

FCC 47 CFR PART 15 SUBPART C
CERTIFICATION TEST REPORT

For

BLUETOOTH SPEAKER

MODEL No.: 8B020BT, LI-E131BT

Trademark: N/A

FCC ID: 2ADXM8B020BT

REPORT NO: ES160614006E

ISSUE DATE: July 16, 2016

Prepared for

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1 TEST RESULT CERTIFICATION

Applicant:	SHENZHEN TEKSUN TECHNOLOGY CO.,LTD 3F, bldg F7, F518 Idea Land ,Baoyuan Road, Xixiang Avenue, Bao'an District, Shenzhen, China
Manufacturer:	SHENZHEN TEKSUN TECHNOLOGY CO.,LTD 3F, bldg F7, F518 Idea Land ,Baoyuan Road, Xixiang Avenue, Bao'an District, Shenzhen, China
Product Description:	BLUETOOTH SPEAKER
Trade Mark:	N/A
Model Number:	8B020BT, LI-E131BT Note: Two models are same product, only for different customers
File Number:	ES160614006E
Date of Test:	June 14, 2016 to July 16, 2016

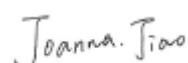
Measurement Procedure Used:

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 2, Subpart J FCC 47 CFR Part 15, Subpart C	PASS

The above equipment was tested by EMTEK (SHENZHEN) CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 2 and Part 15.247.

The test results of this report relate only to the tested sample identified in this report.

Date of Test : _____ June 14, 2016 to July 16, 2016 _____

Prepared by : _____ 

Joanna Jiao/Editor

Reviewer : _____ 

Joe Xia/Supervisor

Approve & Authorized Signer : _____ 

Lisa Wang/Manager

2 EUT TECHNICAL DESCRIPTION

Characteristics	Description
BT Version:	BT 2.1+EDR
Data Rate	1Mbps for BTGFSK modulation 2Mbps for BT pi/4-DQPSK modulation 3Mbps for BT 8DPSK modulation
Modulation:	BT GFSK modulation (1Mbps) BT pi/4-DQPSK modulation (2Mbps) BT 8DPSK modulation (3Mbps)
Operating Frequency Range(s):	2402-2480MHz
Number of Channels:	79 channels
Transmit Power Max:	2.782dBm
Antenna Type :	PCB Antenna
Antenna Gain:	1.9 dBi
Power supply:	<input checked="" type="checkbox"/> DC supply: DC 3.7V internal rechargeable lithium battery or DC 5V from USB Port. <input type="checkbox"/> AC Adapter:
Temperature Range	0°C ~ +40°C

Note: for more details, please refer to the User's manual of the EUT.

3 SUMMARY OF TEST RESULT

FCC Part Clause	Test Parameter	Verdict	Remark
15.247(a)(1)	20 dB Bandwidth	PASS	
15.247(a)(1)	Carrier Frequency Separation	PASS	
15.247(a)(1)	Number of Hopping Frequencies	PASS	
15.247(a)(1)	Average Time of Occupancy (Dwell Time)	PASS	
15.247(b)(1)	Maximum Peak Conducted Output Power	PASS	
15.247(c)	Conducted Spurious Emissions	PASS	
15.247(d) 15.209	Radiated Spurious Emissions	PASS	
15.207	Conducted Emission	PASS	
15.247(b)	Antenna Application	PASS	
	NOTE1: N/A (Not Applicable)		

RELATED SUBMITTAL(S) / GRANT(S):

This submittal(s) (test report) is intended for FCC ID: 2ADXM8B020BT filing to comply with Section 15.247 of the FCC Part 15, Subpart C.

4 TEST METHODOLOGY

4.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

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

FCC 47 CFR Part 2, Subpart J

FCC 47 CFR Part 15, Subpart C

DA 00-705

4.2 MEASUREMENT EQUIPMENT USED

4.2.1 Conducted Emission Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	DUE CAL.
Test Receiver	Rohde & Schwarz	ESCS30	828985/018	05/16/2016	05/15/2017
L.I.S.N.	Schwarzbeck	NNLK8129	8129203	05/16/2016	05/15/2017
50Ω Coaxial Switch	Anritsu	MP59B	M20531	N/A	05/15/2017
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100006	05/16/2016	05/15/2017
Voltage Probe	Rohde & Schwarz	TK9416	N/A	05/16/2016	05/15/2017
I.S.N	Rohde & Schwarz	ENY22	1109.9508.02	05/16/2016	05/15/2017

4.2.2 Radiated Emission Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	DUE CAL.
EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	05/16/2016	05/15/2017
Pre-Amplifier	HP	8447D	2944A07999	05/16/2016	05/15/2017
Bilog Antenna	Schwarzbeck	VULB9163	142	05/16/2016	05/15/2017
Loop Antenna	ARA	PLA-1030/B	1029	05/16/2016	05/15/2017
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	05/16/2016	05/15/2017
Horn Antenna	Schwarzbeck	BBHA 9120	D143	05/16/2016	05/15/2017
Cable	Schwarzbeck	AK9513	ACRX1	05/16/2016	05/15/2017
Cable	Rosenberger	N/A	FP2RX2	05/16/2016	05/15/2017
Cable	Schwarzbeck	AK9513	CRPX1	05/16/2016	05/15/2017
Cable	Schwarzbeck	AK9513	CRRX2	05/16/2016	05/15/2017

4.2.3 Radio Frequency Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	DUE CAL.
Spectrum Analyzer	Agilent	E4407B	88156318	05/16/2016	05/15/2017
Signal Analyzer	Agilent	N9010A	My53470879	05/16/2016	05/15/2017
Power meter	Anritsu	ML2495A	0824006	05/16/2016	05/15/2017
Power sensor	Anritsu	MA2411B	0738172	05/16/2016	05/15/2017

Remark: Each piece of equipment is scheduled for calibration once a year.

4.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (1Mbps for Bluetooth GFSK modulation; 2Mbps for Bluetooth pi/4-DQPSK modulation; 3Mbps for Bluetooth 8DPSK modulation) were used for all test.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Frequency and Channel list for Bluetooth:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	39	2441
1	2403	40	2442	76	2478
2	2404	41	2443	77	2479
...	78	2480

Note: $fc=2402MHz+(k-1) \times 1MHz$ k=1 to 79

Test Frequency and channel for Bluetooth:

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	39	2441	78	2480

5 FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

Bldg 69, Majialong Industry Zone District, Nanshan District, Shenzhen, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

5.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description

EMC Lab.

: Accredited by CNAS, 2013.10.29

The certificate is valid until 2016.10.28

The Laboratory has been assessed and proved to be in compliance with
CNAS-CL01:2006 (identical to ISO/IEC 17025:2005)

The Certificate Registration Number is L2291.

Accredited by TUV Rheinland Shenzhen 2015.4

The Laboratory has been assessed according to the requirements
ISO/IEC 17025.

Accredited by FCC, April 17, 2013

The Certificate Registration Number is 709623.

Accredited by FCC, July 24, 2013

The Certificate Registration Number is 406365.

Accredited by Industry Canada, November 24, 2015

The Certificate Registration Number is 4480A.

Name of Firm

Site Location

: EMTEK(SHENZHEN) CO., LTD.

: Bldg 69, Majialong Industry Zone,
Nanshan District, Shenzhen, Guangdong, China

6 TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

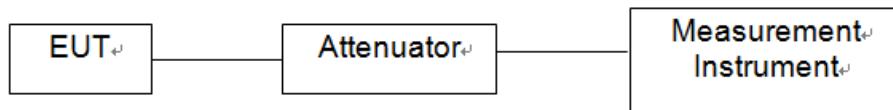
Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-5}$
Maximum Peak Output Power Test	$\pm 1.0 \text{dB}$
Conducted Emissions Test	$\pm 2.0 \text{dB}$
Radiated Emission Test	$\pm 2.0 \text{dB}$
Occupied Bandwidth Test	$\pm 1.0 \text{dB}$
Band Edge Test	$\pm 3 \text{dB}$
All emission, radiated	$\pm 3 \text{dB}$
Antenna Port Emission	$\pm 3 \text{dB}$
Temperature	$\pm 0.5^\circ\text{C}$
Humidity	$\pm 3\%$

Measurement Uncertainty for a level of Confidence of 95%

7 SETUP OF EQUIPMENT UNDER TEST

7.1 RADIO FREQUENCY TEST SETUP 1

The Bluetooth component's antenna port(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.



7.2 RADIO FREQUENCY TEST SETUP 2

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m. The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 and CAN/CSA-CEI/IEC CISPR 22.

Below 30MHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT.

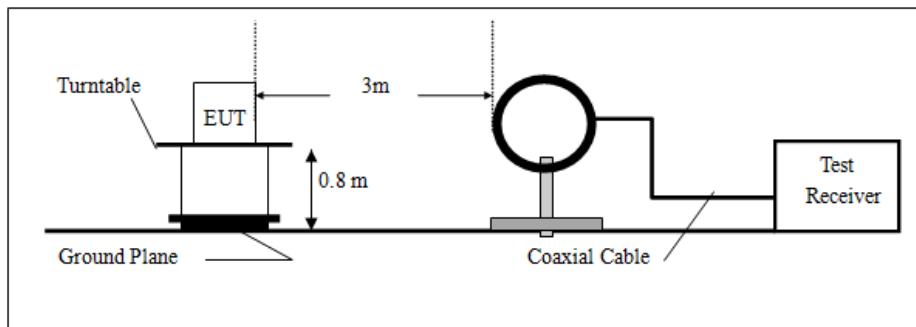
Above 30MHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

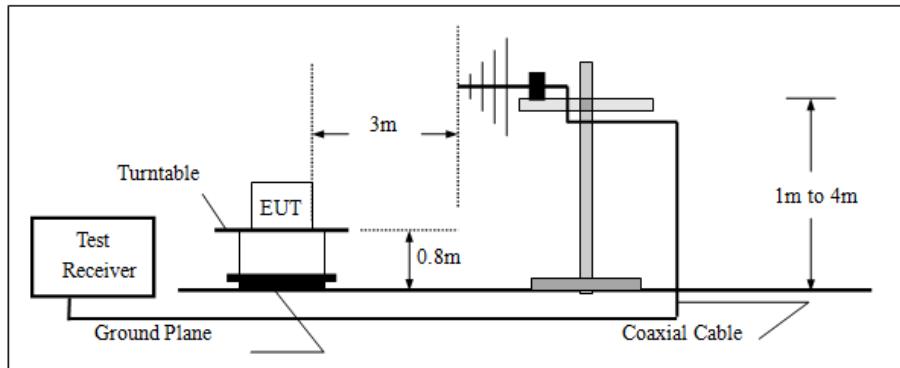
Above 1GHz:

The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

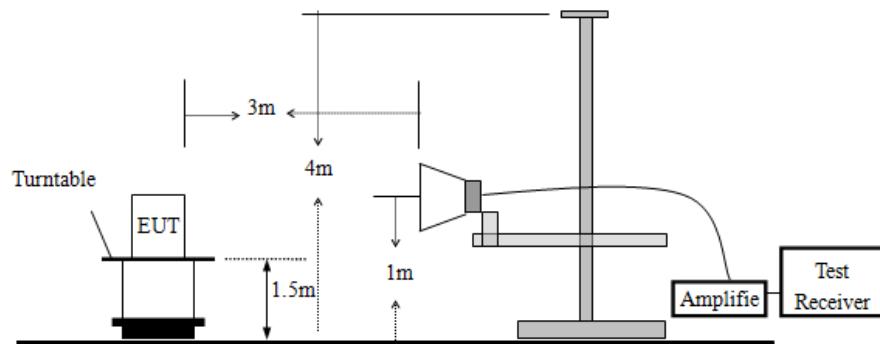
(a) Radiated Emission Test Set-Up, Frequency Below 30MHz



(b) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(c) Radiated Emission Test Set-Up, Frequency above 1000MHz

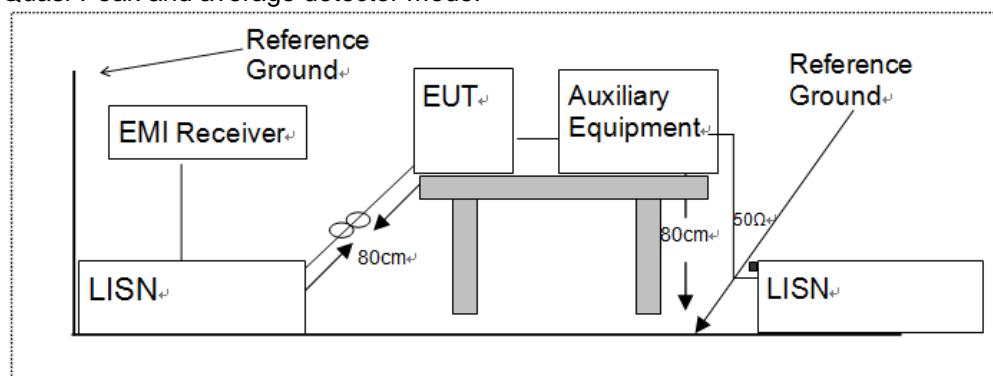


7.3 CONDUCTED EMISSION TEST SETUP

The mains cable of the EUT must be connected to LISN. The LISN shall be placed 0.8 m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8m from the LISN.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the LISN and, where not otherwise provided or specified by the manufacturer, shall be of same length as the mains cable and run parallel to the mains connection at a separation distance of not more than 0.1 m.

According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.



7.4 SUPPORT EQUIPMENT

Item	Equipment	Mfr/Brand	Model/Type No.	Note
1.	Adapter	belkin	F8M670	N/A

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

8 FREQUENCY HOPPING SYSTEM REQUIREMENTS

8.1 Standard Applicable

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

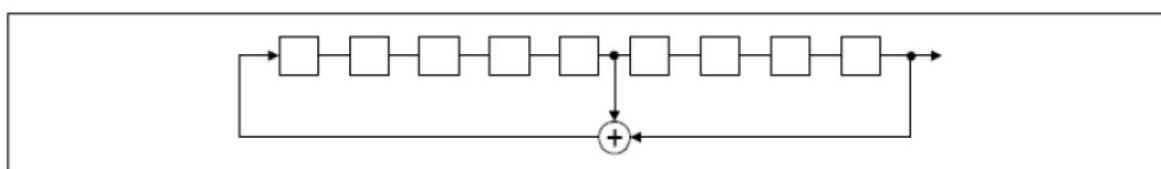
8.2 EUT Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The normal hop is 1 600 hops/s.

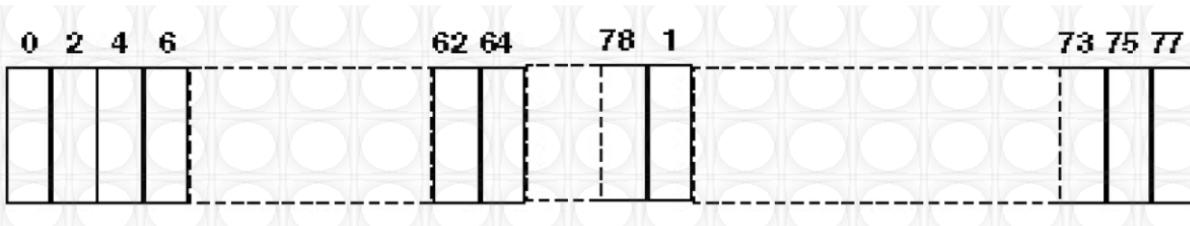
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage, and the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones. Number of shift register stages: 9

Length of pseudo-random sequence: $2^9 - 1 = 524$ bits

Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence



Each frequency used equally on the average by each transmitter.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

8.3 Equal Hopping Frequency Use

All Bluetooth units participating in the piconet are time and hop-synchronized to the channel.

Example of a 79 hopping sequence in data mode:

35, 27, 6, 44, 14, 61, 74, 32, 1, 11, 23, 2, 55, 65, 29, 3, 9, 52, 78, 58, 40, 25, 0, 7, 18, 26, 76, 60, 47, 50, 2, 5, 16, 37, 70, 63, 66, 54, 20, 13, 4, 8, 15, 21, 26, 10, 73, 77, 67, 69, 43, 24, 57, 39, 46, 72, 48, 33, 17, 31, 75, 19, 41, 62, 68, 28, 51, 66, 30, 56, 34, 59, 71, 22, 49, 64, 38, 45, 36, 42, 53

Each Frequency used equally on the average by each transmitter

8.4 Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH- enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

9 TEST REQUIREMENTS

9.1 20DB BANDWIDTH

9.1.1 Applicable Standard

According to FCC Part 15.247(a)(1) and DA 00-705

9.1.2 Conformance Limit

No limit requirement.

9.1.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.1.4 Test Procedure

The EUT was operating in Bluetooth mode and controlled its channel. Printed out the test result from the spectrum by hard copy function.

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

Set to the maximum power setting and enable the EUT transmit continuously

Set RBW = 30 kHz.

Set the video bandwidth (VBW) =100 kHz.

Set Span= approximately 2 to 3 times the 20 dB bandwidth

Set Detector = Peak.

Set Trace mode = max hold.

Set Sweep = auto couple.

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 markerdelta 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.

