FCC RADIO TEST REPORT

FCC ID	:	**PU5-TP00127A**
Equipment	:	**Notebook Computer**
Brand Name	:	**Lenovo**
Model Name	:	**TP00127A**
Applicant	:	**Wistron Corporation** **21F, No. 88, Sec. 1, Hsin Tai Wu Rd., Hsichih Dist, New Taipei City 221,Taiwan**
Manufacturer	:	**Wistron Corporation** **21F, No. 88, Sec. 1, Hsin Tai Wu Rd., Hsichih Dist, New Taipei City 221,Taiwan**
Standard	:	**FCC 47 CFR Part 2, 96**

Equipment: Quectel EM120R-GL tested inside of Lenovo Notebook Computer

The product was received on Dec. 21, 2020 and testing was started from Jan. 15, 2021 and completed on Jan. 16, 2021. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications 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. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

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History of this test report

Report No.	Version	Description	Issued Date
FG0D1617F	01	Initial issue of report	Feb. 01, 2021

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
-	§2.1046	Conducted Output Power	-	See Note
-	§96.41	Peak-to-Average Ratio	-	See Note
-	§96.41	Effective Isotropic Radiated Power	-	See Note
-	§2.1049 §96.41	Occupied Bandwidth	-	See Note
-	§2.1051 §96.41	Conducted Band Edge Measurement	-	See Note
-	§2.1051 §96.41	Conducted Spurious Emission	-	See Note
-	§2.1055	Frequency Stability for Temperature & Voltage	-	See Note
3.4	§2.1051 §96.41	Radiated Spurious Emission	Pass	Under limit 3.65 dB at 10653.000 MHz

Note: The module (Model: EM120R-GL) makes no difference after verifying output power, this report reuses test data from the module report.

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.

Reviewed by: Wii Chang

Report Producer: Yimin Ho

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook Computer
Brand Name	Lenovo
Model Name	TP00127A
FCC ID	PU5-TP00127A
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS/NFC/UWB
EUT Stage	Production Unit

Remark:

1. The above EUT's information was declared by manufacturer.
2. Equipment: Quectel EM120R-GL tested inside of Lenovo Notebook Computer.

WWAN Antenna Information				
Main Antenna	**Manufacturer**	AWAN	**Peak gain (dBi)**	2.19
	Part number	025.901S1.0021	**Type**	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 subjective to this standard	
Tx Frequency	3552.5 MHz ~ 3697.5 MHz
Rx Frequency	3552.5 MHz ~ 3697.5 MHz
Bandwidth	5 MHz / 10 MHz / 15 MHz / 20 MHz
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 Location

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan
Test Site No.	**Sporton Site No.**
	03CH12-HY
Test Engineer	Jack Cheng, Lance Chiang and Chuan Chu
Temperature	22.3~26.4℃
Relative Humidity	58~66%

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

FCC Designation No.: TW0007

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
- ANSI / TIA-603-E
- FCC 47 CFR Part 2, 96
- FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- FCC KDB 940660 D01 Part 96 CBRS Eqpt v01
- 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

