

FCC Test Report

Report No.: RFBDKG-WTW-P22030172

FCC ID: JNZMR0098

Test Model: MR0098

Received Date: 2022/3/4

Test Date: 2022/3/12 ~ 2022/3/16

Issued Date: 2022/4/7

Applicant: LOGITECH FAR EAST LTD.

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
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**FCC Registration /
Designation Number:** 723255 / TW2022



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Release Control Record

Issue No.	Description	Date Issued
RFBDKG-WTW-P22030172	Original release.	2022/4/7

1 Certificate of Conformity

Product: Wireless Mouse

Brand: Logitech

Test Model: MR0098


Sample Status: Engineering sample

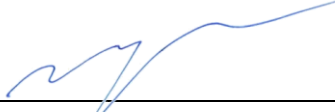
Applicant: LOGITECH FAR EAST LTD.

Test Date: 2022/3/12 ~ 2022/3/16

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:** 2022/4/7
Claire Kuan / Specialist

Approved by :  , **Date:** 2022/4/7
May Chen / 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	Power supply is 1.5Vdc from battery.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -11.9 dB at 2483.50 MHz.
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) (±)
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	5.1 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

Product	Wireless Mouse
Brand	Logitech
Test Model	MR0098
Status of EUT	Engineering sample
Power Supply Rating	1.5Vdc from battery
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	Up to 2 Mbps
Operating Frequency	2405 ~ 2474 MHz
Number of Channel	70
Output Power	1.151 mW
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
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
3	2.4~2.4835	Printed Antenna	None

3. For spurious emissions, the EUT was pre-tested under the following modes:

Test Mode	Description
Mode A	Silent sku
Mode B	Non-silent sku

Note: From the above modes, the worst case was found in **Mode B**. Therefore only the test data of the mode was recorded in this report.

4. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.
5. 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

70 channels are provided to this EUT:

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

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	DATA RATE (Mbps)
1 to 70	1, 40, 70	GFSK	2

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	DATA RATE (Mbps)
1 to 70	70	GFSK	2

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.

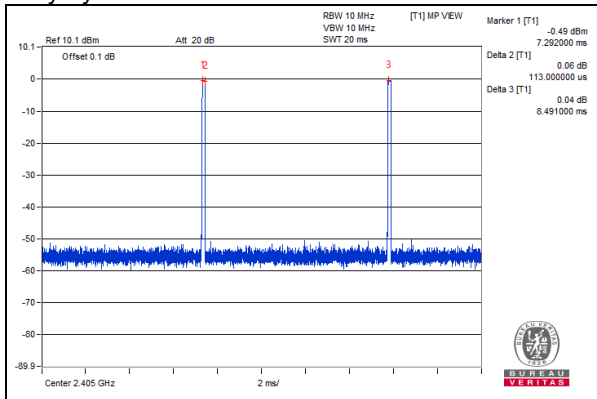
AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
1 to 70	1, 40, 70	GFSK	2

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE \geq 1G	20deg. C, 68%RH	1.5Vdc	Spencer Liao
RE $<$ 1G	25deg. C, 66%RH	1.5Vdc	Sampson Chen
APCM	25deg. C, 60%RH	1.5Vdc	Ryann Wu

3.3 Duty Cycle of Test Signal

$$\text{Duty cycle} = 0.113 / 8.491 = 0.015$$



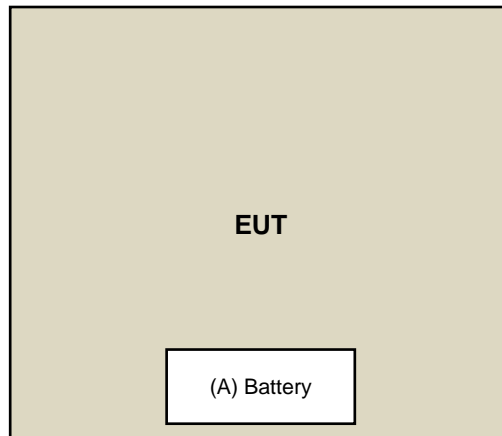
Note: This is highest operational duty cycle.

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	ESR3	102528	2022/2/25	2023/2/24
Spectrum Analyzer KEYSIGHT	N9030B	MY57141948	2021/5/21	2022/5/20
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Boresight Antenna Tower & Turn Table Max-Full	MF-7802BS	MF780208530	NA	NA
Pre_Amplifier EMCI	EMC001340	980142	2021/5/24	2022/5/23
Loop Antenna TESEQ	HLA 6121	45745	2021/7/21	2022/7/20
RF Coaxial Cable JYEBO	5D-FB	LOOPCAB-001	2022/1/6	2023/1/5
RF Coaxial Cable JYEBO	5D-FB	LOOPCAB-002	2022/1/6	2023/1/5
Pre_Amplifier EMCI	EMC330N	980538	2021/4/26	2022/4/25
Bilog Antenna Schwarzbeck	VULB 9168	9168-0842	2021/10/26	2022/10/25
RF Coaxial Cable COMMATE/PEWC	8D	966-5-1	2021/4/26	2022/4/25
RF Coaxial Cable COMMATE/PEWC	8D	966-5-2	2021/4/26	2022/4/25
RF Coaxial Cable COMMATE/PEWC	8D	966-5-3	2021/4/26	2022/4/25
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-ATT5-02	2022/1/10	2023/1/9
Horn Antenna Schwarzbeck	BBHA 9120D	9120D-1819	2021/11/14	2022/11/13
Pre_Amplifier EMCI	EMC12630SE	980509	2021/4/26	2022/4/25
RF Coaxial Cable EMCI	EMC104-SM-SM-1500	180503	2021/4/26	2022/4/25
RF Coaxial Cable EMCI	EMC104-SM-SM-2000	180501	2021/4/26	2022/4/25
RF Coaxial Cable EMCI	EMC104-SM-SM-6000	180506	2021/4/26	2022/4/25

