RADIO TEST REPORT

Report No.: SHATBL2209003W02

Applicant:

XROUND Inc.

Address:

Rm. 4, 10F.,No.738, Zhongzheng Rd., ZhongheDist.,New Taipei City 235

Product Name	:	HEAR Hearing-enhancement earbuds
Brand Name	:	XROUND
Model Name	:	XV-03
Series Model	:	N/A
FCC ID	:	2A2ML-XV03
Test Standard	:	FCC Part 15.247

TEST RESULT CERTIFICATION

Applicant.....:	XROUND Inc.
Address..... :	Rm. 4, 10F.,No.738, Zhongzheng Rd., ZhongheDist.,New Taipei City 235
Manufacturer's Name.....:	XROUND Inc.
Address..... :	Rm. 4, 10F.,No.738, Zhongzheng Rd., ZhongheDist.,New Taipei City 235
Product Description	
Product Name..... :	HEAR Hearing-enhancement earbuds
Brand Name .....:	XROUND
Model Name..... :	XV-03
Series Model.....:	N/A
Test Standards..... :	FCC Part 15.247
Test Procedure..... :	ANSI C63.10-2013

This device described above has been tested by ATBL, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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Date of receipt of test item.....:	2022.09.01
Date (s) of performance of tests. :	2022.12.09~2022.12.17
Date of Issue.....:	2022.12.19
Test Result.....:	Pass

Report Prepared by :

(Jack Suo)

Report Approved by :

(Ghost.Li)

Authorized Signatory :

(Terry Yang)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	2022-12-19	SHATBL2209003W02	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02.

FCC Part15.247,Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	--
15.247(a)(1)	Hopping Channel Separation	PASS	--
15.247(a)(1)&(b)(1)	Output Power	PASS	--
15.209	Radiated Spurious Emission	PASS	--
15.247(d)	Conducted Spurious & Band Edge Emission	PASS	--
15.247(a)(1)(iii)	Number of Hopping Frequency	PASS	--
15.247(a)(1)(iii)	Dwell Time	PASS	--
15.247(a)(1)	Bandwidth	PASS	--
15.205	Restricted bands of operation	PASS	--
Part 15.247(d)/part 15.209(a)	Band Edge Emission	PASS	--
15.203	Antenna Requirement	PASS	--

NOTE:

(1) 'N/A' denotes test is not applicable in this Test Report.

(2)All tests are according to ANSI C63.10-2013.

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	HEAR Hearing-enhancement earbuds	
Trade Name	XROUND	
Model Name	XV-03	
Series Model	N/A	
Model Difference	N/A	
Product Description	The EUT is HEAR Hearing-enhancement earbuds	
	Operation Frequency:	2402~2480 MHz
	Modulation Type:	GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)
	Bluetooth Configuration:	BR+EDR
	Bluetooth Version:	5.2
	Number Of Channel:	79
	Antenna Designation:	FPC
	Antenna Gain (dBi):	0 dBi
Channel List	Please refer to the Note 2.	
Adapter	N/A	
Battery	Model: LIR1254 Brand: Rated 3.6V Charge Limit Voltage:4.2V Capacity: 65mAh	
Hardware version number	N/A	
Software version number	N/A	
Connecting I/O Port(s)	Please refer to the Note 1.	

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.

2.

Channel List					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

3. Table for Filed Antenna

Ant.	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	XROUND	FPC	N/A	0dBi	BLE ANT

2.2 DESCRIPTION OF THE TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Worst Mode	Description	Data Rate/Modulation
Mode 1	TX CH00	1Mbps/GFSK
Mode 2	TX CH39	1Mbps/GFSK
Mode 3	TX CH78	1Mbps/GFSK
Mode 4	TX CH00	2 Mbps/π/4-DQPSK
Mode 5	TX CH39	2 Mbps/π/4-DQPSK
Mode 6	TX CH78	2 Mbps/π/4-DQPSK
Mode7	TX CH00	3 Mbps/8DPSK
Mode 8	TX CH39	3 Mbps/8DPSK
Mode 9	TX CH78	3 Mbps/8DPSK
Mode 10	Hopping	GFSK
Mode 11	Hopping	π/4-DQPSK
Mode 12	Hopping	8DPSK

Note:

(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported.

For Conducted Emission

Test Case	
Conducted Emission	Mode 13 : Keeping BT TX

2.3 FREQUENCY HOPPING SYSTEM REQUIREMENTS

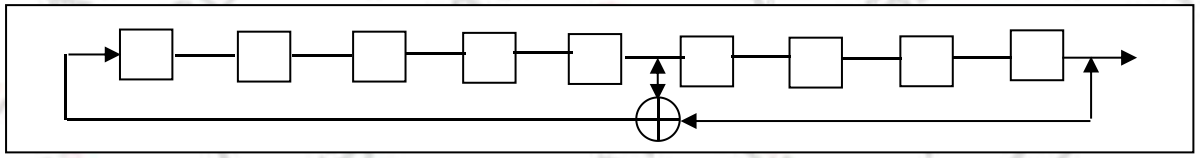
(1)Standard and Limit

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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

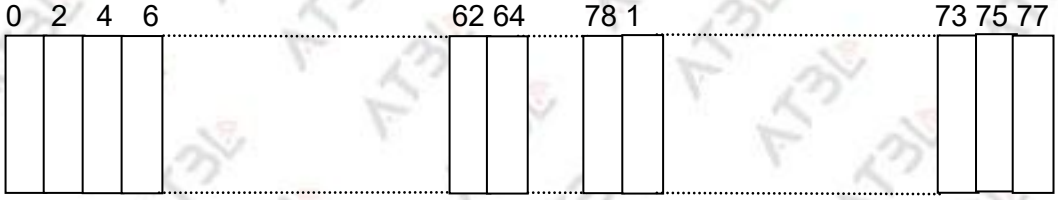
The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination 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.

(2)The Pseudo random sequence may be generated in a Non-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=511bits
Longest sequence of zeros: 8(non-inverted signal)



Liner Feedback Shift Register for Generator of the PRBS sequence

An example of Pseudo random Frequency Hoppong 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.

