8.5 Results LTE – Band 13

The EUT was set to transmit the maximum power.

8.5.1 RF output power

Description:

This paragraph contains average power, peak output power and EIRP measurements for the mobile station. In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Peak and RMS (Power in Burst)
Sweep time:	Auto
Video bandwidth:	Depends on Channel Bandwidth
Resolution bandwidth:	Depends on Channel Bandwidth
Span:	Zero Span
Trace-Mode:	Max Hold

Limits:

FCC	-/-
Nominal Peak Output Power	
+33.00 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

Results:

Output Power (conducted)						
Bandwidth (MHz)	**Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Peak to Average Ratio (dB)**	**Average Output Power (dBm) 16-QAM**	**Peak to Average Ratio (dB)**
5	779.5	1 RB low	23.8	4.53	22.9	5.22
		1 RB high	23.8	4.69	22.7	5.36
		50% RB mid	22.7	4.91	21.7	5.79
		100% RB	22.7	5.76	21.7	6.48
	782	1 RB low	23.6	4.67	22.9	4.68
		1 RB high	23.7	4.59	23.0	4.63
		50% RB mid	22.7	5.89	21.7	5.02
		100% RB	22.7	6.72	21.7	5.64
	784.5	1 RB low	23.7	4.74	22.4	5.70
		1 RB high	23.9	4.52	22.8	5.17
		50% RB mid	22.7	4.89	21.7	5.75
		100% RB	22.7	5.59	21.7	6.54
10	782.0	1 RB low	23.9	5.59	22.7	4.57
		1 RB high	23.9	5.23	22.7	4.47
		50% RB mid	22.7	5.89	21.6	5.03
		100% RB	22.7	6.93	21.6	6.04
Measurement uncertainty			± 0.5 dB			

The output power radiated is measured with the mode wich have the highest conducted output power.

Output Power (radiated)			
Bandwidth (MHz)	**Frequency (MHz)**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**
5	779.5	18.6	17.7
	782.0	18.1	17.4
	784.5	18.7	17.6
10	782.0	18.7	17.5
Measurement uncertainty		± 3.0 dB	

Result: Passed

8.5.2 Frequency stability

Description:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a “call mode”. This is accomplished with the use of a R&S CMW500 DIGITAL RADIOCOMMUNICATION TESTER.
1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom}, connected to the CMW500 and in a simulated call on channel 1412 (centre channel), measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +60°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps remeasuring carrier frequency at each voltage. Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

This measurement was performed with the highest channel bandwidth supported from the EUT on the middle channel

Measurement:

Measurement parameters	
Detector:	Measured with CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	

Limits:

FCC	-/-
Frequency Stability	
< 2.5 ppm	

Results:

FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
3.3	2	0.00000026	0.0026
3.4	-2	-0.00000026	-0.0026
3.5	-6	-0.00000077	-0.0077
3.6	-4	-0.00000051	-0.0051
3.7	3	0.00000038	0.0038
3.8	-3	-0.00000038	-0.0038
3.9	4	0.00000051	0.0051
4.0	-1	-0.00000013	-0.0013
4.1	-6	-0.00000077	-0.0077
4.2	-3	-0.00000038	-0.0038
4.3	2	0.00000026	0.0026
4.4	-2	-0.00000026	-0.0026

FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	7	0.00000090	0.0090
-20	8	0.00000102	0.0102
-10	7	0.00000090	0.0090
± 0	2	0.00000026	0.0026
10	7	0.00000090	0.0090
20	4	0.00000051	0.0051
30	1	0.00000013	0.0013
40	-5	-0.00000064	-0.0064
50	1	0.00000013	0.0013
60	8	0.00000102	0.0102

Additional measurements for RSS-130 (4.3 b)

f_L =777.057 MHz	f_H = 786.945 MHz
f_L – (max freq. error) = 777.057 MHz	f_H + (max freq. error) = 786.945 MHz

Result: **Passed**

8.5.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2009 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 784.5 MHz. This was rounded up to 12.75 GHz. The resolution bandwidth is set as outlined in Part 27.53. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE band 13.

The final open field emission (here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
b) The antenna output was terminated in a 50 ohm load (if possible).
c) A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
d) Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded. The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters.
e) Now each detected emissions were substituted by the substitution method, in accordance with the TIA/EIA 603.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 s
Video bandwidth:	below 150 kHz: 200 Hz 150 kHz ≤ f < 30 MHz: 9 kHz 30 MHz ≤ f < 700 MHz: 100 kHz Above 700 MHz: 1 MHz
Resolution bandwidth:	below 150 kHz: 200 Hz 150 kHz ≤ f < 30 MHz: 9 kHz 30 MHz ≤ f < 700 MHz: 100 kHz Above 700 MHz: 1 MHz
Span:	100 MHz Steps
Trace-Mode:	Max Hold

Limits:

FCC	-/-
Spurious Emissions Radiated	
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
additional for RSS-130: Attenuation ≥ 65 + 10log(P) in any 6.25 kHz (P, Power in Watts)	
-13 dBm*	

Results:

Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the LTE band 13 (779.5 MHz, 782.0 MHz and 784.5 MHz). It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the LTE band 13 into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

The final open field radiated levels are presented on the next pages.
All measurements were done in horizontal and vertical polarization; the plots show the worst case.
The plots show only the middle channel with full resource blocks. If spurious were detected, the lowest and highest channel and all supported channel bandwidths were checked, too.

As can be seen from this data, the emissions from the test item were within the specification limit.

The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

65 + 10 log10 p(watts), dB, for mobile and portable equipment.

Additional information focusing limit line conversion:

* Attenuation ≥ 65 + 10log(P) in any 6.25 kHz = -35 dBm in any 6.25 kHz.
Measurement is made with 1 MHz RBW → 10*log(6.25/1000)=-22 dB.

-35 dBm – (-22dB) = -13dBm

QPSK

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1564.0	No peaks detected.	1564.0	No peaks detected.	1564.0	No peaks detected.
2346.0		2346.0		2346.0	
3128.0		3128.0		3128.0	
3910.0		3910.0		3910.0	
4692.0		4692.0		4692.0	
5474.0		5474.0		5474.0	
6256.0		6256.0		6256.0	
7038.0		7038.0		7038.0	
7820.0		7820.0		7820.0	
Measurement uncertainty			± 3dB		

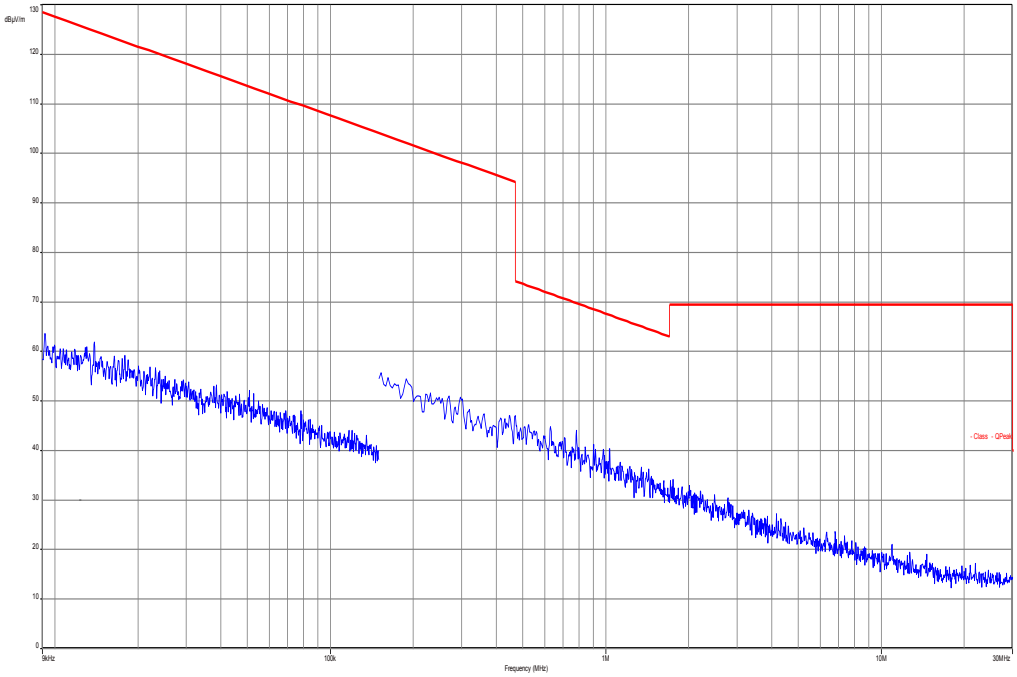
16-QAM

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1564.0	No peaks detected.	1564.0	No peaks detected.	1564.0	No peaks detected.
2346.0		2346.0		2346.0	
3128.0		3128.0		3128.0	
3910.0		3910.0		3910.0	
4692.0		4692.0		4692.0	
5474.0		5474.0		5474.0	
6256.0		6256.0		6256.0	
7038.0		7038.0		7038.0	
7820.0		7820.0		7820.0	
Measurement uncertainty			± 3dB		

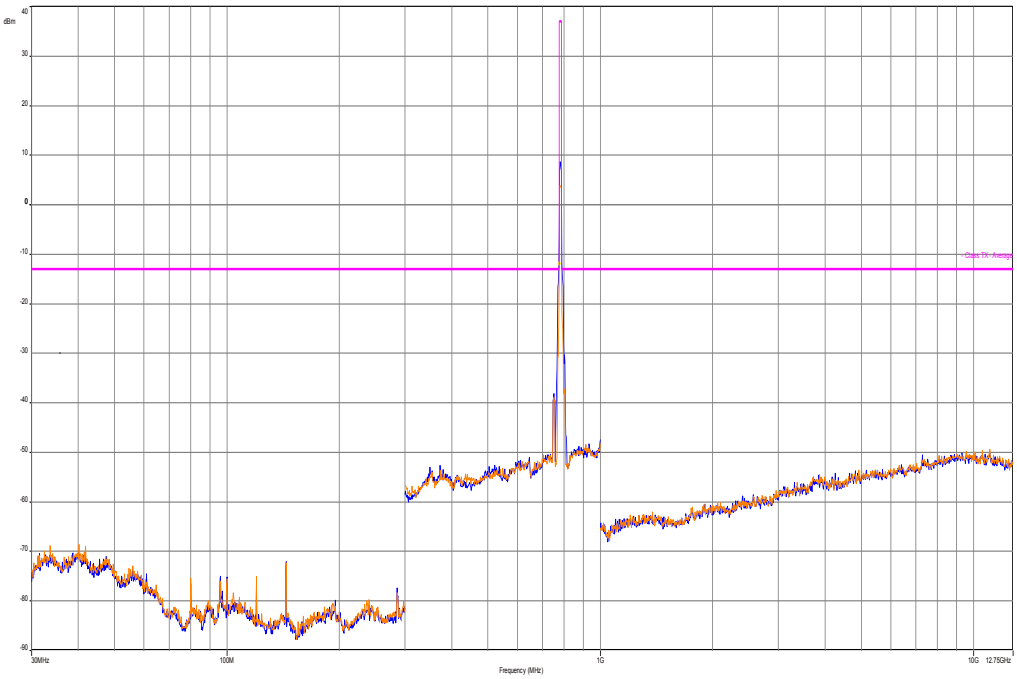
Result: Passed

QPSK with 10 MHz channel bandwidth

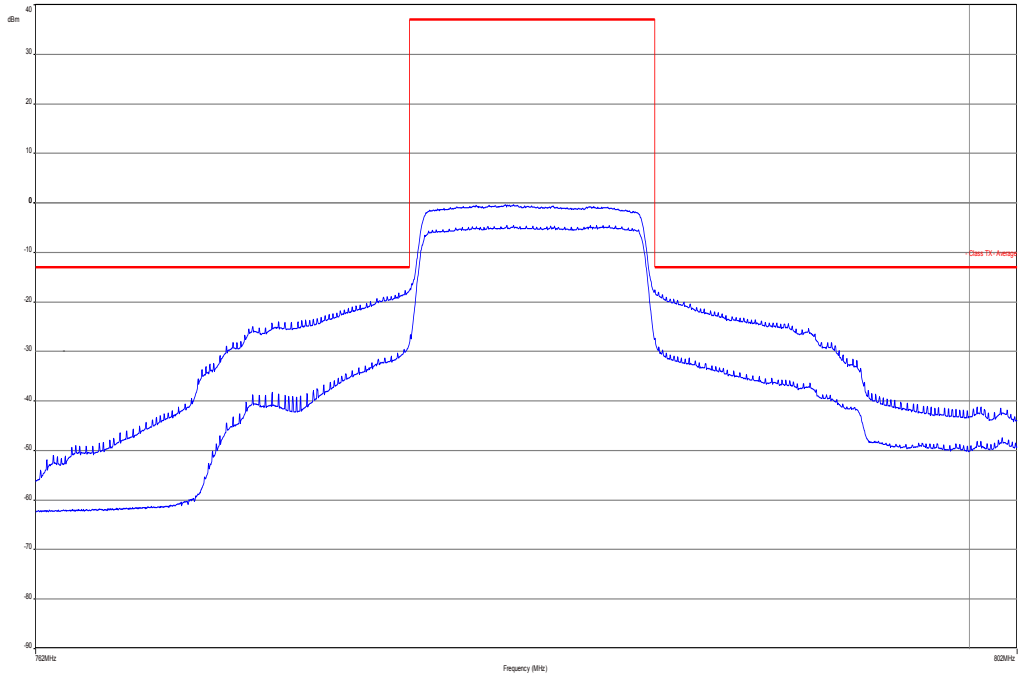
Plot 1: Middle channel, up to 30 MHz



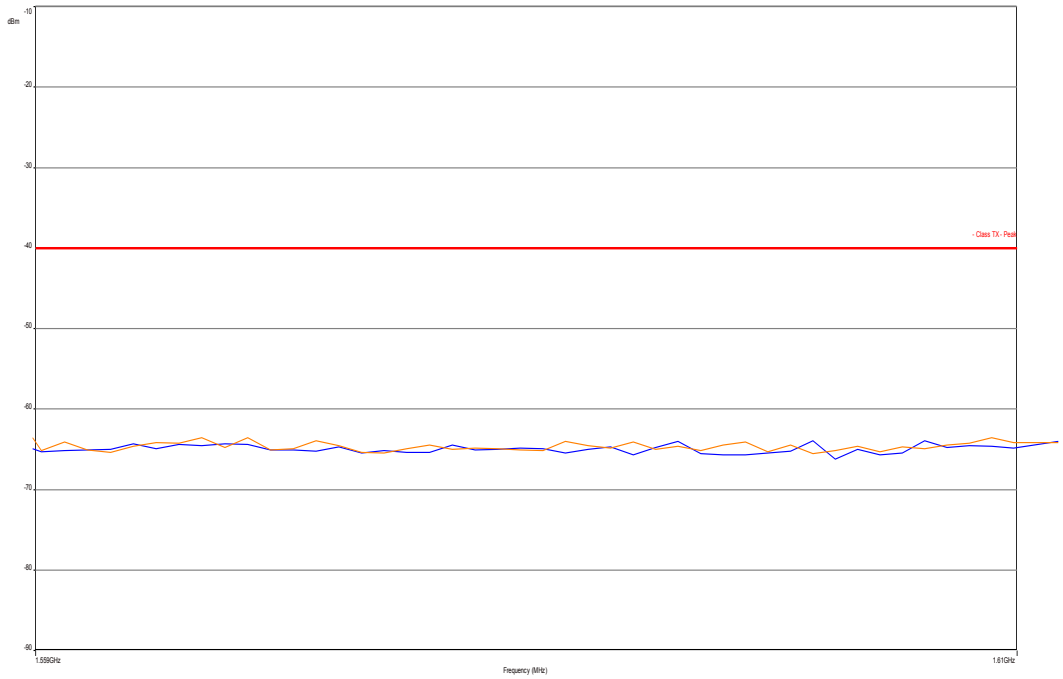
Plot 2: Middle channel, 30 MHz to 12.75 GHz



