TEST REPORT

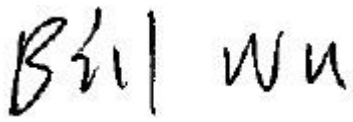
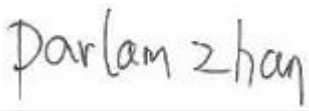
Application No.:	SHEM1911018776CR
FCC ID:	APICRUISEX
IC:	6132A-CRUISEX
Applicant:	Harman International Industries, Incorporated
Address of Applicant:	8500 Balboa Blvd, Northridge, CA91329, UNITED STATES
Manufacturer:	Harman International Industries,Incorporated
Address of Manufacturer:	8500 Balboa Blvd, Northridge, CA91329, UNITED STATES
Factory:	Hangzhou Newsources Electornics CO., Ltd
Address of Factory:	No.7 Houyang Rd, Anxi Industrial Zone, Liangzhu, Hangzhou, 311113, China.
Equipment Under Test (EUT):	
EUT Name:	Power Sports Speaker System
Model No.:	CRUISE X
Trade mark:	JBL
Standard(s) :	47 CFR Part 15, Subpart C 15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5, April 2018
Date of Receipt:	2019-11-12
Date of Test:	2019-12-03 to 2019-12-07
Date of Issue:	2020-03-31
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Parlam Zhan
E&E Section Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

Revision Record			
Version	**Description**	**Date**	**Remark**
00	Original	2020-03-31	/

Authorized for issue by:				
				
		Bill Wu / Project Engineer		
				
		Parlam Zhan / Reviewer		

2 Test Summary

Radio Spectrum Technical Requirement				
Item	**FCC Requirement**	**IC Requirement**	**Method**	**Result**
Antenna Requirement	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	RSS-Gen Clause 6.8	N/A	Customer Declaration
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	RSS-247 Section 5.1(a)	N/A	Pass

N/A: Not applicable

Radio Spectrum Matter Part				
Item	**FCC Requirement**	**IC Requirement**	**Method**	**Result**
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247(b)(1)	RSS-247 Section 5.4(b)	ANSI C63.10 (2013) Section 7.8.5	Pass
20dB Bandwidth	47 CFR Part 15, Subpart C 15.247(a)(1)	RSS-247 Section 5.1(a)	ANSI C63.10 (2013) Section 7.8.7	Pass
Carrier Frequencies Separation	47 CFR Part 15, Subpart C 15.247a(1)	RSS-247 Section 5.1(b)	ANSI C63.10 (2013) Section 7.8.2	Pass
Hopping Channel Number	47 CFR Part 15, Subpart C 15.247a(1)(iii)	RSS-247 Section 5.1(d)	ANSI C63.10 (2013) Section 7.8.3	Pass
Dwell Time	47 CFR Part 15, Subpart C 15.247a(1)(iii)	RSS-247 Section 5.1(d)	ANSI C63.10 (2013) Section 7.8.4	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Section 5.5	ANSI C63.10 (2013) Section 7.8.6	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Section 5.5	ANSI C63.10 (2013) Section 7.8.8	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.205 & 15.209	Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.10.5	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.205 & 15.209	Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.4,6.5,6.6	Pass
99% Bandwidth	-	RSS-Gen Section 6.7	ANSI C63.10 Section 6.9.3	Pass
Frequency Stability	-	RSS-Gen Section 8.11	RSS-Gen Section 6.11	Note1

Note1: Frequency stability requested in RSS GEN S8.11 has been complied since the result of band edge can demonstrate.

Remark: The EUT is a vehicle equipment and not intend to connected to the AC power lines

3 Contents

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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 12V
Test voltage:	DC 12V By Battery
Operation Frequency	2402MHz to 2480MHz
Spectrum Spread Technology	Frequency Hopping Spread Spectrum(FHSS)
Antenna Gain	5.35dBi
Antenna Type	FPC antenna
Channel Spacing	1MHz
Modulation Type	GFSK, π/4DQPSK, 8DPSK
Number of Channels	79

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Blue Test3 (For CSR)	/	2.5.0	/
BT test board	/	Test Plate 2	/
Battery	BOSCH	/	/
Laptop	Lenovo	ThinkPad X100e	/

4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	±8.4 x 10^{-8}
2	Timeout	±2s
3	Duty cycle	±0.37%
4	Occupied Bandwidth	±3%
5	RF conducted power	±0.6dB
6	RF power density	±2.84dB
7	Conducted Spurious emissions	±0.75dB
8	RF Radiated power	±4.6dB (Below 1GHz)
		±4.1dB (Above 1GHz)
9	Radiated Spurious emission test	±4.2dB (Below 30MHz)
		±4.4dB (30MHz-1GHz)
		±4.8dB (1GHz-18GHz)
		±5.2dB (Above 18GHz)
10	Temperature test	±1°C
11	Humidity test	±3%
12	Supply voltages	±1.5%
13	Time	±3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shanghai Branch

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666 Fax: +86 21 6191 5678

No tests were sub-contracted.

4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• CNAS (No. CNAS L0599)

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• NVLAP (LAB CODE: 201034-0)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

• FCC (Designation Number: CN5033)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory. Test Firm Registration Number: 479755.

• ISED (CAB identifier: CN0020)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. ISED#: 8617A.

• VCCI (Member No.: 3061)

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2018-12-20	2019-12-19
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2019-08-13	2020-08-12
Signal Generator	R&S	SMR20	SHEM006-1	2019-08-13	2020-08-12
Signal Generator	Agilent	N5182A	SHEM182-1	2019-08-13	2020-08-12
Communication Tester	R&S	CMW270	SHEM183-1	2019-08-13	2020-08-12
Switcher	Tonscend	JS0806	SHEM184-1	2019-08-13	2020-08-12
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2019-08-13	2020-08-12
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2017-09-25	2020-09-24
AC Power Stabilizer	WOCEN	6100	SHEM045-1	2018-12-26	2019-12-25
DC Power Supply	MCN	MCH-303A	SHEM210-1	2018-12-26	2019-12-25
Conducted test Cable	/	RF01~RF04	/	2018-12-26	2019-12-25
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2018-12-20	2019-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2018-12-20	2019-12-19
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2017-04-10	2020-04-09
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2017-02-28	2020-02-27
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM202-1	2019-04-30	2022-04-29
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2017-10-24	2020-10-23
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2017-01-14	2020-01-13
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2017-12-03	2020-12-02
Pre-amplifier (9KHz-2GHz)	CLAVIIO	BDLNA-0001	SHEM164-1	2019-08-13	2020-08-12
Pre-amplifier (1-18GHz)	CLAVIIO	BDLNA-0118	SHEM050-2	2019-08-13	2020-08-12
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2018-12-20	2019-12-19
Signal Generator	R&S	SMR40	SHEM058-1	2019-08-13	2020-08-12
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2017-07-22	2020-07-21
RE test Cable	/	RE01, RE02, RE06	/	2018-12-26	2019-12-25

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(c)

6.1.2 Conclusion

Standard Requirement:

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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is FPC antenna and no consideration of replacement. The best case gain of the antenna is 5.35dBi.

Antenna location: Refer to Appendix (Internal Photos)

6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

6.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

6.2.2 Conclusion

Standard Requirement:

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

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

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

Compliance for section 15.247(a)(1):

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

> Number of shift register stages: 9

> Length of pseudo-random sequence: 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 follow:

Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band s

7 Radio Spectrum Matter Test Results

7.1 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1)

Test Method: ANSI C63.10 (2013) Section 7.8.5

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥50 hopping channels
	0.25 for 25≤ hopping channels <50
	1 for digital modulation
2400-2483.5	1 for ≥75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

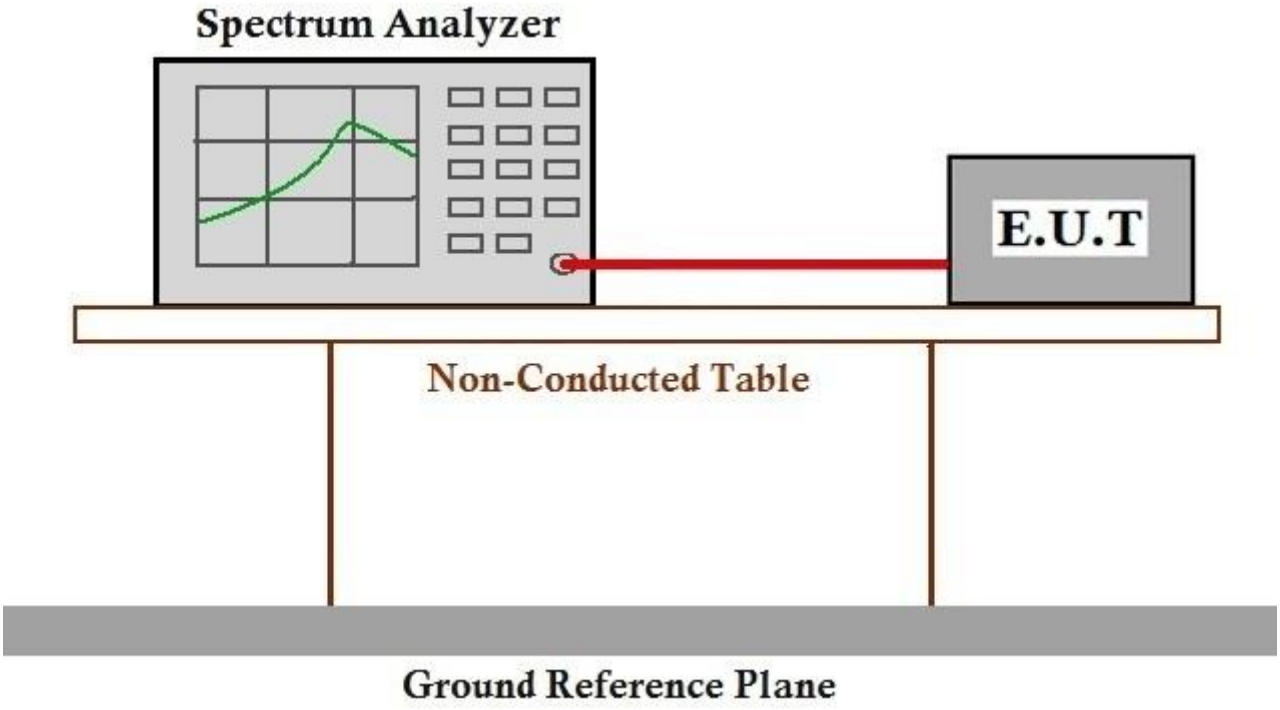
7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.1.2 Test Setup Diagram



