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FCC ID: PKRNVWR1000

Test Model: R1000

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Test Date: Aug. 02 to 03, 2018

Issued Date: Aug. 22, 2018

Applicant: Novatel Wireless, Inc.

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FCC Registration / 810758 / TW1085 for Test Location (1)
Designation Number: 960022 / TW1058 for Test Location (2)



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Table of Contents

Release Control Record	3
1 Certificate of Conformity	4
2 Summary of Test Results.....	5
2.1 Measurement Uncertainty	5
2.2 Modification Record	5
3 General Information	6
3.1 Features of EUT	6
3.2 General Description of EUT	6
3.3 Operating Modes of EUT and Determination of Worst Case Operating Mode	8
3.4 Test Program Used and Operation Descriptions.....	8
3.5 Primary Clock Frequencies of Internal Source	8
4 Configuration and Connections with EUT	9
4.1 Connection Diagram of EUT and Peripheral Devices	9
4.2 Configuration of Peripheral Devices and Cable Connections	10
5 Conducted Emissions at Mains Ports	11
5.1 Limits	11
5.2 Test Instruments	11
5.3 Test Arrangement	12
5.4 Supplementary Information	12
5.5 Test Results.....	13
6 Radiated Emissions up to 1 GHz	15
6.1 Limits	15
6.2 Test Instruments	16
6.3 Test Arrangement	17
6.4 Supplementary Information	17
6.5 Test Results.....	18
7 Radiated Emissions above 1 GHz.....	20
7.1 Limits	20
7.2 Test Instruments	21
7.3 Test Arrangement	22
7.4 Supplementary Information	23
7.5 Test Results.....	24
8 Pictures of Test Arrangements	28
Appendix – Information on the Testing Laboratories	29

Release Control Record

Issue No.	Description	Date Issued
FC180731E06	Original release.	Aug. 22, 2018

1 Certificate of Conformity

Product: 4G LTE Wireless Router
Brand: Inseego
Test Model: R1000
Sample Status: ENGINEERING SAMPLE
Applicant: Novatel Wireless, Inc.
Test Date: Aug. 02 to 03, 2018
Standards: 47 CFR FCC Part 15:2017, Subpart B, Class B
ICES-003:2016 Issue 6, 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 : Wendy Wu, **Date:** Aug. 22, 2018
Wendy Wu / Specialist

Approved by : Tony Chen, **Date:** Aug. 22, 2018
Tony Chen / Senior Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15:2017, Subpart B / ICES-003:2016 Issue 6, Class B

ANSI C63.4:2014

FCC Clause	ICES-003 Clause	Test Item	Result/Remarks	Verdict
15.107	6.1	AC Power Line Conducted Emissions	Minimum passing Class B margin is -8.78 dB at 0.15000 MHz	Pass
15.109	6.2.1	Radiated Emissions up to 1 GHz	Minimum passing Class B margin is -4.92 dB at 957.88 MHz	Pass
	6.2.2	Radiated Emissions above 1 GHz	Minimum passing Class B margin is -8.04 dB at 1566.60 MHz	Pass

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	Expended Uncertainty (k=2) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.84 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.95 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	4.84 dB
	6GHz ~ 18GHz	5.24 dB
	18GHz ~ 40GHz	5.36 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 Novatel Wireless, Inc., for detailed feature description, please refer to the manufacturer's specifications or user's manual.

3.2 General Description of EUT

Product	4G LTE Wireless Router
Brand	Inseego
Test Model	R1000
Sample Status	ENGINEERING SAMPLE
Operating Software	NA
Power Supply Rating	DC 54V from power adapter (full function) or DC 4.5V from battery (only LTE work)
Accessory Device	Adapter x 1
Data Cable Supplied	Adapter Power Cord x 1 (Unshielded, 1.8m), Ethernet Cable x 1 (Unshielded, 1m)

Note:

1. The EUT has below radios as following table:

Radio 1	Radio 2	Radio 3	Radio 4
WLAN - 2TX (2.4GHz)	WLAN - 2TX (5GHz Low Band)	WLAN - 4TX (5GHz High Band)	WWAN

2. Simultaneously transmission condition.

Condition	Technology			
1	WLAN 2.4GHz	WLAN 5GHz (Low Band)	WLAN 5GHz (High Band)	WWAN

3. The antennas provided to the EUT, please refer to the following table:

Antenna No.	Model	Antenna Net. Gain(dBi)	Frequency range	Antenna Type	Connector Type	Cable Length
WiFi_1	C037-511493	2.8	2.4~2.4835GHz	PCB	i-pex(MHF)	100mm
		3.05	5.15~5.35GHz			
WiFi_2	C037-511494	4.41	2.4~2.4835GHz	PCB	i-pex(MHF)	60mm
		4.14	5.15~5.35GHz			
WiFi_DB_1	290-20358	2.79	5.47~5.725GHz	PCB	i-pex(MHF)	160mm
		2.62	5.725~5.85GHz			
WiFi_DB_3	290-20359	4.27	5.47~5.725GHz	PCB	i-pex(MHF)	65mm
		3.7	5.725~5.85GHz			
WiFi_DB_2+ WiFi_DB_4+ GPS	290-20357	3.52	5.47~5.725GHz	PCB	i-pex(MHF)	115mm (DB_2)
		3.45	5.725~5.85GHz			105mm (DB_4)
		2.99	5.47~5.725GHz			
		3	5.725~5.85GHz			230mm (GPS)
		4.58	1575MHz			
LTE	C037-511495	2.9	1850 -1910MHz	PCB	i-pex(MHF)	130mm
		2.98	1710-1755MHz			
		0.25	777-787MHz			

4. The EUT could be supplied from a power adapter as following table:

Brand	Model No.	Spec.
Leader	UNA3-6540240-I1	Input: 100-240Vac, 2.0A, 50/60Hz Output: 54V, 2.4A

