TEST REPORT

No. I19Z60072-WMD03

for

HMD Global Oy

Multi-band GSM/WCDMA/LTE phone with Bluetooth, WLAN

Model Name: TA-1156

FCC ID: 2AJOTTA-1156

with

Hardware Version: 89626_1_12

Software Version: 00WW_0_130

Issued Date: 2019-02-22

TESTING
NVLAP LAB CODE 600118-0

Note:

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I19Z60072-WMD03	Rev.0	1st edition	2019-02-22

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1. Test Laboratory

1.1. Testing Location

Location 1: CTTL(huayuan North Road)

Address: No. 52, Huayuan North Road, Haidian District, Beijing, P. R. China 100191

Location 2: CTTL(Shouxiang)

Address: No. 51 Shouxiang Science Building, Xueyuan Road, Haidian District, Beijing, P. R. China 100191

Location 3:CTTL (BDA)

Address: No.18A, Kangding Street, Beijing Economic-Technology Development Area, Beijing, P. R. China 100176

1.2. Testing Environment

Normal Temperature: 15-35℃

Relative Humidity: 20-75%

1.3. Project data

Testing Start Date: 2019-01-20

Testing End Date: 2019-02-18

1.4. Signature

Dong Yuan

(Prepared this test report)

Zhou Yu

(Reviewed this test report)

Zhao Hui Lin

Deputy Director of the laboratory

(Approved this test report)

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2. Client Information

2.1. Applicant Information

Company Name:	HMD Global Oy
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Email:	Rosario.Casillo@hmdglobal.com
Telephone:	NA
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2.2. Manufacturer Information

Company Name:	HMD Global Oy
Address /Post:	Bertel Jungin aukio 9,02600 Espoo, Finland
Contact:	Rosario Casillo
Email:	Rosario.Casillo@hmdglobal.com
Telephone:	NA
Fax:	NA

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3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1. About EUT

Description	Multi-band GSM/WCDMA/LTE phone with Bluetooth, WLAN
Model Name	TA-1156
FCC ID	2AJOTTA-1156
Antenna	Embedded
Output power	24.18dBm maximum EIRP measured for Band 7
Extreme vol. Limits	3.6VDC to 4.4VDC (nominal: 3.9VDC)
Extreme temp. Tolerance	-10°C to +55°C

Note: Components list, please refer to documents of the manufacturer; it is also included in the original test record of CTTL.

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Date of receipt
UT53a	352907100024082/ 352907100024090	89626_1_12	00WW_0_130	2019-01-18
UT65a	352907100023688/ 352907100023696	89626_1_12	00WW_0_130	2019-01-24

*EUT ID: is used to identify the test sample in the lab internally.

3.3. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery
AE2	Battery

AE1

Model	WT240
Manufacturer	Jiade Energy Technology(Zhuhai) Co.,Ltd.
Capacitance	3920mAh

AE2

Model	WT240
Manufacturer	Dongguan DRN New Energy Co.,Ltd.
Capacitance	3920mAh

*AE ID: is used to identify the test sample in the lab internally.

3.4. General Description

The Equipment Under Test (EUT) is a model of Multi-band GSM/WCDMA/LTE phone with Bluetooth, WLAN with embedded antenna. Manual and specifications of the EUT were provided to fulfil the test.

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4. Reference Documents

4.1. Reference Documents for testing

The following documents listed in this section are referred for testing.

Reference	Title	Version
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-18 Edition
FCC Part 27	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES	10-1-18 Edition
ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	2016
TIA-102.CAAA-E	DIGITAL C4FMCQPSK TRANSCEIVER MEASUREMENT METHODS	2016
ANSI C63.26	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services	2015
KDB 971168 D01	MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS	v03r01

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5. LABORATORY ENVIRONMENT

Control room / conducted chamber did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ˚C, Max. = 35 ˚C
Relative humidity	Min. =20 %, Max. = 80 %
Shielding effectiveness	> 110 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 0.5 Ω

Fully-anechoic chamber 2 (8.6 meters×6.1 meters×3.85 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ˚C, Max. = 30 ˚C
Relative humidity	Min. = 35 %, Max. = 60 %
Shielding effectiveness	> 110 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 1 Ω
Site voltage standing-wave ratio (S_{VSWR})	Between 0 and 6 dB, from 1GHz to 18GHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 4000 MHz

Fully-anechoic chamber FAC-3 (9 meters×6.5 meters×4 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ˚C, Max. = 35 ˚C
Relative humidity	Min. = 15 %, Max. = 75 %
Shielding effectiveness	0.014MHz - 1MHz, >60dB; 1MHz - 1000MHz, >90dB.
Electrical insulation	> 2 MΩ
Ground system resistance	< 4 Ω
Site voltage standing-wave ratio (S_{VSWR})	Between 0 and 6 dB, from 1GHz to 18GHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 4000 MHz

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6. SUMMARY OF TEST RESULTS

6.1. Summary of test results

LTE Band 5

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	22.913(a)	A.1	P
2	Emission Limit	22.917	A.2	P
3	Frequency Stability	2.1055	A.3	P
4	Occupied Bandwidth	2.1049	A.4	P
5	Emission Bandwidth	22.917(b)	A.5	P
6	Band Edge Compliance	22.917(b)	A.6	P
7	Conducted Spurious Emission	22.917	A.7	P

LTE Band 7

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	27.50(h)	A.1	P
2	Emission Limit	27.53(m)	A.2	P
3	Frequency Stability	2.1055	A.3	P
4	Occupied Bandwidth	2.1049	A.4	P
5	Emission Bandwidth	27.53(m)	A.5	P
6	Band Edge Compliance	27.53(m)	A.6	P
7	Conducted Spurious Emission	27.53(m)	A.7	P
8	Peak to Average Power Ratio	27.50(a)	A.8	P

LTE Band 38

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	27.50(h)	A.1	P
2	Emission Limit	27.53(m)	A.2	P
3	Frequency Stability	2.1055	A.3	P
4	Occupied Bandwidth	2.1049	A.4	P
5	Emission Bandwidth	27.53(m)	A.5	P
6	Band Edge Compliance	27.53(m)	A.6	P
7	Conducted Spurious Emission	27.53(m)	A.7	P
8	Peak to Average Power Ratio	27.50(a)	A.8	P

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Terms used in Verdict column

P	Pass, The EUT complies with the essential requirements in the standard.
NP	Not Perform, The test was not performed by CTTL
NA	Not Applicable,The test was not applicable
BR	Re-use test data from basic model report.
F	Fail, The EUT does not comply with the essential requirements in the standard

6.2. Statements

The test cases listed in section 6.1 of this report for the EUT specified in section 3 were performed by CTTL according to the standards or reference documents in section 4.1

The EUT met all applicable requirements of the standards or reference documents in section 4.1.

This report only deals with the LTE functions among the features described in section 3.

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7. Test Equipments Utilized

NO.	Description	TYPE	series number	MANUFACTURE	CAL DUE DATE	Calibration interval
1	EMI Antenna	VULB9163	9163-235	Schwarzbeck	2019-11-20	1 year
2	EMI Antenna	3117	00058889	ETS-Lindgren	2020-01-12	3 years
3	EMI Antenna	3117	00119024	ETS-Lindgren	2020-01-21	3 years
4	Universal Radio Communication Tester	CMW500	159082	R&S	2019-12-25	1 year
5	Spectrum Analyzer	FSU26	200030	R&S	2019-06-04	1 year
6	EMI Antenna	9117	167	Schwarzbeck	2019-04-13	1 year
7	Signal Generator	N5183A	MY49060052	Agilent	2019-03-31	1 year
8	Climate chamber	SH-242	93008556	ESPEC	2019-12-21	2 year
14	Test Receiver	E4440A	MY48250642	Agilent	2019-03-31	1 year
10	Universal Radio Communication Tester	CMW500	143008	R&S	2019-11-26	1 year
11	Power Amplifier	5S1G4	0341863	AR	/	
12	Universal Radio Communication Tester	MT8821C	6201623363	Anritsu	2019-07-21	1 year
13	Universal Radio Communication Tester	MT8821C	6201763159	Anritsu	2019-07-18	1 year

Test Software Utilized

Test Item	Test Software and Version	Software Vendor
ERP/EIRP/RSE	Tile V7.2.3.5	ETS-Lindgren

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ANNEX A: MEASUREMENT RESULTS

A.1 OUTPUT POWER

A.1.1 Summary

During the process of testing, the EUT was controlled via Rhode & Schwarz Digital Radio Communication tester (CMW500) to ensure max power transmission and proper modulation.
In all cases, output power is within the specified limits.

A.1.2 Conducted

A.1.2.1 Method of Measurements

The EUT was set up for the max output power with pseudo random data modulation.
These measurements were done at 3 frequencies (bottom, middle and top of operational frequency range) for each bandwidth.

A.1.2.2 Measurement result

LTE band 5

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)		
			QPSK	16QAM	64QAM
1.4MHz	1 RB high	848.3	24.08	23.09	22.09
		836.5	24.06	23.17	21.82
		824.7	23.92	22.95	21.79
	1 RB low	848.3	24.16	23.16	22.16
		836.5	24.18	23.08	21.86
		824.7	24.14	22.55	21.67
	50% RB mid	848.3	24.12	23.26	22.15
		836.5	24.34	23.11	21.99
		824.7	24.20	22.70	22.09
	100% RB	848.3	23.10	22.18	20.83
		836.5	23.12	22.38	20.59
		824.7	23.05	21.90	20.63
3MHz	1 RB high	847.5	23.98	23.23	22.09
		836.5	24.15	23.12	21.74
		825.5	24.08	23.37	21.82
	1 RB low	847.5	24.15	23.31	22.09
		836.5	24.13	23.27	21.77
		825.5	24.17	22.86	21.65
	50% RB mid	847.5	23.08	22.12	20.96
		836.5	23.10	22.33	20.93
		825.5	23.03	22.15	20.74
	100% RB	847.5	23.06	21.99	20.80

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		836.5	22.97	21.92	20.59
		825.5	23.09	22.24	20.58
5MHz	1 RB high	846.5	24.05	22.58	22.18
		836.5	23.85	22.77	21.78
		826.5	24.04	22.76	21.76
	1 RB low	846.5	24.24	22.58	22.12
		836.5	23.84	22.61	21.83
		826.5	23.95	22.29	21.61
	50% RB mid	846.5	23.20	22.12	20.89
		836.5	23.12	22.21	20.96
		826.5	23.15	22.01	20.78
	100% RB	846.5	23.15	22.27	20.86
		836.5	22.95	22.06	20.58
		826.5	23.07	22.05	20.61
10MHz	1 RB high	844.0	24.12	22.85	22.14
		836.5	24.19	22.95	21.79
		829.0	24.25	23.02	21.83
	1 RB low	844.0	24.22	22.95	22.11
		836.5	24.09	22.76	21.83
		829.0	24.16	23.10	21.64
	50% RB mid	844.0	23.17	22.21	20.94
		836.5	23.13	22.10	20.98
		829.0	23.07	22.19	20.76
	100% RB	844.0	23.17	22.15	20.86
		836.5	23.08	22.02	20.63
		829.0	23.04	22.04	20.61

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LTE band 7

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)		
			QPSK	16QAM	64QAM
5MHz	1 RB high	2567.5	23.58	22.51	20.90
		2535	23.60	22.44	20.86
		2502.5	23.83	22.61	21.13
	1 RB low	2567.5	23.72	22.35	21.03
		2535	23.69	22.73	20.51
		2502.5	23.68	22.60	20.93
	50% RB mid	2567.5	22.68	21.45	19.62
		2535	22.68	21.68	19.67
		2502.5	22.76	21.50	19.71
	100% RB	2567.5	22.63	21.79	19.66
		2535	22.81	21.65	19.63
		2502.5	22.67	21.75	19.63
10MHz	1 RB high	2565	23.76	22.72	20.91
		2535	23.72	22.86	20.88
		2505	23.81	23.18	21.13
	1 RB low	2565	23.84	22.77	21.10
		2535	23.80	22.89	20.54
		2505	23.83	23.09	20.90
	50% RB mid	2565	22.84	21.63	19.60
		2535	22.74	21.70	19.58
		2505	22.57	21.51	19.61
	100% RB	2565	22.66	21.63	19.60
		2535	22.82	21.73	19.58
		2505	22.64	21.55	19.62
15MHz	1 RB high	2562.5	23.71	22.85	20.92
		2535	23.67	22.47	20.93
		2507.5	23.72	23.31	21.14
	1 RB low	2562.5	23.86	23.16	21.01
		2535	23.71	22.80	20.57
		2507.5	23.83	23.39	20.96
	50% RB mid	2562.5	22.55	21.57	19.59
		2535	22.69	21.69	19.63
		2507.5	22.61	21.58	19.71
	100% RB	2562.5	22.58	21.62	19.59
		2535	22.73	21.61	19.63
		2507.5	22.59	21.58	19.62
20MHz	1 RB high	2560	23.31	22.50	20.95

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		2535	23.48	22.38	20.93
		2510	24.07	22.60	21.11
	1 RB low	2560	23.45	22.62	21.06
		2535	23.55	22.37	20.57
		2510	23.85	22.82	20.96
	50% RB mid	2560	22.57	21.54	19.62
		2535	22.67	21.67	19.64
		2510	22.63	21.73	19.68
	100% RB	2560	22.69	21.59	19.63
		2535	22.74	21.69	19.61
		2510	22.66	21.66	19.68

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LTE band 38

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)		
			QPSK	16QAM	64QAM
5MHz	1 RB high	2617.5	23.73	22.75	20.54
		2595.0	23.83	22.34	20.56
		2572.5	23.72	22.57	20.51
	1 RB low	2617.5	24.00	22.80	20.60
		2595.0	23.78	22.32	20.54
		2572.5	23.77	22.65	20.56
	50% RB mid	2617.5	23.09	22.36	20.18
		2595.0	22.88	22.06	20.12
		2572.5	22.78	21.86	19.90
	100% RB	2617.5	22.95	22.01	20.22
		2595.0	22.90	22.10	20.07
		2572.5	22.84	21.97	19.78
10MHz	1 RB high	2615.0	23.87	22.77	20.56
		2595.0	23.84	22.35	20.61
		2575.0	23.86	23.45	20.52
	1 RB low	2615.0	23.96	23.11	20.56
		2595.0	23.84	22.26	20.56
		2575.0	23.80	23.39	20.55
	50% RB mid	2615.0	23.15	22.21	20.18
		2595.0	22.87	21.96	20.12
		2575.0	23.03	21.84	19.81
	100% RB	2615.0	23.17	22.08	20.23
		2595.0	22.82	22.12	20.01
		2575.0	22.86	21.78	19.79
15MHz	1 RB high	2612.5	23.78	22.83	20.58
		2595.0	24.03	22.59	20.52
		2577.5	23.90	22.87	20.52
	1 RB low	2612.5	23.84	23.21	20.62
		2595.0	23.76	22.12	20.54
		2577.5	24.02	22.93	20.55
	50% RB mid	2612.5	22.99	21.95	20.11
		2595.0	22.88	21.98	20.10
		2577.5	23.04	21.83	19.82
	100% RB	2612.5	22.92	21.99	20.17
		2595.0	22.84	21.95	20.08
		2577.5	22.95	21.86	19.73
20MHz	1 RB high	2610.0	24.10	22.31	20.53

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		2595.0	23.72	23.21	20.60
		2580.0	23.56	22.64	20.58
	1 RB low	2610.0	24.16	22.36	20.61
		2595.0	23.61	23.07	20.53
		2580.0	23.61	22.57	20.51
	50% RB mid	2610.0	22.96	22.05	20.18
		2595.0	23.06	22.11	20.08
		2580.0	22.83	21.75	19.88
	100% RB	2610.0	22.89	21.92	20.21
		2595.0	23.00	22.01	20.07
		2580.0	22.80	21.87	19.78

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A.1.3 Radiated

A.1.3.1 Description

This is the test for the maximum radiated power from the EUT.

Rule Part 22.913(a) specifies “Mobile stations are limited to 2.0 watts EIRP.”.

Rule Part 27.50(d) specifies “Fixed, mobile, and portable (handheld) stations operating in the 1710–1755 MHz band are limited to 1 watt EIRP”.

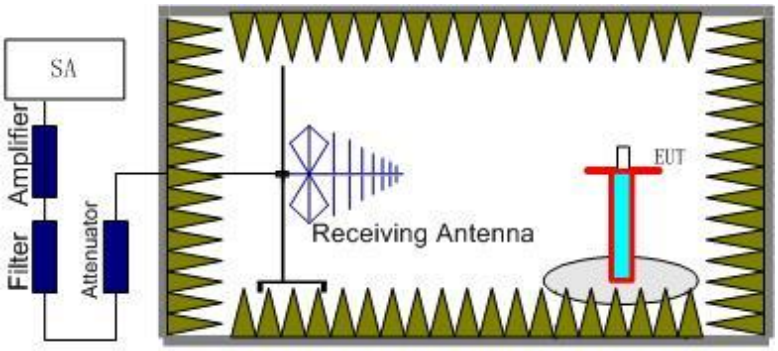
Rule Part 27.50(h)(2) specifies “Mobile stations are limited to 2.0 watts EIRP.”.

Rule Part 27.50(c) specifies “Portable stations (hand-held de-vices) are limited to 3 watts ERP.”.

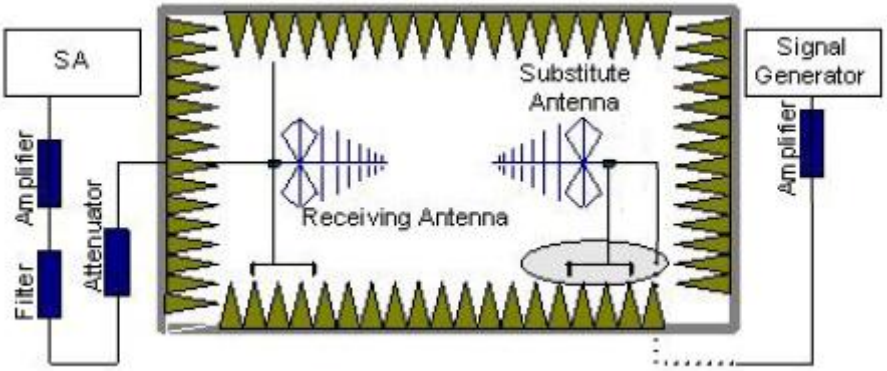
A.1.3.2 Method of Measurement

The measurements procedures in TIA-603E-2016 are used.

1. EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in three channels (High, Middle, Low) were measured with peak detector.



2. The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



In the chamber, a substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere

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with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna. Adjust the level of the signal generator output until the value of the receiver reaches the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. An amplifier should be connected to the Signal Source output port. And the cable should be connected between the amplifier and the substitution antenna.
   The cable loss (P_{cl}), the substitution antenna Gain (G_a) and the amplifier Gain (P_{Ag}) should be recorded after test.
   The measurement results are obtained as described below:
   Power (EIRP) = P_{Mea} - P_{Ag} - P_{cl} - G_a
5. This value is EIRP since the measurement is calibrated using an antenna of known gain (unit dBi) and known input power.
6. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15.

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A.1.3.3 Measurement result

LTE Band 5- ERP 22.913(a)

Limits: ≤38.45dBm (7W)

LTE Band 5_1.4MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
824.70	-21.05	2.26	45.79	0.95	2.15	21.28	38.45	17.17	H
836.50	-20.48	2.26	45.66	0.82	2.15	21.59	38.45	16.86	H
848.30	-21.47	2.27	45.55	0.80	2.15	20.46	38.45	17.99	H

LTE Band 5_3MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
825.50	-21.00	2.26	45.79	0.94	2.15	21.32	38.45	17.13	H
836.50	-20.67	2.26	45.66	0.82	2.15	21.40	38.45	17.05	H
847.50	-21.36	2.27	45.56	0.81	2.15	20.59	38.45	17.86	H

LTE Band 5_5MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
826.50	-21.10	2.25	45.77	0.93	2.15	21.20	38.45	17.25	H
836.50	-20.47	2.26	45.66	0.82	2.15	21.60	38.45	16.85	H
846.50	-21.39	2.26	45.56	0.82	2.15	20.58	38.45	17.87	H

LTE Band 5_10MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
829.00	-21.14	2.13	45.74	0.90	2.15	21.22	38.45	17.23	H
836.50	-20.59	2.26	45.66	0.82	2.15	21.48	38.45	16.97	H
844.00	-21.24	2.26	45.59	0.82	2.15	20.76	38.45	17.69	H

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LTE Band 5_1.4MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
824.70	-21.88	2.26	45.79	0.95	2.15	20.45	38.45	18.00	H
836.50	-21.48	2.26	45.66	0.82	2.15	20.59	38.45	17.86	H
848.30	-22.27	2.27	45.55	0.80	2.15	19.66	38.45	18.79	H

LTE Band 5_3MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
825.50	-21.89	2.26	45.79	0.94	2.15	20.43	38.45	18.02	H
836.50	-22.33	2.26	45.66	0.82	2.15	19.74	38.45	18.71	H
847.50	-22.80	2.27	45.56	0.81	2.15	19.15	38.45	19.30	H

LTE Band 5_5MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
826.50	-21.97	2.25	45.77	0.93	2.15	20.33	38.45	18.12	H
836.50	-21.39	2.26	45.66	0.82	2.15	20.68	38.45	17.77	H
846.50	-22.24	2.26	45.56	0.82	2.15	19.73	38.45	18.72	H

LTE Band 5_10MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
829.00	-22.61	2.13	45.74	0.90	2.15	19.75	38.45	18.70	H
836.50	-21.45	2.26	45.66	0.82	2.15	20.62	38.45	17.83	H
844.00	-22.13	2.26	45.59	0.82	2.15	19.87	38.45	18.58	H

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LTE Band 5_1.4MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
824.70	-23.30	2.26	45.79	0.95	2.15	19.03	38.45	19.42	H
836.50	-22.88	2.26	45.66	0.82	2.15	19.19	38.45	19.26	H
848.30	-23.64	2.27	45.55	0.80	2.15	18.29	38.45	20.16	H

LTE Band 5_3MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
825.50	-23.17	2.26	45.79	0.94	2.15	19.15	38.45	19.30	H
836.50	-23.06	2.26	45.66	0.82	2.15	19.01	38.45	19.44	H
847.50	-23.30	2.27	45.56	0.81	2.15	18.65	38.45	19.80	H

LTE Band 5_5MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
826.50	-23.51	2.25	45.77	0.93	2.15	18.79	38.45	19.66	H
836.50	-22.85	2.26	45.66	0.82	2.15	19.22	38.45	19.23	H
846.50	-23.82	2.26	45.56	0.82	2.15	18.15	38.45	20.30	H

LTE Band 5_10MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
829.00	-23.50	2.13	45.74	0.90	2.15	18.86	38.45	19.59	H
836.50	-22.52	2.26	45.66	0.82	2.15	19.55	38.45	18.90	H
844.00	-23.69	2.26	45.59	0.82	2.15	18.31	38.45	20.14	H

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LTE Band 7- EIRP Part 27.50(h)(2)

Limits: ≤33dBm (2W)

LTE Band 7_5MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2502.50	-25.25	3.58	45.68	6.10	22.95	33.00	10.05	H
2535.00	-23.53	3.63	44.82	6.16	23.82	33.00	9.18	H
2567.50	-24.03	3.65	44.92	6.22	23.46	33.00	9.54	H

LTE Band 7_10MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2505.00	-25.43	3.59	45.64	6.11	22.73	33.00	10.27	H
2535.00	-23.17	3.63	44.82	6.16	24.18	33.00	8.82	H
2565.00	-24.13	3.65	44.97	6.22	23.41	33.00	9.59	H

LTE Band 7_15MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2507.50	-24.82	3.59	44.92	6.11	22.62	33.00	10.38	H
2535.00	-23.69	3.63	44.82	6.16	23.66	33.00	9.34	H
2562.50	-24.61	3.65	45.67	6.21	23.62	33.00	9.38	H

LTE Band 7_20MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2510.00	-25.03	3.58	45.36	6.12	22.87	33.00	10.13	H
2535.00	-23.67	3.63	44.82	6.16	23.68	33.00	9.32	H
2560.00	-24.92	3.64	45.98	6.21	23.63	33.00	9.37	H

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LTE Band 7_5MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2502.50	-26.52	3.58	45.68	6.10	21.68	33.00	11.32	H
2535.00	-24.40	3.63	44.82	6.16	22.95	33.00	10.05	H
2567.50	-24.71	3.65	44.92	6.22	22.78	33.00	10.22	H

LTE Band 7_10MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2505.00	-26.90	3.59	45.64	6.11	21.26	33.00	11.74	H
2535.00	-24.67	3.63	44.82	6.16	22.68	33.00	10.32	H
2565.00	-24.90	3.65	44.97	6.22	22.64	33.00	10.36	H

LTE Band 7_15MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2507.50	-26.19	3.59	44.92	6.11	21.25	33.00	11.75	H
2535.00	-24.89	3.63	44.82	6.16	22.46	33.00	10.54	H
2562.50	-26.38	3.65	45.67	6.21	21.85	33.00	11.15	H

LTE Band 7_20MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2510.00	-26.11	3.58	45.36	6.12	21.79	33.00	11.21	H
2535.00	-24.41	3.63	44.82	6.16	22.94	33.00	10.06	H
2560.00	-25.55	3.64	45.98	6.21	23.00	33.00	10.00	H

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LTE Band 7_5MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2502.50	-26.70	3.58	45.68	6.10	21.50	33.00	11.50	H
2535.00	-25.27	3.63	44.82	6.16	22.08	33.00	10.92	H
2567.50	-25.59	3.65	44.92	6.22	21.90	33.00	11.10	H

LTE Band 7_10MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2505.00	-27.92	3.59	45.64	6.11	20.24	33.00	12.76	H
2535.00	-25.07	3.63	44.82	6.16	22.28	33.00	10.72	H
2565.00	-25.57	3.65	44.97	6.22	21.97	33.00	11.03	H

LTE Band 7_15MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2507.50	-26.97	3.59	44.92	6.11	20.47	33.00	12.53	H
2535.00	-26.46	3.63	44.82	6.16	20.89	33.00	12.11	H
2562.50	-26.95	3.65	45.67	6.21	21.28	33.00	11.72	H

