



FCC RADIO TEST REPORT

FCC ID : PU5-TP00137BLQ Equipment : Notebook Computer

Brand Name : Lenovo

Model Name : TP00137A, TP00137B
Applicant : Wistron Corporation

21F, No. 88, Sec. 1, Hsin Tai Wu Rd., Hsichih

Dist, New Taipei City 221, Taiwan

Manufacturer : Lenovo PC HK Limited.

23/F, Lincoln House, Taikoo Place, 979 King's Road, Quarry Bay, Hong Kong, P.R. 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 Dec. 08, 2021 and testing was performed from Dec. 17, 2021 to Dec. 28, 2021. 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 partial report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

Louis Win

Sporton International Inc. Wensan Laboratory

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E-mail: Alex@sporton.com.tw Report Version : 02

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Report No.: FG1D0314-04D

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History of this test report

Report No.: FG1D0314-04D

Report No.	Version	Description	Issued Date
FG1D0314-04D	01	Initial issue of report	Jan. 27, 2022
FG1D0314-04D	02	Revise section 3.2.1	Feb. 28, 2022

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Summary of Test Result

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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	-	See Note
-	§2.1049 §90.209	Occupied Bandwidth and 26dB Bandwidth	-	See Note
-	§2.1051 §90.691	Emission masks – In-band emissions	-	See Note
-	§2.1051 §90.691	Emission masks – Out of band emissions	-	See Note
-	§2.1055 §90.213	Frequency Stability for Temperature & Voltage	-	See Note
3.3	§2.1053 §90.691	Field Strength of Spurious Radiation	Pass	Under limit 23.40 dB at 2448.000 MHz

Note: The module (Model: EM05-G) makes no difference after verifying output power, this report reuses test data from the module report.

Declaration of Conformity:

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
 It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
- 2. The measurement uncertainty please refer to this report "Uncertainty of Evaluation".

Comments and Explanations:

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

Reviewed by: Sheng Kuo Report Producer: Cindy Liu

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1 General Description

1.1 Feature of Equipment Under Test

Product Feature					
Equipment	Notebook Computer				
Brand Name	Lenovo				
Model Name	TP00137A, TP00137B				
FCC ID	PU5-TP00137BLQ				
Sample 1	EUT with AVX Antenna				
Sample 2	EUT with AWAN Antenna				
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS				
EUT Stage	Production Unit				

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Remark:

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

WWAN Antenna Information								
	Manufacturer	AVX	Peak gain (dBi)	1.96				
Main Antenna	Part number	025.901X1.0001	Туре	PIFA				
Walli Antenna	Manufacturer	AWAN	Peak gain (dBi)	-1.70				
	Part number	025.901WX.0001	Туре	PIFA				

Remark: The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations 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					
Maximum Output Power to Antenna	23.94 dBm					
Type of Modulation	QPSK / 16QAM					

1.3 Modification of EUT

No modifications are made to the EUT during all test items.

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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.				
Test Site No.	TH03-HY (TAF Code: 1190)				
Test Engineer	Benjamin Lin				
Temperature (°C)	23.5~25				
Relative Humidity (%)	49.4~52				
	The Conducted test item subcontracted to Sporton International Inc. EMC				
Remark	& Wireless Communications Laboratory				

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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.			
rest site No.	03CH16-HY			
Test Engineer	Andy Yang, Karl Hou and Wilson Wu			
Temperature (°C)	20~25			
Relative Humidity (%)	50~60			

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 of 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:

- All test items were verified and recorded according to the standards and without any deviation during the test.
- 2. The TAF code is not including all the FCC KDB listed without accreditation.

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2 **Test Configuration of Equipment Under Test**

Test Mode 2.1

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

For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in Tablet Type (three orthogonal axis (X: flat, Y: portrait, Z: landscape)) and Notebook Type, adjusting the measurement antenna orientation, following C63.26 exploratory test procedures and find EUT with accessory as worst plane.

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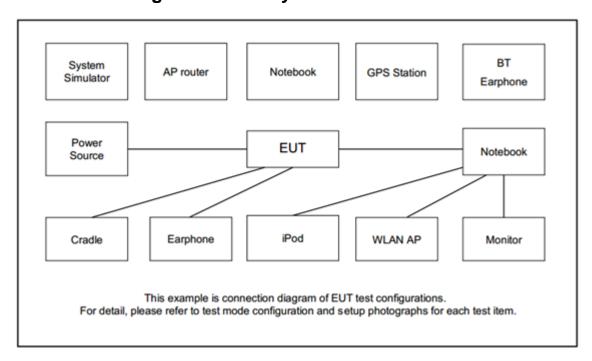
Frequency range investigated for radiated emission is 30 MHz to 9000 MHz.

