

TEST REPORT

Applicant: Shenzhen Mingchuangzhilian Technology Co.,Ltd

Address of Applicant: 4/F,B Block, No.3, East Region, Shangxue Science Park,
Bantian St,Longgang Dist,Shenzhen,China

Manufacturer/ Factory: Shenzhen Mingchuangzhilian Technology Co.,Ltd

Address of Manufacturer/ Factory: 4/F,B Block, No.3, East Region, Shangxue Science Park,
Bantian St,Longgang Dist,Shenzhen,China

Equipment Under Test (EUT)

Product Name: Baby Monitor

Model No.: SM35PTZ, SM35PTZ-TX, SM935E, SM935E-TX

Trade Mark: N/A

FCC ID: 2AKVZ-SM35PTZ

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247

Date of sample receipt: Sep. 02, 2020

Date of Test: Sep. 02 – Oct. 11, 2020

Date of report issued: Oct. 12, 2020

Test Result : PASS *

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

Authorized Signature:

A circular blue ink stamp from GTS (Global United Technology Services) is visible. The stamp contains the text "GTS", "GLOBAL UNITED TECHNOLOGY SERVICES", and "EST. 2019". Overlaid on the stamp is a handwritten signature in black ink, which appears to read "Robinson Luo".

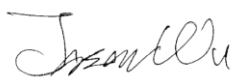
Robinson Luo
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
00	Oct. 12, 2020	Original

Prepared By:



Date:

Oct. 12, 2020

Project Engineer

Check By:


Reviewer

Date:

Oct. 12, 2020

3 Contents

Page

1	COVER PAGE	1
2	VERSION	2
3	CONTENTS	3
4	TEST SUMMARY	4
4.1	MEASUREMENT UNCERTAINTY	4
5	GENERAL INFORMATION	5
5.1	GENERAL DESCRIPTION OF EUT	5
5.2	TEST MODE	7
5.3	TEST FACILITY	7
5.4	TEST LOCATION	7
5.5	OTHER INFORMATION REQUESTED BY THE CUSTOMER.....	7
5.6	DESCRIPTION OF SUPPORT UNITS	7
5.7	DEVIATION FROM STANDARDS.....	7
5.8	ABNORMALITIES FROM STANDARD CONDITIONS.....	7
5.9	ADDITIONAL INSTRUCTIONS.....	7
6	TEST INSTRUMENTS LIST	8
7	TEST RESULTS AND MEASUREMENT DATA	10
7.1	ANTENNA REQUIREMENT	10
7.2	CONDUCTED EMISSIONS	11
7.3	CONDUCTED PEAK OUTPUT POWER.....	14
7.4	20dB EMISSION BANDWIDTH	16
7.5	CARRIER FREQUENCIES SEPARATION.....	18
7.6	HOPPING CHANNEL NUMBER	20
7.7	DWELL TIME	21
7.8	PSEUDORANDOM FREQUENCY HOPPING SEQUENCE	25
7.9	BAND EDGE	26
7.9.1	Conducted Emission Method	26
7.9.2	Radiated Emission Method	28
7.10	SPURIOUS EMISSION	30
7.10.1	Conducted Emission Method.....	30
7.10.2	Radiated Emission Method.....	32
8	TEST SETUP PHOTO	40
9	EUT CONSTRUCTIONAL DETAILS.....	40

4 Test Summary

Test Item	Section	Result
Antenna Requirement	15.203/15.247 (c)	Pass
AC Power Line Conducted Emission	15.207	Pass
Conducted Peak Output Power	15.247 (b)(1)	Pass
20dB Occupied Bandwidth	15.247 (a)(1)	Pass
Carrier Frequencies Separation	15.247 (a)(1)	Pass
Hopping Channel Number	15.247 (a)(1)	Pass
Dwell Time	15.247 (a)(1)	Pass
Pseudorandom Frequency Hopping Sequence	15.247(b)(4)	Pass
Radiated Emission	15.205/15.209	Pass
Band Edge	15.247(d)	Pass

Pass: The EUT complies with the essential requirements in the standard.

Remark : Test according to ANSI C63.10:2013.

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	30MHz-200MHz	3.8039dB	(1)
Radiated Emission	200MHz-1GHz	3.9679dB	(1)
Radiated Emission	1GHz-18GHz	4.29dB	(1)
Radiated Emission	18GHz-40GHz	3.30dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	3.44dB	(1)

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.

5 General Information

5.1 General Description of EUT

Product Name:	Baby Monitor
Model No.:	SM35PTZ, SM35PTZ-TX, SM935E, SM935E-TX
Test Model No.:	SM35PTZ
Remark: All above models are identical in the same PCB layout, interior structure and electrical circuits. The differences are model name for commercial purpose.	
Serial No.:	N/A
Hardware Version:	V04
Software Version:	V11
Test sample(s) ID:	GTS202010000003-1
Sample(s) Status	Engineer sample
Operation Frequency:	2410.875MHz~2471.625MHz
Channel numbers:	19
Channel Separation:	3.375MHz
Modulation technology:	GFSK
Antenna Type:	Integral Antenna
Antenna gain:	2.00dBi
Power supply:	Adapter Model:AW006WR-0500100UV Input:100-240V, 50/60Hz, 0.3A Output:DC 5.0V, 1A

Operation Frequency each of channel							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2410.875	6	2427.750	11	2444.625	16	2461.500
2	2414.250	7	2431.125	12	2448.000	17	2464.875
3	2417.625	8	2434.500	13	2451.375	18	2468.250
4	2421.000	9	2437.875	14	2454.750	19	2471.625
5	2424.375	10	2441.250	15	2458.125		

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel	2410.875MHz
The middle channel	2441.250MHz
The Highest channel	2471.625MHz

5.2 Test mode

Transmitting mode	Keep the EUT in transmitting mode.
-------------------	------------------------------------

5.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations: • FCC —Registration No.: 381383 Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383. • IC —Registration No.: 9079A The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A • NVLAP (LAB CODE:600179-0) Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). LAB CODE:600179-0

5.4 Test Location

All other tests were performed at:
Global United Technology Services Co., Ltd. Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102 Tel: 0755-27798480 Fax: 0755-27798960

5.5 Other Information Requested by the Customer

None.

5.6 Description of Support Units

None

5.7 Deviation from Standards

None.

5.8 Abnormalities from Standard Conditions

None.

5.9 Additional Instructions

Test Software	Special test command provided by manufacturer
Power level setup	Default

6 Test Instruments list

Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 02 2020	July. 01 2025
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 25 2020	June. 24 2021
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 25 2020	June. 24 2021
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 25 2020	June. 24 2021
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 25 2020	June. 24 2021
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 25 2020	June. 24 2021
9	Coaxial Cable	GTS	N/A	GTS211	June. 25 2020	June. 24 2021
10	Coaxial cable	GTS	N/A	GTS210	June. 25 2020	June. 24 2021
11	Coaxial Cable	GTS	N/A	GTS212	June. 25 2020	June. 24 2021
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 25 2020	June. 24 2021
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 25 2020	June. 24 2021
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 25 2020	June. 24 2021
15	Band filter	Amindeon	82346	GTS219	June. 25 2020	June. 24 2021
16	Power Meter	Anritsu	ML2495A	GTS540	June. 25 2020	June. 24 2021
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 25 2020	June. 24 2021
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 25 2020	June. 24 2021
19	Splitter	Agilent	11636B	GTS237	June. 25 2020	June. 24 2021
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 25 2020	June. 24 2021
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 19 2019	Oct. 18 2020
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 19 2019	Oct. 18 2020
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 19 2019	Oct. 18 2020
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 25 2020	June. 24 2021

