

FCC Test Report (15.249)

Report No.: RF150309E02

FCC ID: JNZMR0056

Test Model: M-R0056

Received Date: Mar. 09, 2015

Test Date: Mar. 11, 2015

Issued Date: Mar. 16, 2015

Applicant: LOGITECH FAR EAST LTD.

Address: #2 Creation Rd. 4, Science-Based Ind. Park Hsinchu Taiwan, R.O.C.

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

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Chu Hsien 307, Taiwan R.O.C.

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A D T

Release Control Record

Issue No.	Description	Date Issued
RF150309E02	Original release.	Mar. 16, 2015

1 Certificate of Conformity

Product: 2.4GHz Cordless Mouse

Brand: Logitech

Test Model: M-R0056

Sample Status: ENGINEERING SAMPLE

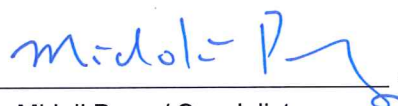
Applicant: LOGITECH FAR EAST LTD.

Test Date: Mar. 11, 2015

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.249)
ANSI C63.10:2009

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 :



Date:

Mar. 16, 2015

Midoli Peng / Specialist

Approved by :



Date:

Mar. 16, 2015

May Chen / Manager

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.249)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	NA	Not applicable, because the port is absent in the EUT.
15.209 15.249 15.249 (d)	Radiated Emission Test Band Edge Measurement Limit: 50dB less than the peak value of fundamental frequency or meet radiated emission limit in section 15.209	PASS	Meet the requirement of limit. Minimum passing margin is -5.8dB at 2400.00MHz.

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	Frequency	Expanded Uncertainty (k=2) ($\pm$)
Radiated Emissions up to 1 GHz	30MHz ~ 1000MHz	5.43 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.72 dB
	6GHz ~ 18GHz	4.00 dB
	18GHz ~ 40GHz	4.11 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	2.4GHz Cordless Mouse
Brand	Logitech
Test Model	M-R0056
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	DC 1.5V from battery
Modulation Type	GFSK
Operating Frequency	2405MHz ~ 2474MHz
Number of Channel	12
Antenna Type	PCB printed Antenna with -0.68 dBi gain
Antenna Connector	NA
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. The EUT may have a lot of colors for marketing requirement.
2. 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 Description of Test Modes

12 channels are provided to this EUT:

Channel	Frequency	Channel	Frequency
1	2405	7	2441
2	2408	8	2444
3	2414	9	2462
4	2417	10	2465
5	2432	11	2471
6	2435	12	2474

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO			DESCRIPTION
	RE $\geq$ 1G	RE<1G	PLC	
-	√	√	-	-

Where **RE $\geq$ 1G**: Radiated Emission above 1GHz & Bandedge Measurement
RE<1G: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission

NOTE: “-” means no effect.

Radiated Emission Test (Above 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
1 to 12	1, 8, 12	GFSK

Radiated Emission Test (Below 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
1 to 12	12	GFSK

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE $\geq$ 1G	22deg. C, 70%RH	DC 1.5V	Gary Cheng
RE<1G	23deg. C, 67%RH	DC 1.5V	Gary Cheng

3.3 Description of Support Units

The EUT has been tested as an independent unit.

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (Section 15.249)

ANSI C63.10-2009

All test items have been performed and recorded as per the above standards.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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)
902 ~ 928 MHz	50	500
2400 ~ 2483.5 MHz	50	500
5725 ~ 5875 MHz	50	500
24 ~ 24.25 GHz	250	2500

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)
0.009 ~ 0.490	$2400/F(\text{kHz})$	300
0.490 ~ 1.705	$24000/F(\text{kHz})$	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

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

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
MXE EMI Receiver Agilent	N9038A	MY50010156	Aug. 11, 2014	Aug. 10, 2015
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-04	Nov. 12, 2014	Nov. 11, 2015
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Feb. 09, 2015	Feb. 08, 2016
RF Cable	NA	CHHCAB_001	Oct. 05, 2014	Oct. 04, 2015
Horn_Antenna AISI	AIH.8018	0000220091110	Aug. 26, 2014	Aug. 25, 2015
Pre-Amplifier Agilent	8449B	300801923	Oct. 28, 2014	Oct. 27, 2015
RF Cable	NA	131206 131215 SNMY23685/4	Jan. 16, 2015	Jan. 15, 2016
Spectrum Analyzer R&S	FSV40	100964	July 05, 2014	July 04, 2015
Pre-Amplifier EMCI	EMC184045	980143	Jan. 16, 2015	Jan. 15, 2016
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Aug. 26, 2014	Aug. 25, 2015
RF Cable	NA	RF104-121 RF104-204	Dec. 11, 2014	Dec. 10, 2015
Software	ADT_Radiated _V8.7.07	NA	NA	NA
Antenna Tower & Turn Table CT	NA	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 horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
- 3 The test was performed in 966 Chamber No. H.
4. The FCC Site Registration No. is 797305.
- 5 The CANADA Site Registration No. is IC 7450H-3.
- 6 Tested Date: Mar. 11, 2015

