



# FCC RF Test Report

**APPLICANT** : Casa Systems, Inc.  
**EQUIPMENT** : 5G Enterprise Small Cell  
**BRAND NAME** : Casa Systems  
**MODEL NAME** : 5G2105-48  
**FCC ID** : 2AO385G2105-48  
**STANDARD** : 47 CFR Part 2, 27(L)  
**CLASSIFICATION** : Licensed Non-Broadcast Station Transmitter (TNB)  
**TEST DATE(S)** : Mar. 02, 2023 ~ Mar. 09, 2023

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.26-2015 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia



**Sporton International Inc. (Kunshan)**

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300  
People's Republic of China**



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### REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FG410208A	Rev. 01	Initial issue of report	Feb. 22, 2024



### SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.4	§2.1046	Conducted Output Power	-	Report Only	-
	§27.50(d)(2)	Equivalent Isotropic Radiated Power (Band 4) (Band 66)	EIRP < 1640 Watt		-
3.5	§24.232(d)	Peak-to-Average Ratio	<13 dB	PASS	-
3.6	§2.1049	Occupied Bandwidth	-	Report Only	-
3.7	§2.1051 §27.53(h)	Conducted Band Edge Measurement (Band 4) (Band 66)	< 43+10log10(P[Watts])	PASS	-
3.8	§2.1051 §27.53(h)	Conducted Spurious Emission (Band 4) (Band 66)	< 43+10log10(P[Watts])	PASS	-
3.9	§2.1055 §27.54	Frequency Stability Temperature & Voltage	Within Authorized Band	PASS	-
4.4	§2.1053 §27.53(h)	Radiated Spurious Emission (Band 4) (Band 66)	< 43+10log <sub>10</sub> (P[Watts])	PASS	Under limit 37.10 dB at 8550.000 MHz

**Conformity Assessment Condition:**

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
- The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty"

**Disclaimer:**

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



# 1 General Description

## 1.1 Applicant

Casa Systems, Inc.  
100 Old River Road Andover MA 01810 USA

## 1.2 Manufacturer

Casa Systems, Inc.  
100 Old River Road Andover MA 01810 USA

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	5G Enterprise Small Cell
Brand Name	Casa Systems
Model Name	5G2105-48
FCC ID	2AO385G2105-48
HW Version	V03
SW Version	FR4.7
EUT Stage	Production Unit

## 1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx Frequency	LTE Band 4 : 2110 MHz ~ 2155 MHz LTE Band 66 : 2110 MHz~ 2180 MHz
Rx Frequency	LTE Band 4 : 1710 MHz ~ 1755 MHz LTE Band 66 : 1710 MHz ~ 1780 MHz
Bandwidth	LTE Band 4 : 5MHz / 10MHz / 15MHz / 20MHz LTE Band 66 : 5MHz / 10MHz / 15MHz / 20MHz
Maximum Output Power to Antenna	<b>External Antenna MIMO &lt;Ant.1+2&gt;:</b> LTE Band 4 : 24.01 dBm LTE Band 66 : 24.08 dBm <b>Internal Antenna MIMO &lt;Ant.1+2&gt;:</b> LTE Band 4 : 23.92 dBm LTE Band 66 : 24.04 dBm
Antenna Gain	<b>External Ant. 1:</b> LTE Band 4 : 8.8 dBi LTE Band 66 : 8.8 dBi <b>External Ant. 2:</b> LTE Band 4 : 8.8 dBi LTE Band 66 : 8.8 dBi <b>Internal Ant. 1:</b> LTE Band 4 : 4.06 dBi LTE Band 66 : 4.06 dBi



	<b>Internal Ant. 2:</b> LTE Band 4 : 4.71 dBi LTE Band 66 : 4.71 dBi
<b>Type of Modulation</b>	QPSK / 16QAM / 64QAM / 256QAM

**Note:**

1. The maximum EIRP is calculated from max output power and max antenna gain, only the maximum EIRP of External Antenna is shown on the report for MIMO mode.
2. LTE Tx is non-signaling mode.
3. The base station only support LTE full RB.
4. For SISO & MIMO mode, the testing has assessed only MIMO mode by referring to the higher output power. The MIMO mode is completely uncorrelated, so the directional gain is selected the maximum gain among all antennas.
5. For Internal & External Antenna, they are the same transmitter, thus Conducted items only test External antenna port by referring to higher output power, and RSE test both Internal & External Antenna.
6. The Internal Antenna and External Antenna support manual switch, the Internal & External antenna can't work at the same time, thus MIMO mode only support MIMO (Internal Ant.1+2) or MIMO (External Ant.1+2), not support MIMO (Internal Ant.1/2 + External Ant.1/2).

### 1.5 Modification of EUT

No modifications are made to the EUT during all test items.

### 1.6 Maximum EIRP Power and Emission Designator

LTE Band 4		QPSK		16QAM/64QAM/256QAM	
BW (MHz)	Frequency Range (MHz)	Maximum EIRP(W)	Emission Designator (99%OBW)	Maximum EIRP(W)	Emission Designator (99%OBW)
5	2112.5 ~ 2152.5	1.8766	4M43G7D	1.8766	4M43W7D
10	2115.0 ~ 2150.0	1.8357	9M03G7D	1.8613	9M03W7D
15	2117.5 ~ 2147.5	1.8575	13M4G7D	1.8575	13M4W7D
20	2120.0 ~ 2145.0	1.9093	18M4G7D	1.8823	18M5W7D
LTE Band 66		QPSK		16QAM/64QAM/256QAM	
BW (MHz)	Frequency Range (MHz)	Maximum EIRP(W)	Emission Designator (99%OBW)	Maximum EIRP(W)	Emission Designator (99%OBW)
5	2112.5 ~ 2177.5	1.8897	4M43G7D	1.9251	4M43W7D
10	2115.0 ~ 2175.0	1.8917	9M03G7D	1.8890	9M03W7D
15	2117.5 ~ 2172.5	1.9148	13M4G7D	1.9122	13M4W7D
20	2120.0 ~ 2170.0	1.9427	18M4G7D	1.9407	18M5W7D

**Note:** LTE Band 66 overlaps the entire frequency range of LTE Band 4. Therefore, the test results provided in this report covers Band 66 as well as Band 4.



### 1.7 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

<b>Test Firm</b>	Sporton International Inc. (Kunshan)		
<b>Test Site Location</b>	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
<b>Test Site No.</b>	<b>Sporton Site No.</b>	<b>FCC Designation No.</b>	<b>FCC Test Firm Registration No.</b>
	03CH04-KS TH01-KS	CN1257	314309

### 1.8 Test Software

Item	Site	Manufacture	Name	Version
1.	TH01-KS	SPORTON	FCC LTE_Ver2.0 Auto_china_210503	2.0
2.	03CH04-KS	AUDIX	E3	210616

### 1.9 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 2, 27(L)
- ANSI C63.26-2015
- FCC KDB 971168 D01 Power Meas License Digital Systems v03r01
- FCC KDB 412172 D01 Determining ERP and EIRP v01r01

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



## 2 Test Configuration of Equipment Under Test

### 2.1 Test Mode

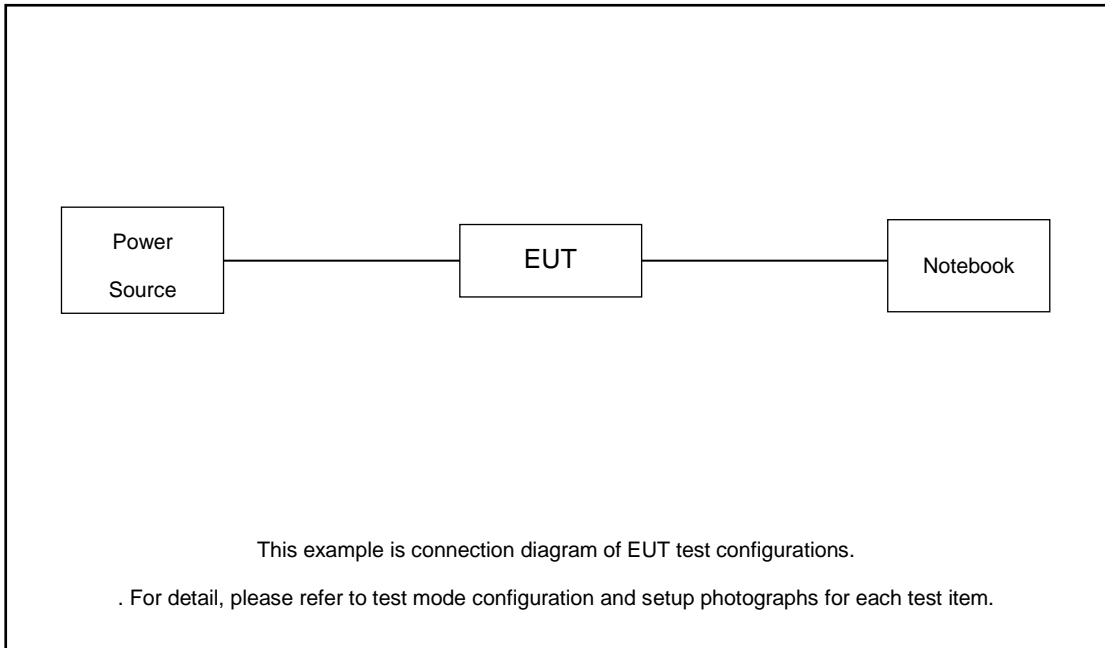
Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas License Digital Systems v03r01 with maximum output power.

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes to find the maximum emission (Y Plane).

Test Items	Band	Bandwidth (MHz)						Modulation				RB #			Test Channel			
		1.4	3	5	10	15	20	QPSK	16 QAM	64 QAM	256 QAM	1	Half	Full	L	M	H	
Max. Output Power	4	-	-	v	v	v	v	v	v	v	v	-	-	v	v	v	v	
	66	-	-	v	v	v	v	v	v	v	v	-	-	v	v	v	v	
Peak-to-Average Ratio	66	-	-				v	v	v	v	v	-	-	v		v		
26dB and 99% Bandwidth	66	-	-	v	v	v	v	v	v			-	-	v		v		
Conducted Band Edge	66	-	-	v	v	v	v	v	v	v	v	-	-	v	v		v	
Conducted Spurious Emission	66	-	-	v	v	v	v	v				-	-	v	v	v	v	
Frequency Stability	66	-	-		v			v				-	-	v		v		
E.I.R.P.	66	-	-	v	v	v	v	v	v	v	v	-	-	v	v	v	v	
Radiated Spurious Emission	66	Worst Case															v	
Note	<ol style="list-style-type: none"> <li>The mark "v" means that this configuration is chosen for testing</li> <li>The mark "-" means that this bandwidth is not supported.</li> <li>The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported.</li> <li>LTE Band 66 overlaps the entire frequency range of LTE Band 4. Therefore, the test results provided in this report covers Band 66 as well as Band 4.</li> </ol>																	



## 2.2 Connection Diagram of Test System



## 2.3 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model No.	FCC ID	Data Cable	Power Cord
1.	Power Supply	GWINSTEK	PSS-2002	N/A	N/A	Unshielded, 1.8 m
2.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	Unshielded AC I/P cable 1.8m
3.	POE Adapter	N/A	N/A	N/A	N/A	N/A

## 2.4 Measurement Results Explanation Example

### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

$$\text{Offset} = \text{RF cable loss} + \text{attenuator factor}.$$

Following shows an offset computation example with cable loss 5.8 dB and 10dB attenuator.

Example :

$$\text{Offset}(dB) = \text{RF cable loss}(dB) + \text{attenuator factor}(dB).$$

$$= 5.8 + 10 = 15.8 \text{ (dB)}$$



### 2.5 Frequency List of Low/Middle/High Channels

LTE Band 4 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
20	Channel	2050	2175	2300
	Frequency	2120	2132.5	2145
15	Channel	2025	2175	2325
	Frequency	2117.5	2132.5	2147.5
10	Channel	2000	2175	2350
	Frequency	2115	2132.5	2150
5	Channel	1975	2175	2375
	Frequency	2112.5	2132.5	2152.5

LTE Band 66 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
20	Channel	66536	66786	67036
	Frequency	2120	2145	2170
15	Channel	66511	66786	67061
	Frequency	2117.5	2145	2172.5
10	Channel	66486	66786	67086
	Frequency	2115	2145	2175
5	Channel	66461	66786	67111
	Frequency	2112.5	2145	2177.5

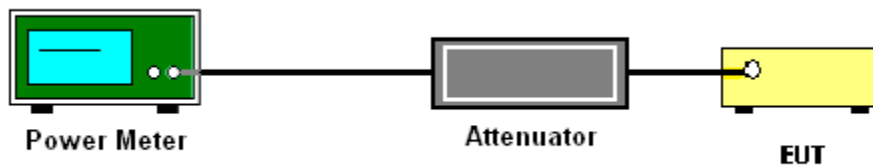
### 3 Conducted Test Items

#### 3.1 Measuring Instruments

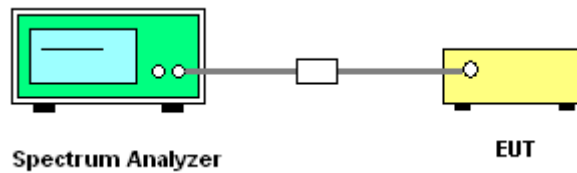
See list of measuring instruments of this test report.

#### 3.2 Test Setup

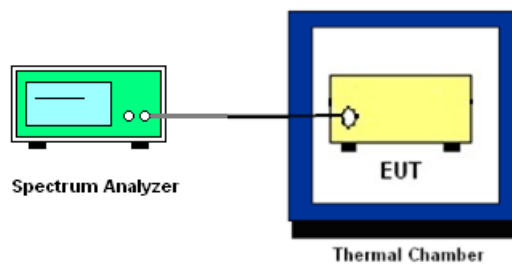
##### 3.2.1 Conducted Output Power



##### 3.2.2 Peak-to-Average Ratio, Occupied Bandwidth, Conducted Band-Edge and Conducted Spurious Emission



##### 3.2.3 Frequency Stability



### 3.3 Test Result of Conducted Test

Please refer to Appendix A.



### 3.4 Conducted Output Power and EIRP

#### 3.4.1 Description of the Conducted Output Power Measurement and EIRP Measurement

A system simulator was used to establish communication with the EUT. Its parameters were set to force the EUT transmitting at maximum output power. The measured power in the radio frequency on the transmitter output terminals shall be reported.

§27.50(d)(2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

- (i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;
- (ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

According to KDB 412172 D01 Power Approach,

$EIRP = P_T + G_T - L_C$ ,  $ERP = EIRP - 2.15$ , where

$P_T$  = transmitter output power in dBm

$G_T$  = gain of the transmitting antenna in dBi

$L_C$  = signal attenuation in the connecting cable between the transmitter and antenna in dB

#### 3.4.2 Test Procedures

1. The testing follows ANSI C63.26 Section 5.2
2. The transmitter output port was connected to the power meter.
3. Set EUT at maximum power.
4. Select lowest, middle, and highest channels for each band and different modulation.
5. Measure and record the power level from the power meter.



