RF TEST REPORT

Report No.: 16050028-FCC-R3

Supersede Report No.: N/A

Applicant	Quectel Wireless Solutions Co., Ltd.
Product Name	Wifi& BT Module
Model No.	FC20
Serial No.	N/A
Test Standard	FCC Part 15.247: 2016, ANSI C63.10: 2013
Test Date	February 07 to March 27, 2017
Issue Date	March 28, 2017
Test Result	☑ Pass ☐ Fail
Equipment complied with the specification	☑
Equipment did not comply with the specification	☐

Leen Yang	David Huang	
Leen Yang Test Engineer	David Huang Checked By	

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Test result presented in this test report is applicable to the tested sample only

Issued by:

SIEMIC (SHENZHEN-CHINA) LABORATORIES

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Laboratories Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.

In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Scope
USA	EMC, RF/Wireless, SAR, Telecom
Canada	EMC, RF/Wireless, SAR, Telecom
Taiwan	EMC, RF, Telecom, SAR, Safety
Hong Kong	RF/Wireless, SAR, Telecom
Australia	EMC, RF, Telecom, SAR, Safety
Korea	EMI, EMS, RF, SAR, Telecom, Safety
Japan	EMI, RF/Wireless, SAR, Telecom
Singapore	EMC, RF, SAR, Telecom
Europe	EMC, RF, SAR, Telecom, Safety

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1. Report Revision History

Report No.	Report Version	Description	Issue Date
16050028-FCC-R3	NONE	Original	March 28, 2017

2. Customer information

Applicant Name	Quectel Wireless Solutions Co., Ltd.
Applicant Add	RM501,Building 13,No.99 TianZhou Road,Xuhui District,Shanghai,China
Manufacturer	Quectel Wireless Solutions Co., Ltd.
Manufacturer Add	RM501,Building 13,No.99 TianZhou Road,Xuhui District,Shanghai,China

3. Test site information

Lab performing tests	SIEMIC (Shenzhen-China) LABORATORIES
Lab Address	Zone A, Floor 1, Building 2 Wan Ye Long Technology Park South Side of Zhoushi Road, Bao' an District, Shenzhen, Guangdong China 518108
FCC Test Site No.	718246
IC Test Site No.	4842E-1
Test Software	Radiated Emission Program-To Shenzhen v2.0

4. Equipment under Test (EUT) Information

Description of EUT:	Wifi& BT Module
Main Model:	FC20
Serial Model:	N/A
Date EUT received:	February 06, 2017
Test Date(s):	February 07 to March 27, 2017
Equipment Category：	DSS
Antenna Gain:	Bluetooth/BLE: 3dBi WIFI(2.4G): 3 dBi WIFI(5150-5250MHz): 3 dBi WIFI(5250-5350MHz): 3 dBi WIFI(5470-5725MHz): 3 dBi WIFI(5725-5850MHz): 3 dBi **（Note: The radio module will be sold without antenna, this antenna only used limited to ERP/EIRP or radiated spurious emission test.）**
Antenna Type：	Fixed External antenna
Type of Modulation:	Bluetooth: GFSK, π /4DQPSK, 8DPSK BLE: GFSK 802.11b: DSSS 802.11g/n20/n40/ac20/ac40/ac80: OFDM
RF Operating Frequency (ies):	WIFI: 802.11b/g/n(20M): 2412-2462 MHz(TX/RX) WIFI: 802.11n(40M): 2422-2452 MHz(TX/RX) 802.11ac 20: 5180-5240 MHz; 5260-5320 MHz; 5500-5700 MHz; 5745-5825 MHz； (TX/RX) 802.11ac 40: 5190-5230 MHz; 5270-5310 MHz; 5510-5710 MHz; 5755-5795 MHz；(TX/RX) 802.11ac 80: 5210 MHz; 5290 MHz; 5530-5690 MHz; 5775 MHz；(TX/RX) Bluetooth& BLE: 2402-2480 MHz

Max. Output Power:	6.736dBm
Number of Channels:	WIFI :802.11b/g/n(20M): 11CH WIFI :802.11n(40M): 7CH WIFI :802.11ac20: 24CH WIFI :802.11ac40: 12CH WIFI :802.11ac80: 6CH Bluetooth: 79CH BLE: 40CH
Port:	N/A
Input Power:	Main supply voltage: 3.3V, 500mA IO supply voltage: 1.8V
Trade Name :	Quectel
FCC ID:	XMR201703FC20

5. Test Summary

The product was tested in accordance with the following specifications.

All testing has been performed according to below product classification:

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.247(a)(1)	Channel Separation	Compliance
§15.247(a)(1)	20 dB Bandwidth	Compliance
§15.247(b)(1)	Peak Output Power	Compliance
§15.247(a)(1)(iii)	Number of Hopping Channel	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(d)	Band Edge& Restricted Band	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Radiated Emissions& Restricted Band	Compliance

Measurement Uncertainty

Emissions		
Test Item	**Description**	**Uncertainty**
Band Edge& Restricted Band and Radiated Emissions& Restricted Band	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	+5.6dB/-4.5dB
-	-	-

6. Measurements, Examination And Derived Results

6.1 Antenna Requirement

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited.
The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.

b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has 1 antenna:
An non-standard and Reverse polarity interface attached Fixed External antenna for Bluetooth/BLE/2.4G WIFI/5G WIFI, the gain is 3dBi for Bluetooth/BLE/2.4G WIFI, the gain is 3dBi for 5150-5250MHz/5250-5350MHz/5470-5725 MHz / 5725-2850MHz MHz 5G WIFI.

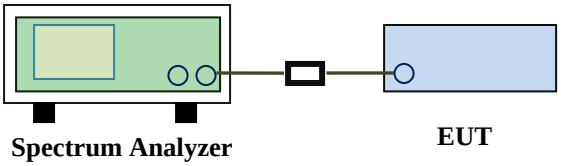
The antenna meets up with the ANTENNA REQUIREMENT.

Result: Compliance.

6.2 Channel Separation

Temperature	22℃
Relative Humidity	55%
Atmospheric Pressure	1013mbar
Test date :	March 15, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247(a)(1)	a)	Channel Separation < 20dB BW and 20dB BW < 25KHz ; Channel Separation Limit=25KHz Chanel Separation < 20dB BW and 20dB BW > 25kHz ; Channel Separation Limit=2/3 20dB BW	☑
Test Setup			
Test Procedure	The test follows FCC Public Notice DA 00-705 Measurement Guidelines. Use the following spectrum analyzer settings: - The EUT must have its hopping function enabled - Span = wide enough to capture the peaks of two adjacent channels - Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span - Video (or Average) Bandwidth (VBW) ≥ RBW - Sweep = auto - Detector function = peak - Trace = max hold - Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.		

Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

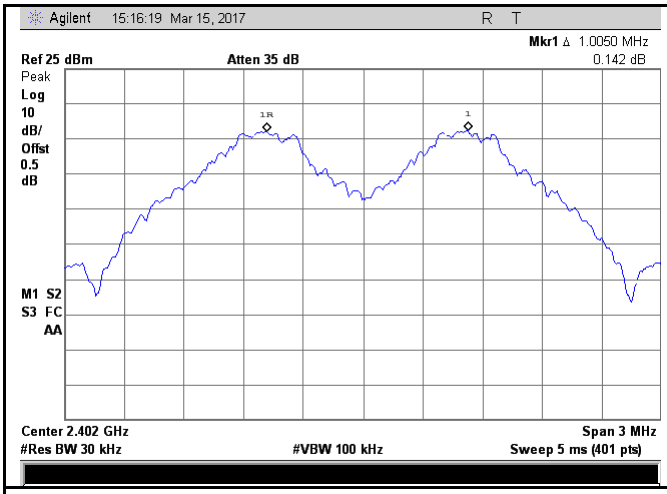
Test Plot ☑ Yes (See below) ☐ N/A

Channel Separation measurement result

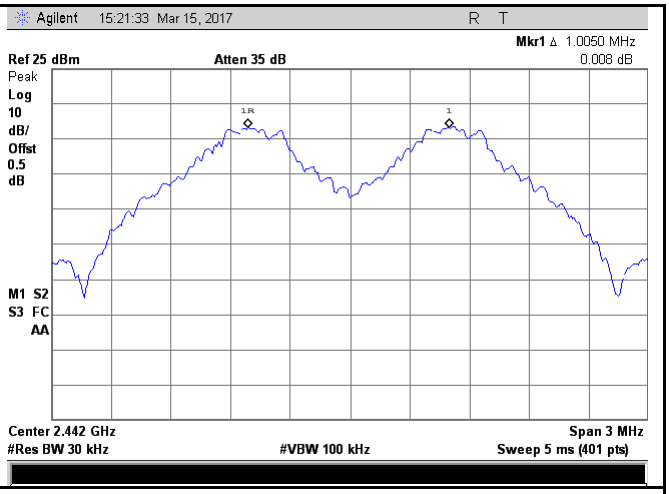
Type/ Modulation	CH	CH Frequency (MHz)	CH Separation (MHz)	Limit (MHz)	Result
CH Separation GFSK	Low Channel	2402	1.005	0.687	Pass
	Adjacency Channel	2403			
	Mid Channel	2440	1.005	0.687	Pass
	Adjacency Channel	2441			
	High Channel	2480	1.005	0.686	Pass
	Adjacency Channel	2479			
CH Separation π /4 DQPSK	Low Channel	2402	1.005	0.867	Pass
	Adjacency Channel	2403			
	Mid Channel	2440	1.005	0.893	Pass
	Adjacency Channel	2441			
	High Channel	2480	1.005	0.864	Pass
	Adjacency Channel	2479			
CH Separation 8DPSK	Low Channel	2402	1.005	0.878	Pass
	Adjacency Channel	2403			
	Mid Channel	2440	1.005	0.872	Pass
	Adjacency Channel	2441			
	High Channel	2480	1.005	0.868	Pass
	Adjacency Channel	2479			

Test Plots

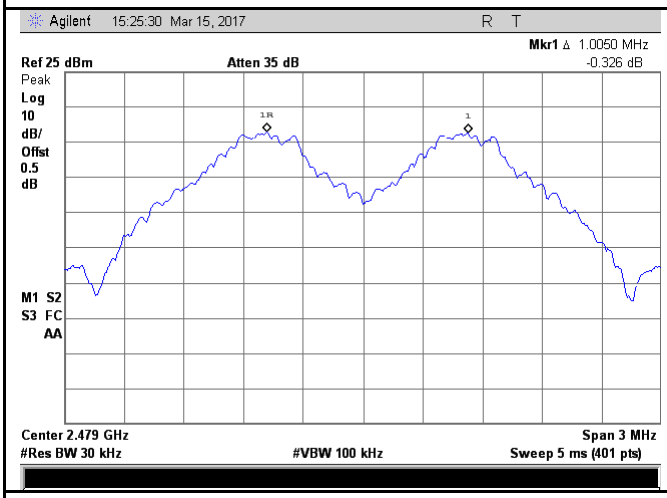
Channel Separation measurement result



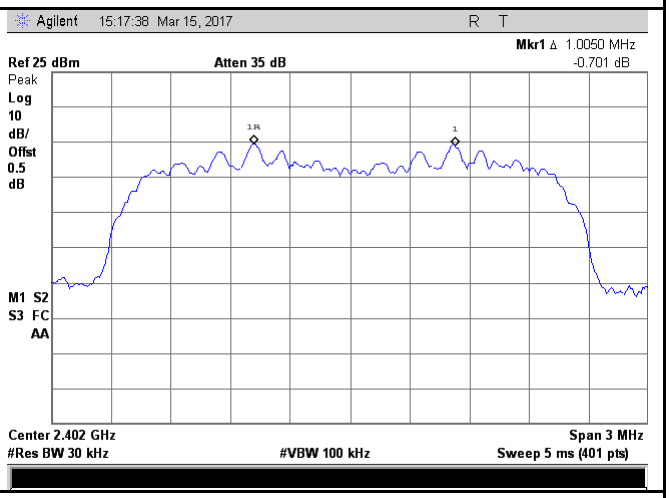
GFSK - Low Channel



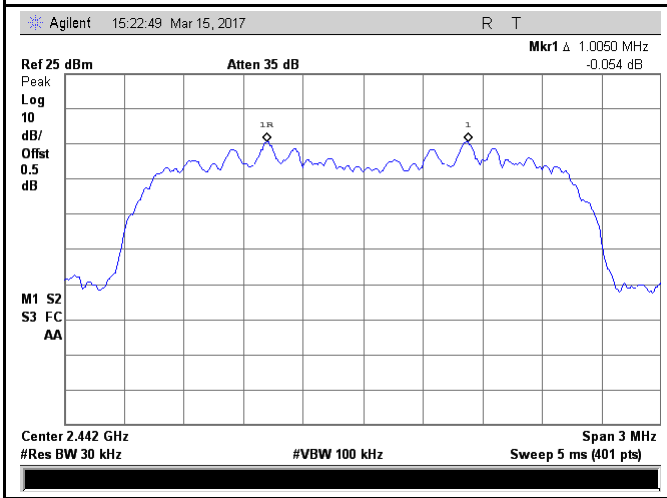
GFSK - Middle Channel



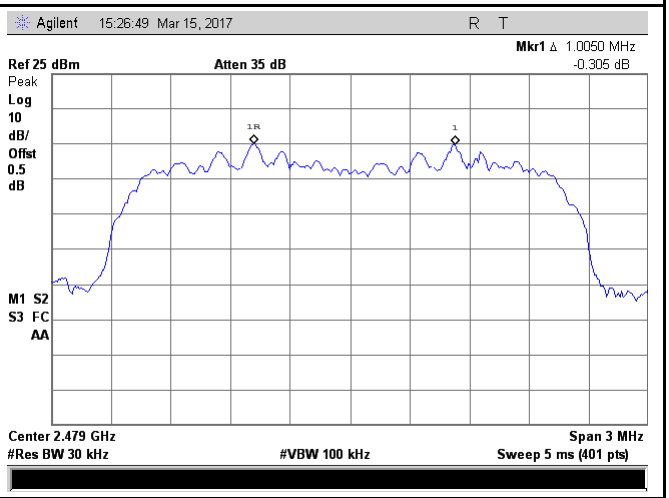
GFSK - High Channel



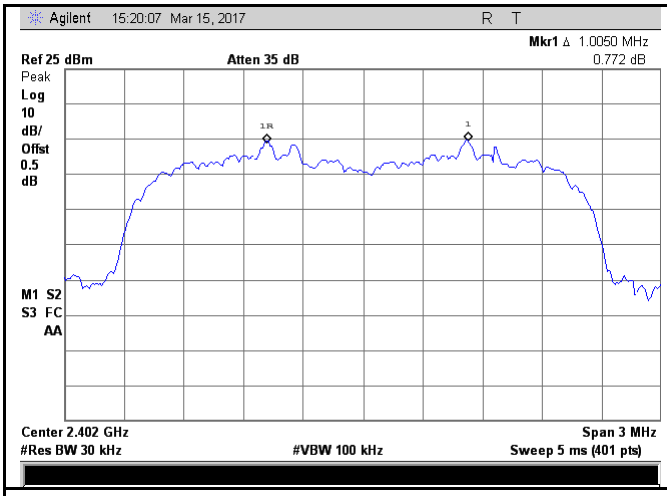
π /4 DPSK - Low Channel



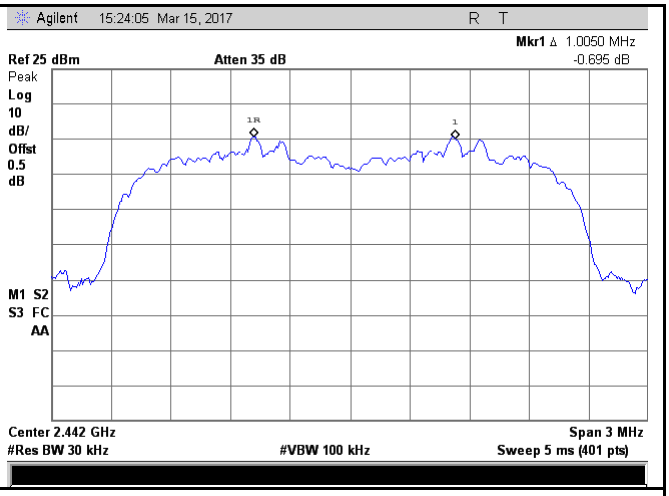
π /4 DQPSK - Middle Channel



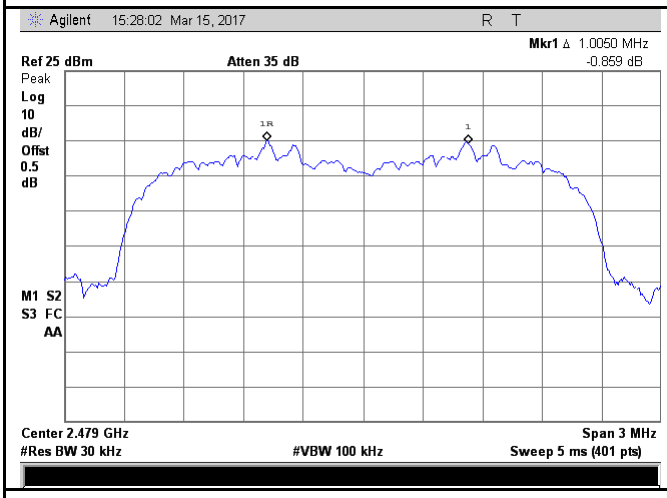
π /4 DQPSK - High Channel



8DPSK - Low Channel



8DPSK - Middle Channel

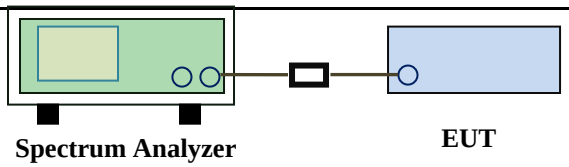


8DPSK - High Channel

6.3 20dB Bandwidth

Temperature	22℃
Relative Humidity	55%
Atmospheric Pressure	1013mbar
Test date :	March 15, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
§15.247(a) (1)	a)	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.	☑
Test Setup			
Test Procedure	The test follows FCC Public Notice DA 00-705 Measurement Guidelines. Use the following spectrum analyzer settings: - Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel - RBW ≥ 1% of the 20 dB bandwidth - VBW ≥ RBW - Sweep = auto - Detector function = peak - Trace = max hold. - The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference		

	marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).
Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

