

FCC Test Report (GFSK)

Report No.: RF200619E02

FCC ID: JNZMR0087

Test Model: MR0087

Received Date: June 19, 2020

Test Date: July 01 to 09, 2020

Issued Date: July 22, 2020

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

Lab Address: E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300,
Taiwan

Test Location: E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300,
Taiwan

**FCC Registration /
Designation Number:** 723255 / TW2022



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification.

Table of Contents

Release Control Record	4
1 Certificate of Conformity.....	5
2 Summary of Test Results	6
2.1 Measurement Uncertainty	6
2.2 Modification Record	6
3 General Information.....	7
3.1 General Description of EUT (GFSK)	7
3.2 Description of Test Modes	8
3.2.1 Test Mode Applicability and Tested Channel Detail	9
3.3 Duty Cycle of Test Signal	10
3.4 Description of Support Units	11
3.4.1 Configuration of System under Test	11
3.5 General Description of Applied Standards and References	12
4 Test Types and Results	13
4.1 Radiated Emission and Bandedge Measurement.....	13
4.1.1 Limits of Radiated Emission and Bandedge Measurement	13
4.1.2 Test Instruments	14
4.1.3 Test Procedures.....	16
4.1.4 Deviation from Test Standard	16
4.1.5 Test Setup.....	17
4.1.6 EUT Operating Conditions.....	18
4.1.7 Test Results	19
4.2 6dB Bandwidth Measurement	24
4.2.1 Limits of 6dB Bandwidth Measurement	24
4.2.2 Test Setup.....	24
4.2.3 Test Instruments	24
4.2.4 Test Procedure	24
4.2.5 Deviation from Test Standard	24
4.2.6 EUT Operating Conditions.....	24
4.2.7 Test Results	25
4.3 Conducted Output Power Measurement.....	26
4.3.1 Limits of Conducted Output Power Measurement	26
4.3.2 Test Setup.....	26
4.3.3 Test Instruments	26
4.3.4 Test Procedures.....	26
4.3.5 Deviation from Test Standard	26
4.3.6 EUT Operating Conditions.....	26
4.4 Power Spectral Density Measurement.....	28
4.4.1 Limits of Power Spectral Density Measurement	28
4.4.2 Test Setup.....	28
4.4.3 Test Instruments	28
4.4.4 Test Procedure	28
4.4.5 Deviation from Test Standard	28
4.4.6 EUT Operating Condition	28
4.4.7 Test Results	29
4.5 Conducted Out of Band Emission Measurement.....	30
4.5.1 Limits of Conducted Out of Band Emission Measurement.....	30
4.5.2 Test Setup.....	30
4.5.3 Test Instruments	30
4.5.4 Test Procedure	30
4.5.5 Deviation from Test Standard	30
4.5.6 EUT Operating Condition	30
4.5.7 Test Results	30

5	Pictures of Test Arrangements.....	32
	Annex A - Band-Edge Measurement.....	33
	Appendix – Information of the Testing Laboratories	34

Release Control Record

Issue No.	Description	Date Issued
RF200619E02	Original release.	July 22, 2020

1 Certificate of Conformity

Product: Wireless Mouse

Brand: Logitech

Test Model: MR0087

Sample Status: ENGINEERING SAMPLE

Applicant: LOGITECH FAR EAST LTD.

Test Date: July 01 to 09, 2020

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 :  , **Date:** July 22, 2020
Claire Kuan / Specialist

Approved by :  , **Date:** July 22, 2020
Clark Lin / Technical Manager

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	NA	Without AC power port of the EUT.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -10.1 dB at 2390.00MHz.
15.247(d)	Antenna Port Emission	PASS	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

Note:

- For 2.4 GHz band compliance with rule 15.247(d) of the band-edge items, the test plots were recorded in Annex A.
- 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	Frequency	Expanded Uncertainty (k=2) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.9 dB
Conducted emissions	-	2.5 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.1 dB
	30MHz ~ 1GHz	5.5 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	5.1 dB
	18GHz ~ 40GHz	5.3 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT (GFSK)

Product	Wireless Mouse
Brand	Logitech
Test Model	MR0087
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	1.5Vdc from battery
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	Up to 2Mbps
Operating Frequency	2405 ~ 2474MHz
Number of Channel	10
Output Power	0.867mW
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. The EUT may have a lot of colors for marketing requirement.
2. The antenna provided to the EUT, please refer to the following table:

Antenna Gain (dBi)	Frequency range(GHz)	Antenna Type	Connector Type
5	2.4~2.4835	Printed Antenna	None

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.
4. The above antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

3.2 Description of Test Modes

10 channels are provided to this EUT:

Channel	Frequency	Channel	Frequency
1	2405MHz	6	2450MHz
2	2408MHz	7	2455MHz
3	2419MHz	8	2461MHz
4	2428MHz	9	2469MHz
5	2444MHz	10	2474MHz

3.2.1 Test Mode Applicability and Tested Channel Detail

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

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

RE $<$ 1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission

APCM: Antenna Port Conducted Measurement

NOTE: No need to concern of Conducted Emission due to the EUT is powered by battery.

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 10	1, 5, 10	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 10	10	GFSK

Antenna Port Conducted Measurement:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ 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.