## **3.5 Peak-to-Average Ratio**

### **3.5.1 Description of the PAR Measurement**

Power Complementary Cumulative Distribution Function (CCDF) curves provide a means for characterizing the power peaks of a digitally modulated signal on a statistical basis. A CCDF curve depicts the probability of the peak signal amplitude exceeding the average power level. Most contemporary measurement instrumentation include the capability to produce CCDF curves for an input signal provided that the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

### **3.5.2 Test Procedures**

1. The testing follows ANSI C63.26 Section 5.2.3.4 (CCDF).
2. The EUT was connected to spectrum analyzer.
3. Set the CCDF (Complementary Cumulative Distribution Function) option in spectrum analyzer.
4. The highest RF powers were measured and recorded the maximum PAPR level associated with a probability of 0.1 %.
5. Record the deviation as Peak to Average Ratio.



### 3.6 Occupied Bandwidth

#### 3.6.1 Description of Occupied Bandwidth Measurement

The occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean transmitted power.

The 26 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 26 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.

#### 3.6.2 Test Procedures

1. The testing follows ANSI C63.26 Section 5.4
2. The EUT was connected to spectrum analyzer.
3. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between two and five times the anticipated OBW.
4. The nominal resolution bandwidth (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.
5. Set the detection mode to peak, and the trace mode to max hold.
6. Determine the reference value: Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace.  
(this is the reference value)
7. Determine the “-26 dB down amplitude” as equal to (Reference Value – X).
8. Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the “-X dB down amplitude” determined in step 6. If a marker is below this “-X dB down amplitude” value it shall be placed as close as possible to this value. The OBW is the positive frequency difference between the two markers.
9. Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.



### 3.7 Conducted Band Edge

#### 3.7.1 Description of Conducted Band Edge Measurement

27.53 (h)

For operations in the 2110-2155 MHz and 2155-2180 MHz band, the FCC limit is  $43 + 10\log_{10}(P[\text{Watts}])$  dB below the transmitter power  $P(\text{Watts})$  in a 1 MHz bandwidth. However, in the 1MHz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

#### 3.7.2 Test Procedures

1. The testing follows ANSI C63.26 section 5.7
2. The EUT was connected to spectrum analyzer.
3. The band edges of low and high channels for the highest RF powers were measured.
4. Set RBW  $\geq 1\%$  EBW in the 1MHz band immediately outside and adjacent to the band edge.
5. Beyond the 1 MHz band from the band edge, RBW=1MHz was used.
6. Set spectrum analyzer with RMS detector.
7. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
8. Checked that all the results comply with the emission limit line.

Example:

$$\begin{aligned} &\text{The limit line is derived from } 43 + 10\log(P)\text{dB below the transmitter power } P(\text{Watts}) \\ &= P(\text{W}) - [43 + 10\log(P)] \text{ (dB)} \\ &= [30 + 10\log(P)] \text{ (dBm)} - [43 + 10\log(P)] \text{ (dB)} = -13\text{dBm.} \end{aligned}$$

9. When using the integration method, the starting frequency of the integration shall be centered at one-half of the RBW away from the band edge.



### 3.8 Conducted Spurious Emission

#### 3.8.1 Description of Conducted Spurious Emission Measurement

The power of any emission outside of the authorized operating frequency ranges must be lower than the transmitter power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

It is measured by means of a calibrated spectrum analyzer and scanned from 30 MHz up to a frequency including its 10<sup>th</sup> harmonic.

#### 3.8.2 Test Procedures

1. The testing follows ANSI C63.26 section 5.7
2. The EUT was connected to spectrum analyzer.
3. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
4. The middle channel for the highest RF power within the transmitting frequency was measured.
5. The conducted spurious emission for the whole frequency range was taken.
6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz.
7. Set spectrum analyzer with RMS detector.
8. Taking the record of maximum spurious emission.
9. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
10. The limit line is derived from  $43 + 10\log(P)$ dB below the transmitter power P(Watts)  
= P(W)- [43 + 10log(P)] (dB)  
= [30 + 10log(P)] (dBm) - [43 + 10log(P)] (dB)  
= -13dBm.





## 3.9 Frequency Stability

### 3.9.1 Description of Frequency Stability Measurement

The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within  $\pm 0.00025\%$  ( $\pm 2.5\text{ppm}$ ) of the center frequency.

### 3.9.2 Test Procedures for Temperature Variation

1. The testing follows ANSI C63.26 section 5.6.4
2. The EUT was set up in the thermal chamber.
3. With power OFF, the temperature was decreased to  $-30^{\circ}\text{C}$  and the EUT was stabilized before testing. Power was applied and the maximum change in frequency was recorded within one minute.
4. With power OFF, the temperature was raised in  $10^{\circ}\text{C}$  step up to  $50^{\circ}\text{C}$ . The EUT was stabilized at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute.

### 3.9.3 Test Procedures for Voltage Variation

1. The testing follows ANSI C63.26 section 5.6.5
2. The EUT was placed in a temperature chamber at  $20\pm 5^{\circ}\text{C}$  and connected with the system simulator.
3. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value for other than hand carried battery equipment.
4. For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.
5. The variation in frequency was measured for the worst case.

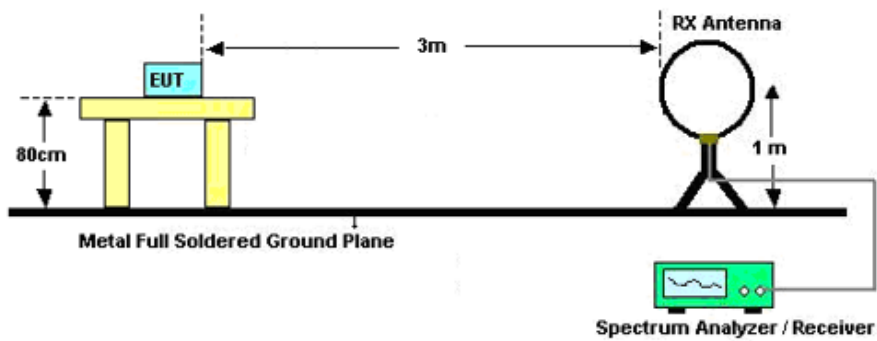
## 4 Radiated Test Items

### 4.1 Measuring Instruments

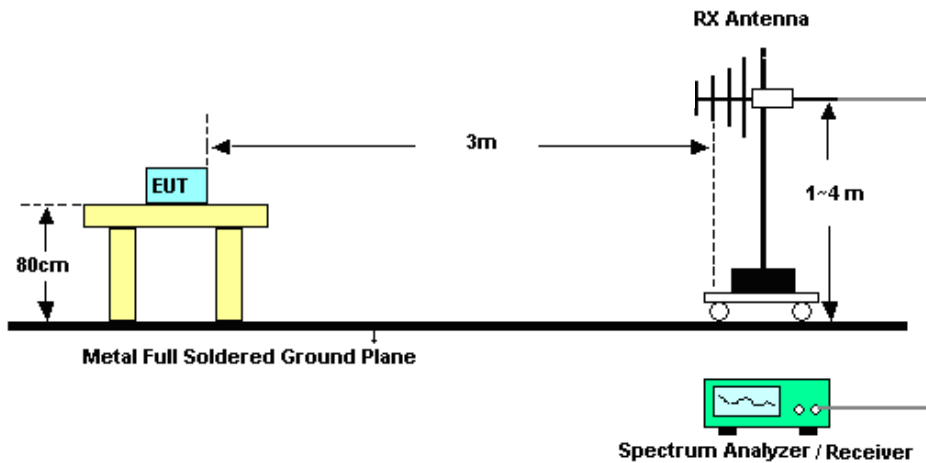
See list of measuring instruments of this test report.

### 4.2 Test Setup

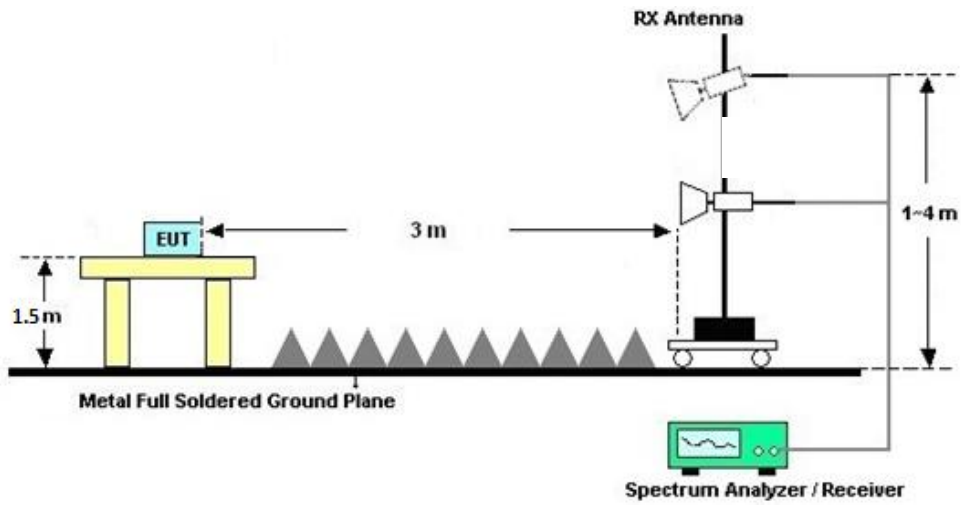
#### 4.2.1 For radiated test below 30MHz



#### 4.2.2 For radiated test from 30MHz to 1GHz



#### 4.2.3 For radiated test above 1GHz



#### 4.3 Test Result of Radiated Test

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

Please refer to Appendix B.



## 4.4 Radiated Spurious Emission

### 4.4.1 Description of Radiated Spurious Emission

The radiated spurious emission was measured by substitution method according to ANSI C63.26. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

### 4.4.2 Test Procedures

1. The testing follows ANSI C63.26 Section 5.5
2. The EUT was placed on a turntable with 0.8 meter height for frequency below 1GHz and 1.5 meter height for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the receiving antenna mounted on the antenna tower.
4. The table was rotated 360 degrees to determine the position of the highest spurious emission.
5. The height of the receiving antenna is varied between 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
6. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
7. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
8. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
9. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
10.  $EIRP (dBm) = S.G. Power - Tx Cable Loss + Tx Antenna Gain$
11.  $ERP (dBm) = EIRP - 2.15$
12. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

The limit line is derived from  $43 + 10\log(P)$ dB below the transmitter power P(Watts)  
=  $P(W) - [43 + 10\log(P)] (dB)$   
=  $[30 + 10\log(P)] (dBm) - [43 + 10\log(P)] (dB)$   
= -13dBm.



## 5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 12, 2022	Mar. 08, 2023~ Mar. 09, 2023	Oct. 11, 2023	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1435004	50MHz Bandwidth	Jan. 05, 2023	Mar. 08, 2023~ Mar. 09, 2023	Jan. 04, 2024	Conducted (TH01-KS)
Temperature & humidity chamber	Hongzhan	LP-150U	H2014011 440	-40~+150°C 20%~95%RH	Jul. 15, 2022	Mar. 08, 2023~ Mar. 09, 2023	Jul. 14, 2023	Conducted (TH01-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY574710 79	10Hz-44G,MAX 30dB	Oct. 12, 2022	Mar. 02, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 16, 2022	Mar. 02, 2023	Oct. 15, 2023	Radiation (03CH04-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	May 24, 2022	Mar. 02, 2023	May 23, 2023	Radiation (03CH04-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	1284	1GHz~18GHz	Oct. 16, 2022	Mar. 02, 2023	Oct. 15, 2023	Radiation (03CH04-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 08, 2023	Mar. 02, 2023	Jan. 07, 2024	Radiation (03CH04-KS)
Amplifier	SONOMA	310N	187289	9KHz-1GHz	May 24, 2022	Mar. 02, 2023	May 23, 2023	Radiation (03CH04-KS)
Amplifier	MITEQ	EM18G40GG A	060728	18~40GHz	Jan. 05, 2023	Mar. 02, 2023	Jan. 04, 2024	Radiation (03CH04-KS)
high gain Amplifier	EM	EM01G18GA	060840	1Ghz-18Ghz	Oct. 12, 2022	Mar. 02, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
Amplifier	Agilent	8449B	3008A023 70	1Ghz-18Ghz	Oct. 12, 2022	Mar. 02, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
AC Power Source	Chroma	61601	F1040900 04	N/A	NCR	Mar. 02, 2023	NCR	Radiation (03CH04-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Mar. 02, 2023	NCR	Radiation (03CH04-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Mar. 02, 2023	NCR	Radiation (03CH04-KS)

NCR: No Calibration Required



## 6 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.26-2015. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

### Uncertainty of Conducted Measurement

Test Item	Uncertainty
Conducted Spurious Emission & Bandedge	±2.26 dB
Occupied Channel Bandwidth	±0.1%
Conducted Power	±0.46 dB
Peak to Average Ratio	±0.46 dB
Frequency Stability	±0.4 Hz

### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.82dB
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### Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.56dB
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### Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.54dB
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----- THE END -----



### Appendix A. Test Results of Conducted Test

Test Engineer :	Simle Wang	Temperature :	22~23°C
		Relative Humidity :	40~42%

### Conducted Output Power(Average power) and EIRP

MIMO External Antenna <1+2>:

LTE-Band4							
Ant	BW	Type of Modulation	Channel	Frequency MHz	Power	Gain	EIRP
1+2	5M	QPSK	1975	2112.5	23.77	8.8	1.8065
		QPSK	2175	2132	23.83	8.8	1.8325
		QPSK	2375	2152.5	23.93	8.8	1.8766
	10M	QPSK	2000	2115	23.78	8.8	1.8098
		QPSK	2175	2132.5	23.74	8.8	1.7931
		QPSK	2350	2150	23.84	8.8	1.8357
	15M	QPSK	2025	2117.5	23.89	8.8	1.8575
		QPSK	2175	2132.5	23.78	8.8	1.8100
		QPSK	2325	2147.5	23.80	8.8	1.8185
	20M	QPSK	2050	2120	24.01	8.8	1.9093
		QPSK	2175	2132.5	23.74	8.8	1.7937
		QPSK	2300	2145	23.71	8.8	1.7816
	5M	16QAM	1975	2112.5	23.80	8.8	1.8211
		16QAM	2175	2132	23.89	8.8	1.8559
		16QAM	2375	2152.5	23.91	8.8	1.8647
	10M	16QAM	2000	2115	23.76	8.8	1.8051
		16QAM	2175	2132.5	23.74	8.8	1.7957
		16QAM	2350	2150	23.90	8.8	1.8613
	15M	16QAM	2025	2117.5	23.89	8.8	1.8567
		16QAM	2175	2132.5	23.82	8.8	1.8289
		16QAM	2325	2147.5	23.84	8.8	1.8356
	20M	16QAM	2050	2120	23.89	8.8	1.8570
		16QAM	2175	2132.5	23.77	8.8	1.8061
		16QAM	2300	2145	23.74	8.8	1.7938
	5M	64QAM	1975	2112.5	23.77	8.8	1.8065
		64QAM	2175	2132	23.83	8.8	1.8325
		64QAM	2375	2152.5	23.93	8.8	1.8766
	10M	64QAM	2000	2115	23.78	8.8	1.8098
		64QAM	2175	2132.5	23.74	8.8	1.7931
		64QAM	2350	2150	23.84	8.8	1.8357
15M	64QAM	2025	2117.5	23.89	8.8	1.8575	