LTE Band 7_20MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2510.00	-27.07	3.58	45.36	6.12	20.83	33.00	12.17	H
2535.00	-25.86	3.63	44.82	6.16	21.49	33.00	11.51	H
2560.00	-26.36	3.64	45.98	6.21	22.19	33.00	10.81	H

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LTE Band 38- EIRP Part 27.50(h)(2)

Limits: ≤33dBm (2W)

LTE Band 38_5MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2572.50	-27.86	3.66	44.92	6.23	19.63	33.00	13.37	H
2595.00	-27.69	3.69	44.91	6.27	19.80	33.00	13.20	H
2617.50	-27.90	3.68	44.94	6.31	19.67	33.00	13.33	H

LTE Band 38_10MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2575.00	-27.49	3.66	44.92	6.23	20.00	33.00	13.00	H
2595.00	-27.52	3.69	44.91	6.27	19.97	33.00	13.03	H
2615.00	-27.82	3.68	44.94	6.31	19.75	33.00	13.25	H

LTE Band 38_15MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2577.50	-27.50	3.66	44.92	6.23	19.99	33.00	13.01	H
2595.00	-27.50	3.69	44.91	6.27	19.99	33.00	13.01	H
2612.50	-27.72	3.68	44.94	6.30	19.84	33.00	13.16	H

LTE Band 38_20MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2580.00	-27.20	3.67	44.92	6.24	20.29	33.00	12.71	H
2595.00	-27.25	3.69	44.91	6.27	20.24	33.00	12.76	H
2610.00	-27.70	3.68	44.94	6.30	19.86	33.00	13.14	H

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LTE Band 38_5MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2572.50	-29.27	3.66	44.92	6.23	18.22	33.00	14.78	H
2595.00	-29.20	3.69	44.91	6.27	18.29	33.00	14.71	H
2617.50	-29.44	3.68	44.94	6.31	18.13	33.00	14.87	H

LTE Band 38_10MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2575.00	-28.70	3.66	44.92	6.23	18.79	33.00	14.21	H
2595.00	-28.84	3.69	44.91	6.27	18.65	33.00	14.35	H
2615.00	-29.12	3.68	44.94	6.31	18.45	33.00	14.55	H

LTE Band 38_15MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2577.50	-29.20	3.66	44.92	6.23	18.29	33.00	14.71	H
2595.00	-29.07	3.69	44.91	6.27	18.42	33.00	14.58	H
2612.50	-29.21	3.68	44.94	6.30	18.35	33.00	14.65	H

LTE Band 38_20MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2580.00	-28.72	3.67	44.92	6.24	18.77	33.00	14.23	H
2595.00	-28.74	3.69	44.91	6.27	18.75	33.00	14.25	H
2610.00	-29.07	3.68	44.94	6.30	18.49	33.00	14.51	H

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LTE Band 38_5MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2572.50	-30.14	3.66	44.92	6.23	17.35	33.00	15.65	H
2595.00	-30.12	3.69	44.91	6.27	17.37	33.00	15.63	H
2617.50	-30.46	3.68	44.94	6.31	17.11	33.00	15.89	H

LTE Band 38_10MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2575.00	-29.65	3.66	44.92	6.23	17.84	33.00	15.16	H
2595.00	-29.88	3.69	44.91	6.27	17.61	33.00	15.39	H
2615.00	-30.11	3.68	44.94	6.31	17.46	33.00	15.54	H

LTE Band 38_15MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2577.50	-30.14	3.66	44.92	6.23	17.35	33.00	15.65	H
2595.00	-30.14	3.69	44.91	6.27	17.35	33.00	15.65	H
2612.50	-30.12	3.68	44.94	6.30	17.44	33.00	15.56	H

LTE Band 38_20 MHz_64QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2580.00	-29.43	3.67	44.92	6.24	18.06	33.00	14.94	H
2595.00	-29.69	3.69	44.91	6.27	17.80	33.00	15.20	H
2610.00	-30.10	3.68	44.94	6.30	17.46	33.00	15.54	H

Peak EIRP(dBm) = P_{Mea}(-23.17dBm) - G_a (-6.16dBi) - P_{Ag} (-44.82dB) - P_{cl} (3.63dB) =24.18dBm

Note: Expanded measurement uncertainty is U = 2.84 dB, k = 2.

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A.2 EMISSION LIMIT

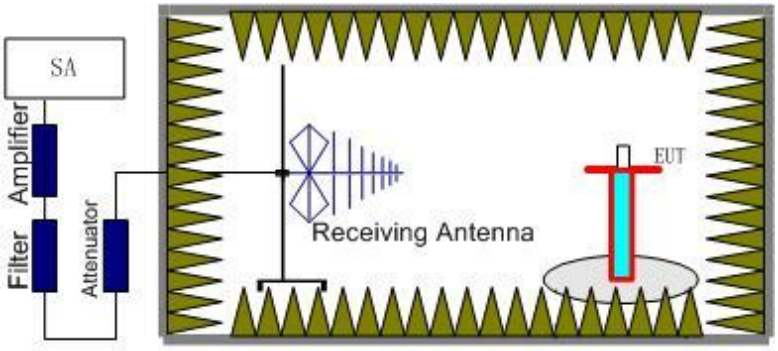
A.2.1 Measurement Method

The measurements procedures in TIA-603E-2016 are used. This measurement is carried out in fully-anechoic chamber FAC-3.

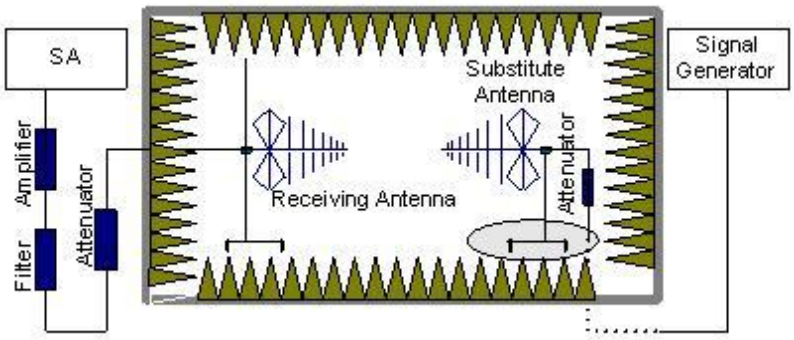
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier. The resolution bandwidth is set 1MHz. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE Bands 5 7 38.

The procedure of radiated spurious emissions is as follows:

1. EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all non-harmonic and harmonics of the transmit frequency through the 10th harmonic were measured with peak detector.



2. The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna. Adjust the level of the signal generator output until the value of the

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receiver reaches the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. The Path loss (P_{pl}) between the Signal Source with the Substitution Antenna and the Substitution Antenna Gain (G_a) should be recorded after test.
   An amplifier should be connected in for the test.
   The Path loss (P_{pl}) is the summation of the cable loss and the gain of the amplifier.
   The measurement results are obtained as described below:
   Power (EIRP)=P_{Mea}+ P_{pl} + G_a
5. This value is EIRP since the measurement is calibrated using an antenna of known gain (unit: dBi) and known input power.
6. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15dB.

A.2.2 Measurement Limit

Part 22.917, Part 27.53(g), Part 27.53(h) specify 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.

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

A.2.3 Measurement Results

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of the LTE Bands 5 7 38. 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 Bands 5 7 38 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 evaluated frequency range is from 30MHz to 26GHz.

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LTE Band 5, 1.4MHz, QPSK, Channel 20407

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1650.01	-44.84	3.57	5.23	2.15	-45.33	-13.00	32.33	H
2474.00	-39.87	4.60	6.02	2.15	-40.60	-13.00	27.60	H
3299.02	-52.95	5.29	7.72	2.15	-52.67	-13.00	39.67	V
4128.02	-50.53	6.04	9.03	2.15	-49.69	-13.00	36.69	H
4939.01	-55.98	6.71	9.84	2.15	-55.00	-13.00	42.00	H
5772.01	-54.56	7.23	10.55	2.15	-53.39	-13.00	40.39	V

LTE Band 5, 1.4MHz, QPSK, Channel 20525

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1673.01	-50.82	3.58	5.19	2.15	-51.36	-13.00	38.36	H
2510.00	-34.70	4.63	6.12	2.15	-35.36	-13.00	22.36	H
3346.02	-50.38	5.31	7.83	2.15	-50.01	-13.00	37.01	H
4186.02	-47.02	6.17	9.09	2.15	-46.25	-13.00	33.25	V
5030.01	-55.86	6.57	9.94	2.15	-54.64	-13.00	41.64	H
5847.01	-54.25	7.23	10.53	2.15	-53.10	-13.00	40.10	H

LTE Band 5, 1.4MHz, QPSK, Channel 20643

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1697.01	-50.00	3.60	5.15	2.15	-50.60	-13.00	37.60	H
2545.00	-32.63	4.66	6.18	2.15	-33.26	-13.00	20.26	H
3394.02	-50.71	5.36	7.95	2.15	-50.27	-13.00	37.27	H
4245.02	-45.03	6.24	9.15	2.15	-44.27	-13.00	31.27	H
5093.01	-53.63	6.75	10.03	2.15	-52.50	-13.00	39.50	H
5942.01	-50.85	7.47	10.51	2.15	-49.96	-13.00	36.96	H

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LTE Band 5, 1.4MHz, 16QAM, Channel 20407

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1650.01	-52.50	3.57	5.23	2.15	-52.99	-13.00	39.99	V
2474.00	-45.67	4.60	6.02	2.15	-46.40	-13.00	33.40	V
3299.02	-53.32	5.29	7.72	2.15	-53.04	-13.00	40.04	V
4127.02	-53.27	6.04	9.03	2.15	-52.43	-13.00	39.43	V
4942.01	-55.84	6.70	9.84	2.15	-54.85	-13.00	41.85	H
5773.01	-55.07	7.23	10.55	2.15	-53.90	-13.00	40.90	H

LTE Band 5, 1.4MHz, 16QAM, Channel 20525

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1673.01	-50.94	3.58	5.19	2.15	-51.48	-13.00	38.48	H
2510.00	-35.63	4.63	6.12	2.15	-36.29	-13.00	23.29	H
3346.02	-52.21	5.31	7.83	2.15	-51.84	-13.00	38.84	H
4186.02	-47.80	6.17	9.09	2.15	-47.03	-13.00	34.03	V
5020.01	-55.49	6.57	9.93	2.15	-54.28	-13.00	41.28	H
5861.01	-54.05	7.27	10.53	2.15	-52.94	-13.00	39.94	H

LTE Band 5, 1.4MHz, 16QAM, Channel 20643

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1697.01	-50.34	3.60	5.15	2.15	-50.94	-13.00	37.94	H
2545.00	-32.67	4.66	6.18	2.15	-33.30	-13.00	20.30	H
3394.02	-50.03	5.36	7.95	2.15	-49.59	-13.00	36.59	H
4247.02	-44.82	6.24	9.15	2.15	-44.06	-13.00	31.06	H
5089.01	-53.38	6.74	10.02	2.15	-52.25	-13.00	39.25	H
5943.01	-51.48	7.47	10.51	2.15	-50.59	-13.00	37.59	H

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LTE Band 5, 1.4MHz, 64QAM, Channel 20407

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1650.01	-44.91	3.57	5.23	2.15	-45.40	-13.00	32.40	H
2474.00	-40.96	4.60	6.02	2.15	-41.69	-13.00	28.69	H
3299.02	-53.25	5.29	7.72	2.15	-52.97	-13.00	39.97	V
4128.02	-51.00	6.04	9.03	2.15	-50.16	-13.00	37.16	H
4939.01	-55.91	6.71	9.84	2.15	-54.93	-13.00	41.93	H
5770.01	-53.98	7.23	10.55	2.15	-52.81	-13.00	39.81	H

LTE Band 5, 1.4MHz, 64QAM, Channel 20525

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1673.01	-50.53	3.58	5.19	2.15	-51.07	-13.00	38.07	H
2510.00	-34.52	4.63	6.12	2.15	-35.18	-13.00	22.18	H
3346.02	-50.19	5.31	7.83	2.15	-49.82	-13.00	36.82	H
4187.02	-47.10	6.18	9.09	2.15	-46.34	-13.00	33.34	H
5028.01	-56.50	6.57	9.94	2.15	-55.28	-13.00	42.28	V
5849.01	-54.43	7.23	10.53	2.15	-53.28	-13.00	40.28	H

LTE Band 5, 1.4MHz, 64QAM, Channel 20643

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1697.01	-50.37	3.60	5.15	2.15	-50.97	-13.00	37.97	H
2545.00	-32.37	4.66	6.18	2.15	-33.00	-13.00	20.00	H
3393.02	-50.81	5.36	7.94	2.15	-50.38	-13.00	37.38	H
4247.02	-45.10	6.24	9.15	2.15	-44.34	-13.00	31.34	H
5094.01	-54.84	6.76	10.03	2.15	-53.72	-13.00	40.72	H
5943.01	-52.80	7.47	10.51	2.15	-51.91	-13.00	38.91	H

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LTE Band 7, 5 MHz, QPSK, Channel 20775

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5010.02	-52.08	6.59	9.91	-48.76	-25.00	23.76	H
7510.01	-45.35	8.35	12.21	-41.49	-25.00	16.49	V
10020.01	-36.81	9.24	12.91	-33.14	-25.00	8.14	V
12524.01	-47.10	10.24	13.21	-44.13	-25.00	19.13	V
15015.00	-45.73	11.24	13.99	-42.98	-25.00	17.98	V
17523.00	-43.38	12.81	14.93	-41.26	-25.00	16.26	H

LTE Band 7, 5 MHz, QPSK, Channel 21100

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5075.02	-51.55	6.70	10.01	-48.24	-25.00	23.24	H
7608.01	-44.14	8.01	12.29	-39.86	-25.00	14.86	V
10150.01	-40.13	9.38	12.96	-36.55	-25.00	11.55	V
12665.01	-49.03	10.36	13.30	-46.09	-25.00	21.09	V
15224.00	-46.03	11.37	13.87	-43.53	-25.00	18.53	V
17740.00	-44.35	12.40	15.24	-41.51	-25.00	16.51	H

LTE Band 7, 5 MHz, QPSK, Channel 21425

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5140.02	-50.84	6.87	10.10	-47.61	-25.00	22.61	H
7706.01	-44.14	8.42	12.36	-40.20	-25.00	15.20	V
10280.01	-39.71	9.57	13.01	-36.27	-25.00	11.27	V
12848.01	-49.55	10.64	13.41	-46.78	-25.00	21.78	V
15413.00	-45.79	11.41	13.75	-43.45	-25.00	18.45	H
17980.00	-43.49	12.90	15.57	-40.82	-25.00	15.82	H

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LTE Band 7, 5 MHz, 16QAM, Channel 20775

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5007.02	-53.36	6.59	9.91	-50.04	-25.00	25.04	H
7510.01	-46.55	8.35	12.21	-42.69	-25.00	17.69	H
10020.01	-36.71	9.24	12.91	-33.04	-25.00	8.04	V
12519.01	-50.85	10.23	13.21	-47.87	-25.00	22.87	V
15031.00	-45.95	11.26	13.98	-43.23	-25.00	18.23	V
17527.00	-43.67	12.83	14.94	-41.56	-25.00	16.56	V

LTE Band 7, 5 MHz, 16QAM, Channel 21100

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5073.02	-52.45	6.70	10.00	-49.15	-25.00	24.15	H
7610.01	-44.22	8.02	12.29	-39.95	-25.00	14.95	V
10150.01	-39.48	9.38	12.96	-35.90	-25.00	10.90	V
12664.01	-50.20	10.36	13.30	-47.26	-25.00	22.26	H
15226.00	-46.64	11.37	13.86	-44.15	-25.00	19.15	V
17751.00	-44.68	12.46	15.25	-41.89	-25.00	16.89	H

LTE Band 7, 5 MHz, 16QAM, Channel 21425

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5140.02	-52.35	6.87	10.10	-49.12	-25.00	24.12	H
7708.01	-46.37	8.42	12.37	-42.42	-25.00	17.42	V
10279.01	-40.32	9.57	13.01	-36.88	-25.00	11.88	V
12826.01	-50.09	10.70	13.40	-47.39	-25.00	22.39	H
15404.00	-46.18	11.40	13.76	-43.82	-25.00	18.82	V
17971.00	-43.45	12.89	15.56	-40.78	-25.00	15.78	H

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LTE Band 7, 5 MHz, 64QAM, Channel 20775

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5007.02	-50.46	6.59	9.91	-47.14	-25.00	22.14	H
7510.01	-46.23	8.35	12.21	-42.37	-25.00	17.37	H
10019.01	-31.40	9.23	12.91	-27.72	-25.00	2.72	V
12523.01	-50.16	10.24	13.21	-47.19	-25.00	22.19	V
15028.00	-46.23	11.25	13.98	-43.50	-25.00	18.50	V
17509.00	-43.57	12.76	14.91	-41.42	-25.00	16.42	V

LTE Band 7, 5 MHz, 64QAM, Channel 21100

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5076.02	-51.33	6.70	10.01	-48.02	-25.00	23.02	H
7611.01	-47.40	8.02	12.29	-43.13	-25.00	18.13	H
10155.01	-37.46	9.37	12.96	-33.87	-25.00	8.87	V
12684.01	-50.18	10.33	13.31	-47.20	-25.00	22.20	V
15225.00	-46.24	11.37	13.86	-43.75	-25.00	18.75	V
17730.00	-44.70	12.35	15.22	-41.83	-25.00	16.83	H

LTE Band 7, 5 MHz, 64QAM, Channel 21425

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
5140.02	-50.02	6.87	10.10	-46.79	-25.00	21.79	H
7706.01	-43.02	8.42	12.36	-39.08	-25.00	14.08	V
10280.01	-41.38	9.57	13.01	-37.94	-25.00	12.94	V
12839.01	-49.20	10.67	13.40	-46.47	-25.00	21.47	H
15398.00	-46.24	11.39	13.76	-43.87	-25.00	18.87	H
17958.00	-43.92	12.89	15.54	-41.27	-25.00	16.27	H

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LTE Band 38, 5MHz, QPSK, Channel 37775

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
5148.02	-49.52	6.88	10.11	-46.29	-13.00	33.29	H
7722.01	-48.61	8.40	12.38	-44.63	-13.00	31.63	H
10299.01	-34.91	9.64	13.02	-31.53	-13.00	18.53	V
12890.01	-49.67	10.53	13.43	-46.77	-13.00	33.77	H
15419.00	-46.16	11.42	13.75	-43.83	-13.00	30.83	H
17991.00	-44.42	12.90	15.59	-41.73	-13.00	28.73	H

LTE Band 38, 5MHz, QPSK, Channel 38000

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
5195.02	-54.66	6.95	10.17	-51.44	-13.00	38.44	V
7787.01	-46.78	8.31	12.43	-42.66	-13.00	29.66	V
9114.01	-53.87	8.93	13.17	-49.63	-13.00	36.63	V
11660.01	-51.45	9.69	13.07	-48.07	-13.00	35.07	H
14274.00	-46.99	10.95	14.45	-43.49	-13.00	30.49	H
16845.00	-42.17	12.06	13.74	-40.49	-13.00	27.49	V

LTE Band 38, 5MHz, QPSK, Channel 38225

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
5239.02	-44.06	7.00	10.23	-40.83	-13.00	27.83	H
7856.01	-43.35	8.37	12.48	-39.24	-13.00	26.24	V
10481.01	-38.60	9.68	13.09	-35.19	-13.00	22.19	V
13104.01	-48.27	10.92	13.65	-45.54	-13.00	32.54	H
15681.00	-46.50	11.58	13.70	-44.38	-13.00	31.38	V
16979.00	-42.55	12.29	13.79	-41.05	-13.00	28.05	H

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LTE Band 38, 5MHz, 16QAM, Channel 37775

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
5150.02	-50.00	6.88	10.11	-46.77	-13.00	33.77	H
7723.01	-48.87	8.39	12.38	-44.88	-13.00	31.88	H
10299.01	-34.44	9.64	13.02	-31.06	-13.00	18.06	V
12838.01	-49.68	10.67	13.40	-46.95	-13.00	33.95	V
15447.00	-45.60	11.46	13.73	-43.33	-13.00	30.33	H
18000.00	-44.13	12.90	15.60	-41.43	-13.00	28.43	V

LTE Band 38, 5MHz, 16QAM, Channel 38000

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
6507.02	-55.05	7.51	11.01	-51.55	-13.00	38.55	H
7788.01	-46.69	8.30	12.43	-42.56	-13.00	29.56	H
9075.01	-54.22	9.00	13.15	-50.07	-13.00	37.07	H
11680.01	-51.65	9.65	13.06	-48.24	-13.00	35.24	V
14276.00	-46.85	10.95	14.44	-43.36	-13.00	30.36	H
16845.00	-42.61	12.06	13.74	-40.93	-13.00	27.93	V

LTE Band 38, 5MHz, 16QAM, Channel 38225

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
5239.02	-45.58	7.00	10.23	-42.35	-13.00	29.35	H
7856.01	-43.34	8.37	12.48	-39.23	-13.00	26.23	V
10480.01	-40.81	9.68	13.09	-37.40	-13.00	24.40	V
13118.01	-48.60	10.86	13.67	-45.79	-13.00	32.79	H
15678.00	-46.61	11.58	13.70	-44.49	-13.00	31.49	V
16986.00	-42.29	12.32	13.79	-40.82	-13.00	27.82	V

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LTE Band 38, 5MHz, 64QAM, Channel 37775

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
5147.02	-55.13	6.88	10.11	-51.90	-13.00	38.90	V
7724.01	-46.97	8.39	12.38	-42.98	-13.00	29.98	H
10303.01	-42.48	9.65	13.02	-39.11	-13.00	26.11	V
12863.01	-50.30	10.60	13.42	-47.48	-13.00	34.48	V
15445.00	-46.05	11.46	13.73	-43.78	-13.00	30.78	V
17977.00	-43.91	12.90	15.57	-41.24	-13.00	28.24	H

LTE Band 38, 5MHz, 64QAM, Channel 38000

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
5194.02	-54.62	6.95	10.17	-51.40	-13.00	38.40	V
7818.01	-55.33	8.31	12.45	-51.19	-13.00	38.19	V
9108.01	-54.44	8.93	13.16	-50.21	-13.00	37.21	H
11676.01	-51.52	9.66	13.06	-48.12	-13.00	35.12	H
14301.00	-46.80	10.98	14.44	-43.34	-13.00	30.34	H
16856.00	-42.66	12.05	13.74	-40.97	-13.00	27.97	V

LTE Band 38, 5MHz, 64QAM, Channel 38225

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
5241.02	-51.03	7.00	10.24	-47.79	-13.00	34.79	H
7856.01	-43.66	8.37	12.48	-39.55	-13.00	26.55	V
9141.01	-54.42	8.93	13.18	-50.17	-13.00	37.17	V
11796.01	-50.52	10.09	13.04	-47.57	-13.00	34.57	V
14397.00	-46.85	11.04	14.42	-43.47	-13.00	30.47	H
16979.00	-42.88	12.29	13.79	-41.38	-13.00	28.38	H

Note: The maximum value of expanded measurement uncertainty for this test item is U = 5.16 dB, k = 2.

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A.3 FREQUENCY STABILITY

A.3.1 Method of Measurement

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of R&S CMW500 DIGITAL RADIO COMMUNICATION TESTER.

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -10℃.
3. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on middle channel for LTE band 5 7 38, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
4. Repeat the above measurements at 10℃ increments from -10℃ to +50℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Re-measure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments re-measuring carrier frequency at each voltage. Pause at nominal voltage for 1.5 hours unpowered, to allow any self-heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +50℃.
7. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10 ℃increments from -10℃ to +50℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

A.3.2 Measurement Limit

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d) (2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3.6VDC and 4.4VDC, with a nominal voltage of 3.9VDC. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. For the purposes of measuring frequency stability these voltage limits are to be used.

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A.3.3 Measurement results

LTE Band 5, 1.4MHz bandwidth (worst case of all bandwidths)

Frequency Error vs Voltage

Voltage (V)	Frequency error (Hz)			Frequency error (ppm)		
	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
3.6	-3.95	-23.47	-0.30	0.0047	0.0281	0.000
3.9	-3.95	-23.35	0.40	0.0047	0.0279	0.000
4.4	-3.86	-24.62	-0.70	0.0046	0.0294	0.001

Frequency Error vs Temperature

Temperature (℃)	Frequency error (Hz)			Frequency error (ppm)		
	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
50	-3.66	-24.12	-0.40	0.0044	0.0288	0.000
40	-4.23	-24.23	-2.80	0.0051	0.0290	0.003
30	-3.33	-23.23	-1.00	0.0040	0.0278	0.001
20	-3.49	-24.32	-0.60	0.0042	0.0291	0.001
10	-2.75	-24.23	-0.70	0.0033	0.0290	0.001
0	-3.00	-23.82	-1.50	0.0036	0.0285	0.002
- 10	-2.72	-24.26	-0.30	0.0033	0.0290	0.000

LTE Band 7, 10MHz bandwidth (worst case of all bandwidths)

Frequency Error vs Voltage

Voltage (V)	Frequency error (Hz)			Frequency error (ppm)		
	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
3.6	-8.38	-11.63	-0.10	0.0033	0.0046	0.000
3.9	-5.78	-11.17	-3.90	0.0023	0.0044	0.002
4.4	-7.00	-11.59	-0.30	0.0028	0.0046	0.000

Frequency Error vs Temperature

Temperature (℃)	Frequency error (Hz)			Frequency error (ppm)		
	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
50	-9.08	-13.55	-1.30	0.0036	0.0053	0.001
40	-8.47	-11.00	-2.60	0.0033	0.0043	0.001
30	-9.46	-10.59	-6.10	0.0037	0.0042	0.002
20	-9.86	-13.05	-4.40	0.0039	0.0051	0.002
10	-8.11	-12.95	-5.20	0.0032	0.0051	0.002
0	-9.60	-12.70	-2.60	0.0038	0.0050	0.001
- 10	-9.18	-12.62	-4.40	0.0036	0.0050	0.002

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LTE Band 38, 10MHz bandwidth (worst case of all bandwidths)

Frequency Error vs Voltage

Voltage (V)	Frequency error (Hz)			Frequency error (ppm)		
	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
3.6	-12.20	15.28	-7.80	0.0047	0.0059	0.003
3.9	15.32	15.96	-1.00	0.0059	0.0062	0.000
4.4	11.67	16.87	-3.10	0.0045	0.0065	0.001

Frequency Error vs Temperature

Temperature (℃)	Frequency error (Hz)			Frequency error (ppm)		
	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
50	10.10	19.21	-3.30	0.0039	0.0074	0.001
40	50.17	15.23	-1.70	0.0193	0.0059	0.001
30	9.87	14.23	-5.00	0.0038	0.0055	0.002
20	10.06	16.89	-2.70	0.0039	0.0065	0.001
10	13.09	15.61	2.70	0.0050	0.0060	0.001
0	11.69	16.82	-2.10	0.0045	0.0065	0.001
- 10	-12.06	16.57	-3.20	0.0046	0.0064	0.001

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A.4 OCCUPIED BANDWIDTH

A.4.1 Occupied Bandwidth Results

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 US Cellular/PCS frequency bands. The table below lists the measured 99% BW. Spectrum analyzer plots are included on the following pages.

