**CETECOM™****CETECOM ICT Services**
consulting - testing - certification >>>

TEST REPORT

Test report no.: 1-8297/14-02-08-B

Deutsche
Akkreditierungsstelle
D-PL-12076-01-00

Testing laboratory

CETECOM ICT Services GmbH

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The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-00

Applicant

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Manufacturer

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61381 Friedrichsdorf / GERMANY

Test standard/s

47 CFR Part 27

Title 47 of the Code of Federal Regulations; Chapter I; Part 27 - Miscellaneous wireless communications services

RSS - 130 Issue 1

Mobile Broadband Services (MBS) Equipment Operating in the Frequency Bands 698-756 MHz and 777-787 MHz

RSS - 139 Issue 2

Spectrum Management and Telecommunications Radio Standards Specification - Advanced Wireless Services Equipment Operating in the Bands 1710-1755 MHz and 2110-2155 MHz

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item: Advanced Telecommunication module (ATM) Roof Version**Model name:** ATM-01 R1-US-4GW**FCC ID:** QWY-ATM-R-522**IC:** 6588A-ATMR522**Frequency:** LTE FDD 4: 1710 MHz to 1755 MHz
LTE FDD 17: 704 MHz to 716 MHz**Technology tested:** LTE FDD**Antenna:** External antenna**Power supply:** 14.0V DC by external power supply**Temperature range:** -30°C to +60°C

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorised:

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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2.2 Application details

Date of receipt of order:	2014-12-19
Date of receipt of test item:	2015-02-17
Start of test:	2015-02-27
End of test:	2015-03-07
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 27	-/-	Title 47 of the Code of Federal Regulations; Chapter I; Part 27 - Miscellaneous wireless communications services
RSS - 130 Issue 1	01.10.2013	Mobile Broadband Services (MBS) Equipment Operating in the Frequency Bands 698-756 MHz and 777-787 MHz
RSS - 139 Issue 2	01.02.2009	Spectrum Management and Telecommunications Radio Standards Specification - Advanced Wireless Services Equipment Operating in the Bands 1710-1755 MHz and 2110-2155 MHz

4 Test environment

Temperature:	T_{nom}	+22 °C during room temperature tests
	T_{max}	+60 °C during high temperature tests
	T_{min}	-30 °C during low temperature tests
Relative humidity content:		42 %
Barometric pressure:		not relevant for this kind of testing
Power supply:	V_{nom}	14.0 V DC by external power supply
	V_{max}	18.0 V
	V_{min}	4.5 V

5 Test item

Kind of test item	:	Advanced Telecommunication module (ATM) Roof Version
HVIN	:	ATM-01 R1-US-4GW
PMN	:	ATM roof version
S/N serial number	:	Radiated / conducted unit: 0000506765
HW hardware status	:	112.010.016
SW software status	:	001.017.047
Frequency band	:	LTE FDD 4: 1710 MHz to 1755 MHz LTE FDD 17: 704 MHz to 716 MHz
Type of modulation	:	QPSK, 16-QAM
Antenna	:	External antenna
Power supply	:	14.0V DC by external power supply
Temperature range	:	-30°C to +60°C

5.1 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup- and EUT-photos are included in test report: 1-8297/14-02-01_AnnexA
1-8297/14-02-01_AnnexB
1-8297/14-02-01_AnnexC

6 Test laboratories sub-contracted

None

7 Summary of measurement results

	No deviations from the technical specifications were ascertained
	There were deviations from the technical specifications ascertained
X	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC identifier	Description	verdict	date	Remark
RF-Testing	CFR Part 27 RSS-130, RSS 139	See table!	2015-06-16	Tests according to manufacturer test plan.

7.1 LTE – Band 4

Test Case	temperature conditions	power source voltages	Pass	Fail	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	complies
Frequency Stability	Nominal	Nominal	☐	☐	☐	☒	-/-
Spurious Emissions Radiated	Nominal	Nominal	☒	☐	☐	☐	complies
Spurious Emissions Conducted	Nominal	Nominal	☐	☐	☐	☒	-/-
Block Edge Compliance	Nominal	Nominal	☒	☐	☐	☐	complies
Occupied Bandwidth	Nominal	Nominal	☐	☐	☐	☒	-/-

Note: NA = Not applicable; NP = Not performed

7.2 LTE – Band 17

Test Case	temperature conditions	power source voltages	Pass	Fail	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	complies
Frequency Stability	Nominal	Nominal	☐	☐	☐	☒	-/-
Spurious Emissions Radiated	Nominal	Nominal	☒	☐	☐	☐	complies
Spurious Emissions Conducted	Nominal	Nominal	☐	☐	☐	☒	-/-
Block Edge Compliance	Nominal	Nominal	☒	☐	☐	☐	complies
Occupied Bandwidth	Nominal	Nominal	☐	☐	☐	☒	-/-

Note: NA = Not applicable; NP = Not performed

8 RF measurements

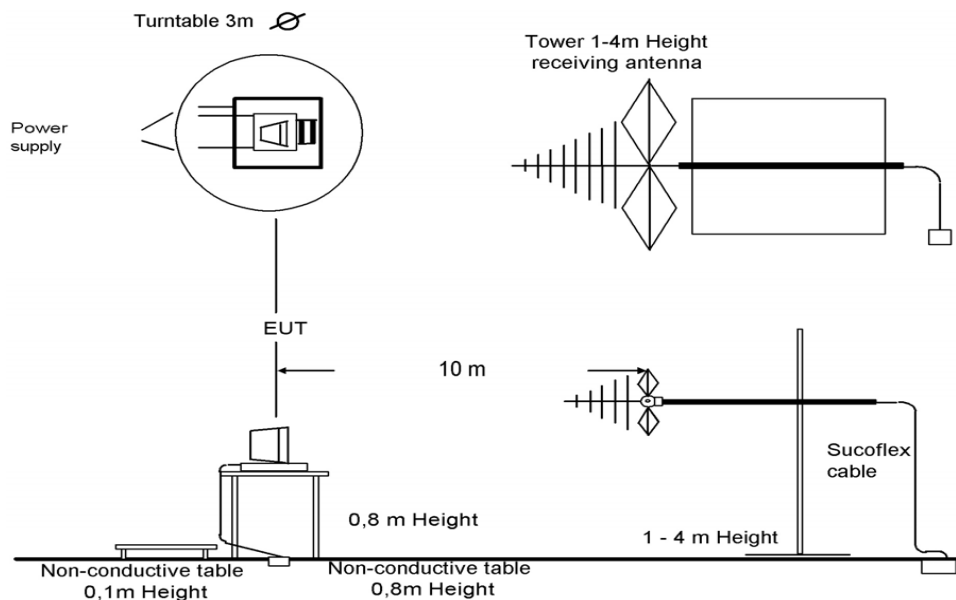
8.1 Description of test setup

For the spurious measurements we use the substitution method according TIA/EIA 603.

8.1.1 Radiated measurements

The radiated emissions from the EUT are performed in a semi anechoic chamber. The EUT is placed on a conductive turntable and powered with nominal voltage. The signalling is performed either from outside the chamber with a signalling unit (AP or other) by air link using a signalling antenna or directly by special test software from the customer.

Semi anechoic chamber



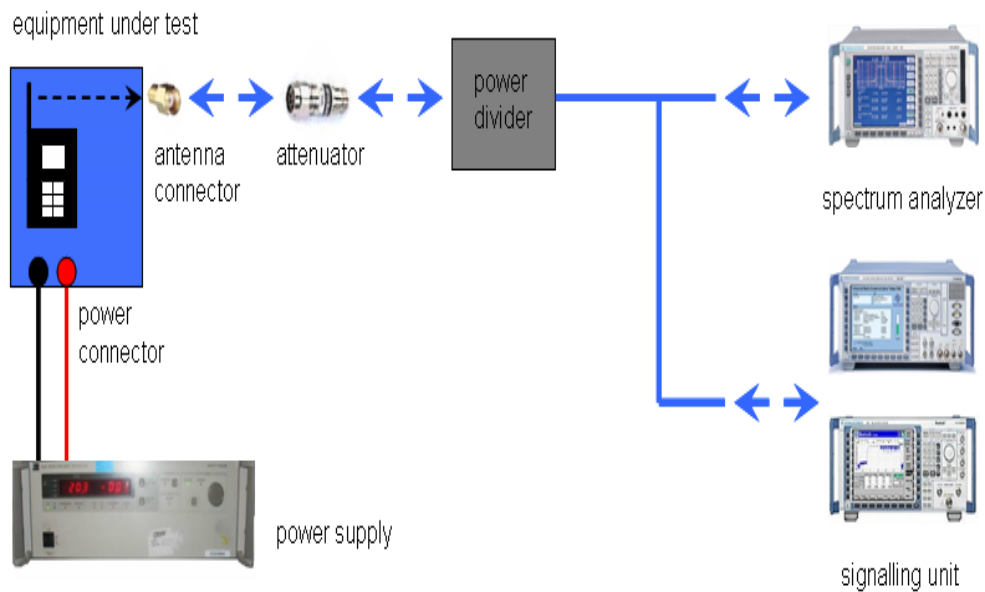
Picture 1: Diagram radiated measurements

9 kHz - 30 MHz:	active loop antenna
30 MHz – 1 GHz:	tri-log antenna
> 1 GHz:	horn antenna

Frequency being measured f	Measuring receiver bandwidth 6 dB	Spectrum analyser bandwidth 3dB
$f < 150 \text{ kHz}$	200 Hz or	300 Hz
$150 \text{ kHz} \leq f < 25 \text{ MHz}$	9 kHz or	10 kHz
$25 \text{ MHz} \leq f < 1000 \text{ MHz}$	120 kHz or	100 kHz
$1000 \text{ MHz} \leq f$		1 MHz
NOTE: Specific requirements in CEPT/ERC/Recommendation 70-03 [2] shall be applied where applicable.		

8.1.2 Conducted measurements

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The signal is first 10dB attenuated before it is power divided (~6dB loss per branch). One of the signal paths is connected to the signalling unit (AP or other), the other one is connected to the spectrum analyzer. The specific losses for both signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm. If special software is used, there is no power divider necessary.



Picture 2: Diagram conducted measurements

The term measuring receiver refers to either a selective voltmeter or a spectrum analyser.

Frequency being measured f	Measuring receiver bandwidth 6 dB	Spectrum analyser bandwidth 3dB
$f < 150 \text{ kHz}$	200 Hz or	300 Hz
$150 \text{ kHz} \leq f < 25 \text{ MHz}$	9 kHz or	10 kHz
$25 \text{ MHz} \leq f < 1000 \text{ MHz}$	120 kHz or	100 kHz
$1000 \text{ MHz} \leq f$		1 MHz
NOTE: Specific requirements in CEPT/ERC/Recommendation 70-03 [2] shall be applied where applicable.		

8.2 LTE technologies supported by EUT**Channel bandwidth**

	Band 4	Band 7	Band 13	Band 17
[MHz]				
		not supported	not supported	
1.4	☒	☐	☐	☐
3	☒	☐	☐	☐
5	☒	☐	☐	☒
10	☒	☐	☐	☒
15	☒	☐	☐	☐
20	☒	☐	☐	☐

Antenna

SISO	☐
SIMO	☐
MISO	☒
MIMO	☐

8.3 Results LTE – Band 4

The EUT was set to transmit the maximum power.

8.3.1 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	IC
Average E.I.R.P. Output Power	
+30.00 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.	

Used setup acc. chapter 8.1.2.

Used equipment see table chapter 9

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)
1.4	1710.7	1 RB low	23.5	4.92	22.6	5.65
		1 RB high	23.6	5.01	22.7	5.67
		50% RB mid	23.4	4.79	22.3	6.38
		100% RB	22.6	5.89	21.3	6.82
	1732.5	1 RB low	22.7	6.38	21.6	4.96
		1 RB high	22.5	6.34	21.4	4.96
		50% RB mid	22.6	6.91	21.7	5.85
		100% RB	21.7	6.91	20.8	7.12
	1754.3	1 RB low	22.5	5.09	21.1	6.40
		1 RB high	22.6	5.07	21.1	6.35
		50% RB mid	22.6	6.30	21.8	7.17
		100% RB	21.5	6.68	20.8	6.87
3	1711.5	1 RB low	23.6	5.62	22.6	4.93
		1 RB high	23.6	5.80	22.7	5.18
		50% RB mid	22.6	6.68	21.3	5.91
		100% RB	22.4	6.49	21.5	6.14
	1732.5	1 RB low	22.6	5.16	21.3	6.39
		1 RB high	22.5	5.11	21.2	6.34
		50% RB mid	21.8	6.49	20.9	6.76
		100% RB	21.7	6.59	20.6	6.82
	1753.5	1 RB low	22.4	7.06	21.0	5.36
		1 RB high	22.6	7.04	21.1	5.30
		50% RB mid	21.5	6.96	20.6	6.49
		100% RB	21.4	7.51	20.6	6.14
5	1712.5	1 RB low	23.4	5.05	22.5	5.04
		1 RB high	23.8	5.27	22.8	5.10
		50% RB mid	22.5	5.98	21.6	6.55
		100% RB	22.5	6.01	21.5	7.14
	1732.5	1 RB low	22.7	6.47	21.5	5.30
		1 RB high	22.8	6.38	21.5	5.18
		50% RB mid	21.7	6.98	20.7	6.28
		100% RB	21.7	7.91	20.6	6.45
	1752.5	1 RB low	22.6	5.12	21.2	6.80
		1 RB high	22.7	5.13	21.4	6.82
		50% RB mid	21.4	6.27	20.6	7.46
		100% RB	21.3	6.14	20.4	7.20

10	1715.0	1 RB low	23.5	5.70	22.7	22.7
		1 RB high	23.2	6.20	22.3	22.3
		50% RB mid	22.5	7.06	21.7	21.7
		100% RB	22.4	7.48	21.4	21.4
	1732.5	1 RB low	22.6	5.19	21.2	21.2
		1 RB high	22.6	5.07	21.3	21.3
		50% RB mid	21.6	6.57	20.7	20.7
		100% RB	21.5	6.72	20.6	20.6
	1750.0	1 RB low	22.4	6.87	21.1	21.1
		1 RB high	22.4	7.09	21.0	21.0
		50% RB mid	21.4	8.03	20.4	20.4
		100% RB	21.3	8.00	20.4	20.4
15	1717.5	1 RB low	23.5	5.05	22.5	22.5
		1 RB high	22.8	5.73	21.9	21.9
		50% RB mid	22.3	6.59	21.2	21.2
		100% RB	22.2	6.64	21.3	21.3
	1732.5	1 RB low	22.6	7.38	21.7	21.7
		1 RB high	22.6	6.83	21.8	21.8
		50% RB mid	21.6	7.79	20.5	20.5
		100% RB	21.4	7.55	20.4	20.4
	1747.5	1 RB low	22.6	5.18	21.2	21.2
		1 RB high	22.5	5.35	21.0	21.0
		50% RB mid	21.4	6.72	20.4	20.4
		100% RB	21.3	7.27	20.3	20.3
20	1720.0	1 RB low	23.7	6.16	22.7	22.7
		1 RB high	22.7	7.10	21.9	21.9
		50% RB mid	22.1	7.95	21.0	21.0
		100% RB	22.2	7.55	21.1	21.1
	1732.5	1 RB low	22.8	5.77	21.9	21.9
		1 RB high	22.6	5.51	21.6	21.6
		50% RB mid	21.6	6.78	20.5	20.5
		100% RB	21.5	6.70	20.5	20.5
	1745.0	1 RB low	22.6	5.37	21.7	21.7
		1 RB high	22.6	5.42	21.6	21.6
		50% RB mid	21.5	8.06	20.4	20.4
		100% RB	21.4	7.62	20.5	20.5
Measurement uncertainty		± 0.5 dB				

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

Output Power (radiated)			
Bandwidth (MHz)	Frequency (MHz)	Average Output Power (dBm) QPSK	Average Output Power (dBm) 16-QAM
1.4	1710.7	20.5	19.6
	1732.5	18.3	17.3
	1754.3	18.6	17.8
3	1711.5	20.5	19.6
	1732.5	18.2	16.9
	1753.5	18.6	17.1
5	1712.5	20.7	19.7
	1732.5	18.4	17.1
	1752.5	18.7	17.4
10	1715.0	20.4	19.6
	1732.5	18.2	16.9
	1750.0	18.4	17.1
15	1717.5	20.4	19.4
	1732.5	18.2	17.4
	1747.5	18.6	17.2
20	1720.0	20.6	19.6
	1732.5	18.4	17.5
	1745.0	18.6	17.7
Measurement uncertainty		± 3.0 dB	

Verdict: [complies](#)

8.3.2 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 C63.4:2014 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 1755 MHz. Measurement made up to 25 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 4.

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 sec.
Video bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span:	100 MHz Steps
Trace-Mode:	Max Hold

Limits:

FCC	IC
Spurious Emissions Radiated	
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Used setup acc. chapter 8.1.1.

