



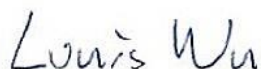
FCC RADIO TEST REPORT

FCC ID : XMR2021EM05G2
Equipment : LTE Module
Brand Name : Quectel Wireless Solutions Co., Ltd.
Model Name : EM05-G
Applicant : Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III (Area B), No.1016
Tianlin Road, Minhang District, Shanghai, China, 20023
Manufacturer : LCFC (HeFei) Electronics Technology Co., Ltd.
No. 3188-1, Yungu Road (Hefei Export Processing Zone), Hefei
Economics & Technology Development Area, Anhui, CHINA
Standard : FCC 47 CFR Part 2, and 90(S)

Equipment: Quectel EM05-G tested inside of Lenovo Notebook Computer.

The product was received on May 11, 2023 and testing was performed from May 22, 2023 to Jun. 01, 2023. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA-603-E and has been in compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.



Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory



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History of this test report

Report No.	Version	Description	Issue Date
FG2N1103-04D	01	Initial issue of report	Jun. 05, 2023

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046 §90.635	Conducted Output Power and Effective Radiated Power	Pass	-
-	-	Peak-to-Average Ratio	Not Required	-
-	§2.1049 §90.209	Occupied Bandwidth and 26dB Bandwidth	Not Required	-
-	§2.1051 §90.691	Emission masks – In-band emissions	Not Required	-
-	§2.1051 §90.691	Emission masks – Out of band emissions	Not Required	-
-	§2.1055 §90.213	Frequency Stability for Temperature & Voltage	Not Required	-
3.3	§2.1053 §90.691	Field Strength of Spurious Radiation	Pass	37.53 dB under the limit at 2458.000 MHz

Note:

- Not required means after assessing, test items are not necessary to carry out.
- This is a variant report by host changing Marketing name, Model name, CPU and Motherboard. All the test cases were performed on original report which can be referred to Sporton Report Number FG2N1103D. Based on the original report, only worst cases were verified.

Conformity Assessment Condition:

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacture who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
- The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty".

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Sheng Kuo

Report Producer: Lucy Wu

1 General Description

1.1 Feature of Equipment Under Test

Product Feature	
Equipment	LTE Module
Brand Name	Quectel Wireless Solutions Co., Ltd.
Model Name	EM05-G
FCC ID	XMR2021EM05G2
Sample 1	EUT with Host 1
Sample 2	EUT with Host 2
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS
EUT Stage	Production Unit

Remark:

1. The above EUT's information was declared by manufacturer.
2. Equipment: Quectel EM05-G tested inside of Lenovo Notebook Computer.

The product was installed into Notebook Computer (Brand Name: Lenovo, Model Name: TP00135C) during test, and the host information was recorded in the following table.

Host Information	
Host 1	Host with Amphenol Taiwan Corporation Antenna
Host 2	Host with Speed Antenna

WWAN Antenna Information for Host				
Main Antenna	Manufacturer	AMPHENOL TAIWAN CORPORATION	Peak gain (dBi)	LTE Band 26: -1.18
	Part number	DC33001YA00	Type	PIFA
	Manufacturer	Speed	Peak gain (dBi)	LTE Band 26: -1.18
	Part number	DC33001Y900	Type	PIFA

Remark: The EUT's information above is declared by manufacturer. Please refer to Disclaimer in report summary.

1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard	
Tx Frequency	814.7 ~ 823.3 MHz
Rx Frequency	859.7 ~ 868.3 MHz
Bandwidth	1.4MHz / 3MHz / 5MHz / 10MHz / 15MHz
Maximum Output Power to Antenna	23.58 dBm
Type of Modulation	QPSK / 16QAM

1.3 Modification of EUT

No modifications made to the EUT during the testing.