		64QAM	2175	2132.5	23.78	8.8	1.8100
		64QAM	2325	2147.5	23.80	8.8	1.8185
	20M	64QAM	2050	2120	23.95	8.8	1.8823
		64QAM	2175	2132.5	23.74	8.8	1.7937
		64QAM	2300	2145	23.71	8.8	1.7816
	5M	256QAM	1975	2112.5	23.76	8.8	1.8022
		256QAM	2175	2132	23.83	8.8	1.8325
		256QAM	2375	2152.5	23.93	8.8	1.8766
	10M	256QAM	2000	2115	23.78	8.8	1.8098
		256QAM	2175	2132.5	23.74	8.8	1.7931
		256QAM	2350	2150	23.84	8.8	1.8357
	15M	256QAM	2025	2117.5	23.89	8.8	1.8575
		256QAM	2175	2132.5	23.78	8.8	1.8100
		256QAM	2325	2147.5	23.80	8.8	1.8185
	20M	256QAM	2050	2120	23.95	8.8	1.8823
		256QAM	2175	2132.5	23.74	8.8	1.7937
		256QAM	2300	2145	23.71	8.8	1.7816





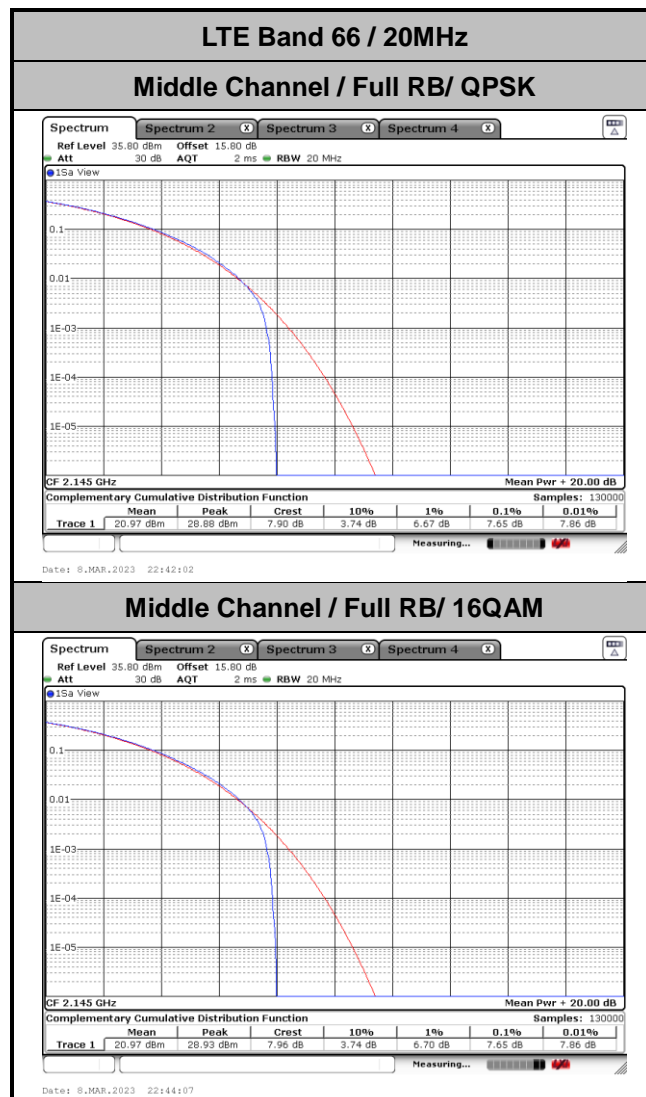
LTE-Band66							
Ant	BW	Type of Modulation	Channel	Frequency MHz	Power	Gain	EIRP
1+2	5M	QPSK	66461	2112.5	23.67	8.8	1.7668
		QPSK	66786	2145	23.96	8.8	1.8897
		QPSK	67111	2177.5	23.73	8.8	1.7917
	10M	QPSK	66486	2115	23.96	8.8	1.8860
		QPSK	66786	2145	23.97	8.8	1.8917
		QPSK	67086	2175	23.71	8.8	1.7836
	15M	QPSK	66511	2117.5	23.76	8.8	1.8013
		QPSK	66786	2145	24.02	8.8	1.9148
		QPSK	67061	2172.5	23.91	8.8	1.8644
	20M	QPSK	66536	2120	23.87	8.8	1.8502
		QPSK	66786	2145	24.08	8.8	1.9427
		QPSK	67036	2170	23.94	8.8	1.8786
	5M	16QAM	66461	2112.5	23.72	8.8	1.7860
		16QAM	66786	2145	24.04	8.8	1.9251
		16QAM	67111	2177.5	23.83	8.8	1.8317
	10M	16QAM	66486	2115	23.92	8.8	1.8727
		16QAM	66786	2145	23.93	8.8	1.8743
		16QAM	67086	2175	23.70	8.8	1.7789
	15M	16QAM	66511	2117.5	23.76	8.8	1.8051
		16QAM	66786	2145	24.02	8.8	1.9122
		16QAM	67061	2172.5	23.93	8.8	1.8730
	20M	16QAM	66536	2120	23.87	8.8	1.8493
		16QAM	66786	2145	24.05	8.8	1.9272
		16QAM	67036	2170	23.92	8.8	1.8694
	5M	64QAM	66461	2112.5	23.69	8.8	1.7752
		64QAM	66786	2145	24.00	8.8	1.9076
		64QAM	67111	2177.5	23.78	8.8	1.8120
	10M	64QAM	66486	2115	23.92	8.8	1.8713
		64QAM	66786	2145	23.96	8.8	1.8890
		64QAM	67086	2175	23.71	8.8	1.7839
	15M	64QAM	66511	2117.5	23.75	8.8	1.7986
		64QAM	66786	2145	24.00	8.8	1.9051
		64QAM	67061	2172.5	23.90	8.8	1.8623
	20M	64QAM	66536	2120	23.88	8.8	1.8521
		64QAM	66786	2145	24.08	8.8	1.9407
		64QAM	67036	2170	23.94	8.8	1.8804
	5M	256QAM	66461	2112.5	23.64	8.8	1.7525
		256QAM	66786	2145	23.98	8.8	1.8987
		256QAM	67111	2177.5	23.81	8.8	1.8226
	10M	256QAM	66486	2115	23.95	8.8	1.8846
		256QAM	66786	2145	23.94	8.8	1.8778
		256QAM	67086	2175	23.68	8.8	1.7712
	15M	256QAM	66511	2117.5	23.77	8.8	1.8069
		256QAM	66786	2145	23.99	8.8	1.9025
		256QAM	67061	2172.5	23.82	8.8	1.8261
	20M	256QAM	66536	2120	23.83	8.8	1.8318
		256QAM	66786	2145	24.07	8.8	1.9354
		256QAM	67036	2170	23.79	8.8	1.8147

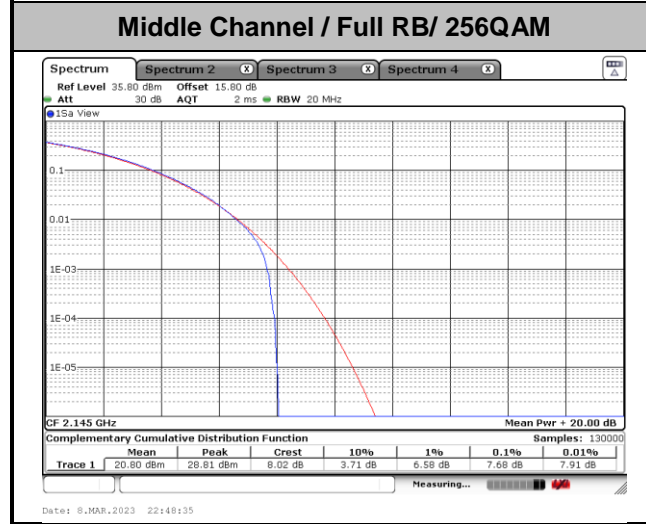
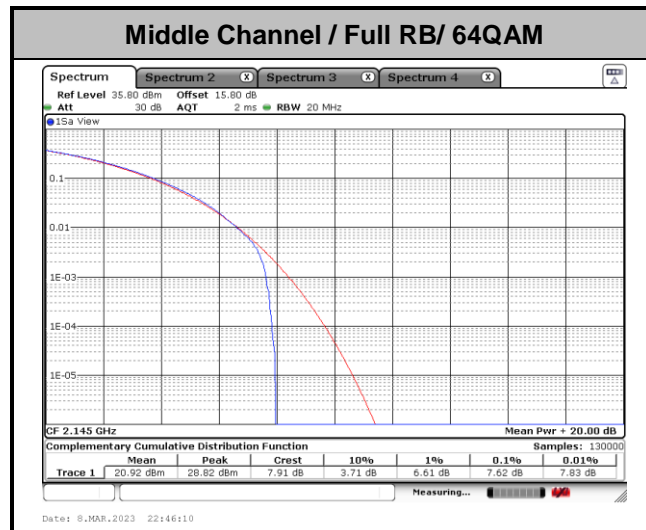


# LTE Band 66\_MIMO Ant1

## Peak-to-Average Ratio

Mode	LTE Band 66 / 20MHz				
Mod.	QPSK	16QAM	64QAM	256QAM	Limit: 13dB
RB Size	Full RB	Full RB	Full RB	Full RB	Result
Middle CH	7.65	7.65	7.62	7.68	PASS

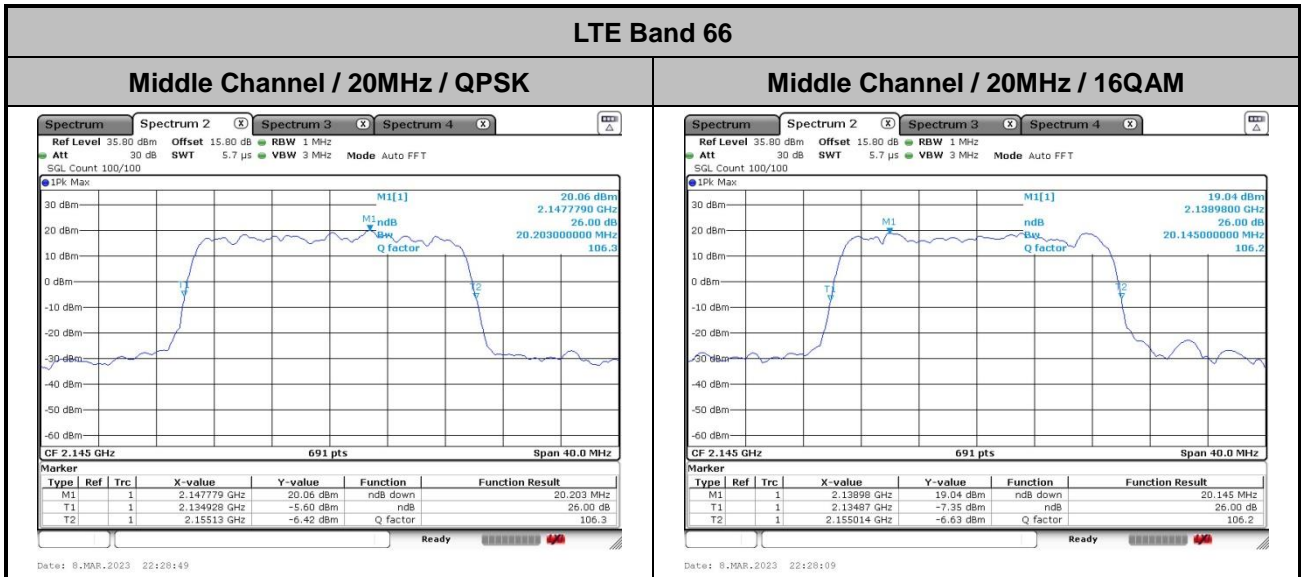






**26dB Bandwidth**

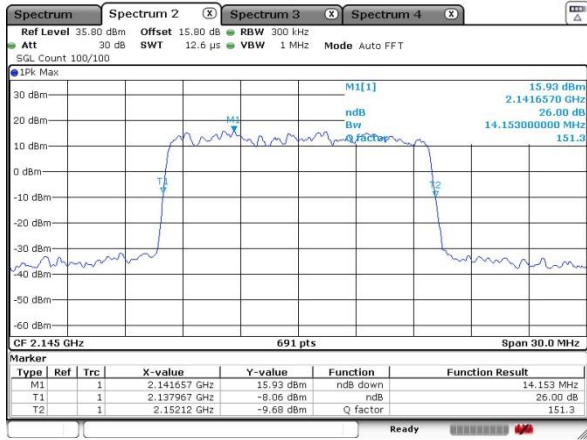
Mode	LTE Band 66 : 26dB BW(MHz)	
BW	20MHz	
Mod.	QPSK	16QAM
Middle CH	20.20	20.15
BW	15MHz	
Mod.	QPSK	16QAM
Middle CH	14.15	14.24
BW	10MHz	
Mod.	QPSK	16QAM
Middle CH	9.73	9.64
BW	5MHz	
Mod.	QPSK	16QAM
Middle CH	4.72	4.75





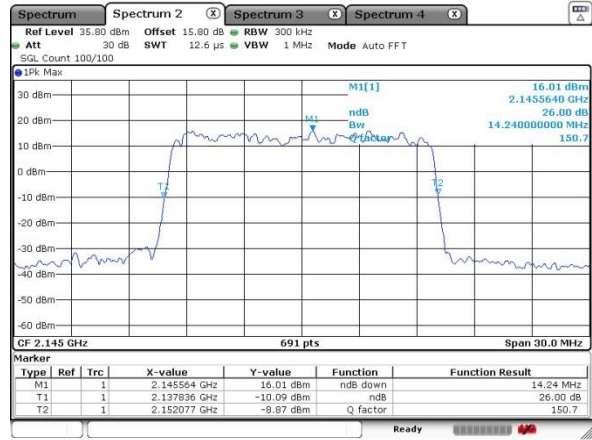
LTE Band 66

Middle Channel / 15MHz / QPSK



Date: 8.MAR.2023 22:00:24

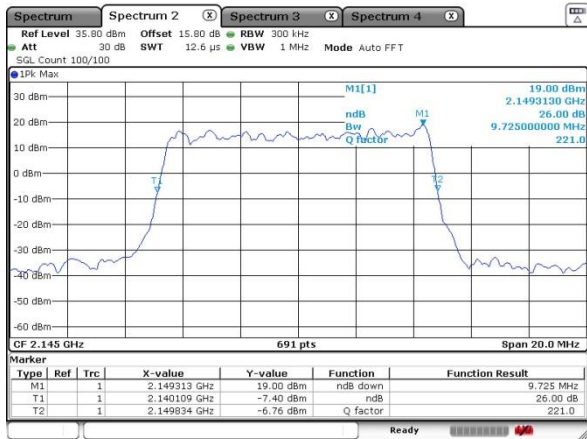
Middle Channel / 15MHz / 16QAM



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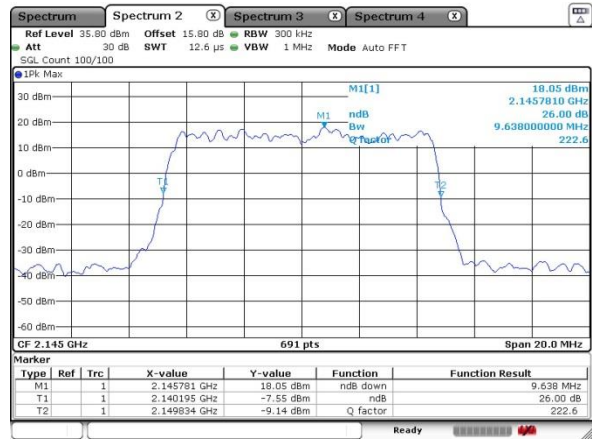
LTE Band 66

