FCC RF Test Report

APPLICANT : Lenovo (Shanghai) Electronics Technology Co., Ltd.

EQUIPMENT : Portable Tablet Computer

BRAND NAME : Lenovo MODEL NAME : TB360ZU

FCC ID : O57TB360ZU

STANDARD : 47 CFR Part 2, and 90(S)

CLASSIFICATION : PCS Licensed Transmitter (PCB)

TEST DATE(S) : Feb. 24, 2023 ~ Mar. 03, 2023

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.26-2015 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

JasonJia

Approved by: Jason Jia





Report No.: FG311926D

Sporton International Inc. (Kunshan)

No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 1 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

TABLE OF CONTENTS

RE	VISIC	ON HISTORY	3
SL	ММА	RY OF TEST RESULT	4
1	GEN	IERAL DESCRIPTION	5
	1.1	Applicant	5
	1.2	Manufacturer	
	1.3	Feature of Equipment Under Test	5
	1.4	Product Specification of Equipment Under Test	5
	1.5	Modification of EUT	5
	1.6	Maximum Conducted Power and Emission Designator	6
	1.7	Testing Site	6
	1.8	Test Software	6
	1.9	Applied Standards	7
2	TES	T CONFIGURATION OF EQUIPMENT UNDER TEST	8
	2.1	Test Mode	8
	2.2	Connection Diagram of Test System	9
	2.3	Support Unit used in test configuration and system	9
	2.4	Measurement Results Explanation Example	9
	2.5	Frequency List of Low/Middle/High Channels	10
3	TES	T RESULT	11
	3.1	Conducted Output Power Measurement	11
	3.2	99% Occupied Bandwidth and 26dB Bandwidth Measurement	
	3.3	Emissions Mask Measurement	13
	3.4	Emissions Mask – Out Of Band Emissions Measurement	
	3.5	Field Strength of Spurious Radiation Measurement	
	3.6	Frequency Stability Measurement	19
4	LIST	OF MEASURING EQUIPMENT	21
5	UNC	ERTAINTY OF EVALUATION	22
ΔΕ	PFNF	DIX A. TEST RESULTS OF CONDUCTED TEST	
AF	PEND	DIX B. TEST RESULTS OF RADIATED TEST	
ΑF	PEND	DIX C. TEST SETUP PHOTOGRAPHS	

Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 2 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FG311926D	Rev. 01	Initial issue of report	Apr. 07, 2023

 Sporton International Inc. (Kunshan)
 Page Number
 : 3 of 21

 TEL: +86-512-57900158
 Report Issued Date
 : Apr. 07, 2023

 FCC ID: O57TB360ZU
 Report Version
 : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	§2.1046	Conducted Output Power	_	Report only	-
3.2	§2.1049 §90.209	Occupied Bandwidth and 26dB Bandwidth	_	Report only	-
3.3	§2.1051 §90.691	Emission masks – In-band emissions	< 50+10log ₁₀ (P[Watts])	PASS	-
3.4	§2.1051 §90.691	Emission masks – Out of band emissions	< 43+10log ₁₀ (P[Watts])	PASS	-
3.5	§2.1053 Field Strength of Spurio		< 43+10log ₁₀ (P[Watts])	PASS	Under limit 46.57 dB at 2440.000 MHz
3.6	§2.1055 §90.213	Frequency Stability for Temperature & Voltage	< 2.5 ppm	PASS	-

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

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.

Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 4 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

1 General Description

1.1 Applicant

Lenovo (Shanghai) Electronics Technology Co., Ltd.

Section 304-305, Building No. 4, # 222, Meiyue Road, China (Shanghai) Pilot Free Trade Zone

1.2 Manufacturer

Lenovo PC HK Limited

23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong, China

1.3 Feature of Equipment Under Test

	Product Feature
Equipment	Portable Tablet Computer
Brand Name	Lenovo
Model Name	TB360ZU
FCC ID	O57TB360ZU
IMEL Code	Conducted: 869864060008140
IMEI Code	Radiation: 869864060010336
HW Version	TB360ZU
SW Version	TB360ZU_RF01_230312
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Product Specification subjective to this standard						
Tx Frequency	814 ~ 824 MHz					
Rx Frequency	859 ~ 869 MHz					
Bandwidth	1.4MHz / 3MHz / 5MHz / 10MHz / 15MHz					
Maximum Output Power to Antenna	24.01 dBm					
Antenna Gain	0.04 dBi					
Type of Modulation	QPSK / 16QAM / 64QAM / 256QAM					