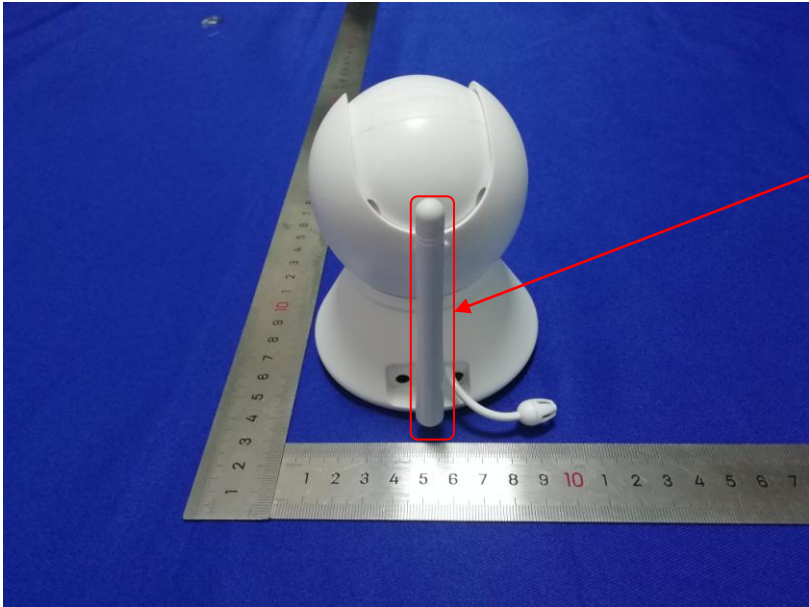
Conducted Emission						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Shielding Room	ZhongYu Electron	7.3(L)x3.1(W)x2.9(H)	GTS252	May.15 2019	May.14 2022
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 25 2020	June. 24 2021
3	Coaxial Switch	ANRITSU CORP	MP59B	GTS225	June. 25 2020	June. 24 2021
4	ENV216 2-L-V-NETZNACHB.DE	ROHDE&SCHWARZ	ENV216	GTS226	June. 25 2020	June. 24 2021
5	Coaxial Cable	GTS	N/A	GTS227	N/A	N/A
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Thermo meter	KTJ	TA328	GTS233	June. 25 2020	June. 24 2021
8	Absorbing clamp	Elektronik-Feinmechanik	MDS21	GTS229	June. 25 2020	June. 24 2021
9	ISN	SCHWARZBECK	NTFM 8158	GTD565	June. 25 2020	June. 24 2021

RF Conducted Test:						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	MXA Signal Analyzer	Agilent	N9020A	GTS566	June. 25 2020	June. 24 2021
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 25 2020	June. 24 2021
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June. 25 2020	June. 24 2021
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	June. 25 2020	June. 24 2021
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	June. 25 2020	June. 24 2021
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	June. 25 2020	June. 24 2021
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	June. 25 2020	June. 24 2021
8	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	June. 25 2020	June. 24 2021

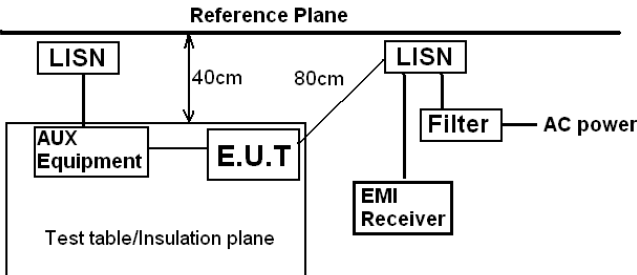
General used equipment:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 25 2020	June. 24 2021
2	Barometer	ChangChun	DYM3	GTS255	June. 25 2020	June. 24 2021

7 Test results and Measurement Data

7.1 Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
15.203 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(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.	
EUT Antenna:	
<i>The antenna is integral antenna, the best case gain of the antenna is 2.00dBi, reference to the appendix II for details</i>	
	

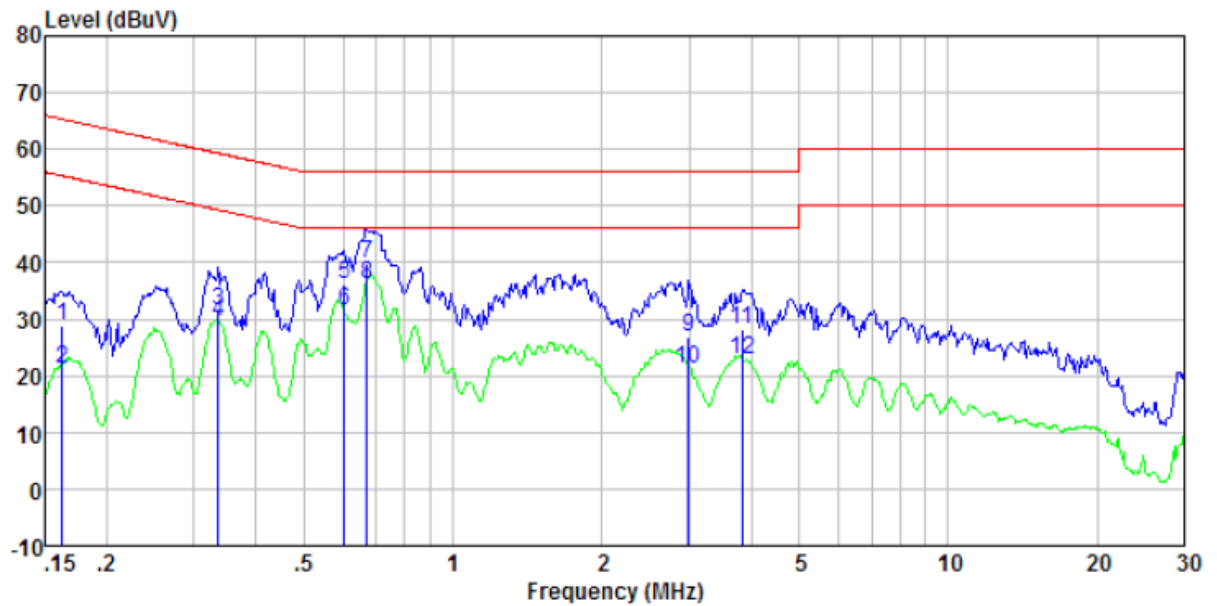
7.2 Conducted Emissions

Test Requirement:	FCC Part15 C Section 15.207						
Test Method:	ANSI C63.10:2013						
Test Frequency Range:	150KHz to 30MHz						
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto						
Limit:	Frequency range (MHz)		Limit (dBuV)				
			Quasi-peak		Average		
	0.15-0.5		66 to 56*		56 to 46*		
	0.5-5		56		46		
	5-30		60		50		
	* Decreases with the logarithm of the frequency.						
Test setup:	Reference Plane  Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m						
Test procedure:	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement.						
Test Instruments:	Refer to section 6.0 for details						
Test mode:	Refer to section 5.2 for details						
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar	
Test voltage:	AC 120V, 60Hz						
Test results:	Pass						

Remark: Both high and low voltages have been tested to show only the worst low voltage test data.

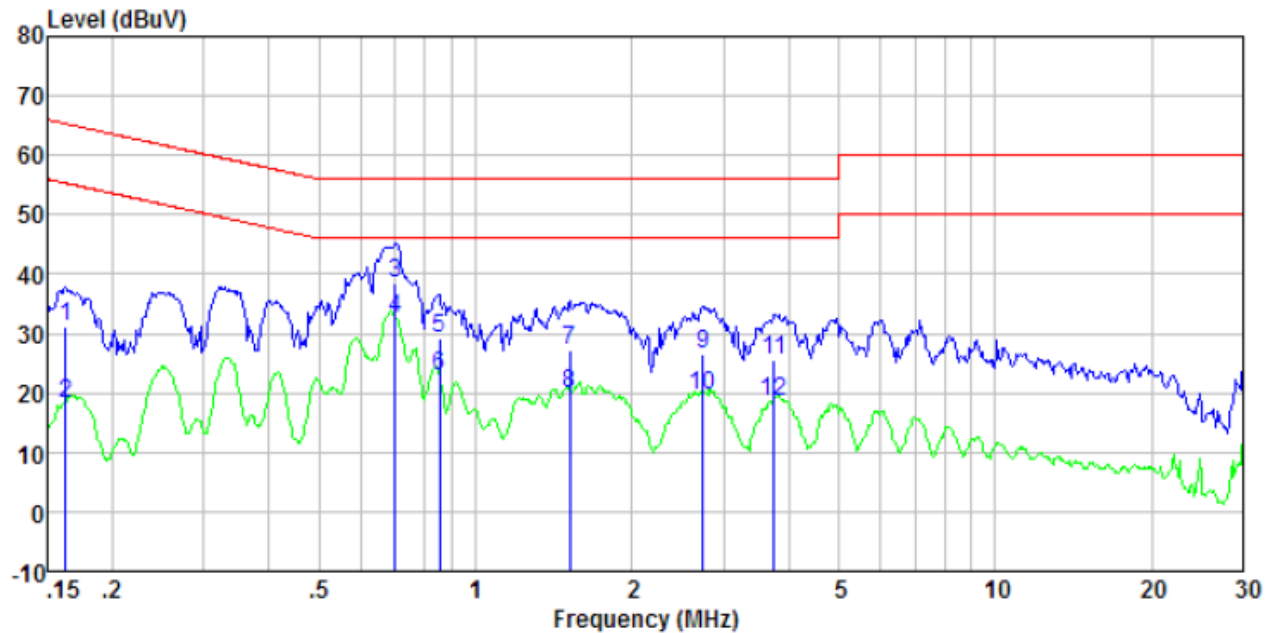
Measurement data

Line:



Freq MHz	Reading level dBuV	LIISN/ISN factor dB	Cable loss dB	level dBuV	Limit level dBuV	Over limit dB	Remark
0.162	28.26	0.40	0.08	28.74	65.34	-36.60	QP
0.162	20.88	0.40	0.08	21.36	55.34	-33.98	Average
0.336	31.14	0.38	0.10	31.62	59.31	-27.69	QP
0.336	28.98	0.38	0.10	29.46	49.31	-19.85	Average
0.604	35.60	0.28	0.12	36.00	56.00	-20.00	QP
0.604	31.00	0.28	0.12	31.40	46.00	-14.60	Average
0.672	39.25	0.27	0.13	39.65	56.00	-16.35	QP
0.672	35.80	0.27	0.13	36.20	46.00	-9.80	Average
2.993	26.61	0.20	0.19	27.00	56.00	-29.00	QP
2.993	20.83	0.20	0.19	21.22	46.00	-24.78	Average
3.840	27.67	0.20	0.18	28.05	56.00	-27.95	QP
3.840	22.50	0.20	0.18	22.88	46.00	-23.12	Average

Neutral:

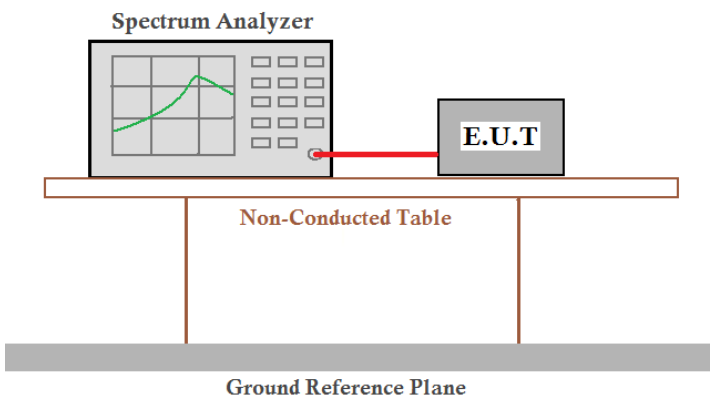


Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	level dBuV	Limit level dBuV	Over limit dB	Remark
0.162	30.72	0.40	0.08	31.20	65.34	-34.14	QP
0.162	17.63	0.40	0.08	18.11	55.34	-37.23	Average
0.701	38.17	0.26	0.13	38.56	56.00	-17.44	QP
0.701	32.16	0.26	0.13	32.55	46.00	-13.45	Average
0.853	28.84	0.23	0.14	29.21	56.00	-26.79	QP
0.853	22.59	0.23	0.14	22.96	46.00	-23.04	Average
1.519	26.73	0.20	0.17	27.10	56.00	-28.90	QP
1.519	19.58	0.20	0.17	19.95	46.00	-26.05	Average
2.736	26.11	0.20	0.19	26.50	56.00	-29.50	QP
2.736	19.11	0.20	0.19	19.50	46.00	-26.50	Average
3.759	25.10	0.20	0.18	25.48	56.00	-30.52	QP
3.759	18.32	0.20	0.18	18.70	46.00	-27.30	Average

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss
4. *If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.*

7.3 Conducted Peak Output Power

Test Requirement:	FCC Part15 C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2013
Limit:	20.97dBm
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. The table is supported by a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

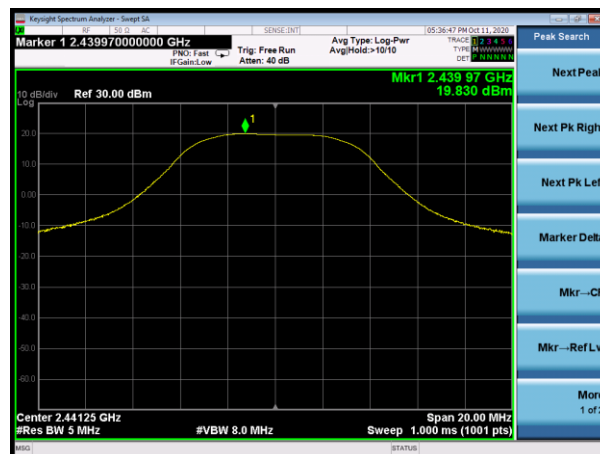
Measurement Data

Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	20.071	20.97	Pass
Middle	19.830		
Highest	19.396		

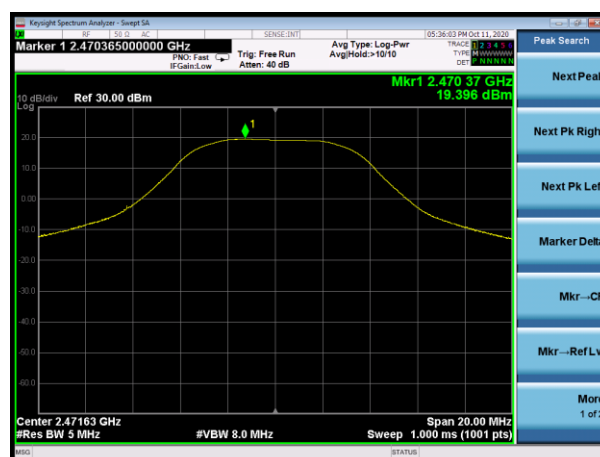
Test plot as follows:



Lowest channel

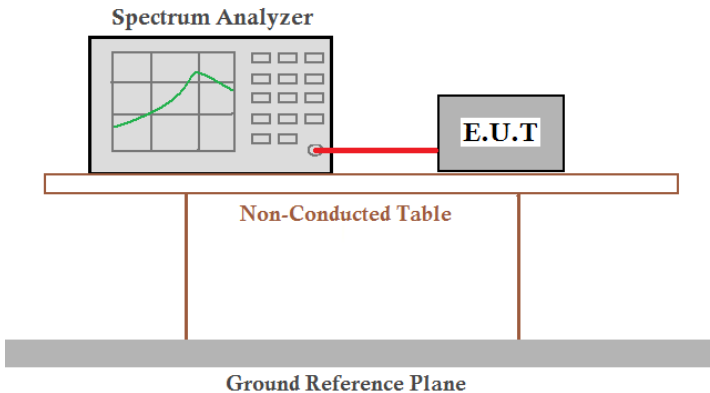


Middle channel



Highest channel

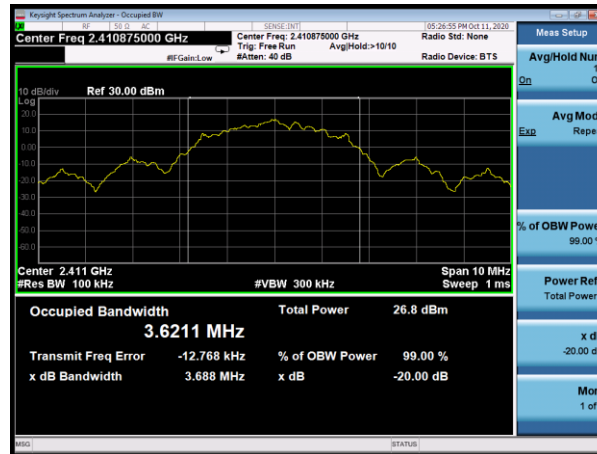
7.4 20dB Emission Bandwidth

Test Requirement:	FCC Part15 C Section 15.247 (a)(2)
Test Method:	ANSI C63.10:2013
Limit:	N/A
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

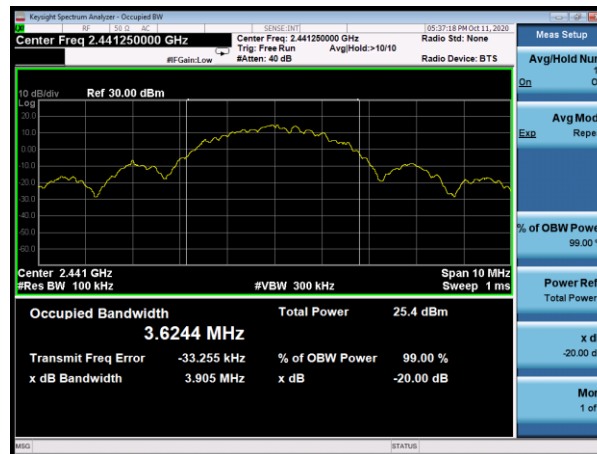
Measurement Data

Test channel	20dB Emission Bandwidth (MHz)	Result
Lowest	3.688	Pass
Middle	3.905	
Highest	3.640	

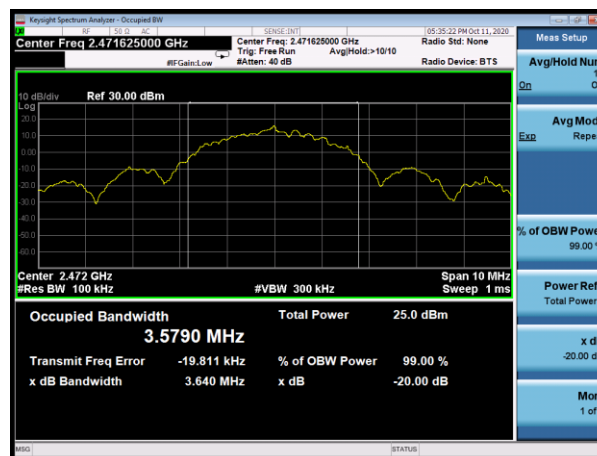
Test plot as follows:



Lowest channel

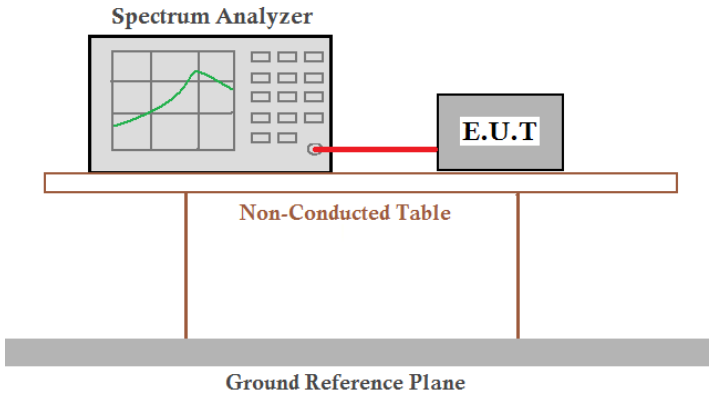


Middle channel



Highest channel

7.5 Carrier Frequencies Separation

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100KHz, VBW=300KHz, detector=Peak
Limit:	0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both are placed on a Non-Conducted Table, which is supported by a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Test channel	Carrier Frequencies Separation (MHz)	Limit (MHz)	Result
Lowest	3.375	2.603	Pass
Middle	3.375	2.603	Pass
Highest	3.375	2.603	Pass

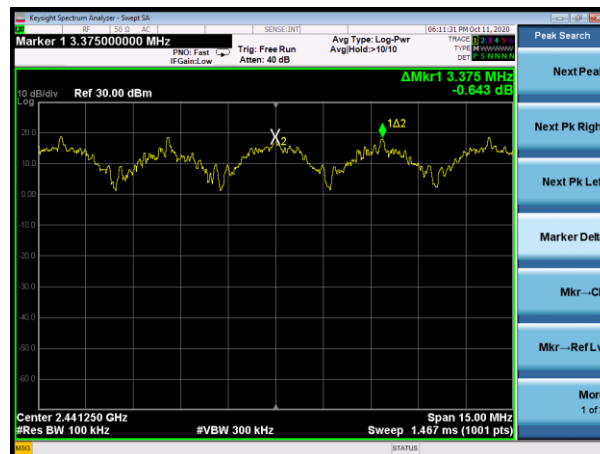
Note: According to section 7.4

Mode	20dB bandwidth (MHz) (worse case)	Limit (MHz) (Carrier Frequencies Separation)
GFSK	3.905	2.603

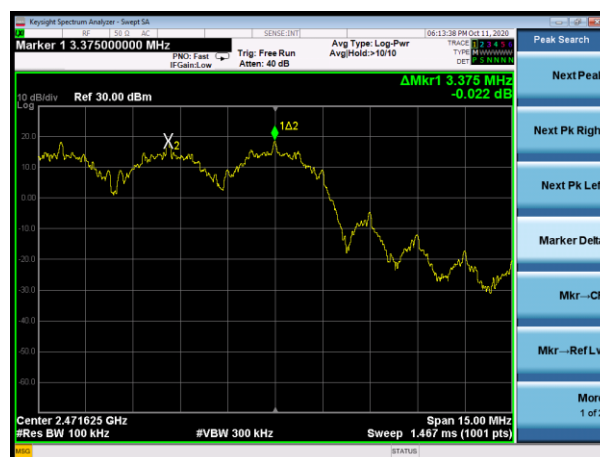
Test plot as follows:



Lowest channel

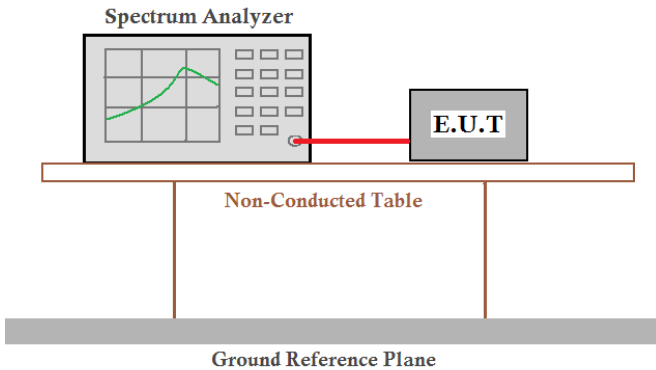


Middle channel



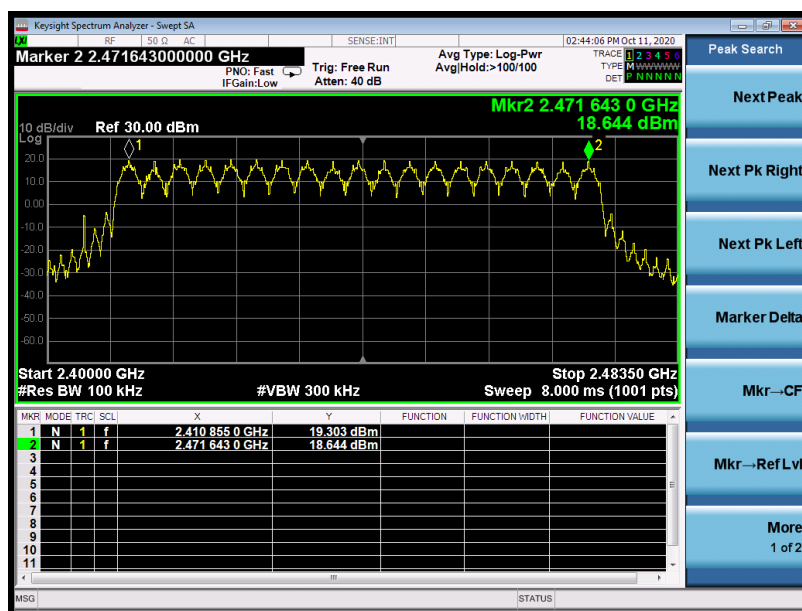
Highest channel

7.6 Hopping Channel Number

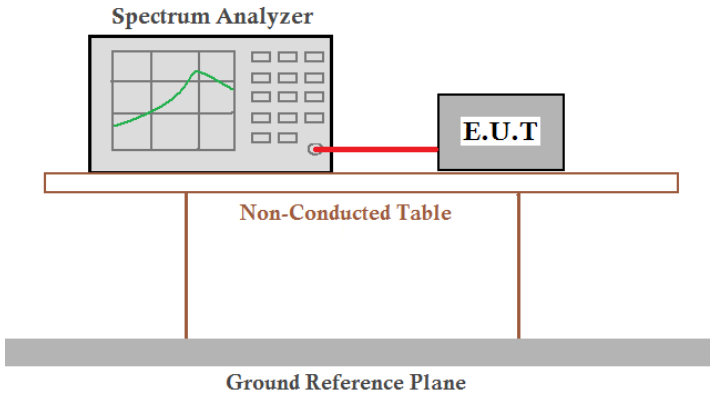
Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak
Limit:	15 channels
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data:

Hopping channel numbers	Limit	Result
19	15	Pass



7.7 Dwell Time

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=1MHz, VBW=1MHz, Span=0Hz, Detector=Peak
Limit:	0.4 Second
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T are placed on a Non-Conducted Table. The table is supported by a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Frequency	Ton (ms)	Dwell time(ms)	Limit(ms)	Result
2410.875MHz	2.50	342.00	400	Pass
2441.250MHz	2.52	344.74	400	Pass
2471.625MHz	2.52	344.74	400	Pass

The formula as below:

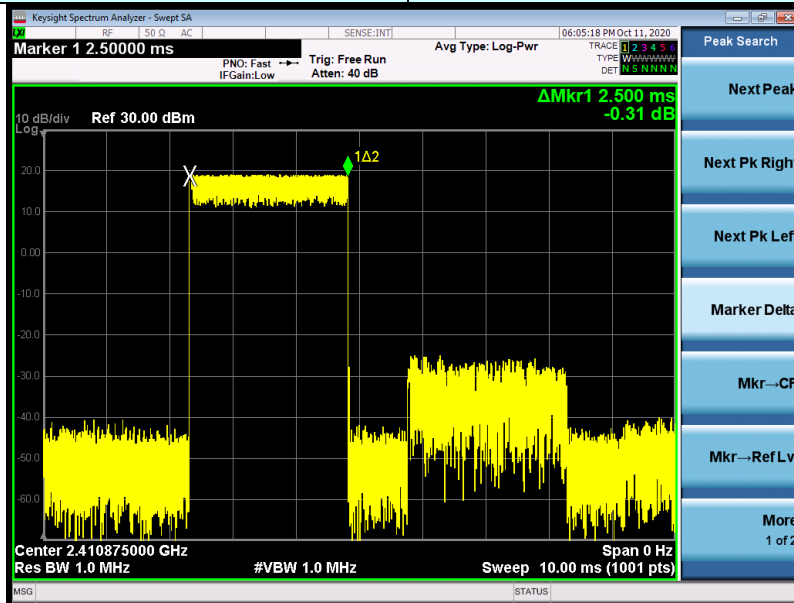
2410.001MHz: Dwell time = Ton * Ton times in 1s * 0.4s * channel numbers=2.50ms*18*0.4*19=342.00ms

