



# TEST REPORT

No. I16Z40886-GTE03

for

**TCL Communication Ltd.**

**LTE / UMTS / GSM mobile phone**

**Model Name: VFD501**

**FCC ID: 2ACCJH050**

with

**Hardware Version: PIO**

**Software Version: v8F27**

**Issued Date: 2016-05-04**

**Note:**

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

**Test Laboratory:**

**FCC 2.948 Listed: No.525429**

CTTL, Telecommunication Technology Labs, Academy of Telecommunication Research, MIIT

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

Tel: +86(0)10-62304633-2512, Fax: +86(0)10-62304633-2504

Email: [cttl\\_terminals@catr.cn](mailto:cttl_terminals@catr.cn), website: [www.chinattl.com](http://www.chinattl.com)

## **REPORT HISTORY**

<b>Report Number</b>	<b>Revision</b>	<b>Description</b>	<b>Issue Date</b>
I16Z40886-GTE03	Rev.0	1st edition	2016-05-04

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## **1. Test Laboratory**

### **1.1. Testing Location**

Company Name: CTTL, Telecommunication Technology Labs, Academy of  
Telecommunication Research, MIIT  
Address: No. 52, Huayuan North Road, Haidian District, Beijing, P. R. China  
100191  
Postal Code: 100191  
Telephone: 00861062304633  
Fax: 00861062304793

### **1.2. Testing Environment**

Normal Temperature: 15-35°C  
Relative Humidity: 20-75%  
Air pressure 980 - 1040 hPa

The climatic requirements above are general exclude the special requirements for dedicated test environments listed in section 5 and some specific test cases in other parts of this report.

### **1.3. Project data**

Testing Start Date: 2016-04-06  
Testing End Date: 2016-04-26

### **1.4. Signature**



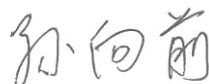
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**Shen Yi**  
**(Prepared this test report)**



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**Zhong Nan**  
**(Reviewed this test report)**



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**Sun Xiang Qian**  
**Deputy Director of the laboratory**  
**(Approved this test report)**



## **2. Client Information**

### **2.1. Applicant Information**

Company Name: TCL Communication Ltd.  
Address /Post: 5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park,  
Pudong Area Shanghai, P.R. China. 201203  
Contact Person: Gong Zhizhou  
Contact Email: zhizhou.gong@tcl.com  
Telephone: 0086-21-31363544  
Fax: 0086-21-61460602

### **2.2. Manufacturer Information**

Company Name: TCL Communication Ltd.  
Address /Post: 5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park,  
Pudong Area Shanghai, P.R. China. 201203  
Contact Person: Gong Zhizhou  
Contact Email: zhizhou.gong@tcl.com  
Telephone: 0086-21-31363544  
Fax: 0086-21-61460602

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

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

Description	LTE / UMTS / GSM mobile phone
Model Name	VFD501
FCC ID	2ACCJH050
Antenna	Integrated
Output power	23.69 dBm maximum EIRP measured for LTE Band 7
Extreme vol. Limits	3.5VDC to 4.2VDC (nominal: 3.8VDC)
Extreme temp. Tolerance	-30°C to +50°C

Note: Components list, please refer to documents of the manufacturer; it is also included in the original test record of CTTL, Telecommunication Technology Labs, Academy of Telecommunication Research, MIIT

The EUT is a variant model of VFD500. All the result is coming from the initial model.

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

EUT ID*	IMEI	HW Version	SW Version
\	\	\	\

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

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

AE ID*	Description
AE1	Battery
AE2	Battery
AE3	Travel charger
AE4	Travel charger
AE5	Travel charger
AE6	Travel charger
AE7	Travel charger
AE8	Travel charger

##### **AE1**

Model	CAB2000047C1
Manufacturer	BYD
Capacitance	2000mAh

##### **AE2**

Model	CAB2000013C2
Manufacturer	SCUD
Capacitance	2000mAh

##### **AE3**

Model	CBA0066AA4C1
Manufacturer	BYD

AE4		
Model		CBA0066AB4C1
Manufacturer		BYD
AE5		
Model		CBA3068AB1C1
Manufacturer		BYD
AE6		
Model		CBA0077AA1C1
Manufacturer		BYD
AE7		
Model		CBA0066AA1C5
Manufacturer		PUAN
AE8		
Model		CBA3068AA1C4
Manufacturer		Aohai

\*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 / UMTS / GSM mobile phone with integrated 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 27	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES	10-1-15 Edition
ANSI/TIA-603-D	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	2015
ANSI C63.4	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	2014
KDB 971168 D01	Measurement Guidance for Certification of Licensed Digital Transmitters	v02r02



## 5. LABORATORY ENVIRONMENT

**Semi-anechoic chamber SAC-1** (23 meters×17meters×10meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 °C, Max. = 35 °C
Relative humidity	Min. = 15 %, Max. = 75 %
Shielding effectiveness	0.014MHz - 1MHz, >60dB; 1MHz - 1000MHz, >90dB.
Electrical insulation	> 2 MΩ
Ground system resistance	< 4Ω
Normalised site attenuation (NSA)	< ± 4 dB, 3m/10m distance, from 30 to 1000 MHz
Site voltage standing-wave ratio ( $S_{VSWR}$ )	Between 0 and 6 dB, from 1GHz to 18GHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 3000 MHz

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

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

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

Temperature	Min. = 15 °C, Max. = 35 °C
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz - 1MHz, >60dB; 1MHz - 1000MHz, >90dB.
Electrical insulation	> 2 MΩ
Ground system resistance	< 4 Ω

## 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 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	2017-03-02	1 year
2	Test Receiver	ESU26	100376	R&S	2016-10-29	1 year
3	EMI Antenna	VULB 9163	302	Schwarzbeck	2017-01-03	3 year
4	EMI Antenna	3117	00119024	ETS-Lindgren	2017-01-20	3 year
5	LISN	ENV216	101200	R&S	2016-07-07	1 year
6	Universal Radio Communication Tester	CMW500	101675	R&S	2016-07-13	1 year
7	Universal Radio Communication Tester	E5515C	MY48361083	Agilent	2016-07-06	1 year
8	Spectrum Analyzer	E4440A	MY48250642	Agilent	2017-03-02	1 year
9	EMI Antenna	9117	167	Schwarzbeck	2016-04-01	3 year
10	EMI Antenna	VULB9163	9163-234	Schwarzbeck	2016-09-15	3 year
11	Signal Generator	N5183A	MY49060052	Agilent	2017-03-07	1 year
12	Climate chamber	SH-241	92007454	ESPEC	2017-12-14	2 year
13	Loop Antenna	HFH2-Z2	829324/007	R&S	2017-12-10	3 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 7**