1.5 Modification of EUT

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

 Sporton International Inc. (Kunshan)
 Page Number
 : 5 of 21

 TEL: +86-512-57900158
 Report Issued Date
 : Apr. 07, 2023

 FCC ID: O57TB360ZU
 Report Version
 : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

1.6 Maximum Conducted Power and Emission Designator

Ľ	TE Band 26	QP	SK	16QAM/64QAM/256QAM			
BW (MHz)	Frequency Range (MHz)	Maximum Conducted power (W)	Emission Designator (99%OBW)	Maximum Conducted power (W)	Emission Designator (99%OBW)		
1.4	814.7 ~ 823.3	0.2377	1M09G7D	0.1928	1M09W7D		
3	815.5 ~ 822.5	0.2404	2M70G7D	0.1837	2M75W7D		
5	816.5 ~ 821.5	0.2339	4M48G7D	0.1972	4M48W7D		
10	819.0	0.2421	9M03G7D	0.2065	8M99W7D		
15	824	0.2518	13M4G7D	0.2051	13M5W7D		

Note: All modulations have been tested, only the worst test results of PSK & QAM are shown in the report.

1.7 Testing Site

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)								
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL: +86-512-57900158 FAX: +86-512-57900958								
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.						
rest site No.	03CH04-KS TH01-KS	CN1257	314309						

1.8 Test Software

ĺ	Item Site		Manufacturer	Name	Version	
	1.	03CH04-KS	AUDIX	E3	6.2009-8-24al	

 Sporton International Inc. (Kunshan)
 Page Number
 : 6 of 21

 TEL: +86-512-57900158
 Report Issued Date
 : Apr. 07, 2023

 FCC ID: O57TB360ZU
 Report Version
 : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

1.9 Applied Standards

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

- 47 CFR Part 2, 90(S)
- ANSI C63.26-2015
- FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- FCC KDB 971168 D02 Misc Rev Approv License Devices v02r01

Remark:

- All test items were verified and recorded according to the standards and without any deviation during the test.
- 2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

Sporton International Inc. (Kunshan)
TEL: +86-512-57900158

 TEL: +86-512-57900158
 Report Issued Date : Apr. 07, 2023

 FCC ID: O57TB360ZU
 Report Version : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

Page Number

: 7 of 21

Test Configuration of Equipment Under Test 2

Test Mode 2.1

During all testing, EUT is in link mode with base station emulator at maximum power level. The spurious emission measurements were carried out in semi-anechoic chamber with 3-meter test range, and EUT is rotated on three test planes to find out the worst emission.

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

Test Items	Band	Bandwidth (MHz				(IHz)		Modulation					RB#			Test Channel		
	24.14	1.4	3	5	10	15	20	QPSK	16QAM	64QAM	256QAM	1	Half	Full	L	М	н	
Max. Output Power	26	v	v	v	v	v	-	v	v	v	v	v		v	v	٧	v	
26dB and 99% Bandwidth	26	>	v	v	>	v	-	v	>					v	>	>		
Emission masks In-band emissions	26	v	v	v	v	v		v	v	v	v	v		v	v		v	
Emission masks – Out of band emissions	26	v	v	v	v	v	-	v				v			v	v	v	
Frequency Stability	26				v		-	v						v		٧		
Radiated Spurious Emission	26		Worst Case							v								
Note	 The mark "v" means that this configuration is chosen for testing The mark "-" means that this bandwidth is not supported. 						•											

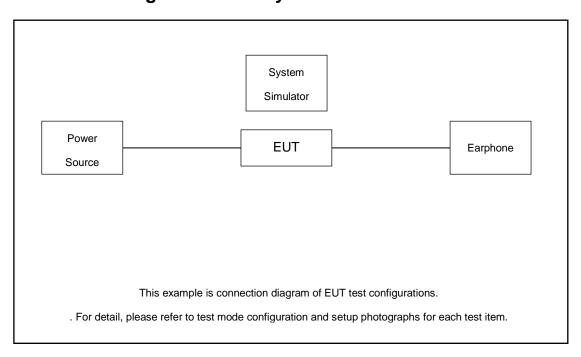
Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU

: 8 of 21 Page Number Report Issued Date: Apr. 07, 2023 Report Version : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

2.2 Connection Diagram of Test System



2.3 Support Unit used in test configuration and system

Item Equipment		quipment Trade Name		FCC ID	Data Cable	Power Cord	
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m	
2.	Earphone	N/A	N/A	N/A	N/A	N/A	

2.4 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss between RF conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level will be exactly the RF output level.

The spectrum analyzer offset is derived from RF cable loss.

Offset = RF cable loss.

The following shows an offset computation example with RF cable loss 4.6 dB.

Example:

 $Offset(dB) = RF \ cable \ loss(dB).$

= 4.6 (dB)

Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 9 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report No.: FG311926D

2.5 Frequency List of Low/Middle/High Channels

LTE Band 26 Channel and Frequency List										
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest						
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						

	LTE Band 26 Cross-rule Channel and Frequency List										
BW [MHz]	Channel/Frequency(MHz)	-	Middle	-							
15	Channel	-	26790	-							
15	Frequency	-	824	-							
10	Channel	-	26790	-							
10	Frequency	-	824	-							
5	Channel	-	26790	-							
5	Frequency	-	824	-							
3	Channel	-	26790	-							
3	Frequency	-	824	-							
4.4	Channel	-	26790	-							
1.4	Frequency	-	824	-							

Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 10 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report No.: FG311926D

3 Test Result

3.1 Conducted Output Power Measurement

3.1.1 Description of the Conducted Output Power 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.

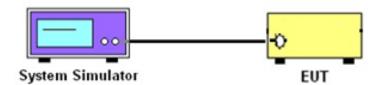
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

- 1. The transmitter output port was connected to the system simulator.
- 2. Set EUT at maximum power through the 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.

3.1.4 Test Setup



3.1.5 Test Result of Conducted Output Power

Please refer to Appendix A.

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 11 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

3.2 99% Occupied Bandwidth and 26dB Bandwidth Measurement

3.2.1 Description of (Occupied) Bandwidth Limitations Measurement

The 99% occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean transmitted power.

The emission bandwidth is defined as the width of the signal between two points, located at the 2 sides of the carrier frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

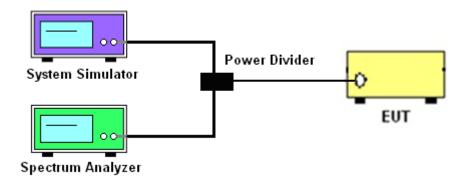
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

- 1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
- 2. The 26dB and 99% occupied bandwidth (BW) of the middle channel for the highest RF power with full RB sizes were measured.

3.2.4 Test Setup



3.2.5 Test Result of 99% Occupied Bandwidth and 26dB Bandwidth

Please refer to Appendix A.

Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 12 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

3.3 Emissions Mask Measurement

3.3.1 Description of Emissions Mask Measurement

Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of FCC Part 90.691.(a):

- (a) 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 Log₁₀(f/6.1) decibels or 50 + 10 Log₁₀(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 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 + 10Log₁₀(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.

3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

- 1. The EUT was connected to spectrum analyzer and base station via power divider.
- 2. The emissions mask of low and high channels for the highest RF powers were measured.
- The measured RBW and the VBW set 3 times of RBW are then set in spectrum analyzer, and the RBW correction factor 10log (1% of OBW/measured RBW)(dB) was compensated, if required.
- 4. The test results were shown below plots with a correction offset factor including cable loss, insertion loss of power divider.

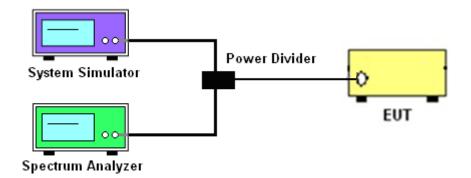
 Sporton International Inc. (Kunshan)
 Page Number
 : 13 of 21

 TEL: +86-512-57900158
 Report Issued Date
 : Apr. 07, 2023

 FCC ID: O57TB360ZU
 Report Version
 : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

3.3.4 Test Setup



3.3.5 Test Result (Plots) of Conducted Emissions Mask

Please refer to Appendix A.

Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 14 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

3.4 Emissions Mask - Out Of Band Emissions Measurement

3.4.1 Description of Conducted Emissions Out of band emissions measurement

The power of any emission FCC Part 90.691 (a)(2) on any frequency removed from the assigned frequency by out of the authorized bandwidth at least 43 + 10 log (P) dB. It is measured by means of a calibrated spectrum analyzer and scanned from 30 MHz up to a frequency including its 10th harmonic.

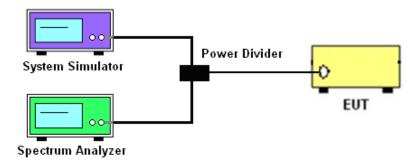
3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

- 1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
- The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
 The path loss was compensated to the results for each measurement.
- 3. The middle channel for the highest RF power within the transmitting frequency was measured.
- 4. The conducted spurious emission for the whole frequency range was taken.
- 5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
- 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
- 7. The limit line is derived from 43 + 10log(P)dB below the transmitter power P(Watts)

3.4.4 Test Setup



3.4.5 Test Result (Plots) of Conducted Emission

Please refer to Appendix A.

Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 15 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report No.: FG311926D

3.5 Field Strength of Spurious Radiation Measurement

3.5.1 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+10log₁₀(P[Watts]) dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

- 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.
- 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. EIRP (dBm) = S.G. Power Tx Cable Loss + Tx Antenna Gain
- 11. ERP (dBm) = 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 + 10log(P) dB below the transmitter power P(Watts)

Sporton International Inc. (Kunshan)
TEL: +86-512-57900158

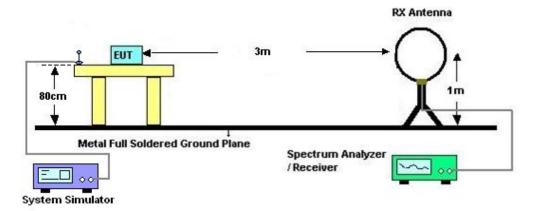
FCC ID : O57TB360ZU

Page Number : 16 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

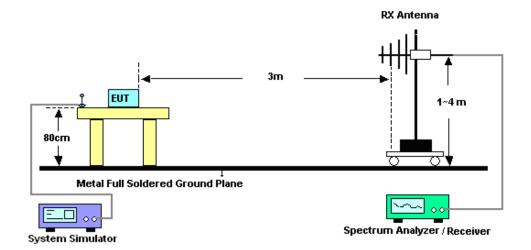
Report No.: FG311926D

3.5.4 Test Setup

For radiated test from 30MHz



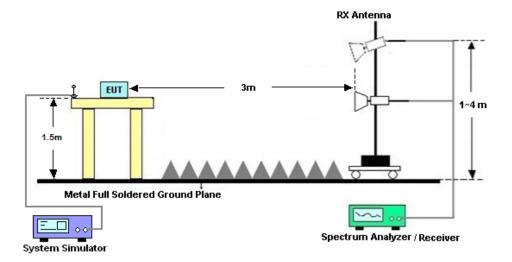
For radiated test from 30MHz to 1GHz



TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 17 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

For radiated test above 1GHz



3.5.5 Test Result of Field Strength of Spurious Radiated

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.

Please refer to Appendix B.

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 18 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report No.: FG311926D

3.6 Frequency Stability Measurement

Description of Frequency Stability Measurement 3.6.1

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 ±0.00025% (±2.5ppm) of the center frequency according to FCC Part 90.213.

3.6.2 **Measuring Instruments**

The measuring equipment is listed in the section 4 of this test report.

3.6.3 **Test Procedures for Temperature Variation**

- 1. The EUT was set up in the thermal chamber and connected with the base station.
- 2. With power OFF, the temperature was decreased to -30°C and the EUT was stabilized for three hours. Power was applied and the maximum change in frequency was recorded within one minute.
- With power OFF, the temperature was raised in 10°C step up to 50°C. The EUT was stabilized 3. at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute.

