

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

## TEST REPORT

Test report no.: 1-8297/14-04-04-A

Deutsche  
Akkreditierungsstelle  
D-PL-12076-01-00

### Testing laboratory

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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

**peiker acustic GmbH & Co. KG**

Max-Planck Str. 28-32

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

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

### Test Item

**Kind of test item:** Telematic Control Unit**Model name:** ATM-01 R1-RoW-4G**FCC ID:** QWY-ATM-R-132

Frequency: LTE FDD 7: 2502.5 MHz – 2567.5 MHz

Technology tested: LTE

Antenna: External antenna

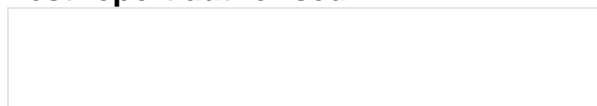
Power supply: 14.0 V DC by external power supply

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:

Andreas Luckenbill  
Lab Manager  
Radio Communications & EMC

### Test performed:

Marco Bertolino  
Lab Manager  
Radio Communications & EMC

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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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**This test report replaces the test report with the number 1-8297/14-04-04-A and dated 2015-04-23**

### 2.2 Application details

Date of receipt of order:	2015-02-23
Date of receipt of test item:	2015-03-17
Start of test:	2015-03-18
End of test:	2015-07-22
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

### 3.1 Measurement guidance

Guidance	Version	Description
ANSI C63.4-2014	-/-	American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American national standard of procedures for compliance testing of unlicensed wireless devices

#### 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	:	Telematic Control Unit
Type identification	:	ATM-01 R1-RoW-4G
S/N serial number	:	Radiated unit: 0000503806 Conducted unit: 0000503803
HW hardware status	:	102.010.010
SW software status	:	001.017.047
Frequency band	:	LTE FDD 7: 2502.5 MHz – 2567.5 MHz
Type of modulation	:	QPSK, 16-QAM
Antenna	:	External antenna
Power supply	:	14.0 V 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: 1-8297/14-04-01\_AnnexA  
1-8297/14-04-01\_AnnexB  
1-8297/14-04-01\_AnnexC

#### 6 Test laboratories sub-contracted

None

## 7 Summary of measurement results

<input checked="" type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input type="checkbox"/>	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	See table!	2015-07-22	-/-

### 7.1 LTE – Band 7

Test Case	temperature conditions	power source voltages	Pass	Fail	NA	NP	Remark
RF Output Power	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Frequency Stability	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Spurious Emissions Radiated	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Spurious Emissions Conducted	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Block Edge Compliance	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
Occupied Bandwidth	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-

**Note:** NA = Not applicable; NP = Not performed

## 8 Description of test setup

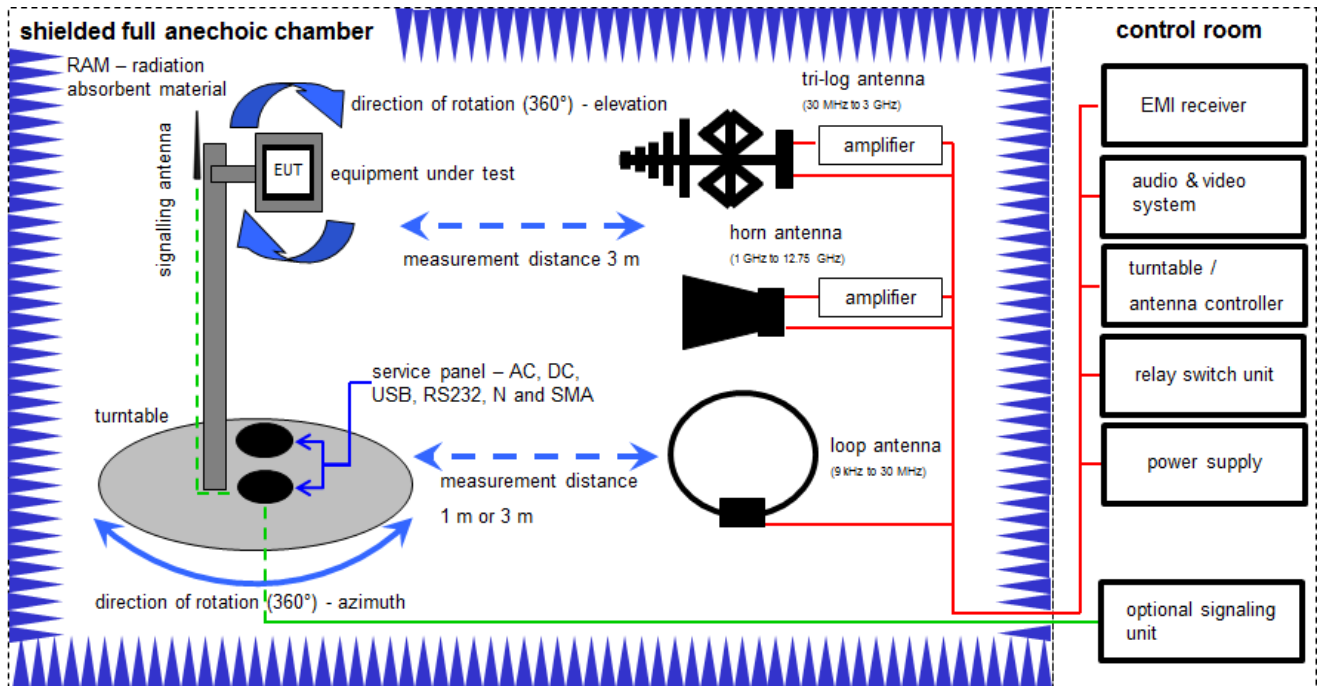
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements 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 analysers 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).

**Agenda:** Kind of Calibration

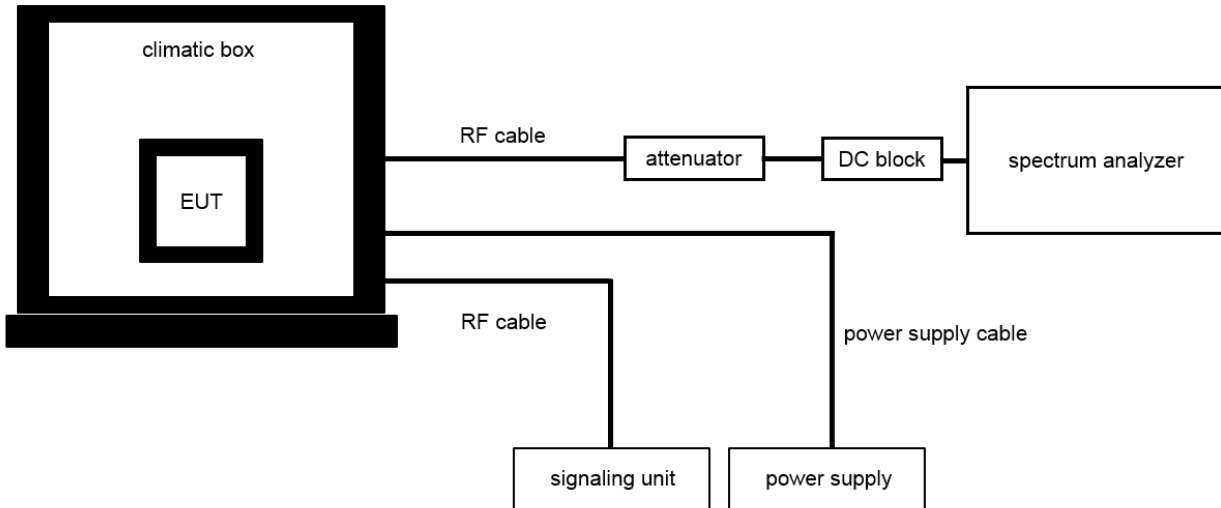
k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
v/k!	Attention: extended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

## 8.1 Shielded fully anechoic chamber



### Equipment table:

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	vIKI!	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	vIKI!	29.10.2014	29.10.2017
8	90	MXE EMI Receiver 20 Hz to 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	06.03.2015	06.03.2016
9	n. a.	Wideband Radio Communication Tester	CMW500	R&S	116854	300004625	k	29.01.2014	29.01.2016
10	11b	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev		
11	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	22.07.2013	22.07.2015
12	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015

**8.2 Conducted measurements normal and extreme conditions****Conducted measurements normal & extreme conditions**

$$OP = AV + CA$$

(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:

$$OP \text{ [dBm]} = 6.0 \text{ [dBm]} + (11.7) \text{ [dB]} = 17.7 \text{ [dBm]} (58.88 \text{ mW})$$

**Equipment table:**

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A029	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	22.01.2015	22.01.2016
2	n. a.	Wideband Radio Communication Tester	CMW500	R&S	116854	300004625	k	29.01.2014	29.01.2016
3	n. a.	Power Supply 0-20V; 0-5A	6632B	HP	US37478366	400000117	vIKII	20.01.2015	20.01.2017
4	n. a.	Temperature Test Chamber	VT 4002	Heraeus Voetsch	521/83761	300002326	Ve	26.09.2013	26.09.2015



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

	Band 7
[MHz]	
1.4	<input type="checkbox"/>
3	<input type="checkbox"/>
5	<input checked="" type="checkbox"/>
10	<input checked="" type="checkbox"/>
15	<input checked="" type="checkbox"/>
20	<input checked="" type="checkbox"/>

**Antenna**

SISO	<input type="checkbox"/>
SIMO	<input type="checkbox"/>
MISO	<input checked="" type="checkbox"/>
MIMO	<input type="checkbox"/>

## 10 Test Results

### 10.1 Results LTE – Band 7

The EUT was set to transmit the maximum power.

#### 10.1.1 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 difference between the measured peak and average value is calculated.

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
Used test setup:	see chapter 8.2

##### Limits:

FCC
AVG: 33 dBm
Max Output Power
In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

**Results:**

Output Power (conducted)								
Bandwidth (MHz)	Frequency (MHz)	Resource block allocation	Average Output Power (dBm) QPSK	Peak Output Power (dBm) QPSK	Peak to Average Ratio (dB)	Average Output Power (dBm) 16-QAM	Peak Output Power (dBm) 16-QAM	Peak to Average Ratio (dB)
5	2502.5	1 RB low	23.4	28.8	5.38	22.3	27.4	5.14
		1 RB high	23.4	28.9	5.46	22.4	27.6	5.20
		50% RB mid	22.2	28.4	6.21	21.3	28.1	6.77
		100% RB	22.2	28.5	6.30	21.3	28.6	7.29
	2535	1 RB low	23.6	30.3	6.65	22.3	27.8	5.45
		1 RB high	23.5	30.2	6.66	22.3	27.8	5.49
		50% RB mid	22.5	29.7	7.19	21.5	28.1	6.59
		100% RB	22.4	30.5	8.09	21.4	28.2	6.78
	2567.5	1 RB low	23.9	28.7	4.83	22.6	29.0	6.40
		1 RB high	23.3	28.3	4.96	22.1	28.7	6.57
		50% RB mid	22.4	28.5	6.09	21.5	28.7	7.18
		100% RB	22.4	28.5	6.14	21.4	28.9	7.49
10	2505	1 RB low	23.3	29.3	6.03	22.4	27.8	5.38
		1 RB high	23.5	29.6	6.05	22.5	27.9	5.38
		50% RB mid	22.1	29.6	7.47	21.2	27.8	6.61
		100% RB	22.1	29.8	7.67	21.1	27.7	6.64
	2535	1 RB low	23.3	28.5	5.20	22.0	28.5	6.48
		1 RB high	23.4	28.6	5.18	22.0	28.5	6.50
		50% RB mid	22.4	29.2	6.84	21.5	29.7	8.21
		100% RB	22.2	29.1	6.88	21.3	28.9	7.64
	2565	1 RB low	23.7	30.2	6.47	22.4	27.4	4.95
		1 RB high	23.2	29.9	6.74	22.0	27.1	5.13
		50% RB mid	22.6	30.2	7.64	21.7	28.0	6.34
		100% RB	22.4	29.8	7.44	21.4	27.9	6.48
15	2507.5	1 RB low	23.3	28.7	5.36	22.4	28.4	6.01
		1 RB high	23.5	28.9	5.38	22.6	28.6	6.02
		50% RB mid	22.0	28.7	6.73	21.2	29.1	7.87
		100% RB	22.0	28.9	6.86	21.1	28.6	7.48
	2535	1 RB low	23.3	30.6	7.29	22.5	28.1	5.60
		1 RB high	23.5	30.7	7.19	22.7	28.1	5.36
		50% RB mid	22.3	30.5	8.19	21.2	27.9	6.71
		100% RB	22.2	29.9	7.73	21.1	27.9	6.76
	2562.5	1 RB low	23.7	28.6	4.92	22.3	28.8	6.53
		1 RB high	23.1	28.3	5.16	21.8	28.6	6.78
		50% RB mid	22.4	28.8	6.38	21.6	29.1	7.47
		100% RB	22.3	29.2	6.94	21.3	28.9	7.63

20	2510	1 RB low	23.3	30.0	6.71	22.4	27.7	5.30
		1 RB high	23.4	30.1	6.74	22.6	28.0	5.39
		50% RB mid	22.1	30.1	7.98	21.1	27.8	6.73
		100% RB	22.1	29.6	7.54	21.2	28.1	6.88
	2535	1 RB low	23.4	29.1	5.68	22.4	29.0	6.60
		1 RB high	23.6	29.2	5.56	22.8	29.1	6.31
		50% RB mid	22.2	29.3	7.09	21.2	29.3	8.08
		100% RB	22.2	29.2	7.01	21.2	28.8	7.63
	2560	1 RB low	23.7	28.9	5.15	22.7	28.1	5.38
		1 RB high	23.3	28.6	5.27	22.4	27.9	5.51
		50% RB mid	22.5	30.1	7.58	21.6	28.2	6.59
		100% RB	22.5	30.0	7.47	21.6	28.1	6.48
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	2502.5	22.4	21.4
	2535	21.6	20.3
	2567.5	22.6	21.3
10	2505	22.5	21.5
	2535	21.4	20.0
	2565	22.4	21.1
15	2507.5	22.5	21.6
	2535	21.5	20.7
	2562.5	22.4	21.0
20	2510	22.4	21.6
	2535	21.6	20.8
	2560	22.4	21.4
Measurement uncertainty		± 3.0 dB	

**Verdict:** [complies](#)

### 10.1.2 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  $V_{max}$ . 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:	
Used test setup:	see chapter 8.2

#### Limits:

FCC
Frequency Stability
< 2.5 ppm

**Results:****FREQ ERROR versus VOLTAGE**

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
4.5	31	0.00000122	0.0122
4.8	28	0.00000110	0.0110
8.0	19	0.00000075	0.0075
14.0	21	0.00000083	0.0083
18.0	12	0.00000047	0.0047

**FREQ ERROR versus TEMPERATURE**

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	14	0.00000055	0.0055
-20	16	0.00000063	0.0063
-10	16	0.00000063	0.0063
± 0	37	0.00000146	0.0146
10	36	0.00000142	0.0142
20	32	0.00000126	0.0126
30	13	0.00000051	0.0051
40	13	0.00000051	0.0051
50	22	0.00000087	0.0087
60	14	0.00000055	0.0055

**Verdict:** [complies](#)

### 10.1.3 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 C63.4-2014 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 2569.3 MHz. This was rounded up to 26 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 7.

- a) The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna. For measurements above 1 GHz the EUT is placed on a 1.5 meter high stand.
- b) The antenna output was terminated in a 50 ohm load (if possible).
- c) A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- d) Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded. The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters.
- e) Now each detected emissions were substituted by the substitution method, in accordance with the TIA/EIA 603.

#### Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 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
Used test setup:	see chapter 8.1

#### Limits:

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



**Results:**

Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the LTE band 7. 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 7 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.

10 MHz is used to show a combination of high output power and wide signal. If there is any emission detected, also the setup with the highest output power will be measured.

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

The bandedges are special investigated with a lower bandwidth and integrated over 1 MHz with the channel power function of the spectrum analyser. All emissions of the module at the band edges are below -13dBm.

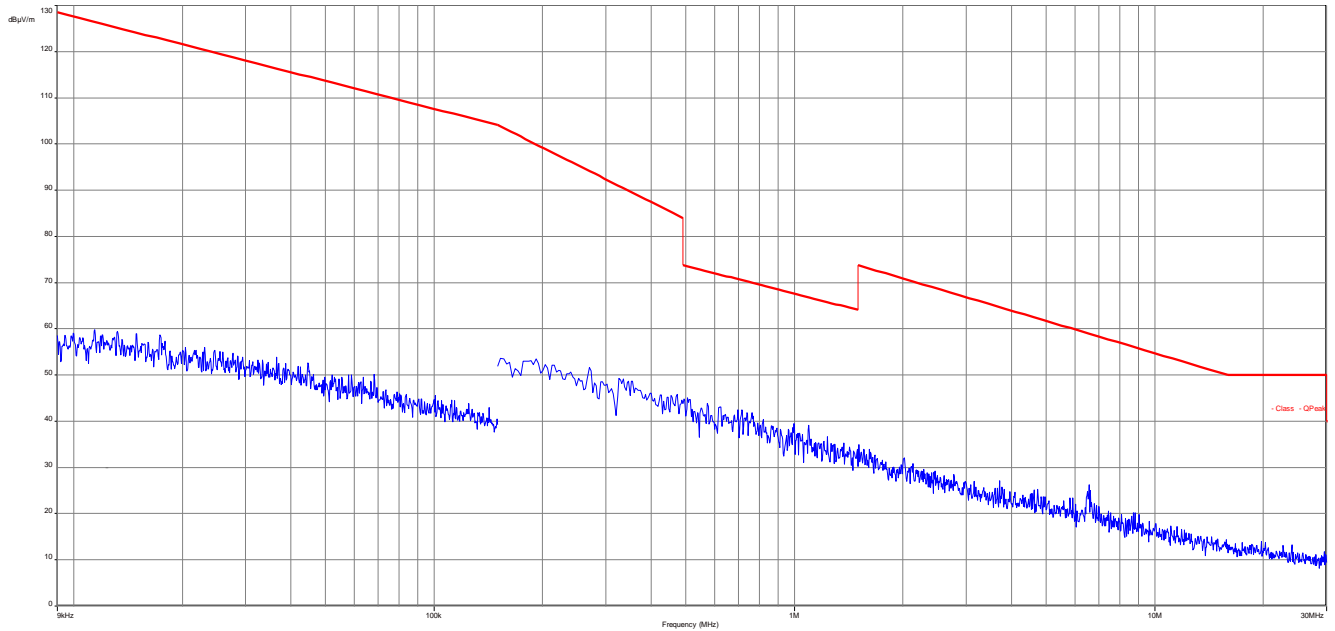
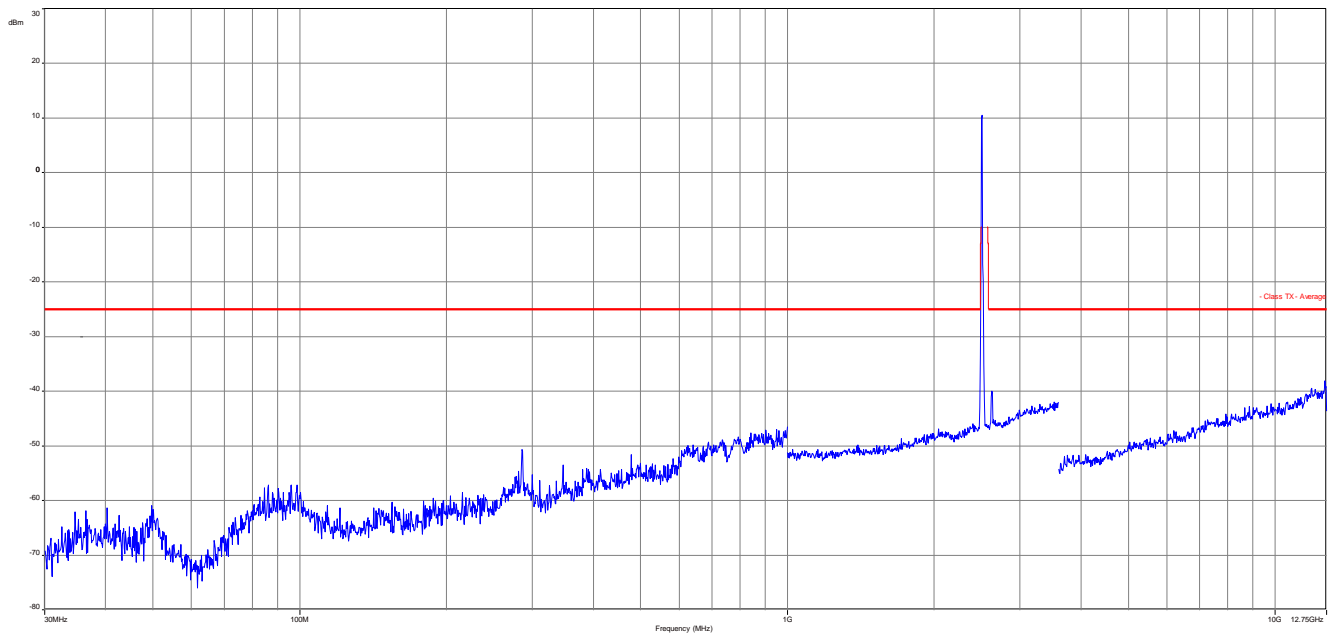
**QPSK**

