

## FCC Test Report

**Report No.:** RF180528C19-2

**FCC ID:** O57TBX705F

**Test Model:** Lenovo TB-X705F

**Received Date:** May 28, 2018

**Test Date:** Jun. 02, 2018 ~ Jun. 19, 2018

**Issued Date:** Jun. 25, 2018

**Applicant:** Lenovo(Shanghai) Electronics Technology Co., Ltd.

**Address:** NO.68 BUILDING, 199 FENJU RD, China (Shanghai) Pilot Free Trade Zone, 200131, CHINA

**Manufacturer:** Lenovo PC HK Limited

**Address:** 23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong

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

**Test Location (2):** No.215, Sec. 3, Beixin Rd., Xindian Dist., New Taipei City 231, Taiwan, R.O.C

**FCC Registration /  
Designation Number:** 427177 / TW0011



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. The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any government agencies.

## Table of Contents

<b>Release Control Record</b> .....	<b>4</b>
<b>1 Certificate of Conformity</b> .....	<b>5</b>
<b>2 Summary of Test Results</b> .....	<b>6</b>
2.1 Measurement Uncertainty .....	6
2.2 Modification Record .....	7
<b>3 General Information</b> .....	<b>8</b>
3.1 General Description of EUT .....	8
3.2 Description of Test Modes .....	10
3.2.1 Test Mode Applicability and Tested Channel Detail .....	11
3.3 Duty Cycle of Test Signal .....	12
3.4 Description of Support Units .....	13
3.4.1 Configuration of System under Test .....	13
3.5 General Description of Applied Standards .....	13
<b>4 Test Types and Results</b> .....	<b>14</b>
4.1 Radiated Emission and Bandedge Measurement .....	14
4.1.1 Limits of Radiated Emission and Bandedge Measurement .....	14
4.1.2 Test Instruments .....	15
4.1.3 Test Procedures .....	16
4.1.4 Deviation from Test Standard .....	16
4.1.5 Test Set Up .....	17
4.1.6 EUT Operating Conditions .....	18
4.1.7 Test Results .....	19
4.2 Conducted Emission Measurement .....	27
4.2.1 Limits of Conducted Emission Measurement .....	27
4.2.2 Test Instruments .....	27
4.2.3 Test Procedures .....	28
4.2.4 Deviation from Test Standard .....	28
4.2.5 Test Setup .....	28
4.2.6 EUT Operating Condition .....	28
4.2.7 Test Results .....	29
4.3 Number of Hopping Frequency Used .....	33
4.3.1 Limits of Hopping Frequency Used Measurement .....	33
4.3.2 Test Setup .....	33
4.3.3 Test Instruments .....	33
4.3.4 Test Procedure .....	33
4.3.5 Deviation from Test Standard .....	33
4.3.6 Test Results .....	34
4.4 Dwell Time on Each Channel .....	35
4.4.1 Limits of Dwell Time on Each Channel Measurement .....	35
4.4.2 Test Setup .....	35
4.4.3 Test Instruments .....	35
4.4.4 Test Procedures .....	35
4.4.5 Deviation from Test Standard .....	35
4.4.6 Test Results .....	36
4.5 Channel Bandwidth .....	38
4.5.1 Limits of Channel Bandwidth Measurement .....	38
4.5.2 Test Setup .....	38
4.5.3 Test Instruments .....	38
4.5.4 Test Procedure .....	38
4.5.5 Deviation from Test Standard .....	38
4.5.6 EUT Operating Condition .....	38
4.5.7 Test Results .....	39
4.6 Occupied Bandwidth Measurement .....	40

4.6.1	Test Setup .....	40
4.6.2	Test Instruments .....	40
4.6.3	Test Procedure .....	40
4.6.4	Deviation from Test Standard .....	40
4.6.5	EUT Operating Conditions .....	40
4.6.6	Test Results .....	41
4.7	Hopping Channel Separation .....	42
4.7.1	Limits of Hopping Channel Separation Measurement .....	42
4.7.2	Test Setup .....	42
4.7.3	Test Instruments .....	42
4.7.4	Test Procedure .....	42
4.7.5	Deviation from Test Standard .....	42
4.7.6	Test Results .....	43
4.8	Maximum Output Power .....	44
4.8.1	Limits of Maximum Output Power Measurement .....	44
4.8.2	Test Setup .....	44
4.8.3	Test Instruments .....	44
4.8.4	Test Procedure .....	44
4.8.5	Deviation from Test Standard .....	44
4.8.6	EUT Operating Condition .....	44
4.8.7	Test Results .....	45
4.9	Conducted Out of Band Emission Measurement .....	46
4.9.1	Limits Of Conducted Out of Band Emission Measurement .....	46
4.9.2	Test Instruments .....	46
4.9.3	Test Procedure .....	46
4.9.4	Deviation from Test Standard .....	46
4.9.5	EUT Operating Condition .....	46
4.9.6	Test Results .....	46
<b>5</b>	<b>Pictures of Test Arrangements .....</b>	<b>51</b>
	<b>Appendix – Information on the Testing Laboratories .....</b>	<b>52</b>

### Release Control Record

Issue No.	Description	Date Issued
RF180528C19-2	Original Release	Jun. 25, 2018

## 1 Certificate of Conformity

**Product:** Portable Tablet Computer

**Brand:** Lenovo

**Test Model:** Lenovo TB-X705F

**Sample Status:** Production Unit

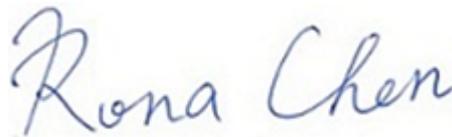
**Applicant:** Lenovo(Shanghai) Electronics Technology Co., Ltd.

**Test Date:** Jun. 02, 2018 ~ Jun. 19, 2018

**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 RF characteristics under the conditions specified in this report.

**Prepared by :**



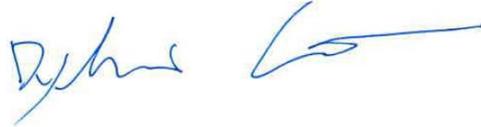
,

**Date:**

Jun. 25, 2018

Rona Chen / Specialist

**Approved by :**



,

**Date:**

Jun. 25, 2018

Dylan Chiou / Project Engineer

## 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	Meet the requirement of limit. Minimum passing margin is -8.28 dB at 0.20474 MHz.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	Pass	Meet the requirement of limit.
15.247(a)(1)(iii)	Dwell Time on Each Channel	Pass	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	Pass	Meet the requirement of limit.
15.247(b)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	Pass	Reference only
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -11.67 dB at 77.25 MHz.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

**Note:** If The Frequency Hopping System operating in 2400-2483.5 MHz band and the output power less than 125 mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of hopping channel whichever is greater.

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.0153 dB
	200 MHz ~ 1000 MHz	2.0224 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	1.0121 dB
	18 GHz ~ 40 GHz	1.1508 dB

## 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

<b>Product</b>	Portable Tablet Computer
<b>Brand</b>	Lenovo
<b>Test Model</b>	Lenovo TB-X705F
<b>Status of EUT</b>	Production Unit
<b>Power Supply Rating</b>	3.85 Vdc (Battery) 5 Vdc (Adapter or host equipment)
<b>Modulation Type</b>	GFSK, $\pi/4$ -DQPSK, 8DPSK
<b>Transfer Rate</b>	1/2/3 Mbps
<b>Operating Frequency</b>	2402 ~ 2480 MHz
<b>Number of Channel</b>	79
<b>Output Power</b>	10.86 dBm / 12.19 mW
<b>Antenna Type</b>	Monopole antenna with -2.47 dBi gain
<b>Antenna Connector</b>	N/A
<b>Product HW Version</b>	Lenovo Tablet TB-X705F
<b>Product SW Version</b>	TB-X705F_RF01_20180518
<b>Accessory Device</b>	Refer to Note as below
<b>Data Cable Supplied</b>	Refer to Note as below

Note:

- The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter 1	Salom	SC-41	I/P: 100-240 Vac, 50/60 Hz, 0.3 A O/P: 5 Vdc, 2 A
Adapter 2	AcBel	SC-41	I/P: 100-240 Vac, 50/60 Hz, 0.3 A O/P: 5 Vdc, 2 A
Battery 1	SCUD	L16D2P31	3.85 Vdc, 7000 mAh
Battery 2	Celxpert	L16D2P31	3.85 Vdc, 7000 mAh
USB Cable 1 (White)	LiQi	LQ-02300039	1 m shielded cable w/o core
USB Cable 2 (Black)	LiQi	LQ-02300040	1 m shielded cable w/o core
LCD Panel 1	BOE	TV101WUM-LL0/TV101WUM-LL1	10.1 "
LCD Panel 2	INNOLUX	P101KZD-AF0/P101KZD-AF1	10.1 "
Photo Camera 1	O-film	L8856A00	8M AF
Photo Camera 2	Q-tech	F8856CB	8M AF
Photo Camera 3	Lcetron	LE5132FM	5M FF
Photo Camera 4	Holitech	MF80G	5M FF
CPU	Qualcomm	SDA-450-A-792NSP-TR-01-0-AA	792nsp

\* USB Cable 1 and USB Cable 2 is electrically identical, difference models are for color distinguished. Therefore, only USB Cable 1 is as a representative for final test.