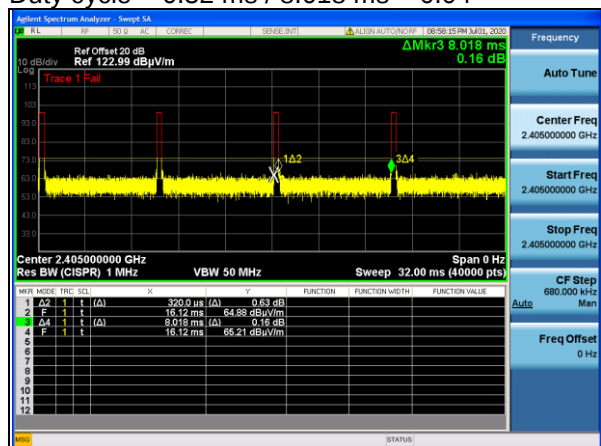
AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
1 to 10	1, 5, 10	GFSK

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE $\geq$ 1G	24deg. C, 69%RH	1.5Vdc	Nelson Teng
RE $<$ 1G	25deg. C, 65%RH	1.5Vdc	Nelson Teng
APCM	25deg. C, 65%RH	1.5Vdc	Jyunchun Lin

3.3 Duty Cycle of Test Signal

Duty cycle = 0.32 ms / 8.018 ms = 0.04

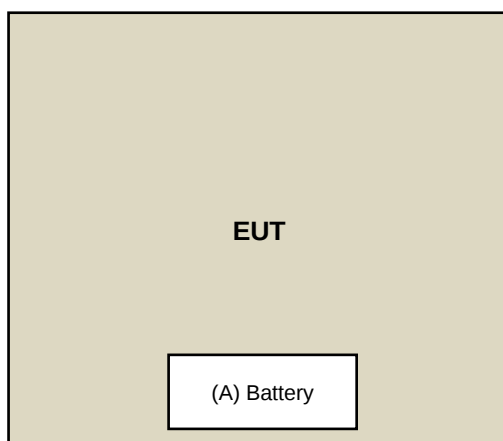


3.4 Description of Support Units

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.	Battery	Duracell	AA	NA	NA	Provided by Lab

3.4.1 Configuration of System under Test



3.5 General Description of Applied Standards and References

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

Test Standard:

FCC Part 15, Subpart C (15.247)

ANSI C63.10-2013

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

References Test Guidance:

KDB 558074 D01 15.247 Meas Guidance v05r02

All test items have been performed as a reference to the above KDB test guidance.

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

For Radiated emission & BandEdge test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver R&S	ESR7	102026	Apr. 22, 2020	Apr. 21, 2021
Spectrum Analyzer Keysight	N9030B	MY57141948	May 22, 2020	May 21, 2021
Pre-Amplifier EMCi	EMC330N	980538	Apr. 28, 2020	Apr. 27, 2021
Loop Antenna Electro-Metrics	EM-6879	264	Feb. 18, 2020	Feb. 17, 2021
Trilog Broadband Antenna SCHWARZBECK	VULB9168	9168-0842	Nov. 08, 2019	Nov. 07, 2020
RF Cable	8D	966-5-1	Apr. 29, 2020	Apr. 28, 2021
RF Cable	8D	966-5-2	Apr. 29, 2020	Apr. 28, 2021
RF Cable	8D	966-5-3	Apr. 29, 2020	Apr. 28, 2021
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-ATT5-02	Jan. 14, 2020	Jan. 13, 2021
Horn_Antenna SCHWARZBECK	BBHA 9120D	9120D-1819	Nov. 24, 2019	Nov. 23, 2020
Pre-Amplifier EMCi	EMC12630SE	980509	Apr. 29, 2020	Apr. 28, 2021
RF Cable EMCi	EMC104-SM-SM-1500	180503	Apr. 29, 2020	Apr. 28, 2021
RF Cable EMCi	EMC104-SM-SM-2000	180501	Apr. 29, 2020	Apr. 28, 2021
RF Cable EMCi	EMC104-SM-SM-6000	180506	Apr. 29, 2020	Apr. 28, 2021
Pre-Amplifier EMCi	EMC184045SE	980387	Jan. 15, 2020	Jan. 14, 2021
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170519	Nov. 24, 2019	Nov. 23, 2020
RF Cable	EMC102-KM-KM-1200	160924	Jan. 15, 2020	Jan. 14, 2021
RF Cable	EMC-KM-KM-4000	200214	Mar. 11, 2020	Mar. 10, 2021
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Boresight Antenna Tower & Turn Table Max-Full	MF-7802BS	MF780208530	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 966 Chamber No. 5.
3. Tested Date: July 01 to 09, 2020

For other test items:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer R&S	FSV40	100964	May 29, 2020	May 28, 2021
Power meter Anritsu	ML2495A	1529002	July 26, 2019	July 25, 2020
Power sensor Anritsu	MA2411B	1339443	July 26, 2019	July 25, 2020
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 14, 2020	Apr. 13, 2021
Software	ADT_RF Test Software V6.6.5.4	NA	NA	NA

- NOTE:**
1. The test was performed in Oven room 2.
 2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 3. Tested Date: July 09, 2020

4.1.3 Test Procedures

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. 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.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 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 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.

