Test Report

Applicant:	FLYSKY RC MODEL TECHNOLOGY CO., LTD
Address of Applicant:	West building3, Huangjianyuan Ind, Park QIAOLI North Gate Changping Town, Dongguan, China
Manufacturer:	ShenZhen FLYSKY Technology Co.,Ltd
Address of Manufacturer:	16F, Huafeng Building, No. 6006 Shennan Road, Futian District, Shenzhen, Guangdong, China
Factory:	FLYSKY RC MODEL TECHNOLOGY CO., LTD
Address of Factory:	West building3, Huangjianyuan Ind, Park QIAOLI North Gate Changping Town, Dongguan, China

Equipment Under Test (EUT)

Product Name:	2.4G MODULE
Model No.:	FRM302
Trade Mark:	FLYSKY
FCC ID:	N4ZFRM30200
Applicable standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.247
Date of sample receipt:	May 13, 2020
Date of Test:	May 13-18, 2020
Date of report issued:	May 19, 2020
Test Result :	PASS *

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

Authorized Signature:

Robinson Lo
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	*May 19, 2020*	*Original*

Prepared By: ***Date:*** *May 19, 2020*

Project Engineer

Check By: ***Date:*** *May 19, 2020*

Reviewer

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4 Test Summary

Test Item	Section	Result
Antenna Requirement	15.203/15.247 (c)	Pass
AC Power Line Conducted Emission	15.207	N/A
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:	2.4G MODULE
Model No.:	FRM302
Serial No.:	N/A
Test sample(s) ID:	GTS201907000121-1
Sample(s) Status	Engineer sample
Operation Frequency:	2402.406MHz~2479.136MHz
Channel numbers:	63
Modulation technology:	Lora
Antenna Type:	External Antenna
Antenna gain:	3dBi
Power supply:	External power supply (powered by battery): DC5~28V Internal power supply (powered by remote control): DC5~10V

Remark: The system works in the frequency range of 2402.406MHz to 2479.136MHz. This band has been divided to 63 independent channels. Radio system uses 32 different channels; the minimum channel separation is ≥1MHz. By using various switch-on times, hopping scheme and channel frequencies, the system can guarantee a jamming free radio transmission. The channel list is below.

Operation Frequency each of channel							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402.406	17	2421.909	33	2441.411	49	2462.071
2	2403.625	18	2423.128	34	2442.630	50	2463.290
3	2404.844	19	2424.347	35	2445.006	51	2464.509
4	2406.063	20	2425.565	36	2446.225	52	2465.728
5	2407.282	21	2426.784	37	2447.444	53	2466.947
6	2408.501	22	2428.003	38	2448.663	54	2468.165
7	2409.720	23	2429.222	39	2449.882	55	2469.384
8	2410.939	24	2430.441	40	2451.101	56	2470.603
9	2412.158	25	2431.660	41	2452.320	57	2471.822
10	2413.376	26	2432.879	42	2453.539	58	2473.041
11	2414.595	27	2434.098	43	2454.758	59	2474.260
12	2415.814	28	2435.317	44	2455.976	60	2475.479
13	2417.033	29	2436.536	45	2457.195	61	2476.698
14	2418.252	30	2437.754	46	2458.414	62	2477.917
15	2419.471	31	2438.973	47	2459.633	63	2479.136
16	2420.690	32	2440.192	48	2460.852	64	

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	2402.406MHz
The middle channel	2440.192MHz
The Highest channel	2479.136MHz

5.2 Test mode

Transmitting mode	Keep the EUT in transmitting mode.

For Radiated Emission tests:

Both power supply modes have been tested.

For other tests:

Pre-test External power supply and Internal power supply modes, and found that the worst case was the External power supply.

For External power supply

During the test, the test voltage was tuned from DC5V to DC28V, and found that the worst case was the DC28V. So the report just shows that condition's data.

For Internal power supply

During the test, the test voltage was tuned from DC5V to DC10V, and found that the worst case was the DC10V. So the report just shows that condition's data.

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 Description of Support Units

Manufacturer	Description	Model	Serial Number
ShenZhen FLYSKY Technology Co.,Ltd	2.4GHz 10CHANNELS RECEIVER	FTr10	N/A
MEILI	DC POWER SUPPLY	MCH-305A	011121168

5.6 Deviation from Standards

None.

5.7 Abnormalities from Standard Conditions

None.

5.8 Additional Instructions

Software (Used for test) from client

Built-in by manufacturer, power set 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. 03 2015	July. 02 2020
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. 26 2019	June. 25 2020
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 26 2019	June. 25 2020
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 26 2019	June. 25 2020
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 26 2019	June. 25 2020
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 26 2019	June. 25 2020
9	Coaxial Cable	GTS	N/A	GTS211	June. 26 2019	June. 25 2020
10	Coaxial cable	GTS	N/A	GTS210	June. 26 2019	June. 25 2020
11	Coaxial Cable	GTS	N/A	GTS212	June. 26 2019	June. 25 2020
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 26 2019	June. 25 2020
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 26 2019	June. 25 2020
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 26 2019	June. 25 2020
15	Band filter	Amindeon	82346	GTS219	June. 26 2019	June. 25 2020
16	Power Meter	Anritsu	ML2495A	GTS540	June. 26 2019	June. 25 2020
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 26 2019	June. 25 2020
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 26 2019	June. 25 2020
19	Splitter	Agilent	11636B	GTS237	June. 26 2019	June. 25 2020
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 26 2019	June. 25 2020
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. 26 2019	June. 25 2020

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. 26 2019	June. 25 2020
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 26 2019	June. 25 2020
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June. 26 2019	June. 25 2020
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	June. 26 2019	June. 25 2020
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	June. 26 2019	June. 25 2020
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	June. 26 2019	June. 25 2020
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	June. 26 2019	June. 25 2020
8	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 26 2019	June. 25 2020
9	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	June. 26 2019	June. 25 2020

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. 26 2019	June. 25 2020
2	Barometer	ChangChun	DYM3	GTS255	June. 26 2019	June. 25 2020

7 Test results and Measurement Data

7.1 Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)

15.203 requirement:

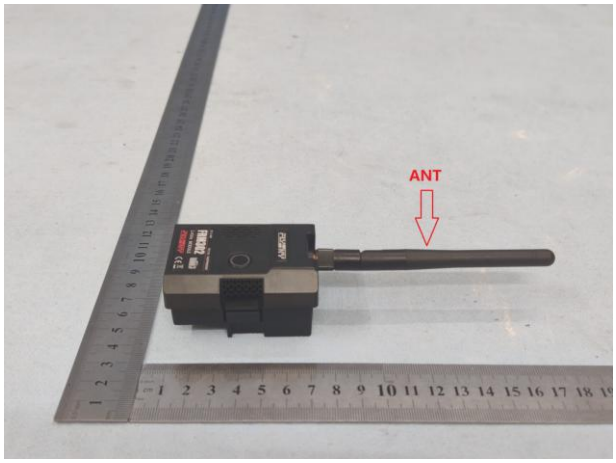
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit 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:

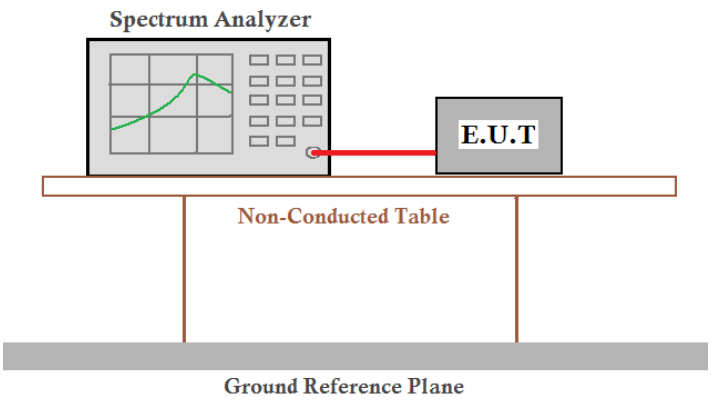
(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

EUT Antenna:

The antenna is external antenna, the best case gain of the antenna is 3dBi.



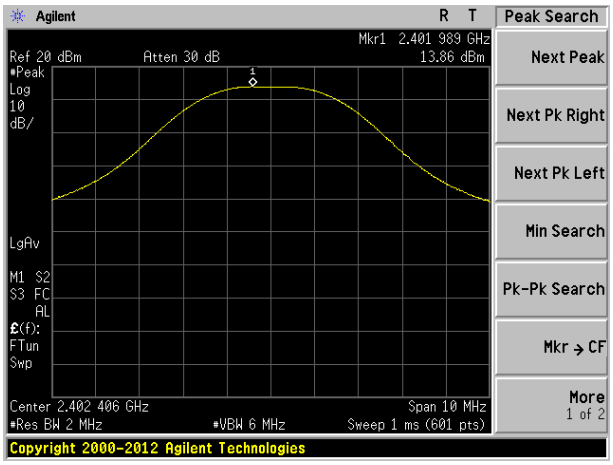
7.2 Conducted Peak Output Power

Test Requirement:	FCC Part15 C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2013
Limit:	20.97dBm
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

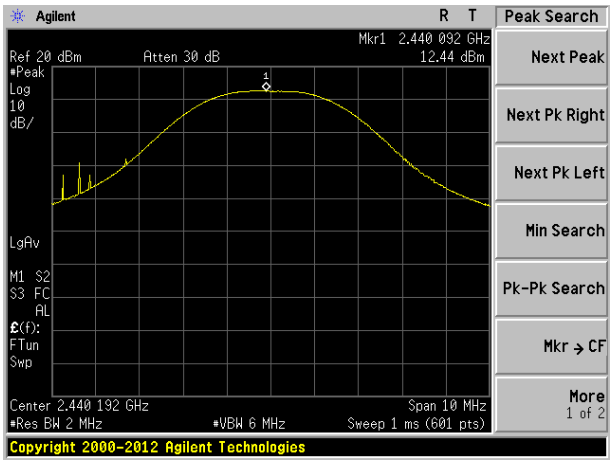
Measurement Data

Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	13.86	20.97	Pass
Middle	12.44		
Highest	11.24		

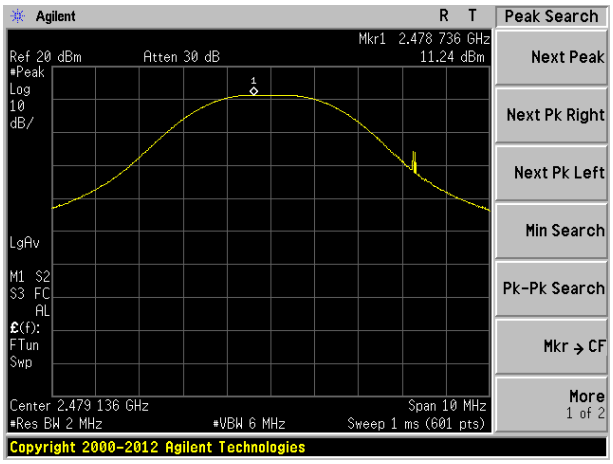
Test plot as follows:



Lowest channel

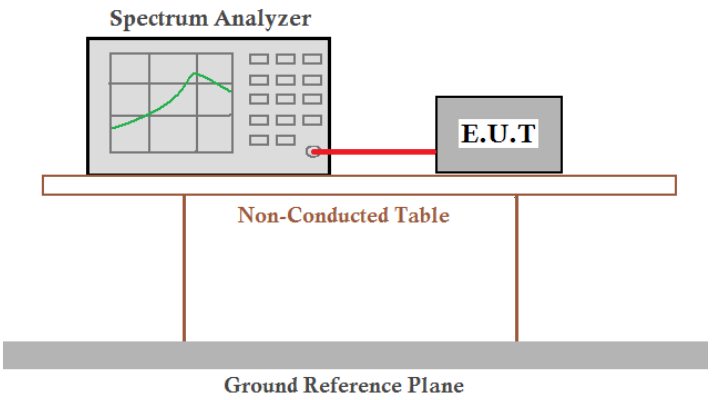


Middle channel



Highest channel

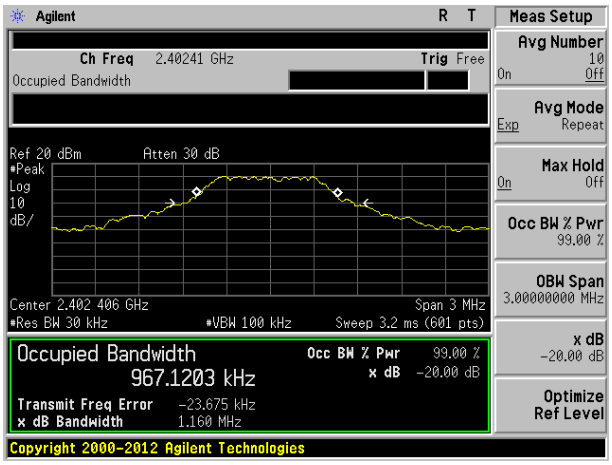
7.3 20dB Emission Bandwidth

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Limit:	N/A
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

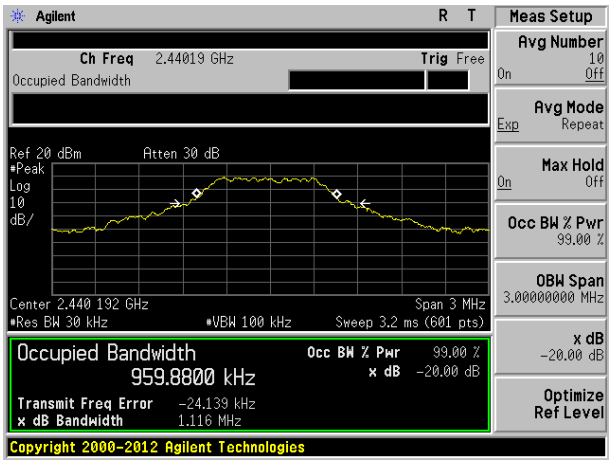
Measurement Data

Test channel	20dB Emission Bandwidth (MHz)	Result
Lowest	1.160	Pass
Middle	1.116	
Highest	1.128	

