RF TEST REPORT

Applicant	Quectel Wireless Solutions Co., Ltd
FCC ID	XMR202008EC25AFXD
Product	LTE Module
Brand	Quectel
Model	EC25-AFXD; EC25-AFXD MINIPCIE
Report No.	R2203A0238-R4
Issue Date	April 11, 2022

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 2 (2021)/ FCC CFR 47 Part 90R (2021)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Peng Tao

Performed by: Peng Tao

Kai Xu

Approved by: Kai Xu

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TABLE OF CONTENT

1. Test Laboratory 4
1.1. Notes of the Test Report 4
1.2. Test facility 4
1.3. Testing Location 4
2. General Description of Equipment under Test 5
3. Applied Standards 7
4. Test Configuration 8
5. Test Case Results 9
5.1. RF Power Output 9
5.2. Effective Radiated Power 11
5.3. Occupied Bandwidth 14
5.4. Emission Mask 18
5.5. Band Edge Compliance 21
5.6. Peak-to-Average Power Ratio (PAPR) 27
5.7. Frequency Stability 29
5.8. Spurious Emissions at Antenna Terminals 33
5.9. Radiates Spurious Emission 37
6. Main Test Instruments 41
ANNEX A: The EUT Appearance 42
ANNEX B: Test Setup Photos 43
ANNEX C: Product Change Description 1 44
ANNEX D: Product Change Description 2 45

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Summary of measurement results

No.	Test Type	Clause in FCC rules	Verdict
1	RF power output	2.1046/90.635 (b)	PASS
2	Effective Radiated Power	90.542	PASS
3	Occupied Bandwidth	2.1049/ 90.209	PASS
4	Emission Masks	90.210(b)	PASS
5	Band Edges Compliance	2.1051 / 90.543	PASS
6	Peak-to-Average Power Ratio	KDB 971168 D01(5.7)	PASS
7	Frequency Stability	90.539 (c)	PASS
8	Spurious Emissions at Antenna Terminals	90.543 (e)	PASS
9	Radiates Spurious Emission	90.543 (e)	PASS
Date of Testing: June 29, 2018~ July 16, 2018 and July 26, 2018 and August 3, 2019~ August 13, 2019			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard. All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

EC25-AFXD; EC25-AFXD MINIPCIE (Report No.: R2203A0238-R4) is a variant model of EC25-AFXD; EC25-AFXD MINIPCIE (Report No.: R2007A0434-R4). Test values duplicated from Original for variant. There is no test for variant in this report. The detailed product change description please refers to the ANNEX D.

EC25-AFXD; EC25-AFXD MINIPCIE (Report No.: R2007A0434-R4) is a variant model of EC25-AFX; EC25-AFX MINIPCIE (Report No.: R1907A0408-R4V1). Only Radiated Spurious Emissions of the worst band are verified for EC25-AFXD; EC25-AFXD MINIPCIE. The data did not get worse so it was not recorded in this report. The detailed product change description please refers to the ANNEX C.

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1. Test Laboratory

1.1. Notes of the Test Report

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1.2. Test facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

1.3. Testing Location

Company:	TA Technology (Shanghai) Co., Ltd.
Address:	No.145, Jintang Rd, Tangzhen Industry Park, Pudong
City:	Shanghai
Post code:	201201
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2. General Description of Equipment under Test

Client Information

Applicant	Quectel Wireless Solutions Co., Ltd
Applicant address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Manufacturer	Quectel Wireless Solutions Co., Ltd
Manufacturer address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

General Information

EUT Description			
Model	EC25-AFXD; EC25-AFXD MINIPCIE		
Product IMEI	863010031218428		
Hardware Version	R1.0		
Software Version	EC25AFXDGAR07A01M1G		
Power Supply	External Power Supply		
Antenna Type	The EUT don't have standard Antenna, The Antenna used for testi ng in this report is the after-market accessory (Dipole Antenna)		
Antenna Gain	4dBi		
Test Mode(s)	LTE Band 14;		
Test Modulation	QPSK 16QAM;		
LTE Category	4		
Maximum E.R.P.	LTE Band 14:	23.48dBm	
Rated Power Supply Voltage	3.8V		
Extreme Voltage	Minimum: 3.3V Maximum: 4.3V		
Extreme Temperature	Lowest: -40°C Highest: +85°C		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	LTE Band 14	788 ~ 798	758 ~ 768
Note: The information of the EUT is declared by the manufacturer.			

Accessory equipment	
Evaluation Board	RF Cable
RS232-to-USB Cable	Antenna: Dipole Antenna
Headset	DC 5V Adaptor

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EC25-AFX and EC25-AFX MINIPCIE are all LTE modules. They support the same frequency bands, use the same chipset and share the same software & hardware design. The main difference is on the carrier board.
EC25-AFX MINIPCIE makes up of EC25-AFX module and PCIe transferred board.
The transferred board switches EC25-AFX module to follow PCI Express Mini Card 1.2 standard connector protocol. No any other internal changes in EC25-AFX module.
Two models are identical in interior structure and components, and just connector interface is different for the marketing requirement.