5. Power supplied from batteries condition only support WWAN function.

6. The EUT incorporates a MIMO function:

2.4GHz Band			
MODULATION MODE	DATA RATE (MCS)	TX & RX CONFIGURATION	
802.11b	1 ~ 11Mbps	2TX	2RX
802.11g	6 ~ 54Mbps	2TX	2RX
802.11n (HT20)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11n (HT40)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
VHT20	MCS0~8 Nss=1	2TX	2RX
	MCS0~8 Nss=2	2TX	2RX
VHT40	MCS0~9 Nss=1	2TX	2RX
	MCS0~9 Nss=2	2TX	2RX
5GHz Band (Low Band)			
MODULATION MODE	DATA RATE (MCS)	TX & RX CONFIGURATION	
802.11a	6 ~ 54Mbps	2TX	2RX
802.11n (HT20)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11n (HT40)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11ac (VHT20)	MCS0~8 Nss=1	2TX	2RX
	MCS0~8 Nss=2	2TX	2RX
802.11ac (VHT40)	MCS0~9 Nss=1	2TX	2RX
	MCS0~9 Nss=2	2TX	2RX
802.11ac (VHT80)	MCS0~9 Nss=1	2TX	2RX
	MCS0~9 Nss=2	2TX	2RX
5GHz Band (High band)			
MODULATION MODE	DATA RATE (MCS)	TX & RX CONFIGURATION	
802.11a	6 ~ 54Mbps	4TX	4RX
802.11n (HT20)	MCS 0~7	4TX	4RX
	MCS 8~15	4TX	4RX
	MCS 16~23	4TX	4RX
	MCS 24~31	4TX	4RX
802.11n (HT40)	MCS 0~7	4TX	4RX
	MCS 8~15	4TX	4RX
	MCS 16~23	4TX	4RX
	MCS 24~31	4TX	4RX
802.11ac (VHT20)	MCS0~8 Nss=1	4TX	4RX
	MCS0~8 Nss=2	4TX	4RX
	MCS0~9 Nss=3	4TX	4RX
	MCS0~8 Nss=4	4TX	4RX
802.11ac (VHT40)	MCS0~9 Nss=1	4TX	4RX
	MCS0~9 Nss=2	4TX	4RX
	MCS0~9 Nss=3	4TX	4RX
	MCS0~9 Nss=4	4TX	4RX
802.11ac (VHT80)	MCS0~9 Nss=1	4TX	4RX
	MCS0~9 Nss=2	4TX	4RX
	MCS0~9 Nss=3	4TX	4RX
	MCS0~9 Nss=4	4TX	4RX

Note:

1. All of modulation mode support beamforming function except and 802.11a/b/g modulation mode.

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

For radiated emission test, the EUT has been pre-tested under following test modes, and test mode A was the worst case for final test.

Mode	Test Condition			
	Radiated emission			
	Power in	Lan Speed	LTE Band	Arrangement
A	Adapter	1000Mbps	Band 2	Vertical Placement
B	Battery	NA	Band 2	Vertical Placement
C	Adapter	1000Mbps	Band 4	Vertical Placement
D	Adapter	1000Mbps	Band 13	Vertical Placement
E	Adapter	100Mbps	Band 2	Vertical Placement
F	Adapter	10Mbps	Band 2	Vertical Placement

NOTE: The test configurations are defined by the applicant requirement.

Test mode is presented in the report as below.

Mode	Test Condition			
	Power in	Lan Speed	LTE Band	Arrangement
1	Adapter	1000Mbps	Band 2	Vertical Placement

3.4 Test Program Used and Operation Descriptions

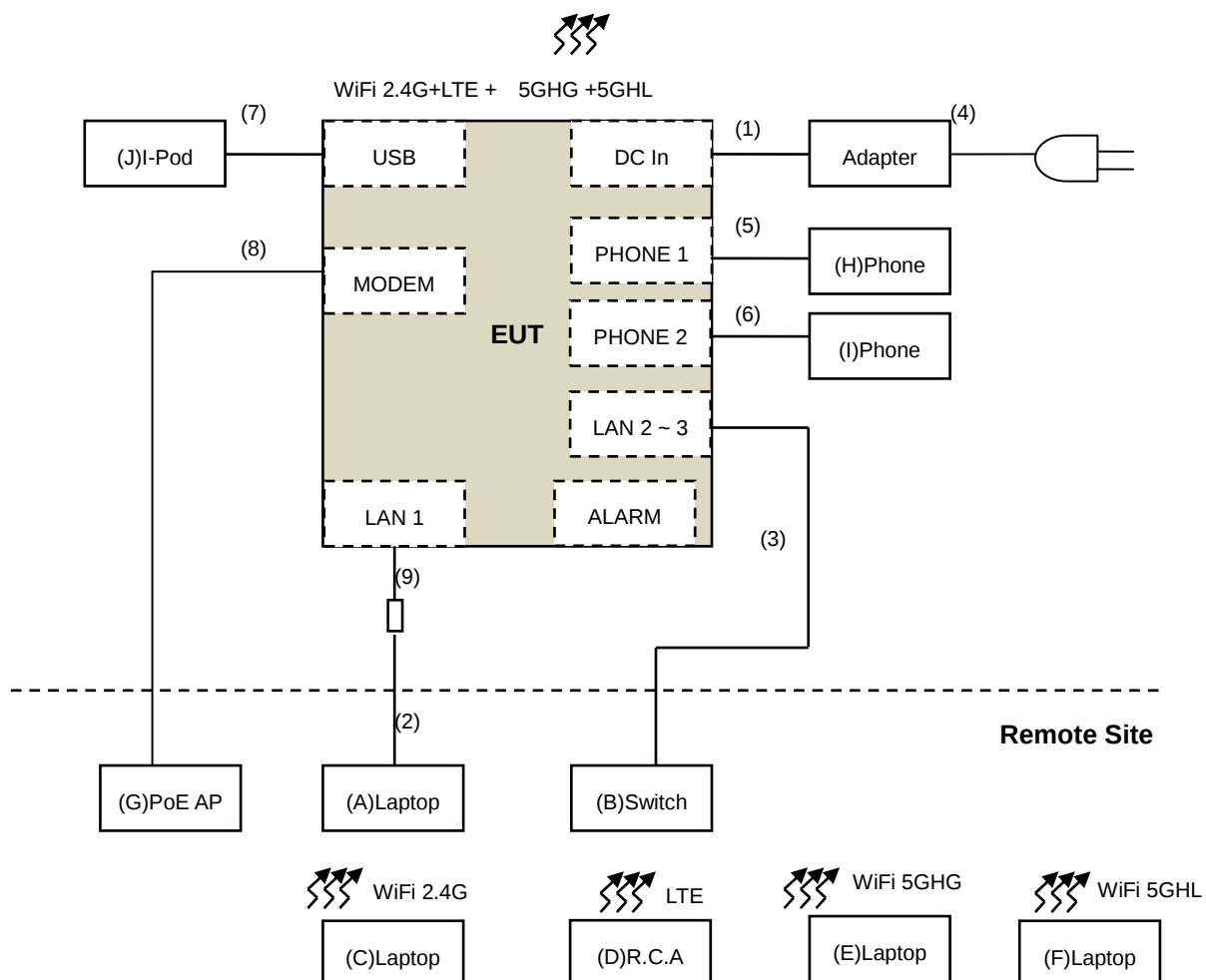
1. Turn on the power of all equipment.
2. Support unit A (Laptop) runs "Ping.exe" program to communicate with EUT via UTP cable.
3. Support units C,E and F (Laptop) runs "Ping.exe" program to communicate with EUT via wireless.
4. The EUT links support unit D (R.C.A) via LTE.
5. Support unit H (Phone) & Support unit I (Phone) are calling to each other via EUT.
6. The support unit G (PoE AP) was powered by EUT
7. Support unit A (Laptop) runs a test program "USB test z.bat.exe" to under reads and writes messages continually via (J) I-Pod by one USB cable.