Product	Brand	Model	Description
EMMC1 + DDR1	SAMSUNG	KMGD6001BM-B421 (3+32)	32G
EMMC2 + DDR2	HYNIX	H9TQ26ADFTBCUR-KUM (3+32)	32G
EMMC3 + DDR3	SAMSUNG	KMRH60014A-B614 (4+64)	64G
EMMC4 + DDR4	HYNIX	H9TQ52ACLTMCUR-KUM (4+64)	64G
Speaker	Keysound	QM171219AM48	--
Motor 1	AWA	YK2455R	--
Motor 2	Baolong	BLX-431320S	--
Main Board 1	huashen	W92ME1B3-3-03	--
Main Board 2	yilianda	W92ME1B3-3-05	--
BT/WLAN Module	Qualcomm	WCN-3680B-0-79BWLNSP	--

2. The Adapter 1 and Adapter 2 had been pre-tested to determine the worst-case. The worst case was found in Adapter 1. Therefore, only Adapter 1 was chosen for the final test.
3. The EUT contains two samples.

Sample	Configurations
A	EUT + Battery 1 + LCD Panel 1 + Photo Camera 1 + Photo Camera 3 + EMMC 3 + DDR 3 + Motor 1 + Main Board 1
B	EUT + Battery 2 + LCD Panel 2 + Photo Camera 2 + Photo Camera 4 + EMMC 4 + DDR 4 + Motor 2 + Main Board 2

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.

### 3.2 Description of Test Modes

79 channels are provided to this EUT:

Channel	Freq. (MHz)						
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

### 3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE $\geq$ 1G	RE $<$ 1G	PLC	APCM	
A	√	√	√	√	Sample A
B	-	√	√	-	Sample B

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

**NOTE:**

1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-plane**.
2. “-” means no effect.

**Radiated Emission Test (Above 1 GHz):**

- 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 Technology	Modulation Type	Packet Type
A	0 to 78	0, 39, 78	FHSS	GFSK	DH5
	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

**Radiated Emission Test (Below 1 GHz):**

- 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 Technology	Modulation Type	Packet Type
A, B	0 to 78	78	FHSS	GFSK	DH5

**Power Line Conducted Emission Test:**

- 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	Test Condition
A, B	BT + USB Cable + Adapter

**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.

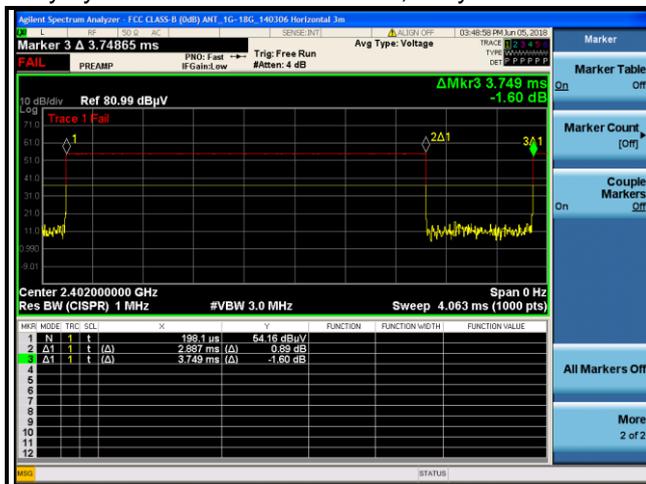
EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
A	0 to 78	0, 39, 78	FHSS	GFSK	DH5
	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

**Test Condition:**

Applicable To	Environmental Conditions	Input Power	Tested by
RE≥1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Charles Hsiao
RE<1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Charles Hsiao
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Getaz Yang Jisyong Wang
APCM	25 deg. C, 65 % RH	3.85 Vdc	Gavin Wu

**3.3 Duty Cycle of Test Signal**

Duty cycle = 2.887/3.749 = 0.770, Duty factor = 10 \* log(1/0.770) = 1.1



### 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.

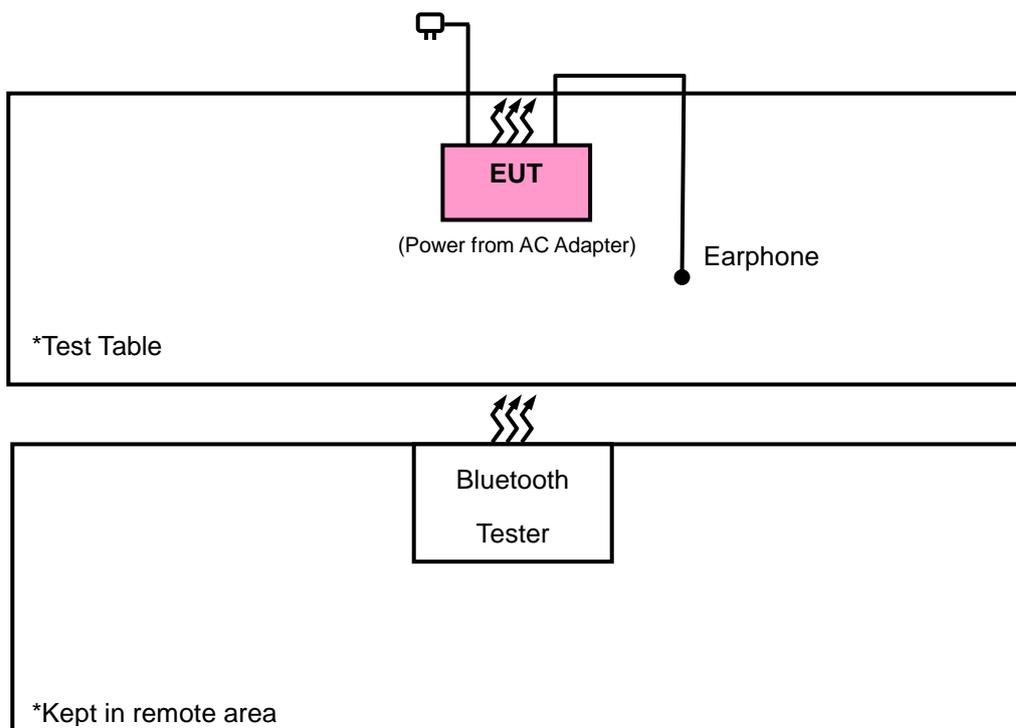
No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Earphone	N/A	N/A	N/A	N/A

No.	Signal Cable Description of The Above Support Units
1.	N/A

Note:

1. All power cords of the above support units are non-shielded (1.8m).

#### 3.4.1 Configuration of System under Test



### 3.5 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)

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 20 dB 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 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent Technologies	N9038A	MY52260177	Jul. 05, 2017	Jul. 04, 2018
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Jan. 11, 2018	Jan. 10, 2019
Double Ridge Guide Horn Antenna EMCO	3115	5619	Nov. 30, 2017	Nov. 29, 2018
BILOG Antenna SCHWARZBECK	VULB 9168	9168-153	Dec. 06, 2017	Dec. 05, 2018
Fixed Attenuator Mini-Circuits	BW-N10W5+	NA	Jul. 07, 2017	Jul. 06, 2018
Bluetooth Tester	CBT	100980	Jun. 28, 2017	Jun. 27, 2019
Loop Antenna	EM-6879	269	Aug. 11, 2017	Aug. 10, 2018
Preamplifier Agilent	310N	187226	Jun. 23, 2017	Jun. 22, 2018
Preamplifier Agilent	83017A	MY39501357	Jun. 23, 2017	Jun. 22, 2018
HORN Antenna Schwarzbeck	BBHA 9120D	9120D-969	Dec. 12, 2017	Dec. 11, 2018
Power Meter Anritsu	ML2495A	1012010	Aug. 15, 2017	Aug. 14, 2018
Power Sensor Anritsu	MA2411B	1315050	Aug. 15, 2017	Aug. 14, 2018
RF signal cable ETS-LINDGREN	5D-FB	Cable-CH1-01(RFC -SMS-100-SMS-12 0+RFC-SMS-100-S MS-400)	Jun. 26, 2017	Jun. 25, 2018
RF signal cable ETS-LINDGREN	8D-FB	Cable-CH1-02(RFC -SMS-100-SMS-24)	Jun. 26, 2017	Jun. 25, 2018
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 8.130425b	NA	NA	NA
Antenna Tower MF	NA	NA	NA	NA
Turn Table MF	NA	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	NA	NA	NA

- Note: 1. The calibration interval of the above test instruments is 12/24 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HsinTien Chamber 1.
3. The horn antenna and preamplifier (model: 83017A) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The IC Site Registration No. is IC7450I-1.

#### 4.1.3 Test Procedures

##### **For Radiated Emission below 30 MHz**

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 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. Both 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 9 kHz at frequency below 30 MHz.

##### **For Radiated Emission above 30 MHz**

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) 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 detected 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:**

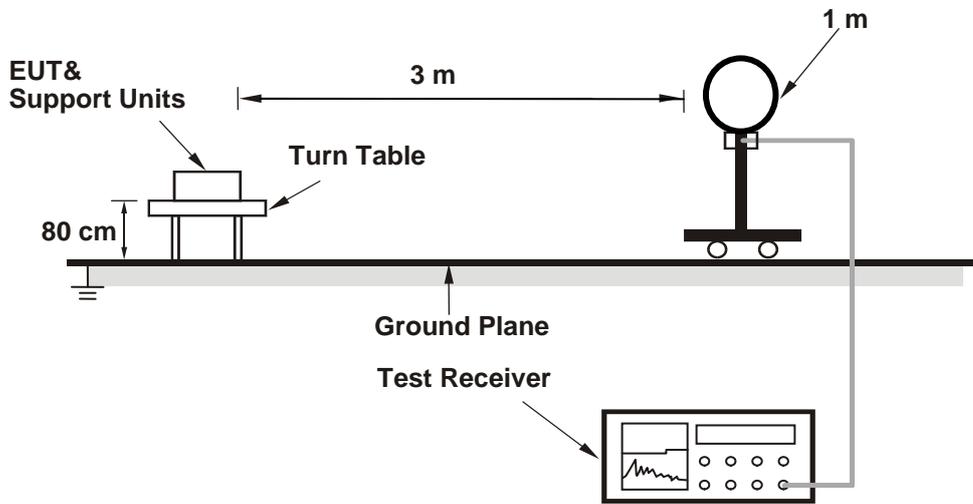
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98 %) or 10 Hz (Duty cycle  $\geq 98$  %) for Average detection (AV) at frequency above 1 GHz. (RBW = 1 MHz, VBW = 1 kHz)
4. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