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3. Applied Standards

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

Test standards:
FCC CFR 47 Part 90R (2021)
ANSI C63.26 (2015)

Reference standard:
FCC 47 CFR Part 2 (2021)
KDB 971168 D01 Power Meas License Digital Systems v03r01

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4. Test Configuration

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes. EUT stand-up position (Z axis), lie-down position (X, Y axis). Receiver antenna polarization (horizontal and vertical), the worst emission was found in position (X axis, horizontal polarization) and the worst case was recorded.

All mode and data rates and positions were investigated.
The following testing in LTE is set based on the maximum RF Output Power.

Test modes are chosen as the worst case configuration below for LTE Band 14

Test items	Bandwidth (MHz)		Modulation		RB			Test Channel		
	5	10	QPSK	16QAM	1	50%	100%	L	M	H
RF power output	O	O	O	O	O	O	O	O	O	O
Effective Isotropic Radiated power	O	O	O	O	O	O	O	O	O	O
Occupied Bandwidth	O	O	O	O	-	-	O	O	O	O
Emission Mask	O	O	O	O	O	-	O	O	-	O
Band Edge Compliance	O	O	O	O	O	-	O	O	-	O
Peak-to-Average Power Ratio	O	O	O	O	-	-	O	O	O	O
Frequency Stability	O	O	O	O	-	-	O	O	-	O
Spurious Emissions at Antenna Terminals	O	O	O	-	O	-	-	O	O	O
Radiates Spurious Emission	O	-	O	-	O	-	-	O	O	O
Note	1. The mark “O” means that this configuration is chosen for testing. 2. The mark “-” means that this configuration is not testing.									

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5. Test Case Results

5.1. RF Power Output

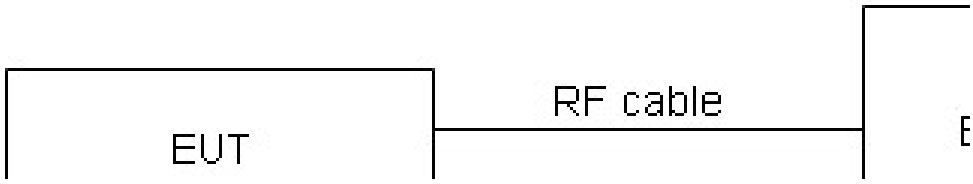
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

During the process of the testing, The EUT is controlled by the Base Station Simulator to ensure max power transmission and proper modulation.

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

Limits

Part 90.635 (b) the maximum output power of the transmitter for mobile stations is 100 watts.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.4 dB.

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Test Results

LTE Band 14				Conducted Power(dBm)		
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)		
				23305/790.5	23330/793	23355/795.5
5MHz	QPSK	1	0	23.81	23.59	23.59
		1	13	23.64	23.84	23.75
		1	24	23.68	23.88	23.90
		12	0	22.83	22.83	22.75
		12	6	22.77	22.80	22.71
		12	13	22.82	22.85	22.77
		25	0	22.89	22.76	22.73
	16QAM	1	0	22.50	22.47	22.42
		1	13	22.38	22.61	22.54
		1	24	22.21	22.57	22.22
		12	0	21.65	21.68	21.74
		12	6	21.84	21.59	21.85
		12	13	21.67	21.50	21.65
		25	0	21.77	21.73	21.69
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)		
				/	23330/793	/
10MHz	QPSK	1	0	/	23.73	/
		1	25	/	23.85	/
		1	49	/	23.53	/
		25	0	/	22.84	/
		25	13	/	22.78	/
		25	25	/	22.82	/
		50	0	/	22.83	/
	16QAM	1	0	/	22.70	/
		1	25	/	23.38	/
		1	49	/	22.85	/
		25	0	/	21.64	/
		25	13	/	21.80	/
		25	25	/	21.76	/
		50	0	/	21.77	/

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5.2. Effective Radiated Power

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

The testing follows FCC KDB 971168 v03r01 Section 5.8 and ANSI C63.26 (2015).

a) Connect the equipment as illustrated. Mount the equipment with the manufacturer specified antenna in a vertical orientation on a manufacturer specified mounting surface located on a non-conducting rotating platform of a RF anechoic chamber (preferred) or a standard radiation site.

b) Key the transmitter, then rotate the EUT 360° azimuthally and record spectrum analyzer power level (LVL) measurements at angular increments that are sufficiently small to permit resolution of all peaks. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading at each angular increment. (Note: several batteries may be needed to offset the effect of battery voltage droop, which should not exceed 5% of the manufactured specified battery voltage during transmission).

c) Replace the transmitter under test with a vertically polarized half-wave dipole (or an antenna whose gain is known relative to an ideal half-wave dipole). The center of the antenna should be at the same location as the center of the antenna under test.