3.6.4 **Test Procedures for Voltage Variation**

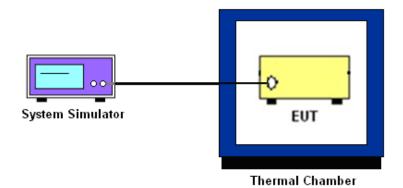
- 1. The EUT was placed in a temperature chamber at 20±5°C and connected with the system simulator.
- 2. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value for other than hand carried battery equipment.
- 3. For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the
- 4. battery operating end point, which shall be specified by the manufacturer.
- The variation in frequency was measured for the worst case. 5.

Report Template No.: BU5-FWLTE Version 2.0

Report No.: FG311926D

FCC ID: O57TB360ZU

3.6.5 Test Setup



3.6.6 Test Result of Temperature Variation

Please refer to Appendix A.

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 20 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report No.: FG311926D

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 12, 2022	Feb. 24, 2023	Oct. 11, 2023	Conducted (TH01-KS)
Power divider	STI	STI08-0055	-	0.5~40GHz	NCR	Feb. 24, 2023	NCR	Conducted (TH01-KS)
Temperature & humidity chamber	Hongzhan	LP-150U	H2014011440	-40~+150°C 20%~95%RH	Jul. 15, 2022	Feb. 24, 2023	Jul. 14, 2023	Conducted (TH01-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY57471079	10Hz-44G,MAX 30dB	Oct. 12, 2022	Mar. 03, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 16, 2022	Mar. 03, 2023	Oct. 15, 2023	Radiation (03CH04-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	May 24, 2022	Mar. 03, 2023	May 23, 2023	Radiation (03CH04-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	1284	1GHz~18GHz	Jan. 04, 2023	Mar. 03, 2023	Jan. 03, 2024	Radiation (03CH04-KS)
Amplifier	SONOMA	310N	187289	9KHz-1GHz	Jan. 04, 2023	Mar. 03, 2023	Jan. 03, 2024	Radiation (03CH04-KS)
high gain Amplifier	EM	EM01G18G A	060840	1Ghz-18Ghz	Oct. 12, 2022	Mar. 03, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
Amplifier	Agilent	8449B	3008A02370	1Ghz-18Ghz	Oct. 12, 2022	Mar. 03, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Mar. 03, 2023	NCR	Radiation (03CH04-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Mar. 03, 2023	NCR	Radiation (03CH04-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Mar. 03, 2023	NCR	Radiation (03CH04-KS)

NCR: No Calibration Required

Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : 21 of 21
Report Issued Date : Apr. 07, 2023
Report Version : Rev. 01

Report No.: FG311926D

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.26-2015. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Measurement

Test Item	Uncertainty	
Conducted Power	±0.46 dB	
Conducted Emissions	±0.48 dB	
Occupied Channel Bandwidth	±0.1 %	

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

Measuring Uncertainty for a Level of	3.3dB
Confidence of 95% (U = 2Uc(y))	3.3UB

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.8dB
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Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.8dB
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----- THE END -----

 Sporton International Inc. (Kunshan)
 Page Number
 : 22 of 21

 TEL: +86-512-57900158
 Report Issued Date
 : Apr. 07, 2023

 FCC ID: O57TB360ZU
 Report Version
 : Rev. 01

Report Template No.: BU5-FWLTE Version 2.0

Appendix A. Test Results of Conducted Test

Test Engineer :	Simle Wang	Temperature :	22~23 ℃
rest Engineer.		Relative Humidity :	40~42%

Report No.: FG311926D

Conducted Output Power (Average power)

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
	Chan	nel	26790			
	Frequency	/ (MHz)		824		
15	QPSK	1	0	24.01		
15	QPSK	1	74	23.80		
15	QPSK	75	0	22.89		
15	16QAM	1	0	23.12		
15	64QAM	1	0	22.13		
15	256QAM	1	0	19.03		
	15Cha	nnel			26740	
	Frequency	/ (MHz)			819	
10	QPSK	1	0		23.84	
10	16QAM	1	0		23.15	
	Chan	nel		26715	26740	26765
	Frequency	/ (MHz)		816.5	819	821.5
5	QPSK	1	0	23.47	23.56	23.69
5	16QAM	1	0	22.87	22.91	22.95
	Chan	nel		26705	26740	26775
Frequency (MHz)				815.5	819	822.5
3	QPSK	1	0	23.68	23.72	23.81
3	16QAM	1	0	22.37	22.61	22.64
Channel				26697	26740	26783
Frequency (MHz)				814.7	819	823.3
1.4	QPSK	1	0	23.72	23.74	23.76
1.4	16QAM	1	0	22.56	22.69	22.85