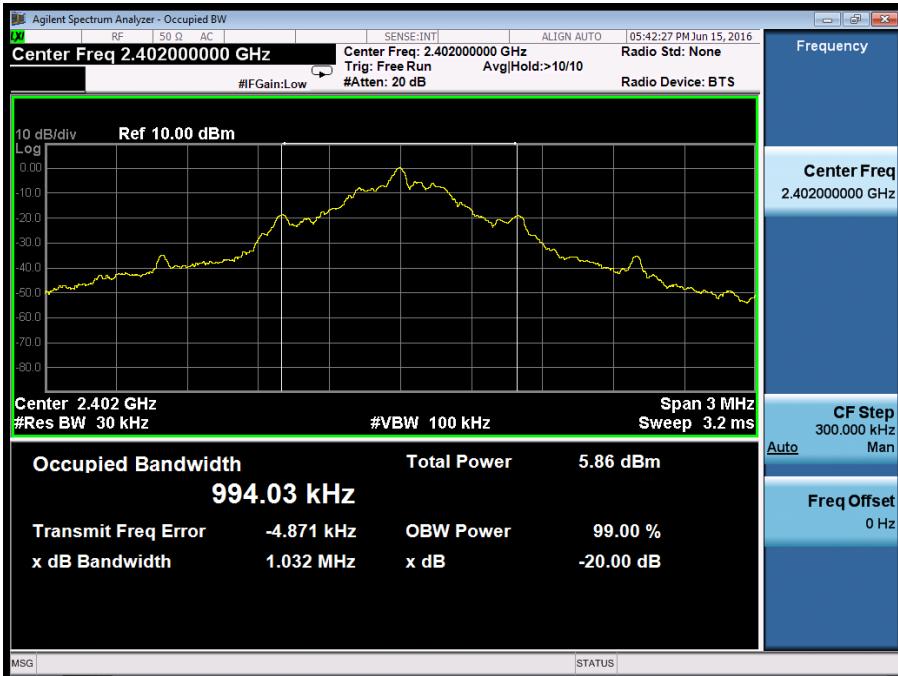
If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

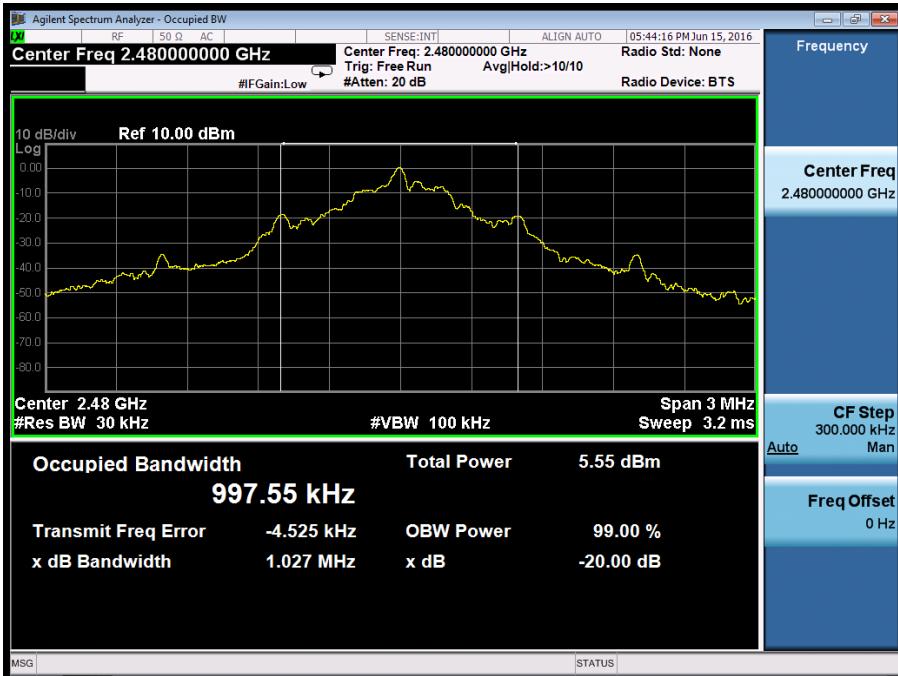
Measure and record the results in the test report.

Test Results

Temperature:	24°C	Test Date:	June 15, 2016
Humidity:	53 %	Test By:	KK

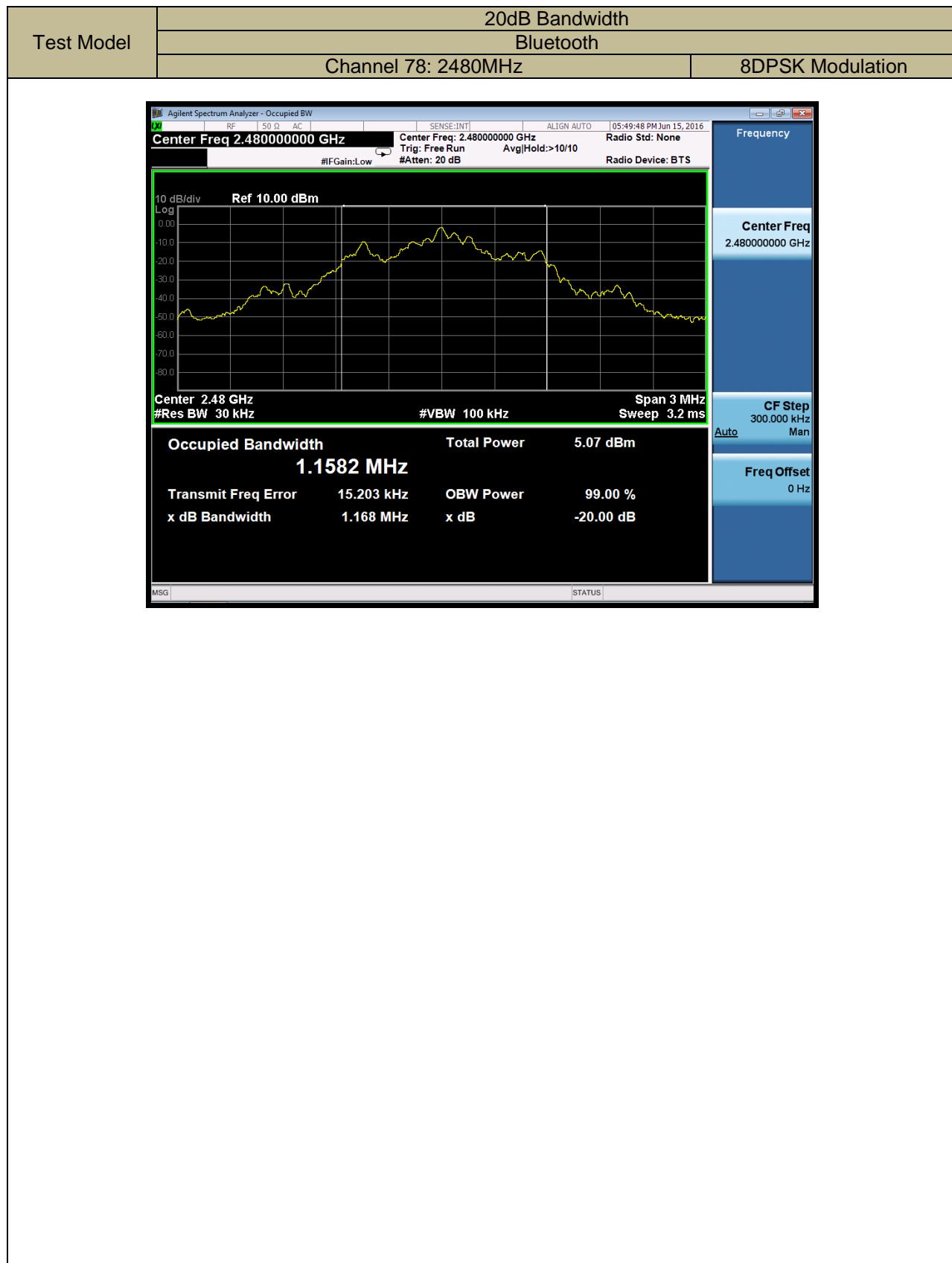
Modulation Mode	Channel Number	Channel Frequency (MHz)	20dB Bandwidth (kHz)
GFSK	00	2402	1032.00
	39	2441	1035.00
	78	2480	1027.00
pi/4-DQPSK	00	2402	1101.00
	39	2441	1102.00
	78	2480	1098.00
8DPSK	00	2402	1168.00
	39	2441	1223.00
	78	2480	1168.00
Note: N/A (Not Applicable)			

Test Model	20dB Bandwidth	
	Bluetooth	
	Channel 0: 2402MHz	GFSK Modulation
	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.402000000 GHz</p> <p>Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Span 3 MHz</p> <p>Sweep 3.2 ms</p> <p>Occupied Bandwidth 994.03 kHz</p> <p>Total Power 5.86 dBm</p> <p>Transmit Freq Error -4.871 kHz</p> <p>x dB Bandwidth 1.032 MHz</p> <p>OBW Power 99.00 %</p> <p>x dB -20.00 dB</p>	
	20dB Bandwidth	
	Bluetooth	
	Channel 39: 2441MHz	GFSK Modulation
	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.441000000 GHz</p> <p>Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Span 3 MHz</p> <p>Sweep 3.2 ms</p> <p>Occupied Bandwidth 1.0000 MHz</p> <p>Total Power 6.14 dBm</p> <p>Transmit Freq Error -1.959 kHz</p> <p>x dB Bandwidth 1.035 MHz</p> <p>OBW Power 99.00 %</p> <p>x dB -20.00 dB</p>	

Test Model	20dB Bandwidth
	Bluetooth
	Channel 78: 2480MHz
GFSK Modulation	
 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.480000000 GHz</p> <p>Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Span 3 MHz</p> <p>Sweep 3.2 ms</p> <p>Occupied Bandwidth 997.55 kHz</p> <p>Total Power 5.55 dBm</p> <p>Transmit Freq Error -4.525 kHz</p> <p>x dB Bandwidth 1.027 MHz</p> <p>OBW Power 99.00 %</p> <p>x dB -20.00 dB</p> <p>CF Step 300.000 kHz</p> <p>Freq Offset 0 Hz</p>	
Test Model	20dB Bandwidth
	Bluetooth
	Channel 0: 2402MHz
pi/4-DQPSK Modulation	
 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.402000000 GHz</p> <p>Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Span 3 MHz</p> <p>Sweep 3.2 ms</p> <p>Occupied Bandwidth 1.0874 MHz</p> <p>Total Power 4.66 dBm</p> <p>Transmit Freq Error -5.401 kHz</p> <p>x dB Bandwidth 1.101 MHz</p> <p>OBW Power 99.00 %</p> <p>x dB -20.00 dB</p> <p>CF Step 300.000 kHz</p> <p>Freq Offset 0 Hz</p>	

Test Model	20dB Bandwidth
	Bluetooth
	Channel 39: 2441MHz pi/4-DQPSK Modulation
	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.441000000 GHz</p> <p>Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Center 2.441 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 3.2 ms</p> <p>Occupied Bandwidth 1.0931 MHz</p> <p>Total Power 5.34 dBm</p> <p>Transmit Freq Error -2.784 kHz OBW Power 99.00 %</p> <p>x dB Bandwidth 1.102 MHz x dB -20.00 dB</p> <p>CF Step 300.000 kHz Man</p> <p>Freq Offset 0 Hz</p>
Test Model	20dB Bandwidth
	Bluetooth
	Channel 78: 2480MHz pi/4-DQPSK Modulation
	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.480000000 GHz</p> <p>Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Center 2.48 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 3.2 ms</p> <p>Occupied Bandwidth 1.0828 MHz</p> <p>Total Power 4.71 dBm</p> <p>Transmit Freq Error -3.324 kHz OBW Power 99.00 %</p> <p>x dB Bandwidth 1.098 MHz x dB -20.00 dB</p> <p>CF Step 300.000 kHz Man</p> <p>Freq Offset 0 Hz</p>

Test Model	20dB Bandwidth	
	Bluetooth	
	Channel 0: 2402MHz	8DPSK Modulation
Test Model	20dB Bandwidth	
	Bluetooth	
	Channel 39: 2441MHz	8DPSK Modulation



9.2 CARRIER FREQUENCY SEPARATION

9.2.1 Applicable Standard

According to FCC Part 15.247(a)(1) and DA 00-705

9.2.2 Conformance Limit

Frequency hopping systems operating in the 2400-2483.5MHz band shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

In case of an output power less than 125mW, the frequency hopping system may have channels separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

9.2.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.2.4 Test Procedure

- According to FCC Part15.247(a)(1)

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Set the RBW =100kHz. Set VBW =300kHz.

Set the span = wide enough to capture the peaks of two adjacent channels

Set Sweep time = auto couple.

Set Detector = peak. Set Trace mode = max hold.

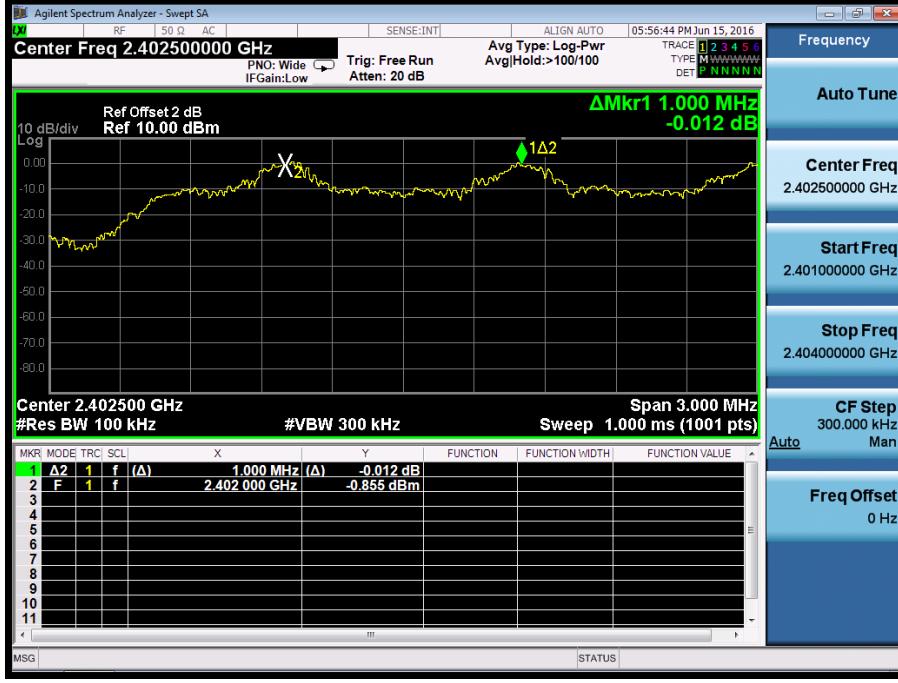
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Test Results

Temperature:	24°C	Test Date:	June 15, 2016
Humidity:	53 %	Test By:	KK

Modulation Mode	Channel Number	Channel Frequency (MHz)	Frequency Seperation (kHz)	Limit (kHz)	Verdict
GFSK	0	2402	1000.0	>688.00	PASS
	39	2441	1000.0	>690.00	PASS
	78	2480	1000.0	>684.67	PASS
pi/4-DQPSK	0	2402	1000.0	>734.00	PASS
	39	2441	1000.0	>734.67	PASS
	78	2480	1000.0	>732.00	PASS
8DPSK	0	2402	1000.0	>778.67	PASS
	39	2441	1000.0	>815.33	PASS
	78	2480	1000.0	>778.67	PASS
Note: Limit = 20dB bandwidth*2/3 for GFSK , pi/4-DQPSK and 8DPSK Modulation, if it is greater than 25kHz and the output power is less than 125mW (21dBm).					

Test Model	Carrier Frequency Separation																																																																																																														
	Bluetooth																																																																																																														
	Channel 0: 2402MHz	GFSK Modulation																																																																																																													
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Test Model	Carrier Frequency Separation				
	Bluetooth				
	Channel 78: 2480MHz	GFSK Modulation			
 <p>The screenshot shows the Agilent Spectrum Analyzer interface with the following parameters:</p> <ul style="list-style-type: none"> Center Freq: 2.479500000 GHz Span: 3.000 MHz Sweep: 1.000 ms (1001 pts) Marker 1: Δ2, -1.000 MHz, -0.047 dB Marker 2: X2, 2.480000 GHz, -2.070 dBm Marker 3: Δ1, 2.479500 GHz, -0.012 dB <p>The right panel displays the following frequency settings:</p> <ul style="list-style-type: none"> Auto Tune Center Freq: 2.479500000 GHz Start Freq: 2.478000000 GHz Stop Freq: 2.481000000 GHz CF Step: 300.000 kHz Freq Offset: 0 Hz 					
Test Model	Carrier Frequency Separation				
	Bluetooth				
	Channel 0: 2402MHz	pi/4-DQPSK Modulation			
 <p>The screenshot shows the Agilent Spectrum Analyzer interface with the following parameters:</p> <ul style="list-style-type: none"> Center Freq: 2.402500000 GHz Span: 3.000 MHz Sweep: 1.000 ms (1001 pts) Marker 1: Δ2, 1.000 MHz, -0.012 dB Marker 2: X2, 2.402000 GHz, -0.855 dBm Marker 3: Δ1, 2.402500 GHz, -0.012 dB <p>The right panel displays the following frequency settings:</p> <ul style="list-style-type: none"> Auto Tune Center Freq: 2.402500000 GHz Start Freq: 2.401000000 GHz Stop Freq: 2.404000000 GHz CF Step: 300.000 kHz Freq Offset: 0 Hz 					

Test Model	Carrier Frequency Separation	
	Bluetooth	
	Channel 39: 2441MHz	pi/4-DQPSK Modulation
 <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a center frequency of 2.441500000 GHz. A green marker labeled 'Δ2' indicates a 1.000 MHz offset from the center frequency, with a power level of 1.861 dB. Another marker labeled 'X2' is also visible. The status bar at the bottom shows 'Center 2.441500 GHz', '#Res BW 100 kHz', '#VBW 300 kHz', 'Span 3.000 MHz', and 'Sweep 1.000 ms (1001 pts)'. The right panel contains a 'Frequency' control panel with various parameters set for the measurement.</p>		
Test Model	Carrier Frequency Separation	
	Bluetooth	
	Channel 78: 2480MHz	pi/4-DQPSK Modulation
 <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a center frequency of 2.479500000 GHz. A green marker labeled 'Δ2' indicates a -1.000 MHz offset from the center frequency, with a power level of -0.040 dB. Another marker labeled 'X2' is also visible. The status bar at the bottom shows 'Center 2.479500 GHz', '#Res BW 100 kHz', '#VBW 300 kHz', 'Span 3.000 MHz', and 'Sweep 1.000 ms (1001 pts)'. The right panel contains a 'Frequency' control panel with various parameters set for the measurement.</p>		

Test Model	Carrier Frequency Separation																																																																																																														
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9.3 NUMBER OF HOPPING FREQUENCIES

9.3.1 Applicable Standard

According to FCC Part 15.247(a)(1) (iii)and DA 00-705

9.3.2 Conformance Limit

Frequency hopping systems operating in the 2400-2483.5MHz band shall use at least 15 channels.