Note:

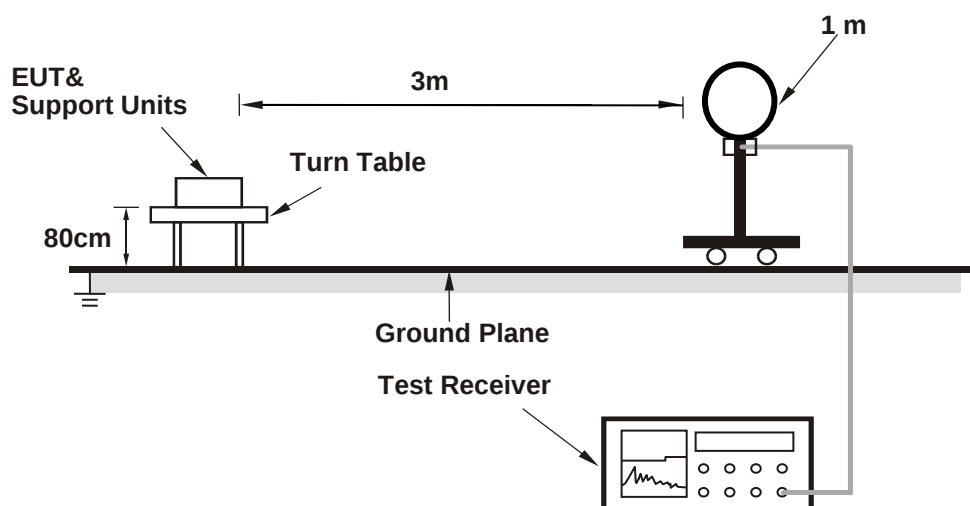
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Average detection (AV) 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

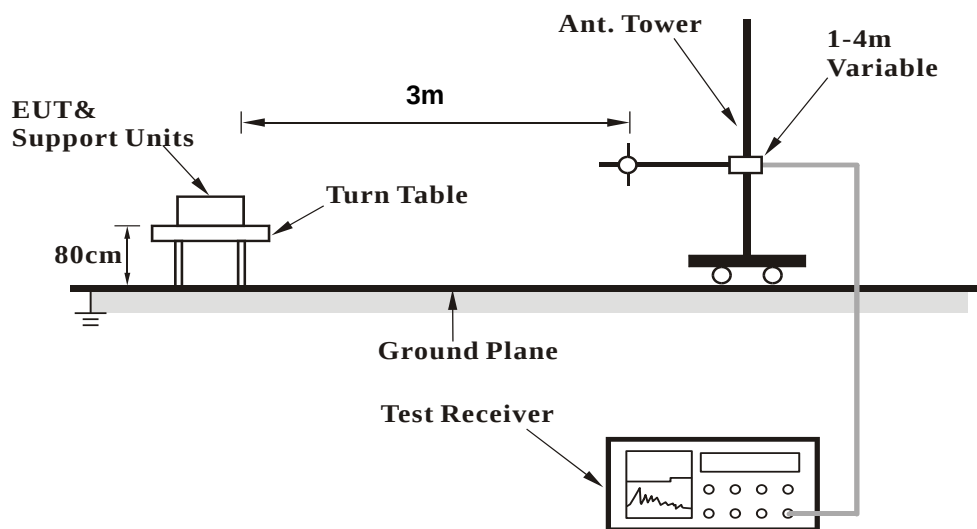
No deviation.

4.1.5 Test Setup

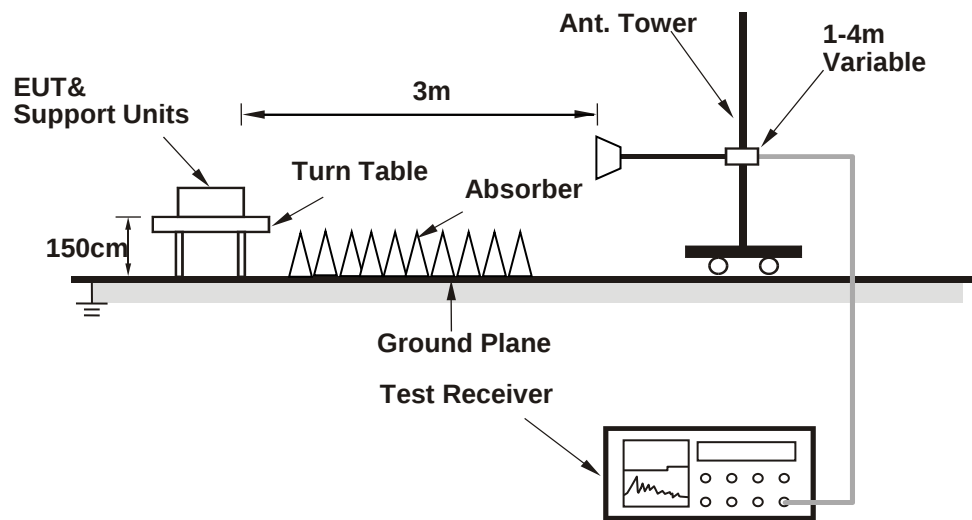
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

4.1.6 EUT Operating Conditions

- Placed the EUT on the testing table.
- Controlling software (RF sample click button) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz Data:

Channel	TX Channel 1	Detector Function	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	56.2 PK	74.0	-17.8	1.01 H	90	58.0	-1.8
2	2390.00	43.9 AV	54.0	-10.1	1.01 H	90	45.7	-1.8
3	*2405.00	99.1 PK			1.01 H	90	100.9	-1.8
4	*2405.00	71.1 AV			1.01 H	90	72.9	-1.8
5	4810.00	58.9 PK	74.0	-15.1	1.27 H	155	56.7	2.2
6	4810.00	30.9 AV	54.0	-23.1	1.27 H	155	28.7	2.2
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	56.1 PK	74.0	-17.9	3.35 V	130	57.9	-1.8
2	2390.00	42.5 AV	54.0	-11.5	3.35 V	130	44.3	-1.8
3	*2405.00	92.9 PK			3.35 V	130	94.7	-1.8
4	*2405.00	64.9 AV			3.35 V	130	66.7	-1.8
5	4810.00	57.5 PK	74.0	-16.5	1.18 V	322	55.3	2.2
6	4810.00	29.5 AV	54.0	-24.5	1.18 V	322	27.3	2.2

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 factor is calculated from following formula:

$$20 \log(\text{Duty cycle}) = 20 \log(0.32 \text{ ms} / 8.018 \text{ ms}) = -28 \text{ dB}$$
 Please see section 3.3 for plotted duty.

