



# TEST REPORT

No. I20N02439-RF-LTE

for

**TCL Communication Ltd.**

**LTE/UMTS/GSM Smartphone**

**Model Name: 4187M**

**FCC ID: 2ACCJB118**

with

**Hardware Version: FS180-MB-V0.2A**

**Software Version: 4187M\_LCAR\_1SIM\_V1.0\_20200814\_UNLOCK**

**Issued Date: 2020-09-10**

**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:**

**SAICT, Shenzhen Academy of Information and Communications Technology**

Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen,  
Guangdong, P. R. China 518026.

Tel:+86(0)755-33322000, Fax:+86(0)755-33322001

Email: yewu@caict.ac.cn. www.saict.ac.cn



## **REPORT HISTORY**

<b>Report Number</b>	<b>Revision</b>	<b>Description</b>	<b>Issue Date</b>
I20N02439-RF-LTE	Rev.0	1st edition	2020-09-10

Note: 4187M is a variant product of 5030J, All the original values of this report are quoted directly from I20N00391-RF-LTE. We didn't perform any additional test case.



## **CONTENTS**

<b>1. SUMMARY OF TEST REPORT .....</b>	<b>4</b>
<b>1.1. TEST ITEMS.....</b>	<b>4</b>
<b>1.2. TEST STANDARDS .....</b>	<b>4</b>
<b>1.3. TEST RESULT .....</b>	<b>4</b>
<b>1.4. TESTING LOCATION .....</b>	<b>4</b>
<b>1.5. PROJECT DATA .....</b>	<b>4</b>
<b>1.6. SIGNATURE.....</b>	<b>4</b>
<b>2. CLIENT INFORMATION .....</b>	<b>5</b>
<b>2.1. APPLICANT INFORMATION.....</b>	<b>5</b>
<b>2.2. MANUFACTURER INFORMATION.....</b>	<b>5</b>
<b>3. EQUIPMENT UNDER TEST (EUT) AND ANCILLARY EQUIPMENT (AE) .....</b>	<b>6</b>
<b>3.1. ABOUT EUT.....</b>	<b>6</b>
<b>3.2. INTERNAL IDENTIFICATION OF EUT USED DURING THE TEST .....</b>	<b>6</b>
<b>3.3. INTERNAL IDENTIFICATION OF AE USED DURING THE TEST.....</b>	<b>6</b>
<b>3.4. GENERAL DESCRIPTION .....</b>	<b>6</b>
<b>4. REFERENCE DOCUMENTS.....</b>	<b>7</b>
<b>5. LABORATORY ENVIRONMENT.....</b>	<b>8</b>
<b>6. SUMMARY OF TEST RESULTS.....</b>	<b>9</b>
<b>7. STATEMENT .....</b>	<b>11</b>
<b>8. TEST EQUIPMENTS UTILIZED.....</b>	<b>12</b>
<b>ANNEX A: MEASUREMENT RESULTS .....</b>	<b>13</b>
<b>A.1 OUTPUT POWER.....</b>	<b>13</b>
<b>A.2 FIELD STRENGTH OF SPURIOUS RADIATION.....</b>	<b>28</b>
<b>A.3 FREQUENCY STABILITY .....</b>	<b>36</b>
<b>A.4 OCCUPIED BANDWIDTH.....</b>	<b>39</b>
<b>A.5 EMISSION BANDWIDTH .....</b>	<b>56</b>
<b>A.6 BAND EDGE COMPLIANCE .....</b>	<b>73</b>
<b>A.7 CONDUCTED SPURIOUS EMISSION .....</b>	<b>85</b>
<b>A.8 PEAK-TO-AVERAGE POWER RATIO .....</b>	<b>88</b>

## 1. SUMMARY OF TEST REPORT

### 1.1. Test Items

Description	LTE/UMTS/GSM Smartphone
Model Name	4187M
Applicant's name	TCL Communication Ltd.
Manufacturer's Name	TCL Communication Ltd.

### 1.2. Test Standards

FCC Part 2/24/27	10-1-19
	Edition
ANSI C63.26	2015
KDB971168 D01	v03r01

### 1.3. Test Result

All test items are pass. Please refer to "6 SUMMARY OF TEST RESULTS" for detail.

### 1.4. Testing Location

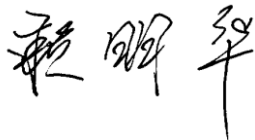
Address: Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong, P. R. China 518026

### 1.5. Project Data

Testing Start Date: 2020-03-16

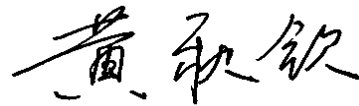
Testing End Date: 2020-04-02

### 1.6. Signature



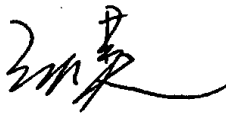
---

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: TCL Communication Ltd.  
Address /Post: 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong  
Contact Person: Gong Zhizhou  
Contact Email: zhizhou.gong@tcl.com  
Telephone: 0086-755-36611722  
Fax: 0086-755-36612000-81722

### **2.2. Manufacturer Information**

Company Name: TCL Communication Ltd.  
Address /Post: 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong  
Contact Person: Gong Zhizhou  
Contact Email: zhizhou.gong@tcl.com  
Telephone: 0086-755-36611722  
Fax: 0086-755-36612000-81722

### **3. EQUIPMENT UNDER TEST (EUT) AND ANCILLARY EQUIPMENT**

#### **(AE)**

#### **3.1. About EUT**

Description	LTE/UMTS/GSM Smartphone
Model Name	4187M
FCC ID	2ACCJB118
Frequency Bands	LTE Bands 2,4,7
Antenna	Integrated
Extreme vol. Limits	3.5VDC to 4.4VDC (nominal: 3.85VDC)
Extreme temp. Tolerance	0°C to +60°C
Condition of EUT as received	No abnormality in appearance

Note: The Declaration of changes from Initial 5030J to Variant 4187M are as below:  
5030J memory is 32G ROM+3G RAM ; 4187M memory is 32G ROM+2G RAM.

#### **3.2. Internal Identification of EUT used during the test**

<b>EUT ID*</b>	<b>IMEI</b>	<b>HW Version</b>	<b>SW Version</b>	<b>Sample Arrival Date</b>
UT05aa	354827110000070	FS180-MB-V0.2	5030J_OFAR_1SIM_V1.4_20200331_UNLOCK	2020-03-11
UT04aa	354827110000187	FS180-MB-V0.2	5030J_OFAR_1SIM_V1.4_20200331_UNLOCK	2020-03-11

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

#### **3.3. Internal Identification of AE used during the test**

<b>AE ID*</b>	<b>Description</b>
AE1	LI-Polymer Battery
AE1-1	
Model	TLp038D7
SN	CAC3860025C7
Manufacturer	VENKE
Capacity	4000mAh
Nominal Voltage	3.85V
AE1-2	
Model	TLp038DA
SN	CAC3860032CA
Manufacturer	TIANMAO
Capacity	4000mAh
Nominal Voltage	3.85V

\*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 LTE/UMTS/GSM Smartphone with integrated antenna. It consists of normal options: lithium battery, charger. Manual and specifications of the EUT were provided to fulfil the test. Samples undergoing test were selected by the Client.



#### 4. REFERENCE DOCUMENTS

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

<b>Reference</b>	<b>Title</b>	<b>Version</b>
FCC Part 24	PERSONAL COMMUNICATIONS SERVICES	10-1-19 Edition
FCC Part 2	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS	10-1-19 Edition
FCC Part 27	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES	10-1-19 Edition
ANSI C63.26	American National Standard of Procedures for Compliance Testing of Licensed Transmitters Used in Licensed Radio Service	2015
KDB971168 D01	Power Meas License Digital Systems	v03r01

## 5. LABORATORY ENVIRONMENT

**Shielded room** did not exceed following limits along the RF testing:

Temperature	Min. = 15 °C, Max. = 35 °C
Relative humidity	Min. = 15 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz>60 dB; 1MHz-18000MHz>90 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 °C, Max. = 35 °C
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 1.4 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/ KDB971168 D01	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)/ KDB971168 D01	A.8	P



## LTE Band 7

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/27.50(h)	A.1	P
2	Field Strength of Spurious Radiation	2.1053/27.53(m)	A.2	P
3	Frequency Stability	2.1055/27.54	A.3	P
4	Occupied Bandwidth	2.1049/27.53(m)	A.4	P
5	Emission Bandwidth	2.1049/27.53(m)	A.5	P
6	Band Edge Compliance	2.1051/27.53(m)	A.6	P
7	Conducted Spurious Emission	2.1051/27.53(m)	A.7	P
8	Peak-to-Average Power Ratio	27.50(a)/ KDB971168 D01	A.8	P



## **7. STATEMENT**

Since the information of samples in this report is provided by the client, the laboratory is not responsible for the authenticity of sample information.

This report takes measured values as criterion of test conclusion. The test conclusion meets the limit requirements.

## 8. TEST EQUIPMENTS UTILIZED

NO.	Description	Type	Manufacture	Series Number	Cal Due Date
1	Test Receiver	ESR7	R&S	101676	2020-11-27
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	2023-01-06
5	Antenna	BBHA 9120D	Schwarzbeck	1593	2022-12-05
6	Antenna	VUBA 9117	Schwarzbeck	207	2020-07-16
7	Antenna	QWH-SL-18 -40-K-SG	Q-par	15979	2023-01-06
8	preamplifier	83017A	Agilent	MY39501110	/
9	Signal Generator	SMB100A	R&S	179725	2020-11-27
10	Fully Anechoic Chamber	FACT3-2.0	ETS-Lindgren	1285	2021-07-19
11	Spectrum Analyzer	FSV40	R&S	101192	2021-01-14
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	2020-12-13
15	Temperature Chamber	SH-241	ESPECs	92007516	2020-10-15
16	DC Power Supply	U3606A	Agilent Technologies	MY50450012	2020-11-13

### 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	23.33	22.95
		1880.0	23.05	22.19
		1850.7	22.72	22.33
	1 RB low	1909.3	23.38	23.00
		1880.0	22.99	22.18
		1850.7	22.73	22.36
	50% RB mid	1909.3	23.52	22.82
		1880.0	23.08	22.18
		1850.7	22.79	22.10
	100% RB	1909.3	22.45	21.30
		1880.0	21.94	20.89
		1850.7	21.77	20.62
3MHz	1 RB high	1908.5	23.39	22.99
		1880.0	23.02	22.03
		1851.5	22.76	22.30
	1 RB low	1908.5	23.35	22.96
		1880.0	22.94	21.98
		1851.5	22.73	22.35
	50% RB mid	1908.5	22.44	21.69
		1880.0	21.98	21.14
		1851.5	21.74	21.01

	100% RB	1908.5	22.40	21.64
		1880.0	21.96	21.13
		1851.5	21.76	21.02
5MHz	1 RB high	1907.5	23.33	23.02
		1880.0	22.97	22.60
		1852.5	22.69	22.35
	1 RB low	1907.5	23.29	22.94
		1880.0	22.84	22.50
		1852.5	22.77	22.39
	50% RB mid	1907.5	22.40	21.57
		1880.0	22.03	21.13
		1852.5	21.76	20.95
	100% RB	1907.5	22.38	21.47
		1880.0	21.90	21.06
		1852.5	21.74	20.85
10MHz	1 RB high	1905.0	23.36	22.87
		1880.0	23.11	22.56
		1855.0	22.71	22.29
	1 RB low	1905.0	23.24	22.75
		1880.0	22.94	22.39
		1855.0	22.73	22.21
	50% RB mid	1905.0	22.33	21.62
		1880.0	22.07	21.35
		1855.0	21.84	21.08
	100% RB	1905.0	22.35	21.43
		1880.0	21.99	21.15
		1855.0	21.76	20.88
15MHz	1 RB high	1902.5	23.37	23.06
		1880.0	23.00	22.79
		1857.5	22.69	22.44
	1 RB low	1902.5	23.27	22.92
		1880.0	22.82	22.68
		1857.5	22.76	22.45
	50% RB mid	1902.5	22.35	21.49
		1880.0	22.03	21.10
		1857.5	21.86	20.90
	100% RB	1902.5	22.35	21.54
		1880.0	22.03	21.19
		1857.5	21.74	20.94



20MHz	1 RB high	1900.0	23.10	23.05
		1880.0	23.15	22.34
		1860.0	22.77	22.48
	1 RB low	1900.0	22.97	22.84
		1880.0	22.95	22.14
		1860.0	22.76	22.48
	50% RB mid	1900.0	21.98	21.39
		1880.0	22.03	21.17
		1860.0	21.73	20.94
	100% RB	1900.0	22.01	21.43
		1880.0	21.96	21.19
		1860.0	21.80	21.02

Note: Expanded measurement uncertainty is  $U = 0.49$  dB,  $k = 1.96$

**LTE band 4**

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
1.4MHz	1 RB high	1754.3	23.11	22.38
		1732.5	22.97	22.57
		1710.7	22.80	22.53
	1 RB low	1754.3	23.08	22.40
		1732.5	22.95	22.59
		1710.7	22.83	22.51
	50% RB mid	1754.3	23.35	22.53
		1732.5	22.99	22.37
		1710.7	22.92	22.33
	100% RB	1754.3	22.27	21.22
		1732.5	21.99	20.86
		1710.7	21.89	20.78
3MHz	1 RB high	1753.5	23.10	22.45
		1732.5	23.04	22.43
		1711.5	22.91	22.37
	1 RB low	1753.5	23.14	22.48
		1732.5	23.00	22.43
		1711.5	22.95	22.41
	50% RB mid	1753.5	22.29	21.54
		1732.5	22.04	21.31
		1711.5	21.90	21.16
	100% RB	1753.5	22.25	21.44
		1732.5	22.02	21.24
		1711.5	22.03	21.15
5MHz	1 RB high	1752.5	23.04	22.92
		1732.5	22.94	22.60
		1712.5	22.84	22.55
	1 RB low	1752.5	23.05	22.91
		1732.5	22.94	22.62
		1712.5	22.86	22.54
	50% RB mid	1752.5	22.28	21.31
		1732.5	22.00	21.16
		1712.5	21.91	21.05
	100% RB	1752.5	22.27	21.34
		1732.5	21.94	21.09
		1712.5	21.98	21.04
10MHz	1 RB high	1750.0	23.19	22.60



		1732.5	22.96	22.52	
		1715.0	22.85	22.40	
		1750.0	23.20	22.55	
	1 RB low		1732.5	22.94	22.44
			1715.0	22.97	22.37
			1750.0	22.27	21.54
	50% RB mid		1732.5	22.02	21.32
			1715.0	21.91	21.34
			1750.0	22.20	21.42
	100% RB		1732.5	21.95	21.15
			1715.0	21.98	21.11
			1747.5	23.17	22.79
15MHz	1 RB high	1732.5	22.97	22.63	
		1717.5	22.90	22.50	
		1747.5	23.11	22.77	
	1 RB low	1732.5	22.97	22.59	
		1717.5	22.86	22.59	
		1747.5	22.23	21.32	
	50% RB mid	1732.5	21.98	21.10	
		1717.5	22.00	21.03	
		1747.5	22.21	21.44	
	100% RB	1732.5	22.06	21.15	
		1717.5	21.85	21.08	
		1745.0	23.09	22.97	
	20MHz	1 RB high	1732.5	22.96	22.67
			1720.0	22.95	22.54
			1745.0	23.02	22.91
1 RB low		1732.5	22.98	22.65	
		1720.0	22.91	22.58	
		1745.0	22.30	21.34	
50% RB mid		1732.5	22.09	21.14	
		1720.0	21.94	21.06	
		1745.0	22.19	21.38	
100% RB		1732.5	22.01	21.14	
		1720.0	21.95	21.07	

Note: Expanded measurement uncertainty is  $U = 0.49$  dB,  $k = 1.96$

**LTE band 7**

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
5MHz	1 RB high	2567.5	22.86	22.61
		2535.0	22.51	22.34
		2502.5	22.82	22.30
	1 RB low	2567.5	22.82	22.60
		2535.0	22.49	22.32
		2502.5	22.77	22.37
	50% RB mid	2567.5	21.93	21.05
		2535.0	21.72	20.77
		2502.5	21.85	21.09
	100% RB	2567.5	21.91	21.02
		2535.0	21.64	20.71
		2502.5	21.89	21.22
10MHz	1 RB high	2565.0	22.80	22.38
		2535.0	22.59	22.18
		2505.0	22.83	22.38
	1 RB low	2565.0	22.74	22.33
		2535.0	22.58	22.04
		2505.0	22.69	22.32
	50% RB mid	2565.0	21.94	21.26
		2535.0	21.67	20.95
		2505.0	21.84	21.22
	100% RB	2565.0	21.99	21.07
		2535.0	21.65	20.81
		2505.0	21.89	21.10
15MHz	1 RB high	2562.5	22.90	22.71
		2535.0	22.60	22.51
		2507.5	22.81	22.28
	1 RB low	2562.5	22.70	22.64
		2535.0	22.60	22.46
		2507.5	22.80	22.28
	50% RB mid	2562.5	21.97	21.05
		2535.0	21.71	20.76
		2507.5	21.93	21.17
	100% RB	2562.5	21.86	21.15
		2535.0	21.73	20.88
		2507.5	21.90	21.07



20MHz	1 RB high	2560.0	23.00	22.70
		2535.0	22.84	22.17
		2510.0	22.90	22.58
	1 RB low	2560.0	22.68	22.48
		2535.0	22.70	22.04
		2510.0	22.79	22.55
	50% RB mid	2560.0	22.03	21.06
		2535.0	21.60	20.81
		2510.0	21.95	21.12
	100% RB	2560.0	21.92	21.10
		2535.0	21.62	20.81
		2510.0	22.04	21.14

Note: Expanded measurement uncertainty is  $U = 0.49$  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.

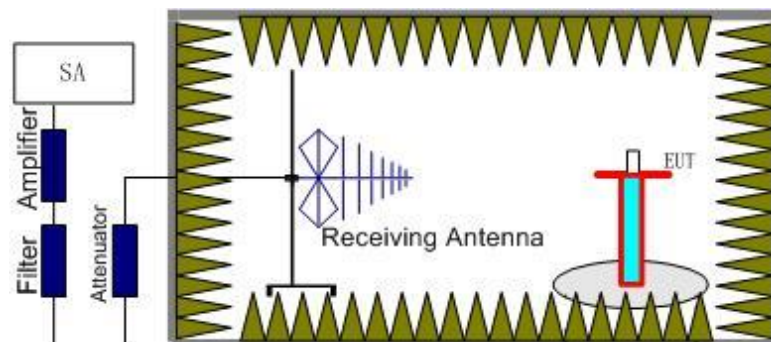
Rule Part 24.232(b) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p. Peak power" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

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".

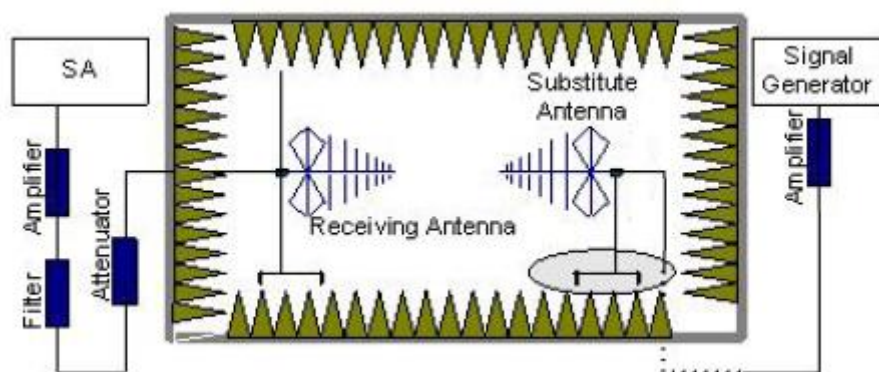
Rule Part 27.50(h)(2) specifies "Mobile stations are limited to 2.0 watts EIRP".

#### A.1.3.2 Method of Measurement

- 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.



