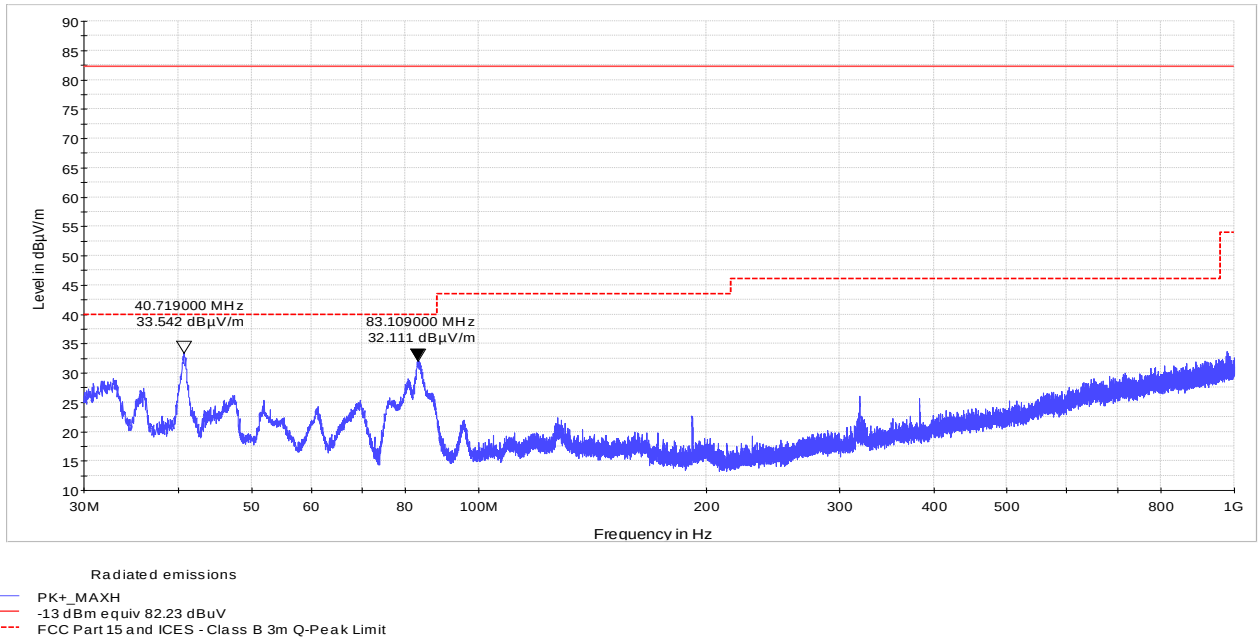


Figure 8.3-13: *Radiated emissions spectral plot, WCDMA, low channel (30 to 1000 MHz)*

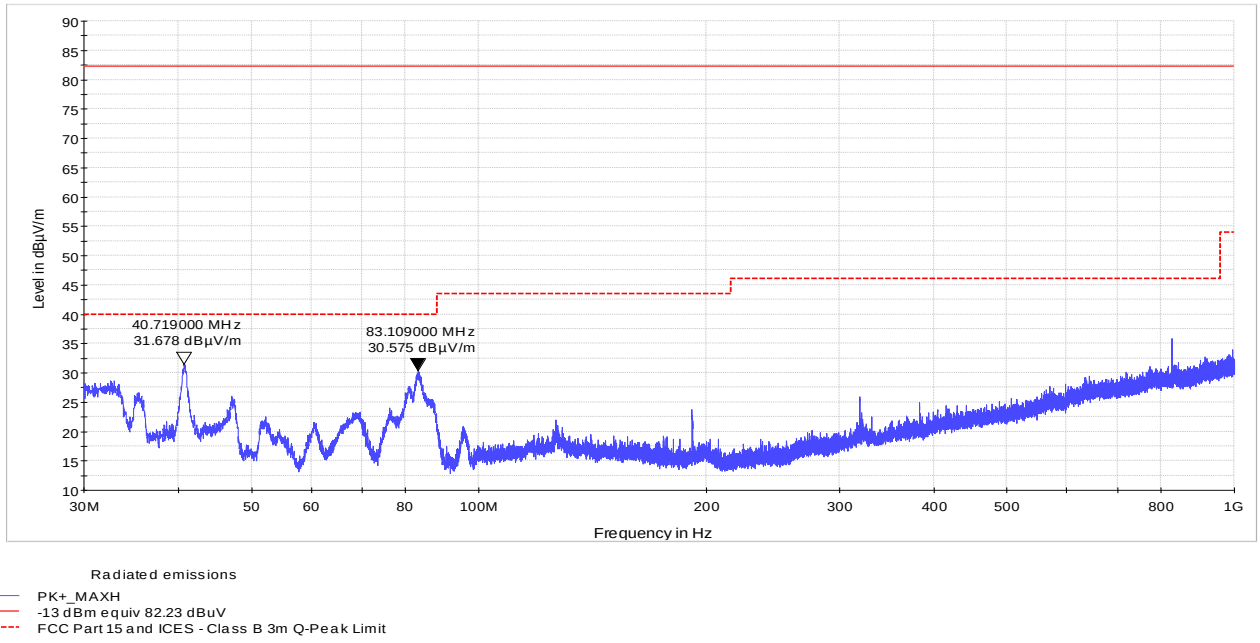


Figure 8.3-14: *Radiated emissions spectral plot, WCDMA, mid channel (30 to 1000 MHz)*

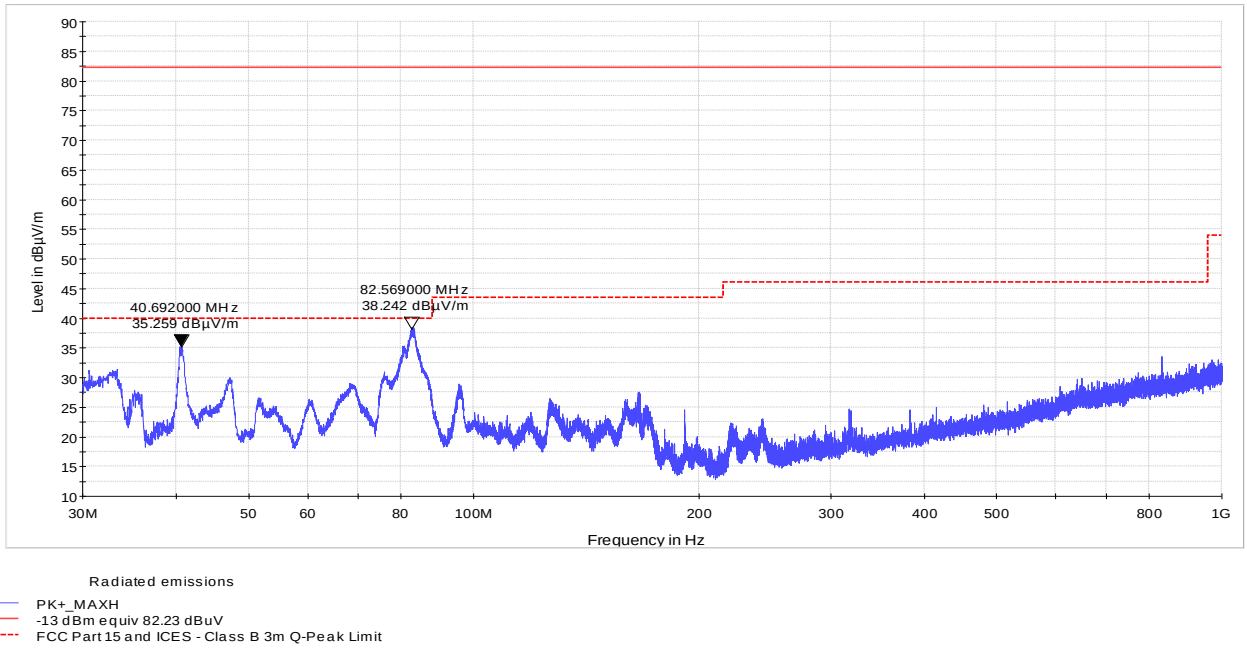


Figure 8.3-15: *Radiated emissions spectral plot, WCDMA, high channel (30 to 1000 MHz)*

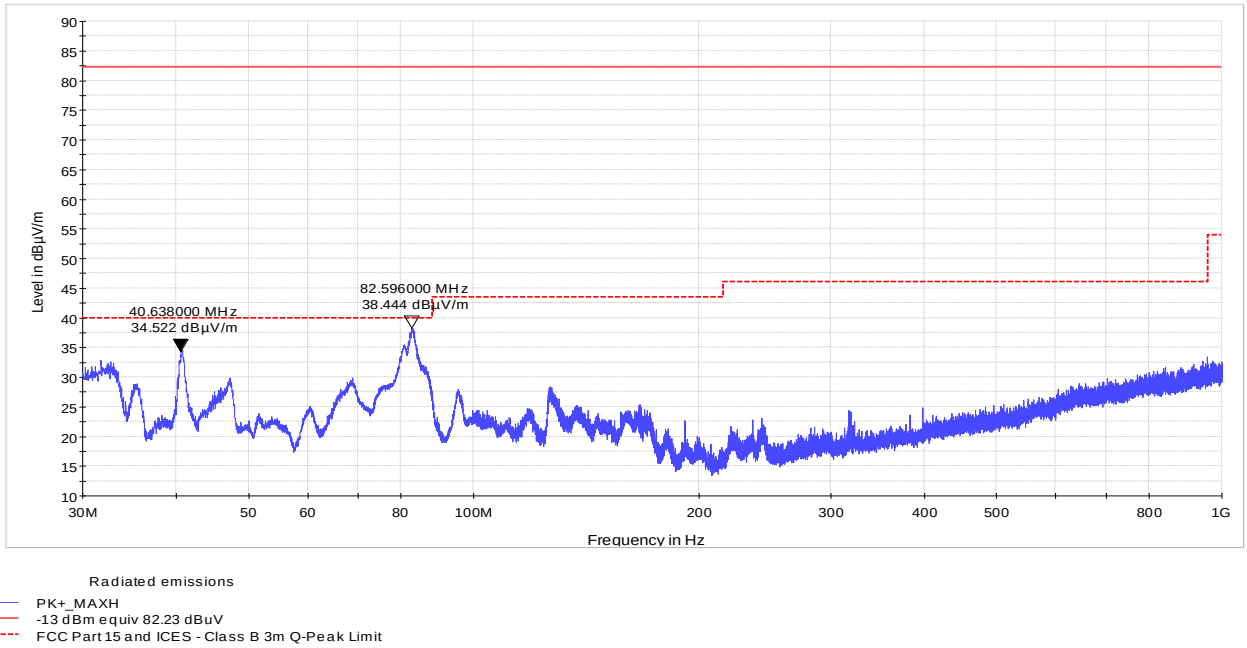
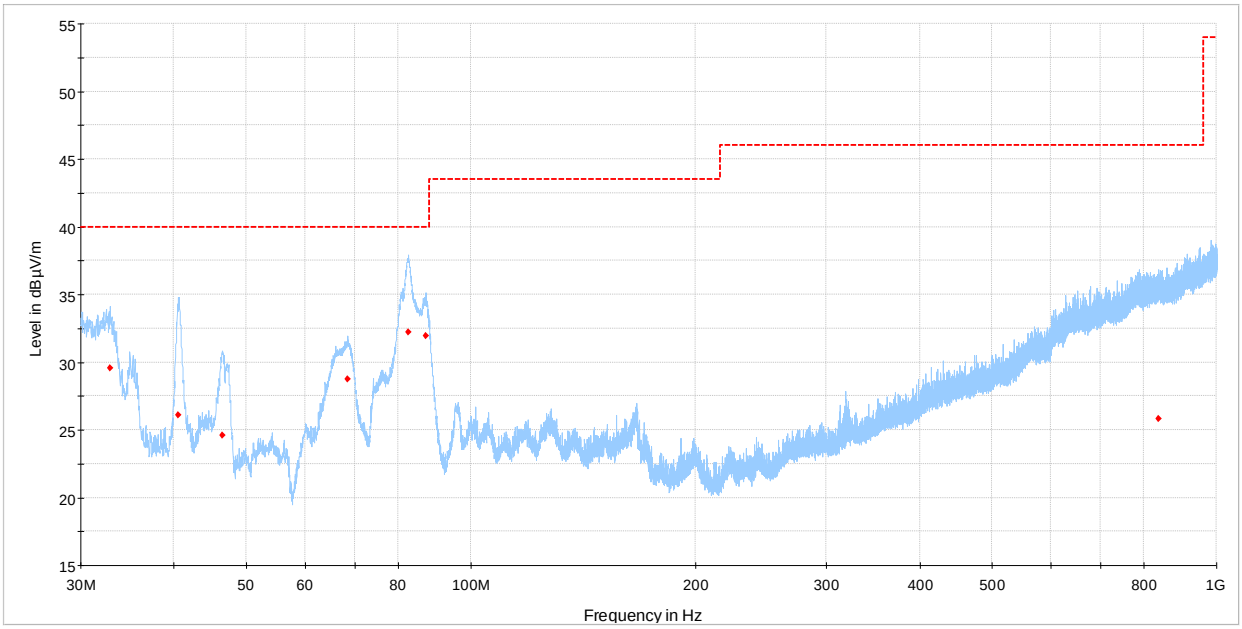