Bandwidth	RB size/offset	Frequency (MHz)	Power(dBm)	
			QPSK	16QAM
5MHz	1 RB high	2567.5	22.32	21.47
		2535	22.63	21.67
		2502.5	22.61	21.40
	1 RB low	2567.5	23.87	22.47
		2535	22.63	21.68
		2502.5	23.30	22.20
	50% RB mid	2567.5	21.59	20.71
		2535	21.67	20.69
		2502.5	20.86	19.94
	100% RB	2567.5	21.65	20.63
		2535	21.62	20.54
		2502.5	20.98	19.90
10MHz	1 RB high	2565	21.46	20.56
		2535	22.33	21.31
		2505	20.75	19.73
	1 RB low	2565	22.87	21.85
		2535	22.66	21.64
		2505	21.92	20.95
	50% RB mid	2565	21.94	21.06
		2535	21.62	20.70
		2505	20.22	19.31

	100% RB	2565	21.79	20.85
		2535	21.65	20.67
		2505	20.32	19.34
15MHz	1 RB high	2562.5	21.71	21.22
		2535	22.15	21.54
		2507.5	21.34	20.71
	1 RB low	2562.5	22.07	21.43
		2535	22.66	21.99
		2507.5	21.91	21.33
	50% RB mid	2562.5	21.96	20.93
		2535	21.71	20.66
		2507.5	19.92	18.86
	100% RB	2562.5	21.69	20.70
		2535	21.74	20.70
		2507.5	20.13	19.09
20MHz	1 RB high	2560	21.61	21.46
		2535	21.59	21.32
		2510	22.17	21.72
	1 RB low	2560	21.31	20.98
		2535	22.56	22.11
		2510	21.76	21.38
	50% RB mid	2560	21.57	20.51
		2535	21.67	20.63
		2510	19.78	18.72
	100% RB	2560	21.33	20.32
		2535	21.68	20.65
		2510	20.18	19.14

### A.1.3 Radiated

#### A.1.3.1 Description

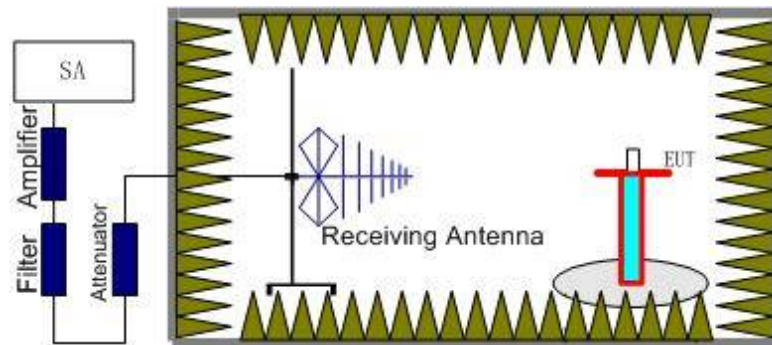
This is the test for the maximum radiated power from the EUT.

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

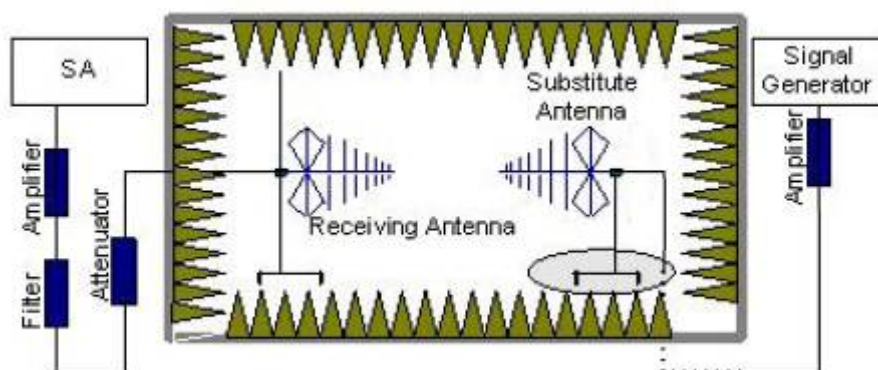
#### A.1.3.2 Method of Measurement

The measurements procedures in TIA-603D-2015 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 7- EIRP 27.50(h)(2)

Limits: ≤33 dBm (2W)

#### LTE Band 7\_5MHz\_QPSK

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	-26.44	3.58	-45.68	-6.10	21.76	33.00	11.24	V
2535.00	-23.66	3.63	-44.82	-6.16	23.69	33.00	9.31	H
2567.50	-25.06	3.65	-44.92	-6.22	22.43	33.00	10.57	H

#### LTE Band 7\_10MHz\_QPSK

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	-26.23	3.59	-45.64	-6.11	21.93	33.00	11.07	H
2535.00	-23.67	3.63	-44.82	-6.16	23.68	33.00	9.32	H
2565.00	-24.81	3.65	-44.97	-6.22	22.73	33.00	10.27	H

#### LTE Band 7\_15MHz\_QPSK

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	-25.85	3.59	-44.92	-6.11	21.59	33.00	11.41	V
2535.00	-23.69	3.63	-44.82	-6.16	23.66	33.00	9.34	H
2562.50	-25.32	3.65	-45.67	-6.21	22.91	33.00	10.09	H

#### LTE Band 7\_20MHz\_QPSK

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	-26.26	3.58	-45.36	-6.12	21.64	33.00	11.36	H
2535.00	-23.70	3.63	-44.82	-6.16	23.65	33.00	9.35	H
2560.00	-25.59	3.64	-45.98	-6.21	22.96	33.00	10.04	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	-27.36	3.58	-45.68	-6.10	20.84	33.00	12.16	V
2535.00	-24.44	3.63	-44.82	-6.16	22.91	33.00	10.09	H
2567.50	-25.45	3.65	-44.92	-6.22	22.04	33.00	10.96	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	-27.32	3.59	-45.64	-6.11	20.84	33.00	12.16	V
2535.00	-24.51	3.63	-44.82	-6.16	22.84	33.00	10.16	H
2565.00	-25.61	3.65	-44.97	-6.22	21.93	33.00	11.07	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	-26.72	3.59	-44.92	-6.11	20.72	33.00	12.28	H
2535.00	-24.52	3.63	-44.82	-6.16	22.83	33.00	10.17	H
2562.50	-26.30	3.65	-45.67	-6.21	21.93	33.00	11.07	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	-27.05	3.58	-45.36	-6.12	20.85	33.00	12.15	H
2535.00	-24.66	3.63	-44.82	-6.16	22.69	33.00	10.31	H
2560.00	-26.60	3.64	-45.98	-6.21	21.95	33.00	11.05	H

Peak EIRP(dBm) = P<sub>Mea</sub>(-23.66 dBm) - G<sub>a</sub> (-6.16dBi) - P<sub>Ag</sub> (-44.82dB) - P<sub>cl</sub> (3.63dB) =23.69dBm

