FCC Test Report

FCC Part 90

Report Reference No.:	HK2302270554-9E
FCC ID :	2A2FCBT4101
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Date of issue ..... :	Apr. 28, 2023
Testing Laboratory Name..... :	**Shenzhen HUAK Testing Technology Co., Ltd.**
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Applicant's name ..... :	**PowUnity GmbH**
Address ..... :	Feldstrasse 9d Innsbruck, 6020 Austria
Test specification..... :	
Standard..... :	**FCC Part 90**

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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
Ratings ..... :	DC 3.7V from battery
Modulation ..... :	QPSK, 16QAM
Hardware version ..... :	V2.2
Software version ..... :	V2.2
Frequency	LTE Band 26
Result ..... :	**PASS**

TEST REPORT

Test Report No. :	HK2302270554-9E	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

Test result	**Pass**

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

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1. Summary

1.1 Test Standards

The tests were performed according to following standards:
FCC Part 90 : PRIVATE LAND MOBILE RADIO 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 ALLOCA-TIONS AND RADIO TREATY MAT-TERS; GENERAL RULES AND REG-ULATIONS

KDB971168 D01 v03r01: MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS

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1.2 Test Description

Requirement	CFR 47 Section	Result
Conducted Output Power	§2.1046; §90.635;	PASS
Peak-to-Average Ratio	§2.1046;	PASS
Effective Radiated Power	§2.1046; §90.635;	PASS
Occupied Bandwidth	§2.1049;	PASS
Band Edge	§2.1051; §90.691	PASS
Conducted Spurious Emission	§2.1051; §90.691	PASS
Field Strength of Spurious Radiation	§2.1053; §90.691	PASS
Frequency Stability for Temperature & Voltage	§2.1055; §90.231	PASS

Note:

1. PASS: Test item meets the requirement.

2. Fail: Test item does not meet the requirement.

3. N/A: Test case does not apply to the test object.

4. The test result judgment is decided by the limit of test standard.

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2. EUT Description

Product Name:	GPS Tracker
Model :	BT41-01
Series Models:	T4101-03-04
Trade Mark:	BikeTrax
Tx Frequency:	LTE Band 26: 814 MHz ~ 824 MHz
Rx Frequency:	LTE Band 26: 859MHz ~ 869 MHz
Bandwidth:	LTE Band 26: 1.4MHz / 3MHz / 5MHz / 10MHz
Type of Modulation:	QPSK/16QAM
Antenna Type:	Internal Antenna
Antenna Gain:	LTE Band 26: 1dBi
Power Supply:	DC 3.7V from battery

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3. General Information

3.1. Test environment and mode

Operating Environment:	
Temperature:	24.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Operation mode:	Keep the EUT in continuous transmitting with modulation
The sample was placed 0.8m above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.	

Description Operation Frequency

LTE Band 26(1.4MHz)		LTE Band 26(3MHz)	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
26697	814.7	26705	815.5
26740	819.0	26740	819.0
26783	823.3	26775	822.5
LTE Band 26(5MHz)		LTE Band 26(10MHz)	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
26715	816.5	26740	819.0
26740	819.0	--	--
26765	821.5	--	--

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3.2. Test Mode

All modes and data rates and positions were investigated.
Test modes are chosen to be reported as the worst case configuration below:

Test Mode		
Band	**Radiated TCs**	**Conducted TCs**
LTE Band 26	QPSK Link (1.4MHz / 3MHz / 5MHz / 10MHz)	16QAM Link (1.4MHz / 3MHz / 5MHz / 10MHz)

Antenna port conducted and radiated test items were performed according to KDB 971168 D01 Power Meas License Digital Systems v03 with maximum output power. Radiated measurements were performed with rotating EUT in different three orthogonal test planes to find the maximum emission.

3.3. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
/	/	/	/	/

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.

2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

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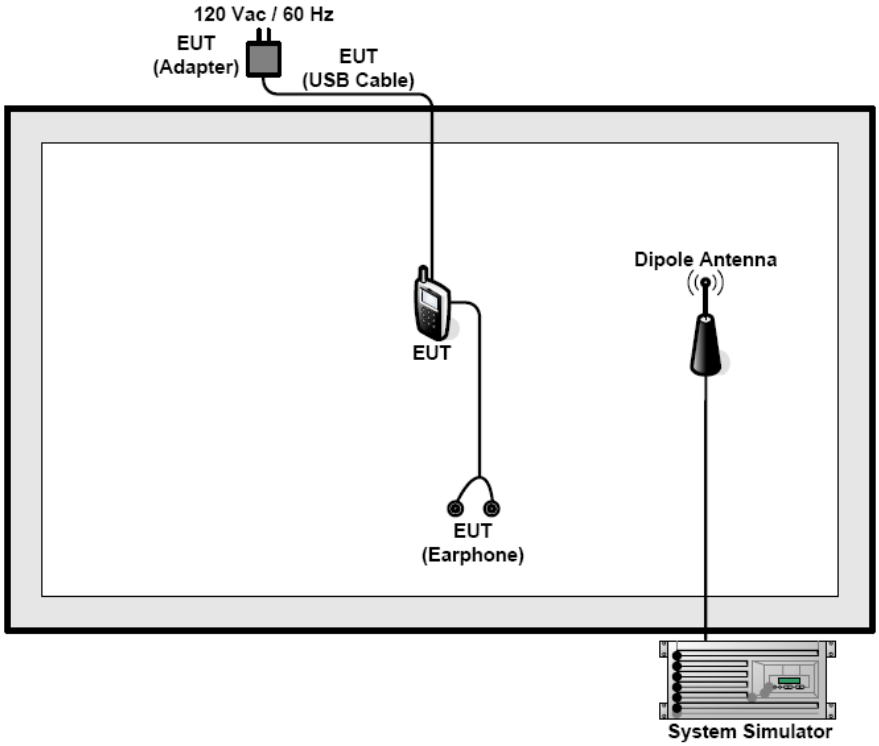
3.4. Configuration of Tested System



3.5. 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 RF conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level will be exactly the RF output level. The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

