



# TEST REPORT

No. I19Z60337-WMD03

for

**TCL Communication Ltd**

**LTE/WCDMA/GSM mobile phone**

**Model Name: VFD 730**

**FCC ID: 2ACCJH104**

with

**Hardware Version: PIO**

**Software Version: v4JT7**

**Issued Date: 2019-04-10**



**Note:**

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## **REPORT HISTORY**

<b>Report Number</b>	<b>Revision</b>	<b>Description</b>	<b>Issue Date</b>
I19Z60337-WMD03	Rev.0	1 <sup>st</sup> edition	2019-04-10



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## **1. Test Laboratory**

### **1.1. Introduction & Accreditation**

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

### **1.2. Testing Location**

Location 1: CTTL(huayuan North Road)

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

Location 2: CTTL(Shouxiang)

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

### 1.3. Testing Environment

Normal Temperature: 15-35°C

Relative Humidity: 20-75%

### 1.4. Project data

Testing Start Date: 2019-02-27

Testing End Date: 2019-04-09

### 1.5. Signature



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**Dong Yuan**  
**(Prepared this test report)**



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**Zhou Yu**  
**(Reviewed this test report)**



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**Zhao Hui Lin**  
**Deputy Director of the laboratory**  
**(Approved this test report)**



## **2. Client Information**

### **2.1. Applicant Information**

Company Name: TCL Communication Ltd  
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### **2.2. Manufacturer Information**

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Shenzhen, Guangdong, P.R. China 518052  
Contact: Gong Zhizhou  
Email: zhizhou.gong@tcl.com  
Telephone: 0086-755-36611722  
Fax: /



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

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

Description	LTE/WCDMA/GSM mobile phone
Model Name	VFD 730
FCC ID	2ACCJH104
Antenna	Embedded
Output power	22.78dBm maximum EIRP measured for Band 7
Extreme vol. Limits	3.5VDC to 4.4VDC (nominal: 3.8VDC)
Extreme temp. Tolerance	-10°C to +40°C

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

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

<b>EUT ID*</b>	<b>IMEI</b>	<b>HW Version</b>	<b>SW Version</b>	<b>Date of receipt</b>
UT28a	354780100206894/ 354780100206902	PIO	v4JT7	2019-2-25
UT53a	354780100207017/ 354780100207025	PIO	v4JT7	2019-3-26

\*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	Battery
AE1	
Model	TLp034E1
Manufacturer	BYD
Capacitance	3500mAh

\*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 LTE/WCDMA/GSM mobile phone with embedded antenna. Manual and specifications of the EUT were provided to fulfil the test.



#### **4. Reference Documents**

##### **4.1. Reference Documents for testing**

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

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



## 5. LABORATORY ENVIRONMENT

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

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

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

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



## 6. SUMMARY OF TEST RESULTS

### 6.1. 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 5

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	§2.1046(a), 22.913(a)	A.1	P
2	Emission Limit	22.917, 2.1051	A.2	P
3	Frequency Stability	22.235, 2.1055	A.3	P
4	Occupied Bandwidth	2.1049(h)(i)	A.4	P
5	Emission Bandwidth	22.917(b)	A.5	P
6	Band Edge Compliance	22.917(b)	A.6	P
7	Conducted Spurious Emission	22.917, 2.1057	A.7	P

#### LTE Band 7

Items	Test Name	Clause in FCC rules	Section in this report	Verdict
1	Output Power	27.50(h)(2)	A.1	P
2	Emission Limit	27.53(m), 2.1051	A.2	P
3	Frequency Stability	27.54, 2.1055	A.3	P
4	Occupied Bandwidth	2.1049(h)(i)	A.4	P
5	Emission Bandwidth	27.53(m)	A.5	P
6	Band Edge Compliance	27.53(m)	A.6	P
7	Conducted Spurious Emission	27.53(m), 2.1057	A.7	P
8	Peak to Average Power Ratio	27.50(a)	A.8	P



## **6.2. Statements**

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

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

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

## 7. Test Equipments Utilized

NO.	Description	TYPE	series number	MANUFACTURE	CAL DUE DATE	Calibration interval
1	Test Receiver	ESU26	100235	R&S	2020-02-27	1 year
2	Test Receiver	ESU26	100376	R&S	2019-11-27	1 year
3	EMI Antenna	3117	00058889	ETS-Lindgren	2020-05-27	3 year
4	Universal Radio Communication Tester	CMW500	159082	R&S	2019-12-25	1 year
5	Spectrum Analyzer	FSU26	200030	R&S	2019-06-04	1 year
6	EMI Antenna	VULB9163	9163-235	Schwarzbeck	2019-11-20	1 year
7	Signal Generator	SMF100A	101295	R&S	2019-11-27	1 year
8	Climate chamber	SH-242	93008556	ESPEC	2019-12-21	2 year
9	Loop Antenna	HFH2-Z2	829324/007	R&S	2019-11-03	1 year

## **ANNEX A: MEASUREMENT RESULTS**

### **A.1 OUTPUT POWER**

#### **A.1.1 Summary**

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

#### **A.1.2 Conducted**

##### **A.1.2.1 Method of Measurements**

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

##### **A.1.2.2 Measurement result**

#### **LTE band 5**

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
1.4MHz	1 RB high	848.3	22.97	22.16
		836.5	23.08	22.21
		824.7	23.11	22.34
	1 RB low	848.3	23.07	22.21
		836.5	23.12	22.50
		824.7	23.11	21.94
	50% RB mid	848.3	23.17	22.44
		836.5	23.24	22.02
		824.7	23.17	22.31
	100% RB	848.3	22.30	21.37
		836.5	22.16	21.48
		824.7	22.37	21.27
3MHz	1 RB high	847.5	23.07	21.92
		836.5	23.18	21.88
		825.5	23.24	22.21
	1 RB low	847.5	23.03	22.29
		836.5	23.33	21.95
		825.5	22.96	22.34
	50% RB mid	847.5	22.15	21.64
		836.5	22.15	21.30
		825.5	22.27	21.40

	100% RB	847.5	22.19	21.42
		836.5	22.11	21.23
		825.5	22.22	21.25
5MHz	1 RB high	846.5	23.08	21.79
		836.5	22.79	21.71
		826.5	23.11	22.41
	1 RB low	846.5	23.16	21.58
		836.5	22.82	21.77
		826.5	23.26	21.97
	50% RB mid	846.5	22.21	21.29
		836.5	22.20	21.04
		826.5	22.41	21.42
	100% RB	846.5	22.09	21.29
		836.5	22.12	21.16
		826.5	22.29	21.12
10MHz	1 RB high	844.0	23.06	22.34
		836.5	22.91	22.51
		829.0	22.93	21.93
	1 RB low	844.0	23.14	22.13
		836.5	23.00	21.92
		829.0	23.16	22.17
	50% RB mid	844.0	22.24	21.31
		836.5	22.23	21.14
		829.0	22.43	21.58
	100% RB	844.0	22.12	21.18
		836.5	22.14	21.20
		829.0	22.17	21.27

**LTE band 7**

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
5MHz	1 RB high	2567.5	22.95	21.72
		2535	23.09	22.17
		2502.5	22.97	21.91
	1 RB low	2567.5	23.02	21.30
		2535	23.41	21.91
		2502.5	22.94	21.46
	50% RB mid	2567.5	21.88	20.86
		2535	22.24	21.15
		2502.5	22.27	21.23
	100% RB	2567.5	21.84	20.81
		2535	22.29	21.22
		2502.5	22.20	21.11
10MHz	1 RB high	2565	22.77	21.75
		2535	23.39	22.28
		2505	22.95	21.94
	1 RB low	2565	22.92	22.11
		2535	23.41	22.51
		2505	23.13	21.76
	50% RB mid	2565	21.96	21.03
		2535	22.28	21.49
		2505	22.14	21.19
	100% RB	2565	21.84	20.78
		2535	22.21	21.28
		2505	22.29	21.24
15MHz	1 RB high	2562.5	23.16	22.01
		2535	23.15	22.65
		2507.5	23.12	22.66
	1 RB low	2562.5	23.34	22.02
		2535	23.14	22.15
		2507.5	23.22	22.23
	50% RB mid	2562.5	21.93	20.91
		2535	22.38	21.32
		2507.5	22.20	21.12
	100% RB	2562.5	21.87	20.82
		2535	22.23	21.21
		2507.5	22.09	21.15
20MHz	1 RB high	2560	22.75	21.48



		2535	23.37	22.01
		2510	22.83	21.90
	1 RB low	2560	22.87	21.80
		2535	23.08	21.93
		2510	23.01	21.96
	50% RB mid	2560	22.03	21.03
		2535	22.39	21.26
		2510	22.21	21.24
	100% RB	2560	22.00	20.91
		2535	22.22	21.29
		2510	22.18	21.13



### A.1.3 Radiated

#### A.1.3.1 Description

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

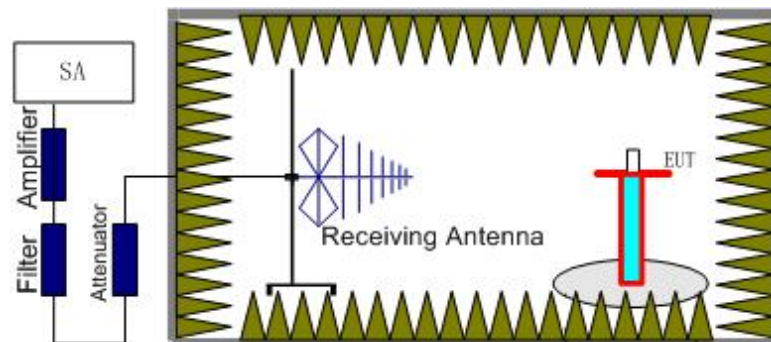
Rule Part 22.913(a) specifies “Mobile stations are limited to 2.0 watts EIRP.”.

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

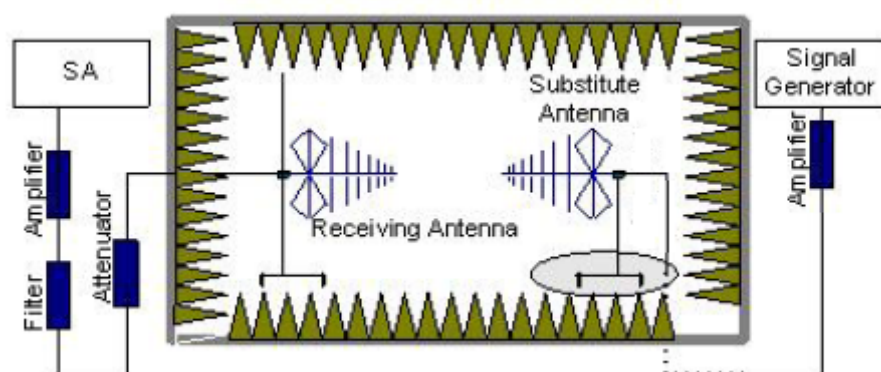
#### A.1.3.2 Method of Measurement

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

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



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



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

The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. An amplifier should be connected to the Signal Source output port. And the cable should be connected between the amplifier and the substitution antenna.

The cable loss ( $P_{cl}$ ), the substitution antenna Gain ( $G_a$ ) and the amplifier Gain ( $P_{Ag}$ ) should be recorded after test.

