

MEASUREMENT REPORT

FCC PART 90


FCC ID: XMR2020EM160RGL2

Application: Quectel Wireless Solutions Company Limited

Application Type: Certification

Product: LTE-A Cat 16 M.2 Module

Model No.: EM160R-GL


Brand Name: 

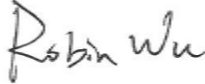
FCC Rule Part(s): Part 90 Subpart S

Classification: PCB Licensed Transmitter (PCB)

Test Procedure(s): ANSI C63.26-2015, KDB 971168 D01v03r01

Test Date: June 12 ~ August 17, 2020

Reviewed By: 
(Sunny Sun)

Approved By: 
(Robin Wu)



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.26-2015. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2009RSU020-U4	Rev. 01	Initial Report	09-02-2020	Valid

CONTENTS

Description	Page
1. INTRODUCTION	6
1.1. Scope	6
1.2. MRT Test Location	6
2. PRODUCT INFORMATION	7
2.1. Equipment Description	7
2.2. Product Specification Subjective to this Report	7
2.3. Description of Available Antennas	8
2.4. EMI Suppression Device(s)/Modifications	8
2.5. Maximum Power, Frequency Tolerance, and Emission Designator	8
2.6. Configuration of Tested System	9
2.7. Test Environment Condition	9
3. TEST EQUIPMENT CALIBRATION DATE.....	10
4. MEASUREMENT UNCERTAINTY.....	12
5. TEST RESULT	13
5.1. Summary	13
5.2. Occupied Bandwidth.....	14
5.2.1. Test Limit	14
5.2.2. Test Procedure.....	14
5.2.3. Test Setting	14
5.2.4. Test Setup	14
5.2.5. Test Result	15
5.3. Frequency Stability Measurement.....	19
5.3.1. Test Limit	19
5.3.2. Test Procedures Used.....	19
5.3.3. Test Setting	19
5.3.4. Test Setup	20
5.3.5. Test Result	21
5.4. Conducted Output Power Measurement	22
5.4.1. Test Limit	22
5.4.2. Test Procedures Used.....	22
5.4.3. Test Setting	22
5.4.4. Test Setup	22
5.4.5. Test Result	23
5.5. Band Edge Measurement	29

5.5.1.	Test Limit	29
5.5.2.	Test Procedure Used.....	29
5.5.3.	Test Setting	29
5.5.4.	Test Setup	30
5.5.5.	Test Result	31
5.6.	Conducted Spurious Emissions.....	35
5.6.1.	Test Limit	35
5.6.2.	Test Procedure Used.....	35
5.6.3.	Test Setting	35
5.6.4.	Test Setup	36
5.6.5.	Test Result	37
5.7.	Radiated Spurious Emissions Measurements	41
5.7.1.	Test Limit	41
5.7.2.	Test Procedure Used.....	41
5.7.3.	Test Setting	41
5.7.4.	Test Setup	41
5.7.5.	Test Result	43
6.	CONCLUSION	44
	Appendix A - Test Setup Photograph	45
	Appendix B - EUT Photograph.....	46

General Information

Applicant:	Quectel Wireless Solutions Company Limited
Applicant Address:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Manufacturer:	Quectel Wireless Solutions Company Limited
Manufacturer Address:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- MRT facility is an FCC accredited testing laboratory (MRT Designation No. CN1166) on the FCC website.
- MRT facility is an ISED recognized testing laboratory (MRT Reg. No. CN0001) on the ISED website.
- MRT facility is a VCCI registered (R-20025, G-20034, C-20020, T-20020) test laboratory with the site description on file at VCCI Council.
- MRT Lab is accredited to ISO 17025 by the A2LA under the A2LA Program (Cert. No. 3628.01) and CNAS under the CNAS Program (Cert. No. L10551) in EMC, Safety, Radio, Telecommunications and SAR testing.

1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada and Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name:	LTE-A Cat 16 M.2 Module
Model No.:	EM160R-GL
Brand Name:	QUECTEL
IMEI:	864292050003514
Single Band:	Band 2, 4, 5, 7, 12, 13, 14, 25, 26, 30, 38, 41, 48, 66
Intra-Band:	CA_41C
Category:	Category 16
Operating Temperature:	-25 ~ 75 °C
Power Type:	3.1 ~ 4.4Vdc, typical 3.7Vdc

2.2. Product Specification Subjective to this Report

FDD Tx Frequency Range:	Band 26: 814 ~ 824 MHz
FDD Rx Frequency Range:	Band 26: 859 ~ 869 MHz
Type of Modulation:	QPSK, 16QAM, 64QAM, 256QAM (DL)

Note 1: For other features of this EUT, test report will be issued separately.

Note 2: The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Note 3: LTE band 26 transmit frequency for part 90 rule is 814 ~ 824MHz and part 22 rule is 824 ~ 849MHz. ERP over 15MHz bandwidth complies the ERP limit line of part 22 rule, therefore ERP of the partial frequency spectrum which falls within part 22 also complies.

2.3. Description of Available Antennas

Technology	Frequency Range (MHz)	Antenna Type	Max Peak Gain (dBi)
LTE Band 2	1850 ~ 1910	Dipole	1.15
LTE Band 4	1710 ~ 1755		-0.50
LTE Band 5	824 ~ 849		1.85
LTE Band 7	2500 ~ 2570		1.32
LTE Band 12	699 ~ 716		-2.43
LTE Band 13	777 ~ 787		-0.10
LTE Band 14	788 ~ 798		2.40
LTE Band 25	1850 ~ 1915		1.15
LTE Band 26	814 ~ 849		1.85
LTE Band 30	2305 ~ 2315		-3.64
LTE Band 38	2570 ~ 2620		0.93
LTE Band 41	2496 ~ 2690		0.93
LTE Band 48	3550 ~ 3700		-3.37
LTE Band 66	1710 ~ 1780		-0.50

Note: All antenna information (Antenna type and Peak Gain) is provided by the manufacturer.

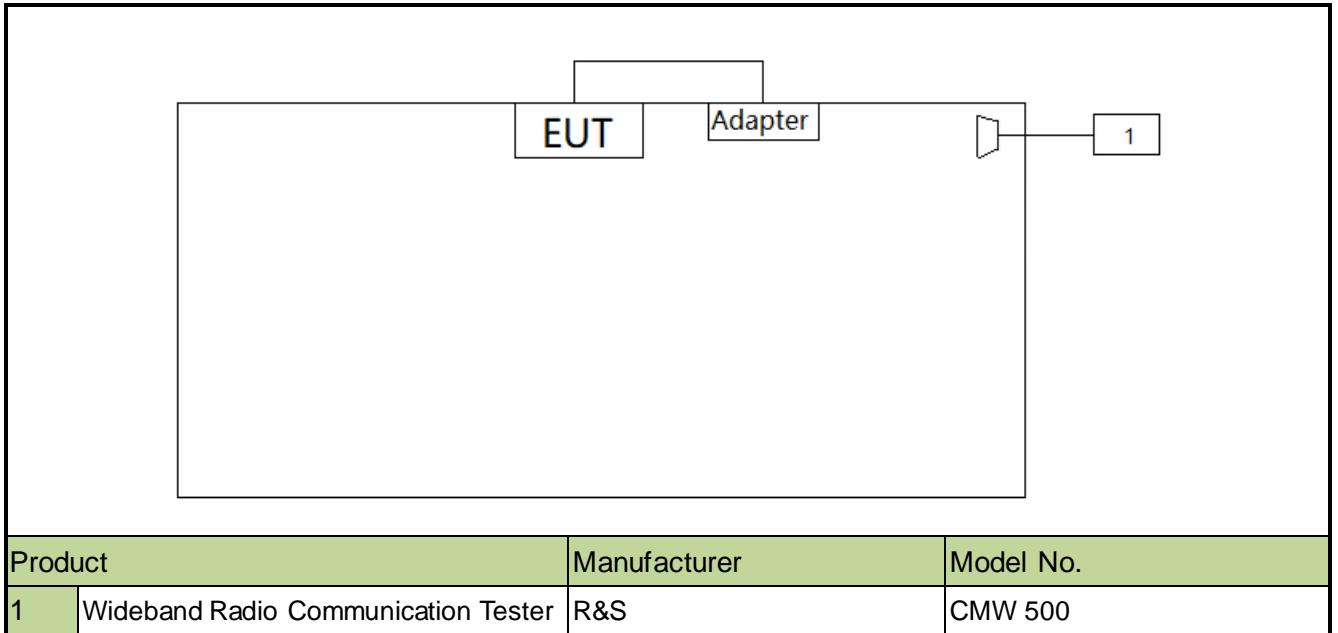
2.4. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.5. Maximum Power, Frequency Tolerance, and Emission Designator

LTE Band 14		QPSK			16QAM			64QAM		
BW (MHz)	Feq. (MHz)	Designator	Tolerance (ppm)	Max Power (W)	Designator	Tolerance (ppm)	Max Power (W)	Designator	Tolerance (ppm)	Max Power (W)
1.4	814.7 ~ 823.3	1M07G7D	-	0.2371	1M08W7D	-	0.1936	1M08W7D	-	0.1730
3	815.5 ~ 822.5	2M68G7D	-	0.2404	2M67W7D	-	0.2109	2M68W7D	-	0.2109
5	816.5 ~ 821.5	4M46G7D	-	0.2404	4M46W7D	-	0.1758	4M47W7D	-	0.1758
10	819.0	8M92G7D	-0.0104	0.2350	8M91W7D	-	0.1811	8M95W7D	-	0.1811
15	821.5	13M3G7D	-	0.2466	13M4W7D	-	0.1892	13M4W7D	-	0.1892

