TEST REPORT

No. I19N01941-RF-LTE

for

Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd

Tracker

Model Name: cp311A-CT

FCC ID: R38YLCP311A-CT

with

Hardware Version: V1.01

Software Version: 3.18.004.P0.190809.cp311A-CT

Issued Date: 2019-09-25

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 SAICT.

Test Laboratory:

Designation Number: CN1210

SAICT, Shenzhen Academy of Information and Communications Technology

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I19N01941-RF-LTE	Rev.0	1st edition	2019-09-25

CONTENTS

1. TEST LABORATORY

1.1. Testing Location

Company Name:	Shenzhen Academy of Information and Communications Technology
Address:	Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong, P. R. China
Postal Code:	518026
Telephone:	+86(0)755-33322000
Fax:	+86(0)755-33322001

1.2. Testing Environment

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

1.3. Project data

Testing Start Date:	2019-09-06
Testing End Date:	2019-09-16

1.4. Signature

Lai Minghua
(Prepared this test report)

Huang Qiuqin
(Reviewed this test report)

Zhang Hao
(Approved this test report)

2. CLIENT INFORMATION

2.1. Applicant Information

Company Name:	Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd
Address /Post:	Building B, Boton Science Park, Chaguang Road, Xili Town, Nanshan District, Shenzhen
Contact Person:	Yentl Chen
Contact Email	chenyanting@yulong.com
Telephone:	+86 15927320221
Fax:	/

2.2. Manufacturer Information

Company Name:	Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd
Address /Post:	Building B, Boton Science Park, Chaguang Road, Xili Town, Nanshan District, Shenzhen
Contact Person:	Yentl Chen
Contact Email	chenyanting@yulong.com
Telephone:	+86 15927320221
Fax:	/

3. EQUIPMENT UNDER TEST (EUT) AND ANCILLARY EQUIPMENT (AE)

3.1. About EUT

Description	Tracker
Model Name	cp311A-CT
FCC ID	R38YLCP311A-CT
Frequency Bands	LTE Bands 2,4,12,13
Antenna	Integrated
Extreme vol. Limits	3.6VDC to 4.2VDC (nominal: 3.8VDC)
Extreme temp. Tolerance	0°C to +40°C
Condition of EUT as received	No abnormality in appearance

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Sample Arrival Date
UT01aa	860778040000291	V1.01	3.18.004.P0.190809.cp311A-CT	2019-09-04
UT09aa	860778040000507	V1.01	3.18.004.P0.190809.cp311A-CT	2019-09-04

*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	Battery1
AE2	Charger1
AE3	Charger2

AE1

Model	Li-polymer
Manufacturer	Ningbo Veken
Capacitance	760mAh

AE2

Model	618045
Manufacturer	Shenzhen Kosun

AE3

Model	RD0501000-USBA-18MG
Manufacturer	Shenzhen RUIDE

*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 FDD-LTE tracker with integrated antenna. It consists of normal options: lithium battery, charger. Manual and specifications of the EUT were provided to fulfil the test.

4. REFERENCE DOCUMENTS

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

Reference	Title	Version
FCC Part 24	PERSONAL COMMUNICATIONS SERVICES	10-1-18 Edition
FCC Part 2	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS	10-1-18 Edition
FCC Part 27	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES	10-1-18 Edition
ANSI C63.26	American National Standard of Procedures for Compliance Testing of Licensed Transmitters Used in Licensed Radio Service	2015

5. LABORATORY ENVIRONMENT

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

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. =20 %, Max. = 80 %
Shielding effectiveness	> 110 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 4 Ω

Fully-anechoic chamber did not exceed following limits along the EMC testing

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 15 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz> 60 dB; 1MHz-18000MHz>90 dB
Electrical insulation	> 2MΩ
Ground system resistance	< 4 Ω
Voltage Standing Wave Ratio （VSWR）	≤ 6 dB, from 1 to 18 GHz，3 m distance
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

6. SUMMARY OF TEST RESULTS

Abbreviations used in this clause:		
Verdict Column	P	Pass
	F	Fail
	NA	Not applicable
	NM	Not measured
Location Column	A/B/C/D	The test is performed in test location A, B, C or D which are described in section 1.1 of this report

LTE Band 2

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/24.232	A.1	P
2	Field Strength of Spurious Radiation	2.1053/24.238	A.2	P
3	Frequency Stability	2.1055/24.235	A.3	P
4	Occupied Bandwidth	2.1049/24.238	A.4	P
5	Emission Bandwidth	2.1049/24.238	A.5	P
6	Band Edge Compliance	2.1051/24.238	A.6	P
7	Conducted Spurious Emission	2.1051/24.238	A.7	P
8	Peak to Average Power Ratio	24.232	A.8	P

LTE Band 4

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/27.50(d)	A.1	P
2	Field Strength of Spurious Radiation	2.1053/27.53(h)	A.2	P
3	Frequency Stability	2.1055/27.54	A.3	P
4	Occupied Bandwidth	2.1049/27.53(g)	A.4	P
5	Emission Bandwidth	2.1049/27.53(g)	A.5	P
6	Band Edge Compliance	2.1051/27.53(h)	A.6	P
7	Conducted Spurious Emission	2.1051/27.53(h)	A.7	P
8	Peak to Average Power Ratio	27.50(d)	A.8	P

LTE Band 12

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/27.50(c)	A.1	P
2	Field Strength of Spurious Radiation	2.1053/27.53(g)	A.2	P
3	Frequency Stability	2.1055/27.54	A.3	P
4	Occupied Bandwidth	2.1049/27.53(g)	A.4	P
5	Emission Bandwidth	2.1049/27.53(g)	A.5	P
6	Band Edge Compliance	2.1051/27.53(g)	A.6	P
7	Conducted Spurious Emission	2.1051/27.53(g)	A.7	P
8	Peak to Average Power Ratio	27.50(a)	A.8	P

LTE Band 13

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/27.50(b)	A.1	P
2	Field Strength of Spurious Radiation	2.1053/27.53(c)	A.2	P
3	Frequency Stability	2.1055/27.54	A.3	P
4	Occupied Bandwidth	2.1049/27.53(c)	A.4	P
5	Emission Bandwidth	2.1049/27.53(c)	A.5	P
6	Band Edge Compliance	2.1051/27.53(c)	A.6	P
7	Conducted Spurious Emission	2.1051/27.53(c)	A.7	P
8	Peak to Average Power Ratio	27.50(a)	A.8	P

7. STATEMENT

Since the information of samples in this report is provided by the client, the laboratory is not respo nsible for the authenticity of sample information.
This report takes measured values as criterion of test conclusion. The test conlusion meets the li mit requirements.

8. TEST EQUIPMENTS UTILIZED

NO.	Description	Type	Manufacture	Series Number	Cal Due Date
1	Test Receiver	ESR7	R&S	101676	2019-11-28
2	BiLog Antenna	3142E	ETS	00224831	2021-05-17
3	Horn Antenna	3117	ETS-lindgren	00066577	2022-04-02
4	Horn Antenna	QSH-SL-18-26-S-20	Q-par	17013	2020-01-15
5	Antenna	BBHA 9120D	Schwarzbeck	1593	2019-12-11
6	Antenna	VUBA 9117	Schwarzbeck	207	2020-07-16
7	Antenna	QWH-SL-18-40-K-SG	Q-par	15979	2020-01-16
8	preamplifier	83017A	Agilent	MY39501110	/
9	Signal Generator	SMB100A	R&S	179725	2019-11-28
10	Fully Anechoic Chamber	FACT3-2.0	ETS-Lindgren	1285	2020-07-20
11	Spectrum Analyzer	FSV40	R&S	101192	2020-05-20
12	Universal Radio Communication Tester	CMW500	R&S	152499	2020-07-17
13	Universal Radio Communication Tester	CMW500	R&S	129146	2020-04-24
14	Spectrum Analyzer	FSU	R&S	101506	2019-12-13
15	Temperature Chamber	SH-241	ESPECs	92007516	2019-11-13
16	DC Power Supply	U3606A	Agilent Technologies	MY50450012	2019-11-13

Test software

Item	Name	Vesion
Radiated	EMC32	Version 10.01.00

ANNEX A: MEASUREMENT RESULTS

A.1 OUTPUT POWER

Reference

FCC: CFR Part 2.1046, 24.232, 27.50.

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.

This result contains peak output power and ERP/EIRP measurements for the EUT.

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 2

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
1.4MHz	1 RB high	1909.3	22.83	21.94
		1880.0	22.72	21.76
		1850.7	22.69	21.72
	1 RB low	1909.3	22.88	21.75
		1880.0	22.75	22.02
		1850.7	22.81	21.96
	50% RB mid	1909.3	22.39	21.43
		1880.0	22.48	21.49
		1850.7	22.47	21.46
	100% RB	1909.3	21.75	21.03
		1880.0	21.62	20.89
		1850.7	21.65	20.98
3MHz	1 RB high	1908.5	22.55	22.11
		1880.0	22.48	22.07
		1851.5	22.58	21.49
	1 RB low	1908.5	22.88	21.95
		1880.0	22.66	22.05
		1851.5	22.53	21.42
	50% RB mid	1908.5	21.72	20.93
		1880.0	21.67	20.87
		1851.5	21.68	20.75

	100% RB	1908.5	21.81	20.93
		1880.0	21.72	20.81
		1851.5	21.73	20.88
5MHz	1 RB high	1907.5	22.74	21.79
		1880.0	22.51	21.95
		1852.5	22.62	21.67
	1 RB low	1907.5	22.92	21.62
		1880.0	22.79	22.19
		1852.5	22.84	21.50
	50% RB mid	1907.5	21.89	20.96
		1880.0	21.81	21.01
		1852.5	21.89	21.09
	100% RB	1907.5	21.96	21.10
		1880.0	21.95	21.18
		1852.5	21.87	20.81
10MHz	1 RB high	1905.0	22.94	22.10
		1880.0	22.62	22.09
		1855.0	22.63	22.04
	1 RB low	1905.0	22.87	22.11
		1880.0	22.71	22.10
		1855.0	22.61	22.18
	50% RB mid	1905.0	21.86	20.88
		1880.0	21.78	20.98
		1855.0	21.92	21.06
	100% RB	1905.0	21.78	20.83
		1880.0	21.75	20.86
		1855.0	21.81	20.91
15MHz	1 RB high	1902.5	22.71	21.93
		1880.0	22.56	21.88
		1857.5	22.66	21.72
	1 RB low	1902.5	22.64	21.75
		1880.0	22.49	21.83
		1857.5	22.58	21.66
	50% RB mid	1902.5	21.83	20.88
		1880.0	21.76	20.83
		1857.5	21.81	20.91
	100% RB	1902.5	21.77	20.81
		1880.0	21.64	20.78
		1857.5	21.68	20.72

20MHz	1 RB high	1900.0	22.91	21.97
		1880.0	22.64	21.91
		1860.0	22.78	21.89
	1 RB low	1900.0	22.66	21.76
		1880.0	22.51	21.86
		1860.0	22.56	21.64
	50% RB mid	1900.0	21.81	20.93
		1880.0	21.75	20.88
		1860.0	21.78	20.81
	100% RB	1900.0	21.66	20.77
		1880.0	21.67	20.84
		1860.0	21.84	20.88

Note: Expanded measurement uncertainty is U = 0.488 dB, k = 1.96

LTE band 4

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
1.4MHz	1 RB high	1754.3	22.83	21.89
		1732.5	22.96	21.86
		1710.7	23.00	22.31
	1 RB low	1754.3	22.85	22.01
		1732.5	22.87	22.08
		1710.7	22.91	22.11
	50% RB mid	1754.3	22.48	21.46
		1732.5	22.43	21.47
		1710.7	22.47	21.48
	100% RB	1754.3	21.96	20.98
		1732.5	21.93	20.93
		1710.7	21.98	21.03
3MHz	1 RB high	1753.5	22.88	21.98
		1732.5	22.76	22.05
		1711.5	22.83	21.96
	1 RB low	1753.5	22.77	22.05
		1732.5	22.89	22.15
		1711.5	22.65	21.84
	50% RB mid	1753.5	21.91	21.11
		1732.5	21.77	21.09
		1711.5	21.86	21.08
	100% RB	1753.5	21.94	21.12
		1732.5	21.91	21.06
		1711.5	21.81	20.93
5MHz	1 RB high	1752.5	22.65	21.73
		1732.5	22.58	21.64
		1712.5	22.68	21.83
	1 RB low	1752.5	22.78	21.81
		1732.5	22.72	21.75
		1712.5	22.68	21.72
	50% RB mid	1752.5	21.94	21.01
		1732.5	21.86	20.86
		1712.5	21.78	20.91
	100% RB	1752.5	21.81	20.97
		1732.5	21.88	21.07
		1712.5	21.77	20.85
10MHz	1 RB high	1750.0	22.96	22.06
		1732.5	23.05	22.11

		1715.0	23.11	22.16
	1 RB low	1750.0	22.89	22.16
		1732.5	22.76	22.02
		1715.0	23.01	22.08
	50% RB mid	1750.0	22.03	20.95
		1732.5	21.91	20.93
		1715.0	21.87	20.98
	100% RB	1750.0	21.78	20.88
		1732.5	21.89	20.91
		1715.0	21.68	20.76
15MHz	1 RB high	1747.5	22.94	21.97
		1732.5	22.89	21.96
		1717.5	22.98	22.03
	1 RB low	1747.5	22.83	21.91
		1732.5	22.78	21.88
		1717.5	22.75	21.69
	50% RB mid	1747.5	21.96	21.01
		1732.5	21.92	20.98
		1717.5	21.88	20.84
	100% RB	1747.5	21.83	20.92
		1732.5	21.78	20.86
		1717.5	21.81	20.88
20MHz	1 RB high	1745.0	22.87	21.99
		1732.5	22.61	21.93
		1720.0	22.91	21.97
	1 RB low	1745.0	22.77	21.94
		1732.5	22.72	22.01
		1720.0	22.91	22.06
	50% RB mid	1745.0	21.93	20.97
		1732.5	21.88	20.96
		1720.0	21.76	20.69
	100% RB	1745.0	21.88	20.95
		1732.5	21.91	21.03
		1720.0	21.85	20.93

Note: Expanded measurement uncertainty is U = 0.488 dB, k = 1.96

LTE band 12

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
1.4MHz	1 RB high	715.3	23.45	22.30
		707.5	23.23	22.38
		699.7	23.29	22.19
	1 RB low	715.3	23.42	22.27
		707.5	23.18	22.18
		699.7	23.43	22.36
	50% RB mid	715.3	22.47	21.45
		707.5	22.38	21.44
		699.7	22.49	21.45
	100% RB	715.3	22.46	21.49
		707.5	22.30	21.20
		699.7	22.38	21.28
3MHz	1 RB high	714.5	23.46	22.48
		707.5	23.44	22.49
		700.5	23.01	22.29
	1 RB low	714.5	23.49	22.41
		707.5	23.35	22.43
		700.5	23.42	22.43
	50% RB mid	714.5	22.49	21.47
		707.5	22.38	21.45
		700.5	22.41	21.40
	100% RB	714.5	22.49	21.56
		707.5	22.40	21.44
		700.5	22.39	21.39
5MHz	1 RB high	713.5	23.49	22.44
		707.5	23.23	22.33
		701.5	23.07	22.18
	1 RB low	713.5	23.33	22.23
		707.5	23.04	22.09
		701.5	23.47	22.41
	50% RB mid	713.5	22.12	21.16
		707.5	22.08	21.05
		701.5	22.32	21.36
	100% RB	713.5	22.36	21.38
		707.5	22.03	21.09
		701.5	22.08	21.11
10MHz	1 RB high	711.0	23.06	22.16

		707.5	22.88	21.98
		704.0	23.11	22.27
	1 RB low	711.0	23.23	22.36
		707.5	23.18	22.21
		704.0	23.17	22.25
	50% RB mid	711.0	22.23	21.26
		707.5	22.02	21.05
		704.0	22.09	21.16
	100% RB	711.0	22.05	21.23
		707.5	21.96	21.02
		704.0	22.15	21.21

Note: Expanded measurement uncertainty is U = 0.488 dB, k = 1.96

LTE band 13

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
5MHz	1 RB high	784.5	22.93	21.69
		782.0	23.09	21.70
		779.5	22.94	21.44
	1 RB low	784.5	22.97	21.70
		782.0	23.11	22.34
		779.5	22.89	21.55
	50% RB mid	784.5	22.18	21.02
		782.0	22.20	21.16
		779.5	22.08	20.93
	100% RB	784.5	22.03	20.98
		782.0	22.05	21.18
		779.5	22.01	21.07
10MHz	1 RB high	782.0	22.86	22.12
	1 RB low	782.0	22.97	22.27
	50% RB mid	782.0	22.01	21.04
	100% RB	782.0	21.98	21.01

Note: Expanded measurement uncertainty is U = 0.488 dB, k = 1.96

A.1.3 Radiated

A.1.3.1 Description

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

Rule Part 24.232(b) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p. Peak power" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

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”.

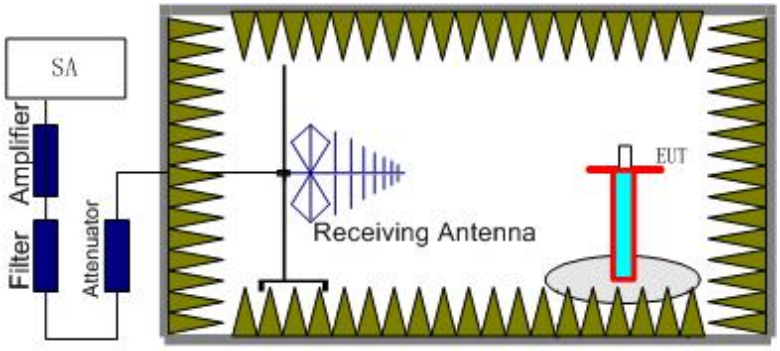
Rule Part 27.50(h)(2) specifies “Mobile stations are limited to 2.0 watts EIRP.”.

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

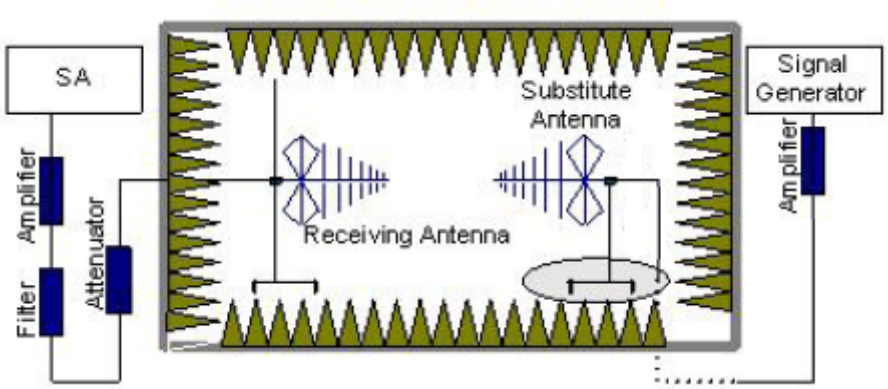
Rule Part 27.50(a)(3) specifies “For mobile and portable stations transmitting in the 2305–2315 MHz band or the 2350–2360 MHz band, the average EIRP must not exceed 50 milliwatts within any 1 megahertz of authorized bandwidth, except that for mobile and portable stations compliant with 3GPP LTE standards or another advanced mobile broadband protocol that avoids concentrating energy at the edge of the operating band the average EIRP must not exceed 250 milliwatts within any 5 megahertz of authorized bandwidth but may exceed 50 milliwatts within any 1 megahertz of authorized bandwidth.”

A.1.3.2 Method of Measurement

1. For radiated emissions measurements performed at frequencies less than or equal to 1 GHz, EUT was placed on a 80 cm high non-conductive stand at a 3 meter test distance from the receive antenna. For radiated measurements performed at frequencies above 1 GHz, EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. Receiving antenna was placed on the antenna mast 3 meters from the EUT. For emission measurements. The receiving antenna shall be varied from 1 m to 4 m in height above the reference ground in a search for the relative positioning that produces the maximum radiated signal level. 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 with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna and adjusts 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(dBi) (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 -2.15dB.

A.1.3.3 Measurement result

LTE Band 2- EIRP 24. 232(b)

Limits: ≤33dBm (2W)

LTE Band 2_1.4MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1850.70	-14.35	-29.30	10.00	24.95	33.00	H
1880.00	-15.35	-29.40	10.00	24.05	33.00	H
1909.30	-17.52	-29.30	10.00	21.78	33.00	H

LTE Band 2_3MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1851.50	-13.89	-29.30	10.00	25.41	33.00	H
1880.00	-15.35	-29.40	10.00	24.05	33.00	H
1908.50	-16.86	-29.30	10.00	22.44	33.00	H

LTE Band 2_5MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1852.50	-14.42	-29.30	10.00	24.88	33.00	H
1880.00	-15.89	-29.40	10.00	23.51	33.00	H
1907.50	-16.69	-29.30	10.00	22.61	33.00	H

LTE Band 2_10MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1855.00	-14.04	-29.30	10.00	25.26	33.00	H
1880.00	-15.60	-29.40	10.00	23.80	33.00	H
1905.00	-16.13	-29.30	10.00	23.17	33.00	H

LTE Band 2_15MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1857.50	-14.02	-29.30	10.00	25.28	33.00	H
1880.00	-14.12	-29.40	10.00	25.28	33.00	H
1902.50	-16.67	-29.30	10.00	22.63	33.00	H

LTE Band 2_20 MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1860.00	-14.75	-29.30	10.00	24.55	33.00	H
1880.00	-14.56	-29.40	10.00	24.84	33.00	H
1900.00	-15.53	-29.30	10.00	23.77	33.00	H

LTE Band 2_1.4MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1850.70	-14.34	-29.30	10.00	24.96	33.00	H
1880.00	-15.32	-29.40	10.00	24.08	33.00	H
1909.30	-17.55	-29.30	10.00	21.75	33.00	H

LTE Band 2_3MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1851.50	-14.77	-29.30	10.00	24.53	33.00	H
1880.00	-15.32	-29.40	10.00	24.08	33.00	H
1908.50	-17.02	-29.30	10.00	22.28	33.00	H

LTE Band 2_5MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1852.50	-14.41	-29.30	10.00	24.89	33.00	H
1880.00	-15.84	-29.40	10.00	23.56	33.00	H
1907.50	-17.10	-29.30	10.00	22.20	33.00	H

LTE Band 2_10MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1855.00	-14.69	-29.30	10.00	24.61	33.00	H
1880.00	-15.62	-29.40	10.00	23.78	33.00	H
1905.00	-16.24	-29.30	10.00	23.06	33.00	H

LTE Band 2_15MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1857.50	**-13.86**	**-29.30**	**10.00**	**25.44**	**33.00**	**H**
1880.00	-15.48	-29.40	10.00	23.92	33.00	H
1902.50	-16.32	-29.30	10.00	22.98	33.00	H

LTE Band 2_20 MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1860.00	-14.21	-29.30	10.00	25.09	33.00	H
1880.00	-14.72	-29.40	10.00	24.68	33.00	H
1900.00	-15.08	-29.30	10.00	24.22	33.00	H

Peak EIRP (dBm)=P_{Mea}(-13.86dBm)-(P_{cl}+P_{Ag})(-29.30dB)+G_a(10.00dB) =25.44dBm

LTE Band 4- EIRP 27.50(d)

Limits: ≤30dBm (1W)

LTE Band 4_1.4MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1710.70	-18.70	-29.60	7.90	18.80	30.00	H
1732.50	-16.88	-29.60	7.90	20.62	30.00	H
1754.30	-14.54	-29.50	7.90	22.86	30.00	H

LTE Band 4_3MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1711.50	-17.93	-29.60	7.90	19.57	30.00	H
1732.50	-12.42	-29.60	7.90	25.08	30.00	H
1753.50	**-10.53**	**-29.50**	**7.90**	**26.87**	**30.00**	**H**

LTE Band 4_5MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1712.50	-13.95	-29.60	7.90	23.55	30.00	H
1732.50	-12.00	-29.60	7.90	25.50	30.00	H
1752.50	-11.08	-29.50	7.90	26.32	30.00	H

LTE Band 4_10MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1715.00	-13.99	-29.60	7.90	23.51	30.00	H
1732.50	-12.69	-29.60	7.90	24.81	30.00	H
1750.00	-11.38	-29.50	7.90	26.02	30.00	H

LTE Band 4_15MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1717.50	-16.62	-29.60	7.90	20.88	30.00	H
1732.50	-16.53	-29.60	7.90	20.97	30.00	H
1747.50	-15.17	-29.50	7.90	22.23	30.00	H

LTE Band 4_20MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1720.00	-16.52	-29.60	7.90	20.98	30.00	H
1732.50	-16.55	-29.60	7.90	20.95	30.00	H
1745.00	-15.98	-29.50	7.90	21.42	30.00	H