Middle Channel / 10MHz / QPSK



Date: 8.MAR.2023 21:13:10

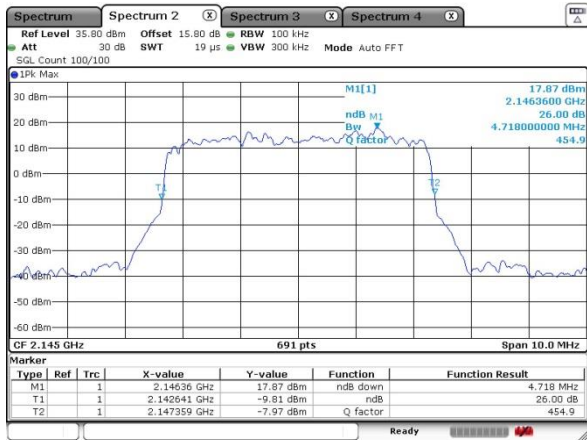
Middle Channel / 10MHz / 16QAM



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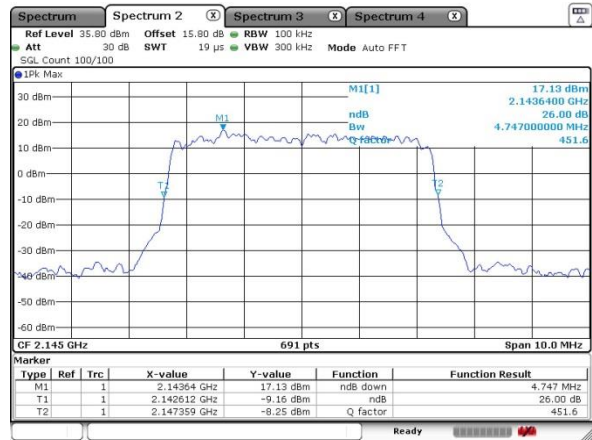
LTE Band 66

Middle Channel / 5MHz / QPSK



Date: 8.MAR.2023 19:43:24

Middle Channel / 5MHz / 16QAM

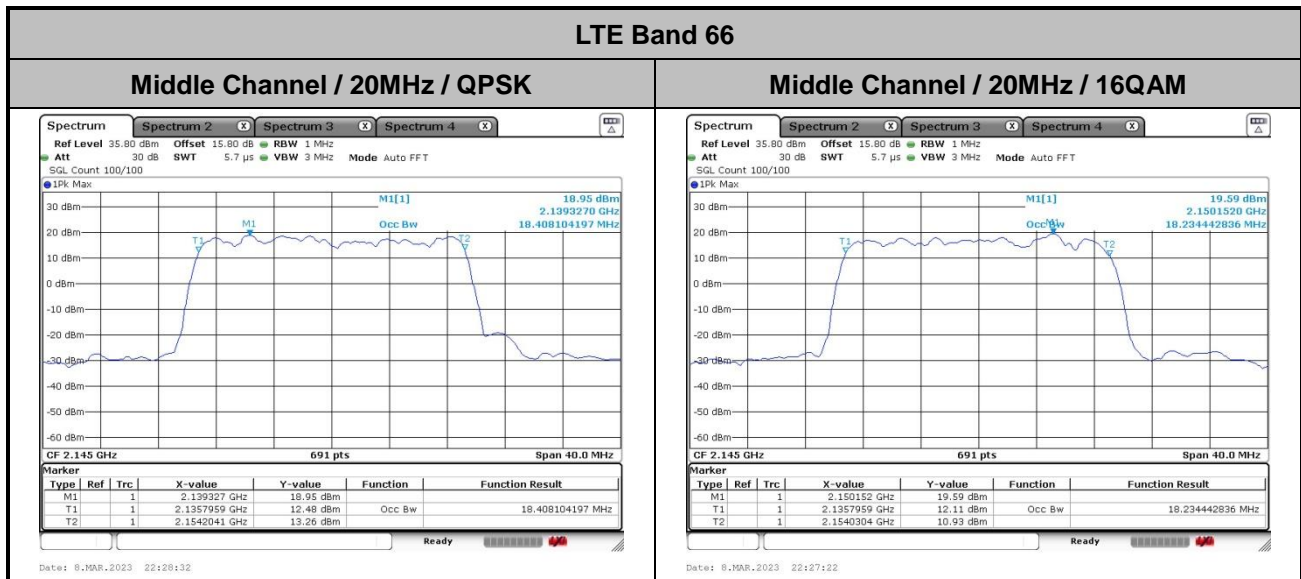


Date: 8.MAR.2023 19:43:53



## Occupied Bandwidth

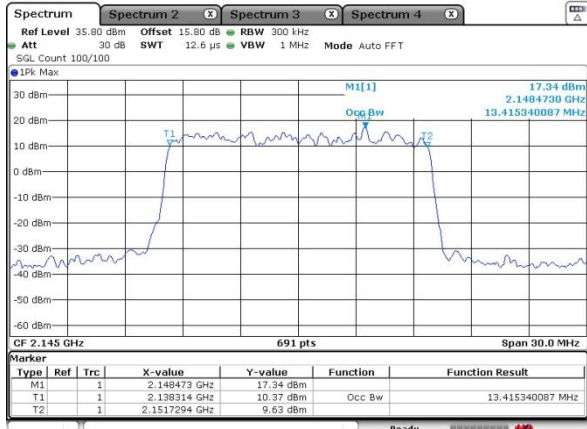
Mode	LTE Band 66 : 99%OBW(MHz)	
BW	20MHz	
Mod.	QPSK	16QAM
Middle CH	18.41	18.23
BW	15MHz	
Mod.	QPSK	16QAM
Middle CH	13.42	13.42
BW	10MHz	
Mod.	QPSK	16QAM
Middle CH	8.97	9.03
BW	5MHz	
Mod.	QPSK	16QAM
Middle CH	4.43	4.40





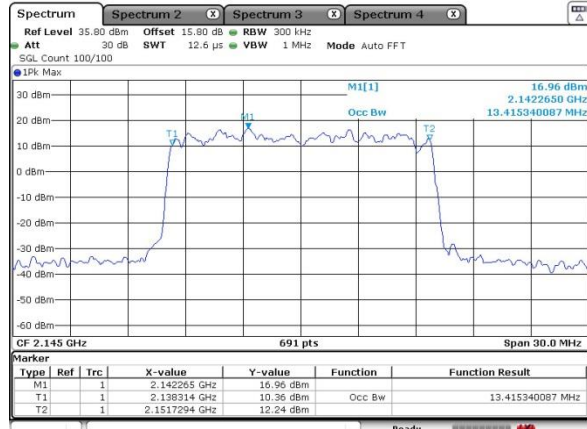
LTE Band 66

Middle Channel / 15MHz / QPSK



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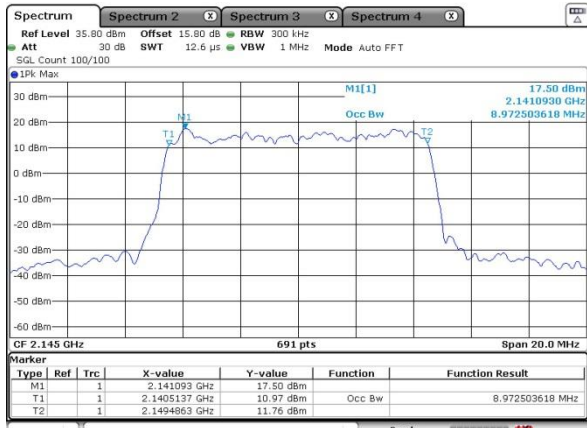
Middle Channel / 15MHz / 16QAM



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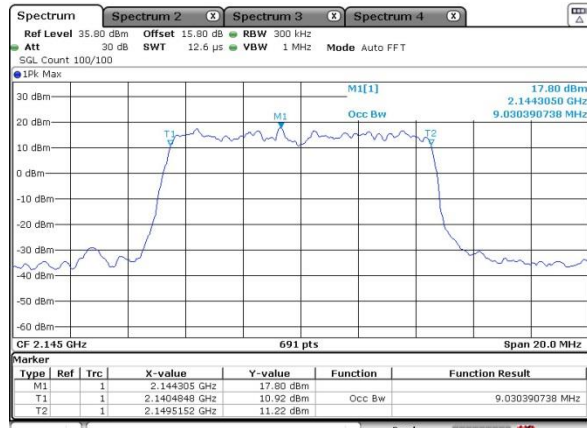
LTE Band 66

Middle Channel / 10MHz / QPSK



Date: 8.MAR.2023 21:11:55

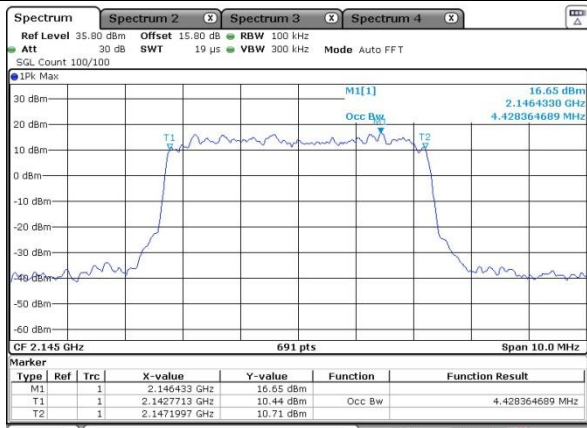
Middle Channel / 10MHz / 16QAM



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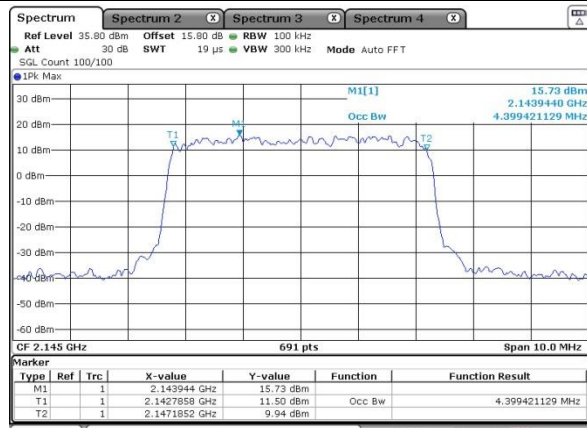
LTE Band 66

Middle Channel / 5MHz / QPSK



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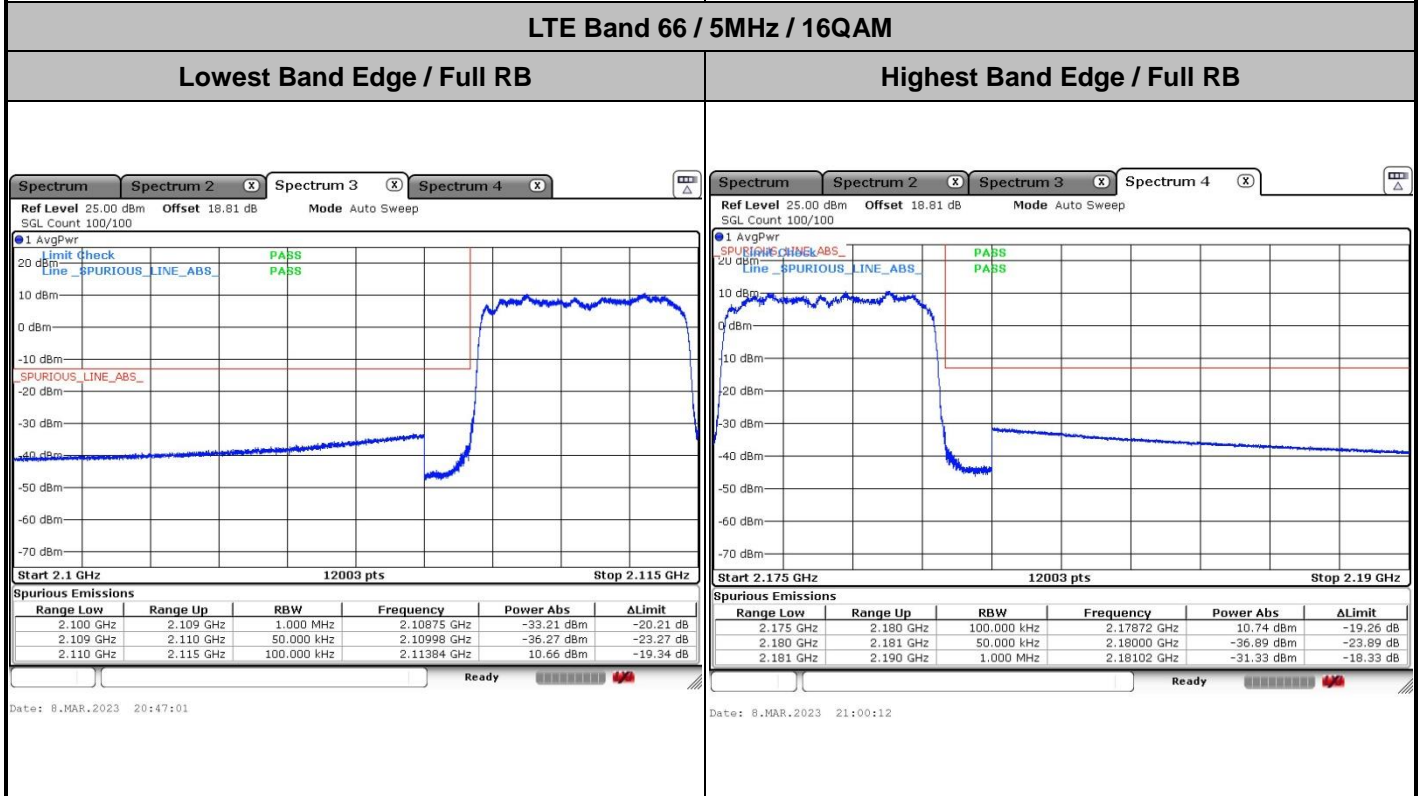
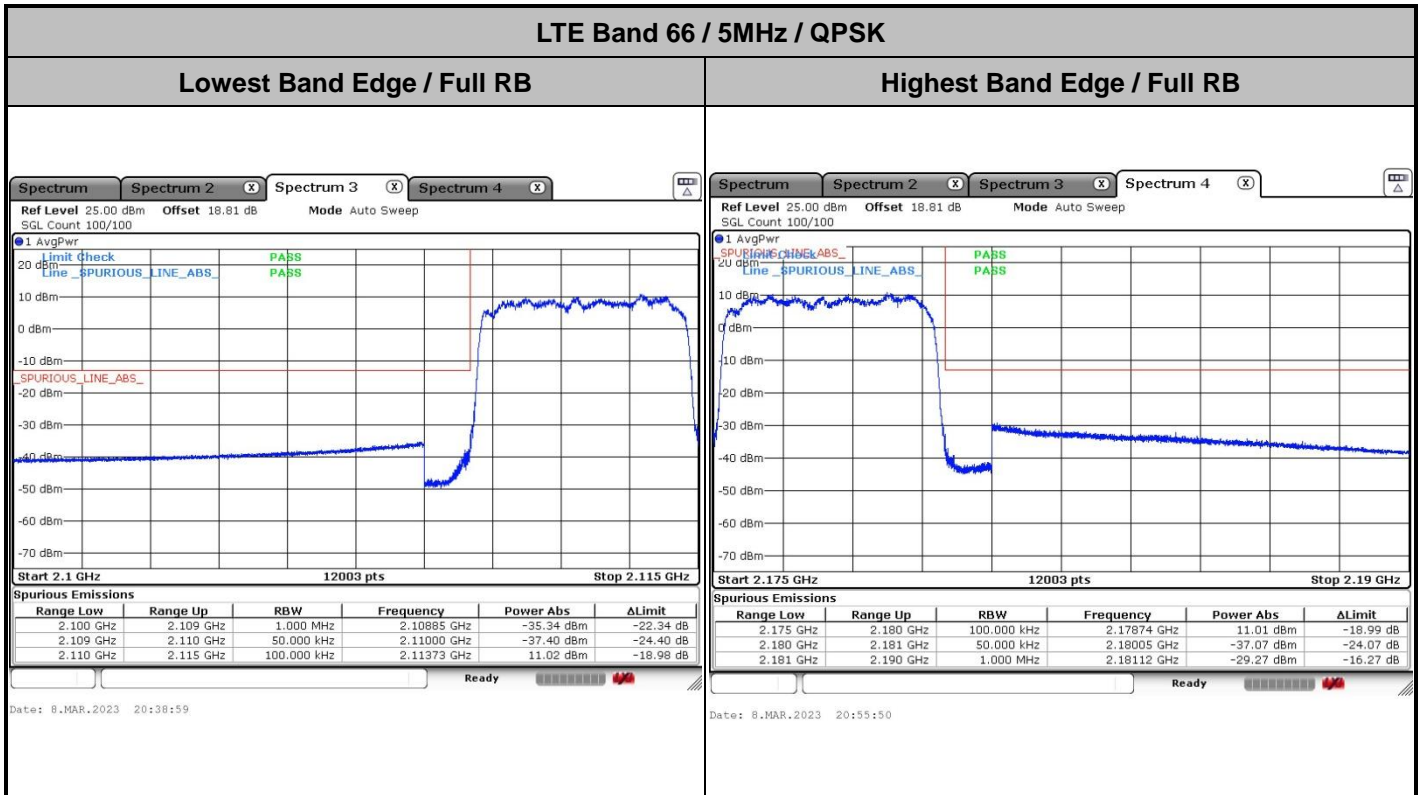
Middle Channel / 5MHz / 16QAM



