



FCC TEST REPORT

Test report
On Behalf of
Shenzhen SEI Robotics Co., Ltd
For
OTT+speaker
Model No.: SK410A,SK410AX("X" on behalf of one of 26
English Letters A-Z)

FCC ID: 2AOVU-SK410AX

Prepared for : **Shenzhen SEI Robotics Co., Ltd**
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Date of Test: **Jan.29, 2021~ Feb.24, 2021 and**
Mar.8, 2021~ Mar.19, 2021

Date of Report: **Mar.21, 2021**

Report Number: **TZ210101970-E3**

The test report apply only to the specific sample(s) tested under stated test conditions
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TEST RESULT CERTIFICATION

Applicant's name : **Shenzhen SEI Robotics Co., Ltd**
4th Floor, Productivity Building D, #5 Hi-Tech Middle 2nd Road,
Address : Shenzhen Hi-Tech Industrial Park, Nanshan District, Shenzhen,
China
Manufacture's Name : **Shenzhen SEI Robotics Co., Ltd**
4th Floor, Productivity Building D, #5 Hi-Tech Middle 2nd Road,
Address : Shenzhen Hi-Tech Industrial Park, Nanshan District, Shenzhen,
China

Product description

Trade Mark: N/A
Product name : OTT+speaker
Model and/or type reference : SK410A,SK410AX("X" on behalf of one of 26 English Letters A-Z)
Standards : FCC Rules and Regulations Part 15 Subpart C Section 15.247
ANSI C63.10: 2013

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Date of Test :
Date (s) of performance of tests : Jan.29, 2021~ Feb.24, 2021 and
Mar.8, 2021~ Mar.19, 2021
Date of Issue : Mar.21, 2021
Test Result : **Pass**

Testing Engineer : Anna Hu

(Anna Hu)

Technical Manager : Hugo Chen

(Hugo Chen)

Authorized Signatory : Andy Zhang

(Andy Zhang)



Revision History

Revision	Issue Date	Revisions	Revised By
00	Feb.25, 2021	Initial Issue	Andy Zhang



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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	: OTT+speaker
Model Number	: SK410A,SK410AX("X" on behalf of one of 26 English Letters A-Z)
Model Declaration	: All the same except for model name and color of cover
Test Model	: SK410A
Power Supply	: DC 12V by adapter
Hardware version	: SMB.282.05
Software version	: Android 10
Sample ID	: TZ210101970-2#&TZ210101970-4#

Bluetooth

Bluetooth Version	: V5.0
Channel Number	: 79 Channels for Bluetooth BR/EDR(DSS) : 40 Channels for BLE (DTS)
Modulation Technology	: GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth BR/EDR (DSS) : GFSK for BLE (DTS)
Data Rates	: Bluetooth BR/EDR (DSS): 1/2/3Mbps : BLE (DTS): 1/2Mbps
Antenna Type And Gain	: Internal Antenna 3: : 3.52dBi

WiFi

WLAN	: Supported IEEE 802.11a/b/g/n/ac/ax IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz / 5180-5240MHz / 5745-5825MHz IEEE 802.11a: 5180-5240MHz / 5745-5825MHz
WLAN FCC Operation Frequency	: IEEE 802.11ac VHT20: 5180-5240MHz / 5745-5825MHz : IEEE 802.11ac VHT40: 5190-5230MHz / 5755-5795MHz : IEEE 802.11ac VHT80: 5210MHz / 5775MHz : IEEE 802.11ax HT20: 2412-2462MHz / 5180-5240MHz / 5745-5825MHz : IEEE 802.11ax HT40: 5190-5230MHz / 5755-5795MHz : IEEE 802.11ax HT80: 5210MHz / 5775MHz
WLAN Channel Number	: 11 Channels for 2412-2462MHz(IEEE 802.11b/g/n HT20) : 4 Channels for 5180-5240MHz (IEEE 802.11a/ac VHT20/n HT20/ax HT20) : 2 Channels for 5190-5230MHz (IEEE 802.11ac VHT40/n HT40/ax HT40) : 1 Channels for 5210MHz (IEEE 802.11ac VHT80/ax HT80) : 5 Channels for 5745-5825MHz(IEEE 802.11a/ac VHT20/n HT20/ax HT20) : 2 Channels for 5755-5795MHz(IEEE 802.11ac VHT40/n HT40/ax HT40)



1 Channels for 5775MHz(IEEE 802.11ac VHT80/ax HT80)

WLAN Modulation Technology : IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK)
IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK)
IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK)
IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK)
IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
IEEE 802.11ax: OFDM (1024-QAM,256QAM, 64QAM, 16QAM, QPSK, BPSK)

Antenna 1:

4.56dBi(Max.), for TX/RX (WLAN 2.4G Band)
4.08dBi(Max.), for TX/RX (WLAN 5.2G Band)
5.87dBi (Max.), for TX/RX (WLAN 5.8G Band)

Antenna Type And Gain

: Antenna 2:

3.94dBi(Max.), for TX/RX (WLAN 2.4G Band)
4.37dBi(Max.), for TX/RX (WLAN 5.2G Band),
7.2dBi(Max.), for TX/RX (WLAN 5.8G Band)
802.11n/ac/ax support 2T2R.[Antenna 1 and Antenna 2]

Note1: Antenna position refer to EUT Photos



1.2. Host System Configuration List and Details

supplied by the lab supplied by the manufacturer

Manufacturer	Description	Model	Serial Number	Certificate
RUIJING	Adapter1	RJ23-W120100US	N/A	N/A
FRECOM	Adapter2	F12L33-120100SPAU	N/A	N/A

1.3. External I/O Cable

I/O Port Description	Quantity	Cable
HDMI Port	1	1.8m, un-shielded
Optical Port	1	N/A
LAN Port	1	N/A
USB Port	1	N/A
DC Port	1	N/A

1.4 Description of Test Facility

FCC

Designation Number: CN1275

Test Firm Registration Number: 167722

Shenzhen Tongzhou Testing Co.,Ltd has been listed on the US Federal Communications Commission

list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA

Certificate Number: 5463.01

Shenzhen Tongzhou Testing Co.,Ltd has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

IC

ISED#: 22033

CAB identifier: CN0099

Shenzhen Tongzhou Testing Co.,Ltd has been listed by Innovation, Science and Economic Development Canada to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010



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 Shenzhen Tongzhou Testing Co.,Ltd's 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 Measurement Uncertainty

Test Item	Frequency Range	Uncertainty	Note
Radiation Uncertainty	9KHz~30MHz	±3.08dB	(1)
	30MHz~1000MHz	±4.42dB	(1)
	1GHz~40GHz	±4.06dB	(1)
Conduction Uncertainty	150kHz~30MHz	±2.23dB	(1)

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

1.7 Description of Test Modes

Bluetooth operates in the unlicensed ISM Band at 2.4GHz.

The following operating modes were applied for the related test items. 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)
BT V 3.0	2402	1/2/3
	2441	1/2/3
	2480	1/2/3
For Conducted Emission		
Test Mode		TX Mode
For Radiated Emission		
Test Mode		TX Mode

Worst-case mode and channel used for 150 kHz-30 MHz power line conducted emissions was the mode and channel with the highest output power that was determined to be TX (3Mbps-High Channel).

Worst-case mode and channel used for 9kHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be TX(3Mbps-High Channel).

Pre-test AC conducted emission at supplied by Adapter Mode, recorded worst case.