Plot 3: Middle channel, band zoom, AVG

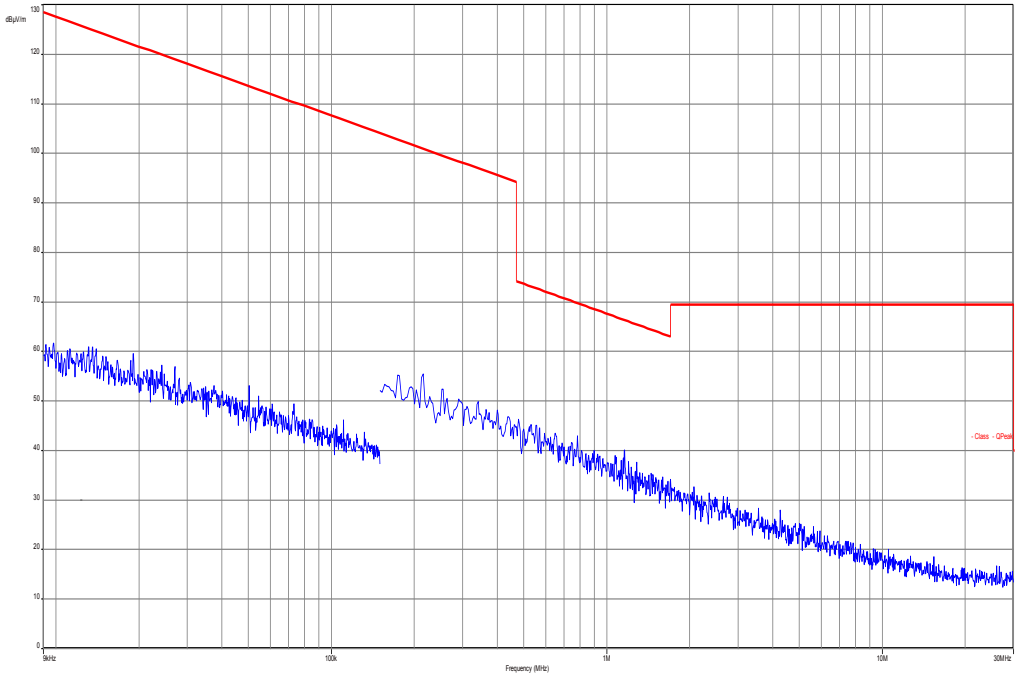


Plot 4: Middle channel, Special band: 1559 MHz to 1610 MHz

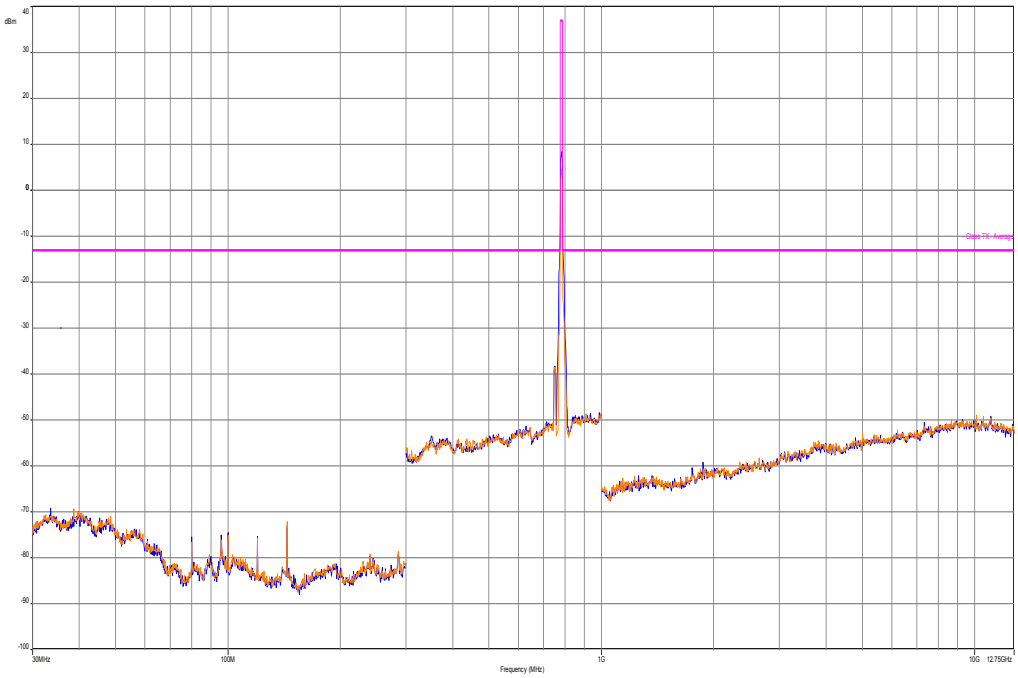


16-QAM with 10 MHz channel bandwidth

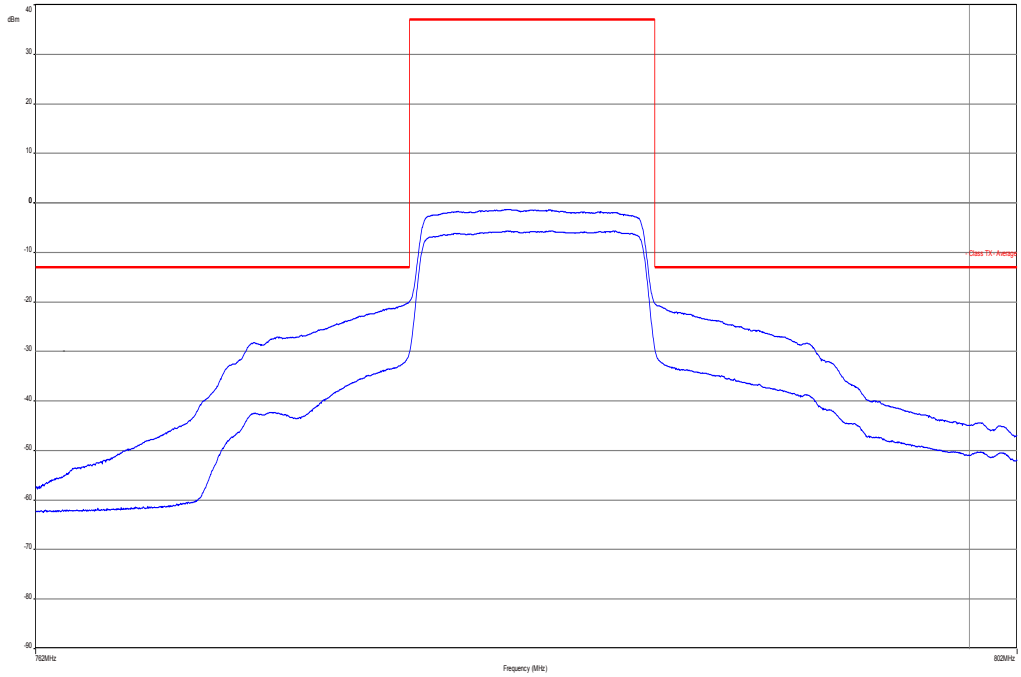
Plot 5: Middle channel, up to 30 MHz



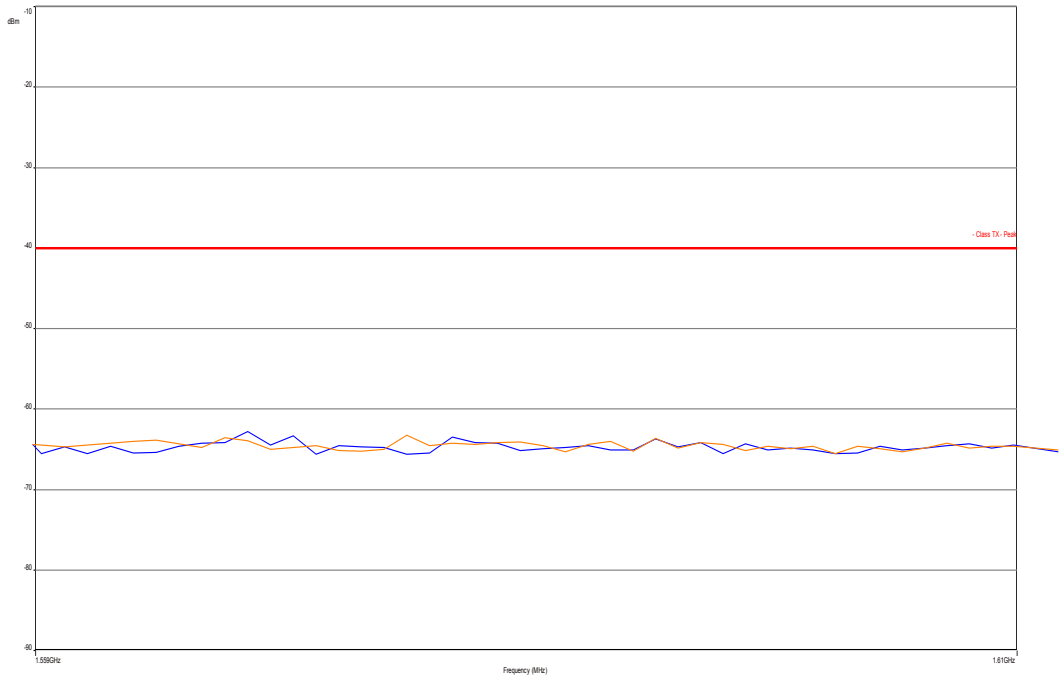
Plot 6: Middle channel, 30 MHz to 12.75 GHz



Plot 7: Middle channel, band zoomed, AVG



Plot 8: Middle channel, Special band: 1559 MHz to 1610 MHz



8.5.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.
1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested data taken from 30 MHz to 25 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Resolution bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Span:	30 MHz – 25 GHz
Trace-Mode:	Max Hold

Limits:

FCC	-/-
Spurious Emissions Conducted	
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Results: for 5 MHz channel bandwidth

QPSK

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1559.0	No spurious emissions detected!	1564.0	No spurious emissions detected!	1569.0	No spurious emissions detected!
2338.5		2346.0		2353.5	
3118.0		3128.0		3138.0	
3897.5		3910.0		3922.5	
4677.0		4692.0		4707.0	
5456.5		5474.0		5491.5	
6236.0		6256.0		6276.0	
7015.5		7038.0		7060.5	
7795.0		7820.0		7845.0	
Measurement uncertainty		± 3dB			

16-QAM

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1559.0	No spurious emissions detected!	1564.0	No spurious emissions detected!	1569.0	No spurious emissions detected!
2338.5		2346.0		2353.5	
3118.0		3128.0		3138.0	
3897.5		3910.0		3922.5	
4677.0		4692.0		4707.0	
5456.5		5474.0		5491.5	
6236.0		6256.0		6276.0	
7015.5		7038.0		7060.5	
7795.0		7820.0		7845.0	
Measurement uncertainty		± 3dB			

Result: Passed

Results: for 10 MHz channel bandwidth

QPSK

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1564.0	No spurious emissions detected!	1564.0	No spurious emissions detected!	1564.0	No spurious emissions detected!
2346.0		2346.0		2346.0	
3128.0		3128.0		3128.0	
3910.0		3910.0		3910.0	
4692.0		4692.0		4692.0	
5474.0		5474.0		5474.0	
6256.0		6256.0		6256.0	
7038.0		7038.0		7038.0	
7820.0		7820.0		7820.0	
Measurement uncertainty		± 3dB			

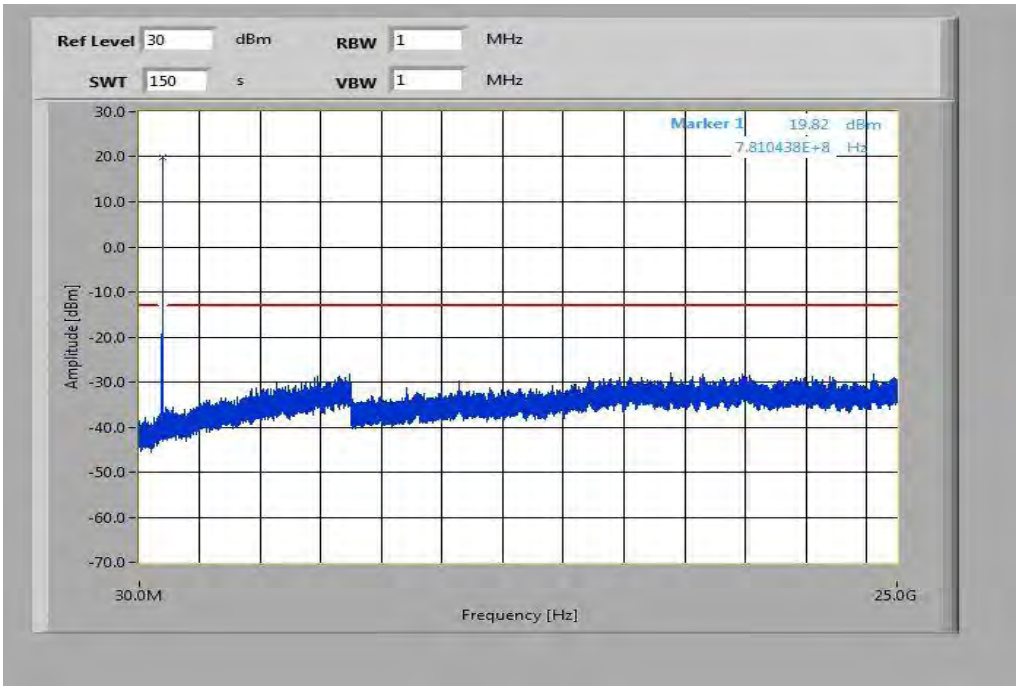
16-QAM

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1564.0	No spurious emissions detected!	1564.0	No spurious emissions detected!	1564.0	No spurious emissions detected!
2346.0		2346.0		2346.0	
3128.0		3128.0		3128.0	
3910.0		3910.0		3910.0	
4692.0		4692.0		4692.0	
5474.0		5474.0		5474.0	
6256.0		6256.0		6256.0	
7038.0		7038.0		7038.0	
7820.0		7820.0		7820.0	
Measurement uncertainty		± 3dB			

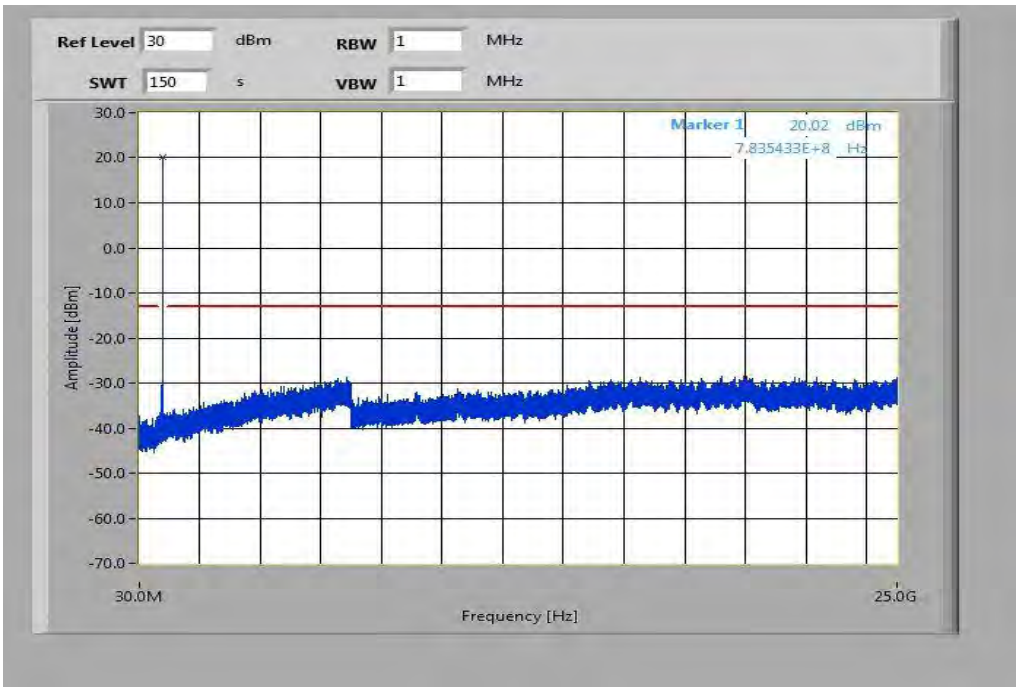
Result: Passed

Plots for 5 MHz channel bandwidth, QPSK

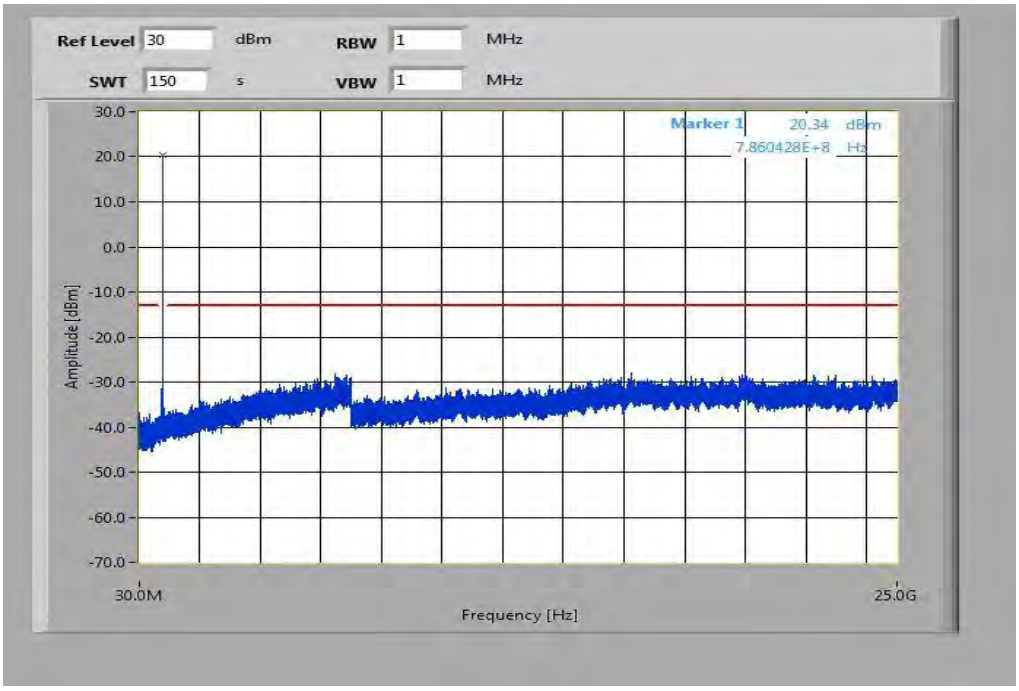
Plot 1: Lowest channel, 30 MHz to 25 GHz



Plot 2: Middle channel, 30 MHz to 25 GHz

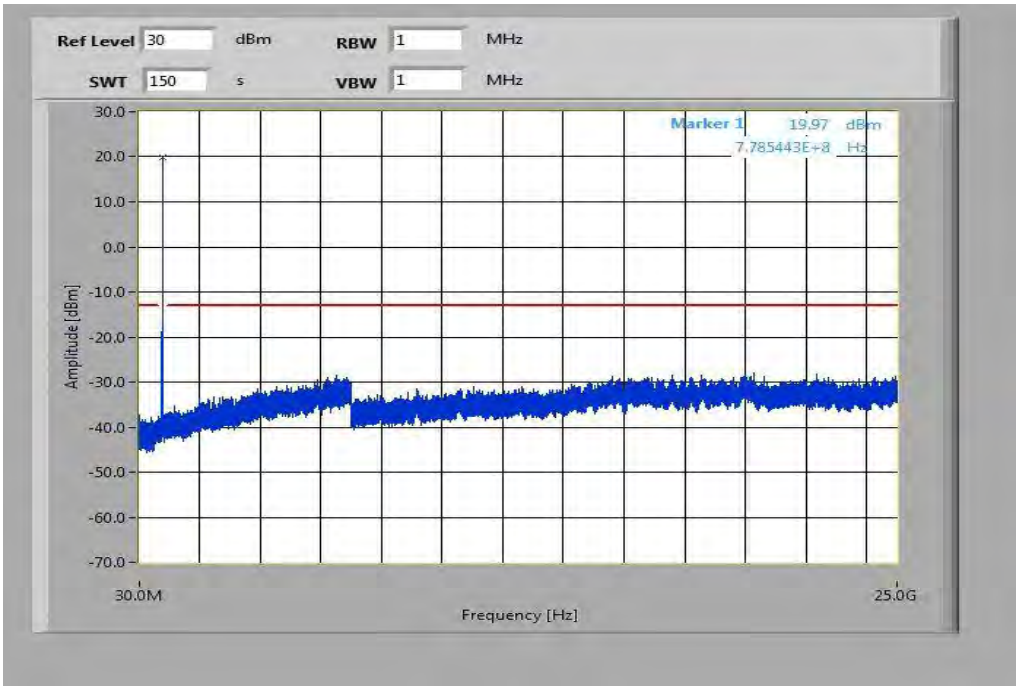


Plot 3: Highest channel, 30 MHz to 25 GHz

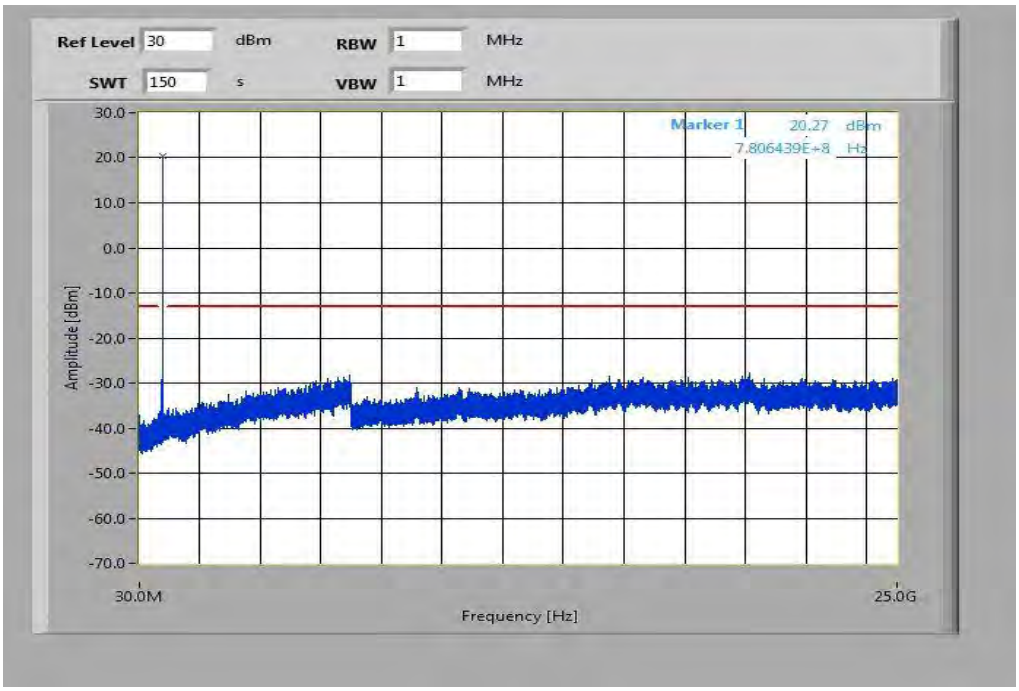


Plots for 5 MHz channel bandwidth, 16-QAM

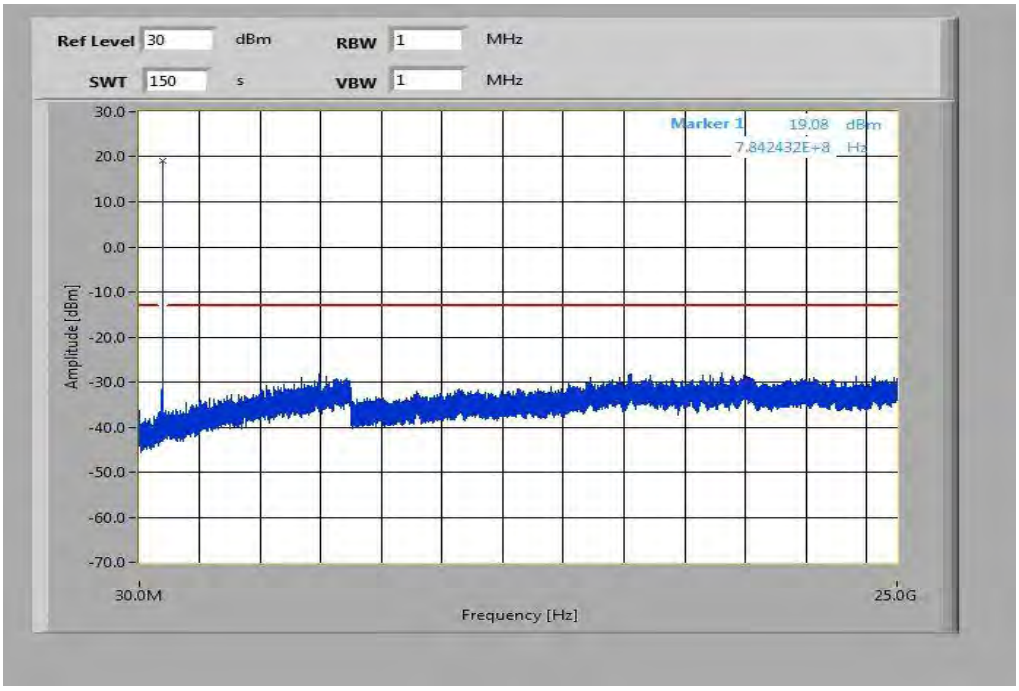
Plot 4: Lowest channel, 30 MHz to 25 GHz