9.3.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.3.4 Test Procedure

- According to FCC Part15.247(a)(1)(iii)

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation (2390-2440MHz) and(2440-2490MHz)

RBW \geq 1% of the span

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

Test Results

Temperature:

24°C

Test Date:

June 15, 2016

Humidity:

53 %

Test By:

KK

Hopping Channel Frequency Range	Quantity of Hopping Channel	Quantity of Hopping Channel limit
2402-2480	79	>15

Test Model	Number Of Hopping Frequencies	
	Bluetooth	
	Span: 2390-2440MHz	
 <p>Agilent Spectrum Analyzer - Swept SA</p> <p>Start Freq 2.390000000 GHz</p> <p>Ref Offset 2 dB Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Mkr1 2.435 00 GHz 1.459 dBm</p> <p>Start 2.39000 GHz Stop 2.44000 GHz</p> <p>#Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (1001 pts)</p> <p>MSG STATUS</p>		
Test Model	Number Of Hopping Frequencies	
	Bluetooth	
	Span: 2440-2490MHz	
 <p>Agilent Spectrum Analyzer - Swept SA</p> <p>Start Freq 2.440000000 GHz</p> <p>Ref Offset 2 dB Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Mkr1 2.441 00 GHz 1.414 dBm</p> <p>Start 2.44000 GHz Stop 2.49000 GHz</p> <p>#Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (1001 pts)</p> <p>MSG STATUS</p>		

9.4 AVERAGE TIME OF OCCUPANCY (DWELL TIME)

9.4.1 Applicable Standard

According to FCC Part 15.247(a)(1)(iii) and DA 00-705

9.4.2 Conformance Limit

For frequency hopping systems operating in the 2400-2483.5MHz band, the average time of occupancy on any channel shall not be greater than 0.4s within a period of 0.4s multiplied by the number of hopping channels employed.

9.4.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.4.4 Test Procedure

- According to FCC Part15.247(a)(1)(iii)

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel

RBW = 1 MHz

VBW \geq RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

If possible, use the marker-delta function to determine the dwell time. 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.

9.4.5 Test Results

Temperature:

24°C

Test Date:

June 15, 2016

Humidity:

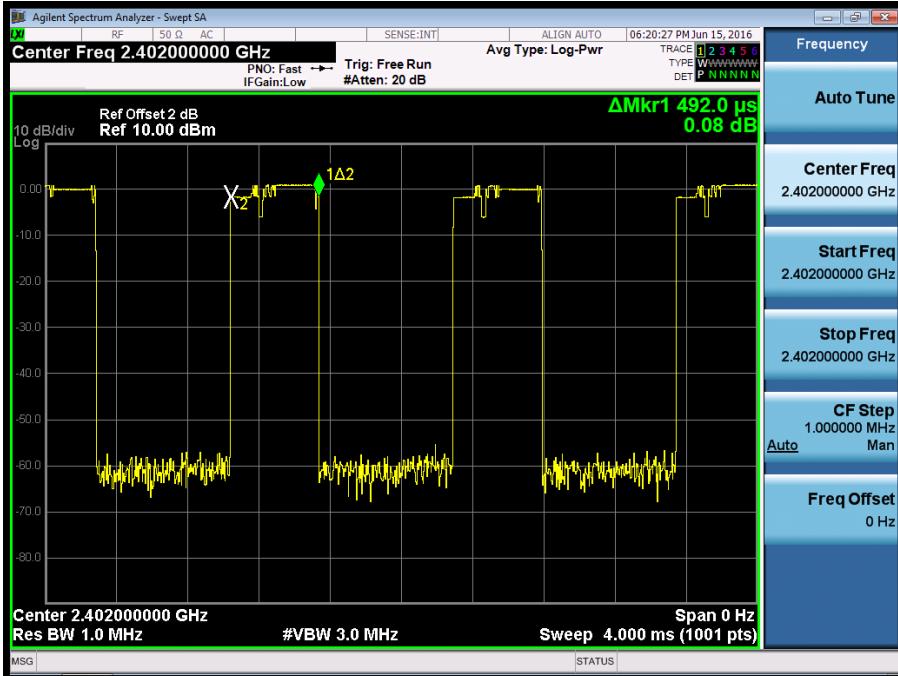
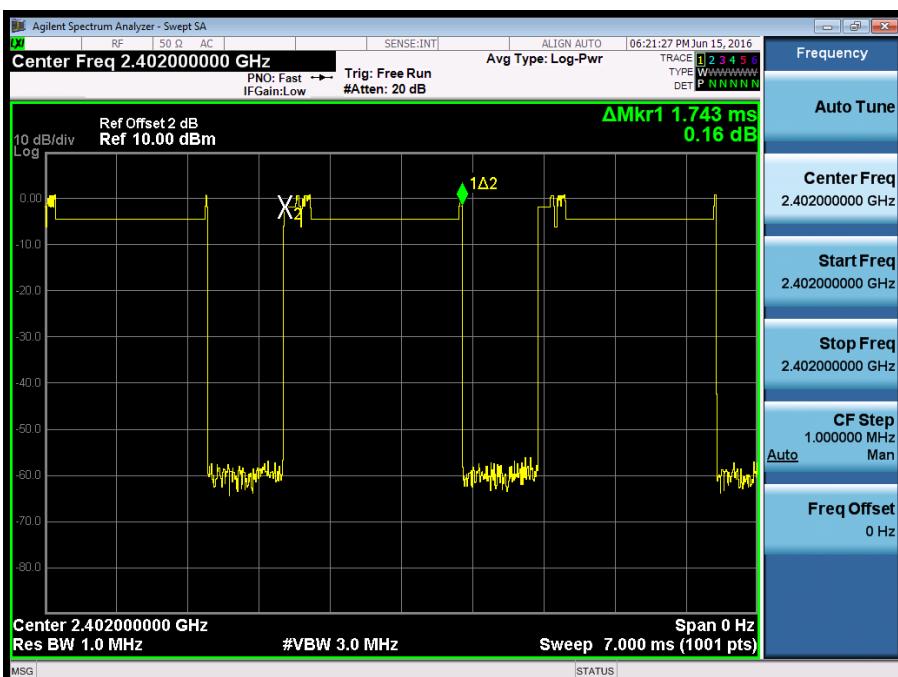
53 %

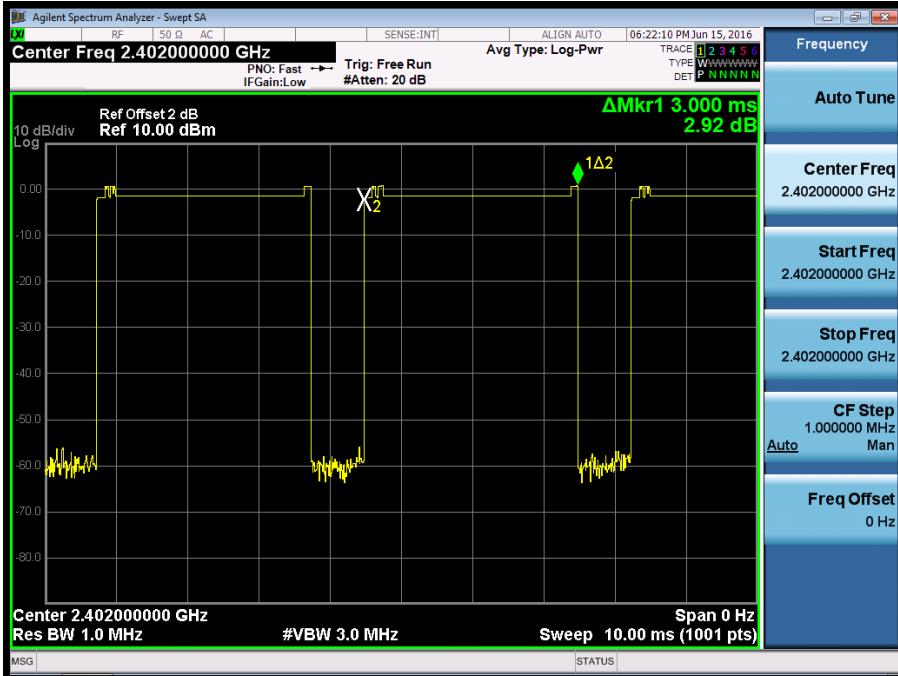
Test By:

KK

Bluetooth (GFSK, pi/4-DQPSK, 8DPSK) mode have been tested, and the worst result(GFSK) was report as below:

Modulation Mode	Channel Number	Packet type	Pluse width (ms)	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	0	DH1	0.492	157.44	<400	PASS
	0	DH3	1.743	278.88	<400	PASS
	0	DH5	3.000	320.00	<400	PASS
Note: Dwell Time(DH1)=PW*(1600/2/79)*31.6 Dwell Time(DH3)=PW*(1600/4/79)*31.6 Dwell Time(DH5)=PW*(1600/6/79)*31.6						

Test Model	Average Time Of Occupancy (Dwell Time)			
	Bluetooth		GFSK DH1	
	CH 0: 2402MHz			
	 <p>Agilent Spectrum Analyzer - Swept SA</p> <p>Center Freq 2.402000000 GHz</p> <p>Ref Offset 2 dB Ref 10.00 dBm</p> <p>Avg Type: Log-Pwr</p> <p>PNO: Fast Trig: Free Run IFGain:Low #Atten: 20 dB</p> <p>Frequency</p> <p>Auto Tune</p> <p>Center Freq 2.402000000 GHz</p> <p>Start Freq 2.402000000 GHz</p> <p>Stop Freq 2.402000000 GHz</p> <p>CF Step 1.000000 MHz Auto</p> <p>Freq Offset 0 Hz</p> <p>ΔMkr1 492.0 μs 0.08 dB</p> <p>1Δ2</p> <p>10 dB/div Log</p> <p>0.00 -10.00 -20.00 -30.00 -40.00 -50.00 -60.00 -70.00 -80.00</p> <p>Center 2.402000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 4.000 ms (1001 pts)</p>			
Test Model	Average Time Of Occupancy (Dwell Time)			
	Bluetooth		GFSK DH3	
	CH 0: 2402MHz			
	 <p>Agilent Spectrum Analyzer - Swept SA</p> <p>Center Freq 2.402000000 GHz</p> <p>Ref Offset 2 dB Ref 10.00 dBm</p> <p>Avg Type: Log-Pwr</p> <p>PNO: Fast Trig: Free Run IFGain:Low #Atten: 20 dB</p> <p>Frequency</p> <p>Auto Tune</p> <p>Center Freq 2.402000000 GHz</p> <p>Start Freq 2.402000000 GHz</p> <p>Stop Freq 2.402000000 GHz</p> <p>CF Step 1.000000 MHz Auto</p> <p>Freq Offset 0 Hz</p> <p>ΔMkr1 1.743 ms 0.16 dB</p> <p>1Δ2</p> <p>10 dB/div Log</p> <p>0.00 -10.00 -20.00 -30.00 -40.00 -50.00 -60.00 -70.00 -80.00</p> <p>Center 2.402000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 7.000 ms (1001 pts)</p>			

Test Model	Average Time Of Occupancy (Dwell Time)		
	Bluetooth		
	CH 0: 2402MHz	GFSK	DH5
 <p>The screenshot shows a spectrum analysis window with the following parameters:</p> <ul style="list-style-type: none"> Center Freq: 2.402000000 GHz Ref Offset: 2 dB Ref: 10.00 dBm Span: 0 Hz Sweep: 10.00 ms (1001 pts) Res BW: 1.0 MHz #VBW: 3.0 MHz <p>A green arrow labeled "1Δ2" points to a sharp peak at approximately -10 dBm. The right panel displays the following settings:</p> <ul style="list-style-type: none"> Frequency: Auto Tune Center Freq: 2.40200000 GHz Start Freq: 2.40200000 GHz Stop Freq: 2.40200000 GHz CF Step: 1.000000 MHz (Auto) Freq Offset: 0 Hz 			

9.5 MAXIMUM PEAK CONDUCTED OUTPUT POWER

9.5.1 Applicable Standard

According to FCC Part 15.247(b)(1) and DA 00-705

9.5.2 Conformance Limit

The max For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

9.5.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.5.4 Test Procedure

- According to FCC Part15.247(b)(1)

As an alternative to a peak power measurement, compliance with the limit can be based on a measurement of the maximum conducted output power.

Use the following spectrum analyzer settings:

Set Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel (about 10MHz)

Set RBW > the 20 dB bandwidth of the emission being measured (about 3MHz)

Set VBW \geq RBW

Set Sweep = auto

Set Detector function = peak

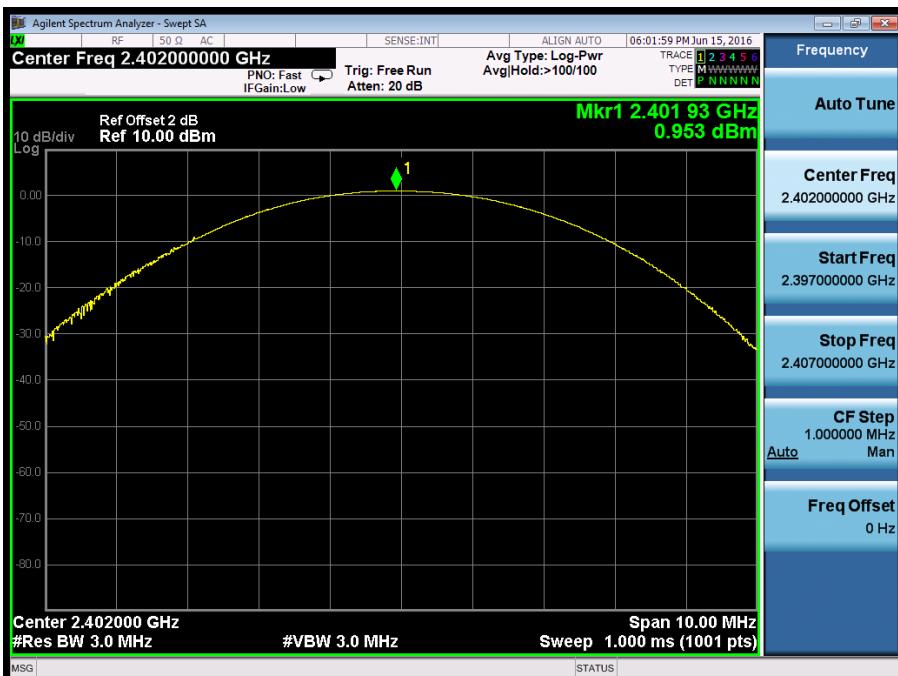
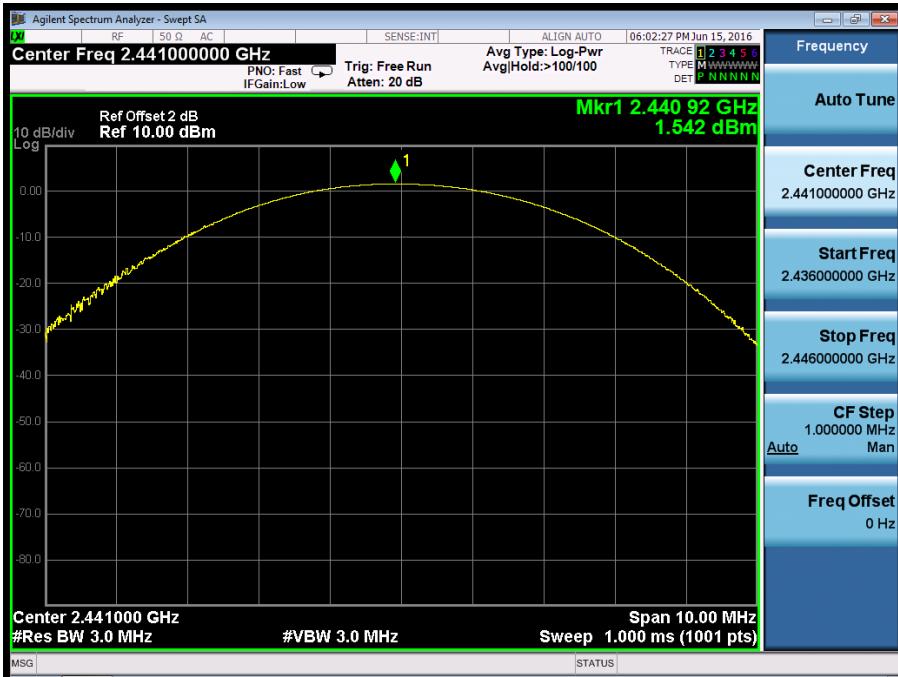
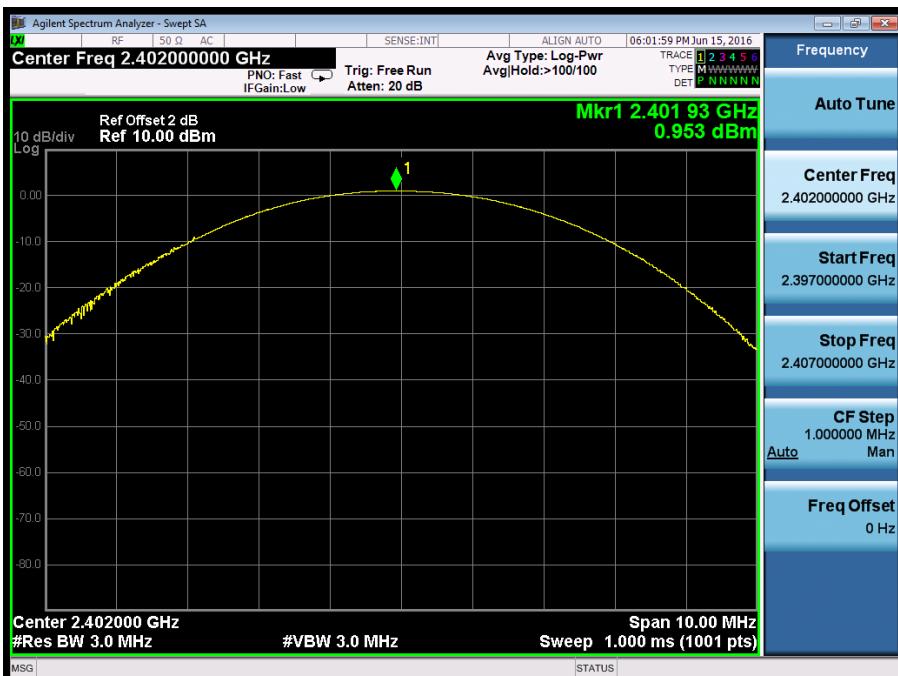
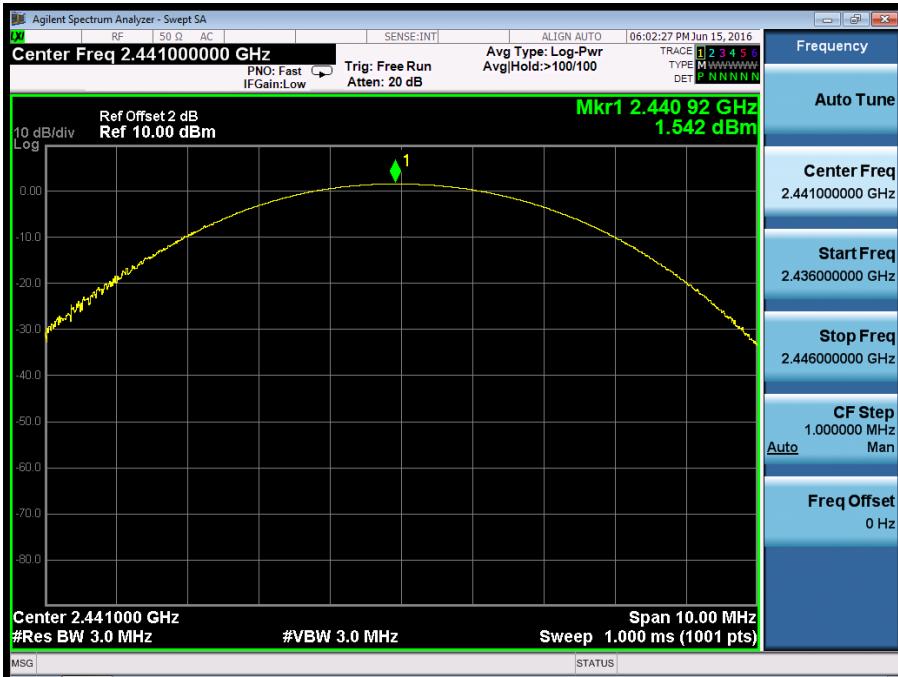
Set Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission to determine the peak amplitude level.