4.1.3 Test Procedures

- 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.
- f. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

Note:

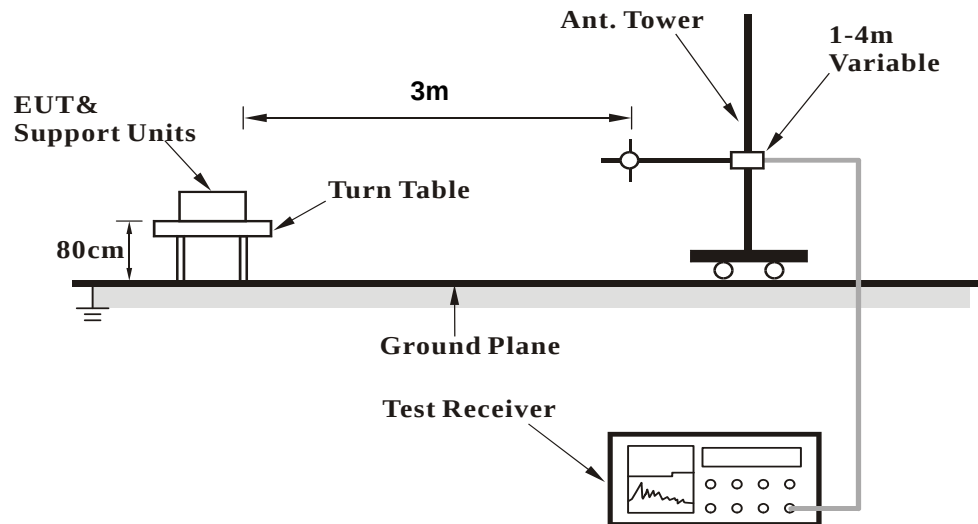
1. For emission measurements above 1 GHz, the EUT shall be placed at a height of 1.5 m above the ground at 3 meter chamber room for test.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

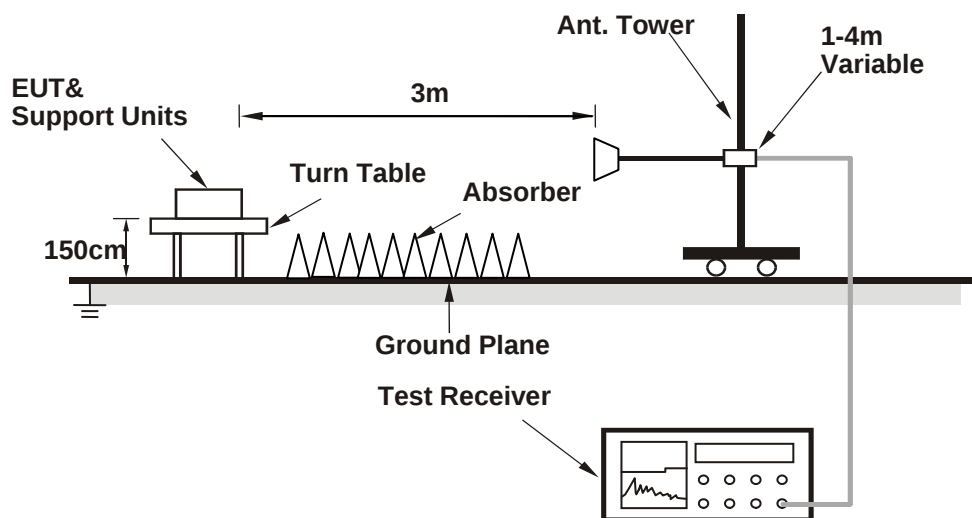
No deviation.

4.1.5 Test Set Up

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



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

4.1.6 EUT Operating Conditions

1. Placed the EUT on testing table.
2. Controlling software (RF Sample with C-U0008 [Num Lock]) has been activated to set the EUT under transmission/receiving condition continuously.