2441.501MHz: Dwell time = Ton * Ton times in 1s * 0.4s * channel numbers=2.52ms*18*0.4*19=342.74ms

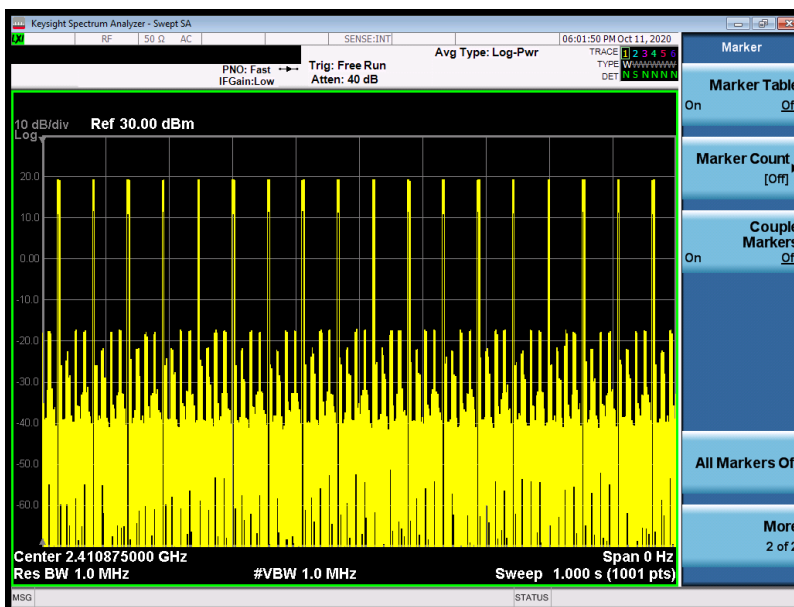
2477.001MHz: Dwell time = Ton * Ton times in 1s * 0.4s * channel numbers=2.52ms*18*0.4*19=342.74ms

Test plot as follows:

Frequency:	2410.875MHz
------------	-------------



Ton

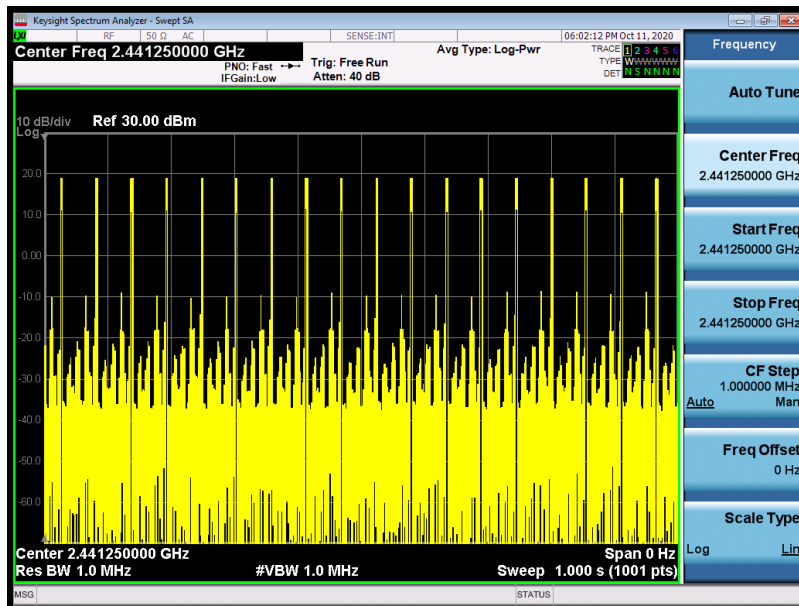


Ton times in 1s

Frequency:	2441.250MHz
------------	-------------



Ton



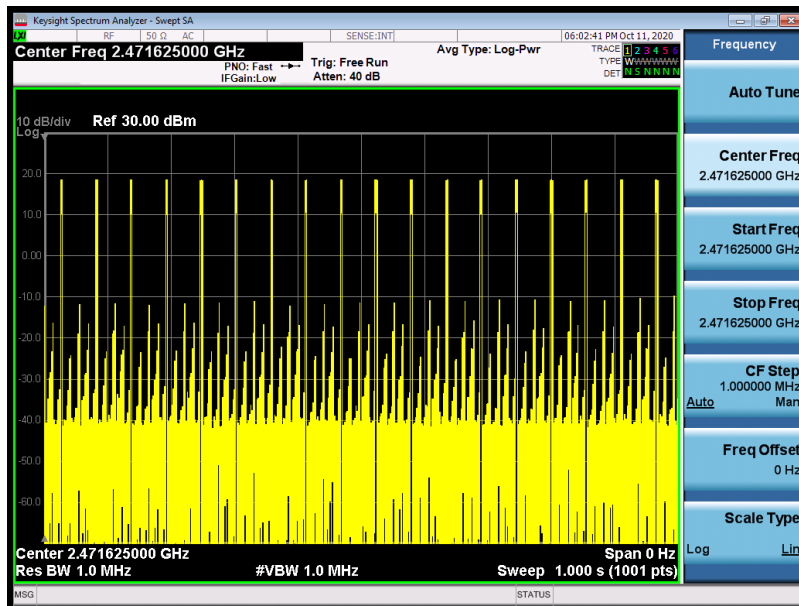
Ton times in 1s

Frequency:

2471.625MHz

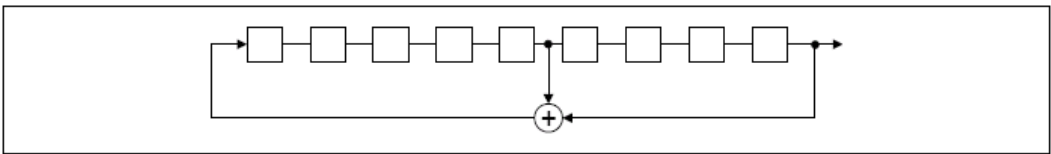
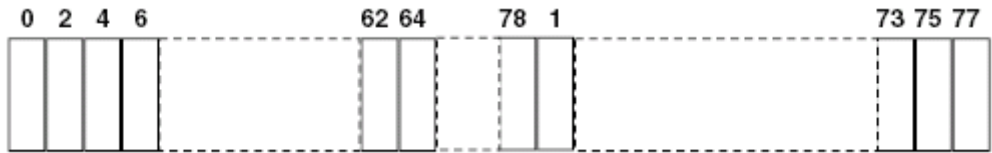


Ton



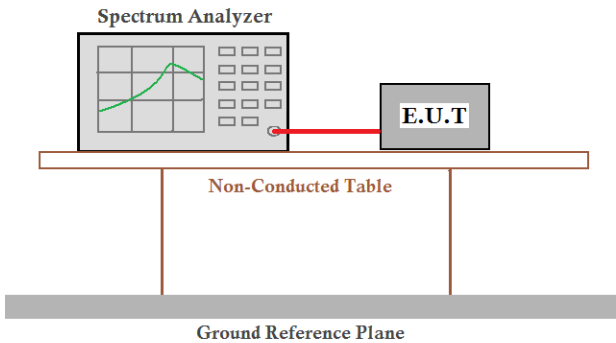
Ton times in 1s

7.8 Pseudorandom Frequency Hopping Sequence

Test Requirement:	FCC Part15 C Section 15.247 (a)(1) requirement:
	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. 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. (g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section. (h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.
	EUT Pseudorandom Frequency Hopping Sequence The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones. • Number of shift register stages: 9 • Length of pseudo-random sequence: $2^9 - 1 = 511$ bits • Longest sequence of zeros: 8 (non-inverted signal)  <i>Linear Feedback Shift Register for Generation of the PRBS sequence</i> An example of Pseudorandom Frequency Hopping Sequence as follow:  Each frequency used equally on the average by each transmitter. The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals. it 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.