Channel	TX Channel 5	Detector Function	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	*2444.00	98.4 PK			1.18 H	106	100.2	-1.8
2	*2444.00	70.4 AV			1.18 H	106	72.2	-1.8
3	4888.00	59.7 PK	74.0	-14.3	1.27 H	155	57.6	2.1
4	4888.00	31.7 AV	54.0	-22.3	1.27 H	155	29.6	2.1
5	7332.00	62.2 PK	74.0	-11.8	1.07 H	307	53.1	9.1
6	7332.00	34.2 AV	54.0	-19.8	1.07 H	307	25.1	9.1
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	*2444.00	94.3 PK			3.96 V	144	96.1	-1.8
2	*2444.00	66.3 AV			3.96 V	144	68.1	-1.8
3	4888.00	58.4 PK	74.0	-15.6	1.18 V	326	56.3	2.1
4	4888.00	30.4 AV	54.0	-23.6	1.18 V	326	28.3	2.1
5	7332.00	54.7 PK	74.0	-19.3	2.34 V	169	45.6	9.1
6	7332.00	26.7 AV	54.0	-27.3	2.34 V	169	17.6	9.1

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 factor is calculated from following formula:

$$20 \log(\text{Duty cycle}) = 20 \log(0.32 \text{ ms} / 8.018 \text{ ms}) = -28 \text{ dB}$$
Please see section 3.3 for plotted duty.

Channel	TX Channel 10	Detector Function	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	*2474.00	98.3 PK			1.20 H	90	100.2	-1.9
2	*2474.00	70.3 AV			1.20 H	90	72.2	-1.9
3	2483.50	56.2 PK	74.0	-17.8	1.20 H	90	58.1	-1.9
4	2483.50	28.2 AV	54.0	-25.8	1.20 H	90	30.1	-1.9
5	4948.00	59.9 PK	74.0	-14.1	1.23 H	168	57.5	2.4
6	4948.00	31.9 AV	54.0	-22.1	1.23 H	168	29.5	2.4
7	7422.00	61.8 PK	74.0	-12.2	1.07 H	292	52.4	9.4
8	7422.00	33.8 AV	54.0	-20.2	1.07 H	292	24.4	9.4
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	*2474.00	94.2 PK			4.00 V	140	96.1	-1.9
2	*2474.00	66.2 AV			4.00 V	140	68.1	-1.9
3	2483.50	55.5 PK	74.0	-18.5	4.00 V	140	57.4	-1.9
4	2483.50	27.5 AV	54.0	-26.5	4.00 V	140	29.4	-1.9
5	4948.00	58.3 PK	74.0	-15.7	1.20 V	333	55.9	2.4
6	4948.00	30.3 AV	54.0	-23.7	1.20 V	333	27.9	2.4
7	7422.00	54.8 PK	74.0	-19.2	2.28 V	158	45.4	9.4
8	7422.00	26.8 AV	54.0	-27.2	2.28 V	158	17.4	9.4

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

$$20 \log(\text{Duty cycle}) = 20 \log(0.32 \text{ ms} / 8.018 \text{ ms}) = -28.0 \text{ dB}$$
Please see section 3.3 for plotted duty.

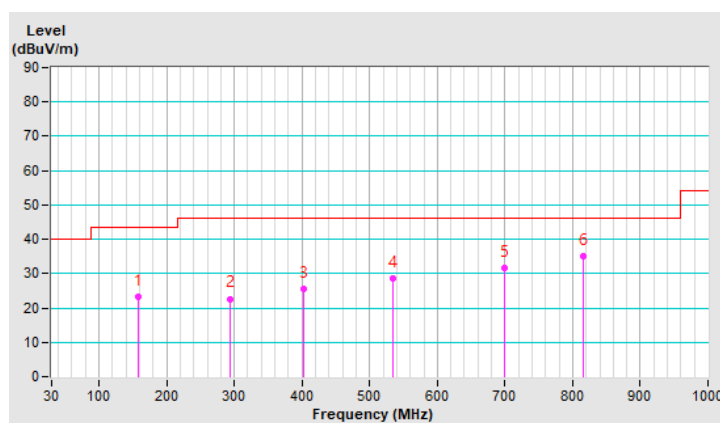
Below 1GHz Data:

Channel	TX Channel 10	Detector Function	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

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	157.89	23.4 QP	43.5	-20.1	2.00 H	0	30.7	-7.3
2	293.23	22.7 QP	46.0	-23.3	2.00 H	229	29.4	-6.7
3	402.94	25.4 QP	46.0	-20.6	1.00 H	304	29.2	-3.8
4	534.67	28.5 QP	46.0	-17.5	3.00 H	113	29.1	-0.6
5	699.25	31.6 QP	46.0	-14.4	3.00 H	210	28.7	2.9
6	815.00	35.1 QP	46.0	-10.9	3.00 H	360	29.7	5.4

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 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