4.1.7 Test Results

ABOVE 1GHz DATA

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2400.00	68.2 PK	74.0	-5.8	1.79 H	332	36.28	31.92
2	2400.00	27.7 AV	54.0	-26.3	1.79 H	332	-4.22	31.92
3	*2405.00	103.7 PK	114.0	-10.3	1.78 H	333	71.77	31.93
4	*2405.00	63.2 AV	94.0	-30.8	1.78 H	333	31.27	31.93
5	4810.00	51.5 PK	74.0	-22.5	1.52 H	87	10.66	40.84
6	4810.00	11.0 AV	54.0	-43.0	1.52 H	87	-29.84	40.84
7	7215.00	54.9 PK	74.0	-19.1	1.50 H	108	9.72	45.18
8	7215.00	14.4 AV	54.0	-39.6	1.50 H	108	-30.78	45.18
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2400.00	58.8 PK	74.0	-15.2	1.50 V	147	26.88	31.92
2	2400.00	18.3 AV	54.0	-35.7	1.50 V	147	-13.62	31.92
3	*2405.00	95.2 PK	114.0	-18.8	1.50 V	148	63.27	31.93
4	*2405.00	54.7 AV	94.0	-39.3	1.50 V	148	22.77	31.93
5	4810.00	49.6 PK	74.0	-24.4	1.54 V	51	8.76	40.84
6	4810.00	9.1 AV	54.0	-44.9	1.54 V	51	-31.74	40.84
7	7215.00	53.1 PK	74.0	-20.9	1.52 V	0	7.92	45.18
8	7215.00	12.6 AV	54.0	-41.4	1.52 V	0	-32.58	45.18

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
5. " * ": Fundamental frequency.
6. The average value of fundamental frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty factor is calculated from following formula:

$$20 \log (\text{Duty cycle}) = 20 \log (0.11 \text{ ms} / 11.665 \text{ ms}) = -40.5 \text{ dB}$$
Please see page 17 for plotted duty.

CHANNEL	TX Channel 8	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2444.00	103.5 PK	114.0	-10.5	1.41 H	89	71.47	32.03
2	*2444.00	63.0 AV	94.0	-31.0	1.41 H	89	30.97	32.03
3	4888.00	50.1 PK	74.0	-23.9	1.66 H	144	9.35	40.75
4	4888.00	9.6 AV	54.0	-44.4	1.66 H	144	-31.15	40.75
5	7332.00	55.2 PK	74.0	-18.8	1.65 H	141	9.69	45.51
6	7332.00	14.7 AV	54.0	-39.3	1.65 H	141	-30.81	45.51
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2444.00	94.6 PK	114.0	-19.4	1.52 V	91	62.57	32.03
2	*2444.00	54.1 AV	94.0	-39.9	1.52 V	91	22.07	32.03
3	4888.00	48.9 PK	74.0	-25.1	1.47 V	89	8.15	40.75
4	4888.00	8.4 AV	54.0	-45.6	1.47 V	89	-32.35	40.75
5	7332.00	54.7 PK	74.0	-19.3	1.50 V	100	9.19	45.51
6	7332.00	14.2 AV	54.0	-39.8	1.50 V	100	-31.31	45.51

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
5. " * ": Fundamental frequency.
6. The average value of fundamental frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty factor is calculated from following formula:

$$20 \log (\text{Duty cycle}) = 20 \log (0.11 \text{ ms} / 11.665 \text{ ms}) = -40.5 \text{ dB}$$
Please see page 17 for plotted duty.

