

## FCC Test Report (Radiated Test)

**Report No.:** RF151228C18B-5

**FCC ID:** VPYLB1DX

**Test Model:** 1DX

**Received Date:** Dec. 28, 2015

**Test Date:** Jun. 04 ~ Jun. 06, 2016

**Issued Date:** Jun. 13, 2016

**Applicant:** Murata Manufacturing Co., Ltd.

**Address:** 10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555, Japan

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

**Lab Address:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan, R.O.C.

**Test Location:** No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)



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## Table of Contents

<b>Release Control Record .....</b>	<b>3</b>
<b>1 Certificate of Conformity.....</b>	<b>4</b>
<b>2 Summary of Test Results .....</b>	<b>5</b>
2.1 Measurement Uncertainty .....	5
2.2 Modification Record .....	5
<b>3 General Information.....</b>	<b>6</b>
3.1 General Description of EUT .....	6
3.2 Description of Test Modes .....	7
3.2.1 Test Mode Applicability and Tested Channel Detail.....	8
3.3 Description of Support Units .....	9
3.3.1 Configuration of System under Test .....	9
3.4 General Description of Applied Standards .....	9
<b>4 Test Types and Results .....</b>	<b>10</b>
4.1 Radiated Emission and Bandedge Measurement.....	10
4.1.1 Limits of Radiated Emission and Bandedge Measurement .....	10
4.1.2 Test Instruments .....	11
4.1.3 Test Procedures.....	12
4.1.4 Deviation from Test Standard .....	12
4.1.5 Test Set Up .....	13
4.1.6 EUT Operating Conditions.....	13
4.1.7 Test Results .....	14
<b>5 Pictures of Test Arrangements.....</b>	<b>18</b>
<b>Appendix – Information on the Testing Laboratories .....</b>	<b>19</b>

### Release Control Record

Issue No.	Description	Date Issued
RF151228C18B-5	Original release	Jun. 13, 2016

## 1 Certificate of Conformity

**Product:** Communication Module

**Brand:** MURATA

**Test Model:** 1DX

**Sample Status:** Engineering sample

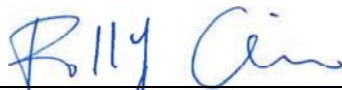
**Applicant:** Murata Manufacturing Co., Ltd.

**Test Date:** Jun. 04 ~ Jun. 06, 2016

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)  
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 EMC characteristics under the conditions specified in this report.


**Prepared by :**

  
Polly Chien / Specialist

**Date:**

Jun. 13, 2016

**Approved by :**

  
Ken Liu / Senior Manager

**Date:**

Jun. 13, 2016

## 2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Refer to Note
15.205 & 209	Radiated Emissions and	Pass	Meet the requirement of limit. Minimum passing margin is -1.9dB at 2483.50MHz.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -1.9dB at 2483.50MHz.
15.247(d)	Antenna Port Emission	Pass	Refer to Note
15.247(a)(2)	6dB bandwidth	Pass	Refer to Note
15.247(b)	Conducted power	Pass	Refer to Note
15.247(e)	Power Spectral Density	Pass	Refer to Note
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note: For other test items were recorded in Report No.: RF151228C18B-2.

### 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	Expended Uncertainty (k=2) ( $\pm$ )
Radiated Emissions up to 1 GHz	30MHz ~ 200MHz	3.63 dB
	200MHz ~ 1000MHz	3.64 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

Product	Communication Module
Brand	MURATA
Test Model	1DX
Status of EUT	Engineering sample
Power Supply Rating	3.6Vdc VBAT and 3.3Vdc VDDIO
Modulation Type	GFSK
Transfer Rate	1Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Channel Spacing	2MHz
Output Power	7.379mW
Antenna Type	Monopole antenna with 1.4dBi gain
Antenna Connector	NA
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. This report is issued as a supplementary report of BV ADT report no. RF151228C18-5.
2. This report is prepared for FCC class II permissive change. The differences compared with original report is declaring the antenna gain from average value 0.6dBi to peak value 1.4dBi and the antenna design is identical. Therefore, radiated emission was re-tested.
3. 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

40 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

### 3.2.1 Test Mode Applicability and Tested Channel Detail

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

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

**NOTE:** The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane**.

#### 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.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

#### 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.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
-	0 to 39	19	GFSK	1

#### Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (SYSTEM)	TESTED BY
RE $\geq$ 1G	25deg. C, 65%RH	120Vac, 60Hz	Match Tsui
RE $<$ 1G	20deg. C, 69%RH	120Vac, 60Hz	Bayu Chen



### 3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

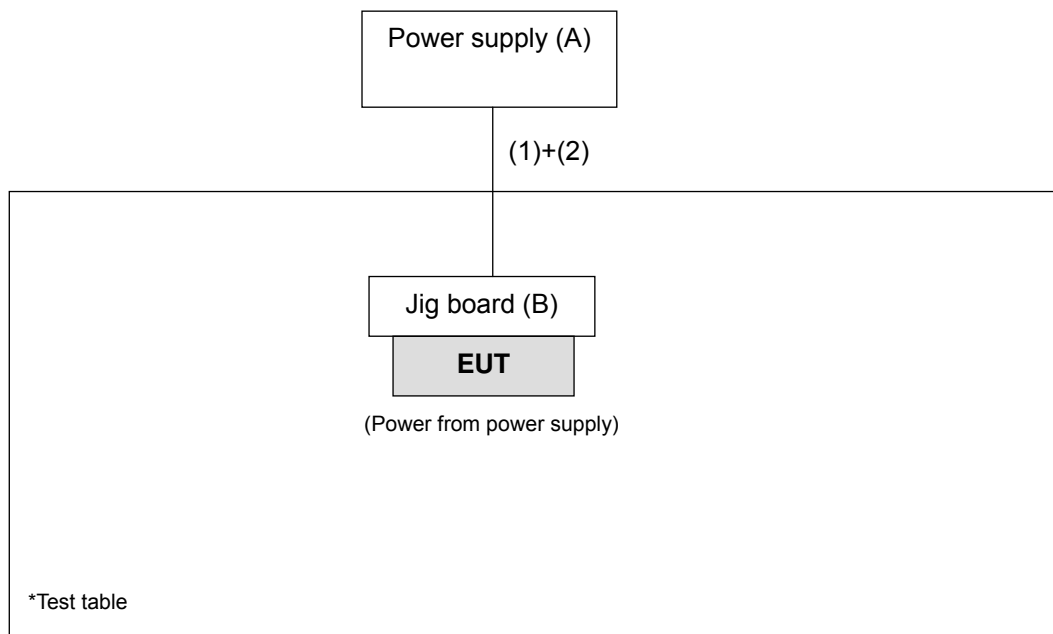
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Power Supply	Topward	6603D	700637	NA	-
B.	Jig board	MURATA	P2ML4452-1	1~	NA	Provided by manufacturer

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item A was placed under the test table.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC power cable	4	1	-	0	Provided by manufacturer
2.	DC power cable	4	1.8	-	0	-

#### 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 (15.247)**  
**KDB 558074 D01 DTS Meas Guidance v03r05**  
 ANSI C63.10-2013

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

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

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

**Note:**

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 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.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
Test Receiver ROHDE & SCHWARZ	ESCS30	100289	Dec. 23, 2015	Dec. 22, 2016
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	Apr. 19, 2016	Apr. 18, 2017
BILOG Antenna SCHWARZBECK	VULB9168	9168-148	Jan. 18, 2016	Jan. 17, 2017
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Jan. 08, 2016	Jan. 07, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Jan. 18, 2016	Jan. 17, 2017
Preamplifier Agilent	8449B	3008A01911	Aug. 09, 2015	Aug. 08, 2016
Preamplifier Agilent	8447D	2944A10638	Aug. 09, 2015	Aug. 08, 2016
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-02(30 9222 +248780)	Aug. 09, 2015	Aug. 08, 2016
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-03(27 4092)	Aug. 09, 2015	Aug. 08, 2016
RF signal cable Woken	8D-FB	Cable-CH9-01	Aug. 11, 2015	Aug. 10, 2016
Software BV ADT	ADT_Radiated_ V7.6.15.9.4	NA	NA	NA
Antenna Tower EMCO	2070/2080	512.835.4684	NA	NA
Turn Table EMCO	2087-2.03	NA	NA	NA
Antenna Tower & Turn BV ADT	AT100	AT93021705	NA	NA
Turn Table BV ADT	TT100	TT93021705	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	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 9.
  3. The horn antenna and preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
  4. The FCC Site Registration No. is 215374.
  5. The IC Site Registration No. is IC 7450F-9.

