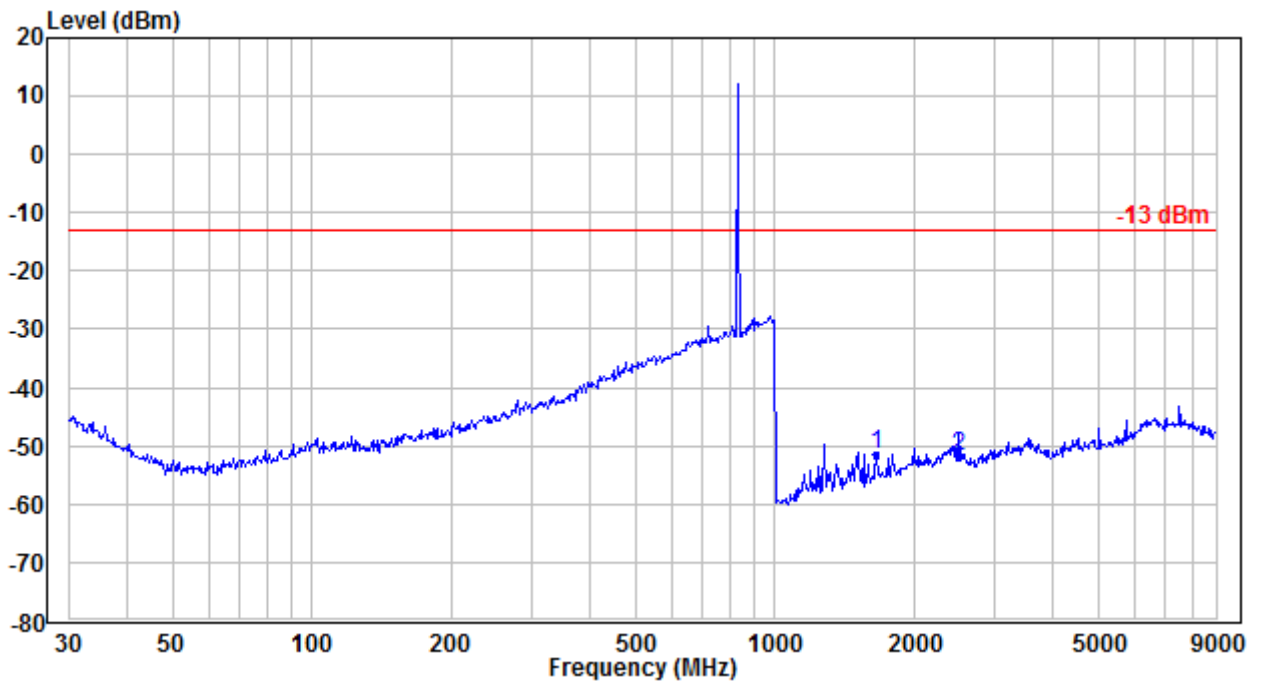
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1693.000	-49.00	4.11	-44.89	-13.00	-31.89	Peak
2	7618.500	-57.26	18.39	-38.87	-13.00	-25.87	Peak