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: 2022/3/12 ~ 2022/3/16

For other test items:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer R&S	FSV40	100964	2021/5/31	2022/5/30
Power Meter Anritsu	ML2495A	1529002	2021/6/21	2022/6/20
Pulse Power Sensor Anritsu	MA2411B	1339443	2021/5/31	2022/5/30
Attenuator WOKEN	MDCS18N-10	MDCS18N-10-01	2021/4/13	2022/4/12
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: 2022/3/15

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:

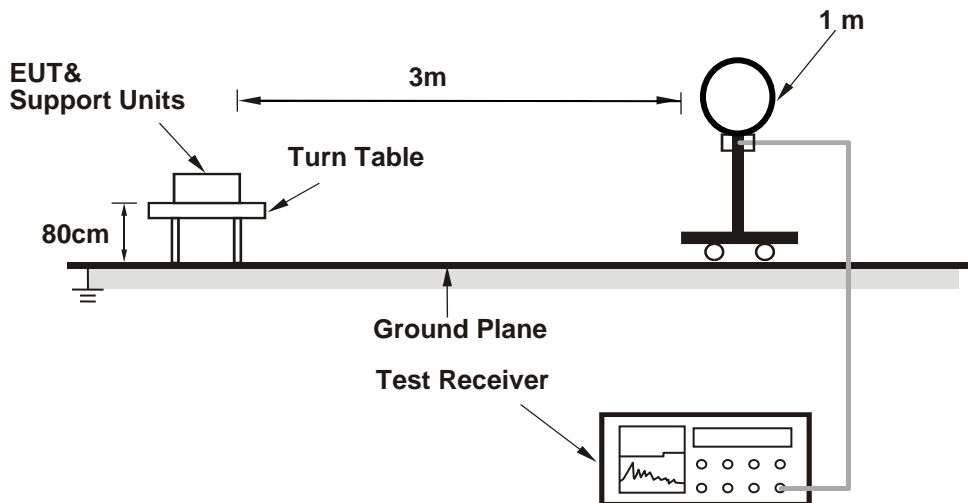
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

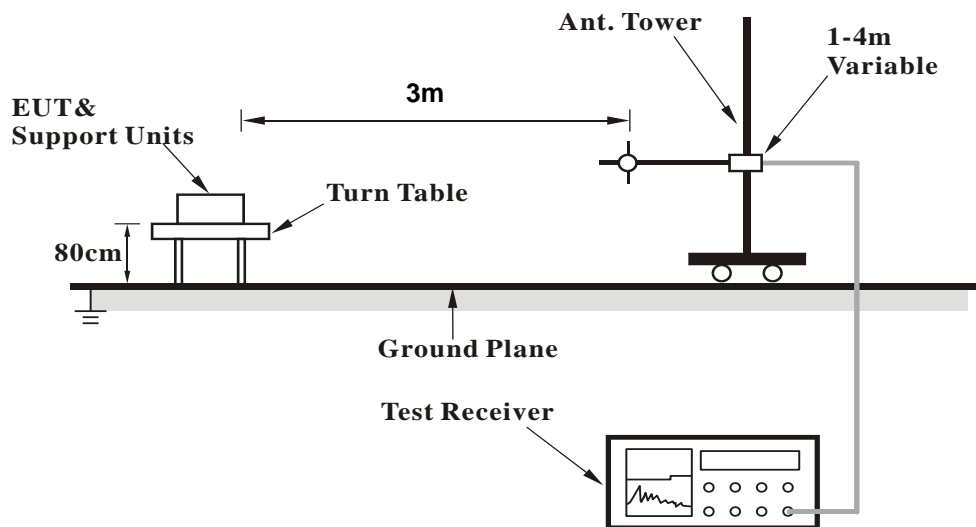
No deviation.