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3.6. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	HKE-059	2023/02/17	2024/02/16
LISN	R&S	ENV216	HKE-002	2023/02/17	2024/02/16
Receiver	R&S	ESR-7	HKE-010	2023/02/17	2024/02/16
Spectrum analyzer	R&S	FSP40	HKE-025	2023/02/17	2024/02/16
Spectrum analyzer	Agilent	N9020A	HKE-048	2023/02/17	2024/02/16
RF automatic control unit	Tonscend	JS0806-1	HKE-060	2023/02/17	2024/02/16
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	2023/02/17	2024/02/16
Bilog Broadband Antenna	Schwarzbeck	VULB9163	HKE-012	2023/02/17	2024/02/16
Horn antenna	Schwarzbeck	9120D	HKE-013	2023/02/17	2024/02/16
High gain antenna	Schwarzbeck	LB-180400KF	HKE-054	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
Preamplifier	Schwarzbeck	BBV 9743	HKE-006	2023/02/17	2024/02/16
Temperature and humidity meter	Boyang	HTC-1	HKE-075	2023/02/17	2024/02/16
High-low temperature chamber	Guangke	HT-80L	HKE-118	2023/02/17	2024/02/16
High pass filter unit	Tonscend	JS0806-F	HKE-055	2023/02/17	2024/02/16
RF Cable(below1GHz)	Times	9kHz-1GHz	HKE-117	2023/02/17	2024/02/16
RF Cable(above 1GHz)	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
Conducted test software	Tonscend	TS+ Rev 2.5.0.0	HKE-081	N/A	N/A
Radiated test software	Tonscend	TS+ Rev 2.5.0.0	HKE-082	N/A	N/A
RF test software	Tonscend	JS1120-B Version 2.6	HKE-083	N/A	N/A
RF test software	Tonscend	JS1120-4	HKE-113	N/A	N/A
RF test software	Tonscend	JS1120-3	HKE-114	N/A	N/A
RF test software	Tonscend	JS1120-1	HKE-115	N/A	N/A
Wireless Communication Test Set	R&S	CMW500	HKE-026	2023/02/17	2024/02/16
Wireless Communication Test Set	R&S	CMU200	HKE-029	2023/02/17	2024/02/16

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4. Facilities and Accreditations

4.1. Information of The Test Laboratory

Shenzhen HUAK 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.

4.2. Measurement Uncertainty

The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10dB	(1)
Radiated Emission	Above 1GHz	4.32dB	(1)
Conducted Disturbance	0.15~30MHz	3.20dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95%
confidence level using a coverage factor of k=2.

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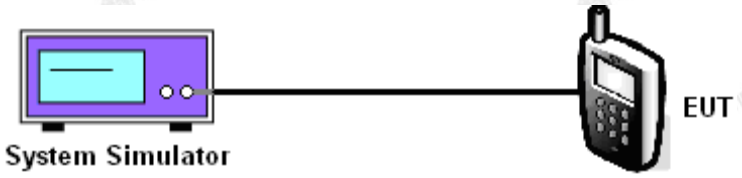
5. Test Results and Measurement Data

5.1. Conducted Output Power Measurement

5.1.1. Test Specification

Test Requirement:	FCC part 90.635
Test Method:	FCC part 2.1046
Limits:	LTE Band 26: 100W
Test Setup:	
Test Procedure:	1. The transmitter output port was connected to the system simulator. 2. Set EUT at maximum power through system simulator. 3. Select lowest, middle, highest channels for each band and different modulation. 4. Measure and record the power level from the system simulator.
Test Result:	PASS

TEST RESULTS

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Conducted Measurement:

LTE FDD Band 26				
TX Channel Bandwidth	RB Size/Offset	Frequency (MHz)	Average Power [dBm]	
			QPSK	16QAM
1.4 MHz	1 RB low	814.7	19.54	18.46
		819.0	19.60	18.36
		823.3	20.26	16.36
	1 RB high	814.7	19.99	18.06
		819.0	19.41	18.18
		823.3	20.11	16.87
	50% RB mid	814.7	19.10	18.06
		819.0	19.72	17.99
		823.3	20.32	17.07
	100% RB	814.7	19.54	19.20
		819.0	19.60	18.68
		823.3	20.26	17.56
3 MHz	1 RB low	815.5	19.33	19.00
		819.0	19.94	18.83
		822.5	20.74	17.00
	1 RB high	815.5	20.31	19.18
		819.0	19.99	18.77
		822.5	19.68	17.05
	50% RB mid	815.5	20.03	18.89
		819.0	20.02	18.84
		822.5	19.75	17.33
	100% RB	815.5	19.89	18.32
		819.0	20.92	19.23
		822.5	20.44	20.11
5 MHz	1 RB low	816.5	19.81	20.16
		819.0	20.09	20.34
		821.5	19.12	18.61
	1 RB high	816.5	20.57	20.79
		819.0	20.37	20.60
		821.5	19.74	18.83
	50% RB mid	816.5	20.48	20.66
		819.0	20.22	20.27
		821.5	19.20	19.09
	100% RB	816.5	19.63	18.43
		819.0	20.12	19.70
		821.5	20.74	17.24
10 MHz	1 RB low	819.0	21.52	19.56
	1 RB high	819.0	20.12	20.09
	50% RB mid	819.0	21.36	19.81
	100% RB	819.0	20.50	19.21

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Radiated Measurement:

Remark:

1. *We measured all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 26; recorded worst case for each Channel Bandwidth of LTE FDD Band 26.*
2. *EIRP=PMea(dBm)-Pcl(dB)+PAg(dB)+Ga(dBi)*
3. *Margin=Limit-ERP*
4. *We measured both Horizontal and Vertical direction, recorded worst case direction.*

LTE FDD Band 26_Channel Bandwidth 1.4MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain(dB)	P_{Ag} (dB)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
814.7	-17.69	2.42	8.45	36.82	25.16	23.01	50.00	26.99	V
819.0	-17.67	3.46	8.45	36.82	24.14	21.99	50.00	28.01	V
823.3	-19.38	2.53	8.36	36.82	23.27	21.12	50.00	28.88	V

LTE FDD Band 26_Channel Bandwidth 3MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain(dB)	P_{Ag} (dB)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
815.5	-19.73	2.42	8.45	36.82	23.12	20.97	50.00	29.03	V
819.0	-17.17	3.46	8.45	36.82	24.64	22.49	50.00	27.51	V
822.5	-18.52	2.53	8.36	36.82	24.13	21.98	50.00	28.02	V