1.4 Testing Site

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333
Test Site No.	Sporton Site No.
	TH03-HY (TAF Code: 1190)
Test Engineer	Cotty Hsu
Temperature (°C)	22.1~22.8
Relative Humidity (%)	53~55
Remark	The Conducted test item subcontracted to Sporton International Inc. EMC & Wireless Communications Laboratory

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010
Test Site No.	Sporton Site No.
	03CH16-HY
Test Engineer	Hao Qun, Gary Guo and Steven Wu
Temperature (°C)	20~25
Relative Humidity (%)	50~65

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC Designation No.: TW1190 and TW3786

1.5 Applied Standards

According to the specifications declared by the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC 47 CFR Part 2, 90
- ♦ ANSI / TIA-603-E
- ♦ ANSI C63.26-2015
- ♦ FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- ♦ FCC KDB 412172 D01 Determining ERP and EIRP v01r01
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ Interim Guidance for Equipment Authorization of Devices with Channel Bandwidths Combined Across Two Contiguous Service Rule Allocations OET/Lab/EACB, June 6, 2013

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.

2 Test Configuration of Equipment Under Test

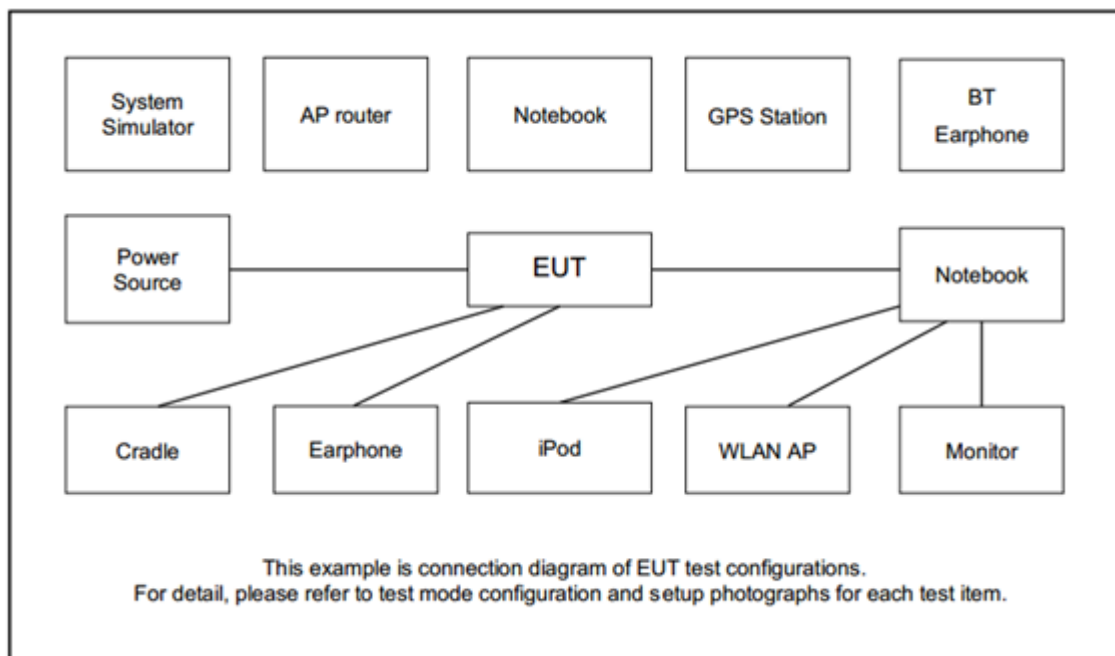
2.1 Test Mode

During all testing, EUT is in link mode with base station emulator at maximum power level.

Frequency range investigated for radiated emission is 30 MHz to 9000 MHz.

