TEST REPORT

No. I19Z62186-WMD03

for

HMD Global Oy

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

Model Name: TA-1216

FCC ID: 2AJOTTA-1216

with

Hardware Version: 89572_1_12

Software Version: 000T_0_110

Issued Date: 2020-01-19

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of CTTL.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S.Government.

Test Laboratory:

CTTL, Telecommunication Technology Labs, CAICT

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I19Z62186-WMD03	Rev.0	1st edition	2020-01-13
I19Z62186-WMD03	Rev.1	2nd edition Removed the reference of ANSI/TIA-102.CAAA-E	2020-01-19

Note: the latest revision of the test report supersedes all previous version.

CONTENTS

1. Test Laboratory

1.1. Introduction & Accreditation

Telecommunication Technology Labs, CAICT is an ISO/IEC 17025:2005 accredited test laboratory under NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM (NVLAP) with lab code 600118-0 and is also an FCC accredited test laboratory (CN5017), and ISED accredited test laboratory (CN0066). The detail accreditation scope can be found on NVLAP website.

1.2. 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

1.3. Testing Environment

Normal Temperature:	15-35℃
Relative Humidity:	20-75%

1.4. Project data

Testing Start Date:	2019-12-10
Testing End Date:	2020-01-13

1.5. 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)

2. Client Information

2.1. Applicant Information

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

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

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-1216
FCC ID	2AJOTTA-1216
Antenna	Embedded
Output power	24.77dBm maximum EIRP measured for LTE Band 7
Extreme vol. Limits	3.6VDC to 4.4VDC (nominal: 3.85VDC)
Extreme temp. Tolerance	-10°C to +45°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
UT01a	354225100003628	89572_1_12	000T_0_110	2019-12-10

*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

AE1

Model	WT130
Manufacturer	GUANGDONG FENGHUA NEW ENERGY CO.,LTD
Capacitance	2920mAh

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

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
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

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

Semi-anechoic chamber 2 / Fully-anechoic chamber 3 (10 meters×6.7 meters×6.15 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	> 100 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 0.5 Ω
Normalised site attenuation (NSA)	<±3.5 dB, 3 m distance
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 3000 MHz

6. SUMMARY OF TEST RESULT

6.1. Summary of test results

LTE Band 5

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	22.913	BR
2	Emission Limit	2.1051/22.917	BR
3	Frequency Stability	2.1055	BR
4	Occupied Bandwidth	2.1049	BR
5	Emission Bandwidth	22.917	BR
6	Band Edge Compliance	22.917	BR
7	Conducted Spurious Emission	22.917	BR

LTE Band 7

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	27.50	P
2	Emission Limit	2.1051/27.53	P
3	Frequency Stability	2.1055	BR
4	Occupied Bandwidth	2.1049	BR
5	Emission Bandwidth	27.53	BR
6	Band Edge Compliance	27.53	BR
7	Conducted Spurious Emission	27.53	BR
8	Peak-to-Average Power Ratio	27.50	BR

Terms used in Verdict column

P	Pass. The EUT complies with the essential requirements in the standard.
NP	Not Performed. 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.

Explanation of worst-case configuration

The worst-case scenario for all measurements is based on the conducted output power measurement investigation results. Output power was measured on QPSK,16QAM and 64QAM modulations. It was found that QPSK was the worst case. All testing was performed using QPSK modulations to represent the worst case unless otherwise stated. The test results shown in the following sections represent the worst case emission.

6.2. Explanation of re-use of test data

The Equipment Under Test (EUT) model TA-1216 (FCC ID: 2AJOTTA-1216) is a variant product of TA-1207 (FCC ID: 2AJOTTA-1207), according to the declaration of changes provided by the applicant and FCC KDB publication 484596 D01, spot check measurements were performed on this device. LTE Band 7 were tested. All the test results are derived from test report No. I19Z62142-WMD03. Please refer Annex A for detail spot check verification data and reference data. The spot check test results are consistent with basic model.

For detail differences between two models please refer the Declaration of Changes document.

7. Test Equipment Utilized

NO.	Description	TYPE	series number	MANUFACTURE	CAL DUE DATE	Calibration interval
1	EMI Antenna	VULB9163	9163-301	Schwarzbeck	2020-02-29	1 year
2	EMI Antenna	3117	00058889	ETS-Lindgren	2020-11-18	1 year
3	EMI Antenna	3117	00119024	ETS-Lindgren	2020-02-25	1 year
4	Universal Radio Communication Tester	CMW500	159082	R&S	2020-12-24	1 year
5	Spectrum Analyzer	FSU26	200030	R&S	2020-06-03	1 year
6	EMI Antenna	9117	167	Schwarzbeck	2020-05-27	1 year
7	Signal Generator	N5183A	MY49060052	Agilent	2020-06-24	1 year
8	Climate chamber	SH-242	93008556	ESPEC	2020-12-21	3 year
9	Radio Communication Analyzer	MT8821C	6201763159	Anritsu	2020-07-23	1 year
10	Test Receiver	E4440A	MY48250642	Agilent	2020-03-18	1 year
11	Universal Radio Communication Tester	CMW500	143008	R&S	2020-11-26	1 year
12	Power Amplifier	5S1G4	0341863	AR	/	

ANNEX A: MEASUREMENT RESULTS

A.1 OUTPUT POWER

A.1.1 Summary

During the process of testing, the EUT was controlled via Rhode & Schwarz Universal Radio Communication Tester (CMW500) or Anritsu Radio Communication Analyzer (MT8821C) 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	24.18	23.20	22.25
		836.5	24.11	23.44	22.49
		824.7	24.31	23.30	22.35
	1 RB low	848.3	24.29	23.21	22.26
		836.5	24.14	23.05	22.11
		824.7	24.36	23.01	22.06
	50% RB mid	848.3	24.19	23.03	22.09
		836.5	24.25	23.21	22.27
		824.7	24.39	23.17	22.22
	100% RB	848.3	23.10	22.29	21.37
		836.5	23.02	22.14	21.22
		824.7	23.24	22.23	21.31
3MHz	1 RB high	847.5	24.08	23.39	22.44
		836.5	24.10	23.24	22.29
		825.5	24.14	23.09	22.14
	1 RB low	847.5	24.17	23.41	22.46
		836.5	24.16	23.35	22.40
		825.5	24.22	23.43	22.48
	50% RB mid	847.5	23.09	22.24	21.32
		836.5	23.15	22.00	21.08
		825.5	23.10	22.16	21.24

	100% RB	847.5	23.18	22.23	21.31
		836.5	23.14	21.95	21.04
		825.5	23.17	22.12	21.21
5MHz	1 RB high	846.5	24.09	22.94	22.00
		836.5	24.15	22.65	21.71
		826.5	24.31	22.82	21.88
	1 RB low	846.5	24.32	22.62	21.69
		836.5	24.03	22.46	21.53
		826.5	24.17	22.83	21.89
	50% RB mid	846.5	23.22	22.28	21.36
		836.5	23.21	22.08	21.16
		826.5	23.29	22.23	21.31
	100% RB	846.5	23.12	22.11	21.19
		836.5	23.11	22.27	21.35
		826.5	23.23	22.09	21.17
10MHz	1 RB high	844.0	24.12	22.91	21.97
		836.5	24.19	23.28	22.33
		829.0	24.17	23.44	22.49
	1 RB low	844.0	24.11	23.09	22.14
		836.5	24.06	23.22	22.28
		829.0	24.26	23.40	22.45
	50% RB mid	844.0	23.32	22.24	21.32
		836.5	23.27	22.38	21.45
		829.0	23.32	22.35	21.43
	100% RB	844.0	23.17	22.20	21.28
		836.5	23.17	22.12	21.21
		829.0	23.20	22.19	21.27

LTE band 7

Bandwidth	RB size/offset	Frequency (MHz)	Power (dBm)		
			QPSK	16QAM	64QAM
5MHz	1 RB high	2567.5	24.17	22.81	21.46
		2535	24.57	22.71	21.37
		2502.5	24.19	22.87	21.52
	1 RB low	2567.5	24.08	22.85	21.51
		2535	24.66	22.91	21.56
		2502.5	24.24	22.92	21.57
	50% RB mid	2567.5	23.29	22.16	20.85
		2535	23.22	22.37	21.06
		2502.5	23.27	22.19	20.88
	100% RB	2567.5	23.14	22.17	20.86
		2535	23.36	22.54	21.21
		2502.5	23.31	22.22	20.91
10MHz	1 RB high	2565	24.34	23.36	21.99
		2535	24.87	23.85	22.45
		2505	24.42	22.94	21.59
	1 RB low	2565	24.32	23.44	22.06
		2535	24.69	23.78	22.38
		2505	24.50	22.95	21.59
	50% RB mid	2565	23.31	22.45	21.13
		2535	23.33	22.41	21.09
		2505	23.23	22.31	20.99
	100% RB	2565	23.30	22.30	20.99
		2535	23.32	22.46	21.14
		2505	23.27	22.32	21.00
15MHz	1 RB high	2562.5	24.18	23.22	21.85
		2535	24.39	22.87	21.52
		2507.5	24.26	23.90	22.49
	1 RB low	2562.5	24.32	23.88	22.48
		2535	24.27	22.63	21.30
		2507.5	24.21	23.83	22.43
	50% RB mid	2562.5	23.24	22.38	21.06
		2535	23.21	22.33	21.02
		2507.5	23.16	22.37	21.05
	100% RB	2562.5	23.22	22.32	21.00
		2535	23.30	22.41	21.09
		2507.5	23.24	22.33	21.01

20MHz	1 RB high	2560	24.30	23.30	21.93
		2535	24.34	23.29	21.92
		2510	23.84	23.24	21.87
	1 RB low	2560	24.77	23.41	22.03
		2535	24.20	23.30	21.92
		2510	23.78	23.16	21.79
	50% RB mid	2560	23.28	22.24	20.93
		2535	23.27	22.30	20.99
		2510	23.34	22.30	20.98
	100% RB	2560	23.23	22.37	21.06
		2535	23.35	22.42	21.10
		2510	23.23	22.31	21.00

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 "The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts."

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".

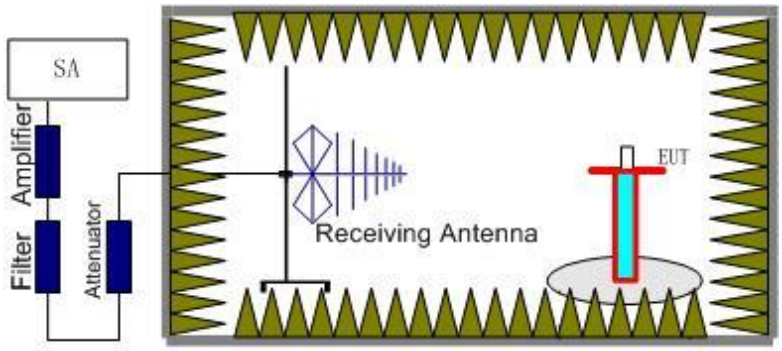
Rule Part 27.50(h) (2) specifies "Mobile stations are limited to 2.0 watts EIRP.".

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

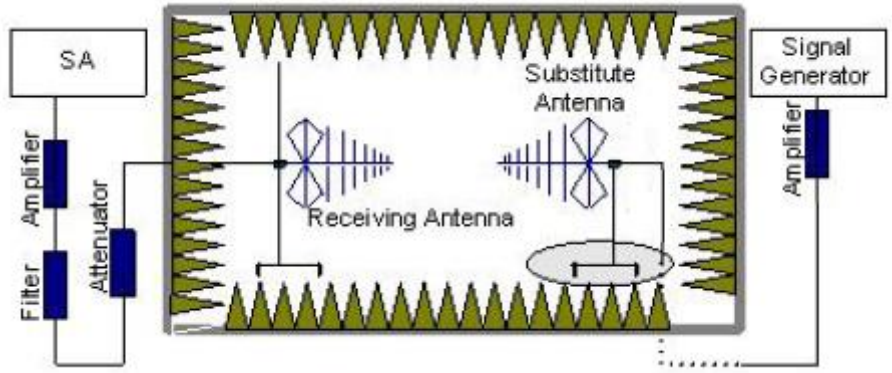
A.1.3.2 Method of Measurement

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 rms 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 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.

A.1.3.3 Measurement result

Spot Check Measurement Results:

LTE Band 7- EIRP

Limits: ≤33 dBm (2W)

LTE Band 7_5MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2502.50	-26.15	3.58	45.68	6.10	22.05	33.00	10.95	H
2535.00	-23.65	3.63	44.82	6.16	23.70	33.00	9.30	H
2567.50	-24.78	3.65	44.92	6.22	22.71	33.00	10.29	H

LTE Band 7_10MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2505.00	-26.04	3.59	45.64	6.11	22.12	33.00	10.88	H
2535.00	-23.55	3.63	44.82	6.16	23.80	33.00	9.20	H
2565.00	-24.83	3.65	44.97	6.22	22.71	33.00	10.29	H

LTE Band 7_15MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2507.50	-25.45	3.59	44.92	6.11	21.99	33.00	11.01	H
2535.00	-23.59	3.63	44.82	6.16	23.76	33.00	9.24	H
2562.50	-25.49	3.65	45.67	6.21	22.74	33.00	10.26	H

LTE Band 7_20 MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2510.00	-25.51	3.58	45.36	6.12	22.39	33.00	10.61	H
2535.00	-23.57	3.63	44.82	6.16	23.78	33.00	9.22	H
2560.00	-25.78	3.64	45.98	6.21	22.77	33.00	10.23	H

LTE Band 7_5MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2502.50	-27.34	3.58	45.68	6.10	20.86	33.00	12.14	H
2535.00	-25.28	3.63	44.82	6.16	22.07	33.00	10.93	H
2567.50	-25.79	3.65	44.92	6.22	21.70	33.00	11.30	H

LTE Band 7_10MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2505.00	-26.94	3.59	45.64	6.11	21.22	33.00	11.78	H
2535.00	-24.80	3.63	44.82	6.16	22.55	33.00	10.45	H
2565.00	-25.66	3.65	44.97	6.22	21.88	33.00	11.12	H

LTE Band 7_15MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2507.50	-26.25	3.59	44.92	6.11	21.19	33.00	11.81	H
2535.00	-24.82	3.63	44.82	6.16	22.53	33.00	10.47	H
2562.50	-26.24	3.65	45.67	6.21	21.99	33.00	11.01	H

LTE Band 7_20 MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2510.00	-26.36	3.58	45.36	6.12	21.54	33.00	11.46	H
2535.00	-24.78	3.63	44.82	6.16	22.57	33.00	10.43	H
2560.00	-26.41	3.64	45.98	6.21	22.14	33.00	10.86	H

LTE Band 7_5MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2502.50	-28.27	3.58	45.68	6.10	19.93	33.00	13.07	H
2535.00	-26.24	3.63	44.82	6.16	21.11	33.00	11.89	H
2567.50	-27.29	3.65	44.92	6.22	20.20	33.00	12.80	H

LTE Band 7_10MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2505.00	-28.34	3.59	45.64	6.11	19.82	33.00	13.18	H
2535.00	-25.87	3.63	44.82	6.16	21.48	33.00	11.52	H
2565.00	-26.82	3.65	44.97	6.22	20.72	33.00	12.28	H

LTE Band 7_15MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2507.50	-27.42	3.59	44.92	6.11	20.02	33.00	12.98	H
2535.00	-26.13	3.63	44.82	6.16	21.22	33.00	11.78	H
2562.50	-27.29	3.65	45.67	6.21	20.94	33.00	12.06	H

LTE Band 7_20 MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2510.00	-27.74	3.58	45.36	6.12	20.16	33.00	12.84	H
2535.00	-25.81	3.63	44.82	6.16	21.54	33.00	11.46	H
2560.00	-27.76	3.64	45.98	6.21	20.79	33.00	12.21	H

Reference Measurement Results from basic model:

LTE Band 5- ERP

Limits: ≤38.45dBm (7W)

LTE Band 5_1.4MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
824.70	-19.91	2.26	45.79	0.95	2.15	22.42	38.45	16.03	H
836.50	-19.55	2.26	45.66	0.82	2.15	22.52	38.45	15.93	H
848.30	-19.96	2.27	45.55	0.80	2.15	21.97	38.45	16.48	H

LTE Band 5_3MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
825.50	-20.17	2.26	45.79	0.94	2.15	22.15	38.45	16.30	H
836.50	-19.45	2.26	45.66	0.82	2.15	22.62	38.45	15.83	H
847.50	-20.25	2.27	45.56	0.81	2.15	21.70	38.45	16.75	H