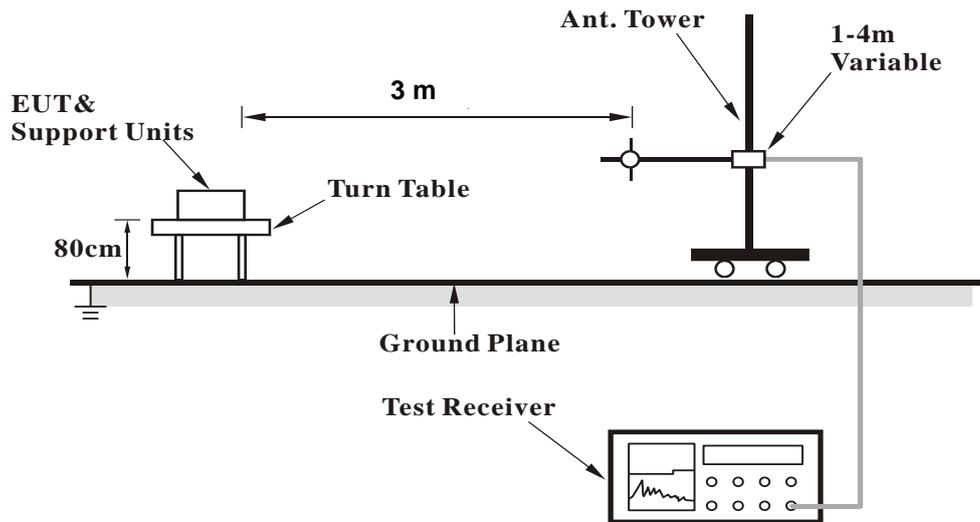
No deviation.

4.1.5 Test Set Up

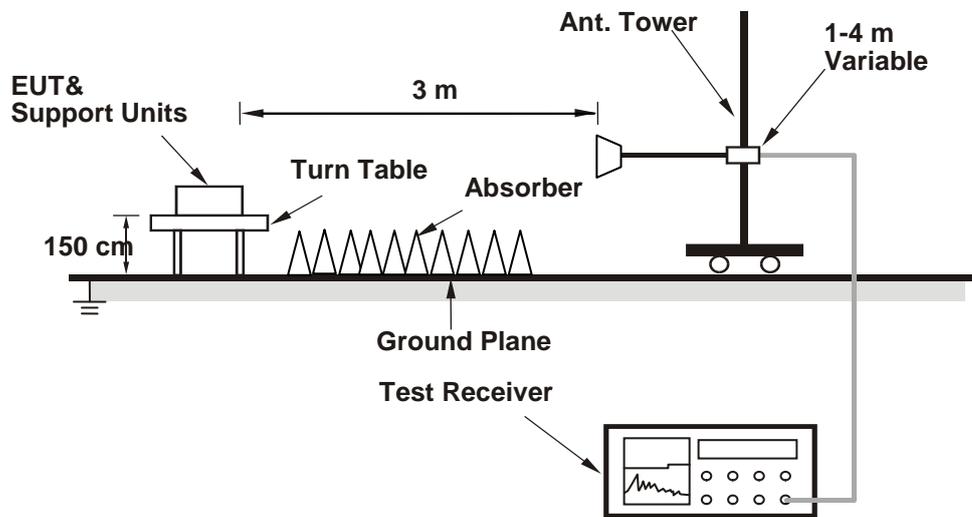
<Radiated Emission below 30 MHz>



<Radiated Emission 30 MHz to 1 GHz>



**<Radiated Emission above 1 GHz>**



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 1 GHz Data:

Mode A

GFSK

EUT Test Condition		Measurement Detail	
Channel	Channel 0	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Charles Hsiao

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2377.77	40.38	38.72	54	-13.62	31.78	5.37	35.49	263	128	Average
2377.77	52.05	50.39	74	-21.95	31.78	5.37	35.49	263	128	Peak
2402	103.6	101.87			31.8	5.4	35.47	263	128	Average
2402	106.24	104.51			31.8	5.4	35.47	263	128	Peak
4804	40.59	32.5	54	-13.41	33.96	8.25	34.12	147	207	Average
4804	47.62	39.53	74	-26.38	33.96	8.25	34.12	147	207	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2374.62	40.3	38.64	54	-13.7	31.78	5.37	35.49	100	91	Average
2374.62	51.16	49.5	74	-22.84	31.78	5.37	35.49	100	91	Peak
2402	100.47	98.74			31.8	5.4	35.47	100	91	Average
2402	103.41	101.68			31.8	5.4	35.47	100	91	Peak
4804	40.62	32.53	54	-13.38	33.96	8.25	34.12	154	55	Average
4804	48.31	40.22	74	-25.69	33.96	8.25	34.12	154	55	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2402 MHz: Fundamental frequency.
- The other emission levels were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Charles Hsiao

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2387.31	40.46	38.75	54	-13.54	31.8	5.4	35.49	263	128	Average
2387.31	52.03	50.32	74	-21.97	31.8	5.4	35.49	263	128	Peak
2441	103.49	101.62			31.85	5.46	35.44	263	128	Average
2441	106.01	104.14			31.85	5.46	35.44	263	128	Peak
2487.28	41.03	39.04	54	-12.97	31.88	5.53	35.42	263	128	Average
2487.28	52.32	50.33	74	-21.68	31.88	5.53	35.42	263	128	Peak
4882	40.68	32.49	54	-13.32	33.98	8.27	34.06	127	7	Average
4882	46.95	38.76	74	-27.05	33.98	8.27	34.06	127	7	Peak

Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2387.22	40.35	38.64	54	-13.65	31.8	5.4	35.49	100	91	Average
2387.22	51.72	50.01	74	-22.28	31.8	5.4	35.49	100	91	Peak
2441	100.43	98.56			31.85	5.46	35.44	100	91	Average
2441	103.84	101.97			31.85	5.46	35.44	100	91	Peak
2498.96	41	38.98	54	-13	31.9	5.53	35.41	100	91	Average
2498.96	52.3	50.28	74	-21.7	31.9	5.53	35.41	100	91	Peak
4882	41.03	32.84	54	-12.97	33.98	8.27	34.06	127	333	Average
4882	47.32	39.13	74	-26.68	33.98	8.27	34.06	127	333	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2441 MHz: Fundamental frequency.
- The other emission levels were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 78	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Charles Hsiao

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	103.33	101.37			31.88	5.5	35.42	263	128	Average
2480	106.31	104.35			31.88	5.5	35.42	263	128	Peak
2483.52	41.68	39.72	54	-12.32	31.88	5.5	35.42	263	128	Average
2483.52	54.35	52.39	74	-19.65	31.88	5.5	35.42	263	128	Peak
4960	40.75	32.48	54	-13.25	33.99	8.29	34.01	157	77	Average
4960	47.37	39.1	74	-26.63	33.99	8.29	34.01	157	77	Peak

Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	100.74	98.78			31.88	5.5	35.42	100	91	Average
2480	103.19	101.23			31.88	5.5	35.42	100	91	Peak
2483.6	41.47	39.51	54	-12.53	31.88	5.5	35.42	100	91	Average
2483.6	52.69	50.73	74	-21.31	31.88	5.5	35.42	100	91	Peak
4960	40.84	32.57	54	-13.16	33.99	8.29	34.01	117	58	Average
4960	48	39.73	74	-26	33.99	8.29	34.01	117	58	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2480 MHz: Fundamental frequency.
- The other emission levels were very low against the limit.

## 8DPSK

EUT Test Condition		Measurement Detail	
Channel	Channel 0	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Charles Hsiao

### Antenna Polarity & Test Distance: Horizontal at 3 m

Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2388.03	40.43	38.72	54	-13.57	31.8	5.4	35.49	263	128	Average
2388.03	51.66	49.95	74	-22.34	31.8	5.4	35.49	263	128	Peak
2402	100.17	98.44			31.8	5.4	35.47	263	128	Average
2402	105.09	103.36			31.8	5.4	35.47	263	128	Peak
4804	40.56	32.47	54	-13.44	33.96	8.25	34.12	124	210	Average
4804	46.61	38.52	74	-27.39	33.96	8.25	34.12	124	210	Peak

### Antenna Polarity & Test Distance: Vertical at 3 m

Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.47	40.44	38.73	54	-13.56	31.8	5.4	35.49	100	91	Average
2389.47	51.64	49.93	74	-22.36	31.8	5.4	35.49	100	91	Peak
2402	97.2	95.47			31.8	5.4	35.47	100	91	Average
2402	102.43	100.7			31.8	5.4	35.47	100	91	Peak
4804	40.16	32.07	54	-13.84	33.96	8.25	34.12	135	216	Average
4804	47.14	39.05	74	-26.86	33.96	8.25	34.12	135	216	Peak

#### Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2402 MHz: Fundamental frequency.
- The other emission levels were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Charles Hsiao

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2387.49	40.36	38.65	54	-13.64	31.8	5.4	35.49	263	128	Average
2387.49	51.71	50	74	-22.29	31.8	5.4	35.49	263	128	Peak
2441	100.39	98.52			31.85	5.46	35.44	263	128	Average
2441	105.8	103.93			31.85	5.46	35.44	263	128	Peak
2494.88	41.02	39	54	-12.98	31.9	5.53	35.41	263	128	Average
2494.88	52.17	50.15	74	-21.83	31.9	5.53	35.41	263	128	Peak
4882	40.84	32.65	54	-13.16	33.98	8.27	34.06	185	188	Average
4882	47.15	38.96	74	-26.85	33.98	8.27	34.06	185	188	Peak

Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2381.82	40.42	38.73	54	-13.58	31.78	5.4	35.49	100	91	Average
2381.82	51.91	50.22	74	-22.09	31.78	5.4	35.49	100	91	Peak
2441	97.85	95.98			31.85	5.46	35.44	100	91	Average
2441	102.79	100.92			31.85	5.46	35.44	100	91	Peak
2491.6	41.1	39.09	54	-12.9	31.9	5.53	35.42	100	91	Average
2491.6	52.81	50.8	74	-21.19	31.9	5.53	35.42	100	91	Peak
4882	40.62	32.43	54	-13.38	33.98	8.27	34.06	125	175	Average
4882	47.03	38.84	74	-26.97	33.98	8.27	34.06	125	175	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2441 MHz: Fundamental frequency.
- The other emission levels were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 78	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Charles Hsiao

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	100.25	98.29			31.88	5.5	35.42	263	128	Average
2480	105.43	103.47			31.88	5.5	35.42	263	128	Peak
2483.88	41.6	39.64	54	-12.4	31.88	5.5	35.42	263	128	Average
2483.88	52.37	50.41	74	-21.63	31.88	5.5	35.42	263	128	Peak
4960	40.72	32.45	54	-13.28	33.99	8.29	34.01	147	224	Average
4960	47.87	39.6	74	-26.13	33.99	8.29	34.01	147	224	Peak

Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	97.7	95.74			31.88	5.5	35.42	100	91	Average
2480	102.07	100.11			31.88	5.5	35.42	100	91	Peak
2483.72	41.51	39.55	54	-12.49	31.88	5.5	35.42	100	91	Average
2483.72	52.22	50.26	74	-21.78	31.88	5.5	35.42	100	91	Peak
4960	40.64	32.37	54	-13.36	33.99	8.29	34.01	172	123	Average
4960	47.71	39.44	74	-26.29	33.99	8.29	34.01	172	123	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2480 MHz: Fundamental frequency.
- The other emission levels were very low against the limit.

**9 kHz ~ 30 MHz Data:**

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

**30 MHz ~ 1 GHz Worst-Case Data:**

**Mode A**

EUT Test Condition		Measurement Detail	
Channel	Channel 78	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Charles Hsiao

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
77.25	28.33	51.11	40	-11.67	8.33	1.11	32.22	152	243	Peak
178.5	21.46	42.47	43.5	-22.04	9.62	1.61	32.24	186	219	Peak
251.94	27.04	44.85	46	-18.96	12.35	1.94	32.1	152	116	Peak
380.5	22.28	37.59	46	-23.72	14.59	2.26	32.16	130	248	Peak
718.6	20.8	30.25	46	-25.2	19.5	3.16	32.11	171	45	Peak
939.1	31.09	37	46	-14.91	21.66	3.62	31.19	128	199	Peak

Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
57.27	23.88	41.38	40	-16.12	13.83	0.9	32.23	196	313	Peak
109.65	11.09	30.03	43.5	-32.41	12.03	1.28	32.25	121	184	Peak
260.85	13.52	31.18	46	-32.48	12.5	1.94	32.1	165	223	Peak
456.1	15.71	29.71	46	-30.29	15.65	2.49	32.14	123	150	Peak
691.3	21.29	31.23	46	-24.71	19.11	3.05	32.1	191	211	Peak
937	31.97	37.91	46	-14.03	21.65	3.62	31.21	130	250	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- The other emission levels were very low against the limit.

### Mode B

EUT Test Condition		Measurement Detail	
Channel	Channel 78	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Charles Hsiao

#### Antenna Polarity & Test Distance: Horizontal at 3 m

Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
96.42	15.17	34.18	43.5	-28.33	11.75	1.28	32.04	145	167	Peak
155.28	21.38	43.57	43.5	-22.12	8.56	1.52	32.27	185	243	Peak
245.19	26.67	44.73	46	-19.33	12.21	1.85	32.12	191	240	Peak
386.8	21.18	36.29	46	-24.82	14.73	2.34	32.18	108	221	Peak
766.9	19.76	28.67	46	-26.24	19.99	3.22	32.12	178	263	Peak
937	29.82	35.76	46	-16.18	21.65	3.62	31.21	128	129	Peak

#### Antenna Polarity & Test Distance: Vertical at 3 m

Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
61.54	23.49	41.96	40	-16.51	12.86	0.9	32.23	145	223	Peak
102.36	10.51	29.13	43.5	-32.99	12.36	1.28	32.26	175	132	Peak
243.03	12.19	30.29	46	-33.81	12.17	1.85	32.12	111	246	Peak
396.6	15.77	30.72	46	-30.23	14.93	2.34	32.22	185	229	Peak
668.2	20.65	30.99	46	-25.35	18.74	3.05	32.13	133	340	Peak
937.7	31.29	37.21	46	-14.71	21.66	3.62	31.2	102	112	Peak

#### Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- The other emission levels were very low against the limit.

## 4.2 Conducted Emission Measurement

### 4.2.1 Limits of Conducted Emission Measurement

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

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

### 4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Nov. 23, 2017	Nov. 22, 2018
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond1-01	Sep. 05, 2017	Sep. 04, 2018
LISN/AMN ROHDE & SCHWARZ (EUT)	ESH3-Z5	835239/001	Mar. 06, 2018	Mar. 05, 2019
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 15, 2017	Aug. 14, 2018
Software ADT	BV ADT_Cond_ V7.3.7.4	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 test was performed in HwaYa Shielded Room 1.  
 3. The VCCI Site Registration No. is C-2040.

#### 4.2.3 Test Procedures

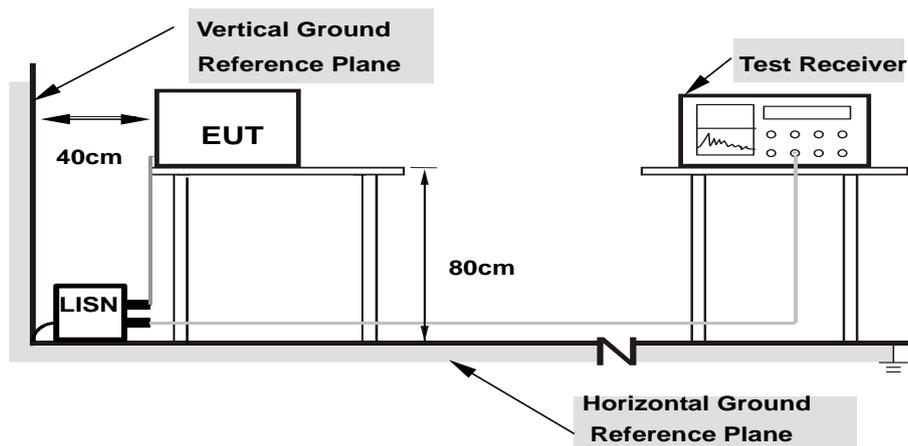
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

**Note:** The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz - 30 MHz.

#### 4.2.4 Deviation from Test Standard

No deviation.

#### 4.2.5 Test Setup



- Note:**
1. Support units were connected to second LISN.
  2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

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

#### 4.2.6 EUT Operating Condition

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

4.2.7 Test Results

**CONDUCTED WORST-CASE DATA : GFSK**

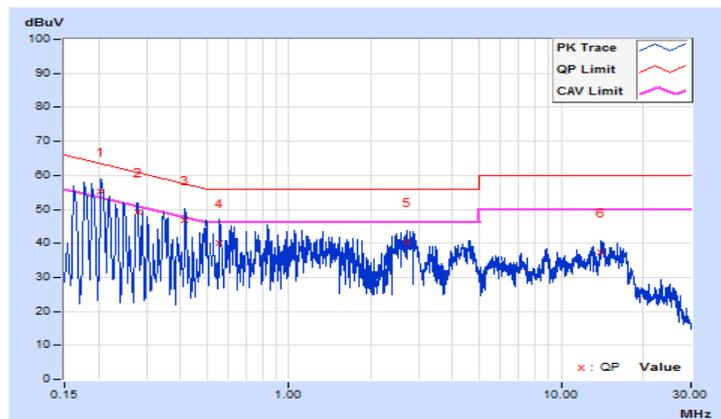
**Mode A**

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Getaz Yang	Test Date	2018/6/5

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	<b>0.20474</b>	<b>10.10</b>	<b>45.04</b>	<b>28.75</b>	<b>55.14</b>	<b>38.85</b>	<b>63.42</b>	<b>53.42</b>	<b>-8.28</b>	<b>-14.57</b>
2	0.27844	10.11	39.11	22.87	49.22	32.98	60.86	50.86	-11.64	-17.88
3	0.41588	10.12	36.71	19.13	46.83	29.25	57.53	47.53	-10.70	-18.28
4	0.55679	10.12	30.00	15.30	40.12	25.42	56.00	46.00	-15.88	-20.58
5	2.72278	10.22	30.03	15.33	40.25	25.55	56.00	46.00	-15.75	-20.45
6	14.08133	10.86	26.44	10.57	37.30	21.43	60.00	50.00	-22.70	-28.57

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

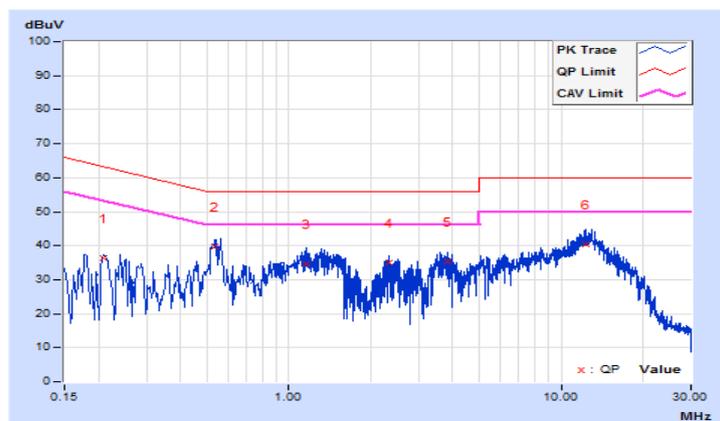


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Getaz Yang	Test Date	2018/6/5

