FCC TEST REPORT

FOR

Shenzhen Unitone Electronics Co., Ltd

Smart phone

Test Model: SMART-5L

List Model No.: P53

Prepared for	:	Shenzhen Unitone Electronics Co., Ltd
Address	:	13-14 Floor, Pengji Bussiness Mansion, No.50, Bagua 1 Road, Futian District, Shenzhen, China

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Tel	:	(+86)755-82591330
Fax	:	(+86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com

Date of receipt of test sample	:	Jan 10, 2017
Number of tested samples	:	1
Serial number	:	20170104010
Date of Test	:	Jan 10, 2017~Feb 13, 2017
Date of Report	:	Feb 13, 2017

FCC TEST REPORT

FCC CFR 47 PART 15 C(15.247)

Report Reference No.	**:**	**LCS1701101117E**
Date of Issue	:	Feb 13, 2017
Testing Laboratory Name ..... :		**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure	:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name..... :		**Shenzhen Unitone Electronics Co., Ltd**
Address	:	13-14 Floor, Pengji Bussiness Mansion, No.50, Bagua 1 Road, Futian District, Shenzhen, China
Test Specification		
Standard	:	FCC CFR 47 PART 15 C(15.247) / ANSI C63.10: 2013
Test Report Form No.	:	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF	:	Dated 2011-03

Test Item Description. ..... :		**Smart phone**
Trade Mark.....	:	UNITONE, WHOOP
Test Model	:	SMART-5L
Ratings	:	DC 3.8V by Li-ion Battery(2000mAh) Recharge Voltage: DC 5V/1A
Result ..... :		**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Calvin Weng/ Administrators	Glin Lu/ Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : LCS1701101117E	Feb 13, 2017 Date of issue

Test Model.....	: SMART-5L
EUT.....	: Smart phone
Applicant.....	**: Shenzhen Unitone Electronics Co., Ltd**
Address.....	: 13-14 Floor, Pengji Bussiness Mansion, No.50, Bagua 1 Road, Futian District, Shenzhen, China
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: Shenzhen Unitone Electronics Co., Ltd**
Address.....	: 13-14 Floor, Pengji Bussiness Mansion, No.50, Bagua 1 Road, Futian District, Shenzhen, China
Telephone.....	: /
Fax.....	: /
Factory.....	: **Shenzhen Unitone Electronics Co., Ltd**
Address.....	: 13-14 Floor, Pengji Bussiness Mansion, No.50, Bagua 1 Road, Futian District, Shenzhen, China
Telephone.....	: /
Fax.....	: /

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Revision	Issue Date	Revisions	Revised By
00	Feb 13, 2017	Initial Issue	Gavin Liang

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1 Description of Device (EUT)

The **Shenzhen Unitone Electronics Co., Ltd**'s Model: SMART-5L or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

Name of EUT	Smart phone
Model Number	SMART-5L
Modulation Type	GMSK for GSM/GPRS, 8-PSK for EDGE,QPSK for UMTS, QPSK, 16QAM for LTE
Antenna Type	PIFA Antenna
Antenna Gain	0.5dBi (max.) For GSM 850; 0.4dBi (max.) For GSM 900; 0.8dBi (max.) For DCS 1800; 0.8dBi (max.) For PCS 1900; 0.8dBi (max.) For WCDMA Band II 0.5dBi (max.) For WCDMA Band V 0.8dBi (max.) For LTE FDD Band 2; 0.8dBi (max.) For LTE FDD Band 4; 0.3dBi (max.) For LTE FDD Band 12; 0.3dBi (max.) For LTE FDD Band 17; -1.5dBi (max.) For BT and WLAN
UMTS Operation Frequency Band	Device supported UMTS FDD Band II/V
WLAN FCC Operation frequency	IEEE 802.11a: 5180-5240MHz/5745-5825MHz IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz/5180-5240MHz/5745-5825MHz IEEE 802.11n HT40:2422-2452MHz/5190-5210MHz/5755-5795MHz
BT FCC Operation frequency	2402MHz-2480MHz
HSDPA Release Version	Release 6
HSUPA Release Version	Release 6
DC-HSUPA Release Version	Not Supported
WCDMA Release Version	R99
LTE Release Version	R9
UMTS Operation Frequency Band	Device supported FDD band 2, FDD band 4, FDD band 12, FDD band 17
WLAN FCC Modulation Type	IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)
BT Modulation Type	GFSK,8DPSK,π/4DQPSK(BT V4.0)
Hardware version	YK606-MB-V6.
Software version	SMART-5L_V01
Android version	Android 6.0
GPS function	Support and only RX
NFC Function	Not Support
WLAN	Supported 802.11a/b/g/n20/n40
Bluetooth	Supported BT V4.0
GSM/EDGE/GPRS	Supported GSM/GPRS/EDGE
GSM/EDGE/GPRS Power Class	GSM850:Power Class 4/ PCS1900:Power Class 1
LTE/UMTS Power Class	Level 3
GSM/EDGE/GPRS Operation Frequency	GSM850 :824.2MHz-848.8MHz/PCS1900:1850.2MHz-1909.8MHz

GSM/EDGE/GPRS Operation Frequency Band	GSM850/PCS1900/GPRS850/GPRS1900/EDGE850/EDGE1900
GSM Release Version	R99
GPRS/EDGE Multislot Class	GPRS/EDGE: Multi-slot Class 12
Extreme temp. Tolerance	-30°C to +50°C
Extreme vol. Limits	3.40VDC to 4.20VDC (nominal: 3.80VDC)
GPRS operation mode	Class B

1.2 Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
Shenzhen HuaJin Electronics Co., Ltd	Power Adapter	HJ-0501000B2-US	---	FCC VoC

1.3 External I/O

I/O Port Description	Quantity	Cable
Earphone Port	1	1.2m
USB Port	1	1.5m unshielded cable

1.4 Description of Test Facility

CNAS Registration Number. is L4595.

FCC Registration Number. is 899208.

Industry Canada Registration Number. is 9642A-1.

ESMD Registration Number. is ARCB0108.

UL Registration Number. is 100571-492.

TUV SUD Registration Number. is SCN1081.

TUV RH Registration Number. is UA 50296516-001

There is one 3m semi-anechoic chamber and one line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.10: 2013, CISPR 22/EN 55022 and CISPR16-1-4 SVSWR requirements.

1.5 Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1. 6 List of Measuring Equipment

Instrument	Manufacture	Model No.	Serial No.	Characteristic	Cal Date	Due Date
EMC Receiver	R&S	ESCS 30	100174	9kHz –	Jun 18, 2016	Jun 17, 2017
Signal analyzer	Agilent	E4448A(External mixers to 40GHz)	US44300469	9kHz~40GHz	Jul 16, 2016	Jul 15, 2017
LISN	MESS Tec	NNB-2/16Z	99079	9KHz-30MHz	Jun 18, 2016	Jun 17, 2017
LISN	EMCO	3819/2NM	9703-1839	9KHz-30MHz	Jun 18, 2016	Jun 17, 2017
RF Cable-CON	UTIFLEX	3102-26886-4	CB049	9KHz-30MHz	Jun 18, 2016	Jun 17, 2017
ISN	SCHAFFNE	ISN ST08	21653	9KHz-30MHz	Jun 18, 2016	Jun 17, 2017
3m Semi Anechoic Chamber	SIDT FRANKONI	SAC-3M	03CH03-HY	30M-18GHz	Jun 18, 2016	Jun 17, 2017
Amplifier	SCHAFFNE	COA9231A	18667	9kHz-2GHzz	Apr 18, 2016	Apr 17, 2017
Amplifier	Agilent	8449B	3008A021	1GHz-26.5GH	Apr 18, 2016	Apr 17, 2017
Amplifier	MITEQ	AMF-6F-260400	9121372	26.5GHz-40G	Apr 18, 2016	Apr 17, 2017
Loop Antenna	R&S	HFH2-Z2	860004/00	9k-30MHz	Apr 18, 2016	Apr 17, 2017
By-log Antenna	SCHWARZB	VULB9163	9163-470	30MHz-1GHz	Apr 18, 2016	Apr 17, 2017
Horn Antenna	EMCO	3115	6741	1GHz-18GHz	Apr 18, 2016	Apr 17, 2017
Horn Antenna	SCHWARZB	BBHA9170	BBHA9170	15GHz-40GH	Apr 18, 2016	Apr 17, 2017
RF Cable-R03m	Jye Bao	RG142	CB021	30MHz-1GHz	Jun 18, 2016	Jun 17, 2017
RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-H	1GHz-40GHz	Jun 18, 2016	Jun 17, 2017
Power Meter	R&S	NRVS	100444	DC-40GHz	Jun 18, 2016	Jun 17, 2017
Power Sensor	R&S	NRV-Z51	100458	DC-30GHz	Jun 18, 2016	Jun 17, 2017
Power Sensor	R&S	NRV-Z32	10057	30MHz-6GHz	Jun 18, 2016	Jun 17, 2017
AC Power Source	HPC	HPA-500E	HPA-9100	AC 0~300V	Jun 18, 2016	Jun 17, 2017
DC power Source	GW	GPC-6030D	C671845	DC 1V-60V	Jun 18, 2016	Jun 17, 2017
Temp. and humidity Chamber	Giant Force	GTH-225-20-S	MAB0103-00	N/A	Jun 18, 2016	Jun 17, 2017
RF CABLE-1m	JYE Bao	RG142	CB034-1m	20MHz-7GHz	Jun 18, 2016	Jun 17, 2017
RF CABLE-2m	JYE Bao	RG142	CB035-2m	20MHz-1GHz	Jun 18, 2016	Jun 17, 2017
Signal Generator	R&S	SMR40	10016	10MHz~40GH	Jul 16, 2016	Jul 15, 2017
Universal Radio Communication Tester	R&S	CMU200	112012	N/A	Oct 27, 2016	Oct 26, 2017
Wideband Radio Communication Tester	R&S	CMW500	1201.0002K50	N/A	Nov 19, 2016	Nov 18, 2017
PSG Analog Signal Generator	Agilent	N8257D	MY46520521	250KHz~20GHz	Nov 19, 2016	Nov 18, 2017
MXA Signal Analyzer	Agilent	N9020A	MY50510140	10Hz~26.5GHz	Oct 27, 2016	Oct 26, 2017
RF Control Unit	Tonscend	JS0806-1	/	/	Nov 19, 2016	Nov 18, 2017
LTE Test Software	Tonscend	JS1120-1	/	Version:	N/A	N/A
Test Software	Ascentest	AT890-SW	20141230	Version:	N/A	N/A
Splitter/Combiner(Qty: 2)	Mini-Circuits	ZAPD-50W 4.2-6.0 GHz	NN256400424	/	Oct 27, 2016	Oct 26, 2017
Splitter/Combine(Qty: 2)	MCLI	PS3-7	4463/4464	/	Oct 27, 2016	Oct 26, 2017
ATT (Qty: 1)	Mini-Circuits	VAT-30+	30912	/	Oct 27, 2016	Oct 26, 2017
EMC Test Software	Audix	E3	/	/	/	/

1.7 Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	3.10dB	(1)
		30MHz~200MHz	2.96dB	(1)
		200MHz~1000MHz	3.10dB	(1)
		1GHz~26.5GHz	3.80dB	(1)
		26.5GHz~40GHz	3.90dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	1.63dB	(1)
Power disturbance	:	30MHz~300MHz	1.60dB	(1)

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

1.8 Description of Test Modes

Bluetooth operates in the unlicensed ISM Band at 2.4GHz. With the introduction of the enhanced data rate (EDR) feature, the data rates can be up to 3 Mb/s. An increase in the peak data rate beyond the basic rate of 1 Mb/s is achieved by modulating the RF carrier using GFSK techniques, resulting in an increase of two to three times the number of bits per symbol. The 2 Mb/s EDR packets use a Pi/4-DQPSK modulation and the 3 Mb/s EDR packets use 8DPSK modulation. The following operating modes were applied for the related test items. For radiated measurement, the test was performed with EUT in X, Y, Z position and the worst case was found when EUT in Y position. All test modes were tested, only the result of the worst case was recorded in the report.

