Report No. SH14040015R02

FCC RF TEST REPORT

Issued to

Waysion Technology (Xiamen) Co., LTD

For

7" Mobile Data Terminal

Model Name	:	X7
Trade Name	:	WAYSION
Brand Name	:	WAYSION
Standard	:	47 CFR Part 15,Subpart C ANSI C63.4-2009
Test date	:	Sep.03,2013 to Sep.04,2013
Issue date	:	Apr.25,2014
FCC ID	:	2ACHTWSP01

by

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CTIA Authorized Test Lab LAB CODE 20081223-00 IEEE 1725 OTA | OFTA 電訊管理局 | ilac-MRA | TAF Testing Laboratory 2030 | GCF Official Observer of Global Certification Forum | Bluetooth BQTF | FCC Reg. No.741109

DIRECTORY

Change History

Issue	Date	Reason for change
1.0	Apr.25,2014	First edition

1. General Information

1.1 Applicant

Waysion Technology (Xiamen) Co., LTD
3E, Rihua Building, No. 8, Xinfeng 2nd Road, Torch High-Tech Zone, Xiamen, Fujian, China

1.2 Manufacturer

Waysion Technology (Xiamen) Co., LTD
3E, Rihua Building, No. 8, Xinfeng 2nd Road, Torch High-Tech Zone, Xiamen, Fujian, China

1.3 Description of EUT

EUT Name..... :	7” Mobile Data Terminal
Model Name..... :	X7
Brand Name..... :	WAYSION
Trade Name ..... :	WAYSION
Hardware Version ..... :	V1.0
Software Version ..... :	V1.0
Modulation Type ..... :	FHSS (GFSK(1Mbps), ∏/4-DQPSK(EDR 2Mbps), 8-DPSK(EDR 3Mbps)
Frequency Range..... :	2.402GHz - 2.480GHz (at interval of 1MHz)
Channel Number..... :	79
EUT Stage ..... :	Production Unit
Antenna Type..... :	Integrated
Antenna Gain..... :	2dBi

*NOTE 1: The EUT contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth Module is F(MHz)=2402+1*n (0<=n<=78). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).*

NOTE 2: For a more detailed description, please refer to Specification or User’s Manual supplied by the applicant and/or manufacture.

2. Facilities and Accreditations

2.1 Test Facility

Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L3572.
A 9*6*6(m) fully anechoic chamber was used for the radiated spurious emissions test.

2.2 Environmental Conditions

Ambient temperature: 20 ~ 25°C
Relative humidity: 40 ~ 60%
Atmosphere pressure: 86-106kPa

2.3 Measurement Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.
Uncertainty of Conducted Emission: ±1.76dB
Uncertainty of Radiated Emission:±3.16dB

2.4 List of Equipments Used

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Service Simulator	Anritsu	MT8852A	6K00002788	2013.9.2	1year
Spectrum Analyzer	R&S	FSP30	101020	2013.6.12	1year
Spectrum Analyzer	Agilent	E4440A	MY46187763	2013.7.26	1year
Spectrum Analyzer	R&S	FSU26	200880	2013.6.18	1year
Power Splitter	Weinschel	1506A	NW521	(n.a.)	(n.a.)
Power Splitter	Mini-Circuits	ZFRSC-183-S+	765001016	(n.a.)	(n.a.)
Attenuator 1	Resnet	10dB	(n.a.)	(n.a.)	(n.a.)
Attenuator 2	Resnet	10dB	(n.a.)	(n.a.)	(n.a.)
Attenuator 3	Resnet	3dB	(n.a.)	(n.a.)	(n.a.)
Receiver	Rohde&Schwarz	ESCI3	100666	2013.6.15	1year
Full-Anechoic Chamber	Albatross	9m*6m*6m	(n.a.)	2013.5.8	2year
Antenna	Schwarzbeck	BBHA 9120C	9120C-384	2013.7.23	1year
Antenna	R&S	HL562	100385	2013.6.18	1year
Antenna	R&S	HF906	100565	2013.6.182	1year
LISN	Rohde&Schwarz	ENV216	812744	2013.9.2	1year
Personal Computer	Lenovo	(n.a.)	(n.a.)	(n.a.)	(n.a.)
Test Antenna – Horn	Schwarzbeck	BBHA9170	BBHA9170171	2013. 7.22	1year
Test Antenna - Loop	Rohde&Schwarz	HFH2-Z2	860004/001	2013.9.2	1year

NOTE:
Equipments listed above have been calibrated and are in the period of validation.

3. Test Standards and Results

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- ANSI C63.4-2009

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

Test items and the results are as bellow:

№	FCC Rules	IC Rules	Test Type	Limits	Result
1	15.247(a)(1)	A8.4(2)	Number of Hopping Frequency	≥ 75Chs	PASS
2	15.247(b)(1)	A8.1(b)	Peak Output Power	≤ 0.125W	PASS
3	15.247(a)(1)	A8.1(a)	20dB Bandwidth	NA	PASS
4	15.247(a)(1)	A8.1(b)	Carrier Frequency Separation	≥ 2/3 of 20dB BW	PASS
5	15.247(a)(1)	A8.1(d)	Time of Occupancy (Dwell time)	≤ 0.4sec in 31.6sec period	PASS
6	15.247(d)	A8.5	Conducted Spurious Emission	< 20 dBc	PASS
7	15.247(d)	A8.5	Band Edge	≤ 20dBc	PASS
8	15.207	Gen 7.2.2	Conducted Emission	15.207(a)	PASS
9	15.247(d)	A8.5	Radiated Emission	15.209(a) & 15.247(d)	PASS
10	15.203 &15.247(b)	A8.4	Antenna Requirement	N/A	Pass

4. Test Conditions Setting

The EUT has been associated with peripherals pursuant to ANSI C63.4-2009 and configuration operated in a manner tended to maximize its emission characteristics in a typical application.
Frequency range investigated: conduction (150 kHz to 30 MHz), radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).
Pre-scanned tests were conducted to determine the final configuration from all possible combinations.

The following tables are showing the test modes as the worst cases and recorded in this report.

TEST MODE			
BT Data Rate / Modulation	**Conducted Mode**	**Radiated Mode**	**AC Conducted Emission**
Bluetooth 1Mbps GFSK	Channel 00_2402 MHz	Channel 00_2402 MHz	NA
	Channel 39_2441 MHz	Channel 39_2441 MHz	
	Channel 78_2480 MHz	Channel 78_2480 MHz	
Bluetooth EDR 2Mbps π /4-DQPSK	Channel 00_2402 MHz	Channel 00_2402 MHz	
	Channel 39_2441 MHz	Channel 39_2441 MHz	
	Channel 78_2480 MHz	Channel 78_2480 MHz	
Bluetooth EDR 3Mbps 8-DPSK	Channel 00_2402 MHz	Channel 00_2402 MHz	
	Channel 39_2441 MHz	Channel 39_2441 MHz	
	Channel 78_2480 MHz	Channel 78_2480 MHz	

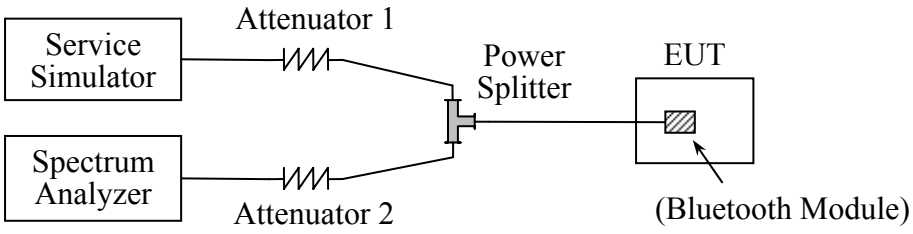
5. Test Result

5.1 Number of Hopping Frequency

5.1.1 Requirement

According to FCC section 15.247(a)(1)(iii), frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

5.1.2 Test Setup



The Bluetooth Module of the EUT, which is powered by the Battery, is coupled to the Spectrum Analyzer (SA) and the Bluetooth Service Simulator (SS) with Attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the SS, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

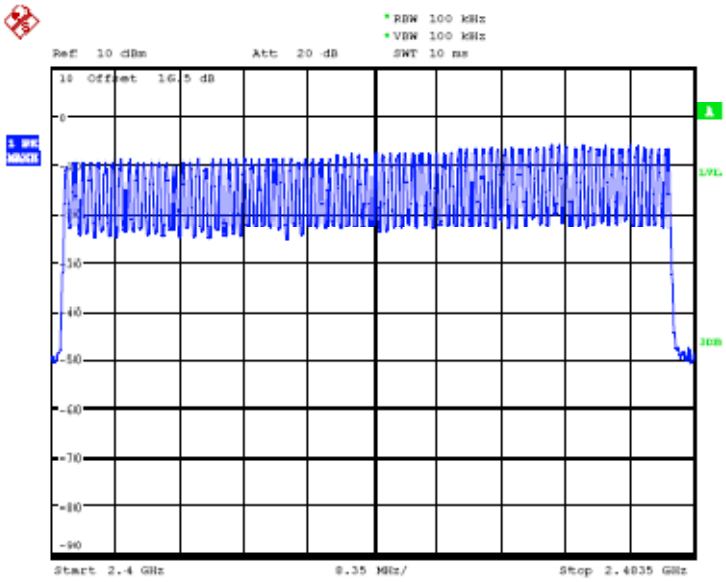
5.1.3 Test Result

The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency compliance to Hopping Sequence and Equal Usage of the channels

A. Test Verdict:

Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Refer to Plot	Verdict
2400 - 2483.5	79	15	Plot A	PASS

B. Test Plot:



(Plot A: 2402MHz to 2480MHz)

5.2 Peak Output Power

5.2.1 Requirement

According to FCC section 15.247(b)(1), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

5.2.2 Test Setup

See section 5.1.2 of this report.