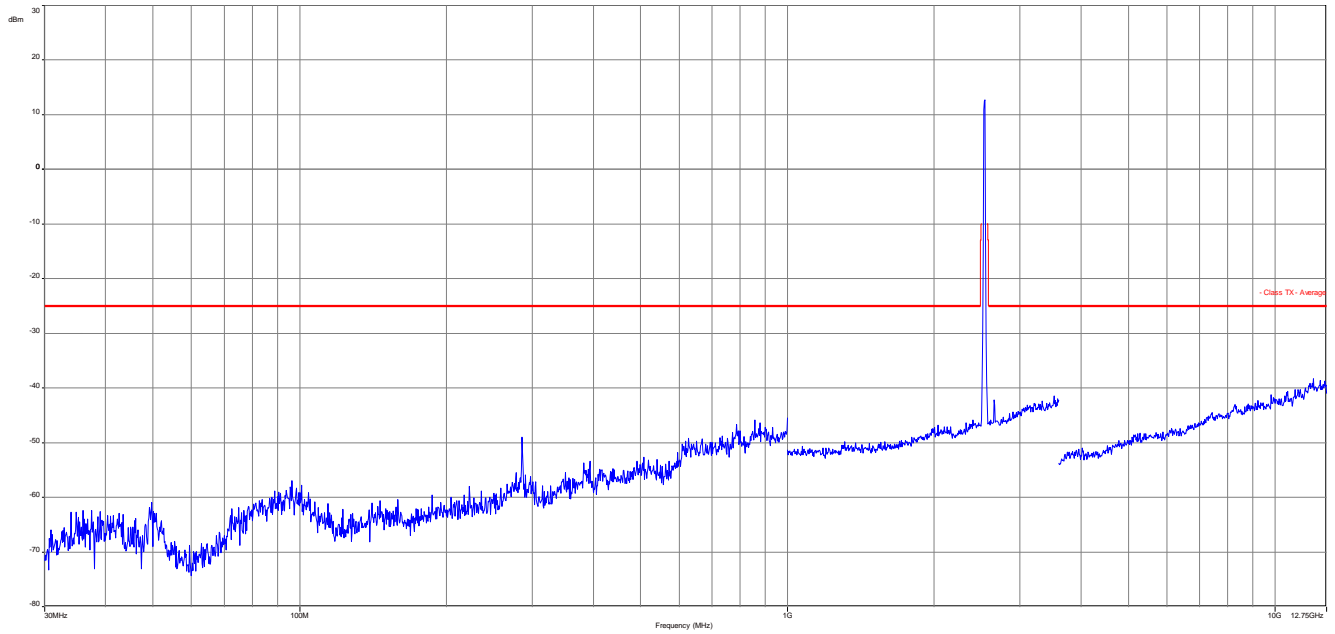
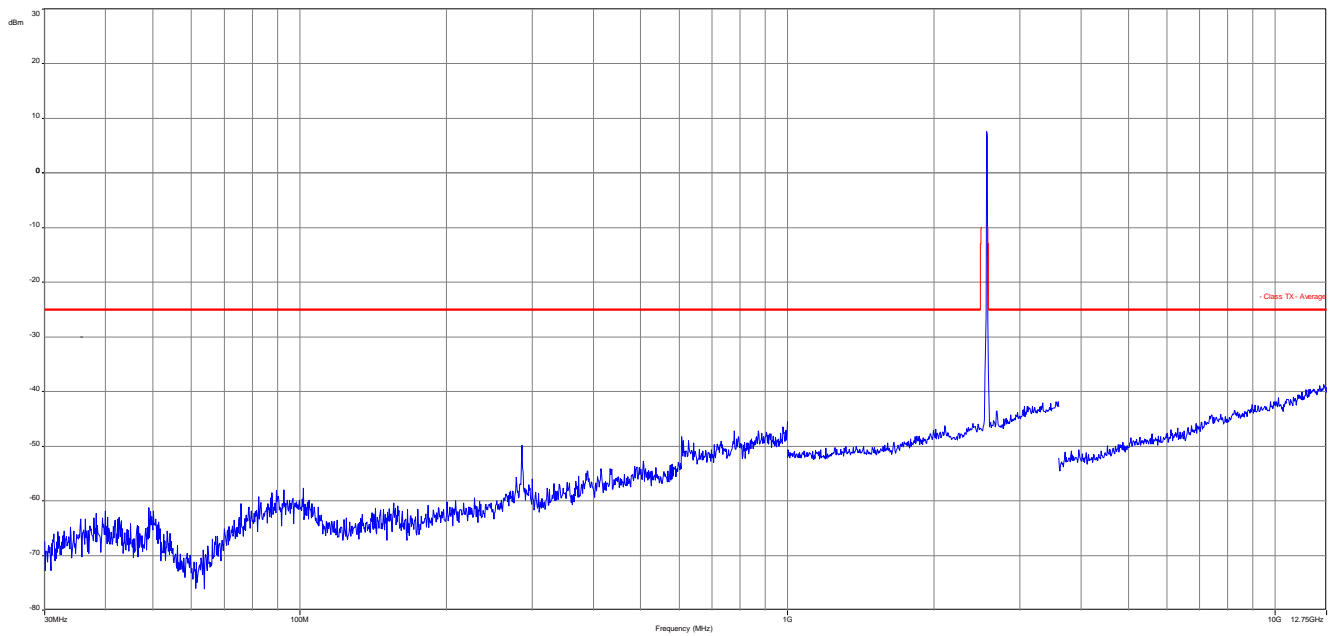
Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
5010.0	-	5070.0	-	5130.0	-
7515.0	-	7605.0	-	7695.0	-
10020.0	-	10140.0	-	10260.0	-
12525.0	-	12675.0	-	12825.0	-
15030.0	-	15210.0	-	15390.0	-
17535.0	-	17745.0	-	17955.0	-
20040.0	-	20280.0	-	20520.0	-
22545.0	-	22815.0	-	23085.0	-
25050.0	-	25350.0	-	25650.0	-
Measurement uncertainty			± 3dB		

**16-QAM**

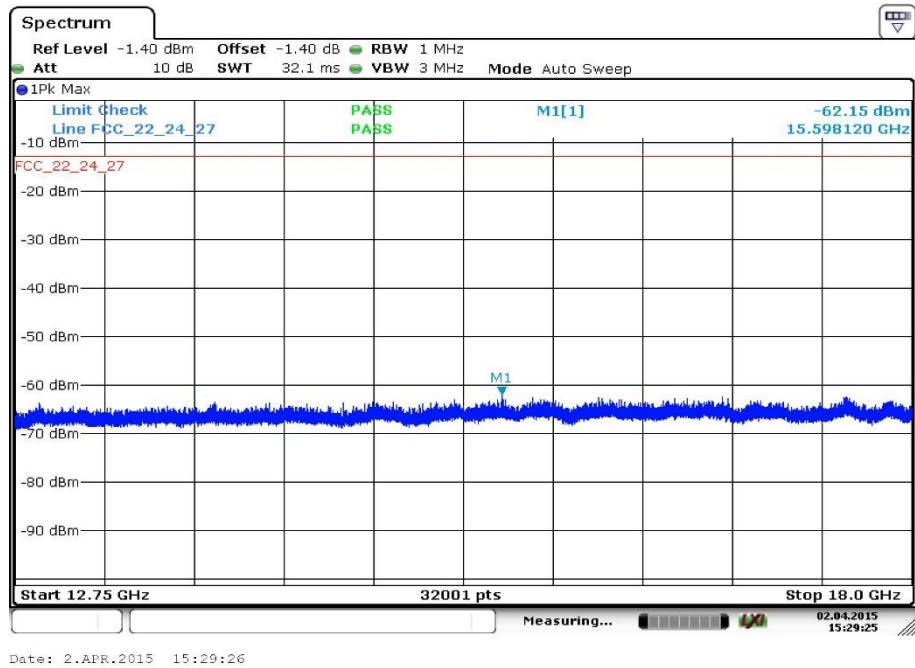
Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
5010.0	-	5070.0	-	5130.0	-
7515.0	-	7605.0	-	7695.0	-
10020.0	-	10140.0	-	10260.0	-
12525.0	-	12675.0	-	12825.0	-
15030.0	-	15210.0	-	15390.0	-
17535.0	-	17745.0	-	17955.0	-
20040.0	-	20280.0	-	20520.0	-
22545.0	-	22815.0	-	23085.0	-
25050.0	-	25350.0	-	25650.0	-
Measurement uncertainty			± 3dB		

**Verdict:** [complies](#)

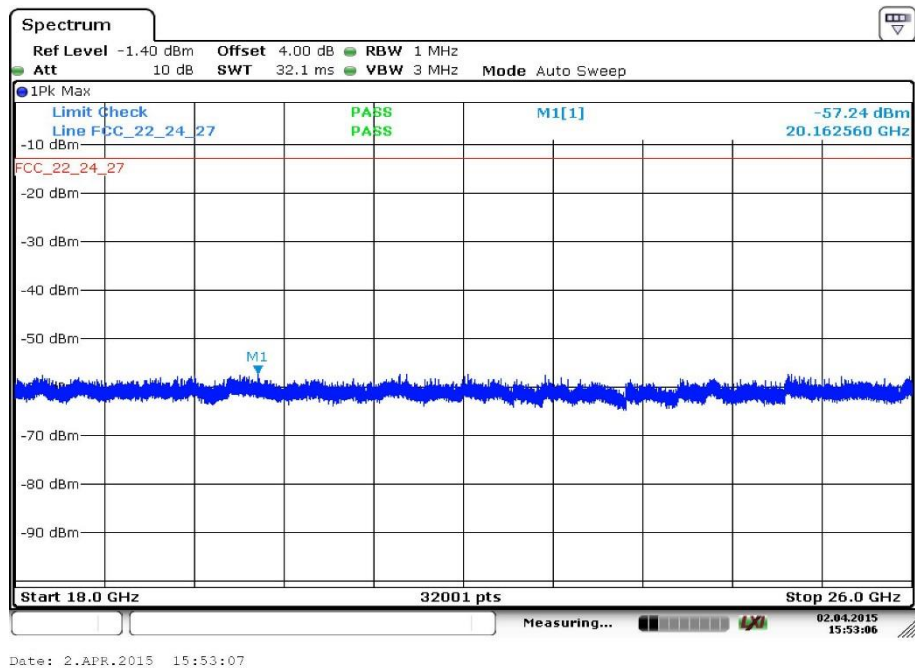
**QPSK with 10 MHz channel bandwidth****Plot 1: Middle channel, up to 30 MHz****Plot 2: Lowest channel, 30 MHz to 12.75 GHz**

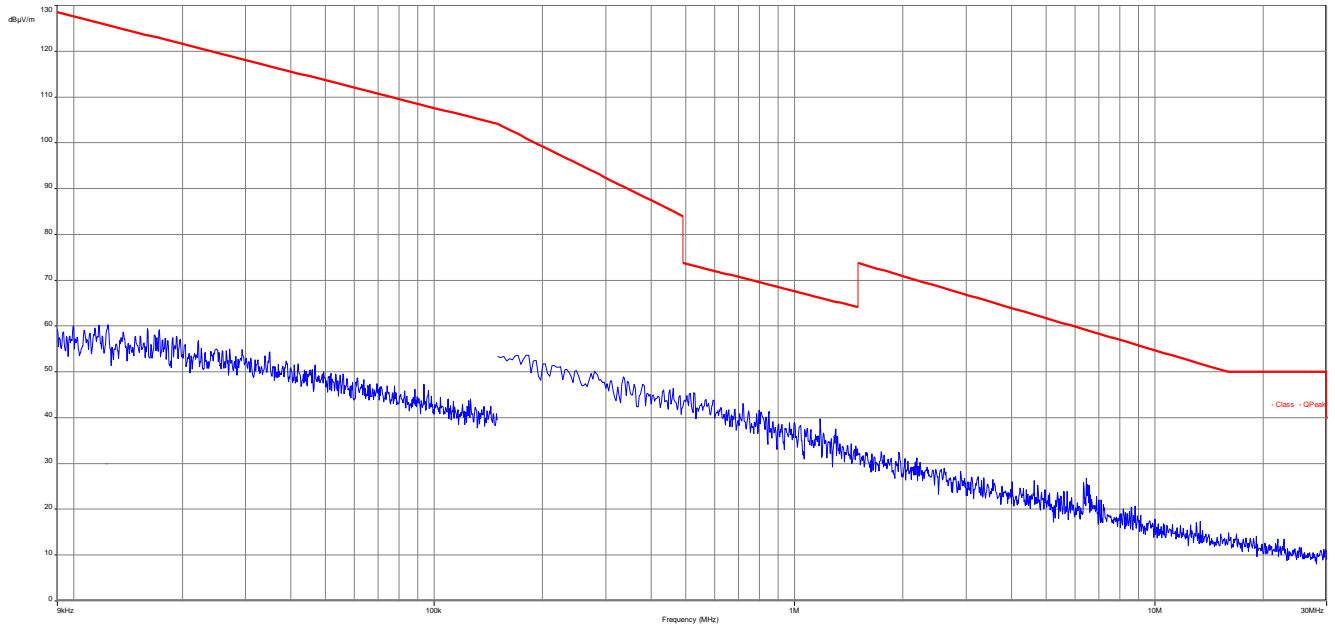
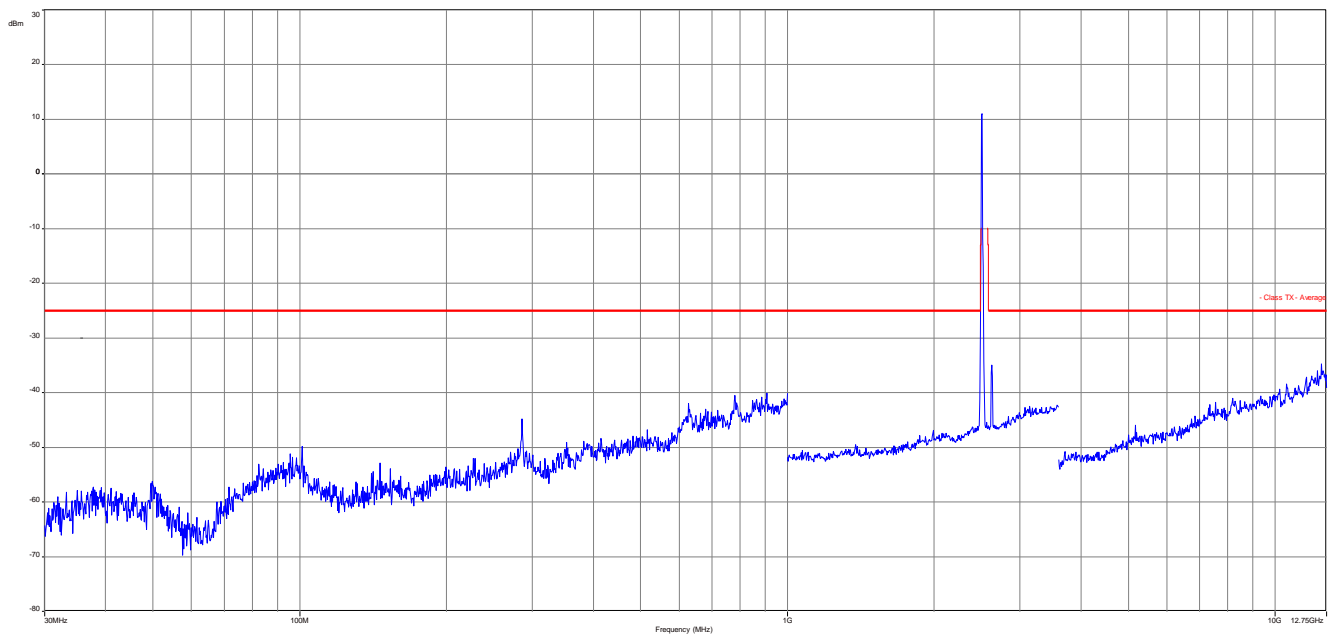
**Plot 3: Middle channel, 30 MHz to 12.75 GHz****Plot 4: Highest channel, 30 MHz to 12.75 GHz**

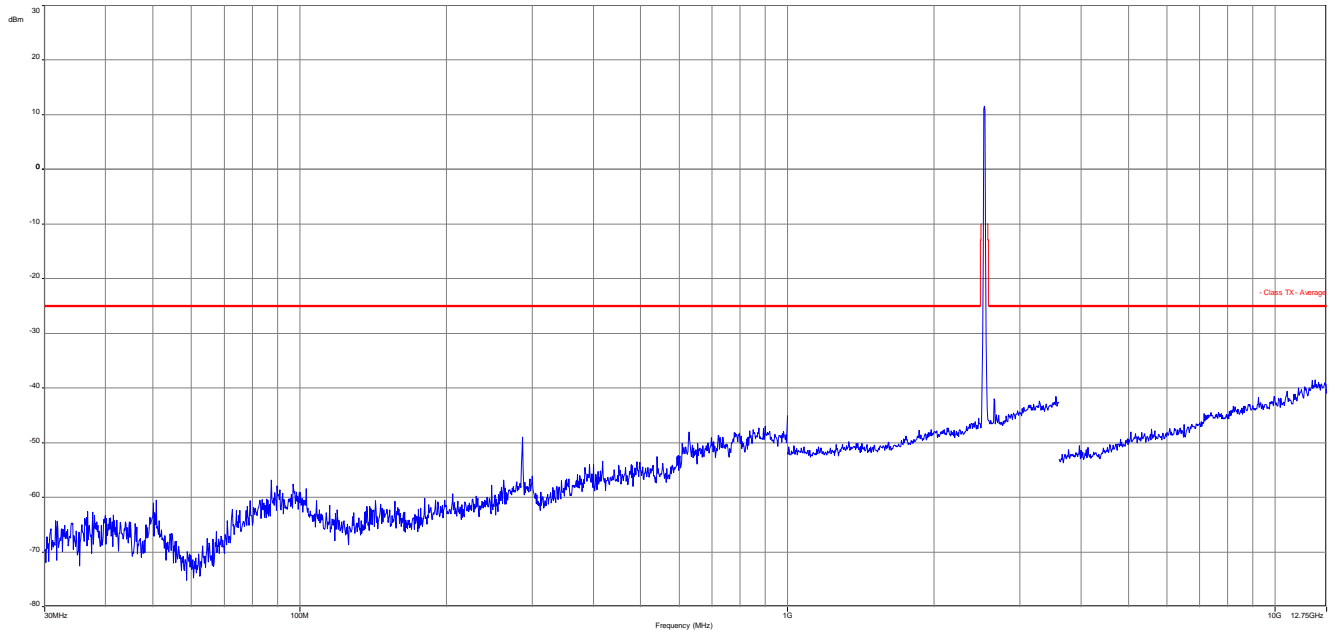
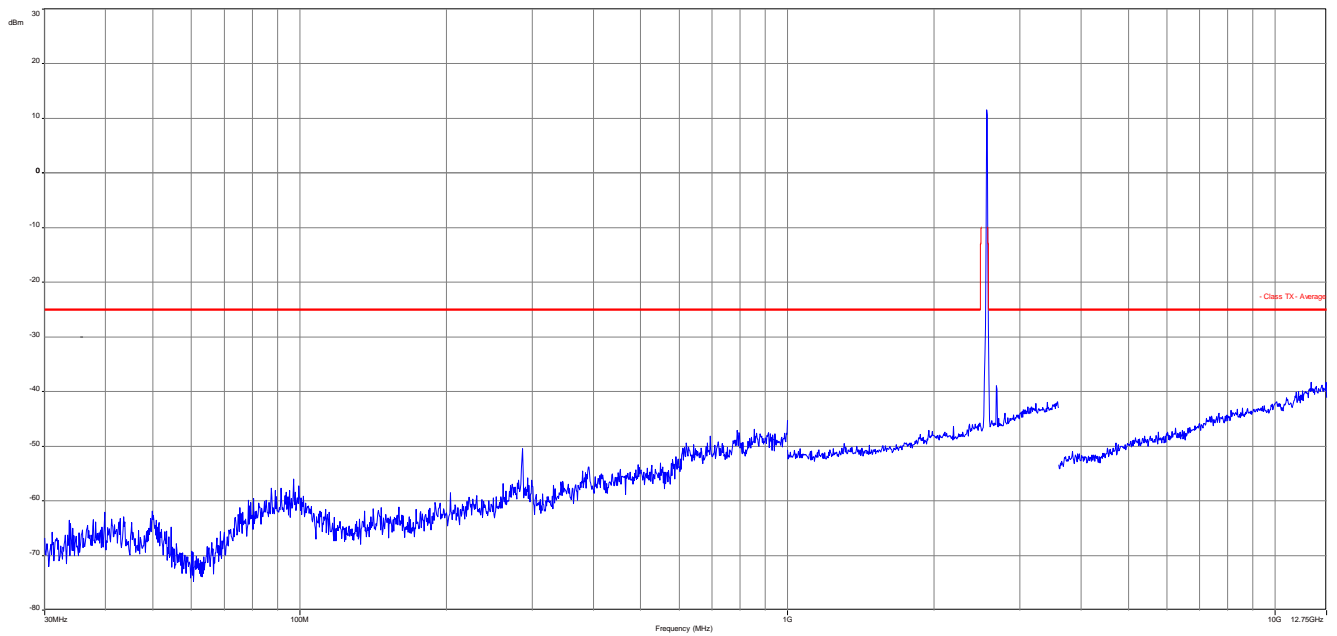
Plot 5: Middle channel, 12.75 GHz to 18 GHz