Conducted	Band	Bandwidth (MHz)			Modulation			RB#		Test Channel						
Test Cases		1.4	3	5	10	15	20	QPSK	16QAM	64QAM	1	Half	Full	L	М	Н
Max. Output Power	26	>	٧	>	v		-	٧	v		V	v	V	>	v	v
E.R.P.	26	v	v	v	v		-	v	v		Max. Power					
Radiated																
Spurious	26			٧	٧		-	V			٧			٧	V	٧
Emission																
	1. Th	1. The mark "v" means that this configuration is chosen for testing														
	2. Tł	ne mar	k "-" m	eans	that th	is band	dwidth	is not supp	orted.							
	3. LT	E Ban	d26 tr	ansmi	t frequ	ency f	or part	22 rule is 8	24MHz-849	MHz, for pa	art90	rule is	814	MHz-8	324MF	Ηz.
Remark	Ef	RP ove	er 15M	Hz ba	ndwidt	h com	plies tl	he ERP lim	it line of par	t22 rule, the	erefor	e ERI	P of th	ne par	tial	
	fre	equenc	y spe	ctrum	which	falls w	ithin pa	art 22 also	complies.					•		
	4. AI	the ra	adiated	test o	ases v	were p	erform	ed with Sa	mple 1.							

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2.2 Connection Diagram of Test System



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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	8821C	N/A	N/A	Unshielded, 1.8 m
2.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A

2.4 Frequency List of Low/Middle/High Channels

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

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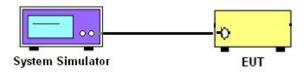
3 Conducted Test Items

3.1 Measuring Instruments

See list of measuring instruments of this test report.

3.1.1 Test Setup

3.1.2 Conducted Output Power



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3.1.3 Test Result of Conducted Test

Please refer to Appendix A.

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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.

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The Conducted 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.

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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.

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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+10log₁₀(P[Watts]) dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

3.3.2 Test Procedures

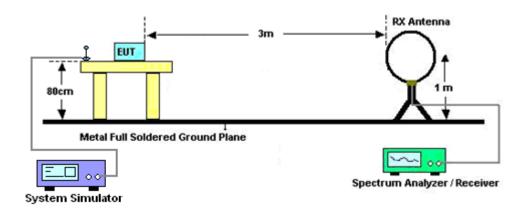
- 1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
- 2. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
- 3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
- 4. 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.
- 5. 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.
- 6. 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.
- 7. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
- 8. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
- 9. Taking the record of output power at antenna port.
- 10. Repeat step 7 to step 8 for another polarization.
- 11. EIRP (dBm) = S.G. Power Tx Cable Loss + Tx Antenna Gain
- 12. ERP (dBm) = EIRP 2.15
- 13. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
- 14. The limit line is derived from 43 + 10log(P) dB below the transmitter power P(Watts)

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3.3.3 Test Setup

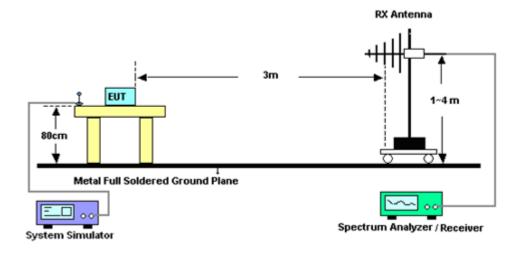
For radiated test below 30MHz



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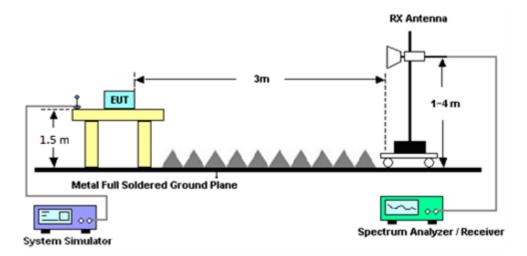
For radiated test from 30MHz to 1GHz

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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.