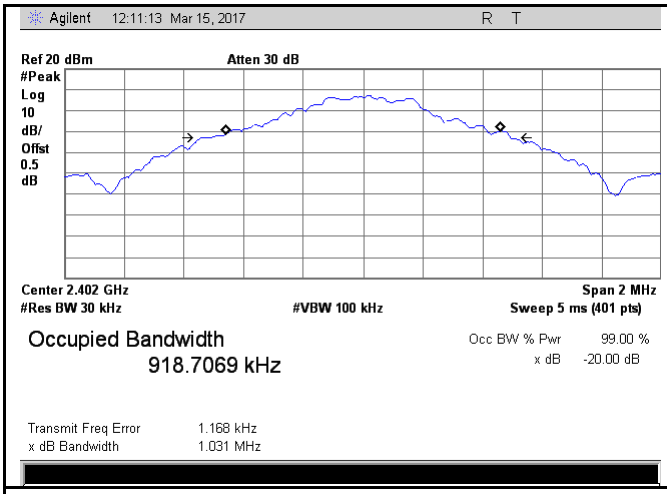
Test Plot ☑ Yes (See below) ☐ N/A

Measurement result

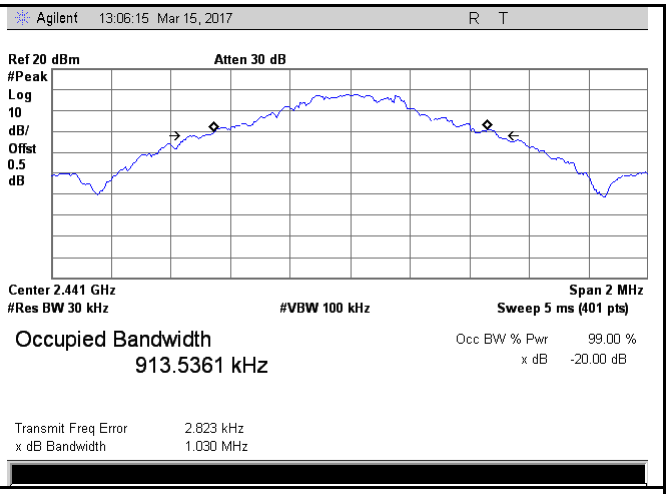
Modulation	CH	CH Frequency (MHz)	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
GFSK	Low	2402	1.031	0.9187
	Mid	2441	1.030	0.9135
	High	2480	1.029	0.9162
π /4 DQPSK	Low	2402	1.300	1.1783
	Mid	2441	1.340	1.1859
	High	2480	1.296	1.1799
8-DPSK	Low	2402	1.317	1.1863
	Mid	2441	1.308	1.1870
	High	2480	1.302	1.1850

Test Plots

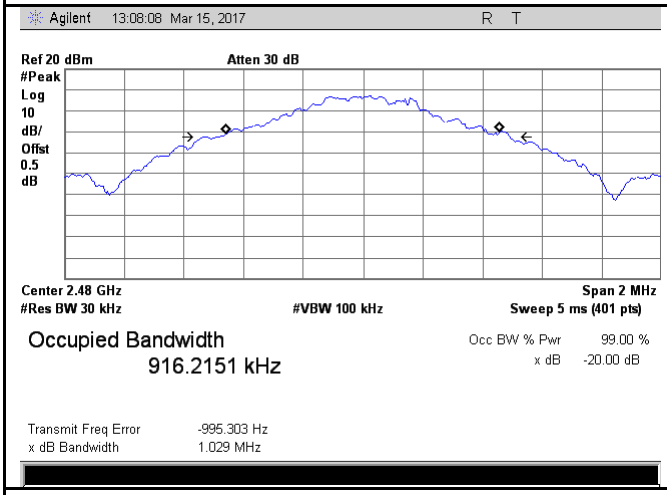
20dB Bandwidth measurement result



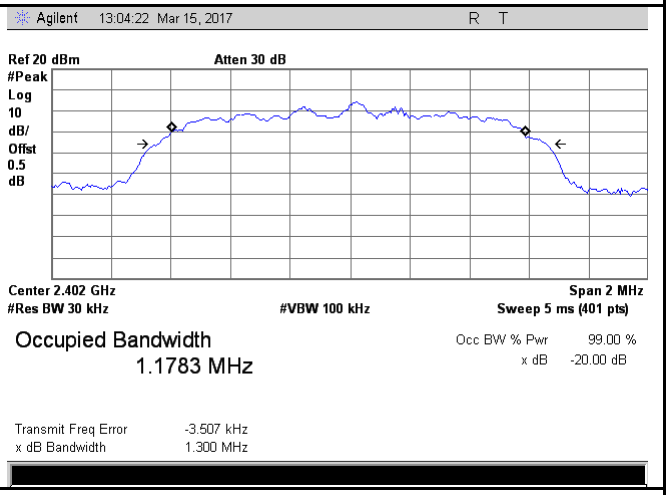
GFSK - Low Channel



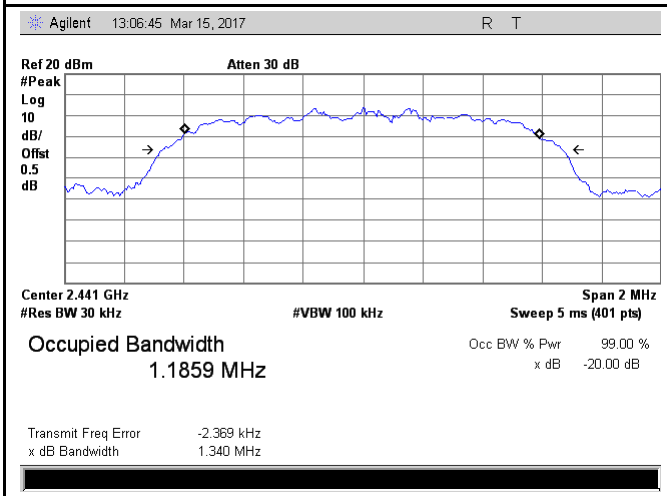
GFSK - Middle Channel



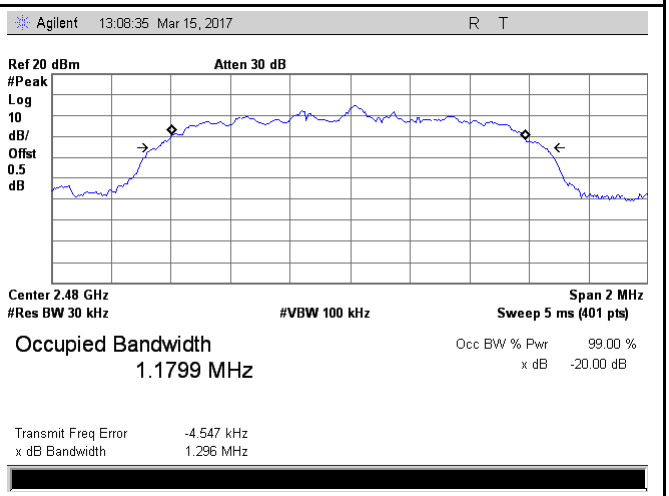
GFSK - High Channel



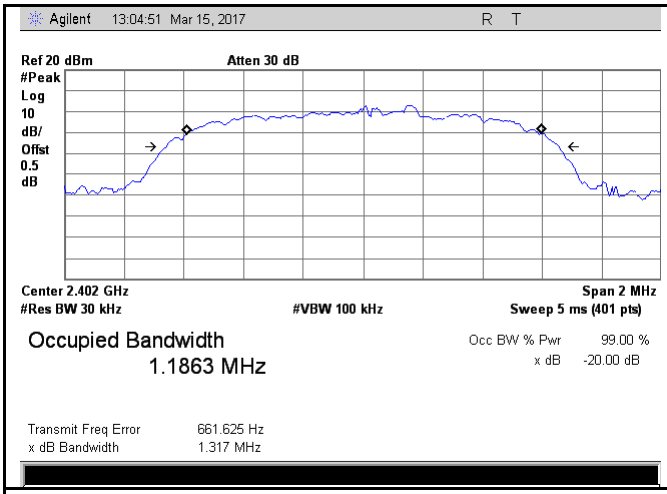
π /4 DPSK - Low Channel



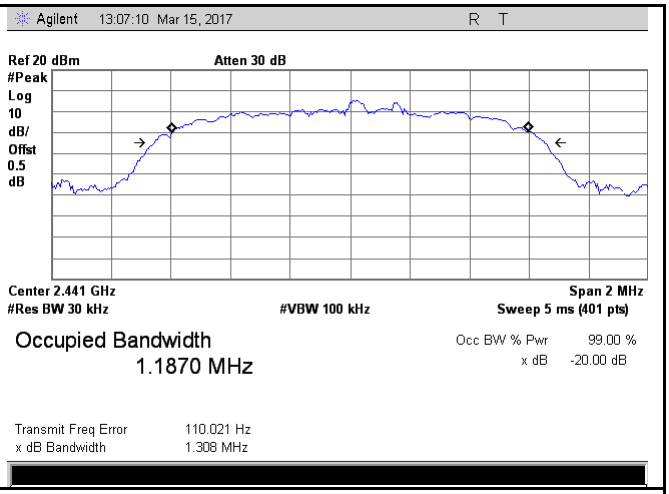
π /4 DQPSK - Middle Channel



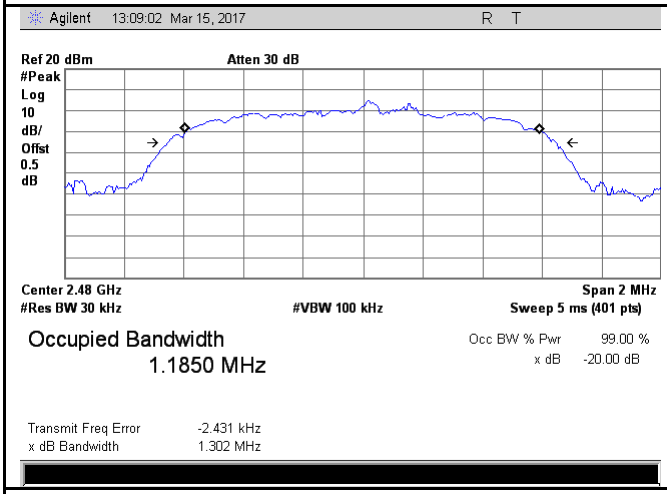
π /4 DQPSK - High Channel



8DPSK - Low Channel



8DPSK - Middle Channel

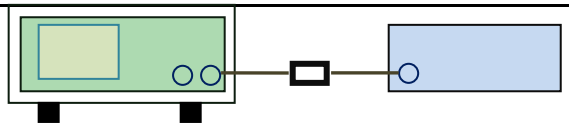


8DPSK - High Channel

6.4 Peak Output Power

Temperature	25℃
Relative Humidity	55%
Atmospheric Pressure	1022mbar
Test date :	March 27, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
§15.247(b) (3)	a)	FHSS in 2400-2483.5MHz with ≥ 75 channels: ≤ 1 Watt	☑
	b)	FHSS in 5725-5850MHz: ≤ 1 Watt	☐
	c)	For all other FHSS in the 2400-2483.5MHz band: ≤ 0.125 Watt.	☑
	d)	FHSS in 902-928MHz with ≥ 50 channels: ≤ 1 Watt	☐
	e)	FHSS in 902-928MHz with ≥ 25 & <50 channels: ≤ 0.25 Watt	☐
	f)	DTS in 902-928MHz, 2400-2483.5MHz: ≤ 1 Watt	☐
Test Setup			
Test Procedure	The test follows FCC Public Notice DA 00-705 Measurement Guidelines. Use the following spectrum analyzer settings: - Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel - RBW > the 20 dB bandwidth of the emission being measured - VBW ≥ RBW - Sweep = auto - Detector function = peak - Trace = max hold - Allow the trace to stabilize.		

	- Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (see the note above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer.
Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

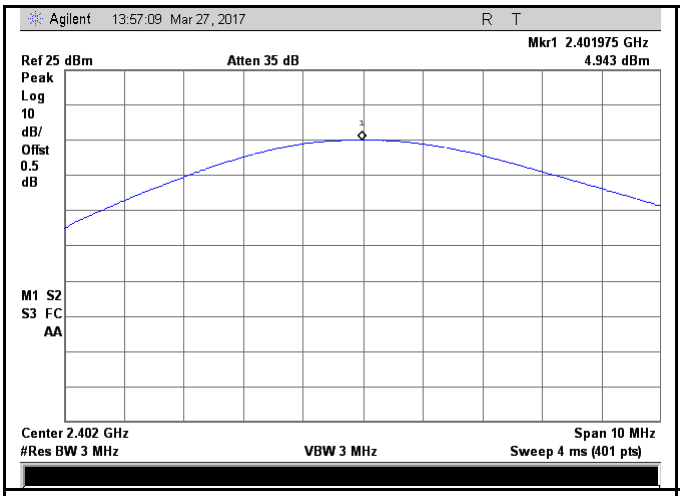
Test Plot ☑ Yes (See below) ☐ N/A

Peak Output Power measurement result

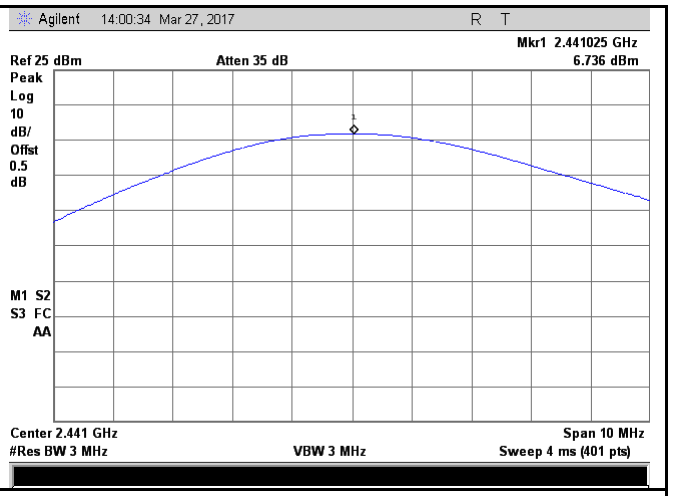
Type	Modulation	CH	Frequency (MHz)	Conducted Power (dBm)	Limit (mW)	Result
Output power	GFSK	Low	2402	4.943	125	Pass
		Mid	2441	**6.736**	125	Pass
		High	2480	6.476	125	Pass
	π /4 DQPSK	Low	2402	3.879	125	Pass
		Mid	2441	5.820	125	Pass
		High	2480	5.554	125	Pass
	8-DPSK	Low	2402	4.317	125	Pass
		Mid	2441	6.161	125	Pass
		High	2480	5.938	125	Pass