Pre-test AC conducted emission at both voltage AC 120V/60Hz and AC 240V/50Hz, recorded worst case.



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 normal operating mode for Hopping Numbers and a continuous transmits mode for other tests.

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

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT 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 the turntable, which is 0.8 m above ground plane. 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

2.4. Test Sample

The application provides 2 samples to meet requirement;

Sample ID	Description
TZ210101970-2#	BT Engineer sample – continuous transmit
TZ210101970-4#	Normal sample – Intermittent transmit



3. SYSTEM TEST CONFIGURATION

3.1 Justification

The system was configured for testing in a continuous transmits condition.

3.2 EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by software (adb command) provided by application.

3.3 Special Accessories

No.	Equipment	Manufacturer	Model No.	Serial No.	Length	shielded/ unshielded	Notes
1	PC	ASUS	X454L	15105-0038A100	/	/	/

3.4 Block Diagram/Schematics

Please refer to the related document.

3.5 Equipment Modifications

Shenzhen Tongzhou Testing Co.,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	Sample ID	Result
§15.247(b)(1)	Maximum Conducted Output Power	TZ210101970-2#	Compliant
§15.247(c)	Frequency Separation And 20 dB Bandwidth	TZ210101970-2#	Compliant
§15.247(a)(1)(ii)	Number Of Hopping Frequency	TZ210101970-2#	Compliant
§15.247(a)(1)(iii)	Time Of Occupancy (Dwell Time)	TZ210101970-2#	Compliant
§15.209, §15.247(d)	Radiated and Conducted Spurious Emissions	TZ210101970-2#& TZ210101970-4#	Compliant
§15.205	Emissions at Restricted Band	TZ210101970-2#	Compliant
§15.207(a)	Conducted Emissions	TZ210101970-4#	Compliant
§15.203	Antenna Requirements	TZ210101970-2#	Compliant
§15.247(i)§2.1093	RF Exposure	N/A	Compliant



5. SUMMARY OF TEST EQUIPMENT

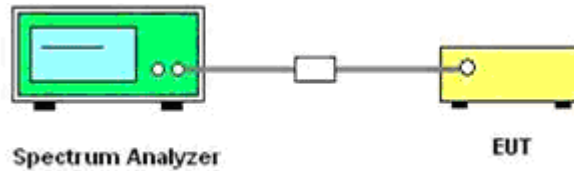
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	MXA Signal Analyzer	Keysight	N9020A	MY52091623	2021/1/4	2022/1/3
2	Power Sensor	Agilent	U2021XA	MY5365004	2021/1/4	2022/1/3
3	Power Meter	Agilent	U2531A	TW53323507	2021/1/4	2022/1/3
4	Wideband Antenna	schwarzbeck	VULB 9163	958	2019/11/16	2022/11/15
5	Horn Antenna	schwarzbeck	9120D-1141	1574	2019/11/16	2022/11/15
6	EMI Test Receiver	R&S	ESCI	100849/003	2021/1/4	2022/1/3
7	Controller	MF	MF7802	N/A	N/A	N/A
8	Amplifier	schwarzbeck	BBV 9743	209	2021/1/4	2022/1/3
9	Amplifier	Tonscend	TSAMP-0518SE	--	2021/1/4	2022/1/3
10	RF Cable(below 1GHz)	HUBER+SUHNER	RG214	N/A	2021/1/4	2022/1/3
11	RF Cable(above 1GHz)	HUBER+SUHNER	RG214	N/A	2021/1/4	2022/1/3
12	Artificial Mains	ROHDE & SCHWARZ	ENV 216	101333-IP	2021/1/4	2022/1/3
12	EMI Test Software	ROHDE & SCHWARZ	ESK1	V1.71	N/A	N/A
14	RE test software	Tonscend	JS32-RE	V2.0.2.0	N/A	N/A
15	Test Software	Tonscend	JS1120-3	V2.5.77.0418	N/A	N/A
16	Horn Antenna	A-INFO	LB-180400-KF	J211020657	2019/11/16	2022/11/15
17	Amplifier	CDSA	PAP-1840	17021	2020/03/24	2021/03/23



6. MEASUREMENT RESULTS

6.1 Peak Power

6.1.1 Block Diagram of Test Setup



6.1.2 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: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

6.1.3 Test Procedure

The transmitter output is connected to the Spectrum Analyzer

6.1.4 Test Results

PASS

Temperature	25.5°C	Humidity	55%
Test Engineer	Anna Hu	Configurations	BT

Remark:

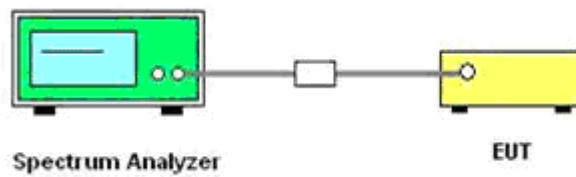
1. Test results including cable loss;
2. please refer to following plots;
3. Measured output power at difference Packet Type for each mode and recorded worst case for each mode.
4. Plesase See Appendix Test Data for BT(BDR&EDR) for Peak Output Power test data

6.2 Frequency Separation and 20 dB Bandwidth

6.2.1 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.

6.2.2 Block Diagram of Test Setup



6.2.3 Test Procedure

Frequency separation test procedure :

- 1). Place the EUT on the table and set it in transmitting mode.
- 2). Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer.
- 3). Set center frequency of Spectrum Analyzer = middle of hopping channel.
- 4). Set the Spectrum Analyzer as RBW = 100 kHz, VBW = 300 kHz, Span = wide enough to capture the peaks of two adjacent channels, Sweep = auto.
- 5). Max hold, mark 2 peaks of hopping channel and record the 2 peaks frequency.

20dB bandwidth test procedure :

- 1). Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel.
- 2). RBW \geq 1% of the 20 dB bandwidth, VBW \geq RBW.
- 3). Detector function = peak.
- 4). Trace = max hold.

6.2.4 Test Results

PASS

Temperature	25.5°C	Humidity	55%
Test Engineer	Anna Hu	Configurations	BT

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. Please See Appendix Test Data for BT(BDR&EDR) for 20dB Bandwidth test data
5. Please See Appendix Test Data for BT(BDR&EDR) for Carrier Frequency Separation test data

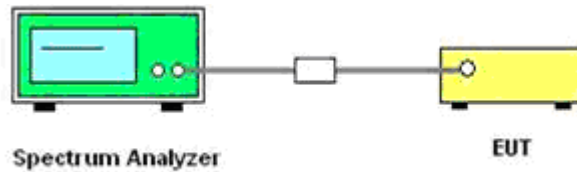


6.3 Number of Hopping Frequency

6.3.1 Limit

According to §15.247(a)(1)(ii) or A8.1 (d), Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

6.3.2 Block Diagram of Test Setup



6.3.3 Test Procedure

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

6.3.4 Test Results

PASS

Temperature	25.5°C	Humidity	55%
Test Engineer	Anna Hu	Configurations	BT

Remark:

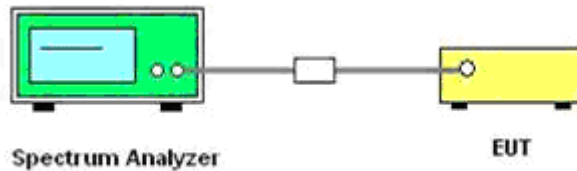
Plesase See Appendix Test Data for BT(BDR&EDR) for Hopping Channel Number test data

6.4 Time of Occupancy (Dwell Time)

6.4.1 Limit

According to §15.247(a)(1)(iii) or A8.1 (d), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

6.4.2 Block Diagram of Test Setup



6.4.3 Test Procedure

- 1). Place the EUT on the table and set it in transmitting mode.
- 2). Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer.
- 3). Set center frequency of Spectrum Analyzer = operating frequency.
- 4). Set the Spectrum Analyzer as RBW, VBW=1MHz, Span = 0Hz, Sweep = auto.
- 5). Repeat above procedures until all frequency measured was complete.