Mode of Operations	Frequency Range (MHz)	Data Rate (Mbps)
GFSK	2402	1
	2441	1
	2480	1
Pi/4 DQPSK	2402	2
	2441	2
	2480	2
8-DPSK	2402	3
	2441	3
	2480	3
For Conducted Emission		
Test Mode	TX Mode	
For Radiated Emission		
Test Mode	TX Mode	

For pre-testing, when performed power line conducted emission measurement, the input Voltage/Frequency AC 120V/60Hz and AC 240V/60Hz were used. Only recorded the worst case in this report.

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

AC conducted emission pre-test at both at power adapter and power from PC modes, recorded worst case;

Worst-case mode and channel used for 150kHz-30 MHz power line conducted emissions was determined to be TX Mode (1Mbps-Hopping).

Worst-case mode and channel used for 9kHz-1000 MHz radiated emissions was determined to be TX-Middle Channel Mode(1Mbps).

***Note: Using a temporary antenna connector for the EUT when conducted measurements are performed.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10: 2013, FCC CFR PART 15C 15.207, 15.209, 15.247 and DA 00-705.

2.1 EUT Configuration

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

2.2 EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209, 15.247 under the FCC Rules Part 15 Subpart C.

2.3 General Test Procedures

2.3.1 Conducted Emissions

According to the requirements in Section 6.2 of ANSI C63.10: 2013, AC power-line conducted emissions shall be measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table and the turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10: 2013

3. SYSTEM TEST CONFIGURATION

3.1 Justification

The system was configured for testing in a continuous transmits condition by engineer mode (*#*#63646633#*#*) enter engineer mode provided by application.

3.2 EUT Exercise Software

N/A.

3.3 Special Accessories

No.	Equipment	Manufacturer	Model No.	Serial No.	Length	shielded/ unshielded	Notes
1	PC	Lenovo	Ideapad	A131101550	/	/	DOC
2	Power adapter	Lenovo	CPA-A090	36200414	1.00m	unshielded	DOC

3.4 Block Diagram/Schematics

Please refer to the related document.

3.5 Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6 Test Setup

Please refer to the test setup photo.

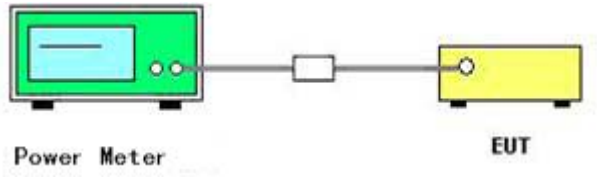
4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C		
FCC Rules	**Description of Test**	**Result**
§15.247(b)(1)	Maximum Conducted Output Power	Compliant
§15.247(a)(1)	Frequency Separation And 20 dB Bandwidth	Compliant
§15.247(a)(1)(iii)	Number Of Hopping Frequency	Compliant
§15.247(a)(1)(iii)	Time Of Occupancy (Dwell Time)	Compliant
§15.209, §15.247(d)	Radiated and Conducted Spurious Emissions	Compliant
§15.205	Emissions at Restricted Band	Compliant
§15.207(a)	Line Conducted Emissions	Compliant
§15.203	Antenna Requirements	Compliant
Note: This is a DSS test report for Smart phone; please refer to other document for the DTS test report (LCS1702080230E).		

5. ANTENNA PORT MEASUREMENT

5.1 Conducted Peak Output Power

5.1.1 Block Diagram of Test Setup



5.1.2 Limit

According to §15.247(b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

5.1.3 Test Procedure

The transmitter output is connected to the Power Meter.
According to ANSI C63.10:2013 Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices; this is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the power meter, through suitable attenuation. The hopping shall be disabled for this test:

5.1.4 Test Results

Temperature	24.2℃	Humidity	35.7%
Test Engineer	Kyle Yin	Configurations	BT

Test Mode	Channel	Frequency (MHz)	Measured Maximum Power (dBm)		Limits (dBm)	Verdict
			Peak	Average		
GFSK	0	2402	5.01	4.73	30.00	PASS
	39	2441	5.16	4.82		
	78	2480	4.16	4.03		
π/4DQPSK	0	2402	4.00	3.78	21.00	PASS
	39	2441	4.09	3.83		
	78	2480	2.92	2.06		
8DPSK	0	2402	4.07	3.81	21.00	PASS
	39	2441	4.18	3.89		
	78	2480	2.96	2.82		

Remark:

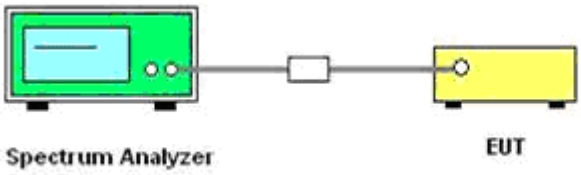
1. *Test results including cable loss;*
2. *Measured output power at difference Packet Type for each mode and recorded worst case for each mode.*
3. *Worst case data at DH5 for GFSK, π/4DQPSK, 8DPSK modulation type;*
4. *Average power is for report only;*

5.2 Frequency Separation and 20 dB Bandwidth

5.2.1 Limit

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

5.2.2 Block Diagram of Test Setup



5.2.3 Test Procedure

A. Place the EUT on the table and set it in transmitting mode.
B. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer.
C. Set to the maximum power setting and enable the EUT transmit continuously.
D. For carrier frequency separation measurement, use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels;
RBW / VBW=100 KHz/ 300KHz; Sweep = auto; Detector function = peak;
Trace = max hold.
E. For 20dB bandwidth measurement, use the following spectrum analyzer settings:
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel;
RBW/VBW=30 KHz/ 100KHz; Sweep = auto; Detector function = peak;
Trace = max hold.

5.2.4 Test Results

5.2.4.1 20dB Bandwidth

Test Mode	Channel	Frequency (MHz)	Measured Bandwidth (KHz)		Limits (KHz)	Verdict
			99%	20dB		
GFSK	0	2402	877.75	832.70	No Limits	PASS
	39	2441	840.31	829.90		
	78	2480	839.25	829.90		
π/4DQPSK	0	2402	1063.80	1118.00	No Limits	PASS
	39	2441	1063.50	1117.00		
	78	2480	1062.90	1118.00		
8DPSK	0	2402	1104.10	1165.00	No Limits	PASS
	39	2441	1103.50	1164.00		
	78	2480	1103.10	1165.00		

Remark:

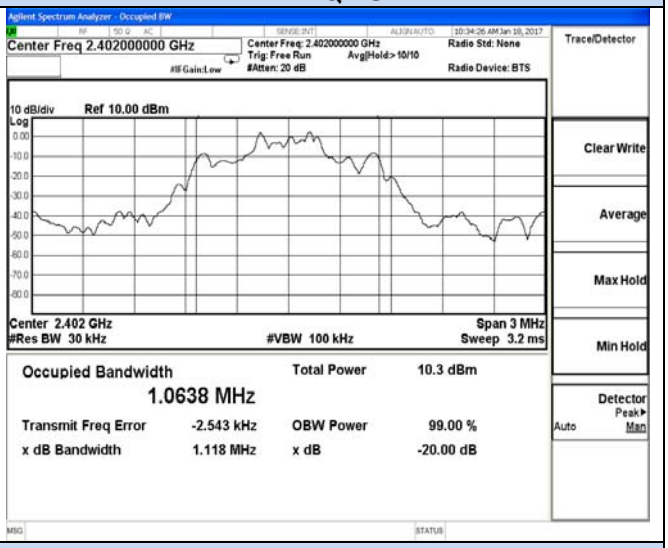
1. *Test results including cable loss;*
2. *Measured output power at difference Packet Type for each mode and recorded worst case for each mode.*
3. *Worst case data at DH5 for GFSK, π/4DQPSK, 8DPSK modulation type;*
4. *Please refer following test plots;*