Used equipment see table chapter 9

Results:

Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the LTE band 4 (1712.5 MHz, 1732.5 MHz and 1752.5 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 4 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 10 MHz bandwidth and 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]
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
Measurement uncertainty			± 3dB		

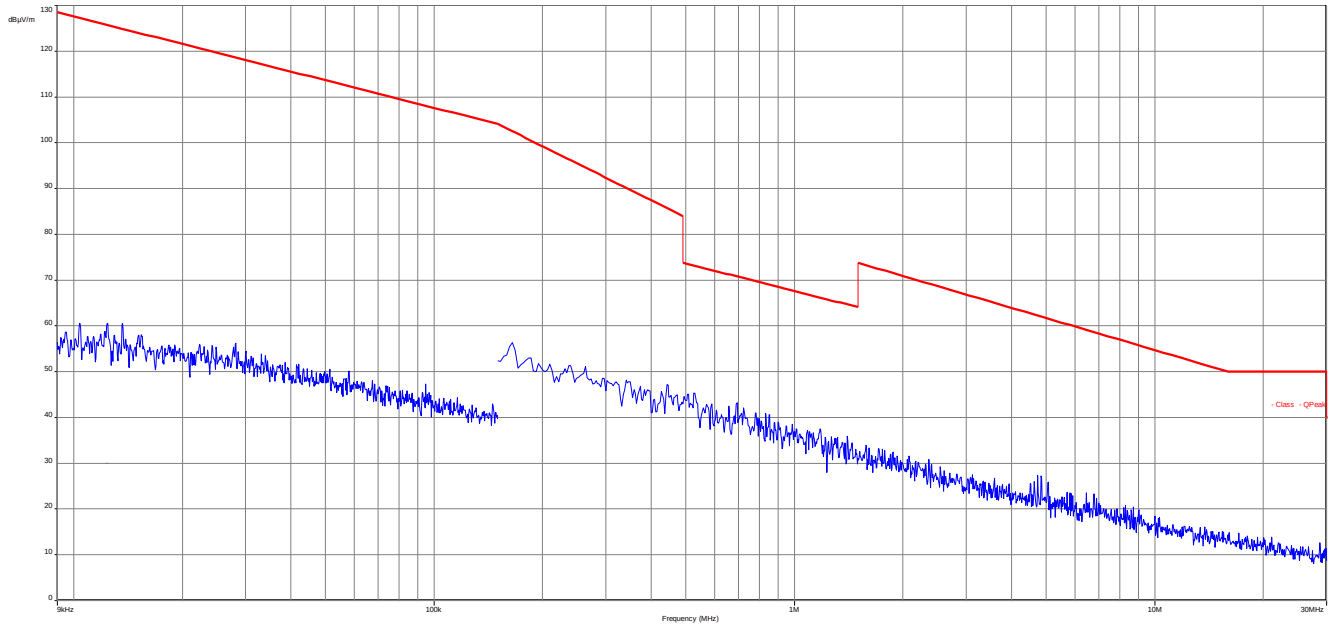
16-QAM

Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
Measurement uncertainty			± 3dB		

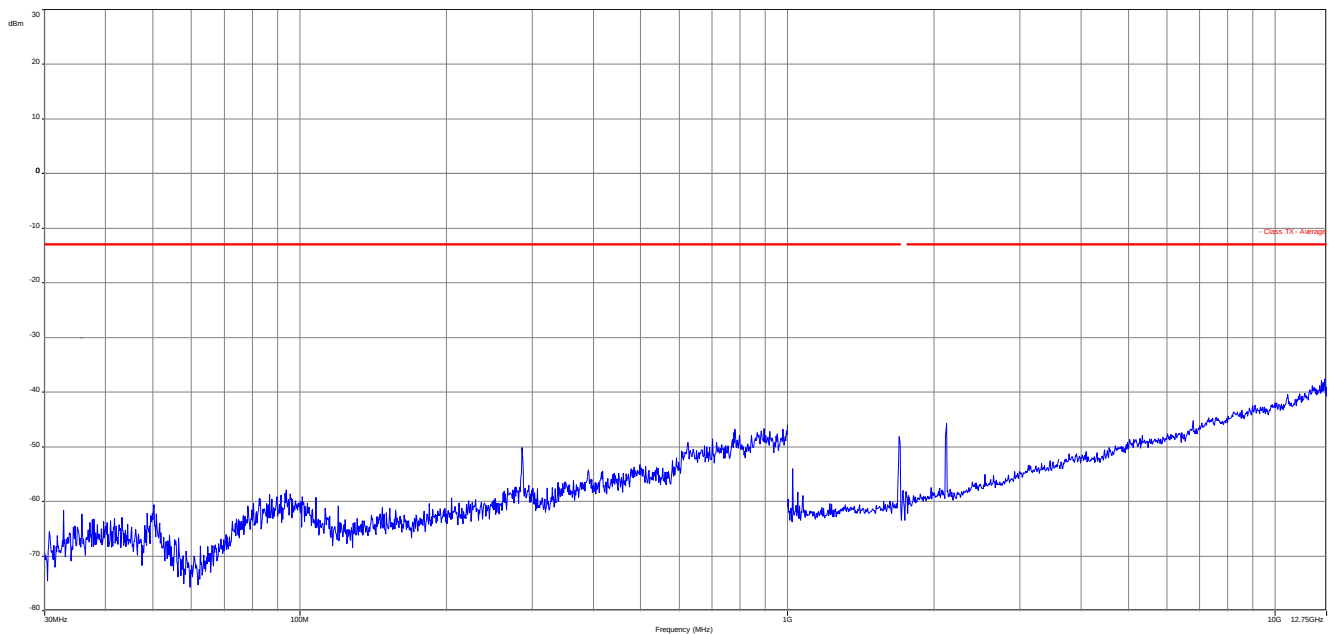
Verdict: [complies](#)

Plots: QPSK with 10 MHz channel bandwidth

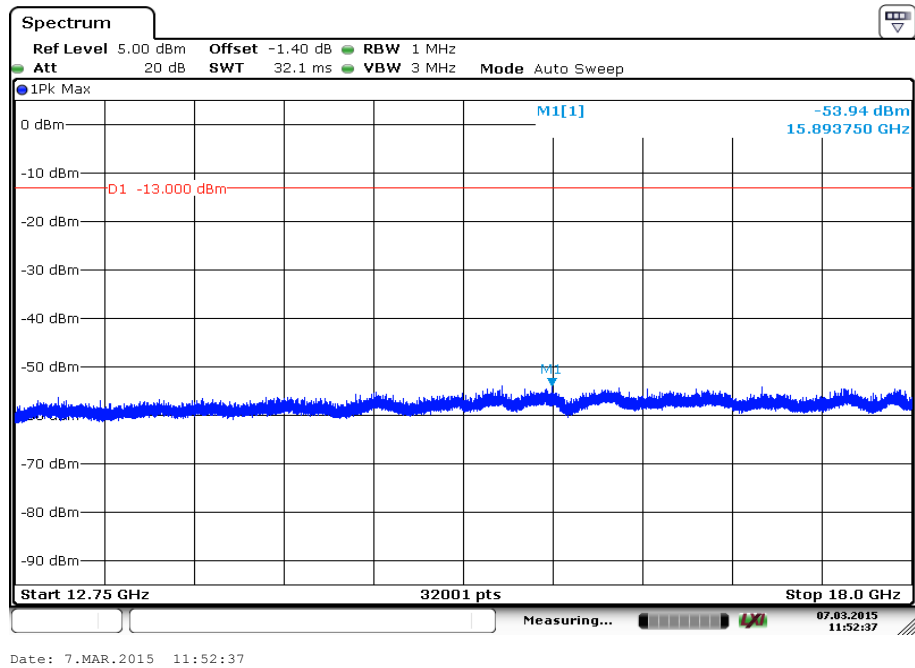
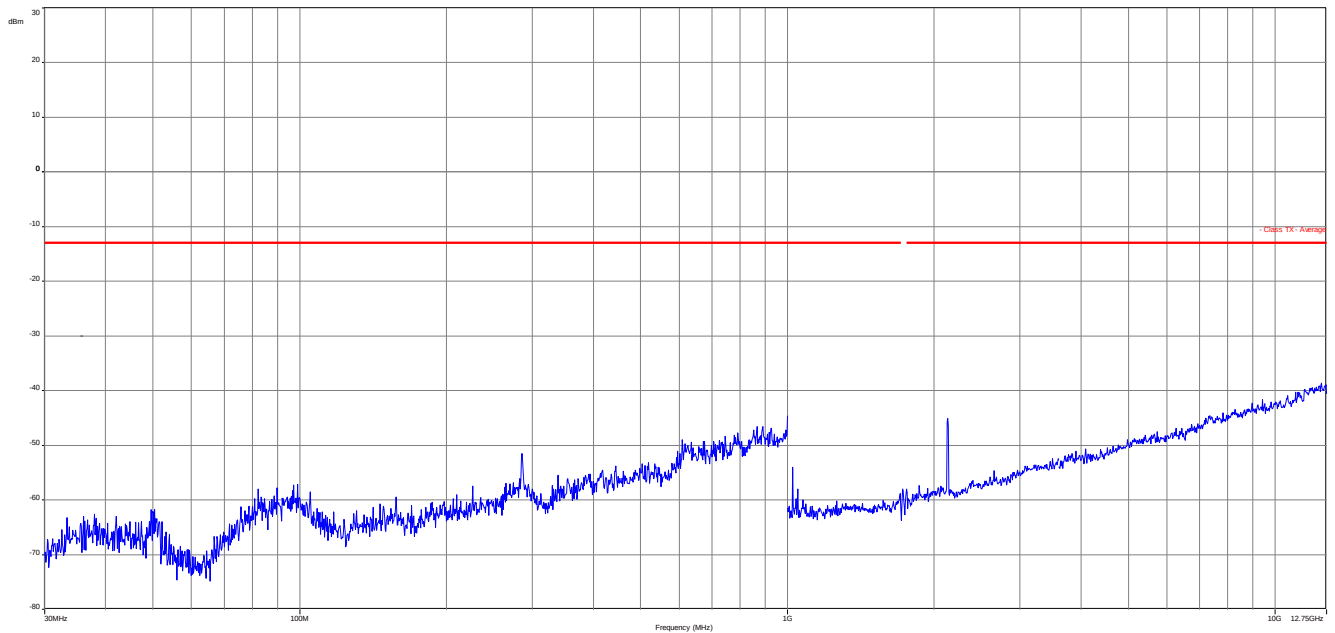
Plot 1: Middle channel – 1732.5 MHz, up to 30 MHz



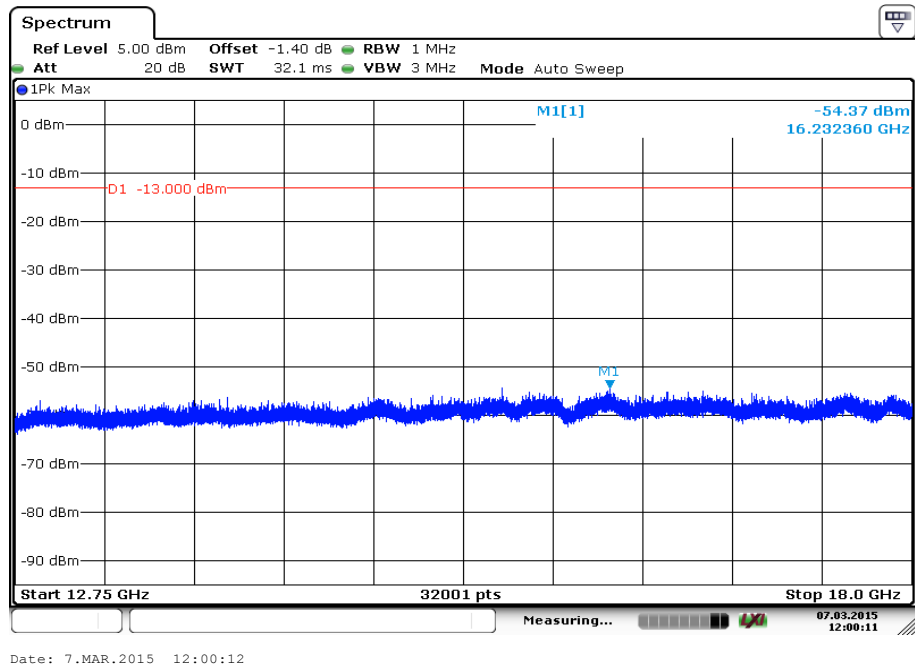
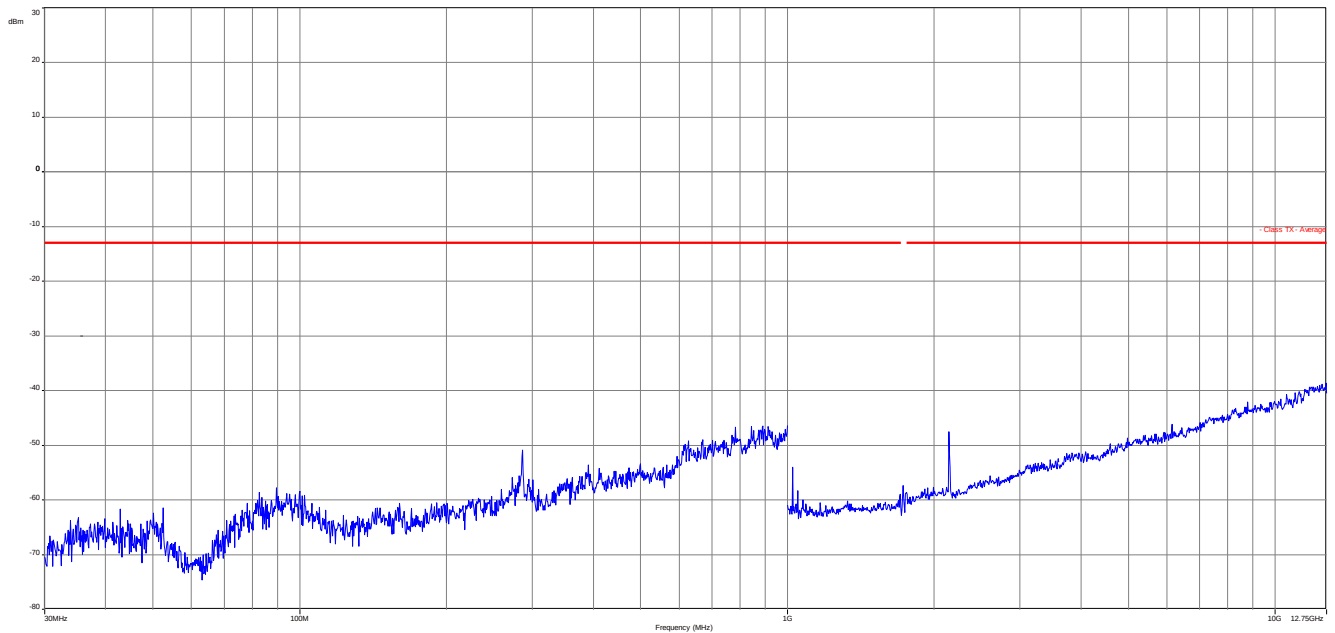
Plot 2: Low channel – 1715 MHz, 30 MHz to 12.75 GHz



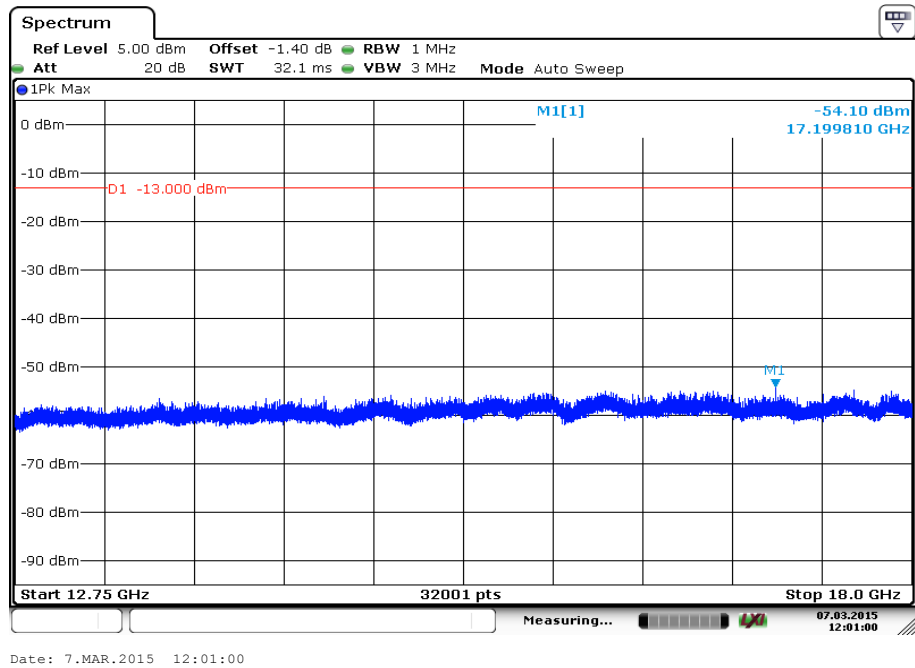
The carrier signal is notched with a 1.7 GHz band rejection filter.

Plot 3: Low channel – 1715 MHz, 12.75 GHz to 18 GHz**Plot 4: Middle channel – 1732.5 MHz, 30 MHz to 12.75 GHz**

The carrier signal is notched with a 1.7 GHz band rejection filter.