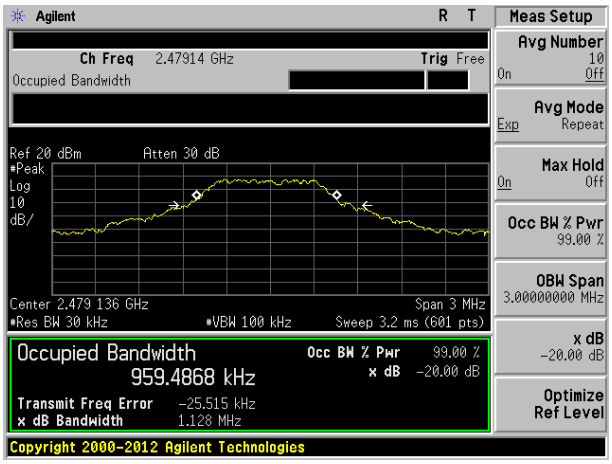
Test plot as follows:



Lowest channel

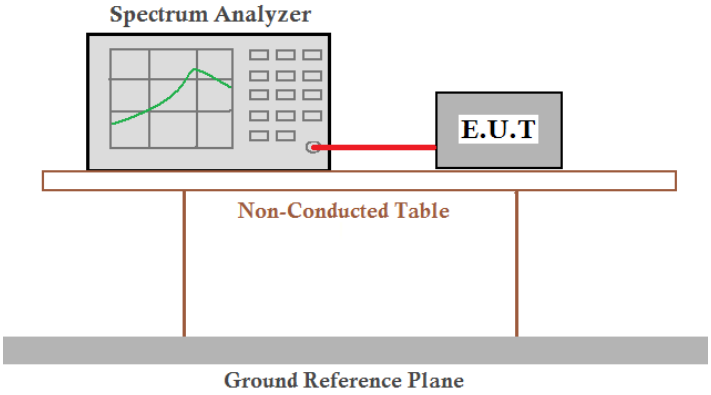


Middle channel



Highest channel

7.4 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:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

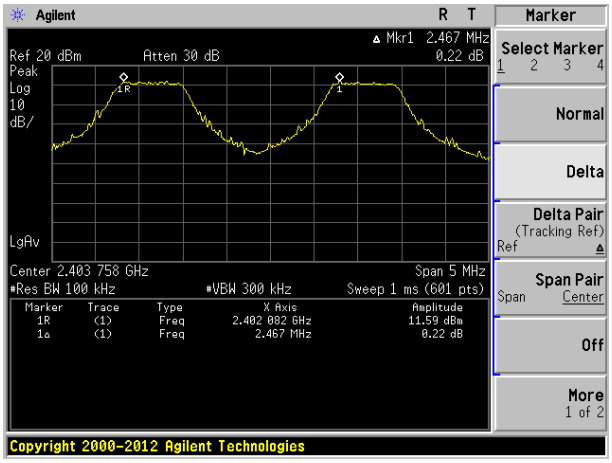
Measurement Data

Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	2467	773.33	Pass
Middle	1233	773.33	Pass
Highest	2450	773.33	Pass

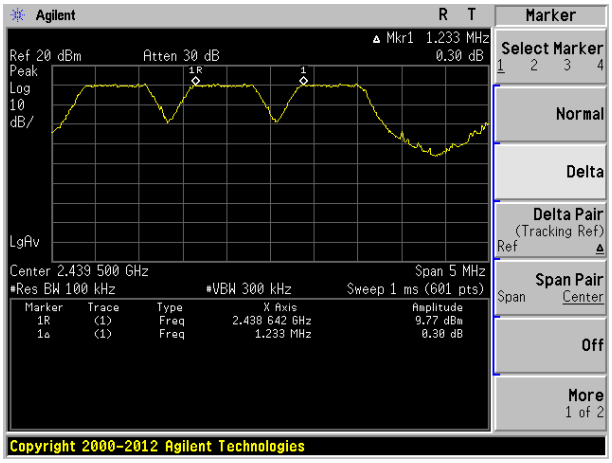
Note: According to section 7.3

Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	1160	773.33

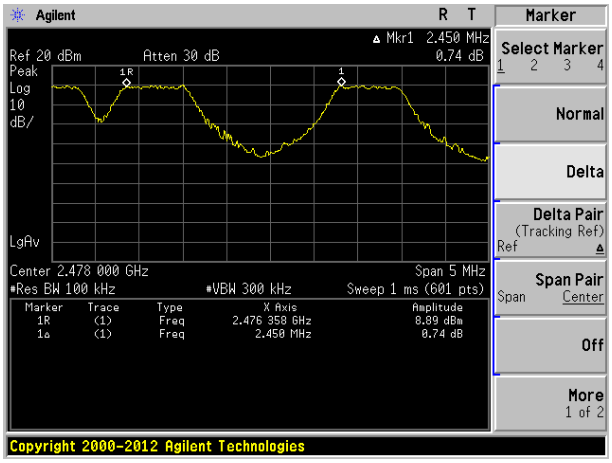
Test plot as follows:



Lowest channel

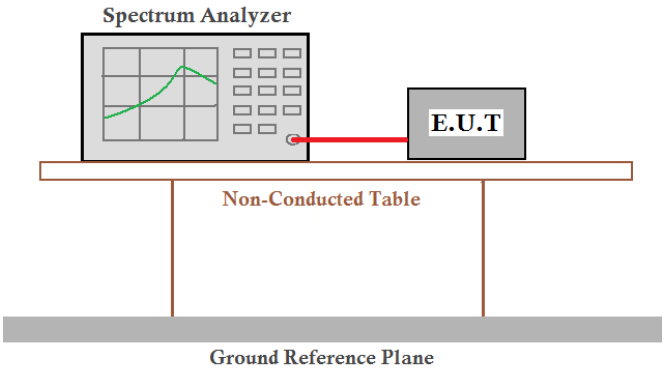


Middle channel



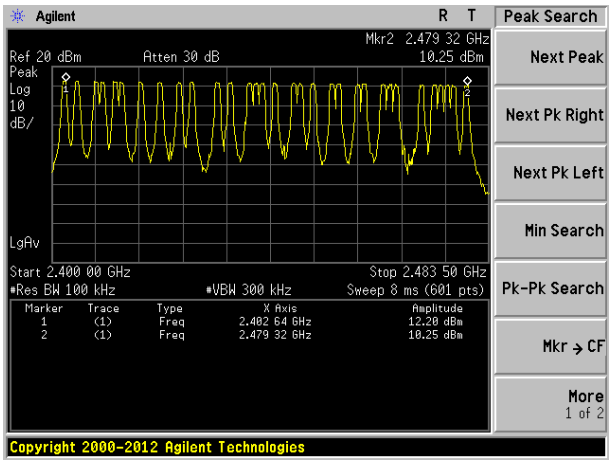
Highest channel

7.5 Hopping Channel Number

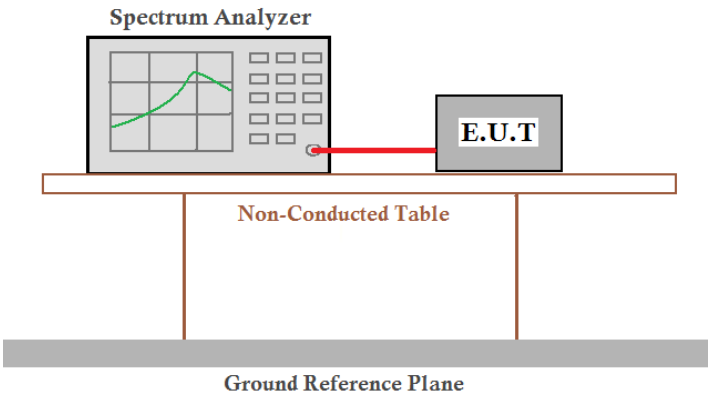
Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak
Limit:	15 channels
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data:

Hopping channel numbers	Limit	Result
32	15	Pass



7.6 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:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Frequency(MHz)	Ton (ms)	Dwell time(ms)	Limit(ms)	Result
2402.406	3.117	239.39	400	Pass
2440.192	3.100	238.08	400	Pass
2479.136	3.100	238.08	400	Pass

The formula as below:

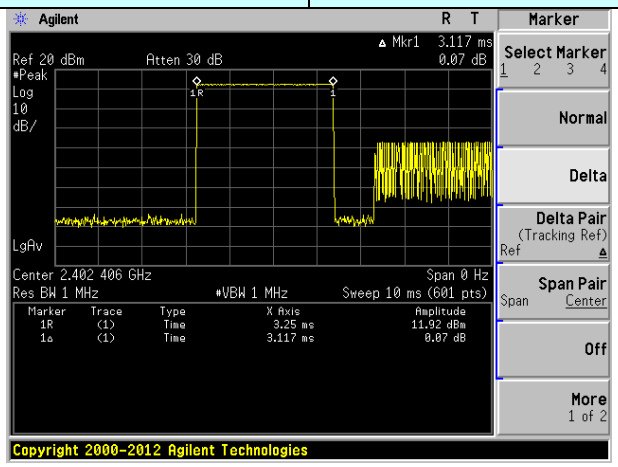
2402.406MHz: Dwell time = Ton * Ton times in 1s * 0.4s * channel numbers=3.117ms*6*0.4*32=239.39ms

2440.192MHz: Dwell time = Ton * Ton times in 1s * 0.4s * channel numbers=3.1ms*6*0.4*32=238.08ms

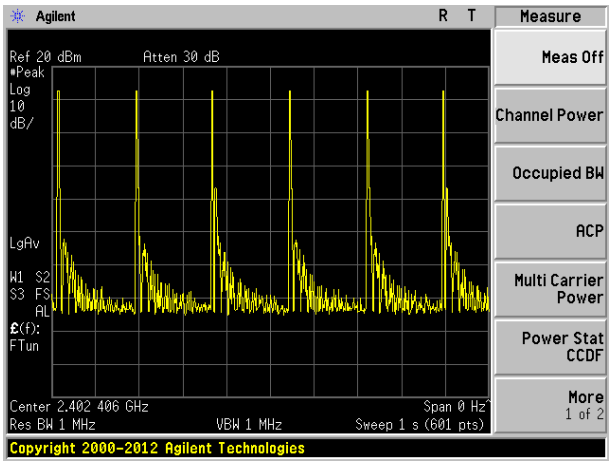
2479.136MHz: Dwell time = Ton * Ton times in 1s * 0.4s * channel numbers=3.1ms*6*0.4*32=238.08ms

Test plot as follows:

Frequency:	2402.406MHz

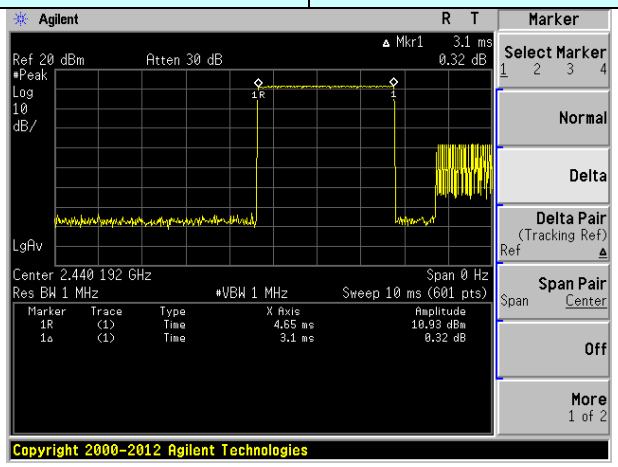


Ton

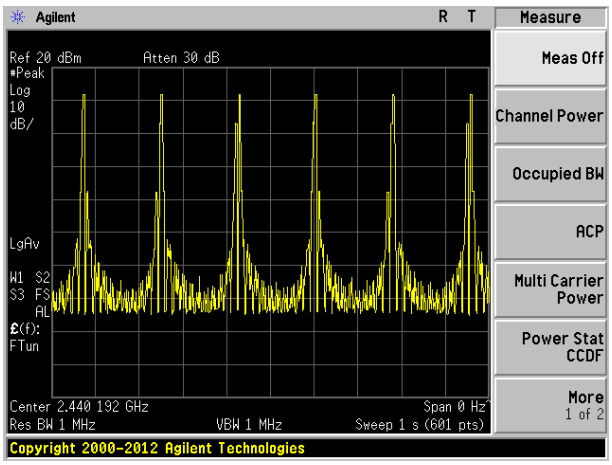


Ton times in 1s

Frequency:	2440.192MHz

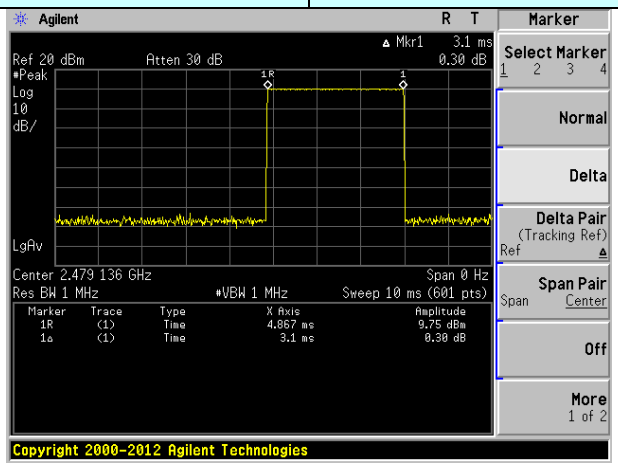


Ton

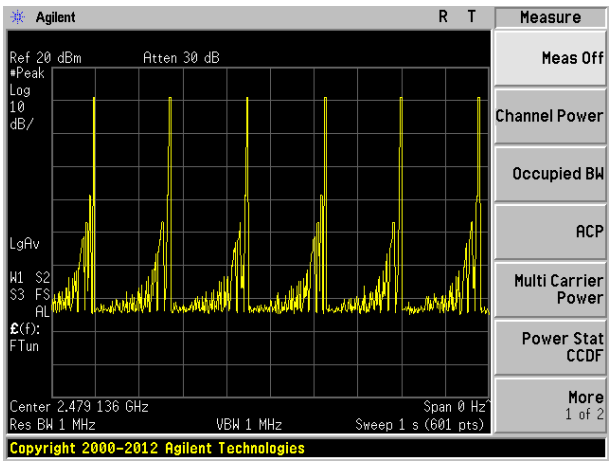


Ton times in 1s

Frequency:	2479.136MHz



Ton



Ton times in 1s

7.7 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.