6.4.4 Test Results

Option 1

The Dwell Time=Burst Width*Total Hops. The detailed calculations are showed as follows:

The duration for dwell time calculation: $0.4[s] \times \text{hopping number} = 0.4[s] \times 79[\text{ch}] = 31.6[s \cdot \text{ch}]$;

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 $1600/6 = 266.67 [\text{ch} \cdot \text{hop}/\text{s}]$

The hops per second on one channel: $266.67 [\text{ch} \cdot \text{hops}/\text{s}] / 79 [\text{ch}] = 3.38 [\text{hop}/\text{s}]$;

The total hops for all channels within the dwell time calculation duration: $3.38 [\text{hop}/\text{s}] \times 31.6[s \cdot \text{ch}] = 106.67 [\text{hop} \cdot \text{ch}]$;

The dwell time for all channels hopping: $106.67 [\text{hop} \cdot \text{ch}] \times \text{Burst Width} [\text{ms}/\text{hop}/\text{ch}]$.

Option 2

The Dwell Time=Burst Width*Total Hops. The detailed calculations are showed as follows:

The duration for dwell time calculation: $0.4[s] \times \text{hopping number} = 0.4[s] \times 79[\text{ch}] = 31.6[s \cdot \text{ch}]$;

The burst width [ms/hop/ch], which is directly measured, refers to the duration on one channel hop.

The dwell time for all channels hopping: $[\text{hops}/3.16\text{s}] \times 10 \times \text{Burst Width} [\text{ms}/\text{hop}/\text{ch}]$.



Result: PASS

Temperature	25.5°C	Humidity	55%
Test Engineer	Anna Hu	Configurations	BT

Remark:

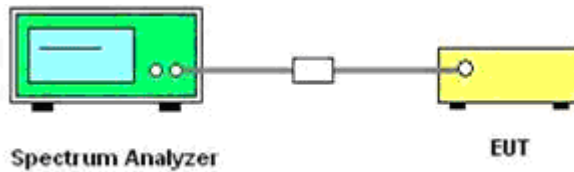
1. *Test results including cable loss;*
2. *please refer to following plots;*
3. *Measured at difference Packet Type for each mode and recorded woest case for each mode.*
4. *Dwell Time Calculate formula:
DH5: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second*
5. *Measured at low, middle and high channel, recorded worst at middle channel;*
6. *Plesase See Appendix Test Data for BT(BDR&EDR) for Dwell Time test data*

6.5 Conducted Spurious Emissions and Band Edges Test

6.5.1 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. Attenuation below the general limits specified in Section 15.209(a) is not required.

6.5.2 Block Diagram of Test Setup



6.5.3 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

6.5.4 Test Results of Conducted Spurious Emissions

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

Temperature	25.5°C	Humidity	55%
Test Engineer	Anna Hu	Configurations	BT

Test Mode	Channel	Frequency (MHz)	Measured Frequency Range	Spurious RF Conducted Emission (dBc)	Limits (dBc)	Verdict
GFSK	0	2402	9 KHz – 26.5 GHz	<-20	-20	PASS
	39	2441	9 KHz – 26.5 GHz	<-20		
	78	2480	9 KHz – 26.5 GHz	<-20		
π/4-DQPSK	0	2402	9 KHz – 26.5 GHz	<-20	-20	PASS
	39	2441	9 KHz – 26.5 GHz	<-20		
	78	2480	9 KHz – 26.5 GHz	<-20		
8DPSK	0	2402	9 KHz – 26.5 GHz	<-20	-20	PASS
	39	2441	9 KHz – 26.5 GHz	<-20		
	78	2480	9 KHz – 26.5 GHz	<-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. Plesase See Appendix Test Data for BT(BDR&EDR) for Band-edge Emissions test data
5. Plesase See Appendix Test Data for BT(BDR&EDR) for Conducted Spurious Emissions test data



6.6 Restricted Band Emission Limit

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.Android 10-6.218	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 ($\pm 45^\circ$) 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 ($\pm 45^\circ$) 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.

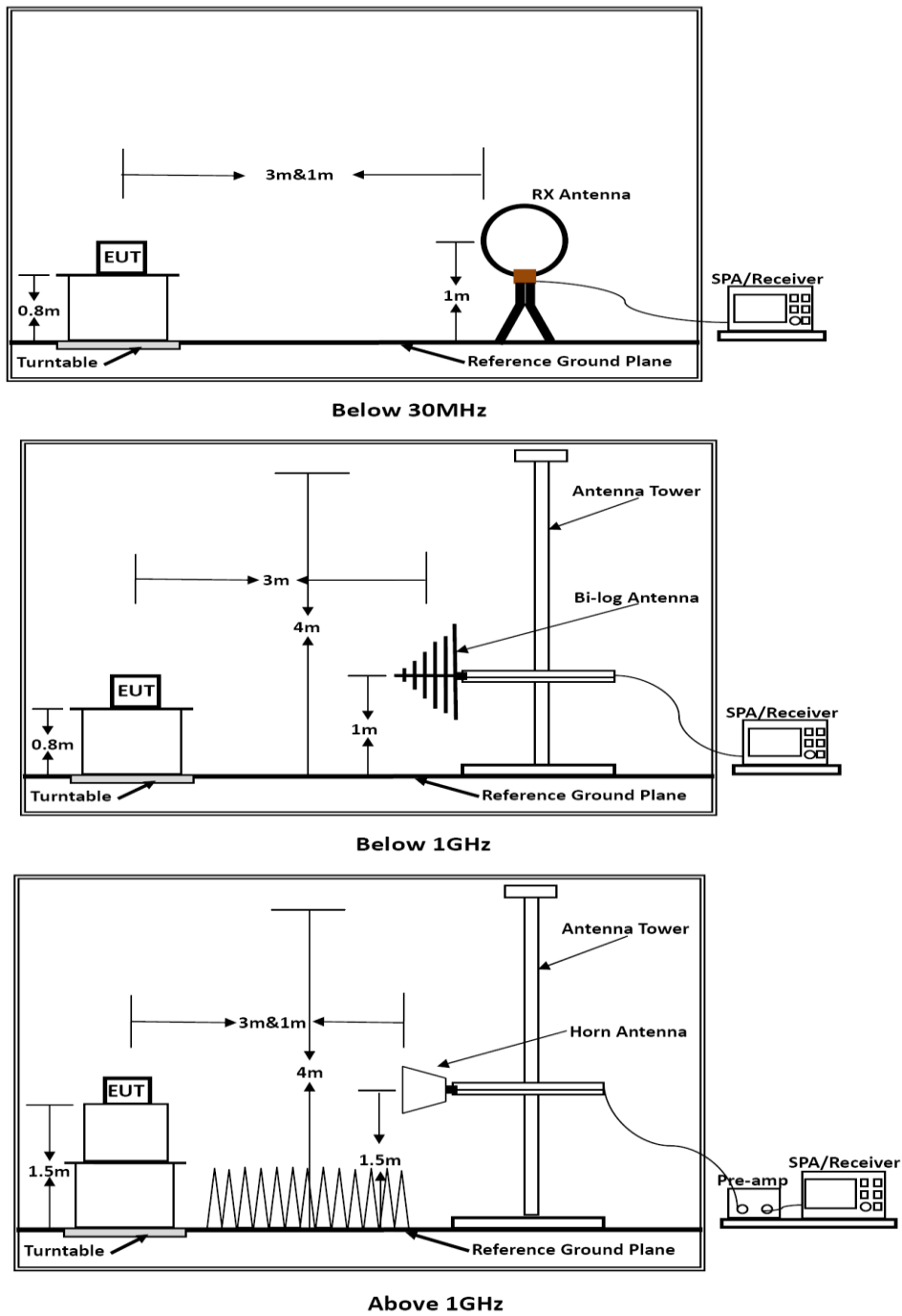
Premeasurement:

- 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



Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1.5m.

