



Test Report No.: RF181022W002-1



# FCC TEST REPORT (Part 15, Subpart C)



Applicant:	Lenovo(Shanghai) Electronics Technology Co., Ltd.
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Manufacturer or Supplier	Lenovo PC HK Limited
Address	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong
Product	Portable Tablet Computer
Brand Name	Lenovo
Model Name	Lenovo TB-X605F
FCC ID	O57TBX605F
Date of tests	Oct. 23, 2018 ~ Nov. 03, 2018

The tests have been carried out according to the requirements of the following standard:

- FCC Part 15, Subpart C, Section 15.247**
- ANSI C63.10-2013**

**CONCLUSION: The submitted sample was found to COMPLY with the test requirement**

Prepared by Roger Li Engineer / Mobile Department	Approved by Sam Tung Manager / Mobile Department
 Date: Nov. 05, 2018	 Date: Nov. 05, 2018

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## RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF180626C04-2	Original release	Aug. 01, 2018
RF181022W002-1	Based on the original report RF180626C04-2 add a battery / two speakers & Lenovo Smart Dock and its adapter.	Nov. 05, 2018

## 1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart C			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is -27.46dB at 0.356000MHz.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	N/A(see note)	Meet the requirement of limit.
15.247(a)(1)(iii)	Dwell Time on Each Channel	N/A(see note)	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	N/A(see note)	Meet the requirement of limit.
15.247(b)	Maximum Peak Output Power	N/A(see note)	Meet the requirement of limit.
15.247(d)& 15.209	Transmitter Radiated Emissions	PASS	Meet the requirement of limit. Minimum passing margin is -5.67dB at 2390MHz.
15.247(d)	Out of band Measurement	N/A(see note)	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

**NOTE:** 1. If The Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of hopping channel whichever is greater.

2. The report RF180626C04-2 was test in Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch.

### 1.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in ETSI TR 100 028-2001:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.66dB
Radiated emissions	9KHz ~ 30MHz	2.68dB
	30MHz ~ 1GMHz	3.26dB
	1GHz ~ 18GHz	4.48dB
	18GHz ~ 40GHz	4.12dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

## 2 GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF EUT

<b>PRODUCT</b>	Portable Tablet Computer
<b>MODEL NAME</b>	Lenovo TB-X605F
<b>POWER SUPPLY</b>	5.0Vdc (adapter or host equipment) 3.85Vdc (Li-ion) DC 5V (HA200)
<b>MODULATION TECHNOLOGY</b>	FHSS
<b>MODULATION TYPE</b>	GFSK, 8DPSK, $\pi/4$ DQPSK
<b>OPERATING FREQUENCY</b>	2402MHz~2480MHz
<b>NUMBER OF CHANNEL</b>	79
<b>MAX. OUTPUT POWER</b>	TB-X605F:10.01mW (Max. Measured) HA-200: 7.852mW (Max. Measured)
<b>ANTENNA TYPE</b>	Monopole Antenna with -5dBi gain
<b>HW VERSION</b>	Lenovo Tablet TB-X605F
<b>SW VERSION</b>	TB-X605F_RF01_20180615
<b>I/O PORTS</b>	Refer to user's manual
<b>CABLE SUPPLIED</b>	USB cable: shielded, detachable, 1.0meter

**NOTE:**

- For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
- There were Sample A, B, C, D, E and F for this project, the difference is as below:

SAMPLE	EUT CONFIGURATION INFORMATION
A	LCD Panel 2+Photo Camera 1+Photo Camera 3+CPU 1+EMMC1+DDR1+speaker 1+speaker 2+ motor2 + Main Broad 1+BT/WLAN Module+ Battery
B	LCD Panel 2+Photo Camera 2+Photo Camera 4+CPU 1+EMMC2+DDR2+speaker 1+speaker 2+motor1 + Main Broad 2 +BT/WLAN Module+ Battery
C	LCD Panel 2+Photo Camera 1+Photo Camera 3+CPU 1+EMMC3+DDR3+speaker 1+speaker 2 +motor2 + Main Broad 1+BT/WLAN Module+ Battery
D	LCD Panel 2+Photo Camera 2+Photo Camera 4+CPU 1+EMMC4+DDR4+speaker 1+speaker 2+motor1 + Main Broad 2+BT/WLAN Module+ Battery
E	LCD Panel 2+Photo Camera 1+Photo Camera 3+CPU 1+EMMC5+DDR5+speaker 1+speaker 2+motor2 + Main Broad 1+BT/WLAN Module+ Battery
F	LCD Panel 2+Photo Camera 2+Photo Camera 4+CPU 1+EMMC6+DDR6+speaker 1+speaker 2+motor1 + Main Broad 2+BT/WLAN Module+ Battery

- For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.