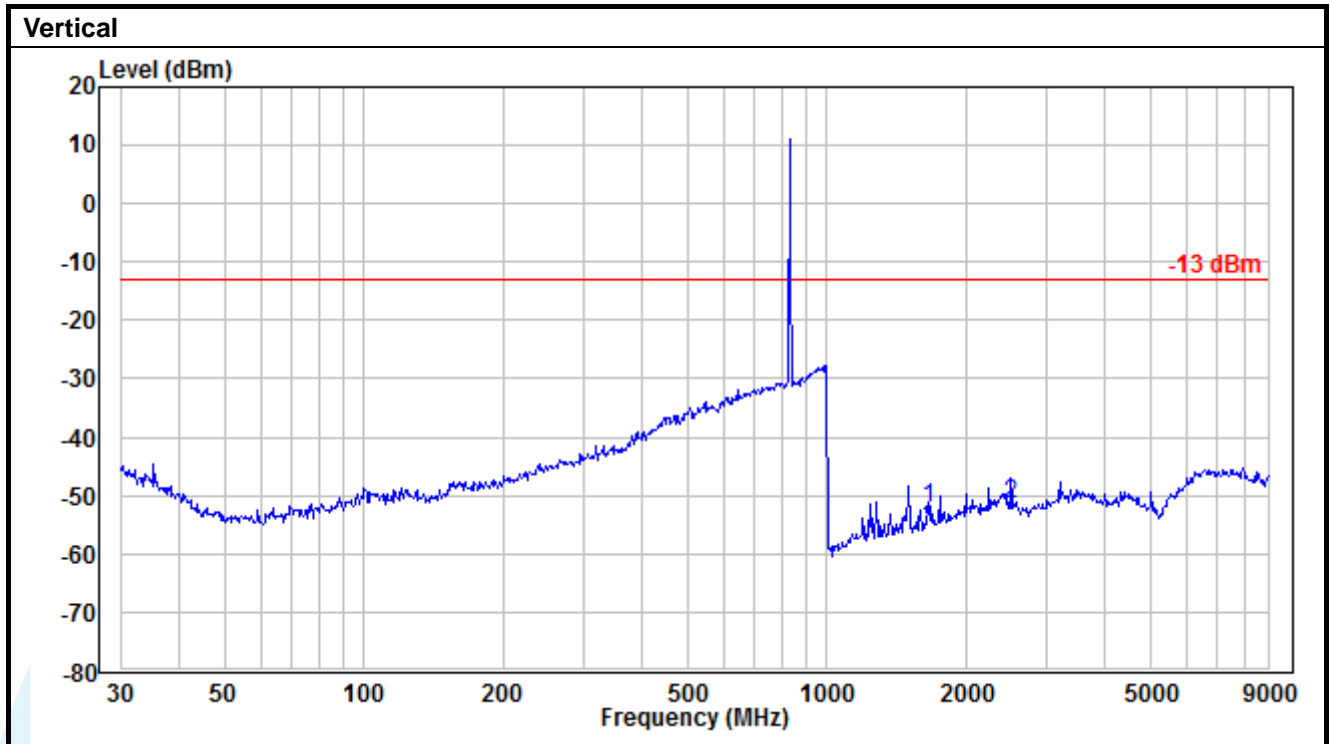
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1693.000	-53.50	4.11	-49.39	-13.00	-36.39	Peak
2	2539.500	-48.90	11.14	-37.76	-13.00	-24.76	Peak

