
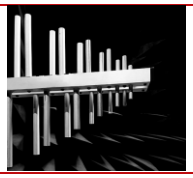
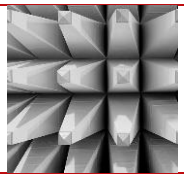

CETECOM™
CETECOM ICT Services
consulting - testing - certification ➤➤➤

TEST REPORT

Test report no.: 1-8297/14-04-05-A

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-00

Testing laboratory

CETECOM ICT Services GmbH
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Accredited Testing Laboratory:
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

peiker acustic GmbH & Co. KG
Max-Planck Str. 28-32
61381 Friedrichsdorf / GERMANY
Phone: -/-
Fax: +49 6172-767-220
Contact: Martin Fleckenstein
e-mail: martin.fleckenstein@peiker.de
Phone: +49 6172 767-1379

Manufacturer

peiker acustic GmbH & Co. KG
Max-Planck Str. 28-32
61381 Friedrichsdorf / GERMANY

Test standard/s

47 CFR Part 22	Title 47 of the Code of Federal Regulations; Chapter I; Part 22 - Public mobile 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 5: 824 MHz – 849 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:

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Test performed:

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Andreas Luckenbill
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 1-8297/14-04-05 and dated 2015-04-01

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:	2015-03-27
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 22	-/-	Title 47 of the Code of Federal Regulations; Chapter I; Part 22 - Public mobile 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: 0000503802
HW hardware status	:	102.010.010
SW software status	:	001.017.047
Frequency band	:	LTE FDD 5: 824 MHz – 849 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

☒	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☐	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 22	See table!	2015-07-24	-/-

7.1 LTE band V

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

Note: NA = Not applicable; NP = Not performed

8 Description of test setup

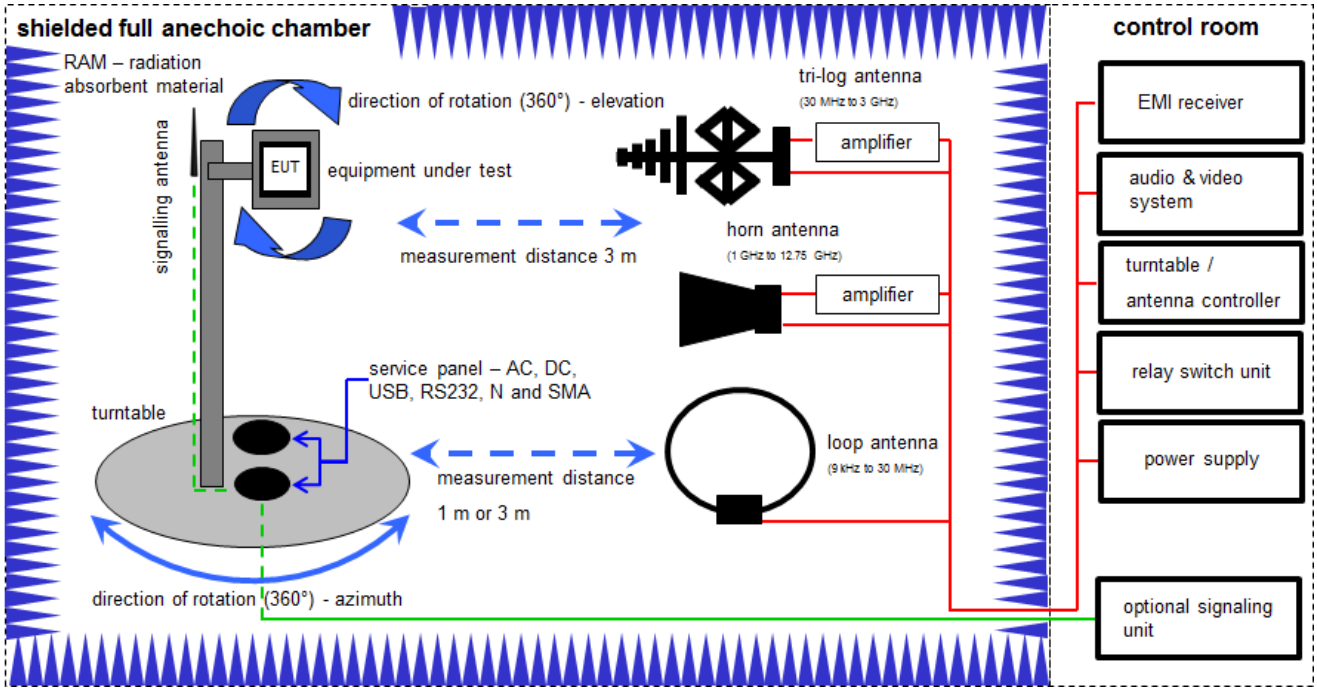
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements 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
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

8.1 Shielded fully anechoic chamber

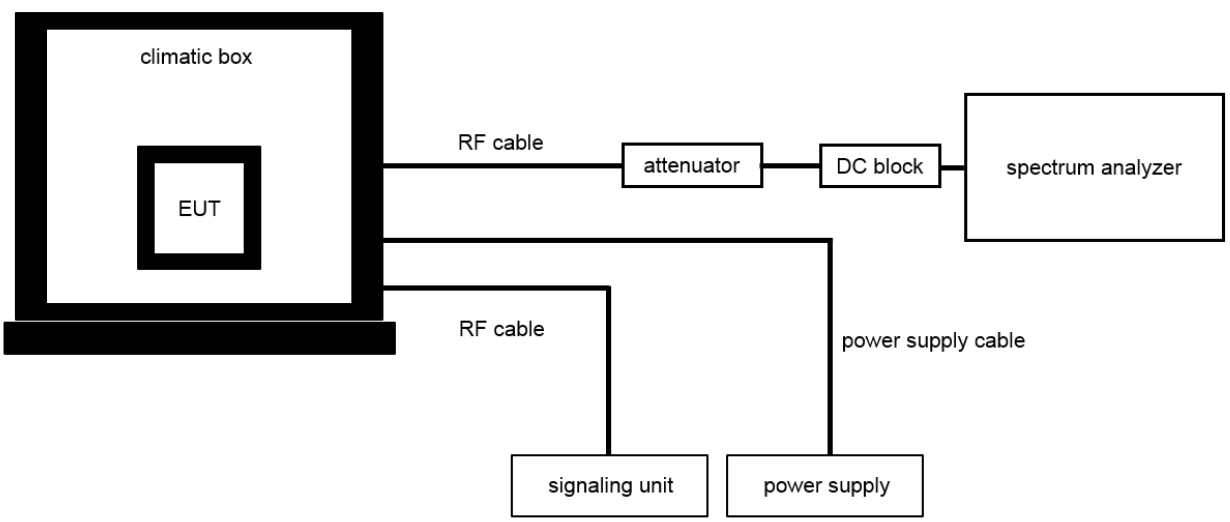


Equipment table:

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	vIKl!	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	vIKl!	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

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 [dBm] = 6.0 [dBm] + (11.7) [dB] = 17.7 [dBm] (58.88 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	vlKl!	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 Test Results

9.1 Results LTE band V

The EUT was set to transmit the maximum power.

9.1.1 RF output power

Description:

This paragraph contains average power, peak output power and ERP 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 peak and average value is calculated.

Measurement parameters	
Measured with CMW500	
Used test setup:	see chapter 8.2

Limits:

FCC
CFR Part 22.913 CFR Part 2.1046
Nominal Peak Output Power
+38.45 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

Results:

			Output Power (conducted)					
Bandwidth (MHz)	**Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Peak 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)**
1.4	824.7	1 RB low	23.8	29.3	5.54	23.0	29.2	6.15
		1 RB high	23.8	29.4	5.58	23.0	29.2	6.19
		50% RB mid	23.7	29.0	5.27	22.7	29.6	6.94
		100% RB	22.8	29.2	6.41	21.7	28.8	7.14
	836.5	1 RB low	23.6	30.0	6.43	22.2	27.4	5.21
		1 RB high	23.6	30.0	6.44	22.2	27.4	5.23
		50% RB mid	23.7	30.8	7.14	22.9	29.3	6.39
		100% RB	22.7	29.6	6.94	21.9	28.7	6.80
	848.3	1 RB low	23.5	28.5	5.02	22.3	28.8	6.54
		1 RB high	23.3	28.3	5.04	22.3	28.8	6.51
		50% RB mid	23.4	29.5	6.10	22.4	29.6	7.21
		100% RB	22.5	30.0	7.49	21.7	28.9	7.18
3	825.5	1 RB low	23.8	29.9	6.12	23.0	28.5	5.50
		1 RB high	23.8	30.0	6.22	22.9	28.5	5.60
		50% RB mid	22.9	30.0	7.08	21.7	27.9	6.15
		100% RB	22.8	29.4	6.56	22.0	27.9	5.88
	836.5	1 RB low	23.6	28.8	5.19	22.3	28.7	6.43
		1 RB high	23.6	28.8	5.16	22.2	28.7	6.45
		50% RB mid	22.7	29.6	6.89	22.0	29.0	6.98
		100% RB	22.7	29.1	6.42	21.6	29.2	7.61
	847.5	1 RB low	23.4	30.5	7.06	22.1	27.5	5.38
		1 RB high	23.2	30.2	7.02	22.0	27.4	5.35
		50% RB mid	22.4	29.8	7.36	21.5	28.1	6.61
		100% RB	22.4	29.1	6.72	21.6	27.8	6.16
5	826.5	1 RB low	23.8	29.3	5.54	22.9	28.2	5.27
		1 RB high	23.7	29.5	5.75	22.8	28.2	5.35
		50% RB mid	22.8	29.2	6.41	22.0	28.9	6.89
		100% RB	22.8	29.2	6.42	21.9	29.3	7.43
	836.5	1 RB low	23.7	30.3	6.59	22.5	28.0	5.45
		1 RB high	23.7	30.3	6.60	22.5	28.0	5.47
		50% RB mid	22.7	29.9	7.20	21.8	28.5	6.66
		100% RB	22.7	30.3	7.56	21.7	28.2	6.51
	846.5	1 RB low	23.6	28.8	5.19	22.4	29.3	6.85
		1 RB high	23.4	28.6	5.19	22.3	29.1	6.80
		50% RB mid	22.5	28.9	6.39	21.5	29.0	7.50
		100% RB	22.4	28.4	6.02	21.5	28.8	7.34

10	829	1 RB low	23.8	30.0	6.18	23.0	28.6	5.56
		1 RB high	23.7	30.1	6.41	23.0	28.8	5.85
		50% RB mid	22.7	30.2	7.50	21.7	28.4	6.72
		100% RB	22.6	30.4	7.80	21.6	28.2	6.61
	836.5	1 RB low	23.6	28.8	5.22	22.4	28.8	6.45
		1 RB high	23.5	28.7	5.22	22.1	28.6	6.46
		50% RB mid	22.6	29.4	6.79	21.7	29.8	8.14
		100% RB	22.5	29.4	6.88	21.7	29.2	7.55
	844	1 RB low	23.5	30.6	7.05	22.2	27.6	5.42
		1 RB high	23.3	30.3	7.03	21.9	27.3	5.41
		50% RB mid	22.4	30.5	8.10	21.4	28.0	6.62
		100% RB	22.4	30.5	8.05	21.4	28.0	6.63
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	824.7	19.9	19.1
	836.5	19.1	18.3
	848.3	19.7	18.6
3	825.5	19.9	19.1
	836.5	19.0	17.7
	847.5	19.6	18.3
5	826.5	19.9	19.0
	836.5	19.1	17.9
	846.5	19.8	18.6
10	829.0	19.9	19.1
	836.5	19.0	17.7
	844.0	19.7	18.4
Measurement uncertainty		± 3.0 dB	

Verdict: **Complies**

9.1.2 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 4180 (centre channel), measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +60°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps remeasuring carrier frequency at each voltage. Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

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
CFR Part 22.355 CFR Part 2.1055
Frequency Stability
± 0.1 ppm

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
4.5	8	0.00000096	0.0096
4.8	7	0.00000084	0.0084
8.0	-1	-0.00000012	-0.0012
14.0	8	0.00000096	0.0096
18.0	-10	-0.00000120	-0.0120

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	4	0.00000048	0.0048
-20	6	0.00000072	0.0072
-10	4	0.00000048	0.0048
± 0	2	0.00000024	0.0024
10	-1	-0.00000012	-0.0012
20	-10	-0.00000120	-0.0120
30	2	0.00000024	0.0024
40	-8	-0.00000096	-0.0096
50	10	0.00000120	0.0120
60	-10	-0.00000120	-0.0120

Verdict: **Complies**

9.1.3 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 846.6 MHz. Measurement made up to 12.75 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE band V.

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 hight 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
CFR Part 22.917 CFR Part 2.1053
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)
-13 dBm

Results:

Radiated emissions measurements were made only at the center carrier frequency of the LTE band V (836.5 MHz). It was decided that measurements at this carrier frequency 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 V 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. If spurious were detected, the lowest and highest channel were checked too. The found values are stated in the table below.

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.

QPSK:

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	-	2	1673.0	-	2	1688.0	-
3	2487.0	-	3	2509.5	-	3	2532.0	-
4	3316.0	-	4	3346.0	-	4	3376.0	-
5	4145.0	-	5	4182.5	-	5	4220.0	-
6	4974.0	-	6	5019.0	-	6	5064.0	-
7	5803.0	-	7	5855.5	-	7	5908.0	-
8	6632.0	-	8	6692.0	-	8	6752.0	-
9	7461.0	-	9	7528.5	-	9	7596.0	-
10	8290.0	-	10	8365.0	-	10	8440.0	-
Measurement uncertainty			± 3dB					

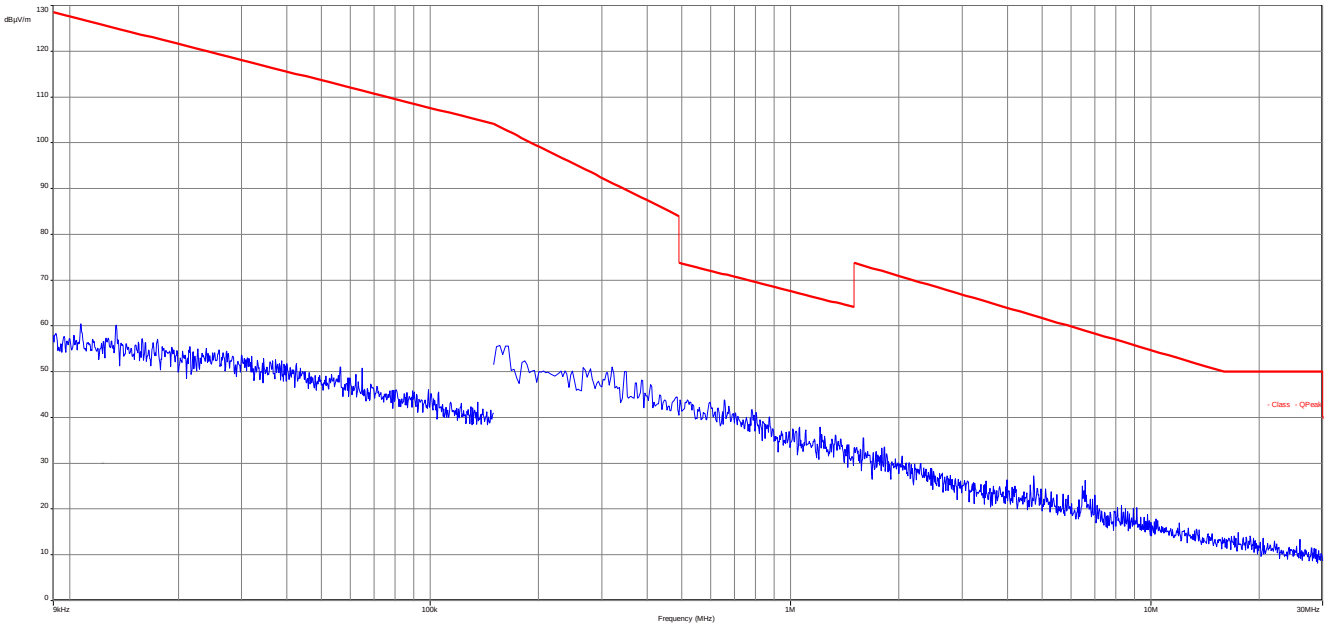
16-QAM:

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	-	2	1673.0	-	2	1688.0	-
3	2487.0	-	3	2509.5	-	3	2532.0	-
4	3316.0	-	4	3346.0	-	4	3376.0	-
5	4145.0	-	5	4182.5	-	5	4220.0	-
6	4974.0	-	6	5019.0	-	6	5064.0	-
7	5803.0	-	7	5855.5	-	7	5908.0	-
8	6632.0	-	8	6692.0	-	8	6752.0	-
9	7461.0	-	9	7528.5	-	9	7596.0	-
10	8290.0	-	10	8365.0	-	10	8440.0	-
Measurement uncertainty			± 3dB					

Verdict: **Complies**

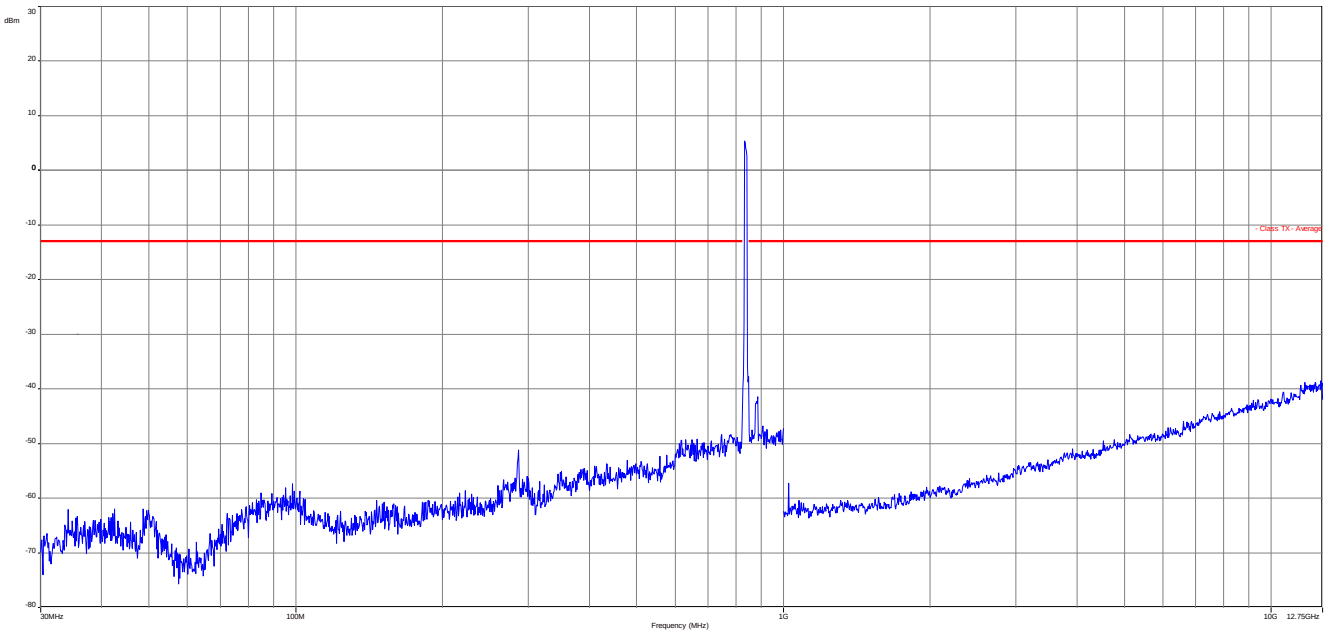
QPSK with 10 MHz channel bandwidth

Plot 1: Channel 20525 (Traffic mode up to 30 MHz)