List of Accessories:

ACCESSORIES	BRAND	MODEL	SPECIFICATION	Manufacturer
AC Adapter 1	Salom	SC-42, SC-43	I/P:100-240Vac, 300mA O/P: 5Vdc, 2000mA	-
AC Adapter 2	AcBel	SC-42, SC-43	I/P:100-240Vac, 300mA O/P: 5Vdc, 2000mA	-
AC Adapter 1 (For Dock)	XinSPower	A241-1202000U	I/P:100-240Vac, 800mA O/P: 12Vdc, 2000mA	-
AC Adapter 2 (For Dock)	N/A	CYSE20-120200U	I/P:100-240Vac, 600mA O/P: 12Vdc, 2000mA	-
Lenovo Smart Dock	Lenovo	Lenovo HA-200	I/P: 12Vdc, 2000mA O/P: 5Vdc, 1500mA	
Battery 1	Lenovo	L18D1P32	Rating: 3.85Vdc, 4850mAh	Amperex
Battery 2	Lenovo	L18D1P32	Rating: 3.85Vdc, 4850mAh	Sunwoda
USB Cable 1 (White)	LiQi	LQ-02300039	1.0m shielded cable w/o core	-
USB Cable 2 (Black)	LiQi	LQ-02300040	1.0m shielded cable w/o core	-
LCD Panel1 (Black)	BOE	TV101WUM-LL2	10.1 "	-
LCD Panel2(White)	BOE	TV101WUM-LL3	10.1 "	-
EMMC1+DDR1	SAMSUNG	KMQE60013M-B318(2+16)	16G	-
EMMC2+DDR2	HYNIX	H9TQ17ABJTCCUR-KUM(2+16)	16G	-
EMMC3+DDR3	SAMSUNG	KMGD6001BM-B421(3+32)	32G	-
EMMC4+DDR4	HYNIX	H9TQ27ADFTMCUR-KUM(3+32)	32G	-
EMMC5+DDR5	SAMSUNG	KMRH60014A-B614(4+64)	64G	-
EMMC6+DDR6	HYNIX	H9TQ52ACLTMCUR-KUM(4+64)	64G	-
Speaker 1	Keysound	QM171219AW84	-	-
Speaker 2	Keysound	QM171219AW85	-	-
Speaker 3	Honghua	SB9655B	-	-
Speaker 4	Honghua	SB9655A	-	-
motor1	AWA	YK2455R	-	-
Motor2	Baolong	BLX-431320S	-	-
Photo Camera 1	Lcetron	LE5143AM	5M AF	-
Photo Camera 2	Holitek	MF81Q	5M AF	-
Photo Camera 3	Lcetron	ZRT2509V-P102F	2M FF	-
Photo Camera 4	Holitech	HSU1005	2M FF	-
CPU	Qualcomm	SDA450	792nsp	-
Main Broad 1	huashen	W93M71B2-3-03	-	-
Main Broad 2	yilianda	W93M71B2-3-05	-	-
BT/WLAN Module	Qualcomm	WCN3680B	-	-

Remark:

1. USB cabel 1 and USB cable 2 is identical, difference models are for color distinguished. Therefore, only USB cable 1 is as a representative for final test.
2. LCD Panel 1 and LCD Panel 2 is identical, difference models are for color distinguished. Therefore, only LCD Panel 2 is as a representative for final test.



## 2.2 DESCRIPTION OF TEST MODES

79 channels are provided to this EUT:

CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	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		



2.2.1 CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photograph of the test configuration for reference.

2.2.2 TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. The worst case was found when positioned on X axis for radiated emission. Following channel(s) was (were) selected for the final test as listed below:

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	APCM	
-	√	√	√	√	-

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

**RADIATED EMISSION TEST (BELOW 1 GHz):**

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
- 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
-	0 to 78	0	FHSS	GFSK	DH5

**RADIATED EMISSION TEST (ABOVE 1 GHz):**

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
- 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
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	DH5

**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, antenna ports (if EUT with antenna diversity architecture), and packet types.
- Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 78	0, 39, 78	FHSS	GFSK	DH5
0 to 78	0, 39, 78	FHSS	$\pi/4$ DQPSK	DH5
0 to 78	0, 39, 78	FHSS	8DPSK	DH5

**TEST CONDITION:**

**TB-X605F**

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE (SYSTEM)	TESTED BY
RE<1G	22deg. C, 54%RH	DC 5V By Adapter	Rose Ma
RE≥1G	22deg. C, 54%RH	DC 5V By Adapter	Rose Ma
PLC	24deg. C, 55%RH	DC 5V By Adapter	John Wen
APCM	25deg. C, 60%RH	DC 3.85V from battery	Rain Wang

**HA200**

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE (SYSTEM)	TESTED BY
RE<1G	22deg. C, 54%RH	DC 12V	Vincent
RE≥1G	22deg. C, 54%RH	DC 12V	Vincent
PLC	24deg. C, 55%RH	DC 12V	John Wen
APCM	25deg. C, 60%RH	DC 12V	Bert Ma



### 2.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

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

**FCC Part 15, Subpart C. Section 15.247**

**ANSI C63.10-2013**

**FCC Public Notice DA 00-705**

- NOTE:**
1. All test items have been performed and recorded as per the above standards.
  2. The EUT is also considered as a kind of computer peripheral, because the connection to computer is necessary for typical use. It has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (Certification). The test report has been issued separately.

