

#### 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 10 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<br>On spurious detection re-measurement<br>below 1 GHz with 100 kHz<br>Above 1 GHz with 1 MHz |
| Resolution bandwidth:  | Pre-measurement with 1 MHz<br>On spurious detection re-measurement<br>below 1 GHz with 100 kHz<br>Above 1 GHz with 1 MHz |
| Span:                  | 10 MHz – 12 GHz                                                                                                          |
| Trace-Mode:            | Max Hold                                                                                                                 |

##### Limits:

| FCC                                                      | -/- |
|----------------------------------------------------------|-----|
| Spurious Emissions Conducted                             |     |
| Attenuation $\geq 43 + 10\log(P)$<br>(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]        |
|                               | No peaks detected. |                    | No peaks detected. |                    | No peaks detected. |
|                               |                    |                    |                    |                    |                    |
|                               |                    |                    |                    |                    |                    |
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|                               |                    |                    |                    |                    |                    |
| 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]        |
|                               | No peaks detected. |                    | No peaks detected. |                    | No peaks detected. |
|                               |                    |                    |                    |                    |                    |
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|                               |                    |                    |                    |                    |                    |
| Measurement uncertainty       |                    |                    | ± 3dB              |                    |                    |

**Result:** Passed

**Results:** for 10 MHz channel bandwidth

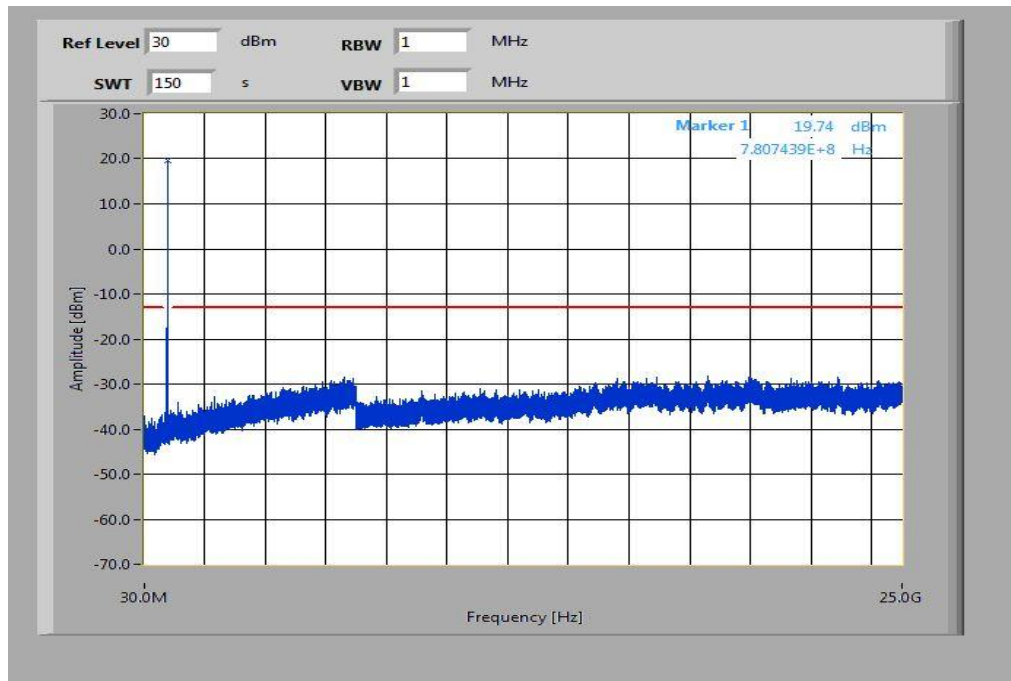
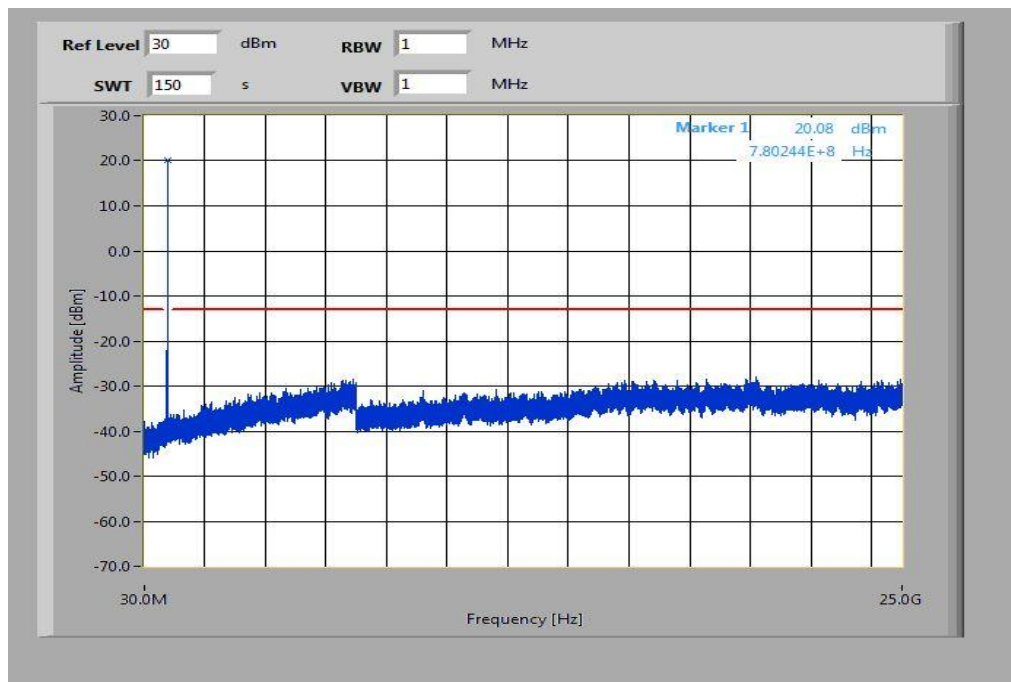
**QPSK**

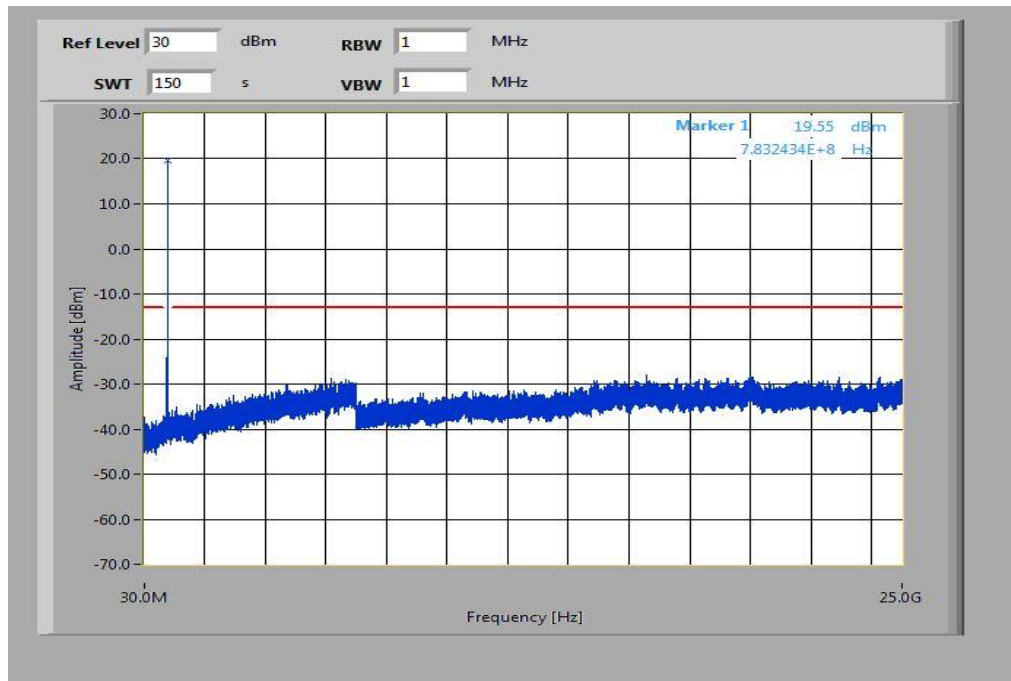
| Spurious Emission Level (dBm) |                    |                    |                    |                    |                    |
|-------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Lowest channel                |                    | Middle channel     |                    | Highest channel    |                    |
| Spurious emissions            | Level [dBm]        | Spurious emissions | Level [dBm]        | Spurious emissions | Level [dBm]        |
|                               | No peaks detected. |                    | No peaks detected. |                    | No peaks detected. |
|                               |                    |                    |                    |                    |                    |
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|                               |                    |                    |                    |                    |                    |
| Measurement uncertainty       |                    |                    | ± 3dB              |                    |                    |

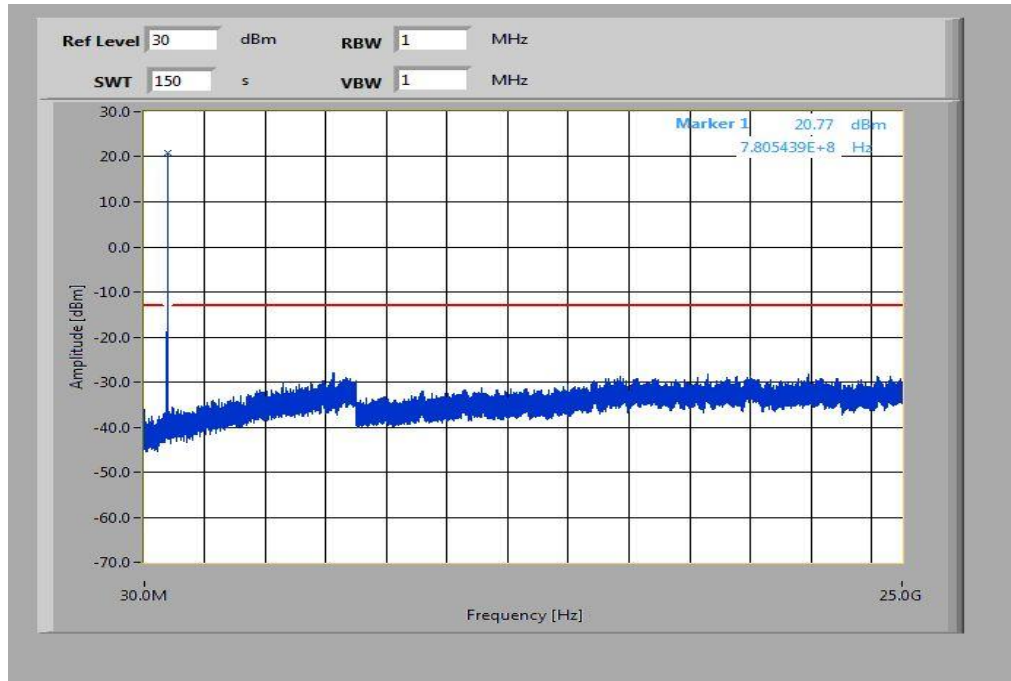
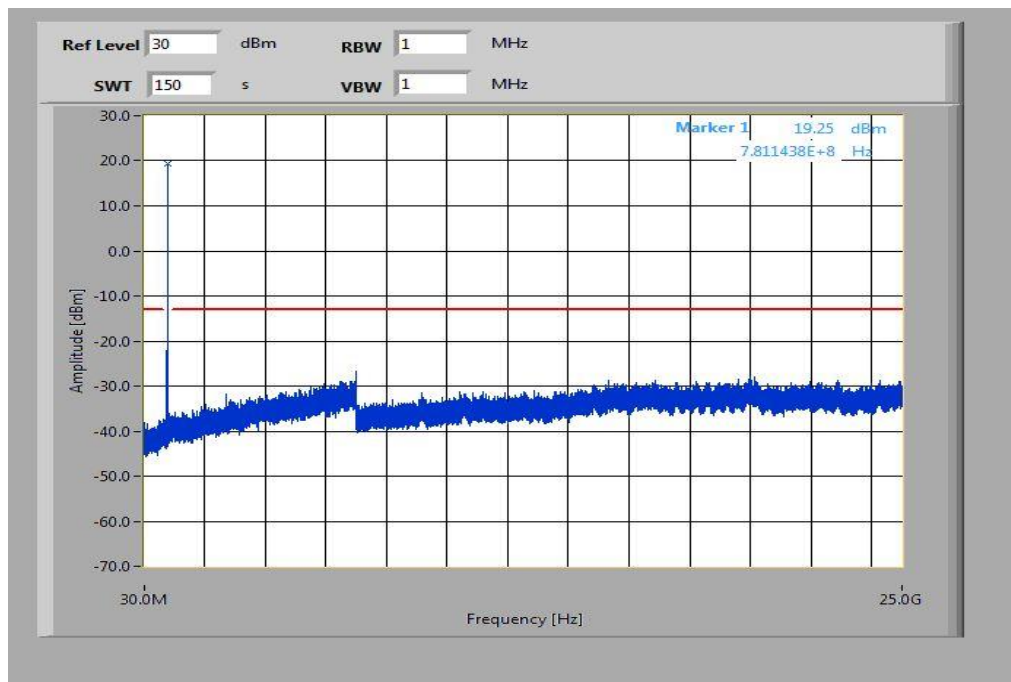
**16-QAM**

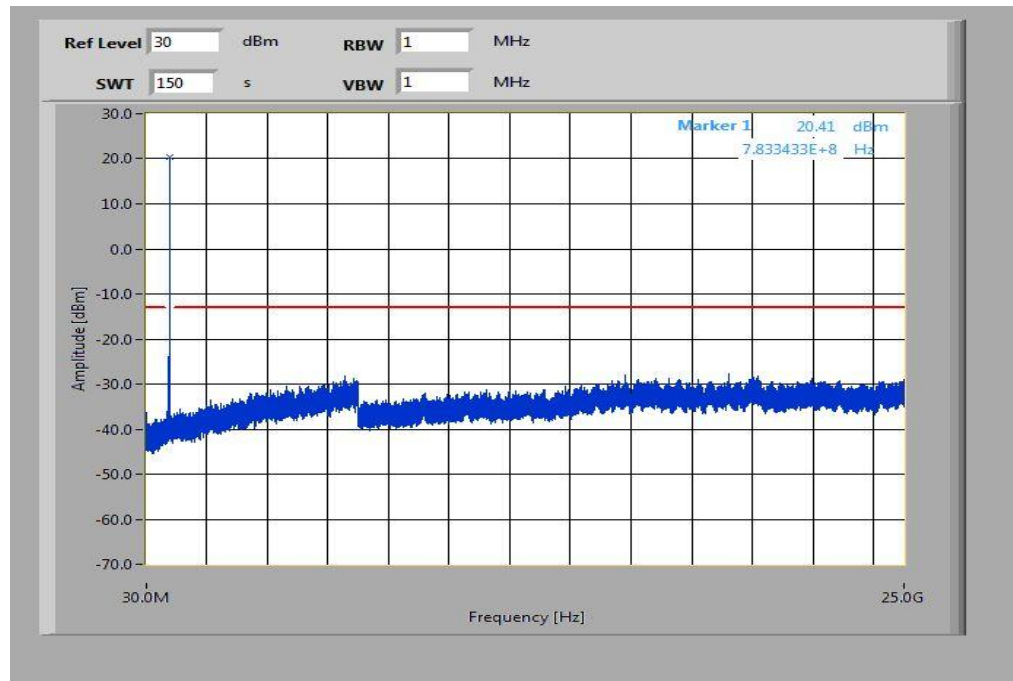
| Spurious Emission Level (dBm) |                    |                    |                    |                    |                    |
|-------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Lowest channel                |                    | Middle channel     |                    | Highest channel    |                    |
| Spurious emissions            | Level [dBm]        | Spurious emissions | Level [dBm]        | Spurious emissions | Level [dBm]        |
|                               | No peaks detected. |                    | No peaks detected. |                    | No peaks detected. |
|                               |                    |                    |                    |                    |                    |
|                               |                    |                    |                    |                    |                    |
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|                               |                    |                    |                    |                    |                    |
|                               |                    |                    |                    |                    |                    |
|                               |                    |                    |                    |                    |                    |
| Measurement uncertainty       |                    |                    | ± 3dB              |                    |                    |