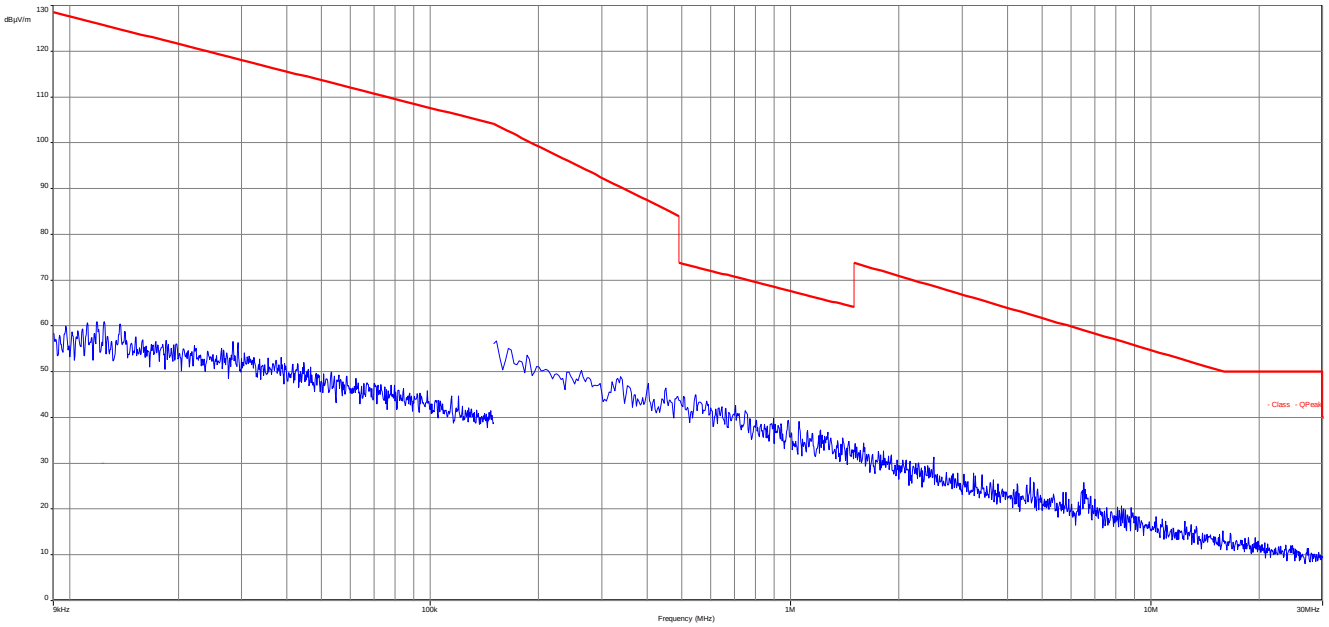
T

Plot 2: Channel 20525 (30 MHz – 12.75 GHz)

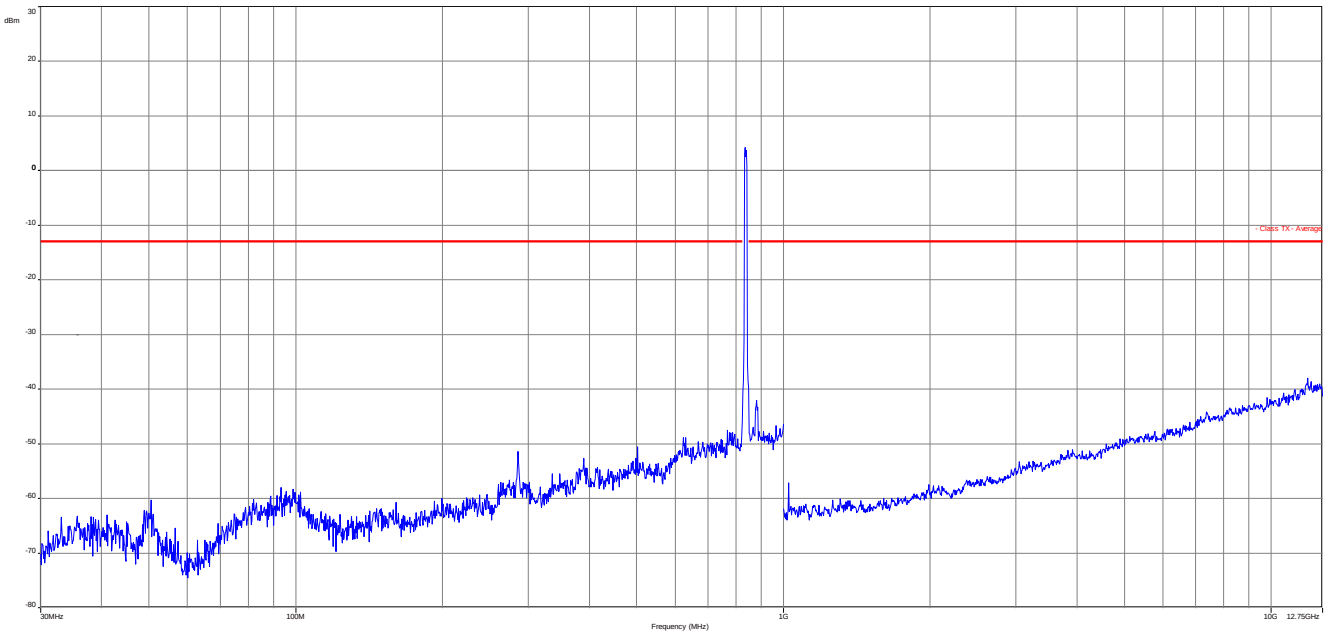


16-QAM with 10 MHz channel bandwidth

Plot 3: Channel 20525 (Traffic mode up to 30 MHz)



Plot 4: Channel 20525 (30 MHz – 12.75 GHz)



9.1.4 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. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 9 GHz, data taken from 10 MHz to 26 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Resolution bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Span:	10 MHz – 26 GHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

FCC
CFR Part 22.917 CFR Part 2.1051
Spurious Emissions Conducted
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)
-13 dBm

Results: **for 1.4 MHz channel bandwidth**

QPSK

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1649.4	-	2	1673.0	-	2	1696,6	-
3	2474.1	-	3	2509.5	-	3	2544,9	-
4	3298.8	-	4	3346.0	-	4	3393,2	-
5	4123.5	-	5	4182.5	-	5	4241,5	-
6	4948.2	-	6	5019.0	-	6	5089,8	-
7	5772.9	-	7	5855.5	-	7	5938,1	-
8	6597.6	-	8	6692.0	-	8	6786,4	-
9	7422.3	-	9	7258.5	-	9	7634,7	-
10	8247.0	-	10	8365.0	-	10	8483	-
Measurement uncertainty			± 0.5dB					

16-QAM

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1649.4	-	2	1673.0	-	2	1696.6	-
3	2474.1	-	3	2509.5	-	3	2544.9	-
4	3298.8	-	4	3346.0	-	4	3393.2	-
5	4123.5	-	5	4182.5	-	5	4241.5	-
6	4948.2	-	6	5019.0	-	6	5089.8	-
7	5772.9	-	7	5855.5	-	7	5938.1	-
8	6597.6	-	8	6692.0	-	8	6786.4	-
9	7422.3	-	9	7258.5	-	9	7634.7	-
10	8247.0	-	10	8365.0	-	10	8483.0	-
Measurement uncertainty			± 0.5dB					

Results: **for 3 MHz channel bandwidth**

QPSK

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1651.0	-	2	1673.0	-	2	1695.0	-
3	2476.5	-	3	2509.5	-	3	2542.5	-
4	3302.0	-	4	3346.0	-	4	3390.0	-
5	4127.5	-	5	4182.5	-	5	4237.5	-
6	4953.0	-	6	5019.0	-	6	5085.0	-
7	5778.5	-	7	5855.5	-	7	5932.5	-
8	6604.0	-	8	6692.0	-	8	6780.0	-
9	7429.5	-	9	7258.5	-	9	7627.5	-
10	8255.0	-	10	8365.0	-	10	8475.0	-
Measurement uncertainty				± 0.5dB				

16-QAM

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1651.0	-	2	1673.0	-	2	1695.0	-
3	2476.5	-	3	2509.5	-	3	2542.5	-
4	3302.0	-	4	3346.0	-	4	3390.0	-
5	4127.5	-	5	4182.5	-	5	4237.5	-
6	4953.0	-	6	5019.0	-	6	5085.0	-
7	5778.5	-	7	5855.5	-	7	5932.5	-
8	6604.0	-	8	6692.0	-	8	6780.0	-
9	7429.5	-	9	7258.5	-	9	7627.5	-
10	8255.0	-	10	8365.0	-	10	8475.0	-
Measurement uncertainty				± 0.5dB				

Results: **for 5 MHz channel bandwidth**

QPSK

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1653.0	-	2	1673.0	-	2	1693.0	-
3	2479.5	-	3	2509.5	-	3	2539.5	-
4	3306.0	-	4	3346.0	-	4	3386.0	-
5	4132.5	-	5	4182.5	-	5	4232.5	-
6	4959.0	-	6	5019.0	-	6	5079.0	-
7	5785.5	-	7	5855.5	-	7	5925.5	-
8	6612.0	-	8	6692.0	-	8	6772.0	-
9	7438.5	-	9	7528.5	-	9	7618.5	-
10	8265.0	-	10	8365.0	-	10	8465.0	-
Measurement uncertainty			± 0.5dB					

16-QAM

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1653.0	-	2	1673.0	-	2	1693.0	-
3	2479.5	-	3	2509.5	-	3	2539.5	-
4	3306.0	-	4	3346.0	-	4	3386.0	-
5	4132.5	-	5	4182.5	-	5	4232.5	-
6	4959.0	-	6	5019.0	-	6	5079.0	-
7	5785.5	-	7	5855.5	-	7	5925.5	-
8	6612.0	-	8	6692.0	-	8	6772.0	-
9	7438.5	-	9	7528.5	-	9	7618.5	-
10	8265.0	-	10	8365.0	-	10	8465.0	-
Measurement uncertainty			± 0.5dB					

Results: **for 10 MHz channel bandwidth**

QPSK

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	-	2	1673.0	-	2	1688.0	-
3	2487.0	-	3	2509.5	-	3	2532.0	-
4	3316.0	-	4	3346.0	-	4	3376.0	-
5	4145.0	-	5	4182.5	-	5	4220.0	-
6	4974.0	-	6	5019.0	-	6	5064.0	-
7	5803.0	-	7	5855.5	-	7	5908.0	-
8	6632.0	-	8	6692.0	-	8	6752.0	-
9	7461.0	-	9	7528.5	-	9	7596.0	-
10	8290.0	-	10	8365.0	-	10	8440.0	-
Measurement uncertainty				± 0.5dB				

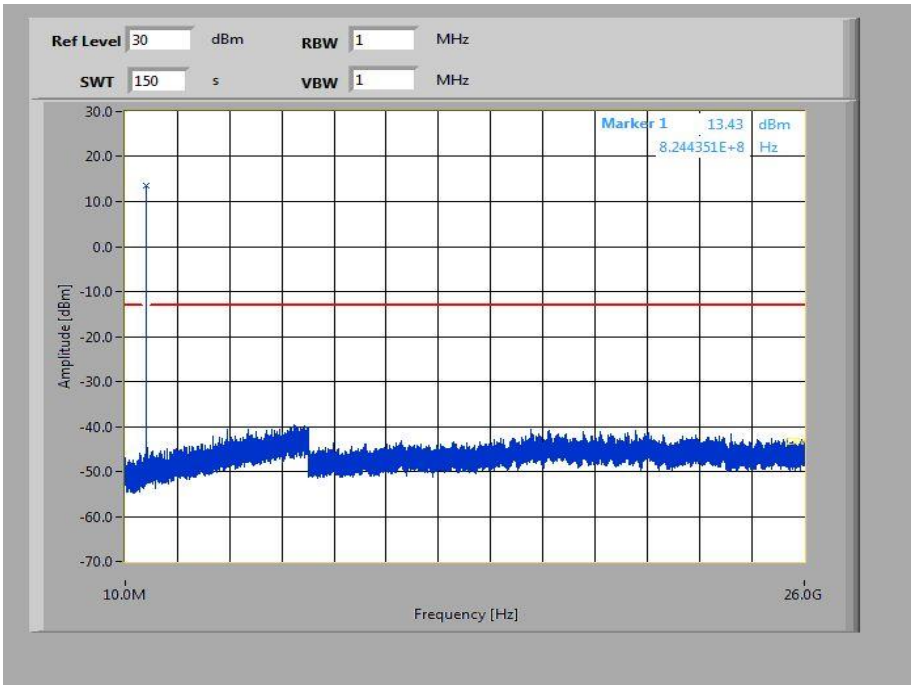
16-QAM

Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	-	2	1673.0	-	2	1688.0	-
3	2487.0	-	3	2509.5	-	3	2532.0	-
4	3316.0	-	4	3346.0	-	4	3376.0	-
5	4145.0	-	5	4182.5	-	5	4220.0	-
6	4974.0	-	6	5019.0	-	6	5064.0	-
7	5803.0	-	7	5855.5	-	7	5908.0	-
8	6632.0	-	8	6692.0	-	8	6752.0	-
9	7461.0	-	9	7528.5	-	9	7596.0	-
10	8290.0	-	10	8365.0	-	10	8440.0	-
Measurement uncertainty				± 0.5dB				

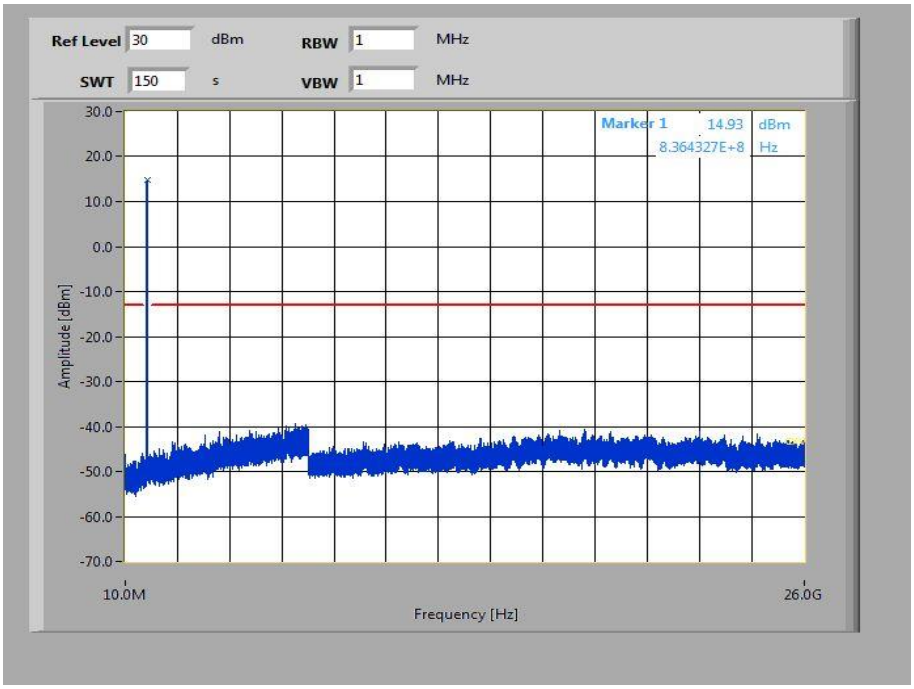
Verdict: **Complies**

Plots: QPSK with 1.4 MHz channel bandwidth

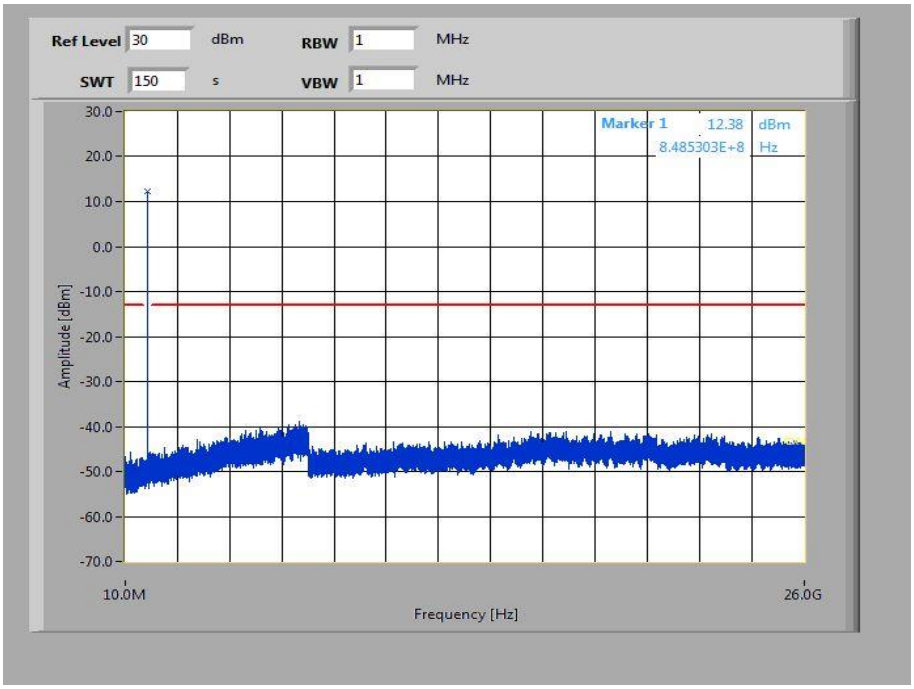
Plot 1: Lowest Channel (10 MHz - 26 GHz)



Plot 2: Middle Channel (10 MHz - 26 GHz)