7.1.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM191101877601

7.2 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)

Test Method: ANSI C63.10 (2013) Section 7.8.7

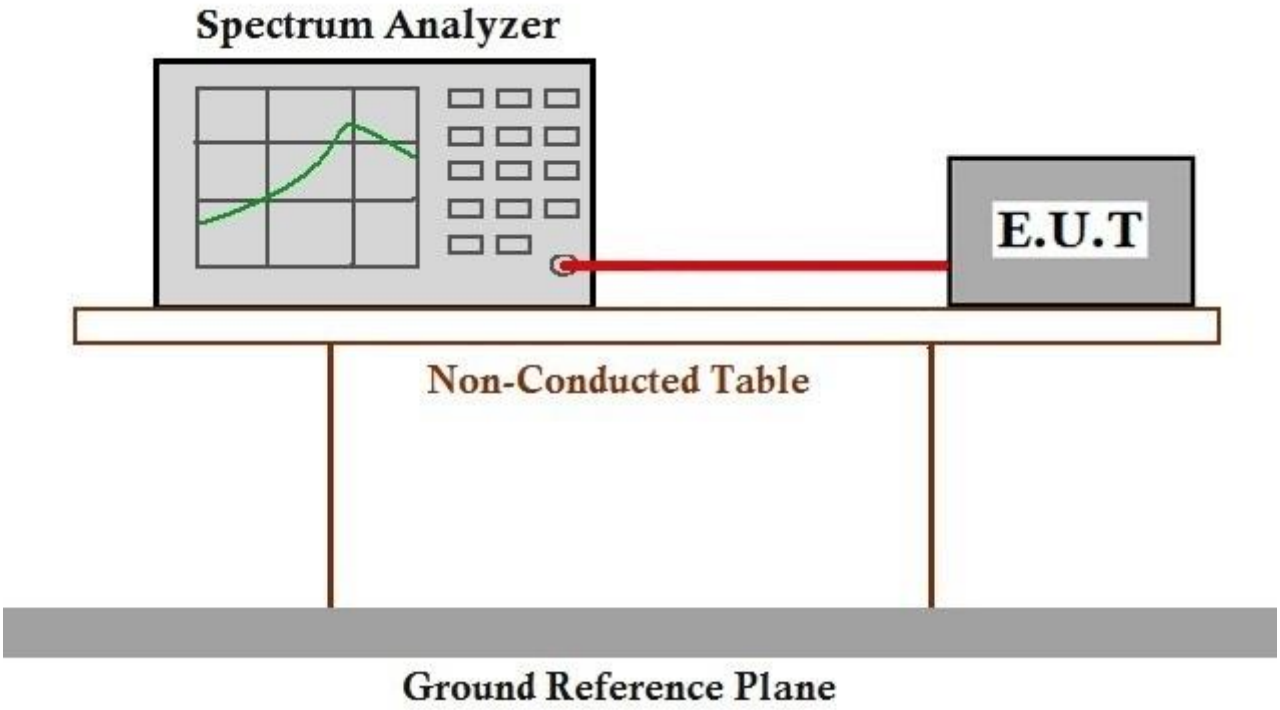
7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.2.2 Test Setup Diagram



7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM191101877601

7.3 Carrier Frequencies Separation

Test Requirement	47 CFR Part 15, Subpart C 15.247a(1)
Test Method:	ANSI C63.10 (2013) Section 7.8.2
Limit:	2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W

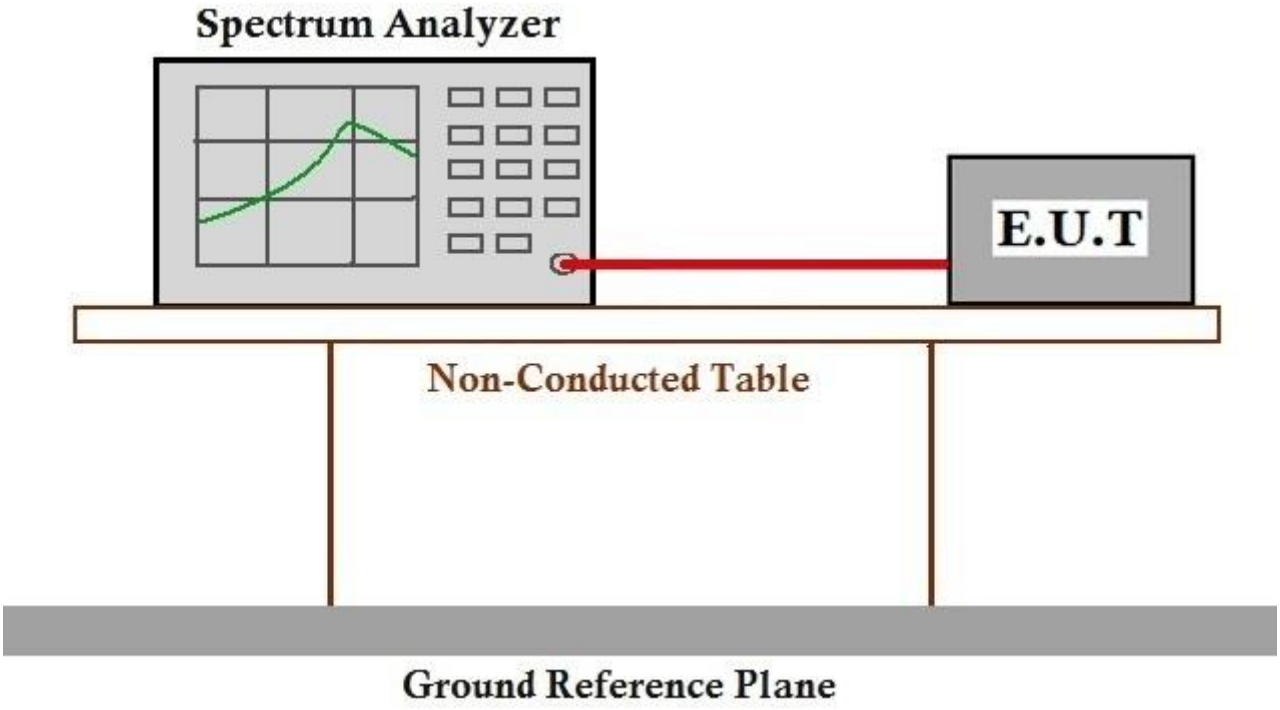
7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.3.2 Test Setup Diagram



7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM191101877601

7.4 Hopping Channel Number

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

Test Method: ANSI C63.10 (2013) Section 7.8.3

Limit:

Frequency range(MHz)	Number of hopping channels (minimum)
902-928	50 for 20dB bandwidth <250kHz
	25 for 20dB bandwidth ≥250kHz
2400-2483.5	15
5725-5850	75

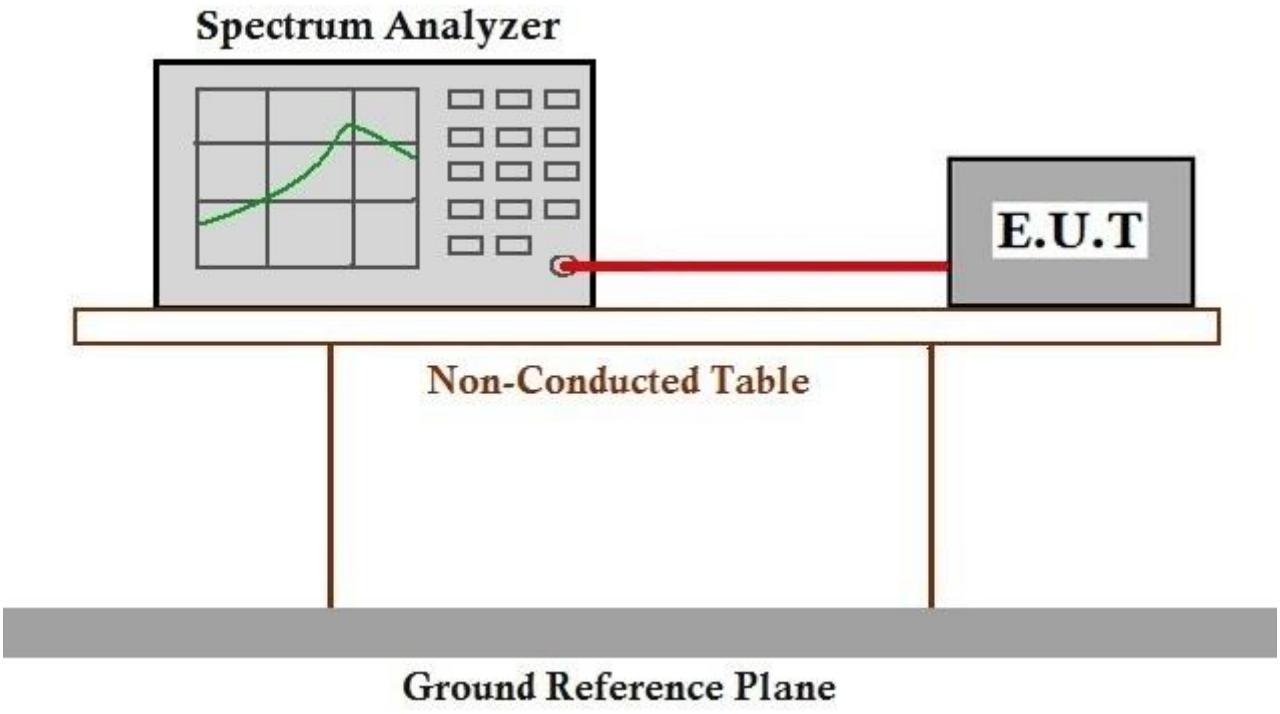
7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM191101877601