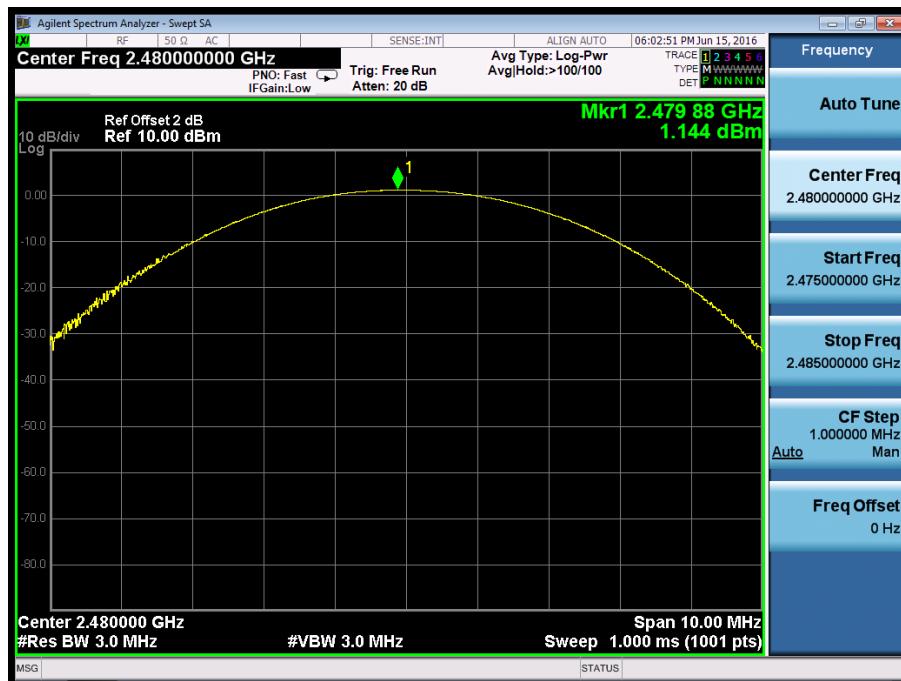
Test Results

Temperature:	24°C	Test Date:	June 15, 2016
Humidity:	53 %	Test By:	KK

Operation Mode	Channel Number	Channel Frequency (MHz)	Measurement Level (dBm)	Limit (dBm)	Verdict
GFSK	0	2402	0.953	21	PASS
	39	2441	1.542	21	PASS
	78	2480	1.144	21	PASS
pi/4-DQPSK	0	2402	1.894	21	PASS
	39	2441	2.450	21	PASS
	78	2480	2.061	21	PASS
8DPSK	0	2402	2.346	21	PASS
	39	2441	2.782	21	PASS
	78	2480	2.426	21	PASS
Note: N/A					

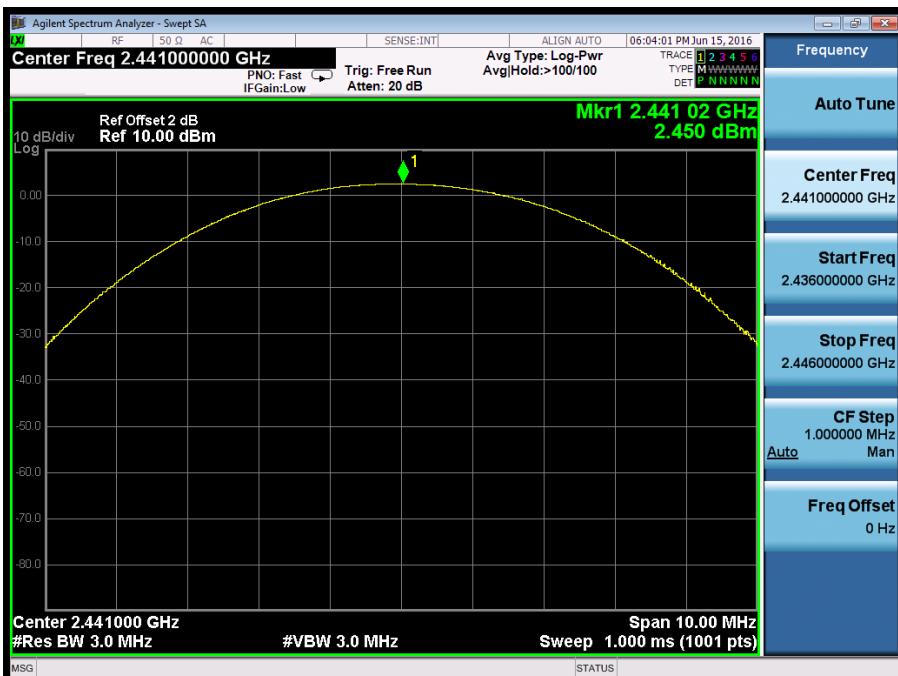
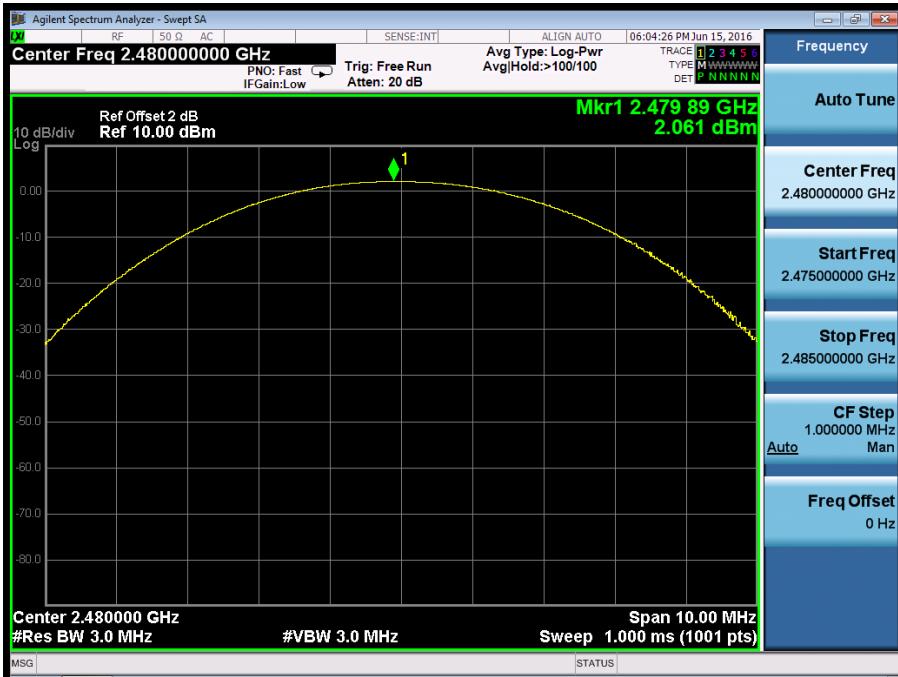
Test Model	Maximum Peak Conducted Output Power												
	Bluetooth												
	Channel 0: 2402MHz		GFSK										
 <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a single peak labeled 'Mkr1' at 2.40193 GHz with a power of 0.953 dBm. The plot has a logarithmic scale from -80.0 to 0.0 dB. The center frequency is set to 2.402000000 GHz, and the span is 10.00 MHz. The right panel shows various frequency parameters: Center Freq 2.402000000 GHz, Start Freq 2.397000000 GHz, Stop Freq 2.407000000 GHz, CF Step 1.000000 MHz, and Freq Offset 0 Hz.</p>													
<table border="1"> <tr> <td rowspan="3">Test Model</td> <td colspan="3">Maximum Peak Conducted Output Power</td></tr> <tr> <td colspan="2">Bluetooth</td><td></td></tr> <tr> <td colspan="2">Channel 39: 2441MHz</td><td>GFSK</td></tr> </table>  <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a single peak labeled 'Mkr1' at 2.44092 GHz with a power of 1.542 dBm. The plot has a logarithmic scale from -80.0 to 0.0 dB. The center frequency is set to 2.441000000 GHz, and the span is 10.00 MHz. The right panel shows various frequency parameters: Center Freq 2.441000000 GHz, Start Freq 2.436000000 GHz, Stop Freq 2.446000000 GHz, CF Step 1.000000 MHz, and Freq Offset 0 Hz.</p>				Test Model	Maximum Peak Conducted Output Power			Bluetooth			Channel 39: 2441MHz		GFSK
Test Model	Maximum Peak Conducted Output Power												
	Bluetooth												
	Channel 39: 2441MHz		GFSK										
Test Model	Maximum Peak Conducted Output Power												
	Bluetooth												
	Channel 0: 2402MHz		GFSK										
 <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a single peak labeled 'Mkr1' at 2.40193 GHz with a power of 0.953 dBm. The plot has a logarithmic scale from -80.0 to 0.0 dB. The center frequency is set to 2.402000000 GHz, and the span is 10.00 MHz. The right panel shows various frequency parameters: Center Freq 2.402000000 GHz, Start Freq 2.397000000 GHz, Stop Freq 2.407000000 GHz, CF Step 1.000000 MHz, and Freq Offset 0 Hz.</p>													
<table border="1"> <tr> <td rowspan="3">Test Model</td> <td colspan="3">Maximum Peak Conducted Output Power</td></tr> <tr> <td colspan="2">Bluetooth</td><td></td></tr> <tr> <td colspan="2">Channel 39: 2441MHz</td><td>GFSK</td></tr> </table>  <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a single peak labeled 'Mkr1' at 2.44092 GHz with a power of 1.542 dBm. The plot has a logarithmic scale from -80.0 to 0.0 dB. The center frequency is set to 2.441000000 GHz, and the span is 10.00 MHz. The right panel shows various frequency parameters: Center Freq 2.441000000 GHz, Start Freq 2.436000000 GHz, Stop Freq 2.446000000 GHz, CF Step 1.000000 MHz, and Freq Offset 0 Hz.</p>				Test Model	Maximum Peak Conducted Output Power			Bluetooth			Channel 39: 2441MHz		GFSK
Test Model	Maximum Peak Conducted Output Power												
	Bluetooth												
	Channel 39: 2441MHz		GFSK										

Test Model	Maximum Peak Conducted Output Power		
	Bluetooth		
	Channel 78: 2480MHz		GFSK

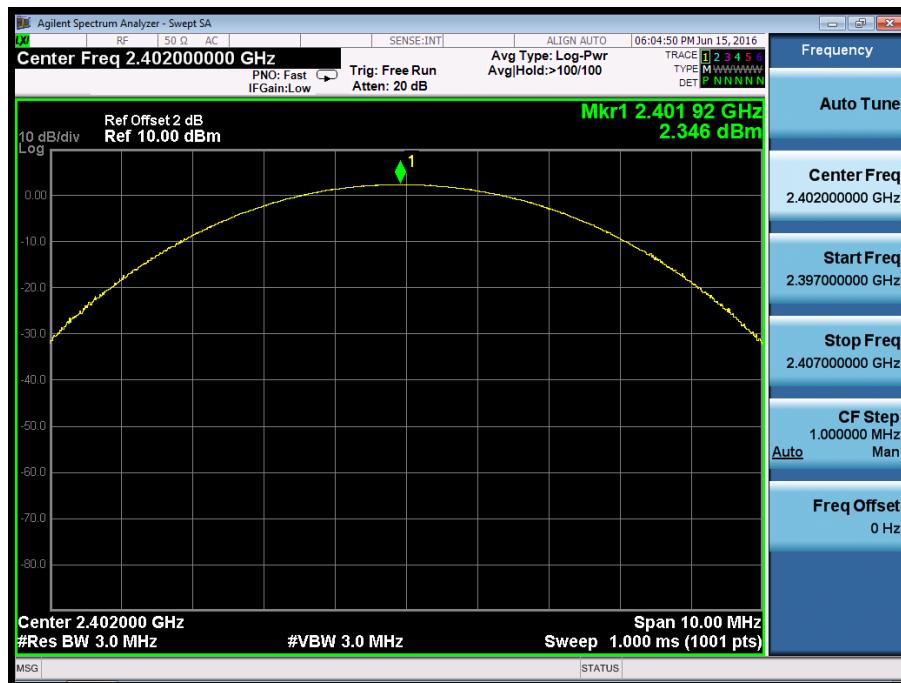


Test Model	Maximum Peak Conducted Output Power		
	Bluetooth		
	Channel 0: 2402MHz		pi/4-DQPSK

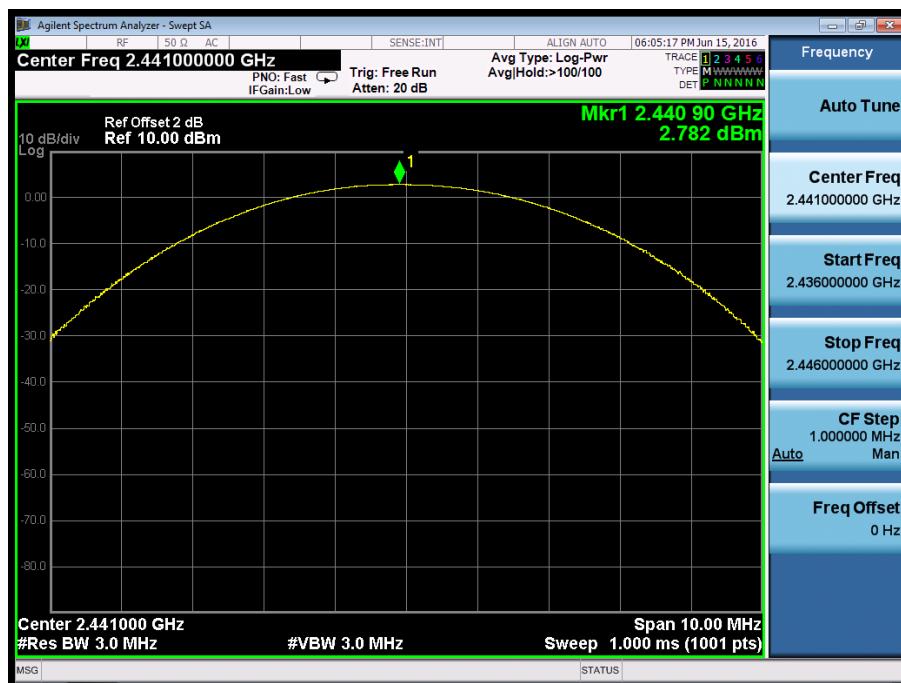


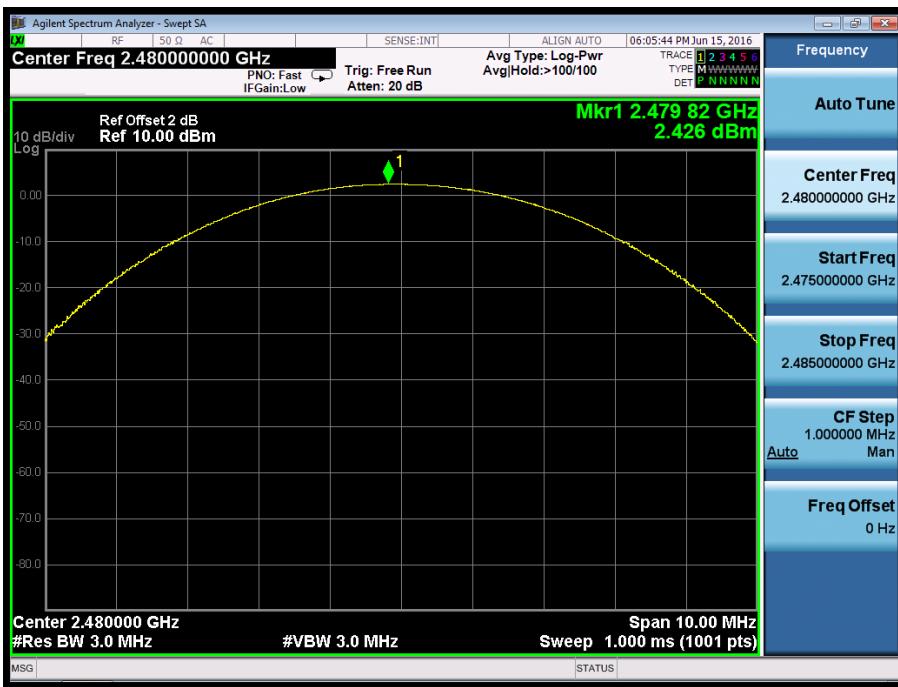
Test Model	Maximum Peak Conducted Output Power		
	Bluetooth		
	Channel 39: 2441MHz	pi/4-DQPSK	
 <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a single peak labeled 'Mkr1' at 2.441 02 GHz and 2.450 dBm. The plot has a logarithmic scale from -80.0 to 10.0 dB/div. The center frequency is set to 2.441000000 GHz, and the span is 10.00 MHz. The right panel shows various frequency parameters: Auto Tune, Center Freq 2.441000000 GHz, Start Freq 2.436000000 GHz, Stop Freq 2.446000000 GHz, CF Step 1.000000 MHz, and Freq Offset 0 Hz.</p>			
Test Model	Maximum Peak Conducted Output Power		
	Bluetooth		
	Channel 78: 2480MHz	pi/4-DQPSK	
 <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a single peak labeled 'Mkr1' at 2.479 89 GHz and 2.061 dBm. The plot has a logarithmic scale from -80.0 to 10.0 dB/div. The center frequency is set to 2.480000000 GHz, and the span is 10.00 MHz. The right panel shows various frequency parameters: Auto Tune, Center Freq 2.480000000 GHz, Start Freq 2.475000000 GHz, Stop Freq 2.485000000 GHz, CF Step 1.000000 MHz, and Freq Offset 0 Hz.</p>			

Test Model	Maximum Peak Conducted Output Power		
	Bluetooth		
	Channel 0: 2402MHz	8DPSK	



Test Model	Maximum Peak Conducted Output Power		
	Bluetooth		
	Channel 39: 2441MHz	8DPSK	



Test Model	Maximum Peak Conducted Output Power	
	Bluetooth	
	Channel 78: 2480MHz	8DPSK
 <p>The screenshot shows the Agilent Spectrum Analyzer interface. The main window displays a spectrum plot with a single peak labeled 'Mkr1' at 2.479 82 GHz and 2.426 dBm. The plot has a logarithmic scale from -80.0 to 0.0 dB. The center frequency is set to 2.480000000 GHz. The right panel shows various parameters: Center Freq 2.480000000 GHz, Start Freq 2.475000000 GHz, Stop Freq 2.485000000 GHz, CF Step 1.00000 MHz, and Freq Offset 0 Hz. The bottom status bar indicates: Center 2.480000 GHz, #Res BW 3.0 MHz, #VBW 3.0 MHz, Span 10.00 MHz, Sweep 1.000 ms (1001 pts), and MSG [] STATUS [].</p>		

9.6 CONDUCTED SUPRIOS EMISSION

9.6.1 Applicable Standard

According to FCC Part 15.247(d) and DA 00-705

9.6.2 Conformance Limit

According to FCC Part 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

9.6.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.6.4 Test Procedure

The transmitter output (antenna port) was connected to the spectrum analyzer

■ Reference level measurement

Establish a reference level by using the following procedure:

Set instrument center frequency to DSS channel center frequency.