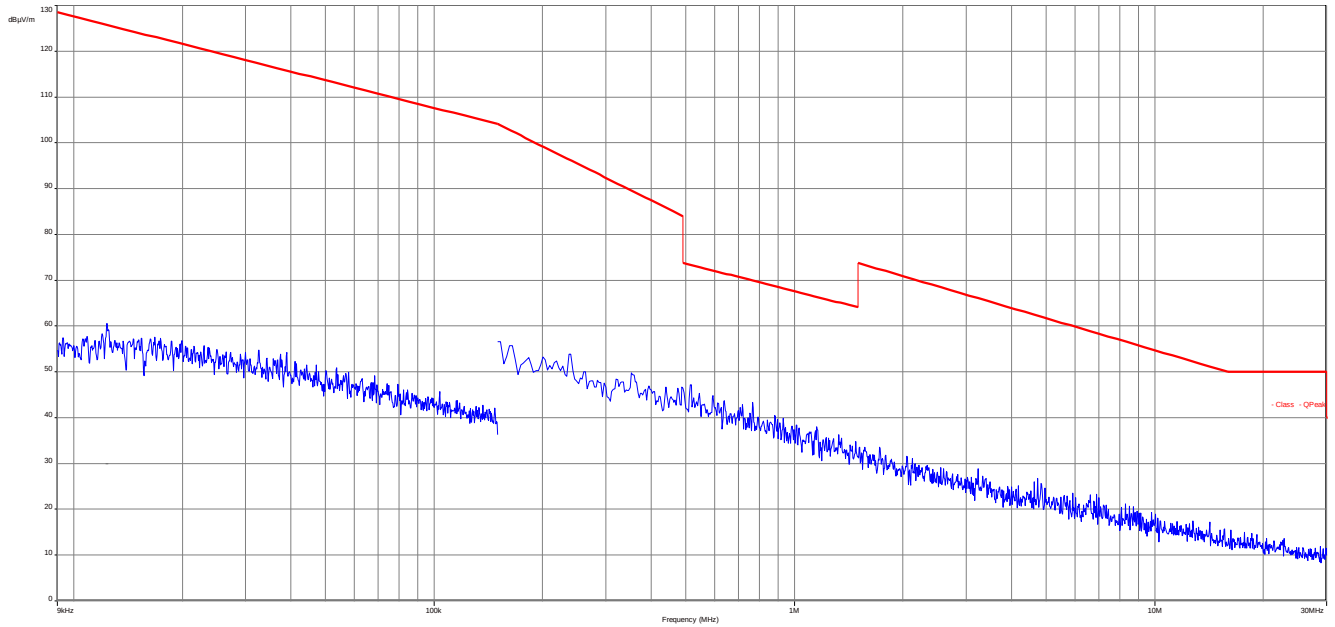
Plot 5: Middle channel – 1732.5 MHz, 12.75 GHz to 18 GHz**Plot 6: Middle channel – 1750 MHz, 30 MHz to 12.75 GHz**

The carrier signal is notched with a 1.7 GHz band rejection filter.

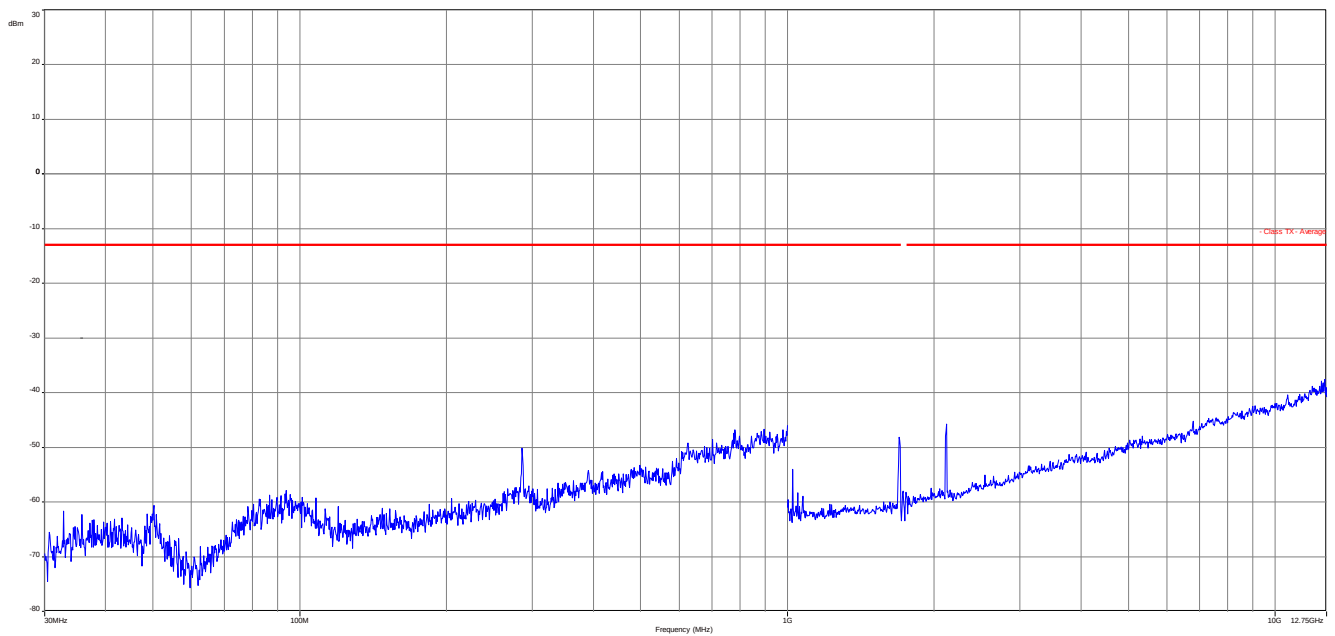
Plot 7: Middle channel – 1750 MHz, 12.75 GHz to 18 GHz

Plots: 16-QAM with 10 MHz channel bandwidth

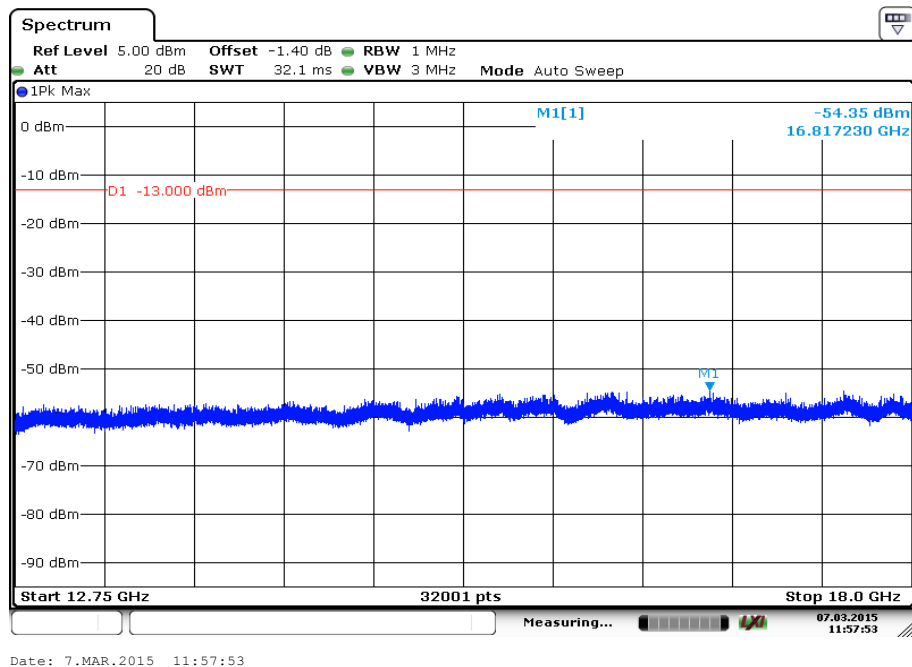
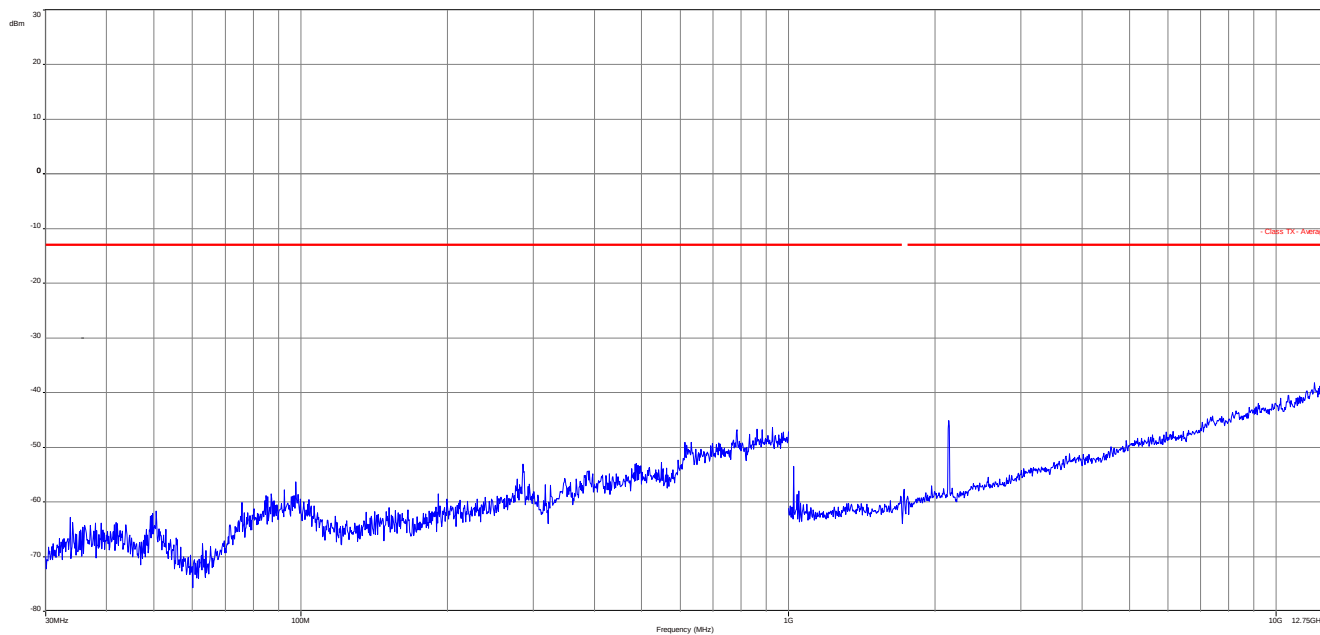
Plot 1: Middle channel – 1732.5 MHz, up to 30 MHz



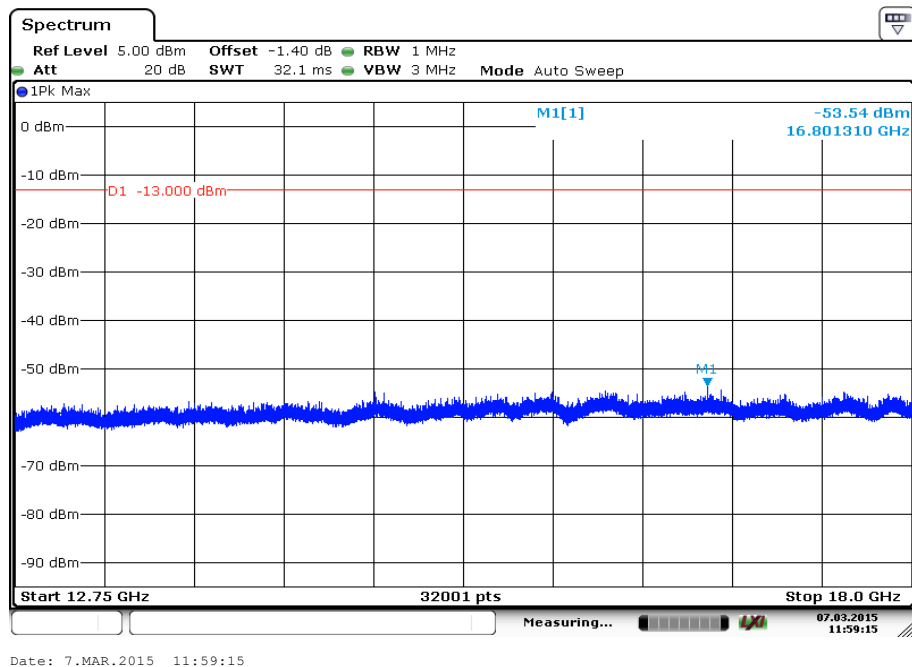
Plot 2: Low channel – 1715 MHz, 30 MHz to 12.75 GHz



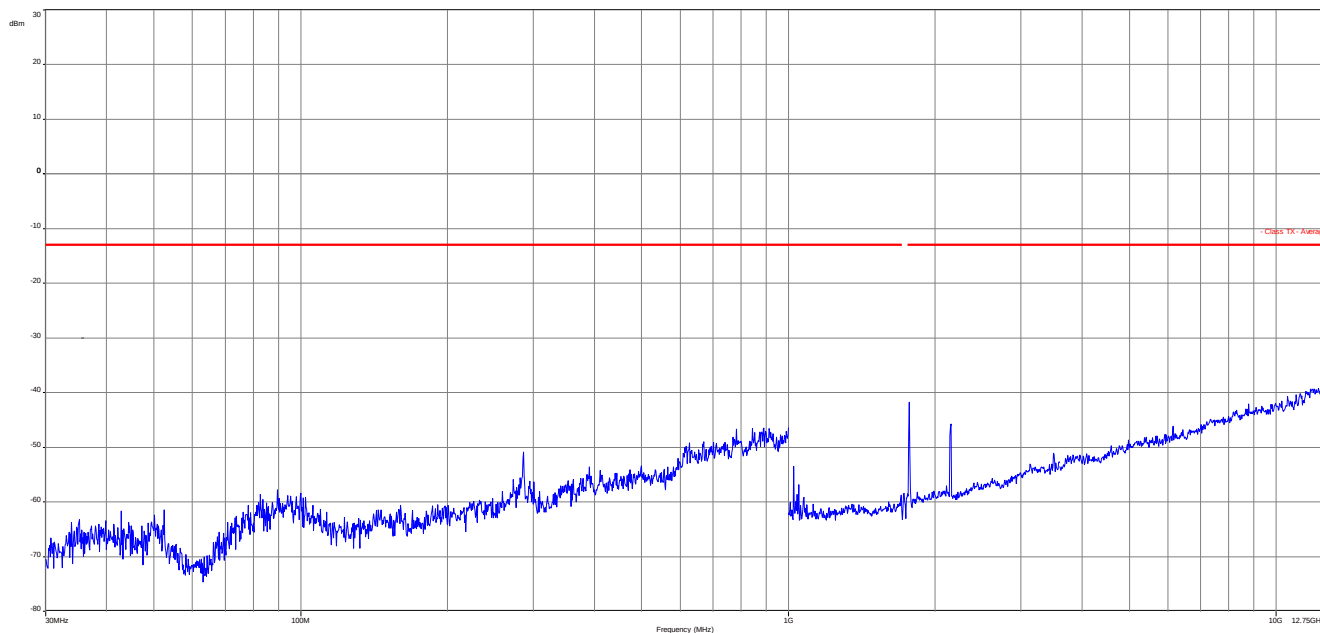
The carrier signal is notched with a 1.7 GHz band rejection filter.

Plot 3: Low channel – 1715 MHz, 12.75 GHz to 18 GHz**Plot 4: Middle channel – 1732.5 MHz, 30 MHz to 12.75 GHz**

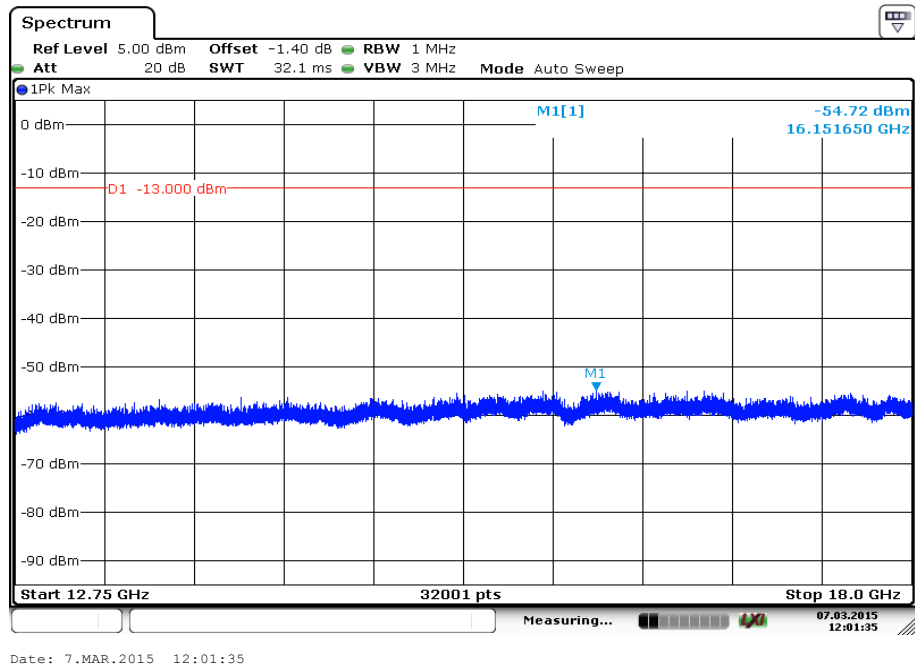
The carrier signal is notched with a 1.7 GHz band rejection filter.

Plot 5: Middle channel – 1732.5 MHz, 12.75 GHz to 18 GHz

Date: 7.MAR.2015 11:59:15

Plot 6: Middle channel – 1750 MHz, 30 MHz to 12.75 GHz

The carrier signal is notched with a 1.7 GHz band rejection filter.

Plot 7: Middle channel – 1750 MHz, 12.75 GHz to 18 GHz

8.3.3 Block edge compliance

Description:

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

For the measurement the lowest, middle and highest channel bandwidth was used. If spurious were found the other bandwidths were measured, too.