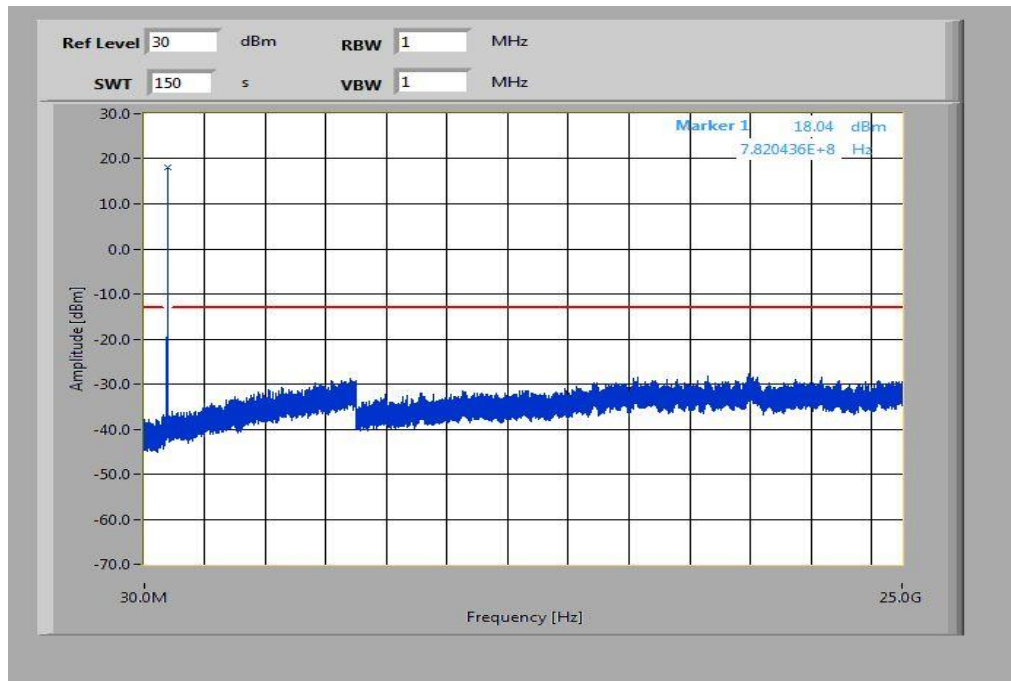
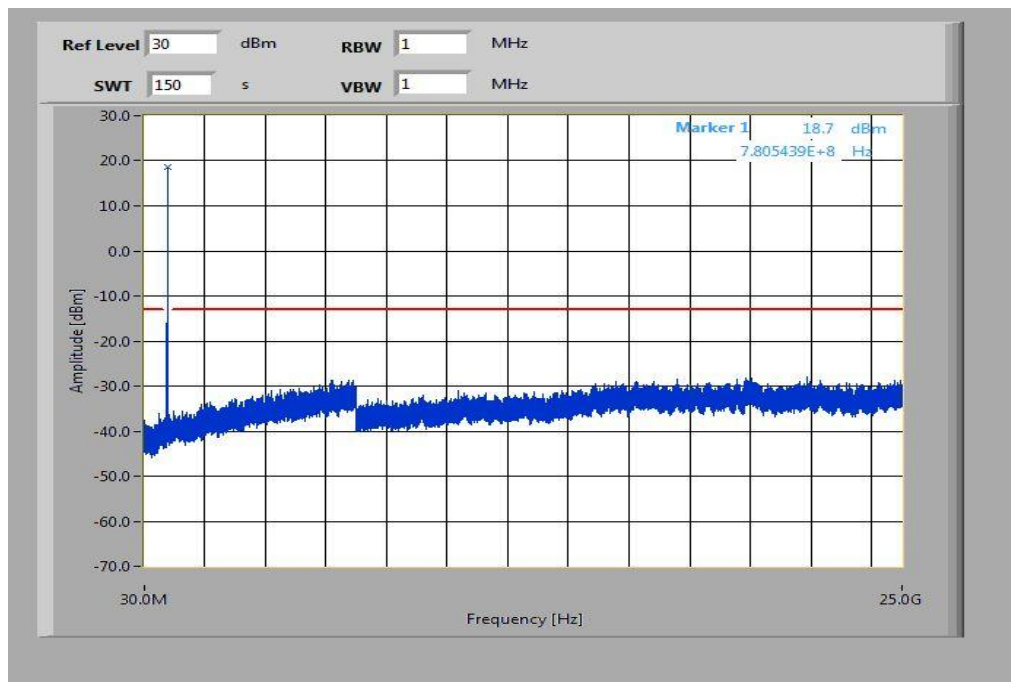
**Result:** **Passed**

**Plots for 5 MHz channel bandwidth, QPSK****Plot 1: Lowest channel, 10 MHz to 25 GHz****Plot 2: Middle channel, 10 MHz to 25 GHz**

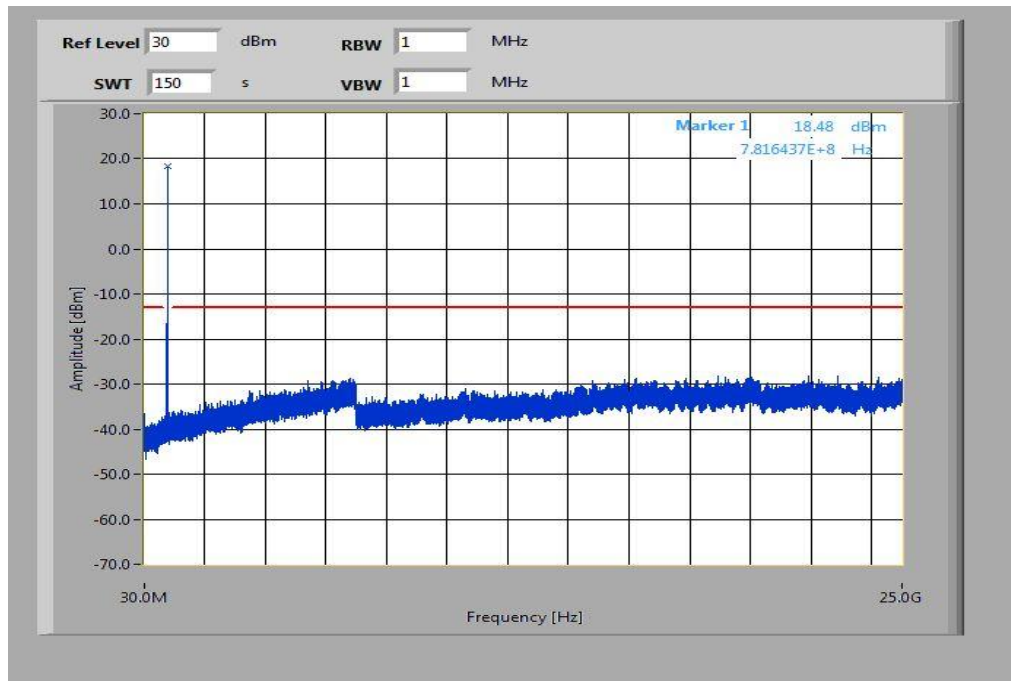
**Plot 3:** Highest channel, 10 MHz to 25 GHz

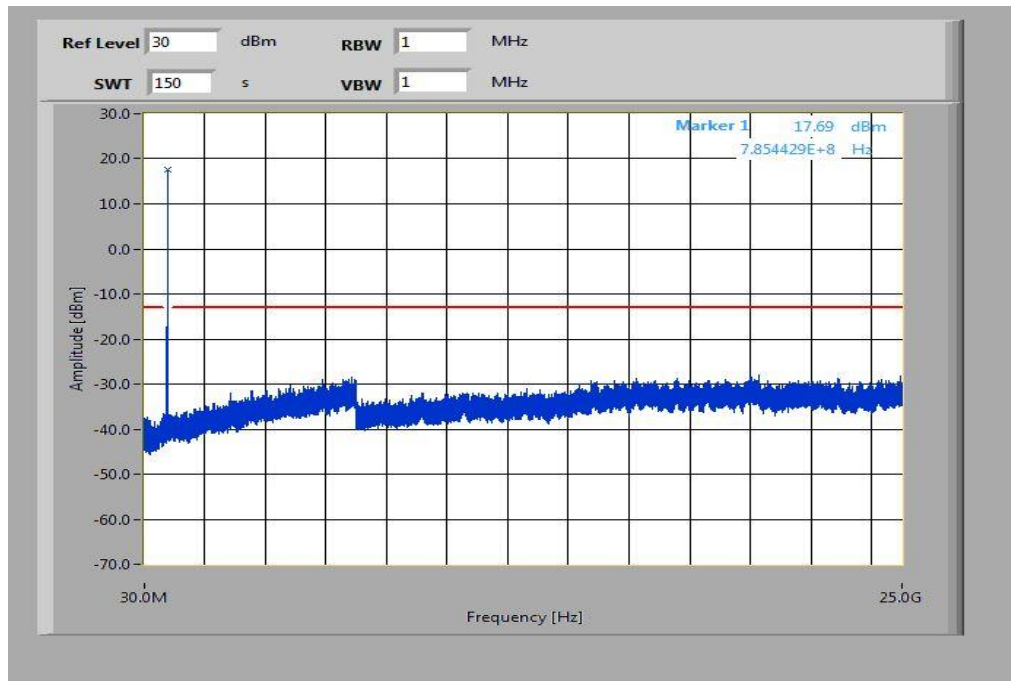
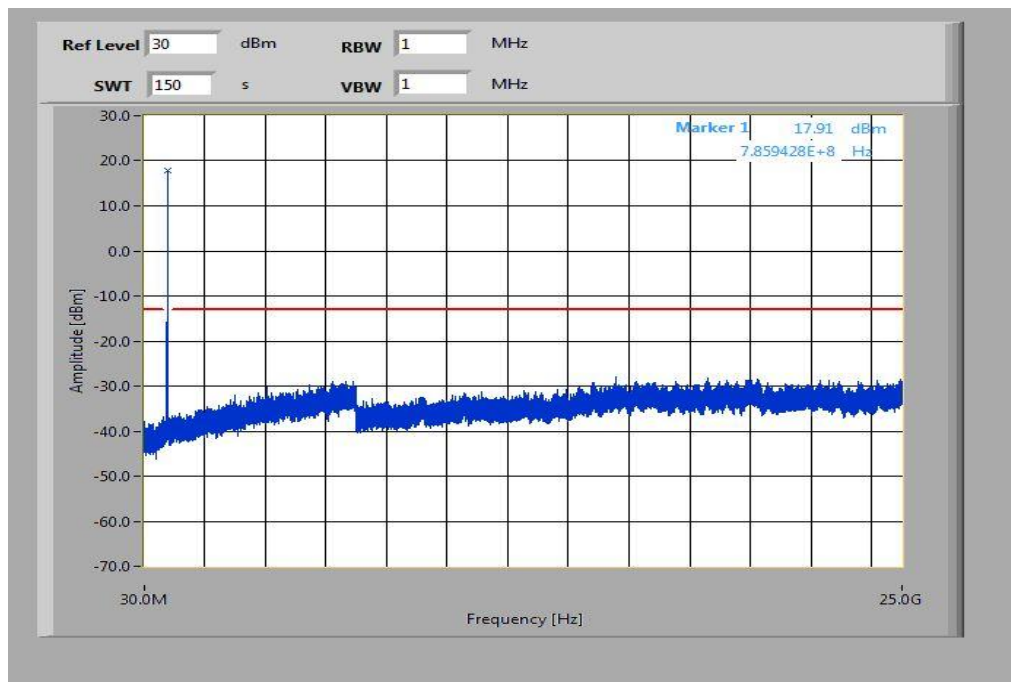
**Plots for 5 MHz channel bandwidth, 16-QAM****Plot 4: Lowest channel, 10 MHz to 25 GHz****Plot 5: Middle channel, 10 MHz to 25 GHz**

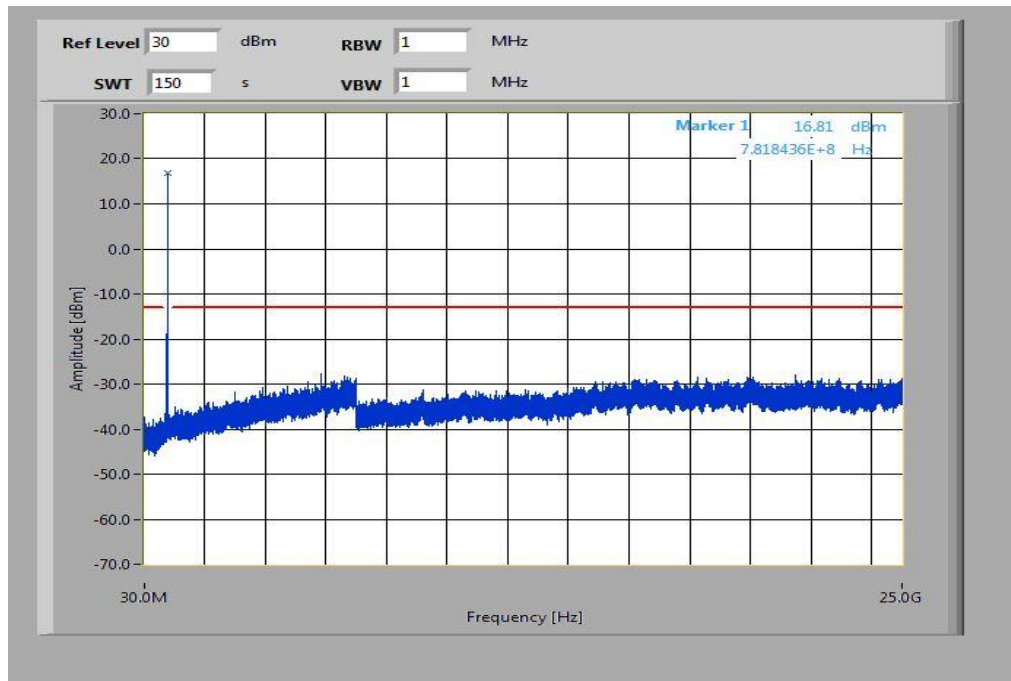
**Plot 6:** Highest channel, 10 MHz to 25 GHz

**Plots for 10 MHz channel bandwidth, QPSK****Plot 1: Lowest channel, 10 MHz to 25 GHz****Plot 2: Middle channel, 10 MHz to 25 GHz**



**Plot 3:** Highest channel, 10 MHz to 25 GHz

**Plots for 10 MHz channel bandwidth, 16-QAM****Plot 4: Lowest channel, 10 MHz to 25 GHz****Plot 5: Middle channel, 10 MHz to 25 GHz**

**Plot 6:** Highest channel, 10 MHz to 25 GHz

### 8.5.5 Block edge compliance

#### Description:

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

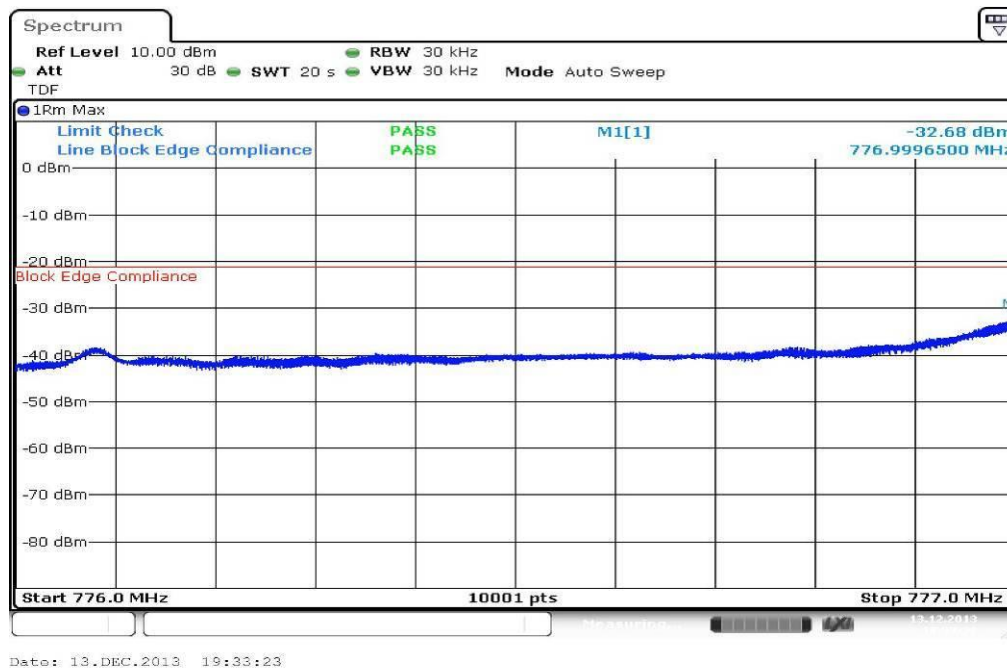
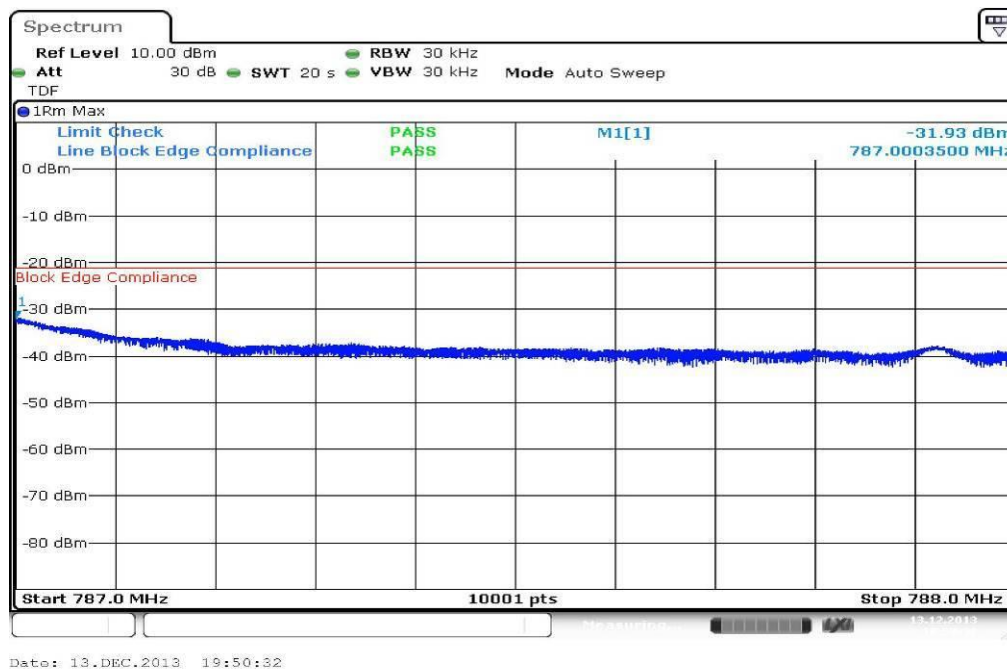
#### Measurement:

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

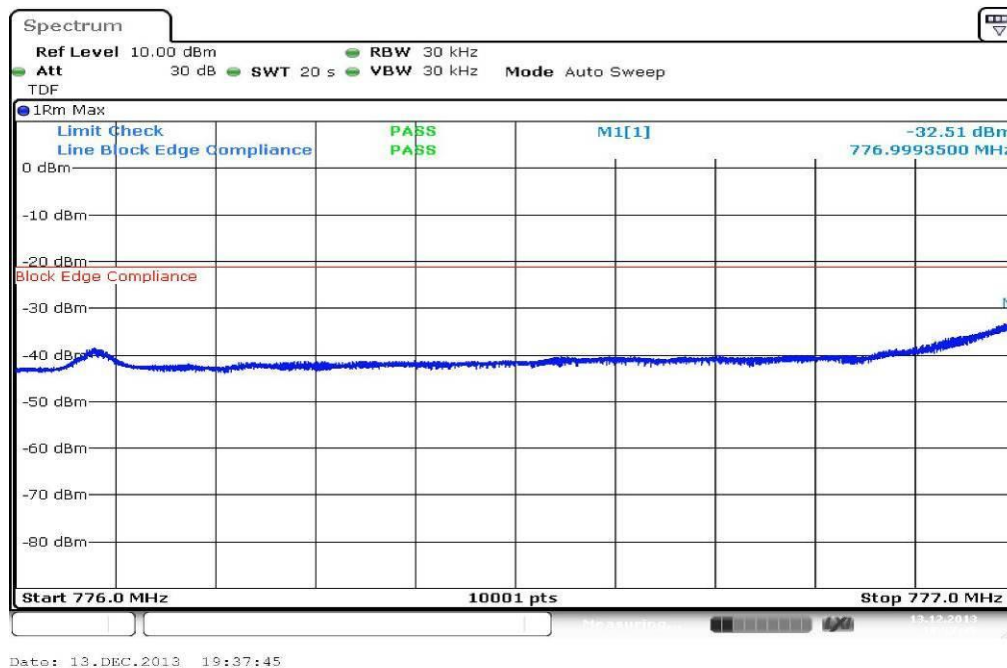
#### Limits:

| FCC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -/- |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Block Edge Compliance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |
| <p>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 <math>43 + 10 \log(P)</math> dB."</p> <p>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:</p> <p>"An alternative is to add an additional correction factor of <math>10 \log(RBW1/RBW2)</math> to the <math>43 + 10 \log(P)</math> limit. RBW1 is the narrower measurement resolution bandwidth and RBW2 is either the 1% emissions bandwidth or 1 MHz."</p> <p>When using a 30 kHz bandwidth, this yields a -5.2288 adjustment to the limit [<math>10 \log(30\text{kHz}/100\text{kHz}) = -5.2288</math>]. When this adjustment is applied to the limit, the limit becomes -18.2288.</p> |     |
| -18.23 dBm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |

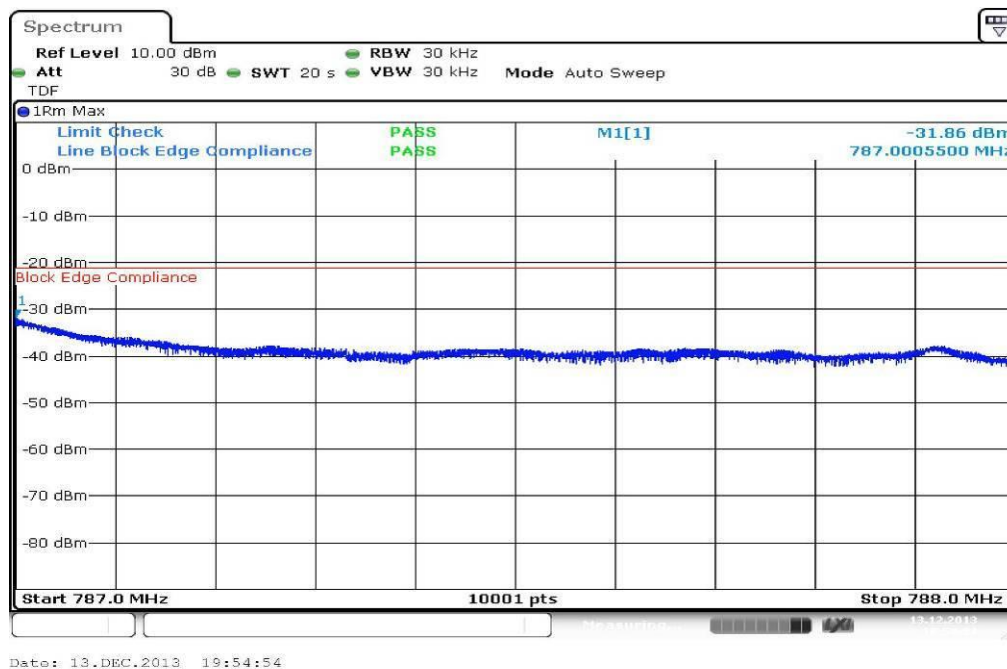
The limit line in the plots is the over all LTE bands and channel bandwidths worst case -21.24 dBm.

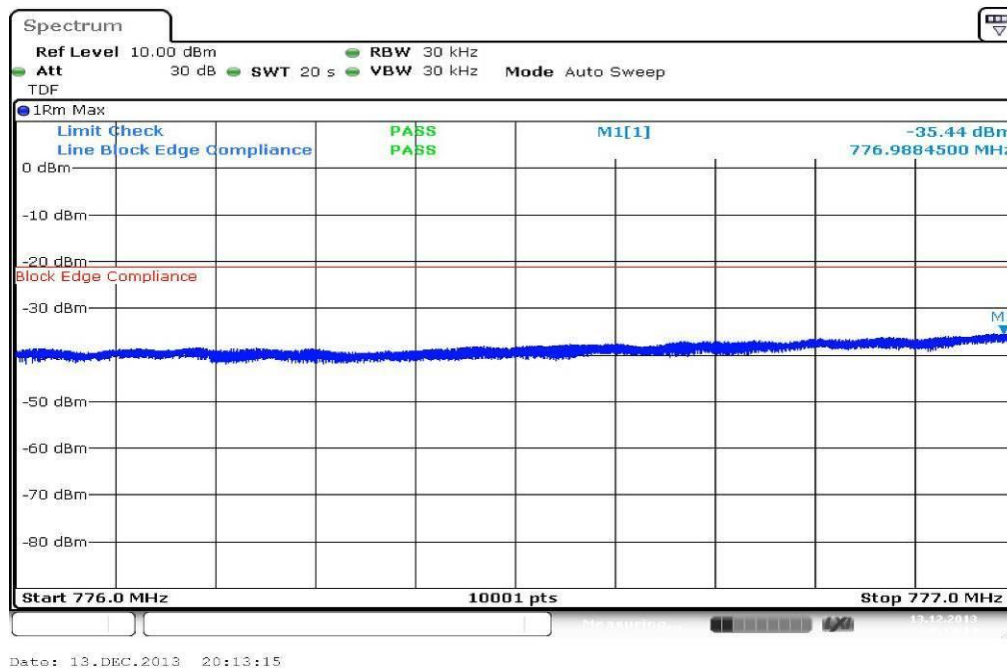
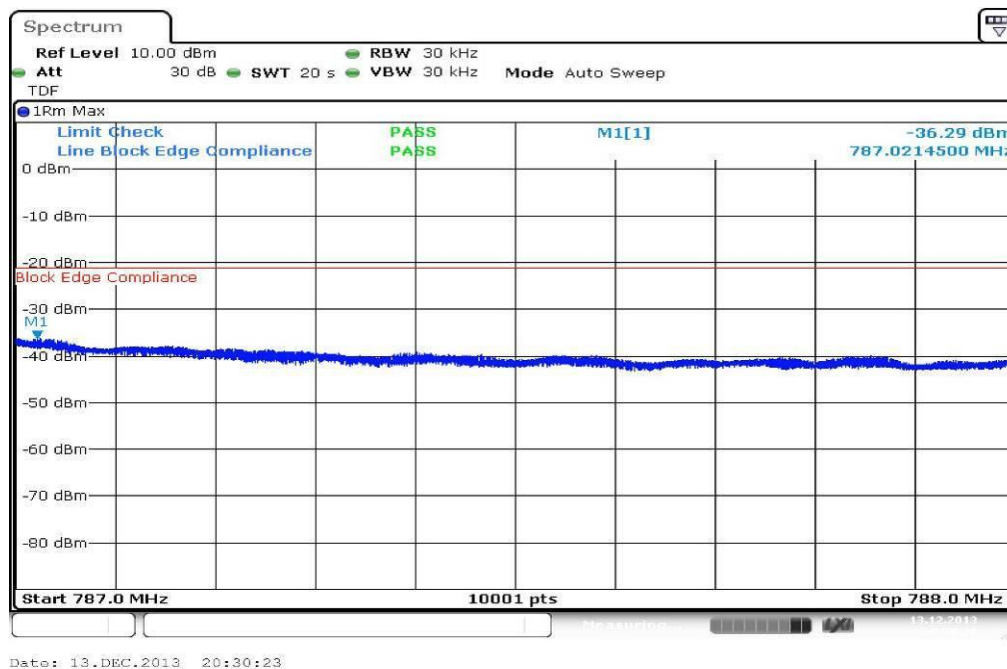
**Results: 5 MHz channel bandwidth****Plot 1: Lowest channel, QPSK modulation****Plot 2: Highest channel, QPSK modulation**

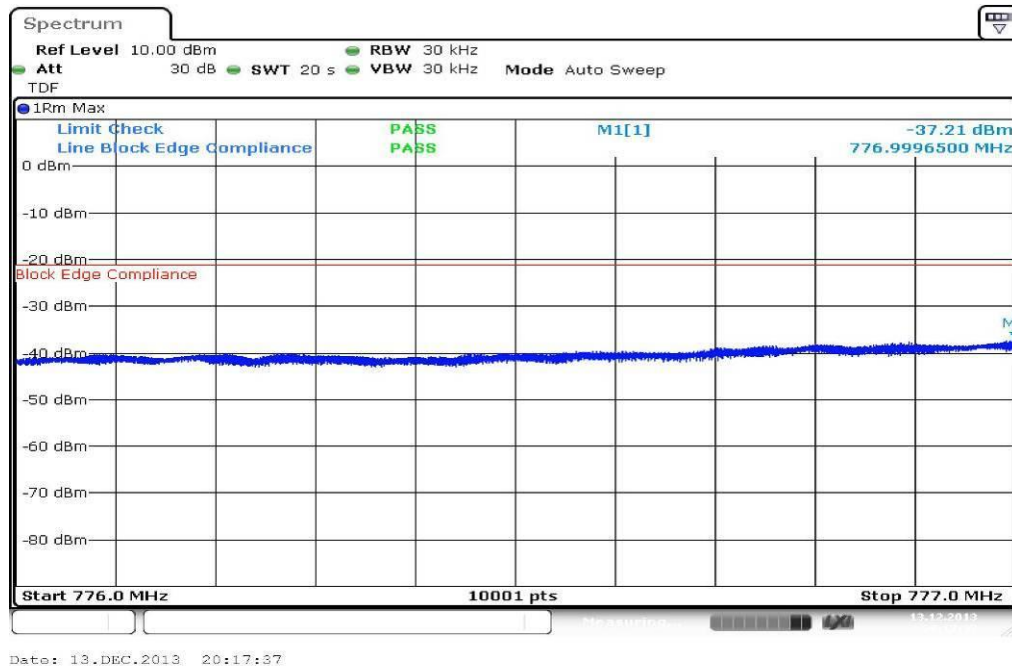
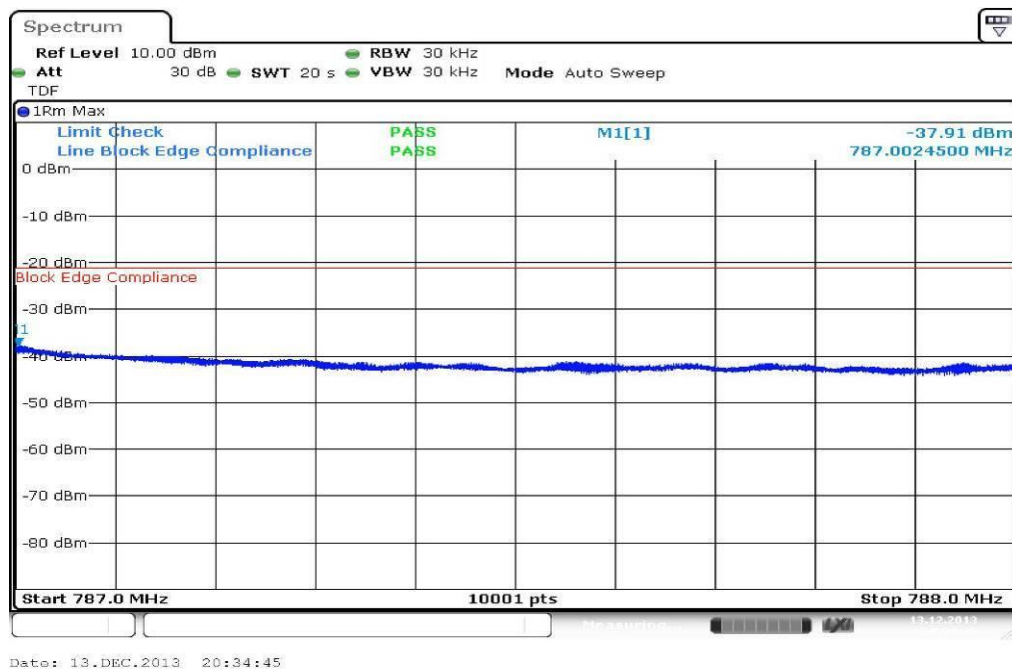
Plot 3: Lowest channel, 16 – QAM modulation



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 13 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 |     |

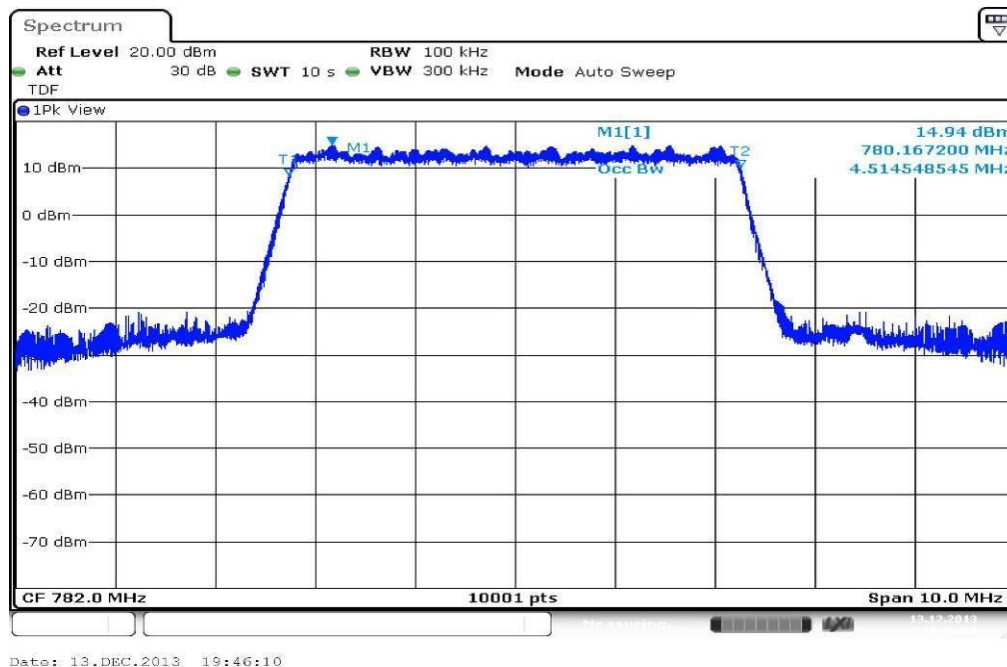
**Results:**

| Occupied Bandwidth - QPSK |                                                               |                       |
|---------------------------|---------------------------------------------------------------|-----------------------|
| Bandwidth [MHz]           | 99% OBW (kHz)                                                 | 26 dB bandwidth (kHz) |
| 5                         | 4500                                                          | 4990                  |
| 10                        | 9063                                                          | 10177                 |
| Measurement uncertainty   | $\pm 100$ kHz to $\pm 300$ kHz depending on channel bandwidth |                       |

| Occupied Bandwidth – 16-QAM |                                                               |                       |
|-----------------------------|---------------------------------------------------------------|-----------------------|
| Bandwidth [MHz]             | 99% OBW (kHz)                                                 | 26 dB bandwidth (kHz) |
| 5                           | 4515                                                          | 5015                  |
| 10                          | 9057                                                          | 10147                 |
| Measurement uncertainty     | $\pm 100$ kHz to $\pm 300$ kHz depending on channel bandwidth |                       |