Plot 5: Middle channel, 30 MHz to 25 GHz

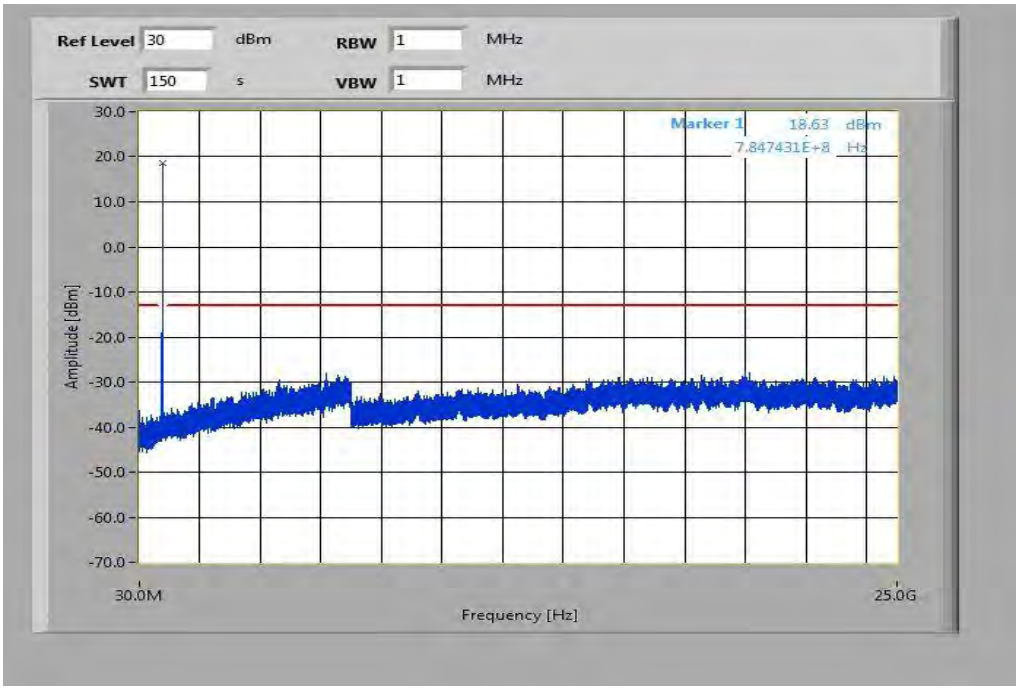


Plot 6: Highest channel, 30 MHz to 25 GHz

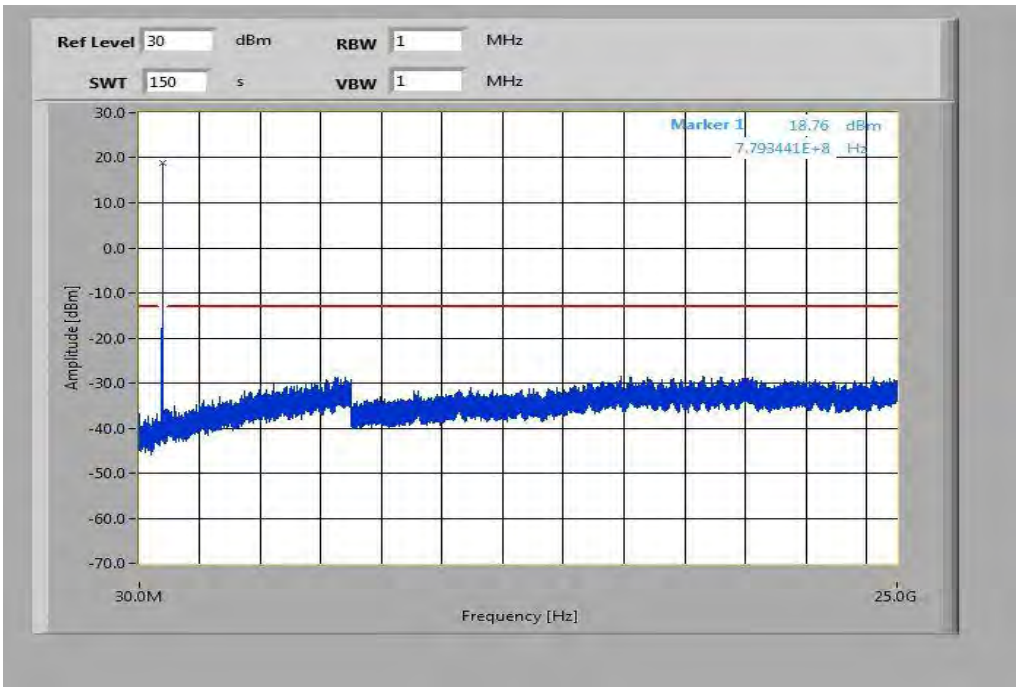


Plots for 10 MHz channel bandwidth, QPSK

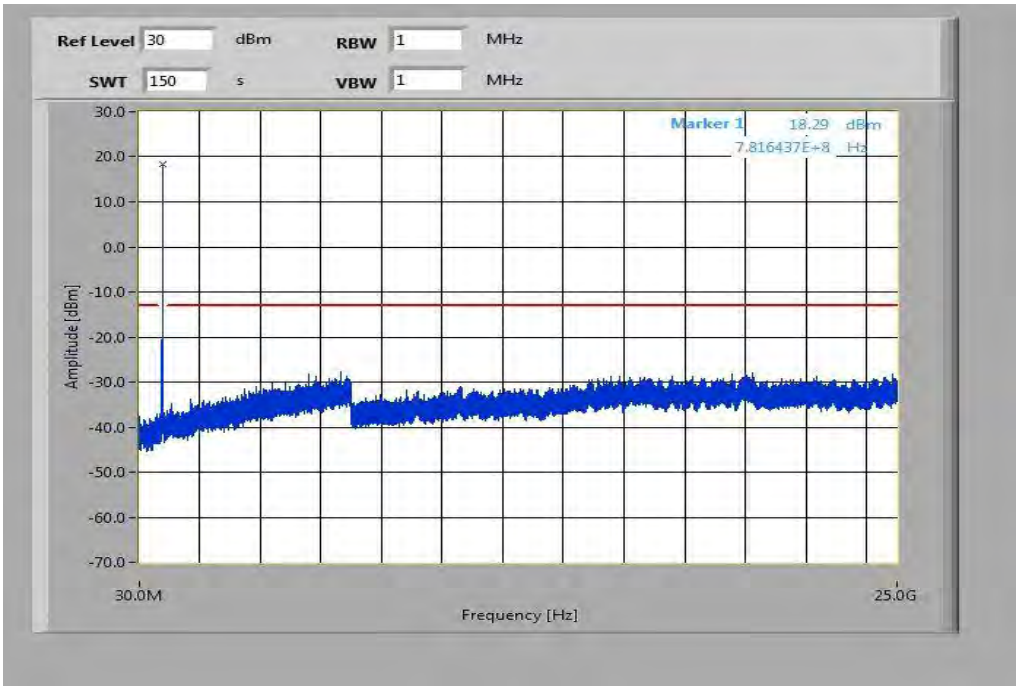
Plot 1: Lowest channel, 30 MHz to 25 GHz



Plot 2: Middle channel, 30 MHz to 25 GHz

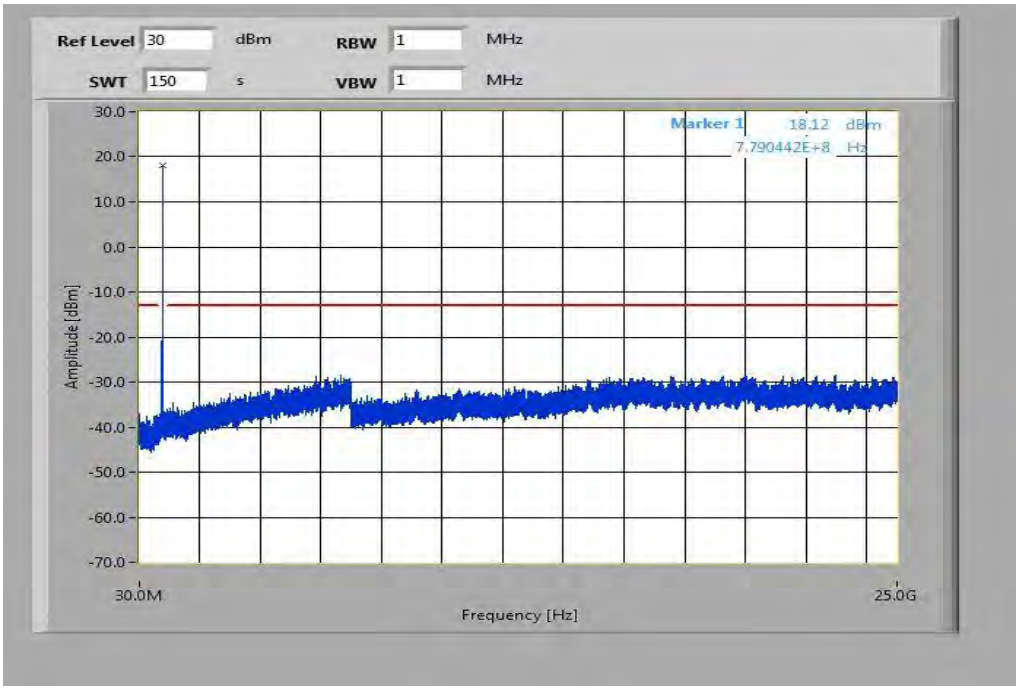


Plot 3: Highest channel, 30 MHz to 25 GHz

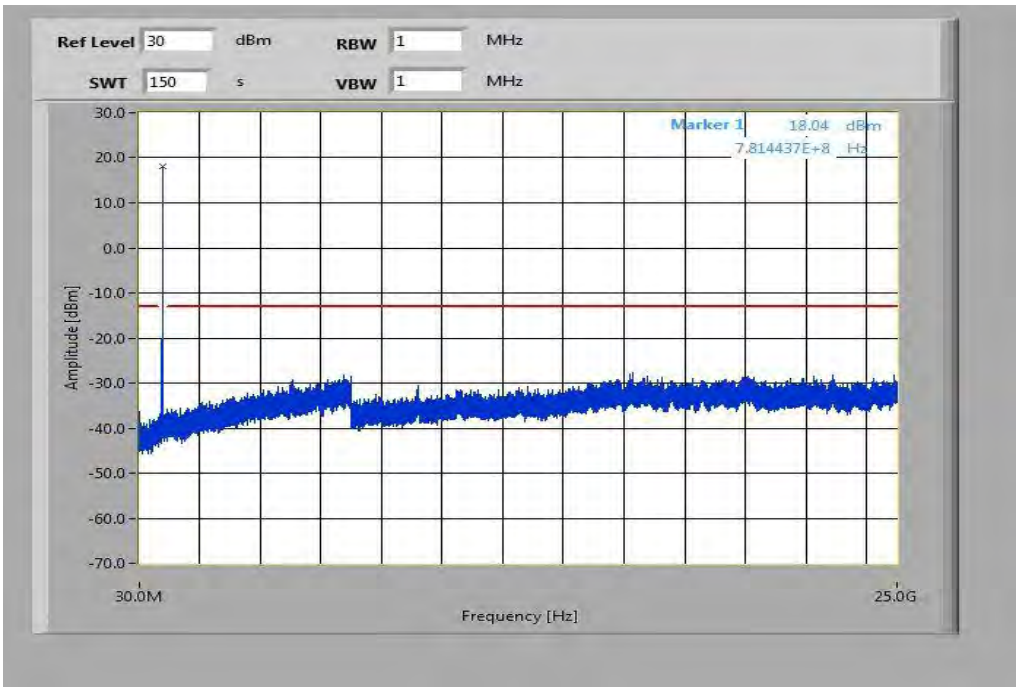


Plots for 10 MHz channel bandwidth, 16-QAM

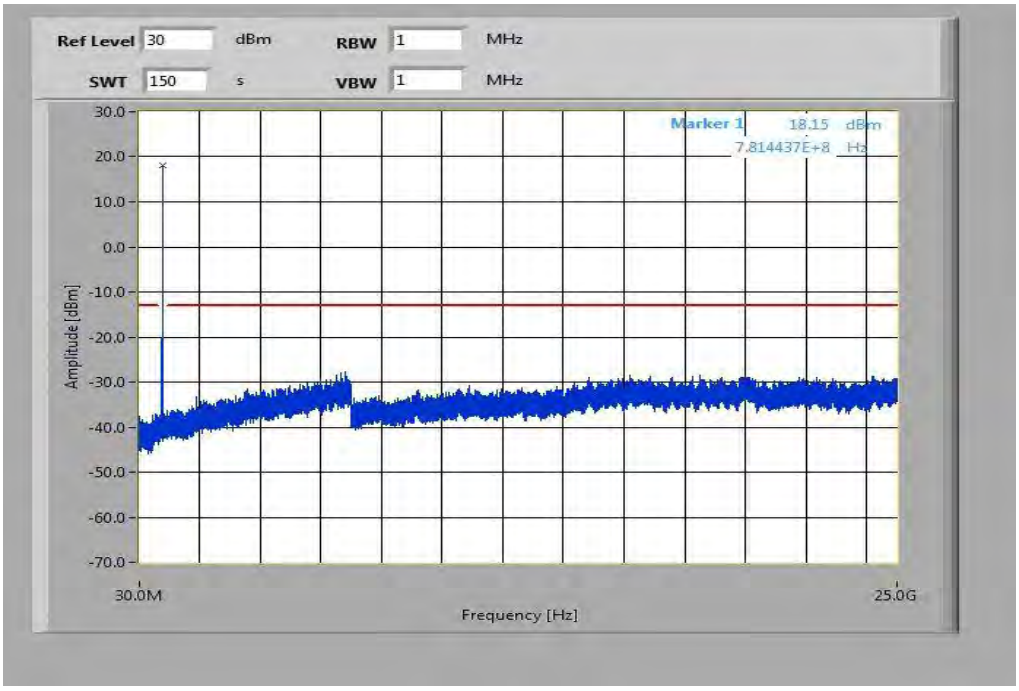
Plot 4: Lowest channel, 30 MHz to 25 GHz



Plot 5: Middle channel, 30 MHz to 25 GHz



Plot 6: Highest channel, 30 MHz to 25 GHz



8.5.5 Block edge compliance

Description:

The spectrum at the band edges must comply with the spurious emissions limits.

Measurement:

Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold

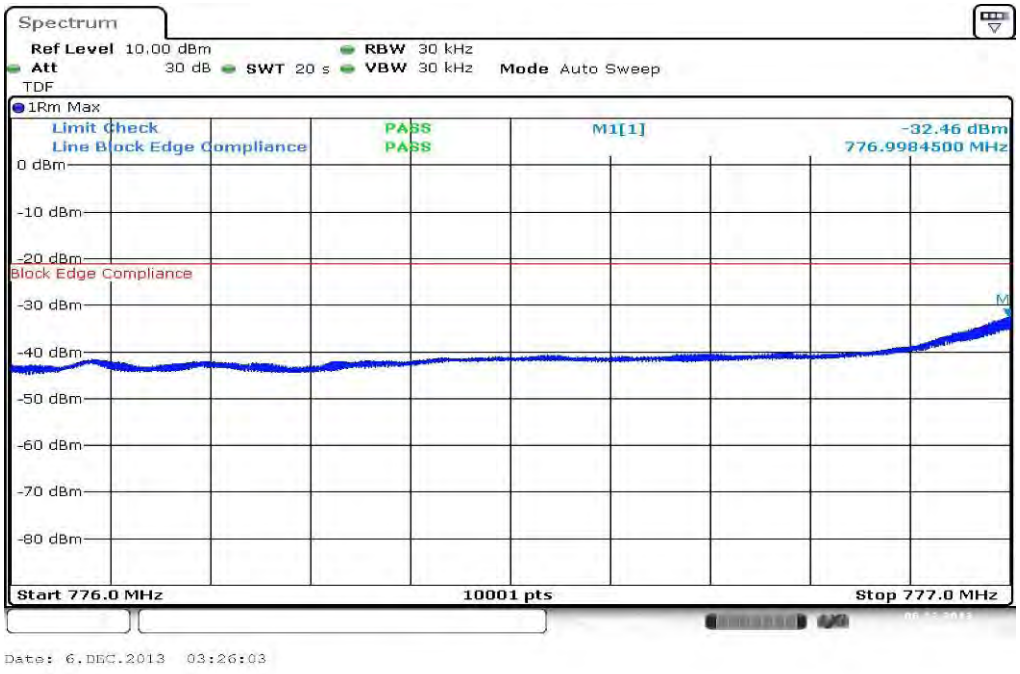
Limits:

FCC	-/-
Block Edge Compliance	
Part 27.53 specifies that “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.” However, in publication number 890810, The FCC Office of Engineering and Technology specified the following correction to the limits when a resolution bandwidth smaller than 1% of the emission bandwidth is used: “An alternative is to add an additional correction factor of 10 Log (RBW1/ RBW2) to the 43 +10 log(P) limit. RBW1 is the narrower measurement resolution bandwidth and RBW2 is either the 1% emissions bandwidth or 1 MHz.” When using a 30 kHz bandwidth, this yields a -5.2288 adjustment to the limit [10 log(30kHz/100kHz) = -5.2288]. When this adjustment is applied to the limit, the limit becomes -18.2288.	
-18.23 dBm	

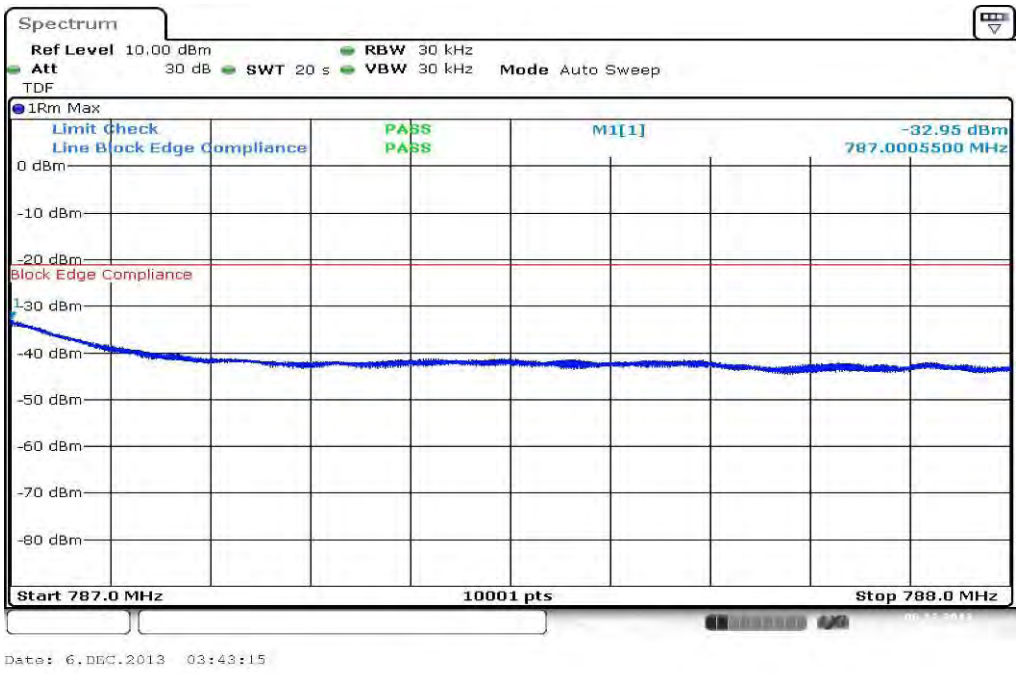
The limit line in the plots is the over all LTE bands and channel bandwidths worst case -21.24 dBm.