4.1.5 Test Setup

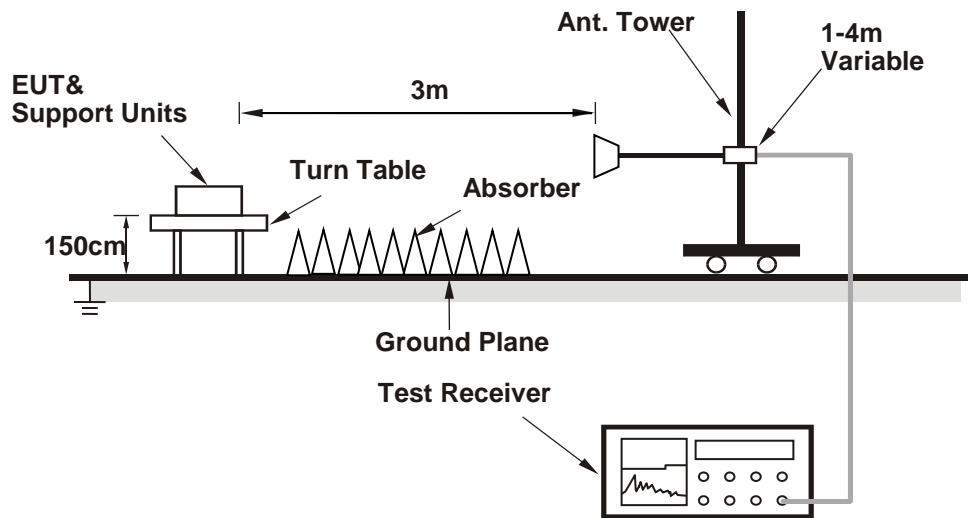
For Radiated emission below 30MHz



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 with Receiver [Number Lock]) has been activated to set the EUT under transmission condition continuously at specific channel frequency.
 - ◆ UFY TX Modulated standard duty cycle 2405MHz
 - ◆ UFY TX Modulated standard duty cycle 2444MHz
 - ◆ UFY TX Modulated standard duty cycle 2474MHz

4.1.7 Test Results

Above 1GHz Data:

RF Mode	TX_GFSK	Channel	CH 1 : 2405 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 3 MHz
Input Power	1.5 Vdc	Environmental Conditions	23 °C, 74 % RH
Tested By	Nelson Teng		

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	59.2 PK	74.0	-14.8	1.46 H	67	61.9	-2.7
2	2390.00	21.7 AV	54.0	-32.3	1.46 H	67	24.4	-2.7
3	*2405.00	95.5 PK			1.46 H	67	98.2	-2.7
4	*2405.00	58.0 AV			1.46 H	67	60.7	-2.7
5	4810.00	46.1 PK	74.0	-27.9	2.12 H	207	44.6	1.5
6	4810.00	8.6 AV	54.0	-45.4	2.12 H	207	7.1	1.5

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	56.7 PK	74.0	-17.3	1.05 V	59	59.4	-2.7
2	2390.00	19.2 AV	54.0	-34.8	1.05 V	59	21.9	-2.7
3	*2405.00	93.5 PK			3.77 V	217	96.2	-2.7
4	*2405.00	56.0 AV			3.77 V	217	58.7	-2.7
5	4810.00	45.1 PK	74.0	-28.9	1.61 V	337	43.6	1.5
6	4810.00	7.6 AV	54.0	-46.4	1.61 V	337	6.1	1.5

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)
- Margin value = Emission Level – Limit value
- The other emission levels were very low against the limit.
- " * ": Fundamental frequency.
- 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:
 $20 \log(\text{Duty cycle}) = 20 \log(0.113 \text{ ms} / 8.491 \text{ ms}) = -37.5 \text{ dB}$

RF Mode	TX_GFSK	Channel	CH 40 : 2444 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 3 MHz
Input Power	1.5 Vdc	Environmental Conditions	23 °C, 74 % RH
Tested By	Nelson Teng		

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	95.4 PK			1.47 H	78	98.2	-2.8
2	*2444.00	57.9 AV			1.47 H	78	60.7	-2.8
3	4888.00	47.8 PK	74.0	-26.2	2.42 H	187	46.3	1.5
4	4888.00	10.3 AV	54.0	-43.7	2.42 H	187	8.8	1.5
5	7332.00	43.5 PK	74.0	-30.5	2.06 H	183	36.3	7.2
6	7332.00	6.0 AV	54.0	-48.0	2.06 H	183	-1.2	7.2

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	*2444.00	94.7 PK			4.00 V	244	97.5	-2.8
2	*2444.00	57.2 AV			4.00 V	244	60.0	-2.8
3	4888.00	45.9 PK	74.0	-28.1	1.49 V	356	44.4	1.5
4	4888.00	8.4 AV	54.0	-45.6	1.49 V	356	6.9	1.5
5	7332.00	43.8 PK	74.0	-30.2	1.83 V	283	36.6	7.2
6	7332.00	6.3 AV	54.0	-47.7	1.83 V	283	-0.9	7.2

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)
- Margin value = Emission Level – Limit value
- The other emission levels were very low against the limit.
- " * ": Fundamental frequency.
- 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:
 $20 \log(\text{Duty cycle}) = 20 \log(0.113 \text{ ms} / 8.491 \text{ ms}) = -37.5 \text{ dB}$