5.2.3 Test Result

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

A. Test Verdict:

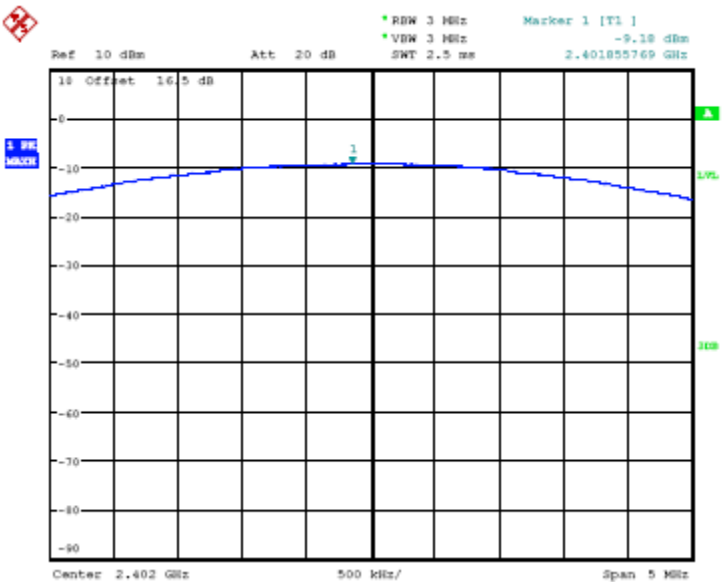
Channel	Frequency (MHz)	Measured Output Peak Power(dBm)	Limit	Verdict
		Data Rate/Modulation		
		GFSK	dBm	
		1Mbps		
0	2402	-9.18	30	PASS
39	2441	-7.32		PASS
78	2480	-6.13		PASS

Channel	Frequency (MHz)	Measured Output Peak Power(dBm)		Limit	Verdict
		Data Rate/Modulation			
		π /4-DQPSK	8-DPSK	dBm	
		2Mbps	3Mbps		
0	2402	-11.05	-9.08	21	PASS
39	2441	-9.09	-8.61		PASS
78	2480	-7.12	-6.71		PASS

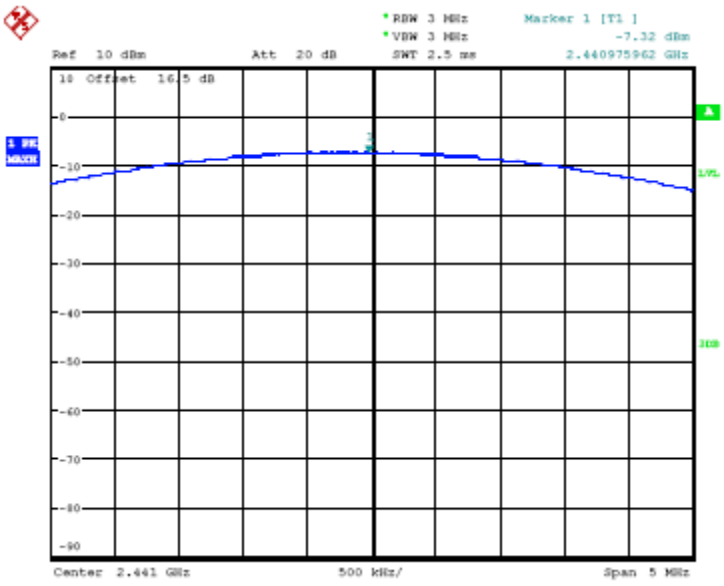
GFSK (1Mbps)

Channel	Frequency (MHz)	Measured Output Peak Power			Limit		Verdict
		dBm	W	Refer to Plot	dBm	W	
0	2402	-9.18	0.00012	Plot A	30	1	PASS
39	2441	-7.32	0.00019	Plot B			PASS
78	2480	-6.13	0.00024	Plot C			PASS

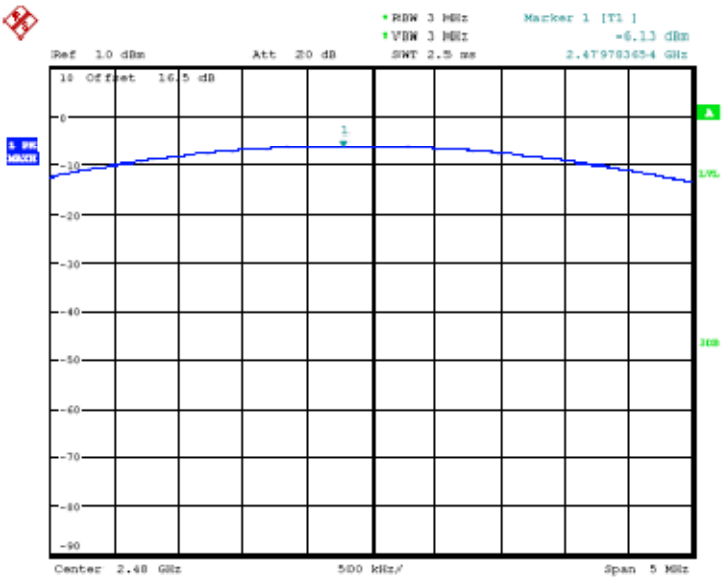
B. Test Plot:



(Plot A: Channel = 2402)



(Plot B: Channel = 2441)



(Plot C: Channel = 2480)

5.3 20dB Bandwidth

5.3.1 Definition

The 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth (10*log1% = 20dB) taking the total RF output power.

5.3.2 Test Setup

See section 5.1.2 of this report.

5.3.3 Test Result

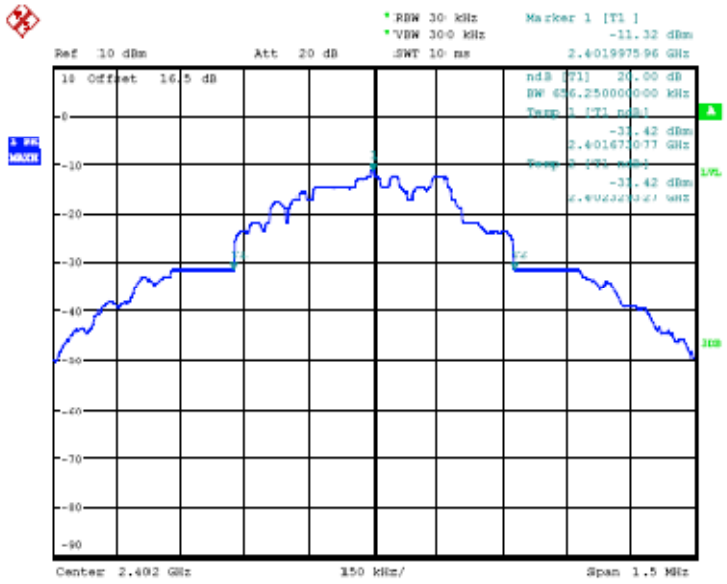
The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to record the 20dB bandwidth of the Module.