2.6. Configuration of Tested System



2.7. Test Environment Condition

Ambient Temperature	15°C~35°C
Relative Humidity	20%RH ~75%RH

3. TEST EQUIPMENT CALIBRATION DATE

Radiated Emission - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2021/08/01
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2020/11/07
PXA Signal Analyzer	Keysight	9030B	MRTSUE06395	1 year	2020/09/03
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2020/11/10
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2021/03/31
Broad Band Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06023	1 year	2020/10/13
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06597	1 year	2021/02/23
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2020/11/15
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2021/06/11
EMC Cable	HUBER+SUHN ER	SF126-2M	MRTSUE06732	1 year	2021/04/11
Thermohyrometer	Testo	608-H1	MRTSUE06403	1 year	2021/08/08
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2021/04/30

Radiated Emission - AC2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Keysight	N9038A	MRTSUE06125	1 year	2021/08/01
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2020/11/07
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2020/11/10
Bilog Period Antenna	Schwarzbeck	VULB 9162	MRTSUE06022	1 year	2020/10/13
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06171	1 year	2020/10/27
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06597	1 year	2021/02/23
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06176	1 year	2020/11/15
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2021/06/11
EMC Cable	HUBER+SUHN ER	SF126-2M	MRTSUE06733	1 year	2021/04/10
Temperature/Humidity Meter	Minggao	ETH529	MRTSUE06170	1 year	2020/12/15
Anechoic Chamber	RIKEN	Chamber-AC2	MRTSUE06213	1 year	2021/04/30

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2021/04/15
EXA Signal Analyzer	Keysight	N9010B	MRTSUE06452	1 year	2021/07/11
Signal Analyzer	R&S	FSV40	MRTSUE06218	1 year	2021/04/15
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2020/11/07
Power Meter	Agilent	U2021XA	MRTSUE06030	1 year	2020/11/18
DC Power Supply	GWINSTEK	DPS-3303C	MRTSUE06064	N/A	N/A
True RMS Clamp Meter	Fluke	319	MRTSUE06080	1 year	2021/05/06
Directional Coupler	Agilent	87301D	MRTSUE06082	1 year	2021/03/25
Attenuator	MVE	6dB	MRTSUE06534	1 year	2020/12/12
Attenuator	MVE	10dB	MRTSUE06543	1 year	2020/12/12
Temperature & Humidity Chamber	BAOYT	BYH-150CL	MRTSUE06051	1 year	2020/11/07
Thermohygrometer	testo	608-H1	MRTSUE06401	1 year	2021/08/08

Software	Version	Function
EMI Software	V3	EMI Test Software

4. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Radiated Emission Measurement
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): Horizontal: 9kHz~300MHz: 5.04dB 300MHz~1GHz: 4.95dB 1GHz~40GHz: 6.40dB Vertical: 9kHz~300MHz: 5.24dB 300MHz~1GHz: 6.03dB 1GHz~40GHz: 6.40dB
Spurious Emissions, Conducted
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.78dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.13dB
Power Spectrum Density
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.15dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.28%

5. TEST RESULT

5.1. Summary

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	Occupied Bandwidth	N/A	Conducted	Pass	Section 5.2
2.1055, 90.213	Frequency Stability	< 2.5 ppm		Pass	Section 5.3
90.635	Conducted Output Power	< 100W		Pass	Section 5.4
2.1051, 90.691(a)	Band Edge	< 50 + 10log ₁₀ (P _[Watts]) within 37.5kHz of Block Edge		Pass	Section 5.5, 5.6
2.1051, 90.691(a)	Spurious Emission	< 43 + 10log ₁₀ (P _[Watts])			
2.1053, 90.691(a)	Spurious Emissions	< 43 + 10log ₁₀ (P _[Watts])	Radiated	Pass	Section 5.7

Notes:

- 1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 2) All supported modulation types were evaluated. The worst-case emission of modulation was selected. Therefore, the Frequency Stability, Channel Band Edge, Radiated & Conducted Spurious Emission were presented in the test report.
- 3) This report is supplemented to MRT Original "2006RSU008-U4" Report & FCC ID: XMR2020EM160RGL updating FCC ID.

5.2. Occupied Bandwidth

5.2.1. Test Limit

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

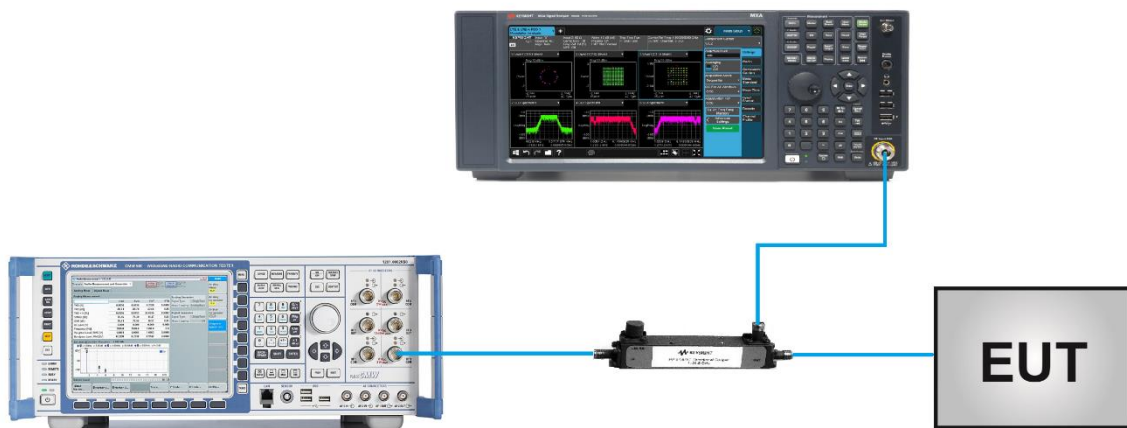
5.2.2. Test Procedure

ANSI C63.26-2015 - Section 5.4

5.2.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency
2. RBW = The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW
3. VBW $\geq 3 \times$ RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize
8. Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

5.2.4. Test Setup



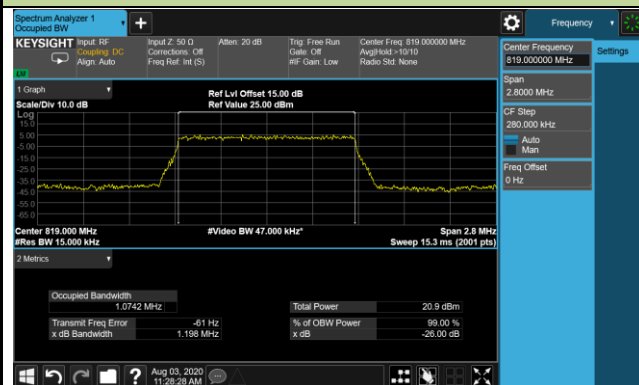
5.2.5. Test Result

Product	LTE-A Cat 16 M.2 Module	Test Engineer	Candy Luo
Test Date	2020/08/03	Test Site	SR6
Test Band	Band 26		

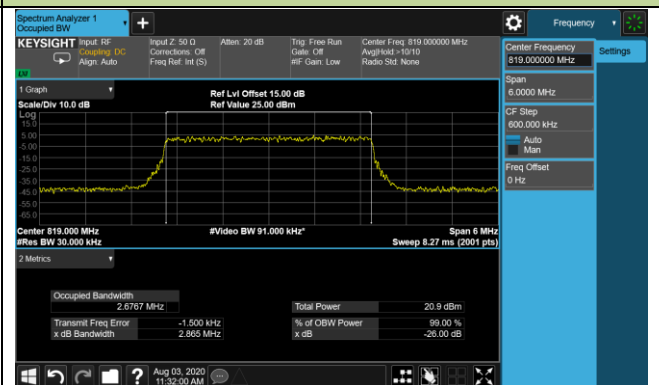
Modulation	Frequency (MHz)	Bandwidth (MHz)	99% Bandwidth (MHz)
QPSK	819.0	1.4	1.07
		3	2.68
		5	4.46
		10	8.92
16QAM	819.0	1.4	1.08
		3	2.67
		5	4.46
		10	8.91
64QAM	819.0	1.4	1.08
		3	2.68
		5	4.47
		10	8.95
QPSK	821.5	15	13.34
16QAM			13.36
64QAM			13.37