LTE FDD Band 26_Channel Bandwidth 5MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain(dB)	P_{Ag} (dB)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
816.5	-17.94	2.42	8.45	36.82	24.91	22.76	50.00	27.24	V
819.0	-17.42	3.46	8.45	36.82	24.39	22.24	50.00	27.76	V
821.5	-18.89	2.53	8.36	36.82	23.76	21.61	50.00	28.39	V

LTE FDD Band 26_Channel Bandwidth 10MHz_QPSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain(dB)	P_{Ag} (dB)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
819.0	-15.45	3.46	8.45	36.82	26.36	24.21	50.00	25.79	V

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LTE FDD Band 26_Channel Bandwidth 1.4MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain(dB)	P_{Ag} (dB)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
814.7	-17.96	2.42	8.45	36.82	24.89	22.74	50.00	27.26	V
819.0	-17.62	3.46	8.45	36.82	24.19	22.04	50.00	27.96	V
823.3	-19.01	2.53	8.36	36.82	23.64	21.49	50.00	28.51	V

LTE FDD Band 26_Channel Bandwidth 3MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain(dB)	P_{Ag} (dB)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
815.5	-18.88	2.42	8.45	36.82	23.97	21.82	50.00	28.18	V
819.0	-17.91	3.46	8.45	36.82	23.9	21.75	50.00	28.25	V
822.5	-17.99	2.53	8.36	36.82	24.66	22.51	50.00	27.49	V

LTE FDD Band 26_Channel Bandwidth 5MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain(dB)	P_{Ag} (dB)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
816.5	-17.81	2.42	8.45	36.82	25.04	22.89	50.00	27.11	V
819.0	-17.44	3.46	8.45	36.82	24.37	22.22	50.00	27.78	V
821.5	-19.54	2.53	8.36	36.82	23.11	20.96	50.00	29.04	V

LTE FDD Band 26_Channel Bandwidth 10MHz_16QAM

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	G_a Antenna Gain(dB)	P_{Ag} (dB)	EIRP (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
819.0	-15.17	3.46	8.45	36.82	26.64	24.49	50.00	25.51	V

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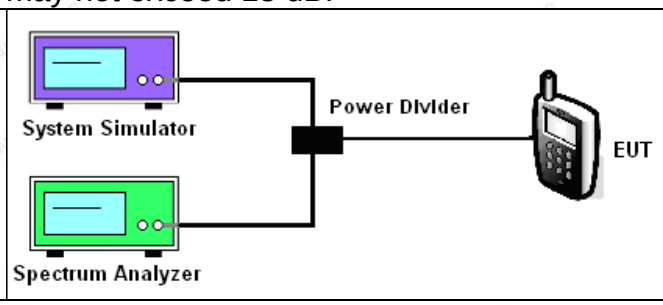
5.2. Peak to Average Ratio

5.2.1. Test Specification

Test Method:	FCC KDB 971168 D01v03
Limit:	The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.
Test Setup:	
Test Procedure:	1. The testing follows FCC KDB 971168 D01v03 Section 5.7.1. 2. The EUT was connected to spectrum analyzer and system simulator via a power divider. 3. Set EUT to transmit at maximum output power. 4. Set the CCDF (Complementary Cumulative Distribution Function) option of the spectrum analyzer. Record the maximum PAPR level associated with a probability of 0.1%.
Test Result:	PASS

TEST RESULTS

Remark:

1. *We were tested all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 26; recorded worst case for each Channel Bandwidth of LTE FDD Band 26.*

LTE FDD Band 26				
TX Channel Bandwidth	Frequency (MHz)	RB Size/Offset	PAPR (dB)	
			QPSK	16QAM
1.4 MHz	814.7	*1RB#0*	10.40	10.12
	819.0		9.17	10.35
	823.3		11.39	12.49
3 MHz	815.5	*1RB#0*	11.64	10.61
	819.0		9.28	12.73
	822.5		10.21	10.66
5 MHz	816.5	*1RB#0*	9.77	10.11
	819.0		11.89	9.62
	821.5		9.46	9.61
10 MHz	819.0	*1RB#0*	9.71	10.56

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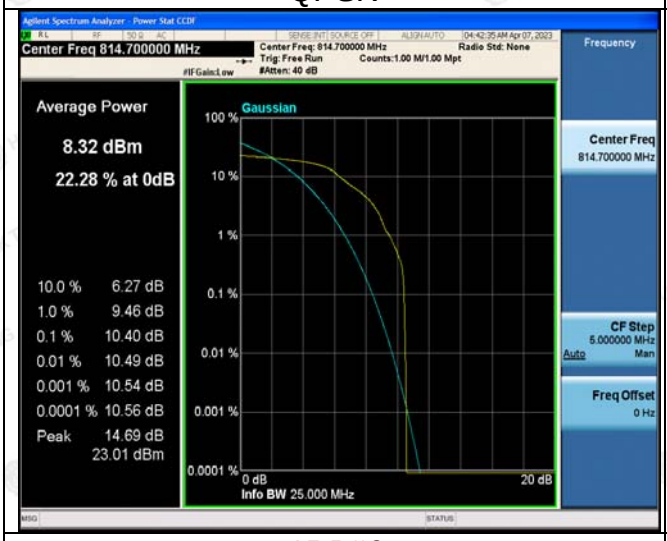
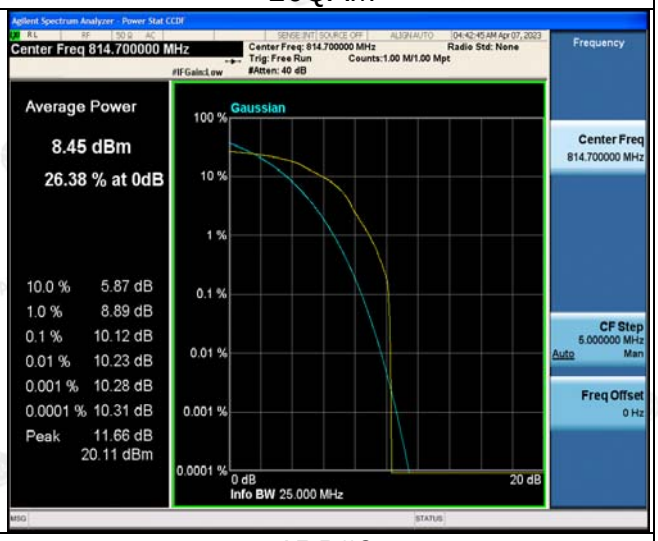
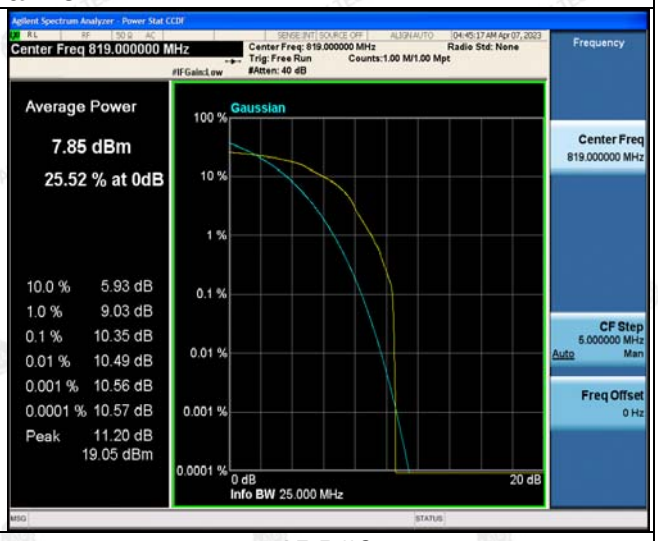
LTE FDD Band 26-1.4MHz Channel Bandwidth PAPR	
QPSK	16QAM
	