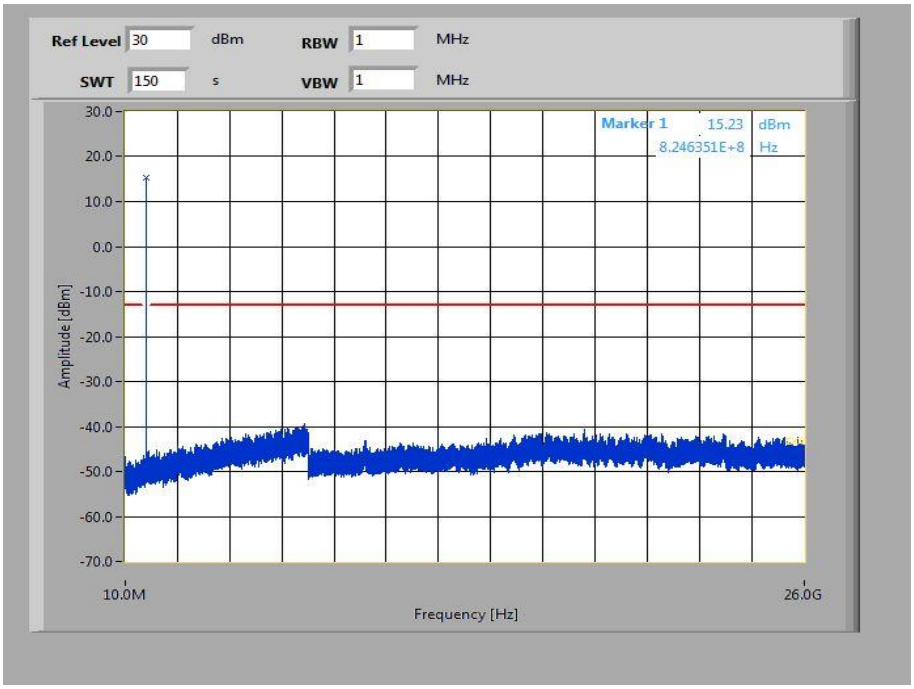


Plot 3: Highest Channel (10 MHz - 26 GHz)

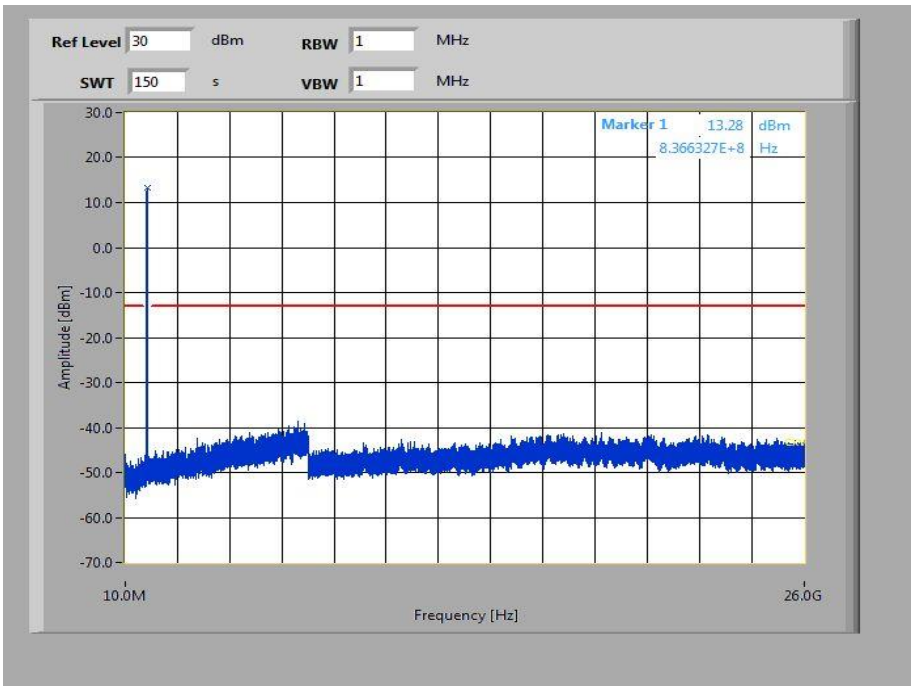


Plots: 16-QAM with 1.4 MHz channel bandwidth

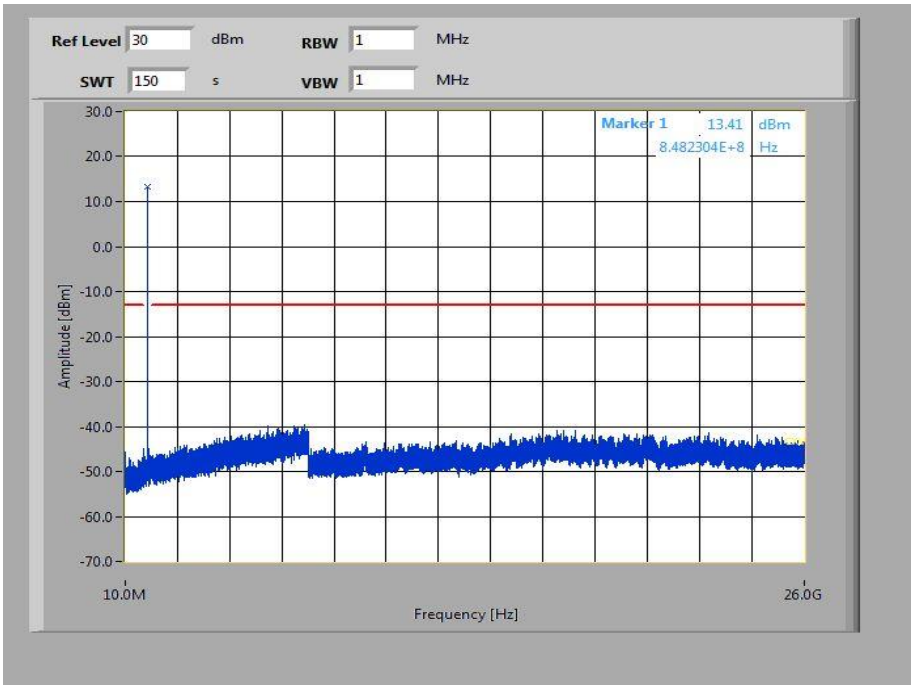
Plot 1: Lowest Channel (10 MHz - 26 GHz)



Plot 2: Middle Channel (10 MHz - 26 GHz)

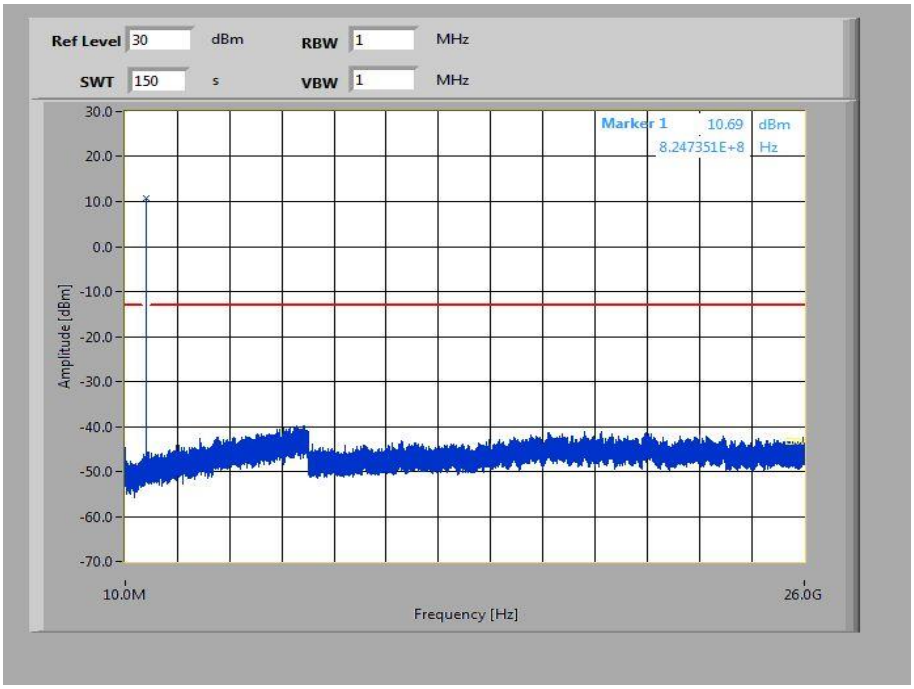


Plot 3: Highest Channel (10 MHz - 26 GHz)

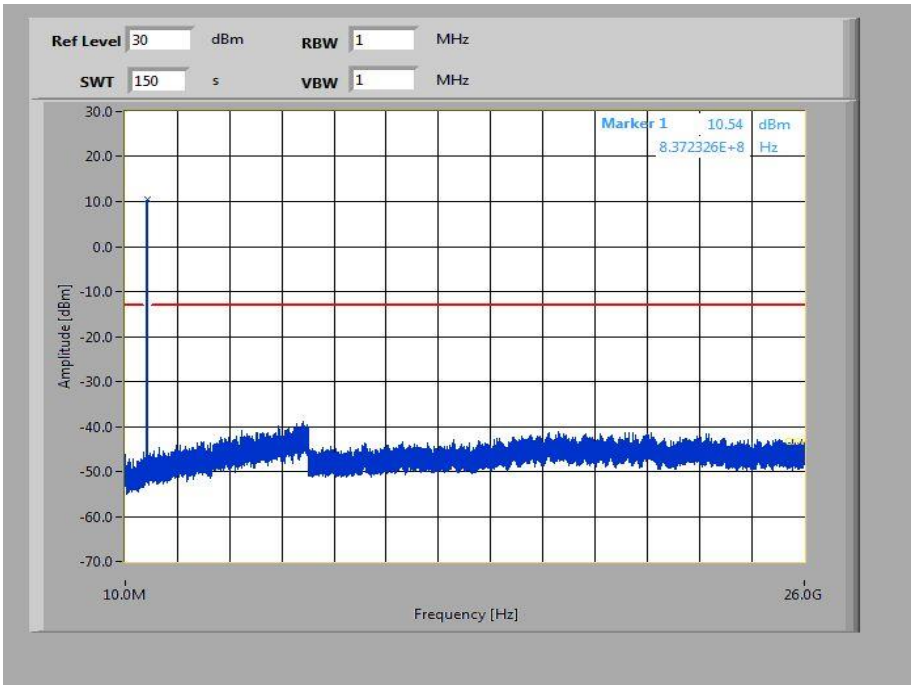


Plots: QPSK with 3 MHz channel bandwidth

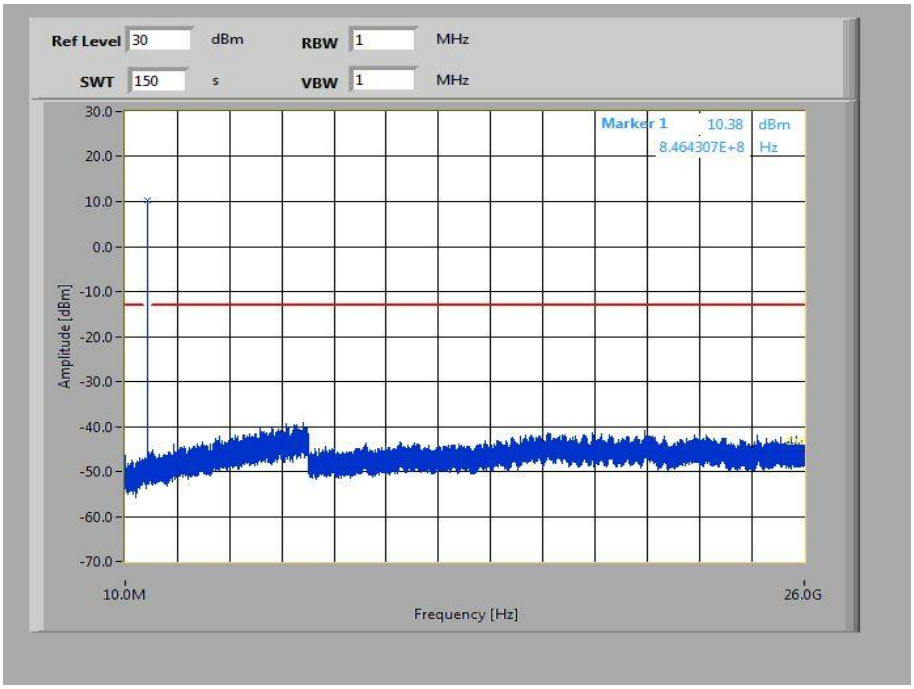
Plot 4: Lowest Channel (10 MHz - 26 GHz)



Plot 5: Middle Channel (10 MHz - 26 GHz)

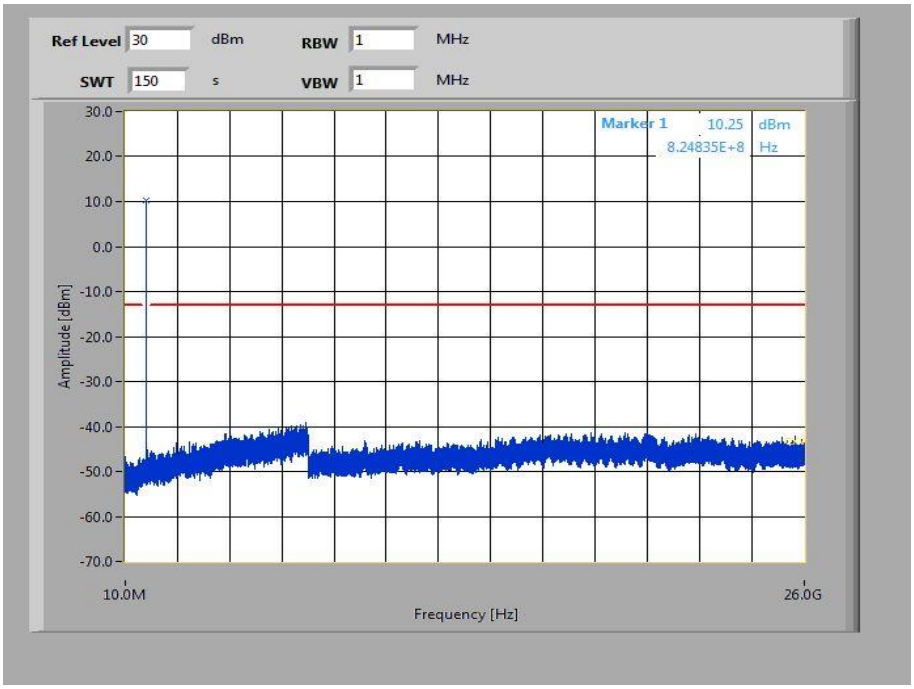


Plot 6: Highest Channel (10 MHz - 26 GHz)

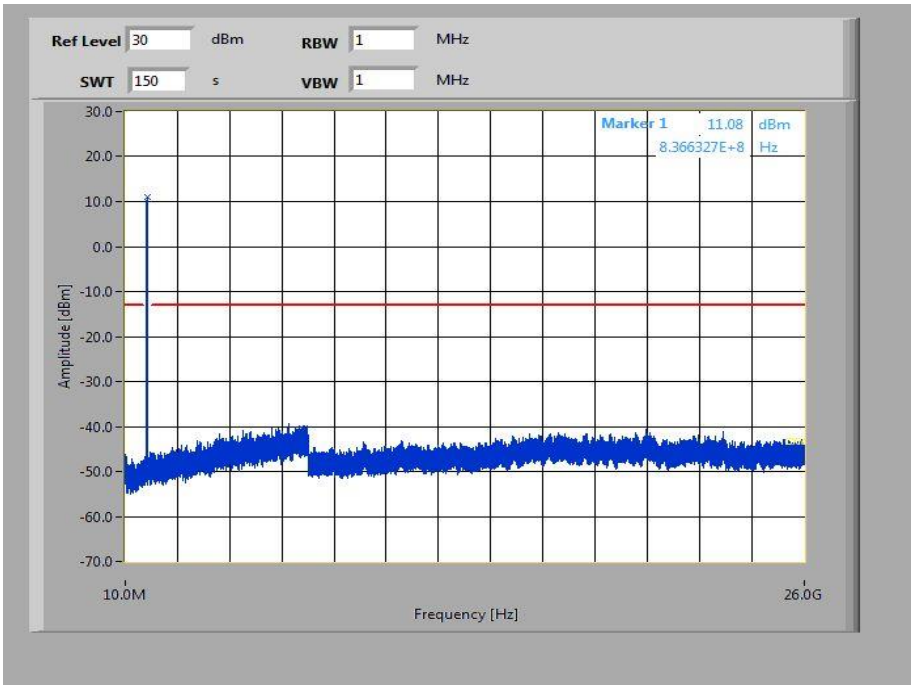


Plots: 16-QAM with 3 MHz channel bandwidth

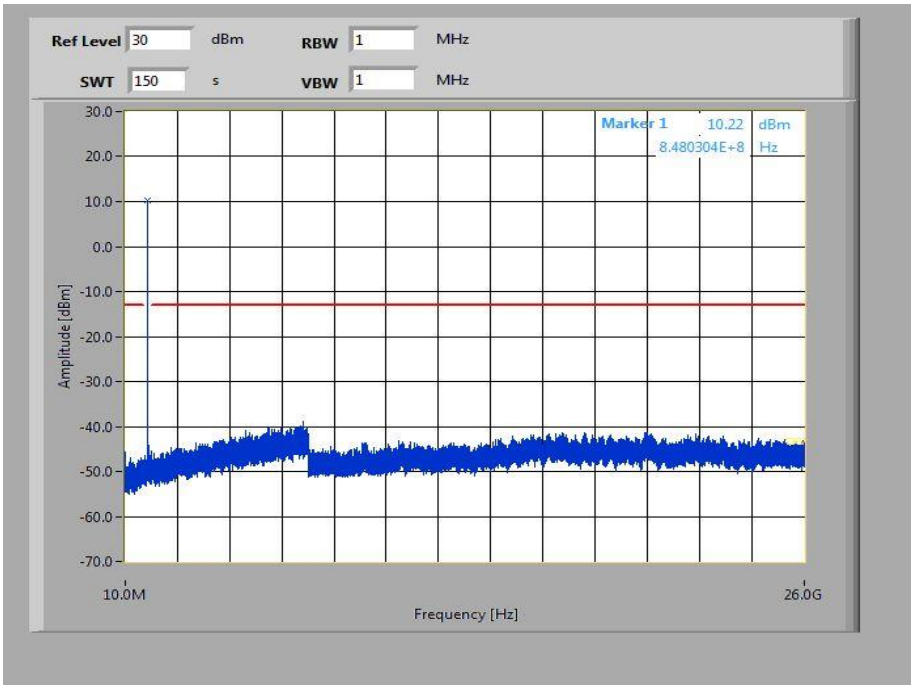
Plot 4: Lowest Channel (10 MHz - 26 GHz)



