5.6 BAND EDGE AT ANTENNA TERMINALS

Test Requirement: FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 24.238(a)

Test Method: ANSI/TIA-603-E-2016 & KDB 971168 D01v03

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 transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer.

For each band edge measurement:

1) Set the spectrum analyzer span to include the block edge frequency.
2) Set a marker to point the corresponding band edge frequency in each test case.
3) Set display line at -13 dBm
4) Set resolution bandwidth to at least 1% of emission bandwidth.
5) Set spectrum analyzer with RMS detector.
6) Record the max trace plot into the test report

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:

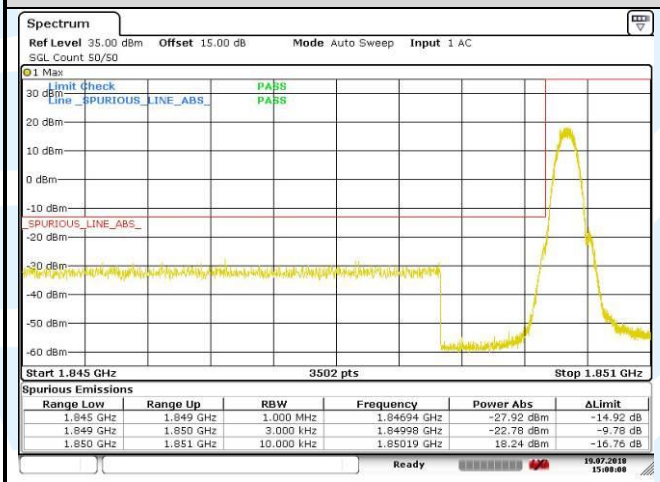
GSM 1Tx-slot

Lowest Channel

Highest Channel

GPRS 1Tx-slot

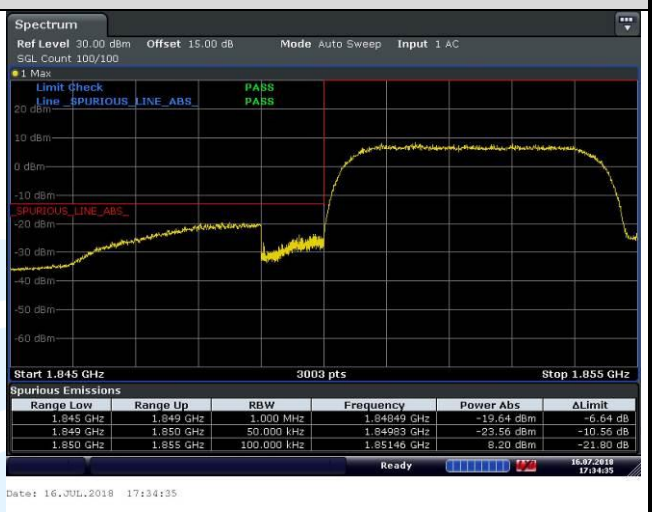
Lowest Channel



Highest Channel

WCDMA RMC 12.2Kbps	HSDPA

Lowest Channel



Highest Channel

HSUPA

Lowest Channel	Highest Channel

5.7 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Requirement: FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 24.238(a)(b)

Test Method: ANSI/TIA-603-E-2016 & KDB 971168 D01v03

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.

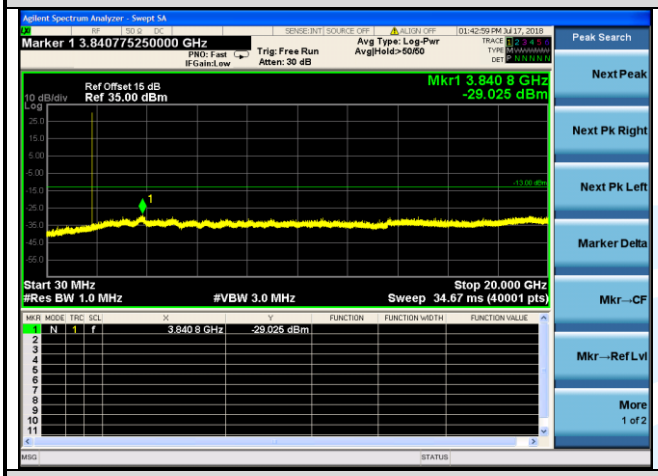
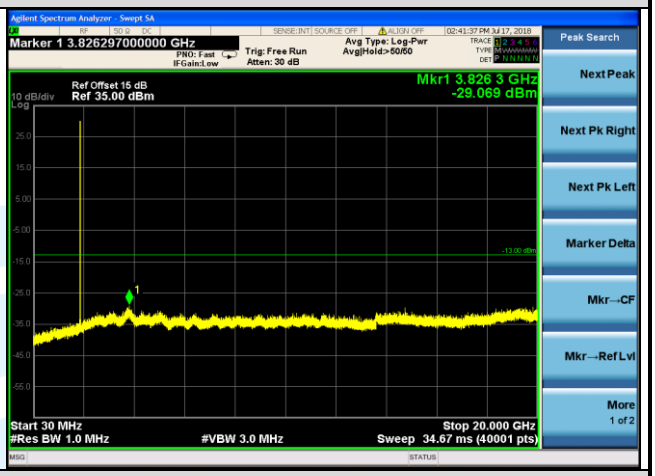
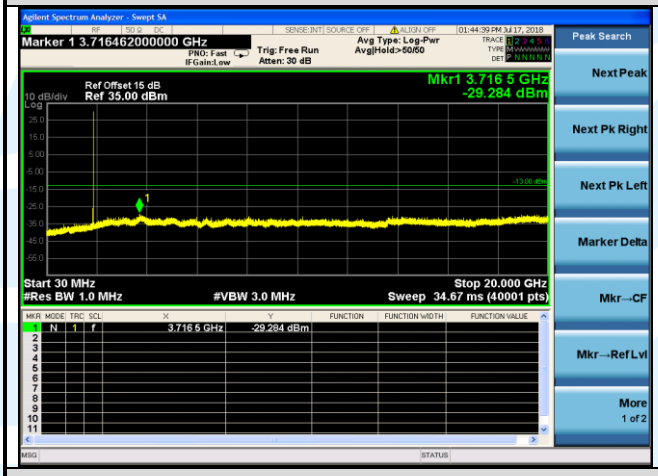
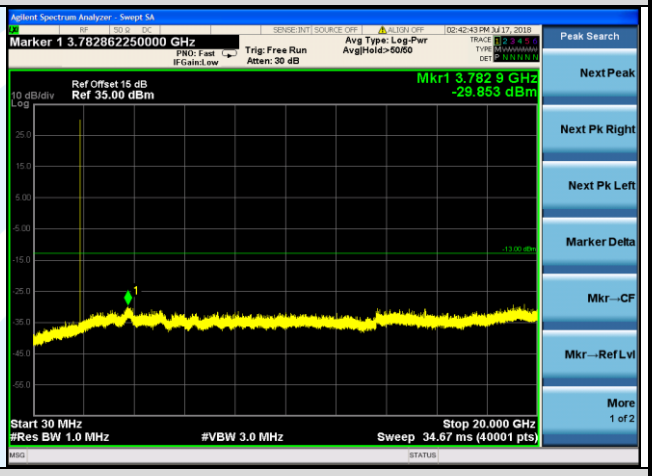
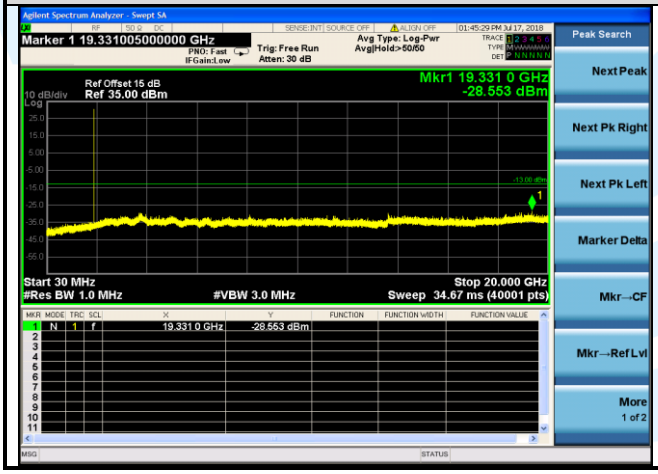
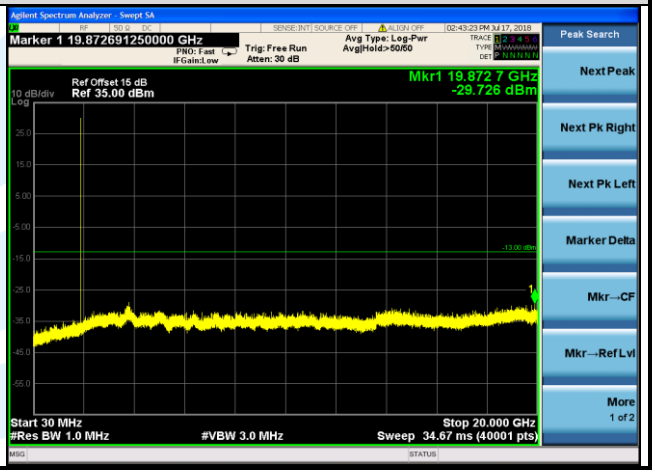
Test Setup: Refer to section 4.2.2 for details.

