



FCC RADIO TEST REPORT

FCC ID : PU5-TP00132C
Equipment : Notebook Computer
Brand Name : Lenovo
Model Name : TP00132C
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, China
Standard : FCC 47 CFR Part 2, Part 27(D)

Equipment: Fibocom L860-GL-16 tested inside of Lenovo Notebook Computer.

The product was received on Dec. 09, 2022 and testing was performed from Jan. 21, 2023 to Jan. 31, 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 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.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory



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History of this test report

Report No.	Version	Description	Issue Date
FG2D0922C	01	Initial issue of report	Feb. 23, 2023



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power	Reporting only	-
-	-	Peak-to-Average Ratio	-	See Note
3.3	§27.50 (a)(3)	Effective Isotropic Radiated Power	Pass	-
-	§2.1049	Occupied Bandwidth	-	See Note
-	§2.1051 §27.53 (a)(4)	Conducted Band Edge Measurement	-	See Note
-	§2.1051 §27.53 (a)(4)	Conducted Spurious Emission	-	See Note
-	§2.1055 §27.54	Frequency Stability Temperature & Voltage	-	See Note
4.2	§2.1053 §27.53 (a)(4)	Radiated Spurious Emission	Pass	15.08 dB under limit at 9231.000 MHz

Note:

1. For host device, Equivalent Isotropic Radiated Power and Radiated Spurious Emission are verified and complies with the limit in this test report.
2. For host device, the Conducted Output Power is no difference after compared to module (Model: L860-GL-16)

Conformity Assessment Condition:

1. 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/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. Please refer to the section "Uncertainty of Evaluation" for 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: Rachel Hsieh

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook Computer
Brand Name	Lenovo
Model Name	TP00132C
FCC ID	PU5-TP00132C
Sample 1	EUT with AVX/ Ethertronics Antenna
Sample 2	EUT with LUXSHARE-ICT Antenna
Integrated WLAN Module	Brand Name: Intel Model Name: AX211D2W FCC ID: PD9AX211D2
Integrated NFC Module	Brand Name: Foxconn Model Name: T77H747
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS/NFC WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80/VHT160 WLAN 11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
EUT Stage	Production Unit

Remark:

1. The above EUT's information was declared by manufacturer.
2. Equipment: Fibocom L860-GL-16 tested inside of Lenovo Notebook Computer.

WWAN Antenna Information				
Main Antenna	Manufacturer	AVX/ Ethertronics	Peak gain (dBi)	LTE Band 30: 1.91
	Part number	SA31F29287AA	Type	PIFA
	Manufacturer	LUXSHARE-ICT	Peak gain (dBi)	LTE Band 30: -1.1
	Part number	SA31F29290AA	Type	PIFA

Remark: The above EUT's information was 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	2307.5 MHz ~ 2312.5 MHz
Rx Frequency	2352.5 MHz ~ 2357.5 MHz
Bandwidth	5MHz / 10MHz
Maximum Output Power to Antenna	21.47 dBm
Type of Modulation	QPSK / 16QAM / 64QAM

1.3 Modification of EUT

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



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	Mike Yeh
Temperature (°C)	22.8~23.4
Relative Humidity (%)	52~55
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	Andy Yang, Karl Hou 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 of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ ANSI C63.26-2015
- ♦ FCC 47 CFR Part 2, Part 27(D)
- ♦ ANSI / TIA-603-E
- ♦ FCC KDB 971168 Power Meas License Digital Systems D01 v03r01
- ♦ FCC KDB 412172 D01 Determining ERP and EIRP v01r01
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01

Remark:

1. 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.