20dB Bandwidth and 99% Bandwidth

GFSK

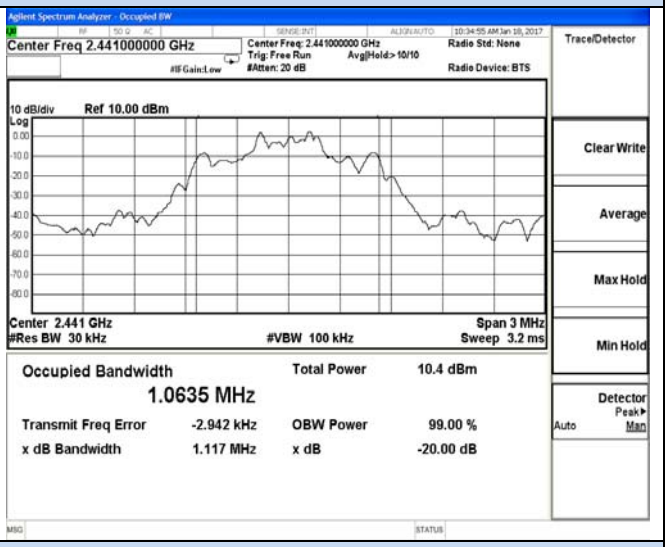
Channel 0 / 2402 MHz

π/4DQPSK



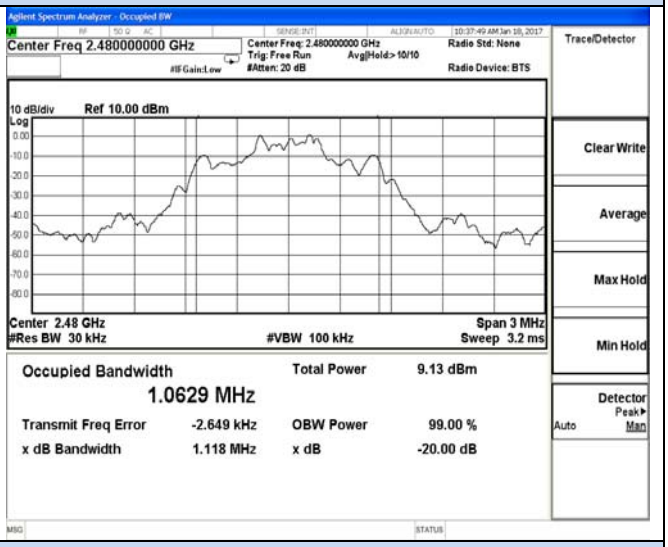
Channel 0 / 2402 MHz

Channel 39 / 2441 MHz

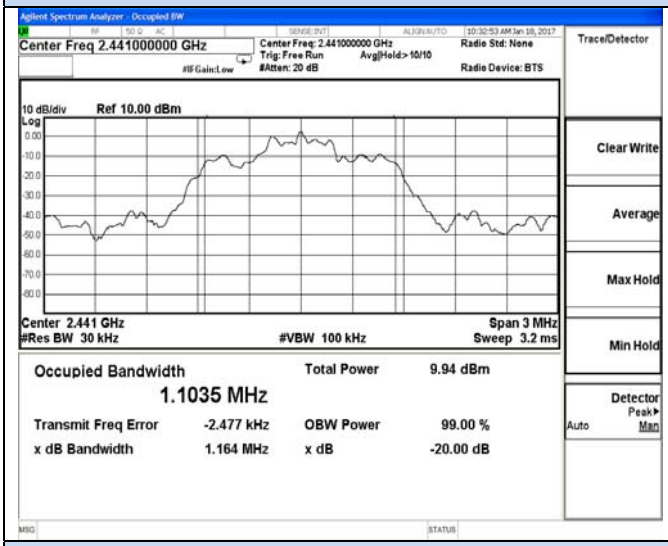
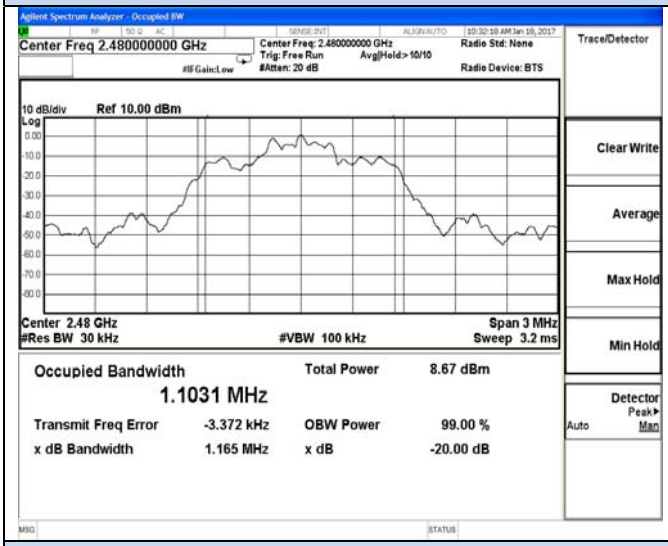


Channel 39 / 2441 MHz

Channel 78 / 2480 MHz



Channel 78 / 2480 MHz

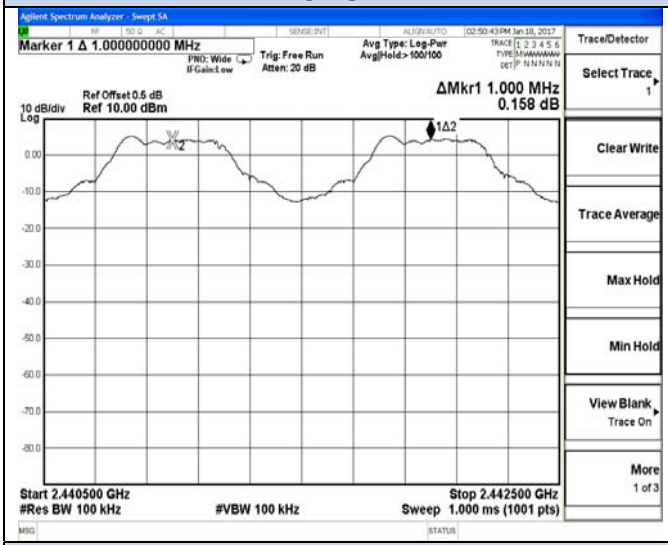
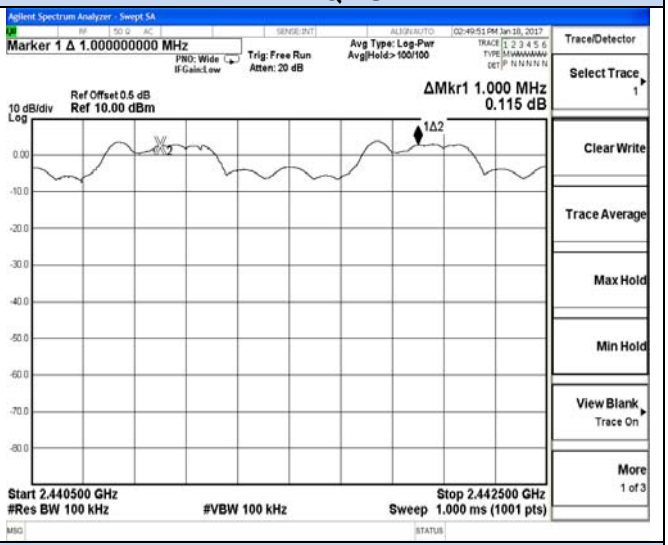
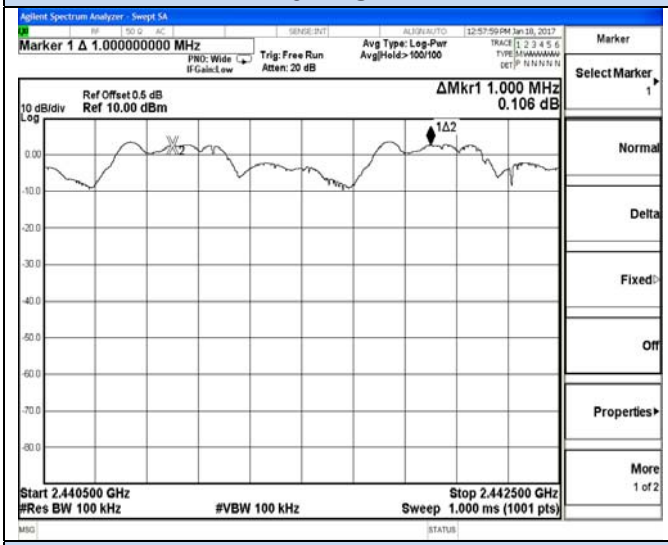
20dB Bandwidth and 99% Bandwidth	
8DPSK	
	
Channel 0 / 2402 MHz	
	
Channel 39 / 2441 MHz	
	
Channel 78 / 2480 MHz	

5.2.4.2 Frequency Separation

The Measurement Result With 1Mbps For GFSK Modulation				
Channel	20dB Bandwidth (KHz)	Channel Separation (MHz)	Limit (KHz)	Result
Low	832.70	1.000	832.70	Pass
Middle	829.90		829.90	Pass
High	829.90		829.90	Pass
The Measurement Result With 2Mbps For π/4-DQPSK Modulation				
Channel	20dB Bandwidth (KHz)	Channel Separation (MHz)	Limit (KHz)	Result
Low	1118.00	1.000	745.33	Pass
Middle	1117.00		744.67	Pass
High	1118.00		745.33	Pass
The Measurement Result With 3Mbps For 8-DPSK Modulation				
Channel	20dB Bandwidth (KHz)	Channel Separation (MHz)	Limit (KHz)	Result
Low	1165.00	1.000	776.67	Pass
Middle	1164.00		776.00	Pass
High	1165.00		776.67	Pass

Remark:

1. *Test results including cable loss;*
2. *please refer to following plots;*
3. *Measured at difference Packet Type for each mode and recorded worst case for each mode.*
4. *Worst case data at DH5 for GFSK, π/4-DQPSK, 8DPSK modulation type;*
5. *We measured low, middle and high channels, recorded worst case at middle channel;*

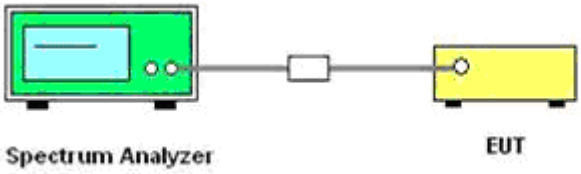
Frequency Separation	
GFSK	π/4DQPSK
	
Channel 39 / 2441 MHz	Channel 39 / 2441 MHz
8DPSK	
	
Channel 39 / 2441 MHz	

5.3 Number of Hopping Frequency

5.3.1 Limit

According to §15.247(a) (1) (iii), Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

5.3.2 Block Diagram of Test Setup



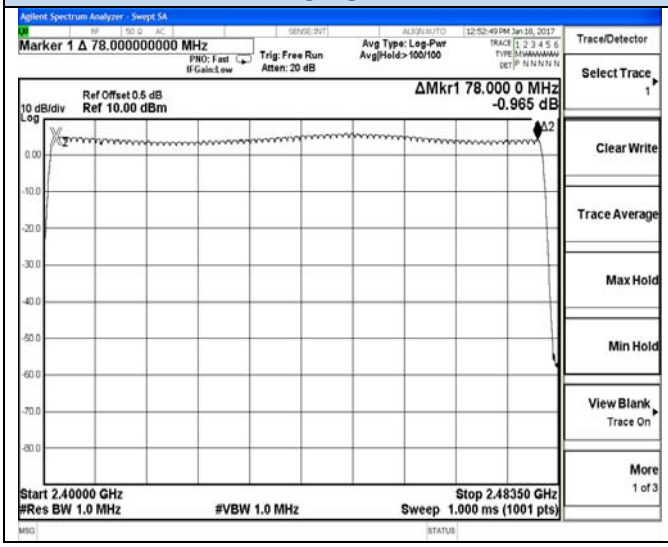
5.3.3 Test Procedure

A. Place the EUT on the table and set it in transmitting mode.
B. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer.
C. Set Spectrum Analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
D. Set the Spectrum Analyzer as RBW, VBW=1MHz.
E. Max hold, view and count how many channel in the band.

5.3.4 Test Results

Test Mode	Measurement Result (No. of Channels)	Limit (No. of Channels)	Result
GFSK	79	≥15	PASS
π/4DQPSK	79	≥15	PASS
8DPSK	79	≥15	PASS

Remark:
1. *Test results including cable loss;*
2. *Measured output power at difference Packet Type for each mode and recorded worst case for each mode.*
3. *Worst case data at DH5 for GFSK, π/4DQPSK, 8DPSK modulation type;*
4. *Record test plots only for GFSK;*
5. *Please refer following test plots;*

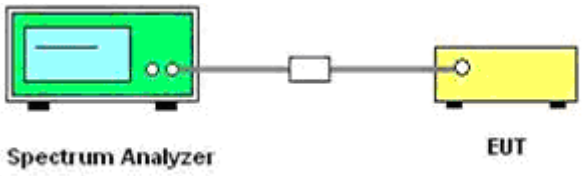
Number of Hopping Frequency	
GFSK	
	

5.4 Time of Occupancy (Dwell Time)

5.4.1 Limit

According to §15.247(a) (1) (iii), Frequency hopping systems operating in the 2400MHz- 2483.5 MHz bands. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4seconds multiplied by the number of hopping channels employed.