7.5 Dwell Time

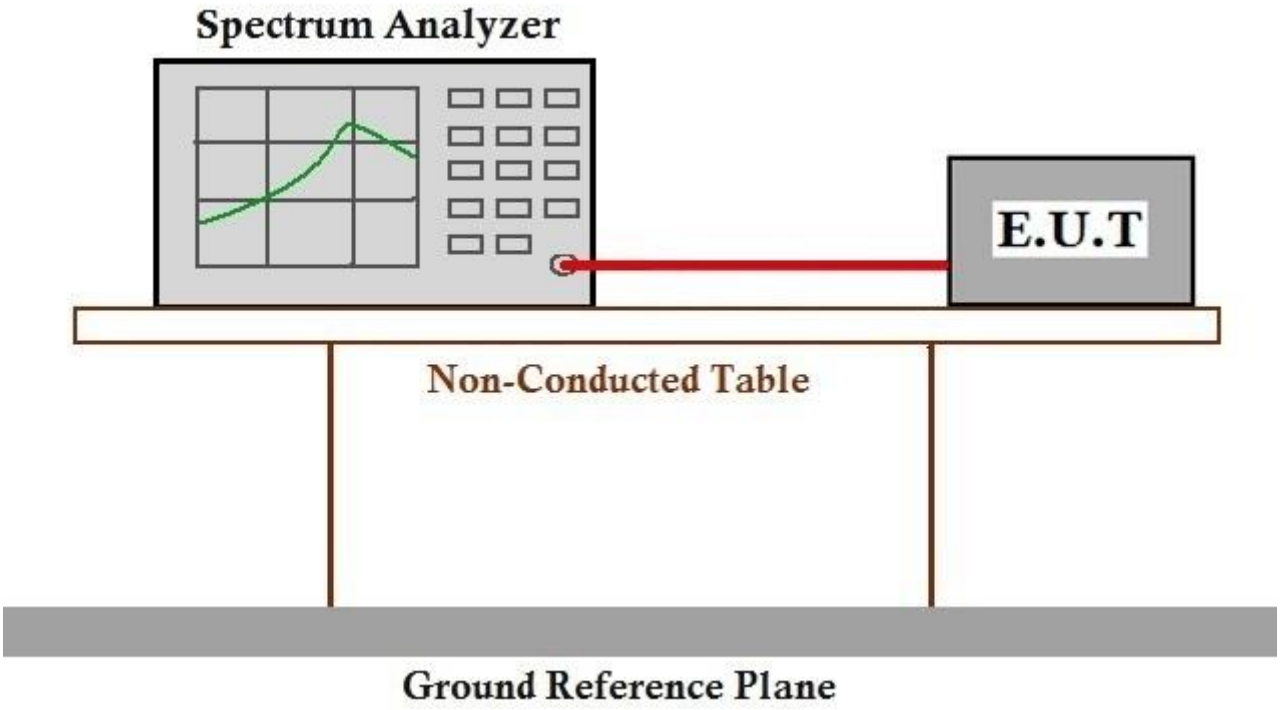
Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)
Test Method: ANSI C63.10 (2013) Section 7.8.4
Limit:

Frequency(MHz)	Limit
902-928	0.4S within a 20S period(20dB bandwidth<250kHz)
	0.4S within a 10S period(20dB bandwidth≥250kHz)
2400-2483.5	0.4S within a period of 0.4S multiplied by the number of hopping channels
5725-5850	0.4S within a 30S period

7.5.1 E.U.T. Operation

Operating Environment:
Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar
Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.5.2 Test Setup Diagram



7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM191101877601

7.6 Conducted Band Edges Measurement

Test Requirement: 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 7.8.6

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)

7.6.1 E.U.T. Operation

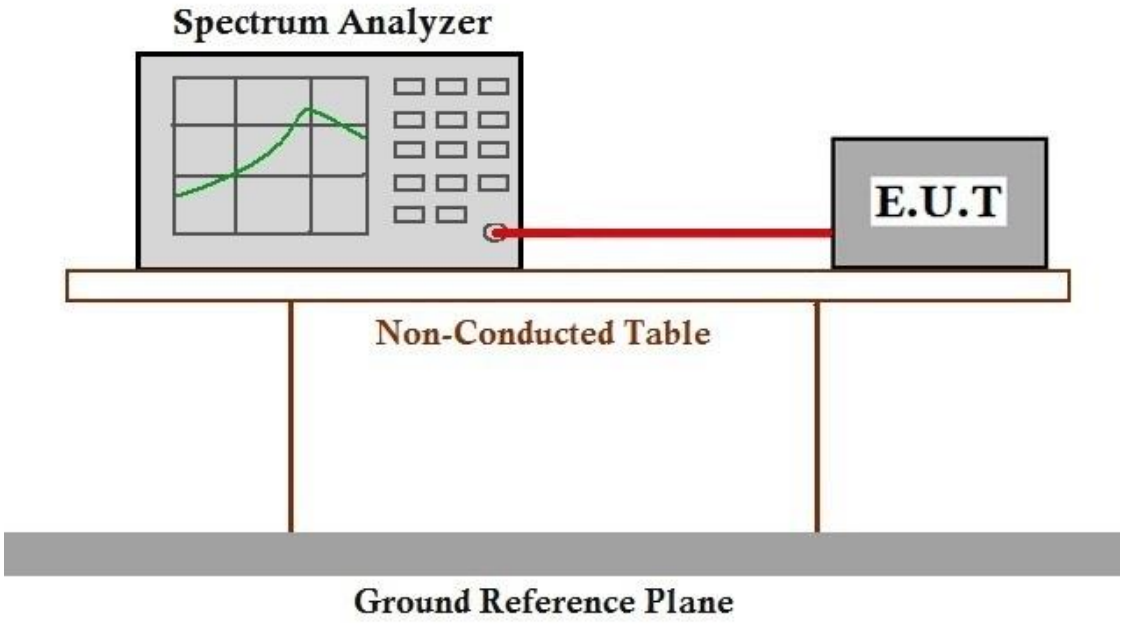
Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode: a:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.6.2 Test Setup Diagram



7.6.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM191101877601

7.7 Conducted Spurious Emissions

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 7.8.8
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)

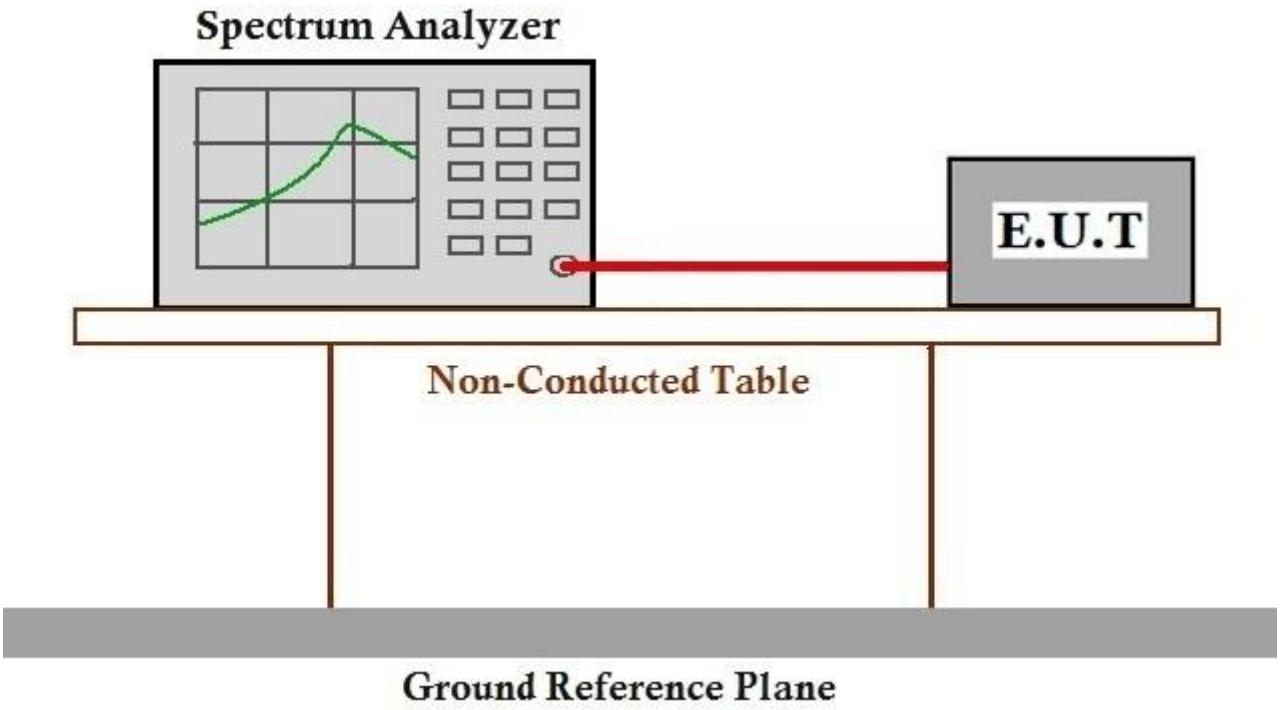
7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.7.2 Test Setup Diagram



7.7.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM191101877601

7.8 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

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
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.		

