

## TEST REPORT FOR RF TESTING

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Report No.: SRTC2020-9004(F)-20050601(C)

Product Name: Mobile Broadband Internet Device

Product Model: K87CA

Applicant: ZTE Corporation

Manufacturer: ZTE Corporation

Specification: FCC Part 2, Part 24E, Part 22H, Part 27 (2019)

FCC ID: SRQ-K87CA

The State Radio\_monitoring\_center Testing Center (SRTC)

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## 1. GENERAL INFORMATION

### 1.1 Notes of the test report

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### 1.2 Information about the testing laboratory

Company:	The State Radio_monitoring_center Testing Center (SRTC)
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### 1.3 Applicant's details

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### 1.4 Manufacturer's details

Company:	ZTE Corporation
Address:	ZTE Plaza, Keji Road South, Hi-Tech, Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China
City:	Shenzhen
Country or Region:	P.R.China
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## 1.5 Test Environment

Date of Receipt of test sample at SRTC:	2020-05-06
Testing Start Date:	2020-05-06
Testing End Date:	2020-06-22

Environmental Data:	Temperature (°C)	Humidity (%)
Ambient	25	30
Maximum Extreme	55	---
Minimum Extreme	-10	---

Normal Supply Voltage (V d.c.):	3.80
Maximum Extreme Supply Voltage (V d.c.):	4.35
Minimum Extreme Supply Voltage (V d.c.):	3.60

## 2 DESCRIPTION OF THE EQUIPMENT UNDER TEST

### 2.1 Final Equipment Build Status

Frequency Range	LTE Band 2: Tx:1850~1910MHz Rx:1930~1990MHz LTE Band 4: Tx:1710~1755MHz Rx:2110~2155MHz LTE Band 5: Tx:824~849 MHz Rx:869 ~894MHz LTE Band 7: Tx:2500~2570MHz Rx:2620~2690MHz LTE Band 12: Tx:699~716MHz Rx:729~746MHz LTE Band 13: Tx:777~787 MHz Rx:746~756 MHz LTE Band 66: Tx:1710~1780 MHz Rx:2110~2200 MHz
Modulation Type	QPSK/16QAM/64QAM
Antenna Type	Fixed Internal Antenna
Antenna Gain	LTE Band2:1.2dBi/LTE Band4:0.8dBi/LTE Band5:-0.6dBi LTE Band7:0.3dBi/LTE Band12:-2.0dBi LTE Band13:-1.0dBi/LTE Band66:0.8dBi
Power Supply	Battery/Charger
Hardware Version	K87CAHW1.0
Software Version	K87CAV1.0.0B01
IMEI	862750040000660

## 2.2 Support Equipment

The following support equipment was used to exercise the DUT during testing:

Equipment	Battery 1
Manufacturer	ZHUHAI COSMX BATTERY CO., LTD.
Model Number	Li3945T44P8hA69203

Equipment	Charger 1
Manufacturer	RUIJING
Model Number	STC-A51D-Z

Equipment	Charger 2
Manufacturer	AOHAI
Model Number	STC-A51D-Z

Equipment	Charger 3
Manufacturer	Chenyang
Model Number	STC-A520A-Z

Equipment	Charger 4
Manufacturer	Ruijing
Model Number	STC-A520A-Z

Equipment	USB cable 1
Manufacturer	Shen Zhen Shi Yi HUA XING Electron Co.,Ltd
Model Number	USB-MU5-W-100-M

Equipment	USB cable 2
Manufacturer	King Power Electronics Co., Ltd
Model Number	USB-MU5-W-100-M