5.4.2 Block Diagram of Test Setup



5.4.3 Test Procedure

A. Place the EUT on the table and set it in transmitting mode.
B. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer.
C. Set center frequency of Spectrum Analyzer = operating frequency.
D. Set the Spectrum Analyzer as RBW, VBW=1MHz, Span = 0Hz, Sweep = auto.
E. Repeat above procedures until all frequency measured were complete.

5.4.4 Test Results

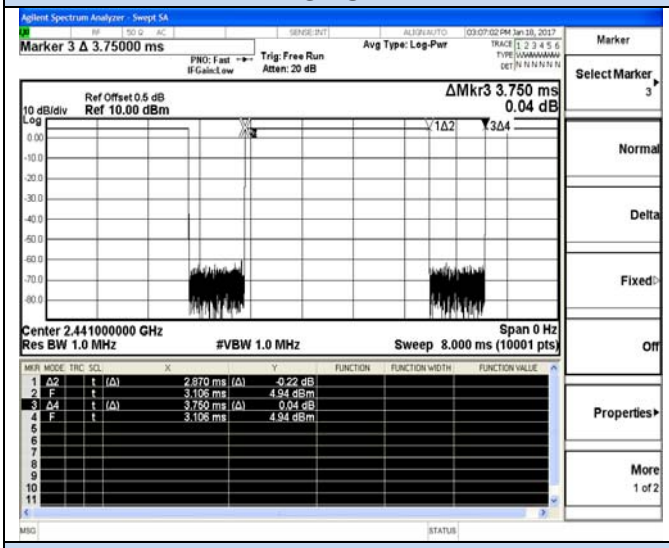
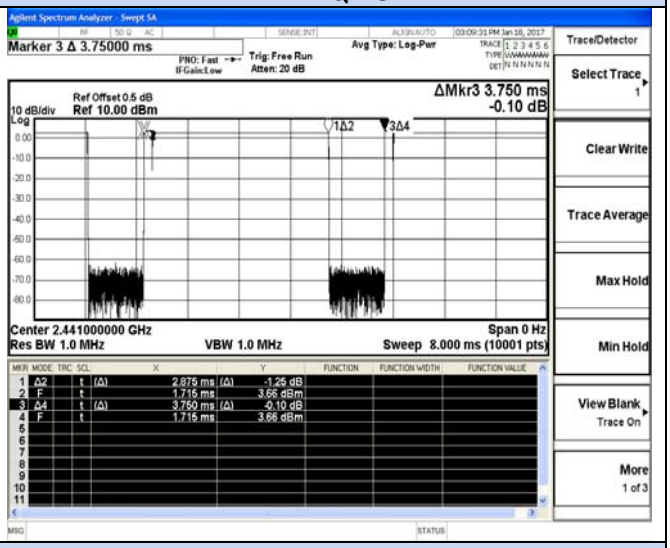
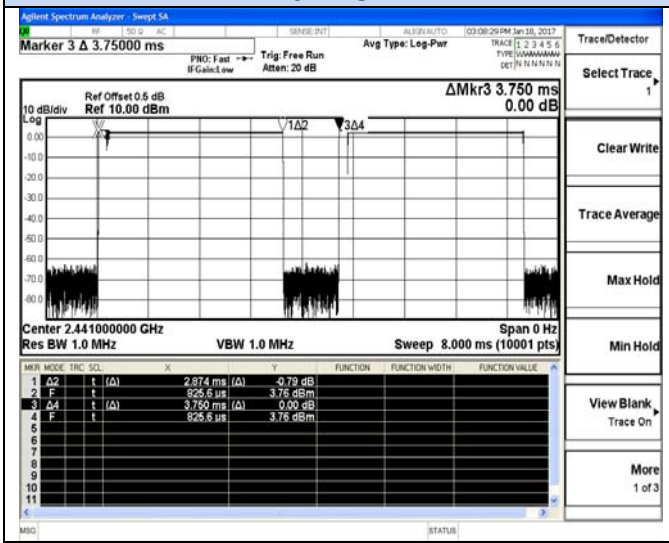
The Dwell Time=Burst Width*Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4[s]*hopping number=0.4[s]*79[ch]=31.6[s*ch];
The burst width [ms/hop/ch], which is directly measured, refers to the duration on one channel hop.
The hops per second for all channels: The selected EUT Conf uses a slot type of 5-Tx&1-Rx and a hopping rate of 1600 [ch*hop/s] for all channels. So the final hopping rate for all channels is 1600/6=266.67 [ch*hop/s]
The hops per second on one channel: 266.67 [ch*hops/s]/79 [ch]=3.38 [hop/s];
The total hops for all channels within the dwell time calculation duration: 3.38 [hop/s]*31.6[s*ch]=106.67 [hop*ch];
The dwell time for all channels hopping: 106.67 [hop*ch]*Burst Width [ms/hop/ch].

Mode	Frequency (MHz)	Burst Type	Pulse Width (ms)	Dwell Time (S)	Limit (S)	Verdict
GFSK	2441	3DH5	2.870	0.3061	0.4	PASS
π/4-DQPSK	2441	3DH5	2.874	0.3066	0.4	PASS
8DPSK	2441	3DH5	2.875	0.3067	0.4	PASS

Remark:
1. *Test results including cable loss;*
2. *please refer to following plots;*
3. *Measured at difference Packet Type for each mode and recorded worst case for each mode.*
4. *Worst case data at DH5 for GFSK, π/4-DQPSK ,8DPSK modulation type;*
5. *Dwell Time Calculate formula:*

DH1: Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second
DH3: Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second
DH5: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second

6. *Measured at low, middle and high channel, recorded worst at middle channel;*

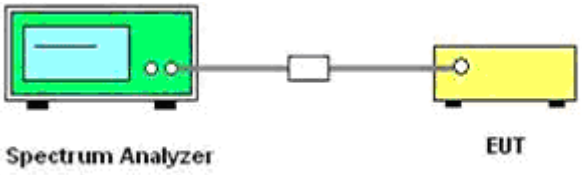
<table>
<tr><th colspan="2">Dwell time</th></tr>
<tr><th>GFSK</th><th>π/4-DQPSK</th></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Channel 39 / 2441 MHz - DH5</td><td>Channel 39 / 2441 MHz - 2DH5</td></tr>
<tr><th>8DPSK</th><th></th></tr>
<tr><td> 
</td><td></td></tr>
<tr><td>Channel 39 / 2441 MHz – 3DH5</td><td></td></tr>
</table>

5.5 Conducted Spurious Emissions

5.5.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

5.5.2 Block Diagram of Test Setup



5.5.3 Test Procedure

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 KHz. The video bandwidth is set to 300 KHz.

Measurements are made over the 9 KHz to 26.5GHz range with the transmitter set to the lowest, middle, and highest channels

5.5.4 Test Results of Conducted Spurious Emissions

No non-compliance noted. Only record the worst test result (TX-GFSK) in this report. The test data refer to the following page.

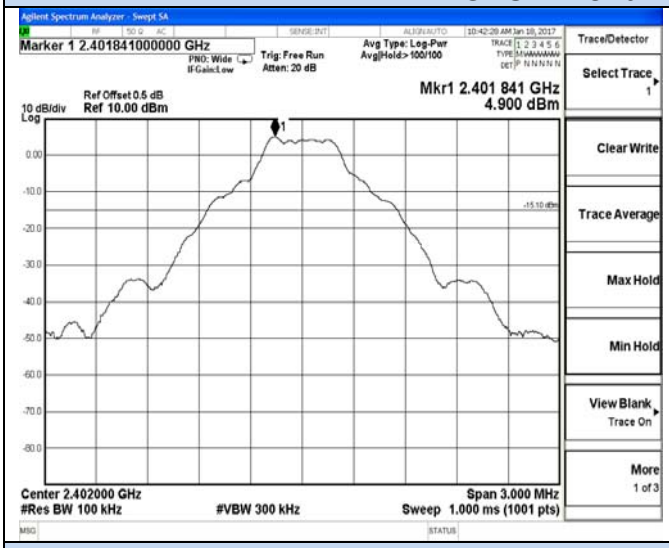
Test Mode	Channel	Frequency (MHz)	Spurious RF Conducted Emission (dBc)	Limits (dBc)	Verdict
GFSK	0	2402	<-20	-20	PASS
	39	2441	<-20		
	78	2480	<-20		
π/4-DQPSK	0	2402	<-20	-20	PASS
	39	2441	<-20		
	78	2480	<-20		
8DPSK	0	2402	<-20	-20	PASS
	39	2441	<-20		
	78	2480	<-20		

Remark:

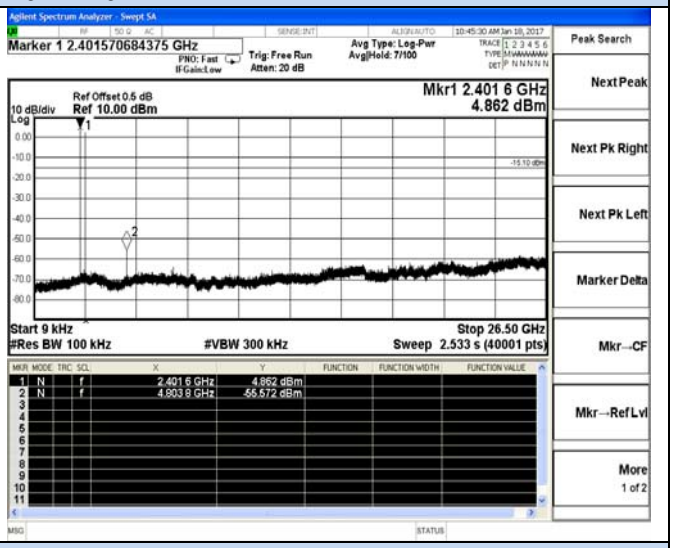
1. *Test results including cable loss;*
2. *please refer to following plots;*
3. *Measured at difference Packet Type for each mode and recorded worst case for each mode.*
4. *Worst case data at DH5 for GFSK, π/4-DQPSK, 8DPSK modulation type;*
5. *Only recorded conducted spurious emission at GFSK test plots; recorded conducted band edge at GFSK and 8DPSK;*