d) Connect the antenna to a signal generator with a known output power and record the path loss (in dB) as LOSS. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading.LOSS = Generator Output Power (dBm) – Analyzer reading (dBm)

e) Determine the effective radiated output power at each angular position from the readings in steps b) and d) using the following equation:ERP (dBm) = LVL (dBm) + LOSS (dB)

f) The maximum ERP is the maximum value determined in the preceding step.

g) When calculating ERP, in addition to knowing the antenna radiation and matching characteristics, it is necessary to know the loss values of all elements (e.g.transmission line attenuation, mismatches, filters, combiners) interposed between the point where transmitter output power is measured, and the point where power is applied to the antenna. ERP can then be calculated as follows:

EEIRP (dBm) = Output Power (dBm) - Losses (dB) + Antenna Gain (dBi)

where:dBd refers to gain relative to an ideal dipole.

EIRP (dBm) = ERP (dBm) + 2.15 (dB.)

The RB allocation refers to section 5.1, using the maximum output power configuration.

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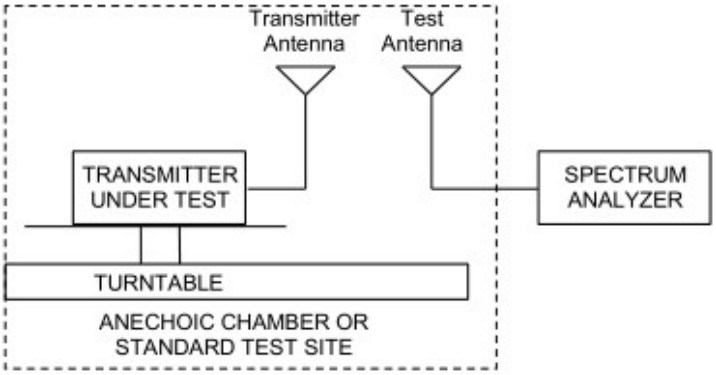
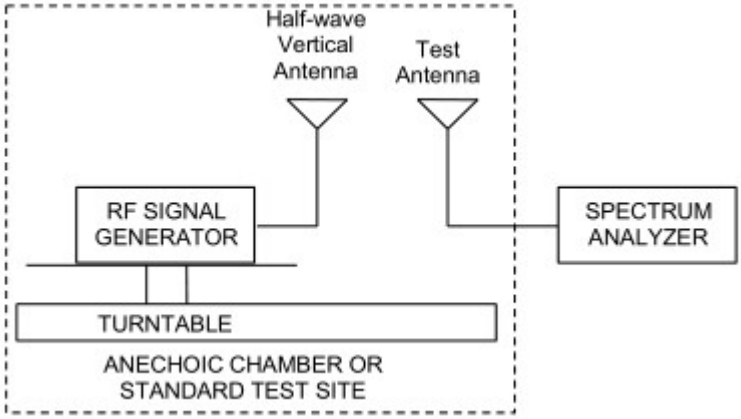
Test setup





Note: Area side:2.4mX3.6m

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Z axis) and the worst case was recorded.

Limits

90.542(7) Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 1.19 dB

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Test Results:

The measurement is performed for both of horizontal and vertical antenna Polarization, and only the data of worst mode is recorded in this report.

LTE Band 14						
Bandwidth	**Channel**	**Frequency (MHz)**	**Polarization**	**ERP (dBm)**	**Limit (dBm)**	**Conclusion**
5MHz (QPSK)	Low	790.5	Horizontal	23.23	34.77	Pass
	Mid	793	Horizontal	23.06	34.77	Pass
	High	795.5	Horizontal	23.29	34.77	Pass
10MHz (QPSK)	Mid	793	Horizontal	23.48	34.77	Pass
5MHz (16QAM)	Low	790.5	Horizontal	22.51	34.77	Pass
	Mid	793	Horizontal	22.53	34.77	Pass
	High	795.5	Horizontal	22.61	34.77	Pass
10MHz (16QAM)	Mid	793	Horizontal	23.04	34.77	Pass