The measurement method is from KDB 971168 4.2:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (i.e., two to five times the OBW).

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.

c) Set the reference level of the instrument as required to keep the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope must be at least 10log (OBW / RBW) below the reference level.

d) Set the detection mode to peak, and the trace mode to max hold.

e) Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.

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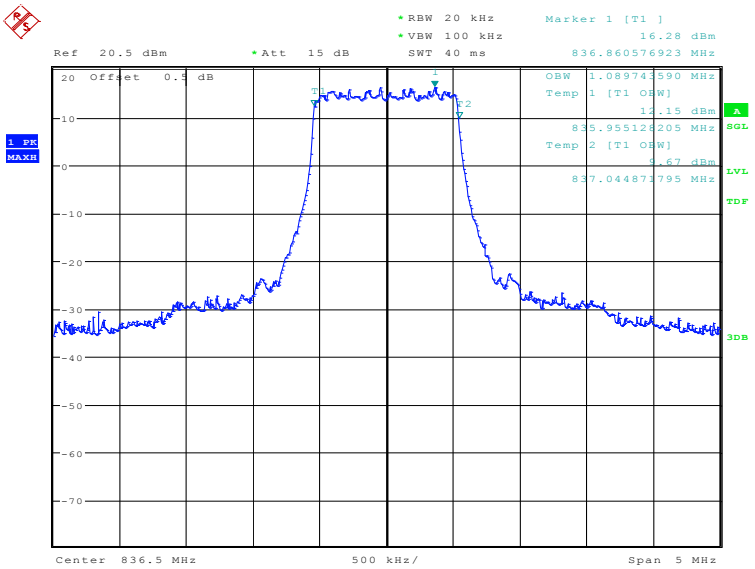
LTE band 5, 1.4MHz (99%)

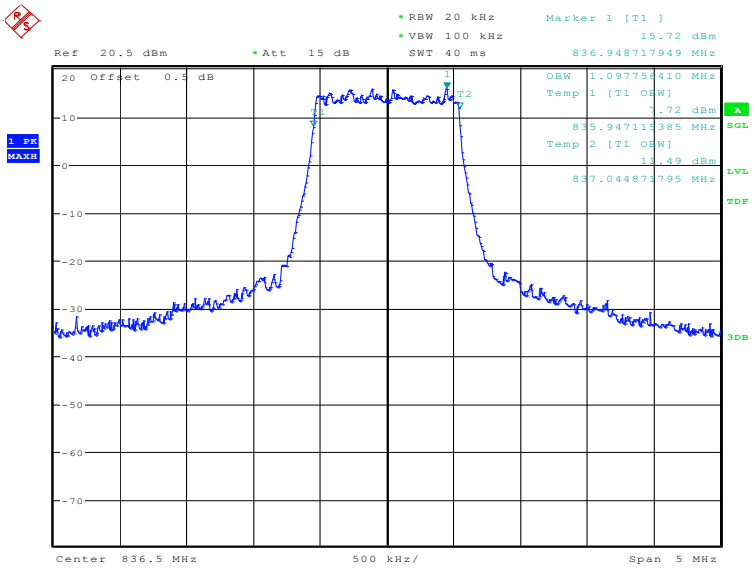
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
836.5	QPSK	16QAM	64QAM
	1089.74	1097.76	1089.74

LTE band 5, 1.4MHz Bandwidth, QPSK (99% BW)



Date: 23.JAN.2019 21:04:23

LTE band 5, 1.4MHz Bandwidth, 16QAM (99% BW)



Date: 23.JAN.2019 21:05:47

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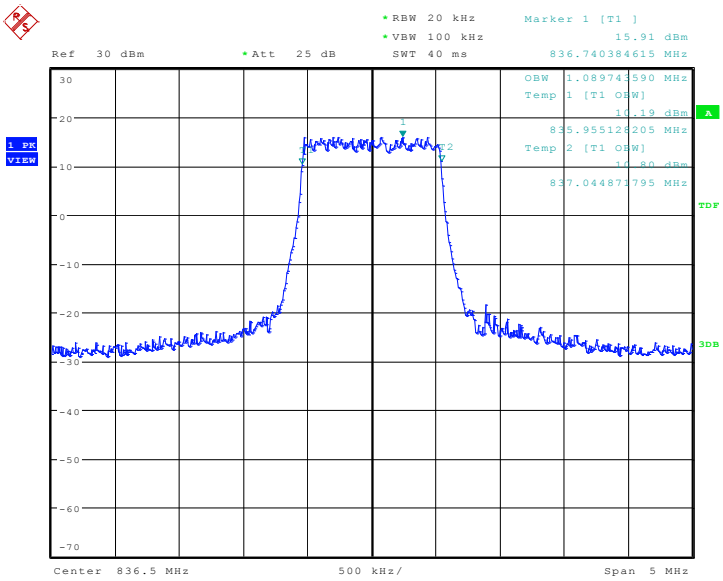
LTE band 5, 1.4MHz Bandwidth, 64QAM (99% BW)



Date: 15.FEB.2019 15:21:13

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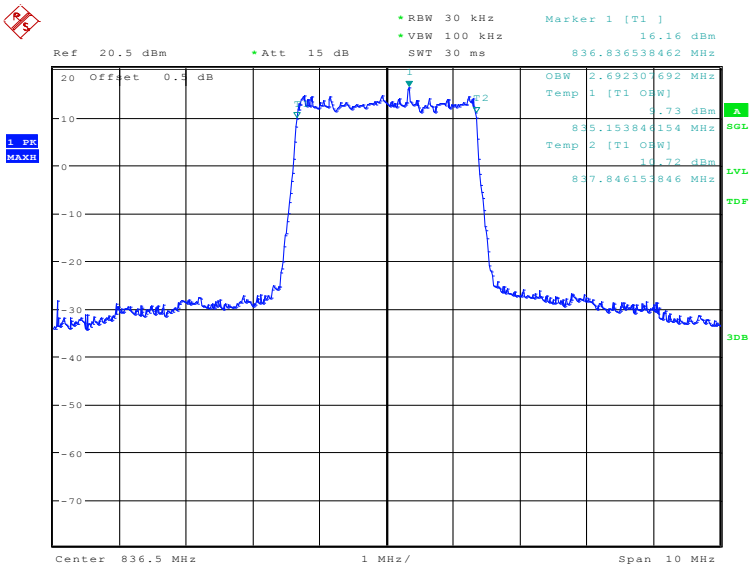
LTE band 5, 3MHz (99%)

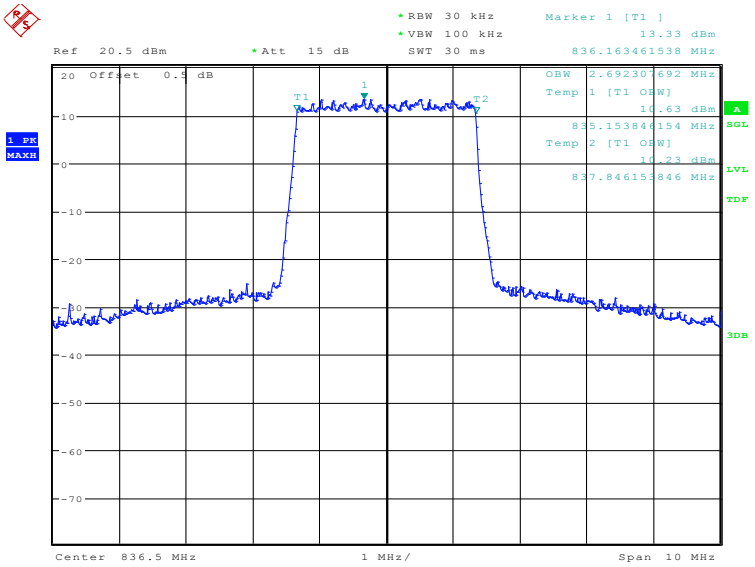
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
836.5	QPSK	16QAM	64QAM
	2692.31	2692.31	2708.33

LTE band 5, 3MHz Bandwidth, QPSK (99% BW)



Date: 23.JAN.2019 21:07:12

LTE band 5, 3MHz Bandwidth, 16QAM (99% BW)



Date: 23.JAN.2019 21:08:35

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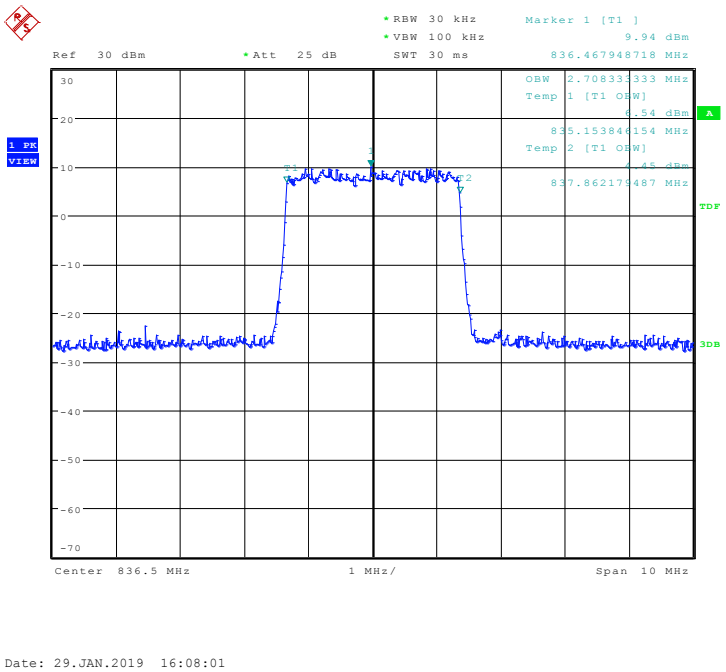
LTE band 5, 3MHz Bandwidth, 64QAM (99% BW)



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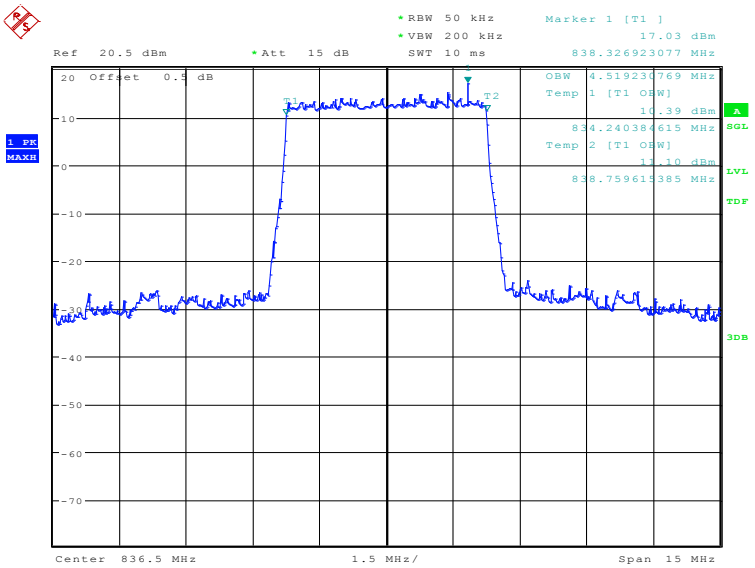
LTE band 5, 5MHz (99%)

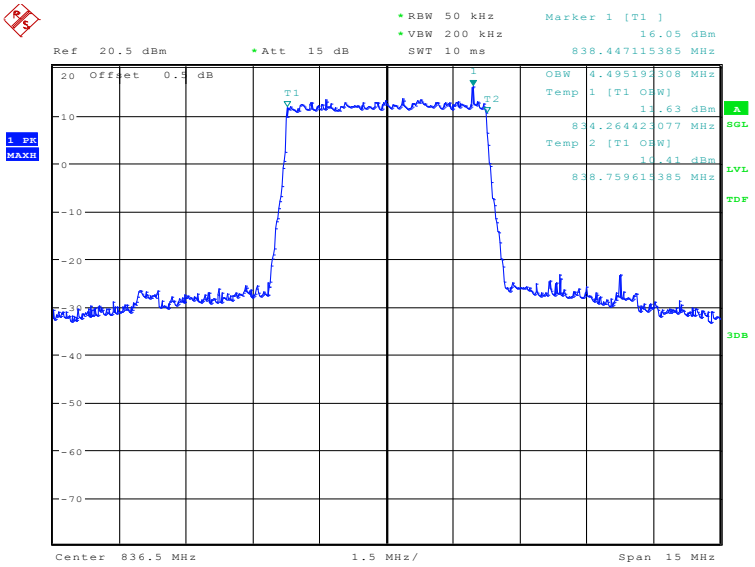
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
836.5	QPSK	16QAM	64QAM
	4519.23	4495.19	4495.19

LTE band 5, 5MHz Bandwidth, QPSK (99% BW)



Date: 23.JAN.2019 21:10:00

LTE band 5, 5MHz Bandwidth, 16QAM (99% BW)



Date: 23.JAN.2019 21:11:24

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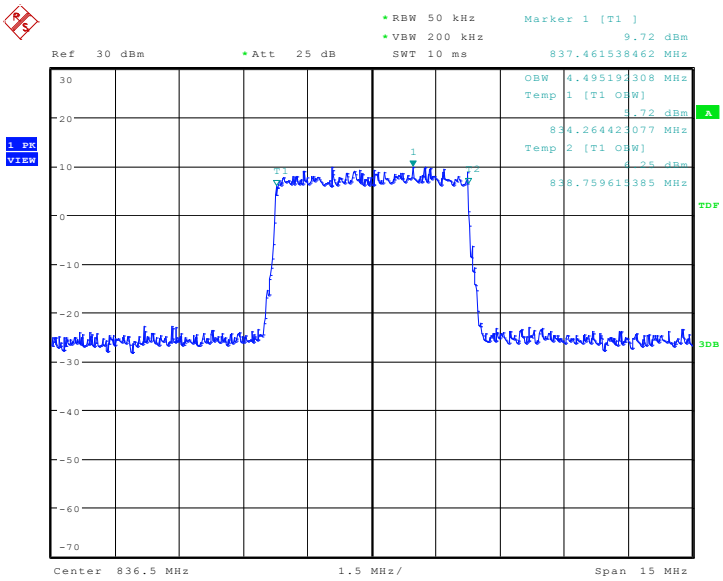
LTE band 5, 5MHz Bandwidth,64QAM (99% BW)



Date: 29.JAN.2019 16:09:31

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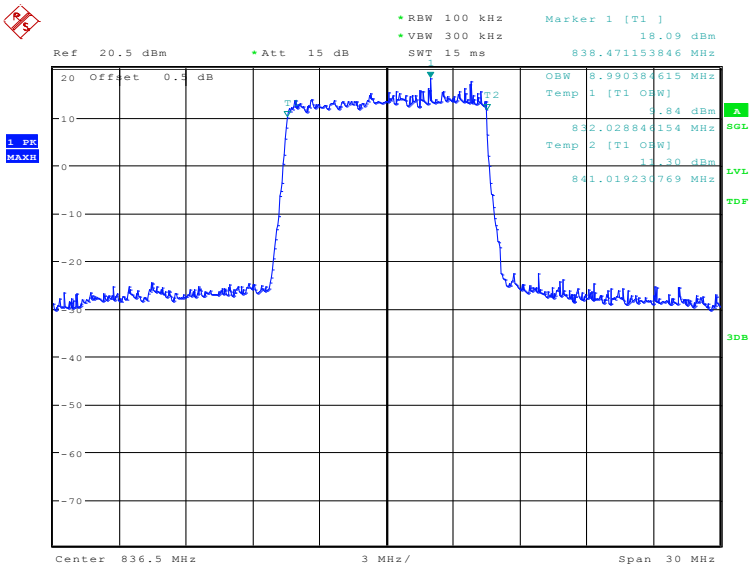
LTE band 5, 10MHz (99%)

Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
836.5	QPSK	16QAM	64QAM
	8990.38	8942.31	8990.38

LTE band 5, 10MHz Bandwidth, QPSK (99% BW)



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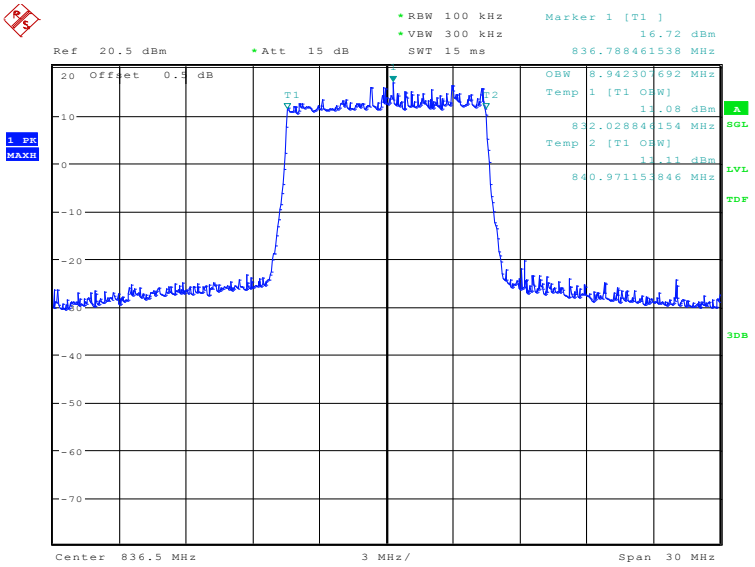
LTE band 5, 10MHz Bandwidth, 16QAM (99% BW)



Date: 23.JAN.2019 21:14:13

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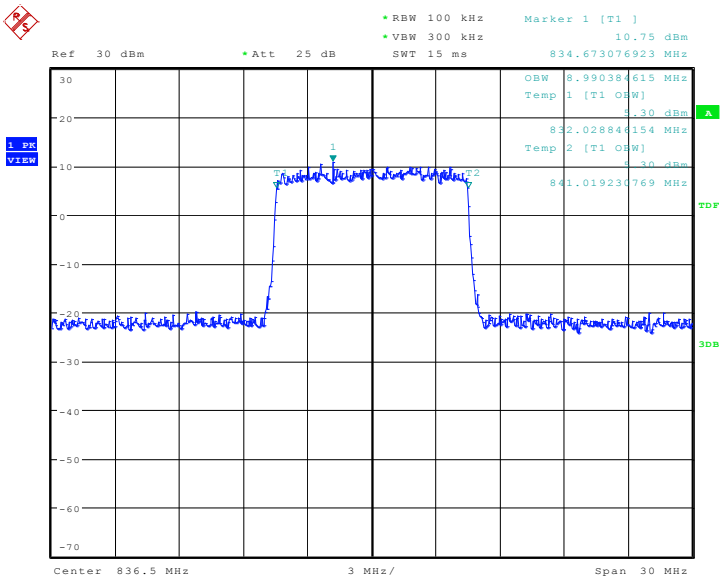
LTE band 5, 10MHz Bandwidth, 64QAM (99% BW)



Date: 29.JAN.2019 16:35:52

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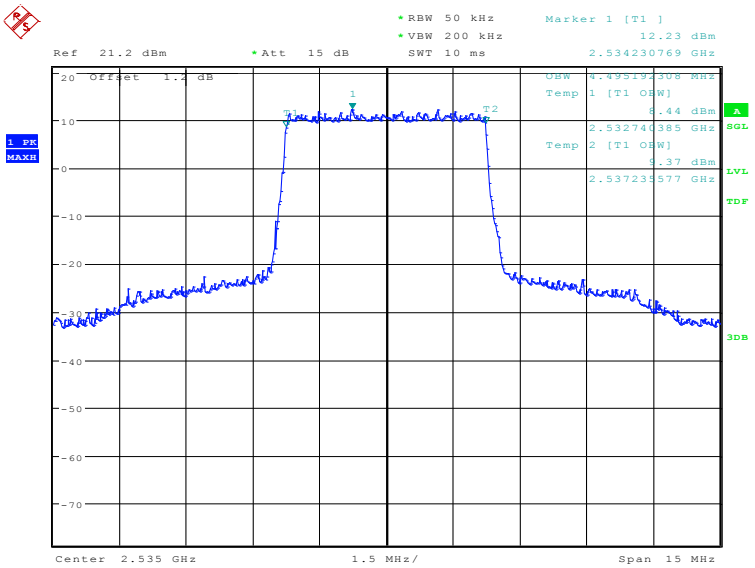
LTE band 7, 5MHz (99%)

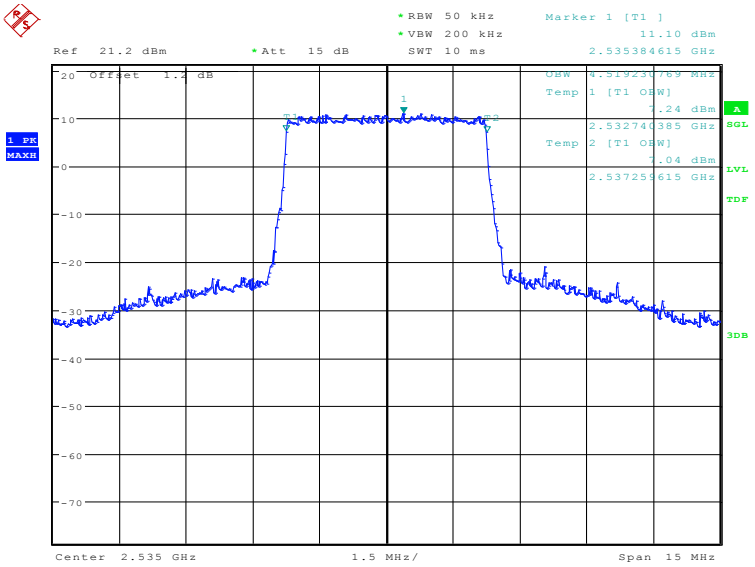
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
2535.0	QPSK	16QAM	64QAM
	4495.19	4519.23	4519.23

LTE band 7, 5MHz Bandwidth, QPSK (99% BW)



Date: 23.JAN.2019 21:15:40

LTE band 7, 5MHz Bandwidth, 16QAM (99% BW)



Date: 23.JAN.2019 21:17:03

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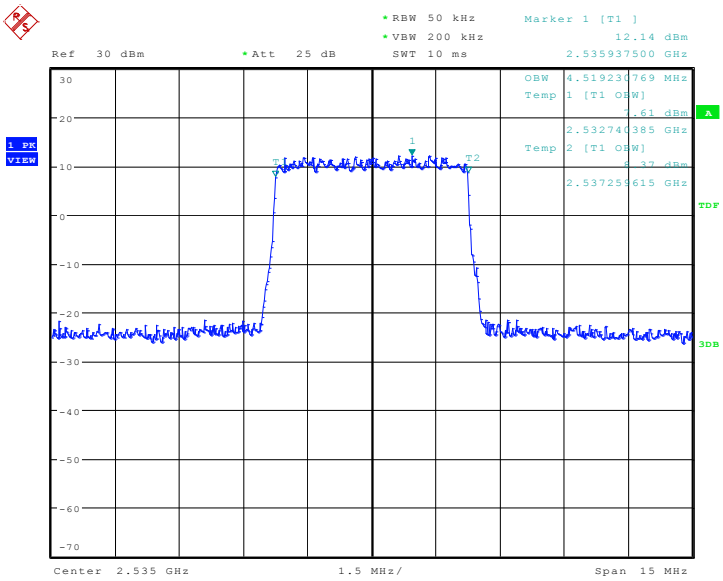
LTE band 7, 5MHz Bandwidth,64QAM (99% BW)



Date: 29.JAN.2019 15:33:05

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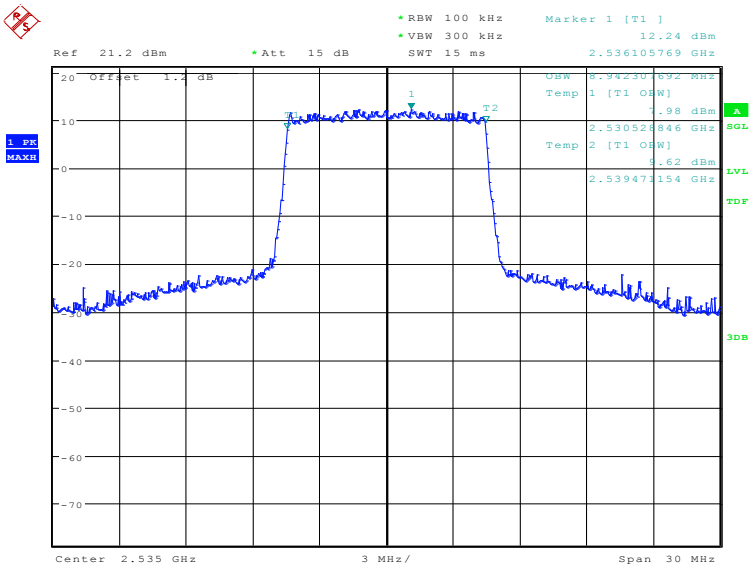
LTE band 7, 10MHz (99%)

Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
2535.0	QPSK	16QAM	64QAM
	8942.31	8990.38	8942.31

LTE band 7, 10MHz Bandwidth, QPSK (99% BW)



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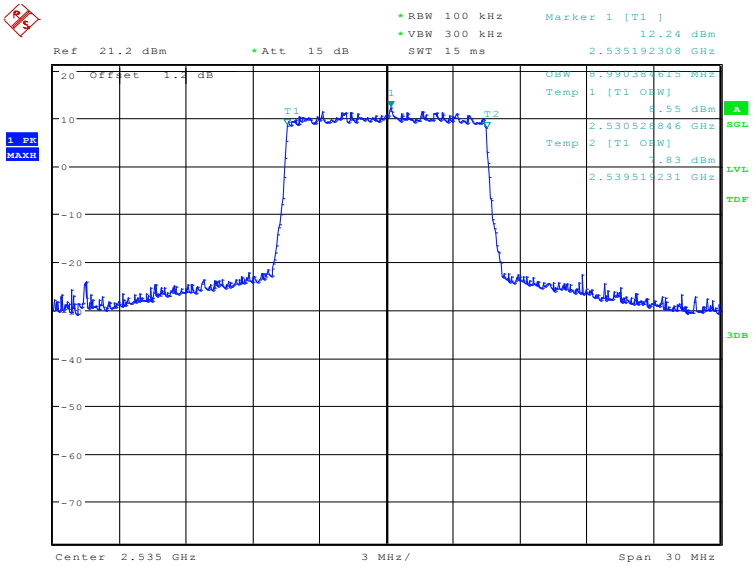
LTE band 7, 10MHz Bandwidth, 16QAM (99% BW)



Date: 23.JAN.2019 21:19:52

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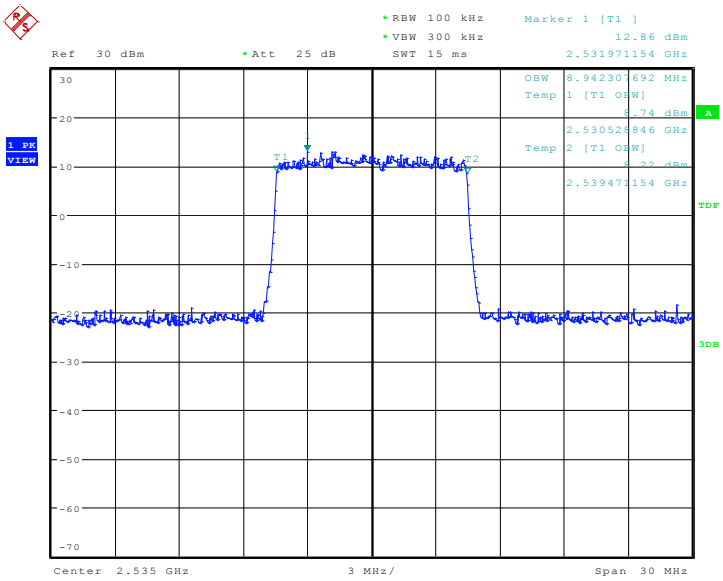
LTE band 7, 10MHz Bandwidth, 64QAM (99% BW)



Date: 29.JAN.2019 15:35:02

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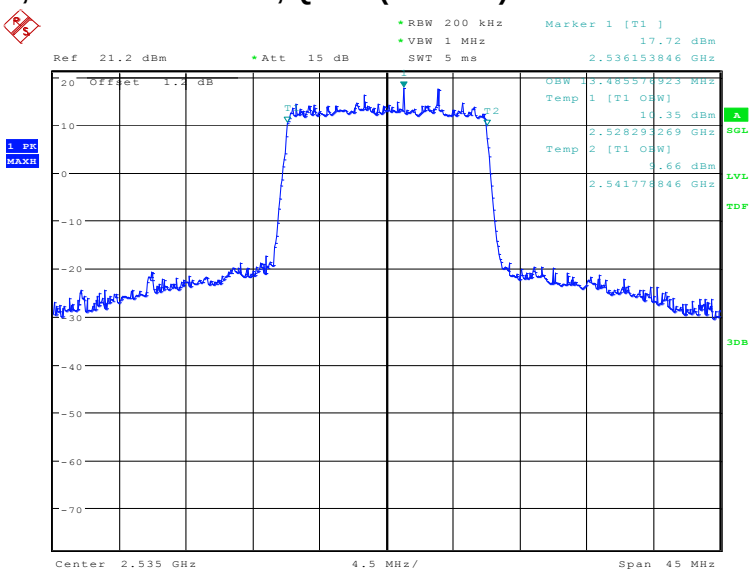
LTE band 7, 15MHz (99%)

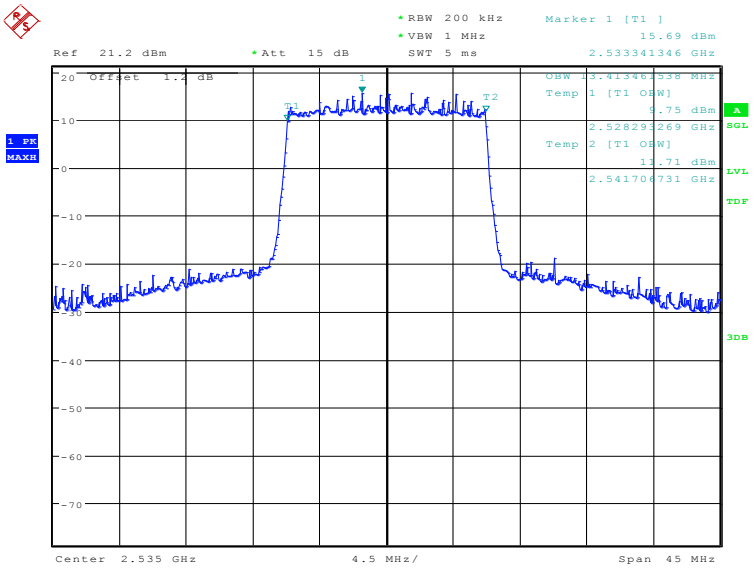
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
2535.0	QPSK	16QAM	64QAM
	13485.58	13413.46	13485.58

LTE band 7, 15MHz Bandwidth, QPSK (99% BW)



Date: 23.JAN.2019 21:21:18

LTE band 7, 15MHz Bandwidth, 16QAM (99% BW)



Date: 23.JAN.2019 21:22:41

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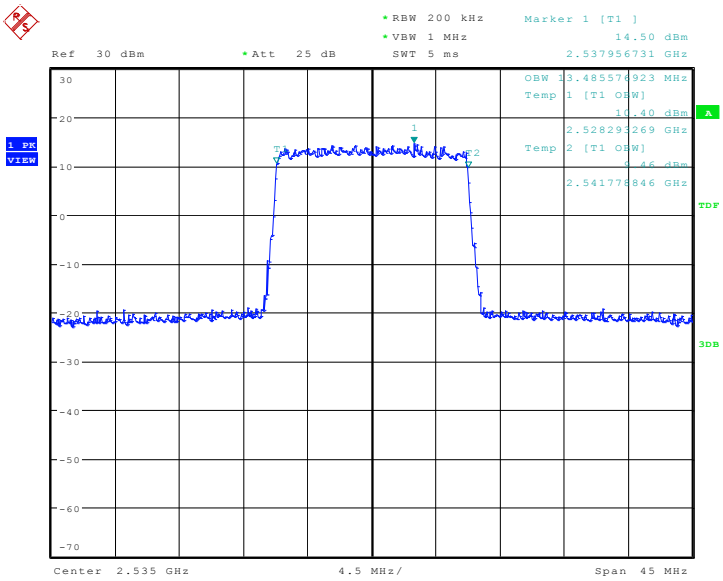
LTE band 7, 15MHz Bandwidth, 64QAM (99% BW)



Date: 29.JAN.2019 15:36:25

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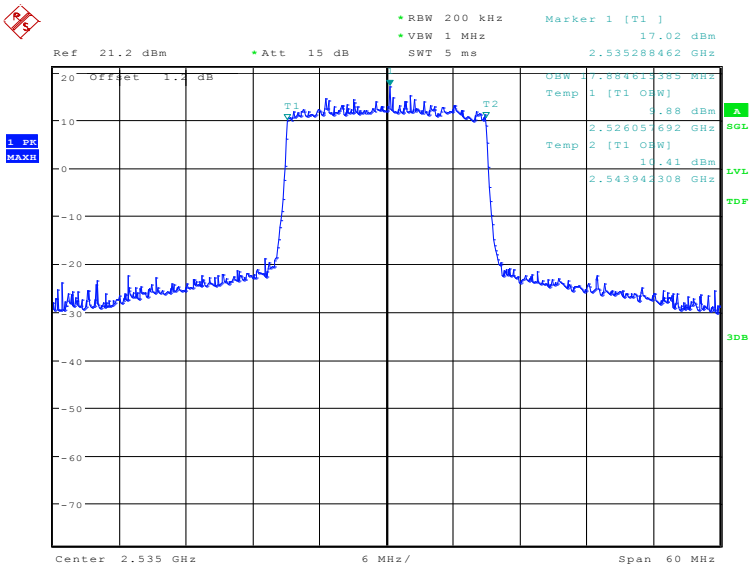
LTE band 7, 20MHz (99%)

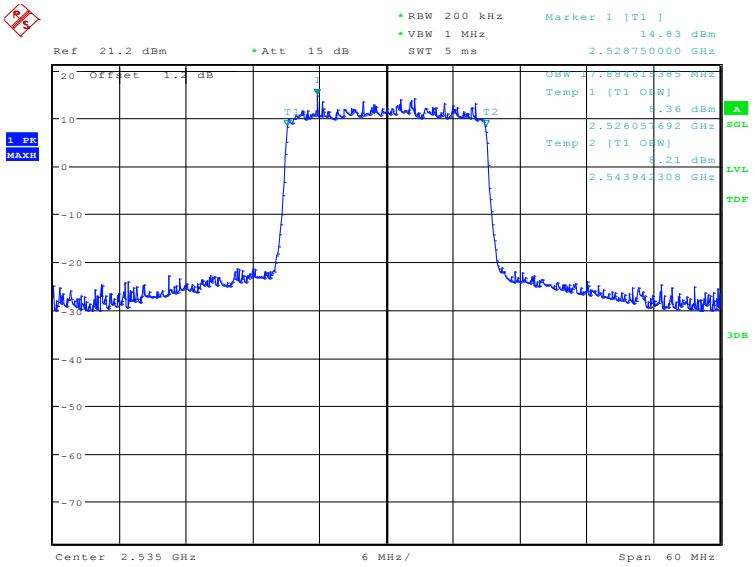
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
2535.0	QPSK	16QAM	64QAM
	17884.62	17884.62	17788.46

LTE band 7, 20MHz Bandwidth, QPSK (99% BW)



Date: 23.JAN.2019 21:24:06

LTE band 7, 20MHz Bandwidth, 16QAM (99% BW)



Date: 23.JAN.2019 21:25:30

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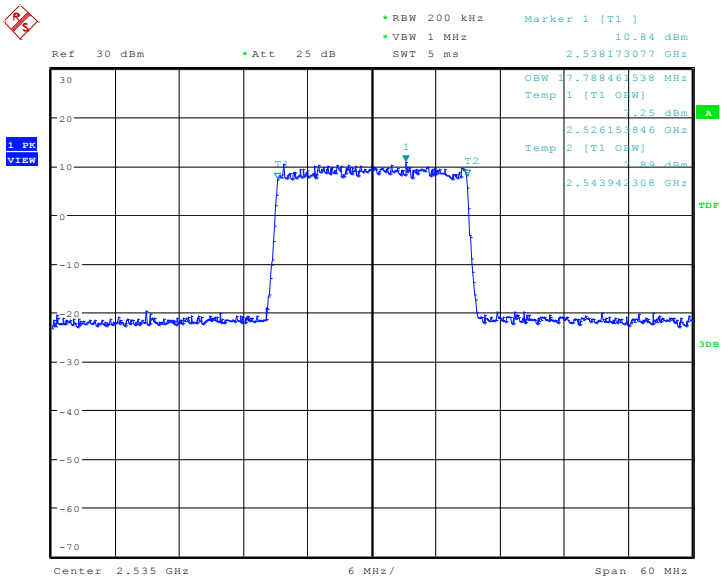
LTE band 7, 20MHz Bandwidth, 64QAM (99% BW)



Date: 29.JAN.2019 15:39:15

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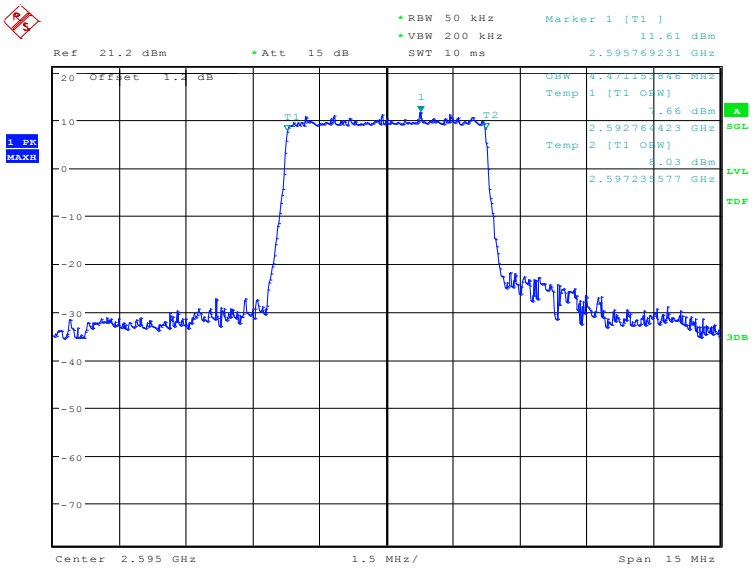
LTE band 38, 5MHz (99%)

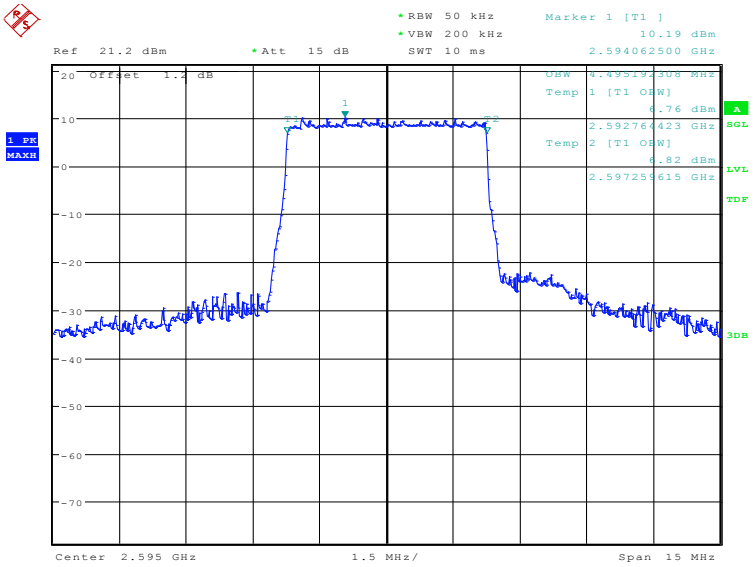
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
2595.0	QPSK	16QAM	64QAM
	4471.15	4495.19	4495.19

LTE band 38, 5MHz Bandwidth, QPSK (99% BW)



Date: 28.JAN.2019 14:51:29

LTE band 38, 5MHz Bandwidth,16QAM (99% BW)



Date: 28.JAN.2019 14:52:53

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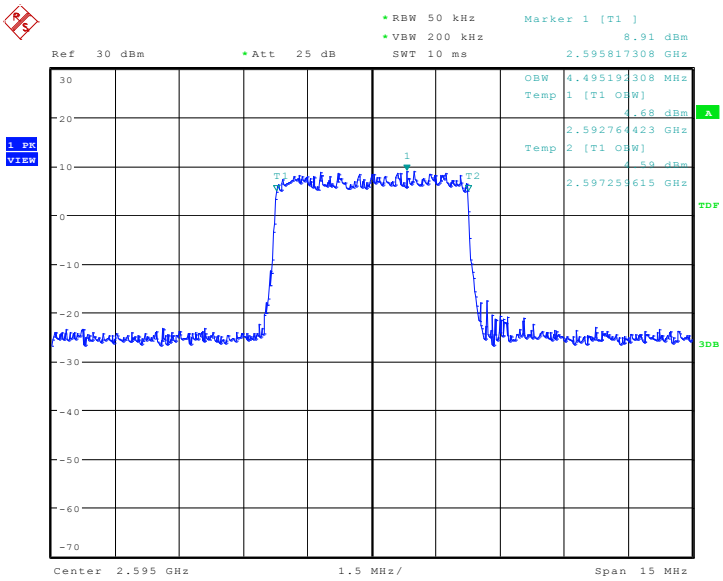
LTE band 38, 5MHz Bandwidth,64QAM (99% BW)



Date: 29.JAN.2019 15:49:31

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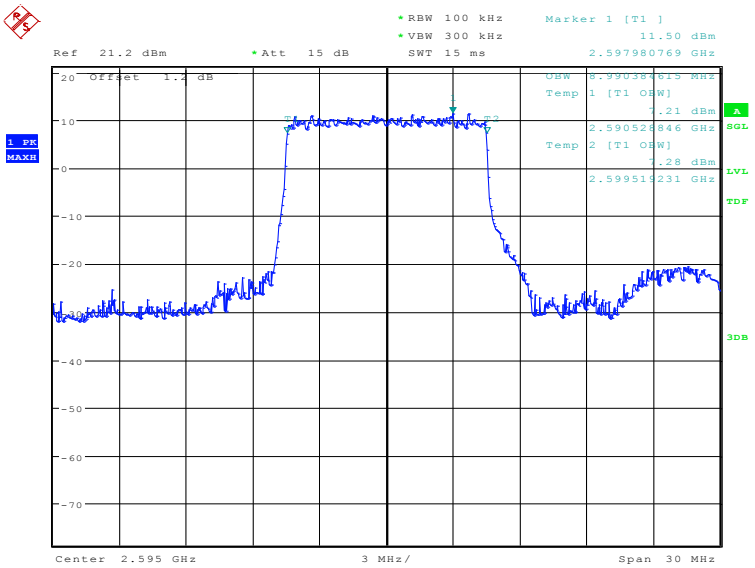
LTE band 38, 10MHz (99%)

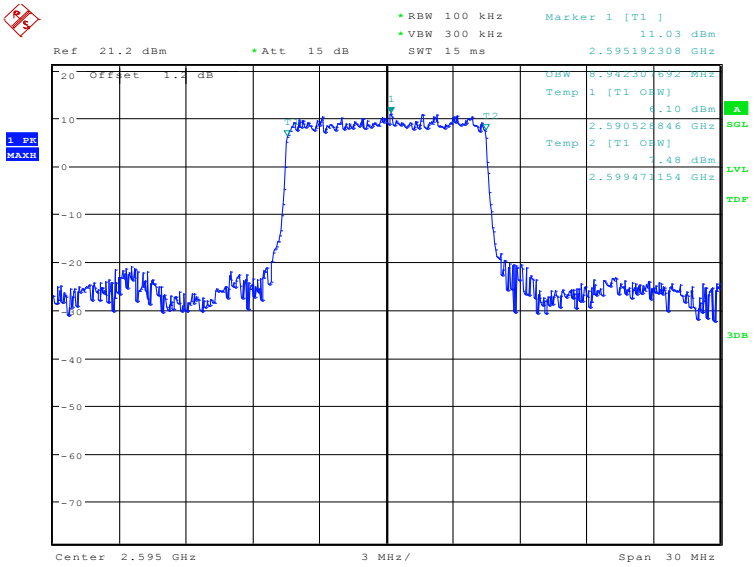
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
2595.0	QPSK	16QAM	64QAM
	8990.38	8942.31	8942.31

LTE band 38, 10MHz Bandwidth, QPSK (99% BW)



Date: 28.JAN.2019 14:54:19

LTE band 38, 10MHz Bandwidth,16QAM (99% BW)



Date: 28.JAN.2019 14:55:43

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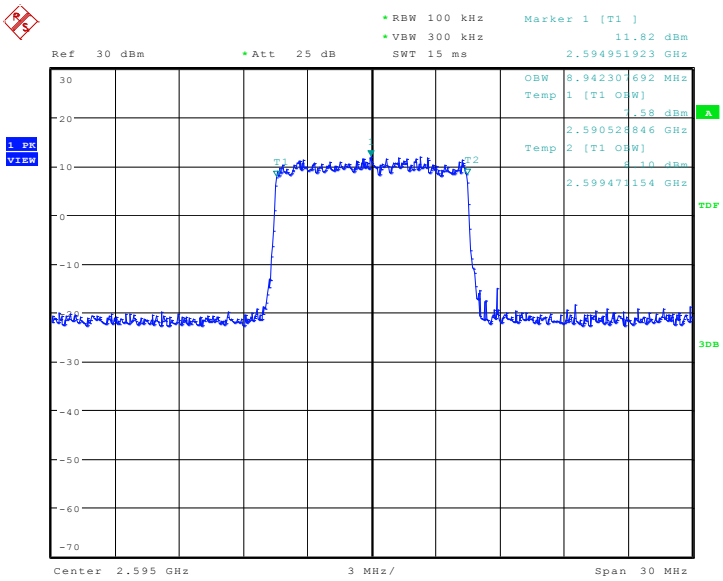
LTE band 38, 10MHz Bandwidth, 64QAM (99% BW)



Date: 15.FEB.2019 15:25:26

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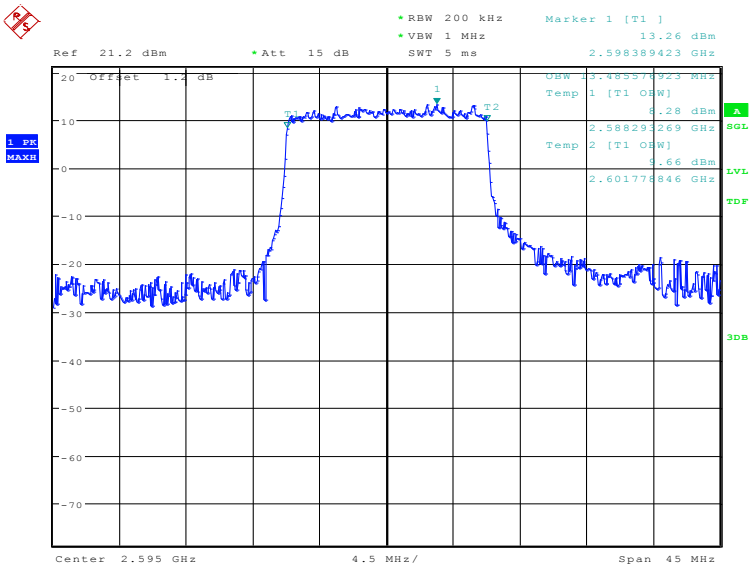
LTE band 38, 15MHz (99%)

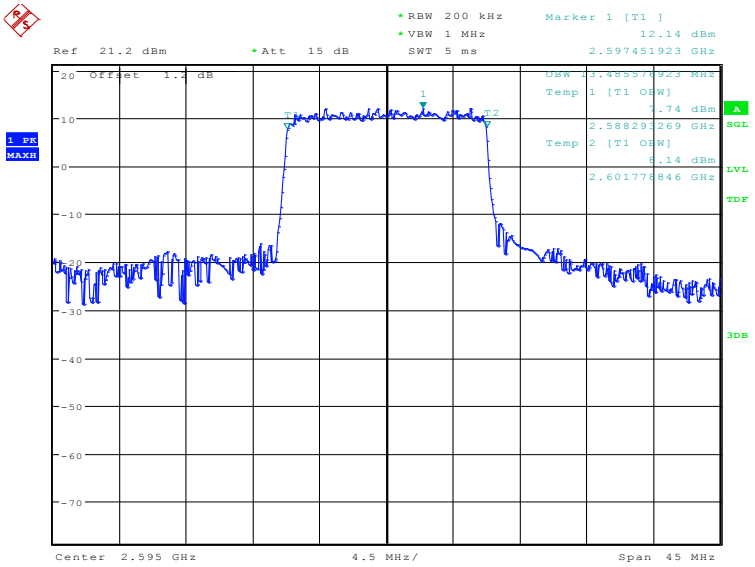
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
2595.0	QPSK	16QAM	64QAM
	13485.58	13485.58	13485.58

LTE band 38,15MHz Bandwidth, QPSK (99% BW)



Date: 28.JAN.2019 14:57:08

LTE band 38, 15MHz Bandwidth,16QAM (99% BW)



Date: 28.JAN.2019 14:58:32

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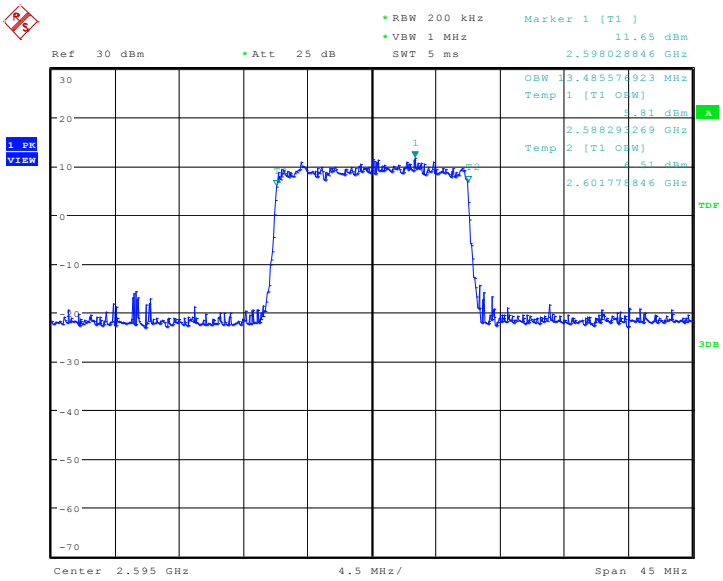
LTE band 38, 15MHz Bandwidth, 64QAM (99% BW)