## 2.3 Summary table

FCC Rule Part	Frequency Range(MHz)	EIRP/ERP (W)	Frequency Tolerance (ppm)	Emission Designator	Emission Bandwidth (MHz)	Measured 26dBC Bandwidth (MHz)	Communication Type
LTE BAND2							
24E	1850.7-1909.3	0.261	0.100	1M08G7D	1.4M	1.307	QPSK
	1850.7-1909.3	0.244	0.100	1M08D7W	1.4M	1.303	16QAM
	1850.7-1909.3	0.184	0.100	1M08W7D	1.4M	1.295	64QAM
	1851.5-1908.5	0.293	-0.099	2M69G7D	3M	3.007	QPSK
	1851.5-1908.5	0.206	-0.099	2M70D7W	3M	2.999	16QAM
	1851.5-1908.5	0.207	-0.099	2M69W7D	3M	2.984	64QAM
	1852.5-1907.5	0.258	0.100	4M49G7D	5M	4.994	QPSK
	1852.5-1907.5	0.223	0.100	4M48D7W	5M	4.990	16QAM
	1852.5-1907.5	0.194	0.100	4M48W7D	5M	4.997	64QAM
	1855-1905	0.294	-0.100	8M95G7D	10M	9.850	QPSK
	1855-1905	0.214	-0.100	8M94D7W	10M	9.719	16QAM
	1855-1905	0.200	-0.100	8M95W7D	10M	9.687	64QAM
	1857.5-1902.5	0.305	0.086	13M4G7D	15M	14.490	QPSK
	1857.5-1902.5	0.242	0.086	13M4D7W	15M	14.500	16QAM
	1857.5-1902.5	0.213	0.086	13M4W7D	15M	14.510	64QAM
	1860-1900	0.272	-0.095	17M9G7D	20M	19.240	QPSK
	1860-1900	0.214	-0.095	17M9D7W	20M	19.160	16QAM
	1860-1900	0.210	-0.095	17M8W7D	20M	19.260	64QAM
LTE BAND4							
27	1710.7-1754.3	0.327	0.088	1M08G7D	1.4M	1.314	QPSK
	1710.7-1754.3	0.284	0.088	1M08D7W	1.4M	1.298	16QAM
	1710.7-1754.3	0.215	0.088	1M08W7D	1.4M	1.277	64QAM
	1711.5-1753.5	0.305	0.089	2M70G7D	3M	2.985	QPSK
	1711.5-1753.5	0.277	0.089	2M70D7W	3M	2.992	16QAM
	1711.5-1753.5	0.225	0.089	2M69W7D	3M	2.985	64QAM
	1712.5-1752.5	0.308	0.099	4M49G7D	5M	4.975	QPSK
	1712.5-1752.5	0.265	0.099	4M49D7W	5M	4.947	16QAM
	1712.5-1752.5	0.228	0.099	4M48W7D	5M	4.940	64QAM
	1715-1750	0.310	-0.093	8M94G7D	10M	9.777	QPSK
	1715-1750	0.254	-0.093	8M94D7W	10M	9.858	16QAM
	1715-1750	0.223	-0.093	8M94W7D	10M	9.755	64QAM
	1717.5-1747.5	0.313	0.100	13M4G7D	15M	14.440	QPSK
	1717.5-1747.5	0.275	0.100	13M4D7W	15M	14.460	16QAM
	1717.5-1747.5	0.211	0.100	13M4W7D	15M	14.390	64QAM
	1720-1745	0.301	0.100	17M9G7D	20M	19.060	QPSK
	1720-1745	0.286	0.100	17M8D7W	20M	19.120	16QAM
	1720-1745	0.222	0.100	17M8W7D	20M	19.200	64QAM

LTE BAND5							
22H	824.7-848.3	0.238	-0.092	1M08G7D	1.4M	1.246	QPSK
	824.7-848.3	0.138	-0.092	1M08D7W	1.4M	1.241	16QAM
	824.7-848.3	0.143	-0.092	1M09W7D	1.4M	1.245	64QAM
	825.5-847.5	0.215	-0.093	2M69G7D	3M	2.957	QPSK
	825.5-847.5	0.155	-0.093	2M70D7W	3M	2.979	16QAM
	825.5-847.5	0.153	-0.093	2M70W7D	3M	2.971	64QAM
	826.5-846.5	0.223	0.092	4M48G7D	5M	4.964	QPSK
	826.5-846.5	0.148	0.092	4M49D7W	5M	4.950	16QAM
	826.5-846.5	0.148	0.092	4M48W7D	5M	4.882	64QAM
	829-844	0.213	-0.100	8M94G7D	10M	9.688	QPSK
	829-844	0.140	-0.100	8M91D7W	10M	9.644	16QAM
	829-844	0.160	-0.100	8M96W7D	10M	9.653	64QAM
LTE BAND7							
27	2502.5-2567.5	0.259	-0.099	4M48G7D	5M	4.970	QPSK
	2502.5-2567.5	0.231	-0.099	4M48D7W	5M	4.941	16QAM
	2502.5-2567.5	0.213	-0.099	4M49W7D	5M	4.953	64QAM
	2505-2565	0.288	0.092	8M96G7D	10M	9.667	QPSK
	2505-2565	0.226	0.092	8M96D7W	10M	9.627	16QAM
	2505-2565	0.215	0.092	8M95W7D	10M	9.644	64QAM
	2507.5-2562.5	0.278	-0.095	13M4G7D	15M	14.410	QPSK
	2507.5-2562.5	0.226	-0.095	13M4D7W	15M	14.410	16QAM
	2507.5-2562.5	0.191	-0.095	13M4W7D	15M	14.370	64QAM
	2510-2560	0.290	-0.097	17M9G7D	20M	19.120	QPSK
	2510-2560	0.236	-0.097	17M9D7W	20M	19.170	16QAM
	2510-2560	0.195	-0.097	17M8W7D	20M	19.050	64QAM
LTE BAND12							
27	699.7-715.3	0.143	-0.100	1M08G7D	1.4M	1.241	QPSK
	699.7-715.3	0.101	-0.100	1M08D7W	1.4M	1.239	16QAM
	699.7-715.3	0.107	-0.100	1M08W7D	1.4M	1.230	64QAM
	700.5-714.5	0.146	-0.099	2M70G7D	3M	2.958	QPSK
	700.5-714.5	0.102	-0.099	2M70D7W	3M	2.974	16QAM
	700.5-714.5	0.103	-0.099	2M70W7D	3M	2.965	64QAM
	701.5-713.5	0.152	0.087	4M48G7D	5M	4.954	QPSK
	701.5-713.5	0.102	0.087	4M47D7W	5M	4.914	16QAM
	701.5-713.5	0.099	0.087	4M49W7D	5M	4.889	64QAM
	704-711	0.156	0.098	8M93G7D	10M	9.632	QPSK
	704-711	0.103	0.098	8M95D7W	10M	9.552	16QAM
	704-711	0.103	0.098	8M95W7D	10M	9.642	64QAM
LTE BAND13							
27	779.5-784.5	0.183	0.094	4M48G7D	5M	4.964	QPSK
	779.5-784.5	0.179	0.094	4M48D7W	5M	4.865	16QAM
	779.5-784.5	0.147	0.094	4M48W7D	5M	4.943	16QAM
	782	0.193	0.097	8M92G7D	10M	9.660	QPSK
	782	0.111	0.097	8M92D7W	10M	9.577	16QAM
	782	0.113	0.097	8M93W7D	10M	9.469	16QAM



