FCC TEST REPORT

FOR

Shenzhen Reiie intelligent technology Co., ltd

2.4G Wireless Controller

Test Model: RT-MWK07

List Model No.: RT-MWK07, RT307, RT-MWK07RF, i7, i07, i7+, i7S, K07, RiiK07, Rii07, ZW-52007, ZW-52007BT, ZW-52007-1, ZW-52007-2

Prepared for	:	Shenzhen Reiie intelligent technology Co., ltd
Address	:	401, 4F, NO.1 Building, Zhongkenuo Industry Park, Hezhou Development Zone, Xixiang Street, Baoan District, Shenzhen City, China

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample	:	Feb 28, 2017
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	Feb 28, 2017~Mar 08, 2017
Date of Report	:	Mar 08, 2017

FCC TEST REPORT FCC CFR 47 PART 15 C(15.247)	
Report Reference No. ..... :	**LCS1702282450E**
Date of Issue ..... :	Mar 08, 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 Reiie intelligent technology Co., ltd**
Address ..... :	401, 4F, NO.1 Building, Zhongkenuo Industry Park, Hezhou Development Zone, Xixiang Street, Baoan District, Shenzhen City, 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. ..... :	**2.4G Wireless Controller**
Trade Mark..... :	N/A
Test Model ..... :	RT-MWK07
Ratings ..... :	DC 3V by 1.5V AAA type Battery*2
Result ..... :	**Positive**

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

FCC -- TEST REPORT

Test Report No. : LCS1702282450E	Mar 08, 2017 Date of issue

Test Model.....	: RT-MWK07
EUT.....	: 2.4G Wireless Controller
Applicant.....	**: Shenzhen Reiie intelligent technology Co., ltd**
Address.....	: 401, 4F, NO.1 Building, Zhongkenuo Industry Park, Hezhou Development Zone, Xixiang Street, Baoan District, Shenzhen City, China
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: Shenzhen Reiie intelligent technology Co., ltd**
Address.....	: 401, 4F, NO.1 Building, Zhongkenuo Industry Park, Hezhou Development Zone, Xixiang Street, Baoan District, Shenzhen City, China
Telephone.....	: /
Fax.....	: /
Factory.....	: **Shenzhen Reiie intelligent technology Co., ltd**
Address.....	: 401, 4F, NO.1 Building, Zhongkenuo Industry Park, Hezhou Development Zone, Xixiang Street, Baoan District, Shenzhen City, 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	Mar 08, 2017	Initial Issue	Gavin Liang

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1 Description of Device (EUT)

EUT	:	2.4G Wireless Controller
Test Model	:	RT-MWK07
List Model No.	:	RT-MWK07, RT307, RT-MWK07RF, i7, i07, i7+, i7S, K07, RiiK07, Rii07, ZW-52007, ZW-52007BT, ZW-52007-1, ZW-52007-2
Model Declaration	:	PCB board, structure and internal of these model(s) are the same, so no additional models were tested.
Hardware Version	:	RT-K07-V22
Software Version	:	V01
Power Supply	:	DC 3V by 1.5V AAA type Battery*2
EUT Supports Radios Application	:	2.4GHz FHSS
2.4GHz FHSS	:	
Operating Frequency	:	2.407-2.477GHz
Channel Number	:	16 channels(DSS)
Channel Spacing	:	1MHz(Minimum) 13MHz(Maximum)
Modulation Type	:	GFSK
Antenna Description	:	PCB Antenna, -1dBi(Max.)

1.2 Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
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1.3 External I/O

I/O Port Description	Quantity	Cable
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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 List Of Measuring Equipments

Instrument	Manufacture	Model No.	Serial No.	Characteristics	Cal Date	Due Date
EMC Receiver	R&S	ESCS 30	100174	9kHz – 2.75GHz	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 FRANKONIA	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-26.5GHz	Apr 18, 2016	Apr 17, 2017
Amplifier	MITEQ	AMF-6F-260400	9121372	26.5GHz-40GHz	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-40GHz	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 Soure	GW	GPC-6030D	C671845	DC 1V-60V	Jun 18, 2016	Jun 17, 2017
Temp. and Humidigy 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~40GHz	Jul 16, 2016	Jul 15, 2017
Universal Radio Communication Tester	R&S	CMU200	112012	N/A	Oct 27, 2016	Oct 26, 2017
Wideband Radia Communication Tester	R&S	CMW500	1201.0002K50	N/A	Nov 19, 2016	Nov 18, 2017
MXG Vector Signal Generator	Agilent	N5182A	MY47071151	250KHz~6GHz	Oct 27, 2016	Oct 26, 2017
MXG Vector Signal Generator	Agilent	E4438C	MY42081396	250KHz~6GHz	Oct 27, 2016	Oct 26, 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
DC Power Supply	Agilent	E3642A	/	0-8V,5A/0-20V,2.5A	May 20, 2016	May 19, 2017

RF Control Unit	Tonscend	JS0806-1	/	/	Nov 19, 2016	Nov 18, 2017
LTE Test Software	Tonscend	JS1120-1	/	Version: 2.5.7.0	N/A	N/A
X-series USB Peak and Average Power Sensor Agilent	Agilent	U2021XA	MY54080022	/	Oct 27, 2016	Oct 26, 2017
4 Ch.Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	MY54080016	/	Oct 27, 2016	Oct 26, 2017
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

1.6 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.

1.7 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

The device operates in the unlicensed ISM Band at 2.4GHz. The data rates can be up to 1 Mb/s. The rate of 1 Mb/s is achieved by modulating the RF carrier using GFSK techniques. 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 worse 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	2407	1
	2440	1
	2477	1
For Conducted Emission		
Test Mode	TX Mode	
For Radiated Emission		
Test Mode	TX Mode	

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

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

Operating channel & frequency list:

Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	2407	7	2435	13	2467
2	2408	8	2437	14	2468
3	2410	9	2440	15	2469
4	2414	10	2441	16	2477
5	2421	11	2442		
6	2428	12	2455		

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 transmit condition.

3.2 EUT Exercise Software

N/A.

3.3 Special Accessories

N/A.

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.

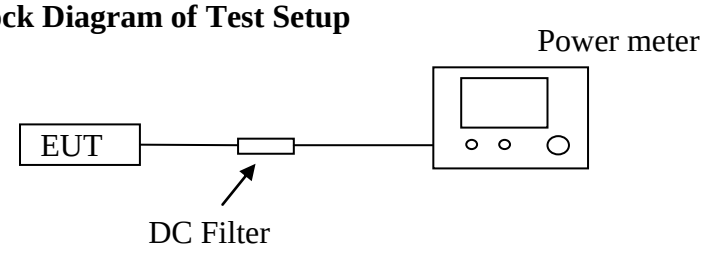
4. SUMMARY OF TEST RESULTS

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	N/A
§15.203	Antenna Requirements	Compliant

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.

5.1.4 Test Results

Temperature	25.5℃	Humidty	48.8%
Test Engineer	Kyle Yin	Configurations	TX

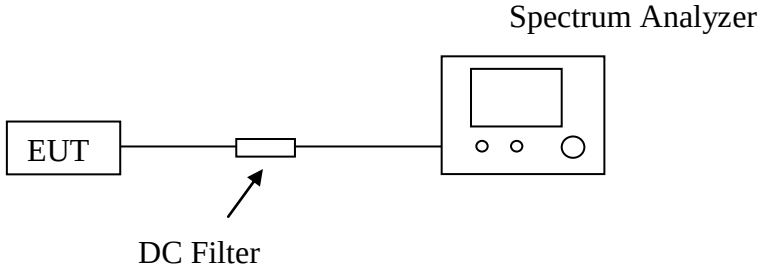
Mode	Frequency (MHz)	Output Power (dBm, Peak)	Output Power (mW, Peak)	Limit (mW)	Result
GFSK	2407	5.116	3.25	125	Pass
	2440	4.984	3.15	125	Pass
	2477	4.936	3.12	125	Pass

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=100KHz / 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=30KHz / 100KHz; Sweep = auto; Detector function = peak;
   Trace = max hold.