LTE Band 5_5MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
826.50	-20.09	2.25	45.77	0.93	2.15	22.21	38.45	16.24	H
836.50	-19.36	2.26	45.66	0.82	2.15	22.71	38.45	15.74	H
846.50	-20.19	2.26	45.56	0.82	2.15	21.78	38.45	16.67	H

LTE Band 5_10MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
829.00	-20.08	2.13	45.74	0.90	2.15	22.28	38.45	16.17	H
836.50	-19.43	2.26	45.66	0.82	2.15	22.64	38.45	15.81	H
844.00	-20.15	2.26	45.59	0.82	2.15	21.85	38.45	16.60	H

LTE Band 5_1.4MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
824.70	-21.37	2.26	45.79	0.95	2.15	20.96	38.45	17.49	H
836.50	-20.58	2.26	45.66	0.82	2.15	21.49	38.45	16.96	H
848.30	-20.98	2.27	45.55	0.80	2.15	20.95	38.45	17.50	H

LTE Band 5_3MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
825.50	-21.80	2.26	45.79	0.94	2.15	20.52	38.45	17.93	H
836.50	-20.96	2.26	45.66	0.82	2.15	21.11	38.45	17.34	H
847.50	-21.30	2.27	45.56	0.81	2.15	20.65	38.45	17.80	H

LTE Band 5_5MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
826.50	-21.72	2.25	45.77	0.93	2.15	20.58	38.45	17.87	H
836.50	-21.17	2.26	45.66	0.82	2.15	20.90	38.45	17.55	H
846.50	-21.21	2.26	45.56	0.82	2.15	20.76	38.45	17.69	H

LTE Band 5_10MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
829.00	-21.61	2.13	45.74	0.90	2.15	20.75	38.45	17.70	H
836.50	-20.58	2.26	45.66	0.82	2.15	21.49	38.45	16.96	H
844.00	-21.23	2.26	45.59	0.82	2.15	20.77	38.45	17.68	H

LTE Band 5_1.4MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
824.70	-22.40	2.26	45.79	0.95	2.15	19.93	38.45	18.52	H
836.50	-21.37	2.26	45.66	0.82	2.15	20.70	38.45	17.75	H
848.30	-22.11	2.27	45.55	0.80	2.15	19.82	38.45	18.63	H

LTE Band 5_3MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
825.50	-22.56	2.26	45.79	0.94	2.15	19.76	38.45	18.69	H
836.50	-21.89	2.26	45.66	0.82	2.15	20.18	38.45	18.27	H
847.50	-22.25	2.27	45.56	0.81	2.15	19.70	38.45	18.75	H

LTE Band 5_5MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
826.50	-22.51	2.25	45.77	0.93	2.15	19.79	38.45	18.66	H
836.50	-21.94	2.26	45.66	0.82	2.15	20.13	38.45	18.32	H
846.50	-22.26	2.26	45.56	0.82	2.15	19.71	38.45	18.74	H

LTE Band 5_10MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
829.00	-22.42	2.13	45.74	0.90	2.15	19.94	38.45	18.51	H
836.50	-21.73	2.26	45.66	0.82	2.15	20.34	38.45	18.11	H
844.00	-22.25	2.26	45.59	0.82	2.15	19.75	38.45	18.70	H

LTE Band 7- EIRP

Limits: ≤33 dBm (2W)

LTE Band 7_5MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2502.50	-24.58	3.58	45.68	6.10	23.62	33.00	9.38	H
2535.00	-23.10	3.63	44.82	6.16	24.25	33.00	8.75	H
2567.50	-23.62	3.65	44.92	6.22	23.87	33.00	9.13	H

LTE Band 7_10MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2505.00	-24.37	3.59	45.64	6.11	23.79	33.00	9.21	H
2535.00	-22.61	3.63	44.82	6.16	24.74	33.00	8.26	H
2565.00	-23.60	3.65	44.97	6.22	23.94	33.00	9.06	H

LTE Band 7_15MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2507.50	-23.72	3.59	44.92	6.11	23.72	33.00	9.28	H
2535.00	-22.63	3.63	44.82	6.16	24.72	33.00	8.28	H
2562.50	-24.16	3.65	45.67	6.21	24.07	33.00	8.93	H

LTE Band 7_20 MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2510.00	-23.99	3.58	45.36	6.12	23.91	33.00	9.09	H
2535.00	-22.58	3.63	44.82	6.16	24.77	33.00	8.23	H
2560.00	-24.57	3.64	45.98	6.21	23.98	33.00	9.02	H

LTE Band 7_5MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2502.50	-26.09	3.58	45.68	6.10	22.11	33.00	10.89	H
2535.00	-24.71	3.63	44.82	6.16	22.64	33.00	10.36	H
2567.50	-25.18	3.65	44.92	6.22	22.31	33.00	10.69	H

LTE Band 7_10MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2505.00	-25.65	3.59	45.64	6.11	22.51	33.00	10.49	H
2535.00	-23.85	3.63	44.82	6.16	23.50	33.00	9.50	H
2565.00	-24.47	3.65	44.97	6.22	23.07	33.00	9.93	H

LTE Band 7_15MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2507.50	-25.20	3.59	44.92	6.11	22.24	33.00	10.76	H
2535.00	-24.23	3.63	44.82	6.16	23.12	33.00	9.88	H
2562.50	-25.68	3.65	45.67	6.21	22.55	33.00	10.45	H

LTE Band 7_20 MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2510.00	-24.48	3.58	45.36	6.12	23.42	33.00	9.58	H
2535.00	-23.21	3.63	44.82	6.16	24.14	33.00	8.86	H
2560.00	-25.34	3.64	45.98	6.21	23.21	33.00	9.79	H

LTE Band 7_5MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2502.50	-26.96	3.58	45.68	6.10	21.24	33.00	11.76	H
2535.00	-25.25	3.63	44.82	6.16	22.10	33.00	10.90	H
2567.50	-26.01	3.65	44.92	6.22	21.48	33.00	11.52	H

LTE Band 7_10MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2505.00	-26.64	3.59	45.64	6.11	21.52	33.00	11.48	H
2535.00	-24.69	3.63	44.82	6.16	22.66	33.00	10.34	H
2565.00	-25.90	3.65	44.97	6.22	21.64	33.00	11.36	H

LTE Band 7_15MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2507.50	-26.07	3.59	44.92	6.11	21.37	33.00	11.63	H
2535.00	-25.06	3.63	44.82	6.16	22.29	33.00	10.71	H
2562.50	-26.87	3.65	45.67	6.21	21.36	33.00	11.64	H

LTE Band 7_20 MHz_64QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
2510.00	-26.07	3.58	45.36	6.12	21.83	33.00	11.17	H
2535.00	-24.50	3.63	44.82	6.16	22.85	33.00	10.15	H
2560.00	-26.83	3.64	45.98	6.21	21.72	33.00	11.28	H

Peak EIRP (dBm) = P_{Mea}(-22.58dBm) - G_a (-6.16dBi) - P_{Ag} (-44.82dB) - P_{cl} (3.63dB) = 24.77dBm

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

A.2 EMISSION LIMIT

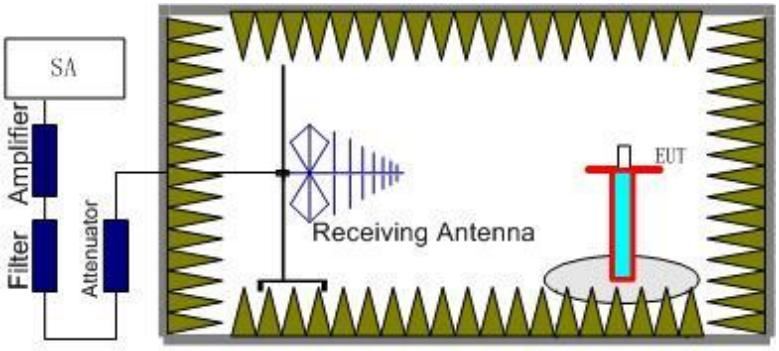
A.2.1 Measurement Method

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

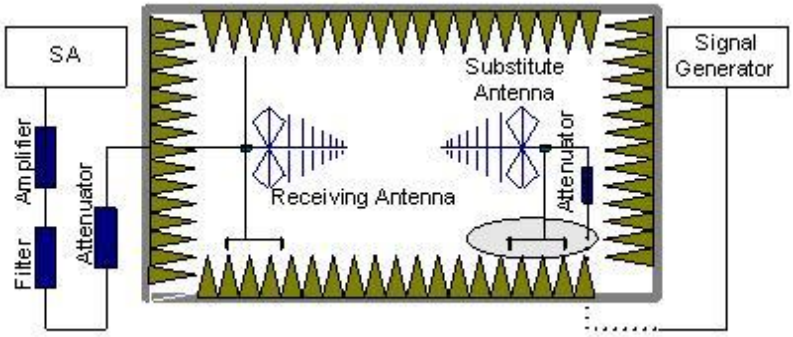
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier. The resolution bandwidth is set 1MHz. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and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

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, 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

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. 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 24.238 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.

Part 27.53(c) states for operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 +

10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

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. 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 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 range of evaluated frequency is from 30MHz to 26GHz.

Spot Check Measurement Results:

LTE Band 7, 5 MHz, QPSK, Channel 20775

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
5009.02	-55.99	6.59	9.91	-52.67	-25.00	27.67	V
7511.01	-45.41	8.35	12.21	-41.55	-25.00	16.55	H
10020.01	-48.45	9.24	12.91	-44.78	-25.00	19.78	H
12497.01	-49.46	10.18	13.20	-46.44	-25.00	21.44	V
15006.00	-45.71	11.22	14.00	-42.93	-25.00	17.93	V
17518.00	-42.59	12.79	14.93	-40.45	-25.00	15.45	H

LTE Band 7, 5 MHz, QPSK, Channel 21100

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
5077.02	-56.63	6.71	10.01	-53.33	-25.00	28.33	H
7609.01	-45.91	8.01	12.29	-41.63	-25.00	16.63	H
10151.01	-49.51	9.38	12.96	-45.93	-25.00	20.93	H
12685.01	-49.28	10.32	13.31	-46.29	-25.00	21.29	H
15205.00	-45.93	11.39	13.88	-43.44	-25.00	18.44	H
17738.00	-43.42	12.39	15.23	-40.58	-25.00	15.58	H

LTE Band 7, 5 MHz, QPSK, Channel 21425

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
5138.02	-55.93	6.86	10.09	-52.70	-25.00	27.70	H
7706.01	-47.07	8.42	12.36	-43.13	-25.00	18.13	H
10284.01	-46.14	9.59	13.01	-42.72	-25.00	17.72	H
12849.01	-49.35	10.64	13.41	-46.58	-25.00	21.58	V
15392.00	-45.67	11.38	13.76	-43.29	-25.00	18.29	V
17970.00	-43.20	12.89	15.56	-40.53	-25.00	15.53	H

Reference Measurement Results from basic model:

LTE Band 5, 1.4MHz, QPSK, Channel 20407

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1655.01	-59.53	3.57	5.22	2.15	-60.03	-13.00	47.03	H
2460.00	-45.30	4.58	5.98	2.15	-46.05	-13.00	33.05	V
3306.02	-54.53	5.29	7.73	2.15	-54.24	-13.00	41.24	H
4131.02	-56.03	6.05	9.03	2.15	-55.20	-13.00	42.20	H
4944.01	-54.55	6.70	9.84	2.15	-53.56	-13.00	40.56	H
5777.01	-54.61	7.22	10.54	2.15	-53.44	-13.00	40.44	H

LTE Band 5, 1.4MHz, QPSK, Channel 20525

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1673.01	-58.80	3.58	5.19	2.15	-59.34	-13.00	46.34	H
2517.00	-52.00	4.64	6.13	2.15	-52.66	-13.00	39.66	H
3342.02	-55.12	5.31	7.82	2.15	-54.76	-13.00	41.76	H
4196.02	-54.69	6.20	9.10	2.15	-53.94	-13.00	40.94	H
5030.01	-54.73	6.57	9.94	2.15	-53.51	-13.00	40.51	H
5854.01	-54.10	7.25	10.53	2.15	-52.97	-13.00	39.97	V

LTE Band 5, 1.4MHz, QPSK, Channel 20643

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1697.01	-58.86	3.60	5.15	2.15	-59.46	-13.00	46.46	H
2559.00	-52.45	4.67	6.21	2.15	-53.06	-13.00	40.06	H
3385.02	-55.08	5.35	7.92	2.15	-54.66	-13.00	41.66	V
4250.02	-55.83	6.24	9.15	2.15	-55.07	-13.00	42.07	H
5088.01	-54.24	6.74	10.02	2.15	-53.11	-13.00	40.11	H
5936.01	-52.98	7.47	10.51	2.15	-52.09	-13.00	39.09	V

LTE Band 7, 5 MHz, QPSK, Channel 20775

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
5010.02	-56.96	6.59	9.91	-53.64	-25.00	28.64	V
7508.01	-33.28	8.36	12.21	-29.43	-25.00	4.43	V
10024.01	-42.92	9.25	12.91	-39.26	-25.00	14.26	H
12515.01	-49.57	10.22	13.21	-46.58	-25.00	21.58	H
15005.00	-44.91	11.22	14.00	-42.13	-25.00	17.13	V
17522.00	-43.00	12.81	14.93	-40.88	-25.00	15.88	H

LTE Band 7, 5 MHz, QPSK, Channel 21100

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
5073.02	-55.14	6.70	10.00	-51.84	-25.00	26.84	H
7606.01	-33.15	8.00	12.28	-28.87	-25.00	3.87	V
10155.01	-43.20	9.37	12.96	-39.61	-25.00	14.61	H
12659.01	-48.86	10.37	13.30	-45.93	-25.00	20.93	H
15228.00	-45.88	11.37	13.86	-43.39	-25.00	18.39	H
17748.00	-44.23	12.45	15.25	-41.43	-25.00	16.43	H

LTE Band 7, 5 MHz, QPSK, Channel 21425

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
5139.02	-53.13	6.86	10.09	-49.90	-25.00	24.90	H
7703.01	-32.45	8.42	12.36	-28.51	-25.00	3.51	V
10286.01	-39.55	9.60	13.01	-36.14	-25.00	11.14	H
12829.01	-48.86	10.69	13.40	-46.15	-25.00	21.15	H
15418.00	-45.94	11.42	13.75	-43.61	-25.00	18.61	H
17974.00	-42.95	12.89	15.56	-40.28	-25.00	15.28	H

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

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 and Anritsu MT8821C Radio Communication Analyzer.

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -30℃.
3. With the EUT, powered via nominal voltage, connected to the CMW500 or MT8821C and in a simulated call on mid channel of the LTE Bands 5,7, 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 -30℃ to +50℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments remeasuring carrier frequency at each voltage. Pause at nominal voltage for 1 1/2 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 or MT8821C 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 -30℃ to +50℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

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 3.85VDC.. 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.

A.3.2 Measurement results

LTE Band 5, 10MHz bandwidth QPSK (worst case of all bandwidths)

Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20	3.85	824.405	848.580	0.64	0.0008
50				1.53	0.0018
40				1.60	0.0019
30				-9.07	0.0108
10				-7.31	0.0087
0				15.07	0.0180
-10				1.00	0.0012
-20				0.47	0.0006
-30					

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.6	20	824.405	848.580	-10.53	0.0126
4.4				1.11	0.0013

LTE Band 7, 20MHz bandwidth QPSK (worst case of all bandwidths)

Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20	3.85	2500.600	2569.400	-65.95	0.0260
50				48.02	0.0189
40				1.79	0.0007
30				0.00	0.0000
10				59.12	0.0233
0				0.12	0.0000
-10				-0.79	0.0003
-20				0.29	0.0001
-30					

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.6	20	2500.600	2569.400	0.20	0.0001
4.4				1.56	0.0006

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 ANSI C63.26:

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 skirt.