1RB#0	1RB#0
Low Channel	
	
1RB#0	1RB#0
Middle Channel	

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	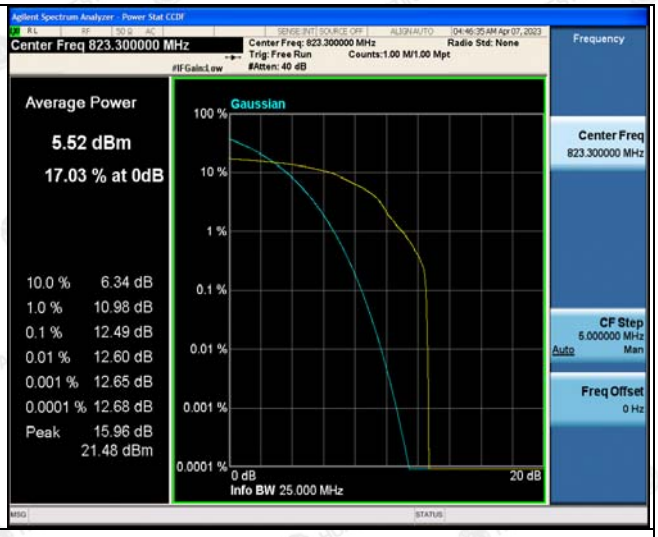
1RB#0	*1RB#0*
High Channel	

LTE FDD Band 26-3MHz Channel Bandwidth PAPR	
QPSK	*16QAM*
1RB#0	*1RB#0*
Low Channel	

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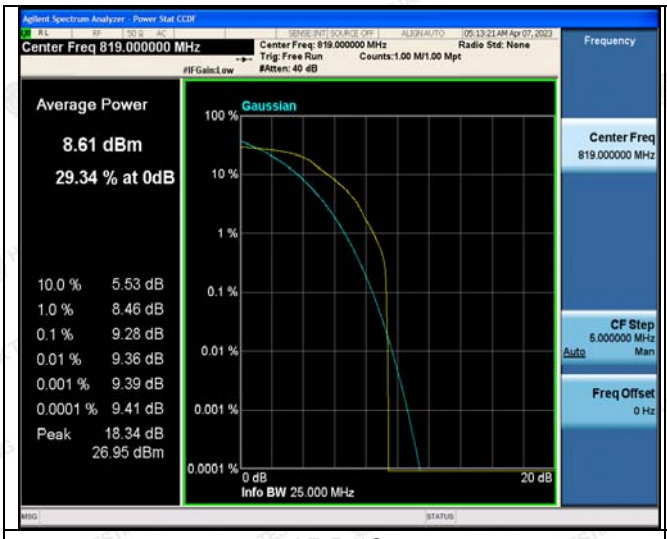
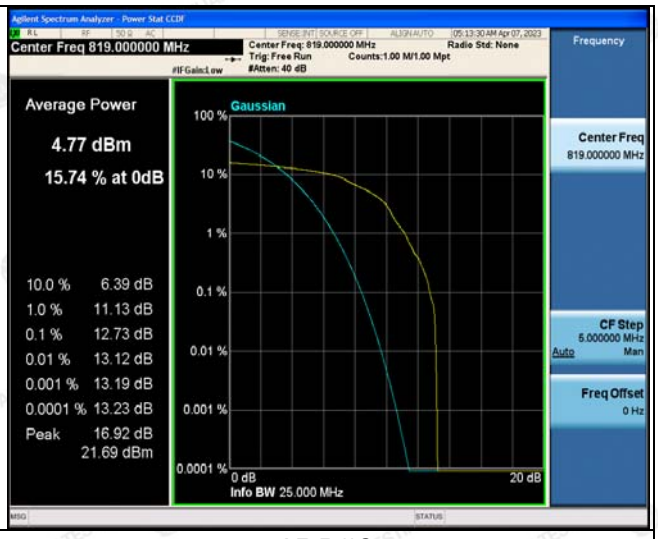
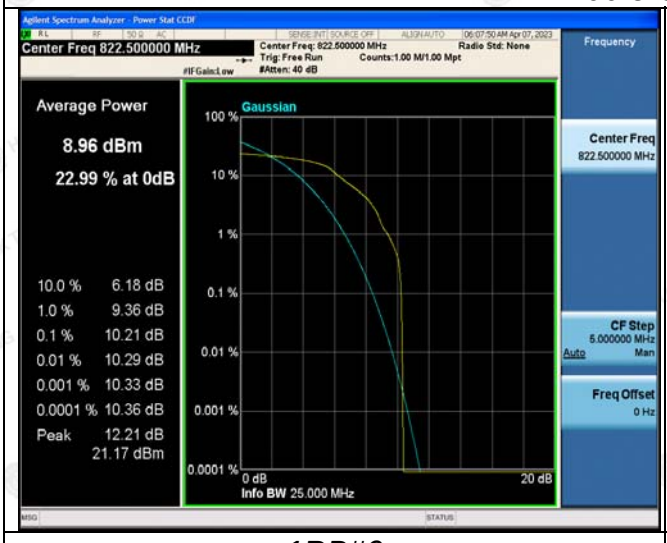