Measurement:

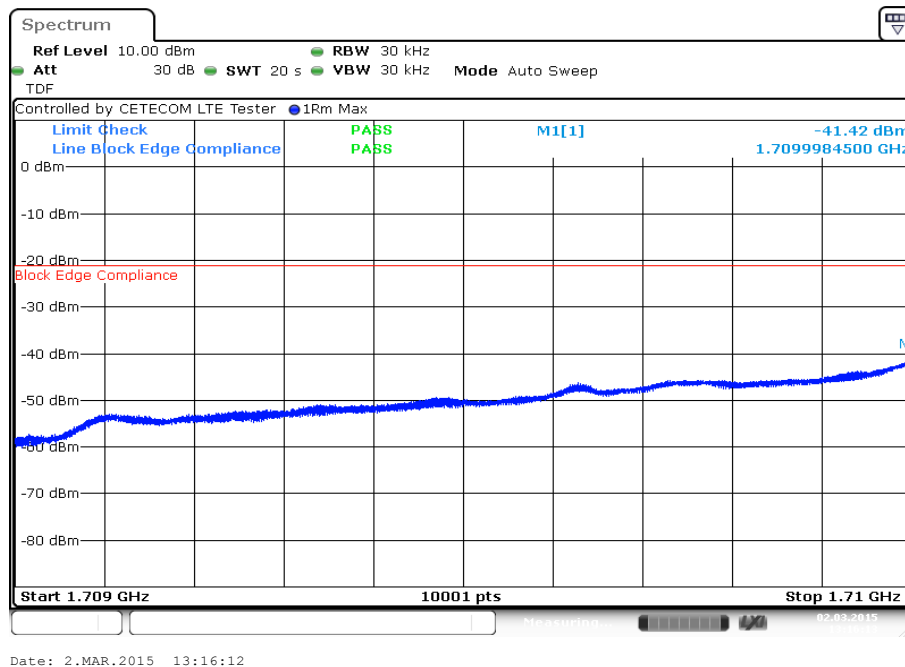
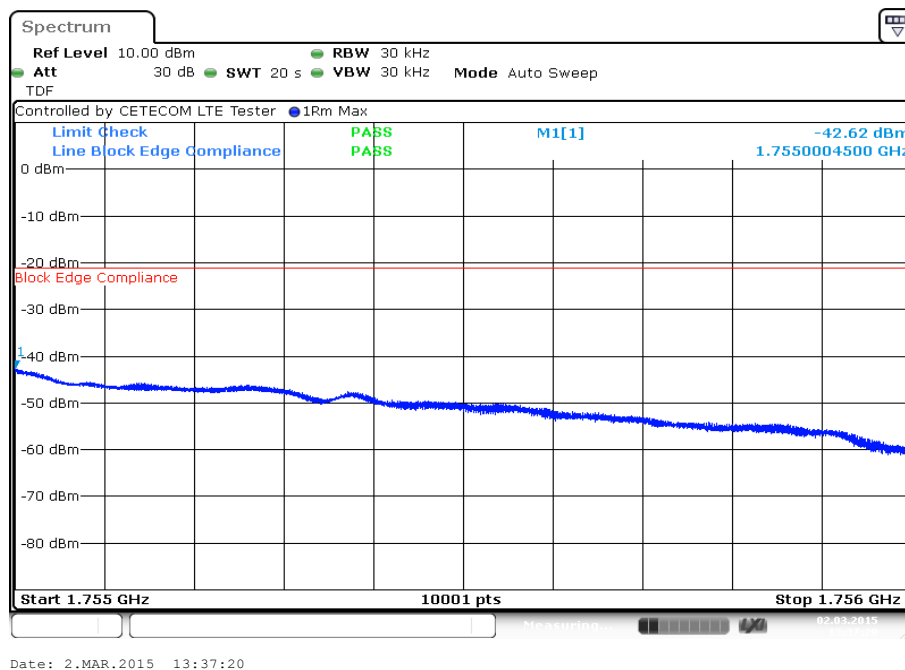
Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold

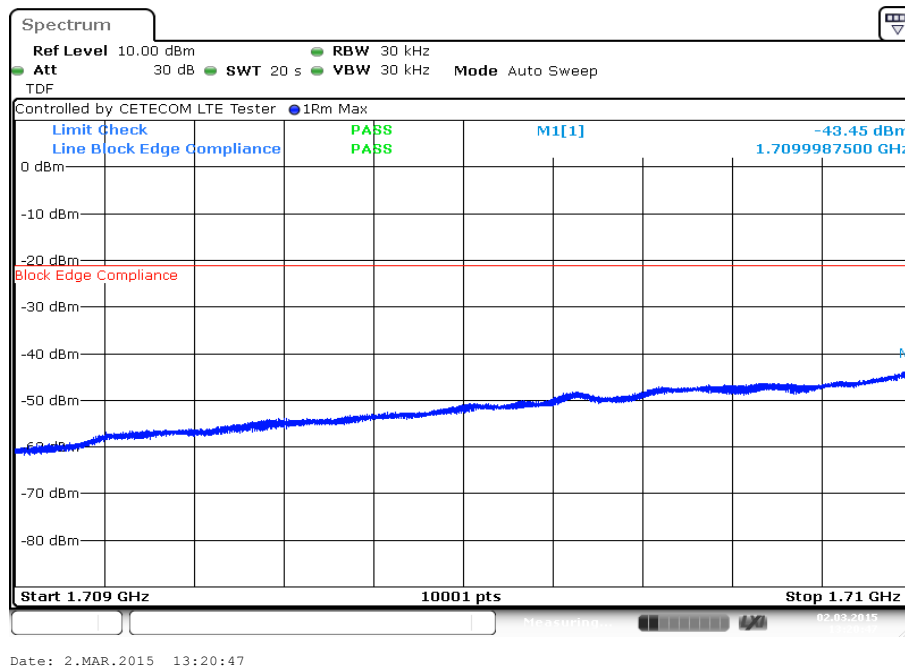
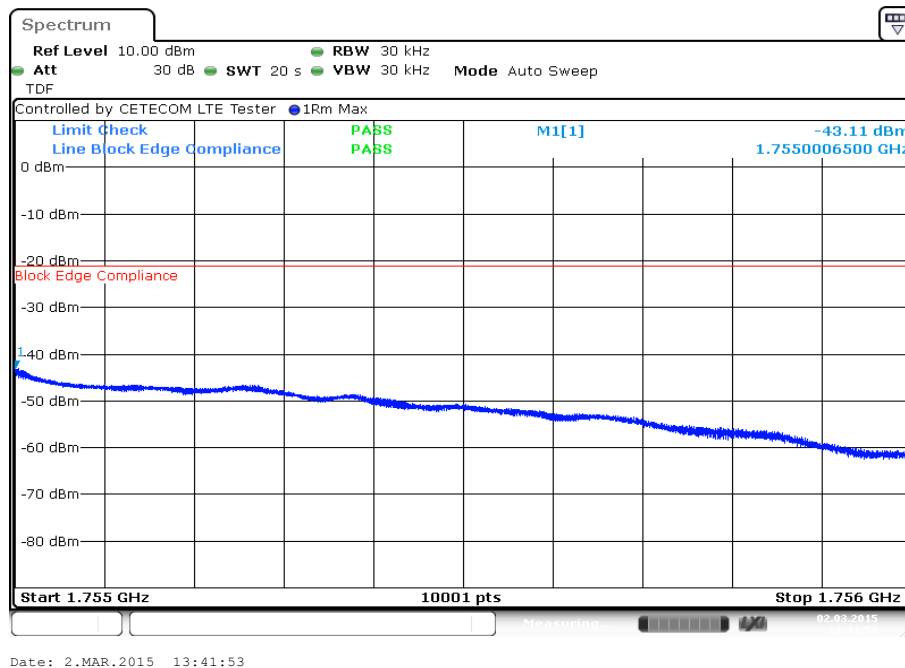
Limits:

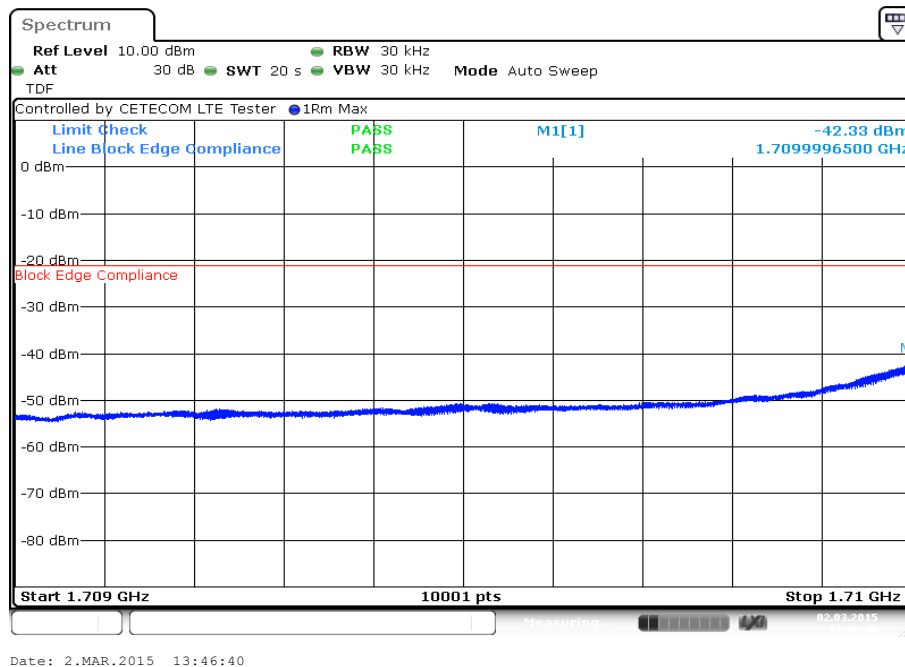
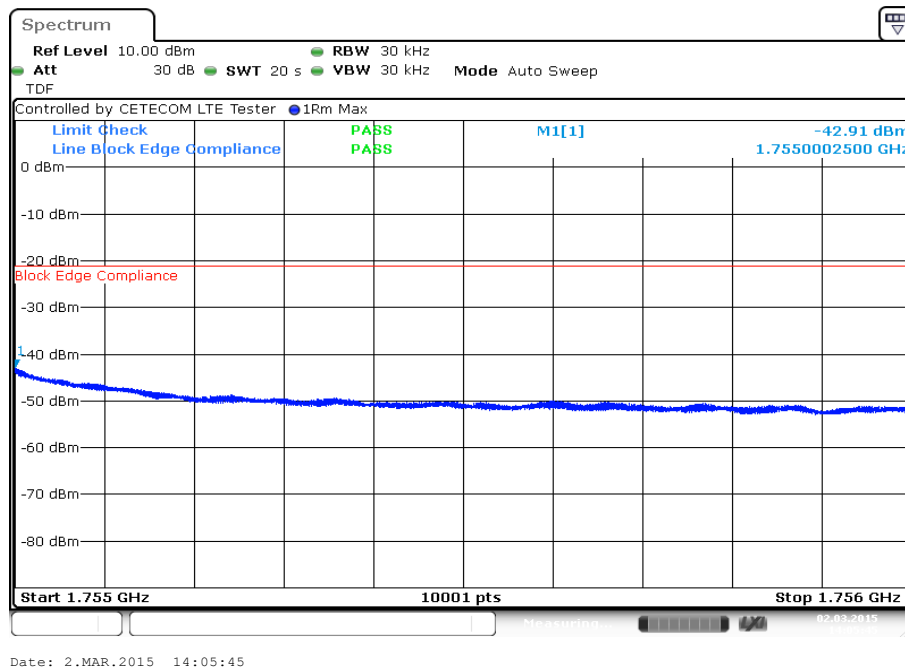
FCC	IC
Block Edge Compliance	
Part 27.53 specifies that “the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.” However, in publication number 890810, The FCC Office of Engineering 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 -8.239 adjustment to the limit [$10 \log(30\text{kHz}/50\text{kHz}) = -8.239$]. When this adjustment is applied to the limit, the limit becomes -21.24.	
-21.24 dBm	

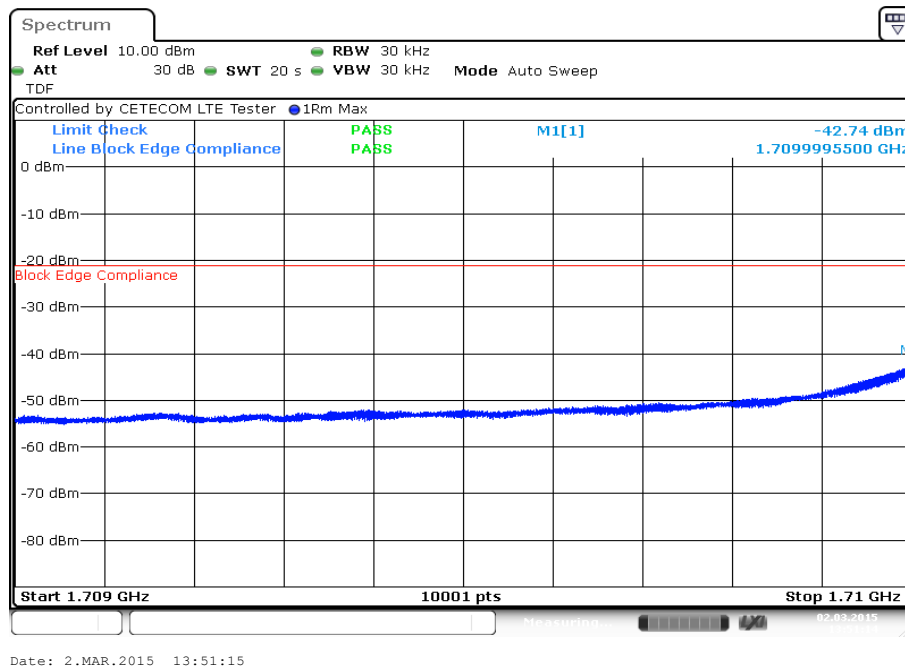
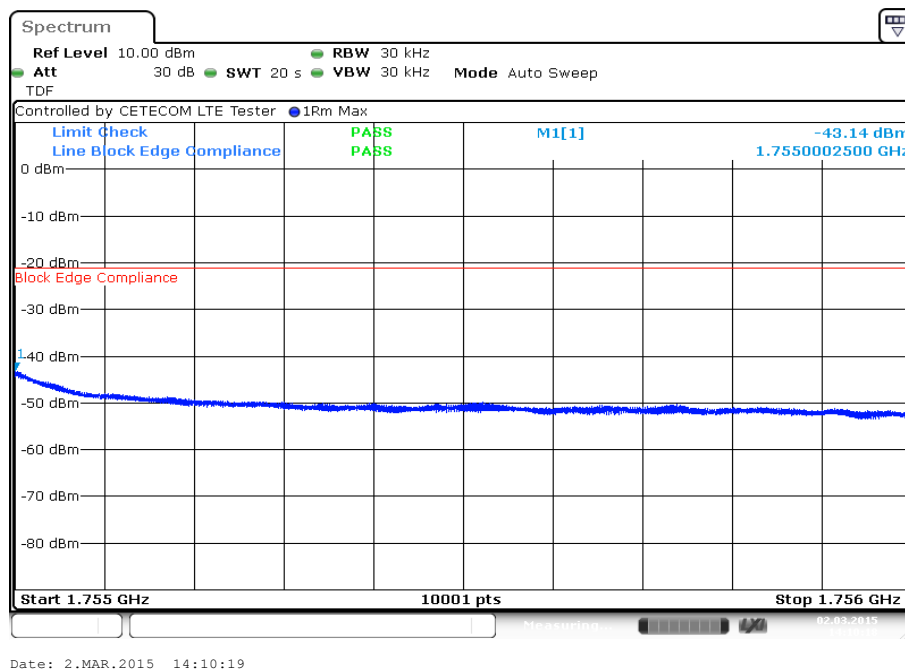
Used setup acc. chapter 8.1.2.

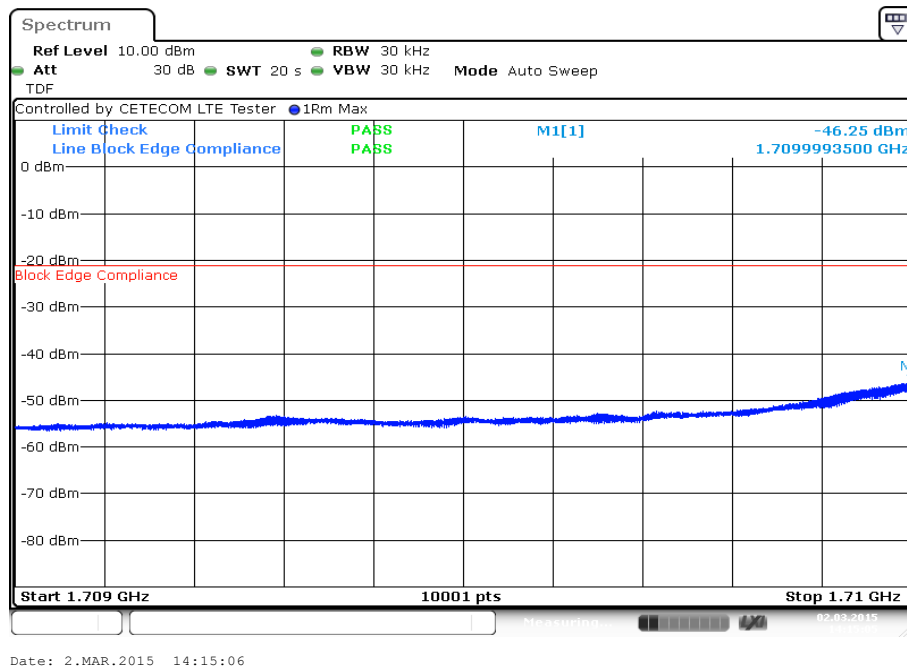
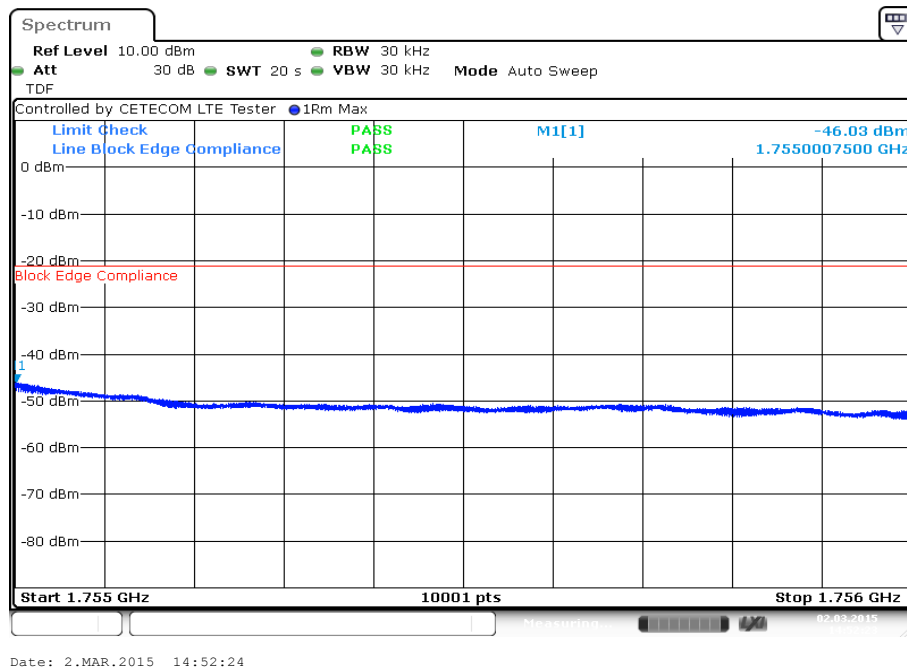
Used equipment see table chapter 9