RF Conducted Spurious Emissions

GFSK – Channel 0 / 2402 MHz

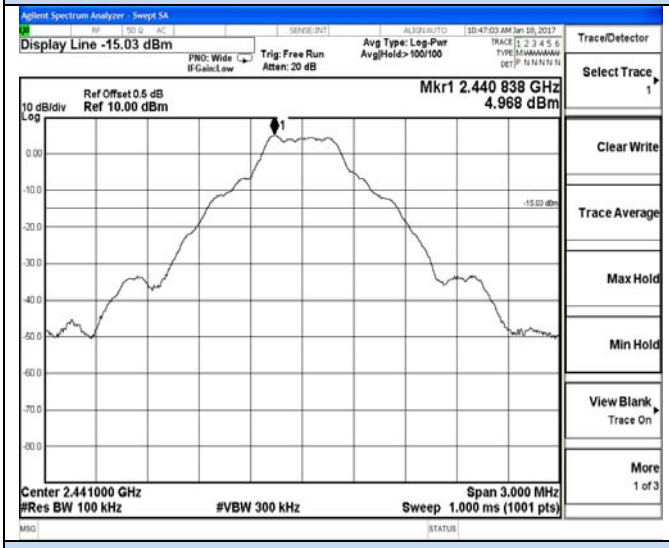


2399.5 – 2404.5 MHz

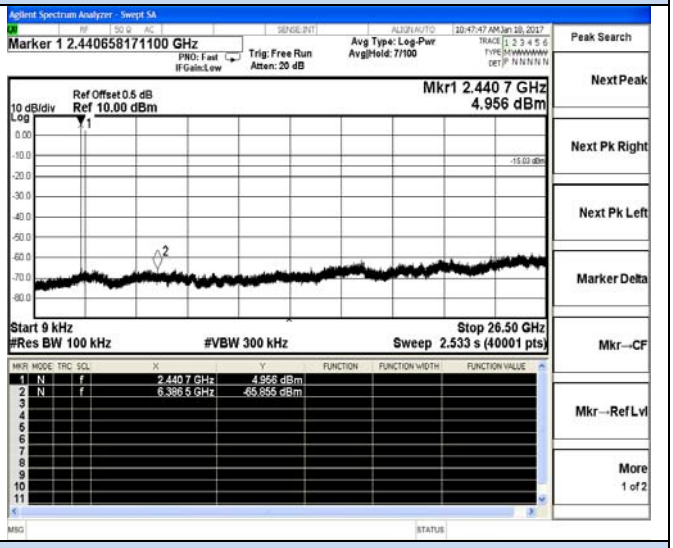


9 KHz – 26.5 GHz

GFSK – Channel 39 / 2441 MHz

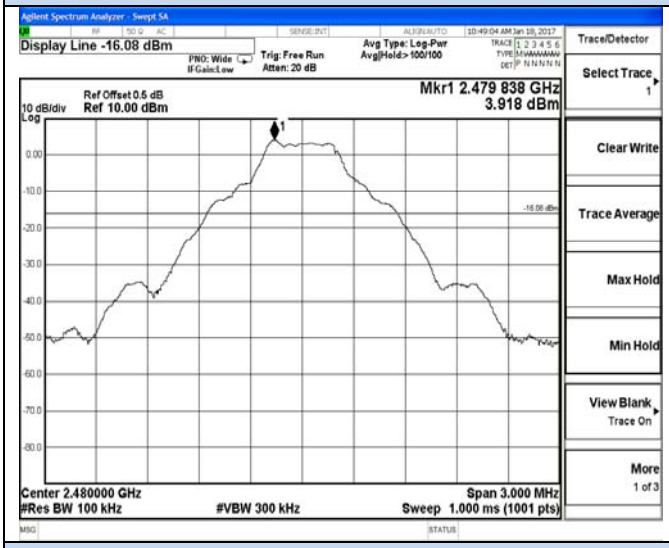


2438.5 – 2443.5 MHz

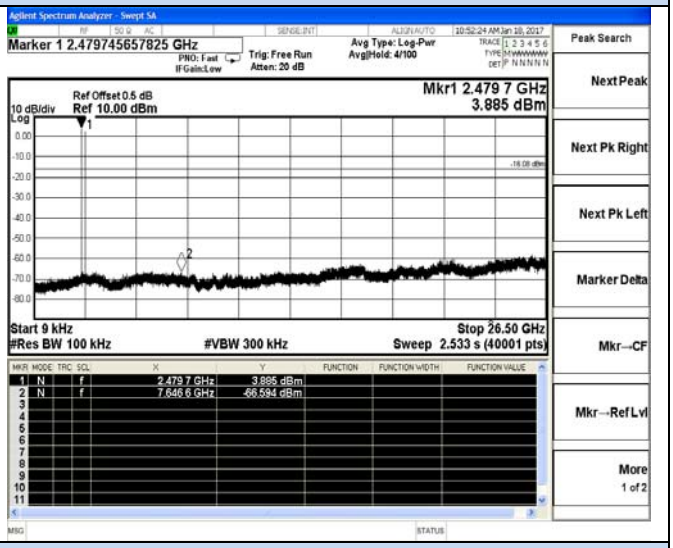


9 KHz – 26.5 GHz

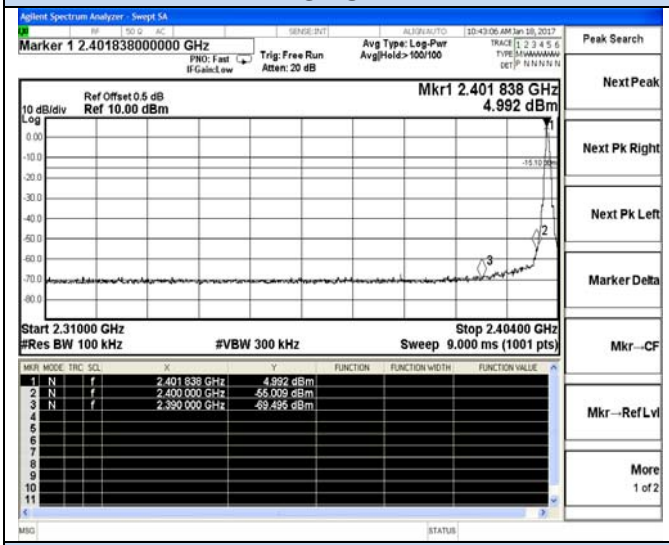
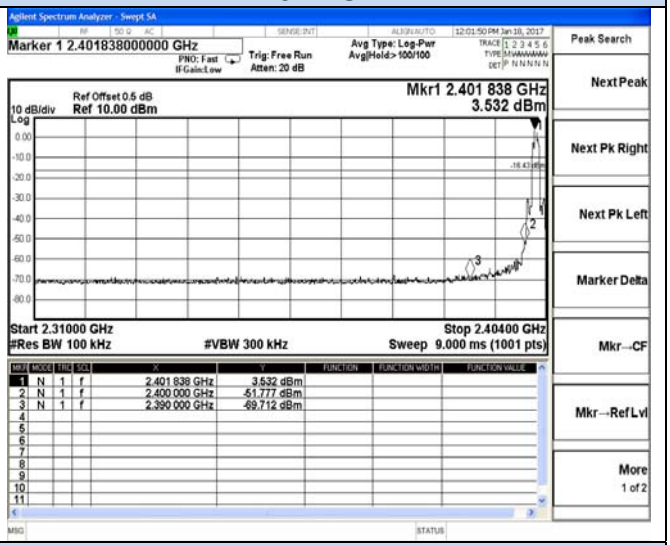
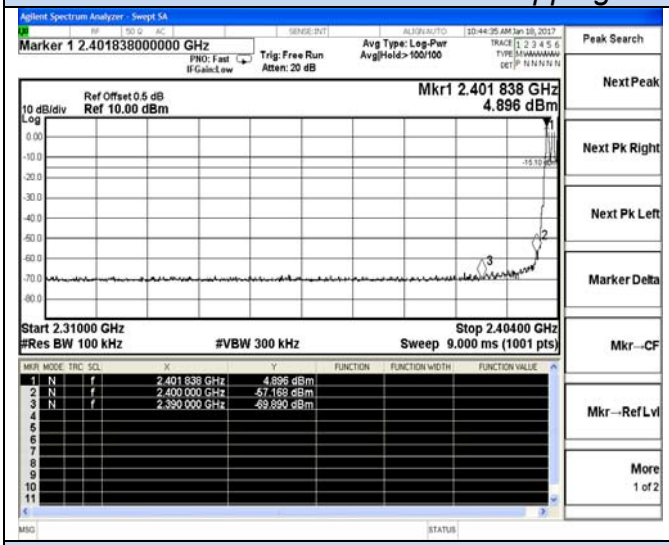
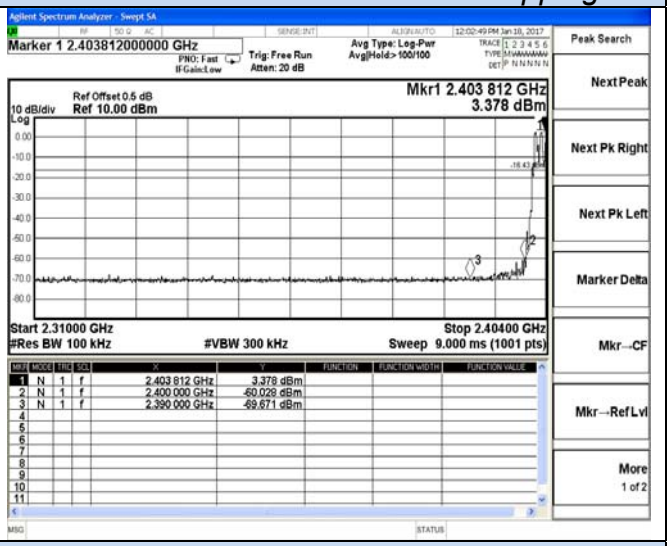
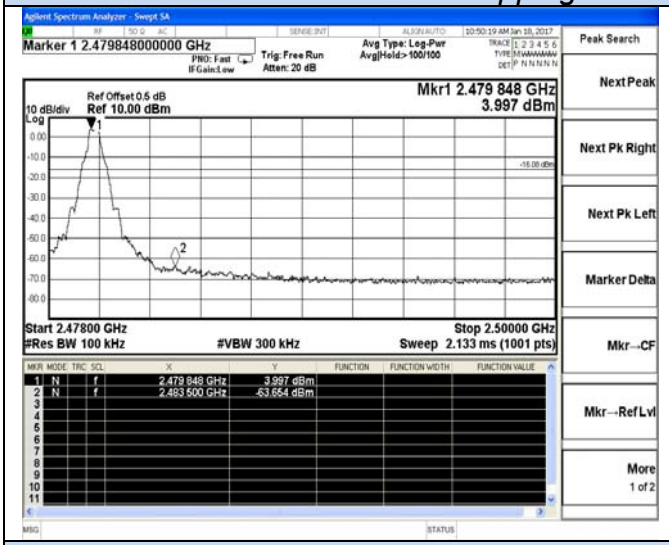
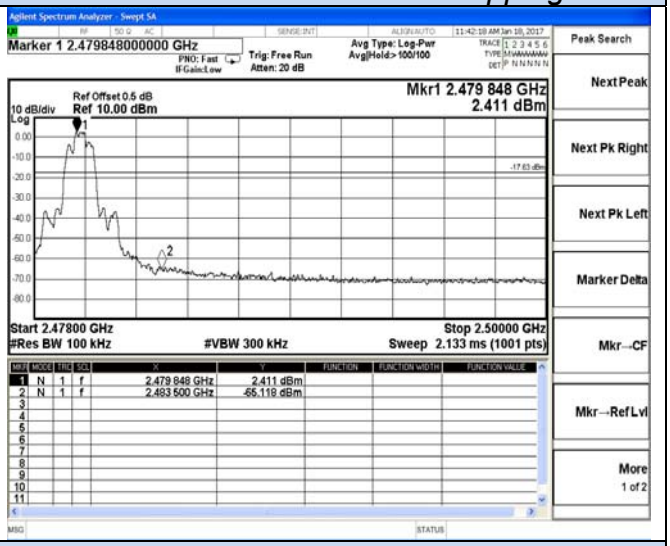
GFSK – Channel 78 / 2480 MHz