Note: 1. EIRP= E.R.P+2.15

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5.3. Occupied Bandwidth

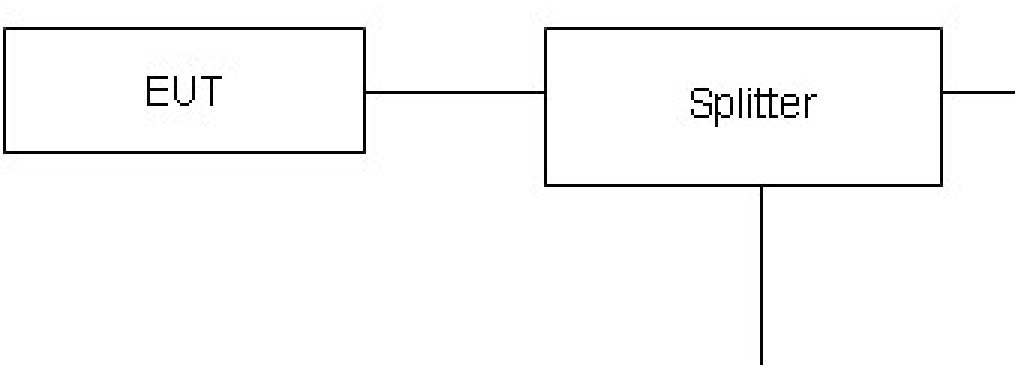
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The occupied bandwidth is measured using spectrum analyzer.
RBW is set to 100 kHz, VBW is set to 300 kHz for LTE Band 14 (5MHz).
RBW is set to 300 kHz, VBW is set to 1MHz for LTE Band 14 (10MHz).
99% power and -26dBc occupied bandwidths are recorded. Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

No specific occupied bandwidth requirements in part 2.1049.
Part 90.209 (a) Each authorization issued to a station licensed under this part will show an emission designator representing the class of emission authorized. The designator will be prefixed by a specified necessary bandwidth. This number does not necessarily indicate the bandwidth occupied by the emission at any instant. In those cases where part 2.202 of this chapter does not provide a formula for the computation of necessary bandwidth, the occupied bandwidth, as defined in part 2 of this chapter, may be used in lieu of the necessary bandwidth.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 624Hz.

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Test Result

LTE Band 14						
RB	Modulation	Bandwidth (MHz)	Channel	Frequency (MHz)	99% Power Bandwidth(MHz)	-26dBc Bandwidth(MHz)
100%	QPSK	5	23305	790.5	4.5134	5.042
			23330	793	4.5283	5.041
			23355	795.5	4.5084	5.030
		10	23330	793	9.0203	10.150
	16QAM	5	23305	790.5	4.5379	5.039
			23330	793	4.5042	5.004
			23355	795.5	4.5339	5.041
		10	23330	793	9.0272	9.992

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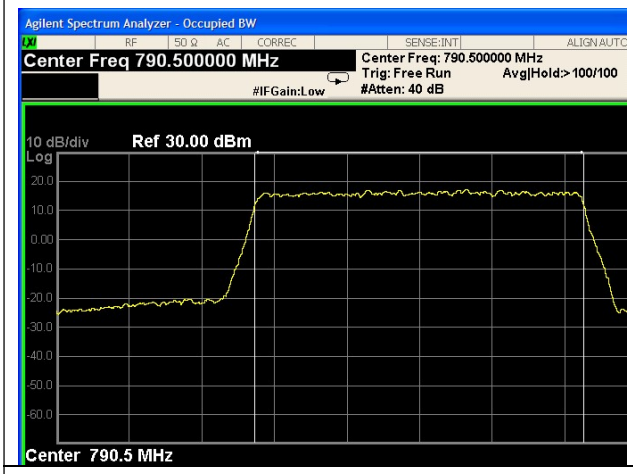
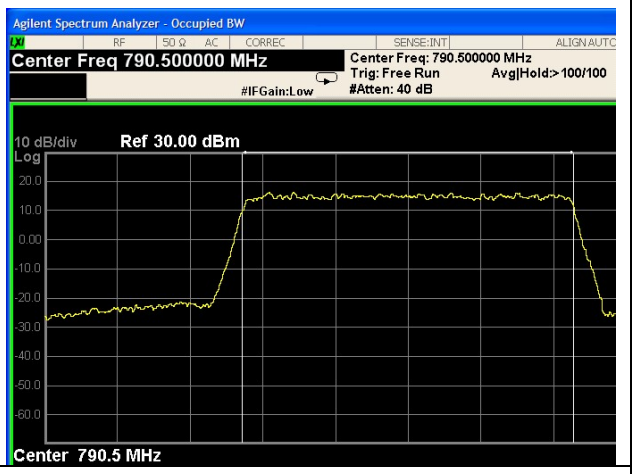
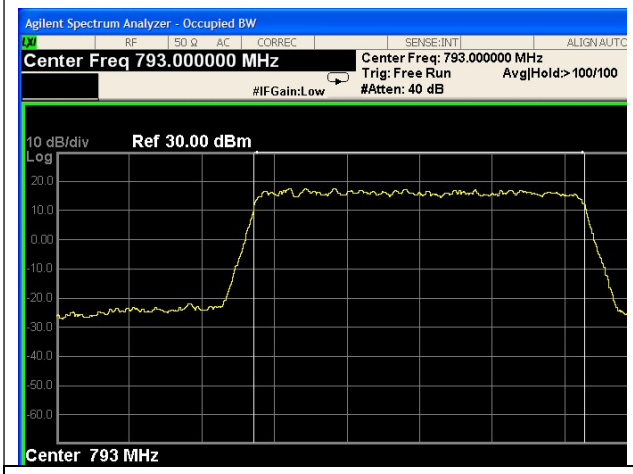
LTE Band 14 QPSK 5MHz CH-Low