Results: 1.4 MHz channel bandwidth**Plot 1: Lowest channel, QPSK modulation****Plot 2: Highest channel, QPSK modulation**

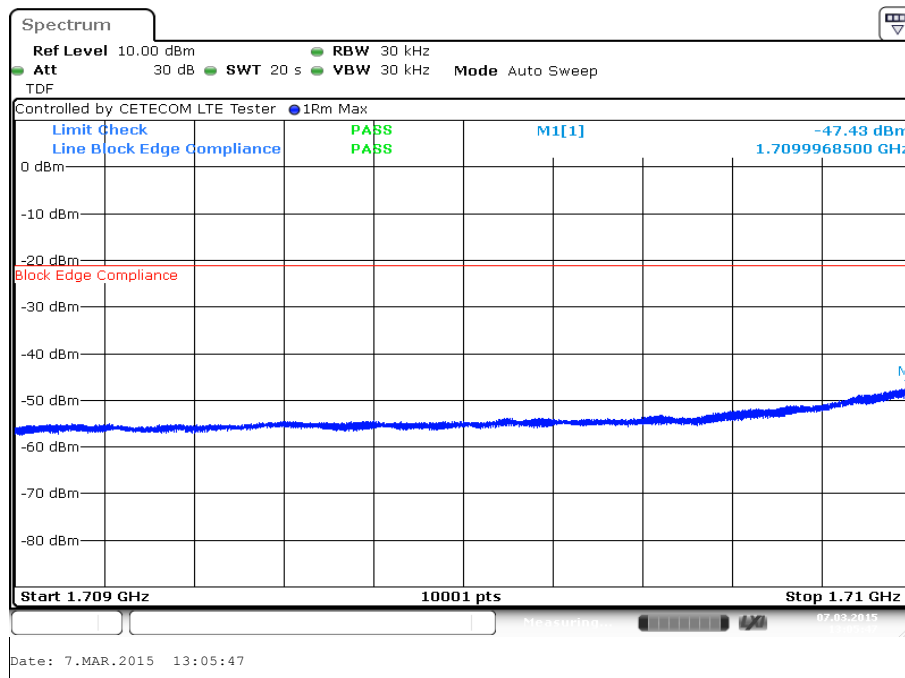
Plot 3: Lowest channel, 16 – QAM modulation**Plot 4: Highest channel, 16 – QAM modulation**

Results: 3 MHz channel bandwidth**Plot 1: Lowest channel, QPSK modulation****Plot 2: Highest channel, QPSK modulation**

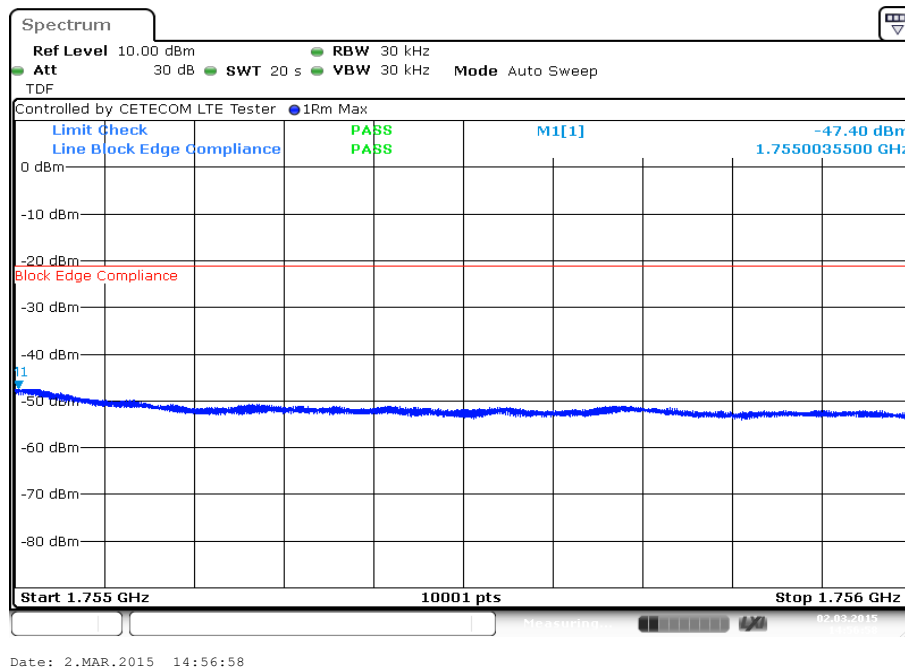
Plot 3: Lowest channel, 16 – QAM modulation**Plot 4: Highest channel, 16 – QAM modulation**

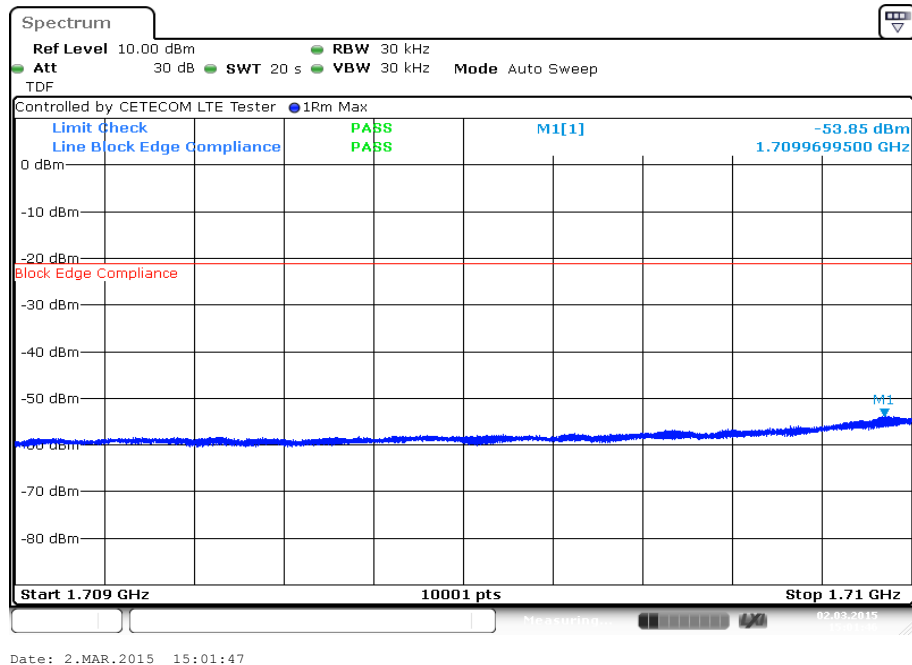
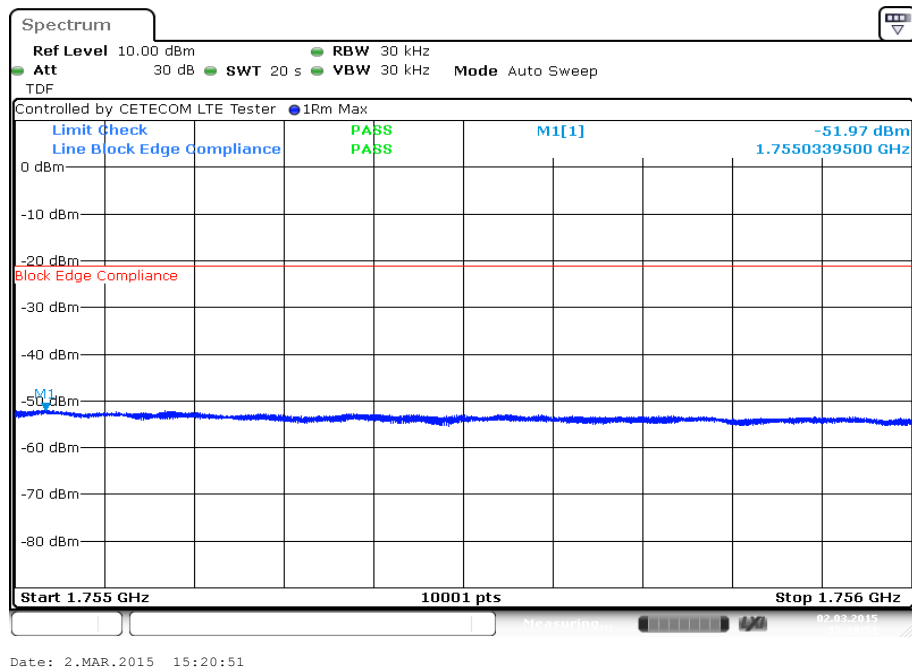
Results: 5 MHz channel bandwidth**Plot 1: Lowest channel, QPSK modulation****Plot 2: Highest channel, QPSK modulation**

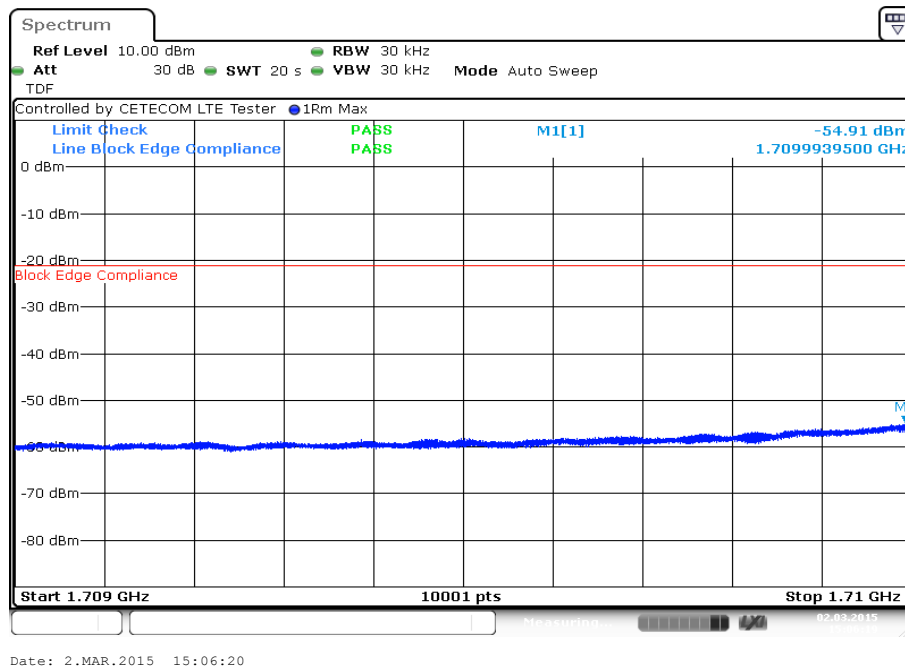
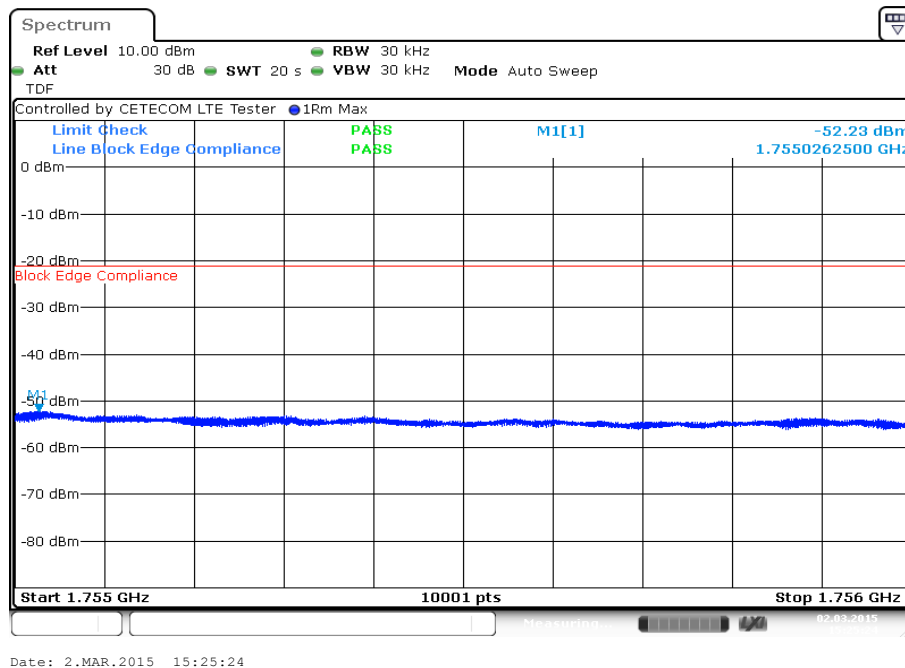
Plot 3: Lowest channel, 16 – QAM modulation

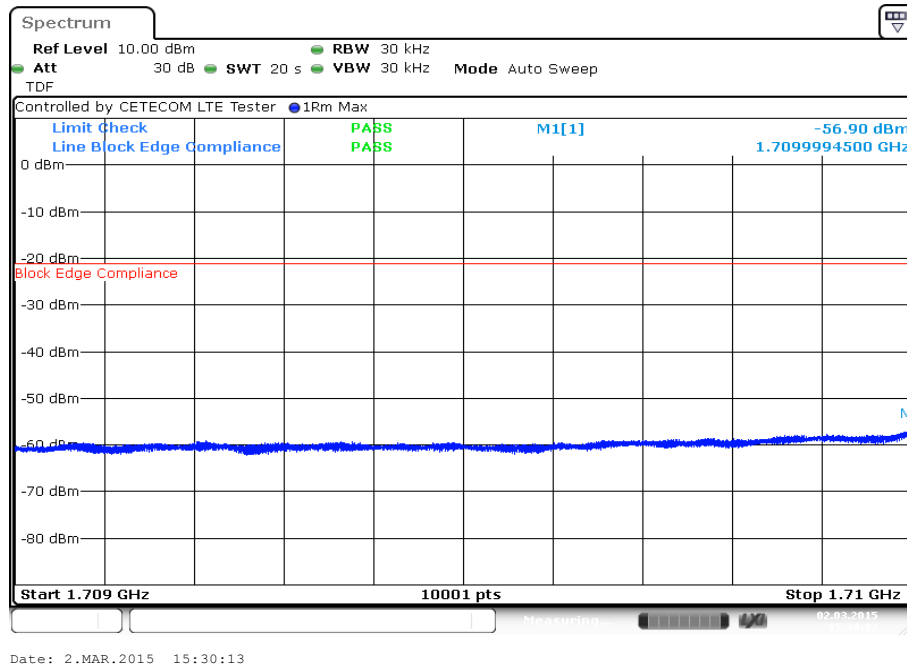
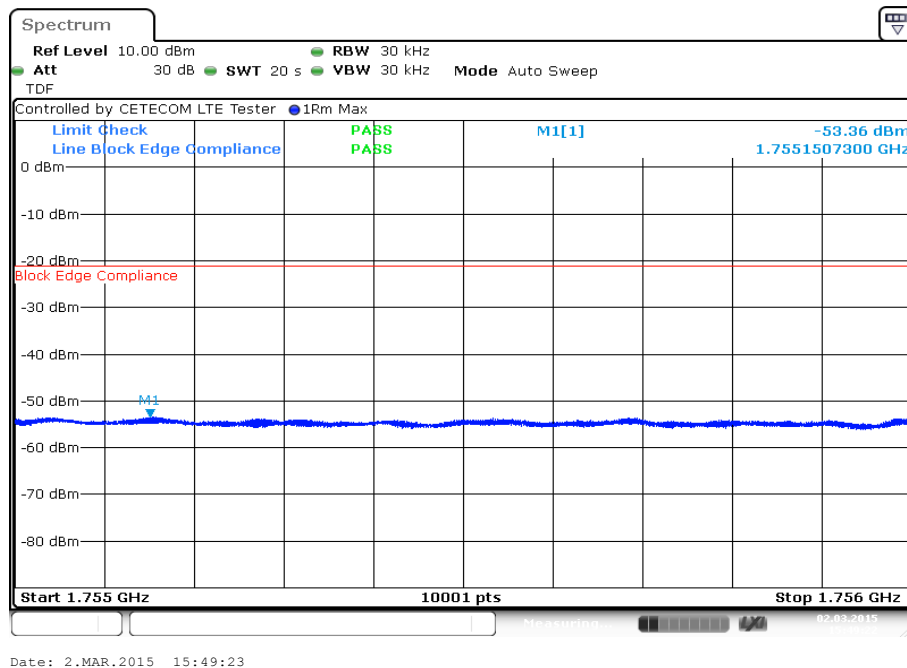