A. Test Verdict

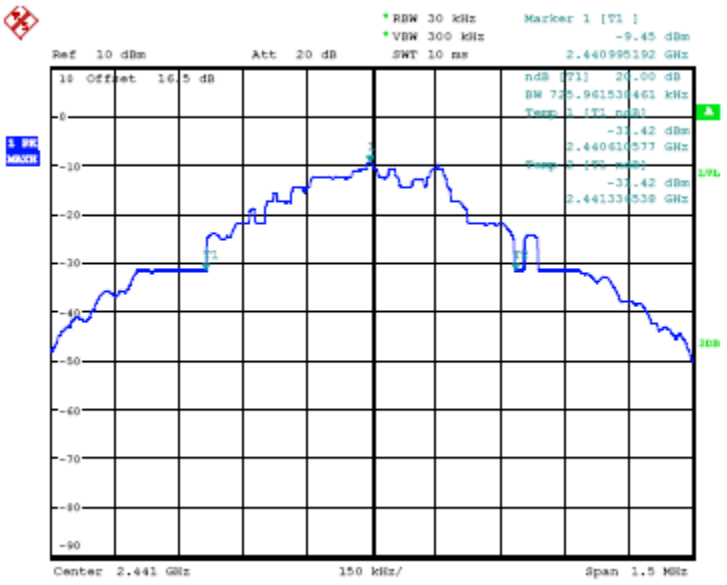
The maximum 20dB bandwidth measured is 1.288MHz according to the table below.

Modulation	Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Refer to Plot
GFSK	0	2402	0.656	Plot A
	39	2441	0.726	Plot B
	78	2480	0.808	Plot C
π /4-DQPSK	0	2402	1.272	Plot D
	39	2441	1.276	Plot E
	78	2480	1.166	Plot F
8-DPSK	0	2402	1.288	Plot G
	39	2441	1.288	Plot H
	78	2480	1.125	Plot I

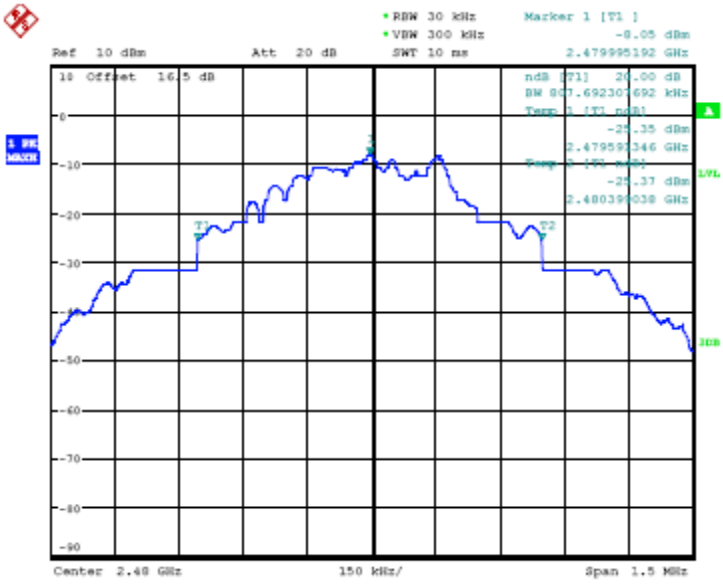
B. Test Plot:



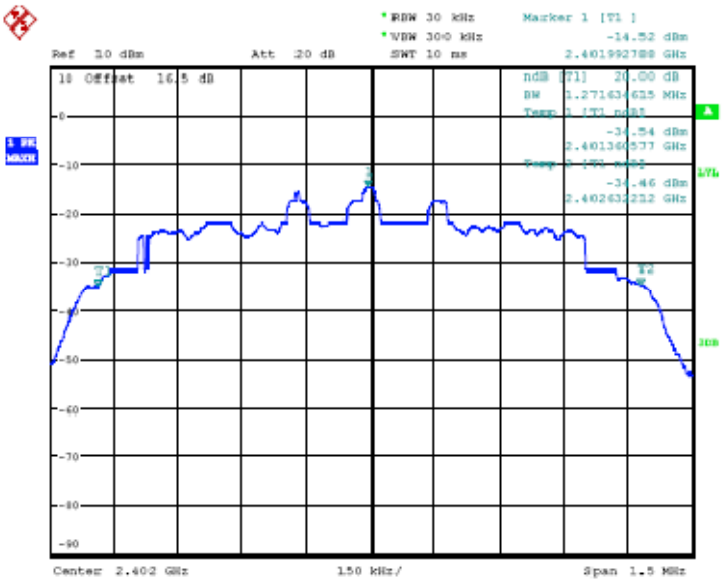
(Plot A: Channel = 2402)



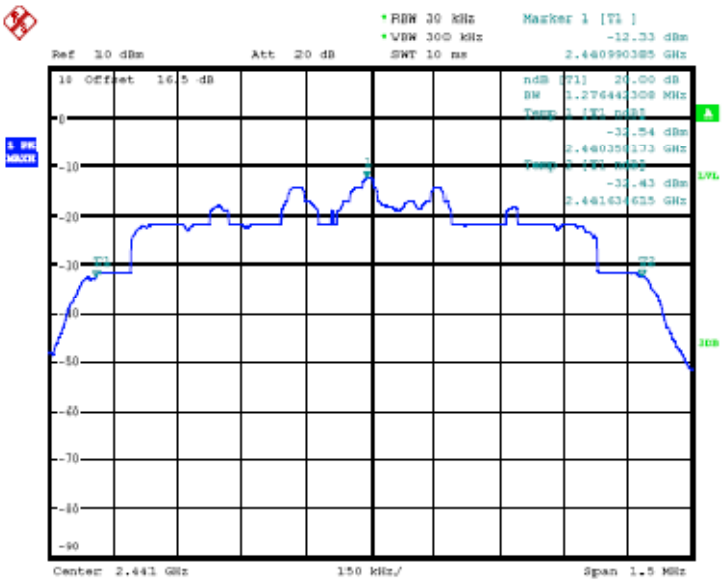
(Plot B: Channel = 2441)



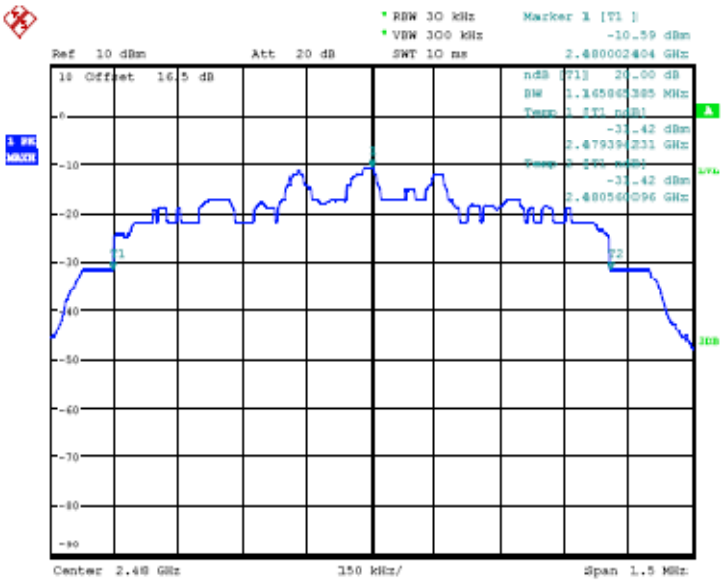
(Plot C: Channel = 2480)



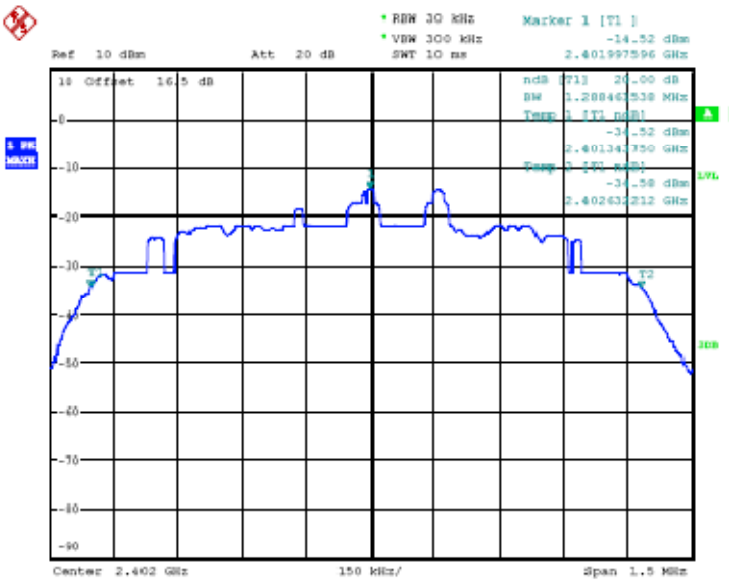
(Plot D: Channel = 2402)



