

TEST REPORT

CERTIFICATE OF CONFORMITY

Standard: 47 CFR FCC Part 15, Subpart C (Section 15.249)

Report No.: RFBBDJ-WTW-P24090476

FCC ID: RRC-AM10

Product: Wireless Gaming Mouse

Brand: TUL

Model No.: ALPHYN AM10

Received Date: 2024/9/24

Test Date: 2024/9/27 ~ 2024/10/16

Issued Date: 2024/11/5

Applicant: TUL Corporation

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

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FCC Registration / 198487 / TW2021

Designation Number:

Approved by: Jeremy Lin, **Date:** 2024/11/5
Jeremy Lin / Project Engineer

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Prepared by : Ivy Lin / Specialist



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Release Control Record

Issue No.	Description	Date Issued
RFBBDJ-WTW-P24090476	Original release.	2024/11/5

1 Certificate

Product: Wireless Gaming Mouse

Brand: TUL

Test Model: ALPHYN AM10

Sample Status: Engineering sample

Applicant: TUL Corporation

Test Date: 2024/9/27 ~ 2024/10/16

Standard: 47 CFR FCC Part 15, Subpart C (Section 15.249)

Measurement procedure: ANSI C63.10-2013

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 RF characteristics under the conditions specified in this report.

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.249)			
Standard / Clause	Test Item	Result	Remark
15.207	AC Power Conducted Emissions	Pass	Minimum passing margin is -9.92 dB at 0.73984 MHz
15.209 / 15.249(d)	Radiated Emissions below 1 GHz	Pass	Minimum passing margin is -11.3 dB at 56.48 MHz
15.209 / 15.249(a) / 15.249(d) / 15.249(e)	Radiated Emissions above 1 GHz	Pass	Minimum passing margin is -11.2 dB at 2390.00 MHz
15.215 (c)	20 dB Bandwidth	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Specification	Expanded Uncertainty (k=2) (±)
AC Power Conducted Emissions	9 kHz ~ 30 MHz	2.90 dB
Radiated Emissions below 1 GHz	9 kHz ~ 30 MHz	2.85 dB
	30 MHz ~ 1 GHz	5.7 dB
Radiated Emissions above 1 GHz	1 GHz ~ 6 GHz	3.06 dB
	6 GHz ~ 18 GHz	3.06 dB
	18 GHz ~ 40 GHz	3.29 dB
20 dB Bandwidth	-	960 Hz

The other instruments specified are routine verified to remain within the calibrated levels, no measurement uncertainty is required to be calculated.

2.2 Supplementary Information

There is not any deviation from the test standards for the test method, and no modifications required for compliance.

3 General Information

3.1 General Description

Product	Wireless Gaming Mouse
Brand	TUL
Test Model	ALPHYN AM10
Status of EUT	Engineering sample
Power Supply Rating	3.7Vdc from Battery or 5Vdc from host equipment
Modulation Type	GFSK
Transfer Rate	2 Mbps
Operating Frequency	2.403 GHz ~ 2.48 GHz
Number of Channel	78
Field Strength Of Fundamental	80.5 dBuV/m (Average) at 3 meters

Note:

1. The EUT uses following accessory.

Item	Specification
USB Cable	Shielded 1.8m

2. There are Bluetooth and SRD technology used for the EUT.
3. Bluetooth and SRD technology can not transmit at same time.
4. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

3.2 Antenna Description of EUT

1. The antenna information is listed as below.

Brand	Model	Gain(dBi)	Frequency range	Antenna Type	Connector Type
Onewave	WAN223216F2451SH08	2.46	2.4 GHz ~ 2.4835 GHz	Chip	none

* Due to radiated measurements are made and the antenna gain is already accounted for this device, so provide an antenna datasheet and/or antenna measurement report is not required. The antenna dimensions and pictures (include antenna wire length if have) are stated in EUT photo exhibit.

3.3 Channel List

78 channels are provided to this EUT:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2403	20	2423	40	2443	60	2463
1	2404	21	2424	41	2444	61	2464
2	2405	22	2425	42	2445	62	2465
3	2406	23	2426	43	2446	63	2466
4	2407	24	2427	44	2447	64	2467
5	2408	25	2428	45	2448	65	2468
6	2409	26	2429	46	2449	66	2469
7	2410	27	2430	47	2450	67	2470
8	2411	28	2431	48	2451	68	2471
9	2412	29	2432	49	2452	69	2472
10	2413	30	2433	50	2453	70	2473
11	2414	31	2434	51	2454	71	2474
12	2415	32	2435	52	2455	72	2475
13	2416	33	2436	53	2456	73	2476
14	2417	34	2437	54	2457	74	2477
15	2418	35	2438	55	2458	75	2478
16	2419	36	2439	56	2459	76	2479
17	2420	37	2440	57	2460	77	2480
18	2421	38	2441	58	2461		
19	2422	39	2442	59	2462		

3.4 Test Mode Applicability and Tested Channel Detail

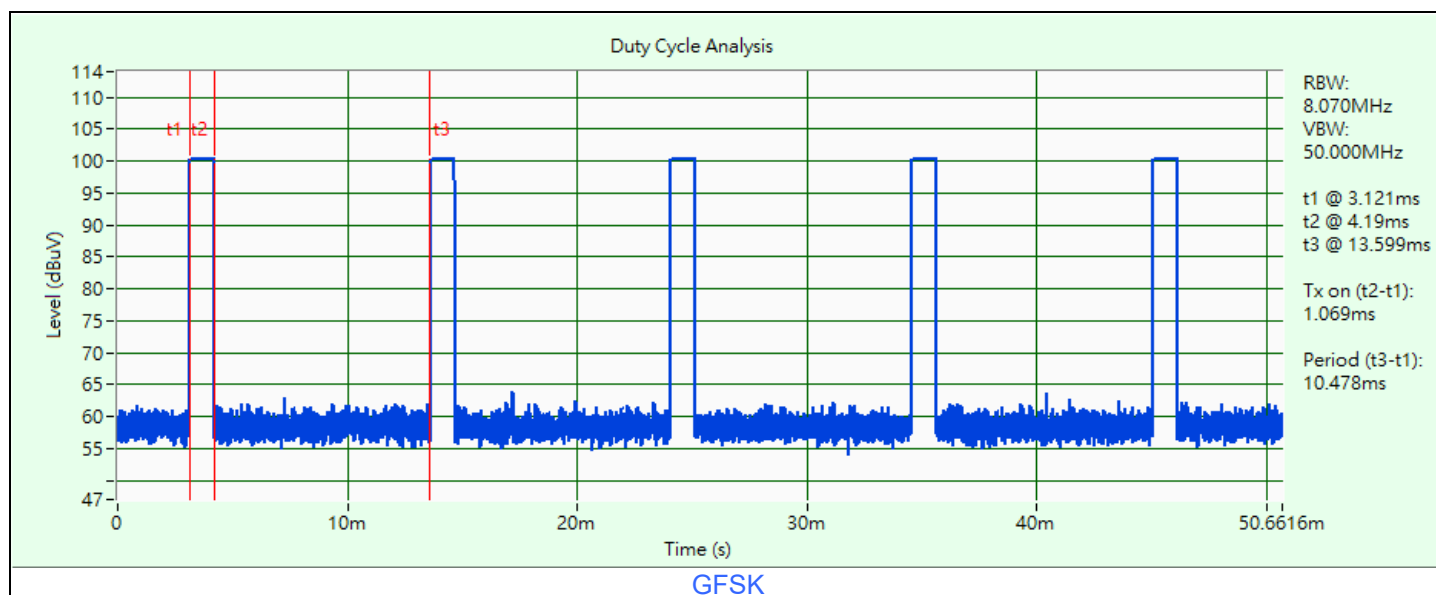
Pre-Scan:	1. For Unwanted Emission below 1 GHz has Charging with NB/ Charging with Adapter mode of power supply. Pre-scan and find the worst charging case as a representative test condition.
Worst Case:	1. For Unwanted Emission below 1 GHz Charging with NB mode is the worst charging case of power supply.