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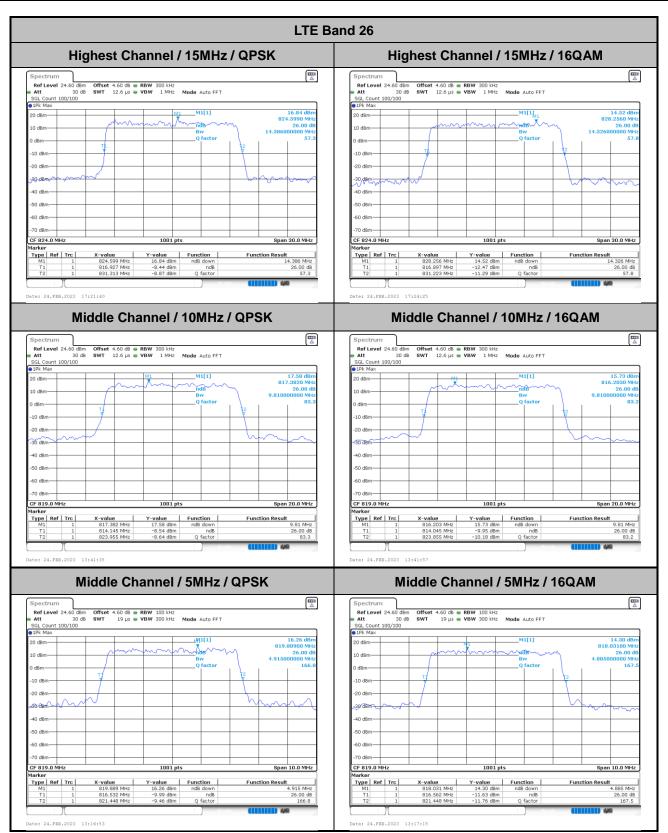
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Sporton International Inc. (Kunshan) Page Number : A1 of A32

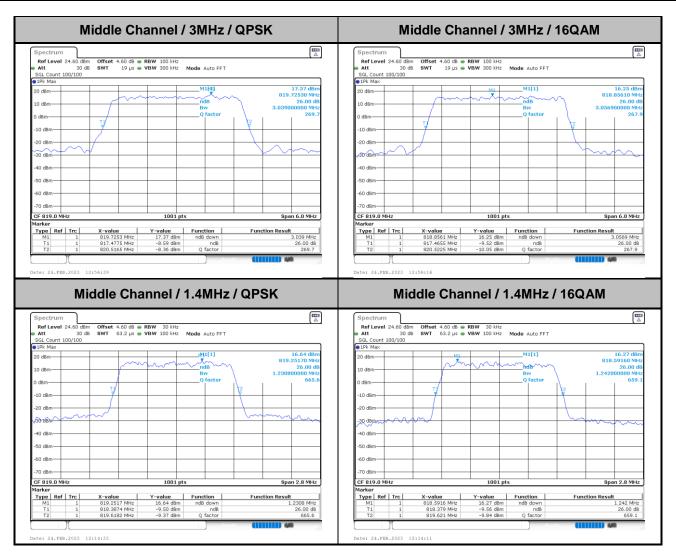
26dB Bandwidth

Mode	LTE Band 26 : 26dB BW(MHz)		
BW	15MHz		
Mod.	QPSK	16QAM	
Low CH	14.39	14.33	
BW	10MHz		
Mod.	QPSK	16QAM	
Mid CH	9.81	9.81	
BW	5MHz		
Mod.	QPSK	16QAM	
Mid CH	4.92	4.89	
BW	3MHz		
Mod.	QPSK	16QAM	
Mid CH	3.04	3.06	
BW	1.4MHz		
Mod.	QPSK	16QAM	
Mid CH	1.23	1.24	