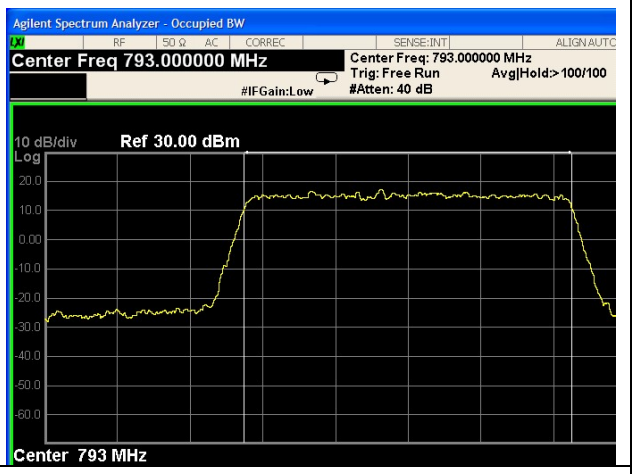
LTE Band 14 16QAM 5MHz CH-Low



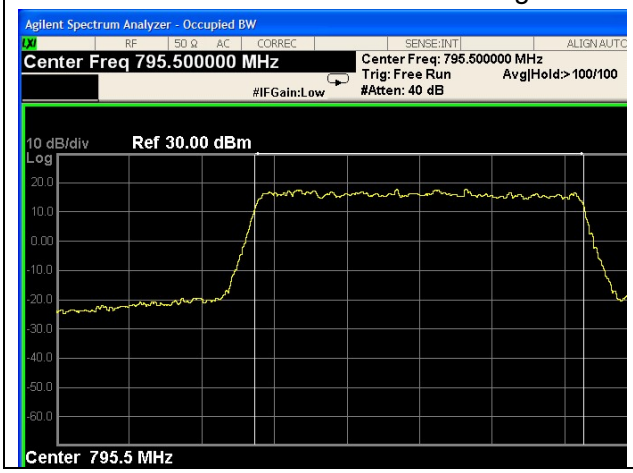
LTE Band 14 QPSK 5MHz CH-Middle



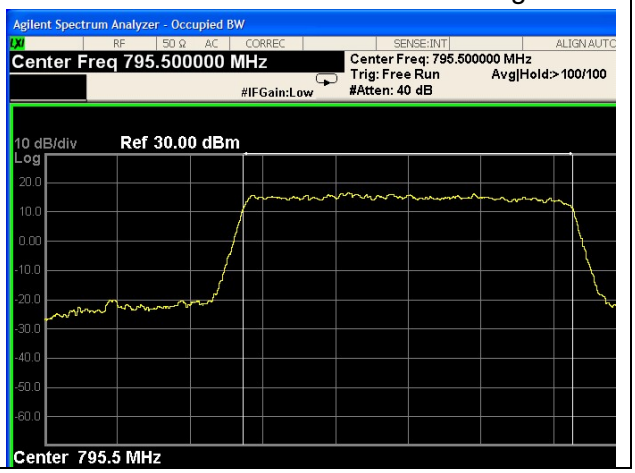
LTE Band 14 16QAM 5MHz CH-Middle



LTE Band 14 QPSK 5MHz CH-High



LTE Band 14 16QAM 5MHz CH-High



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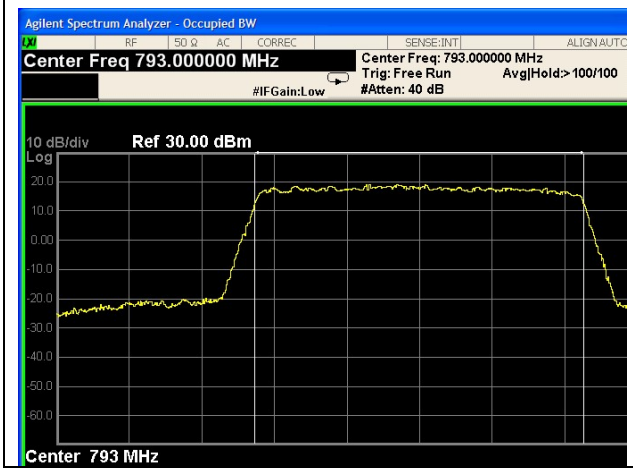
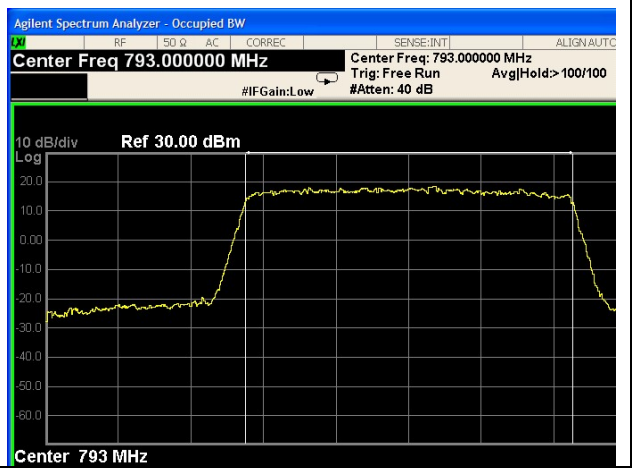
LTE Band 14 QPSK 10MHz CH-Middle	LTE Band 14 16QAM 10MHz CH-Middle
	