Test Plots

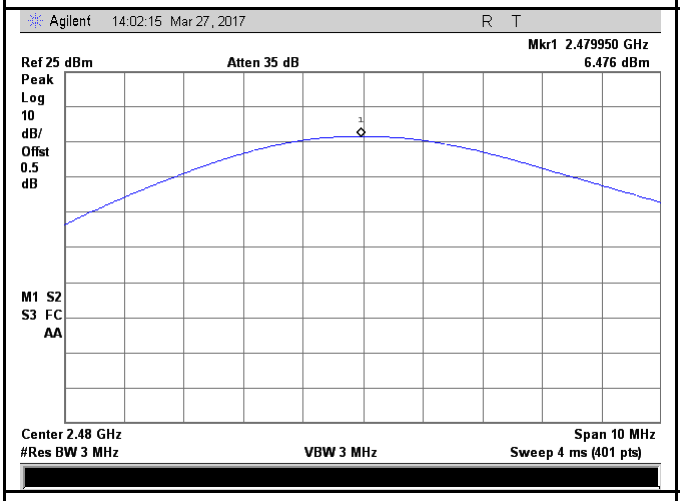
Output Power measurement result



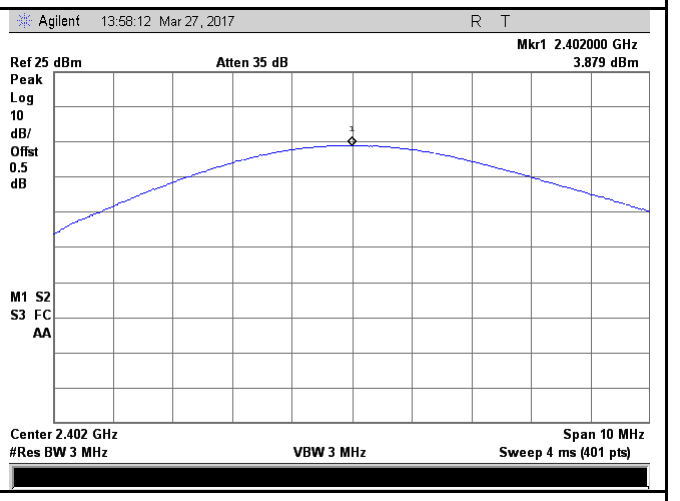
GFSK Output power - Low CH 2402



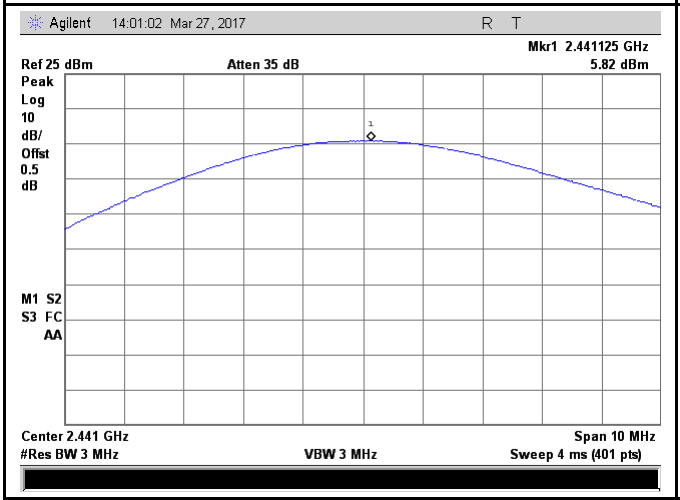
GFSK Output power - Mid CH 2441



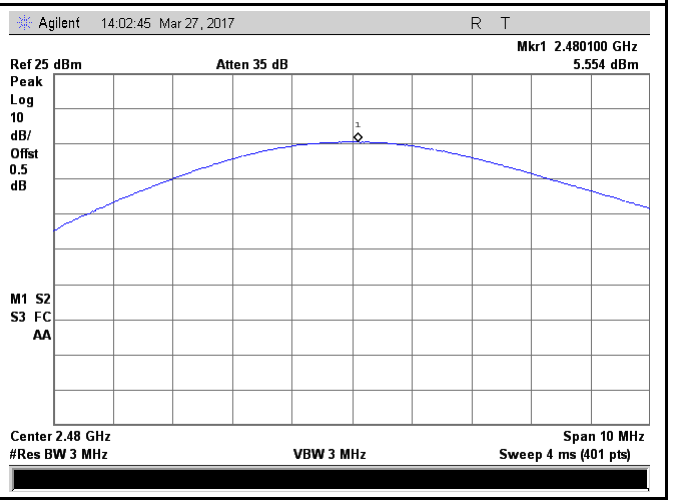
GFSK Output power - High CH 2480



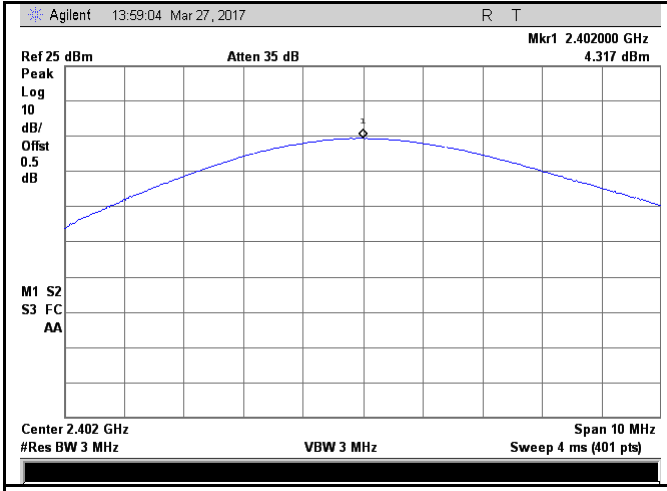
π /4 DQPSK Output power - Low CH 2402



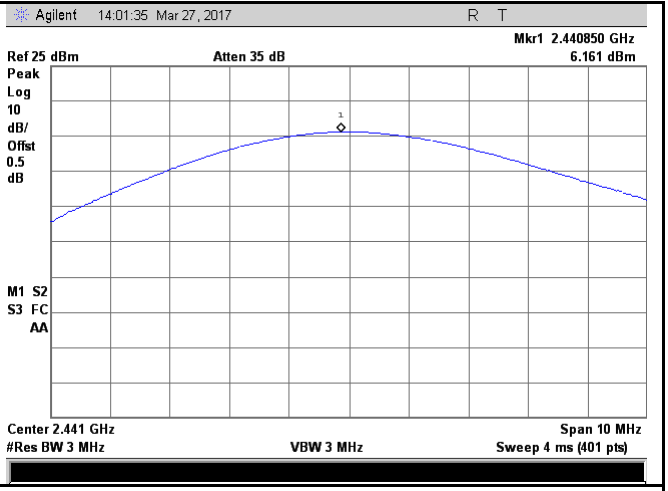
π /4 DQPSK Output power - Mid CH 2441



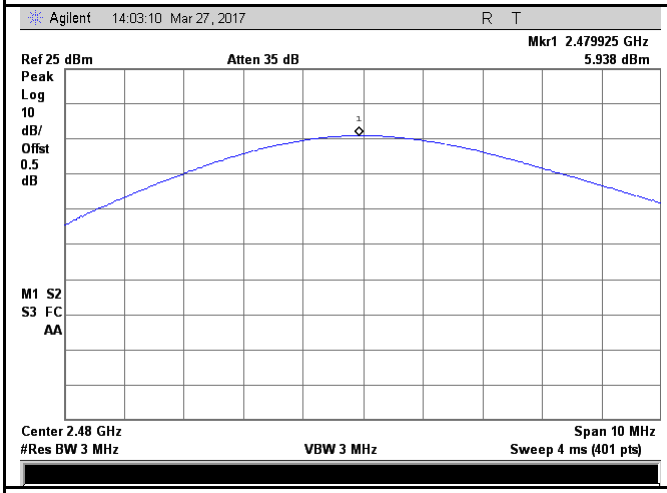
π /4 DQPSK Output power - High CH 2480



8DPSK Output power - Low CH 2402



8DPSK Output power - Mid CH 2441

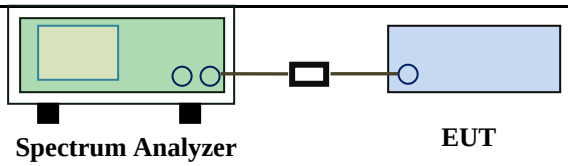


8DPSK Output power - High CH 2480

6.5 Number of Hopping Channel

Temperature	22℃
Relative Humidity	55%
Atmospheric Pressure	1013mbar
Test date :	March 15, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
§15.247(a)(1)(iii)	a)	FHSS in 2400-2483.5MHz ≥ 15 channels	☑
Test Setup			
Test Procedure	The test follows FCC Public Notice DA 00-705 Measurement Guidelines. Use the following spectrum analyzer settings: The EUT must have its hopping function enabled. - Span = the frequency band of operation - RBW ≥ 1% of the span - VBW ≥ RBW - Sweep = auto - Detector function = peak - Trace = max hold - Allow trace to fully stabilize. - It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).		
Remark			
Result	☑ Pass	☐ Fail	

Test Data ☑ Yes ☐ N/A

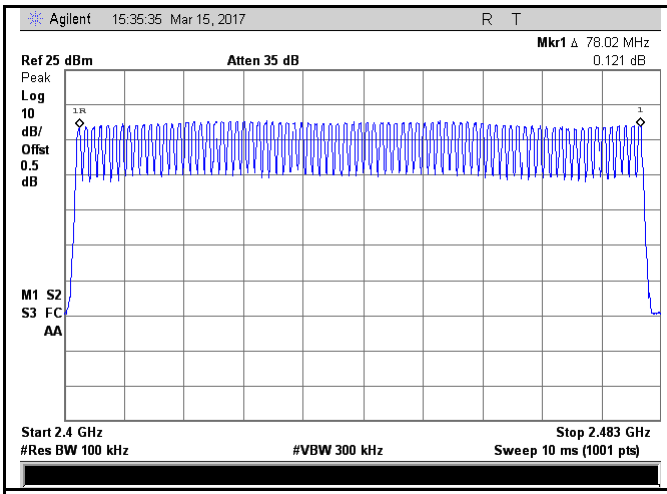
Test Plot ☑ Yes (See below) ☐ N/A

Number of Hopping Channel measurement result

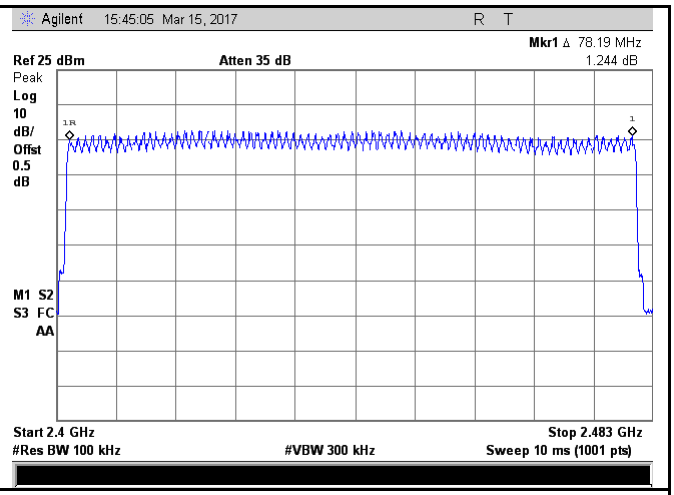
Type	Modulation	Frequency Range	Number of Hopping Channel	Limit
Number of Hopping Channel	GFSK	2400-2483.5	79	15
	π /4 DQPSK	2400-2483.5	79	15
	8-DPSK	2400-2483.5	79	15

Test Plots

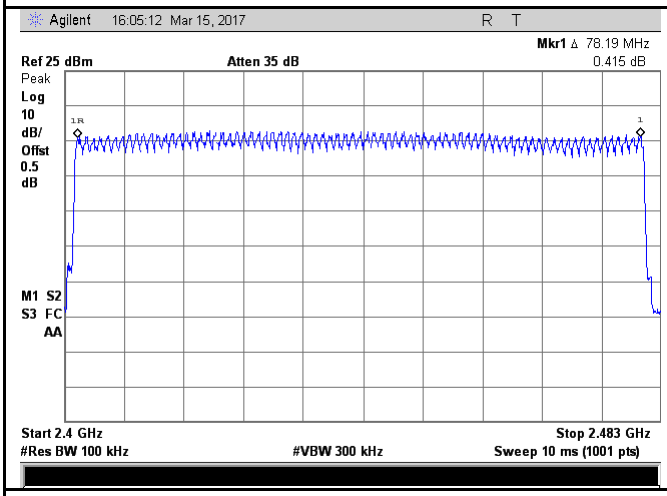
Number of Hopping Channels measurement result



GFSK



π /4DQPSK

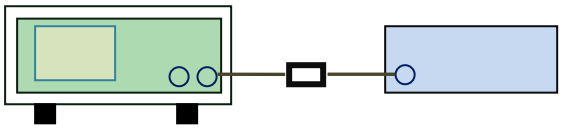


8DPSK

6.6 Time of Occupancy (Dwell Time)

Temperature	22℃
Relative Humidity	55%
Atmospheric Pressure	1013mbar
Test date :	March 15, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
§15.247(a)(1)(iii)	a)	Dwell Time < 0.4s	☑
Test Setup			
Test Procedure	The test follows FCC Public Notice DA 00-705 Measurement Guidelines. Use the following spectrum analyzer - Span = zero span, centered on a hopping channel - RBW = 1 MHz - VBW ≥ RBW - Sweep = as necessary to capture the entire dwell time per hopping channel - Detector function = peak - use the marker-delta function to determine the dwell time		
Remark			
Result	☑ Pass ☐ Fail		

Test Data ☑ Yes ☐ N/A

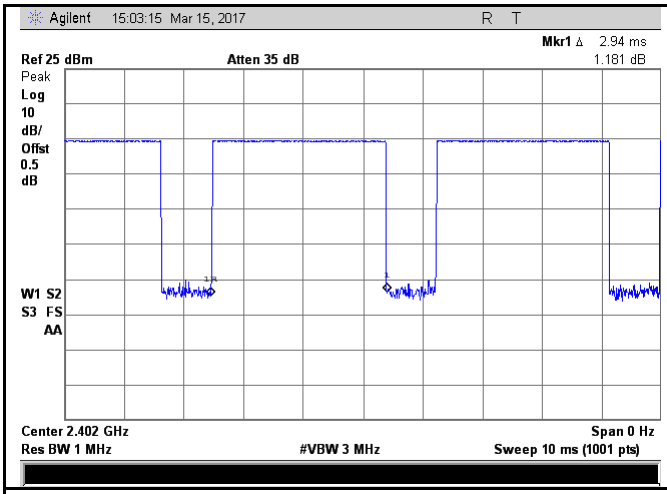
Test Plot ☑ Yes (See below) ☐ N/A

Dwell Time measurement result

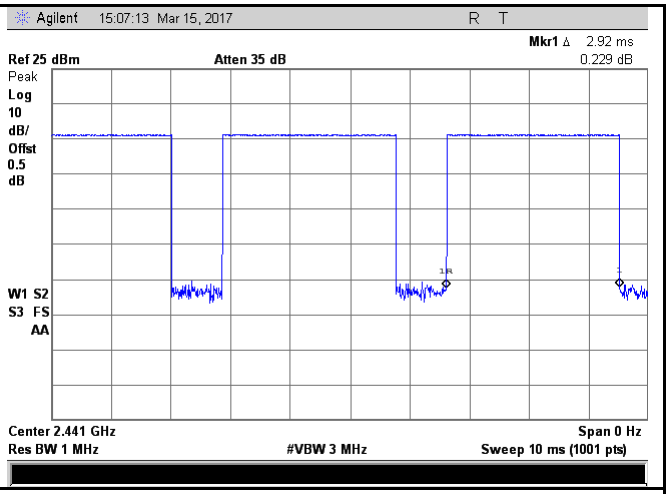
Type	Modulation	CH	Pulse Width (ms)	Dwell Time (ms)	Limit (ms)	Result
Dwell Time	GFSK	Low	2.94	313.600	400	Pass
		Mid	2.92	311.467	400	Pass
		High	2.92	311.467	400	Pass
	π /4 DQPSK	Low	2.96	315.733	400	Pass
		Mid	2.94	313.600	400	Pass
		High	2.94	313.600	400	Pass
	8-DPSK	Low	2.93	312.533	400	Pass
		Mid	2.96	315.733	400	Pass
		High	2.94	313.600	400	Pass
Note: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6						