## **A.2 EMISSION LIMIT**

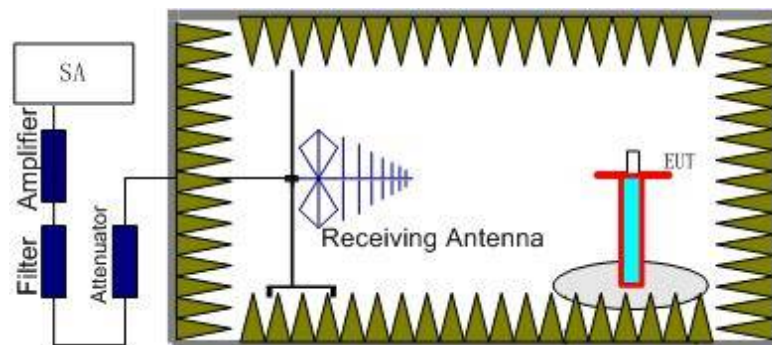
### **A.2.1 Measurement Method**

The measurements procedures in TIA-603D-2015 are used. This measurement is carried out in fully-anechoic chamber FAC-3.

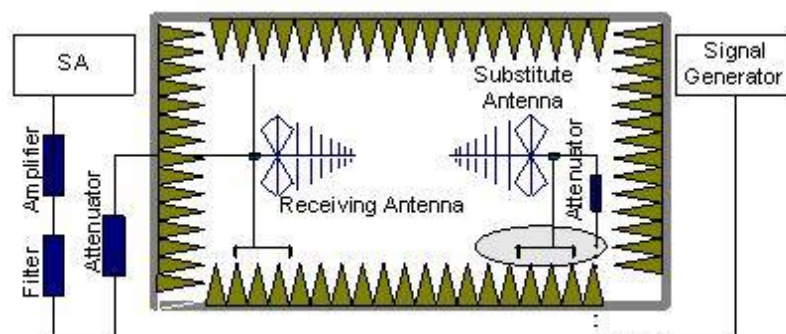
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier. The resolution bandwidth is set 1MHz. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and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

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

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 Limit

Part 27.53(m) all 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 Band7. 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 Band7 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.

**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
5005.18	-46.68	6.27	-9.91	-43.04	-13.00	30.04	H
7508.04	-52.06	7.56	-12.21	-47.41	-13.00	34.41	H
10010.73	-47.96	8.48	-12.90	-43.54	-13.00	30.54	H
12541.65	-51.75	9.57	-13.22	-48.10	-13.00	35.10	V
15007.13	-47.33	10.53	-14.00	-43.86	-13.00	30.86	V
17574.95	-47.73	12.69	-15.00	-45.42	-13.00	32.42	H

**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
5068.60	-56.27	6.42	-10.00	-52.69	-13.00	39.69	V
7472.94	-57.73	7.36	-12.17	-52.92	-13.00	39.92	H
9906.80	-56.87	8.14	-12.99	-52.02	-13.00	39.02	V
12471.23	-52.05	9.24	-13.19	-48.10	-13.00	35.10	H
15004.50	-49.75	10.55	-14.00	-46.30	-13.00	33.30	H
17316.67	-44.68	11.57	-14.50	-41.75	-13.00	28.75	H

**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
5135.33	-49.30	6.40	-10.09	-45.61	-13.00	32.61	H
7702.52	-50.33	7.29	-12.36	-45.26	-13.00	32.26	H
10270.20	-49.77	8.97	-13.01	-45.73	-13.00	32.73	H
12837.59	-50.27	9.56	-13.40	-46.43	-13.00	33.43	V
15403.20	-47.81	10.75	-13.76	-44.80	-13.00	31.80	H
17973.26	-44.70	12.51	-15.56	-41.65	-13.00	28.65	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
4870.41	-60.17	6.34	-9.77	-56.74	-13.00	43.74	H
7508.14	-54.35	7.56	-12.21	-49.70	-13.00	36.70	H
10010.42	-47.80	8.48	-12.90	-43.38	-13.00	30.38	H
12529.65	-50.34	9.51	-13.22	-46.63	-13.00	33.63	V
14944.90	-48.98	10.69	-14.04	-45.63	-13.00	32.63	V
17355.77	-47.32	11.63	-14.58	-44.37	-13.00	31.37	V

**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
5069.99	-47.84	6.42	-10.00	-44.26	-13.00	31.26	H
7605.54	-50.90	7.40	-12.28	-46.02	-13.00	33.02	H
10140.69	-48.53	8.35	-12.96	-43.92	-13.00	30.92	H
12663.70	-51.40	9.34	-13.30	-47.44	-13.00	34.44	V
15216.75	-50.25	10.73	-13.87	-47.11	-13.00	34.11	H
17745.66	-45.45	11.47	-15.24	-41.68	-13.00	28.68	V

**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
5135.23	-49.41	6.40	-10.09	-45.72	-13.00	32.72	H
7702.72	-52.11	7.29	-12.36	-47.04	-13.00	34.04	H
10270.38	-49.31	8.97	-13.01	-45.27	-13.00	32.27	H
12838.19	-47.84	9.56	-13.40	-44.00	-13.00	31.00	V
15398.26	-47.47	10.74	-13.76	-44.45	-13.00	31.45	H
17973.06	-44.26	12.51	-15.56	-41.21	-13.00	28.21	H

### **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 -30°C.
3. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on middle channel for LTE band 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 -30°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 decrements from +50°C to -30°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 4.2VDC, with a nominal voltage of 3.8VDC. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress.

**A.3.3 Measurement results****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	-3	13	0.001	0.005
3.7	3	9	0.001	0.004
4.2	-3	10	0.001	0.004

**Frequency Error vs Temperature**

Temperature (°C)	Frequency error (Hz)		Frequency error (ppm)	
	QPSK	16QAM	QPSK	16QAM
50°	2	10	0.001	0.004
40°	1	15	0.000	0.006
30°	7	11	0.003	0.004
20°	6	12	0.002	0.005
10°	-3	7	0.001	0.003
0°	0	12	0.000	0.005
- 10°	5	14	0.002	0.006
- 20°	1	10	0.000	0.004
- 30°	8	17	0.003	0.007