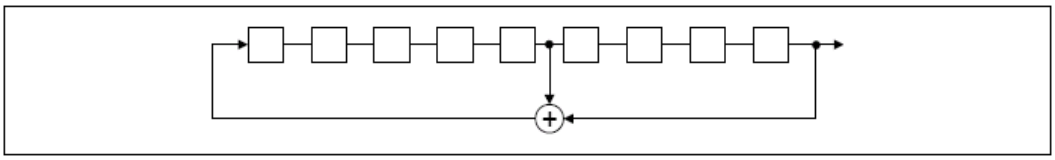
(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be 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

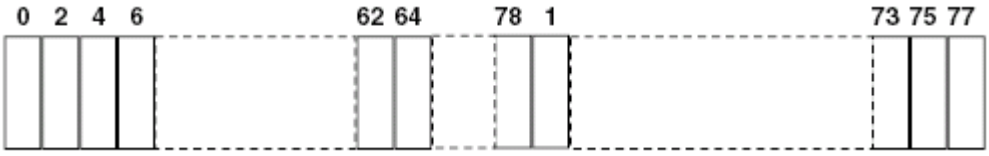
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized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



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



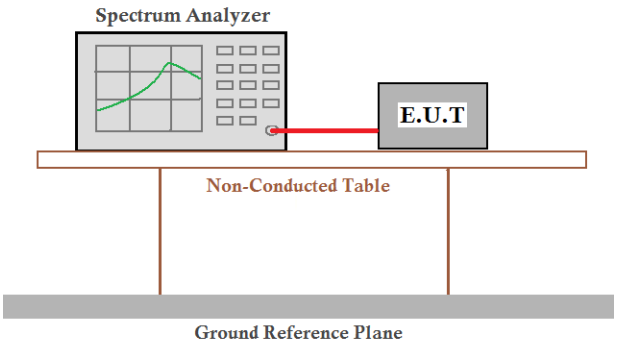
Each frequency used equally on the average by each transmitter.

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.

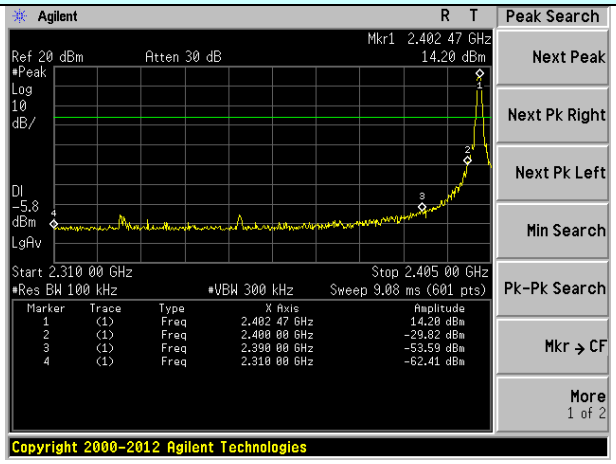
7.8 Band Edge

7.8.1 Conducted Emission Method

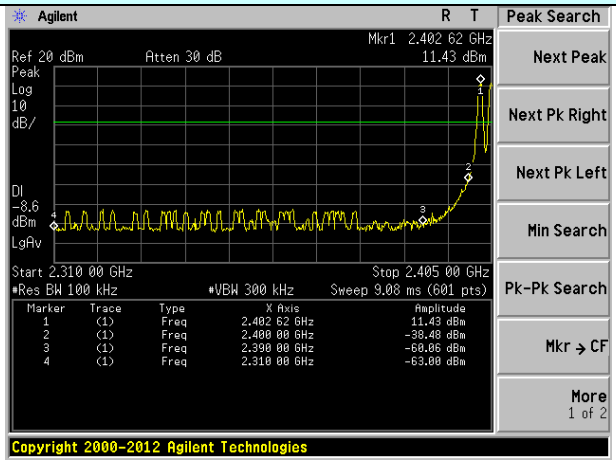
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Detector=Peak
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by 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:	
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

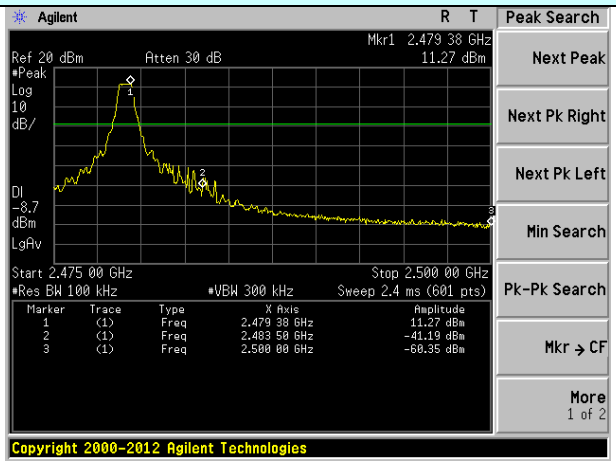


No-hopping mode

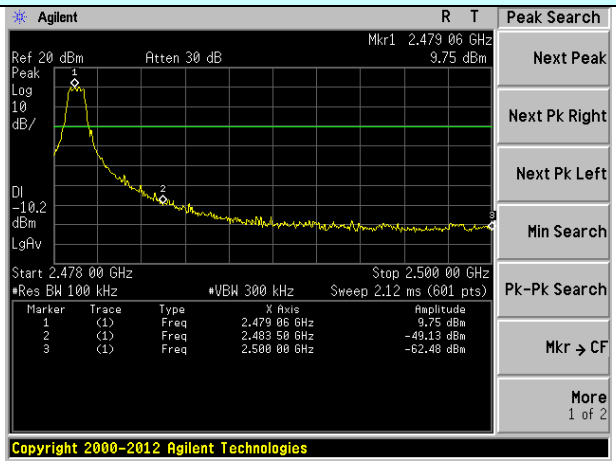


Hopping mode

Test channel:	Highest channel



No-hopping mode



Hopping mode

7.8.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209 and 15.205
Test Method:	ANSI C63.10:2013
Test Frequency Range:	All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed.
Test site:	Measurement Distance: 3m

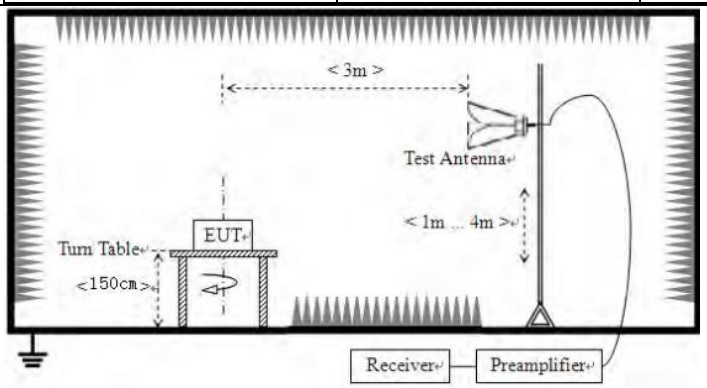
Receiver setup:

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					

Test voltage:	External power supply : DC28V Internal power supply : DC10V

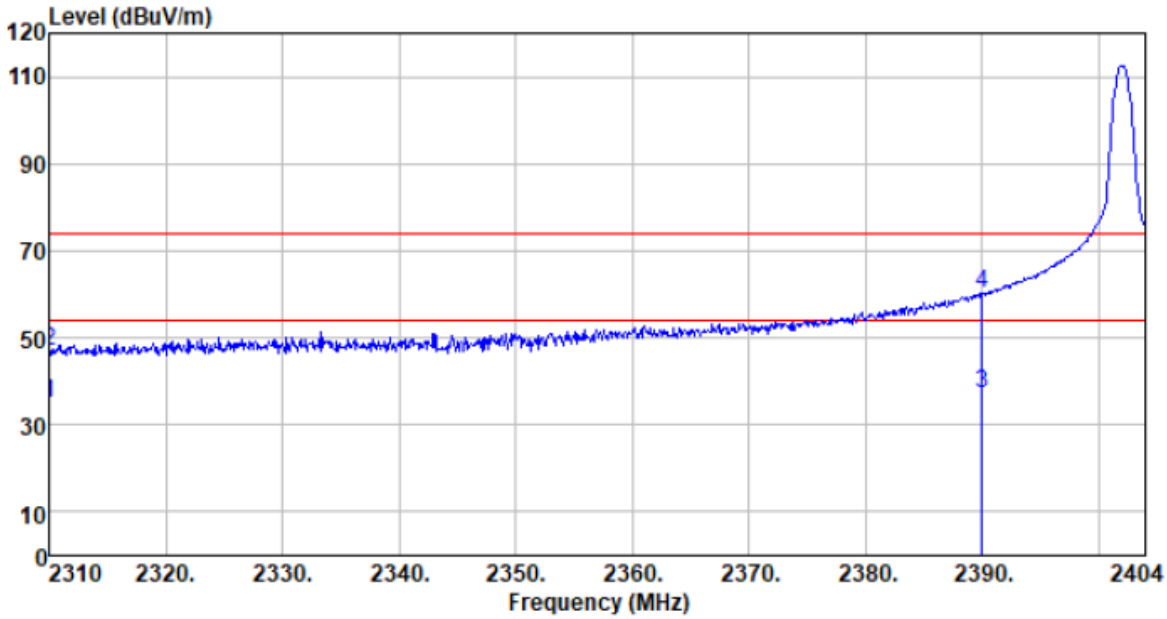
Measurement Data

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.*

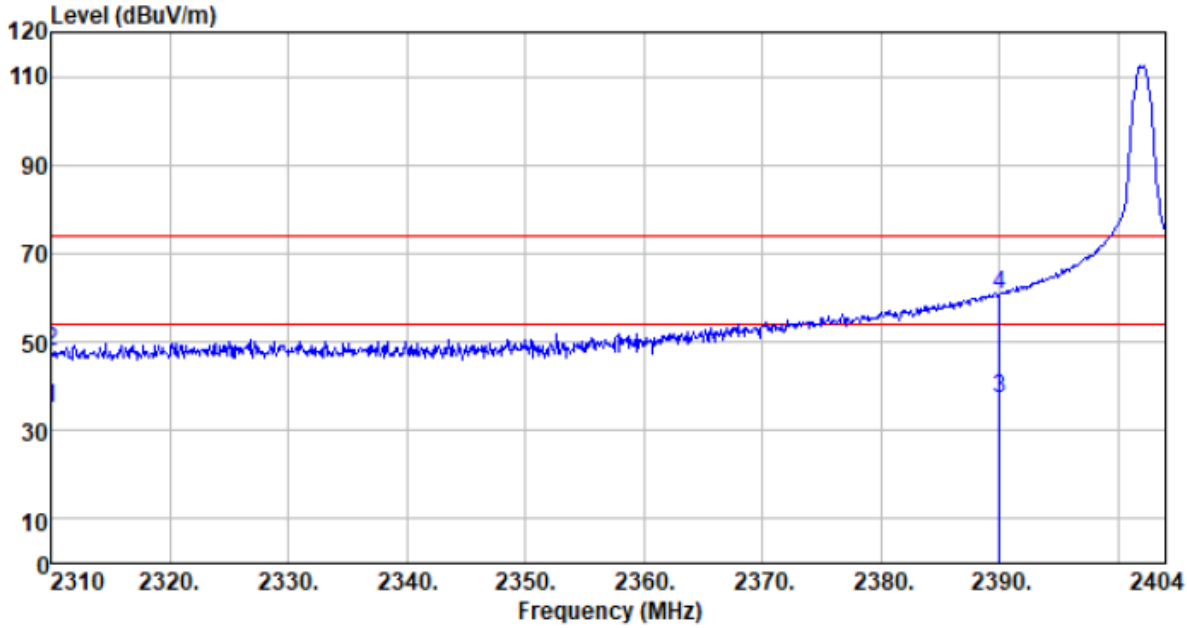
External power supply

Test channel:	Lowest	Polarization:	Vertical



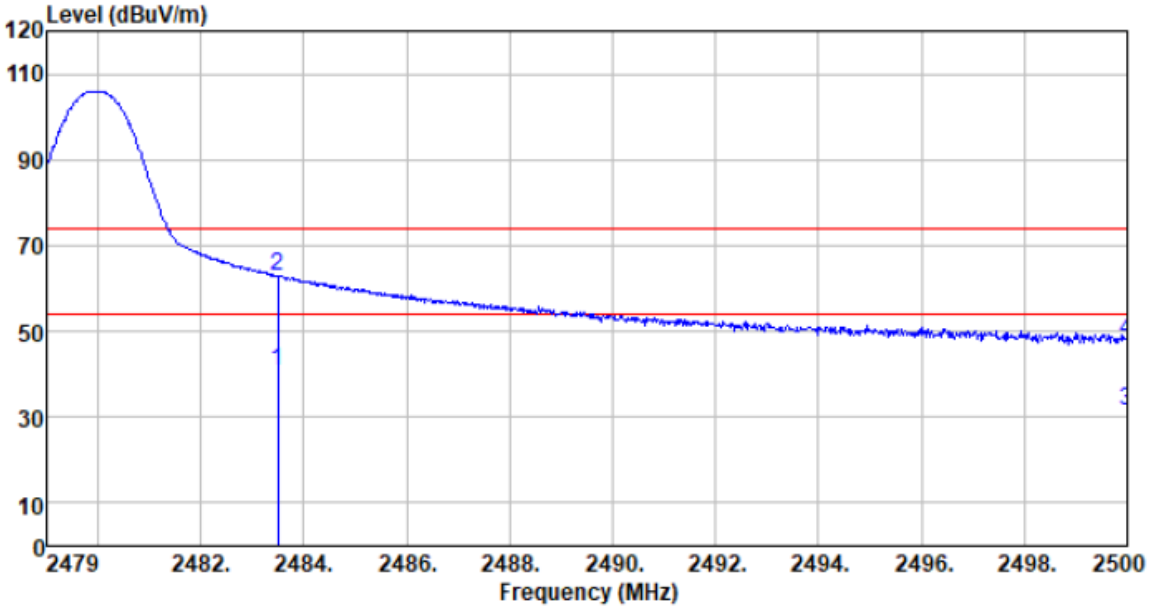
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	35.65	27.14	2.81	30.43	35.17	54.00	-18.83	Average
2310.000	47.53	27.14	2.81	30.43	47.05	74.00	-26.95	Peak
2389.994	37.22	27.37	2.91	30.24	37.26	54.00	-16.74	Average
2389.994	60.10	27.37	2.91	30.24	60.14	74.00	-13.86	Peak