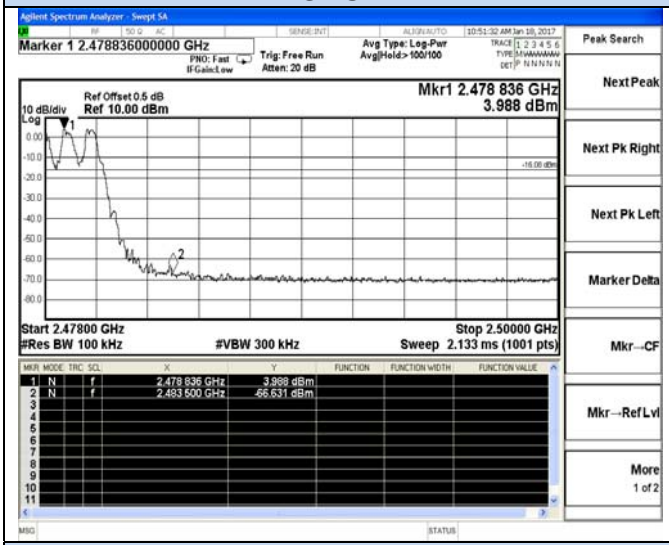
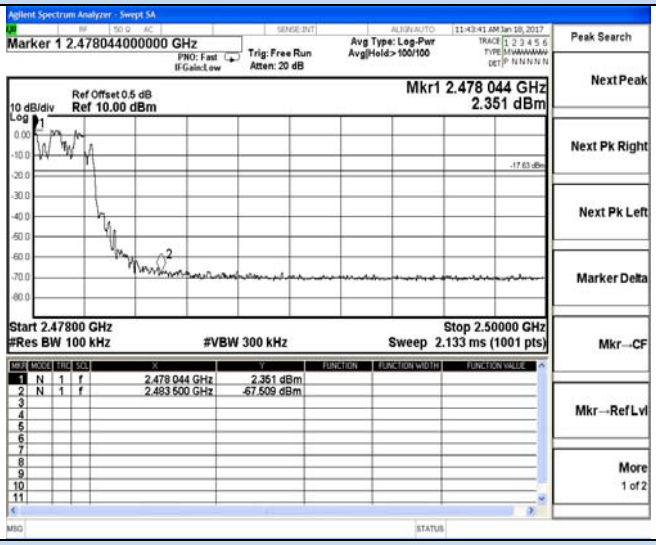


2477.5 – 2482.5 MHz



9 KHz – 26.5 GHz

Band-edge for RF conducted emissions	
GFSK	8DPSK
	
Channel 0 / 2402 MHz – Non-Hopping	Channel 0 / 2402 MHz – Non-Hopping
	
Channel 0 / 2402 MHz – Hopping	Channel 0 / 2402 MHz – Hopping
	
Channel 78 / 2480 MHz – Non-Hopping	Channel 78 / 2480 MHz – Non-Hopping

Band-edge for RF conducted emissions	
GFSK	8DPSK
	
Channel 78 / 2480 MHz – Hopping	Channel 78 / 2480 MHz – Hopping

6. RADIATED MEASUREMENT

6.6.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
\1\ 0.495-0.505	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	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	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			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

6.6.2. Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10^{th} carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

6.6.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 0.8 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

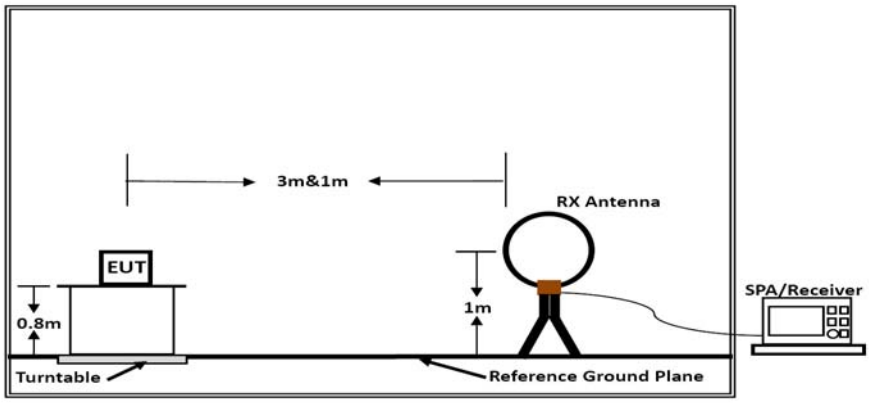
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

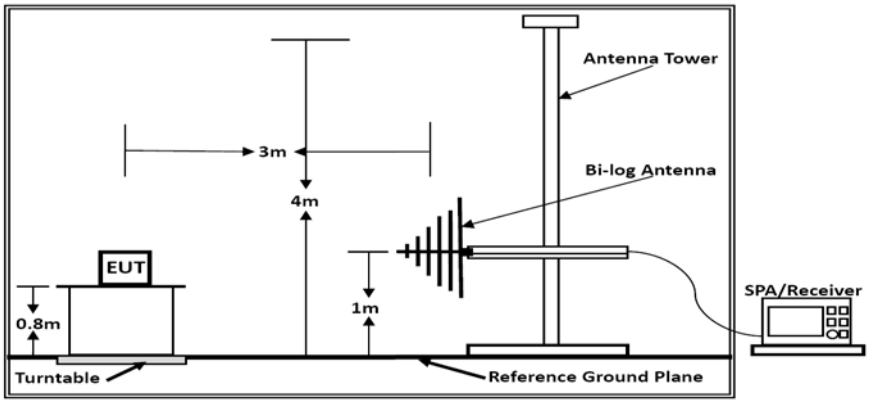
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

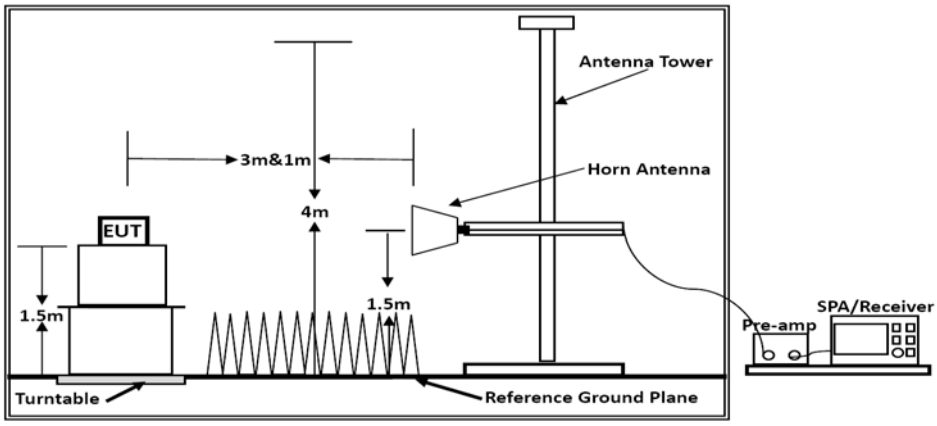
6.6.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1m.

Distance extrapolation factor = 20 log (specific distanc [3m] / test distance [1.5m]) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

6.6.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

6.6.6. Results of Radiated Emissions (9 kHz~30MHz)

Temperature	25℃	Humidity	60%
Test Engineer	Chaz	Configurations	BT

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

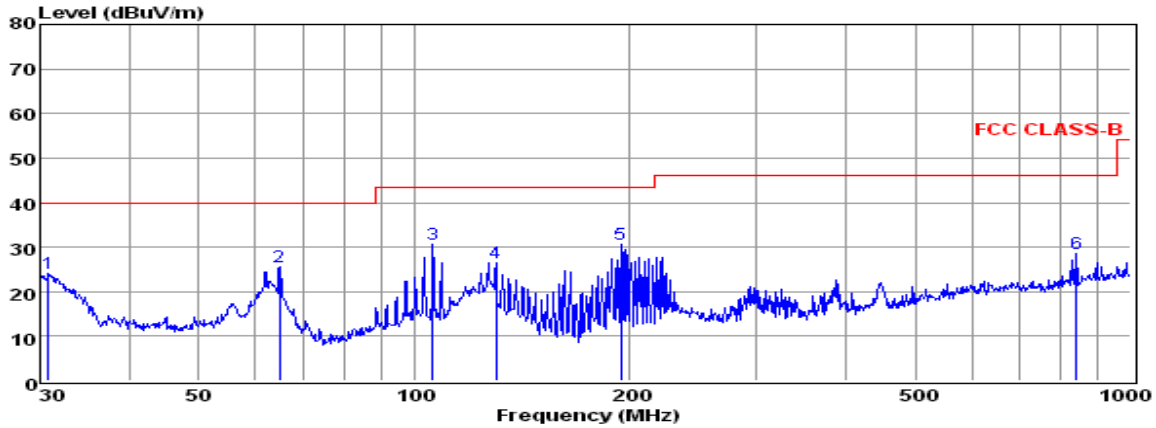
PASS.

Only record the worst test result in this report.

The test data please refer to following page.