LTE Band 4_1.4MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1710.70	-17.28	-29.60	7.90	20.22	30.00	H
1732.50	-14.15	-29.60	7.90	23.35	30.00	H
1754.30	-13.62	-29.50	7.90	23.78	30.00	H

LTE Band 4_3MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1711.50	-16.76	-29.60	7.90	20.74	30.00	H
1732.50	-13.58	-29.60	7.90	23.92	30.00	H
1753.50	-16.42	-29.50	7.90	20.98	30.00	H

LTE Band 4_5MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1712.50	-17.31	-29.60	7.90	20.19	30.00	H
1732.50	-15.57	-29.60	7.90	21.93	30.00	H
1752.50	-15.92	-29.50	7.90	21.48	30.00	H

LTE Band 4_10MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1715.00	-14.50	-29.60	7.90	23.00	30.00	H
1732.50	-13.21	-29.60	7.90	24.29	30.00	H
1750.00	-12.54	-29.50	7.90	24.86	30.00	H

LTE Band 4_15MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1717.50	-14.59	-29.60	7.90	22.91	30.00	H
1732.50	-13.77	-29.60	7.90	23.73	30.00	H
1747.50	-12.25	-29.50	7.90	25.15	30.00	H

LTE Band 4_20MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1720.00	-13.81	-29.60	7.90	23.69	30.00	H
1732.50	-13.57	-29.60	7.90	23.93	30.00	H
1745.00	-11.89	-29.50	7.90	25.51	30.00	H

Peak EIRP (dBm)=P_{Mea}(-10.53dBm)-(P_{cl}+P_{Ag})(-29.50dB)+G_a(7.90dB) =26.87dBm

LTE Band 12 - ERP 27.50(c)(10)

Limits: ≤34.77dBm (3W)

LTE Band 12_1.4MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
699.70	-19.05	-34.80	-0.80	2.15	12.80	34.77	H
707.50	-19.26	-34.70	-0.80	2.15	12.49	34.77	H
715.30	-18.44	-34.70	-0.80	2.15	13.31	34.77	H

LTE Band 12_3MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
700.50	-19.13	-34.80	-0.80	2.15	12.72	34.77	H
707.50	-19.61	-34.70	-0.80	2.15	12.14	34.77	H
714.50	-18.14	-34.70	-0.80	2.15	13.61	34.77	H

LTE Band 12_5MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
701.50	-19.29	-34.80	-0.80	2.15	12.56	34.77	H
707.50	-19.67	-34.70	-0.80	2.15	12.08	34.77	H
713.50	**-17.95**	**-34.70**	**-0.80**	**2.15**	**13.80**	**34.77**	**H**

LTE Band 12_10MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
704.00	-19.63	-34.80	-0.80	2.15	12.22	34.77	H
707.50	-19.01	-34.70	-0.80	2.15	12.74	34.77	H
711.00	-21.16	-34.70	-0.80	2.15	10.59	34.77	H

LTE Band 12_1.4MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
699.70	-18.75	-34.80	-0.80	2.15	13.10	34.77	H
707.50	-20.14	-34.70	-0.80	2.15	11.61	34.77	H
715.30	-18.35	-34.70	-0.80	2.15	13.40	34.77	H

LTE Band 12_3MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
700.50	-18.82	-34.80	-0.80	2.15	13.03	34.77	H
707.50	-20.44	-34.70	-0.80	2.15	11.31	34.77	H
714.50	-18.34	-34.70	-0.80	2.15	13.41	34.77	H

LTE Band 12_5MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
701.50	-18.64	-34.80	-0.80	2.15	13.21	34.77	H
707.50	-20.43	-34.70	-0.80	2.15	11.32	34.77	H
713.50	-18.16	-34.70	-0.80	2.15	13.59	34.77	H

LTE Band 12_10MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
704.00	-19.01	-34.80	-0.80	2.15	12.84	34.77	H
707.50	-19.40	-34.70	-0.80	2.15	12.35	34.77	H
711.00	-21.10	-34.70	-0.80	2.15	10.65	34.77	H

Peak ERP (dBm)=P_{Mea}(-17.95dBm)-(P_{cl}+P_{Ag})(-34.70dB)+G_a(-0.80dB) -2.15dB =13.80dBm

LTE Band 13- ERP 27.50(b)(10)

Limits: ≤34.77dBm (3W)

LTE Band 13_5MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
779.50	**-19.97**	**-34.00**	**-0.30**	**2.15**	**11.58**	**34.77**	**H**
782.00	-20.02	-34.00	-0.30	2.15	11.53	34.77	H
784.50	-20.31	-34.00	-0.30	2.15	11.24	34.77	H

LTE Band 13_10MHz_QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
782.00	-20.14	-34.00	-0.30	2.15	11.41	34.77	H
782.00	-20.29	-34.00	-0.30	2.15	11.26	34.77	H
782.00	-20.27	-34.00	-0.30	2.15	11.28	34.77	H

LTE Band 13_5MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
779.50	-21.15	-34.00	-0.30	2.15	10.40	34.77	H
782.00	-21.52	-34.00	-0.30	2.15	10.03	34.77	H
784.50	-20.82	-34.00	-0.30	2.15	10.73	34.77	H

LTE Band 13_10MHz_16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
782.00	-21.11	-34.00	-0.30	2.15	10.44	34.77	H
782.00	-21.10	-34.00	-0.30	2.15	10.45	34.77	H
782.00	-21.20	-34.00	-0.30	2.15	10.35	34.77	H

Peak ERP (dBm)=P_{Mea}(-19.97dBm)-(P_{cl}+P_{Ag})(-34.00dB)+G_a(-0.30dB) -2.15dB =11.58dBm

ANALYZER SETTINGS:

RBW = VBW = 8MHz for occupied bandwidths equal to or less than 5MHz.

RBW = VBW = 20MHz for occupied bandwidths equal to or greater than 10MHz.

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

Note: Both of Vertical and Horizontal polarizations are evaluated, but only the worst case is recorded in this report.

A.2 FIELD STRENGTH OF SPURIOUS RADIATION

Reference

FCC: CFR 2.1053, 24.238, 27.53.

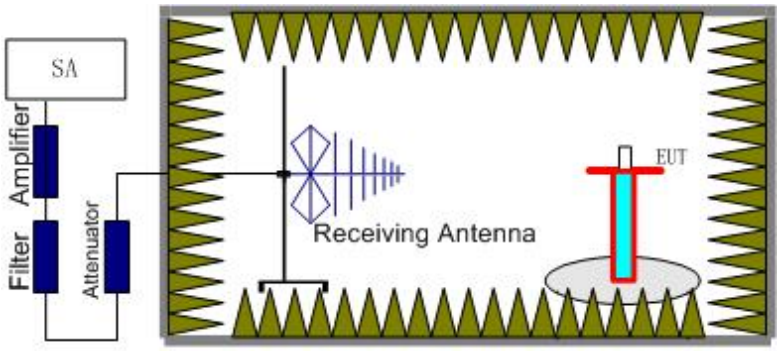
A.2.1 Measurement Method

This measurement is carried out in fully-anechoic chamber FAC-3.

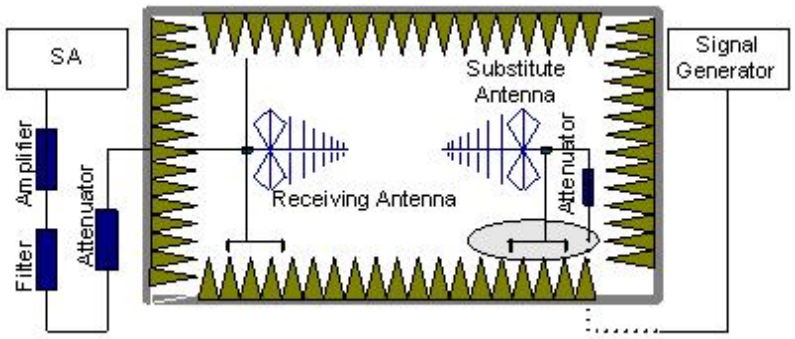
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier. The resolution bandwidth is set 1MHz as outlined in Part 24.238, Part 27.53(h). The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE Bands 2, 4, 12,13.

The procedure of radiated spurious emissions is as follows:

1. For radiated emissions measurements performed at frequencies less than or equal to 1 GHz, EUT was placed on a 80 cm high non-conductive stand at a 3 meter test distance from the receive antenna. For radiated measurements performed at frequencies above 1 GHz, EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. Receiving antenna was placed on the antenna mast 3 meters from the EUT. For emission measurements. The receiving antenna shall be varied from 1 m to 4 m in height above the reference ground in a search for the relative positioning that produces the maximum radiated signal level. 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, 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 and adjusts 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(dBi) (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 Results

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of the LTE Bands 2, 4, 12,13. 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 2, 4, 12, 13 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.
Only worst case result is given below.

LTE Band 2, 1.4MHz, QPSK, Channel 18607

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2812.27	-42.12	1.00	11.40	-31.72	-13.00	V
5551.00	-41.56	1.40	13.20	-29.76	-13.00	H
7401.50	-51.70	1.90	11.50	-42.10	-13.00	H
11101.50	-56.19	2.50	11.00	-47.69	-13.00	V
13336.00	-58.54	2.50	12.90	-48.14	-13.00	V
17034.00	-55.59	2.90	13.20	-45.29	-13.00	V

LTE Band 2, 1.4MHz, QPSK, Channel 18900

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2837.33	-42.44	1.00	11.40	-32.04	-13.00	V
5638.50	-45.14	1.30	13.20	-33.24	-13.00	H
7518.00	-53.21	1.80	11.50	-43.51	-13.00	H
11277.50	-54.18	2.50	11.00	-45.68	-13.00	V
15484.00	-59.69	2.40	15.50	-46.59	-13.00	V
16963.50	-55.37	2.90	13.20	-45.07	-13.00	V

LTE Band 2, 1.4MHz, QPSK, Channel 19193

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2910.93	-42.28	1.00	11.40	-31.88	-13.00	V
5727.00	-44.82	1.50	13.40	-32.92	-13.00	H
7635.50	-51.08	1.80	11.50	-41.38	-13.00	H
13024.50	-60.27	2.30	13.70	-48.87	-13.00	V
15090.50	-56.57	2.50	13.00	-46.07	-13.00	V
17115.00	-54.19	2.90	13.20	-43.89	-13.00	H

LTE Band 2, 1.4MHz, 16QAM, Channel 18607

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2913.87	-42.66	1.00	11.40	-34.41	-13.00	V
5551.00	-44.47	1.30	13.20	-34.72	-13.00	H
7401.00	-50.84	1.90	11.50	-43.39	-13.00	H
14523.00	-57.48	2.60	11.90	-50.33	-13.00	V
15499.00	-60.08	2.40	15.50	-49.13	-13.00	V
17142.00	-55.61	3.20	13.20	-47.76	-13.00	H

LTE Band 2, 1.4MHz, 16QAM, Channel 18900

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2895.20	-42.10	1.00	11.40	-33.85	-13.00	V
5639.00	-43.80	1.30	13.20	-34.05	-13.00	H
7518.50	-50.05	1.80	11.50	-42.50	-13.00	H
12366.50	-59.21	2.60	14.10	-49.86	-13.00	V
16127.00	-59.97	2.60	16.90	-47.82	-13.00	H
17556.00	-53.55	3.30	11.20	-47.80	-13.00	V

LTE Band 2, 1.4MHz, 16QAM, Channel 19193

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2920.00	-41.97	1.00	11.40	-33.72	-13.00	V
5726.50	-44.35	1.50	13.20	-34.80	-13.00	H
7635.50	-52.16	1.80	11.50	-44.61	-13.00	H
12231.00	-60.46	2.60	14.10	-51.11	-13.00	V
14472.50	-57.77	2.60	11.90	-50.62	-13.00	V
17181.00	-55.04	3.20	13.20	-47.19	-13.00	V

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

LTE Band 4, 1.4MHz QPSK, Channel 19957

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2911.20	-42.49	1.00	11.40	-32.09	-13.00	V
5131.00	-46.47	1.30	12.60	-35.17	-13.00	H
6841.00	-45.68	1.80	11.90	-35.58	-13.00	H
12928.00	-58.88	2.50	13.70	-47.68	-13.00	V
15298.00	-57.48	2.70	13.00	-47.18	-13.00	H
16859.50	-55.10	2.90	13.20	-44.80	-13.00	H

LTE Band 4, 1.4MHz, QPSK, Channel 20175

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2898.40	-41.97	1.00	11.40	-31.57	-13.00	V
3464.00	-56.37	1.10	12.30	-45.17	-13.00	H
5196.50	-37.62	1.60	12.60	-26.62	-13.00	H
6928.50	-43.34	1.80	11.90	-33.24	-13.00	H
15450.00	-59.58	2.40	15.50	-46.48	-13.00	H
17162.00	-55.79	3.20	13.20	-45.79	-13.00	H

LTE Band 4, 1.4MHz, QPSK, Channel 20393

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2909.07	-42.06	1.00	11.40	-31.66	-13.00	V
5261.50	-44.21	1.60	13.20	-32.61	-13.00	H
7015.50	-49.07	1.80	11.90	-38.97	-13.00	H
13632.00	-59.73	2.50	12.90	-49.33	-13.00	V
15285.00	-56.80	2.90	13.20	-46.50	-13.00	V
16932.00	-55.51	2.90	13.20	-45.21	-13.00	V

LTE Band 4, 1.4MHz, 16QAM, Channel 19957

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2817.33	-42.43	1.00	11.40	-34.18	-13.00	V
5130.50	-46.03	1.60	12.60	-37.18	-13.00	H
6841.00	-45.72	1.80	11.90	-37.77	-13.00	H
15942.00	-60.94	2.60	16.90	-48.79	-13.00	H
17040.00	-56.21	2.90	13.20	-48.06	-13.00	V
17880.50	-52.99	3.60	11.20	-47.54	-13.00	V

LTE Band 4, 1.4MHz, 16QAM, Channel 20175

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2914.40	-41.21	1.00	11.40	-32.96	-13.00	V
5196.00	-42.26	1.20	12.60	-33.01	-13.00	V
6928.00	-45.86	1.80	11.90	-37.91	-13.00	H
14645.50	-57.88	2.60	11.90	-50.73	-13.00	H
15980.00	-60.27	2.60	16.90	-48.12	-13.00	H
17145.50	-56.33	2.90	13.20	-48.18	-13.00	H

LTE Band 4, 1.4MHz, 16QAM, Channel 20393

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2910.13	-42.17	1.00	11.40	-33.92	-13.00	V
5262.00	-45.60	1.60	13.20	-36.15	-13.00	H
7015.50	-52.42	1.80	11.90	-44.47	-13.00	H
14508.50	-56.72	2.60	11.90	-49.57	-13.00	V
15808.00	-60.61	2.60	16.90	-48.46	-13.00	V
16729.00	-57.94	2.90	15.20	-47.79	-13.00	V

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

LTE Band 12, 1.4MHz, QPSK, Channel 23017

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2922.40	-41.53	1.00	11.40	-33.28	-13.00	V
4195.00	-60.37	1.20	12.60	-51.12	-13.00	H
4894.50	-61.43	1.40	12.60	-52.38	-13.00	H
6293.00	-60.41	1.60	12.80	-51.36	-13.00	H
6599.00	-62.58	1.70	12.80	-53.63	-13.00	V
9076.50	-61.71	2.10	12.00	-53.96	-13.00	V

LTE Band 12, 1.4MHz, QPSK, Channel 23095

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2944.80	-41.87	1.00	11.40	-33.62	-13.00	V
4242.50	-60.51	1.20	12.60	-51.26	-13.00	H
4950.00	-57.60	1.30	12.60	-48.45	-13.00	V
6363.50	-59.92	1.60	12.80	-50.87	-13.00	H
7282.00	-61.63	1.90	11.90	-53.78	-13.00	V
9170.50	-60.86	2.10	12.00	-53.11	-13.00	V

LTE Band 12, 1.4MHz, QPSK, Channel 23173

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2906.40	-41.80	1.00	11.40	-33.55	-13.00	V
4289.00	-60.24	1.20	12.70	-50.89	-13.00	H
5003.50	-57.82	1.30	12.60	-48.67	-13.00	H
6434.50	-57.88	1.60	12.80	-48.83	-13.00	H
8340.50	-62.48	1.80	12.40	-54.03	-13.00	V
9469.50	-60.55	2.10	11.90	-52.90	-13.00	H

LTE Band 12, 1.4MHz, 16QAM, Channel 23017

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2902.93	-42.00	1.00	11.40	-33.75	-13.00	V
4195.50	-61.00	1.20	12.60	-51.75	-13.00	H
4894.50	-61.95	1.40	12.60	-52.90	-13.00	V
6293.00	-60.82	1.60	13.40	-51.17	-13.00	H
7957.50	-61.94	1.90	11.50	-54.49	-13.00	H
9118.00	-62.24	2.10	12.00	-54.49	-13.00	V

LTE Band 12, 1.4MHz 16QAM, Channel 23095

Frequency(MHz)	PMea(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2836.53	-42.17	1.00	11.40	-33.92	-13.00	V
4242.50	-61.12	1.20	12.60	-51.87	-13.00	H
4949.00	-63.79	1.30	12.60	-54.64	-13.00	H
6363.50	-60.22	1.60	12.80	-51.17	-13.00	H
7269.50	-62.44	1.90	11.90	-54.59	-13.00	H
8738.00	-61.94	1.90	12.00	-53.99	-13.00	V

LTE Band 12, 1.4MHz, 16QAM, Channel 23173

Frequency(MHz)	PMea(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2811.73	-42.17	1.00	11.40	-33.92	-13.00	V
3574.00	-63.61	1.20	12.30	-54.66	-13.00	H
4289.00	-63.50	1.20	12.70	-54.15	-13.00	H
5003.50	-59.21	1.20	12.60	-49.96	-13.00	V
6434.00	-56.43	1.60	12.80	-47.38	-13.00	H
7918.00	-62.06	1.90	11.50	-54.61	-13.00	H

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

LTE Band 13, 5 MHz, QPSK, Channel 23205

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2918.13	-42.38	1.00	11.40	-34.13	-13.00	V
4248.00	-65.70	1.20	12.60	-56.45	-13.00	H
4793.50	-64.17	1.30	12.60	-55.02	-13.00	V
5441.50	-60.69	1.30	13.20	-50.94	-13.00	H
6218.50	-61.41	1.60	13.40	-51.76	-13.00	H
8043.50	-61.17	1.80	11.50	-53.62	-13.00	H

LTE Band 13, 5 MHz, QPSK, Channel 23230

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2977.87	-42.14	1.00	11.40	-33.89	-13.00	V
4532.50	-64.69	1.20	12.60	-55.44	-13.00	V
4992.00	-65.35	1.30	12.60	-56.20	-13.00	H
5459.50	-63.14	1.30	13.20	-53.39	-13.00	H
7024.50	-62.86	1.80	11.90	-54.91	-13.00	V
8344.00	-61.96	1.80	12.40	-53.51	-13.00	V

LTE Band 13, 5 MHz, QPSK, Channel 23255

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2924.27	-43.04	1.20	12.60	-33.79	-13.00	V
4028.00	-65.42	1.20	12.60	-56.17	-13.00	V
5476.00	-59.88	1.30	13.20	-50.13	-13.00	H
7041.50	-60.75	1.80	11.90	-52.80	-13.00	H
7933.50	-61.46	1.90	11.50	-54.01	-13.00	H
9923.00	-60.19	2.20	11.60	-52.94	-13.00	H

LTE Band 13, 5 MHz, 16QAM, Channel 23205

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2935.20	-42.14	1.00	11.40	-33.89	-13.00	V
4627.00	-63.96	1.30	12.70	-54.71	-13.00	V
5441.50	-60.77	1.30	13.20	-51.02	-13.00	H
6219.00	-58.89	1.60	13.40	-49.24	-13.00	H
6996.00	-61.23	1.80	11.90	-53.28	-13.00	H
9175.00	-61.61	2.10	12.00	-53.86	-13.00	V

LTE Band 13, 5 MHz, 16QAM, Channel 23230

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2986.40	-42.07	1.00	11.40	-33.82	-13.00	V
5459.00	-64.97	1.30	13.20	-55.22	-13.00	H
6521.50	-63.12	1.70	12.80	-54.17	-13.00	H
7279.00	-61.58	1.90	11.90	-53.73	-13.00	V
8349.00	-63.31	1.80	12.40	-54.86	-13.00	V
9127.00	-61.45	2.10	12.00	-53.70	-13.00	H

LTE Band 13, 5 MHz, 16QAM, Channel 23255

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2974.13	-41.71	1.00	11.40	-33.46	-13.00	V
4107.00	-64.95	1.20	12.60	-55.70	-13.00	V
4642.50	-64.50	1.30	12.70	-55.25	-13.00	V
5477.00	-60.19	1.30	13.20	-50.44	-13.00	H
7248.50	-60.71	1.90	11.90	-52.86	-13.00	H
8307.50	-61.91	1.80	12.40	-53.46	-13.00	V

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

A.3 FREQUENCY STABILITY

Reference

FCC: CFR Part 2.1055, 24.235, 27.54.

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 0℃.
3. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on middle channel, 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 5℃ increments from 0℃ to +40℃. 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 +40℃.
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 5 ℃ increments from +40℃ to 0℃. 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

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. 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 4.2VDC, with a nominal voltage of 3.8VDC. 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. These voltages represent a tolerance from -5.4% to 10.8%. For the purposes of measuring frequency stability these voltage limits are to be used.

A.4.3 Measurement results

LTE Band 2, 1.4MHz bandwidth (worst case of all bandwidths)

Frequency Error vs Voltage

Voltage (V)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
3.6	19	23	0.010	0.012
3.8	22	8	0.012	0.004
4.2	31	17	0.016	0.009

Frequency Error vs Temperature

Temperature (℃)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
0	27	9	0.014	0.005
5	14	11	0.007	0.006
10	8	14	0.004	0.007
15	15	15	0.008	0.008
20	16	22	0.009	0.012
25	33	31	0.018	0.016
30	29	16	0.015	0.009
35	24	7	0.013	0.004
40	17	12	0.009	0.006

Expanded measurement uncertainty is 10 Hz, k = 2

LTE Band 4, 1.4MHz bandwidth (worst case of all bandwidths)

Frequency Error vs Voltage

Voltage (V)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
3.6	23	11	0.013	0.006
3.8	15	25	0.009	0.014
4.2	8	9	0.005	0.005

Frequency Error vs Temperature

Temperature (℃)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
0	14	15	0.008	0.009
5	27	24	0.016	0.014
10	22	17	0.013	0.010
15	13	18	0.008	0.010
20	6	5	0.003	0.003
25	9	6	0.005	0.003
30	18	23	0.010	0.013
35	11	14	0.006	0.008
40	14	11	0.008	0.006

Expanded measurement uncertainty is 10Hz, k = 2

LTE Band 12, 1.4MHz bandwidth (worst case of all bandwidths)

Frequency Error vs Voltage

Voltage (V)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
3.6	12	16	0.017	0.023
3.8	14	31	0.020	0.044
4.2	7	27	0.010	0.038

Frequency Error vs Temperature

Temperature (℃)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
0	11	16	0.016	0.023
5	9	32	0.013	0.045
10	31	8	0.044	0.011
15	26	17	0.037	0.024
20	22	6	0.031	0.008
25	18	3	0.025	0.004
30	15	19	0.021	0.027
35	17	21	0.024	0.030
40	11	16	0.016	0.023

Expanded measurement uncertainty is 10Hz, k = 2

LTE Band 13, 5MHz bandwidth (worst case of all bandwidths)

Frequency Error vs Voltage

Voltage (V)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
3.6	12	22	0.015	0.028
3.8	14	18	0.018	0.023
4.2	19	13	0.024	0.017

Frequency Error vs Temperature

Temperature (℃)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
0	12	21	0.015	0.027
5	14	15	0.018	0.019
10	7	18	0.009	0.023
15	8	27	0.010	0.035
20	15	23	0.019	0.029
25	6	16	0.008	0.020
30	9	9	0.012	0.012
35	14	17	0.018	0.022
40	23	13	0.029	0.017

Expanded measurement uncertainty is 10Hz, k = 2

A.4 OCCUPIED BANDWIDTH

Reference

FCC: CFR Part 2.1049, 24.238, 27.53.

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.

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.