The measurement results are obtained as described below:

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

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

**A.1.3.3 Measurement result**

**LTE Band 5- ERP 22.913(a)**

**Limits:** ≤38.45dBm (7W)

**LTE Band 5\_1.4MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
824.70	-24.24	2.26	45.79	0.95	2.15	18.09	38.45	20.36	H
836.50	-23.72	2.26	45.66	0.82	2.15	18.35	38.45	20.10	H
848.30	-24.54	2.27	45.55	0.80	2.15	17.39	38.45	21.06	H

**LTE Band 5\_3MHz\_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)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
825.50	-24.43	2.26	45.79	0.94	2.15	17.89	38.45	20.56	H
836.50	-23.96	2.26	45.66	0.82	2.15	18.11	38.45	20.34	H
847.50	-24.22	2.27	45.56	0.81	2.15	17.73	38.45	20.72	H

**LTE Band 5\_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(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
826.50	-24.43	2.25	45.77	0.93	2.15	17.87	38.45	20.58	H
836.50	-23.83	2.26	45.66	0.82	2.15	18.24	38.45	20.21	H
846.50	-24.38	2.26	45.56	0.82	2.15	17.59	38.45	20.86	H

**LTE Band 5\_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(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
829.00	-24.47	2.13	45.74	0.90	2.15	17.89	38.45	20.56	H
836.50	-23.82	2.26	45.66	0.82	2.15	18.25	38.45	20.20	H
844.00	-24.57	2.26	45.59	0.82	2.15	17.43	38.45	21.02	H



**LTE Band 5\_1.4MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
824.70	-25.03	2.26	45.79	0.95	2.15	17.30	38.45	21.15	H
836.50	-24.70	2.26	45.66	0.82	2.15	17.37	38.45	21.08	H
848.30	-25.27	2.27	45.55	0.80	2.15	16.66	38.45	21.79	H

**LTE Band 5\_3MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
825.50	-25.25	2.26	45.79	0.94	2.15	17.07	38.45	21.38	H
836.50	-24.89	2.26	45.66	0.82	2.15	17.18	38.45	21.27	H
847.50	-25.24	2.27	45.56	0.81	2.15	16.71	38.45	21.74	H

**LTE Band 5\_5MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
826.50	-25.19	2.25	45.77	0.93	2.15	17.11	38.45	21.34	H
836.50	-24.79	2.26	45.66	0.82	2.15	17.28	38.45	21.17	H
846.50	-24.95	2.26	45.56	0.82	2.15	17.02	38.45	21.43	H

**LTE Band 5\_10MHz\_16QAM**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>ci</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
829.00	-25.38	2.13	45.74	0.90	2.15	16.98	38.45	21.47	H
836.50	-24.92	2.26	45.66	0.82	2.15	17.15	38.45	21.30	H
844.00	-25.22	2.26	45.59	0.82	2.15	16.78	38.45	21.67	H



**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>c</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2502.50	-26.70	3.58	45.68	6.10	21.50	33.00	11.50	H
2535.00	-25.23	3.63	44.82	6.16	22.12	33.00	10.88	H
2567.50	-25.71	3.65	44.92	6.22	21.78	33.00	11.22	H

**LTE Band 7\_10MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>c</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2505.00	-26.39	3.59	45.64	6.11	21.77	33.00	11.23	H
2535.00	-25.04	3.63	44.82	6.16	22.31	33.00	10.69	H
2565.00	-25.86	3.65	44.97	6.22	21.68	33.00	11.32	H

**LTE Band 7\_15MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>c</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2507.50	-26.11	3.59	44.92	6.11	21.33	33.00	11.67	H
2535.00	-25.07	3.63	44.82	6.16	22.28	33.00	10.72	H
2562.50	-26.21	3.65	45.67	6.21	22.02	33.00	10.98	H

**LTE Band 7\_20MHz\_QPSK**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	P <sub>c</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2510.00	-26.00	3.58	45.36	6.12	21.90	33.00	11.10	H
2535.00	-24.57	3.63	44.82	6.16	22.78	33.00	10.22	H
2560.00	-26.24	3.64	45.98	6.21	22.31	33.00	10.69	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(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2502.50	-27.79	3.58	45.68	6.10	20.41	33.00	12.59	H
2535.00	-25.99	3.63	44.82	6.16	21.36	33.00	11.64	H
2567.50	-26.58	3.65	44.92	6.22	20.91	33.00	12.09	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(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2505.00	-27.38	3.59	45.64	6.11	20.78	33.00	12.22	H
2535.00	-25.66	3.63	44.82	6.16	21.69	33.00	11.31	H
2565.00	-26.67	3.65	44.97	6.22	20.87	33.00	12.13	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(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2507.50	-26.87	3.59	44.92	6.11	20.57	33.00	12.43	H
2535.00	-25.98	3.63	44.82	6.16	21.37	33.00	11.63	H
2562.50	-26.63	3.65	45.67	6.21	21.60	33.00	11.40	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(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
2510.00	-27.17	3.58	45.36	6.12	20.73	33.00	12.27	H
2535.00	-25.39	3.63	44.82	6.16	21.96	33.00	11.04	H
2560.00	-26.94	3.64	45.98	6.21	21.61	33.00	11.39	H

Peak EIRP(dBm) = P<sub>Mea</sub>(-24.57dBm) - G<sub>a</sub> (-6.16dBi) - P<sub>Ag</sub> (-44.82dB) - P<sub>cl</sub> (3.63dB) = 22.78dBm

**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: Expanded measurement uncertainty is  $U = 0.96$  dB,  $k = 2$ .

## A.2 EMISSION LIMIT

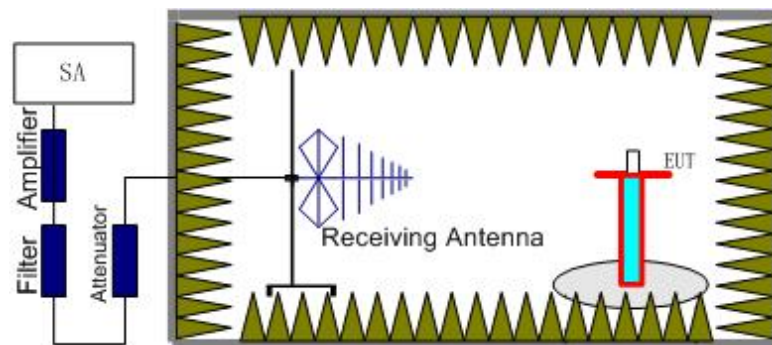
### A.2.1 Measurement Method

The measurements procedures in TIA-603D-2010 are used. This measurement is carried out in fully-anechoic chamber FAC-3.

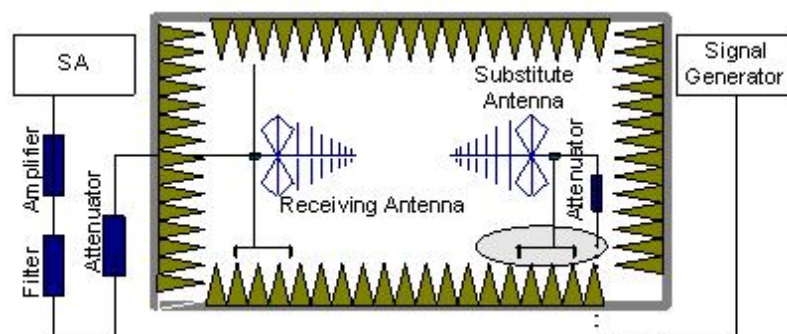
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier. The resolution bandwidth is set 1MHz. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and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

#### The procedure of radiated spurious emissions is as follows:

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



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



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

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

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

### A.2.2 Measurement Limit

Part 22.917, Part 27.53(g) 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.

### A.2.3 Measurement Results

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of the LTE Bands 5-7. It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the LTE Bands 5-7 into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this. The evaluated frequency range is from 30MHz to 26GHz.





**LTE Band 5, 1.4MHz, QPSK, Channel 20407**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Margin(dB)	Polarization
1659.01	-59.01	3.57	5.21	2.15	-59.52	-13.00	46.52	H
2474.00	-49.77	4.60	6.02	2.15	-50.50	-13.00	37.50	H
3299.02	-54.85	5.29	7.72	2.15	-54.57	-13.00	41.57	V
4116.02	-55.40	6.04	9.02	2.15	-54.57	-13.00	41.57	H
4935.01	-54.89	6.72	9.84	2.15	-53.92	-13.00	40.92	H
5771.01	-54.37	7.23	10.55	2.15	-53.20	-13.00	40.20	H

**LTE Band 5, 1.4MHz, QPSK, Channel 20525**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Margin(dB)	Polarization
1673.01	-57.41	3.58	5.19	2.15	-57.95	-13.00	44.95	H
2510.00	-49.49	4.63	6.12	2.15	-50.15	-13.00	37.15	H
3353.02	-54.46	5.32	7.85	2.15	-54.08	-13.00	41.08	V
4172.02	-55.19	6.14	9.07	2.15	-54.41	-13.00	41.41	V
5029.01	-54.61	6.57	9.94	2.15	-53.39	-13.00	40.39	H
5852.01	-54.09	7.24	10.53	2.15	-52.95	-13.00	39.95	H

**LTE Band 5, 1.4MHz, QPSK, Channel 20643**

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Margin(dB)	Polarization
1697.01	-52.39	3.60	5.15	2.15	-52.99	-13.00	39.99	H
2545.00	-48.42	4.66	6.18	2.15	-49.05	-13.00	36.05	H
3388.02	-55.31	5.35	7.93	2.15	-54.88	-13.00	41.88	V
4243.02	-54.86	6.25	9.14	2.15	-54.12	-13.00	41.12	H
5082.01	-55.64	6.72	10.01	2.15	-54.50	-13.00	41.50	V
5934.01	-53.82	7.47	10.51	2.15	-52.93	-13.00	39.93	H



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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Margin(dB)	Polarization
1650.01	-51.29	3.57	5.23	2.15	-51.78	-13.00	38.78	H
2475.00	-47.56	4.60	6.03	2.15	-48.28	-13.00	35.28	H
3300.02	-55.28	5.29	7.72	2.15	-55.00	-13.00	42.00	V
4113.02	-55.93	6.04	9.01	2.15	-55.11	-13.00	42.11	H
4936.01	-55.03	6.71	9.84	2.15	-54.05	-13.00	41.05	H
5764.01	-54.97	7.24	10.55	2.15	-53.81	-13.00	40.81	H

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Margin(dB)	Polarization
1673.01	-57.55	3.58	5.19	2.15	-58.09	-13.00	45.09	H
2510.00	-50.51	4.63	6.12	2.15	-51.17	-13.00	38.17	H
3350.02	-54.26	5.32	7.84	2.15	-53.89	-13.00	40.89	H
4185.02	-55.05	6.17	9.09	2.15	-54.28	-13.00	41.28	V
5030.01	-55.54	6.57	9.94	2.15	-54.32	-13.00	41.32	H
5868.01	-53.32	7.29	10.53	2.15	-52.23	-13.00	39.23	H

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Margin(dB)	Polarization
1697.01	-55.51	3.60	5.15	2.15	-56.11	-13.00	43.11	H
2545.00	-51.33	4.66	6.18	2.15	-51.96	-13.00	38.96	H
3381.02	-55.01	5.35	7.91	2.15	-54.60	-13.00	41.60	H
4256.02	-55.20	6.23	9.16	2.15	-54.42	-13.00	41.42	H
5089.01	-55.60	6.74	10.02	2.15	-54.47	-13.00	41.47	H
5934.01	-51.80	7.47	10.51	2.15	-50.91	-13.00	37.91	H



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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit (dBm)	Margin(dB)	Polarization
5009.02	-57.00	6.59	9.91	-53.68	-25.00	28.68	H
7512.01	-49.49	8.34	12.21	-45.62	-25.00	20.62	H
10020.01	-52.06	9.24	12.91	-48.39	-25.00	23.39	V
12529.01	-49.58	10.26	13.22	-46.62	-25.00	21.62	H
15005.00	-45.73	11.22	14.00	-42.95	-25.00	17.95	H
17520.00	-42.79	12.80	14.93	-40.66	-25.00	15.66	V

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit (dBm)	Margin(dB)	Polarization
5072.02	-57.30	6.69	10.00	-53.99	-25.00	28.99	V
7606.01	-50.98	8.00	12.28	-46.70	-25.00	21.70	H
10146.01	-52.53	9.39	12.96	-48.96	-25.00	23.96	V
12664.01	-49.31	10.36	13.30	-46.37	-25.00	21.37	V
15228.00	-45.19	11.37	13.86	-42.70	-25.00	17.70	V
17738.00	-44.18	12.39	15.23	-41.34	-25.00	16.34	V

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit (dBm)	Margin(dB)	Polarization
5137.02	-54.97	6.86	10.09	-51.74	-25.00	26.74	V
7706.01	-52.50	8.42	12.36	-48.56	-25.00	23.56	H
10280.01	-52.24	9.57	13.01	-48.80	-25.00	23.80	V
12854.01	-48.84	10.63	13.41	-46.06	-25.00	21.06	V
15413.00	-44.62	11.41	13.75	-42.28	-25.00	17.28	V
17974.00	-42.21	12.89	15.56	-39.54	-25.00	14.54	H

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit (dBm)	Margin(dB)	Polarization
5009.02	-57.12	6.59	9.91	-53.80	-25.00	28.80	V
7512.01	-50.23	8.34	12.21	-46.36	-25.00	21.36	H
10020.01	-50.79	9.24	12.91	-47.12	-25.00	22.12	V
12529.01	-49.25	10.26	13.22	-46.29	-25.00	21.29	H
15025.00	-45.86	11.25	13.98	-43.13	-25.00	18.13	H
17498.00	-42.21	12.72	14.90	-40.03	-25.00	15.03	H

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit (dBm)	Margin(dB)	Polarization
5136.02	-55.76	6.86	10.09	-52.53	-25.00	27.53	H
7705.01	-52.10	8.42	12.36	-48.16	-25.00	23.16	H
10274.01	-51.97	9.55	13.01	-48.51	-25.00	23.51	V
12843.01	-49.16	10.66	13.41	-46.41	-25.00	21.41	H
15386.00	-46.43	11.38	13.77	-44.04	-25.00	19.04	V
17978.00	-44.23	12.90	15.57	-41.56	-25.00	16.56	H

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

Frequency(MHz)	P <sub>Mea</sub> (dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit (dBm)	Margin(dB)	Polarization
5136.02	-55.76	6.86	10.09	-52.53	-25.00	27.53	H
7705.01	-52.10	8.42	12.36	-48.16	-25.00	23.16	H
10274.01	-51.97	9.55	13.01	-48.51	-25.00	23.51	V
12843.01	-49.16	10.66	13.41	-46.41	-25.00	21.41	H
15386.00	-46.43	11.38	13.77	-44.04	-25.00	19.04	V
17978.00	-44.23	12.90	15.57	-41.56	-25.00	16.56	H

Note: The maximum value of expanded measurement uncertainty for this test item is  $U = 4.2$  dB,  $k = 2$ .