3.5 Primary Clock Frequencies of Internal Source

The EUT is provided by Novatel Wireless, Inc., 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



4.2 Configuration of Peripheral Devices and Cable Connections

No.	Product	Brand	Model No.	Serial No.	FCC ID	Remark
A	Laptop	DELL	PP32LA	HSLB32S	FCC DoC	Provided by Lab
B	Switch	NA	NA	NA	NA	Provided by Lab
C	Laptop	DELL	PP27L	6YLB32S	FCC DoC	Provided by Lab
D	R.C.A (Radio Communication Analyzer)	ANRITSU	MT8821C	6261786083	NA	Provided by Lab
E	Laptop	DELL	P70F	JJY07L2	FCC DoC	Provided by Lab
F	Laptop	DELL	P70F	1KY07L2	FCC DoC	Provided by Lab
G	PoE AP	D-Link	DAP-3662	NA	NA	Supplied by client
H	Phone	TENDEL	K-311	NA	NA	Supplied by client
I	Phone	TENDEL	K-311	NA	NA	Supplied by client
J	I-Pod	Apple	MD778TA/A	CC4JMH7LF4T1	NA	Provided by Lab

NOTE:

1. All power cords of the above support units are non-shielded (1.8 m).

No.	Descriptions	Qty.	Length (m)	Shielded (Yes/ No)	Cores (Number)	Remark
1	DC Cable	1	1.5	No	0	Supplied by Client
2	Cat 5e Cable	1	10	No	0	Provided by Lab
3	Cat 5e Cable	2	10	No	0	Provided by Lab
4	AC Cable	1	1.8	No	0	Supplied by client
5	RJ-11 Cable	1	1.8	No	0	Supplied by client
6	RJ-11 Cable	1	1.8	No	0	Supplied by client
7	USB Cable	1	0.1	Yes	0	Provided by Lab
8	Cat 5e Cable	1	10	No	0	Provided by Lab
9	Cat 5e Cable	1	1	No	0	Supplied by Client

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.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver R&S	ESCS 30	100375	May 15, 2018	May 14, 2019
Line-Impedance Stabilization Network (for EUT) SCHWARZBECK	NSLK-8127	8127-522	Aug. 31, 2017	Aug. 30, 2018
Line-Impedance Stabilization Network (for Peripheral) R&S	ENV 216	10072	June 04, 2018	June 03, 2019
RF Cable	5D-FB	COACAB-002	Feb. 23, 2018	Feb. 22, 2019
10 dB PAD EMEC	STI02-2200-10	001	Mar. 16, 2018	Mar. 15, 2019
50 ohms Terminator	N/A	EMC-03	Sep. 22, 2017	Sep. 21, 2018
50 ohms Terminator	N/A	EMC-02	Sep. 22, 2017	Sep. 21, 2018
Software BVADT	BVADT_Cond_ V7.3.7.4	NA	NA	NA

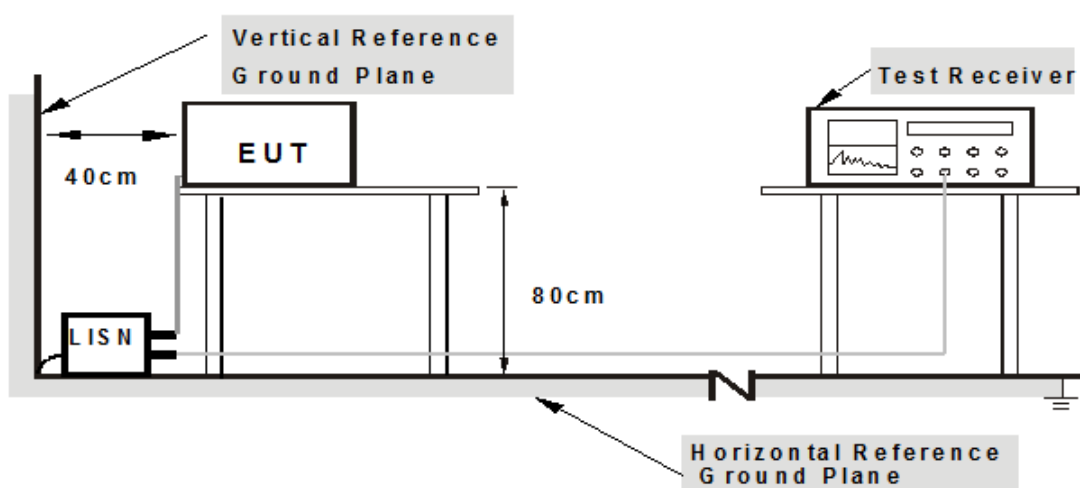
Note:

1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Conducted Room C
3. The VCCI Con C Registration No. is C-3611.
4. Tested Date: Aug. 03, 2018

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/ 50uH 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 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.