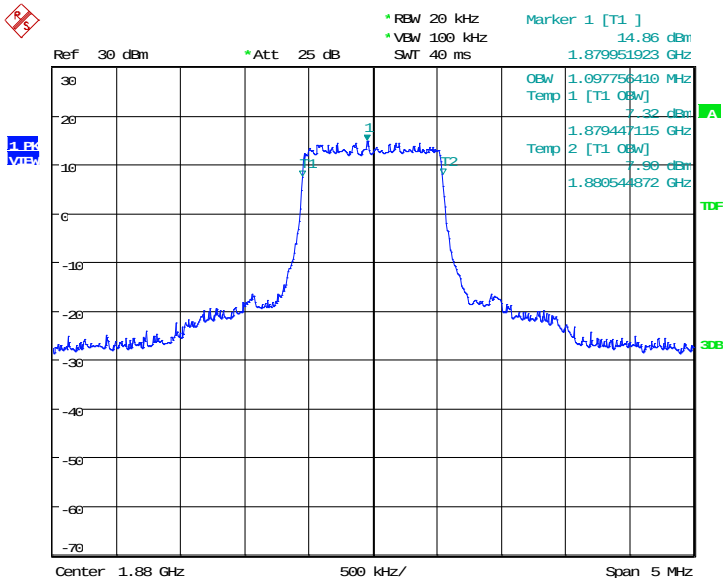
d) Set the detection mode to peak, and the trace mode to max hold.

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

LTE band 2, 1.4MHz (99% BW)

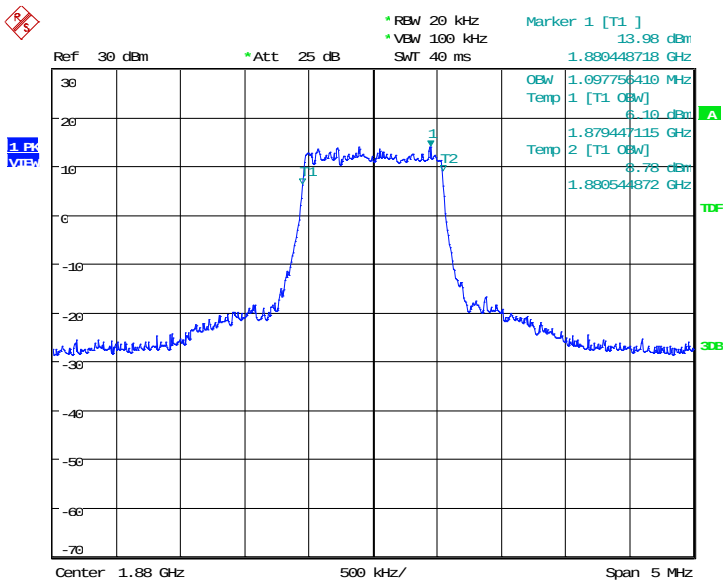
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1880.0	QPSK	16QAM
	1097.76	1097.76

LTE band 2, 1.4MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 08:24:22

LTE band 2, 1.4MHz Bandwidth, 16QAM (99% BW)

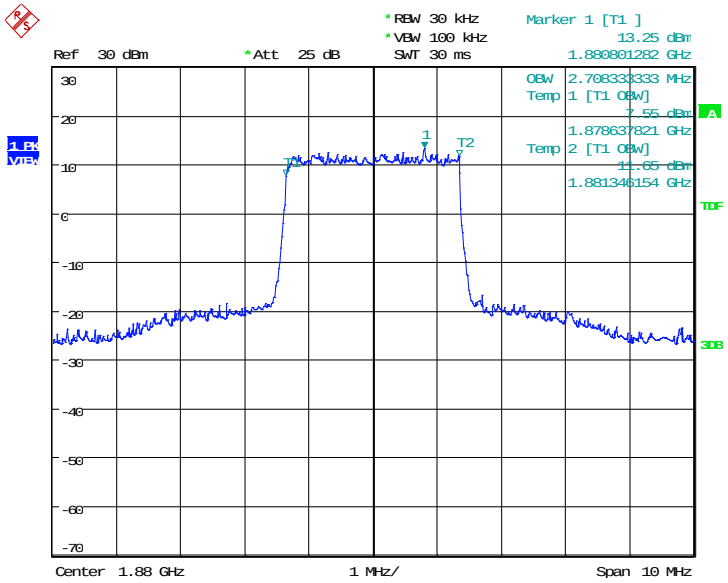


Date: 8.SEP.2019 08:24:36

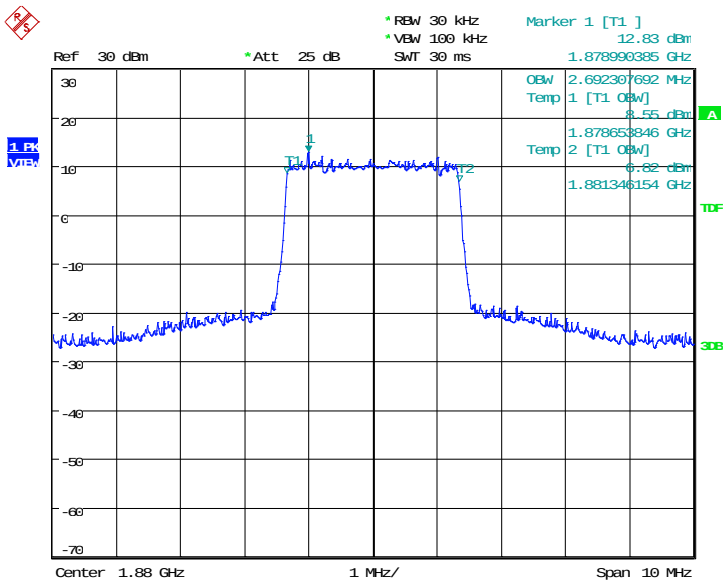
LTE band 2, 3MHz (99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1880.0	QPSK	16QAM
	2708.33	2692.31

LTE band 2, 3MHz Bandwidth, QPSK (99% BW)



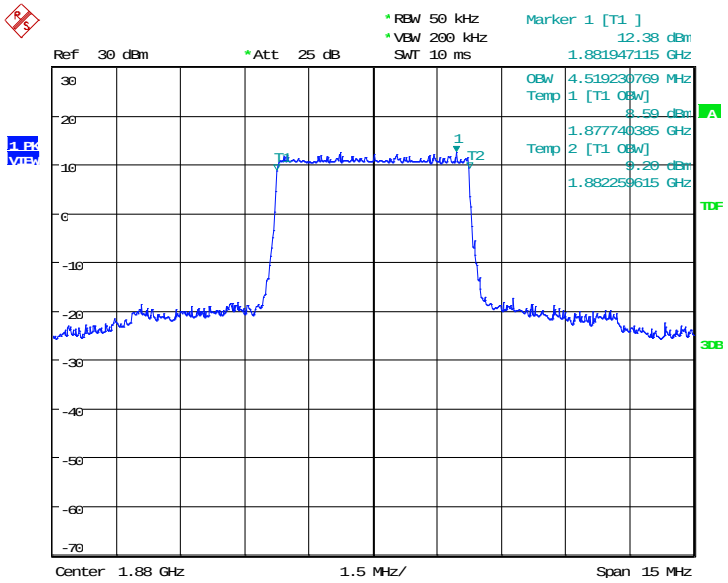
LTE band 2, 3MHz Bandwidth, 16QAM (99% BW)



LTE band 2, 5MHz (99% BW)

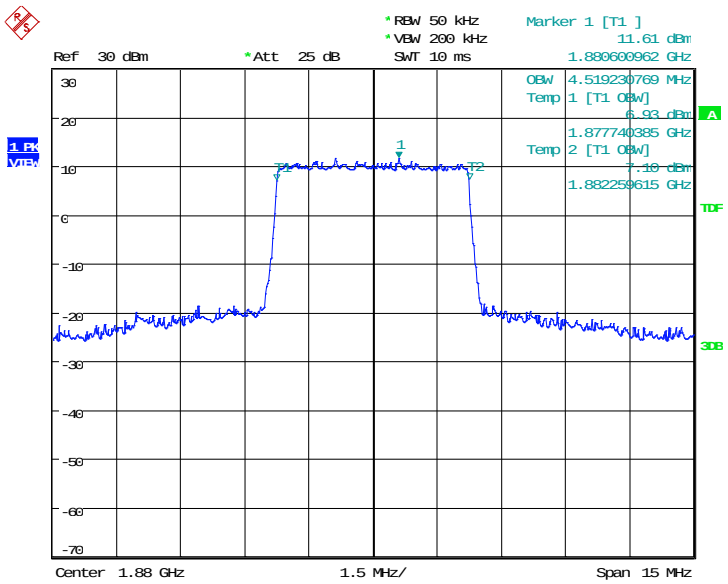
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1880.0	QPSK	16QAM
	4519.23	4519.23

LTE band 2, 5MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 08:35:14

LTE band 2, 5MHz Bandwidth,16QAM (99% BW)

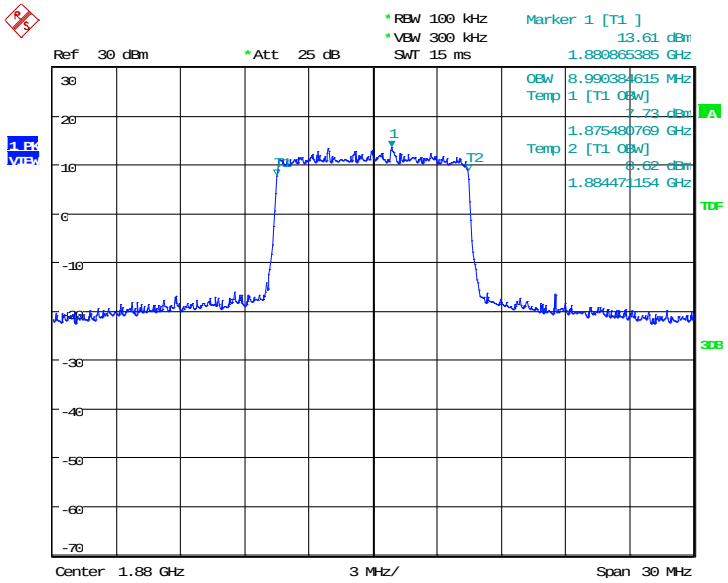


Date: 8.SEP.2019 08:35:28

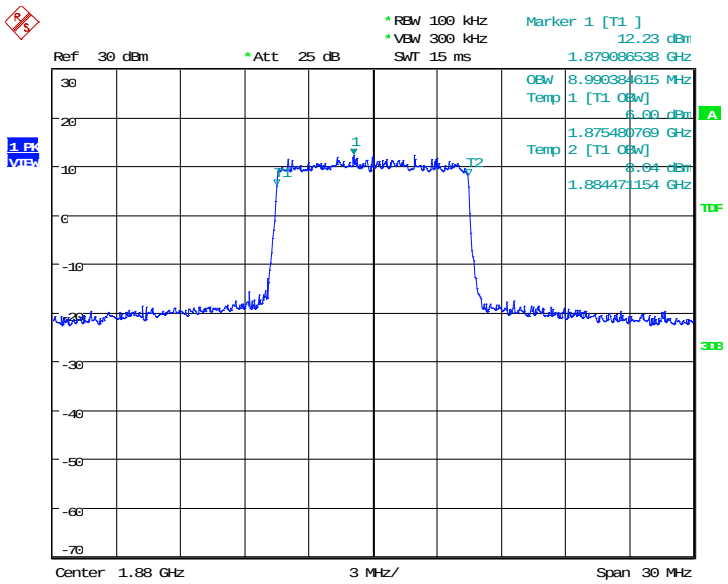
LTE band 2, 10MHz (99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1880.0	QPSK	16QAM
	8990.38	8990.38

LTE band 2, 10MHz Bandwidth, QPSK (99% BW)



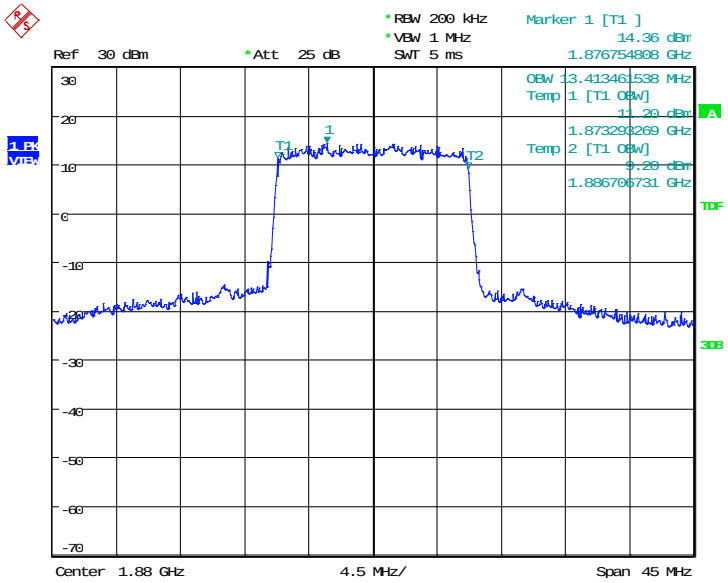
LTE band 2, 10MHz Bandwidth, 16QAM (99% BW)



LTE band 2, 15MHz (99% BW)

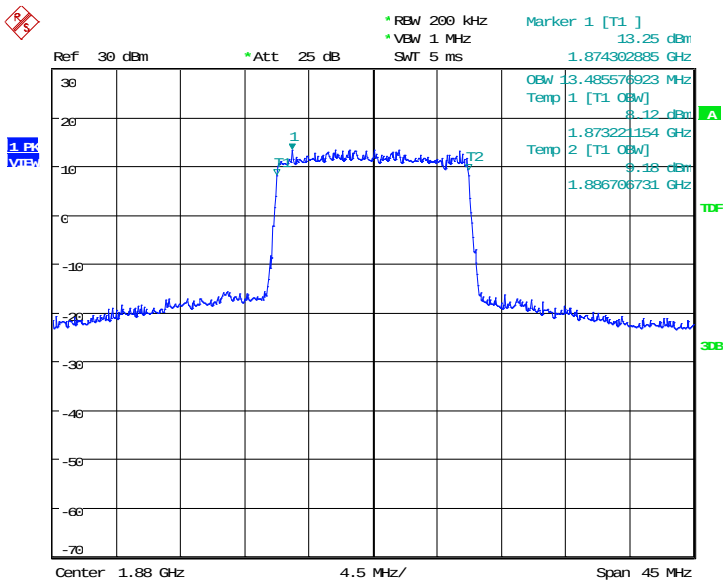
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1880.0	QPSK	16QAM
	13413.46	13485.58

LTE band 2, 15MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 08:46:09

LTE band 2, 15MHz Bandwidth, 16QAM (99% BW)

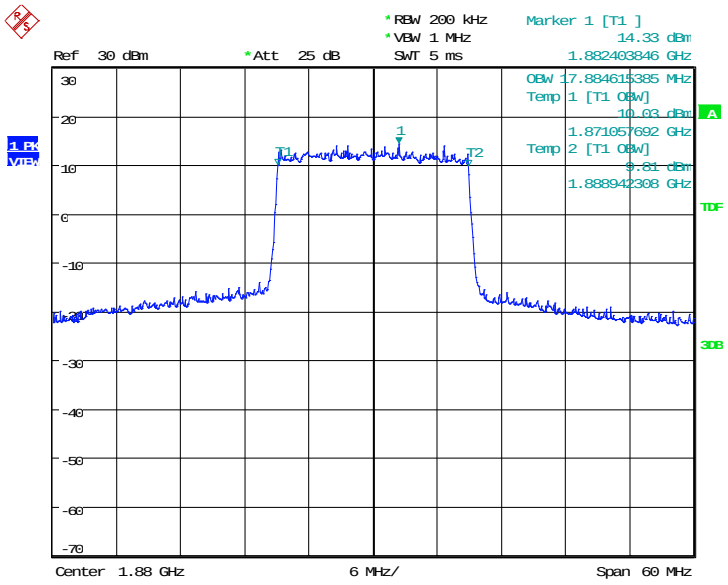


Date: 8.SEP.2019 08:46:23

LTE band 2, 20MHz (99% BW)

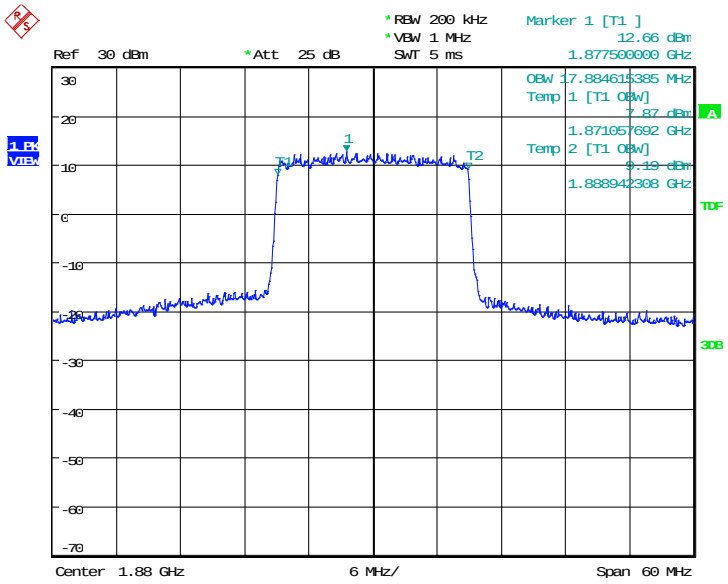
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1880.0	QPSK	16QAM
	17884.62	17884.62

LTE band 2, 20MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 08:51:38

LTE band 2, 20MHz Bandwidth, 16QAM (99% BW)

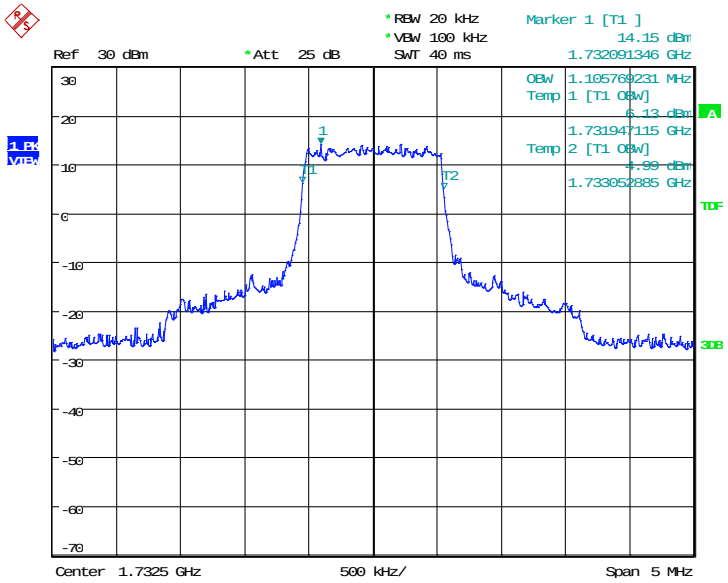


Date: 8.SEP.2019 08:51:51

LTE band 4, 1.4MHz (99% BW)

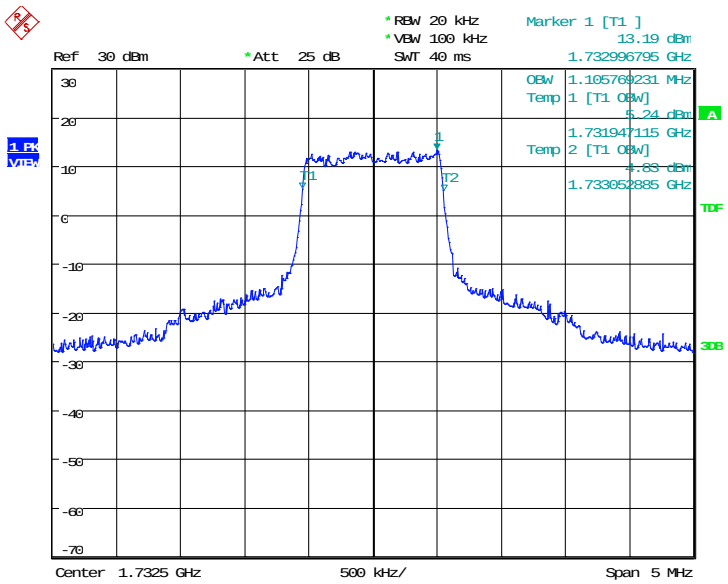
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1732.5	QPSK	16QAM
	1105.77	1105.77

LTE band 4, 1.4MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 08:57:41

LTE band 4, 1.4MHz Bandwidth, 16QAM (99% BW)

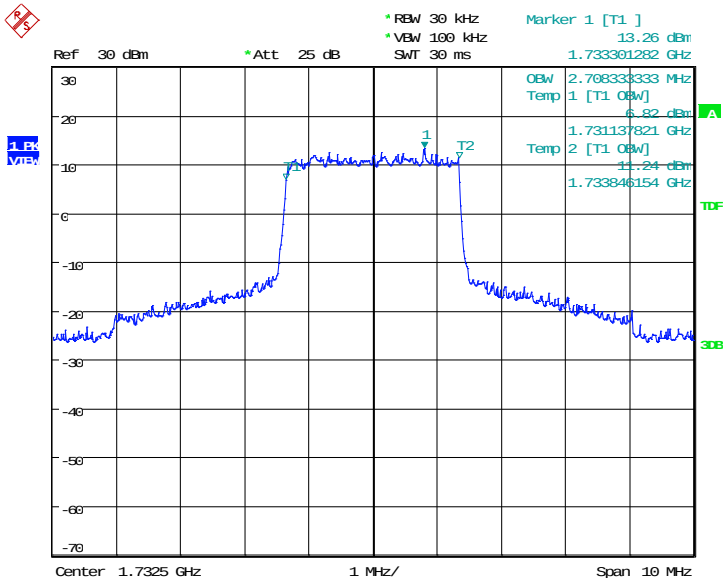


Date: 8.SEP.2019 08:57:54

LTE band 4, 3MHz (99% BW)

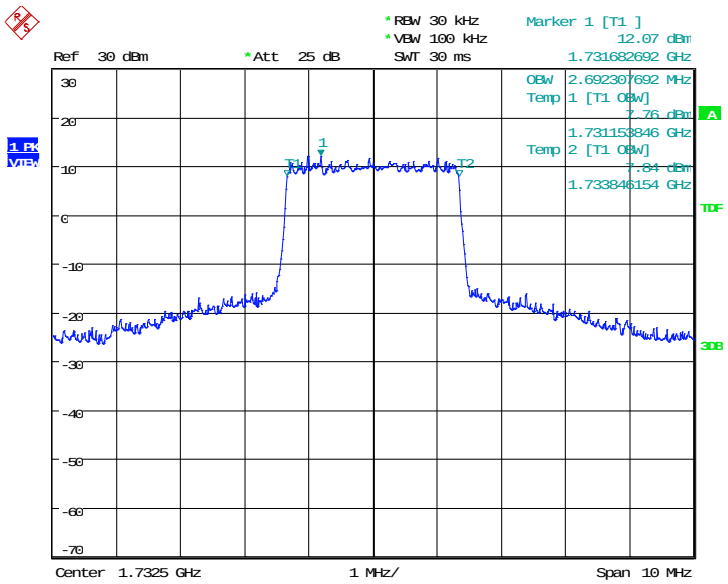
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1732.5	QPSK	16QAM
	2708.33	2692.31

LTE band 4, 3MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 09:03:09

LTE band 4, 3MHz Bandwidth, 16QAM (99% BW)

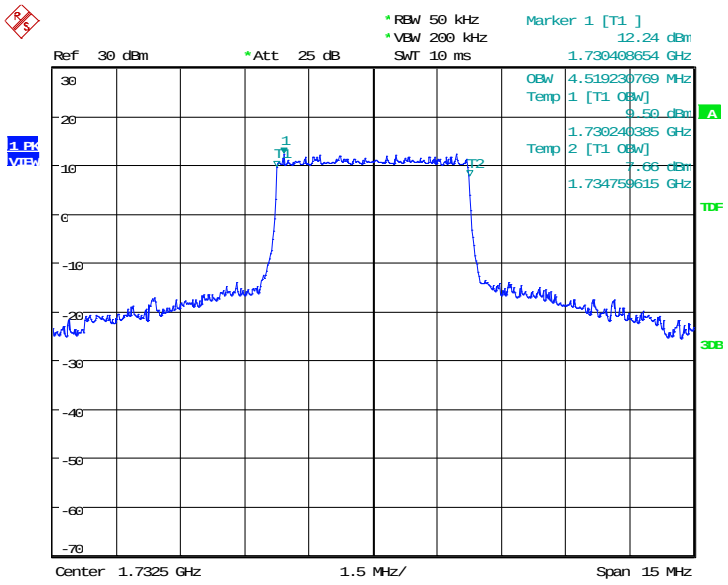


Date: 8.SEP.2019 09:03:22

LTE band 4, 5MHz (99% BW)