### **A.3 FREQUENCY STABILITY**

#### **A.3.1 Method of Measurement**

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

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -10°C.
3. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on middle channel for LTE band 5 7, 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 -10°C to +40°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 +40°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 -10°C to +40°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 3.8VDC. 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.3.3 Measurement results**

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

**Frequency Error vs Voltage**

Voltage (V)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
3.5	3.68	-25.42	0.0044	0.0304
3.8	-2.42	-25.42	0.0029	0.0304
4.4	-3.19	-24.12	0.0038	0.0288

**Frequency Error vs Temperature**

Temperature (°C)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
40	-3.02	-24.81	0.0036	0.0297
30	-2.20	-24.43	0.0026	0.0292
20	-2.55	-24.26	0.0030	0.0290
10	-2.30	-23.17	0.0027	0.0277
0	-2.86	-24.45	0.0034	0.0292
- 10	-4.84	-25.26	0.0058	0.0302

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

**Frequency Error vs Voltage**

Voltage (V)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
3.5	-7.88	-10.76	0.0031	0.0042
3.8	-5.84	-10.84	0.0023	0.0043
4.4	-9.80	-12.27	0.0039	0.0048

**Frequency Error vs Temperature**

Temperature (°C)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
40	-9.16	-11.20	0.0036	0.0044
30	-10.10	-11.30	0.0040	0.0045
20	-7.90	-11.63	0.0031	0.0046
10	-5.84	-15.19	0.0023	0.0060
0	-5.51	-11.19	0.0022	0.0044
- 10	-9.57	-12.59	0.0038	0.0050



## **A.4 OCCUPIED BANDWIDTH**

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

Occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the US Cellular/PCS frequency bands. The table below lists the measured 99% BW. Spectrum analyzer plots are included on the following pages.

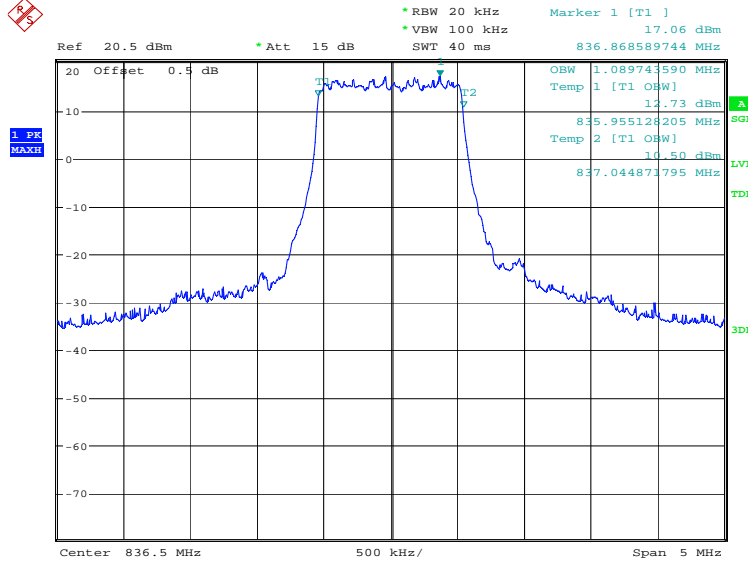
The measurement method is from KDB 971168 4.2:

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (i.e., two to five times the OBW).
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.
- c) Set the reference level of the instrument as required to keep the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope must be at least  $10\log(\text{OBW} / \text{RBW})$  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 5, 1.4MHz (99%)**

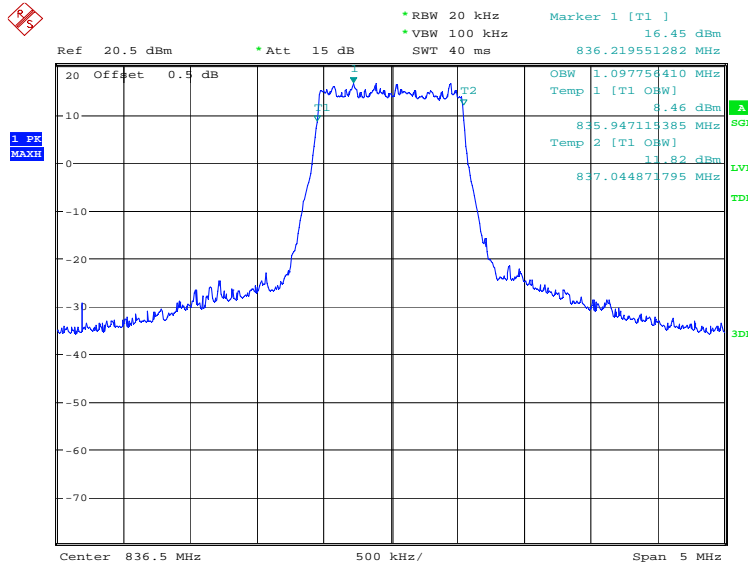
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
836.5	QPSK	16QAM
	1089.74	1097.76

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



Date: 27.FEB.2019 20:34:11

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



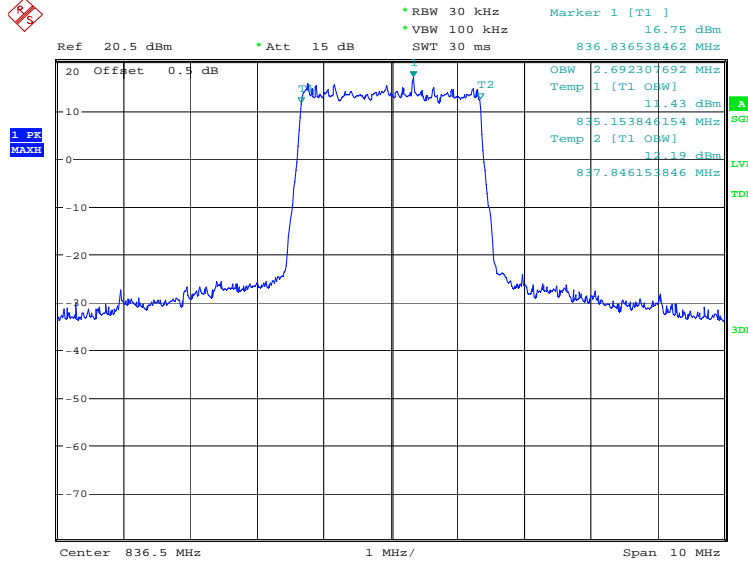
Date: 27.FEB.2019 20:35:35



**LTE band 5, 3MHz (99%)**

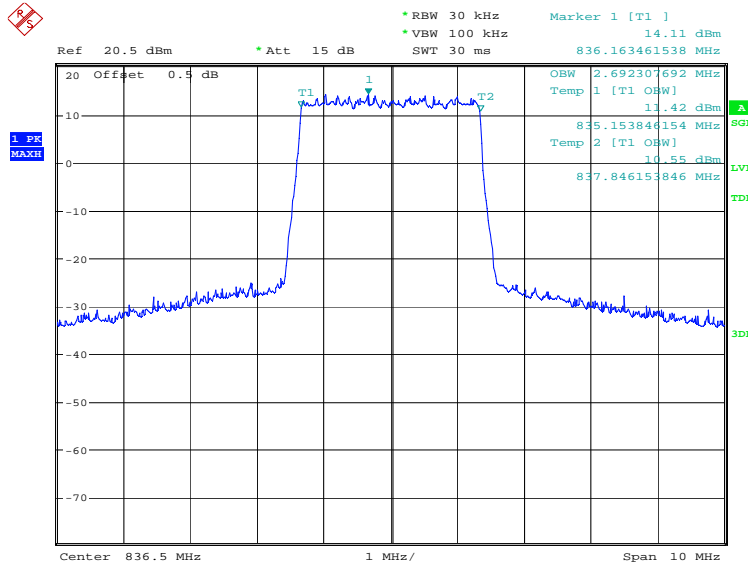
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
836.5	QPSK	16QAM
	2692.31	2692.31

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



Date: 27.FEB.2019 20:37:00

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

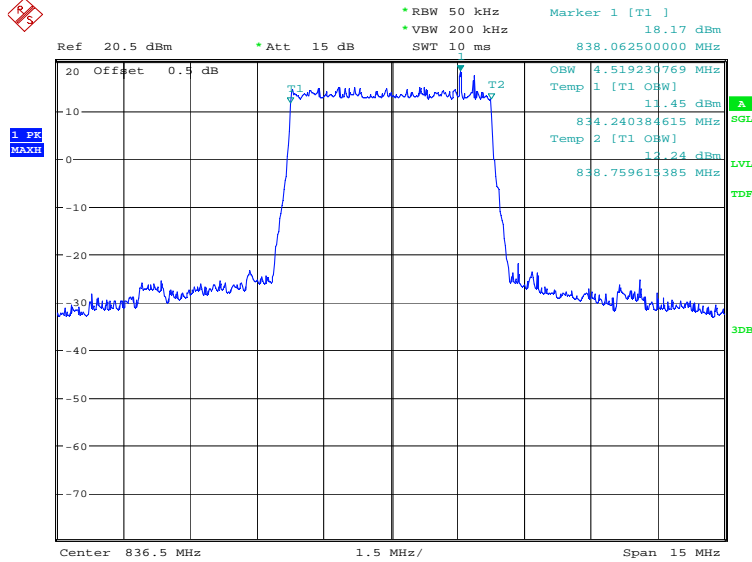


Date: 27.FEB.2019 20:38:24

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

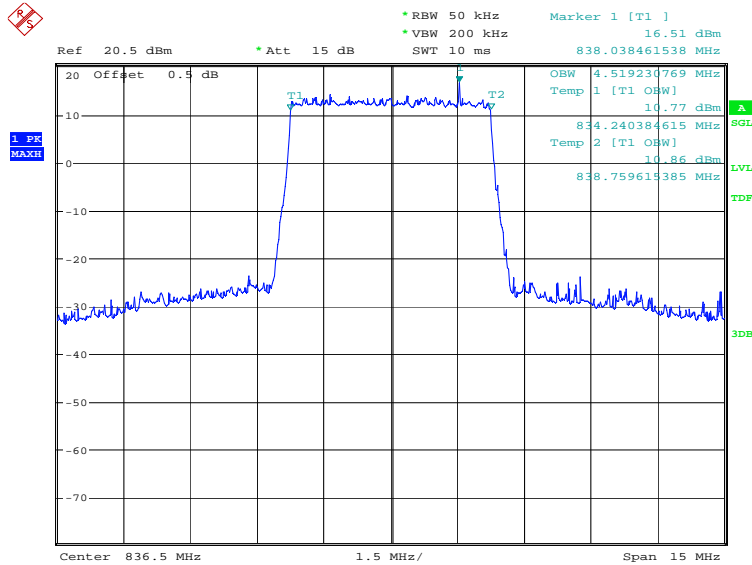
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
836.5	QPSK	16QAM
	4519.23	4519.23

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



Date: 27.FEB.2019 20:39:49

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

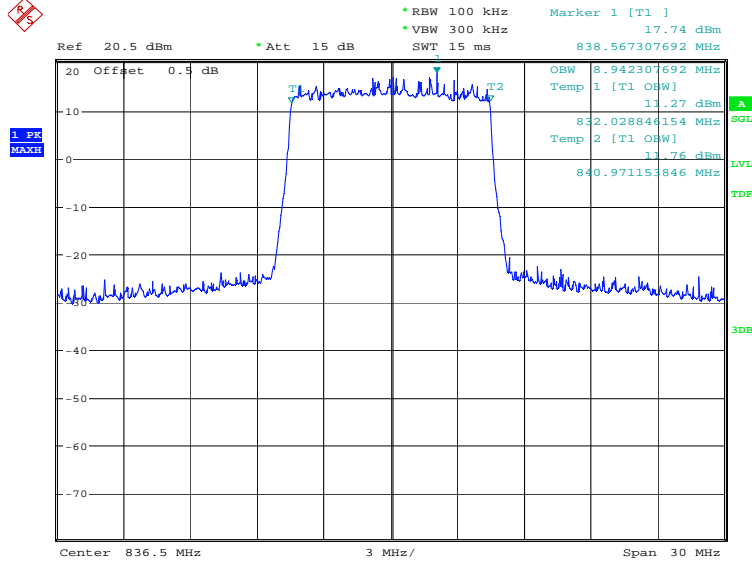


Date: 27.FEB.2019 20:41:13

**LTE band 5, 10MHz (99%)**

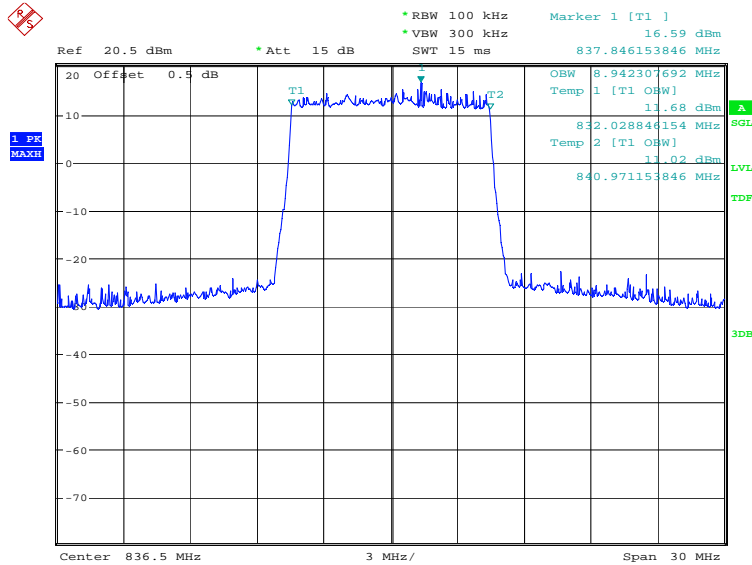
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
836.5	QPSK	16QAM
	8942.31	8942.31