99% Bandwidth - QPSK

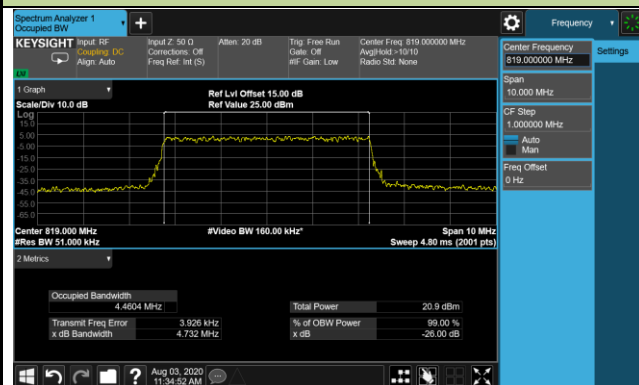
1.4MHz Channel Bandwidth



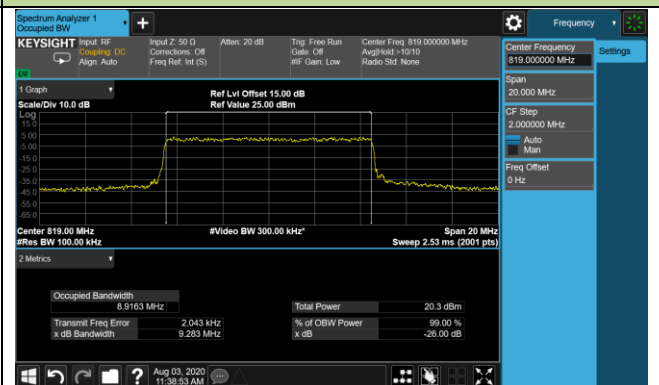
3MHz Channel Bandwidth



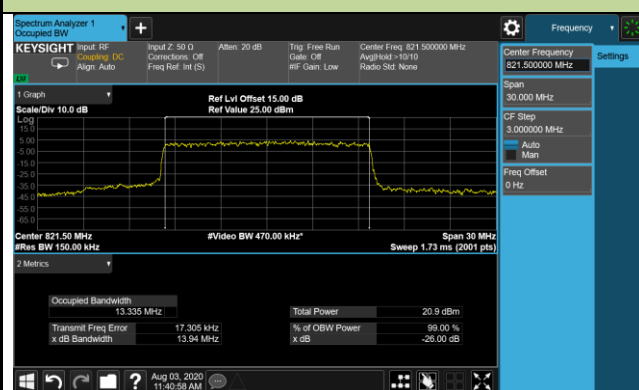
5MHz Channel Bandwidth



10MHz Channel Bandwidth

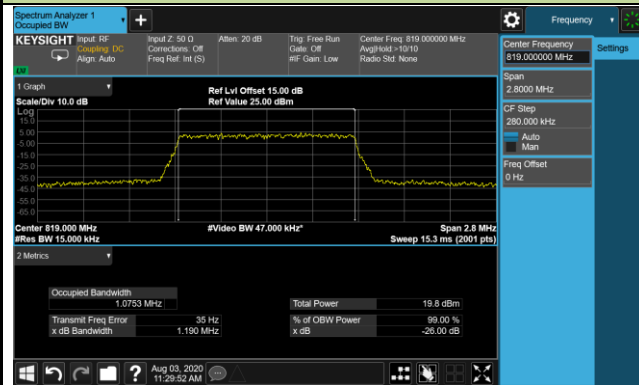


15MHz Channel Bandwidth

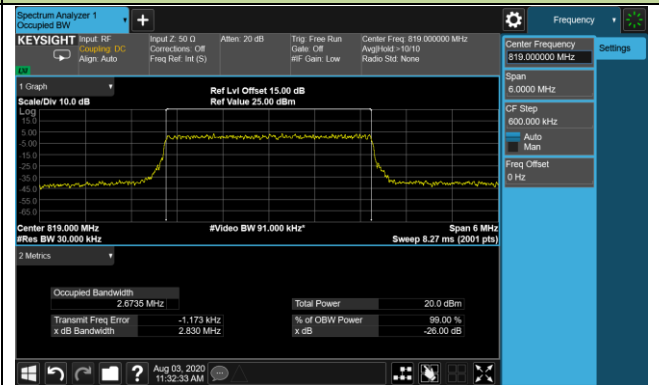


99% Bandwidth - 16QAM

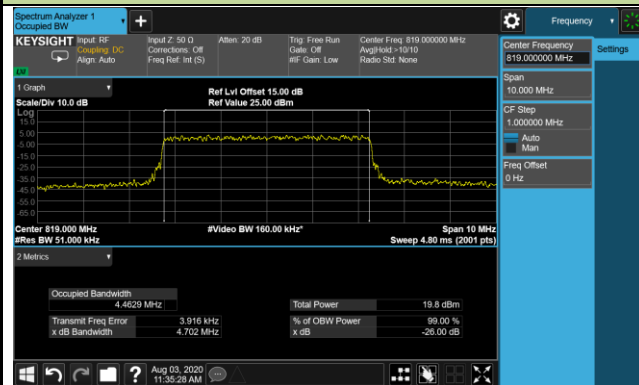
1.4MHz Channel Bandwidth



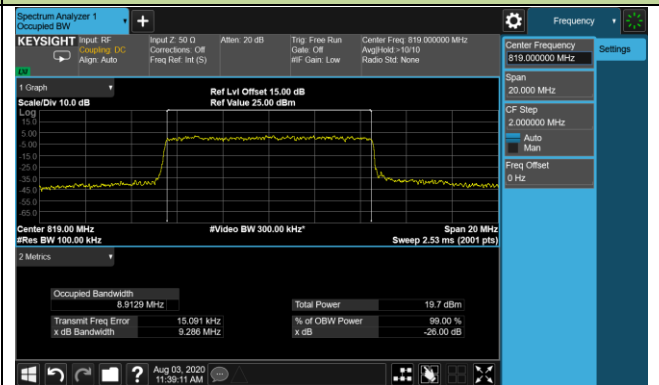
3MHz Channel Bandwidth



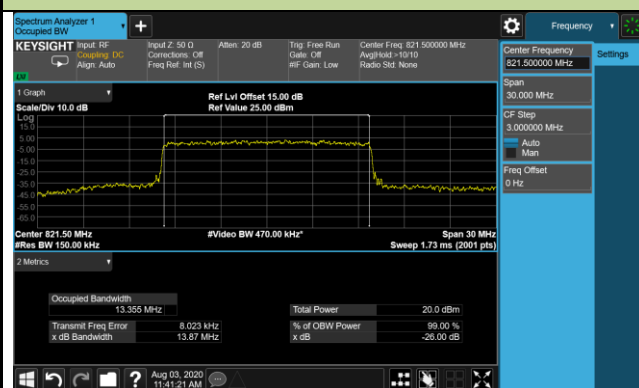
5MHz Channel Bandwidth



10MHz Channel Bandwidth

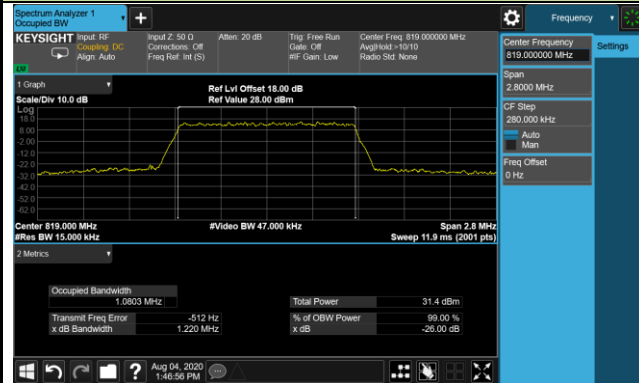


15MHz Channel Bandwidth

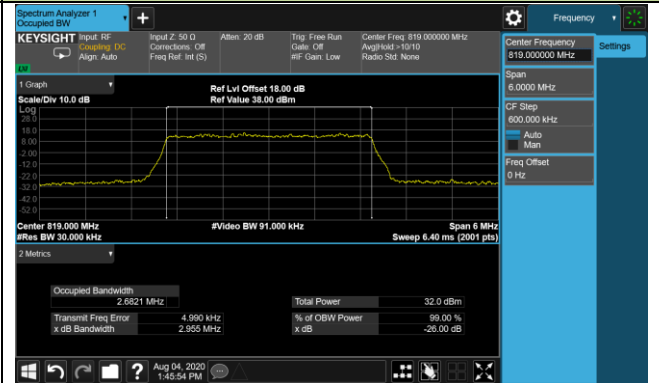


99% Bandwidth - 64QAM

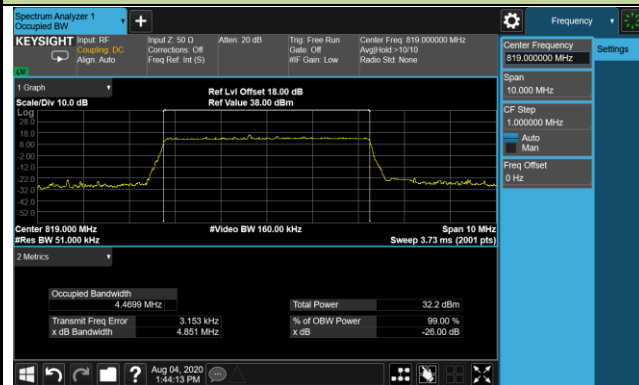
1.4MHz Channel Bandwidth



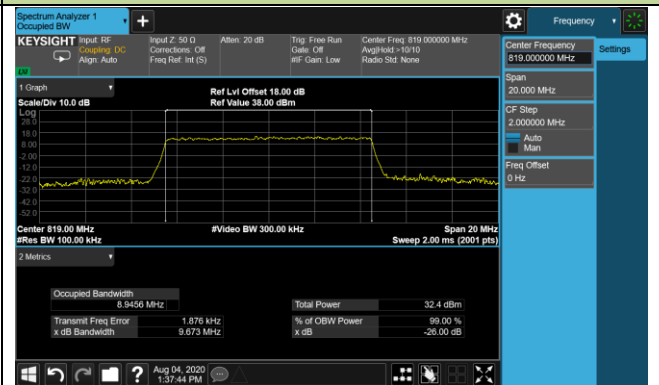
3MHz Channel Bandwidth



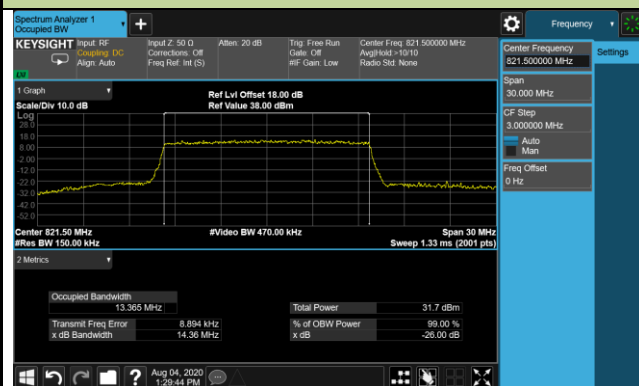
5MHz Channel Bandwidth



10MHz Channel Bandwidth



15MHz Channel Bandwidth



5.3. Frequency Stability Measurement

5.3.1. Test Limit

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.