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5.4. Emission Mask

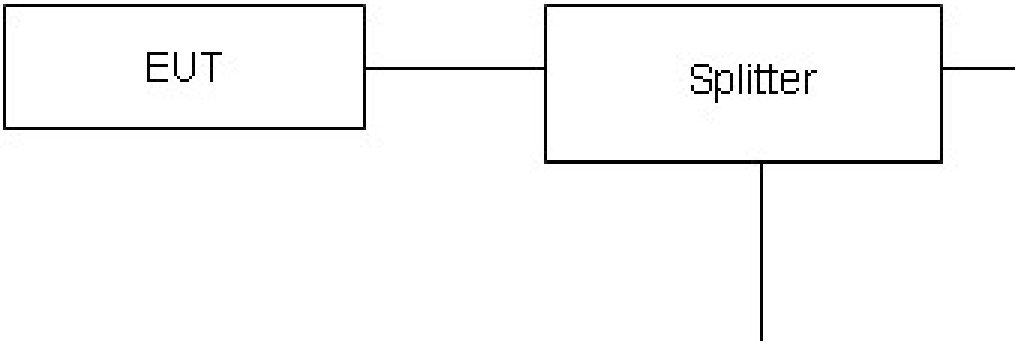
Ambient condition

Temperature	Relative humidity
21°C ~25°C	40%~60%

Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The band edge of the lowest and highest channels were measured. The average detector is used.
RBW is set to 51kHz, VBW is set to 160kHz for 5MHz, .
RBW is set to 100kHz, VBW is set to 300kHz for 10MHz,
Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

Rule Part 90.210(b) For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Rule Part 90.1323(a) The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96, U=0.684dB.

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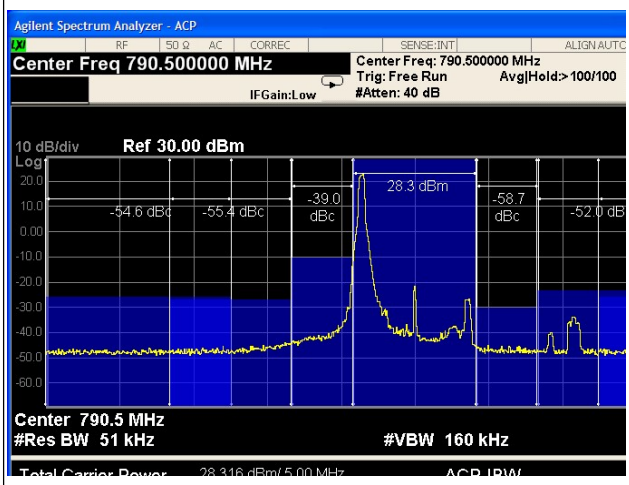
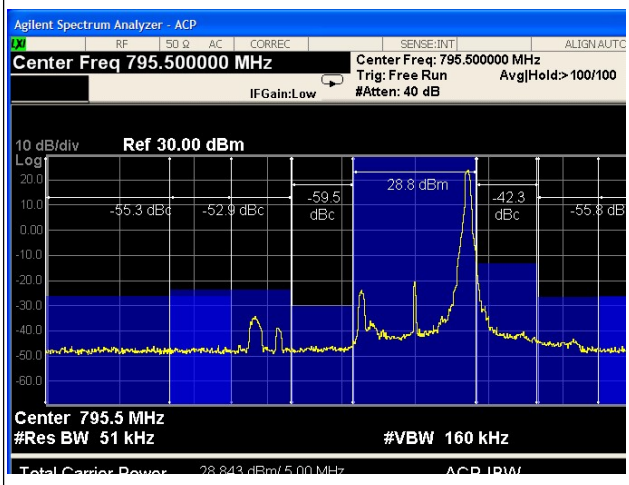
Test Result:

LTE Band 14 QPSK 1RB 5MHz CH Low

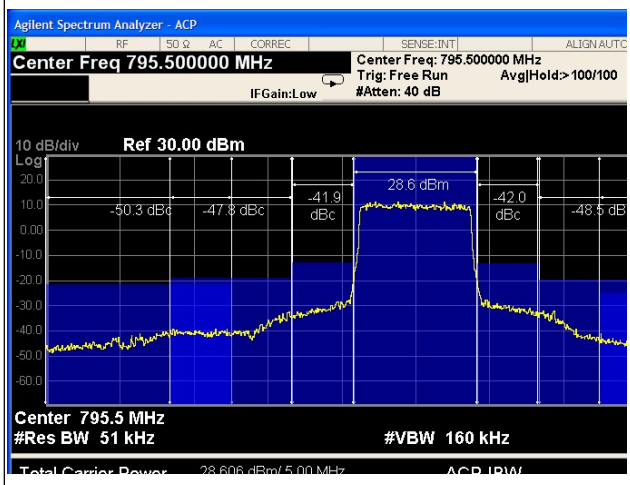


LTE Band 14 QPSK 100%RB 5MHz CH Low

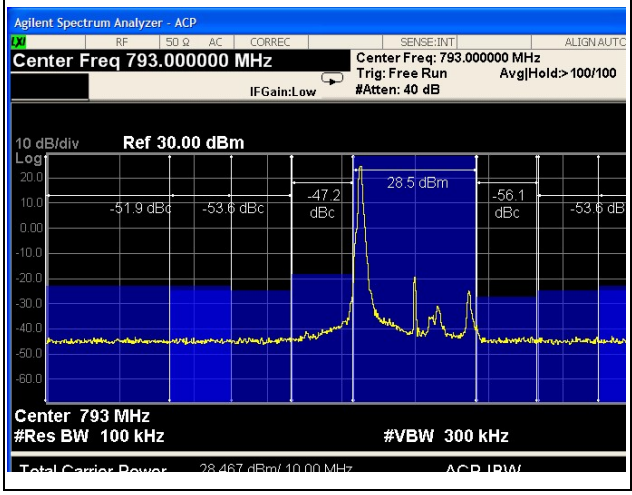
LTE Band 14 QPSK 1RB 5MHz CH High



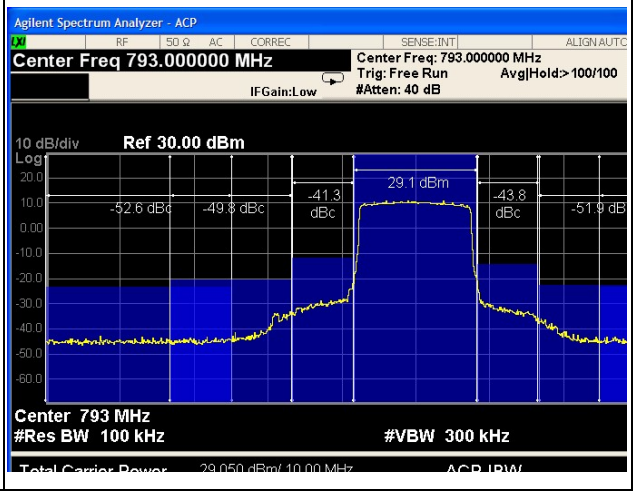
LTE Band 14 QPSK 100%RB 5MHz CH Low



LTE Band 14 QPSK 1RB 10MHz CH Middle



LTE Band 14 QPSK 100%RB 10MHz CH Middle



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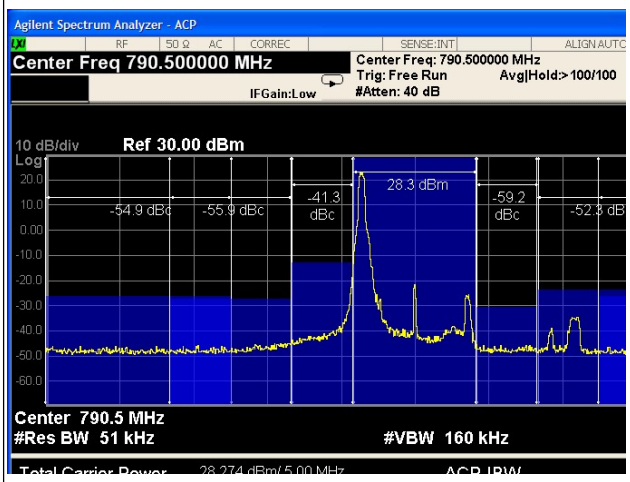
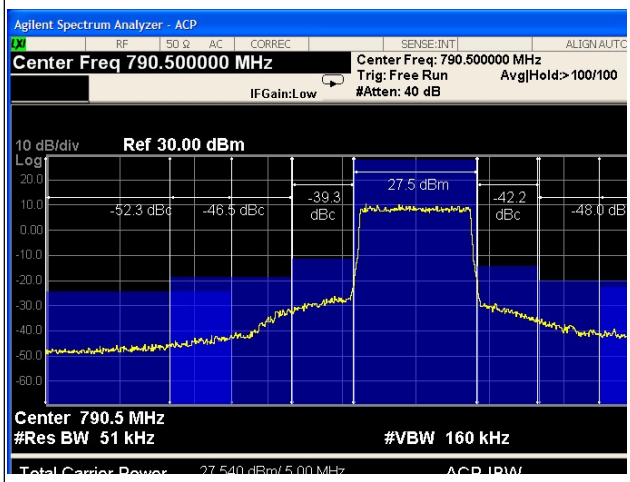
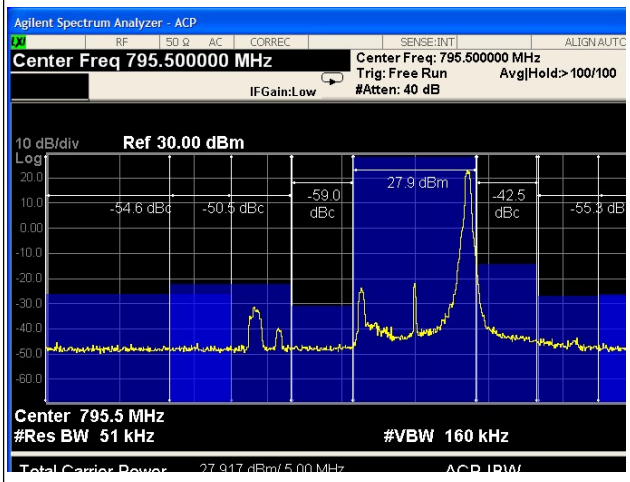
LTE Band 14 16QAM 1RB 5MHz CH Low