Set Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel.

Set the RBW = 100 kHz. Set the VBW \geq 3 x RBW.

Set Detector = peak. Set Sweep time = auto couple.

Set Trace mode = max hold. Allow trace to fully stabilize.

Use the peak marker function to determine the maximum Maximum conducted level.

Note that the channel found to contain the maximum conducted level can be used to establish the reference level.

■ Band-edge Compliance of RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation

Set RBW \geq 1% of the span=100kHz Set VBW \geq RBW

Set Sweep = auto Set Detector function = peak Set Trace = max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.

The marker-delta value now displayed must comply with the limit specified in this Section.

Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

■ Conducted Spurious RF Conducted Emission

Use the following spectrum analyzer settings:

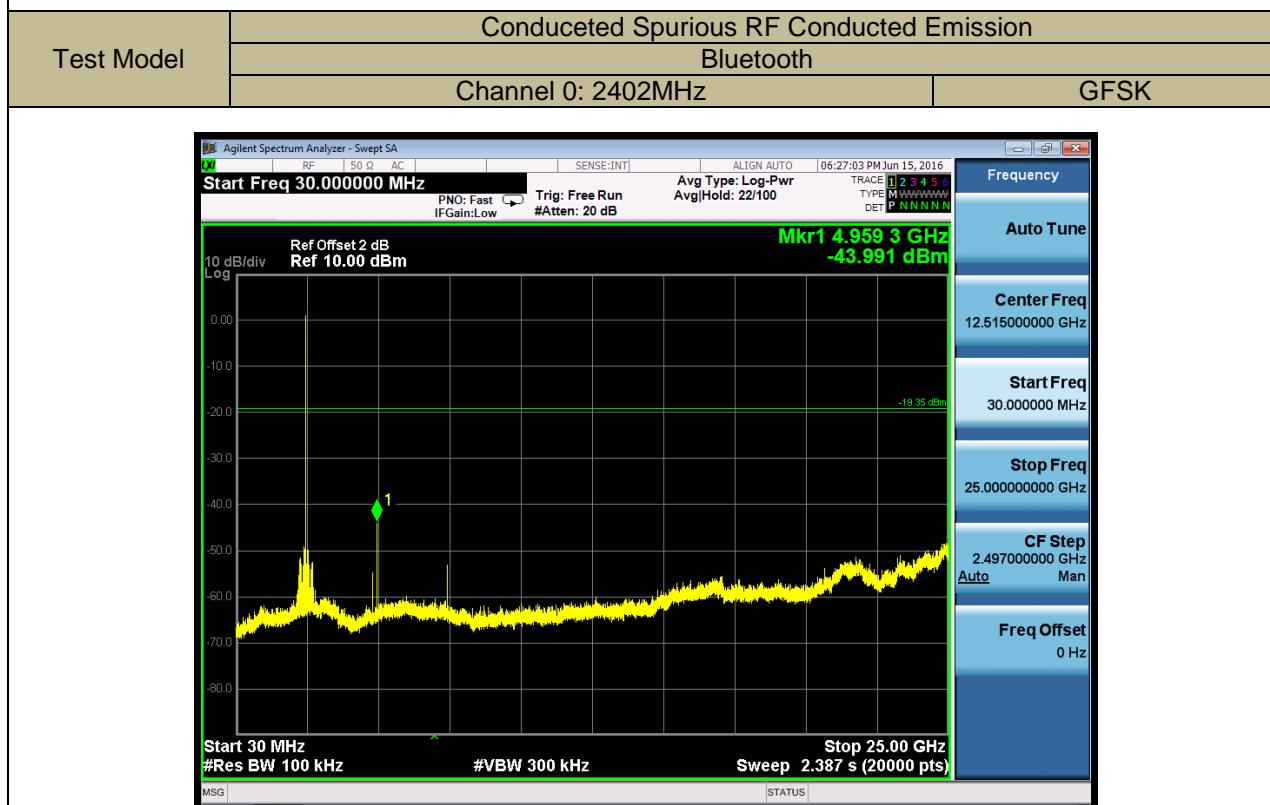
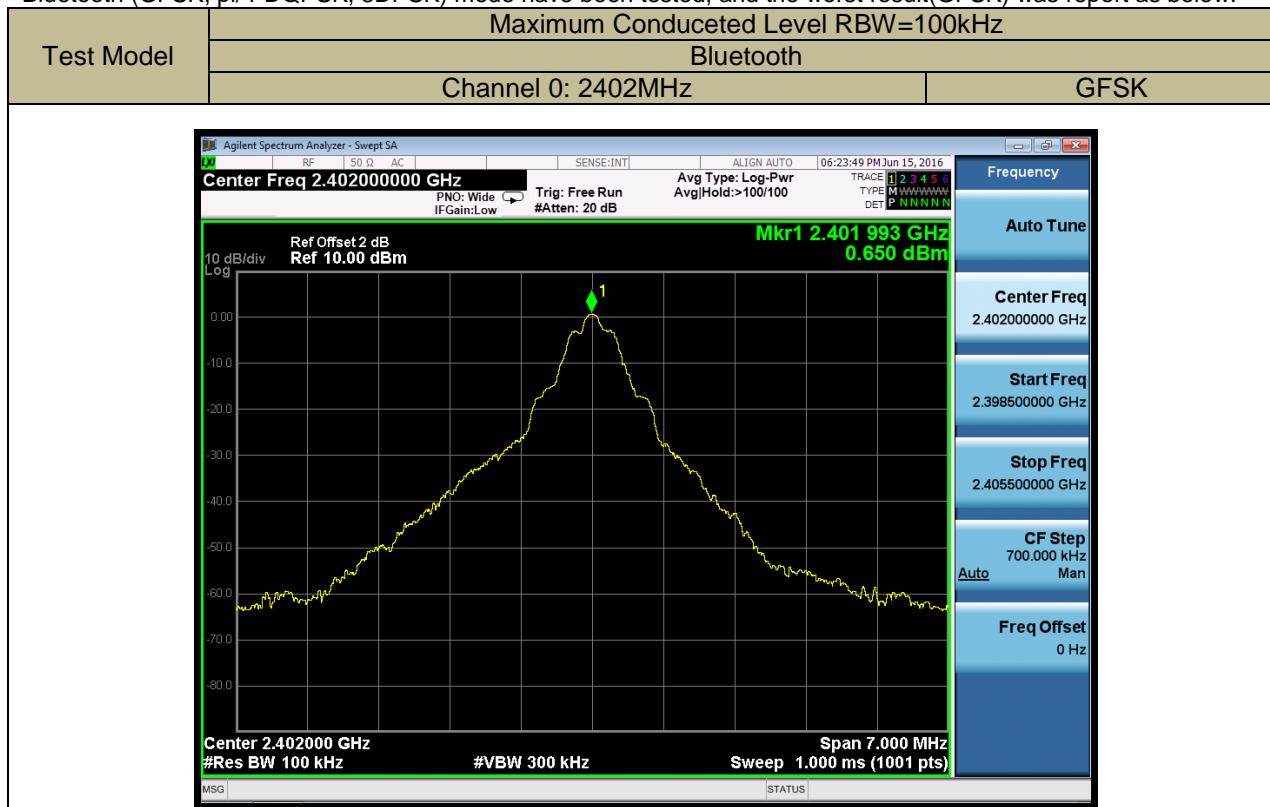
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.(30MHz to 25GHz). Set RBW = 100 kHz Set VBW \geq RBW

Set Sweep = auto Set Detector function = peak Set Trace = max hold

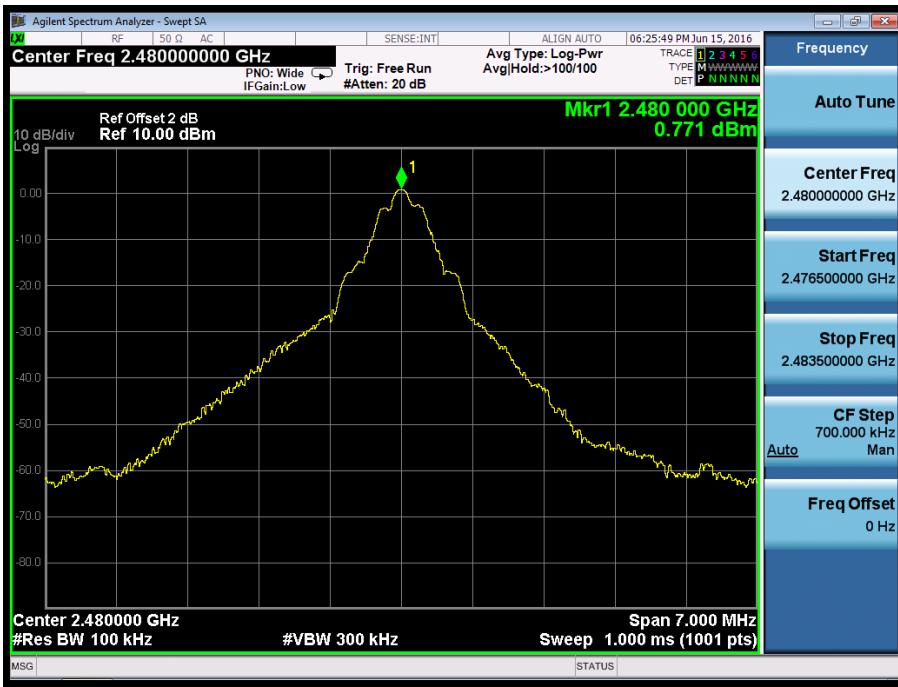
Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section.

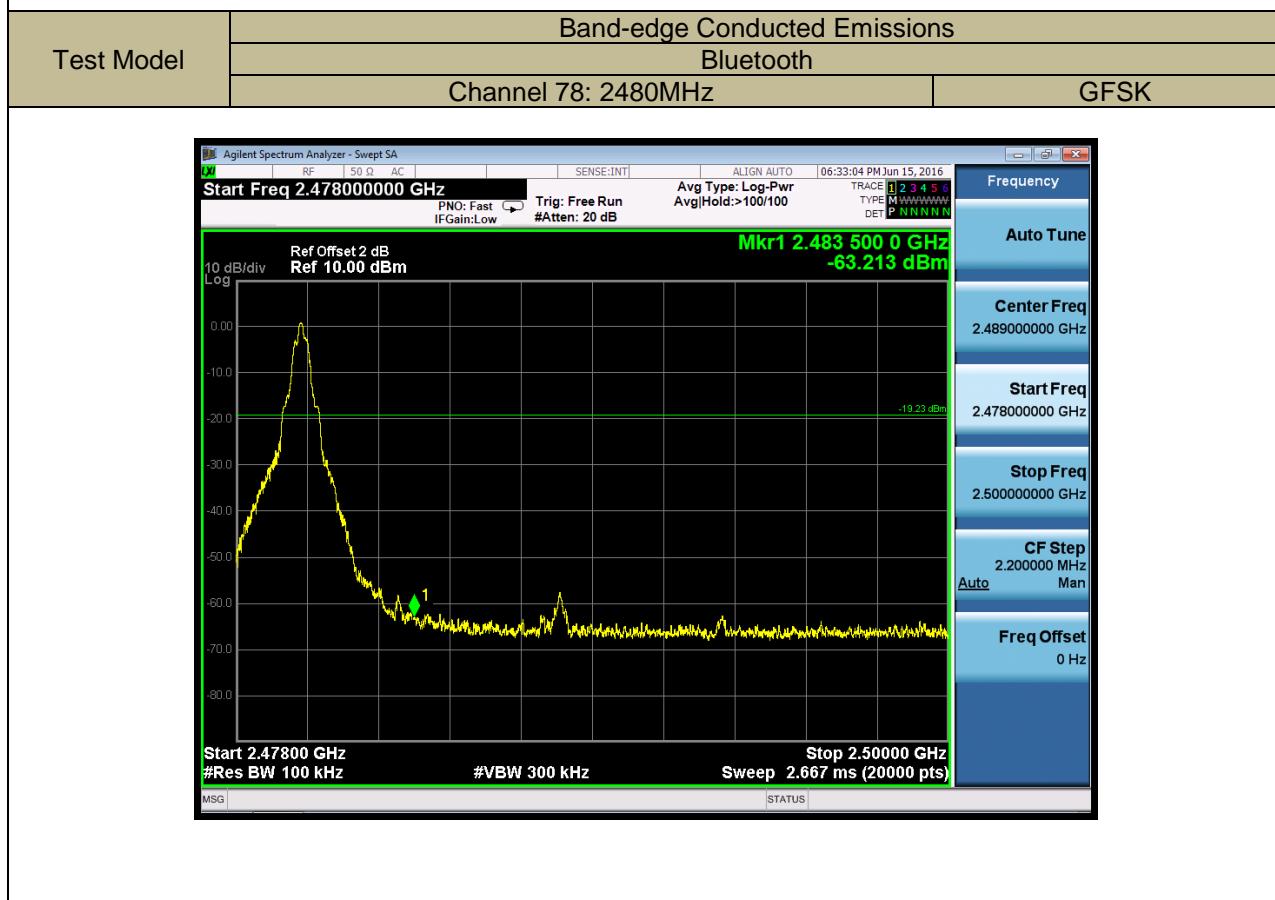
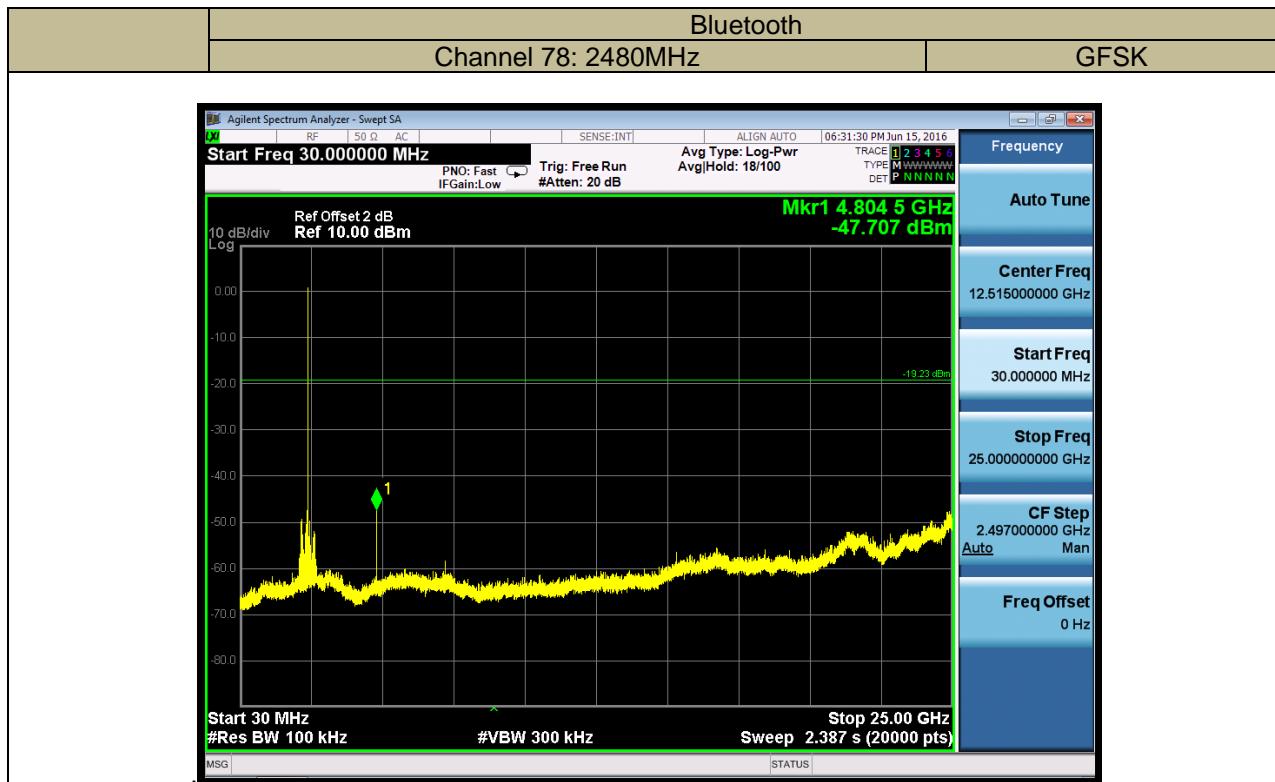
9.6.5 Test Results

Bluetooth (GFSK, pi/4-DQPSK, 8DPSK) mode have been tested, and the worst result(GFSK) was report as below:



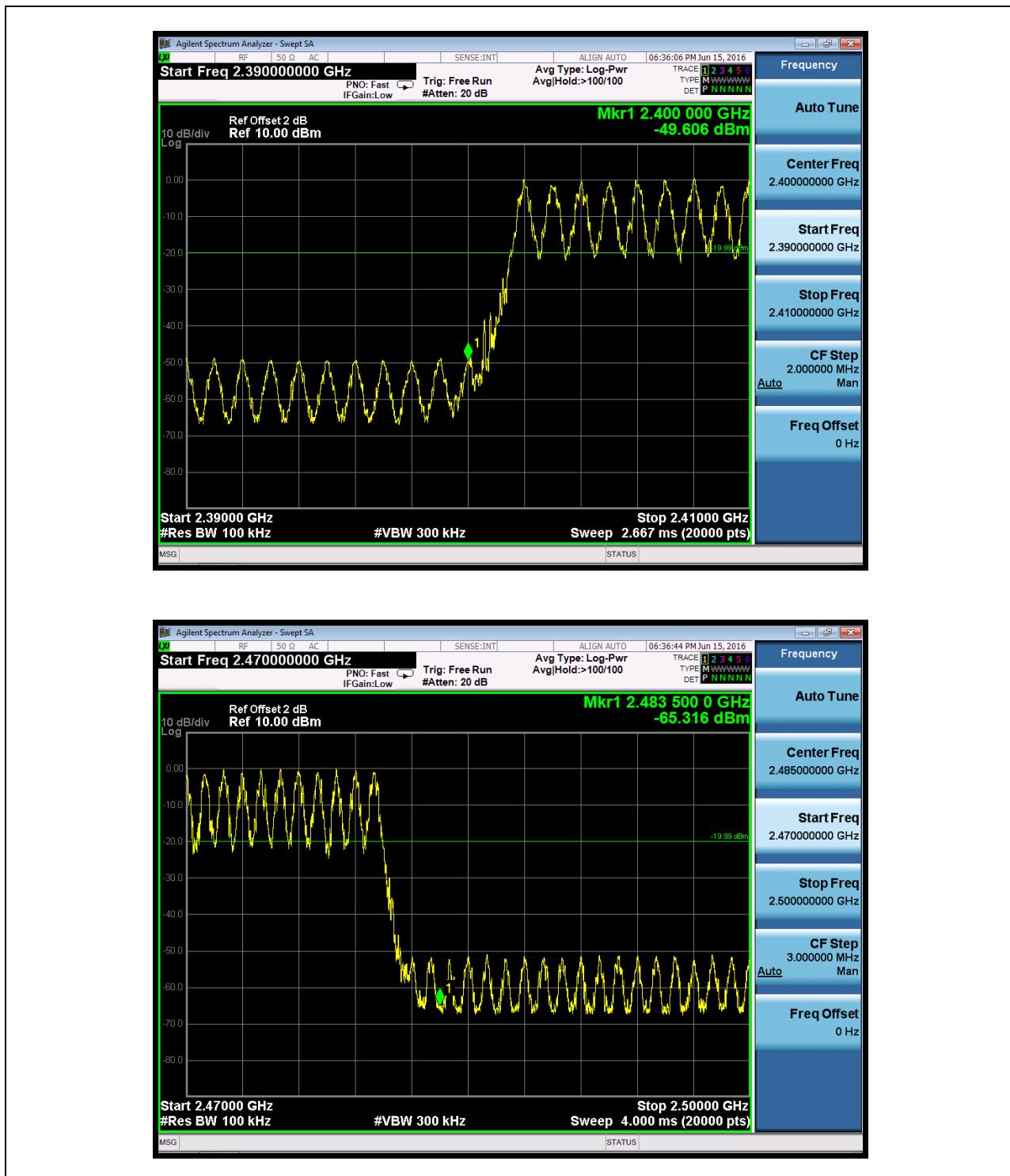
Test Model	Band-edge Conducted Emissions		
	Bluetooth		GFSK
	Channel 0: 2402MHz		
	Maximum Conducted Level RBW=100kHz		
Test Model	Bluetooth		GFSK
	Channel 39: 2441MHz		

Test Model	Conducted Spurious RF Conducted Emission		
	Bluetooth		GFSK
	Channel 39: 2441MHz		
 <p>Agilent Spectrum Analyzer - Swept SA</p> <p>Start Freq 30.000000 MHz</p> <p>Ref Offset 2 dB Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Mkr1 4.804 5 GHz -47.707 dBm</p> <p>Start 30 MHz #Res BW 100 kHz #VBW 300 kHz Stop 25.00 GHz Sweep 2.387 s (20000 pts)</p> <p>MSG STATUS</p> <p>Frequency</p> <p>Auto Tune</p> <p>Center Freq 12.515000000 GHz</p> <p>Start Freq 30.000000 MHz</p> <p>Stop Freq 25.000000000 GHz</p> <p>CF Step 2.497000000 GHz Auto Man</p> <p>Freq Offset 0 Hz</p>			
<p>Maximum Conducted Level RBW=100kHz</p> <p>Bluetooth</p> <p>Channel 78: 2480MHz</p>			GFSK
 <p>Agilent Spectrum Analyzer - Swept SA</p> <p>Center Freq 2.480000000 GHz</p> <p>Ref Offset 2 dB Ref 10.00 dBm</p> <p>10 dB/div Log</p> <p>Mkr1 2.480 000 GHz 0.771 dBm</p> <p>Center 2.480000 GHz #Res BW 100 kHz #VBW 300 kHz Span 7.000 MHz Sweep 1.000 ms (1001 pts)</p> <p>MSG STATUS</p> <p>Frequency</p> <p>Auto Tune</p> <p>Center Freq 2.480000000 GHz</p> <p>Start Freq 2.476500000 GHz</p> <p>Stop Freq 2.483500000 GHz</p> <p>CF Step 700.000 kHz Auto Man</p> <p>Freq Offset 0 Hz</p>			
Test Model	Conducted Spurious RF Conducted Emission		



Test Model	Maximum Conducted Level RBW=100kHz
------------	------------------------------------

	Bluetooth Hopping Mode	GFSK
Test Model	Conducted Spurious RF Conducted Emission Bluetooth	GFSK
	Hopping Mode	GFSK
	<p>Start Freq 2.400000000 GHz PNO: Fast Trig: Free Run Avg Type: Log-Pwr IFGain:Low #Atten: 20 dB Avg Hold:>100/100 TRACE 1 2 3 4 5 6 Ref Offset 2 dB Ref 10.00 dBm Mkr1 2.471 016 GHz 1.009 dBm 10 dB/div Log Start 2.40000 GHz #Res BW 100 kHz #VBW 300 kHz Stop 2.48350 GHz Sweep 8.000 ms (20000 pts)</p>	
	<p>Start Freq 30.000000 MHz PNO: Fast Trig: Free Run Avg Type: Log-Pwr IFGain:Low #Atten: 20 dB Avg Hold: 10/100 TRACE 1 2 3 4 5 6 Ref Offset 2 dB Ref 10.00 dBm Mkr1 4.954 3 GHz -47.123 dBm 10 dB/div Log Start 30 MHz #Res BW 100 kHz #VBW 300 kHz Stop 25.00 GHz Sweep 2.387 s (20000 pts)</p>	
	Band-edge Conducted Emissions Bluetooth	GFSK
	Hopping Mode	GFSK



9.7 RADIATED SPURIOUS EMISSION

9.7.1 Applicable Standard

According to FCC Part 15.247(d) and 15.209 and DA 00-705

9.7.2 Conformance Limit

According to FCC Part 15.247(d): radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
According to FCC Part 15.205, Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

According to FCC Part 15.205, the level of any transmitter spurious emission in Restricted bands shall not exceed the level of the emission specified in the following table

Restricted Frequency(MHz)	Field Strength (μ V/m)	Field Strength ($dB\mu$ V/m)	Measurement Distance
0.009-0.490	2400/F(KHz)	20 log (μ V/m)	300
0.490-1.705	2400/F(KHz)	20 log (μ V/m)	30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

9.7.3 Test Configuration

Test according to clause 7.2 radio frequency test setup 2

9.7.4 Test Procedure

This test is required for any spurious emission that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz(1GHz to 25GHz), 100 kHz for $f < 1$ GHz(30MHz to 1GHz)

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.10-2013 respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data. Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. 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. Submit this data.

Repeat above procedures until all frequency measured was complete.

9.7.5 Test Results

■ Spurious Emission below 30MHz (9KHz to 30MHz)

Temperature:	24°C	Test Date:	N/A
Humidity:	53 %	Test By:	N/A
Test mode:	TX Mode		

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
--	--	--	--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor = $40\log(\text{Specific distance/ test distance})(\text{ dB})$;
Limit line=Specific limits(dBuV) + distance extrapolation factor

■ Spurious Emission 30MHz – 1000MHz

Temperature:	24°C	Test Date:	June 20, 2016
Humidity:	53 %	Test By:	KK

Bluetooth (GFSK, pi/4-DQPSK, 8DPSK) mode have been tested, and the worst results GFSK mode has been recorded, the test plots, see the page Page 46.

The worst point as below:

Frequency (MHz)	Polarity H/V	QP(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)
299.66	H	39.91	46	6.09

■ Spurious Emission Above 1GHz (1GHz to 25GHz)

Bluetooth (GFSK, pi/4-DQPSK, 8DPSK) mode have been tested, and the worst result(GFSK) was report as below:

Temperature:	24°C	Test Date:	June 20, 2016
Humidity:	53 %	Test By:	KK
Test mode:	GFSK	Frequency:	Channel 0: 2402MHz

Freq. (MHz)	Ant.Po. l. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
5046.000	V	43.28	28.50	74	54	-30.72	-25.50
6491.00	V	47.32	31.40	74	54	-26.68	-22.60
7256.00	V	47.46	31.20	74	54	-26.54	-22.80
8497.000	H	45.98	30.60	74	54	-28.02	-23.40
9925.000	H	48.33	33.50	74	54	-25.67	-20.50
11710.00	H	49.98	31.20	74	54	-24.02	-22.80

Temperature:	24°C	Test Date:	June 20, 2016
Humidity:	53 %	Test By:	KK
Test mode:	GFSK	Frequency:	Channel 39: 2441MHz

Freq. (MHz)	Ant.Po. l. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
5070.61	V	43.66	28.28	74	54	-30.34	-25.72
6493.64	V	46.88	31.03	74	54	-27.12	-22.97
7287.82	V	47.36	31.04	74	54	-26.64	-22.96
8540.81	H	46.08	30.86	74	54	-27.92	-23.14
9944.19	H	48.67	33.11	74	54	-25.33	-20.89
11722.99	H	50.13	30.88	74	54	-23.87	-23.12

Temperature:	24°C	Test Date:	June 20, 2016
Humidity:	53 %	Test By:	KK
Test mode:	GFSK	Frequency:	Channel 78: 2480MHz

Freq. (MHz)	Ant.Po. l. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
5051.78	V	43.62	28.89	74	54	-30.38	-25.11
6531.06	V	47.39	31.38	74	54	-26.61	-22.62
7295.39	V	47.90	31.58	74	54	-26.10	-22.42
8506.37	H	46.48	30.51	74	54	-27.52	-23.49
9971.13	H	48.24	33.62	74	54	-25.76	-20.38
11725.57	H	50.01	30.77	74	54	-23.99	-23.23

Note: (1) All Readings are Peak Value (VBW=3MHz) and Peak Value (VBW=10Hz).

(2) Emission Level= Reading Level+Probe Factor +Cable Loss.

(3) Data of measurement within this frequency range shown “ -- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

■ Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

Bluetooth (GFSK, pi/4-DQPSK, 8DPSK, Hopping) mode have been tested, and the worst result(GFSK, Hopping) was report as below:

Temperature:	24°C	Test Date:	June 20, 2016
Humidity:	53 %	Test By:	KK
Test mode:	GFSK	Frequency:	Channel 0: 2402MHz

Frequency (MHz)	Polarity H/V	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)	AV(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)
2385.6	H	39.99	74	-34.01	21.70	54	-32.3
2361.68	V	42.48	74	-31.52	26.70	54	-27.3

Temperature:	24°C	Test Date:	June 20, 2016
Humidity:	53 %	Test By:	KK
Test mode:	GFSK	Frequency:	Channel 78: 2480MHz

Frequency (MHz)	Polarity H/V	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)	AV(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)
2483.632	H	42.36	74	-31.64	26.10	54	-27.9
2485.563	V	50.74	74	-23.26	35.40	54	-18.6

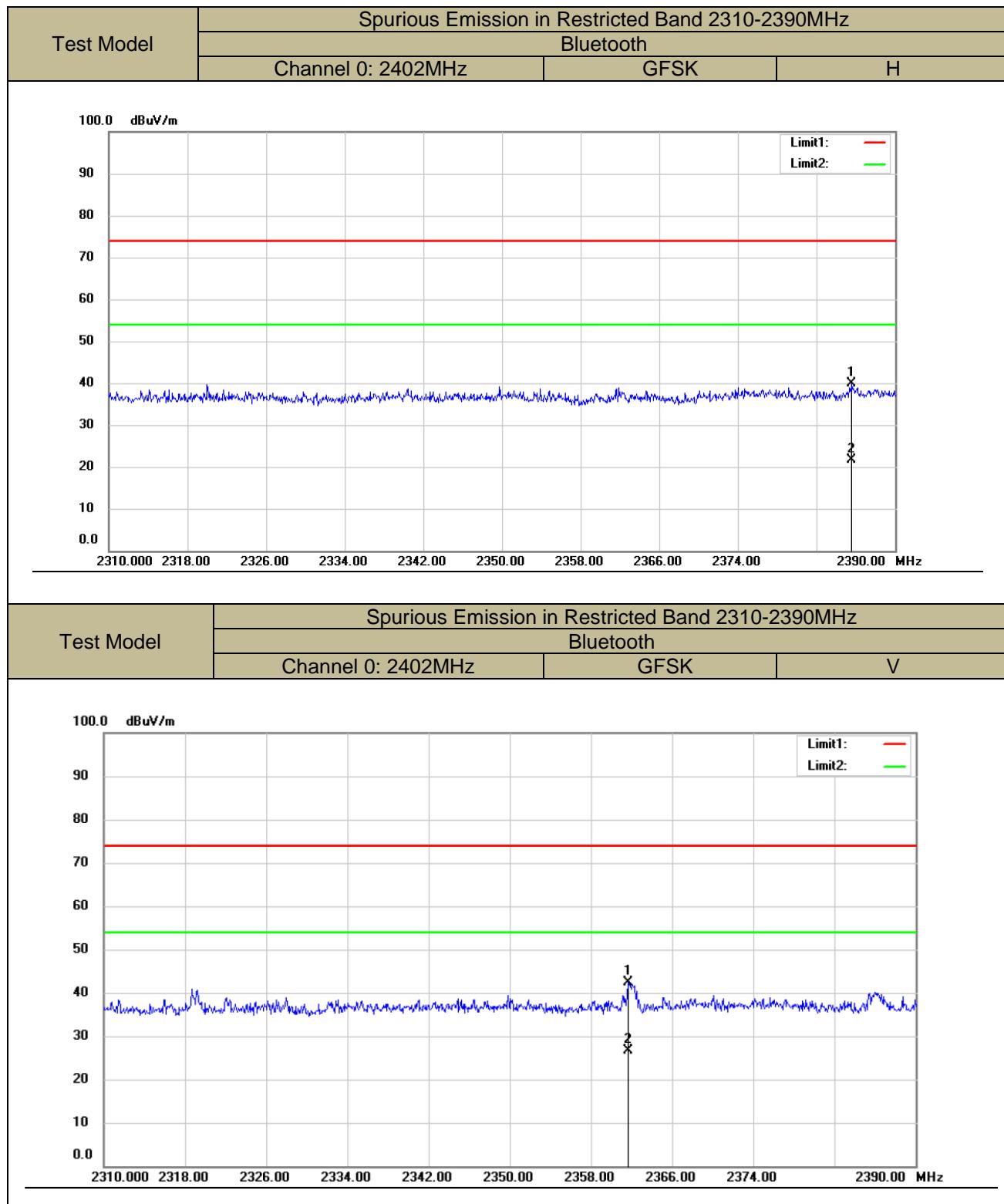
Temperature:	24°C	Test Date:	June 20, 2016
Humidity:	53 %	Test By:	KK
Test mode:	GFSK	Frequency:	Hopping

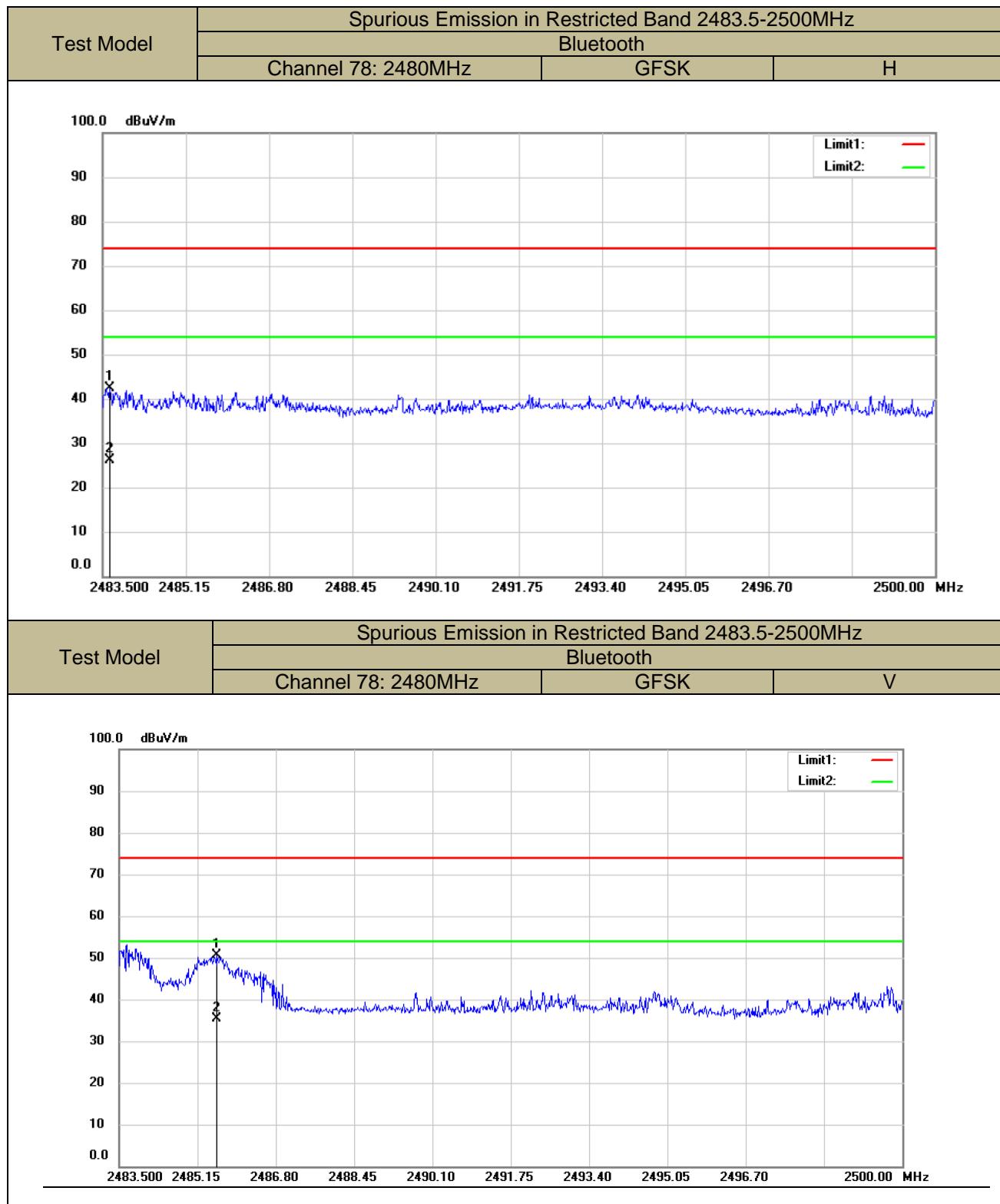
Frequency (MHz)	Polarity H/V	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)	AV(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)
2394.360	H	49.51	74	-24.49	31.20	54	-22.80
2362.250	V	44.33	74	-29.67	29.60	54	-24.40
2400.000	H	58.61	74	-15.39	40.10	54	-13.90
2400.000	V	60.16	74	-13.84	42.30	54	-11.70