(3)Frequency Hopping System
This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with a Bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements FCC Part 15.247 rule.

2.4 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

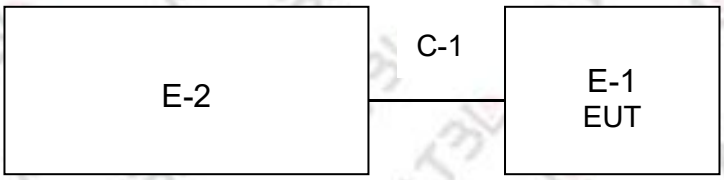
During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of FHSS.

Test software Version	Test program: Bluetooth		
(Power control software) Parameters(1/2/3Mbps)	Power class: DH1 rate:4:27 2DH1 rate:20:54 3DH1 rate:24:83	Power class: DH3 rate:11:183 2DH3 rate:26:367 3DH3 rate:27:552	Power class: DH5 rate:15:339 2DH5 rate:30:679 3DH5 rate:31:1021

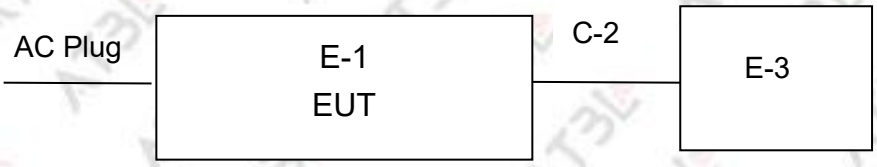
RF Function	Type	Mode Or Modulation type	Ant Gain(dBi)	Antenna Type	Software For Testing
BT	BR+EDR	GFSK	0	FPC	Provided by the customer
		π/4-DQPSK	0		
		8DPSK	0		

2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



Conduction Emission Test



2.6LABORATORY INFORMATION

Company Name:	Shanghai ATBL Technology Co., Ltd.
Address:	Building 8,No.160 Basheng Road,Waigaoqiao Free Trade Zone,Pudong New Area,Shanghai
Telephone:	+86(0)21-51298625
The FCC Registration Number (FRN):	0031025281
A2LA Number:	6184.01
CNAS Number:	CNAS L14531

2.7 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y ±U**, where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.958dB
2	Conducted spurious emissions	±2.988dB
3	All emissions, radiated 30MHz-1GHz	±2.50dB
4	All emissions, radiated 1GHz-18GHz	±3.51dB
5	Occupied bandwidth	±2.320Hz
6	Power spectral density	±0.886dB

2.8 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-2	Adapter	OPPO	VCA7JCCH	N/A	N/A
C-1	USB	N/A	20cm	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
C-2	Notebook	Lenovo	DESKTOP-USDEO09	00326-10000-00000-AA636	N/A
E-3	USB Cable	N/A	100cm	N/A	N/A

Note:

(1) For detachable type I/O cable should be specified the length in cm in『Length』column.

2.9 EQUIPMENTS LIST

2.9.1 Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Management number	Calibrated until
Test Receiver	R&S	ESCI	100469	SHATBL-E003	2023.09.27
Spectrum Analyzer	Agilent	N9020A	MY50200811	SHATBL-E017	2023.09.27
Bilog Antenna	SCHWARZBECK	VLUB 9168	01174	SHATBL-E008	2023.09.27
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	SHATBL-E009	2023.09.27
Pre-Amplifier (0.1M-3GHz)	JPT	JPA-10M1G35	2101010003500 1	SHATBL-E005	2023.09.27
Pre-Amplifier (1G-18GHz)	JPT	JPA0118-55-30 3A	1910001800055 000	SHATBL-E006	2023.09.27
Temperature & Humidity	DeLi	DeLi	N/A	SHATBL-E016	2023.09.27
Antenna/Turntable Controller	Brilliant	N/A	N/A	SHATBL-E007	N/A
Test SW	FALA	EMC-RI(Ver.4A2)		SHATBL-E046	N/A

2.9.2 Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Management number	Calibration date
Test Receiver	R&S	ESPI	101679	SHATBL-E012	2023.09.27
LISN	R&S	ENV216	101300	SHATBL-E013	2023.09.27
LISN	R&S	ENV216	100333	SHATBL-E041	2023.09.27
Temperature & Humidity	DeLi	DeLi	N/A	SHATBL-E015	2023.09.27
Test SW	FALA	EZ-EMC(Ver.EMC-CON3A1.1)		SHATBL-E044	N/A

2.9.3 RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	equipment number	Calibrated until
MIMO Power measurement test Set	DARE	RPR3006W	16I00054SN016	SHATBL-W006	2023.09.27
			RPR6W-20001005	SHATBL-W013	2023.09.27
Signal Analyzer	Agilent	N9020A	MY57300196	SHATBL-W004	2023.09.27
Signal Generator	Agilent	N5182B	MY46240556	SHATBL-W005	2023.09.27
Wireless Communications Test Set	R&S	CMW500	101331	SHATBL-W007	2023.09.27
Temperature & Humidity	Deli	deli	N/A	SHATBL-W011	2023.09.27
Attenuator	Agilent	8494B	DC-18G	SHATBL-W009	2023.09.27
Attenuator	Agilent	8496B	DC-18G	SHATBL-W010	2023.09.27
power splitter	MNK	MPD-DC/6-2S	62315 G51	SHATBL-W015	2023.09.27
			62315 G52	SHATBL-W016	2023.09.27
Filter	Chengdu kangmaiwei	ZBSF-C2400-2483.5-T3	N/A	SHATBL-W021	N/A
Constant temperature and humidity box	KSON	THS-B6C-150	6159K	SHATBL-W019	2023.09.27
Test SW	FALA	LZ-RF(Ver.LzRF-03A3.1)		SHATBL-W020	N/A

3.EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

FREQUENCY (MHz)	Conducted Emission limit (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

