

FCC Certification Test Report

Report No.: FC180626C04

Test Model: Lenovo TB-X605F

FCC ID: O57TBX605F

Received Date: Jun. 26, 2018

Test Date: Jun. 29, 2018 ~ Jun. 30, 2018

Issued Date: Jul. 16, 2018

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

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Manufacturer: Lenovo PC HK Limited

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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**FCC Registration /
Designation Number:** 328930 / TW1050



Certificate #4327.01



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Release Control Record

Issue No.	Description	Date Issued
FC180626C04	Original Release	Jul. 16, 2018

1 Certificate of Conformity

Product: Portable Tablet Computer
Brand: Lenovo
Test Model: Lenovo TB-X605F
Sample Status: Production Unit
Applicant: Lenovo(Shanghai) Electronics Technology Co., Ltd.
Test Date: Jun. 29, 2018 ~ Jun. 30, 2018
Standards: 47 CFR FCC Part 15, Subpart B, Class B
ANSI C63.4:2014

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Rona Chen, **Date:** Jul. 16, 2018
Rona Chen / Specialist

Approved by : Carl Chen, **Date:** Jul. 16, 2018
Carl Chen / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart B, Class B

ANSI C63.4:2014

FCC Clause	Test Item	Result/Remarks	Verdict
15.107	AC Power Line Conducted Emissions	Minimum passing Class B margin is -8.28 dB at 0.49408 MHz	Pass
15.109	Radiated Emissions up to 1 GHz	Minimum passing Class B margin is -7.52 dB at 957.41 MHz	Pass
	Radiated Emissions above 1 GHz	Minimum passing Class B margin is -17.08 dB at 24306.29 MHz	Pass

Note: There is no deviation to the applied test methods and requirements covered by the scope of this report.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expanded Uncertainty (k=2) (\pm)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 1 GHz	4.70 dB
Radiated Emissions above 1 GHz	Above 1 GHz	2.26 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 Features of EUT

The tests reported herein were performed according to the method specified by Lenovo(Shanghai) Electronics Technology Co., Ltd., for detailed feature description, please refer to the manufacturer's specifications or user's manual.

3.2 General Description of EUT

Product	Portable Tablet Computer
Brand	Lenovo
Test Model	Lenovo TB-X605F
Status of EUT	Production Unit
Operating Software	Android 8.1.0
Power Supply Rating	3.85 Vdc (Battery) 5 Vdc (Adapter or host equipment)
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

1. The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter 1	Salom	SC-41	I/P: 100-240 Vac, 50/60 Hz, 0.3 A O/P: 5 Vdc, 2 A
Adapter 2	AcBel	SC-41	I/P: 100-240 Vac, 50/60 Hz, 0.3 A O/P: 5 Vdc, 2 A
Battery	ATL	L18D1P32	3.85 Vdc, 4850 mAh
USB Cable 1 (White)	LiQi	LQ-02300039	1 m shielded cable w/o core
USB Cable 2 (Black)	LiQi	LQ-02300040	1 m shielded cable w/o core
LCD Panel 1 (Black)	BOE	TV101WUM-LL2	10.1 "
LCD Panel 2 (White)	BOE	TV101WUM-LL3	10.1 "
Photo Camera 1	Lcetron	LE5143AM	5M AF
Photo Camera 2	Holitek	MF81Q	5M AF
Photo Camera 3	Lcetron	ZRT2509V-P102F	2M FF
Photo Camera 4	Holitek	HSU1005	2M FF
CPU	Qualcomm	SDA450	792nsp

* USB Cable 1 and USB Cable 2 is electrically identical, difference models are for color distinguished. Therefore, only USB Cable 1 is as a representative for final test.

* LCD Panel 1 and LCD Panel 2 is electrically identical, difference models are for color distinguished. Therefore, only LCD Panel 2 is as a representative for final test.

Product	Brand	Model	Description
EMMC1 + DDR1	SAMSUNG	KMQE60013M-B318 (2+16)	16G
EMMC2 + DDR2	HYNIX	H9TQ17ABJTCCUR-KUM (2+16)	16G
EMMC3 + DDR3	SAMSUNG	KMGD6001BM-B421 (3+32)	32G
EMMC4 + DDR4	HYNIX	H9TQ27ADFTMCUR-KUM (3+32)	32G
EMMC5 + DDR5	SAMSUNG	KMRH60014A-B614 (4+64)	64G
EMMC6 + DDR6	HYNIX	H9TQ52ACLTMCUR-KUM (4+64)	64G
Speaker 1	Keysound	QM171219AW84	--
Speaker 2	Keysound	QM171219AW85	--
Motor 1	AWA	YK2455R	--
Motor 2	Baolong	BLX-431320S	--
Main Board 1	huashen	W93M71B2-3-03	--
Main Board 2	yilianda	W93M71B2-3-05	--
BT/WLAN Module	Qualcomm	WCN-3680B-0-79BWLNS P	--

3.3 Construction of EUT

EUT has been pre-tested under following configurations.