LTE BAND66							
27	1710.7-1779.3	0.242	-0.100	1M08G7D	1.4M	1.253	QPSK
	1710.7-1779.3	0.197	-0.100	1M08D7W	1.4M	1.237	16QAM
	1710.7-1779.3	0.169	-0.100	1M08W7D	1.4M	1.232	64QAM
	1711.5-1778.5	0.234	-0.100	2M70G7D	3M	2.977	QPSK
	1711.5-1778.5	0.216	-0.100	2M70D7W	3M	2.982	16QAM
	1711.5-1778.5	0.171	-0.100	2M70W7D	3M	2.960	64QAM
	1712.5-1777.5	0.227	-0.076	4M49G7D	5M	4.908	QPSK
	1712.5-1777.5	0.197	-0.076	4M48D7W	5M	4.942	16QAM
	1712.5-1777.5	0.177	-0.076	4M49W7D	5M	4.944	64QAM
	1715-1775	0.239	-0.093	8M95G7D	10M	9.688	QPSK
	1715-1775	0.204	-0.093	8M94D7W	10M	9.701	16QAM
	1715-1775	0.185	-0.093	8M93W7D	10M	9.618	64QAM
	1717.5-1772.5	0.226	0.095	13M4G7D	15M	14.410	QPSK
	1717.5-1772.5	0.221	0.095	13M5D7W	15M	14.330	16QAM
	1717.5-1772.5	0.189	0.095	13M4W7D	15M	14.250	64QAM
	1720-1770	0.233	0.100	17M9G7D	20M	19.070	QPSK
	1720-1770	0.218	0.100	17M9D7W	20M	19.010	16QAM
	1720-1770	0.196	0.100	17M8W7D	20M	18.970	64QAM

### **3 REFERENCE SPECIFICATION**

Specification	Version	Title
FCC Part 2	2019	Frequency allocations and radio treaty matters; general rules and regulations
FCC Part 22	2019	Public mobile services
FCC Part 24	2019	Personal communications services
FCC Part 27	2019	Miscellaneous wireless communications services
ANSI C63.26	2015	American national standard for compliance testing of transmitters used in licensed radio services
KDB 971168 D01	April 9, 2018	Measurement guidance for certification of licensed digital transmitters
TIA-603-E-2016	March 2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

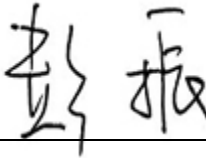

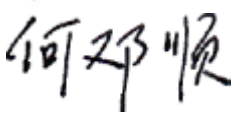
### **4 KEY TO NOTES AND RESULT CODES**

The following are the definition of the test result.

Code	Meaning
PASS	Test result shows that the requirements of the relevant specification have been met.
FAIL	Test result shows that the requirements of the relevant specification have not been met.
NT	Normal Temperature
NV	Nominal voltage
HV	High voltage
LV	Low voltage

## 5 RESULT SUMMARY

No.	Test case	FCC reference	Verdict
1	RF Power Output	2.1046	Pass
2	Effective Radiated Power and Effective Isotropic Radiated Power	22.913(a)(5), 24.232(c), 27.50(b)(10), 27.50(c)(10), 27.50(h)(2), 27.50(d)(4), 27.50(a)(3)	Pass
3	Occupied Bandwidth	2.1049	Pass
4	Peak-Average Ratio	24.232(d), 27.50(d)(5)	Pass
5	Emission Bandwidth	2.1049	Pass
6	Spurious Emissions at antenna terminals	2.1051, 22.917(a), 24.238(a), 27.53(c), 27.53(g), 27.53(h), 27.53(m), 27.53(a)	Pass
7	Band Edges Compliance	2.1051, 22.917(a), 24.238(a), 27.53(c), 27.53(g), 27.53(h), 27.53(m), 27.53(a)	Pass
8	Frequency Stability	2.1055, 22.355, 24.235, 27.54	Pass
9	Radiated Spurious Emissions	2.1053, 22.917(a), 24.238(a), 27.53(c), 27.53(g), 27.53(h), 27.53(f), 27.53(a), 27.53(m)	Pass

This Test Report Is Issued by: Mr. Peng Zhen 	Checked by: Mr. Li Bin 
Tested by: Mr. He Dengshun 	Issued date:  20200622

## **6 TEST RESULT**

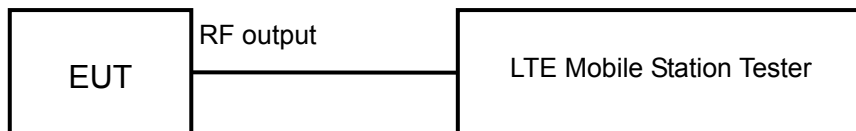
### **6.1 RF Power Output**

Rule Part(s)  
FCC: 2.1046

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test Setup:



Test procedure:

After a radio link has been established between EUT and Tester, the output power of the cell signal of the testing equipment will be decreased until the output power of the EUT reach a maximum value. Then the test data can be read at the tester screen. The loss between RF output port of the EUT and the input port of the tester will be taken into consideration.