Distance extrapolation factor = $20 \log (\text{specific distance [3m]} / \text{test distance [1.5m]})$ (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	24°C	Humidity	55.2%
Test Engineer	Anna Hu	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 = $40 \log(\text{specific distance} / \text{test distance})$ (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.

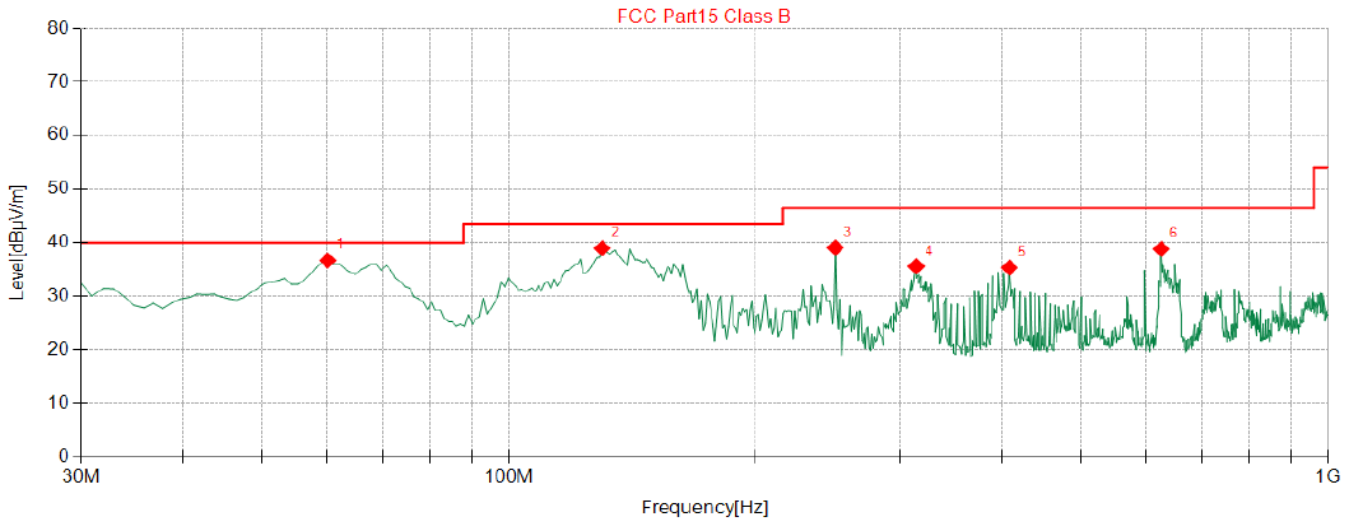
6.6.7. Results of Radiated Emissions (30MHz~1GHz)

Temperature	24°C	Humidity	55.2%
Test Engineer	Anna Hu	Configurations	8-DPSK, High Channel



Below 1GHz (Worst case: 8-DPSK, High Channel) with Adapter1[Model: RJ23-W120100US]

Vertical



◆ QP Detector

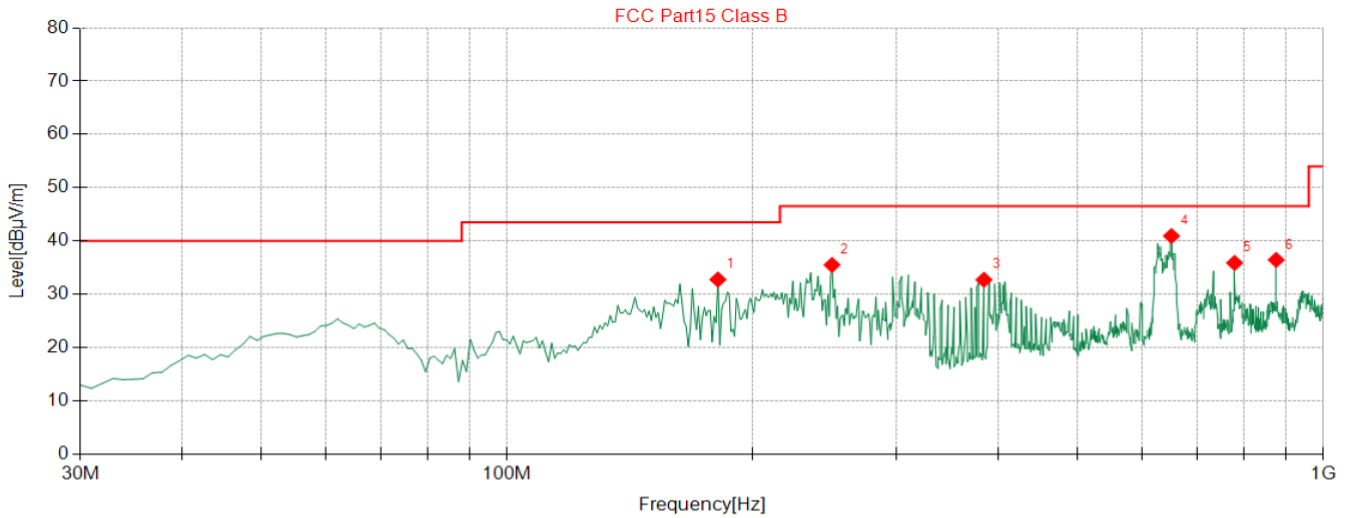
Suspected Data List							
NO.	Freq. [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	60.070	36.68	40.00	3.32	100	194	Vertical
2	129.91	38.96	43.50	4.54	100	249	Vertical
3	250.19	39.07	46.50	7.43	100	220	Vertical
4	314.21	35.58	46.50	10.92	100	352	Vertical
5	408.30	35.33	46.50	11.17	100	24	Vertical
6	625.58	38.82	46.50	7.68	100	169	Vertical

***Note:

- 1). Pre-scan all modes and recorded the worst case results in this report (Worst case: 8-DPSK, High Channel)
- 2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 3). Margin=Limit-Result Level



Horizontal



◆ QP Detector

Suspected Data List							
NO.	Freq. [MHz]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	181.32	32.75	43.50	10.75	100	60	Horizontal
2	250.19	35.50	46.50	11.00	100	287	Horizontal
3	384.05	32.70	46.50	13.80	100	150	Horizontal
4	651.77	40.93	46.50	5.57	100	308	Horizontal
5	778.84	35.87	46.50	10.63	100	119	Horizontal
6	875.84	36.44	46.50	10.06	100	249	Horizontal