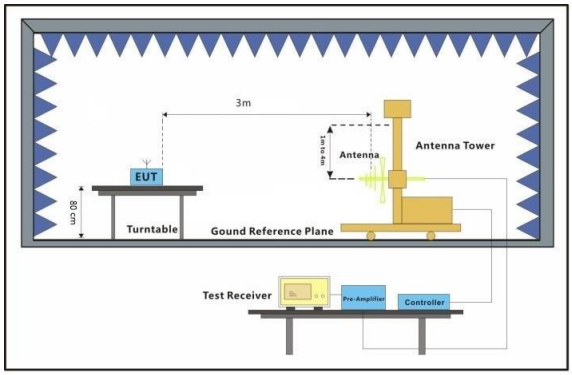
7.8.1 E.U.T. Operation

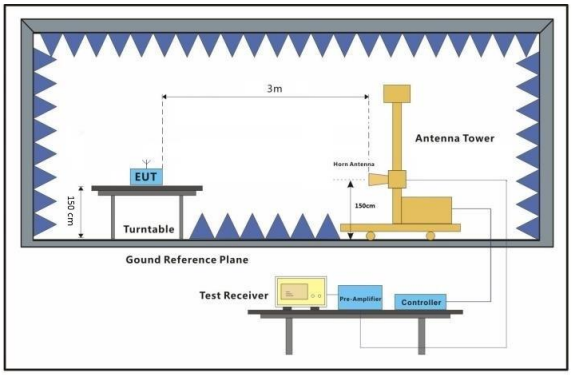
Operating Environment:

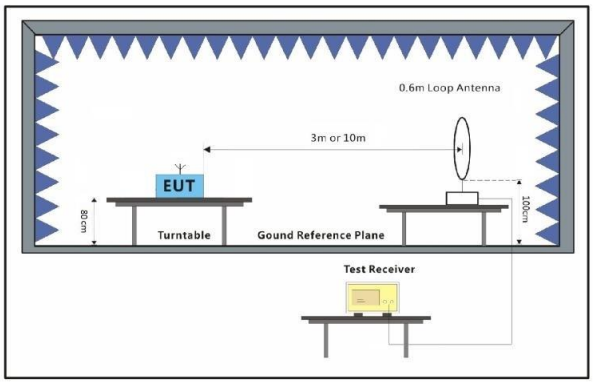
Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.8.2 Test Setup Diagram







7.8.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

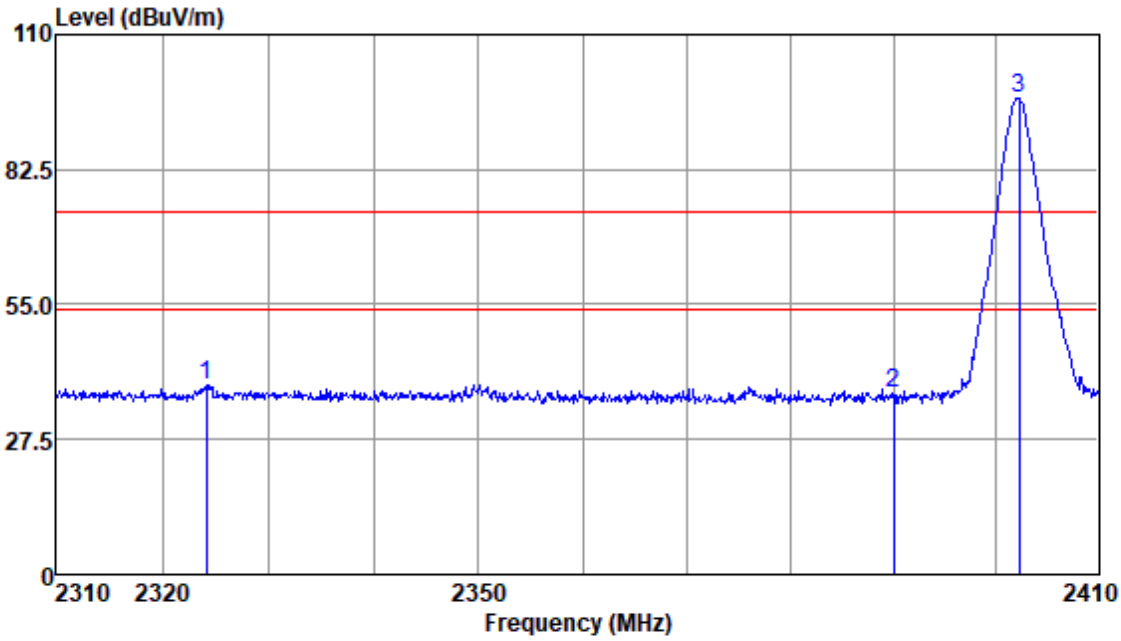
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

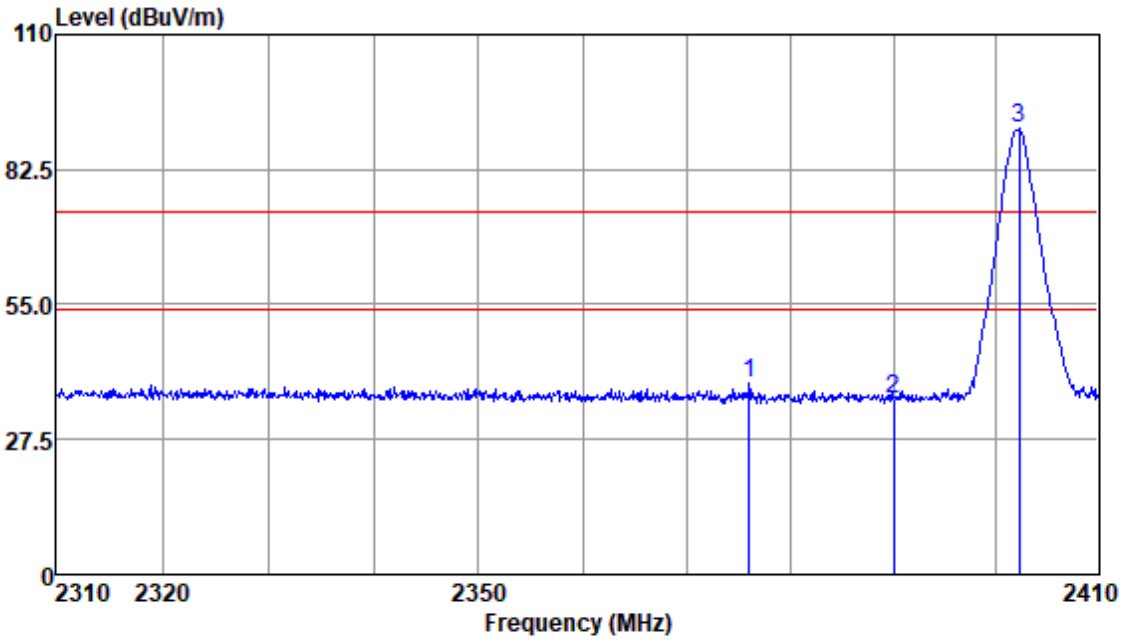


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2324.14	46.88	25.94	3.03	38.48	74.00	-35.52	Peak
2390.00	45.27	26.03	3.15	37.05	74.00	-36.95	Peak
2402.25	105.29	26.05	3.14	97.08	74.00	23.08	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

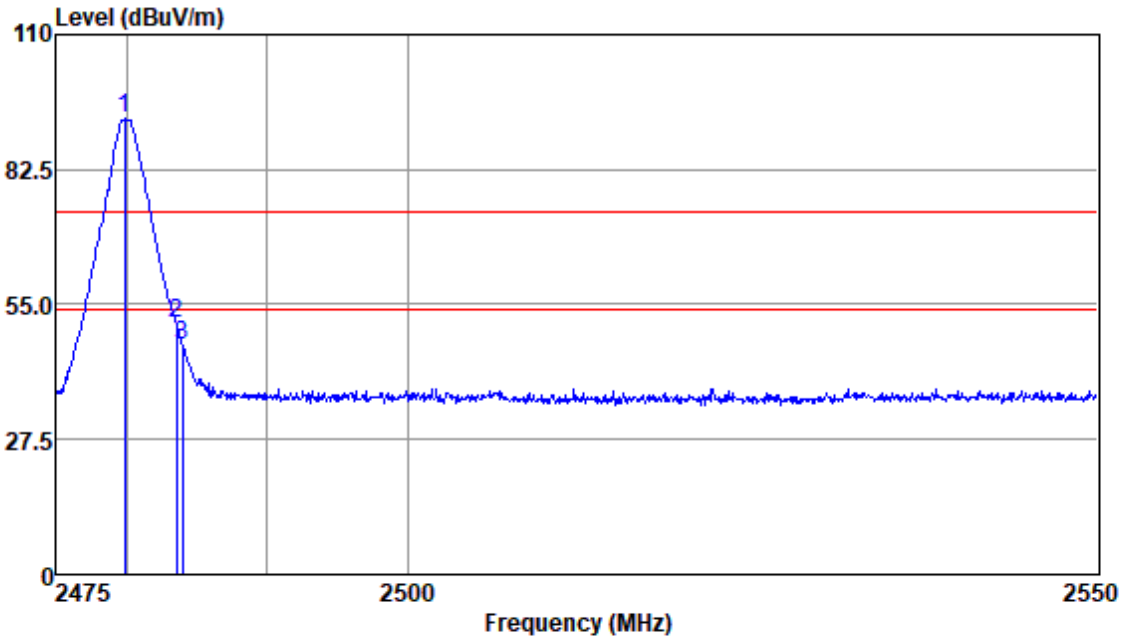


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2376.03	47.29	26.01	3.17	39.08	74.00	-34.92	Peak
2390.00	43.75	26.03	3.15	35.53	74.00	-38.47	Peak
2402.25	99.10	26.05	3.14	90.89	74.00	16.89	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