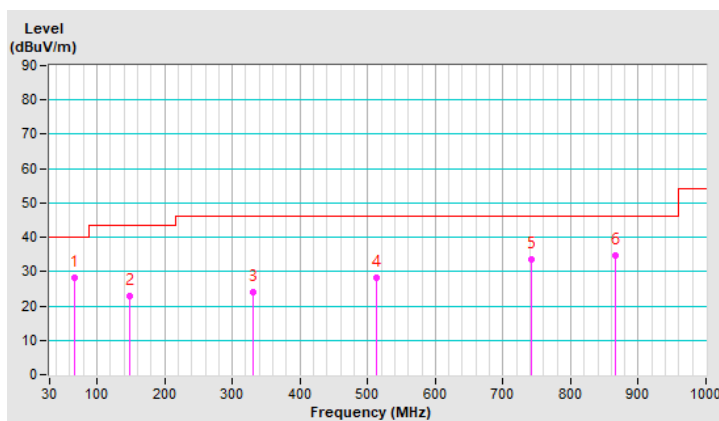


Channel	TX Channel 10	Detector Function	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

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	66.62	28.2 QP	40.0	-11.8	1.00 V	4	37.4	-9.2
2	148.44	22.9 QP	43.5	-20.6	4.00 V	360	30.4	-7.5
3	330.89	23.8 QP	46.0	-22.2	2.00 V	303	29.4	-5.6
4	512.19	28.1 QP	46.0	-17.9	1.00 V	73	29.1	-1.0
5	741.08	33.7 QP	46.0	-12.3	4.00 V	94	29.8	3.9
6	866.09	34.6 QP	46.0	-11.4	4.00 V	16	28.7	5.9

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 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

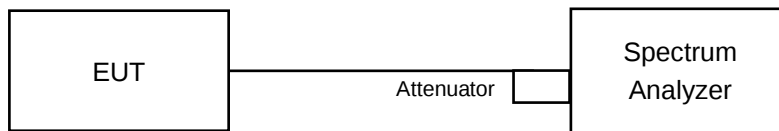


4.2 6dB Bandwidth Measurement

4.2.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedure

- Set resolution bandwidth (RBW) = 100kHz
- 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 6 dB relative to the maximum level measured in the fundamental emission

4.2.5 Deviation from Test Standard

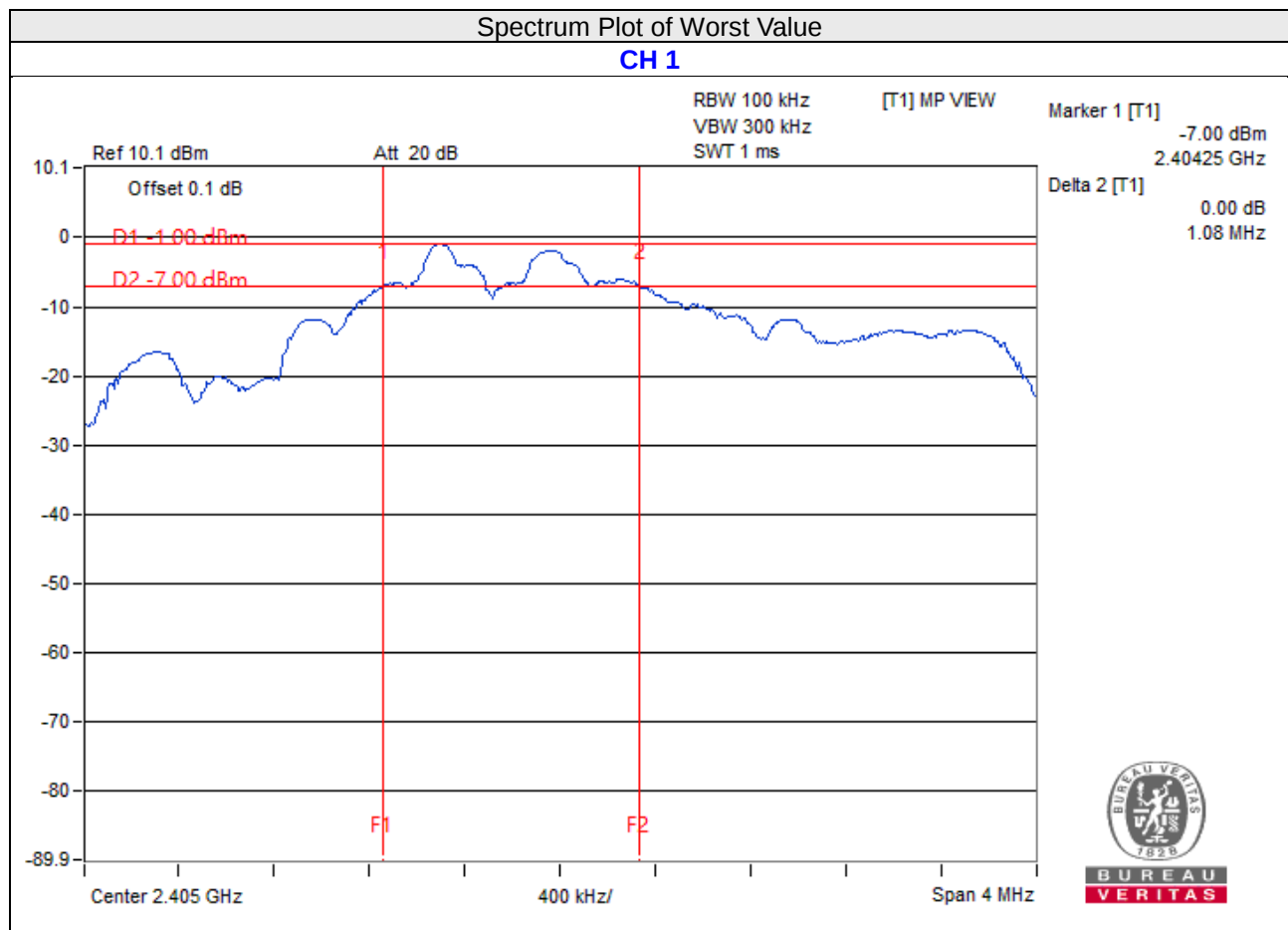
No deviation.

