



## FCC Part 24 Test Report Part 24 Subpart E

Report Reference No.: HK2302270554-12E

FCC ID.: 2A2FCBT4101

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Date of issue: Apr. 28, 2023

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Heping, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Applicant's name : PowUnity GmbH

Address : Feldstrasse 9d Innsbruck, 6020 Austria

Test specification :

Standard : FCC CFR Title 47 Part 2, Part 24E

TRF Originator: Shenzhen HUAKE Testing Technology Co., Ltd.

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Test item description : GPS Tracker

Trade Mark : BikeTrax

Manufacturer : PowUnity GmbH

Model/Type reference: BT41-01

Series Models : T4101-03-04

Modulation Type : BPSK, QPSK

Rating : DC 3.7V from battery

Hardware version : V2.2

Software version: V2.2

Result: **PASS**

**TEST REPORT**

<b>Test Report No. :</b>	<b>HK2302270554-12E</b>	Apr. 28, 2023
		Date of issue

Equipment under Test : GPS Tracker

Model /Type : BT41-01

Series Models : T4101-03-04

**Applicant** : **PowUnity GmbH**

Address : Feldstrasse 9d Innsbruck, 6020 Austria

**Manufacturer** : **PowUnity GmbH**

Address : Feldstrasse 9d Innsbruck, 6020 Austria

<b>Test Result:</b>	<b>PASS</b>
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The test report merely corresponds to the test sample.  
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.



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**\*\* Modified History \*\***

Revision	Description	Issued Data	Remark
Revision 1.0	Initial Test Report Release	Apr. 28, 2023	Jason Zhou





## **1 Test Standards**

The tests were performed according to following standards:

[FCC Part 24](#):PUBLIC MOBILE SERVICES.

[TIA/EIA 603 D June 2010](#):Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.

[47 CFR FCC Part 15 Subpart B](#): Unintentional Radiators.

[FCC Part 2](#): FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS.

[KDB971168 D01:v02r02](#) MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS.

[ANSI C63.4:2014](#):Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.



## 2 Summary

### 2.1 General Remarks

Date of receipt of test sample	:	Feb. 27, 2023
Testing commenced on	:	Feb. 27, 2023
Testing concluded on	:	Apr. 28, 2023

### 2.2 Product Description

The PowUnity GmbH's Model:BT41-01 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

Name of EUT:	GPS Tracker
Model/Type reference:	BT41-01
Series Models:	T4101-03-04
Power supply:	DC 3.7V from battery
Modulation Type:	BPSK, QPSK
Antenna Type:	Internal Antenna
Antenna Gain:	1dBi
Operation Frequency Band:	LTE Band 2
Operation frequency:	LTE Band 2: 1850~1910 MHz(TX), 1930~1990 MHz(TX)
LTE Release:	R8
Extreme temp. Tolerance:	-30°C to +70°C
Extreme vol. Limits:	3.15VDC to 4.26VDC (nominal: 3.7VDC)

### 2.3 Equipment Under Test

#### Power supply system utilised

Power supply voltage	:	<input type="radio"/> 120V/ 60 Hz	<input type="radio"/> 115V/60Hz
		<input type="radio"/> 12 V DC	<input type="radio"/> 24 V DC
		<input checked="" type="radio"/> Other (specified in blank below)	

DC 3.7V from battery

### 2.4 Short Description of the Equipment Under Test (EUT)

#### 2.4.1 General Description

This is a GPS Tracker.

For more details, refer to the user's manual of the EUT.



## 2.5 Test Frequency List

TX Channel Bandwidth	Frequency (MHz)	channel
3.75KHz	1850.1	18601
	1877.6	18876
	1909.9	19199
15KHz	1850.1	18601
	1877.6	18876
	1909.9	19199

## 2.6 Normal Accessory Setting

Fully charged battery was used during the test.

## 2.7 EUT Configuration

The following peripheral devices and interface cables were connected during the measurement:

- - supplied by the manufacturer
- - supplied by the lab

○	Power Cable	Length (m) :	/
		Shield :	/
		Detachable :	/
○	Multimeter	Manufacturer :	/
		Model No. :	/

## 2.8 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2A2FCBT4101** filing to comply with FCC Part 24, Rules.

## 2.9 Modifications

No modifications were implemented to meet testing criteria.



## 2.10 General Test Conditions/Configurations

### 2.10.1 Test Environment

Environment Parameter	Selected Values During Tests	
Relative Humidity	Ambient	
Temperature	TN	Ambient
Voltage	VL	3.15V
	VN	3.70V
	VH	4.26V

NOTE: VL=lower extreme test voltage VN=nominal voltage  
VH=upper extreme test voltage TN=normal temperature





### 3 Test Environment

#### 3.1 Information of the Test Laboratory

Shenzhen HUAKE Testing Technology Co., Ltd.  
Add.: 1-2/F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping,  
Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Testing Laboratory Authorization:

A2LA Accreditation Code is 4781.01.  
FCC Designation Number is CN1229.  
Canada IC CAB identifier is CN0045.  
CNAS Registration Number is L9589.

#### 3.2 Environmental Conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

#### 3.3 Test Description

PCSBand (1850-1915MHz pairedwith 1930-1995MHz)

Test Item	FCCRuleNo.	Requirements	Verdict
Effective(Isotropic)Radiated Output Power	Part§2.1046, Part§24.232	EIRP ≤ 2W	Pass
Peak-Average Ratio	Part§2.1046, Part§24.232	FCC:Limit≤13dB	Pass
Bandwidth	Part§2.1049 RSS-133	OBW: Nolimit. EBW: Nolimit.	Pass
Band Edges Compliance	Part§2.1051, Part§24.238	≤ -13dBm/1%*EBW, In1MHz bands immediately outside and adjacent to The frequency block.	Pass
Spurious Emission at Antenna Terminals	Part§2.1051, Part§24.238	≤-13dBm/1MHz, from 9kHz to10th harmonics but outside authorized Operating frequency ranges.	Pass
Field Strength of Spurious Radiation	Part§2.1053, Part§24.238	≤ -13dBm/1MHz.	Pass
Frequency Stability	Part§2.1055, Part§24.235	FCC:within authorized frequency block.	Pass

NOTE 1:For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

Remark:

1. The measurement uncertainty is not included in the test result.



### 3.4 Equipments Used During the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	ENV216	R&S	HKE-059	2023/02/17	2024/02/16
LISN	R&S	ENV216	HKE-002	2023/02/17	2024/02/16
Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	2023/02/17	2024/02/16
Receiver	R&S	ESR-7	HKE-010	2023/02/17	2024/02/16
Spectrum analyzer	Agilent	N9020A	HKE-048	2023/02/17	2024/02/16
RF automatic control unit	Tonscend	JS0806-2	HKE-060	2023/02/17	2024/02/16
Horn antenna	Schwarzbeck	9120D	HKE-013	2023/02/17	2024/02/16
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	2023/02/17	2024/02/16
Preamplifier	EMCI	EMC051845SE	HKE-015	2023/02/17	2024/02/16
Preamplifier	Agilent	83051A	HKE-016	2023/02/17	2024/02/16
Temperature and humidity meter	Boyang	HTC-1	HKE-075	2023/02/17	2024/02/16
High pass filter unit	Tonscend	JS0806-F	HKE-055	2023/02/17	2024/02/16
RF cable	Times	1-40G	HKE-034	2023/02/17	2024/02/16
Power meter	Agilent	E4419B	HKE-085	2023/02/17	2024/02/16
Power Sensor	Agilent	E9300A	HKE-086	2023/02/17	2024/02/16
Wireless Communication Test Set	R&S	CMU200	HKE-026	2023/02/17	2024/02/16
High gain antenna	Schwarzbeck	LB-180400KF	HKE-054	2023/02/17	2024/02/16
Horn antenna	Schwarzbeck	9120D	HKE-135	2023/02/17	2024/02/16
High gain antenna	Schwarzbeck	LB-180400KF	HKE-128	2023/02/17	2024/02/16
Broadband antenna	Schwarzbeck	VULB 9163	HKE-087	2023/02/17	2024/02/16
Signal generator	Agilent	E4433B	HKE-120	2023/02/17	2024/02/16
Signal generator	Agilent	E4421B	HKE-121	2023/02/17	2024/02/16



## 4 Test Conditions and Results

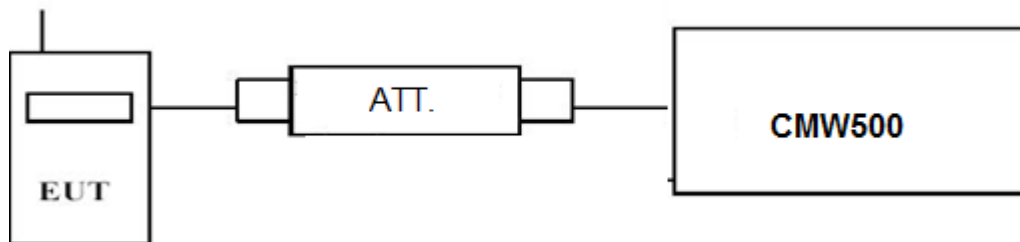
### 4.1 Output Power

#### 4.1.1 Conducted Output Power

##### TEST APPLICABLE

During the process of testing, the EUT was controlled via R&S Digital Radio Communication tester (CMW500) to ensure max power transmission and proper modulation. This result contains output power and EIRP measurements for the EUT. In all cases, output power is within the specified limits.

##### TEST CONFIGURATION



##### TEST PROCEDURE

###### **Conducted Power Measurement:**

- Place the EUT on a bench and set it in transmitting mode.
- Connect a low loss RF cable from the antenna port to a CMW500 by an Att.
- EUT Communicate with CMW500 then selects a channel for testing.
- Add a correction factor to the display CMW500, and then test.

##### TEST RESULTS

Remark:

- We measured all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 2;

LTE FDD Band 2				
Modulation	Sub-carrier spacing (KHz)	Tones	Frequency (MHz)	Average Power [dBm]
BPSK	3.75	1@0	1850.1	22.05
		1@47	1850.1	22.00
		1@0	1877.6	23.38
		1@47	1877.6	23.38
		1@0	1909.9	22.13
		1@47	1909.9	22.10
	15	1@0	1850.1	22.21
		1@11	1850.1	23.25
		12@0	1850.1	22.78
		1@0	1877.6	23.03
		1@11	1877.6	23.06
		12@0	1877.6	23.13
		1@0	1909.9	22.37
		1@11	1909.9	23.22
		12@0	1909.9	22.70

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QPSK	3.75	1@0	1850.1	22.04
		1@47	1850.1	22.99
		1@0	1877.6	23.45
		1@47	1877.6	23.31
		1@0	1909.9	22.14
		1@47	1909.9	23.15
	15	1@0	1850.1	23.10
		1@11	1850.1	23.81
		12@0	1850.1	22.93
		1@0	1877.6	23.21
		1@11	1877.6	23.04
		12@0	1877.6	23.58
		1@0	1909.9	22.27
		1@11	1909.9	22.42
		12@0	1909.9	22.76