Conducted Test Cases	Band	Bandwidth (MHz)						Modulation		RB #			Test Channel		
		1.4	3	5	10	15	20	QPSK	16QAM	1	Half	Full	L	M	H
Max. Output Power	26	v	v	v	v	v	-	v	v	v			v	v	v
E.R.P.	26	v	v	v	v	v	-	v	v	Max. Power					
Radiated Spurious Emission	26			v	v	v	-	v		v			v	v	v
Remark	<ol style="list-style-type: none"> The mark "v" means that this configuration is chosen for testing The mark "-" means that this bandwidth is not supported. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported. All the radiated test cases were performed with Battery 1 and Sample 1. 														

2.2 Connection Diagram of Test System



2.3 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model No.	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8821C	N/A	N/A	Unshielded, 1.8 m
2.	Earphone	Lenovo	TS300-01MS21-8S	N/A	Unshielded, 1.2 m	N/A

2.4 Frequency List of Low/Middle/High Channels

LTE Band 26 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
15	Channel	26765	-	-
	Frequency	821.5	-	-
10	Channel	-	26740	-
	Frequency	-	819	-
5	Channel	26715	26740	26765
	Frequency	816.5	819	821.5
3	Channel	26705	26740	26775
	Frequency	815.5	819	822.5
1.4	Channel	26697	26740	26783
	Frequency	814.7	819	823.3

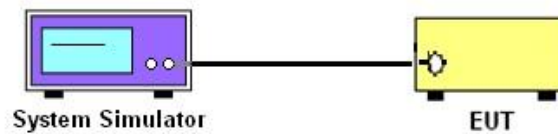
3 Conducted Test Items

3.1 Measuring Instruments

See list of measuring instruments of this test report.

3.1.1 Test Setup

3.1.2 Conducted Output Power



3.1.3 Test Result of Conducted Test

Please refer to Appendix A.

3.2 Conducted Output Power Measurement and ERP Measurement

3.2.1 Description of the Conducted Output Power Measurement and ERP Measurement

A system simulator was used to establish communication with the EUT. Its parameters were set to enforce EUT transmitting at the maximum power. The measured power in the radio frequency on the transmitter output terminals shall be reported.

The output power of mobile transmitters must not exceed 100 Watts for LTE Band 26.

According to KDB 412172 D01 Power Approach,

$EIRP = P_T + G_T - L_C$, where

P_T = transmitter output power in dBm

G_T = gain of the transmitting antenna in dBi

L_C = signal attenuation in the connecting cable between the transmitter and antenna in dB

3.2.2 Test Procedures

1. The transmitter output port was connected to the system simulator.
2. Set EUT at maximum power through system simulator.
3. Select lowest, middle, and highest channels for each band and different modulation.
4. Measure and record the power level from the system simulator.

3.3 Field Strength of Spurious Radiation Measurement

3.3.1 Description of Field Strength of Spurious Radiated Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E. The power of any emission FCC Part 90.691 on any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth at least $43 + 10 \log (P)$ dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

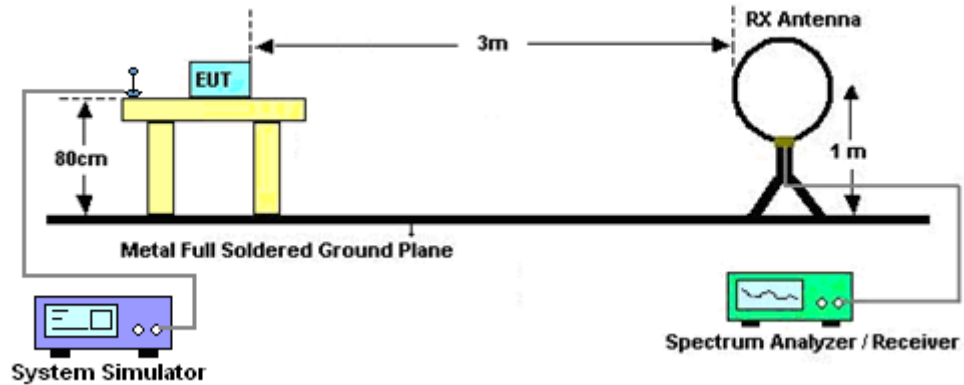
The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log_{10}(P[\text{Watts}])$ dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