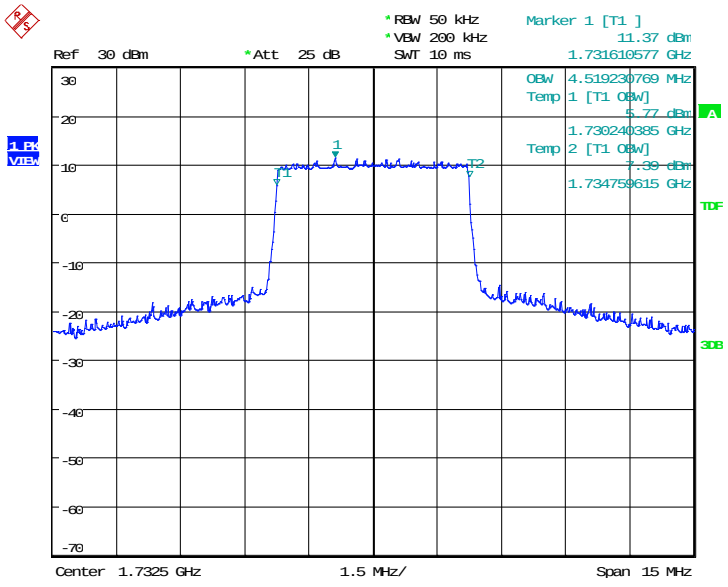
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1732.5	QPSK	16QAM
	4519.23	4519.23

LTE band 4, 5MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 09:08:35

LTE band 4, 5MHz Bandwidth,16QAM (99% BW)

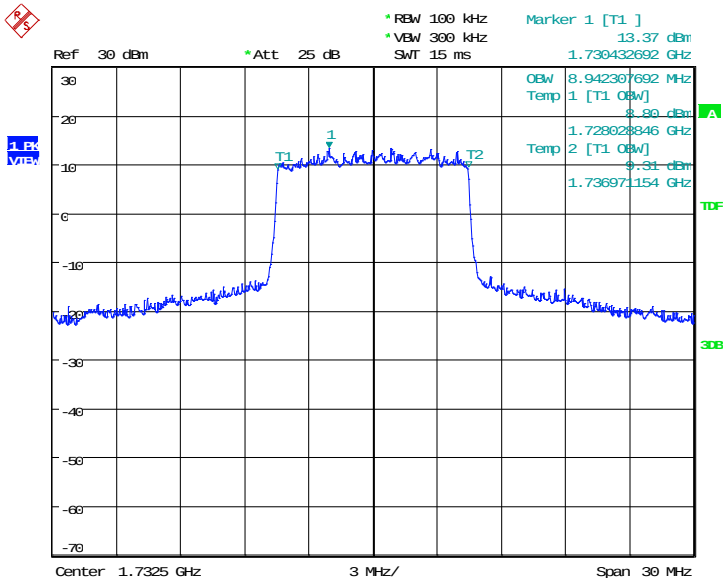


Date: 8.SEP.2019 09:08:48

LTE band 4, 10MHz (99% BW)

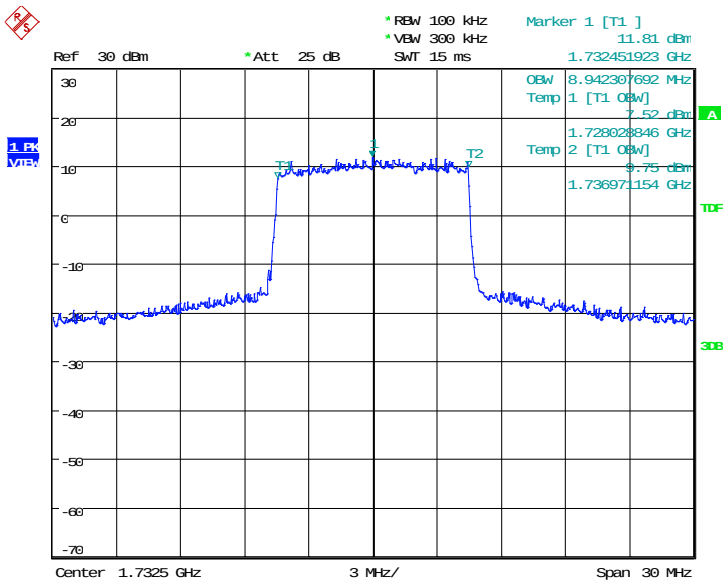
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1732.5	QPSK	16QAM
	8942.31	8942.31

LTE band 4, 10MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 09:14:03

LTE band 4, 10MHz Bandwidth, 16QAM (99% BW)

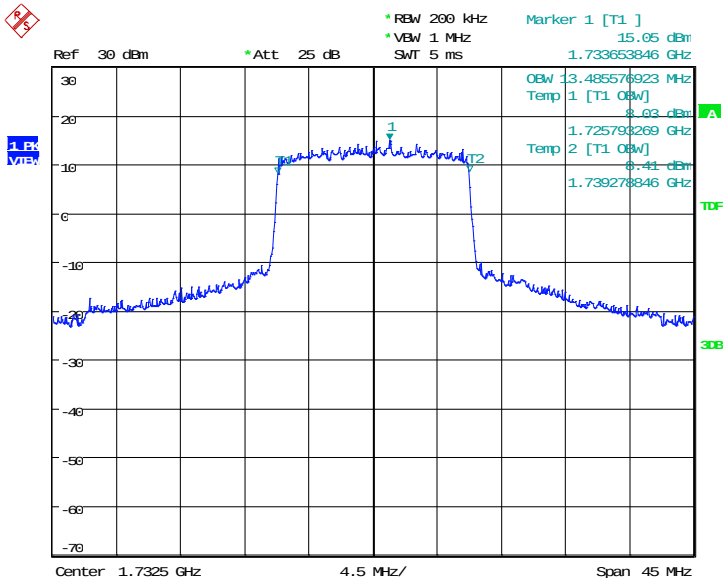


Date: 8.SEP.2019 09:14:17

LTE band 4, 15MHz (99% BW)

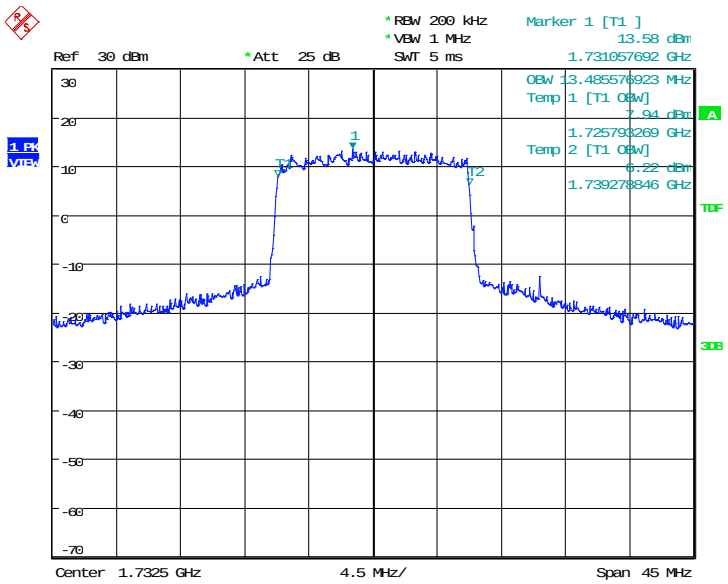
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1732.5	QPSK	16QAM
	13485.58	13485.58

LTE band 4, 15MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 09:19:29

LTE band 4, 15MHz Bandwidth, 16QAM (99% BW)

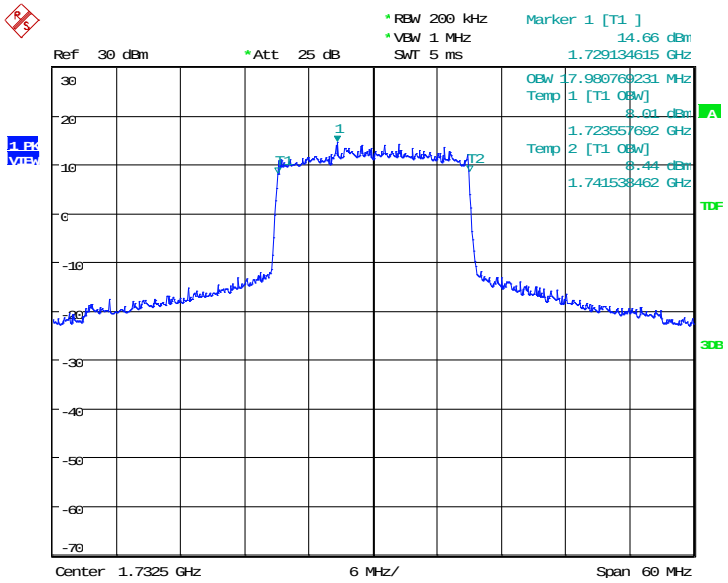


Date: 8.SEP.2019 09:19:43

LTE band 4, 20MHz (99% BW)

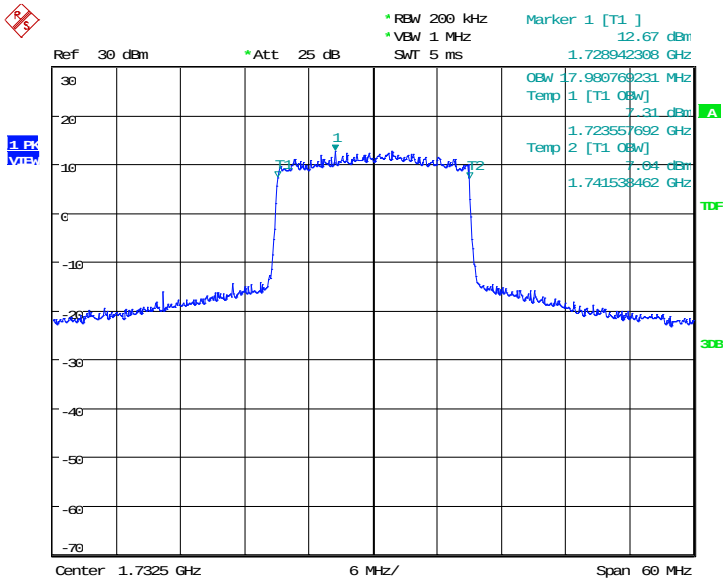
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
1732.5	QPSK	16QAM
	17980.77	17980.77

LTE band 4, 20MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 09:27:55

LTE band 4, 20MHz Bandwidth, 16QAM (99% BW)

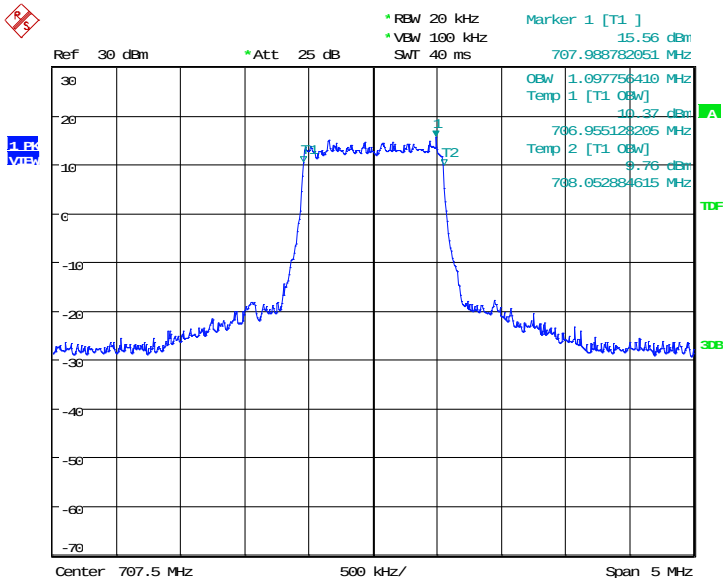


Date: 8.SEP.2019 09:28:09

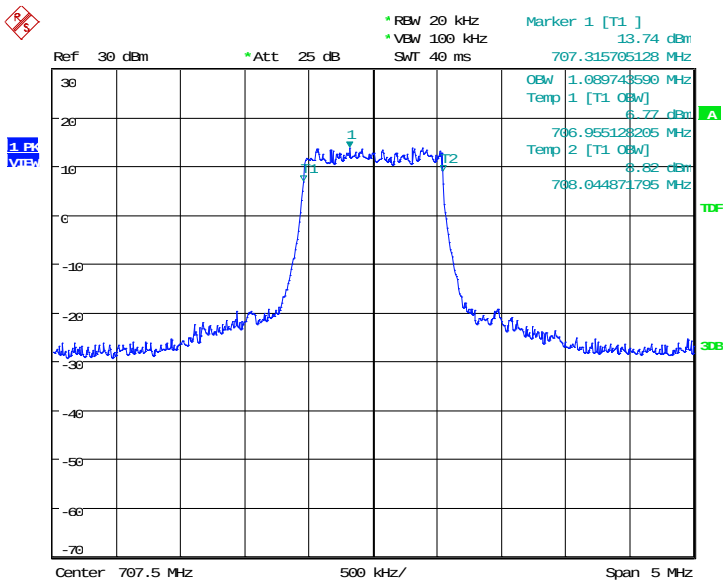
LTE band 12, 1.4MHz (99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
707.5	QPSK	16QAM
	1097.76	1089.74

LTE band 12, 1.4MHz Bandwidth, QPSK (99% BW)



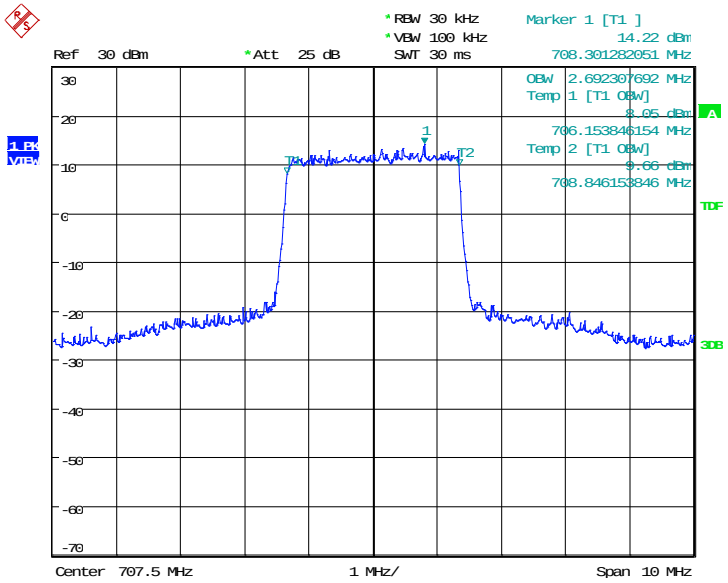
LTE band 12, 1.4MHz Bandwidth, 16QAM (99% BW)



LTE band 12, 3MHz (99% BW)

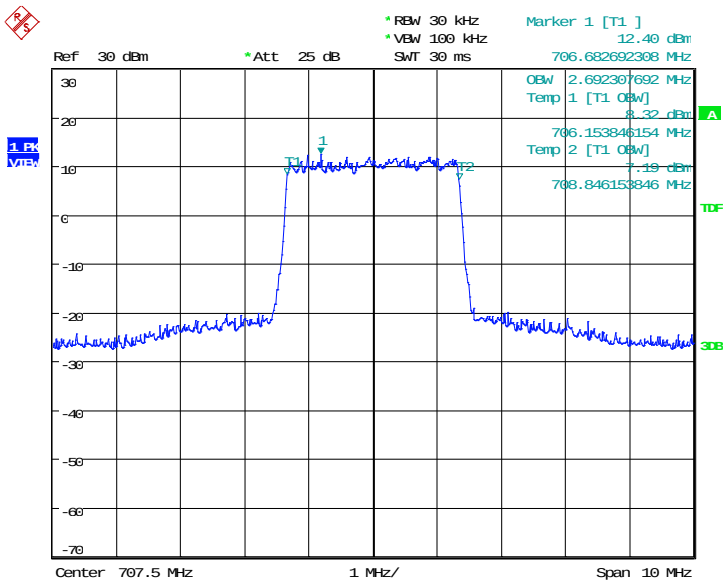
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
707.5	QPSK	16QAM
	2692.31	2692.31

LTE band 12, 3MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 10:30:27

LTE band 12, 3MHz Bandwidth, 16QAM (99% BW)

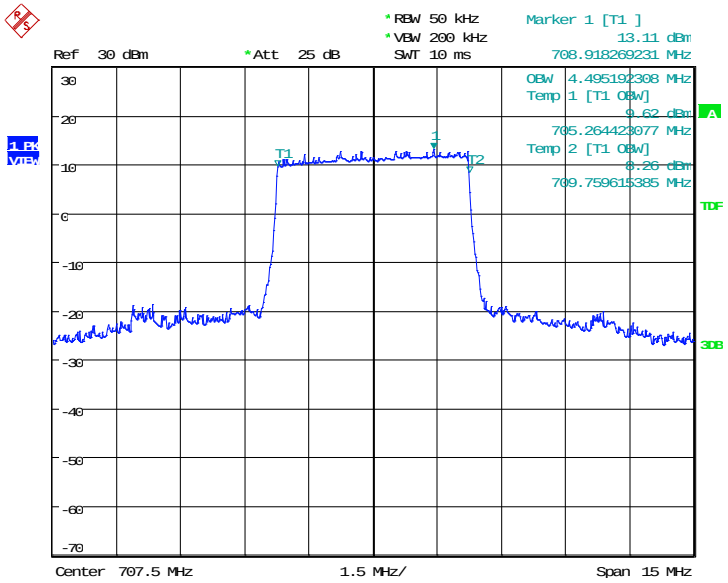


Date: 8.SEP.2019 10:30:41

LTE band 12, 5MHz (99% BW)

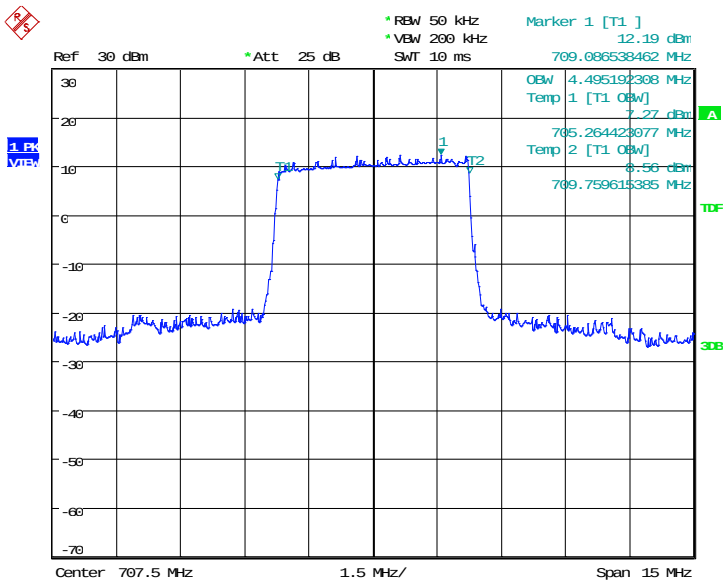
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
707.5	QPSK	16QAM
	4495.19	4495.19

LTE band 12, 5MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 10:35:55

LTE band 12, 5MHz Bandwidth,16QAM (99% BW)

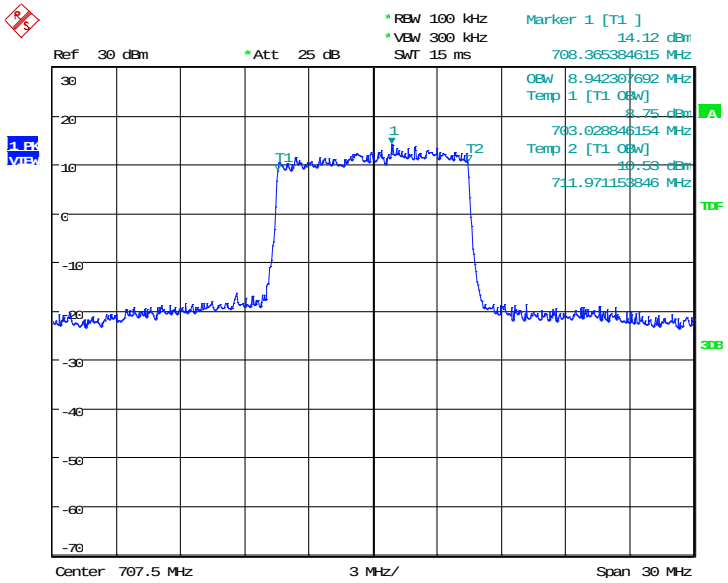


Date: 8.SEP.2019 10:36:09

LTE band 12, 10MHz (99% BW)

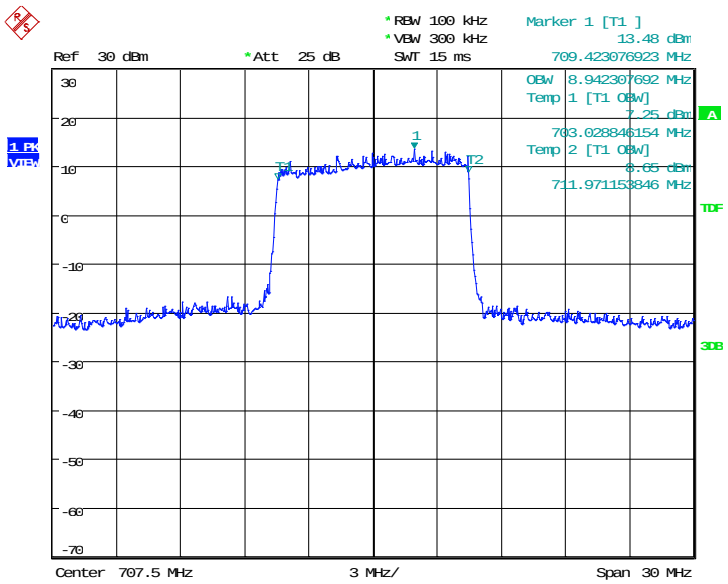
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
707.5	QPSK	16QAM
	8942.31	8942.31

LTE band 12, 10MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 10:41:23

LTE band 12, 10MHz Bandwidth, 16QAM (99% BW)

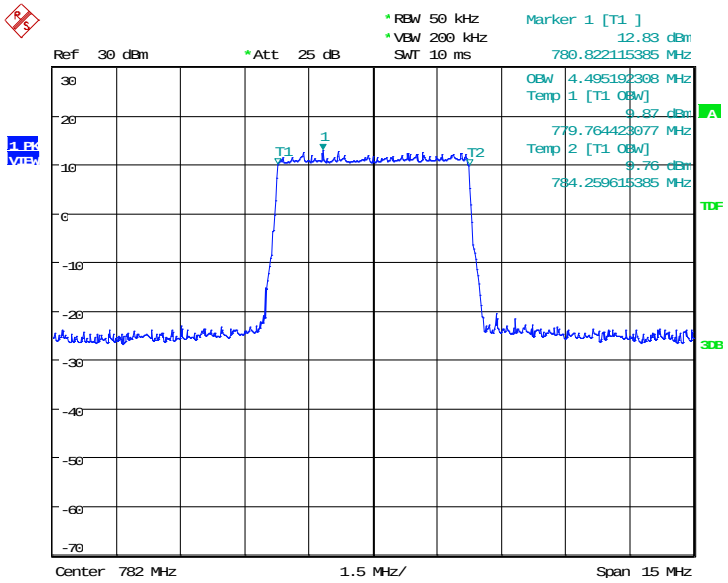


Date: 8.SEP.2019 10:41:37

LTE band 13, 5MHz (99% BW)

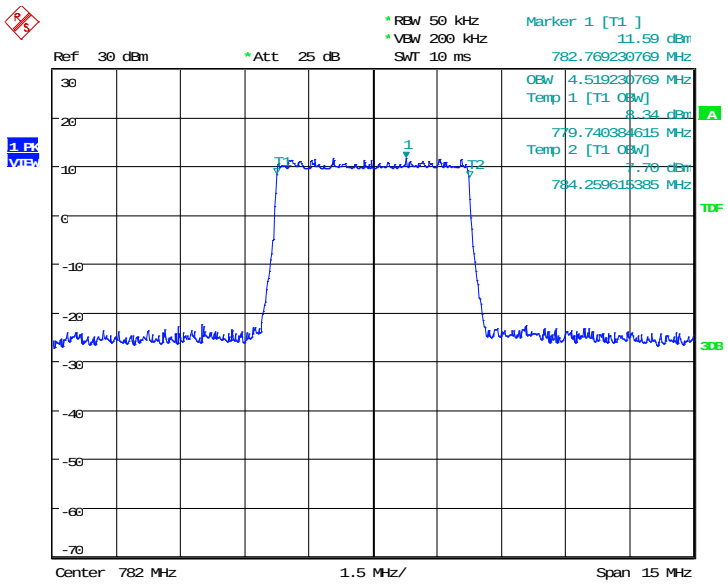
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
782.5	QPSK	16QAM
	4495.19	4519.23

LTE band 13, 5MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 17:19:22

LTE band 13, 5MHz Bandwidth,16QAM (99% BW)

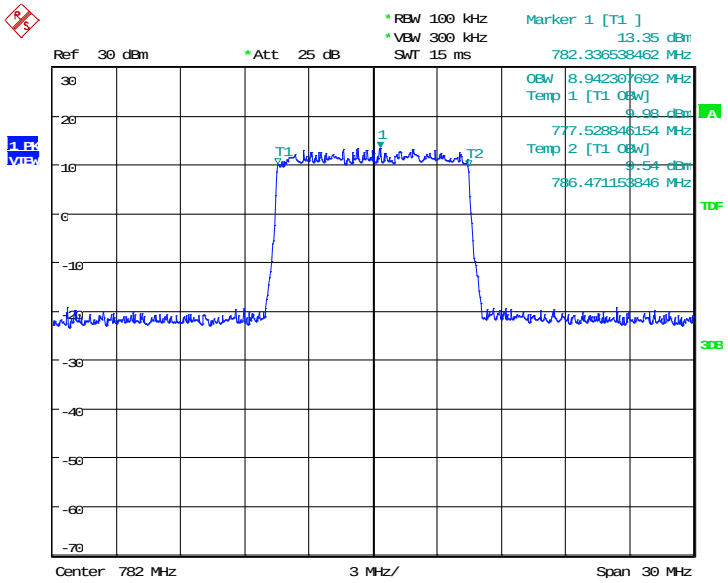


Date: 8.SEP.2019 17:19:35

LTE band 13, 10MHz (99% BW)

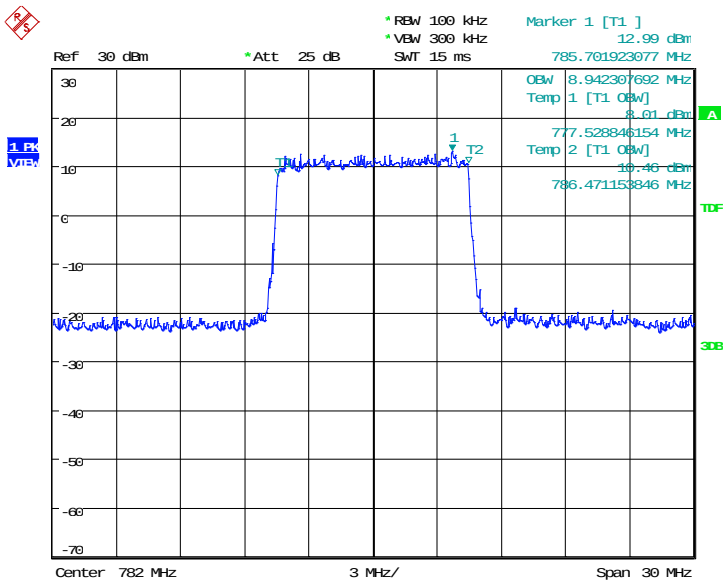
Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)	
782.5	QPSK	16QAM
	8942.31	8942.31

LTE band 13, 10MHz Bandwidth, QPSK (99% BW)



Date: 8.SEP.2019 17:33:44

LTE band 13, 10MHz Bandwidth, 16QAM (99% BW)



Date: 8.SEP.2019 17:36:30

Note: Expanded measurement uncertainty is U = 3428Hz, k = 2

A.5 EMISSION BANDWIDTH

Reference

FCC: CFR Part 2.1049, 24.238, 27.53.