LTE Band 5/ 10 MHz _Lowest Channel

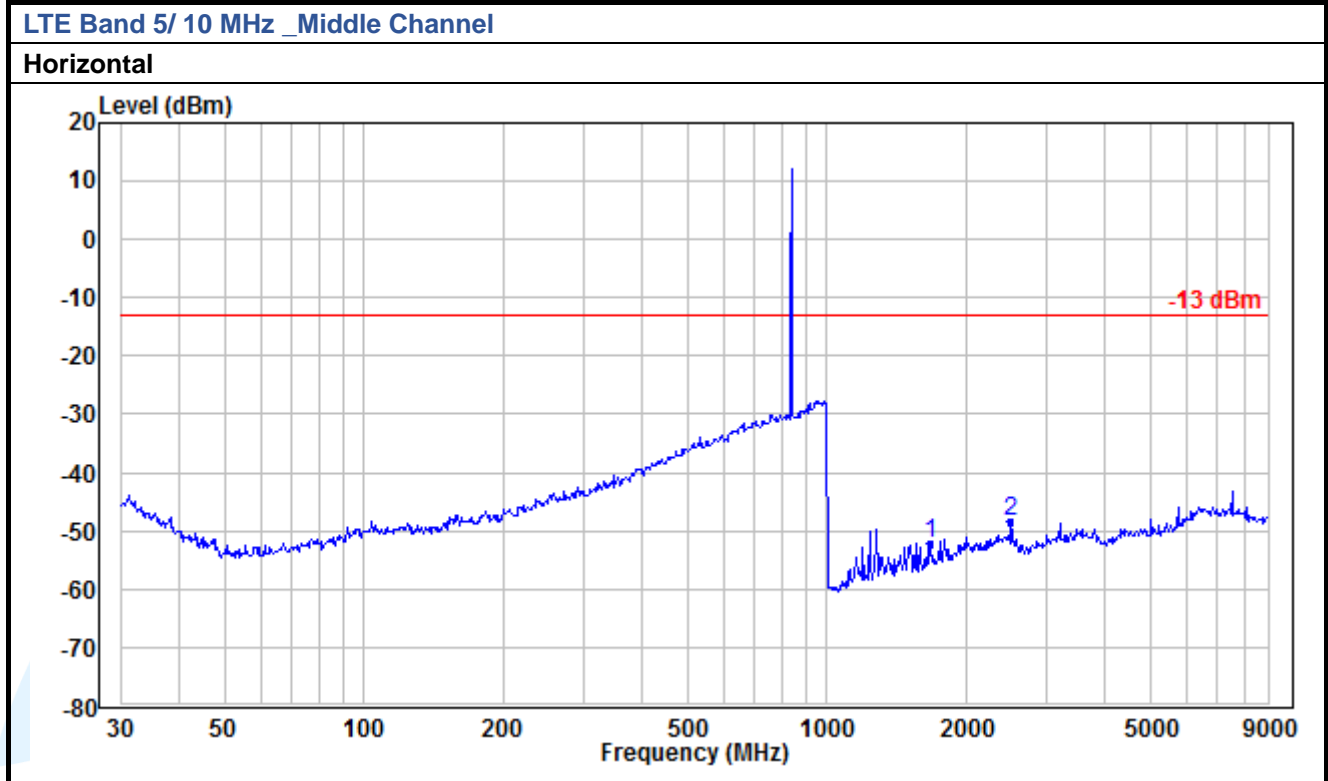
Horizontal



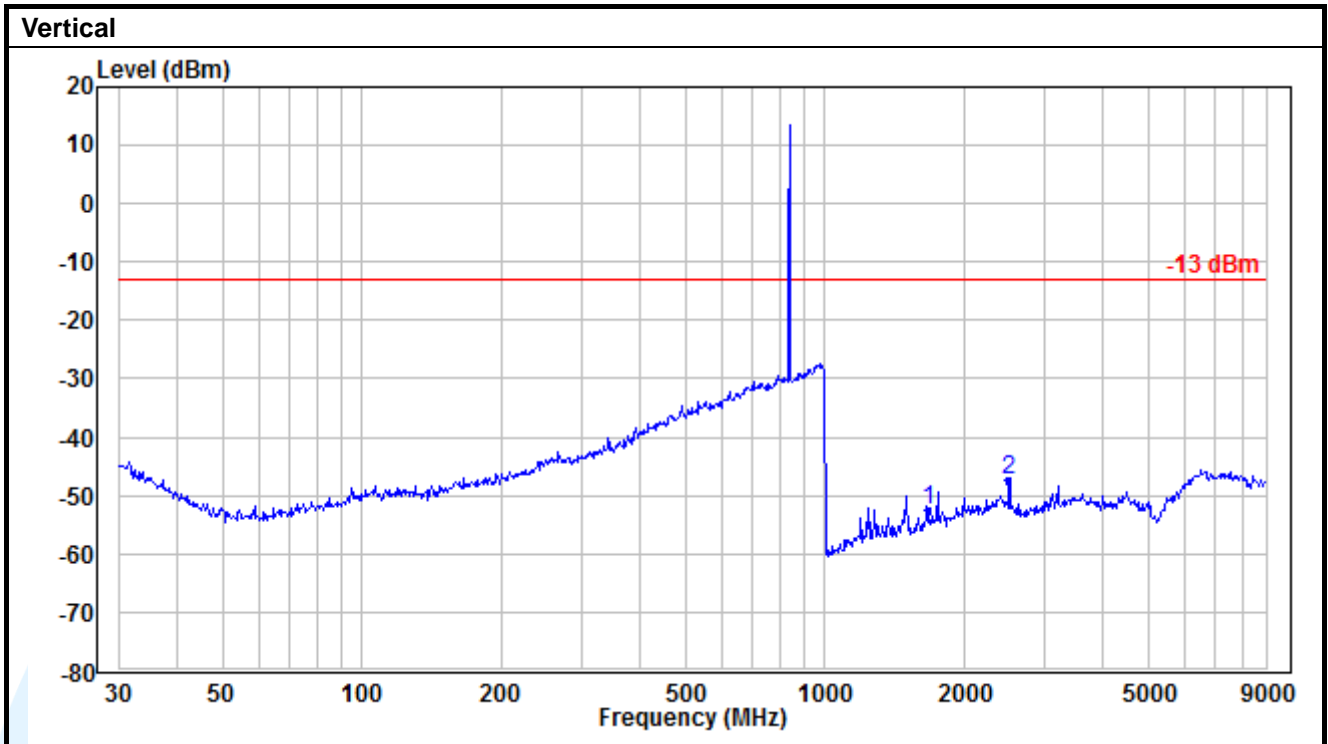
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1658.000	-55.21	3.71	-51.50	-13.00	-38.50	Peak
2	2487.000	-63.10	11.18	-51.92	-13.00	-38.92	Peak