1RB#0

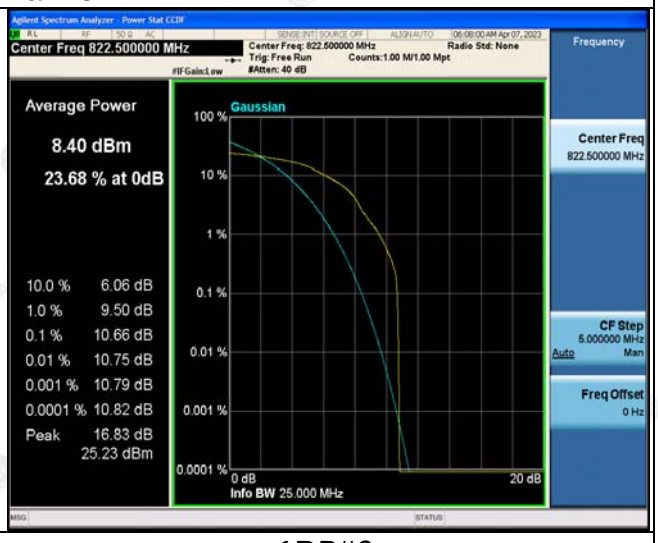


1RB#0

Middle Channel



1RB#0



1RB#0

High Channel

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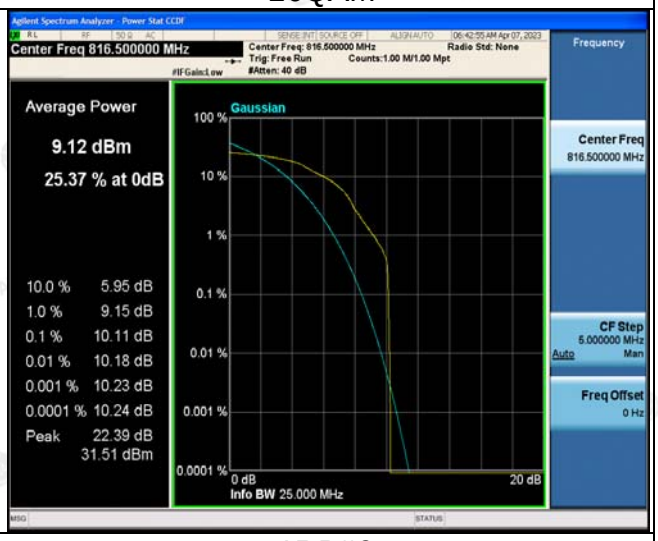
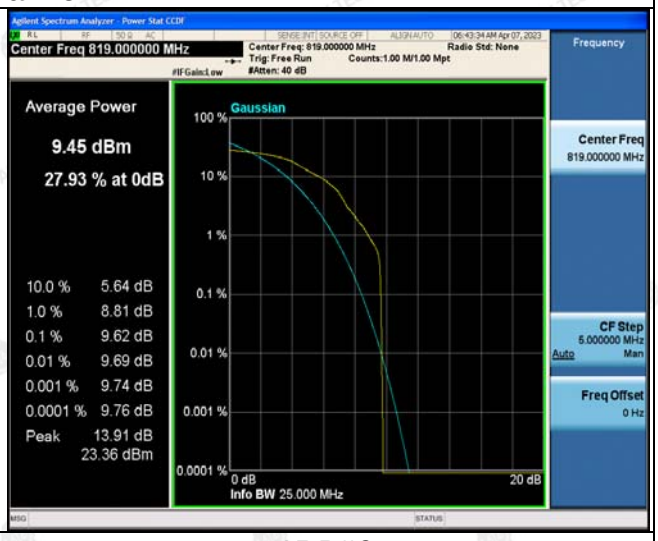
LTE FDD Band 26-5MHz Channel Bandwidth PAPR	
QPSK	16QAM
	
1RB#0	1RB#0
Low Channel	
	
1RB#0	1RB#0
Middle Channel	

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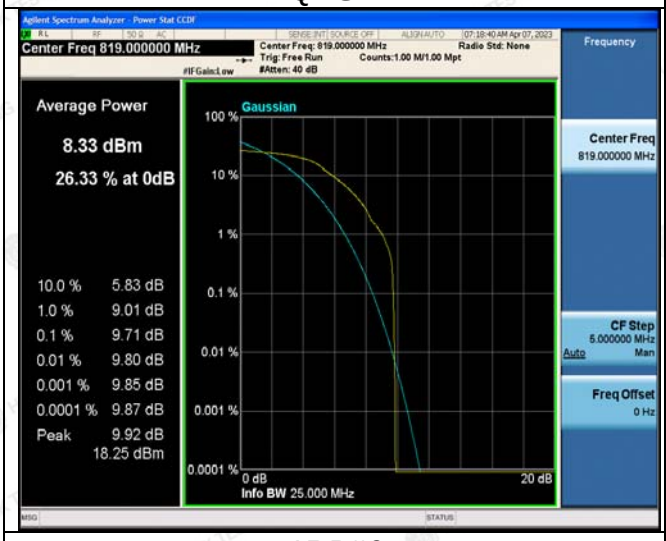
1RB#0	*1RB#0*
High Channel	

LTE FDD Band 26-10MHz Channel Bandwidth PAPR	
QPSK	*16QAM*
	
1RB#0	*1RB#0*

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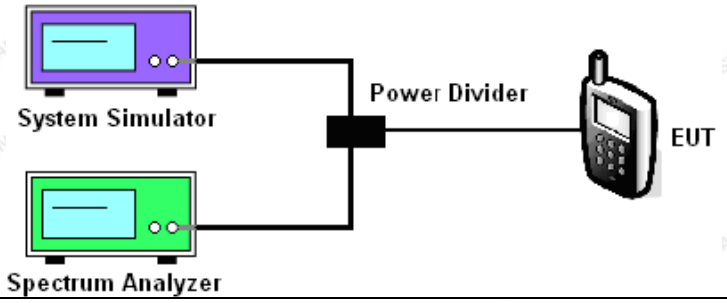
5.3. 99% Occupied Bandwidth and 26dB Bandwidth Measurement