Figure 8.3-16: *Radiated emissions spectral plot, WCDMA, two carriers (30 to 1000 MHz)*



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators.

Figure 8.3-17: *Radiated emissions spectral plot (30 to 1000 MHz) WCDMA*

Table 8.3-4: *Radiated emissions (Quasi-Peak) results for WCDMA*

Frequency (MHz)	Quasi-Peak field strength[1] (dBµV/m)	3 m Quasi-Peak limit [3] (dBµV/m)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Antenna height (cm)	Pol. (V/H)	Turn table position (°)	Correction factor[2] (dB)
68.430000	28.73	40.00	11.27	100	120	362.4	H	55.0	9.6
87.060000	31.92	40.00	8.08	100	120	305.0	V	0.0	9.0
82.500000	32.22	40.00	7.78	100	120	109.7	V	80.0	8.9
40.560000	26.11	40.00	13.89	100	120	108.8	V	111.0	14.5
32.850000	29.54	40.00	10.46	100	120	106.3	V	168.0	20.6
46.410000	24.61	40.00	15.39	100	120	115.8	V	162.0	11.3
835.050000	25.79	46.00	20.21	100	120	405.0	H	30.0	25.3

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions have been recorded.

Sample calculation: 28.73 dBµV/m (field strength) = 19.13 dBµV (receiver reading) + 9.6 dB (Correction factor)

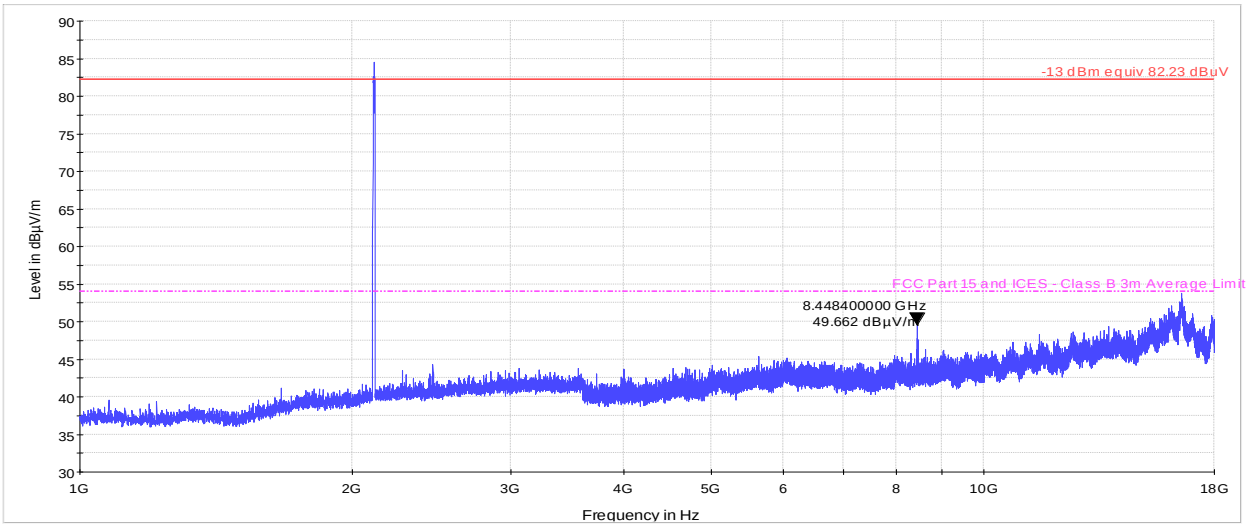


Figure 8.3-18: *Radiated emissions spectral plot, WCDMA, low channel (1–18 GHz)*

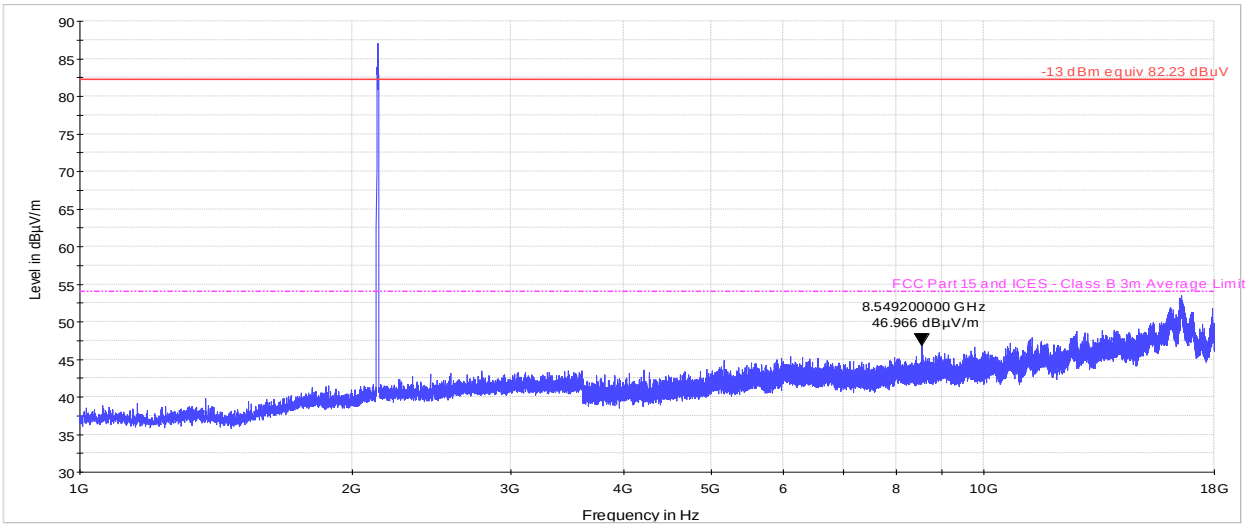


Figure 8.3-19: *Radiated emissions spectral plot, WCDMA, mid channel (1–18 GHz)*

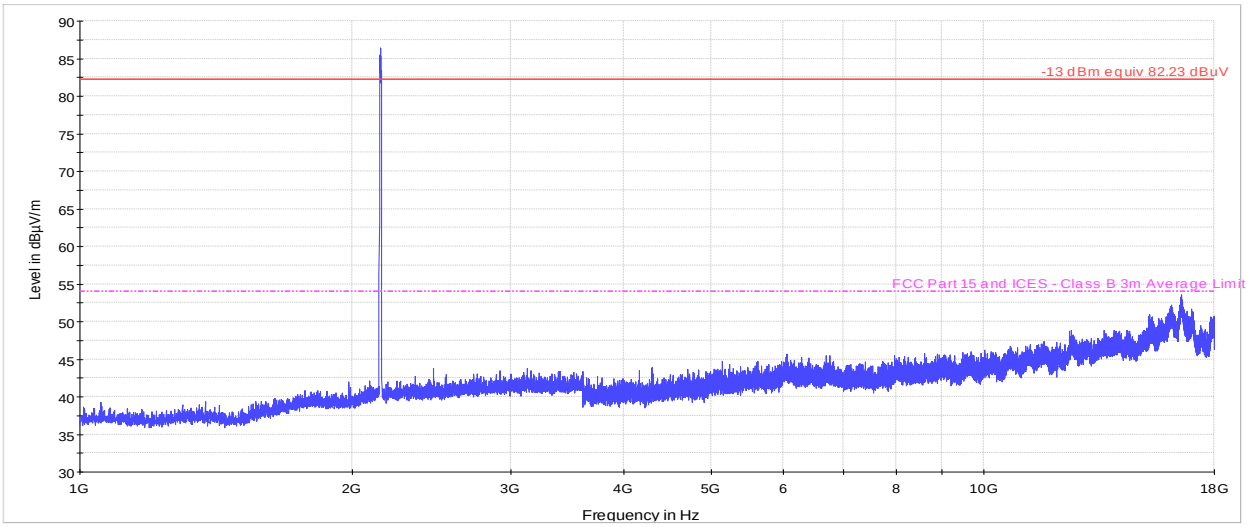


Figure 8.3-20: *Radiated emissions spectral plot, WCDMA, high channel (1–18 GHz)*