- 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 ( $P_r$ ).
- 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:

$$\text{Power (EIRP)} = P_{Mea} - P_{Ag} - P_{cl} + G_a$$

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 <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1850.70	-14.31	-29.30	9.80	24.79	33.00	H
1880.00	-14.51	-29.40	9.80	24.69	33.00	H
1909.30	-13.19	-29.30	9.80	25.91	33.00	H

**LTE Band 2\_3MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1851.50	-14.48	-29.30	9.80	24.62	33.00	H
1880.00	-15.03	-29.40	9.80	24.17	33.00	H
<b>1908.50</b>	<b>-13.09</b>	<b>-29.30</b>	<b>9.80</b>	<b>26.01</b>	<b>33.00</b>	<b>H</b>

**LTE Band 2\_5MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1852.50	-15.78	-29.30	9.80	23.32	33.00	H
1880.00	-15.07	-29.40	9.80	24.13	33.00	H
1907.50	-15.39	-29.30	9.80	23.71	33.00	H

**LTE Band 2\_10MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1855.00	-14.63	-29.30	9.80	24.47	33.00	H
1880.00	-14.36	-29.40	9.80	24.84	33.00	H
1905.00	-14.15	-29.30	9.80	24.95	33.00	H

**LTE Band 2\_15MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1857.50	-14.44	-29.30	9.80	24.66	33.00	H
1880.00	-14.32	-29.40	9.80	24.88	33.00	H
1902.50	-14.50	-29.30	9.80	24.60	33.00	H

**LTE Band 2\_20 MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1860.00	-14.48	-29.30	9.80	24.62	33.00	H
1880.00	-14.13	-29.40	9.80	25.07	33.00	H
1900.00	-14.70	-29.30	9.80	24.40	33.00	H

**LTE Band 2\_1.4MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1850.70	-15.47	-29.30	9.80	23.63	33.00	H
1880.00	-15.19	-29.40	9.80	24.01	33.00	H
1909.30	-14.63	-29.30	9.80	24.47	33.00	H

**LTE Band 2\_3MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1851.50	-15.53	-29.30	9.80	23.57	33.00	H
1880.00	-15.77	-29.40	9.80	23.43	33.00	H
1908.50	-15.22	-29.30	9.80	23.88	33.00	H

**LTE Band 2\_5MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1852.50	-15.30	-29.30	9.80	23.80	33.00	H
1880.00	-15.26	-29.40	9.80	23.94	33.00	H
1907.50	-14.66	-29.30	9.80	24.44	33.00	H

**LTE Band 2\_10MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1855.00	-15.19	-29.30	9.80	23.91	33.00	H
1880.00	-14.59	-29.40	9.80	24.61	33.00	H
1905.00	-14.96	-29.30	9.80	24.14	33.00	H

**LTE Band 2\_15MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1857.50	-14.98	-29.30	9.80	24.12	33.00	H
1880.00	-14.73	-29.40	9.80	24.47	33.00	H
1902.50	-15.34	-29.30	9.80	23.76	33.00	H

**LTE Band 2\_20 MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1860.00	-14.98	-29.30	9.80	24.12	33.00	H
1880.00	-15.87	-29.40	9.80	23.33	33.00	H
1900.00	-15.19	-29.30	9.80	23.91	33.00	H

Peak EIRP (dBm)=P<sub>Mea</sub>(-13.09dBm)-(P<sub>cl</sub>+P<sub>Ag</sub>)(-29.30dB)+G<sub>a</sub>(9.80dB) =26.01dBm

**LTE Band 4- EIRP 27.50(d)**
**Limits:** ≤30dBm (1W)

**LTE Band 4\_1.4MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1710.70	-13.82	-29.60	8.10	23.88	30.00	H
1732.50	-13.02	-29.60	8.10	24.68	30.00	H
1754.30	-12.95	-29.50	8.10	24.65	30.00	H

**LTE Band 4\_3MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1711.50	-13.14	-29.60	8.10	24.56	30.00	H
1732.50	-13.17	-29.60	8.10	24.53	30.00	H
1753.50	-13.39	-29.50	8.10	24.21	30.00	H

**LTE Band 4\_5MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1712.50	-13.13	-29.60	8.10	24.57	30.00	H
1732.50	-13.55	-29.60	8.10	24.15	30.00	H
1752.50	-13.58	-29.50	8.10	24.02	30.00	H

**LTE Band 4\_10MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1715.00	-12.90	-29.60	8.10	24.80	30.00	H
1732.50	-12.79	-29.60	8.10	24.91	30.00	H
1750.00	-14.03	-29.50	8.10	23.57	30.00	H

**LTE Band 4\_15MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1717.50	-12.89	-29.60	8.10	24.81	30.00	H
1732.50	-12.89	-29.60	8.10	24.81	30.00	H
1747.50	-13.22	-29.50	8.10	24.38	30.00	H

**LTE Band 4\_20MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
<b>1720.00</b>	<b>-12.76</b>	<b>-29.60</b>	<b>8.10</b>	<b>24.94</b>	<b>30.00</b>	<b>H</b>
1732.50	-12.88	-29.60	8.10	24.82	30.00	H
1745.00	-13.08	-29.50	8.10	24.52	30.00	H



**LTE Band 4\_1.4MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1710.70	-13.93	-29.60	8.10	23.77	30.00	H
1732.50	-13.45	-29.60	8.10	24.25	30.00	H
1754.30	-14.28	-29.50	8.10	23.32	30.00	H

**LTE Band 4\_3MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1711.50	-13.21	-29.60	8.10	24.49	30.00	H
1732.50	-12.89	-29.60	8.10	24.81	30.00	H
1753.50	-13.78	-29.50	8.10	23.82	30.00	H

**LTE Band 4\_5MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1712.50	-13.25	-29.60	8.10	24.45	30.00	H
1732.50	-13.78	-29.60	8.10	23.92	30.00	H
1752.50	-14.48	-29.50	8.10	23.12	30.00	H

**LTE Band 4\_10MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1715.00	-14.22	-29.60	8.10	23.48	30.00	H
1732.50	-13.40	-29.60	8.10	24.30	30.00	H
1750.00	-14.04	-29.50	8.10	23.56	30.00	H

**LTE Band 4\_15MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1717.50	-13.83	-29.60	8.10	23.87	30.00	H
1732.50	-13.90	-29.60	8.10	23.80	30.00	H
1747.50	-13.97	-29.50	8.10	23.63	30.00	H

**LTE Band 4\_20MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1720.00	-13.48	-29.60	8.10	24.22	30.00	H
1732.50	-13.60	-29.60	8.10	24.10	30.00	H
1745.00	-13.54	-29.50	8.10	24.06	30.00	H

Peak EIRP (dBm)=P<sub>Mea</sub>(-12.76dBm)-(P<sub>cl</sub>+P<sub>Ag</sub>)(-29.60dB)+G<sub>a</sub>(8.10dB) =24.94dBm

**LTE Band 7- EIRP 27.50(h)(2)****Limits:** ≤33 dBm (2W)**LTE Band 7\_5MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
2502.50	-14.74	-28.70	10.70	24.66	33.00	H
2535.00	-15.02	-28.60	10.70	24.28	33.00	H
2567.50	-14.39	-28.60	10.70	24.91	33.00	H

**LTE Band 7\_10MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
2505.00	-15.08	-28.70	10.70	24.32	33.00	H
2535.00	-14.74	-28.60	10.70	24.56	33.00	H
2565.00	-14.45	-28.60	10.70	24.85	33.00	H

**LTE Band 7\_15MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Polarization
2507.50	-15.16	-28.70	10.70	24.24	33.00	H
<b>2535.00</b>	<b>-14.20</b>	<b>-28.60</b>	<b>10.70</b>	<b>25.10</b>	<b>33.00</b>	<b>H</b>
2562.50	-14.79	-28.60	10.70	24.51	33.00	H

**LTE Band 7\_20MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
2510.00	-15.63	-28.70	10.70	23.77	33.00	H
2535.00	-14.85	-28.60	10.70	24.45	33.00	H
2560.00	-14.22	-28.60	10.70	25.08	33.00	H

**LTE Band 7\_5MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
2502.50	-17.52	-28.70	10.70	21.88	33.00	H
2535.00	-16.15	-28.60	10.70	23.15	33.00	H
2567.50	-16.25	-28.60	10.70	23.05	33.00	H

**LTE Band 7\_10MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
2505.00	-18.03	-28.70	10.70	21.37	33.00	H
2535.00	-15.51	-28.60	10.70	23.79	33.00	H
2565.00	-16.52	-28.60	10.70	22.78	33.00	H

**LTE Band 7\_15MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
2507.50	-17.05	-28.70	10.70	22.35	33.00	H
2535.00	-16.14	-28.60	10.70	23.16	33.00	H
2562.50	-16.80	-28.60	10.70	22.50	33.00	H

**LTE Band 7\_20MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)+ P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
2510.00	-16.79	-28.70	10.70	22.61	33.00	H
2535.00	-15.62	-28.60	10.70	23.68	33.00	H
2560.00	-16.30	-28.60	10.70	23.00	33.00	H

Peak EIRP (dBm)=P<sub>Mea</sub>(-14.20dBm)-(P<sub>cl</sub>+P<sub>Ag</sub>)(-28.60dB)+G<sub>a</sub>(10.70dB) =25.10dBm

**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 =

2.90dB(30MHz-3GHz)/3.50dB(3GHz-18GHz)/3.90dB(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.

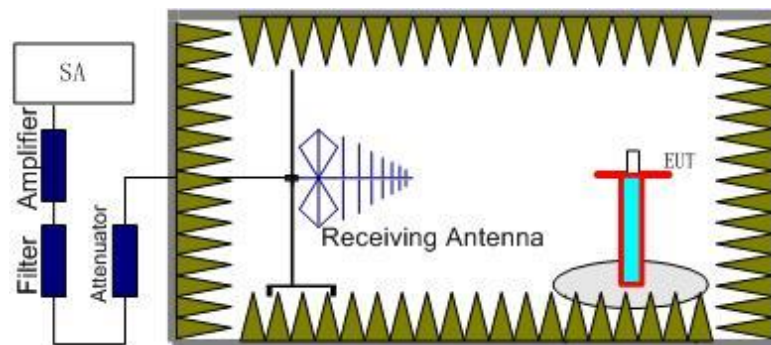
### **A.2.1 Measurement Method**

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

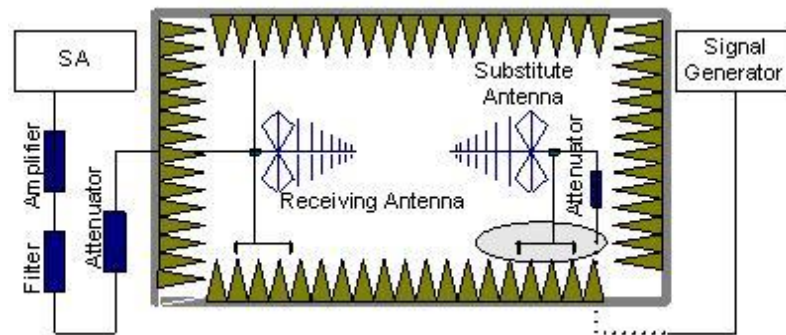
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier. The resolution bandwidth is set 1MHz as outlined in Part 24.238, 27.53(h). The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE Bands 2,4,7.

### **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:

$$\text{Power (EIRP)} = P_{Mea} - P_{pl} + G_a$$

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,  $ERP = EIRP - 2.15\text{dB}$ .

### A.2.2 Measurement Results

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of the LTE Bands 2,4,7. It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the LTE Bands 2,4,7 into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

Only worst case result is given below.

**LTE Band 2, 1.4MHz, QPSK, Channel 18607**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2841.33	-52.18	1.00	11.50	-41.68	-13.00	V
3700.00	-56.64	1.10	12.20	-45.54	-13.00	H
5550.50	-53.72	1.40	13.10	-42.02	-13.00	V
10221.00	-55.98	2.10	10.80	-47.28	-13.00	H
12951.50	-54.16	2.50	13.30	-43.36	-13.00	H
16788.50	-54.56	2.90	16.50	-40.96	-13.00	V

**LTE Band 2, 1.4MHz, QPSK, Channel 18900**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2857.87	-51.80	1.00	11.50	-41.30	-13.00	V
3759.50	-60.95	1.10	12.40	-49.65	-13.00	H
5638.50	-53.73	1.30	13.10	-41.93	-13.00	V
9798.00	-56.73	2.30	11.30	-47.73	-13.00	H
13157.00	-55.14	2.40	13.30	-44.24	-13.00	H
17010.00	-52.61	2.90	14.50	-41.01	-13.00	H

**LTE Band 2, 1.4MHz, QPSK, Channel 19193**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2833.60	-51.96	1.00	11.50	-41.46	-13.00	V
3817.50	-54.88	1.20	12.40	-43.68	-13.00	V
5726.50	-49.60	1.50	13.10	-38.00	-13.00	V
11986.50	-56.55	2.60	12.60	-46.55	-13.00	V
15043.00	-54.68	2.40	12.40	-44.68	-13.00	V
17026.50	-53.23	2.90	14.50	-41.63	-13.00	V

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2841.33	-52.30	1.00	11.50	-41.80	-13.00	V
3700.50	-58.08	1.10	12.20	-46.98	-13.00	H
5550.50	-55.74	1.40	13.10	-44.04	-13.00	V
12952.00	-48.80	2.40	13.80	-37.40	-13.00	H
14836.50	-53.66	2.70	12.40	-43.96	-13.00	V
16777.50	-55.12	2.90	16.50	-41.52	-13.00	V

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2545.87	-51.40	1.00	11.50	-40.90	-13.00	H
3759.00	-59.37	1.10	12.40	-48.07	-13.00	H
5638.50	-57.60	1.30	13.10	-45.80	-13.00	V
12101.50	-55.24	2.60	12.60	-45.24	-13.00	V
14466.00	-52.75	2.60	11.20	-44.15	-13.00	H
16822.50	-53.11	2.90	14.50	-41.51	-13.00	H

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2844.80	-51.40	1.00	11.50	-40.90	-13.00	V
3817.50	-54.03	1.20	12.40	-42.83	-13.00	V
5726.50	-50.86	1.50	13.10	-39.26	-13.00	V
11453.00	-50.69	2.60	11.00	-42.29	-13.00	V
14465.50	-51.87	2.60	11.20	-43.27	-13.00	V
16748.00	-54.86	2.90	16.50	-41.26	-13.00	V

Note: The maximum value of expanded measurement uncertainty for this test item is  $U = 2.90\text{dB}(30\text{MHz}-3\text{GHz})/3.50\text{dB}(3\text{GHz}-18\text{GHz})/3.90\text{dB}(18\text{GHz}-40\text{GHz})$ ,  $k = 2$

**LTE Band 4, 1.4MHz QPSK, Channel 19957**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2861.07	-52.20	1.00	11.50	-41.70	-13.00	V
3420.00	-61.15	1.10	12.20	-50.05	-13.00	H
5130.50	-57.78	1.60	12.50	-46.88	-13.00	H
11972.00	-53.73	2.60	12.60	-43.73	-13.00	V
14130.00	-54.73	2.50	11.90	-45.33	-13.00	V
16887.00	-52.43	2.90	14.50	-40.83	-13.00	V

**LTE Band 4, 1.4MHz, QPSK, Channel 20175**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2912.00	-52.60	1.00	11.50	-42.10	-13.00	H
3464.00	-60.72	1.10	12.20	-49.62	-13.00	H
5196.50	-58.31	1.60	12.50	-47.41	-13.00	V
11111.00	-54.89	2.50	10.50	-46.89	-13.00	V
14009.50	-54.07	2.50	11.90	-44.67	-13.00	H
17035.00	-52.72	2.90	14.50	-41.12	-13.00	V

**LTE Band 4, 1.4MHz, QPSK, Channel 20393**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2640.27	-52.48	1.00	11.50	-41.98	-13.00	V
5261.00	-55.08	1.60	13.10	-43.58	-13.00	H
10482.50	-54.71	2.30	10.80	-46.21	-13.00	H
12277.00	-55.31	2.60	13.80	-44.11	-13.00	V
14201.00	-54.21	2.60	11.90	-44.91	-13.00	V
16768.00	-54.81	2.90	16.50	-41.21	-13.00	V



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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2510.67	-51.50	1.00	11.50	-41.00	-13.00	H
3420.50	-59.09	1.10	12.20	-47.99	-13.00	H
5131.00	-57.98	1.30	12.50	-46.78	-13.00	H
11073.50	-54.76	2.30	10.50	-46.56	-13.00	V
14104.00	-54.38	2.50	11.90	-44.98	-13.00	V
17122.50	-53.06	2.90	14.50	-41.46	-13.00	H

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2869.07	-52.55	1.00	11.50	-42.05	-13.00	V
3464.00	-60.41	1.10	12.20	-49.31	-13.00	H
5196.00	-54.42	1.80	12.50	-43.72	-13.00	H
12124.50	-53.67	2.60	12.60	-43.67	-13.00	V
14752.50	-54.02	2.70	12.40	-44.32	-13.00	H
17017.50	-52.46	2.90	14.50	-40.86	-13.00	V

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2839.47	-52.29	1.00	11.50	-41.79	-13.00	V
5261.50	-52.98	1.60	13.10	-41.48	-13.00	V
10308.50	-55.92	2.30	10.80	-47.42	-13.00	H
12277.00	-48.90	2.60	13.80	-37.70	-13.00	V
14510.50	-52.95	2.60	11.20	-44.35	-13.00	V
16756.00	-54.56	2.90	16.50	-40.96	-13.00	V

Note: The maximum value of expanded measurement uncertainty for this test item is  $U = 2.90\text{dB}(30\text{MHz}-3\text{GHz})/3.50\text{dB}(3\text{GHz}-18\text{GHz})/3.90\text{dB}(18\text{GHz}-40\text{GHz})$ ,  $k = 2$

**LTE Band 7, 5 MHz, QPSK, Channel 20775**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2926.13	-52.51	1.00	11.50	-42.01	-25.00	H
8062.50	-58.05	1.80	11.30	-48.55	-25.00	V
10001.00	-52.32	2.00	11.30	-43.02	-25.00	H
12502.00	-42.33	2.40	13.80	-30.93	-25.00	V
14014.00	-52.77	2.50	11.90	-43.37	-25.00	H
17090.50	-52.78	2.90	14.50	-41.18	-25.00	H

**LTE Band 7, 5 MHz, QPSK, Channel 21100**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2980.53	-52.76	1.00	11.50	-42.26	-25.00	V
5065.50	-57.45	1.20	12.50	-46.15	-25.00	V
10131.00	-51.28	2.20	11.30	-42.18	-25.00	H
12033.00	-54.38	2.70	12.60	-44.48	-25.00	H
12664.50	-43.87	2.60	13.80	-32.67	-25.00	H
16901.50	-52.55	2.90	14.50	-40.95	-25.00	H

**LTE Band 7, 5 MHz, QPSK, Channel 21425**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2945.07	-52.05	1.00	11.50	-41.55	-25.00	H
5130.50	-56.26	1.30	12.50	-45.06	-25.00	V
10261.00	-49.76	2.10	10.80	-41.06	-25.00	H
11712.00	-55.33	2.50	12.60	-45.23	-25.00	V
12826.50	-44.72	2.50	13.30	-33.92	-25.00	H
16904.00	-52.75	2.90	14.50	-41.15	-25.00	V

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2982.13	-52.67	1.00	11.50	-42.17	-25.00	H
8348.00	-59.09	1.80	12.00	-48.89	-25.00	V
10001.50	-53.27	2.00	11.30	-43.97	-25.00	H
12502.00	-43.09	2.40	13.80	-31.69	-25.00	V
14422.50	-52.31	2.60	11.20	-43.71	-25.00	H
16951.50	-52.36	2.90	14.50	-40.76	-25.00	V

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2942.67	-52.92	1.00	11.50	-42.42	-25.00	H
5065.50	-57.92	1.20	12.50	-46.62	-25.00	V
10131.50	-50.29	2.20	11.30	-41.19	-25.00	H
11732.00	-55.51	2.50	12.60	-45.41	-25.00	V
12664.50	-44.01	2.60	13.80	-32.81	-25.00	H
17032.00	-51.86	2.90	14.50	-40.26	-25.00	H

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2986.67	-52.67	1.00	11.50	-42.17	-25.00	V
5130.50	-56.06	1.60	12.50	-45.16	-25.00	V
10261.50	-47.68	2.10	10.80	-38.98	-25.00	H
11687.00	-53.61	2.60	11.00	-45.21	-25.00	H
12827.00	-44.07	2.50	13.30	-33.27	-25.00	H
16829.00	-52.52	2.90	14.50	-40.92	-25.00	V

Note: The maximum value of expanded measurement uncertainty for this test item is  $U = 2.90\text{dB}(30\text{MHz}-3\text{GHz})/3.50\text{dB}(3\text{GHz}-18\text{GHz})/3.90\text{dB}(18\text{GHz}-40\text{GHz})$ ,  $k = 2$

### **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°C.
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 10°C increments from 0°C to +50°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Re-measure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments re-measuring carrier frequency at each voltage. Pause at nominal voltage for 1.5 hours unpowered, to allow any self-heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +50°C.
7. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10 °C increments from +50°C to 0°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5°C 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 3.5VDC and 4.4VDC, with a nominal voltage of 3.85VDC. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. 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.3.3 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
3.5	22	13	0.012	0.007
3.85	16	22	0.009	0.012
4.4	31	17	0.016	0.009

**Frequency Error vs Temperature**

Temperature (°C)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
0	23	21	0.012	0.011
10	15	36	0.008	0.019
20	11	25	0.006	0.013
30	17	17	0.009	0.009
40	24	9	0.013	0.005
50	26	16	0.014	0.009

 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
3.5	23	8	0.013	0.005
3.85	9	11	0.005	0.006
4.4	14	12	0.008	0.007

**Frequency Error vs Temperature**

Temperature (°C)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
0	26	12	0.015	0.007
10	15	15	0.009	0.009
20	17	27	0.010	0.016
30	24	19	0.014	0.011
40	23	22	0.013	0.013
50	11	8	0.006	0.005

 Expanded measurement uncertainty is 10Hz,  $k = 2$

**LTE Band 7, 5MHz bandwidth (worst case of all bandwidths)****Frequency Error vs Voltage**

Voltage (V)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
3.5	11	22	0.004	0.009
3.85	24	12	0.009	0.005
4.4	8	17	0.003	0.007

**Frequency Error vs Temperature**

Temperature (°C)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
0	13	33	0.005	0.013
10	24	16	0.009	0.006
20	17	28	0.007	0.011
30	18	24	0.007	0.009
40	22	19	0.009	0.007
50	16	3	0.006	0.001

Expanded measurement uncertainty is 10 Hz,  $k = 2$



## **A.4 OCCUPIED BANDWIDTH**

### **Reference**

FCC: CFR Part 2.1049, 24.238, 27.53.