5.3.1. Test Specification

Test Method:	FCC part 2.1049
Limit:	N/A
Test Setup:	
Test Procedure:	1. The testing follows FCC KDB 971168 D01v03 Section 4.2. 2. The EUT was connected to the spectrum analyzer and system simulator via a power divider. 3. The RF output of the 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 99% occupied bandwidth were measured, set RBW= 1% of OBW, VBW= 3*RBW, sample detector, trace maximum hold. 5. The 26dB bandwidth were measured, set RBW= 1% of EBW, VBW= 3*RBW, peak detector, trace maximum hold.
Test Result:	PASS

TEST RESULTS

Remark:

1. *We were tested all RB Configuration refer 3GPP TS136 521 for each Channel Bandwidth of LTE FDD Band 26; recorded worst case for each Channel Bandwidth of LTE FDD Band 26.*

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LTE FDD Band 26						
TX Channel Bandwidth	RB Size/Offset	Frequency (MHz)	-26dBc Emission bandwidth (MHz)		99% Occupied bandwidth (MHz)	
			QPSK	16QAM	QPSK	16QAM
1.4 MHz	6RB#0	814.7	1.274	1.281	1.0907	1.0938
		819.0	1.277	1.283	1.0919	1.0951
		823.3	1.268	1.269	1.0921	1.0818
3 MHz	6RB#0	815.5	1.276	1.278	1.0976	1.0977
		819.0	1.260	1.287	1.0943	1.0955
		822.5	1.281	1.294	1.0943	1.0928
5 MHz	6RB#0	816.5	1.287	1.284	1.1080	1.1075
		819.0	1.291	1.297	1.1036	1.1089
		821.5	1.290	1.289	1.1004	1.0966
10 MHz	6RB#0	819.0	1.290	1.306	1.1003	1.1062

LTE FDD Band 26-1.4MHz Channel Bandwidth

QPSK

6RB#0

16QAM

6RB#0

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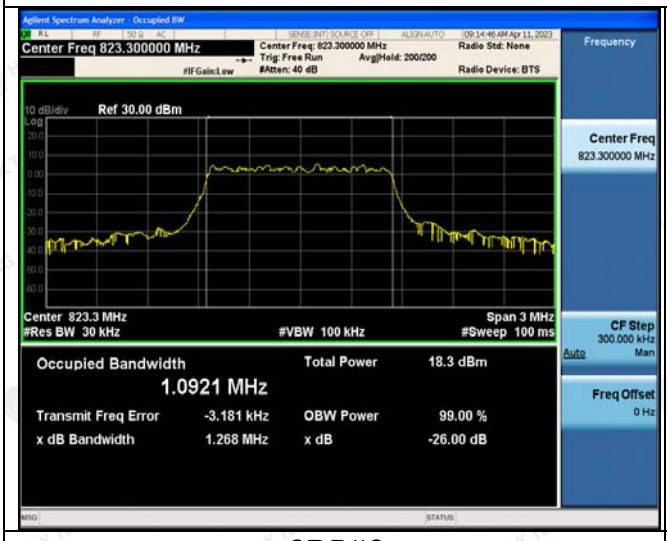
Low Channel