3.3.2 Test Procedures

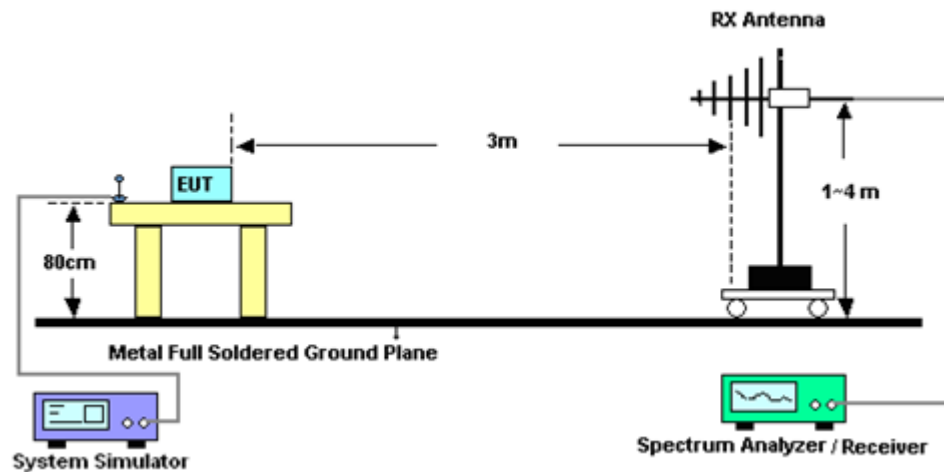
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
1. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
2. The table was rotated 360 degrees to determine the position of the highest spurious emission.
3. The height of the receiving antenna is varied between one meter and four meters to search the maximum spurious emission for both horizontal and vertical polarizations.
4. For testing below 1GHz, make the measurement with the spectrum analyzer's RBW = 100 kHz, VBW = 3MHz, Sweep = 500ms, Taking the record of maximum spurious emission.
5. For testing above 1GHz, make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, Sweep = 500ms, Taking the record of maximum spurious emission.
6. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
7. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
8. Taking the record of output power at antenna port.
9. Repeat step 7 to step 8 for another polarization.
10. $\text{EIRP (dBm)} = \text{S.G. Power} - \text{Tx Cable Loss} + \text{Tx Antenna Gain}$
11. $\text{ERP (dBm)} = \text{EIRP} - 2.15$
12. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
13. The limit line is derived from $43 + 10 \log(P)$ dB below the transmitter power P(Watts)

3.3.3 Test Setup

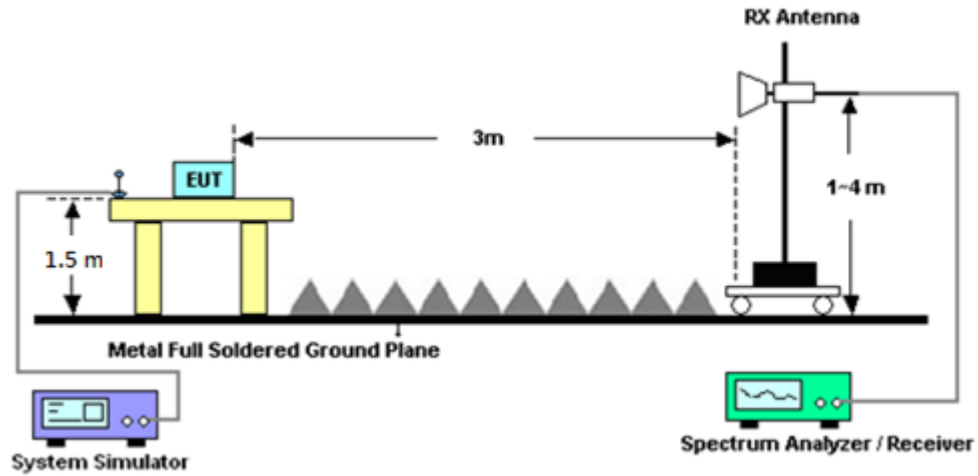
For radiated test below 30MHz



For radiated test from 30MHz to 1GHz



For radiated test above 1GHz



3.3.4 Test Result of Field Strength of Spurious Radiated

Please refer to Appendix B.