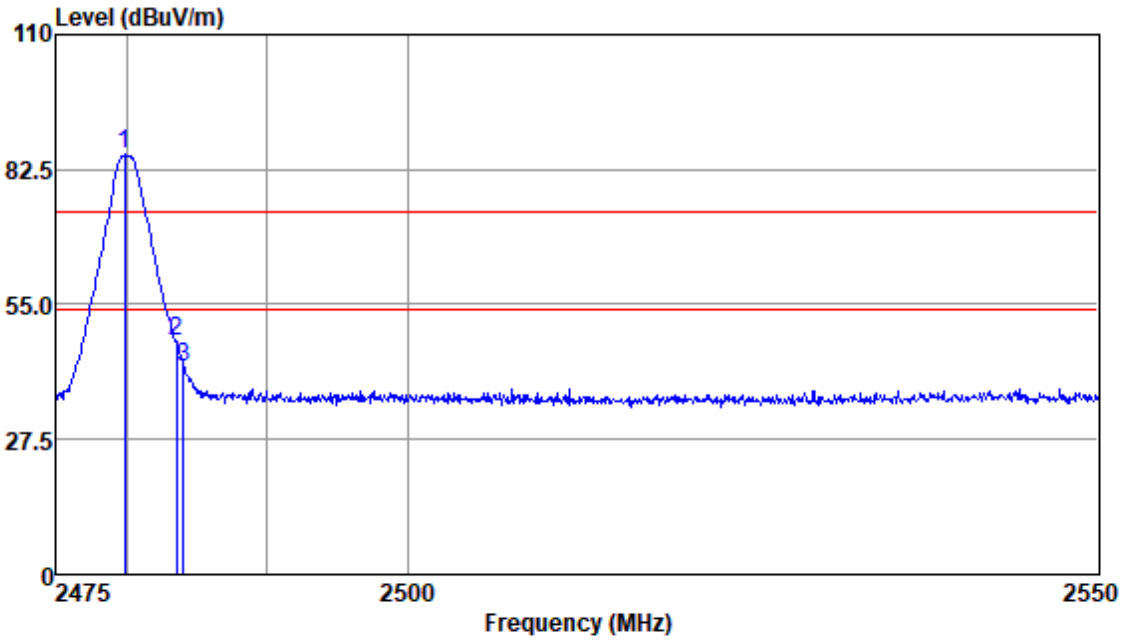


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2479.81	101.03	26.17	3.14	92.77	74.00	18.77	Peak
2483.50	59.43	26.18	3.14	51.18	74.00	-22.82	Peak
2483.96	55.03	26.18	3.14	46.78	74.00	-27.22	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High

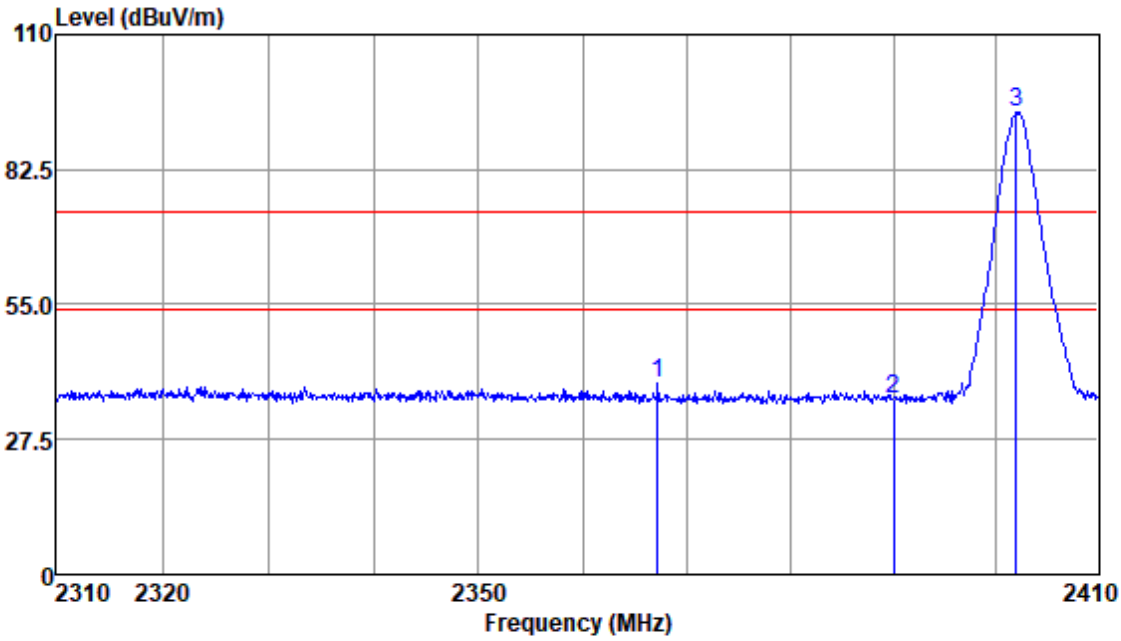


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2479.81	93.75	26.17	3.14	85.49	74.00	11.49	Peak
2483.50	55.67	26.18	3.14	47.42	74.00	-26.58	Peak
2484.03	50.62	26.18	3.14	42.37	74.00	-31.63	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Horizontal; Modulation:π/4 DQPSK; ; Channel:Low

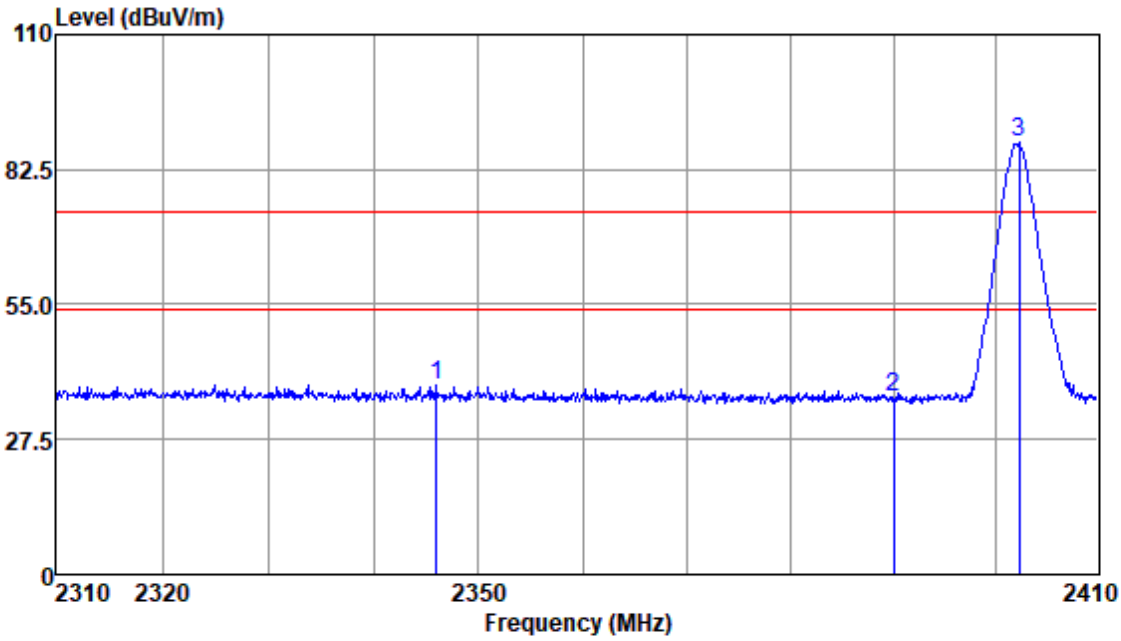


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2367.18	47.27	26.00	3.17	39.06	74.00	-34.94	Peak
2390.00	43.86	26.03	3.15	35.64	74.00	-38.36	Peak
2401.95	102.40	26.05	3.14	94.19	74.00	20.19	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Vertical; Modulation:π/4 DQPSK; ; Channel:Low