Following channel(s) was (were) selected for the final test as listed below:

Test Item	EUT Configure Mode	Tested Channel	Modulation	Data Rate Parameter
AC Power Conducted Emissions	B	-	-	-
	C	-	-	-
20 dB Bandwidth	A	0, 38, 77	GFSK	2Mb/s
Radiated Emissions below 1 GHz	A	38	GFSK	2Mb/s
	B	-	-	-
Radiated Emissions above 1 GHz	A	0, 38, 77	GFSK	2Mb/s
EUT Configure Mode:	A	EUT only		
	B	Charging with NB		
	C	Charging with Adapter		

3.5 Duty Cycle of Test Signal

GFSK: Duty cycle = $1.069 \text{ ms} / 10.478 \text{ ms} \times 100\% = 10.2\%$



3.6 Test Program Used and Operation Descriptions

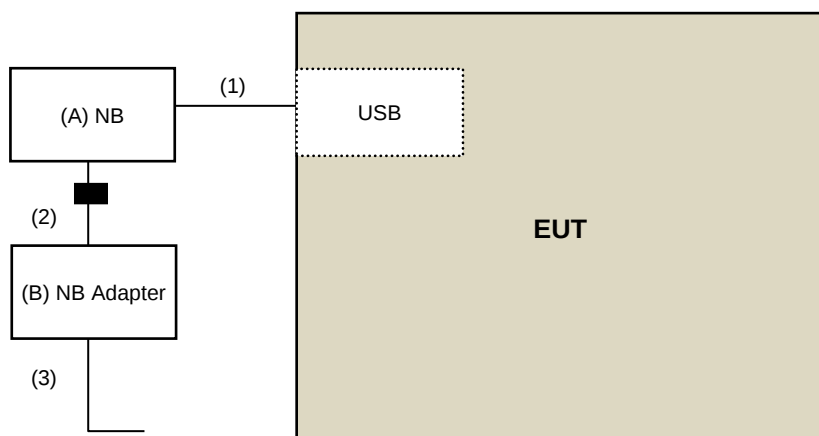
Controlling software (Mouse RF Test App) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

3.7 Connection Diagram of EUT and Peripheral Devices

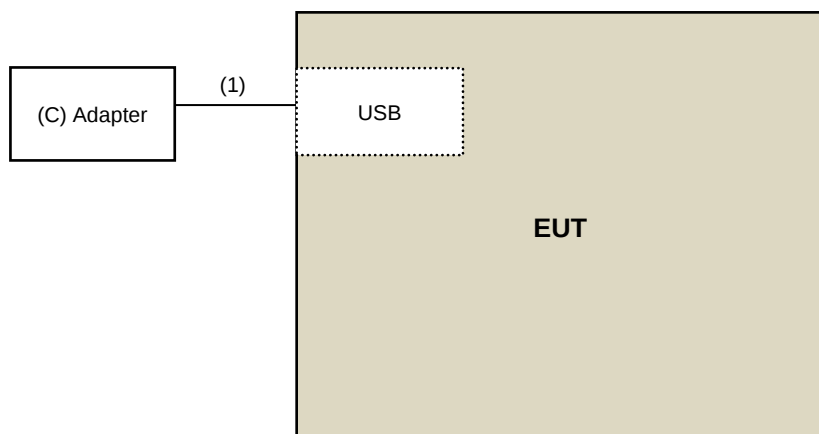
Mode A



Mode B



Mode C



3.8 Configuration of Peripheral Devices and Cable Connections

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	NB	Dell	P90F	N/A	N/A	Provided by Lab
B	NB Adapter	Dell	LA65NS2-01	N/A	N/A	Provided by Lab
C	Adapter	Belkin	WCB007dq	N/A	N/A	Provided by Lab

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	C to A cable	1	1.8	Y	0	Supplied by applicant
2	NB Adapter DC cable	1	1.8	N	1	Provided by Lab
3	NB Adapter AC cable	1	0.9	N	0	Provided by Lab

4 Test Instruments

The calibration interval of the all test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.1 AC Power Conducted Emissions

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
* Isolation Transformer Erika Fiedler	D-65396	46	2023/4/20	2025/4/19
50 ohm terminal resistance LYNICS	0900510	E1-011484	2024/8/12	2025/8/11
50 ohm terminal resistance SUHNER	65BNC-5001	E1-010773	2024/3/13	2025/3/12
EMI Test Receiver R&S	ESCI	100412	2024/9/3	2025/9/2
Fixed Attenuator STI	STI02-2200-10	NO.1	2024/9/12	2025/9/11
Isolation Transformer Erika Fiedler	D-65396	017	2024/9/18	2025/9/17
LISN R&S	ENV216	100024	2024/9/6	2025/9/5
		101196	2024/5/22	2025/5/21
		101197	2024/7/11	2025/7/10
LISN Schwarzbeck	NNLK 8121	8121-731	2024/6/12	2025/6/11
		8121-808	2024/4/26	2025/4/25
	NNLK 8129	8129229	2024/6/14	2025/6/13
RF Coaxial Cable PEWC	5D-FB	Cable-CO10-01	2024/2/7	2025/2/6
Software BVADT	Cond_V7.4.1.0	N/A	N/A	N/A
V-LISN Schwarzbeck	NNBL 8226-2	8226-142	2024/8/28	2025/8/27

Notes:

- * The calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA
- The test was performed in Linkou Conduction 10.
- Tested Date: 2024/9/30