**Result:** Passed



**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                                                                                                                                           | -/- |
| 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<br>(MHz)       | Frequency<br>(MHz) | Resource<br>block<br>allocation | Average<br>Output<br>Power (dBm)<br>QPSK | Peak to<br>Average<br>Ratio (dB) | Average<br>Output<br>Power (dBm)<br>16-QAM | Peak to<br>Average<br>Ratio (dB) |
| 5                        | 706.5              | 1 RB low                        | 23.7                                     | 4.34                             | 22.8                                       | 5.22                             |
|                          |                    | 1 RB high                       | 23.8                                     | 4.54                             | 22.6                                       | 4.80                             |
|                          |                    | 50% RB mid                      | 22.6                                     | 4.86                             | 21.6                                       | 5.78                             |
|                          |                    | 100% RB                         | 22.6                                     | 5.37                             | 21.6                                       | 6.35                             |
|                          | 710.0              | 1 RB low                        | 23.6                                     | 4.49                             | 23.0                                       | 4.57                             |
|                          |                    | 1 RB high                       | 23.6                                     | 4.37                             | 22.9                                       | 4.61                             |
|                          |                    | 50% RB mid                      | 22.7                                     | 5.59                             | 21.5                                       | 4.93                             |
|                          |                    | 100% RB                         | 22.6                                     | 6.79                             | 21.6                                       | 5.50                             |
|                          | 713.5              | 1 RB low                        | 23.6                                     | 4.58                             | 22.5                                       | 5.25                             |
|                          |                    | 1 RB high                       | 23.6                                     | 4.62                             | 22.5                                       | 5.24                             |
|                          |                    | 50% RB mid                      | 22.6                                     | 4.93                             | 21.6                                       | 5.73                             |
|                          |                    | 100% RB                         | 22.6                                     | 5.59                             | 21.7                                       | 6.61                             |
| 10                       | 709.0              | 1 RB low                        | 23.7                                     | 5.12                             | 22.8                                       | 4.50                             |
|                          |                    | 1 RB high                       | 23.7                                     | 5.06                             | 22.9                                       | 4.63                             |
|                          |                    | 50% RB mid                      | 22.7                                     | 5.88                             | 21.8                                       | 5.11                             |
|                          |                    | 100% RB                         | 22.6                                     | 6.17                             | 21.6                                       | 5.10                             |
|                          | 710.0              | 1 RB low                        | 23.7                                     | 4.45                             | 22.5                                       | 5.49                             |
|                          |                    | 1 RB high                       | 23.7                                     | 4.63                             | 22.4                                       | 5.19                             |
|                          |                    | 50% RB mid                      | 22.6                                     | 4.98                             | 21.7                                       | 5.68                             |
|                          |                    | 100% RB                         | 22.6                                     | 5.92                             | 21.6                                       | 6.53                             |
|                          | 711.0              | 1 RB low                        | 23.8                                     | 5.62                             | 22.5                                       | 4.46                             |
|                          |                    | 1 RB high                       | 23.7                                     | 5.51                             | 22.4                                       | 4.66                             |
|                          |                    | 50% RB mid                      | 22.7                                     | 5.85                             | 21.5                                       | 4.99                             |
|                          |                    | 100% RB                         | 22.7                                     | 6.88                             | 21.7                                       | 5.51                             |
| Measurement uncertainty  |                    |                                 | ± 0.5 dB                                 |                                  |                                            |                                  |

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

| Output Power (radiated) |                 |                                    |                                      |
|-------------------------|-----------------|------------------------------------|--------------------------------------|
| Bandwidth (MHz)         | Frequency (MHz) | Average Output Power (dBm)<br>QPSK | Average Output Power (dBm)<br>16-QAM |
| 5                       | 706.5           | 17.9                               | 16.9                                 |
|                         | 710.0           | 17.6                               | 17.0                                 |
|                         | 713.5           | 18.0                               | 16.9                                 |
| 10                      | 709.0           | 17.8                               | 17.0                                 |
|                         | 710.0           | 17.7                               | 16.5                                 |
|                         | 711.0           | 18.2                               | 16.9                                 |
| 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         | 6                    | 0.00000085          | 0.0085                |
| 3.4         | 10                   | 0.00000141          | 0.0141                |
| 3.5         | 1                    | 0.00000014          | 0.0014                |
| 3.6         | -6                   | -0.00000085         | -0.0085               |
| 3.7         | 4                    | 0.00000056          | 0.0056                |
| 3.8         | -2                   | -0.00000028         | -0.0028               |
| 3.9         | 3                    | 0.00000042          | 0.0042                |
| 4.0         | -6                   | -0.00000085         | -0.0085               |
| 4.1         | -1                   | -0.00000014         | -0.0014               |
| 4.2         | 3                    | 0.00000042          | 0.0042                |
| 4.3         | 8                    | 0.00000113          | 0.0113                |
| 4.4         | 6                    | 0.00000085          | 0.0085                |

**FREQ ERROR versus TEMPERATURE**

| Temperature (°C) | Frequency Error (Hz) | Frequency Error (%) | Frequency Error (ppm) |
|------------------|----------------------|---------------------|-----------------------|
| -30              | 11                   | 0.00000155          | 0.0155                |
| -20              | -4                   | -0.00000056         | -0.0056               |
| -10              | 4                    | 0.00000056          | 0.0056                |
| ± 0              | -2                   | -0.00000028         | -0.0028               |
| 10               | -5                   | -0.00000070         | -0.0070               |
| 20               | -4                   | -0.00000056         | -0.0056               |
| 30               | -3                   | -0.00000042         | -0.0042               |
| 40               | 1                    | 0.00000014          | 0.0014                |
| 50               | 8                    | 0.00000113          | 0.0113                |
| 60               | 2                    | 0.00000028          | 0.0028                |

**Additional measurements for RSS-130 (4.3 b)**

|                                                        |                                                        |
|--------------------------------------------------------|--------------------------------------------------------|
| $f_L = 704.044 \text{ MHz}$                            | $f_H = 715.957 \text{ MHz}$                            |
| $f_L - (\text{max freq. error}) = 704.044 \text{ MHz}$ | $f_H + (\text{max freq. error}) = 715.957 \text{ MHz}$ |

**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 30 MHz 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:

- The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- The antenna output was terminated in a 50 ohm load (if possible).
- A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- 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.
- 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 1 GHz: 100 kHz<br>Above 1 GHz: 1 MHz |
| Resolution bandwidth:  | Below 1 GHz: 100 kHz<br>Above 1 GHz: 1 MHz |
| Span:                  | 100 MHz Steps                              |
| Trace-Mode:            | Max Hold                                   |

#### Limits:

| FCC                                                      | -/- |
|----------------------------------------------------------|-----|
| Spurious Emissions Radiated                              |     |
| Attenuation $\geq 43 + 10\log(P)$<br>(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 plots. 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.

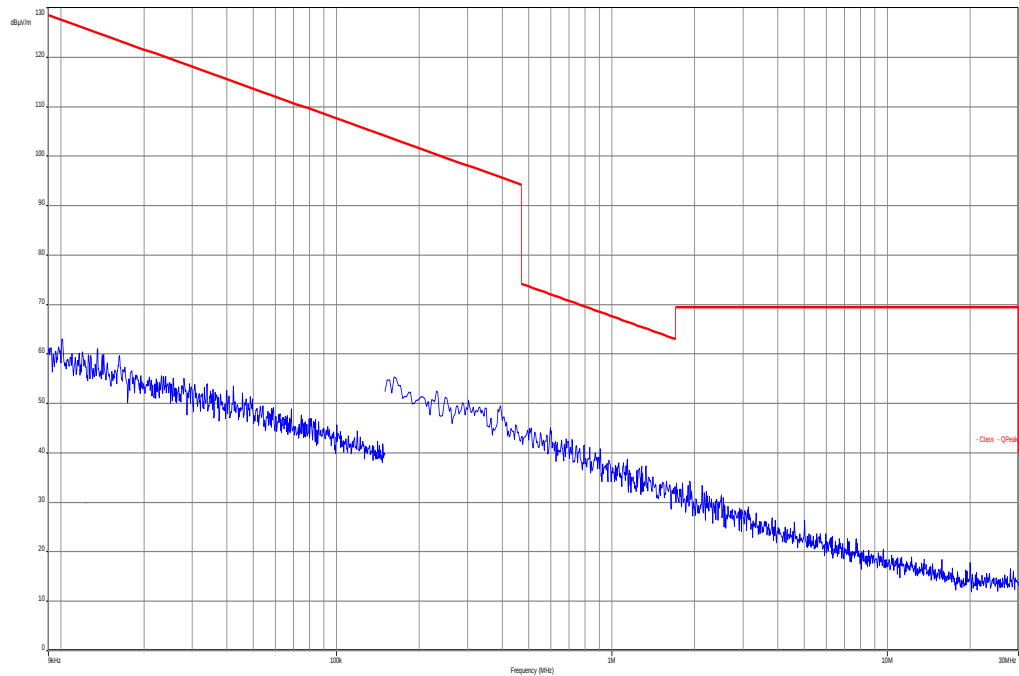
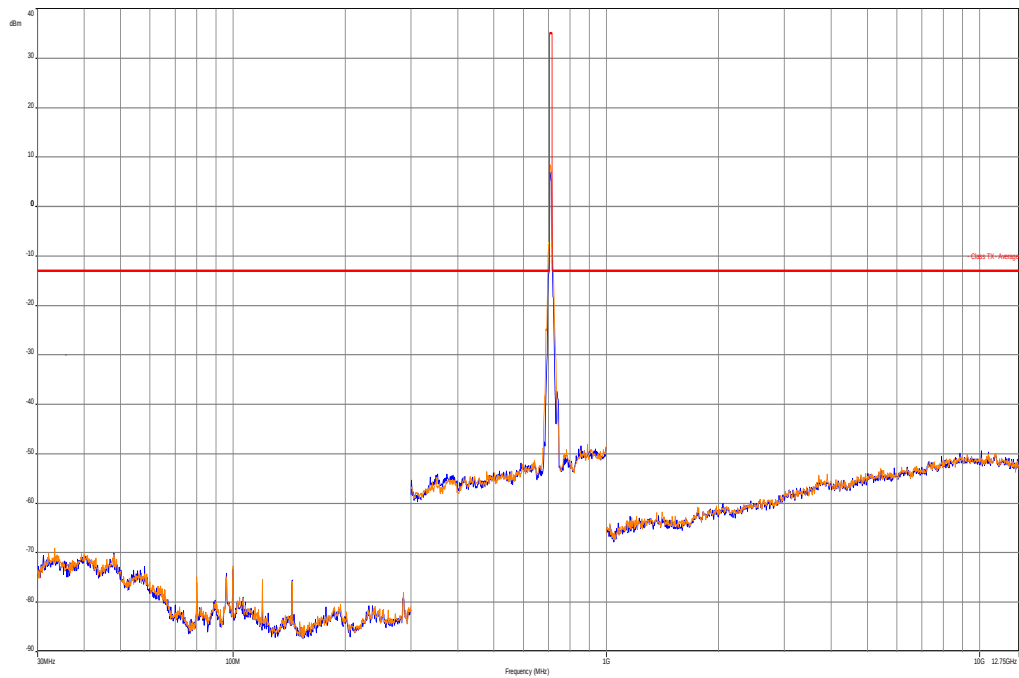
**QPSK**

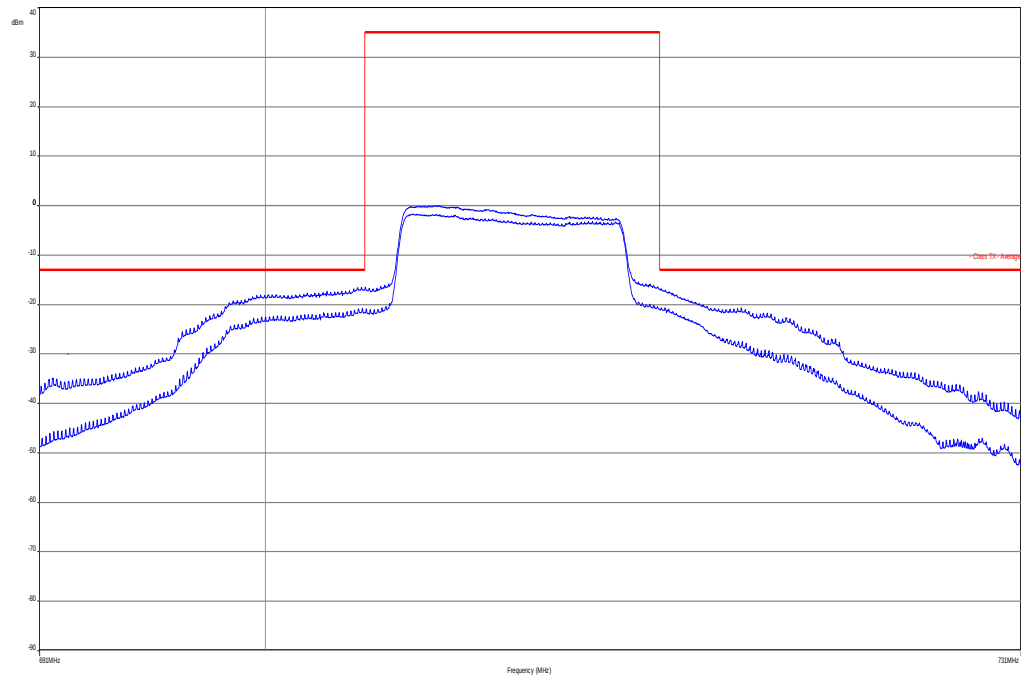
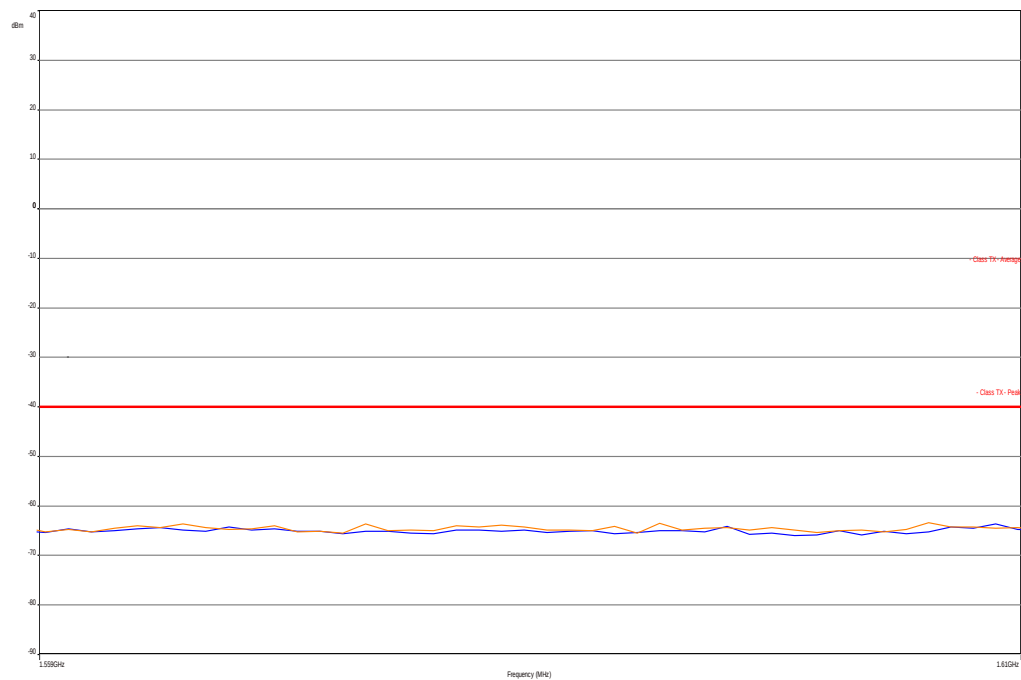
| Spurious Emission Level (dBm) |                                 |                    |                                 |                    |                                 |
|-------------------------------|---------------------------------|--------------------|---------------------------------|--------------------|---------------------------------|
| Lowest channel                |                                 | Middle channel     |                                 | Highest channel    |                                 |
| Spurious emissions            | Level [dBm]                     | Spurious emissions | Level [dBm]                     | Spurious emissions | Level [dBm]                     |
|                               | No spurious emissions detected. |                    | No spurious emissions detected. |                    | No spurious emissions detected. |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
| Measurement uncertainty       |                                 |                    | ± 3dB                           |                    |                                 |