7.9 Band Edge

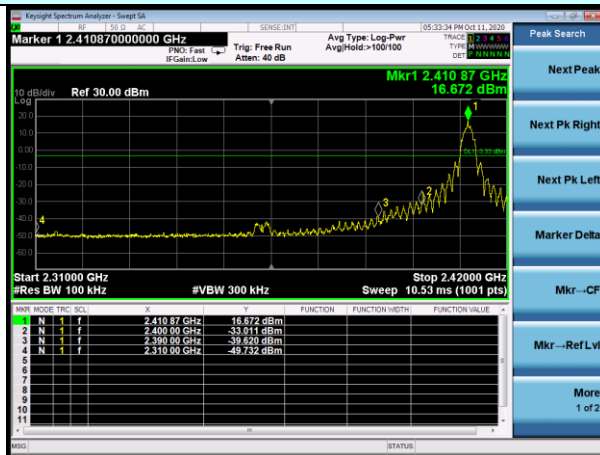
7.9.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Detector=Peak
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. The table is supported by a Ground Reference Plane.
Test Instruments:	Refer to section6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

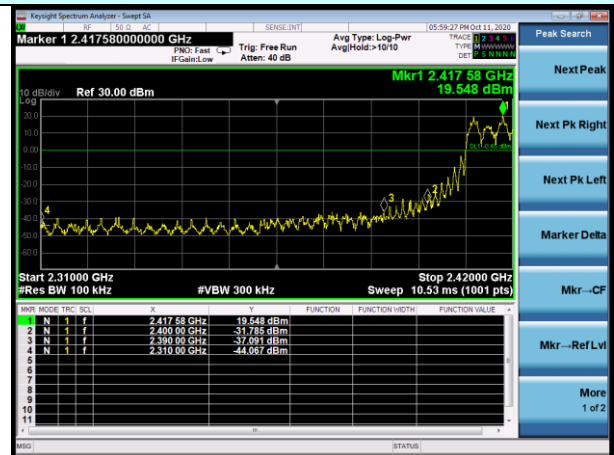
Test plot as follows:

Test channel:

Lowest channel



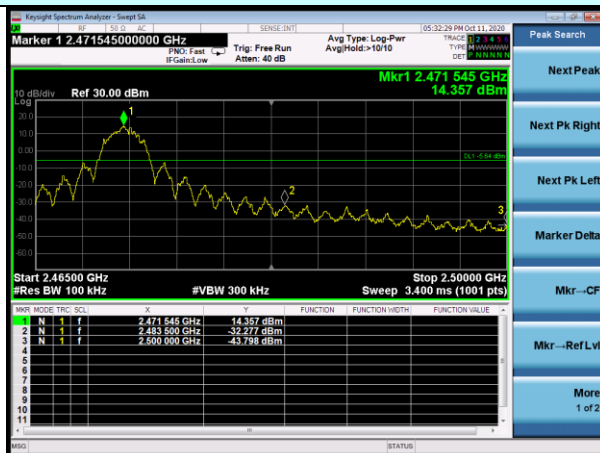
No-hopping mode



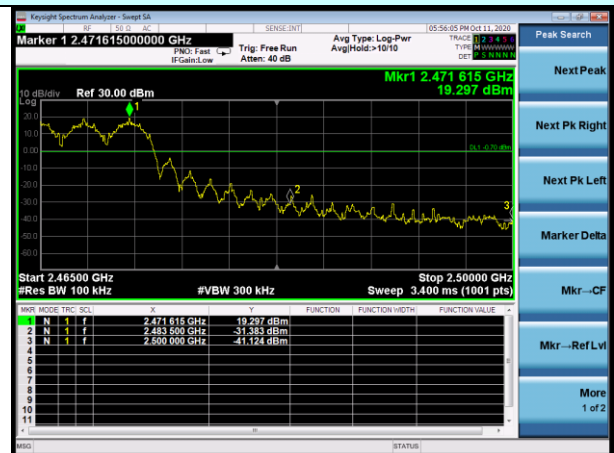
Hopping mode

Test channel:

Highest channel

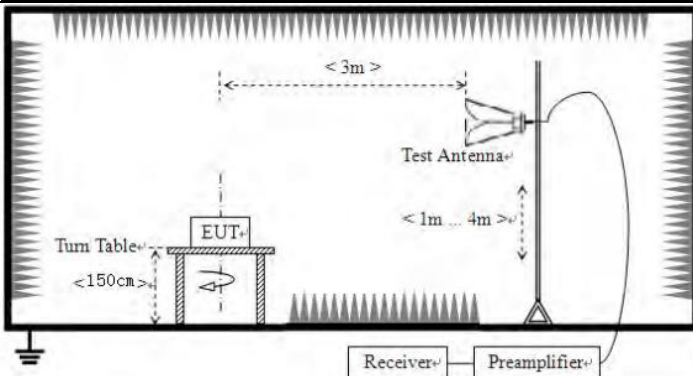


No-hopping mode



Hopping mode

7.9.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209 and 15.205						
Test Method:	ANSI C63.10:2013						
Test Frequency Range:	All restriction band have been tested, and 2.3GHz to 2.5GHz band is the worse case						
Test site:	Measurement Distance: 3m						
Receiver setup:	Frequency	Detector		RBW	VBW	Remark	
	Above 1GHz	Peak		1MHz	3MHz	Peak Value	
		Peak		1MHz	10Hz	Average Value	
Limit:	Frequency			Limit (dBuV/m @3m)		Remark	
	Above 1GHz			54.00		Average Value	
				74.00		Peak Value	
Test setup:							
Test Procedure:	1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. 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. 4. 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 and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. 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.						
Test Instruments:	Refer to section 6.0 for details						
Test mode:	Refer to section 5.2 for details						
Temp. / Hum.	Temp.:	25 °C	Humid.:	52%	Press.:	1 012mbar	
Test results:	Pass						

Measurement Data

Remark:

1. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

Test channel:	Lowest
---------------	--------

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2390.00	53.02	27.59	5.38	34.01	51.98	74.00	-22.02	Horizontal
2400.00	61.74	27.58	5.39	34.01	60.70	74.00	-13.30	Horizontal
2390.00	54.88	27.59	5.38	34.01	53.84	74.00	-20.16	Vertical
2400.00	63.78	27.58	5.39	34.01	62.74	74.00	-11.26	Vertical

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2390.00	39.69	27.59	5.38	34.01	38.65	54.00	-15.35	Horizontal
2400.00	48.10	27.58	5.39	34.01	47.06	54.00	-6.94	Horizontal
2390.00	41.19	27.59	5.38	34.01	40.15	54.00	-13.85	Vertical
2400.00	49.30	27.58	5.39	34.01	48.26	54.00	-5.74	Vertical

Test channel:	Highest
---------------	---------

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	53.43	27.53	5.47	33.92	52.51	74.00	-21.49	Horizontal
2500.00	49.55	27.55	5.49	29.93	52.66	74.00	-21.34	Horizontal
2483.50	55.78	27.53	5.47	33.92	54.86	74.00	-19.14	Vertical
2500.00	52.22	27.55	5.49	29.93	55.33	74.00	-18.68	Vertical

Average value:

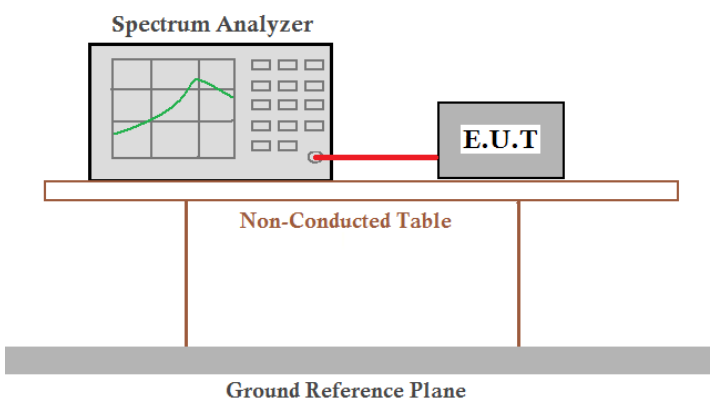
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	39.92	27.53	5.47	33.92	39.00	54.00	-15.00	Horizontal
2500.00	36.14	27.55	5.49	29.93	39.25	54.00	-14.75	Horizontal
2483.50	42.18	27.53	5.47	33.92	41.26	54.00	-12.74	Vertical
2500.00	37.80	27.55	5.49	29.93	40.91	54.00	-13.09	Vertical

Remark:

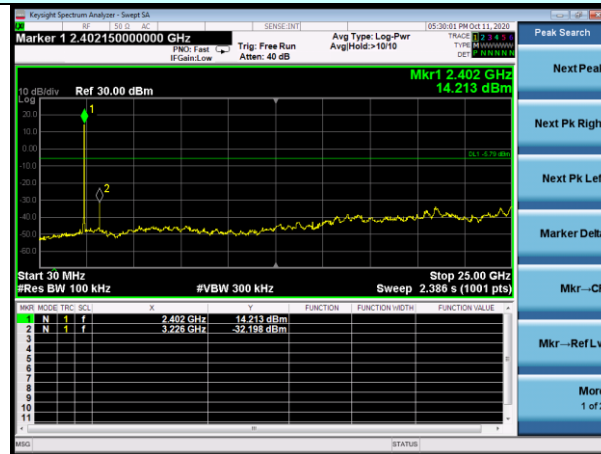
1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.