Test channel:	Lowest	Polarization:	Horizontal



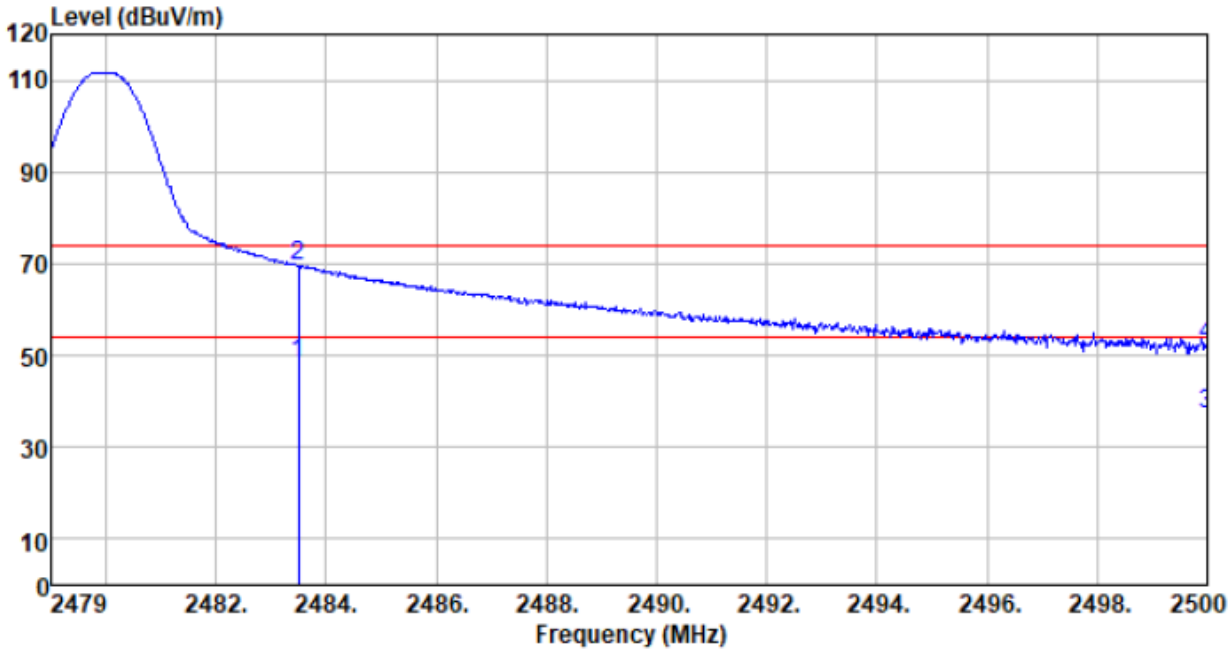
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	35.68	27.14	2.81	30.43	35.20	54.00	-18.80	Average
2310.000	48.25	27.14	2.81	30.43	47.77	74.00	-26.23	Peak
2389.994	37.20	27.37	2.91	30.24	37.24	54.00	-16.76	Average
2389.994	60.80	27.37	2.91	30.24	60.84	74.00	-13.16	Peak

Test channel:	Highest	Polarization:	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2483.500	40.20	27.66	2.99	30.12	40.73	54.00	-13.27	Average
2483.500	62.53	27.66	2.99	30.12	63.06	74.00	-10.94	Peak
2500.000	30.88	27.70	3.01	30.13	31.46	54.00	-22.54	Average
2500.000	47.08	27.70	3.01	30.13	47.66	74.00	-26.34	Peak

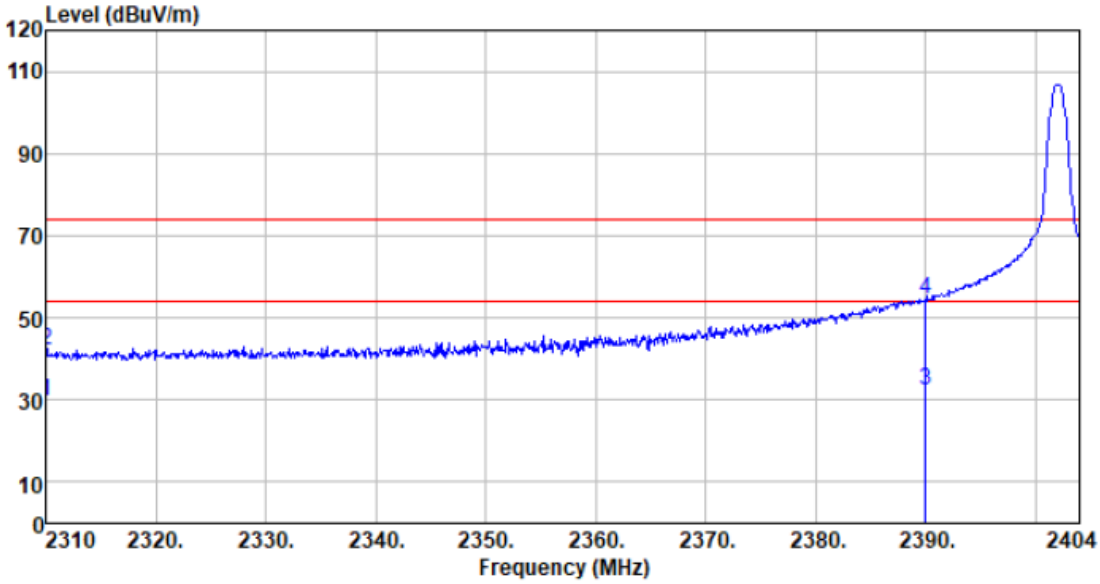
Test channel:	Highest	Polarziation:	Horizontal



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2483.500	47.81	27.66	2.99	30.12	48.34	54.00	-5.66	Average
2483.500	68.92	27.66	2.99	30.12	69.45	74.00	-4.55	Peak
2500.000	36.40	27.70	3.01	30.13	36.98	54.00	-17.02	Average
2500.000	51.56	27.70	3.01	30.13	52.14	74.00	-21.86	Peak

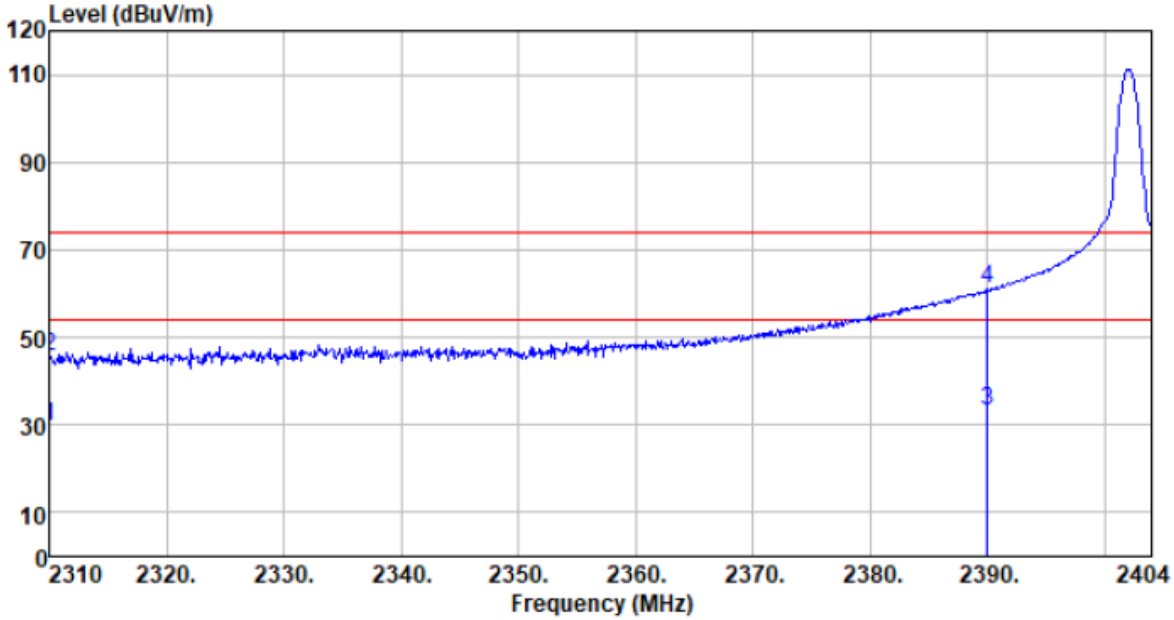
Internal power supply

Test channel:	Lowest	Polarization:	Vertical



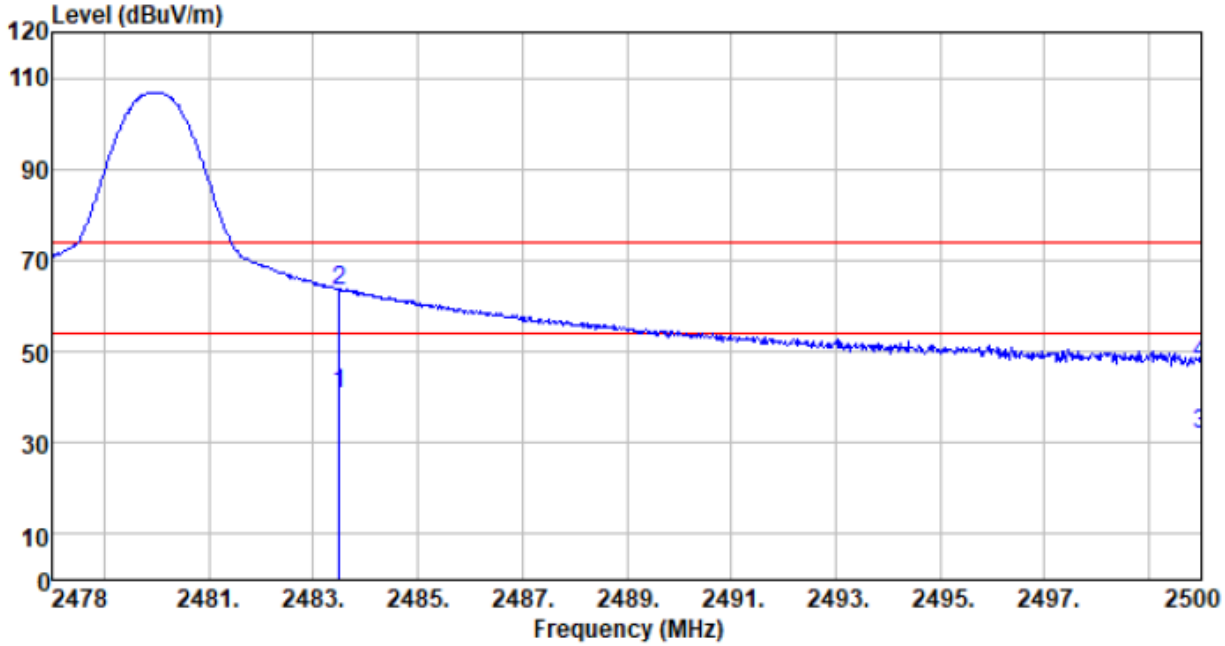
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	29.95	27.14	2.81	30.43	29.47	54.00	-24.53	Average
2310.000	42.57	27.14	2.81	30.43	42.09	74.00	-31.91	Peak
2390.000	32.08	27.37	2.91	30.24	32.12	54.00	-21.88	Average
2390.000	54.36	27.37	2.91	30.24	54.40	74.00	-19.60	Peak

Test channel:	Lowest	Polarization:	Horizontal



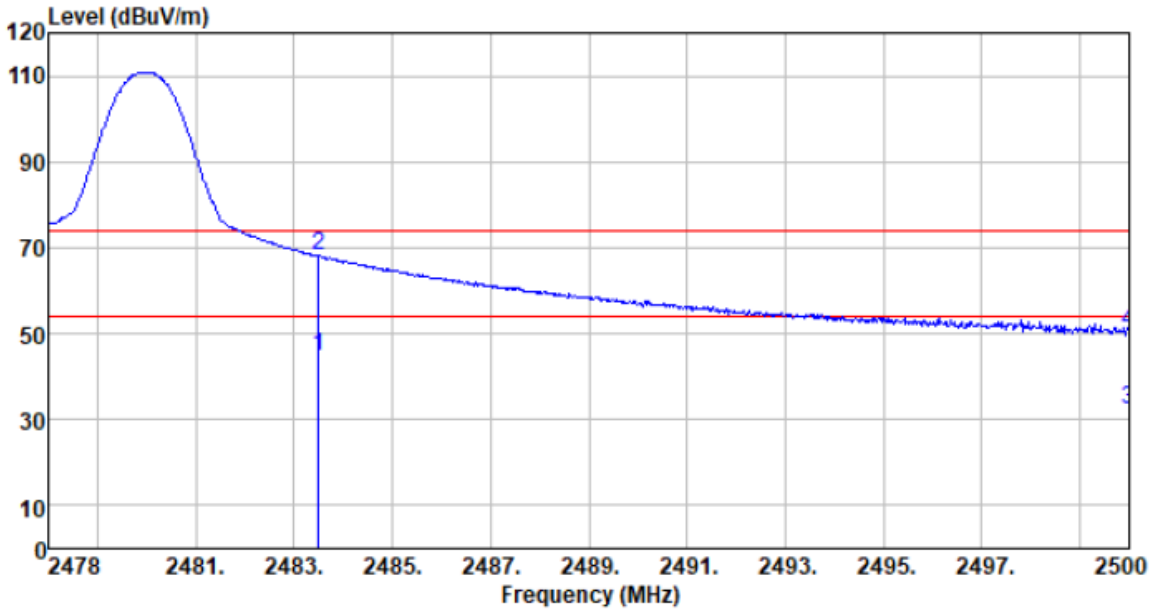
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	30.10	27.14	2.81	30.43	29.62	54.00	-24.38	Average
2310.000	46.21	27.14	2.81	30.43	45.73	74.00	-28.27	Peak
2390.000	33.38	27.37	2.91	30.24	33.42	54.00	-20.58	Average
2390.000	61.02	27.37	2.91	30.24	61.06	74.00	-12.94	Peak

Test channel:	Highest	Polarization:	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2483.500	40.29	27.66	2.99	30.12	40.82	54.00	-13.18	Average
2483.500	62.96	27.66	2.99	30.12	63.49	74.00	-10.51	Peak
2500.000	31.31	27.70	3.01	30.13	31.89	54.00	-22.11	Average
2500.000	46.97	27.70	3.01	30.13	47.55	74.00	-26.45	Peak