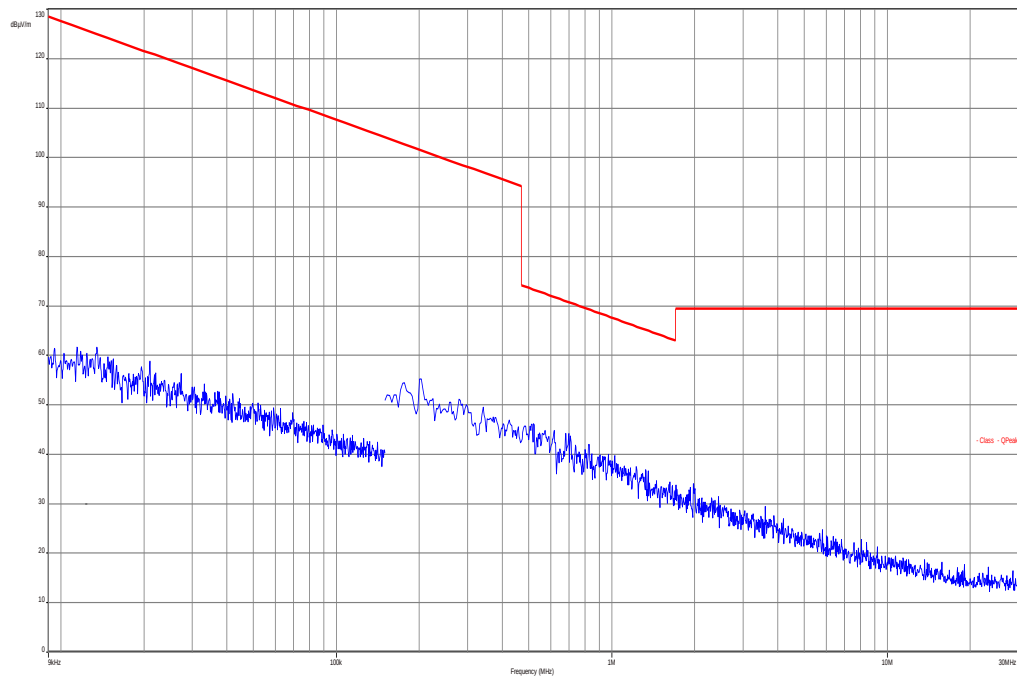
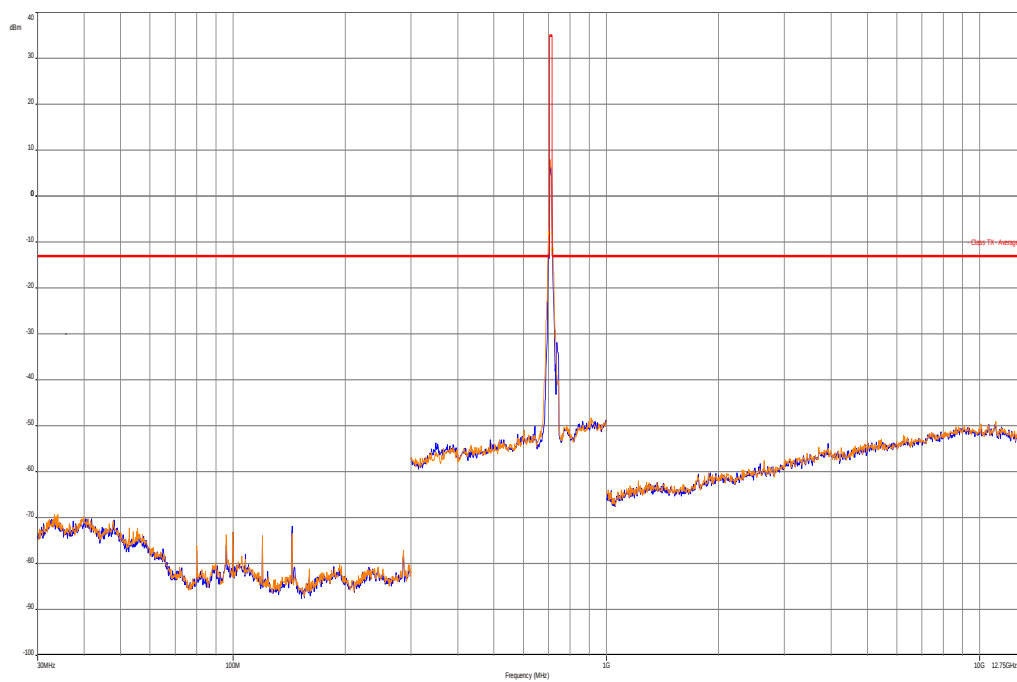
**16-QAM**

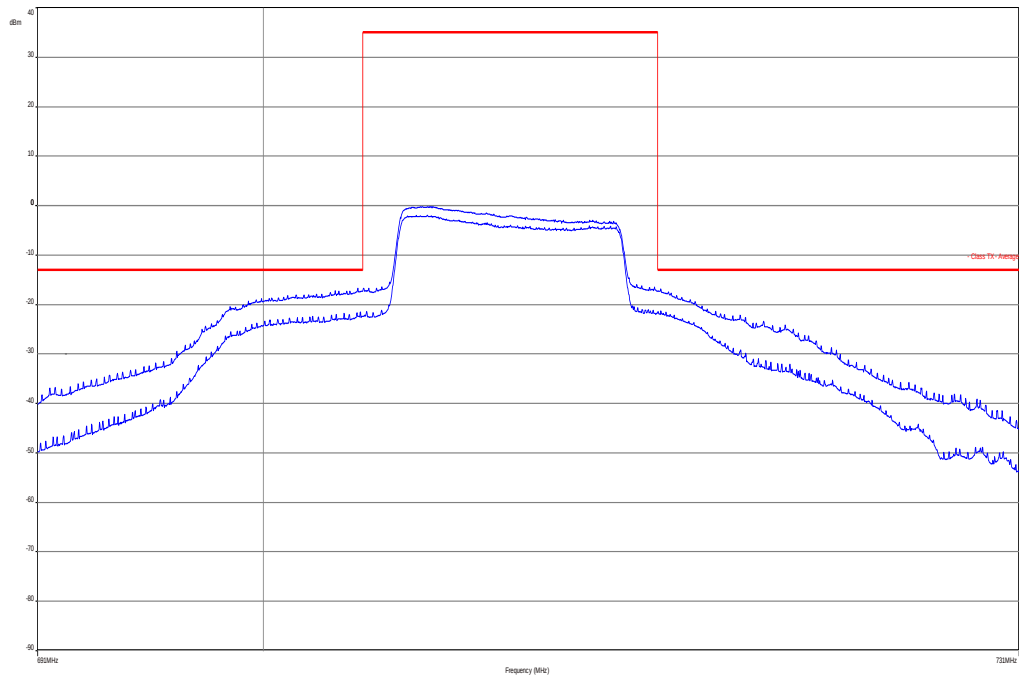
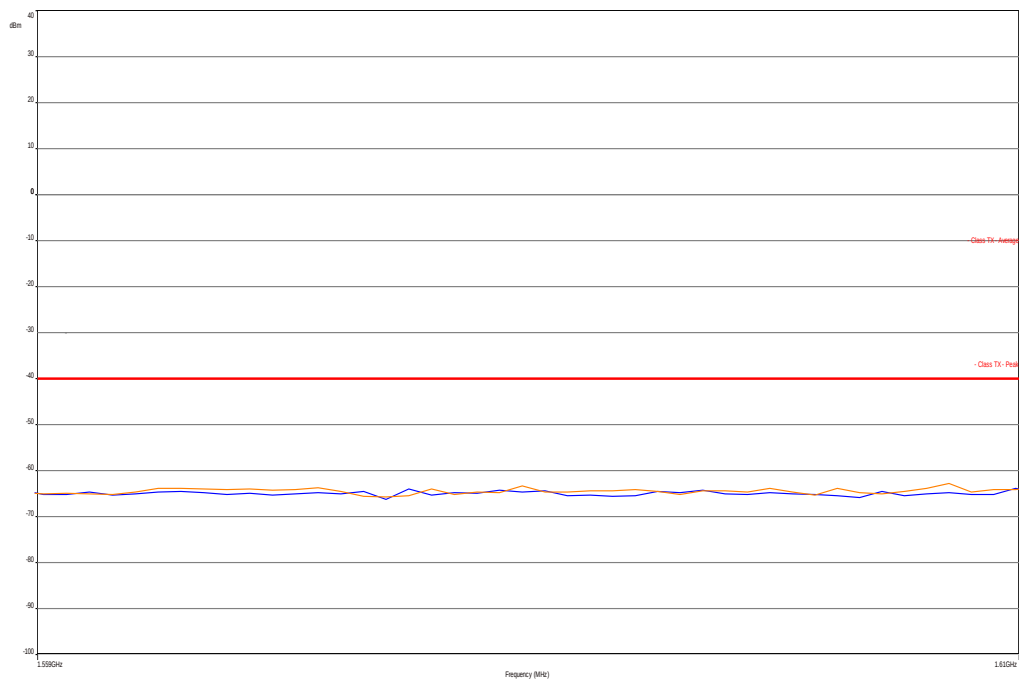
| Spurious Emission Level (dBm) |                                 |                    |                                 |                    |                                 |
|-------------------------------|---------------------------------|--------------------|---------------------------------|--------------------|---------------------------------|
| Lowest channel                |                                 | Middle channel     |                                 | Highest channel    |                                 |
| Spurious emissions            | Level [dBm]                     | Spurious emissions | Level [dBm]                     | Spurious emissions | Level [dBm]                     |
|                               | No spurious emissions detected. |                    | No spurious emissions detected. |                    | No spurious emissions detected. |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
| 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****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 zoom****Plot 8: 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 10 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<br>On spurious detection re-measurement<br>below 1 GHz with 100 kHz<br>Above 1 GHz with 1 MHz |
| Resolution bandwidth:  | Pre-measurement with 1 MHz<br>On spurious detection re-measurement<br>below 1 GHz with 100 kHz<br>Above 1 GHz with 1 MHz |
| Span:                  | 10 MHz – 12 GHz                                                                                                          |
| Trace-Mode:            | Max Hold                                                                                                                 |

### Limits:

| FCC                                                      | -/- |
|----------------------------------------------------------|-----|
| Spurious Emissions Conducted                             |     |
| Attenuation $\geq 43 + 10\log(P)$<br>(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]                     |
|                               | No spurious emissions detected. |                    | No spurious emissions detected. |                    | No spurious emissions detected. |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
| 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]                     |
|                               | No spurious emissions detected. |                    | No spurious emissions detected. |                    | No spurious emissions detected. |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
| Measurement uncertainty       |                                 |                    | ± 3dB                           |                    |                                 |

**Result:** Passed

**Results:** for 10 MHz channel bandwidth

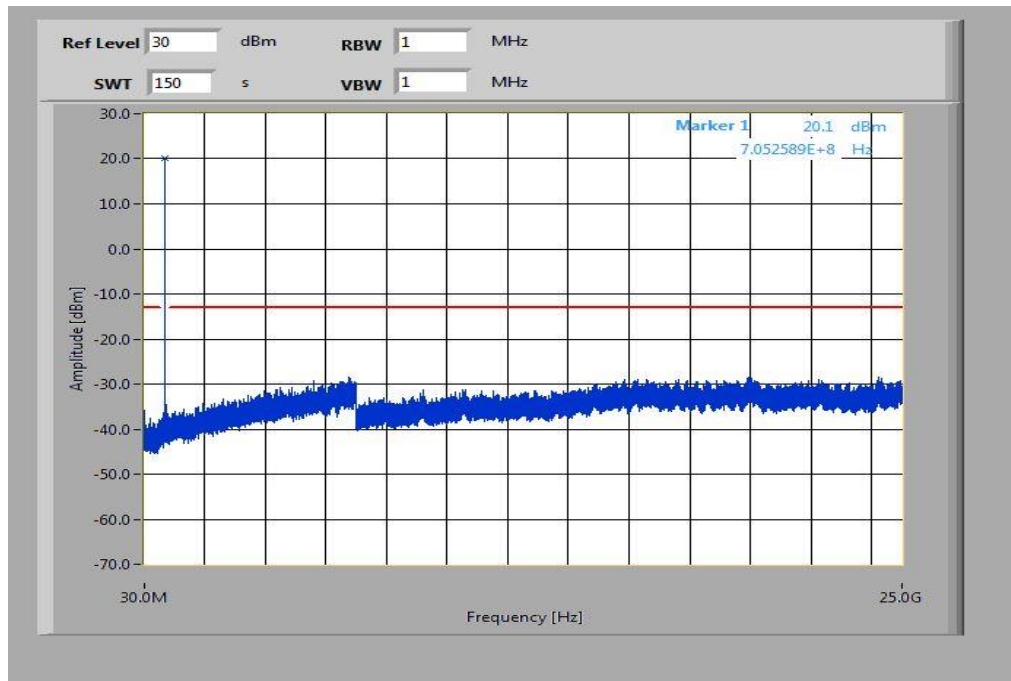
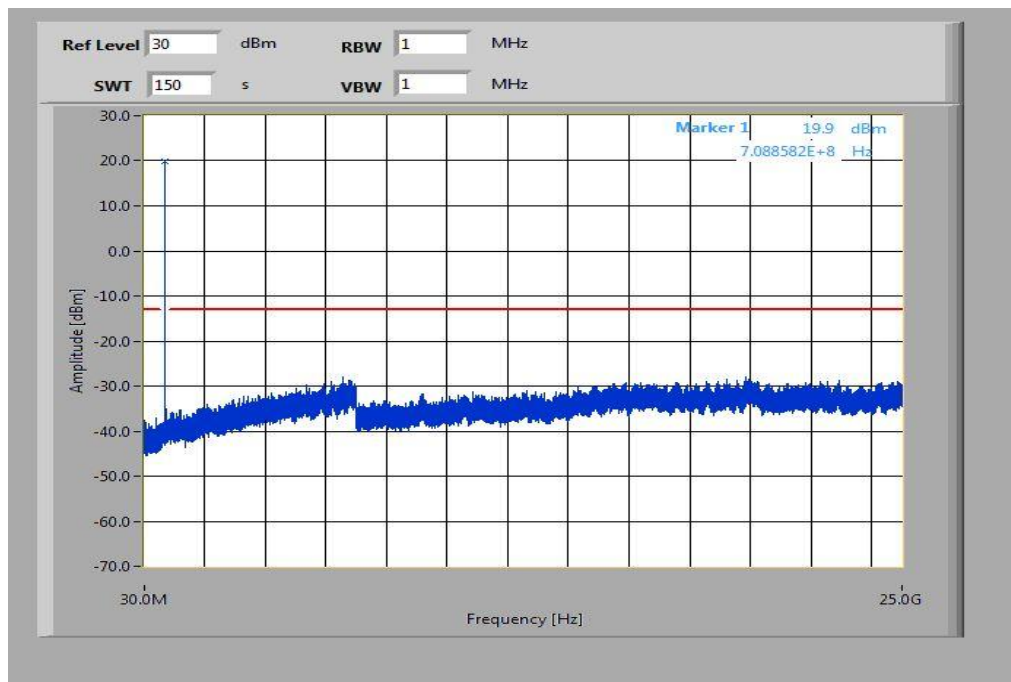
**QPSK**

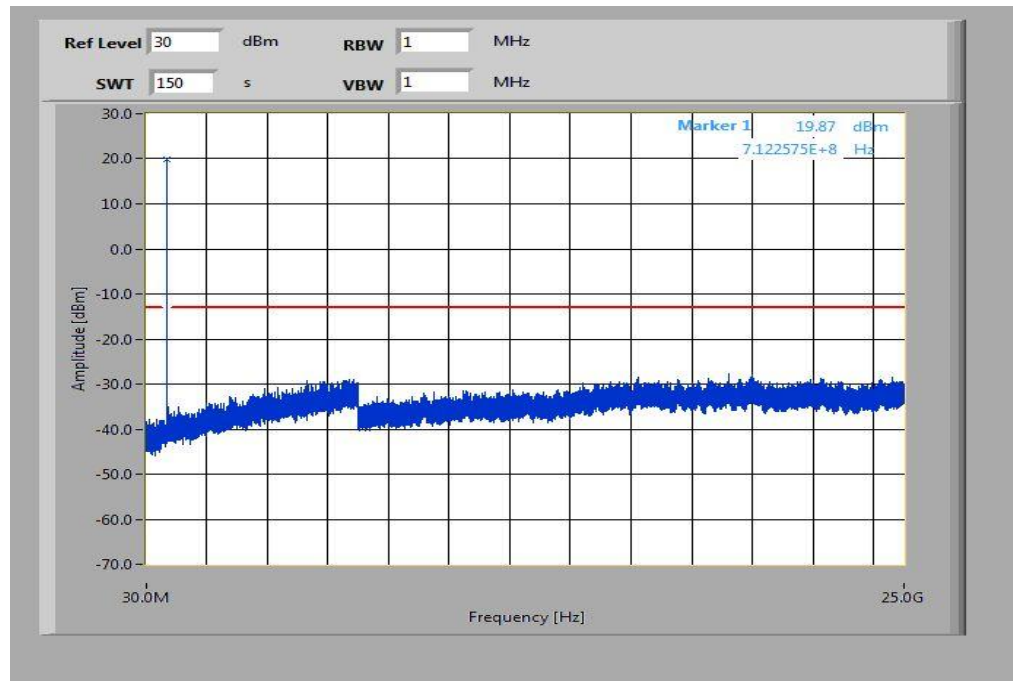
| Spurious Emission Level (dBm) |                                 |                    |                                 |                    |                                 |
|-------------------------------|---------------------------------|--------------------|---------------------------------|--------------------|---------------------------------|
| Lowest channel                |                                 | Middle channel     |                                 | Highest channel    |                                 |
| Spurious emissions            | Level [dBm]                     | Spurious emissions | Level [dBm]                     | Spurious emissions | Level [dBm]                     |
|                               | No spurious emissions detected. |                    | No spurious emissions detected. |                    | No spurious emissions detected. |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
| Measurement uncertainty       |                                 |                    | ± 3dB                           |                    |                                 |