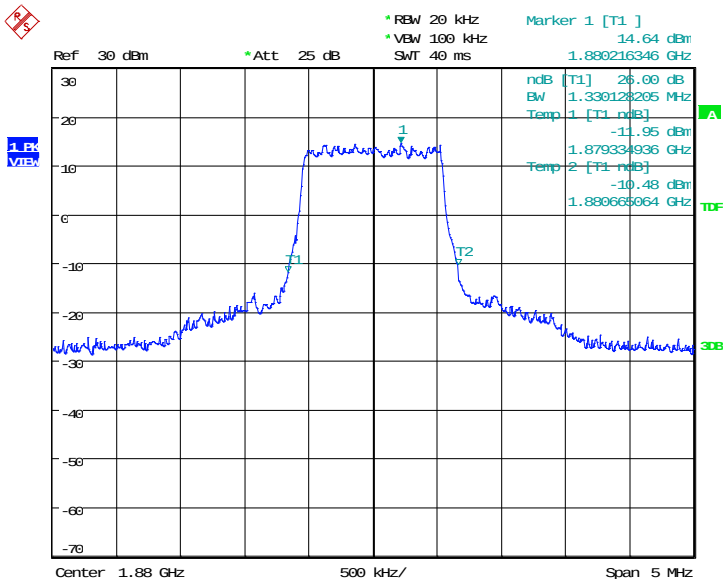
A.5.1Emission Bandwidth Results

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.

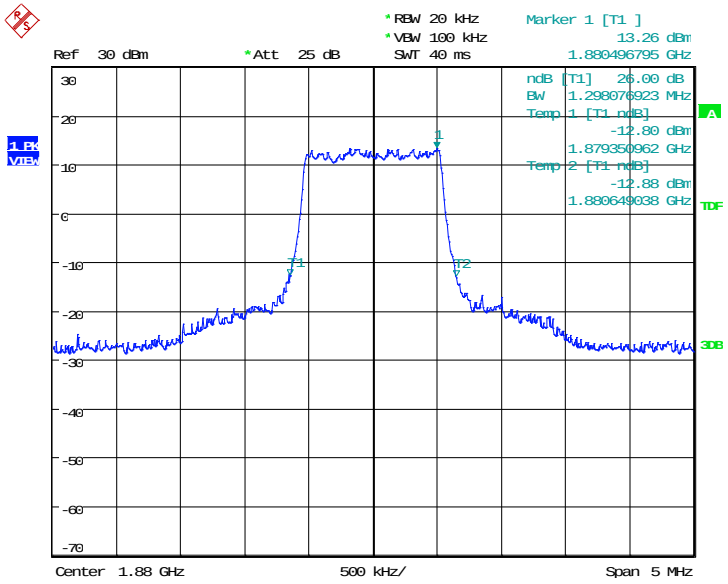
LTE band 2, 1.4MHz (-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1880.0	QPSK	16QAM
	1330.13	1298.08

LTE band 2, 1.4MHz Bandwidth, QPSK (-26dBc BW)



LTE band 2, 1.4MHz Bandwidth, 16QAM (-26dBc BW)

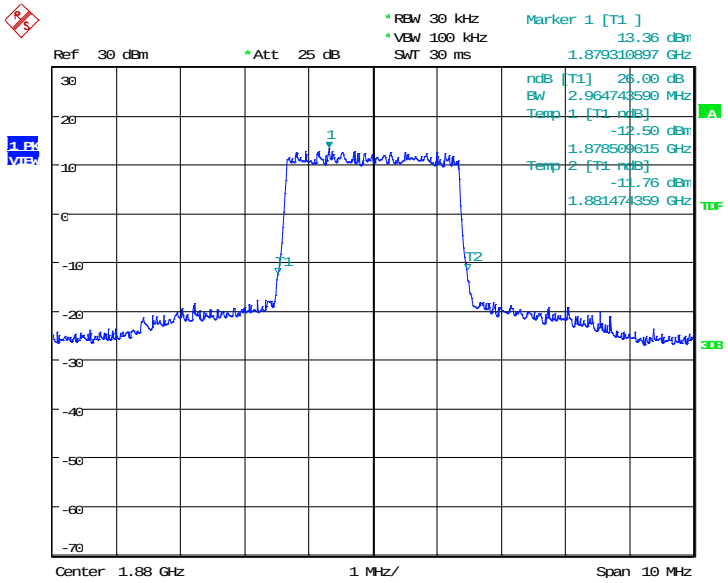


Date: 8.SEP.2019 08:25:46

LTE band 2, 3MHz (-26dBc BW)

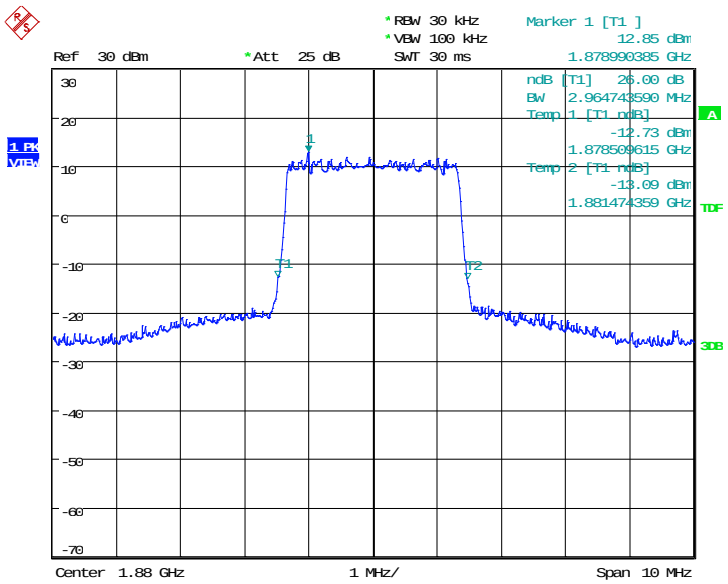
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	QPSK	16QAM
1880.0	2964.74	2964.74

LTE band 2, 3MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 08:30:56

LTE band 2, 3MHz Bandwidth, 16QAM (-26dBc BW)

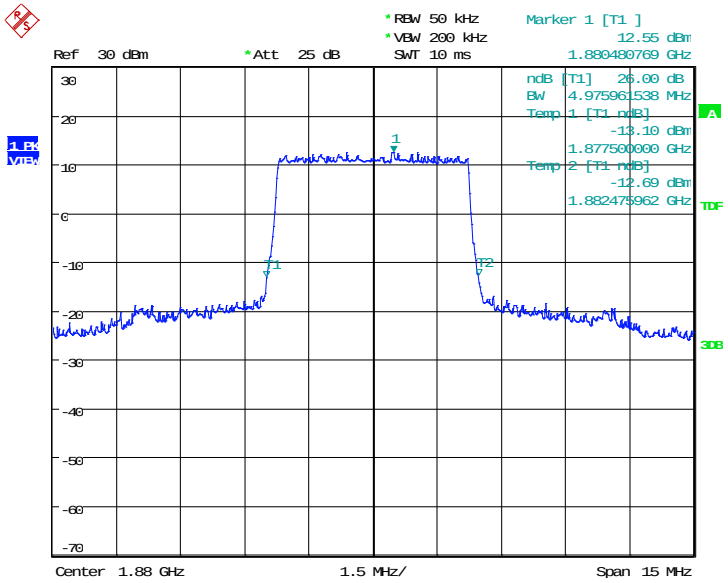


Date: 8.SEP.2019 08:31:12

LTE band 2, 5MHz (-26dBc BW)

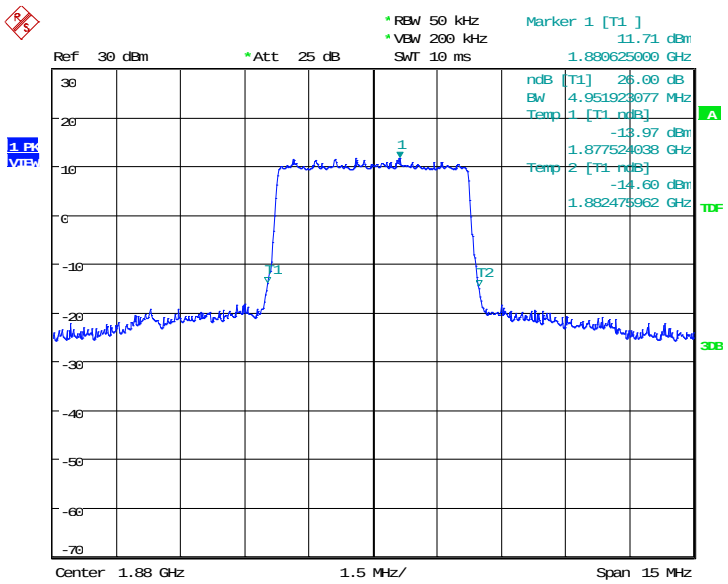
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1880.0	QPSK	16QAM
	4975.96	4951.92

LTE band 2, 5MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 08:36:22

LTE band 2, 5MHz Bandwidth,16QAM (-26dBc BW)

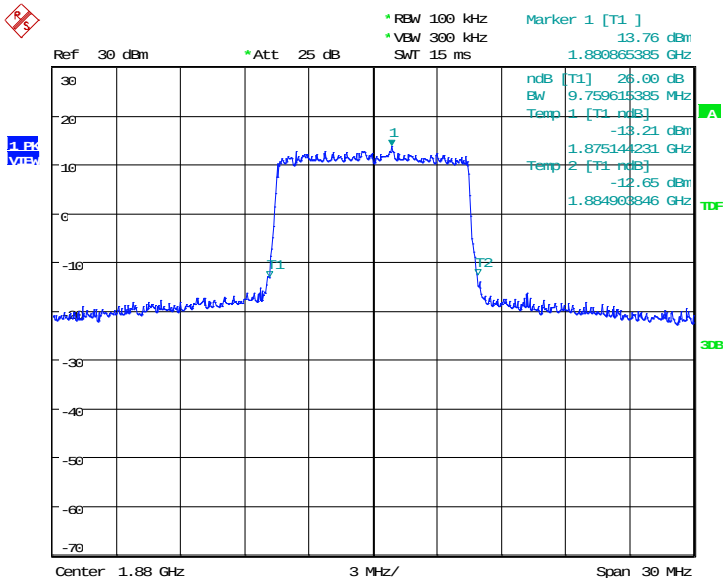


Date: 8.SEP.2019 08:36:38

LTE band 2, 10MHz (-26dBc BW)

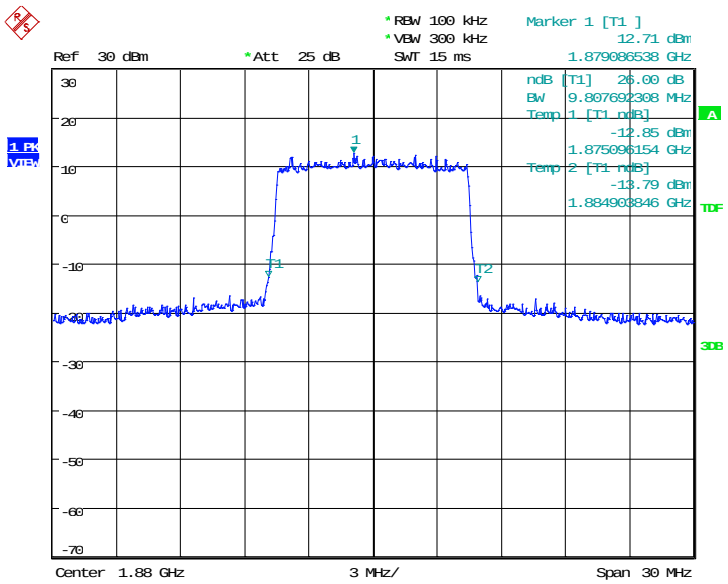
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	QPSK	16QAM
1880.0	9759.62	9807.69

LTE band 2, 10MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 08:41:50

LTE band 2, 10MHz Bandwidth, 16QAM (-26dBc BW)

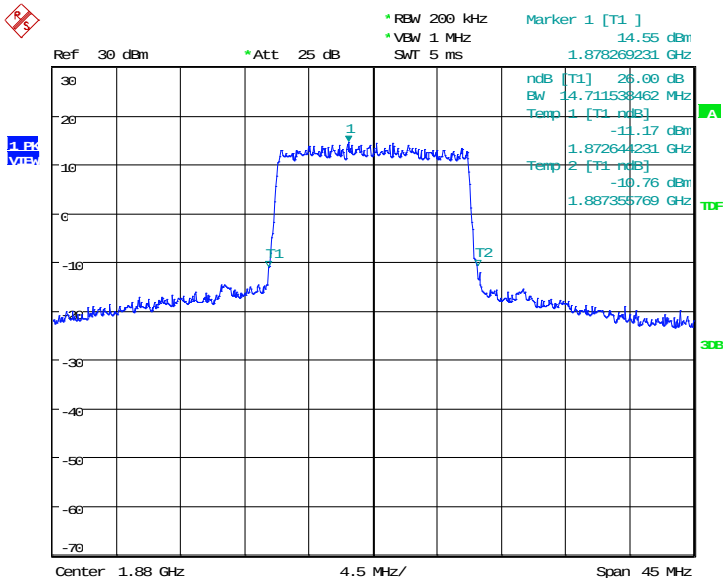


Date: 8.SEP.2019 08:42:06

LTE band 2, 15MHz (-26dBc BW)

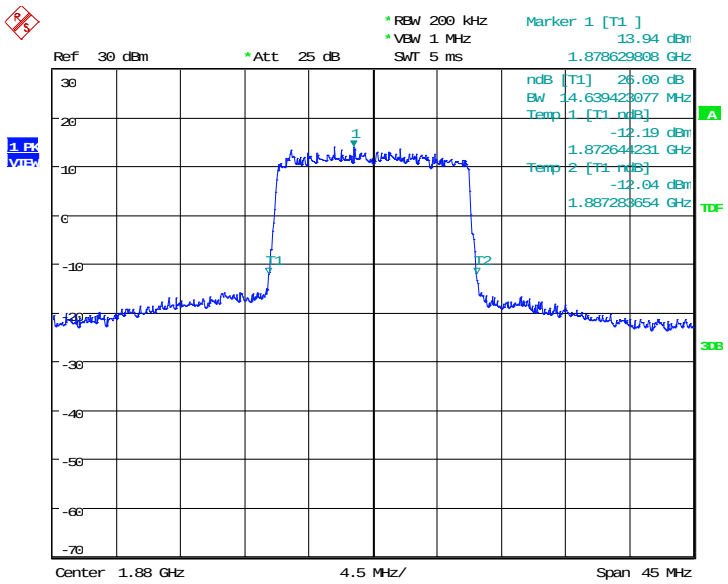
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	QPSK	16QAM
1880.0	14711.54	14639.42

LTE band 2, 15MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 08:47:17

LTE band 2, 15MHz Bandwidth, 16QAM (-26dBc BW)

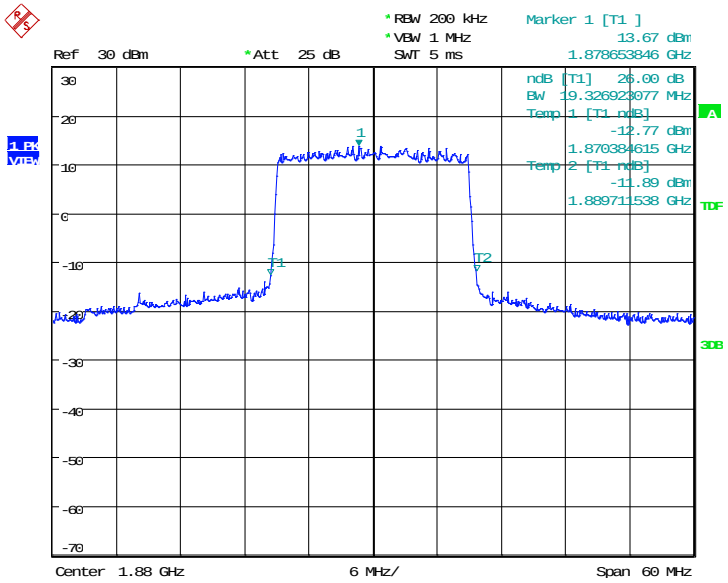


Date: 8.SEP.2019 08:47:33

LTE band 2, 20MHz (-26dBc BW)

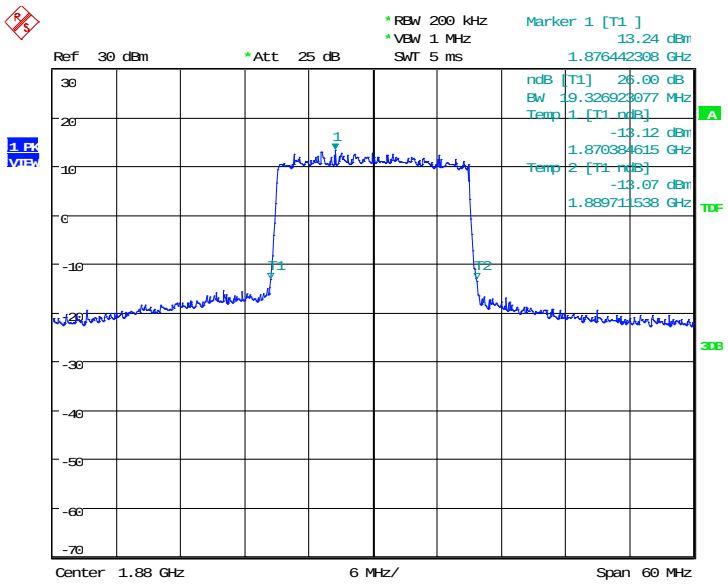
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1880.0	QPSK	16QAM
	19326.92	19326.92

LTE band 2, 20MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 08:52:46

LTE band 2, 20MHz Bandwidth, 16QAM (-26dBc BW)

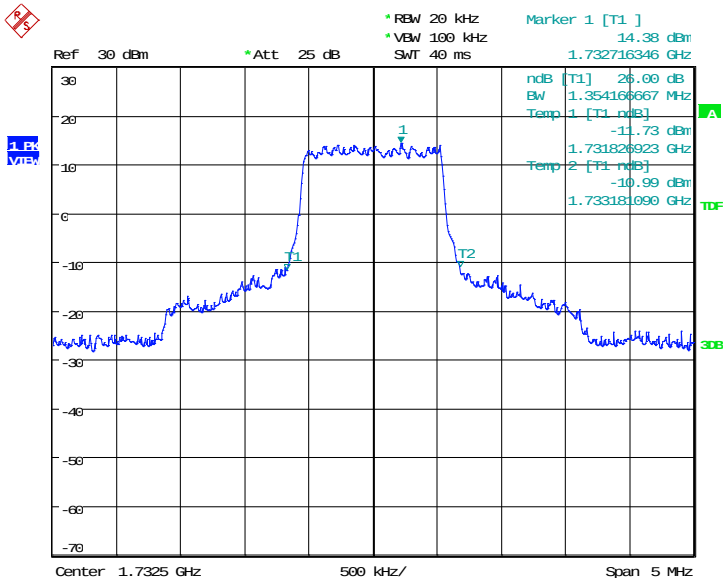


Date: 8.SEP.2019 08:53:01

LTE band 4, 1.4MHz (-26dBc BW)

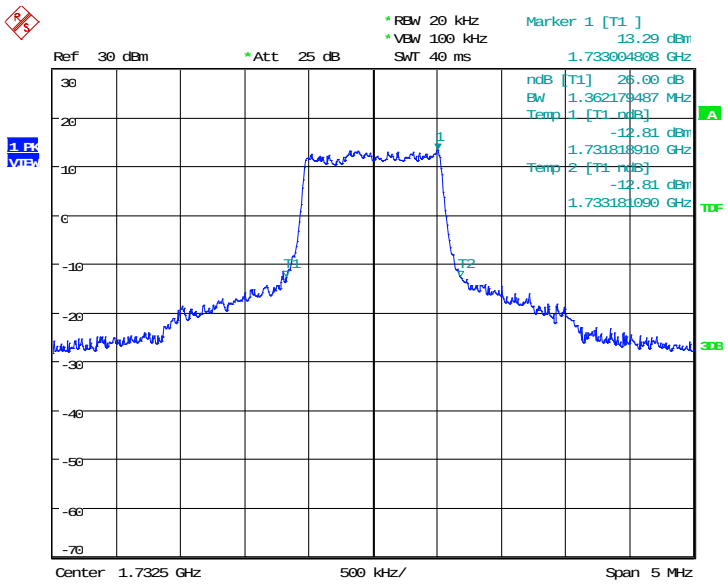
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	QPSK	16QAM
1732.5	1354.17	1362.18

LTE band 4, 1.4MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 08:58:49

LTE band 4, 1.4MHz Bandwidth, 16QAM (-26dBc BW)

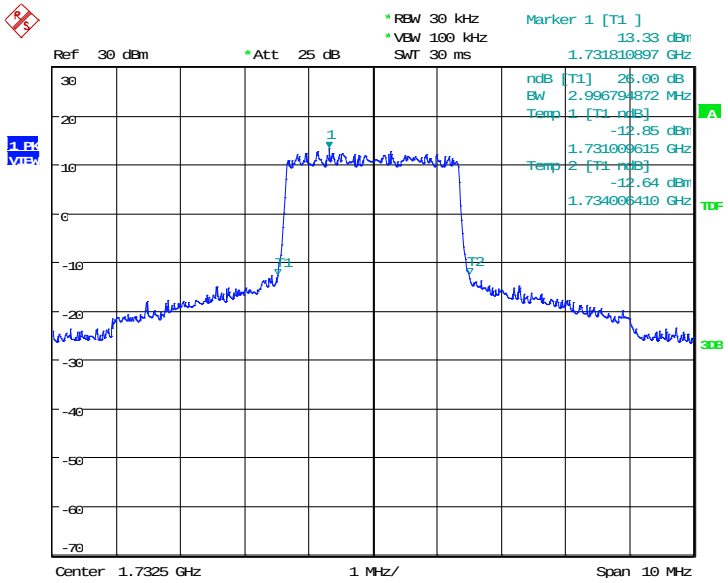


Date: 8.SEP.2019 08:59:04

LTE band 4, 3MHz (-26dBc BW)