Test Plots

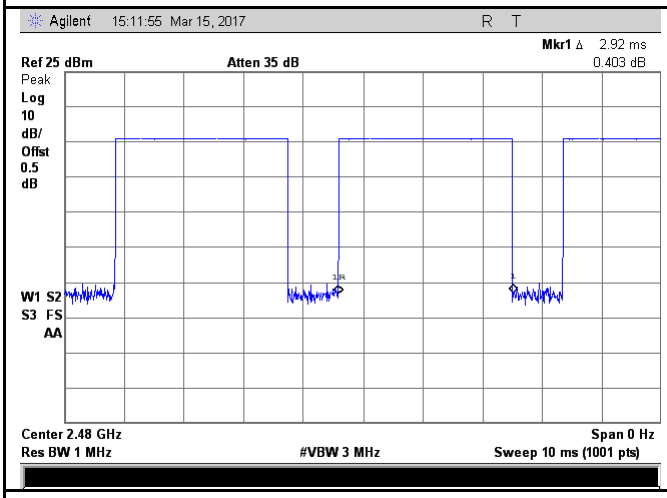
Dwell Time measurement result



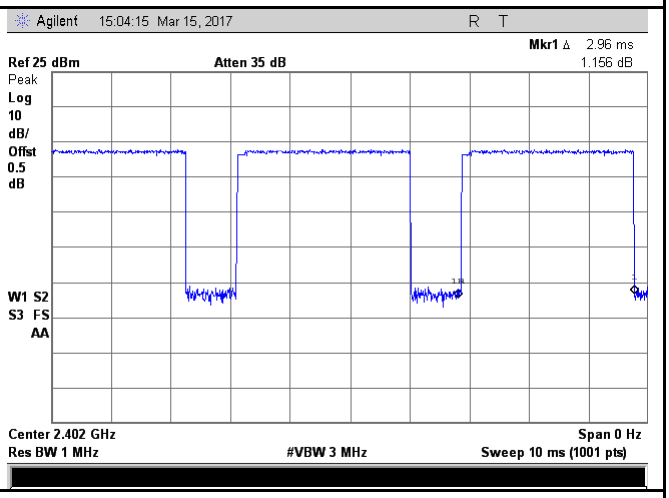
GFSK - Low CH 2402



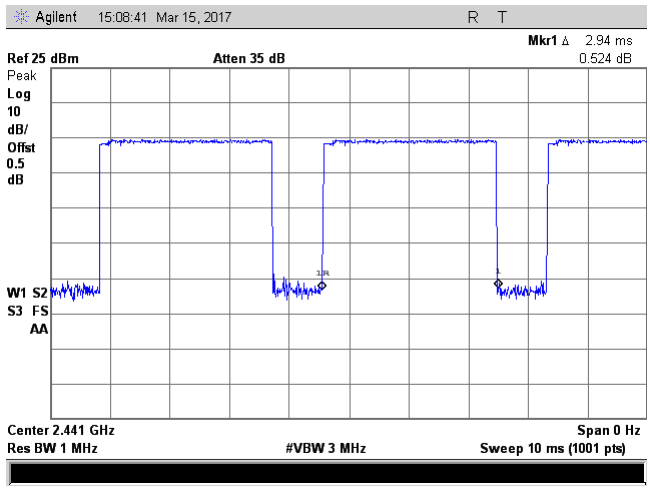
GFSK - Mid CH 2441



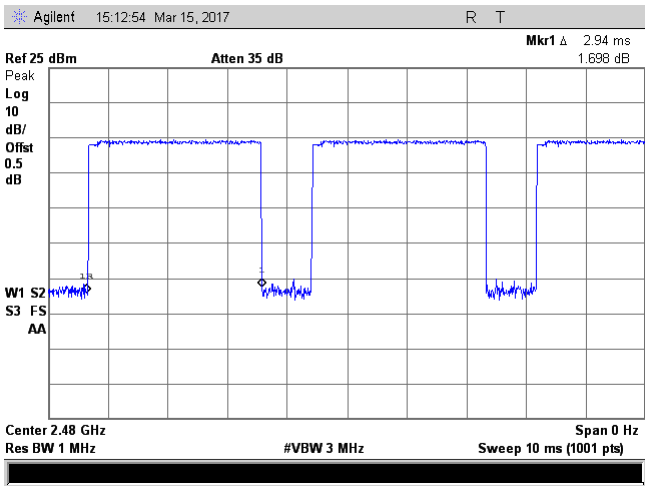
GFDK - High CH 2480



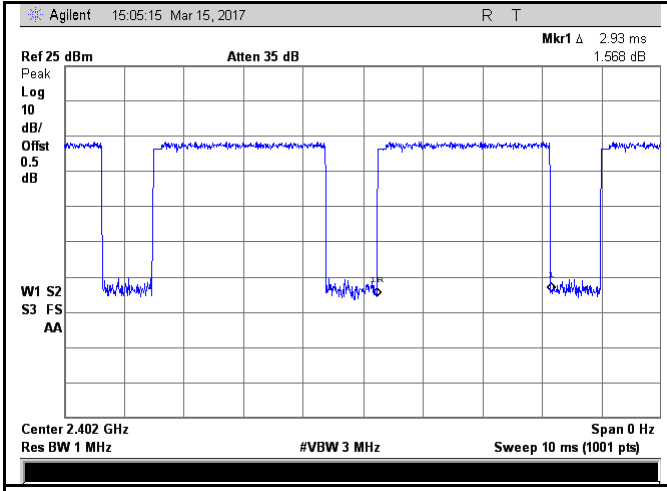
π /4 DQPSK - Low CH 2402



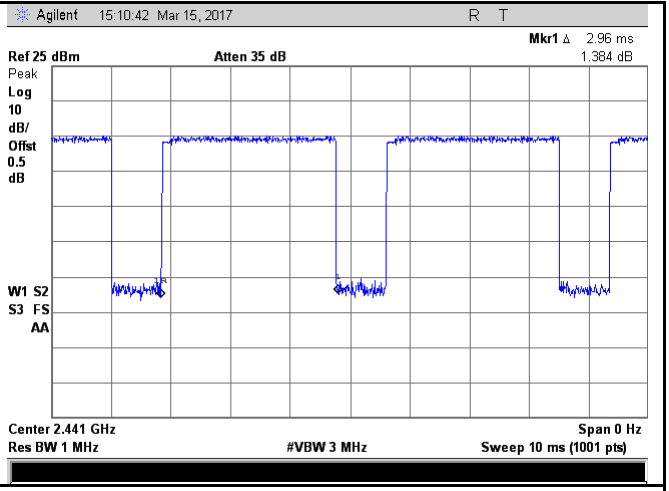
π /4 DQPSK - Mid CH 2441



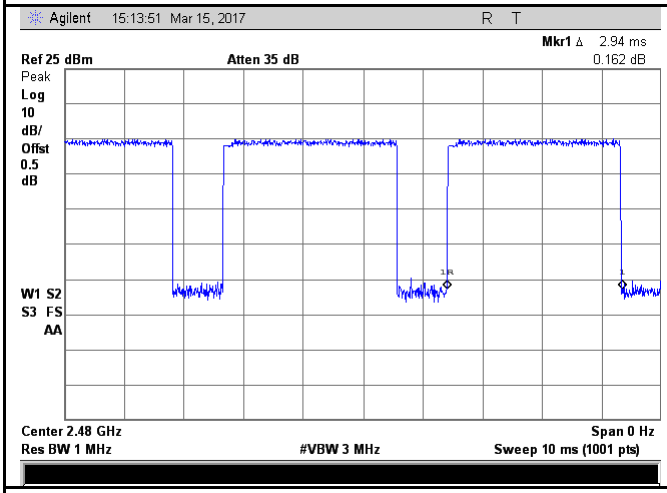
π /4 DQPSK - High CH 2480



8DPSK - Low CH 2402



8DPSK - Mid CH 2441

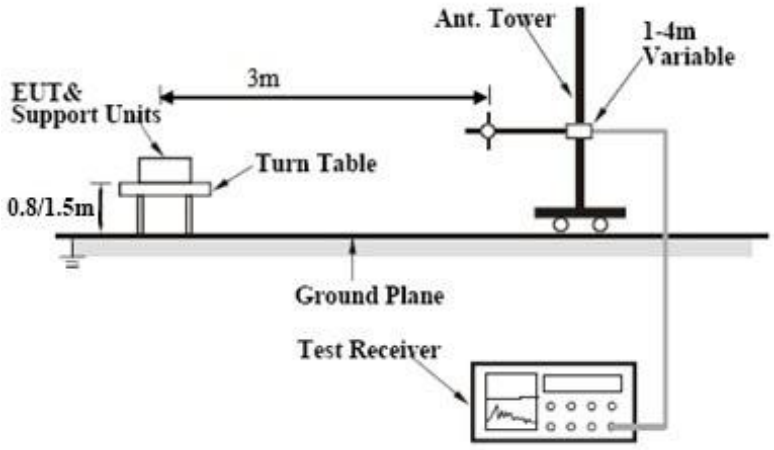


8DPSK - High CH 2480

6.7 Band Edge & Restricted Band

Temperature	24℃
Relative Humidity	55%
Atmospheric Pressure	1010mbar
Test date :	March 17, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
§15.247(a)(1)(iii)	a)	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.☐	☑
Test Setup			
Test Procedure	The test follows FCC Public Notice DA 00-705 Measurement Guidelines. Radiated Method Only - 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator. - 2. Position the EUT without connection to measurement instrument. Put it on the Rotated table and turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range,		

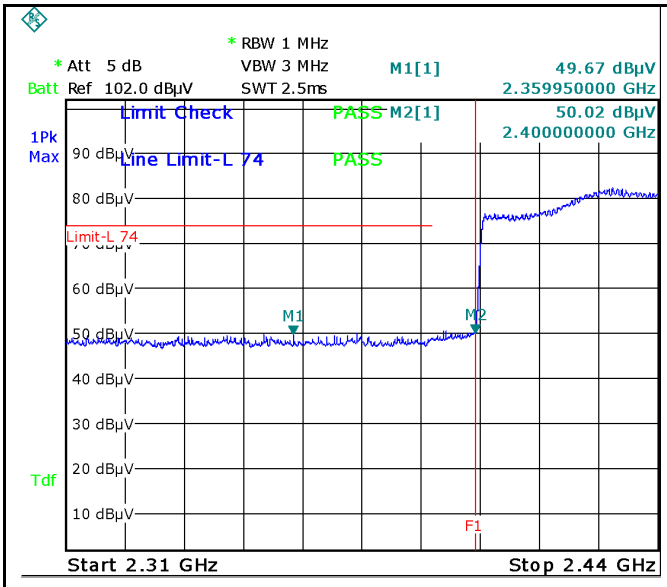
	and make sure the instrument is operated in its linear range. - 3. First, set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, check the emission of EUT, if pass then set Spectrum Analyzer as below: a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasiy Peak detection at frequency below 1GHz. b. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak measurement at frequency above 1GHz. c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz with Peak detection for Average Measurement as below at frequency above 1GHz. - 4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency. - 5. Repeat above procedures until all measured frequencies were complete.
Remark	
Result	☑ Pass ☐ Fail

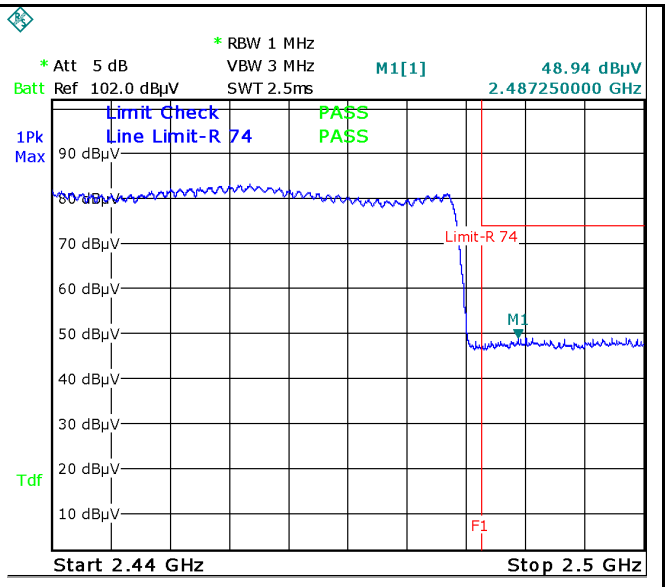
Test Data ☐ Yes ☑ N/A

Test Plot ☑ Yes (See below) ☐ N/A

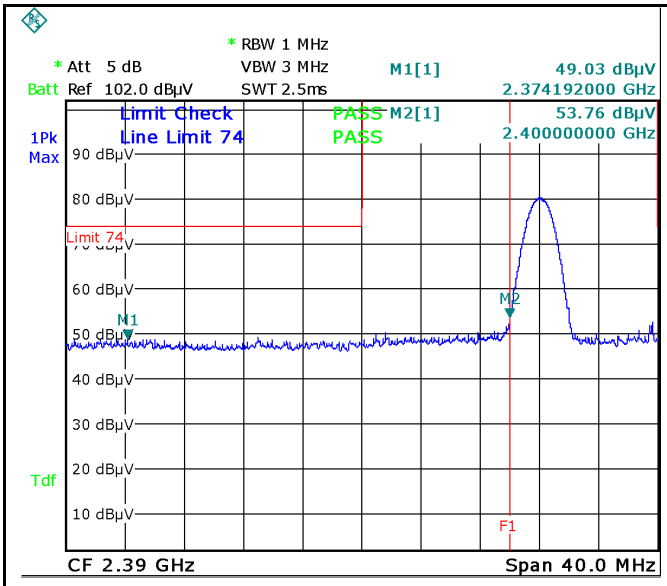
Test Plots

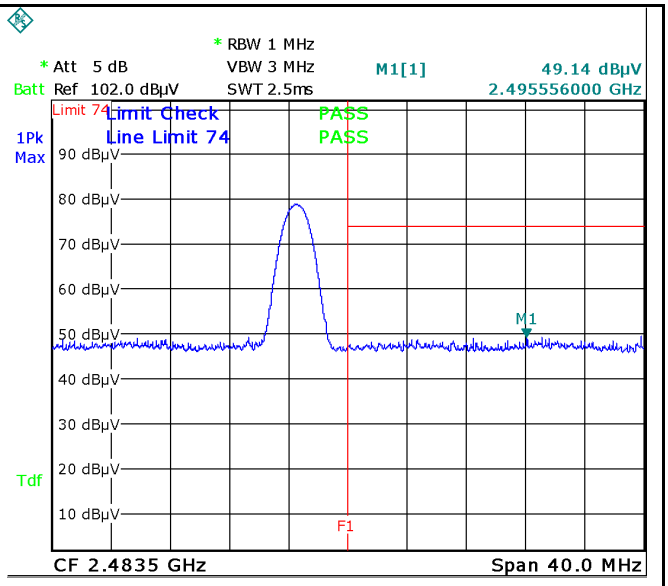
GFSK Mode:





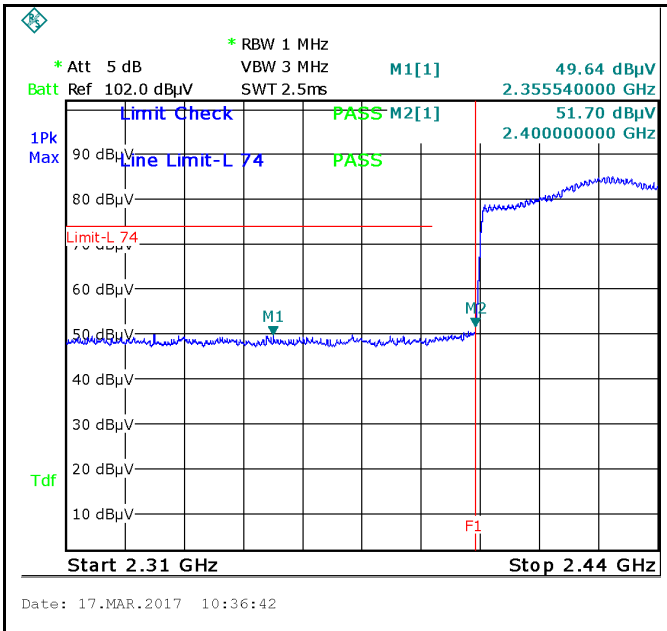
GFSK-Hopping Left Side-PK **Note: F1 is frequency 2400MHz**	GFSK-Hopping Right Side-PK **Note: F1 is frequency 2483.5MHz**
Note: (no need if PK value less than the AV limit)	Note: (no need if PK value less than the AV limit)
GFSK-Hopping Left Side-AV	GFSK-Hopping Right Side-AV





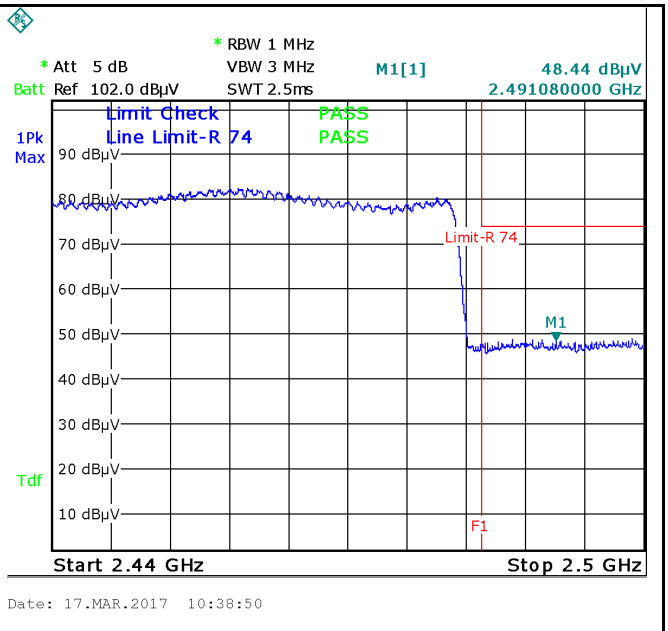
GFSK-Left Side-PK **Note: F1 is frequency 2400MHz**	GFSK-Right Side-PK **Note: F1 is frequency 2483.5MHz**
Note: (no need if PK value less than the AV limit)	Note: (no need if PK value less than the AV limit)
GFSK-Left Side-AV	GFSK-Right Side-AV

π /4 DQPSK Mode:



π /4 DQPSK-Hopping Left Side-PK

Note: F1 is frequency 2400MHz



π /4 DQPSK-Hopping Right Side-PK

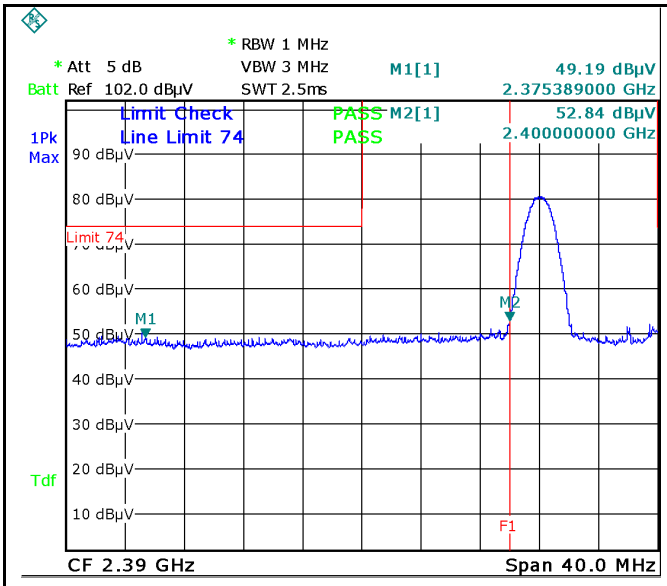
Note: F1 is frequency 2483.5MHz

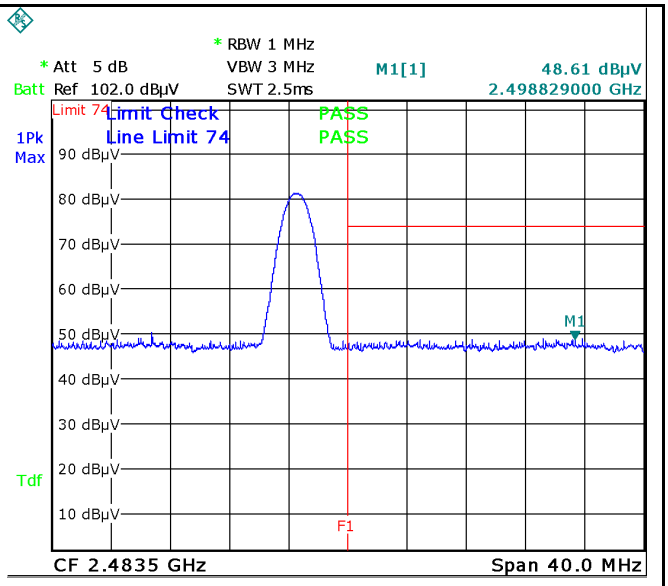
Note: (no need if PK value less than the AV limit)

Note: (no need if PK value less than the AV limit)

π /4 DQPSK-Hopping Left-AV

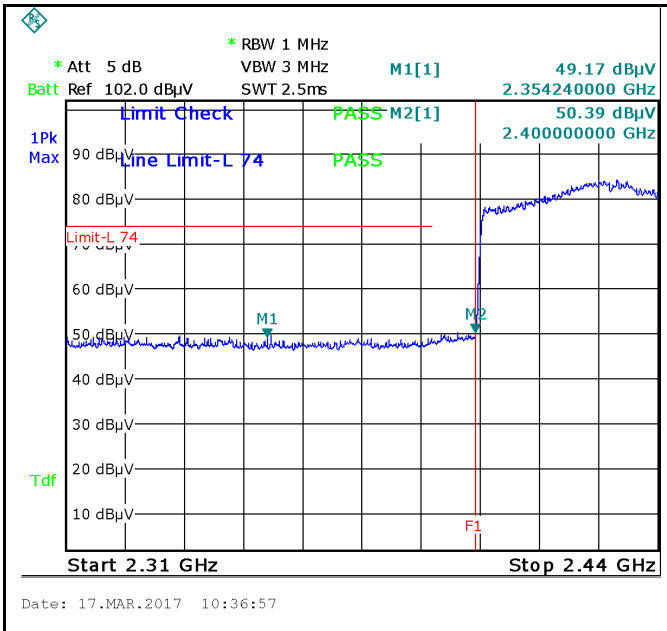
π /4 DQPSK-Hopping Right-AV





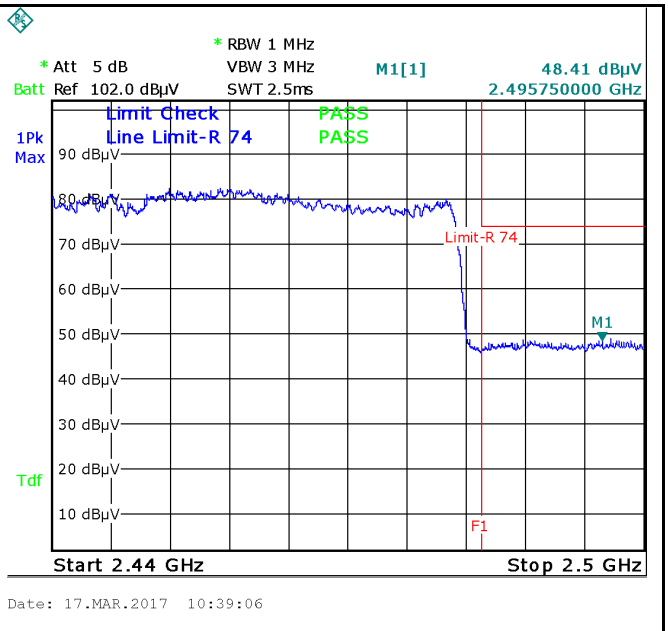
π /4 DQPSK-Left Side-PK **Note: F1 is frequency 2400MHz**	π /4 DQPSK-Right Side-PK **Note: F1 is frequency 2483.5MHz**
Note: (no need if PK value less than the AV limit)	Note: (no need if PK value less than the AV limit)
π /4 DQPSK-Left Side-AV	π /4 DQPSK-Right Side-AV

8-DPSK Mode:



8DPSK-Hopping Left Side-PK

Note: F1 is frequency 2400MHz



8DPSK-Hopping Right Side-PK

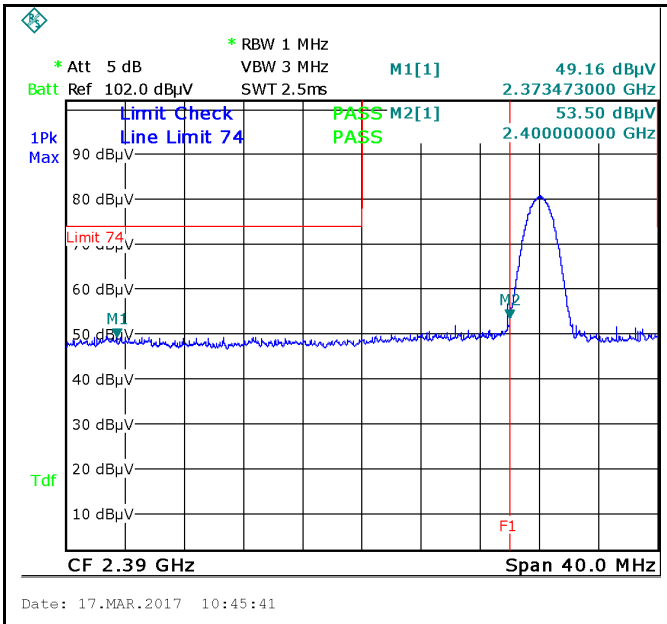
Note: F1 is frequency 2483.5MHz

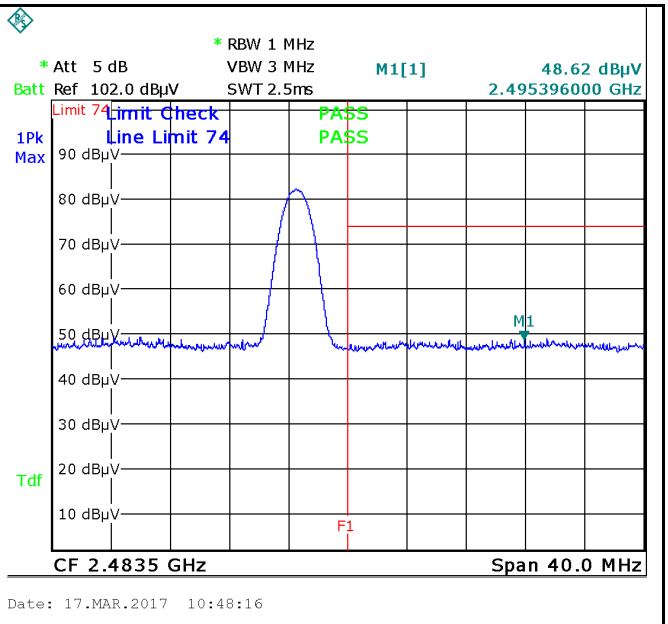
Note: (no need if PK value less than the AV limit)

Note: (no need if PK value less than the AV limit)

8DPSK-Hopping Left-AV

8DPSK-Hopping Right-AV



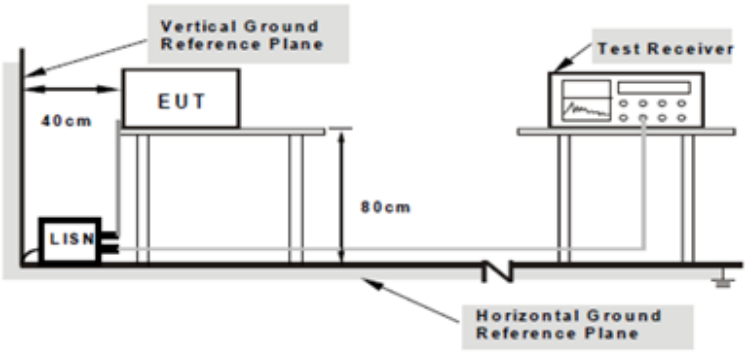


8DPSK-Left Side-PK **Note: F1 is frequency 2400MHz**	8DPSK-Right Side-PK **Note: F1 is frequency 2483.5MHz**
Note: (no need if PK value less than the AV limit)	Note: (no need if PK value less than the AV limit)
8DPSK-Left Side-AV	8DPSK-Right Side-AV

6.8 AC Power Line Conducted Emissions

Temperature	24℃
Relative Humidity	55%
Atmospheric Pressure	1010mbar
Test date :	March 17, 2017
Tested By :	Leen Yang

Requirement(s):

<table>
<tr><th>Spec</th><th>Item</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td>47CFR§15.207, RSS210 (A8.1)</td><td>a)</td><td>For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 [mu]H/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequencies ranges.
<table>
<tr><th rowspan="2">Frequency ranges (MHz)</th><th colspan="2">Limit (dBμV)</th></tr>
<tr><th>QP</th><th>Average</th></tr>
<tr><td>0.15 ~ 0.5</td><td>66 – 56</td><td>56 – 46</td></tr>
<tr><td>0.5 ~ 5</td><td>56</td><td>46</td></tr>
<tr><td>5 ~ 30</td><td>60</td><td>50</td></tr>
</table></td><td>☑</td></tr>
<tr><td>Test Setup</td><td colspan="3"> 

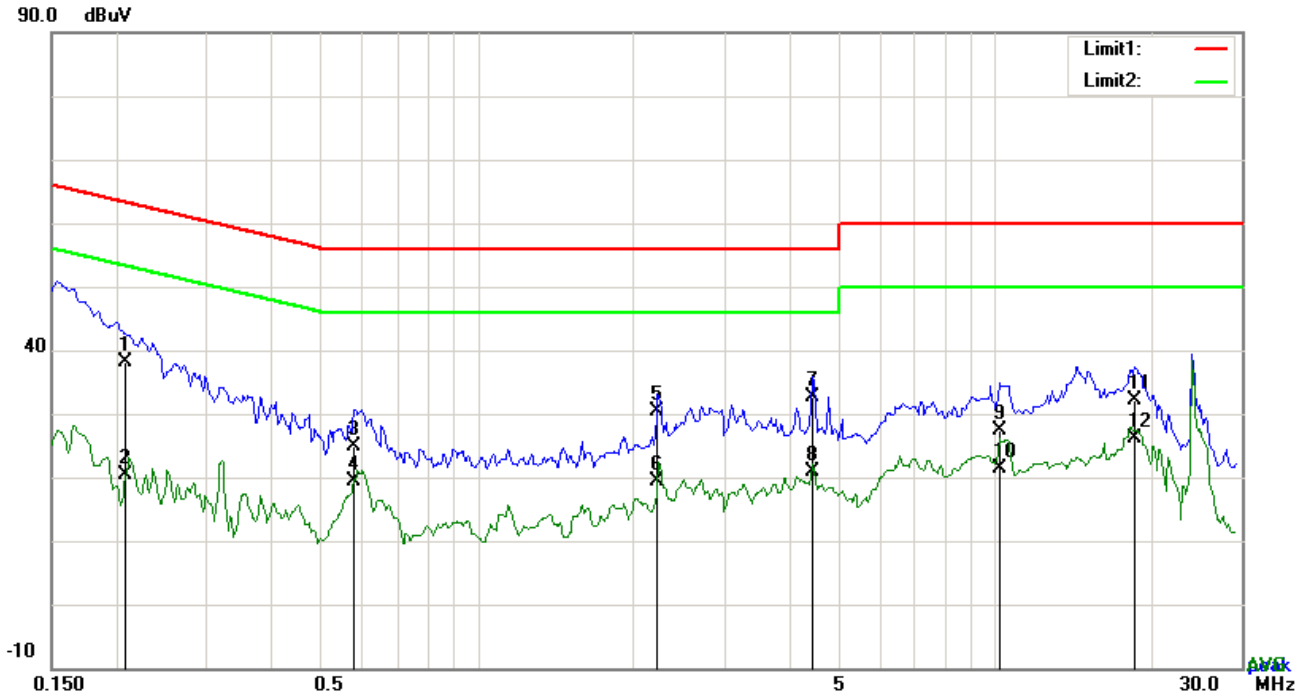
Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.</td></tr>
<tr><td>Procedure</td><td colspan="3">1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50W/50mH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss</td></tr>
</table>

	coaxial cable. 4. All other supporting equipment were powered separately from another main supply. 5. The EUT was switched on and allowed to warm up to its normal operating condition. 6. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver. 7. High peaks, relative to the limit line, The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. 8. Step 7 was then repeated for the LIVE line (for AC mains) or DC line (for DC power).
Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes (See below) ☐ N/A

Test Mode:	Bluetooth Mode

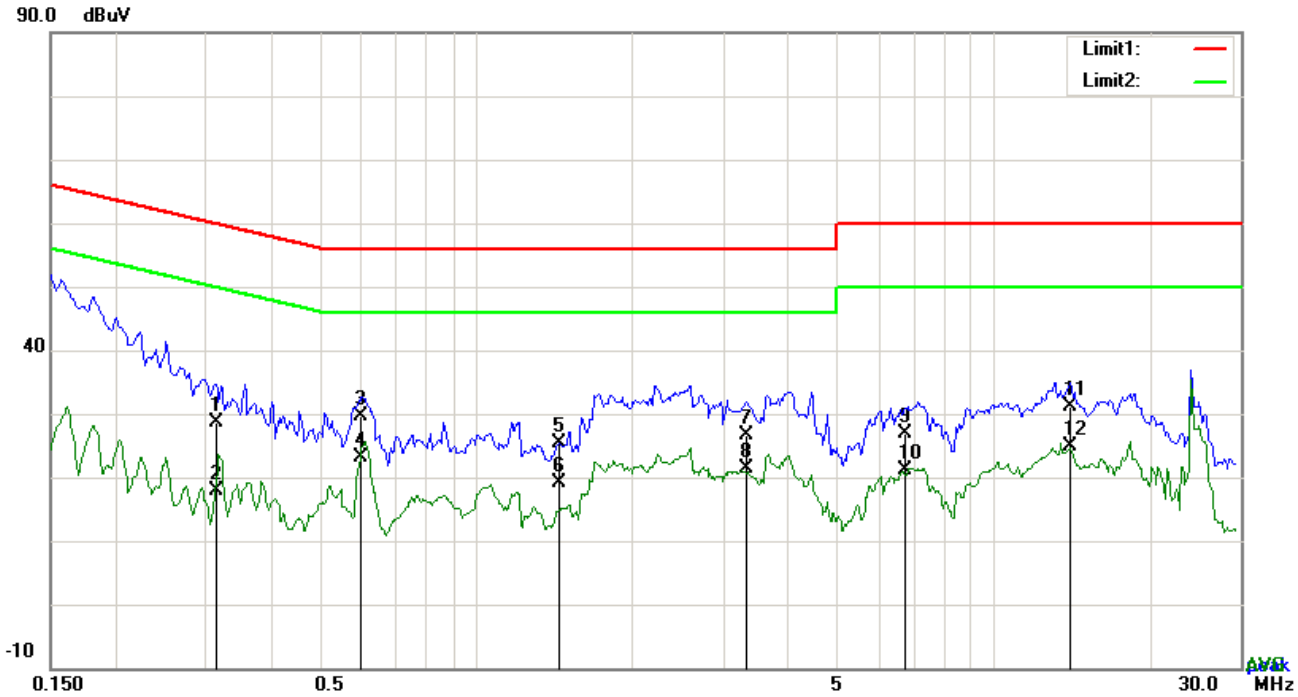


Test Data

Phase Line Plot at 120Vac, 60Hz

No.	P/L	Frequency	Reading	Detector	Corrected	Result	Limit	Margin
		(MHz)	(dBuV)		(dB}	(dBuV)	(dBuV)	(dB)
1	L1	0.2085	28.20	QP	10.03	38.23	63.26	-25.03
2	L1	0.2085	10.29	AVG	10.03	20.32	53.26	-32.94
3	L1	0.5790	14.96	QP	10.03	24.99	56.00	-31.01
4	L1	0.5790	9.46	AVG	10.03	19.49	46.00	-26.51
5	L1	2.2287	20.21	QP	10.05	30.26	56.00	-25.74
6	L1	2.2287	9.24	AVG	10.05	19.29	46.00	-26.71
7	L1	4.4508	22.50	QP	10.07	32.57	56.00	-23.43
8	L1	4.4508	10.79	AVG	10.07	20.86	46.00	-25.14
9	L1	10.2267	17.32	QP	10.15	27.47	60.00	-32.53
10	L1	10.2267	11.23	AVG	10.15	21.38	50.00	-28.62
11	L1	18.6780	21.81	QP	10.28	32.09	60.00	-27.91
12	L1	18.6780	15.96	AVG	10.28	26.24	50.00	-23.76