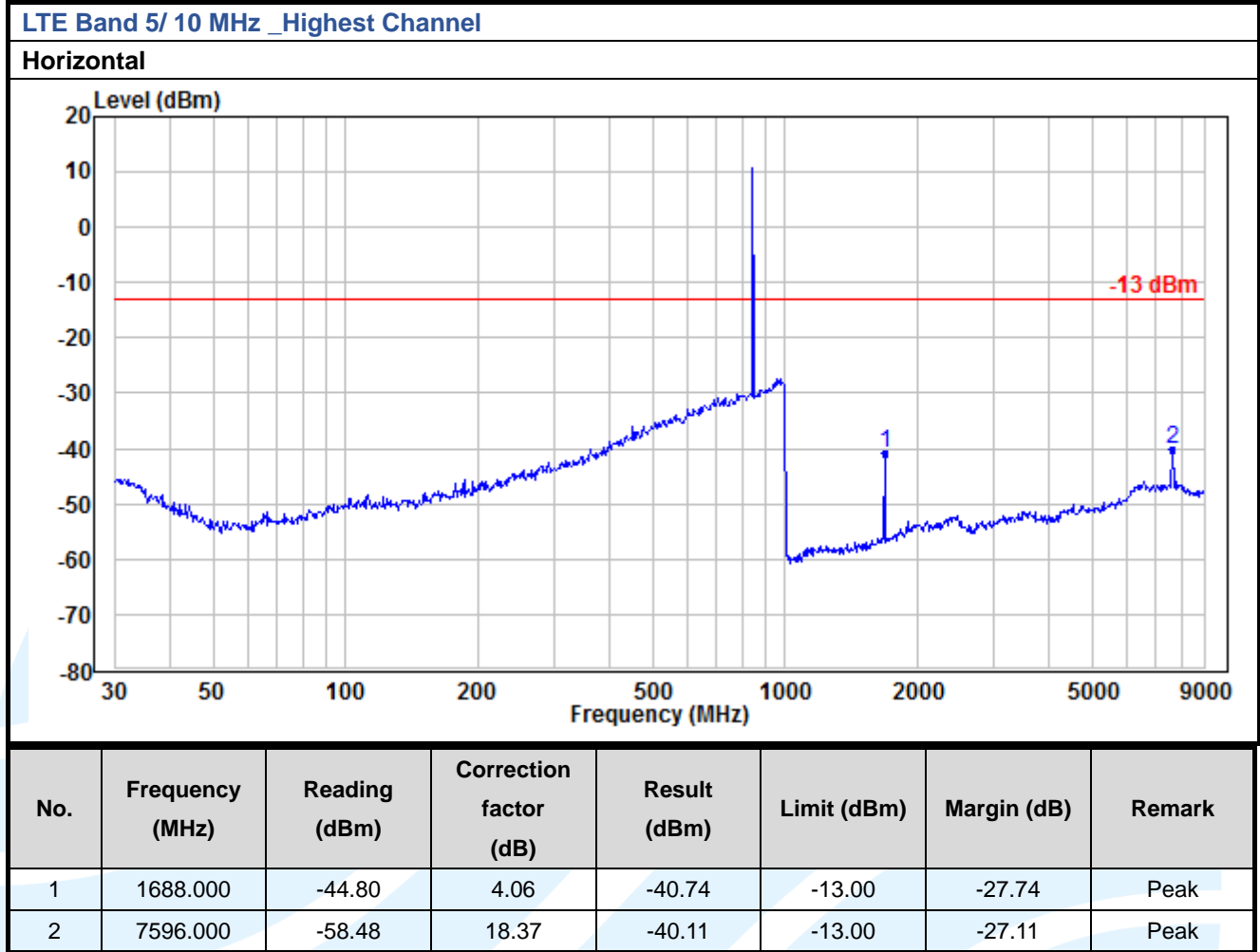
No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1658.000	-55.77	3.71	-52.06	-13.00	-39.06	Peak
2	2487.000	-62.50	11.18	-51.32	-13.00	-38.32	Peak