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

For the actual test configuration, please refer to the related Item – Photographs of the Test Configuration.

5.4 Supplementary Information

There is not any deviation from the test standards for the test method.

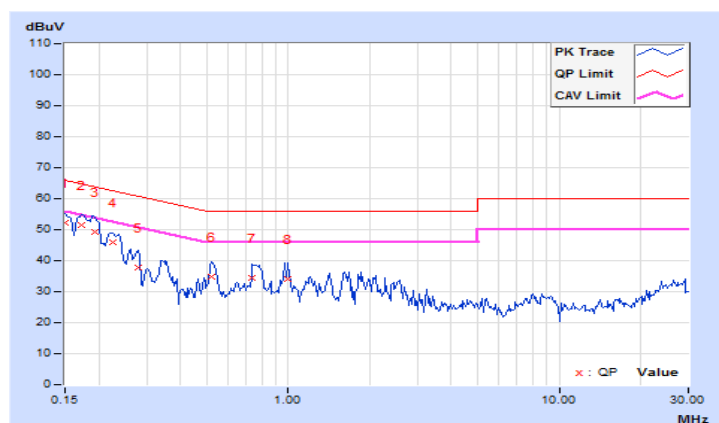
5.5 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	26°C, 69%RH
Tested by	Eagle Chen		
Test Mode	Mode 1		

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	0.15000	9.97	42.38	37.25	52.35	47.22	66.00	56.00	-13.65	-8.78
2	0.17344	9.97	41.40	35.31	51.37	45.28	64.79	54.79	-13.42	-9.51
3	0.19297	9.98	39.22	33.60	49.20	43.58	63.91	53.91	-14.71	-10.33
4	0.22422	9.98	35.79	32.17	45.77	42.15	62.66	52.66	-16.89	-10.51
5	0.27891	9.98	27.62	15.81	37.60	25.79	60.85	50.85	-23.25	-25.06
6	0.52109	10.00	24.69	17.80	34.69	27.80	56.00	46.00	-21.31	-18.20
7	0.73594	10.02	24.26	16.28	34.28	26.30	56.00	46.00	-21.72	-19.70
8	0.99375	10.05	24.00	18.39	34.05	28.44	56.00	46.00	-21.95	-17.56

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

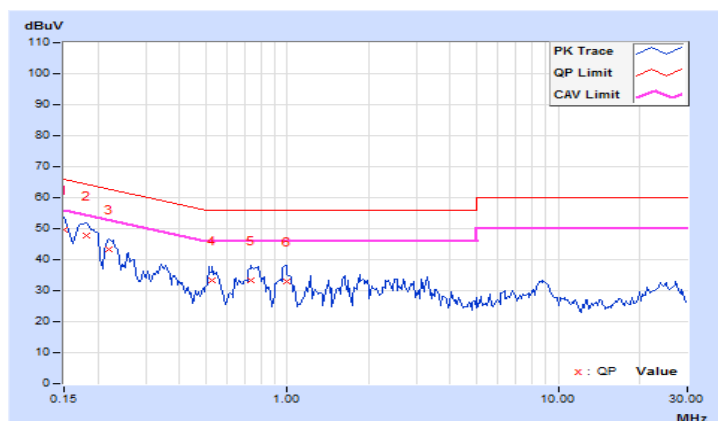


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	26°C, 69%RH
Tested by	Eagle Chen		
Test Mode	Mode 1		

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	0.15000	9.98	39.66	35.03	49.64	45.01	66.00	56.00	-16.36	-10.99
2	0.18125	9.99	37.95	34.17	47.94	44.16	64.43	54.43	-16.49	-10.27
3	0.22031	9.99	33.25	28.91	43.24	38.90	62.81	52.81	-19.57	-13.91
4	0.52891	10.02	23.20	17.24	33.22	27.26	56.00	46.00	-22.78	-18.74
5	0.73594	10.04	23.17	14.96	33.21	25.00	56.00	46.00	-22.79	-21.00
6	0.98984	10.06	23.03	18.19	33.09	28.25	56.00	46.00	-22.91	-17.75

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				
960-1000	49.5	43.5	47	37

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 (uV/m).
 3. QP detector shall be applied if not specified.

6.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY50010125	Apr. 12, 2018	Apr. 11, 2019
	N9038A	MY50010132	June 06, 2018	June 05, 2019
Pre-Amplifier Sonoma	310N	352925	Aug. 28, 2017	Aug. 27, 2018
	310N	352926	Aug. 28, 2017	Aug. 27, 2018
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-359	Dec. 11, 2017	Dec. 10, 2018
	VULB 9168	9168-358	Dec. 06, 2017	Dec. 05, 2018
Fixed attenuator Mini-Circuits	UNAT-5+	CHF-001	Sep. 07, 2017	Sep. 06, 2018
	UNAT-5+	CHF-002	Sep. 07, 2017	Sep. 06, 2018
RF Cable	8D-FB	CHFCAB-001-1 CHFCAB-001-3 CHFCAB-001-4	Sep. 20, 2017	Sep. 19, 2018
		CHFCAB-002-1 CHFCAB-002-3 CHFCAB-002-4	Sep. 20, 2017	Sep. 19, 2018
Software BVADT	ADT_Radiated_V 8.7.08	NA	NA	NA
Antenna Tower & Turn Table CT	NA	NA	NA	NA