4.2 Radiated Emissions below 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Bi_Log Antenna Schwarzbeck	VULB 9168	137	2023/10/13	2024/10/12
Coupling / Decoupling Network Schwarzbeck	CDNE-M2	00097	2024/5/28	2025/5/27
	CDNE-M3	00091	2024/5/28	2025/5/27
MXE EMI Receiver Agilent	N9038A	MY51210129	2024/3/22	2025/3/21
Preamplifier Agilent	8447D	2944A11064	2024/2/15	2025/2/14
Preamplifier EMCI	EMC001340	980269	2024/6/25	2025/6/24
Radiating Loop Antenna TESEQ	RLA 6120-20	80002	2024/7/30	2025/7/29
RF Coaxial Cable Pacific	8D-FB	Cable-CH6-02	2024/6/25	2025/6/24
Signal Analyzer R&S	FSV40	101544	2024/6/20	2025/6/19
Software BVADT	Radiated_V8.7.08	N/A	N/A	N/A
Tower ADT	AT100	0306	N/A	N/A
Turn Table ADT	TT100	0306	N/A	N/A

Notes:

1. The test was performed in Linkou 966 Chamber 6 (CH 6).
2. Tested Date: 2024/9/28

4.3 Radiated Emissions above 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Boresight antenna tower fixture BV	BAF-02	6	N/A	N/A
High Pass Filter Wainwright	WHK 3.1/18G-10SS	SN 8	2024/5/24	2025/5/23
Horn Antenna EMCO	3115	00028257	2023/11/12	2024/11/11
Horn Antenna ETS-Lindgren	3117-PA	00215857	2023/11/12	2024/11/11
Horn Antenna Schwarzbeck	BBHA 9170	212	2023/10/16	2024/10/15
		BBHA9170241	2023/10/16	2024/10/15
MXE EMI Receiver Agilent	N9038A	MY51210129	2024/3/22	2025/3/21
Notch Filter Micro-Tronics	BRC50703-01	010	2024/5/24	2025/5/23
	BRM17690	005	2024/5/24	2025/5/23
Preamplifier EMCI	EMC0126545 EMC184045B	980076	2024/2/15	2025/2/14
		980175	2024/8/25	2025/8/24
		980235	2024/2/15	2025/2/14
Preamplifier HP	8449B	3008A01201	2024/2/15	2025/2/14
RF Coaxial Cable EMCI	EMC104	190801	2024/7/5	2025/7/4
		190804	2024/7/5	2025/7/4
RF Coaxial Cable EMEC	EM102-KMKM-100	02	2024/7/5	2025/7/4
RF Coaxial Cable HUBER+SUHNER	SF-104	Cable-CH6-01	2024/7/5	2025/7/4
Signal Analyzer R&S	FSV40	101042	2024/9/12	2025/9/11
		101544	2024/6/20	2025/6/19
Software BVADT	Radiated_V7.7.1.1.1	N/A	N/A	N/A
Tower ADT	AT100	0306	N/A	N/A
Turn Table ADT	TT100	0306	N/A	N/A

Notes:

1. The test was performed in Linkou 966 Chamber 6 (CH 6).
2. Tested Date: 2024/9/27

4.4 20 dB Bandwidth

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
PXA Signal Analyzer Keysight	N9030A	MY54490260	2024/7/17	2025/7/16
Signal Analyzer R&S	FSV40	101042	2024/9/12	2025/9/11
Software	ADT_RF Test Software V6.6.5.4	N/A	N/A	N/A

Notes:

1. The test was performed in LK - Oven
2. Tested Date: 2024/10/16

5 Limits of Test Items

5.1 AC Power Conducted Emissions

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Notes:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

5.2 Radiated Emissions below 1 GHz

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).

5.3 Radiated Emissions above 1 GHz

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following.

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
2400 ~ 2483.5 MHz	50	500

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits as below table, whichever is the lesser attenuation.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
Above 960	500	3

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. 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.

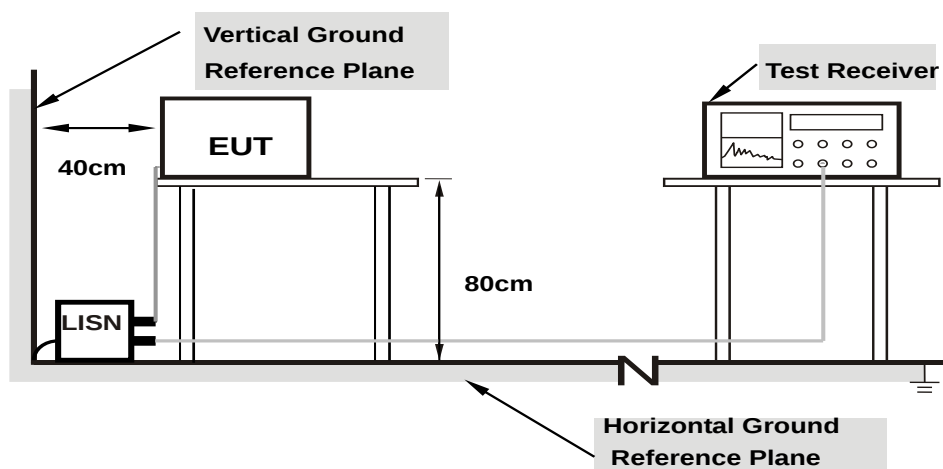
5.4 20 dB Bandwidth

The 20dB bandwidth shall be specified in operating frequency band.

6 Test Arrangements

6.1 AC Power Conducted Emissions

6.1.1 Test Setup



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

For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.1.2 Test Procedure

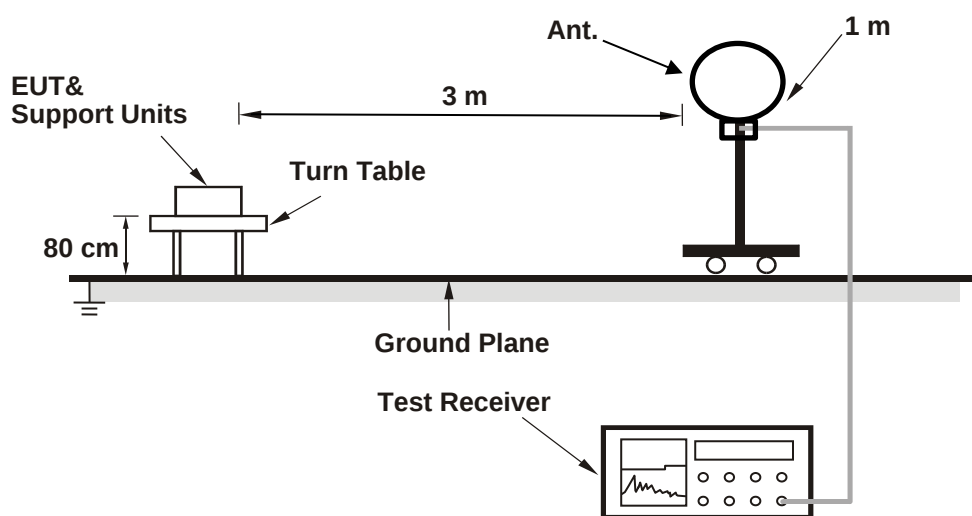
- The EUT was placed on a 0.8 meter to the top of table and placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The 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 frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

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.