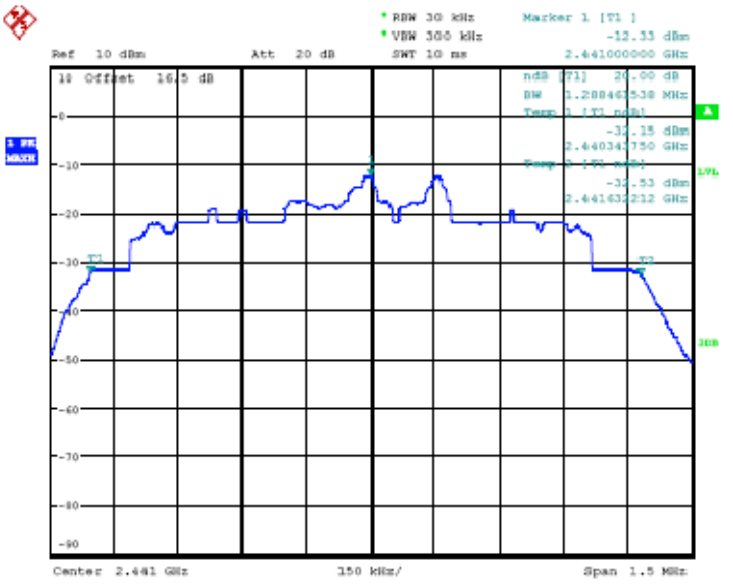
(Plot E: Channel = 2441)



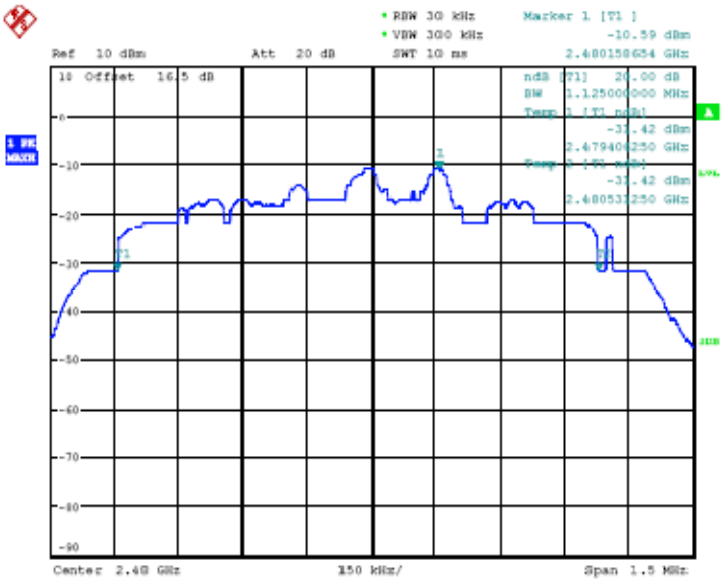
(Plot F: Channel = 2480)



(Plot G: Channel = 2402)



(Plot H: Channel = 2441)



(Plot I: Channel = 2480)

5.4 Carried Frequency Separation

5.4.1 Definition

According to FCC section 15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

5.4.2 Test Setup

See section 5.1.2 of this report.

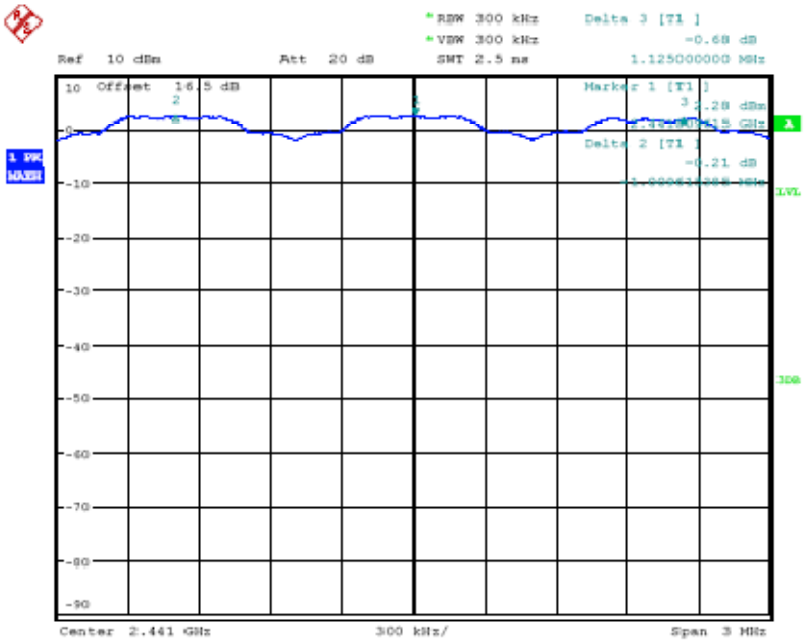
5.4.3 Test Result

The Bluetooth Module operates at hopping-on test mode.
For any adjacent channels, the Module does have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel (refer to section 错误！未找到引用源。), whichever is greater. So, the verdict is PASS.

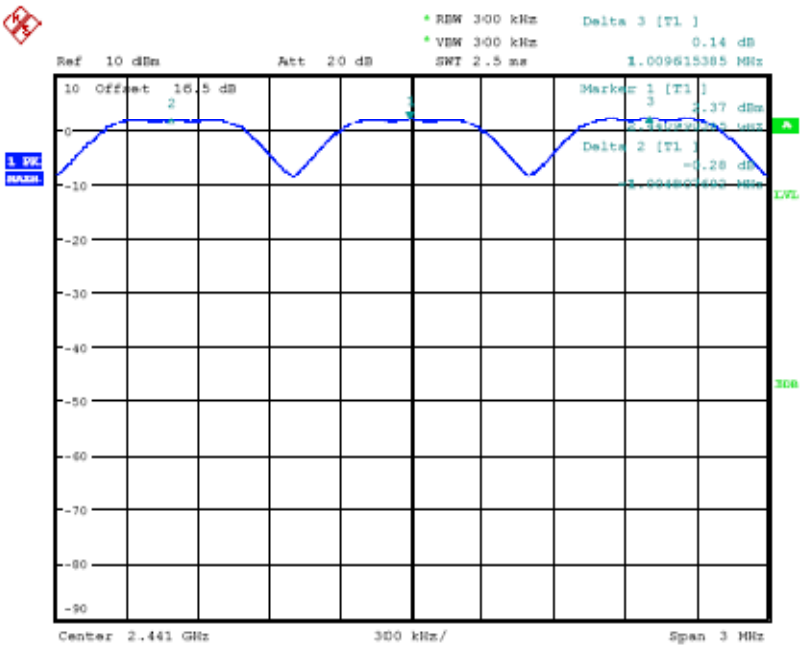
A. Test Verdict:

Modulation	Carried Frequency Separation（KHz）	Limit (MHz)	Refer to Plot	Result
GFSK	1009	0.025 or 2/3 the 20dB bandwidth	Plot A	PASS
π /4-DQPSK	1004	0.025 or 2/3 the 20dB bandwidth	Plot B	PASS
8DPSK	1004	0.025 or 2/3 the 20dB bandwidth	Plot C	PASS

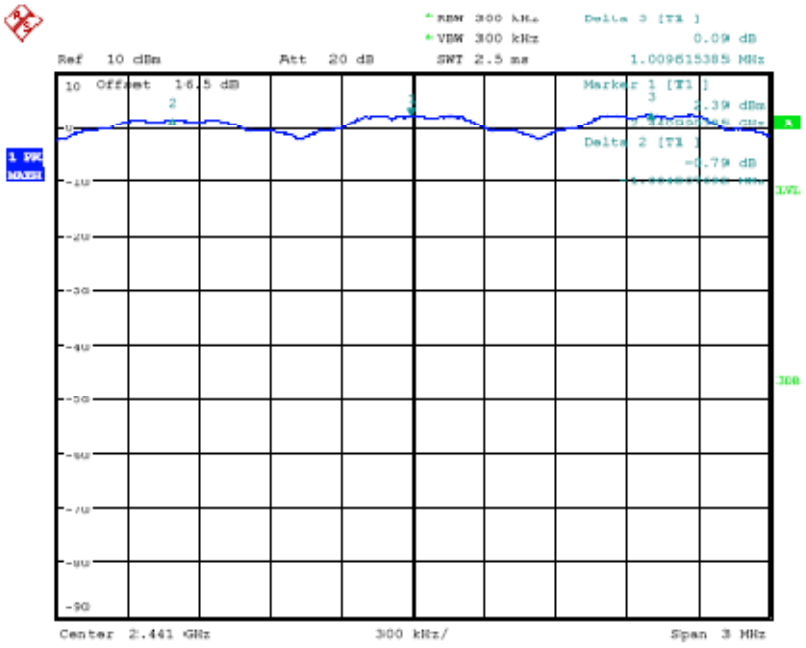
B. Test Plot:



(Plot A: GFSK Channel)



(Plot B: π/4-DQPSK Channel)



(Plot C: 8DPSK Channel)

5.5 Time of Occupancy (Dwell time)

5.5.1 Requirement

According to FCC section 15.247(a)(1)(iii), frequency hopping systems in the 2400 - 2483.5MHz band shall use at least 15 non-overlapping channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.5.2 Test Setup

See section 5.1.2 of this report.