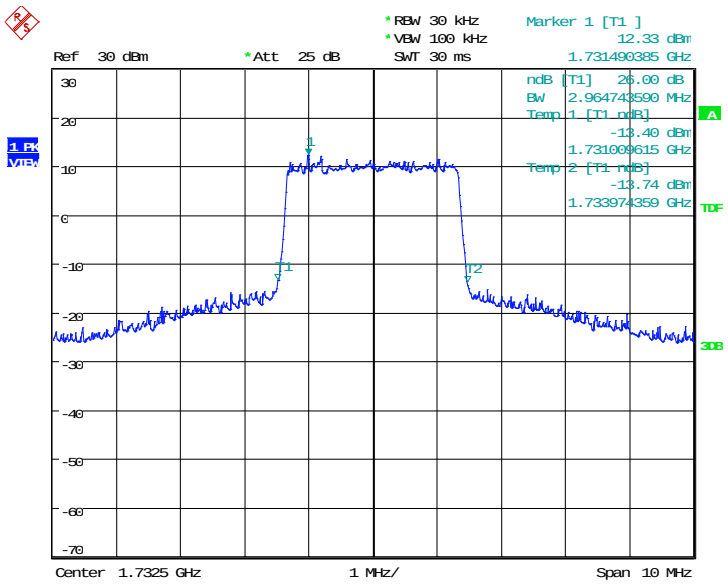
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	QPSK	16QAM
1732.5	2996.79	2964.74

LTE band 4, 3MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 09:04:16

LTE band 4, 3MHz Bandwidth, 16QAM (-26dBc BW)

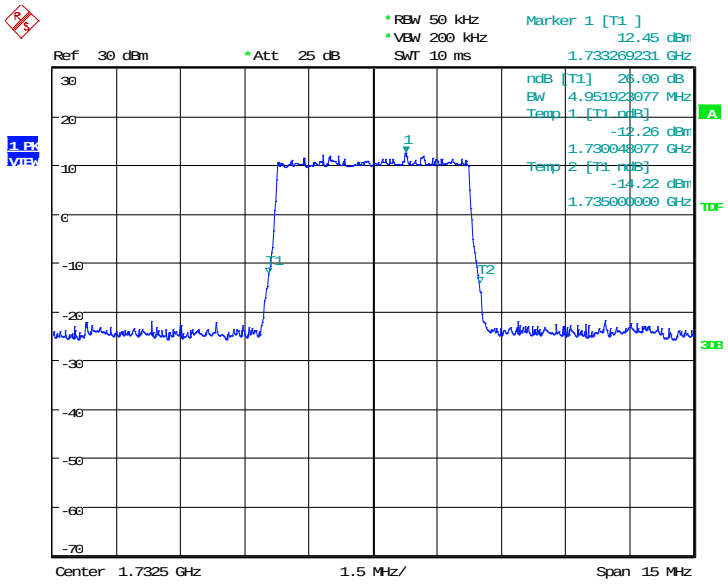


Date: 8.SEP.2019 09:04:32

LTE band 4, 5MHz (-26dBc BW)

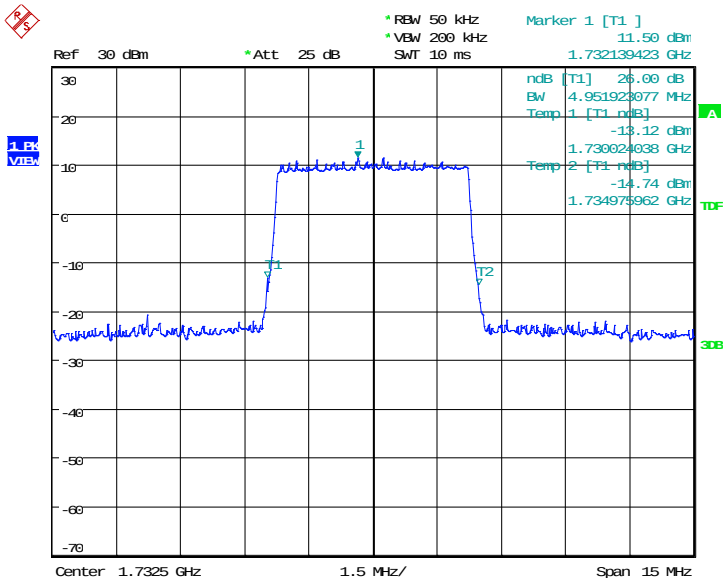
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1732.5	QPSK	16QAM
	4951.92	4951.92

LTE band 4, 5MHz Bandwidth, QPSK (-26dBc BW)



Date: 11.SEP.2019 12:42:03

LTE band 4, 5MHz Bandwidth,16QAM (-26dBc BW)

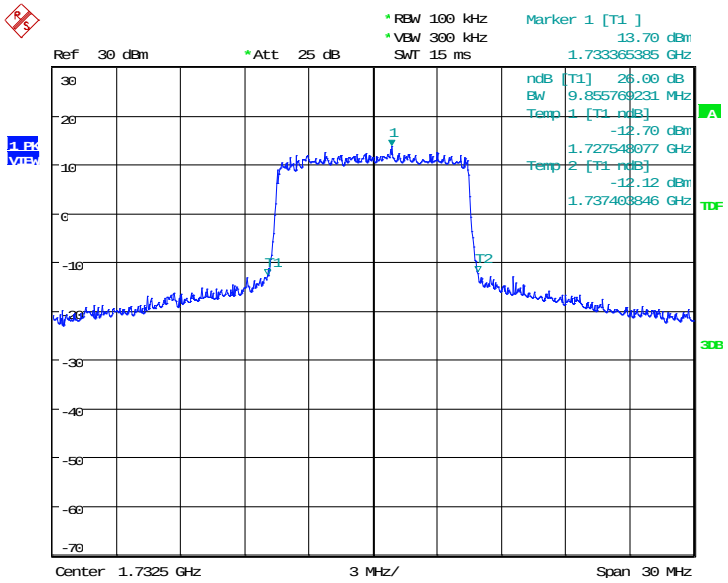


Date: 11.SEP.2019 12:41:27

LTE band 4, 10MHz (-26dBc BW)

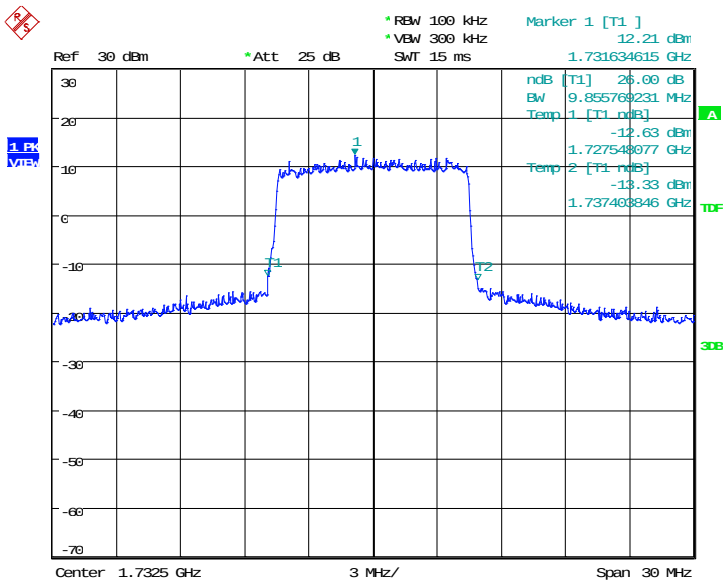
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	QPSK	16QAM
1732.5	9855.77	9855.77

LTE band 4, 10MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 09:15:11

LTE band 4, 10MHz Bandwidth, 16QAM (-26dBc BW)

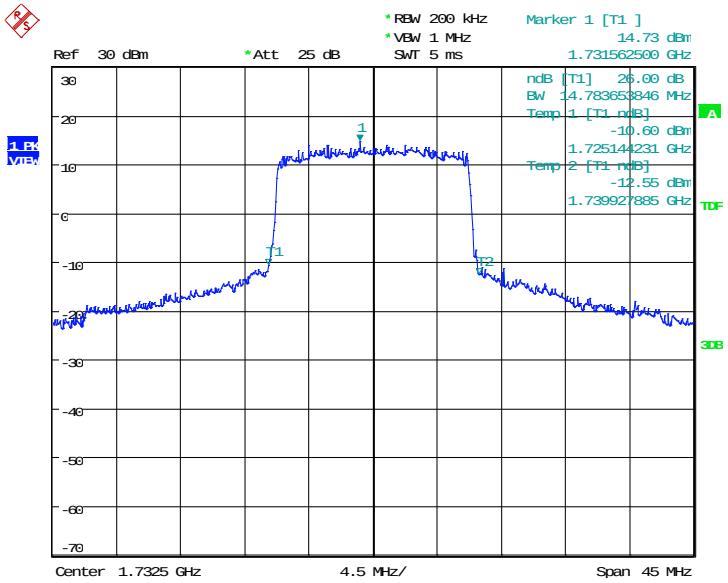


Date: 8.SEP.2019 09:15:26

LTE band 4, 15MHz (-26dBc BW)

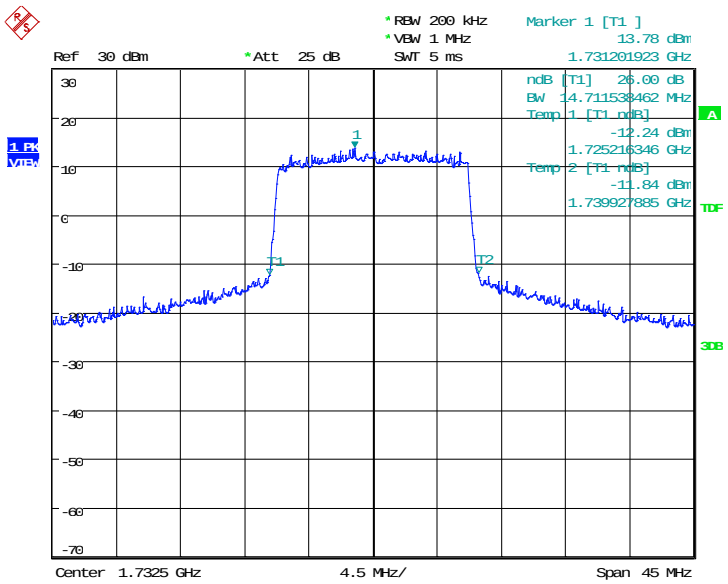
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1732.5	QPSK	16QAM
	14783.65	14711.54

LTE band 4, 15MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 09:20:37

LTE band 4, 15MHz Bandwidth, 16QAM (-26dBc BW)

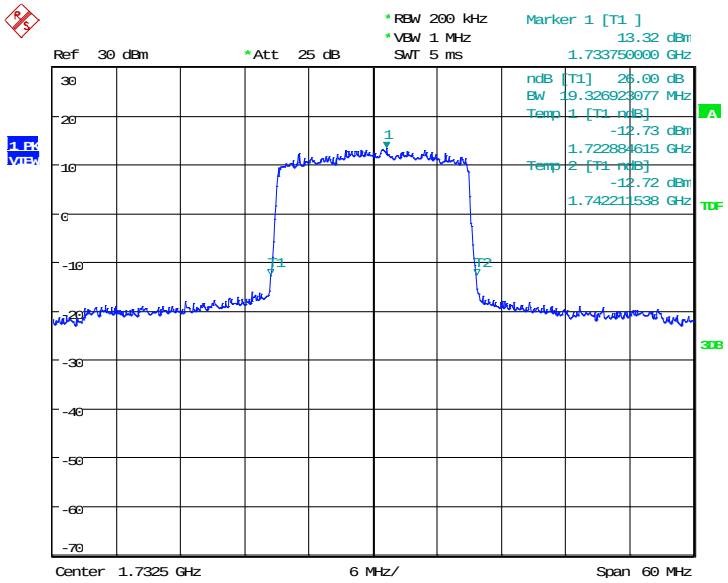


Date: 8.SEP.2019 09:20:53

LTE band 4, 20MHz (-26dBc BW)

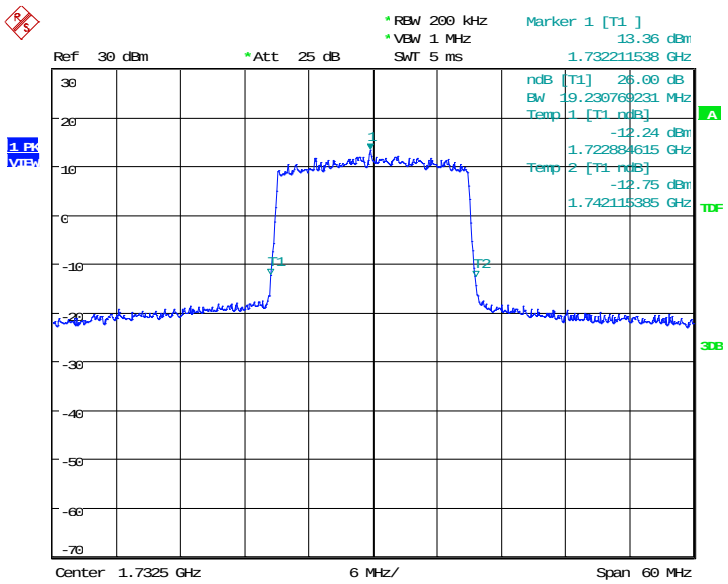
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1732.5	QPSK	16QAM
	19326.92	19230.77

LTE band 4, 20MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 09:54:02

LTE band 4, 20MHz Bandwidth, 16QAM (-26dBc BW)

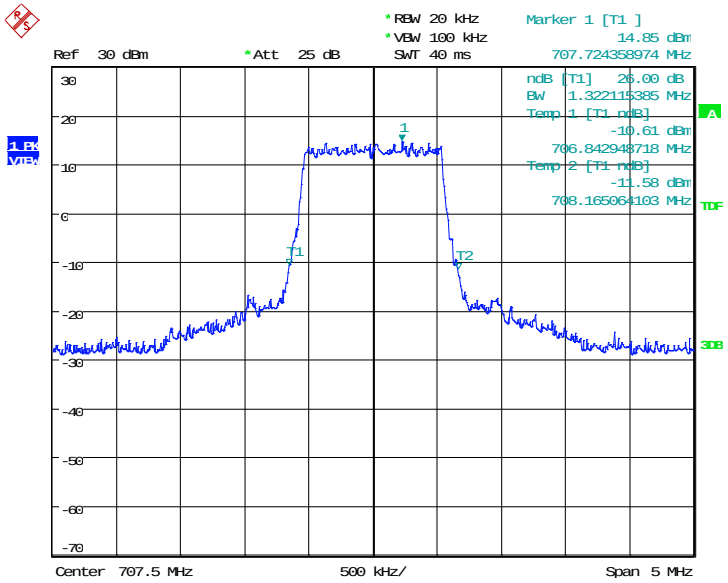


Date: 8.SEP.2019 09:54:17

LTE band 12, 1.4MHz (-26dBc BW)

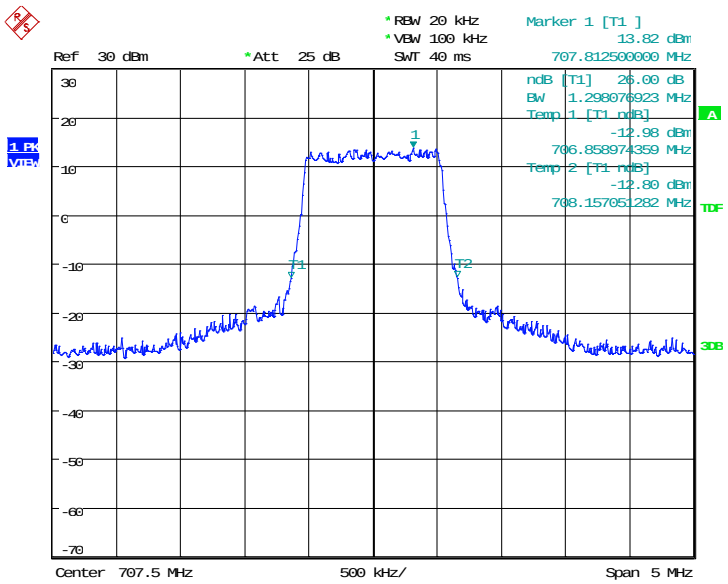
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
707.5	QPSK	16QAM
	1322.12	1298.08

LTE band 12, 1.4MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 10:26:07

LTE band 12, 1.4MHz Bandwidth, 16QAM (-26dBc BW)

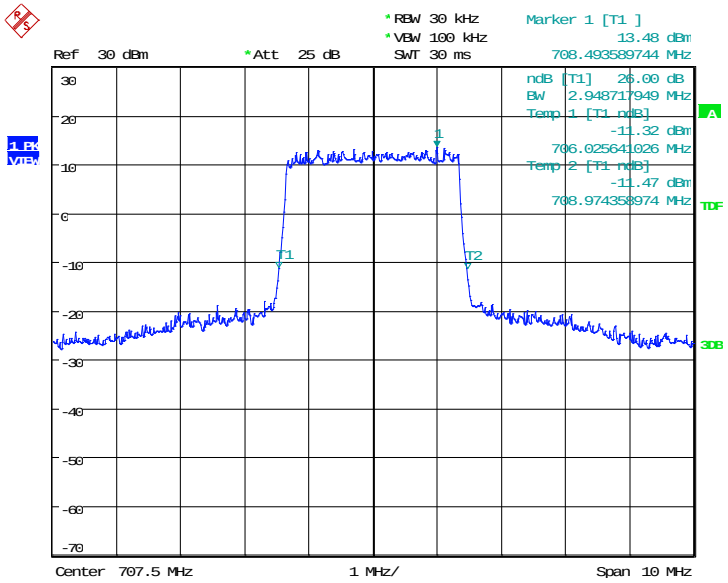


Date: 8.SEP.2019 10:26:23

LTE band 12, 3MHz (-26dBc BW)

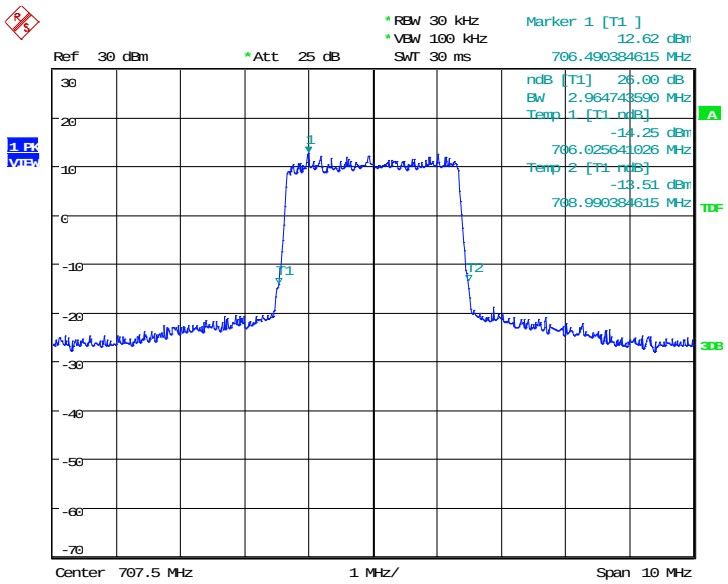
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
707.5	QPSK	16QAM
	2948.72	2964.74

LTE band 12, 3MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 10:31:35

LTE band 12, 3MHz Bandwidth, 16QAM (-26dBc BW)

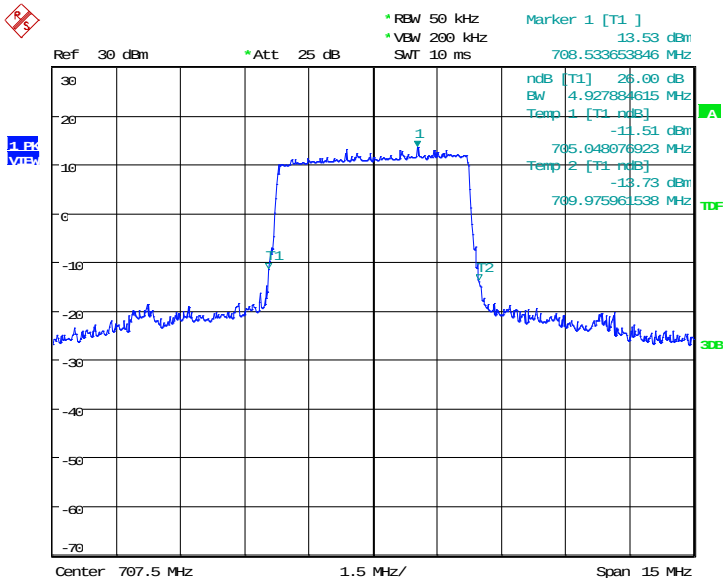


Date: 8.SEP.2019 10:31:50

LTE band 12, 5MHz (-26dBc BW)

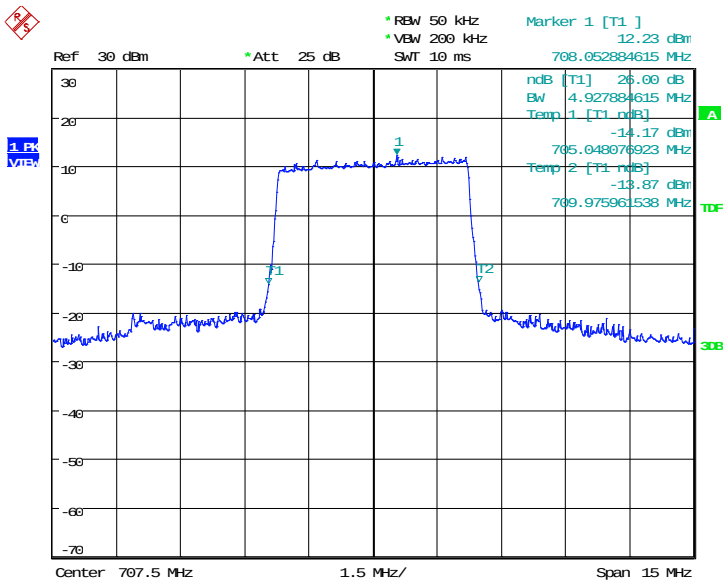
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	QPSK	16QAM
707.5	4927.88	4927.88

LTE band 12, 5MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 10:37:03

LTE band 12, 5MHz Bandwidth,16QAM (-26dBc BW)

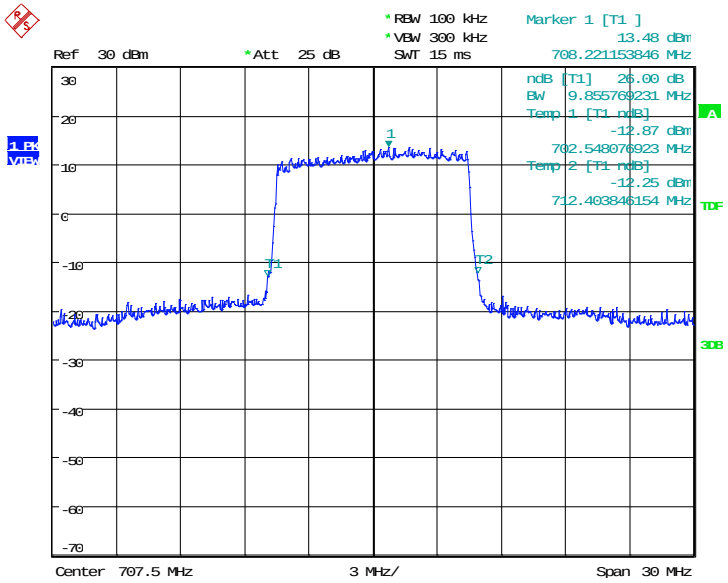


Date: 8.SEP.2019 10:37:19

LTE band 12, 10MHz (-26dBc BW)