Note:

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.



4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	May 22, 2023~ Jun. 01, 2023	Sep. 19, 2023	Radiation (03CH16-HY)
Spectrum Analyzer	Keysight	N9010B	MY60241055	10Hz~44GHz	Jul. 22, 2022	May 22, 2023~ Jun. 01, 2023	Jul. 21, 2023	Radiation (03CH16-HY)
Signal Generator	Agilent	MG3694C	163401	0.1Hz~40GHz	Feb. 08, 2023	May 22, 2023~ Jun. 01, 2023	Feb. 07, 2024	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	40103 & 07	30MHz to 1GHz	Apr. 23, 2023	May 22, 2023~ Jun. 01, 2023	Apr. 22, 2024	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N-06	47020 & 06	30MHz to 1GHz	Oct. 08, 2022	May 22, 2023~ Jun. 01, 2023	Oct. 07, 2023	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-02114	1G~18GHz	Aug. 09, 2022	May 22, 2023~ Jun. 01, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1G~18GHz	Mar. 23, 2023	May 22, 2023~ Jun. 01, 2023	Mar. 22, 2024	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 04, 2022	May 22, 2023~ Jun. 01, 2023	Jul. 03, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM1G18G	060812	1-18GHz	Dec. 26, 2022	May 22, 2023~ Jun. 01, 2023	Dec. 25, 2023	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2022	May 22, 2023~ Jun. 01, 2023	Dec. 08, 2023	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A	MY57290111	3Hz~26.5GHz	Dec. 15, 2022	May 22, 2023~ Jun. 01, 2023	Dec. 14, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	805935/4	N/A	Aug. 09, 2022	May 22, 2023~ Jun. 01, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	802434/4	N/A	Aug. 09, 2022	May 22, 2023~ Jun. 01, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5 757	N/A	Aug. 09, 2022	May 22, 2023~ Jun. 01, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	May 22, 2023~ Jun. 01, 2023	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	May 22, 2023~ Jun. 01, 2023	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	May 22, 2023~ Jun. 01, 2023	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	May 22, 2023~ Jun. 01, 2023	N/A	Radiation (03CH16-HY)
Radio Communication Analyzer	Anritsu	MT8821C	6262025353	LTE FDD/TDD LTE-2CC DLCA/ULCA	Oct. 13, 2022	May 23, 2023	Oct. 12, 2023	Conducted (TH03-HY)
Coupler	Warison	20dB 25W SMA Directional Coupler	#B	1-18GHz	Jan. 06, 2023	May 23, 2023	Jan. 05, 2024	Conducted (TH03-HY)

5 Measurement Uncertainty

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.98 dB
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Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.54 dB
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Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power & ERP)

LTE Band 26 Maximum Average Power [dBm] (GT - LC = -1.18 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
15	1	0	QPSK	23.30	-	-	19.97	0.0993
15	1	0	16-QAM	22.67	-	-	19.34	0.0859
Limit	Power < 100W			Result			Pass	

LTE Band 26 Maximum Average Power [dBm] (GT - LC = -1.18 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
10	1	0	QPSK	-	23.55	-	20.22	0.1052
10	1	0	16-QAM	-	22.56	-	19.23	0.0838
Limit	Power < 100W			Result			Pass	

LTE Band 26 Maximum Average Power [dBm] (GT - LC = -1.18 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
5	1	0	QPSK	23.45	23.46	23.45	20.13	0.1030
5	1	0	16-QAM	22.68	22.31	22.01	19.35	0.0861
Limit	Power < 100W			Result			Pass	