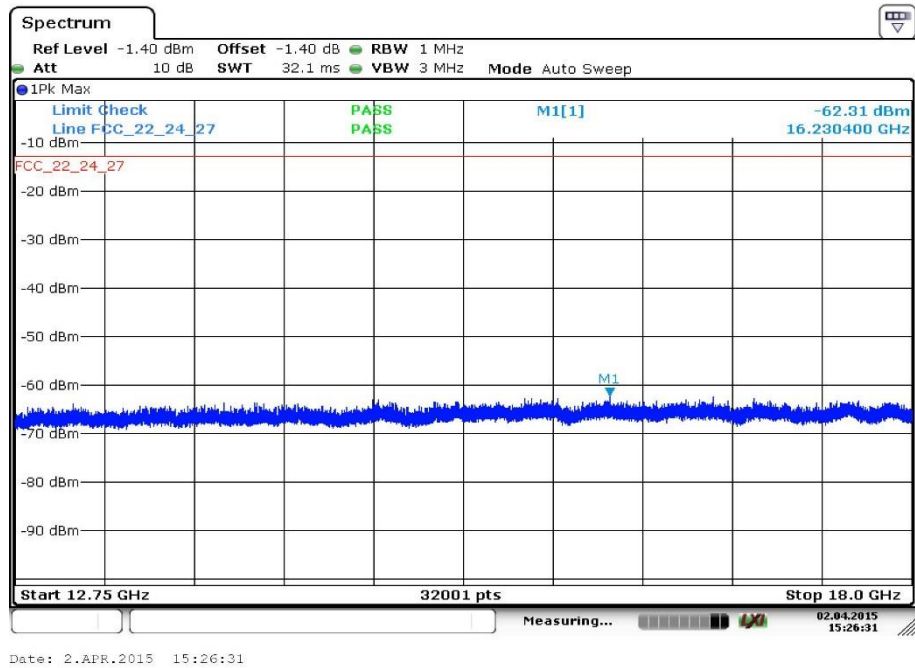
Plot 6: Middle channel, 18 GHz to 26 GHz



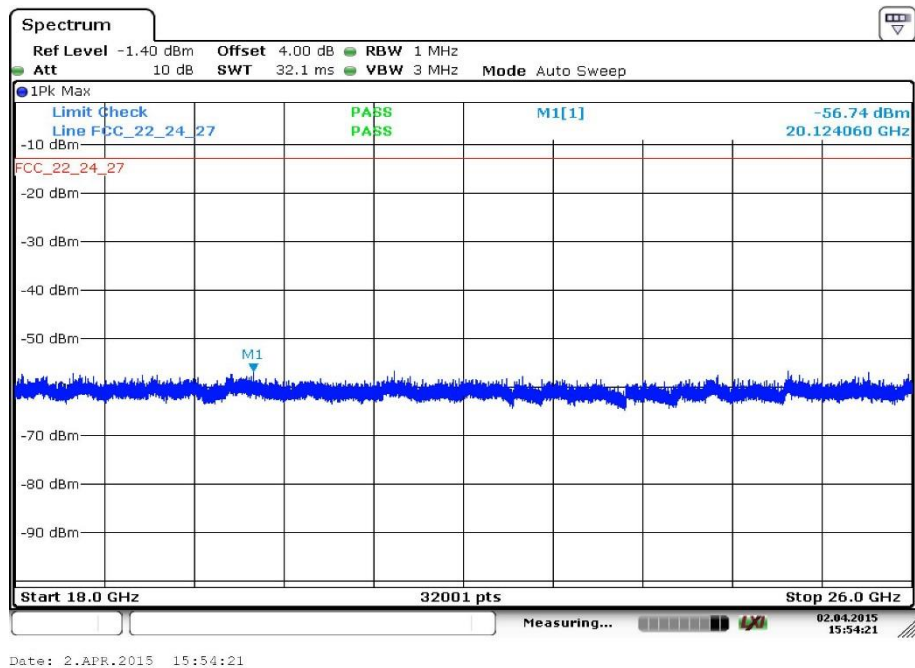
**16-QAM with 10 MHz channel bandwidth****Plot 7: Middle channel, up to 30 MHz****Plot 8: Low channel, 30 MHz to 12.75 GHz**

**Plot 9: Middle channel, 30 MHz to 12.75 GHz****Plot 10: Highest channel, 30 MHz to 12.75 GHz**

Plot 11: Middle channel, 12.75 GHz to 18 GHz



Plot 12: Middle channel, 18 GHz to 26 GHz





#### 10.1.4 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.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

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:	Peak
Sweep time:	Auto
Video bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Resolution bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Span:	10 MHz – 25 GHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.1

##### Limits:

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

**Results:** for 5 MHz channel bandwidth

**QPSK**

Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
5005.0	-	5070.0	-	5135.0	-
7507.5	-	7605.0	-	7702.5	-
10010.0	-	10140.0	-	10270.0	-
12512.5	-	12675.0	-	12837.5	-
15015.0	-	15210.0	-	15405.0	-
17517.5	-	17745.0	-	17972.5	-
20020.0	-	20280.0	-	20540.0	-
22522.5	-	22815.0	-	23107.5	-
25025.0	-	25350.0	-	25675.0	-
Measurement uncertainty			± 3dB		

**16-QAM**

Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
5005.0	-	5070.0	-	5135.0	-
7507.5	-	7605.0	-	7702.5	-
10010.0	-	10140.0	-	10270.0	-
12512.5	-	12675.0	-	12837.5	-
15015.0	-	15210.0	-	15405.0	-
17517.5	-	17745.0	-	17972.5	-
20020.0	-	20280.0	-	20540.0	-
22522.5	-	22815.0	-	23107.5	-
25025.0	-	25350.0	-	25675.0	-
Measurement uncertainty			± 3dB		

**Verdict:** [complies](#)

**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]
5010.0	-	5070.0	-	5130.0	-
7515.0	-	7605.0	-	7695.0	-
10020.0	-	10140.0	-	10260.0	-
12525.0	-	12675.0	-	12825.0	-
15030.0	-	15210.0	-	15390.0	-
17535.0	-	17745.0	-	17955.0	-
20040.0	-	20280.0	-	20520.0	-
22545.0	-	22815.0	-	23085.0	-
25050.0	-	25350.0	-	25650.0	-
Measurement uncertainty			± 3dB		

**16-QAM**

Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
5010.0	-	5070.0	-	5130.0	-
7515.0	-	7605.0	-	7695.0	-
10020.0	-	10140.0	-	10260.0	-
12525.0	-	12675.0	-	12825.0	-
15030.0	-	15210.0	-	15390.0	-
17535.0	-	17745.0	-	17955.0	-
20040.0	-	20280.0	-	20520.0	-
22545.0	-	22815.0	-	23085.0	-
25050.0	-	25350.0	-	25650.0	-
Measurement uncertainty			± 3dB		

**Verdict:** **complies**

**Results:** for 15 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]
5015.0	-	5070.0	-	5125.0	-
7522.5	-	7605.0	-	7687.5	-
10030.0	-	10140.0	-	10250.0	-
12537.5	-	12675.0	-	12812.5	-
15045.0	-	15210.0	-	15375.0	-
17552.5	-	17745.0	-	17937.5	-
20060.0	-	20280.0	-	20500.0	-
22567.5	-	22815.0	-	23062.5	-
25075.0	-	25350.0	-	25625.0	-
Measurement uncertainty			± 3dB		

**16-QAM**

Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
5015.0	-	5070.0	-	5125.0	-
7522.5	-	7605.0	-	7687.5	-
10030.0	-	10140.0	-	10250.0	-
12537.5	-	12675.0	-	12812.5	-
15045.0	-	15210.0	-	15375.0	-
17552.5	-	17745.0	-	17937.5	-
20060.0	-	20280.0	-	20500.0	-
22567.5	-	22815.0	-	23062.5	-
25075.0	-	25350.0	-	25625.0	-
Measurement uncertainty			± 3dB		

**Verdict:** [complies](#)

**Results:** for 20 MHz channel bandwidth

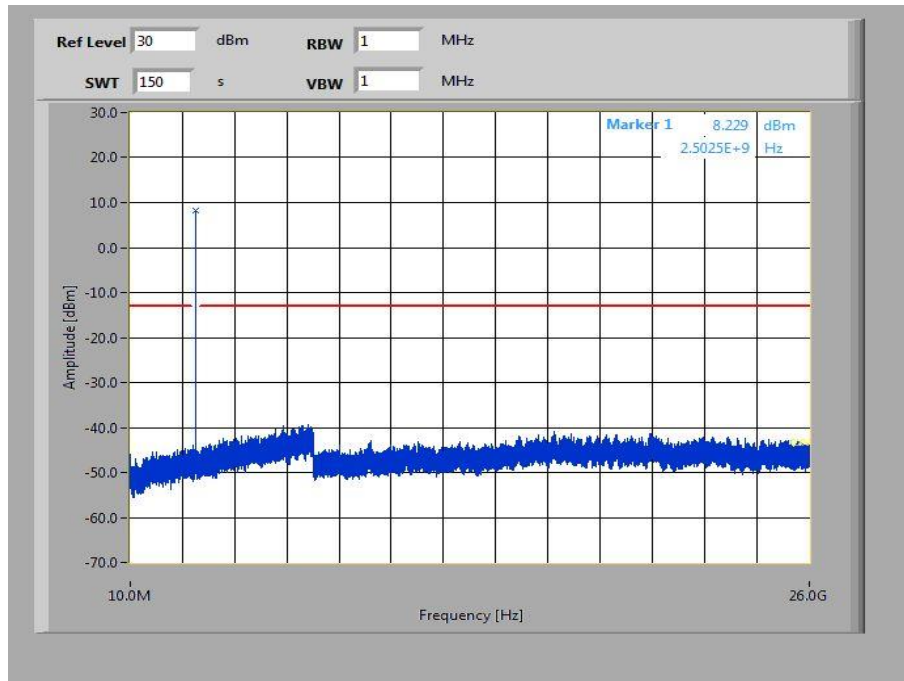
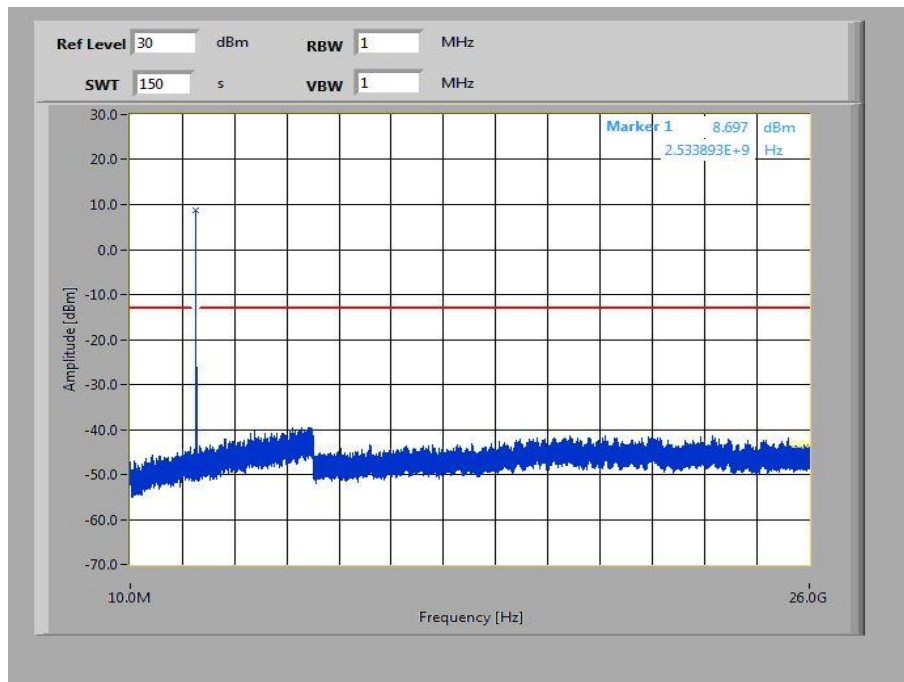
**QPSK**

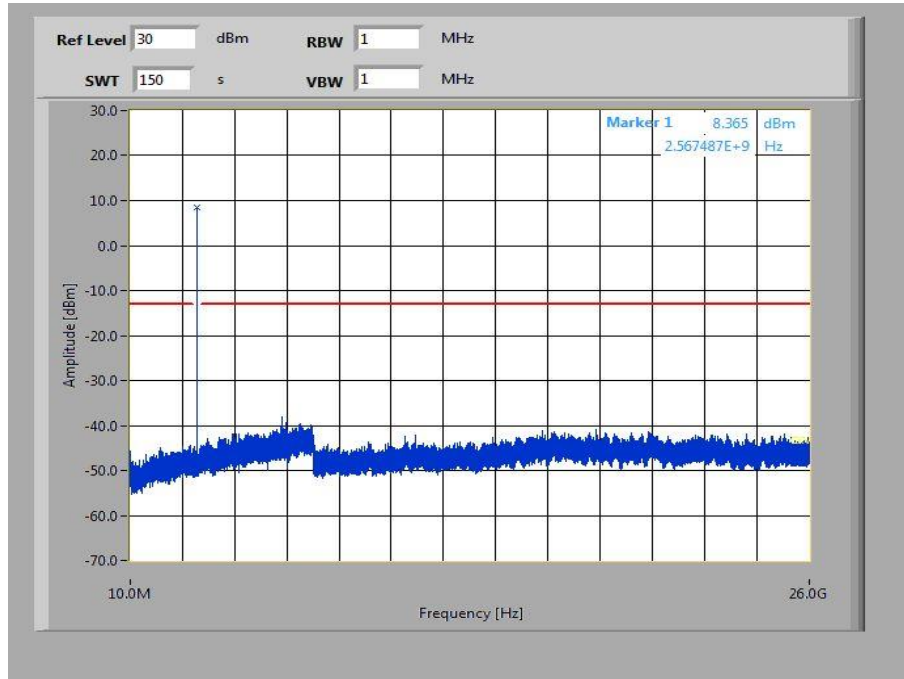
Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
5020.0	-	5070.0	-	5120.0	-
7530.0	-	7605.0	-	7680.0	-
10040.0	-	10140.0	-	10240.0	-
12550.0	-	12675.0	-	12800.0	-
15060.0	-	15210.0	-	15360.0	-
17570.0	-	17745.0	-	17920.0	-
20080.0	-	20280.0	-	20480.0	-
22590.0	-	22815.0	-	23040.0	-
25100.0	-	25350.0	-	25600.0	-
Measurement uncertainty			± 3dB		

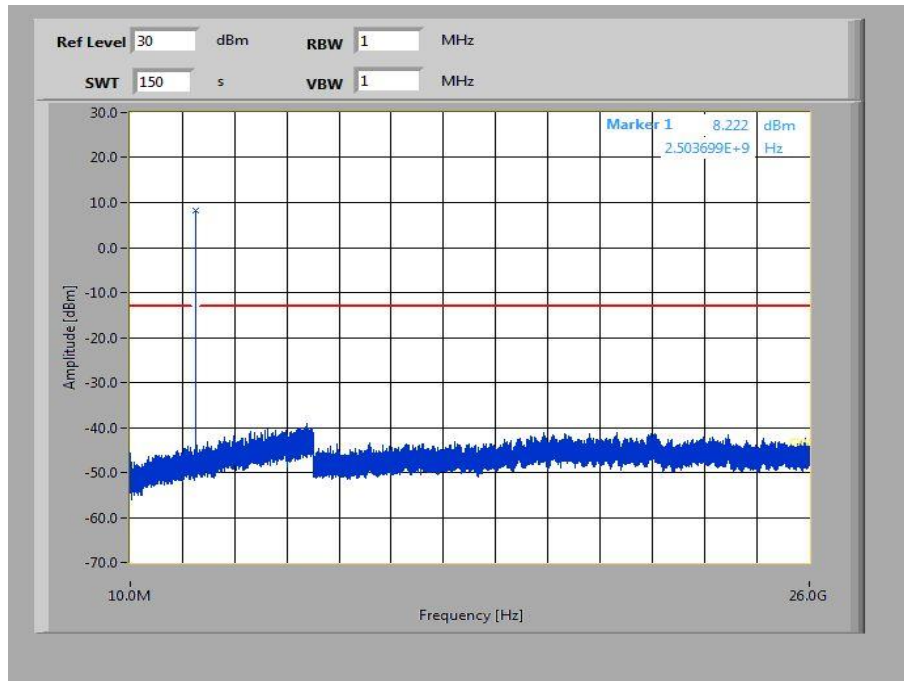
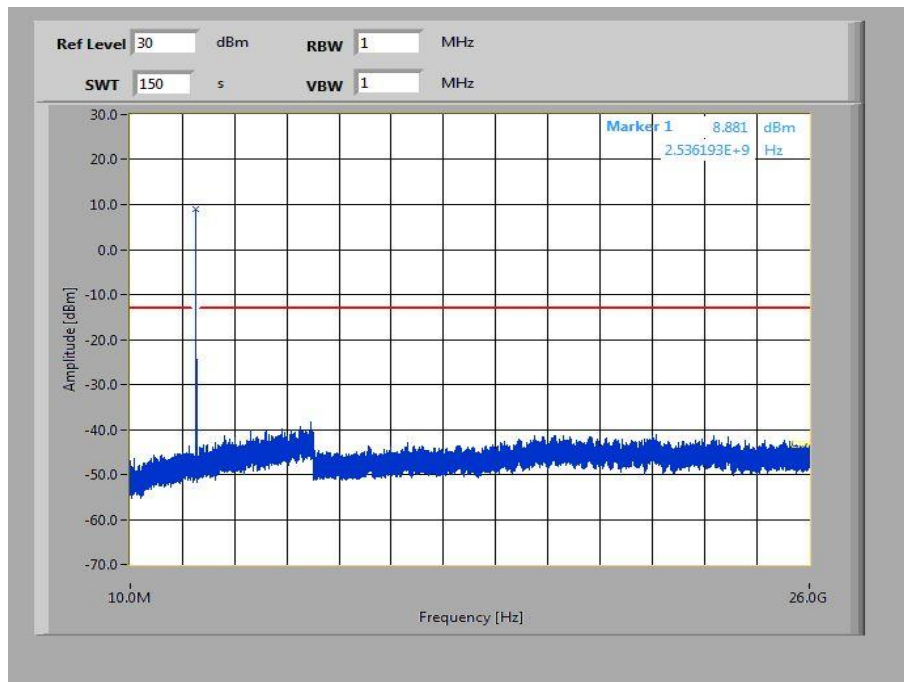
**16-QAM**

Spurious Emission Level (dBm)					
Lowest channel		Middle channel		Highest channel	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
5020.0	-	5070.0	-	5120.0	-
7530.0	-	7605.0	-	7680.0	-
10040.0	-	10140.0	-	10240.0	-
12550.0	-	12675.0	-	12800.0	-
15060.0	-	15210.0	-	15360.0	-
17570.0	-	17745.0	-	17920.0	-
20080.0	-	20280.0	-	20480.0	-
22590.0	-	22815.0	-	23040.0	-
25100.0	-	25350.0	-	25600.0	-
Measurement uncertainty			± 3dB		