### **A.4.1 Occupied Bandwidth Results**

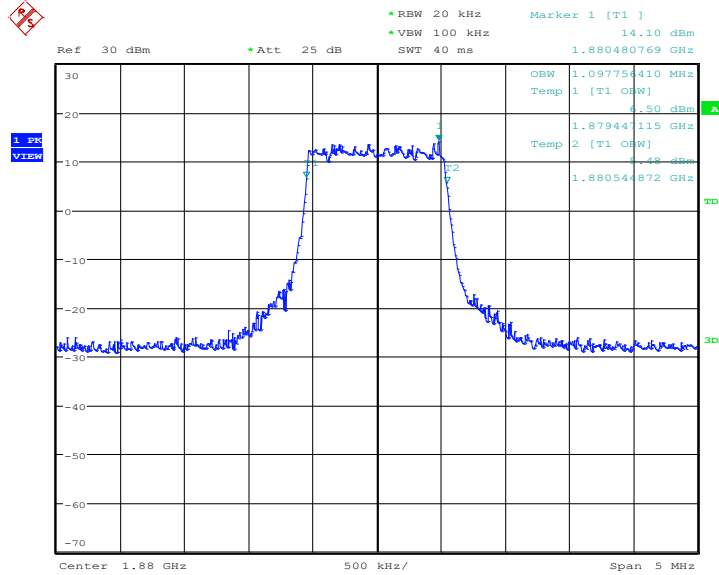
Occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the US Cellular/PCS frequency bands. The table below lists the measured 99% BW. Spectrum analyzer plots are included on the 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  $10\log(\text{OBW} / \text{RBW})$  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)**

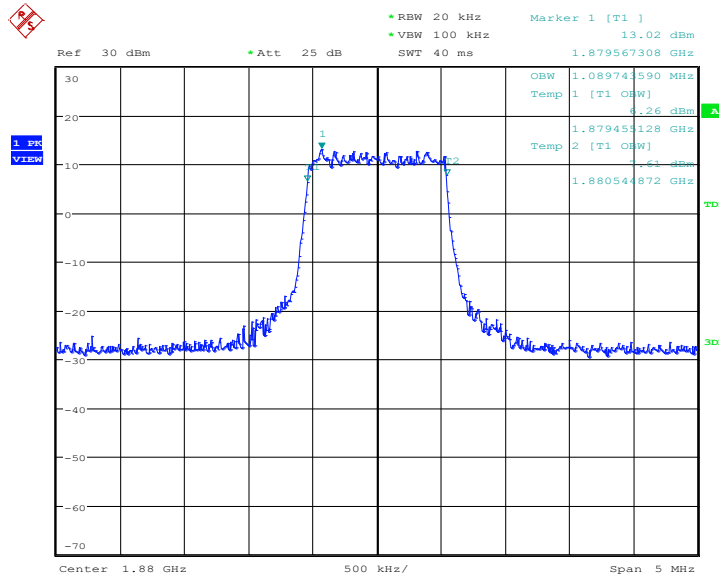
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	1880.0	QPSK
1097.76		1089.74

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



Date: 16.MAR.2020 19:09:45

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



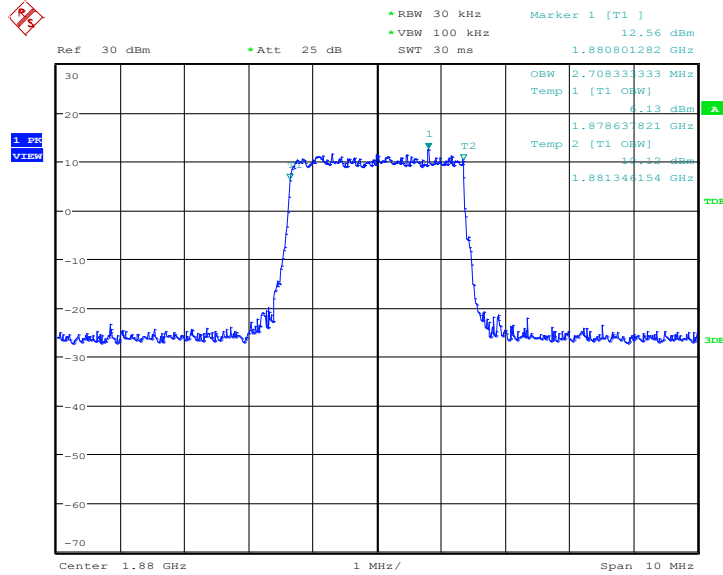
Date: 16.MAR.2020 19:09:58



**LTE band 2, 3MHz (99% BW)**

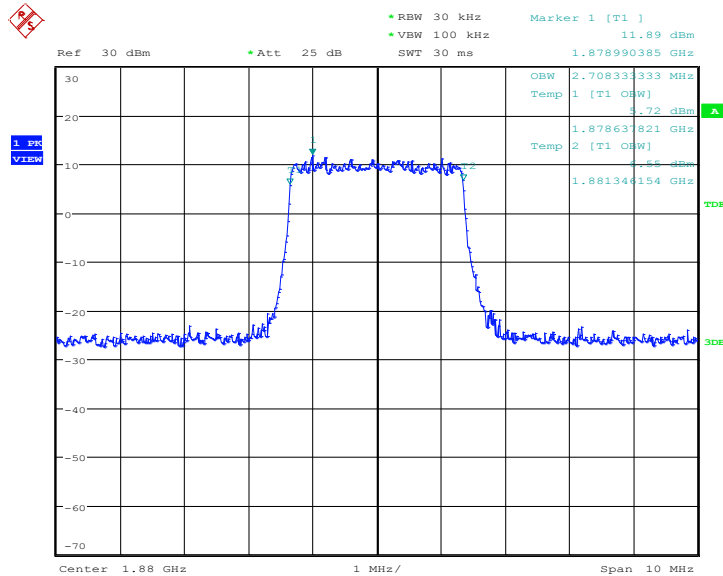
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	1880.0	QPSK
2708.33		2708.33

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



Date: 16.MAR.2020 19:14:02

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

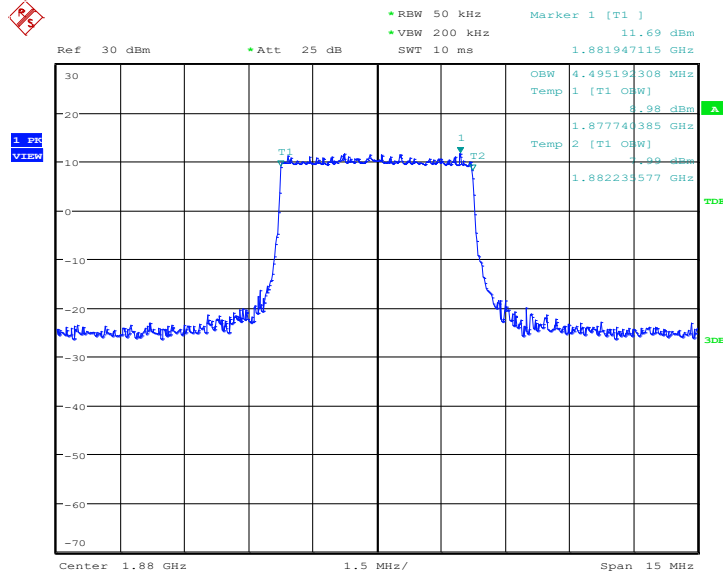


Date: 16.MAR.2020 19:14:16

**LTE band 2, 5MHz (99% BW)**

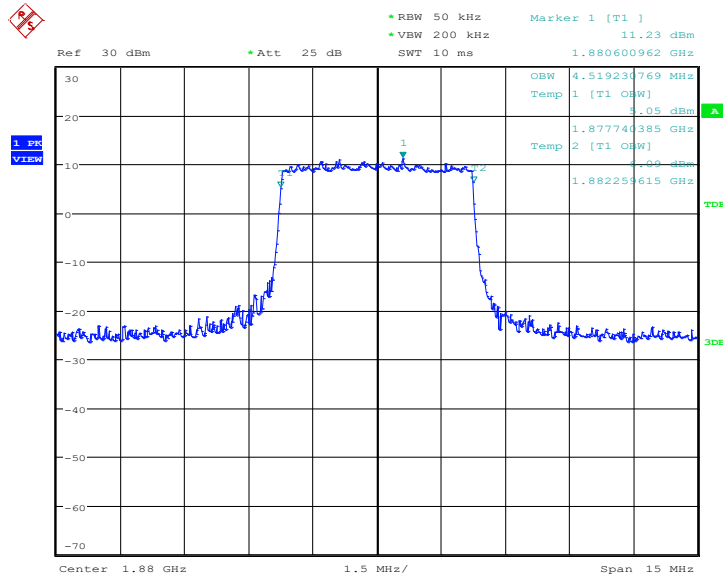
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	1880.0	QPSK
4495.19		4519.23

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



Date: 16.MAR.2020 19:18:22

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

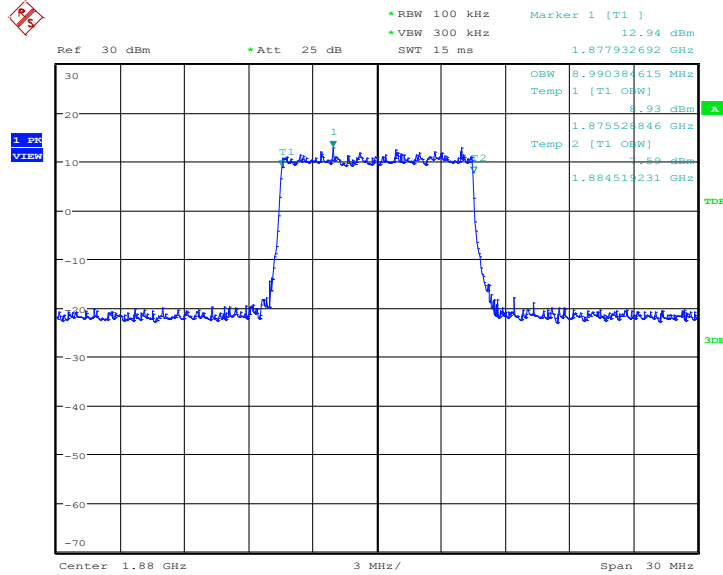


Date: 16.MAR.2020 19:18:36

**LTE band 2, 10MHz (99% BW)**

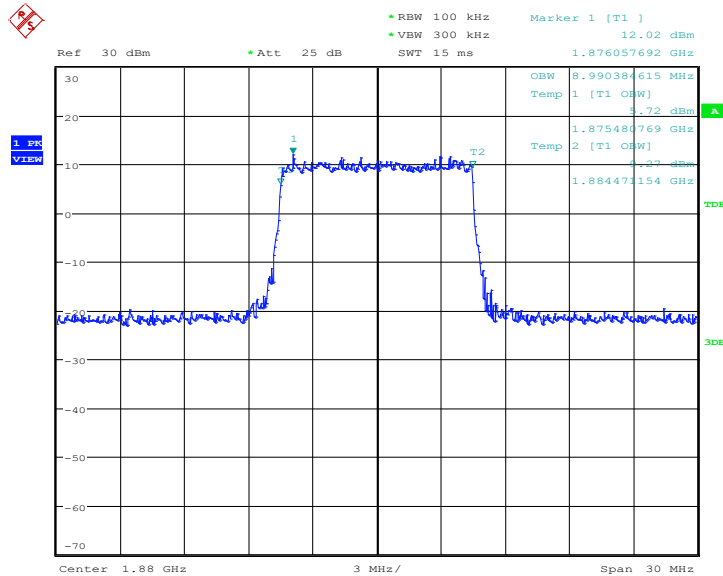
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
1880.0	QPSK	16QAM
	8990.38	8990.38

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



Date: 16.MAR.2020 19:22:42

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

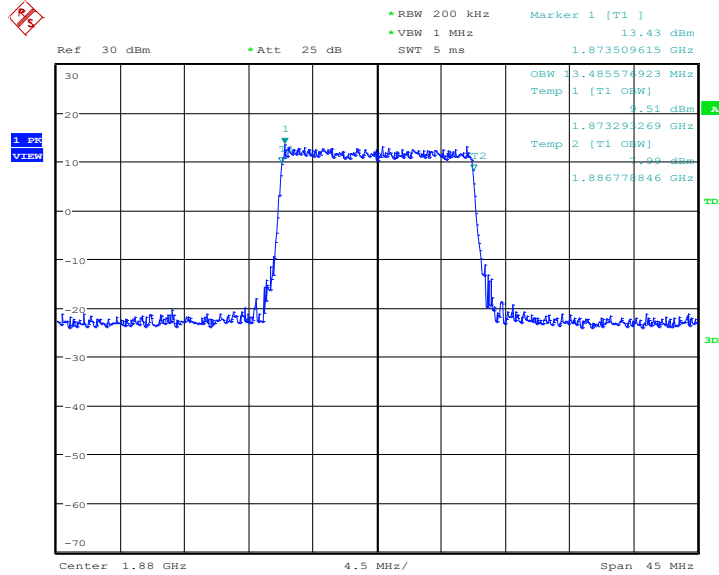


Date: 16.MAR.2020 19:22:55

**LTE band 2, 15MHz (99% BW)**

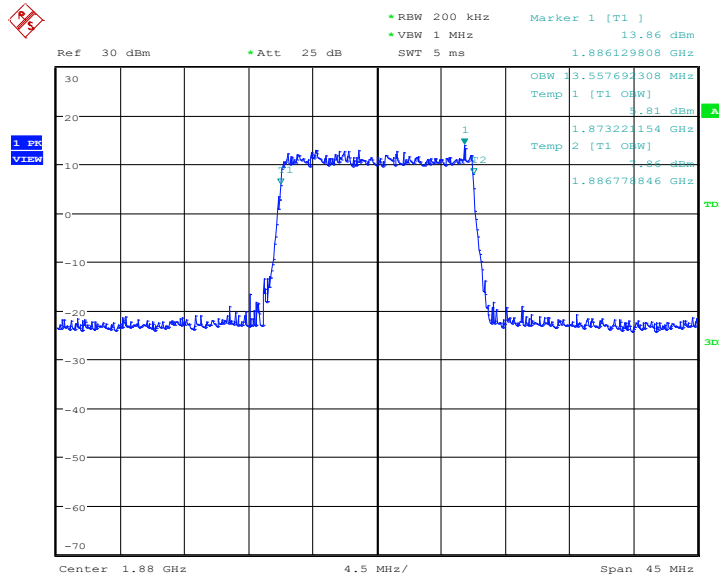
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	1880.0	QPSK
	13485.58	13557.69

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



Date: 16.MAR.2020 19:27:02

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

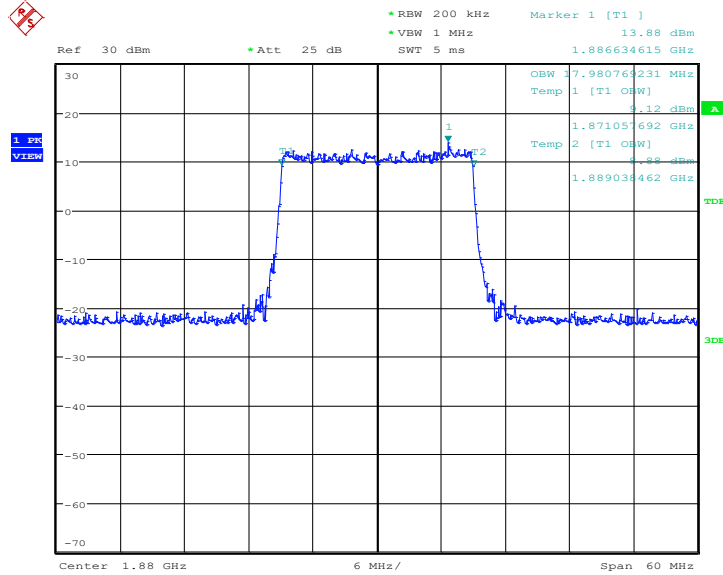


Date: 16.MAR.2020 19:27:15

**LTE band 2, 20MHz (99% BW)**

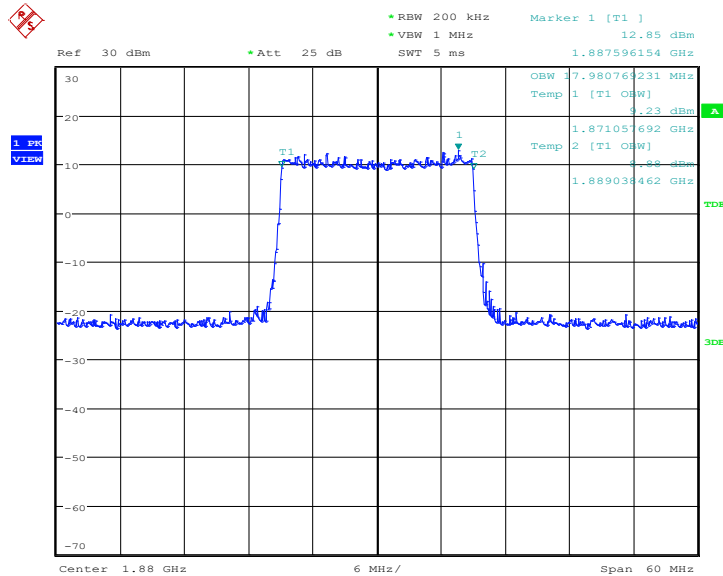
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	1880.0	QPSK
17980.77		17980.77

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



Date: 16.MAR.2020 19:31:22

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

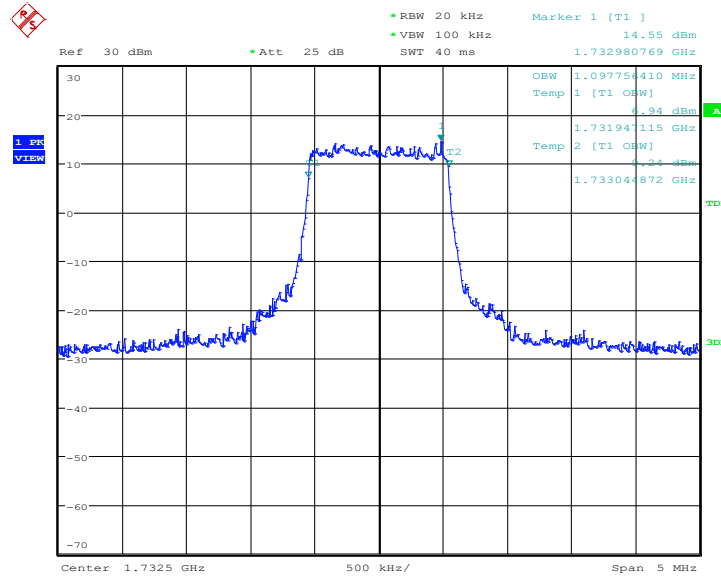


Date: 16.MAR.2020 19:31:36

**LTE band 4, 1.4MHz (99% BW)**

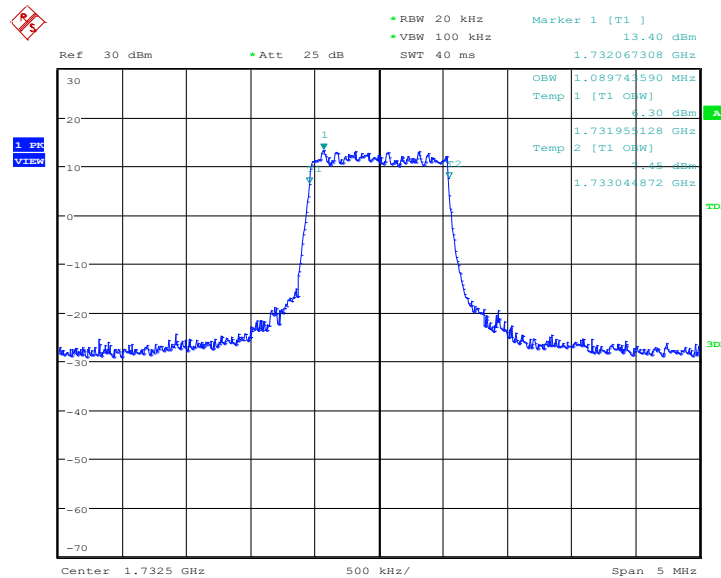
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
1732.5	QPSK	16QAM
	1097.76	1089.74

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



Date: 16.MAR.2020 19:36:15

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

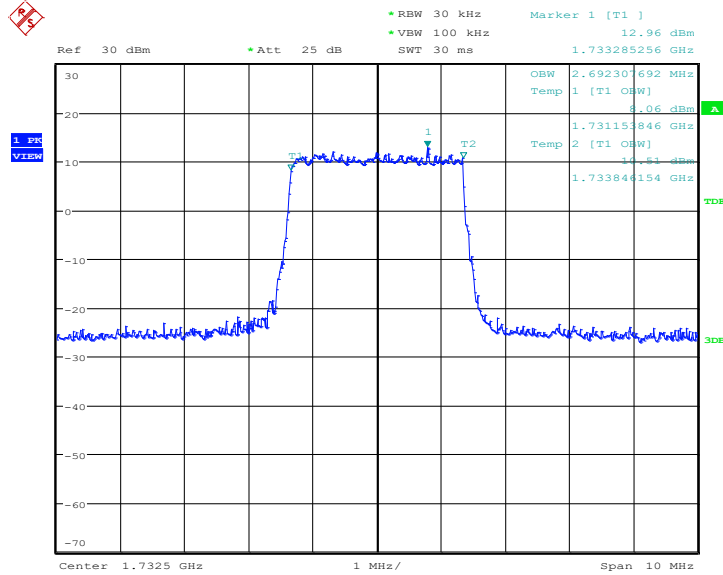


Date: 16.MAR.2020 19:36:29

**LTE band 4, 3MHz (99% BW)**

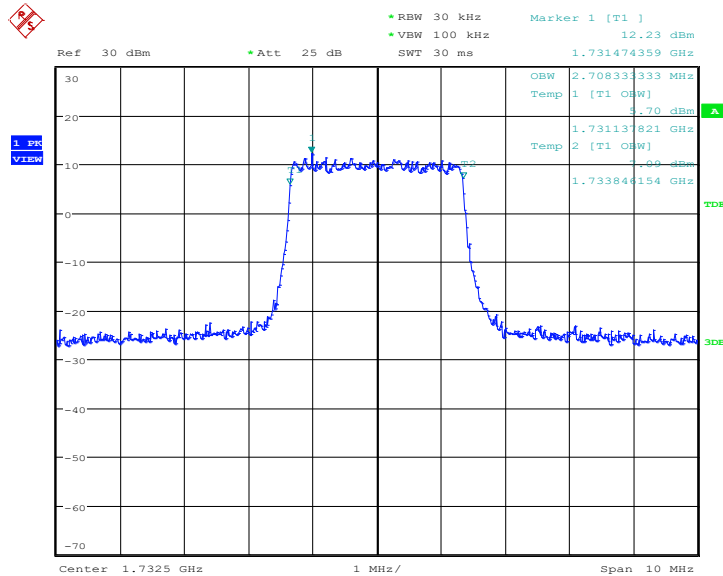
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	1732.5	QPSK
2692.31		2708.33

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



Date: 16.MAR.2020 19:40:35

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

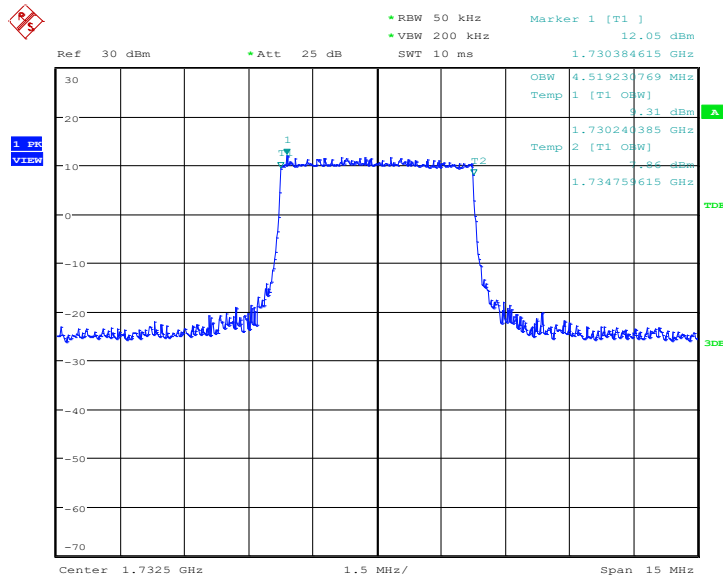


Date: 16.MAR.2020 19:40:48

**LTE band 4, 5MHz (99% BW)**

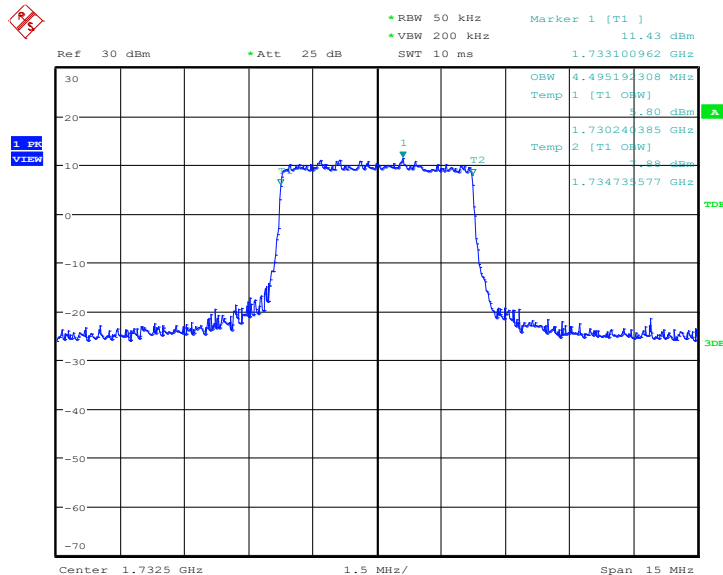
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
1732.5	QPSK	16QAM
	4519.23	4495.19