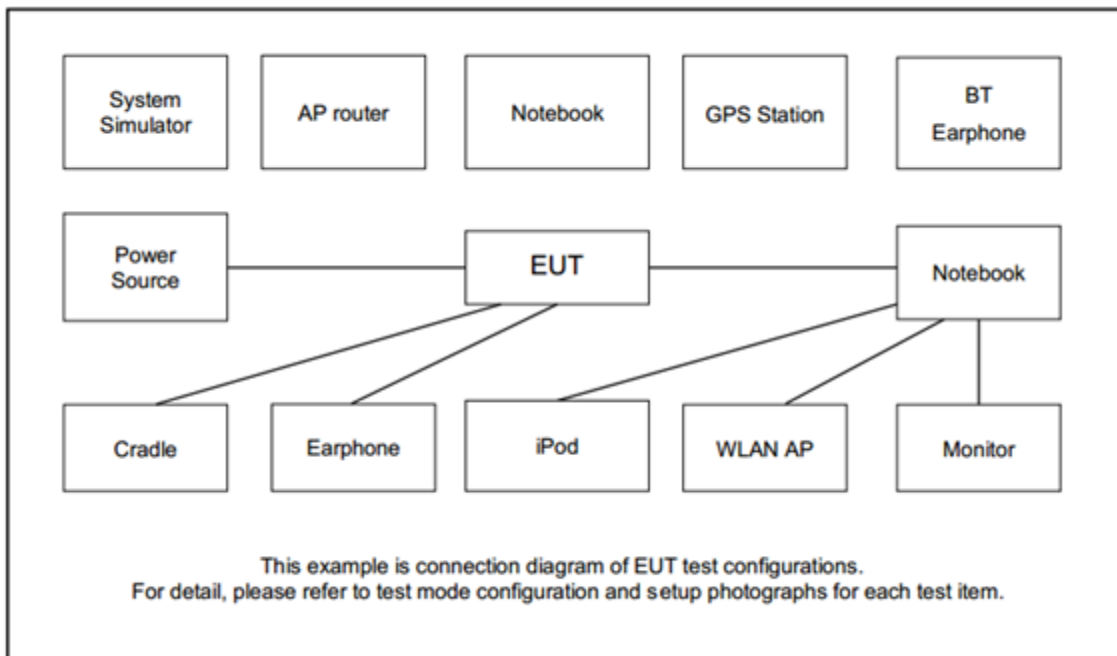
2 Test Configuration of Equipment Under Test

2.1 Test Mode

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

Test Items	Band	Bandwidth (MHz)						Modulation			RB #			Test Channel		
		1.4	3	5	10	15	20	QPSK	16QAM	64QAM	1	Half	Full	L	M	H
Max. Output Power	30	-	-	v	v	-	-	v	v		v			v	v	v
E.I.R.P	30	-	-	v	v	-	-	v	v		Max. Power					
Radiated Spurious Emission	30	-	-	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. All the radiated test cases were performed with Adapter 1 and Sample 1. 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. For modulation of QPSK/16QAM, the maximum power of QPSK/16QAM is higher than other modulation (64QAM), therefore, according to engineering evaluation, we choose higher power (QPSK/16QAM) to perform all tests and show in the report. 															

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.	Earphone	Lenovo	TS300-01MS21-8S	N/A	Shielded, 1.2 m	N/A
2.	System Simulator	Anritsu	MT8821C	N/A	N/A	Unshielded, 1.8 m

2.4 Frequency List of Low/Middle/High Channels

LTE Band 30 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
10	Channel	-	27710	-
	Frequency	-	2310	-
5	Channel	27685	27710	27735
	Frequency	2307.5	2310	2312.5

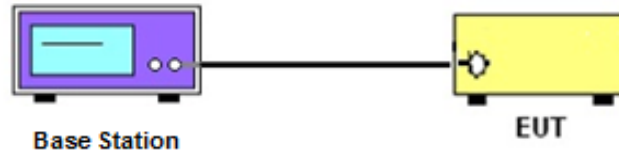
3 Conducted Test Items

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

3.2.1 Description of the Conducted Output Power Measurement

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

3.2.2 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.



3.3 Effective Isotropic Radiated Power

3.3.1 Description of Effective Isotropic Radiated Power

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. For mobile and portable stations using time division duplexing (TDD) technology, the duty cycle must not exceed 38 percent in the 2305-2315 MHz and 2350-2360 MHz bands. Mobile and portable stations using FDD technology are restricted to transmitting in the 2305-2315 MHz band. Power averaging shall not include intervals in which the transmitter is off.

Remark: EIRP use worst case measure the total power to cover per 5MHz Power.