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



Date: 27.FEB.2019 20:42:38

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

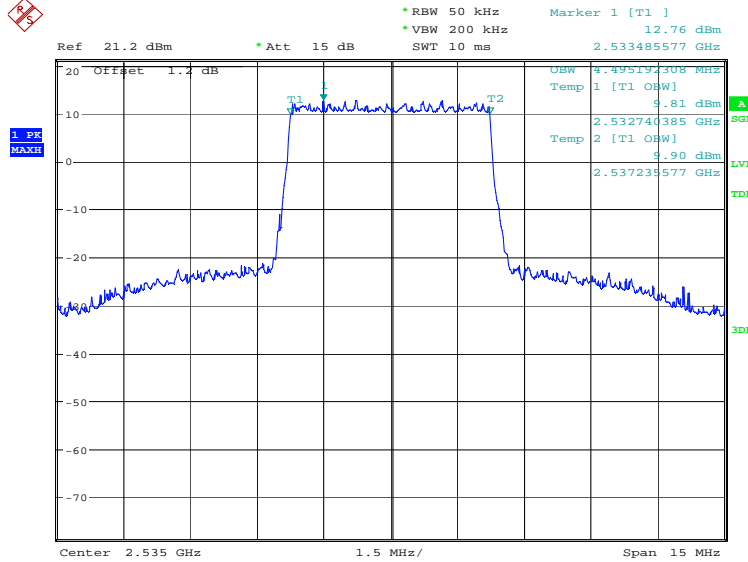


Date: 27.FEB.2019 20:44:02

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

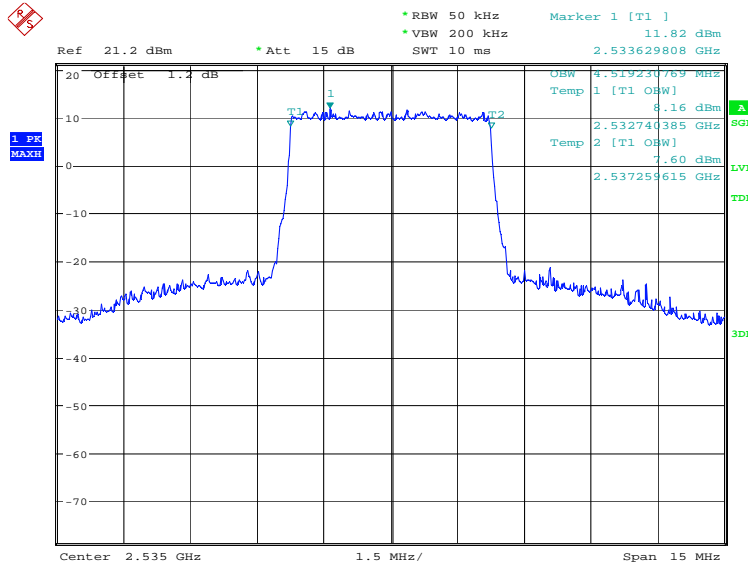
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
2535.0	QPSK	16QAM
	4495.19	4519.23

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



Date: 27.FEB.2019 20:45:29

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

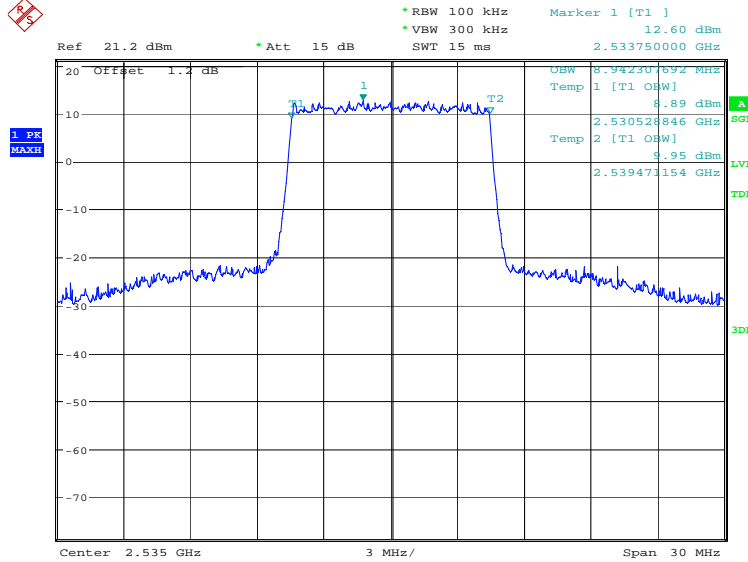


Date: 27.FEB.2019 20:46:53

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

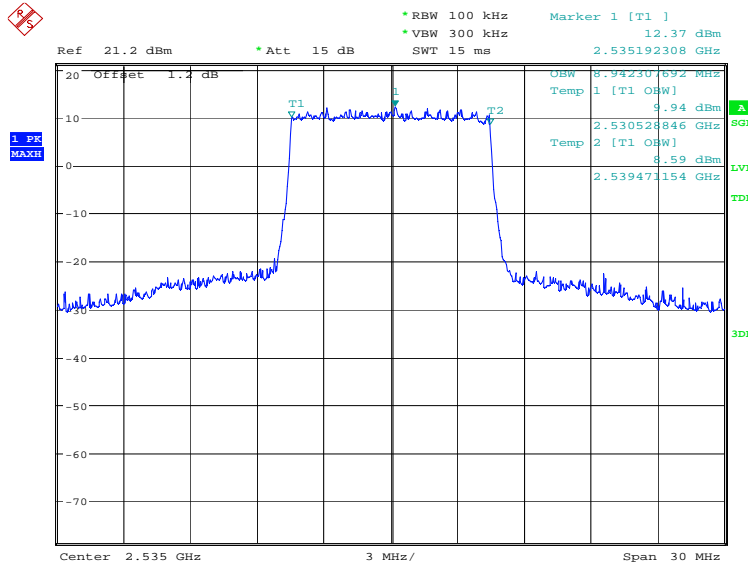
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
2535.0	QPSK	16QAM
	8942.31	8942.31

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



Date: 27.FEB.2019 20:48:18

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

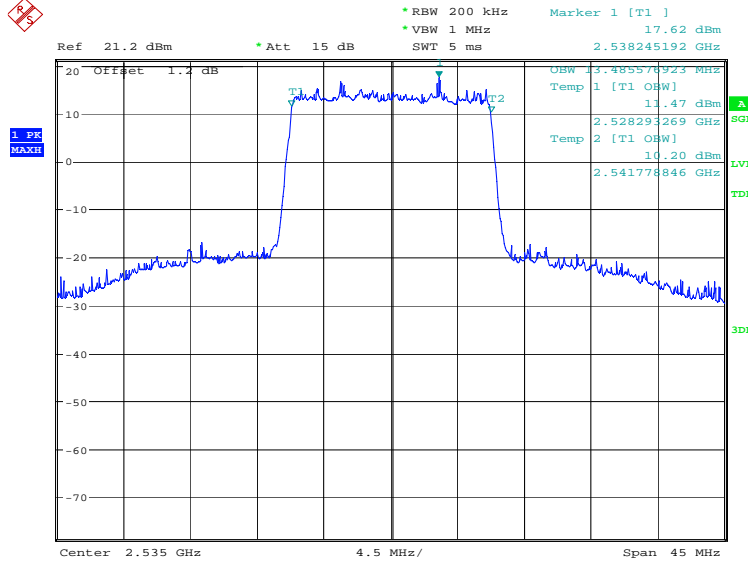


Date: 27.FEB.2019 20:49:42

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

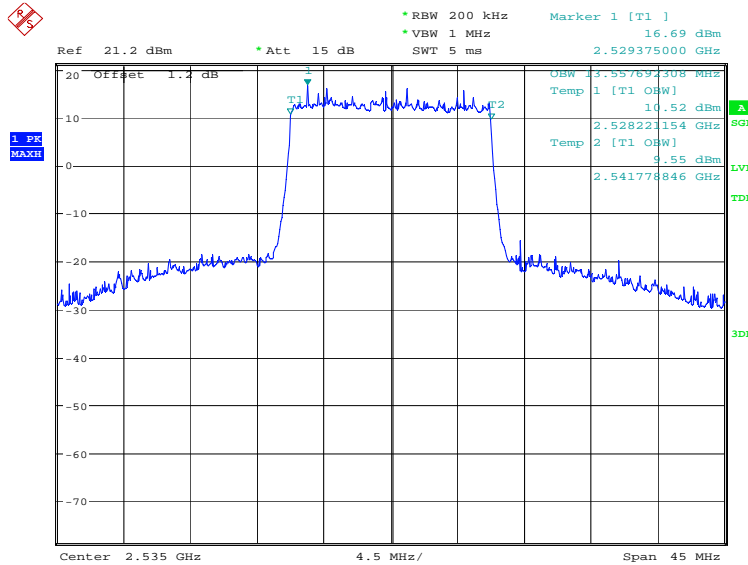
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
2535.0	QPSK	16QAM
	13485.58	13557.69

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



Date: 27.FEB.2019 20:51:07

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

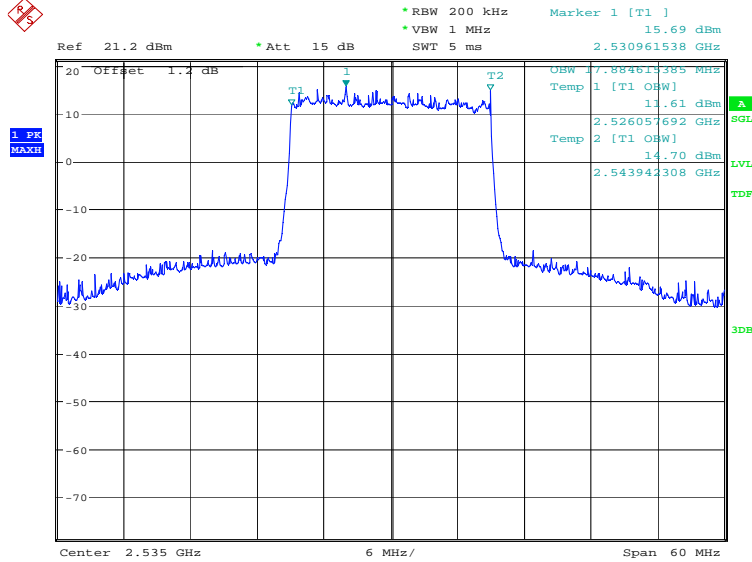


Date: 27.FEB.2019 20:52:31

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

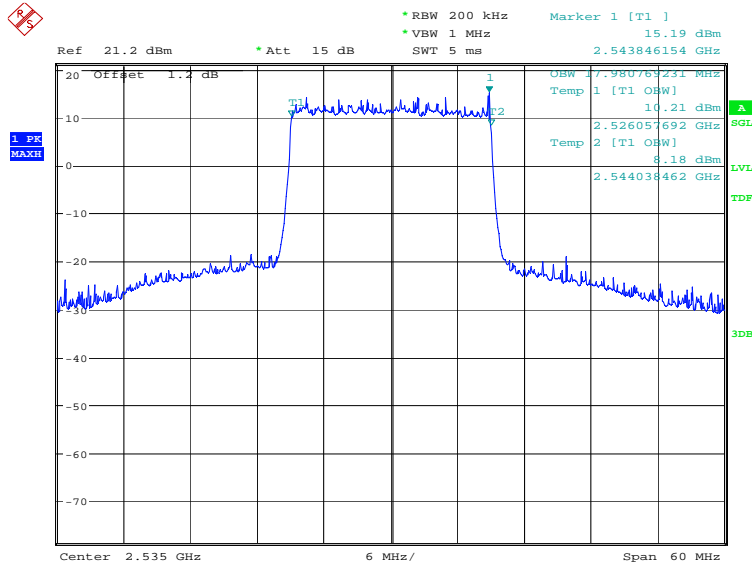
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
2535.0	QPSK	16QAM
	17884.62	17980.77