Part	Brand	Model	Specification	Configuration					
				1	2	3	4	5	6
Battery	ATL	L18D1P32	3.85 Vdc, 4940 mAh	V	V	V	V	V	V
LCD Panel 1 (Black)	BOE	TV101WUM-LL2	10.1 "						
LCD Panel 2 (White)	BOE	TV101WUM-LL3	10.1 "	V	V	V	V	V	V
Photo Camera 1	Lcetron	LE5143AM	5M AF	V		V		V	
Photo Camera 2	Holitek	MF81Q	5M AF		V		V		V
Photo Camera 3	Lcetron	ZRT2509V-P102F	2M FF	V		V		V	
Photo Camera 4	Holitek	HSU1005	2M FF		V		V		V
CPU	Qualcomm	SDM450	792nsp	V	V	V	V	V	V
EMMC1 + DDR1	SAMSUNG	KMQE60013M-B318 (2+16)	16G	V					
EMMC2 + DDR2	HYNIX	H9TQ17ABJTCCUR-KUM (2+16)	16G		V				
EMMC3 + DDR3	SAMSUNG	KMGD6001BM-B421 (3+32)	32G			V			
EMMC4 + DDR4	HYNIX	H9TQ27ADFTMCUR-KUM (3+32)	32G				V		
EMMC5 + DDR5	SAMSUNG	KMRH60014A-B614 (4+64)	64G					V	
EMMC6 + DDR6	HYNIX	H9TQ52ACLTMCUR-KUM (4+64)	64G						V
Speaker 1	Keysound	QM171219AW84	--	V	V	V	V	V	V
Speaker 2	Keysound	QM171219AW85	--	V	V	V	V	V	V
Motor 1	AWA	YK2455R	--		V		V		V
Motor 2	Baolong	BLX-431320S	--	V		V		V	
Main Board 1	huashen	W93M71B2-3-03	--	V		V		V	
Main Board 2	yilianda	W93M71B2-3-05	--		V		V		V
BT/WLAN Module	Qualcomm	WCN-3680B-0-79BWLNSP	--	V	V	V	V	V	V

* Above EMMC+DDR only which has the maximum capacity was chosen for final test. Therefore, configuration 5 and 6 were the representative sample for final test.

3.4 Operating Modes of EUT and Determination of Worst Case Operating Mode

Test modes are presented in the report as below.

Mode	Config.	Test Condition
Conducted Emission		
1	5	BT Link + WLAN (2.4G) Link + GPS & GLONASS Rx + Earphone + USB Cable + Adapter 1
2	5	BT Link + WLAN (5G) Link + Beidou Rx + Earphone + USB Cable + Adapter 2
3	5	BT Link + WLAN (5G) Link + FM Rx + Earphone + USB Cable + Adapter 2
4	5	BT Link + WLAN (5G) Link + Front Camera + Earphone + USB Cable + Adapter 2
5	5	BT Link + WLAN (5G) Link + Rear Camera + Earphone + USB Cable + Adapter 2
6	5	BT Link + WLAN (5G) Link + MPEG 4 + Earphone + USB Cable + Adapter 2
7	5	BT Link + WLAN (5G) Link + H-Pattern + Earphone + USB Cable + USB Link to Notebook
8	6	BT Link + WLAN (5G) Link + Front Camera + Earphone + USB Cable + Adapter 2
9	6	BT Link + WLAN (5G) Link + Rear Camera + Earphone + USB Cable + Adapter 2
Radiated Emission		
1	5	BT Link + WLAN (2.4G) Link + GPS & GLONASS Rx + Earphone + USB Cable + Adapter 1
2	5	BT Link + WLAN (5G) Link + Beidou Rx + Earphone + USB Cable + Adapter 2
3	5	BT Link + WLAN (2.4G) Link + FM Rx + Earphone + USB Cable + Adapter 1
4	5	BT Link + WLAN (2.4G) Link + Front Camera + Earphone + USB Cable + Adapter 1
5	5	BT Link + WLAN (2.4G) Link + Rear Camera + Earphone + USB Cable + Adapter 1
6	5	BT Link + WLAN (2.4G) Link + MPEG 4 + Earphone + USB Cable + Adapter 1
7	5	BT Link + WLAN (2.4G) Link + H-Pattern + Earphone + USB Cable + USB Link to Notebook
8	5	BT Link + WLAN (2.4G) Link + H-Pattern + (Stand-alone)
9	6	BT Link + WLAN (2.4G) Link + Front Camera + Earphone + USB Cable + USB Link to Notebook
10	6	BT Link + WLAN (2.4G) Link + Rear Camera + Earphone + USB Cable + USB Link to Notebook

Remark:

1. For conducted emission test, test mode 4 was the worst case and only this mode was presented in the report.
2. For radiated emission test, test mode 7 was the worst case and only this mode was presented in the report.

3.5 Test Program Used and Operation Descriptions

Conducted Emission:

- a. The EUT was charged from adapter.
- b. The EUT linked with Bluetooth earphone.
- c. The EUT sent audio signal to the earphone.
- d. The EUT played Front Camera.
- e. The EUT communicated data with the Wireless AP which acted as a communication partner.

Radiated Emission:

- a. The EUT was charged from Notebook via USB Cable.
- b. The EUT linked with Bluetooth earphone.
- c. The EUT sent audio signal to the earphone.
- d. The EUT sent "H" patterns to Monitor, and Monitor played them.
- e. The EUT sent "H" patterns to Printer, and Printer printed them out.
- f. The EUT communicated data with the Wireless AP which acted as a communication partner.