5.3.2. Test Procedures Used

ANSI C63.26-2015 - Section 5.6

5.3.3. Test Setting

Frequency Stability Under Temperature Variations:

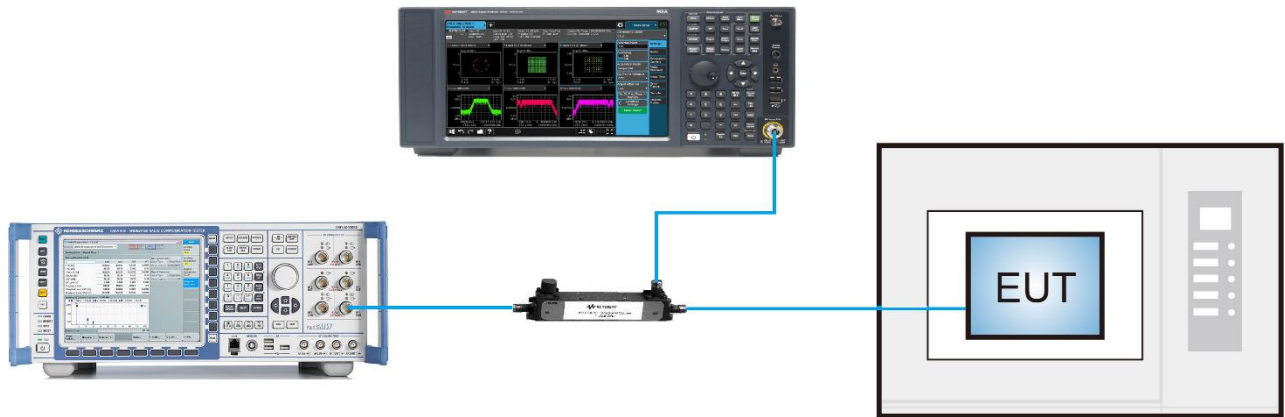
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C decreased per stage until the lowest temperature reached.

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.

5.3.4. Test Setup



5.3.5. Test Result

Product	LTE-A Cat 16 M.2 Module	Temperature	-30 ~ 50°C
Test Engineer	Candy Luo	Relative Humidity	53%
Test Site	TR3	Test Date	2020/06/19
Test Band	LTE Band 26		

Voltage (%)	Power (VDC)	Temp (°C)	Frequency Tolerance (ppm)
100%	3.7	- 30	-0.0096
		- 20	-0.0067
		- 10	-0.0082
		0	-0.0041
		+ 10	-0.0104
		+ 20 (Ref)	0.0088
		+ 30	-0.0052
		+ 40	-0.0072
		+ 50	-0.0094
115%	4.2	+ 20	-0.0071
85%	3.1	+ 20	-0.0030

5.4. Conducted Output Power Measurement

5.4.1. Test Limit

The maximum output power of the transmitter for mobile stations is 100 watts (20dBw).

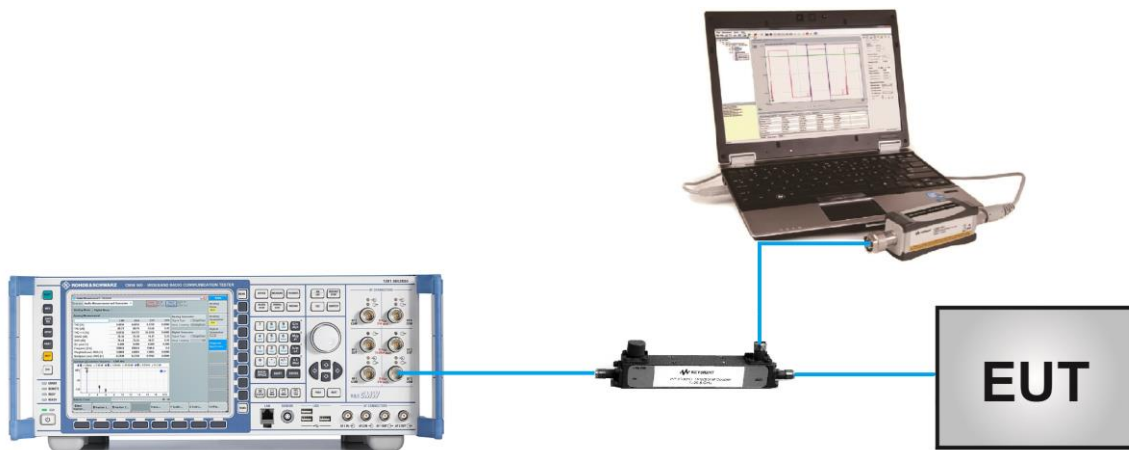
5.4.2. Test Procedures Used

ANSI C63.26-2015 - Section 5.2

5.4.3. Test Setting

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

5.4.4. Test Setup



5.4.5. Test Result

Product	LTE-A Cat 16 M.2 Module	Test Engineer	Candy Luo
Test Date	2020/08/17	Test Site	SR6
Test Band	LTE Band 26		

Channel No.	Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	Output Power (W)	Limit (W)
QPSK							
26697	814.7	1.4	1	0	23.51	0.2244	< 100
26740	819.0				23.49	0.2234	< 100
26783	823.3				23.59	0.2286	< 100
26697	814.7	1.4	1	2	23.68	0.2333	< 100
26740	819.0				23.55	0.2265	< 100
26783	823.3				23.75	0.2371	< 100
26697	814.7	1.4	1	6	23.65	0.2317	< 100
26740	819.0				23.63	0.2307	< 100
26783	823.3				23.61	0.2296	< 100
26697	814.7	1.4	6	0	23.36	0.2168	< 100
26740	819.0				23.25	0.2113	< 100
26783	823.3				23.29	0.2133	< 100
26705	815.5	3	1	0	23.64	0.2312	< 100
26740	819.0				23.55	0.2265	< 100
26775	822.5				23.51	0.2244	< 100
26705	815.5	3	1	7	23.81	0.2404	< 100
26740	819.0				23.68	0.2333	< 100
26775	822.5				23.81	0.2404	< 100
26705	815.5	3	1	14	23.7	0.2344	< 100
26740	819.0				23.55	0.2265	< 100
26775	822.5				23.65	0.2317	< 100
26705	815.5	3	15	0	23.35	0.2163	< 100
26740	819.0				23.39	0.2183	< 100
26775	822.5				23.11	0.2046	< 100

Channel No.	Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	Output Power (W)	Limit (W)
QPSK							
26715	816.5	5	1	0	23.29	0.2133	< 100
26740	819.0				23.68	0.2333	< 100
26765	821.5				23.66	0.2323	< 100
26715	816.5	5	1	12	23.65	0.2317	< 100
26740	819.0				23.81	0.2404	< 100
26765	821.5				23.73	0.2360	< 100
26715	816.5	5	1	24	23.26	0.2118	< 100
26740	819.0				23.66	0.2323	< 100
26765	821.5				23.6	0.2291	< 100
26715	816.5	5	25	0	23.27	0.2123	< 100
26740	819.0				23.25	0.2113	< 100
26765	821.5				23.13	0.2056	< 100
26740	819.0	10	1	0	23.55	0.2265	< 100
			1	24	23.43	0.2203	< 100
			1	49	23.71	0.2350	< 100
			50	0	23.02	0.2004	< 100
26765	821.5	15	1	0	23.92	0.2466	< 100
			1	36	23.66	0.2323	< 100
			1	74	23.77	0.2382	< 100
			75	0	23.13	0.2056	< 100

Channel No.	Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	Output Power (W)	Limit (W)
16QAM							
26697	814.7	1.4	1	0	22.62	0.1828	< 100
26740	819.0				22.71	0.1866	< 100
26783	823.3				22.64	0.1837	< 100
26697	814.7	1.4	1	2	22.75	0.1884	< 100
26740	819.0				22.87	0.1936	< 100
26783	823.3				22.82	0.1914	< 100
26697	814.7	1.4	1	6	22.71	0.1866	< 100
26740	819.0				22.78	0.1897	< 100
26783	823.3				22.69	0.1858	< 100
26697	814.7	1.4	6	0	21.57	0.1435	< 100
26740	819.0				21.87	0.1538	< 100
26783	823.3				22.74	0.1879	< 100
26705	815.5	3	1	0	22.58	0.1811	< 100
26740	819.0				22.98	0.1986	< 100
26775	822.5				22.77	0.1892	< 100
26705	815.5	3	1	7	22.73	0.1875	< 100
26740	819.0				23.11	0.2046	< 100
26775	822.5				22.89	0.1945	< 100
26705	815.5	3	1	14	22.59	0.1816	< 100
26740	819.0				22.98	0.1986	< 100
26775	822.5				22.74	0.1879	< 100
26705	815.5	3	15	0	21.89	0.1545	< 100
26740	819.0				22.01	0.1589	< 100
26775	822.5				21.65	0.1462	< 100