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



Date: 27.FEB.2019 20:53:57

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



Date: 27.FEB.2019 20:55:21



## **A.5 EMISSION BANDWIDTH**

### **A.5.1 Emission Bandwidth Results**

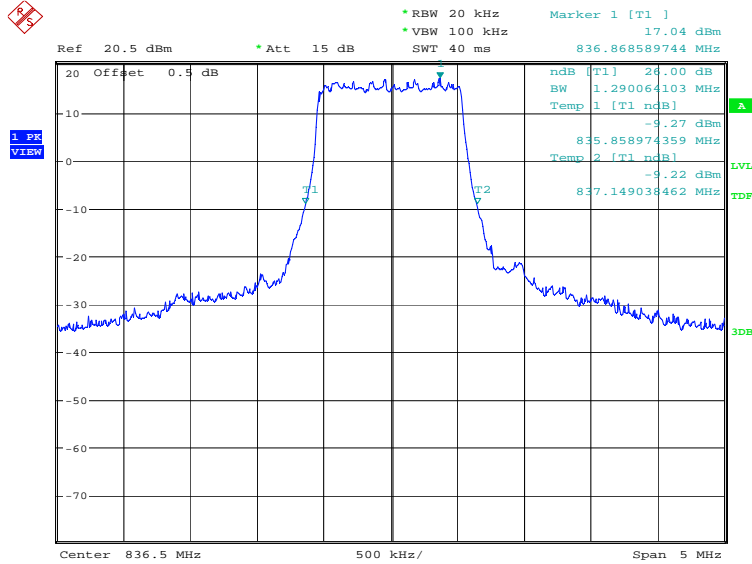
The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. Table below lists the measured -26dBc BW. Spectrum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



**LTE band 5, 1.4MHz (-26dBc)**

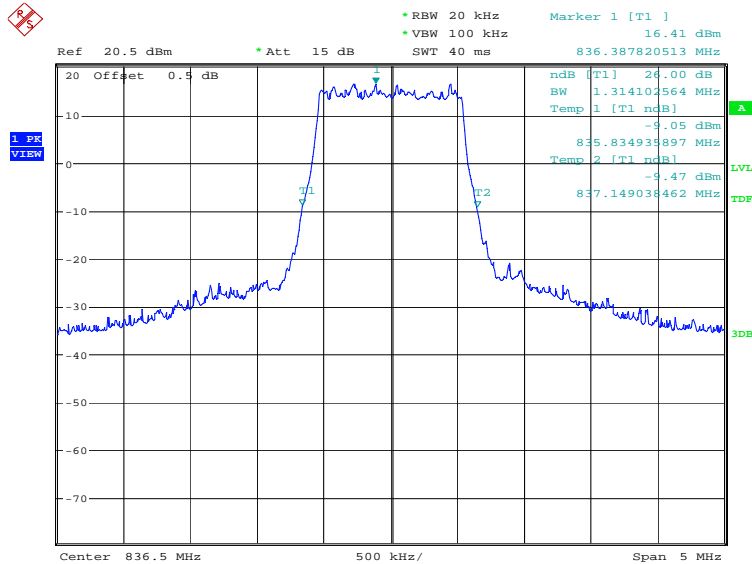
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
836.5	QPSK	16QAM
	1290.06	1314.10

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



Date: 27.FEB.2019 20:57:20

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

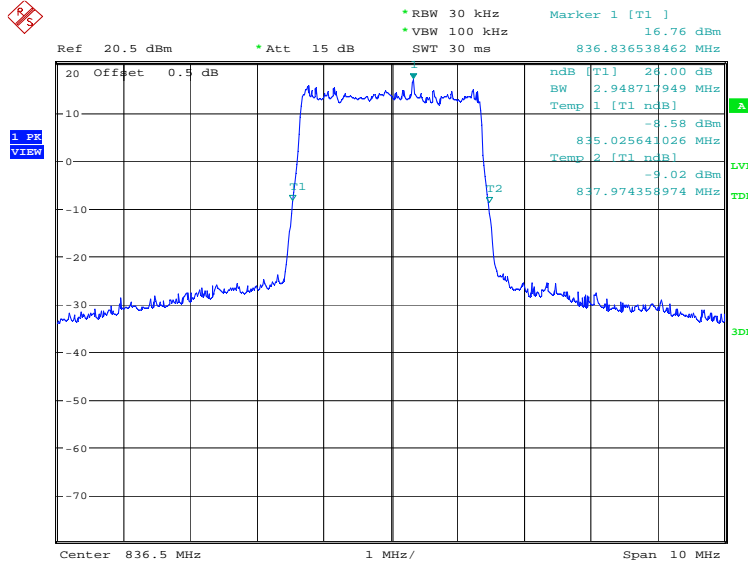


Date: 27.FEB.2019 20:58:44

**LTE band 5, 3MHz (-26dBc)**

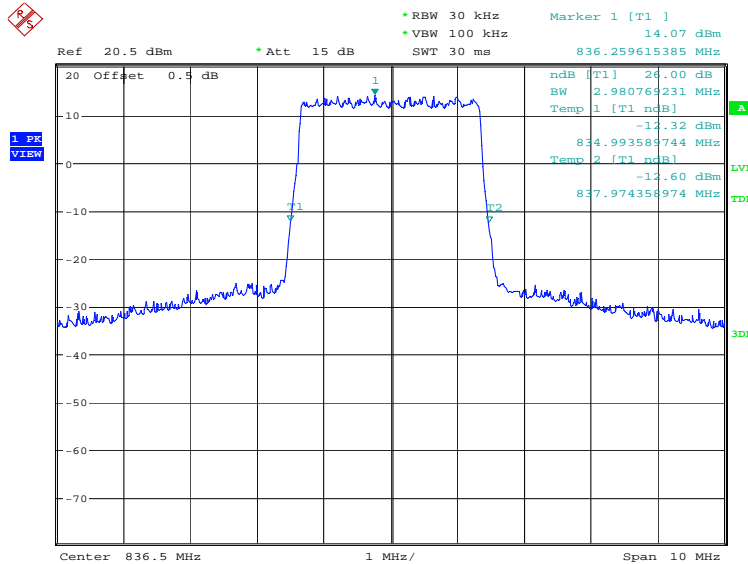
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
836.5	QPSK	16QAM
	2948.72	2980.77

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



Date: 27.FEB.2019 21:00:10

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

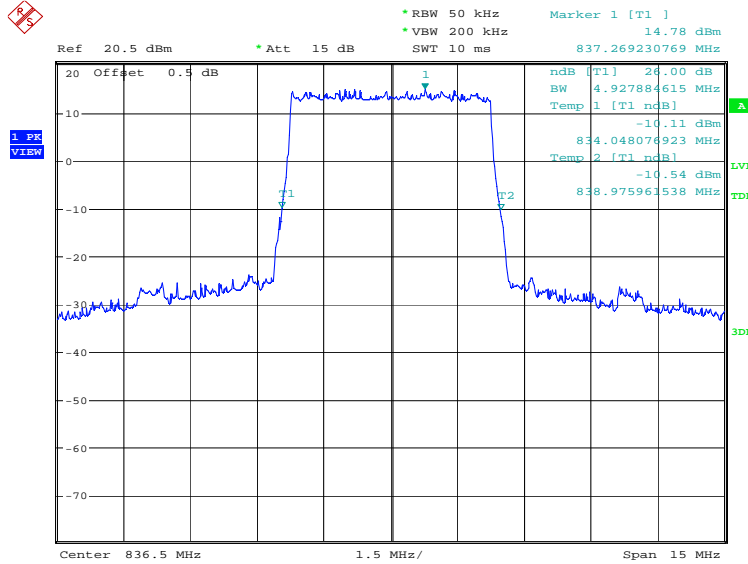


Date: 27.FEB.2019 21:01:34

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

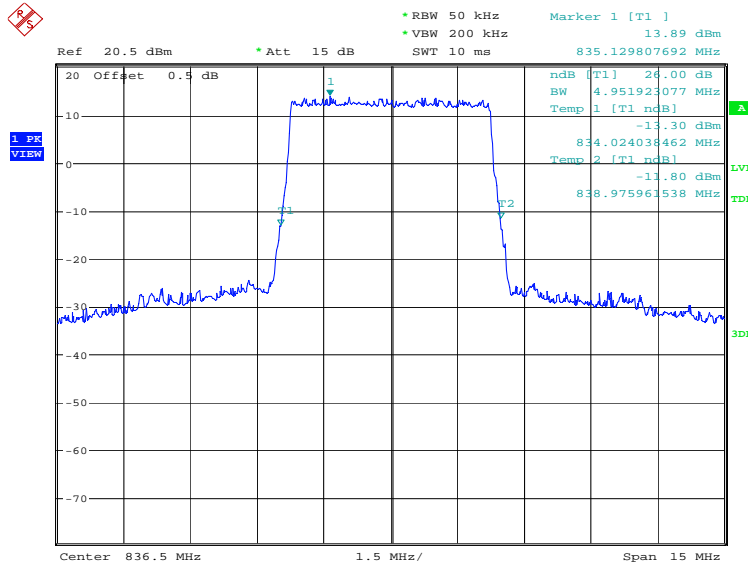
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
836.5	QPSK	16QAM
	4927.88	4951.92

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



Date: 27.FEB.2019 21:03:00

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

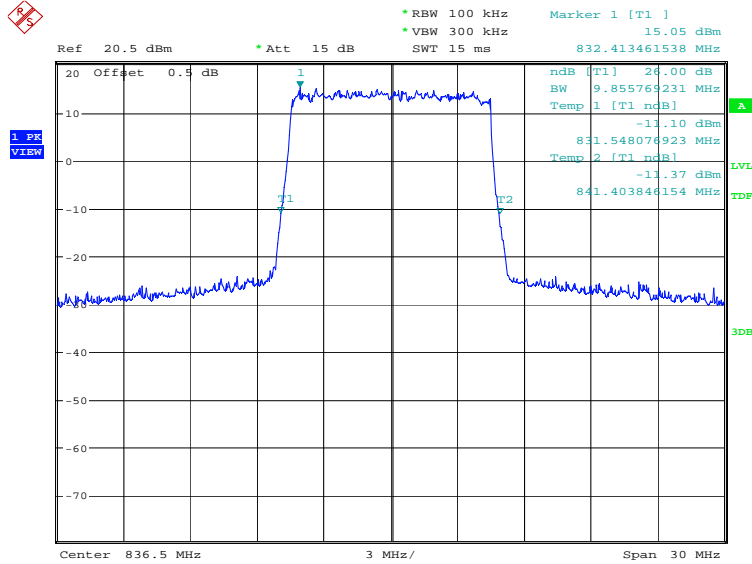


Date: 27.FEB.2019 21:04:24

**LTE band 5, 10MHz (-26dBc)**

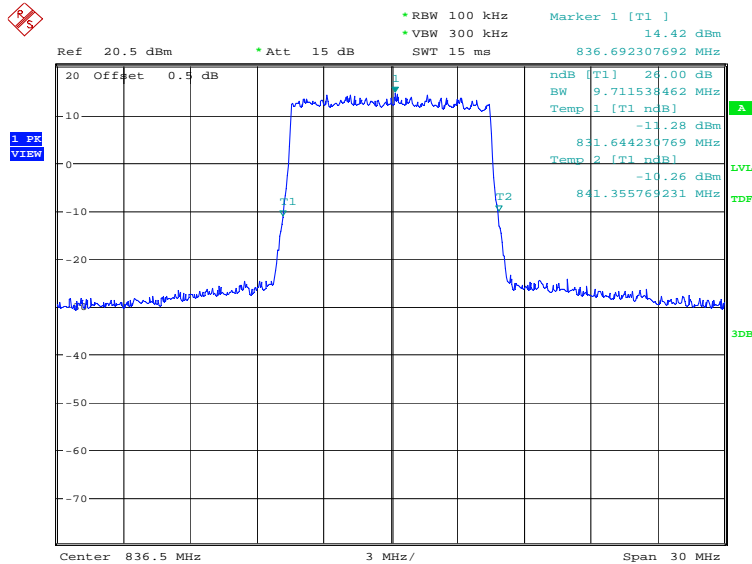
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
836.5	QPSK	16QAM
	9855.77	9711.54