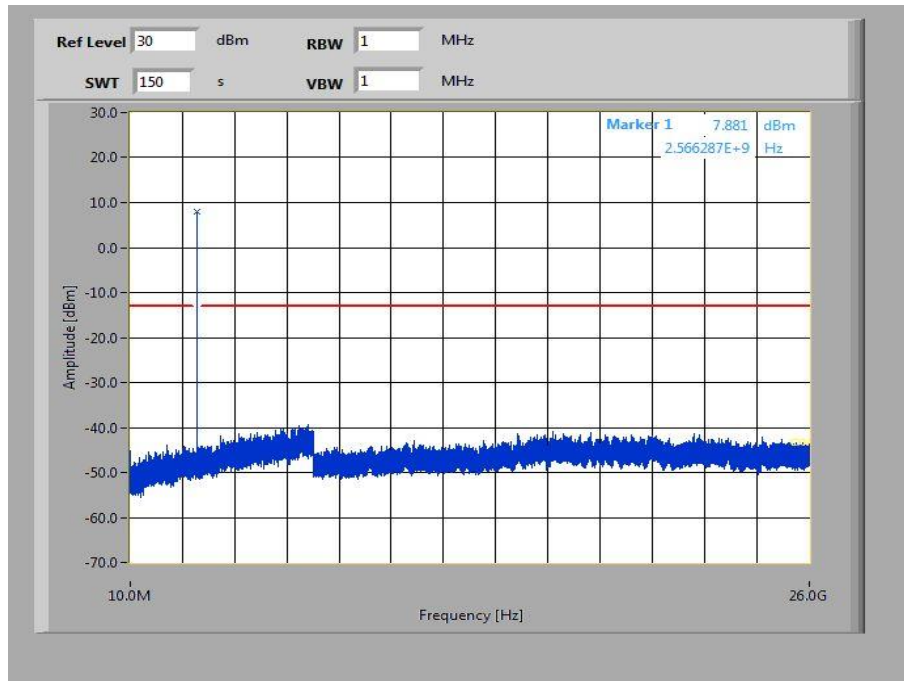
**Verdict:** **complies**

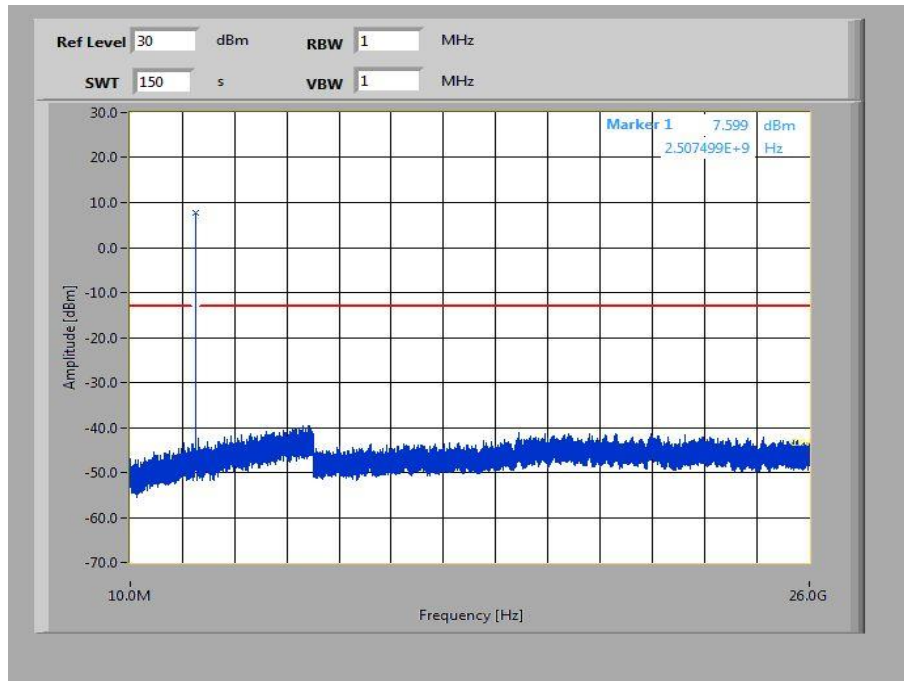
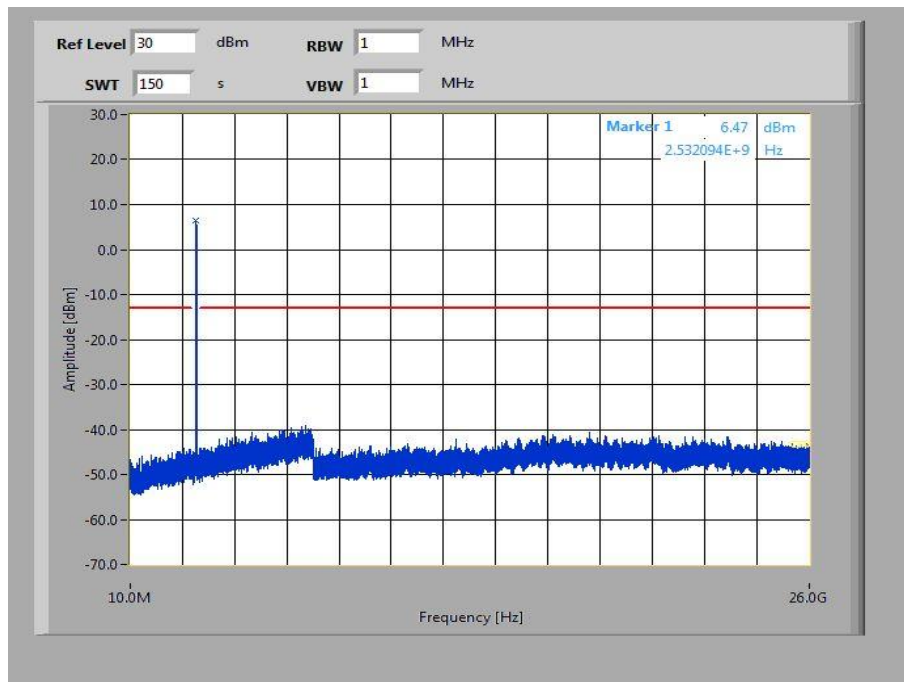
**Plots for 5 MHz channel bandwidth, QPSK****Plot 1: Lowest channel, 10 MHz to 26 GHz****Plot 2: Middle channel, 10 MHz to 26 GHz**

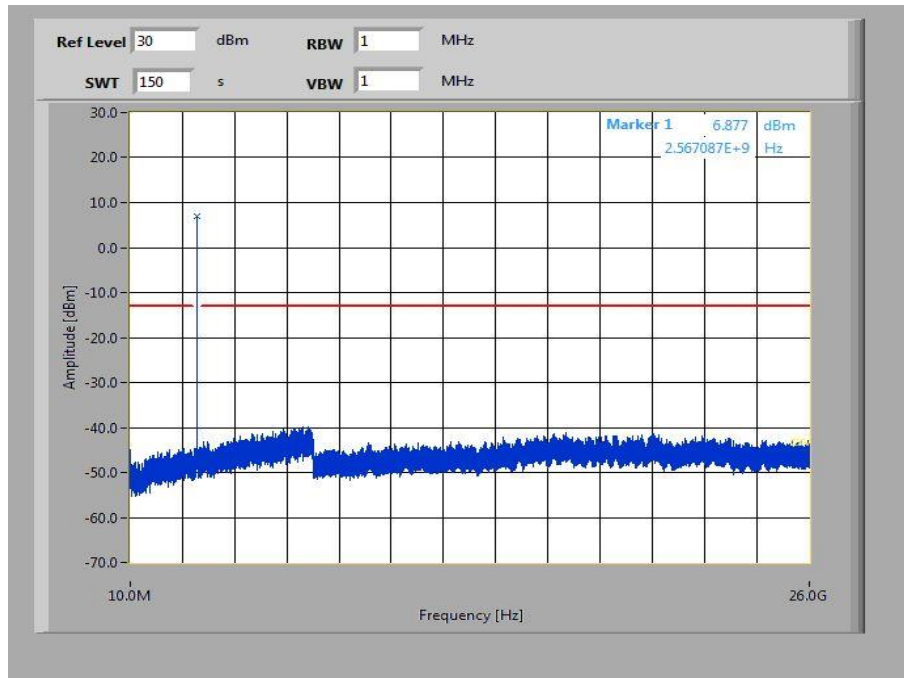
**Plot 3:** Highest channel, 10 MHz to 26 GHz

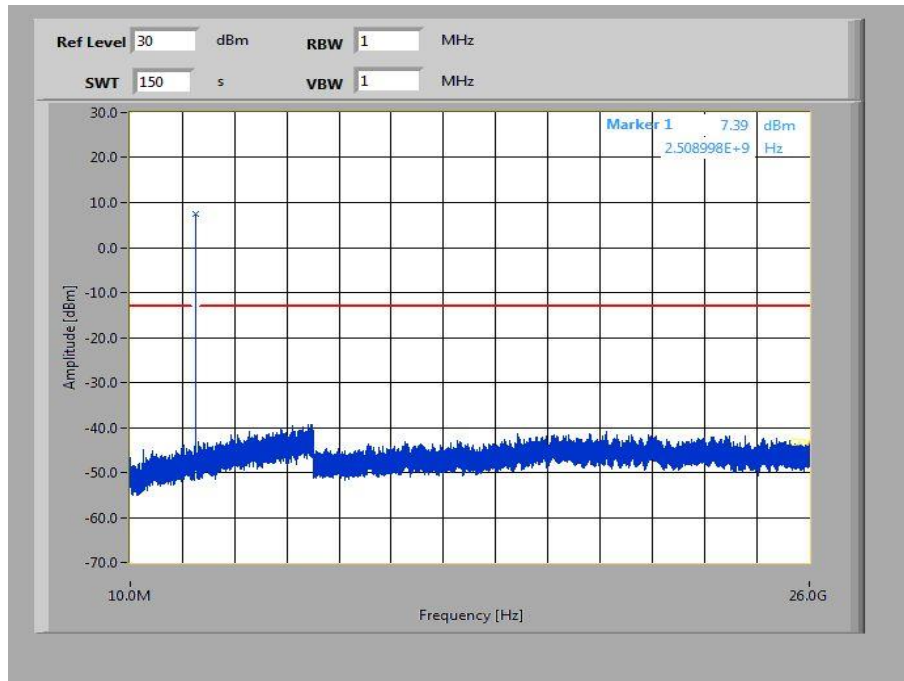
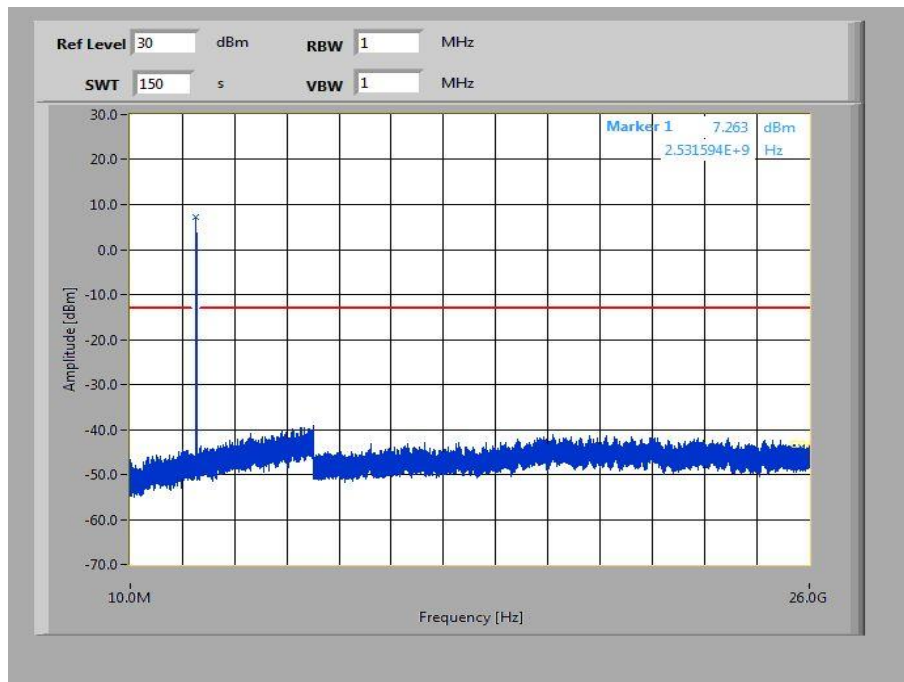
**Plots for 5 MHz channel bandwidth, 16-QAM****Plot 4: Lowest channel, 10 MHz to 26 GHz****Plot 5: Middle channel, 10 MHz to 26 GHz**

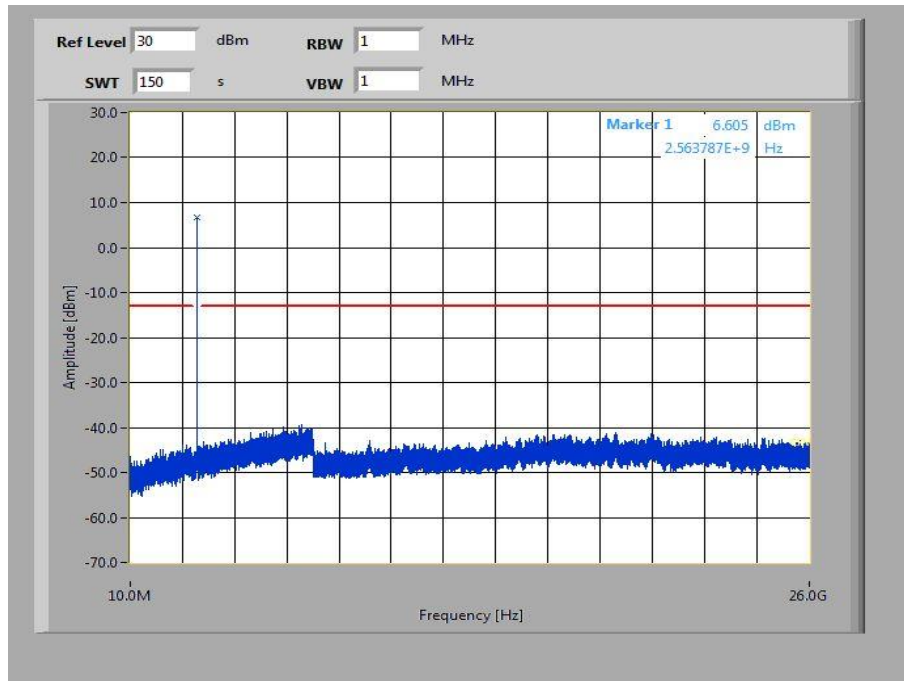


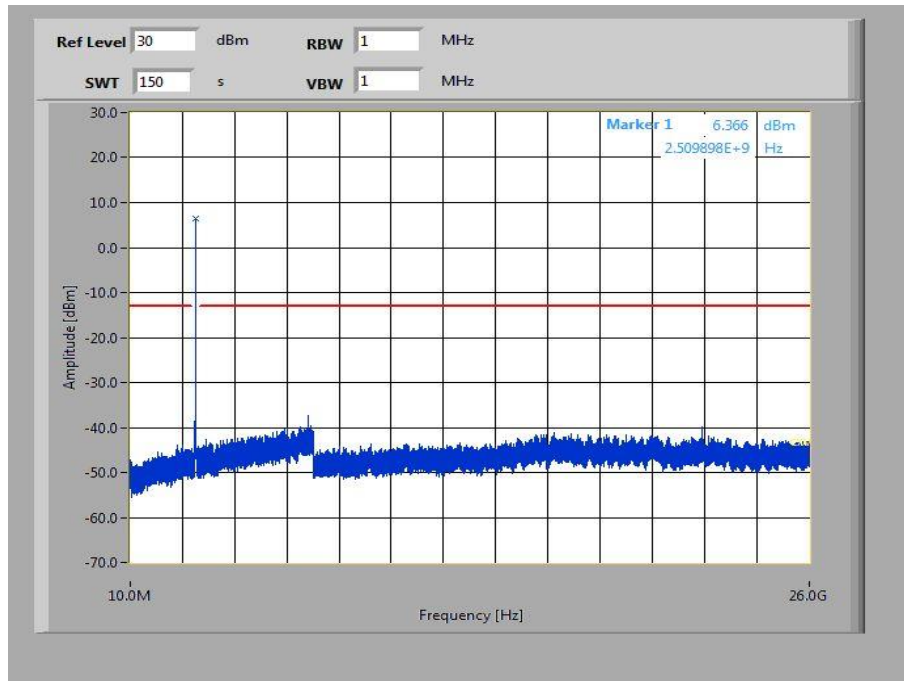
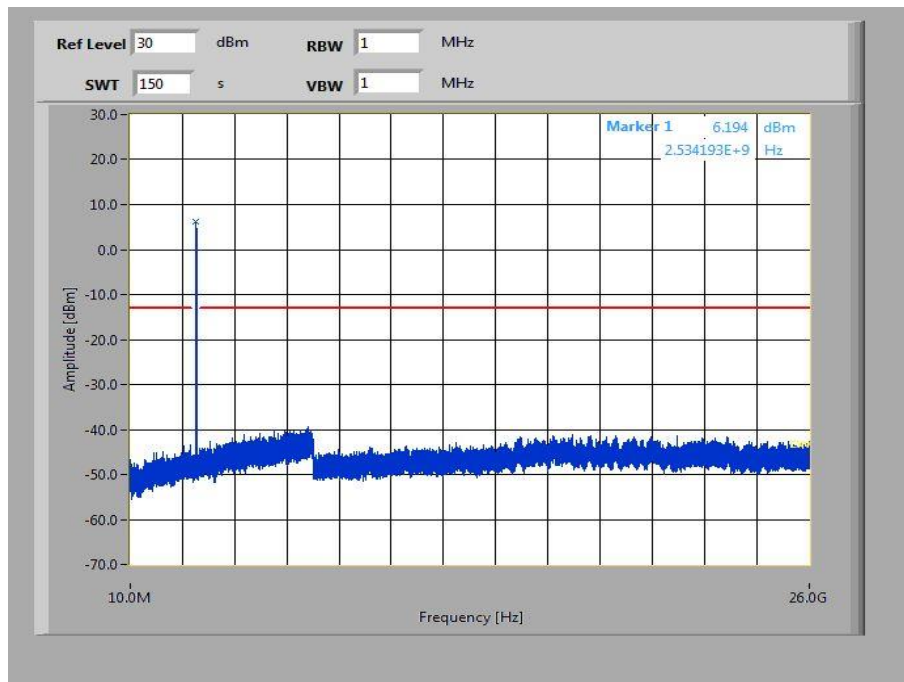
**Plot 6:** Highest channel, 10 MHz to 26 GHz

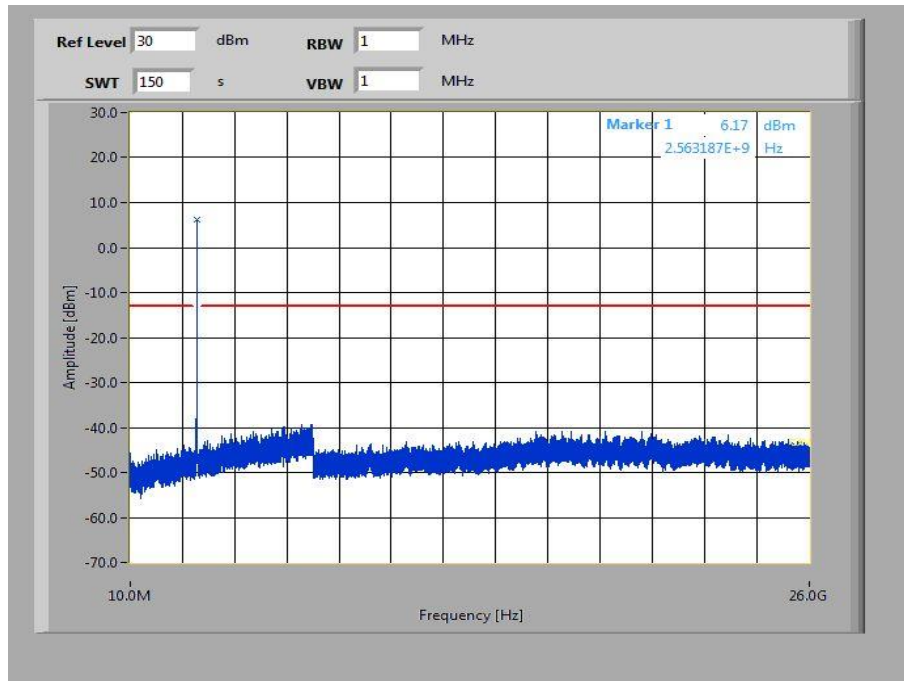
**Plots for 10 MHz channel bandwidth, QPSK****Plot 1: Lowest channel, 10 MHz to 26 GHz****Plot 2: Middle channel, 10 MHz to 26 GHz**