Test channel:	Highest	Polarization:	Horizontal



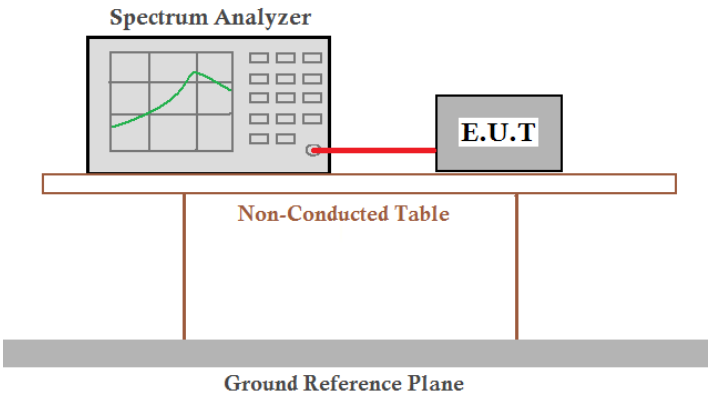
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2483.500	44.02	27.66	2.99	30.12	44.55	54.00	-9.45	Average
2483.500	67.53	27.66	2.99	30.12	68.06	74.00	-5.94	Peak
2500.000	31.69	27.70	3.01	30.13	32.27	54.00	-21.73	Average
2500.000	49.91	27.70	3.01	30.13	50.49	74.00	-23.51	Peak

Remark:

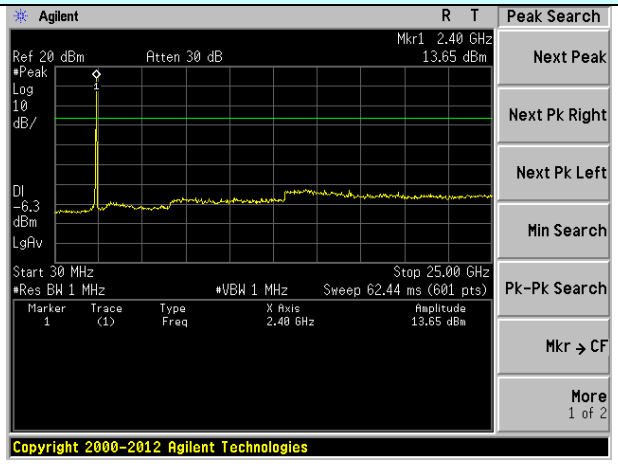
1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*

7.9 Spurious Emission

7.9.1 Conducted Emission Method

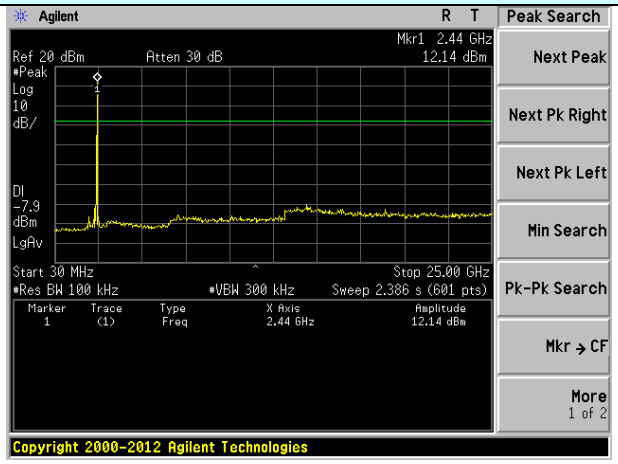
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below 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:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Lowest channel



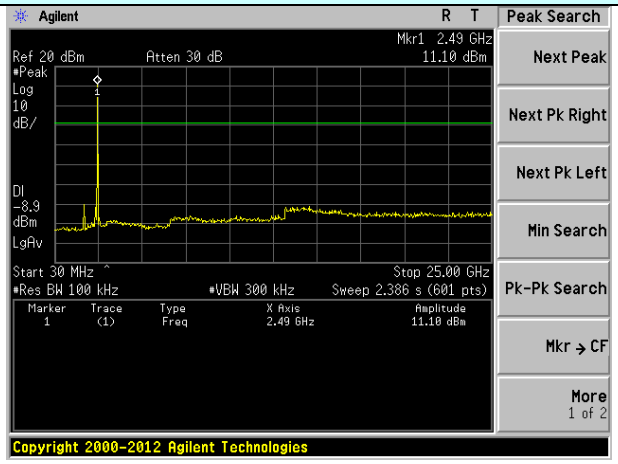
30MHz~25GHz

Middle channel



30MHz~25GHz

Highest channel



30MHz~25GHz

7.9.2 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:

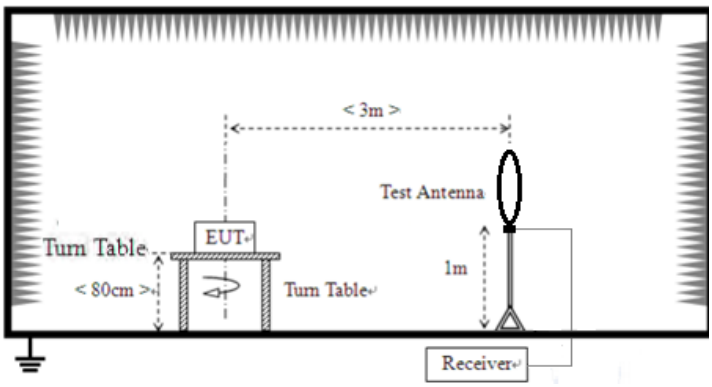
Frequency	Detector	RBW	VBW	Value
9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:
(Spurious Emissions)

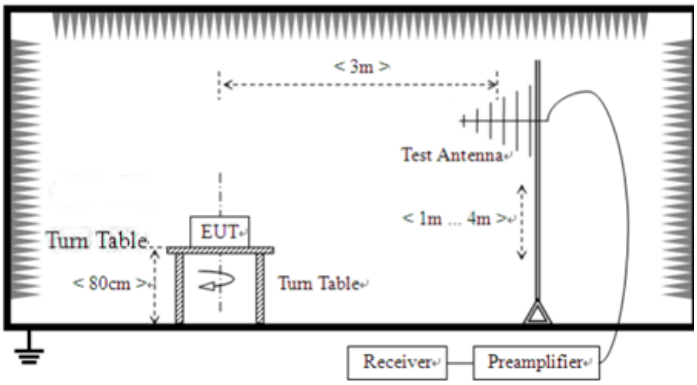
Frequency	Limit (uV/m)	Value	Measurement Distance
0.009MHz-0.490MHz	2400/F(KHz)	QP	300m
0.490MHz-1.705MHz	24000/F(KHz)	QP	300m
1.705MHz-30MHz	30	QP	30m
30MHz-88MHz	100	QP	3m
88MHz-216MHz	150	QP	
216MHz-960MHz	200	QP	
960MHz-1GHz	500	QP	
Above 1GHz	500	Average	
	5000	Peak	

Test setup:

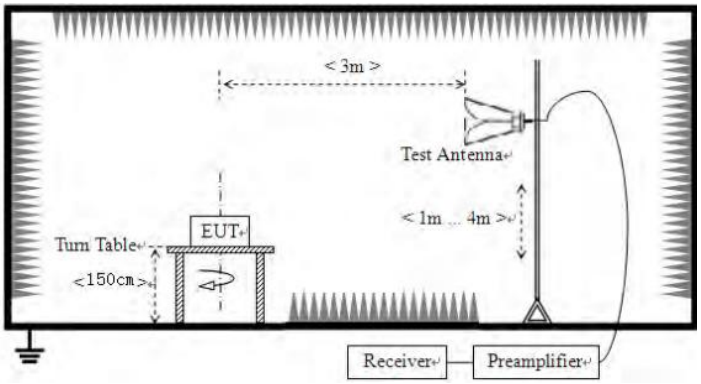
Below 30MHz



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
Test voltage:	External power supply : DC28V Internal power supply : DC10V

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:

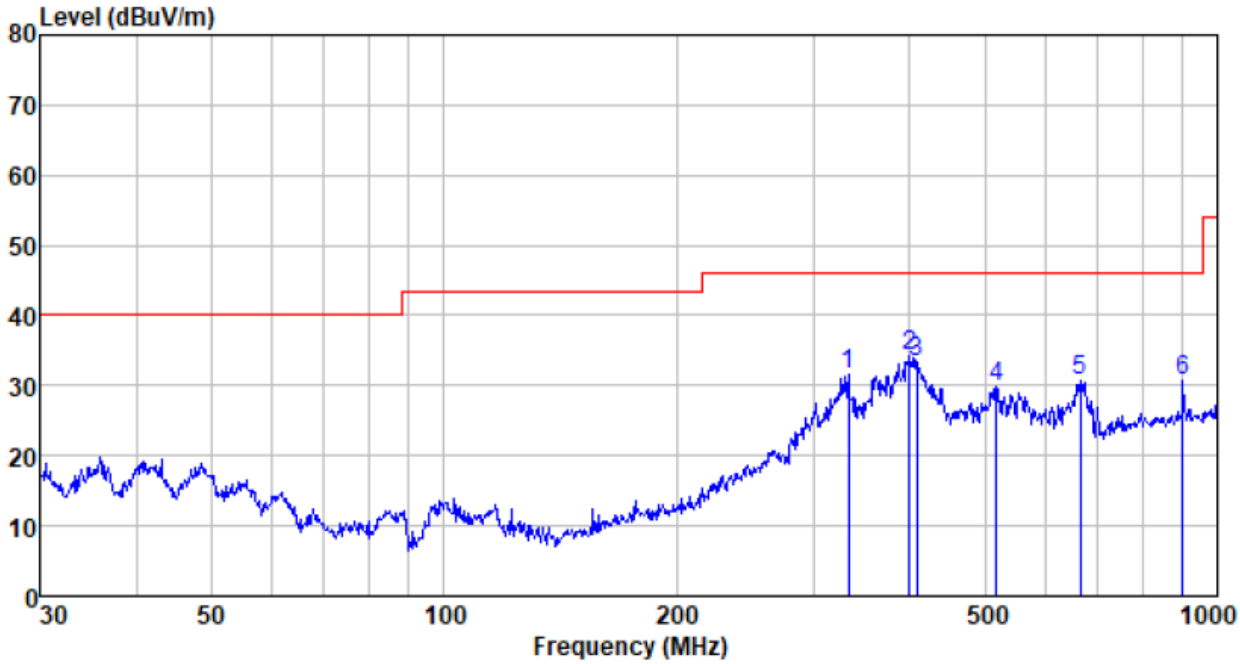
- **Below 30MHz**

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**

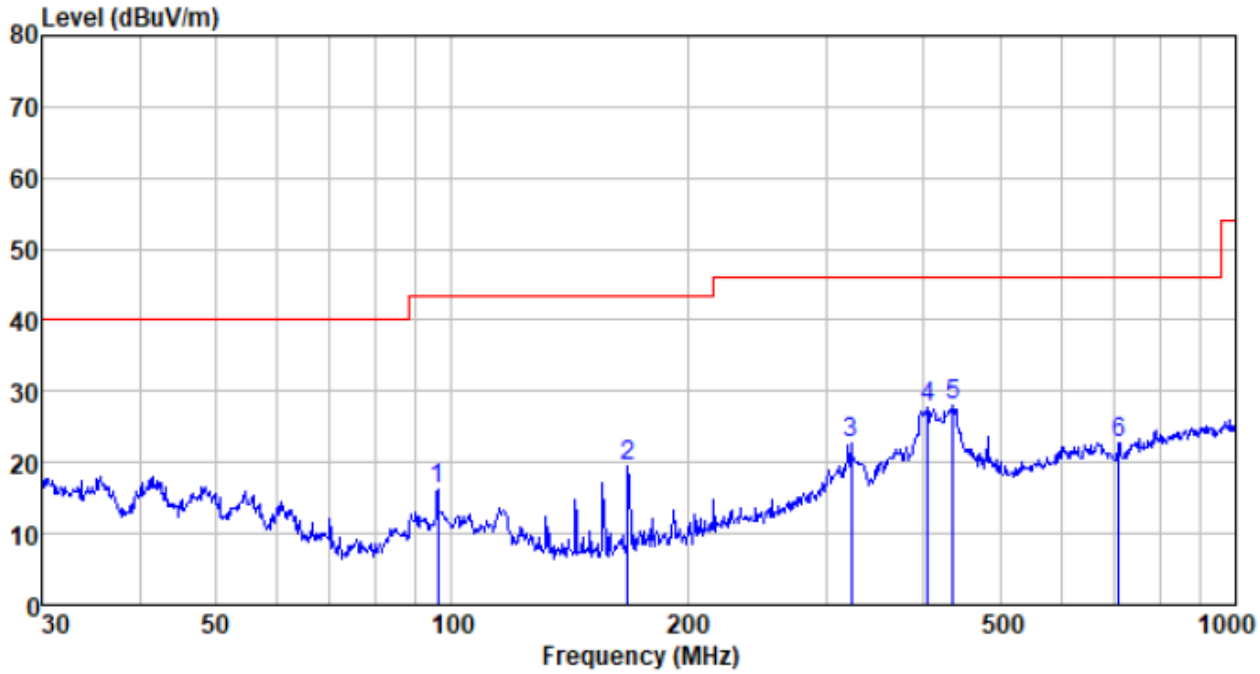
Pre-scan all test modes, found worst case at 2479.136MHz, and so only show the test result of 2479.136MHz.