5.2.4 Test Results

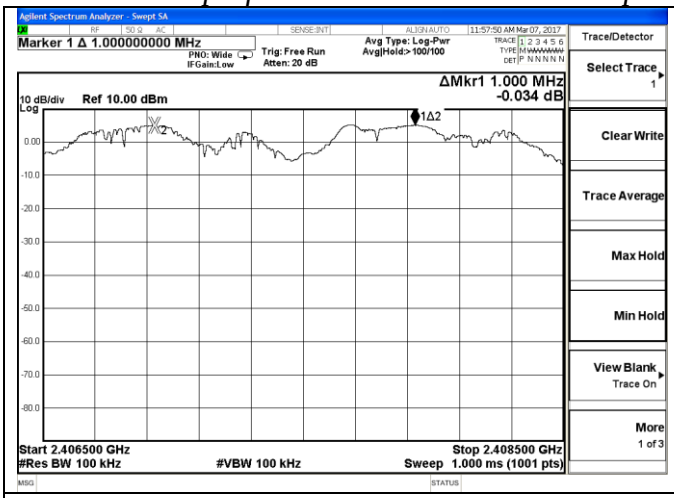
Temperature	25.5℃	Humidty	48.8%
Test Engineer	Kyle Yin	Configurations	TX

The Measurement Result With 1Mbps For GFSK Modulation		
20dB Bandwidth Measurement		
Channel	**20dB Bandwidth (MHz)**	**Limit**
Low	1.129	Non-specified
Middle	1.221	Non-specified
High	1.205	Non-specified

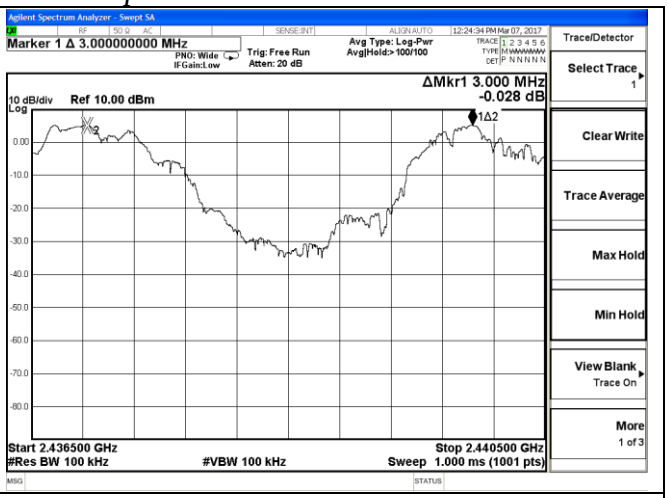
Channel Separation Measurement			
Channel	**Channel Separation (MHz)**	**Limit (MHz)**	**Result**
Low	1.000	>=25 KHz or 2/3*20dB BW	Pass
Middle	3.000	>=25 KHz or 2/3*20dB BW	Pass
High	8.000	>=25 KHz or 2/3*20dB BW	Pass

The test data refer to the following page.

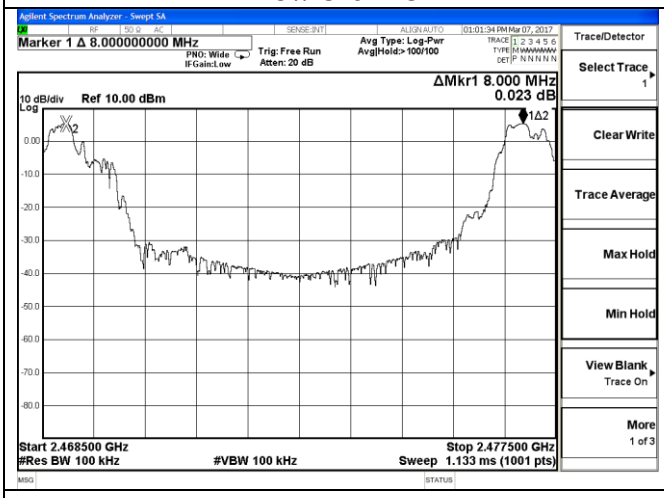
For Frequency Separation Measurement, the Low, Mid and High channels were performed and recorded the test plots in this report.



Low channel

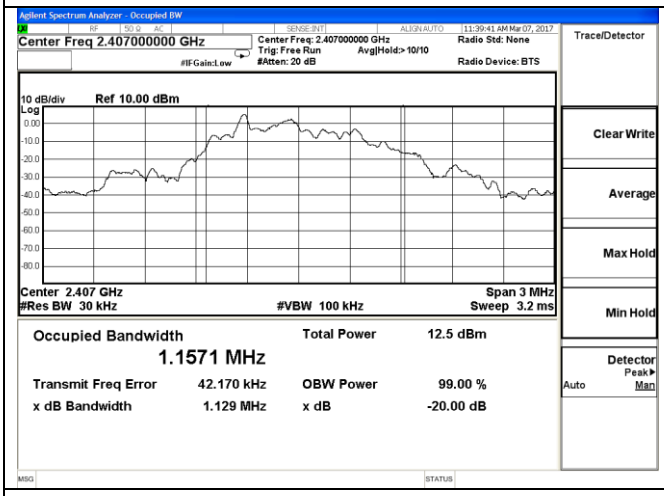


Middle channel

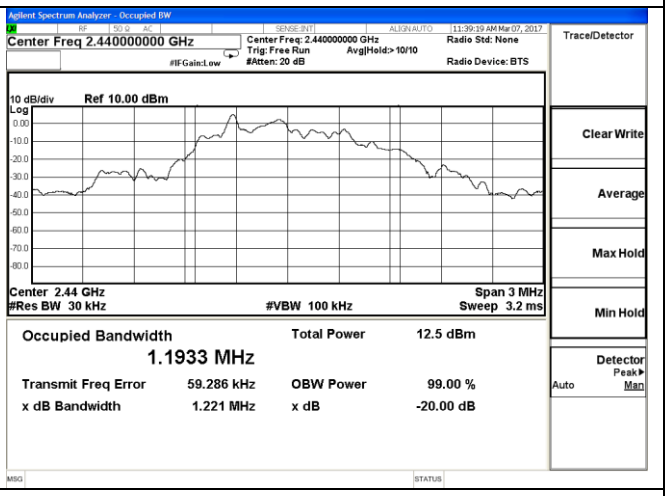


High channel

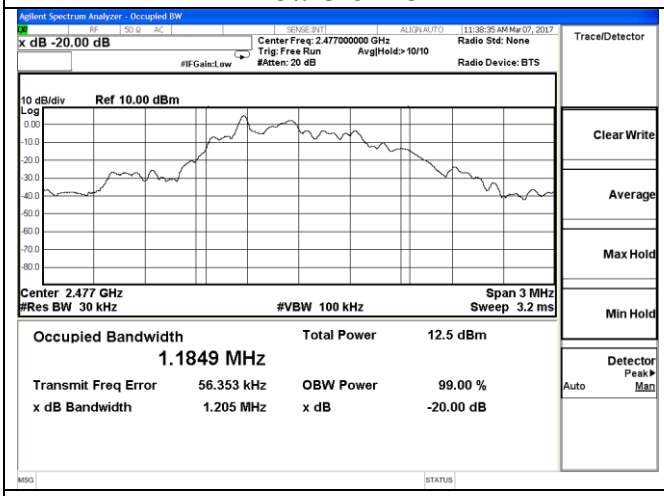
Measurement of 20dB Bandwidth



Low channel



Mid channel



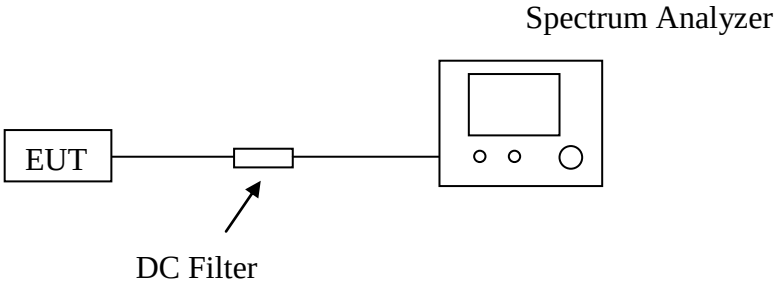
High channel

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.