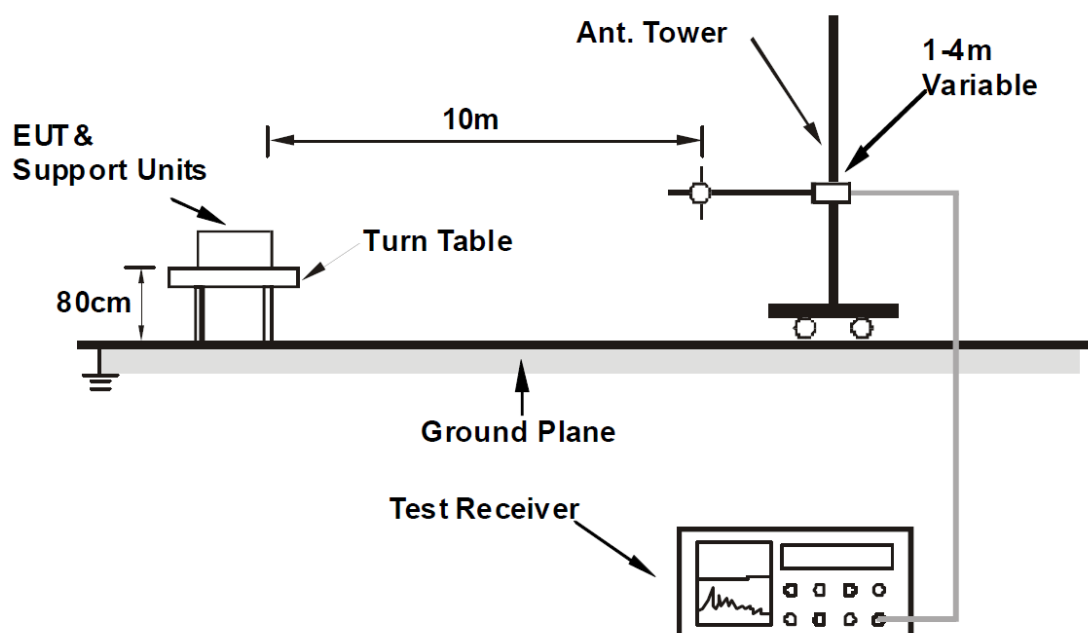
Note:

1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Chamber F room
3. The VCCI Site Registration No. is R-3252.
4. The CANADA Site Registration No. is IC 7450H-1.
5. Tested Date: Aug. 02, 2018

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 up to 1 GHz.

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



For the actual test configuration, please refer to the related Item – Photographs of the Test Configuration.

6.4 Supplementary Information

There is not any deviation from the test standards for the test method.

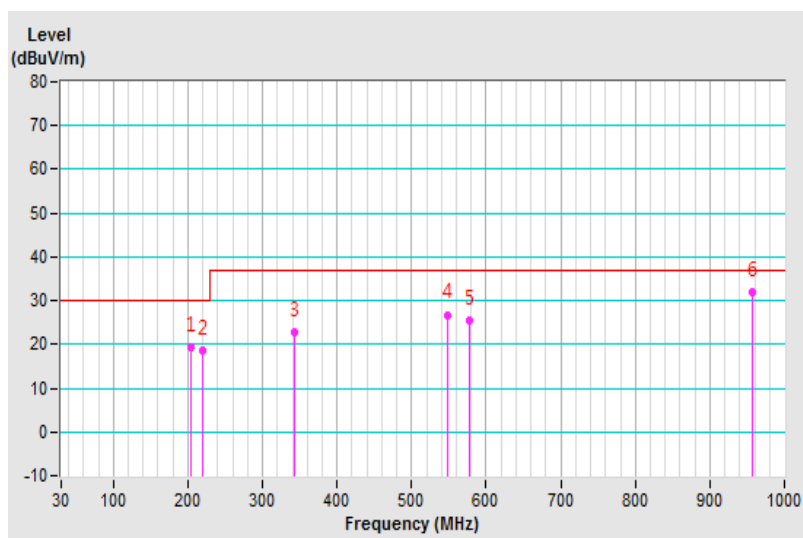
6.5 Test Results

Frequency Range	30MHz ~ 1GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	120Vac, 60Hz	Environmental Conditions	24°C, 67%RH
Tested by	Duncan Wang		
Test Mode	Mode 1		

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	203.27	19.38 QP	30.00	-10.62	4.00 H	282	34.78	-15.40
2	219.10	18.53 QP	30.00	-11.47	4.00 H	147	34.16	-15.63
3	342.90	22.82 QP	37.00	-14.18	3.00 H	14	33.27	-10.45
4	548.63	26.78 QP	37.00	-10.22	4.00 H	299	32.58	-5.80
5	577.25	25.45 QP	37.00	-11.55	1.00 H	14	30.31	-4.86
6	957.88	32.08 QP	37.00	-4.92	1.98 H	197	29.77	2.31

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

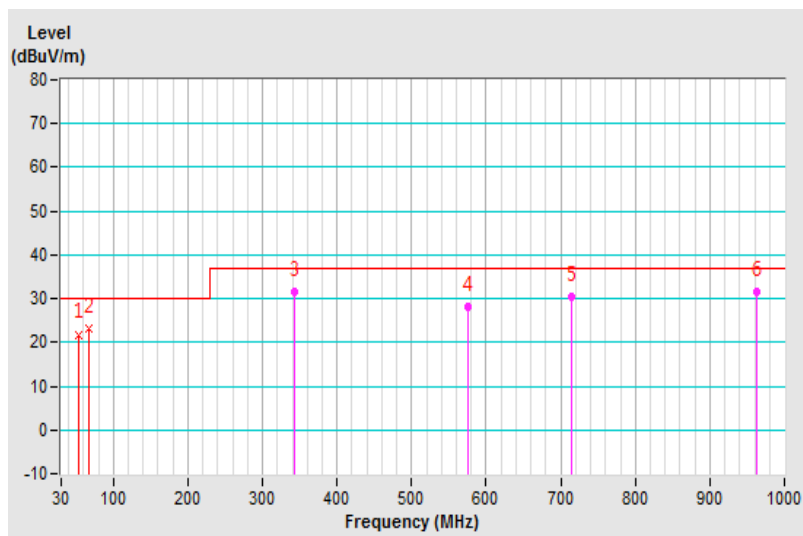


Frequency Range	30MHz ~ 1GHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP), 120kHz
Input Power	120Vac, 60Hz	Environmental Conditions	24°C, 67%RH
Tested by	Duncan Wang		
Test Mode	Mode 1		