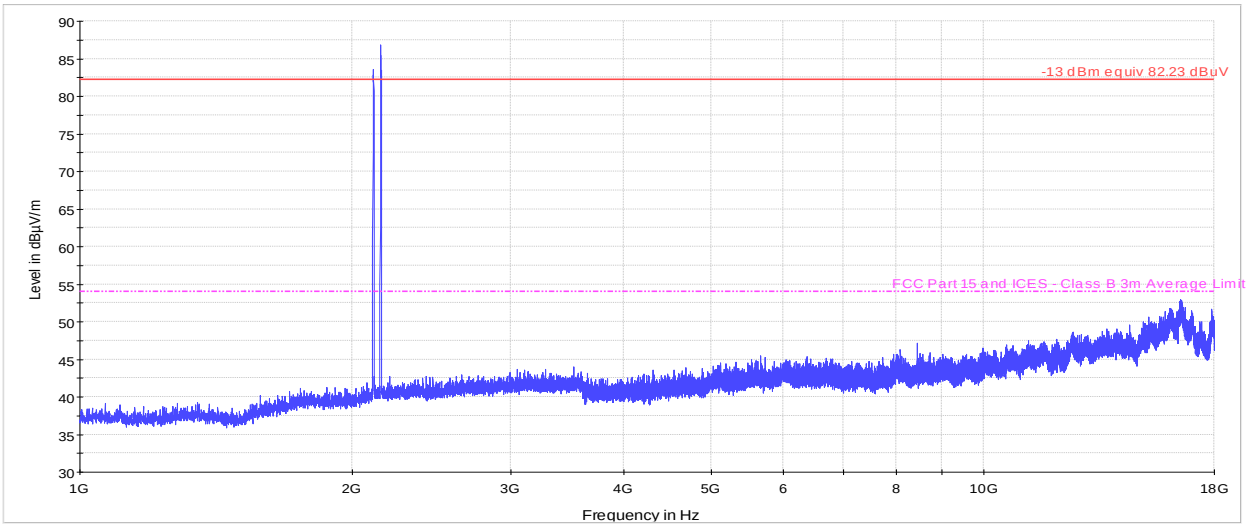
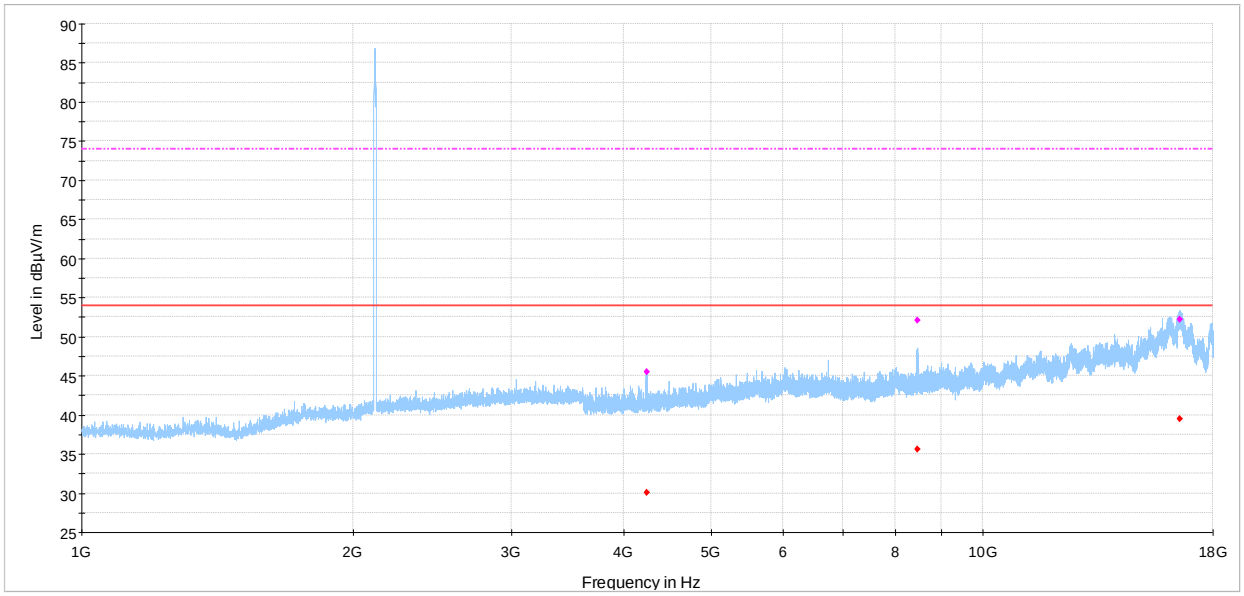


Figure 8.3-21: *Radiated emissions spectral plot, WCDMA, two carriers (1–18 GHz)*



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators.

Figure 8.3-22: *Radiated emissions spectral plot (1 to 18 GHz) WCDMA*

Table 8.3-5: *Radiated emissions (Peak) results for WCDMA*

Frequency (MHz)	Peak field strength (dBµV/m)	3 m Peak limit (dBµV/m)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Antenna height (cm)	Pol. (V/H)	Turn table position (°)	Correction factor[2] (dB)
4237.346429	45.44	74.00	28.56	100	1000	129.2	V	20.0	-7.7
8457.278571	52.09	74.00	21.91	100	1000	203.0	H	300.0	-1.9
16538.635714	52.22	74.00	21.78	100	1000	337.7	V	164.0	12.4

Table 8.3-6: *Radiated emissions (CAverage) results for WCDMA*

Frequency (MHz)	CAverage field strength[1] (dBµV/m)	3 m CAverage limit (dBµV/m)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Antenna height (cm)	Pol. (V/H)	Turn table position (°)	Correction factor[2] (dB)
4237.346429	30.11	54.00	23.89	100	1000	129.2	V	20.0	-7.7
8457.278571	35.64	54.00	18.36	100	1000	203.0	H	300.0	-1.9
16538.635714	39.51	54.00	14.49	100	1000	337.7	V	164.0	12.4

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) − amplifier gain (dB)

Sample calculation: 30.11 dBµV/m (field strength) = 37.81 dBµV (receiver reading) + (−7.7) dB (Correction factor)

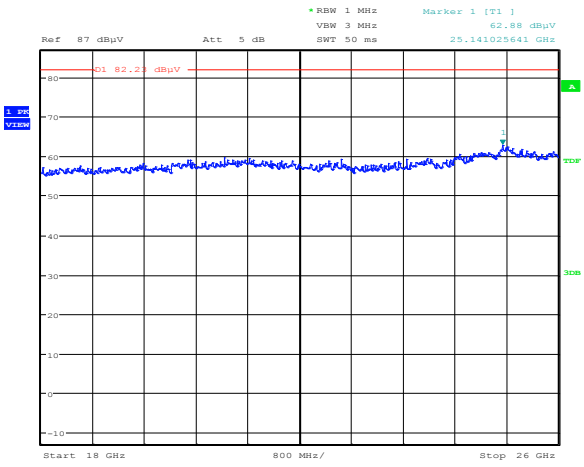


Figure 8.3-6: *Radiated emissions spectral plot, WCDMA, low channel (18–26 GHz)*

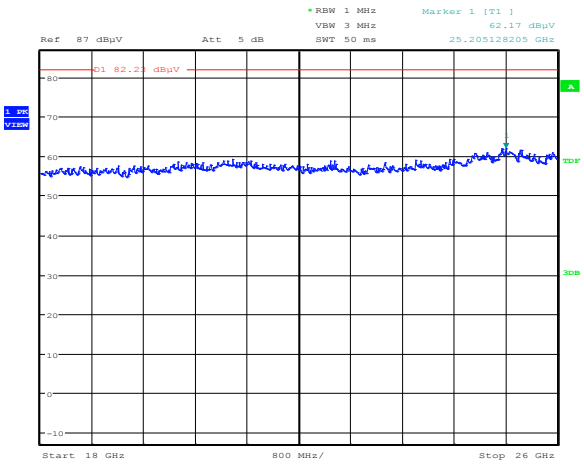


Figure 8.3-7: *Radiated emissions spectral plot, WCDMA, mid channel (18–26 GHz)*

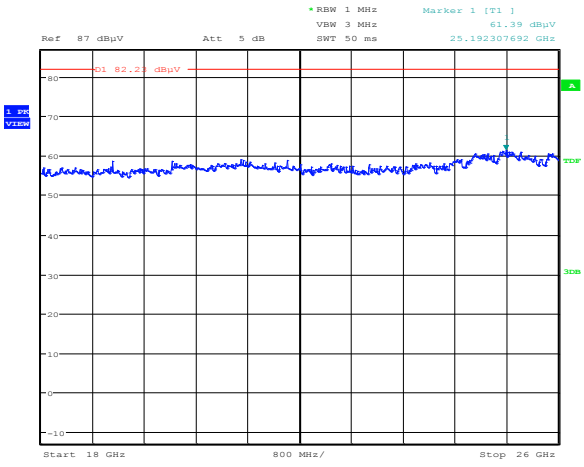


Figure 8.3-8: *Radiated emissions spectral plot, WCDMA, high channel (18–26 GHz)*

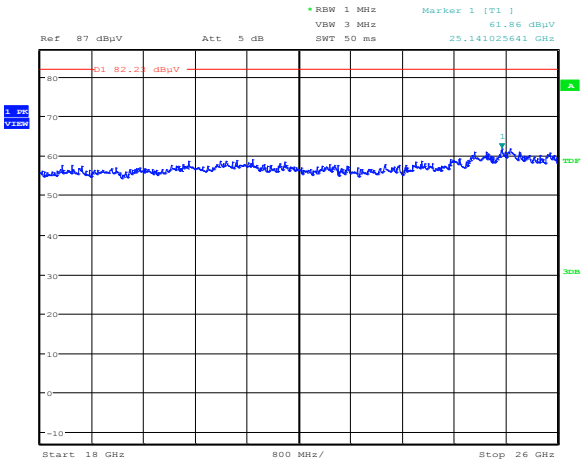


Figure 8.3-9: *Radiated emissions spectral plot, WCDMA, two carriers (18–26 GHz)*

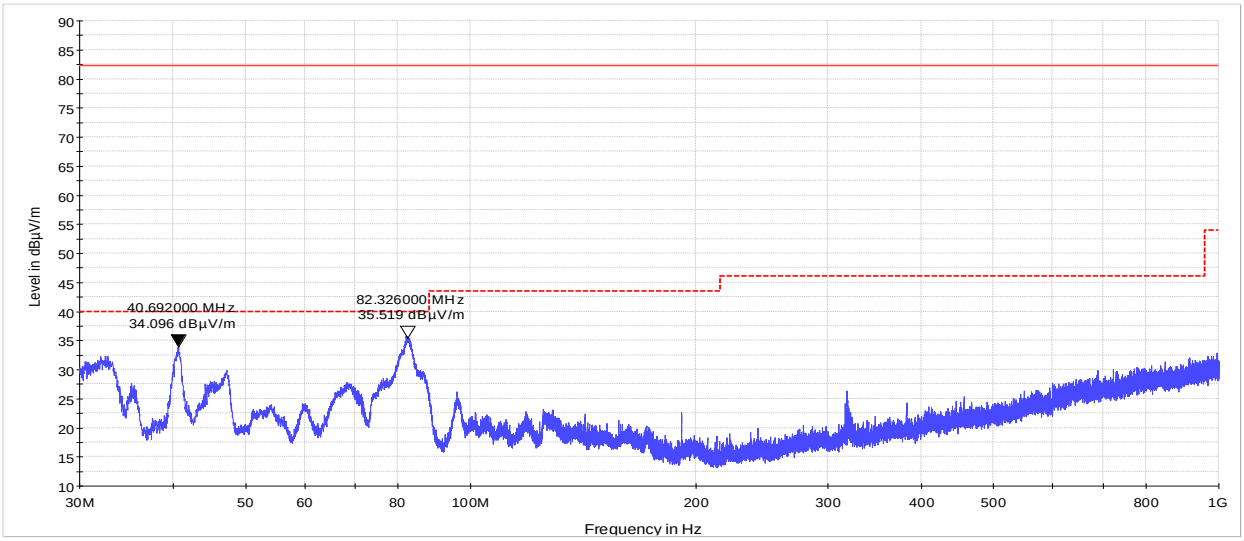


Figure 8.3-10: *Radiated emissions spectral plot, WCDMA and LTE mixed mode (30–1000 MHz)*