## **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:

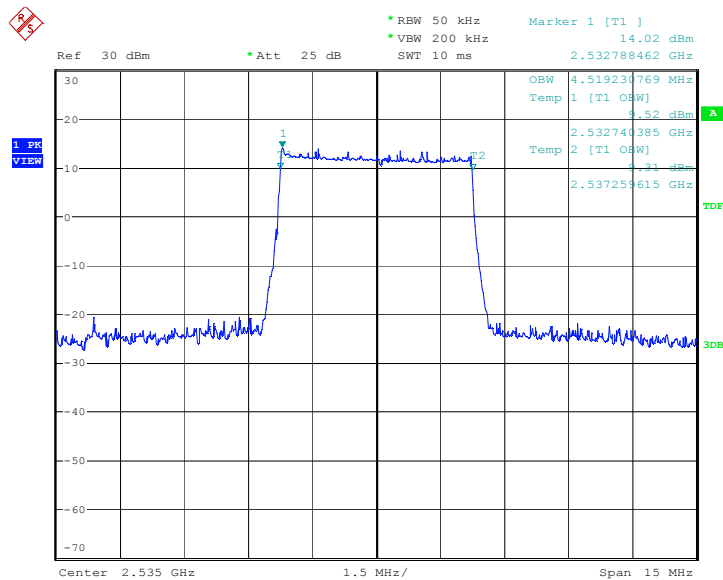
- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (i.e., two to five times the OBW).
- b) The nominal IF filter bandwidth (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 7, 5MHz (99%)

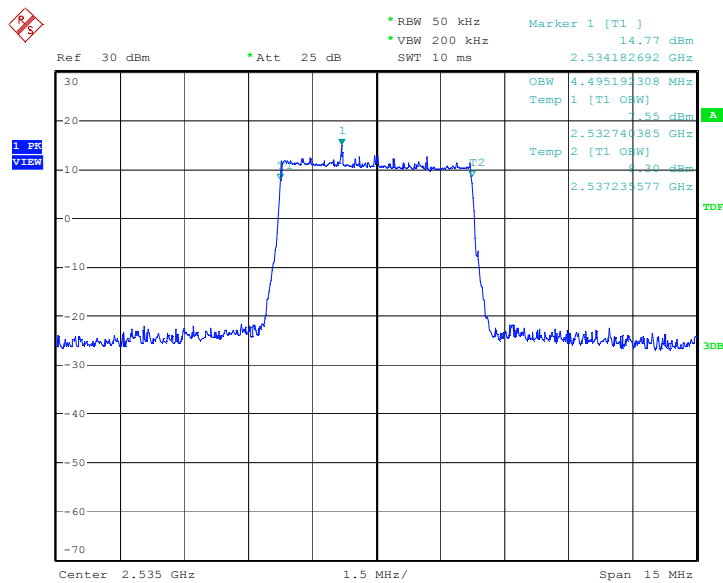
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
2535.0	QPSK	16QAM
	4519.23	4495.19

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



Date: 22.APR.2016 23:13:25

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

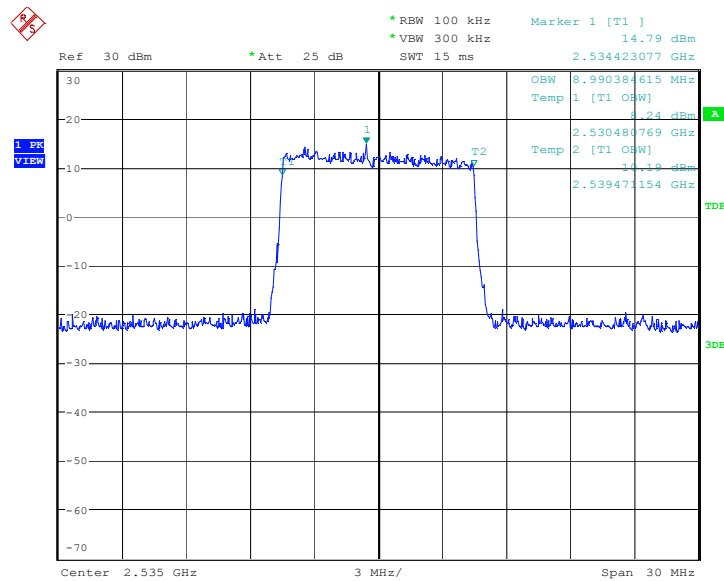


Date: 22.APR.2016 23:13:40

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

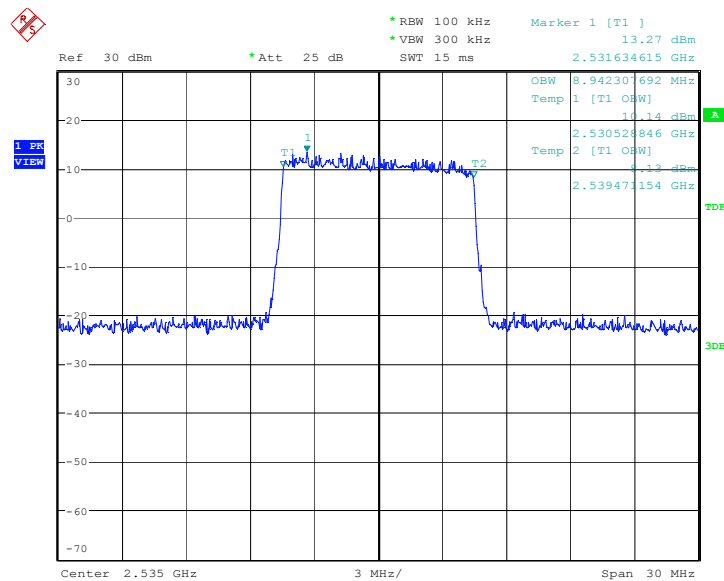
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
2535.0	QPSK	16QAM
	8990.38	8942.31