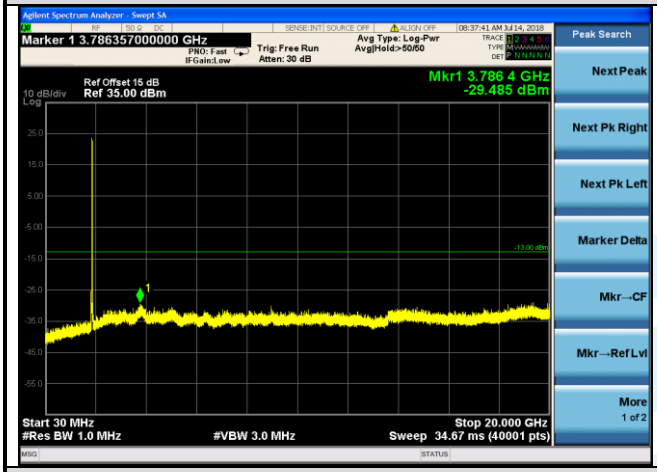
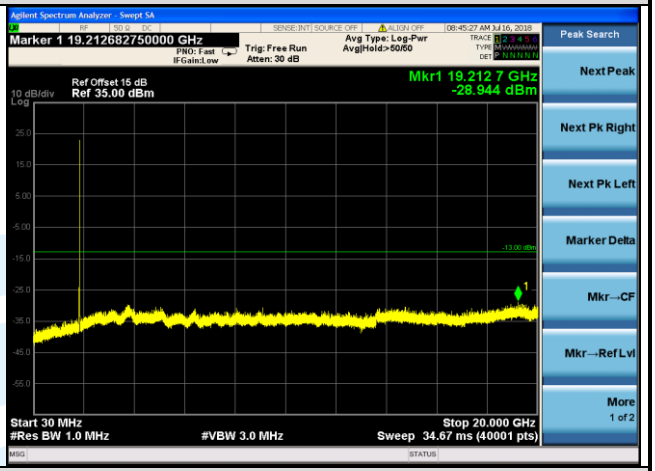
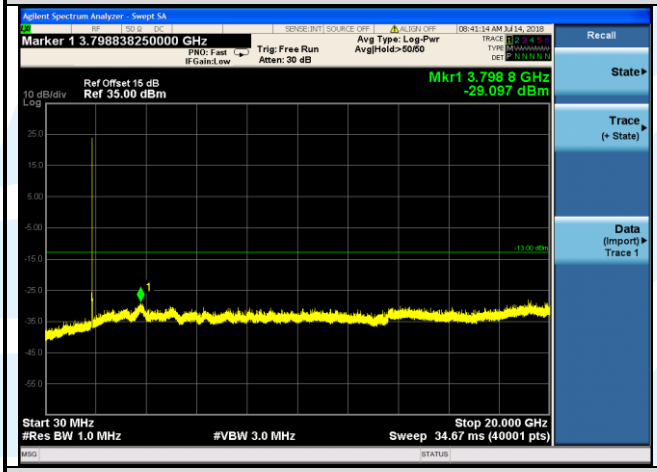
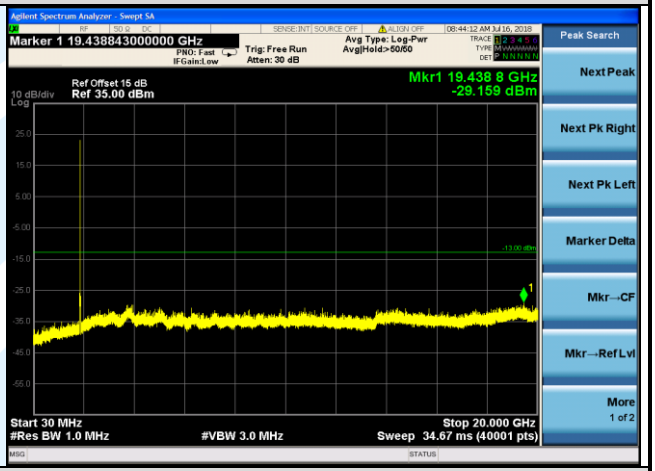
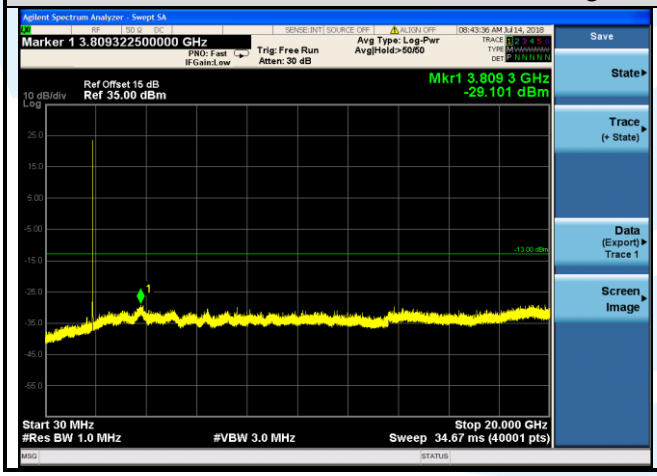
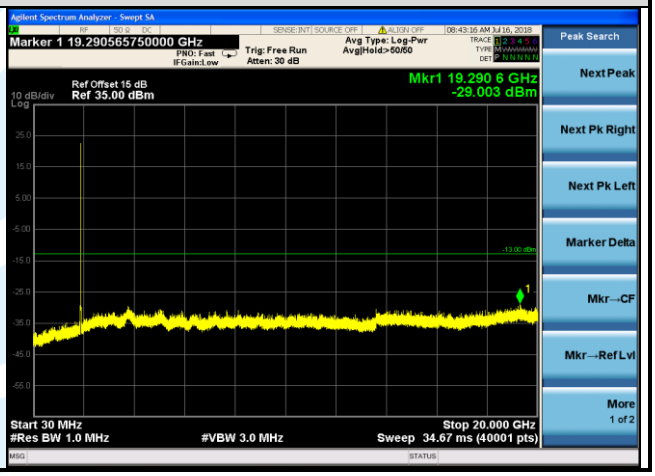
Instruments Used: Refer to section 3 for details