Limits: No RF Power Output requirements in part 2.1046.

Test result:

The test results are shown in Appendix A.

## 6.2 Effective Radiated Power and Effective Isotropic Radiated Power

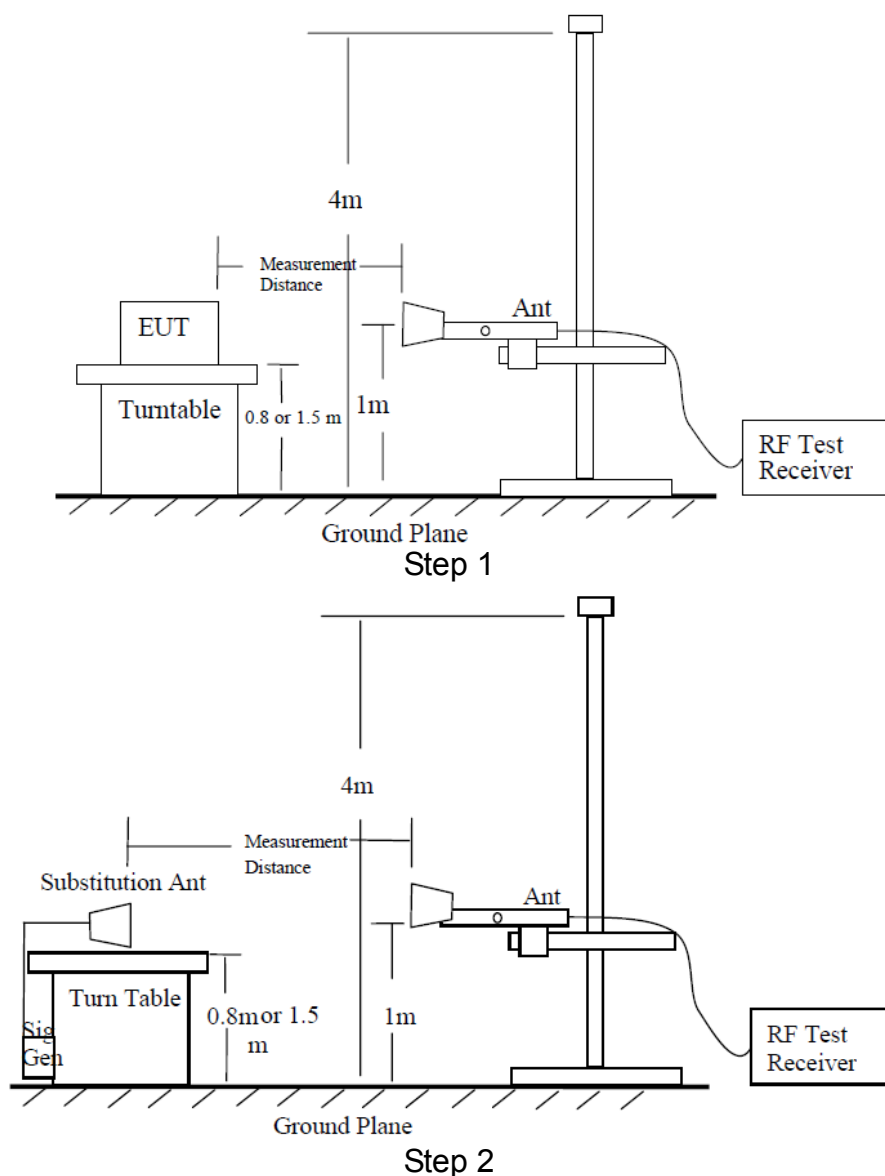
Rule Part(s)

FCC: 22.913(a) (5), 24.232(c), 27.50(b) (10), 27.50(c) (10), 27.50(h) (2), 27.50(d) (4), 27.50(a) (3)

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test setup:



Test procedure:

The measurements procedures in TIA-603-E-2016 are used.

Step 1:

The measurement is carried out in the chamber. EUT was placed on a 0.8m ( $f < 1\text{GHz}$ )/1.5m ( $f > 1\text{GHz}$ ) high non-conductive table at a 3 meters test distance from the test receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT. The height of receiving antenna from 1m to 4m and varies in certain range to find the maximum power value. A radio link shall be established between EUT and Tester. The output power of the cell signal of the tester will be decreased until the output power of the EUT reach a maximum value. A peak detector is used and RBW is set to 100KHz( $f < 1\text{GHz}$ )/1MHz ( $f > 1\text{GHz}$ ). The antenna shall be performed under horizontal and vertical polarization. The turn table shall be rotated from 0 to 360 degrees for detecting the maximum power value on spectrum analyzer or receiver. And the maximum value of the receiver should be recorded as (Pr).

Step 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. To repeat the same procedure as step1 and the level of signal generator will be adjusted till the same power value on the spectrum analyzer or receiver. The ERP/EIRP of the EUT can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna.

A power (Pmea) is applied to the input of the substitution antenna, and adjusts the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (Pmea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

A "reference path loss" should be calculated after test. The attenuation of "reference path loss" is the cable loss between the Signal Source with the Substitution Antenna (Pca) and the Substitution Antenna Gain (Ga).

The measurement results are obtained as described below:

Power (EIRP) = Pmea+ Pca+ Ga

#### **ERP/EIRP LIMIT**

This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15dB) and known input power. ERP can be calculated from EIRP by subtracting the gain of the dipole,  $\text{ERP} = \text{EIRP} - 2.15 \text{ (dB)}$ .