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



Date: 22.APR.2016 23:19:08

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

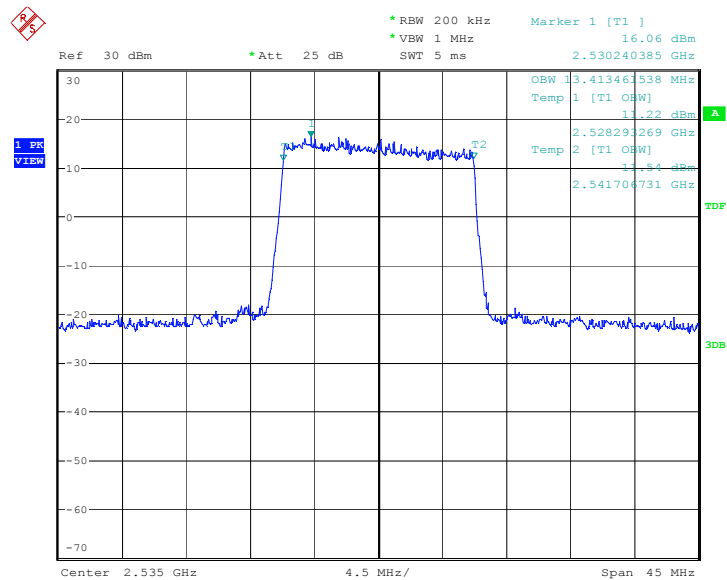


Date: 22.APR.2016 23:19:25

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

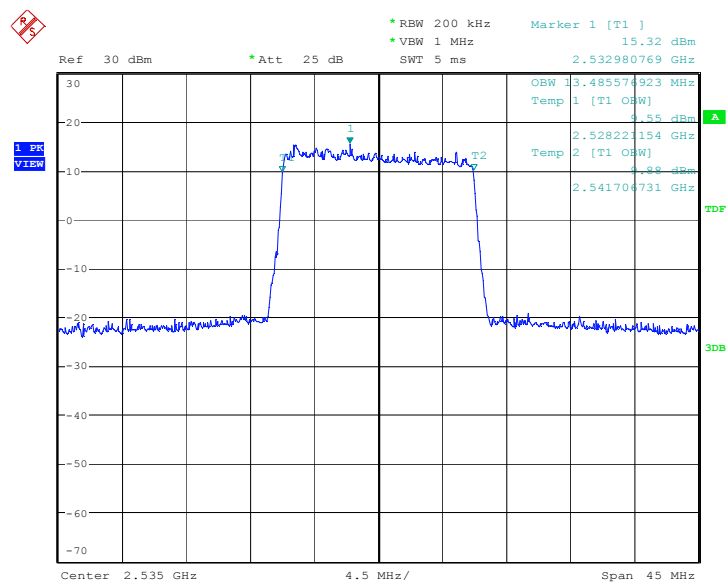
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
2535.0	QPSK	16QAM
	13413.46	13485.58

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



Date: 22.APR.2016 23:24:58

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

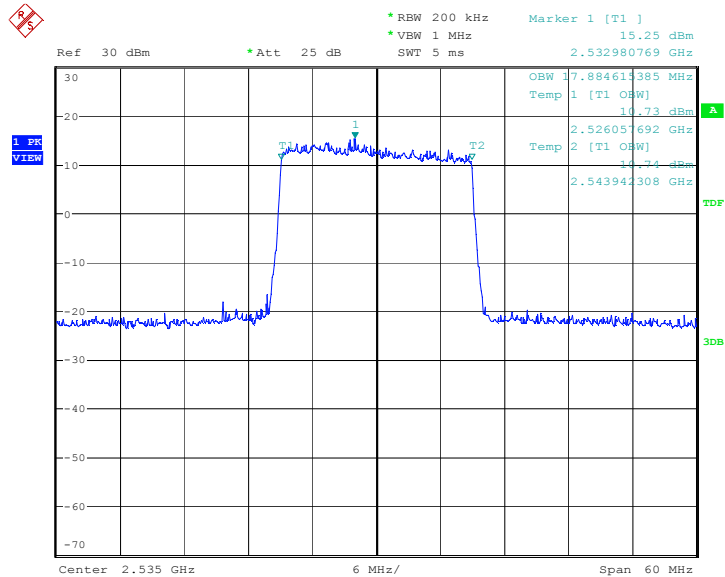


Date: 22.APR.2016 23:25:14

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

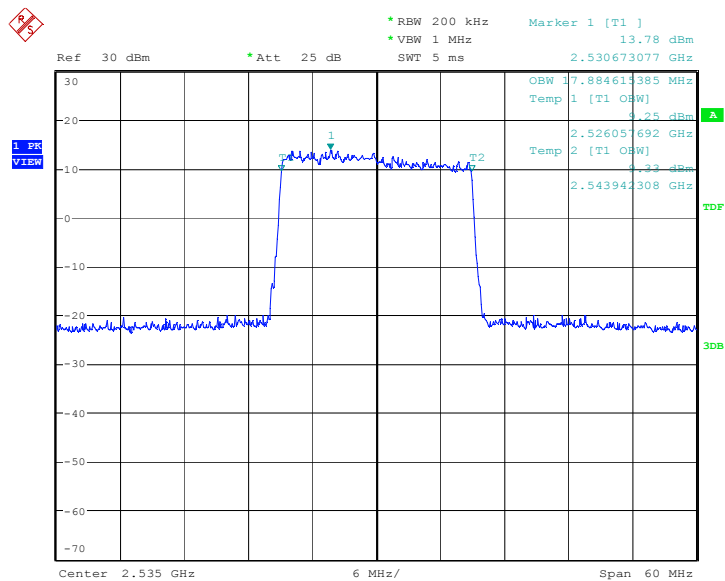
Frequency(MHz)	Occupied Bandwidth (99%)( kHz)	
2535.0	QPSK	16QAM
	17884.62	17884.62

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



Date: 22.APR.2016 23:30:51

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



Date: 22.APR.2016 23:31:06



## **A.5 EMISSION BANDWIDTH**

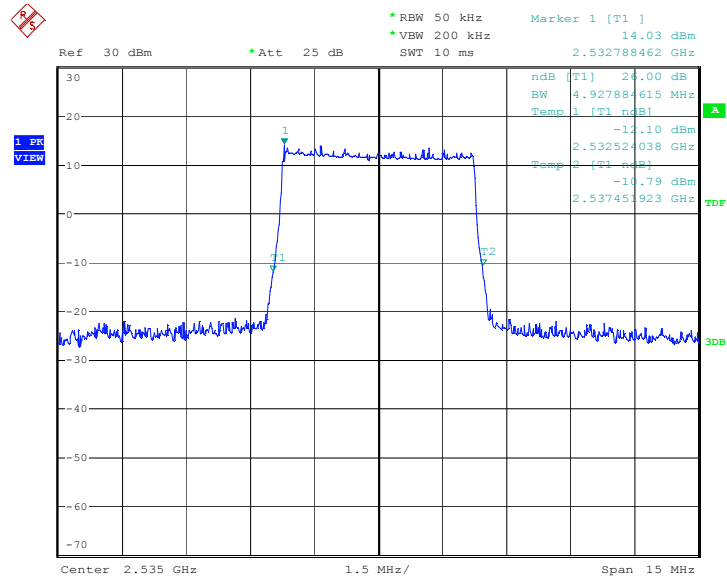
### **A.5.1 Emission Bandwidth Results**

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 7, 5MHz (-26dBc)