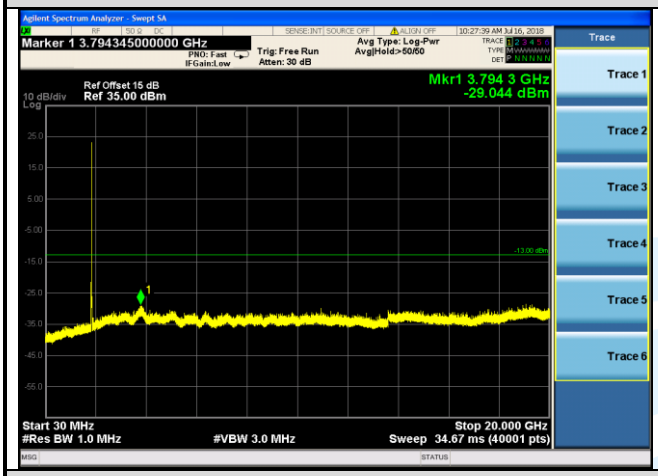
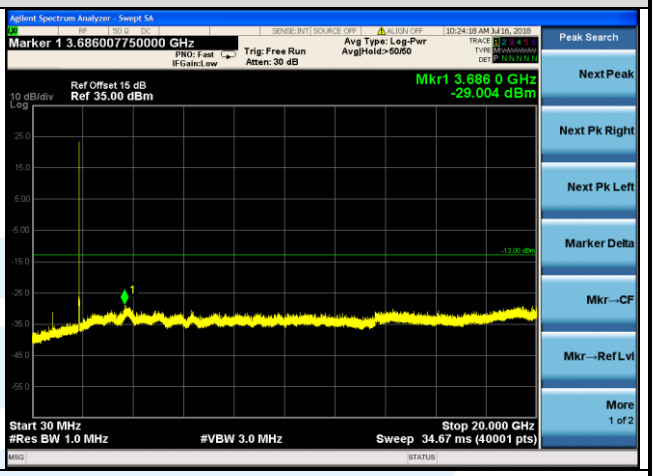
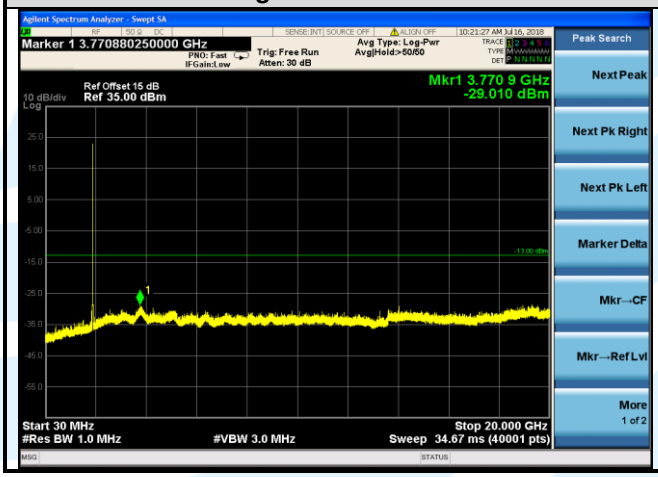
Test Mode: Link mode

Test Results: Pass

The test plot as follows:

GSM 1Tx-slot	GPRS 1Tx-slot
Lowest Channel	
	
Middle Channel	
	
Highest Channel	
	

WCDMA RMC 12.2Kbps	HSDPA
Lowest Channel	
	
Middle Channel	
	
Highest Channel	
	

HSUPA	
Lowest Channel	**Middle Channel**
	
Highest Channel	
	N/A

5.8 FIELD STRENGTH OF SPURIOUS RADIATION

Test Requirement: FCC 47 CFR Part 2.1053 & FCC 47 CFR Part 24.238(a)(b)

Test Method: ANSI/TIA-603-E-2016 & KDB 971168 D01v03

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(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd)

EIRP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBi)

EIRP=ERP+2.15dB

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.

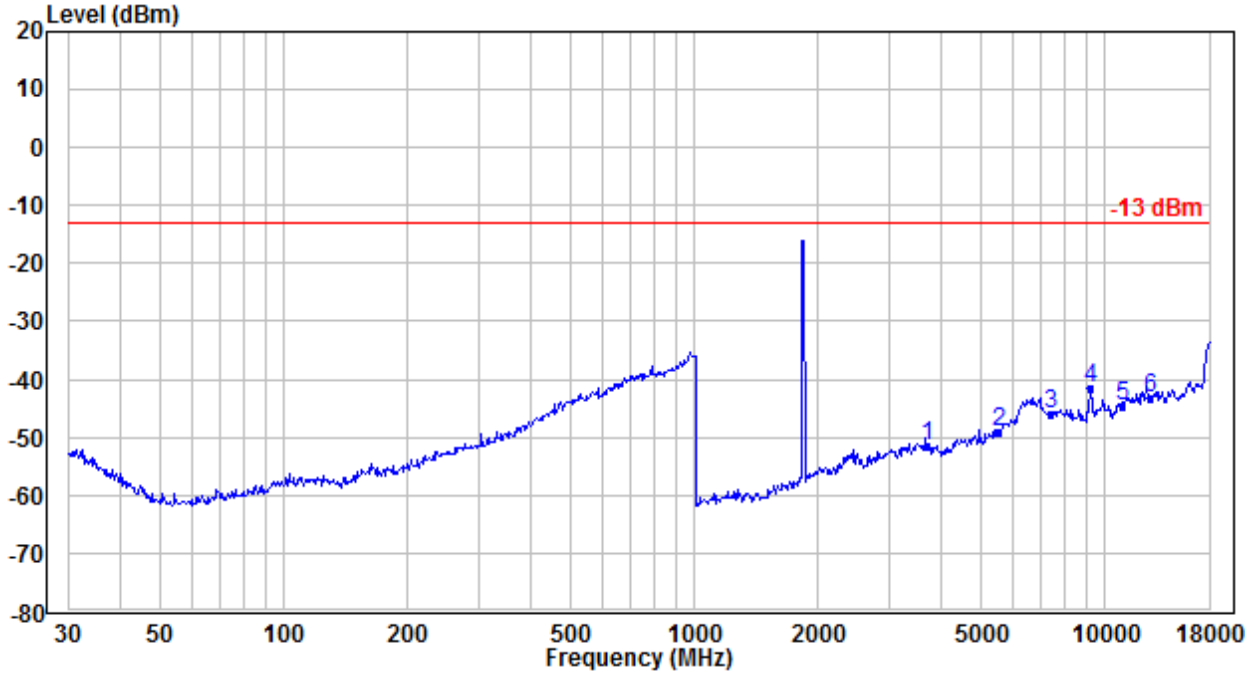
Test Result: Pass

The measurement data as follows:

Radiated Emission Test Data

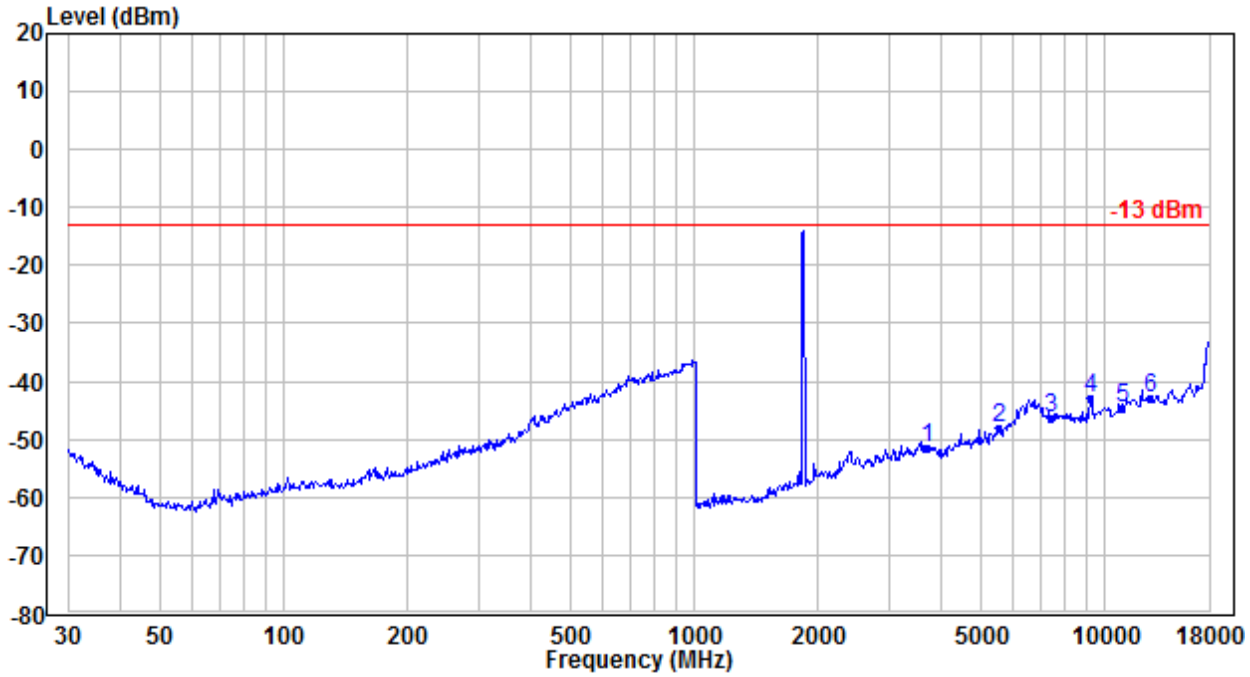
GSM 1Tx-slot_Lowest Channel

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3700.400	-107.43	55.96	-51.47	-13.00	-38.47	Peak
2	5550.600	-113.11	63.99	-49.12	-13.00	-36.12	Peak
3	7400.800	453.89	-500.00	-46.11	-13.00	-33.11	Peak
4	9251.000	458.44	-500.00	-41.56	-13.00	-28.56	Peak
5	11101.200	455.56	-500.00	-44.44	-13.00	-31.44	Peak
6	12951.400	456.75	-500.00	-43.25	-13.00	-30.25	Peak

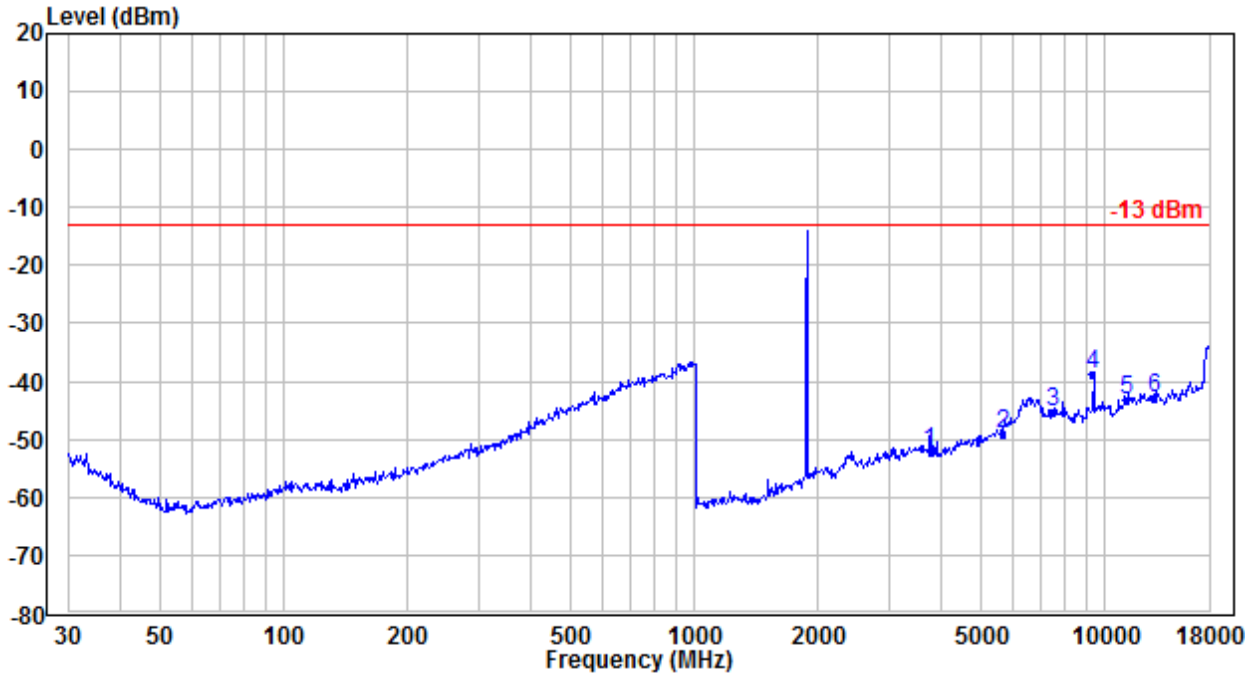
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3700.400	-107.43	55.96	-51.47	-13.00	-38.47	Peak
2	5550.600	-111.89	63.99	-47.90	-13.00	-34.90	Peak
3	7400.800	453.64	-500.00	-46.36	-13.00	-33.36	Peak
4	9251.000	457.23	-500.00	-42.77	-13.00	-29.77	Peak
5	11101.200	455.56	-500.00	-44.44	-13.00	-31.44	Peak
6	12951.400	457.26	-500.00	-42.74	-13.00	-29.74	Peak