Date: 29.JAN.2019 15:53:35

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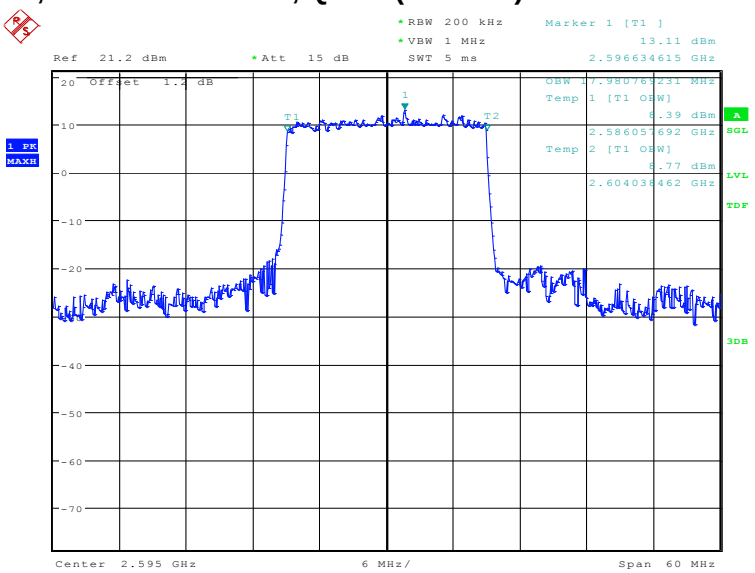
LTE band 38, 20MHz (99%)

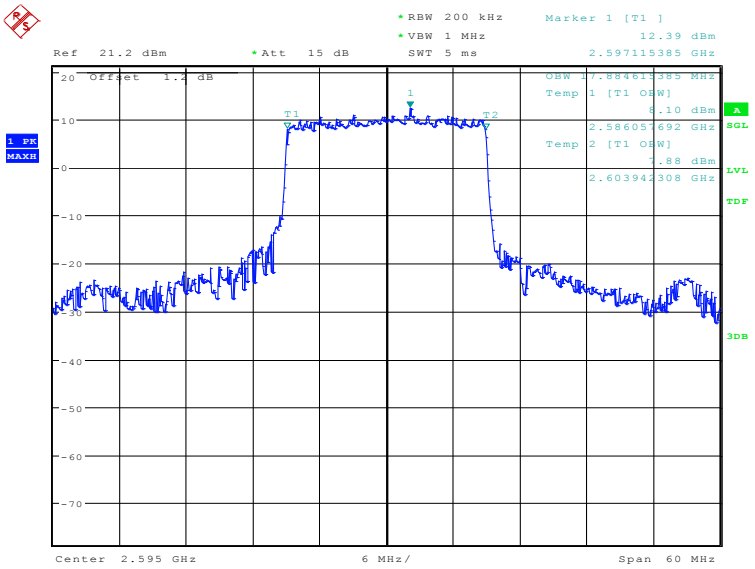
Frequency(MHz)	Occupied Bandwidth (99%)(kHz)		
2595.0	QPSK	16QAM	64QAM
	17980.77	17884.62	17980.77

LTE band 38, 20MHz Bandwidth, QPSK (99% BW)



Date: 28.JAN.2019 14:59:58

LTE band 38, 20MHz Bandwidth,16QAM (99% BW)



Date: 28.JAN.2019 15:01:22

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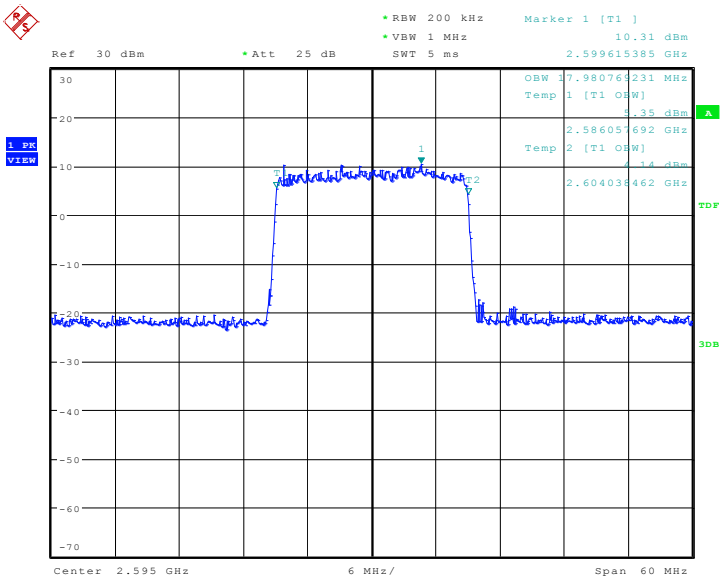
LTE band38, 20MHz Bandwidth, 64QAM (99% BW)



Date: 29.JAN.2019 15:54:46

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A.5 EMISSION BANDWIDTH

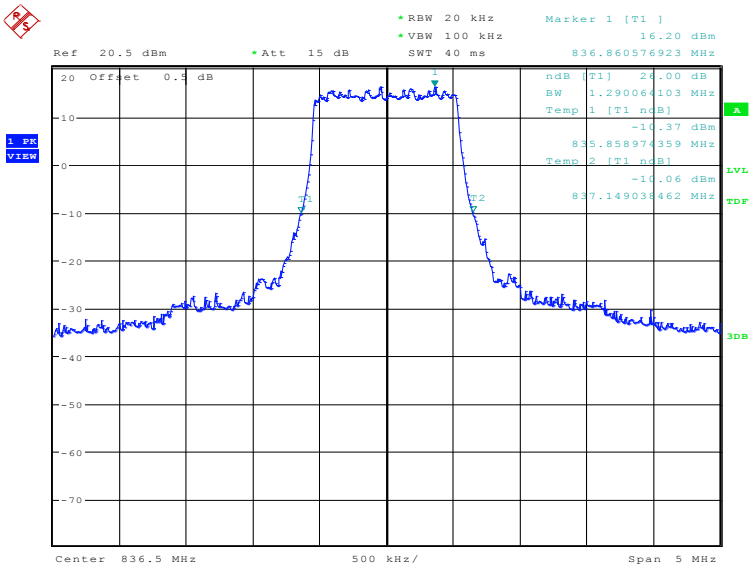
A.5.1Emission Bandwidth Results

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. Table below lists the measured -26dBc BW. Spectrum analyzer plots are included on the following pages.

LTE band 5, 1.4MHz (-26dBc)

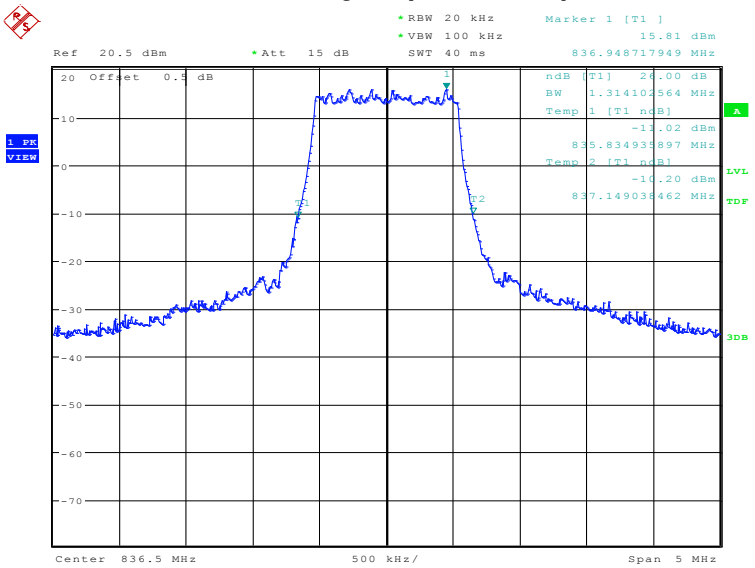
Frequency(MHz)	Emission Bandwidth (-26dBc)(kHz)		
836.5	QPSK	16QAM	64QAM
	1290.06	1314.10	1290.06

LTE band 5, 1.4MHz Bandwidth, QPSK (-26dBc BW)



Date: 23.JAN.2019 21:56:37

LTE band 5, 1.4MHz Bandwidth, 16QAM (-26dBc BW)



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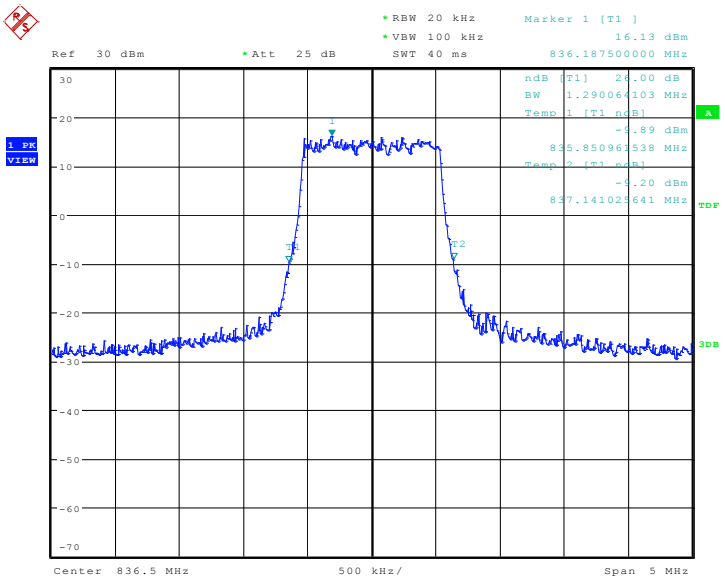
Date: 23.JAN.2019 21:58:01

LTE band 5, 1.4MHz Bandwidth, 64QAM (-26dBc BW)



Date: 15.FEB.2019 15:22:36

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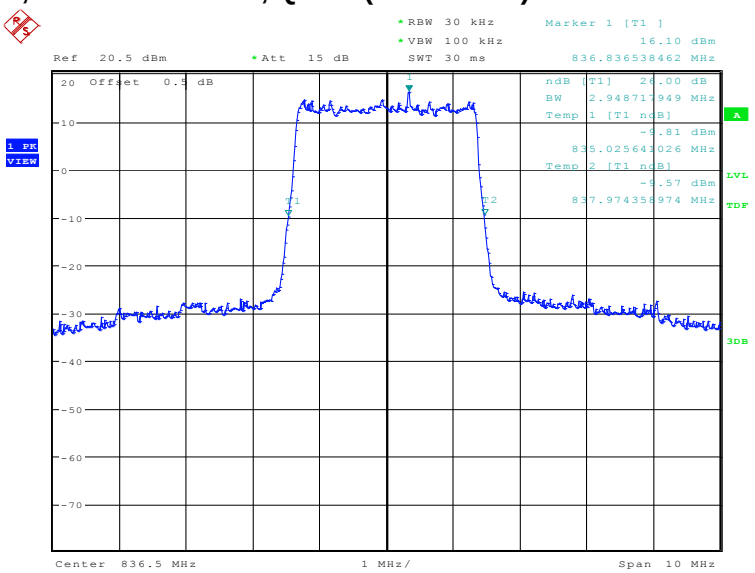
LTE band 5, 3MHz (-26dBc)

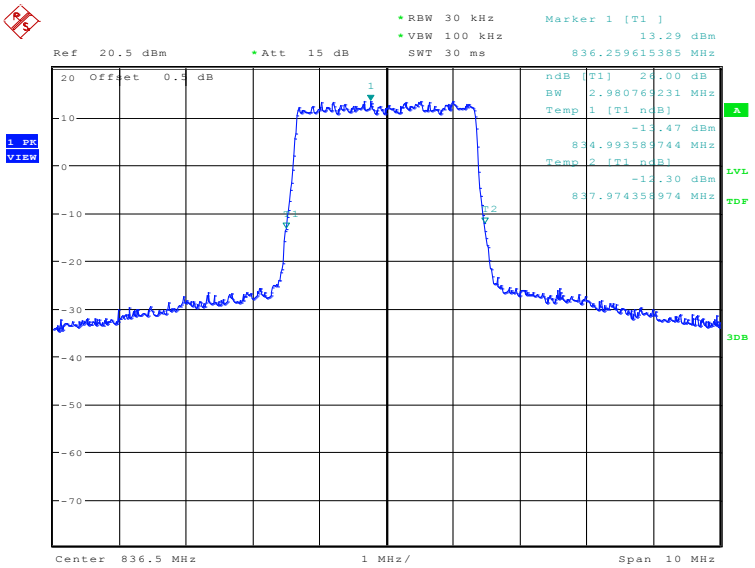
Frequency(MHz)	Emission Bandwidth (-26dBc)(kHz)		
836.5	QPSK	16QAM	64QAM
	2948.72	2980.77	2948.72

LTE band 5, 3MHz Bandwidth, QPSK (-26dBc BW)



Date: 23.JAN.2019 21:59:27

LTE band 5, 3MHz Bandwidth, 16QAM (-26dBc BW)



Date: 23.JAN.2019 22:00:51

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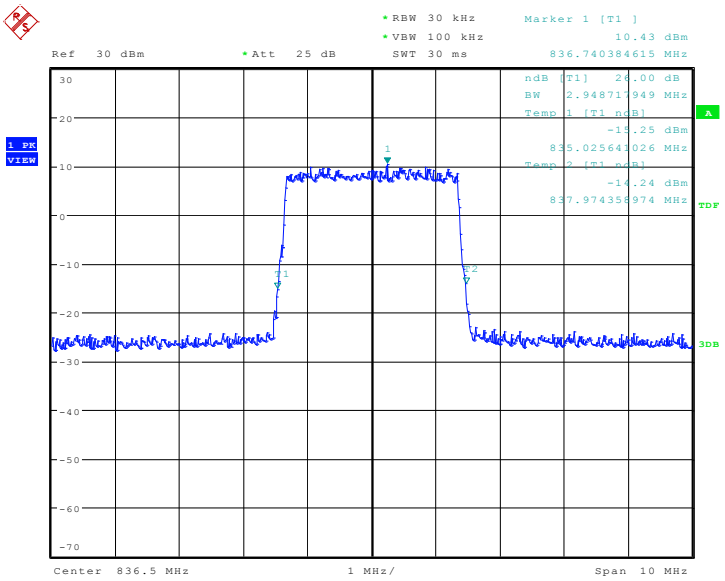
LTE band 5, 3MHz Bandwidth, 64QAM (-26dBc BW)



Date: 29.JAN.2019 16:08:23

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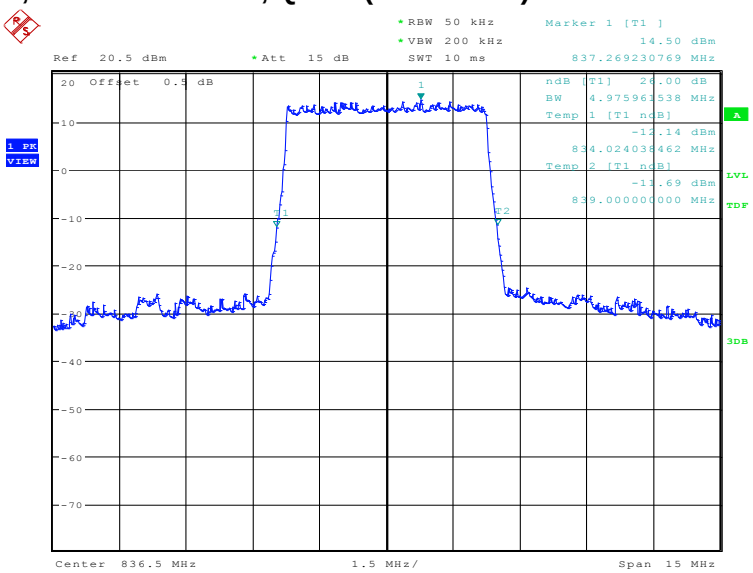
LTE band 5, 5MHz (-26dBc)

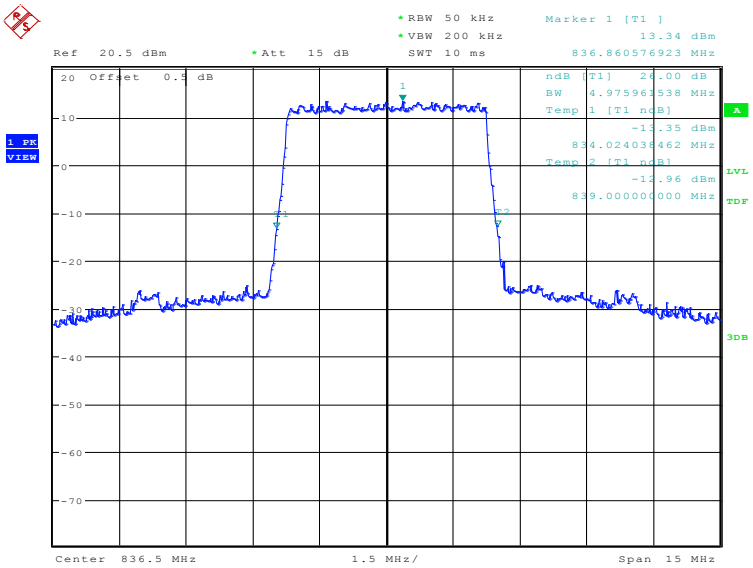
Frequency(MHz)	Emission Bandwidth (-26dBc)(kHz)		
836.5	QPSK	16QAM	64QAM
	4975.96	4975.96	4903.85

LTE band 5, 5MHz Bandwidth, QPSK (-26dBc BW)



Date: 23.JAN.2019 22:02:17

LTE band 5, 5MHz Bandwidth, 16QAM (-26dBc BW)



Date: 23.JAN.2019 22:03:41

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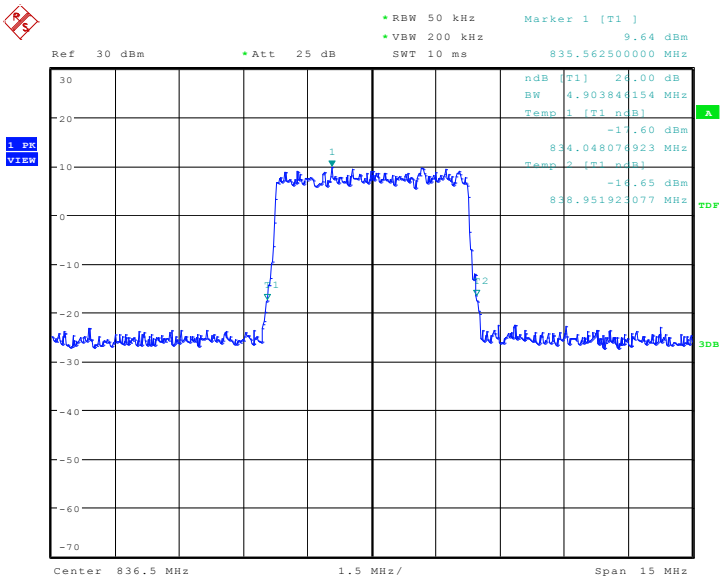
LTE band 5, 5MHz Bandwidth,64QAM (-26dBc BW)



Date: 29.JAN.2019 16:09:52

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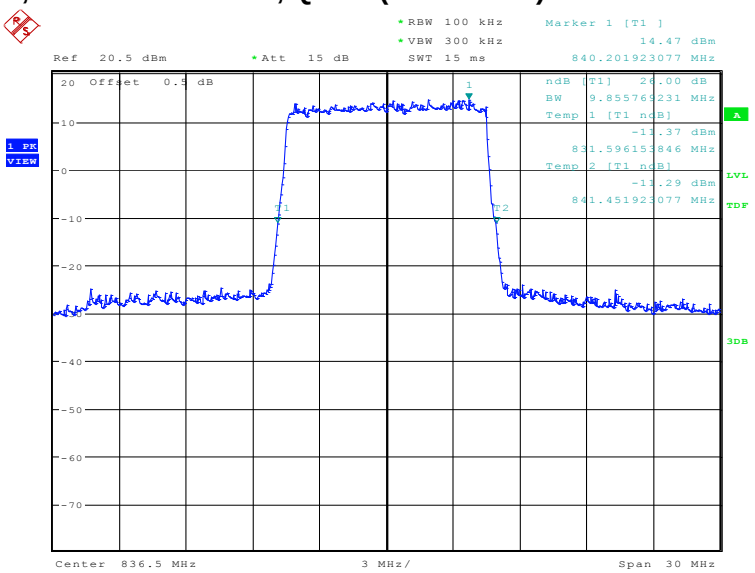
LTE band 5, 10MHz (-26dBc)

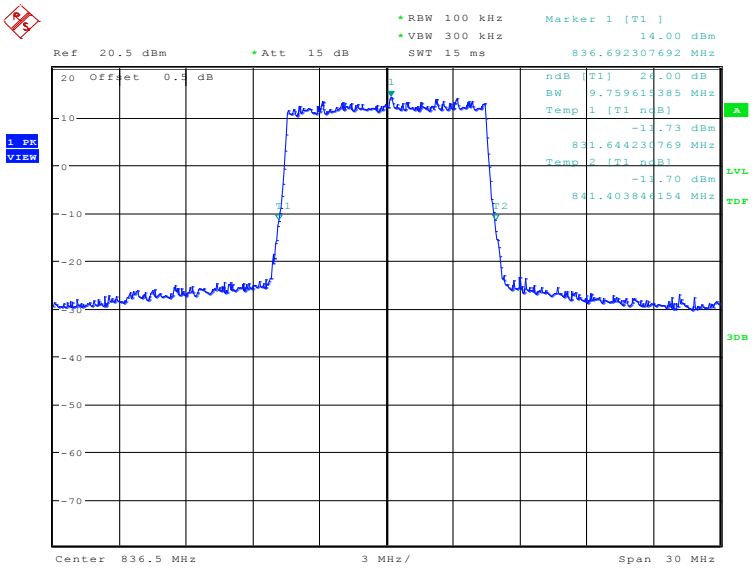
Frequency(MHz)	Emission Bandwidth (-26dBc)(kHz)		
836.5	QPSK	16QAM	64QAM
	9855.77	9759.62	9711.54

LTE band 5, 10MHz Bandwidth, QPSK (-26dBc BW)



Date: 23.JAN.2019 22:05:07

LTE band 5, 10MHz Bandwidth, 16QAM (-26dBc BW)



Date: 23.JAN.2019 22:06:31

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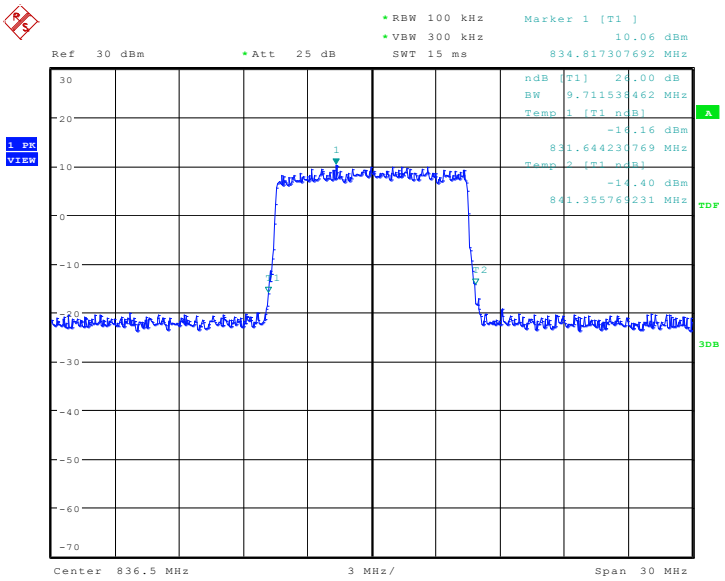
LTE band 5, 10MHz Bandwidth, 64QAM (-26dBc BW)



Date: 29.JAN.2019 16:36:11

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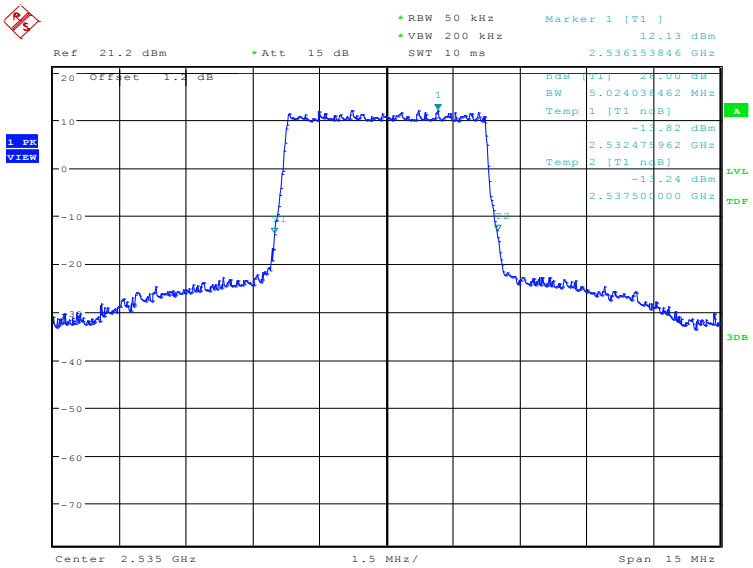
LTE band 7, 5MHz (-26dBc)

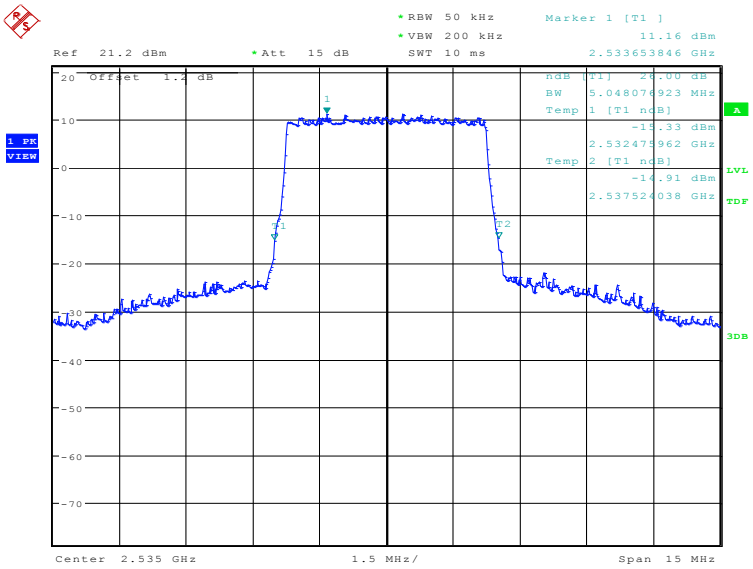
Frequency(MHz)	Emission Bandwidth (-26dBc)(kHz)		
2535.0	QPSK	16QAM	64QAM
	5024.04	5048.08	4903.85