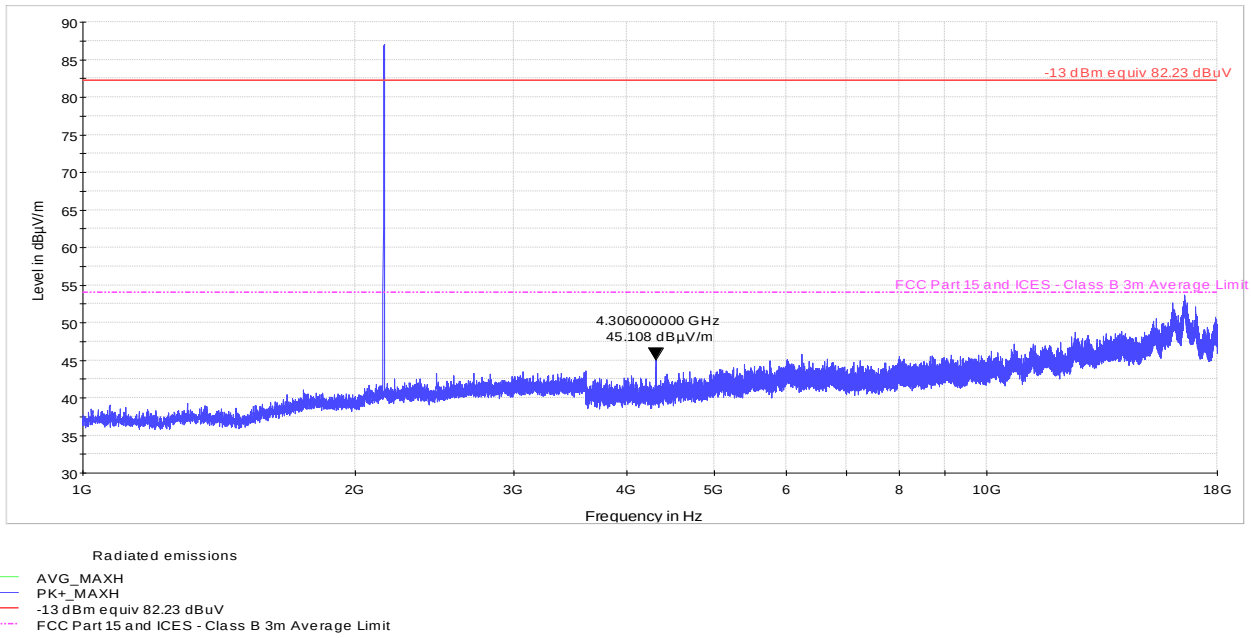


Figure 8.3-11: *Radiated emissions spectral plot, WCDMA and LTE mixed mode (1–18 GHz)*

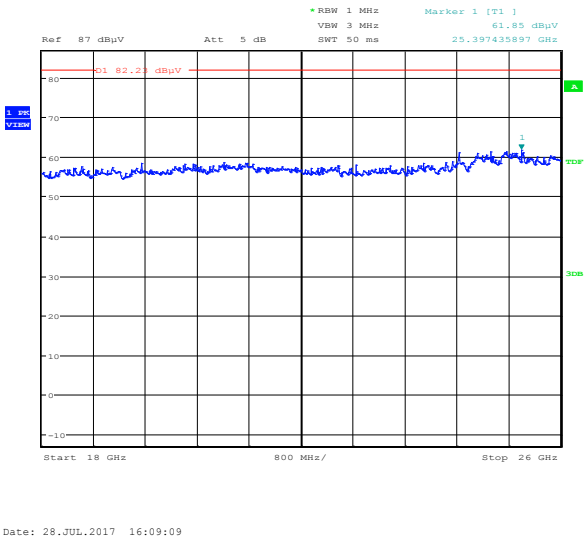


Figure 8.3-12: *Radiated emissions spectral plot, WCDMA and LTE mixed mode (18–26 GHz)*

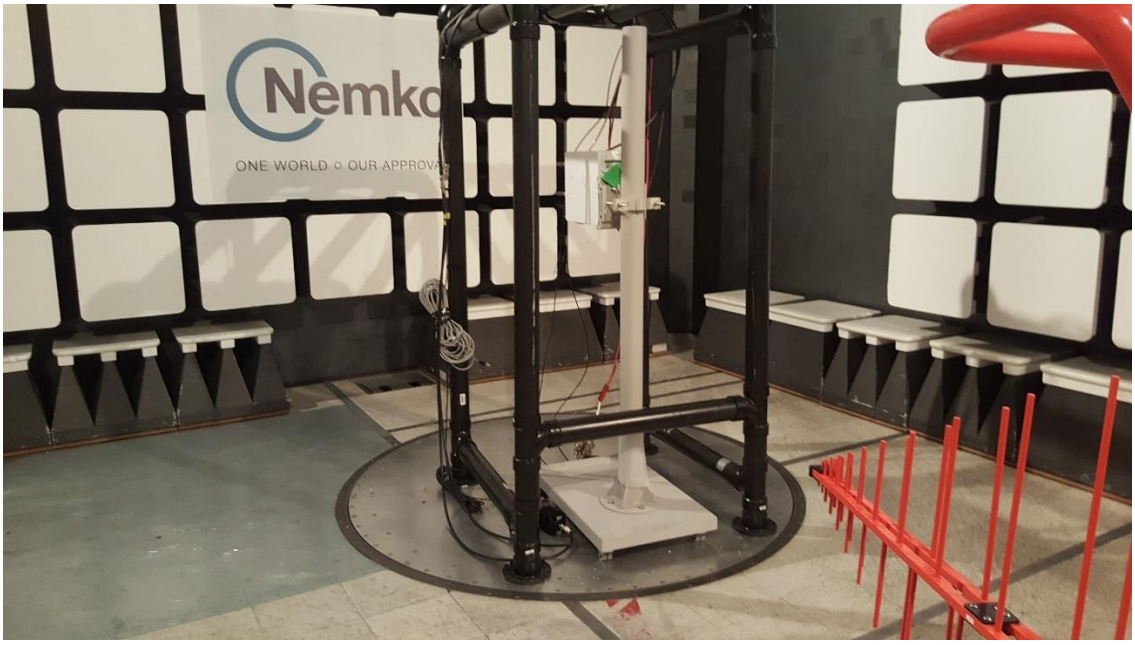


Figure 8.3-13: *Set-up for Radiated Spurious Emission*

Figure 8.3-14: *Set-up for Radiated Spurious Emission*

8.4 FCC 27.54 and RSS-139, Section 6.4 Frequency stability

8.4.1 Definitions and limits

FCC:
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-139, Section 6.4:
The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

8.4.2 Test summary

Test date	July 14, 2017	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	33 %

8.4.3 Observations, settings and special notes

26 dBc points including frequency tolerance were assessed to remain within assigned band.
Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	300 Hz
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.4.4 Test data

Table 8.4-1: *Frequency error results*

Temperature, °C	Voltage, V_{DC}	Frequency error, Hz
+50	54	+3.04
+40	54	−4.17
+30	54	−4.75
+20	54	+3.82
+20	48	−3.76
+20	40	−3.17
+10	54	−3.28
0	54	−4.04
−10	54	+3.73
−20	54	−4.19
−30	54	−3.03

Max negative drift: 4.75 Hz, Max positive drift: 3.82 Hz

Table 8.4-2: *Frequency stability within the authorized bands, LTE results*

BW, MHz/ Channel	Port	26 dB band edge, MHz	Max. drift, Hz	Corrected BE, MHz	Limit, MHz	Margin, kHz
5, Low	A	2110.129	−4.750	2110.129	2110.000	128.995
5, High	A	2179.861	+3.820	2179.861	2180.000	138.996
5, Low	B	2110.139	−4.750	2110.139	2110.000	138.995
5, High	B	2179.863	+3.820	2179.863	2180.000	136.996
10, Low	A	2110.324	−4.750	2110.324	2110.000	323.995
10, High	A	2179.683	+3.820	2179.683	2180.000	316.996
10, Low	B	2110.337	−4.750	2110.337	2110.000	336.995
10, High	B	2179.666	+3.820	2179.666	2180.000	333.996
15, Low	A	2110.540	−4.750	2110.540	2110.000	539.995
15, High	A	2179.450	+3.820	2179.450	2180.000	549.996
15, Low	B	2110.560	−4.750	2110.560	2110.000	559.995
15, High	B	2179.425	+3.820	2179.425	2180.000	574.996
20, Low	A	2110.765	−4.750	2110.765	2110.000	764.995
20, High	A	2179.215	+3.820	2179.215	2180.000	784.996
20, Low	B	2110.790	−4.750	2110.790	2110.000	789.995
20, High	B	2179.225	+3.820	2179.225	2180.000	774.996

Table 8.4-3: *Frequency stability within the authorized bands, WCDMA results*

BW, MHz/ Channel	Port	26 dB band edge, MHz	Max. drift, Hz	Corrected BE, MHz	Limit, MHz	Margin, kHz
5, Low	A	2110.168	−4.750	2110.168	2110.000	167.995
5, High	A	2154.833	+3.820	2154.833	2155.000	166.996
5, Low	B	2110.170	−4.750	2110.170	2110.000	169.995
5, High	B	2154.827	+3.820	2154.827	2155.000	172.996

8.5 FCC Part 2.1049 and RSS-Gen, 6.6 Occupied bandwidth

8.5.1 Definitions and limits

FCC:
The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

RSS-Gen, 6.6
The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

8.5.2 Test summary

Test date	July 12, 2017	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1009 mbar
Verdict	Pass	Relative humidity	33 %

8.5.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	≥1 % of span
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.5.4 Test data

Table 8.5-1: *Occupied bandwidth, LTE results*

Remarks	Frequency, MHz	99% OBW, MHz	26 dB BW, MHz
5 MHz, QPSK, Port A	2112.5	4.4782	4.743
5 MHz, QPSK, Port A	2145.0	4.4772	4.734
5 MHz, QPSK, Port A	2177.5	4.4758	4.721
5 MHz, QPSK, Port B	2112.5	4.4762	4.723
5 MHz, QPSK, Port B	2145.0	4.4775	4.715
5 MHz, QPSK, Port B	2177.5	4.4772	4.726
10 MHz, QPSK, Port A	2115.0	8.9317	9.352
10 MHz, QPSK, Port A	2145.0	8.9330	9.380
10 MHz, QPSK, Port A	2175.0	8.9270	9.366
10 MHz, QPSK, Port B	2115.0	8.9312	9.327
10 MHz, QPSK, Port B	2145.0	8.9281	9.339
10 MHz, QPSK, Port B	2175.0	8.9279	9.331
15 MHz, QPSK, Port A	2117.5	13.382	13.920
15 MHz, QPSK, Port A	2145.0	13.380	13.940
15 MHz, QPSK, Port A	2172.5	13.387	13.900
15 MHz, QPSK, Port B	2117.5	13.383	13.880
15 MHz, QPSK, Port B	2145.0	13.384	13.940
15 MHz, QPSK, Port B	2172.5	13.386	13.850
20 MHz, QPSK, Port A	2120.0	17.835	18.470
20 MHz, QPSK, Port A	2145.0	17.839	18.440
20 MHz, QPSK, Port A	2170.0	17.841	18.430
20 MHz, QPSK, Port B	2120.0	17.838	18.420
20 MHz, QPSK, Port B	2145.0	17.842	18.450
20 MHz, QPSK, Port B	2170.0	17.841	18.450

Table 8.5-2: *Occupied bandwidth, WCDMA results*

Remarks	Frequency, MHz	99% OBW, MHz	26 dB BW, MHz
5 MHz, QPSK, Port A	2112.5	4.1690	4.664
5 MHz, QPSK, Port A	2132.5	4.1690	4.667
5 MHz, QPSK, Port A	2152.5	4.1678	4.665
5 MHz, QPSK, Port B	2112.5	4.1754	4.660
5 MHz, QPSK, Port B	2132.5	4.1589	4.659
5 MHz, QPSK, Port B	2152.5	4.1685	4.654