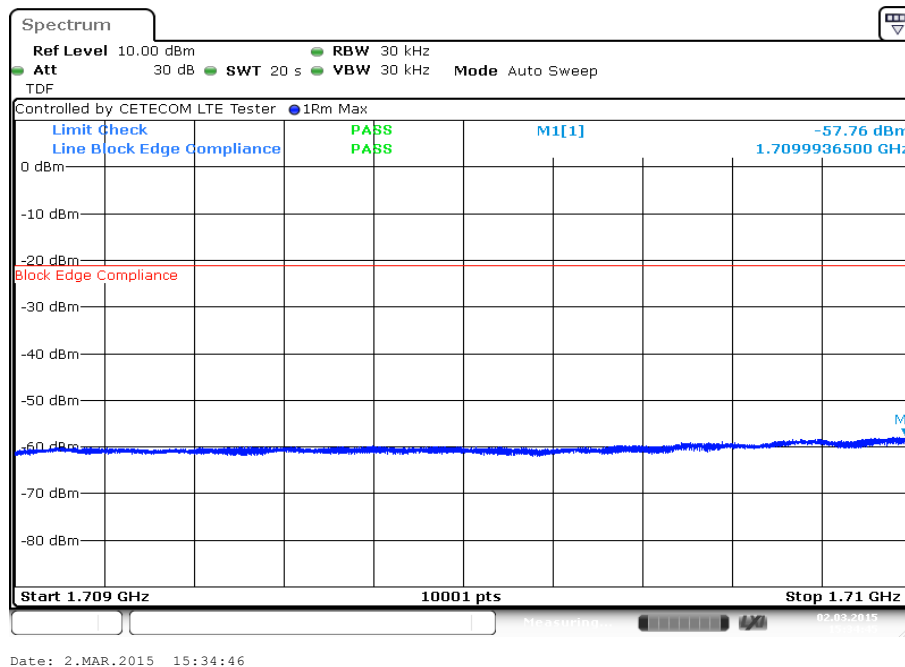
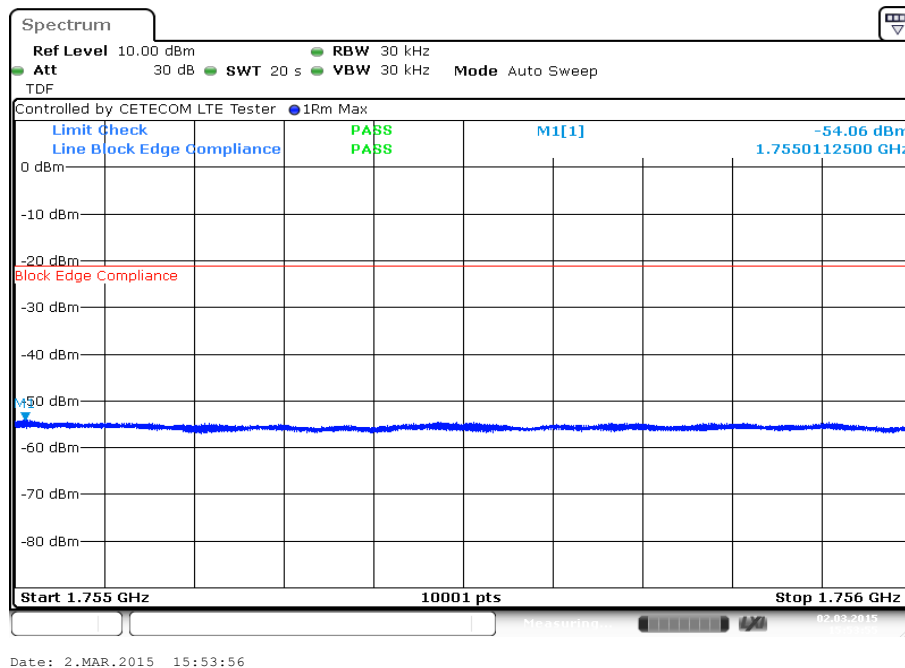
Plot 4: Highest channel, 16 – QAM modulation

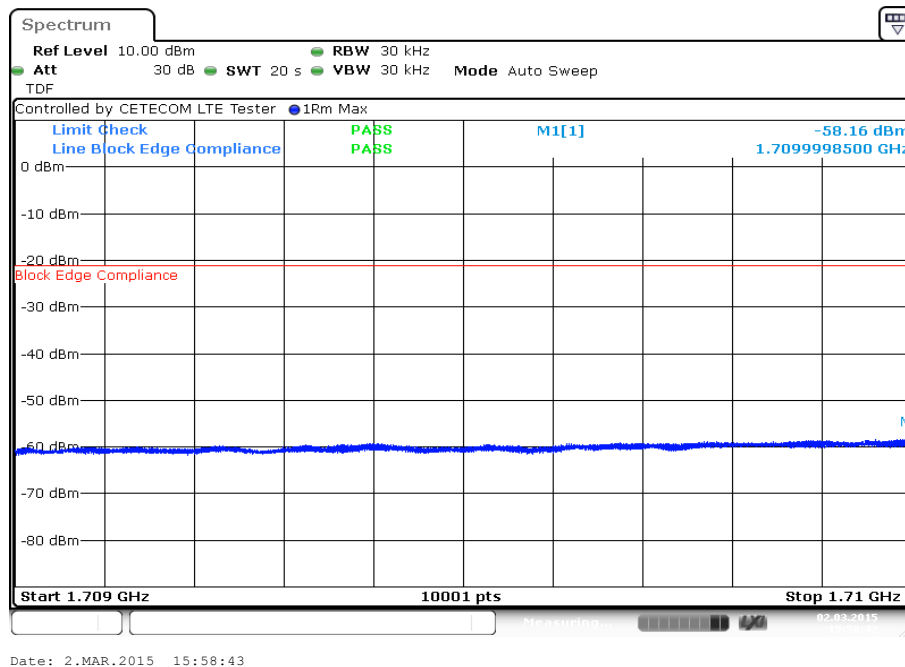
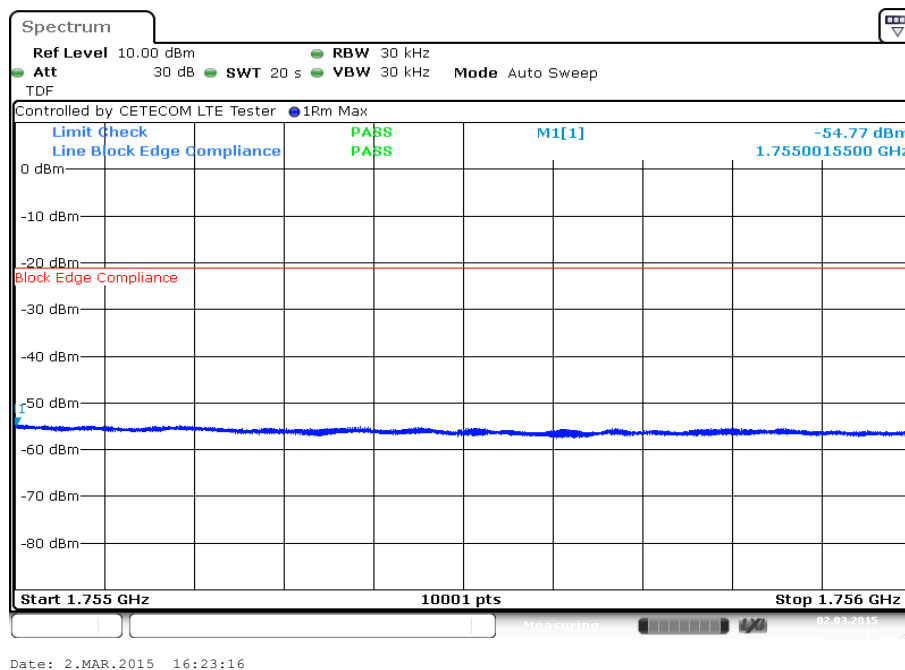


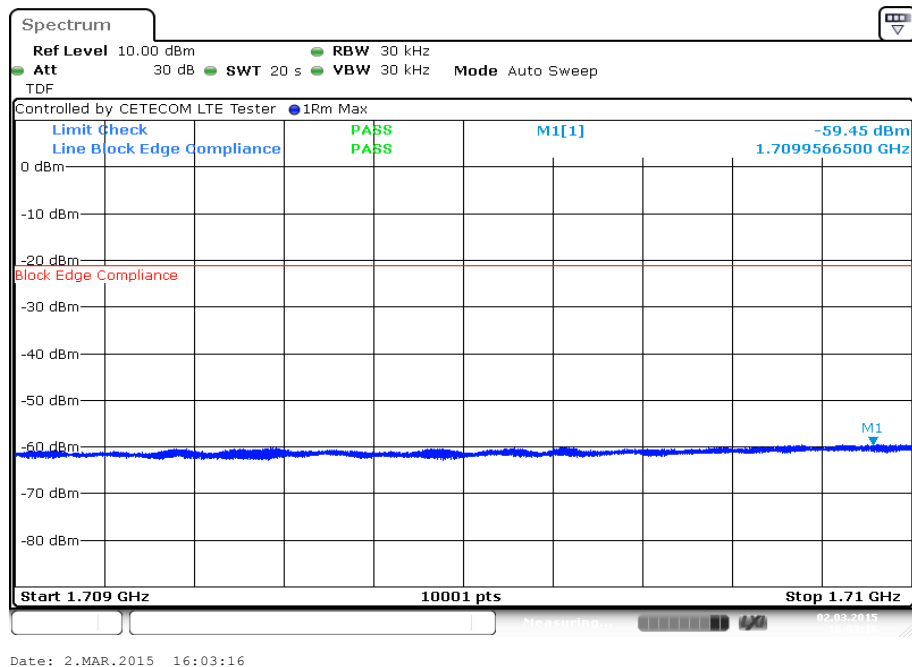
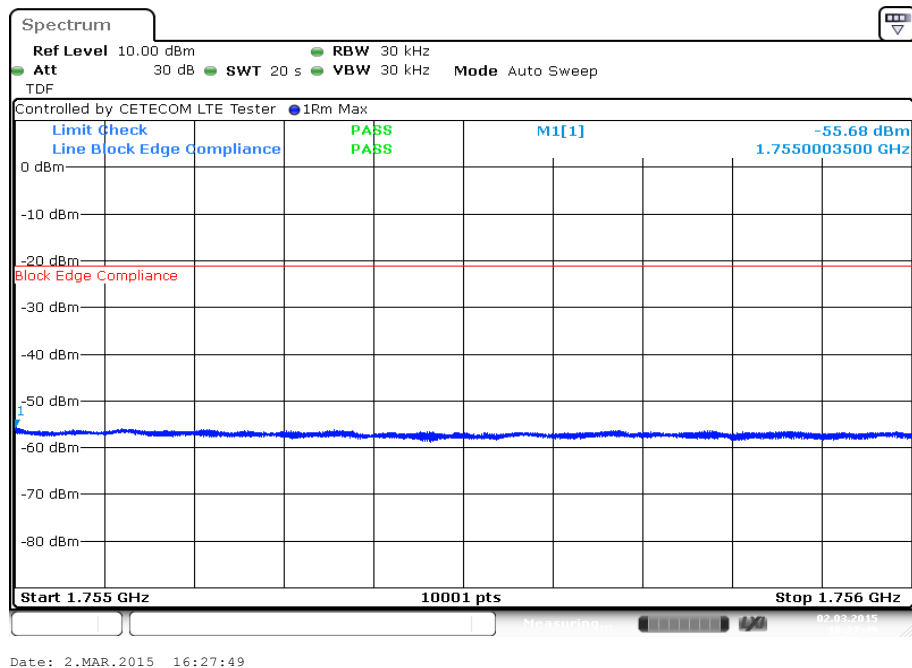
Results: 10 MHz channel bandwidth**Plot 1: Lowest channel, QPSK modulation****Plot 2: Highest channel, QPSK modulation**

Plot 3: Lowest channel, 16 – QAM modulation**Plot 4: Highest channel, 16 – QAM modulation**

Results: 15 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: 20 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****Verdict: complies**

8.4 Results LTE – Band 17

The EUT was set to transmit the maximum power.

8.4.1 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	IC
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.	

Used setup acc. chapter 8.1.2.

Used equipment see table chapter 9

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	22.2	5.89	21.2	5.53
		1 RB high	21.7	5.92	20.7	5.39
		50% RB mid	20.7	6.79	19.9	7.19
		100% RB	20.6	6.80	19.7	7.62
	710.0	1 RB low	21.6	6.76	20.3	5.64
		1 RB high	21.9	6.15	20.6	5.05
		50% RB mid	20.6	7.14	19.5	6.55
		100% RB	20.5	7.16	19.5	6.54
	713.5	1 RB low	21.6	4.72	20.4	6.31
		1 RB high	21.8	5.07	20.6	6.59
		50% RB mid	20.6	6.32	19.7	7.17
		100% RB	20.5	6.17	19.6	7.47
10	709.0	1 RB low	22.0	6.57	21.1	5.92
		1 RB high	21.8	6.19	20.9	5.53
		50% RB mid	20.5	7.74	19.5	6.77
		100% RB	20.4	7.99	19.4	6.75
	710.0	1 RB low	21.7	5.49	20.2	6.77
		1 RB high	21.8	5.11	20.3	6.42
		50% RB mid	20.4	6.77	19.5	8.11
		100% RB	20.4	6.90	19.5	7.55
	711.0	1 RB low	21.5	7.38	20.2	5.68
		1 RB high	21.7	6.86	20.3	5.23
		50% RB mid	20.4	7.80	19.5	6.26
		100% RB	20.5	8.21	19.3	6.90
Measurement uncertainty			± 0.5 dB			

The radiated output power is measured in the mode with 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	20.0	19.0
	710.0	18.4	17.1
	713.5	19.5	18.3
10	709.0	19.8	18.9
	710.0	18.3	16.8
	711.0	19.4	18.0
Measurement uncertainty		± 3.0 dB	

Verdict: [complies](#)

8.4.2 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 C63.4:2014 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 Above 1 GHz: 1 MHz
Resolution bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span:	100 MHz Steps
Trace-Mode:	Max Hold

Limits:

FCC	IC
Spurious Emissions Radiated	
Attenuation $\geq 43 + 10\log(P)$ (P, Power in Watts)	
-13 dBm	

Used setup acc. chapter 8.1.1.

Used equipment see table chapter 9

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 10 MHz bandwidth and 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]
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
Measurement uncertainty			± 3dB		

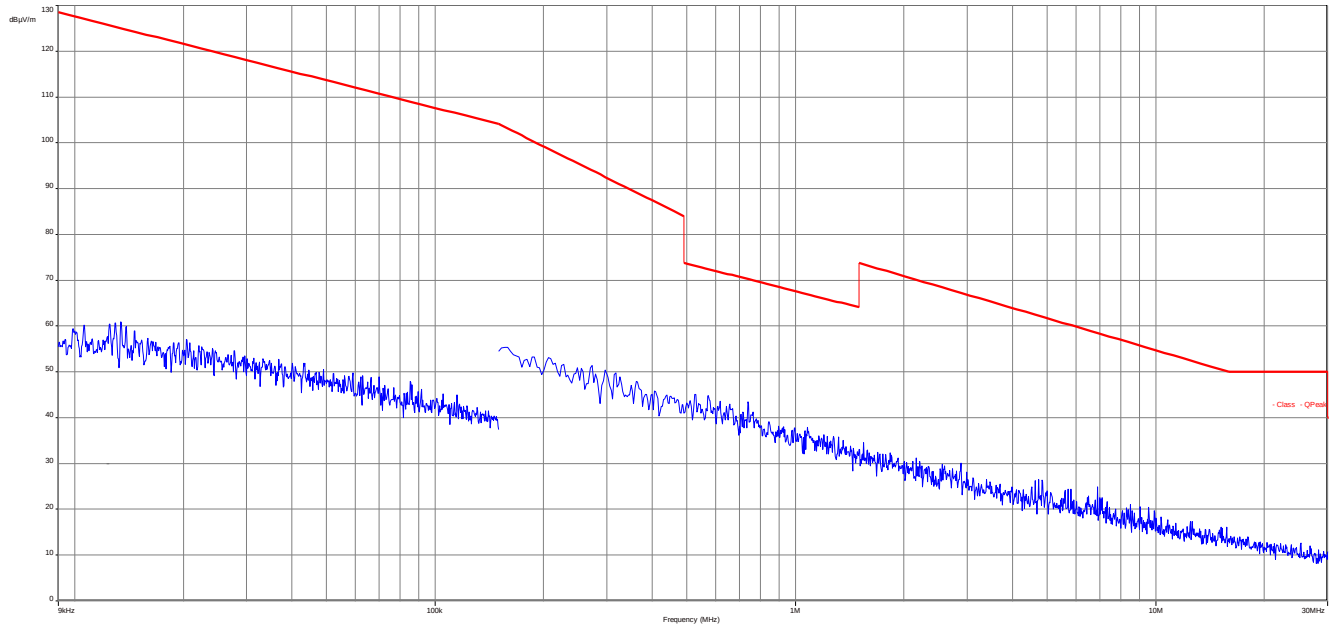
16-QAM

Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
Measurement uncertainty			± 3dB		