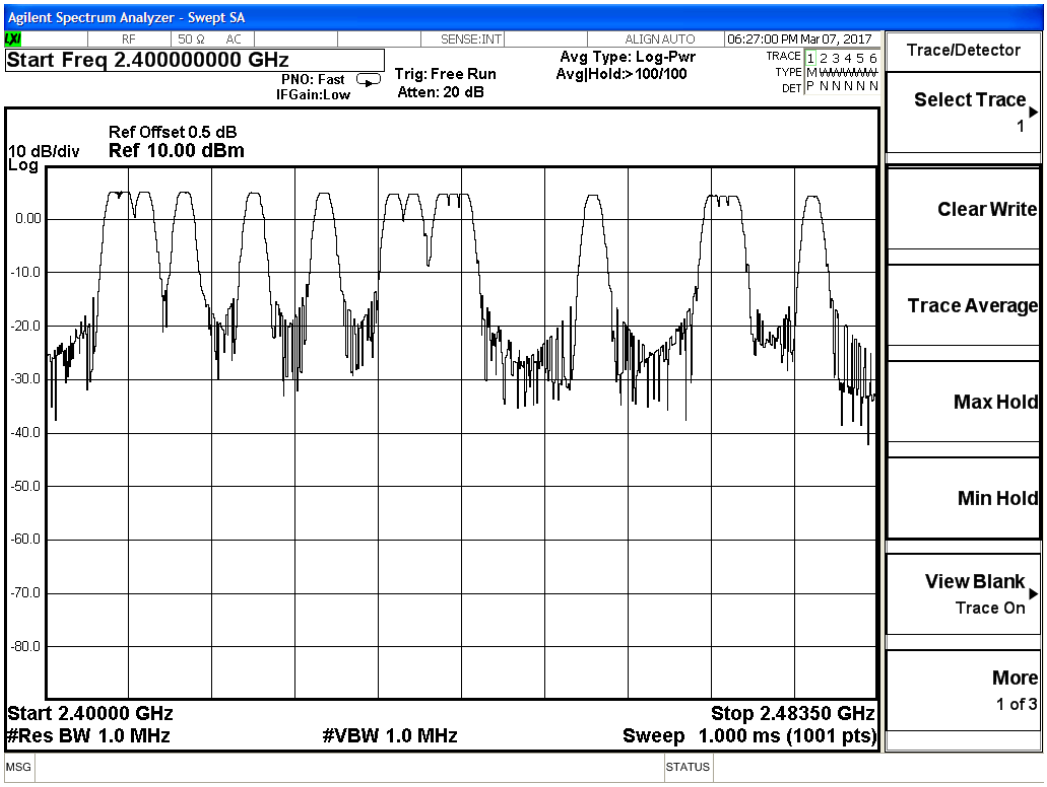
5.3.4 Test Results

Temperature	25.5℃	Humidty	48.8%
Test Engineer	Kyle Yin	Configurations	TX

Test Mode	Measurement Result (No. of Ch)	Limit (No. of Ch)	Result
Hopping(GFSK)	16	≥15	Pass

The worst test data refer to the following page.

Test Plot For Number of Hopping Channel(GFSK)

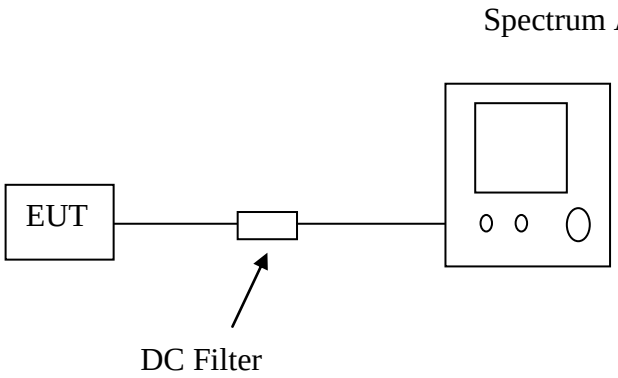


5.4 Time Of Occupancy (Dwell Time)

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(hopping) 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 time= long enough to capture a single pulse length(here we set it 2ms).
E. Set the Spectrum Analyzer as RBW, VBW=1MHz, Span = 0Hz, Sweep time=100ms, in order to capture the pulses number per 100ms. And calculate total pulses length.
F. Repeat above procedures until all frequency measured were complete.