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.20838	10.10	26.22	15.49	36.32	25.59	63.27	53.27	-26.95	-27.68
2	0.53318	10.12	29.48	18.70	39.60	28.82	56.00	46.00	-16.40	-17.18
3	1.16660	10.14	24.40	12.86	34.54	23.00	56.00	46.00	-21.46	-23.00
4	2.33960	10.19	24.66	12.10	34.85	22.29	56.00	46.00	-21.15	-23.71
5	3.81367	10.26	25.21	11.92	35.47	22.18	56.00	46.00	-20.53	-23.82
6	12.26318	10.62	29.91	15.15	40.53	25.77	60.00	50.00	-19.47	-24.23

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



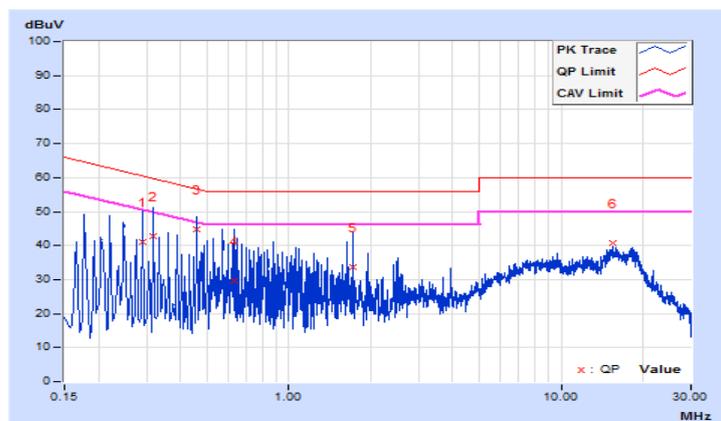
**Mode B**

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Jisyong Wang	Test Date	2018/6/19

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.29076	10.11	30.96	8.39	41.07	18.50	60.50	50.50	-19.43	-32.00
2	0.31813	10.11	32.63	10.27	42.74	20.38	59.76	49.76	-17.02	-29.38
3	0.45889	10.12	34.56	8.63	44.68	18.75	56.71	46.71	-12.03	-27.96
4	0.62689	10.13	19.36	5.50	29.49	15.63	56.00	46.00	-26.51	-30.37
5	1.71009	10.17	23.61	2.21	33.78	12.38	56.00	46.00	-22.22	-33.62
6	15.50848	10.95	29.80	17.77	40.75	28.72	60.00	50.00	-19.25	-21.28

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

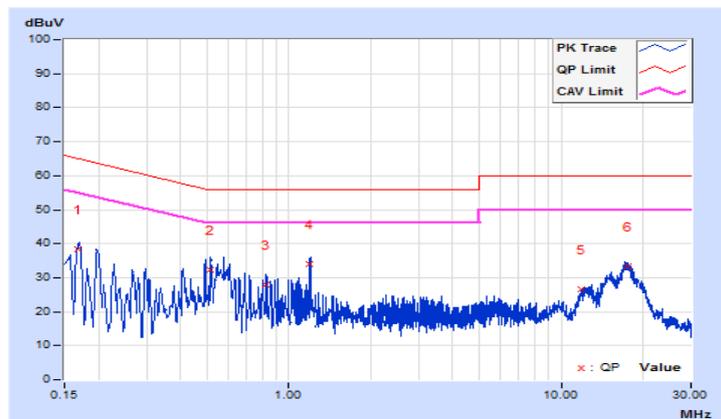


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Jisyong Wang	Test Date	2018/6/19

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16834	9.68	28.56	15.58	38.24	25.26	65.04	55.04	-26.80	-29.78
2	0.51754	9.68	22.72	6.08	32.40	15.76	56.00	46.00	-23.60	-30.24
3	0.82669	9.68	18.12	3.88	27.80	13.56	56.00	46.00	-28.20	-32.44
4	1.19549	9.69	24.36	11.16	34.05	20.85	56.00	46.00	-21.95	-25.15
5	11.80571	9.91	16.68	3.89	26.59	13.80	60.00	50.00	-33.41	-36.20
6	17.54168	10.01	23.36	10.81	33.37	20.82	60.00	50.00	-26.63	-29.18

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

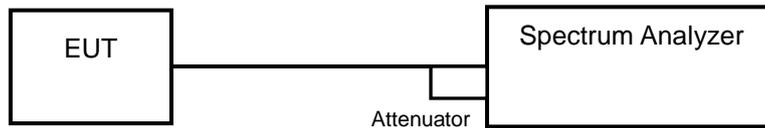


### 4.3 Number of Hopping Frequency Used

#### 4.3.1 Limits of Hopping Frequency Used Measurement

At least 15 channels frequencies, and should be equally spaced.

#### 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 Procedure

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- d. Set the SA on View mode and then plot the result on SA screen.
- e. Repeat above procedures until all frequencies measured were complete.

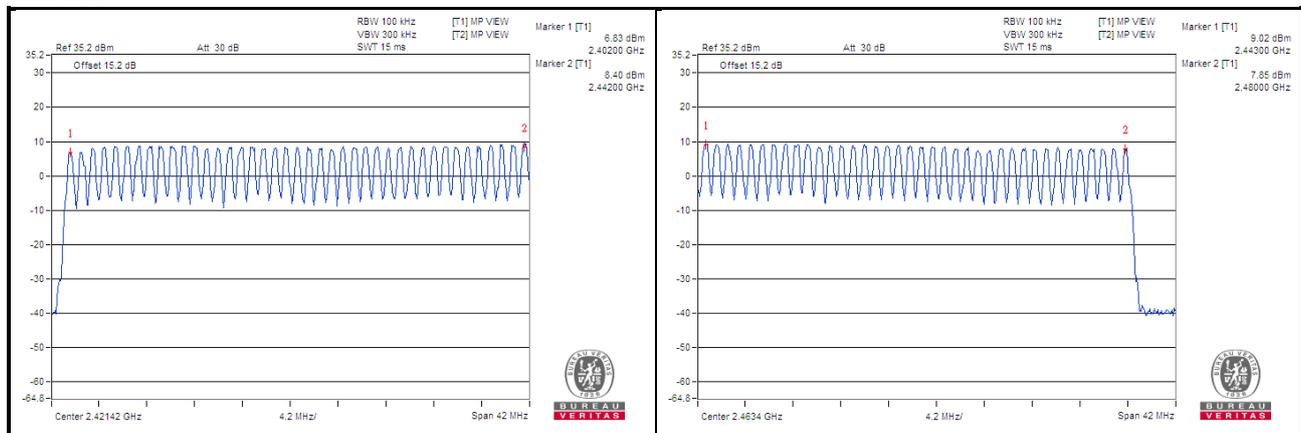
#### 4.3.5 Deviation from Test Standard

No deviation.

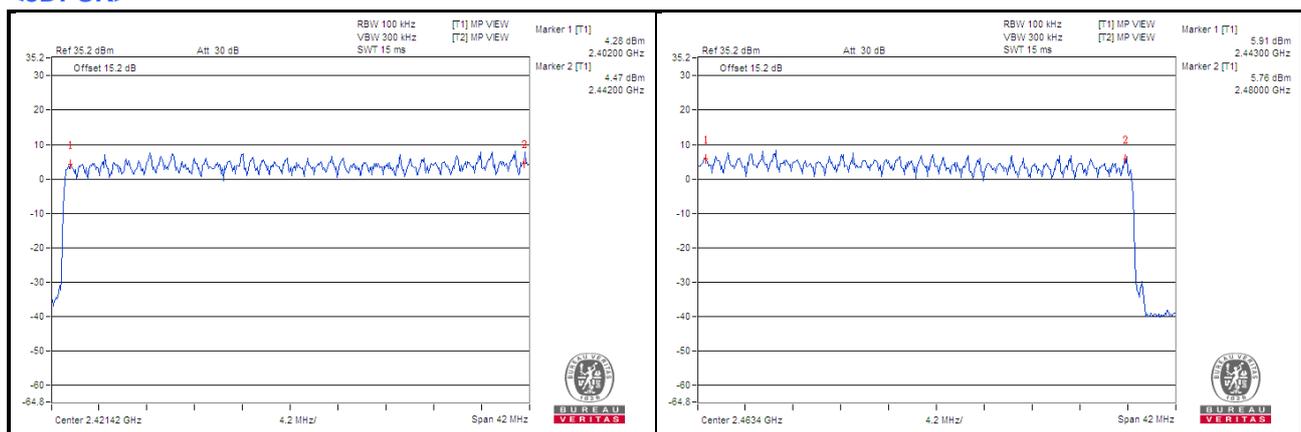
### 4.3.6 Test Results

There are 79 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

#### <GFSK>



#### <8DPSK>

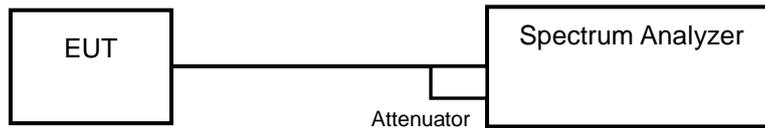


#### 4.4 Dwell Time on Each Channel

##### 4.4.1 Limits of Dwell Time on Each Channel Measurement

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

##### 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 Procedures

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- c. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- e. Repeat above procedures until all different time-slot modes have been completed.

##### 4.4.5 Deviation from Test Standard

No deviation.