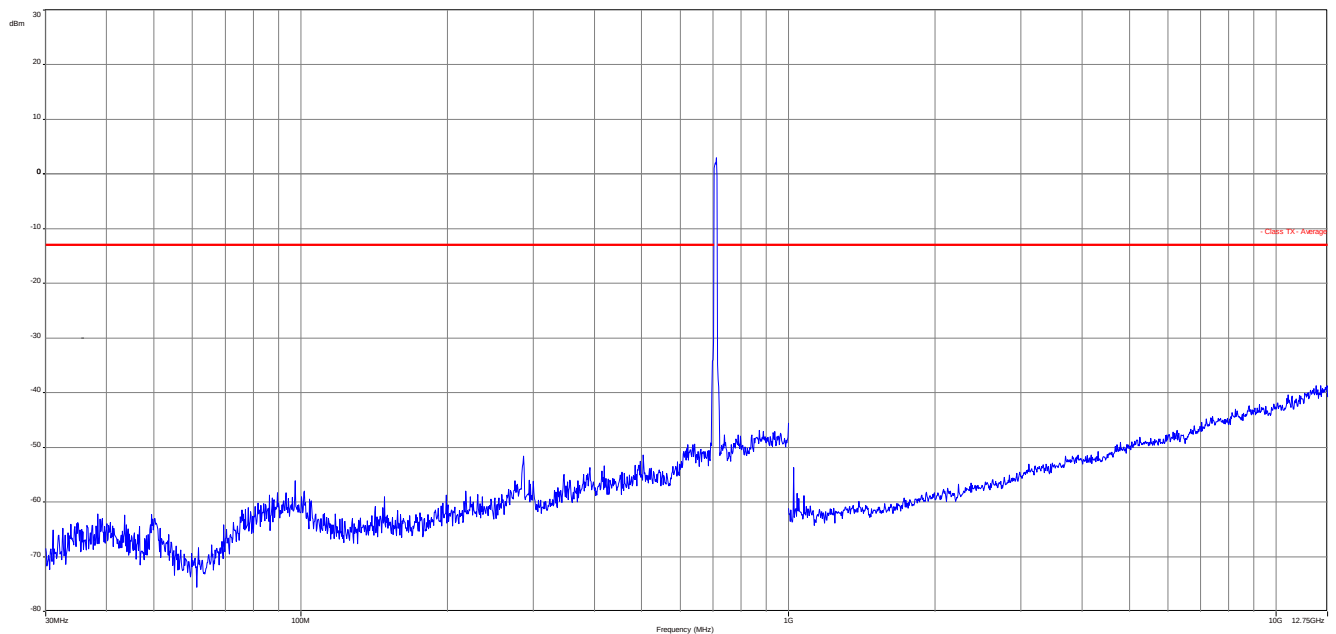
Verdict: [complies](#)

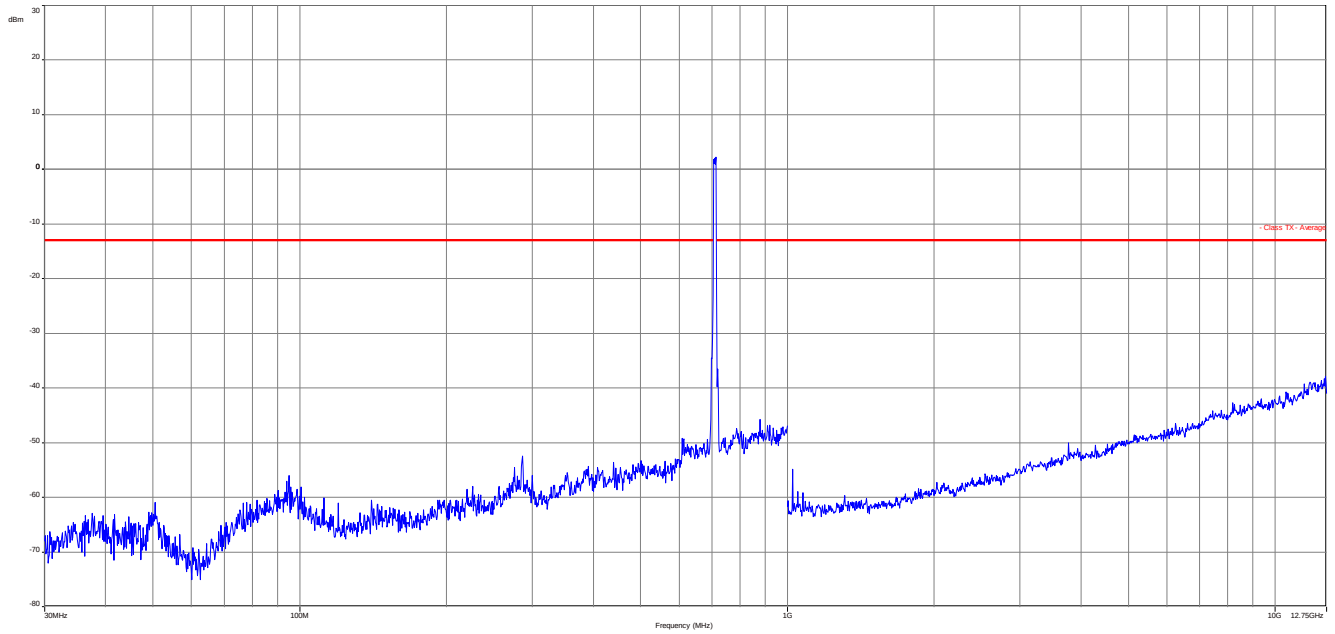
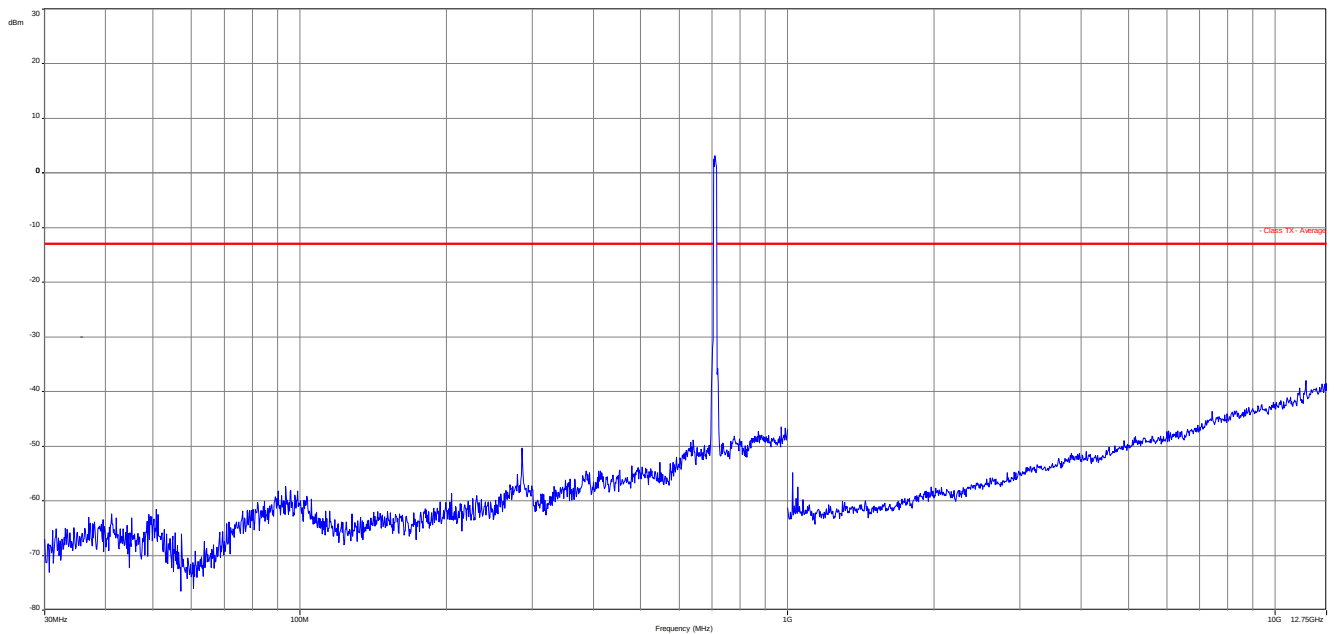
Plots: QPSK with 10 MHz channel bandwidth

Plot 1: Middle channel, up to 30 MHz



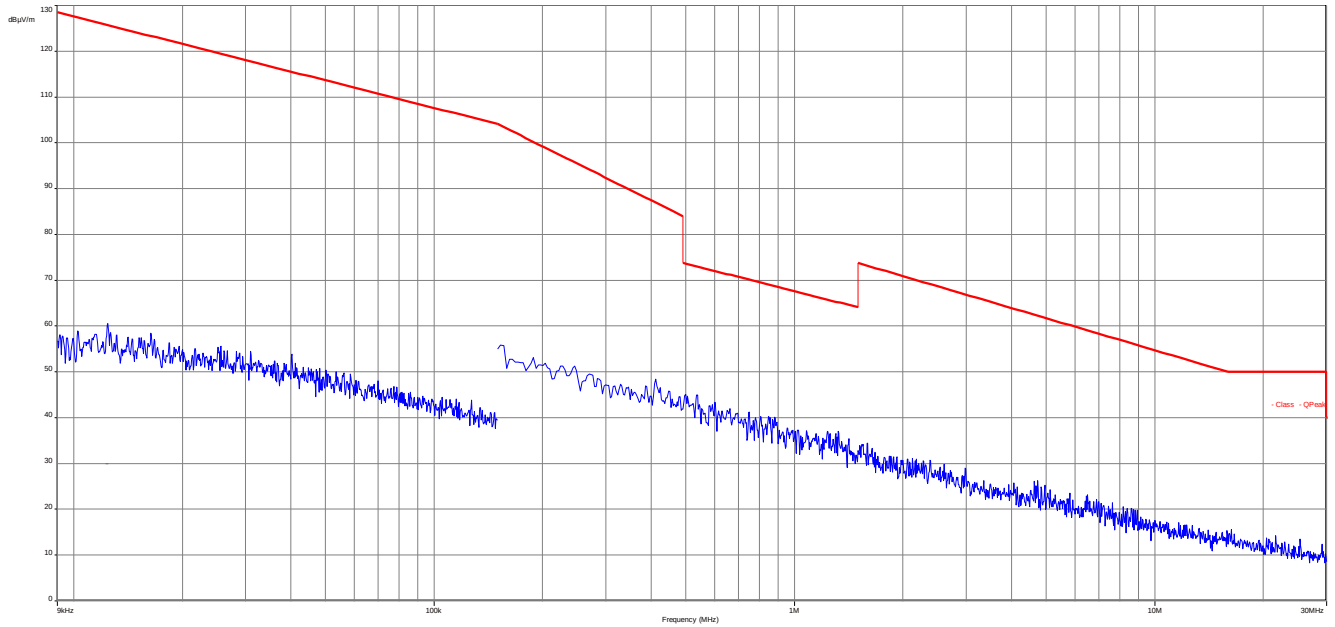
Plot 2: Low channel, 30 MHz to 12.75 GHz



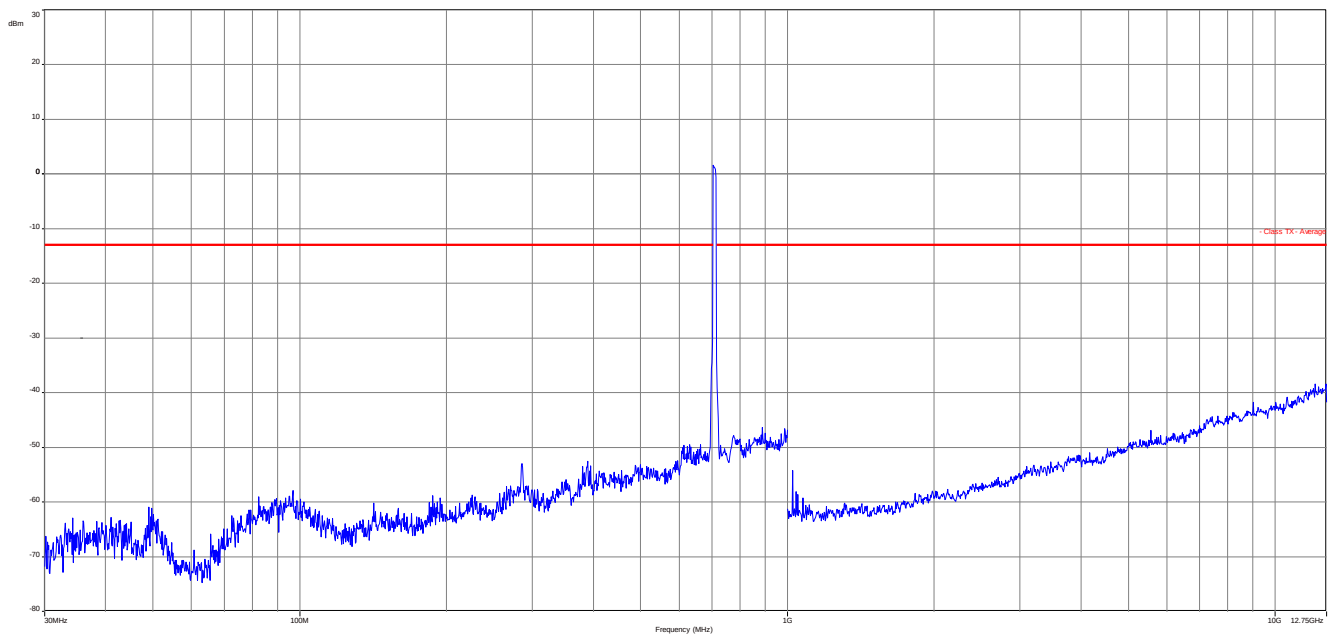
Plot 3: Middle channel, 30 MHz to 12.75 GHz**Plot 4: High channel, 30 MHz to 12.75 GHz**

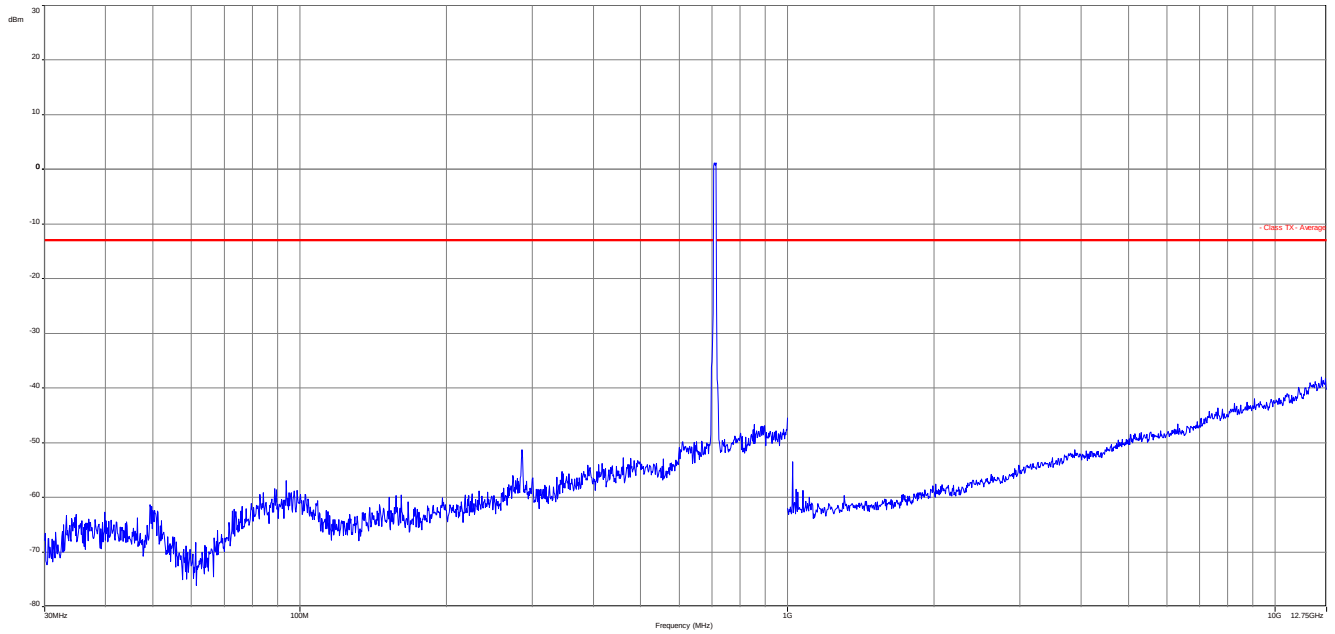
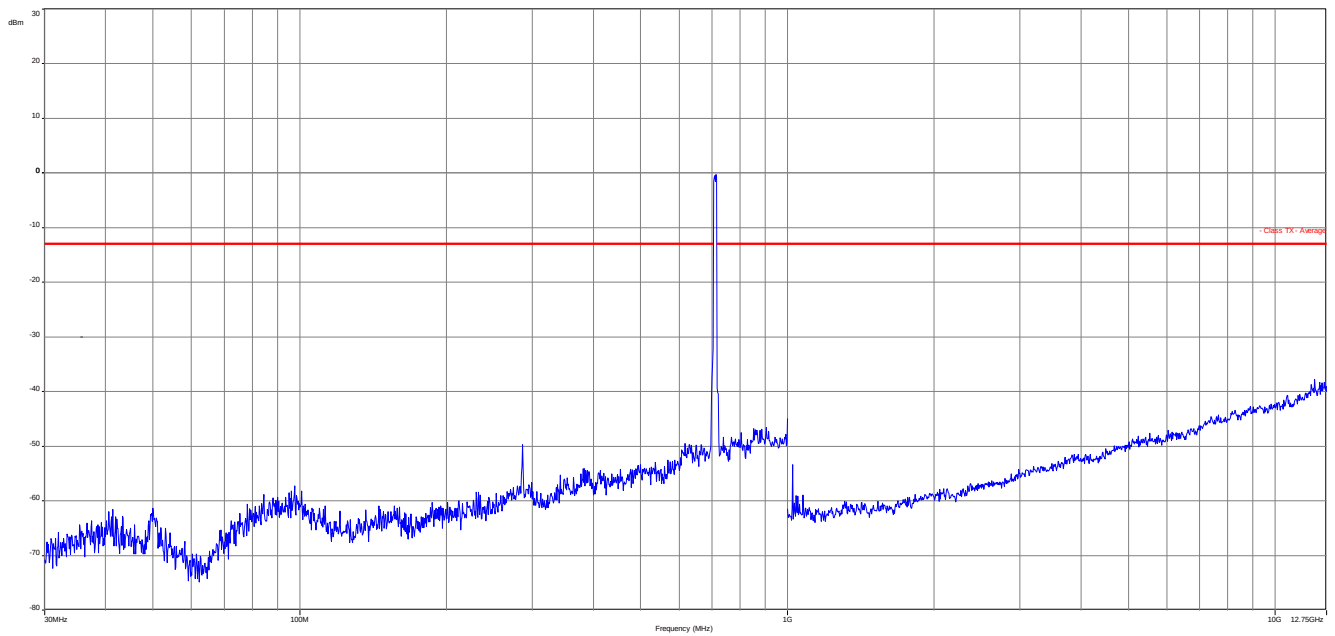
Plots: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, up to 30 MHz