Date: 8.MAR.2023 19:41:04



# Conducted Band Edge

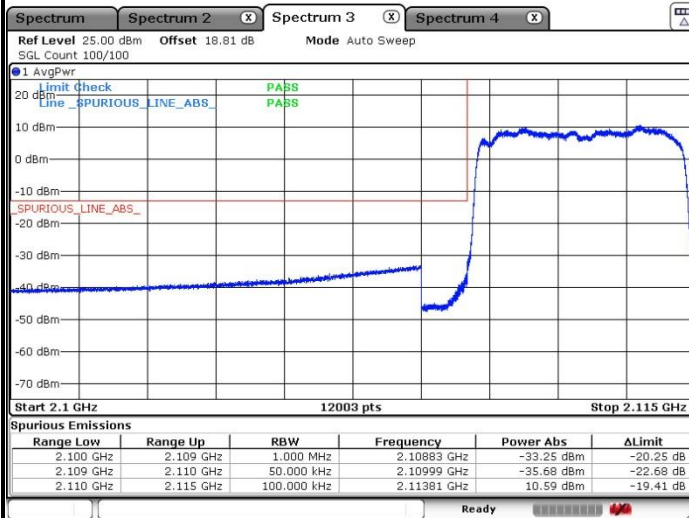




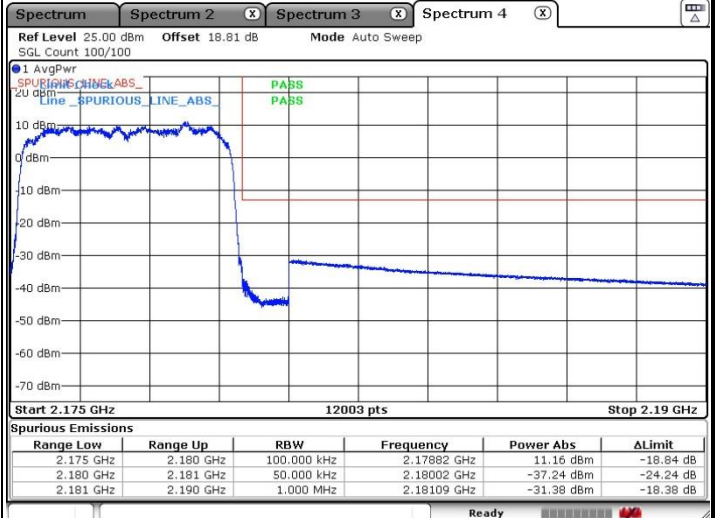


LTE Band 66 / 5MHz / 64QAM

Lowest Band Edge / Full RB

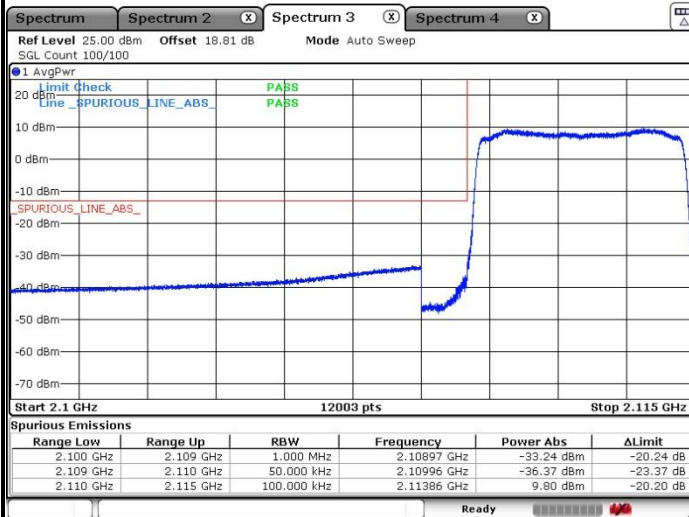


Highest Band Edge / Full RB

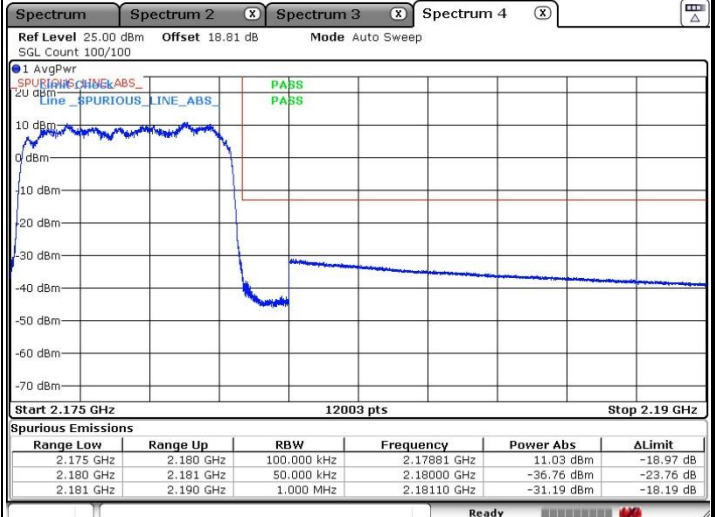


LTE Band 66 / 5MHz / 256QAM

Lowest Band Edge / Full RB



Highest Band Edge / Full RB

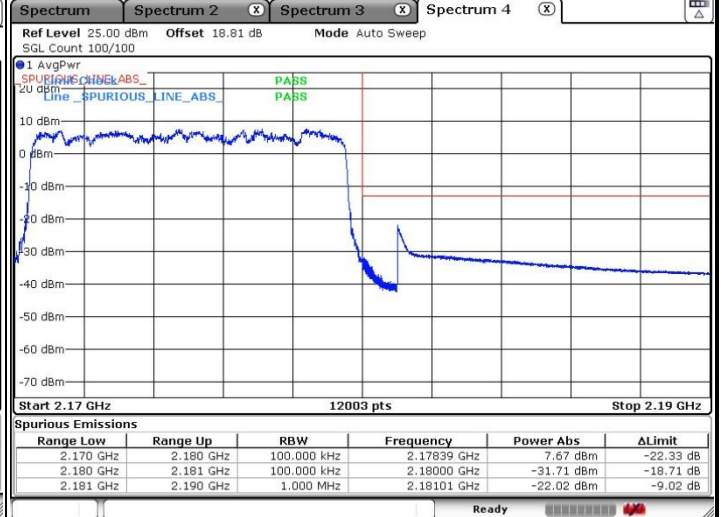
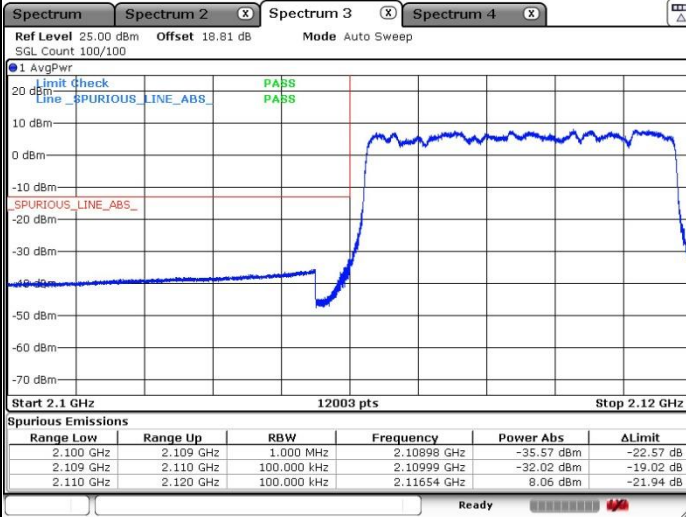




LTE Band 66 / 10MHz / QPSK

Lowest Band Edge / Full RB

Highest Band Edge / Full RB



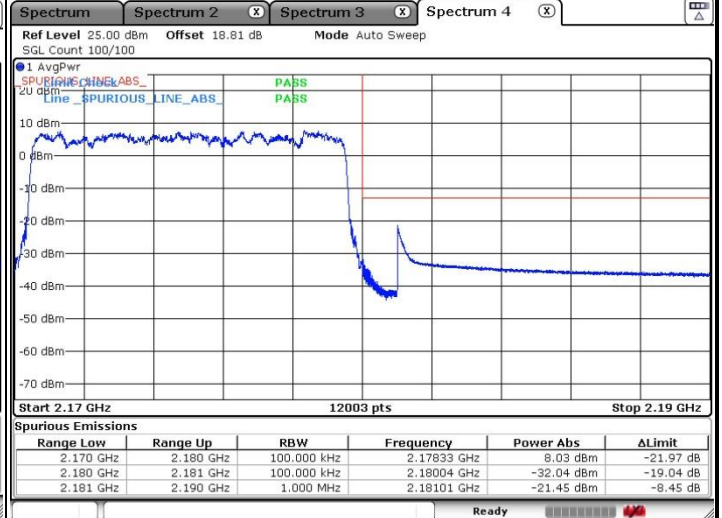
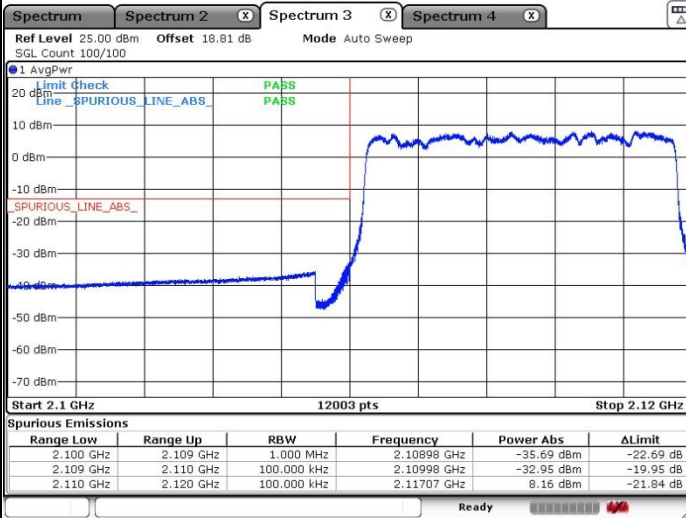
Date: 8.MAR.2023 21:20:54

Date: 8.MAR.2023 21:27:35

LTE Band 66 / 10MHz / 16QAM

Lowest Band Edge / Full RB

Highest Band Edge / Full RB



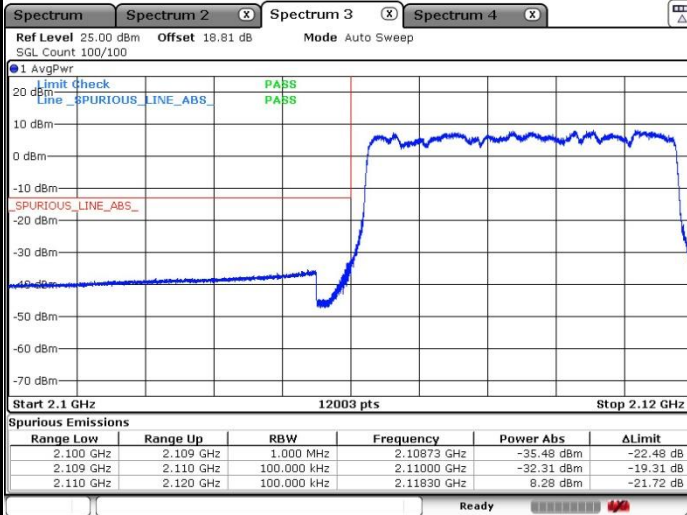
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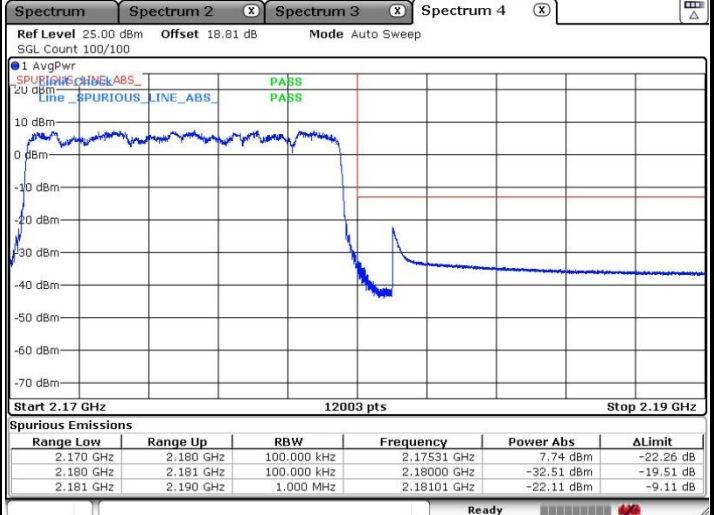