### 4.4.6 Test Results

#### GFSK

Mode	Number of Transmission in a 31.6 (79 Hopping*0.4)	Length of Transmission Time (msec)	Result (msec)	Limit (sec)
DH1	50 (times / 5 sec) * 6.32 = 316 times	0.48	151.7	0.4
DH3	26 (times / 5 sec) * 6.32 = 164.32 times	1.73	284.3	0.4
DH5	16 (times / 5 sec) * 6.32 = 101.12 times	2.95	298.3	0.4

**Note:** Test plots of the transmitting time slot are shown as below.



### 8DPSK

Mode	Number of Transmission in a 31.6 (79 Hopping*0.4)	Length of Transmission Time (msec)	Result (msec)	Limit (sec)
3DH1	50 (times / 5 sec) * 6.32 = 316 times	0.438	138.4	0.4
3DH3	26 (times / 5 sec) * 6.32 = 164.32 times	1.73	284.3	0.4
3DH5	18 (times / 5 sec) * 6.32 = 113.76 times	2.96	336.7	0.4

**Note:** Test plots of the transmitting time slot are shown as below.

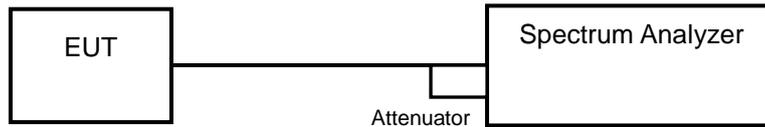


## 4.5 Channel Bandwidth

### 4.5.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5 MHz, if the 20 dB bandwidth of hopping channel is greater than 25 kHz, two-thirds 20 dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

### 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

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
- Repeat above procedures until all frequencies measured were complete.

### 4.5.5 Deviation from Test Standard

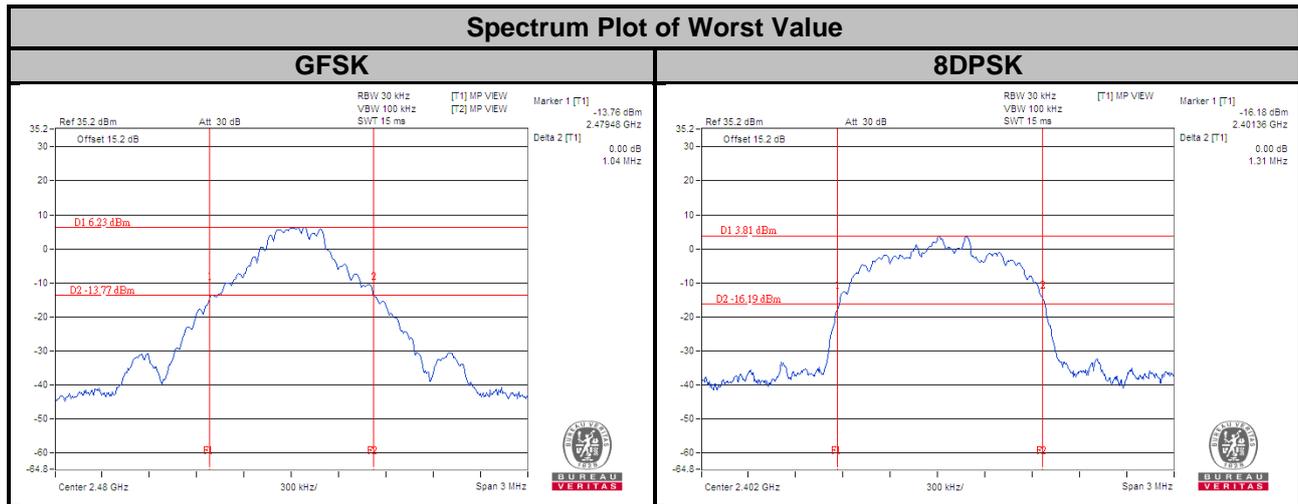
No deviation.

### 4.5.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

#### 4.5.7 Test Results

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.99	1.31
39	2441	1.03	1.31
78	2480	1.04	1.30



## 4.6 Occupied Bandwidth Measurement

### 4.6.1 Test Setup



### 4.6.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument

### 4.6.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1 % to 5 % of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

### 4.6.4 Deviation from Test Standard

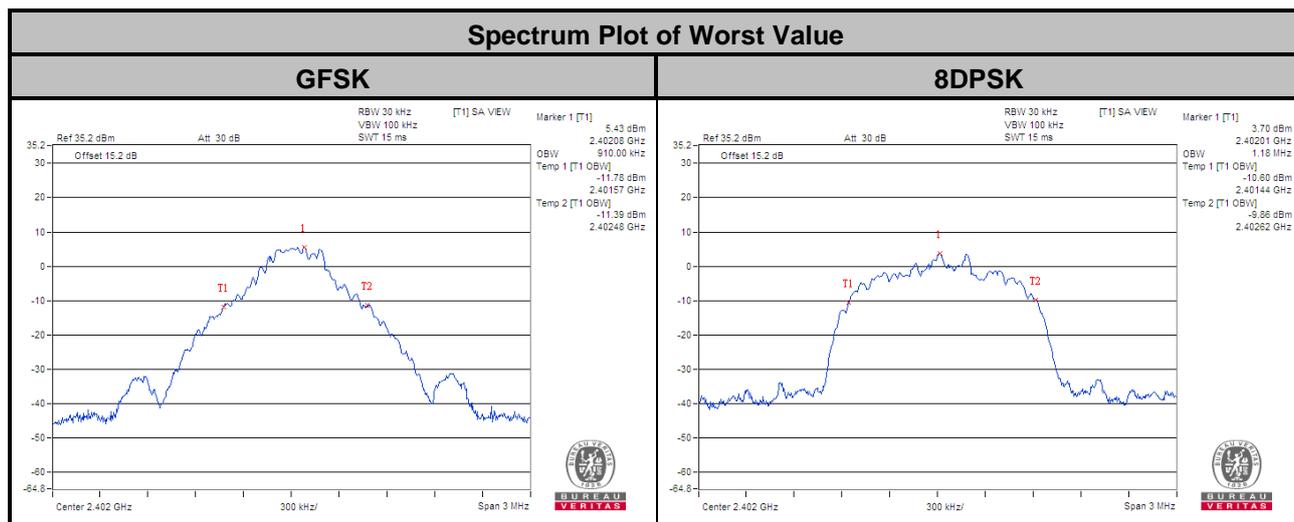
No deviation.

### 4.6.5 EUT Operating Conditions

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

#### 4.6.6 Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.91	1.18
39	2441	0.91	1.18
78	2480	0.91	1.17

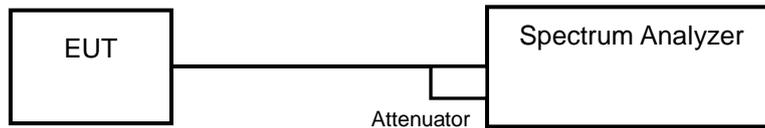


## 4.7 Hopping Channel Separation

### 4.7.1 Limits of Hopping Channel Separation Measurement

At least 25 kHz or two-third of 20 dB hopping channel bandwidth (whichever is greater).

### 4.7.2 Test Setup



### 4.7.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.7.4 Test Procedure

#### Measurement Procedure REF

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
- By using the MaxHold function record the separation of two adjacent channels.
- Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
- Repeat above procedures until all frequencies measured were complete.

### 4.7.5 Deviation from Test Standard

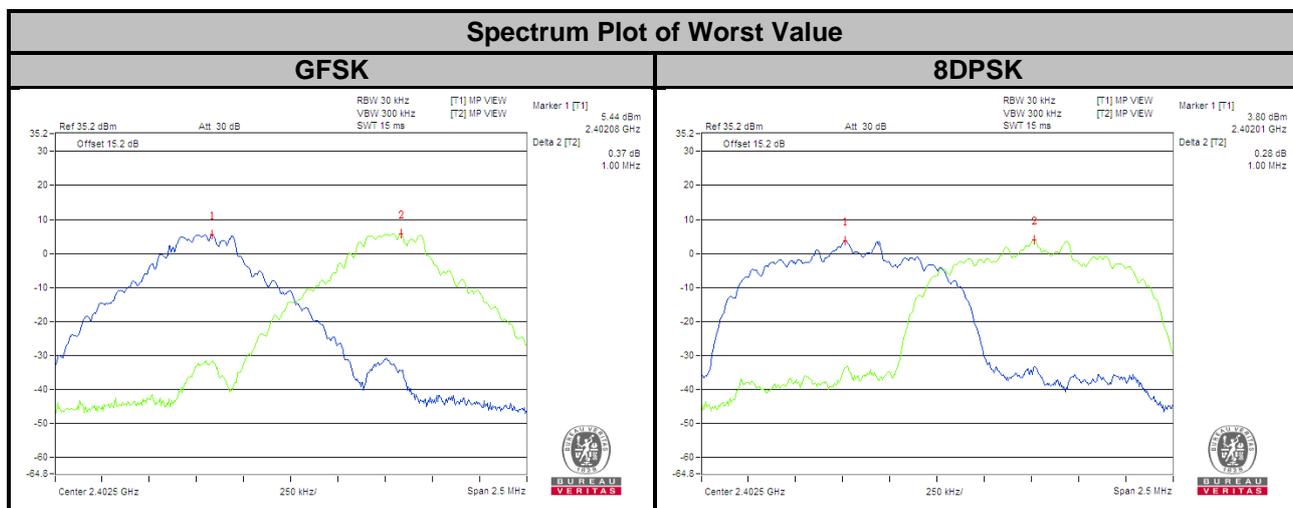
No deviation.