Plot 5: Middle Channel (10 MHz - 26 GHz)

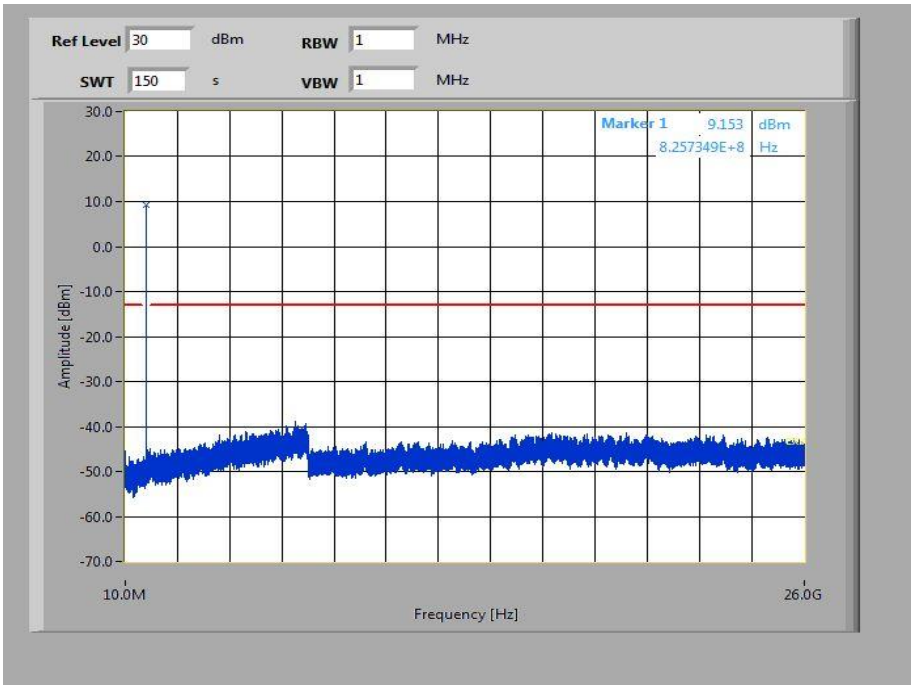


Plot 6: Highest Channel (10 MHz - 26 GHz)

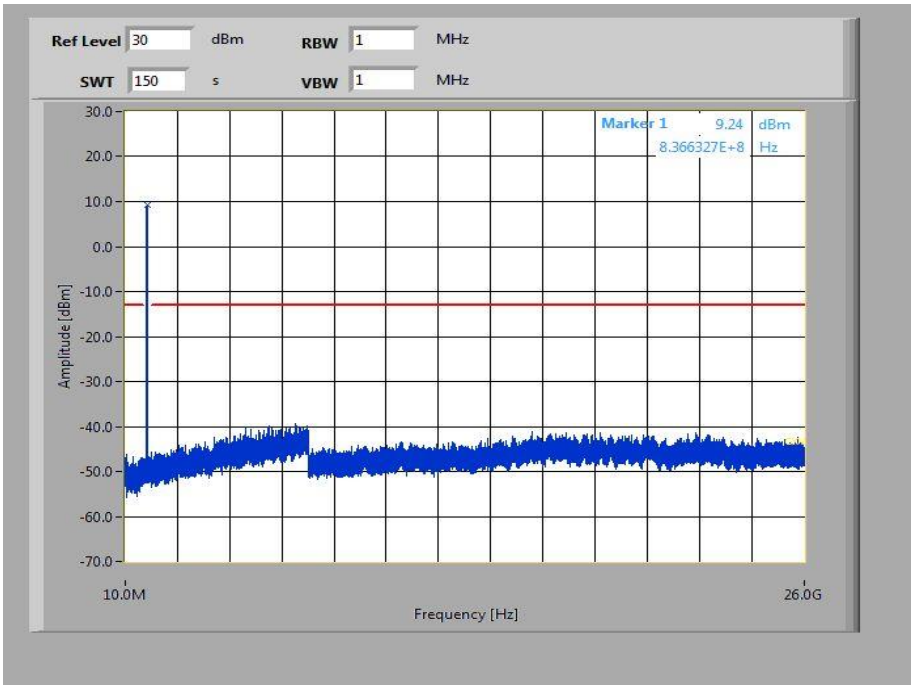


Plots: QPSK with 5 MHz channel bandwidth

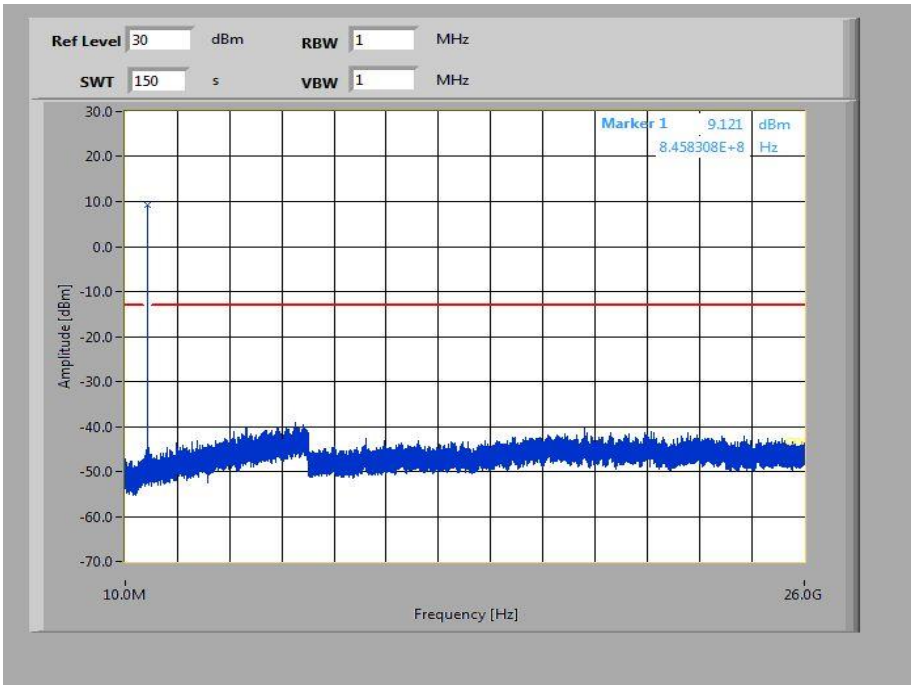
Plot 1: Lowest Channel (10 MHz - 26 GHz)



Plot 2: Middle Channel (10 MHz - 26 GHz)

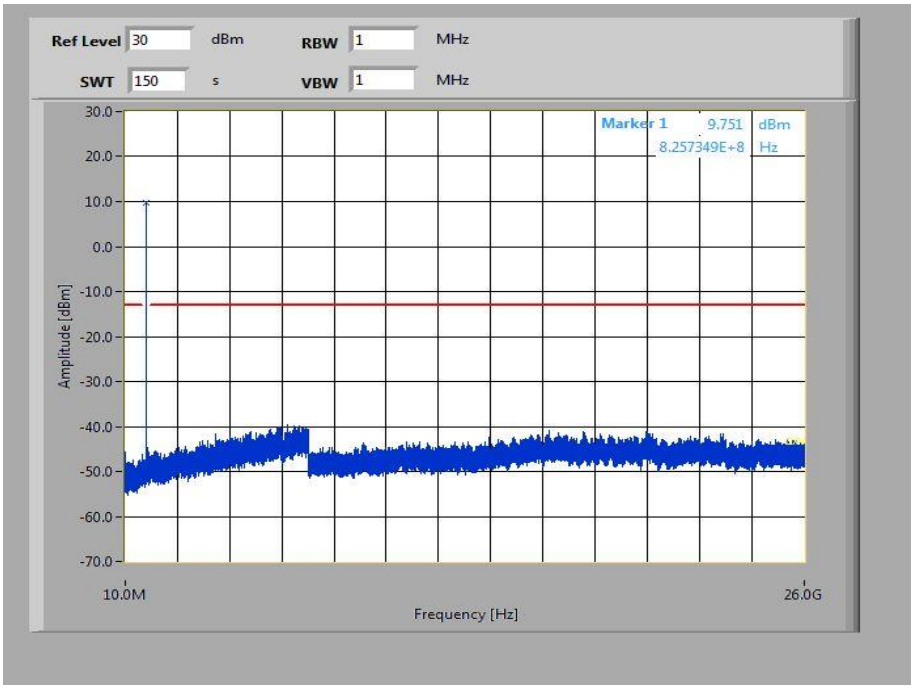


Plot 3: Highest Channel (10 MHz - 26 GHz)

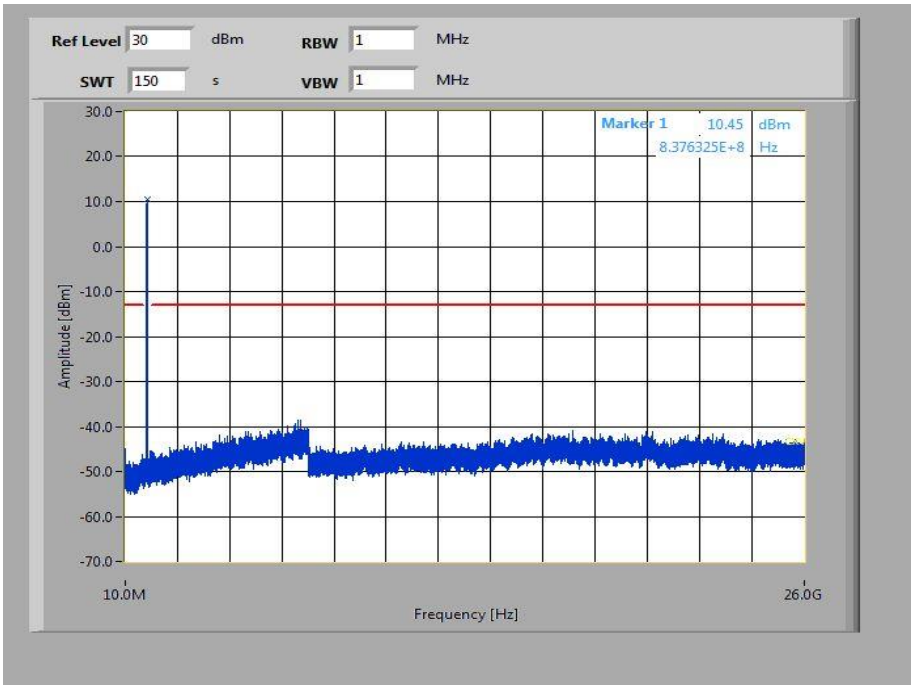


Plots: 16-QAM with 5 MHz channel bandwidth

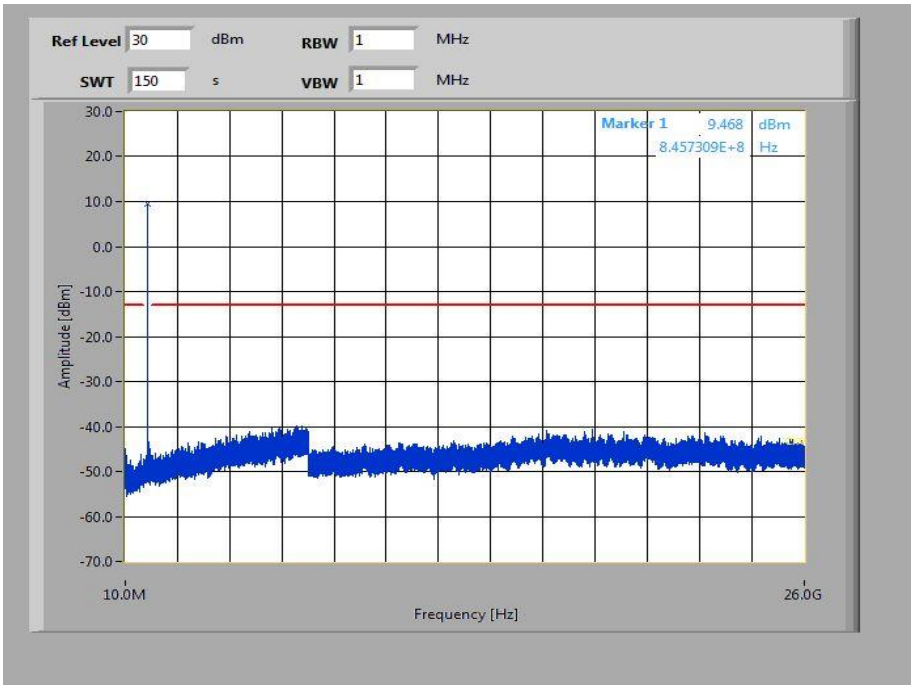
Plot 4: Lowest Channel (10 MHz - 26 GHz)



Plot 5: Middle Channel (10 MHz - 26 GHz)

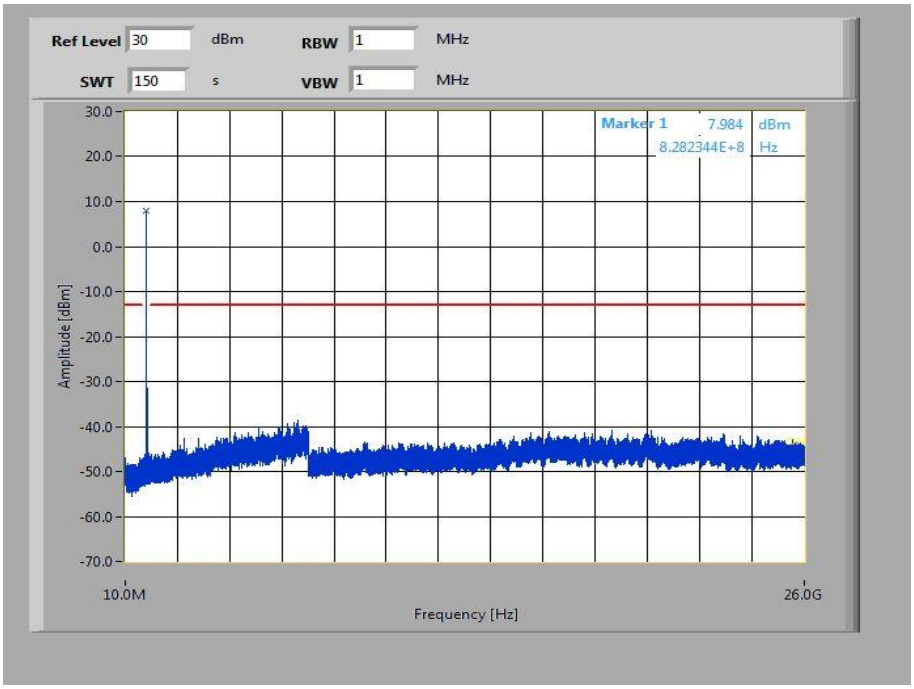


Plot 6: Highest Channel (10 MHz - 26 GHz)

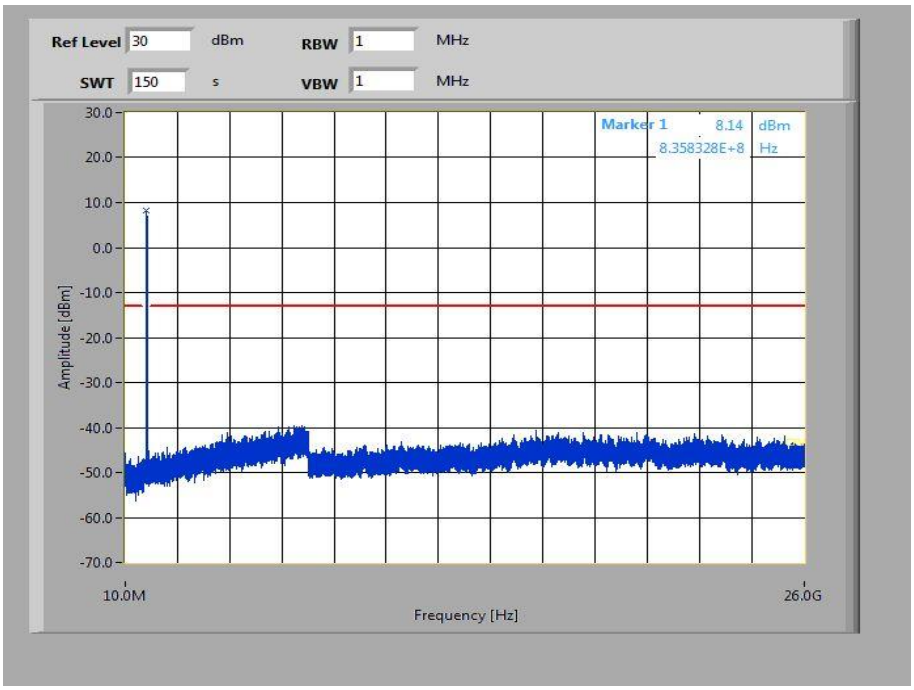


Plots: QPSK with 10 MHz channel bandwidth

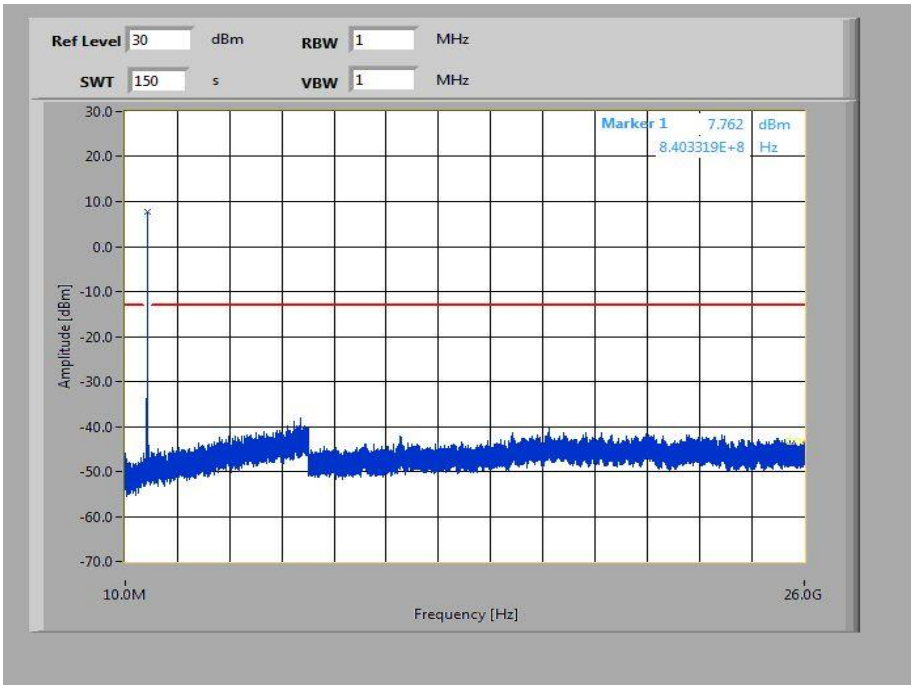
Plot 1: Lowest Channel (10 MHz - 26 GHz)