CHANNEL	TX Channel 12	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

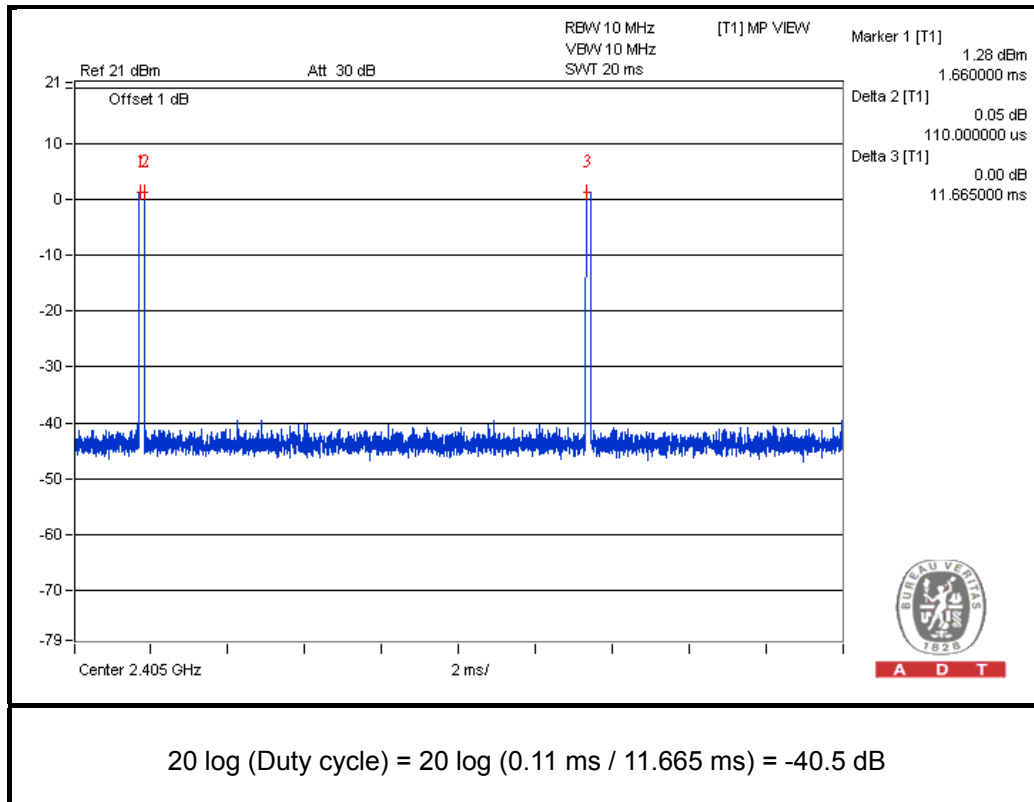
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2474.00	103.3 PK	114.0	-10.7	1.51 H	193	71.21	32.09
2	*2474.00	62.8 AV	94.0	-31.2	1.51 H	193	30.71	32.09
3	2483.50	65.8 PK	74.0	-8.2	1.67 H	163	33.67	32.13
4	2483.50	25.3 AV	54.0	-28.7	1.67 H	163	-6.83	32.13
5	4948.00	51.2 PK	74.0	-22.8	1.50 H	155	10.49	40.71
6	4948.00	10.7 AV	54.0	-43.3	1.50 H	155	-30.01	40.71
7	7422.00	55.1 PK	74.0	-18.9	1.54 H	144	9.29	45.81
8	7422.00	14.6 AV	54.0	-39.4	1.54 H	144	-31.21	45.81
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2474.00	93.5 PK	114.0	-20.5	1.63 V	156	61.41	32.09
2	*2474.00	53.0 AV	94.0	-41.0	1.63 V	156	20.91	32.09
3	2483.50	55.5 PK	74.0	-18.5	1.50 V	147	23.37	32.13
4	2483.50	15.0 AV	54.0	-39.0	1.50 V	147	-17.13	32.13
5	4948.00	49.1 PK	74.0	-24.9	1.53 V	154	8.39	40.71
6	4948.00	8.6 AV	54.0	-45.4	1.53 V	154	-32.11	40.71
7	7422.00	53.8 PK	74.0	-20.2	1.52 V	321	7.99	45.81
8	7422.00	13.3 AV	54.0	-40.7	1.52 V	321	-32.51	45.81

REMARKS:

- Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
- Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
- The other emission levels were very low against the limit.
- Margin value = Emission Level – Limit value
- " * ": Fundamental frequency.
- The average value of fundamental frequency is: Average = Peak value + 20 log(Duty cycle) Where the duty factor is calculated from following formula:

$$20 \log (\text{Duty cycle}) = 20 \log (0.11 \text{ ms} / 11.665 \text{ ms}) = -40.5 \text{ dB}$$
Please see page 17 for plotted duty.

Duty Cycle



BELOW 1GHz WORST-CASE DATA

CHANNEL	TX Channel 12	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	Below 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	64.29	24.7 QP	40.0	-15.3	1.00 H	84	39.03	-14.35
2	71.81	19.9 QP	40.0	-20.1	2.00 H	23	35.66	-15.79
3	131.32	19.5 QP	43.5	-24.1	1.50 H	307	33.64	-14.19
4	140.53	22.2 QP	43.5	-21.3	2.00 H	45	35.51	-13.33
5	175.26	20.0 QP	43.5	-23.5	1.50 H	2	33.98	-13.96
6	315.03	20.0 QP	46.0	-26.0	1.50 H	160	31.27	-11.26
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	63.08	32.4 QP	40.0	-7.6	1.50 V	0	46.75	-14.36
2	75.74	25.3 QP	40.0	-14.7	1.00 V	31	41.85	-16.56
3	142.42	37.6 QP	43.5	-5.9	1.00 V	35	50.80	-13.18
4	163.04	32.2 QP	43.5	-11.3	1.00 V	349	45.16	-12.98
5	174.29	35.6 QP	43.5	-7.9	1.00 V	158	49.43	-13.80
6	190.83	29.5 QP	43.5	-14.0	1.00 V	179	45.20	-15.67

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

5 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 accredited and approved according to ISO/IEC 17025.

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

Linko EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF Lab/Telecom Lab

Tel: 886-3-5935343

Fax: 886-3-5935342

Hwa Ya EMC/RF/Safety

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

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

--- END ---