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List of Measuring Equipment 4

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Base Station (Measure)	Anritsu	MT8821C	6262025341	N/A	Oct. 05, 2021	Dec. 17, 2021	Oct. 04, 2022	Conducted (TH03-HY)
Signal Generator	Agilent	MG3694C	163401	0.1Hz~40GHz	Jan. 31, 2021	Dec. 25, 2021~ Dec. 28, 2021	Jan. 30, 2022	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N -06	41912 & 05	30MHz to 1GHz	Feb. 08, 2021	Dec. 25, 2021~ Dec. 28, 2021	Feb. 07, 2022	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N -06	47020 & 06	30MHz to 1GHz	Oct. 09, 2021	Dec. 25, 2021~ Dec. 28, 2021	Oct. 08, 2022	Radiation (03CH16-HY)
Horn Antenna	SCHWARZB ECK	BBHA 9120 D	9120D-02114	1G~18GHz	Aug. 04, 2021	Dec. 25, 2021~ Dec. 28, 2021	Aug. 03, 2022	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 05. 2021	Dec. 25, 2021~ Dec. 28, 2021	Jul. 04. 2022	Radiation (03CH16-HY)
Amplifier	EMCI	EMC051845SE	980729	1-18GHz	Jul. 09, 2021	Dec. 25, 2021~ Dec. 28, 2021	Jul. 08, 2022	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2021	Dec. 25, 2021~ Dec. 28, 2021	Dec. 08, 2022	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A	MY57290111	3Hz~26.5GHz	Dec. 15, 2021	Dec. 25, 2021~ Dec. 28, 2021	Dec. 14, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/4PE	NA	Aug. 28, 2021	Dec. 25, 2021~ Dec. 28, 2021	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/4PE	NA	Aug. 28, 2021	Dec. 25, 2021~ Dec. 28, 2021	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-57 57	NA	Aug. 28, 2021	Dec. 25, 2021~ Dec. 28, 2021	Aug. 27, 2022	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Dec. 25, 2021~ Dec. 28, 2021	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Dec. 25, 2021~ Dec. 28, 2021	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Dec. 25, 2021~ Dec. 28, 2021	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Dec. 25, 2021~ Dec. 28, 2021	N/A	Radiation (03CH16-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 07, 2021	Dec. 25, 2021~ Dec. 28, 2021	Sep. 06, 2022	Radiation (03CH16-HY)

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5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of	0.00 dD
Confidence of 95% (U = 2Uc(y))	2.86 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))	3.68 dB
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Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power & ERP)

	LTE E	Band 26 M	aximum A	verage Po	wer [dBm]	(GT - LC =	= 1.96 dB)	
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
10	1	0		-	23.94	-		
10	1	25		-	23.84	-		
10	1	49		-	23.59	-		
10	25	0	QPSK	-	23.07	-	23.75	0.2371
10	25	12		-	22.99	-		
10	25	25		-	22.95	-		
10	50	0		-	22.93	-		
10	1	0		-	22.74	-		
10	1	25		-	23.08	-		
10	1	49		-	22.59	-		
10	25	0	16-QAM	-	21.70	-	22.89	0.1945
10	25	12		-	22.10	-		
10	25	25		-	21.93	-		
10	50	0		-	22.01	-		
Limit	Conduc	ted power	< 100W		Result		Pa	ISS

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	LTE E	Band 26 M	laximum A	verage Po	wer [dBm]	(GT - LC =	: 1.96 dB)	
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
5	1	0		23.65	23.92	23.84		
5	1	12		23.61	23.83	23.52		
5	1	24		23.54	23.57	23.82		
5	12	0	QPSK	22.79	23.07	22.85	23.73	0.2360
5	12	7	-	22.85	22.99	22.78		
5	12	13		22.77	22.95	22.69		
5	25	0		22.76	22.95	22.78		
5	1	0		22.94	22.70	22.77		
5	1	12		22.51	23.10	22.60		
5	1	24		22.67	22.61	22.55		
5	12	0	16-QAM	21.77	21.67	21.98	22.91	0.1954
5	12	7		21.79	22.05	21.80		
5	12	13		21.76	21.86	21.82		
5	25	0		21.76	22.00	21.84		
Limit	Conduc	ted power	< 100W		Result		Pa	iss