#### 4.1.3 Test Procedures

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) 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 and average detect 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.

**Note:**

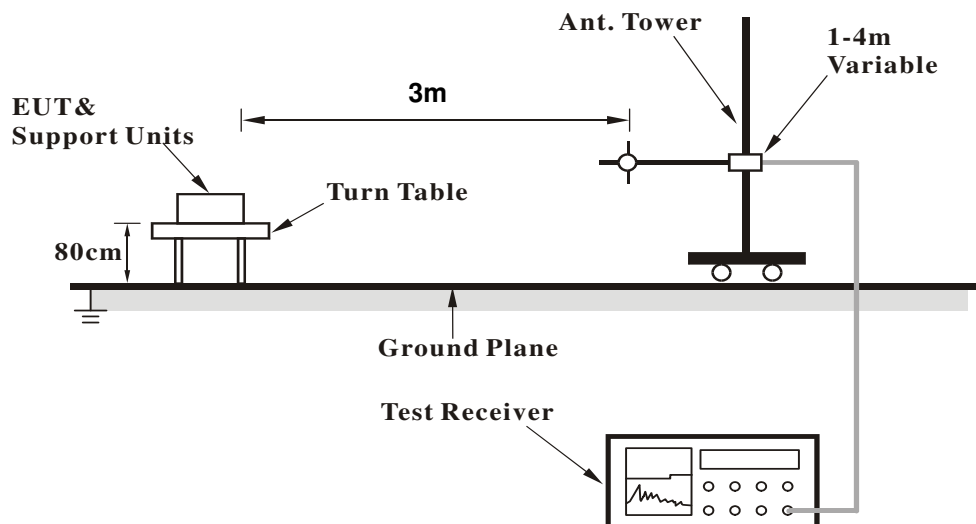
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average (Duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor ( $10 \log(1/\text{duty cycle})$ ).
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

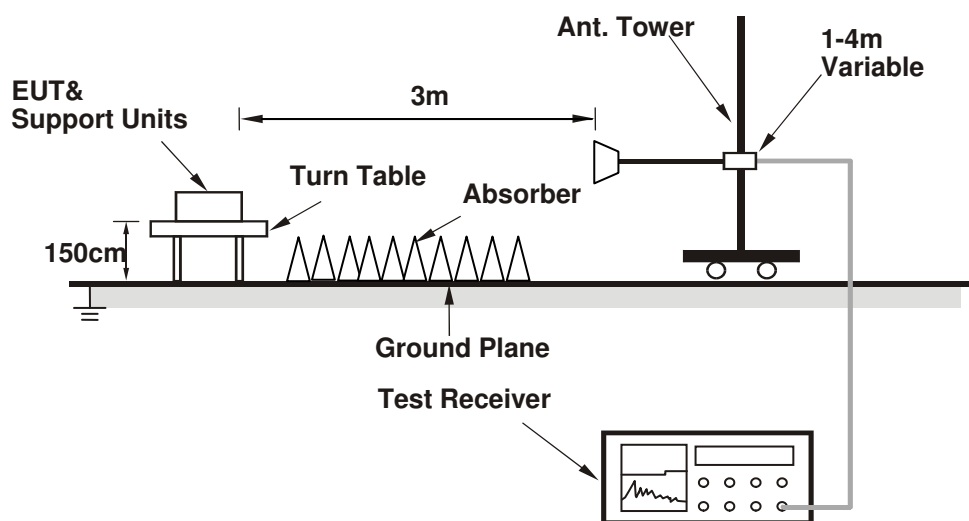
No deviation.

#### 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

Set the EUT under transmission condition continuously at specific channel frequency.