LTE Band 66 / 10MHz / 64QAM

Lowest Band Edge / Full RB

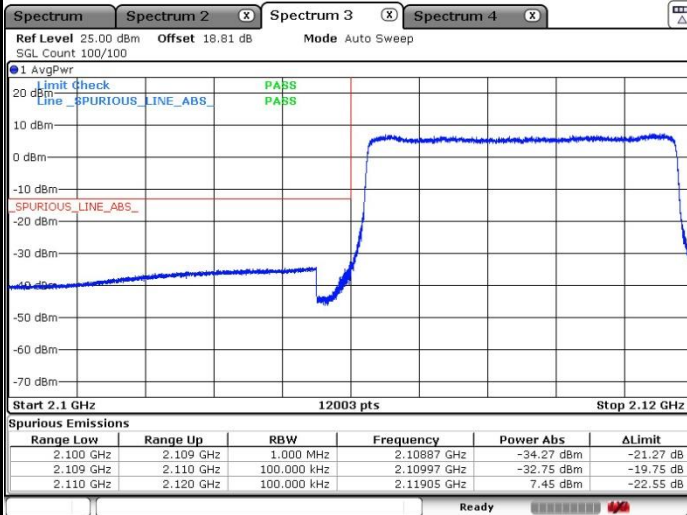


Highest Band Edge / Full RB

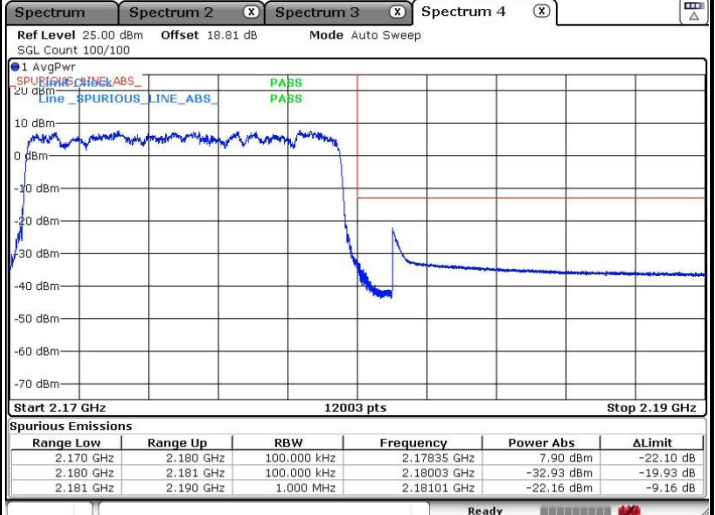


LTE Band 66 / 10MHz / 256QAM

Lowest Band Edge / Full RB



Highest Band Edge / Full RB

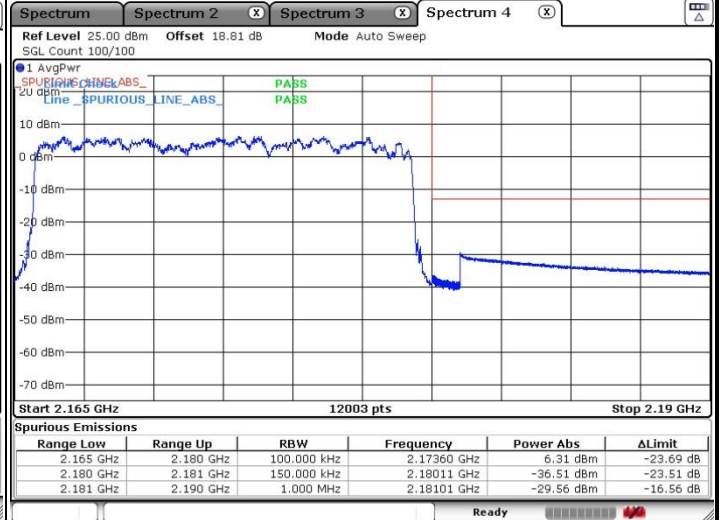
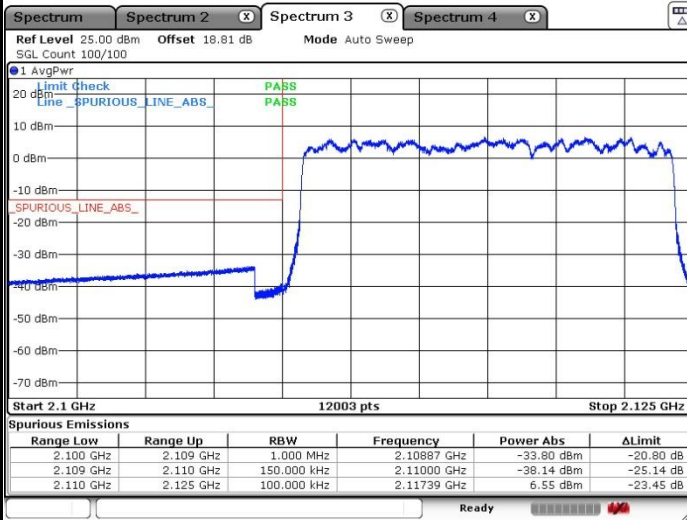




LTE Band 66 / 15MHz / QPSK

Lowest Band Edge / Full RB

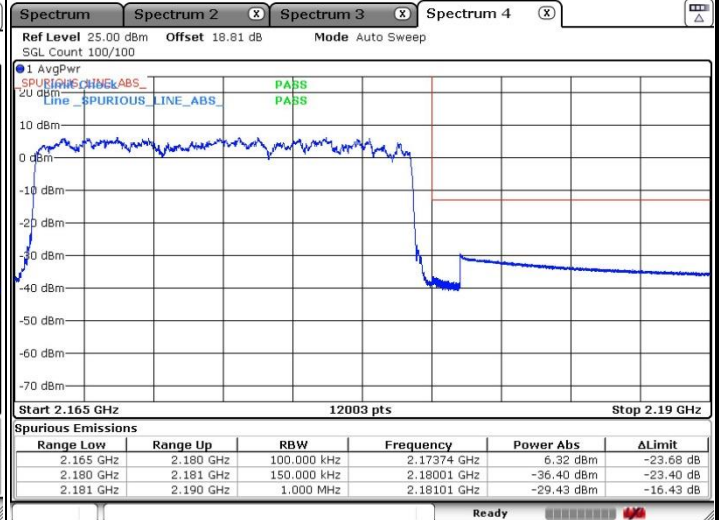
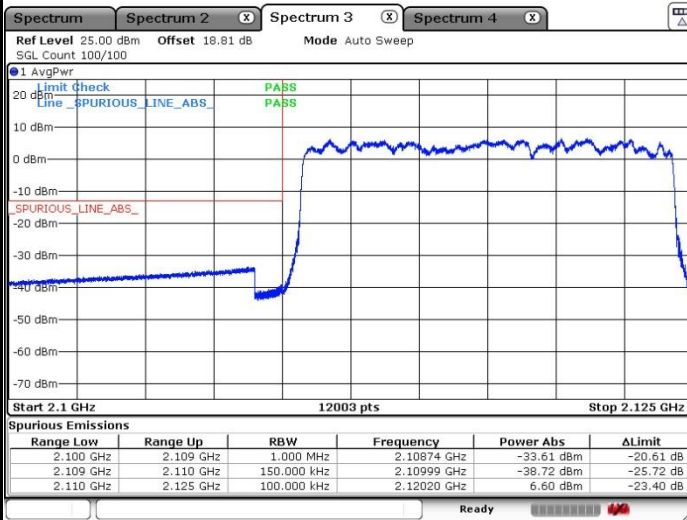
Highest Band Edge / Full RB



LTE Band 66 / 15MHz / 16QAM

Lowest Band Edge / Full RB

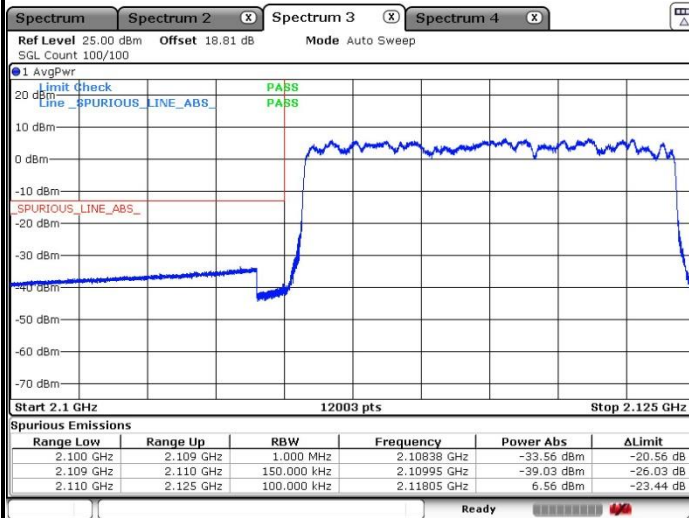
Highest Band Edge / Full RB





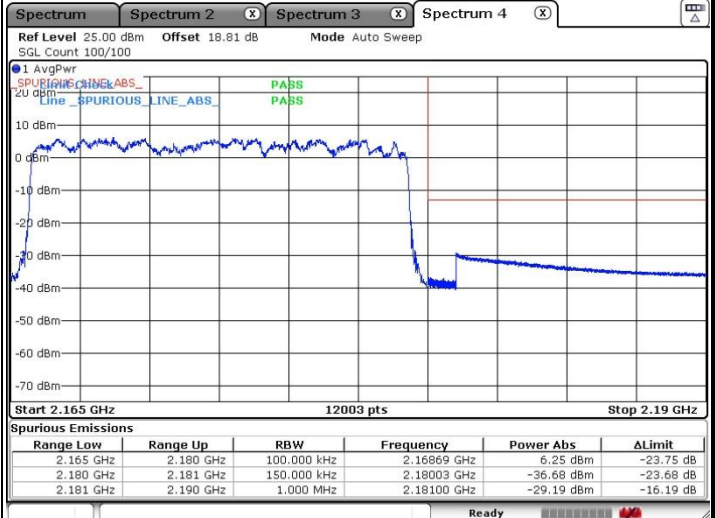
LTE Band 66 / 15MHz / 64QAM

Lowest Band Edge / Full RB



Date: 8.MAR.2023 22:08:27

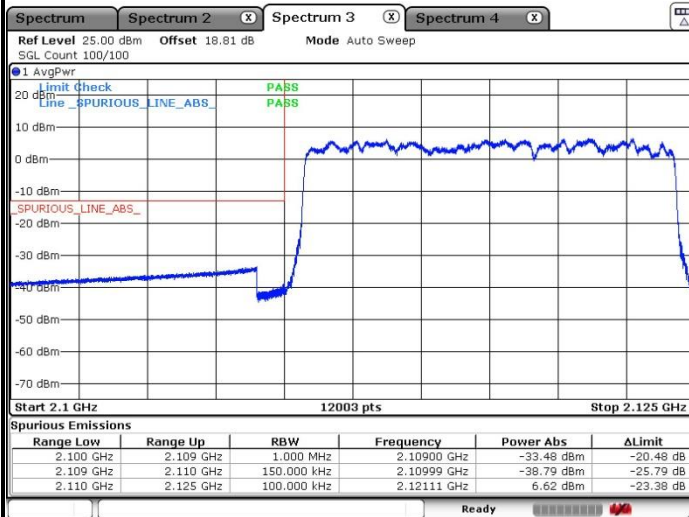
Highest Band Edge / Full RB



Date: 8.MAR.2023 22:20:04

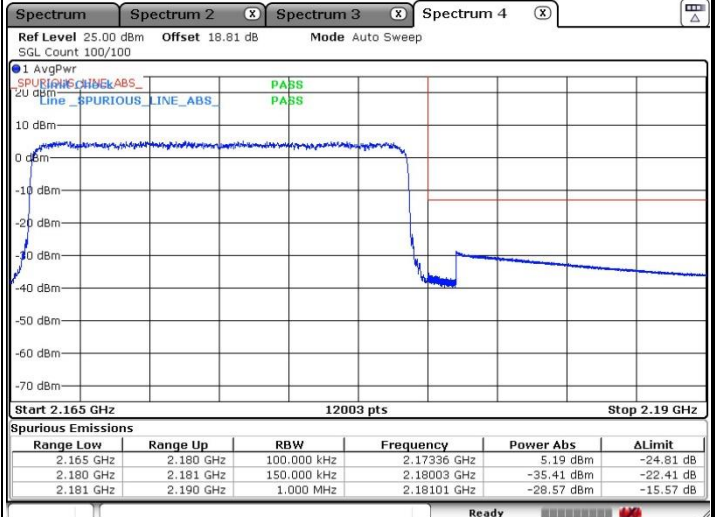
LTE Band 66 / 15MHz / 256QAM

Lowest Band Edge / Full RB



Date: 8.MAR.2023 22:09:29

Highest Band Edge / Full RB



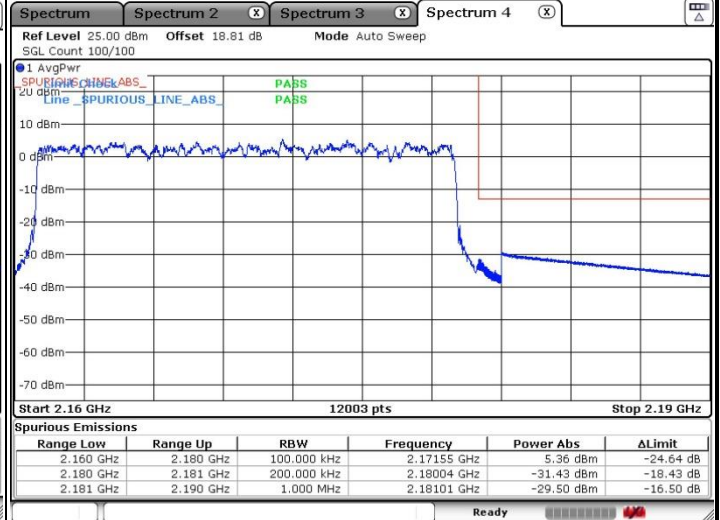
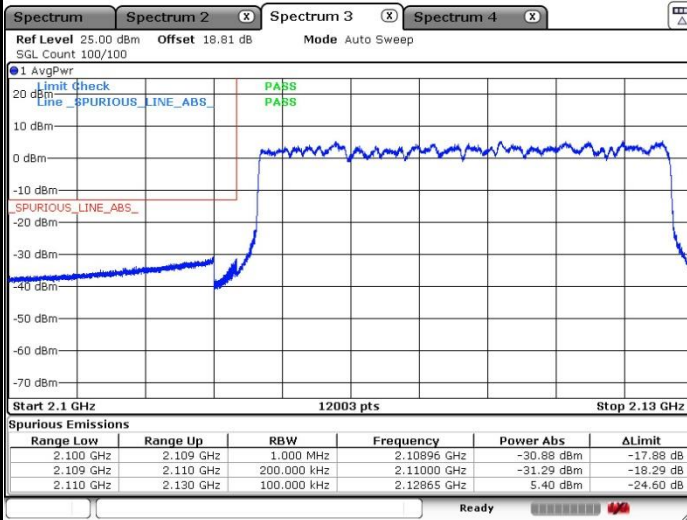
Date: 8.MAR.2023 22:22:13