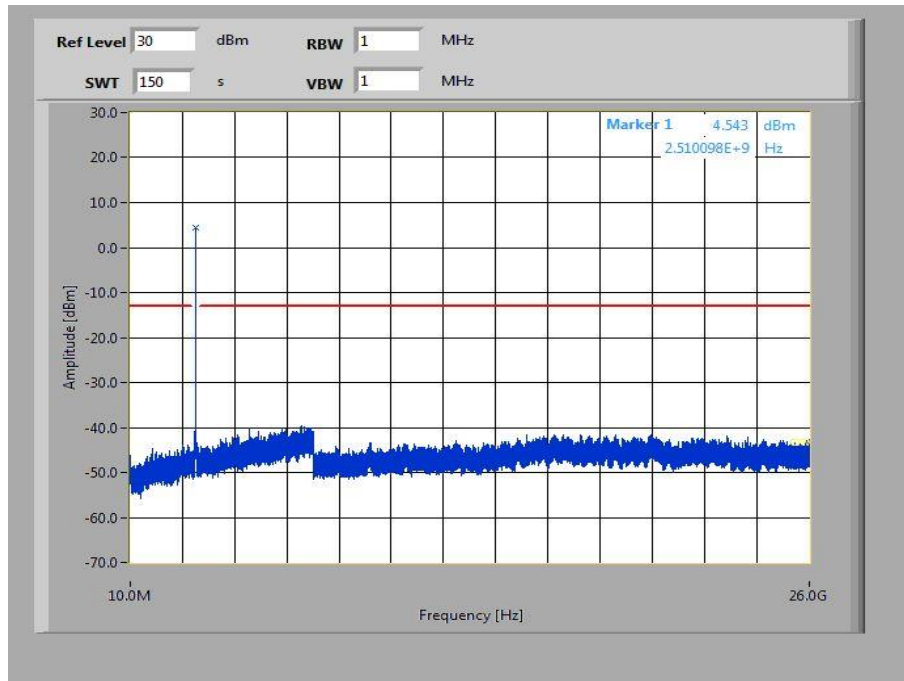
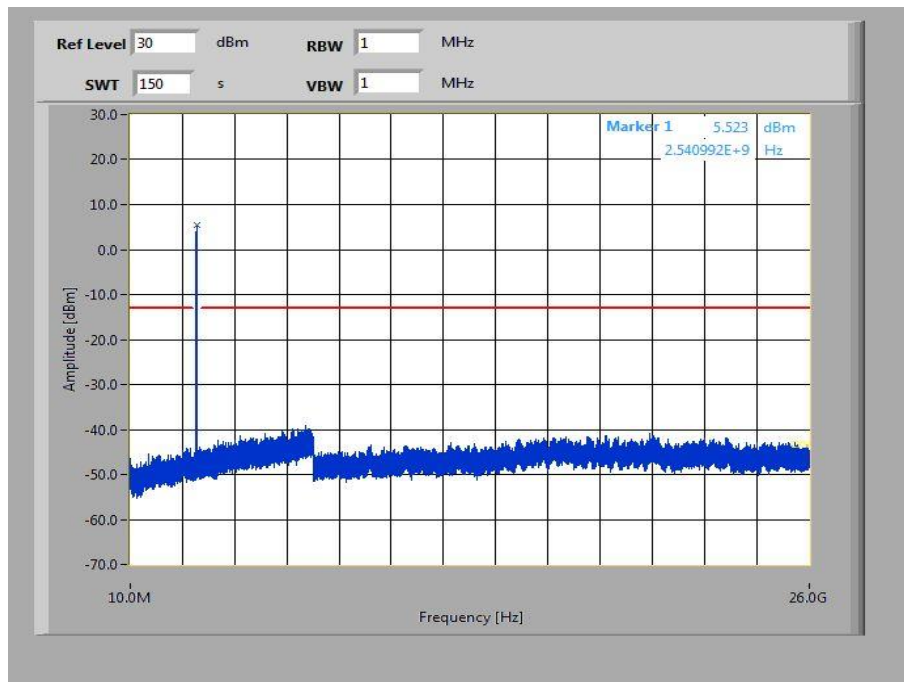
**Plot 3:** Highest channel, 10 MHz to 26 GHz

**Plots for 10 MHz channel bandwidth, 16-QAM****Plot 4: Lowest channel, 10 MHz to 26 GHz****Plot 5: Middle channel, 10 MHz to 26 GHz**

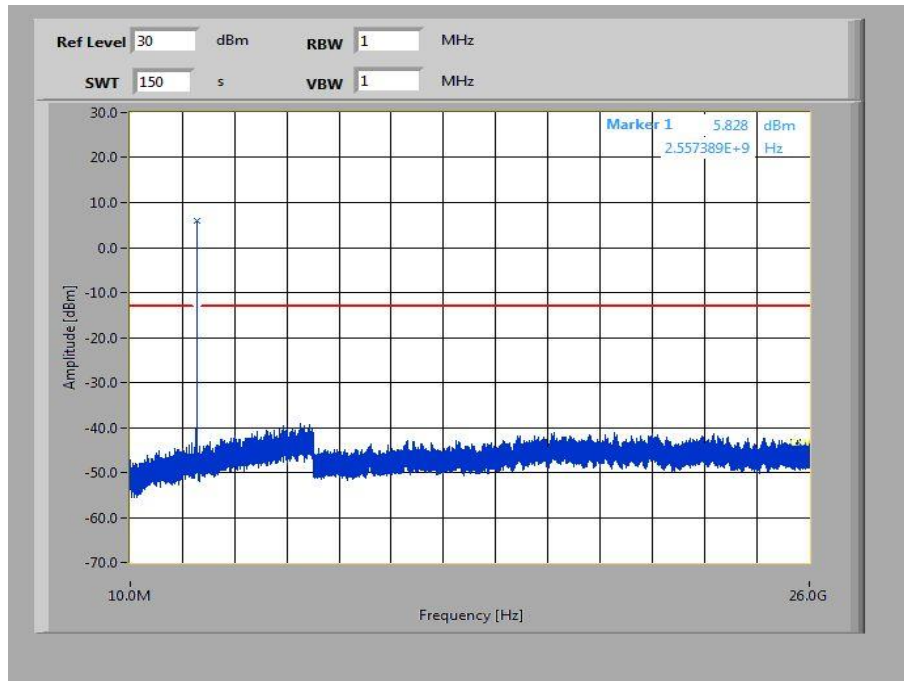
**Plot 6:** Highest channel, 10 MHz to 26 GHz

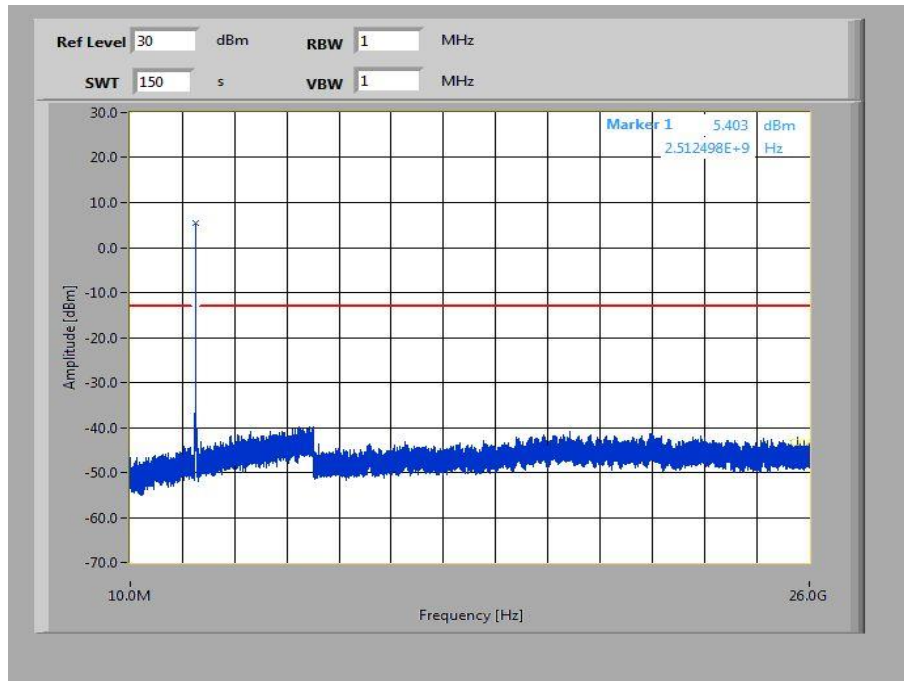
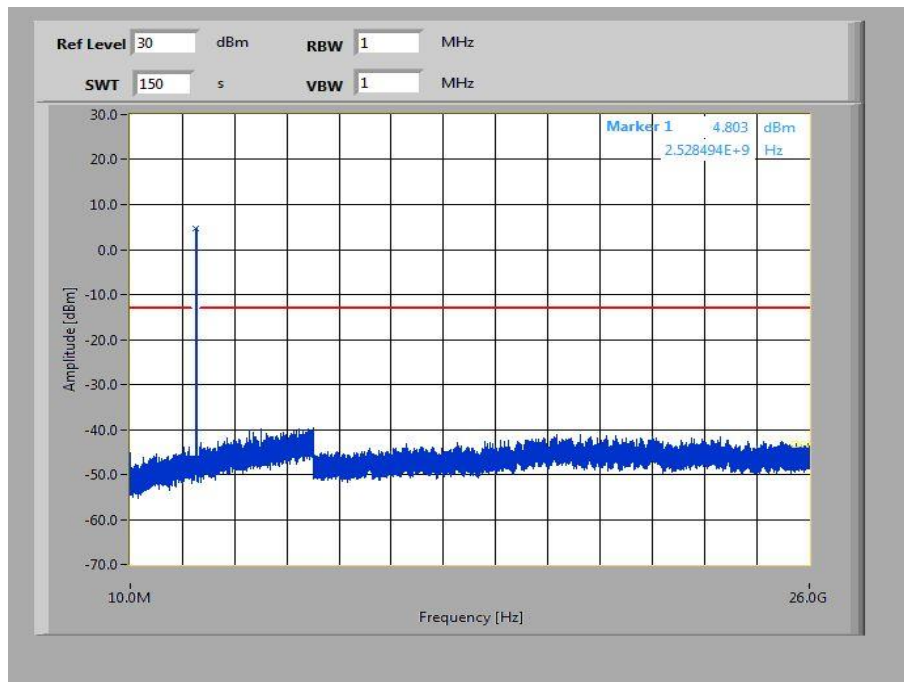
**Plots for 15 MHz channel bandwidth, QPSK****Plot 1: Lowest channel, 10 MHz to 26 GHz****Plot 2: Middle channel, 10 MHz to 26 GHz**

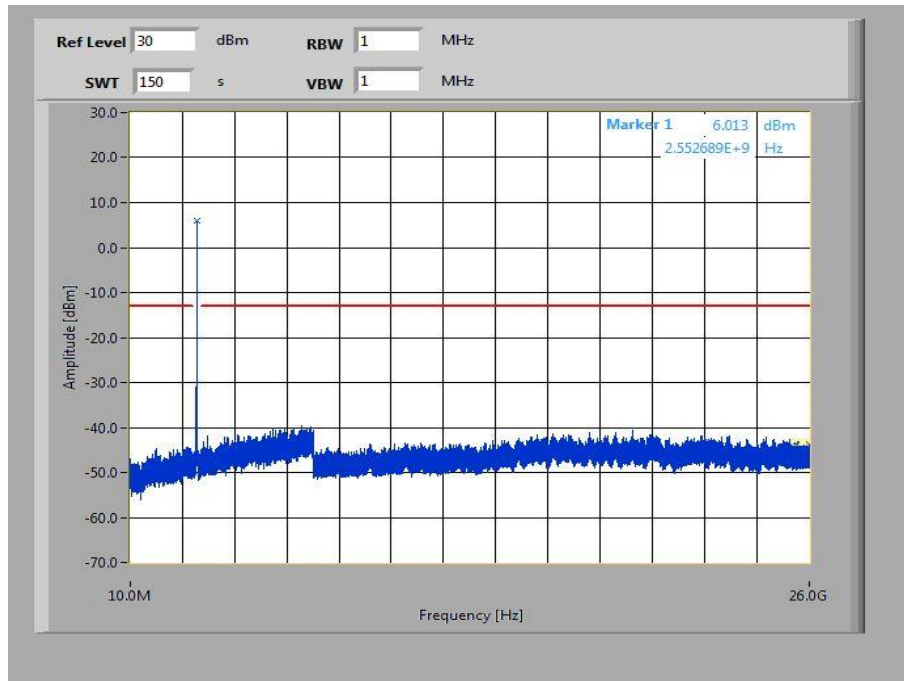
**Plot 3:** Highest channel, 10 MHz to 26 GHz

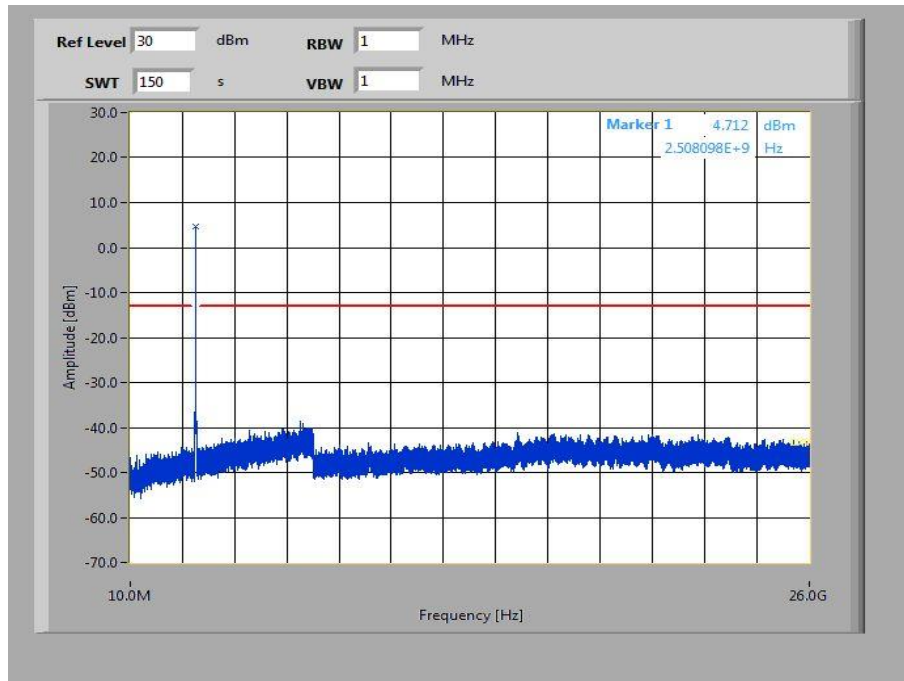
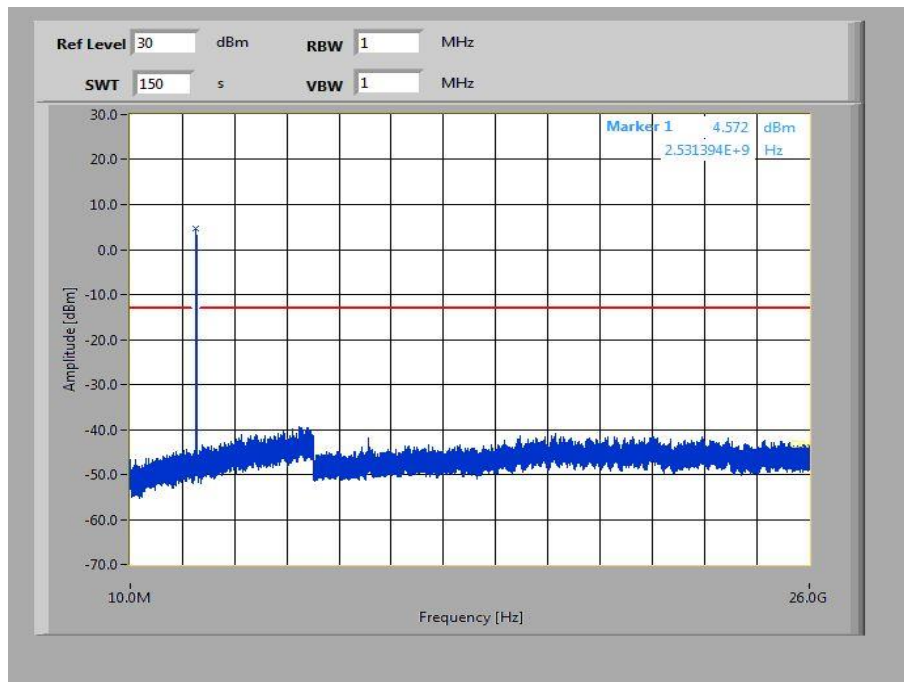
**Plots for 15 MHz channel bandwidth, 16-QAM****Plot 4: Lowest channel, 10 MHz to 26 GHz****Plot 5: Middle channel, 10 MHz to 26 GHz**

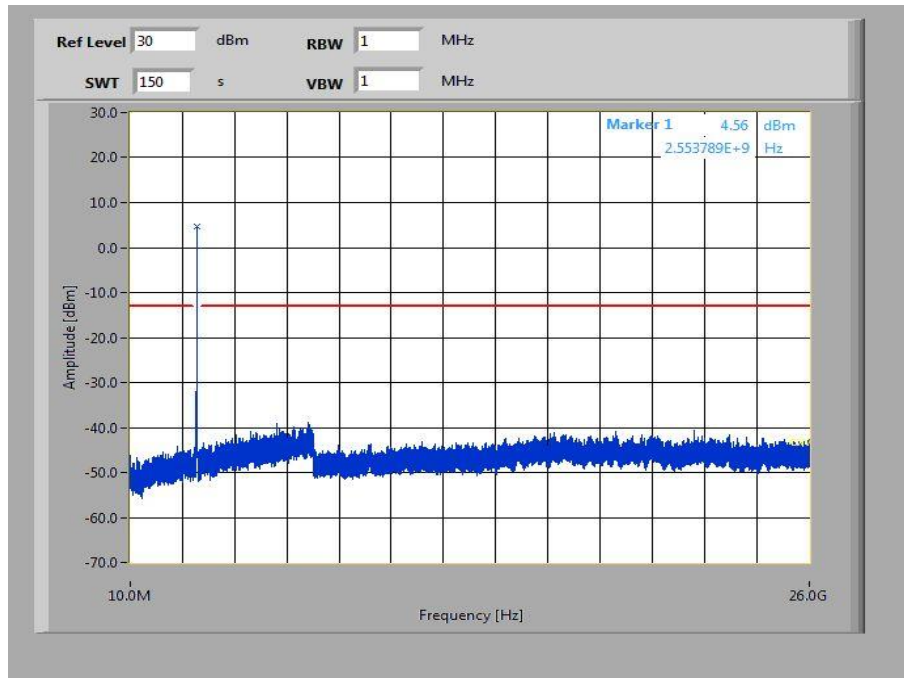


**Plot 6:** Highest channel, 10 MHz to 26 GHz

**Plots for 20 MHz channel bandwidth, QPSK****Plot 1: Lowest channel, 10 MHz to 26 GHz****Plot 2: Middle channel, 10 MHz to 26 GHz**

**Plot 3:** Highest channel, 10 MHz to 26 GHz

**Plots for 20 MHz channel bandwidth, 16-QAM****Plot 4: Lowest channel, 10 MHz to 26 GHz****Plot 5: Middle channel, 10 MHz to 26 GHz**

**Plot 6:** Highest channel, 10 MHz to 26 GHz

### 10.1.5 Block edge compliance

#### Description:

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

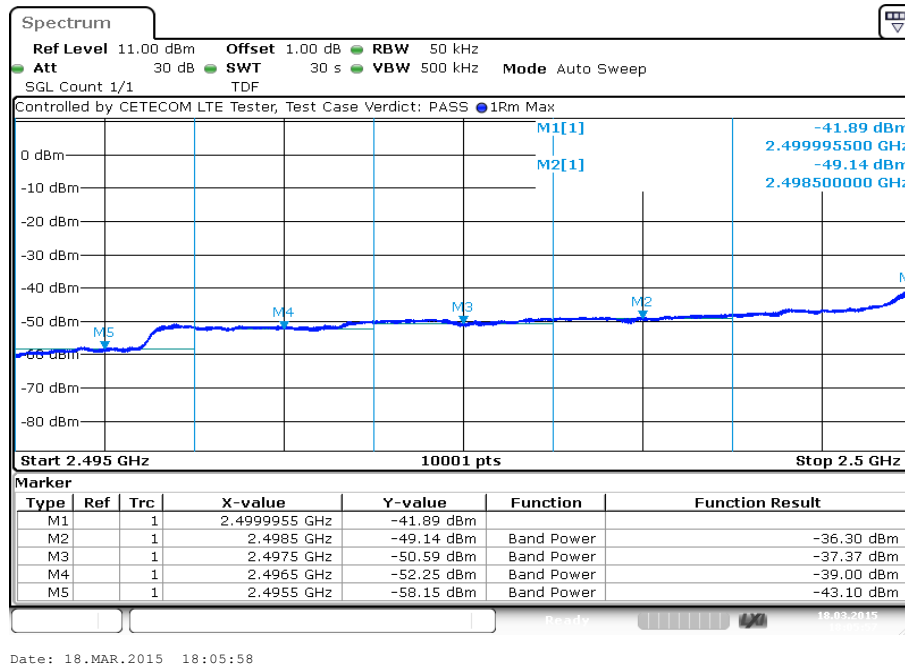
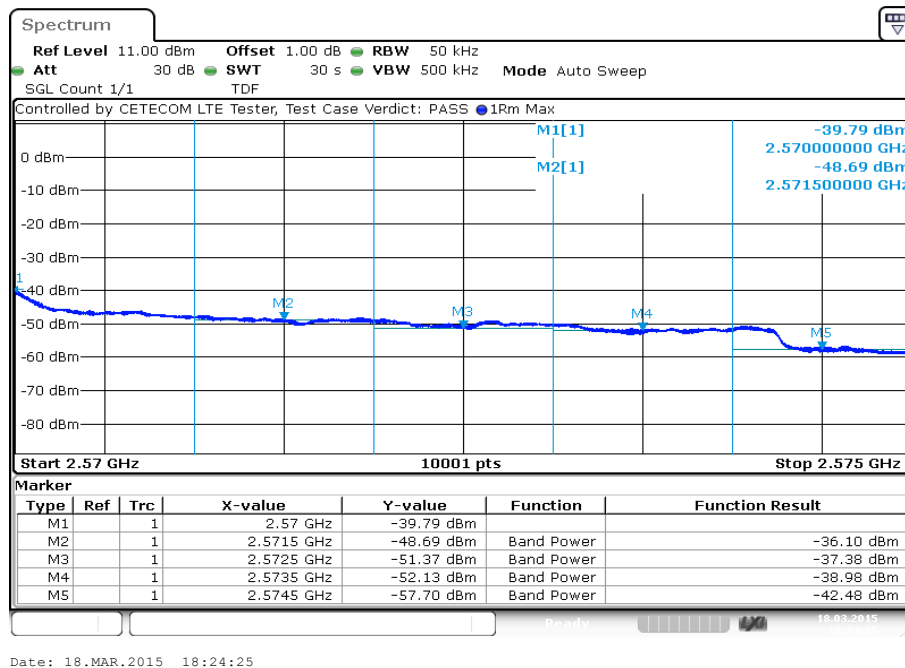
For the measurement the lowest, middle and highest channel bandwidth was used. If spurious were found the other bandwidths were measured, too.