	LTE E	Band 26 M	aximum A	verage Po	wer [dBm]	(GT - LC =	: 1.96 dB)	
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
3	1	0		23.65	23.88	23.78		
3	1	8		23.62	23.83	23.52		
3	1	14		23.60	23.60	23.75		
3	8	0	QPSK	22.75	23.07	22.80	23.69	0.2339
3	8	4	-	22.78	22.97	22.72		
3	8	7		22.78	22.89	22.71		
3	15	0		22.70	22.93	22.71		
3	1	0		22.60	22.63	22.70		
3	1	8		22.61	23.04	22.57		
3	1	14		22.66	22.59	22.57		
3	8	0	16-QAM	21.77	21.62	21.99	22.85	0.1928
3	8	4		21.82	22.08	21.73		
3	8	7		21.69	21.86	21.78		
3	15	0		21.72	22.01	21.79		
Limit	Conduc	ted power	< 100W		Result		Pa	iss

	LTE E	Band 26 M	aximum A	verage Po	wer [dBm]	(GT - LC =	: 1.96 dB)	
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
1.4	1	0		23.67	23.59	23.59		
1.4	1	3		23.53	23.53	23.82		
1.4	1	5		23.53	23.53	23.78		
1.4	3	0	QPSK	23.70	23.58	23.52	23.63	0.2307
1.4	3	1		23.53	23.54	23.61		
1.4	3	3		23.59	23.52	23.54		
1.4	6	0		22.57	22.65	22.85		
1.4	1	0		22.60	22.56	22.79		
1.4	1	3		22.54	22.54	22.80		
1.4	1	5		22.60	22.55	22.88		
1.4	3	0	16-QAM	22.62	22.62	22.89	22.7	0.1862
1.4	3	1		22.55	22.51	22.77		
1.4	3	3		22.62	22.54	22.77		
1.4	6	0		21.54	21.59	21.60		
Limit	Conduc	ted power	< 100W		Result		Pa	ass

Appendix B. Test Results of Radiated Test

LTE Band 26

Report No.: FG1D0314-04D

	LTE Band 26 / 5MHz / 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)			
	1628	-56.36	-13	-43.36	-71.93	-59.712	3.86	9.37	Н			
	2443	-50.72	-13	-37.72	-70.24	-54.25	4.77	10.46	Н			
	3257	-52.98	-13	-39.98	-75.23	-57.25	5.52	11.94	Н			
									Н			
									Н			
									Н			
Lowest									Н			
	1628	-54.62	-13	-41.62	-70.05	-57.97	3.86	9.37	V			
	2443	-49.92	-13	-36.92	-69.33	-53.45	4.77	10.46	V			
	3257	-53.45	-13	-40.45	-75.59	-57.72	5.52	11.94	V			
									V			
									V			
									V			
	1632	-53.19	-13	-40.19	-68.76	-56.56	3.86	9.39	Н			
	2448	-36.40	-13	-23.40	-55.9	-39.96	4.77	10.49	Н			
	3267	-52.92	-13	-39.92	-75.14	-57.24	5.53	12.00	Н			
									Н			
									Н			
									Н			
Middle									Н			
	1632	-53.91	-13	-40.91	-69.35	-57.28	3.86	9.39	V			
	2448	-39.17	-13	-26.17	-58.56	-42.73	4.77	10.49	V			
	3267	-53.59	-13	-40.59	-75.71	-57.91	5.53	12.00	V			
									V			
									V			
									V			

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	1640	-51.62	-13	-38.62	-67.22	-55.03	3.87	9.44	Н
	2456	-51.43	-13	-38.43	-70.9	-55.00	4.78	10.51	Н
	3277	-51.87	-13	-38.87	-74.09	-56.24	5.53	12.06	Н
									Н
									Н
									Н
									Н
Highest	1640	-52.08	-13	-39.08	-67.55	-55.49	3.87	9.44	V
	2456	-49.69	-13	-36.69	-69.09	-53.26	4.78	10.51	V
	3277	-52.94	-13	-39.94	-75.06	-57.31	5.53	12.06	V
									V
									V
									V
									V

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

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	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)			
	1629	-56.37	-13	-43.37	-71.94	-59.73	3.86	9.37	Н			
	2440	-50.76	-13	-37.76	-70.3	-54.28	4.77	10.44	Н			
	3258	-53.19	-13	-40.19	-75.44	-57.47	5.52	11.95	Н			
									Н			
									Н			
									Н			
Middle									Н			
Middle	1629	-55.52	-13	-42.52	-70.94	-58.88	3.86	9.37	V			
	2440	-48.78	-13	-35.78	-68.19	-52.30	4.77	10.44	V			
	3258	-53.49	-13	-40.49	-75.63	-57.77	5.52	11.95	V			
									V			
									V			
									V			
									V			

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

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