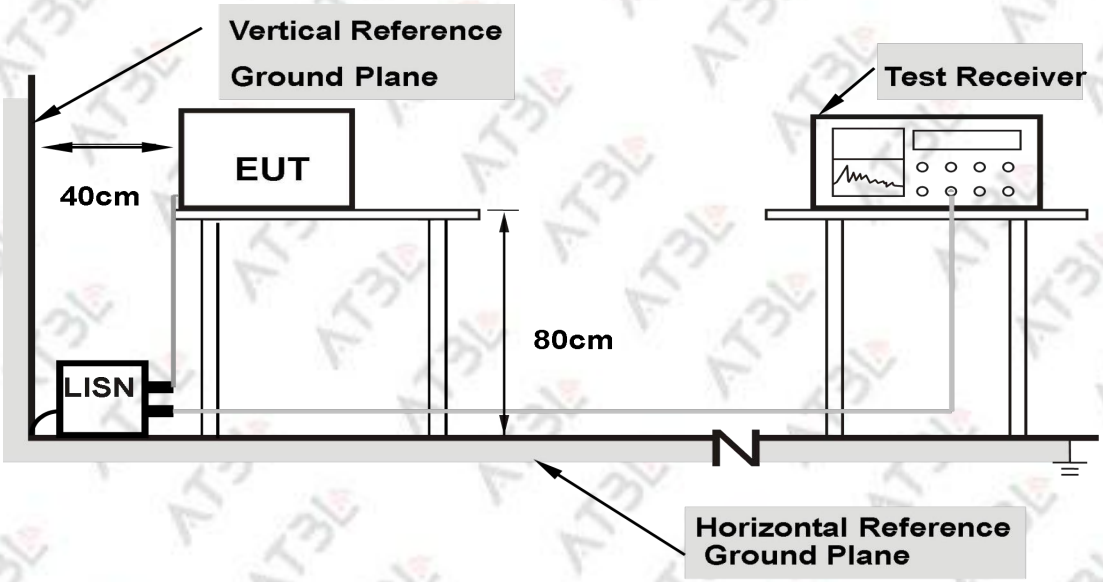
The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.1.2 TEST PROCEDURE

a. The EUT is 0.8 m from the horizontal ground plane and 0.4 m from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment are powered from additional LISN(s). The LISN provides 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN is at least 80 cm from the nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.1.3 TEST SETUP



Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes support units.

3.1.4 EUT OPERATING CONDITIONS

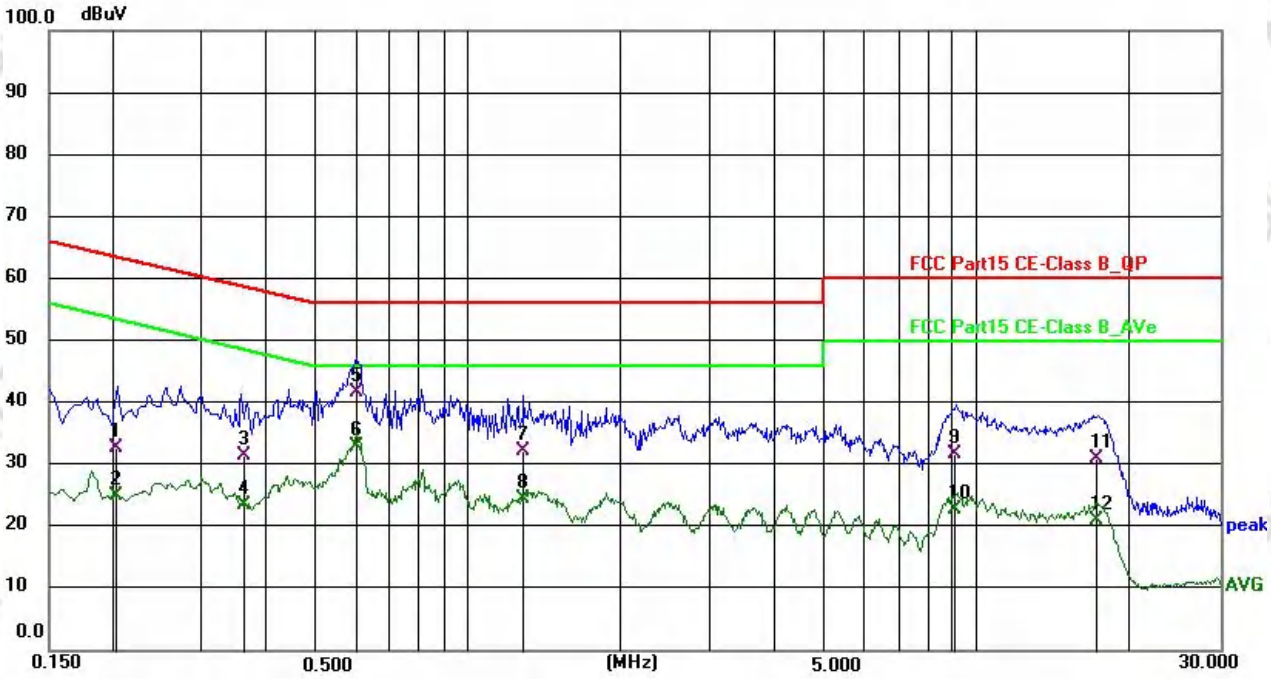
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.1.5 TEST RESULT

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 13		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.2033	22.02	10.75	32.77	63.47	-30.70	QP
2	0.2033	14.24	10.75	24.99	53.47	-28.48	AVG
3	0.3634	20.80	10.68	31.48	58.65	-27.17	QP
4	0.3634	12.75	10.68	23.43	48.65	-25.22	AVG
5	0.6066	31.11	10.68	41.79	56.00	-14.21	QP
6	0.6066	22.30	10.68	32.98	46.00	-13.02	AVG
7	1.2925	21.41	10.73	32.14	56.00	-23.86	QP
8	1.2925	13.71	10.73	24.44	46.00	-21.56	AVG
9	9.1006	21.12	10.65	31.77	60.00	-28.23	QP
10	9.1006	12.09	10.65	22.74	50.00	-27.26	AVG
11	17.2351	19.93	10.94	30.87	60.00	-29.13	QP
12	17.2351	10.07	10.94	21.01	50.00	-28.99	AVG