5.5.3 Test Result

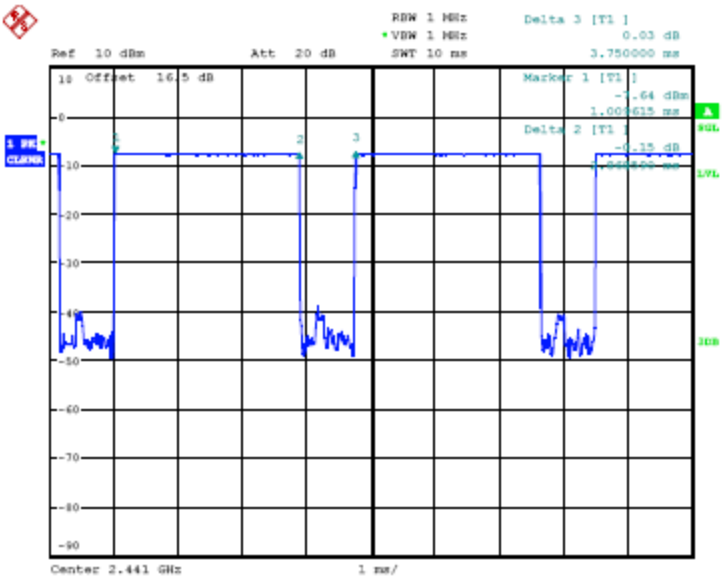
The average time of occupancy on any channel within the Period can be calculated with formulas:
DH5 : {Total of Dwell} = {Pulse Time} * (1600 / 6) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4s * {Number of Hopping Frequency}
The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

A. Test Verdict:

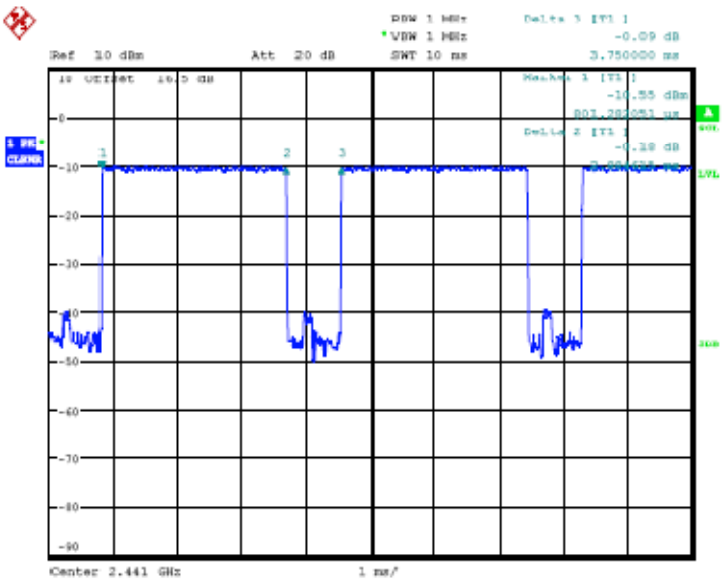
Modulation	Channel	Pulse Time		Total of Dwell (ms)	Limit (ms)	Verdict
		ms	Refer to Plot			
GFSK	39	2.87	Plot A	306.13	400	PASS
π /4-DQPSK	39	2.88	Plot B	307.2		PASS
8-DPSK	39	2.88	Plot C	307.2		PASS

B. Test Plot:

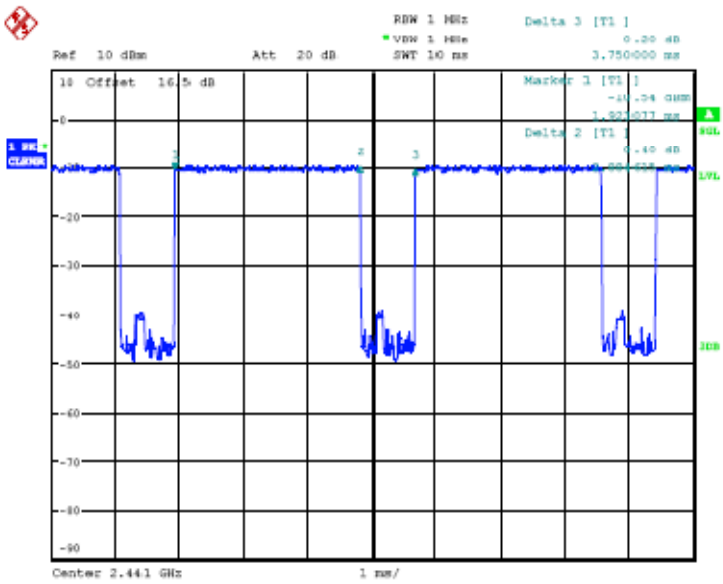
Note: the following plots record the Pulse Time of the Module carrier.



(Plot A: GFSK Channel = 2441)



(Plot B: π/4-DQPSK Channel = 2441)



(Plot C: 8-DPSK Channel = 24410)

5.6 Conducted Spurious Emissions

5.6.1 Requirement

According to FCC section 15.247(c), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.6.2 Test Setup

See section 5.1.2 of this report.

5.6.3 Test Result

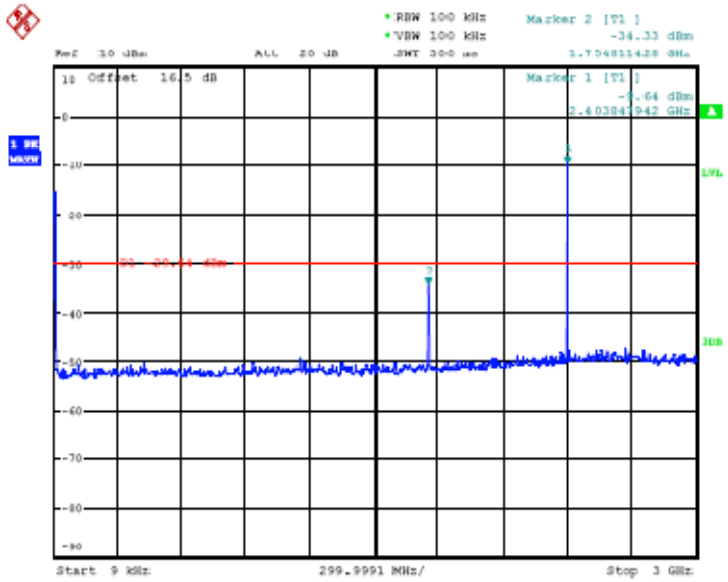
The Bluetooth Module operates at hopping-off test mode. The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

A. Test Verdict

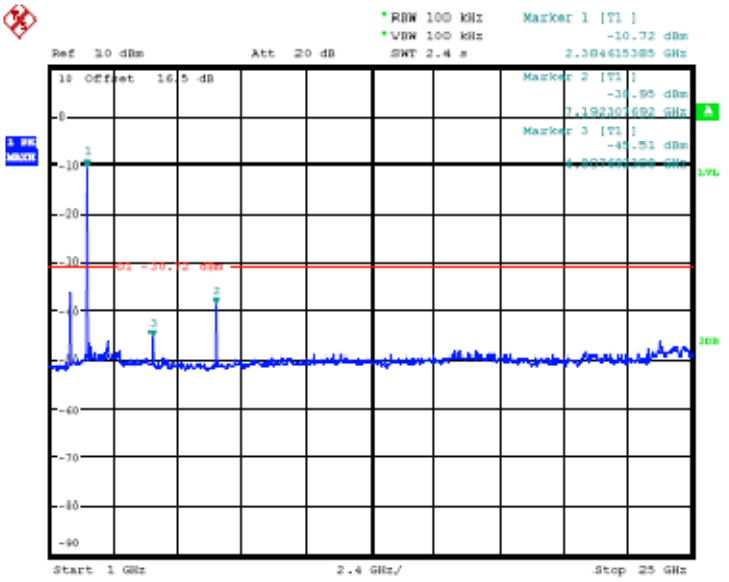
Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Refer to Plot	Limit (dBm)		Verdict
				Carrier Level	Calculated -20dBc Limit	
0	2402	-34.33	Plot A.1/A.2	-9.64	-29.64	PASS
39	2441	-33.63	Plot B.1/B.2	-9.06	-29.06	PASS
78	2480	-32.74	Plot C.1/C.2	-7.08	-27.08	PASS

B. Test Plot

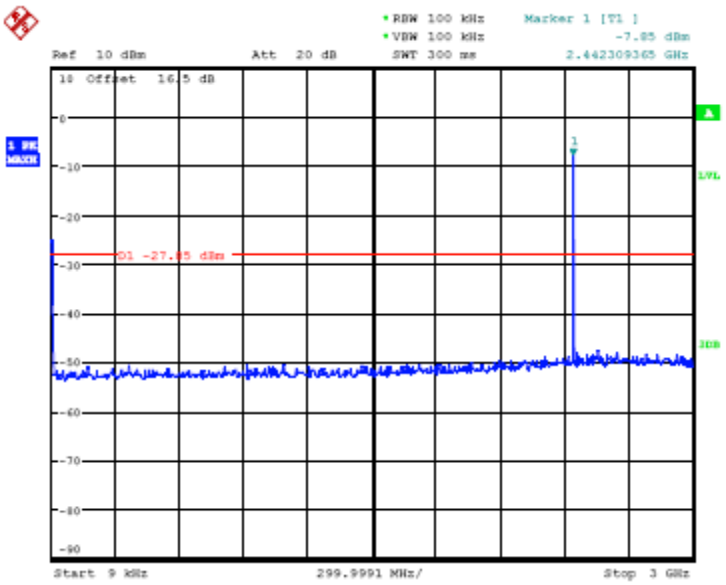
Note: the power of the Module transmitting frequency should be ignored.