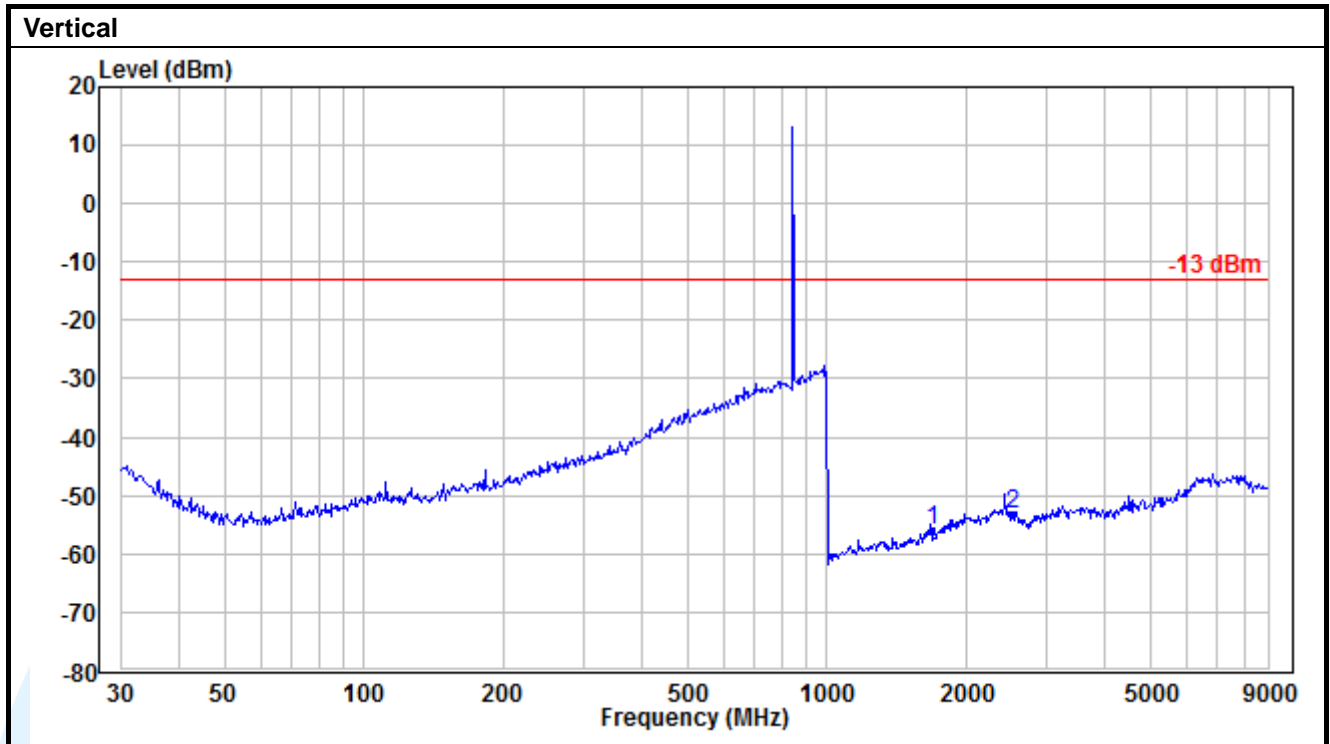


No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1673.000	-56.09	3.88	-52.21	-13.00	-39.21	Peak
2	2509.500	-59.62	11.16	-48.46	-13.00	-35.46	Peak



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1673.000	-56.40	3.88	-52.52	-13.00	-39.52	Peak
2	2509.500	-58.65	11.16	-47.49	-13.00	-34.49	Peak





No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1688.000	-59.95	4.06	-55.89	-13.00	-42.89	Peak
2	2532.000	-64.31	11.15	-53.16	-13.00	-40.16	Peak

Remark:

1) All the above radiation data, the fundamental frequency is not marked, it may exceed the limit, please ignore it.

5.9 FREQUENCY STABILITY

Test Requirement: FCC 47 CFR Part 2.1055 & FCC 47 CFR Part 22.355

Test Method: ANSI/TIA-603-E-2016 & KDB 971168 D01v03r01

Limits: The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

Test Setup: Refer to section 4.2.2 for details.