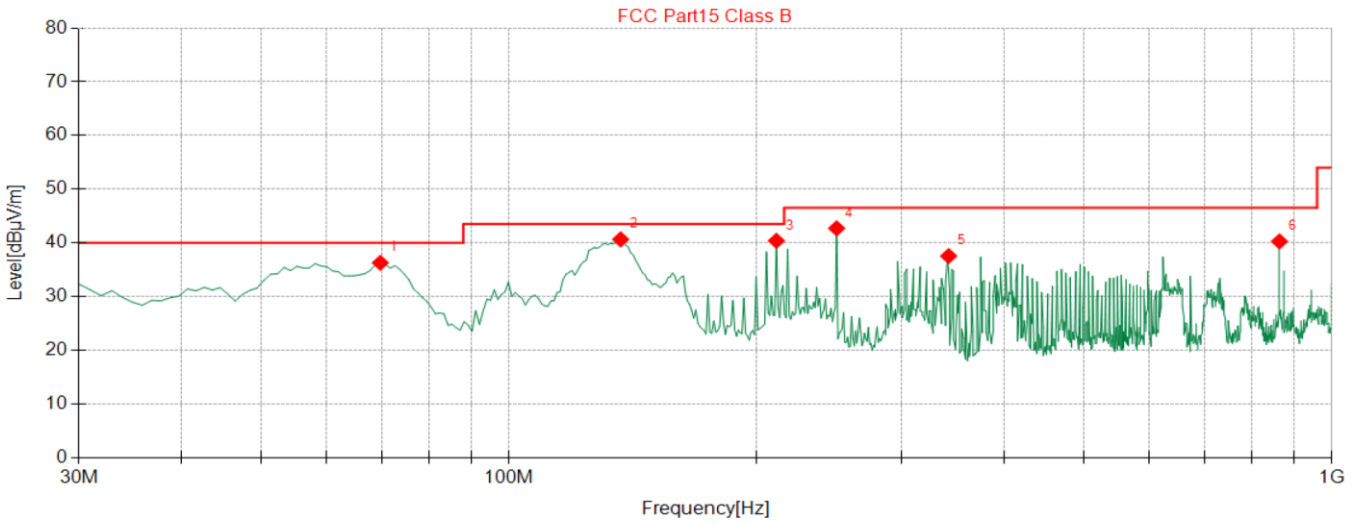
***Note:

- 1). Pre-scan all modes and recorded the worst case results in this report (Worst case: 8-DPSK, High Channel)
- 2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 3). Margin=Limit-Result Level



Below 1GHz (Worst case: 8-DPSK, High Channel) with Adapter2[Model: F12L33-120100SPAU]

Vertical



◆ QP Detector

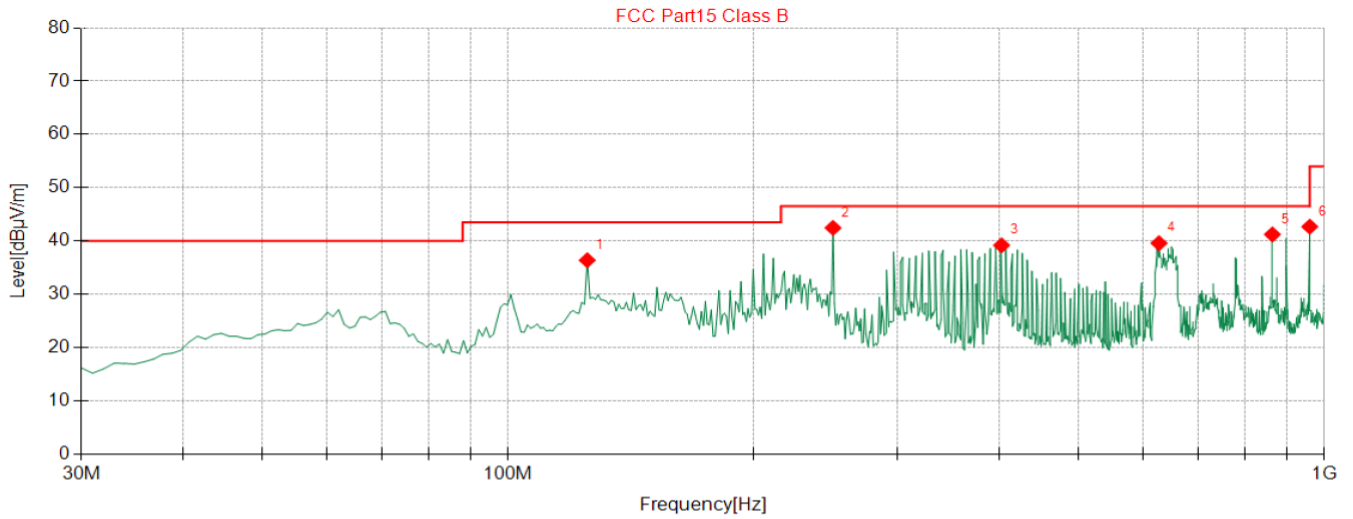
Suspected Data List							
NO.	Freq. [MHz]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	69.770	36.27	40.00	3.73	100	195	Vertical
2	136.70	40.63	43.50	2.87	200	244	Vertical
3	211.39	40.38	43.50	3.12	100	222	Vertical
4	250.19	42.70	46.50	3.80	100	3	Vertical
5	342.34	37.53	46.50	8.97	200	266	Vertical
6	864.20	40.26	46.50	6.24	100	330	Vertical

***Note:

- 1). Pre-scan all modes and recorded the worst case results in this report (Worst case: 8-DPSK, High Channel)
- 2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 3). Margin=Limit-Result Level



Horizontal



◆ QP Detector

Suspected Data List							
NO.	Freq. [MHz]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	125.06	36.37	43.50	7.13	300	95	Horizontal
2	250.19	42.45	46.50	4.05	100	191	Horizontal
3	402.48	39.18	46.50	7.32	100	239	Horizontal
4	627.52	39.58	46.50	6.92	100	234	Horizontal
5	864.20	41.22	46.50	5.28	100	46	Horizontal
6	960.23	42.68	54.00	11.32	100	170	Horizontal

***Note:

- 1). Pre-scan all modes and recorded the worst case results in this report (Worst case: 8-DPSK, High Channel)
- 2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 3). Margin=Limit-Result Level



5.5.8. Results for Radiated Emissions (Above 1GHz)

Temperature	24°C	Humidity	55.2%
Test Engineer	Anna Hu	Configurations	8-DPSK, High Channel

Above 1GHz

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

Freq. MHz	Reading dBuv	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
4804.00	52.83	33.06	35.04	3.94	54.79	74.00	19.21	Peak	Horizontal
4804.00	40.37	33.06	35.04	3.94	42.33	54.00	11.67	Average	Horizontal
4804.00	57.33	33.06	35.04	3.94	59.29	74.00	14.71	Peak	Vertical
4804.00	43.73	33.06	35.04	3.94	45.69	54.00	8.31	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.
4882.00	58.55	33.16	35.15	3.96	60.52	74.00	13.48	Peak	Horizontal
4882.00	41.89	33.16	35.15	3.96	43.86	54.00	10.14	Average	Horizontal
4882.00	58.74	33.16	35.15	3.96	60.71	74.00	13.29	Peak	Vertical
4882.00	43.21	33.16	35.15	3.96	45.18	54.00	8.82	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.
4960.00	59.28	33.26	35.14	3.98	61.38	74.00	12.62	Peak	Horizontal
4960.00	41.00	33.26	35.14	3.98	43.10	54.00	10.90	Average	Horizontal
4960.00	59.84	33.26	35.14	3.98	61.94	74.00	12.06	Peak	Vertical
4960.00	40.76	33.26	35.14	3.98	42.86	54.00	11.14	Average	Vertical