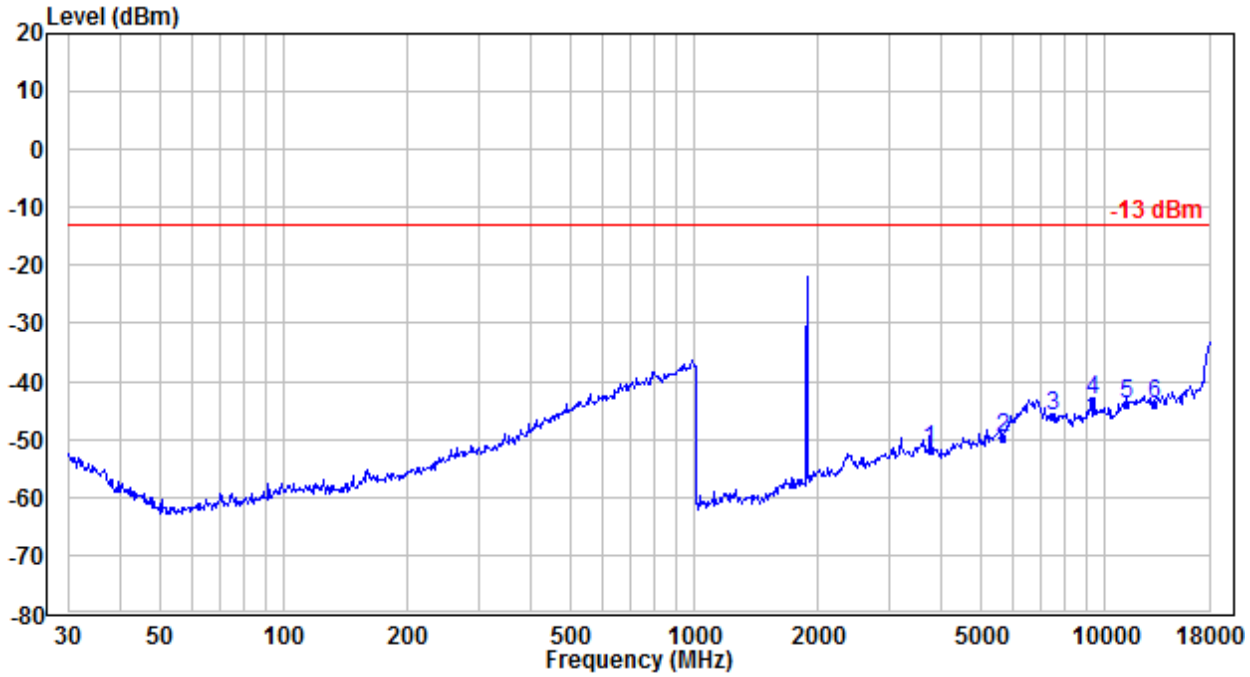
GSM 1Tx-slot_Middle Channel

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3760.000	-108.47	56.30	-52.17	-13.00	-39.17	Peak
2	5640.000	-113.79	64.64	-49.15	-13.00	-36.15	Peak
3	7520.000	454.76	-500.00	-45.24	-13.00	-32.24	Peak
4	9400.000	461.30	-500.00	-38.70	-13.00	-25.70	Peak
5	11280.000	456.85	-500.00	-43.15	-13.00	-30.15	Peak
6	13160.000	457.25	-500.00	-42.75	-13.00	-29.75	Peak

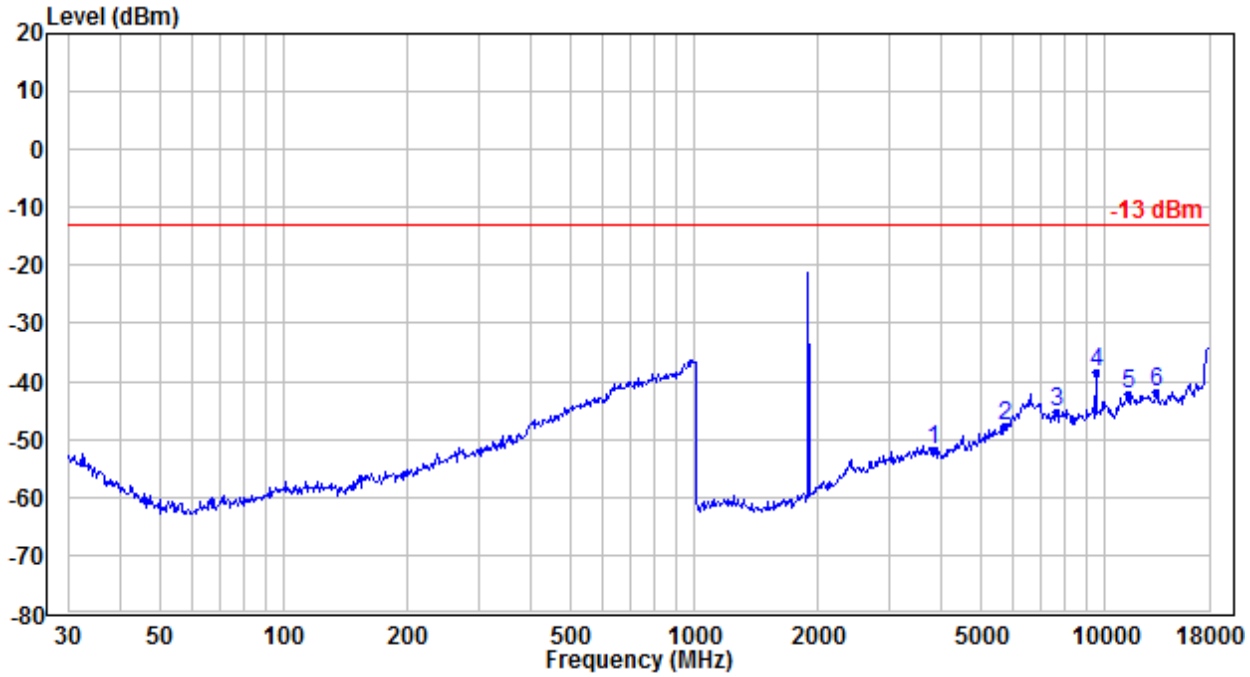
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3760.000	-108.19	56.30	-51.89	-13.00	-38.89	Peak
2	5640.000	-114.35	64.64	-49.71	-13.00	-36.71	Peak
3	7520.000	453.89	-500.00	-46.11	-13.00	-33.11	Peak
4	9400.000	456.79	-500.00	-43.21	-13.00	-30.21	Peak
5	11280.000	455.94	-500.00	-44.06	-13.00	-31.06	Peak
6	13160.000	456.16	-500.00	-43.84	-13.00	-30.84	Peak

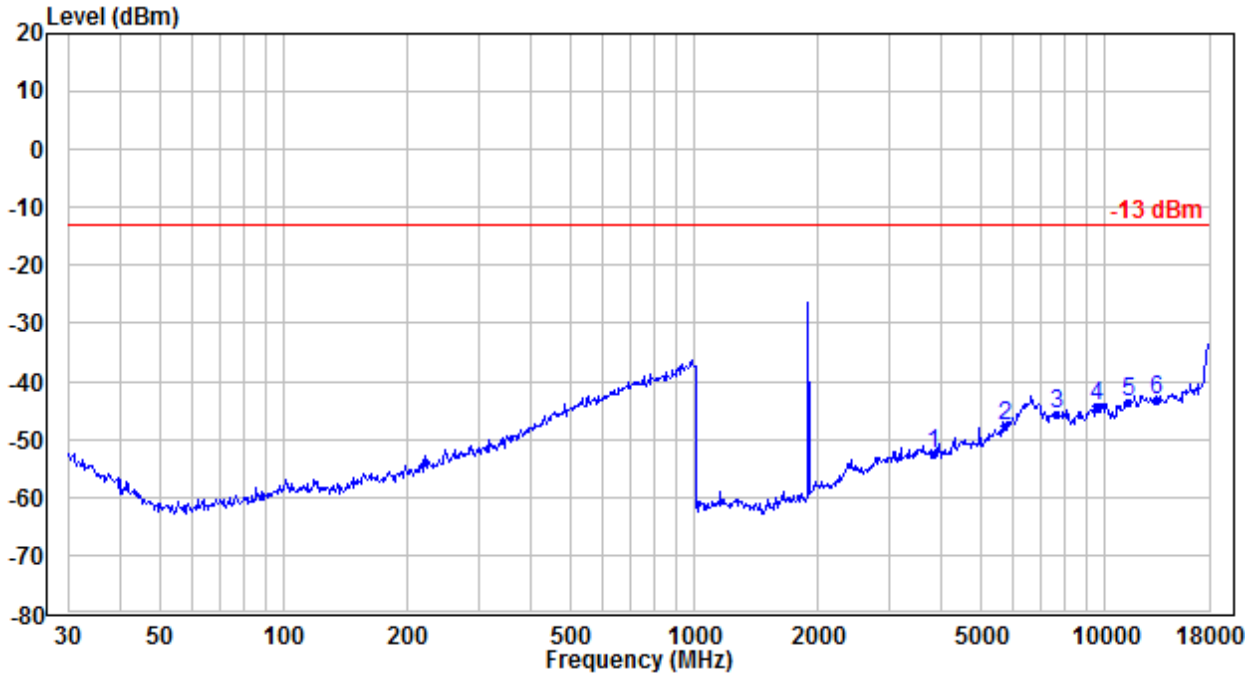
GSM 1Tx-slot_Highest Channel

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3819.600	-108.39	56.65	-51.74	-13.00	-38.74	Peak
2	5729.400	-113.14	65.29	-47.85	-13.00	-34.85	Peak
3	7639.200	454.66	-500.00	-45.34	-13.00	-32.34	Peak
4	9549.000	461.58	-500.00	-38.42	-13.00	-25.42	Peak
5	11458.800	457.91	-500.00	-42.09	-13.00	-29.09	Peak
6	13368.600	458.17	-500.00	-41.83	-13.00	-28.83	Peak