7.10 Spurious Emission

7.10.1 Conducted Emission Method

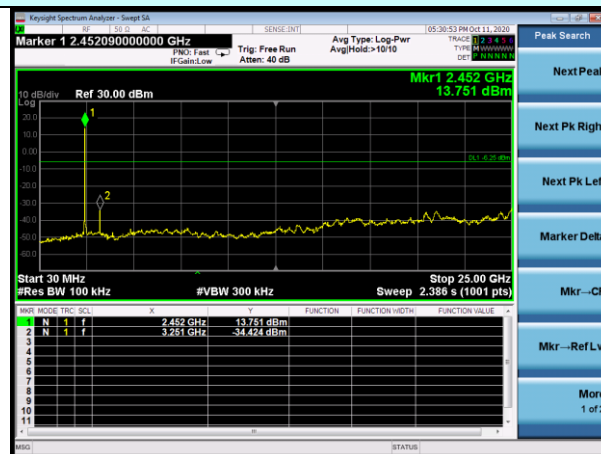
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Test setup:	 The diagram illustrates the test setup for conducted emission measurement. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table, which is supported by two vertical legs. Below the table is a Ground Reference Plane, represented by a thick grey bar.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Lowest channel



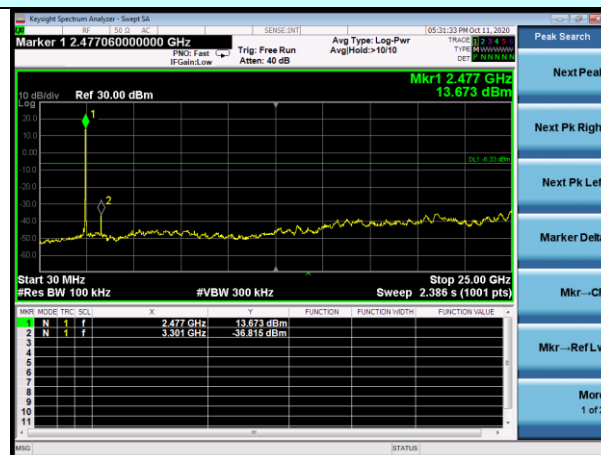
30MHz~25GHz

Middle channel



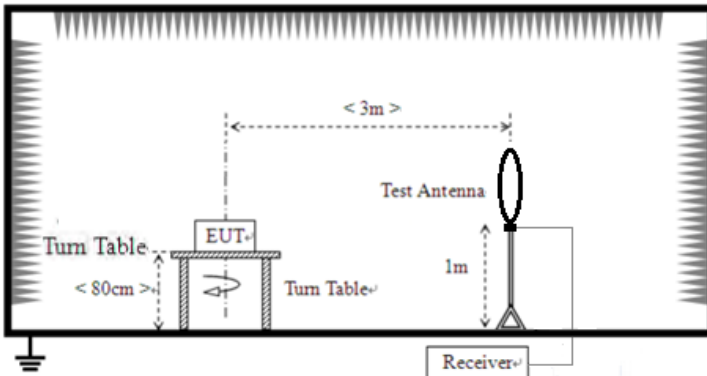
30MHz~25GHz

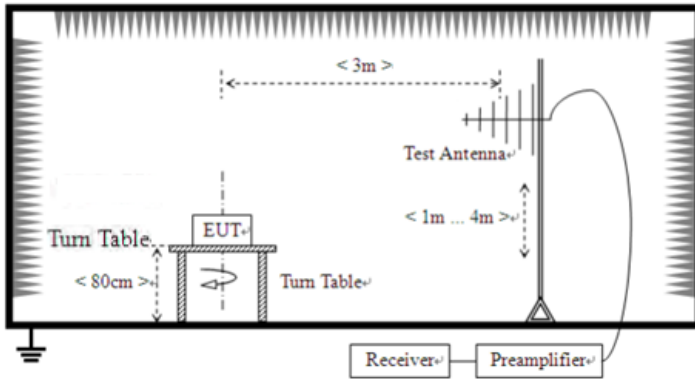
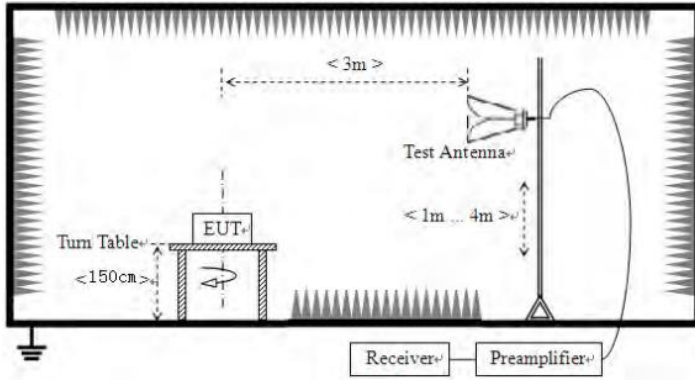
Highest channel



30MHz~25GHz

7.10.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
Limit: (Spurious Emissions)	Frequency		Limit (uV/m)	Value	Measurement Distance
	0.009MHz-0.490MHz		2400/F(KHz)	QP	300m
	0.490MHz-1.705MHz		24000/F(KHz)	QP	300m
	1.705MHz-30MHz		30	QP	30m
	30MHz-88MHz		100	QP	3m
	88MHz-216MHz		150	QP	
	216MHz-960MHz		200	QP	
	960MHz-1GHz		500	QP	
	Above 1GHz		500	Average	
			5000	Peak	
Test setup:	Below 30MHz				
					
Below 1GHz					

	 Above 1GHz 
Test Procedure:	1. The EUT was placed on the top of a rotating table (0.8 meters for below 1GHz and 1.5meters for above 1GHz) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. 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. 4. 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 and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. 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.
Test Instruments:	Refer to section 5.8 for details
Test mode:	Refer to section 5.2 for details
Temp. / Hum.	Temp.: 25 °C Humid.: 52% Press.: 1 012mbar

Test results:	Pass
---------------	------

Remark:

1. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

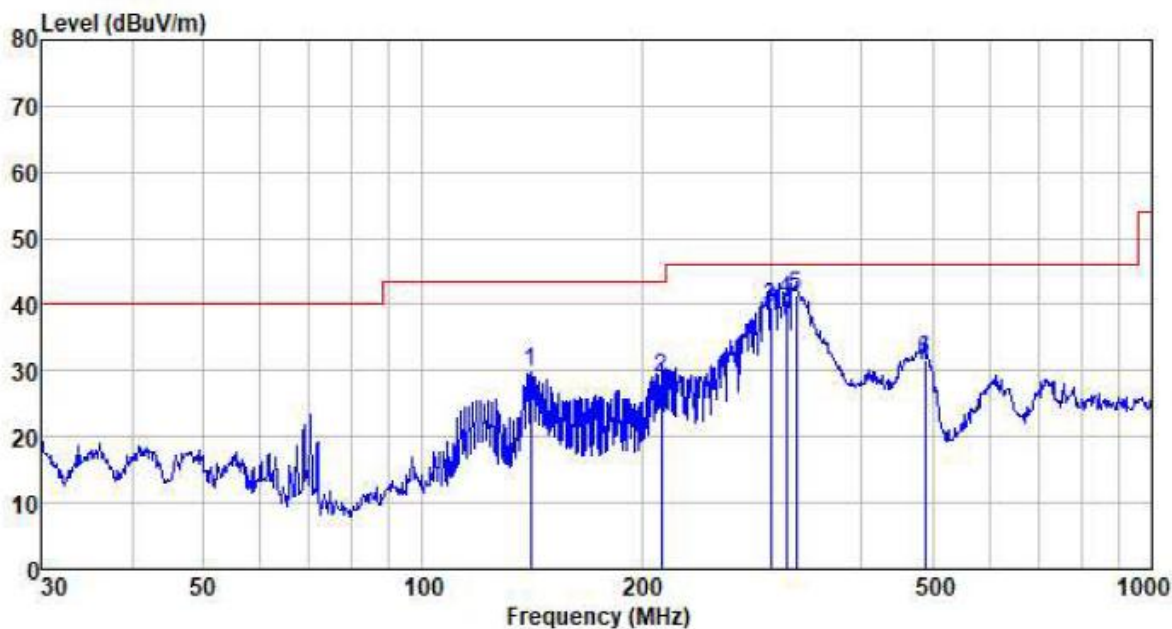
Measurement data:**■ Below 30MHz**

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

■ 30MHz ~ 1GHz

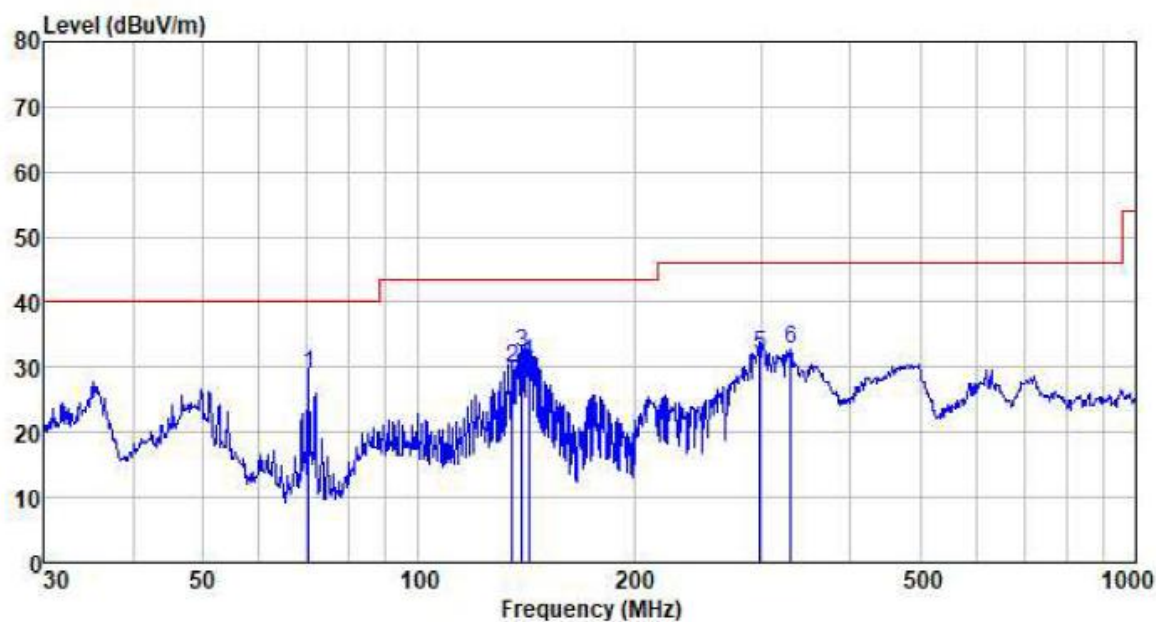
Pre-scan all test modes, found worst case at 2410.875MHz, and so only show the test result of 2410.875MHz

Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
140.835	58.00	7.41	1.51	37.02	29.90	43.50	-13.60	QP
212.270	53.59	10.87	1.91	37.34	29.03	43.50	-14.47	QP
300.367	60.95	13.60	2.36	37.42	39.49	46.00	-6.51	QP
315.481	61.69	13.90	2.44	37.44	40.59	46.00	-5.41	QP
325.596	62.13	14.09	2.49	37.45	41.26	46.00	-4.74	QP
489.027	48.84	17.10	3.26	37.51	31.69	46.00	-14.31	QP

Vertical:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
70.337	56.93	7.50	0.94	36.45	28.92	40.00	-11.08	QP
135.032	57.68	7.78	1.47	36.98	29.95	43.50	-13.55	QP
139.361	60.32	7.45	1.50	37.01	32.26	43.50	-11.24	QP
142.324	58.91	7.44	1.52	37.03	30.84	43.50	-12.66	QP
299.316	53.40	13.60	2.35	37.42	31.93	46.00	-14.07	QP
330.195	53.50	14.18	2.52	37.45	32.75	46.00	-13.25	QP

■ Above 1GHz

Test channel:	Lowest
---------------	--------

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4821.75	41.69	31.78	8.60	32.09	49.98	74.00	-24.02	Vertical
7232.63	35.29	36.15	11.65	32.00	51.09	74.00	-22.91	Vertical
9643.50	34.04	37.95	14.14	31.62	54.51	74.00	-19.49	Vertical
12054.38	*					74.00		Vertical
14465.25	*					74.00		Vertical
16876.13	*					74.00		Vertical
4821.75	40.21	31.78	8.60	32.09	48.50	74.00	-25.50	Horizontal
7232.63	35.37	36.15	11.65	32.00	51.17	74.00	-22.84	Horizontal
9643.50	32.88	37.95	14.14	31.62	53.35	74.00	-20.65	Horizontal
12054.38	*					74.00		Horizontal
14465.25	*					74.00		Horizontal
16876.13	*					74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4821.75	30.74	31.78	8.60	32.09	39.03	54.00	-14.97	Vertical
7232.63	24.15	36.15	11.65	32.00	39.95	54.00	-14.05	Vertical
9643.50	24.38	37.95	14.14	31.62	44.85	54.00	-9.15	Vertical
12054.38	*					54.00		Vertical
14465.25	*					54.00		Vertical
16876.13	*					54.00		Vertical
4821.75	29.72	31.78	8.60	32.09	38.01	54.00	-15.99	Horizontal
7232.63	23.94	36.15	11.65	32.00	39.74	54.00	-14.27	Horizontal
9643.50	22.62	37.95	14.14	31.62	43.09	54.00	-10.91	Horizontal
12054.38	*					54.00		Horizontal
14465.25	*					54.00		Horizontal
16876.13	*					54.00		Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “*”, means this data is the too weak instrument of signal is unable to test.

Test channel:	Middle
---------------	--------

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4882.50	40.67	31.85	8.67	32.12	49.07	74.00	-24.93	Vertical
7323.75	35.32	36.37	11.72	31.89	51.52	74.00	-22.48	Vertical
9765.00	35.02	38.35	14.25	31.62	56.00	74.00	-18.00	Vertical
12206.25	*					74.00		Vertical
14647.50	*					74.00		Vertical
17088.75	*					74.00		Vertical
4882.50	41.01	31.85	8.67	32.12	49.41	74.00	-24.59	Horizontal
7323.75	34.29	36.37	11.72	31.89	50.49	74.00	-23.52	Horizontal
9765.00	34.18	38.35	14.25	31.62	55.16	74.00	-18.84	Horizontal
12206.25	*					74.00		Horizontal
14647.50	*					74.00		Horizontal
17088.75	*					74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4882.50	31.49	31.85	8.67	32.12	39.89	54.00	-14.11	Vertical
7323.75	23.62	36.37	11.72	31.89	39.82	54.00	-14.18	Vertical
9765.00	24.27	38.35	14.25	31.62	45.25	54.00	-8.75	Vertical
12206.25	*					54.00		Vertical
14647.50	*					54.00		Vertical
17088.75	*					54.00		Vertical
4882.50	31.11	31.85	8.67	32.12	39.51	54.00	-14.49	Horizontal
7323.75	23.37	36.37	11.72	31.89	39.57	54.00	-14.44	Horizontal
9765.00	23.89	38.35	14.25	31.62	44.87	54.00	-9.13	Horizontal
12206.25	*					54.00		Horizontal
14647.50	*					54.00		Horizontal
17088.75	*					54.00		Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “*”, means this data is too weak instrument of signal is unable to test.

Test channel:	Highest
---------------	---------

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4943.25	46.46	31.93	8.73	32.16	54.96	74.00	-19.04	Vertical
7414.88	36.16	36.59	11.79	31.78	52.76	74.00	-21.24	Vertical
9886.50	38.44	38.81	14.38	31.88	59.75	74.00	-14.25	Vertical
12358.13	*					74.00		Vertical
14829.75	*					74.00		Vertical
17301.38	*					74.00		Vertical
4943.25	45.59	31.93	8.73	32.16	54.09	74.00	-19.91	Horizontal
7414.88	35.37	36.59	11.79	31.78	51.97	74.00	-22.04	Horizontal
9886.50	33.87	38.81	14.38	31.88	55.18	74.00	-18.82	Horizontal
12358.13	*					74.00		Horizontal
14829.75	*					74.00		Horizontal
17301.38	*					74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4943.25	37.32	31.93	8.73	32.16	45.82	54.00	-8.18	Vertical
7414.88	26.06	36.59	11.79	31.78	42.66	54.00	-11.34	Vertical
9886.50	26.93	38.81	14.38	31.88	48.24	54.00	-5.76	Vertical
12358.13	*					54.00		Vertical
14829.75	*					54.00		Vertical
17301.38	*					54.00		Vertical
4943.25	35.92	31.93	8.73	32.16	44.42	54.00	-9.58	Horizontal
7414.88	24.75	36.59	11.79	31.78	41.35	54.00	-12.66	Horizontal
9886.50	23.12	38.81	14.38	31.88	44.43	54.00	-9.57	Horizontal
12358.13	*					54.00		Horizontal
14829.75	*					54.00		Horizontal
17301.38	*					54.00		Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “*”, means this data is the too weak instrument of signal is unable to test.

8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

---End---