22.913(a) (5)

The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

24.232(c)

Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

27.50(b) (10)

Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

27.50(c) (10)

Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

27.50(h) (2)

Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

27.50(d) (4)

Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

27.50(a) (3)

Mobile and portable stations (i) For mobile and portable stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band, the average EIRP must not exceed 50 milliwatts within any 1 megahertz of authorized bandwidth, except that for mobile and portable stations compliant with 3GPP LTE standards or another advanced mobile broadband protocol that avoids concentrating energy at the edge of the operating band the average EIRP must not exceed 250 milliwatts within any 5 megahertz of authorized bandwidth but may exceed 50 milliwatts within any 1 megahertz of authorized bandwidth.

Test result:

The test results are shown in Appendix B.

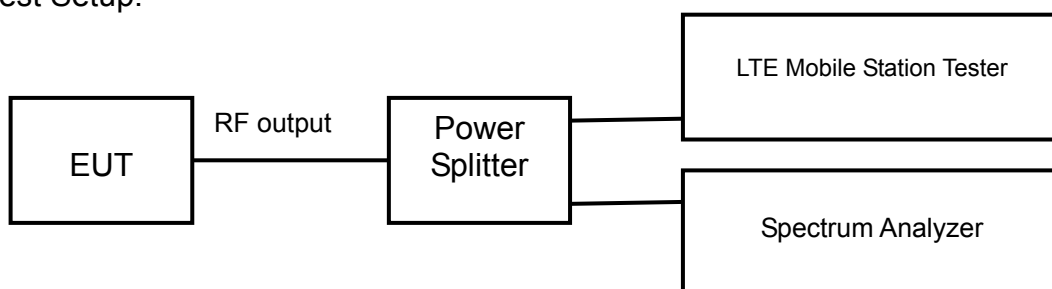
### 6.3 Occupied Bandwidth

Rule Part(s)  
FCC: 2.1049

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test Setup:



Test procedure:  
KDB 971168 D01 v03r01 – Section 4.2

Test Setting:

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW  $\geq$  3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Limits: No specific occupied bandwidth requirements in part 2.1049

Test result:

The test results are shown in Appendix A.



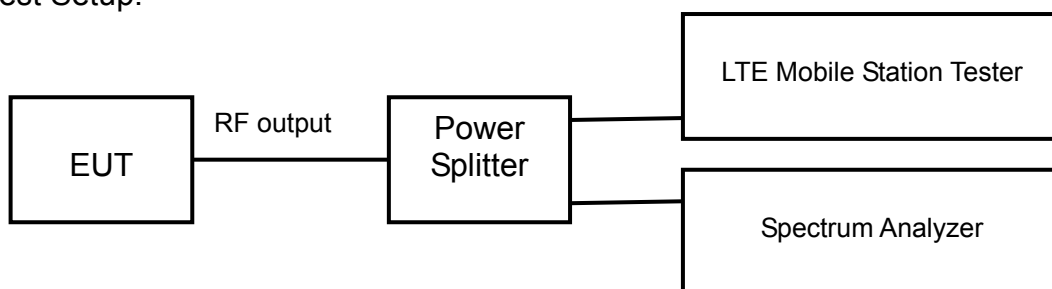
## 6.4 Emission Bandwidth

Rule Part(s)  
FCC: 2.1049

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test Setup:



Test procedure:  
KDB 971168 D01 v03r01 – Section 4.2

Test Setting:

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW  $\geq$  3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of 26dB bandwidth observed in Step 7

Limits: No specific emission bandwidth requirements in part 2.1049.

Test result:  
The test results are shown in Appendix A.

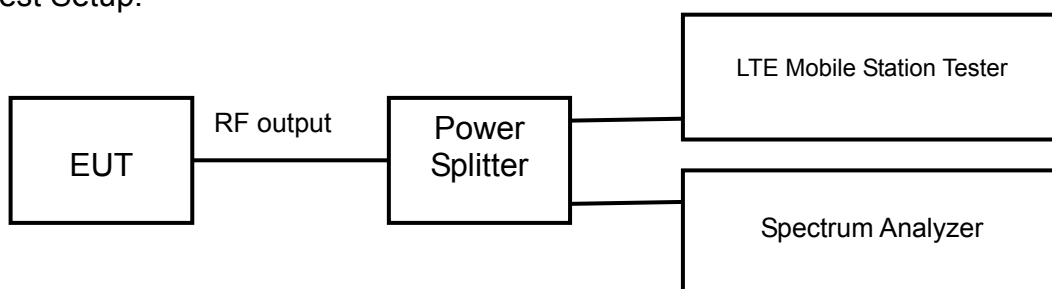
## 6.5 Peak-Average Ratio

Rule Part(s)  
FCC: 24.232(d), 27.50(d) (5)

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test Setup:



Test procedure:  
KDB 971168 D01 v03r01 – Section 5.7.1

Test Setting:

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW ≥ OBW or specified reference bandwidth
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

Limits

24.232(d), 27.50(d) (5)

In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

Test result:

The test results are shown in Appendix A.