TEL: +86-512-57900158 FCC ID: O57TB360ZU



: A3 of A32

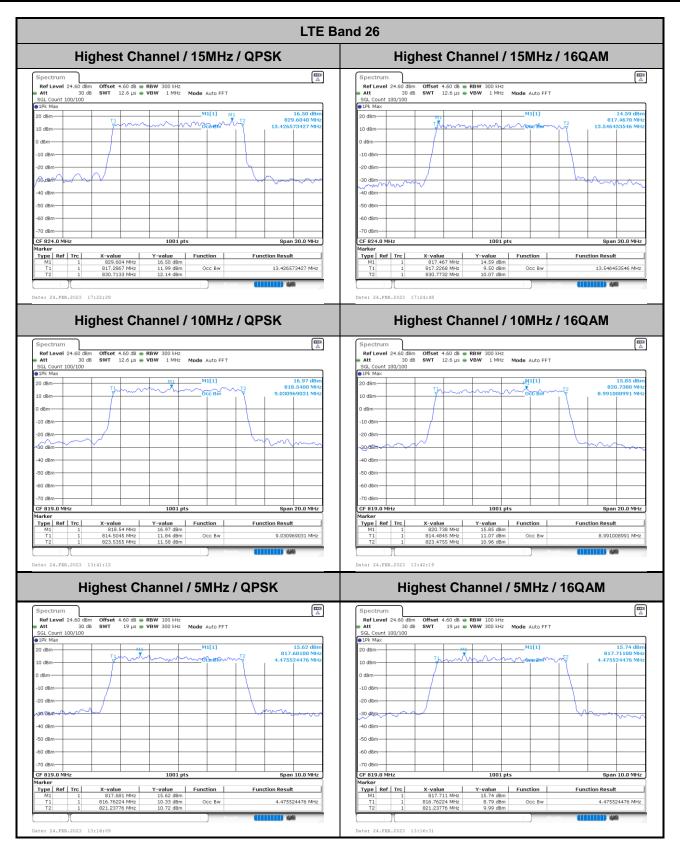


Occupied Bandwidth

Mode	LTE Band 26 : 99%OBW(MHz)		
BW	15MHz		
Mod.	QPSK	16QAM	
Low CH	13.43	13.54	
BW	10MHz		
Mod.	QPSK	16QAM	
Mid CH	9.03	8.99	
BW	5MHz		
Mod.	QPSK	16QAM	
Mid CH	4.48	4.48	
BW	3MHz		
Mod.	QPSK	16QAM	
Mid CH	2.70	2.75	
BW	1.4MHz		
Mod.	QPSK	16QAM	
Mid CH	1.09	1.09	