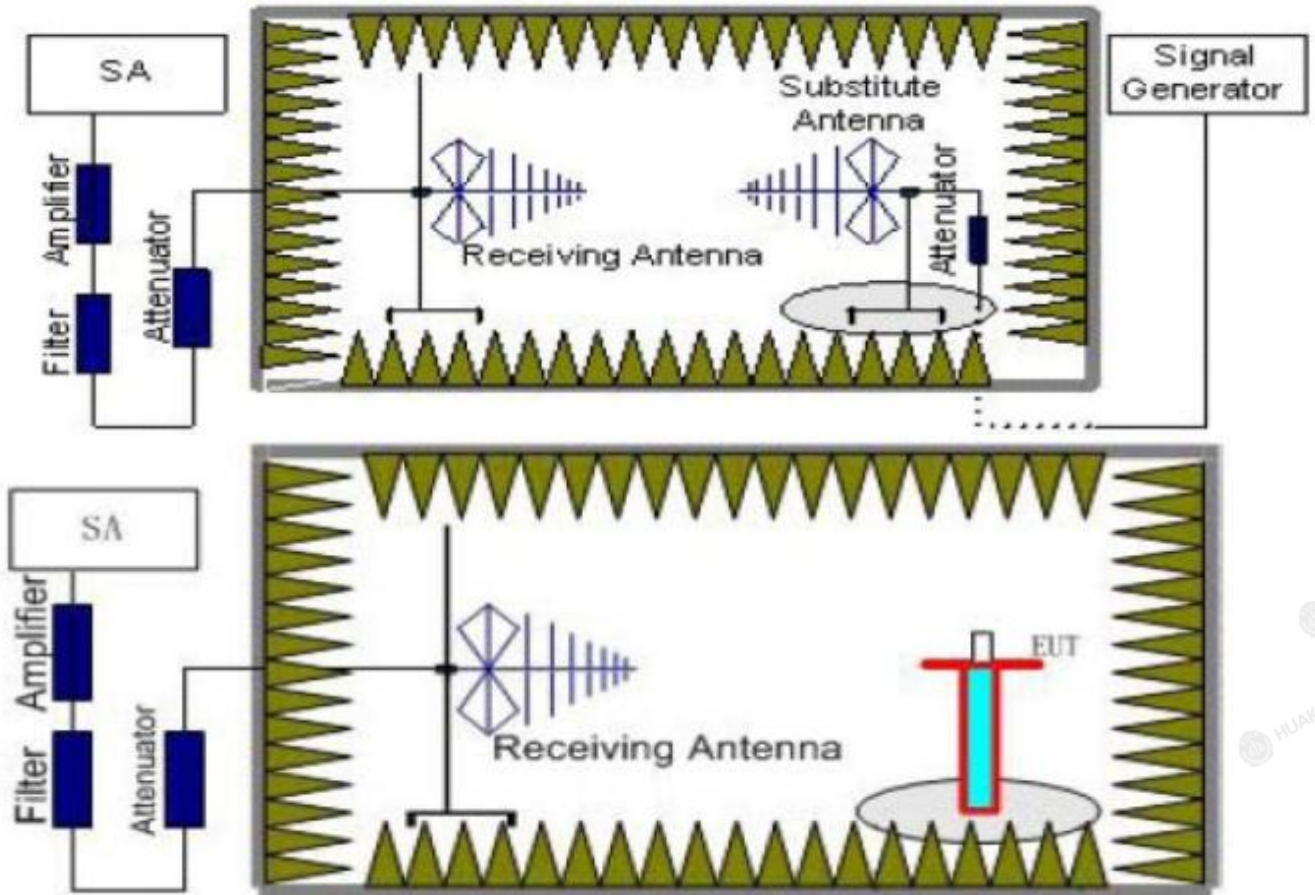
### 4.1.2. Radiated Output Power

#### LIMIT

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

Rule Part 24.232(b) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p.

#### TEST CONFIGURATION



#### TEST PROCEDURE

1. EUT was placed on a 1.50 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 1.50m. 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. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
3. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz, VBW=3MHz, And the maximum value of the receiver should be recorded as (P<sub>r</sub>).
4. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna.



- A power ( $P_{Mea}$ ) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach 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.
- A amplifier should be connected to the Signal Source output port. And the cable should be connect 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:  
 $Power(EIRP) = P_{Mea} - P_{cl} + G_a$   
We used SMF100A microwave signal generator which signal level can up to 33dBm, so we not used power Amplifier for substitution test; The measurement results are amend as described below:  
 $Power(EIRP) = P_{Mea} - P_{cl} + G_a$
- This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
- ERP can be calculated from EIRP by subtracting the gain of the dipole,  $ERP = EIRP - 2.15\text{dBi}$ .

## TEST RESULTS

### Radiated Measurement:

#### Remark:

- We measured all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 2; recorded worst case for each Channel Bandwidth of LTE FDD Band 2.
- $EIRP = P_{Mea}(\text{dBm}) - P_{cl}(\text{dB}) + P_{Ag}(\text{dB}) + G_a(\text{dBi})$
- We measured both Horizontal and Vertical direction, recorded worst case direction.

#### LTE FDD Band 2-3.75KHz-BPSK

Frequency (MHz)	$P_{Mea}$ (dBm)	$P_{cl}$ (dB)	$G_a$ Antenna Gain(dB)	$P_{Ag}$ (dB)	Burst Average EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1850.1	-12.44	3.41	10.24	33.6	27.99	33.01	5.02	V
1877.6	-13.26	3.49	10.24	33.6	27.09	33.01	5.92	V
1909.9	-14.44	3.55	10.23	33.6	25.84	33.01	7.17	V

#### LTE FDD Band 2-15KHz-BPSK

Frequency (MHz)	$P_{Mea}$ (dBm)	$P_{cl}$ (dB)	$G_a$ Antenna Gain(dB)	$P_{Ag}$ (dB)	Burst Average EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1850.1	-11.81	3.41	10.24	33.6	28.62	33.01	4.39	V
1877.6	-13.66	3.49	10.24	33.6	26.69	33.01	6.32	V
1909.9	-14.14	3.55	10.23	33.6	26.14	33.01	6.87	V

#### LTE FDD Band 2-3.75KHz-QPSK

Frequency (MHz)	$P_{Mea}$ (dBm)	$P_{cl}$ (dB)	$G_a$ Antenna Gain(dB)	$P_{Ag}$ (dB)	Burst Average EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1850.1	-16.91	3.41	10.24	33.6	23.52	33.01	9.49	V
1877.6	-15.81	3.49	10.24	33.6	24.54	33.01	8.47	V
1909.9	-16.92	3.55	10.23	33.6	23.36	33.01	9.65	V

*LTE FDD Band 2-15KHz-QPSK*

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	G <sub>a</sub> Antenna Gain(dB)	P <sub>Aq</sub> (dB)	Burst Average EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1850.1	-15.28	3.41	10.24	33.6	25.15	33.01	7.86	V
1877.6	-14.6	3.49	10.24	33.6	25.75	33.01	7.26	V
1909.9	-15.14	3.55	10.23	33.6	25.14	33.01	7.87	V



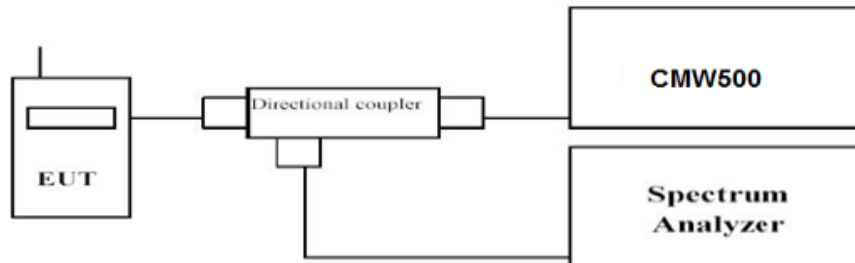


## 4.2 Peak-to-Average Ratio (PAR)

### LIMIT

The Peak-to-Average Ratio (PAR) of the transmission may not exceed 13 dB.

### TEST CONFIGURATION



### TEST PROCEDURE

1. Refer to instrument's analyzer instruction manual for details on how to use the power statistics/CCDF function;
2. Set resolution/measurement bandwidth  $\geq$  signal's occupied bandwidth;
3. Set the number of counts to a value that stabilizes the measured CCDF curve;
4. Set the measurement interval as follows:
  - 1). for continuous transmissions, set to 1 ms;
  - 2). for burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize and set the measurement interval to a time that is less than or equal to the burst duration.
5. Record the maximum PAPR level associated with a probability of 0.1%.

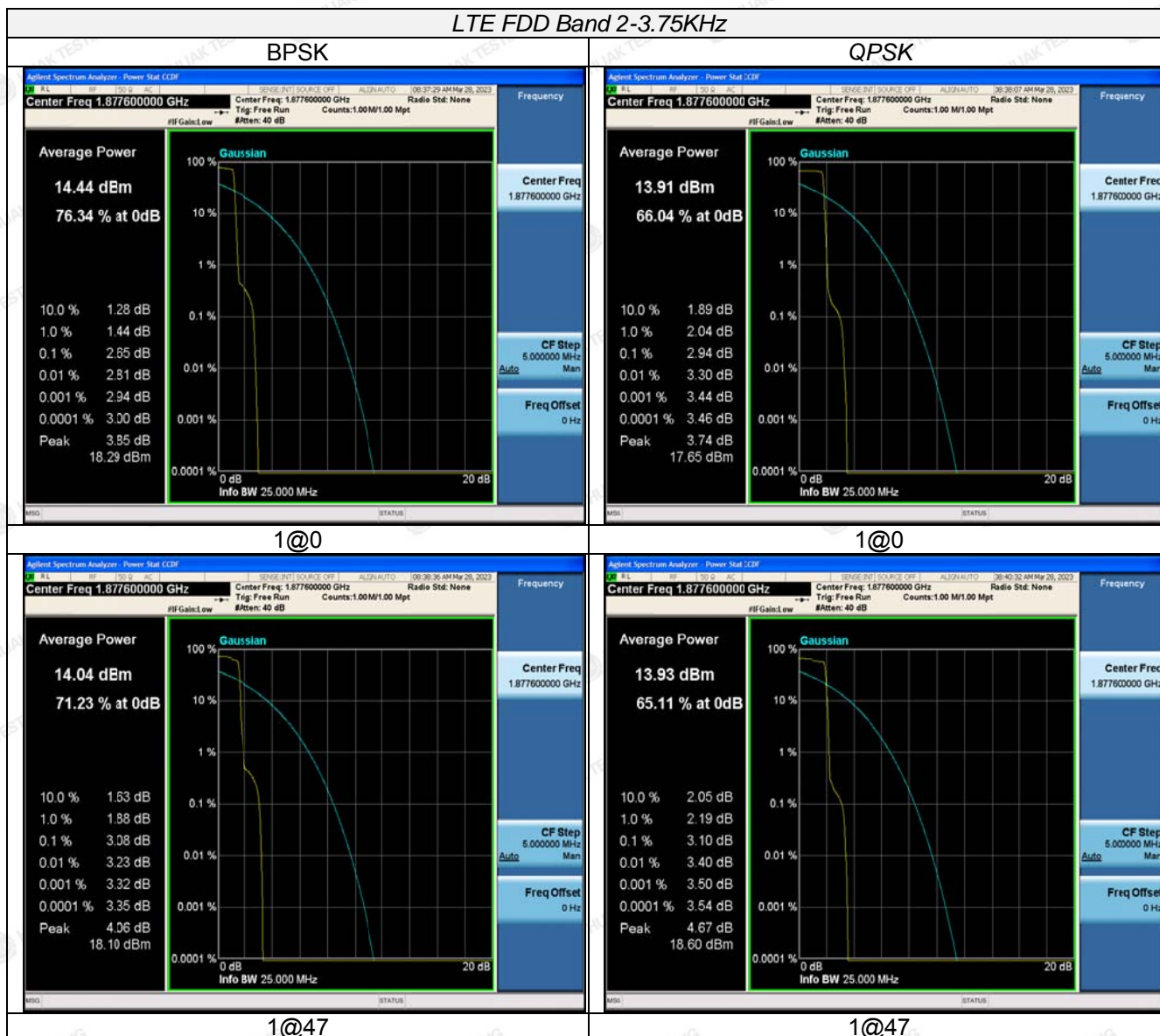
### TEST RESULTS

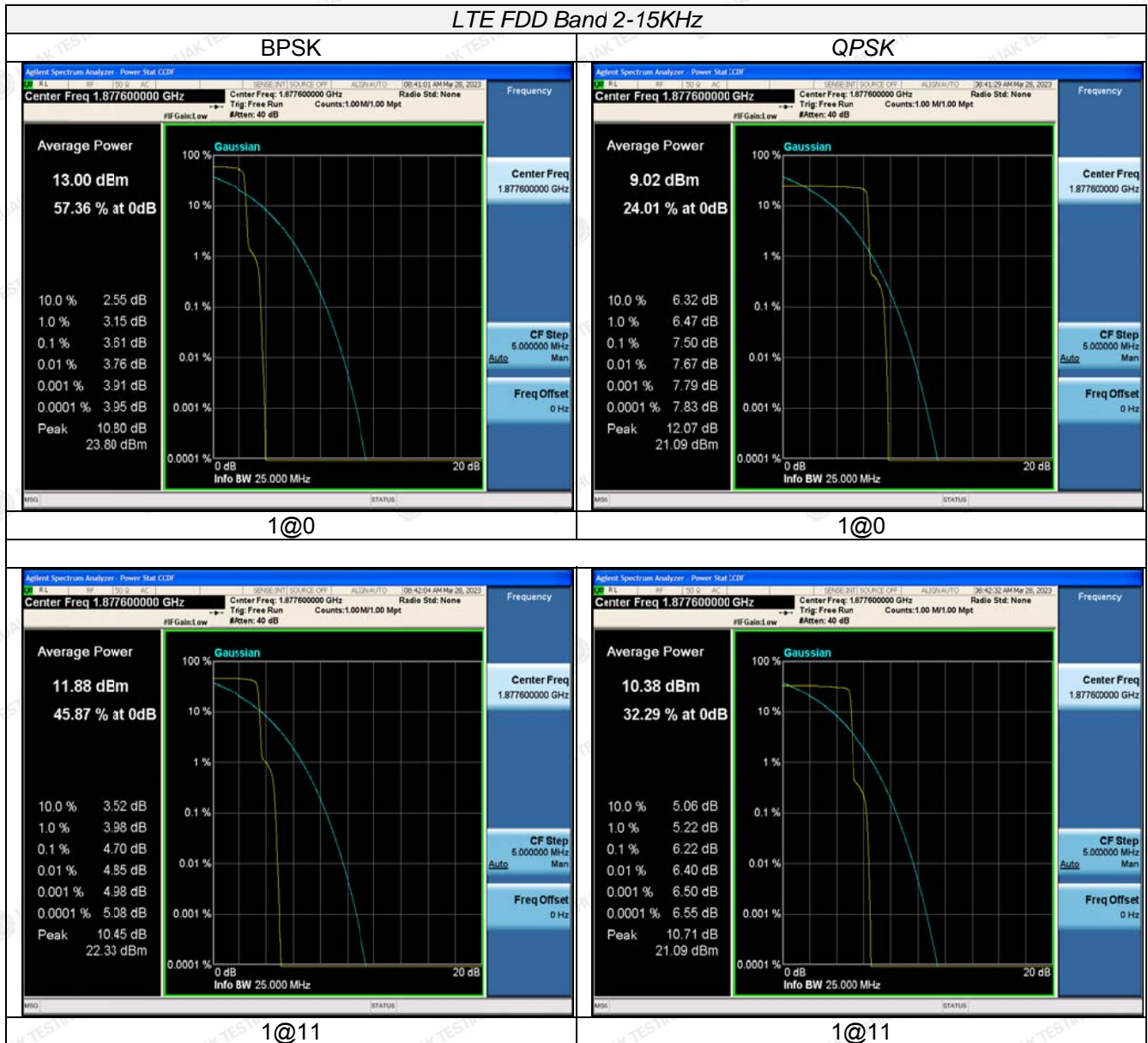
Remark:

1. We measured all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 2; recorded worst case for each Channel Bandwidth of LTE FDD Band 2.
- 2.