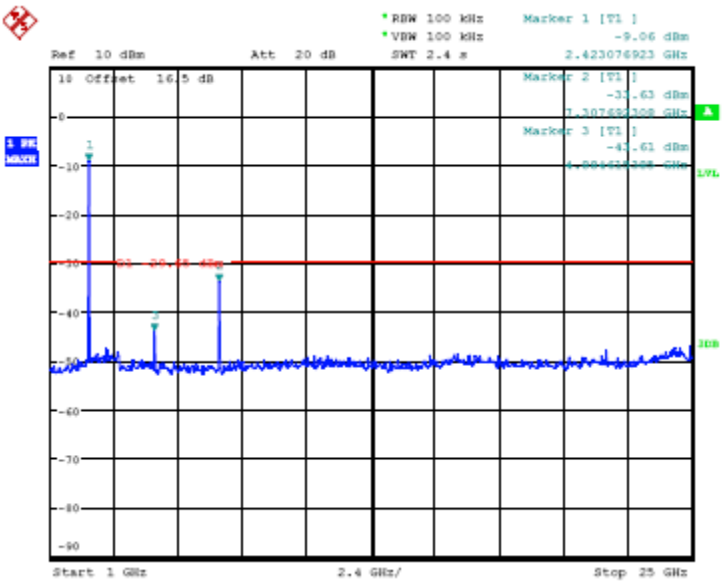
(Plot A.1: Channel = 0, 30MHz to 3GHz)



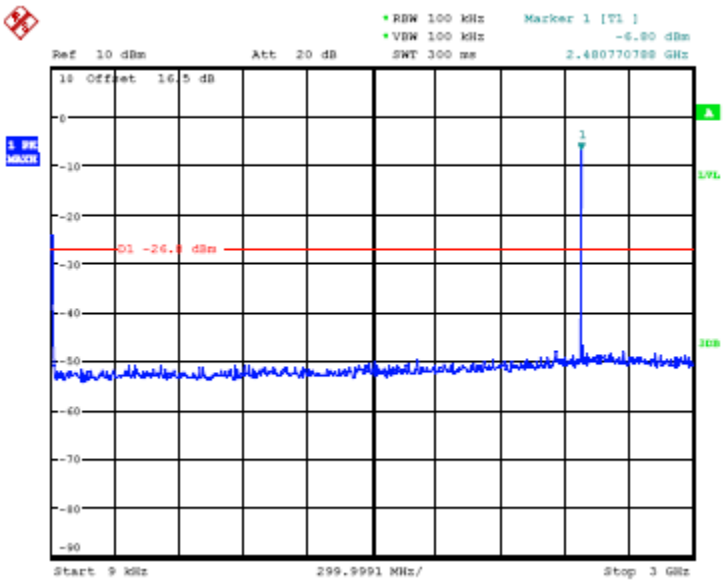
(Plot A.2: Channel = 0, 3GHz to 25GHz)



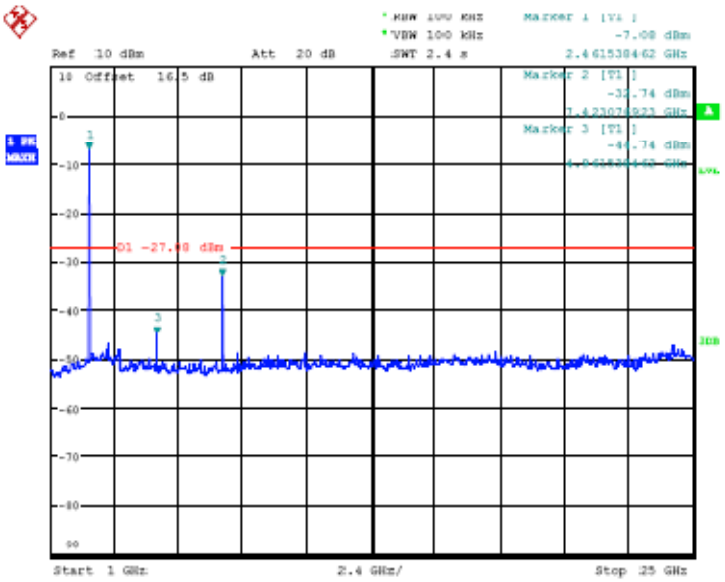
(Plot B.1: Channel = 39, 30MHz to 3GHz)



(Plot B.2: Channel = 39, 3GHz to 25GHz)



(Plot C.1: Channel = 78, 30MHz to 3GHz)



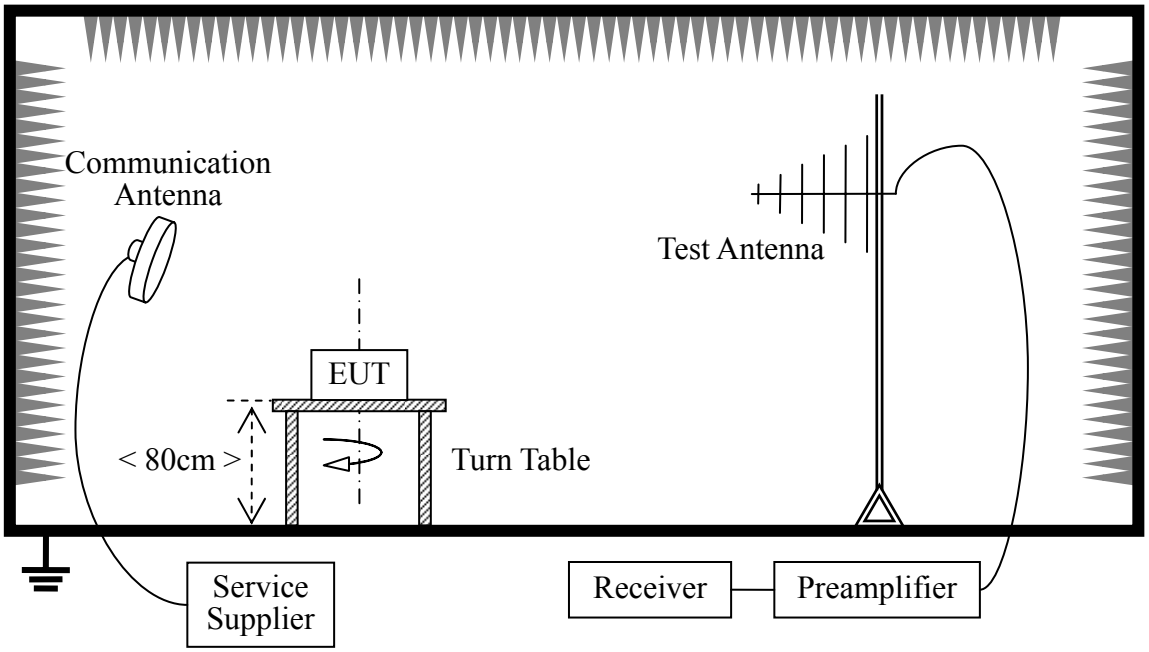
(Plot C.2: Channel = 78, 3GHz to 25GHz)

5.7 Band Edge

5.7.1 Requirement

According to FCC section 15.247(c), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.7.2 Test Setup