RF Mode	TX_GFSK	Channel	CH 70 : 2474 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 3 MHz
Input Power	1.5 Vdc	Environmental Conditions	23 °C, 74 % RH
Tested By	Nelson Teng		

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	95.7 PK			1.43 H	74	98.6	-2.9
2	*2474.00	58.2 AV			1.43 H	74	61.1	-2.9
3	2483.50	62.1 PK	74.0	-11.9	1.43 H	74	65.0	-2.9
4	2483.50	24.6 AV	54.0	-29.4	1.43 H	74	27.5	-2.9
5	4948.00	47.6 PK	74.0	-26.4	2.83 H	172	45.9	1.7
6	4948.00	10.1 AV	54.0	-43.9	2.83 H	172	8.4	1.7
7	7422.00	44.0 PK	74.0	-30.0	2.34 H	196	36.6	7.4
8	7422.00	6.5 AV	54.0	-47.5	2.34 H	196	-0.9	7.4

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	91.7 PK			1.24 V	354	94.6	-2.9
2	*2474.00	54.2 AV			1.24 V	354	57.1	-2.9
3	2483.50	56.0 PK	74.0	-18.0	1.24 V	354	58.9	-2.9
4	2483.50	18.5 AV	54.0	-35.5	1.24 V	354	21.4	-2.9
5	4948.00	45.2 PK	74.0	-28.8	1.39 V	358	43.5	1.7
6	4948.00	7.7 AV	54.0	-46.3	1.39 V	358	6.0	1.7
7	7422.00	43.6 PK	74.0	-30.4	1.67 V	255	36.2	7.4
8	7422.00	6.1 AV	54.0	-47.9	1.67 V	255	-1.3	7.4

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)
- Margin value = Emission Level – Limit value
- The other emission levels were very low against the limit.
- " * ": Fundamental frequency.
- 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:
 $20 \log(\text{Duty cycle}) = 20 \log(0.113 \text{ ms} / 8.491 \text{ ms}) = -37.5 \text{ dB}$

Below 1GHz Data:

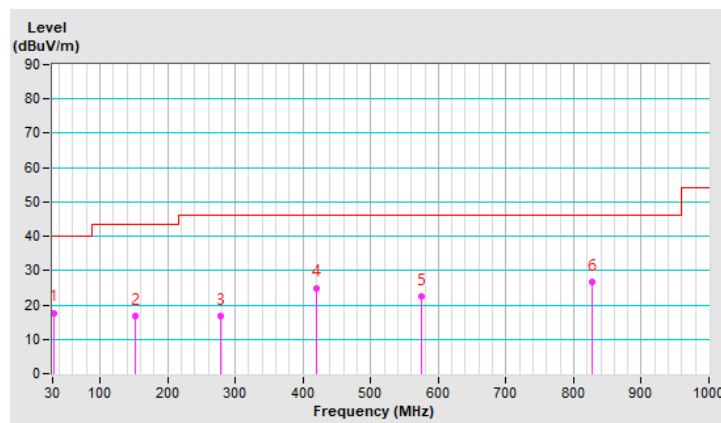
RF Mode	TX_GFSK	Channel	CH 70 : 2474 MHz
Frequency Range	9 kHz ~ 1 GHz	Detector Function & Bandwidth	(QP) RB = 120kHz
Input Power	1.5 Vdc	Environmental Conditions	25 °C, 69 % RH
Tested By	Sampson Chen		

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	32.57	17.7 QP	40.0	-22.3	1.50 H	232	31.6	-13.9
2	152.37	16.6 QP	43.5	-26.9	3.00 H	158	29.2	-12.6
3	278.67	16.6 QP	46.0	-29.4	1.50 H	14	29.4	-12.8
4	420.88	25.0 QP	46.0	-21.0	3.00 H	360	34.1	-9.1
5	575.22	22.5 QP	46.0	-23.5	1.50 H	359	28.6	-6.1
6	827.86	26.7 QP	46.0	-19.3	1.50 H	154	28.7	-2.0

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



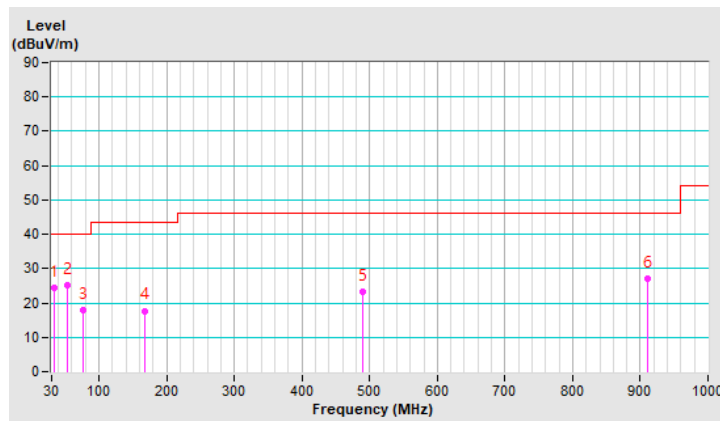
RF Mode	TX_GFSK	Channel	CH 70 : 2474 MHz
Frequency Range	9 kHz ~ 1 GHz	Detector Function & Bandwidth	(QP) RB = 120kHz
Input Power	1.5 Vdc	Environmental Conditions	25 °C, 69 % RH
Tested By	Sampson Chen		