#### Measurement:

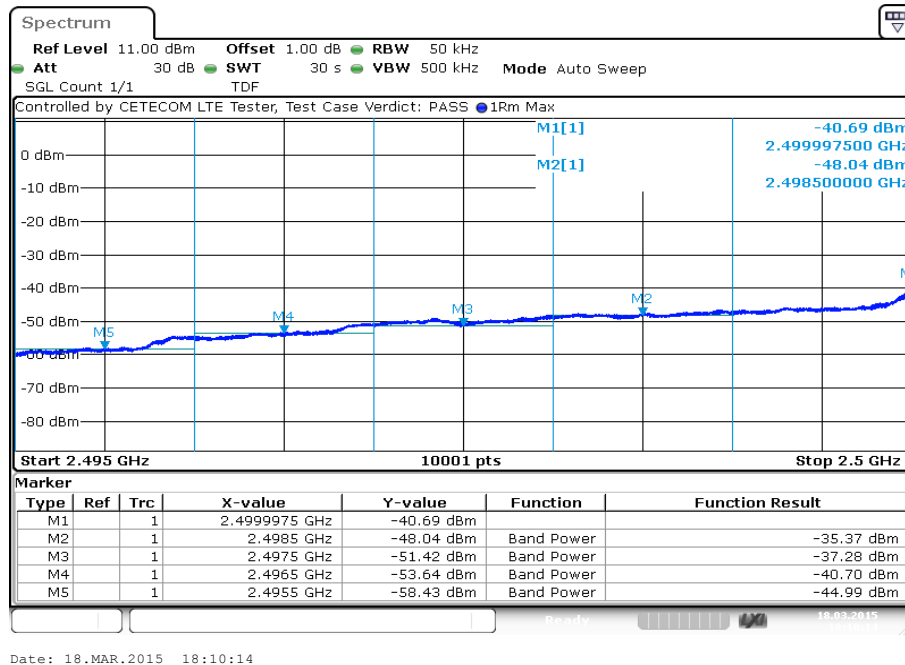
Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

#### Limits:

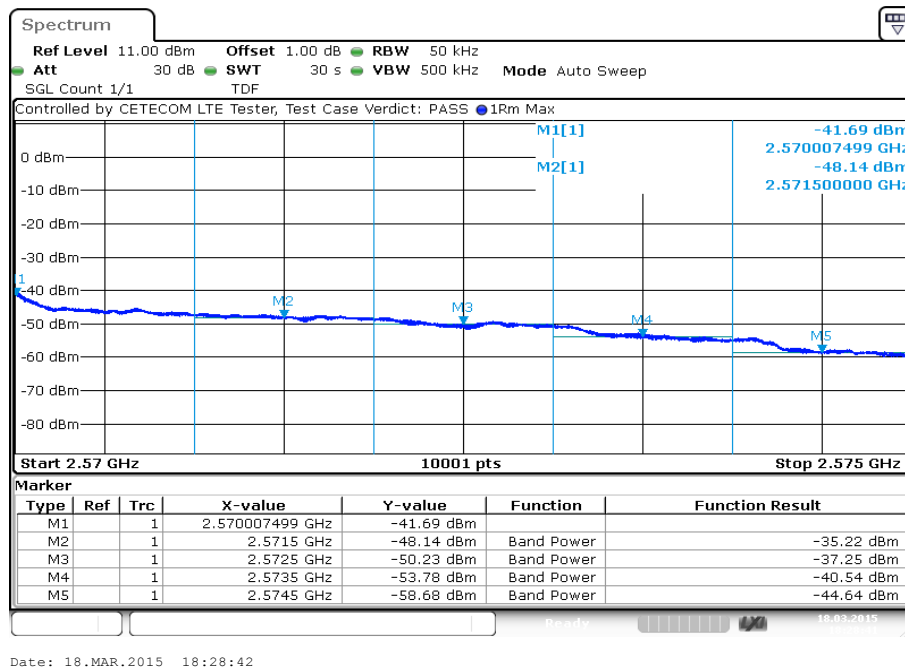
FCC
Block Edge Compliance
<p>Part 27.53 specifies that “the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least <math>43 + 10 \log(P)</math> dB.”</p> <p>However, in publication number 890810, The FCC Office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

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

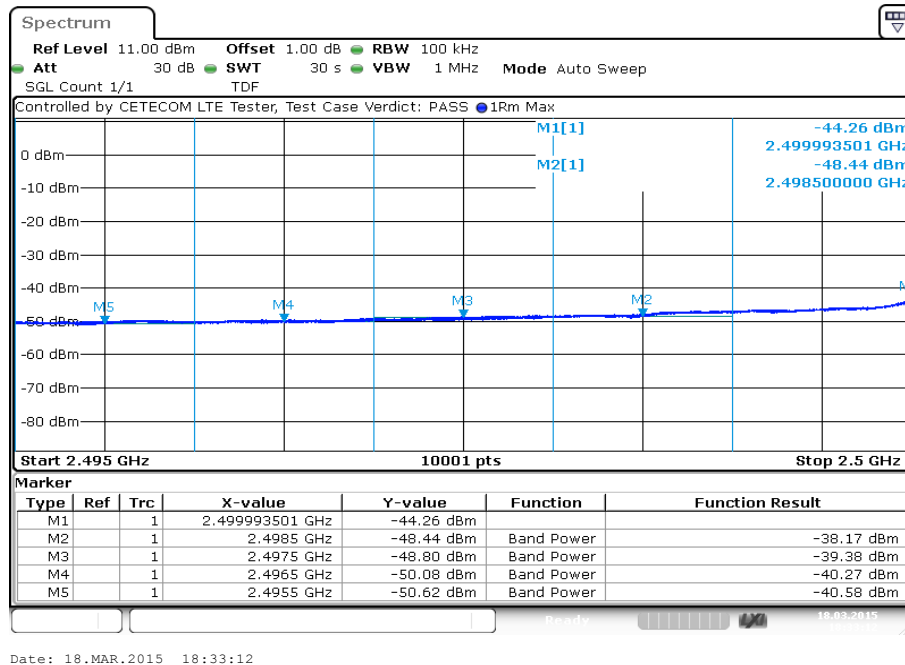
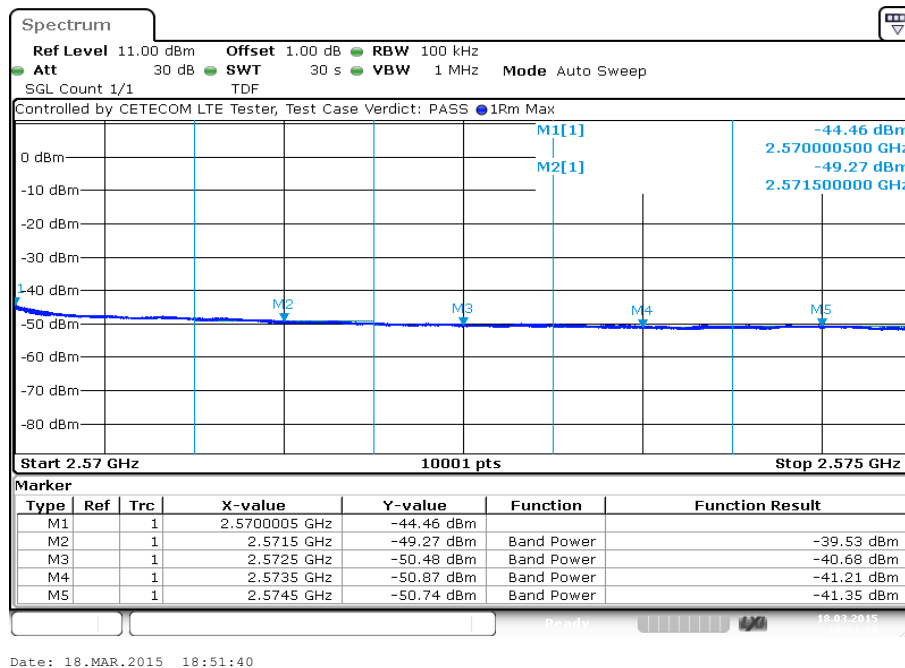
Plot 3: Lowest channel, 16 – QAM modulation



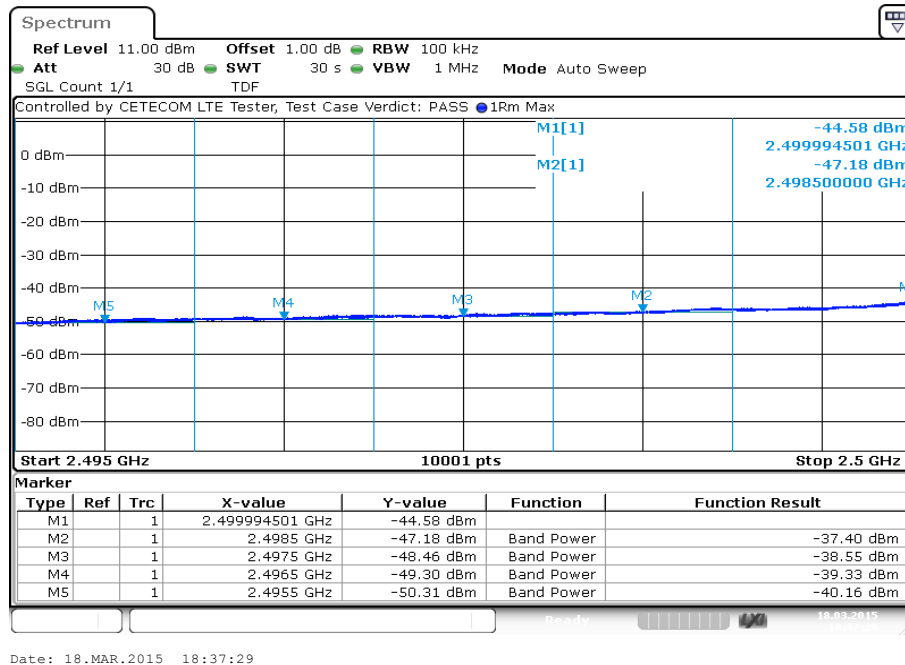
Plot 4: Highest channel, 16 – QAM modulation



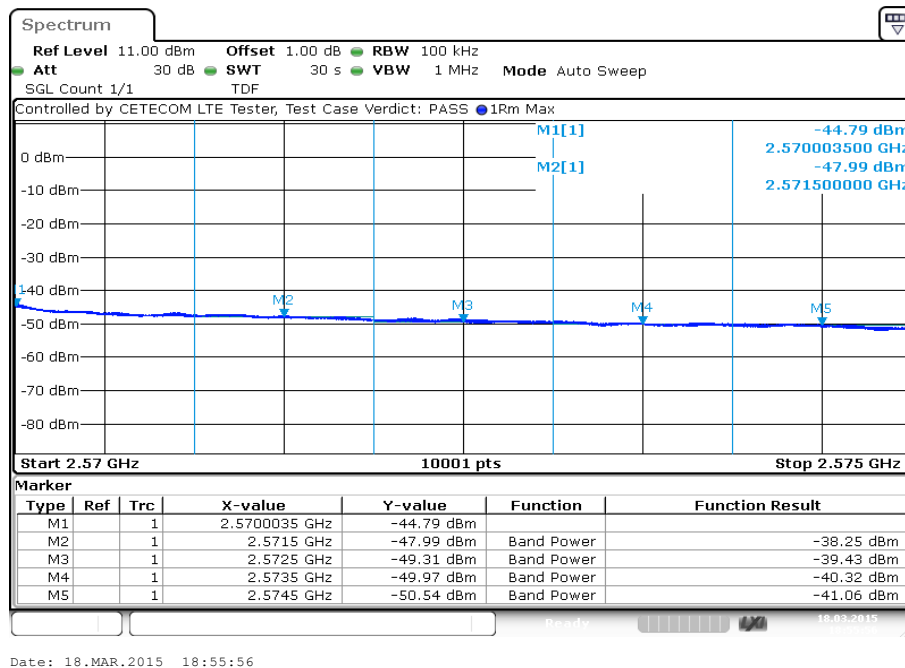


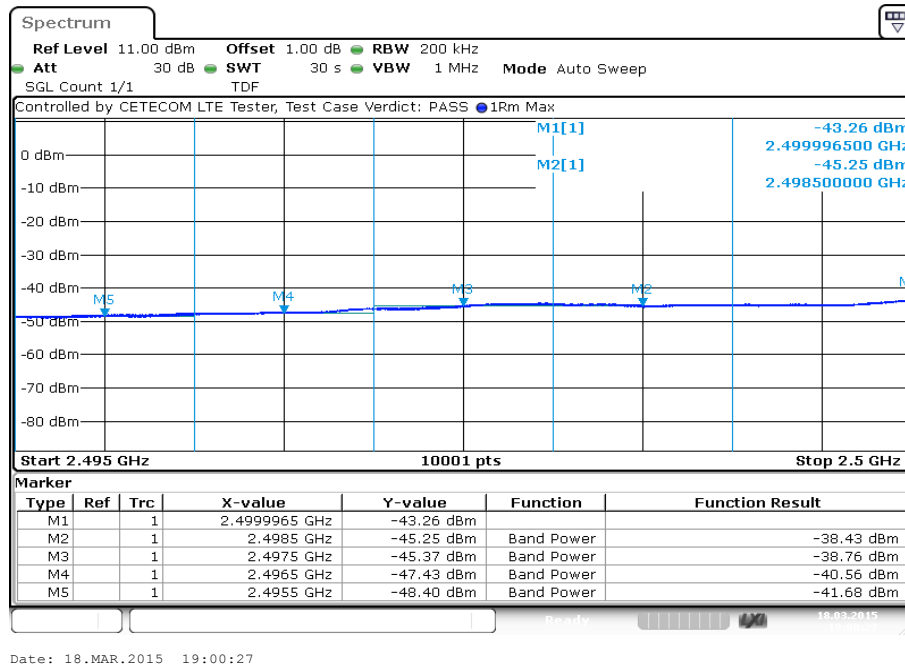
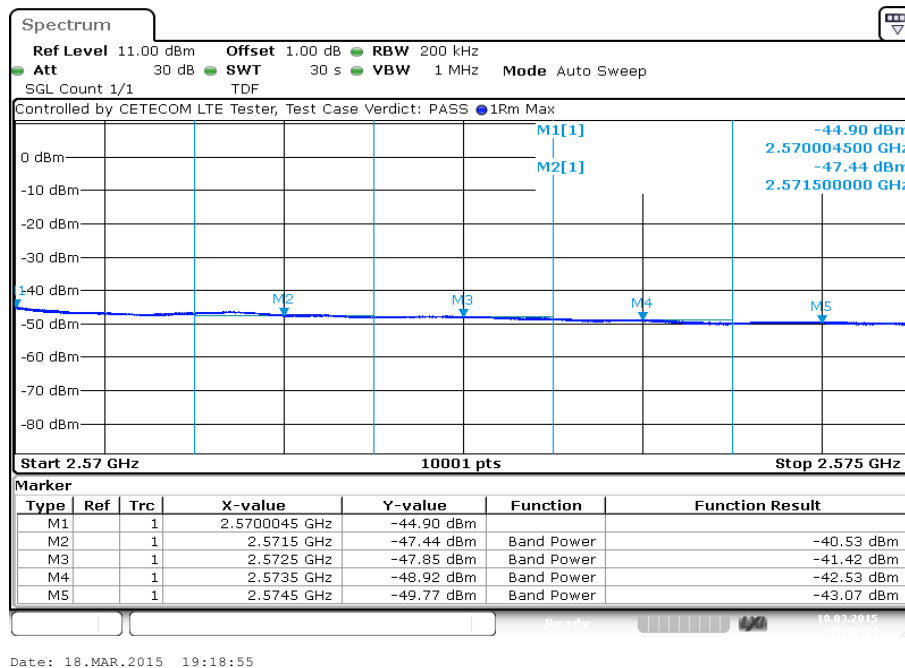
**Results: 10 MHz channel bandwidth****Plot 1: Lowest channel, QPSK modulation****Plot 2: Highest channel, QPSK modulation**