### 2.4 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	PC	HP	A6608CN	3CR83825X3	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	AC Line: Unshielded, Detachable 1.5m

### 3 TEST TYPES AND RESULTS

#### 3.1 CONDUCTED EMISSION MEASUREMENT

##### 3.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB $\mu$ V)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56	56 to 46
0.5 ~ 5	56	46
5 ~ 30	60	50

**NOTE:** 1. The lower limit shall apply at the transition frequencies.

- The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.
- All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

##### 3.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR3	101900	Mar. 15,18	Mar. 14,19
EMC32 test software	Rohde&Schwarz	EMC32	NA	NA	NA
LISN network	Rohde&Schwarz	ENV216	101922	Mar. 15,18	Mar. 14,19

**NOTE:** 1. The test was performed in CE shielded room.

- The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

### 3.1.3 TEST PROCEDURES

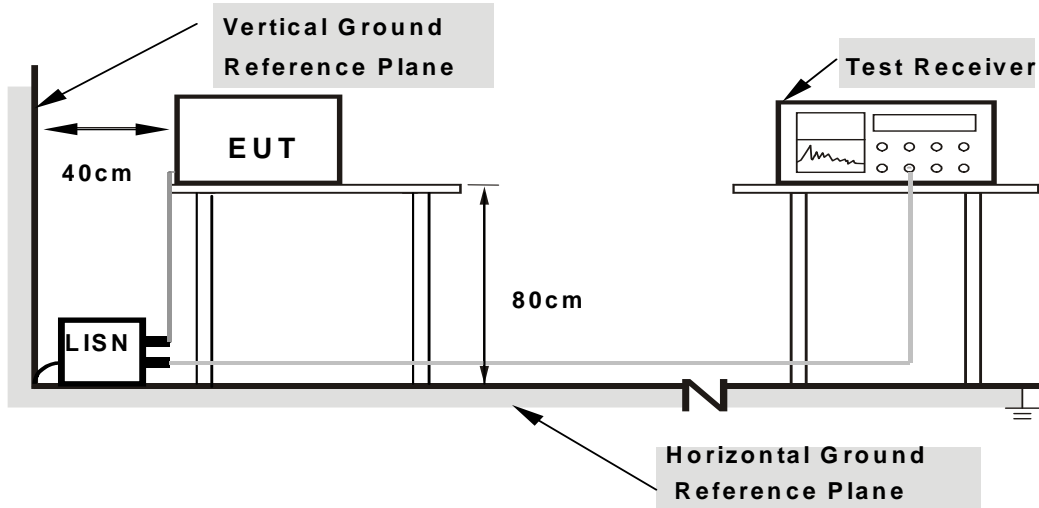
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling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

**NOTE:** All modes of operation were investigated and the worst-case emissions are reported.

### 3.1.4 DEVIATION FROM TEST STANDARD

No deviation.

### 3.1.5 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).

### 3.1.6 EUT OPERATING CONDITIONS

- a. Turned on the power and connected of all equipment.
- b. EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

### 3.1.7 TEST RESULTS

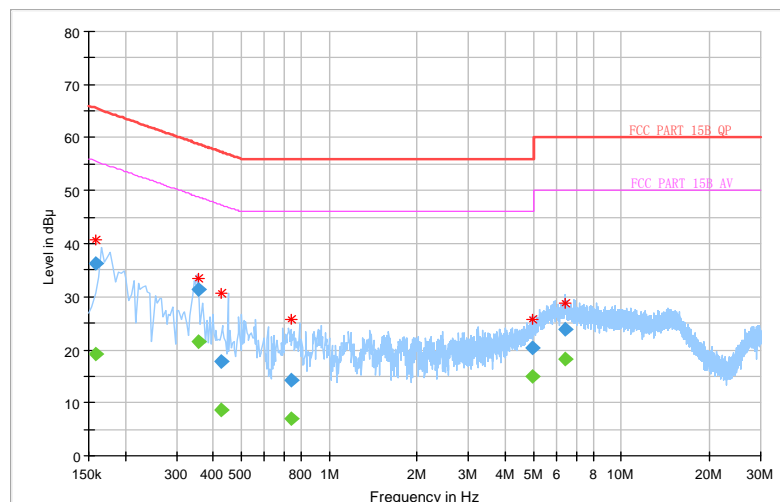
#### CONDUCTED WORST-CASE DATA:

<b>TEST VOLTAGE</b>	Input 120 Vac, 60 Hz	<b>Detector Function &amp; Resolution Bandwidth</b>	Quasi-Peak (QP) / Average (AV), 9 kHz
<b>ENVIRONMENTAL CONDITIONS</b>	24deg. C, 43RH	<b>TESTED BY</b>	John Wen

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.158000	---	19.27	55.57	-36.30	L1	ON	9.6
0.158000	36.37	---	65.57	-29.20	L1	ON	9.6
0.356000	---	21.54	48.82	-27.28	L1	ON	9.7
<b>0.356000</b>	<b>31.36</b>	---	<b>58.82</b>	<b>-27.46</b>	<b>L1</b>	<b>ON</b>	<b>9.7</b>
0.428000	---	8.71	47.29	-38.58	L1	ON	9.7
0.428000	17.82	---	57.29	-39.47	L1	ON	9.7
0.740000	---	7.05	46.00	-38.95	L1	ON	9.7
0.740000	14.36	---	56.00	-41.64	L1	ON	9.7
4.952000	---	14.92	46.00	-31.08	L1	ON	9.7
4.952000	20.37	---	56.00	-35.63	L1	ON	9.7
6.412000	---	18.14	50.00	-31.86	L1	ON	9.8
6.412000	23.96	---	60.00	-36.04	L1	ON	9.8

- REMARKS:**
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
  2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
  3. The emission levels of other frequencies were very low against the limit.
  4. Margin value = Emission level - Limit value
  5. Correction factor = Insertion loss + Cable loss
  6. Emission Level = Correction Factor + Reading Value.