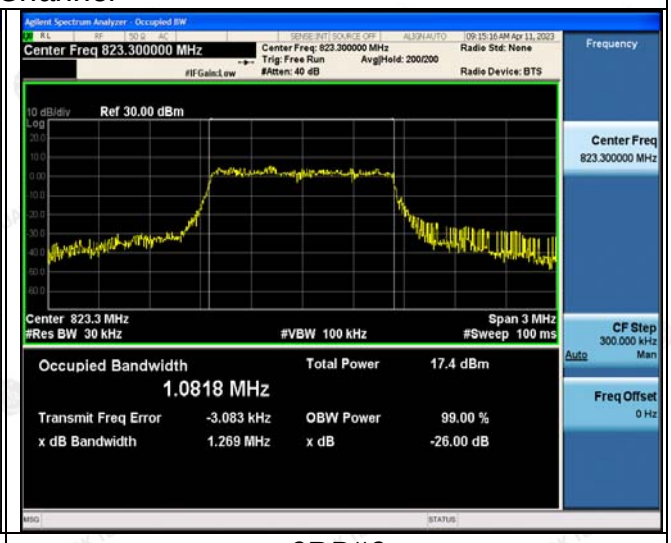
6RB#0

6RB#0

Middle Channel



6RB#0



6RB#0

High Channel

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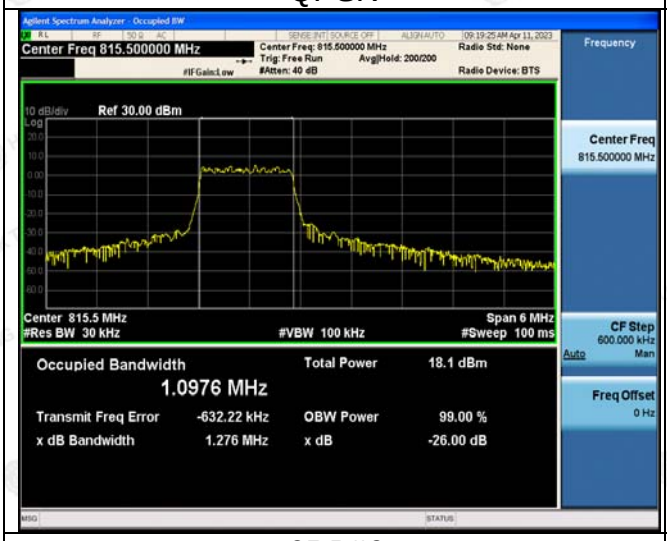
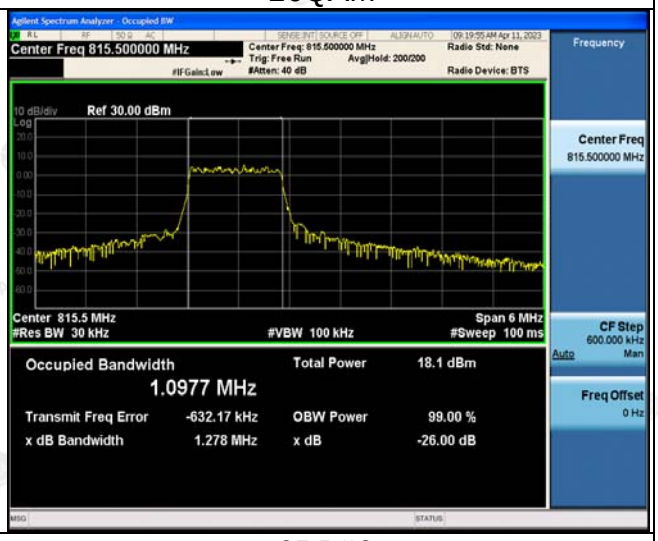
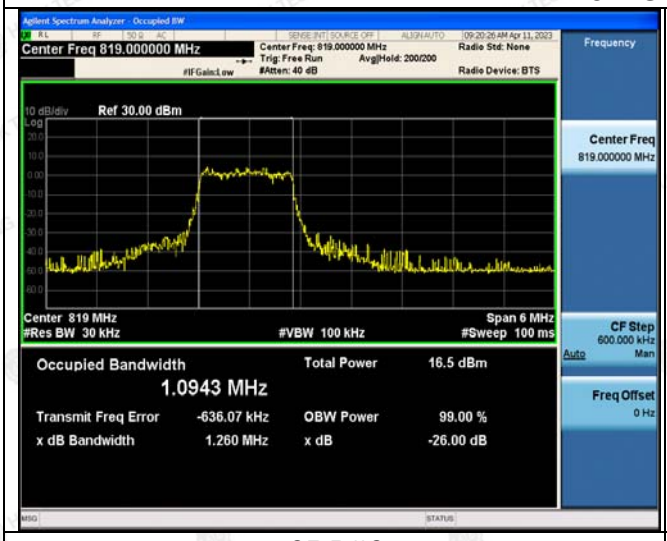
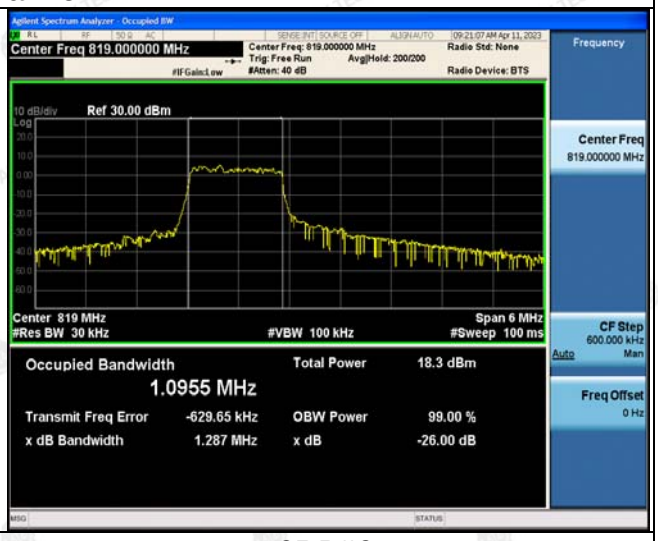
LTE FDD Band 26-3MHz Channel Bandwidth	
QPSK	16QAM
	
6RB#0	6RB#0
Low Channel	
	
6RB#0	6RB#0

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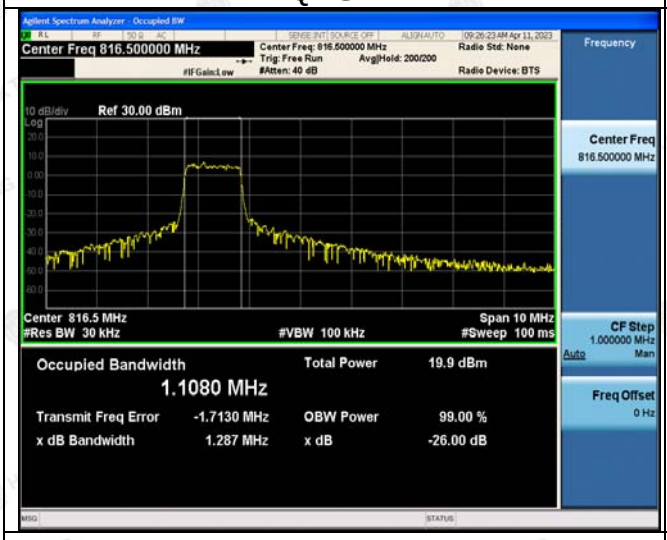
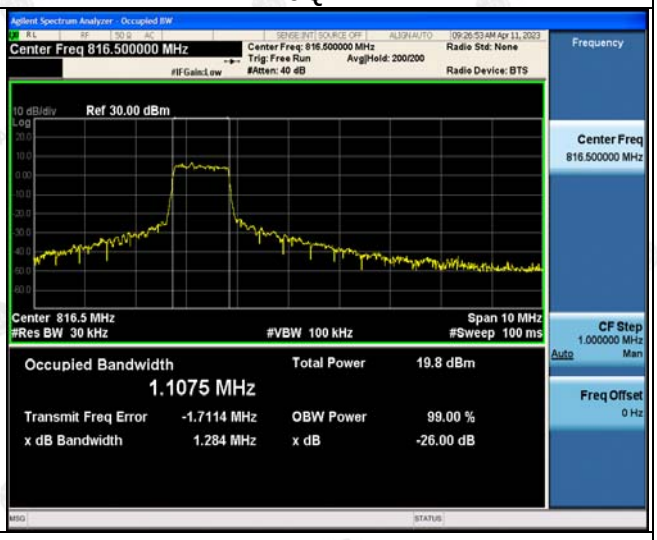
Middle Channel	
6RB#0	6RB#0
High Channel	
LTE FDD Band 26-5MHz Channel Bandwidth	
QPSK	16QAM
	