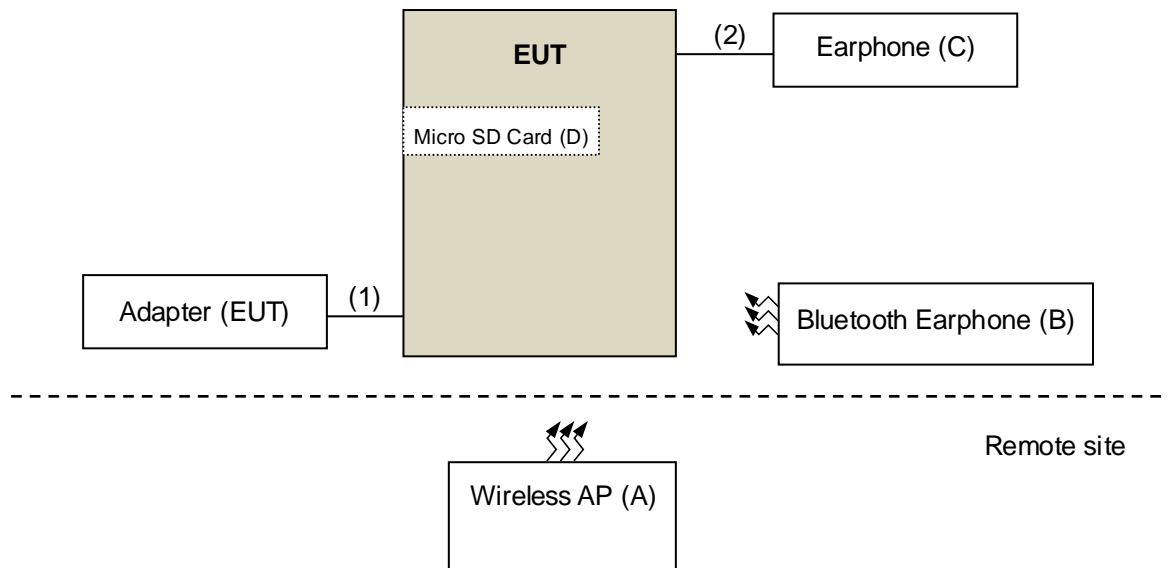
3.6 Primary Clock Frequencies of Internal Source

The highest frequency generated or used within the EUT or on which the EUT operates or tunes is 5 GHz, provided by Lenovo(Shanghai) Electronics Technology Co., Ltd., for detailed internal source, please refer to the manufacturer's specifications.

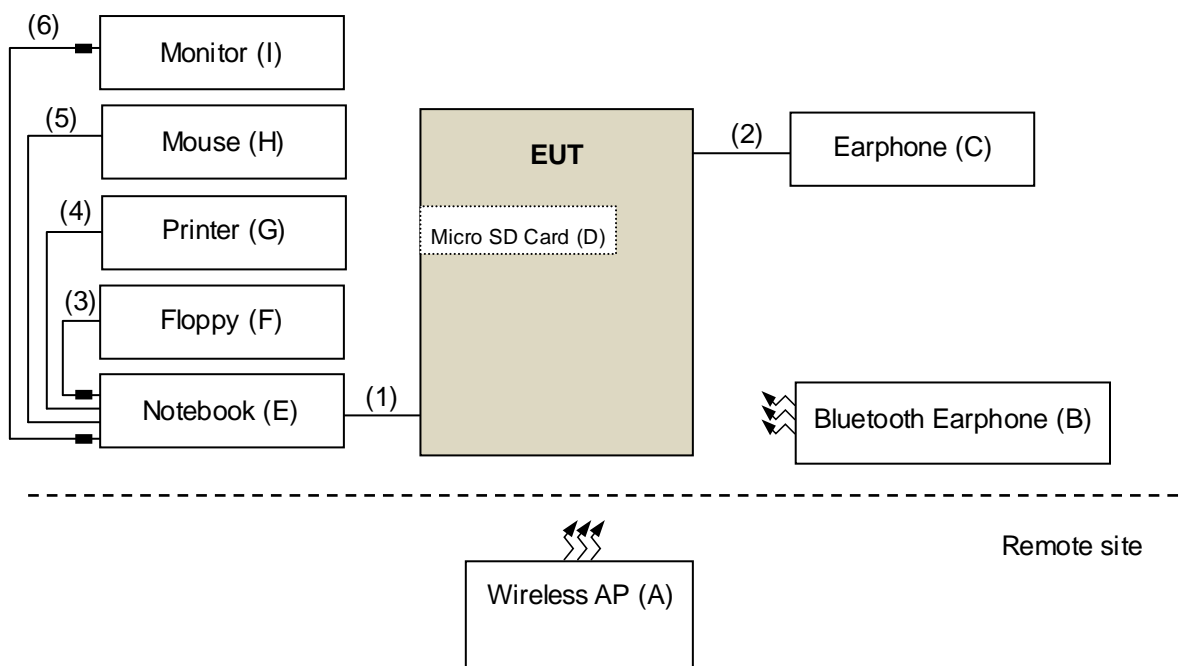
4 Configuration and Connections with EUT

4.1 Connection Diagram of EUT and Peripheral Devices

Conducted Emission:



Radiated Emission:



4.2 Configuration of Peripheral Devices and Cable Connections

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	11a/n USB 1000M Router	D-LINK	DIR826L	QBQ91C9000416	N/A	--
B.	BLUETOOTH EARPHONE	ELECOM	LBT-MPHS400	N/A	N/A	--
C.	Earphone	Apple	MB770FE/B	N/A	N/A	--
D.	Micro SD Card	Transcend	N/A	N/A	N/A	--
E.	Notebook	DELL	E6440	FMLNM32	N/A	--
F.	External USB Floppy	SONY	MPF82E	50010254	FCC DoC Approved	--
G.	Printer	EPSON	T22	MEEZ070388	N/A	--
H.	Mouse	DELL	MS111-P	CN-011D3V-71581-1 CJ-0195	FCC DoC Approved	--
I.	Monitor	DELL	U2410	CN082W XD-72872-0CR-06DL	Doc	For Radiated Emission up to 1GHz test
		DELL	U2713HM	CN-07JNY5-74445-3 8T-400S	N/A	For Radiated Emission above 1GHz test

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items A~B acted as communication partners to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB Cable	1	1	Y	0	Accessory of the EUT
2.	Earphone Cable	1	1.2	Y	0	--
3.	Floppy Cable	1	0.5	Y	1	--
4.	Printer Cable	1	1.8	Y	0	--
5.	Mouse Cable	1	1.8	Y	0	--
6.	VGA Cable	1	1.8	Y	2	--

Note: The core(s) is(are) originally attached to the cable(s).