Full Spectrum







**BUREAU  
VERITAS**

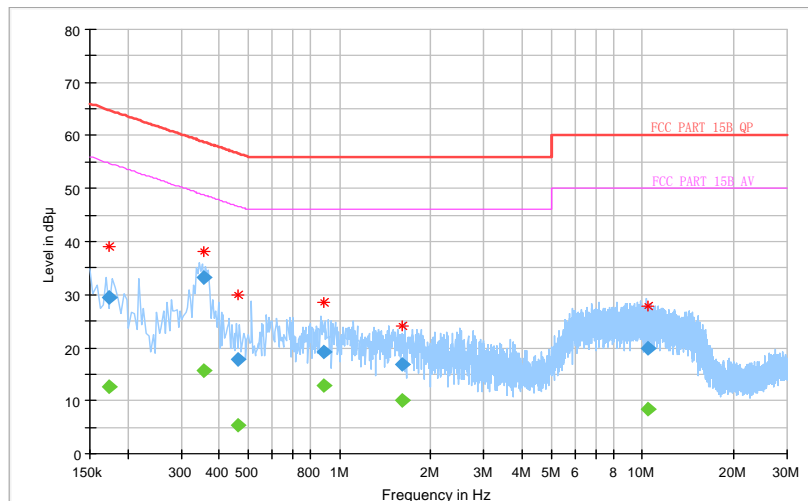
**Test Report No.: RF181022W002-1**

<b>TEST VOLTAGE</b>	Input 120 Vac, 60 Hz	<b>Detector Function &amp; Resolution Bandwidth</b>	Quasi-Peak (QP) / Average (AV), 9 kHz
<b>ENVIRONMENTAL CONDITIONS</b>	24deg. C, 43RH	<b>TESTED BY</b>	John Wen

Frequency (MHz)	QuasiPeak (dBUV)	CAverage (dBUV)	Limit (dBUV)	Margin (dB)	Line	Filter	Corr. (dB)
0.174000	---	12.63	54.77	-42.14	N	ON	10.2
0.174000	29.39	---	64.77	-35.37	N	ON	10.2
0.356000	---	15.62	48.82	-33.20	N	ON	10.0
0.356000	33.23	---	58.82	-25.60	N	ON	10.0
0.464000	---	5.37	46.62	-41.25	N	ON	10.1
0.464000	17.82	---	56.62	-38.80	N	ON	10.1
0.888000	---	12.80	46.00	-33.20	N	ON	9.9
0.888000	19.13	---	56.00	-36.87	N	ON	9.9
1.604000	---	9.99	46.00	-36.01	N	ON	9.9
1.604000	16.96	---	56.00	-39.04	N	ON	9.9
10.384000	---	8.47	50.00	-41.53	N	ON	9.9
10.384000	19.83	---	60.00	-40.17	N	ON	9.9

- REMARKS:**
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
  2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
  3. The emission levels of other frequencies were very low against the limit.
  4. Margin value = Emission level - Limit value
  5. Correction factor = Insertion loss + Cable loss
  6. Emission Level = Correction Factor + Reading Value.

Full Spectrum



### 3.2 RADIATED EMISSION AND BANDEDGE MEASUREMENT

#### 3.2.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a). 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. As shown in 15.35(b), 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.

### 3.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	Euroshieldpn-CT0001143-1216	Apr. 21,18	Apr. 20,19
Bilog Antenna	ETS-LINDGREN	3143B	00161965	Nov. 26,16	Nov. 25,18
Horn Antenna	ETS-LINDGREN	3117	00168728	Nov. 26,16	Nov. 25,18
Loop antenna	Daze	ZN30900A	0708	Nov. 20,17	Nov. 19,18
Horn Antenna (18GHz-40GHz)	N/A	QWH-SL-18-40-K-SG/QMS-00361	15433	Dec. 16,16	Dec. 15,18
Test Software	E3	V 9.160323	N/A	N/A	N/A
Test Software	ADT	ADT_Radiated_V7.6.15.9.2	N/A	N/A	N/A
10dB Attenuator	JFW/USA	50HF-010-SMA	1505	Jul. 09,18	Jul. 08,19
MXE EMI Receiver	KEYSIGHT	N9038A-544	MY54450026	Mar. 16,18	Mar. 15,19
Signal Pre-Amplifier	EMSI	EMC 9135	980249	Jul. 09,18	Jul. 08,19
Signal Pre-Amplifier	EMSI	EMC 012645B	980257	Jul. 09,18	Jul. 08,19
Signal Pre-Amplifier	EMSI	EMC 184045B	980259	Jul. 09,18	Jul. 08,19

- NOTE:**
1. The calibration interval of the above test instruments is 12 months or 24 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
  2. The test was performed in 3m Chamber.
  3. The FCC Site Registration No. is 525120.