Plot 2: Middle Channel (10 MHz - 26 GHz)

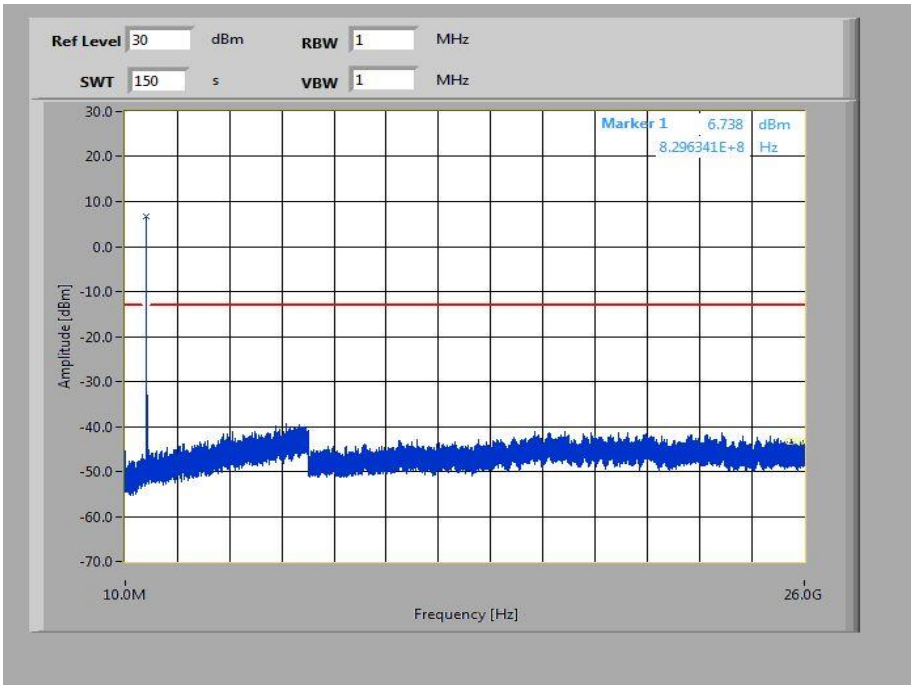


Plot 3: Highest Channel (10 MHz - 26 GHz)

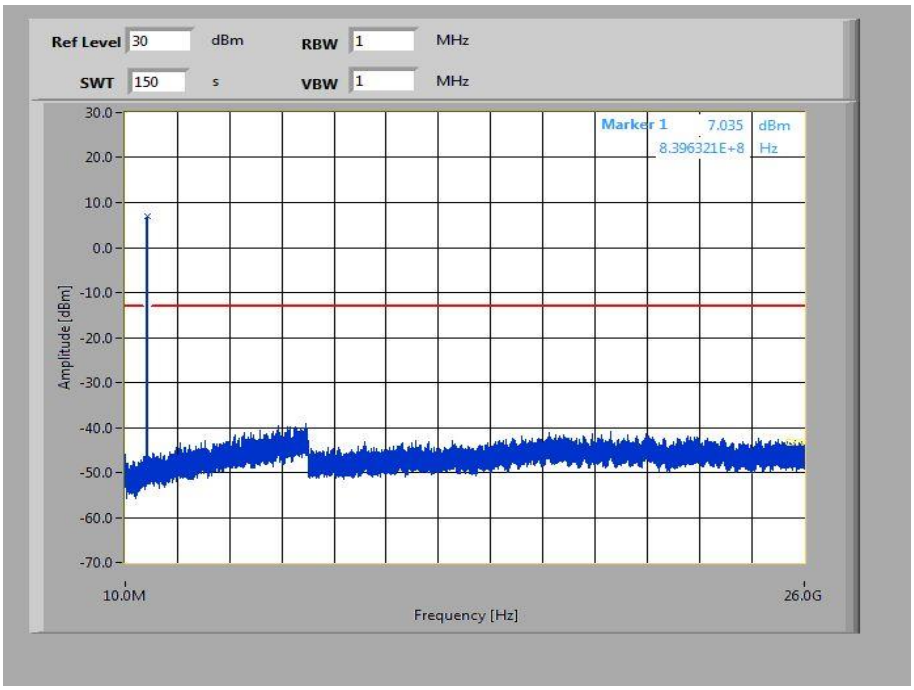


Plots: 16-QAM with 10 MHz channel bandwidth

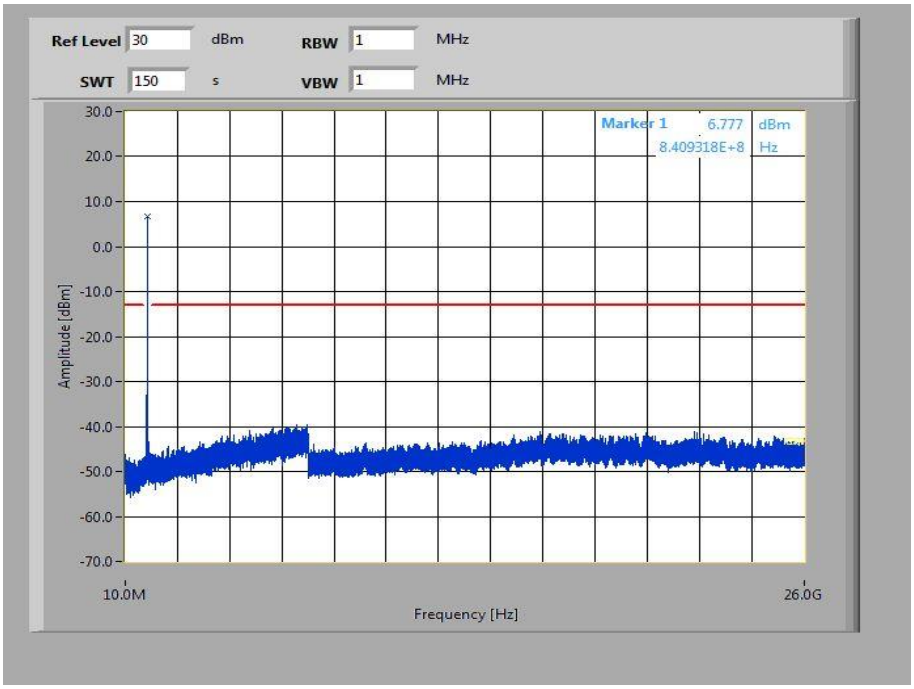
Plot 4: Lowest Channel (10 MHz - 26 GHz)



Plot 5: Middle Channel (10 MHz - 26 GHz)



Plot 6: Highest Channel (10 MHz - 26 GHz)



9.1.5 Block edge compliance

Description:

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

Measurement:

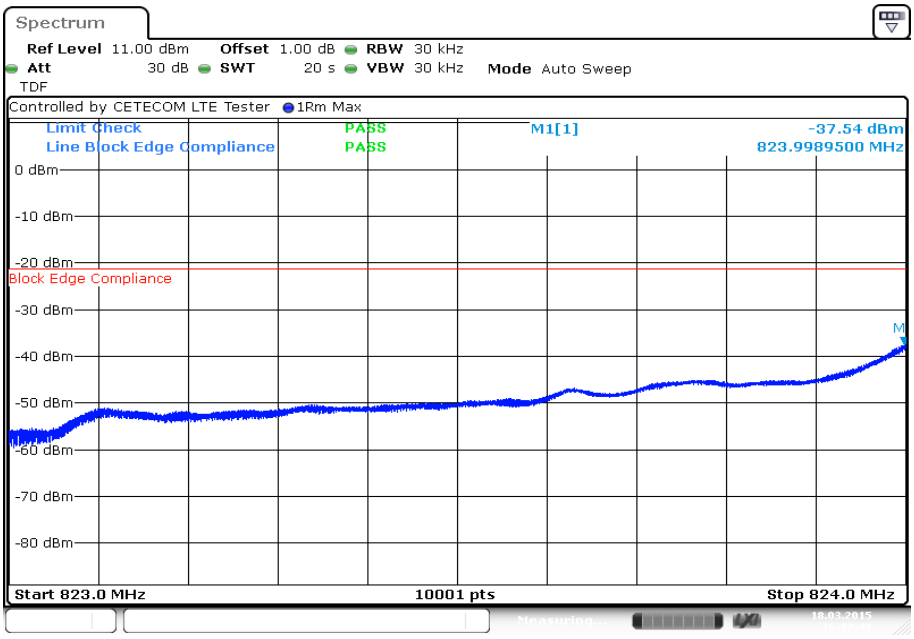
Measurement parameters	
Detector:	RMS
Sweep time:	60 s
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

FCC
CFR Part 22.917 CFR Part 2.1051
Block Edge Compliance
Part 22.917 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 -5.23 adjustment to the limit [10 log(30kHz/100kHz) = -5.23]. When this adjustment is applied to the limit, the limit becomes -18.23 dBm.
-18.23 dBm