LTE FDD Band 2				
Frequency (MHz)	Sub-carrier spacing (KHz)	Tones	Modulation PAPR (dB)	
			BPSK	QPSK
1877.6	3.75	1@0	2.65	2.94
		1@47	3.08	3.10
1877.6	15	1@0	3.61	7.50
		1@11	4.70	6.22







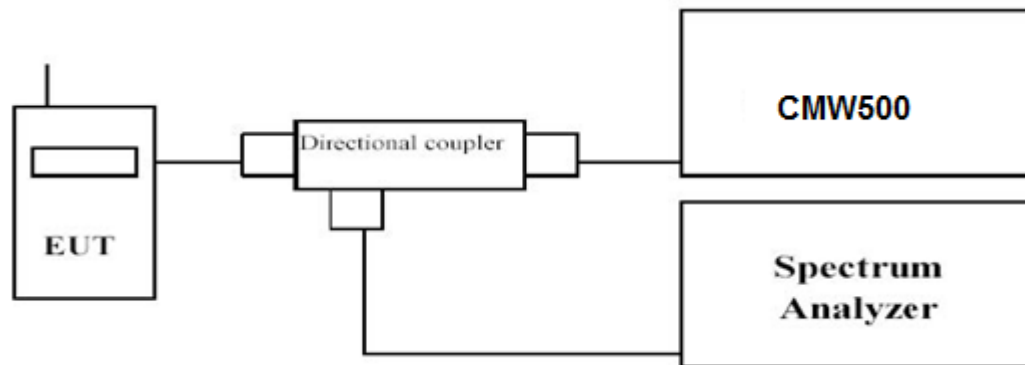


## 4.3 Occupied Bandwidth and Emission Bandwidth

### LIMIT

N/A

### TEST CONFIGURATION



### TEST PROCEDURE

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer. The occupied bandwidth was measured with the spectrum analyzer at low, middle and high channel in each band. The -26dBc Emission bandwidth was also measured and recorded.

Set RBW was set to about 1% of emission BW, VBW  $\geq 3$  times RBW.

-26dBc display line was placed on the screen (or 99% bandwidth), the occupied bandwidth is the delta frequency between the two points where the display line intersects the signal trace.

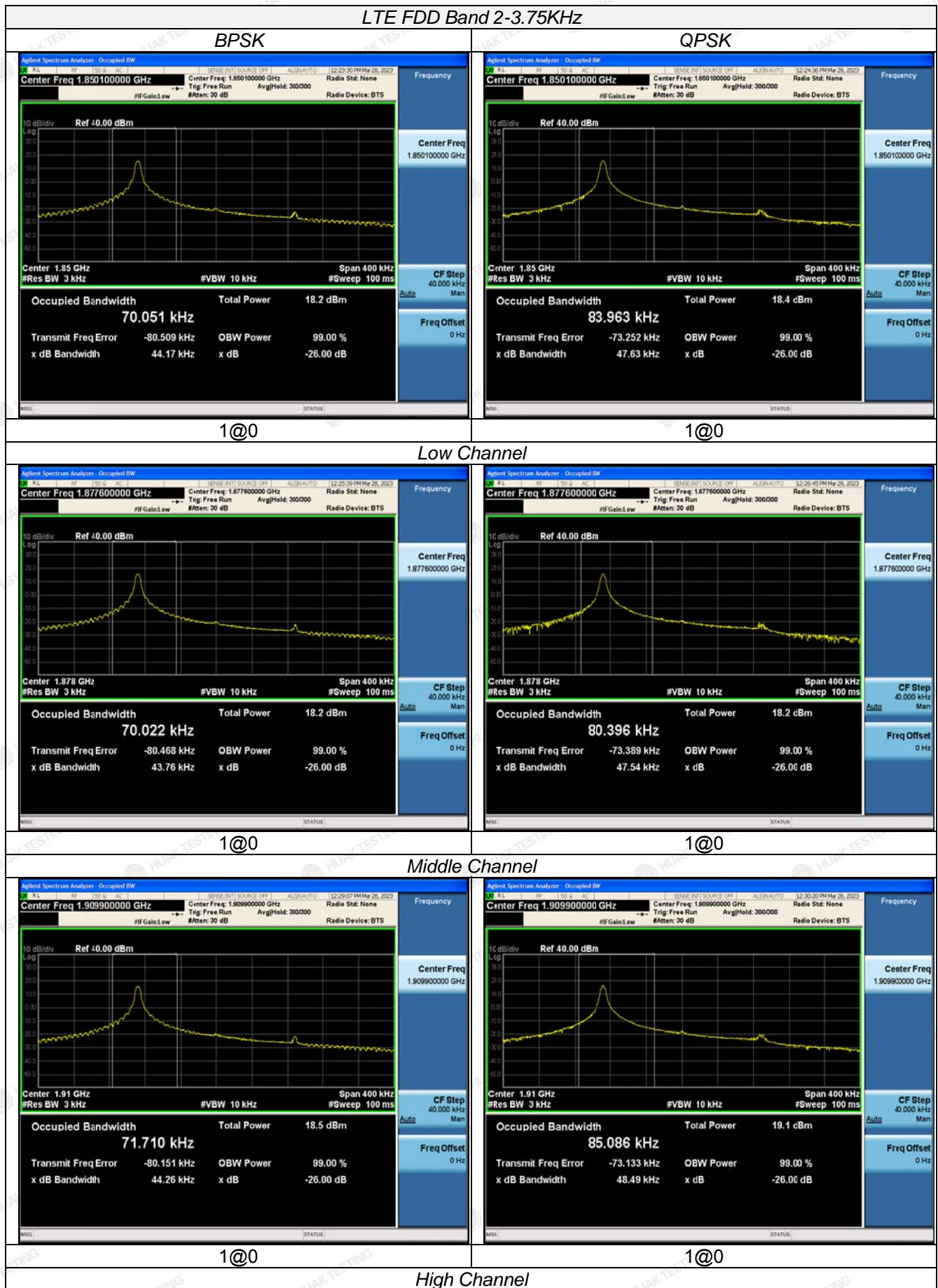
### TEST RESULTS

Remark:

1. We were tested all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 2; recorded worst case for each Channel Bandwidth of LTE FDD Band 2.

LTE FDD Band 2						
Sub-carrier spacing (KHz)	Tones	Frequency (MHz)	-26dBc Emission bandwidth (KHz)		99% Occupied bandwidth (KHz)	
			BPSK	QPSK	BPSK	QPSK
3.75	1@0	1850.1	44.17	47.63	70.051	83.963
	1@0	1877.6	43.76	47.54	70.022	80.396
	1@0	1909.9	44.26	48.49	71.710	85.086
15	1@0	1850.1	105.0	115.1	125.97	121.83
	1@0	1877.6	106.1	116.0	127.68	120.89
	1@0	1909.9	113.7	116.9	122.14	122.36
	12@0	1850.1	249.2	222.2	185.23	194.37
	12@0	1877.6	249.0	249.0	185.62	185.97
	12@0	1909.9	252.1	249.1	189.79	186.00