Channel No.	Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	Output Power (W)	Limit (W)
16QAM							
26715	816.5	5	1	0	22.74	0.1879	< 100
26740	819.0				22.52	0.1786	< 100
26765	821.5				22.51	0.1782	< 100
26715	816.5	5	1	12	23.08	0.2032	< 100
26740	819.0				22.79	0.1901	< 100
26765	821.5				22.61	0.1824	< 100
26715	816.5	5	1	24	22.54	0.1795	< 100
26740	819.0				22.67	0.1849	< 100
26765	821.5				22.53	0.1791	< 100
26715	816.5	5	25	0	21.84	0.1528	< 100
26740	819.0				21.70	0.1479	< 100
26765	821.5				21.75	0.1496	< 100
26740	819.0	10	1	0	22.49	0.1774	< 100
			1	24	22.46	0.1762	< 100
			1	49	22.58	0.1811	< 100
			50	0	21.58	0.1439	< 100
26765	821.5	15	1	0	23.50	0.2239	< 100
			1	36	22.47	0.1766	< 100
			1	74	23.51	0.2244	< 100
			75	0	20.75	0.1189	< 100

Channel No.	Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	Output Power (W)	Limit (W)
64QAM							
26697	814.7	1.4	1	0	22.08	0.1614	< 100
26740	819.0				22.02	0.1592	< 100
26783	823.3				22.15	0.1641	< 100
26697	814.7	1.4	1	2	22.24	0.1675	< 100
26740	819.0				22.10	0.1622	< 100
26783	823.3				22.38	0.1730	< 100
26697	814.7	1.4	1	6	22.15	0.1641	< 100
26740	819.0				22.17	0.1648	< 100
26783	823.3				22.25	0.1679	< 100
26697	814.7	1.4	6	0	21.23	0.1327	< 100
26740	819.0				21.17	0.1309	< 100
26783	823.3				20.95	0.1245	< 100
26705	815.5	3	1	0	22.31	0.1702	< 100
26740	819.0				22.51	0.1782	< 100
26775	822.5				22.23	0.1671	< 100
26705	815.5	3	1	7	22.41	0.1742	< 100
26740	819.0				22.74	0.1879	< 100
26775	822.5				22.21	0.1663	< 100
26705	815.5	3	1	14	22.37	0.1726	< 100
26740	819.0				22.62	0.1828	< 100
26775	822.5				22.21	0.1663	< 100
26705	815.5	3	15	0	21.29	0.1346	< 100
26740	819.0				23.24	0.2109	< 100
26775	822.5				21.03	0.1268	< 100

Channel No.	Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	Output Power (W)	Limit (W)
64QAM							
26715	816.5	5	1	0	21.92	0.1556	< 100
26740	819.0				22.14	0.1637	< 100
26765	821.5				22.45	0.1758	< 100
26715	816.5	5	1	12	22.20	0.1660	< 100
26740	819.0				22.21	0.1663	< 100
26765	821.5				22.39	0.1734	< 100
26715	816.5	5	1	24	21.87	0.1538	< 100
26740	819.0				22.17	0.1648	< 100
26765	821.5				22.30	0.1698	< 100
26715	816.5	5	25	0	21.24	0.1330	< 100
26740	819.0				21.21	0.1321	< 100
26765	821.5				21.11	0.1291	< 100
26740	819.0	10	1	0	22.56	0.1803	< 100
			1	24	22.42	0.1746	< 100
			1	49	22.58	0.1811	< 100
			50	0	20.98	0.1253	< 100
26765	821.5	15	1	0	22.77	0.1892	< 100
			1	36	22.59	0.1816	< 100
			1	74	22.68	0.1854	< 100
			75	0	21.24	0.1330	< 100

5.5. Band Edge Measurement

5.5.1. Test Limit

Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \text{ Log}(f/6.1)$ decibels or $50 + 10 \text{ Log}(P)$ decibels or 80decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10\text{Log}_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

5.5.2. Test Procedure Used

ANSI C63.26-2015 - Section 5.7

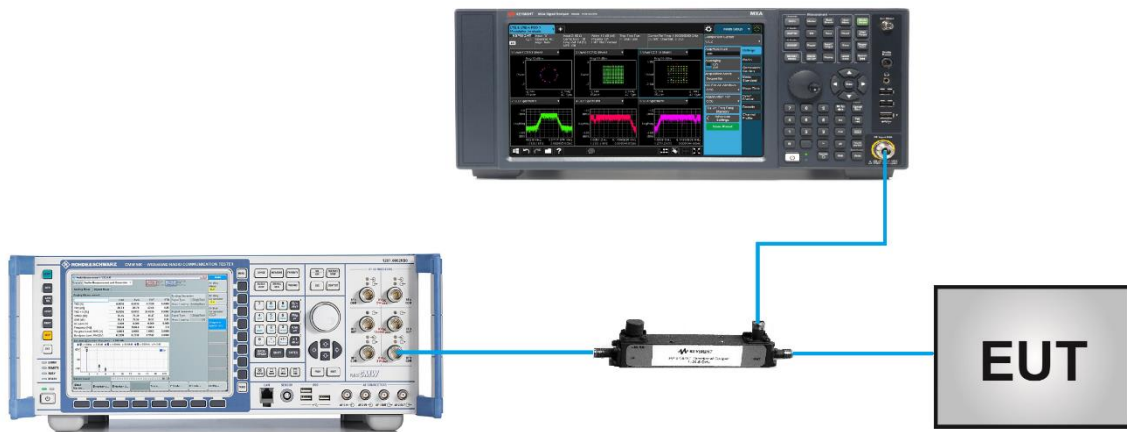
5.5.3. Test Setting

1. Set the analyzer frequency to low or high channel
2. $\text{RBW} \geq$ The nominal RBW shall be in the range of 1% of the anticipated OBW (in the 1MHz band immediately outside and adjacent to the band edge). For improvement of the accuracy in the measurement of the average power of a noise-like emission, a RBW narrower than the specified reference bandwidth can be used (generally limited to no less than 1% of the OBW), provided that a subsequent integration is performed over the full required measurement bandwidth. This integration should be performed using the spectrum analyzer's band power functions.
3. $\text{VBW} \geq 3 \cdot \text{RBW}$
4. Sweep time = auto
5. Detector = power averaging (rms)
6. Set sweep trigger to “free run.”
7. User gate triggered such that the analyzer only sweeps when the device is transmitting at full

power

- Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

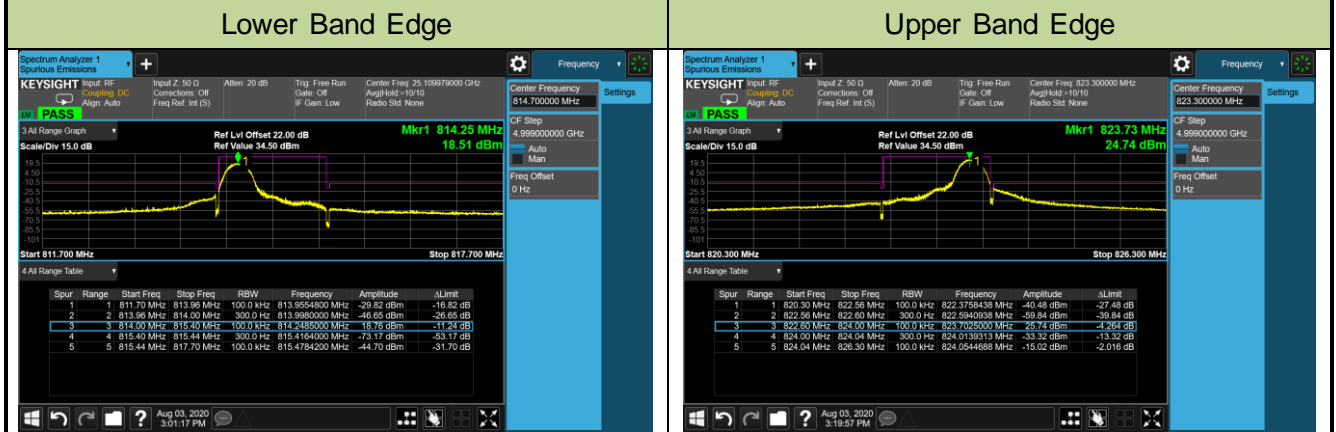
5.5.4. Test Setup



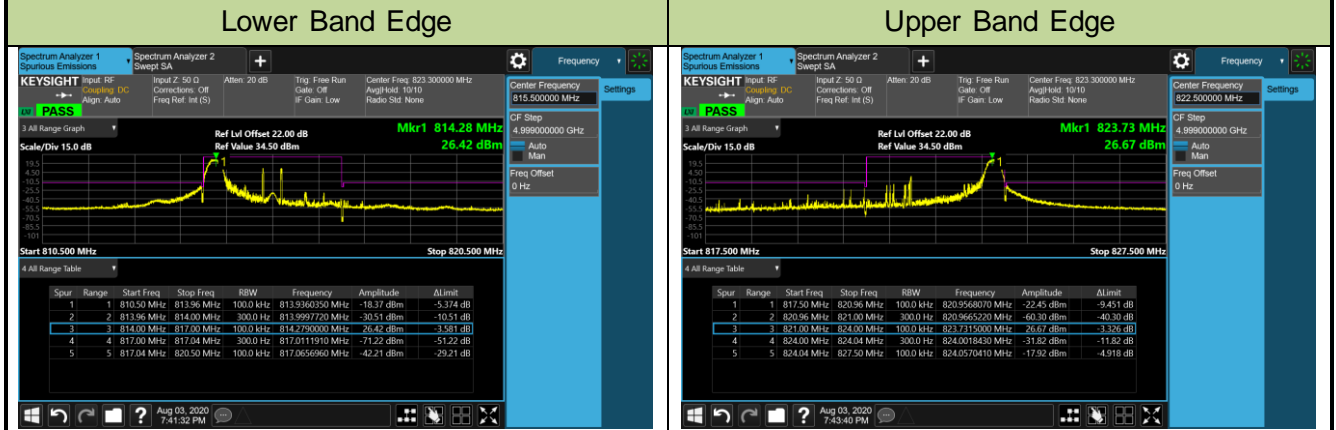
5.5.5. Test Result

Product	LTE-A Cat 16 M.2 Module	Test Engineer	Gordon Qi
Test Date	2020/08/03	Test Site	SR6
Test Band	Band 26	Test Result	Pass