### 3.2.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna is a broadband antenna, and its height 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 Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

**NOTE:**

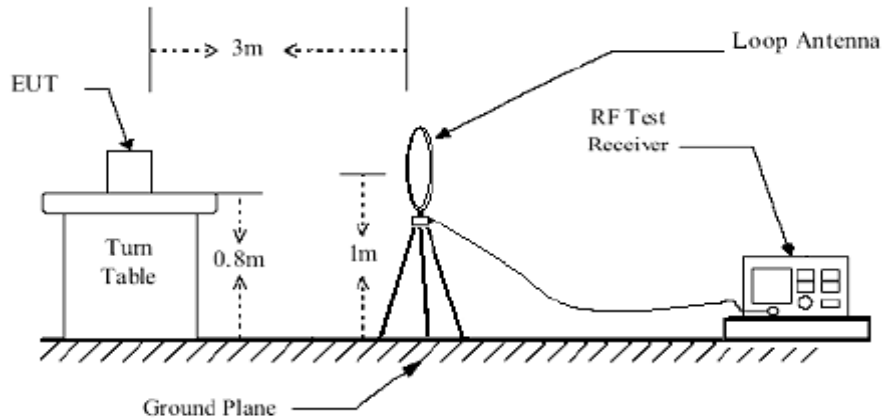
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz for Average detection (AV) at frequency above 1GHz.
4. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from  $20\log(\text{dwell time}/100 \text{ ms})$ , in an effort to demonstrate compliance with the 15.209 limit.
5. All modes of operation were investigated and the worst-case emissions are reported.

### 3.2.4 DEVIATION FROM TEST STANDARD

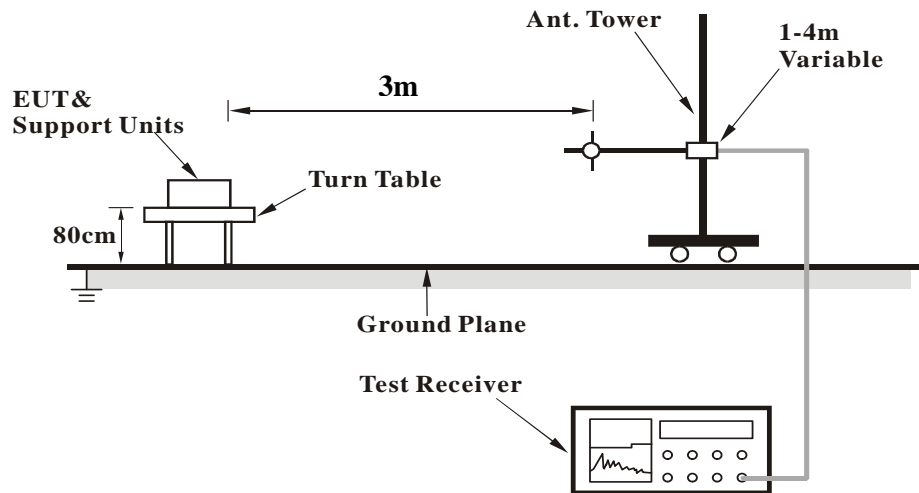
No deviation.

### 3.2.5 TEST SETUP

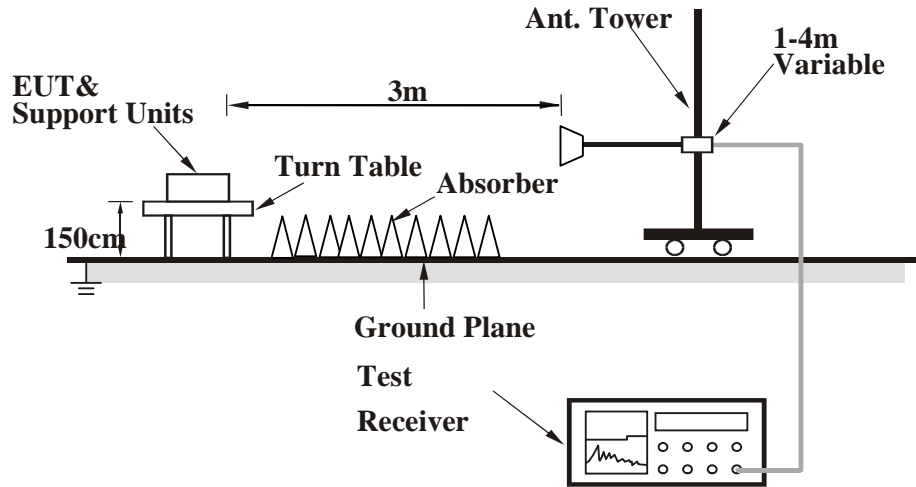
#### < Frequency Range below 30MHz >



#### < Frequency Range 30MHz~1GHz >



<Frequency Range above 1GHz>



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

### 3.2.6 EUT OPERATING CONDITIONS

- Set the EUT under full load condition and placed them on a testing table.
- Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.
- The necessary accessories enable the EUT in full functions.