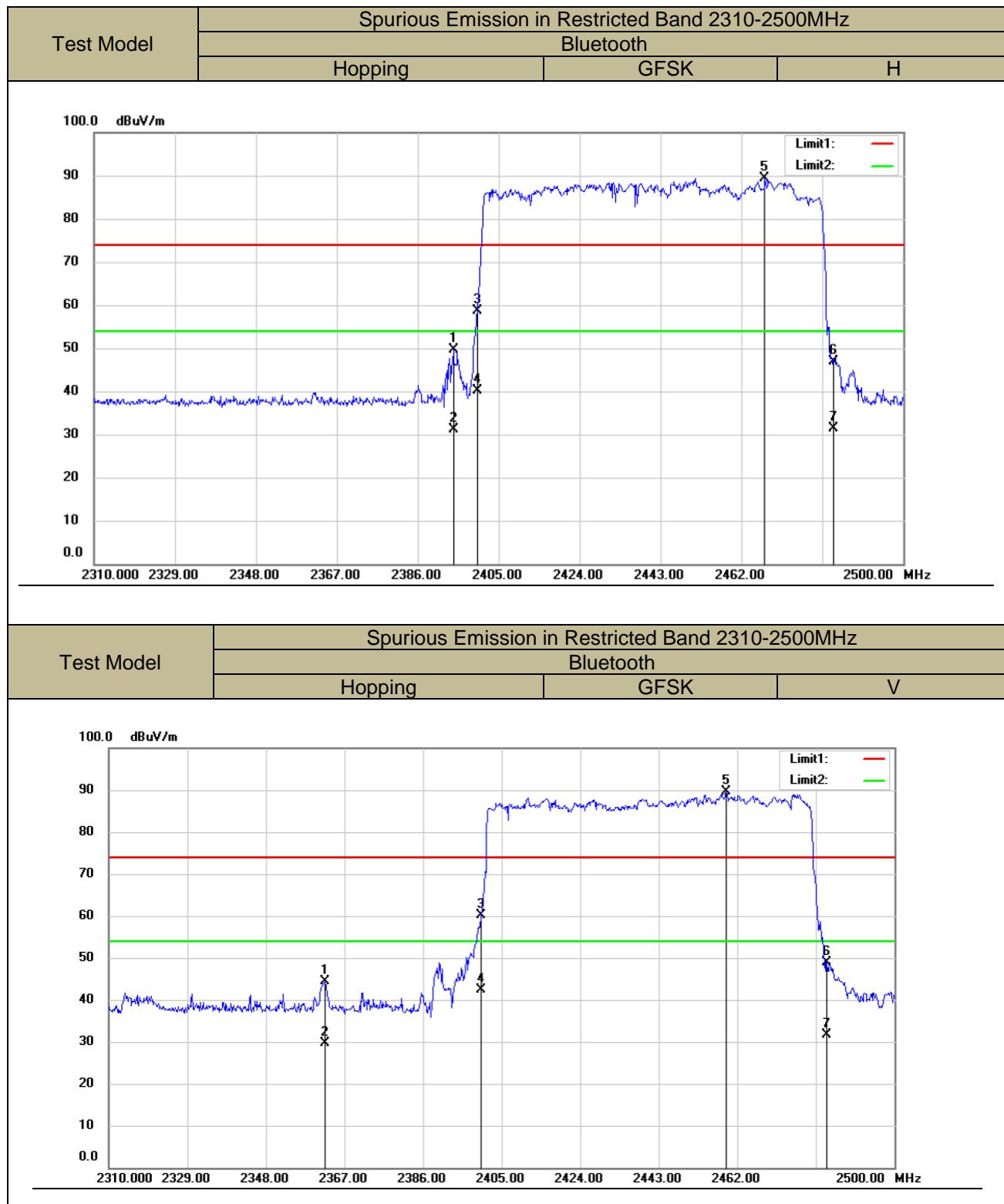
Note: (1) All Readings are Peak Value (VBW=3MHz) and Peak Value (VBW=10Hz).

(2) Emission Level= Reading Level+Probe Factor +Cable Loss.

(3) Data of measurement within this frequency range shown “ -- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

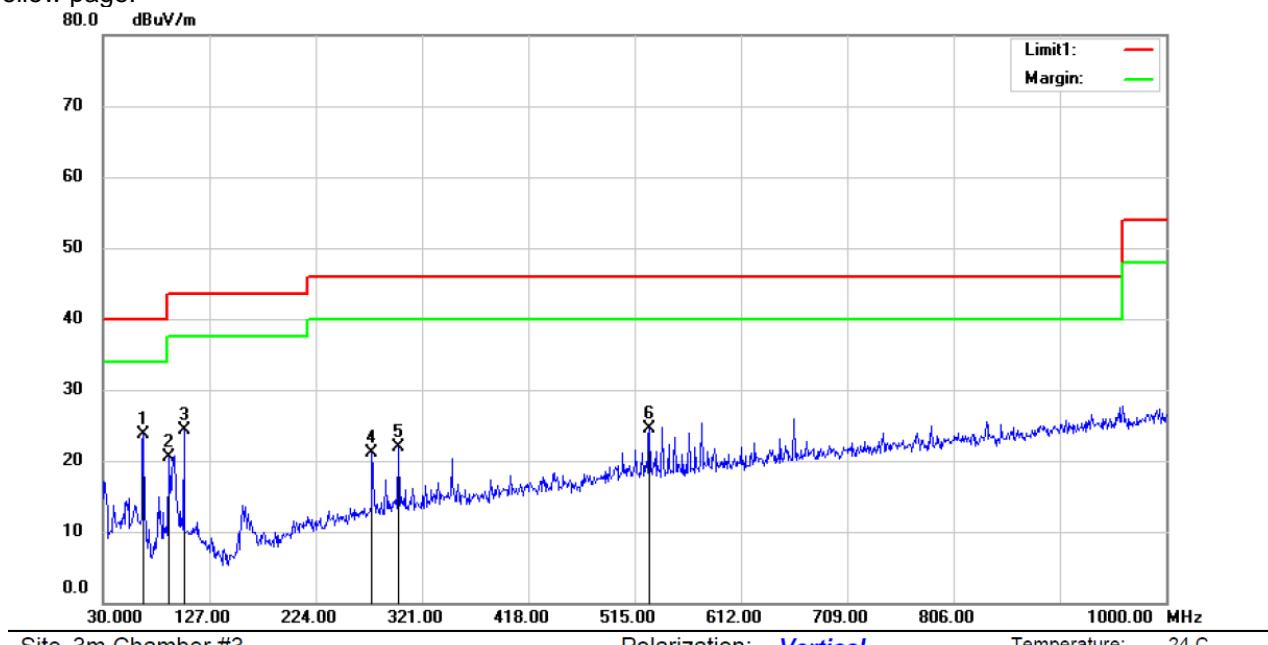






■ Spurious Emission below 1GHz (30MHz to 1GHz)

Bluetooth (GFSK, pi/4-DQPSK, 8DPSK) mode have been tested, and the worst results has been recorded on the follow page.



Site 3m Chamber #3

Polarization: **Vertical**

Temperature: 24 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 53 %

M/N: 2402

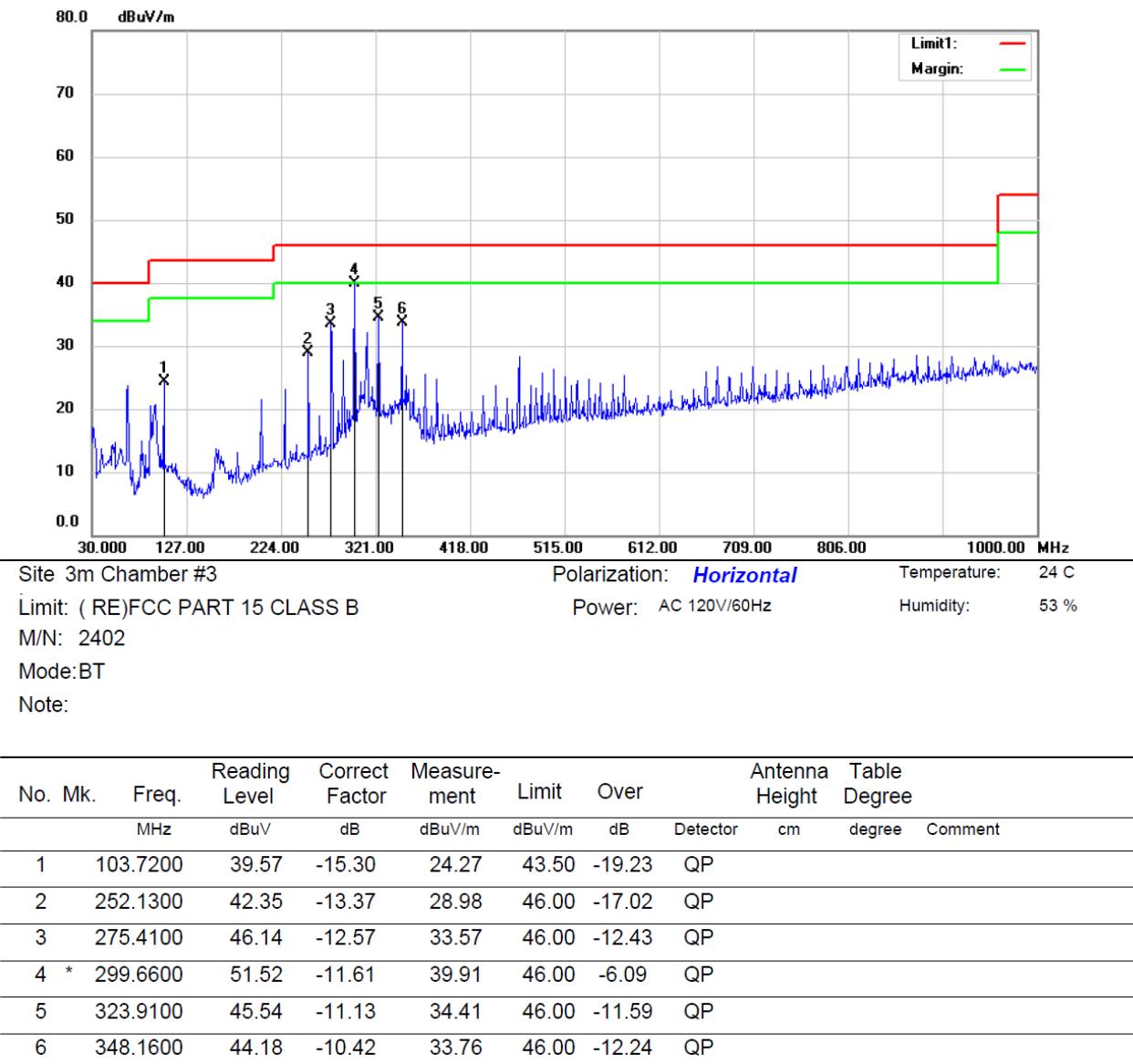
Mode:BT

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	66.8600	40.66	-17.01	23.65	40.00	-16.35	QP			
2		90.1400	38.20	-17.79	20.41	43.50	-23.09	QP			
3		103.7200	39.57	-15.30	24.27	43.50	-19.23	QP			
4		275.4100	33.63	-12.57	21.06	46.00	-24.94	QP			
5		299.6600	33.55	-11.61	21.94	46.00	-24.06	QP			
6		528.5800	31.49	-7.00	24.49	46.00	-21.51	QP			

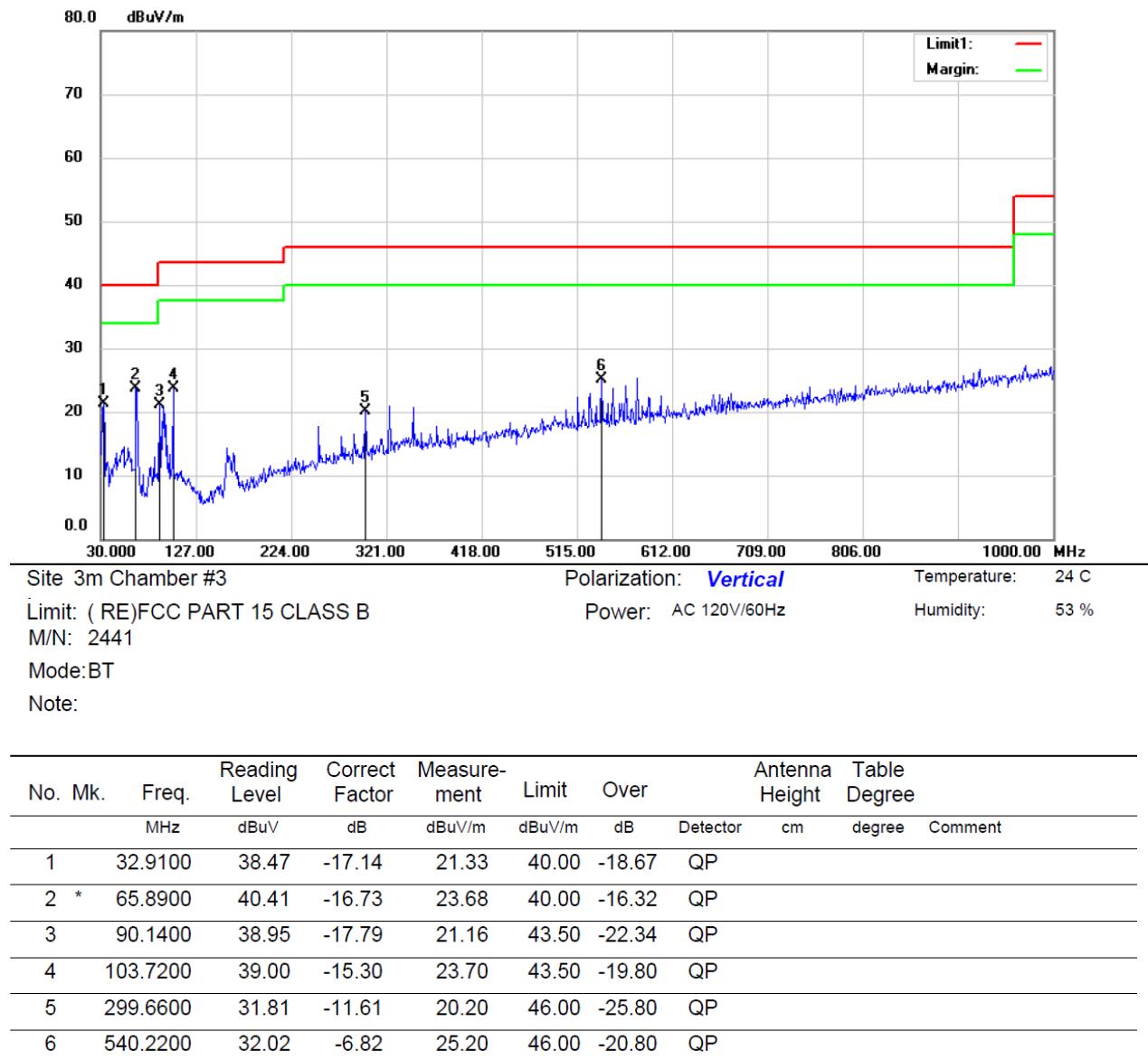
*:Maximum data x:Over limit !:over margin