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



Date: 27.FEB.2019 21:05:50

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

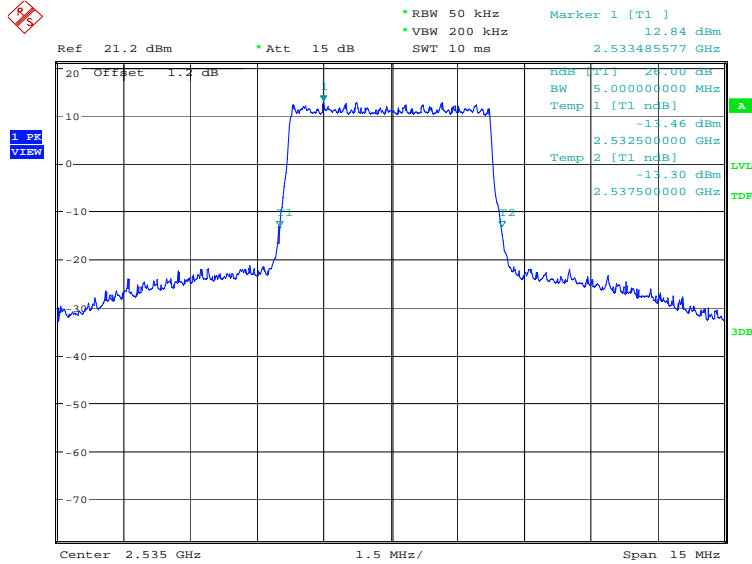


Date: 27.FEB.2019 21:07:14

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

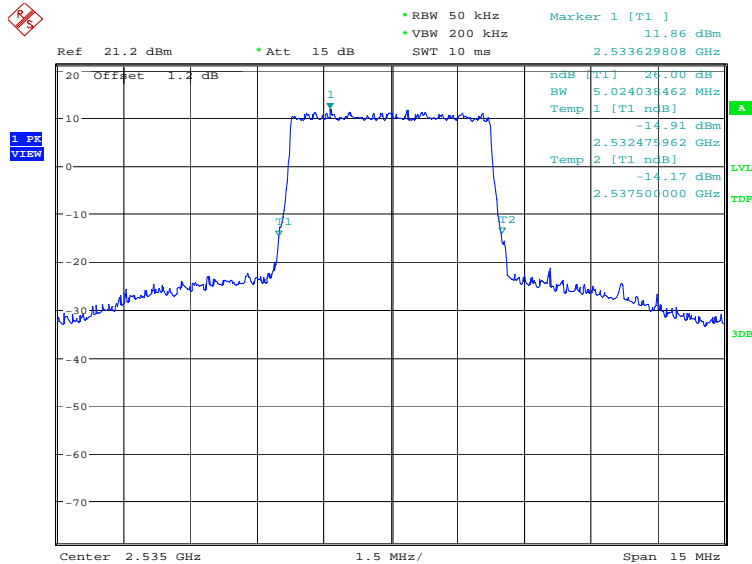
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
2535.0	QPSK	16QAM
	5000.00	5024.04

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



Date: 27.FEB.2019 21:08:42

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

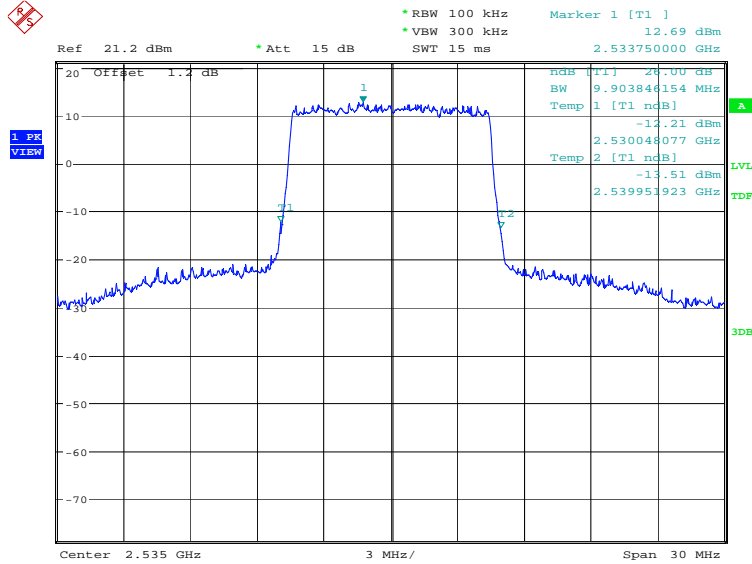


Date: 27.FEB.2019 21:10:06

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

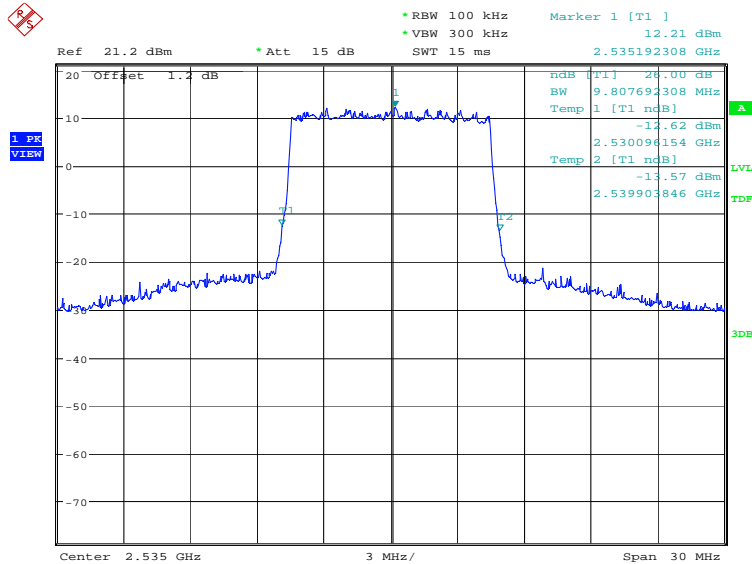
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
2535.0	QPSK	16QAM
	9903.85	9807.69

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



Date: 27.FEB.2019 21:11:32

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

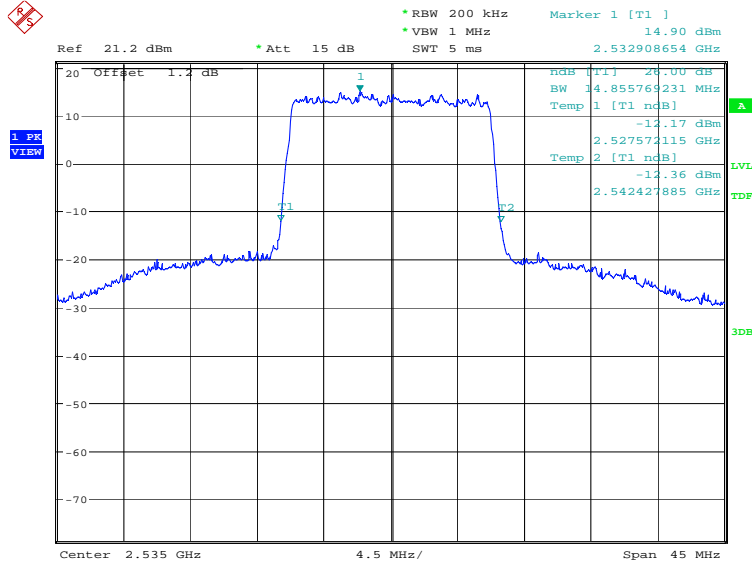


Date: 27.FEB.2019 21:12:56

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

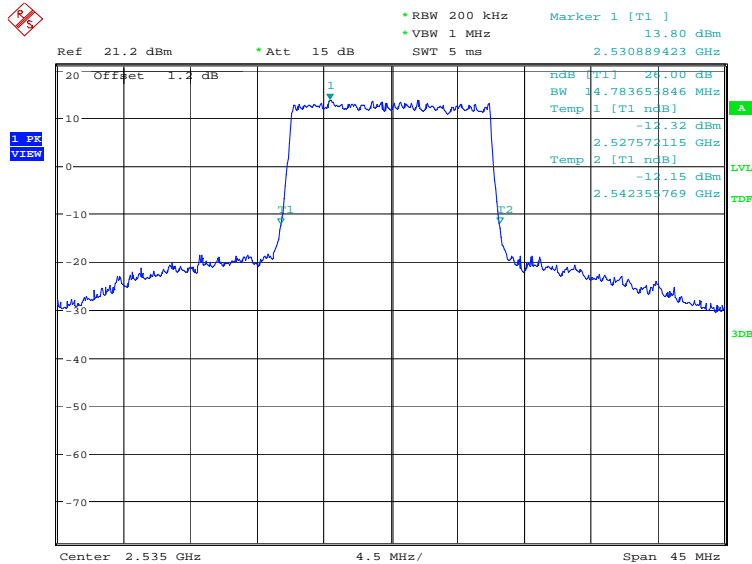
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
2535.0	QPSK	16QAM
	14855.77	14783.65

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



Date: 27.FEB.2019 21:14:22

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

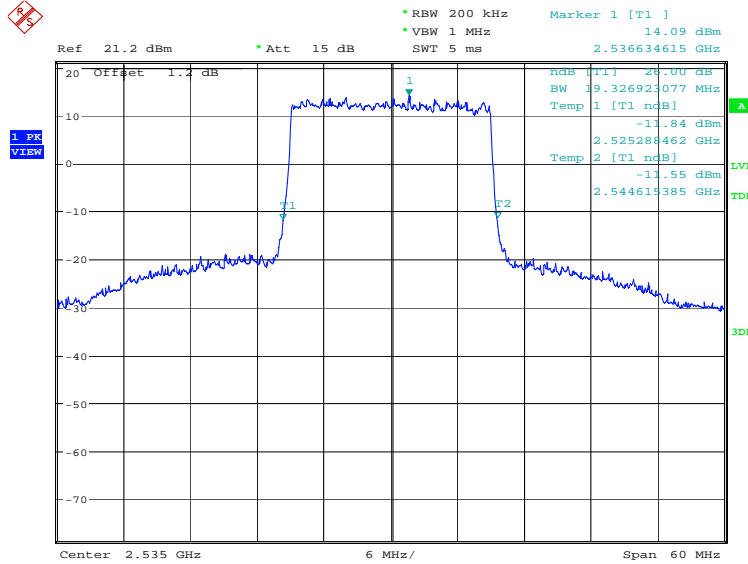


Date: 27.FEB.2019 21:15:46

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

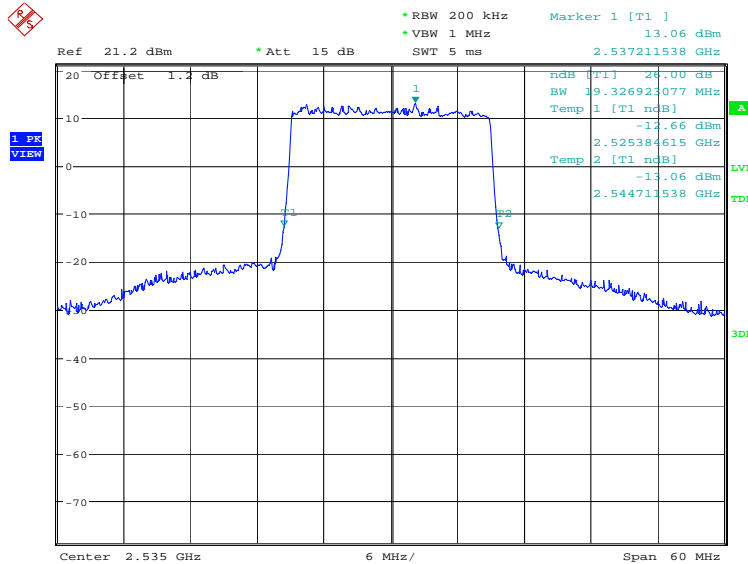
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
2535.0	QPSK	16QAM
	19326.92	19326.92

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



Date: 27.FEB.2019 21:17:12

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



Date: 27.FEB.2019 21:18:37





## **A.6 BAND EDGE COMPLIANCE**

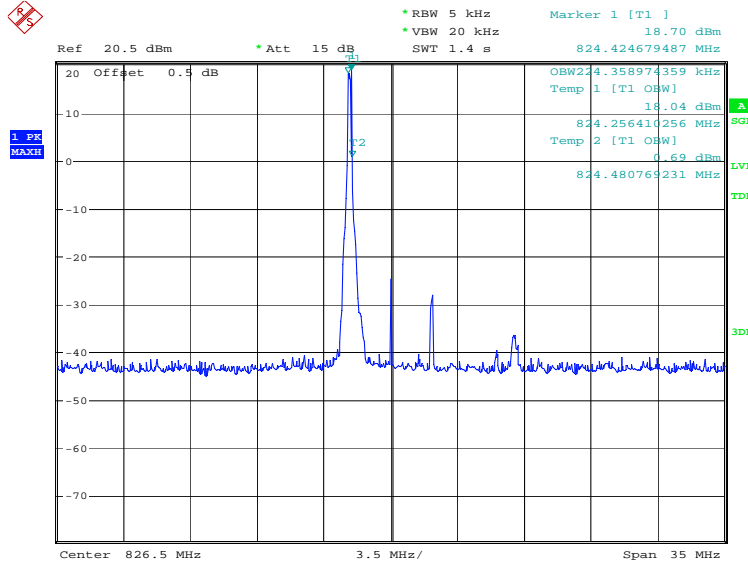
### **A.6.1 Measurement limit**

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

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

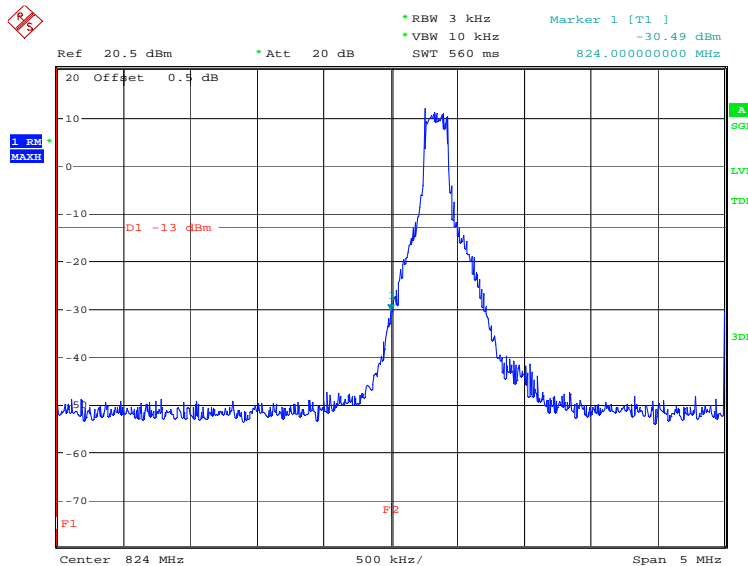
Part 27.53(m) states that for mobile digital stations, the attenuation factor shall be not less than  $40 + 10 \log(P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log(P)$  dB on all frequencies between 5 megahertz and  $X$  megahertz from the channel edge, and  $55 + 10 \log(P)$  dB on all frequencies more than  $X$  megahertz from the channel edge, where  $X$  is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less 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.6.2 Measurement result**  
**Only worst case result is given below**  
**LTE band 5**  
**OBW: 1RB-low\_offset**