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



Date: 16.MAR.2020 19:44:52

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



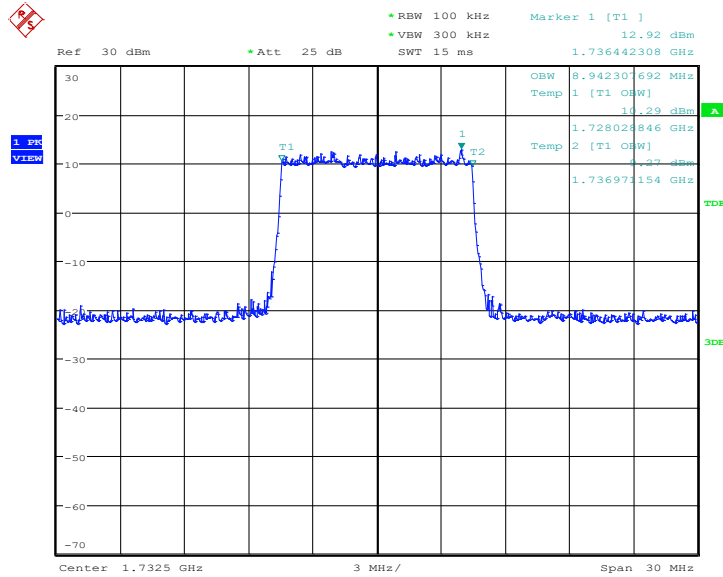
Date: 16.MAR.2020 19:45:06



**LTE band 4, 10MHz (99% BW)**

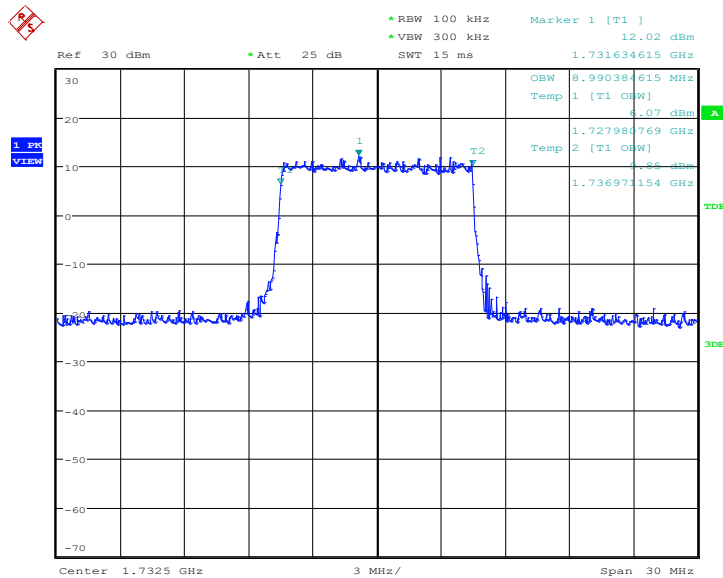
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
1732.5	QPSK	16QAM
	8942.31	8990.38

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



Date: 16.MAR.2020 19:49:10

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

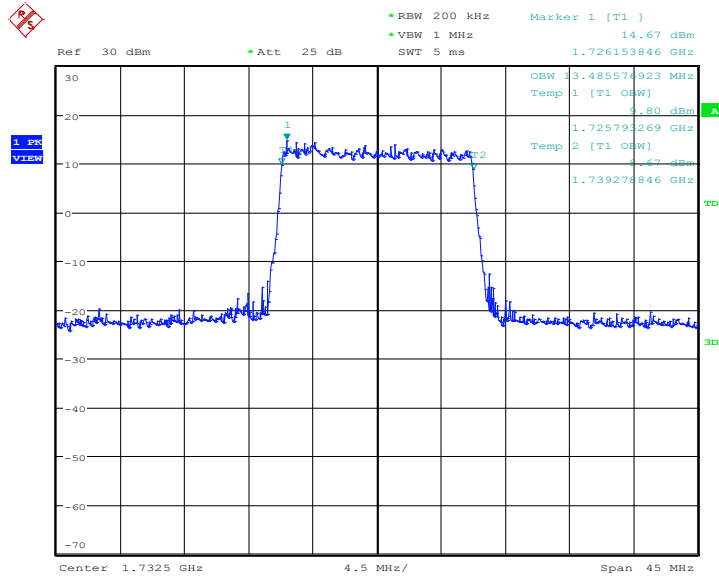


Date: 16.MAR.2020 19:49:24

**LTE band 4, 15MHz (99% BW)**

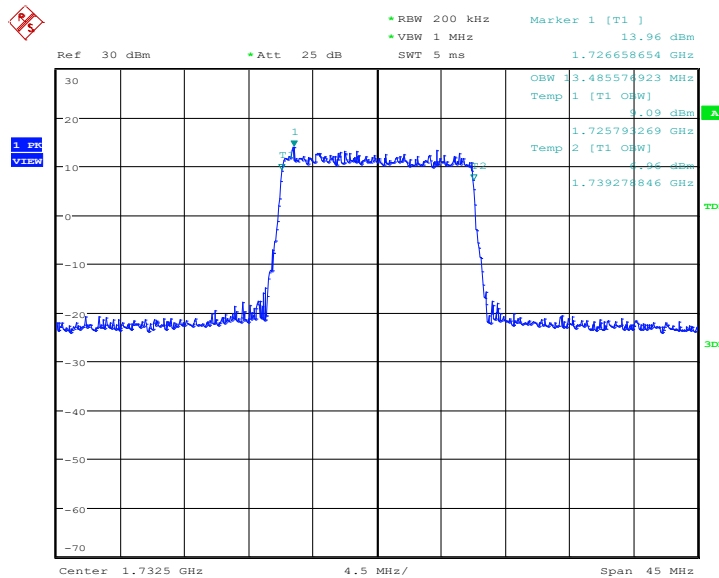
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	1732.5	QPSK
13485.58		13485.58

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



Date: 16.MAR.2020 19:53:30

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

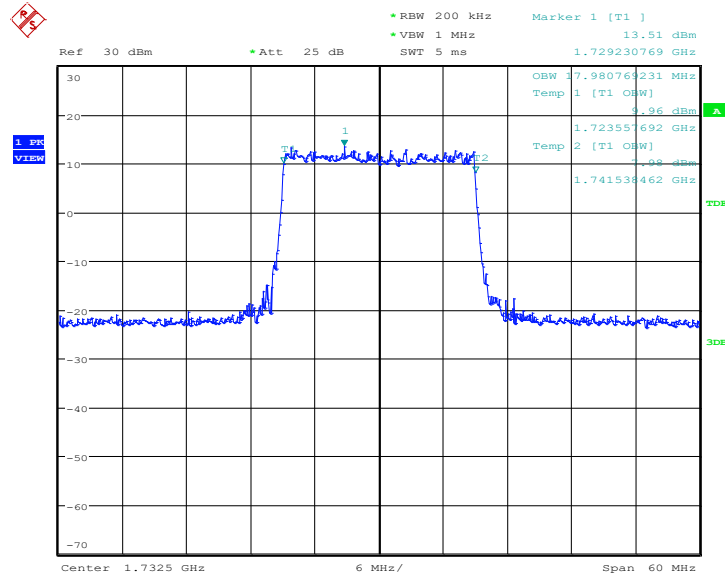


Date: 16.MAR.2020 19:53:44

**LTE band 4, 20MHz (99% BW)**

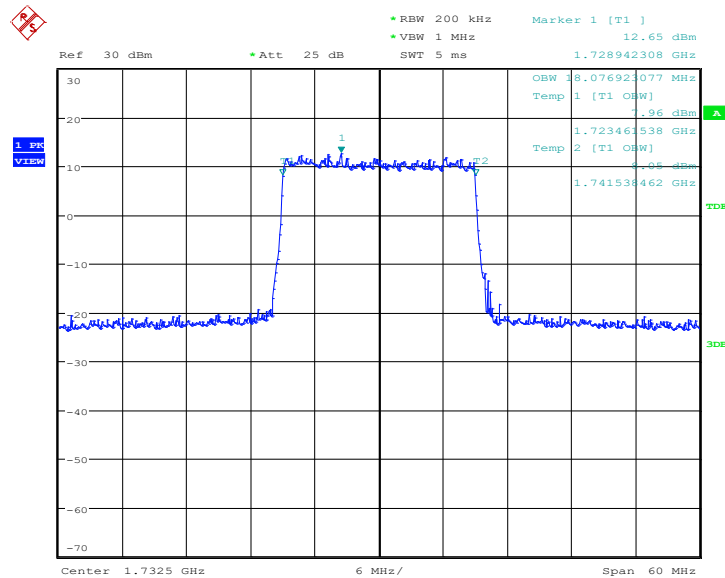
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
1732.5	QPSK	16QAM
	17980.77	18076.92

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



Date: 16.MAR.2020 19:57:50

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

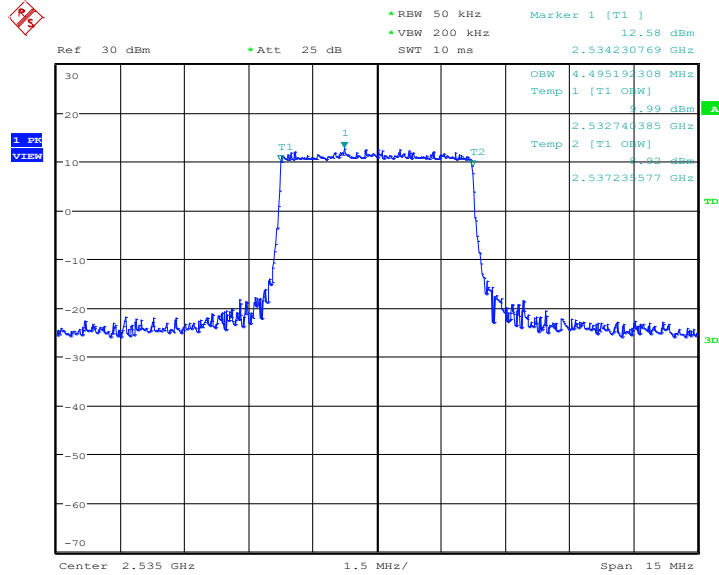


Date: 16.MAR.2020 19:58:04

**LTE band 7, 5MHz (99% BW)**

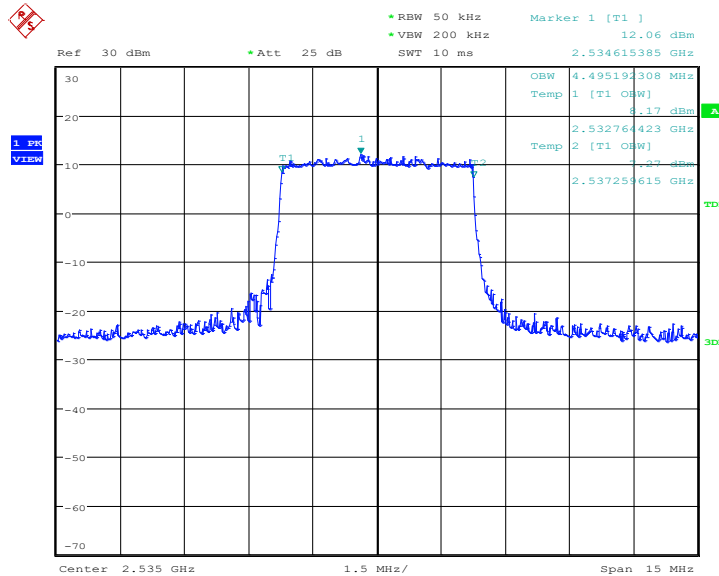
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
2535.0	QPSK	16QAM
	4495.19	4495.19

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



Date: 16.MAR.2020 18:50:51

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

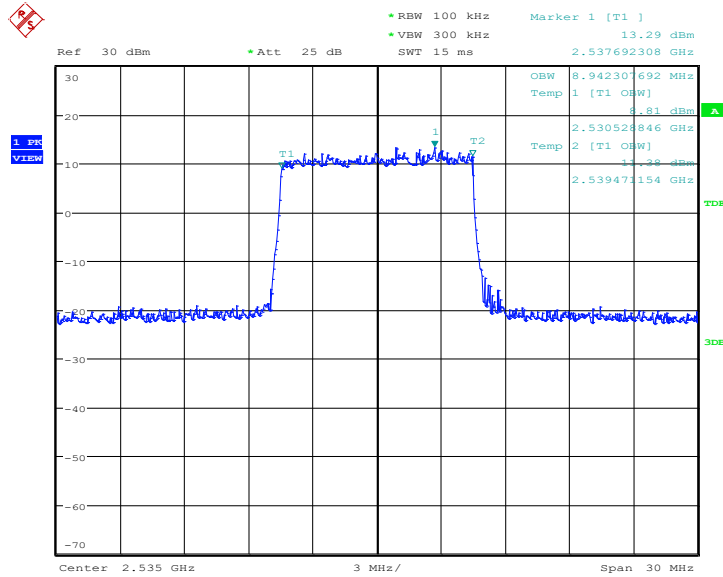


Date: 16.MAR.2020 18:51:04

**LTE band 7, 10MHz (99% BW)**

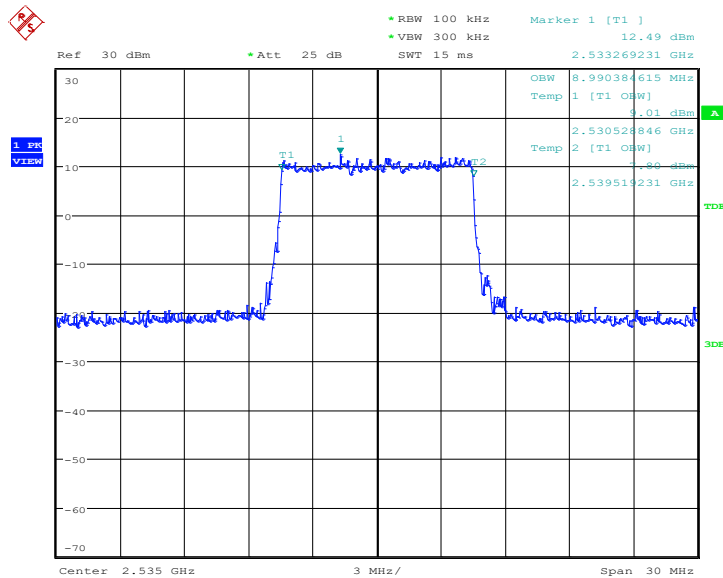
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	2535.0	QPSK
8942.31		8990.38

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



Date: 16.MAR.2020 18:55:11

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

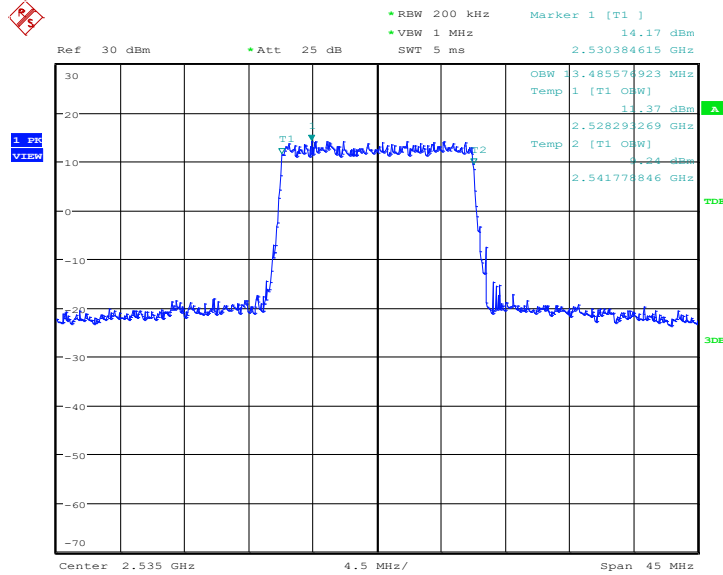


Date: 16.MAR.2020 18:55:24

**LTE band 7, 15MHz (99% BW)**

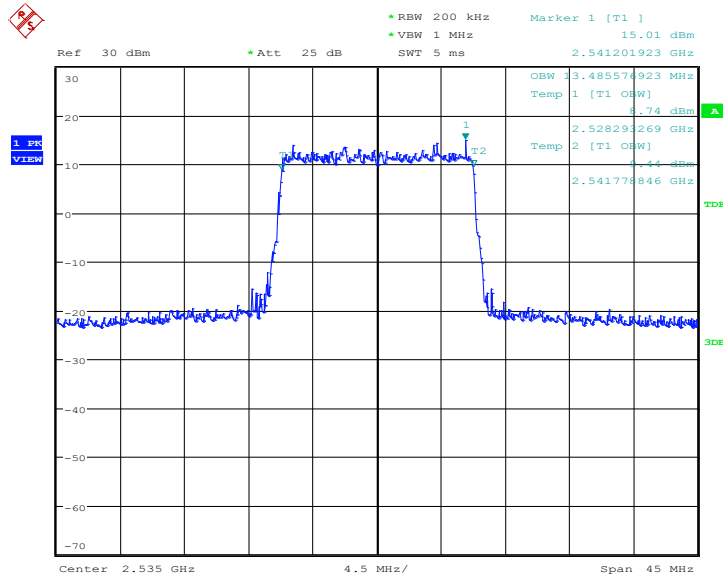
Frequency(MHz)	Occupied Bandwidth (99% BW)( kHz)	
	2535.0	QPSK
13485.58		13485.58

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



Date: 16.MAR.2020 18:59:31

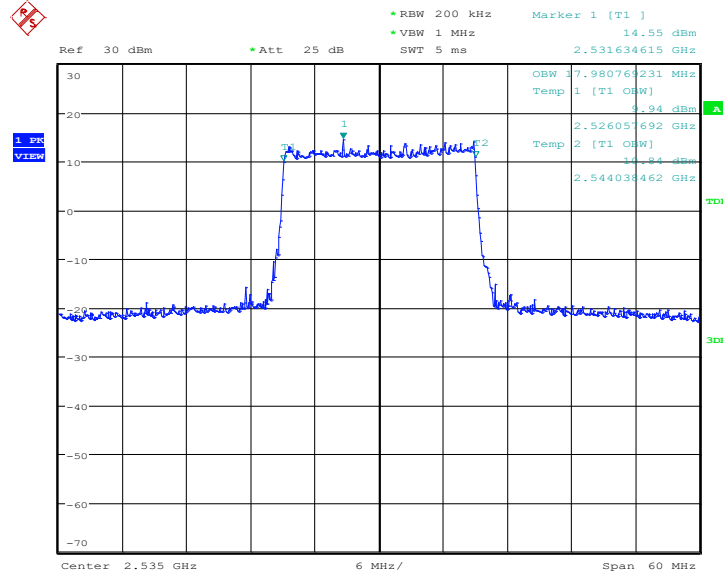
**LTE band 7, 15MHz Bandwidth, 16QAM (99% BW)**



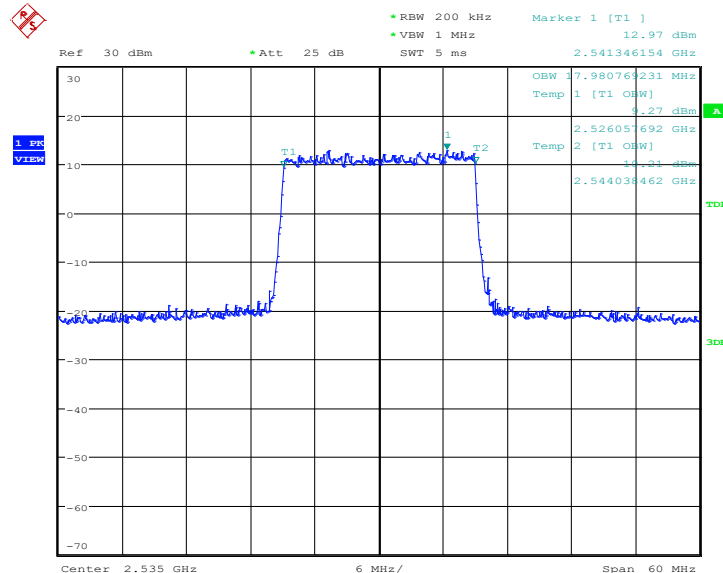
Date: 16.MAR.2020 18:59:45

**LTE band 7, 20MHz (99% BW)**

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

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


Date: 16.MAR.2020 19:03:51

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


Date: 16.MAR.2020 19:04:05

 Note: Expanded measurement uncertainty is  $U = 3428 \text{ Hz}$ ,  $k = 2$

## A.5 EMISSION BANDWIDTH

### Reference

FCC: CFR Part 2.1049, 24.238, 27.53.