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	33.15	24.3 QP	40.0	-15.7	1.00 V	360	38.1	-13.8
2	54.15	25.3 QP	40.0	-14.7	1.50 V	360	38.2	-12.9
3	77.19	17.9 QP	40.0	-22.1	1.00 V	329	34.8	-16.9
4	168.57	17.7 QP	43.5	-25.8	1.50 V	360	30.8	-13.1
5	490.24	23.2 QP	46.0	-22.8	1.00 V	246	30.9	-7.7
6	910.17	27.1 QP	46.0	-18.9	1.50 V	77	28.3	-1.2

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 of frequency range 30 MHz ~ 1 GHz.
5. The emission levels were very low against the limit of frequency range 9 kHz ~ 30 MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

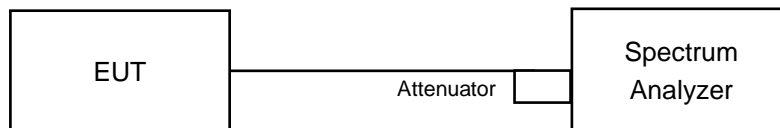


4.2 6dB Bandwidth Measurement

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

- a. Set resolution bandwidth (RBW) = 100kHz
- b. Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- c. Trace mode = max hold.
- d. Sweep = auto couple.
- e. 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.

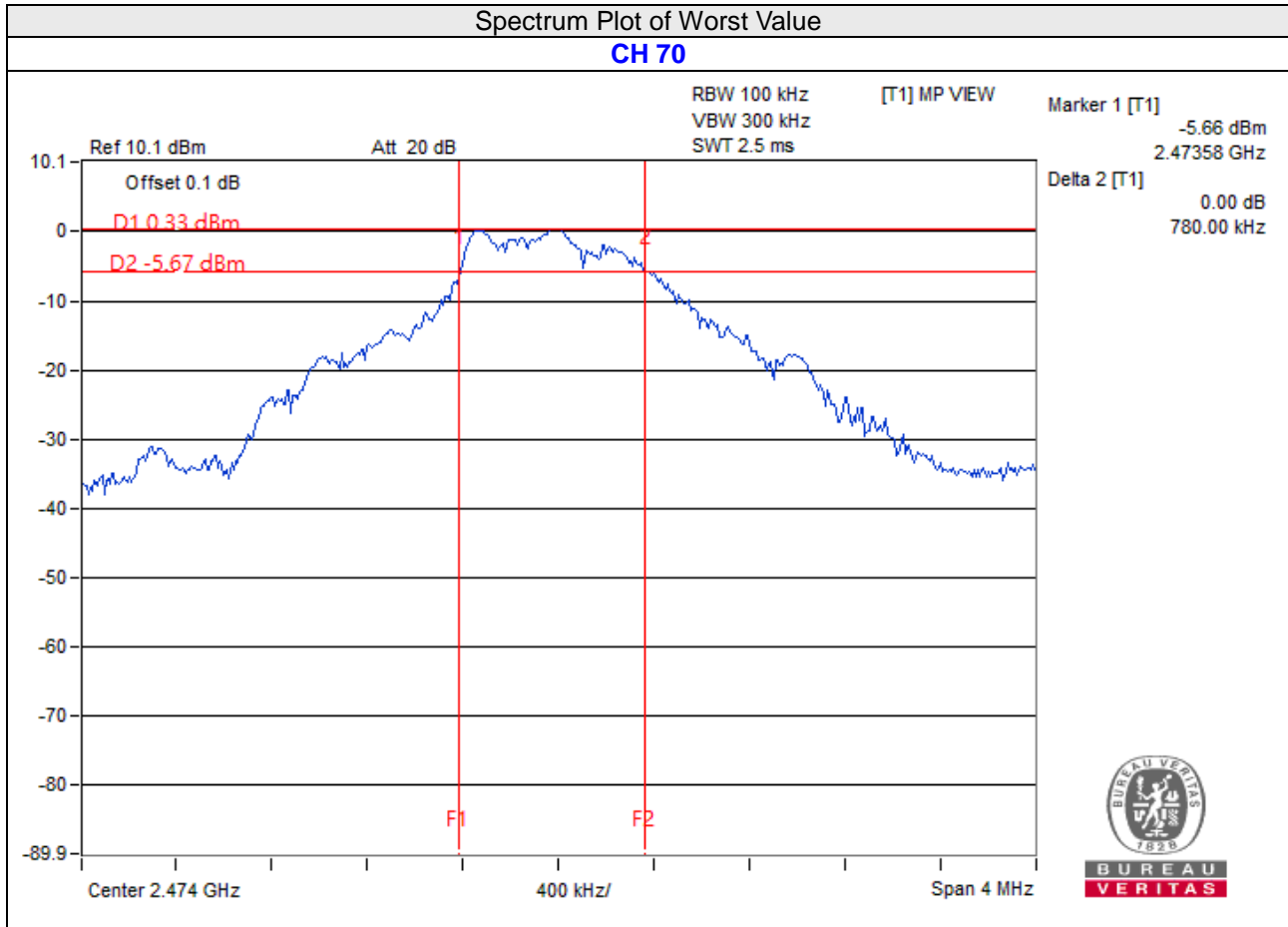
4.2.6 EUT Operating Conditions

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

- ◆ UFY TX Modulated standard duty cycle 2405MHz
- ◆ UFY TX Modulated standard duty cycle 2444MHz
- ◆ UFY TX Modulated standard duty cycle 2474MHz