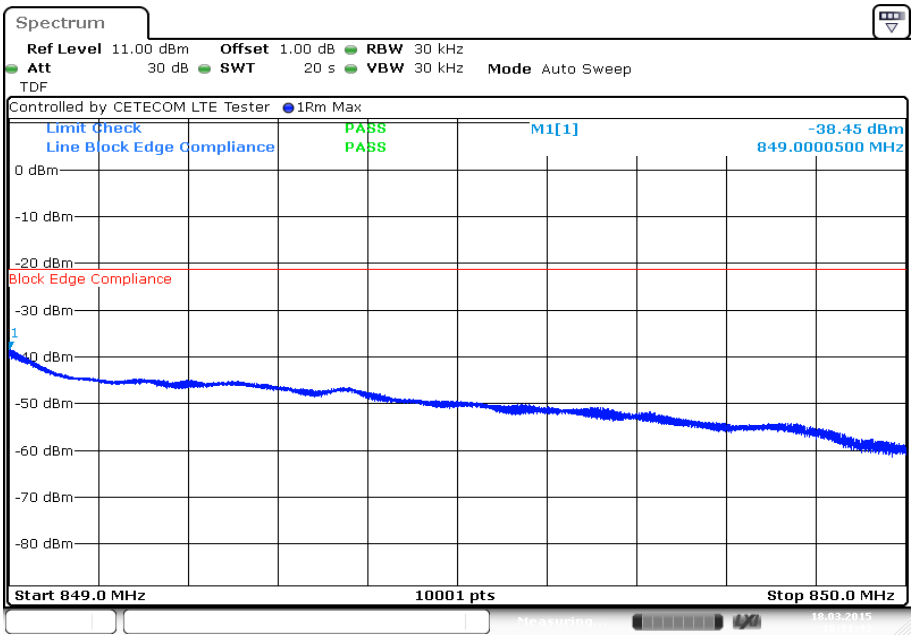
Results: **1.4 MHz channel bandwidth**

Plot 1: Lowest channel – QPSK



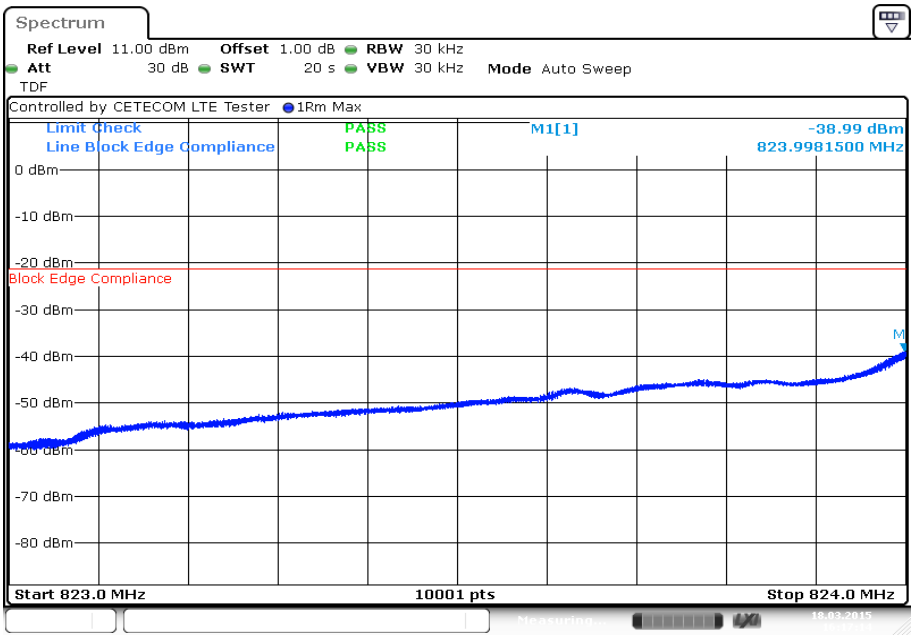
Date: 18.MAR.2015 16:12:42

Plot 2: Highest channel – QPSK



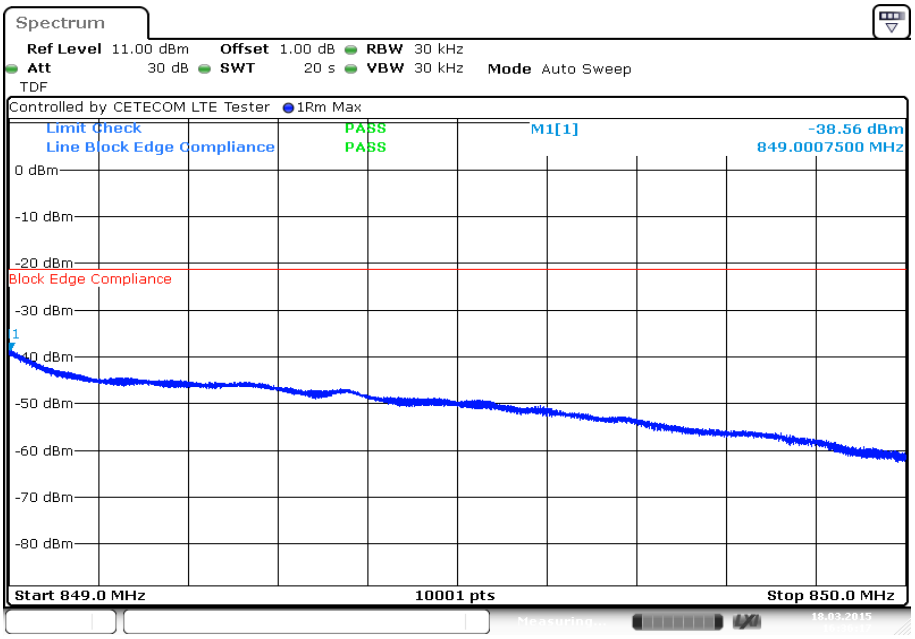
Date: 18.MAR.2015 16:31:43

Plot 3: Lowest channel – 16-QAM



Date: 18.MAR.2015 16:17:15

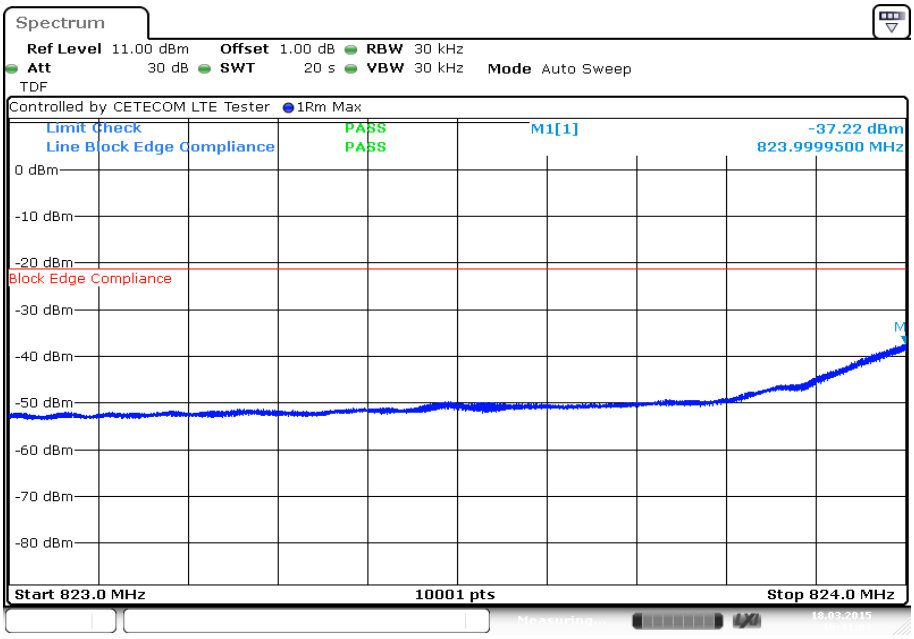
Plot 4: Highest channel – 16-QAM



Date: 18.MAR.2015 16:36:16

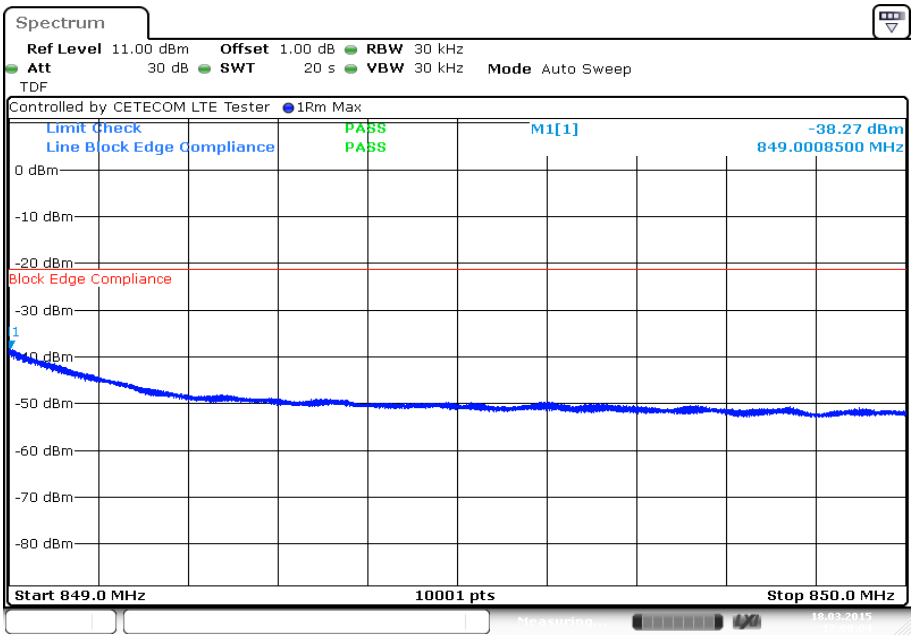
Results: **3 MHz channel bandwidth**

Plot 1: Lowest channel – QPSK



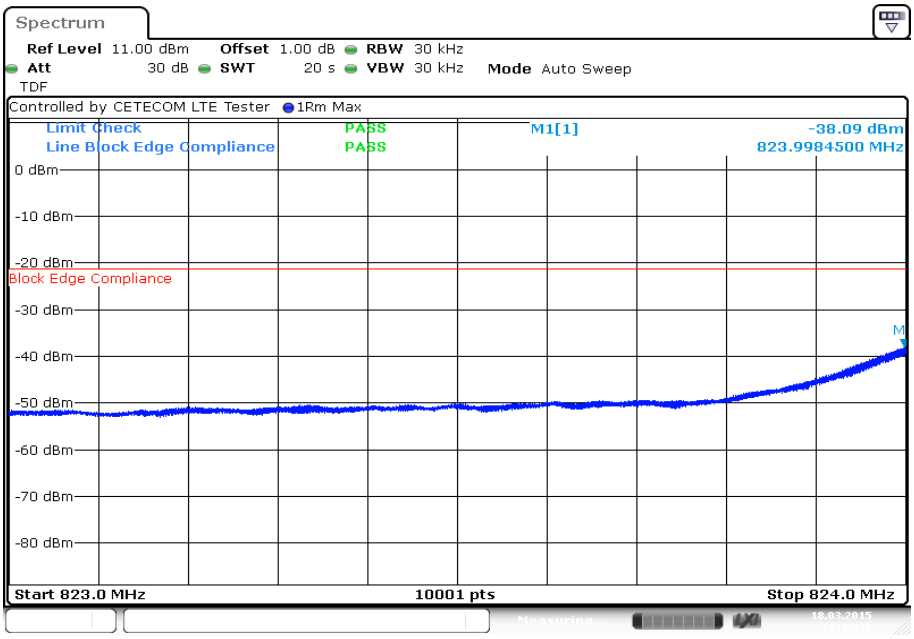
Date: 18.MAR.2015 16:41:03

Plot 2: Highest channel – QPSK



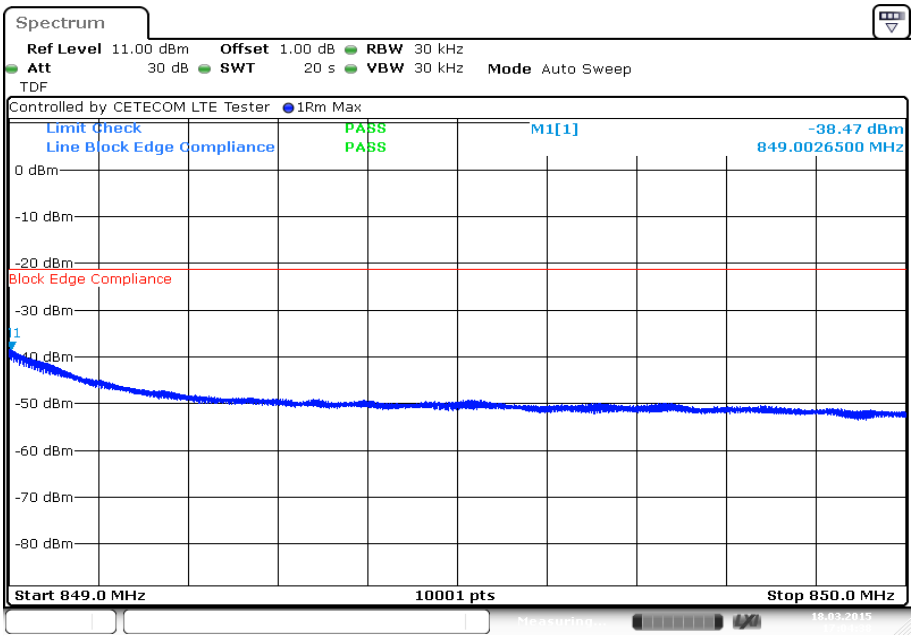
Date: 18.MAR.2015 17:00:05

Plot 3: Lowest channel – 16-QAM



Date: 18.MAR.2015 16:45:37

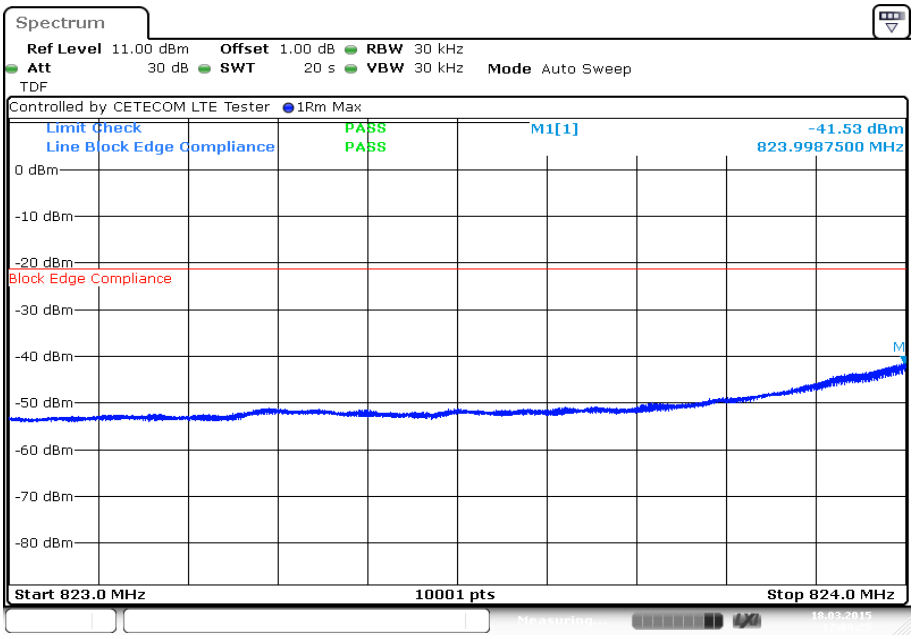
Plot 4: Highest channel – 16-QAM



Date: 18.MAR.2015 17:04:38

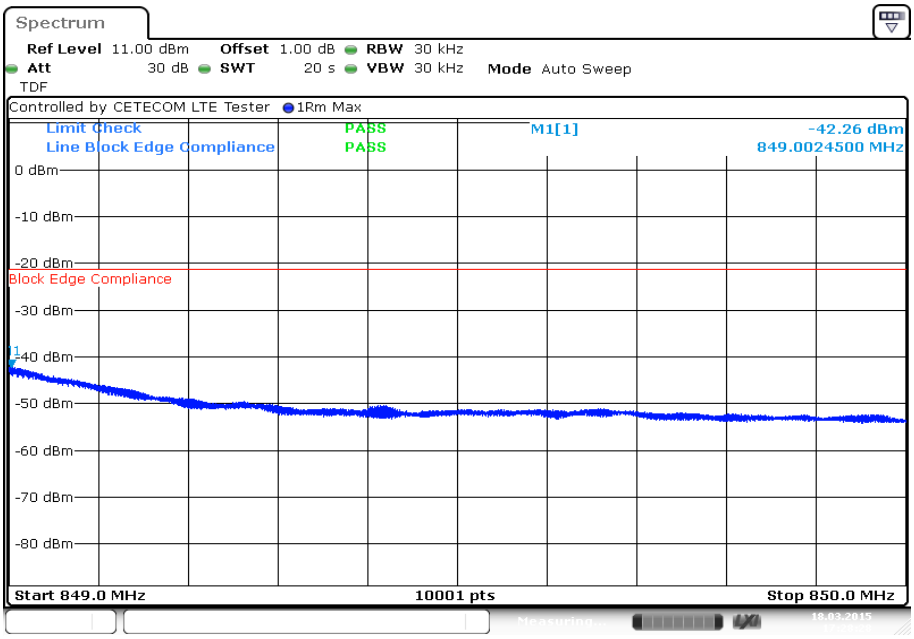
Results: **5 MHz channel bandwidth**

Plot 1: Lowest channel – QPSK



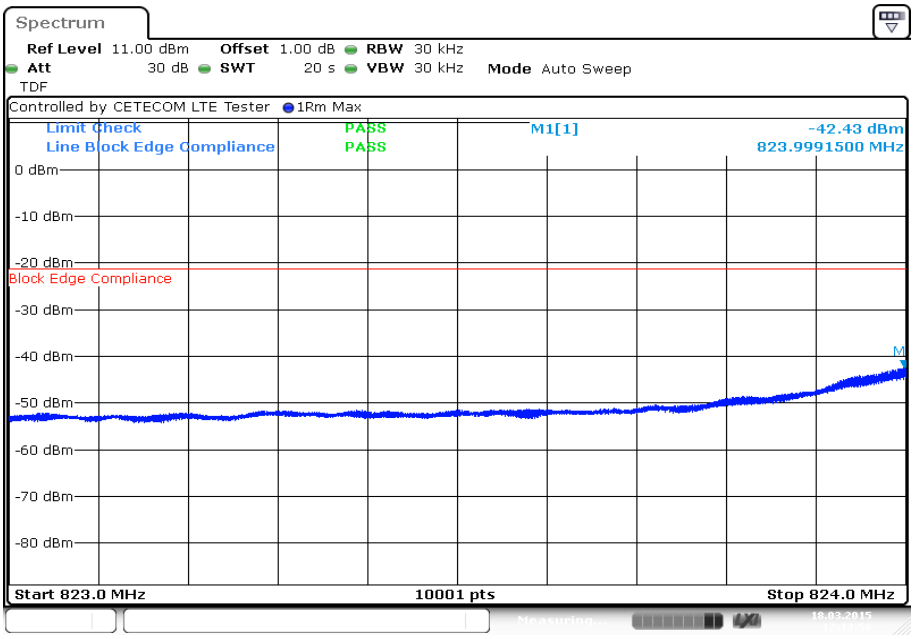
Date: 18.MAR.2015 17:09:26

Plot 2: Highest channel – QPSK



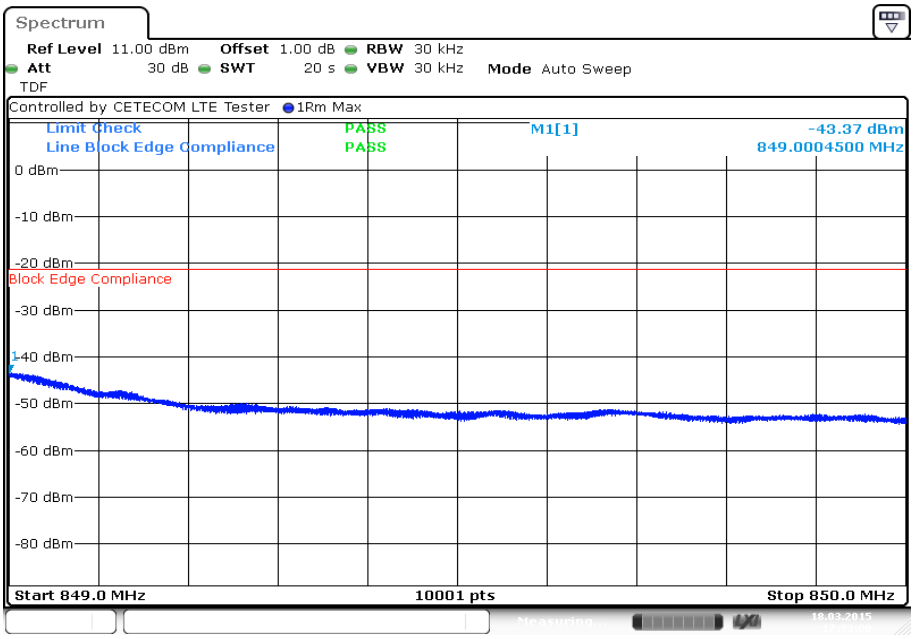
Date: 18.MAR.2015 17:28:27

Plot 3: Lowest channel – 16-QAM



Date: 18.MAR.2015 17:13:59

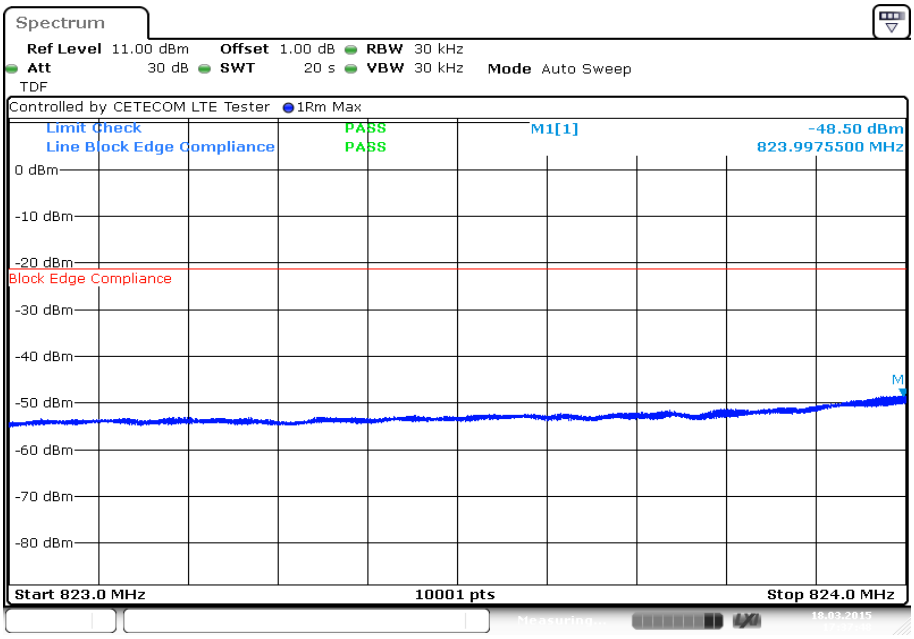
Plot 4: Highest channel – 16-QAM



Date: 18.MAR.2015 17:33:01

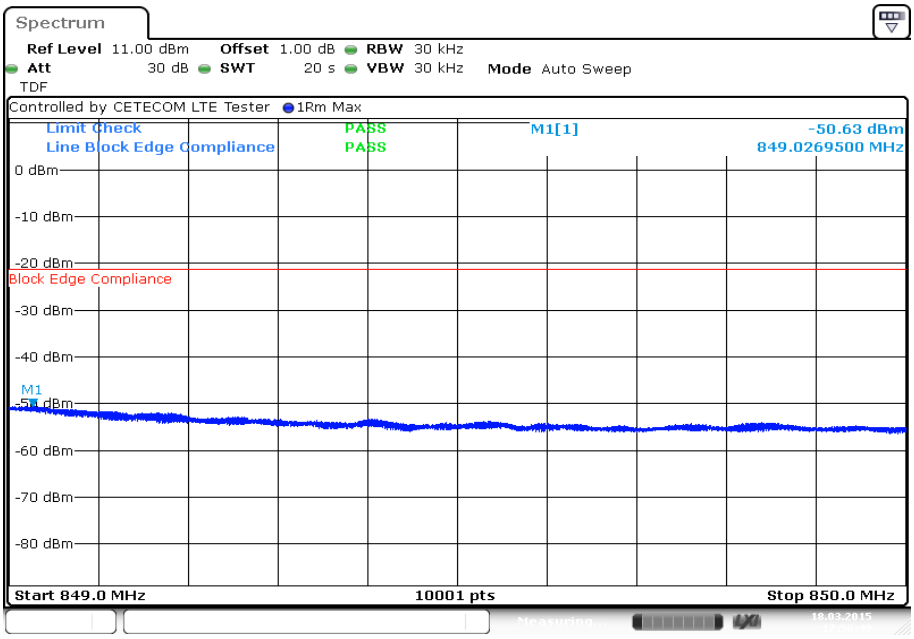
Results: **10 MHz channel bandwidth**

Plot 1: Lowest channel – QPSK



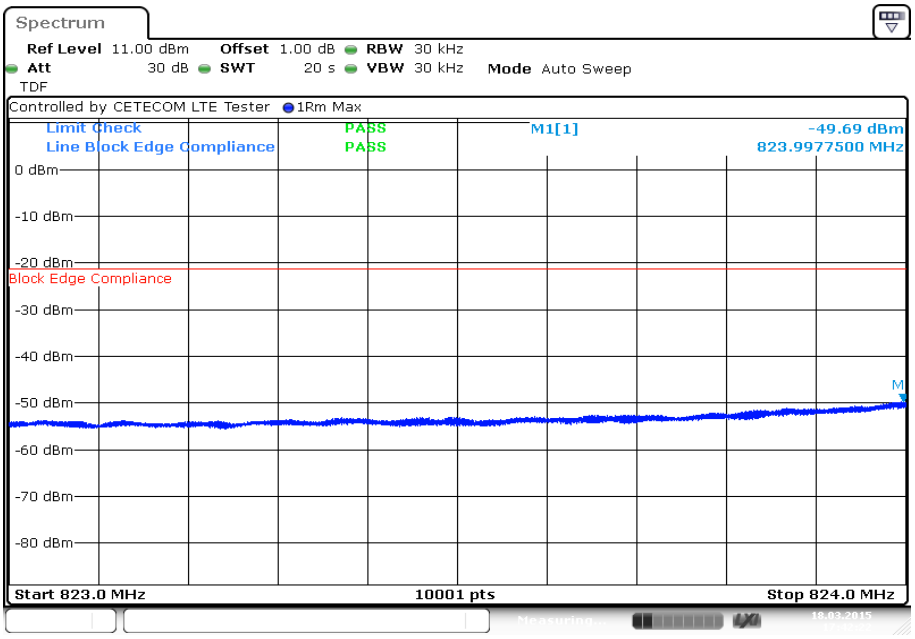
Date: 18.MAR.2015 17:37:48

Plot 2: Highest channel – QPSK



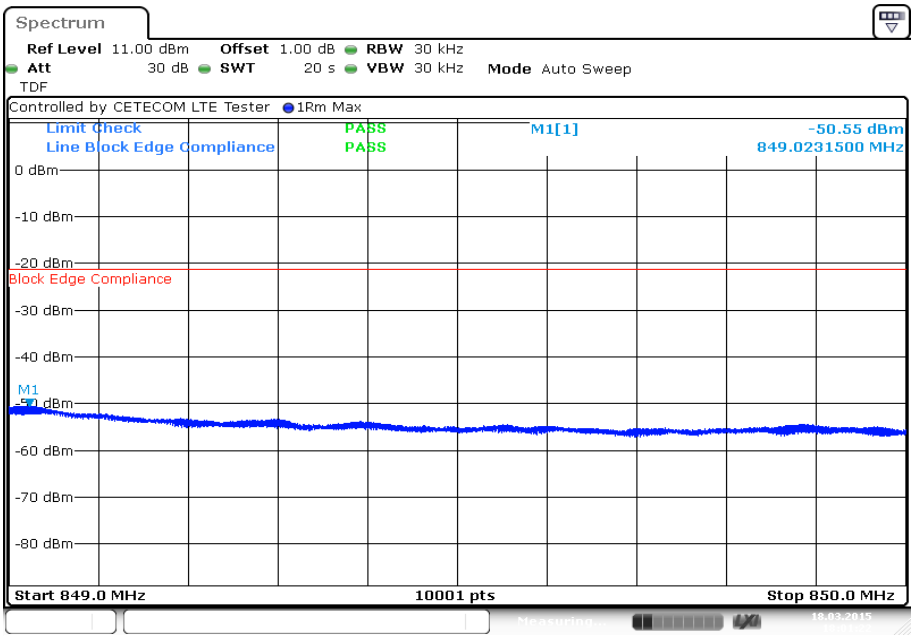
Date: 18.MAR.2015 17:56:50

Plot 3: Lowest channel – 16-QAM



Date: 18.MAR.2015 17:42:21

Plot 4: Highest channel – 16-QAM



Date: 18.MAR.2015 18:01:23

Verdict: **Complies**

9.1.6 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 extreme and mid frequencies of the LTE band V. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	10 kHz
Resolution bandwidth:	10 kHz
Span:	2 x nominal BW
Trace-Mode:	Max Hold
Used test setup:	see chapter 8.2