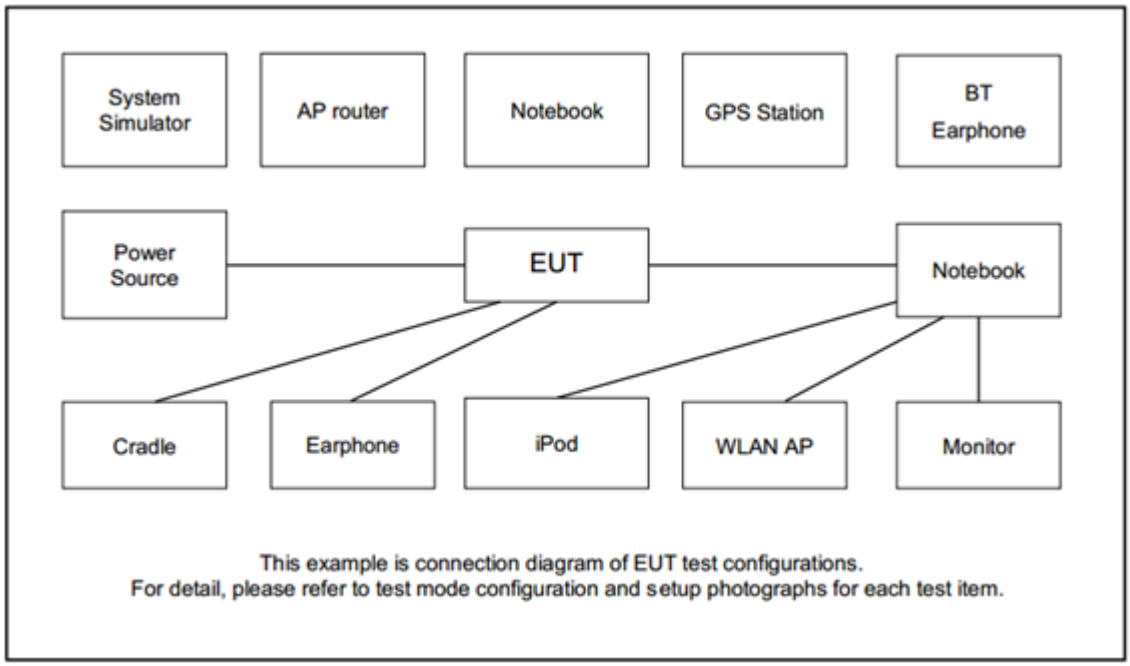
2.1 Test Mode

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.

For radiated measurement, pre-scanned in Tablet type (three orthogonal panels, X, Y, Z) and Notebook type. The worst cases (X plane with Accessory) were recorded in this report.

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
Radiated Spurious Emission	48	-	-				v	v			v			v	v	v
Remark	1. The mark "**v** " means that this configuration is chosen for testing 2. The mark "-" means that this bandwidth is not supported. 3. 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.															

2.2 Connection Diagram of Test System



2.3 Support Unit used in test configuration

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.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A

2.4 Frequency List of Low/Middle/High Channels

LTE Band 48 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
20	Channel	55340	55990	56640
	Frequency	3560.0	3625.0	3690.0