4.2.7 Test Results

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2405	0.85	0.5	Pass
40	2444	0.8	0.5	Pass
70	2474	0.78	0.5	Pass

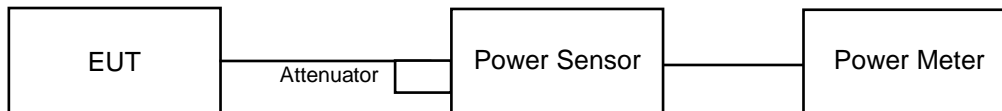


4.3 Conducted Output Power Measurement

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

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

- ◆ TX Modulated low duty cycle 2405MHz
- ◆ TX Modulated low duty cycle 2444MHz
- ◆ TX Modulated low duty cycle 2474MHz

4.3.7 Test Results

FOR PEAK POWER

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
1	2405	0.9036	-0.44	30	Pass
40	2444	1.04	0.17	30	Pass
70	2474	1.151	0.61	30	Pass

FOR AVERAGE POWER

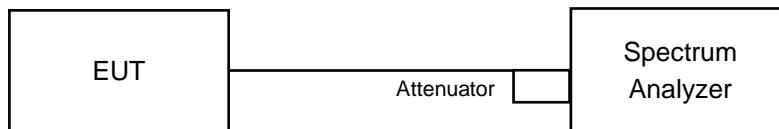
Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
1	2405	0.8933	-0.49
40	2444	1.033	0.14
70	2474	1.14	0.57

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

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

4.4.5 Deviation from Test Standard

No deviation.