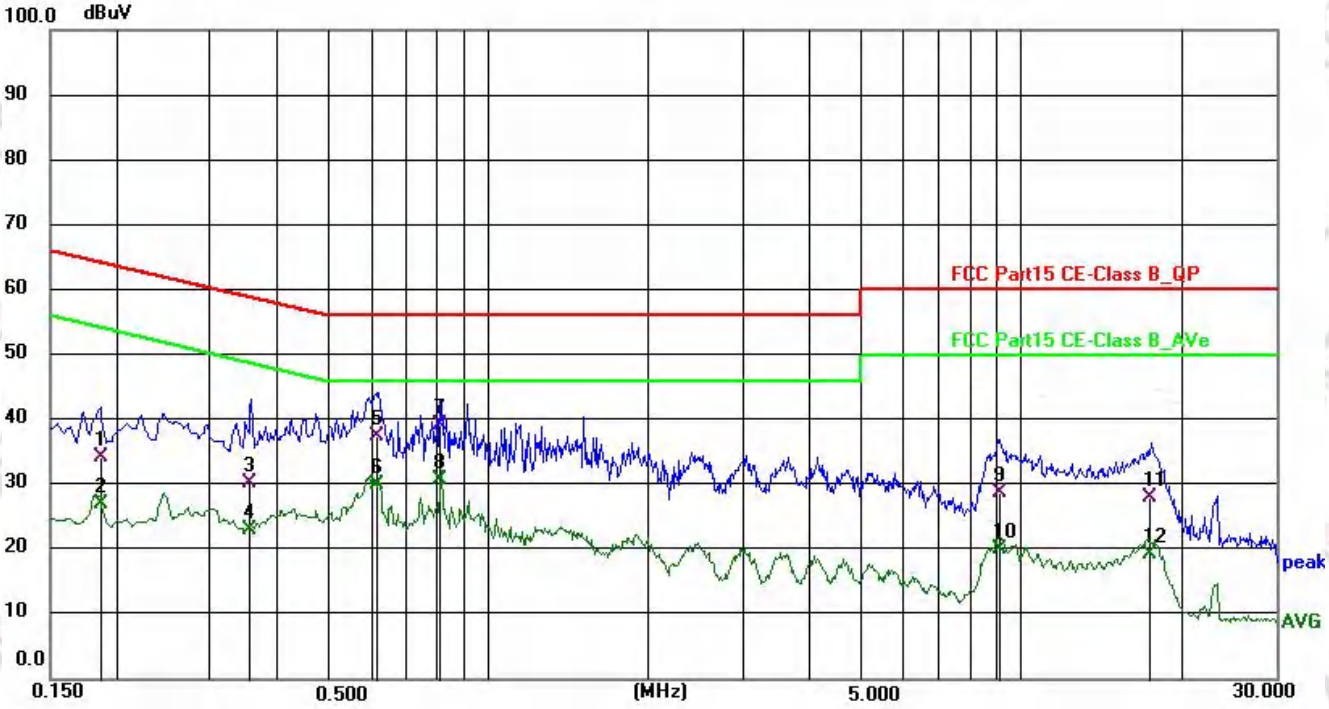
Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.
3. Factor=LISN factor+Cable loss+Limiter (10dB)



Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 13		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1870	23.75	10.41	34.16	64.17	-30.01	QP
2	0.1870	16.49	10.41	26.90	54.17	-27.27	AVG
3	0.3528	19.98	10.31	30.29	58.90	-28.61	QP
4	0.3528	12.79	10.31	23.10	48.90	-25.80	AVG
5	0.6187	27.17	10.34	37.51	56.00	-18.49	QP
6	0.6187	19.57	10.34	29.91	46.00	-16.09	AVG
7	0.8122	28.84	10.35	39.19	56.00	-16.81	QP
8	0.8122	20.34	10.35	30.69	46.00	-15.31	AVG
9	9.1071	18.37	10.36	28.73	60.00	-31.27	QP
10	9.1071	9.68	10.36	20.04	50.00	-29.96	AVG
11	17.5092	17.08	10.82	27.90	60.00	-32.10	QP
12	17.5092	8.45	10.82	19.27	50.00	-30.73	AVG

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.
3. Factor=LISN factor+Cable loss+Limiter (10dB)



3.2 RADIATED EMISSION MEASUREMENT

3.2.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205 (a)&209(a) limit in the table and according to ANSI C63.10-2013below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 1000MHz)

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (1GHz-25 GHz)

FREQUENCY (MHz)	(dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

LIMITS OF RESTRICTED FREQUENCY BANDS

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

For Radiated Emission

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP/AV
Start Frequency	9 kHz/150kHz(Peak/QP/AV)
Stop Frequency	150kHz/30MHz(Peak/QP/AV)
RB / VB (emission in restricted band)	200Hz (From 9kHz to 0.15MHz)/ 9kHz (From 0.15MHz to 30MHz); 200Hz (From 9kHz to 0.15MHz)/ 9kHz (From 0.15MHz to 30MHz)

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP
Start Frequency	30 MHz(Peak/QP)
Stop Frequency	1000 MHz (Peak/QP)
RB / VB (emission in restricted band)	120 kHz / 300 kHz

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/AV
Start Frequency	1000 MHz(Peak/AV)
Stop Frequency	10th carrier harmonic(Peak/AV)
RB / VB (emission in restricted band)	1MHz / 3MHz(Peak) 1 MHz/1/T MHz(AVG)

For Restricted band

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	2310MHz to 2500MHz
RB / VB	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

3.2.2 TEST PROCEDURE

a. The measuring distance at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz,and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 m (above 1GHz is 1.5 m) above the ground at a 3 m anechoic chamber test site. The table was rotated 360 degree to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m (above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarization of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and QuasiPeak detector mode will be re-measured.
e. If the Peak Mode measured value is compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and no additional QP Mode measurement was performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