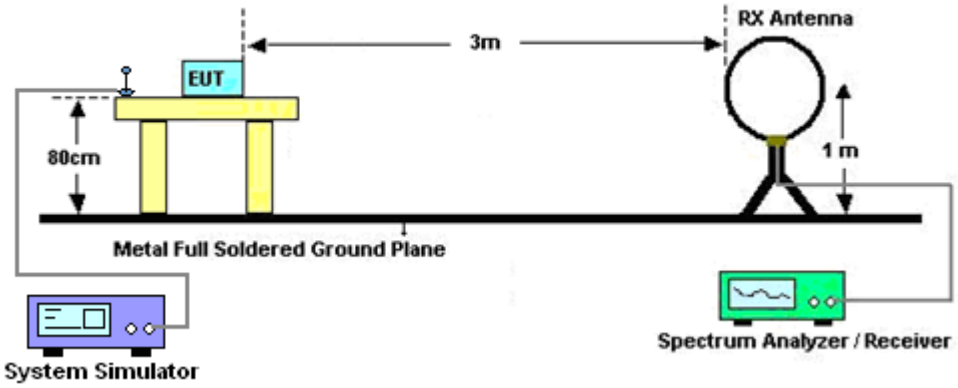
3 Radiated Test Items

3.1 Measuring Instruments

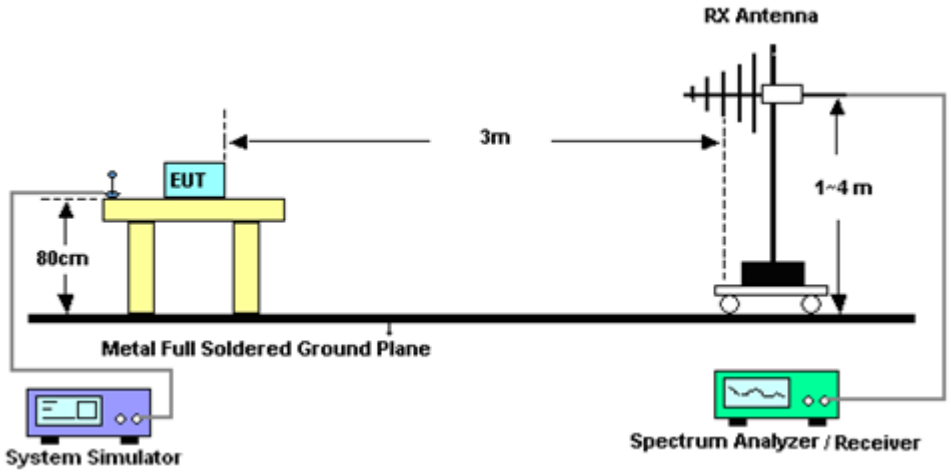
See list of measuring instruments of this test report.

3.2 Test Setup

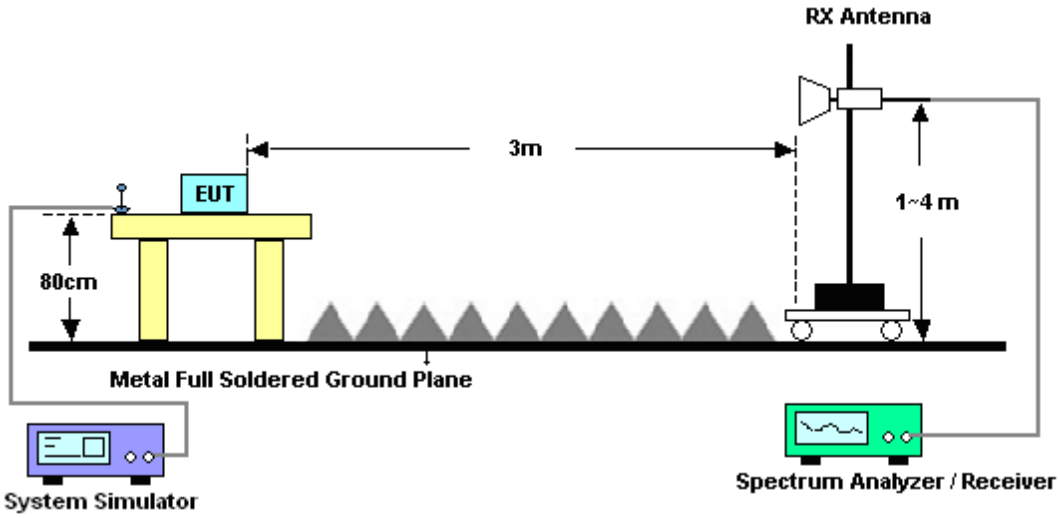
For radiated emissions below 30MHz



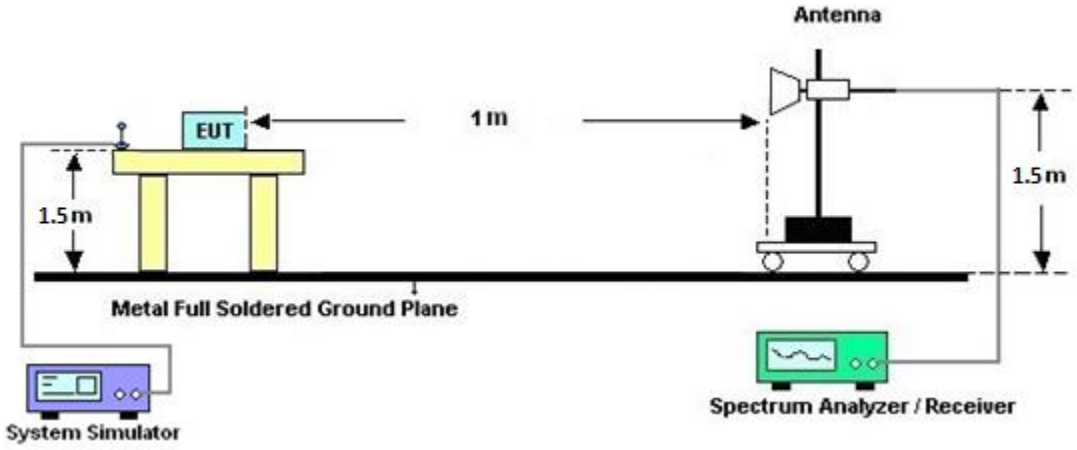
For radiated emissions from 30MHz to 1GHz