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

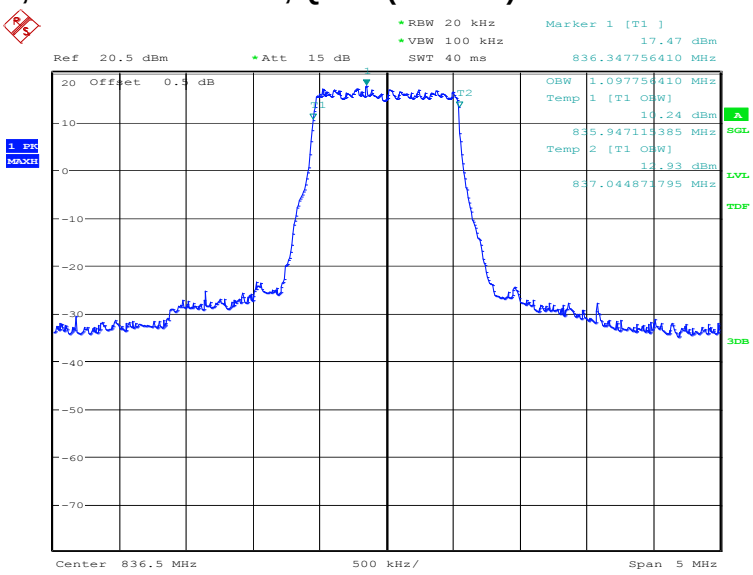
c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

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

LTE band 5, 1.4MHz (99%)

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

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



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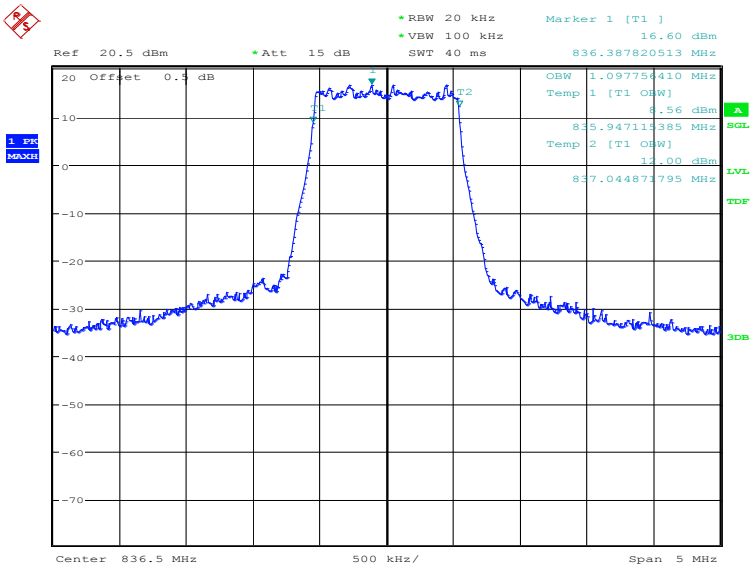
LTE band 5, 1.4MHz Bandwidth, 16QAM (99% BW)



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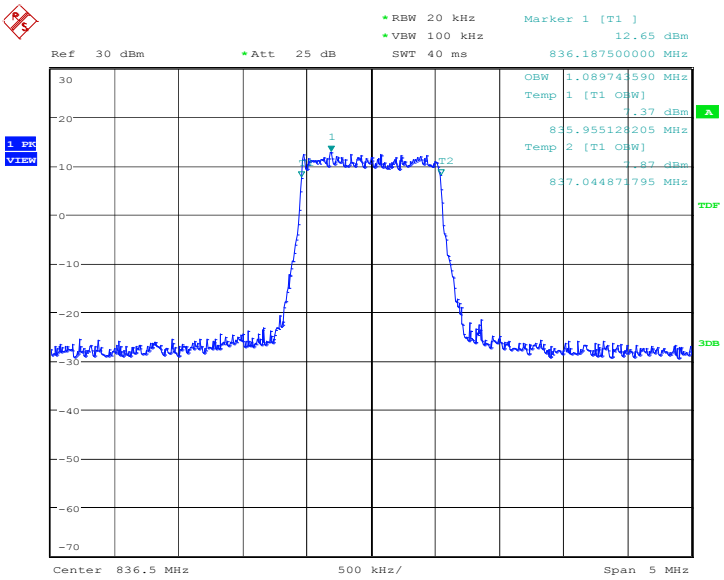
LTE band 5, 1.4MHz Bandwidth, 64QAM (99% BW)

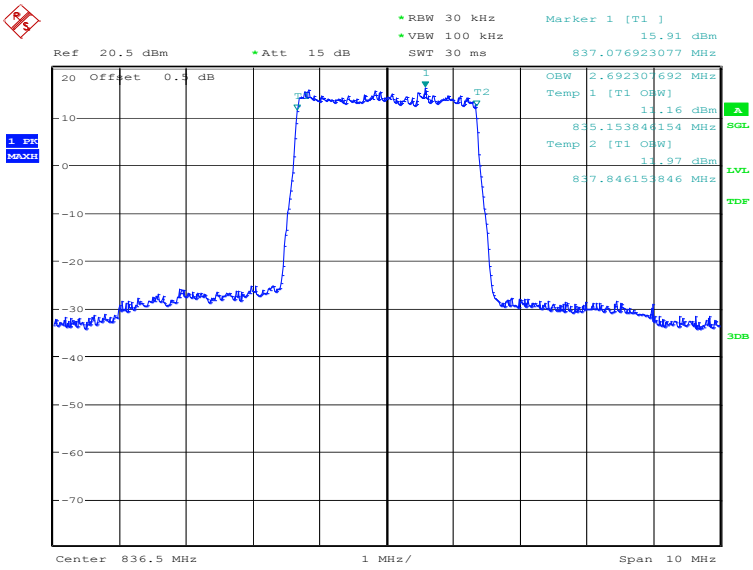


Date: 18.DEC.2019 14:06:09

LTE band 5, 3MHz (99%)

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

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



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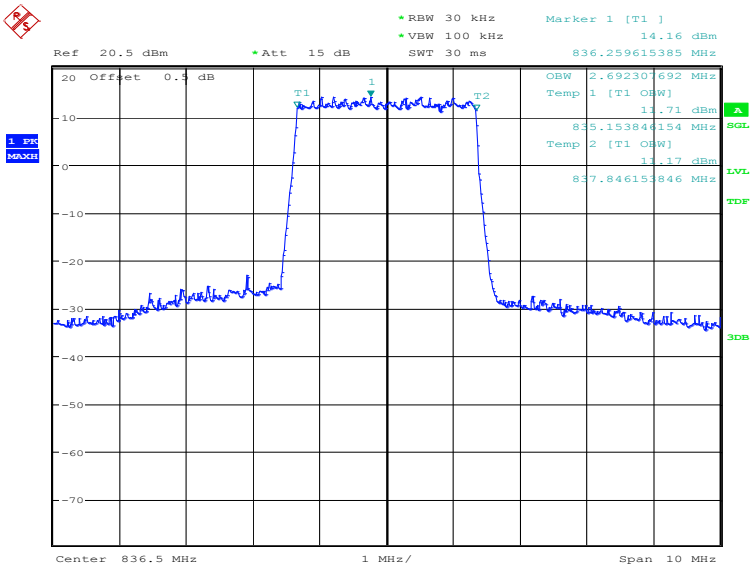
LTE band 5, 3MHz Bandwidth, 16QAM (99% BW)



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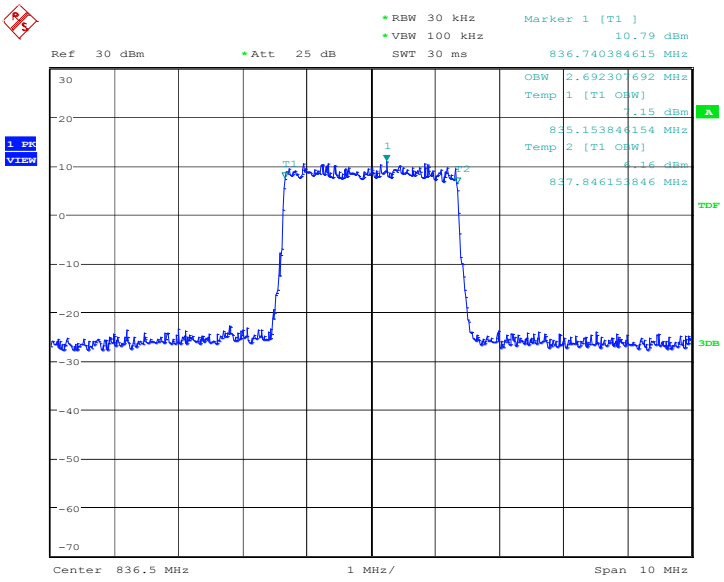
LTE band 5, 3MHz Bandwidth, 64QAM (99% BW)

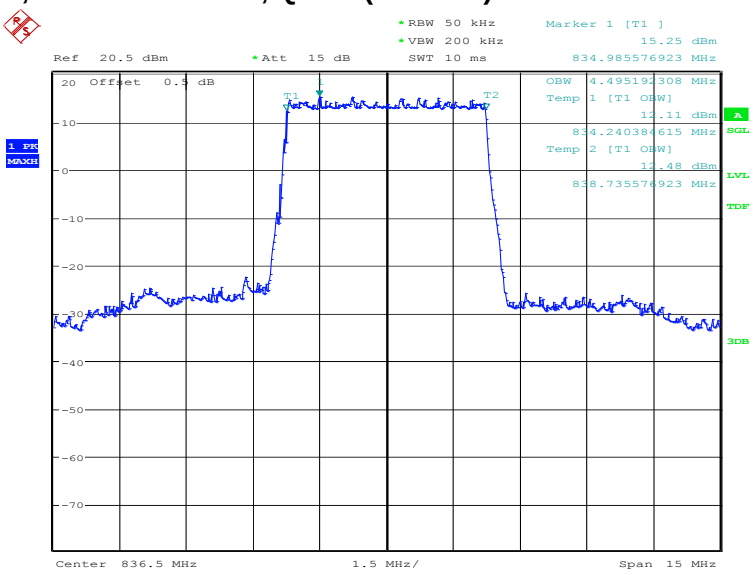


Date: 18.DEC.2019 14:13:16

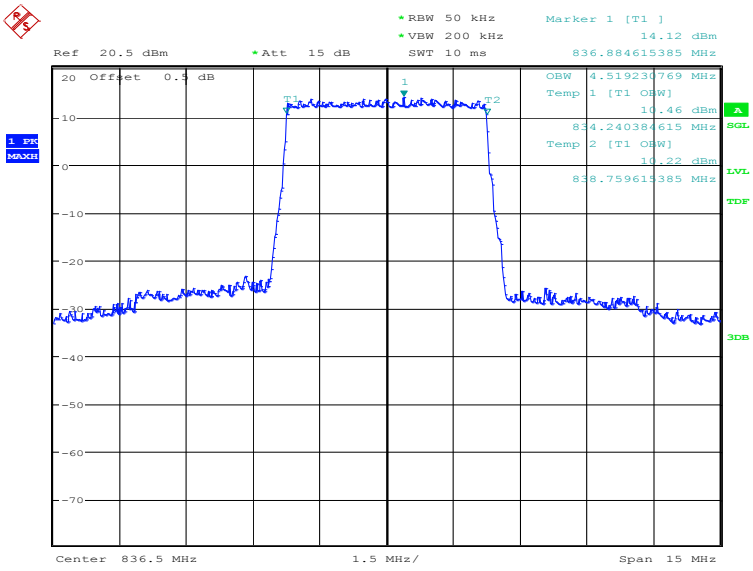
LTE band 5, 5MHz (99%)

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

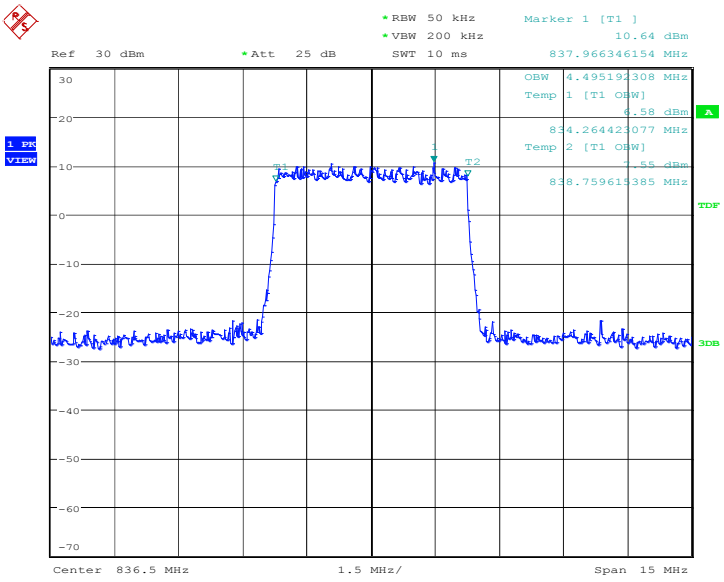
LTE band 5, 5MHz Bandwidth, QPSK (99% BW)



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



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

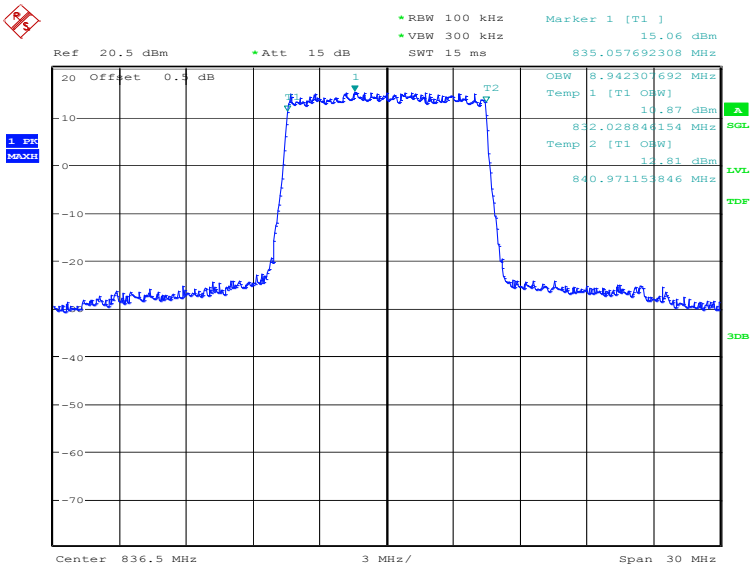


Date: 18.DEC.2019 14:14:21

LTE band 5, 10MHz (99%)

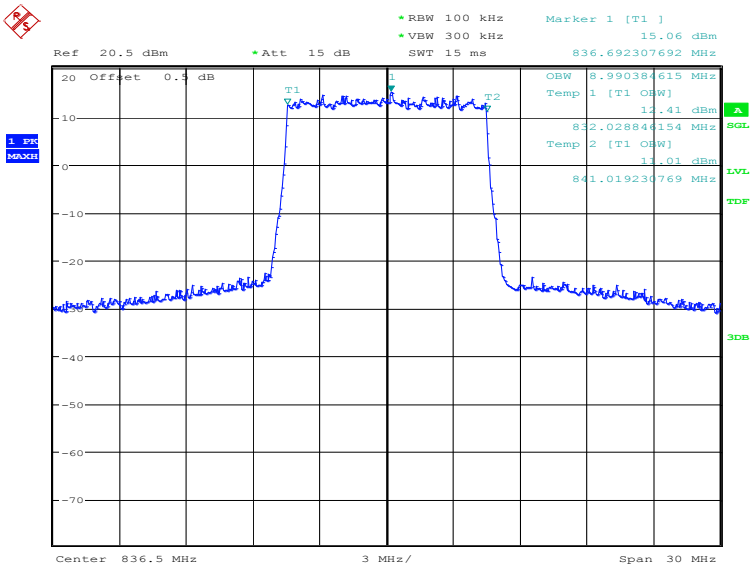
Frequency (MHz)	Occupied Bandwidth (99%) (kHz)		
836.5	QPSK	16QAM	64QAM
	8942.31	8990.38	8990.38