3.2.7 TEST RESULTS

**BELOW 1GHz WORST-CASE DATA:**

**9 KHz – 30 MHz data:** the amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required in the report.

**30 MHz – 1GHz data:**

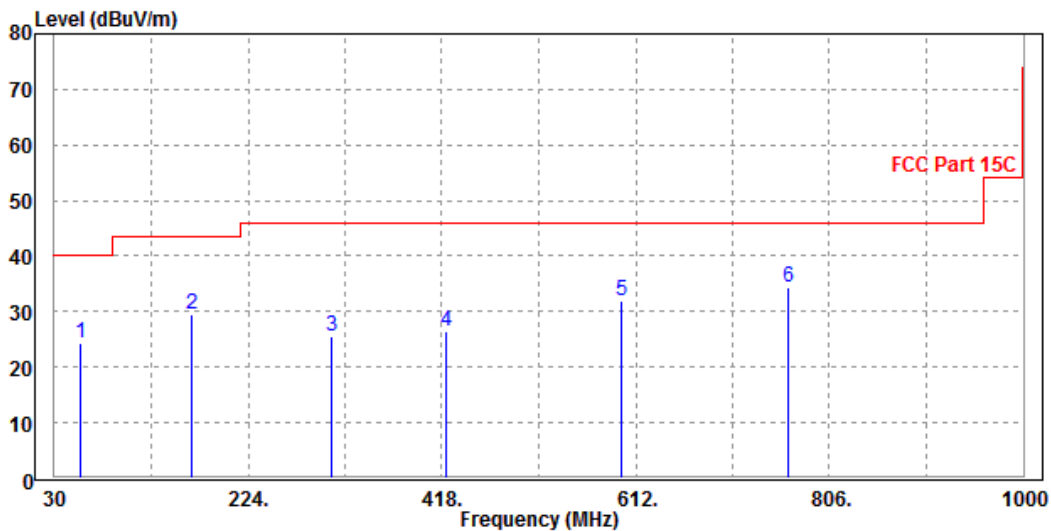
**GFSK DH5**

<b>CHANNEL</b>	Channel 0	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP)
<b>FREQUENCY RANGE</b>	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (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
56.19	24.36	53.86	40	-15.64	6.8	1.04	37.34	100	0	QP
167.74	29.46	54.09	43.5	-14.04	10.41	1.68	36.72	100	0	QP
307.42	25.41	45.65	46	-20.59	14.04	2.24	36.52	100	0	QP
422.85	26.6	43.36	46	-19.4	17.31	2.7	36.77	100	0	QP
598.42	32.06	46.18	46	-13.94	19.97	3.16	37.25	100	0	QP
765.26	34.28	45.15	46	-11.72	22.9	3.76	37.53	100	0	QP

**REMARKS:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

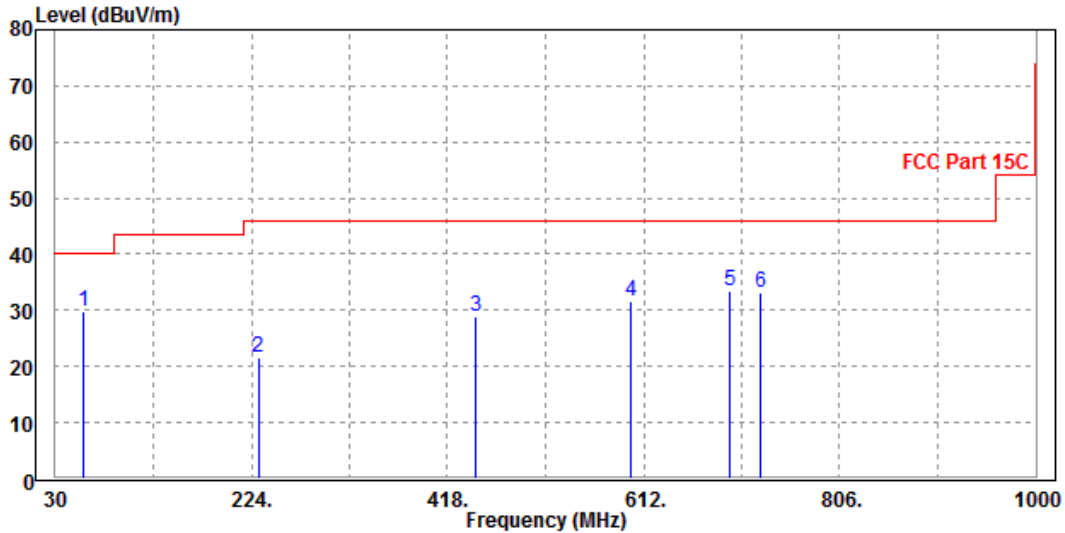


<b>CHANNEL</b>	Channel 0	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP)
<b>FREQUENCY RANGE</b>	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (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
57.16	29.71	59.2	40	-10.29	6.8	1.05	37.34	100	360	QP
230.79	21.74	44.44	46	-24.26	11.89	1.94	36.53	100	360	QP
446.13	28.84	45.36	46	-17.16	17.52	2.79	36.83	100	360	QP
599.39	31.62	45.72	46	-14.38	19.99	3.16	37.25	100	360	QP
697.36	33.46	44.67	46	-12.54	22.63	3.52	37.36	100	360	QP
727.43	33.18	44.2	46	-12.82	22.78	3.63	37.43	100	360	QP