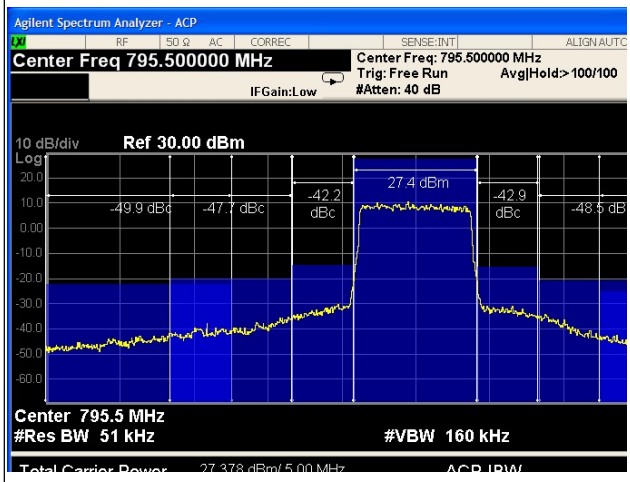
LTE Band 14 16QAM 100%RB 5MHz CH Low



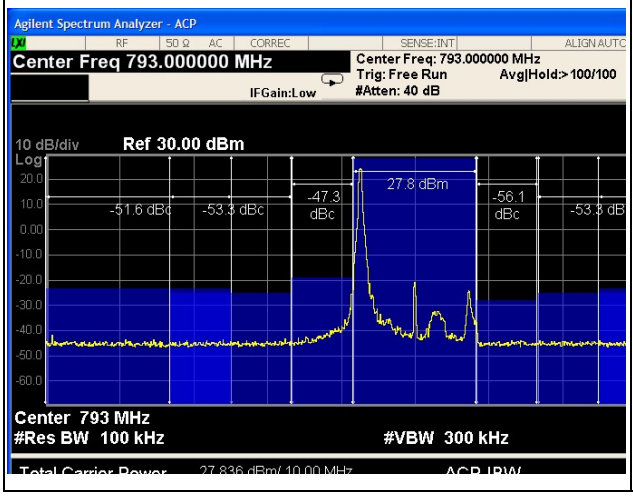
LTE Band 14 16QAM 1RB 5MHz CH High



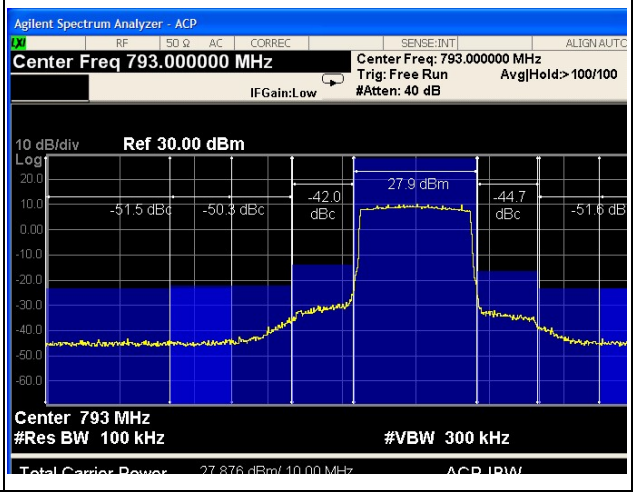
LTE Band 14 16QAM 100%RB 5MHz CH Low



LTE Band 14 16QAM 1RB 10MHz CH Middle



LTE Band 14 16QAM 100%RB 10MHz CH Middle



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