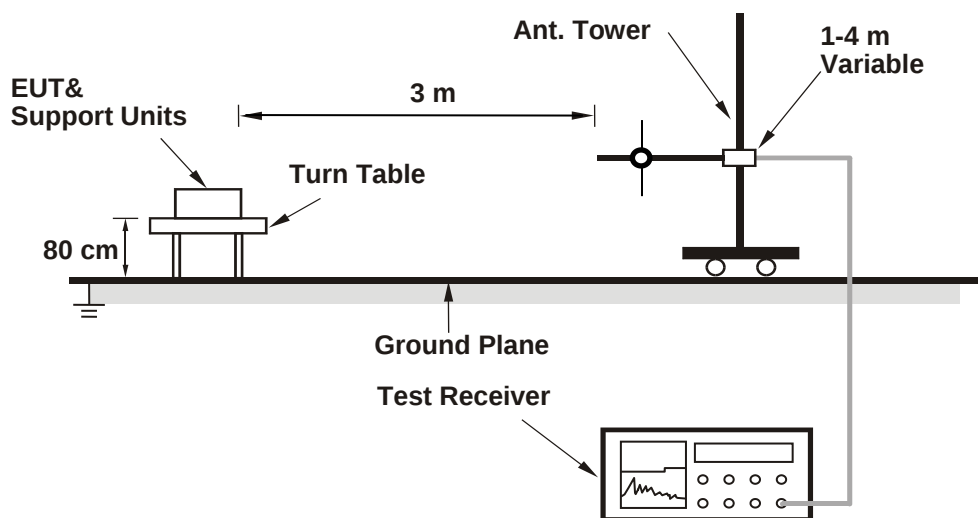
6.2 Radiated Emissions below 1 GHz

6.2.1 Test Setup

For Radiated emission below 30 MHz



For Radiated emission above 30 MHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.2.2 Test Procedure

For Radiated emission below 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode, except for the frequency band (9 kHz to 90 kHz and 110 kHz to 490 kHz) set to average detect function and peak detect function.

Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 200 Hz at frequency below 150 kHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz or 10 kHz at frequency (150 kHz to 30 MHz).
3. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated emission above 30 MHz

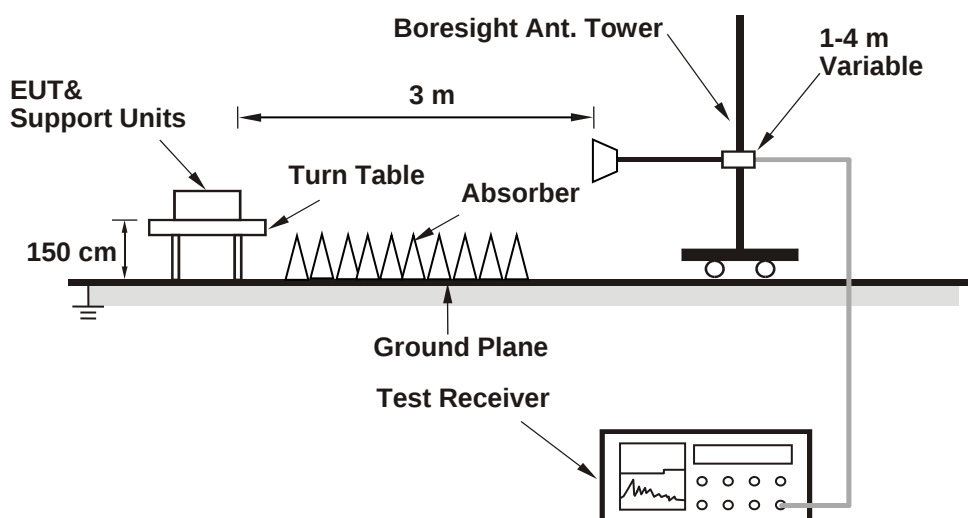
- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna 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.
- d. 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.
- e. 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.

Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

6.3 Radiated Emissions above 1 GHz

6.3.1 Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.3.2 Test Procedure

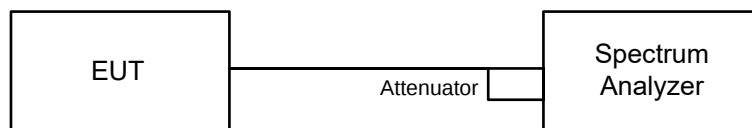
- The EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The height of antenna 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 peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Notes:

- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) and Average detection (AV) at frequency above 1 GHz.
- According to ANSI C63.10 section 6.6.4 and 4.1.4.2.2. For fundamental and harmonic signal measurement, according to ANSI C63.10 section 7.5, the average value = peak value + duty cycle correction factor. For duty cycle correction factor values, see the Test Signal Duty Cycle section in this report.
- All modes of operation were investigated and the worst-case emissions are reported.

6.4 20 dB Bandwidth

6.4.1 Test Setup



6.4.2 Test Procedure

- Set resolution bandwidth (RBW) = 1% to 5% of the OBW.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

7 Test Results of Test Item

7.1 AC Power Conducted Emissions

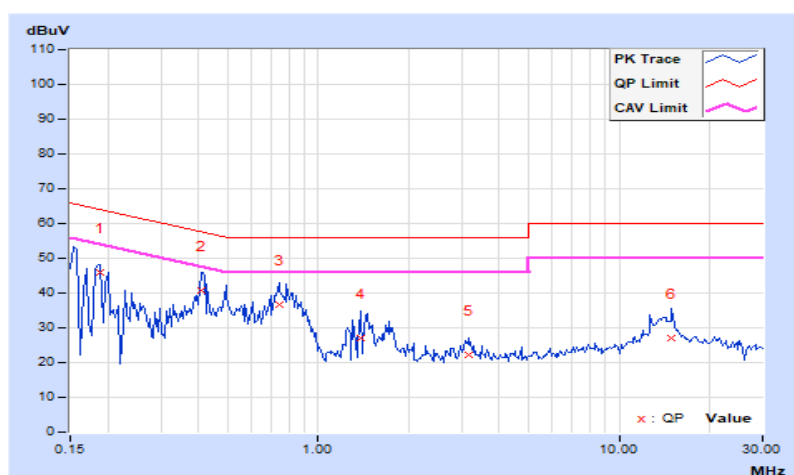
Mode B

Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75 % RH
Tested By	Pirar Hsieh		

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	0.18906	9.63	36.25	19.95	45.88	29.58	64.08	54.08	-18.20	-24.50
2	0.40781	9.64	31.13	17.43	40.77	27.07	57.69	47.69	-16.92	-20.62
3	0.73984	9.65	27.05	26.43	36.70	36.08	56.00	46.00	-19.30	-9.92
4	1.38281	9.67	17.32	3.81	26.99	13.48	56.00	46.00	-29.01	-32.52
5	3.17188	9.75	12.31	-0.60	22.06	9.15	56.00	46.00	-33.94	-36.85
6	14.88672	10.20	17.02	11.40	27.22	21.60	60.00	50.00	-32.78	-28.40