Plot 2: Low channel, 30 MHz to 12.75 GHz



Plot 3: Middle channel, 30 MHz to 12.75 GHz**Plot 4: High channel, 30 MHz to 12.75 GHz**

8.4.3 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

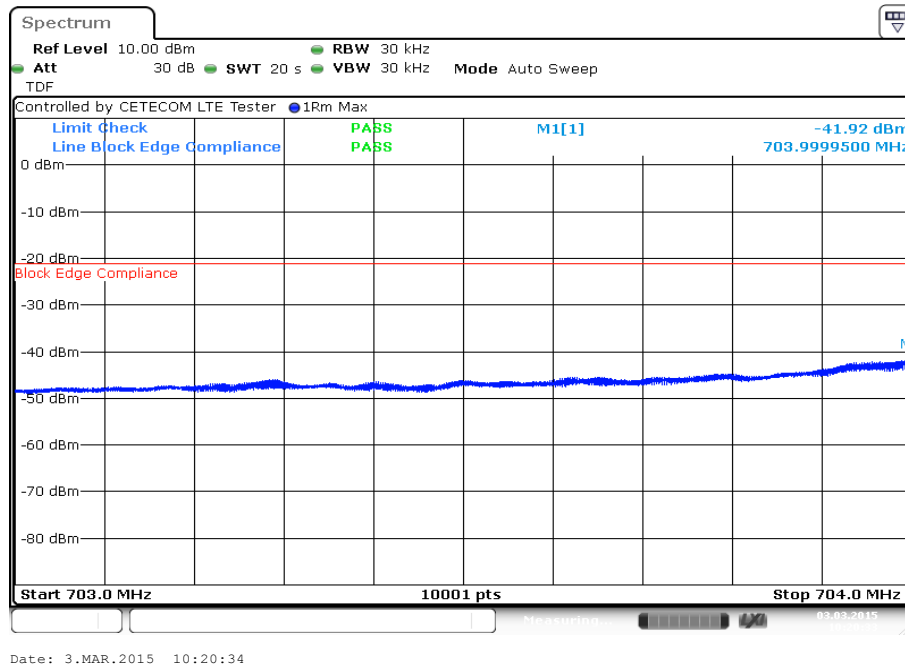
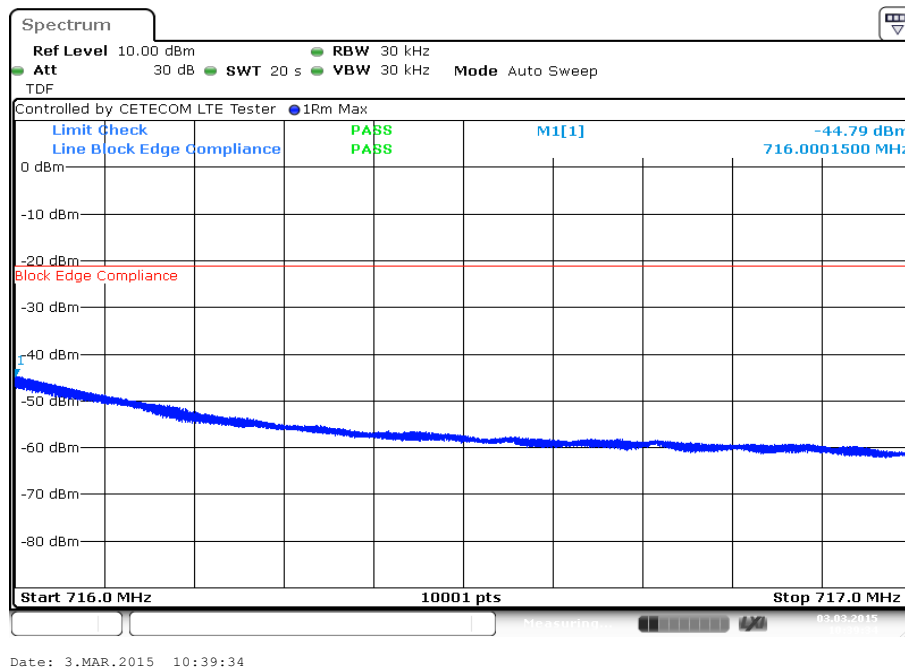
Limits:

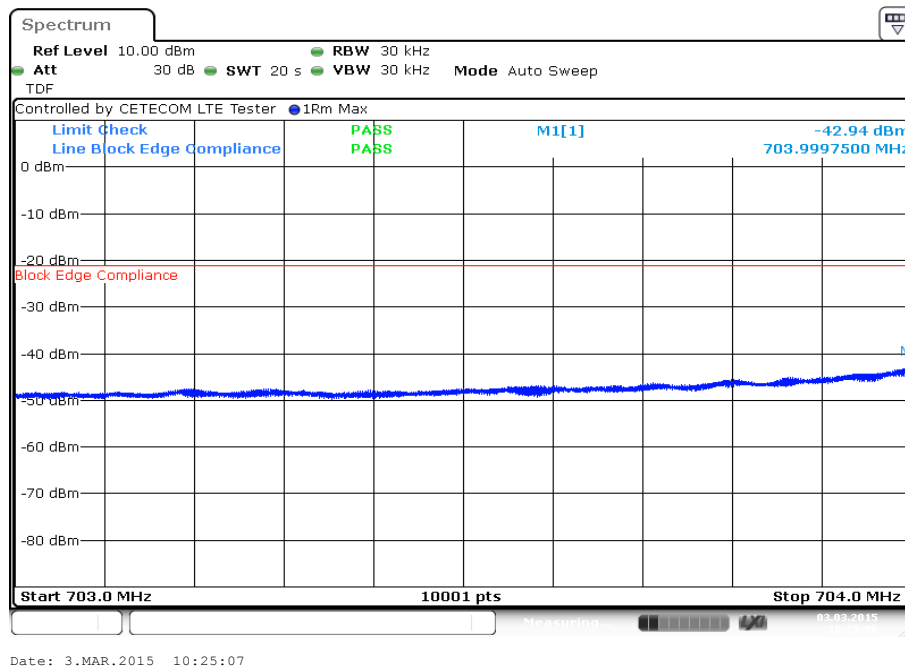
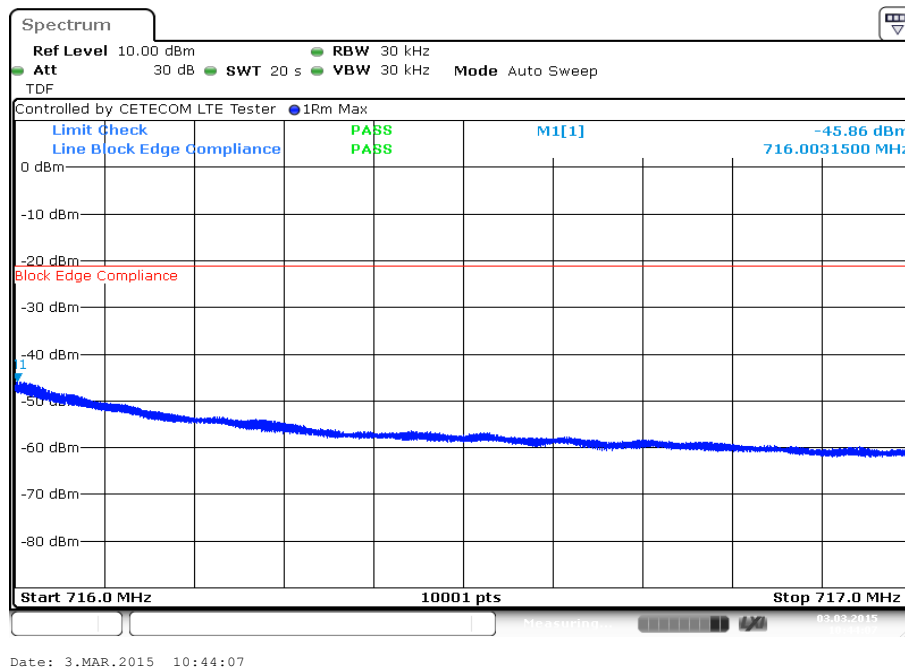
FCC	IC
Block Edge Compliance	
Part 27.53 specifies that “the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.” However, in publication number 890810, The FCC Office of Engineering 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 [$10 \log(30\text{kHz}/100\text{kHz}) = -5.2288$]. When this adjustment is applied to the limit, the limit becomes -18.2288.	
-18.23 dBm	

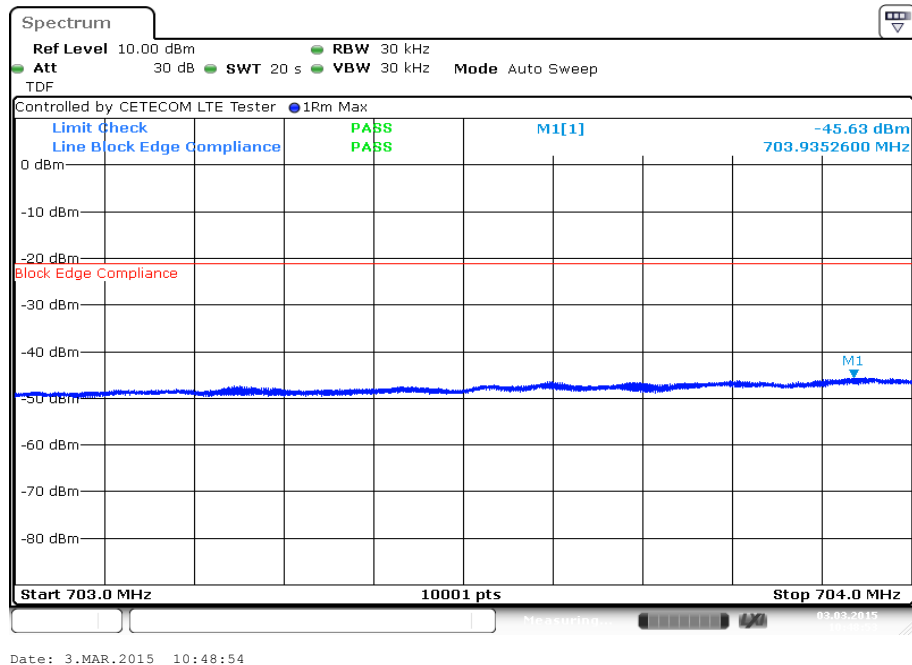
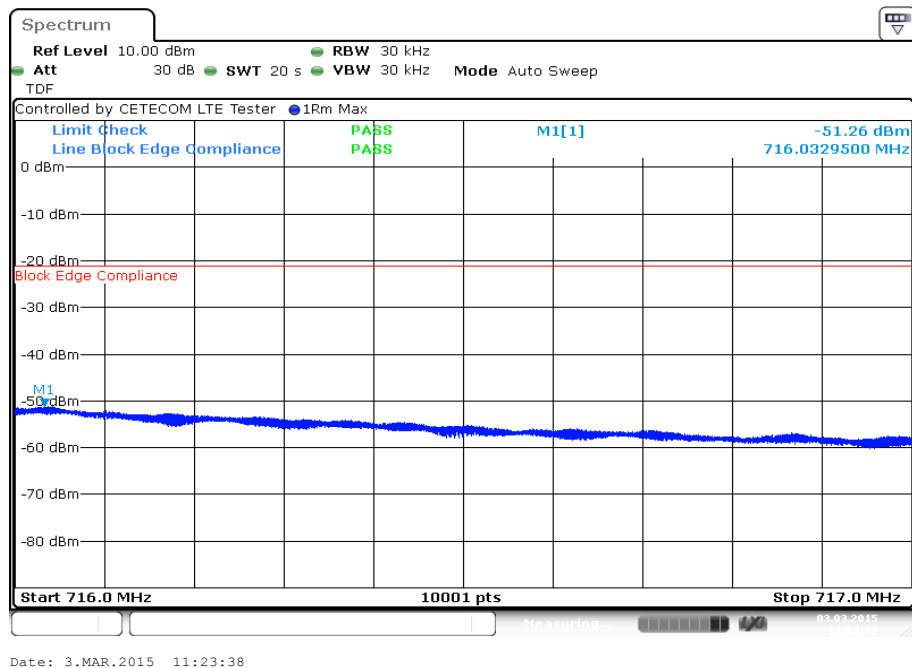
The limit line in the plots is the over all LTE bands and channel bandwidths worst case -21.24 dBm.

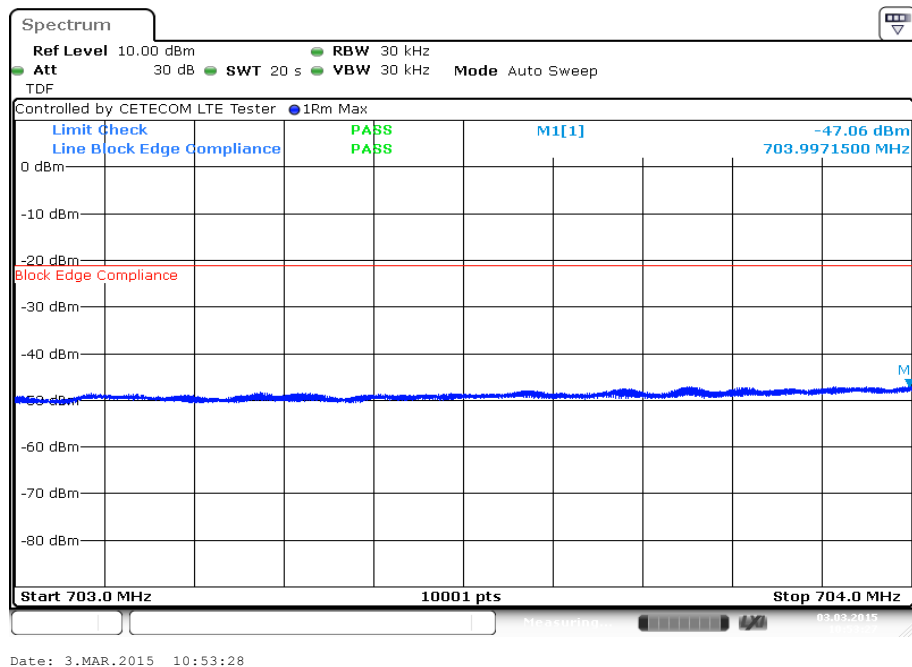
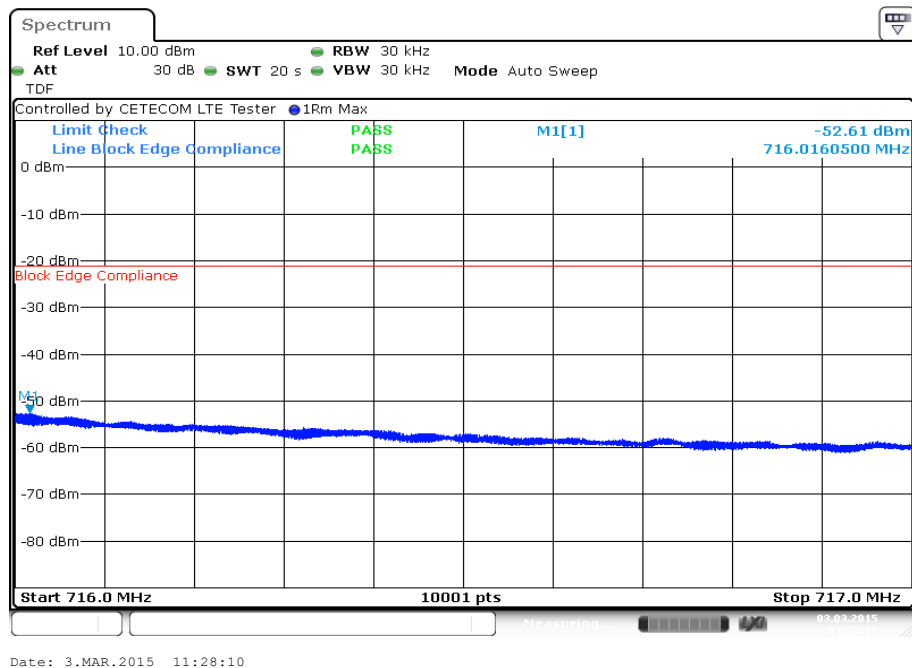
Used setup acc. chapter 8.1.2.

Used equipment see table chapter 9

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****Verdict: complies**

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 (Lab/Item).

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	Ve	20.01.2015	20.01.2018
2	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vKl!	08.05.2013	08.05.2015
3	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev		
4	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne		
5	90	Active Loop Antenna 10 kHz to 30 MHz	6502	Kontron Psychotech	8905-2342	300000256	k	13.06.2013	13.06.2015
6	90	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne		
7	90	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vKl!	29.10.2014	29.10.2017
8	90	MXE EMI Receiver 20 Hz to 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	13.03.2014	13.03.2015
9	11b	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev		
10	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	22.07.2013	22.07.2015
11	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015
12	A029	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	22.01.2015	22.01.2016
13	n. a.	Wideband Radio Communication Tester	CMW500	R&S	102375	300004187	k	28.01.2015	28.01.2017

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
vKl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

10 Observations

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

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2015-03-25
A	New editorial requirements (Canada)	2015-04-28
B	Editorial corrections	2015-06-16

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



Deutsche Akkreditierungsstelle GmbH

Befehle 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 / DC, 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 07.03.2014 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 77 Seiten.

Registrierungsnummer der Urkunde: D-PL-12076-01-00

Frankfurt am Main, 07.03.2014

Date of issue of the Certificate

Im Auftrag der DAkkS
 Anette Spillner

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Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen
 Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAkkS). Ausgenommen davon ist die separate
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 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).
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 erkennen ihre Akkreditierungen gegenseitig an.

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 EA: www.european-accreditation.org
 ILAC: www.ilac.org
 IAF: www.iaf.eu

Note:

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

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