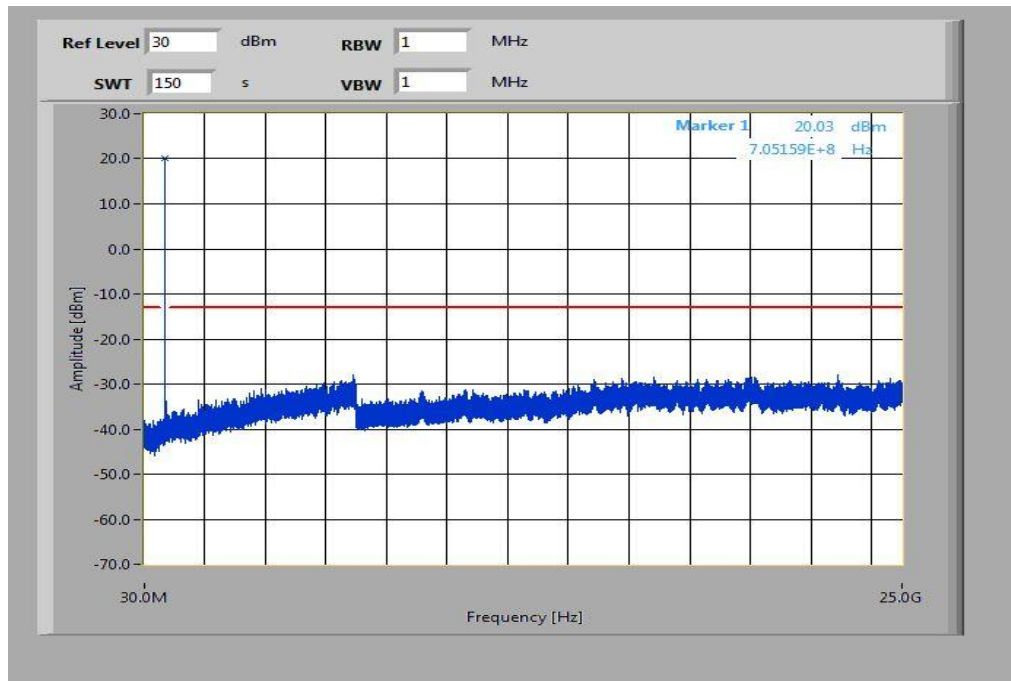
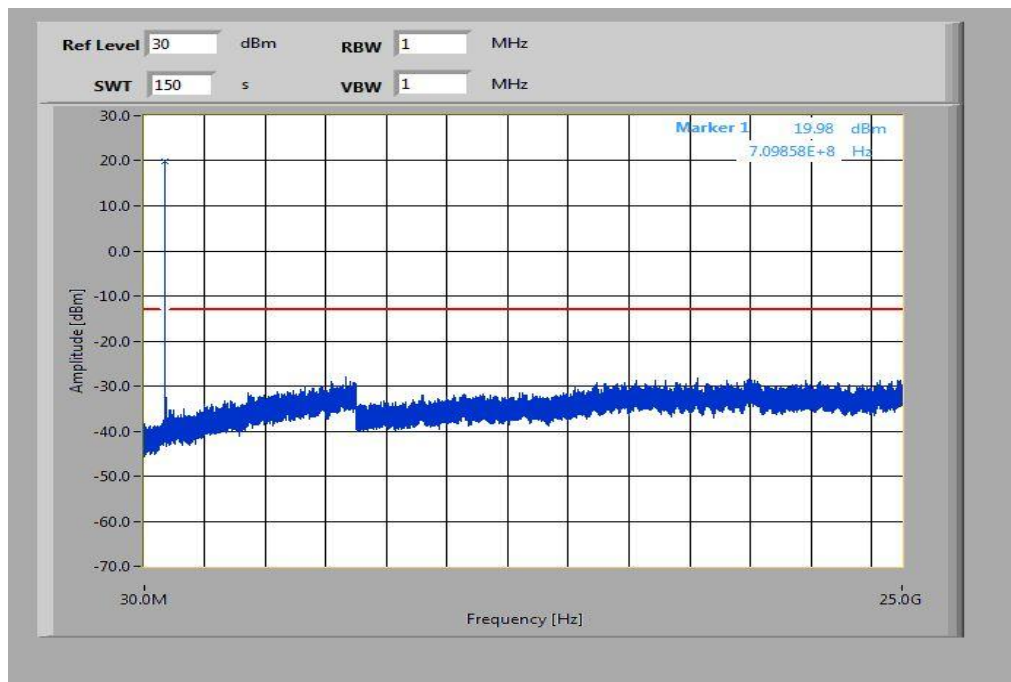
**16-QAM**

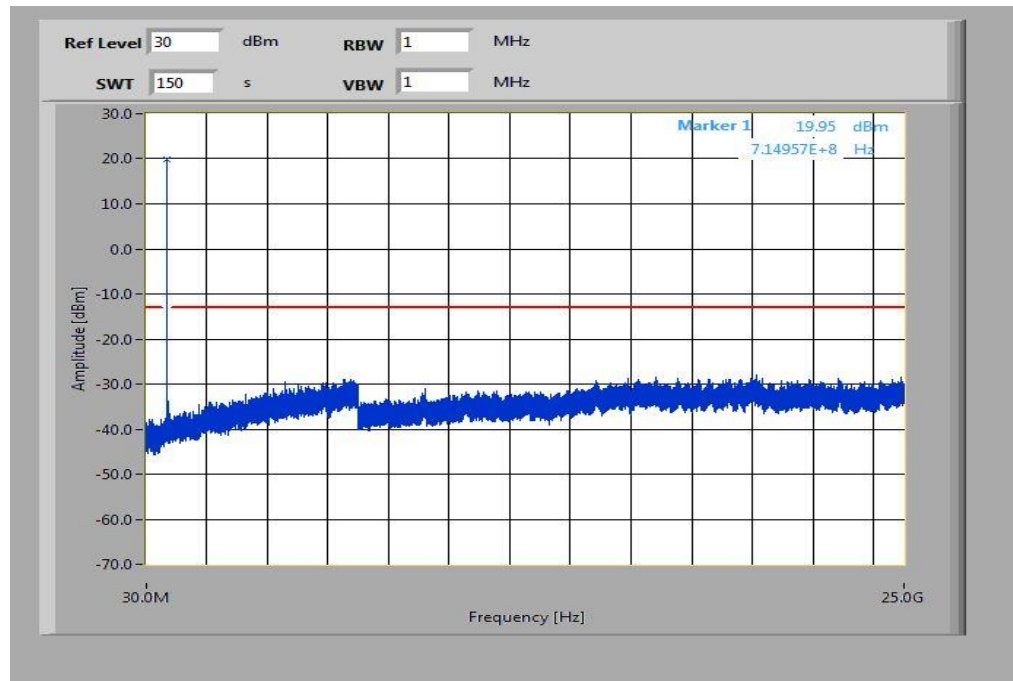
| Spurious Emission Level (dBm) |                                 |                    |                                 |                    |                                 |
|-------------------------------|---------------------------------|--------------------|---------------------------------|--------------------|---------------------------------|
| Lowest channel                |                                 | Middle channel     |                                 | Highest channel    |                                 |
| Spurious emissions            | Level [dBm]                     | Spurious emissions | Level [dBm]                     | Spurious emissions | Level [dBm]                     |
|                               | No spurious emissions detected. |                    | No spurious emissions detected. |                    | No spurious emissions detected. |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
|                               |                                 |                    |                                 |                    |                                 |
| Measurement uncertainty       |                                 |                    | ± 3dB                           |                    |                                 |

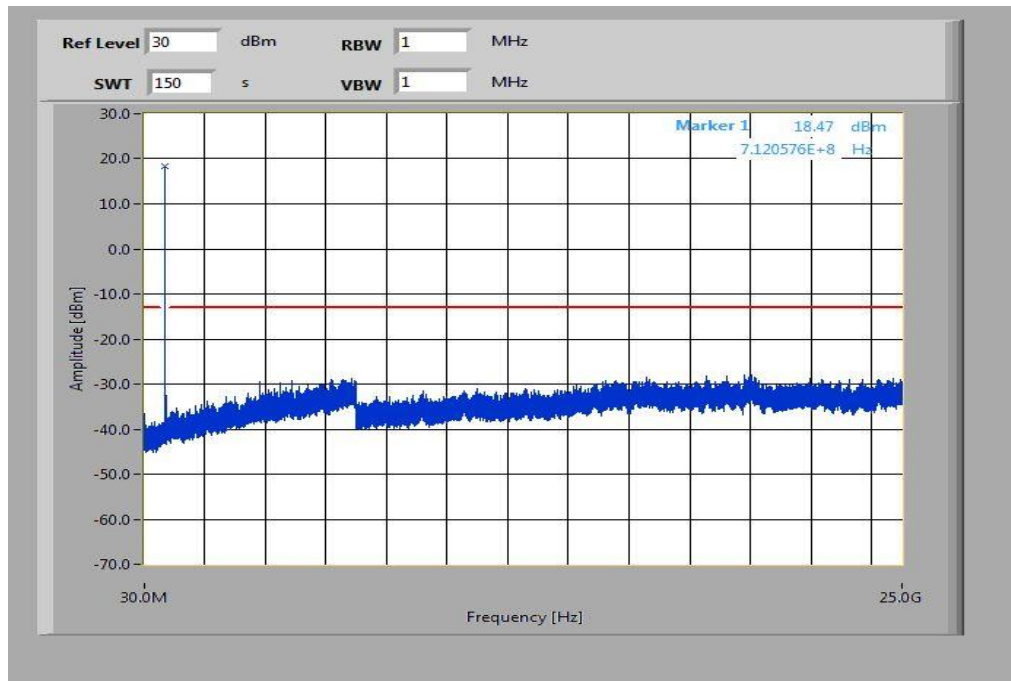
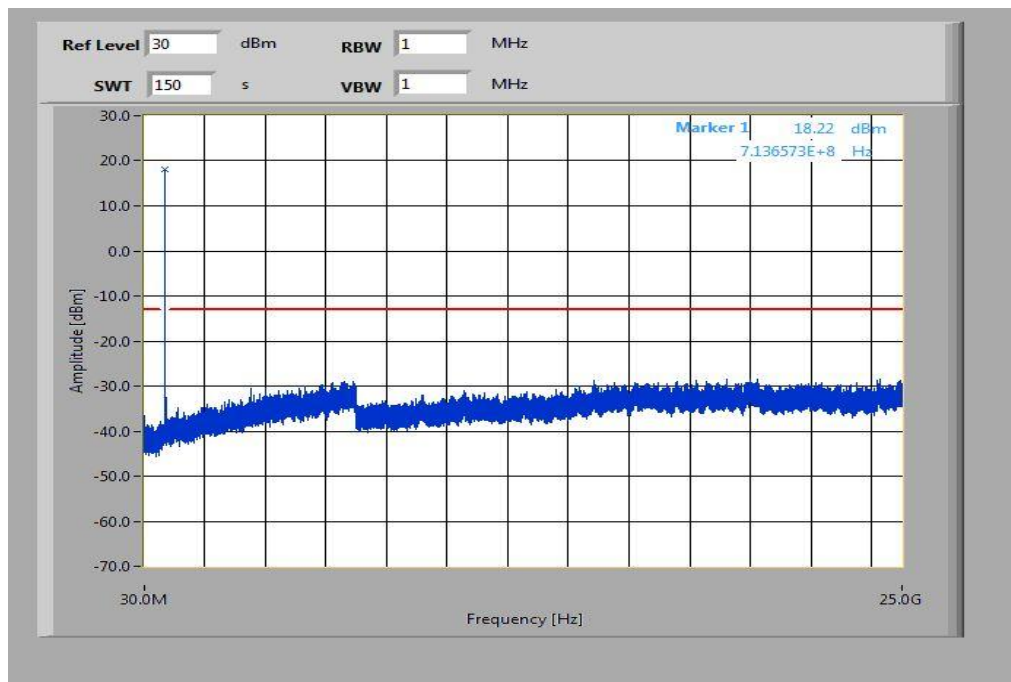
**Result:** Passed

**Plots for 5 MHz channel bandwidth, QPSK****Plot 1: Lowest channel, 10 MHz to 25 GHz****Plot 2: Middle channel, 10 MHz to 25 GHz**

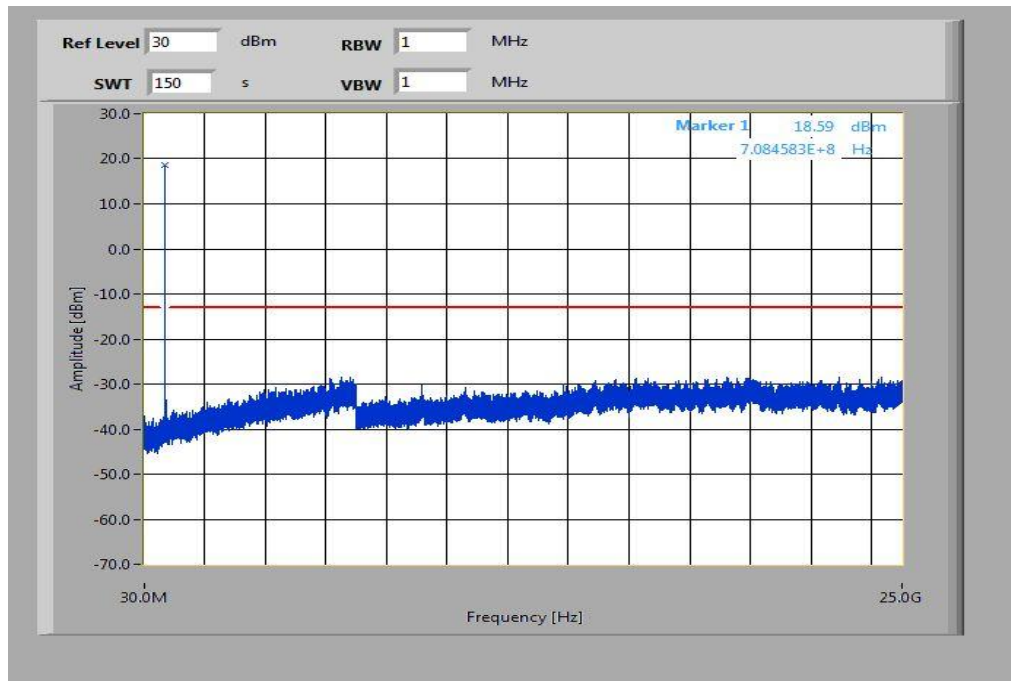
**Plot 3:** Highest channel, 10 MHz to 25 GHz