FCC ID: O57TB360ZU

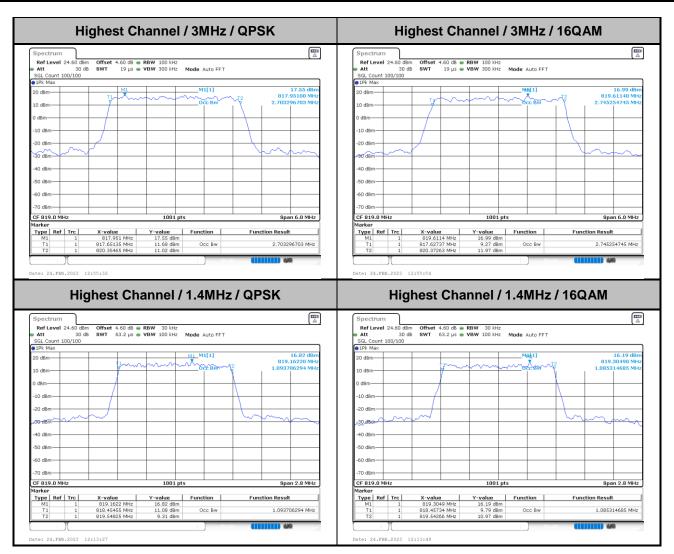
: A5 of A32



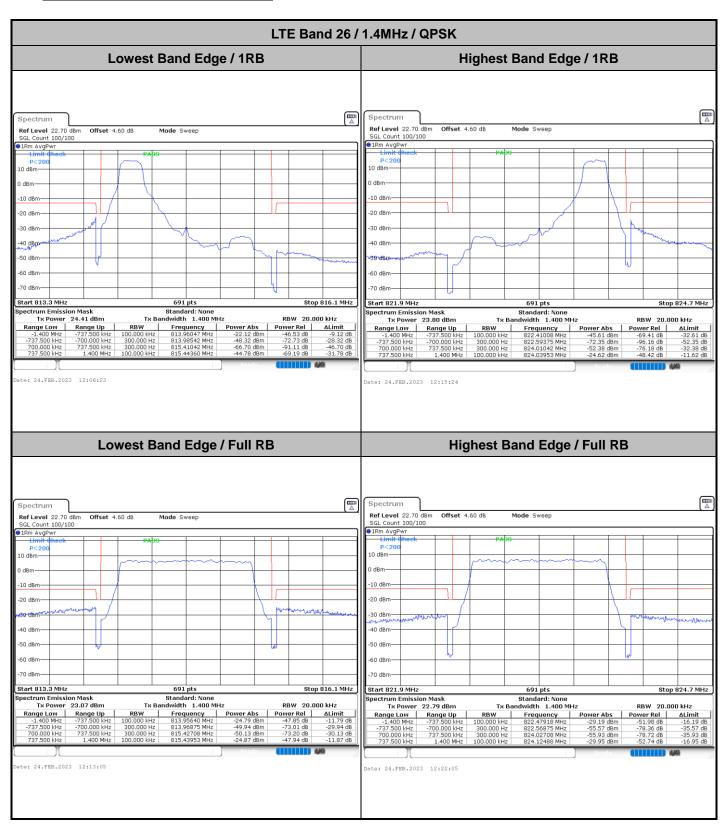
Report No.: FG311926D

: A6 of A32

Page Number

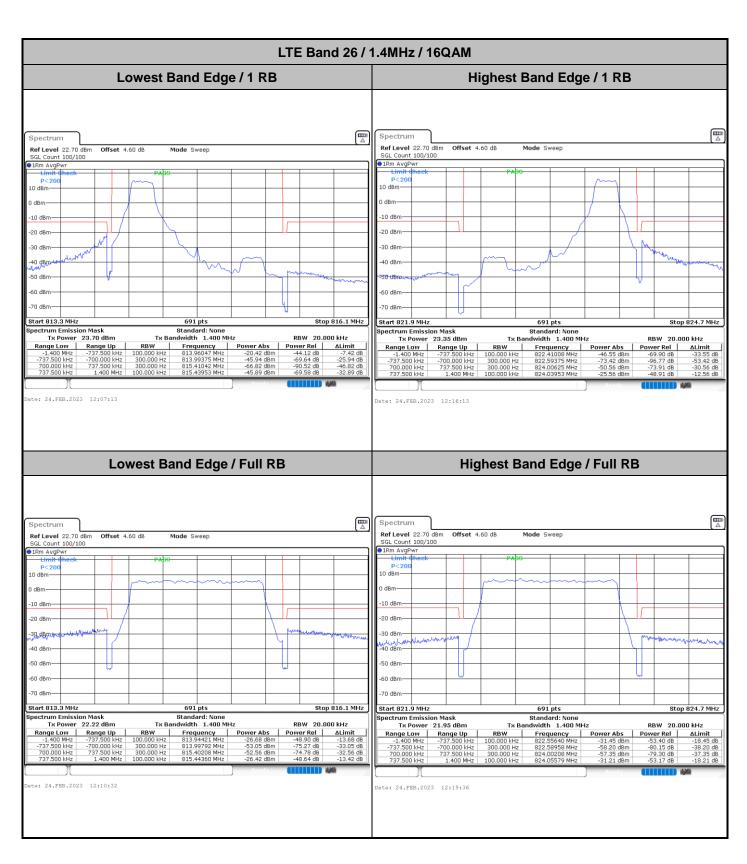


Conducted Band Edge



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TEL: +86-512-57900158 FCC ID: O57TB360ZU Page Number : A8 of A32



Sporton International Inc. (Kunshan)

TEL: +86-512-57900158 FCC ID: O57TB360ZU