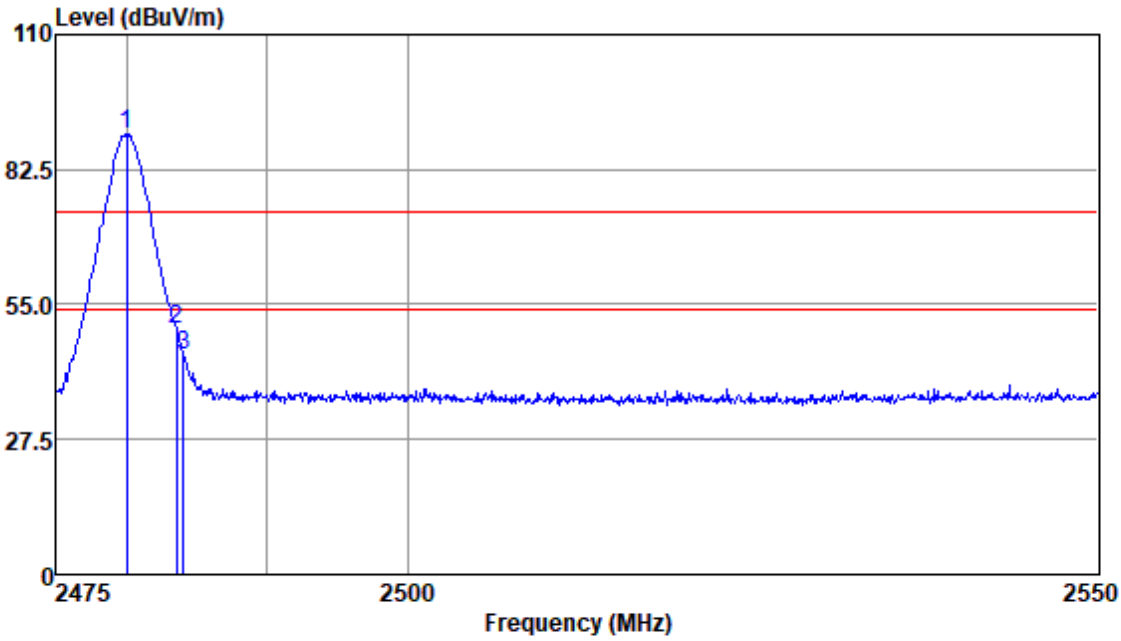


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2346.01	46.84	25.97	3.10	38.54	74.00	-35.46	Peak
2390.00	44.28	26.03	3.15	36.06	74.00	-37.94	Peak
2402.25	96.18	26.05	3.14	87.97	74.00	13.97	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Horizontal; Modulation:π/4 DQPSK; ; Channel:High

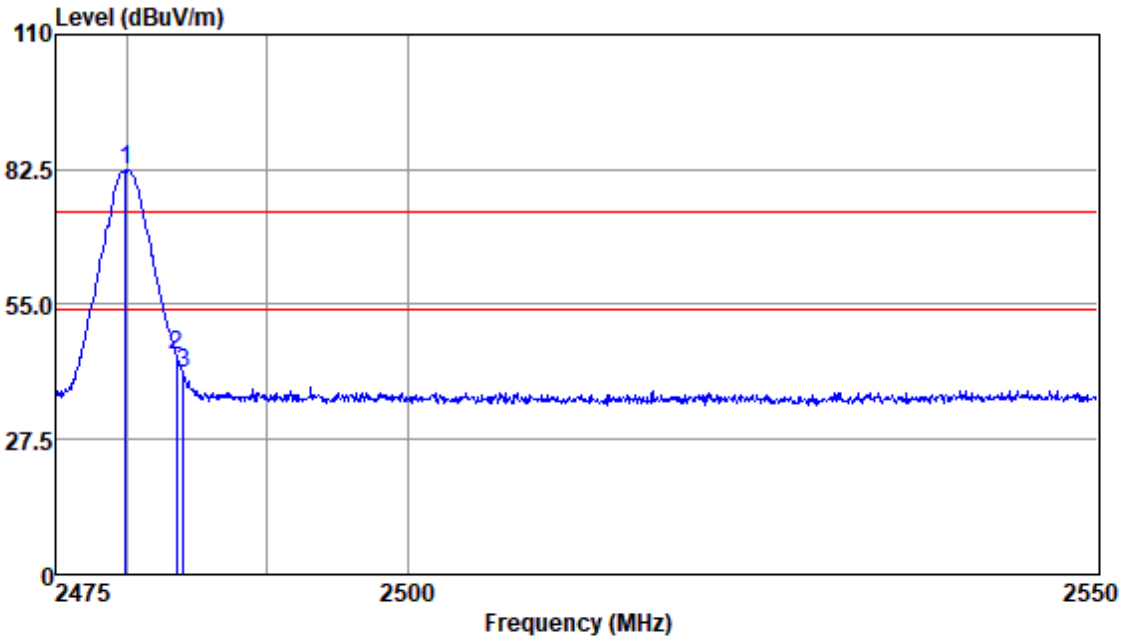


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2479.96	97.86	26.17	3.14	89.60	74.00	15.60	Peak
2483.50	58.23	26.18	3.14	49.98	74.00	-24.02	Peak
2484.03	52.97	26.18	3.14	44.72	74.00	-29.28	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Vertical; Modulation:π/4 DQPSK; ; Channel:High

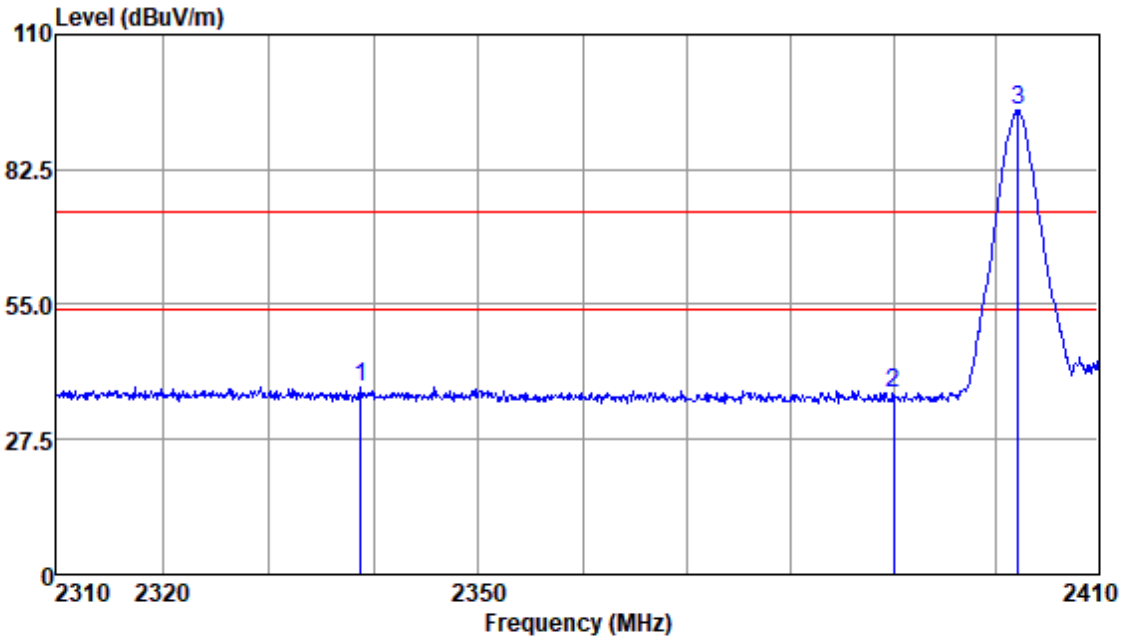


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2479.88	90.66	26.17	3.14	82.40	74.00	8.40	Peak
2483.50	53.01	26.18	3.14	44.76	74.00	-29.24	Peak
2484.03	49.16	26.18	3.14	40.91	74.00	-33.09	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:Low

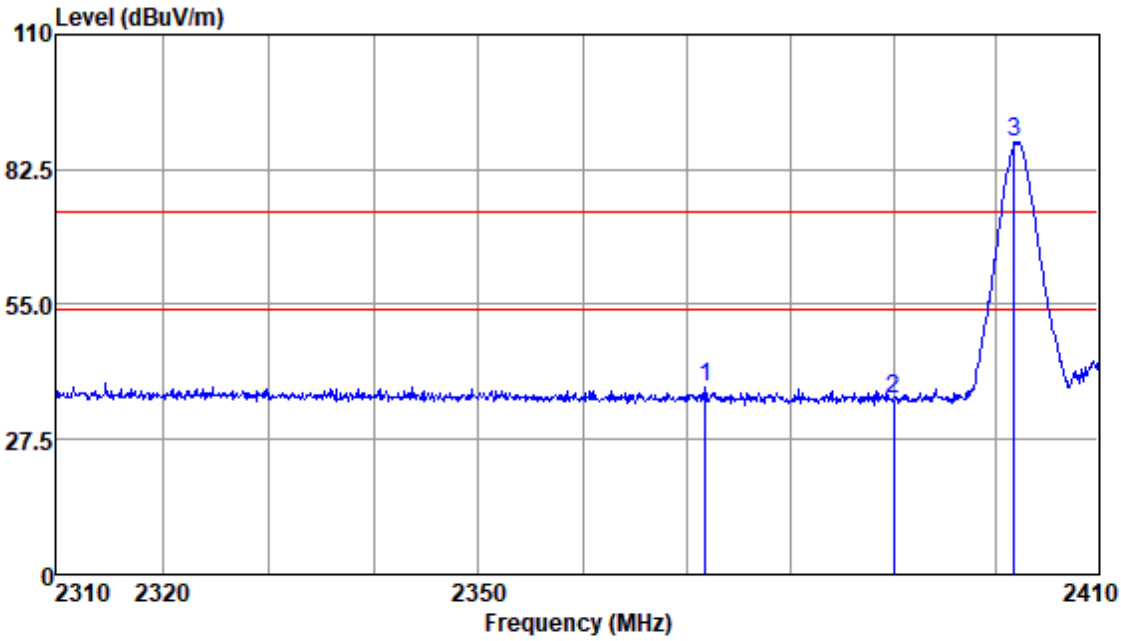


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2338.76	46.57	25.96	3.08	38.24	74.00	-35.76	Peak
2390.00	45.12	26.03	3.15	36.90	74.00	-37.10	Peak
2402.15	102.87	26.05	3.14	94.66	74.00	20.66	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:Low