The worst test result for π/4-DQPSK, Channel 0 / 2402MHz

Freq. MHz	Reading dBuv	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
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			dB	dB					
4804.00	59.17	33.06	35.04	3.94	61.13	74.00	12.87	Peak	Horizontal
4804.00	39.82	33.06	35.04	3.94	41.78	54.00	12.22	Average	Horizontal
4804.00	52.80	33.06	35.04	3.94	54.76	74.00	19.24	Peak	Vertical
4804.00	40.20	33.06	35.04	3.94	42.16	54.00	11.84	Average	Vertical



The worst test result for $\pi/4$ -DQPSK, 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.
4882.00	58.18	33.16	35.15	3.96	60.15	74.00	13.85	Peak	Horizontal
4882.00	43.69	33.16	35.15	3.96	45.66	54.00	8.34	Average	Horizontal
4882.00	59.33	33.16	35.15	3.96	61.30	74.00	12.70	Peak	Vertical
4882.00	42.30	33.16	35.15	3.96	44.27	54.00	9.73	Average	Vertical

The worst test result for $\pi/4$ -DQPSK,, 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.
4960.00	53.13	33.26	35.14	3.98	55.23	74.00	18.77	Peak	Horizontal
4960.00	43.50	33.26	35.14	3.98	45.60	54.00	8.40	Average	Horizontal
4960.00	57.51	33.26	35.14	3.98	59.61	74.00	14.39	Peak	Vertical
4960.00	39.36	33.26	35.14	3.98	41.46	54.00	12.54	Average	Vertical

The worst test result for 8-DPSK, Channel 0 / 2402MHz

Freq. MHz	Reading dBuv	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuv/m	Limit dBuv/m	Margin dB	Remark	Pol.
4804.00	53.84	33.06	35.04	3.94	55.80	74.00	18.20	Peak	Horizontal
4804.00	41.29	33.06	35.04	3.94	43.25	54.00	10.75	Average	Horizontal
4804.00	57.84	33.06	35.04	3.94	59.80	74.00	14.20	Peak	Vertical
4804.00	41.26	33.06	35.04	3.94	43.22	54.00	10.78	Average	Vertical

The worst test result for 8-DPSK, 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.
4882.00	56.44	33.16	35.15	3.96	58.41	74.00	15.59	Peak	Horizontal
4882.00	43.88	33.16	35.15	3.96	45.85	54.00	8.15	Average	Horizontal
4882.00	56.64	33.16	35.15	3.96	58.61	74.00	15.39	Peak	Vertical



4882.00	41.46	33.16	35.15	3.96	43.43	54.00	10.57	Average	Vertical
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The worst test result for 8-DPSK,, 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.
4960.00	56.56	33.26	35.14	3.98	58.66	74.00	15.34	Peak	Horizontal
4960.00	41.49	33.26	35.14	3.98	43.59	54.00	10.41	Average	Horizontal
4960.00	57.33	33.26	35.14	3.98	59.43	74.00	14.57	Peak	Vertical
4960.00	41.01	33.26	35.14	3.98	43.11	54.00	10.89	Average	Vertical

Notes:

- 1). Measuring frequencies from 9k~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30 MHz.
- 2). Radiated emissions measured in frequency range from 9k~10th 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.
- 4). Measured = Reading + Ant. Fac - Pre. Fac. + Cab. Loss; Margin = Limit - Measured

6.7. AC Power line conducted emissions

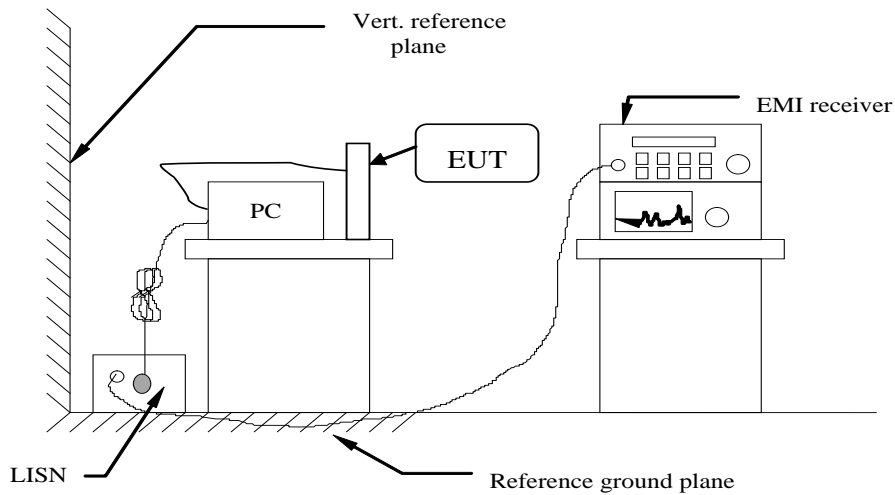
6.7.1 Standard Applicable

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 is 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

6.7.2 Block Diagram of Test Setup



6.7.3 Test Results

Temperature	24.4°C	Humidity	55.2%
Test Engineer	Anna Hu	Configurations	8-DPSK(High Channel)

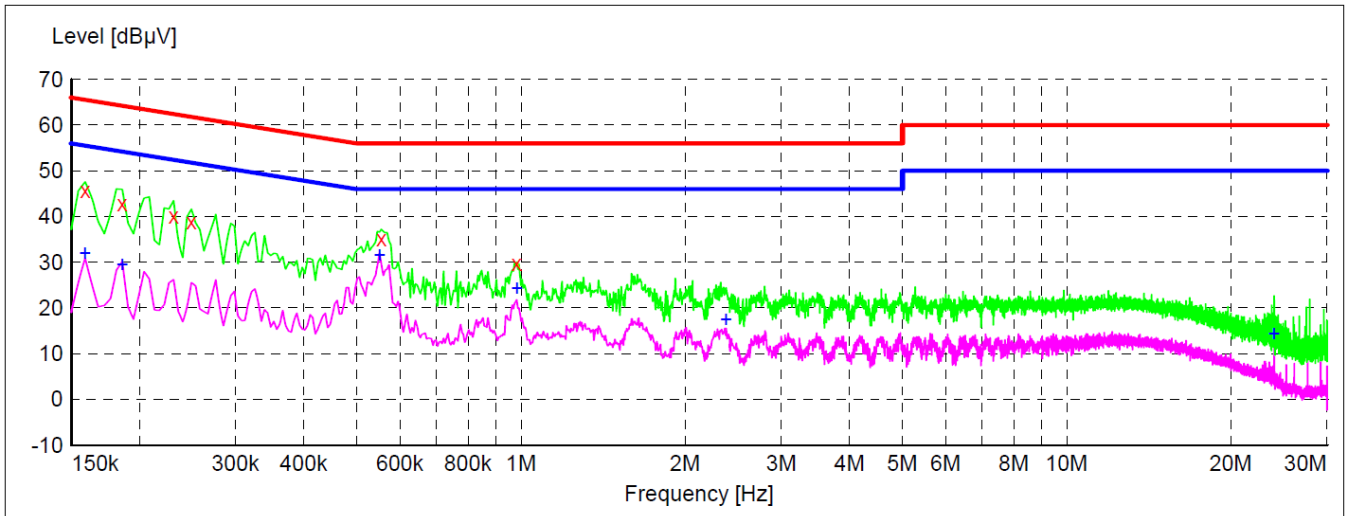
PASS.