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

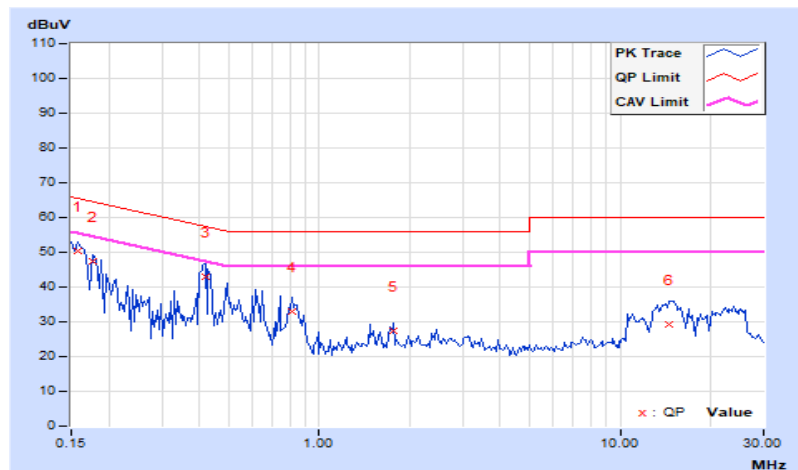


Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75 % RH
Tested By	Pirar Hsieh		

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	0.15781	9.63	40.74	26.35	50.37	35.98	65.58	55.58	-15.21	-19.60
2	0.17734	9.62	37.89	21.58	47.51	31.20	64.61	54.61	-17.10	-23.41
3	0.41953	9.61	33.22	20.56	42.83	30.17	57.46	47.46	-14.63	-17.29
4	0.81406	9.64	23.19	13.51	32.83	23.15	56.00	46.00	-23.17	-22.85
5	1.76563	9.68	17.80	15.91	27.48	25.59	56.00	46.00	-28.52	-20.41
6	14.62500	10.20	18.98	12.61	29.18	22.81	60.00	50.00	-30.82	-27.19

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



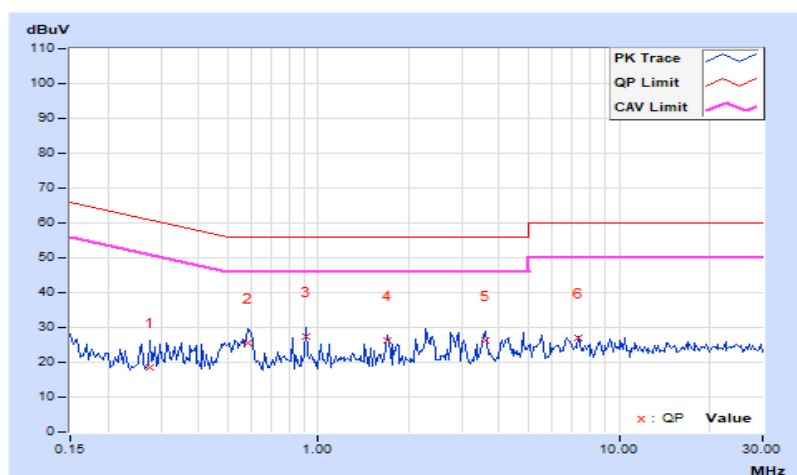
Mode C

Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75 % RH
Tested By	Pirar Hsieh		

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	0.27500	9.63	8.94	-1.53	18.57	8.10	60.97	50.97	-42.40	-42.87
2	0.58750	9.64	16.02	12.09	25.66	21.73	56.00	46.00	-30.34	-24.27
3	0.91172	9.65	17.92	13.41	27.57	23.06	56.00	46.00	-28.43	-22.94
4	1.70313	9.68	16.69	8.96	26.37	18.64	56.00	46.00	-29.63	-27.36
5	3.60938	9.78	16.62	-1.36	26.40	8.42	56.00	46.00	-29.60	-37.58
6	7.33984	9.96	17.15	-7.38	27.11	2.58	60.00	50.00	-32.89	-47.42

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

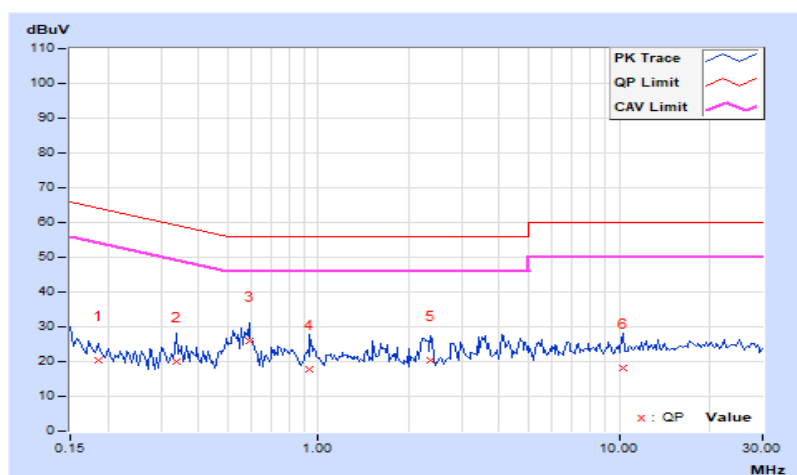


Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75 % RH
Tested By	Pirar Hsieh		

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	0.18516	9.62	10.74	3.63	20.36	13.25	64.25	54.25	-43.89	-41.00
2	0.33750	9.61	10.23	3.13	19.84	12.74	59.26	49.26	-39.42	-36.52
3	0.59141	9.63	16.23	11.31	25.86	20.94	56.00	46.00	-30.14	-25.06
4	0.93516	9.65	8.20	4.24	17.85	13.89	56.00	46.00	-38.15	-32.11
5	2.37109	9.71	10.84	-1.03	20.55	8.68	56.00	46.00	-35.45	-37.32
6	10.38281	10.08	8.12	-1.61	18.20	8.47	60.00	50.00	-41.80	-41.53

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



7.2 Radiated Emissions below 1 GHz

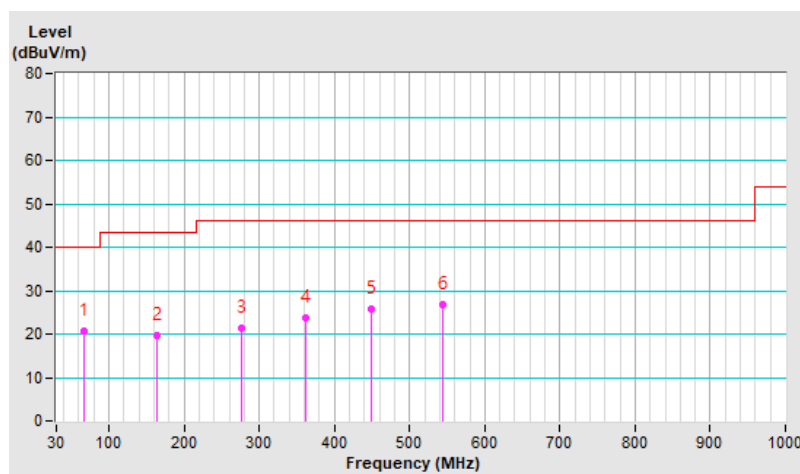
Mode A

RF Mode	GFSK	Channel	CH 38 : 2441 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	QP: RB=120kHz, DET=Quasi-Peak
Input Power	3.7 Vdc	Environmental Conditions	25 °C, 75 % RH
Tested By	Jed Wu		

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	66.62	20.7 QP	40.0	-19.3	1.96 H	356	30.7	-10.0
2	163.13	19.8 QP	43.5	-23.7	1.82 H	320	27.5	-7.7
3	277.25	21.4 QP	46.0	-24.6	1.73 H	117	27.5	-6.1
4	361.89	23.8 QP	46.0	-22.2	1.42 H	74	28.0	-4.2
5	448.22	25.7 QP	46.0	-20.3	1.53 H	349	27.9	-2.2
6	543.42	26.8 QP	46.0	-19.2	1.61 H	16	27.4	-0.6

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.