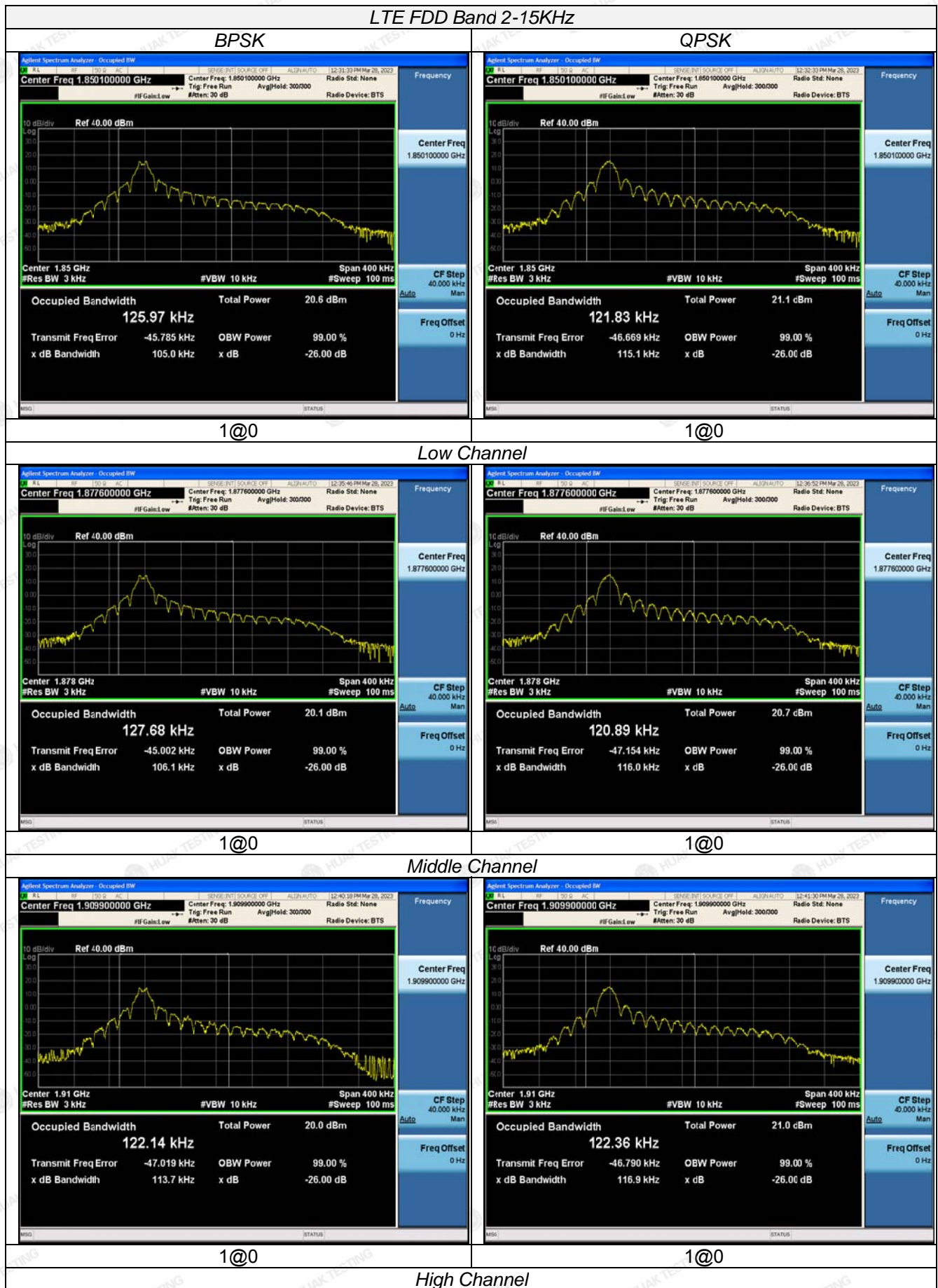


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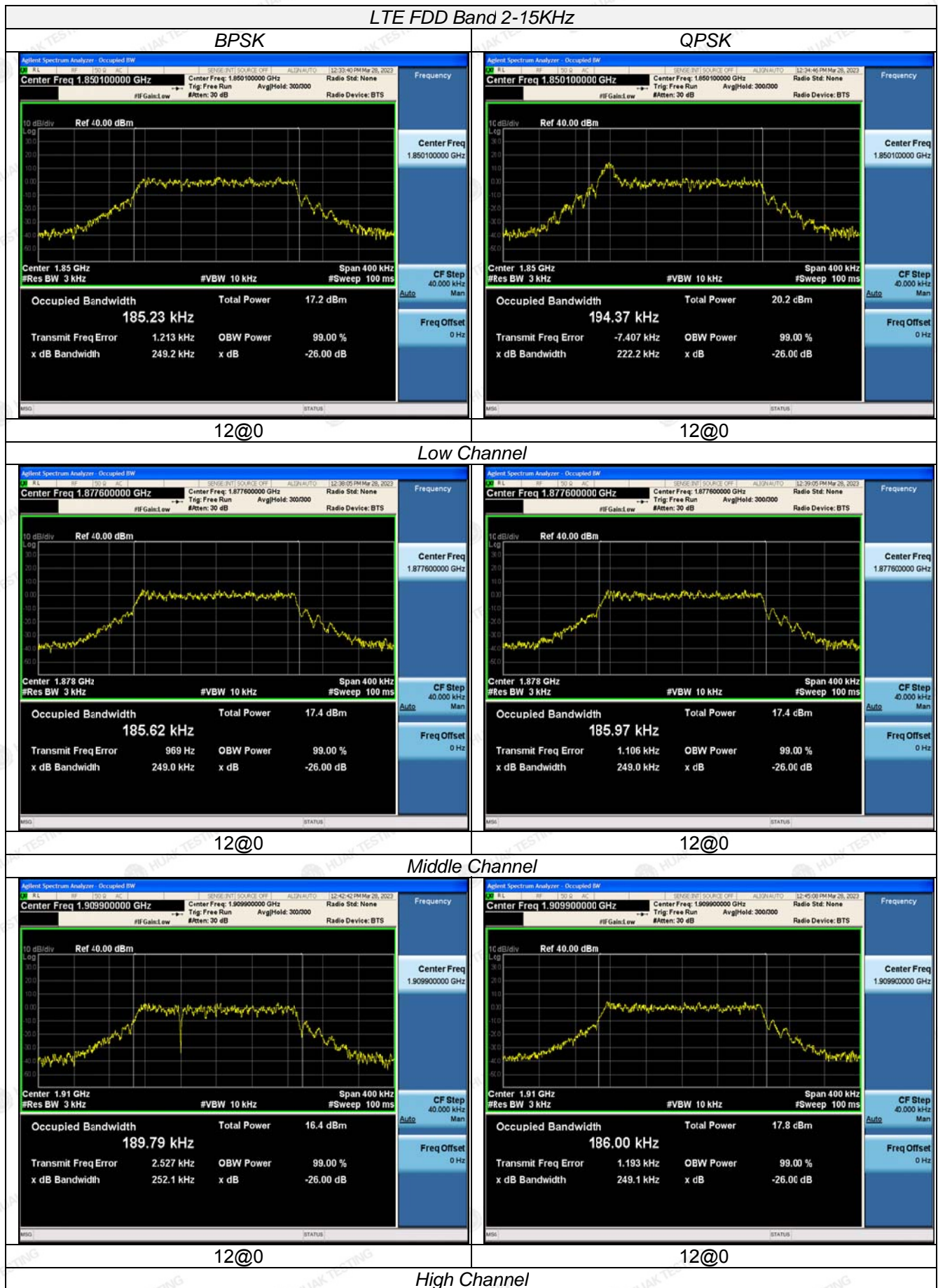




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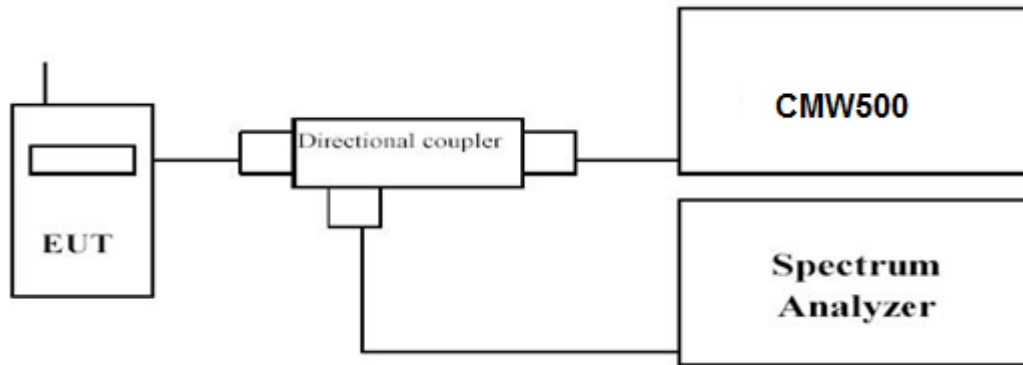


## 4.4 Band Edge Compliance

### LIMIT

Per FCC §24.238 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.

### TEST CONFIGURATION



### TEST PROCEDURE

1. The transmitter output port was connected to base station.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator, the path loss was compensated to the results for each measurement.
3. Set EUT at maximum power through base station.
4. Select lowest and highest channels for each band and different modulation.
5. Measure Band edge using RMS (Average) detector by spectrum.

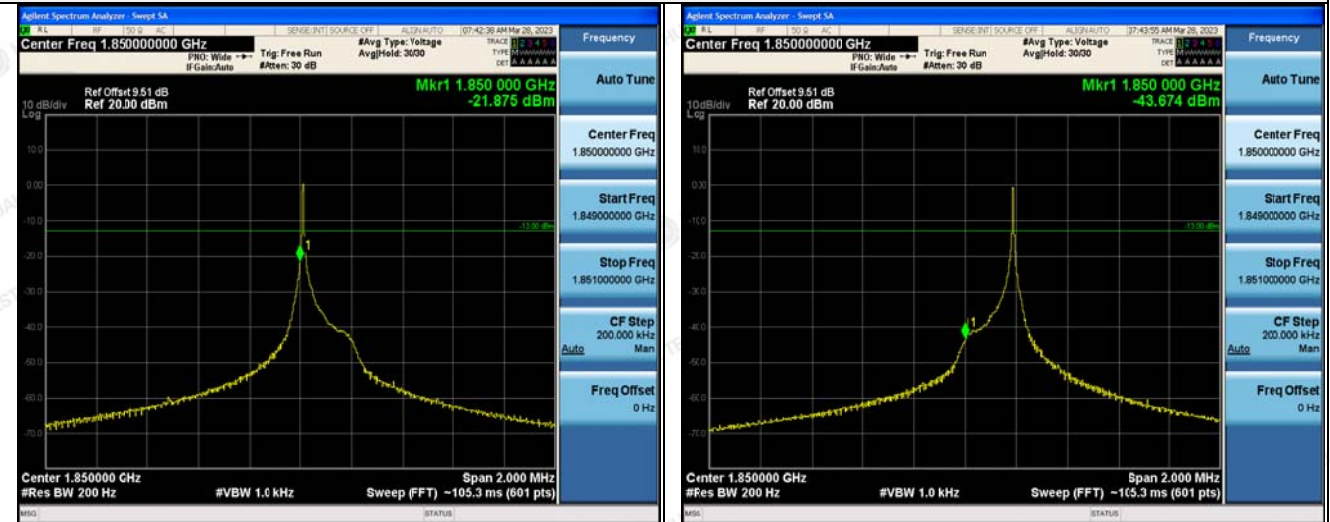
### TEST RESULTS

Remark:

1. We were tested all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 2; recorded worst case for each Channel Bandwidth of LTE FDD Band 2.