4.2.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.2.7 Test Results

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2405	1.08	0.5	Pass
8	2444	1.08	0.5	Pass
12	2474	1.11	0.5	Pass

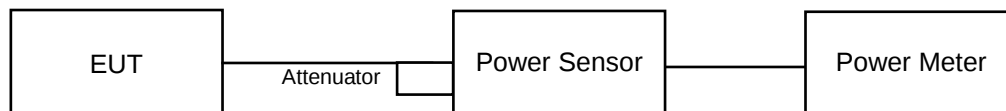


4.3 Conducted Output Power Measurement

4.3.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedures

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

Same as Item 4.2.6.

FOR PEAK POWER

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
1	2405	0.8035	-0.95	30	Pass
8	2444	0.8472	-0.72	30	Pass
12	2474	0.867	-0.62	30	Pass

FOR AVERAGE POWER

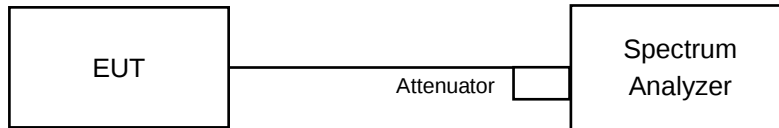
Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
1	2405	0.7816	-1.07
8	2444	0.8204	-0.86
12	2474	0.8356	-0.78

4.4 Power Spectral Density Measurement

4.4.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedure

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.

4.4.5 Deviation from Test Standard

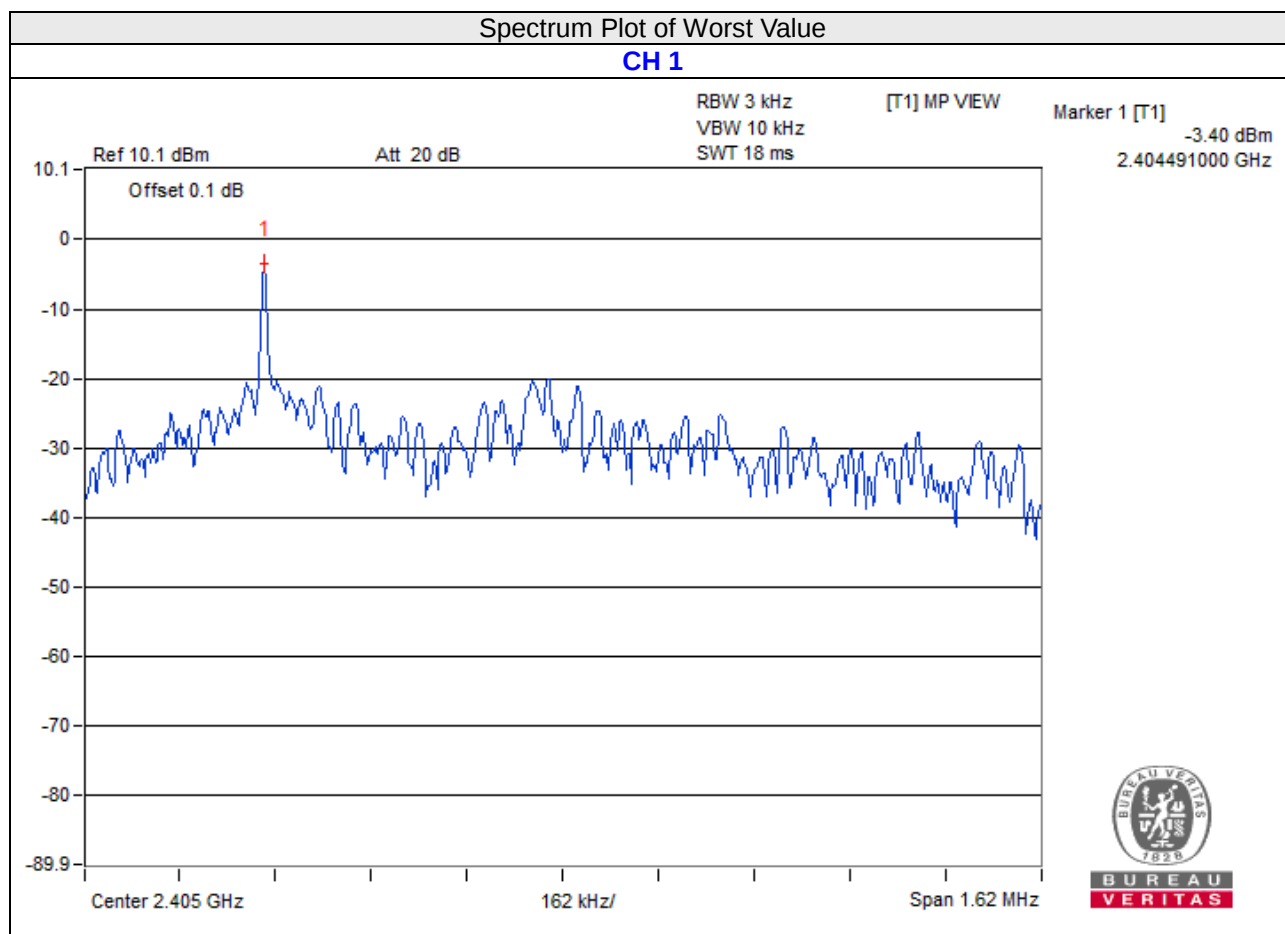
No deviation.