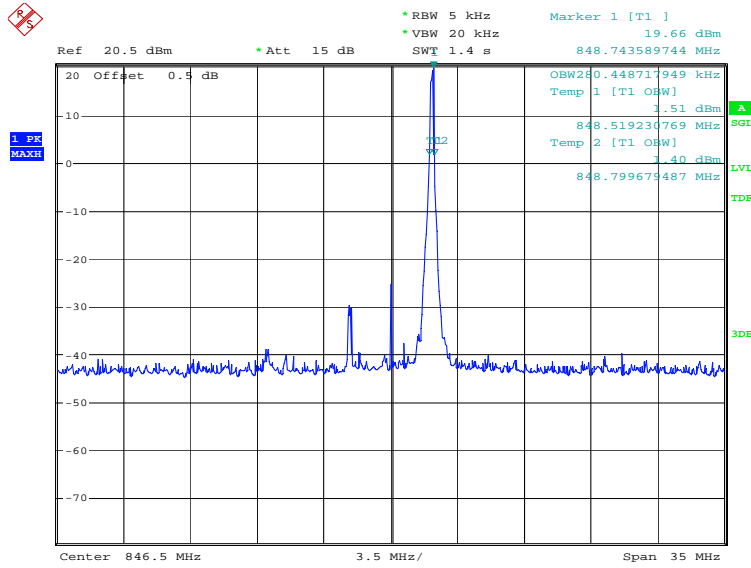
Date: 12.MAR.2019 16:10:17

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



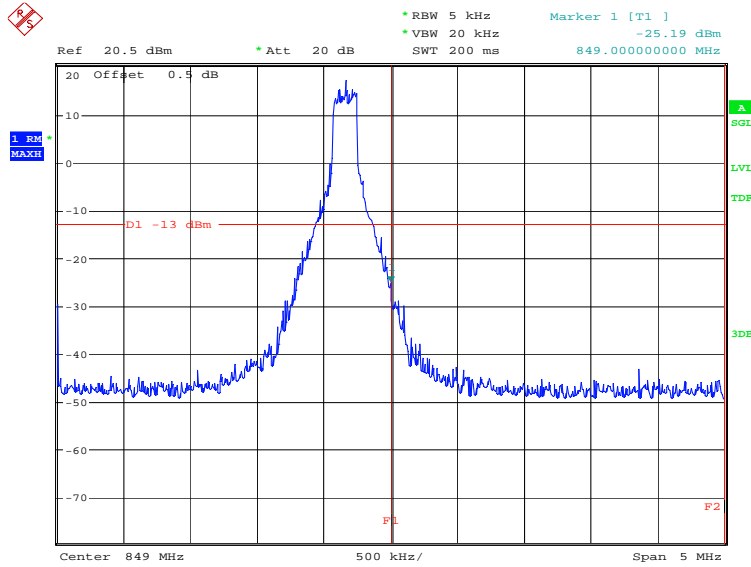
Date: 12.MAR.2019 16:10:32

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



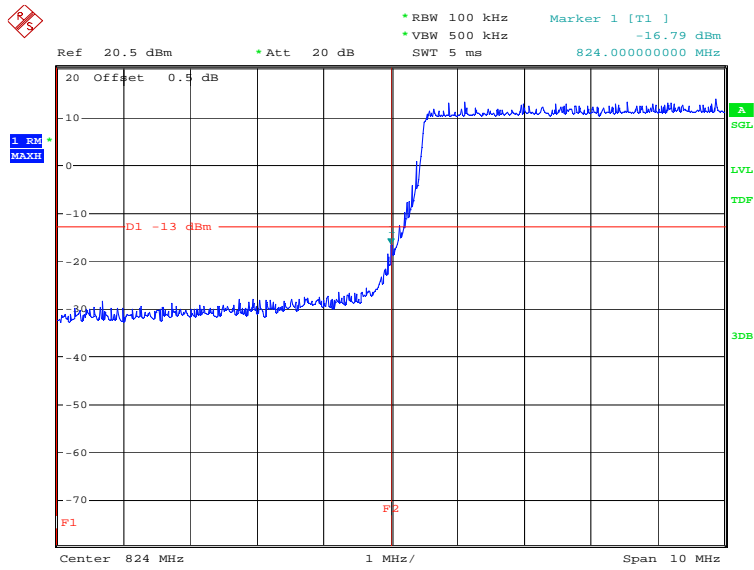
Date: 12.MAR.2019 16:11:52

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



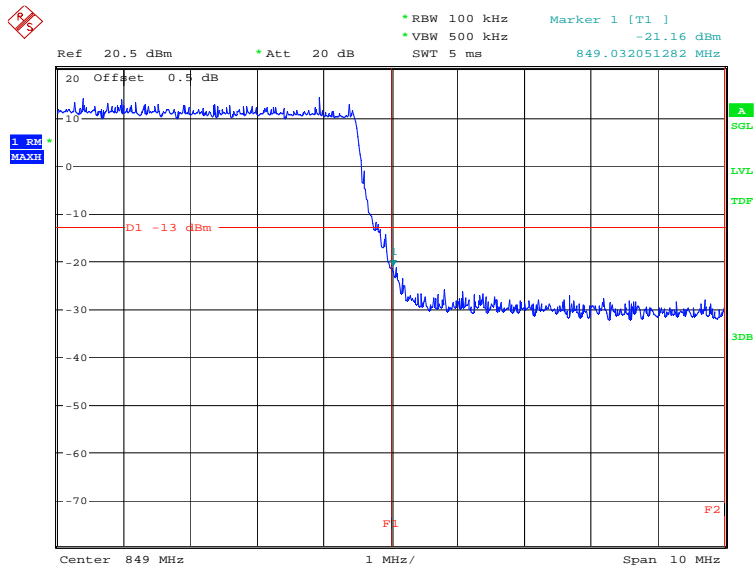
Date: 12.MAR.2019 16:12:07

### LOW BAND EDGE BLOCK-10MHz-100%RB



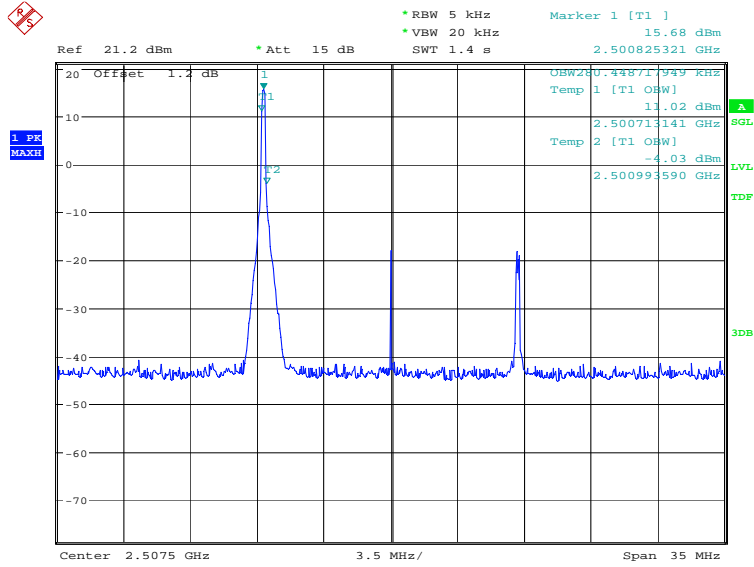
Date: 12.MAR.2019 16:04:55

### HIGH BAND EDGE BLOCK-10MHz-100%RB



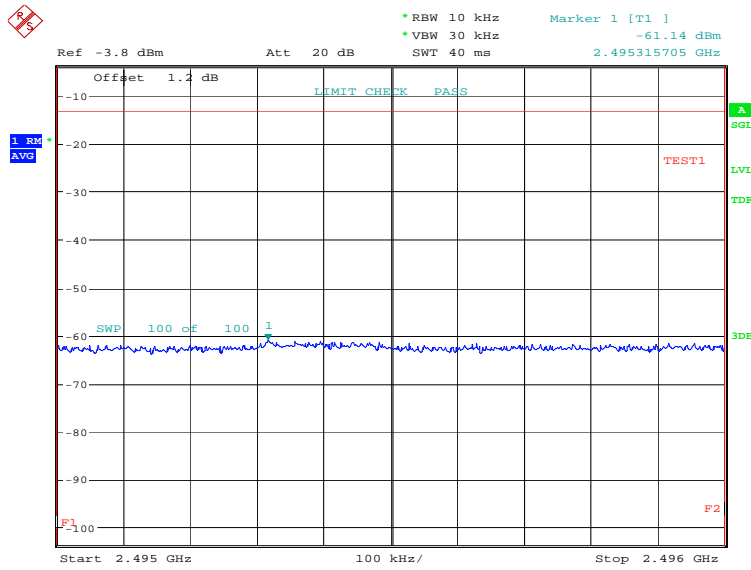
Date: 12.MAR.2019 16:05:24

LTE band 7  
OBW: 1RB-low\_offset

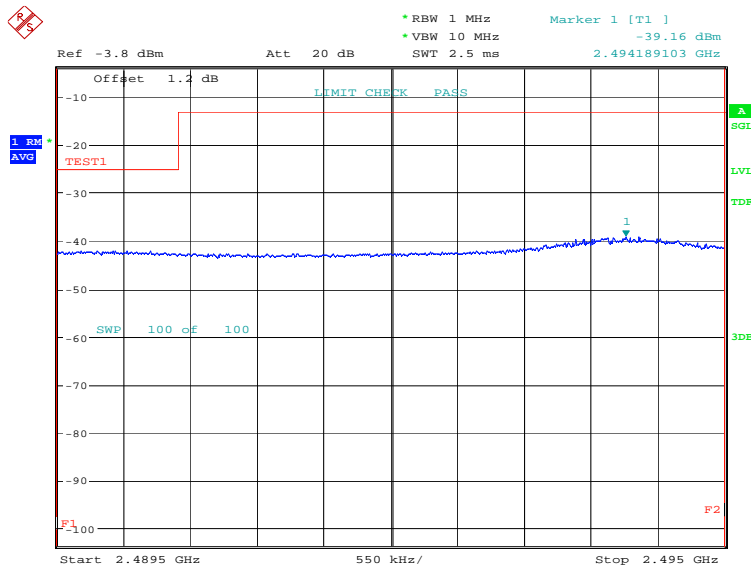


Date: 12.MAR.2019 16:21:20

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

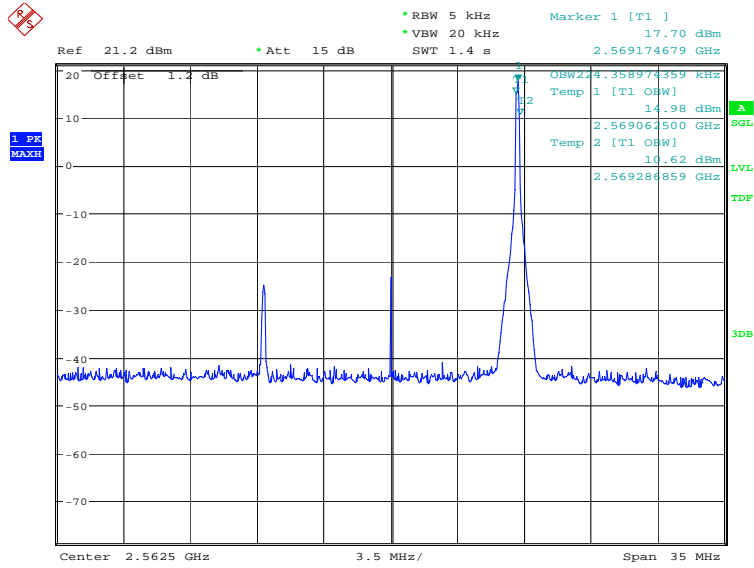


Date: 12.MAR.2019 16:21:40



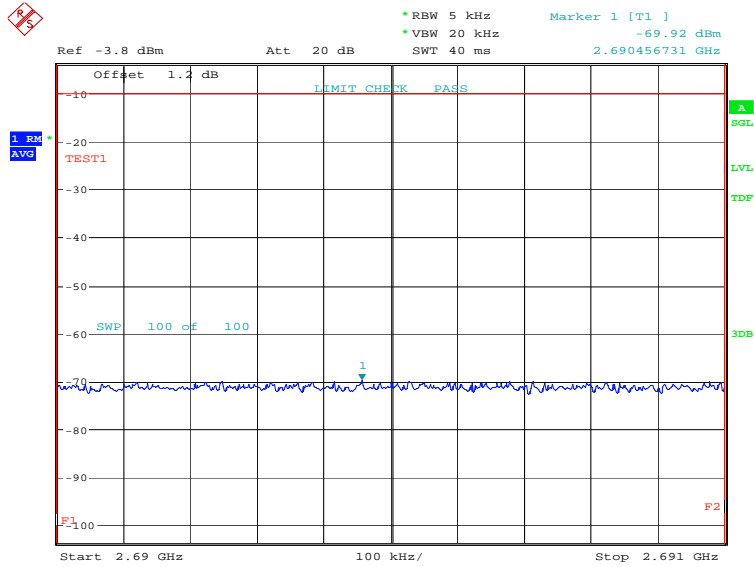
Date: 12.MAR.2019 16:21:55

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

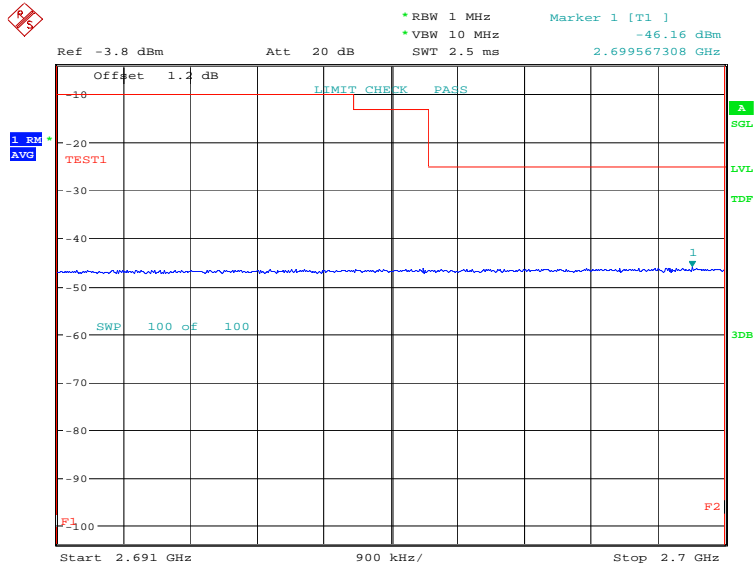


Date: 12.MAR.2019 16:23:17

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



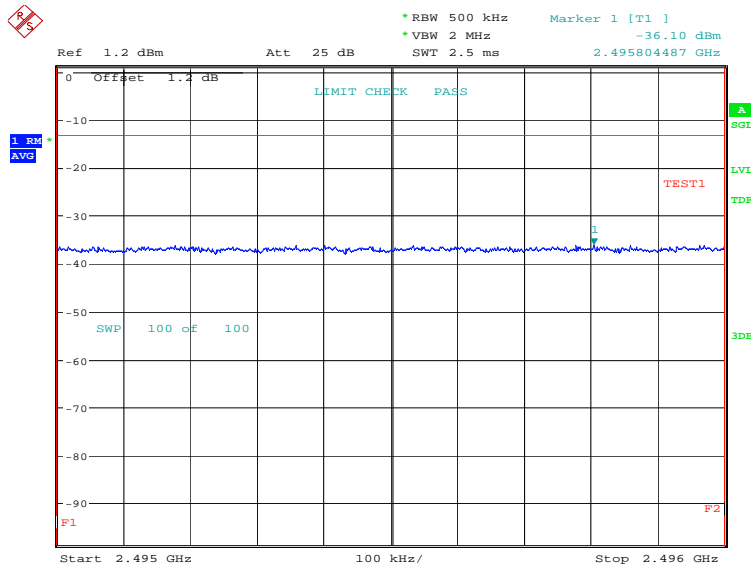
Date: 12.MAR.2019 16:23:37



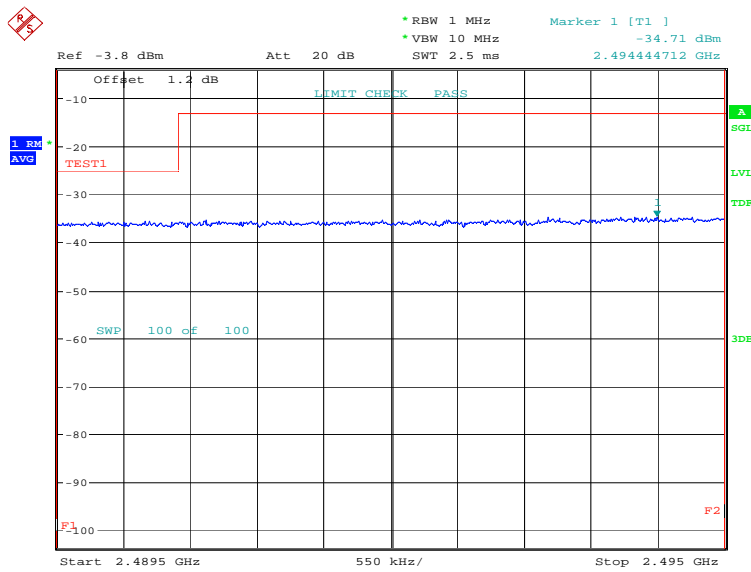
Date: 12.MAR.2019 16:23:52



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

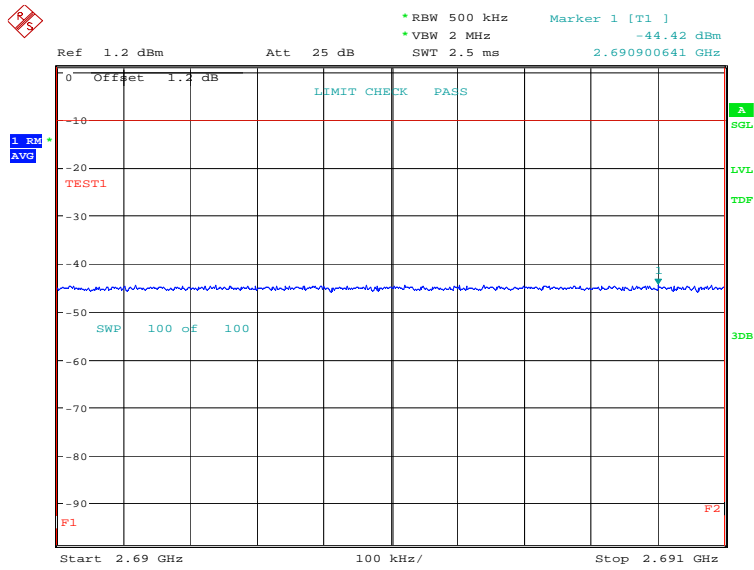


Date: 12.MAR.2019 16:18:04

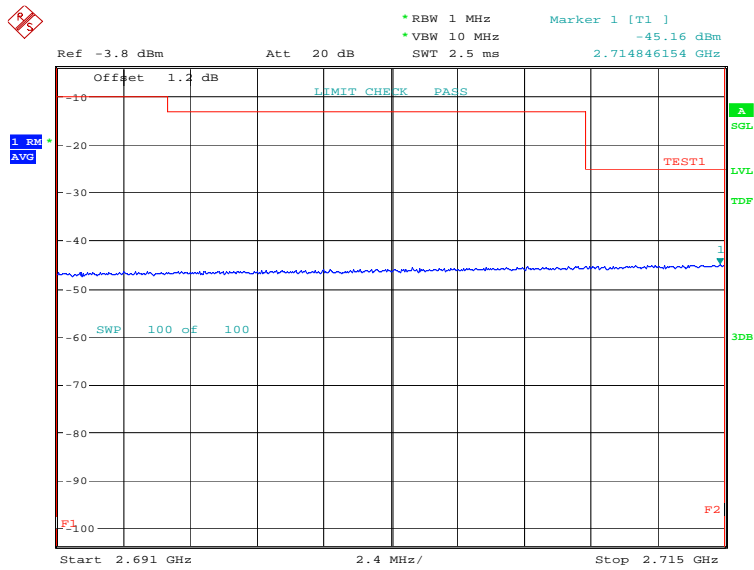


Date: 12.MAR.2019 16:18:19

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



Date: 12.MAR.2019 16:18:52



Date: 12.MAR.2019 16:19:07

## **A.7 CONDUCTED SPURIOUS EMISSION**

### **A.7.1 Measurement Method**

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

1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 9 GHz, data taken from 10 MHz to 25 GHz.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.
3. The number of sweep points of spectrum analyzer is set to 30001 which is greater than span/RBW.

### **A. 7.2 Measurement Limit**

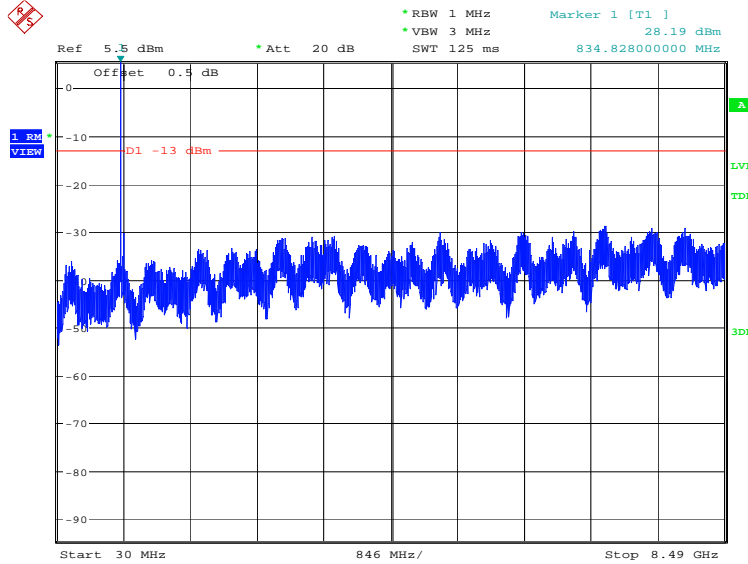