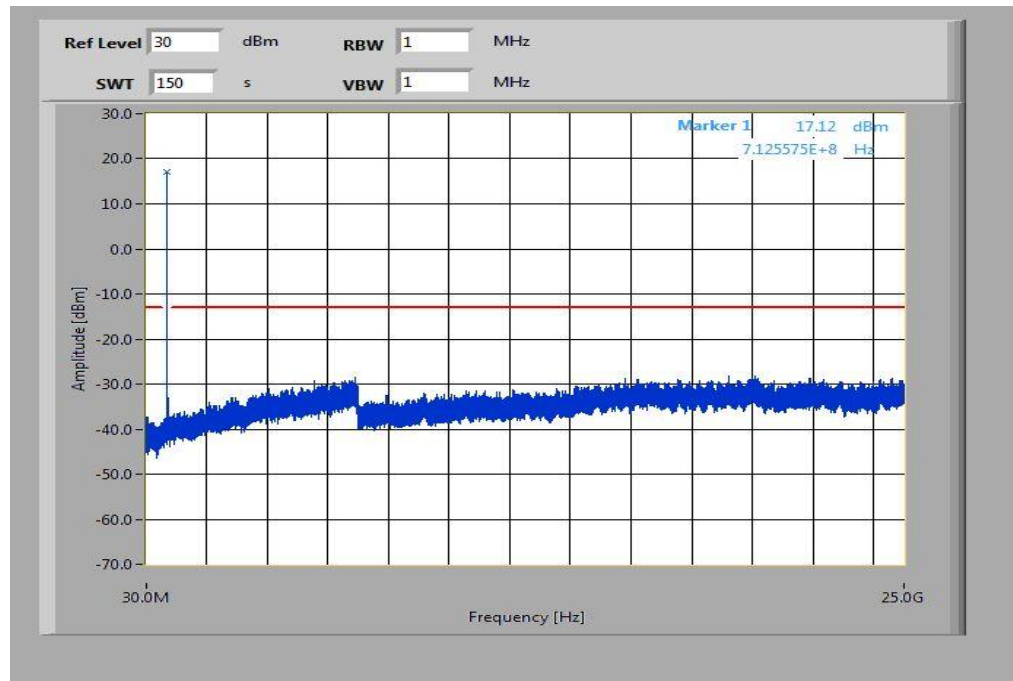
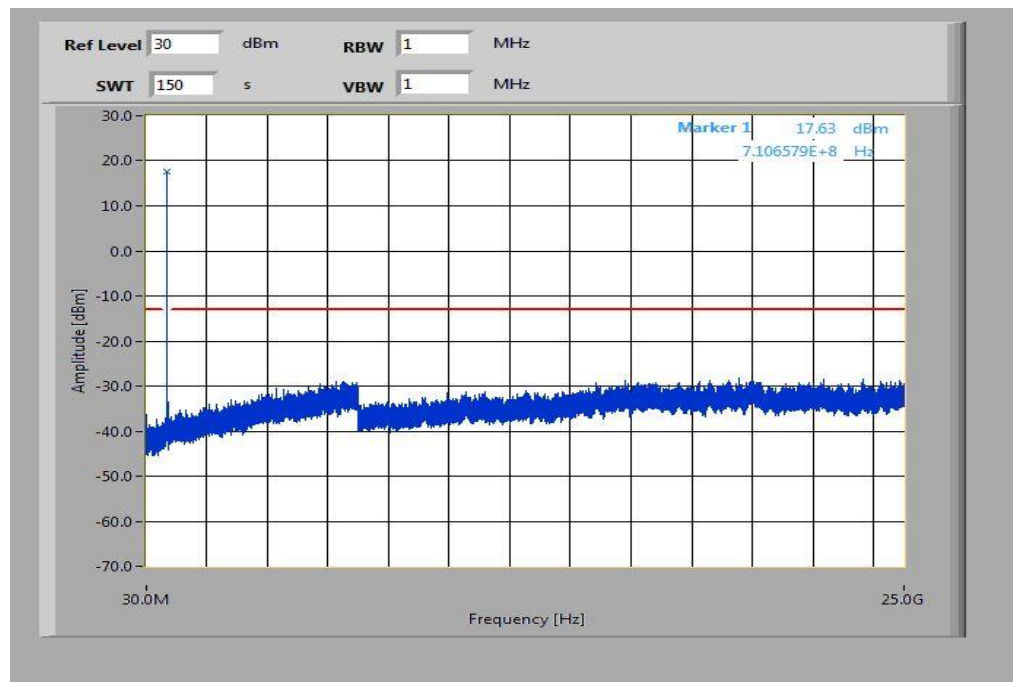
**Plots for 5 MHz channel bandwidth, 16-QAM****Plot 4: Lowest channel, 10 MHz to 25 GHz****Plot 5: Middle channel, 10 MHz to 25 GHz**

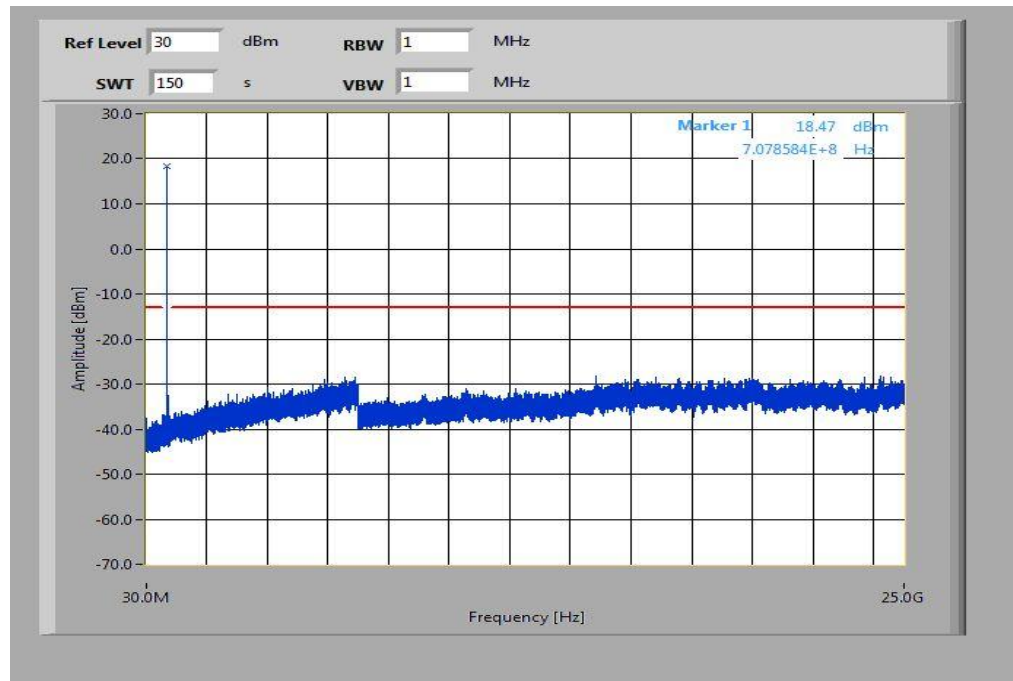
**Plot 6:** Highest channel, 10 MHz to 25 GHz

**Plots for 10 MHz channel bandwidth, QPSK****Plot 1: Lowest channel, 10 MHz to 25 GHz****Plot 2: Middle channel, 10 MHz to 25 GHz**



**Plot 3:** Highest channel, 10 MHz to 25 GHz

**Plots for 10 MHz channel bandwidth, 16-QAM****Plot 4: Lowest channel, 10 MHz to 25 GHz****Plot 5: Middle channel, 10 MHz to 25 GHz**

**Plot 6:** Highest channel, 10 MHz to 25 GHz

### 8.6.5 Block edge compliance

#### Description:

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

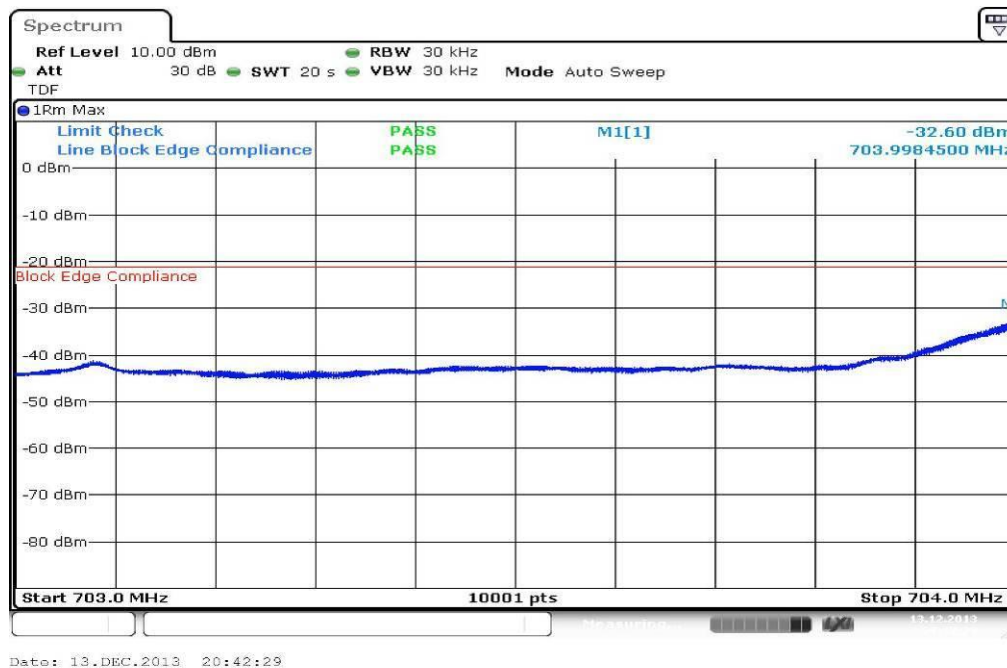
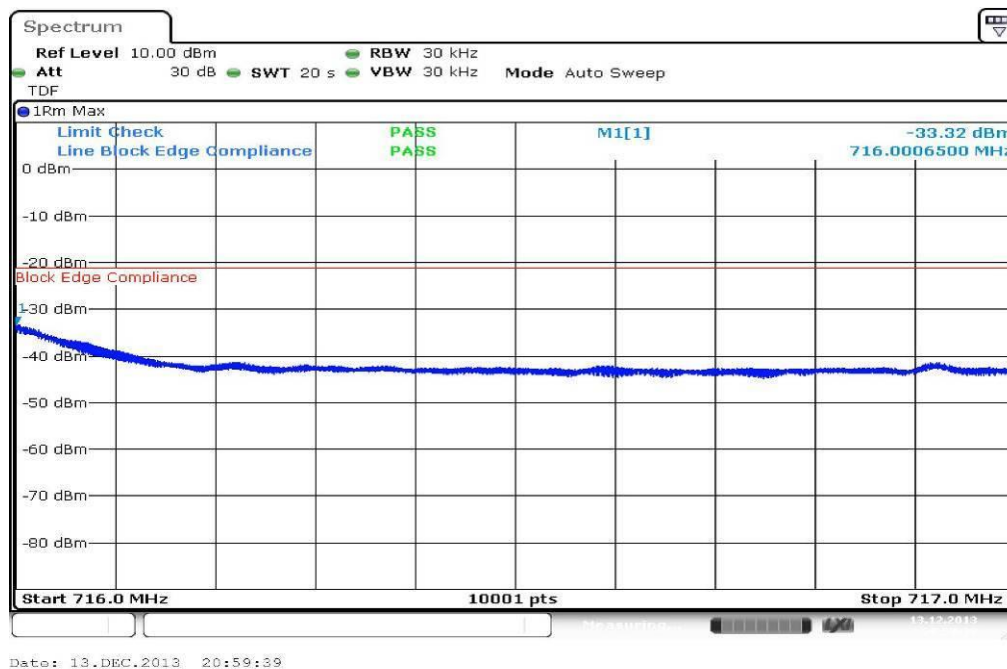
#### Measurement:

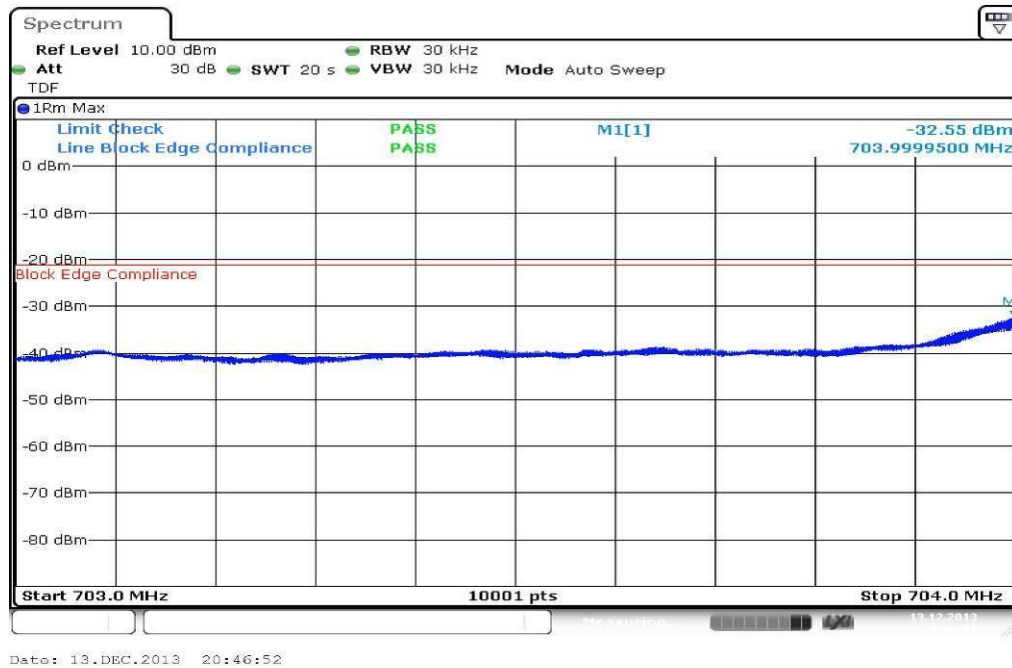
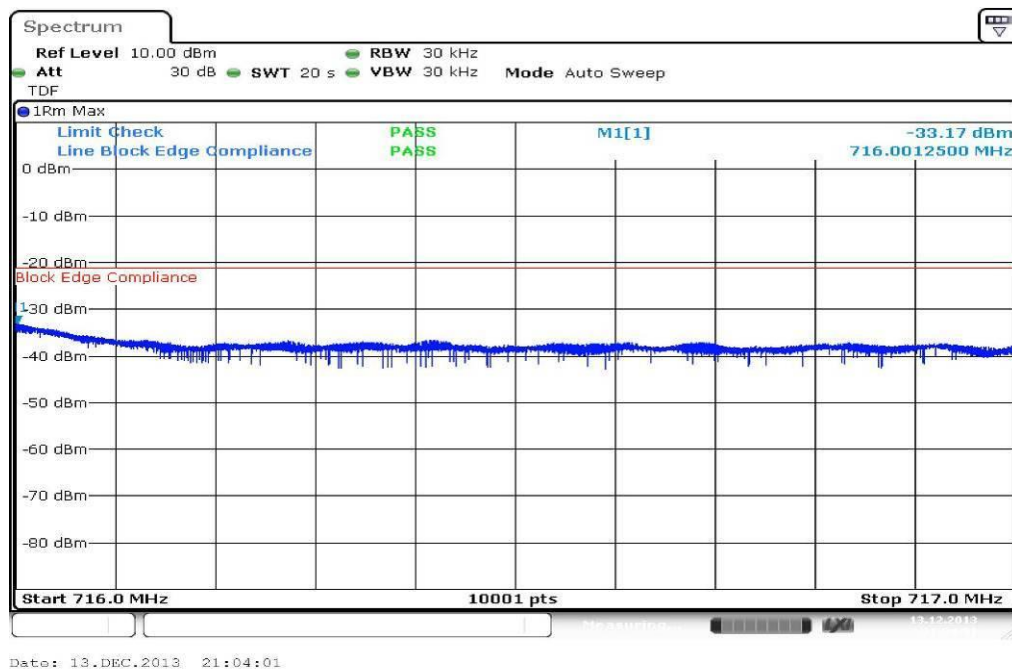
| Measurement parameters |          |
|------------------------|----------|
| Detector:              | RMS      |
| Sweep time:            | 20 sec.  |
| Video bandwidth:       | 30 kHz   |
| Resolution bandwidth:  | 30 kHz   |
| Span:                  | 1 MHz    |
| Trace-Mode:            | Max Hold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