Operator: CSL



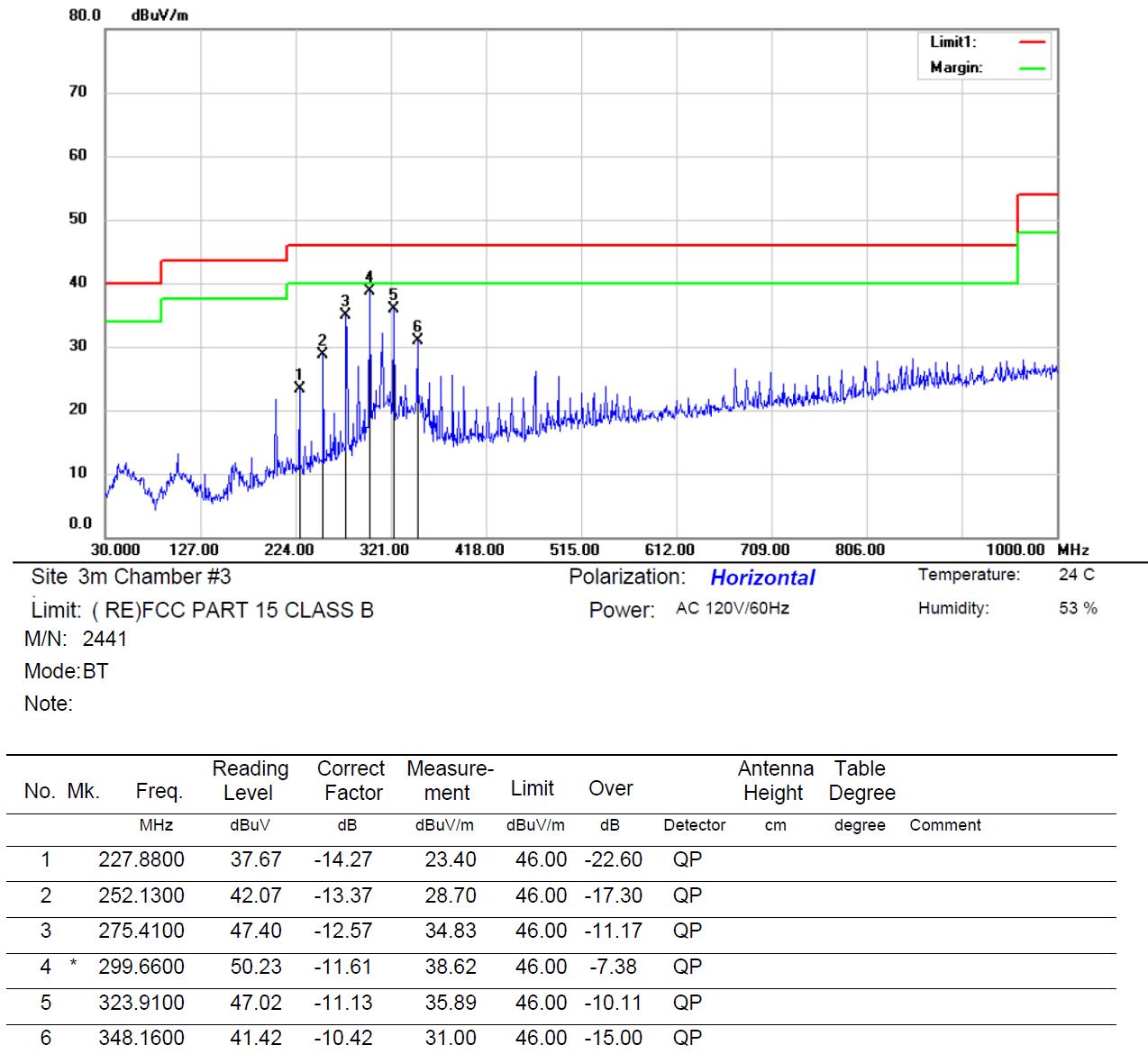
*:Maximum data x:Over limit !:over margin

Operator: CSL



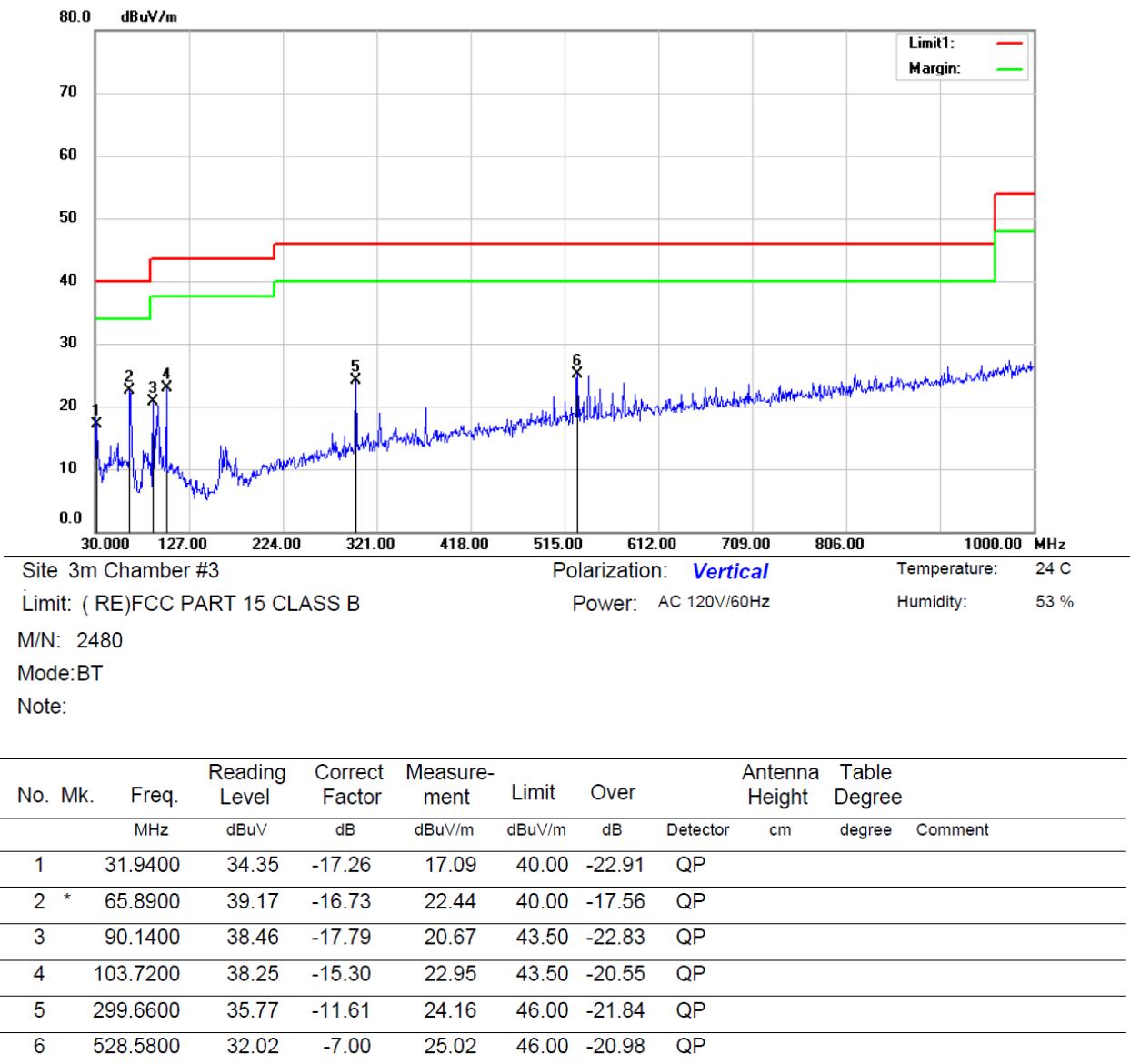
*:Maximum data x:Over limit !:over margin

Operator: CSL



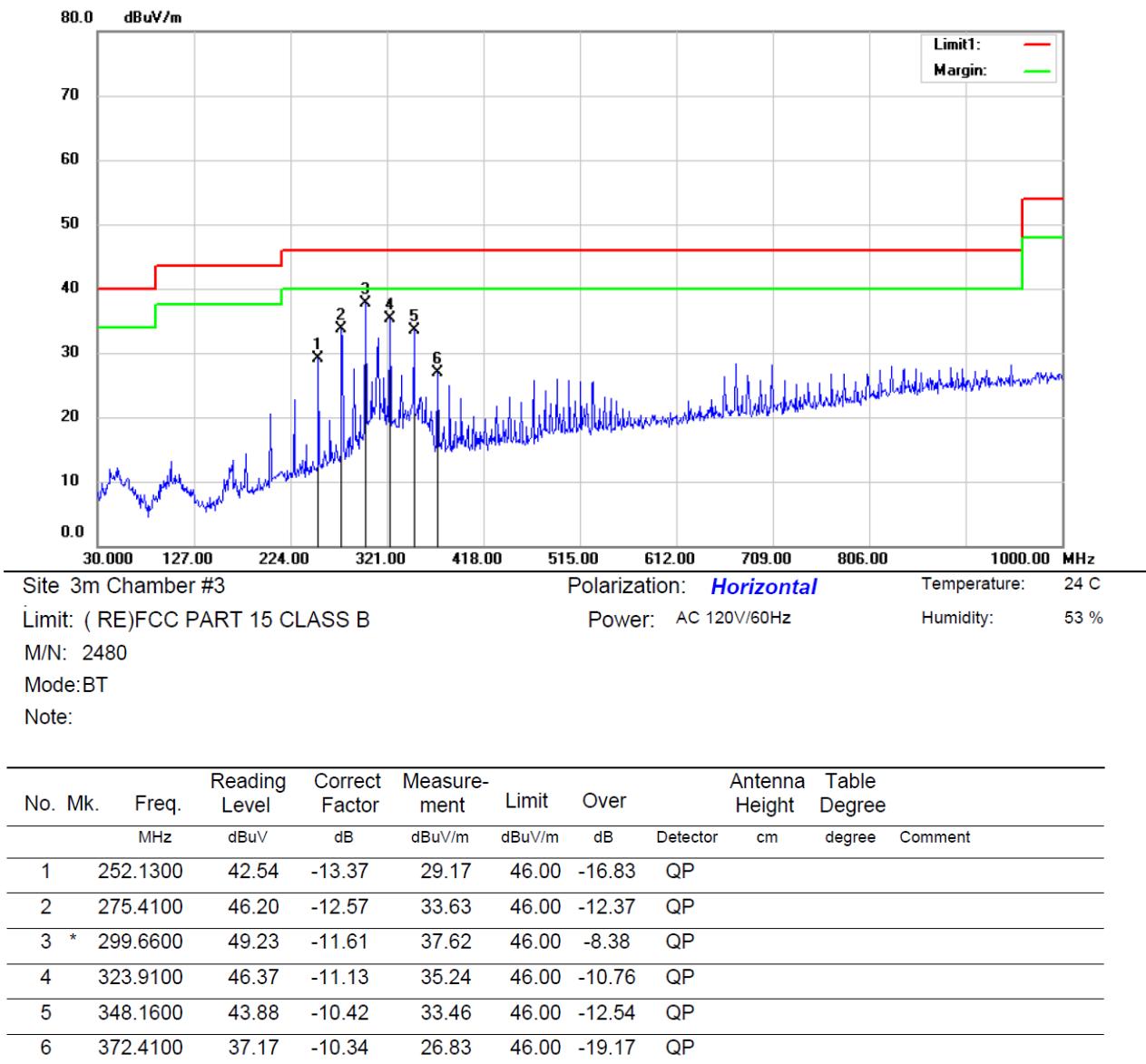
*:Maximum data x:Over limit !:over margin

Operator: CSL



*:Maximum data x:Over limit !:over margin

Operator: CSL



*:Maximum data x:Over limit !:over margin

Operator: CSL

9.8 CONDUCTED EMISSION TEST

9.8.1 Applicable Standard

According to FCC Part 15.207(a)

9.8.2 Conformance Limit

Frequency(MHz)	Conducted Emission Limit	
	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

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

9.8.3 Test Configuration

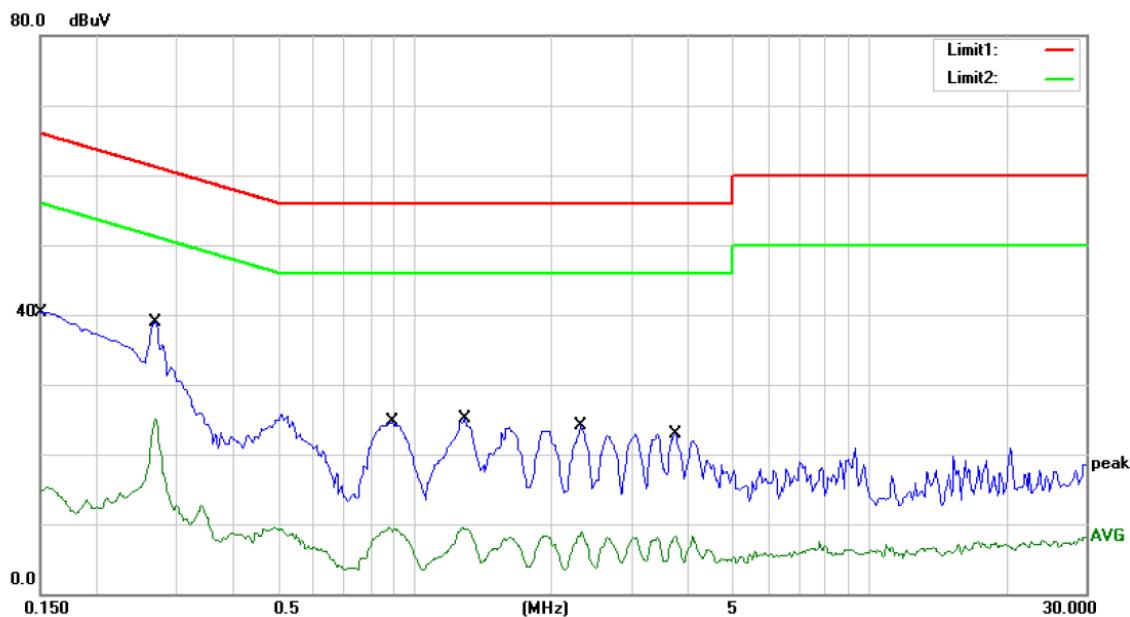
Test according to clause 7.3 conducted emission test setup

9.8.4 Test Procedure

The EUT was placed on a table which is 0.8m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Repeat above procedures until all frequency measured were complete.

9.8.5 Test Results

Note: We measured Conducted Emission at GFSK, $\pi/4$ DQPSK and 8DPSK mode with the voltage 120V&240V and the worst results for GFSK Low channel with 120V/60Hz has been recorded on the follow page.



Site Conduction #1

Phase: **N**

Temperature: 26

Limit: (CE)FCC PART 15 class B_QP

Power: AC 120V//60Hz

Humidity: 60 %

Mode: TX

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Detector	Comment
			Level	Factor	ment				
1		0.1500	40.27	0.00	40.27	66.00	-25.73	QP	
2		0.1500	15.27	0.00	15.27	56.00	-40.73	AVG	
3 *		0.2700	38.97	0.00	38.97	61.12	-22.15	QP	
4		0.2700	25.02	0.00	25.02	51.12	-26.10	AVG	
5		0.8950	24.68	0.00	24.68	56.00	-31.32	QP	
6		0.8950	9.56	0.00	9.56	46.00	-36.44	AVG	
7		1.2900	25.15	0.00	25.15	56.00	-30.85	QP	
8		1.2900	9.50	0.00	9.50	46.00	-36.50	AVG	
9		2.3100	24.14	0.00	24.14	56.00	-31.86	QP	
10		2.3100	8.83	0.00	8.83	46.00	-37.17	AVG	
11		3.7500	22.95	0.00	22.95	56.00	-33.05	QP	
12		3.7500	8.34	0.00	8.34	46.00	-37.66	AVG	

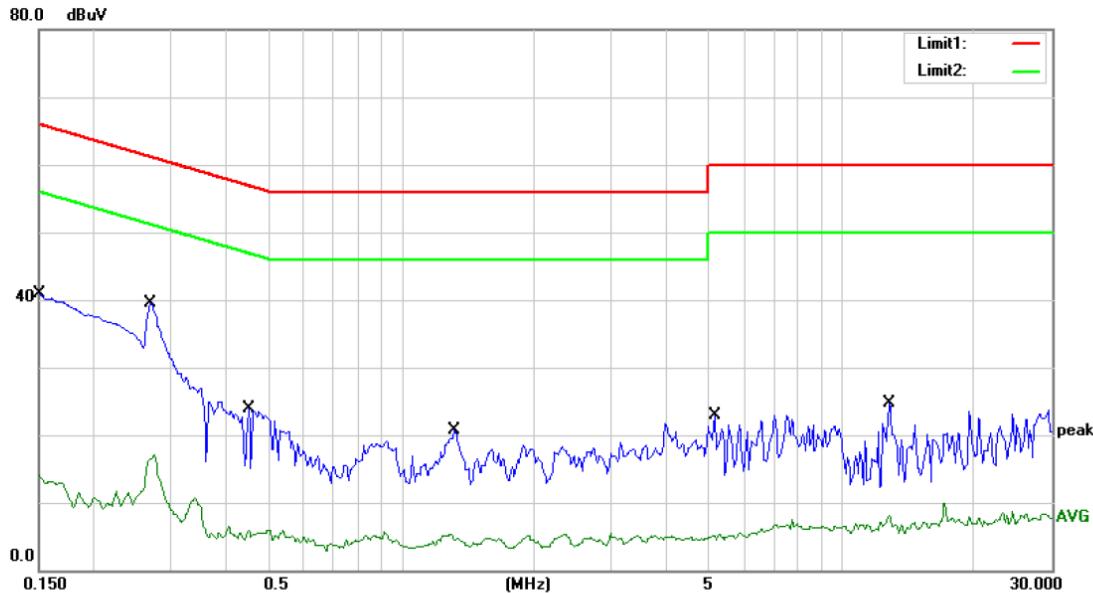
*:Maximum data

x:Over limit

!:over margin

Comment: Factor build in receiver.

Operator: Vern



Site Conduction #1

Phase: **L1**

Temperature: 26

Limit: (CE)FCC PART 15 class B_QP

Power: AC 120V/60Hz

Humidity: 60 %

Mode: TX

Note:

No.	Mk.	Freq. MHz	Reading Level	Correct Factor	Measure- ment	Limit dBuV	Over dB	Detector	Comment
			dBuV	dB	dBuV				
1		0.1500	40.95	0.00	40.95	66.00	-25.05	QP	
2		0.1500	14.20	0.00	14.20	56.00	-41.80	AVG	
3	*	0.2700	39.49	0.00	39.49	61.12	-21.63	QP	
4		0.2700	17.10	0.00	17.10	51.12	-34.02	AVG	
5		0.4500	23.96	0.00	23.96	56.88	-32.92	QP	
6		0.4500	6.00	0.00	6.00	46.88	-40.88	AVG	
7		1.3200	20.70	0.00	20.70	56.00	-35.30	QP	
8		1.3200	5.27	0.00	5.27	46.00	-40.73	AVG	
9		5.1400	22.98	0.00	22.98	60.00	-37.02	QP	
10		5.1400	5.37	0.00	5.37	50.00	-44.63	AVG	
11		12.8250	24.68	0.00	24.68	60.00	-35.32	QP	
12		12.8250	8.19	0.00	8.19	50.00	-41.81	AVG	

*:Maximum data

x:Over limit

!:over margin

Comment: Factor build in receiver.

Operator: Vern

9.9 ANTENNA APPLICATION

9.9.1 Antenna Requirement

Standard	Requirement
FCC CRF Part 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 use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 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. And according to FCC 47 CFR Section 15.247 (b), if 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 6dBi.

The EUT'S antenna is PCB Antenna. The antenna's gain is 1.9dBi, and the antenna can't be replaced by the user which in accordance to section 15.203, please refer to the photos.

9.9.2 Result

PASS.