Test Mode:	Bluetooth Mode

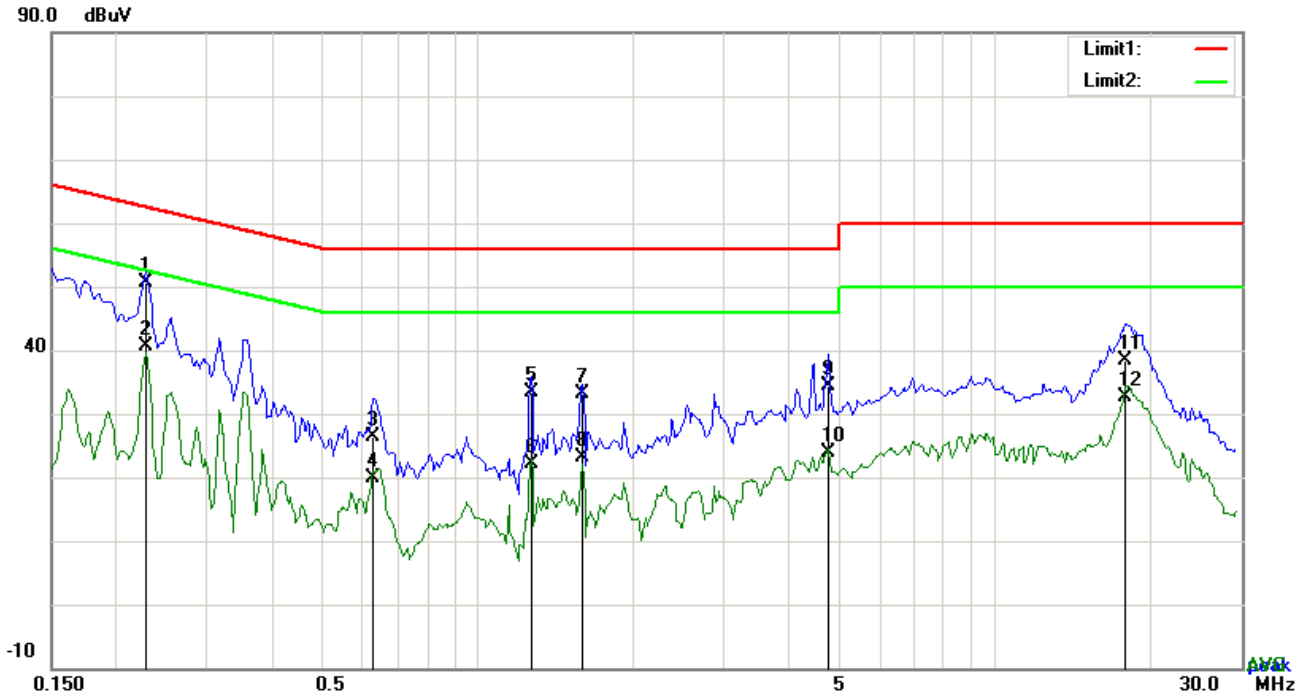


Test Data

Phase Neutral Plot at 120Vac, 60Hz

No.	P/L	Frequency	Reading	Detector	Corrected	Result	Limit	Margin
		(MHz)	(dBuV)		(dB}	(dBuV)	(dBuV)	(dB)
1	N	0.3138	18.56	QP	10.02	28.58	59.87	-31.29
2	N	0.3138	7.98	AVG	10.02	18.00	49.87	-31.87
3	N	0.5985	19.63	QP	10.02	29.65	56.00	-26.35
4	N	0.5985	13.11	AVG	10.02	23.13	46.00	-22.87
5	N	1.4409	15.37	QP	10.03	25.40	56.00	-30.60
6	N	1.4409	9.03	AVG	10.03	19.06	46.00	-26.94
7	N	3.3237	16.66	QP	10.05	26.71	56.00	-29.29
8	N	3.3237	11.39	AVG	10.05	21.44	46.00	-24.56
9	N	6.7557	16.87	QP	10.09	26.96	60.00	-33.04
10	N	6.7557	10.93	AVG	10.09	21.02	50.00	-28.98
11	N	14.0565	20.89	QP	10.19	31.08	60.00	-28.92
12	N	14.0565	14.71	AVG	10.19	24.90	50.00	-25.10

Test Mode:	Bluetooth Mode

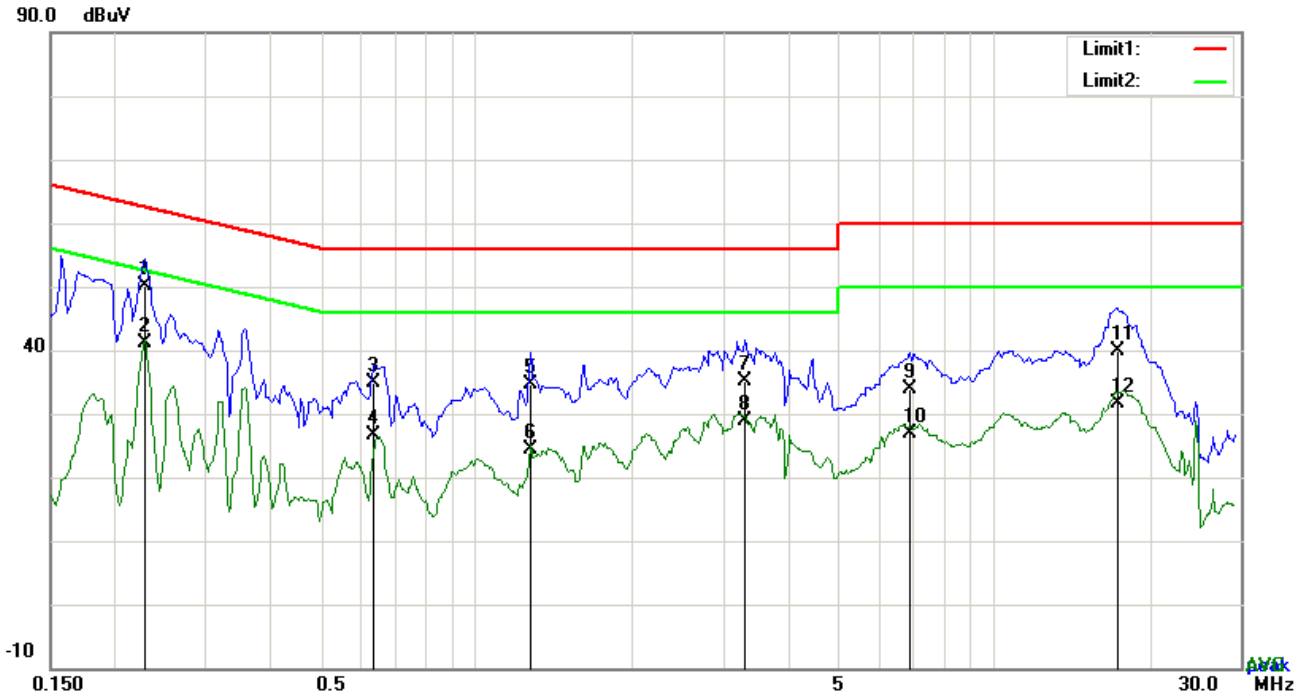


Test Data

Phase Line Plot at 240Vac, 60Hz

No.	P/L	Frequency	Reading	Detector	Corrected	Result	Limit	Margin
		(MHz)	(dBuV)		(dB}	(dBuV)	(dBuV)	(dB)
1	L1	0.2280	40.66	QP	10.03	50.69	62.52	-11.83
2	L1	0.2280	30.51	AVG	10.03	40.54	52.52	-11.98
3	L1	0.6297	16.23	QP	10.03	26.26	56.00	-29.74
4	L1	0.6297	9.74	AVG	10.03	19.77	46.00	-26.23
5	L1	1.2732	23.46	QP	10.03	33.49	56.00	-22.51
6	L1	1.2732	12.14	AVG	10.03	22.17	46.00	-23.83
7	L1	1.5969	22.97	QP	10.04	33.01	56.00	-22.99
8	L1	1.5969	13.11	AVG	10.04	23.15	46.00	-22.85
9	L1	4.7628	24.22	QP	10.08	34.30	56.00	-21.70
10	L1	4.7628	13.78	AVG	10.08	23.86	46.00	-22.14
11	L1	17.9253	28.14	QP	10.27	38.41	60.00	-21.59
12	L1	17.9253	22.26	AVG	10.27	32.53	50.00	-17.47

Test Mode:	Bluetooth Mode



Test Data

Phase Neutral Plot at 240Vac, 60Hz

No.	P/L	Frequency	Reading	Detector	Corrected	Result	Limit	Margin
		(MHz)	(dBuV)		(dB}	(dBuV)	(dBuV)	(dB)
1	N	0.2280	40.01	QP	10.02	50.03	62.52	-12.49
2	N	0.2280	31.19	AVG	10.02	41.21	52.52	-11.31
3	N	0.6336	24.95	QP	10.02	34.97	56.00	-21.03
4	N	0.6336	16.64	AVG	10.02	26.66	46.00	-19.34
5	N	1.2693	24.51	QP	10.03	34.54	56.00	-21.46
6	N	1.2693	14.32	AVG	10.03	24.35	46.00	-21.65
7	N	3.2964	25.10	QP	10.05	35.15	56.00	-20.85
8	N	3.2964	18.75	AVG	10.05	28.80	46.00	-17.20
9	N	6.8883	23.86	QP	10.10	33.96	60.00	-26.04
10	N	6.8883	16.66	AVG	10.10	26.76	50.00	-23.24
11	N	17.3013	29.63	QP	10.23	39.86	60.00	-20.14
12	N	17.3013	21.34	AVG	10.23	31.57	50.00	-18.43

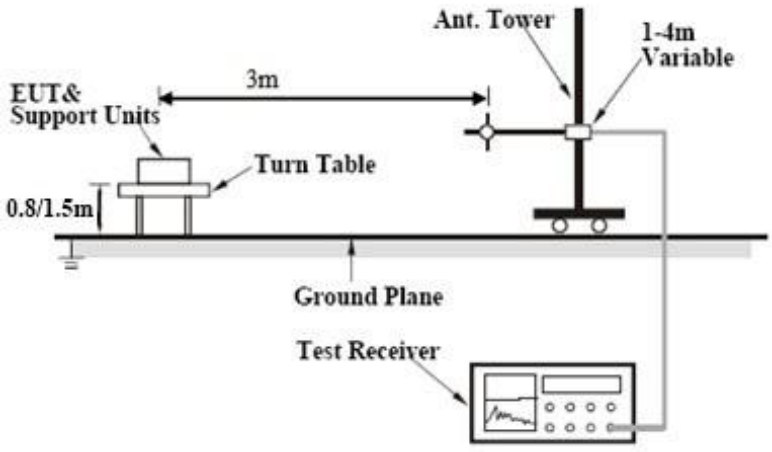
6.9 Radiated Spurious Emissions & Restricted Band

Temperature	24℃
Relative Humidity	55%
Atmospheric Pressure	1010mbar
Test date :	March 17, 2017
Tested By :	Leen Yang

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.205, §15.209, §15.247(d)	a)	Except higher limit as specified elsewhere in other section, the emissions from the low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges	☑

Frequency range (MHz)	Field Strength (μV/m)
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

Test Setup	
Procedure	1. The EUT was switched on and allowed to warm up to its normal operating condition. 2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:

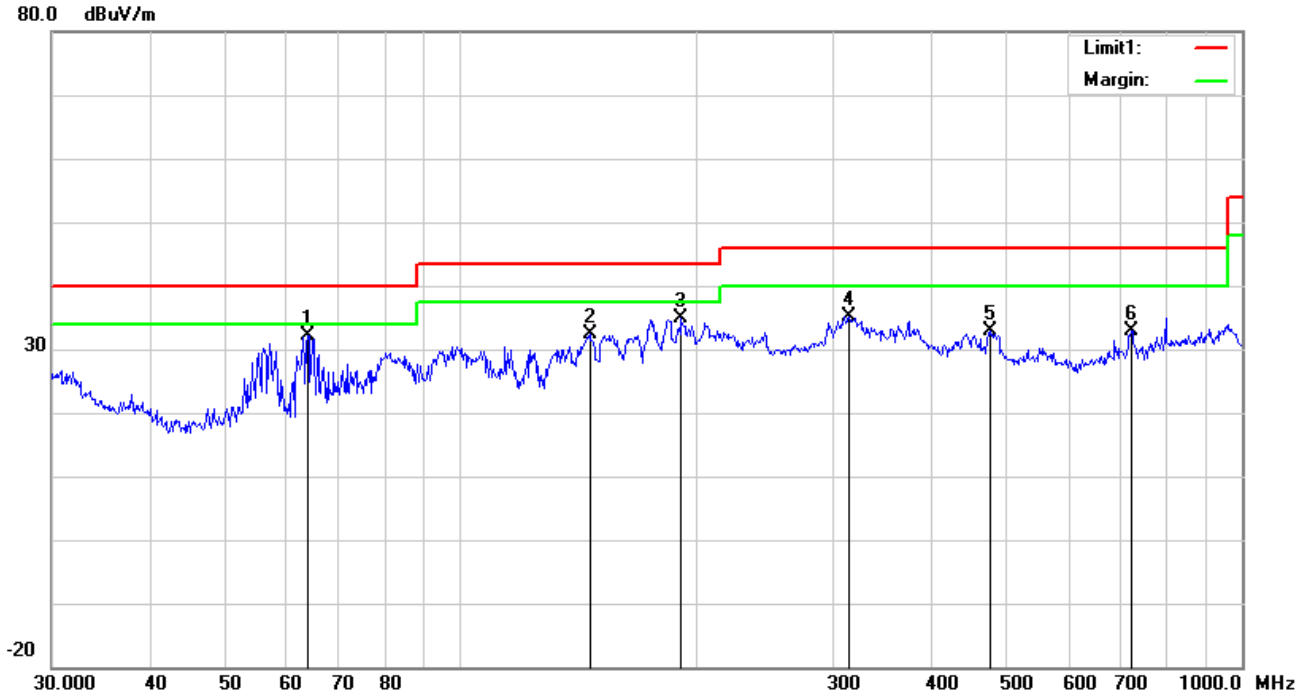
	a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen. b. The EUT was then rotated to the direction that gave the maximum emission. c. Finally, the antenna height was adjusted to the height that gave the maximum emission. 3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasiy Peak detection at frequency below 1GHz. 4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak measurement at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz with Peak detection for Average Measurement as below at frequency above 1GHz. 5. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.
Remark	
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes (See below) ☐ N/A

Test Mode:	Bluetooth Mode

Below 1GHz

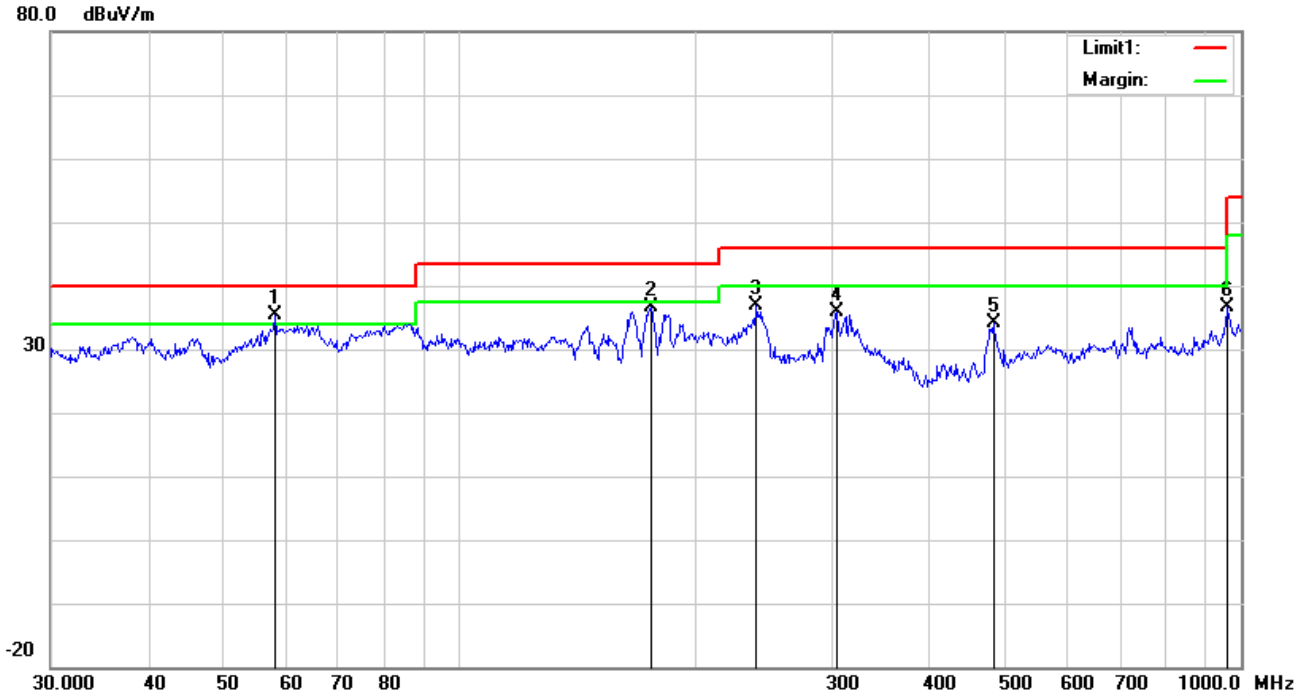


Test Data

Horizontal Polarity Plot @3m

No.	P/L	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
		(MHz)	(dBuV/m)		(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	( )
1	H	63.7588	46.24	peak	7.49	22.40	0.85	32.18	40.00	-7.82	100	85
2	H	146.3735	40.77	peak	12.60	22.37	1.31	32.31	43.50	-11.19	100	205
3	H	191.7450	43.94	peak	11.65	22.33	1.54	34.80	43.50	-8.70	100	140
4	H	314.3765	41.66	peak	13.90	22.25	1.86	35.17	46.00	-10.83	100	54
5	H	475.4991	35.17	peak	17.21	21.86	2.28	32.80	46.00	-13.20	100	173
6	H	721.7259	31.14	peak	20.46	21.31	2.68	32.97	46.00	-13.03	100	215