LTE band 7, 5MHz Bandwidth, QPSK (-26dBc BW)



Date: 23.JAN.2019 22:07:58

LTE band 7, 5MHz Bandwidth,16QAM (-26dBc BW)



Date: 23.JAN.2019 22:09:22

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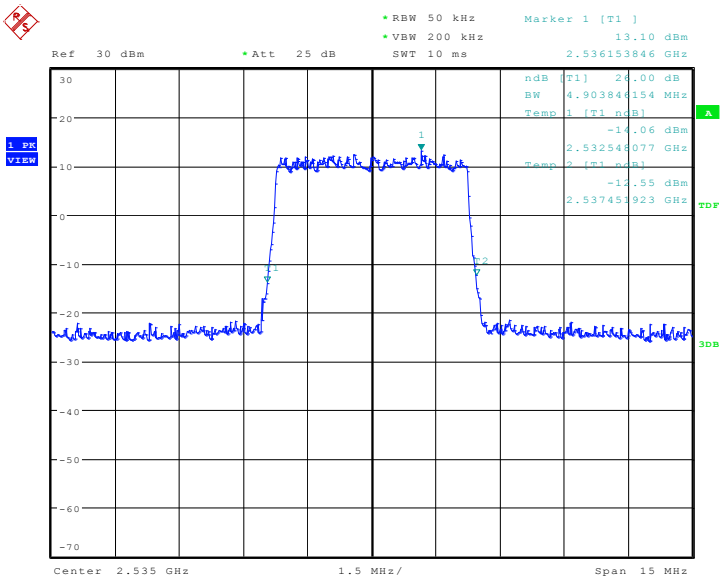
LTE band 7, 5MHz Bandwidth,64QAM (-26dBc BW)



Date: 29.JAN.2019 15:34:02

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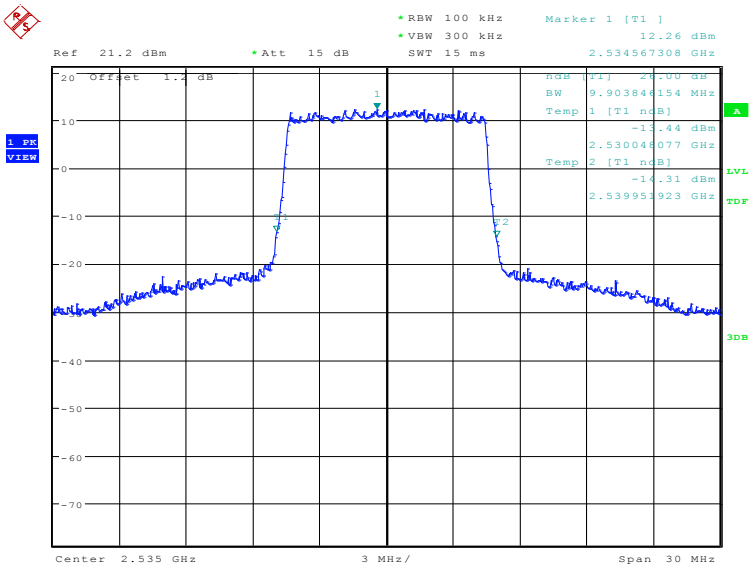
LTE band 7, 10MHz (-26dBc)

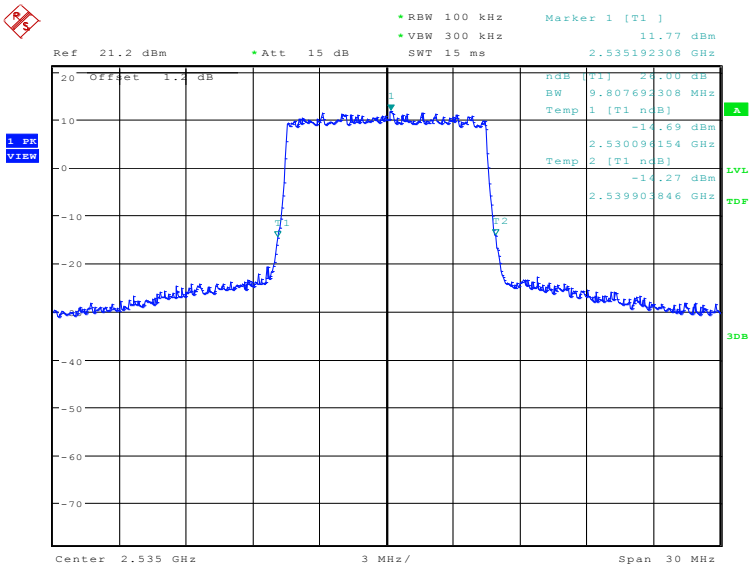
Frequency(MHz)	Emission Bandwidth (-26dBc)(kHz)		
2535.0	QPSK	16QAM	64QAM
	9903.85	9807.69	9711.54

LTE band 7, 10MHz Bandwidth, QPSK (-26dBc BW)



Date: 23.JAN.2019 22:10:48

LTE band 7, 10MHz Bandwidth,16QAM (-26dBc BW)



Date: 23.JAN.2019 22:12:12

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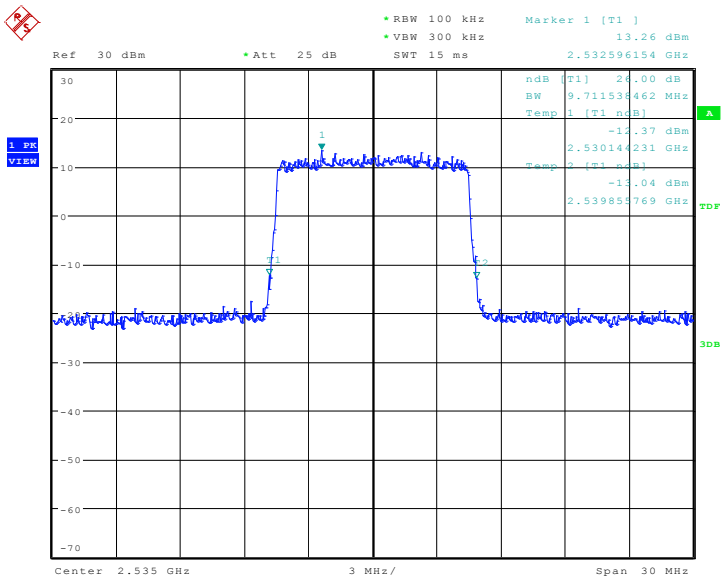
LTE band 7, 10MHz Bandwidth, 64QAM (-26dBc BW)



Date: 29.JAN.2019 15:35:23

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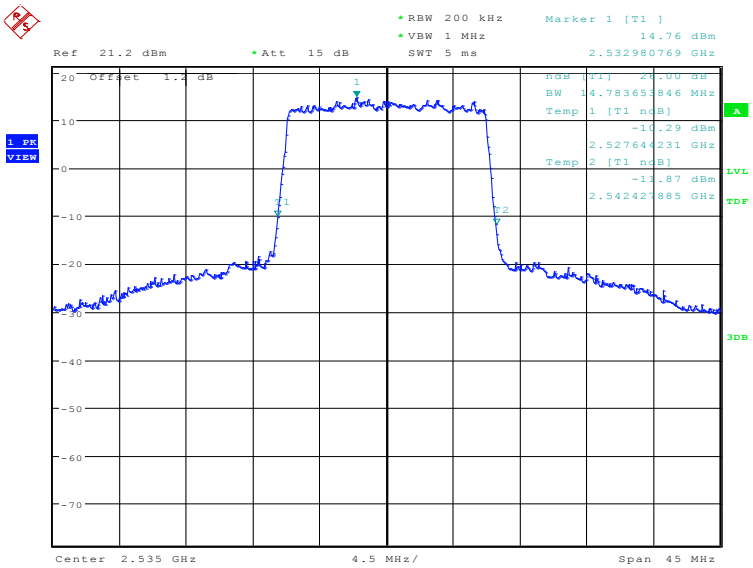
LTE band 7, 15MHz (-26dBc)

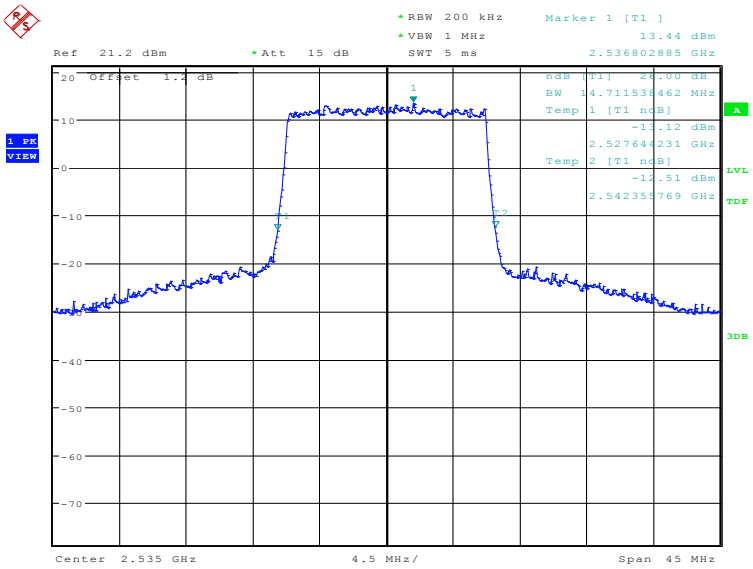
Frequency(MHz)	Emission Bandwidth (-26dBc)(kHz)		
2535.0	QPSK	16QAM	64QAM
	14783.65	14711.54	14711.54

LTE band 7, 15MHz Bandwidth, QPSK (-26dBc BW)



Date: 23.JAN.2019 22:13:38

LTE band 7, 15MHz Bandwidth,16QAM (-26dBc BW)



Date: 23.JAN.2019 22:15:02

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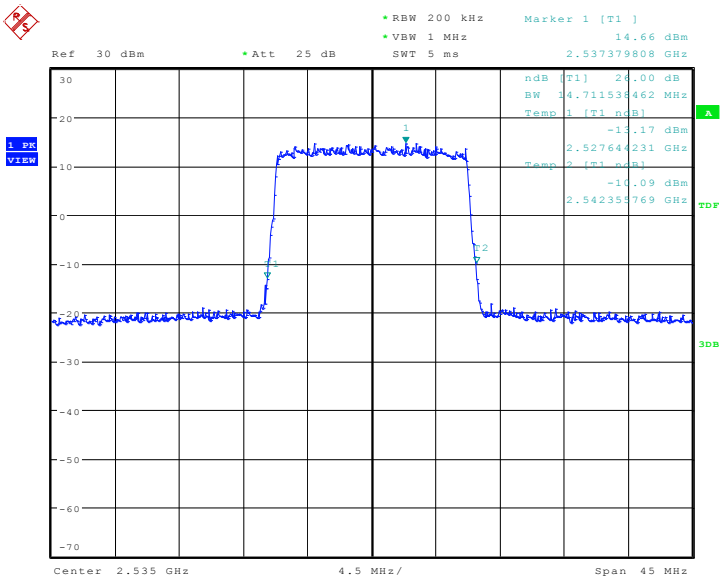
LTE band 7, 15MHz Bandwidth, 64QAM (-26dBc BW)



Date: 29.JAN.2019 15:36:56

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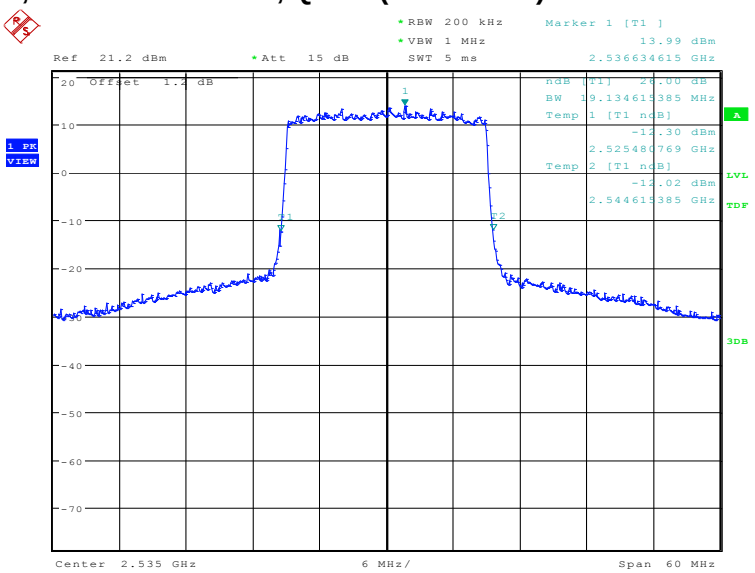
LTE band 7, 20MHz (-26dBc)

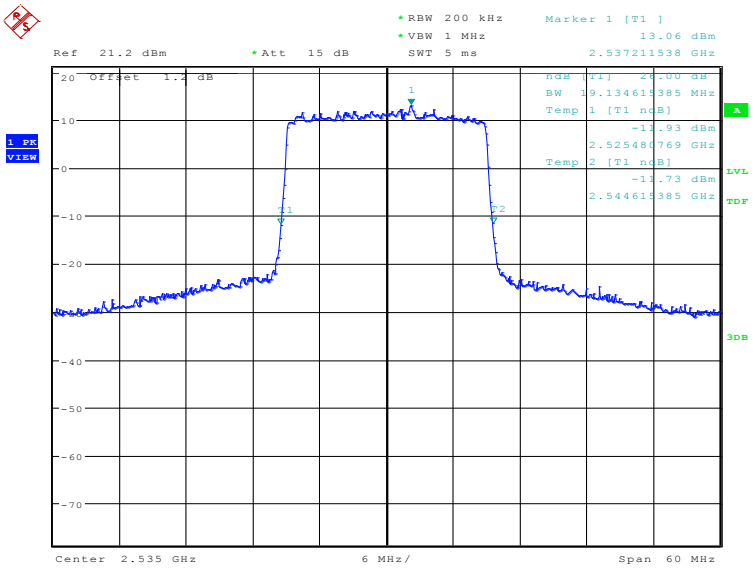
Frequency(MHz)	Emission Bandwidth (-26dBc)(kHz)		
2535.0	QPSK	16QAM	64QAM
	19134.62	19134.62	19326.92

LTE band 7, 20MHz Bandwidth, QPSK (-26dBc BW)



Date: 23.JAN.2019 22:16:28

LTE band 7, 20MHz Bandwidth,16QAM (-26dBc BW)



Date: 23.JAN.2019 22:17:52

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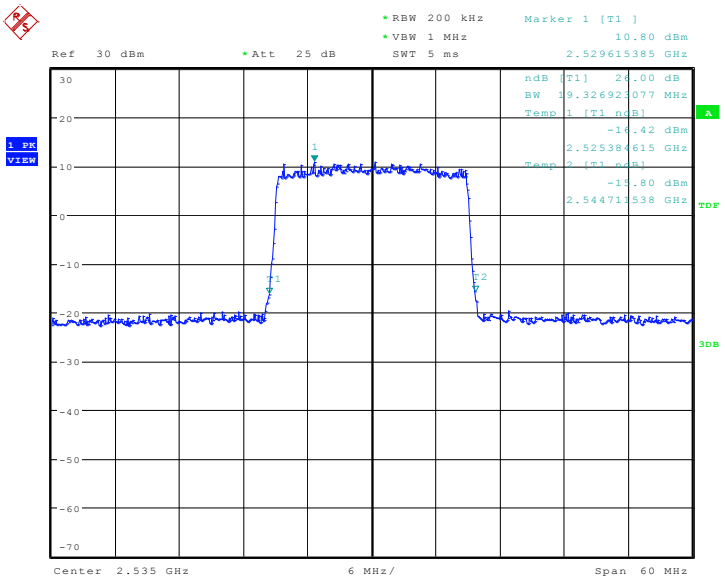
LTE band 7, 20MHz Bandwidth, 64QAM (-26dBc BW)



Date: 29.JAN.2019 15:43:34

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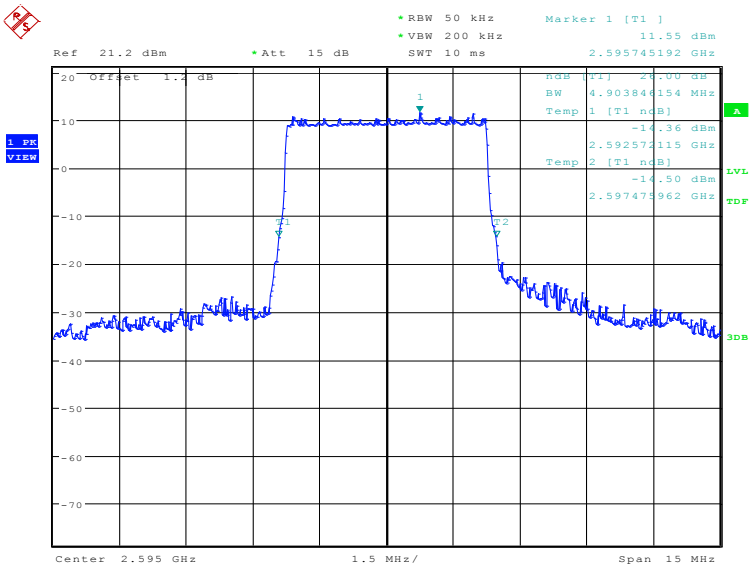
LTE band 38, 5MHz (-26dBc)

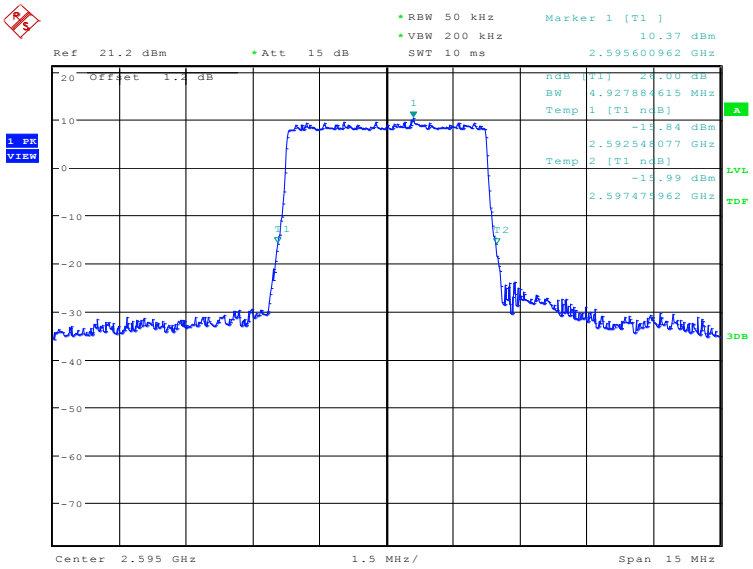
Frequency(MHz)	Occupied Bandwidth (-26dBc) (kHz)		
2595.0	QPSK	16QAM	64QAM
	4903.85	4927.88	4903.85

LTE band 38, 5MHz Bandwidth, QPSK (-26dBc BW)



Date: 28.JAN.2019 15:04:26

LTE band 38, 5MHz Bandwidth,16QAM (-26dBc BW)



Date: 28.JAN.2019 15:05:50

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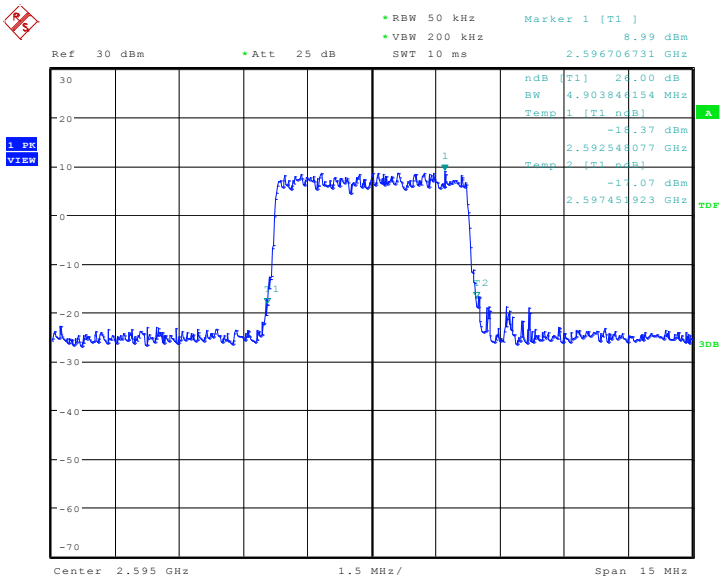
LTE band 38, 5MHz Bandwidth,64QAM (-26dBc BW)



Date: 29.JAN.2019 15:50:48

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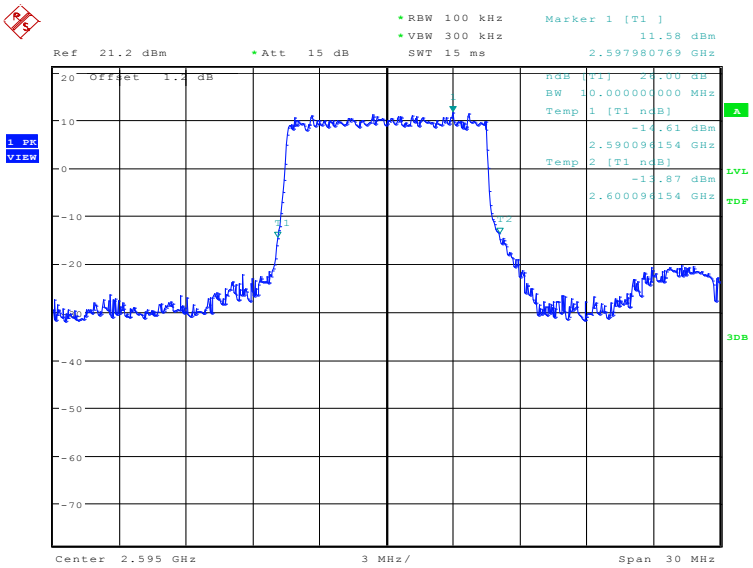
LTE band 38, 10MHz (-26dBc)

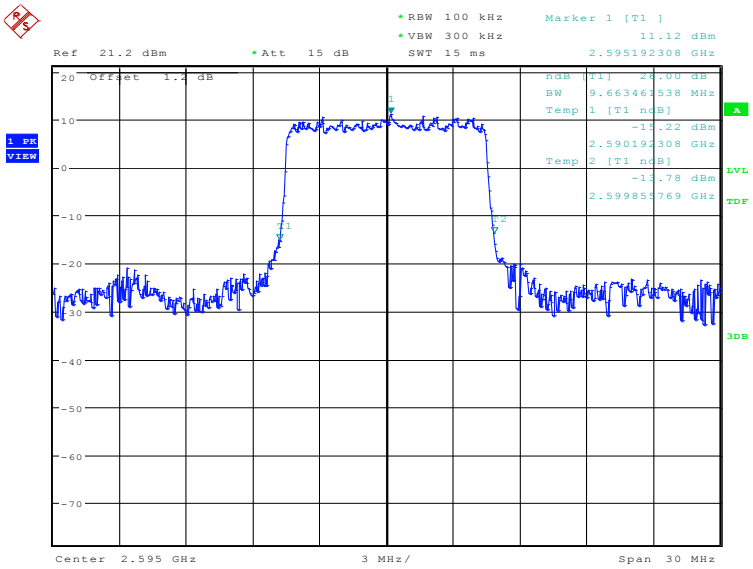
Frequency(MHz)	Occupied Bandwidth (-26dBc) (kHz)		
2595.0	QPSK	16QAM	64QAM
	10000.00	9663.46	9711.54

LTE band 38, 10MHz Bandwidth, QPSK (-26dBc BW)



Date: 28.JAN.2019 15:07:16

LTE band 38, 10MHz Bandwidth,16QAM (-26dBc BW)



Date: 28.JAN.2019 15:08:40

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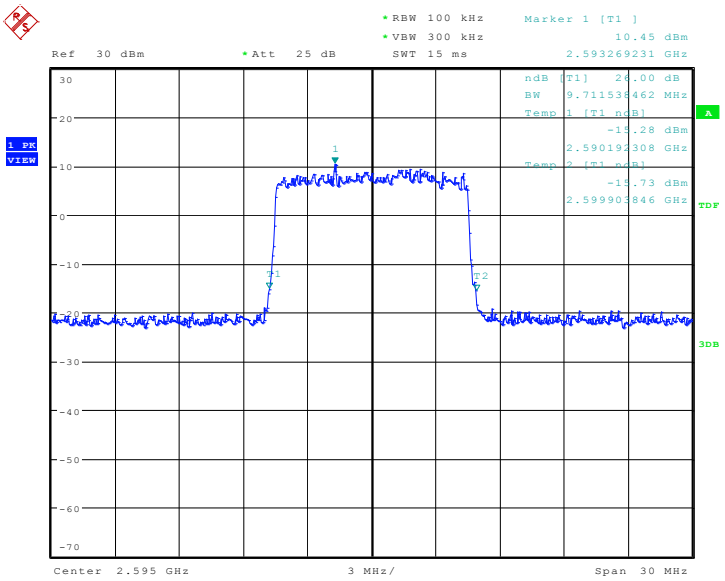
LTE band 38, 10MHz Bandwidth, 64QAM (-26dBc BW)