External power supply
Horizontal:



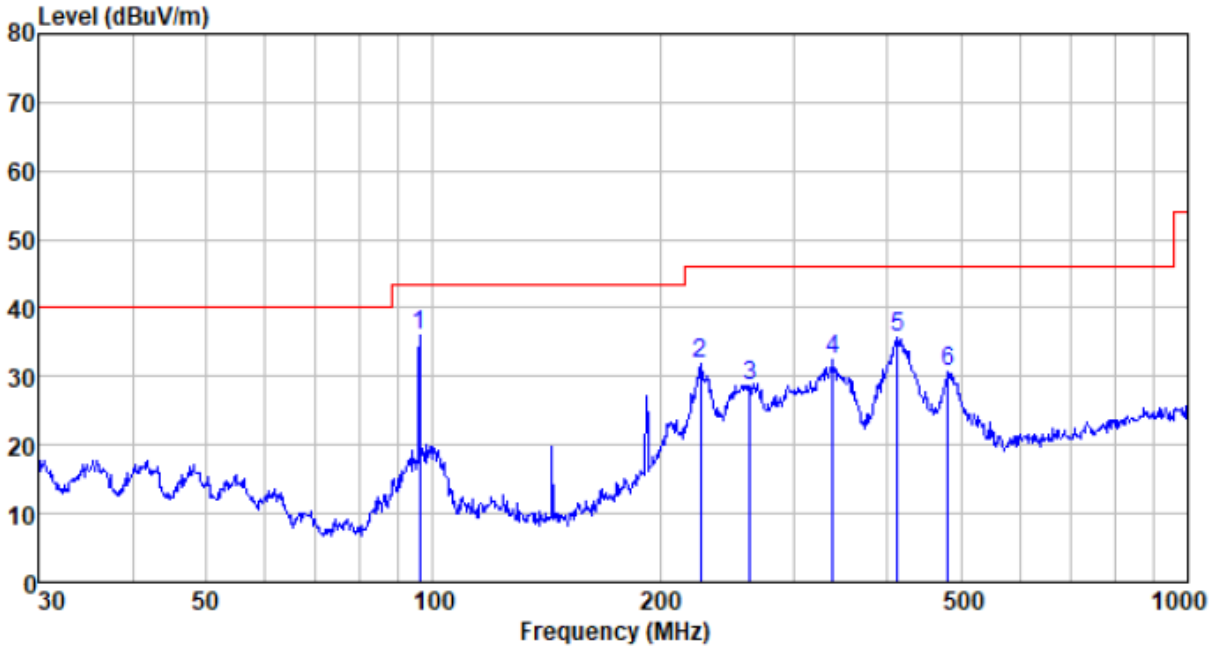
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
333.687	44.99	14.20	2.54	30.02	31.71	46.00	-14.29	QP
400.432	45.73	15.41	2.85	29.70	34.29	46.00	-11.71	QP
408.946	44.49	15.58	2.90	29.68	33.29	46.00	-12.71	QP
517.248	38.38	17.61	3.38	29.52	29.85	46.00	-16.15	QP
665.804	36.58	19.60	3.97	29.40	30.75	46.00	-15.25	QP
903.309	33.04	22.41	4.87	29.50	30.82	46.00	-15.18	QP

Vertical:



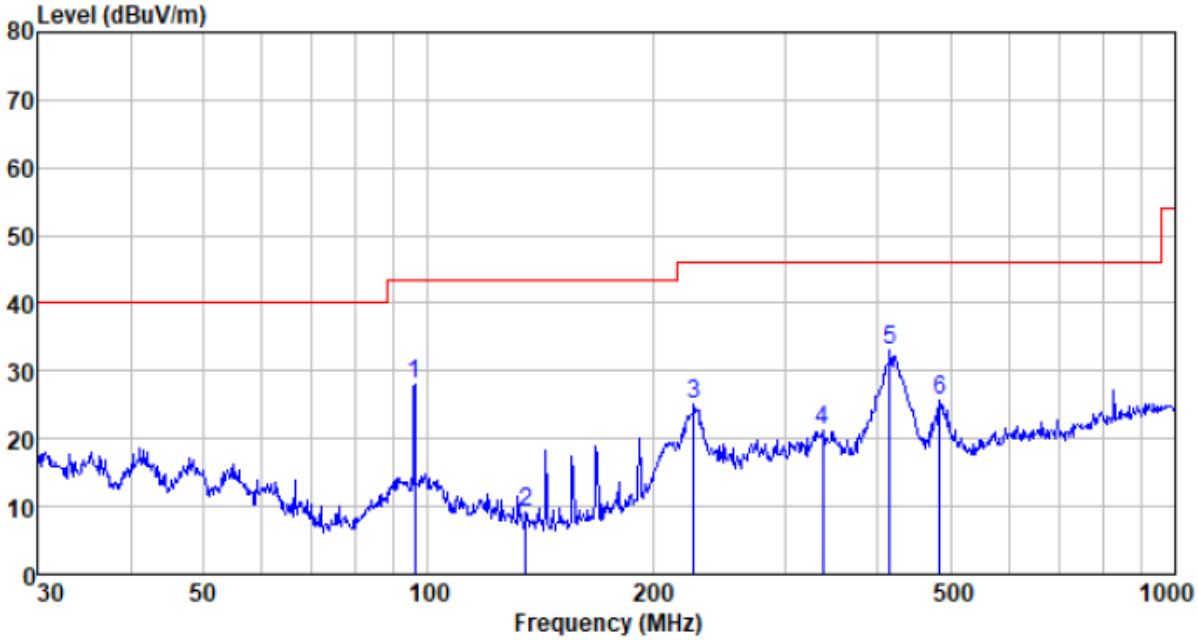
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
96.099	40.05	11.65	1.16	36.69	16.17	43.50	-27.33	QP
167.824	46.65	8.46	1.67	37.18	19.60	43.50	-23.90	QP
323.320	43.67	14.04	2.49	37.45	22.75	46.00	-23.25	QP
404.667	47.05	15.42	2.88	37.52	27.83	46.00	-18.17	QP
435.590	46.45	16.08	3.03	37.52	28.04	46.00	-17.96	QP
709.182	36.56	19.79	4.12	37.63	22.84	46.00	-23.16	QP

Internal power supply
Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
96.099	59.78	11.65	1.16	36.69	35.90	43.50	-7.60	QP
226.099	55.75	11.38	1.99	37.36	31.76	46.00	-14.24	QP
262.896	51.36	12.55	2.19	37.39	28.71	46.00	-17.29	QP
338.400	53.14	14.31	2.57	37.46	32.56	46.00	-13.44	QP
411.824	54.66	15.59	2.91	37.52	35.64	46.00	-10.36	QP
480.528	48.20	16.93	3.22	37.51	30.84	46.00	-15.16	QP

Vertical:

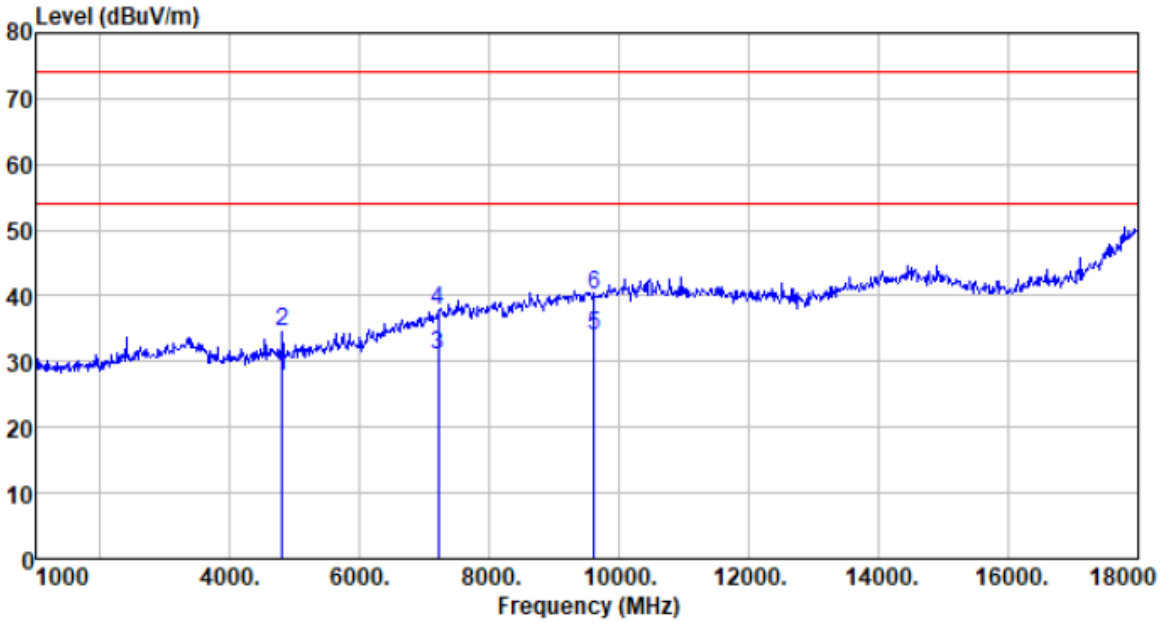


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
96.099	51.98	11.65	1.16	36.69	28.10	43.50	-15.40	QP
135.032	36.84	7.78	1.47	36.98	9.11	43.50	-34.39	QP
226.894	49.15	11.38	2.00	37.36	25.17	46.00	-20.83	QP
337.216	41.72	14.29	2.56	37.46	21.11	46.00	-24.89	QP
414.722	51.92	15.63	2.92	37.52	32.95	46.00	-13.05	QP
483.910	42.81	17.01	3.23	37.51	25.54	46.00	-20.46	QP

■ **Above 1GHz**

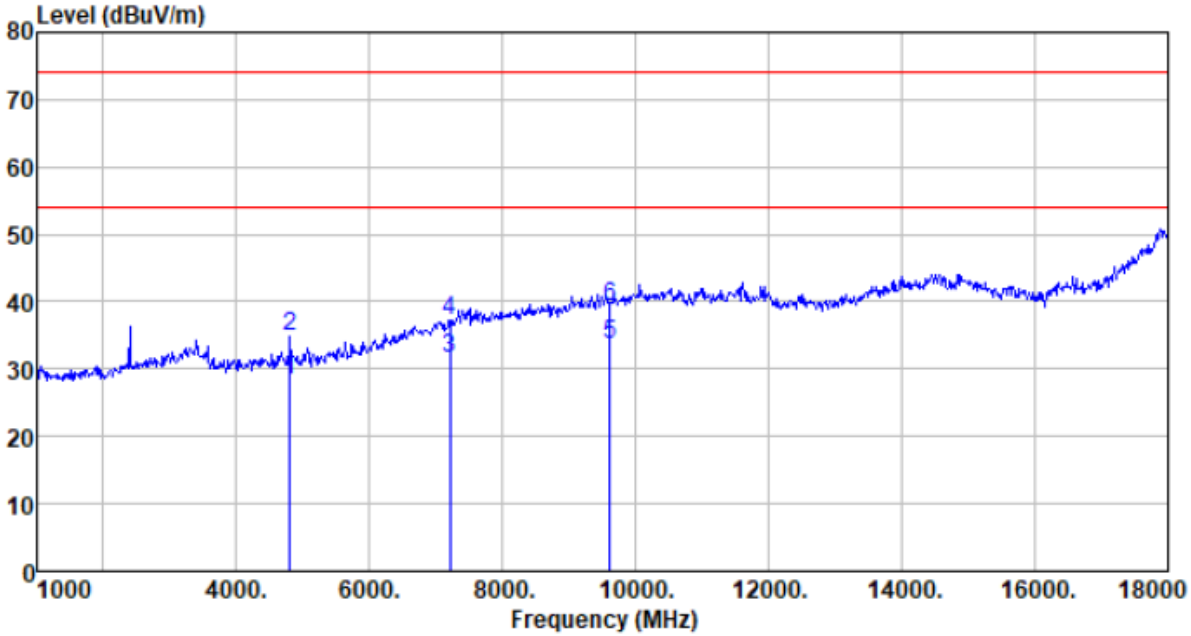
External power supply

Test channel:	Lowest	Polarziation:	Vertical



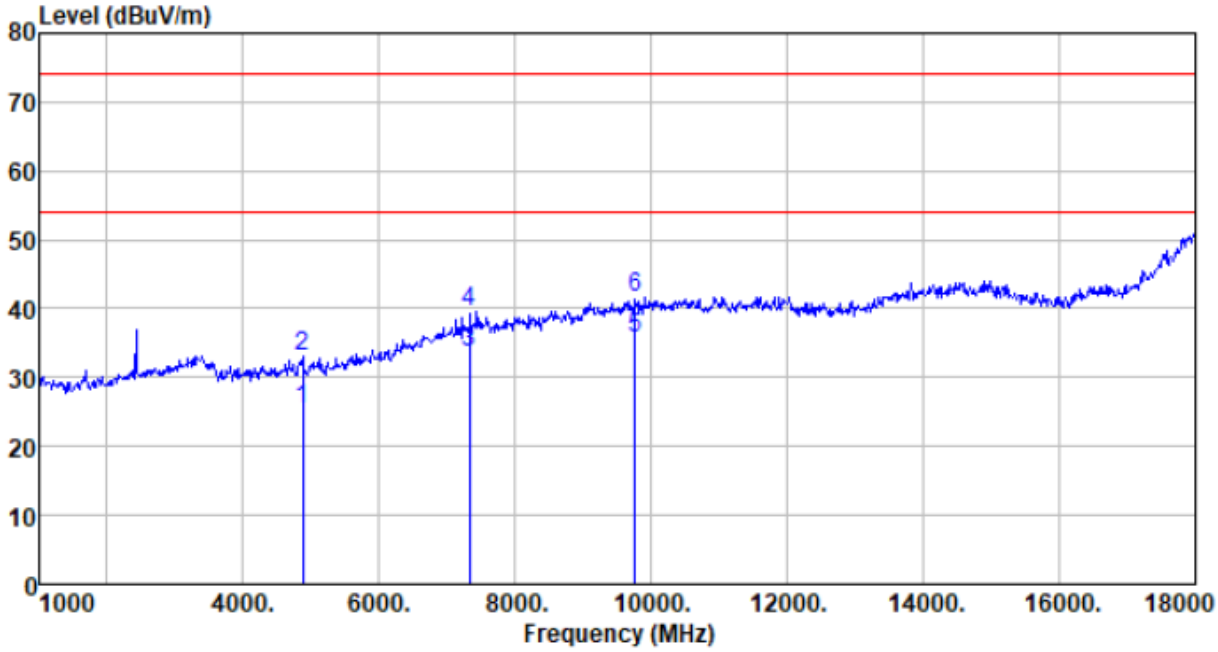
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4804.813	29.62	31.20	4.61	37.73	27.70	54.00	-26.30	Average
4804.813	36.40	31.20	4.61	37.73	34.48	74.00	-39.52	Peak
7207.219	24.01	36.16	6.48	35.63	31.02	54.00	-22.98	Average
7207.219	30.82	36.16	6.48	35.63	37.83	74.00	-36.17	Peak
9609.625	23.02	37.93	7.97	34.94	33.98	54.00	-20.02	Average
9609.625	29.32	37.93	7.97	34.94	40.28	74.00	-33.72	Peak