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	53.22	21.83 QP	30.00	-8.17	1.00 V	325	34.50	-12.67
2	66.37	23.07 QP	30.00	-6.93	1.05 V	342	37.13	-14.06
3	342.90	31.46 QP	37.00	-5.54	4.00 V	324	41.57	-10.11
4	574.99	28.18 QP	37.00	-8.82	3.00 V	113	32.38	-4.20
5	714.75	30.55 QP	37.00	-6.45	1.00 V	219	32.19	-1.64
6	962.19	31.67 QP	37.00	-5.33	2.00 V	63	28.03	3.64

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 Peak: 69.5	Avg: 43.5 Peak: 63.5	Not defined	Not defined
Above 3000			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 Peak: 80	Avg: 54 Peak: 74	Avg: 56 Peak: 76	Avg: 50 Peak: 70
Above 3000			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 1000MHz, 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 20dB under any condition of modulation.

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	5th harmonic of the highest frequency or 40GHz, whichever is lower

7.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY50010125	Apr. 12, 2018	Apr. 11, 2019
Pre-Amplifier Agilent	8449B	3008A01975	Feb. 22, 2018	Feb. 21, 2019
Horn Antenna SCHWARZBECK	BBHA 9120D	D123	Dec. 01, 2017	Nov. 30, 2018
RF Coaxial Cable	EMC104-SM-SM -11000	170209	Mar. 06, 2018	Mar. 05, 2019
RF Coaxial Cable	EMC104-SM-SM -6000	170207	Mar. 06, 2018	Mar. 05, 2019
RF Coaxial Cable	EMC104-SM-SM -2500	170206	Mar. 06, 2018	Mar. 05, 2019
Spectrum Analyzer Agilent	E4446A	MY48250254	Nov. 21, 2017	Nov. 20, 2018
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Dec. 05, 2017	Dec. 04, 2018
Horn Antenna SCHWARZBECK	BBHA 9170	9170-424	Dec. 13, 2017	Dec. 12, 2018
RF Cable	SUCOFLEX 102	36442/2 36434/2	Dec. 05, 2017	Dec. 04, 2018
Software BVADT	ADT_Radiated_ V8.7.08	NA	NA	NA
Antenna Tower & Turn Table CT	NA	NA	NA	NA
Fix tool for Boresight antenna tower	BAF-01	5	NA	NA

Note:

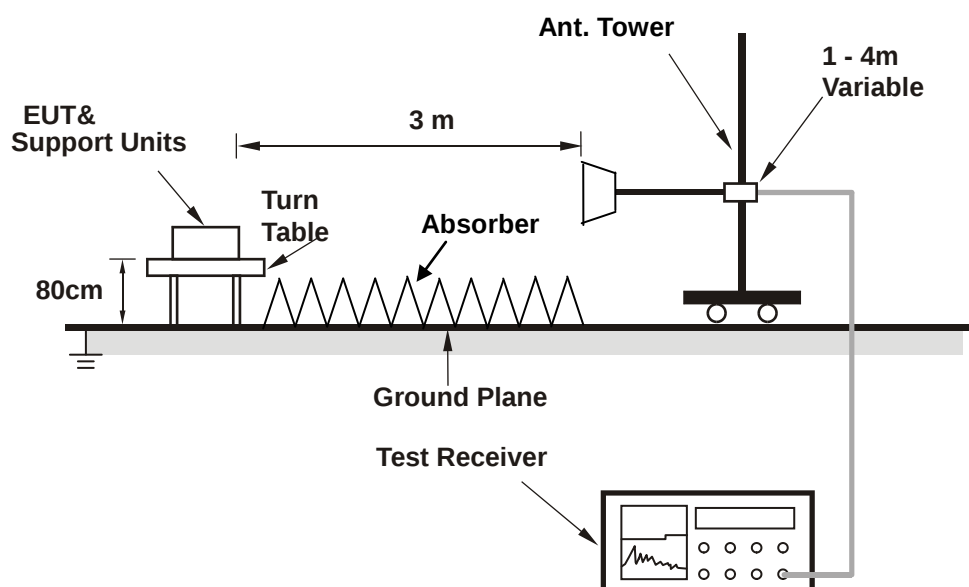
1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Chamber F room
3. Tested Date: Aug. 02, 2018

7.3 Test Arrangement

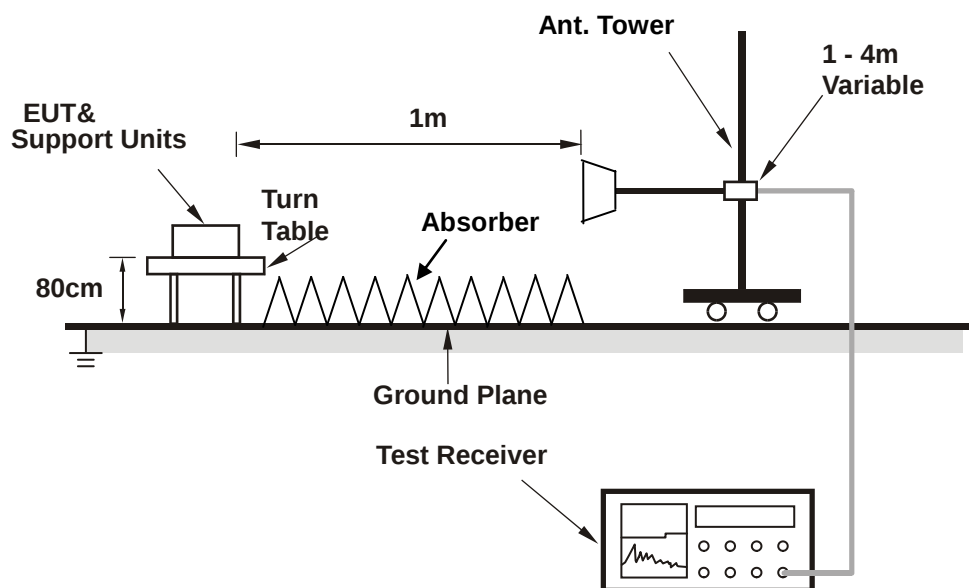
- The EUT was placed on the top of a rotating table 0.8 meters above the ground at an accredited chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 / 1 meters away from the interference-receiving antenna, which was mounted on the top 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 3dB 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 1MHz and video bandwidth is 3MHz for Peak detection (PK) at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1GHz.