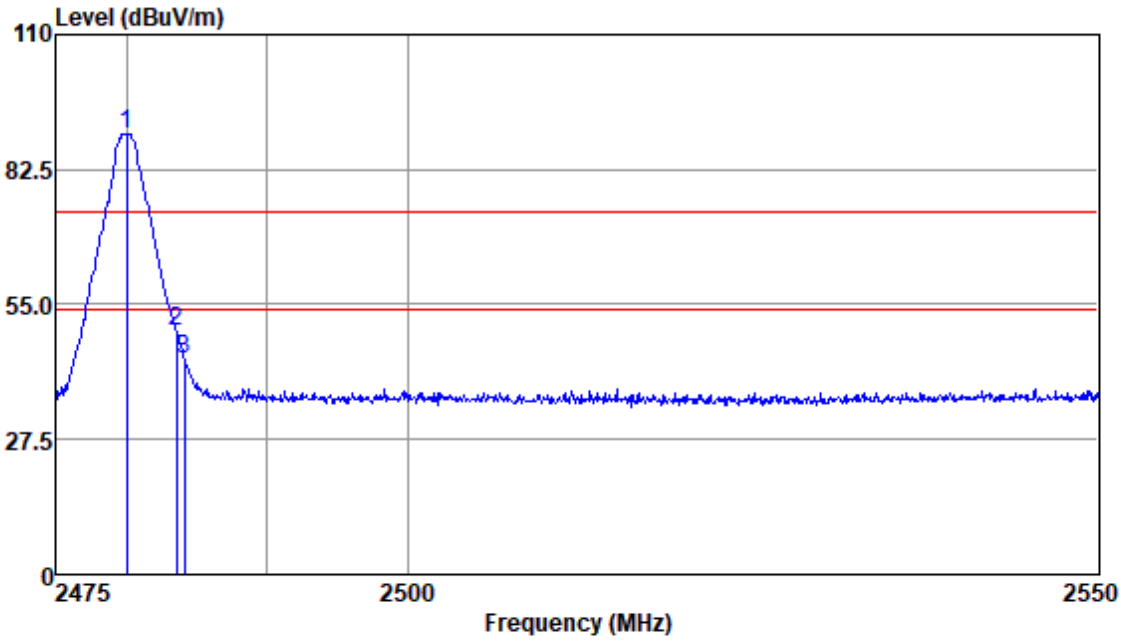


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2371.80	46.49	26.01	3.17	38.28	74.00	-35.72	Peak
2390.00	43.74	26.03	3.15	35.52	74.00	-38.48	Peak
2401.74	96.36	26.05	3.15	88.16	74.00	14.16	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:High

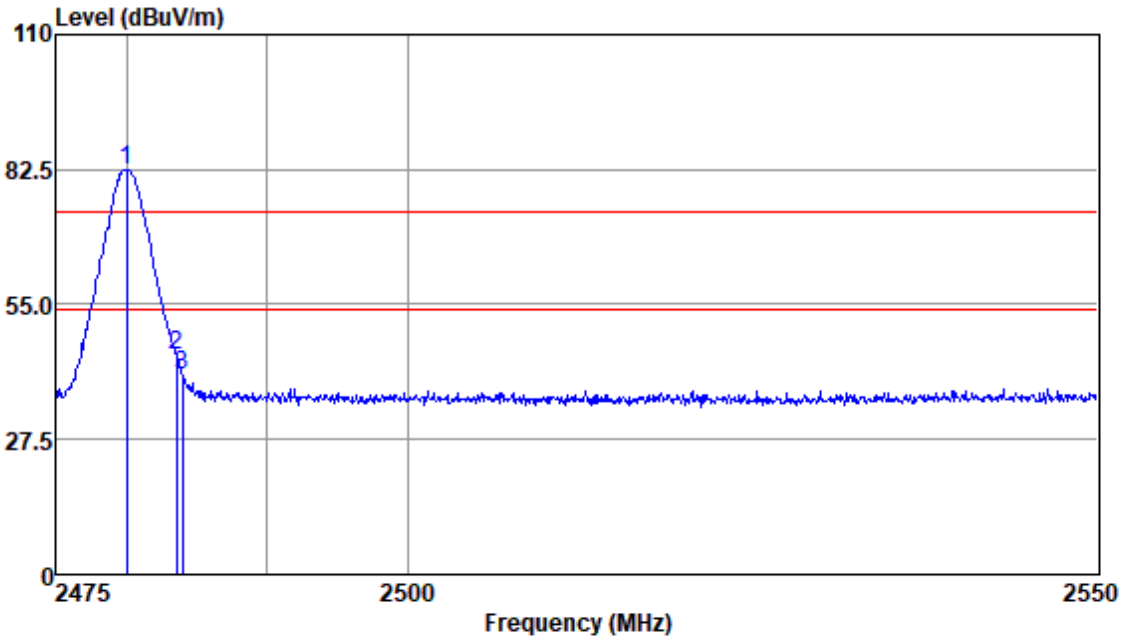


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2479.96	98.12	26.17	3.14	89.86	74.00	15.86	Peak
2483.50	57.79	26.18	3.14	49.54	74.00	-24.46	Peak
2484.11	52.20	26.18	3.14	43.95	74.00	-30.05	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dBuv/m	dBuv/m	dB	
2479.96	90.83	26.17	3.14	82.57	74.00	8.57	Peak
2483.50	52.98	26.18	3.14	44.73	74.00	-29.27	Peak
2483.96	48.99	26.18	3.14	40.74	74.00	-33.26	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss

7.9 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Limit:

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
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.		

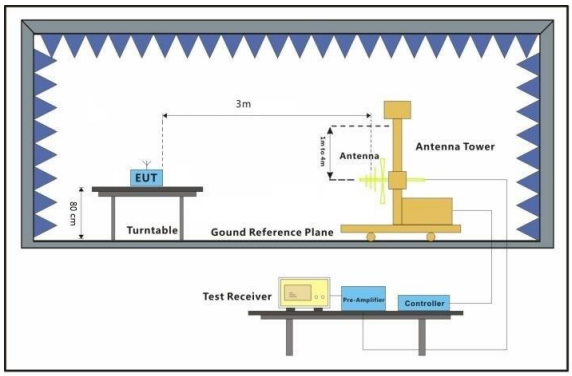
7.9.1 E.U.T. Operation

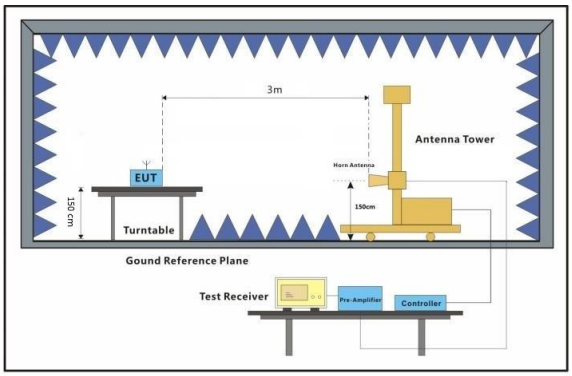
Operating Environment:

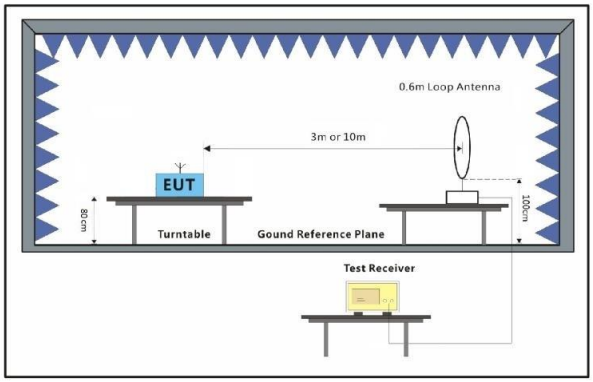
Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.9.2 Test Setup Diagram







7.9.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark:

1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.

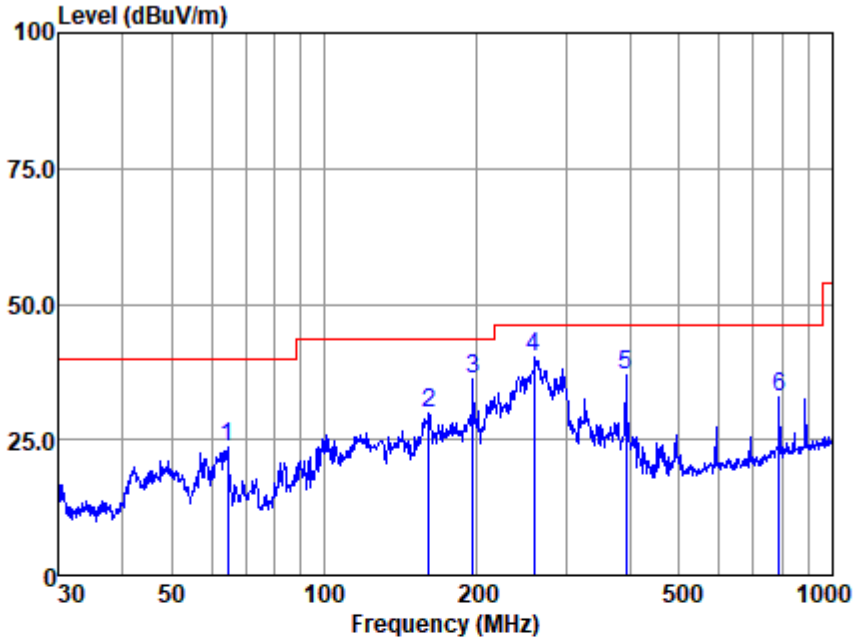
2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown