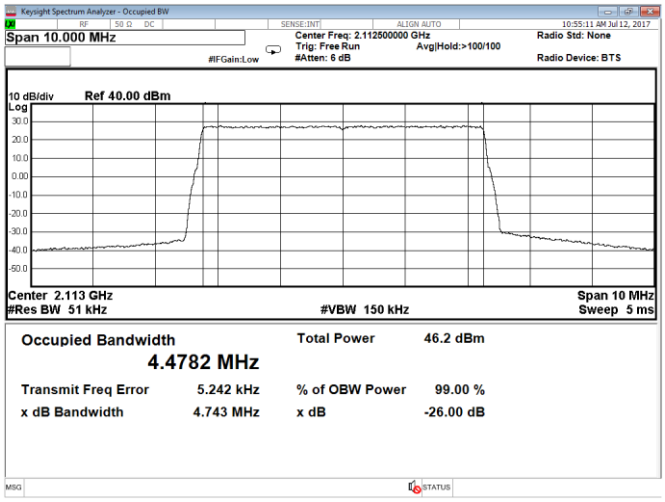


Figure 8.5-1: *Occupied bandwidth, QPSK, LTE, 5 MHz, Port A, Low channel*

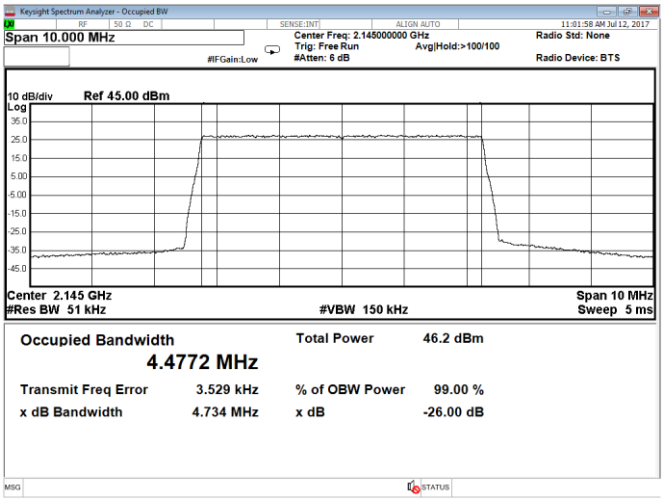


Figure 8.5-2: *Occupied bandwidth, QPSK, LTE, 5 MHz, Port A, Mid channel*

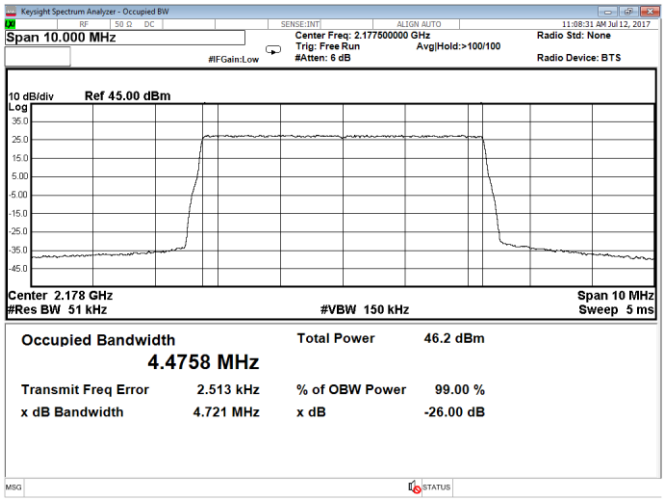


Figure 8.5-3: *Occupied bandwidth, QPSK, LTE, 5 MHz, Port A, High channel*

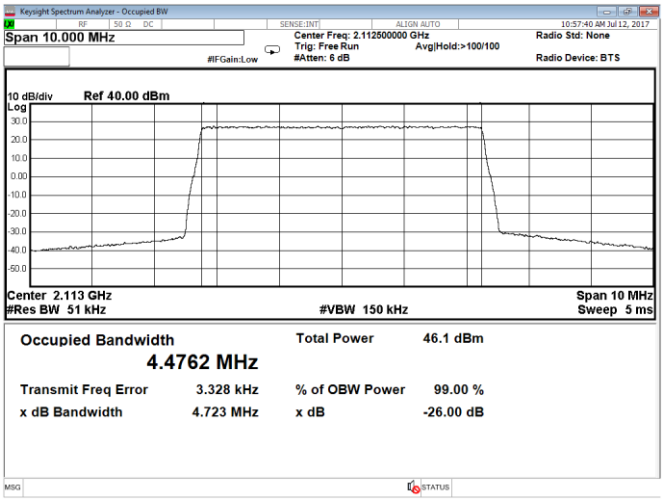


Figure 8.5-4: *Occupied bandwidth, QPSK, LTE, 5 MHz, Port B, Low channel*

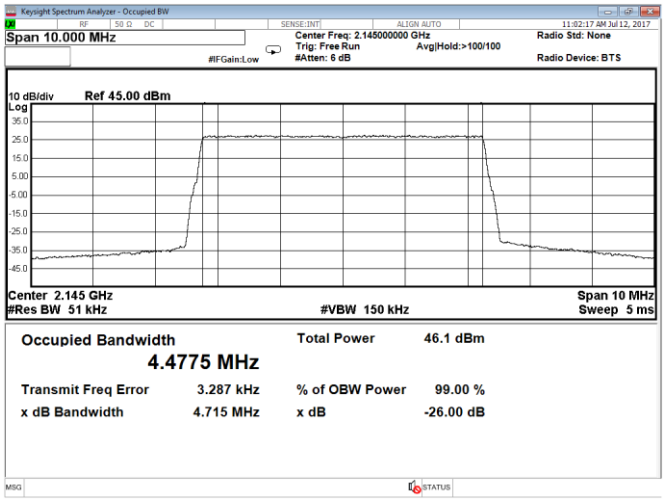


Figure 8.5-5: *Occupied bandwidth, QPSK, LTE, 5 MHz, Port B, Mid channel*

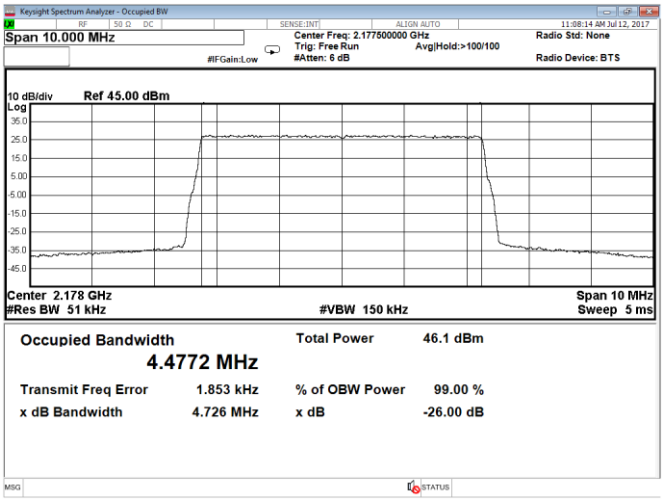


Figure 8.5-6: *Occupied bandwidth, QPSK, LTE, 5 MHz, Port B, High channel*

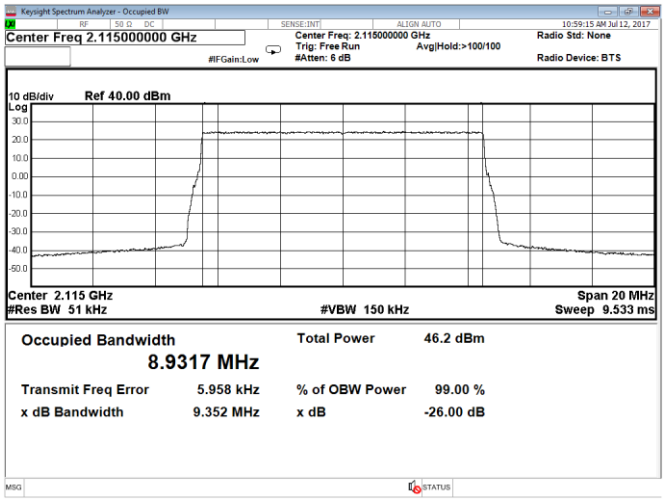


Figure 8.5-7: *Occupied bandwidth, QPSK, LTE, 10 MHz, Port A, Low channel*

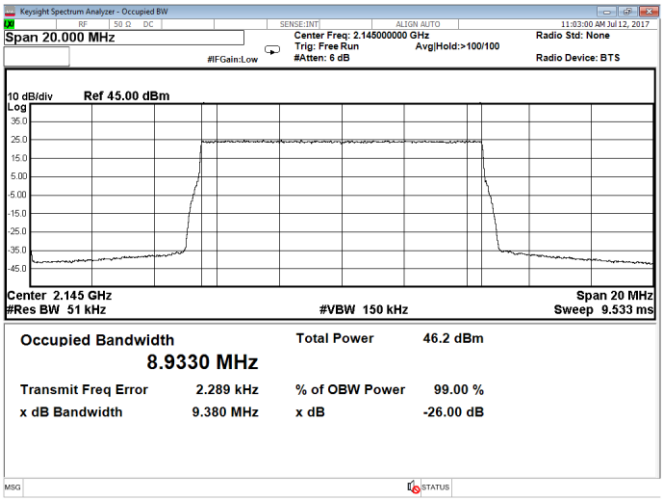


Figure 8.5-8: *Occupied bandwidth, QPSK, LTE, 10 MHz, Port A, Mid channel*

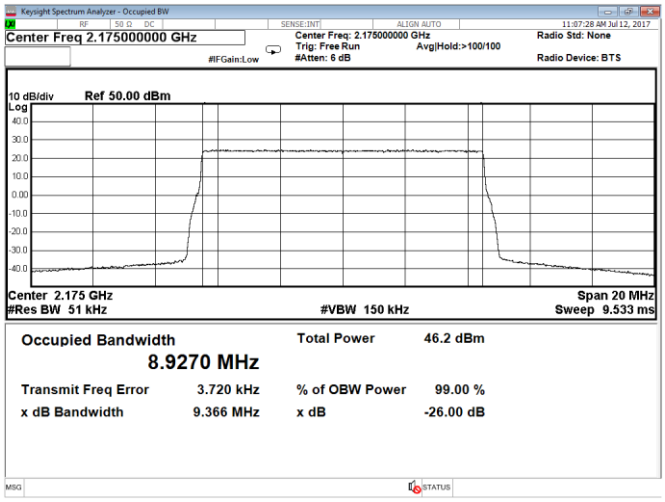


Figure 8.5-9: *Occupied bandwidth, QPSK, LTE, 10 MHz, Port A, High channel*

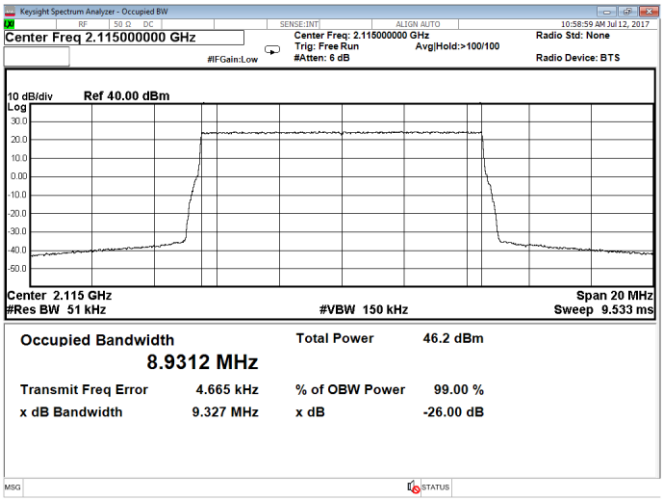


Figure 8.5-10: *Occupied bandwidth, QPSK, LTE, 10 MHz, Port B, Low channel*

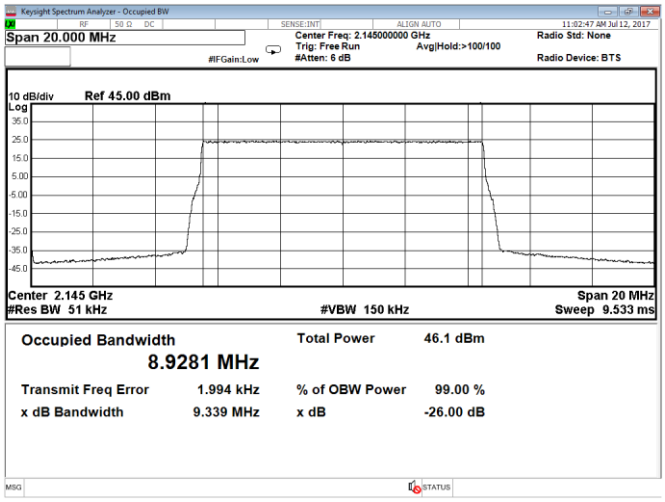


Figure 8.5-11: *Occupied bandwidth, QPSK, LTE, 10 MHz, Port B, Mid channel*