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



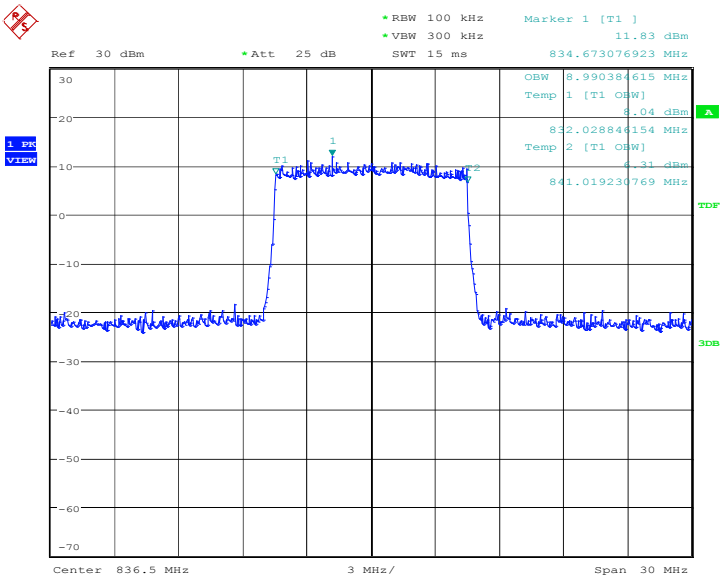
Date: 10.DEC.2019 23:49:34

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



Date: 10.DEC.2019 23:50:59

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

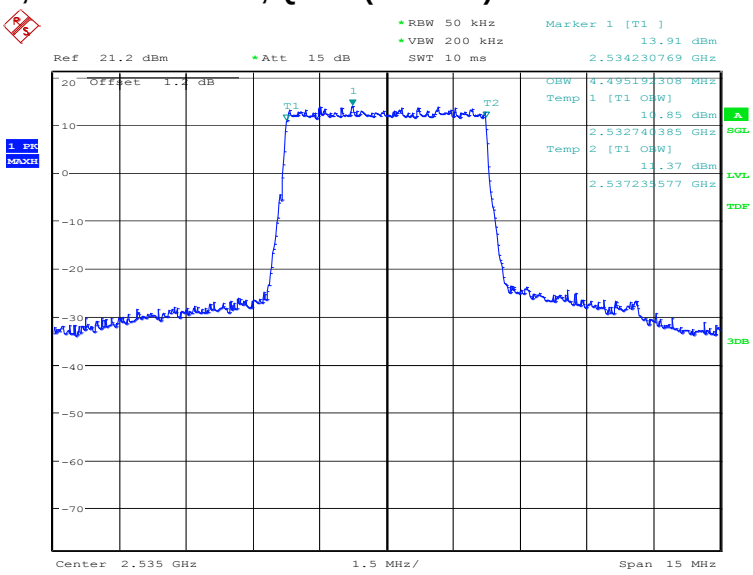


Date: 18.DEC.2019 14:49:03

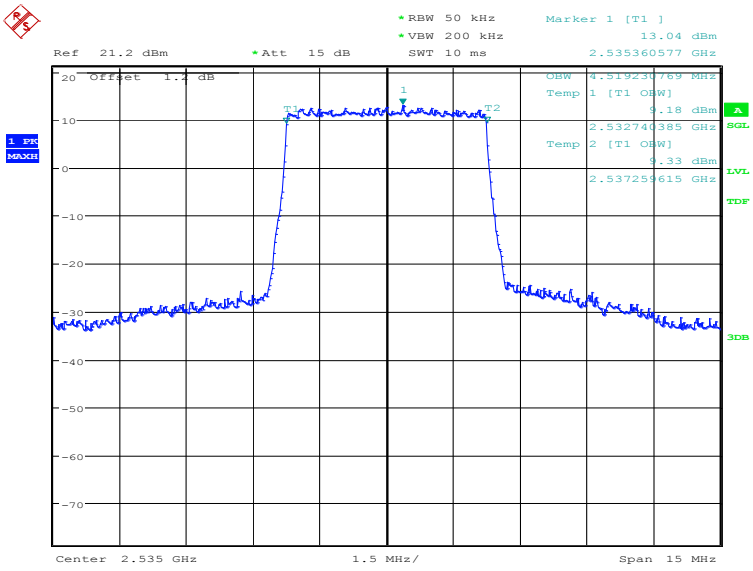
LTE band 7, 5MHz (99%)

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

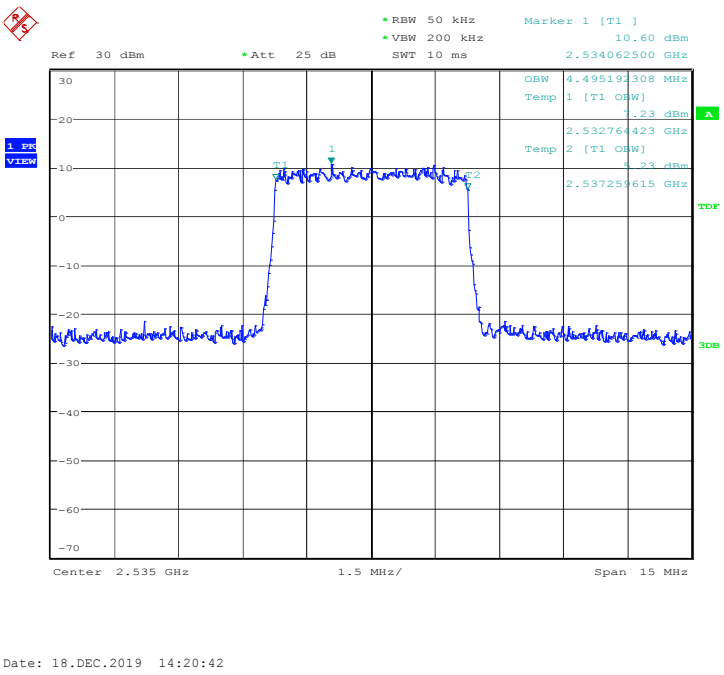
LTE band 7, 5MHz Bandwidth, QPSK (99% BW)



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



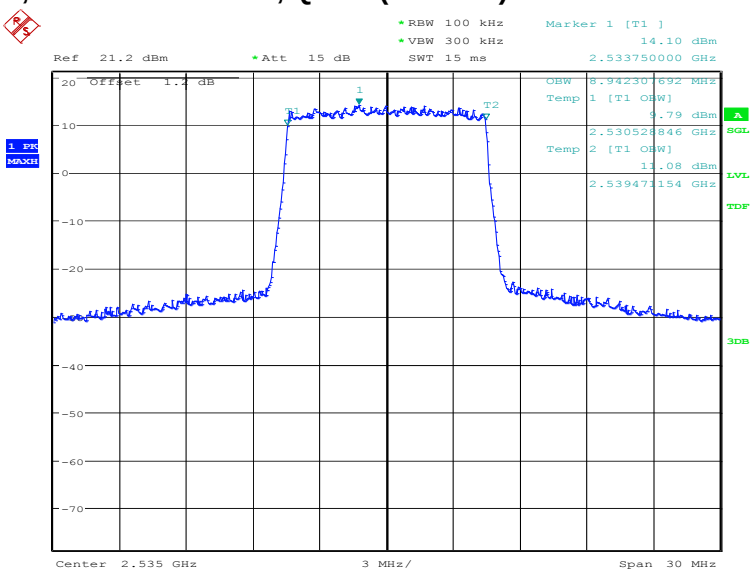
LTE band 7, 5MHz Bandwidth,64QAM (99% BW)



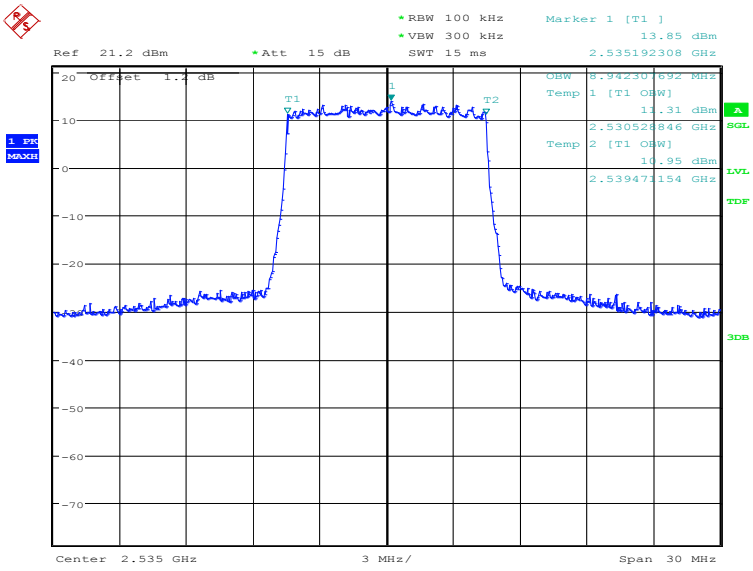
LTE band 7, 10MHz (99%)

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

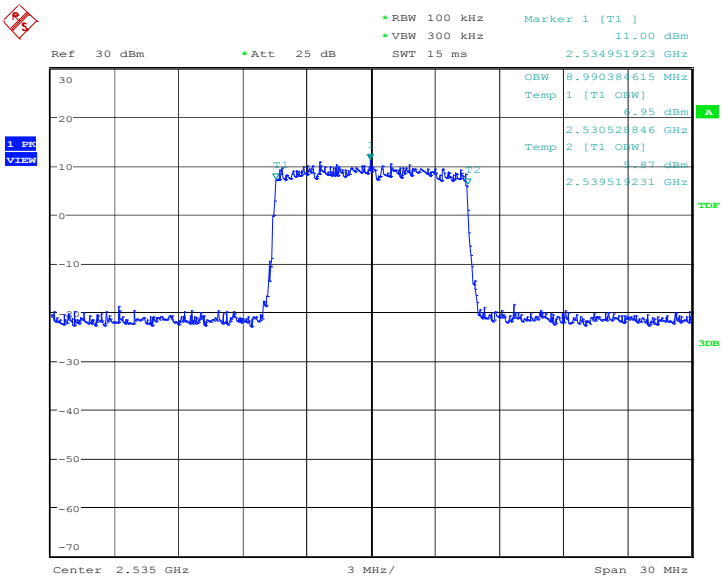
LTE band 7, 10MHz Bandwidth, QPSK (99% BW)



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



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



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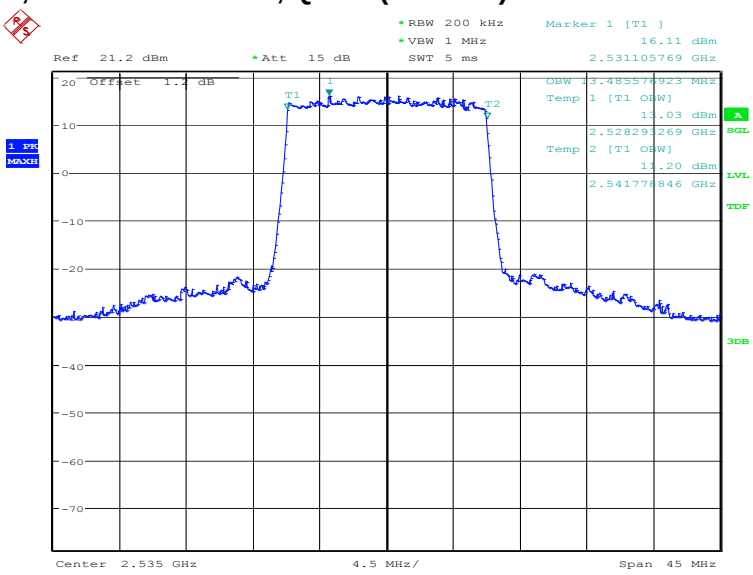
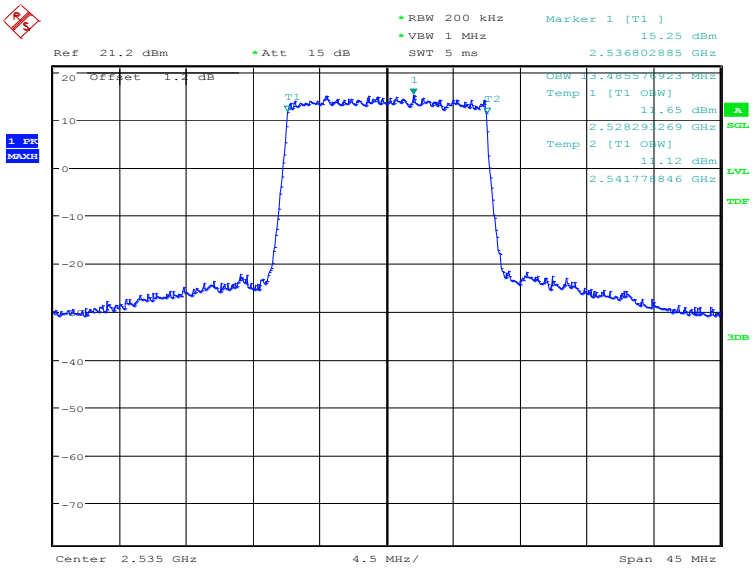
LTE band 7, 15MHz (99%)

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

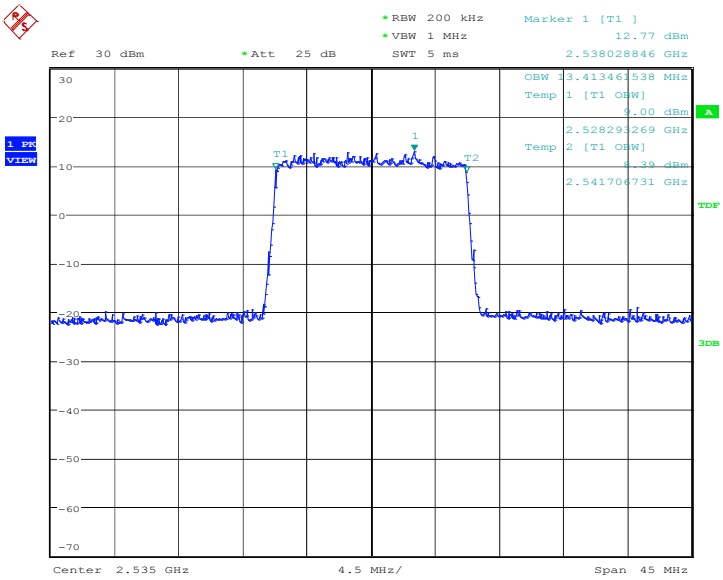
LTE band 7, 15MHz Bandwidth, QPSK (99% BW)



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



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



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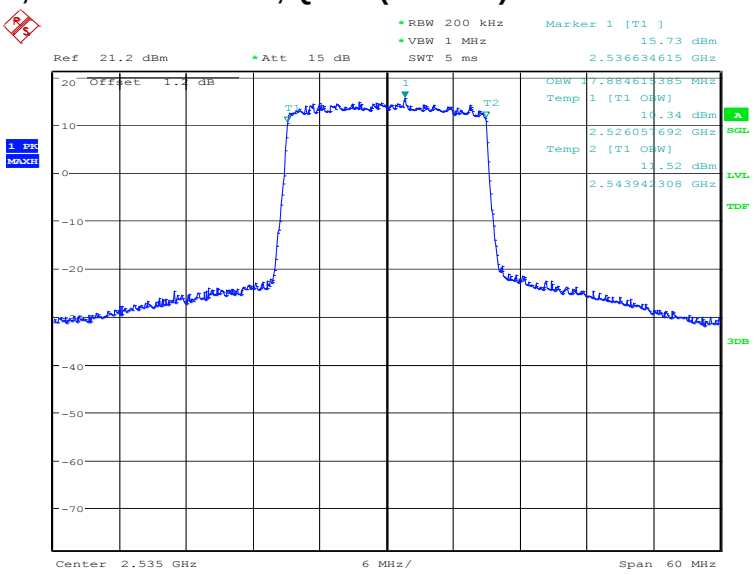
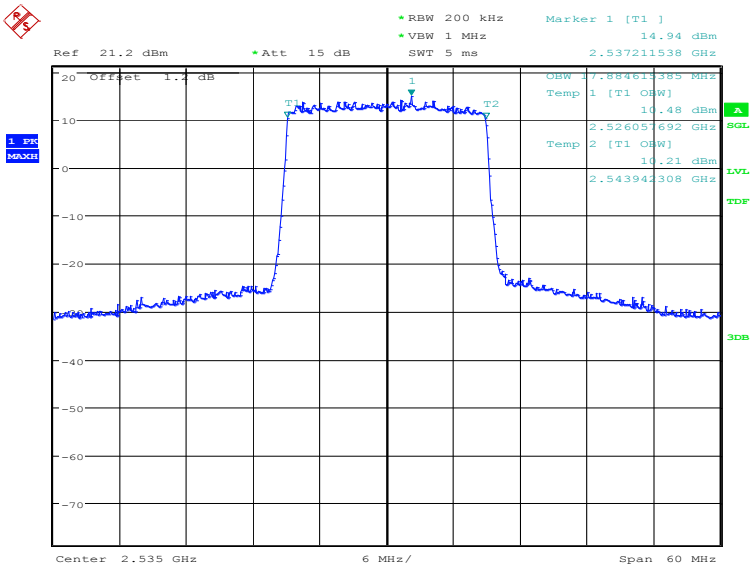
LTE band 7, 20MHz (99%)

Frequency (MHz)	Occupied Bandwidth (99%) (kHz)		
2535.0	QPSK	16QAM	64QAM
	17884.62	17884.62	17980.77

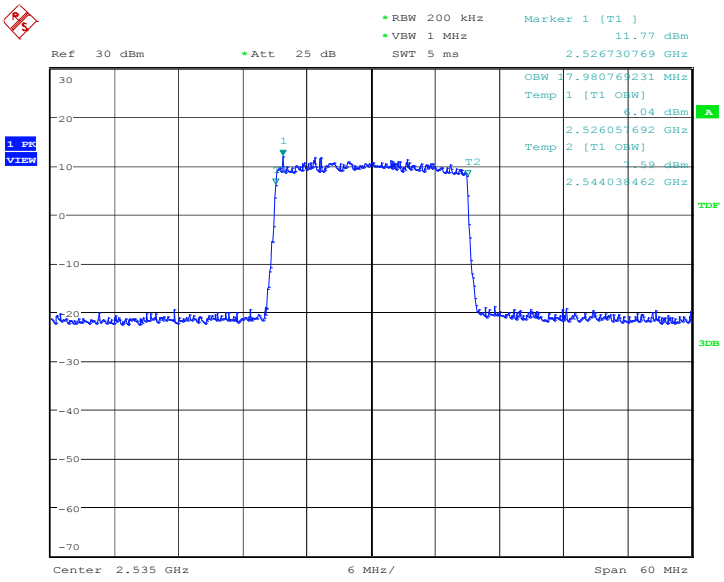
LTE band 7, 20MHz Bandwidth, QPSK (99% BW)



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



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



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.