## 6.6 Spurious Emissions at antenna terminal

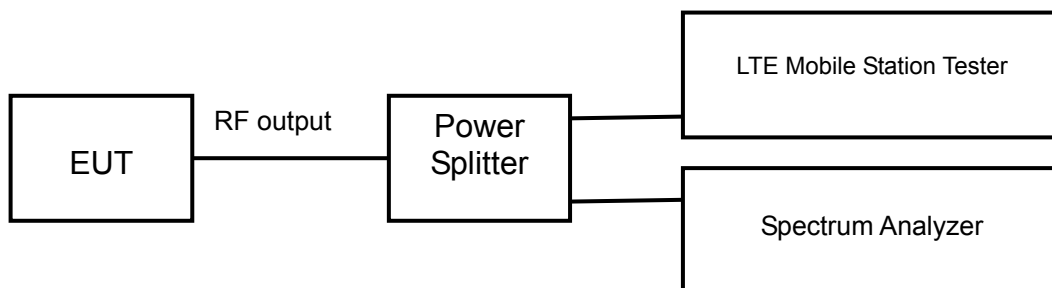
Rule Part(s)

FCC: 2.1051, 22.917(a), 24.238(a), 27.53(c), 27.53(g), 27.53(h), 27.53(m), 27.53(a)

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test Setup:



Test procedure:

KDB 971168 D01 v03r01 – Section 6.0

Test Setting:

1. Start frequency was set to 30MHz and stop frequency was set to at least 10 \* the fundamental frequency
2. Detector = RMS
3. RBW=1MHz
4. VBW=3MHz
5. Trace mode = trace average for continuous emissions, max hold for pulse emissions
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Limits

The minimum permissible attenuation level of any spurious emission is  $43 + \log_{10}(P)$  (P [Watts]), where P is the transmitter power in Watts.

For Band 30, the minimum permissible attenuation level of any spurious emission <2288MHz and >2365MHz is  $70 + \log_{10}(P)$  (P [Watts]).

For Band 7 and 41, the minimum permissible attenuation level of any spurious emission is  $55 + \log_{10}(P)$  (P [Watts]).

Test result:

The test results are shown in Appendix A.

## 6.7 Band Edges Compliance

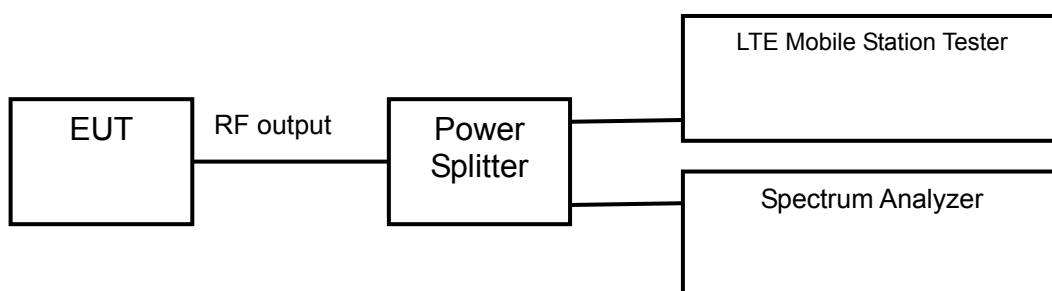
Rule Part(s)

FCC: 2.1051, 22.917(a), 24.238(a), 27.53(c), 27.53(g), 27.53(h), 27.53(m), 27.53(a)

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test Setup:



Test procedure:

KDB 971168 D01 v03r01 – Section 6.0

Test Setting:

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW > 1% of the emission bandwidth
4. VBW > 3 x RBW
5. Detector = RMS
6. Number of sweep points  $\geq 2 \times \text{Span/RBW}$
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Limits

The minimum permissible attenuation level of any spurious emission is  $43 + \log_{10}(P)$  [Watts], where P is the transmitter power in Watts.

The minimum permissible attenuation level for Band 30 is  $> 43 + 10\log_{10}(P)$  [Watts] at 2300-2305MHz & 2345-2360MHz,  $> 55 + 10\log_{10}(P)$  [Watts] at 2320-2324MHz & 2341-2345MHz,  $> 61 + 10\log_{10}(P)$  [Watts] at 2324-2328MHz & 2337-2341MHz,  $> 67 + 10\log_{10}(P)$  [Watts] at 2288-2292MHz & 2328- 2337MHz, and  $> 70 + 10\log_{10}(P)$  [Watts] at frequencies < 2288MHz & >2365MHz.

Per 22.917(b) 24.238(a) 27.53(h) in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier

center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

Per 27.53(g) for operations in the 698-746 MHz band, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30 kHz may be employed to demonstrate compliance with the out-of-band emissions limit.

Per 27.53(c)(5) for operations in the 776-788 MHz band, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30 kHz may be employed to demonstrate compliance with the out-of-band emissions limit.

For all plots showing emissions in the 763 – 775MHz and 793 – 805MHz band, the FCC limit per 27.53(c)(4) is  $65 + 10\log_{10}(P) = -35\text{dBm}$  in a 6.25kHz bandwidth.

Per 27.53(a)(5) in the 1 MHz bands immediately outside and adjacent to the channel blocks at 2305, 2310, 2315, 2320, 2345, 2350, 2355, and 2360 MHz, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e., 1 MHz). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Per 27.53(m) for operations in the BRS/EBS bands, the attenuation factor shall be not less than  $40 + 10 \log (P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log (P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and  $55 + 10 \log (P)$  dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth. In addition, the attenuation factor shall not be less that  $43 + 10 \log (P)$  dB on all frequencies between 2490.5 MHz and 2496 MHz and  $55 + 10 \log (P)$  dB at or below 2490.5MHz.