#### 4.1.7 Test Results

Above 1GHz Worst-case Data:

CHANNEL	TX Channel 0	DETECTOR	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	2390.00	60.5 PK	74.0	-13.5	1.15 H	240	63.40	-2.90
2	2390.00	49.1 AV	54.0	-4.9	1.15 H	240	52.00	-2.90
3	*2402.00	107.7 PK			1.15 H	240	72.90	34.80
4	*2402.00	102.1 AV			1.15 H	240	67.30	34.80
5	4804.00	51.9 PK	74.0	-22.1	1.05 H	50	47.30	4.60
6	4804.00	40.5 AV	54.0	-13.5	1.05 H	50	35.90	4.60
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	2390.00	60.4 PK	74.0	-13.6	3.20 V	210	63.30	-2.90
2	2390.00	48.9 AV	54.0	-5.1	3.20 V	210	51.80	-2.90
3	*2402.00	107.5 PK			3.20 V	210	72.70	34.80
4	*2402.00	102.1 AV			3.20 V	210	67.30	34.80
5	4804.00	50.7 PK	74.0	-23.3	1.20 V	240	46.10	4.60
6	4804.00	37.5 AV	54.0	-16.5	1.20 V	240	32.90	4.60

#### 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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.

CHANNEL	TX Channel 19	DETECTOR	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	*2440.00	107.9 PK			1.10 H	220	72.90	35.00
2	*2440.00	102.5 AV			1.10 H	220	67.50	35.00
3	4880.00	52.1 PK	74.0	-21.9	1.04 H	60	47.60	4.50
4	4880.00	40.8 AV	54.0	-13.2	1.04 H	60	36.30	4.50
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	*2440.00	107.5 PK			1.17 V	256	72.50	35.00
2	*2440.00	102.1 AV			1.17 V	256	67.10	35.00
3	4880.00	50.2 PK	74.0	-23.8	1.00 V	60	45.70	4.50
4	4880.00	37.0 AV	54.0	-17.0	1.00 V	60	32.50	4.50

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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	*2480.00	107.8 PK			1.19 H	200	72.60	35.20
2	*2480.00	102.5 AV			1.19 H	200	67.30	35.20
3	2483.50	66.7 PK	74.0	-7.3	1.19 H	200	69.20	-2.50
4	<b>2483.50</b>	<b>52.1 AV</b>	<b>54.0</b>	<b>-1.9</b>	<b>1.19 H</b>	<b>200</b>	<b>54.60</b>	<b>-2.50</b>
5	4960.00	51.7 PK	74.0	-22.3	1.00 H	60	46.90	4.80
6	4960.00	40.4 AV	54.0	-13.6	1.00 H	60	35.60	4.80
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	*2480.00	107.8 PK			3.15 V	195	72.60	35.20
2	*2480.00	102.5 AV			3.15 V	195	67.30	35.20
3	2483.50	66.6 PK	74.0	-7.4	3.15 V	195	69.10	-2.50
4	<b>2483.50</b>	<b>52.1 AV</b>	<b>54.0</b>	<b>-1.9</b>	<b>3.15 V</b>	<b>195</b>	<b>54.60</b>	<b>-2.50</b>
5	4960.00	50.6 PK	74.0	-23.4	1.10 V	250	45.80	4.80
6	4960.00	37.3 AV	54.0	-16.7	1.10 V	250	32.50	4.80

#### 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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.



Below 1GHz worst-case data:

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 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	31.94	28.3 QP	40.0	-11.7	1.49 H	66	44.20	-15.90
2	61.04	26.8 QP	40.0	-13.2	1.49 H	279	41.80	-15.00
3	134.76	28.5 QP	43.5	-15.0	1.49 H	288	43.40	-14.90
4	425.76	22.2 QP	46.0	-23.8	1.49 H	327	31.90	-9.70
5	747.80	33.0 QP	46.0	-13.0	1.49 H	11	36.60	-3.60
6	906.88	30.7 QP	46.0	-15.3	1.99 H	137	31.70	-1.00
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	33.88	32.3 QP	40.0	-7.7	1.01 V	334	47.70	-15.40
2	84.32	16.2 QP	40.0	-23.8	1.51 V	7	35.20	-19.00
3	154.16	19.0 QP	43.5	-24.5	1.01 V	291	32.90	-13.90
4	371.44	21.0 QP	46.0	-25.0	2.00 V	24	31.90	-10.90
5	730.34	34.1 QP	46.0	-11.9	1.01 V	331	38.00	-3.90
6	941.80	31.8 QP	46.0	-14.2	1.01 V	280	31.90	-0.10

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)
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:

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**Hsin Chu EMC/RF/Telecom 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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