1.4MHz Channel Bandwidth - 1RB

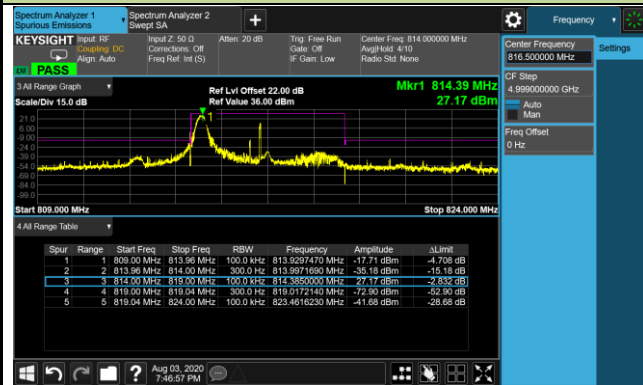


3MHz Channel Bandwidth - 1RB

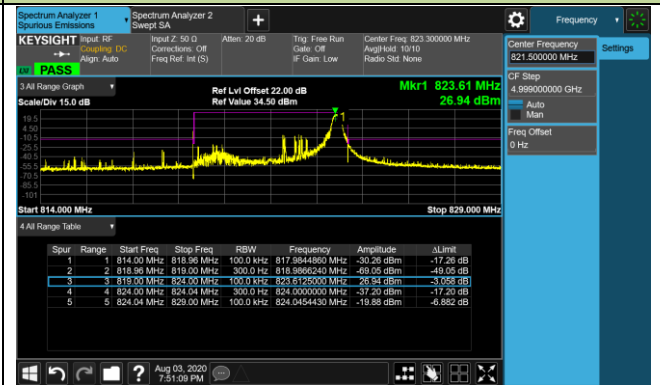


5MHz Channel Bandwidth - 1RB

Lower Band Edge

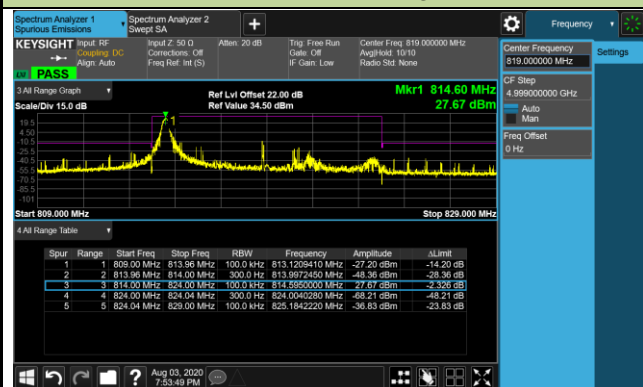


Upper Band Edge

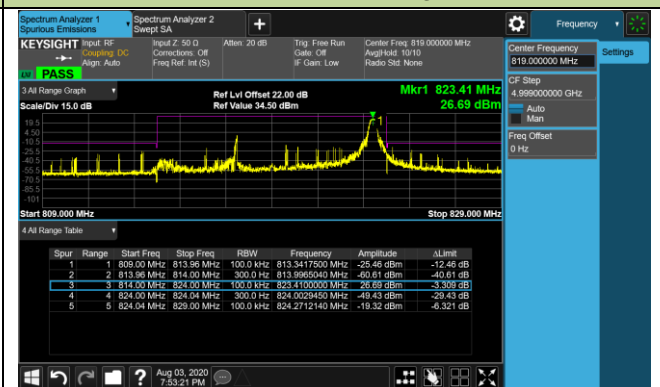


10MHz Channel Bandwidth - 1RB

Lower Band Edge

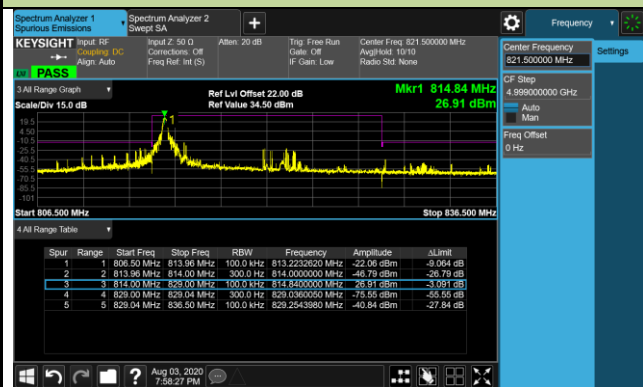


Upper Band Edge

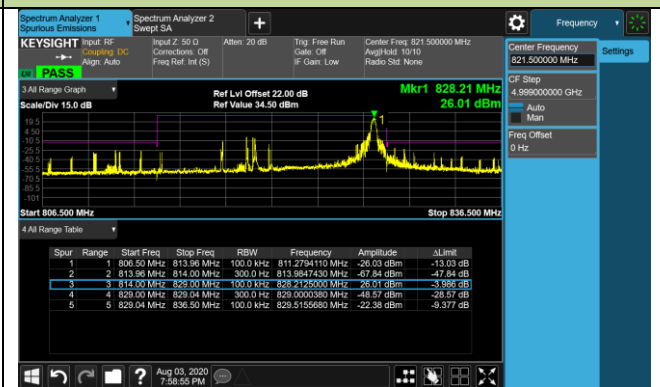


15MHz Channel Bandwidth - 1RB

Lower Band Edge

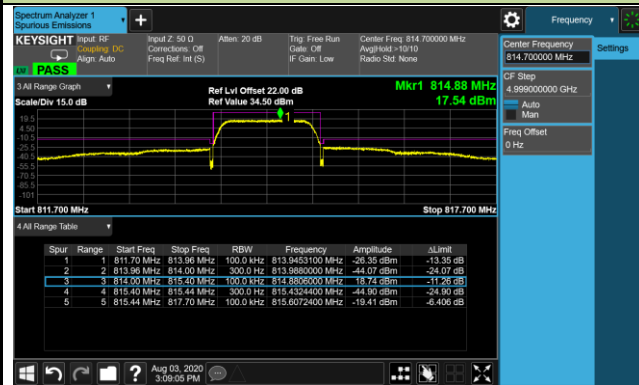


Upper Band Edge

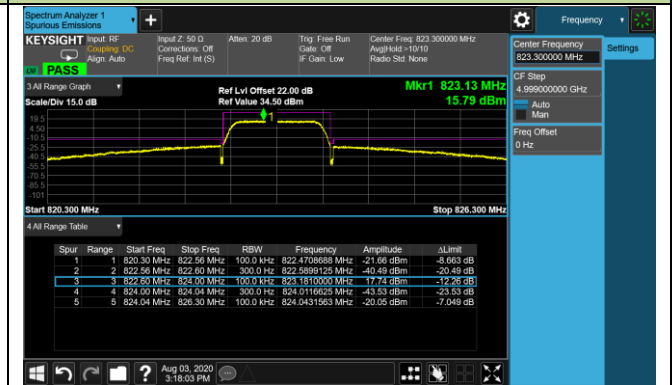


1.4MHz Channel Bandwidth - Full RB

Lower Band Edge

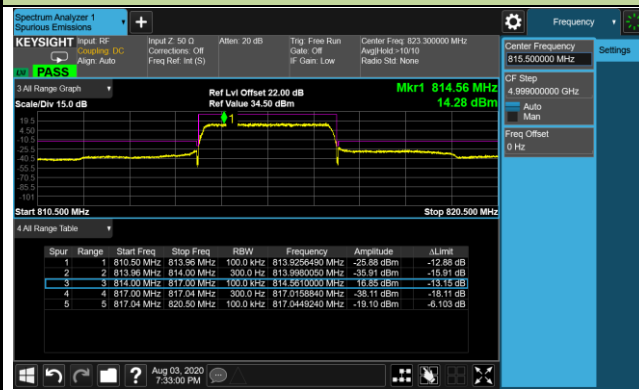


Upper Band Edge

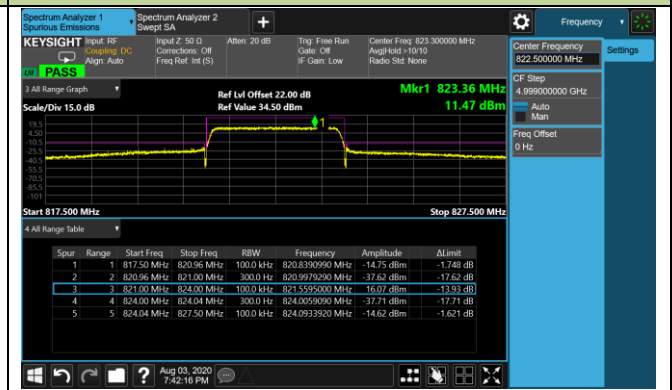


3MHz Channel Bandwidth - Full RB

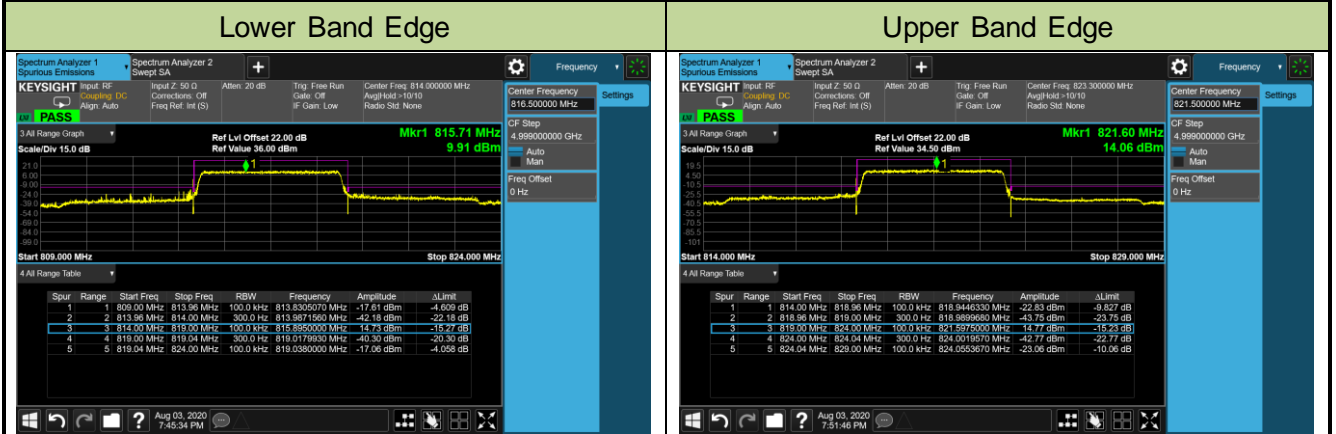
Lower Band Edge



Upper Band Edge



5MHz Channel Bandwidth - Full RB



10MHz Channel Bandwidth - Full RB



15MHz Channel Bandwidth - Full RB



5.6. Conducted Spurious Emissions

5.6.1. Test Limit

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated, and the worst-case configuration results are reported in this section.

For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10\log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

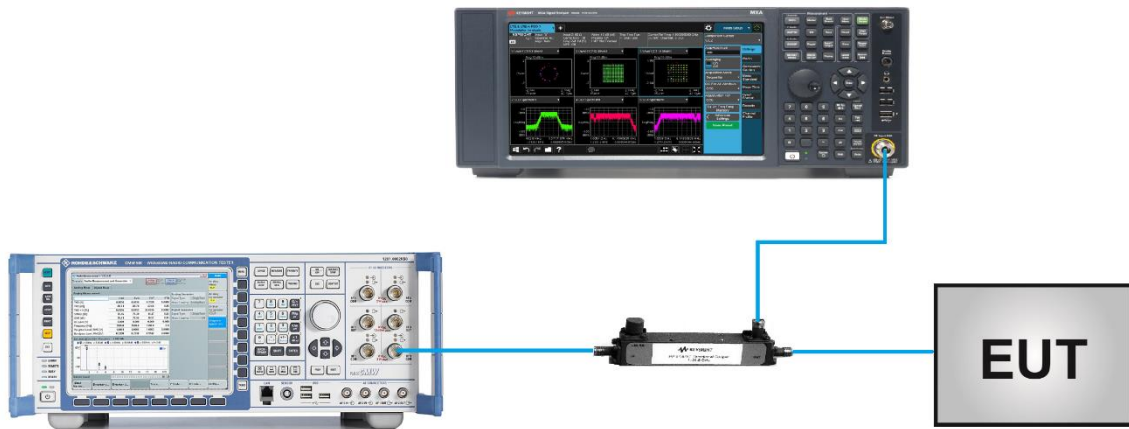
5.6.2. Test Procedure Used

ANSI C63.26-2015 - Section 5.7

5.6.3. Test Setting

1. Set the analyzer frequency to low, mid, high channel.
2. RBW = 1MHz
3. VBW \geq 3*RBW