Below 1GHz



Test Data

Vertical Polarity Plot @3m

No.	P/L	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
		(MHz)	(dBuV/m)		(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(cm)	(°)
1	V	58.2030	49.46	QP	7.50	22.40	0.76	35.32	40.00	-4.68	100	327
2	V	176.2686	46.19	peak	11.30	22.25	1.36	36.60	43.50	-6.90	100	360
3	V	239.9873	45.93	peak	11.54	22.31	1.67	36.83	46.00	-9.17	100	261
4	V	303.5437	42.80	peak	13.67	22.28	1.81	36.00	46.00	-10.00	100	222
5	V	482.2156	36.36	peak	17.34	21.85	2.32	34.17	46.00	-11.83	100	353
6	V	962.1623	31.31	peak	22.81	20.76	3.24	36.60	54.00	-17.40	100	297

Above 1GHz

Test Mode:	Transmitting Mode

Low Channel: GFSK Mode (Worst Case) (2402 MHz)

Frequency (MHz)	S.A. Reading (dBµV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4804	39.47	AV	V	33.67	6.86	32.66	47.34	54	-6.66
4804	39.85	AV	H	33.67	6.86	32.66	47.72	54	-6.28
4804	48.62	PK	V	33.67	6.86	32.66	56.49	74	-17.51
4804	46.21	PK	H	33.67	6.86	32.66	54.08	74	-19.92
17801	24.69	AV	V	45.03	11.21	32.38	48.55	54	-5.45
17801	25.31	AV	H	45.03	11.21	32.38	49.17	54	-4.83
17801	40.58	PK	V	45.03	11.21	32.38	64.44	74	-9.56
17801	42.36	PK	H	45.03	11.21	32.38	66.22	74	-7.78

Middle Channel: GFSK Mode (Worst Case) (2441 MHz)

Frequency (MHz)	S.A. Reading (dBµV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4882	39.33	AV	V	33.71	6.95	32.74	47.25	54	-6.75
4882	38.99	AV	H	33.71	6.95	32.74	46.91	54	-7.09
4882	48.87	PK	V	33.71	6.95	32.74	56.79	74	-17.21
4882	47.54	PK	H	33.71	6.95	32.74	55.46	74	-18.54
17818	25.45	AV	V	45.15	11.18	32.41	49.37	54	-4.63
17818	23.94	AV	H	45.15	11.18	32.41	47.86	54	-6.14
17818	40.88	PK	V	45.15	11.18	32.41	64.8	74	-9.2
17818	42.02	PK	H	45.15	11.18	32.41	65.94	74	-8.06

High Channel: GFSK Mode (Worst Case) (2480 MHz)

Frequency (MHz)	S.A. Reading (dBμV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4960	38.19	AV	V	33.9	6.76	32.74	46.11	54	-7.89
4960	38.75	AV	H	33.9	6.76	32.74	46.67	54	-7.33
4960	48.06	PK	V	33.9	6.76	32.74	55.98	74	-18.02
4960	47.73	PK	H	33.9	6.76	32.74	55.65	74	-18.35
17827	24.48	AV	V	45.22	11.35	32.38	48.67	54	-5.33
17827	24.93	AV	H	45.22	11.35	32.38	49.12	54	-4.88
17827	42.66	PK	V	45.22	11.35	32.38	66.85	74	-7.15
17827	41.39	PK	H	45.22	11.35	32.38	65.58	74	-8.42

Note:

*1, The testing has been conformed to 10*2480MHz=24,800MHz*
2, All other emissions more than 30 dB below the limit
3, X-Axis, Y-Axis and Z-Axis were investigated. The results above show only the worst case.

Annex A. TEST INSTRUMENT

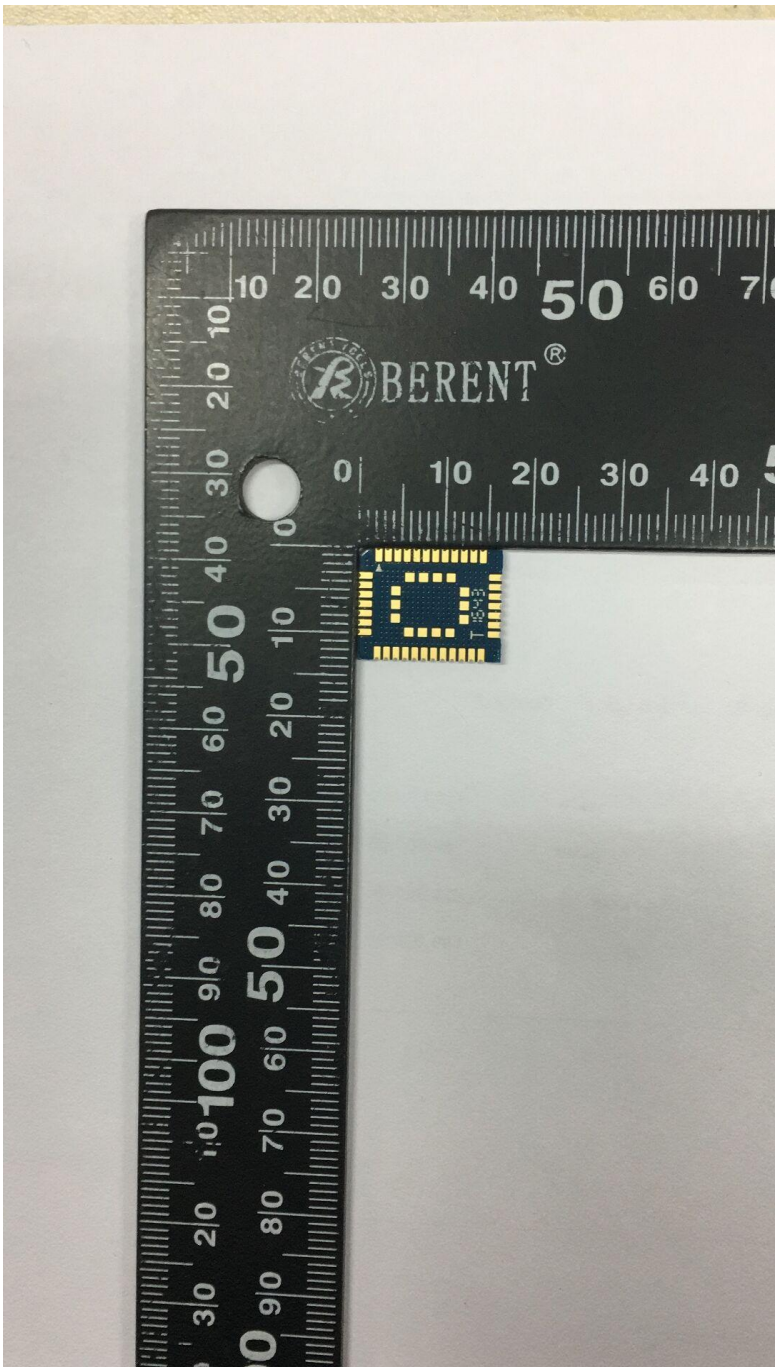
Instrument	Model	Serial #	Cal Date	Cal Due	In use
AC Line Conducted					
EMI test receiver	ESCS30	8471241027	09/16/2016	09/15/2017	☑
Line Impedance	LI-125A	191106	09/24/2016	09/23/2017	☑
Line Impedance	LI-125A	191107	09/24/2016	09/23/2017	☑
LISN	ISN T800	34373	09/24/2016	09/23/2017	☑
Double Ridge Horn Antenna (1 ~18GHz)	AH-118	71283	09/23/2016	09/22/2017	☑
Transient Limiter	LIT-153	531118	08/31/2016	08/30/2017	☑
RF conducted test					
Agilent ESA-E SERIES	E4407B	MY45108319	09/16/2016	09/15/2017	☑
Power Splitter	1#	1#	08/31/2016	08/30/2017	☑
DC Power Supply	E3640A	MY40004013	09/16/2016	09/15/2017	☑
Radiated Emissions					
EMI test receiver	ESL6	100262	09/16/2016	09/15/2017	☑
Positioning Controller	UC3000	MF780208282	11/18/2016	11/17/2017	☑
OPT 010 AMPLIFIER (0.1-1300MHz)	8447E	2727A02430	08/31/2016	08/30/2017	☑
Microwave Preamplifier (1 ~ 26.5GHz)	8449B	3008A02402	03/24/2016	03/23/2017	☑
Bilog Antenna (30MHz~6GHz)	JB6	A110712	09/20/2016	09/19/2017	☑
Double Ridge Horn Antenna (1 ~18GHz)	AH-118	71283	09/23/2016	09/22/2017	☑
Universal Radio Communication Tester	CMU200	121393	09/24/2016	09/23/2017	☑