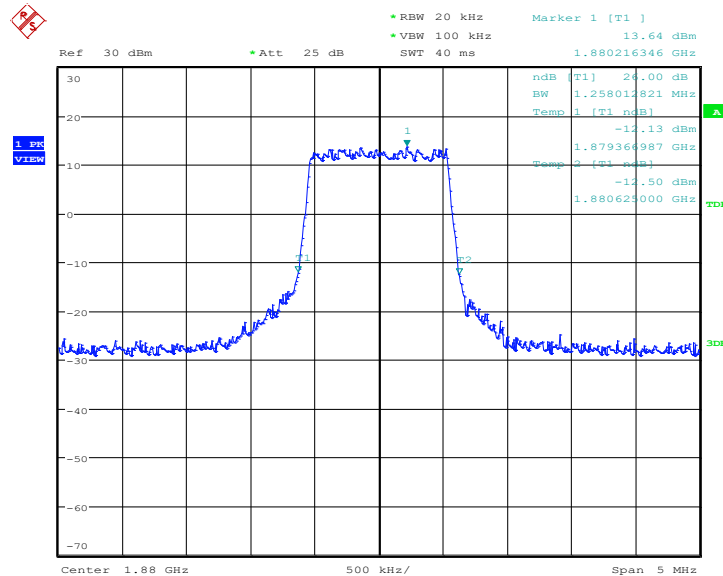
### A.5.1 Emission Bandwidth Results

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
	1258.01	1298.08

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

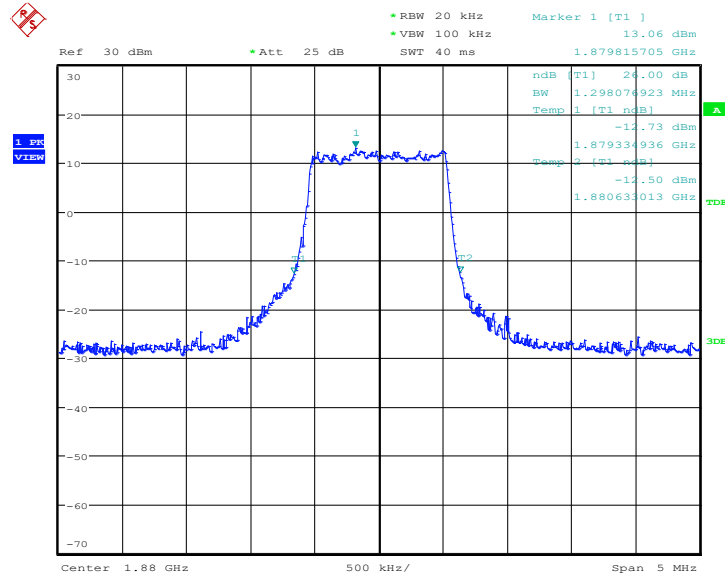


Date: 16.MAR.2020 19:10:52





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

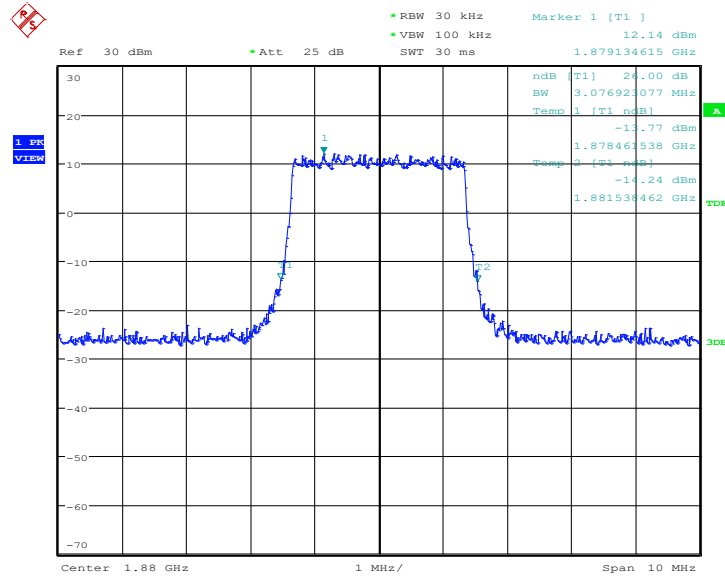


Date: 16.MAR.2020 19:11:08

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

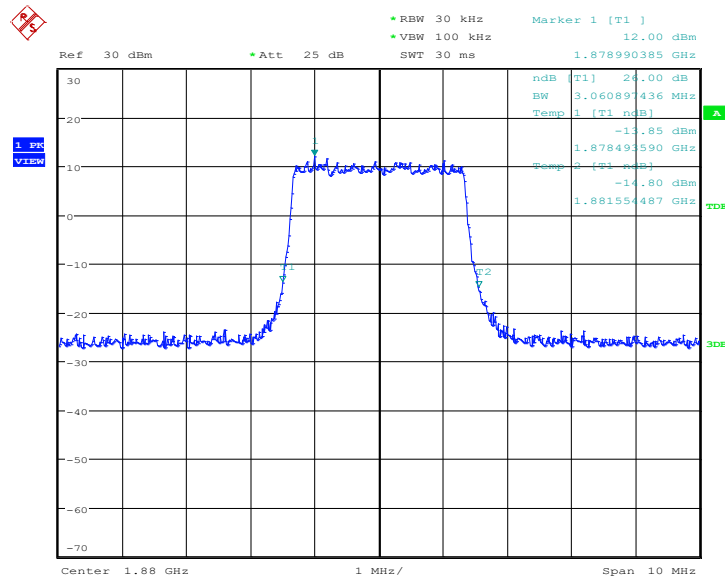
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	1880.0	QPSK
3076.92		3060.90

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



Date: 16.MAR.2020 19:15:10

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

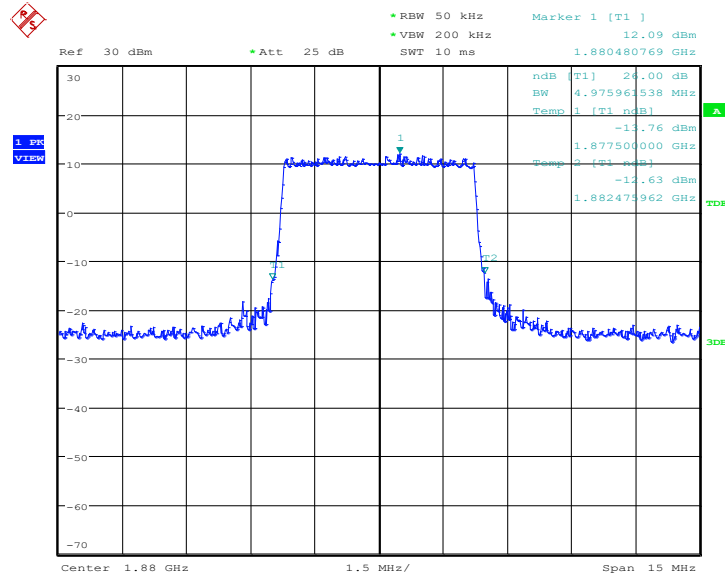


Date: 16.MAR.2020 19:15:26

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

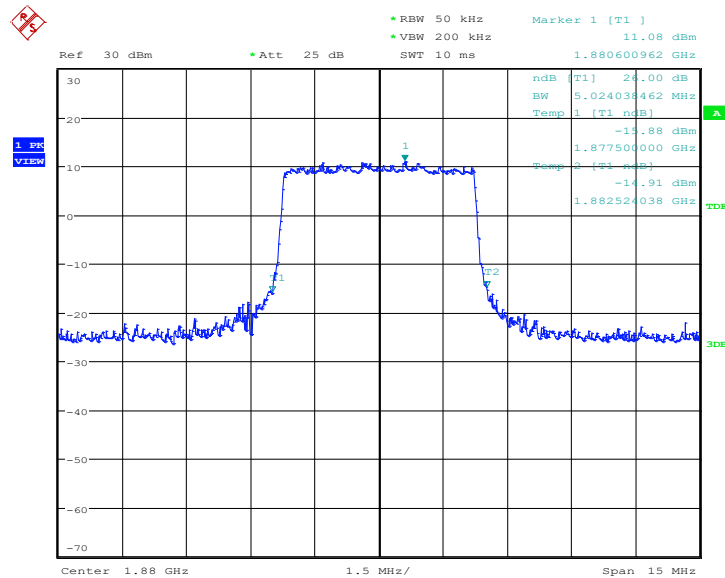
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	1880.0	QPSK
4975.96		5024.04

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



Date: 16.MAR.2020 19:19:30

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

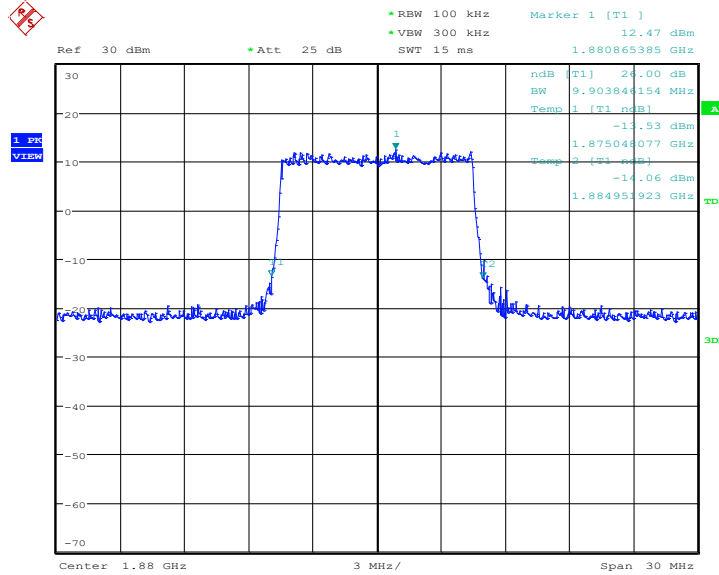


Date: 16.MAR.2020 19:19:46

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

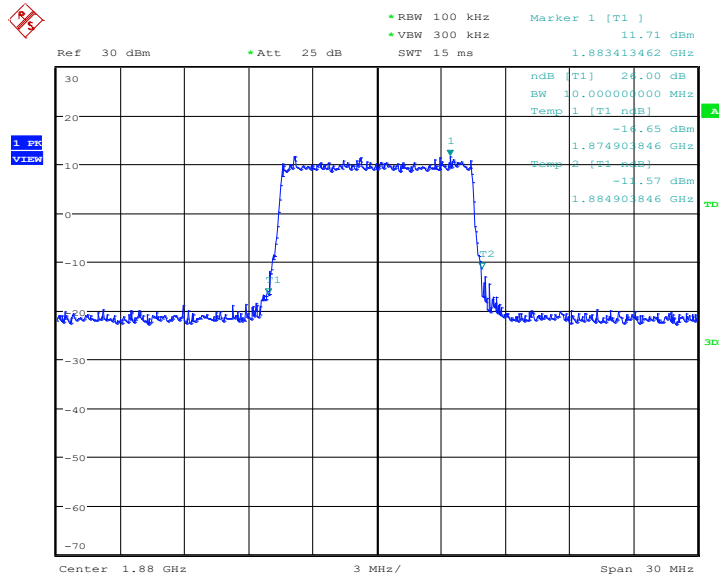
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1880.0	QPSK	16QAM
	9903.85	10000.00

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



Date: 16.MAR.2020 19:23:49

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

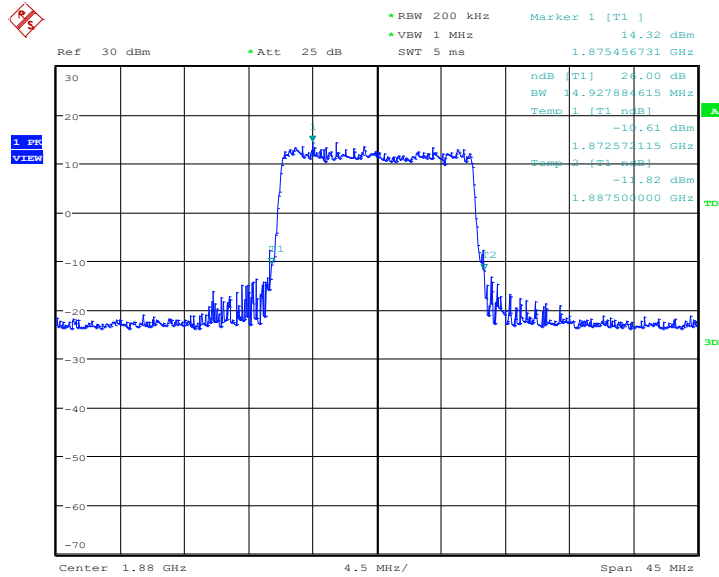


Date: 16.MAR.2020 19:24:05

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

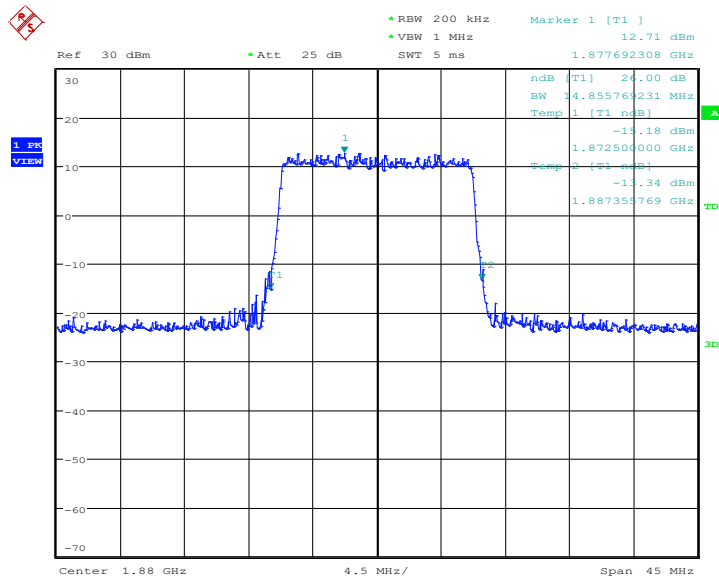
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	1880.0	QPSK
14927.88		14855.77

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



Date: 16.MAR.2020 19:28:10

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

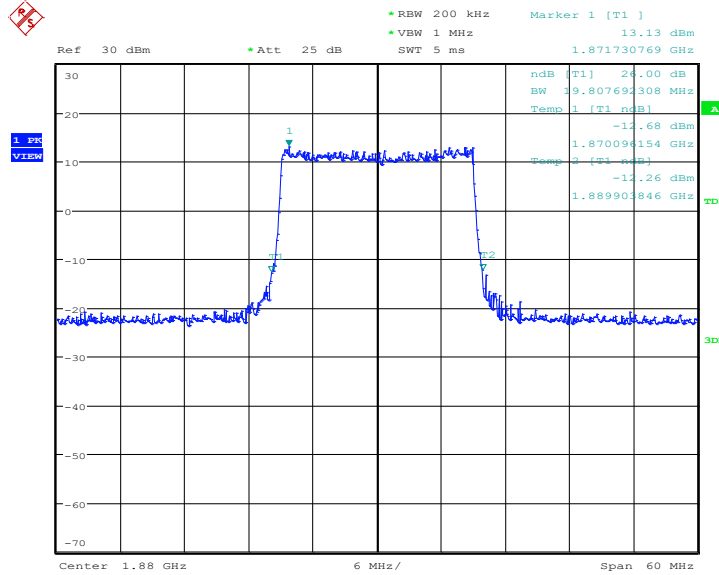


Date: 16.MAR.2020 19:28:25

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

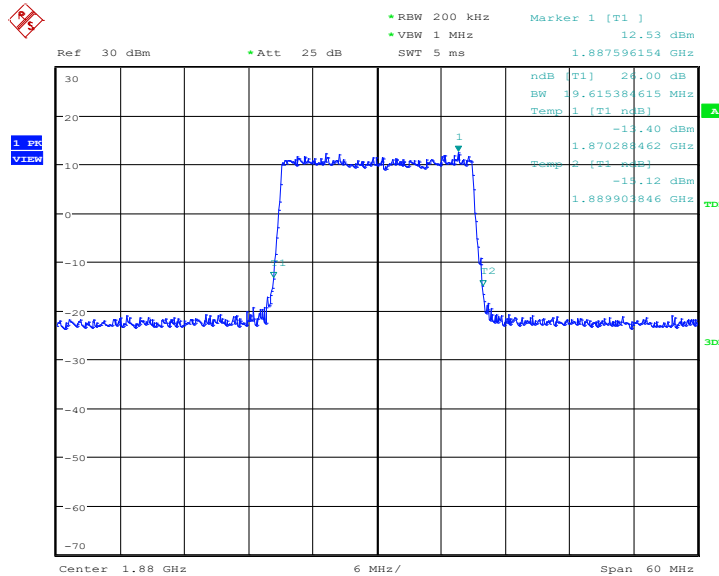
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	1880.0	QPSK
	19807.69	19615.38

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



Date: 16.MAR.2020 19:32:30

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

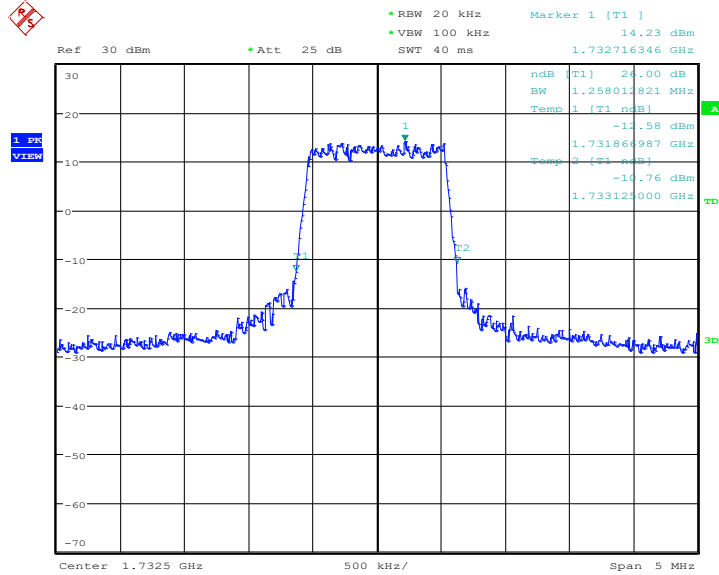


Date: 16.MAR.2020 19:32:46

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

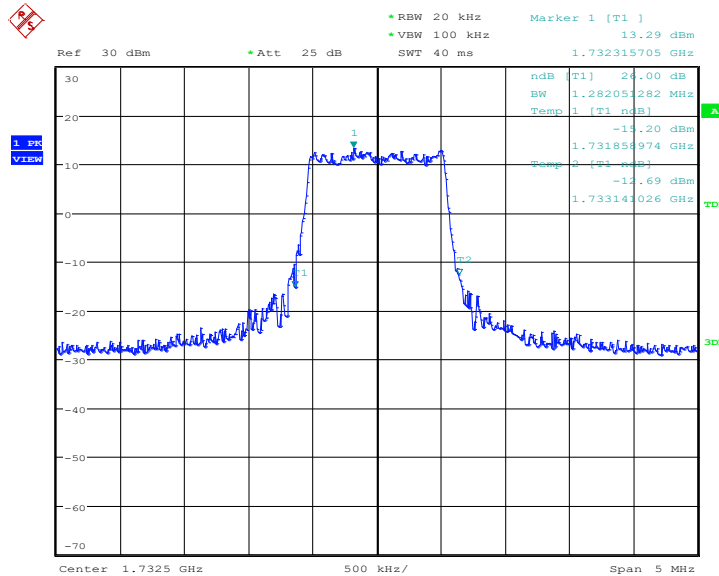
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1732.5	QPSK	16QAM
	1258.01	1282.05

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



Date: 16.MAR.2020 19:37:23

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

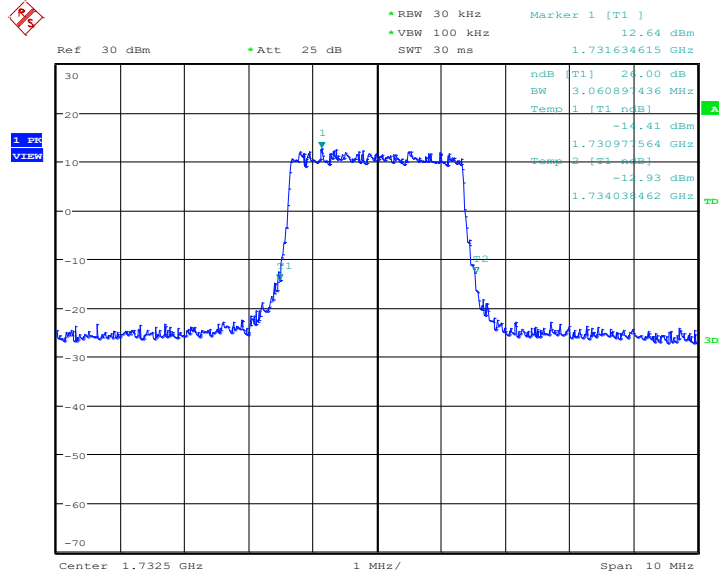


Date: 16.MAR.2020 19:37:39

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

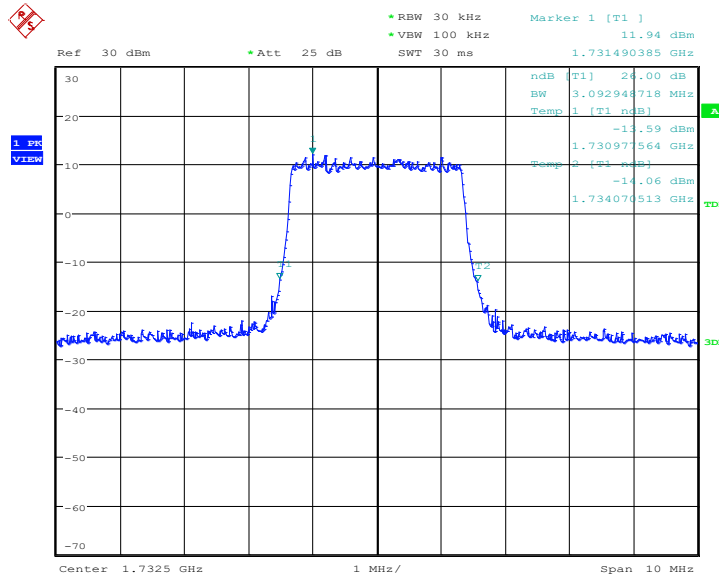
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	1732.5	QPSK
3060.90		3092.95