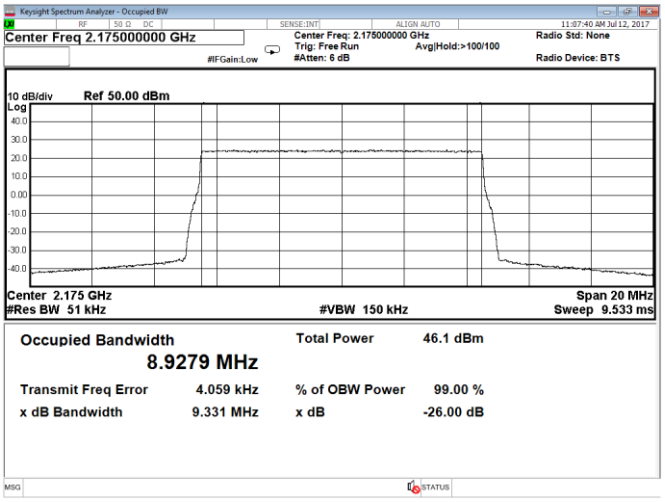


Figure 8.5-12: *Occupied bandwidth, QPSK, LTE, 10 MHz, Port B, High channel*

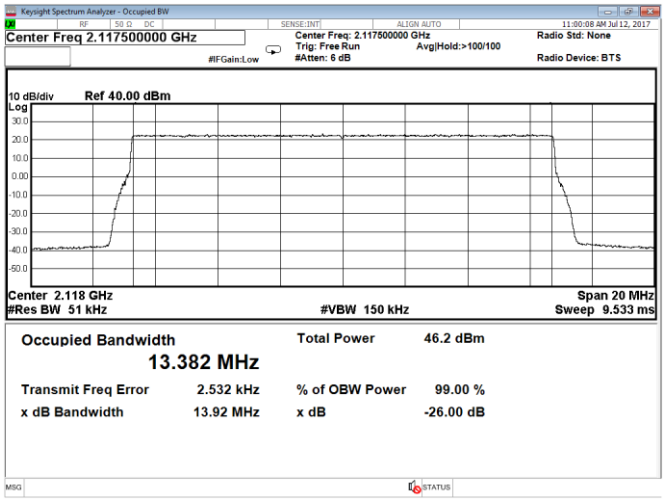


Figure 8.5-13: *Occupied bandwidth, QPSK, LTE, 15 MHz, Port A, Low channel*

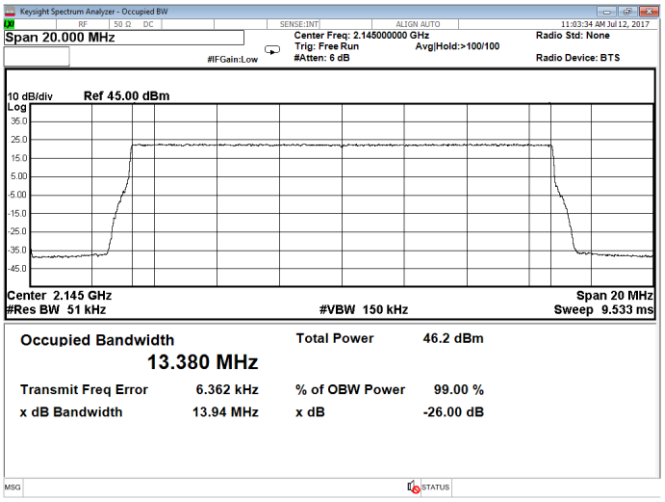


Figure 8.5-14: *Occupied bandwidth, QPSK, LTE, 15 MHz, Port A, Mid channel*

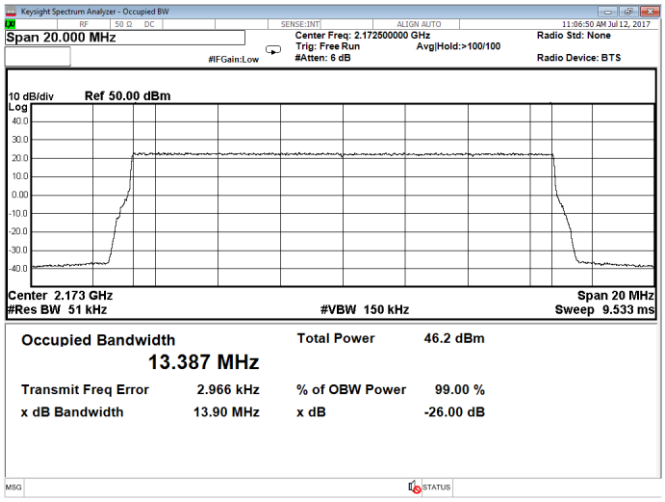


Figure 8.5-15: *Occupied bandwidth, QPSK, LTE, 15 MHz, Port A, High channel*

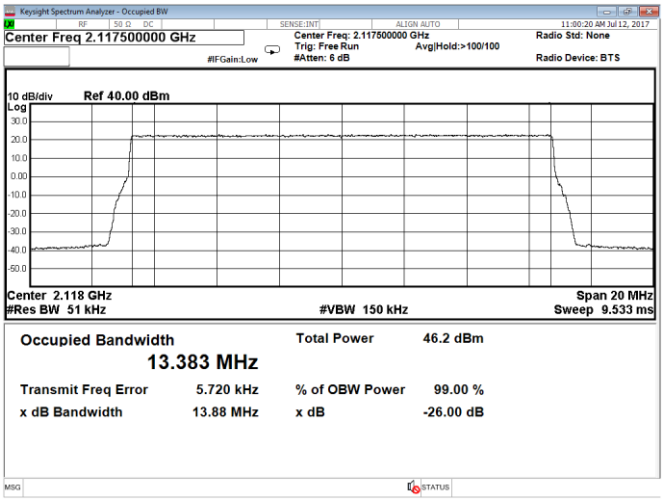


Figure 8.5-16: *Occupied bandwidth, QPSK, LTE, 15 MHz, Port B, Low channel*

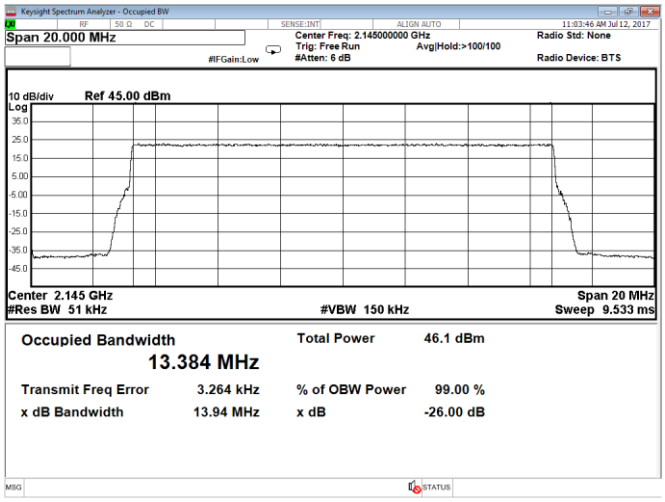


Figure 8.5-17: *Occupied bandwidth, QPSK, LTE, 15 MHz, Port B, Mid channel*

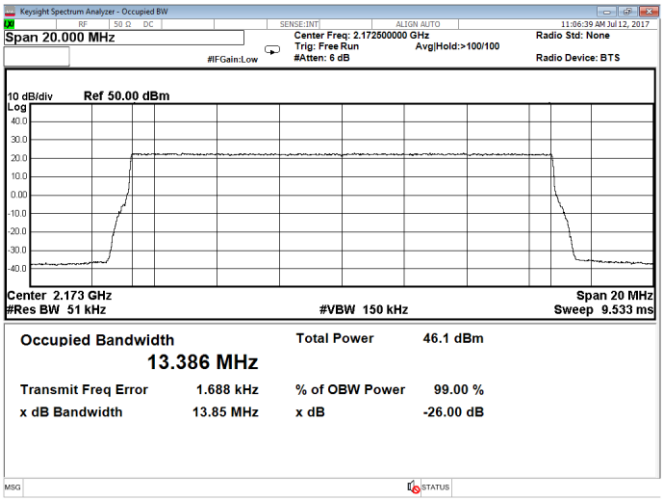


Figure 8.5-18: *Occupied bandwidth, QPSK, LTE, 15 MHz, Port B, High channel*

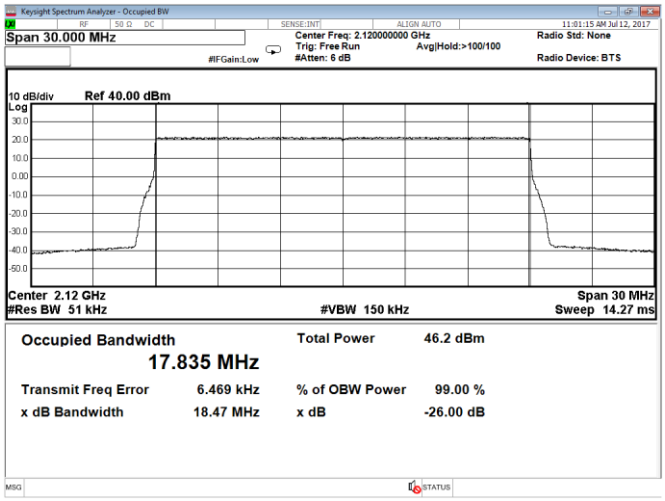


Figure 8.5-19: *Occupied bandwidth, QPSK, LTE, 20 MHz, Port A, Low channel*

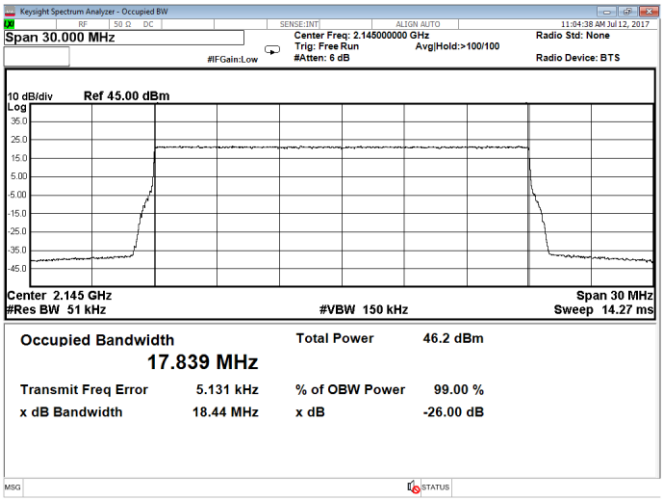


Figure 8.5-20: *Occupied bandwidth, QPSK, LTE, 20 MHz, Port A, Mid channel*

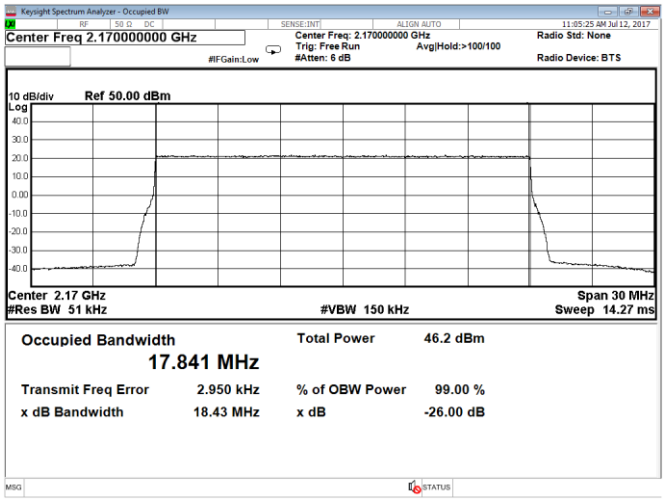


Figure 8.5-21: *Occupied bandwidth, QPSK, LTE, 20 MHz, Port A, High channel*

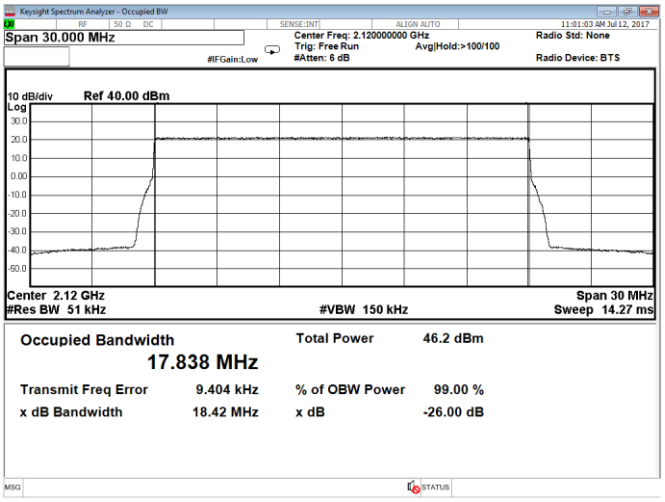


Figure 8.5-22: *Occupied bandwidth, QPSK, LTE, 20 MHz, Port B, Low channel*