4. Sweep time = auto
5. Detector = power averaging (rms)
6. Set sweep trigger to "free run."
7. User gate triggered such that the analyzer only sweeps when the device is transmitting at full power.
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple.
To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

5.6.4. Test Setup



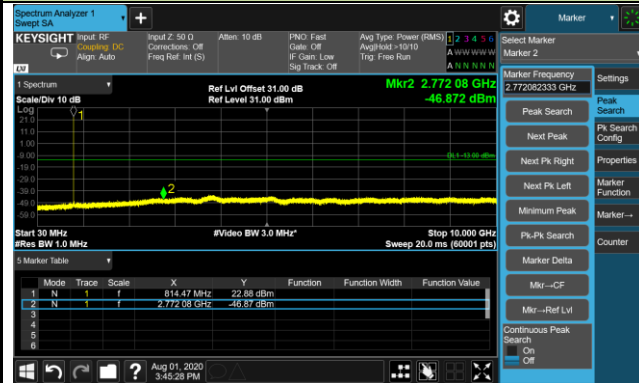
5.6.5. Test Result

Product	LTE-A Cat 16 M.2 Module	Test Engineer	Candy Luo
Test Date	2020/06/30	Test Site	SR6
Test Band	Band 26	Test Result	Pass

Channel	Frequency (MHz)	Channel Bandwidth (MHz)	Frequency Range (MHz)	Max Spurious Emissions (dBm)	Limit (dBm)	Result
QPSK						
26697	814.7	1.4	30 ~ 10000	-46.87	≤ -13.00	Pass
26740	819.0	1.4	30 ~ 10000	-46.36	≤ -13.00	Pass
26783	823.3	1.4	30 ~ 10000	-45.37	≤ -13.00	Pass
26705	815.5	3	30 ~ 10000	-45.83	≤ -13.00	Pass
26740	819.0	3	30 ~ 10000	-46.91	≤ -13.00	Pass
26775	822.5	3	30 ~ 10000	-45.77	≤ -13.00	Pass
26715	816.5	5	30 ~ 10000	-44.05	≤ -13.00	Pass
26740	819.0	5	30 ~ 10000	-43.19	≤ -13.00	Pass
26765	821.5	5	30 ~ 10000	-43.97	≤ -13.00	Pass
26740	819.0	10	30 ~ 10000	-44.09	≤ -13.00	Pass
26745	821.5	15	30 ~ 10000	-43.34	≤ -13.00	Pass

1.4MHz Channel Bandwidth

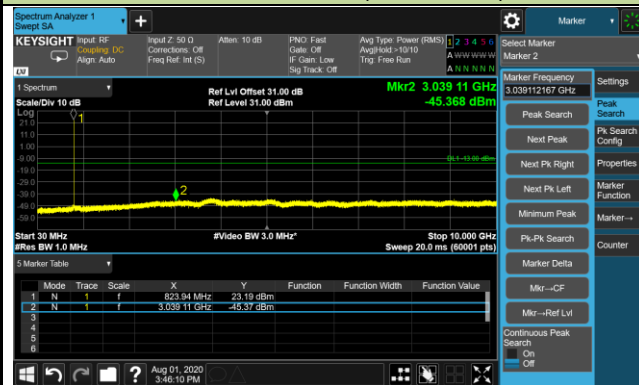
Channel 26697 (814.7MHz)



Channel 26740 (819.0MHz)

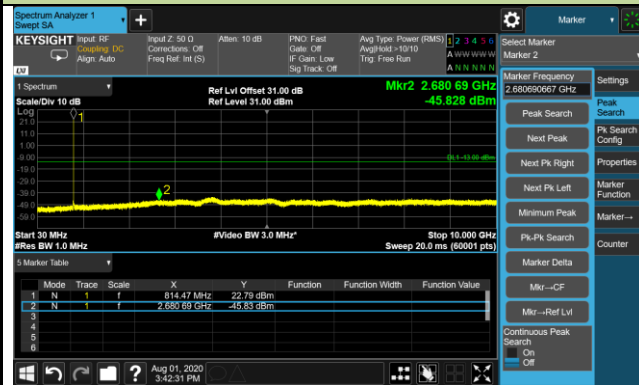


Channel 26783 (823.3MHz)



3MHz Channel Bandwidth

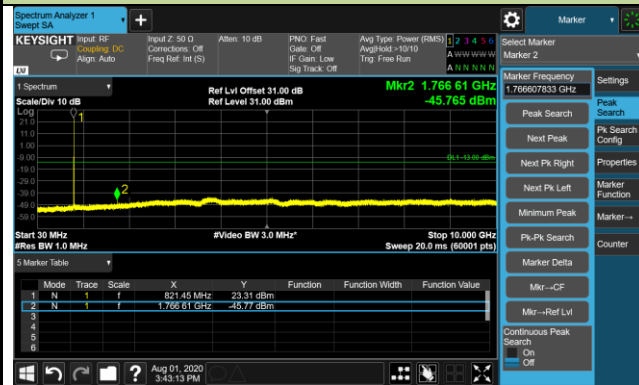
Channel 26705 (815.5MHz)



Channel 26740 (819.0MHz)



Channel 26775 (822.5MHz)