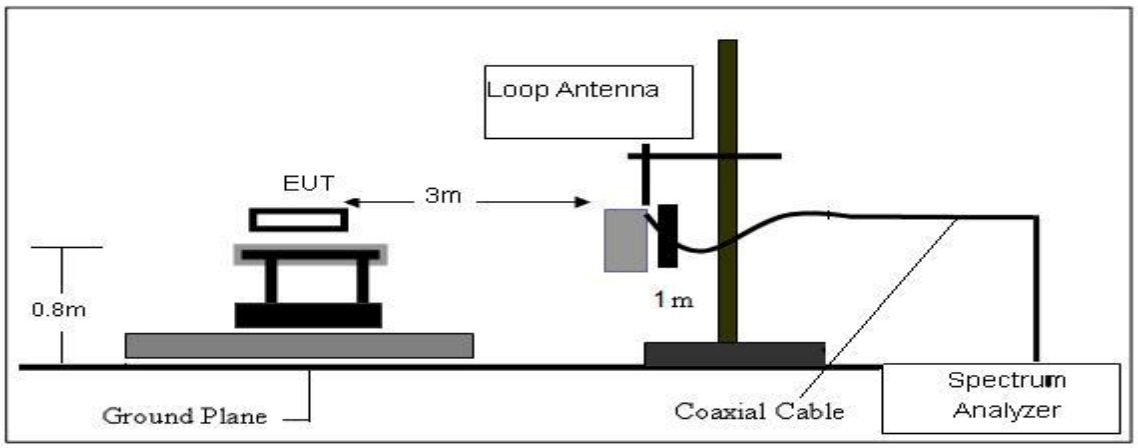
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

3.2.3 DEVIATION FROM TEST STANDARD

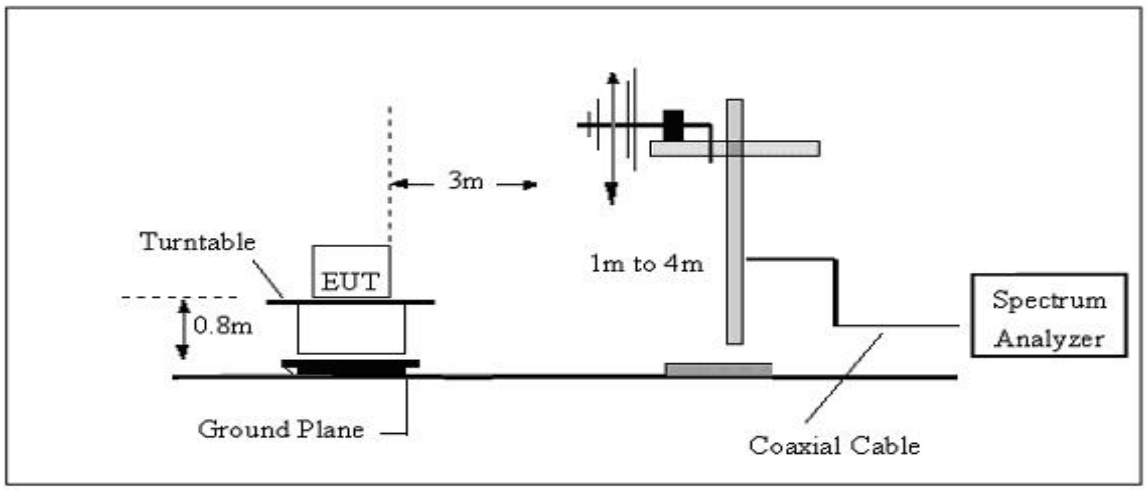
No deviation.

3.2.4 TESTSETUP

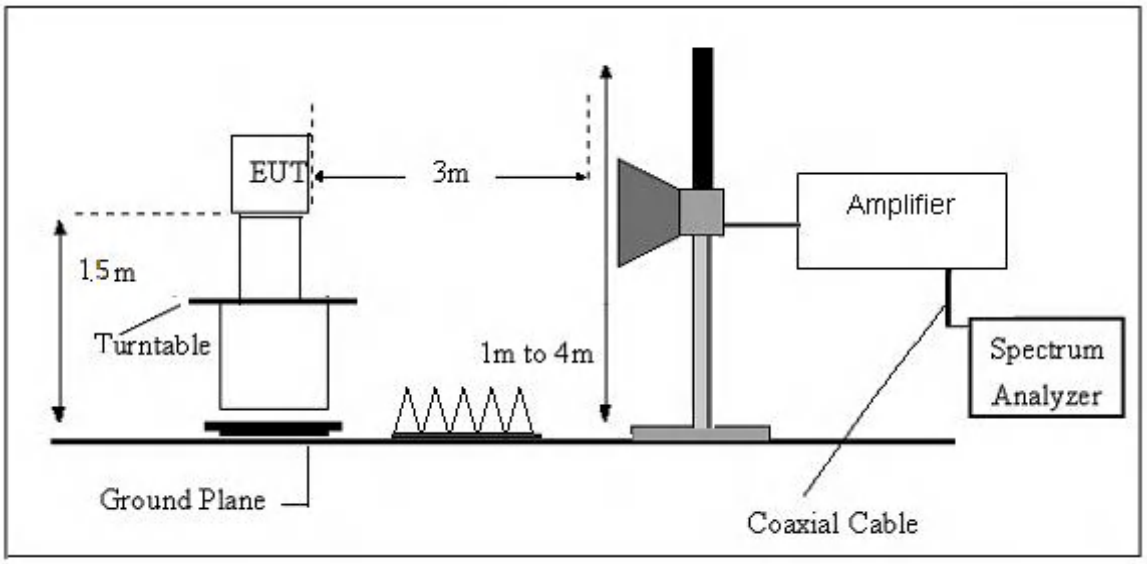
(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



3.2.5 EUT OPERATING CONDITIONS

Please refer to section 3.1.4 of this report.