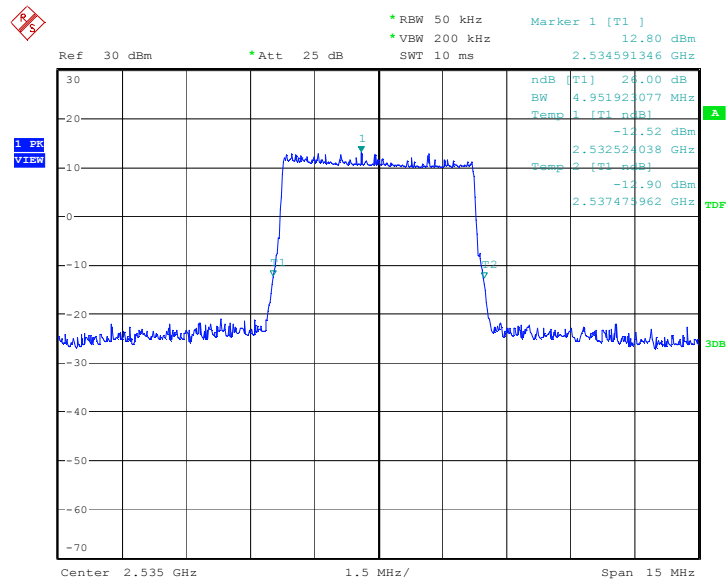
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
2535.0	QPSK	16QAM
	4927.88	4951.92

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



Date: 22.APR.2016 23:14:33

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

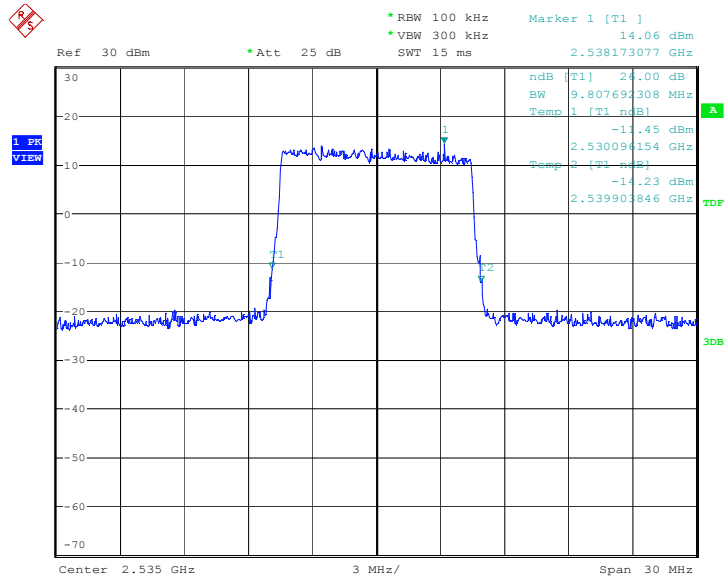


Date: 22.APR.2016 23:14:51

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

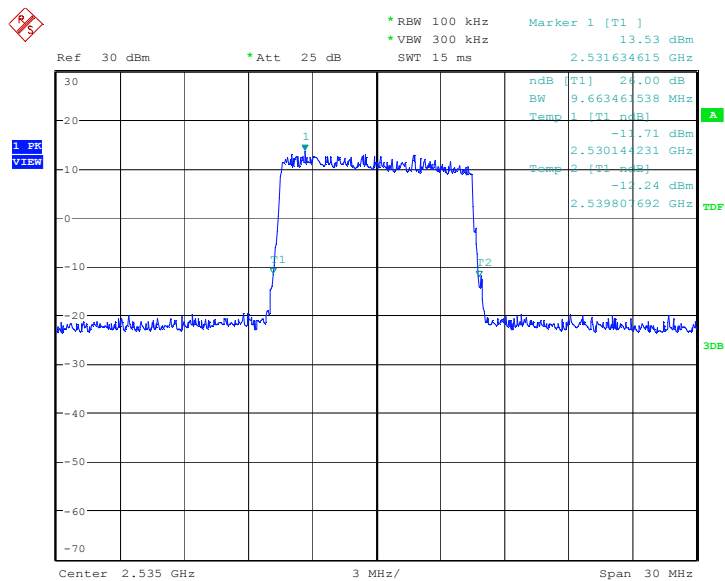
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
2535.0	QPSK	16QAM
	9807.69	9663.46

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



Date: 22.APR.2016 23:20:18

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

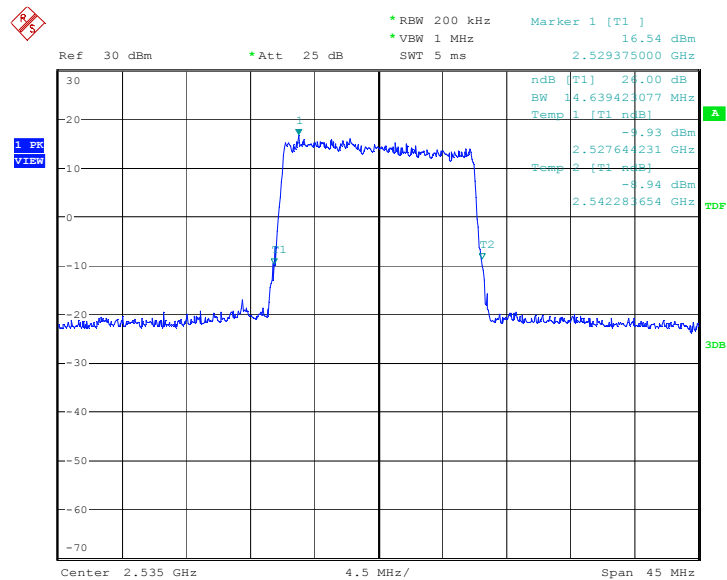


Date: 22.APR.2016 23:20:35

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

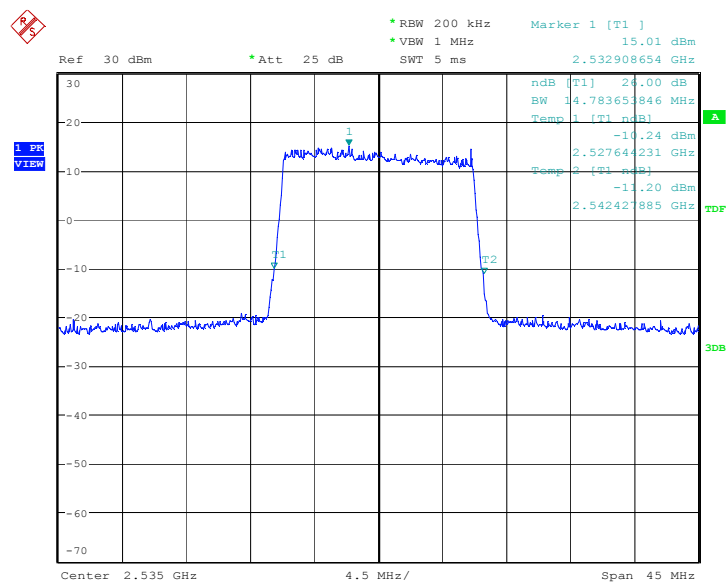
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
2535.0	QPSK	16QAM
	14639.42	14783.65