Below 1GHz:
Mode:b; Polarization:Horizontal

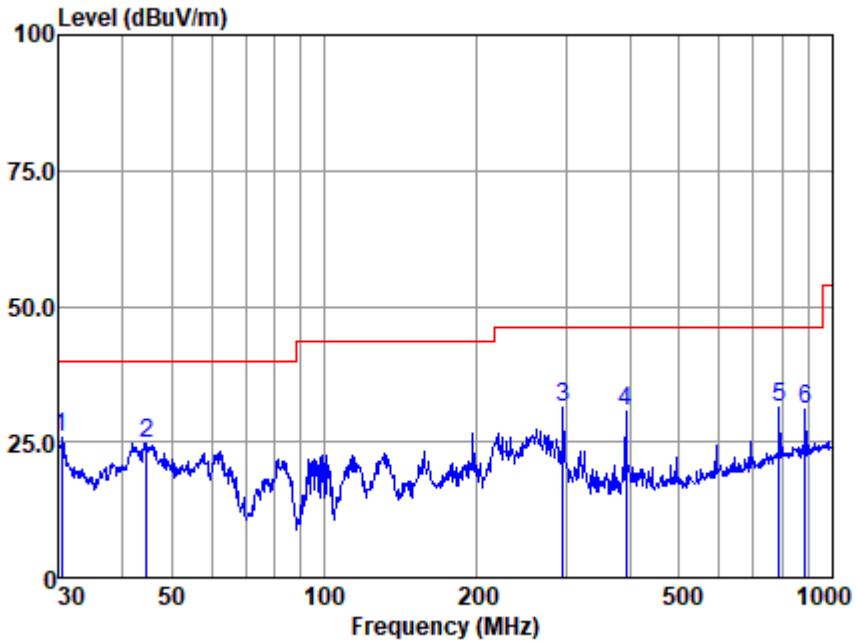


Antenna Polarity :HORIZONTAL
EUT/Project :18774CR
Test mode :b

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	64.433	53.24	12.05	0.61	42.30	23.60	40.00	-16.40	QP
2	160.346	57.80	12.99	1.46	42.22	30.03	43.50	-13.47	QP
3	196.510	66.75	9.73	1.74	42.18	36.04	43.50	-7.46	QP
4	259.234	68.47	11.82	2.21	42.10	40.40	46.00	-5.60	QP
5	393.472	60.66	15.01	3.07	41.92	36.82	46.00	-9.18	QP
6	787.851	48.94	21.72	4.32	41.99	32.99	46.00	-13.01	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a; Polarization:Vertical



Antenna Polarity :VERTICAL
EUT/Project :18774CR
Test mode :b

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	30.424	52.52	15.35	0.45	42.38	25.94	40.00	-14.06	QP
2	44.743	53.36	13.39	0.40	42.33	24.82	40.00	-15.18	QP
3	295.147	57.91	13.03	2.39	42.12	31.21	46.00	-14.79	QP
4	393.472	54.58	15.01	3.07	41.92	30.74	46.00	-15.26	QP
5	787.851	47.24	21.72	4.32	41.99	31.29	46.00	-14.71	QP
6	887.610	45.51	22.61	4.61	41.69	31.04	46.00	-14.96	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Above 1GHz:

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	40.04	6.18	46.22	54	-7.78	peak
7206	38.67	10.63	49.30	54	-4.70	peak
9608	35.56	14.38	49.94	54	-4.06	peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	34.19	6.18	40.37	54	-13.63	peak
7206	35.96	10.63	46.59	54	-7.41	peak
9608	34.88	14.38	49.26	54	-4.74	peak

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4882	34.26	7.00	41.26	54	-12.74	peak
7323	38.00	11.13	49.13	54	-4.87	peak
9764	34.93	14.36	49.29	54	-4.71	peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4882	34.01	7.00	41.01	54	-12.99	peak
7323	36.96	11.13	48.09	54	-5.91	peak
9764	33.40	14.36	47.76	54	-6.24	peak

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	38.78	7.49	46.27	54	-7.73	peak
7440	38.02	11.65	49.67	54	-4.33	peak
9920	31.82	14.40	46.22	54	-7.78	peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	37.62	7.49	45.11	54	-8.89	peak
7440	35.99	11.65	47.64	54	-6.36	peak
9920	34.50	14.40	48.90	54	-5.10	peak

Mode:b; Polarization:Horizontal; Modulation:π/4 DQPSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	36.61	6.18	42.79	54	-11.21	peak
7206	39.47	10.63	50.10	54	-3.90	peak
9608	29.90	14.38	44.28	54	-9.72	peak

Mode:b; Polarization:Vertical; Modulation:π/4 DQPSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	33.90	6.18	40.08	54	-13.92	peak
7206	33.90	10.63	44.53	54	-9.47	peak
9608	33.78	14.38	48.16	54	-5.84	peak

Mode:b; Polarization:Horizontal; Modulation:π/4 DQPSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4882	39.63	7.00	46.63	54	-7.37	peak
7323	37.22	11.13	48.35	54	-5.65	peak
9764	34.43	14.36	48.79	54	-5.21	peak

Mode:b; Polarization:Vertical; Modulation:π/4 DQPSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4882	36.91	7.00	43.91	54	-10.09	peak
7323	36.80	11.13	47.93	54	-6.07	peak
9764	34.55	14.36	48.91	54	-5.09	peak

Mode:b; Polarization:Horizontal; Modulation:π/4 DQPSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	37.21	7.49	44.70	54	-9.30	peak
7440	33.67	11.65	45.32	54	-8.68	peak
9920	31.32	14.40	45.72	54	-8.28	peak

Mode:b; Polarization:Vertical; Modulation:π/4 DQPSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	34.86	7.49	42.35	54	-11.65	peak
7440	37.09	11.65	48.74	54	-5.26	peak
9920	33.93	14.40	48.33	54	-5.67	peak

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	37.61	6.18	43.79	54	-10.21	peak
7206	35.48	10.63	46.11	54	-7.89	peak
9608	34.76	14.38	49.14	54	-4.86	peak

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	33.82	6.18	40.00	54	-14.00	peak
7206	35.07	10.63	45.70	54	-8.30	peak
9608	34.54	14.38	48.92	54	-5.08	peak

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4882	37.07	7.00	44.07	54	-9.93	peak
7323	37.36	11.13	48.49	54	-5.51	peak
9764	37.32	14.36	51.68	54	-2.32	peak

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4882	34.96	7.00	41.96	54	-12.04	peak
7323	39.80	11.13	50.93	54	-3.07	peak
9764	33.35	14.36	47.71	54	-6.29	peak

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	38.23	7.49	45.72	54	-8.28	peak
7440	35.58	11.65	47.23	54	-6.77	peak
9920	34.47	14.40	48.87	54	-5.13	peak

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	40.15	7.49	47.64	54	-6.36	peak
7440	36.14	11.65	47.79	54	-6.21	peak
9920	34.52	14.40	48.92	54	-5.08	peak

7.10 99% Bandwidth

Test Requirement RSS-Gen Section 6.7

Test Method: ANSI C63.10 Section 6.9.3

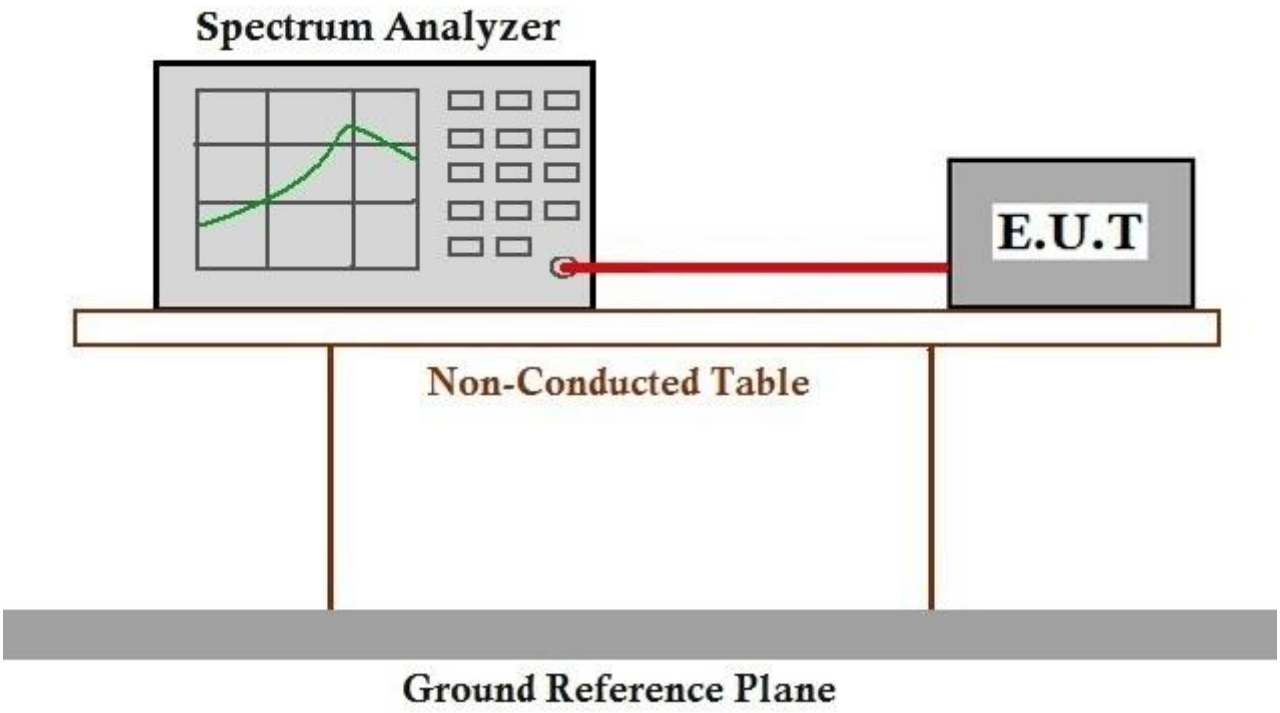
7.10.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.10.2 Test Setup Diagram



7.10.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM191101877601

8 Test Setup Photographs

Refer to the < Test Setup photos-FCC>.

9 EUT Constructional Details

Refer to the < External Photos > & < Internal Photos >.

- End of the Report -