4.4.6 EUT Operating Condition

Same as Item 4.2.6.

4.4.7 Test Results

Channel	Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass /Fail
1	2405	-3.40	8	Pass
8	2444	-3.44	8	Pass
12	2474	-3.44	8	Pass

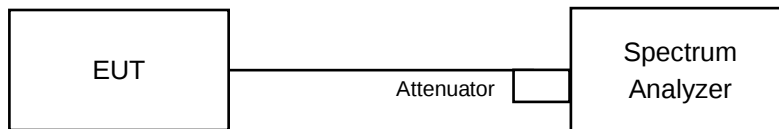


4.5 Conducted Out of Band Emission Measurement

4.5.1 Limits of Conducted Out of Band Emission Measurement

Below 20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

4.5.5 Deviation from Test Standard

No deviation.

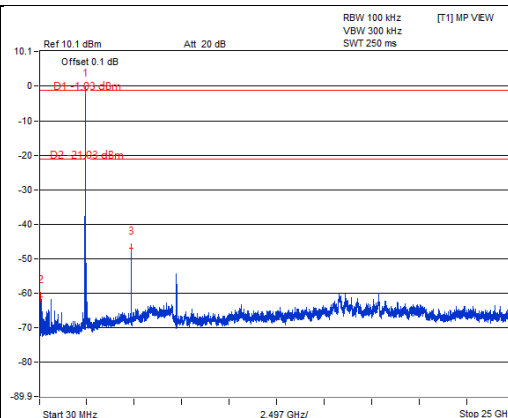
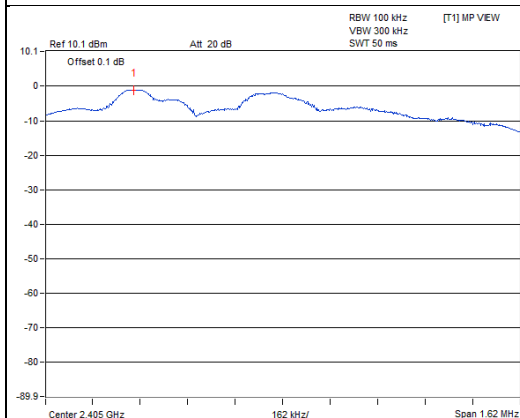
4.5.6 EUT Operating Condition

Same as Item 4.3.6.

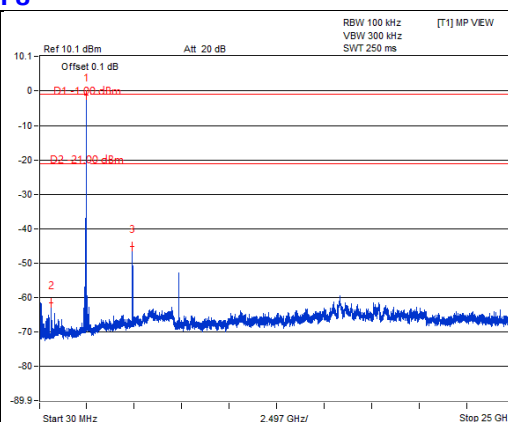
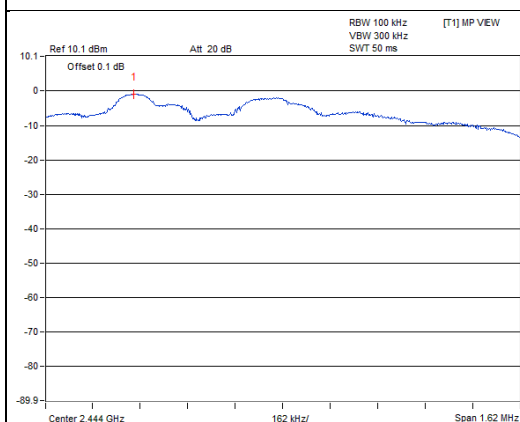
4.5.7 Test Results

The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

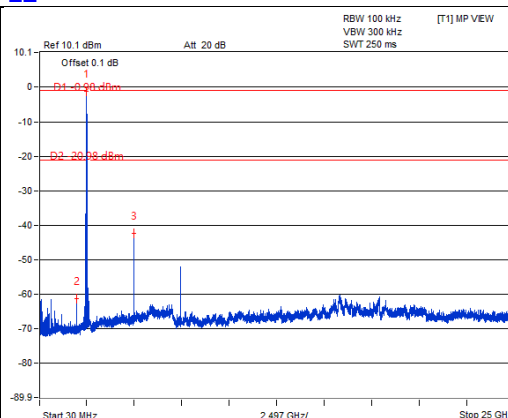
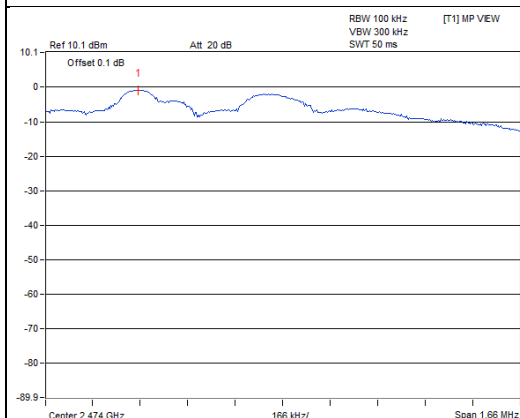
CH 1