Test channel:	Lowest	Polarziation:	Horizontal



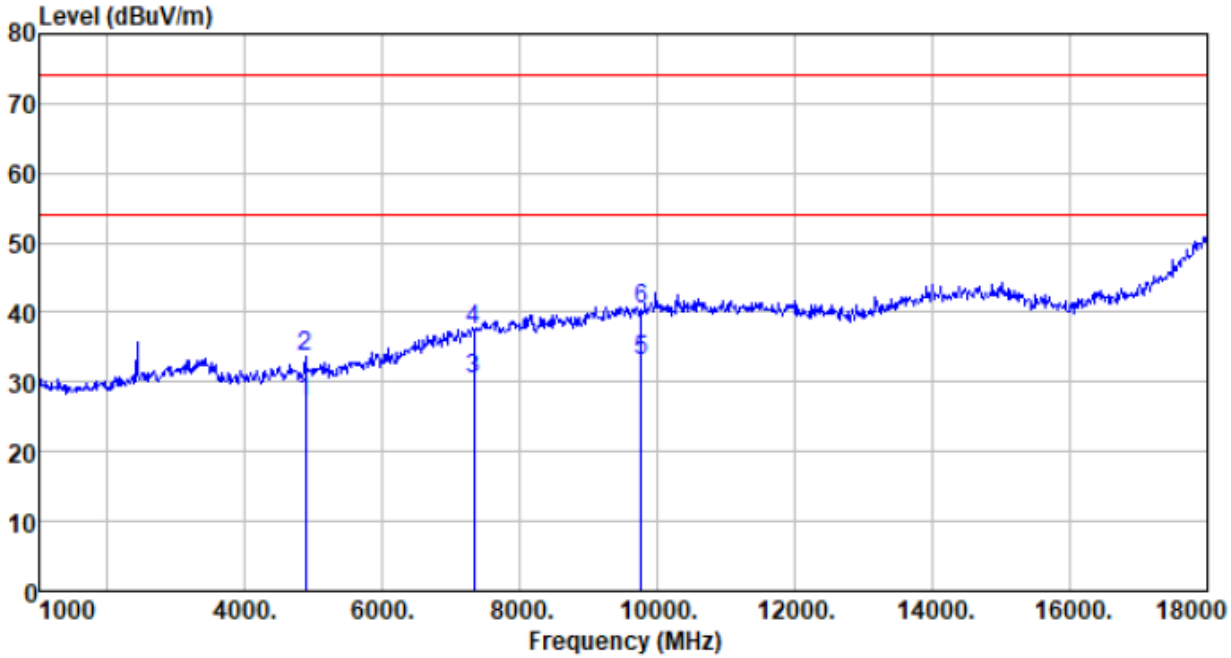
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4804.813	30.41	31.20	4.61	37.73	28.49	54.00	-25.51	Average
4804.813	36.68	31.20	4.61	37.73	34.76	74.00	-39.24	Peak
7207.219	24.43	36.16	6.48	35.63	31.44	54.00	-22.56	Average
7207.219	30.26	36.16	6.48	35.63	37.27	74.00	-36.73	Peak
9609.625	22.83	37.93	7.97	34.94	33.79	54.00	-20.21	Average
9609.625	28.43	37.93	7.97	34.94	39.39	74.00	-34.61	Peak

Test channel:	Middle	Polarziation:	Vertical



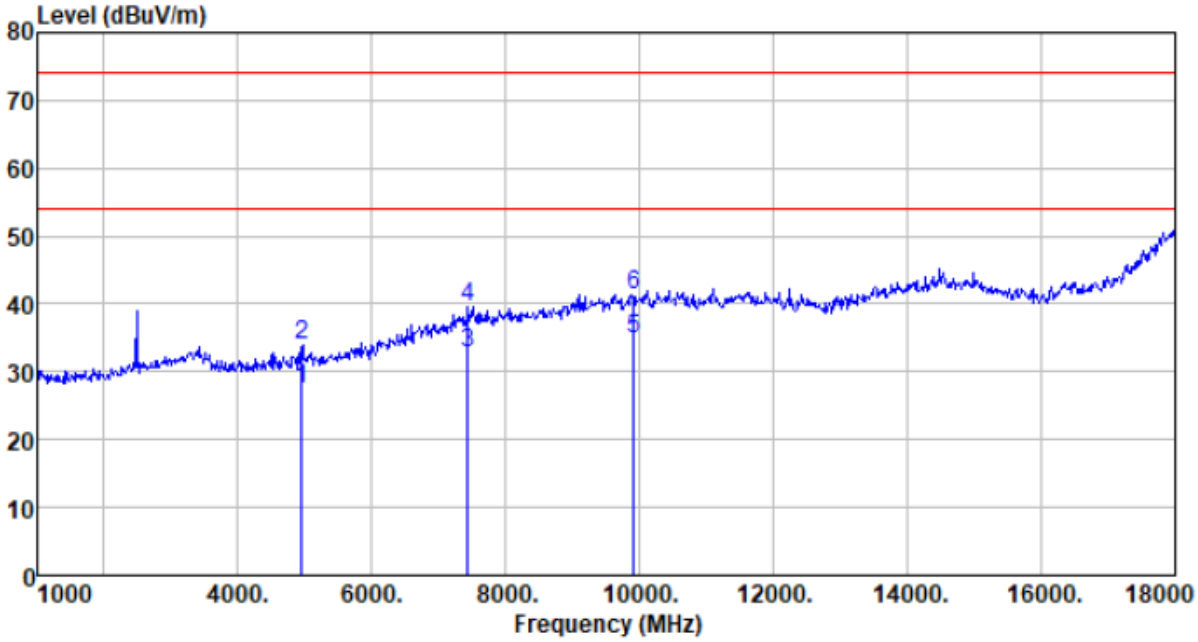
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.384	27.01	31.31	4.69	37.75	25.26	54.00	-28.74	Average
4880.384	34.96	31.31	4.69	37.75	33.21	74.00	-40.79	Peak
7320.577	26.24	36.43	6.63	35.60	33.70	54.00	-20.30	Average
7320.577	32.14	36.43	6.63	35.60	39.60	74.00	-34.40	Peak
9760.769	24.57	38.10	8.03	35.03	35.67	54.00	-18.33	Average
9760.769	30.62	38.10	8.03	35.03	41.72	74.00	-32.28	Peak

Test channel:	Middle	Polarziation:	Horizontal



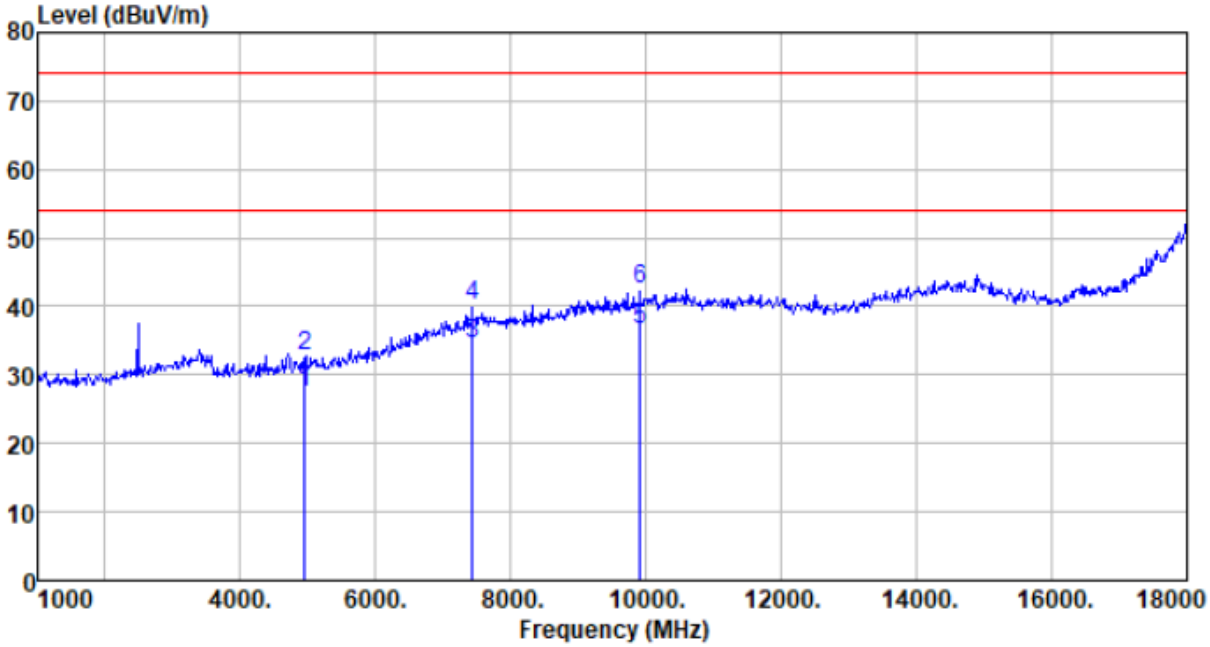
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.384	28.76	31.31	4.69	37.75	27.01	54.00	-26.99	Average
4880.384	35.47	31.31	4.69	37.75	33.72	74.00	-40.28	Peak
7320.577	23.03	36.43	6.63	35.60	30.49	54.00	-23.51	Average
7320.577	29.93	36.43	6.63	35.60	37.39	74.00	-36.61	Peak
9760.769	22.01	38.10	8.03	35.03	33.11	54.00	-20.89	Average
9760.769	29.30	38.10	8.03	35.03	40.40	74.00	-33.60	Peak

Test channel:	Highest	Polarziation:	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4958.271	29.02	31.44	4.79	37.78	27.47	54.00	-26.53	Average
4958.271	35.47	31.44	4.79	37.78	33.92	74.00	-40.08	Peak
7437.407	25.04	36.66	6.77	35.56	32.91	54.00	-21.09	Average
7437.407	31.65	36.66	6.77	35.56	39.52	74.00	-34.48	Peak
9916.542	23.54	38.30	8.09	35.14	34.79	54.00	-19.21	Average
9916.542	30.05	38.30	8.09	35.14	41.30	74.00	-32.70	Peak

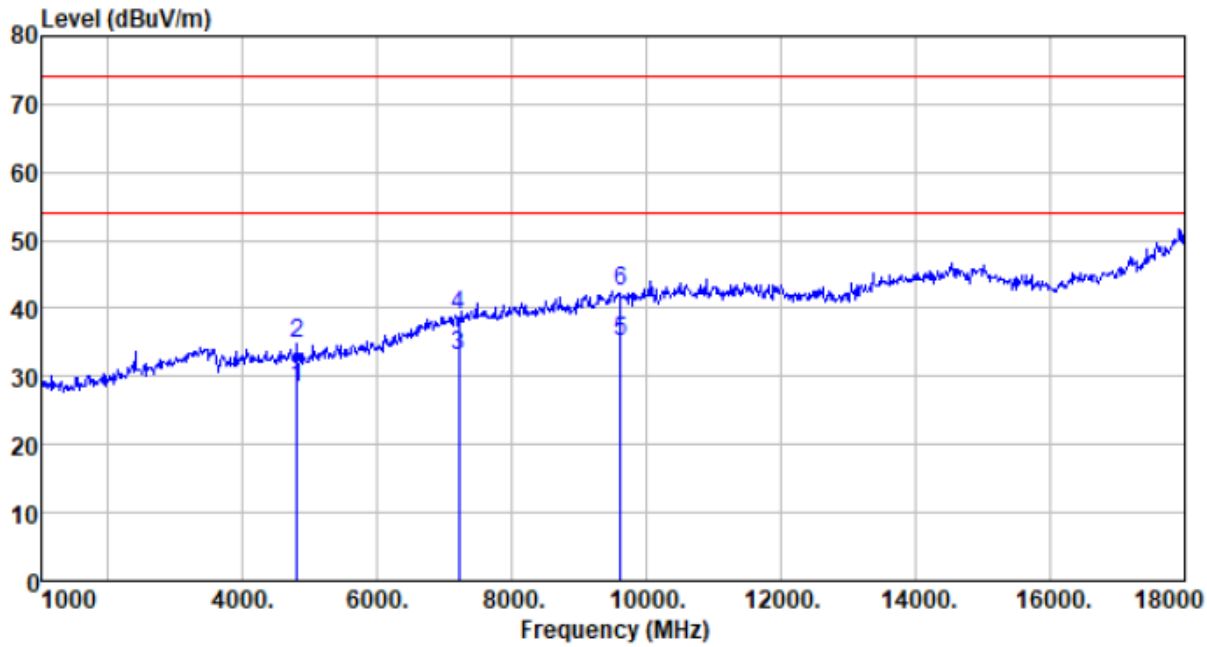
Test channel:	Highest	Polarziation:	Horizontal



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4958.271	29.01	31.44	4.79	37.78	27.46	54.00	-26.54	Average
4958.271	34.31	31.44	4.79	37.78	32.76	74.00	-41.24	Peak
7437.407	26.57	36.66	6.77	35.56	34.44	54.00	-19.56	Average
7437.407	32.35	36.66	6.77	35.56	40.22	74.00	-33.78	Peak
9916.542	25.21	38.30	8.09	35.14	36.46	54.00	-17.54	Average
9916.542	31.35	38.30	8.09	35.14	42.60	74.00	-31.40	Peak