Results: **5 MHz channel bandwidth**

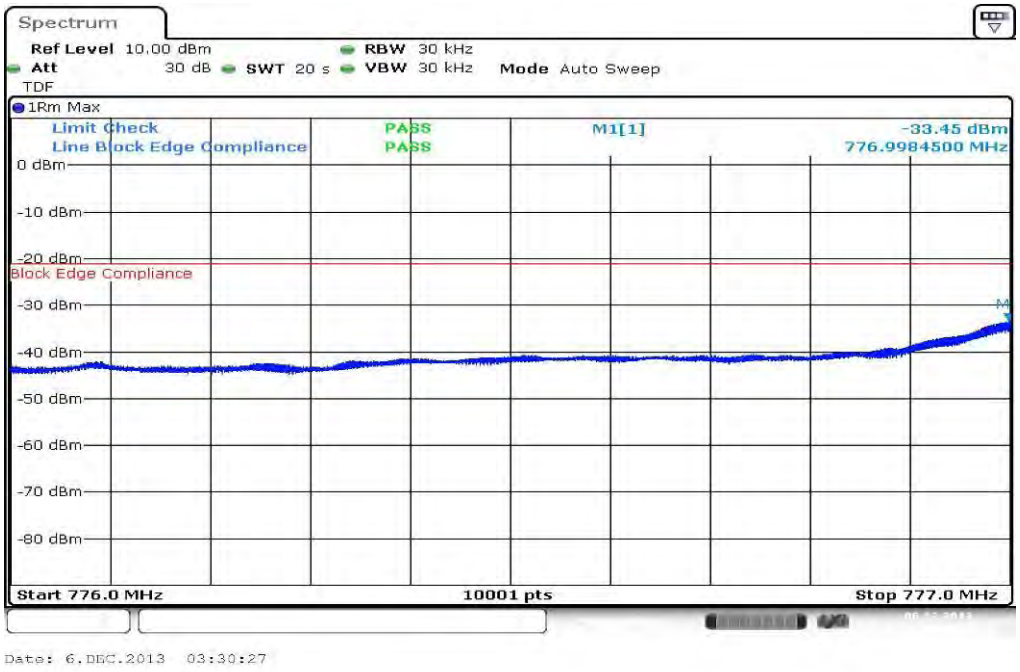
Plot 1: Lowest channel, QPSK modulation



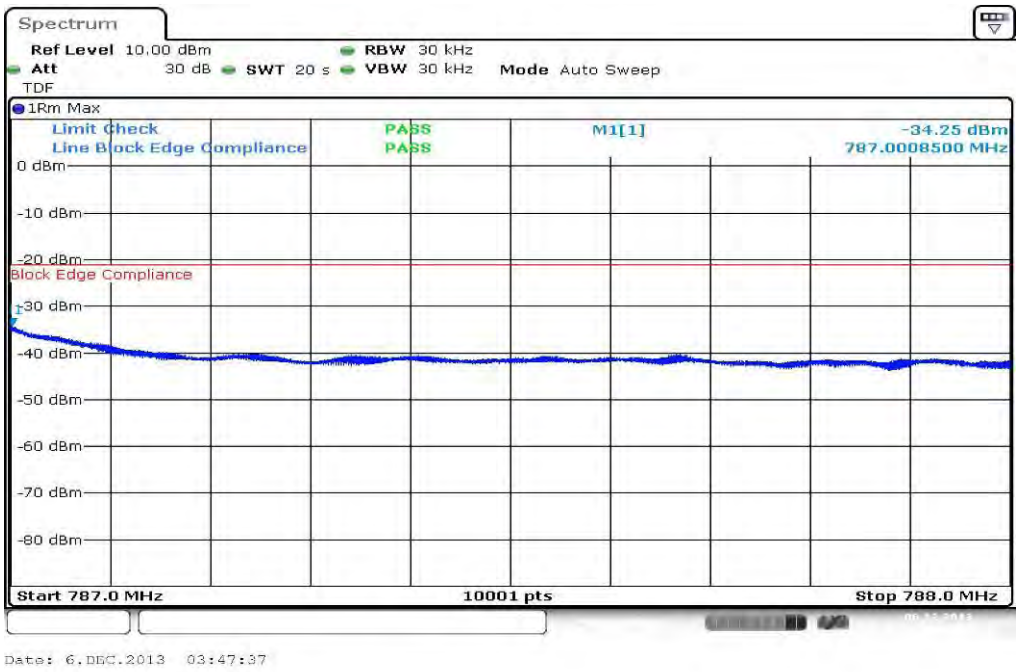
Plot 2: Highest channel, QPSK modulation



Plot 3: Lowest channel, 16 – QAM modulation

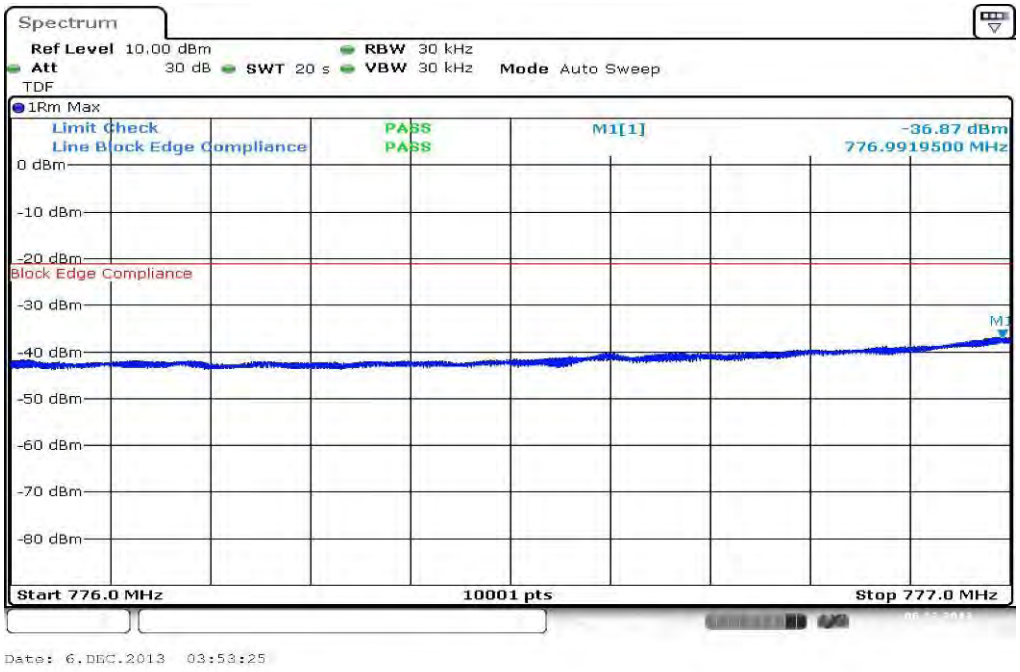


Plot 4: Highest channel, 16 – QAM modulation

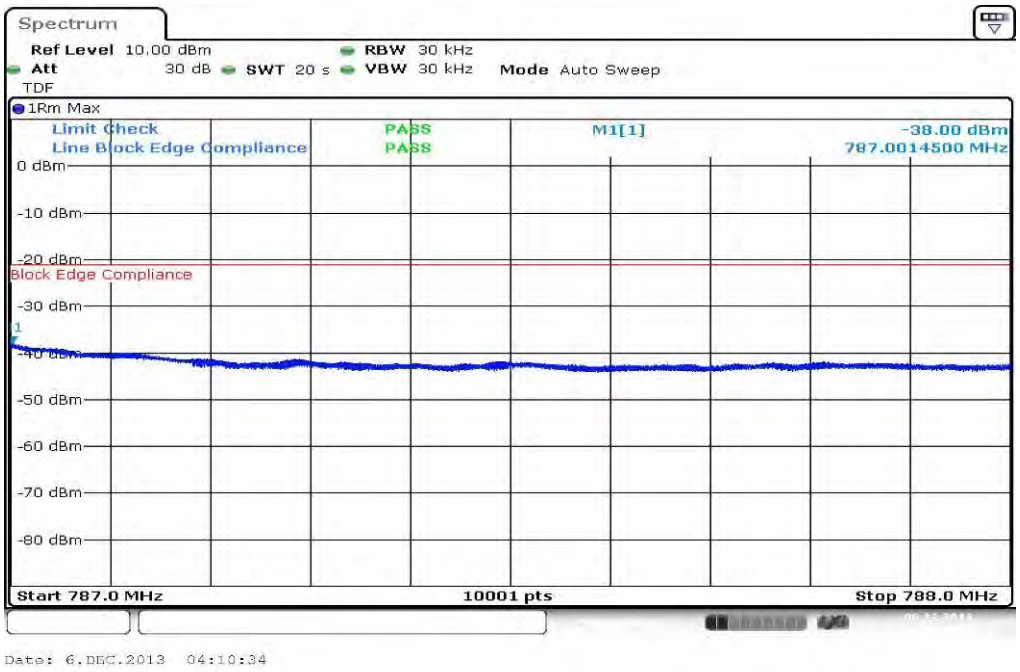


Results: **10 MHz channel bandwidth**

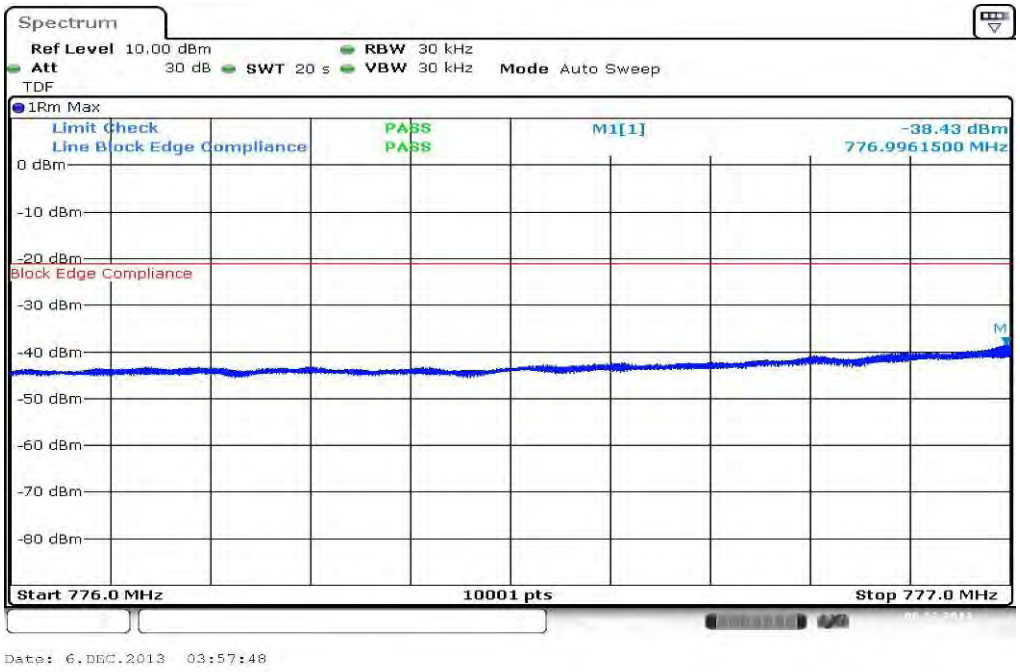
Plot 1: Lowest channel, QPSK modulation



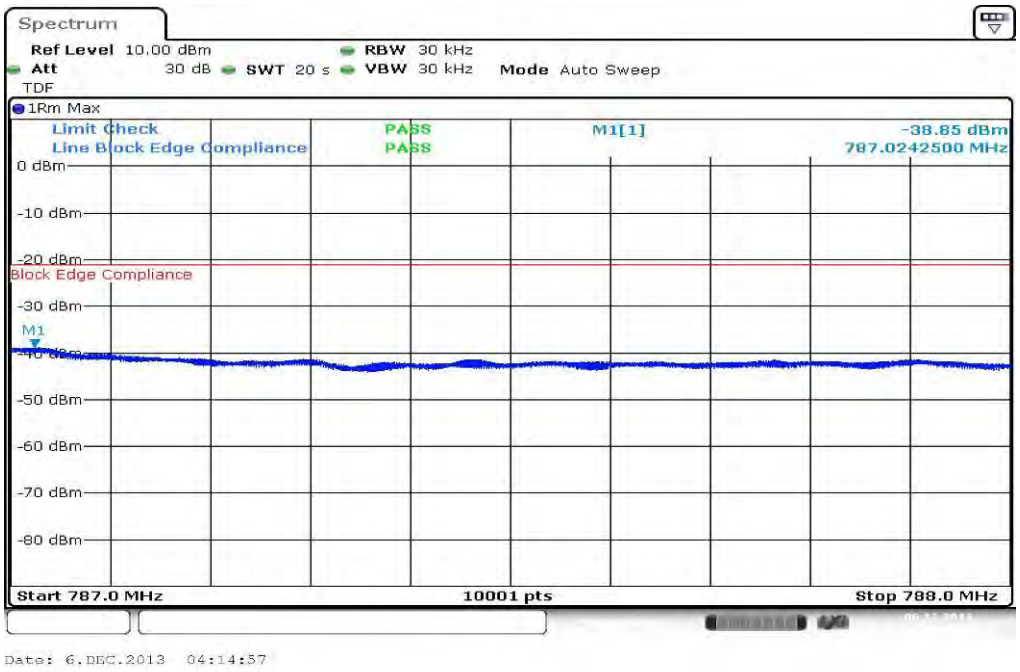
Plot 2: Highest channel, QPSK modulation



Plot 3: Lowest channel, 16 – QAM modulation



Plot 4: Highest channel, 16 – QAM modulation



Result: **Passed**

8.5.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the mid frequencies of the LTE band 17 frequency band. The table below lists the measured 99% power and 26 dB occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Part 27.53 requires a measurement bandwidth of at least 1% of the occupied bandwidth.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	Depends on Channel Bandwidth
Resolution bandwidth:	Depends on Channel Bandwidth
Span:	Depends on Channel Bandwidth
Trace-Mode:	Max Hold

Limits:

FCC	-/-
Occupied Bandwidth	
Spectrum must fall completely in the specified band	

Results:

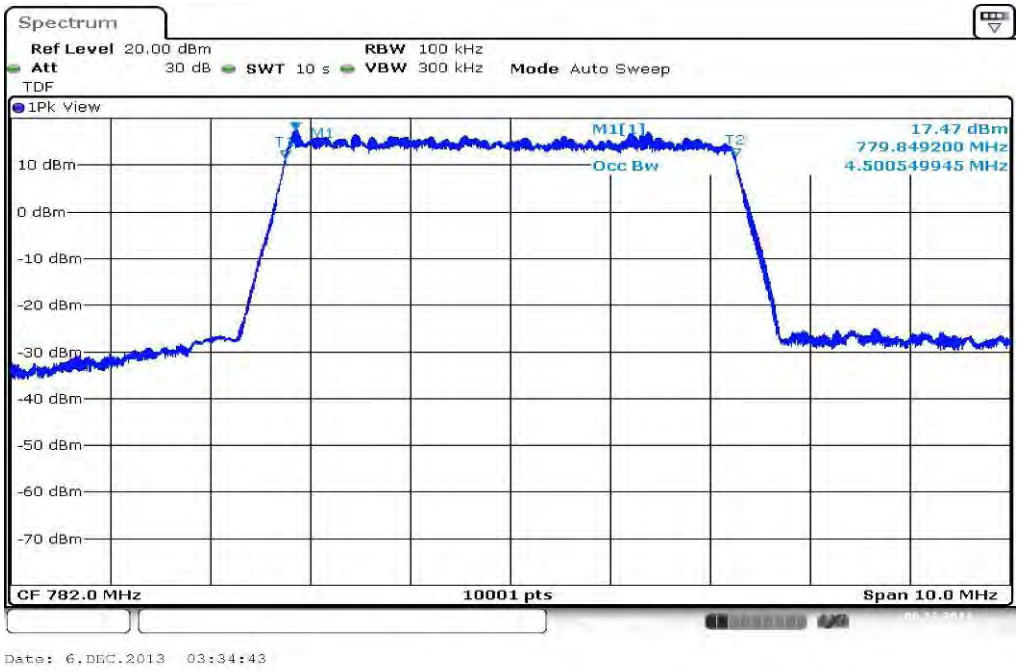
Occupied Bandwidth - QPSK		
Bandwidth [MHz]	**99% OBW (kHz)**	**26 dB bandwidth**
5	4501	4993
10	9065	10163
Measurement uncertainty	± 100 kHz to ± 300 kHz depending on channel bandwidth	

Occupied Bandwidth – 16-QAM		
Bandwidth [MHz]	**99% OBW (kHz)**	**26 dB bandwidth**
5	4517	5021
10	9057	10139
Measurement uncertainty	± 100 kHz to ± 300 kHz depending on channel bandwidth	

Result: **Passed**

Plots: QPSK

Plot 1: 5 MHz, 99% OBW



Plot 2: 10 MHz, 99% OBW

Plots: 16-QAM

Plot 1: 5 MHz, 99% OBW

Plot 2: 10 MHz, 99% OBW

8.6 Results LTE – Band 17

The EUT was set to transmit the maximum power.

8.6.1 RF output power

Description:

This paragraph contains average power, peak output power and EIRP measurements for the mobile station. In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Peak and RMS (Power in Burst)
Sweep time:	Auto
Video bandwidth:	Depends on Channel Bandwidth
Resolution bandwidth:	Depends on Channel Bandwidth
Span:	Zero Span
Trace-Mode:	Max Hold

Limits:

FCC	-/-
34.77 dBm	37 dBm
Nominal Peak Output Power	
In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

Results:

Output Power (conducted)						
Bandwidth (MHz)	**Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Peak to Average Ratio (dB)**	**Average Output Power (dBm) 16-QAM**	**Peak to Average Ratio (dB)**
5	706.5	1 RB low	23.4	4.43	22.5	4.99
		1 RB high	23.7	4.07	22.6	4.26
		50% RB mid	22.4	4.73	21.5	5.60
		100% RB	22.3	5.51	21.4	6.24
	710.0	1 RB low	23.4	4.01	22.7	3.85
		1 RB high	23.4	4.15	22.7	3.48
		50% RB mid	22.5	5.51	21.5	4.52
		100% RB	22.3	6.15	21.3	5.05
	713.5	1 RB low	23.3	3.61	22.2	4.62
		1 RB high	23.4	3.76	22.2	4.49
		50% RB mid	22.4	4.47	21.4	5.45
		100% RB	22.3	5.15	21.5	5.90
10	709.0	1 RB low	23.4	4.84	22.6	4.59
		1 RB high	23.4	4.30	22.6	3.50
		50% RB mid	22.4	5.53	21.4	4.51
		100% RB	22.4	5.83	21.3	4.99
	710.0	1 RB low	23.4	4.47	22.2	5.28
		1 RB high	23.4	4.04	22.1	4.56
		50% RB mid	22.4	4.60	21.5	5.47
		100% RB	22.4	5.37	21.4	5.93
	711.0	1 RB low	23.5	5.26	22.3	4.65
		1 RB high	23.4	4.55	22.2	4.04
		50% RB mid	22.4	5.64	21.4	4.63
		100% RB	22.3	5.88	21.4	4.95
Measurement uncertainty			± 0.5 dB			

The output power radiated is measured with the mode wich have the highest conducted output power.