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



Date: 16.MAR.2020 19:41:42

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



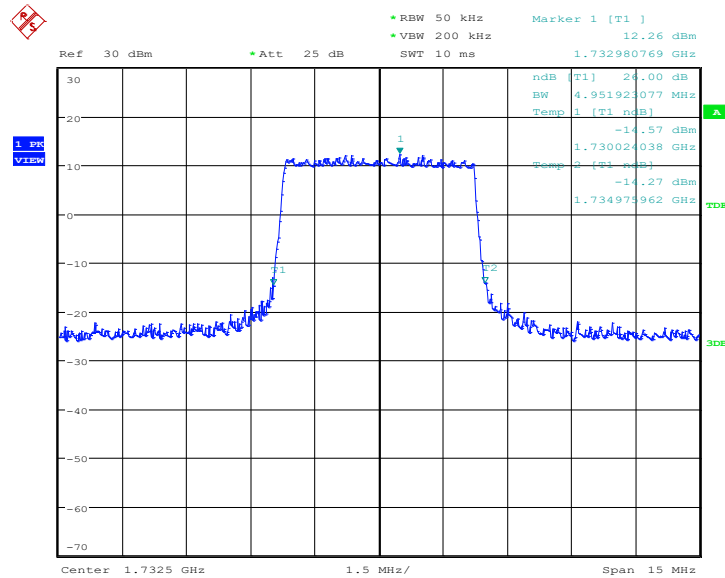
Date: 16.MAR.2020 19:41:58



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

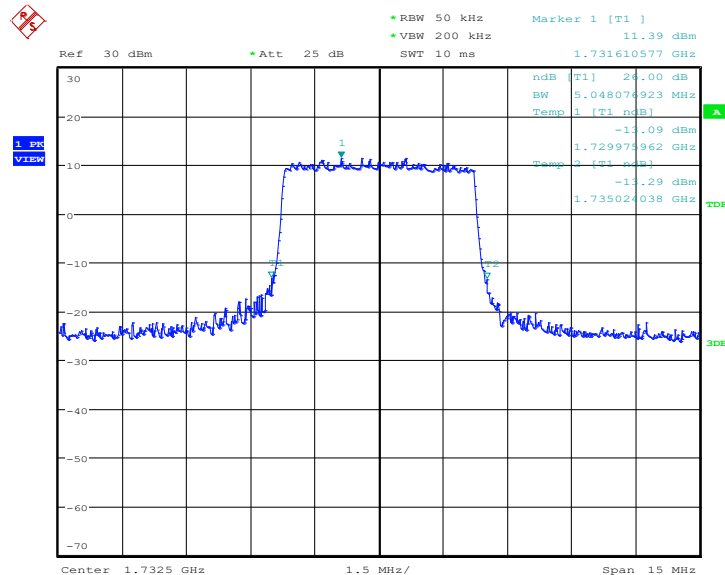
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1732.5	QPSK	16QAM
	4951.92	5048.08

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



Date: 16.MAR.2020 19:46:00

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

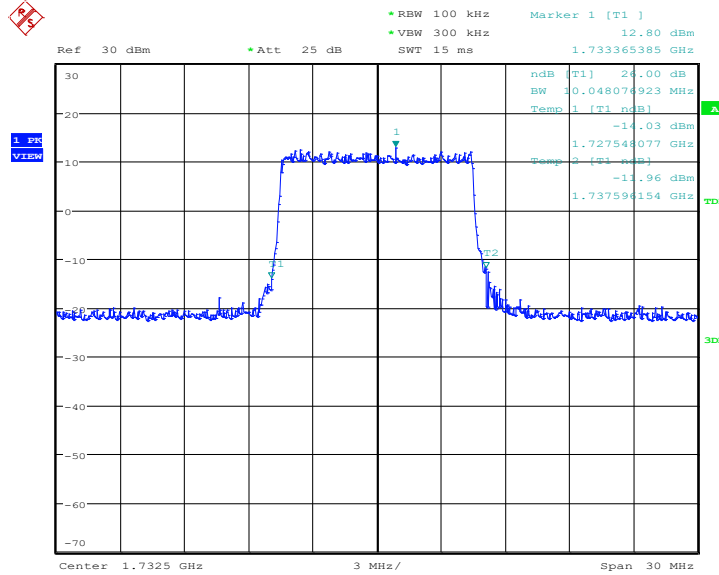


Date: 16.MAR.2020 19:46:16

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

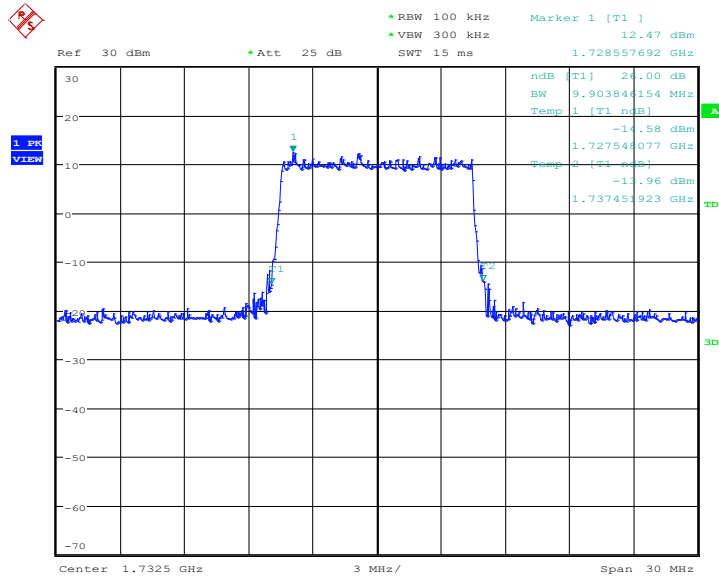
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
1732.5	QPSK	16QAM
	10048.08	9903.85

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



Date: 16.MAR.2020 19:50:18

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

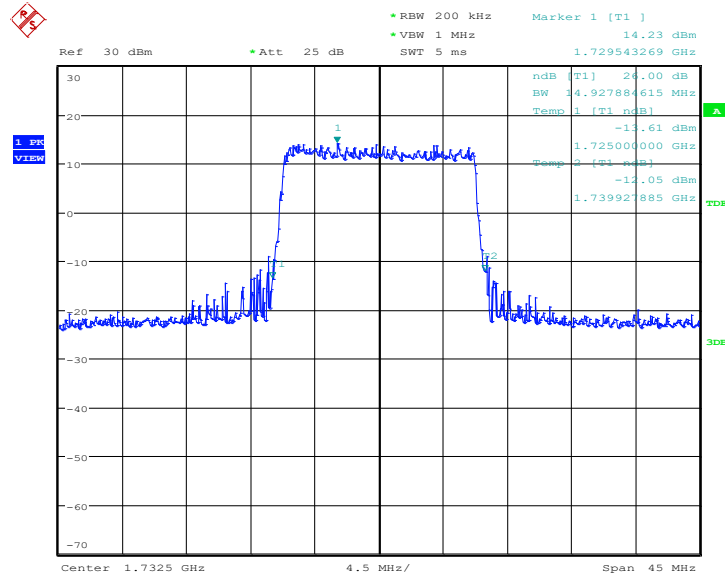


Date: 16.MAR.2020 19:50:33

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

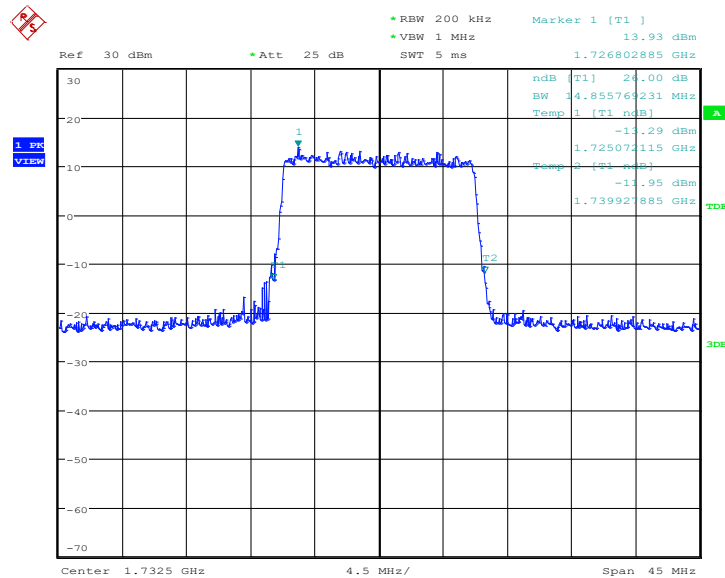
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	1732.5	QPSK
14927.88		14855.77

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



Date: 16.MAR.2020 19:54:38

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

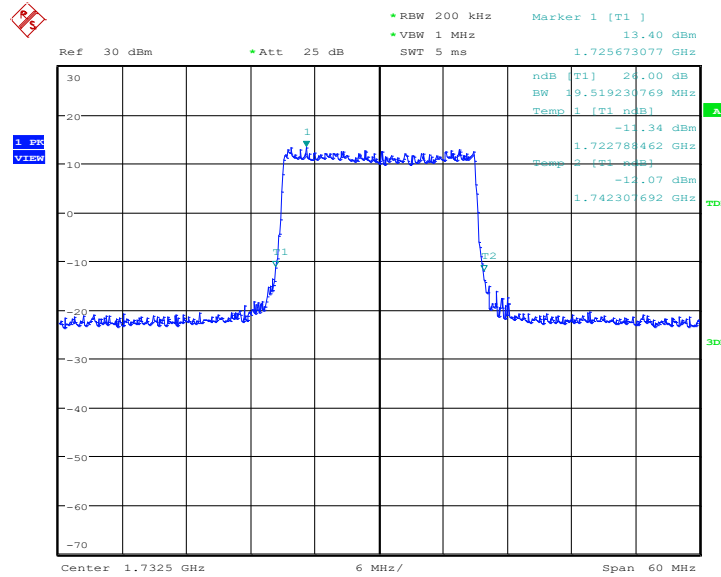


Date: 16.MAR.2020 19:54:54

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

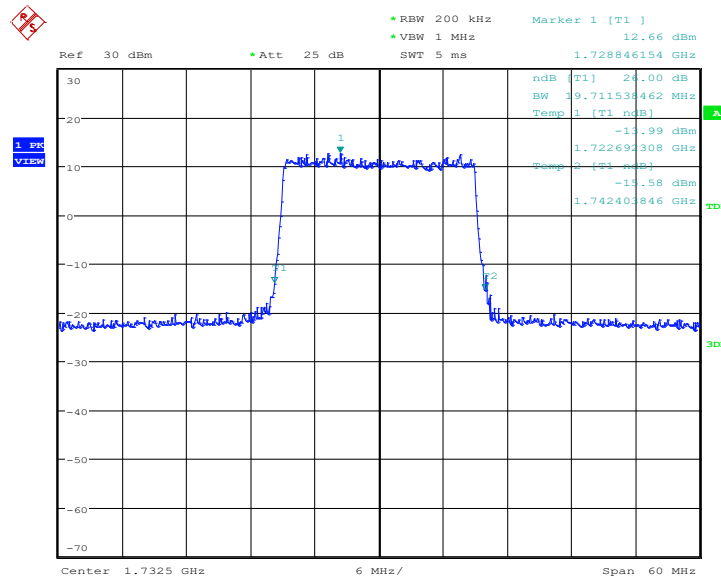
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	1732.5	QPSK
19519.23		19711.54

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



Date: 16.MAR.2020 19:58:58

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

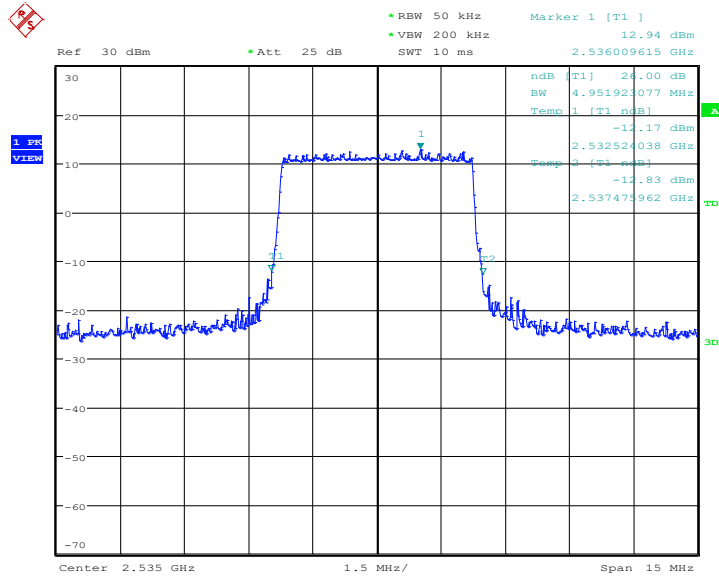


Date: 16.MAR.2020 19:59:14

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

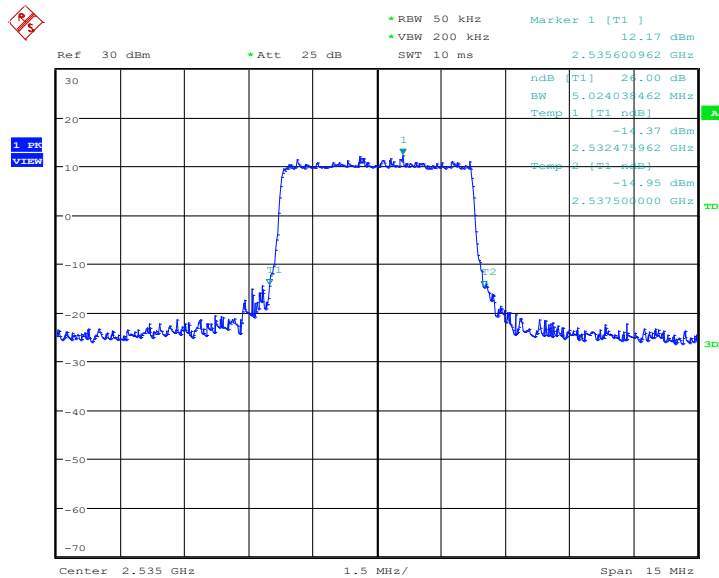
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
2535.0	QPSK	16QAM
	4951.92	5024.04

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



Date: 16.MAR.2020 18:51:58

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

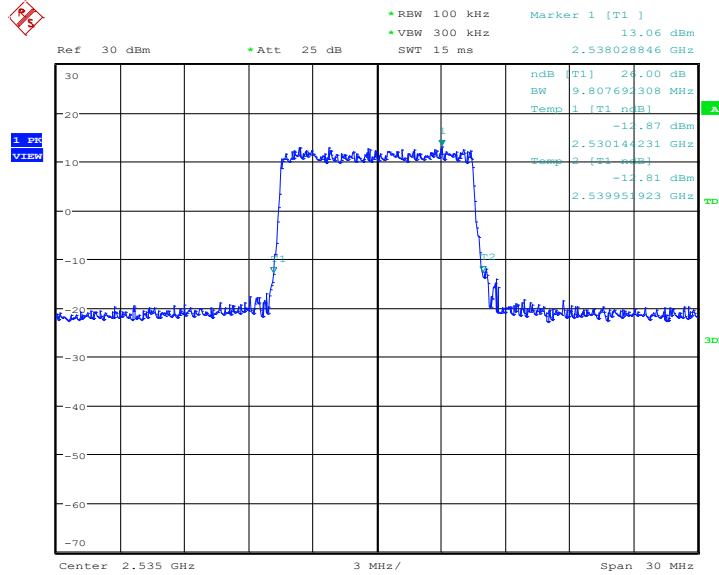


Date: 16.MAR.2020 18:52:14

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

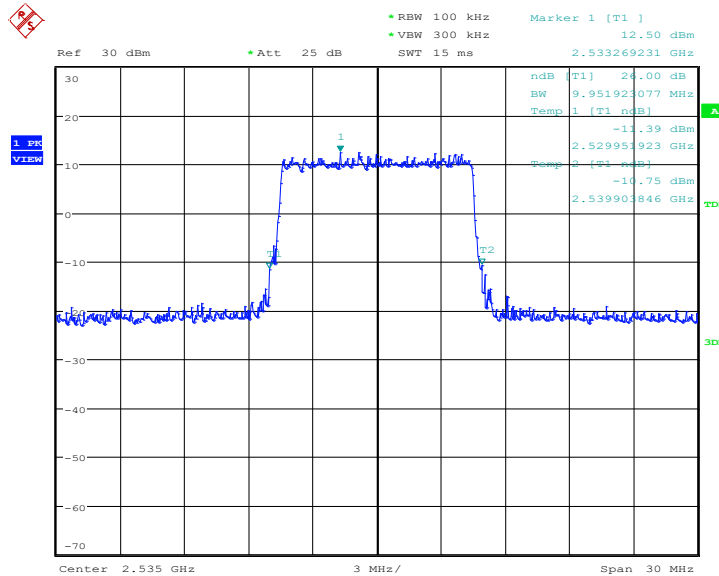
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
2535.0	QPSK	16QAM
	9807.69	9951.92

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



Date: 16.MAR.2020 18:56:18

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

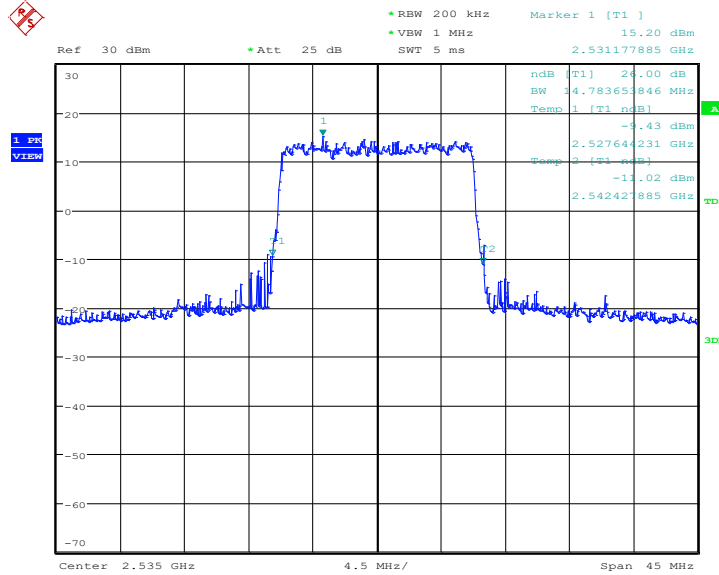


Date: 16.MAR.2020 18:56:34

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

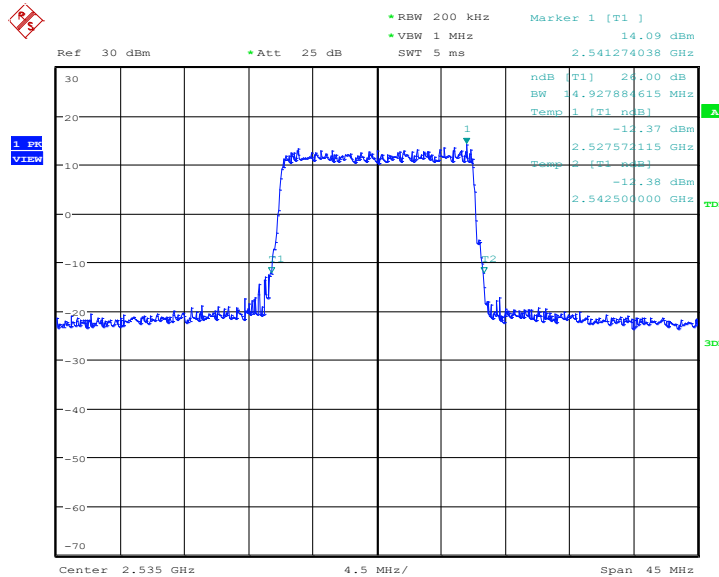
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	2535.0	QPSK
14783.65		14927.88

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



Date: 16.MAR.2020 19:00:39

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

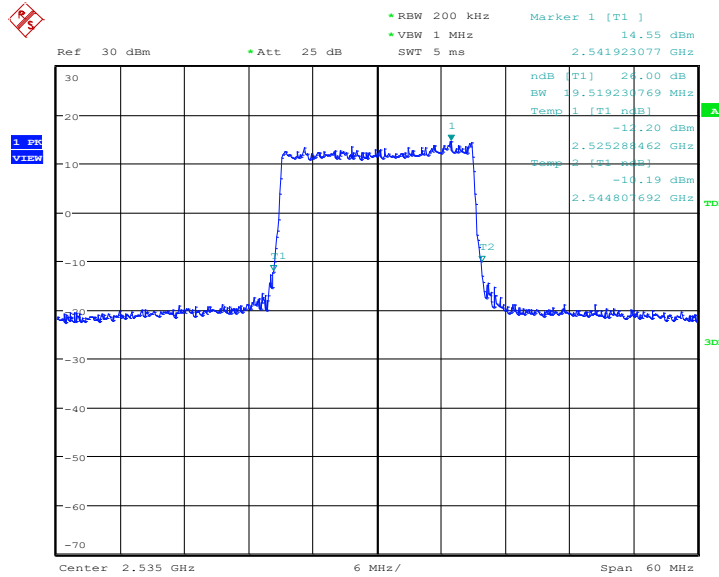


Date: 16.MAR.2020 19:00:54

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

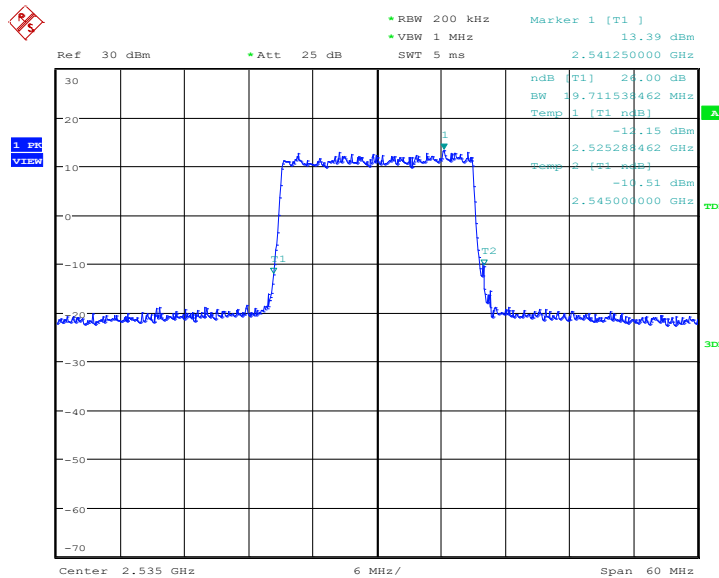
Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)	
	2535.0	QPSK
19519.23		19711.54