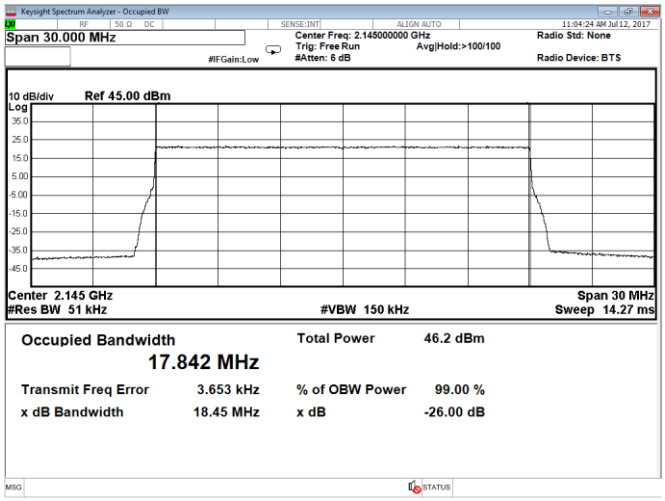


Figure 8.5-23: *Occupied bandwidth, QPSK, LTE, 20 MHz, Port B, Mid channel*

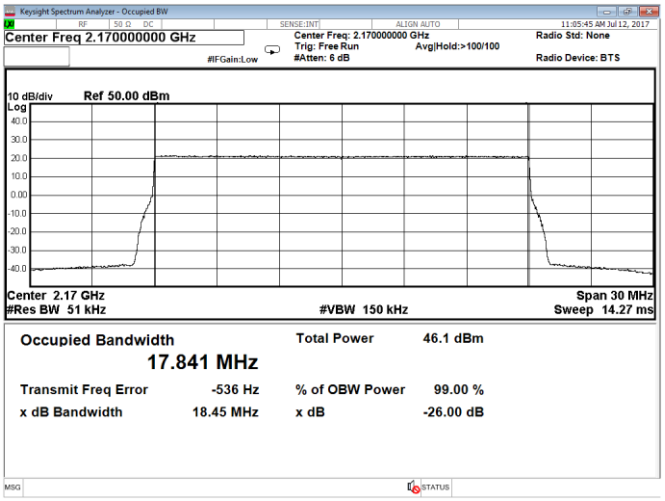


Figure 8.5-24: *Occupied bandwidth, QPSK, LTE, 20 MHz, Port B, High channel*

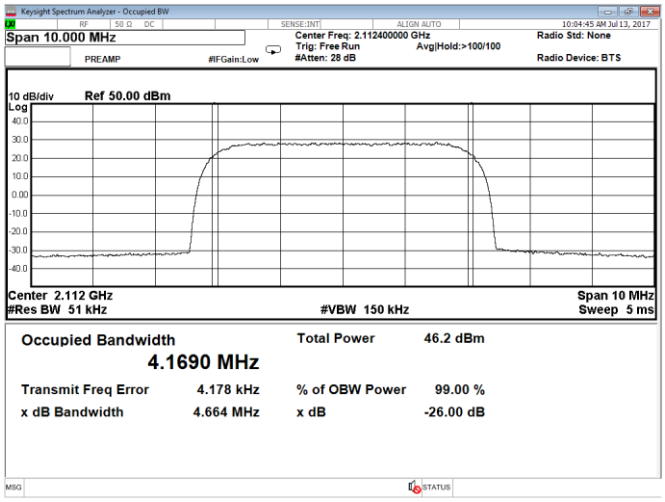


Figure 8.5-25: *Occupied bandwidth, QPSK, WCDMA, 5 MHz, Port A, Low channel*

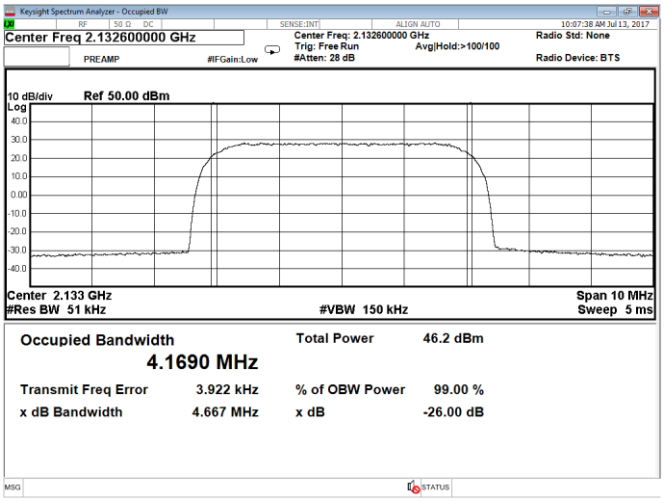


Figure 8.5-26: *Occupied bandwidth, QPSK, WCDMA, 5 MHz, Port A, Mid channel*

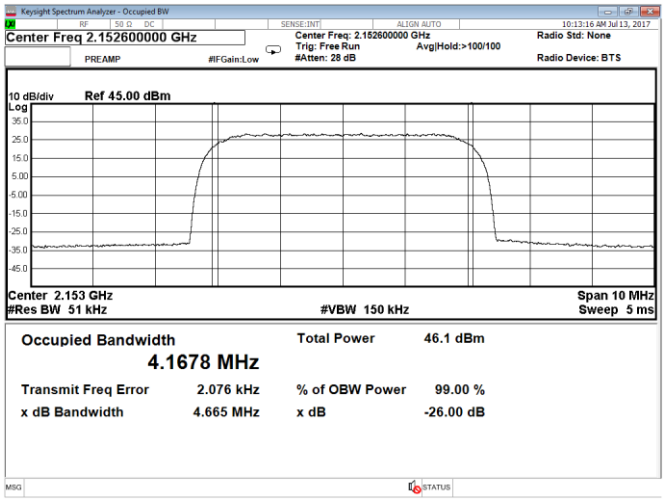


Figure 8.5-27: *Occupied bandwidth, QPSK, WCDMA, 5 MHz, Port A, High channel*

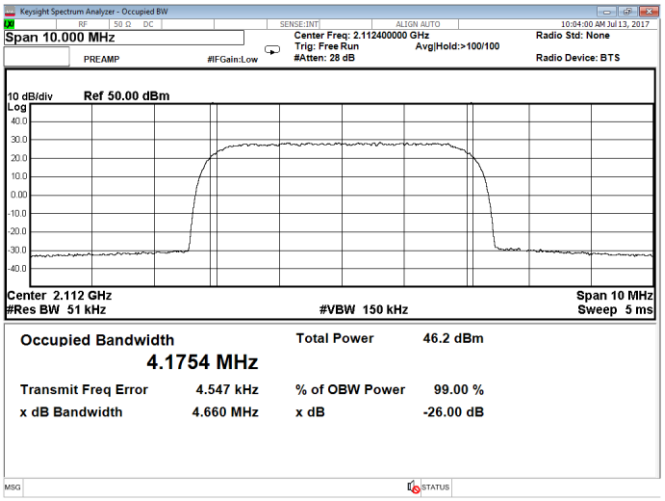


Figure 8.5-28: *Occupied bandwidth, QPSK, WCDMA, 5 MHz, Port B, Low channel*

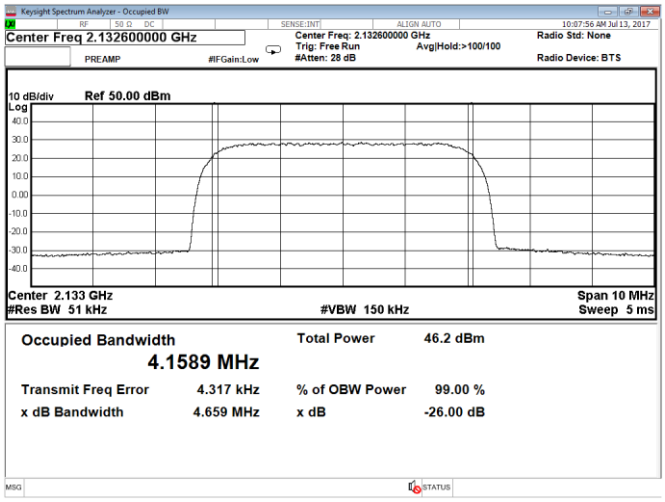


Figure 8.5-29: *Occupied bandwidth, QPSK, WCDMA, 5 MHz, Port B, Mid channel*

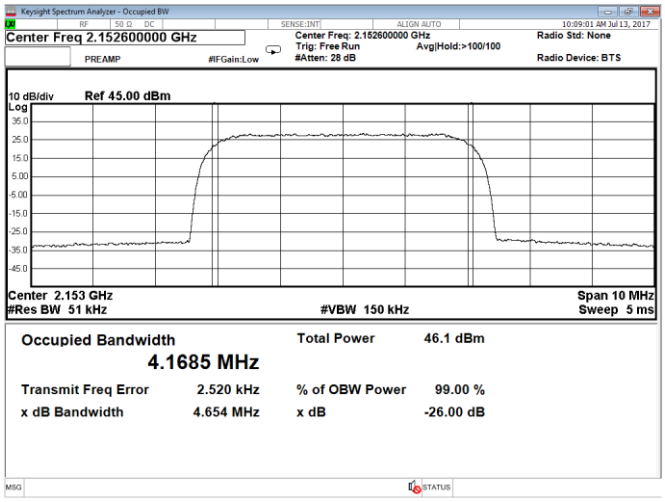


Figure 8.5-30: *Occupied bandwidth, QPSK, WCDMA, 5 MHz, Port B, High channel*

8.6 RSS-Gen, 7.1.3 Receiver conducted limits

8.6.1 Definitions and limits

If the receiver has a detachable antenna of known impedance, an antenna-conducted spurious emissions measurement is permitted as an alternative to radiated measurement. However, the radiated method of Section 7.1.2 is preferred.