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



Date: 22.APR.2016 23:26:07

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



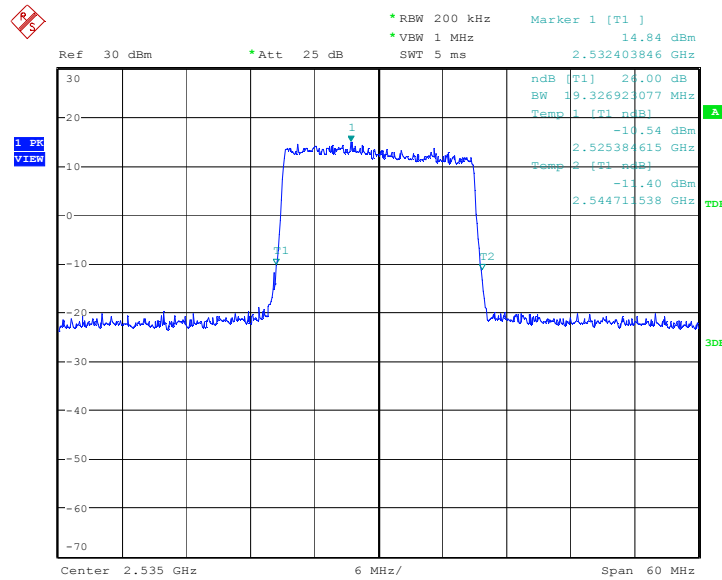
Date: 22.APR.2016 23:26:25



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

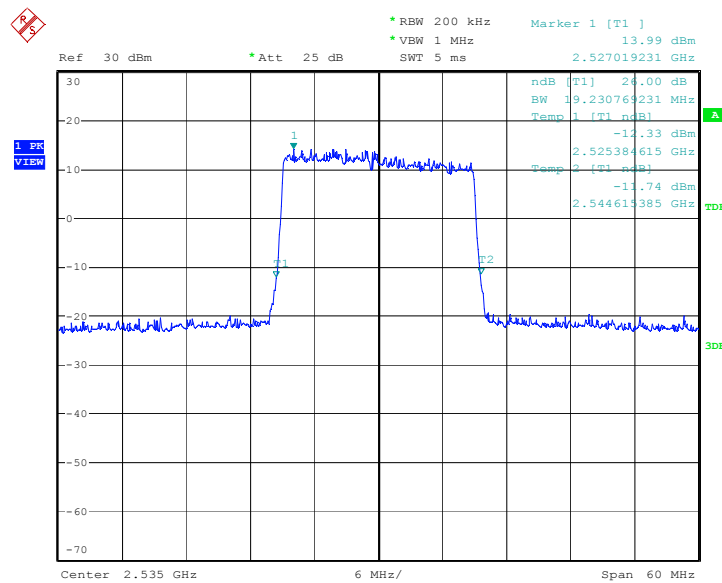
Frequency(MHz)	Occupied Bandwidth (-26dBc)( kHz)	
	QPSK	16QAM
2535.0	19326.92	19230.77

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



Date: 22.APR.2016 23:32:00

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



Date: 22.APR.2016 23:32:17

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

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

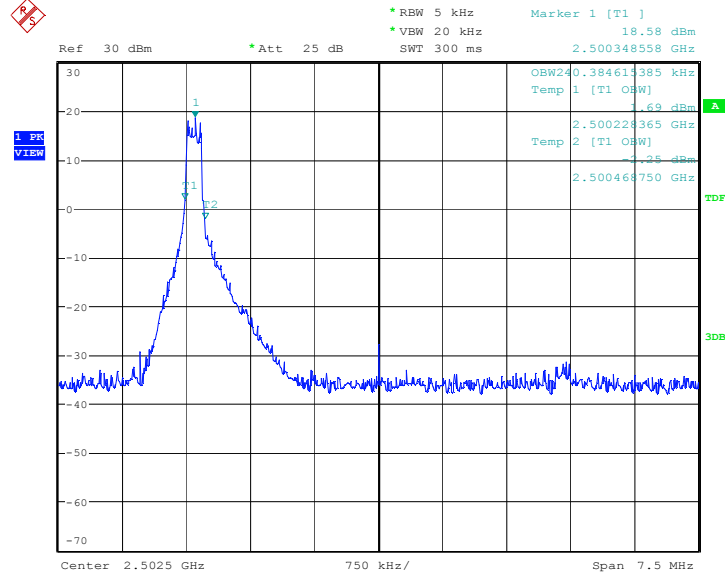
Part 27.53(m) states that for mobile digital stations, the attenuation factor shall be not less than  $40 + 10 \log (P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log (P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel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