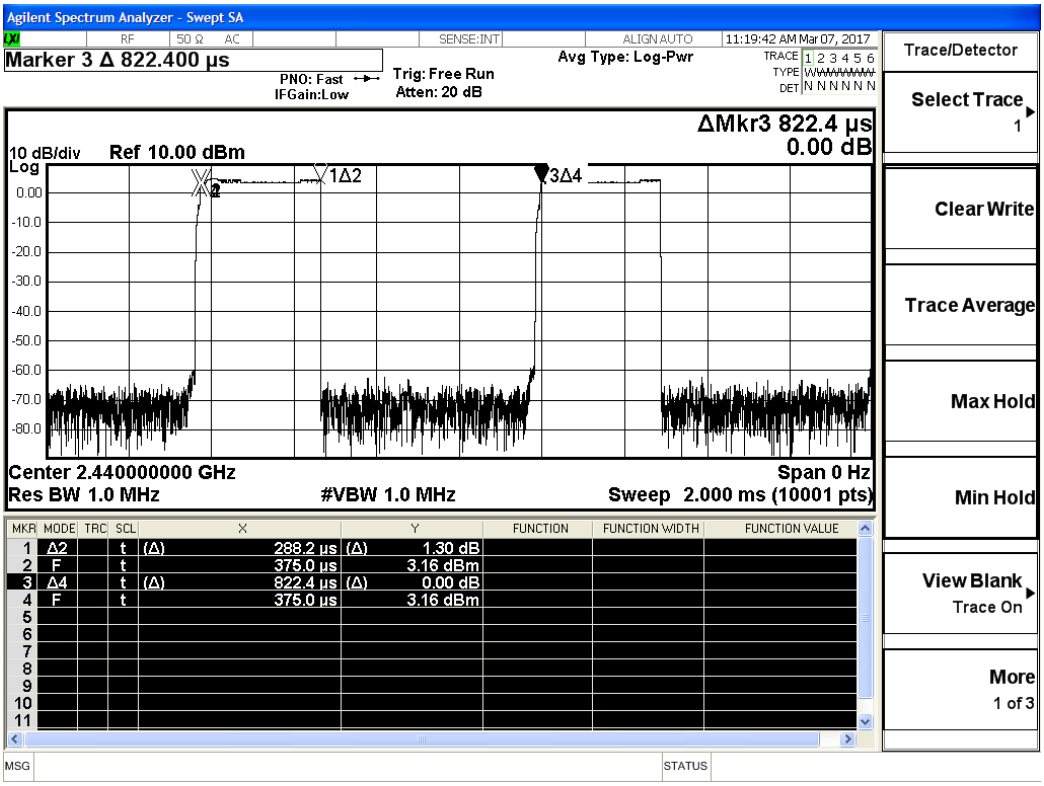
5.4.4 Test Results

Temperature	25.5℃	Humidty	48.8%
Test Engineer	Kyle Yin	Configurations	TX

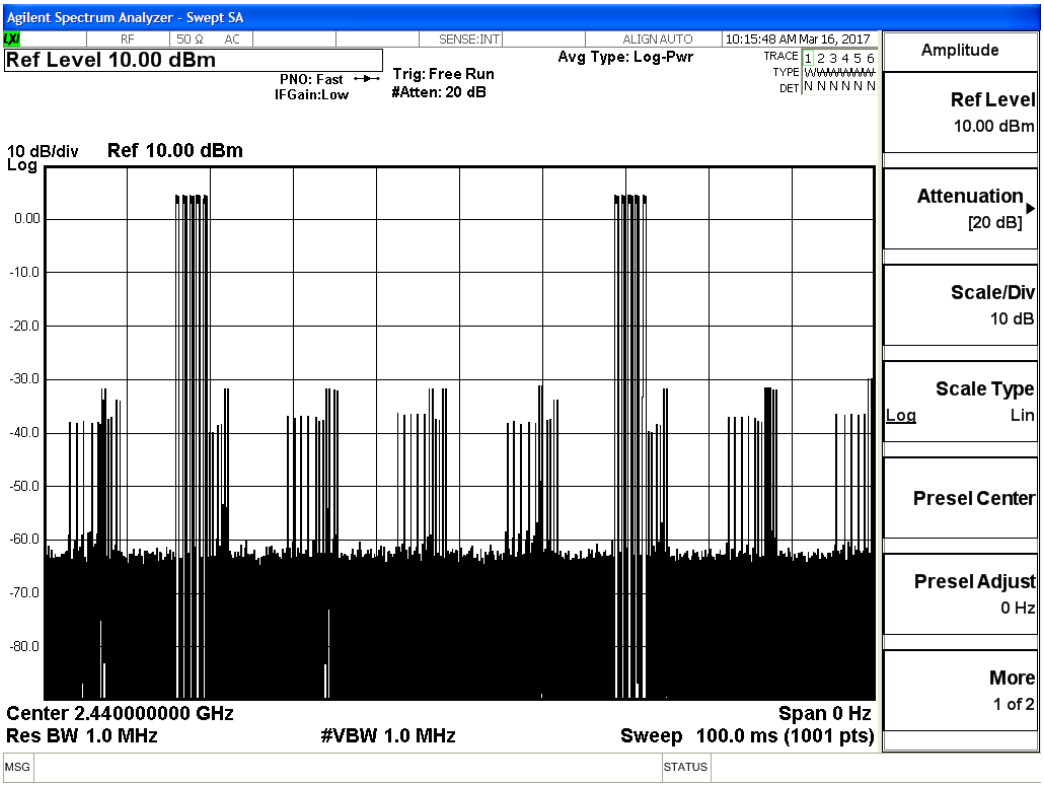
Channel	Duration of Each Pulse(ms)	Total Pulse number	Observation Period (s)	Dwell Time (ms)	Limit (ms)
Middle	0.2882	640	6.4	184.448	400

Calculation formula:

Dwell Time=Burst Length(ms)=Duration of Each Pulse*Total Pulse number
=0.2882*10*(6.4/0.1)ms=184.448ms



Duration of Each Pulse



Pulses number Per 100mS

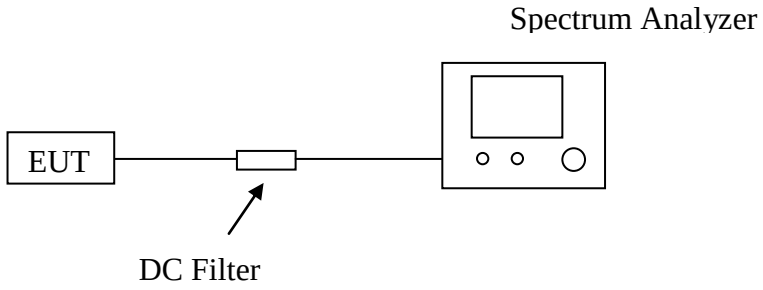
Note: only recorded the worst case of Mid channel.

5.5 Conducted Spurious Emissions and Band Edges Test

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.

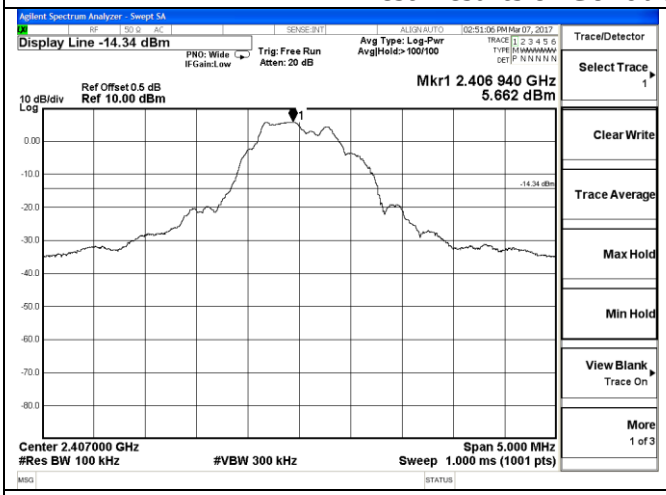
Measurements are made over the 9kHz to 26.5GHz range with the transmitter set to the lowest, middle, and highest channels

5.5.4 Test Results of Conducted Spurious Emissions

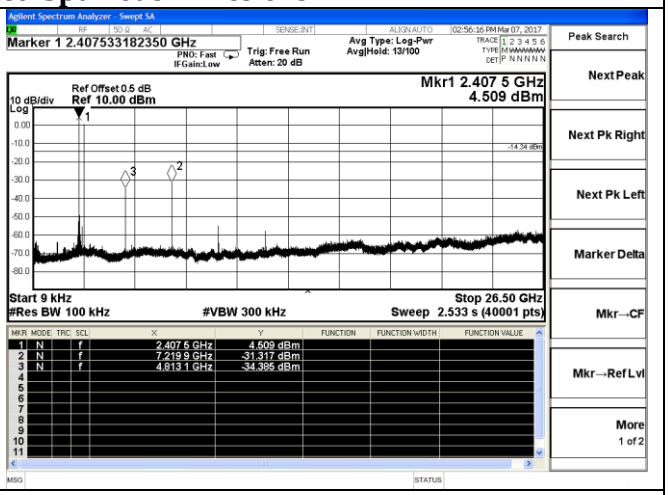
No non-compliance noted. Only record the worst test result (TX-GFSK) in this report. The test data refer to the following page.

Temperature	25.5℃	Humidty	48.8%
Test Engineer	Kyle Yin	Configurations	TX

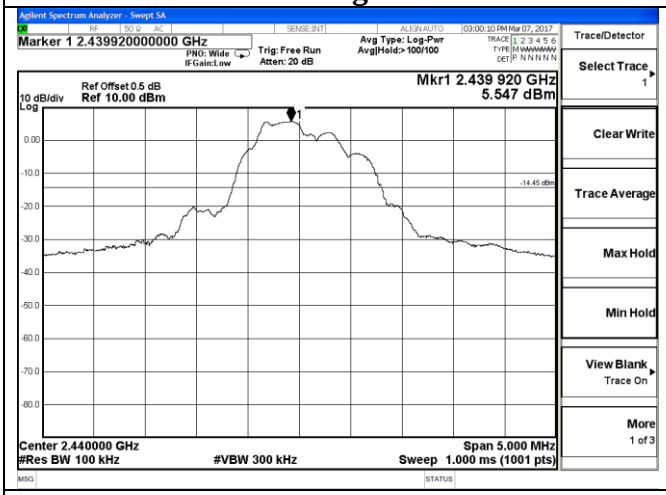
Test Results of Conducted Spurious Emissions