5 Conducted Emissions at Mains Ports

5.1 Limits

Frequency (MHz)	Class A (dBuV)		Class B (dBuV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 - 0.5	79	66	66 - 56	56 - 46
0.50 - 5.0	73	60	56	46
5.0 - 30.0	73	60	60	50

Notes: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases linearly with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

5.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESR3	102412	Feb. 08, 2018	Feb. 07, 2019
RF signal cable Woken	5D-FB	Cable-cond2-01	Sep. 08, 2017	Sep. 07, 2018
LISN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Feb. 05, 2018	Feb. 04, 2019
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Aug. 02, 2017	Aug. 01, 2018
Software ADT	BV ADT_Cond_ V7.3.7.4	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

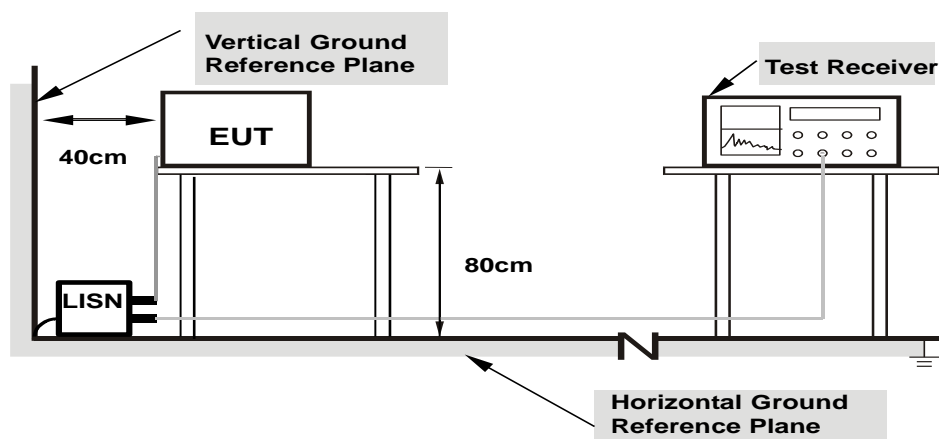
2. The test was performed in HwaYa Shielded Room 2.

3. The VCCI Site Registration No. is C-2047.

5.3 Test Arrangement

- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50 uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The test results of conducted emissions at mains ports are recorded of six worst margins for quasi-peak (mandatory) [and average (if necessary)] values against the limits at frequencies of interest unless the margin is 20 dB or greater.

Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.



Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

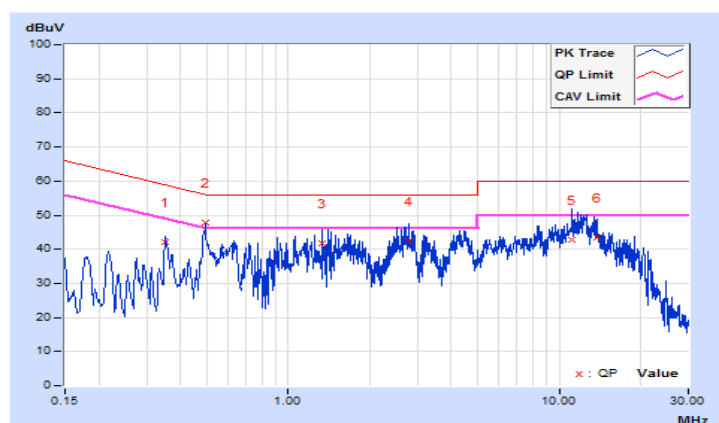
5.4 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 60%RH
Tested by	Daniel Lin	Test Date	2018/6/29
Test Mode	Mode 4		

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.35296	10.34	31.80	22.84	42.14	33.18	58.89	48.89	-16.75	-15.71
2	0.49408	10.35	37.47	24.99	47.82	35.34	56.10	46.10	-8.28	-10.76
3	1.33082	10.42	31.49	19.46	41.91	29.88	56.00	46.00	-14.09	-16.12
4	2.79707	10.47	31.87	22.55	42.34	33.02	56.00	46.00	-13.66	-12.98
5	11.09409	10.65	32.11	21.36	42.76	32.01	60.00	50.00	-17.24	-17.99
6	13.79981	10.72	32.80	20.25	43.52	30.97	60.00	50.00	-16.48	-19.03

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

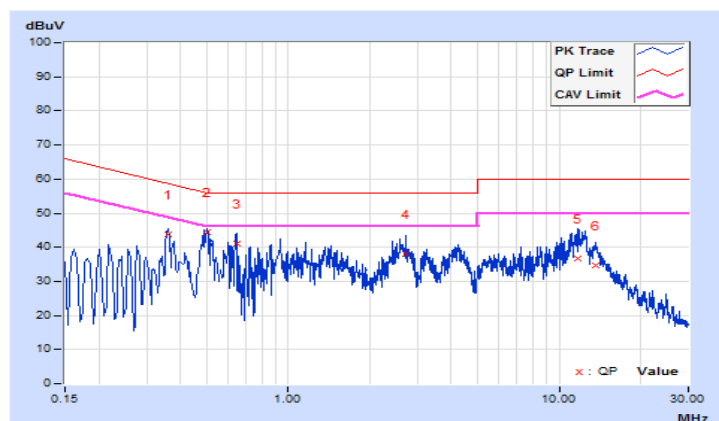


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 60%RH
Tested by	Daniel Lin	Test Date	2018/6/29
Test Mode	Mode 4		