For radiated emissions from 1GHz to 18GHz



For radiated emissions above 18GHz



3.3 Test Result of Radiated Test

Please refer to Appendix A.

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 a comparison data 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.

3.4 Radiated Spurious Emission

3.4.1 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 -40dBm / MHz .

The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

3.4.2 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.
   Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
   EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain
   ERP (dBm) = EIRP - 2.15
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
   The limit line is −40dBm/MHz

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	Jul. 14, 2020	Jan. 15, 2021~ Jan. 16, 2021	Jul. 13, 2021	Radiation (03CH12-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01 N-06	40103 & 07	30MHz~1GHz	Apr. 29, 2020	Jan. 15, 2021~ Jan. 16, 2021	Apr. 28, 2021	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1328	1GHz~18GHz	Nov. 23, 2020	Jan. 15, 2021~ Jan. 16, 2021	Nov. 22, 2021	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1212	1GHz ~ 18GHz	May 20, 2020	Jan. 15, 2021~ Jan. 16, 2021	May 19, 2021	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz~40GHz	Dec. 11, 2020	Jan. 15, 2021~ Jan. 16, 2021	Dec. 10, 2021	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	00993	18GHz ~ 40GHz	Nov. 19, 2020	Jan. 15, 2021~ Jan. 16, 2021	Nov. 18, 2021	Radiation (03CH12-HY)
Preamplifier	COM-POWER	PA-103	161075	10MHz~1GHz	Mar. 25, 2020	Jan. 15, 2021~ Jan. 16, 2021	Mar. 24, 2021	Radiation (03CH12-HY)
Preamplifier	Keysight	83017A	MY57280120	1GHz~26.5GHz	Jul. 20, 2020	Jan. 15, 2021~ Jan. 16, 2021	Jul. 19, 2021	Radiation (03CH12-HY)
Preamplifier	E-INSTRUMENT TECH LTD.	ERA-100M-18G-56-01-A70	EC1900249	1GHz~18GHz	Dec. 05, 2020	Jan. 15, 2021~ Jan. 16, 2021	Dec. 04, 2021	Radiation (03CH12-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz~40GHz	Dec. 11, 2020	Jan. 15, 2021~ Jan. 16, 2021	Dec. 10, 2021	Radiation (03CH12-HY)
Spectrum Analyzer	Agilent	N9010A	MY54200485	10Hz~44GHz	Feb. 10, 2020	Jan. 15, 2021~ Jan. 16, 2021	Feb. 09, 2021	Radiation (03CH12-HY)
Signal Generator	Anritsu	MG3694C	163401	0.1Hz~40GHz	Feb. 15, 2020	Jan. 15, 2021~ Jan. 16, 2021	Feb. 14, 2021	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz~30MHz	Mar. 12, 2020	Jan. 15, 2021~ Jan. 16, 2021	Mar. 11, 2021	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0058/126E	30MHz~18GHz	Dec. 11, 2020	Jan. 15, 2021~ Jan. 16, 2021	Dec. 10, 2021	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30MHz~40GHz	Feb. 25, 2020	Jan. 15, 2021~ Jan. 16, 2021	Feb. 24, 2021	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30MHz~40GHz	Feb. 25, 2020	Jan. 15, 2021~ Jan. 16, 2021	Feb. 24, 2021	Radiation (03CH12-HY)
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Jan. 15, 2021~ Jan. 16, 2021	N/A	Radiation (03CH12-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Jan. 15, 2021~ Jan. 16, 2021	N/A	Radiation (03CH12-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Jan. 15, 2021~ Jan. 16, 2021	N/A	Radiation (03CH12-HY)
Software	Audix	E3 6.2009-8-24	RK-000989	N/A	N/A	Jan. 15, 2021~ Jan. 16, 2021	N/A	Radiation (03CH12-HY)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.07**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.21**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.80**