LTE Band 66 / 20MHz / QPSK

Lowest Band Edge / Full RB

Highest Band Edge / Full RB



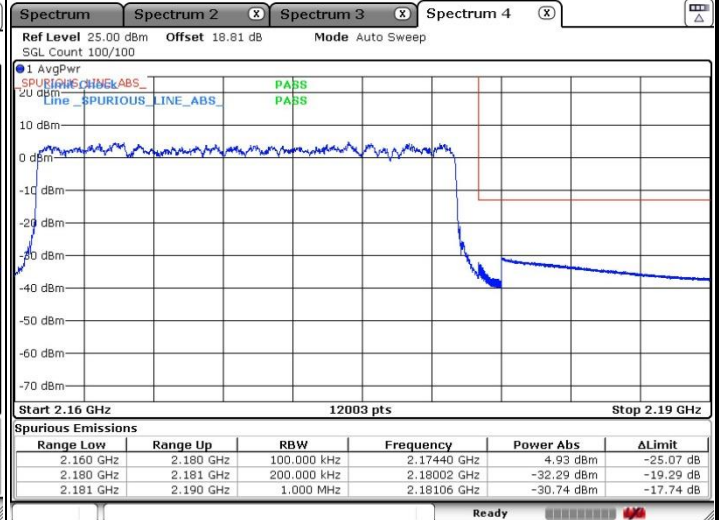
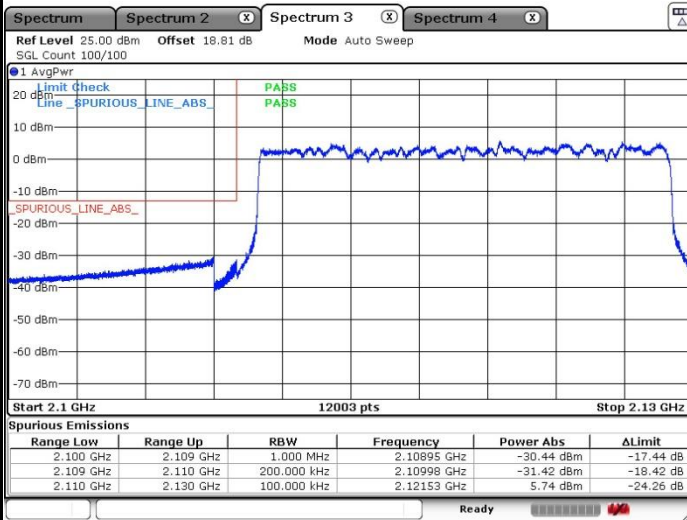
Date: 8.MAR.2023 22:54:33

Date: 8.MAR.2023 23:05:31

LTE Band 66 / 20MHz / 16QAM

Lowest Band Edge / Full RB

Highest Band Edge / Full RB



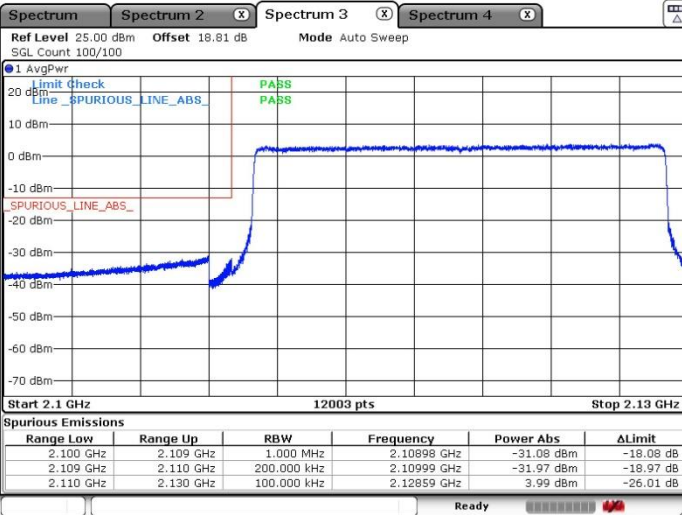
Date: 8.MAR.2023 22:55:57

Date: 8.MAR.2023 23:12:18

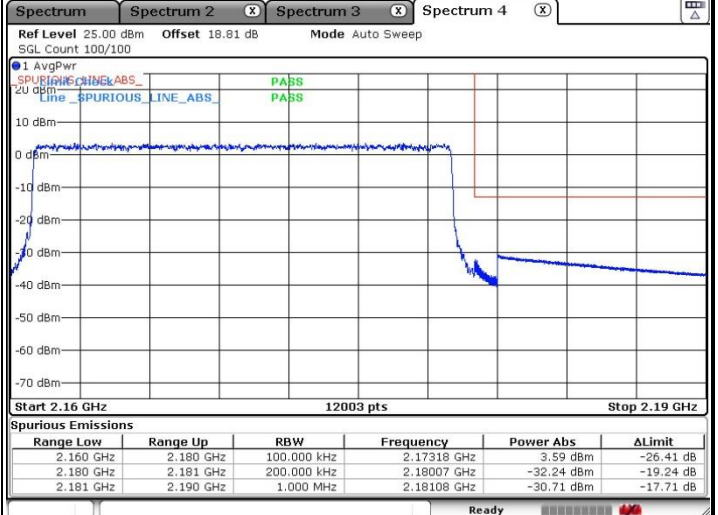


LTE Band 66 / 20MHz / 64QAM

Lowest Band Edge / Full RB

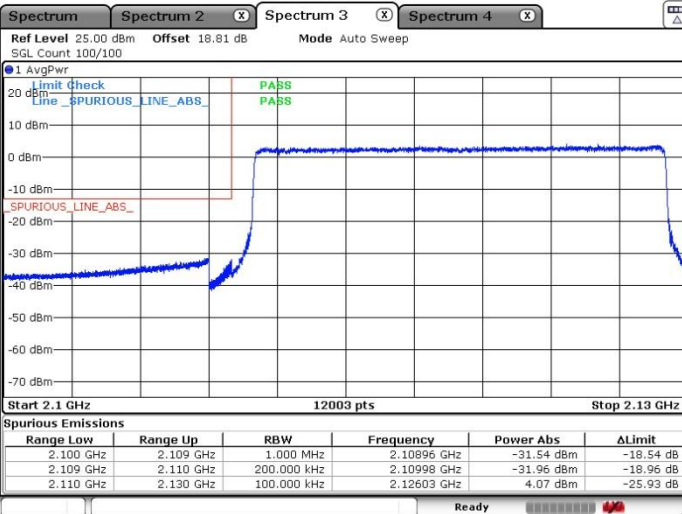


Highest Band Edge / Full RB

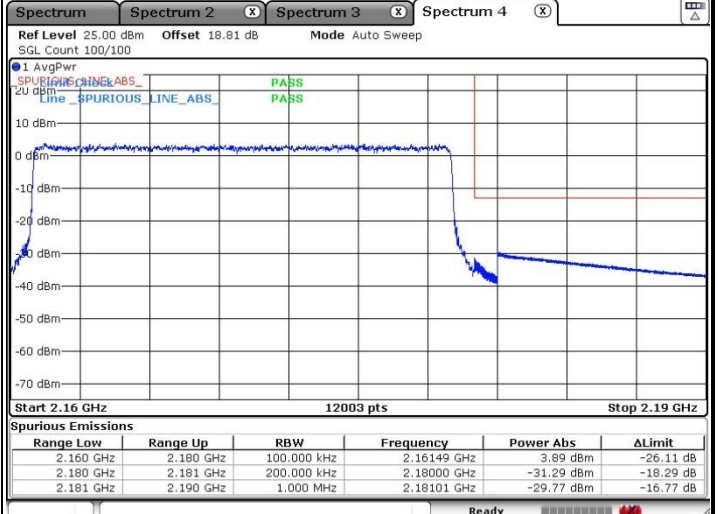


LTE Band 66 / 20MHz / 256QAM

Lowest Band Edge / Full RB

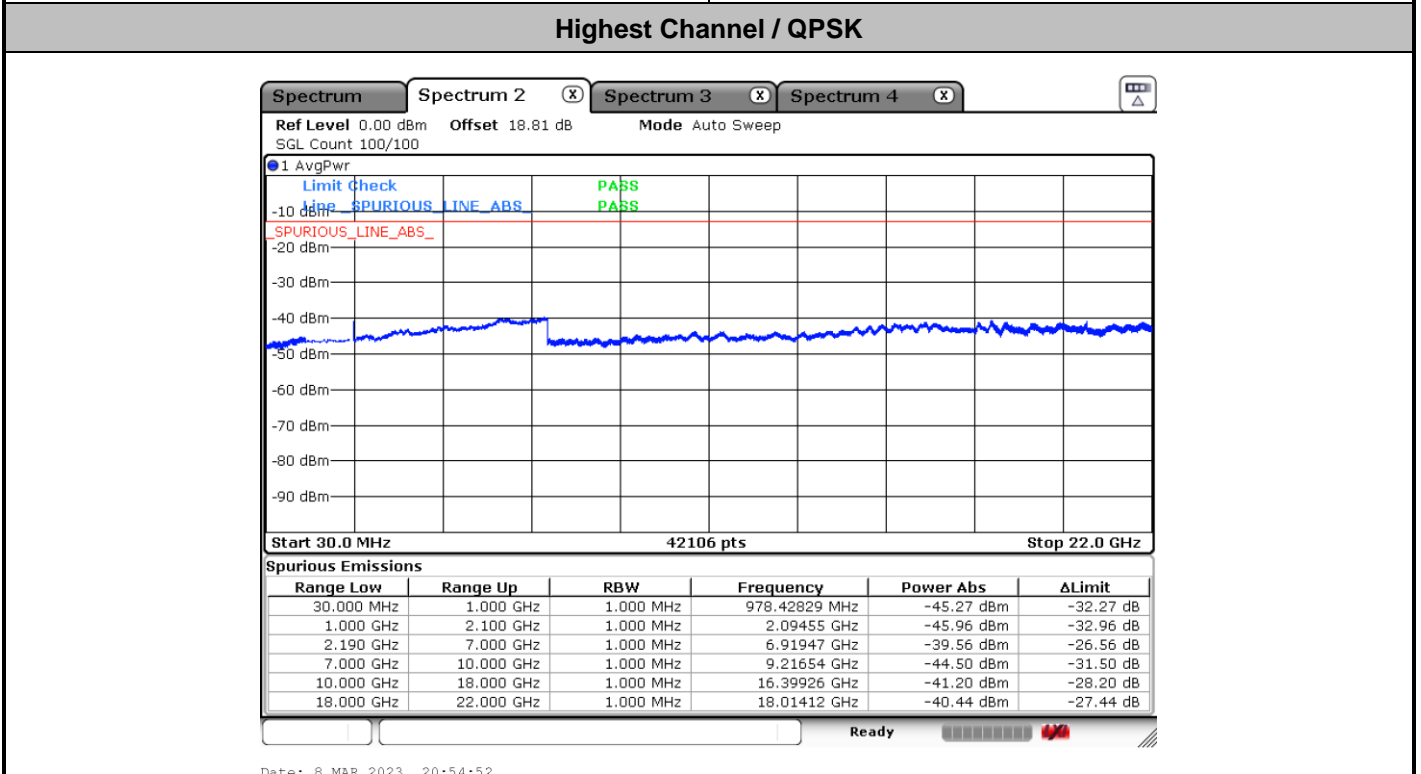
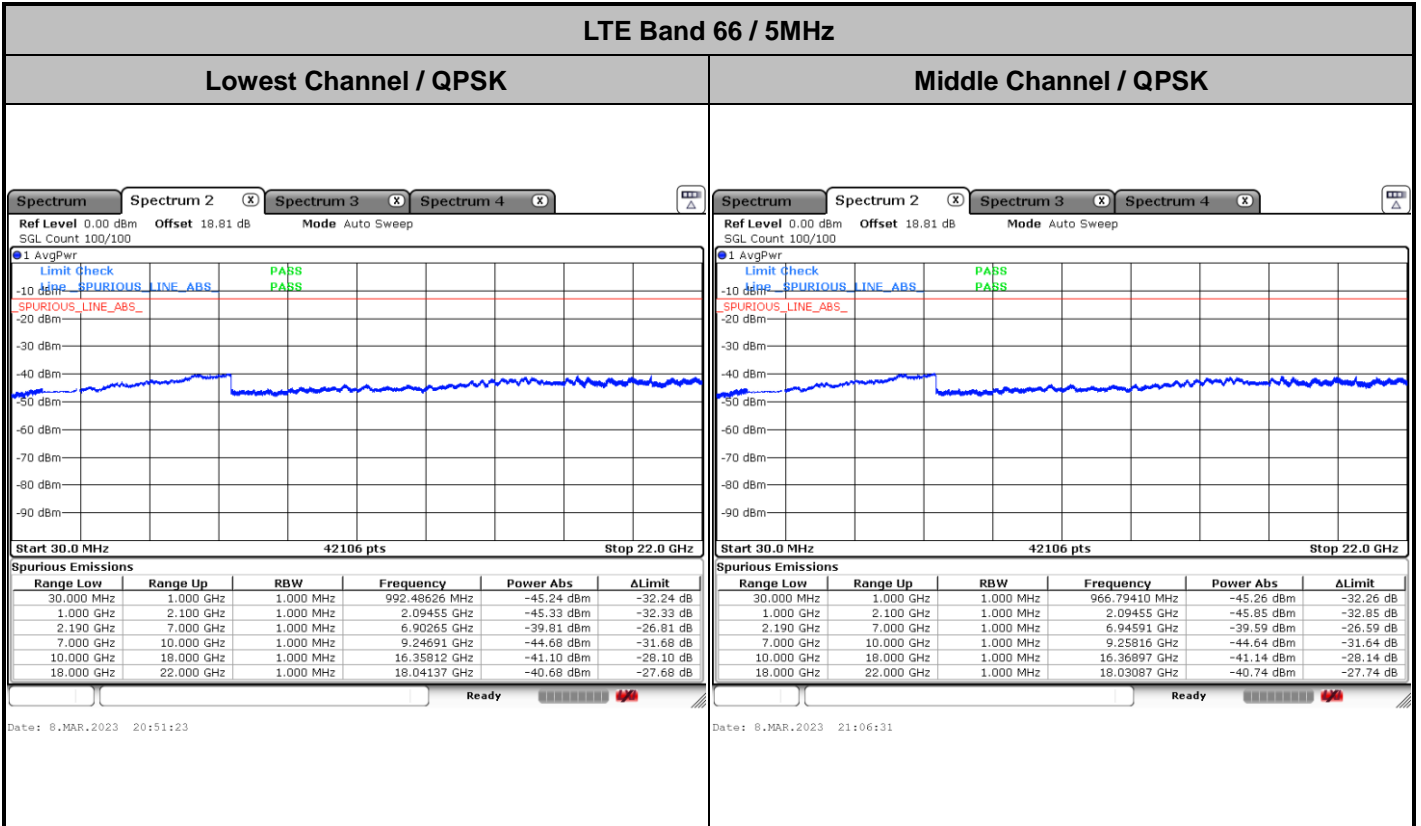