Date: 29.JAN.2019 15:52:41

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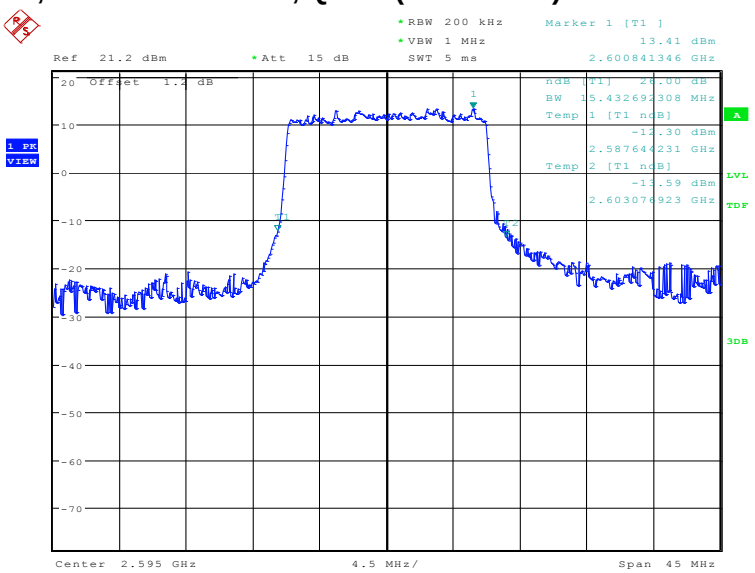
LTE band 38, 15MHz (-26dBc)

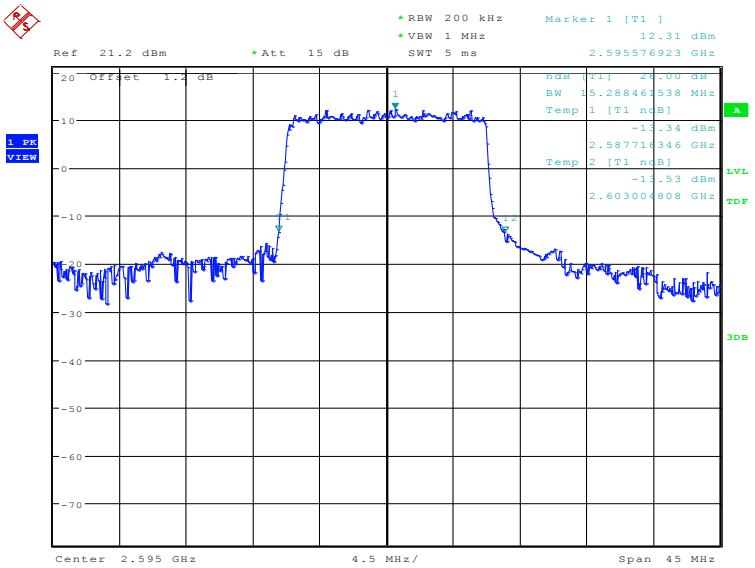
Frequency(MHz)	Occupied Bandwidth (-26dBc) (kHz)		
2595.0	QPSK	16QAM	64QAM
	15432.69	15288.46	14711.54

LTE band 38, 15MHz Bandwidth, QPSK (-26dBc BW)



Date: 28.JAN.2019 15:10:06

LTE band 38, 15MHz Bandwidth,16QAM (-26dBc BW)



Date: 28.JAN.2019 15:11:31

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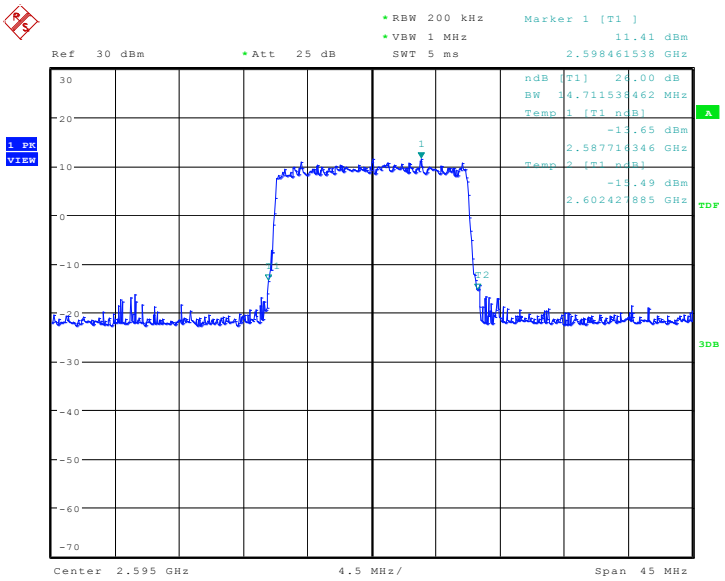
LTE band 38, 15MHz Bandwidth, 64QAM (-26dBc BW)



Date: 29.JAN.2019 15:53:55

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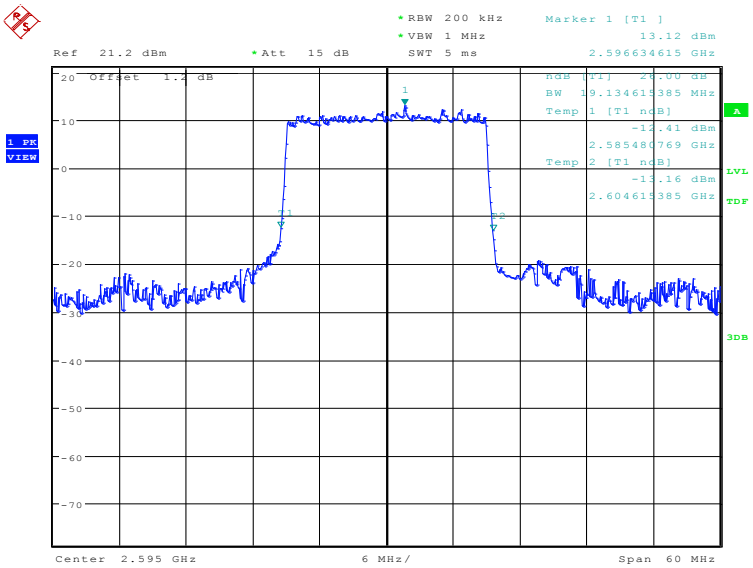
LTE band 38, 20MHz (-26dBc)

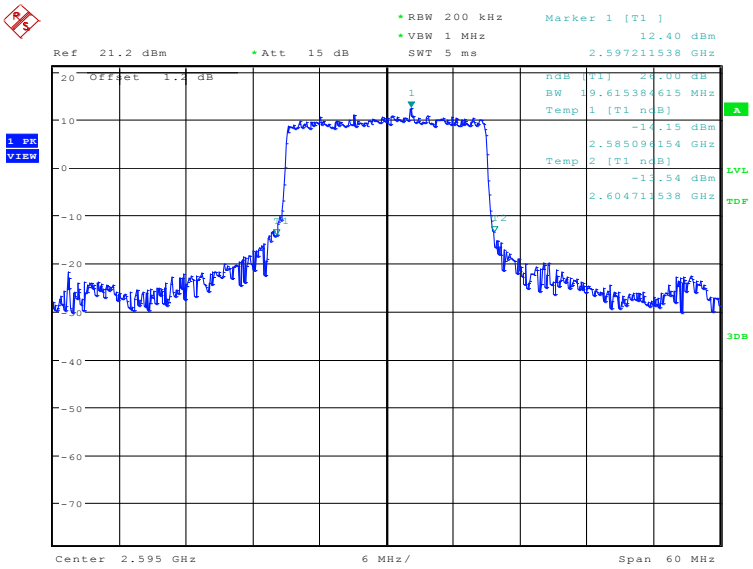
Frequency(MHz)	Occupied Bandwidth (-26dBc) (kHz)		
2595.0	QPSK	16QAM	64QAM
	19134.62	19615.38	19326.92

LTE band 38, 20MHz Bandwidth, QPSK (-26dBc BW)



Date: 28.JAN.2019 15:12:57

LTE band 38, 20MHz Bandwidth,16QAM (-26dBc BW)



Date: 28.JAN.2019 15:14:21

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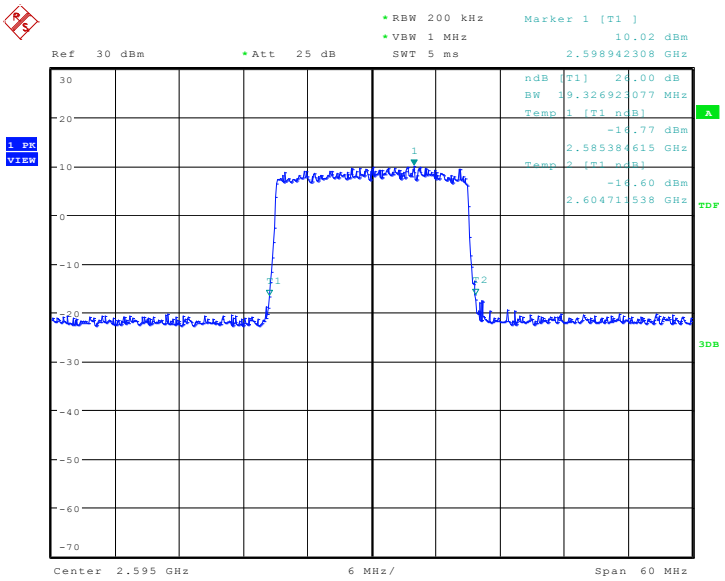
LTE band38, 20MHz Bandwidth, 64QAM (-26dBc BW)



Date: 29.JAN.2019 15:55:24

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A.6 BAND EDGE COMPLIANCE

A.6.1 Measurement limit

Part 22.917(b), 27.53(h) state that on any frequency outside frequency band of the US Cellular/PCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log (P) dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

According to KDB 971168 6.0, a relaxation of the reference bandwidth is often provided for measurements within a specified frequency range at the edge of the authorized frequency block/band. This is often implemented by permitting the use of a narrower RBW (typically limited to a minimum RBW of 1% of the OBW) for measuring the out-of-band emissions without a requirement to integrate the result over the full reference bandwidth.

Part 27.53(m) states that for mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

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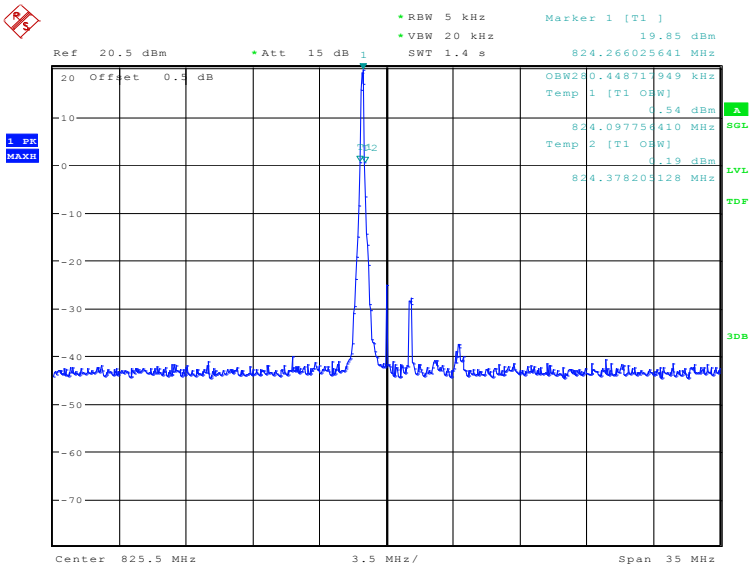
A.6.2 Measurement result

Only worst case result is given below

LTE band 5

OBW: 1RB-low_offset



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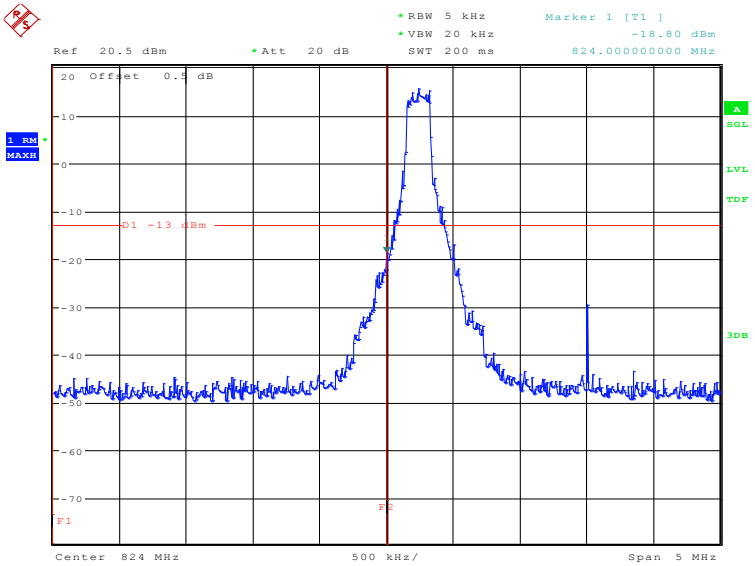
LOW BAND EDGE BLOCK-1RB-low_offset



Date: 15.FEB.2019 04:22:49

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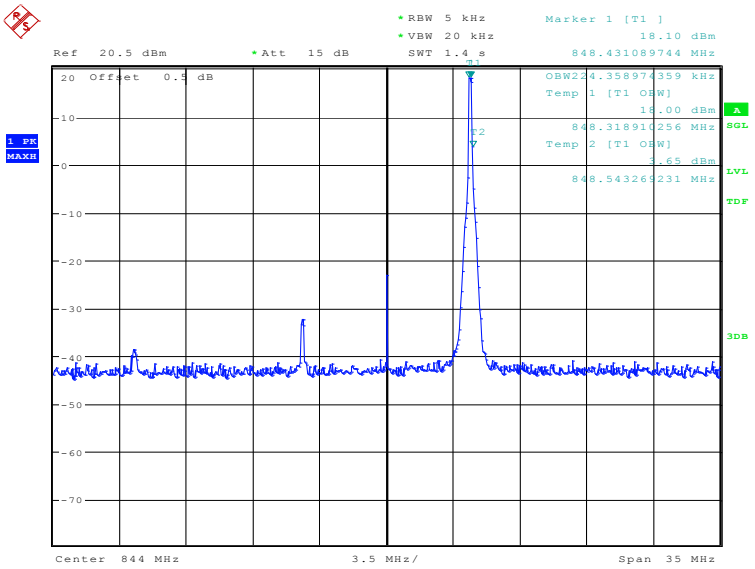
OBW: 1RB-high_offset



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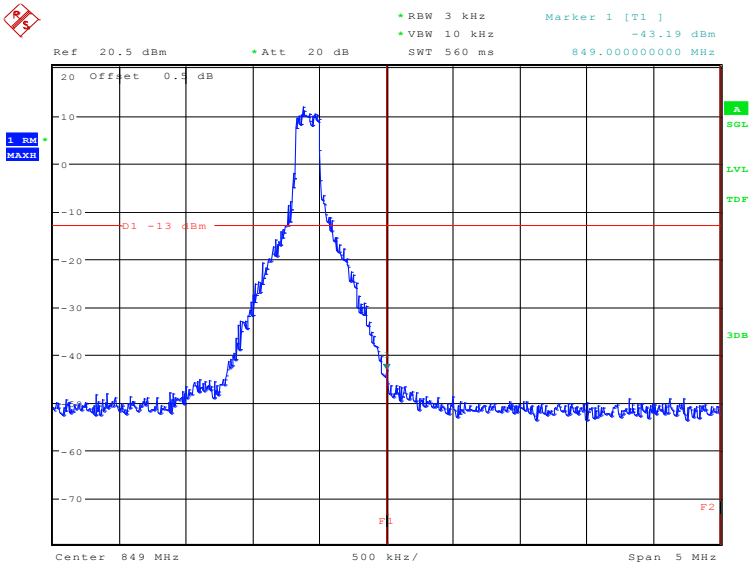
HIGH BAND EDGE BLOCK-1RB-high_offset



Date: 15.FEB.2019 04:20:02

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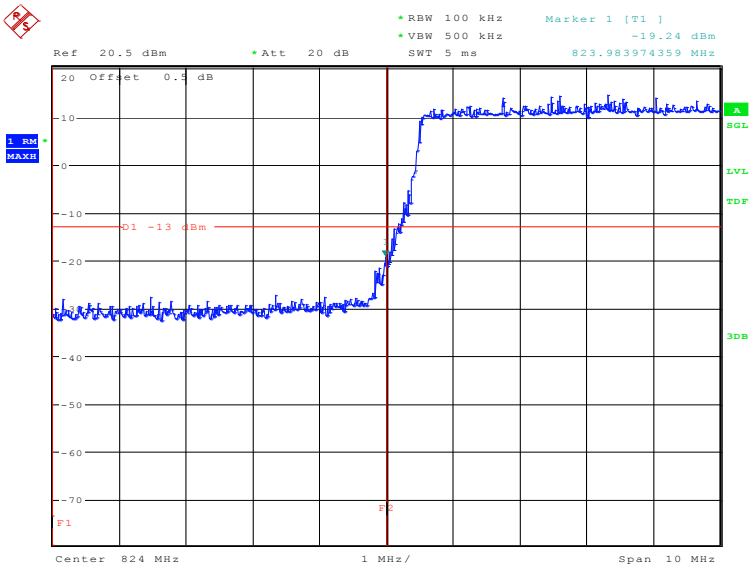
LOW BAND EDGE BLOCK-10MHz-100%RB



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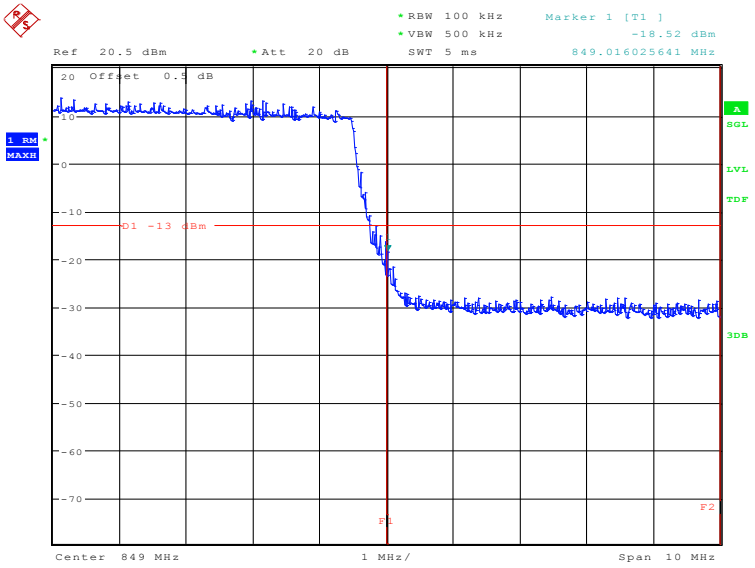
HIGH BAND EDGE BLOCK-10MHz-100%RB



Date: 15.FEB.2019 04:25:58

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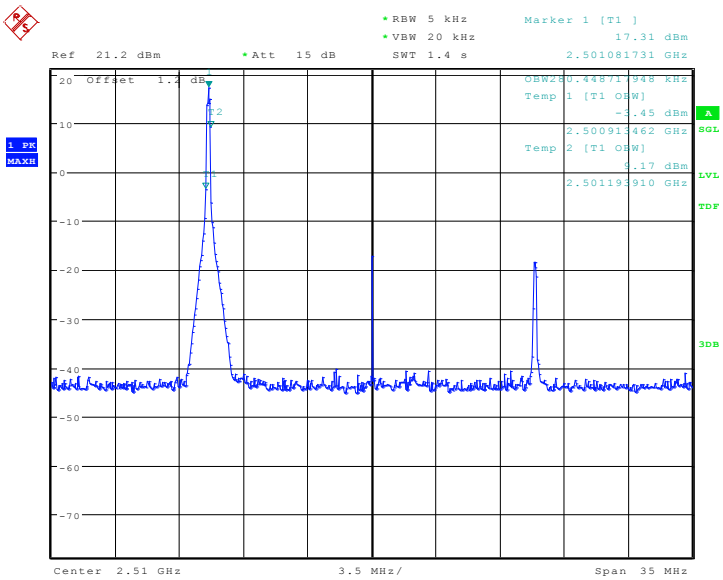
LTE band 7

OBW: 1RB-low_offset



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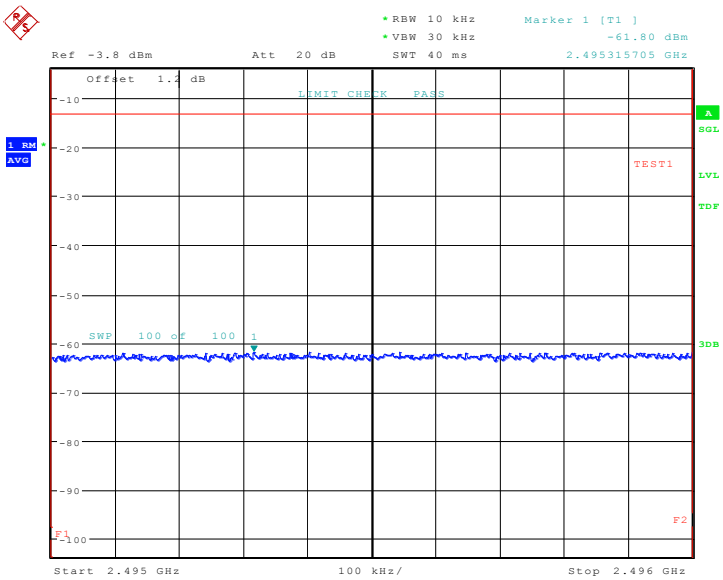
LOW BAND EDGE BLOCK-1RB-low_offset



Date: 15.FEB.2019 04:34:26

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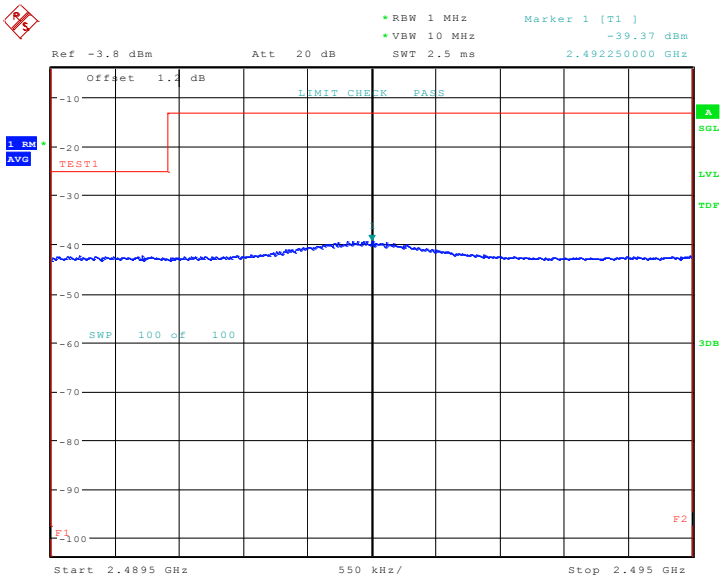

Date: 15.FEB.2019 04:34:41

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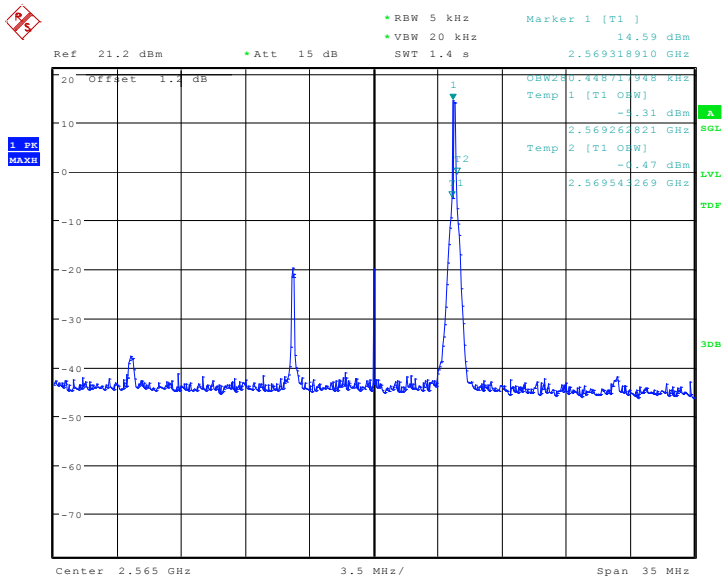
OBW: 1RB-high_offset



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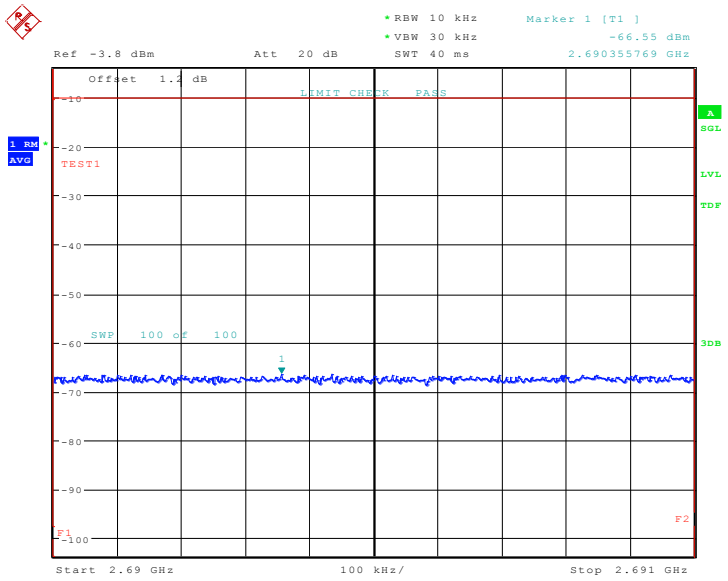
HIGH BAND EDGE BLOCK-1RB-high_offset



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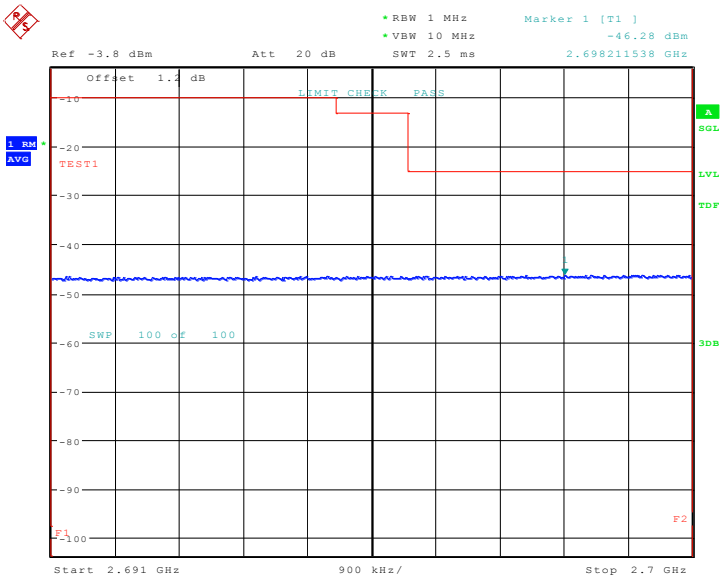