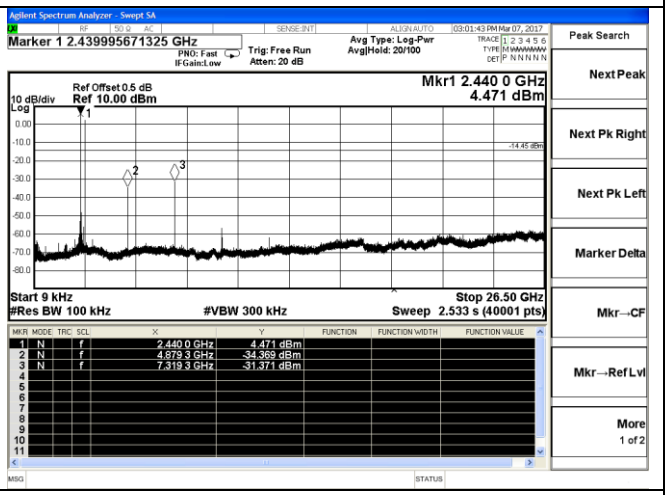
Reference Highest value



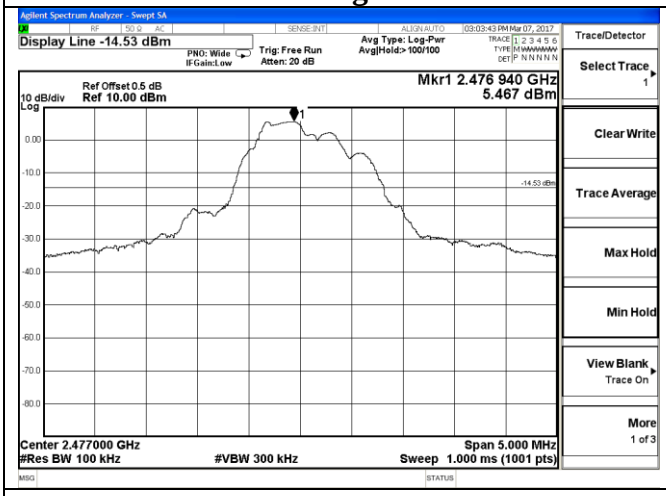
Low channel



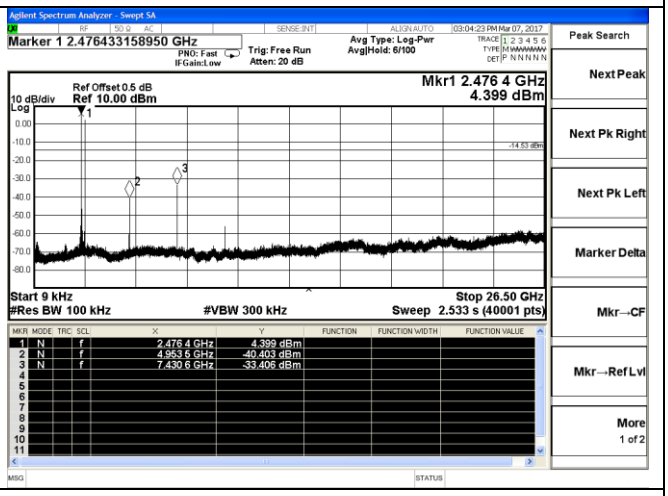
Reference Highest value



Mid channel



Reference Highest value



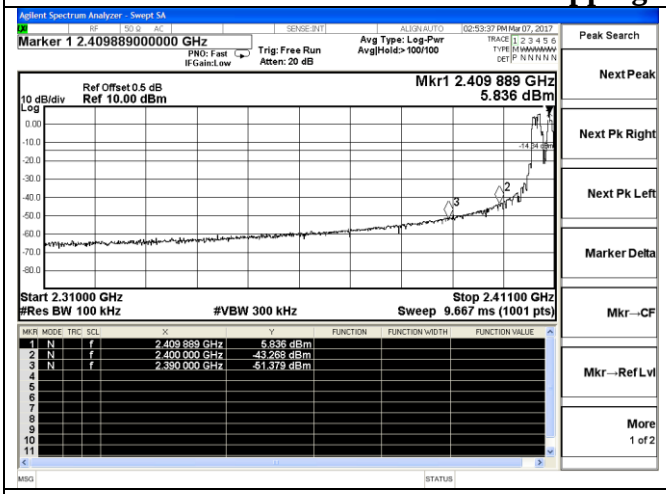
High channel

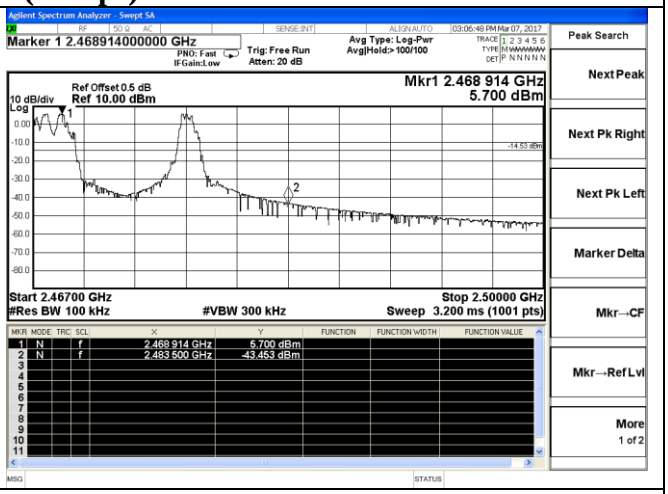
5.5.5 Test Results of Band Edges

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

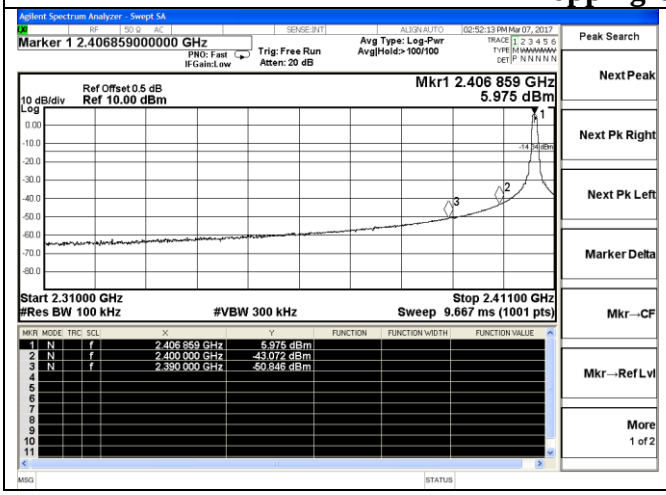
Test Results of Band Edges

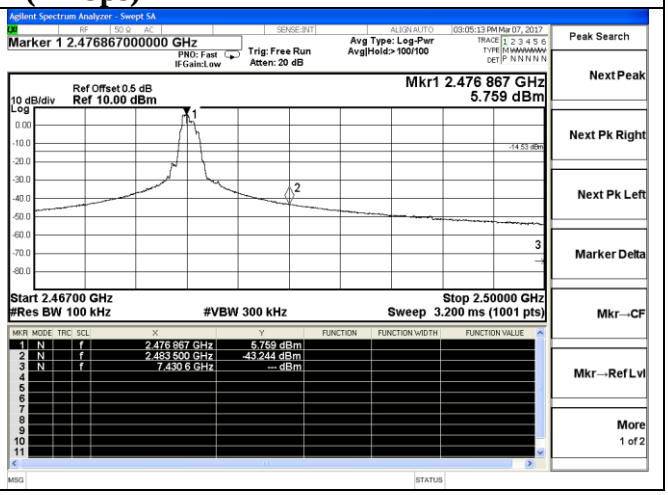
Hopping On (1Mbps)





Hopping Off (1Mbps)