3.2.6 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG

3.2.7 TEST RESULTS

(9kHz-30MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 3.7V	Test Mode:	TX Mode

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =40 log (specific distance/test distance)(dB);

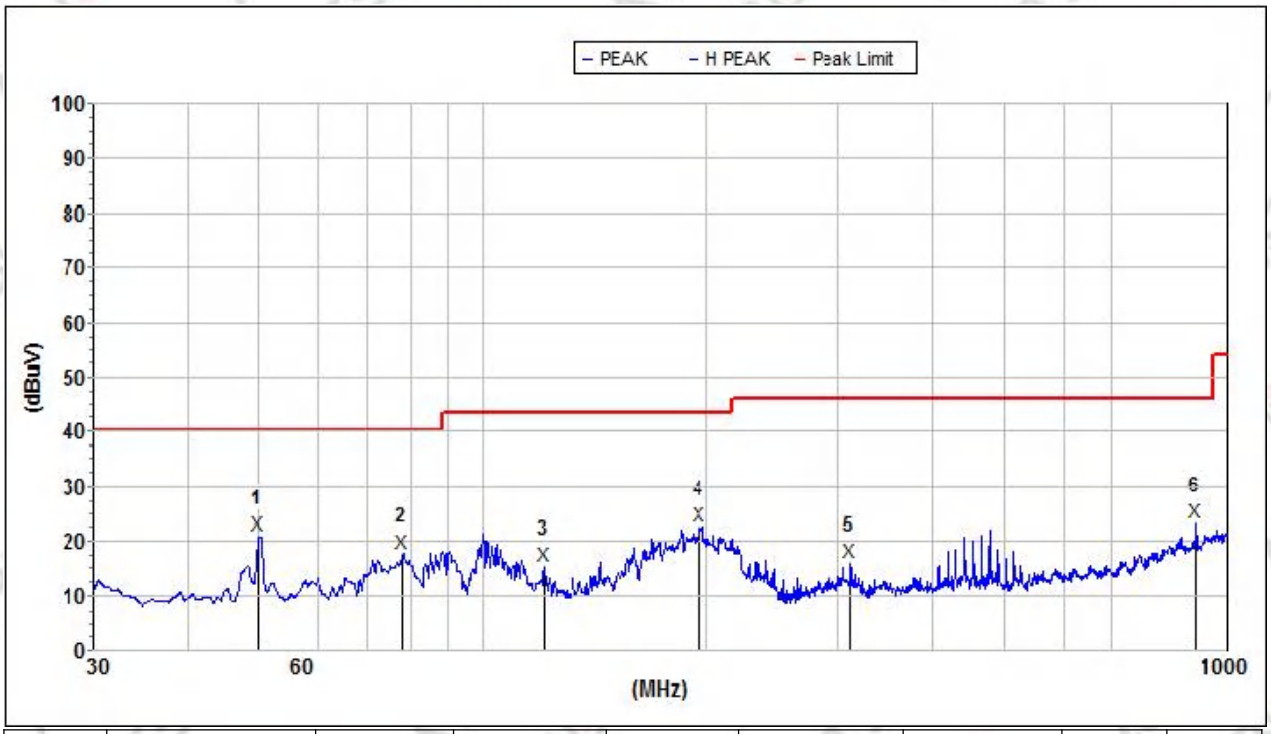
Limit line = specific limits (dBuv) + distance extrapolation factor.

(30MHz-1000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode		

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2402 Horizontal



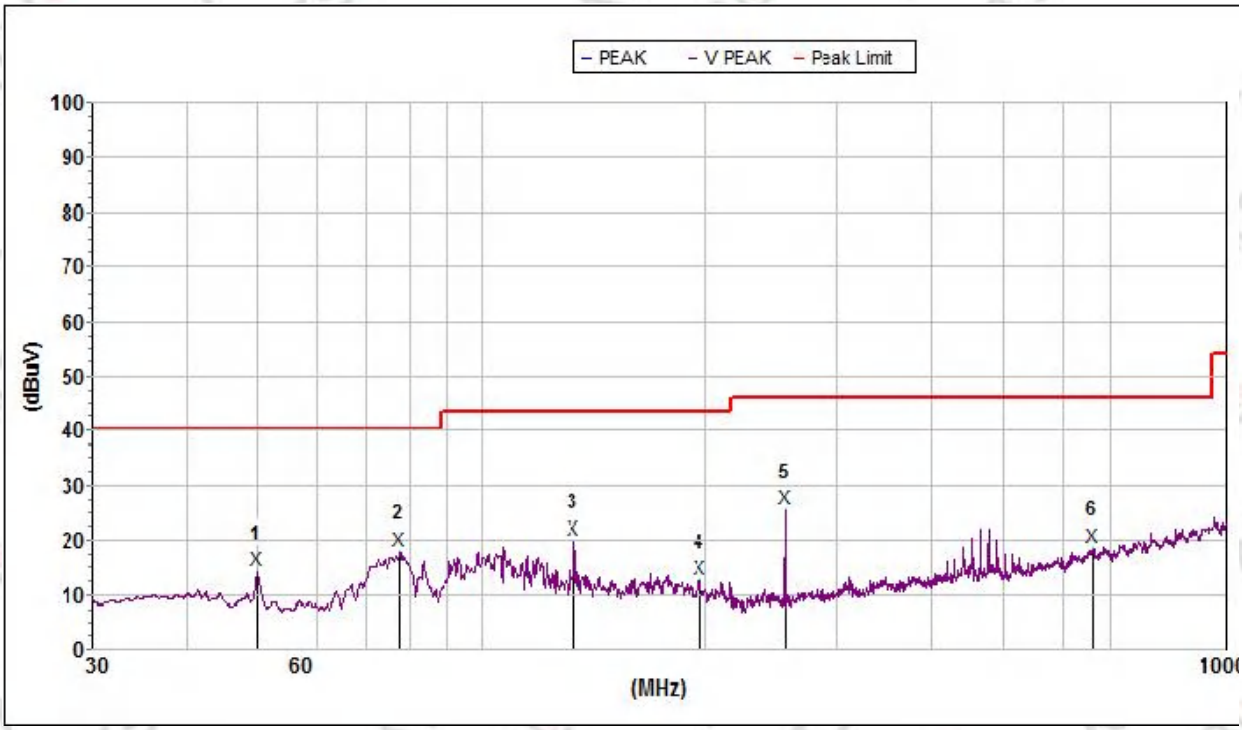
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	49.881404	20.9	40.0	19.1	13.5	32.6	0.8	H
2	78.001995	17.9	40.0	22.1	9.6	32.9	0.9	H
3	120.487690	15.3	43.5	28.2	12.3	32.9	1.4	H
4	195.821956	22.7	43.5	20.8	10.1	32.8	2.3	H
5	311.632553	16.0	46.0	30.0	12.9	32.7	2.7	H
6	904.894515	23.5	46.0	22.5	19.7	31.6	3.7	H