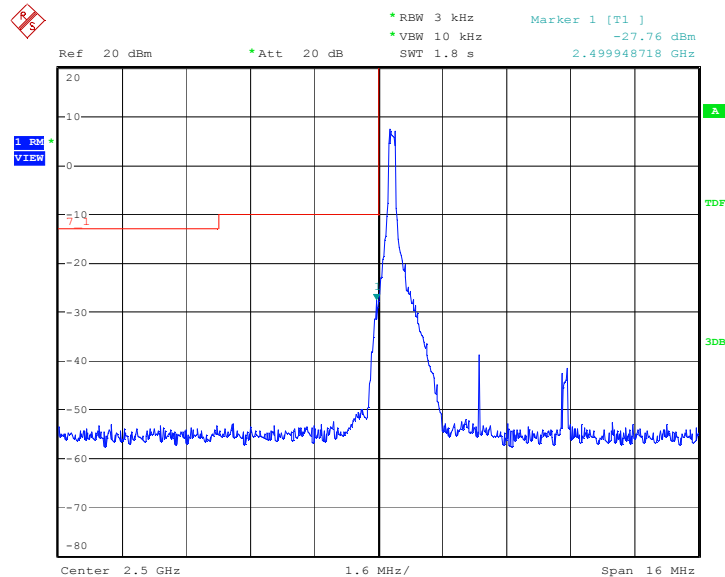
LTE band 7

OBW: 1RB-low\_offset



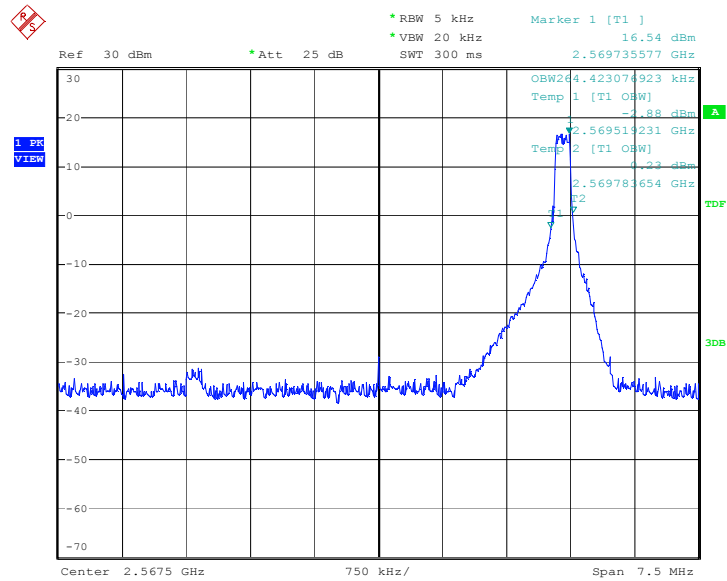
Date: 23.APR.2016 03:49:42

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



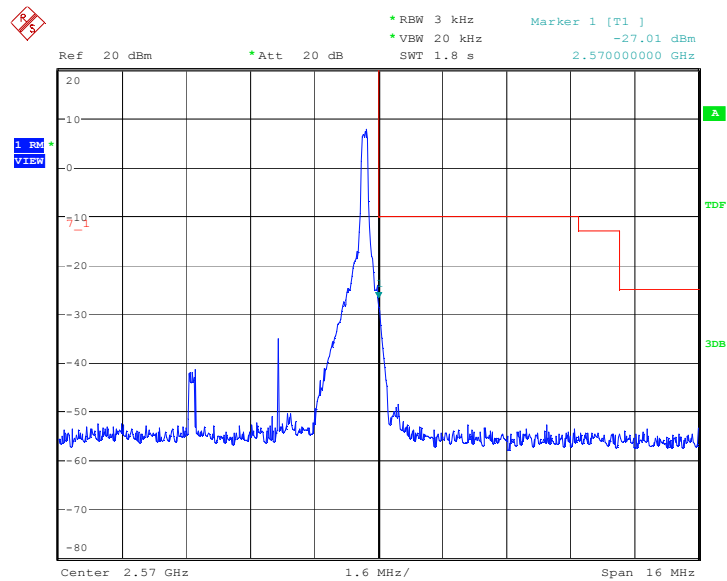
Date: 23.APR.2016 03:50:29

### OBW: 1RB-high\_offset



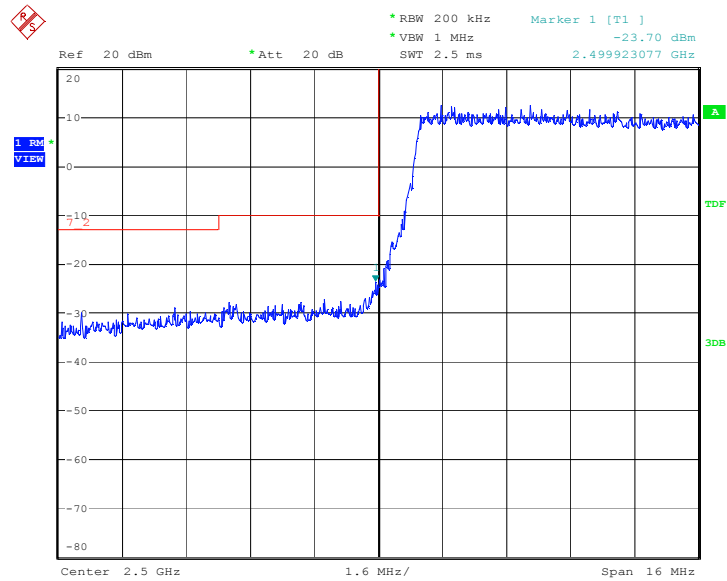
Date: 23.APR.2016 03:47:54

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



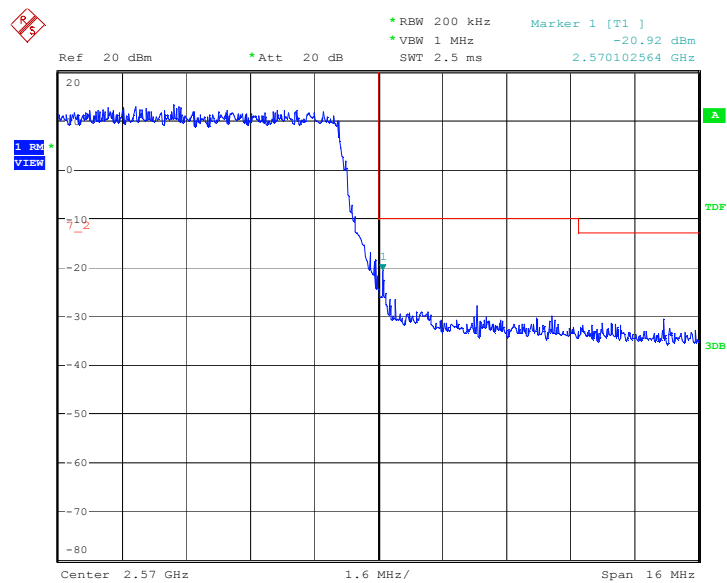
Date: 23.APR.2016 03:48:41

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



Date: 23.APR.2016 03:44:18

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



Date: 23.APR.2016 03:45:06

## **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**

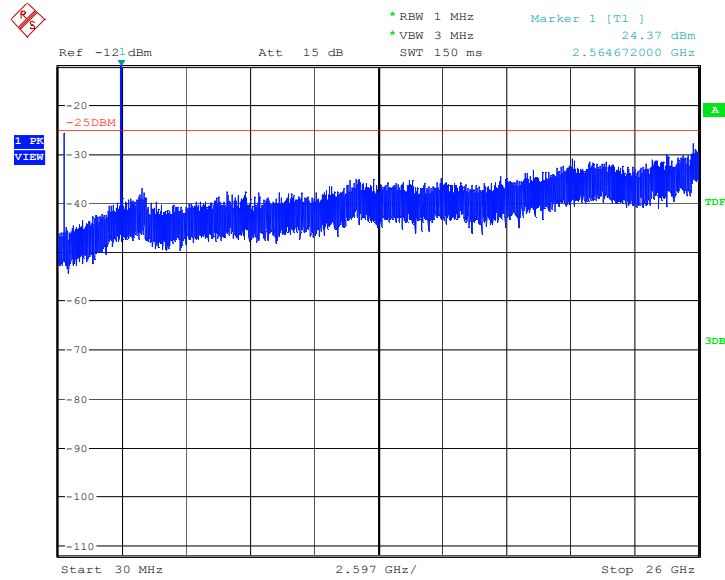
Part 27.53(m)(4) specifies for mobile digital stations, the attenuation factor shall be not less than  $40 + 10 \log (P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log (P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel 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 7: 30MHz – 26GHz**

Spurious emission limit –13dBm.



Date: 23.APR.2016 03:46:33

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

### **Reference**

FCC: CFR Part 27.50(a)

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

According to KDB 971168:

- 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)	
2510.0	QPSK	16QAM
	6.92	7.47

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