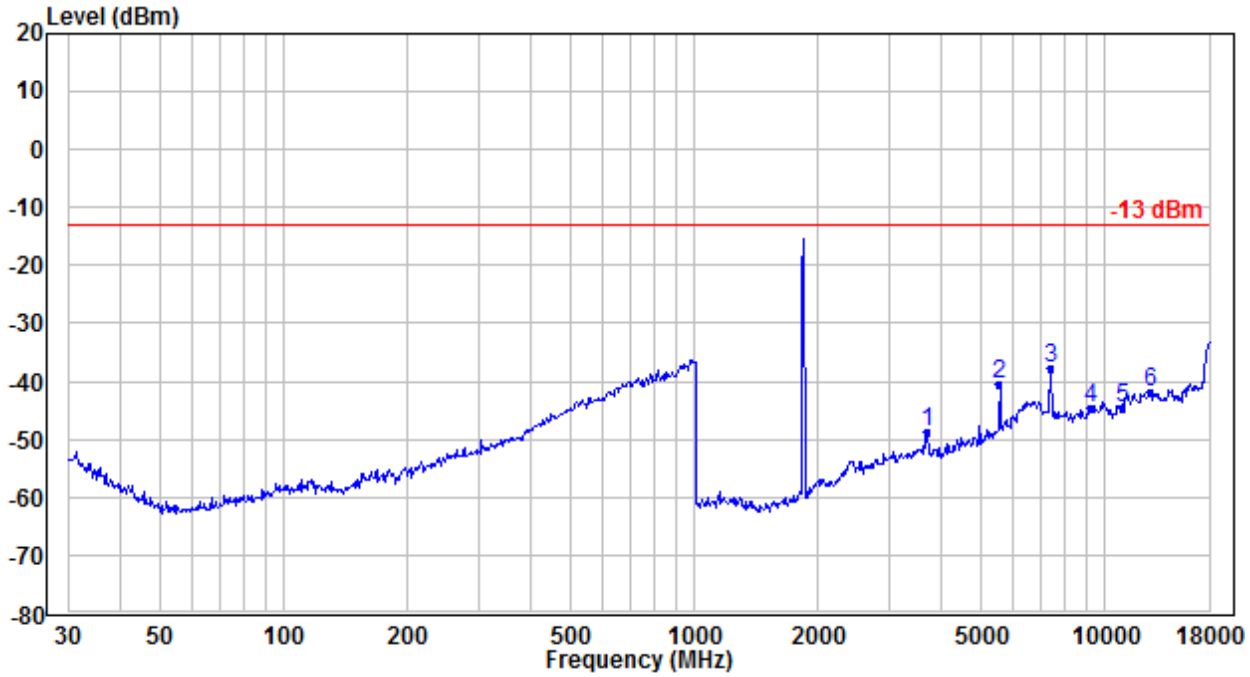
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3819.600	-109.21	56.65	-52.56	-13.00	-39.56	Peak
2	5729.400	-113.14	65.29	-47.85	-13.00	-34.85	Peak
3	7639.200	454.44	-500.00	-45.56	-13.00	-32.56	Peak
4	9549.000	455.90	-500.00	-44.10	-13.00	-31.10	Peak
5	11458.800	456.49	-500.00	-43.51	-13.00	-30.51	Peak
6	13368.600	456.87	-500.00	-43.13	-13.00	-30.13	Peak

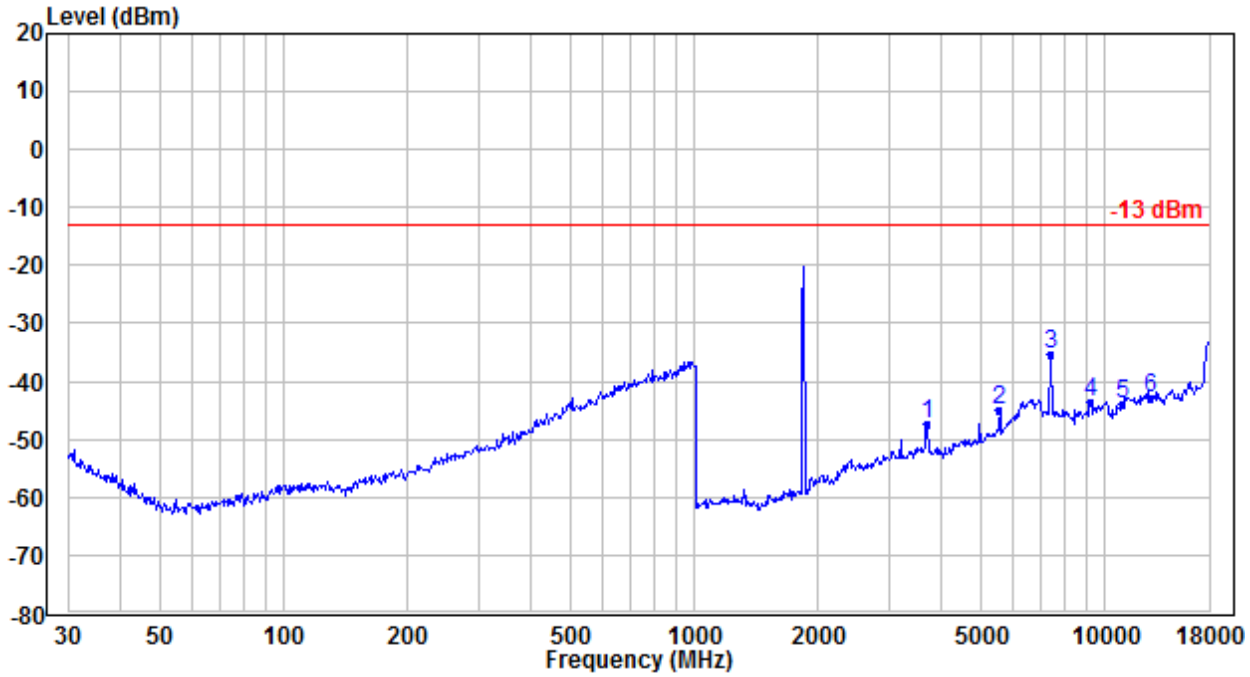
WCDMA RMC 12.2Kbps_Lowest Channel

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3704.800	-104.76	55.98	-48.78	-13.00	-35.78	Peak
2	5557.200	-104.53	64.03	-40.50	-13.00	-27.50	Peak
3	7409.600	462.39	-500.00	-37.61	-13.00	-24.61	Peak
4	9262.000	455.39	-500.00	-44.61	-13.00	-31.61	Peak
5	11114.400	455.56	-500.00	-44.44	-13.00	-31.44	Peak
6	12966.800	458.20	-500.00	-41.80	-13.00	-28.80	Peak