Plot 3: Lowest channel, 16 – QAM modulation

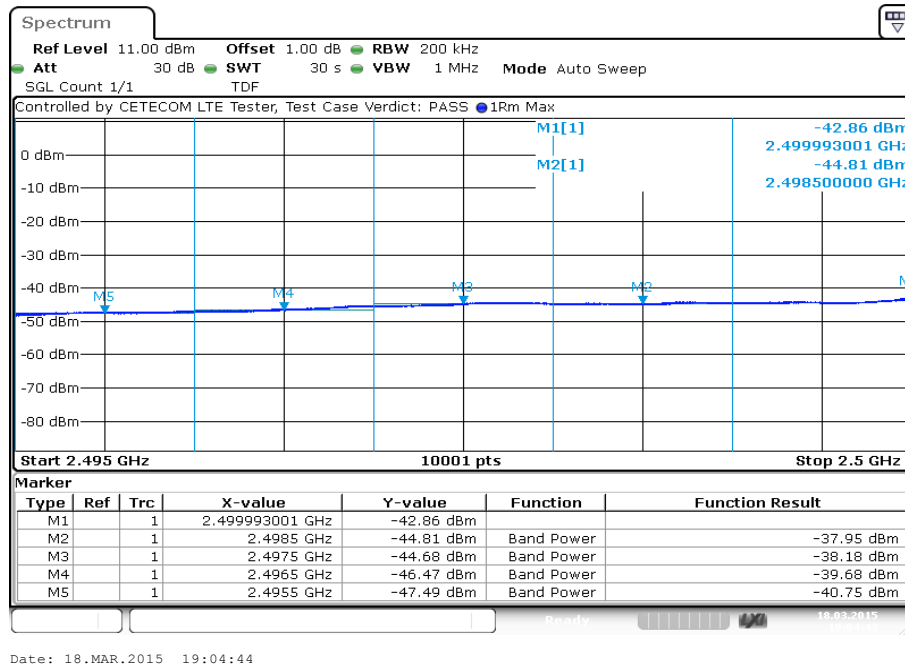


Plot 4: Highest channel, 16 – QAM modulation

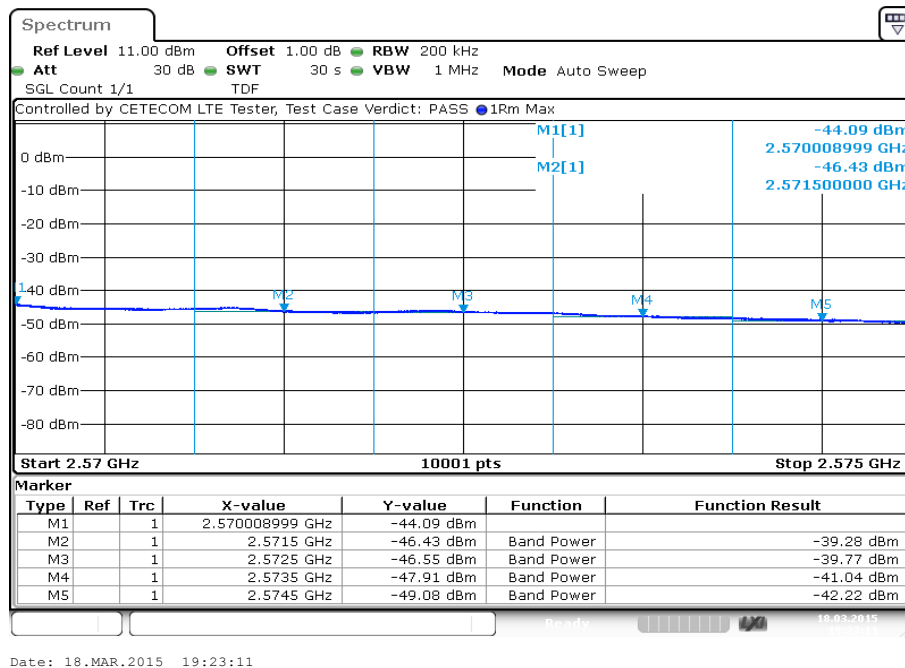


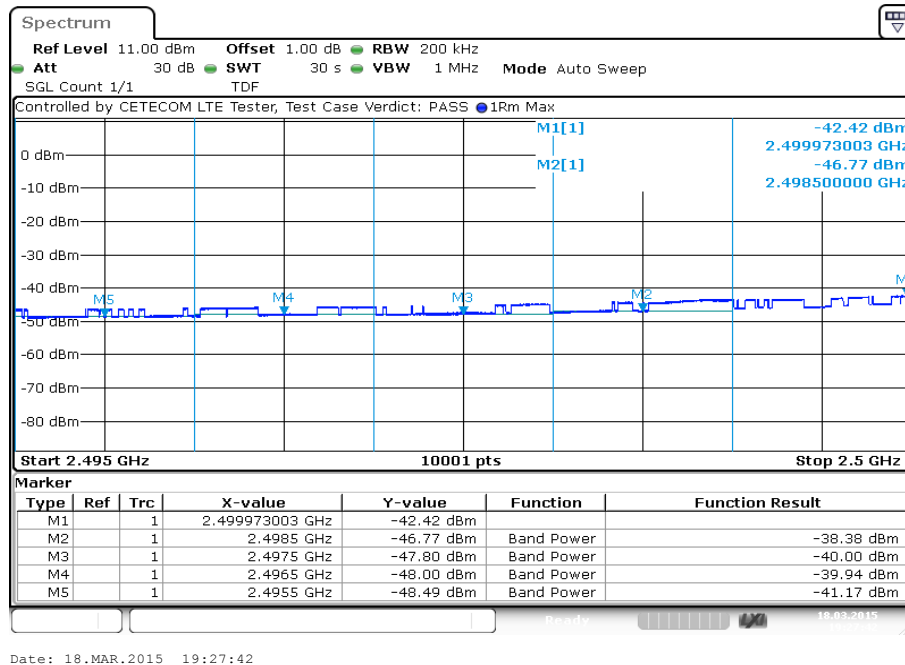
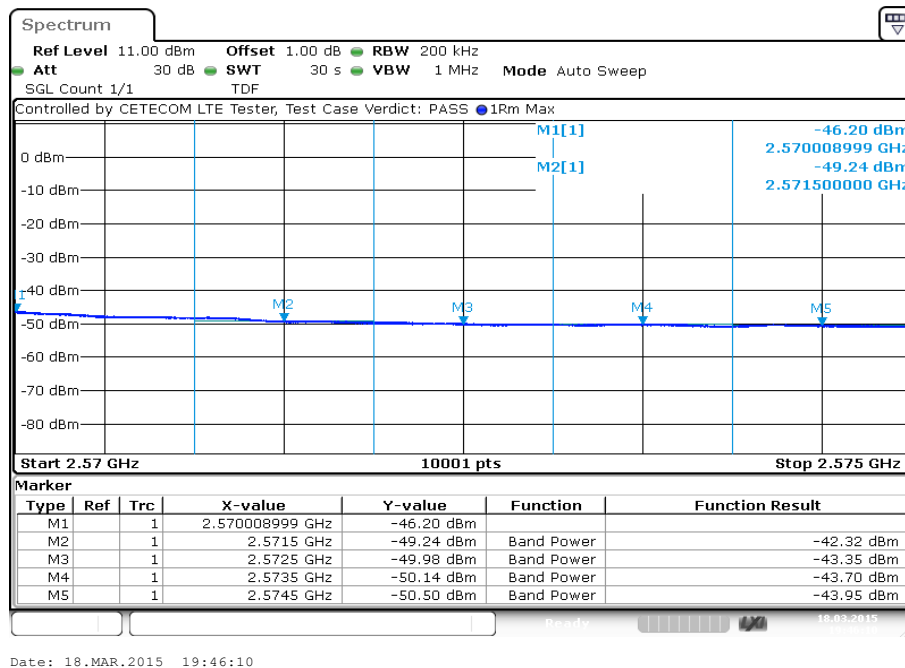
**Results: 15 MHz channel bandwidth****Plot 1: Lowest channel, QPSK modulation****Plot 2: Highest channel, QPSK modulation**

Plot 3: Lowest channel, 16 – QAM modulation

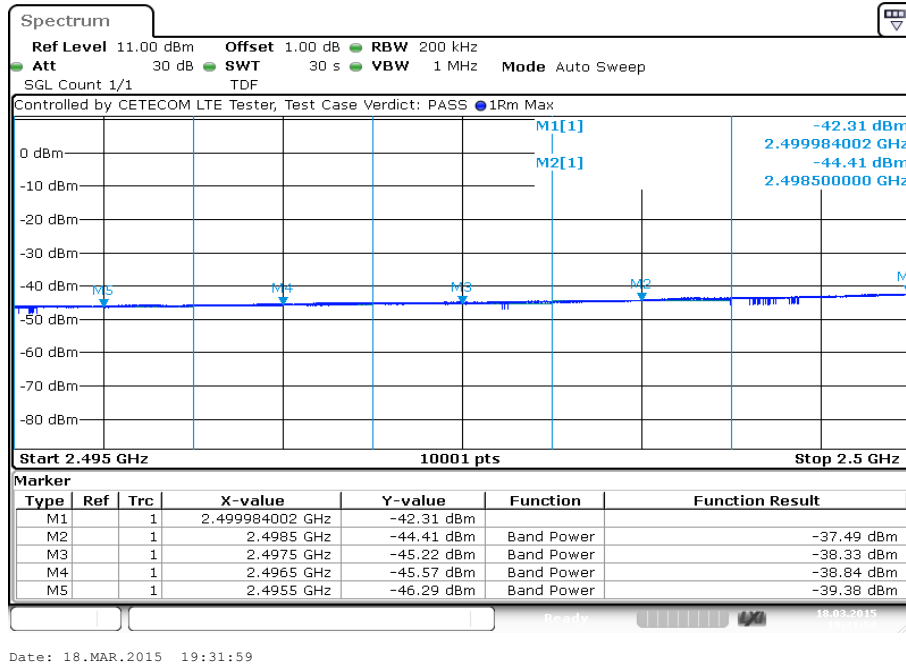


Plot 4: Highest channel, 16 – QAM modulation

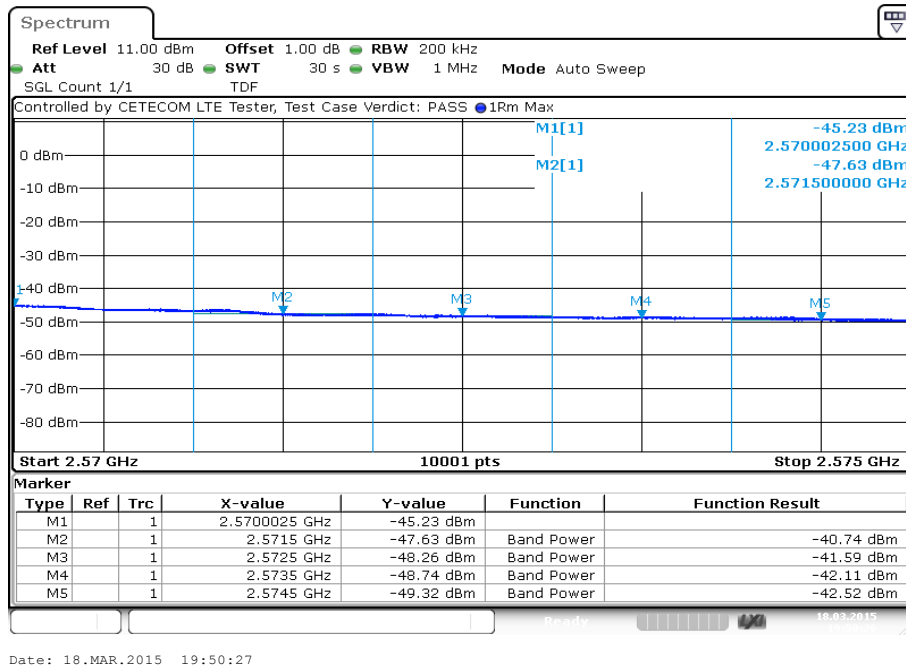


**Results: 20 MHz channel bandwidth****Plot 1: Lowest channel, QPSK modulation****Plot 2: Highest channel, QPSK modulation**

Plot 3: Lowest channel, 16 – QAM modulation



Plot 4: Highest channel, 16 – QAM modulation

**Verdict:** **complies**

### 10.1.6 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 7. The table below lists the measured 99% power and -26dBc 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
Used test setup:	see chapter 8.2

**Limits:**

FCC
Occupied Bandwidth
Spectrum must fall completely in the specified band

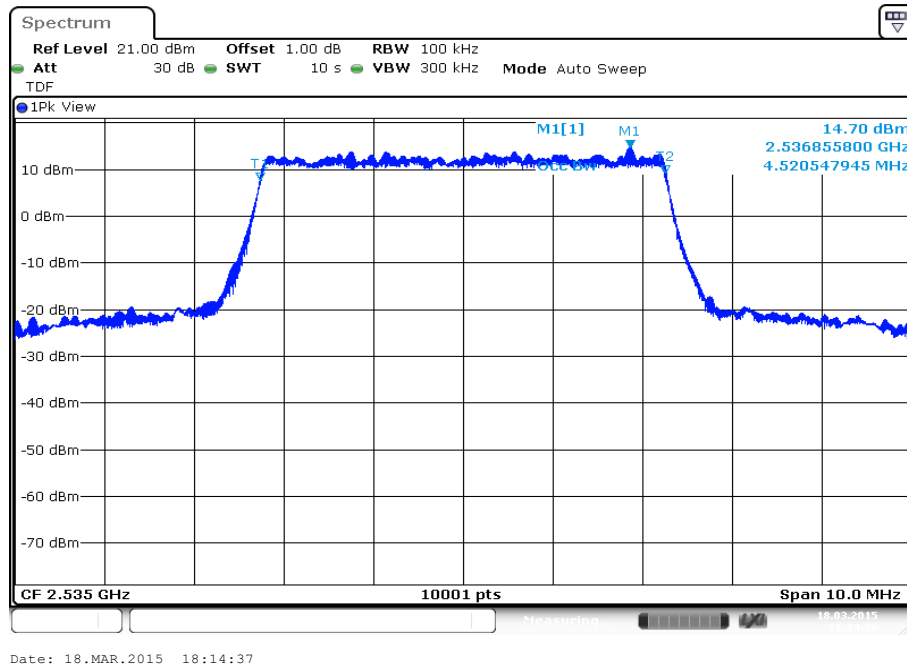
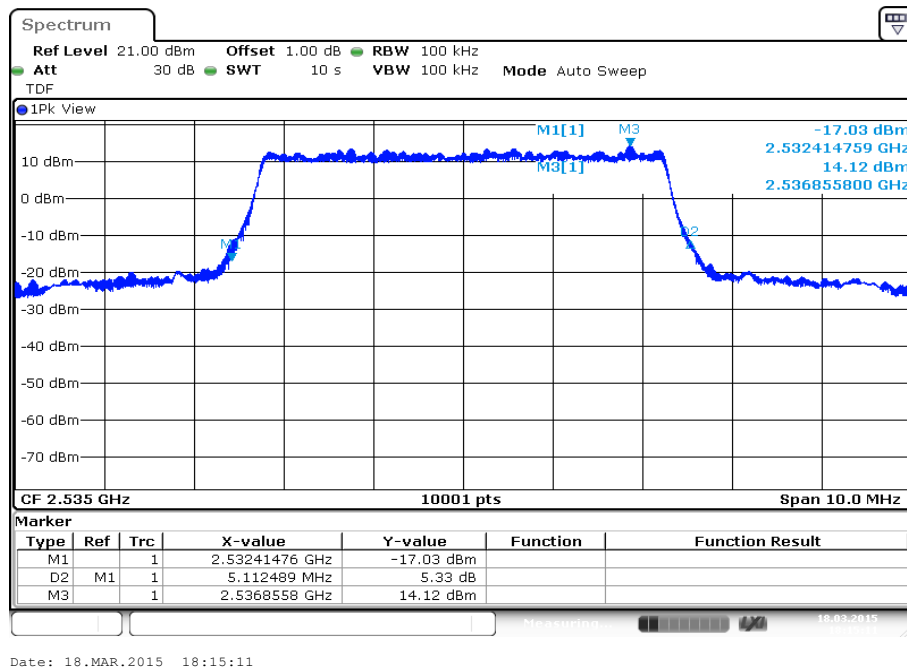
**Results:**

Occupied Bandwidth - QPSK		
Bandwidth [MHz]	99% OBW (kHz)	-26 dBc BW (kHz)
5	4.52	5.11
10	9.09	10.23
15	13.46	14.90
20	17.99	19.96
Measurement uncertainty	± 100 kHz	

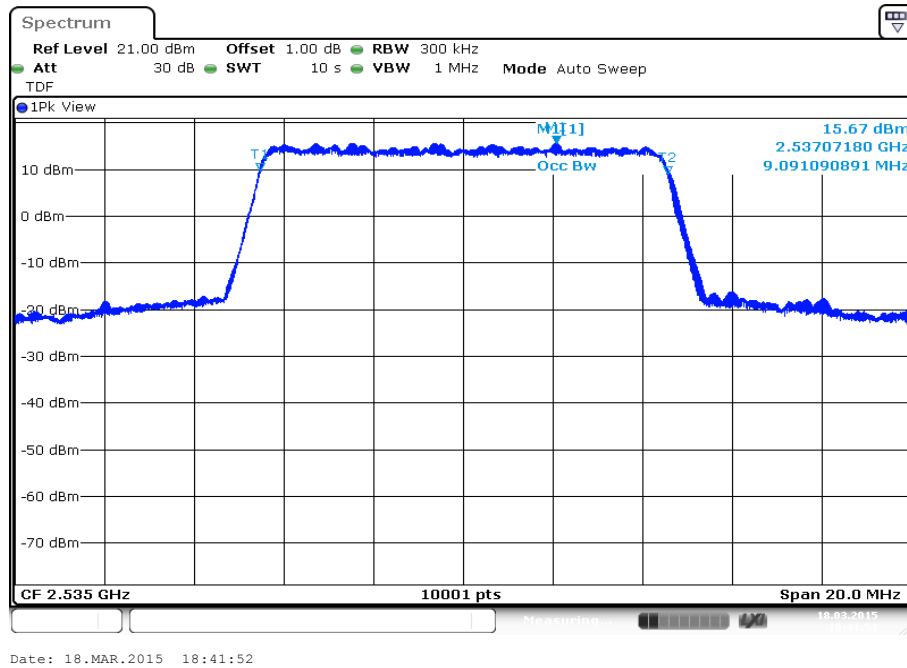
Occupied Bandwidth – 16-QAM		
Bandwidth [MHz]	99% OBW (kHz)	-26 dBc BW (kHz)
5	4.51	5.05
10	9.08	10.13
15	13.46	14.85
20	17.99	20.06
Measurement uncertainty	± 100 kHz	