#### 4.7.6 Test Results

Channel	Freq. (MHz)	Adjacent Channel Separation (MHz)		20 dB Bandwidth (MHz)		Minimum Limit (MHz)		Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK	GFSK	8DPSK	
0	2402	1.00	1.00	0.99	1.31	0.66	0.88	Pass
39	2441	1.00	1.00	1.03	1.31	0.69	0.88	Pass
78	2480	1.00	1.00	1.04	1.30	0.70	0.87	Pass

**Note:**

- The minimum limit is two-third 20 dB bandwidth.

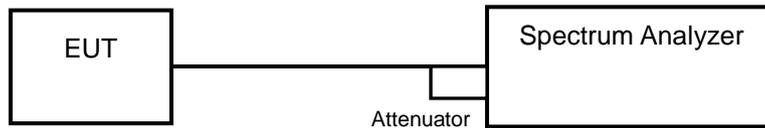


## 4.8 Maximum Output Power

### 4.8.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125 mW.

### 4.8.2 Test Setup



### 4.8.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.8.4 Test Procedure

4. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
5. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
6. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3 MHz RBW and 10 MHz VBW.
7. Measure the captured power within the band and recording the plot.
8. Repeat above procedures until all frequencies required were complete.

### 4.8.5 Deviation from Test Standard

No deviation.

### 4.8.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.8.7 Test Results

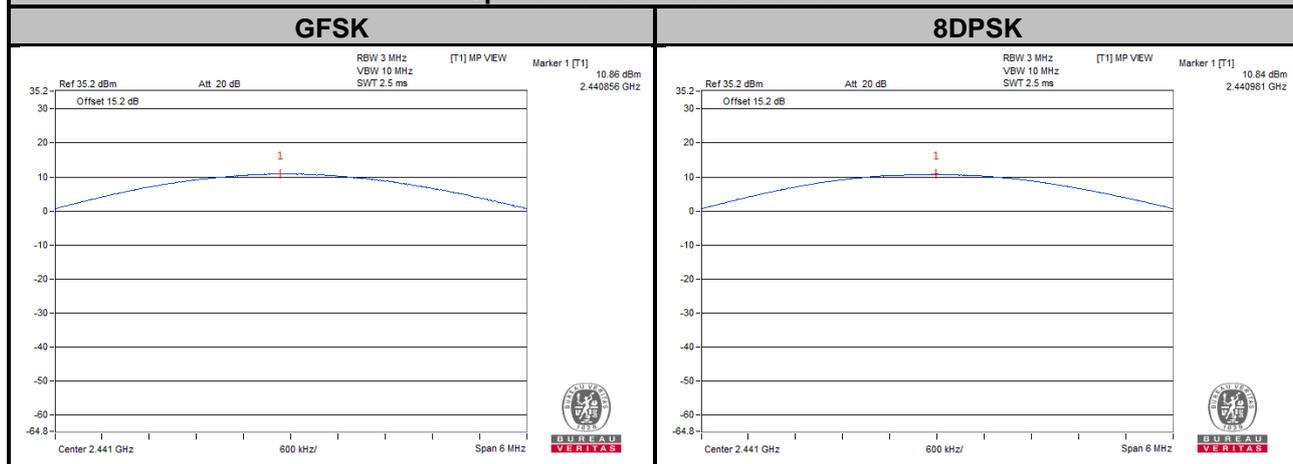
<GFSK>

Channel	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Power Limit (mW)	Pass / Fail
0	2402	8.375	9.23	125	Pass
39	2441	12.19	10.86	125	Pass
78	2480	9.661	9.85	125	Pass

<8DPSK>

Channel	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Power Limit (mW)	Pass / Fail
0	2402	8.472	9.28	125	Pass
39	2441	12.134	10.84	125	Pass
78	2480	9.954	9.98	125	Pass

Spectrum Plot of Worst Value



## 4.9 Conducted Out of Band Emission Measurement

### 4.9.1 Limits Of Conducted Out of Band Emission Measurement

Below  $-20$  dB of the highest emission level of operating band (in 100 kHz RBW).

### 4.9.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.9.3 Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100 kHz and 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

### 4.9.4 Deviation from Test Standard

No deviation.

### 4.9.5 EUT Operating Condition

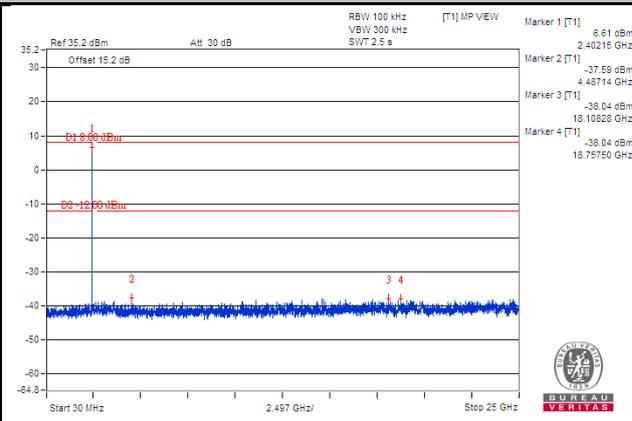
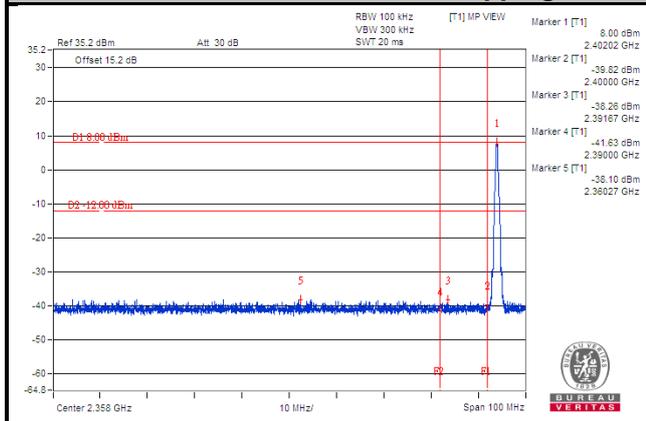
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

### 4.9.6 Test Results

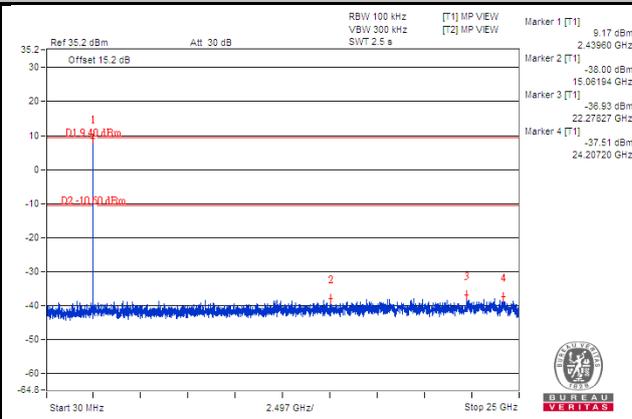
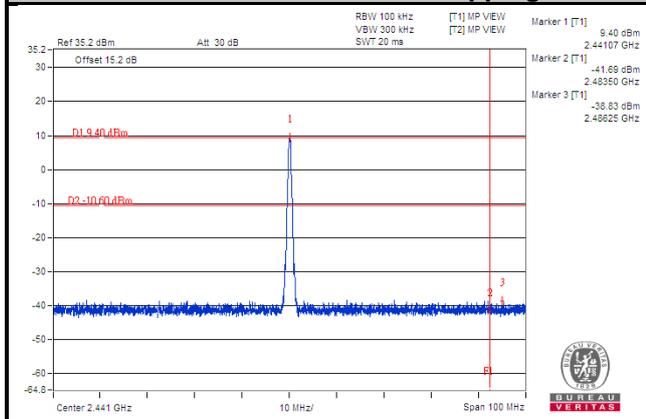
The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement.

**GFSK**

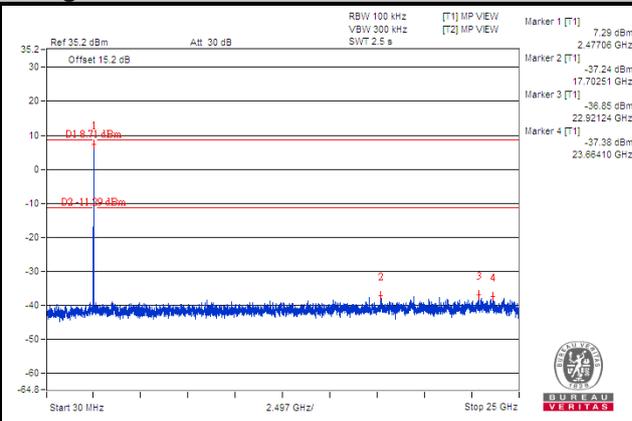
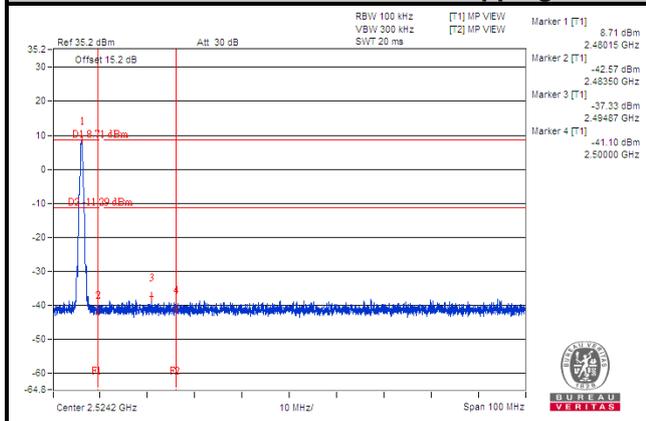
**Hopping Disabled\_Low Channel**