Test result:

The test results are shown in Appendix A.

## 6.8 Frequency Stability

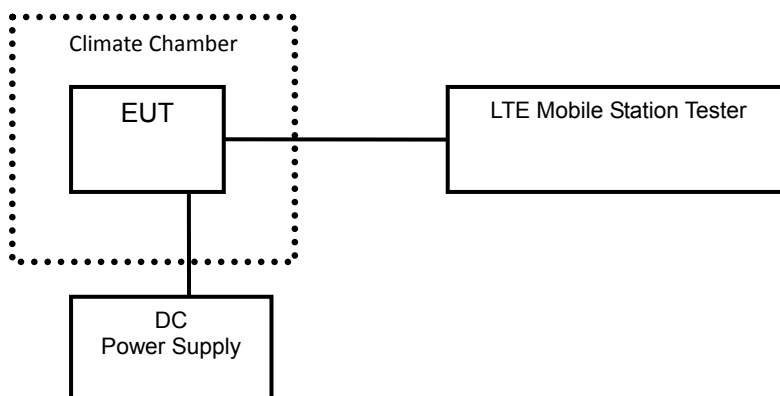
Rule Part(s)

FCC: 2.1055, 22.355, 24.235, 27.54

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test setup:



Test Procedure:

ANSI/TIA-603-E-2016

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C (The temperature range can be declared by the manufacturer). A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Limits: For Part 22, the frequency stability of the transmitter shall be maintained within  $\pm 0.00025\%$  ( $\pm 2.5$  ppm) of the center frequency. For Part 24, Part 27, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test result:

The test results are shown in Appendix A.

## 6.9 Radiated Spurious Emissions

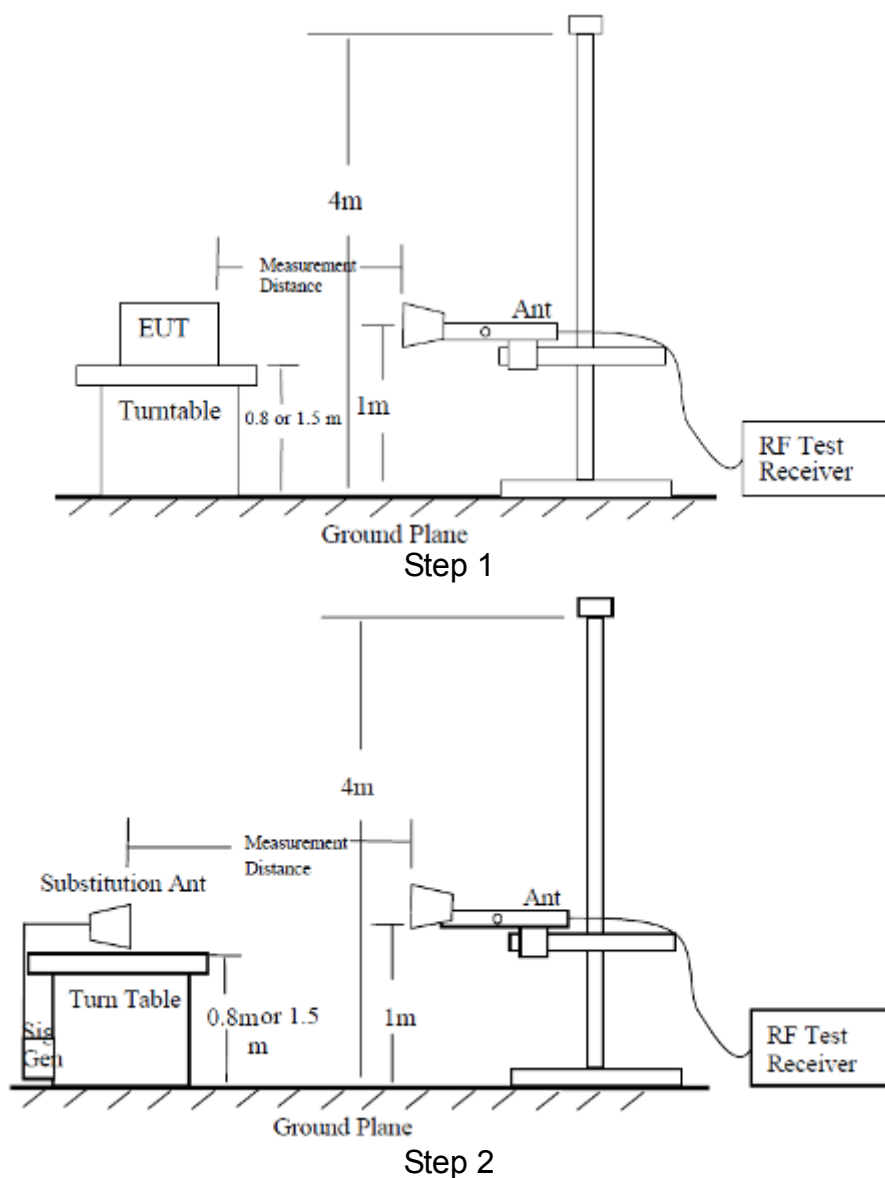
Rule Part(s)

FCC: 2.1053, 22.917(a), 24.238(a), 27.53(c), 27.53(g), 27.53(h), 27.53(f), 27.53(a), 27.53(m)

Ambient condition:

Temperature	Relative humidity	Pressure
25°C	30%	101.9kPa

Test Setup:



**Test procedure:**

The measurements procedures in TIA-603-E-2016 are used.