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



Date: 16.MAR.2020 19:04:59

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



Date: 16.MAR.2020 19:05:15

Note: Expanded measurement uncertainty is  $U = 3428 \text{ Hz}$ ,  $k = 2$



## 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

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

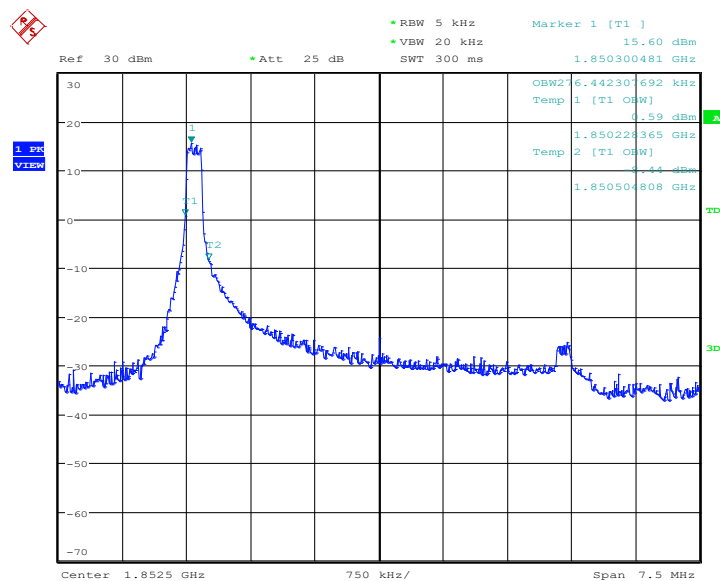
A relaxation of the reference bandwidth is often provided for measurements within a specified frequency range at the edge of the authorized frequency block/band. This is often implemented by permitting the use of a narrower RBW (typically limited to a minimum RBW of 1% of the OBW) for measuring the out-of-band 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