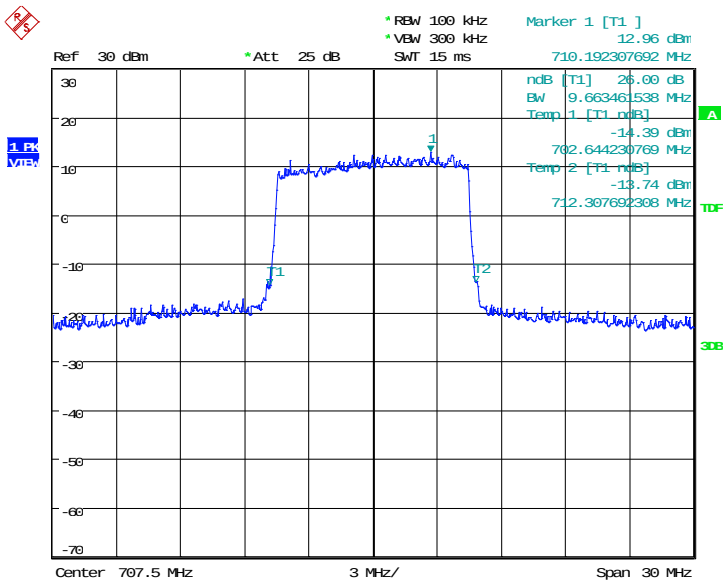
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	QPSK	16QAM
707.5	9855.77	9663.46

LTE band 12, 10MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 10:42:31

LTE band 12, 10MHz Bandwidth, 16QAM (-26dBc BW)

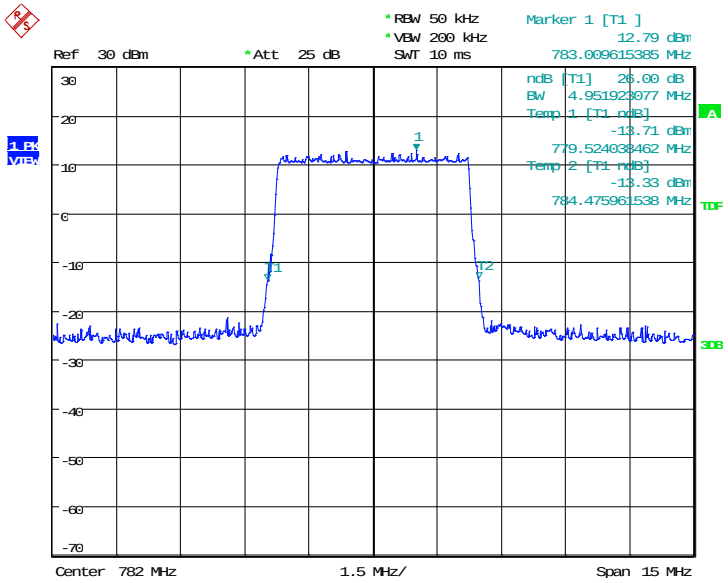


Date: 8.SEP.2019 10:42:47

LTE band 13, 5MHz (-26dBc BW)

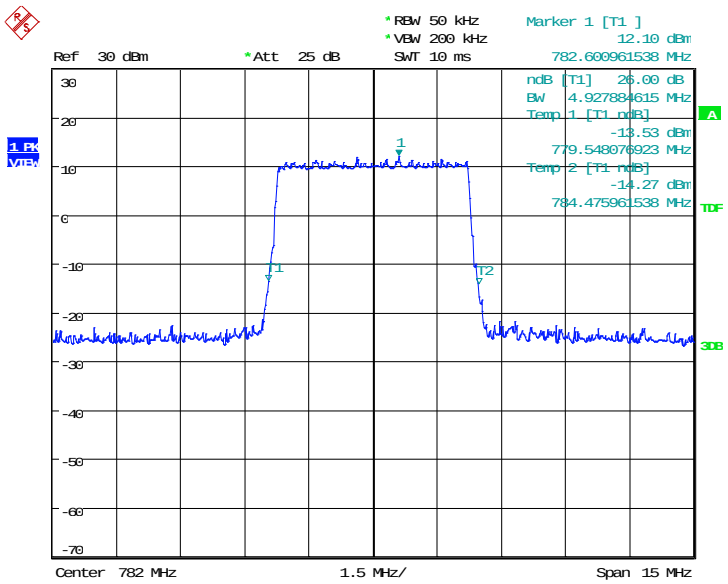
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
782.5	QPSK	16QAM
	4951.92	4927.88

LTE band 13, 5MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 17:20:30

LTE band 13, 5MHz Bandwidth,16QAM (-26dBc BW)

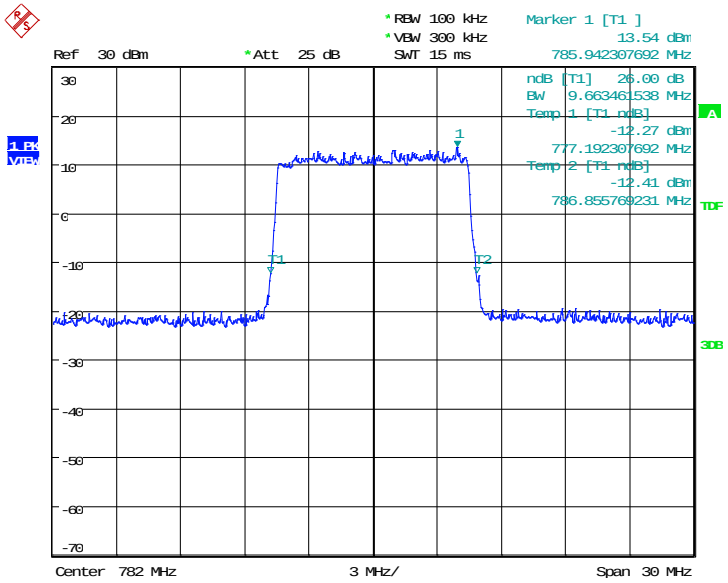


Date: 8.SEP.2019 17:20:45

LTE band 13, 10MHz (-26dBc BW)

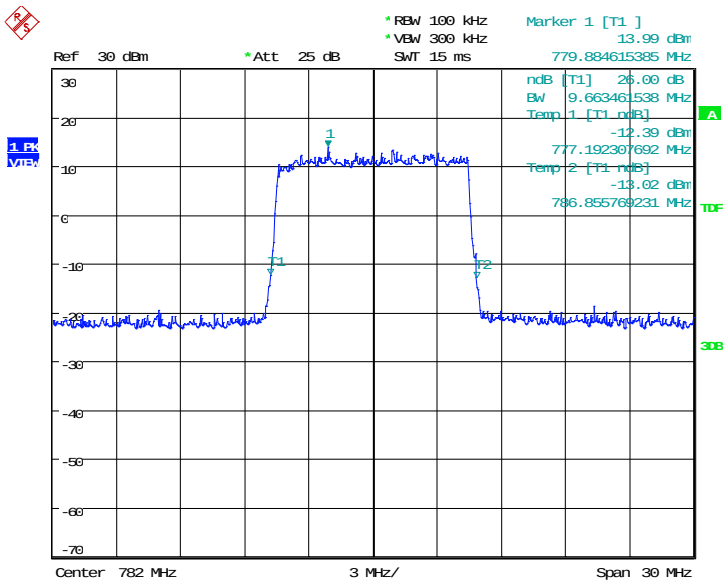
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
782.5	QPSK	16QAM
	9663.46	9663.46

LTE band 13, 10MHz Bandwidth, QPSK (-26dBc BW)



Date: 8.SEP.2019 18:12:19

LTE band 13, 10MHz Bandwidth, 16QAM (-26dBc BW)



Date: 8.SEP.2019 18:12:41

Note: Expanded measurement uncertainty is U = 3428Hz, k = 2

A.6 BAND EDGE COMPLIANCE

Reference

FCC: CFR Part 2.1051, 24.238, 27.53.

A.6.1 Measurement limit

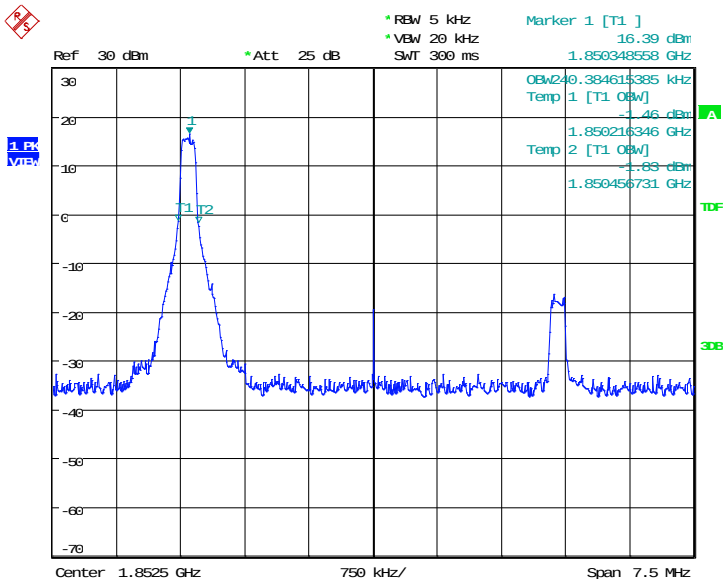
On any frequency outside frequency band of the US Cellular/PCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log (P) dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm. A relaxation of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