The test data please refer to following page.



Note: AC Conducted Emission of AC Mains @ AC 120V/60Hz @ 8-DPSK (worst case) with Adapter1[Model: RJ23-W120100US]

Live



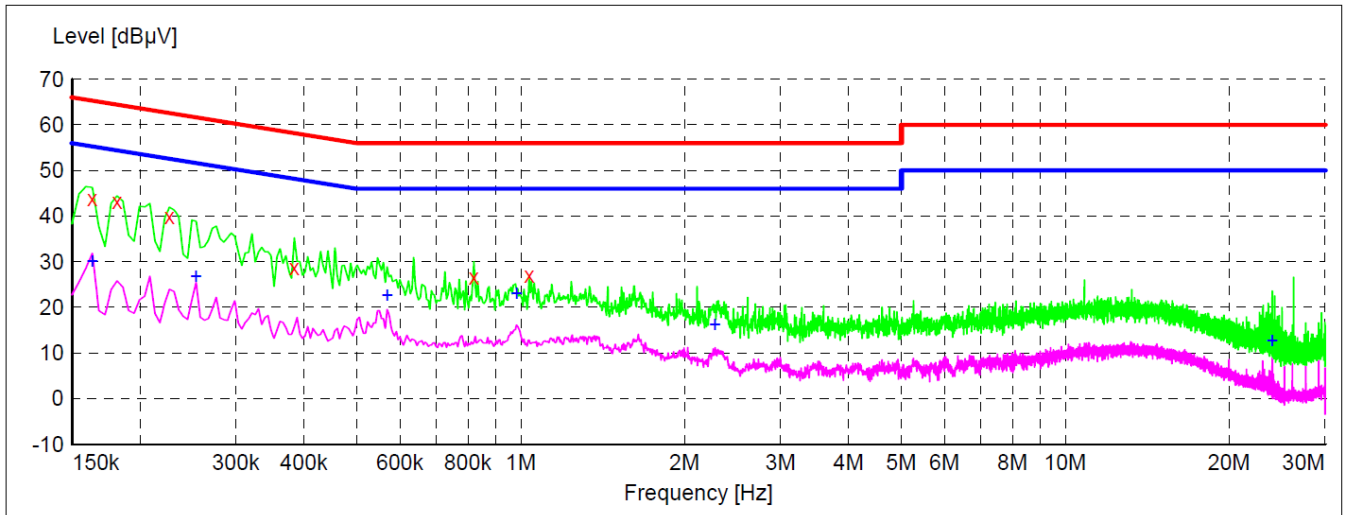
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.159000	45.60	10.0	66	19.9	QP	L1	GND
0.186000	42.70	10.4	64	21.5	QP	L1	GND
0.231000	40.00	10.5	62	22.4	QP	L1	GND
0.249000	38.90	10.4	62	22.9	QP	L1	GND
0.555000	35.00	9.9	56	21.0	QP	L1	GND
0.982500	29.70	9.8	56	26.3	QP	L1	GND
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.159000	32.00	10.0	56	23.5	AV	L1	GND
0.186000	29.40	10.4	54	24.8	AV	L1	GND
0.550500	31.50	9.9	46	14.5	AV	L1	GND
0.982500	24.40	9.8	46	21.6	AV	L1	GND
2.377500	17.40	9.7	46	28.6	AV	L1	GND
24.000000	14.30	10.1	50	35.7	AV	L1	GND

Note:

- 1). Pre-scan all modes and recorded the worst case results in this report
- 2). Emission level (dBµV) = 20 log Emission level (uV).
- 3). Margin=Limit-Level



Neutral



Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.163500	43.70	10.0	65	21.6	QP	N	GND
0.181500	43.10	10.3	64	21.3	QP	N	GND
0.226500	39.90	10.5	63	22.7	QP	N	GND
0.384000	28.60	10.0	58	29.6	QP	N	GND
0.820500	26.50	9.8	56	29.5	QP	N	GND
1.036500	26.90	9.8	56	29.1	QP	N	GND
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.163500	30.10	10.0	55	25.2	AV	N	GND
0.253500	26.80	10.4	52	24.8	AV	N	GND
0.568500	22.70	9.9	46	23.3	AV	N	GND
0.982500	23.00	9.8	46	23.0	AV	N	GND
2.274000	16.20	9.7	46	29.8	AV	N	GND
23.991000	12.80	10.1	50	37.2	AV	N	GND

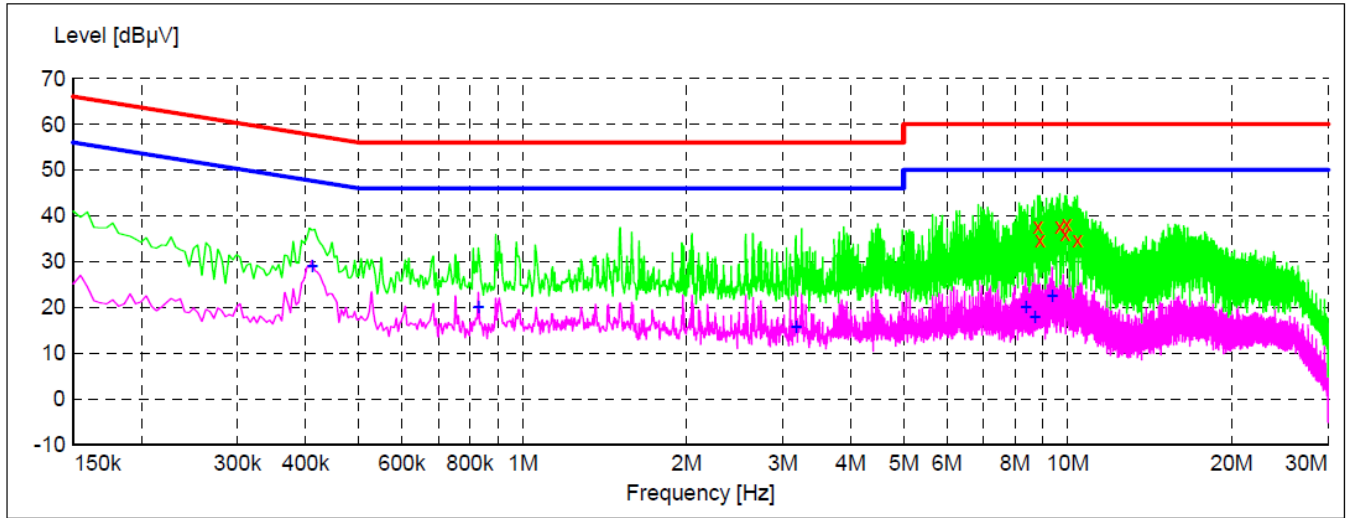
Note:

- 1). Pre-scan all modes and recorded the worst case results in this report
- 2). Emission level (dBuV) = 20 log Emission level (uV).
- 3). Margin=Limit-Level



Note: AC Conducted Emission of AC Mains @ AC 120V/60Hz @ 8-DPSK (worst case) with Adapter2[Model: F12L33-120100SPAU]