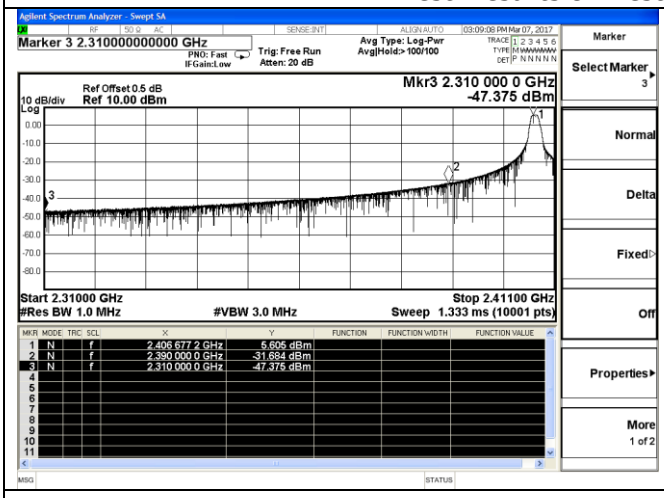


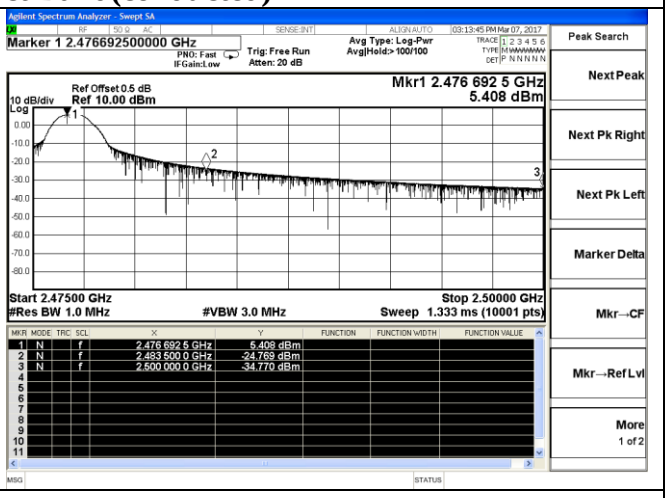


5.6 Restrict Band

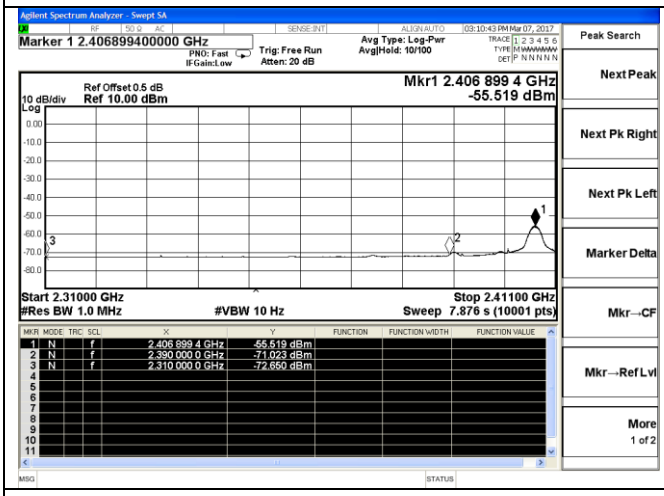
No non-compliance noted. Only record the worst test result in this report. The test data refer to the following page.

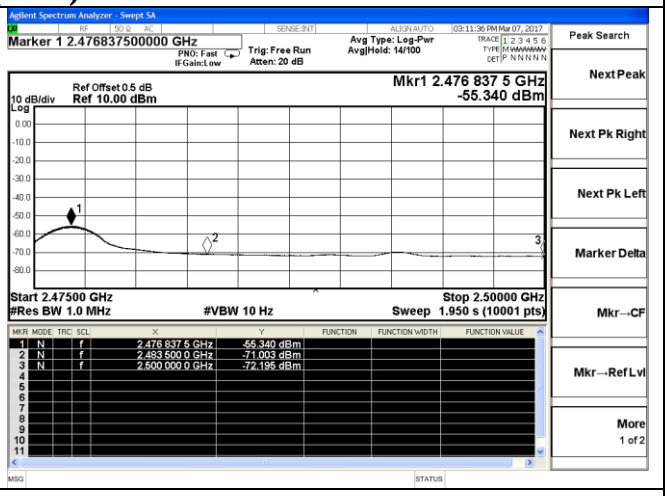
Test Results of Restrict Band(conducted)





GFSK(Peak)





GFSK(Average)

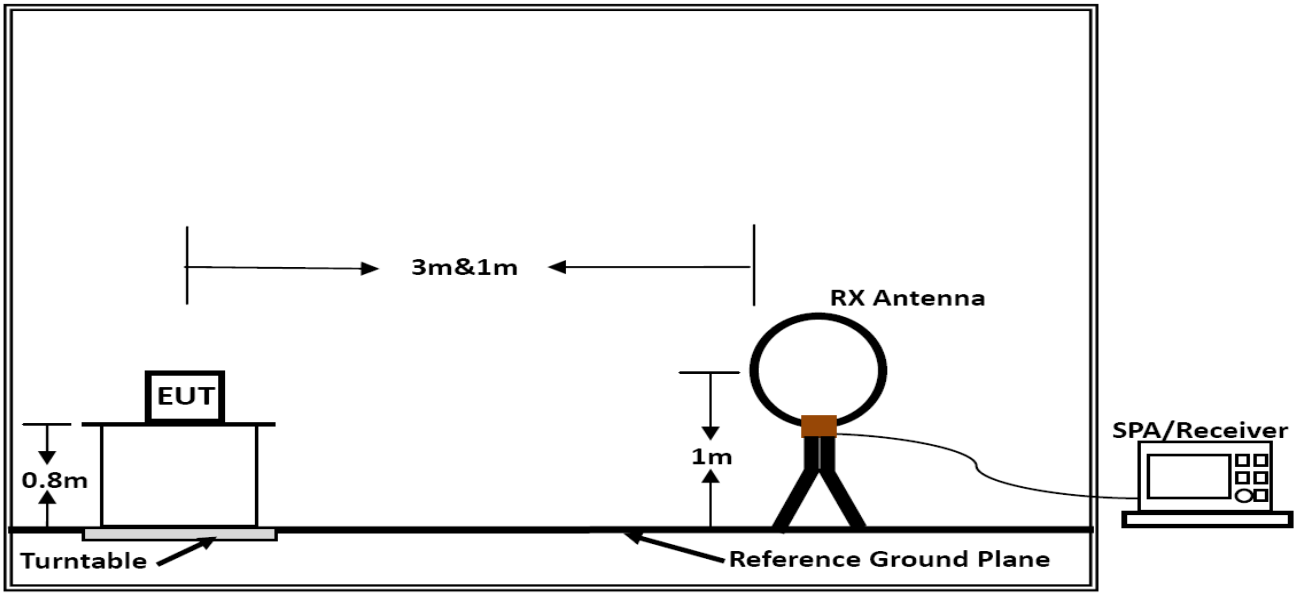
Test Results of Restrict Band (calculated radiation)							
Mode	Freq. MHz	Reading Level dBm	Antenna Gain dBi	Calculated E dBuV/m	Limit dBuV/m	Margin dB	Remark
GFSK	2310.000	-47.375	-1.00	46.86	74.00	-27.15	Peak
	2390.000	-31.684	-1.00	62.55	74.00	-11.45	Peak
	2483.500	-24.769	-1.00	69.46	74.00	-4.54	Peak
	2500.000	-34.770	-1.00	59.46	74.00	-14.54	Peak
	2310.000	-72.650	-1.00	21.58	54.00	-32.42	Average
	2390.000	-71.023	-1.00	23.21	54.00	-30.79	Average
	2483.500	-71.003	-1.00	23.23	54.00	-30.77	Average
	2500.000	-72.195	-1.00	22.04	54.00	-31.97	Average

Note:

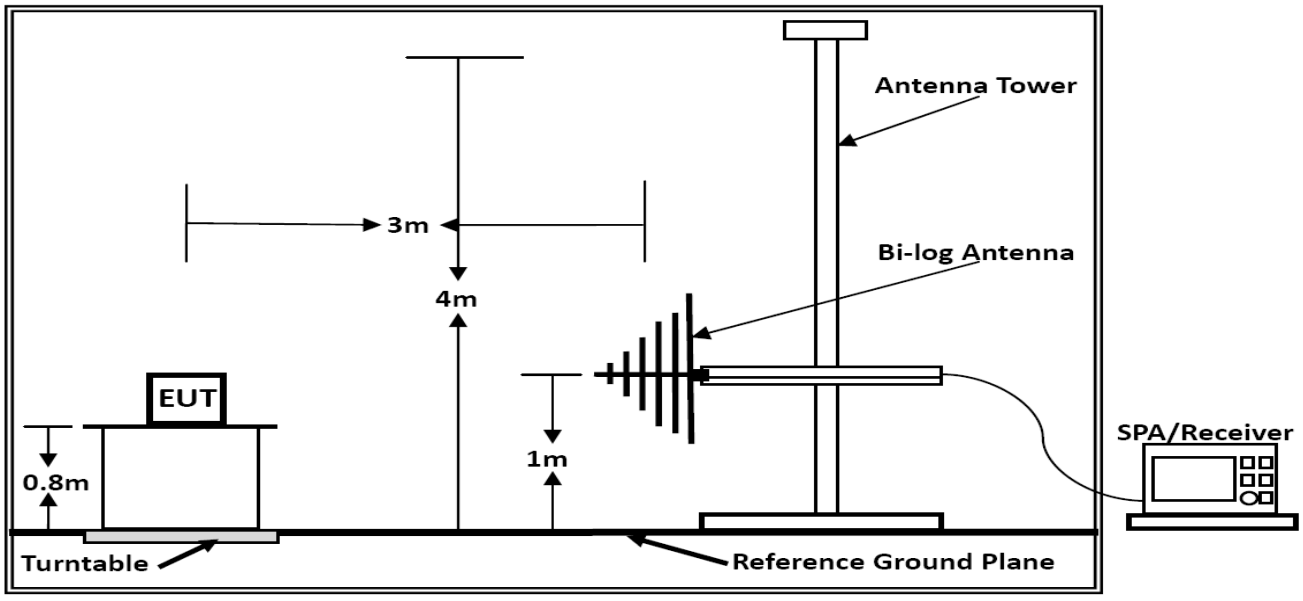
1). All modes have been tested and we only record the worst test result;
2). Measured E=Reading Level+Antenna Gain+104.77-(20LogD), Where D is 3

6. RADIATED MEASUREMENT

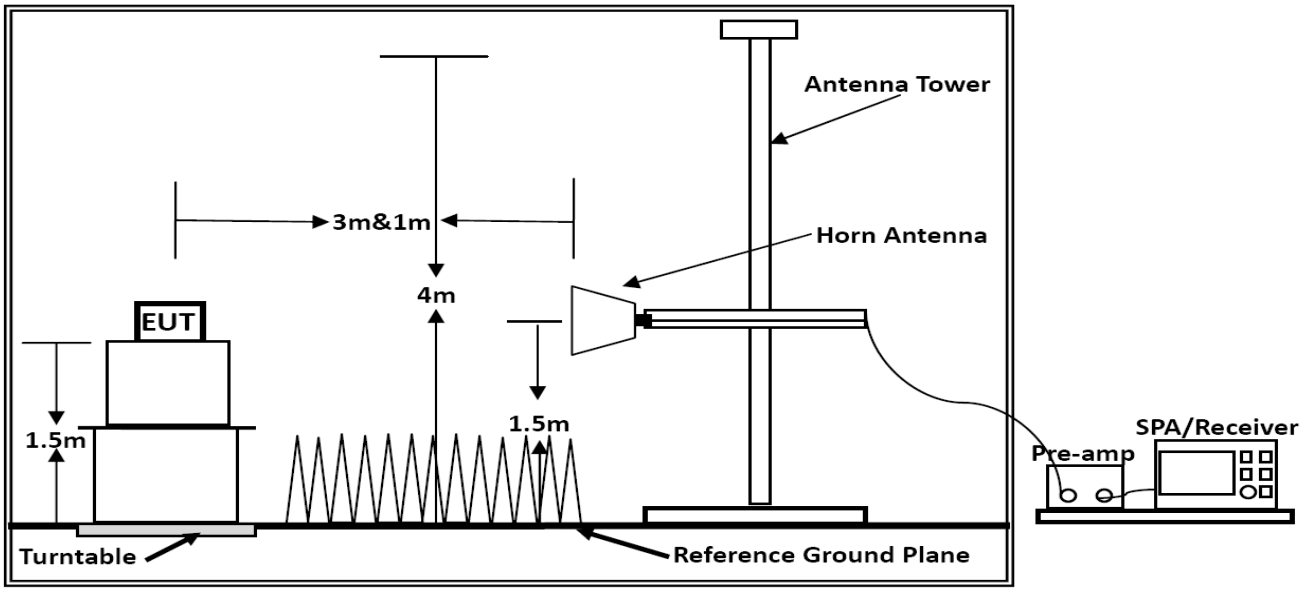
6.1 Block Diagram of Test Setup



Below 30MHz



Below 1GHz



Above 1GHz

6.2 Radiated Emission Limit

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 0.490-0.510MHz.

\2\ Above 38.6

Part 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector.

Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

Part 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (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

6.3 Instruments Setting

The following table is the setting of spectrum analyzer and receiver.

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

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 100kHz for QP

6.4 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 polarisations 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.

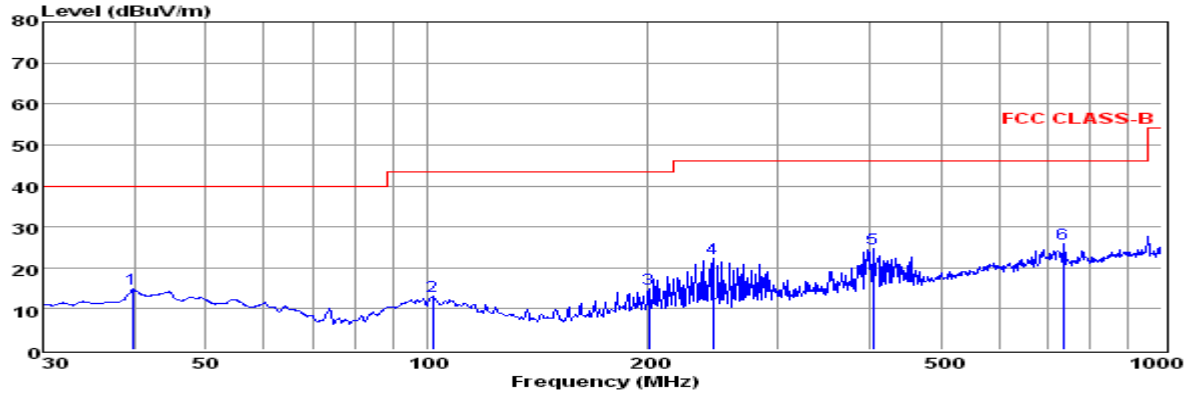
6.5 Results for Radiated Emissions

PASS.

Only record the worst test result in this report.
The radiated emissions from 9kHz to 30MHz are at least 20dB below the official limit and no need to report.
The test data please refer to following page:

Below 1GHz

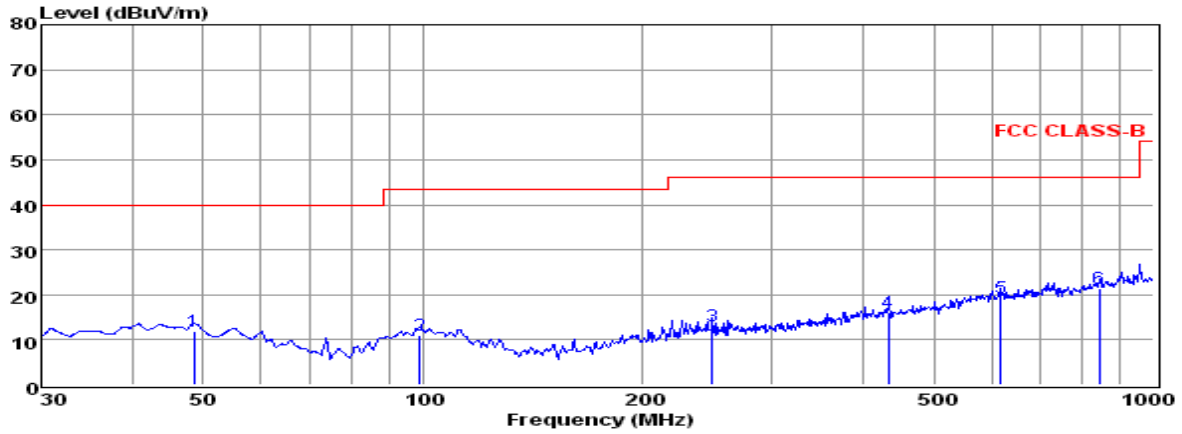
Horizontal:



	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	39.71	0.91	0.38	13.51	14.80	40.00	-25.20	QP
2	101.64	-0.61	0.60	13.01	13.00	43.50	-30.50	QP
3	200.69	3.46	0.84	10.59	14.89	43.50	-28.61	QP
4	245.09	9.43	0.90	12.08	22.41	46.00	-23.59	QP
5	404.67	8.08	1.32	15.16	24.56	46.00	-21.44	QP
6	734.49	4.82	1.74	19.24	25.80	46.00	-20.20	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	48.50	-1.88	0.35	13.34	11.81	40.00	-28.19	QP
2	98.83	-2.82	0.61	13.09	10.88	43.50	-32.62	QP
3	248.55	-0.11	1.02	12.07	12.98	46.00	-33.02	QP
4	434.07	-0.55	1.18	15.53	16.16	46.00	-29.84	QP
5	618.54	-0.74	1.51	18.52	19.29	46.00	-26.71	QP
6	842.13	-0.91	1.88	20.49	21.46	46.00	-24.54	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 mode and recorded the worst case results in this report (TX-Low 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:

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4814.0	55.28	33.06	35.04	3.94	57.24	74.00	-16.76	Peak	Horizontal
4814.0	39.68	33.06	35.04	3.94	41.64	54.00	-12.36	Average	Horizontal
4814.0	59.29	33.06	35.04	3.94	61.25	74.00	-12.75	Peak	Vertical
4814.0	41.94	33.06	35.04	3.94	43.90	54.00	-10.10	Average	Vertical
7221.00	54.65	34.25	36.11	4.45	57.24	74.00	-16.76	Peak	Horizontal
7221.00	40.00	34.25	36.11	4.45	42.59	54.00	-11.41	Average	Horizontal
7221.00	58.79	34.25	36.11	4.45	61.38	74.00	-12.62	Peak	Vertical
7221.00	42.14	34.25	36.11	4.45	44.73	54.00	-9.27	Average	Vertical
16849.00	56.64	38.22	40.17	5.91	60.60	74.00	-13.40	Peak	Horizontal
16849.00	45.32	38.22	40.17	5.91	49.28	54.00	-4.72	Average	Horizontal
16849.00	61.28	38.22	40.17	5.91	65.24	74.00	-8.76	Peak	Vertical
16849.00	45.70	38.22	40.17	5.91	49.66	54.00	-4.34	Average	Vertical

The worst test result for GFSK, TX-Middle Channel:

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4880.0	55.23	33.16	35.15	3.96	57.20	74.00	-16.80	Peak	Horizontal
4880.0	44.16	33.16	35.15	3.96	46.13	54.00	-7.87	Average	Horizontal
4880.0	59.10	33.16	35.15	3.96	61.07	74.00	-12.93	Peak	Vertical
4880.0	41.98	33.16	35.15	3.96	43.95	54.00	-10.05	Average	Vertical
7320.00	54.84	34.32	36.19	4.48	57.45	74.00	-16.55	Peak	Horizontal
7320.00	44.31	34.32	36.19	4.48	46.92	54.00	-7.08	Average	Horizontal
7320.00	58.60	34.32	36.19	4.48	61.21	74.00	-12.79	Peak	Vertical
7320.00	41.66	34.32	36.19	4.48	44.27	54.00	-9.73	Average	Vertical
17080.00	56.60	38.3	40.25	5.95	60.60	74.00	-13.40	Peak	Horizontal
17080.00	45.37	38.3	40.25	5.95	49.37	54.00	-4.63	Average	Horizontal
17080.00	61.17	38.3	40.25	5.95	65.17	74.00	-8.83	Peak	Vertical
17080.00	46.15	38.3	40.25	5.95	50.15	54.00	-3.85	Average	Vertical

The worst test result for GFSK, TX-High Channel:

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab.. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4954.0	54.96	33.26	35.14	3.98	57.06	74.00	-16.94	Peak	Horizontal
4954.0	43.00	33.26	35.14	3.98	45.10	54.00	-8.90	Average	Horizontal
4954.0	59.04	33.26	35.14	3.98	61.14	74.00	-12.86	Peak	Vertical
4954.0	42.24	33.26	35.14	3.98	44.34	54.00	-9.66	Average	Vertical
7431.00	55.19	34.39	36.27	4.52	57.83	74.00	-16.17	Peak	Horizontal
7431.00	42.81	34.39	36.27	4.52	45.45	54.00	-8.55	Average	Horizontal
7431.00	59.03	34.39	36.27	4.52	61.67	74.00	-12.33	Peak	Vertical
7431.00	42.27	34.39	36.27	4.52	44.91	54.00	-9.09	Average	Vertical
17339.00	57.27	38.38	40.32	5.99	61.32	74.00	-12.68	Peak	Horizontal
17339.00	44.94	38.38	40.32	5.99	48.99	54.00	-5.01	Average	Horizontal
17339.00	60.80	38.38	40.32	5.99	64.85	74.00	-9.15	Peak	Vertical
17339.00	46.10	38.38	40.32	5.99	50.15	54.00	-3.85	Average	Vertical

Notes:

1. *Measuring frequencies from 9k~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30MHz.*
2. *Radiated emissions measured in frequency range from 9k~10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.*
3. *Emission from 18~25GHz have at least have 20dB margin, therefore, it's not recorded in the test report.*

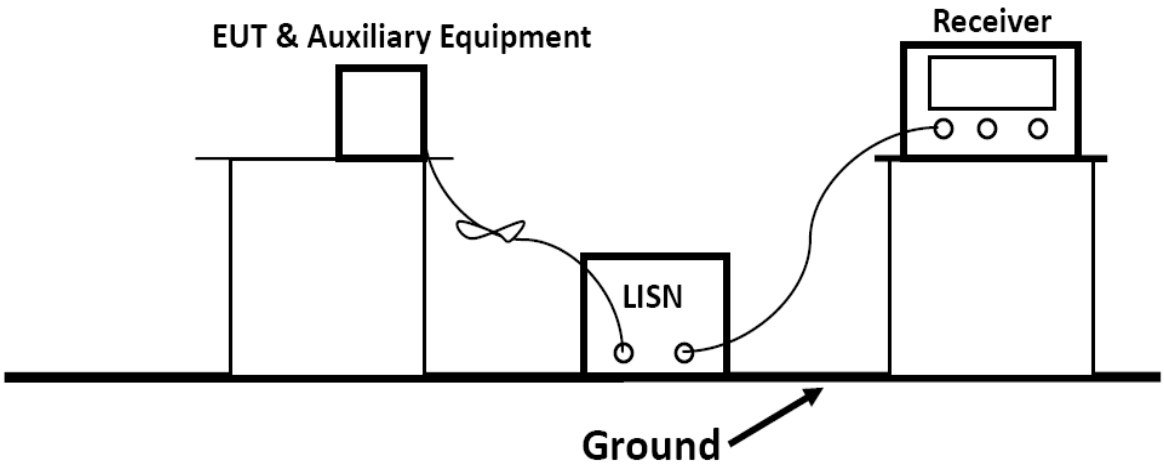
7. LINE CONDUCTED EMISSIONS

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 microvolt (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

7.2 Block Diagram of Test Setup



7.3 Test Results

N/A

The EUT is powered by battery only, without any I/O port that directly or indirectly connected to the AC power.

8. ANTENNA REQUIREMENT

8.1 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.

8.2 Antenna Connected Construction

8.2.1. Antenna Connector Construction

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

The EUT use a PCB antenna, the maximum gain is -1.0dBi; more information as follows.

8.2.2. 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 refer 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.

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