Output Power (radiated)			
Bandwidth (MHz)	**Frequency (MHz)**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**
5	706.5	8.3	7.2
	710.0	7.6	6.9
	713.5	9.2	8.0
10	709.0	8.0	7.2
	710.0	7.6	6.4
	711.0	9.3	8.1
Measurement uncertainty		± 3.0 dB	

Result: **Passed**

8.6.2 Frequency stability

Description:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a “call mode”. This is accomplished with the use of a R&S CMW500 DIGITAL RADIOCOMMUNICATION TESTER.
1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom}, connected to the CMW500 and in a simulated call on channel 1412 (centre channel), measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +60°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps remeasuring carrier frequency at each voltage. Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

This measurement was performed with the highest channel bandwidth supported from the EUT on the middle channel

Measurement:

Measurement parameters	
Detector:	Measured with CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	

Limits:

FCC	-/-
Frequency Stability	
< 2.5 ppm	

Results:

FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
3.3	-1	-0.00000014	-0.0014
3.4	-5	-0.00000070	-0.0070
3.5	-8	-0.00000113	-0.0113
3.6	8	0.00000113	0.0113
3.7	1	0.00000014	0.0014
3.8	-4	-0.00000056	-0.0056
3.9	1	0.00000014	0.0014
4.0	-3	-0.00000042	-0.0042
4.1	2	0.00000028	0.0028
4.2	2	0.00000028	0.0028
4.3	-6	-0.00000085	-0.0085
4.4	-5	-0.00000070	-0.0070

FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	1	0.00000014	0.0014
-20	4	0.00000056	0.0056
-10	6	0.00000085	0.0085
± 0	-4	-0.00000056	-0.0056
10	-5	-0.00000070	-0.0070
20	7	0.00000099	0.0099
30	8	0.00000113	0.0113
40	4	0.00000056	0.0056
50	-3	-0.00000042	-0.0042
60	7	0.00000099	0.0099

Additional measurements for RSS-130 (4.3 b)

f_L =704.048 MHz	f_H = 715.932 MHz
f_L – (max freq. error) = 704.048 MHz	f_H + (max freq. error) = 715.932 MHz

Result: **Passed**

8.6.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2009 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 746 MHz. Measurement is made up to 12.75 GHz. The resolution bandwidth is set as outlined in Part 27.53. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE band 17.

The final open field emission (here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
b) The antenna output was terminated in a 50 ohm load (if possible).
c) A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
d) Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded. The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters.
e) Now each detected emissions were substituted by the substitution method, in accordance with the TIA/EIA 603.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 s
Video bandwidth:	below 150 kHz: 200 Hz 150 kHz ≤ f < 30 MHz: 9 kHz 30 MHz ≤ f < 700 MHz: 100 kHz Above 700MHz: 1 MHz
Resolution bandwidth:	below 150 kHz: 200 Hz 150 kHz ≤ f < 30 MHz: 9 kHz 30 MHz ≤ f < 700 MHz: 100 kHz Above 700 MHz: 1 MHz
Span:	100 MHz Steps
Trace-Mode:	Max Hold

Limits:

FCC	-/-
Spurious Emissions Radiated	
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm*	

Results:

Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the LTE band 17 (706.5 MHz, 710.0 MHz and 713.5 MHz). It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the LTE band 17 into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

The final open field radiated levels are presented on the next pages.
All measurements were done in horizontal and vertical polarization; the plots show the worst case.
The plots show only the middle channel with full resource blocks. If spurious were detected, the lowest and highest channel and all supported channel bandwidths were checked, too.

As can be seen from this data, the emissions from the test item were within the specification limit.

QPSK

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1418.0	-	2513 MHz	-56.6	1422.0	-
2127.0	No peaks detected.		No peaks detected.	2133.0	No peaks detected.
2836.0				2844.0	
3545.0				3555.0	
4254.0				4266.0	
4963.0				4977.0	
5672.0				5688.0	
6381.0				6399.0	
7090.0				7110.0	
Measurement uncertainty			± 3dB		

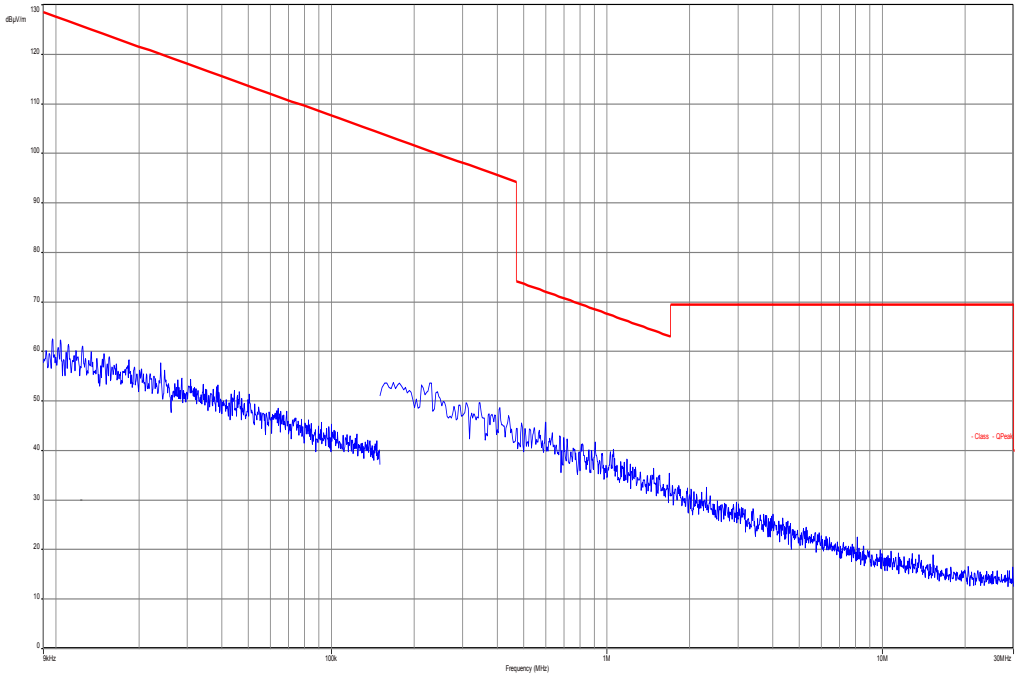
16-QAM

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1418.0	No peaks detected.	1420.0	No peaks detected.	1422.0	No peaks detected.
2127.0		2130.0		2133.0	
2836.0		2840.0		2844.0	
3545.0		3550.0		3555.0	
4254.0		4260.0		4266.0	
4963.0		4970.0		4977.0	
5672.0		5680.0		5688.0	
6381.0		6390.0		6399.0	
7090.0		7100.0		7110.0	
Measurement uncertainty			± 3dB		

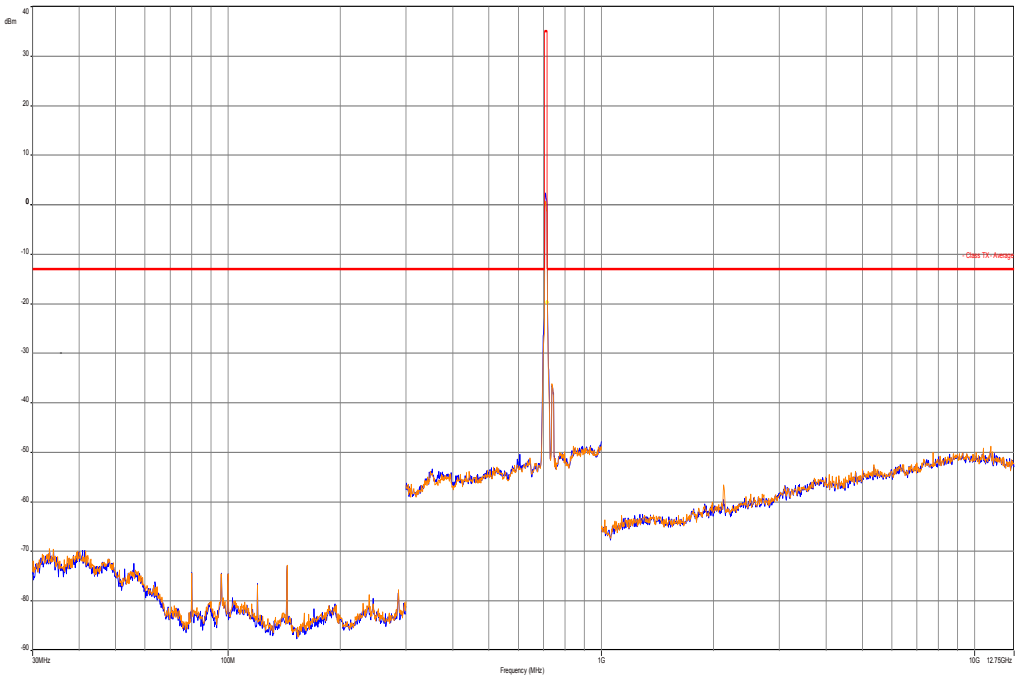
Result: Passed

QPSK with 10 MHz channel bandwidth

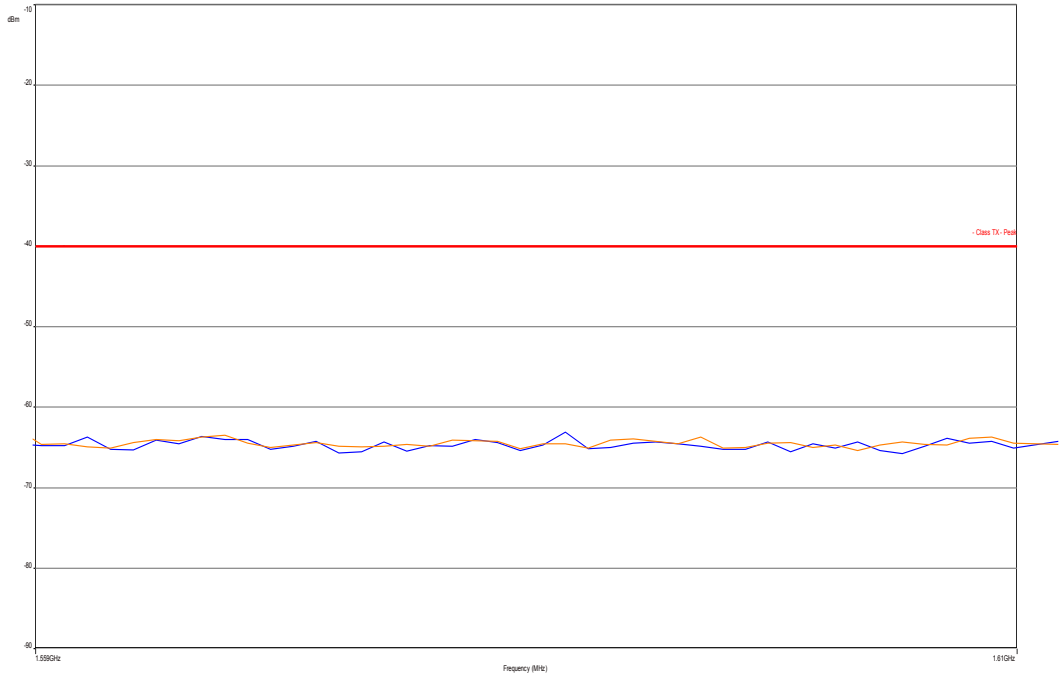
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 12.75 GHz

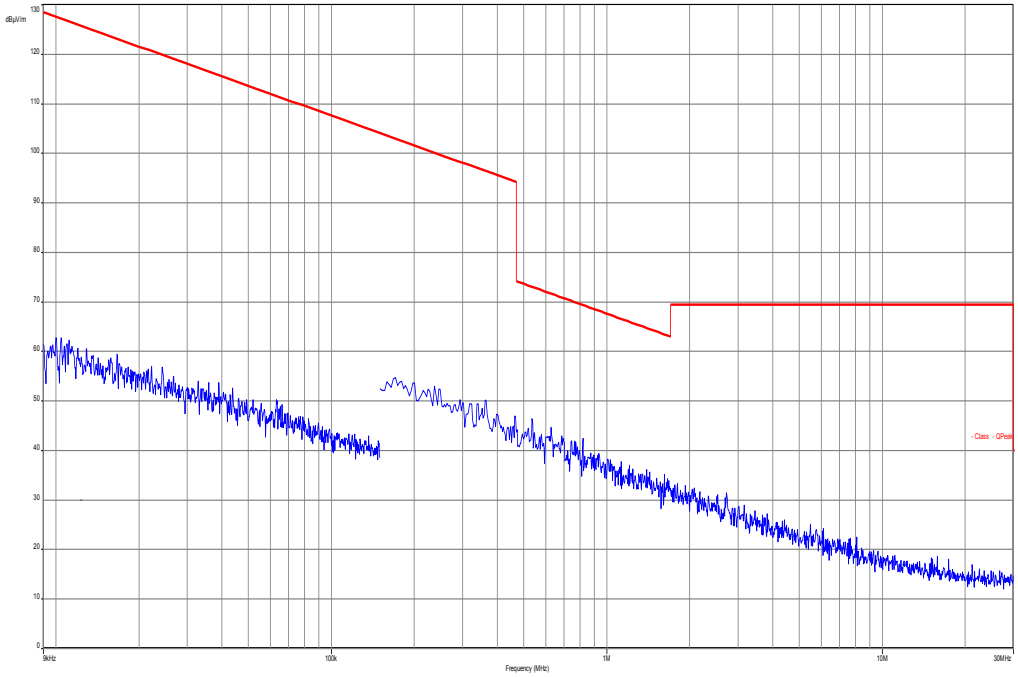


Plot 3: Middle channel, Special band: 1559 MHz to 1610 MHz

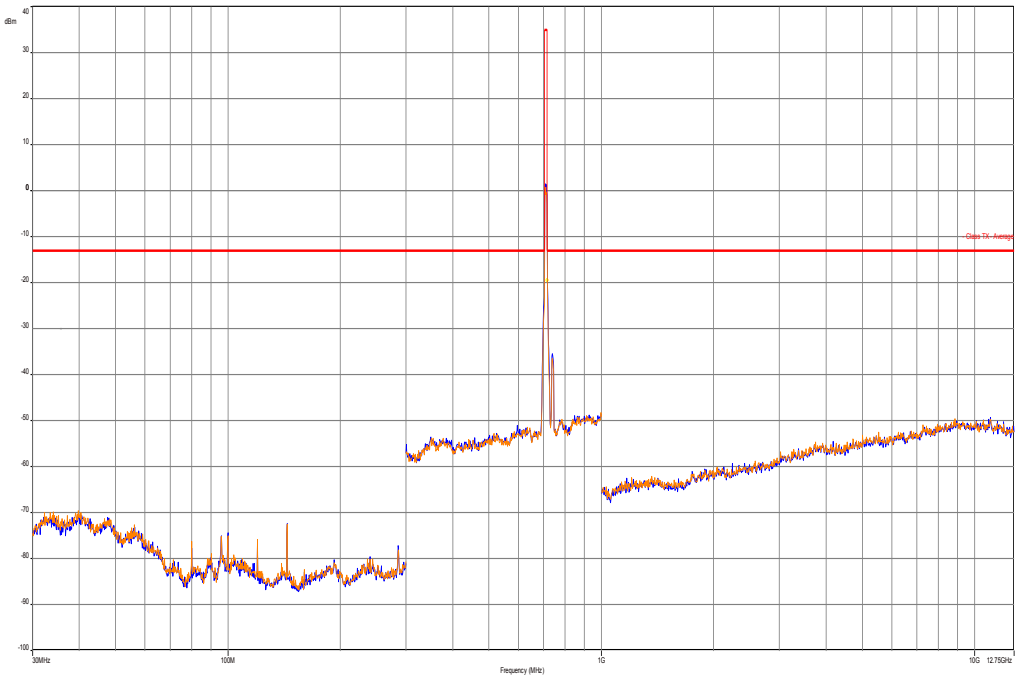


16-QAM with 10 MHz channel bandwidth

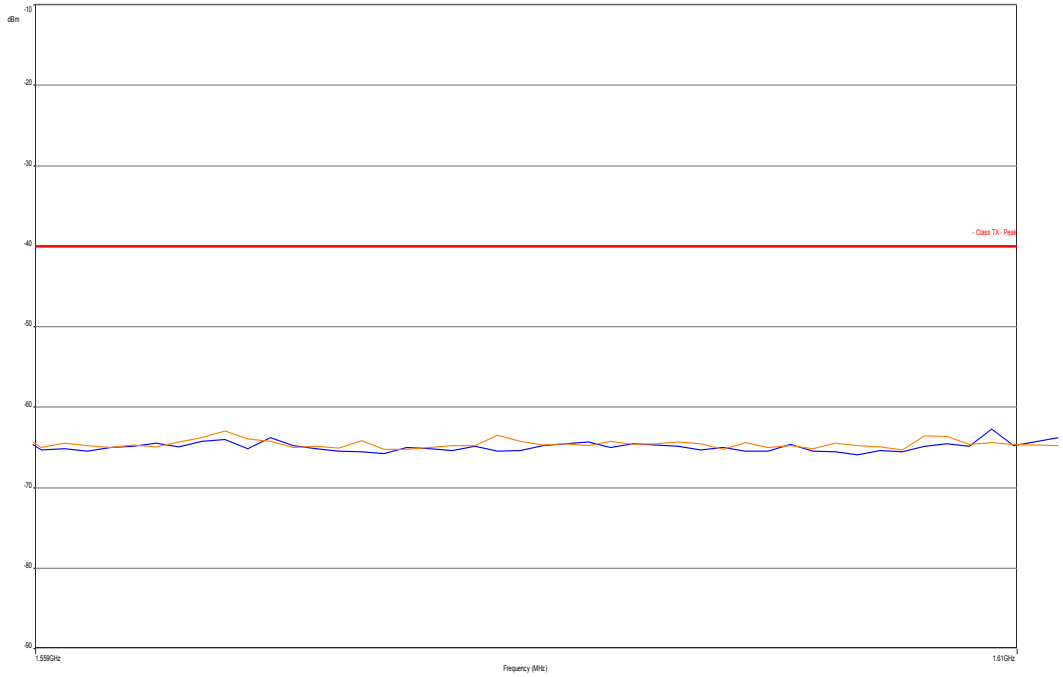
Plot 4: Middle channel, up to 30 MHz



Plot 5: Middle channel, 30 MHz to 12.75 GHz



Plot 6: Middle channel, Special band: 1559 MHz to 1610 MHz



8.6.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.
1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 7460 MHz, data taken from 30 MHz to 25 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Resolution bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Span:	30 MHz – 12 GHz
Trace-Mode:	Max Hold

Limits:

FCC	-/-
Spurious Emissions Conducted	
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Results: for 5 MHz channel bandwidth

QPSK

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1413.0	No spurious emissions detected!	1420.0	No spurious emissions detected!	1427.0	No spurious emissions detected!
2119.5		2130.0		2140.5	
2826.0		2840.0		2854.0	
3532.5		3550.0		3567.5	
4239.0		4260.0		4281.0	
4945.5		4970.0		4994.5	
5652.0		5680.0		5708.0	
6358.5		6390.0		6421.5	
7065.0		7100.0		7135.0	
Measurement uncertainty		± 3dB			