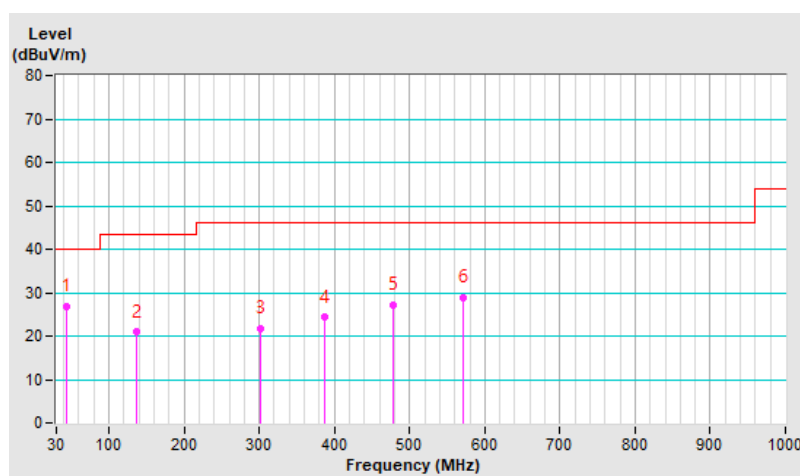


RF Mode	GFSK	Channel	CH 38 : 2441 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	QP: RB=120kHz, DET=Quasi-Peak
Input Power	3.7 Vdc	Environmental Conditions	25 °C, 75 % RH
Tested By	Jed Wu		

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	44.40	26.9 QP	40.0	-13.1	1.83 V	190	35.9	-9.0
2	137.33	20.9 QP	43.5	-22.6	1.24 V	217	29.5	-8.6
3	302.23	21.7 QP	46.0	-24.3	1.79 V	101	27.1	-5.4
4	387.06	24.3 QP	46.0	-21.7	1.03 V	360	28.0	-3.7
5	478.19	27.1 QP	46.0	-18.9	1.99 V	69	28.7	-1.6
6	571.89	28.8 QP	46.0	-17.2	1.21 V	290	28.4	0.4

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.



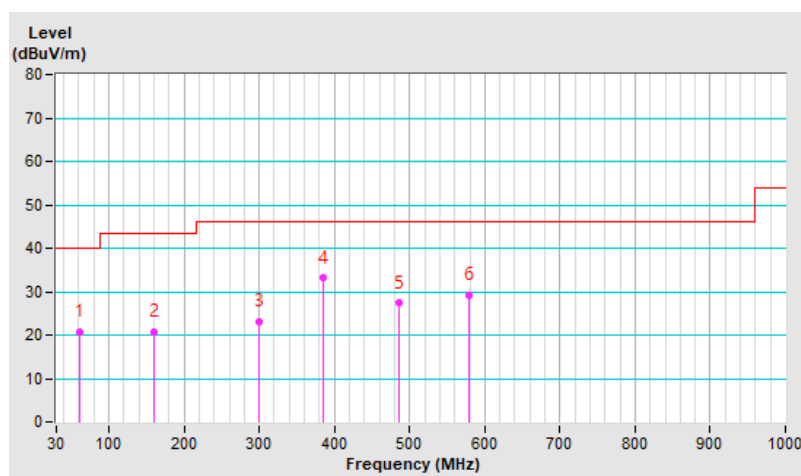
Mode B

Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	QP: RB=120kHz, DET=Quasi-Peak
Input Power	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75 % RH
Tested By	Jed Wu		

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	60.41	20.6 QP	40.0	-19.4	1.63 H	27	29.9	-9.3
2	159.98	20.7 QP	43.5	-22.8	1.34 H	134	28.3	-7.6
3	300.58	23.1 QP	46.0	-22.9	1.98 H	333	28.6	-5.5
4	385.07	33.1 QP	46.0	-12.9	1.57 H	360	36.8	-3.7
5	486.24	27.3 QP	46.0	-18.7	1.84 H	100	28.7	-1.4
6	579.26	29.1 QP	46.0	-16.9	1.23 H	32	28.4	0.7

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.

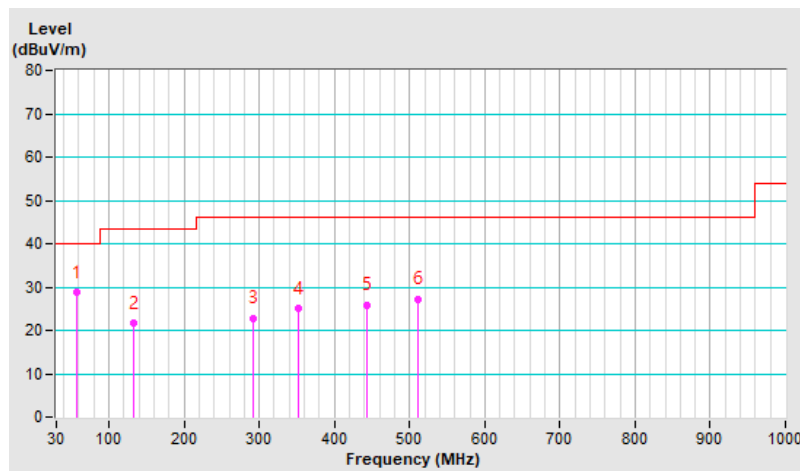


Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	QP: RB=120kHz, DET=Quasi-Peak
Input Power	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75 % RH
Tested By	Jed Wu		

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	56.48	28.7 QP	40.0	-11.3	1.57 V	287	37.7	-9.0
2	132.87	21.6 QP	43.5	-21.9	1.49 V	193	30.6	-9.0
3	291.22	22.7 QP	46.0	-23.3	1.63 V	222	28.5	-5.8
4	351.41	25.0 QP	46.0	-21.0	1.28 V	222	29.5	-4.5
5	443.27	25.7 QP	46.0	-20.3	1.89 V	193	28.0	-2.3
6	511.07	27.2 QP	46.0	-18.8	1.12 V	215	28.3	-1.1

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.