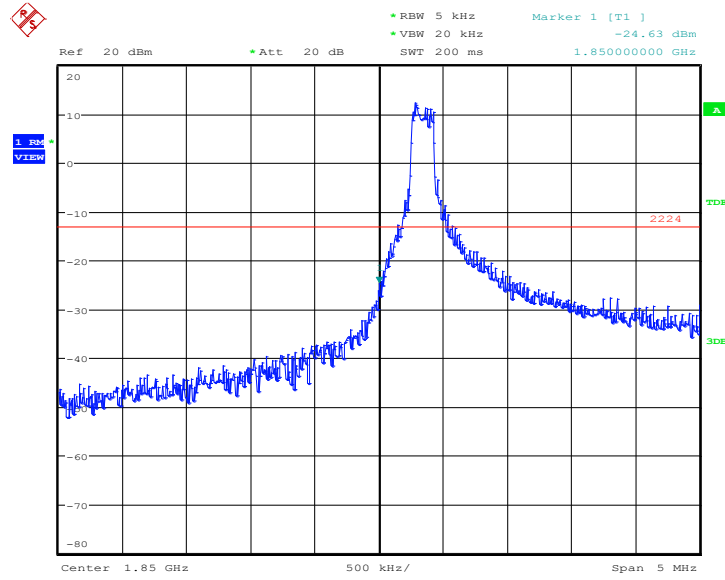
LTE band 2

OBW: 1RB-low\_offset



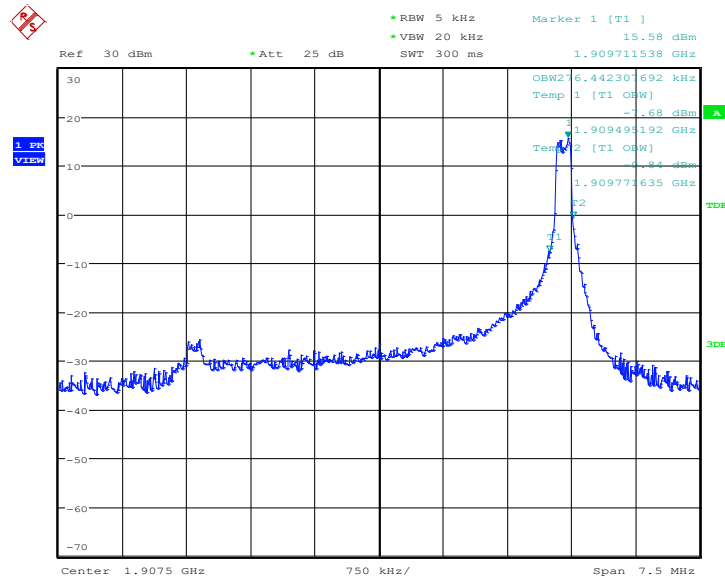
Date: 19.MAR.2020 19:40:30

LOW BAND EDGE BLOCK-1RB-low\_offset



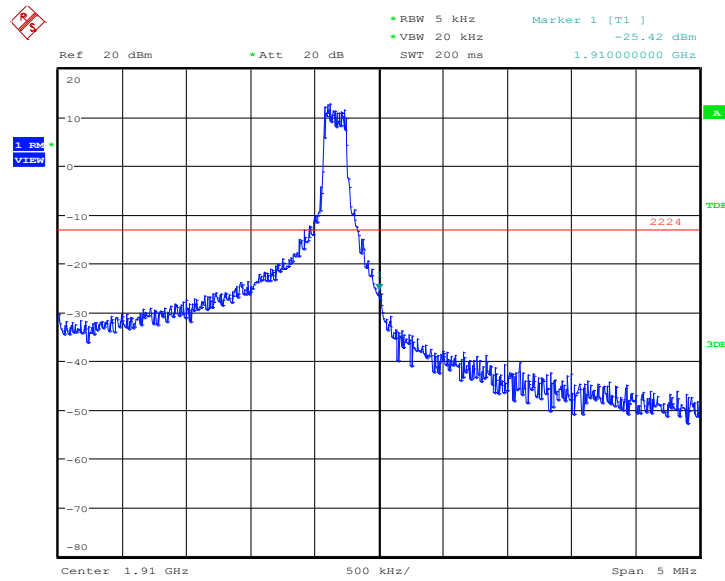
Date: 19.MAR.2020 19:41:14

OBW: 1RB-high\_offset



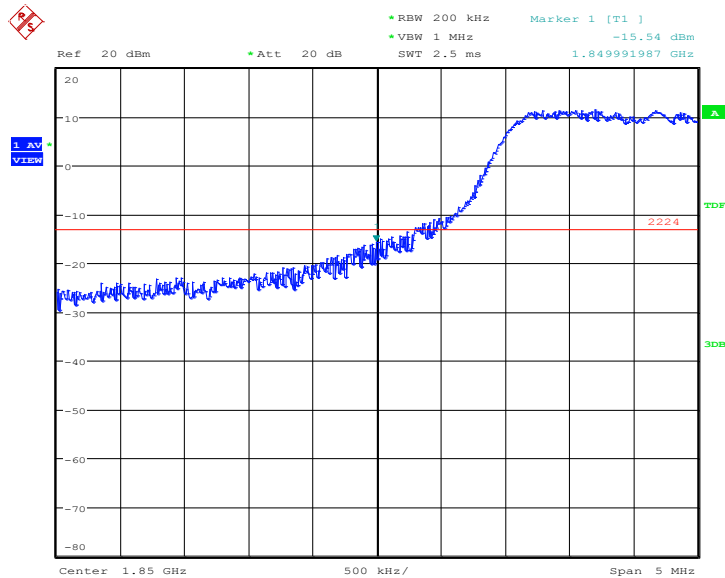
Date: 19.MAR.2020 19:37:01

### HIGH BAND EDGE BLOCK-1RB-high\_offset



Date: 19.MAR.2020 19:37:45

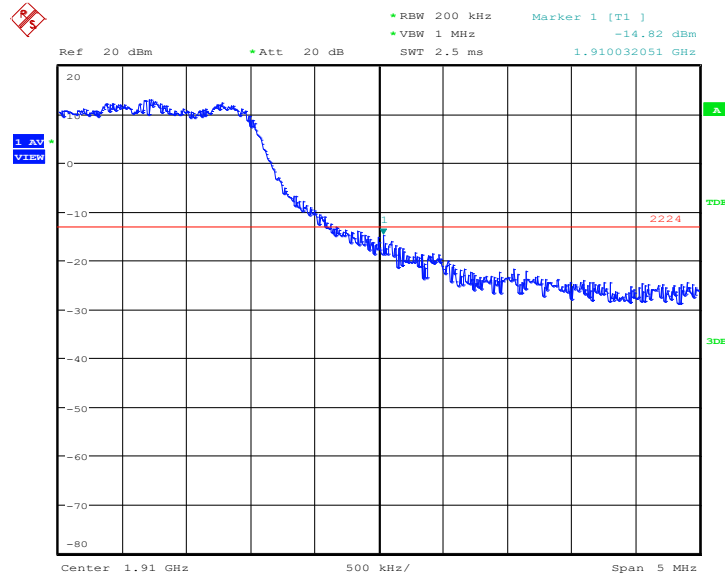
### LOW BAND EDGE BLOCK-20MHz-100%RB



Date: 19.MAR.2020 19:55:01

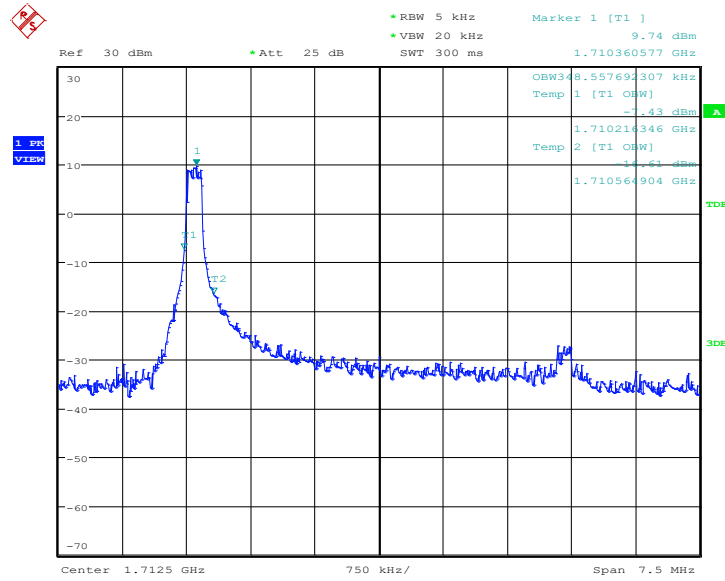


HIGH BAND EDGE BLOCK-20MHz-100%RB



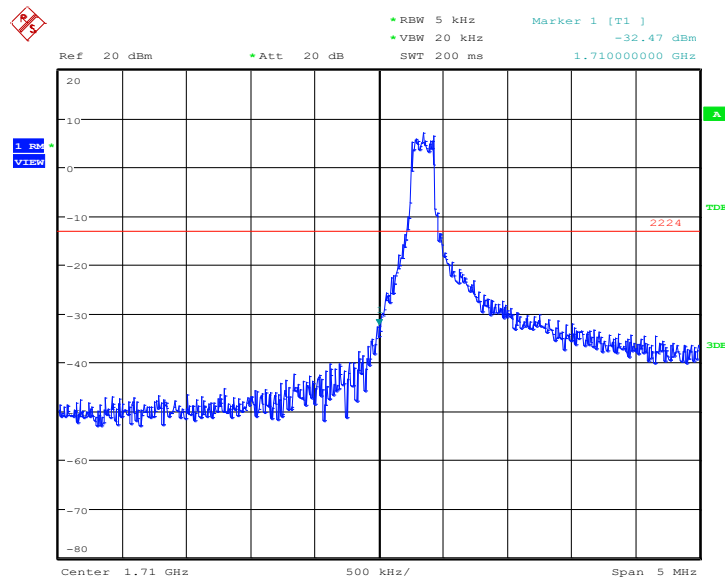
Date: 19.MAR.2020 19:53:07

**LTE band 4**  
**OBW: 1RB-low\_offset**



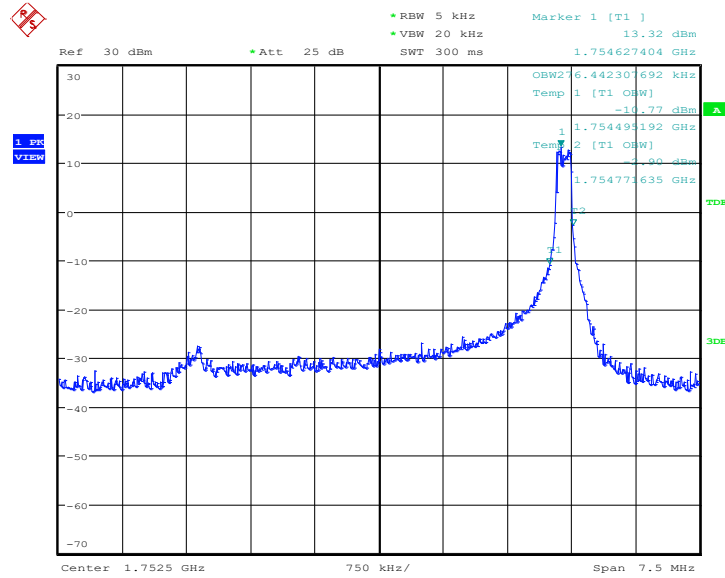
Date: 19.MAR.2020 19:42:09

**LOW BAND EDGE BLOCK-1RB-low\_offset**



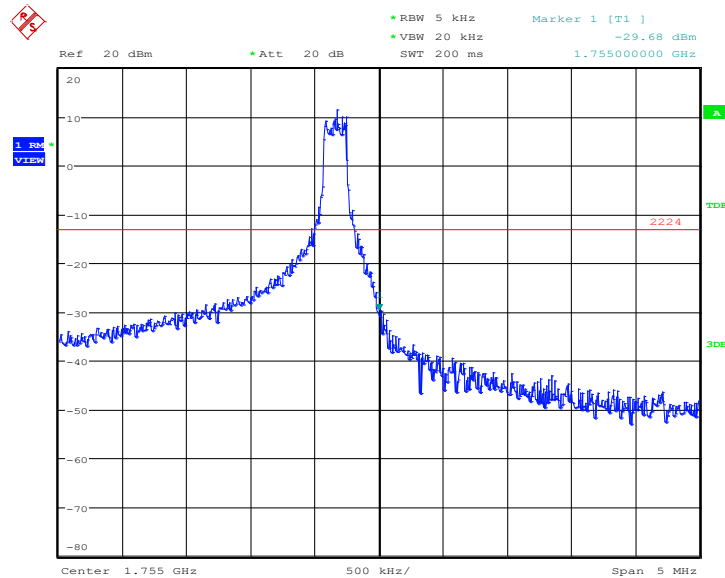
Date: 19.MAR.2020 19:42:53

**OBW: 1RB-high\_offset**



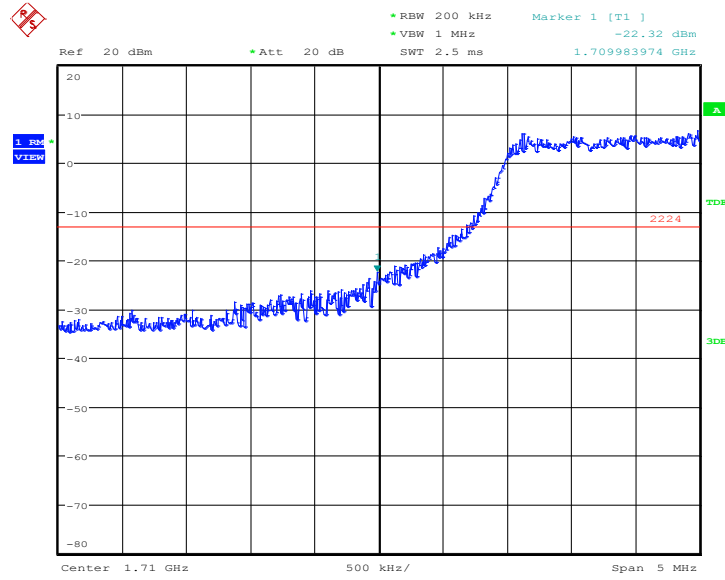
Date: 19.MAR.2020 19:38:40

**HIGH BAND EDGE BLOCK-1RB-high\_offset**



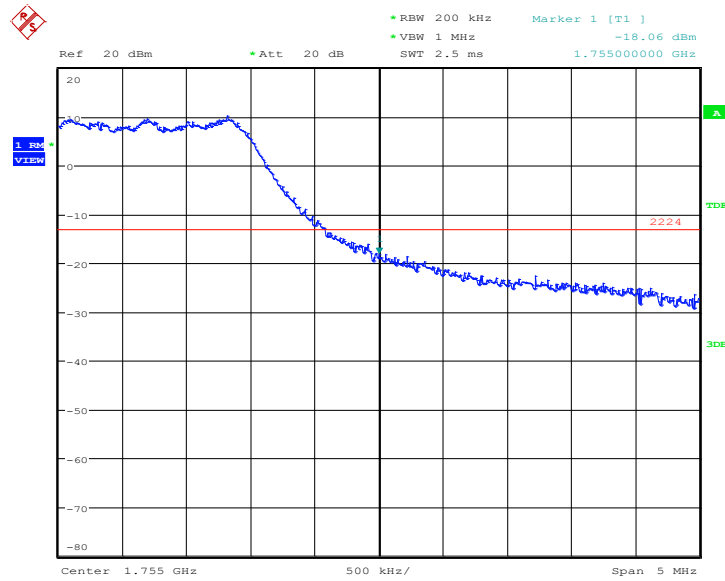
Date: 19.MAR.2020 19:39:25

**LOW BAND EDGE BLOCK-20MHz-100%RB**



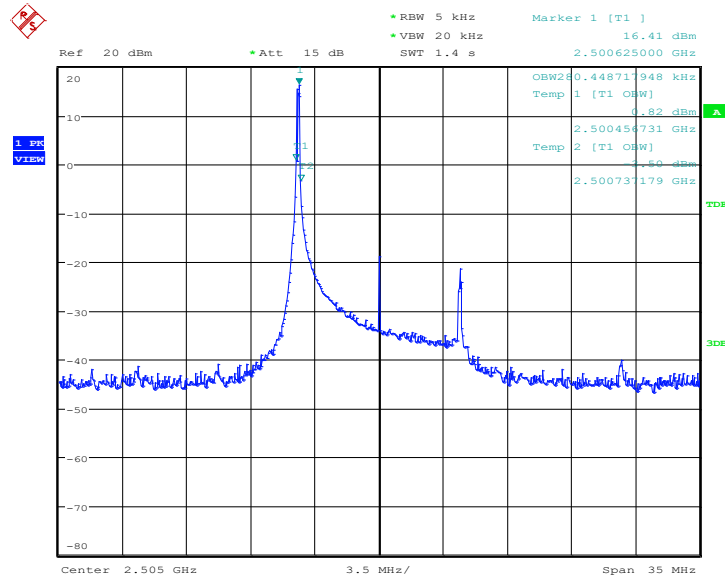
Date: 19.MAR.2020 19:48:03

**HIGH BAND EDGE BLOCK-20MHz-100%RB**



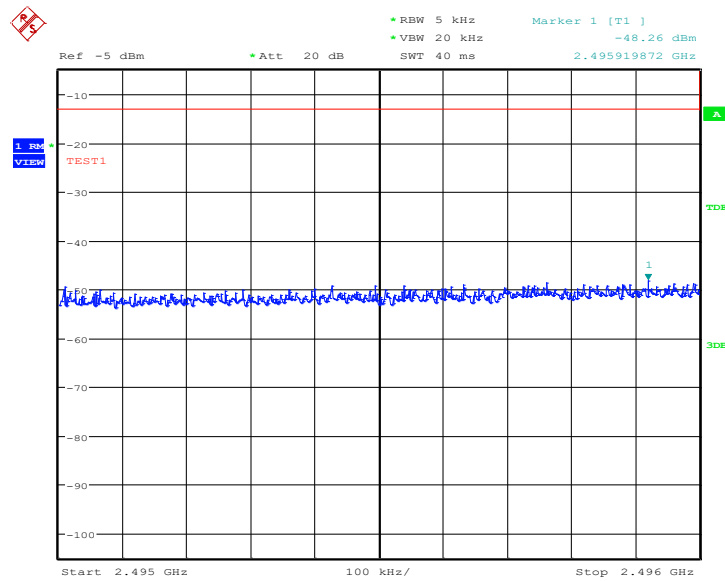
Date: 19.MAR.2020 19:50:06

**LTE band 7**  
**OBW: 1RB-low\_offset**



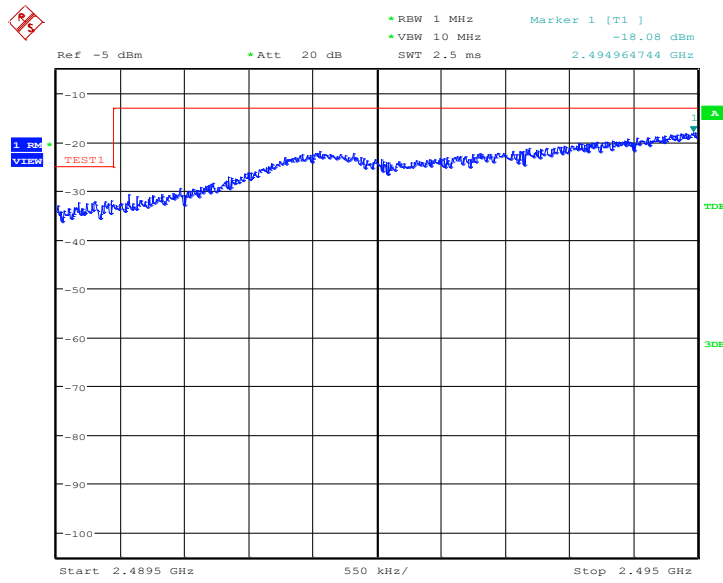
Date: 20.MAR.2020 14:45:45

**LOW BAND EDGE BLOCK-1RB-low\_offset**



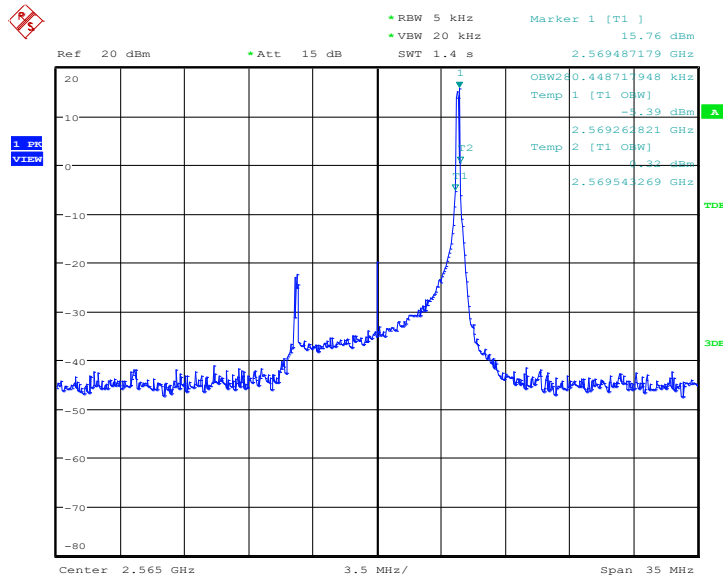
Date: 20.MAR.2020 15:00:33





Date: 20.MAR.2020 14:57:46

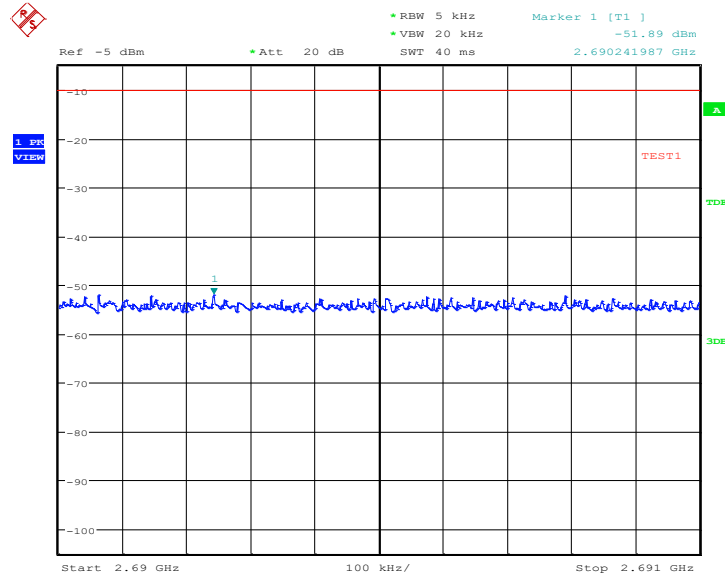
**OBW: 1RB-high\_offset**



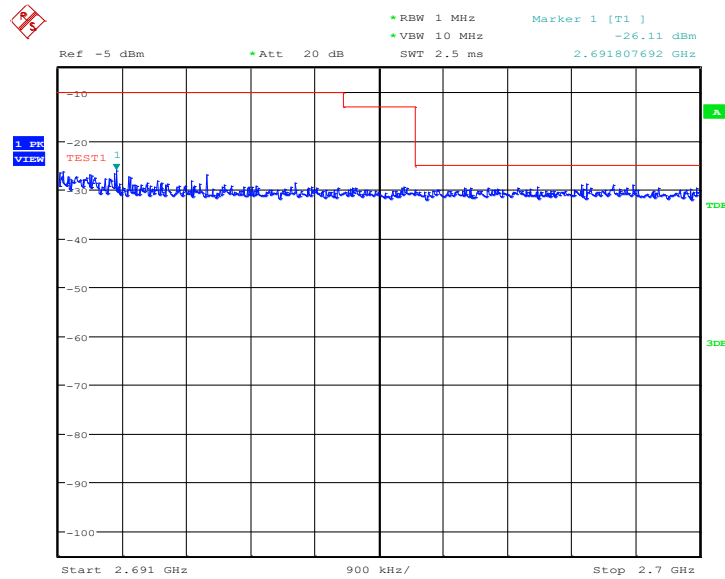
Date: 20.MAR.2020 14:48:01



### HIGH BAND EDGE BLOCK-1RB-high\_offset

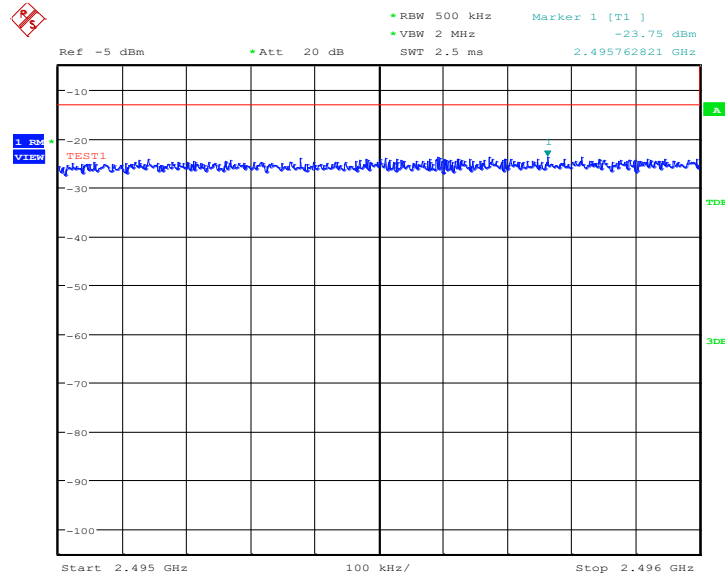


Date: 20.MAR.2020 14:52:44

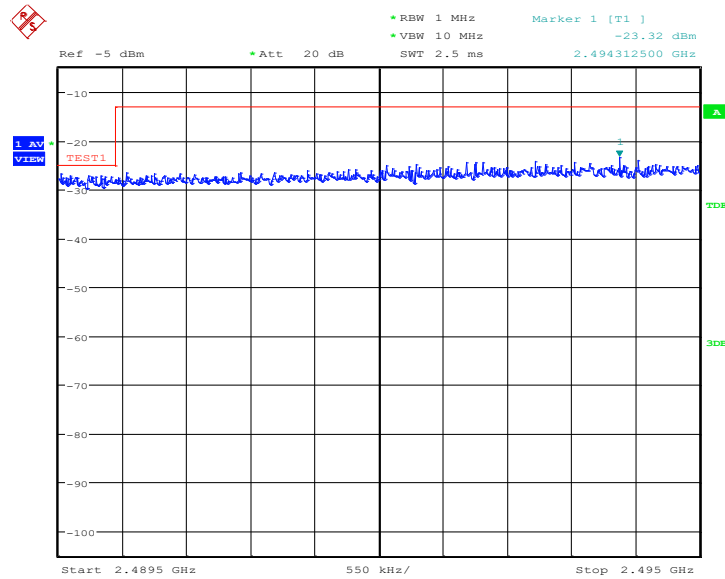


Date: 20.MAR.2020 14:54:19

LOW BAND EDGE BLOCK-20MHz-100%RB

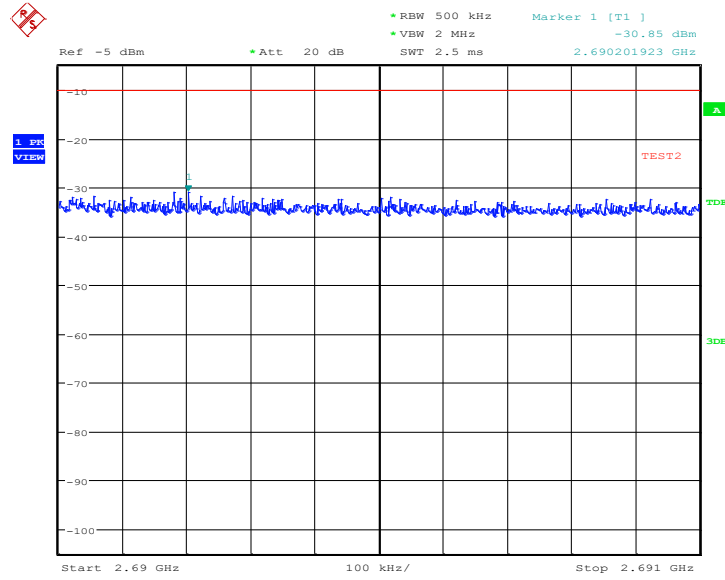


Date: 20.MAR.2020 15:03:54

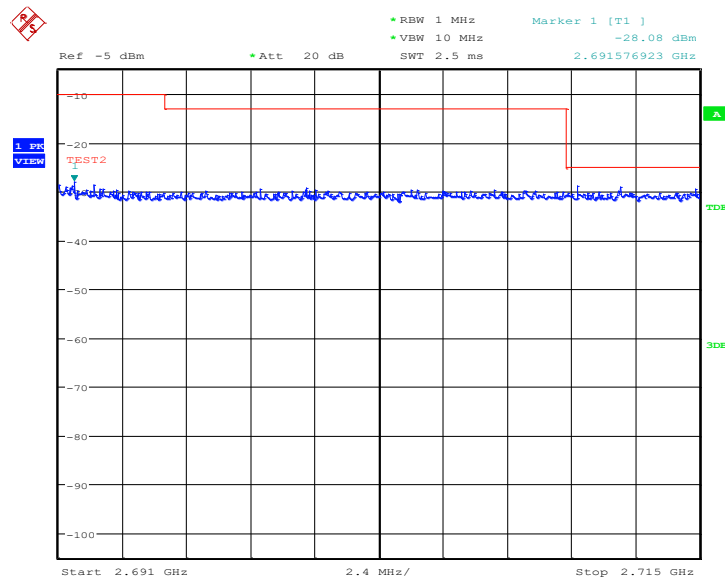


Date: 20.MAR.2020 15:05:39

HIGH BAND EDGE BLOCK-20MHz-100%RB



Date: 20.MAR.2020 15:24:46



Date: 20.MAR.2020 15:07:41

Note: Expanded measurement uncertainty is  $U = 0.49\text{dB}(100\text{kHz}-2\text{GHz})/1.21\text{dB}(2\text{GHz}-26.5\text{GHz})$ ,  $k = 1.96$

## **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 than  $43 + 10 \log(P)$  dB on all frequencies between 2490.5 MHz and 2496 MHz and  $55 + 10 \log(P)$  dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

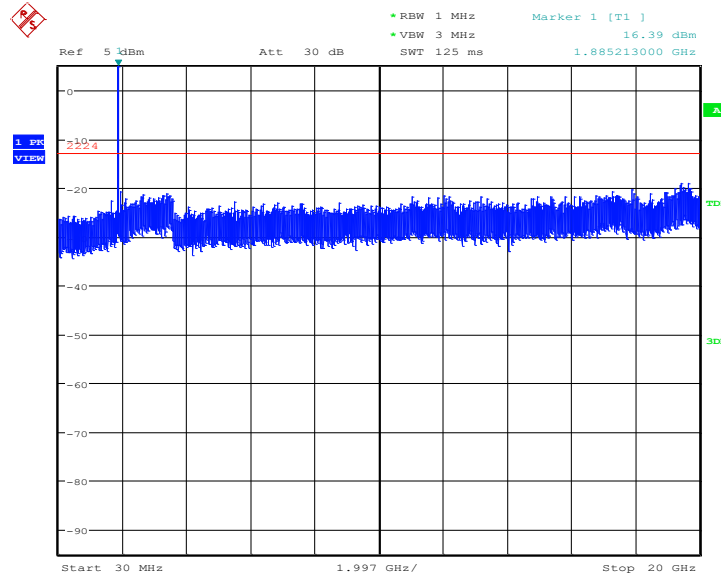
**A. 7.3 Measurement result**

**Only worst case result is given below**

**LTE band 2 20MHz QPSK: 30MHz – 20GHz**

Spurious emission limit –13dBm.

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

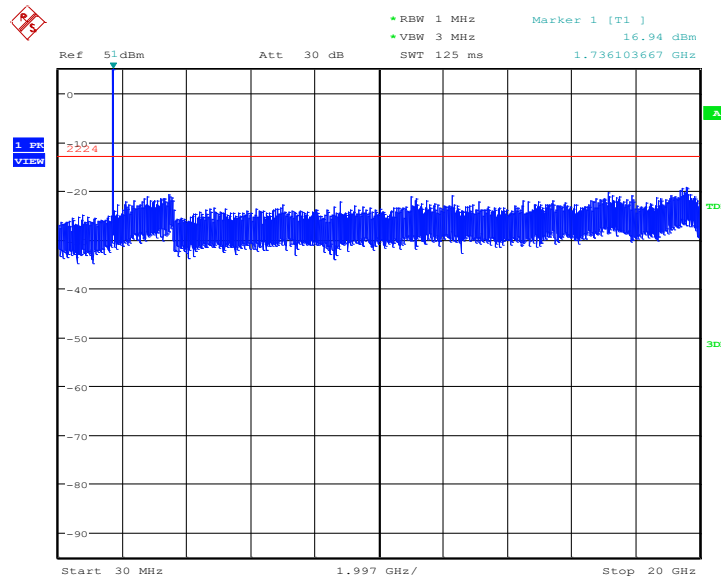


Date: 16.MAR.2020 19:33:40

**LTE band 4 20MHz QPSK: 30MHz – 20GHz**

Spurious emission limit –13dBm.

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

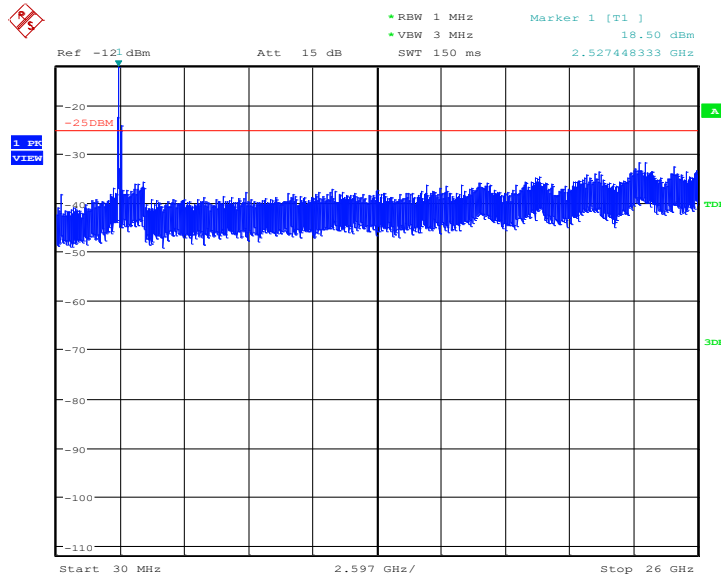


Date: 16.MAR.2020 20:00:08

**LTE band 7 20MHz QPSK: 30MHz – 26GHz**

Spurious emission limit –25dBm.

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



Date: 16.MAR.2020 19:06:09

Note: Expanded measurement uncertainty is  $U = 0.49\text{dB}(100\text{kHz}-2\text{GHz})/1.21\text{dB}(2\text{GHz}-26.5\text{GHz})$ ,  $k = 1.96$

## A.8 PEAK-TO-AVERAGE POWER RATIO

### Reference

FCC: CFR Part 24.232, 27.50(d), KDB971168 D01(5.7).

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  $\geq$  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

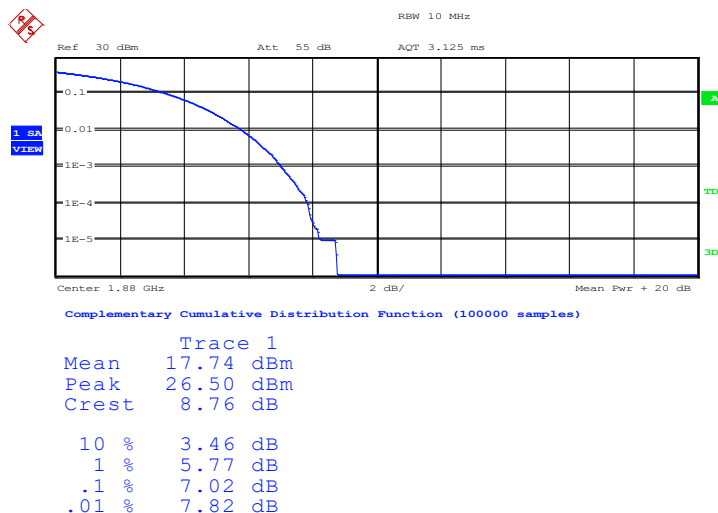
### A.8.2 Measurement results

Only worst case result is given below

#### LTE band 2

Frequency(MHz)	Bandwidth(MHz)	PAPR(dB)	
		QPSK	16QAM
1880.0	20	7.02	7.63

#### LTE band 2, 20MHz Bandwidth, QPSK (PAPR)

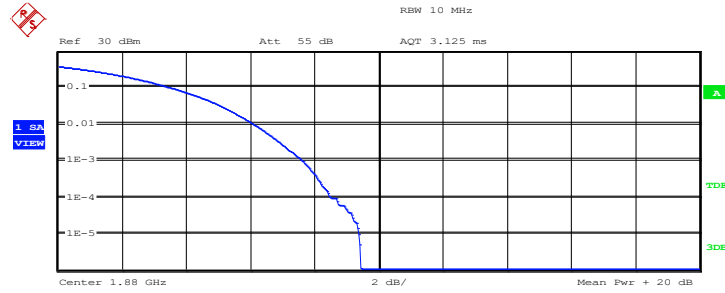


Date: 16.MAR.2020 19:34:43





LTE band 2, 20MHz Bandwidth, 16QAM (PAPR)



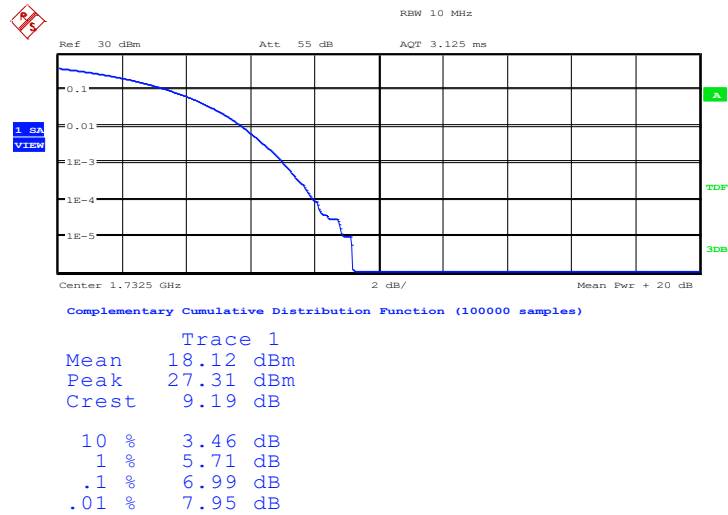
Complementary Cumulative Distribution Function (100000 samples)

Trace 1	
Mean	17.13 dBm
Peak	26.57 dBm
Crest	9.44 dB
10 %	3.53 dB
1 %	6.09 dB
.1 %	7.63 dB
.01 %	8.59 dB

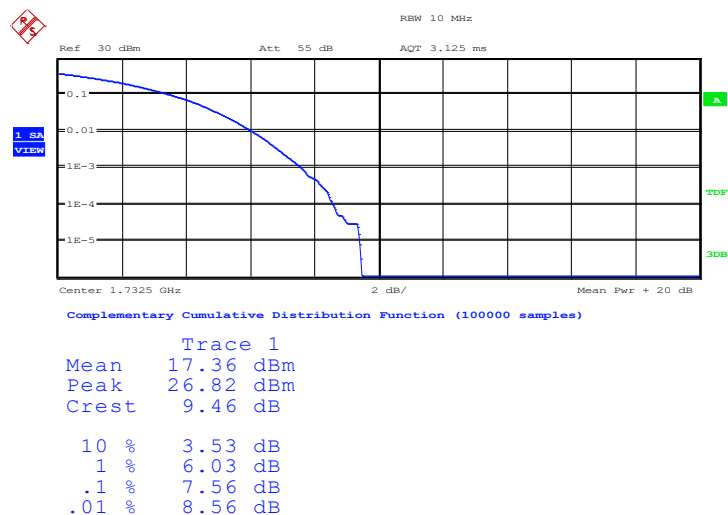
Date: 16.MAR.2020 19:34:50

**LTE band 4**

Frequency(MHz)	Bandwidth(MHz)	PAPR(dB)	
		QPSK	16QAM
1732.5	20	6.99	7.56

**LTE band 4, 20MHz Bandwidth, QPSK (PAPR)**


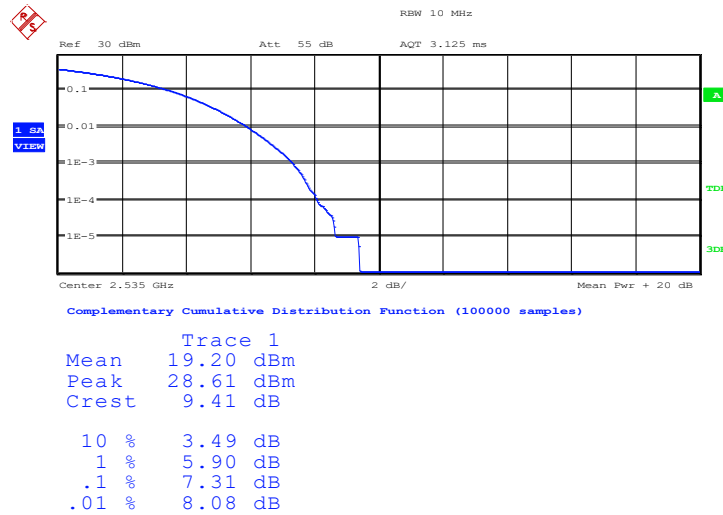
Date: 16.MAR.2020 20:06:55

**LTE band 4, 20MHz Bandwidth, 16QAM (PAPR)**


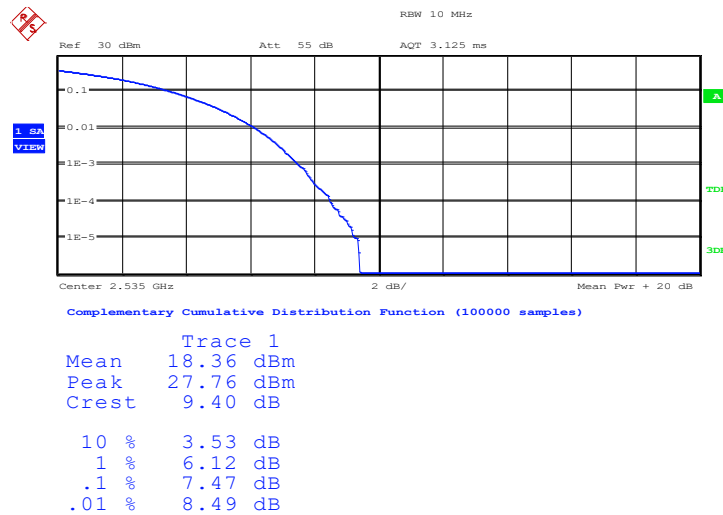
Date: 16.MAR.2020 20:07:01

**LTE band 7**

Frequency(MHz)	Bandwidth(MHz)	PAPR(dB)	
		QPSK	16QAM
2510.0	20	7.31	7.47

**LTE band 7, 20MHz Bandwidth, QPSK (PAPR)**


Date: 16.MAR.2020 19:08:43

**LTE band 7, 20MHz Bandwidth, 16QAM (PAPR)**


Date: 16.MAR.2020 19:08:49

 Note: Expanded measurement uncertainty is  $U = 0.48$ ,  $k = 2$ 
**\*\*\*END OF REPORT\*\*\***