16-QAM

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1413.0	No spurious emissions detected!	1420.0	No spurious emissions detected!	1427.0	No spurious emissions detected!
2119.5		2130.0		2140.5	
2826.0		2840.0		2854.0	
3532.5		3550.0		3567.5	
4239.0		4260.0		4281.0	
4945.5		4970.0		4994.5	
5652.0		5680.0		5708.0	
6358.5		6390.0		6421.5	
7065.0		7100.0		7135.0	
Measurement uncertainty		± 3dB			

Result: Passed

Results: for 10 MHz channel bandwidth

QPSK

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1418.0	No spurious emissions detected!	1420.0	No spurious emissions detected!	1422.0	No spurious emissions detected!
2127.0		2130.0		2133.0	
2836.0		2840.0		2844.0	
3545.0		3550.0		3555.0	
4254.0		4260.0		4266.0	
4963.0		4970.0		4977.0	
5672.0		5680.0		5688.0	
6381.0		6390.0		6399.0	
7090.0		7100.0		7110.0	
Measurement uncertainty			± 3dB		

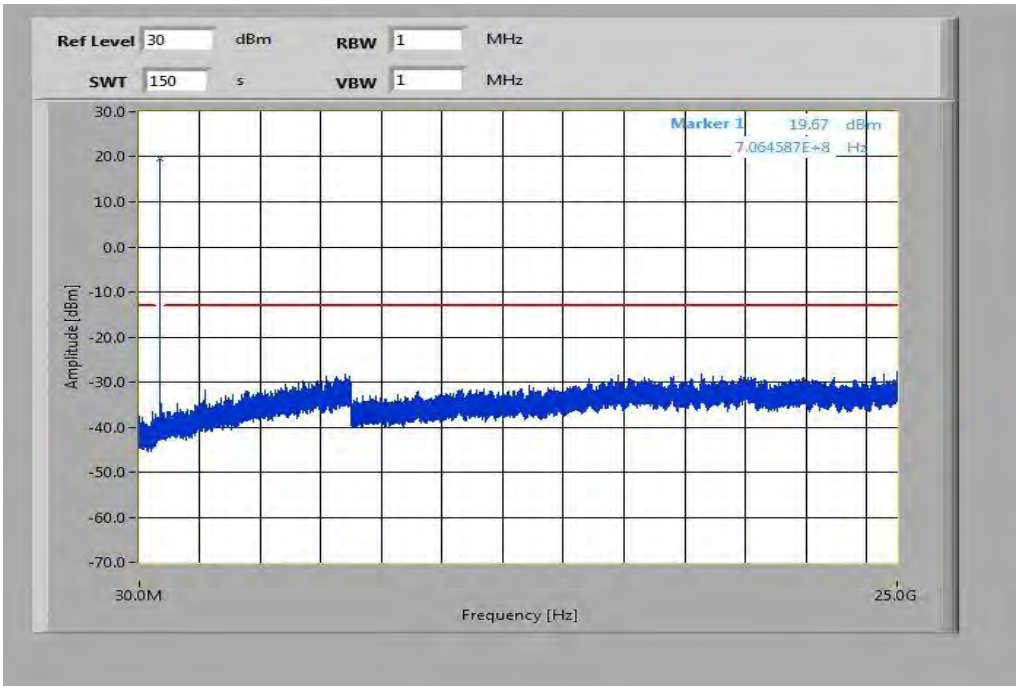
16-QAM

Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
1418.0	No spurious emissions detected!	1420.0	No spurious emissions detected!	1422.0	No spurious emissions detected!
2127.0		2130.0		2133.0	
2836.0		2840.0		2844.0	
3545.0		3550.0		3555.0	
4254.0		4260.0		4266.0	
4963.0		4970.0		4977.0	
5672.0		5680.0		5688.0	
6381.0		6390.0		6399.0	
7090.0		7100.0		7110.0	
Measurement uncertainty			± 3dB		

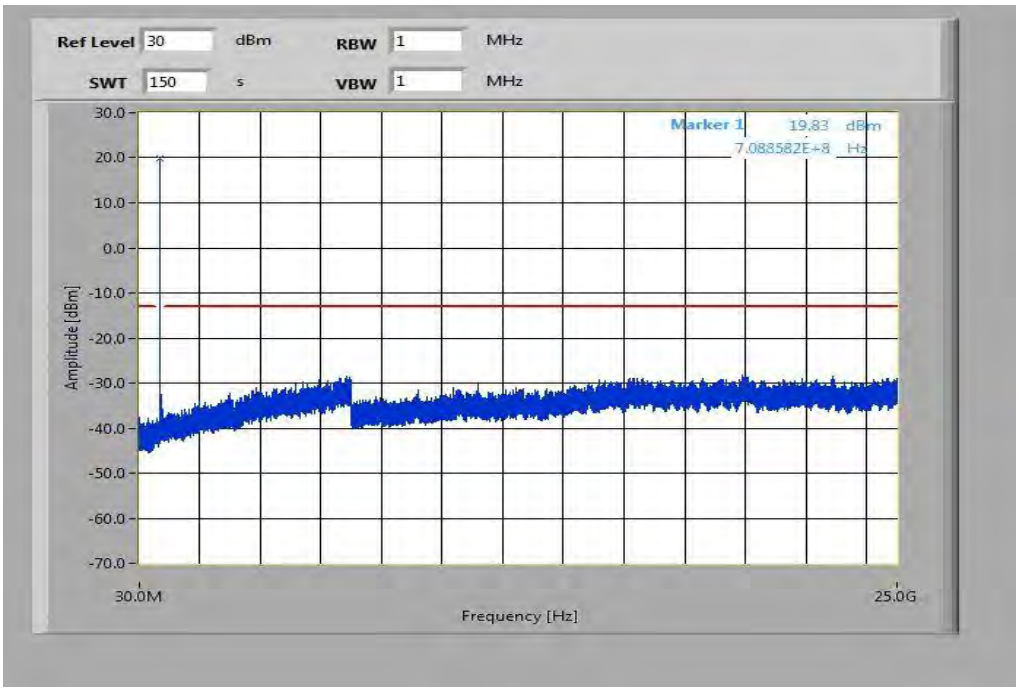
Result: Passed

Plots for 5 MHz channel bandwidth, QPSK

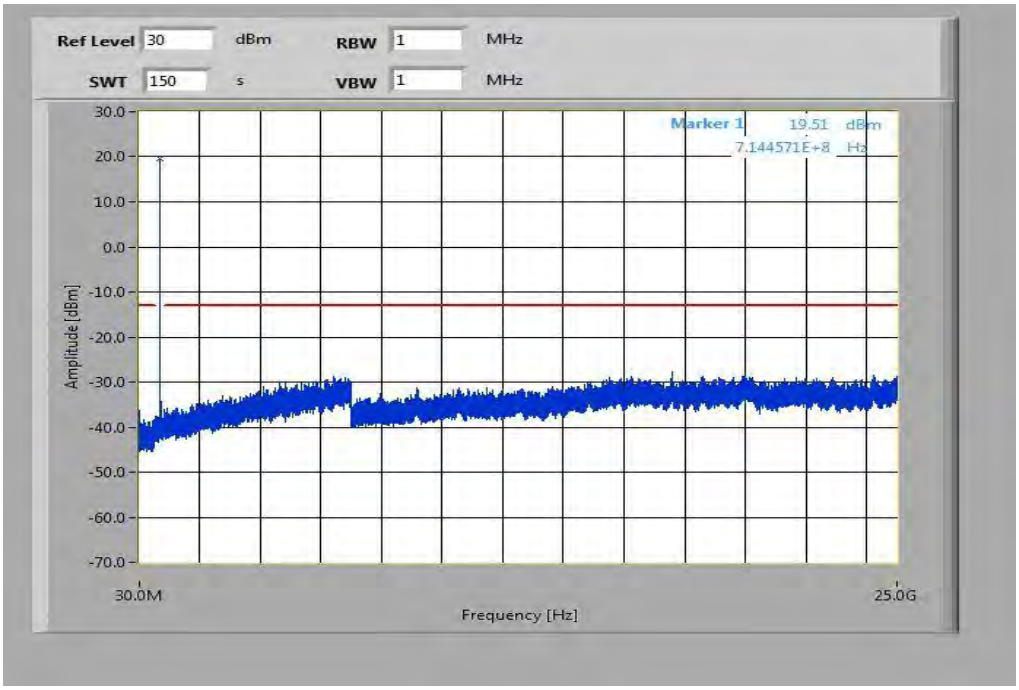
Plot 1: Lowest channel, 30 MHz to 25 GHz



Plot 2: Middle channel, 30 MHz to 25 GHz

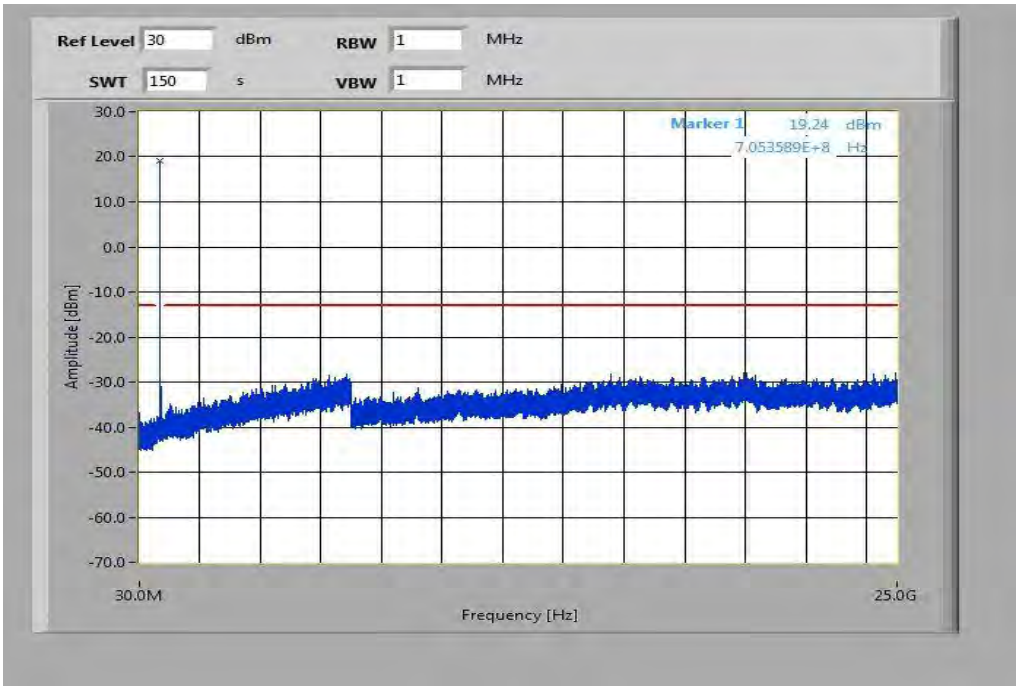


Plot 3: Highest channel, 30 MHz to 25 GHz

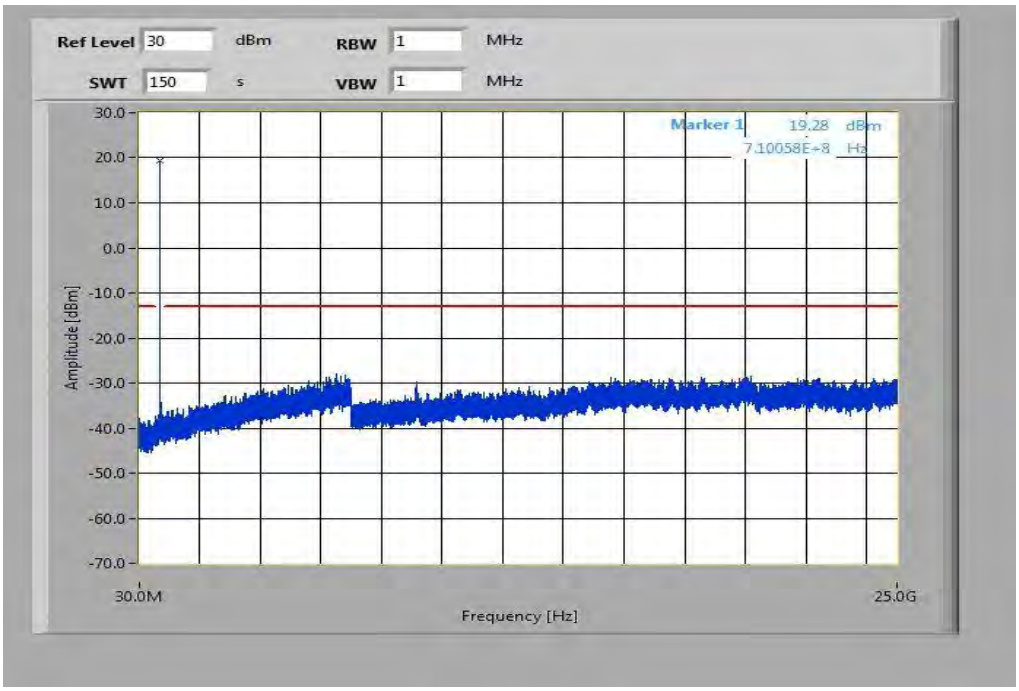


Plots for 5 MHz channel bandwidth, 16-QAM

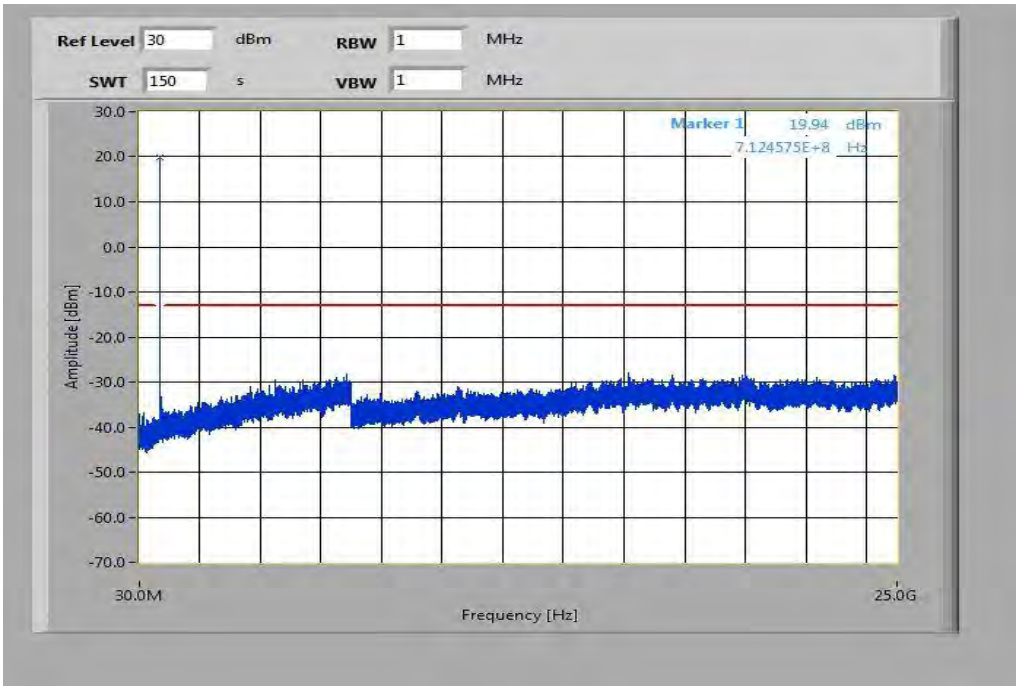
Plot 4: Lowest channel, 30 MHz to 25 GHz



Plot 5: Middle channel, 30 MHz to 25 GHz

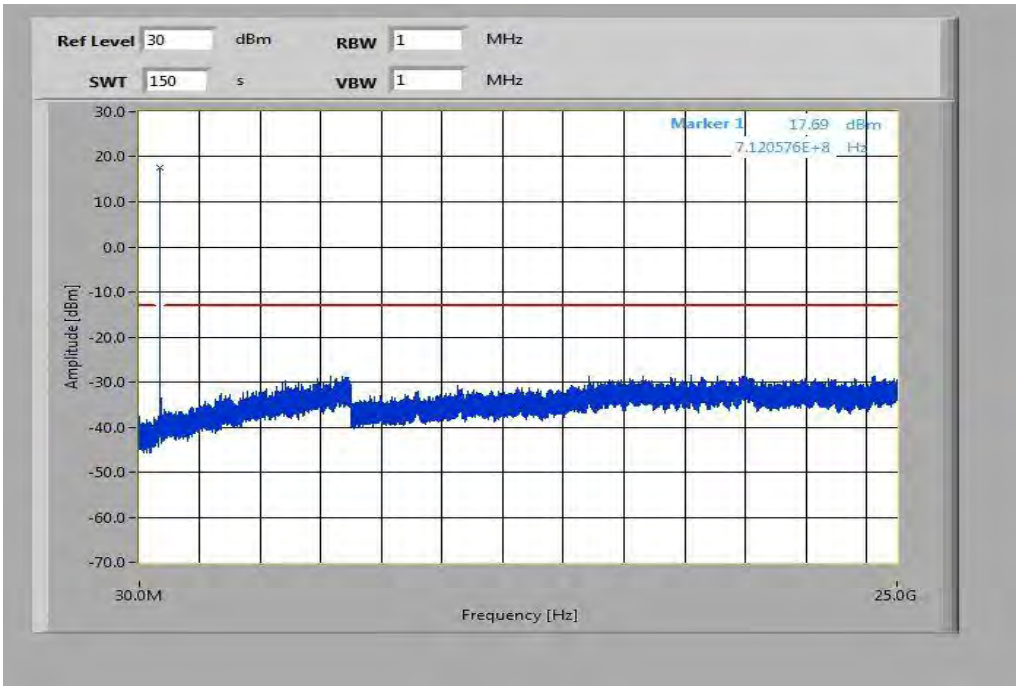


Plot 6: Highest channel, 30 MHz to 25 GHz

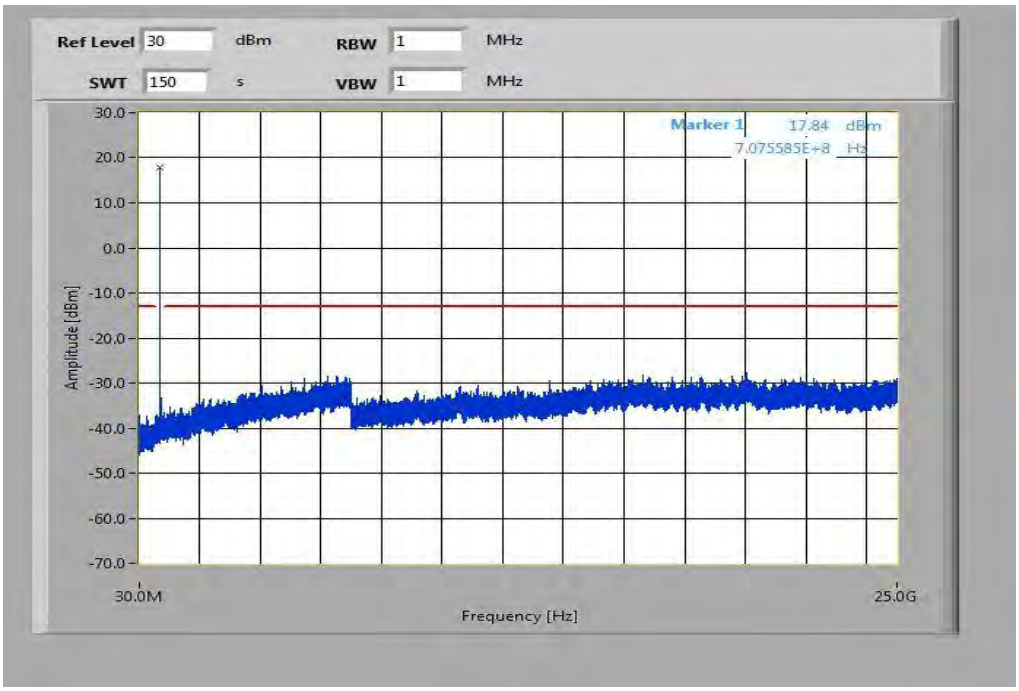


Plots for 10 MHz channel bandwidth, QPSK

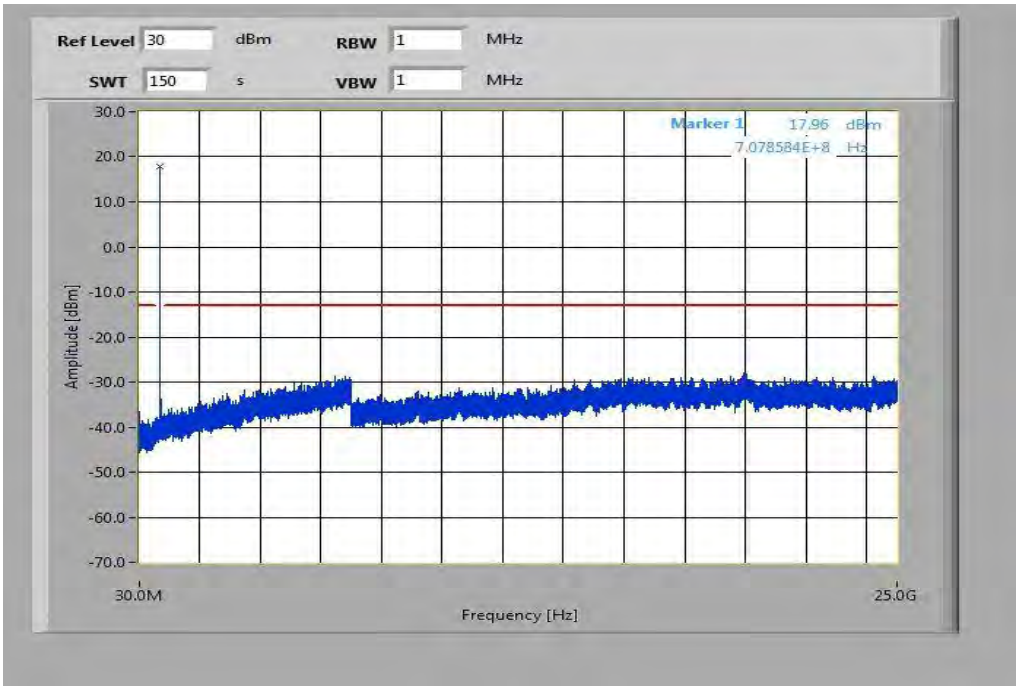
Plot 1: Lowest channel, 30 MHz to 25 GHz