(30MHz-1000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode		

Remark:
3. Margin = Result (Result =Reading + Factor)–Limit
4. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2402 Vertical



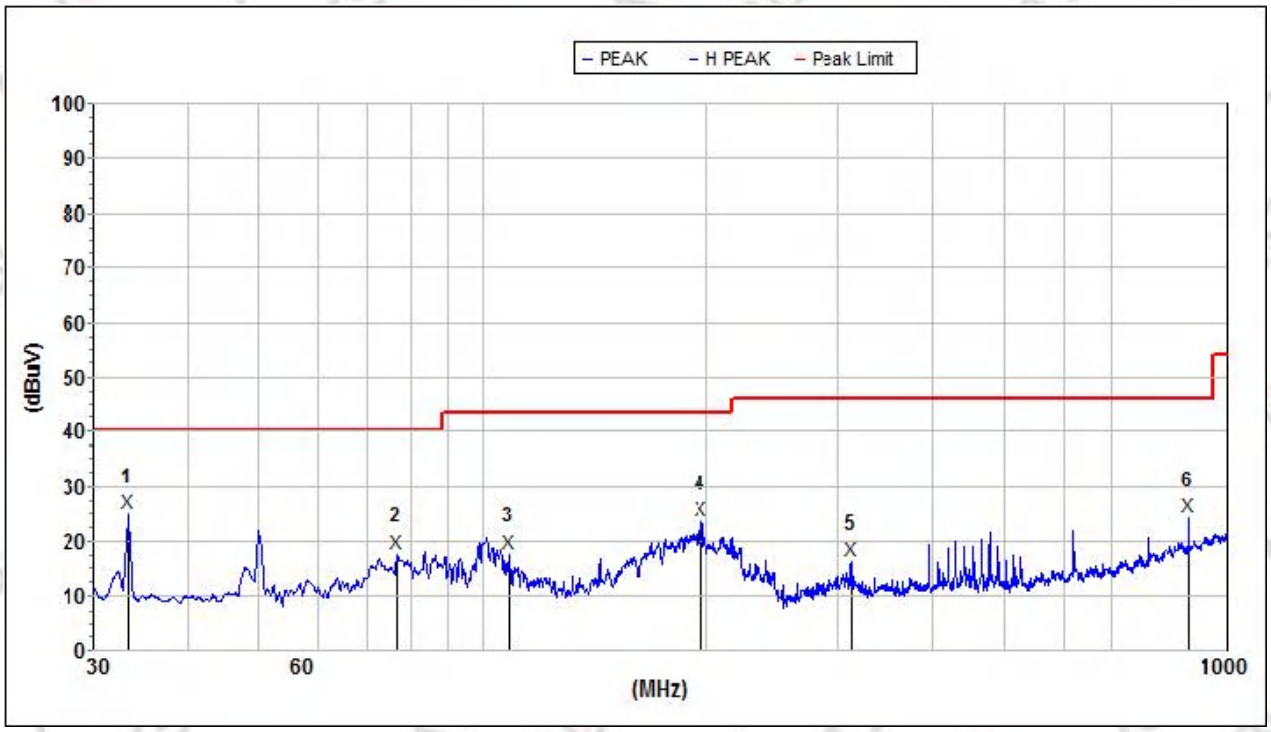
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	49.881404	14.5	40.0	25.5	13.5	32.6	0.8	V
2	77.456872	18.0	40.0	22.0	9.7	32.9	0.9	V
3	133.151089	20.1	43.5	23.4	13.0	32.9	1.4	V
4	196.165587	12.8	43.5	30.7	10.1	32.8	2.3	V
5	254.728354	25.8	46.0	20.2	11.7	32.8	2.6	V
6	663.472897	18.7	46.0	27.3	19.5	32.3	3.4	V

(30MHz-1000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode		

Remark:
5. Margin = Result (Result =Reading + Factor)–Limit
6. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2441 Horizontal