## LTE FDD Band 2-BPSK- 3.75KHz



## Low Channel

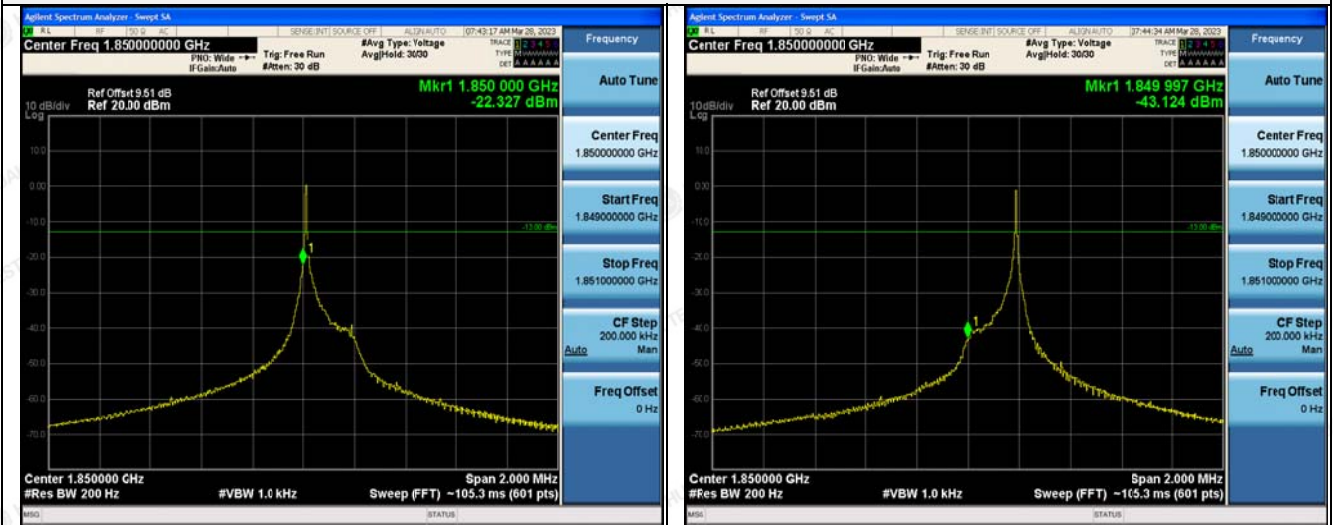


## High Channel

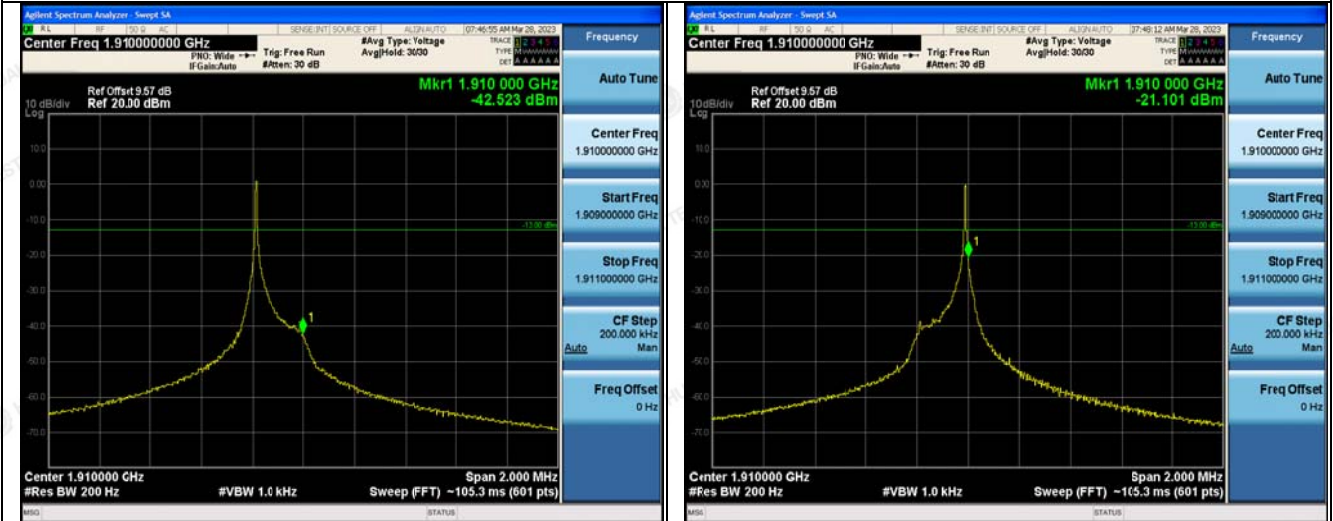




## LTE FDD Band 2-QPSK- 3.75KHz



## Low Channel



## High Channel



LTE FDD Band 2-BPSK- 15KHz

Low Channel

High Channel



1@0



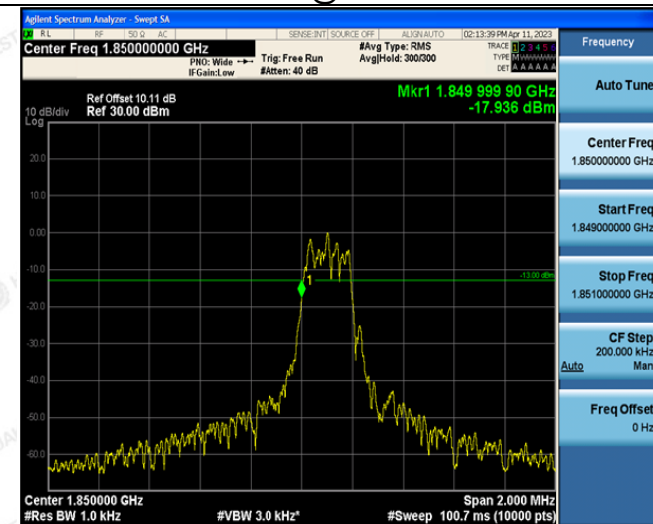
1@0



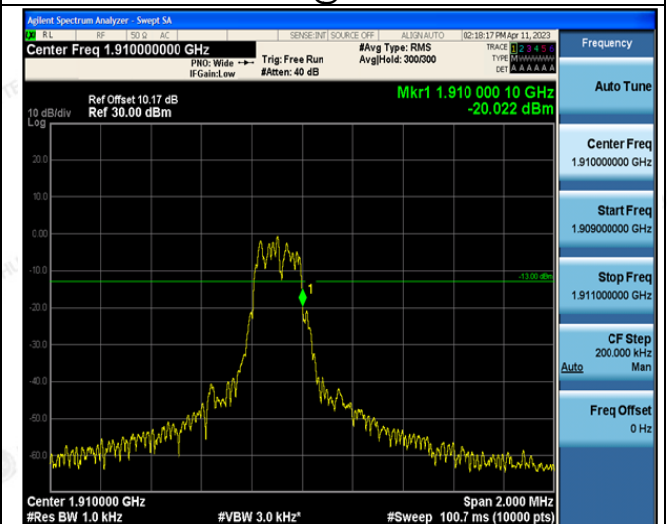
1@11



1@11



12@0



12@0

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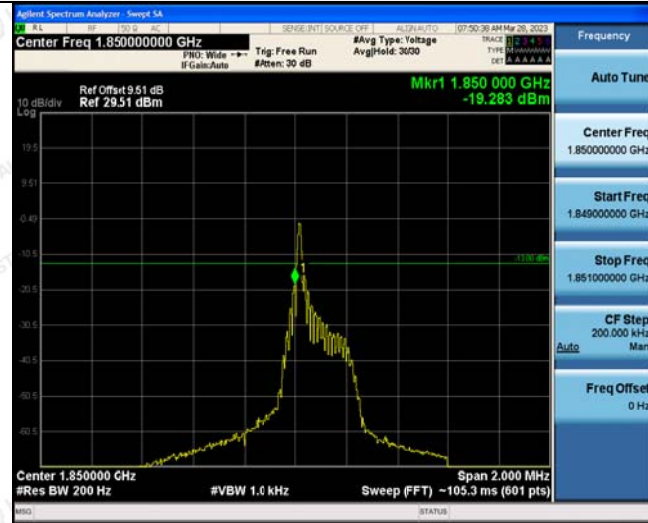
Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China





## LTE FDD Band 2-QPSK- 15KHz

## Low Channel

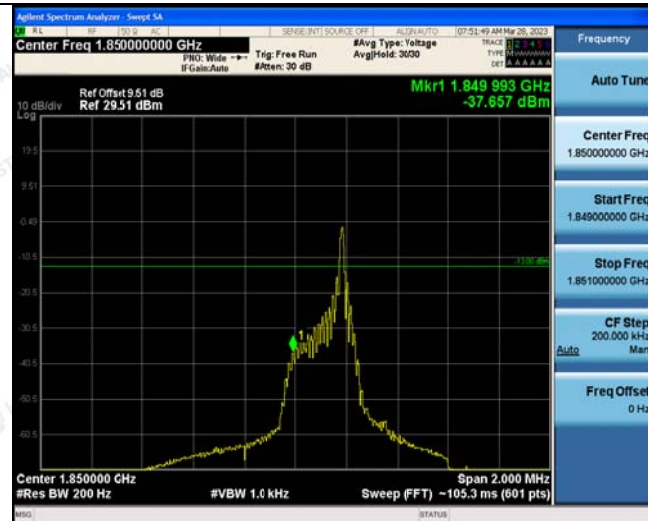


1@0

## High Channel



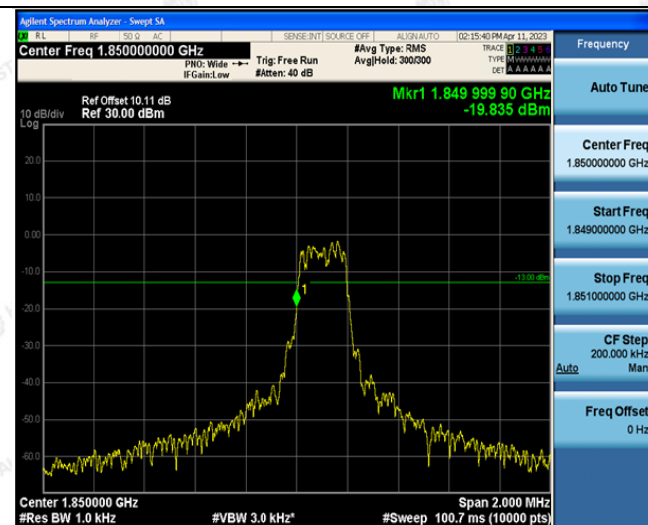
1@0



1@11



1@11



12@0



12@0

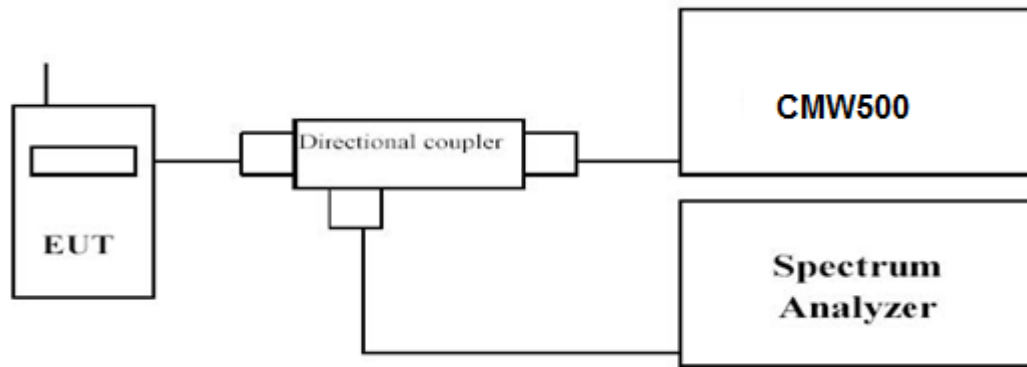


## 4.5 Spurious Emission on Antenna Port

### LIMIT

Per FCC §24.238, 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.

### TEST CONFIGURATION



### TEST PROCEDURE

The EUT was setup according to EIA/TIA 603D.

- Place the EUT on a bench and set it in transmitting mode.
- Connect a low loss RF cable from the antenna port to a spectrum analyzer and CMW500 by a Directional Coupler.
- EUT Communicate with CMW500, then select a channel for testing.
- Add a correction factor to the display of spectrum, and then test.
- The resolution bandwidth of the spectrum analyzer was set sufficient scans were taken to show the out of band Emission if any up to 10<sup>th</sup> harmonic.
- Please refer to following tables for test antenna conducted emissions.

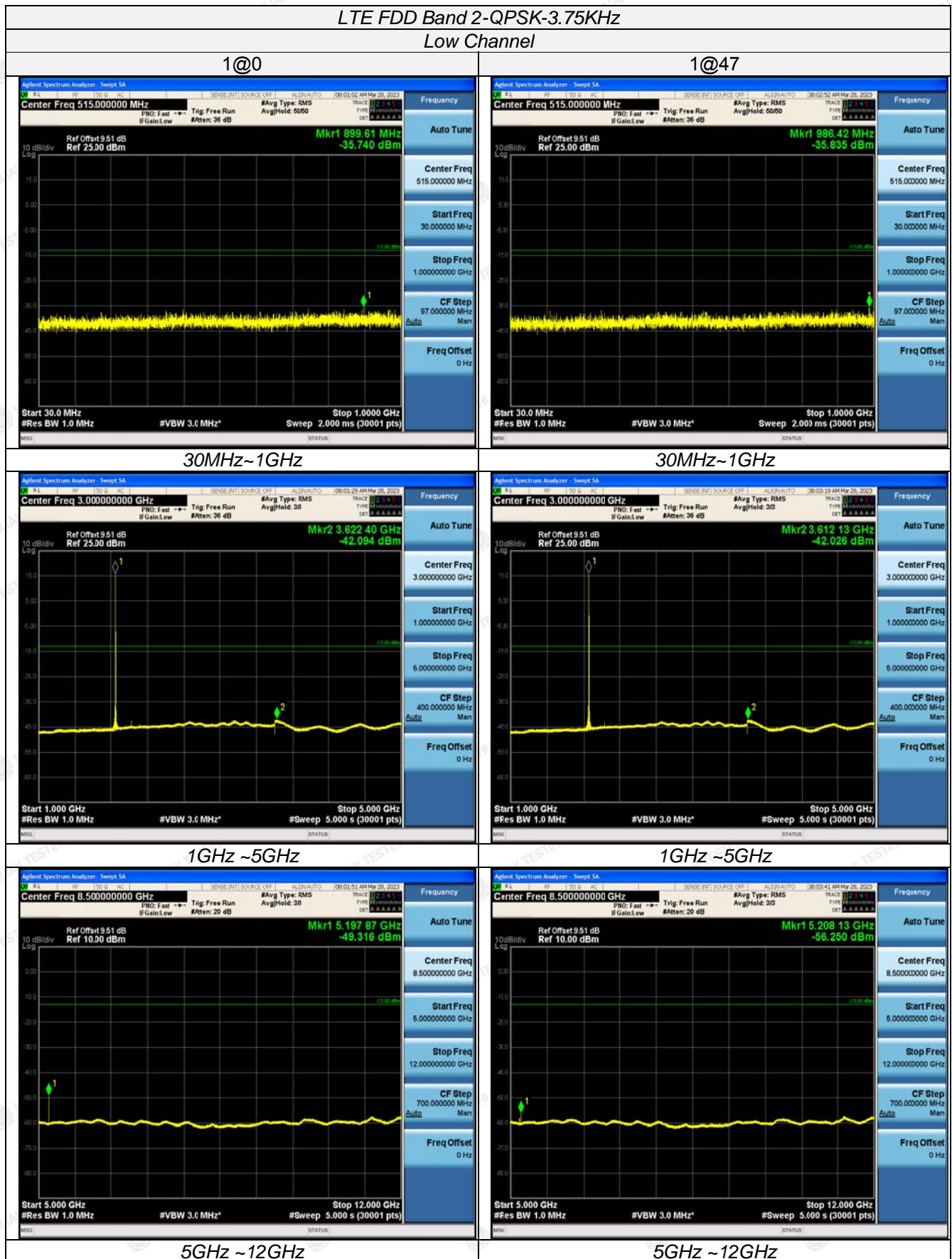
Working Frequency	Sub range (GHz)	RBW	VBW	Sweep time (s)
LTE FDD Band 2	0.01~20	1 MHz	3 MHz	Auto

### TEST RESULTS

Remark:

- We were tested all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 2; recorded worst case at the QPSK Mode for each Channel Bandwidth of LTE FDD Band 2.