LTE Band 26 Maximum Average Power [dBm] (GT - LC = -1.18 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
3	1	0	QPSK	23.41	23.40	23.36	20.08	0.1019
3	1	0	16-QAM	22.61	22.38	21.91	19.28	0.0847
Limit	Power < 100W			Result			Pass	

LTE Band 26 Maximum Average Power [dBm] (GT - LC = -1.18 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
1.4	1	0	QPSK	23.58	23.53	23.33	20.25	0.1059
1.4	1	0	16-QAM	22.65	22.35	21.98	19.32	0.0855
Limit	Power < 100W			Result			Pass	



Appendix B. Test Results of Radiated Test

LTE Band 26

LTE Band 26 / 5MHz / QPSK									
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	1628	-52.81	-13	-39.81	-65.22	-58.49	0.95	8.78	H
	2443	-53.62	-13	-40.62	-69.95	-60.55	1.05	10.13	H
	3257	-53.25	-13	-40.25	-73.22	-60.72	1.12	10.74	H
									H
									H
									H
	1628	-55.78	-13	-42.78	-68.15	-61.46	0.95	8.78	V
	2443	-54.27	-13	-41.27	-70.57	-61.20	1.05	10.13	V
	3257	-55.23	-13	-42.23	-74.98	-62.70	1.12	10.74	V
									V
									V
									V
Middle	1633	-52.53	-13	-39.53	-64.95	-58.26	0.95	8.83	H
	2450	-51.99	-13	-38.99	-68.34	-58.89	1.05	10.10	H
	3267	-54.10	-13	-41.10	-74.08	-61.64	1.12	10.80	H
									H
									H
									H
	1633	-56.76	-13	-43.76	-69.15	-62.49	0.95	8.83	V
	2450	-53.27	-13	-40.27	-69.60	-60.17	1.05	10.10	V
	3267	-55.46	-13	-42.46	-75.23	-63.00	1.12	10.80	V
									V
									V
									V



Highest	1638	-54.18	-13	-41.18	-66.62	-59.96	0.95	8.88	H
	2458	-50.53	-13	-37.53	-66.92	-57.44	1.05	10.12	H
	3277	-54.89	-13	-41.89	-74.87	-62.49	1.11	10.86	H
									H
									H
									H
	1638	-56.44	-13	-43.44	-68.86	-62.22	0.95	8.88	V
	2458	-54.44	-13	-41.44	-70.80	-61.35	1.05	10.12	V
	3277	-55.33	-13	-42.33	-75.12	-62.93	1.11	10.86	V
									V
									V
									V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.

LTE Band 26 / 10MHz / QPSK									
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Middle	1629	-53.42	-13	-40.42	-65.83	-59.11	0.95	8.79	H
	2443	-53.67	-13	-40.67	-70	-60.6	1.05	10.13	H
	3258	-53.49	-13	-40.49	-73.46	-60.97	1.12	10.75	H
									H
									H
									H
	1629	-55.78	-13	-42.78	-68.16	-61.47	0.95	8.79	V
	2443	-55.88	-13	-42.88	-72.18	-62.81	1.05	10.13	V
	3258	-55.20	-13	-42.20	-74.96	-62.68	1.12	10.75	V
									V
									V
									V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.



LTE Band 26 / 15MHz / QPSK									
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	1629	-52.21	-13	-39.21	-64.62	-57.90	0.95	8.79	H
	2444	-57.55	-13	-44.55	-73.88	-64.48	1.05	10.12	H
	3259	-53.49	-13	-40.49	-73.46	-60.98	1.12	10.75	H
									H
									H
									H
	1629	-56.44	-13	-43.44	-68.82	-62.13	0.95	8.79	V
	2444	-58.52	-13	-45.52	-74.83	-65.45	1.05	10.12	V
	3259	-55.42	-13	-42.42	-75.18	-62.91	1.12	10.75	V
									V
									V
									V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.