The antenna-conducted test shall be performed with the antenna disconnected and with the receiver antenna terminals connected to a measuring instrument having equal impedance to that specified for the antenna.

The receiver-spurious emissions measured at the antenna terminals by the antenna-conducted method shall then comply with the following limits:

Receiver-spurious emissions at any discrete frequency shall not exceed 2 nW in the band 30–1000 MHz, nor 5 nW above 1000 MHz.

8.6.2 Test summary

Test date	July 13, 2017	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1009 mbar
Verdict	Pass	Relative humidity	33 %

8.6.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	120 kHz (below 1 GHz), 1 MHz (above 1 GHz)
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.6.4 Test data

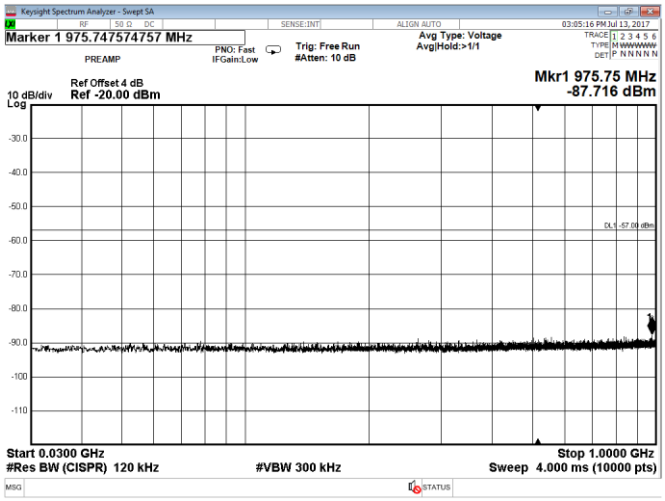


Figure 8.6-1: *Receiver spurious emissions at port A, below 1 GHz*

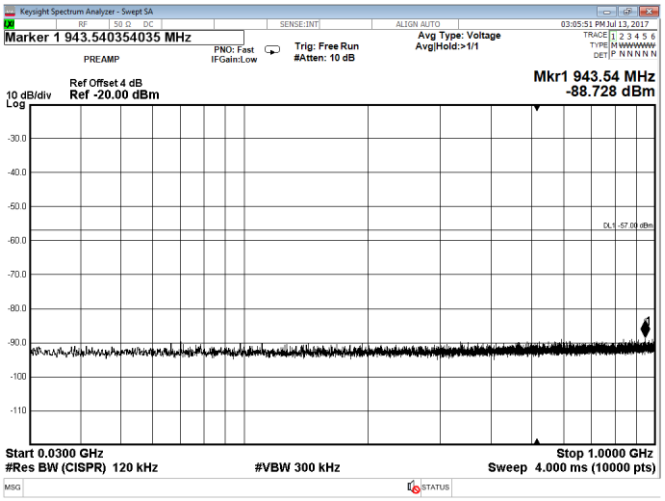


Figure 8.6-2: *Receiver spurious emissions at Port B, below 1 GHz*

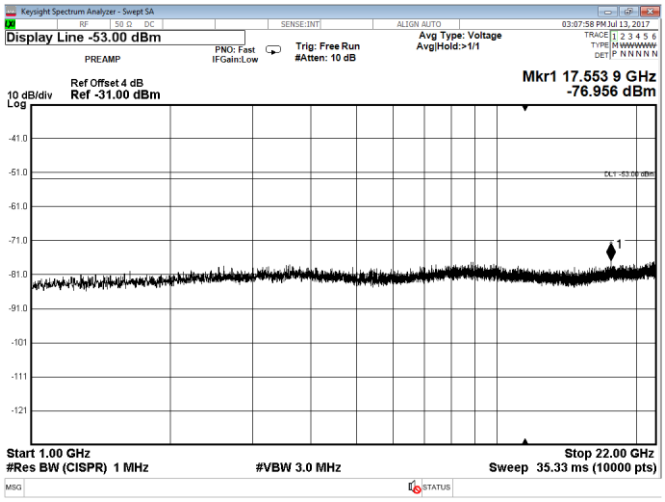


Figure 8.6-3: *Receiver spurious emissions at port A, above 1 GHz*

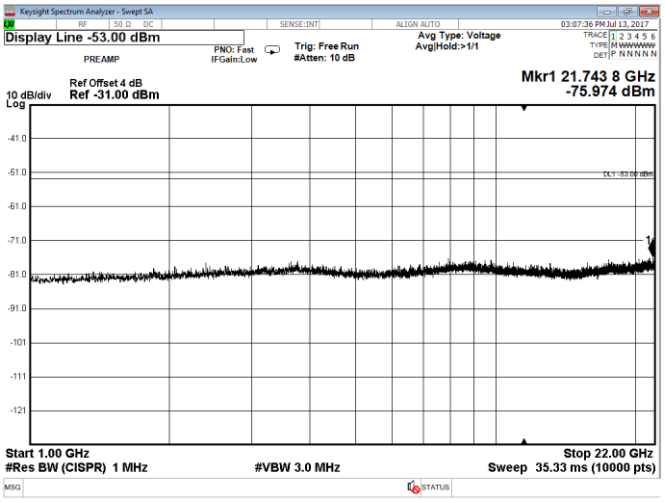
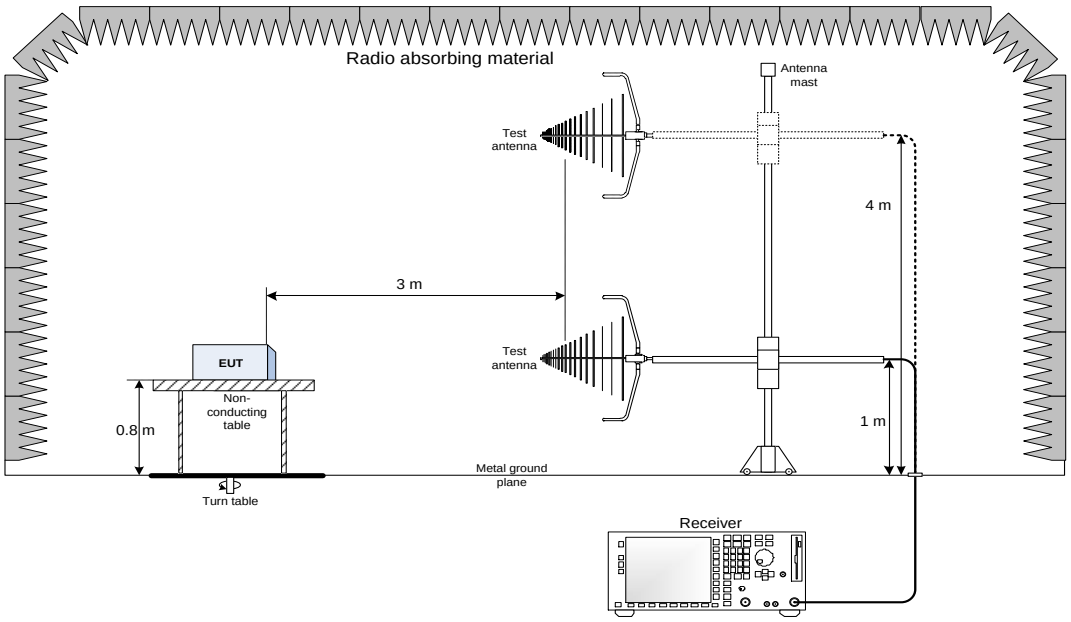


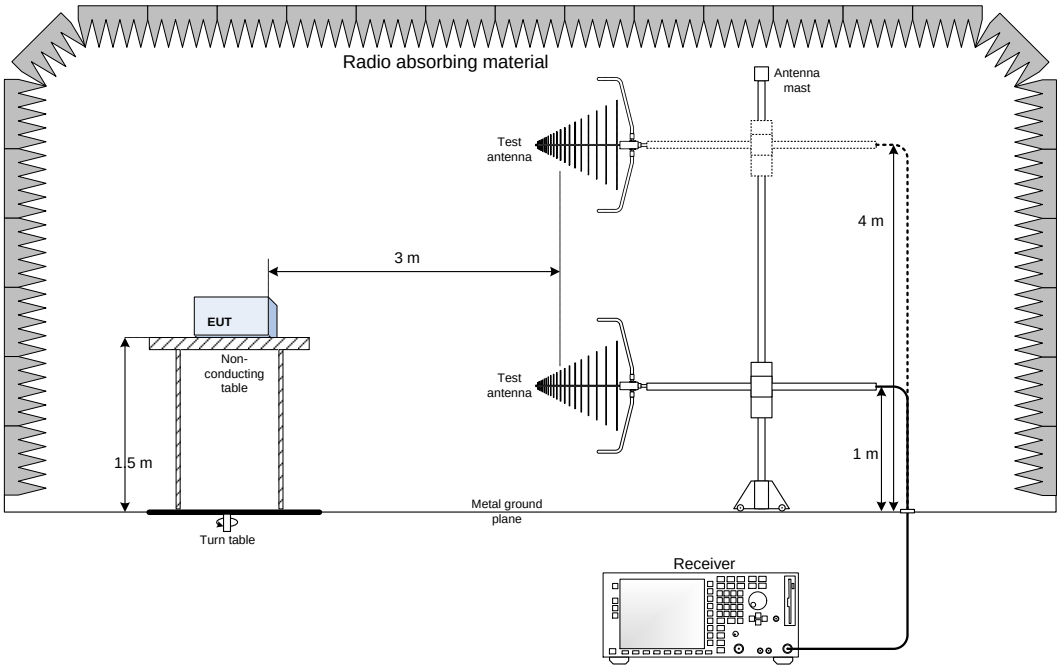
Figure 8.6-4: *Receiver spurious emissions at Port B, above 1 GHz*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up