Limits:

FCC
CFR Part 22.917 CFR Part 2.1049
Occupied Bandwidth
Spectrum must fall completely in the specified band

Results:

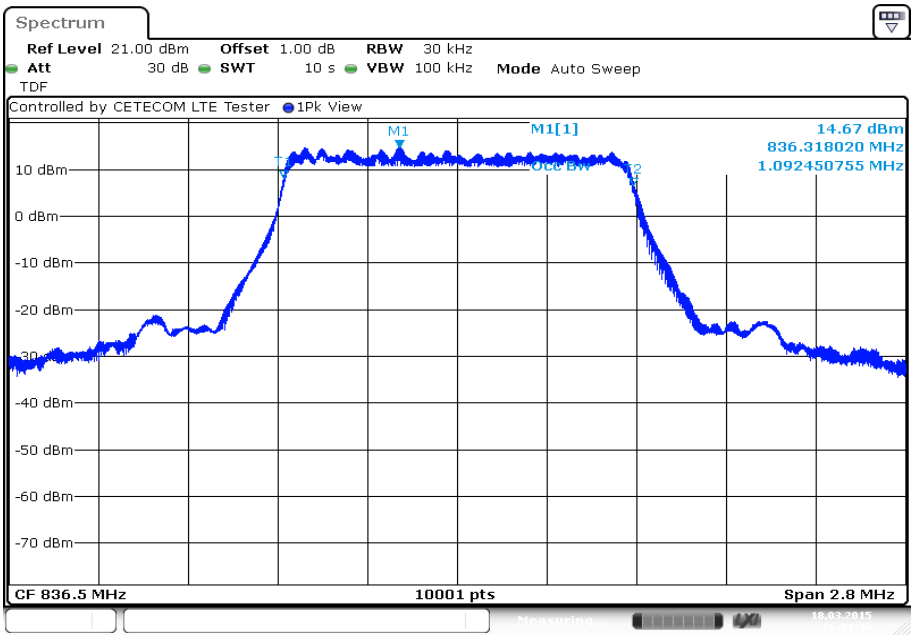
Occupied Bandwidth – QPSK		
Bandwidth (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
1.4	1.09	1.30
3.0	2.73	3.11
5.0	4.50	5.04
10.0	9.06	10.15
Measurement uncertainty	± 10 kHz	

Occupied Bandwidth – 16-QAM		
Bandwidth (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
1.4	1.10	1.31
3.0	2.73	3.14
5.0	4.49	5.00
10.0	9.05	10.09
Measurement uncertainty	± 10 kHz	

Verdict: **Complies**

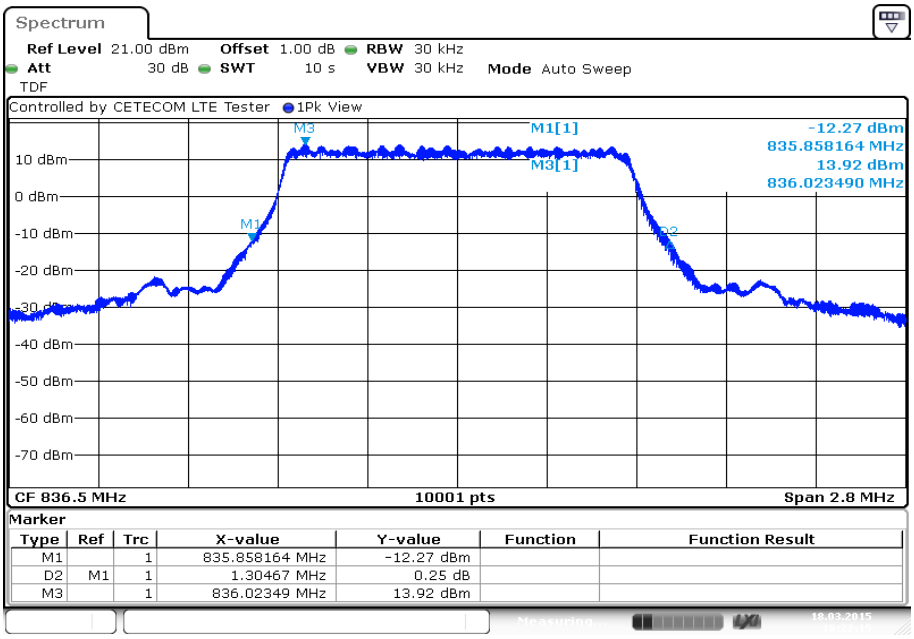
Plots: QPSK

Plot 1: 1.4 MHz (99% - OBW)



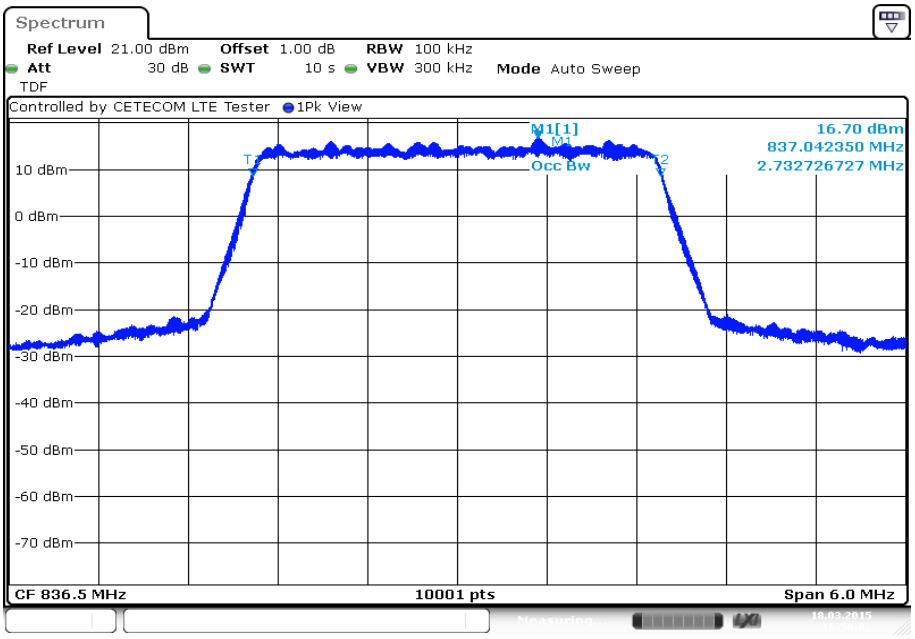
Date: 18.MAR.2015 16:21:41

Plot 2: 1.4 MHz (-26 dBc BW)



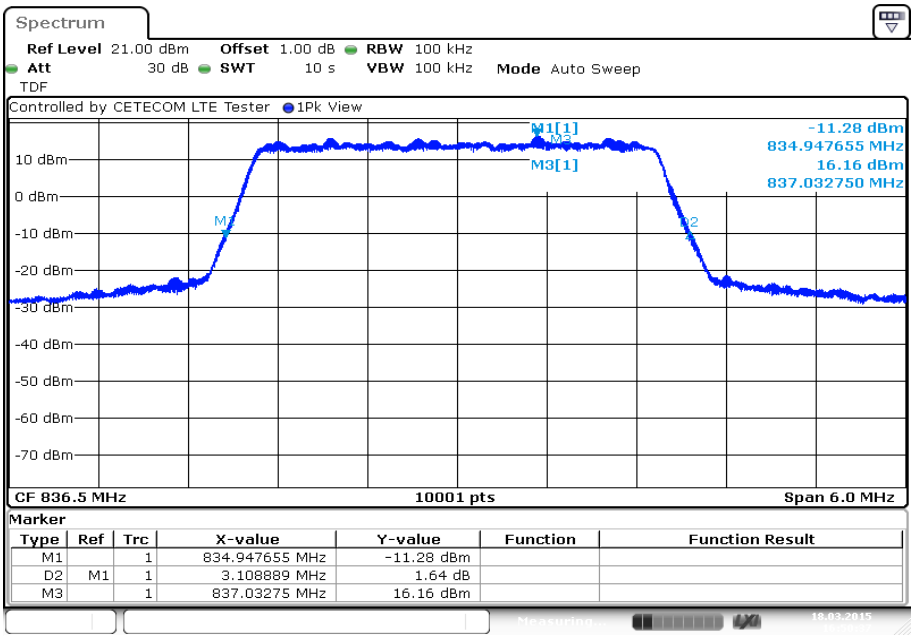
Date: 18.MAR.2015 16:22:16

Plot 3: 3 MHz (99% - OBW)



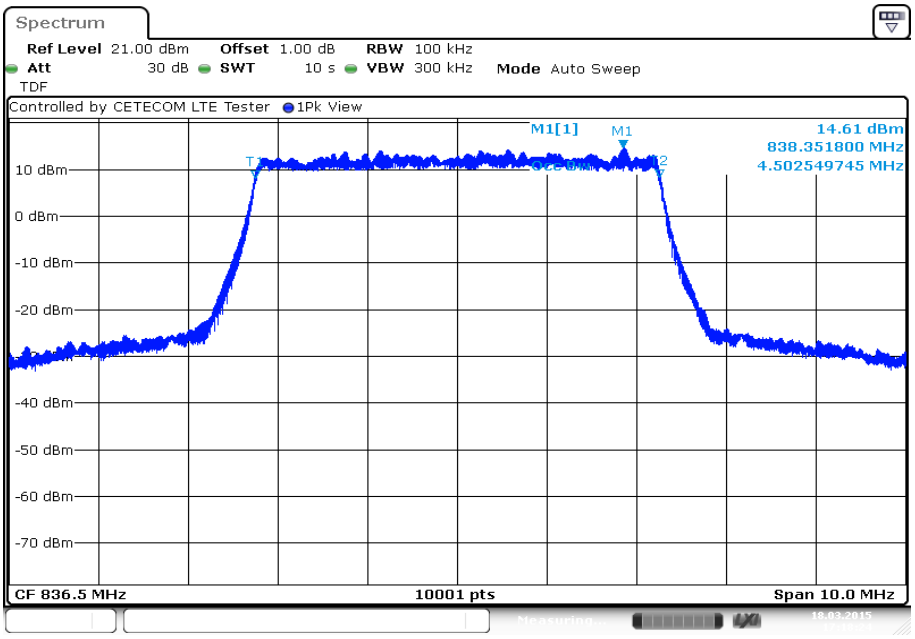
Date: 18.MAR.2015 16:50:03

Plot 4: 3 MHz (-26 dBc BW)



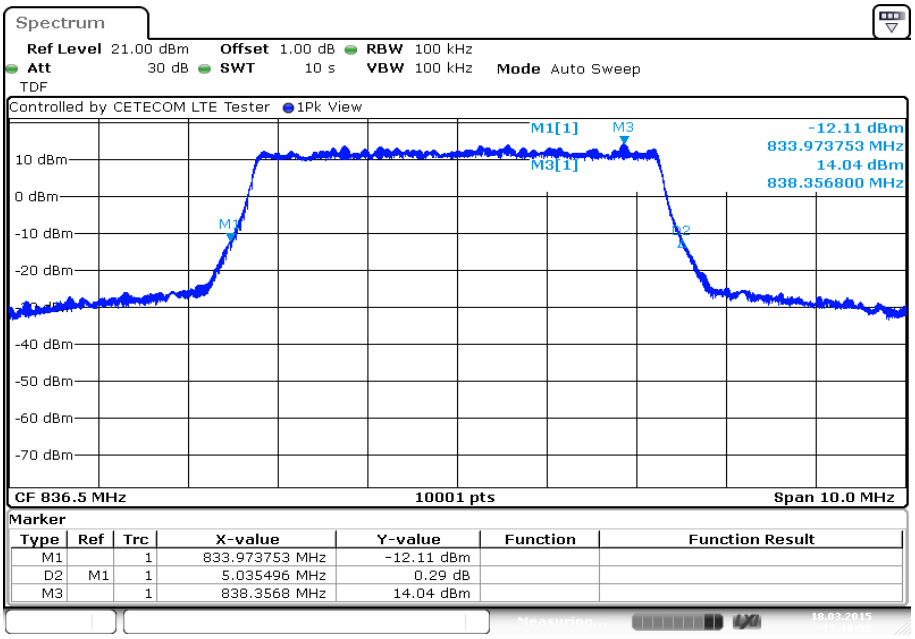
Date: 18.MAR.2015 16:50:37

Plot 5: 5 MHz (99% - OBW)



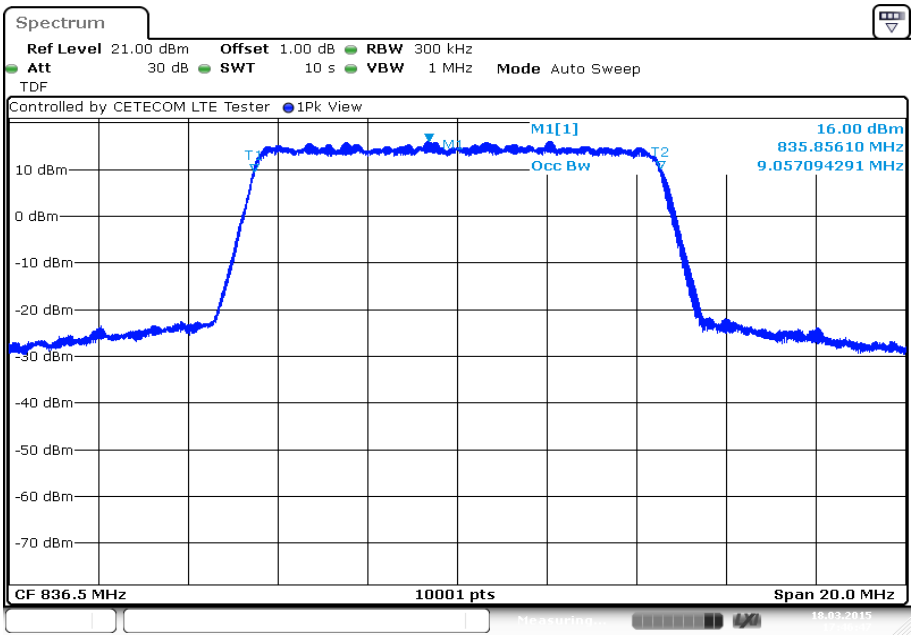
Date: 18.MAR.2015 17:18:25

Plot 6: 5 MHz (-26 dBc BW)



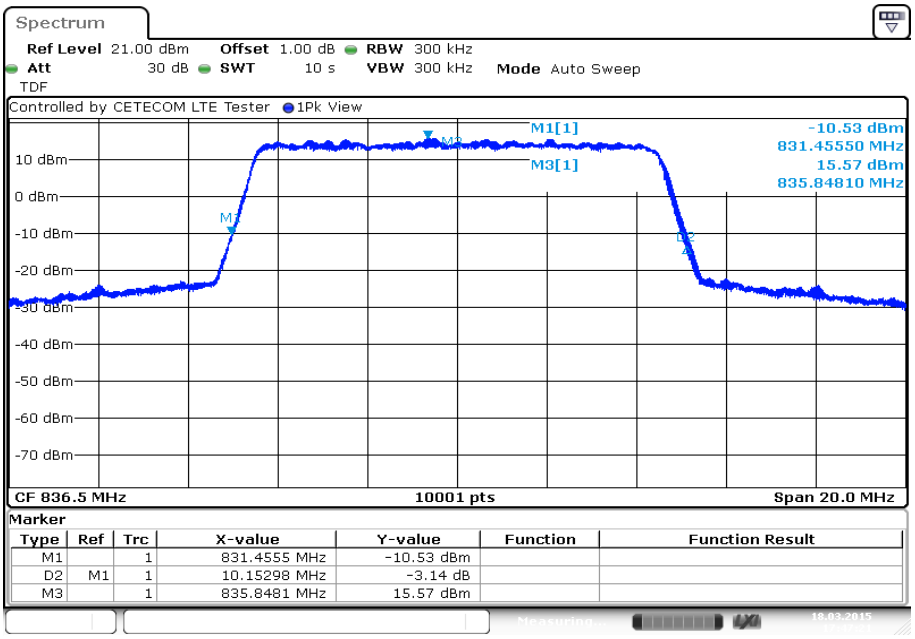
Date: 18.MAR.2015 17:19:00

Plot 7: 10 MHz (99% - OBW)