A.6.2 Measurement result

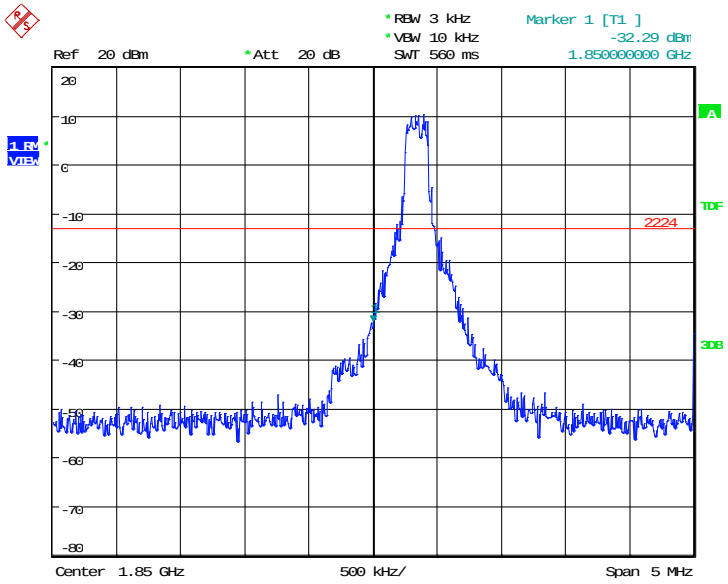
Only worst case result is given below

LTE band 2

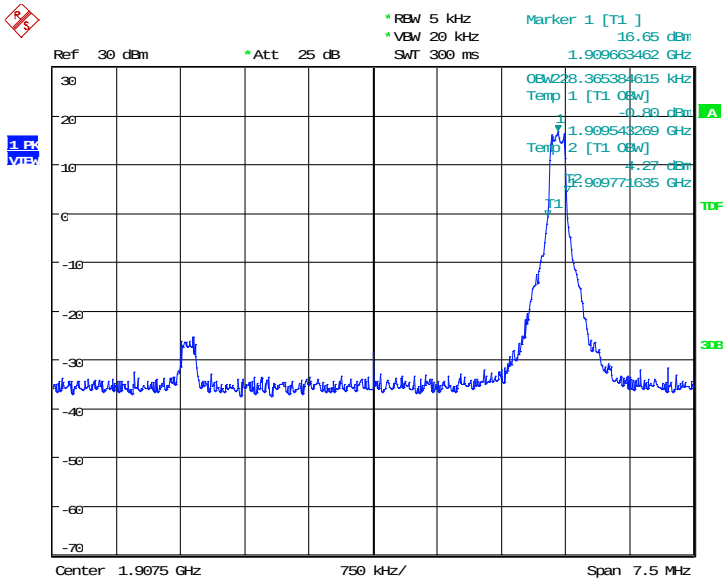
OBW: 1RB-low_offset



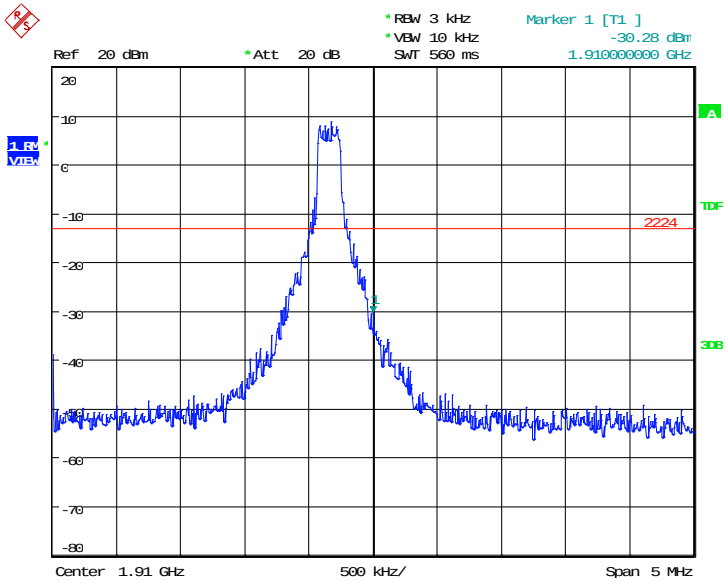
LOW BAND EDGE BLOCK-1RB-low_offset



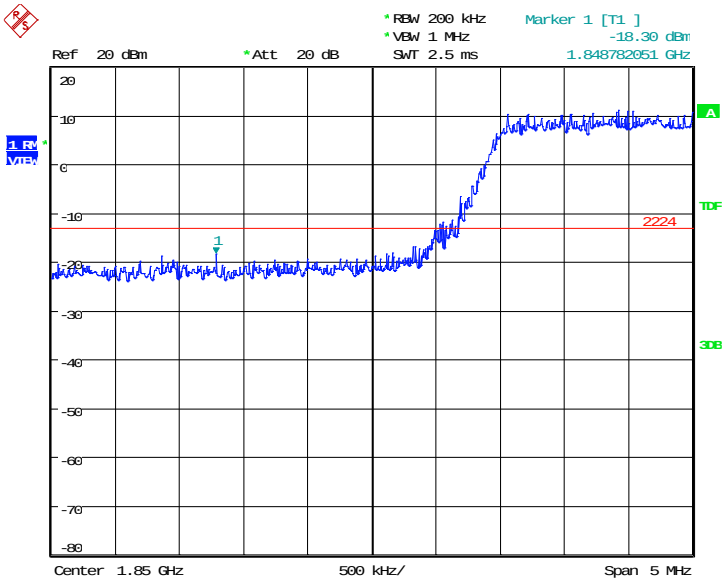
OBW: 1RB-high_offset



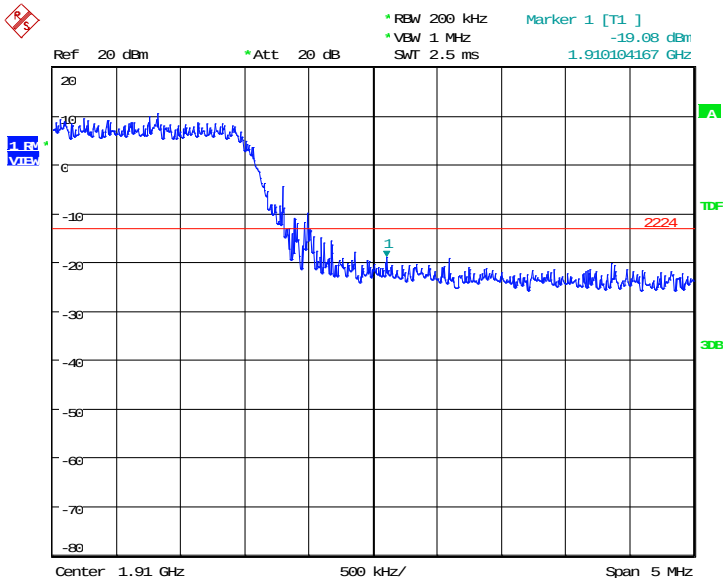
HIGH BAND EDGE BLOCK-1RB-high_offset



LOW BAND EDGE BLOCK-20MHz-100%RB

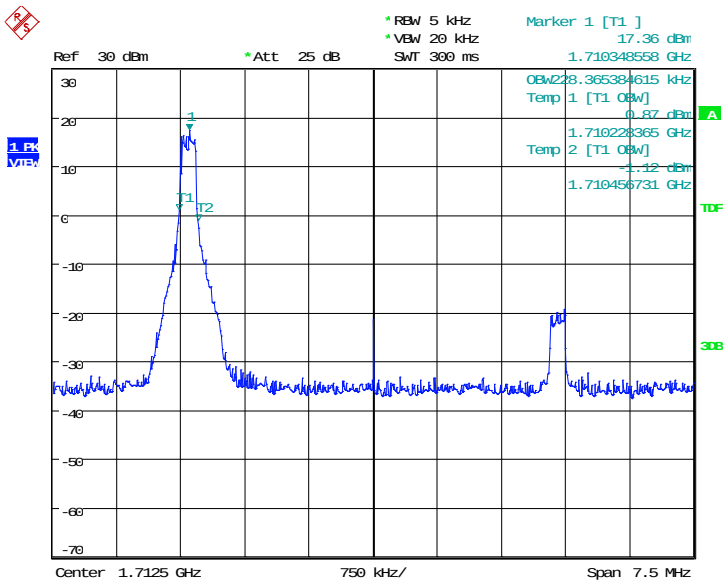


HIGH BAND EDGE BLOCK-20MHz-100%RB



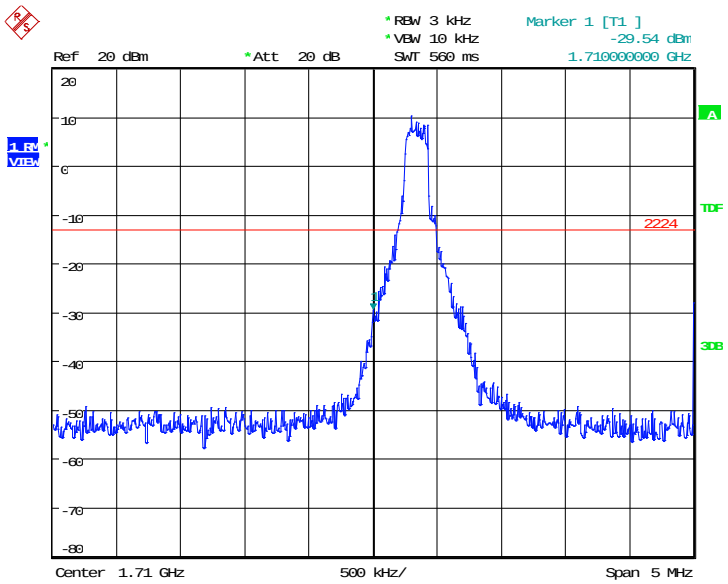
LTE band 4

OBW: 1RB-low_offset



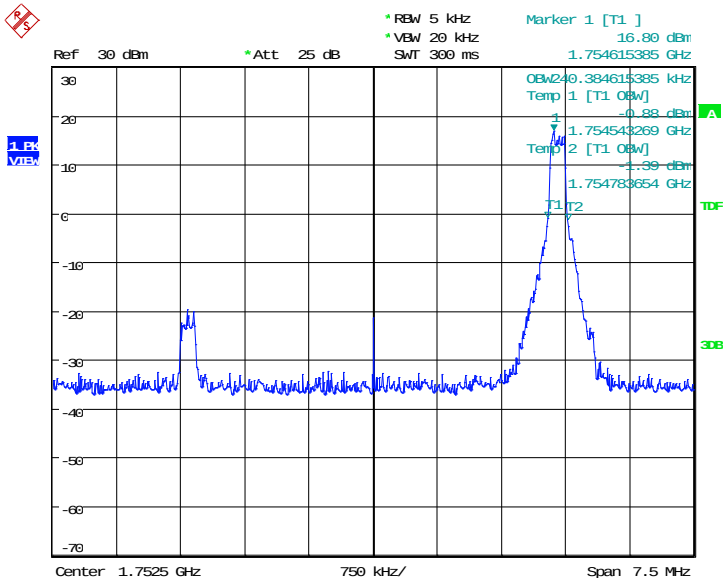
Date: 8.SEP.2019 11:04:42

LOW BAND EDGE BLOCK-1RB-low_offset



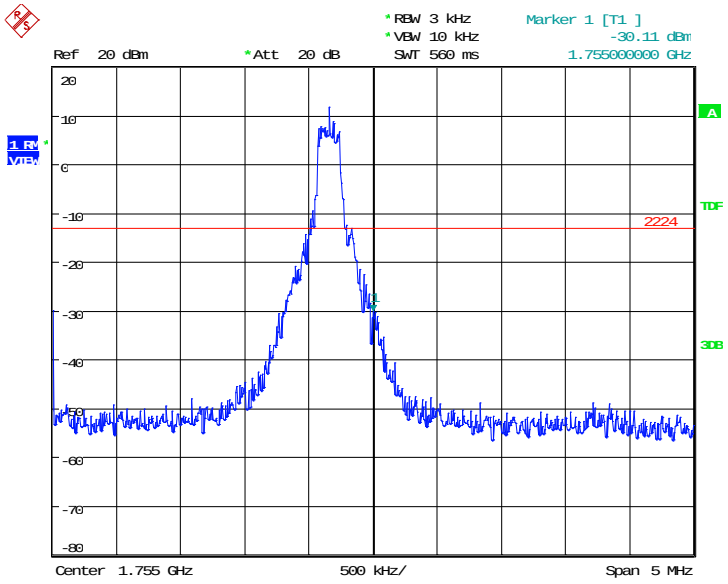
Date: 8.SEP.2019 11:05:26

OBW: 1RB-high_offset



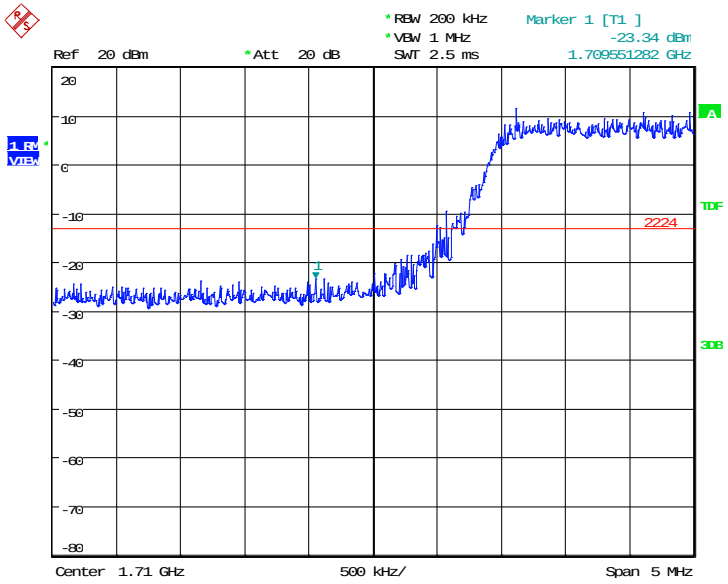
Date: 8.SEP.2019 10:49:16

HIGH BAND EDGE BLOCK-1RB-high_offset

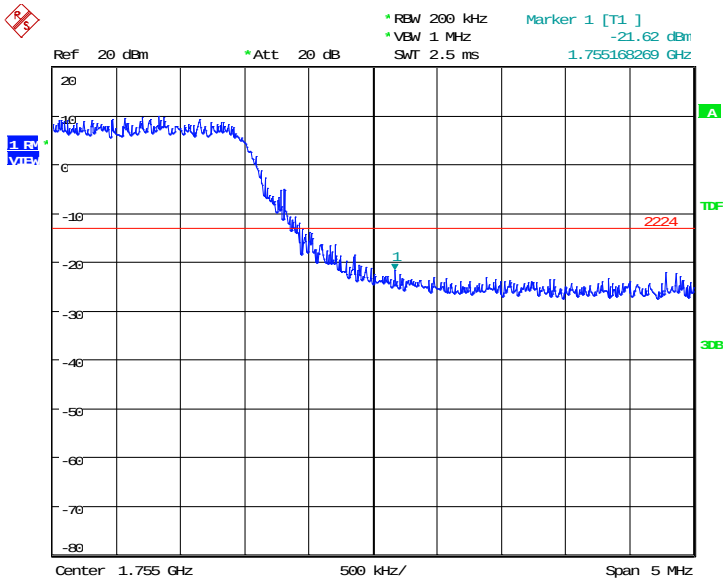


Date: 8.SEP.2019 10:50:00

LOW BAND EDGE BLOCK-20MHz-100%RB

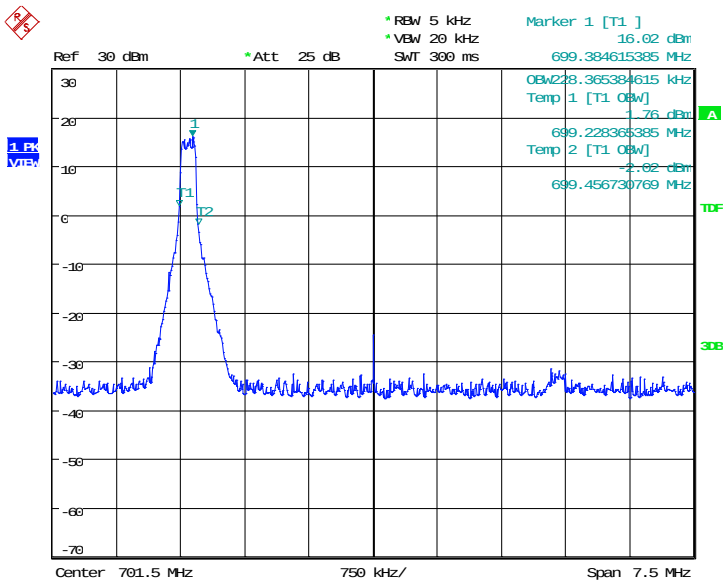


HIGH BAND EDGE BLOCK-20MHz-100%RB



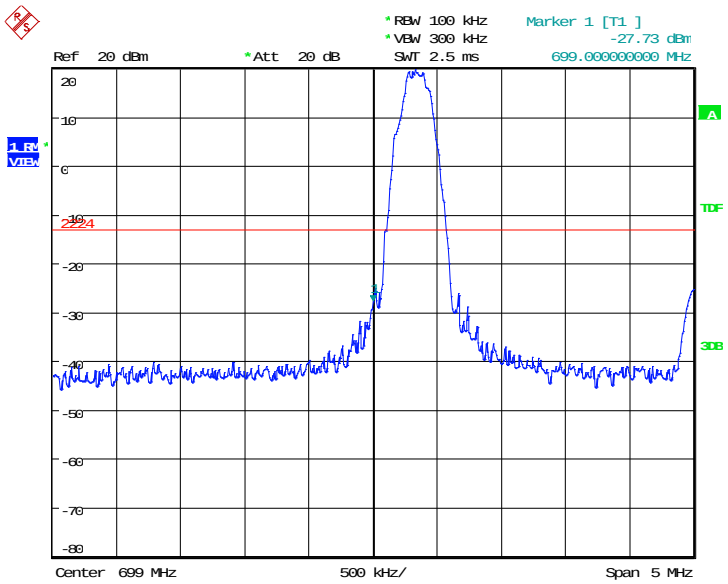
LTE band 12

OBW: 1RB-low_offset



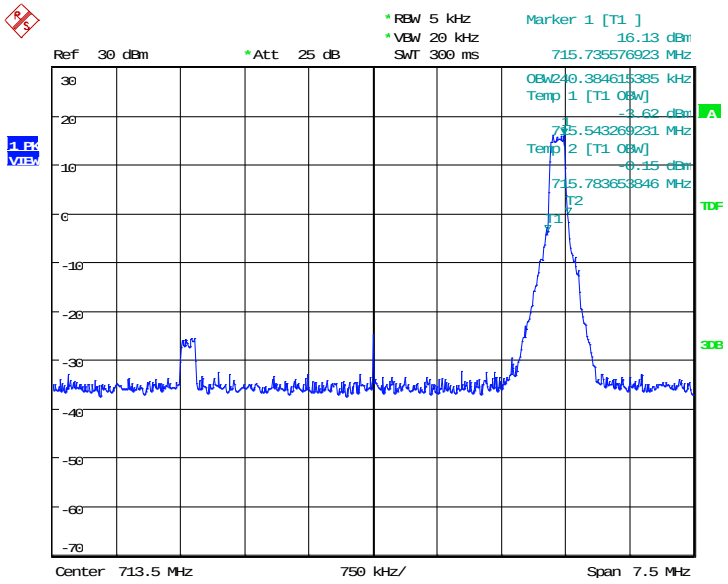
Date: 8.SEP.2019 11:06:22

LOW BAND EDGE BLOCK-1RB-low_offset



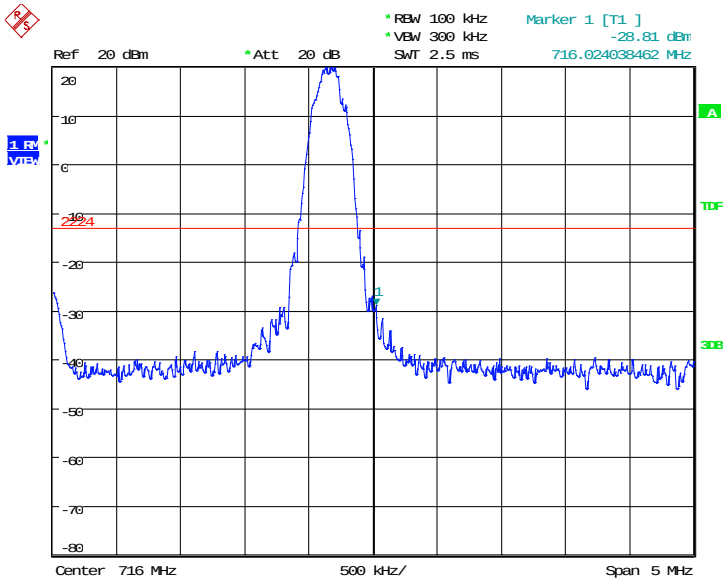
Date: 8.SEP.2019 11:07:06

OBW: 1RB-high_offset



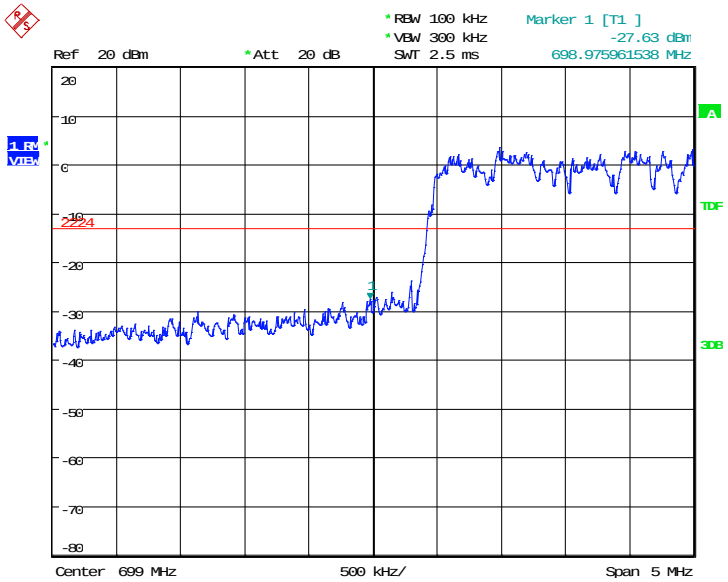
Date: 8.SEP.2019 10:50:59

HIGH BAND EDGE BLOCK-1RB-high_offset



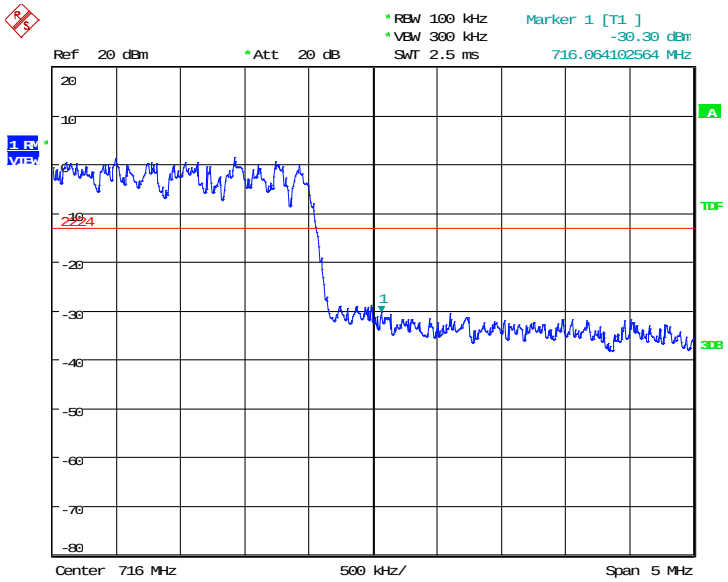
Date: 8.SEP.2019 10:51:43

LOW BAND EDGE BLOCK-10MHz-100%RB



Date: 8.SEP.2019 11:33:35

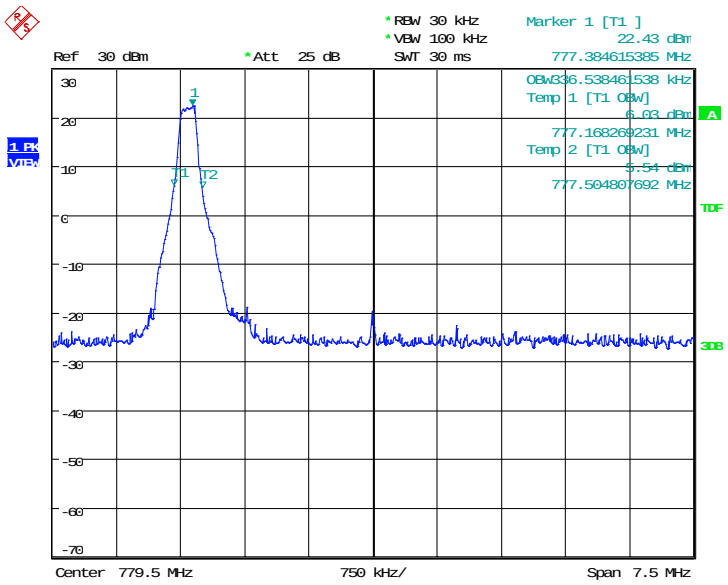
HIGH BAND EDGE BLOCK-10MHz-100%RB



Date: 8.SEP.2019 11:36:21

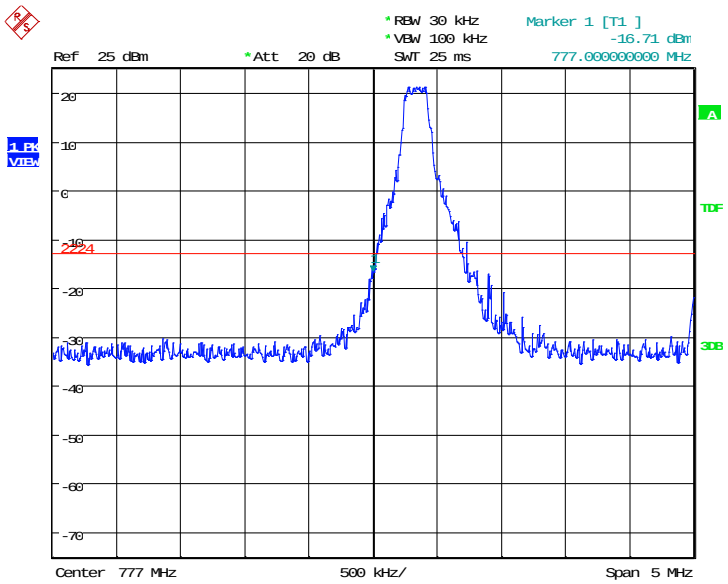
LTE band 13

OBW: 1RB-low_offset



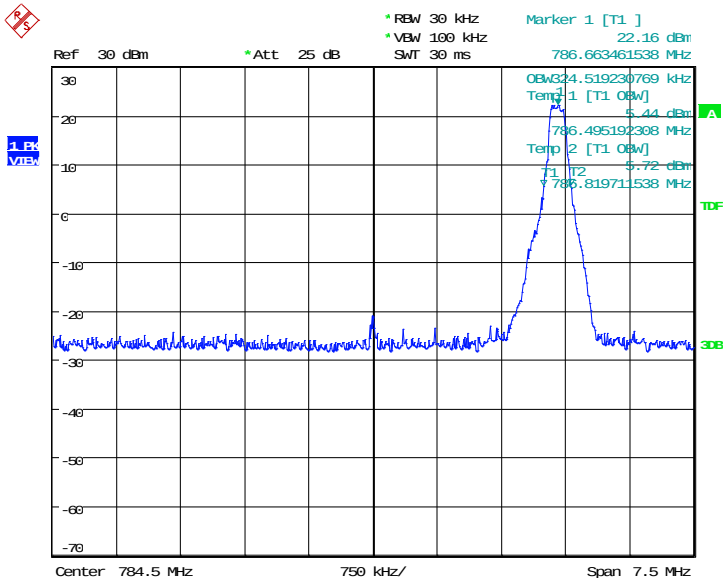
Date: 13.DEC.2019 17:22:45

LOW BAND EDGE BLOCK-1RB-low_offset



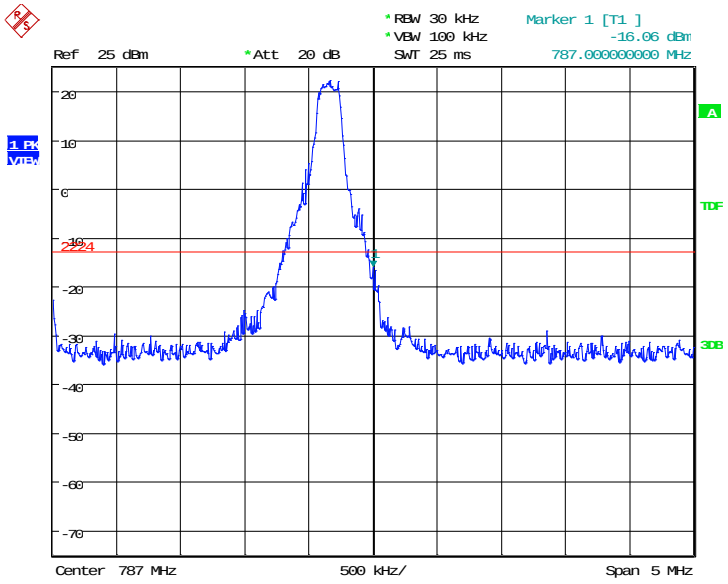
Date: 13.DEC.2019 17:30:12

OBW: 1RB-high_offset



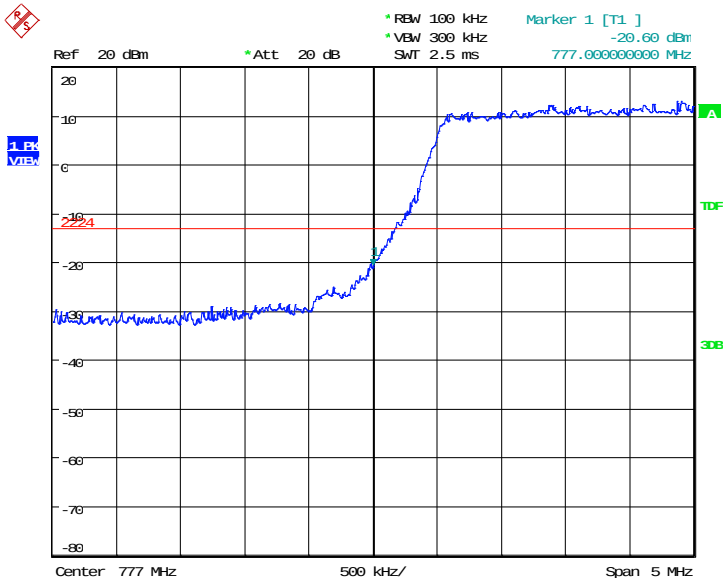
Date: 13.DEC.2019 17:24:01

HIGH BAND EDGE BLOCK-1RB-high_offset

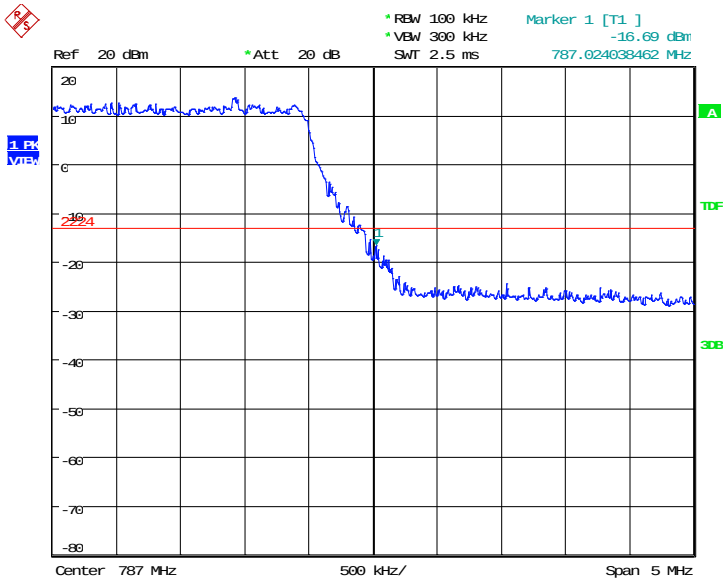


Date: 13.DEC.2019 17:29:02

LOW BAND EDGE BLOCK-5MHz-100%RB



HIGH BAND EDGE BLOCK-5MHz-100%RB



Note: Expanded measurement uncertainty is U = 0.488dB(100KHz-2GHz)/1.211dB(2GHz-26.5GHz), k = 1.96

A.7 CONDUCTED SPURIOUS EMISSION

Reference

FCC: CFR Part 2.1051, 24.238, 27.53.

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 2.1051 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 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(a) states for mobile and portable stations operating in the 2305–2315 MHz and 2350–2360 MHz bands: By a factor of not less than: 43 +10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, not less than 55 + 10 log (P) dB on all frequencies between 2320 and 2324 MHz and on all frequencies between 2341 and 2345 MHz, not less than 61 + 10 log (P) dB on all frequencies between 2324 and 2328 MHz and on all frequencies between 2337 and 2341 MHz, and not less than 67 + 10 log (P) dB onall frequencies between 2328 and 2337MHz;

By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 55 + 10 log (P) dB on all frequencies between 2296 and 2300MHz, 61 + 10 log (P) dB on all frequencies between 2292 and 2296 MHz, 67 + 10 log (P) dB on all frequencies between 2288 and 2292 MHz, and 70 + 10 log (P) dB below 2288 MHz; By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2365 MHz, and not less than 70 + 10 log (P) dB above 2365 MHz.

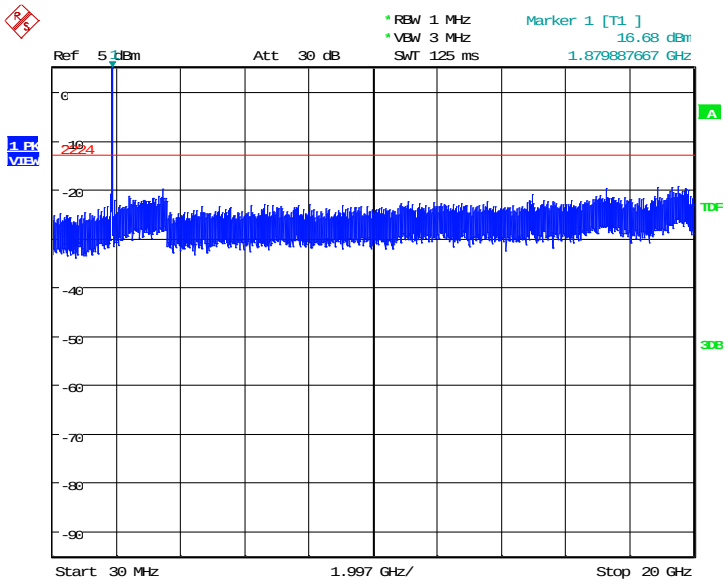
A. 7.3 Measurement result

Only worst case result is given below

LTE band 2 : 30MHz – 20GHz

Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.

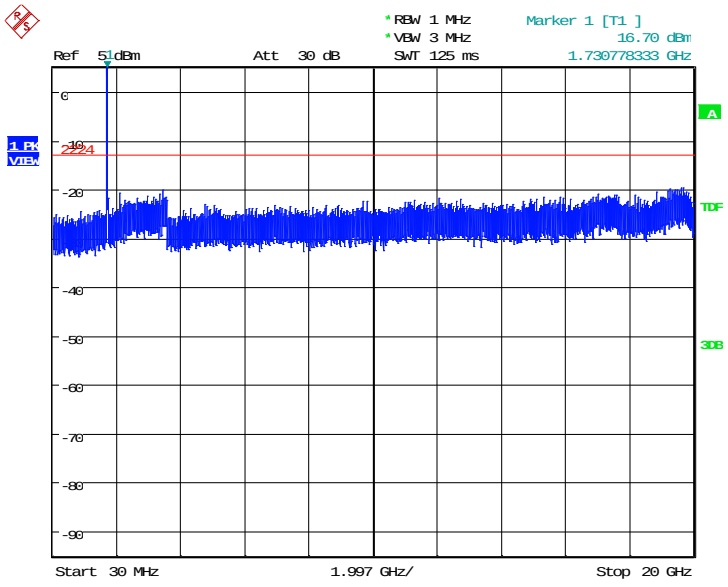


Date: 8.SEP.2019 08:53:56

LTE band 4 : 30MHz – 20GHz

Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.

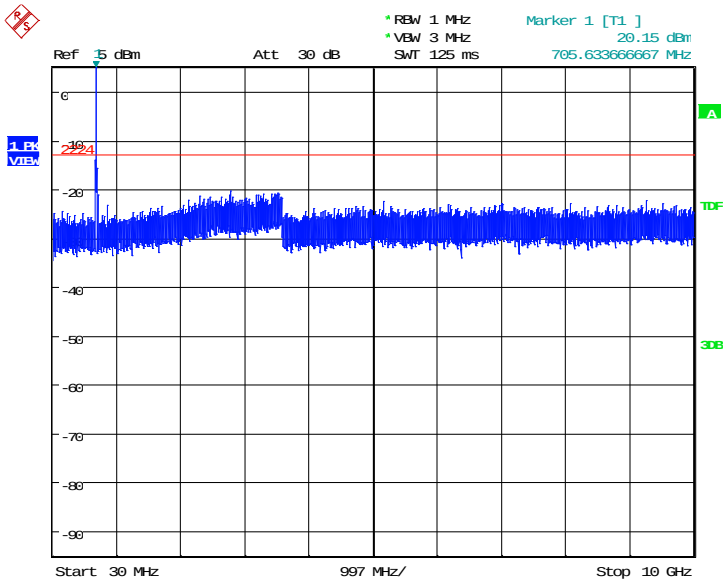


Date: 8.SEP.2019 09:55:12

LTE band 12: 30MHz – 10GHz

Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.

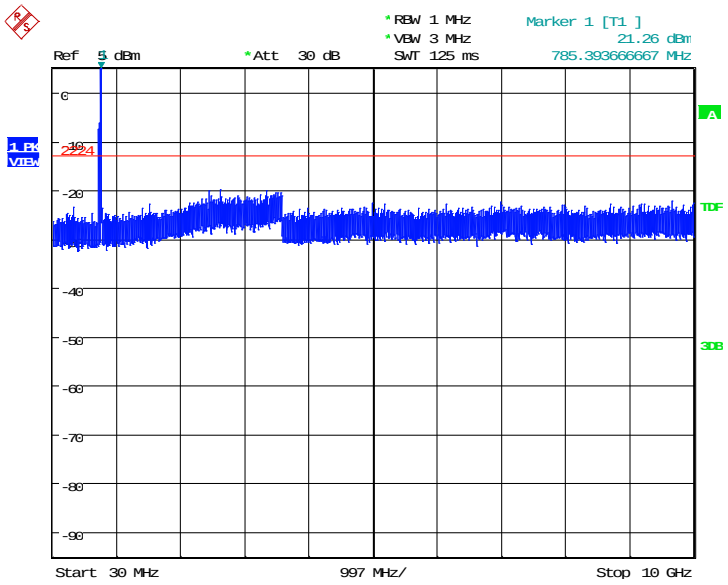


Date: 8.SEP.2019 10:43:41

LTE band 13: 30MHz – 10GHz

Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.



Date: 8.SEP.2019 18:14:29

Note: Expanded measurement uncertainty is U = 0.488dB(100KHz-2GHz)/1.211dB(2GHz-26.5GHz), k = 1.96

A.8 PEAK-TO-AVERAGE POWER RATIO

Reference

FCC: CFR Part 24.232, 27.50(d).

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.

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

Only worst case result is given below

LTE band 2

Frequency(MHz)	Bandwidth(MHz)	PAPR(dB)	
		QPSK	16QAM
1880.0	20	6.89	7.44
	15	6.44	7.05
	10	5.67	6.47
	5	5.42	6.22
	3	5.32	6.09
	1.4	5.54	5.99

LTE band 4

Frequency(MHz)	Bandwidth(MHz)	PAPR(dB)	
		QPSK	16QAM
1732.5	20	6.99	7.50
	15	6.44	7.05
	10	5.48	6.28
	5	5.10	5.90
	3	4.94	5.80
	1.4	5.13	5.64

LTE band 12

Frequency(MHz)	Bandwidth(MHz)	PAPR(dB)	
		QPSK	16QAM
707.5	10	5.58	6.35
	5	5.19	5.96
	3	5.22	5.87
	1.4	5.26	5.99

LTE band 13

Frequency(MHz)	Bandwidth(MHz)	PAPR(dB)	
		QPSK	16QAM
782.0	10	5.90	6.57
	5	5.74	6.54

Note: Expanded measurement uncertainty is U = 0.483, k = 2

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