Annex B. EUT And Test Setup Photographs

Annex B.i. Photograph: EUT External Photo

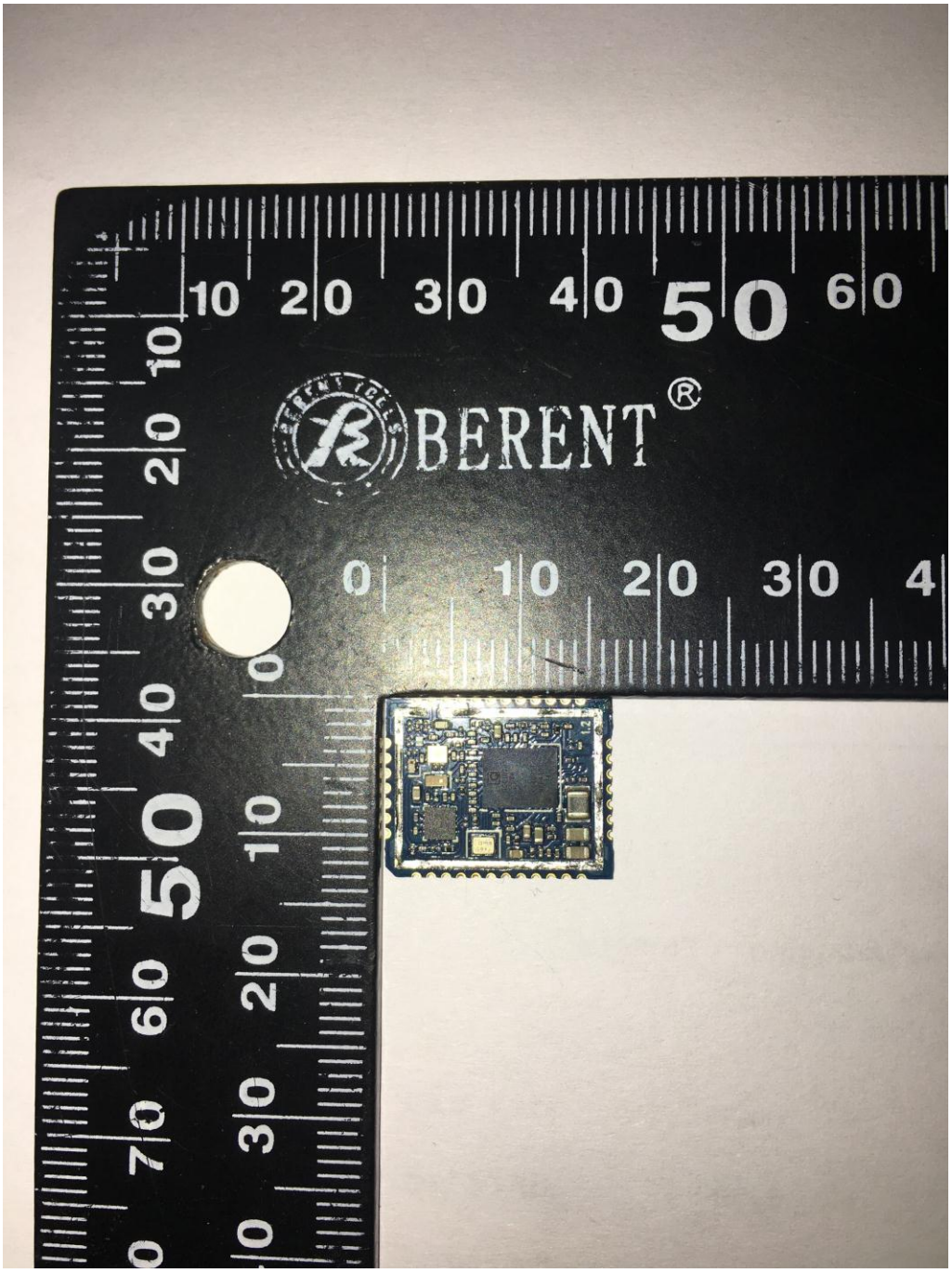
EUT - Front View

EUT - Rear View

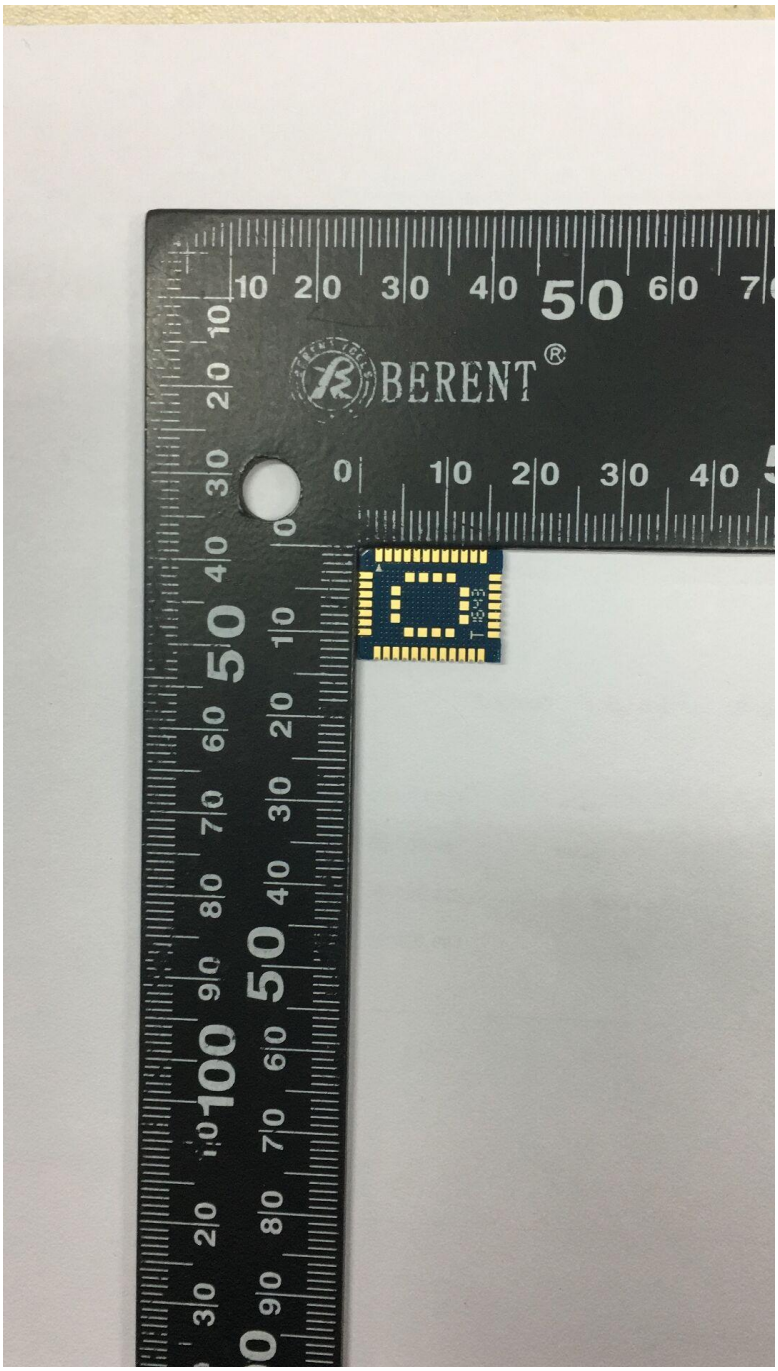


Annex B.ii. Photograph: EUT Internal Photo

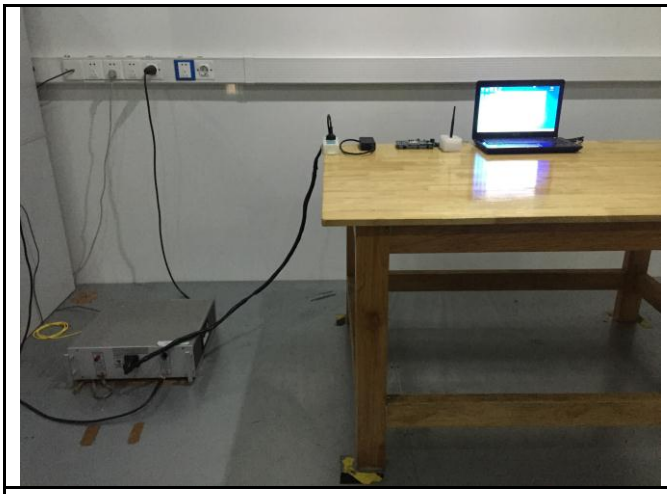
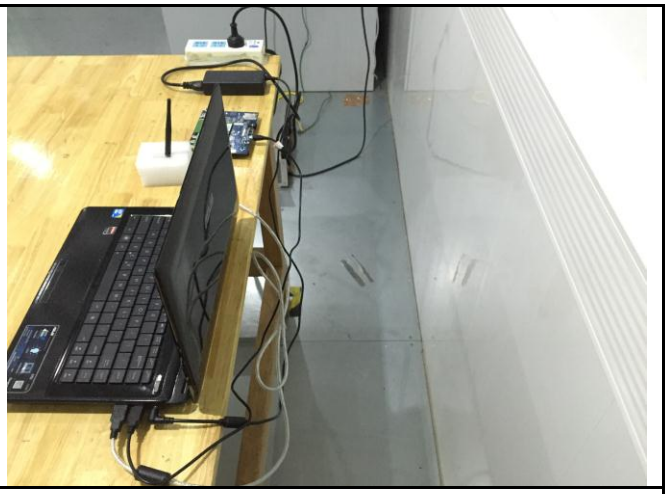
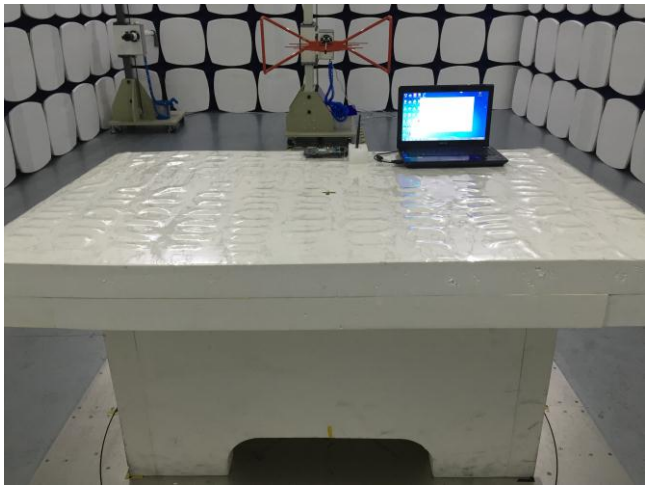
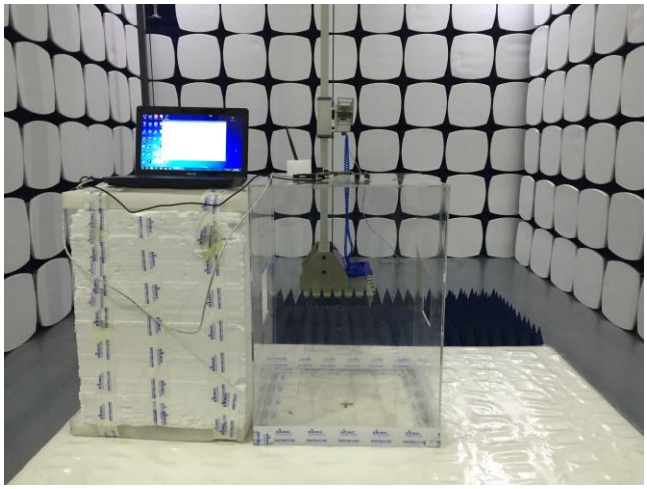
EUT- without Shielding – Front View



EUT - Rear View



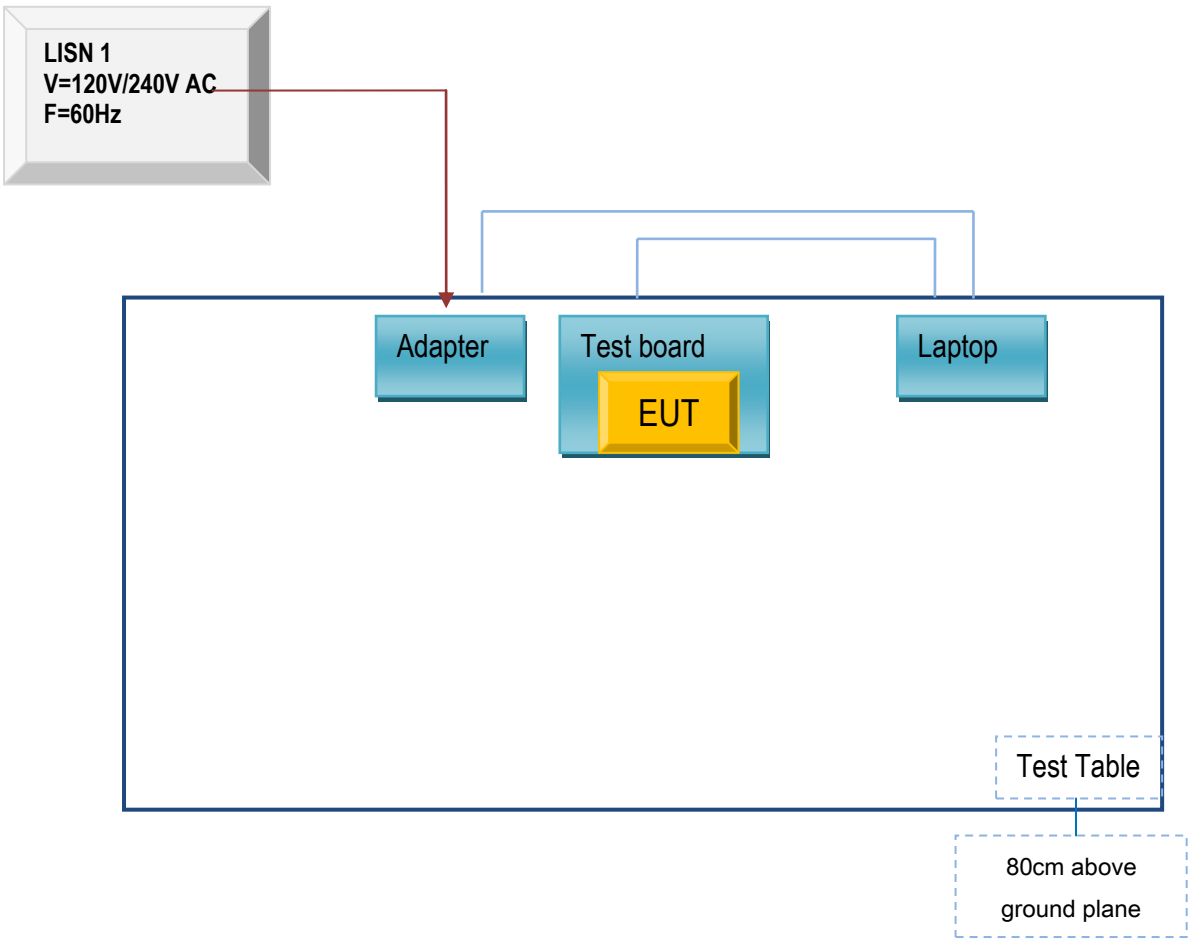
Annex B.iii. Photograph: Test Setup Photo

	
Conducted Emissions Test Setup Front View	Conducted Emissions Test Setup Side View
	
Radiated Spurious Emissions Test Setup Below 1GHz	Radiated Spurious Emissions Test Setup Above 1GHz

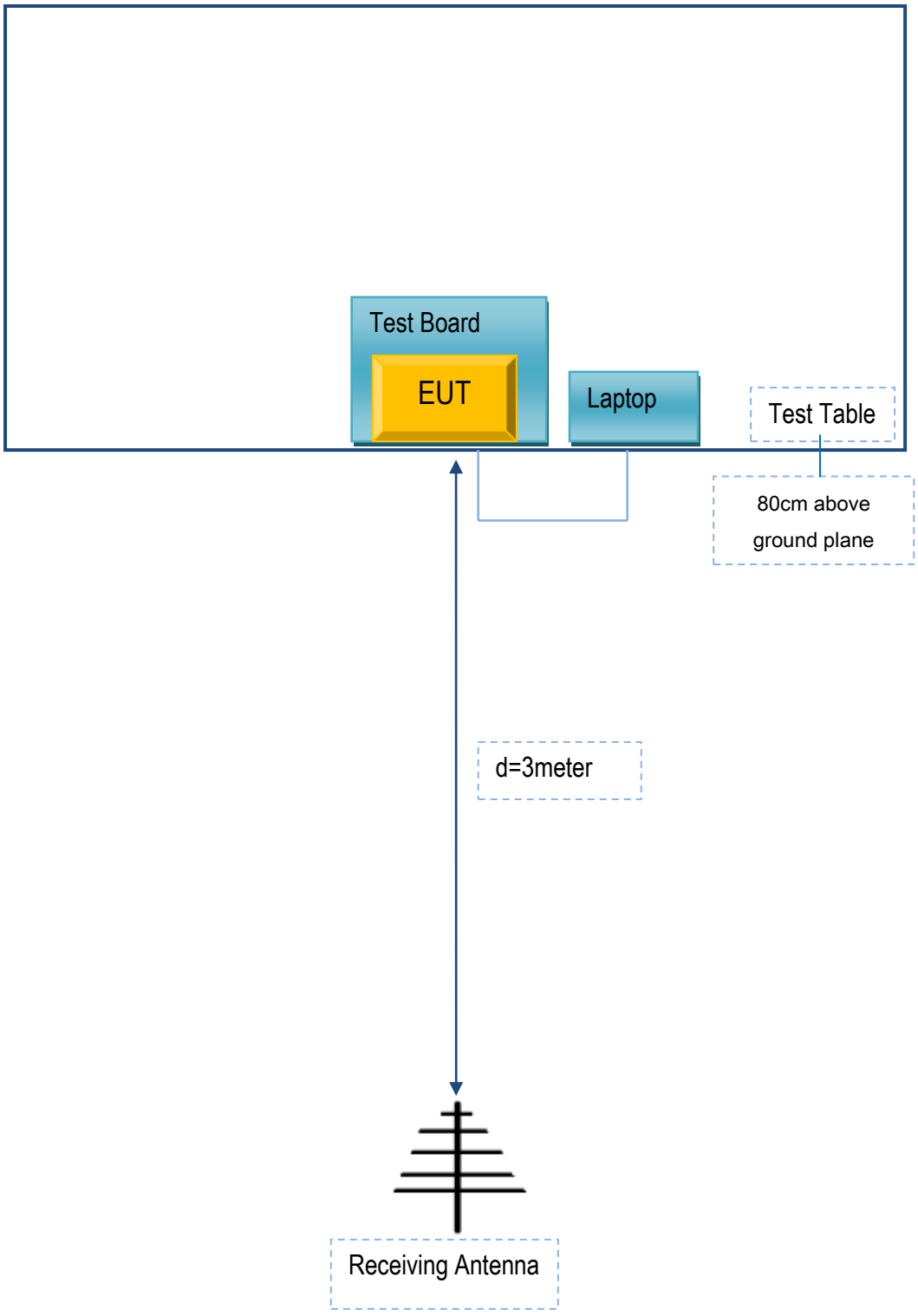
Annex C. TEST SETUP AND SUPPORTING EQUIPMENT

Annex C.ii. TEST SET UP BLOCK

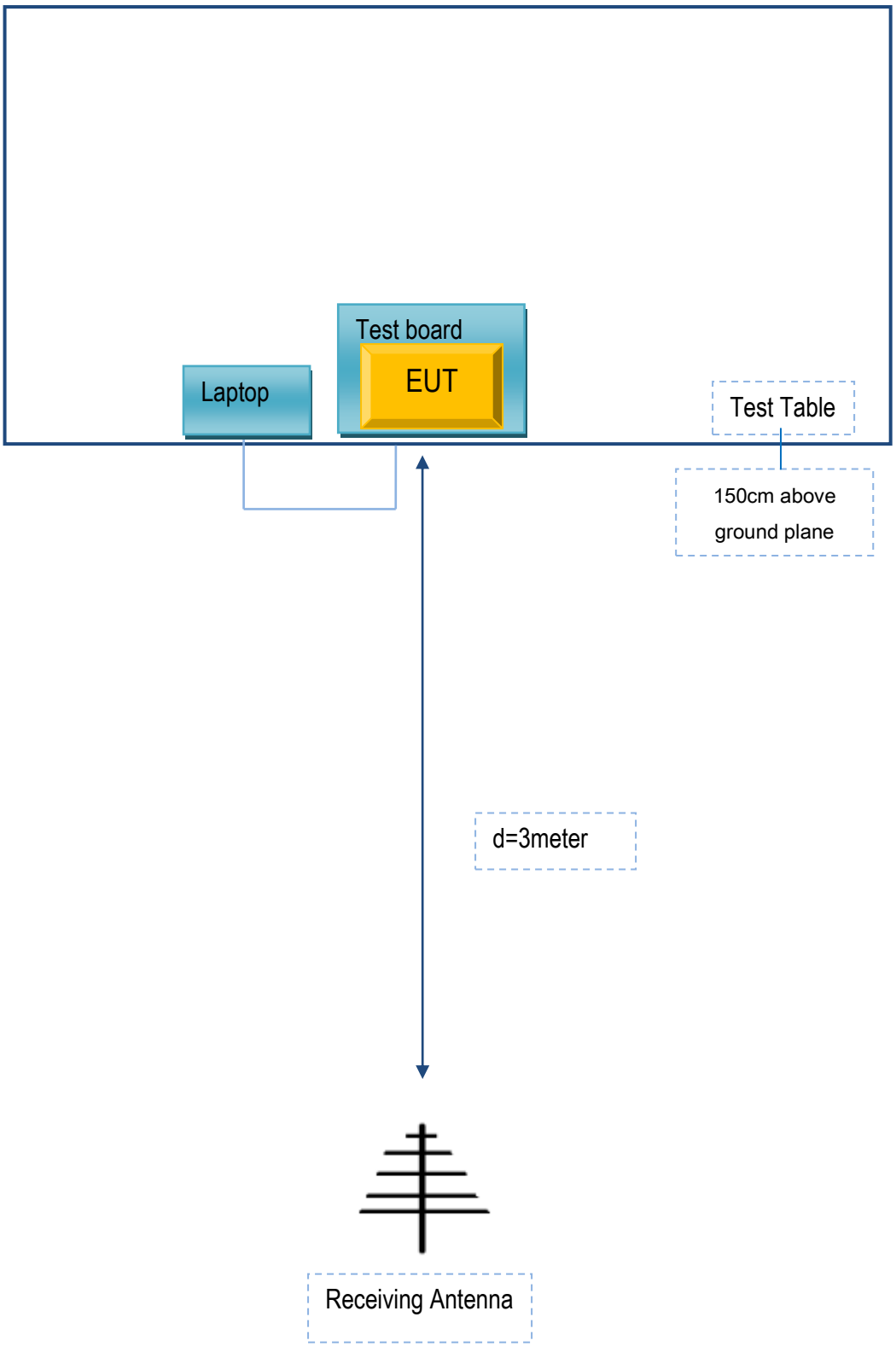
Block Configuration Diagram for AC Line Conducted Emissions



Block Configuration Diagram for Radiated Emissions （Below 1GHz）.



Block Configuration Diagram for Radiated Emissions （Above 1GHz）.



Annex C. il. SUPPORTING EQUIPMENT DESCRIPTION

The following is a description of supporting equipment and details of cables used with the EUT.

Supporting Equipment:

Manufacturer	Equipment Description	Model	Serial No
Lenovo	Laptop	E40	LR-1EHRX
Quectel Wireless Solutions Co., Ltd.	Test Board	Q1-A0770	MP87108N1000974

Supporting Cable:

Cable type	Shield Type	Ferrite Core	Length	Serial No
Power Cable	Un-shielding	No	0.8m	GT211032
USB Cable	Un-shielding	No	1m	MP87108N1000974

Annex D. User Manual / Block Diagram / Schematics / Partlist

Please see the attachment

Annex E. DECLARATION OF SIMILARITY

N/A