Below 1GHz

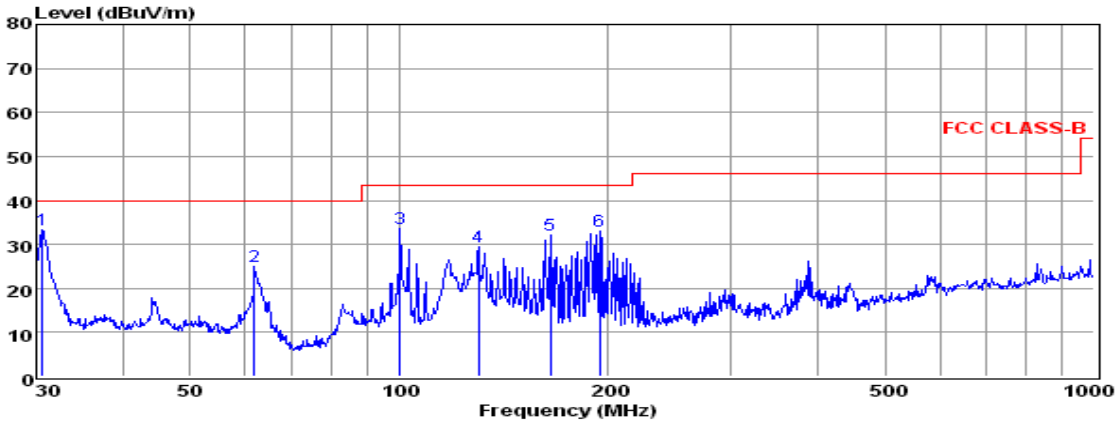
Horizontal:



	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	30.85	11.52	0.39	12.32	24.23	40.00	-15.77	QP
2	64.89	14.19	0.52	10.75	25.46	40.00	-14.54	QP
3	106.01	17.45	0.68	12.61	30.74	43.50	-12.76	QP
4	129.92	16.92	0.76	8.94	26.62	43.50	-16.88	QP
5	194.45	19.24	0.76	10.56	30.56	43.50	-12.94	QP
6	839.18	6.44	1.70	20.46	28.60	46.00	-17.40	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported

Vertical:



	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	30.64	20.65	0.39	12.33	33.37	40.00	-6.63	QP
2	61.78	12.44	0.48	11.99	24.91	40.00	-15.09	QP
3	100.23	19.74	0.60	13.14	33.48	43.50	-10.02	QP
4	129.92	19.67	0.76	8.94	29.37	43.50	-14.13	QP
5	164.91	22.47	0.86	8.82	32.15	43.50	-11.35	QP
6	194.45	21.68	0.76	10.56	33.00	43.50	-10.50	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported

****Note:*
Pre-scan all modes and recorded the worst case results in this report (TX-Mid Channel (1Mbps)).
Emission level (dBuV/m) = 20 log Emission level (uV/m).
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

Above 1GHz

Note: Only recorded the worst test result.
The worst test result for GFSK, TX-Low Channel:

The worst test result for GFSK, Channel 0 / 2402 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4804.0	55.11	33.06	35.04	3.94	57.07	74.00	-16.93	Peak	Horizontal
4804.0	39.78	33.06	35.04	3.94	41.74	54.00	-12.26	Average	Horizontal
4804.0	59.35	33.06	35.04	3.94	61.31	74.00	-12.69	Peak	Vertical
4804.0	42.16	33.06	35.04	3.94	44.12	54.00	-9.88	Average	Vertical

The worst test result for GFSK, Channel 39 / 2441 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4882.0	55.27	33.16	35.15	3.96	57.24	74.00	-16.76	Peak	Horizontal
4882.0	43.78	33.16	35.15	3.96	45.75	54.00	-8.25	Average	Horizontal
4882.0	59.27	33.16	35.15	3.96	61.24	74.00	-12.76	Peak	Vertical
4882.0	42.28	33.16	35.15	3.96	44.25	54.00	-9.75	Average	Vertical

The worst test result for GFSK, Channel 78 / 2480 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab.. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4960.0	54.92	33.26	35.14	3.98	57.02	74.00	-16.98	Peak	Horizontal
4960.0	43.22	33.26	35.14	3.98	45.32	54.00	-8.68	Average	Horizontal
4960.0	58.91	33.26	35.14	3.98	61.01	74.00	-12.99	Peak	Vertical
4960.0	42.31	33.26	35.14	3.98	44.41	54.00	-9.59	Average	Vertical

Notes:

1). Measuring frequencies from 9 KHz - 10^{th} harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30 MHz.

2). Radiated emissions measured in frequency range from 9 KHz - 10^{th} harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.

3). 18~25GHz at least have 20dB margin. No recording in the test report.

7. AC POWER LINE CONDUCTED EMISSIONS

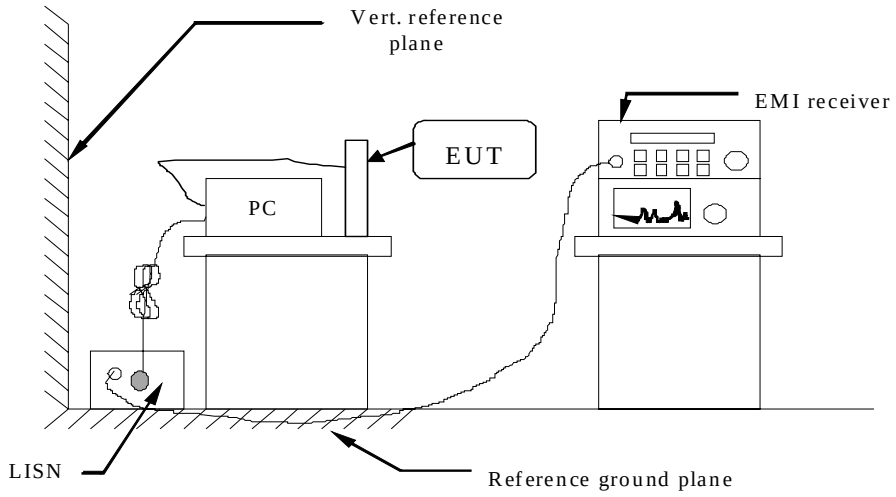
7.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

7.2 Block Diagram of Test Setup



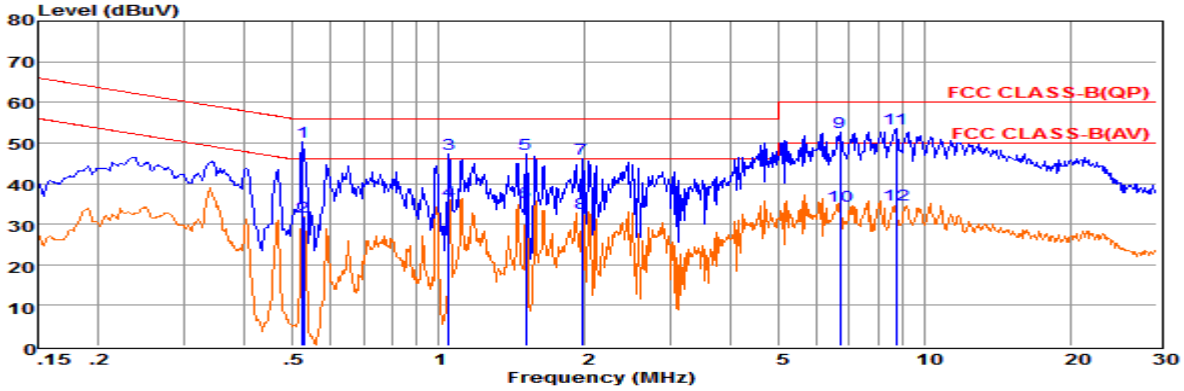
7.3 Test Results

PASS.

The test data please refer to following page.

AC Conducted Emission of power adapter @ AC 120V/60Hz @ GFSK (worst case)

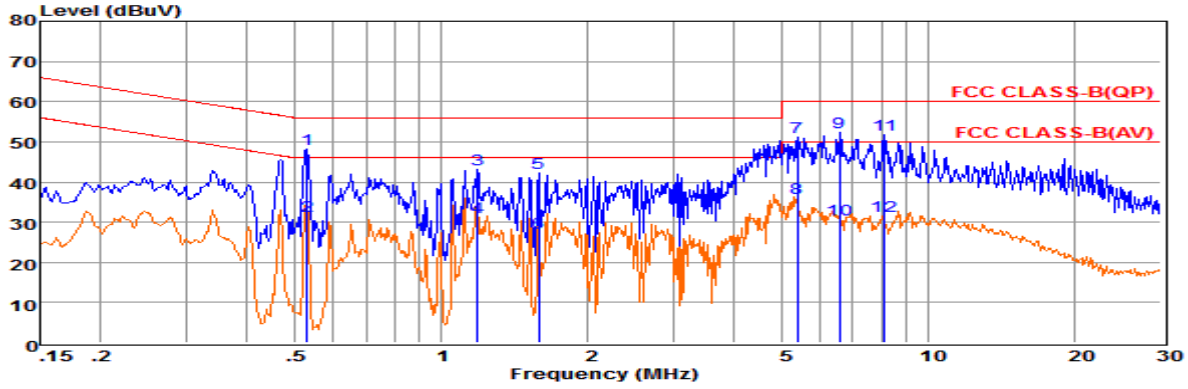
Line:



	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.53	30.51	9.62	0.04	10.00	50.17	56.00	-5.83	QP
2	0.53	12.25	9.62	0.04	10.00	31.91	46.00	-14.09	Average
3	1.05	27.55	9.63	0.05	10.00	47.23	56.00	-8.77	QP
4	1.05	16.07	9.63	0.05	10.00	35.75	46.00	-10.25	Average
5	1.51	27.72	9.64	0.05	10.00	47.41	56.00	-8.59	QP
6	1.51	15.82	9.64	0.05	10.00	35.51	46.00	-10.49	Average
7	1.97	26.32	9.64	0.05	10.00	46.01	56.00	-9.99	QP
8	1.97	13.08	9.64	0.05	10.00	32.77	46.00	-13.23	Average
9	6.70	32.85	9.68	0.07	10.00	52.60	60.00	-7.40	QP
10	6.70	14.75	9.68	0.07	10.00	34.50	50.00	-15.50	Average
11	8.73	33.81	9.69	0.08	10.00	53.58	60.00	-6.42	QP
12	8.73	14.90	9.69	0.08	10.00	34.67	50.00	-15.33	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

Neutral:



	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.53	28.42	9.62	0.04	10.00	48.08	56.00	-7.92	QP
2	0.53	11.82	9.62	0.04	10.00	31.48	46.00	-14.52	Average
3	1.18	23.38	9.63	0.05	10.00	43.06	56.00	-12.94	QP
4	1.19	11.59	9.63	0.05	10.00	31.27	46.00	-14.73	Average
5	1.59	22.55	9.63	0.05	10.00	42.23	56.00	-13.77	QP
6	1.59	7.70	9.63	0.05	10.00	27.38	46.00	-18.62	Average
7	5.39	31.53	9.67	0.06	10.00	51.26	60.00	-8.74	QP
8	5.39	16.21	9.67	0.06	10.00	35.94	50.00	-14.06	Average
9	6.56	32.55	9.68	0.07	10.00	52.30	60.00	-7.70	QP
10	6.56	10.89	9.68	0.07	10.00	30.64	50.00	-19.36	Average
11	8.15	31.94	9.70	0.07	10.00	51.71	60.00	-8.29	QP
12	8.15	11.61	9.70	0.07	10.00	31.38	50.00	-18.62	Average

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

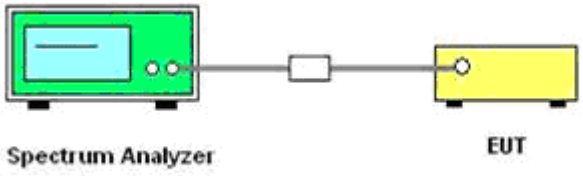
****Note: Pre-scan all modes and recorded the worst case results in this report;*

8. BAND-EDGE MEASUREMENTS FOR RADIATED EMISSIONS

8.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

8.2 Block Diagram of Test Setup



8.3 Measuring Instruments and Setting

Please refer to section 6 of equipment list in this report. The following table is the setting of Spectrum Analyzer.