7.3 Radiated Emissions above 1 GHz

RF Mode	GFSK	Channel	CH 0 : 2403 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=3 MHz, DET=RMS
Input Power	3.7 Vdc	Environmental Conditions	25 °C, 75 % RH
Tested By	Jed Wu		

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	2390.00	53.9 PK	74.0	-20.1	3.18 H	162	54.4	-0.5
2	2390.00	42.8 AV	54.0	-11.2	3.18 H	162	43.3	-0.5
3	2400.00	62.5 PK	74.0	-11.5	3.18 H	162	63.0	-0.5
4	2400.00	42.7 AV	54.0	-11.3	3.18 H	162	43.2	-0.5
5	*2403.00	99.8 PK	114.0	-14.2	3.18 H	162	100.3	-0.5
6	*2403.00	80.0 AV	94.0	-14.0	3.18 H	162	80.5	-0.5
7	4806.00	48.5 PK	74.0	-25.5	2.65 H	149	40.8	7.7
8	4806.00	28.7 AV	54.0	-25.3	2.65 H	149	21.0	7.7

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	2390.00	53.6 PK	74.0	-20.4	4.00 V	201	54.1	-0.5
2	2390.00	42.5 AV	54.0	-11.5	4.00 V	201	43.0	-0.5
3	2400.00	61.7 PK	74.0	-12.3	4.00 V	201	62.2	-0.5
4	2400.00	41.9 AV	54.0	-12.1	4.00 V	201	42.4	-0.5
5	*2403.00	97.8 PK	114.0	-16.2	4.00 V	201	98.3	-0.5
6	*2403.00	78.0 AV	94.0	-16.0	4.00 V	201	78.5	-0.5
7	4806.00	48.0 PK	74.0	-26.0	3.32 V	187	40.3	7.7
8	4806.00	28.2 AV	54.0	-25.8	3.32 V	187	20.5	7.7

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:

$$20 \log(\text{Duty cycle}) = 20 \log(1.069 \text{ ms} / 10.478 \text{ ms}) = -19.8 \text{ dB}$$

RF Mode	GFSK	Channel	CH 38 : 2441 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=3 MHz, DET=RMS
Input Power	3.7 Vdc	Environmental Conditions	25 °C, 75 % RH
Tested By	Jed Wu		

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	*2441.00	100.3 PK	114.0	-13.7	3.95 H	155	100.5	-0.2
2	*2441.00	80.5 AV	94.0	-13.5	3.95 H	155	80.7	-0.2
3	4882.00	49.1 PK	74.0	-24.9	3.42 H	142	41.0	8.1
4	4882.00	29.3 AV	54.0	-24.7	3.42 H	142	21.2	8.1
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	*2441.00	98.3 PK	114.0	-15.7	3.23 V	208	98.5	-0.2
2	*2441.00	78.5 AV	94.0	-15.5	3.23 V	208	78.7	-0.2
3	4882.00	48.6 PK	74.0	-25.4	2.55 V	194	40.5	8.1
4	4882.00	28.8 AV	54.0	-25.2	2.55 V	194	20.7	8.1

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:

$$20 \log(\text{Duty cycle}) = 20 \log(1.069 \text{ ms} / 10.478 \text{ ms}) = -19.8 \text{ dB}$$

RF Mode	GFSK	Channel	CH 77 : 2480 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=3 MHz, DET=RMS
Input Power	3.7 Vdc	Environmental Conditions	25 °C, 75 % RH
Tested By	Jed Wu		

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	*2480.00	99.4 PK	114.0	-14.6	3.41 H	156	99.4	0.0
2	*2480.00	79.6 AV	94.0	-14.4	3.41 H	156	79.6	0.0
3	2483.50	62.5 PK	74.0	-11.5	3.41 H	156	62.5	0.0
4	2483.50	42.7 AV	54.0	-11.3	3.41 H	156	42.7	0.0
5	4960.00	48.0 PK	74.0	-26.0	2.88 H	143	39.9	8.1
6	4960.00	28.2 AV	54.0	-25.8	2.88 H	143	20.1	8.1
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	*2480.00	97.4 PK	114.0	-16.6	3.77 V	195	97.4	0.0
2	*2480.00	77.6 AV	94.0	-16.4	3.77 V	195	77.6	0.0
3	2483.50	60.5 PK	74.0	-13.5	3.77 V	195	60.5	0.0
4	2483.50	40.7 AV	54.0	-13.3	3.77 V	195	40.7	0.0
5	4960.00	47.5 PK	74.0	-26.5	3.09 V	181	39.4	8.1
6	4960.00	27.7 AV	54.0	-26.3	3.09 V	181	19.6	8.1

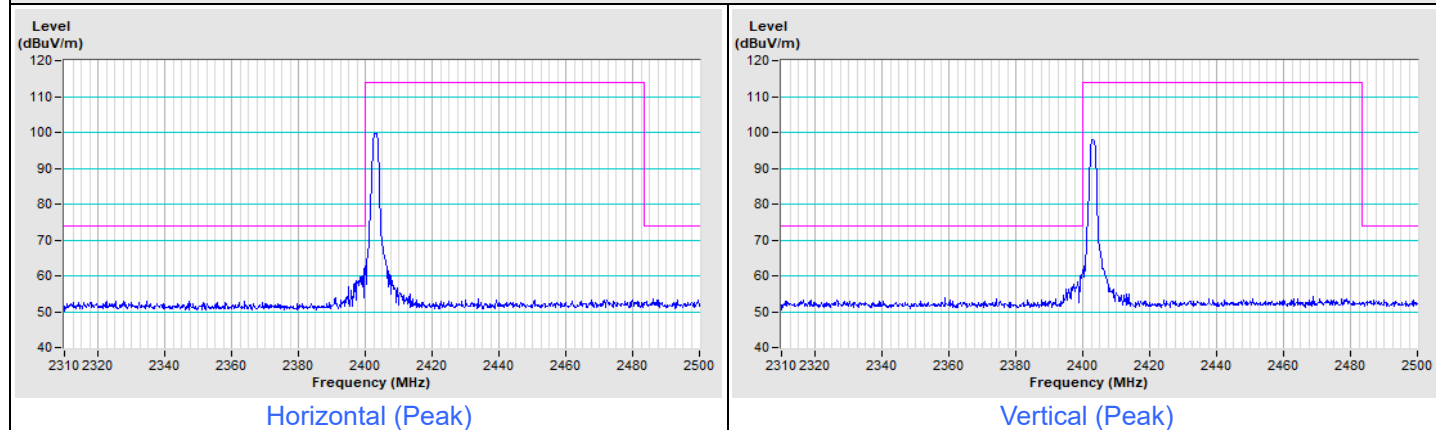
Remarks:

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * " : Fundamental frequency.
6. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty cycle correction factor is calculated from following formula:
 $20 \log(\text{Duty cycle}) = 20 \log(1.069 \text{ ms} / 10.478 \text{ ms}) = -19.8 \text{ dB}$