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.36048	10.31	33.47	21.87	43.78	32.18	58.72	48.72	-14.94	-16.54
2	0.50000	10.33	34.20	21.35	44.53	31.68	56.00	46.00	-11.47	-14.32
3	0.64266	10.35	30.88	19.54	41.23	29.89	56.00	46.00	-14.77	-16.11
4	2.71887	10.51	27.64	16.95	38.15	27.46	56.00	46.00	-17.85	-18.54
5	11.69623	10.76	26.00	11.39	36.76	22.15	60.00	50.00	-23.24	-27.85
6	13.58867	10.82	23.86	12.56	34.68	23.38	60.00	50.00	-25.32	-26.62

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



6 Radiated Emissions up to 1 GHz

6.1 Limits

Emissions radiated outside of the specified bands, shall be according to the general radiated limits as following:

Radiated Emissions Limits at 10 meters (dBμV/m)				
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B	CISPR 22, Class A	CISPR 22, Class B
30-88	39	29.5	40	30
88-216	43.5	33.1		
216-230	46.4	35.6		
230-960			47	37
960-1000	49.5	43.5		

Radiated Emissions Limits at 3 meters (dBμV/m)				
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B	CISPR 22, Class A	CISPR 22, Class B
30-88	49.5	40	50.5	40.5
88-216	54	43.5		
216-230	56.9	46		
230-960				
960-1000	60	54	57.5	47.5

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB μ V/m) = 20 log Emission level (μ V/m).
3. QP detector shall be applied if not specified.

6.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ (V)	ESR	101240	Oct. 24, 2017	Oct. 23, 2018
Test Receiver ROHDE & SCHWARZ (H)	ESR	101264	Dec. 25, 2017	Dec. 24, 2018
BILOG Antenna SCHWARZBECK (V)	VULB9168	9168-160	Nov. 29, 2017	Nov. 28, 2018
BILOG Antenna SCHWARZBECK (H)	VULB9168	9168-156	Nov. 29, 2017	Nov. 28, 2018
Preamplifier Sonoma (V)	310N	352924	Jul. 12, 2017	Jul. 11, 2018
Preamplifier Sonoma (H)	310N	352923	Jul. 12, 2017	Jul. 11, 2018
RF signal cable (with 5dB PAD) Times (V)	LMR-600 (18M) +LMR-400 (7M)	CABLE-CH1 (VER) -01	Oct. 24, 2017	Oct. 23, 2018
RF signal cable (with 5dB PAD) Times (H)	LMR-600 (11.8M) +LMR-400 (7M)	CABLE-CH1 (HOR) -01	Oct. 24, 2017	Oct. 23, 2018
Software BV ADT	BV ADT_Radiated_ V8.7.08	NA	NA	NA
Antenna Tower (V)	MFA-440	9707	NA	NA
Antenna Tower (H)	MFA-440	970705	NA	NA
Turn Table	DS430	50303	NA	NA
Controller (V)	MF7802	074	NA	NA
Controller (H)	MF7802	08093	NA	NA

NOTE: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. The test was performed in HwaYa Chamber 1.

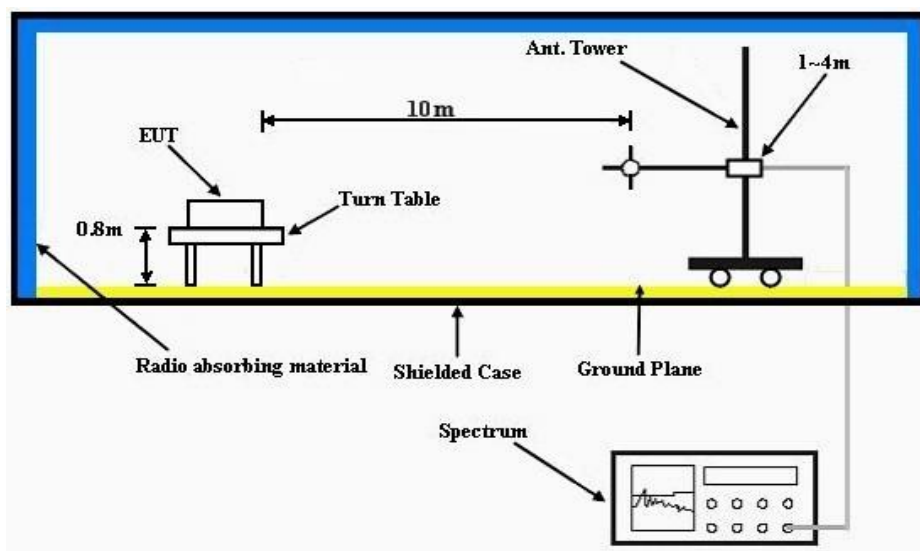
3. The IC Site Registration No. is IC 7450F-1.

4. The VCCI Site Registration No. is R-1893.

6.3 Test Arrangement

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at an accredited test facility. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for quasi-peak detection (QP) at frequency below 1 GHz.



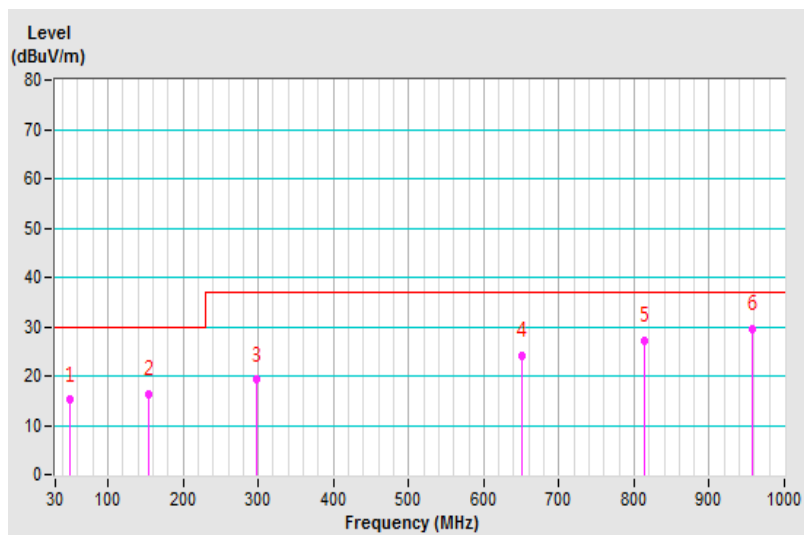
6.4 Test Results

Frequency Range	30MHz ~ 1GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120kHz
Tested by	Jim Lee	Environmental Conditions	25°C, 65%RH
Test Mode	Mode 7	Test Date	2018/6/29