Test Procedures:

- 1) Use CMW 500 or CMU 200 with Frequency Error measurement capability.
 - a) Temp. = -30° to $+50^{\circ}$ C
 - b) Voltage = low voltage, 3.5 Vdc, Normal, 3.8 Vdc and High voltage, 4.35 Vdc.
- 2) Frequency Stability vs Temperature:

The EUT is placed inside a temperature chamber. The temperature is set to 20° C and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured. The temperature is increased by 10 degrees, allowed to stabilize and soak, and then the measurement is repeated. This is repeated until $+50^{\circ}$ C is reached.

- 3) Frequency Stability vs Voltage:

The peak frequency error is recorded (worst-case).

Equipment Used: Refer to section 3 for details.

Test Result: Pass

Modulation	Channel/ Frequency (MHz)	Voltage	Temperature	Deviation	Deviation	Limit	Pass/ Fail		
		(Vdc)	($^{\circ}$ C)	(Hz)	(ppm)	(ppm)			
GSM 1Tx-slot									
GMSK	190 / 836.6	VL	TN	42	0.0502	± 2.5	Pass		
		VN		42	0.0502	± 2.5	Pass		
		VH		40	0.0478	± 2.5	Pass		
				VN	50	40	0.0478	± 2.5	Pass
					40	44	0.0526	± 2.5	Pass
					30	43	0.0514	± 2.5	Pass
					20	41	0.0490	± 2.5	Pass
					10	44	0.0526	± 2.5	Pass
					0	43	0.0514	± 2.5	Pass
					-10	40	0.0478	± 2.5	Pass
					-20	39	0.0466	± 2.5	Pass
					-30	40	0.0478	± 2.5	Pass

Modulation	Channel/ Frequency (MHz)	Voltage	Temperature	Deviation	Deviation	Limit	Pass/ Fail
		(Vdc)	(°C)	(Hz)	(ppm)	(ppm)	
EDGE 1Tx-slot							
8PSK	190 / 836.6	VL	TN	38	0.0454	± 2.5	Pass
		VN		41	0.0490	± 2.5	Pass
		VH		38	0.0454	± 2.5	Pass
		VN	50	40	0.0478	± 2.5	Pass
			40	38	0.0454	± 2.5	Pass
			30	33	0.0394	± 2.5	Pass
			20	33	0.0394	± 2.5	Pass
			10	39	0.0466	± 2.5	Pass
			0	33	0.0394	± 2.5	Pass
			-10	38	0.0454	± 2.5	Pass
			-20	36	0.0430	± 2.5	Pass
			-30	33	0.0394	± 2.5	Pass

Modulation	Channel/ Frequency (MHz)	Voltage	Temperature	Deviation	Deviation	Limit	Pass/ Fail
		(Vdc)	(°C)	(Hz)	(ppm)	(ppm)	
WCDMA RMC 12.2Kbps							
BPSK	4182 / 836.4	VL	TN	34	0.0407	± 2.5	Pass
		VN		33	0.0395	± 2.5	Pass
		VH		30	0.0359	± 2.5	Pass
		VN	50	31	0.0371	± 2.5	Pass
			40	33	0.0395	± 2.5	Pass
			30	29	0.0347	± 2.5	Pass
			20	33	0.0395	± 2.5	Pass
			10	31	0.0371	± 2.5	Pass
			0	31	0.0371	± 2.5	Pass
			-10	31	0.0371	± 2.5	Pass
			-20	30	0.0359	± 2.5	Pass
			-30	30	0.0359	± 2.5	Pass

Modulation	Channel/ Frequency (MHz)	Voltage	Temperature	Deviation	Deviation	Limit	Pass/ Fail
		(Vdc)	(°C)	(Hz)	(ppm)	(ppm)	
LTE Band 5 / 10MHz / Full RB							
QPSK	20525 / 836.5	VL	TN	26	0.0311	± 2.5	Pass
		VN		23	0.0275	± 2.5	Pass
		VH		23	0.0275	± 2.5	Pass
		VN	50	22	0.0263	± 2.5	Pass
			40	23	0.0275	± 2.5	Pass
			30	28	0.0335	± 2.5	Pass
			20	22	0.0263	± 2.5	Pass
			10	24	0.0287	± 2.5	Pass
			0	21	0.0251	± 2.5	Pass
			-10	25	0.0299	± 2.5	Pass
			-20	22	0.0263	± 2.5	Pass
			-30	20	0.0239	± 2.5	Pass

APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.