The measurement method is from ANSI C63.26:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.

b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

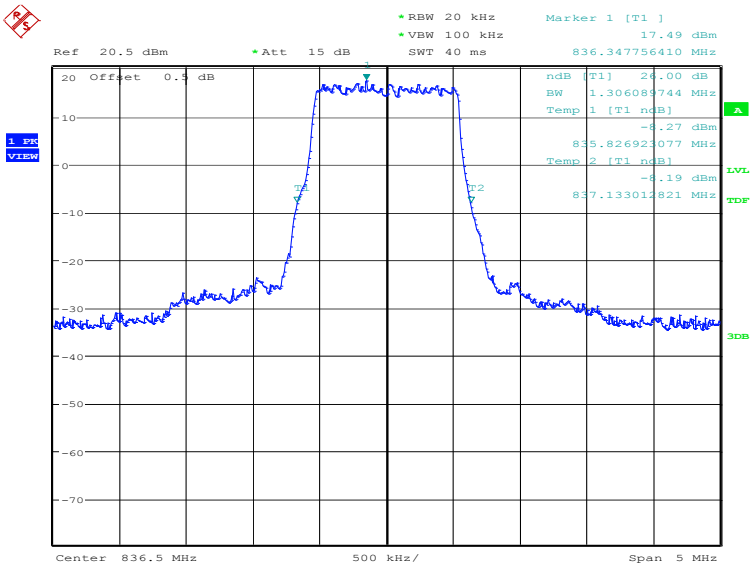
d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target “−X dB” requirement, i.e., if the requirement calls for measuring the −26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.

e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

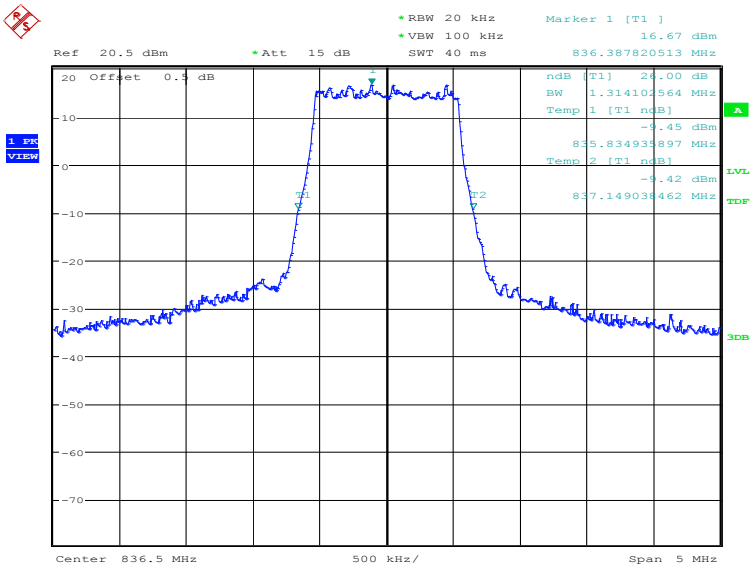
LTE band 5, 1.4MHz (-26dBc)

Frequency (MHz)	Occupied Bandwidth (-26dBc) (kHz)		
836.5	QPSK	16QAM	64QAM
	1306.09	1314.10	1282.05

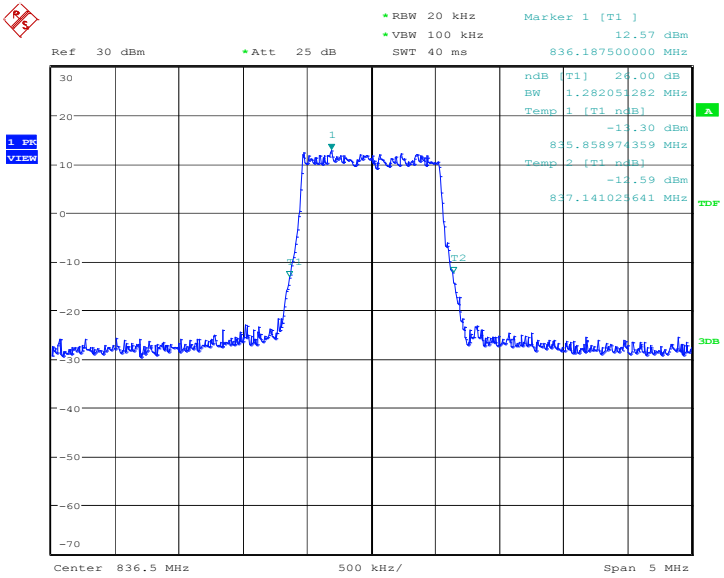
LTE band 5, 1.4MHz Bandwidth, QPSK (-26dBc BW)



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



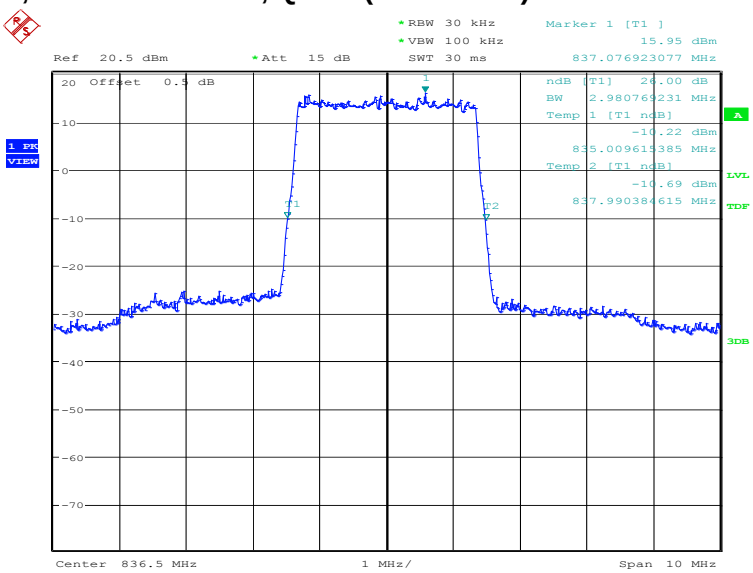
LTE band 5, 1.4MHz Bandwidth, 64QAM (-26dBc BW)



LTE band 5, 3MHz (-26dBc)

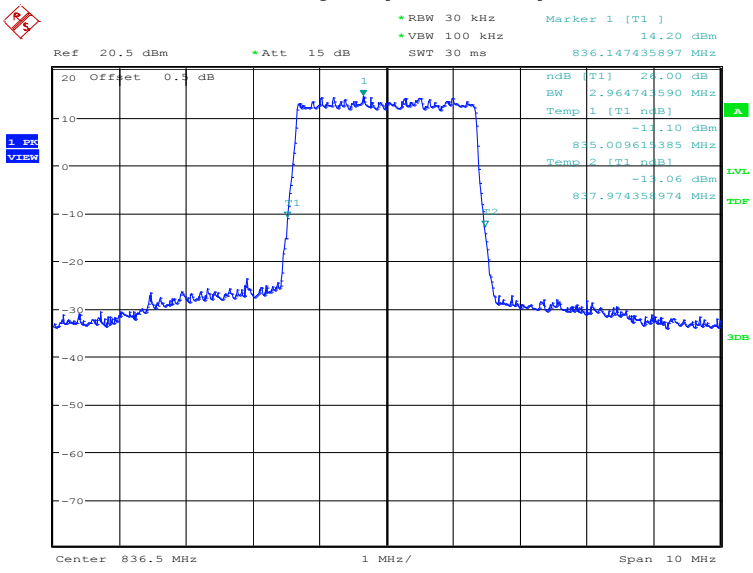
Frequency (MHz)	Occupied Bandwidth (-26dBc) (kHz)		
836.5	QPSK	16QAM	64QAM
	2980.77	2964.74	2948.72

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



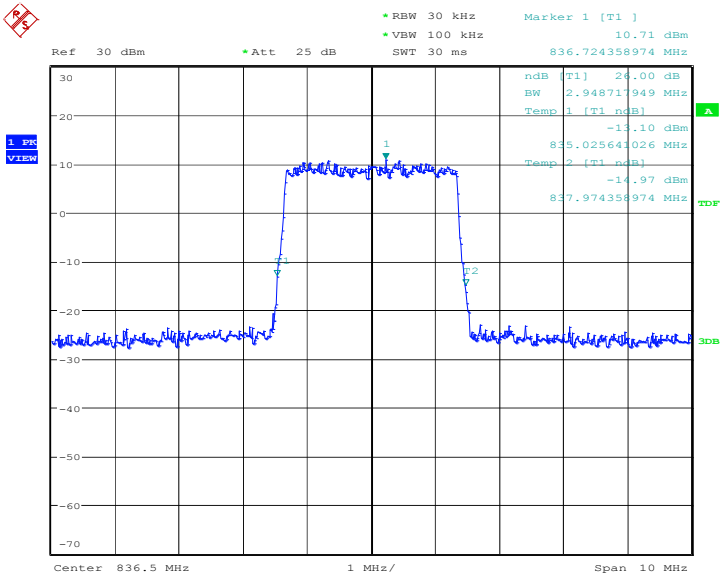
Date: 11.DEC.2019 00:55:14

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



Date: 11.DEC.2019 00:56:40

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

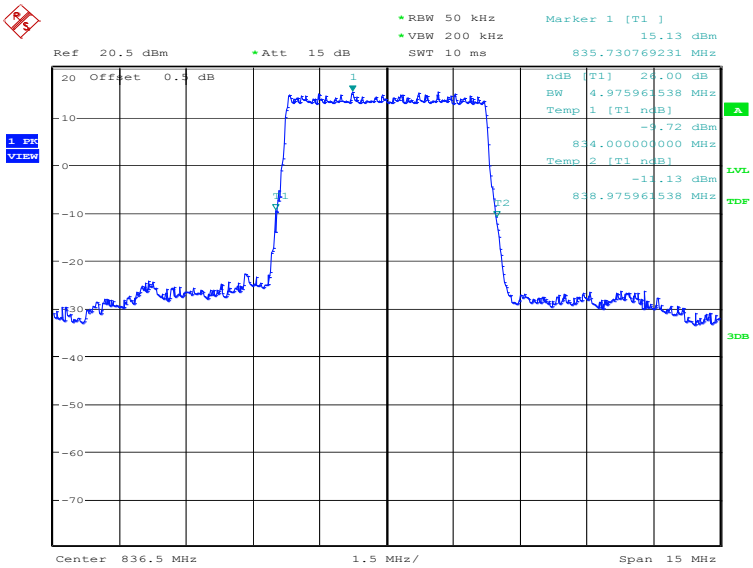


Date: 18.DEC.2019 14:13:39

LTE band 5, 5MHz (-26dBc)

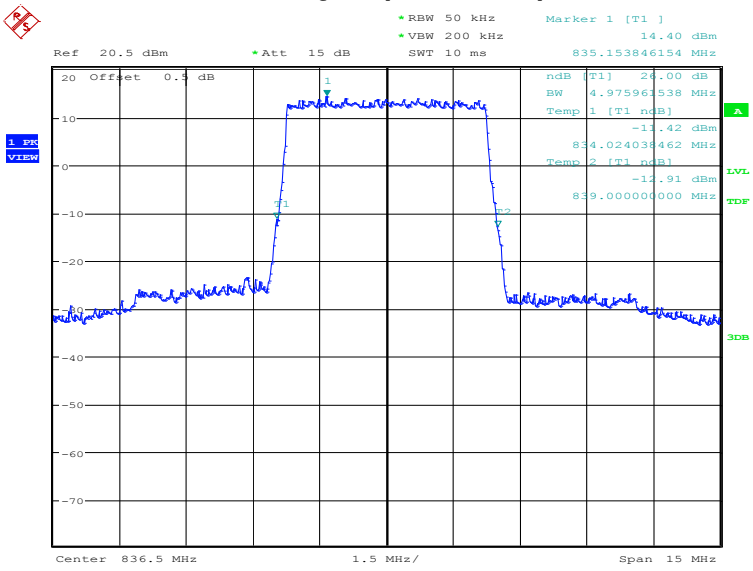
Frequency (MHz)	Occupied Bandwidth (-26dBc) (kHz)		
836.5	QPSK	16QAM	64QAM
	4975.96	4975.96	4879.81

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



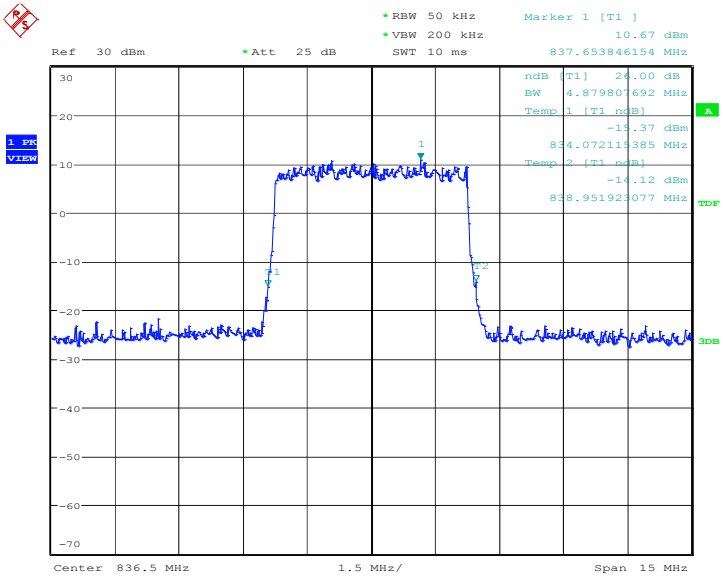
Date: 11.DEC.2019 00:58:07

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



Date: 11.DEC.2019 00:59:33

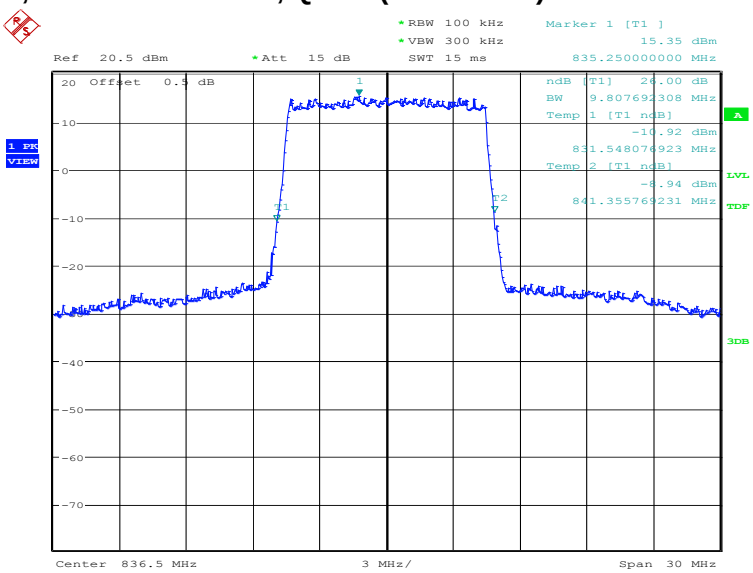
LTE band 5, 5MHz Bandwidth,64QAM (-26dBc BW)



LTE band 5, 10MHz (-26dBc)