Antenna Polarity & Test Distance : Horizontal at 10 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	49.79	15.09 QP	30.00	-14.91	1.00 H	29	28.57	-13.48
2	155.04	16.21 QP	30.00	-13.79	4.00 H	101	29.34	-13.13
3	297.59	19.18 QP	37.00	-17.82	3.50 H	153	31.50	-12.32
4	650.73	24.14 QP	37.00	-12.86	4.00 H	30	28.86	-4.72
5	812.83	27.06 QP	37.00	-9.94	4.00 H	150	28.82	-1.76
6	957.41	29.48 QP	37.00	-7.52	3.50 H	14	28.59	0.89

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

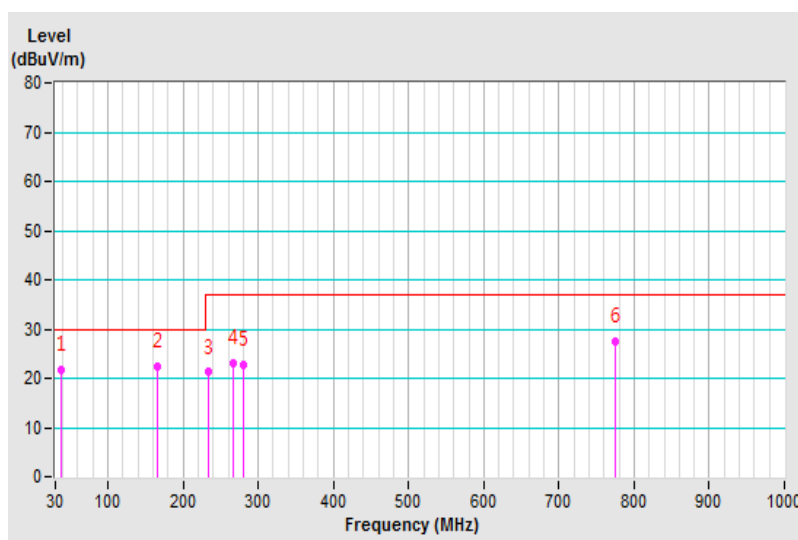


Frequency Range	30MHz ~ 1GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120kHz
Tested by	Jim Lee	Environmental Conditions	25°C, 65%RH
Test Mode	Mode 7	Test Date	2018/6/29

Antenna Polarity & Test Distance : Vertical at 10 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	37.13	21.67 QP	30.00	-8.33	3.00 V	343	35.96	-14.29
2	166.53	22.29 QP	30.00	-7.71	1.00 V	111	35.76	-13.47
3	233.18	21.19 QP	37.00	-15.81	1.00 V	151	36.33	-15.14
4	266.55	23.21 QP	37.00	-13.79	1.50 V	343	36.49	-13.28
5	280.90	22.82 QP	37.00	-14.18	1.00 V	260	35.34	-12.52
6	774.08	27.56 QP	37.00	-9.44	1.50 V	128	29.88	-2.32

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value



7 Radiated Emissions above 1 GHz

7.1 Limits

Emissions radiated outside of the specified bands, shall be according to the general radiated limits as following:

Radiated Emissions Limits at 10 meters (dB μ V/m)				
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B	CISPR 22, Class A	CISPR 22, Class B
1000-3000	Avg: 49.5	Avg: 43.5	Not defined	Not defined
Above 3000	Peak: 69.5	Peak: 63.5	Not defined	Not defined

Radiated Emissions Limits at 3 meters (dB μ V/m)				
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B	CISPR 22, Class A	CISPR 22, Class B
1000-3000	Avg: 60	Avg: 54	Avg: 56 Peak: 76	Avg: 50 Peak: 70
Above 3000	Peak: 80	Peak: 74	Avg: 60 Peak: 80	Avg: 54 Peak: 74

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB μ V/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

Radiated Emissions Limits at 1.5 meters (dB μ V/m)		
Frequencies (MHz)	FCC 15B / ICES-003, Class A	FCC 15B / ICES-003, Class B
Above 18000	Avg: 66 Peak: 86	Avg: 60 Peak: 80

Note: Limit@1.5m = Limit@3m + 20log(3/1.5)

Frequency Range (For unintentional radiators)