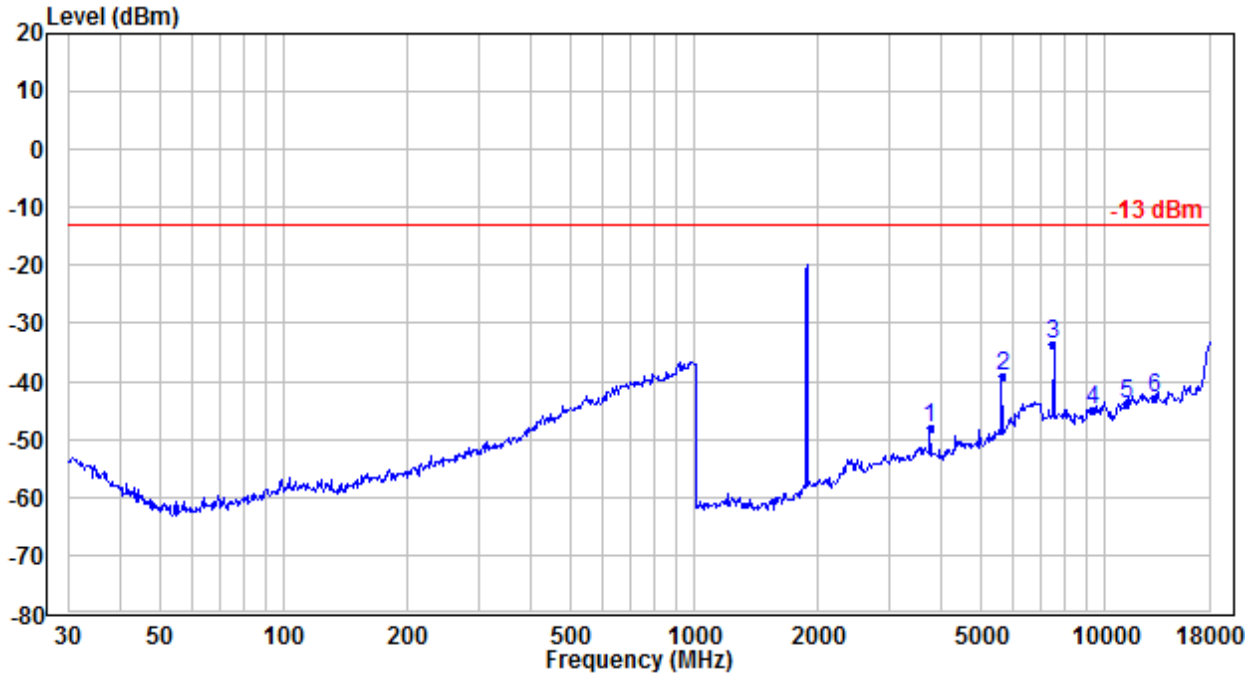
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3704.800	-103.50	55.98	-47.52	-13.00	-34.52	Peak
2	5557.200	-108.87	64.03	-44.84	-13.00	-31.84	Peak
3	7409.600	464.69	-500.00	-35.31	-13.00	-22.31	Peak
4	9262.000	456.53	-500.00	-43.47	-13.00	-30.47	Peak
5	11114.400	456.25	-500.00	-43.75	-13.00	-30.75	Peak
6	12966.800	457.01	-500.00	-42.99	-13.00	-29.99	Peak

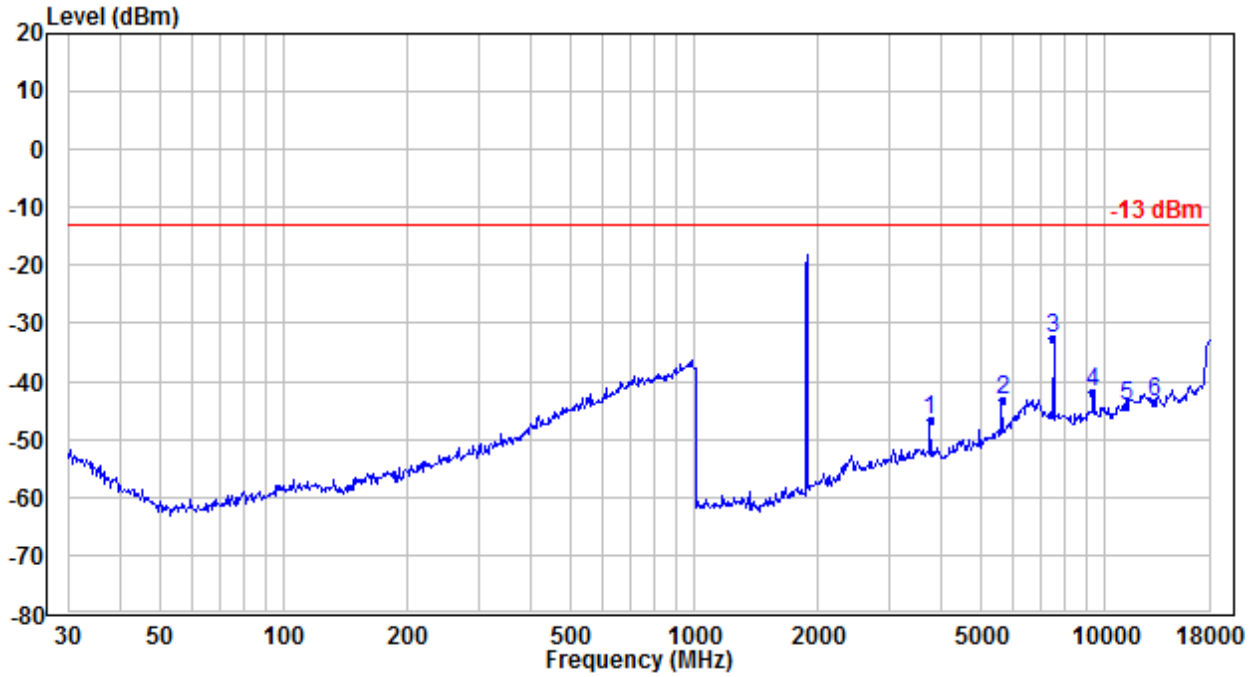
WCDMA RMC 12.2Kbps_Middle Channel

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3760.000	-104.27	56.30	-47.97	-13.00	-34.97	Peak
2	5640.000	-103.61	64.64	-38.97	-13.00	-25.97	Peak
3	7520.000	466.41	-500.00	-33.59	-13.00	-20.59	Peak
4	9400.000	455.04	-500.00	-44.96	-13.00	-31.96	Peak
5	11280.000	455.94	-500.00	-44.06	-13.00	-31.06	Peak
6	13160.000	456.99	-500.00	-43.01	-13.00	-30.01	Peak