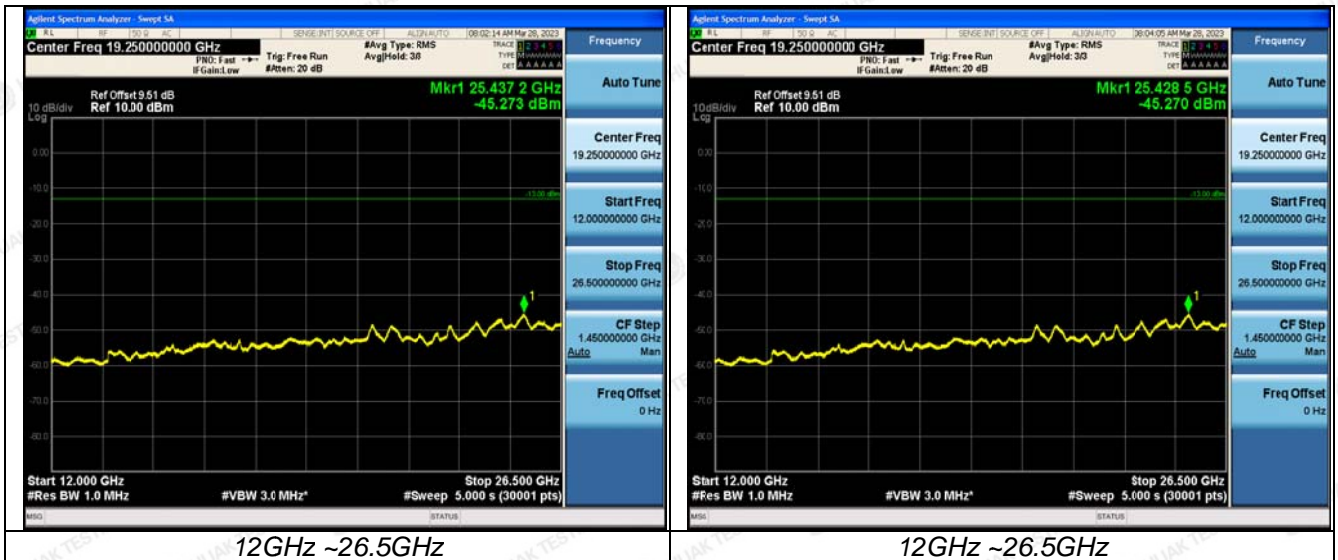




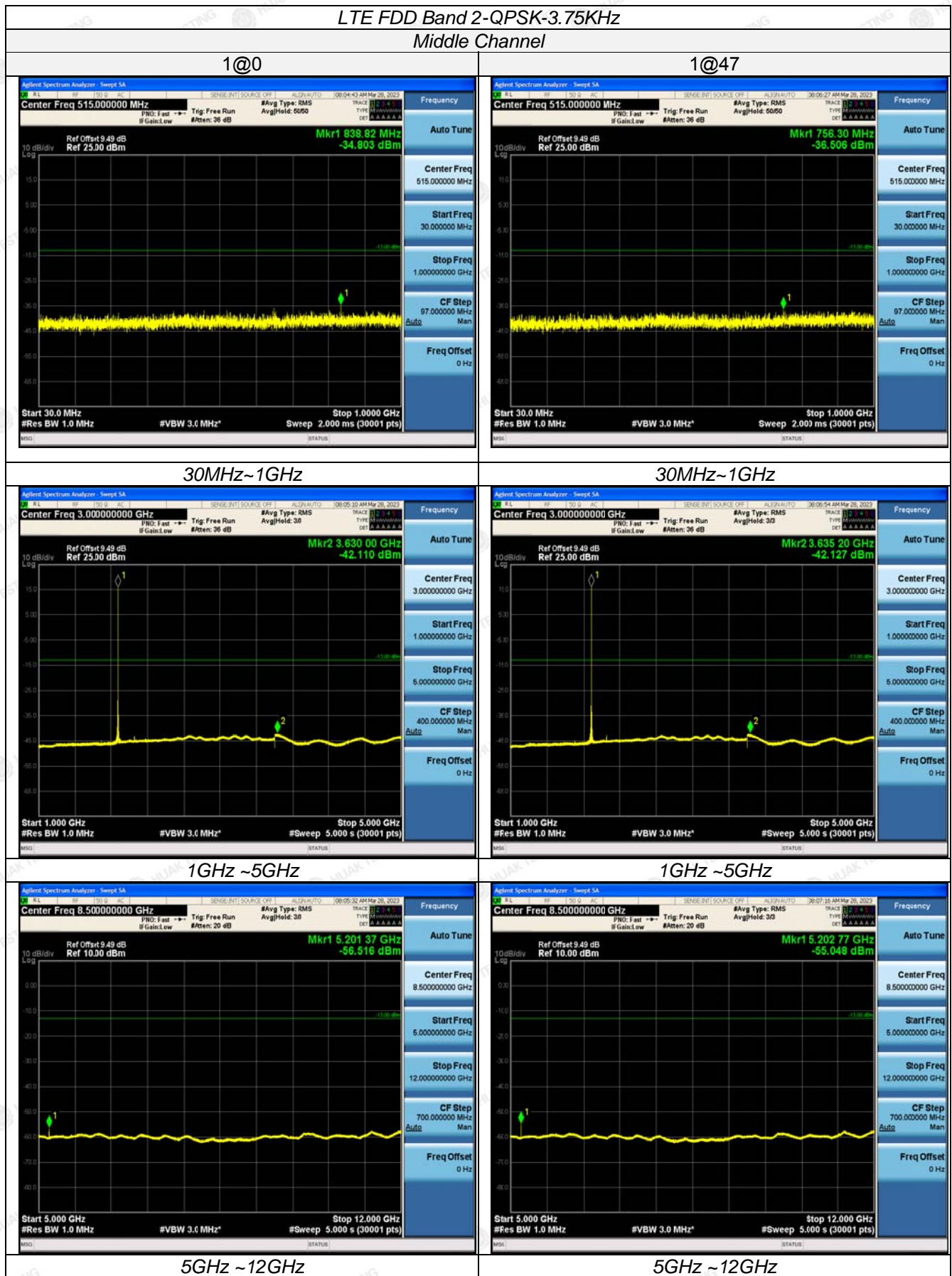
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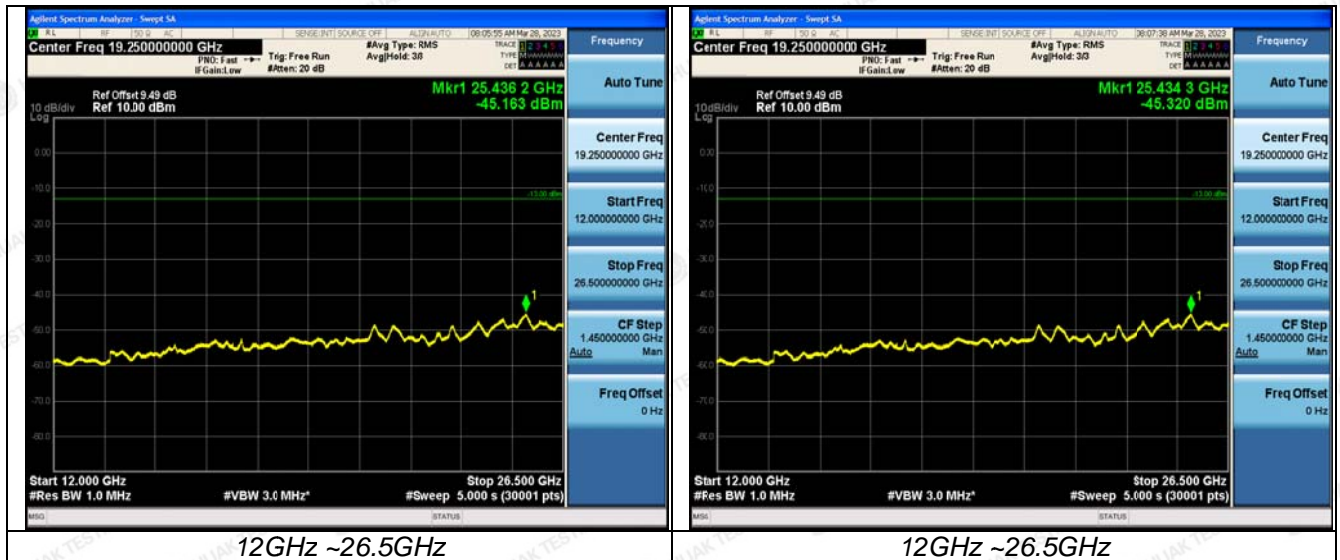




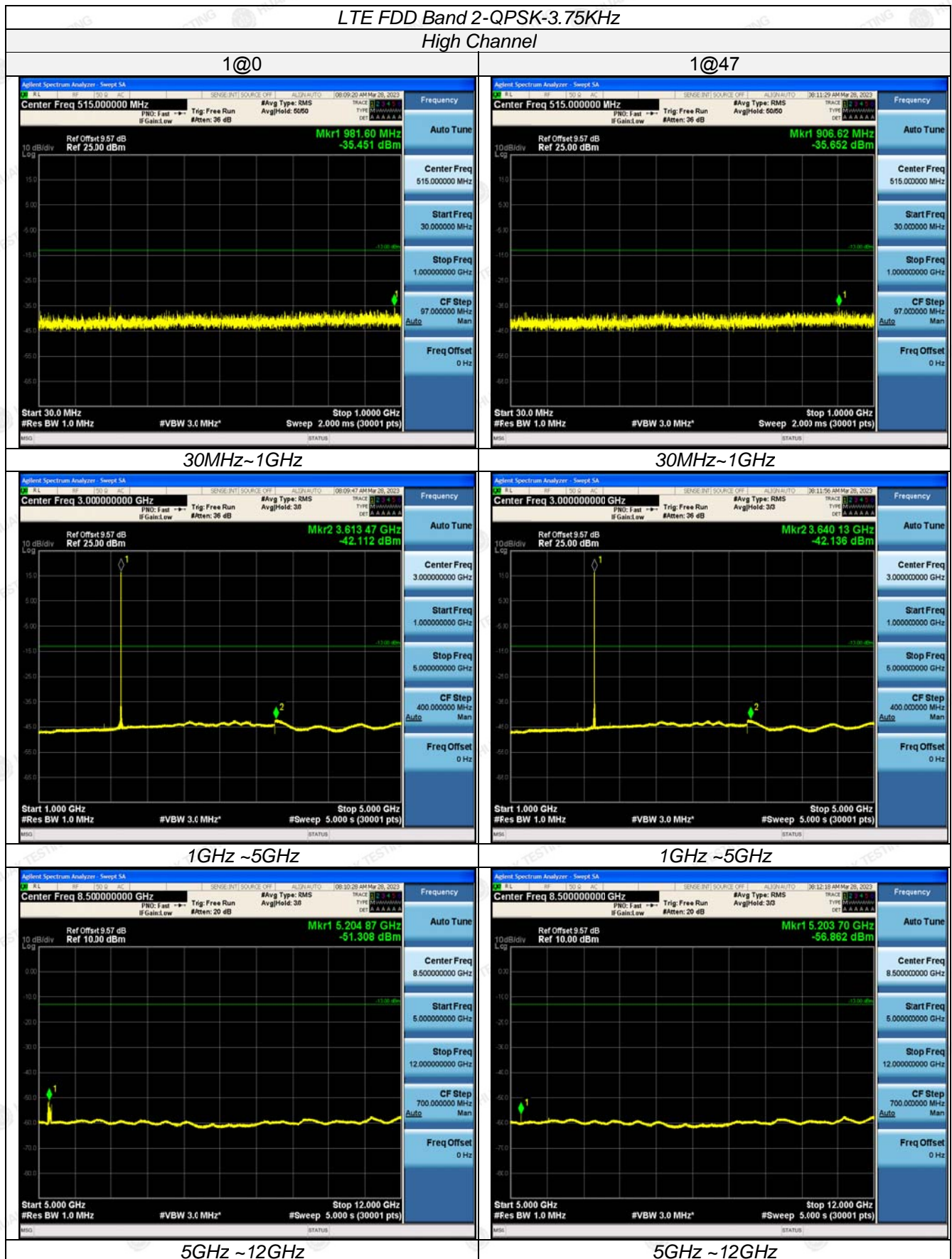
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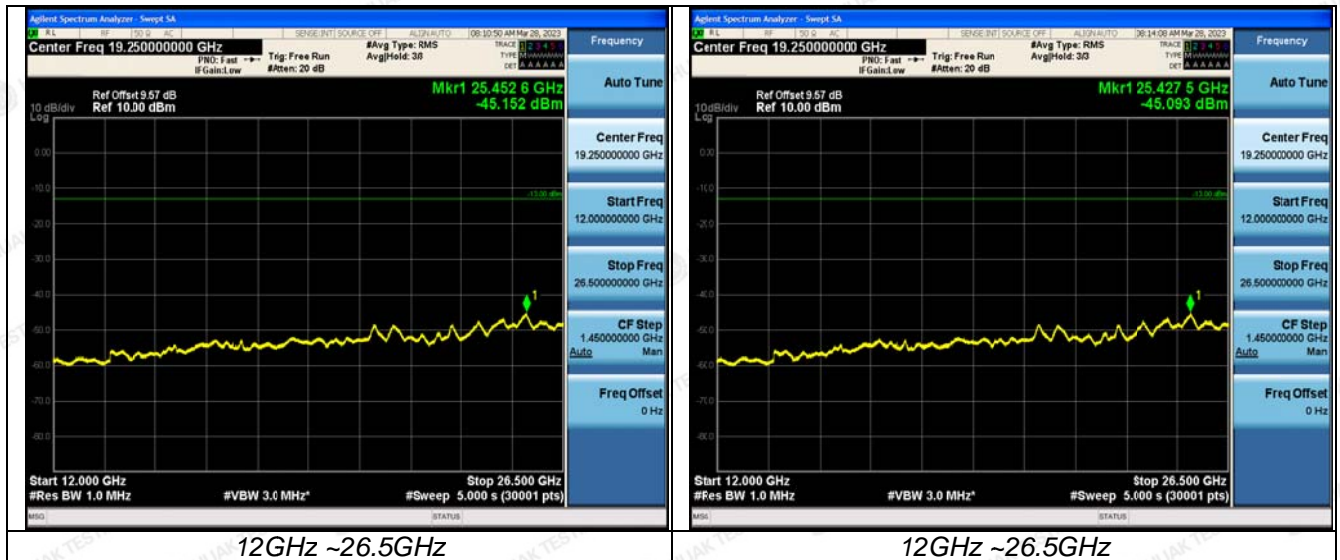