8.4. Test Procedures

According to KDB 412172 section 1.1 Field Strength Approach (linear terms):

$eirp = p_t \times g_t = (E \times d)^2/30$

Where:

p_t = transmitter output power in watts,

g_t = numeric gain of the transmitting antenna (unitless),

E = electric field strength in V/m,

d = measurement distance in meters (m).

$erp = eirp/1.64 = (E \times d)^2/(30 \times 1.64)$

Where all terms are as previously defined.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=1/B for Peak detector.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Compare the resultant electric field strength level to the applicable regulatory limit.
11. Perform radiated spurious emission test duress until all measured frequencies were complete.

8.5. Test Results

GFSK – Non-Hopping							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
2310.000	-61.257	-1.500	0.0	36.001	Peak	74.00	PASS
2390.000	-60.484	-1.500	0.0	36.774	Peak	74.00	PASS
2483.500	-56.037	-1.500	0.0	41.221	Peak	74.00	PASS
2500.000	-63.622	-1.500	0.0	33.636	Peak	74.00	PASS

π/4DQPSK – Non-Hopping							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
2310.000	-62.312	-1.500	0.0	34.946	Peak	74.00	PASS
2390.000	-60.095	-1.500	0.0	37.163	Peak	74.00	PASS
2483.500	-54.886	-1.500	0.0	42.372	Peak	74.00	PASS
2500.000	-62.739	-1.500	0.0	34.519	Peak	74.00	PASS

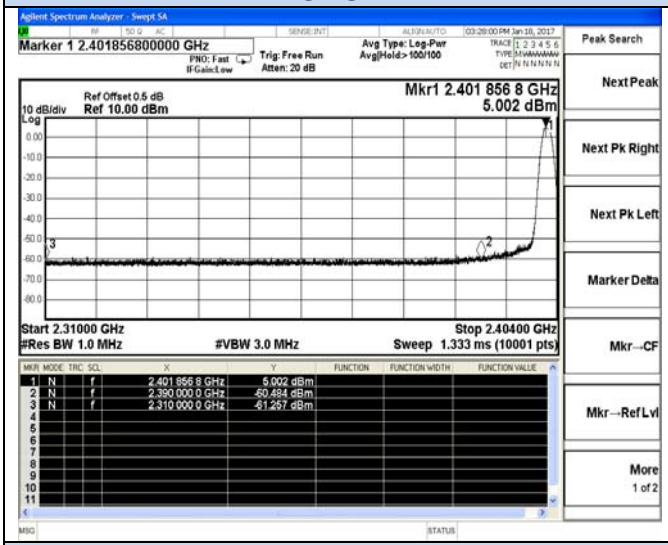
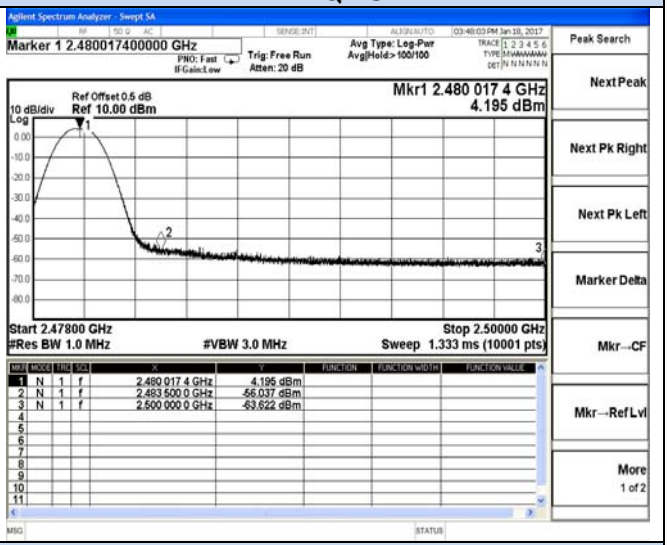
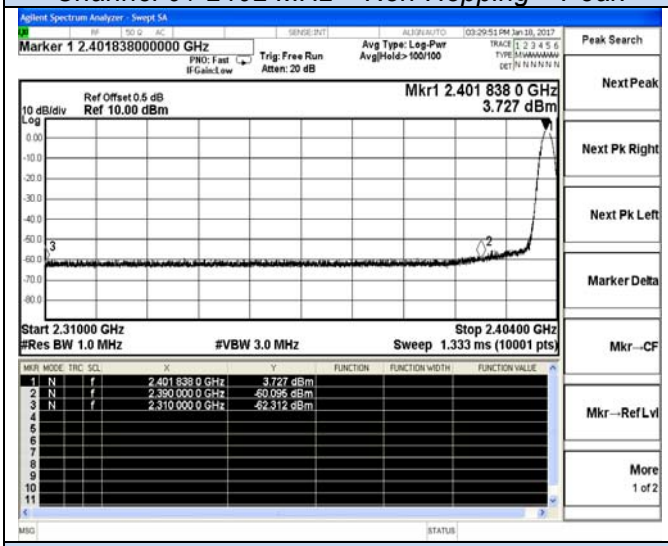
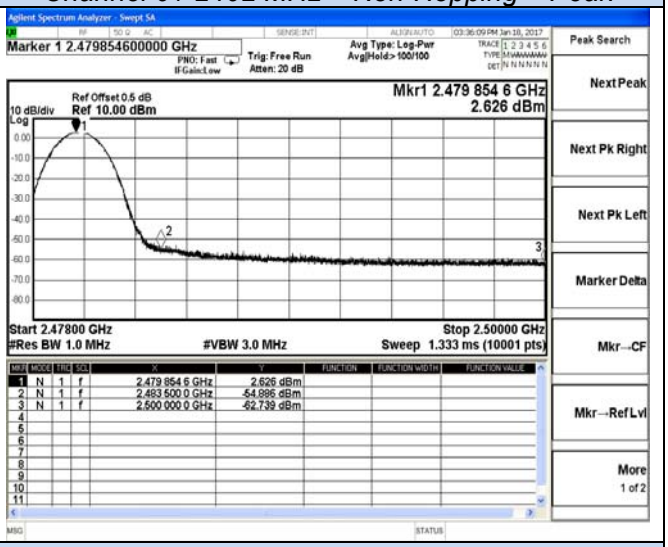
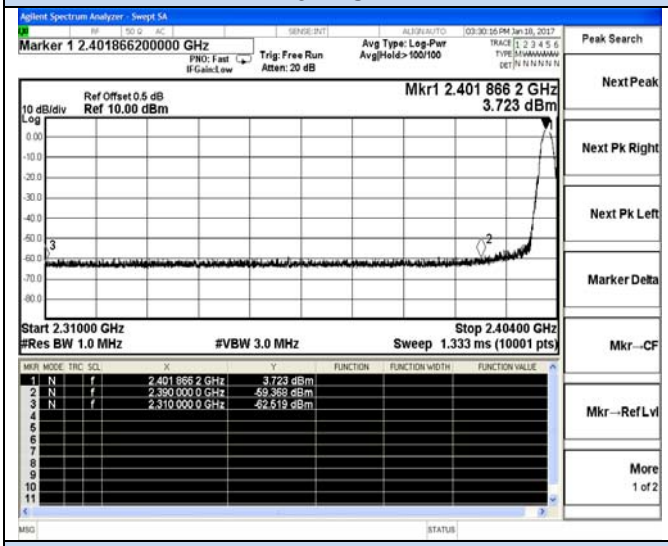
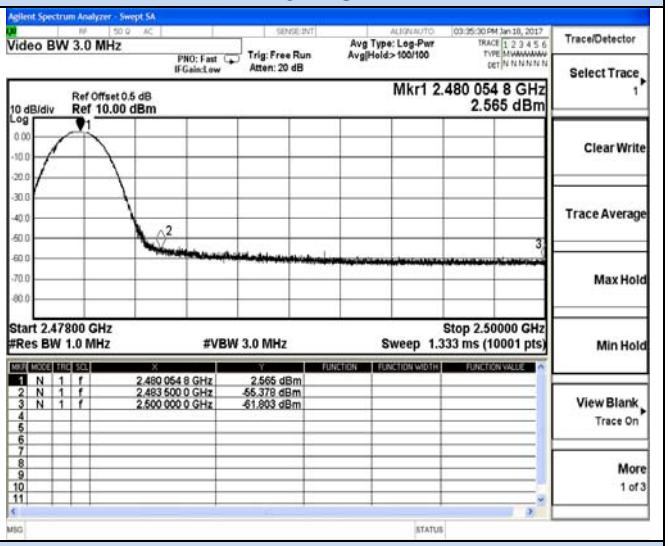
8DPSK – Non-Hopping							
Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
2310.000	-62.519	-1.500	0.0	34.739	Peak	74.00	PASS
2390.000	-59.368	-1.500	0.0	37.890	Peak	74.00	PASS
2483.500	-55.378	-1.500	0.0	41.880	Peak	74.00	PASS
2500.000	-61.803	-1.500	0.0	35.455	Peak	74.00	PASS

Remark:

1. *Measured at difference Packet Type for each mode and recorded worst case for each mode.*
2. *Worst case data at DH5 for GFSK, 8DPSK modulation type;*
3. *Measured at Hopping and Non-Hopping mode, recorded worst at Non-Hopping mode.*
4. *The other emission levels were very low against the limit.*
5. *The average measurement was not performed when the peak measured data under the limit of average detection.*
6. *Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=330KHz/Sweep time=Auto/Detector=Peak;*
7. *Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall*

be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

8. *Please refer to following test plots;*

Band-edge measurements for radiated emissions	
GFSK	π/4DQPSK
	
Channel 0 / 2402 MHz – Non-Hopping – Peak	Channel 0 / 2402 MHz – Non-Hopping – Peak
	
Channel 78 / 2480 MHz – Non-Hopping – Peak	Channel 78 / 2480 MHz – Non-Hopping – Peak
8DPSK	8DPSK
	
Channel 0 / 2402 MHz – Non-Hopping – Peak	Channel 78 / 2480 MHz – Non-Hopping – Peak

9. ANTENNA REQUIREMENT

9.1 Standard Applicable

According to antenna requirement of §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 re-placed 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 Sections 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 Section 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.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

9.2 Antenna Connected Construction

9.2.1. Antenna Connector Construction

The antenna used for transmitting is permanently attached and no consideration of replacement. Please see EUT photo for details.

The BT and WLAN share same PIFA antenna, the maximum gain is -1.50dBi for BT; more information as follows.

9.2.2. Results: Compliance.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Conducted power refers ANSI C63.10:2013 Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices.

Radiated power refers to ANSI C63.10:2013 Radiated emissions tests.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep Time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

Limits

FCC	IC
Antenna Gain	
6 dBi	

Note: The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal Bluetooth devices, the GFSK mode is used.

T_{nom}	V_{nom}	Lowest Channel 2402 MHz	Middle Channel 2441 MHz	Highest Channel 2480 MHz
Conducted power [dBm] Measured with GFSK modulation		5.010	5.089	4.115
Radiated power [dBm] Measured with GFSK modulation		2.317	3.567	1.254
Gain [dBi] Calculated		-2.693	-1.522	-2.861
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

----------THE END OF REPORT----------