Appendix A. Test Results of Radiated Test

LTE Band 48

LTE Band 48 / 20MHz / 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)
Lowest	7102	-53.76	-40	-13.76	-49.51	-63.72	1.78	11.74	H
	10653	-51.95	-40	-11.95	-49.32	-60.38	2.47	10.90	H
	14204	-57.30	-40	-17.30	-59.78	-66.14	2.87	11.71	H
	21307	-55.19	-40	-15.19	-75.8	-71.91	1.98	18.70	H
	24859	-53.56	-40	-13.56	-78.71	-69.57	2.07	18.07	H
	28411	-53.47	-40	-13.47	-79.09	-70.72	2.32	19.56	H
	7102	-48.68	-40	-8.68	-44.04	-58.64	1.78	11.74	V
	10653	-43.65	-40	-3.65	-40.77	-52.08	2.47	10.90	V
	14204	-57.43	-40	-17.43	-59.64	-66.27	2.87	11.71	V
	21307	-56.18	-40	-16.18	-76.66	-72.90	1.98	18.70	V
	24859	-52.60	-40	-12.60	-78.96	-68.61	2.07	18.07	V
	28411	-52.39	-40	-12.39	-79.83	-69.64	2.32	19.56	V
Middle	7232	-57.46	-40	-17.46	-53.36	-67.14	1.85	11.53	H
	10848	-54.61	-40	-14.61	-52.27	-62.94	2.57	10.90	H
	14464	-57.27	-40	-17.27	-59.55	-65.50	2.85	11.09	H
	18077	-55.24	-40	-15.24	-71.61	-71.47	1.76	17.98	H
	21696	-56.35	-40	-16.35	-76.63	-73.14	1.99	18.78	H
	25314	-52.73	-40	-12.73	-78.24	-69.33	2.14	18.74	H
	7230	-51.93	-40	-11.93	-47.56	-61.62	1.84	11.53	V
	10850	-49.41	-40	-9.41	-46.86	-57.74	2.57	10.90	V
	14462	-58.37	-40	-18.37	-59.82	-66.61	2.85	11.09	V
	18077	-56.07	-40	-16.07	-71.51	-72.30	1.76	17.98	V
	21696	-57.16	-40	-17.16	-77.43	-73.95	1.99	18.78	V
	25314	-52.92	-40	-12.92	-79.7	-69.52	2.14	18.74	V

Highest	7362	-49.26	-40	-9.26	-44.99	-58.67	1.92	11.32	H
	11043	-50.88	-40	-10.88	-48.9	-59.20	2.63	10.95	H
	14724	-56.94	-40	-16.94	-60.31	-65.74	2.91	11.72	H
	18410	-55.67	-40	-15.67	-72.9	-71.72	1.87	17.92	H
	22084	-56.16	-40	-16.16	-77.07	-72.95	2.08	18.87	H
	25770	-52.95	-40	-12.95	-78.99	-69.97	2.03	19.05	H
	7362	-45.45	-40	-5.45	-41	-54.86	1.92	11.32	V
	11043	-49.77	-40	-9.77	-47.63	-58.09	2.63	10.95	V
	14724	-58.62	-40	-18.62	-60.32	-67.42	2.91	11.72	V
	18410	-56.62	-40	-16.62	-72.98	-72.67	1.87	17.92	V
	22084	-56.34	-40	-16.34	-77.25	-73.13	2.08	18.87	V
	25770	-51.95	-40	-11.95	-79.17	-68.97	2.03	19.05	V

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