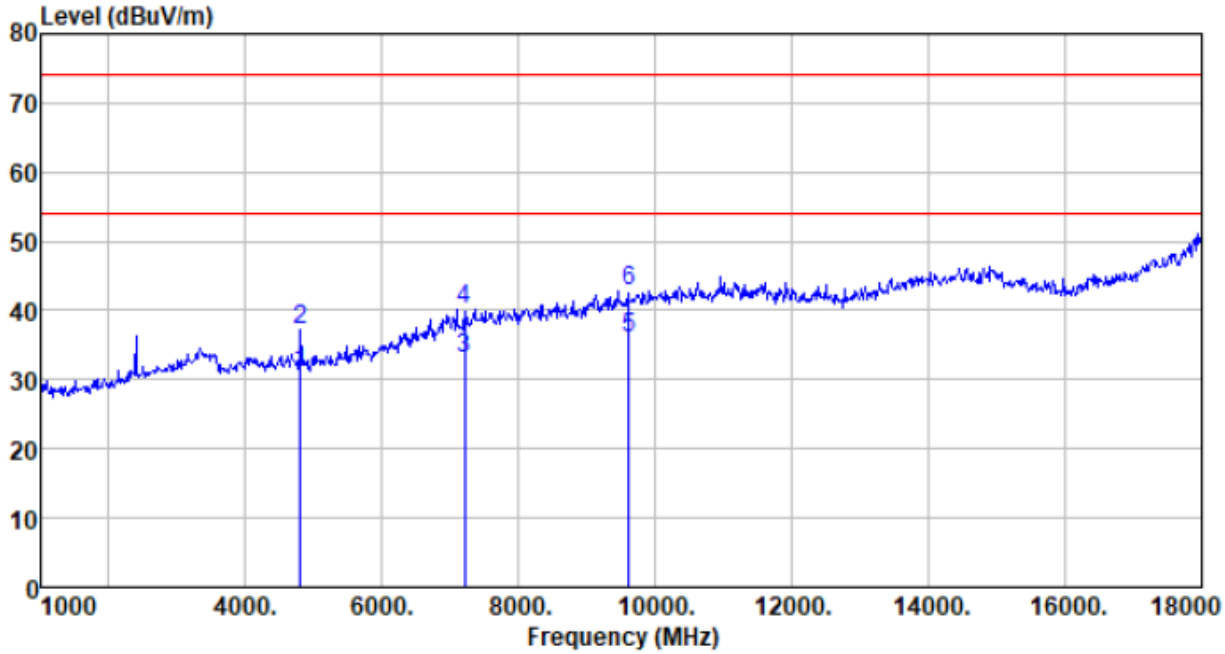
Internal power supply

Test channel:	Lowest	Polarziation:	Vertical



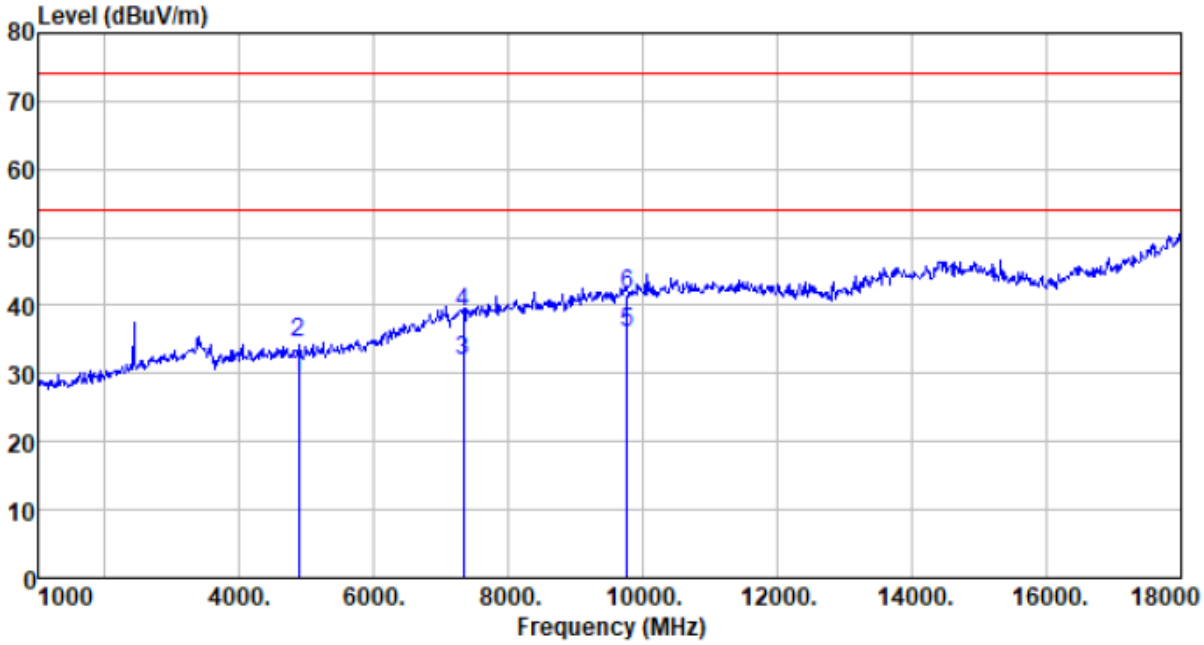
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4804.813	25.63	31.20	9.36	37.73	28.46	54.00	-25.54	Average
4804.813	31.92	31.20	9.36	37.73	34.75	74.00	-39.25	Peak
7207.219	21.35	36.16	11.22	35.63	33.10	54.00	-20.90	Average
7207.219	27.15	36.16	11.22	35.63	38.90	74.00	-35.10	Peak
9609.625	19.19	37.93	12.91	34.94	35.09	54.00	-18.91	Average
9609.625	26.76	37.93	12.91	34.94	42.66	74.00	-31.34	Peak

Test channel:	Lowest	Polarziation:	Horizontal



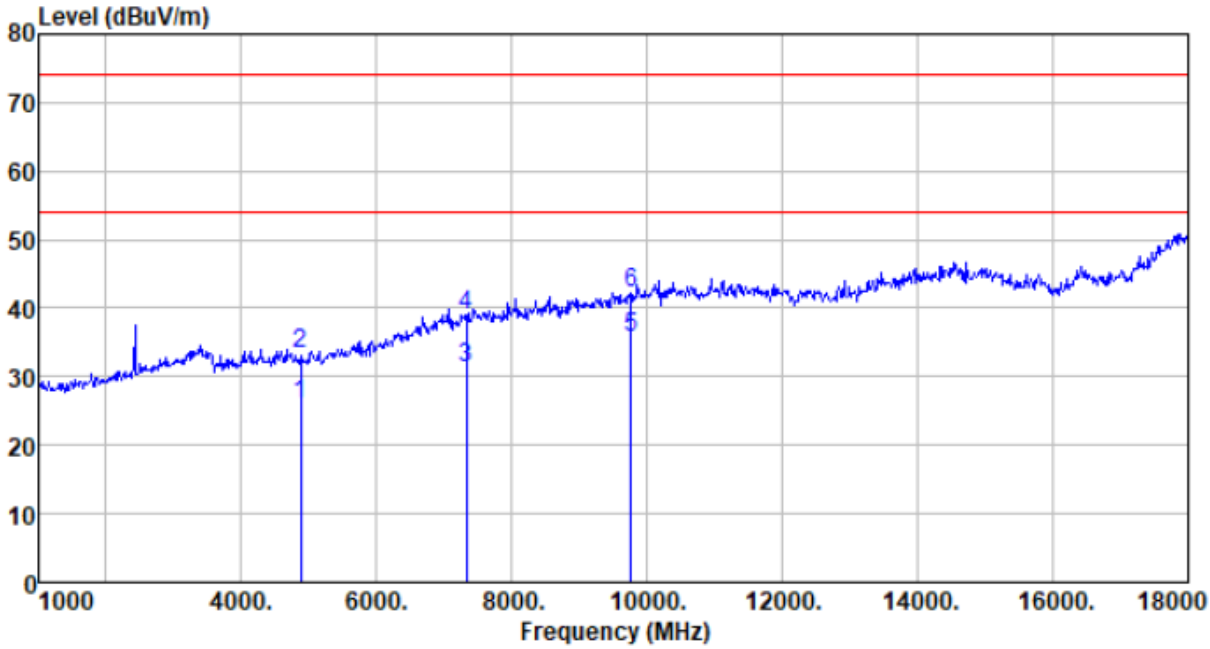
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4804.813	28.05	31.20	9.36	37.73	30.88	54.00	-23.12	Average
4804.813	34.35	31.20	9.36	37.73	37.18	74.00	-36.82	Peak
7207.219	21.35	36.16	11.22	35.63	33.10	54.00	-20.90	Average
7207.219	28.46	36.16	11.22	35.63	40.21	74.00	-33.79	Peak
9609.625	20.03	37.93	12.91	34.94	35.93	54.00	-18.07	Average
9609.625	26.84	37.93	12.91	34.94	42.74	74.00	-31.26	Peak

Test channel:	Middle	Polarziation:	Vertical



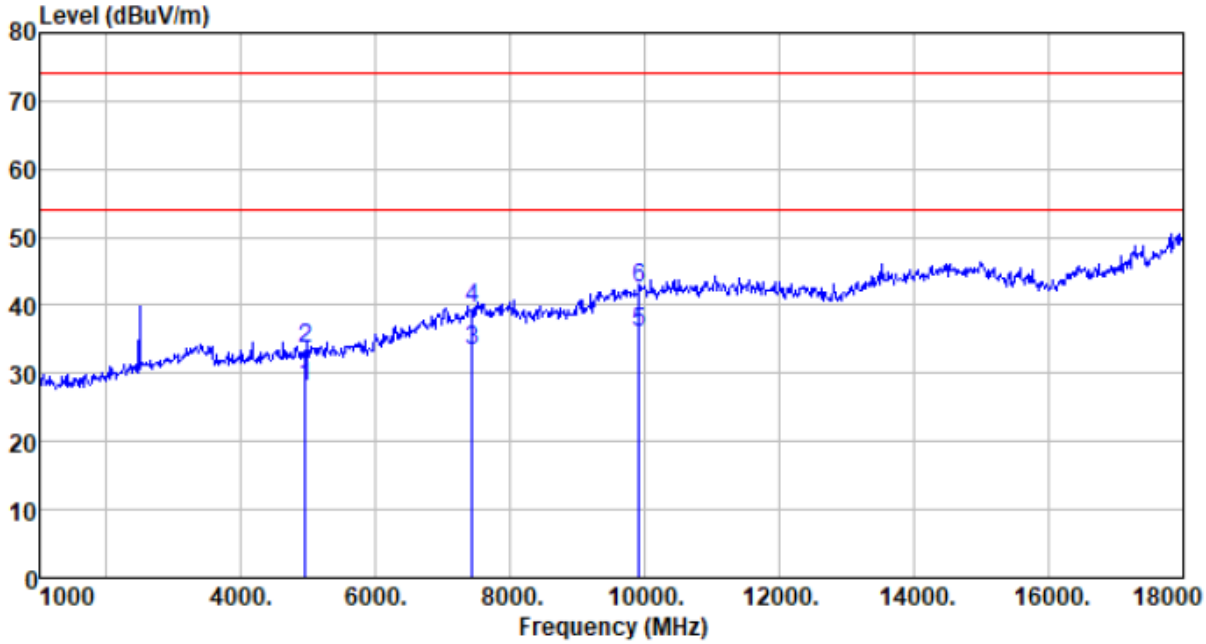
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.384	26.68	31.31	9.42	37.75	29.66	54.00	-24.34	Average
4880.384	31.49	31.31	9.42	37.75	34.47	74.00	-39.53	Peak
7320.577	19.74	36.43	11.30	35.60	31.87	54.00	-22.13	Average
7320.577	26.88	36.43	11.30	35.60	39.01	74.00	-34.99	Peak
9760.769	19.93	38.10	13.01	35.03	36.01	54.00	-17.99	Average
9760.769	25.52	38.10	13.01	35.03	41.60	74.00	-32.40	Peak

Test channel:	Middle	Polarziation:	Horizontal



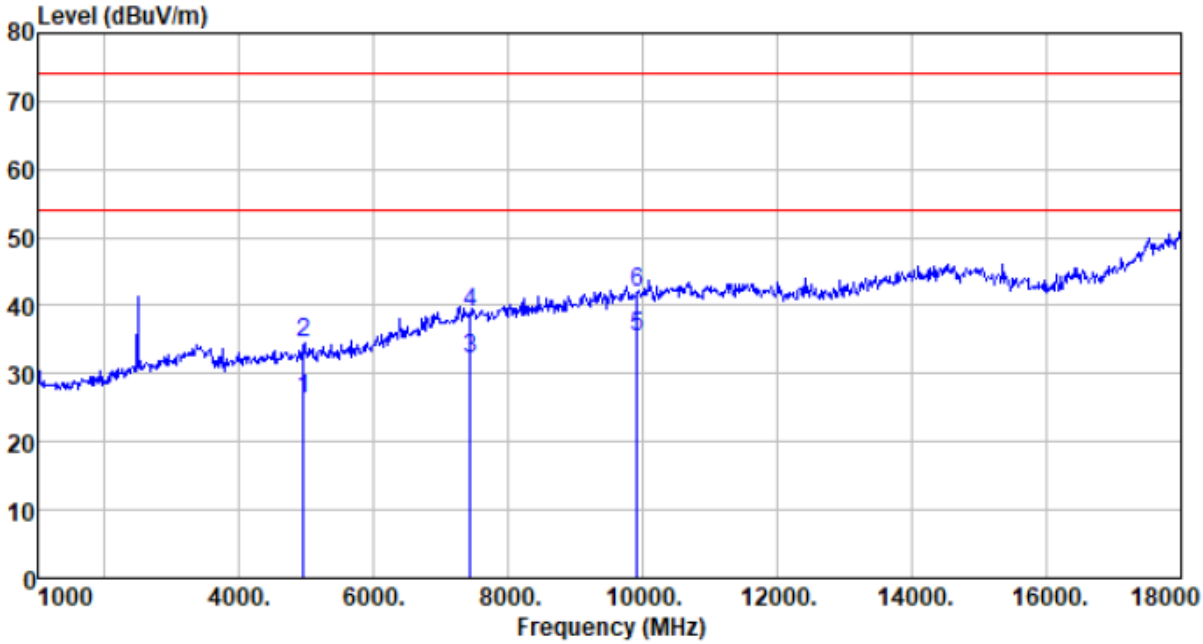
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.384	23.03	31.31	9.42	37.75	26.01	54.00	-27.99	Average
4880.384	30.42	31.31	9.42	37.75	33.40	74.00	-40.60	Peak
7320.577	19.16	36.43	11.30	35.60	31.29	54.00	-22.71	Average
7320.577	26.75	36.43	11.30	35.60	38.88	74.00	-35.12	Peak
9760.769	19.73	38.10	13.01	35.03	35.81	54.00	-18.19	Average
9760.769	26.11	38.10	13.01	35.03	42.19	74.00	-31.81	Peak

Test channel:	Highest	Polarziation:	Vertical



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4958.271	24.92	31.44	9.48	37.78	28.06	54.00	-25.94	Average
4958.271	30.60	31.44	9.48	37.78	33.74	74.00	-40.26	Peak
7437.407	20.93	36.66	11.39	35.56	33.42	54.00	-20.58	Average
7437.407	27.13	36.66	11.39	35.56	39.62	74.00	-34.38	Peak
9916.542	19.72	38.30	13.12	35.14	36.00	54.00	-18.00	Average
9916.542	26.21	38.30	13.12	35.14	42.49	74.00	-31.51	Peak

Test channel:	Highest	Polarziation:	Horizontal



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4958.271	23.05	31.44	9.48	37.78	26.19	54.00	-27.81	Average
4958.271	31.47	31.44	9.48	37.78	34.61	74.00	-39.39	Peak
7437.407	19.70	36.66	11.39	35.56	32.19	54.00	-21.81	Average
7437.407	26.35	36.66	11.39	35.56	38.84	74.00	-35.16	Peak
9916.542	19.05	38.30	13.12	35.14	35.33	54.00	-18.67	Average
9916.542	25.75	38.30	13.12	35.14	42.03	74.00	-31.97	Peak

Remark:

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *No emission found in frequency above 18GHz.*

8 Test Setup Photo

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

9 EUT Constructional Details

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

---End---