6RB#0	6RB#0
Low Channel	

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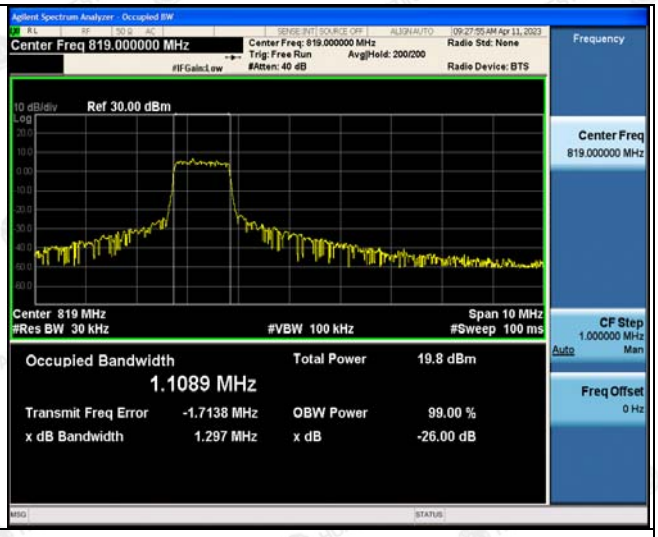
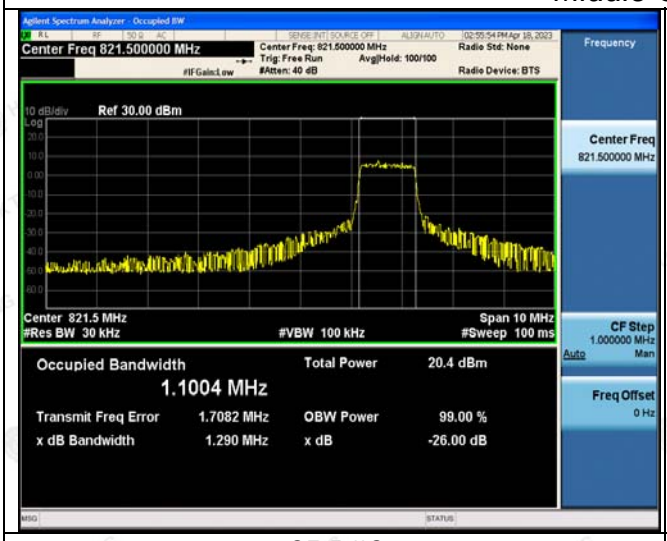
6RB#0

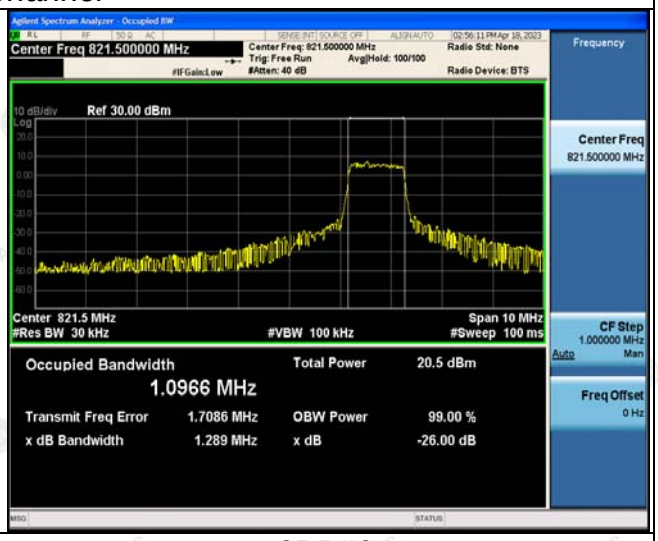


6RB#0

Middle Channel



6RB#0



6RB#0

High Channel

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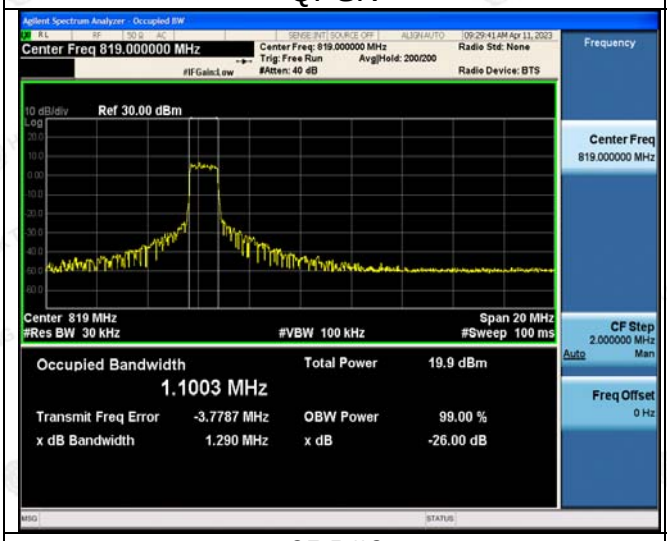
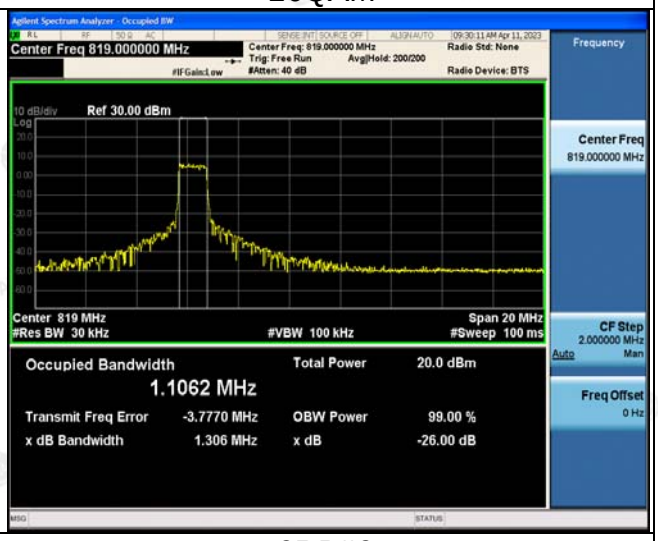
LTE FDD Band 26-10MHz Channel Bandwidth	
QPSK	16QAM
	
6RB#0	6RB#0

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