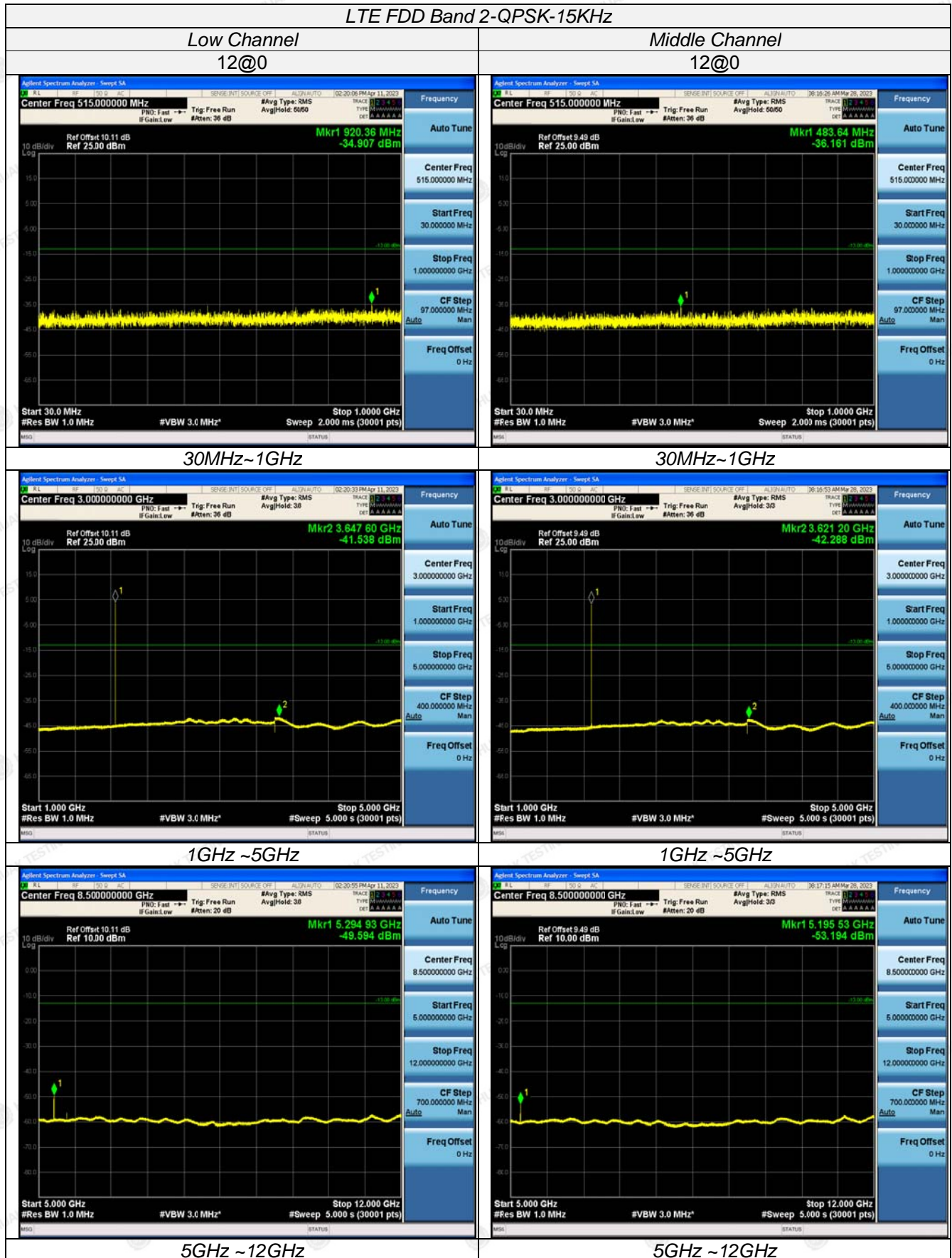
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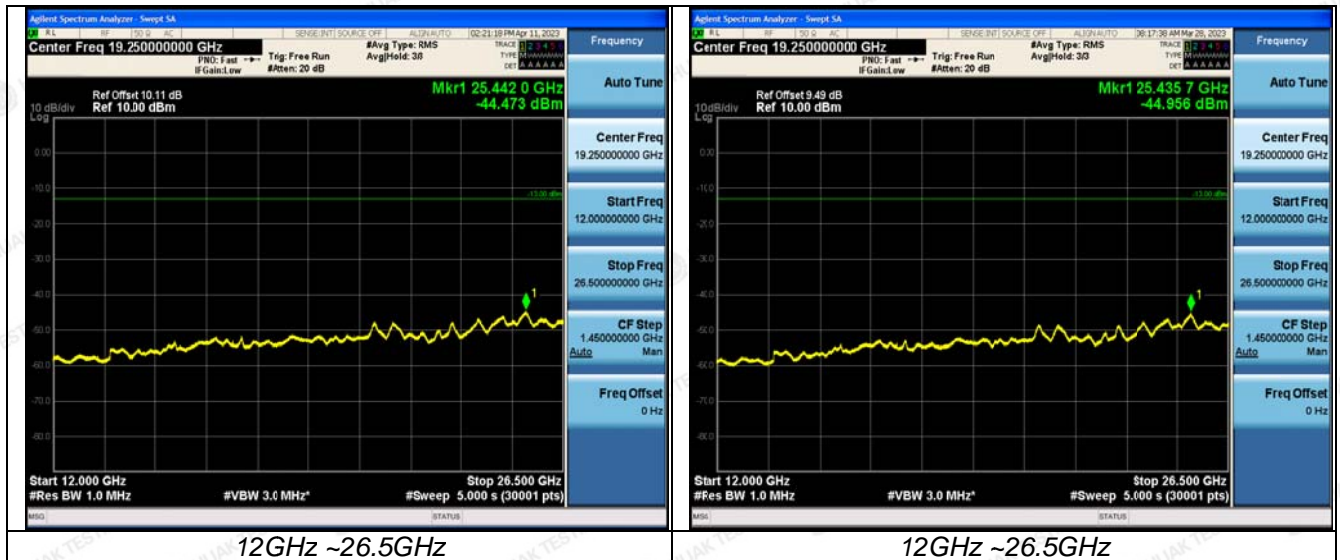




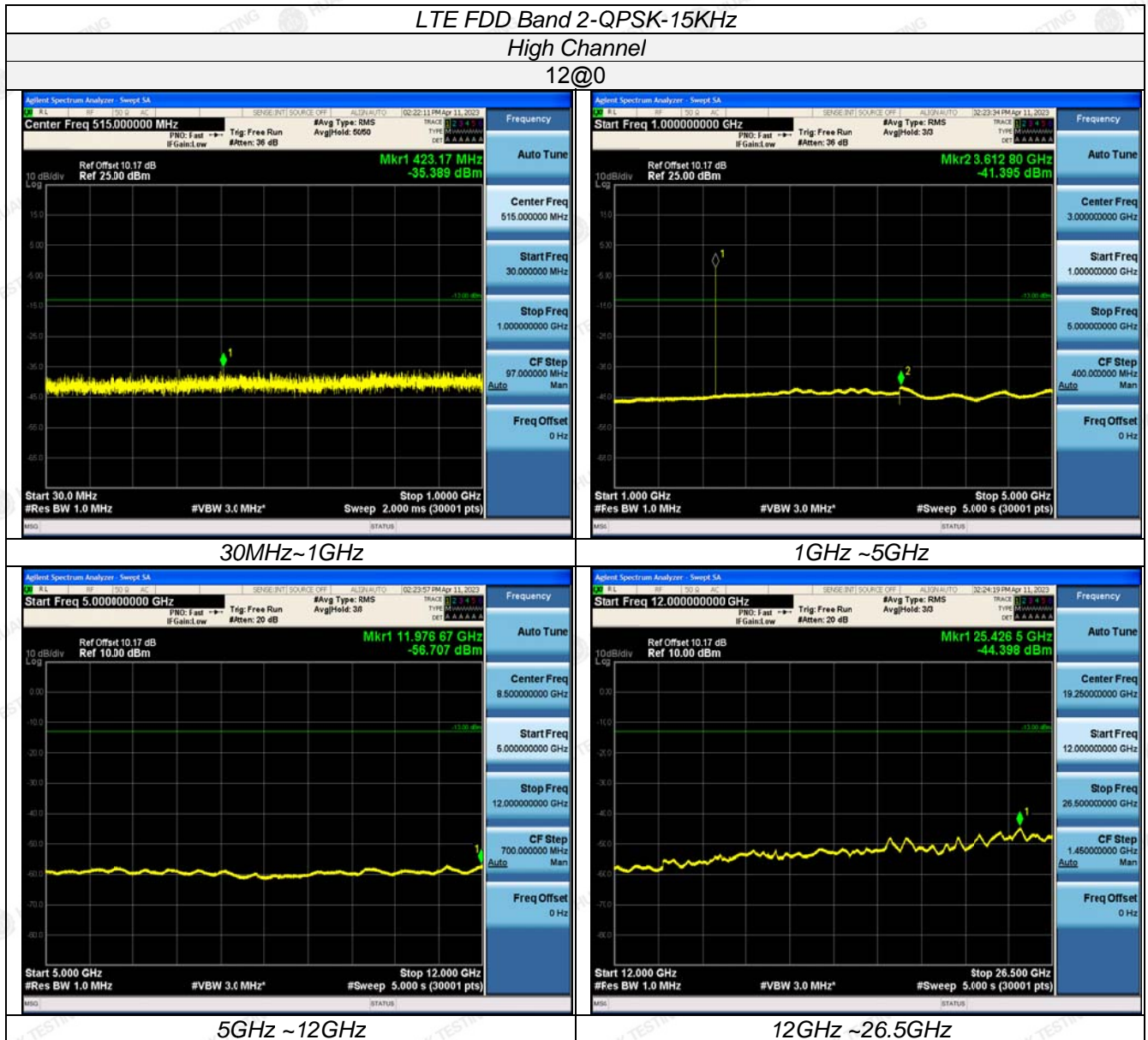
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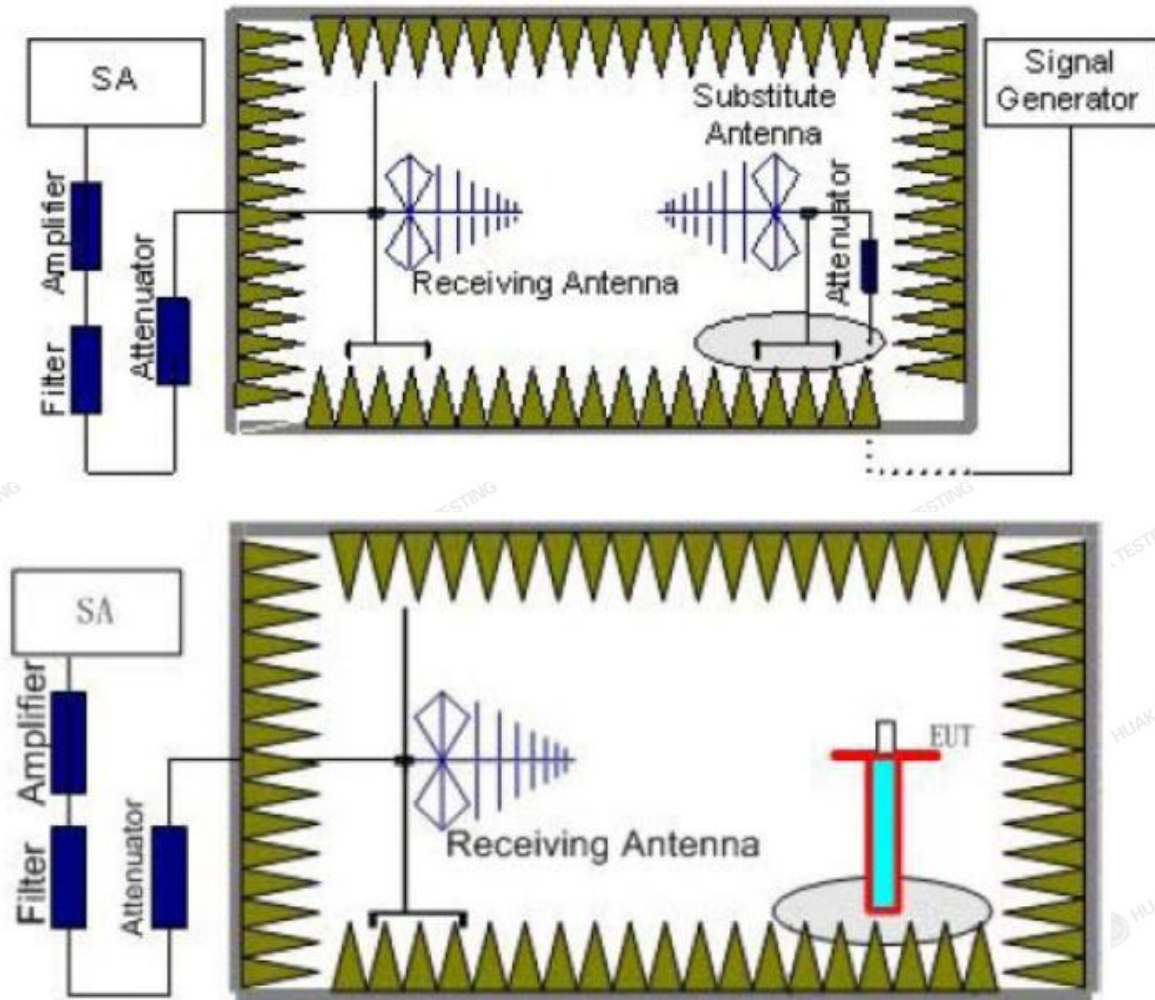


## 4.6 Radiated Spurious Emission

### TEST APPLICABLE

Per FCC §24.238, 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.