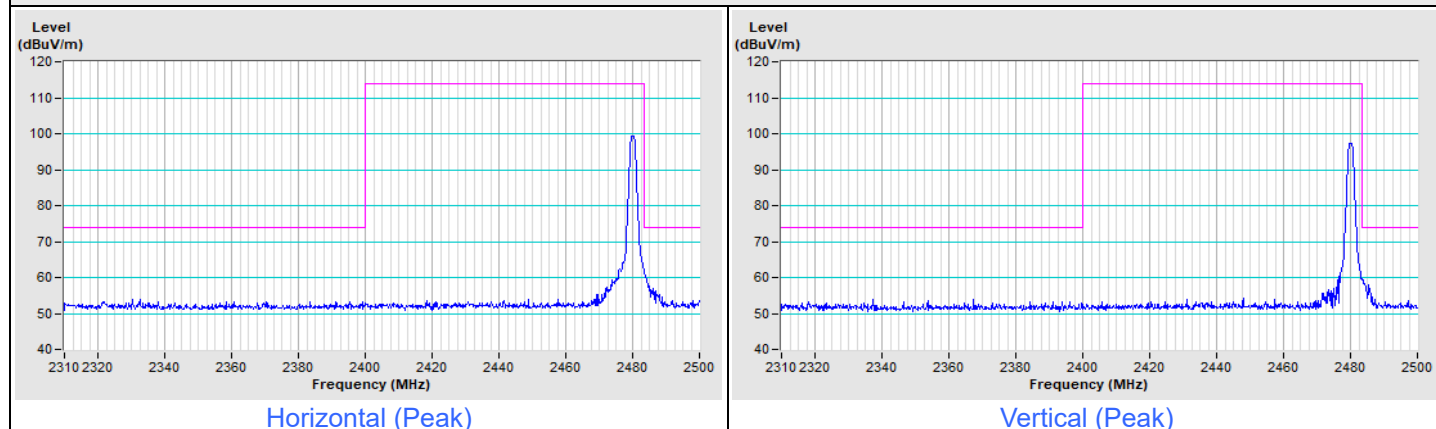
Plot of Band Edge

Frequency Range	2.31 GHz ~ 2.5 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak
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GFSK Channel 0



GFSK Channel 77



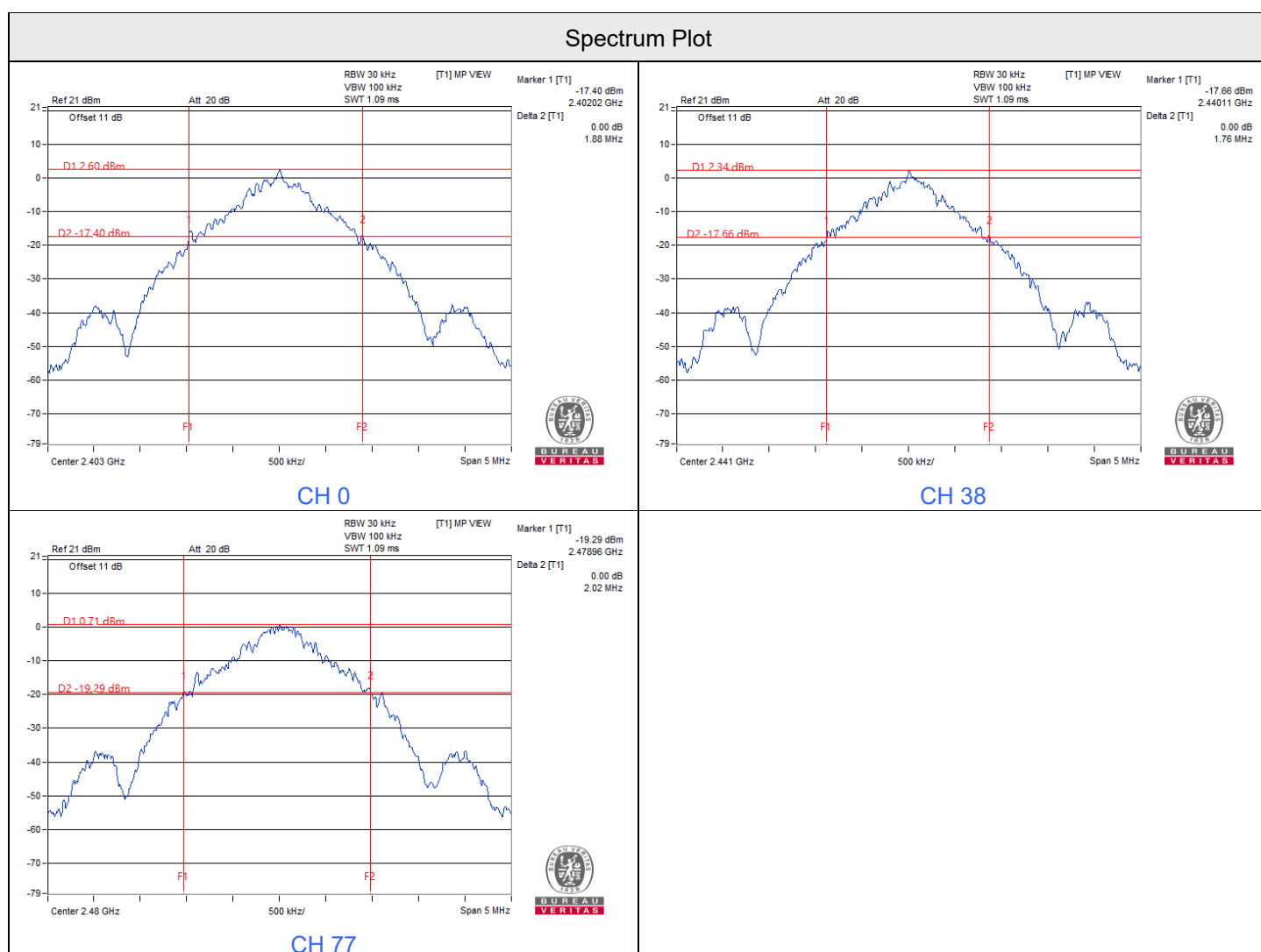
7.4 20 dB Bandwidth

Input Power:	3.7 Vdc	Environmental Conditions:	25°C, 76% RH	Tested By:	Waydi Tuan
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Channel	Channel Frequency (MHz)	20 dB Bandwidth (MHz)	Measured Frequencies		Operating Frequency Band (MHz)	Test Result
			FL (MHz)	FH (MHz)		
0	2403	1.88	2402.02	2403.9	2400 ~ 2483.5	Pass
38	2441	1.76	2440.11	2441.87		Pass
77	2480	2.02	2478.96	2480.98		Pass

Notes:

1. FL is the lowest frequency of the 20 dB bandwidth of power envelope.
2. FH is the highest frequency of the 20 dB bandwidth of power envelope.



8 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo)

9 Information of 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:

Lin Kou EMC/RF Lab

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

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