The spectrum was scanned from 30MHz to the 10th harmonic of the highest frequency generated within the equipment.

**Step 1:**

The measurement is carried out in the chamber. EUT was placed on a 0.8m ( $f < 1\text{GHz}$ )/1.5m ( $f > 1\text{GHz}$ ) high non-conductive table at a 3 meters test distance from the test receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT. The height of receiving antenna from 1m to 4m and varies in certain range to find the maximum power value. A radio link shall be established between EUT and Tester. The output power of the cell signal of the tester will be decreased until the output power of the EUT reach a maximum value. A peak detector is used and RBW is set to 100 kHz ( $f < 1\text{GHz}$ )/1MHz ( $f > 1\text{GHz}$ ). The antenna shall be performed under horizontal and vertical polarization. The turn table shall be rotated from 0 to 360 degrees for detecting the maximum power value on spectrum analyzer or receiver. The spectrum analyzer scans from 30MHz to 10th harmonic of the carrier. A notch filter is necessary in the band near to the carrier frequency. A high pass filter is needed to avoid the distortion of the testing equipment in the band above the carrier frequency.

**Step 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.

A power ( $P_{\text{mea}}$ ) is applied to the input of the substitution antenna, and adjusts the level of the signal generator output until the value of the receiver reach the previously recorded ( $P_r$ ). The power of signal source ( $P_{\text{mea}}$ ) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

A "reference path loss" should be calculated after test. The attenuation of "reference path loss" is the cable loss between the Signal Source with the Substitution Antenna ( $P_{\text{ca}}$ ) and the Substitution Antenna Gain ( $G_a$ ).

**Calculation procedure:**

The data of cable loss and antenna gain has been calibrated in full testing frequency range before the testing.

The power of the Radiated Spurious Emissions is calculated by adding the cable loss and antenna gain. The basic equation with a sample calculation is as followed:

$$\text{Power (EIRP)} = P_{\text{mea}} + P_{\text{ca}} + G_a$$

This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15dB) and known input power. ERP can be calculated from EIRP by subtracting the gain of the dipole,  $\text{ERP} = \text{EIRP} - 2.15 \text{ (dB)}$ .

Assumed the power of signal source record is -20dBm. A cable loss of -30dB, and an antenna gain of 11dB are added.

$$P = P_{\text{mea}} + P_{\text{ca}} + G_a = (-20\text{dBm}) + (-30\text{dB}) + (11\text{dB}) = -39\text{dBm}$$

**Test result:**

The test results are shown in Appendix B.



## **7 MEASUREMENT UNCERTAINTIES**

Items	Uncertainty	
RF Power Output	0.6 dB	
Occupied Bandwidth	3 kHz	
Spurious Emissions	30MHz~1GHz	2.83 dB
	1GHz~12.75GHz	2.50 dB
	12.75GHz~25GHz	2.75 dB
Band Edges Compliance	1.2dB	
Frequency Stability	4 Hz	

## 8 TEST EQUIPMENTS

No.	Name/Model	Manufacturer	S/N	Calibration Date	Calibration Due Date
1	MT8820C Mobile Station Tester	Anritsu	6201300660	2019.08.20	2020.08.19
2	FSV40 Spectrum Analyzer	R&S	101065	2019.08.20	2020.08.19
2	N9020A Spectrum Analyzer	Agilent	MY48010771	2019.08.20	2020.08.19
3	6007 Power Divider	Weinschel	6007-GJ-1	2019.08.20	2020.08.19
4	DC Power Supply E3645A	Agilent	MY40000741	2020.03.01	2021.02.28
5	Temperature chamber SH241	ESPEC	92013758	2019.08.20	2020.08.19
6	12.65m×8.03m×7.50m Fully-Anechoic Chamber	FRANKONIA	----	----	----
7	23.18m×16.88m×9.60m Semi-Anechoic Chamber	FRANKONIA	---	----	----
8	Turn table Diameter:1m	FRANKONIA	----	----	----
9	Turn table Diameter:5m	FRANKONIA	----	----	----
10	Antenna master FAC(MA4.0)	MATURO	----	----	----
11	Antenna master SAC(MA4.0)	MATURO	----	----	----
12	9.080m×5.255m×3.525m Shielding room	FRANKONIA	----	----	----
13	HF 907 Double-Ridged Waveguide Horn Antenna	R&S	100512	2019.08.20	2020.08.19
14	HF 907 Double-Ridged Waveguide Horn Antenna	R&S	100513	2019.08.20	2020.08.19
15	HL562 Ultra log antenna	R&S	100016	2019.08.20	2020.08.19
16	3160-09 Receive antenna	SCHWARZ-BECK	002058-002	2019.08.20	2020.08.19
17	ESI 40 EMI test receiver	R&S	100015	2019.08.20	2020.08.19
18	ESCS30 EMI test receiver	R&S	100029	2019.08.20	2020.08.19
19	HL562 Receive antenna	R&S	100167	2019.08.20	2020.08.19
20	ENV216 AMN	R&S	3560.6550.12	2019.08.20	2020.08.19

## **APPENDIX A – TEST DATA OF CONDUCTED EMISSION**

Please refer to the attachment.

## **APPENDIX B – TEST DATA OF RADIATED EMISSION**

Please refer to the attachment.