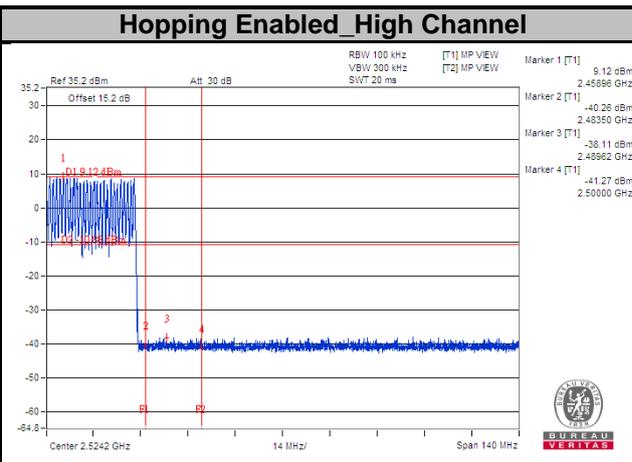
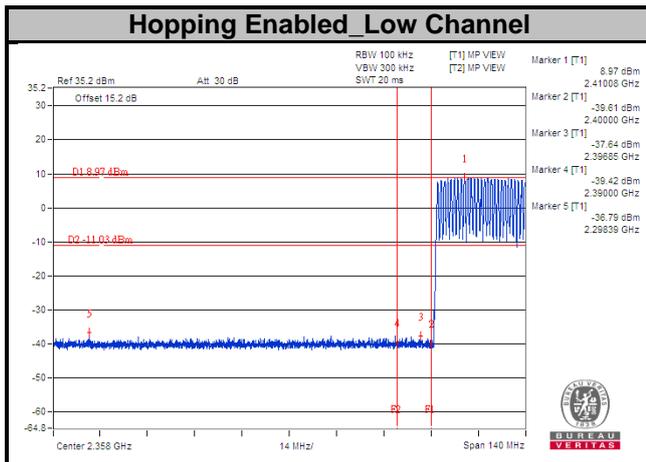


**Hopping Disabled\_Middle Channel**



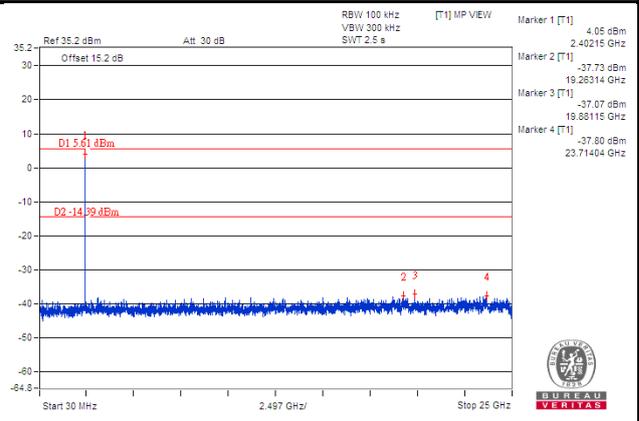
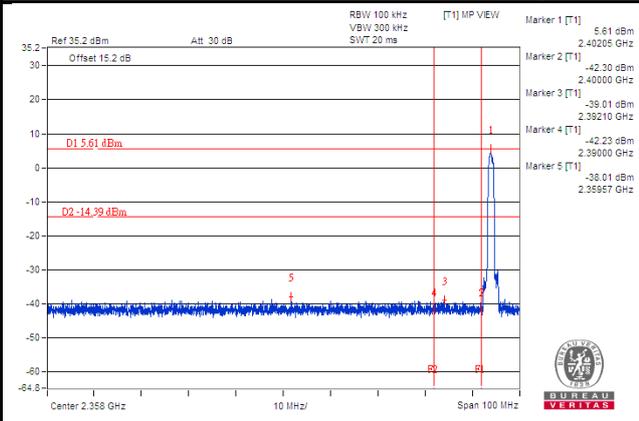
**Hopping Disabled\_High Channel**



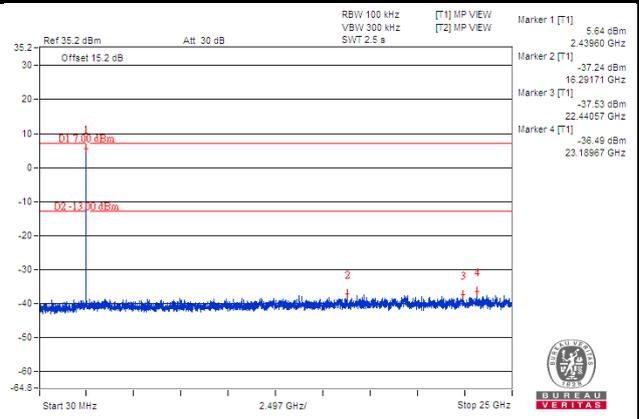
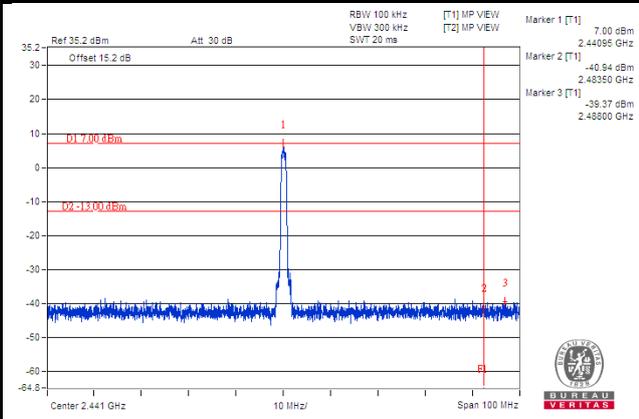


# 8DPSK

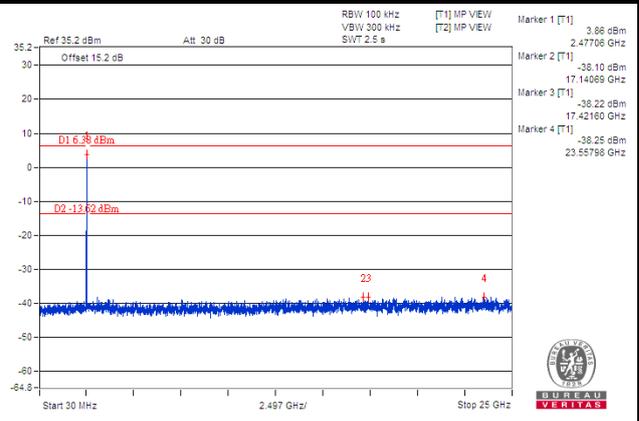
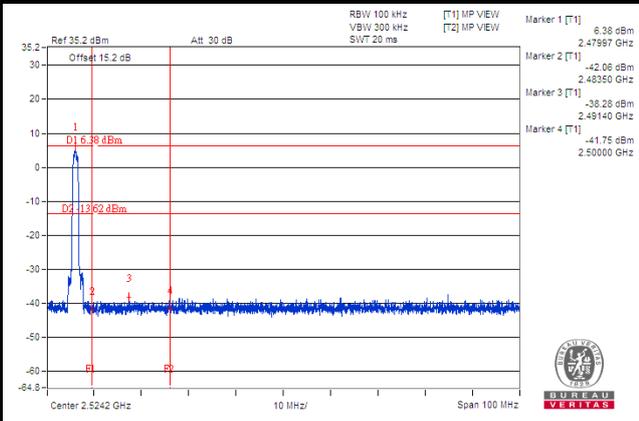
## Hopping Disabled\_Low Channel



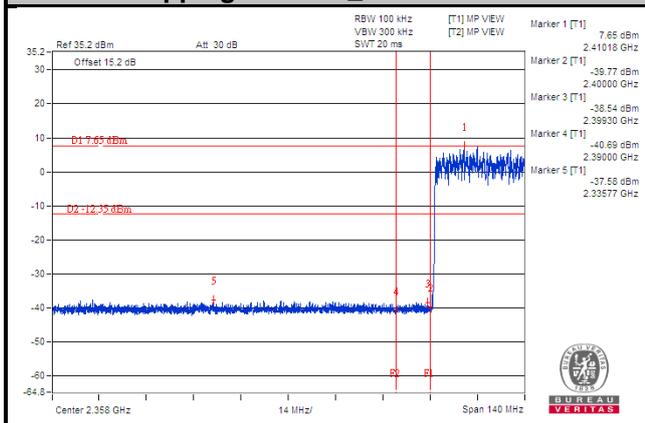
## Hopping Disabled\_Middle Channel



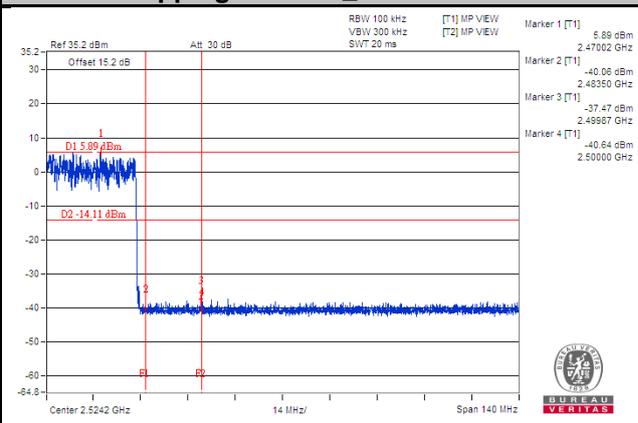
## Hopping Disabled\_High Channel



### Hopping Enabled\_Low Channel



### Hopping Enabled\_Low Channel



## 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 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:

**Linko 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**

Tel: 886-3-3183232

Fax: 886-3-3270892

**Email:** [service.adt@tw.bureauveritas.com](mailto:service.adt@tw.bureauveritas.com)

**Web Site:** [www.bureauveritas-adt.com](http://www.bureauveritas-adt.com)

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

--- END ---