Part 22.917 and Part 27.53(h) specify that the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

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

Part 27.53(m) states that for mobile digital stations, the attenuation factor shall be not less than  $40 + 10 \log(P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log(P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and  $55 + 10 \log(P)$  dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less 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.

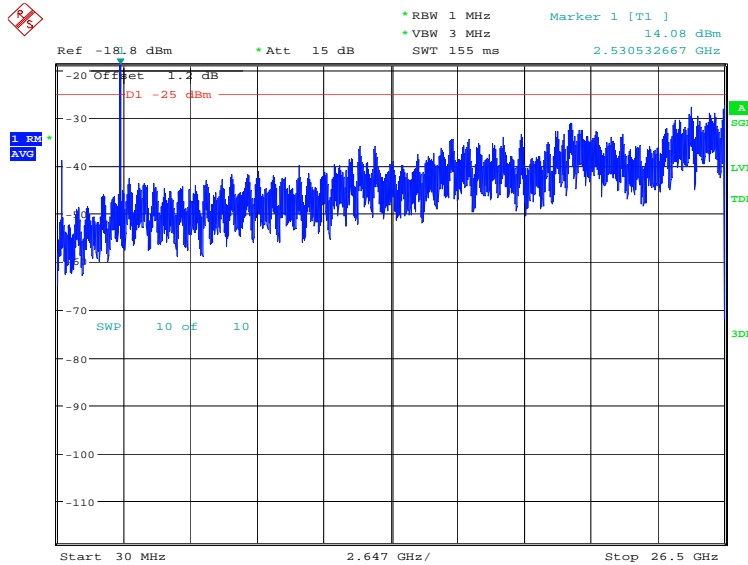
**A. 7.2 Measurement result**  
Only worst case result is given below

**LTE band 5: 30MHz – 8.49GHz**  
Spurious emission limit –13dBm.



Date: 12.MAR.2019 16:01:17

**LTE band 7: 30MHz – 26.5GHz**  
Spurious emission limit –13dBm.



Date: 12.MAR.2019 16:26:51

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

### **Reference**

FCC: CFR 27.50(a)

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

According to KDB 971168 5.7.1:

- a) Refer to instrument's analyzer instruction manual for details on how to use the power statistics/CCDF function;
- b) Set resolution/measurement bandwidth  $\geq$  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**

#### **LTE band 7, 20MHz**

Frequency(MHz)	PAPR(dB)	
	QPSK	16QAM
2510.0	6.89	7.44

## ANNEX B: Accreditation Certificate

<p>United States Department of Commerce National Institute of Standards and Technology</p> 	
<hr/> <p><b>Certificate of Accreditation to ISO/IEC 17025:2005</b></p> <hr/>	
<p>NVLAP LAB CODE: 600118-0</p>	
<p><b>Telecommunication Technology Labs, CAICT</b> Beijing China</p>	
<p><i>is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:</i></p>	
<p><b>Electromagnetic Compatibility &amp; Telecommunications</b></p>	
<p><i>This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).</i></p>	
<hr/> <p>2018-09-28 through 2019-09-30 <i>Effective Dates</i></p>	 <hr/> <p><i>[Signature]</i> For the National Voluntary Laboratory Accreditation Program</p>

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