<Frequency Range 1GHz ~ 18GHz>



<Frequency Range 18GHz ~ 40GHz>



The test arrangement is in accordance with ANSI 63.4:2014. For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

7.4 Supplementary Information

There is not any deviation from the test standards for the test method.

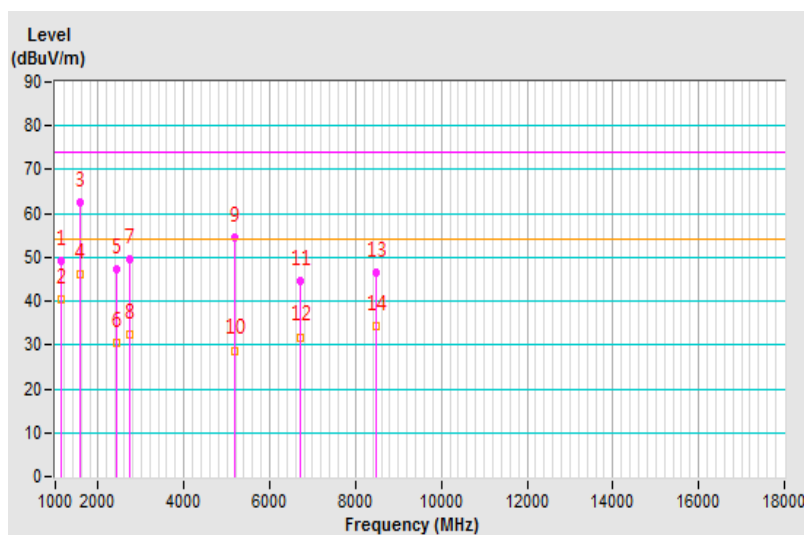
7.5 Test Results

Frequency Range	1GHz ~ 18GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	120Vac, 60Hz	Environmental Conditions	26°C, 66%RH
Tested by	Duncan Wang		
Test Mode	Mode 1		

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	1149.43	49.13 PK	74.00	-24.87	1.00 H	22	59.18	-10.05
2	1149.43	40.38 AV	54.00	-13.62	1.00 H	360	50.43	-10.05
3	1566.60	62.63 PK	74.00	-11.37	1.00 H	360	71.18	-8.55
4	1566.60	45.96 AV	54.00	-8.04	1.00 H	360	54.51	-8.55
5	2415.46	47.38 PK	74.00	-26.62	1.00 H	341	52.86	-5.48
6	2415.46	30.56 AV	54.00	-23.44	1.00 H	0	36.04	-5.48
7	2743.38	49.48 PK	74.00	-24.52	1.00 H	360	54.30	-4.82
8	2743.38	32.48 AV	54.00	-21.52	1.00 H	360	37.30	-4.82
9	5173.73	54.38 PK	74.00	-19.62	1.00 H	46	54.75	-0.37
10	5173.73	28.79 AV	54.00	-25.21	1.00 H	0	29.16	-0.37
11	6701.26	44.65 PK	74.00	-29.35	1.00 H	121	42.40	2.25
12	6701.26	31.84 AV	54.00	-22.16	1.00 H	360	29.59	2.25
13	8484.07	46.38 PK	74.00	-27.62	1.00 H	156	41.90	4.48
14	8484.07	34.14 AV	54.00	-19.86	1.00 H	0	29.66	4.48

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

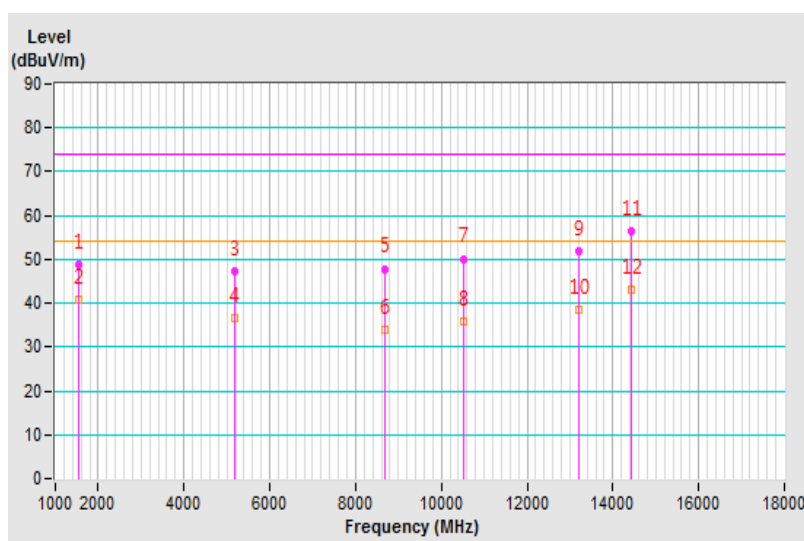


Frequency Range	1GHz ~ 18GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	120Vac, 60Hz	Environmental Conditions	26°C, 66%RH
Tested by	Duncan Wang		
Test Mode	Mode 1		