**REMARKS:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value







**ABOVE 1GHz WORST-CASE DATA:**

**Note:** For higher frequency, the emission is too low to be detected.

**Lenovo TB-X605F**

**GFSK DHS**

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

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (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
2390	43.72	52.34	54	-10.28	32.87	4.88	46.37	100	100	Average
<b>2390</b>	<b>68.33</b>	<b>76.95</b>	<b>74</b>	<b>-5.67</b>	<b>32.87</b>	<b>4.88</b>	<b>46.37</b>	<b>100</b>	<b>100</b>	<b>Peak</b>
2402	101.95	110.55			32.88	4.89	46.37	100	100	Average
2402	104.4	113			32.88	4.89	46.37	100	100	Peak
2483.5	45.85	54.26	54	-8.15	32.98	4.98	46.37	100	100	Average
2483.5	55.25	63.66	74	-18.75	32.98	4.98	46.37	100	100	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (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
2390	41.97	50.59	54	-12.03	32.87	4.88	46.37	100	291	Average
2390	60.8	69.42	74	-13.2	32.87	4.88	46.37	100	291	Peak
2402	94.44	103.04			32.88	4.89	46.37	100	291	Average
2402	97.27	105.87			32.88	4.89	46.37	100	291	Peak
2483.5	42.55	50.96	54	-11.45	32.98	4.98	46.37	100	291	Average
2483.5	53.5	61.91	74	-20.5	32.98	4.98	46.37	100	291	Peak

**REMARKS:**

- Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor  
Margin value = Emission level – Limit value.
- 2402MHz: Fundamental frequency.



Test Report No.: RF181022W002-1

Lenovo HA-200  
GFSK DH5

CHANNEL	TX Channel 78	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (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
2390	42.83	51.45	54	-11.17	32.87	4.88	46.37	100	205	Average
2390	54.6	63.22	74	-19.4	32.87	4.88	46.37	100	205	Peak
2480	107.35	115.76			32.98	4.98	46.37	100	205	Average
2480	108.65	117.06			32.98	4.98	46.37	100	205	Peak
2483.5	45.6	54.01	54	-8.4	32.98	4.98	46.37	100	205	Average
2483.5	55.92	64.33	74	-18.08	32.98	4.98	46.37	100	205	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (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
2390	41.69	50.31	54	-12.31	32.87	4.88	46.37	274	182	Average
2390	51.64	60.26	74	-22.36	32.87	4.88	46.37	274	182	Peak
2480	99.75	108.16			32.98	4.98	46.37	274	182	Average
2480	102.63	111.04			32.98	4.98	46.37	274	182	Peak
2483.5	44	52.41	54	-10	32.98	4.98	46.37	274	182	Average
2483.5	52.07	60.48	74	-21.93	32.98	4.98	46.37	274	182	Peak

**REMARKS:**

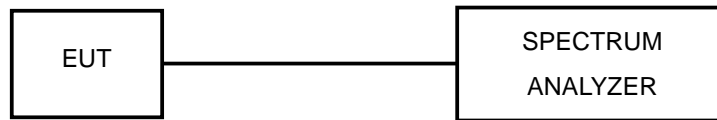
1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor  
Margin value = Emission level – Limit value.
2. 2480MHz: Fundamental frequency.

### 3.3 NUMBER OF HOPPING FREQUENCY USED

#### 3.3.1 LIMIT OF HOPPING FREQUENCY USED

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

#### 3.3.2 TEST SETUP



#### 3.3.3 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Power Meter	ANRITSU	ML2495A	1506002	Mar. 02,18	Mar. 01,19
EXA Signal Analyzer	KEYSIGHT	N9010A-526	MY54510322	Mar. 16,18	Mar. 15,19
EXA Signal Analyzer	KEYSIGHT	N9010A-544	MY54510355	Mar. 16,18	Mar. 15,19
Power Sensor	ANRITSU	MA2411B	1339352	Mar. 16,18	Mar. 15,19
CBT32 BLUETOOTH TESTER 4HU	Rohde&Schwarz	CBT32	101176	Mar. 14,18	Mar. 13,19

**NOTE:**

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
2. The test was performed in RF Oven room.

### 3.3.4 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. 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 completed.

### 3.3.5 DEVIATION FROM TEST STANDARD

No deviation.

### 3.3.6 TEST RESULTS

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

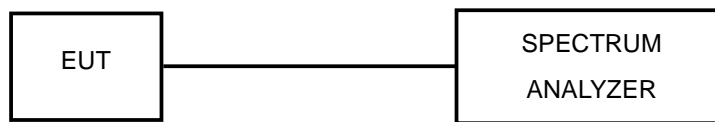
The test results were recorded in Reports No.: RF180724W011R1-1  
& RF180626C04-2.