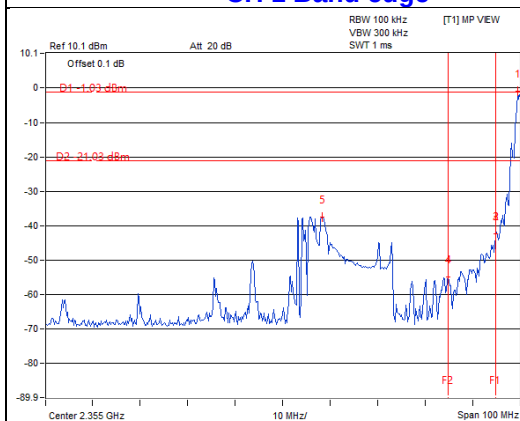
CH 8



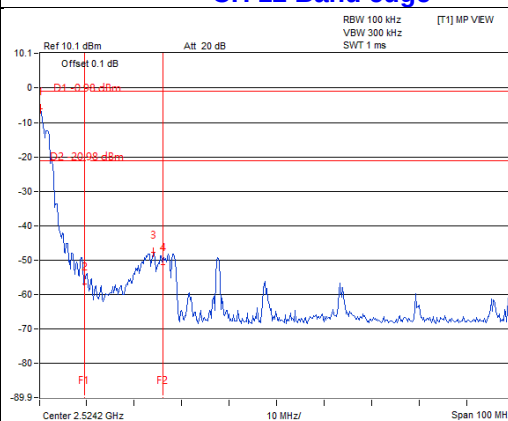
CH 12



CH 1 Band edge



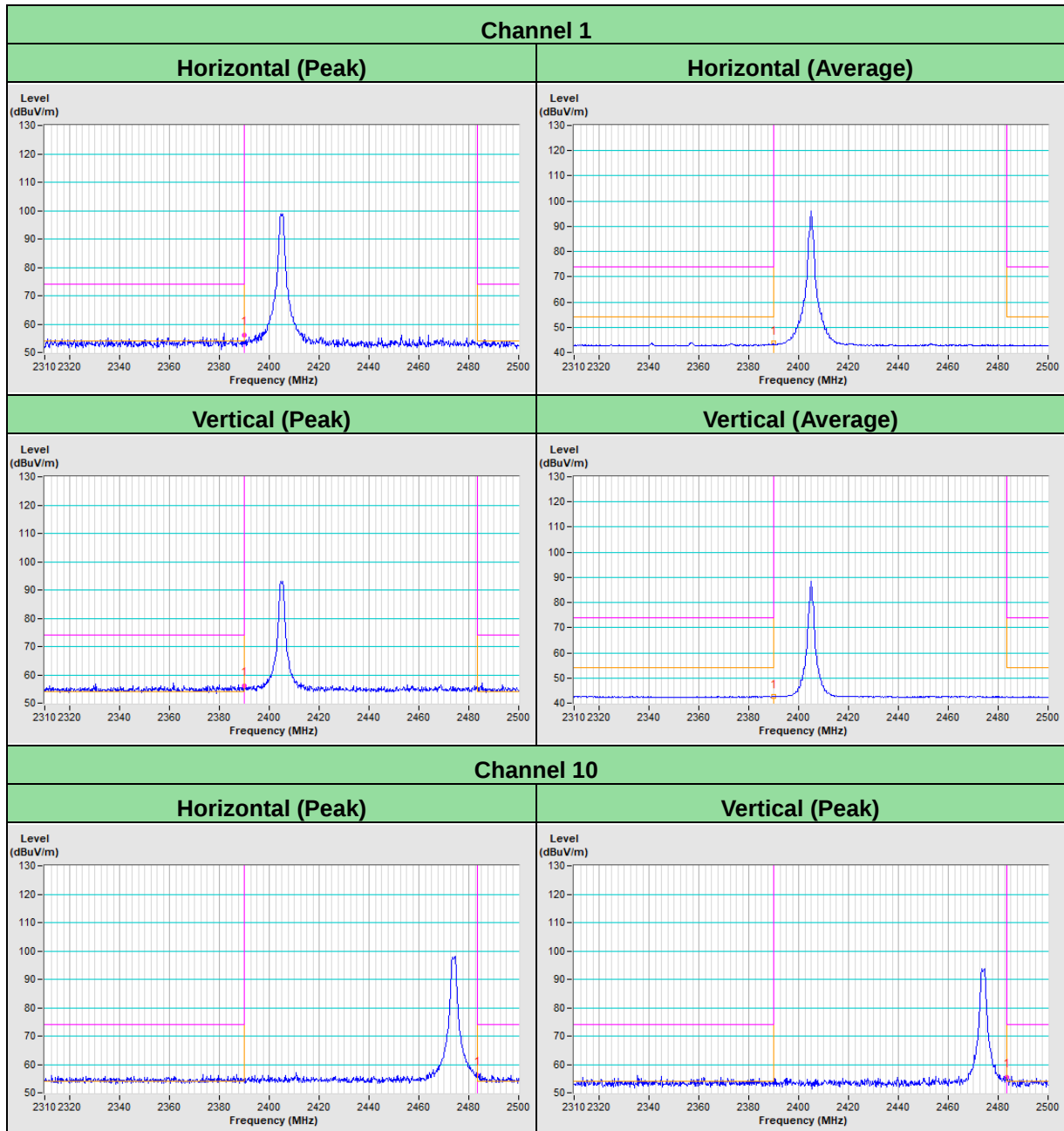
CH 12 Band edge



5 Pictures of Test Arrangements

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

Annex A - Band-Edge Measurement



Appendix – 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

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

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 ---