### TEST CONFIGURATION



### TEST PROCEDURE

1. EUT was placed on a 1.50 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 1.50m. 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. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
3. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz, VBW=3MHz, And the maximum value of the receiver should be recorded as (P<sub>r</sub>).





4. The EUT shall be replaced by a substitution antenna. In the chamber, a substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power ( $P_{Mea}$ ) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach 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.
5. A amplifier should be connected to the Signal Source output port. And the cable should be connect 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:  
 $Power(EIRP) = P_{Mea} - P_{Ag} - P_{cl} + G_a$
6. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
7. ERP can be calculated from EIRP by subtracting the gain of the dipole,  $ERP = EIRP - 2.15dBi$ .
8. In order to make sure test results more clearly, we set frequency range and sweep time for difference frequency range as follows table:

Working Frequency	Subrange (GHz)	RBW	VBW	Sweep time (s)
LTE FDD Band 2	0.03~1	100KHz	300KHz	10
	1~20	1 MHz	3 MHz	2

### TEST LIMITS

According to 24.238 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.

Frequency	Channel	Frequency Range	Verdict
LTE FDD Band 2	Low	30MHz -20GHz	PASS
	Middle	30MHz -20GHz	PASS
	High	30MHz -20GHz	PASS

### Radiated Measurement:

Remark:

1. We measured all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 2; recorded worst case for each Channel Bandwidth of LTE FDD Band 2.
2.  $EIRP = P_{Mea}(dBm) - P_{cl}(dB) + G_a(dBi)$
3. Not recorded other points as values lower than limits.
4.  $Margin = Limit - EIRP$

#### LTE FDD Band 2-15KHz-BPSK-Low Channel

Frequency (MHz)	$P_{Mea}$ (dBm)	$P_{cl}$ (dB)	Distance	$G_a$ Antenna Gain(dB)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3700.2	-41.41	4.39	3.00	12.34	-33.46	-13.00	20.46	H
5550.3	-48.83	5.31	3.00	13.52	-40.62	-13.00	27.62	H
3700.2	-43.92	4.39	3.00	12.34	-35.97	-13.00	22.97	V
5550.3	-51.92	5.31	3.00	13.52	-43.71	-13.00	30.71	V



*LTE FDD Band 2-15KHz-BPSK-Middle Channel*

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	Diatance	G <sub>a</sub> Antenna Gain(dB)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3755.2	-45.03	4.41	3.00	12.34	-37.1	-13.00	24.1	H
5632.8	-49.32	5.38	3.00	13.58	-41.12	-13.00	28.12	H
3755.2	-43.49	4.41	3.00	12.34	-35.56	-13.00	22.56	V
5632.8	-52.67	5.38	3.00	13.58	-44.47	-13.00	31.47	V

*LTE FDD Band 2-15KHz-BPSK-High Channel*

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	Diatance	G <sub>a</sub> Antenna Gain(dB)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3819.8	-42.1	4.45	3.00	12.45	-34.1	-13.00	21.1	H
5729.7	-51.28	5.47	3.00	13.66	-43.09	-13.00	30.09	H
3819.8	-43.45	4.45	3.00	12.45	-35.45	-13.00	22.45	V
5729.7	-53.21	5.48	3.00	13.66	-45.03	-13.00	32.03	V

*LTE FDD Band 2-15KHz-QPSK-Low Channel*

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	Diatance	G <sub>a</sub> Antenna Gain(dB)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3700.2	-40.9	4.39	3.00	12.34	-32.95	-13.00	19.95	H
5550.3	-49.21	5.31	3.00	13.52	-41	-13.00	28	H
3700.2	-43.31	4.39	3.00	12.34	-35.36	-13.00	22.36	V
5550.3	-52.52	5.31	3.00	13.52	-44.31	-13.00	31.31	V

*LTE FDD Band 2-15KHz-QPSK-Middle Channel*

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	Diatance	G <sub>a</sub> Antenna Gain(dB)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3755.2	-44.38	4.41	3.00	12.34	-36.45	-13.00	23.45	H
5632.8	-48.95	5.38	3.00	13.58	-40.75	-13.00	27.75	H
3755.2	-44.12	4.41	3.00	12.34	-36.19	-13.00	23.19	V
5632.8	-52.39	5.38	3.00	13.58	-44.19	-13.00	31.19	V

*LTE FDD Band 2-15KHz-QPSK-High Channel*

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	Diatance	G <sub>a</sub> Antenna Gain(dB)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3819.8	-41.25	4.45	3.00	12.45	-33.25	-13.00	20.25	H
5729.7	-50.45	5.47	3.00	13.66	-42.26	-13.00	29.26	H
3819.8	-42.76	4.45	3.00	12.45	-34.76	-13.00	21.76	V
5729.7	-55.63	5.48	3.00	13.66	-47.45	-13.00	34.45	V

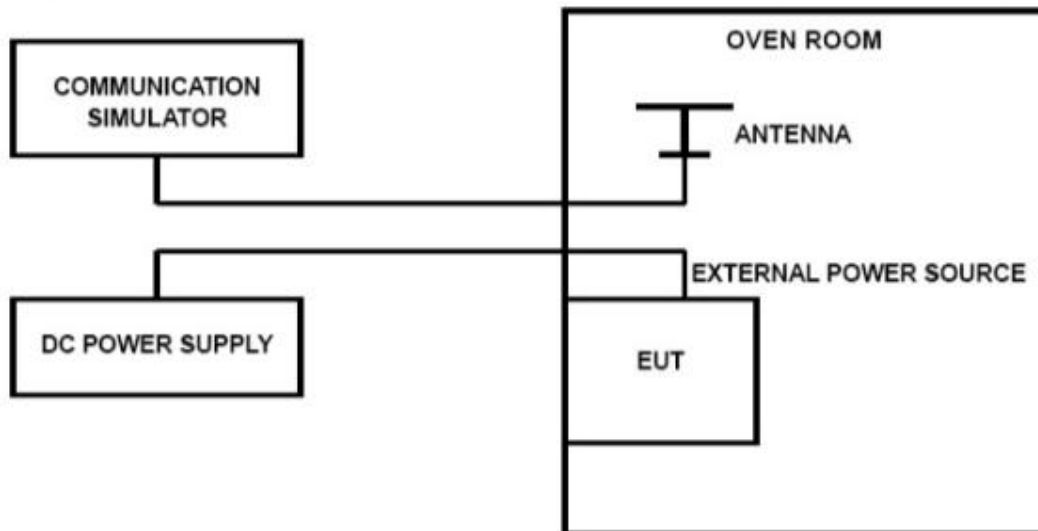


## 4.7 Frequency Stability

### LIMIT

According to §24.235, §2.1055 requirement, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation and should not exceed 2.5ppm.

### TEST CONFIGURATION



### TEST PROCEDURE

The EUT was setup according to EIA/TIA 603D.

#### **Frequency Stability Under Temperature Variations:**

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 2, 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 increments 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.

#### **Frequency Stability Under Voltage Variations:**

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ( $\pm 15\%$ ) and endpoint, record the maximum frequency change.

**TEST RESULTS**

Remark:

1. We tested all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 2; recorded worst case.

LTE Band 2, 15KHz , BPSK (worst case of all bandwidths)

LTE FDD Band 2					
DC Power(V)	Temperature (°C)	Frequency error(Hz)	Frequency error(ppm)	Limit (ppm)	Verdict
3.15	20	-43.02	-0.023253	±2.50	PASS
3.70	20	-37.07	-0.020037	±2.50	PASS
4.26	20	-40.62	-0.021956	±2.50	PASS
3.70	-30	-36.21	-0.019572	±2.50	PASS
3.70	-20	-39.47	-0.021334	±2.50	PASS
3.70	-10	-43.54	-0.023534	±2.50	PASS
3.70	0	-51.42	-0.027386	±2.50	PASS
3.70	10	-42.62	-0.022699	±2.50	PASS
3.70	20	-48.46	-0.025810	±2.50	PASS
3.70	30	-44.17	-0.023525	±2.50	PASS
3.70	40	-51.60	-0.027482	±2.50	PASS
3.70	50	-47.98	-0.025554	±2.50	PASS

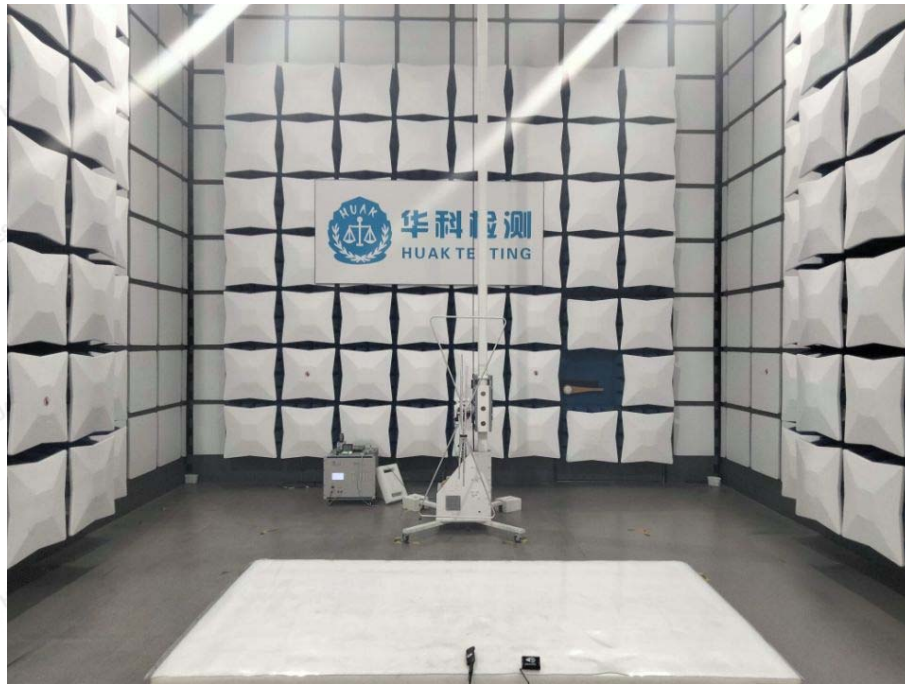
LTE Band 2, 15KHz , QPSK (worst case of all bandwidths)

LTE FDD Band 2					
DC Power(V)	Temperature (°C)	Frequency error(Hz)	Frequency error(ppm)	Limit (ppm)	Verdict
3.15	20	-38.60	-0.020864	±2.50	PASS
3.70	20	-34.06	-0.018410	±2.50	PASS
4.26	20	-31.01	-0.016761	±2.50	PASS
3.70	-30	-40.53	-0.021907	±2.50	PASS
3.70	-20	-45.84	-0.024777	±2.50	PASS
3.70	-10	-40.60	-0.021945	±2.50	PASS
3.70	0	-42.16	-0.022454	±2.50	PASS
3.70	10	-38.27	-0.020382	±2.50	PASS
3.70	20	-42.05	-0.022396	±2.50	PASS
3.70	30	-42.21	-0.022481	±2.50	PASS
3.70	40	-40.86	-0.021762	±2.50	PASS
3.70	50	-40.12	-0.021368	±2.50	PASS





## 5 Test Setup Photos of the EUT



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## 6 Photos of the EUT

Reference to the report: ANNEX A of external photos and ANNEX B of internal photos.

.....End of Report.....