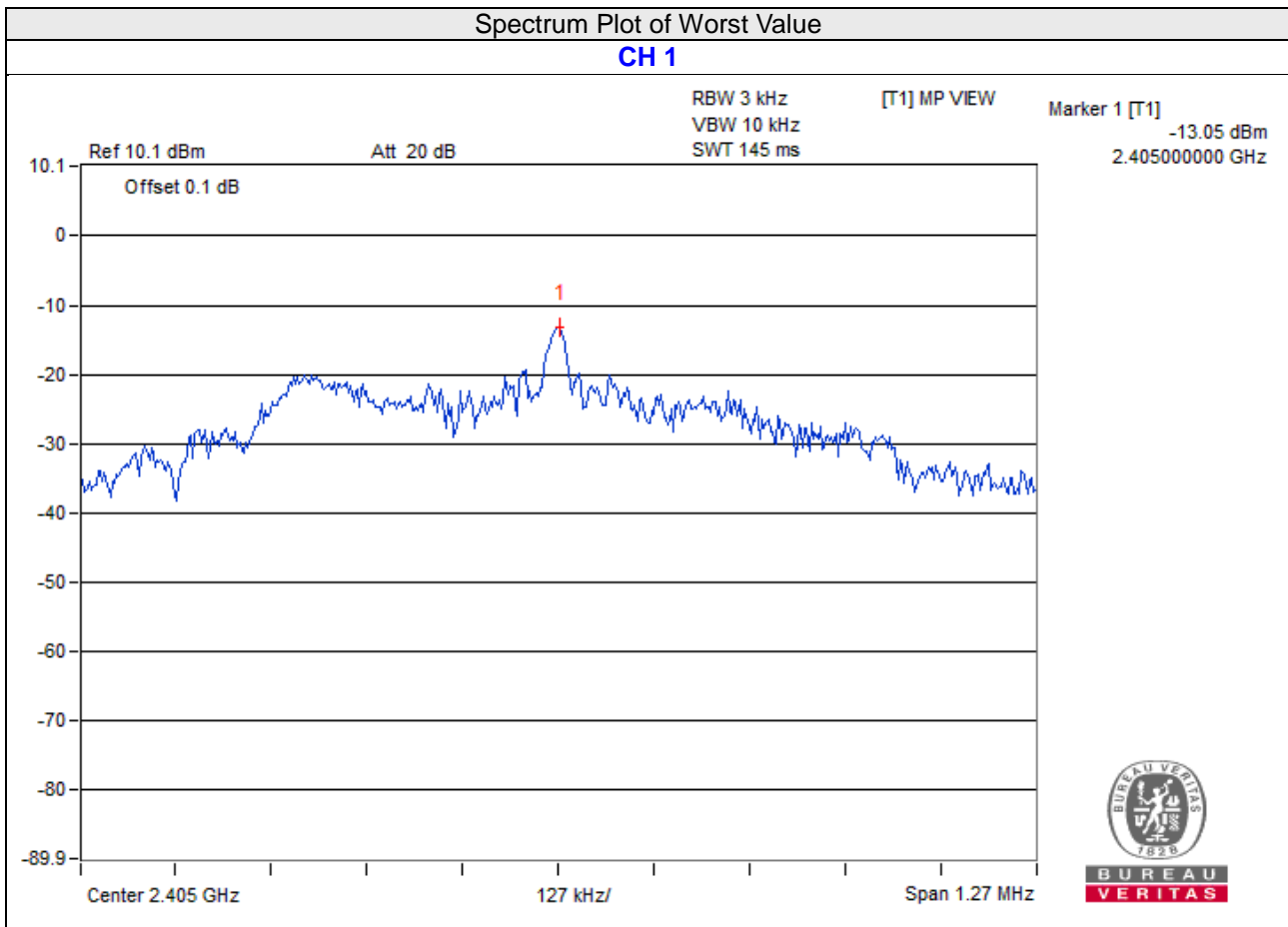
4.4.6 EUT Operating Condition

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

- ◆ UFY TX Modulated standard duty cycle 2405MHz
- ◆ UFY TX Modulated standard duty cycle 2444MHz
- ◆ UFY TX Modulated standard duty cycle 2474MHz

4.4.7 Test Results

Channel	Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass /Fail
1	2405	-13.05	8	Pass
40	2444	-13.61	8	Pass
70	2474	-13.70	8	Pass

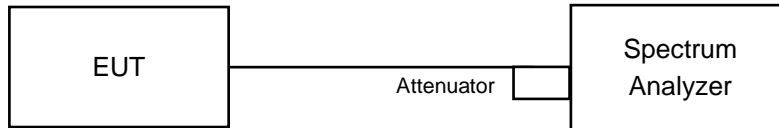


4.5 Conducted Out of Band Emission Measurement

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.