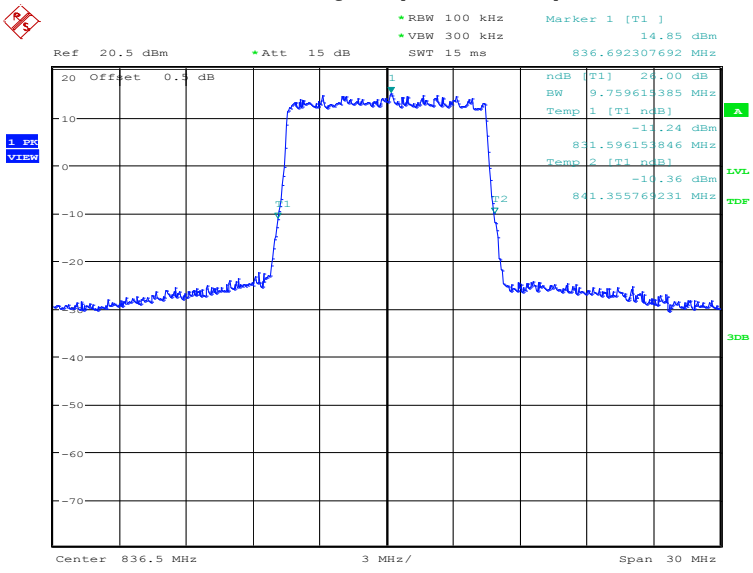
Frequency (MHz)	Occupied Bandwidth (-26dBc) (kHz)		
836.5	QPSK	16QAM	64QAM
	9807.69	9759.62	9711.54

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



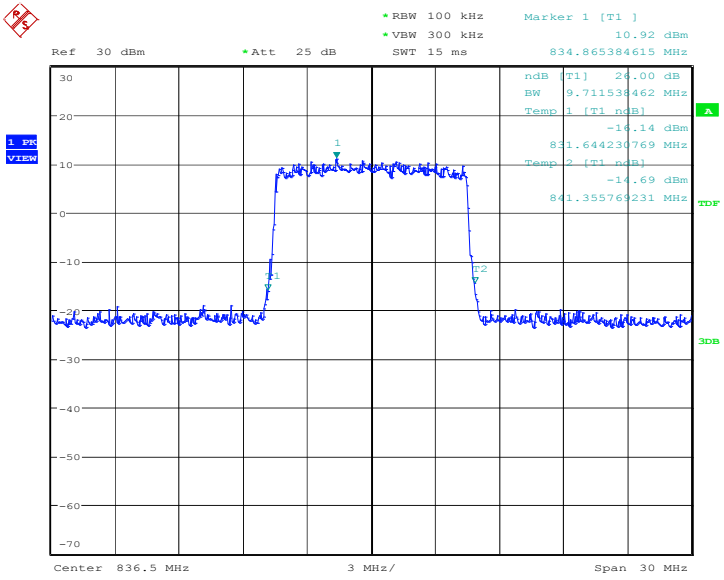
Date: 11.DEC.2019 01:01:00

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



Date: 11.DEC.2019 01:02:26

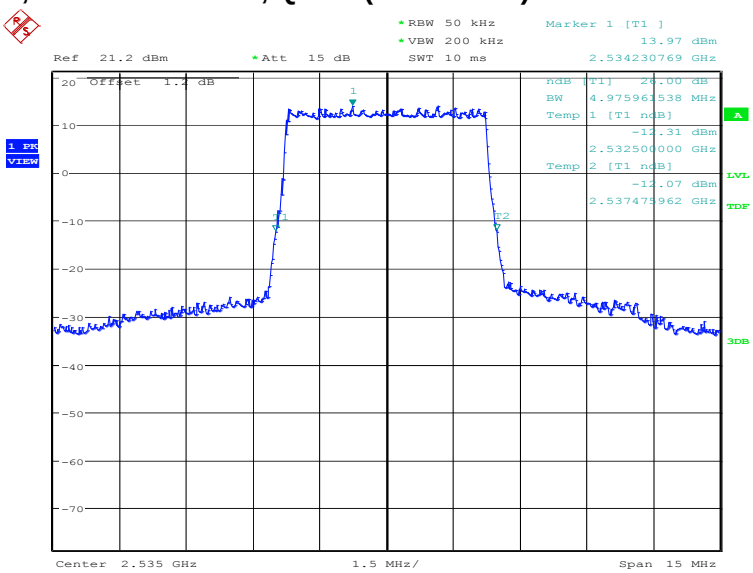
LTE band 5, 10MHz Bandwidth, 64QAM (-26dBc BW)



LTE band 7, 5MHz (-26dBc)

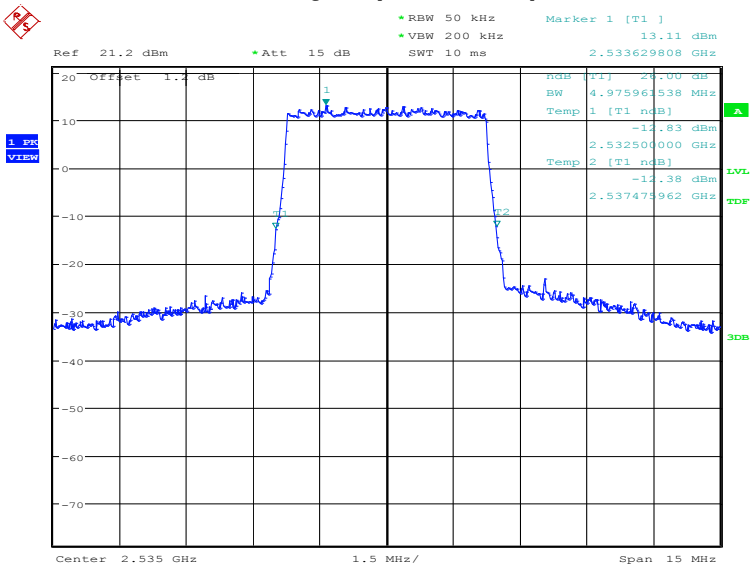
Frequency (MHz)	Occupied Bandwidth (-26dBc) (kHz)		
2535.0	QPSK	16QAM	64QAM
	4975.96	4975.96	4927.88

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



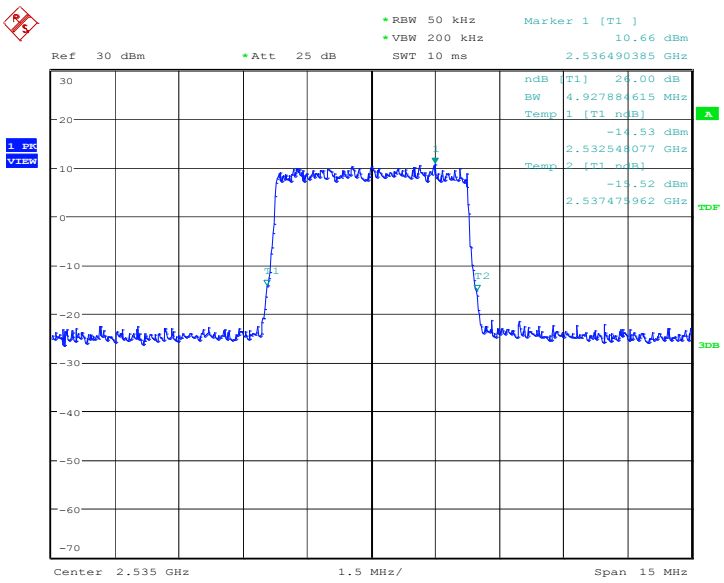
Date: 11.DEC.2019 01:03:54

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



Date: 11.DEC.2019 01:05:20

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

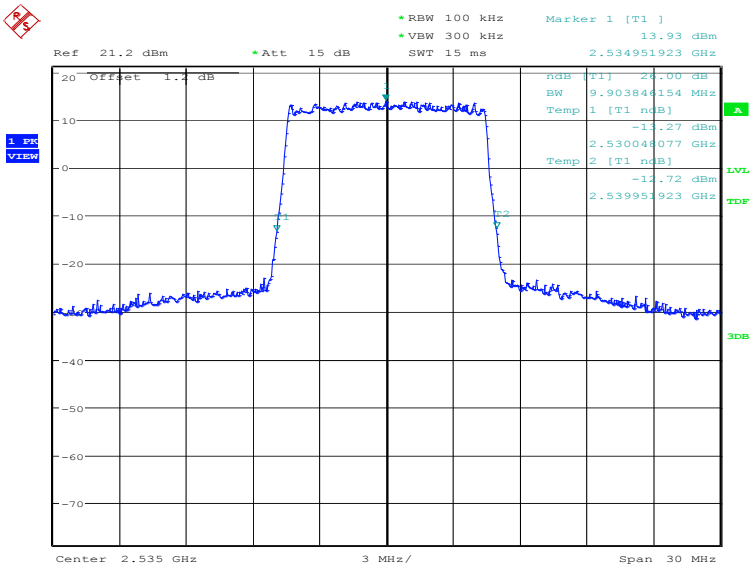


Date: 18.DEC.2019 14:21:29

LTE band 7, 10MHz (-26dBc)

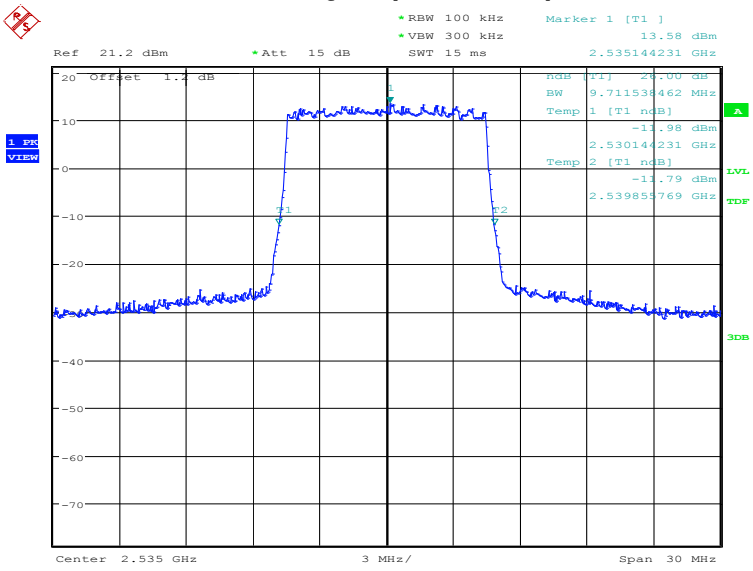
Frequency (MHz)	Occupied Bandwidth (-26dBc) (kHz)		
2535.0	QPSK	16QAM	64QAM
	9903.85	9711.54	9711.54

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



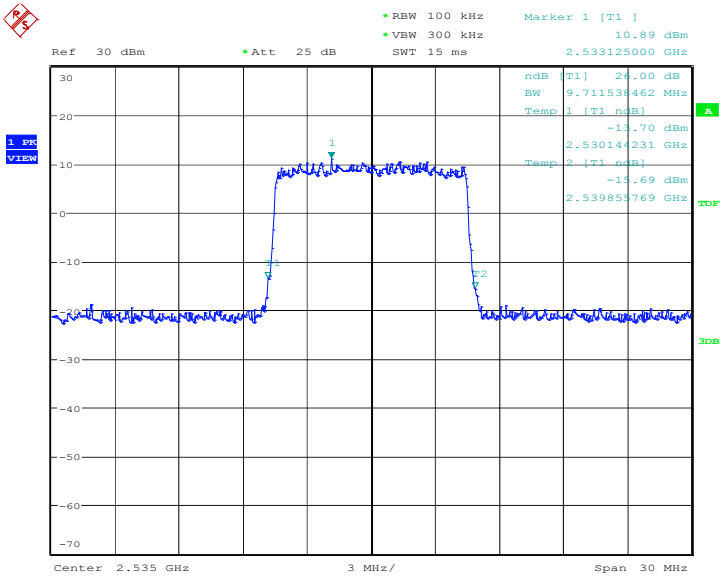
Date: 11.DEC.2019 01:06:48

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



Date: 11.DEC.2019 01:08:14

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

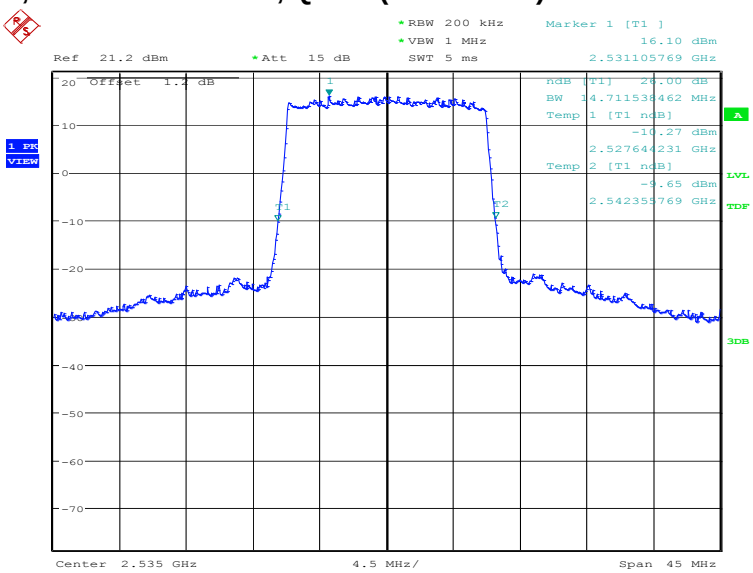


Date: 18.DEC.2019 14:24:10

LTE band 7, 15MHz (-26dBc)

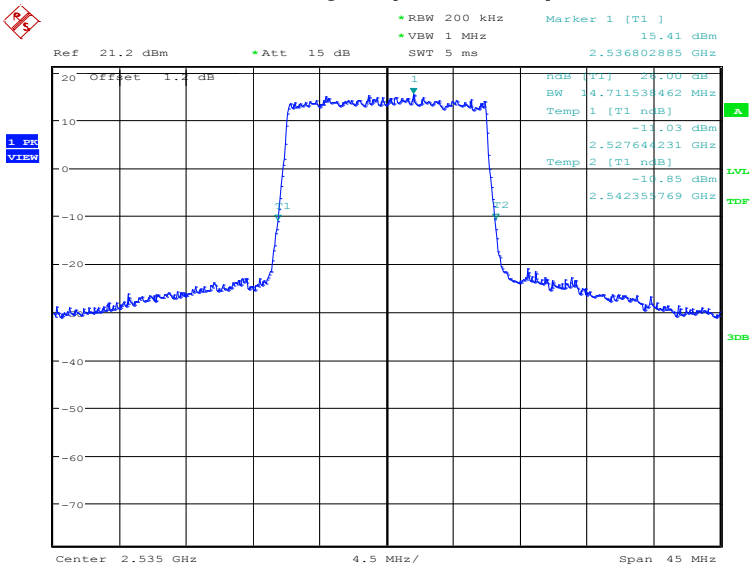
Frequency (MHz)	Occupied Bandwidth (-26dBc) (kHz)		
2535.0	QPSK	16QAM	64QAM
	14711.54	14711.54	14711.54

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



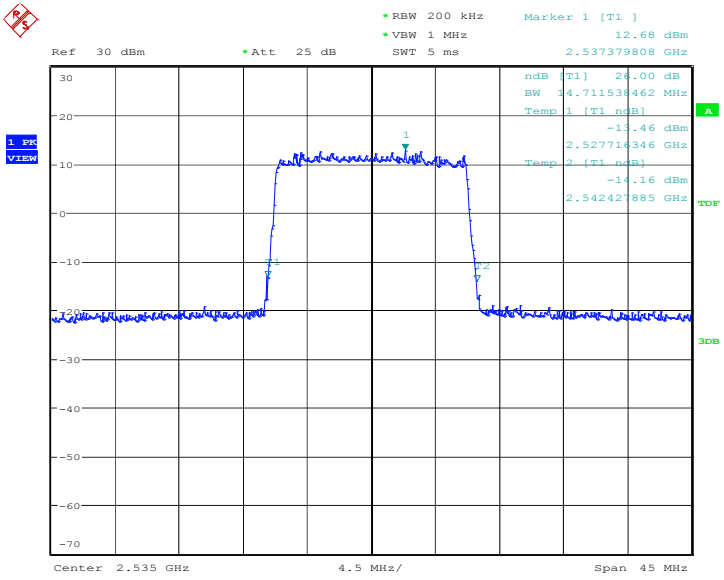
Date: 11.DEC.2019 01:09:41

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



Date: 11.DEC.2019 01:11:07

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

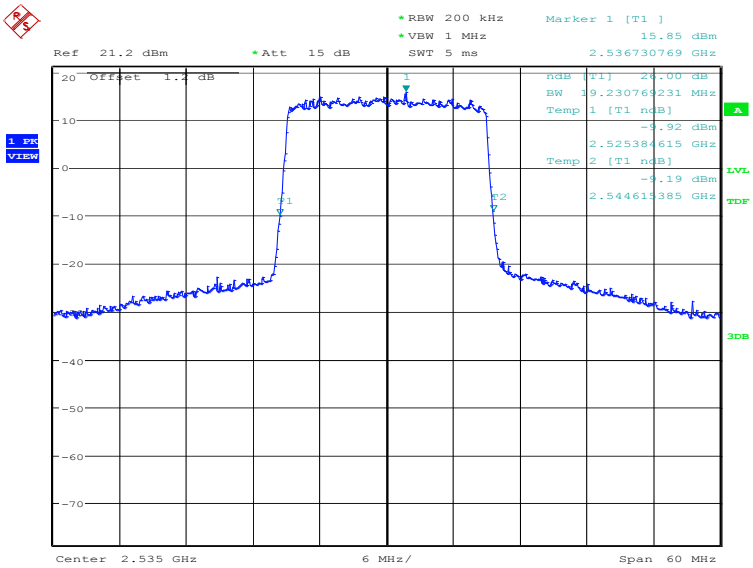


Date: 18.DEC.2019 14:25:47

LTE band 7, 20MHz (-26dBc)