#### Limits:

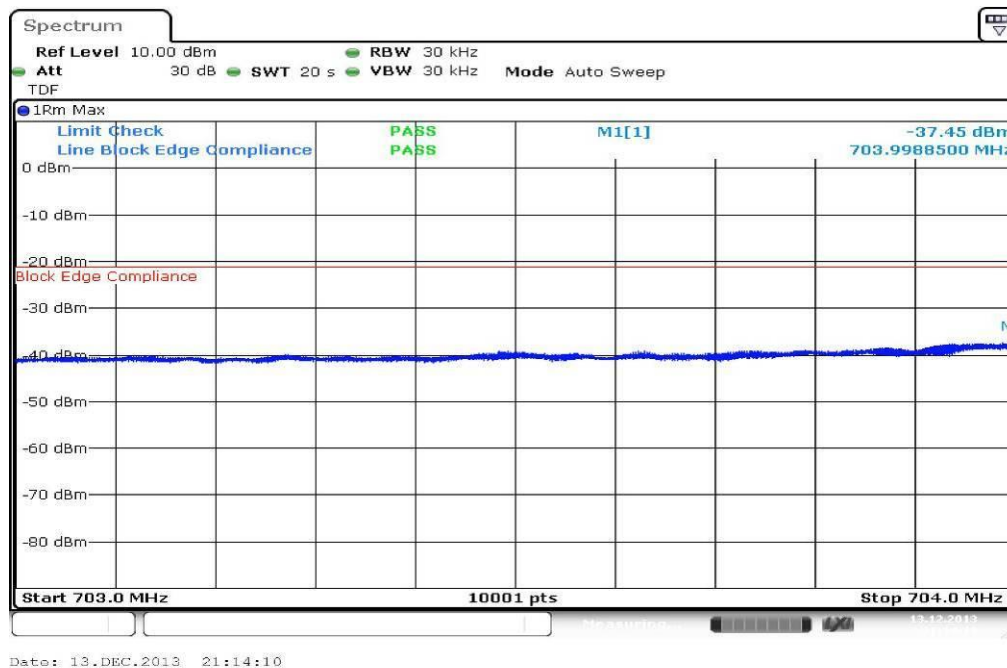
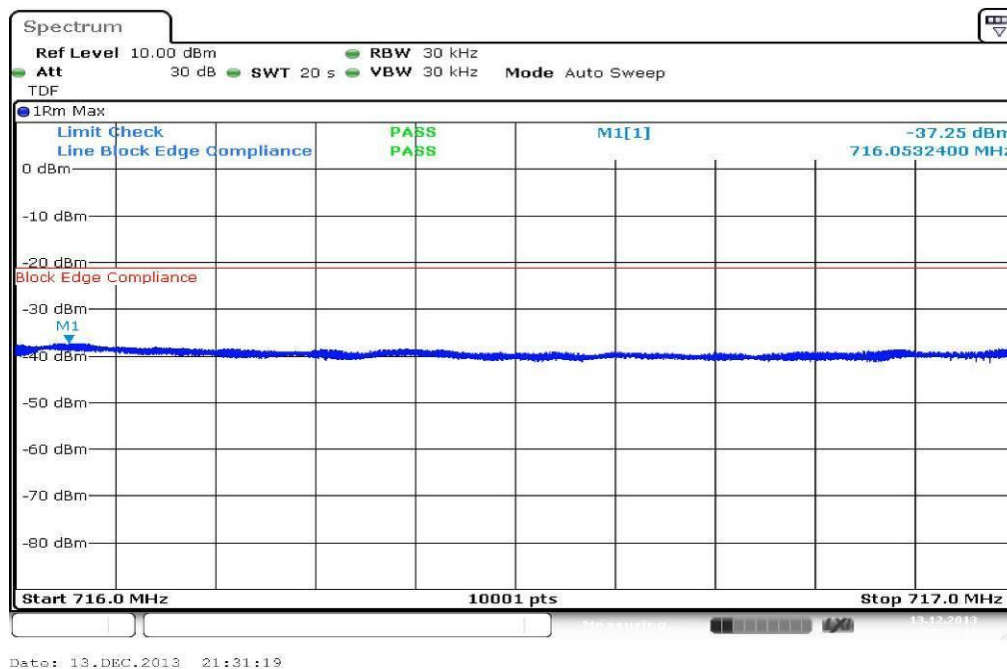
| FCC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -/- |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Block Edge Compliance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |
| <p>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 <math>43 + 10 \log(P)</math> dB.”</p> <p>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:</p> <p>“An alternative is to add an additional correction factor of <math>10 \log(RBW1/RBW2)</math> to the <math>43 + 10 \log(P)</math> limit. RBW1 is the narrower measurement resolution bandwidth and RBW2 is either the 1% emissions bandwidth or 1 MHz.”</p> <p>When using a 30 kHz bandwidth, this yields a -5.2288 adjustment to the limit [<math>10 \log(30\text{kHz}/100\text{kHz}) = -5.2288</math>]. When this adjustment is applied to the limit, the limit becomes -18.2288.</p> |     |
| -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**



**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:

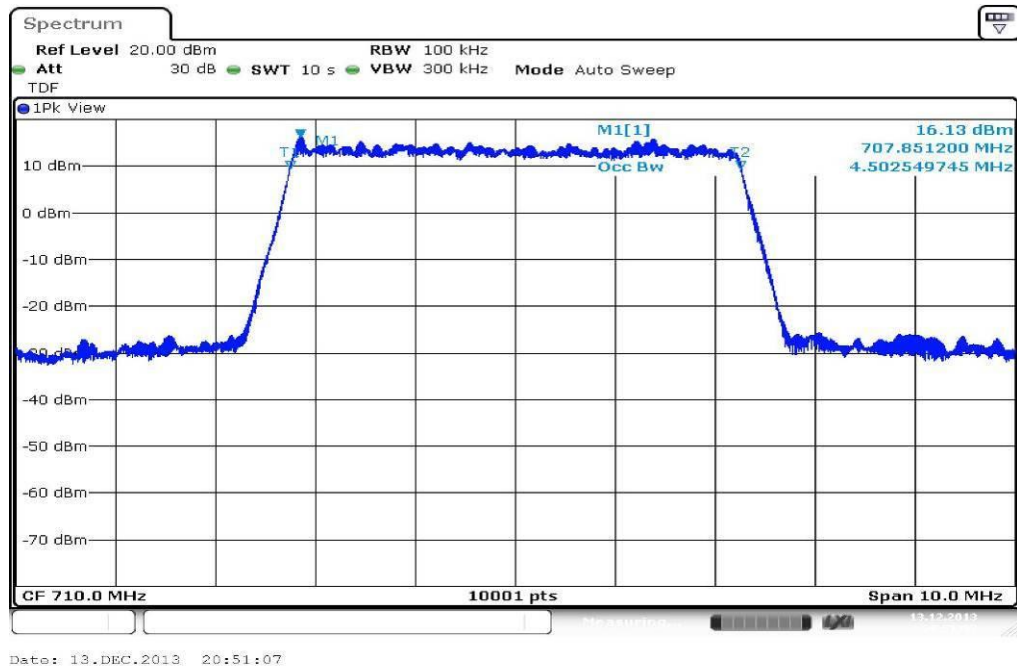
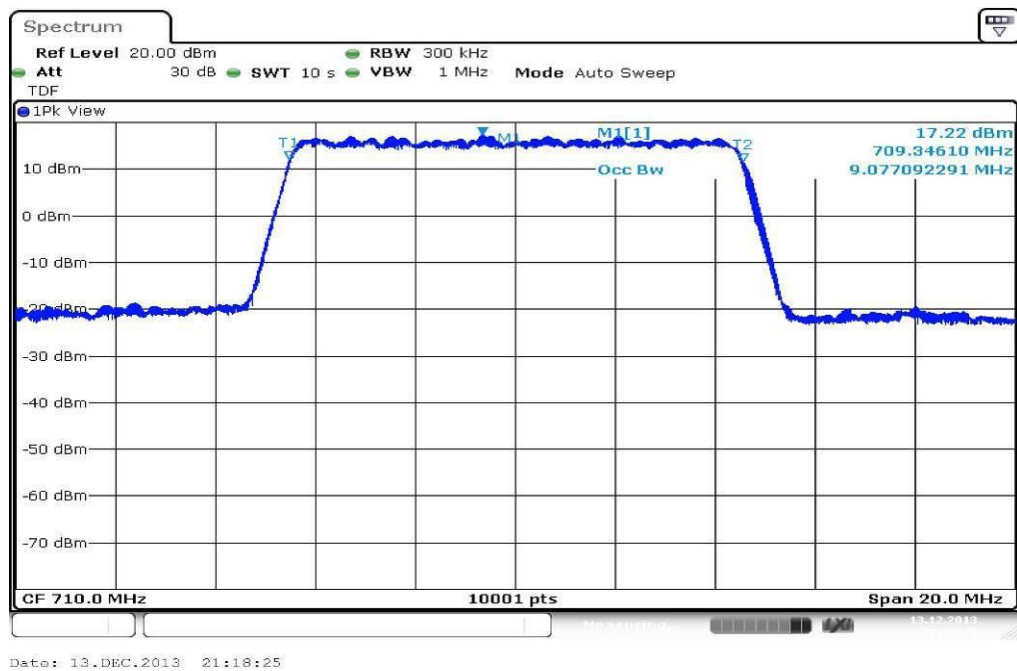
| FCC                                                 | -/- |
|-----------------------------------------------------|-----|
| Occupied Bandwidth                                  |     |
| Spectrum must fall completely in the specified band |     |

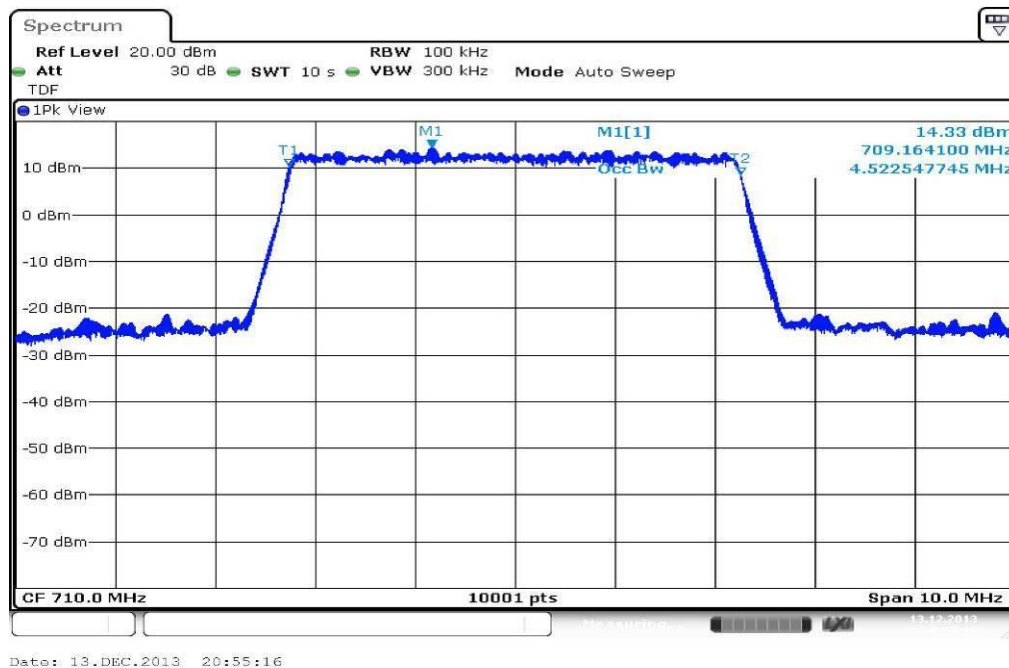
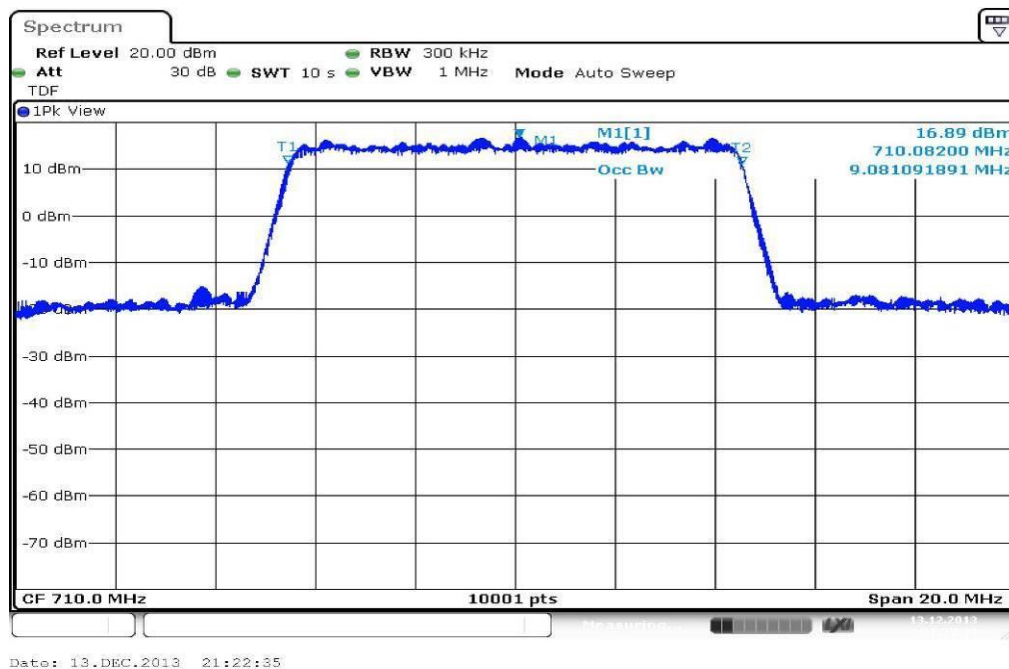
**Results:**

| Occupied Bandwidth - QPSK |                                                               |                 |
|---------------------------|---------------------------------------------------------------|-----------------|
| Bandwidth [MHz]           | 99% OBW (kHz)                                                 | 26 dB bandwidth |
| 5                         | 4503                                                          | 4994            |
| 10                        | 9077                                                          | 10163           |
| Measurement uncertainty   | $\pm 100$ kHz to $\pm 300$ kHz depending on channel bandwidth |                 |

| Occupied Bandwidth – 16-QAM |                                                               |                 |
|-----------------------------|---------------------------------------------------------------|-----------------|
| Bandwidth [MHz]             | 99% OBW (kHz)                                                 | 26 dB bandwidth |
| 5                           | 4523                                                          | 5048            |
| 10                          | 9081                                                          | 10079           |
| Measurement uncertainty     | $\pm 100$ kHz to $\pm 300$ 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       | vIKI!               | 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   | n. a.      | Three-Way Power Splitter, 50 Ohm               | 11850C              | HP Meßtechnik        |            | 300000997       | ne                  |                  |                  |
| 6   | 90         | Active Loop Antenna 10 kHz to 30 MHz           | 6502                | Kontron Psychotech   | 8905-2342  | 300000256       | k                   | 13.06.2013       | 13.06.2015       |
| 7   | n. a.      | Amplifier                                      | js42-00502650-28-5a | Parzich GMBH         | 928979     | 300003143       | ne                  |                  |                  |
| 8   | n. a.      | Highpass Filter                                | WHKX7.0/18G-8SS     | Wainwright           | 18         | 300003789       | ne                  |                  |                  |
| 9   | n. a.      | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz   | VULB9163            | Schwarzbeck          | 371        | 300003854       | vIKI!               | 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  | n. a.      | Wideband Radio Communication Tester            | CMW500              | R&S                  | 102375     | 300004187_0     | k                   | 16.07.2013       | 16.07.2015       |
| 12  | n. a.      | Temperature Test Chamber                       | VT 4002             | Heraeus Voetsch      | 521/83761  | 300002326       | Ve                  | 26.09.2013       | 26.09.2015       |
| 13  | n. a.      | Signal Analyzer 40 GHz                         | FSV40               | R&S                  | 101042     | 300004517       | k                   | 22.10.2012       | 22.01.2014       |
| 14  | n. a.      | Power Supply 0-20V, 0-5A                       | 6632B               | Agilent Technologies | GB42110541 | 400000562       | vIKI!               | 10.01.2013       | 10.01.2016       |

### Agenda: Kind of Calibration

k calibration / calibrated  
 ne not required (k, ev, izw, zw not required)  
 ev periodic self verification  
 Ve long-term stability recognized  
 vIKI! Attention: extended calibration interval  
 NK! Attention: not calibrated

EK limited calibration  
 zw cyclical maintenance (external cyclical maintenance)  
 izw internal cyclical maintenance  
 g blocked for accredited testing  
 \*) 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                   | 2014-01-14      |
| A       | Canada removed / EUT name changed | 2014-01-22      |

**Annex B Further information****Glossary**

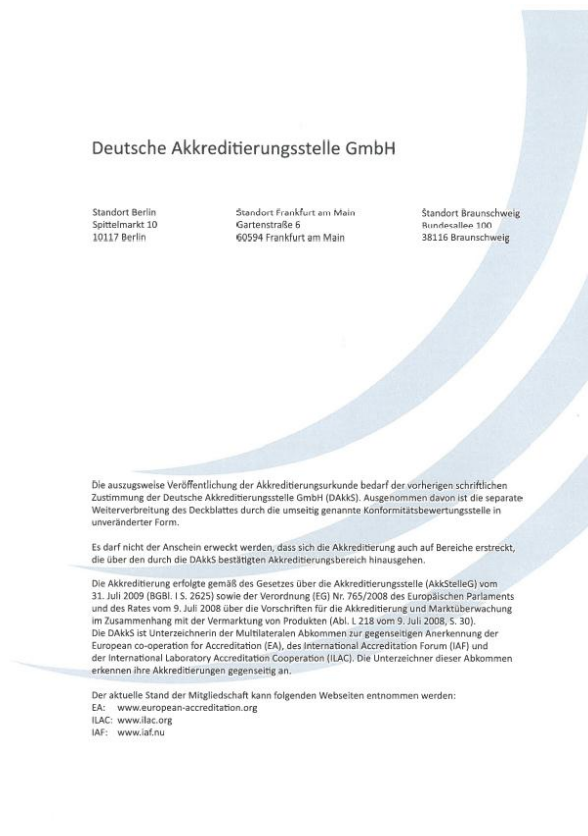
|          |   |                                                |
|----------|---|------------------------------------------------|
| AVG      | - | Average                                        |
| DUT      | - | Device under test                              |
| EMC      | - | Electromagnetic Compatibility                  |
| 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



Back side of certificate



### 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>