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

3.3.2 Test Procedures

The testing follows ANSI C63.26-2015 Section 5.2.4.5

1. Determine the EIRP by adding the effective antenna gain to the adjusted power level.

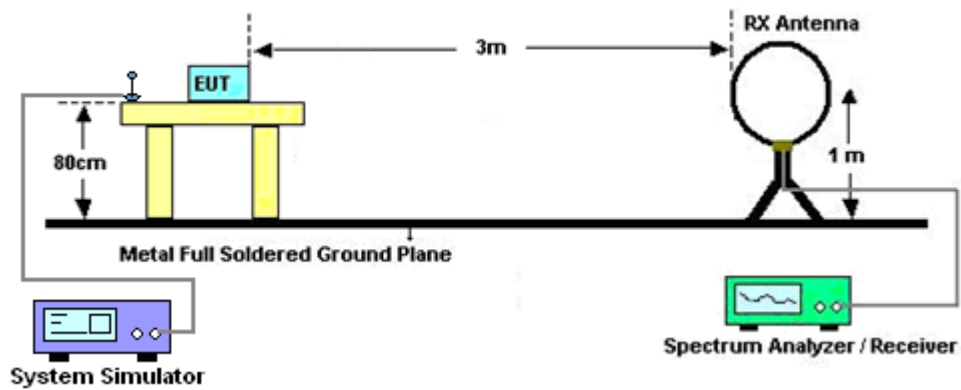
4 Radiated Test Items

4.1 Measuring Instruments

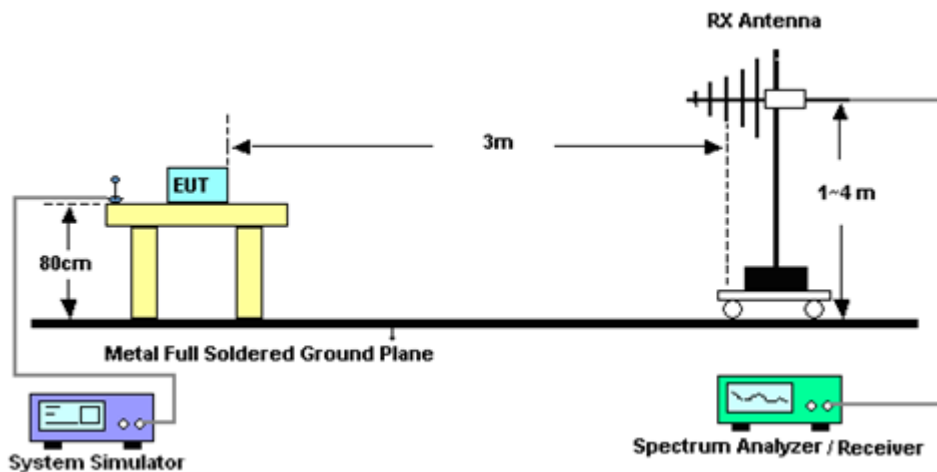
See list of measuring instruments of this test report.