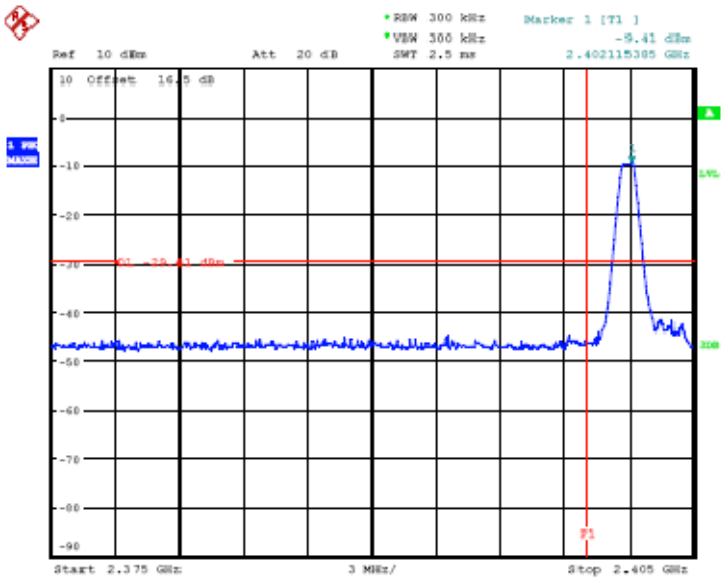


The Bluetooth Module of the EUT is powered by the Battery charged with the AC Adapter which is powered by 120V, 60Hz AC mains supply. The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading. During the measurement, the Bluetooth Module is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under hopping-on test mode transmitting 339 bytes DH5 packages at maximum power.
For the Test Antenna:
Horn Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

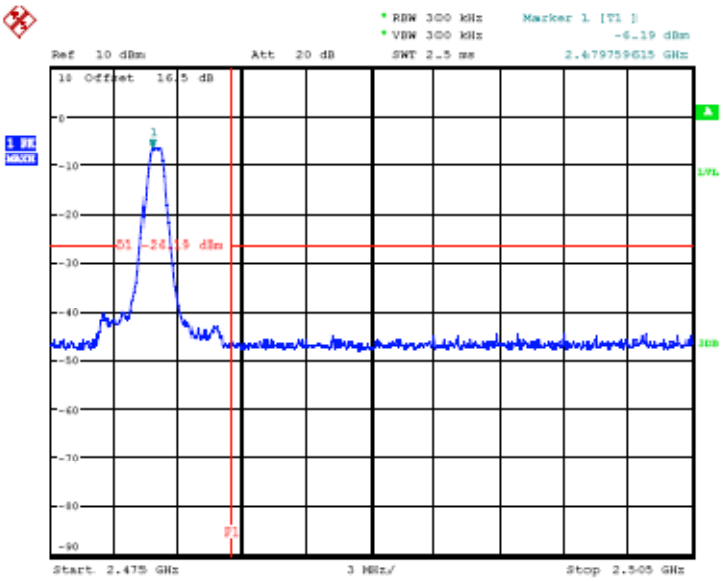
5.7.3 Test Result

A. Conducted Band Edge:

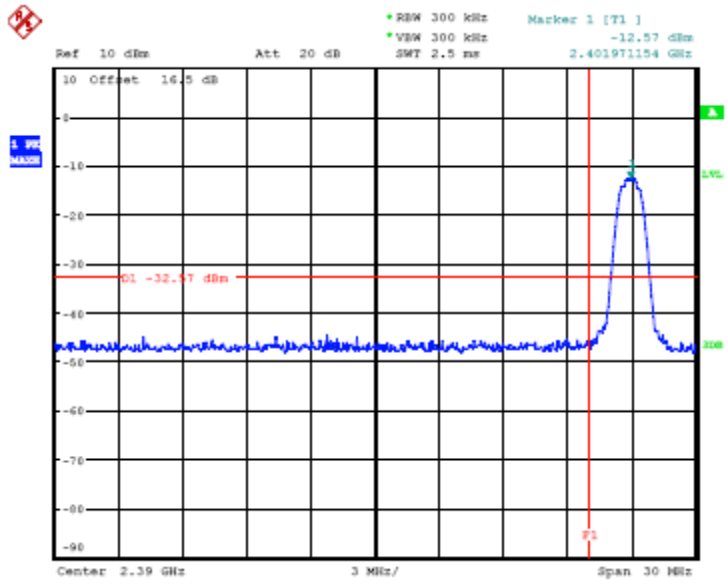
The Bluetooth Module operates at hopping-off test mode. The lowest and highest channels are tested to verify the band edge emissions.



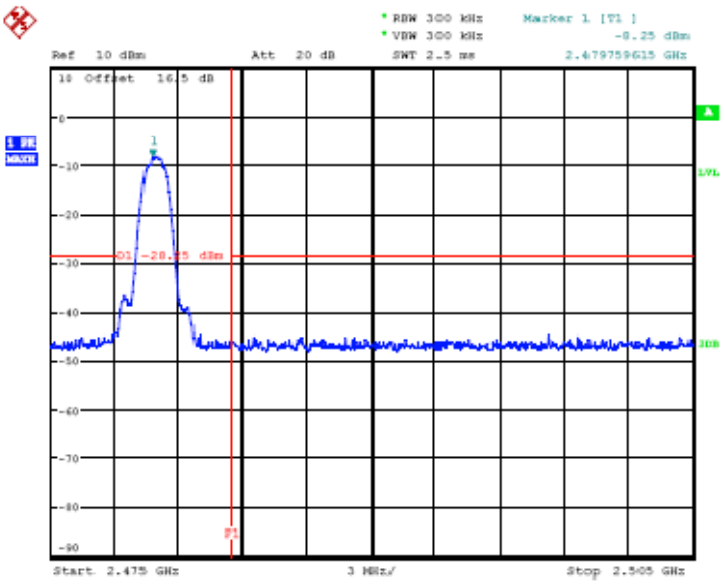
(Plot A: GFSK Channel = 0)



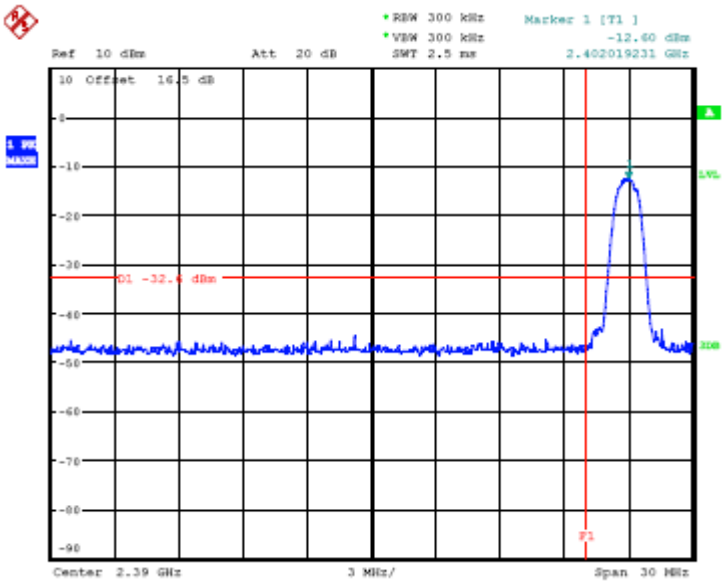
(Plot B: GFSK Channel = 78)



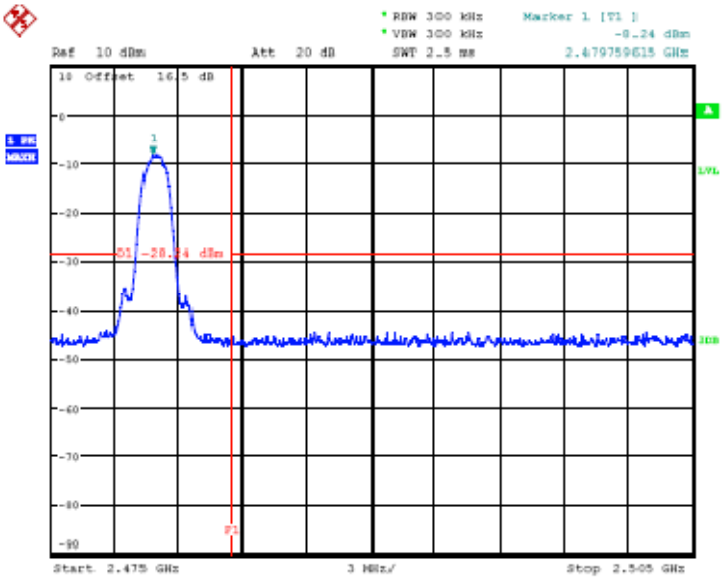
(Plot C: π/4-DQPSK Channel = 0)



(Plot D: π/4-DQPSK Channel = 78)



(Plot E: 8DPSK Channel = 0)



(Plot F: 8DPSK Channel = 78)