Date: 15.FEB.2019 04:44:34

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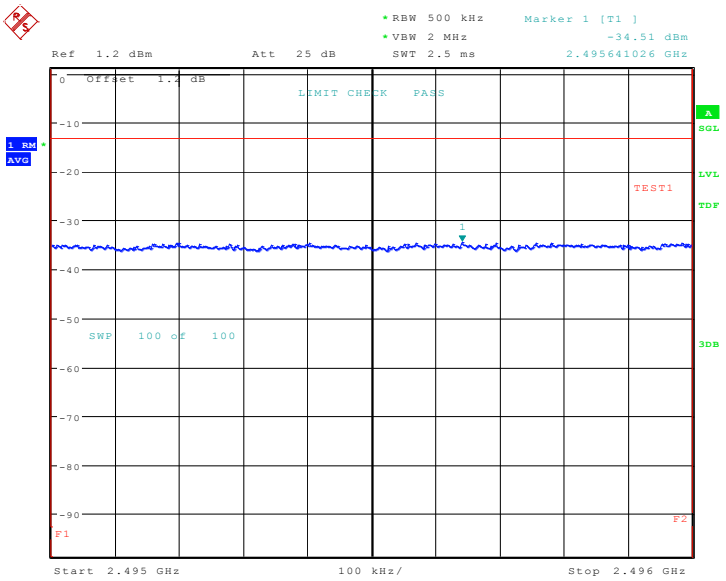
LOW BAND EDGE BLOCK-20MHz-100%RB



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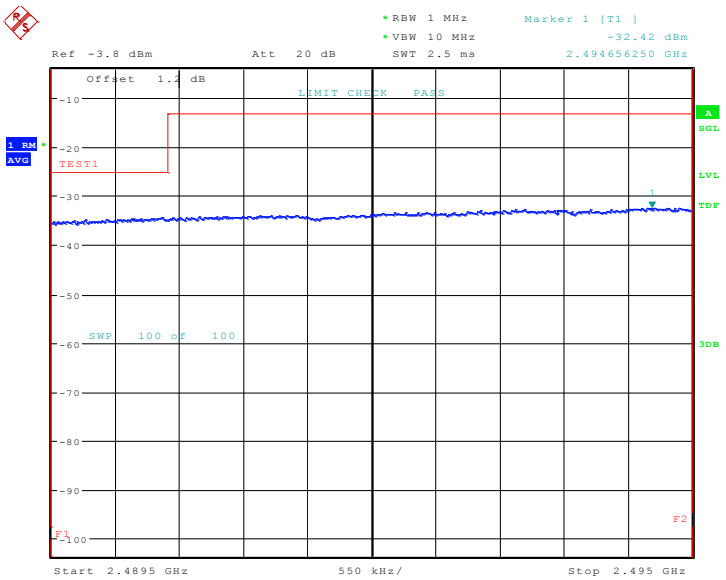

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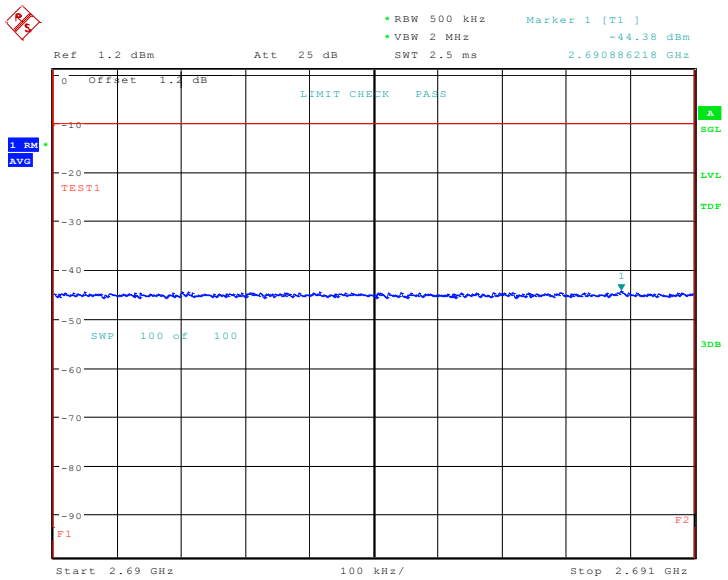
HIGH BAND EDGE BLOCK-20MHz-100%RB



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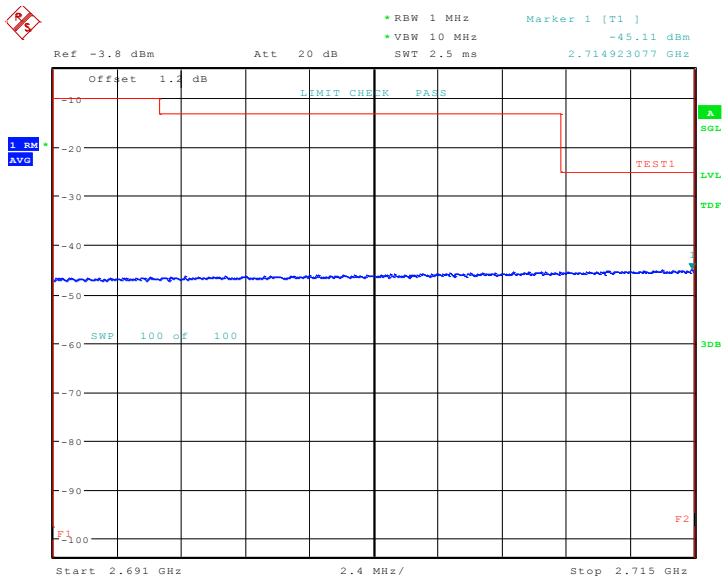

Date: 15.FEB.2019 04:51:20

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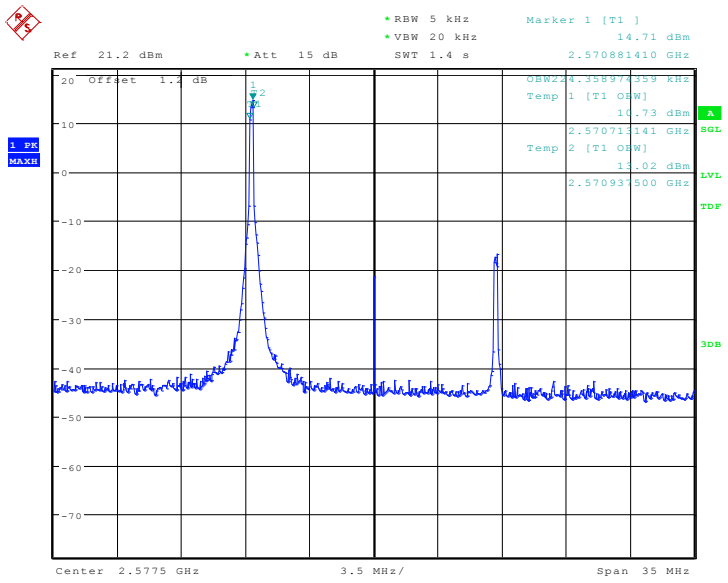
LTE band 38

OBW: 1RB-low_offset



Date: 15.FEB.2019 11:10:43

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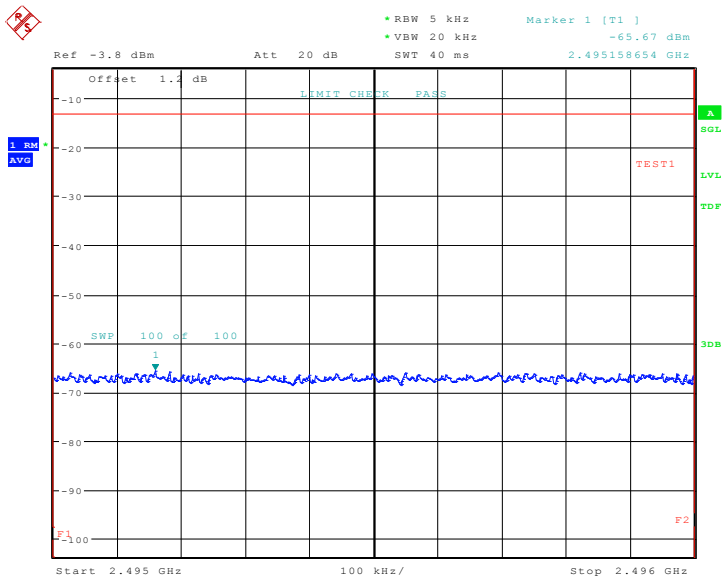

Date: 15.FEB.2019 11:11:03

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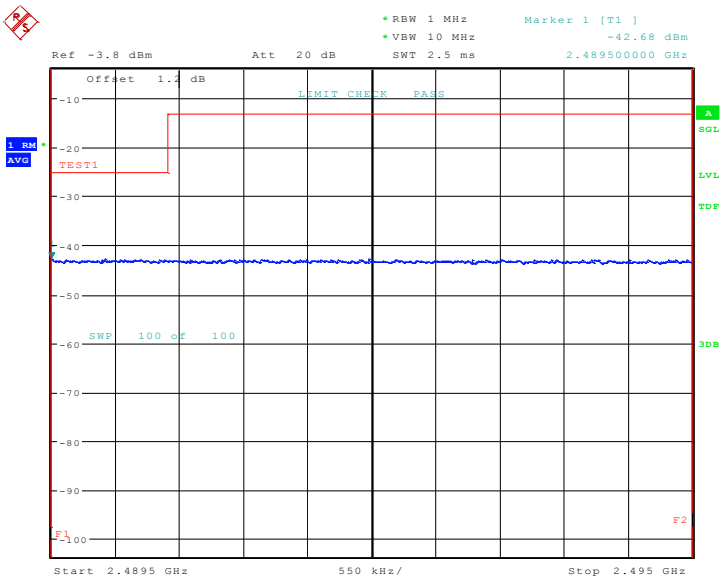

Date: 15.FEB.2019 11:11:18

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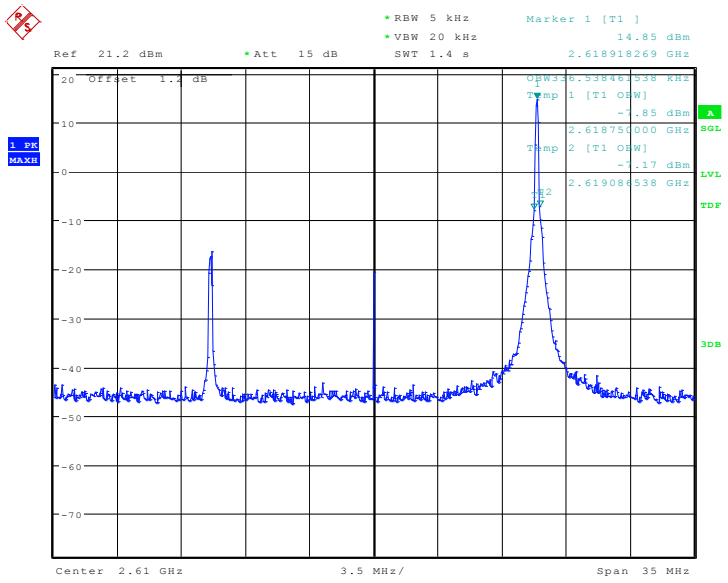
OBW: 1RB-high_offset



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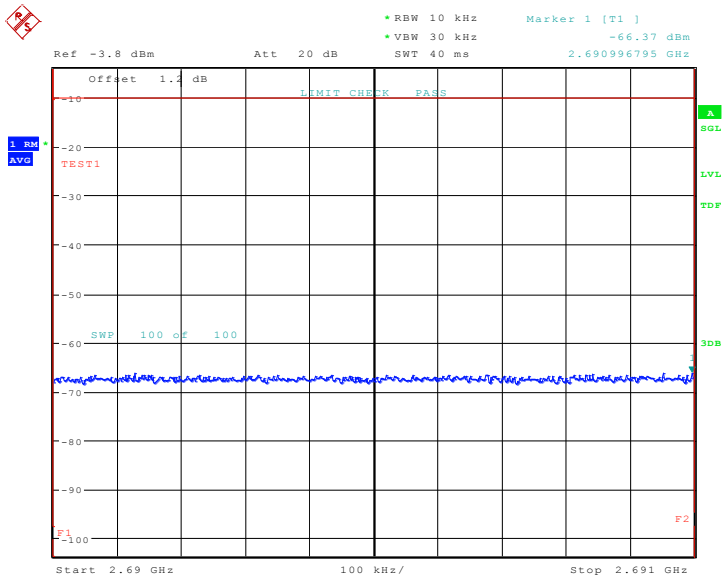

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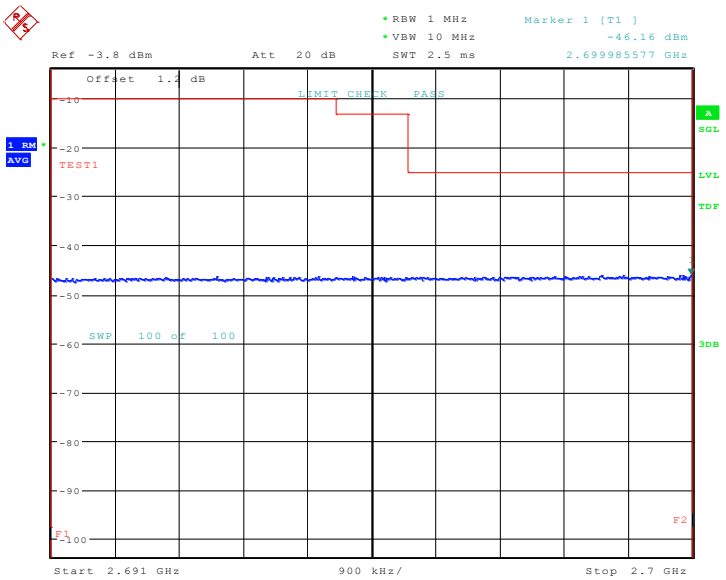

Date: 15.FEB.2019 11:15:35

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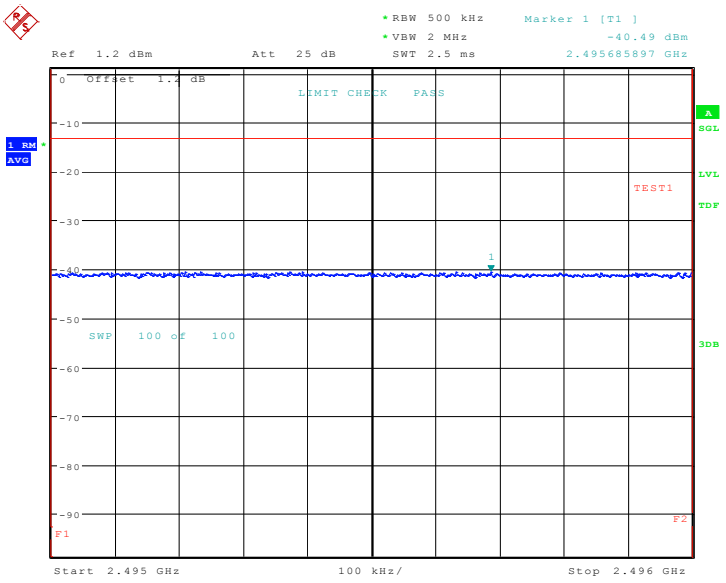
LOW BAND EDGE BLOCK-20MHz-100%RB



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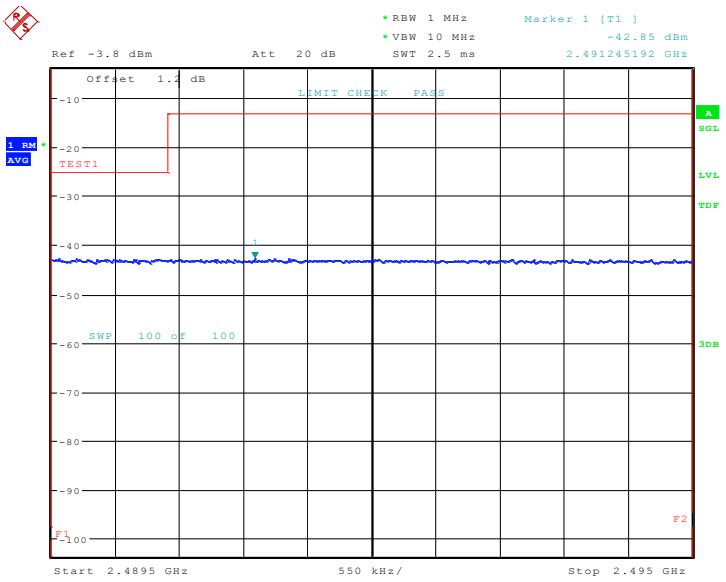

Date: 15.FEB.2019 11:18:32

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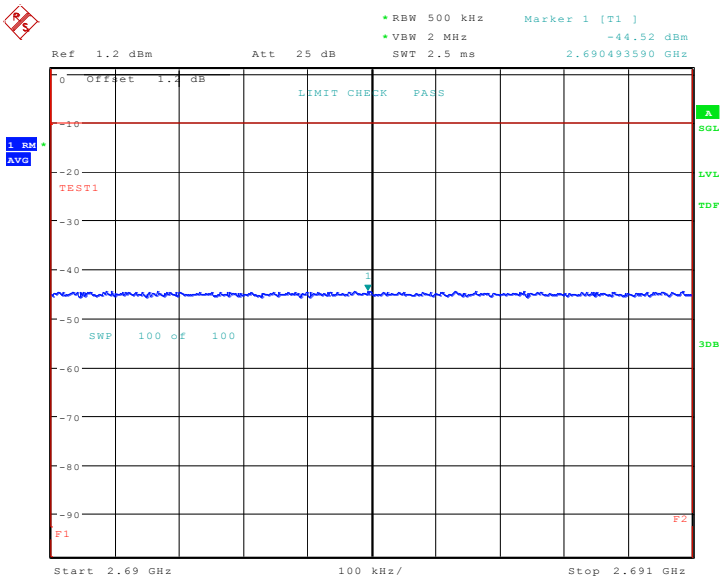
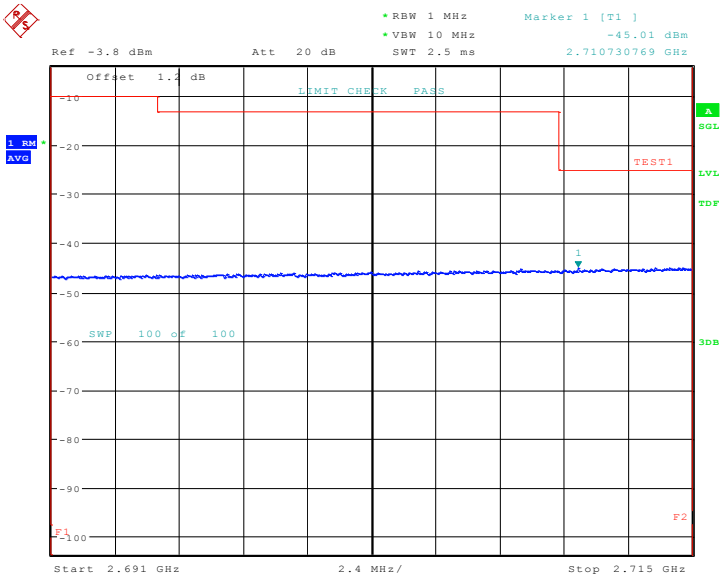
HIGH BAND EDGE BLOCK-20MHz-100%RB



Date: 15.FEB.2019 11:20:19



Date: 15.FEB.2019 11:20:34

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A.7 CONDUCTED SPURIOUS EMISSION

A.7.1 Measurement Method

The following steps outline the procedure used to measure the conducted emissions from the EUT.

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 25 GHz.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.
3. The number of sweep points of spectrum analyzer is set to 30001 which is greater than span/RBW.

A. 7.2 Measurement Limit

Part 22.917, and Part 27.53(h) specify 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.

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

Part 27.53(m)(4) specifies for mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

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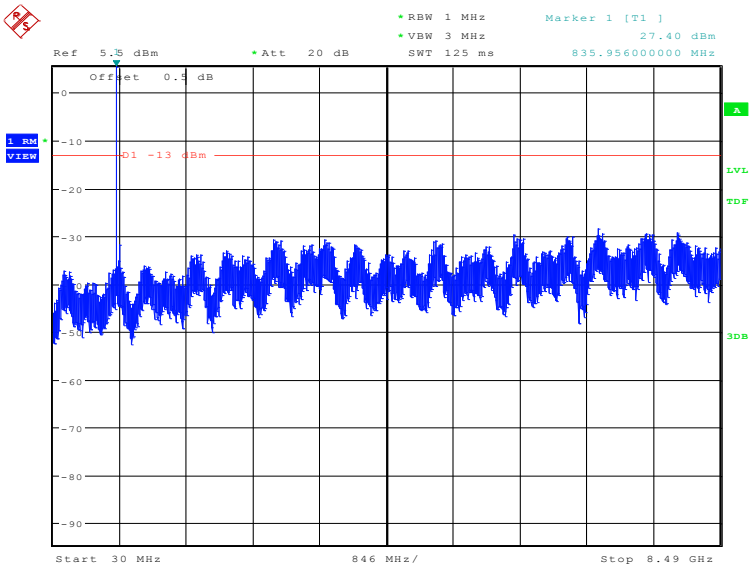
A. 7.3 Measurement result

Only worst case result is given below

LTE band 5: 30MHz – 8.49GHz

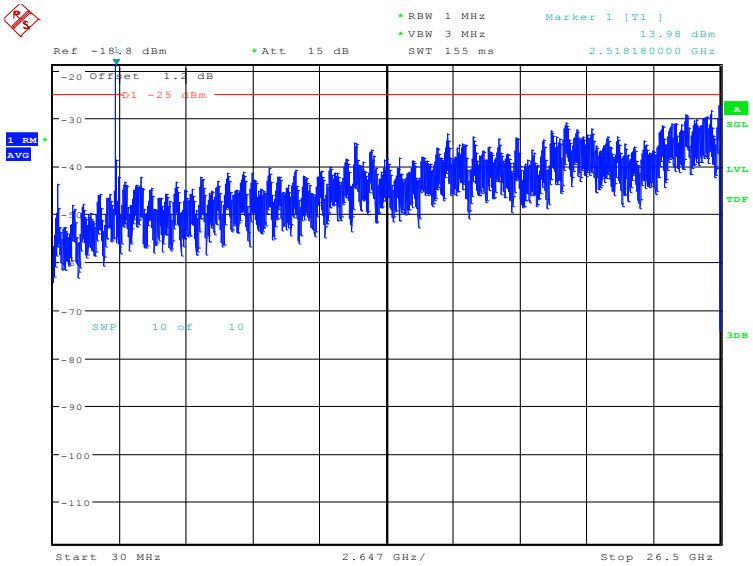
Spurious emission limit –13dBm.



Date: 15.FEB.2019 04:02:52

LTE band 7: 30MHz – 26.5GHz

Spurious emission limit –13dBm.



Date: 15.FEB.2019 04:55:18

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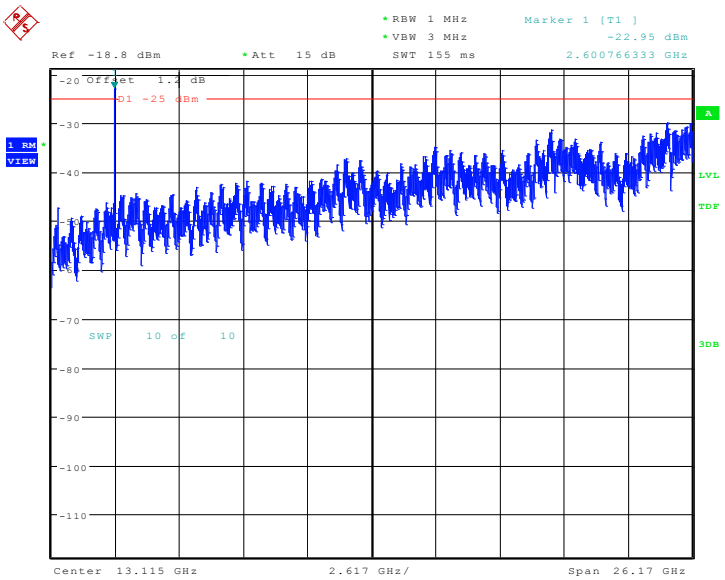
LTE band 38: 30MHz – 26.2GHz

Spurious emission limit –25dBm.



Date: 15.FEB.2019 05:02:56

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A.8 PEAK-TO-AVERAGE POWER RATIO

Reference

FCC: CFR Part 27.50(a)

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

According to KDB 971168 5.7.1:

a)Refer to instrument's analyzer instruction manual for details on how to use the power statistics/CCDF function;

b) Set resolution/measurement bandwidth ≥ signal' s occupied bandwidth;

c) Set the number of counts to a value that stabilizes the measured CCDF curve;

d) Set the measurement interval to 1 ms

e)Record the maximum PAPR level associated with a probability of 0.1%

A.8.1 Measurement limit

not exceed 13 dB

A.8.2 Measurement results

LTE band 7, 20MHz

Frequency(MHz)	PAPR(dB)		
2510.0	QPSK	16QAM	64QAM
	6.89	7.53	7.34

LTE band 38, 20MHz

Frequency(MHz)	PAPR(dB)		
2595.0	QPSK	16QAM	64QAM
	7.15	7.92	9.10

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ANNEX B: Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 600118-0

Telecommunication Technology Labs, CAICT
Beijing
China

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2018-09-28 through 2019-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

*****END OF REPORT*****

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