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	1560.37	48.94 PK	74.00	-25.06	1.00 V	21	57.48	-8.54
2	1560.37	40.71 AV	54.00	-13.29	1.00 V	360	49.25	-8.54
3	5173.73	47.21 PK	74.00	-26.79	1.00 V	334	47.58	-0.37
4	5173.73	36.62 AV	54.00	-17.38	1.00 V	0	36.99	-0.37
5	8668.78	47.83 PK	74.00	-26.17	1.00 V	135	42.55	5.28
6	8668.78	33.90 AV	54.00	-20.10	1.00 V	321	28.62	5.28
7	10503.48	50.14 PK	74.00	-23.86	1.00 V	41	42.48	7.66
8	10503.48	35.95 AV	54.00	-18.05	1.00 V	360	28.29	7.66
9	13220.24	51.79 PK	74.00	-22.21	1.00 V	166	42.30	9.49
10	13220.24	38.63 AV	54.00	-15.37	1.00 V	255	29.14	9.49
11	14419.85	56.29 PK	74.00	-17.71	1.00 V	234	43.45	12.84
12	14419.85	43.06 AV	54.00	-10.94	1.00 V	268	30.22	12.84

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

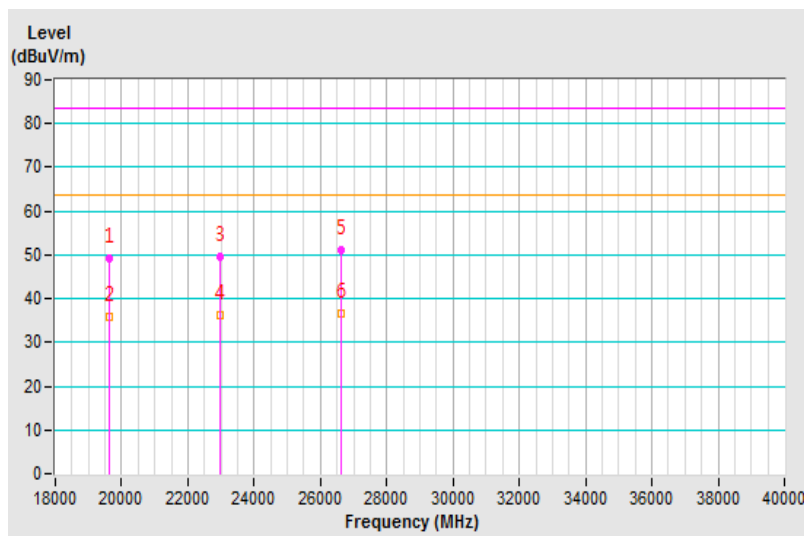


Frequency Range	18GHz ~ 29.25GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	120Vac, 60Hz	Environmental Conditions	23°C, 66%RH
Tested by	Cody Lee		
Test Mode	Mode 1		

Antenna Polarity & Test Distance : Horizontal at 1 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	19649.13	49.31 PK	83.50	-34.19	1.00 H	131	57.52	-8.21
2	19649.13	35.71 AV	63.50	-27.79	1.00 H	211	43.92	-8.21
3	22974.24	49.56 PK	83.50	-33.94	1.00 H	244	57.31	-7.75
4	22974.24	36.29 AV	63.50	-27.21	1.00 H	73	44.04	-7.75
5	26605.54	51.10 PK	83.50	-32.40	1.00 H	54	57.80	-6.70
6	26605.54	36.56 AV	63.50	-26.94	1.00 H	360	43.26	-6.70

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

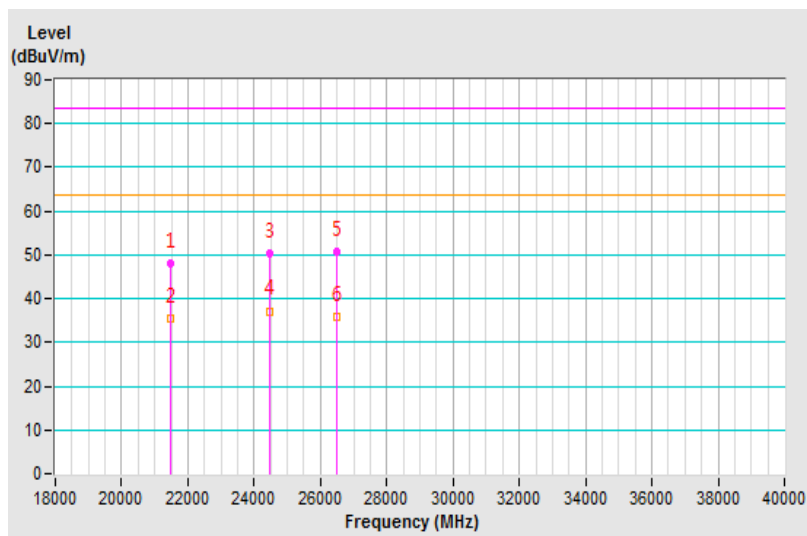


Frequency Range	18GHz ~ 29.25GHz	Detector Function & Resolution Bandwidth	Peak (PK) / Average (AV), 1MHz
Input Power	120Vac, 60Hz	Environmental Conditions	23°C, 66%RH
Tested by	Cody Lee		
Test Mode	Mode 1		

Antenna Polarity & Test Distance : Vertical at 1 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	21456.72	48.13 PK	83.50	-35.37	1.00 V	343	55.90	-7.77
2	21456.72	35.44 AV	63.50	-28.06	1.00 V	70	43.21	-7.77
3	24456.84	50.41 PK	83.50	-33.09	1.00 V	235	57.72	-7.31
4	24456.84	37.16 AV	63.50	-26.34	1.00 V	360	44.47	-7.31
5	26511.54	50.63 PK	83.50	-32.87	1.00 V	40	57.24	-6.61
6	26511.54	35.72 AV	63.50	-27.78	1.00 V	181	42.33	-6.61

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

Please refer to the attached file (Test Setup Photo).

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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