5.8 Radiated Emission

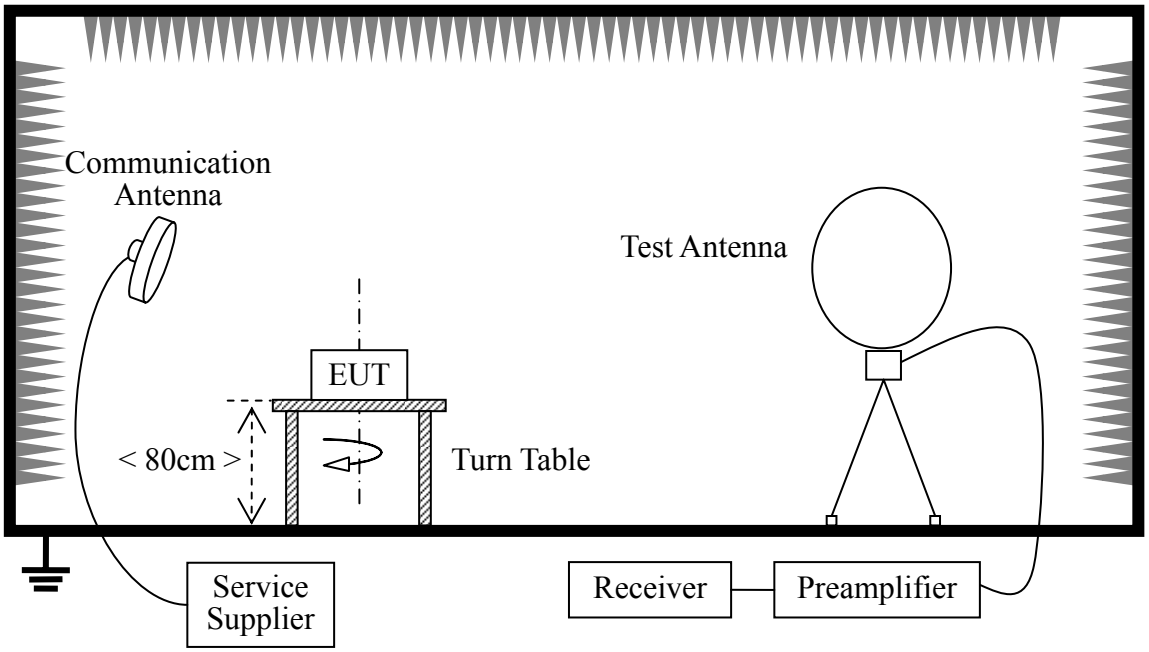
5.8.1 Requirement

According to FCC section 15.247(c), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).
According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

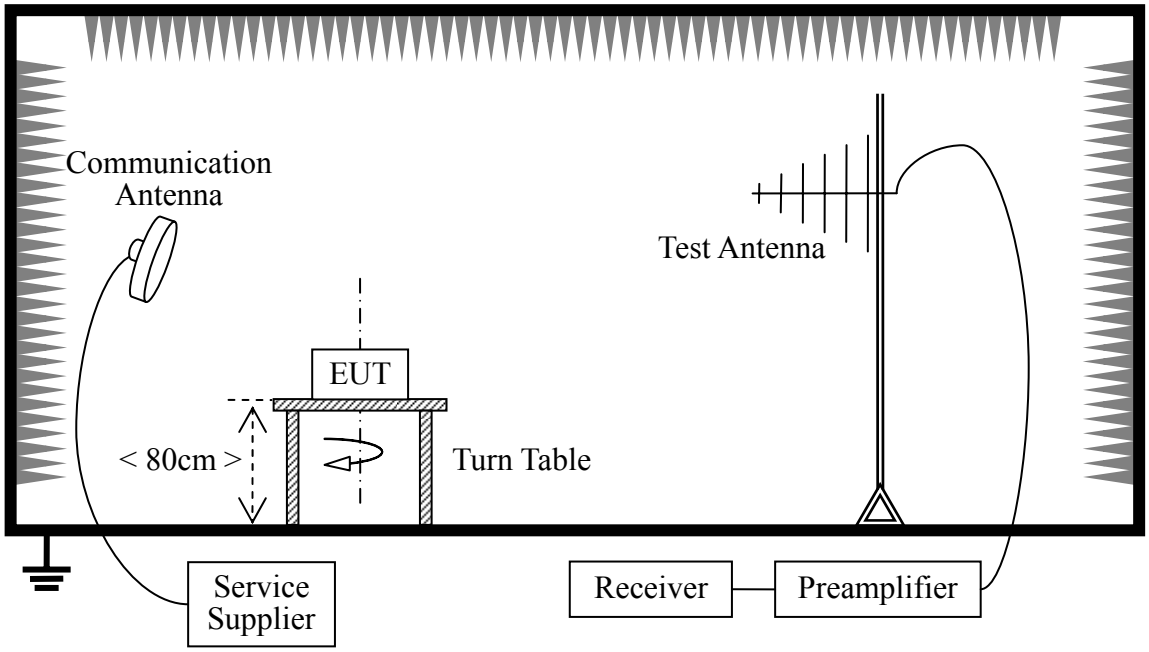
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)	Limit(dBμV/m)	Detector
0.009-0.490	2400/F(kHz)	300	/	/
0.490-1.705	24000/F(kHz)	30	/	/
1.705-30	30	30	/	/
30 - 88	100	3	40	QP
88 - 216	150	3	43.5	QP
216 - 960	200	3	46	QP
960 - 1000	500	3	54	QP
Above 1000	500	3	54	AV

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

5.8.2 Test Setup



Radiated Emissions below 30mhz



Radiated Emissions above 30MHz

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.4 (2003). The EUT was set-up on insulator 80cm above the Ground Plane. The set-up and test methods were according to ANSI C63.4.

The Bluetooth Module of the EUT is powered by the Battery charged with the AC Adapter which is powered by 120V, 60Hz AC mains supply. The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading. During the measurement, the Bluetooth Module is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under hopping-on test mode transmitting 339 bytes DH5 packages at maximum power.

For the Test Antenna: In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength, the azimuth range of turntable was 0^{o} to 360^{o}, the receive antenna has two polarizations horizontal and vertical. When doing measurements above 1GHz, the EUT was placed within the 3dB beam width range of the horn antenna, and the EUT was tested in 3 orthogonal positions as recommended in ANSI C63.4 for Radiated Emissions and the worst-case data was presented.

5.8.3 Test Result

A. Test Result for 9 kHz ~ 30 MHz:

Frequency (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
--	--	10	--	See Note

Note:

a) The amplitude of spurious emissions that are attenuated by more than 10dB below the permissible value has no need to be reported.

b) Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

c) Limit line = specific limits (dBuV) + distance extrapolation factor.

B. Test Result for 30 MHz ~ 10th Harmonic

Channel 0 (2402MHz)

Frequency (MHz)	Level (dBuV)	Limit Line (dBuV)	Margin (dB)	Antenna Polarization	Result
32.910	-	40	-	Horizonta	PASS
59.949	-	40	-	Horizontal	PASS
134.275	-	43.5	-	Horizontal	PASS
900.818	-	46	-	Horizontal	PASS
3016.875	-	54	-	Horizontal	PASS
7059.375	-	54	-	Horizontal	PASS
32.910	-	40	-	Vertical	PASS
51.946	-	40	-	Vertical	PASS
134.275	-	43.5	-	Vertical	PASS
357.981	-	46	-	Vertical	PASS
898.514	-	46	-	Vertical	PASS
4959.375	-	54	-	Vertical	PASS

Channel 39 (2441MHz)

Frequency (MHz)	Level (dBuV)	Limit Line (dBuV)	Margin (dB)	Antenna Polarization	Result
31.698	-	40	-	Horizontal	PASS
46.733	-	40	-	Horizontal	PASS
134.275	-	43.5	-	Horizontal	PASS
723.275	-	46	-	Horizontal	PASS
1818.944	-	54	-	Horizontal	PASS
5221.875	-	54	-	Horizontal	PASS
34.365	-	40	-	Vertical	PASS
52.431	-	40	-	Vertical	PASS
134.275	-	43.5	-	Vertical	PASS
565.440	-	46	-	Vertical	PASS
1645.869	-	54	-	Vertical	PASS
5216.250	-	54	-	Vertical	PASS

Channel 78 (2480MHz)

Frequency (MHz)	Level (dBuV)	Limit Line (dBuV)	Margin (dB)	Antenna Polarization	Result
30.970	-	40	-	Horizontal	PASS
111.723	-	43.5	-	Horizontal	PASS
265.225	-	46	-	Horizontal	PASS
650.558	-	46	-	Horizontal	PASS
1285.775	-	54	-	Horizontal	PASS
5396.250	-	54	-	Horizontal	PASS
32.061	-	40	-	Vertical	PASS
52.068	-	40	-	Vertical	PASS
134.275	-	43.5	-	Vertical	PASS
614.061	-	46	-	Vertical	PASS
1797.094	-	54	-	Vertical	PASS
5220.000	-	54	-	Vertical	PASS

** END OF REPORT **