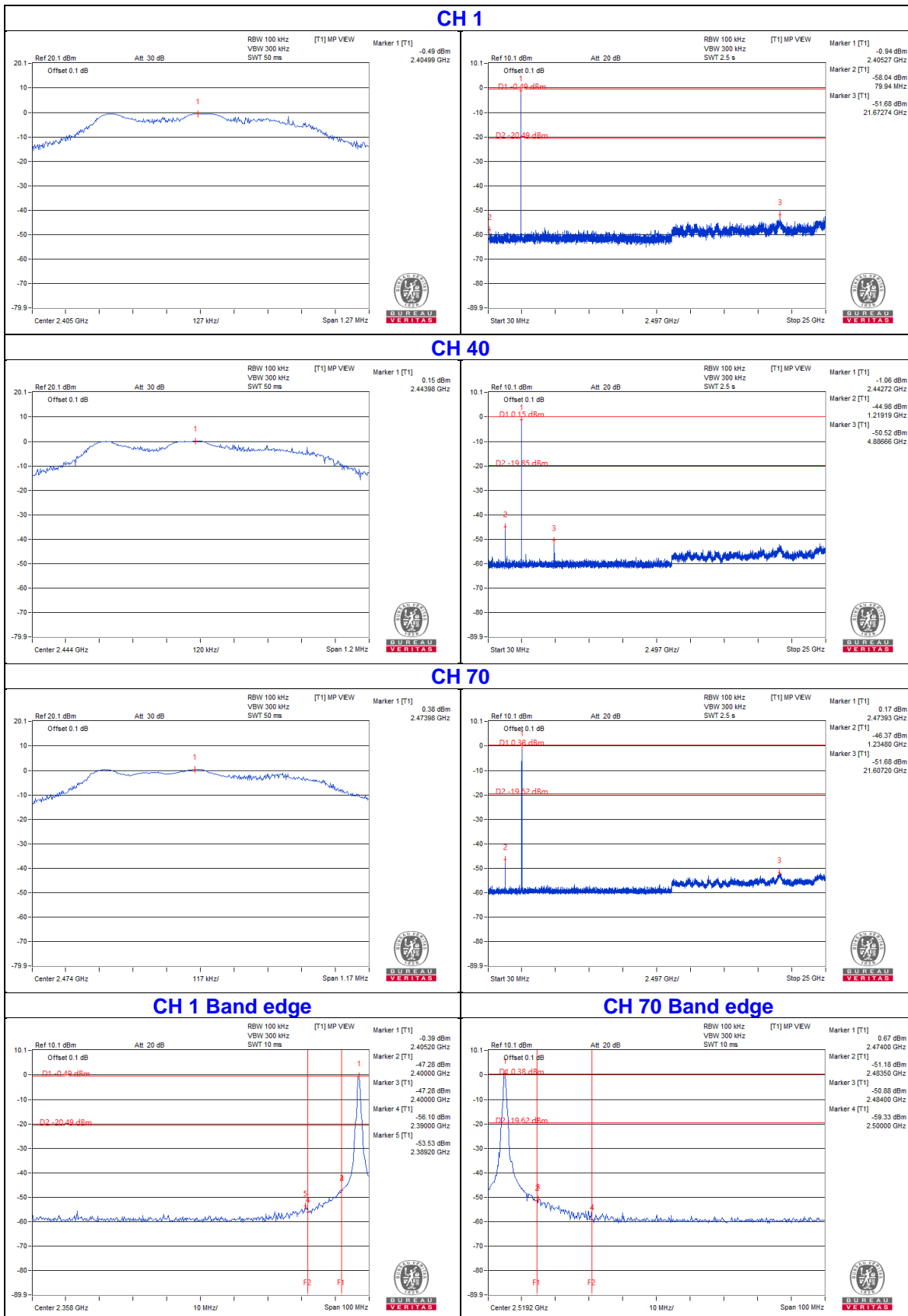
4.5.6 EUT Operating Condition

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

- ◆ UFY TX Modulated standard duty cycle 2405MHz
- ◆ UFY TX Modulated standard duty cycle 2444MHz
- ◆ UFY TX Modulated standard duty cycle 2474MHz

4.5.7 Test Results

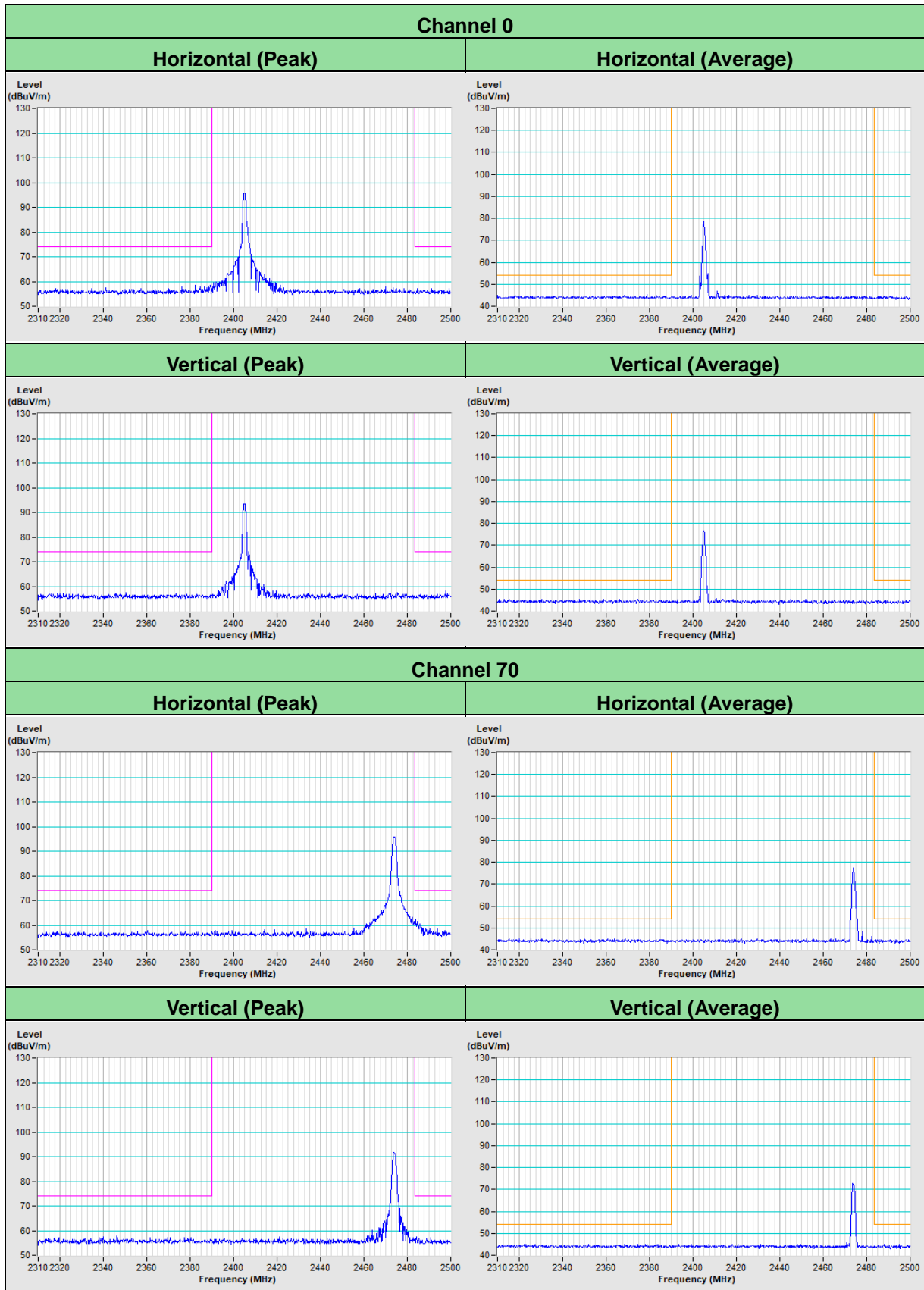
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.



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:

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Fax: 886-2-26051924

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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.

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