### 3.4 DWELL TIME ON EACH CHANNEL

#### 3.4.1 LIMIT OF DWELL TIME USED

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.

#### 3.4.2 TEST SETUP



#### 3.4.3 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

#### 3.4.4 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.



**Test Report No.: RF181022W002-1**

### 3.4.5 DEVIATION FROM TEST STANDARD

No deviation.

### 3.4.6 TEST RESULTS

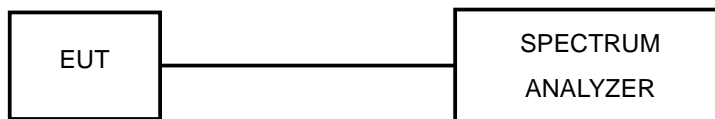
The test results were recorded in Reports No.: RF180724W011R1-1& RF180626C04-2.

### 3.5 CHANNEL BANDWIDTH

#### 3.5.1 LIMITS OF CHANNEL BANDWIDTH

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

#### 3.5.2 TEST SETUP



#### 3.5.3 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

#### 3.5.4 TEST PROCEDURE

- a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. 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.
- c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- d. Repeat above procedures until all frequencies measured were complete.

#### 3.5.5 DEVIATION FROM TEST STANDARD

No deviation.



Test Report No.: RF181022W002-1

### 3.5.6 EUT OPERATING CONDITION

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

### 3.5.7 TEST RESULTS

The test results were recorded in Reports No.: RF180724W011R1-1& RF180626C04-2.

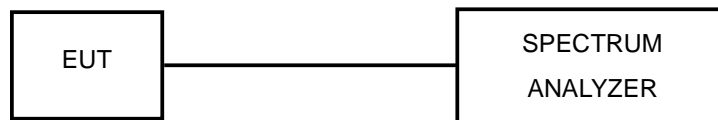


### 3.6 HOPPING CHANNEL SEPARATION

#### 3.6.1 LIMIT OF HOPPING CHANNEL SEPARATION

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

#### 3.6.2 TEST SETUP



#### 3.6.3 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

#### 3.6.4 TEST PROCEDURES

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

#### 3.6.5 DEVIATION FROM TEST STANDARD

No deviation.

#### 3.6.6 TEST RESULTS

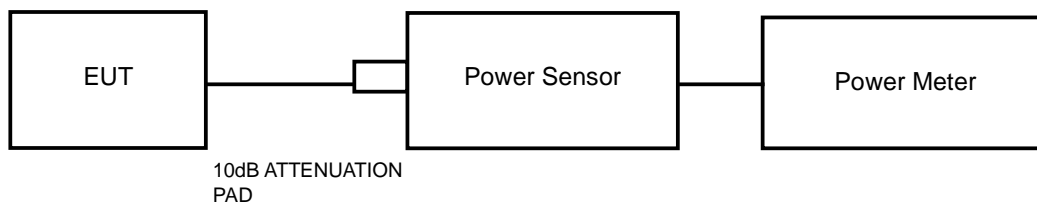
The test results were recorded in Reports No.: RF180724W011R1-1& RF180626C04-2.

### 3.7 MAXIMUM OUTPUT POWER

#### 3.7.1 LIMITS OF MAXIMUM OUTPUT POWER MEASUREMENT

The Maximum Output Power Measurement is 125mW.

#### 3.7.2 TEST SETUP



#### 3.7.3 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

#### 3.7.4 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.

#### 3.7.5 DEVIATION FROM TEST STANDARD

No deviation.

#### 3.7.6 EUT OPERATING CONDITION

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



Test Report No.: RF181022W002-1

### 3.7.7 TEST RESULTS

#### 3.7.7.1 MAXIMUM PEAK OUTPUT POWER

The test results were recorded in Reports No.: RF180724W011R1-1& RF180626C04-2.

#### 3.7.7.2 AVERAGE OUTPUT POWER (FOR REFERENCE)

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

The test results were recorded in Reports No.: RF180724W011R1-1& RF180626C04-2.

### 3.8 OUT OF BAND MEASUREMENT

#### 3.8.1 LIMITS OF OUT OF BAND MEASUREMENT

Below  $-20\text{dB}$  of the highest emission level of operating band (in 100KHz RBW).

#### 3.8.2 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

#### 3.8.3 TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer via a low loss cable. Spectrum Analyzer was set RBW to 100 kHz and VBW to 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. Detector = PEAK and Trace mode = Max Hold. The band edges was measured and recorded.

#### 3.8.4 DEVIATION FROM TEST STANDARD

No deviation.

#### 3.8.5 EUT OPERATING CONDITION

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

#### 3.8.6 TEST RESULTS

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

The test results were recorded in Reports No.: RF180724W011R1-1& RF180626C04-2.



**BUREAU  
VERITAS**

Test Report No.: RF181022W002-1

## 4 PHOTOGRAPHS OF THE TEST CONFIGURATION

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



**BUREAU  
VERITAS**

Test Report No.: RF181022W002-1

## **5 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB**

No any modifications are made to the EUT by the lab during the test.

**---END---**