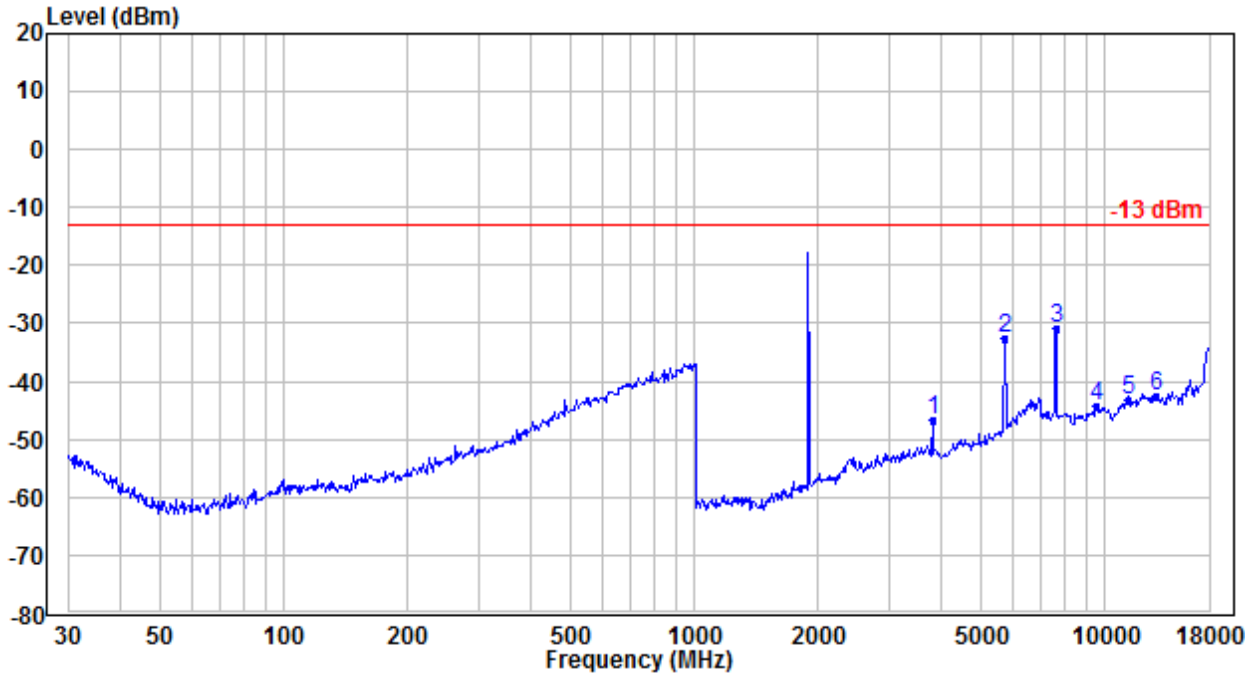
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3760.000	-102.83	56.30	-46.53	-13.00	-33.53	Peak
2	5640.000	-107.78	64.64	-43.14	-13.00	-30.14	Peak
3	7520.000	467.48	-500.00	-32.52	-13.00	-19.52	Peak
4	9400.000	458.24	-500.00	-41.76	-13.00	-28.76	Peak
5	11280.000	455.69	-500.00	-44.31	-13.00	-31.31	Peak
6	13160.000	456.45	-500.00	-43.55	-13.00	-30.55	Peak

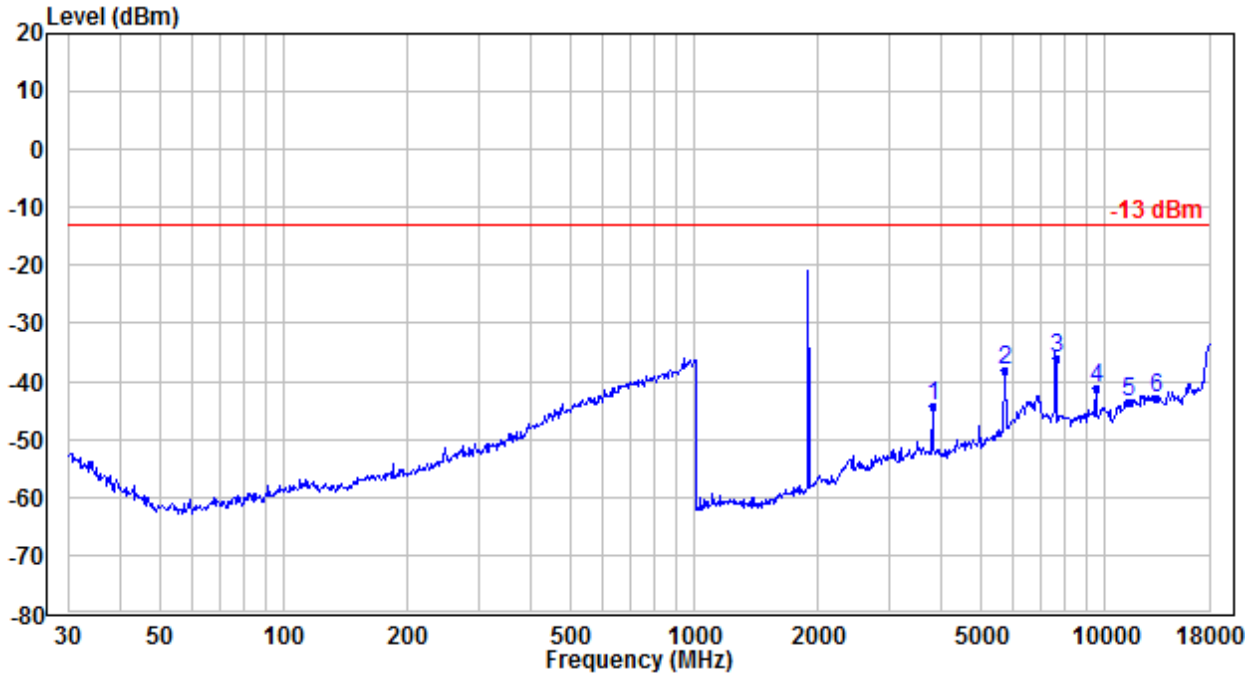
WCDMA RMC 12.2Kbps_Highest Channel

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3815.200	-103.46	56.62	-46.84	-13.00	-33.84	Peak
2	5722.800	-97.68	65.24	-32.44	-13.00	-19.44	Peak
3	7630.400	469.12	-500.00	-30.88	-13.00	-17.88	Peak
4	9538.000	455.90	-500.00	-44.10	-13.00	-31.10	Peak
5	11445.600	456.79	-500.00	-43.21	-13.00	-30.21	Peak
6	13353.200	457.53	-500.00	-42.47	-13.00	-29.47	Peak

Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	3815.200	-101.00	56.62	-44.38	-13.00	-31.38	Peak
2	5722.800	-103.46	65.24	-38.22	-13.00	-25.22	Peak
3	7630.400	463.90	-500.00	-36.10	-13.00	-23.10	Peak
4	9538.000	458.66	-500.00	-41.34	-13.00	-28.34	Peak
5	11445.600	456.32	-500.00	-43.68	-13.00	-30.68	Peak
6	13353.200	457.00	-500.00	-43.00	-13.00	-30.00	Peak

Remark:

1) The disturbance above 18GHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

2) All tested is under the condition of the main wave is filtered out.

3) 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 24.235

Test Method: ANSI/TIA-603-E-2016 & KDB 971168 D01v03

Limits: The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

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°C
   b) Voltage =low voltage, 3.5 Vdc, Normal, 3.8 Vdc and High voltage, 4.3 Vdc.
2) Frequency Stability vs Temperature:

The EUT is place inside a temperature chamber. The temperature is set to 20ºC 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 +50ºC 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 (Vdc)	Temperature (℃)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Pass/ Fail
GSM 1Tx-slot							
GMSK	661 / 1880.0	VL	TN	19	0.0101	Note 1	Pass
		VN		21	0.0112		Pass
		VH		20	0.0106		Pass
		VN	50	20	0.0106		Pass
			40	20	0.0106		Pass
			30	14	0.0074		Pass
			20	16	0.0085		Pass
			10	14	0.0074		Pass
			0	18	0.0096		Pass
			-10	20	0.0106		Pass
			-20	17	0.0090		Pass
			-30	17	0.0090		Pass

Modulation	Channel/ Frequency (MHz)	Voltage (Vdc)	Temperature (℃)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Pass/ Fail
WCDMA RMC 12.2Kbps							
BPSK	9400 / 1880.0	VL	TN	23	0.0122	Note 1	Pass
		VN		21	0.0112		Pass
		VH		23	0.0122		Pass
		VN	50	25	0.0133		Pass
			40	24	0.0128		Pass
			30	20	0.0106		Pass
			20	20	0.0106		Pass
			10	24	0.0128		Pass
			0	23	0.0122		Pass
			-10	18	0.0096		Pass
			-20	22	0.0117		Pass
			-30	23	0.0122		Pass

Note1: The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

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.