Highest Band Edge / Full RB





# Conducted Spurious Emission



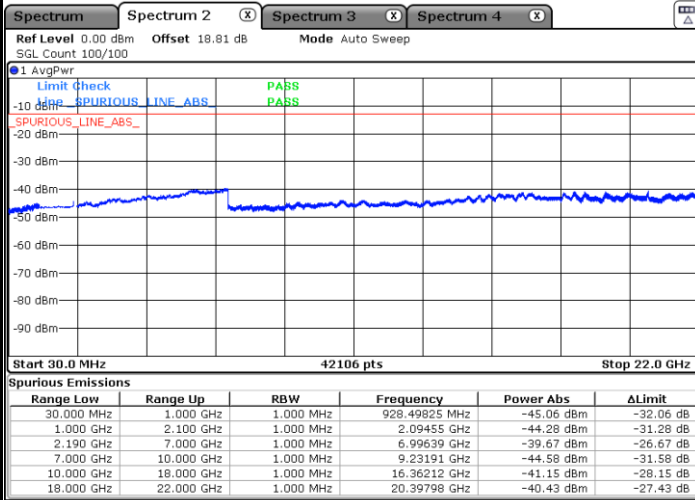




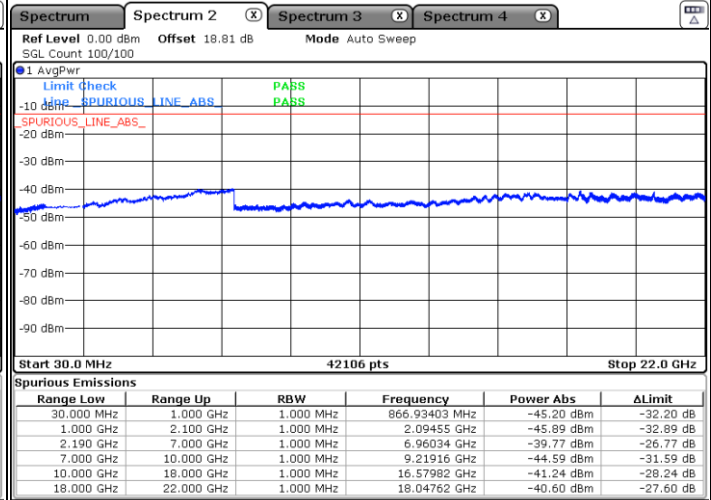
LTE Band 66 / 10MHz

Lowest Channel / QPSK

Middle Channel / QPSK

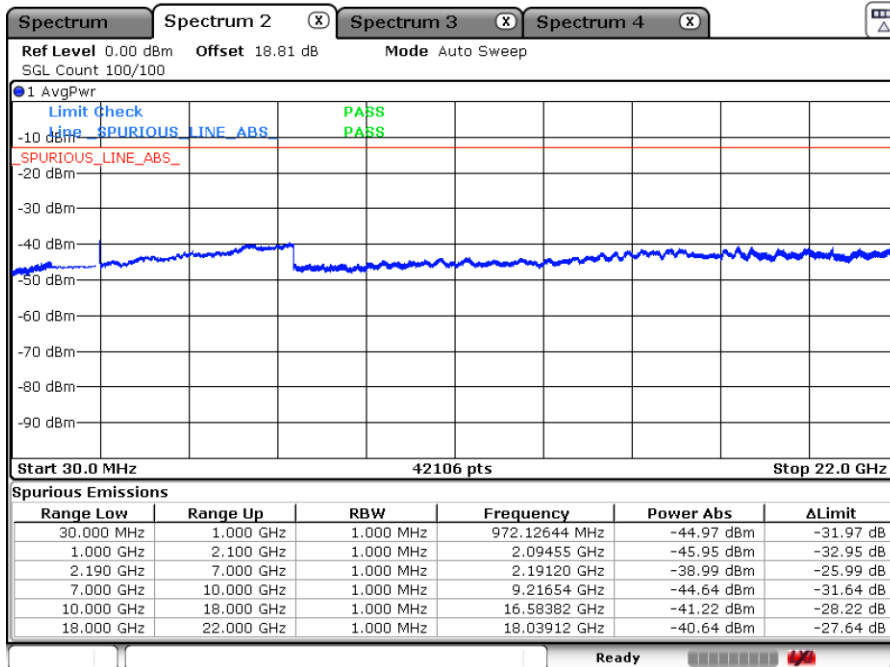


Date: 8.MAR.2023 21:16:38



Date: 8.MAR.2023 21:14:21

Highest Channel / QPSK

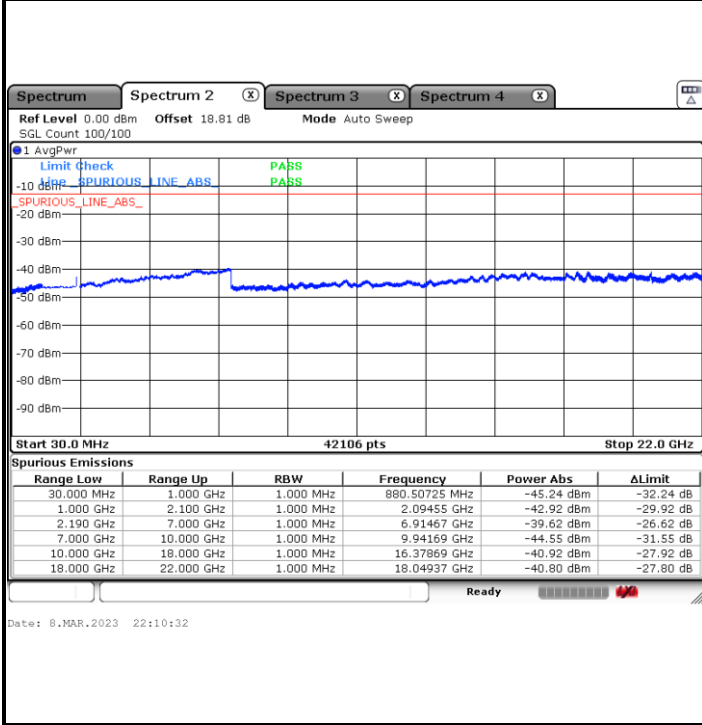


Date: 8.MAR.2023 21:53:50

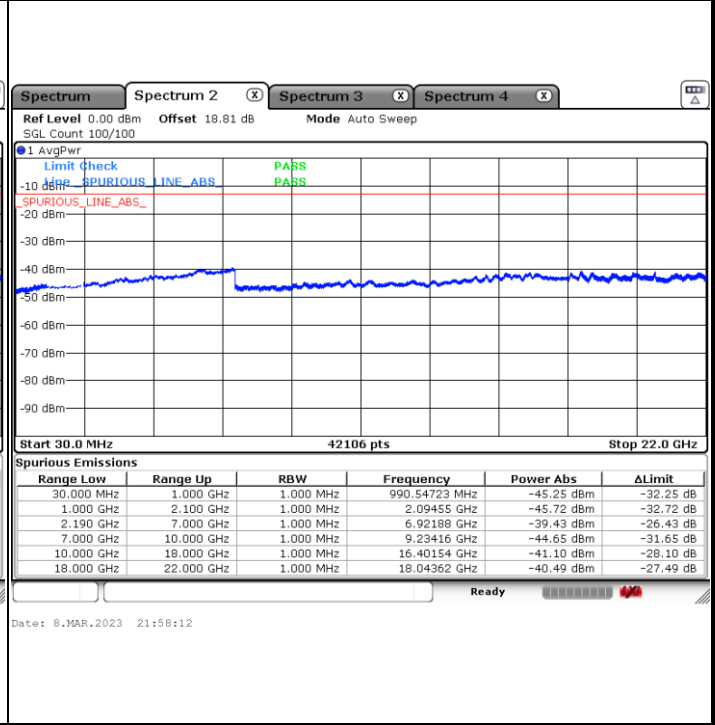


**LTE Band 66 / 15MHz**

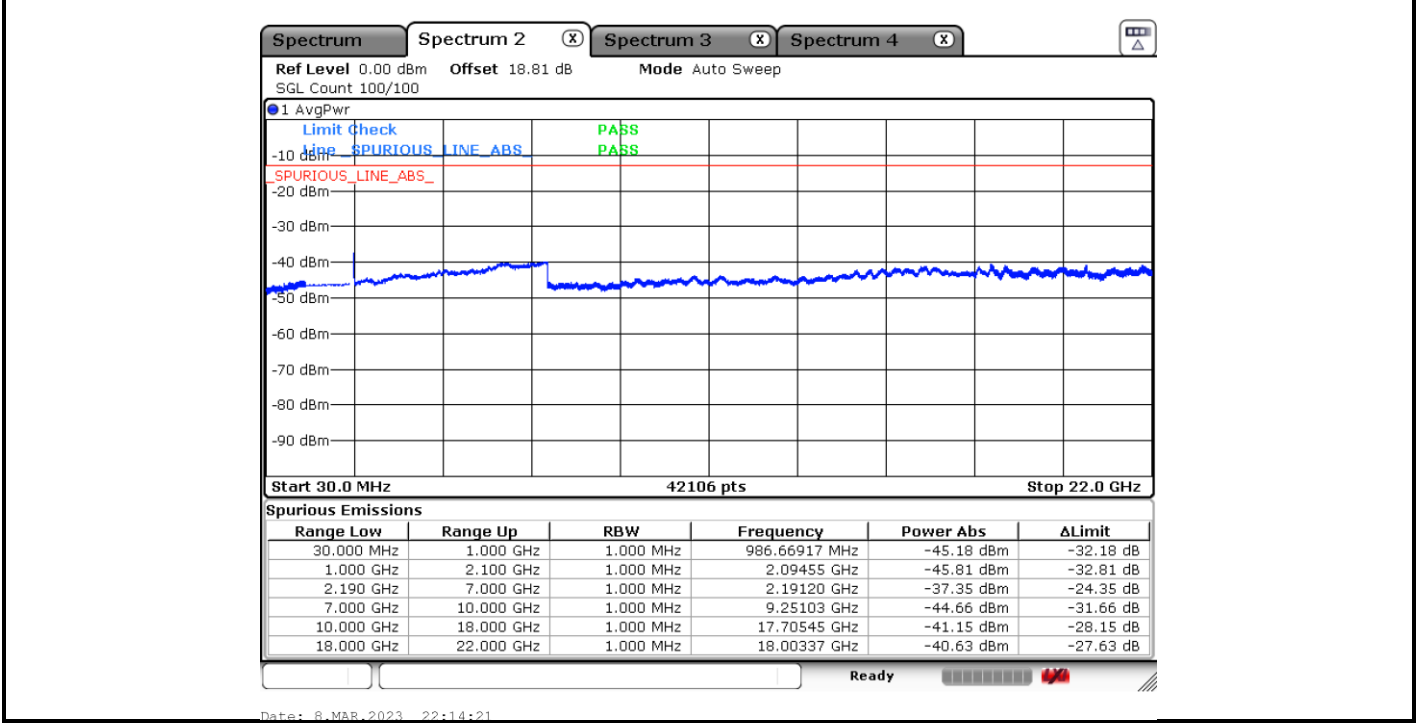
**Lowest Channel / QPSK**



**Middle Channel / QPSK**



**Highest Channel / QPSK**

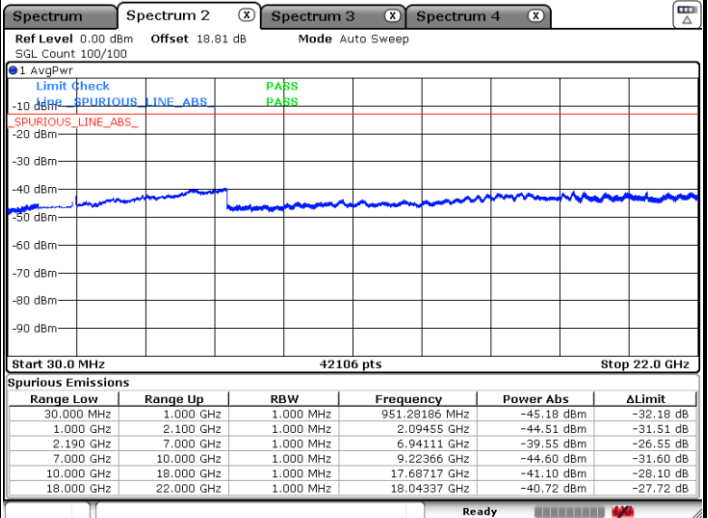
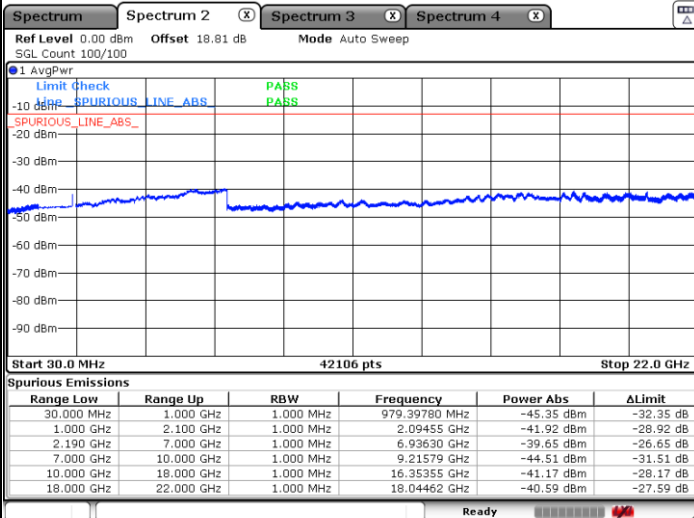




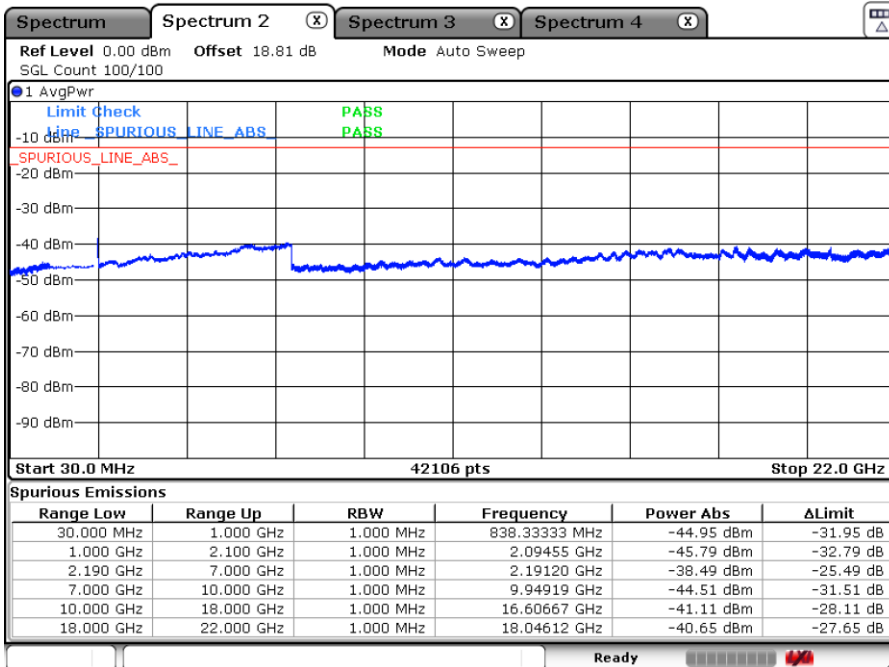
LTE Band 66 / 20MHz

Lowest Channel / QPSK

Middle Channel / QPSK



Highest Channel / QPSK





### Frequency Stability

Test Conditions		LTE Band 66 (QPSK) / Middle Channel	Limit
Temperature (°C)	Voltage (Volt)	BW 20MHz	Note 2.
		Deviation (ppm)	Result
50	Normal Voltage	0.0032	PASS
40	Normal Voltage	0.0017	
30	Normal Voltage	0.0016	
20(Ref.)	Normal Voltage	0.0000	
10	Normal Voltage	0.0005	
0	Normal Voltage	0.0018	
-10	Normal Voltage	0.0016	
-20	Normal Voltage	0.0017	
-30	Normal Voltage	0.0023	
20	Maximum Voltage	0.0028	
20	Normal Voltage	0.0022	
20	Minimum Voltage	0.0007	

**Note:**

1. Normal Voltage =12 V. ; Minimum Voltage =11.4 V. ; Maximum Voltage =12.6 V.
2. The frequency fundamental emissions stay within the authorized frequency block.