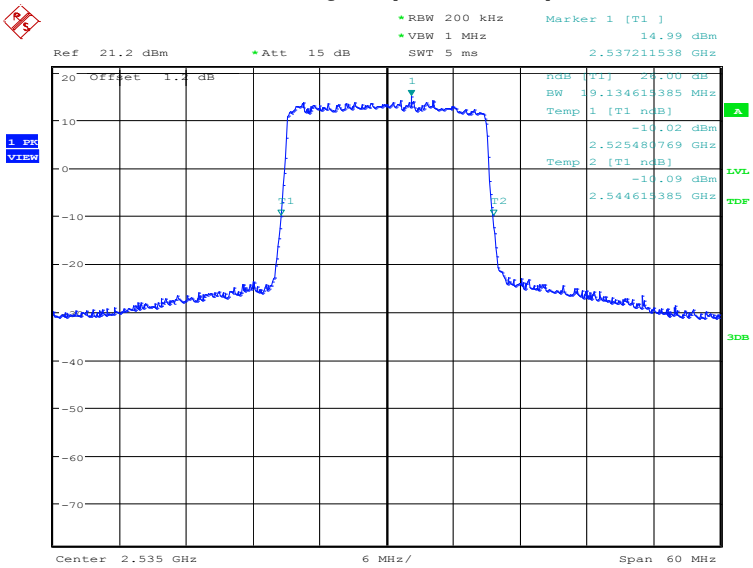
Frequency (MHz)	Occupied Bandwidth (-26dBc) (kHz)		
2535.0	QPSK	16QAM	64QAM
	19230.77	19134.62	19326.92

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



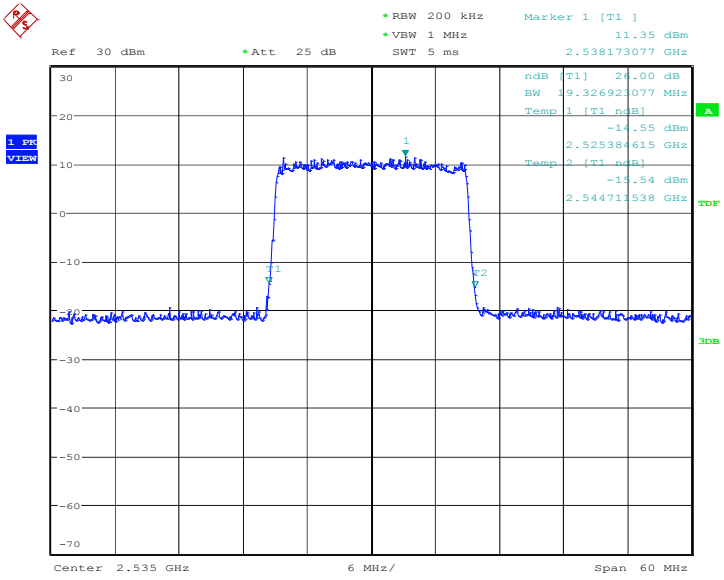
Date: 11.DEC.2019 01:12:34

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



Date: 11.DEC.2019 01:14:00

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



A.6 BAND EDGE COMPLIANCE

A.6.1 Measurement limit

Part 22.917 specifies that the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

According to KDB 971168, 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.

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.

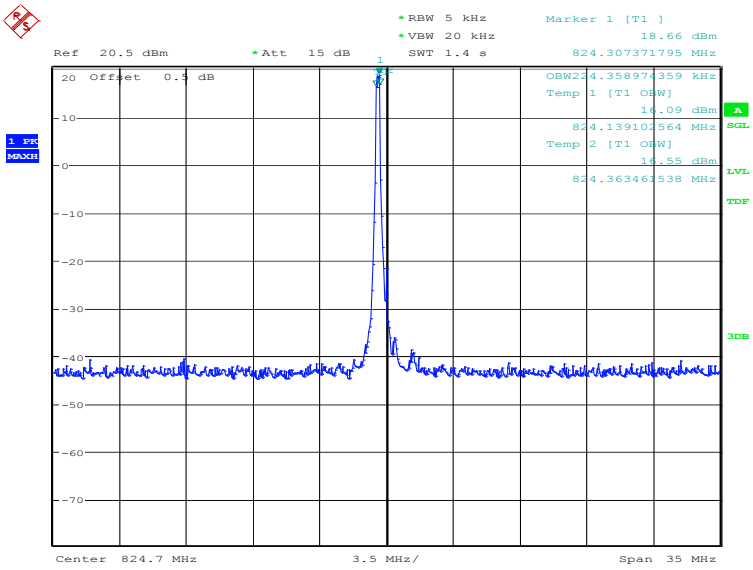
Part 27.53(m)(4) specifies for mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, 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.

A.6.2 Measurement result

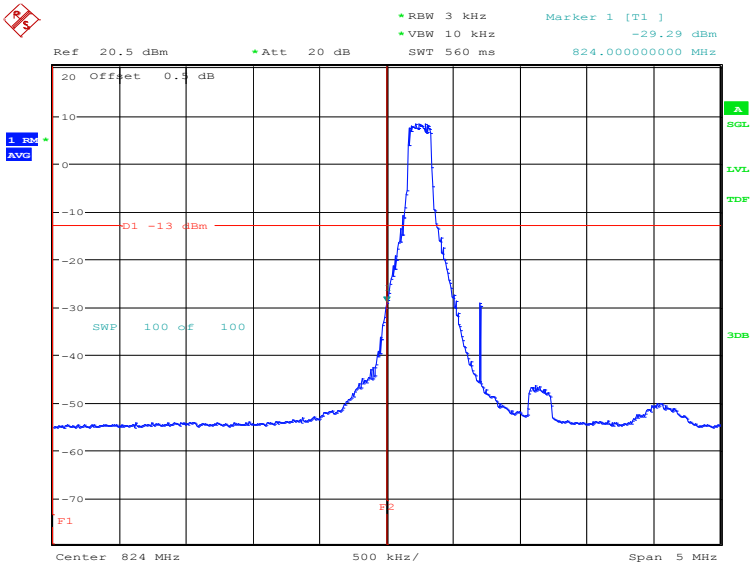
Only the worst case result is given below