Plot 2: Middle channel, 30 MHz to 25 GHz

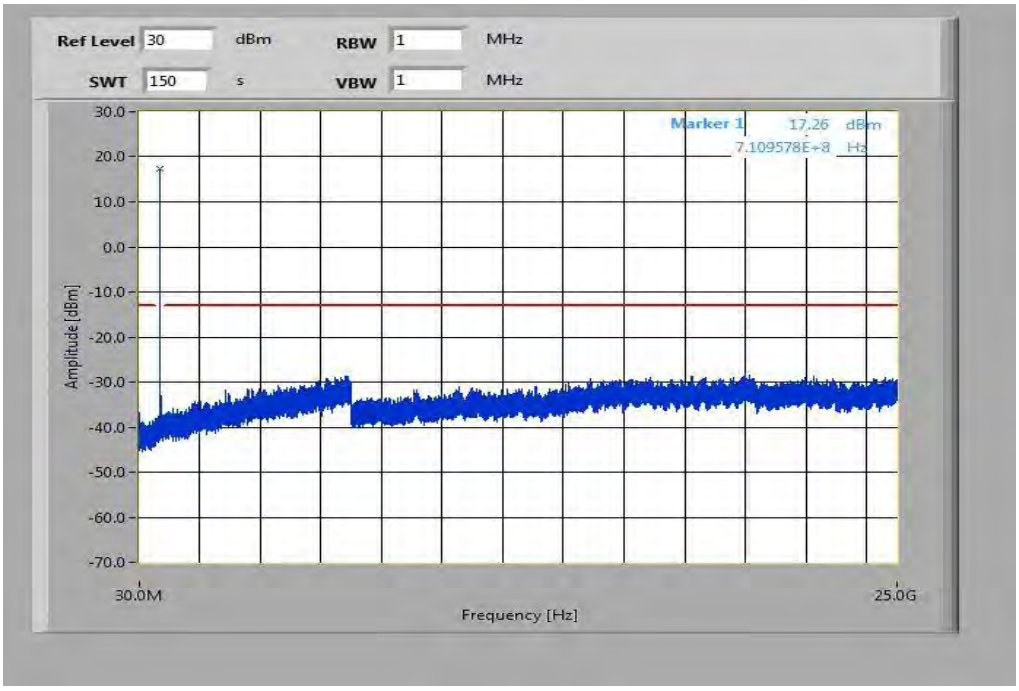


Plot 3: Highest channel, 30 MHz to 25 GHz

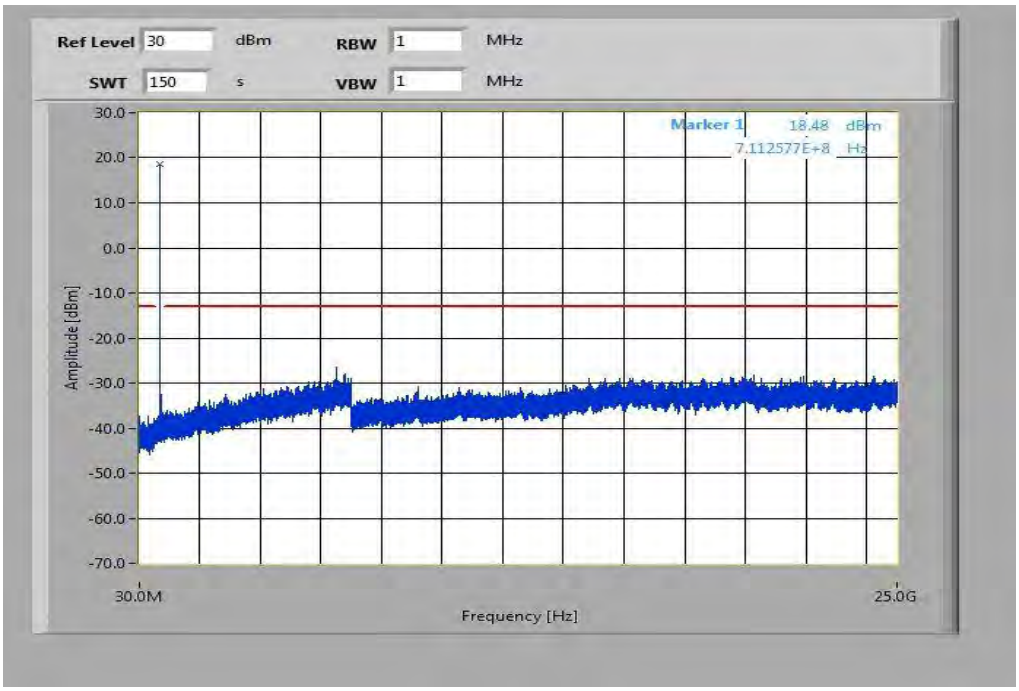


Plots for 10 MHz channel bandwidth, 16-QAM

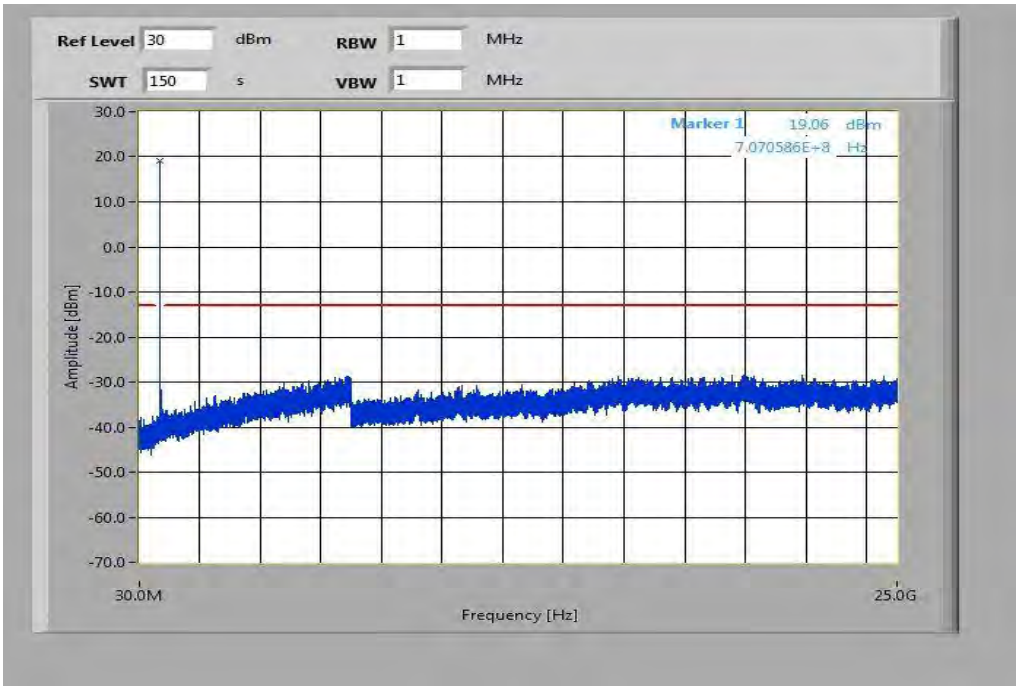
Plot 4: Lowest channel, 30 MHz to 25 GHz



Plot 5: Middle channel, 30 MHz to 25 GHz



Plot 6: Highest channel, 30 MHz to 25 GHz



8.6.5 Block edge compliance

Description:

The spectrum at the band edges must comply with the spurious emissions limits.

Measurement:

Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold

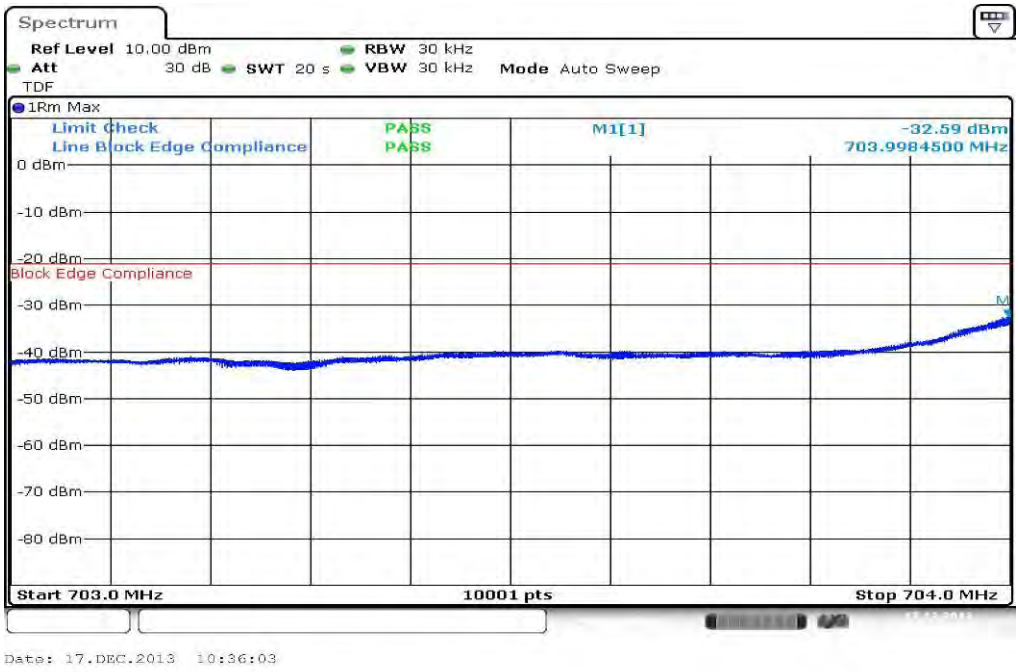
Limits:

FCC	-/-
Block Edge Compliance	
Part 27.53 specifies that “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.” However, in publication number 890810, The FCC Office of Engineering and Technology specified the following correction to the limits when a resolution bandwidth smaller than 1% of the emission bandwidth is used: “An alternative is to add an additional correction factor of 10 Log (RBW1/ RBW2) to the 43 +10 log(P) limit. RBW1 is the narrower measurement resolution bandwidth and RBW2 is either the 1% emissions bandwidth or 1 MHz.” When using a 30 kHz bandwidth, this yields a -5.2288 adjustment to the limit [10 log(30kHz/100kHz) = -5.2288]. When this adjustment is applied to the limit, the limit becomes -18.2288.	
-18.23 dBm	

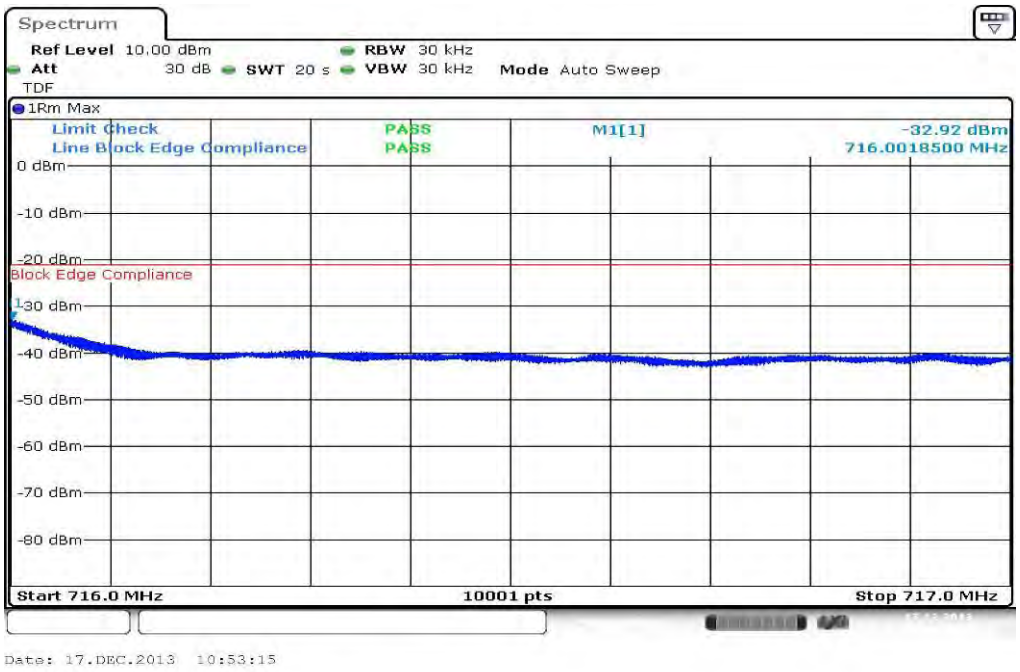
The limit line in the plots is the over all LTE bands and channel bandwidths worst case -21.24 dBm.

Results: **5 MHz channel bandwidth**

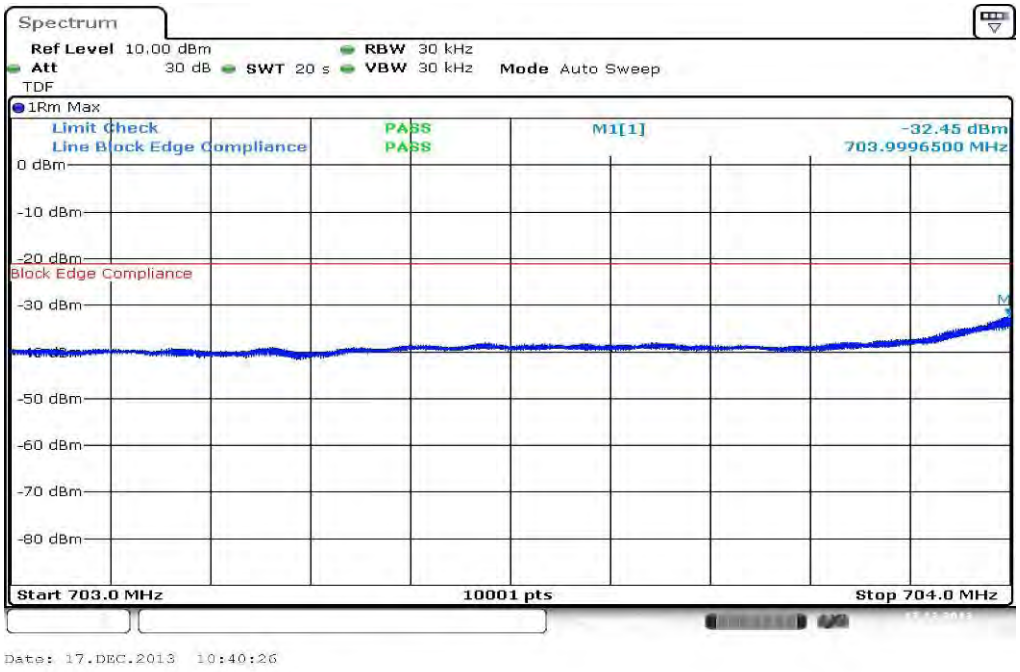
Plot 1: Lowest channel, QPSK modulation



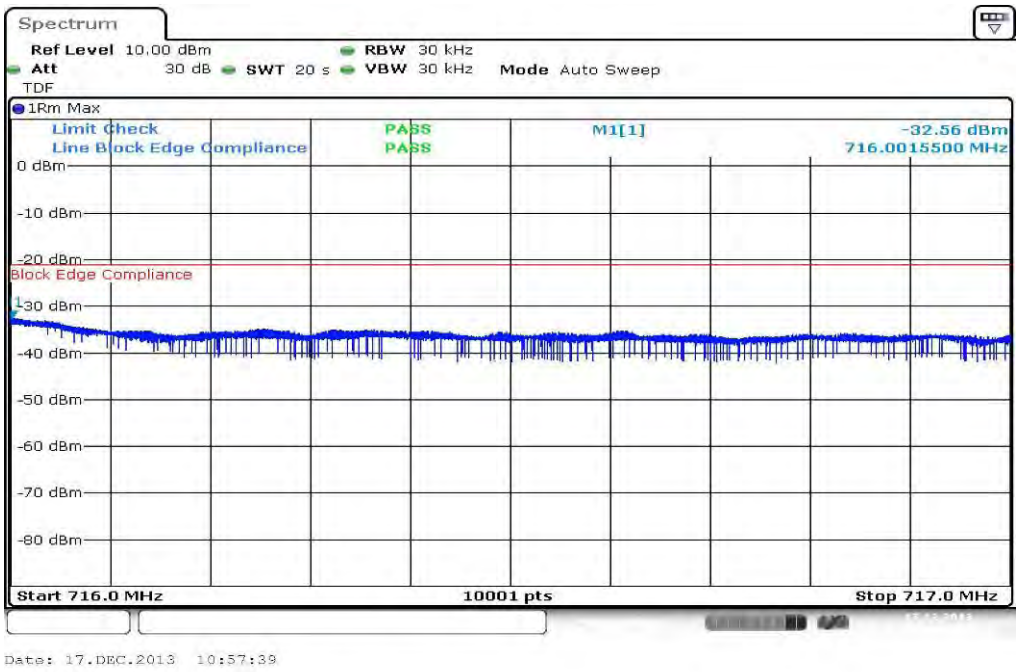
Plot 2: Highest channel, QPSK modulation