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

7.2 Test Instruments

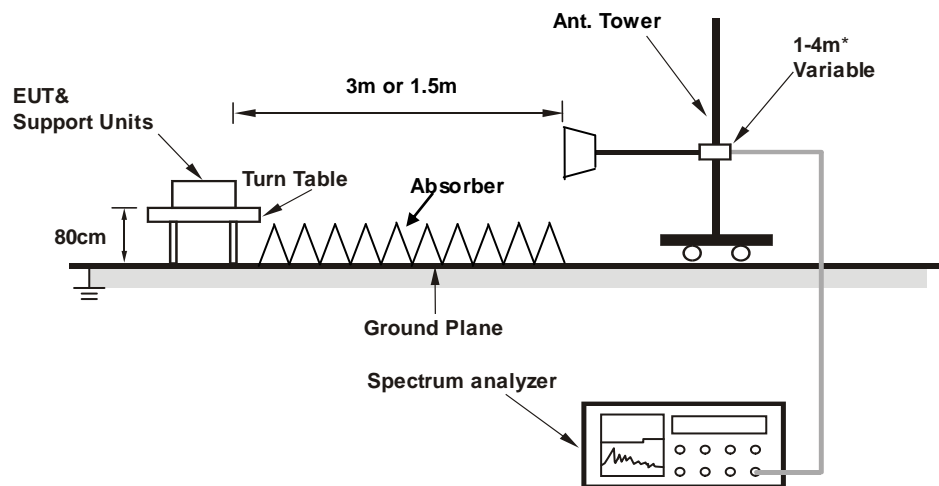
Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ (Above 1GHz)	ESR7	101471	Mar. 01, 2018	Feb. 28, 2019
Spectrum Analyzer Agilent	E4446A	MY51100039	Sep. 05, 2017	Sep. 04, 2018
RF signal cable (with 5dB PAD) Times	LMR-400 (18M)	CABLE-CH2-01	Apr. 27, 2018	Apr. 26, 2019
HORN Antenna (with 4dB PAD) SCHWARZBECK	BBHA 9120 D	9120D-405	Dec. 01, 2017	Nov. 30, 2018
Preamplifier Agilent (Above 1GHz)	8449B	3008A01922	Sep. 15, 2017	Sep. 14, 2018
RF Coaxial Cable JUNFLON+EMC	JUNFLON+EMC10 4-SM-SM-6000	Cable-CH2-02(MVX3221308 G003+130710)	Jun. 11, 2018	Jun. 10, 2019
Software BV ADT	BV ADT_Radiated_ V8.7.08	NA	NA	NA
Antenna Tower BV ADT	AT100	AT93021702	NA	NA
Turn Table BV ADT	TT100	TT93021702	NA	NA
Controller BV ADT	SC100	SC93021702	NA	NA
RF Coaxial Cable EMCI	EMC102-KM-KM-1 000	170820	Aug. 29, 2017	Aug. 28, 2018
RF Coaxial Cable EMCI	EMC102-KM-KM-3 000	170818	Aug. 29, 2017	Aug. 28, 2018
Fix tool for Boresight antenna	BAF-01	2	NA	NA
Pre-amplifier (18GHz-40GHz) EMC	EMC184045B	980175	Nov. 14, 2017	Nov. 13, 2018
HORN Antenna (with 3dB PAD) SCHWARZBECK	BBHA 9170	148	Dec. 13, 2017	Dec. 12, 2018

- Note:
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in HwaYa Chamber 2.
 3. The horn antenna and HP preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
 4. The IC Site Registration No. is IC 7450F-2.
 5. The VCCI Site Registration No. is G-10018.

7.3 Test Arrangement

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at an accredited chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- For frequency range 1 GHz ~ 18 GHz, the EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- For frequency range 18 GHz ~ 40 GHz, the EUT was set 1.5 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The height of antenna can be varied from one meter to four meters, the height of adjustment depends on the EUT height and the antenna 3 dB beamwidth both, to detect the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The spectrum analyzer system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

Note: The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1 GHz.



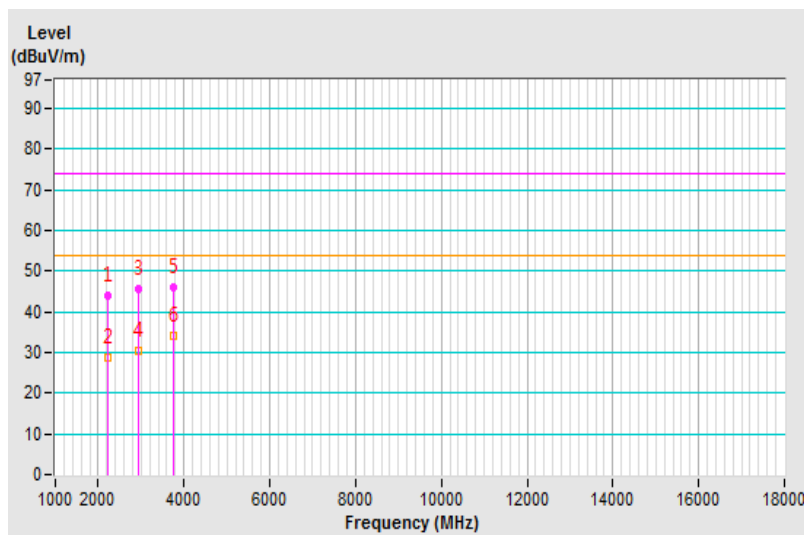
7.4 Test Results

Frequency Range	1GHz ~ 18GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Tested by	Fox Chang	Environmental Conditions	27°C, 64%RH
Test Mode	Mode 7	Test Date	2018/6/30

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2233.82	44.05 PK	74.00	-29.95	1.13 H	205	41.87	2.18
2	2233.82	28.68 AV	54.00	-25.32	1.13 H	205	26.50	2.18
3	2925.71	45.71 PK	74.00	-28.29	1.35 H	348	42.27	3.44
4	2925.71	30.54 AV	54.00	-23.46	1.35 H	348	27.10	3.44
5	3745.70	46.13 PK	74.00	-27.87	1.00 H	96	40.80	5.33
6	3745.70	34.20 AV	54.00	-19.80	1.00 H	96	28.87	5.33

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
– Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