LTE band 5

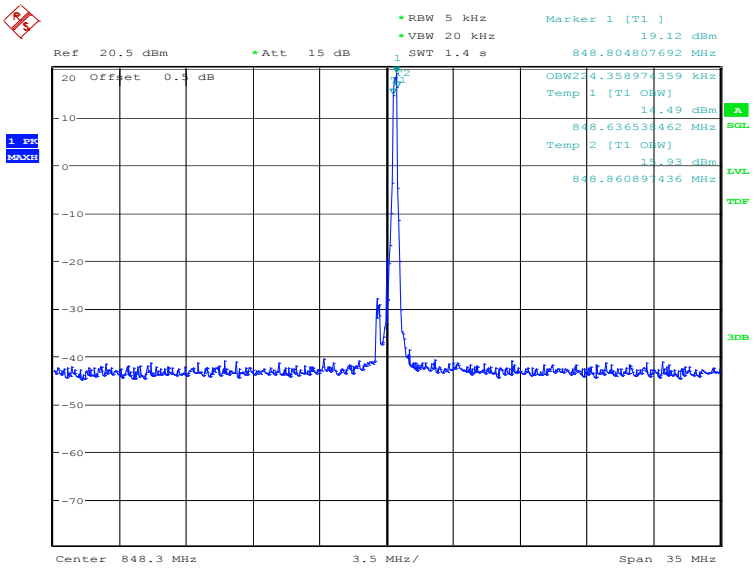
OBW: 1RB-low_offset



LOW BAND EDGE BLOCK-1RB-low_offset

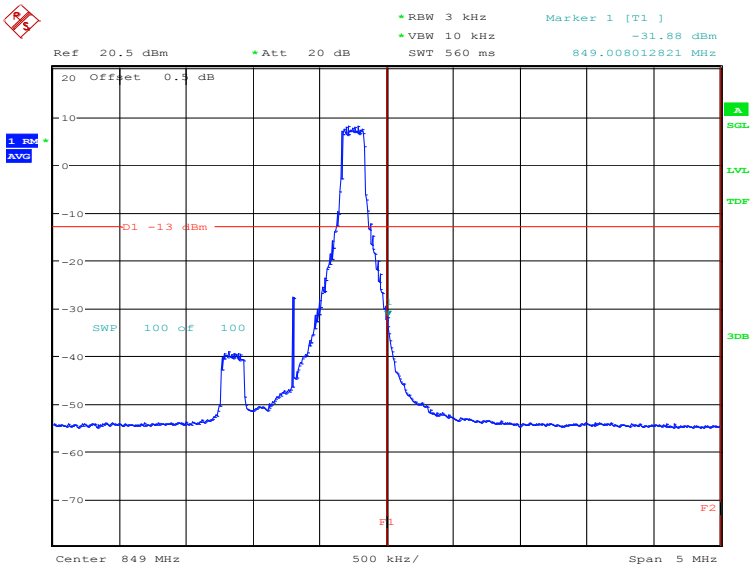


OBW: 1RB-high_offset



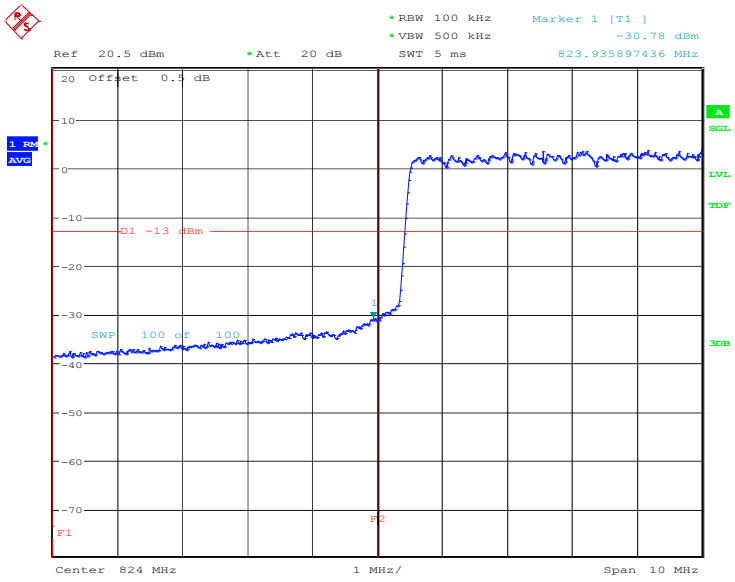
Date: 6.JAN.2020 10:04:30

HIGH BAND EDGE BLOCK-1RB-high_offset



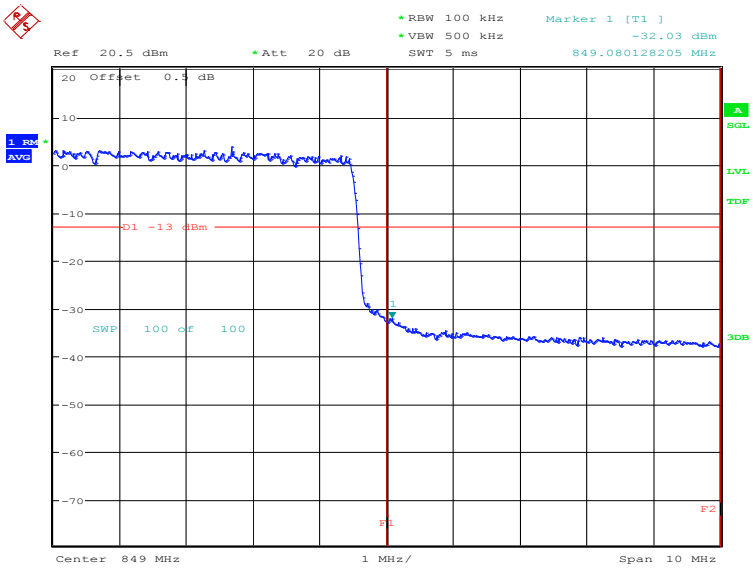
Date: 6.JAN.2020 10:06:09

LOW BAND EDGE BLOCK-10MHz-100%RB



Date: 9.JAN.2020 12:48:22

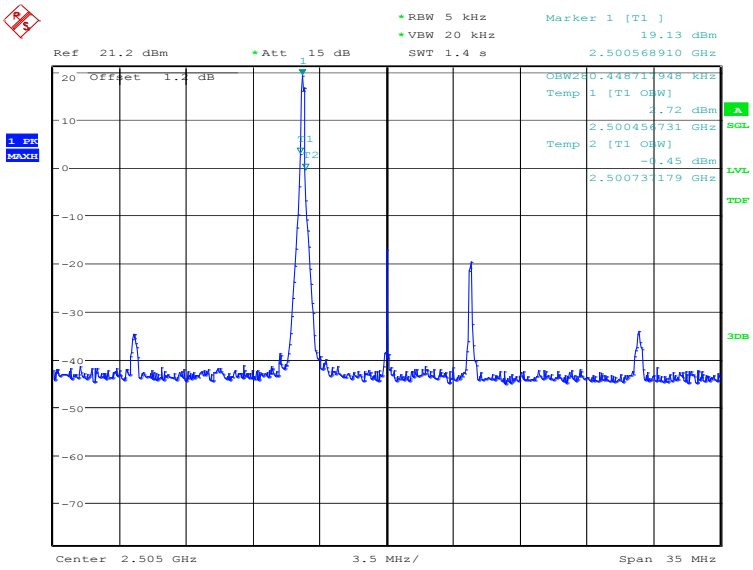
HIGH BAND EDGE BLOCK-10MHz-100%RB



Date: 6.JAN.2020 10:08:05

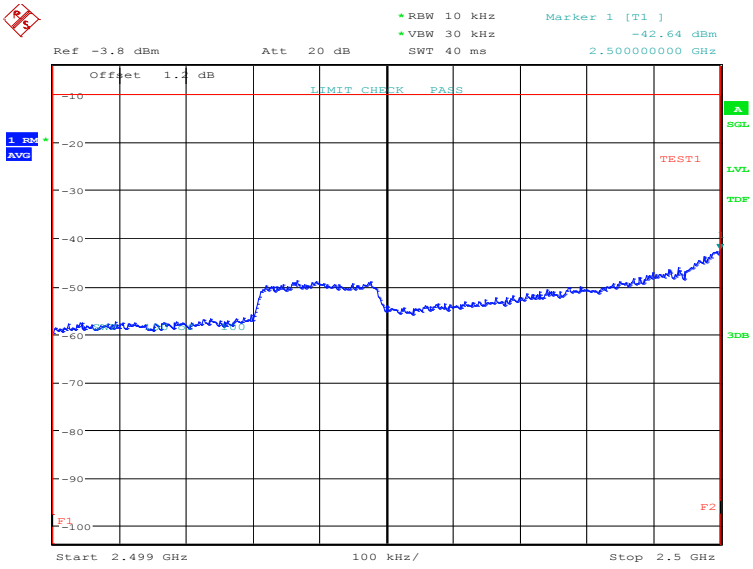
LTE band 7

OBW: 1RB-low_offset

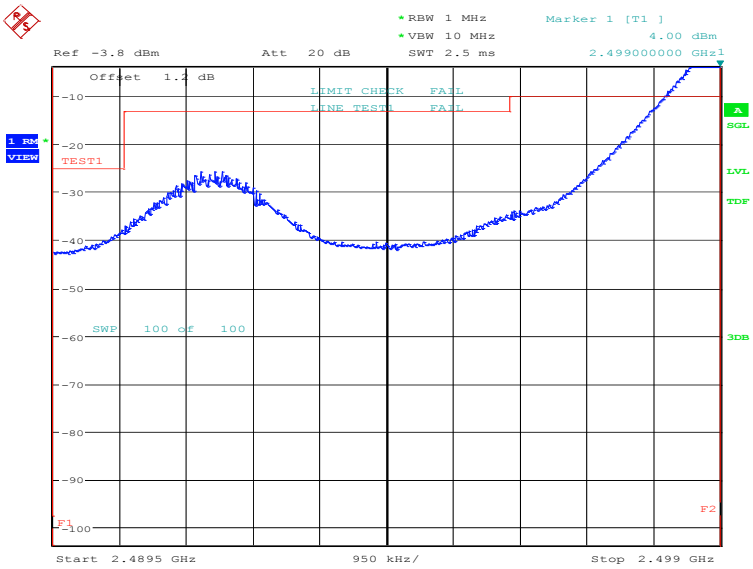


Date: 6.JAN.2020 10:09:26

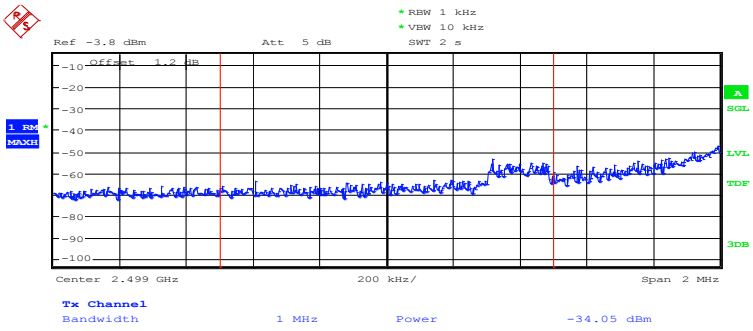
LOW BAND EDGE BLOCK-1RB-low_offset



Date: 6.JAN.2020 10:11:12

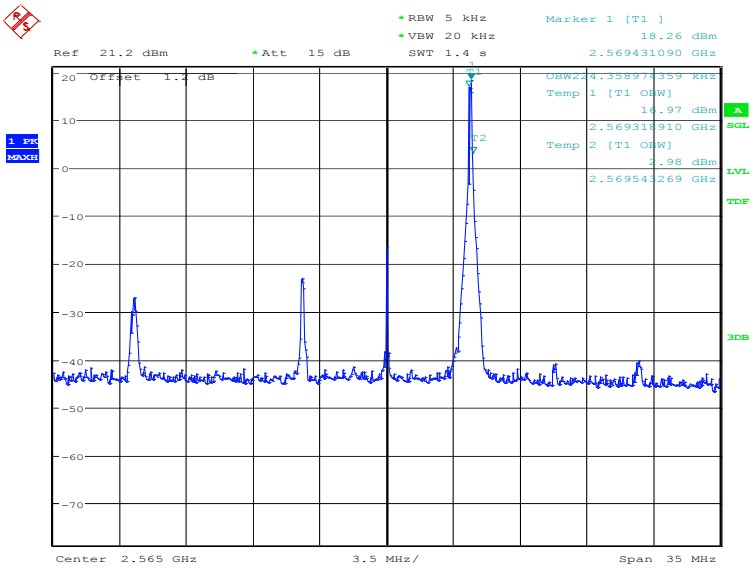


Date: 6.JAN.2020 10:12:55



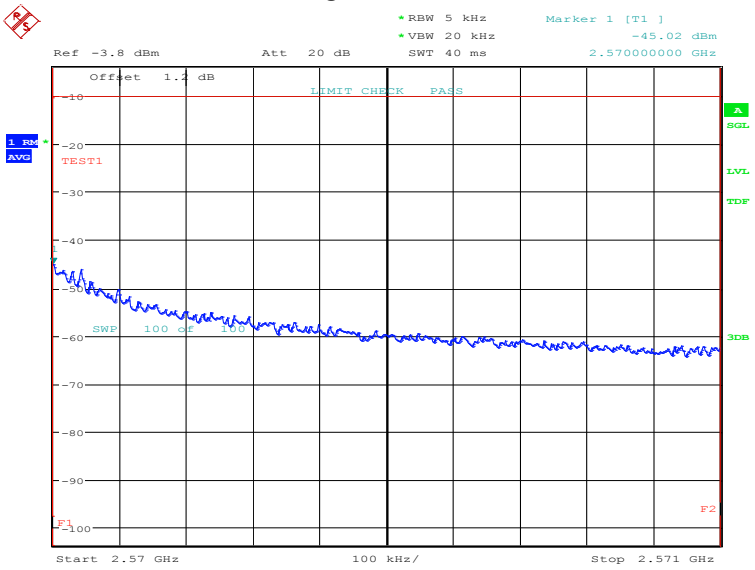
Date: 6.JAN.2020 10:13:07

OBW: 1RB-high_offset

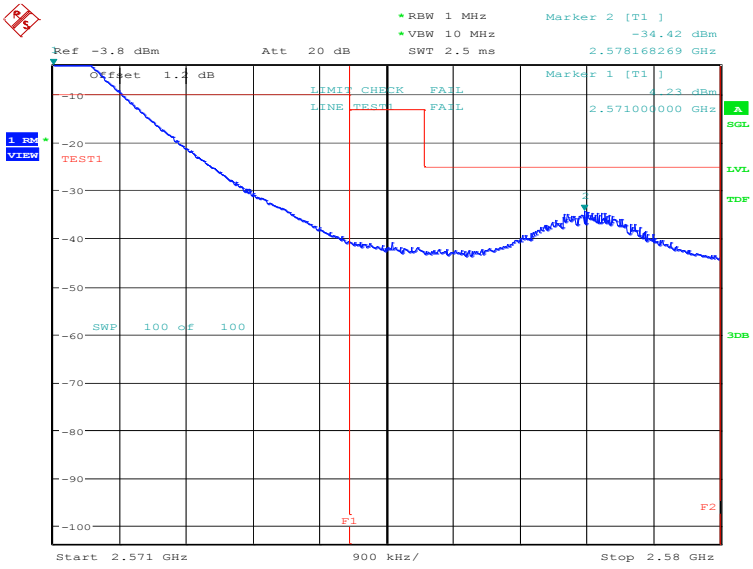


Date: 6.JAN.2020 10:18:48

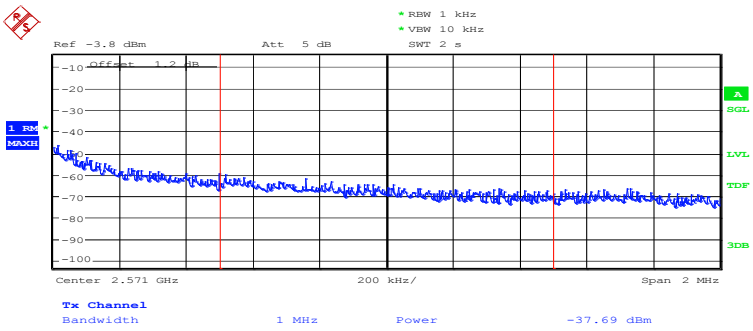
HIGH BAND EDGE BLOCK-1RB-high_offset



Date: 6.JAN.2020 10:20:35

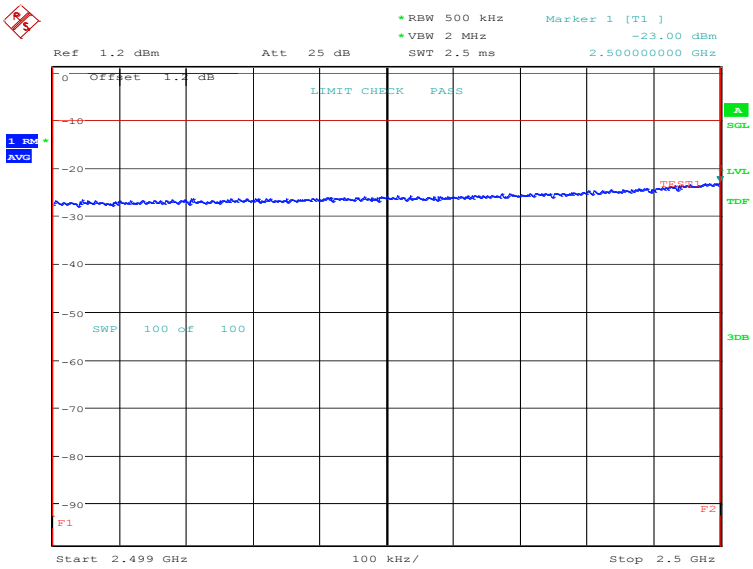


Date: 6.JAN.2020 10:22:20

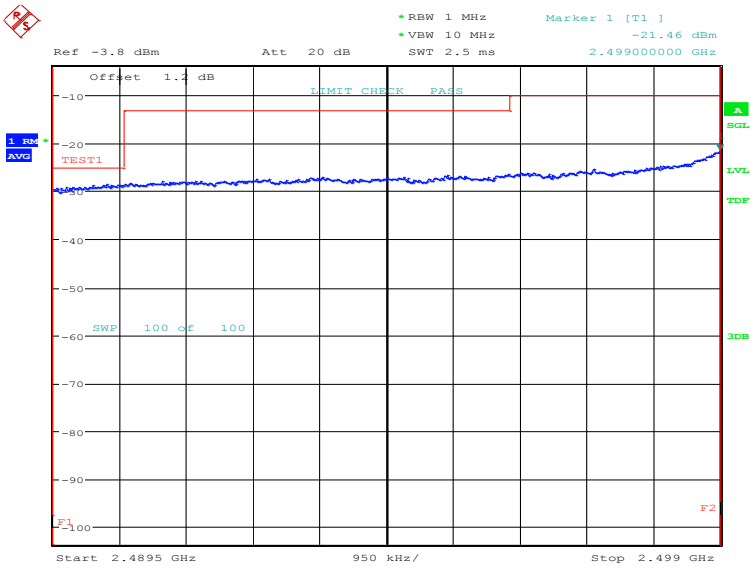


Date: 6.JAN.2020 10:22:33

LOW BAND EDGE BLOCK-20MHz-100%RB

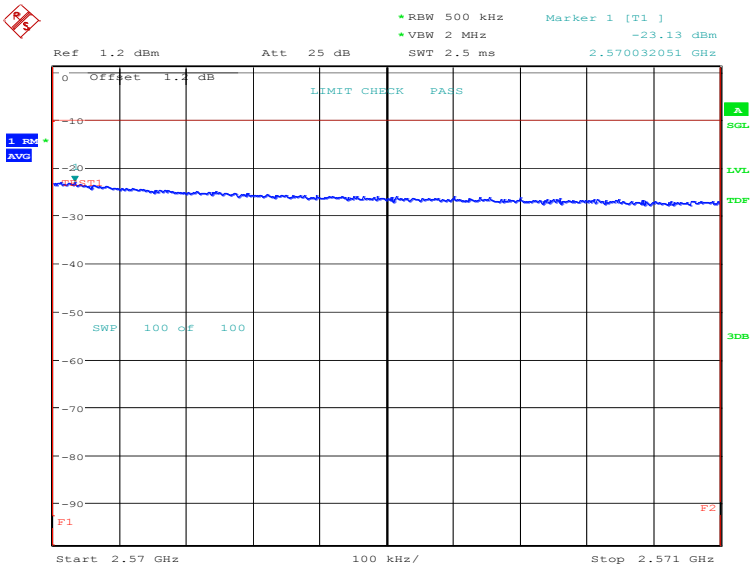


Date: 6.JAN.2020 10:15:06

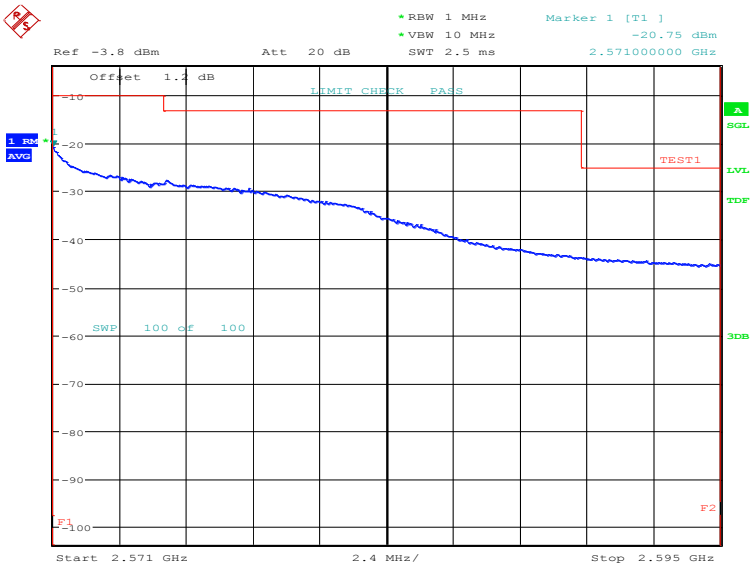


Date: 6.JAN.2020 10:16:47

HIGH BAND EDGE BLOCK-20MHz-100%RB



Date: 6.JAN.2020 10:24:32



Date: 6.JAN.2020 10:26:12

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. In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:
   (a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
   (b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
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 specifies that the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

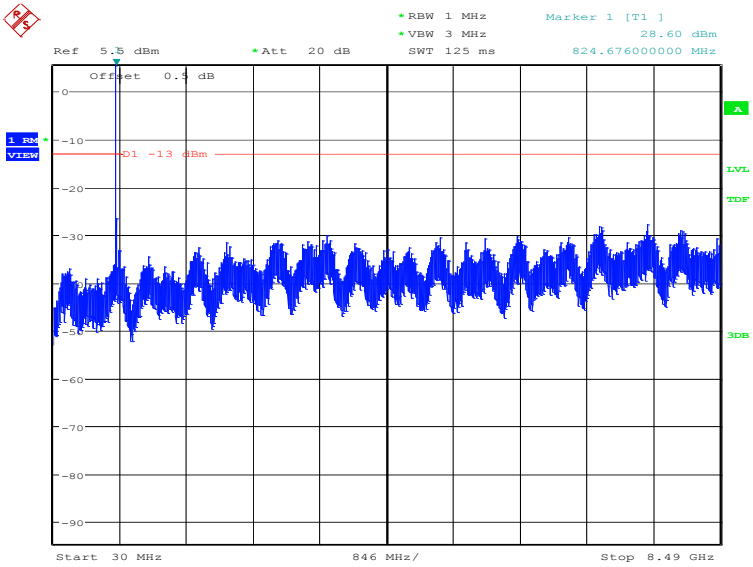
The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. 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.

A. 7.2 Measurement result

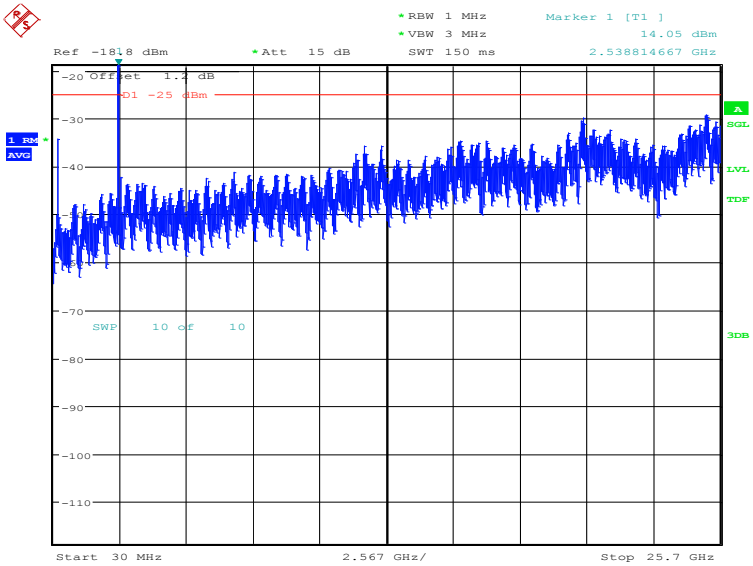
Only the worst case result is given below

LTE band 5: 30MHz – 8.49GHz



Date: 6.JAN.2020 10:50:22

LTE band 7: 30MHz – 25.7GHz



Date: 6.JAN.2020 10:51:40

A.8 PEAK-TO-AVERAGE POWER RATIO

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:

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 1ms;

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)		
2535.0	QPSK	16QAM	64QAM
	6.76	7.44	7.63

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).

2019-09-26 through 2020-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

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