Plot 3: Lowest channel, 16 – QAM modulation

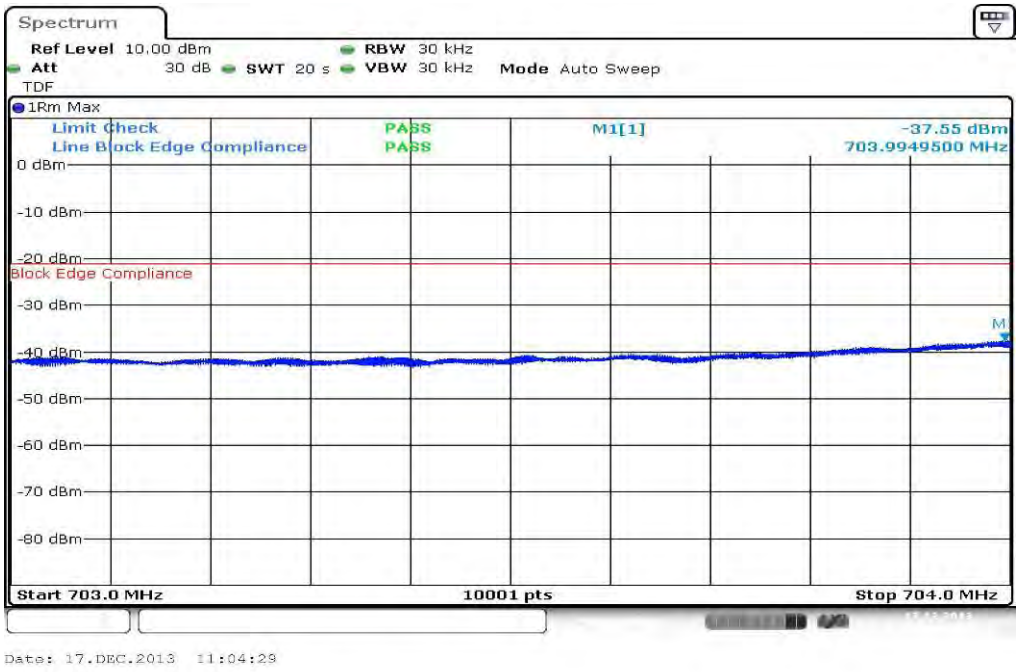


Plot 4: Highest channel, 16 – QAM modulation

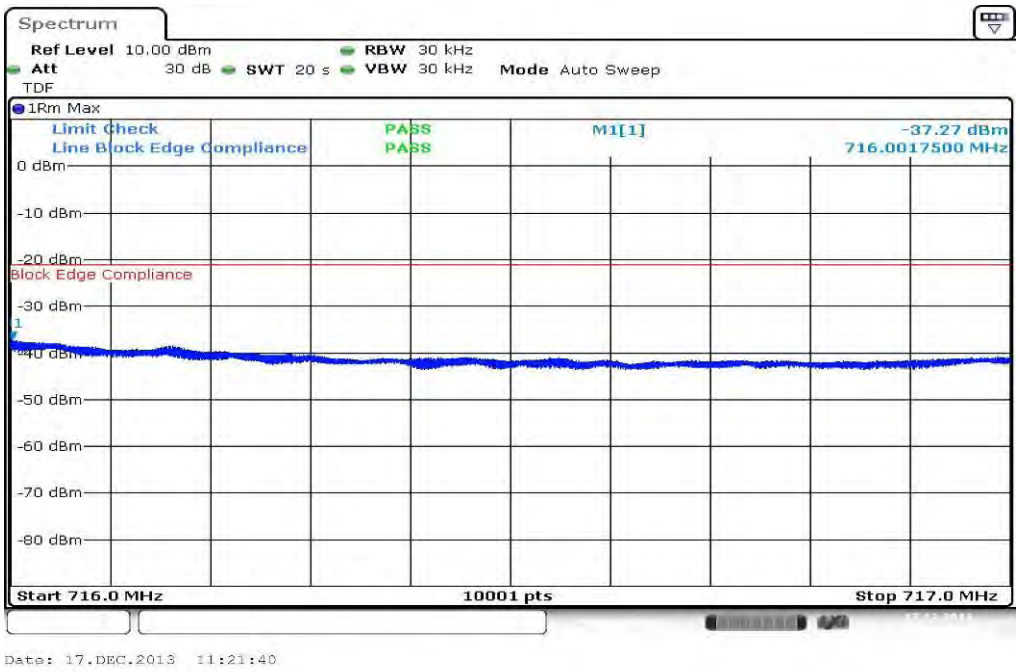


Results: **10 MHz channel bandwidth**

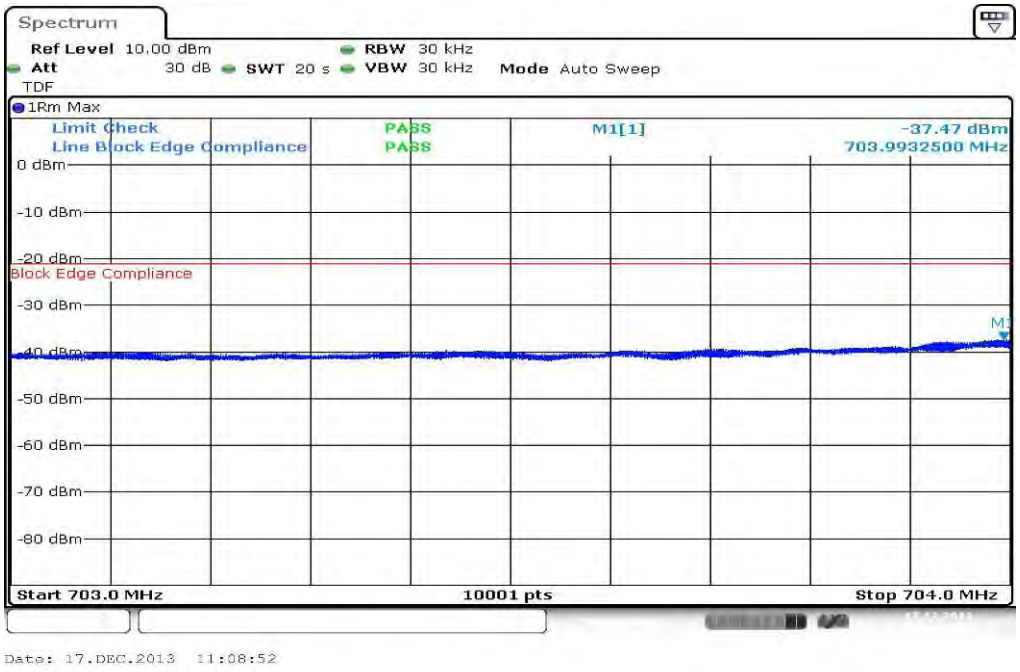
Plot 1: Lowest channel, QPSK modulation



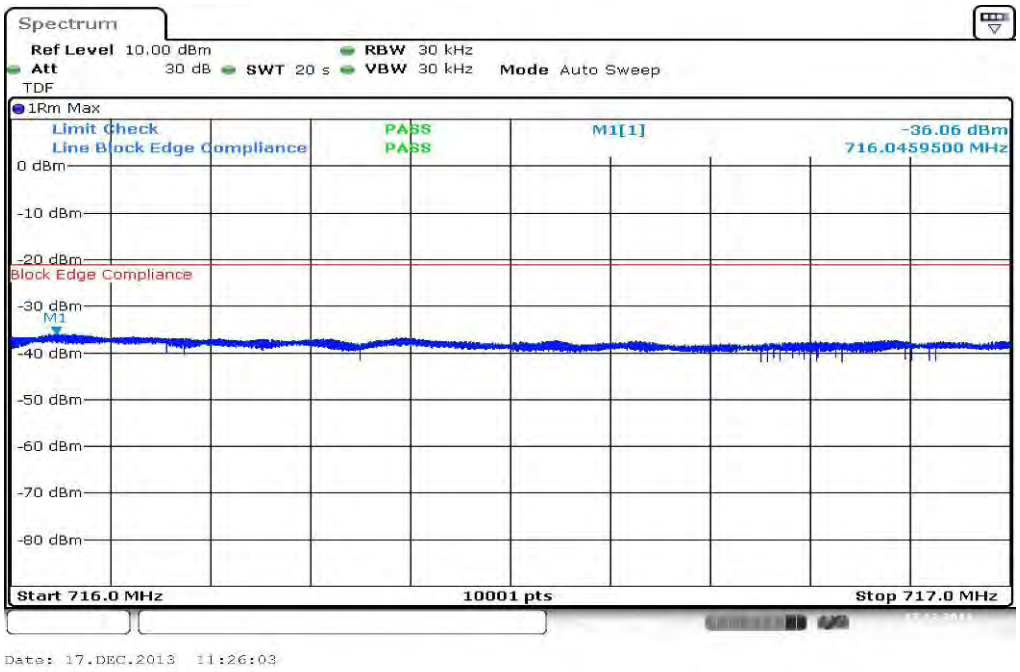
Plot 2: Highest channel, QPSK modulation



Plot 3: Lowest channel, 16 – QAM modulation



Plot 4: Highest channel, 16 – QAM modulation



Result: **Passed**

8.6.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the mid frequencies of the LTE band 17. The table below lists the measured 99% power bandwidths. Spectrum analyzer plots are included on the following pages.

Part 27.53 requires a measurement bandwidth of at least 1% of the occupied bandwidth.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	Depends on Channel Bandwidth
Resolution bandwidth:	Depends on Channel Bandwidth
Span:	Depends on Channel Bandwidth
Trace-Mode:	Max Hold

Limits:

FCC	-/-
Occupied Bandwidth	
Spectrum must fall completely in the specified band	

Results:

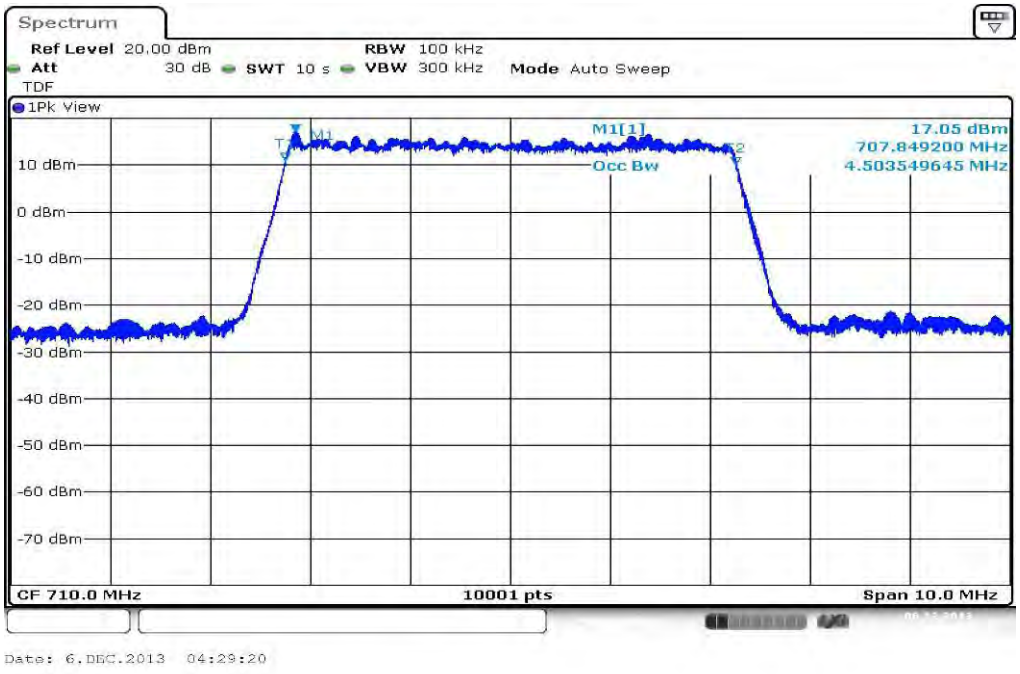
Occupied Bandwidth - QPSK		
Bandwidth [MHz]	**99% OBW (kHz)**	**26 dB bandwidth (kHz)**
5	4504	4995
10	9075	10153
Measurement uncertainty	± 100 kHz to ± 300 kHz depending on channel bandwidth	

Occupied Bandwidth – 16-QAM		
Bandwidth [MHz]	**99% OBW (kHz)**	**26 dB bandwidth (kHz)**
5	4522	5050
10	9075	10069
Measurement uncertainty	± 100 kHz to ± 300 kHz depending on channel bandwidth	

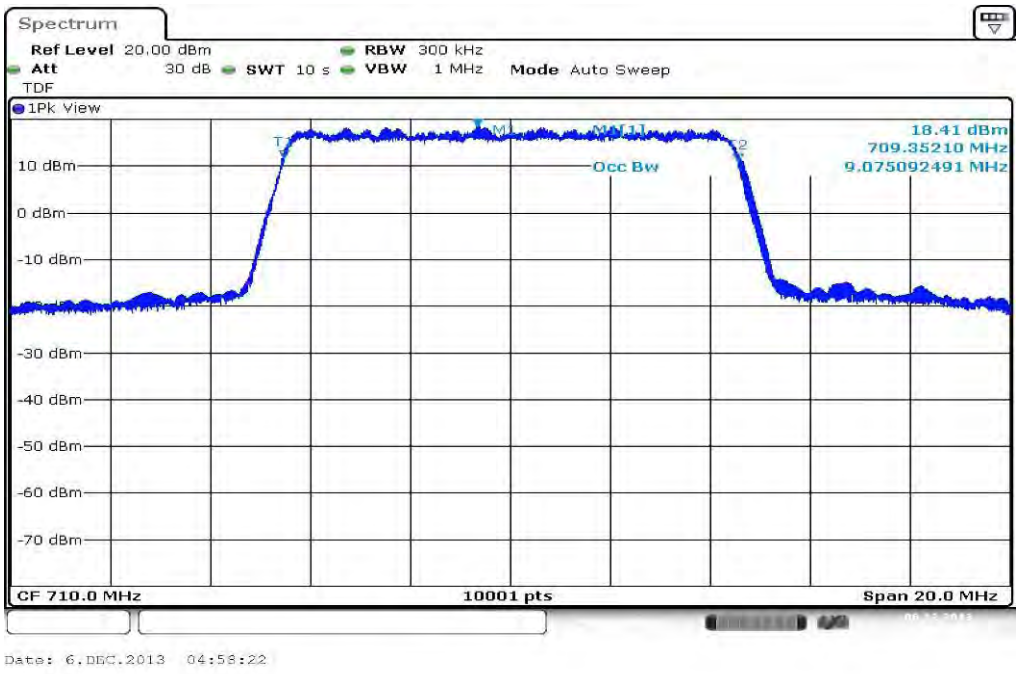
Result: **Passed**

Plots: QPSK

Plot 1: 5 MHz, 99% OBW



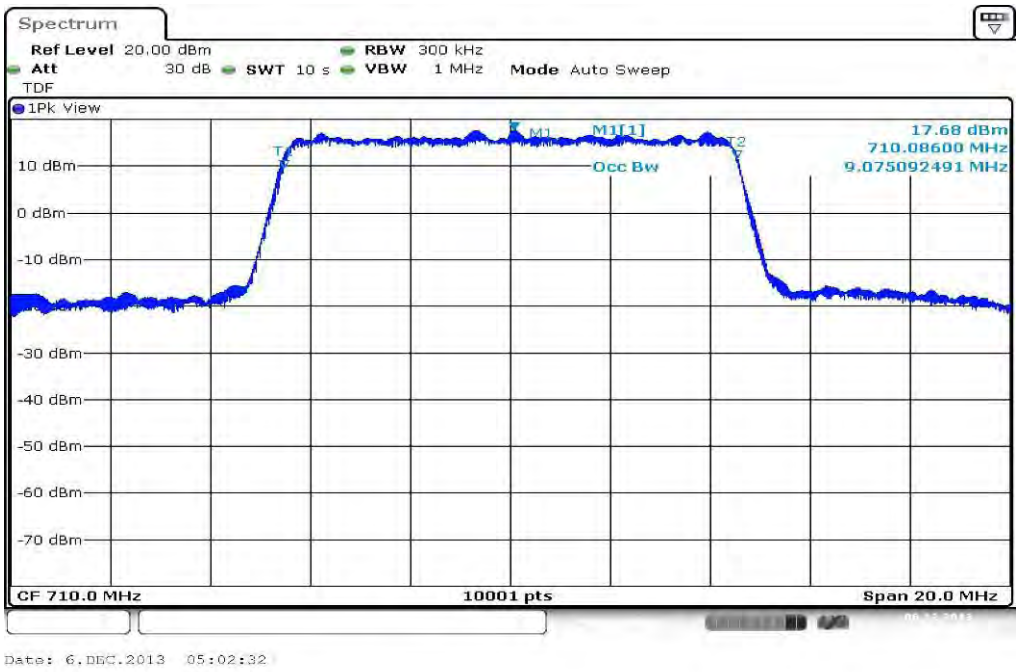
Plot 2: 10 MHz, 99% OBW



Plots: 16-QAM

Plot 1: 5 MHz, 99% OBW

Plot 2: 10 MHz, 99% OBW



9 Test equipment and ancillaries used for tests

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, rf-generating and signalling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Labor/Item).

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vIKl!	08.05.2013	08.05.2015
2	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev		
3	n. a.	Switch / Control Unit	3488A	HP Meßtechnik	*	300000199	ne		
4	n. a.	Switch / Control Unit	3488A	HP Meßtechnik	2719A15013	300001156	ne		
5	9	Isolating Transformer	MPL IEC625 Bus Regeltrennt ravo	Erfi	91350	300001155	ne		
6	n. a.	Three-Way Power Splitter, 50 Ohm	11850C	HP Meßtechnik		300000997	ne		
7	90	Active Loop Antenna 10 kHz to 30 MHz	6502	Kontron Psychotech	8905-2342	300000256	k	13.06.2013	13.06.2015
8	n. a.	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne		
9	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vIKl!	14.10.2011	14.10.2014
10	n. a.	MXE EMI Receiver 20 Hz bis 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	21.02.2013	21.02.2014
11	11b	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP Meßtechnik	00419	300002268	ev		
12	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	22.07.2013	22.07.2015
13	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015
14	n. a.	Temperature Test Chamber	VT 4002	Heraeus Voetsch	521/84193	300003889	Ve	26.09.2013	26.09.2015
15	n. a.	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	22.10.2012	22.01.2014
16	n. a.	Power Supply 0-20V, 0-5A	6632B	Agilent Technologies	GB42110541	400000562	vIKl!	10.01.2013	10.01.2016
17	n. a.	Wideband Radio Communication Tester	CMW500	R&S	102375	300004187_0	k	16.07.2013	16.07.2015

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

10 Observations

No observations exceeding those reported with the single test cases have been made.

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2014-01-15
A	Canada removed / EUT name changed	2014-01-22

Annex B Further information

Glossary

AVG - Average
DUT - Device under test
EMC - Electromagnetic Compatibility
EN - European Standard
EUT - Equipment under test
ETSI - European Telecommunications Standard Institute
FCC - Federal Communication Commission
FCC ID - Company Identifier at FCC
HW - Hardware
IC - Industry Canada
Inv. No. - Inventory number
N/A - Not applicable
PP - Positive peak
QP - Quasi peak
S/N - Serial number
SW - Software

Annex C Accreditation Certificate

Front side of certificate

DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

CETECOM ICT Services GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Drahtgebundene Kommunikation einschließlich xDSL
VoIP und DECT
Akustik
Funk einschließlich WLAN
Short Range Devices (SRD)
RFID
WiMax und Richtfunk
Mobilfunk (GSM / DCS, Over the Air (OTA) Performance)
Elektromagnetische Verträglichkeit (EMV) einschließlich Automotive
Produktsicherheit
SAR und Hearing Aid Compatibility (HAC)
Umweltsimulation
Smart Card Terminals
Bluetooth
Wi-Fi- Services

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 18.01.2013 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 80 Seiten.

Registrierungsnummer der Urkunde: **D-PL-12076-01-01**

Frankfurt am Main, 18.01.2013

Im Auftrag
Dipl.-Ing. (FH) Arti Egner
Abteilungsleiter

Siehe Hinweise auf der Rückseite

Back side of certificate

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
Spittelmarkt 10
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60594 Frankfurt am Main

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Bundesallee 100
38116 Braunschweig

Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAkkS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Konformitätsbewertungsstelle in unveränderter Form.

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Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abl. L 218 vom 9. Juli 2008, S. 30).
Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

Note:

The current certificate including annex is published on our website (see link below) or may be received from CETECOM ICT Services on request.

http://www.cetecom.com/eu/de/cetecom-group/europa/deutschland-saarbruecken/akkreditierungen.html