**Verdict:** [complies](#)

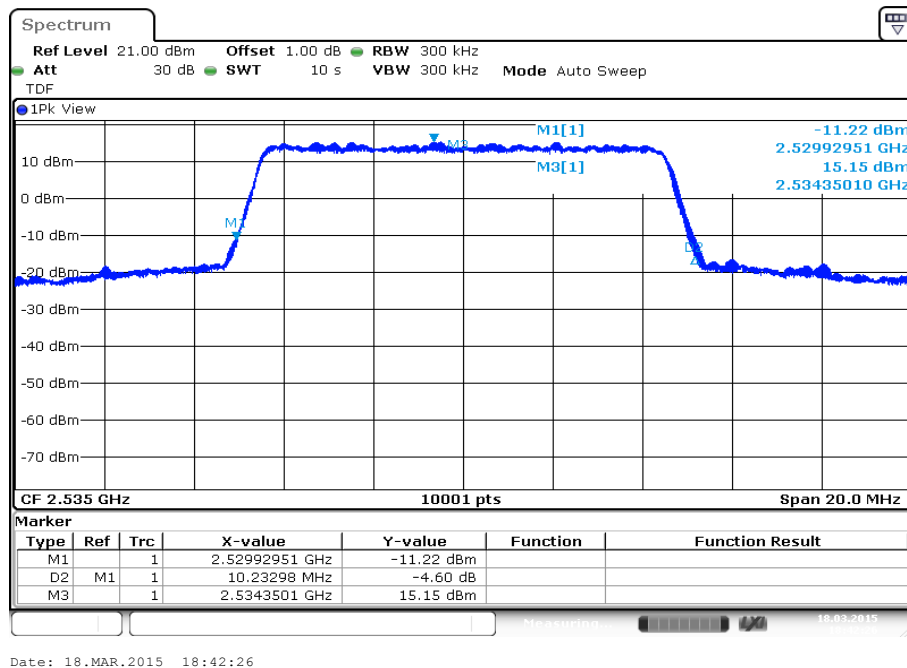


**Plots: QPSK****Plot 1: 5 MHz, 99% OBW****Plot 2: 5 MHz, -26 dBc OBW**

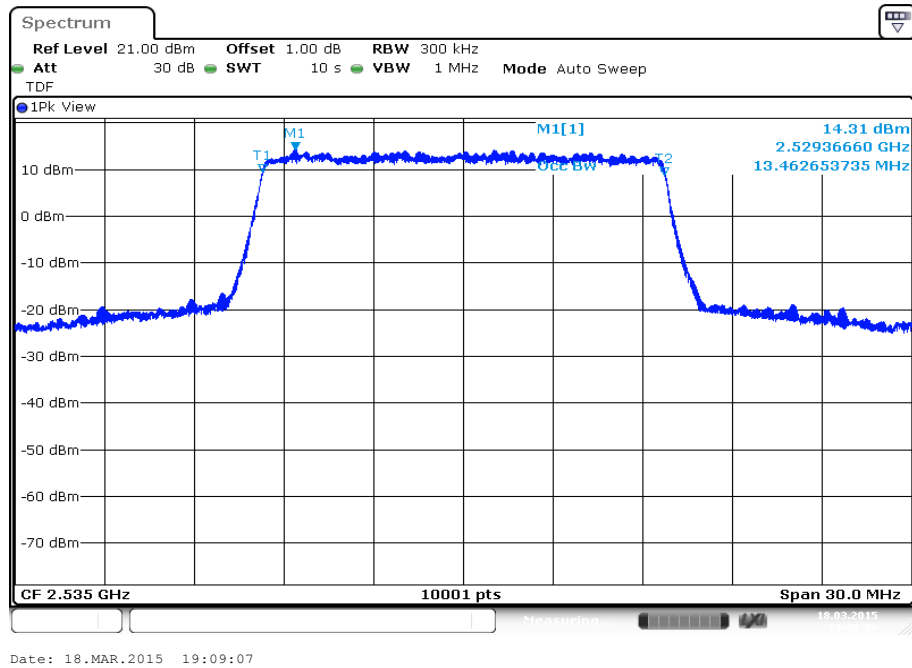
Plot 3: 10 MHz, 99% OBW



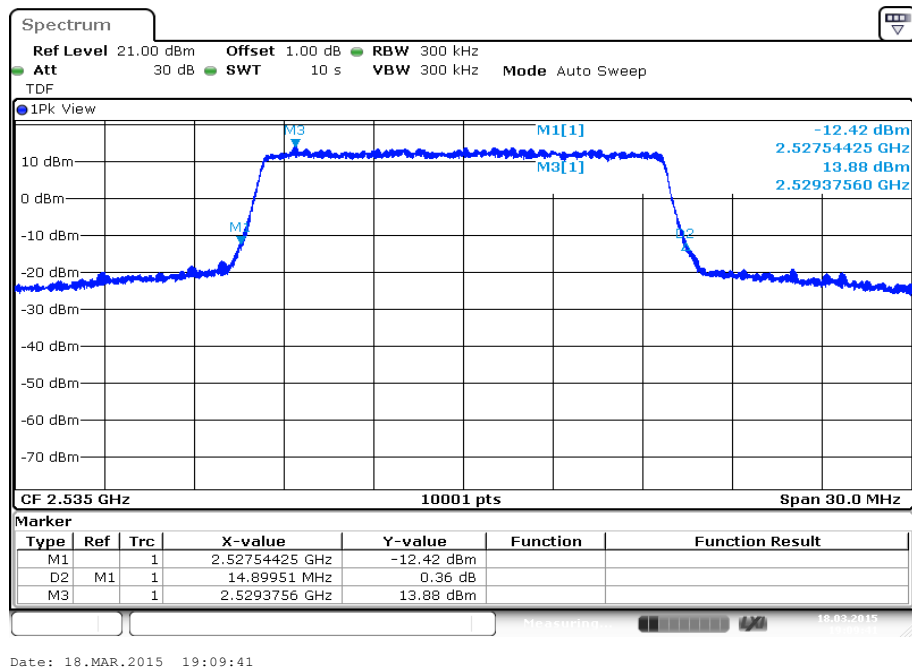
Plot 4: 10 MHz, -26 dBc OBW



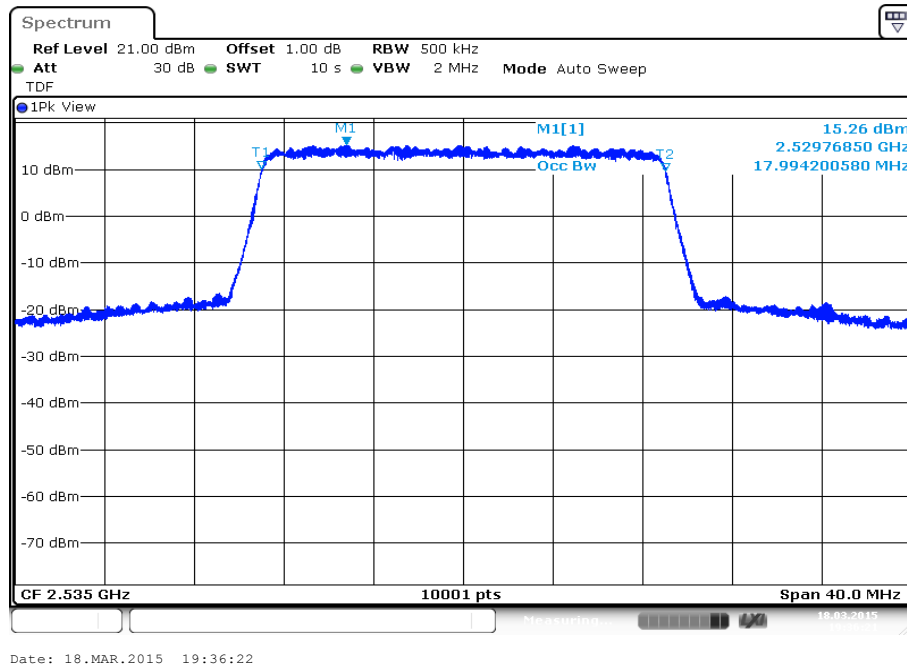
Plot 5: 15 MHz, 99% OBW



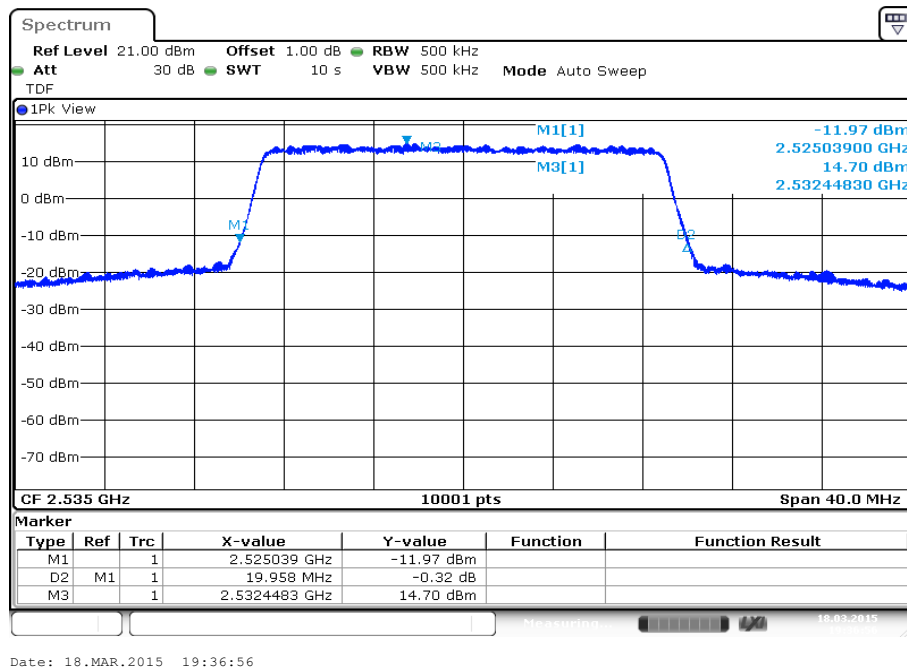
Plot 6: 15 MHz, -26 dBc OBW

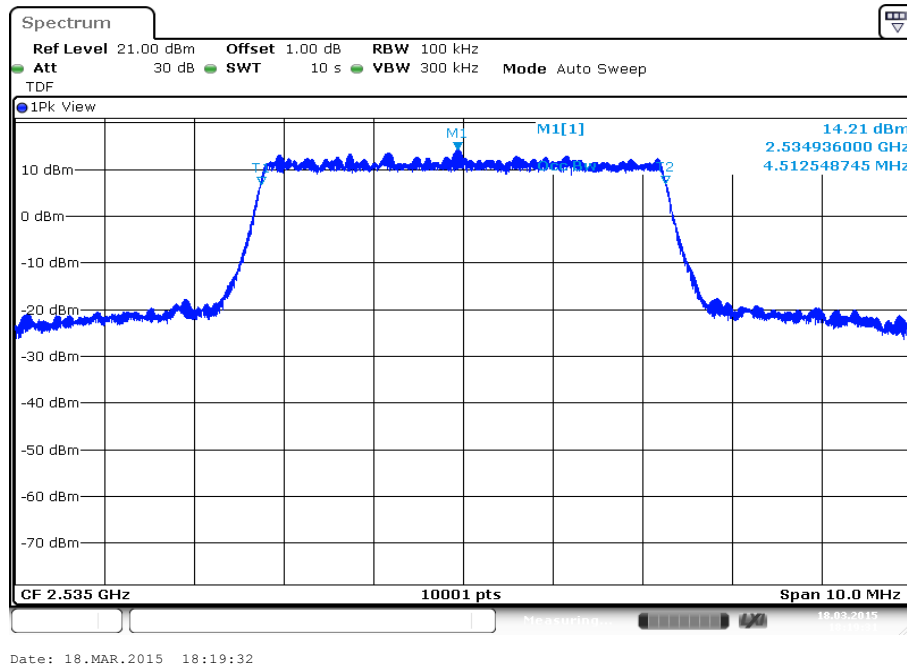
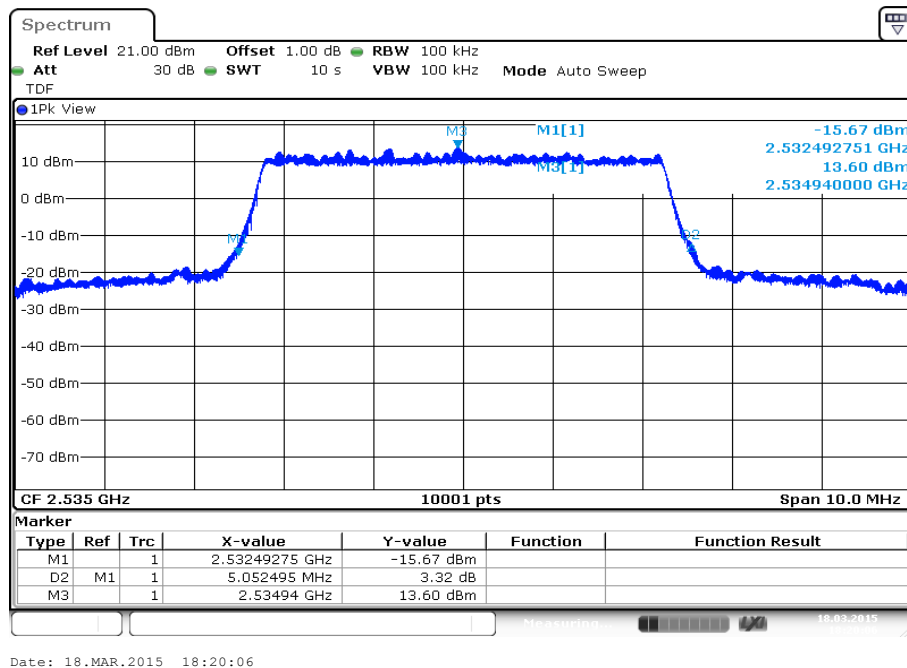


Plot 7: 20 MHz, 99% OBW

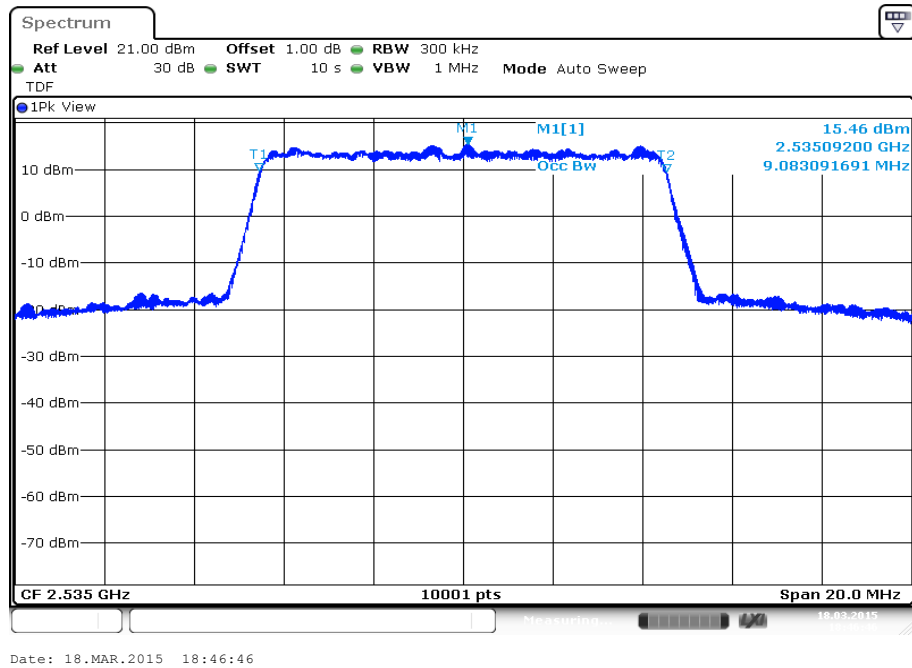


Plot 8: 20 MHz, -26 dBc OBW

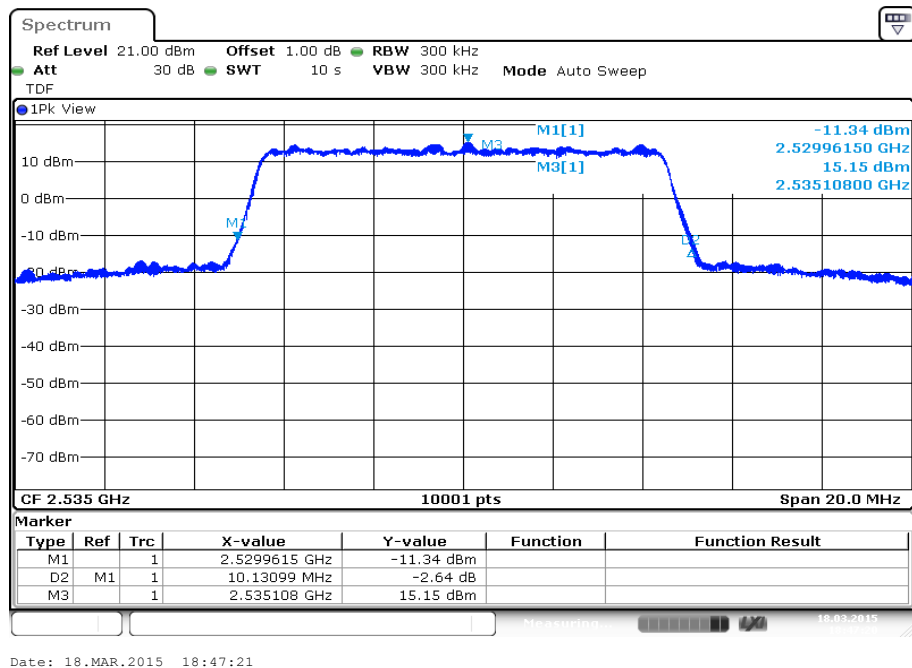


**Plots: 16-QAM****Plot 1: 5 MHz, 99% OBW****Plot 2: 5 MHz, -26 dBc OBW**

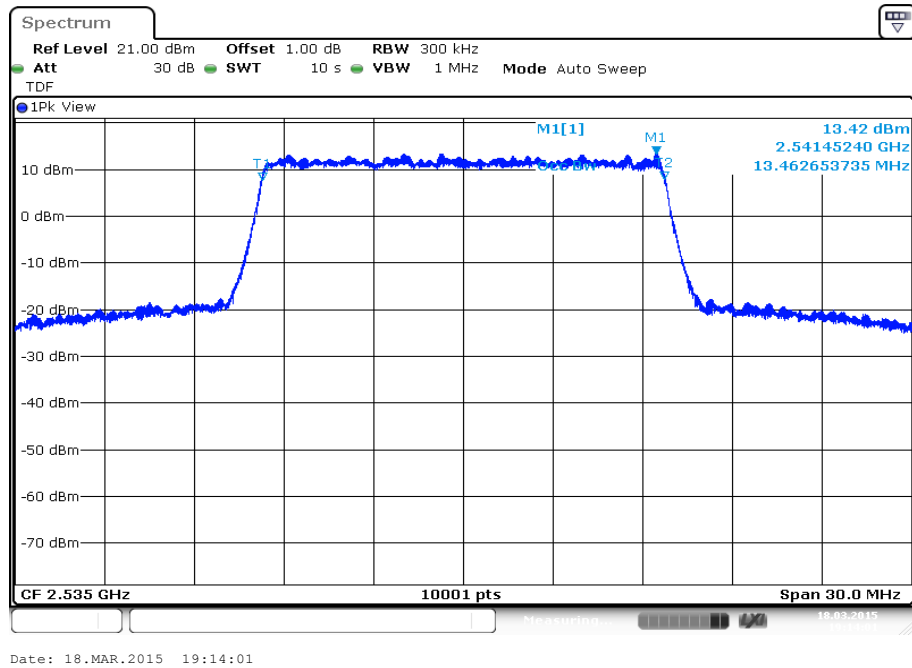
Plot 3: 10 MHz, 99% OBW



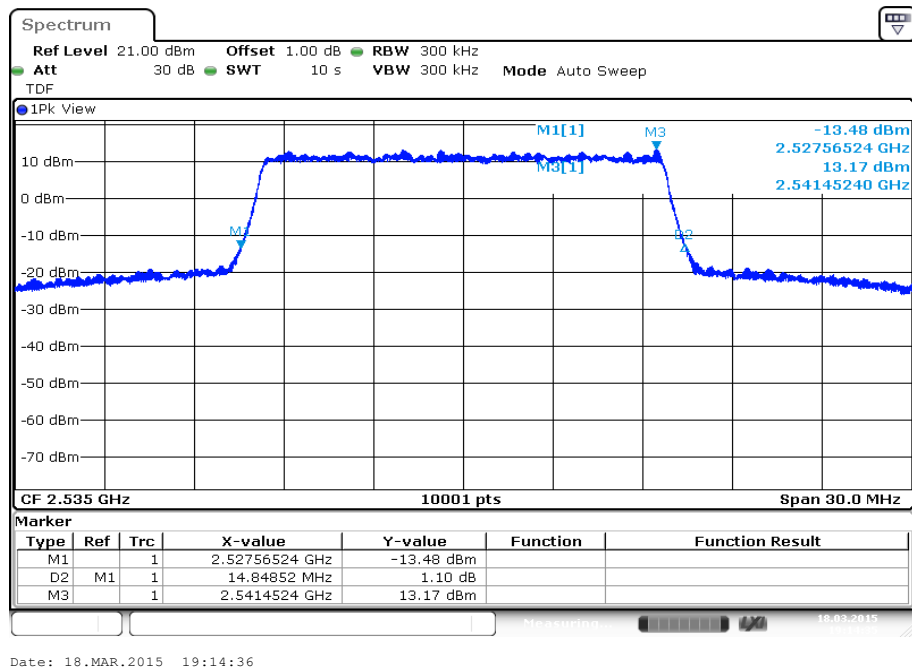
Plot 4: 10 MHz, -26 dBc OBW



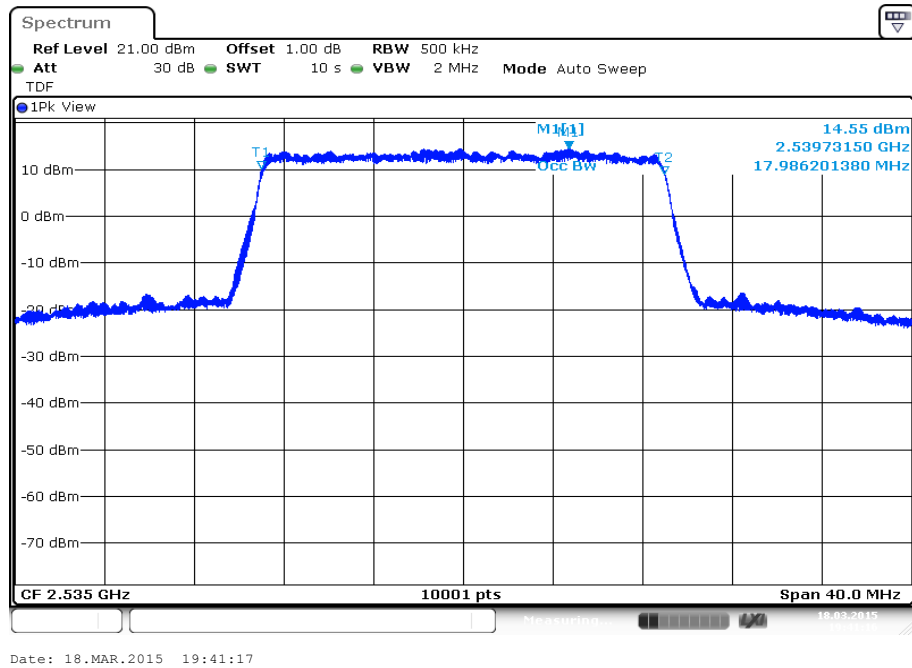
Plot 5: 15 MHz, 99% OBW



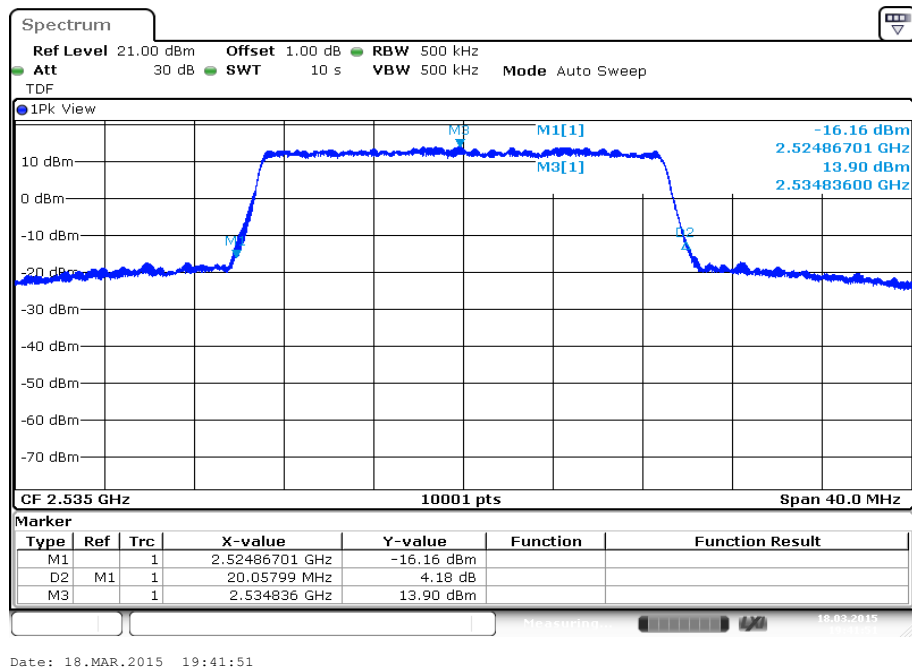
Plot 6: 15 MHz, -26 dBc OBW



Plot 7: 20 MHz, 99% OBW



Plot 8: 20 MHz, -26 dBc OBW





## 11 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	2015-04-23
A	Measurement results for frequency stability 4.5 V added Editorial changes – references to IC removed	2015-07-22

**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



Deutsche Akkreditierungsstelle GmbH

Befehlens 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:

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 VoIP und DECT  
 Akustik  
 Funk einschließlich WLAN  
 Short Range Devices (SRD)  
 RFID  
 WiMax und Richtfunk  
 Mobilfunk (GSM / GPRS, 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

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Frankfurt am Main, 07.03.2014

Satz 03/04 auf der Rückseite

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 10117 Berlin

Standort Frankfurt am Main  
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 60594 Frankfurt am Main

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 38115 Braunschweig

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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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