4.1.1 Test Setup

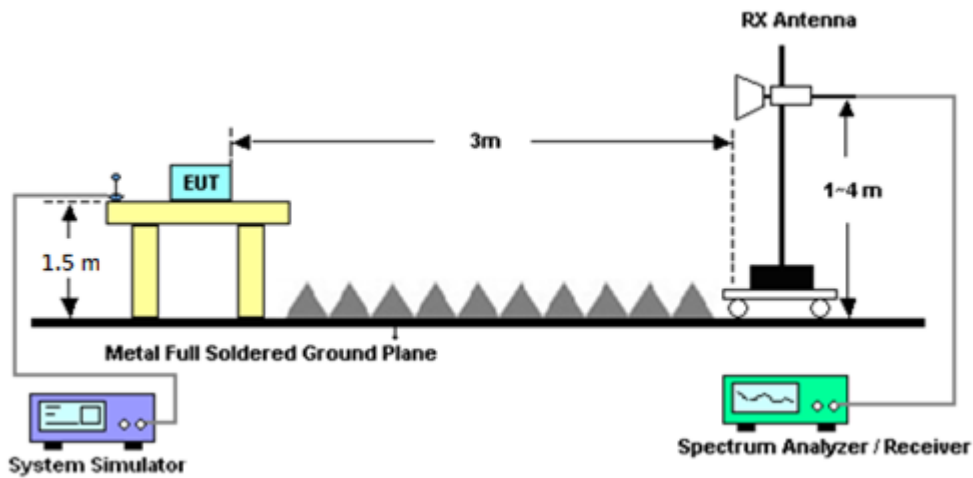
For radiated test below 30MHz



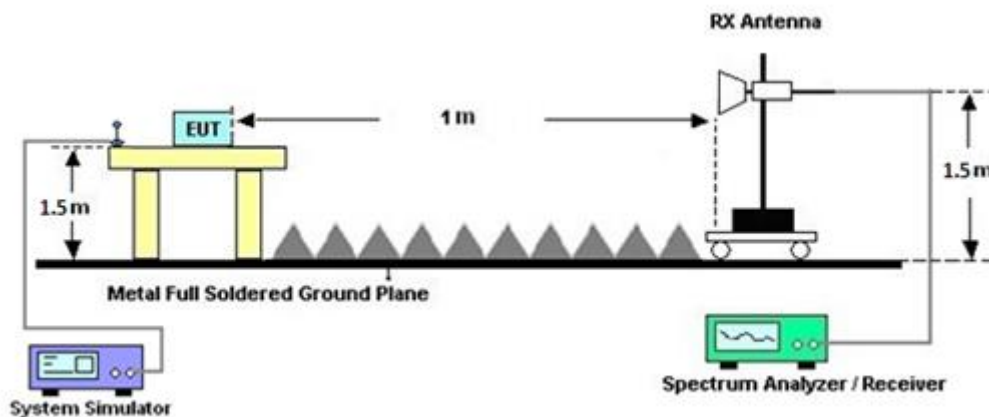
For radiated test from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



4.1.2 Test Result of Radiated Test

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.



4.2 Radiated Spurious Emission Measurement

4.2.1 Description of Radiated Spurious Emission Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E
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 $70 + 10 \log (P)$ dB.
The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

4.2.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 7 and ANSI / TIA-603-E Section 2.2.12.

1. The EUT was placed on a turntable with 0.8 meter height for frequency below 1GHz and 1.5 meter height for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the receiving antenna 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 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
5. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, 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.
$$\text{EIRP (dBm)} = \text{S.G. Power} - \text{Tx Cable Loss} + \text{Tx Antenna Gain}$$
$$\text{ERP (dBm)} = \text{EIRP} - 2.15$$
9. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
The limit line is derived from $70 + 10\log(P)$ dB below the transmitter power P(Watts)
$$= P(\text{W}) - [70 + 10\log(P)] (\text{dB})$$
$$= [30 + 10\log(P)] (\text{dBm}) - [70 + 10\log(P)] (\text{dB})$$
$$= -40\text{dBm}.$$



5 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Radio Communication Analyzer	Anritsu	MT8821C	6262025353	LTE FDD/TDD LTE-2CC DLCA/ULCA	Oct. 13, 2022	Jan. 21, 2023~ Jan. 22, 2023	Oct. 12, 2023	Conducted (TH03-HY)
Coupler	Warison	20dB 25W SMA Directional Coupler	#B	1-18GHz	Jan. 06, 2023	Jan. 21, 2023~ Jan. 22, 2023	Jan. 05, 2024	Conducted (TH03-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	Jan. 20, 2023~ Jan. 31, 2023	Sep. 19, 2023	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA9170	00993	18GHz-40GHz	Nov. 24, 2022	Jan. 20, 2023~ Jan. 31, 2023	Nov. 23, 2023	Radiation (03CH16-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz~44GHz	Oct. 07, 2022	Jan. 20, 2023~ Jan. 31, 2023	Oct. 06, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	Jun. 28, 2022	Jan. 20, 2023~ Jan. 31, 2023	Jun. 27, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	804011/2,804012/2	18-40G	Jan. 03, 2023	Jan. 20, 2023~ Jan. 31, 2023	Jan. 02, 2024	Radiation (03CH16-HY)
Signal Generator	Agilent	MG3694C	163401	0.1Hz~40GHz	Feb. 13, 2022	Jan. 20, 2023~ Jan. 31, 2023	Feb. 12, 2023	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	41912 & 05	30MHz to 1GHz	Feb. 06, 2022	Jan. 20, 2023~ Jan. 31, 2023	Feb. 05, 2023	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N-06	47020 & 06	30MHz to 1GHz	Oct. 08, 2022	Jan. 20, 2023~ Jan. 31, 2023	Oct. 07, 2023	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-02114	1G~18GHz	Aug. 09, 2022	Jan. 20, 2023~ Jan. 31, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1G~18GHz	Mar. 10, 2022	Jan. 20, 2023~ Jan. 31, 2023	Mar. 09, 2023	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 04, 2022	Jan. 20, 2023~ Jan. 31, 2023	Jul. 03, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM1G18G	060812	1-18GHz	Dec. 26, 2022	Jan. 20, 2023~ Jan. 31, 2023	Dec. 25, 2023	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2022	Jan. 20, 2023~ Jan. 31, 2023	Dec. 08, 2023	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A	MY57290111	3Hz~26.5GHz	Dec. 15, 2022	Jan. 20, 2023~ Jan. 31, 2023	Dec. 14, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	805935/4	N/A	Aug. 09, 2022	Jan. 20, 2023~ Jan. 31, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	802434/4	N/A	Aug. 09, 2022	Jan. 20, 2023~ Jan. 31, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5757	N/A	Aug. 09, 2022	Jan. 20, 2023~ Jan. 31, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Jan. 20, 2023~ Jan. 31, 2023	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Jan. 20, 2023~ Jan. 31, 2023	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jan. 20, 2023~ Jan. 31, 2023	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jan. 20, 2023~ Jan. 31, 2023	N/A	Radiation (03CH16-HY)