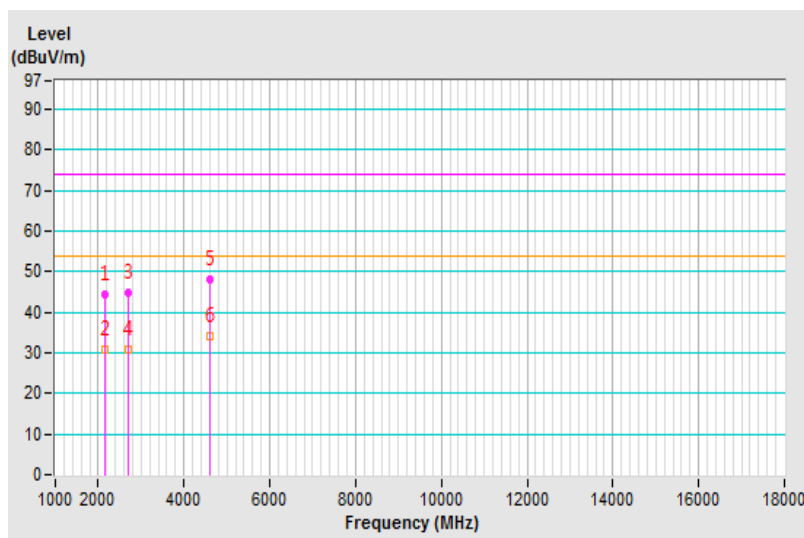


Frequency Range	1GHz ~ 18GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Tested by	Fox Chang	Environmental Conditions	27°C, 64%RH
Test Mode	Mode 7	Test Date	2018/6/30

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2170.31	44.41 PK	74.00	-29.59	1.65 V	312	42.36	2.05
2	2170.31	30.63 AV	54.00	-23.37	1.65 V	312	28.58	2.05
3	2685.24	44.73 PK	74.00	-29.27	1.15 V	250	41.85	2.88
4	2685.24	30.80 AV	54.00	-23.20	1.15 V	250	27.92	2.88
5	4612.34	48.18 PK	74.00	-25.82	1.00 V	92	40.43	7.75
6	4612.34	34.01 AV	54.00	-19.99	1.00 V	92	26.26	7.75

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

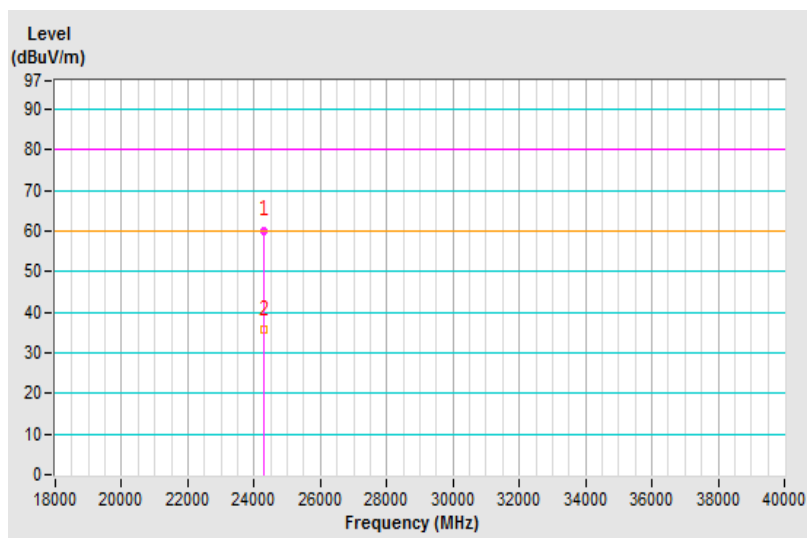


Frequency Range	18GHz ~ 40GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Tested by	Fox Chang	Environmental Conditions	27°C, 64%RH
Test Mode	Mode 7	Test Date	2018/6/30

Antenna Polarity & Test Distance : Horizontal at 1.5 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	24312.86	60.19 PK	80.00	-19.81	1.00 H	171	58.91	1.28
2	24312.86	35.83 AV	60.00	-24.17	1.00 H	171	34.55	1.28

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

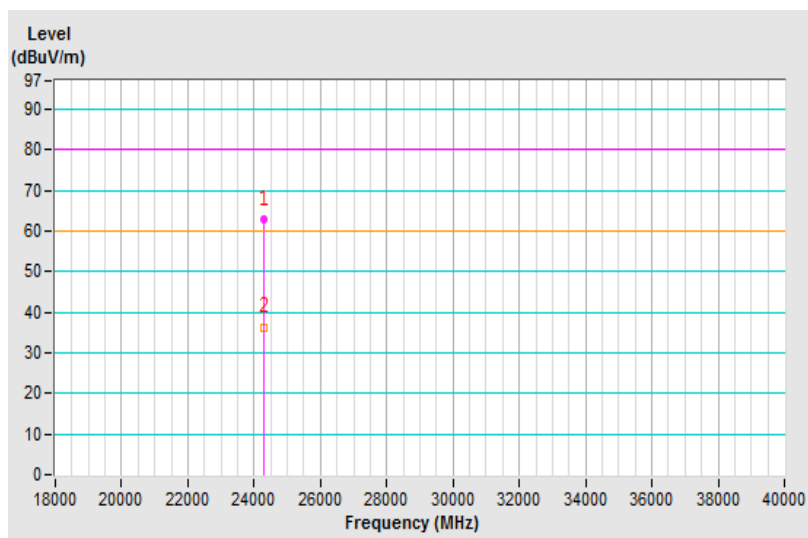


Frequency Range	18GHz ~ 40GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Tested by	Fox Chang	Environmental Conditions	27°C, 64%RH
Test Mode	Mode 7	Test Date	2018/6/30

Antenna Polarity & Test Distance : Vertical at 1.5 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	24306.29	62.92 PK	80.00	-17.08	1.00 V	244	61.63	1.29
2	24306.29	36.36 AV	60.00	-23.64	1.00 V	244	35.07	1.29

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Pre-Amplifier Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value



8 Pictures of Test Arrangements

Refer to Test Set Up Photo.pdf.

Appendix – Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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