Live



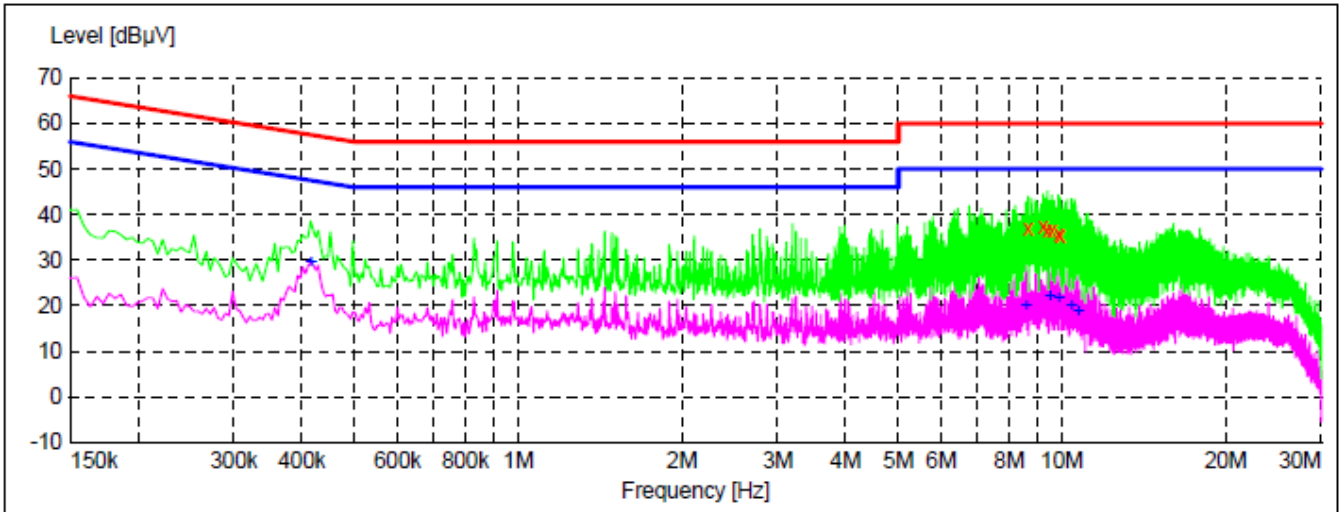
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
8.808000	37.70	9.8	60	22.3	QP	L1	GND
8.884500	34.80	9.8	60	25.2	QP	L1	GND
9.663000	37.60	9.8	60	22.4	QP	L1	GND
9.874500	36.10	9.8	60	23.9	QP	L1	GND
9.955500	38.20	9.8	60	21.8	QP	L1	GND
10.410000	34.70	9.8	60	25.3	QP	L1	GND
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.411000	28.90	10.0	48	18.7	AV	L1	GND
0.829500	19.90	9.8	46	26.1	AV	L1	GND
3.169500	15.80	9.7	46	30.2	AV	L1	GND
8.362500	20.00	9.8	50	30.0	AV	L1	GND
8.686500	17.90	9.8	50	32.1	AV	L1	GND
9.348000	22.40	9.8	50	27.6	AV	L1	GND

Note:

- 1). Pre-scan all modes and recorded the worst case results in this report
- 2). Emission level (dBµV) = 20 log Emission level (uV).
- 3). Margin=Limit-Level



Neutral



Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
8.664000	37.10	9.8	60	22.9	QP	N	GND
9.240000	37.30	9.8	60	22.7	QP	N	GND
9.402000	36.70	9.8	60	23.3	QP	N	GND
9.591000	36.60	9.8	60	23.4	QP	N	GND
9.856500	35.60	9.8	60	24.4	QP	N	GND
9.933000	35.40	9.8	60	24.6	QP	N	GND
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.415500	29.60	10.0	48	17.9	AV	N	GND
8.578500	20.10	9.8	50	29.9	AV	N	GND
9.492000	22.00	9.8	50	28.0	AV	N	GND
9.861000	21.70	9.8	50	28.3	AV	N	GND
10.401000	20.10	9.8	50	29.9	AV	N	GND
10.698000	18.80	9.8	50	31.2	AV	N	GND

Note:

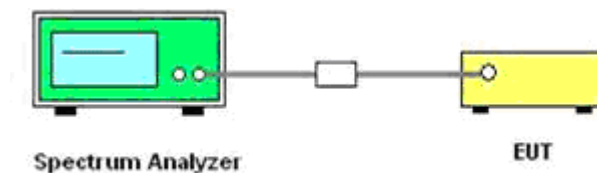
- 1). Pre-scan all modes and recorded the worst case results in this report
- 2). Emission level (dBuV) = 20 log Emission level (uV).
- 3). Margin=Limit-Level

6.8. Band-edge measurements for radiated emissions

6.8.1 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)).

6.8.2. Test Setup Layout



6.8.3. Measuring Instruments and Setting

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

6.8.4. Test Procedures

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

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

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).

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

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 \leq 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.

6.8.5. Test Results

PASS

Temperature	25.5°C	Humidity	55%
Test Engineer	Anna Hu	Configurations	BT

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, 2DH5 for $\pi/4$ DQPSK, 3DH5 for 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=10Hz/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. Plesase See Appendix Test Data for BT(BDR&EDR) for Band-edge measurements for radiated emissions.

6.9. Pseudorandom frequency hopping sequence

6.9.1 Standard Applicable

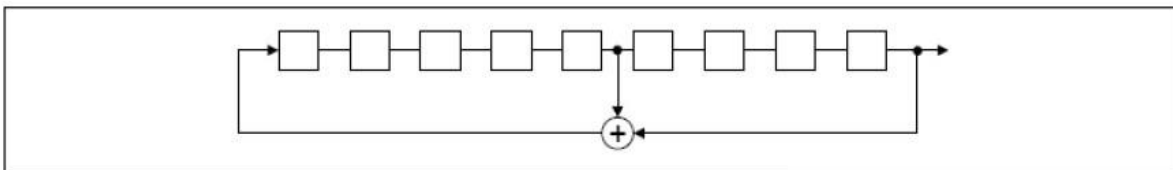
For 47 CFR Part 15C sections 15.247 (a) (1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

6.9.2 EUT Pseudorandom Frequency Hopping Sequence Requirement

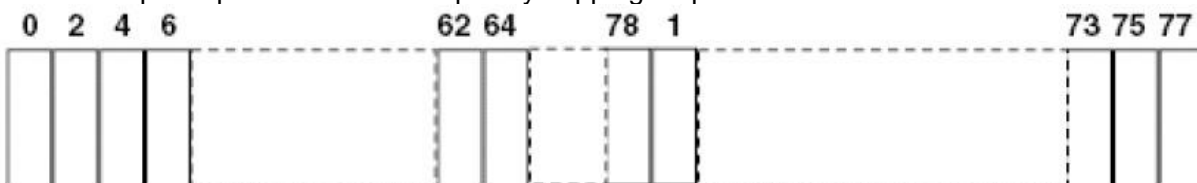
The pseudorandom frequency hopping sequence may be generated in a nine-stage shift register whose 5th first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.



6.10. Antenna requirement

6.10.1 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.

6.10.2 Antenna Connected Construction

6.10.2.1. Standard Applicable

According to § 15.203 & RSS-Gen, 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.

6.10.2.2. Antenna Connector Construction

The directional gains of antenna refer to section 1.1 of this report, and the antenna is an internal antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

6.10.2.3. Results: Compliance.



7. TEST SETUP PHOTOGRAPHS

Please refer to separated files for Test Setup Photos of the EUT.

8.EXTERNAL PHOTOS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9.INTERIOR PHOTOS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

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