Date: 18.MAR.2015 17:46:48

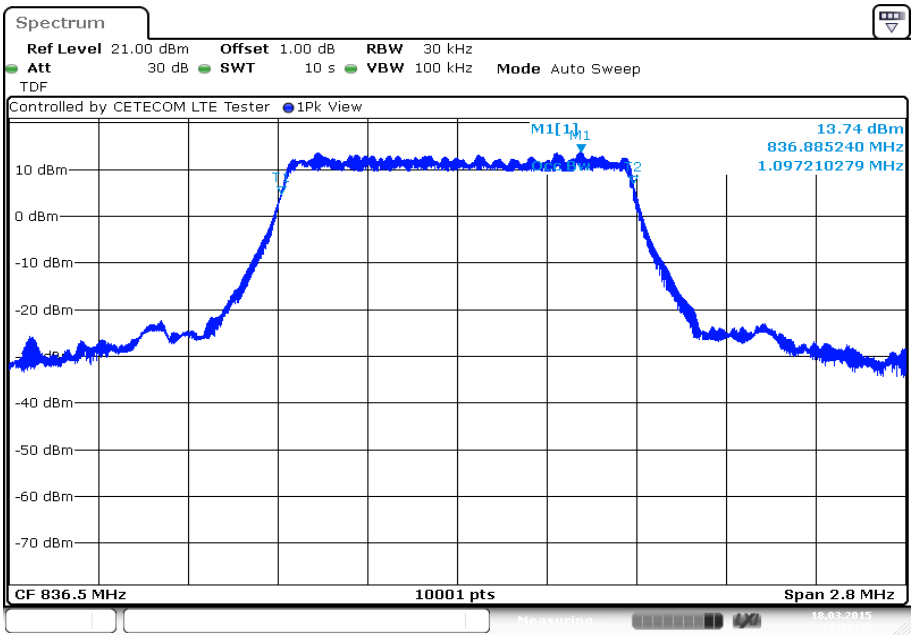
Plot 8: 10 MHz (-26 dBc BW)



Date: 18.MAR.2015 17:47:22

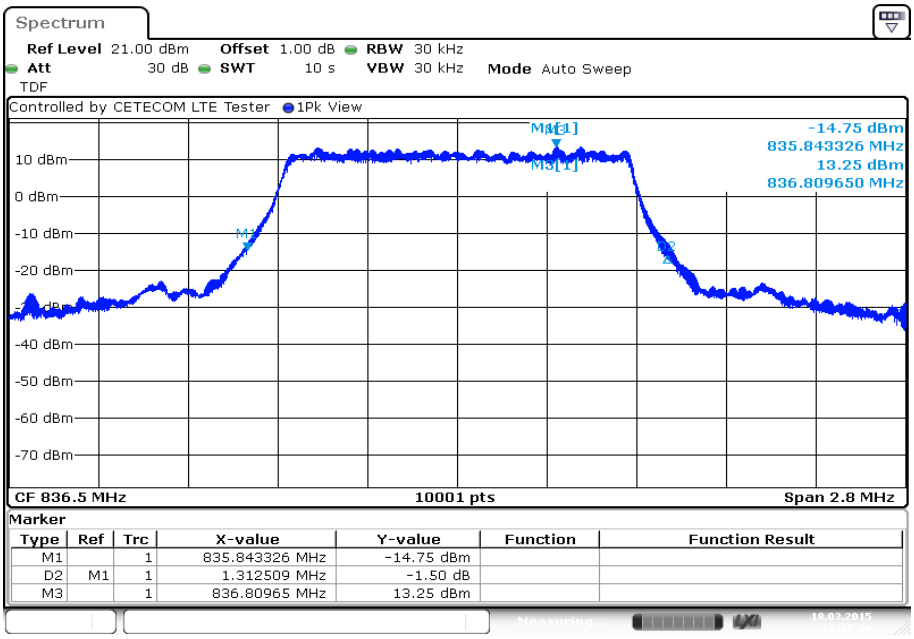
Plots: 16-QAM

Plot 1: 1.4 MHz (99% - OBW)



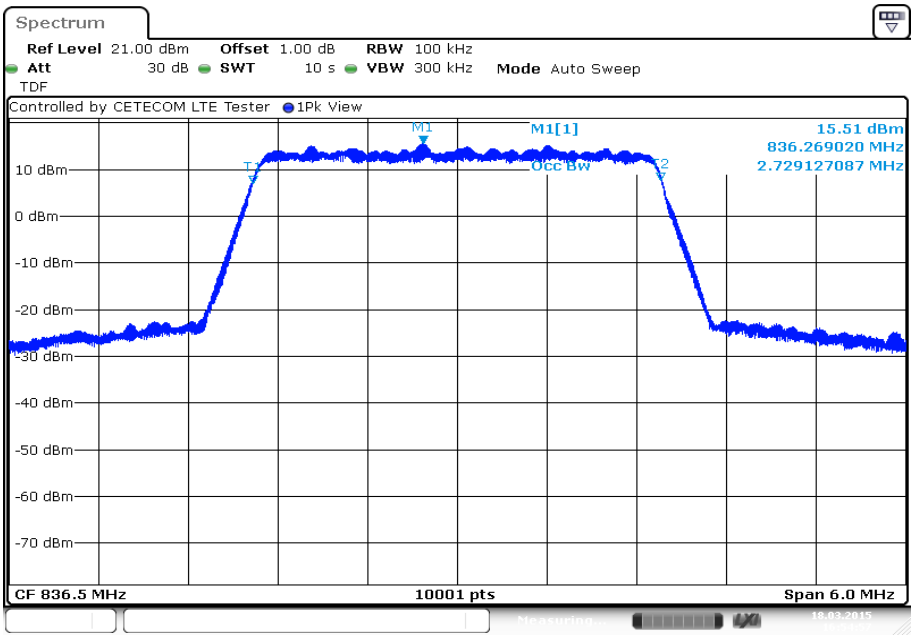
Date: 18.MAR.2015 16:26:36

Plot 2: 1.4 MHz (-26 dBc BW)



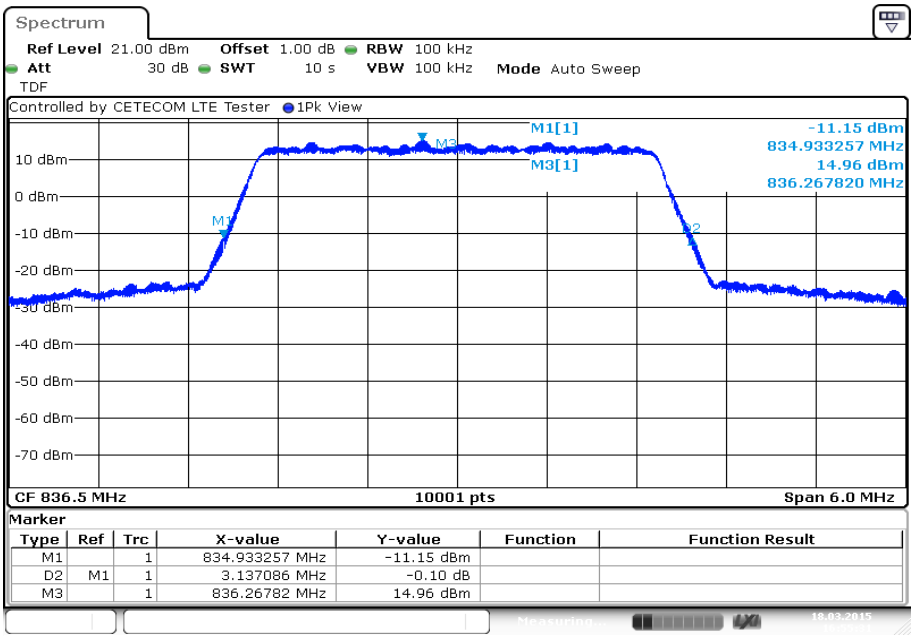
Date: 18.MAR.2015 16:27:10

Plot 3: 3 MHz (99% - OBW)



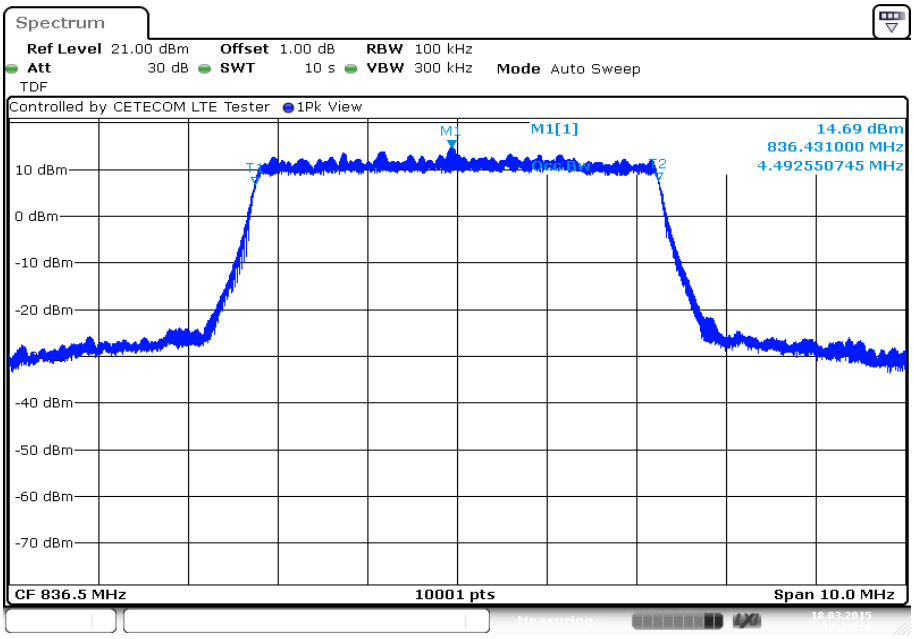
Date: 18.MAR.2015 16:54:57

Plot 4: 3 MHz (-26 dBc BW)



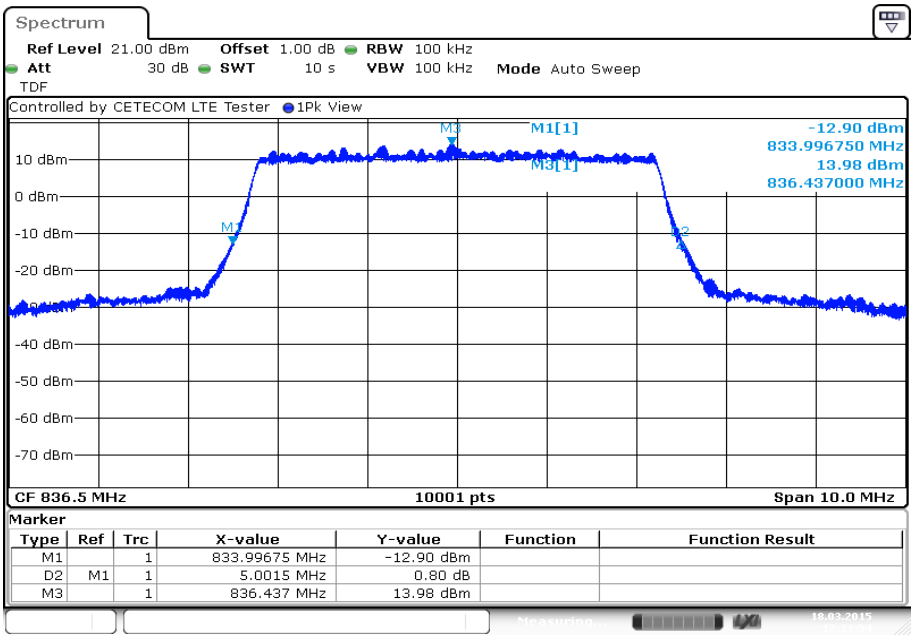
Date: 18.MAR.2015 16:55:32

Plot 5: 5 MHz (99% - OBW)



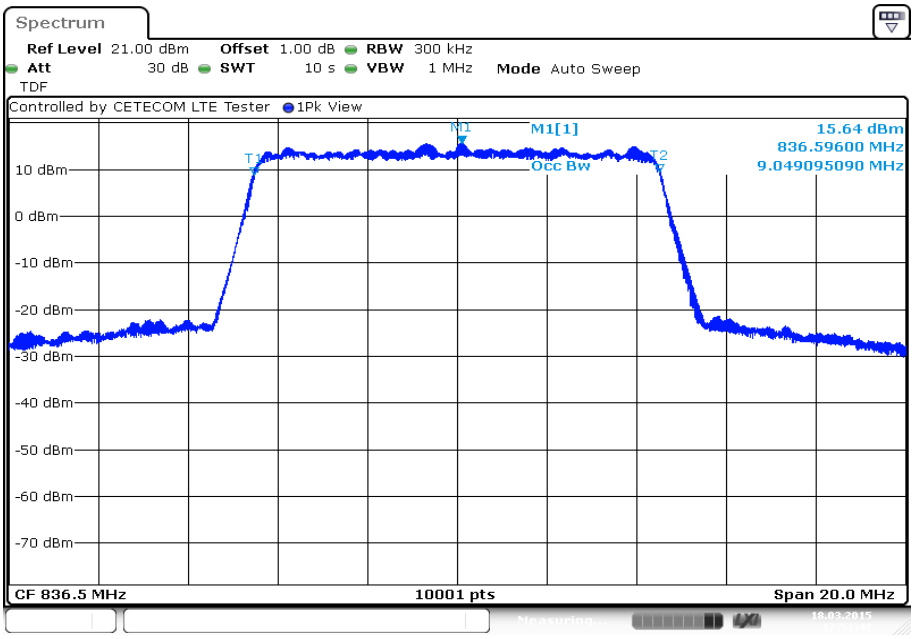
Date: 18.MAR.2015 17:23:20

Plot 6: 5 MHz (-26 dBc BW)



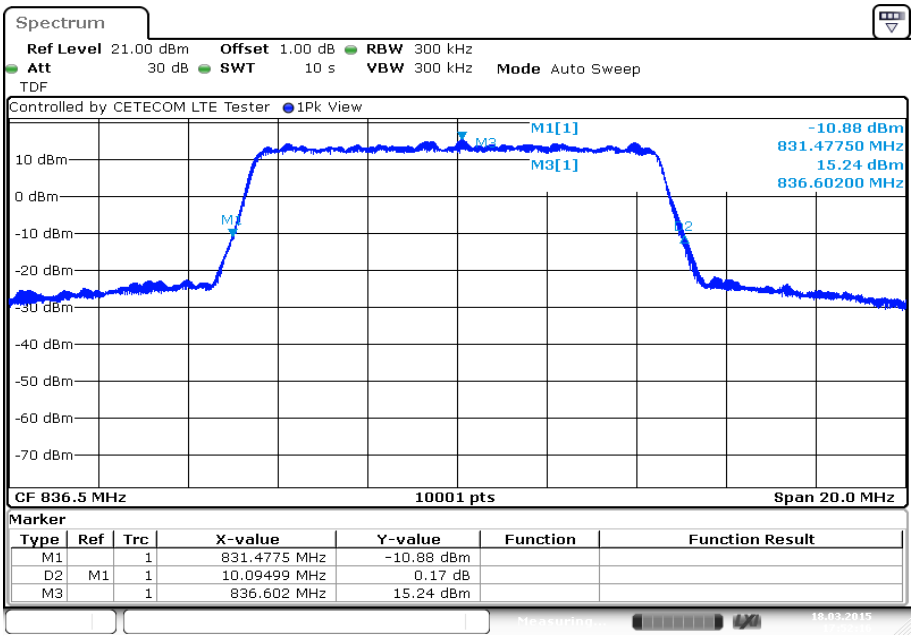
Date: 18.MAR.2015 17:23:54

Plot 7: 10 MHz (99% - OBW)



Date: 18.MAR.2015 17:51:42

Plot 8: 10 MHz (-26 dBc BW)



Date: 18.MAR.2015 17:52:17

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	2015-04-01
A	Result for frequency stability measurement with 4.5 V added Editorial changes – references to IC removed	2015-07-24

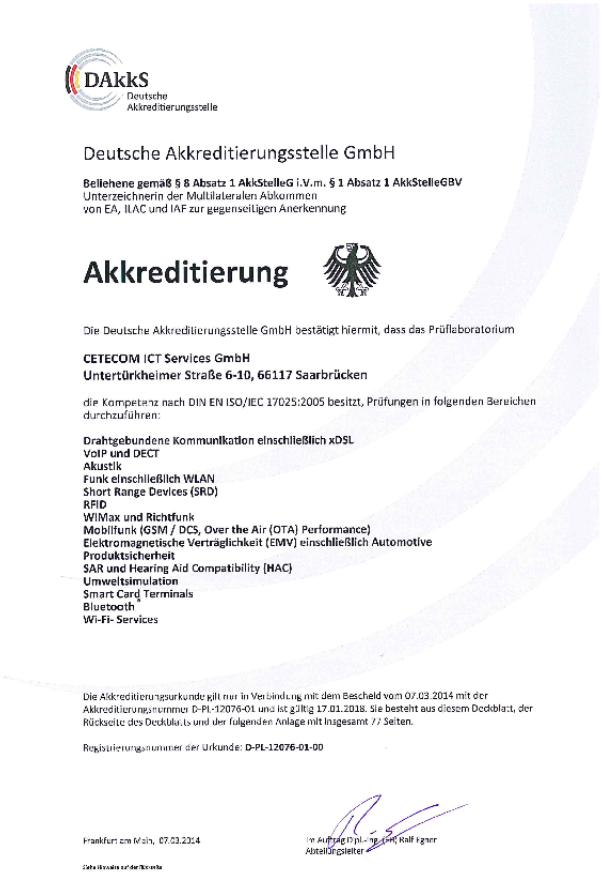
Annex B Further information

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



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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 / DCS, Over the Air (OTA) Performance)
Elektromagnetische Verträglichkeit (EMV) einschließlich Automotive
Produktsicherheit
SAR und Hearing Aid Compatibility (HAC)
Umweltsimulation
Smart Card Terminals
Bluetooth
Wi-Fi- Services

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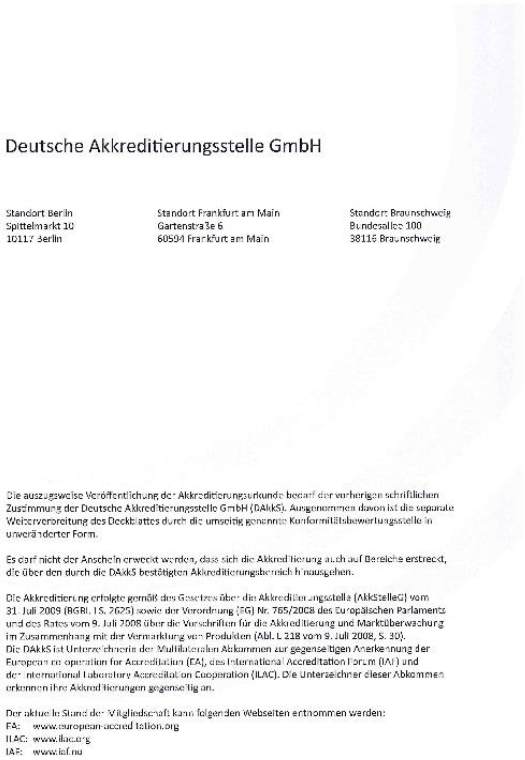
Frankfurt am Main, 07.03.2014

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

Back side of certificate



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60594 Frankfurt am Main

Standort Braunschweig
Bundesallee 100
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ILAC: www.ilac.org
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