6 Uncertainty of Evaluation

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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Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.79 dB
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Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power & EIRP)

LTE Band 30 Maximum Average Power [dBm] (GT - LC = 1.91 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP (W)
10	1	0	QPSK	-	21.47	-	23.38	0.2178
10	1	0	16-QAM	-	20.61	-	22.52	0.1786
Limit	EIRP < 250mW/5MHz			Result			Pass	

LTE Band 30 Maximum Average Power [dBm] (GT - LC = 1.91 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP (W)
5	1	0	QPSK	21.36	21.29	21.25	23.27	0.2123
5	1	0	16-QAM	20.51	20.88	20.58	22.79	0.1901
Limit	EIRP < 250mW/5MHz			Result			Pass	

Total EIRP power is less than partial EIRP limit 250 mW/5MHz.



Appendix B. Test Results of Radiated Test

LTE Band 30

LTE Band 30 / 5MHz / QPSK									
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	4610	-61.96	-40	-21.96	-50.29	-67.89	6.73	12.66	H
	6916	-59.16	-40	-19.16	-55.73	-62.64	8.49	11.97	H
	9221	-55.31	-40	-15.31	-56.55	-56.41	9.71	10.82	H
									H
									H
	4610	-60.99	-40	-20.99	-48.97	-66.92	6.73	12.66	V
	6916	-58.99	-40	-18.99	-55.56	-62.47	8.49	11.97	V
	9221	-56.55	-40	-16.55	-56.77	-57.65	9.71	10.82	V
									V
									V
Middle	4615	-62.29	-40	-22.29	-50.66	-68.19	6.74	12.64	H
	6923	-59.17	-40	-19.17	-55.79	-62.63	8.50	11.95	H
	9231	-55.08	-40	-15.08	-56.34	-56.14	9.72	10.78	H
									H
									H
									H
	4615	-60.56	-40	-20.56	-48.59	-66.46	6.74	12.64	V
	6923	-58.59	-40	-18.59	-55.23	-62.05	8.50	11.95	V
	9231	-56.38	-40	-16.38	-56.6	-57.44	9.72	10.78	V
									V
								V	
								V	



Highest	4620	-62.74	-40	-22.74	-51.15	-68.61	6.75	12.62	H
	6931	-59.04	-40	-19.04	-55.71	-62.48	8.50	11.94	H
	9241	-55.19	-40	-15.19	-56.48	-56.21	9.72	10.74	H
									H
									H
									H
									H
	4620	-62.01	-40	-22.01	-50.08	-67.88	6.75	12.62	V
	6931	-59.23	-40	-19.23	-55.94	-62.67	8.50	11.94	V
	9241	-56.30	-40	-16.30	-56.52	-57.32	9.72	10.74	V
									V
									V
									V
									V

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



LTE Band 30 / 10MHz / QPSK									
Channel	Frequency (MHz)	EIRP (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	4611	-63.87	-40	-23.87	-52.21	-69.79	6.74	12.66	H
	6916	-59.23	-40	-19.23	-55.8	-62.71	8.49	11.97	H
	9222	-55.36	-40	-15.36	-56.6	-56.46	9.71	10.81	H
									H
									H
									H
									H
	4611	-59.52	-40	-19.52	-47.51	-65.44	6.74	12.66	V
	6916	-58.11	-40	-18.11	-54.68	-61.59	8.49	11.97	V
	9222	-56.40	-40	-16.40	-56.61	-57.5	9.71	10.81	V
									V
									V
									V
									V

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