5MHz Channel Bandwidth

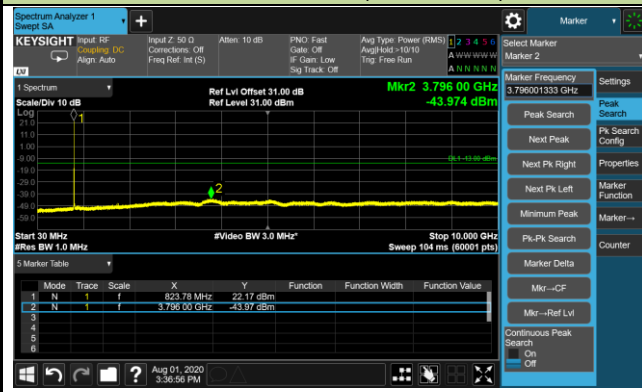
Channel 26715 (816.5MHz)



Channel 26740 (819.0MHz)



Channel 26765 (821.5MHz)



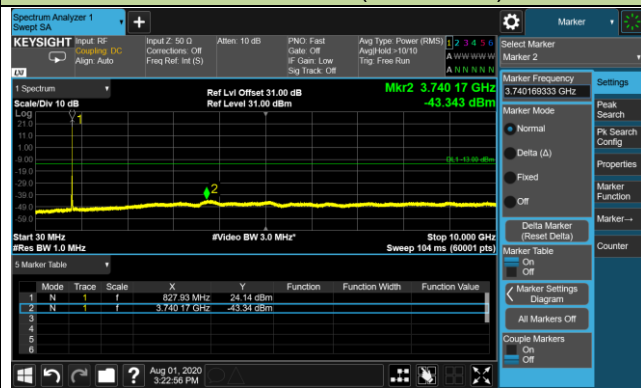
10MHz Channel Bandwidth

Channel 26740 (819.0MHz)



15MHz Channel Bandwidth

Channel 26765 (821.5MHz)



5.7. Radiated Spurious Emissions Measurements

5.7.1. Test Limit

Out of band emissions: 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 emission limit equal to -13dBm.

E (dB μ V/m) = EIRP (dBm) - $20 \log D$ + 104.8; where D is the measurement distance in meters. The emission limit equal to 82.3dB μ V/m.

5.7.2. Test Procedure Used

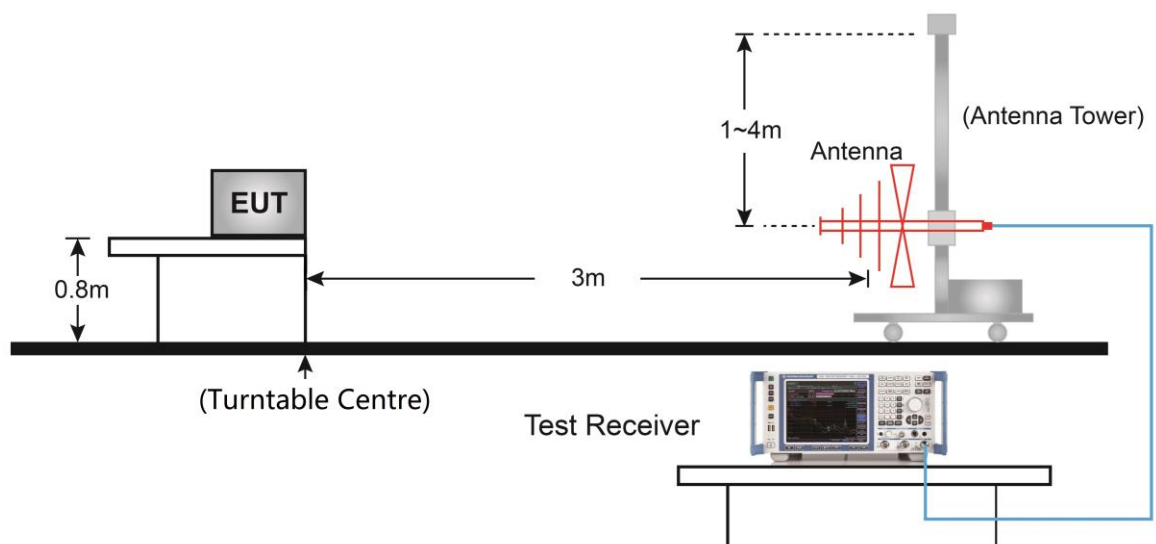
ANSI C63.26-2015 - Section 5.2.7 & 5.5

5.7.3. Test Setting

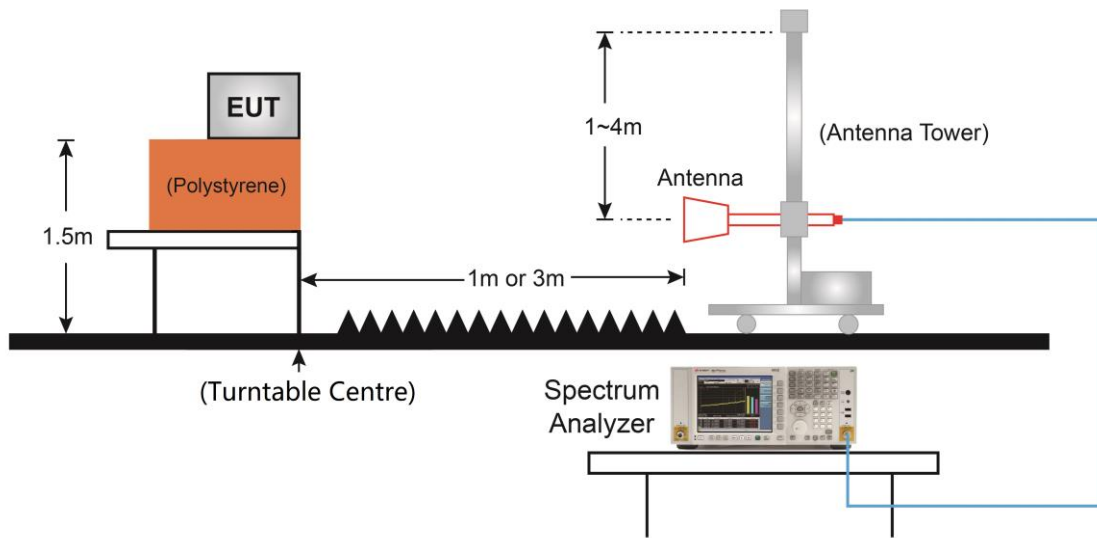
1. RBW = 1MHz
2. VBW \geq 3*RBW
3. Sweep time \geq 10 \times (number of points in sweep) \times (transmission symbol period)
4. Detector = Peak
5. Trace mode = max hold
6. The trace was allowed to stabilize

5.7.4. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



5.7.5. Test Result

Product	LTE-A Cat 16 M.2 Module	Test Engineer	Buter Shi
Test Site	AC1	Test Date	2020/07/02
Test Mode	LTE Band 26 - 1.4MHz Bandwidth, 1RB, QPSK		

Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level(dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
Bottom CH 26697 (814.7MHz)							
311.8	28.7	20.4	49.1	82.3	-33.2	Peak	Horizontal
358.8	26.2	21.2	47.5	82.3	-34.8	Peak	Horizontal
309.8	19.5	20.3	39.9	82.3	-42.4	Peak	Vertical
366.6	19.9	21.5	41.4	82.3	-40.9	Peak	Vertical
1628.1	35.6	-4.6	31.0	82.3	-51.3	Peak	Horizontal
2442.2	33.8	-1.6	32.2	82.3	-50.1	Peak	Horizontal
1628.1	35.9	-4.6	31.3	82.3	-51.0	Peak	Vertical
2442.2	34.4	-1.6	32.8	82.3	-49.5	Peak	Vertical
Middle CH 26740 (819.0MHz)							
311.3	28.8	20.4	49.2	82.3	-33.1	Peak	Horizontal
362.2	25.2	21.3	46.5	82.3	-35.8	Peak	Horizontal
310.3	19.4	20.4	39.7	82.3	-42.6	Peak	Vertical
363.2	20.0	21.4	41.4	82.3	-40.9	Peak	Vertical
1636.7	36.8	-4.7	32.1	82.3	-50.2	Peak	Horizontal
2455.1	34.5	-1.7	32.8	82.3	-49.5	Peak	Horizontal
1636.7	36.0	-4.7	31.3	82.3	-51.0	Peak	Vertical
2455.1	34.1	-1.7	32.4	82.3	-49.9	Peak	Vertical
Top CH 26783 (823.3MHz)							
312.3	27.9	20.4	48.4	82.3	-33.9	Peak	Horizontal
363.2	24.0	21.4	45.4	82.3	-36.9	Peak	Horizontal
310.3	18.9	20.4	39.2	82.3	-43.1	Peak	Vertical
359.3	18.2	21.3	39.4	82.3	-42.9	Peak	Vertical
1645.3	36.1	-4.7	31.4	82.3	-50.9	Peak	Horizontal
2468.0	35.0	-1.7	33.3	82.3	-49.0	Peak	Horizontal
1645.3	35.9	-4.7	31.2	82.3	-51.1	Peak	Vertical
2468.0	34.6	-1.7	32.9	82.3	-49.4	Peak	Vertical

Note: Measure Level (dBm) = Reading Level (dBm) + Factor (dB).

6. CONCLUSION

The data collected relate only the item(s) tested and show that unit is compliance with FCC Rules.

Appendix A - Test Setup Photograph

Refer to "2009RSU020-UT" file.

Appendix B - EUT Photograph

Refer to "2009RSU020-UE" file.