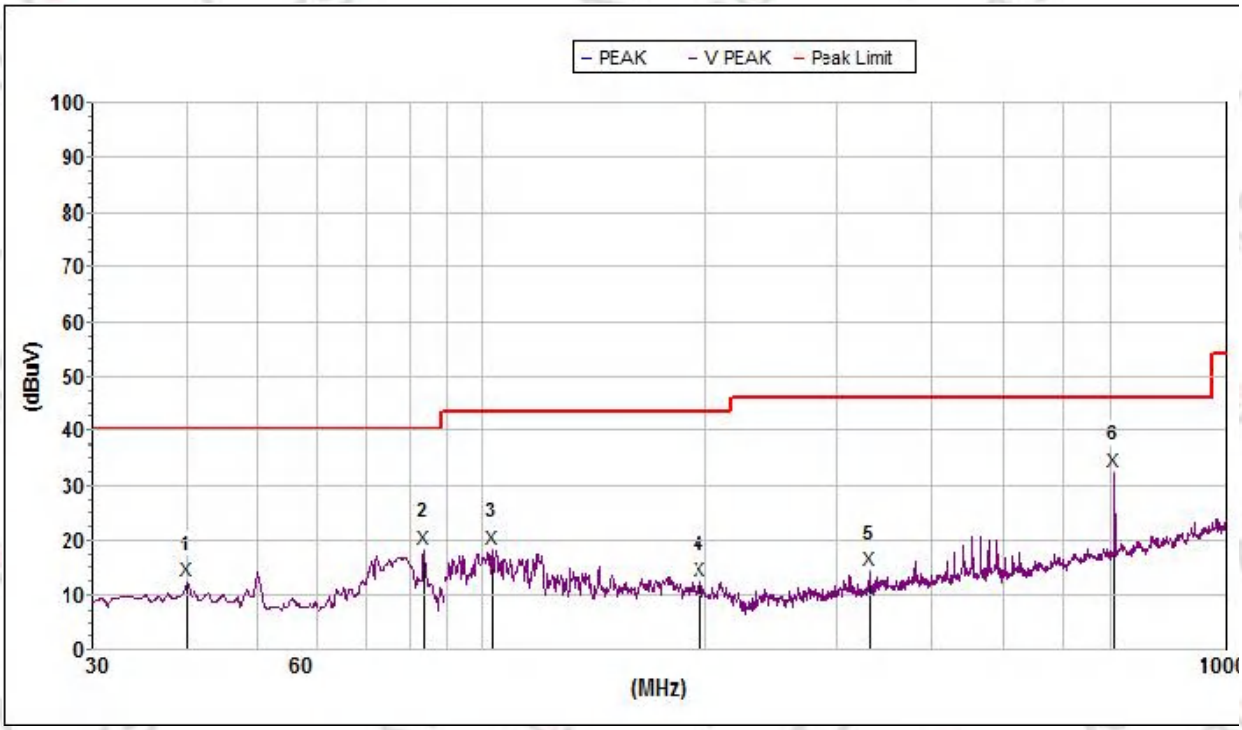
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	33.386359	25.0	40.0	15.0	13.3	32.2	0.8	H
2	76.512057	17.9	40.0	22.1	9.8	32.9	0.9	H
3	108.456682	17.7	43.5	25.8	11.0	32.9	1.4	H
4	196.165587	23.6	43.5	19.9	10.1	32.8	2.3	H
5	312.179411	16.5	46.0	29.5	13.0	32.7	2.7	H
6	884.502865	24.2	46.0	21.8	19.6	31.7	3.6	H

(30MHz-1000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode		

Remark:
7. Margin = Result (Result =Reading + Factor)–Limit
8. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2441 Vertical



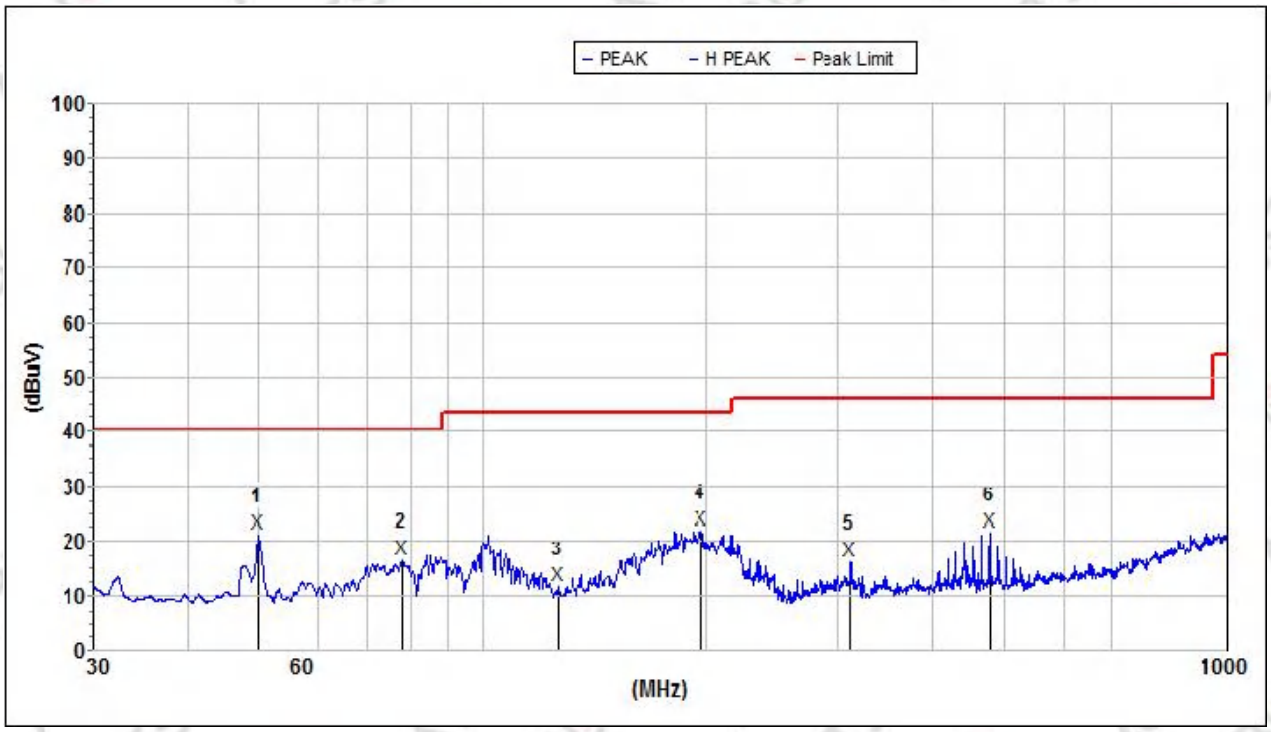
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	40.134716	12.4	40.0	27.6	14.1	32.4	0.8	V
2	83.229823	18.3	40.0	21.7	9.3	32.9	1.0	V
3	103.080039	18.3	43.5	25.2	10.5	32.9	1.4	V
4	196.165587	12.4	43.5	31.1	10.1	32.8	2.3	V
5	331.354746	14.4	46.0	31.6	13.4	32.6	2.7	V
6	707.939987	32.5	46.0	13.5	19.7	32.3	3.6	V

(30MHz-1000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode		

Remark:
9. Margin = Result (Result =Reading + Factor)–Limit
10. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2480 Horizontal



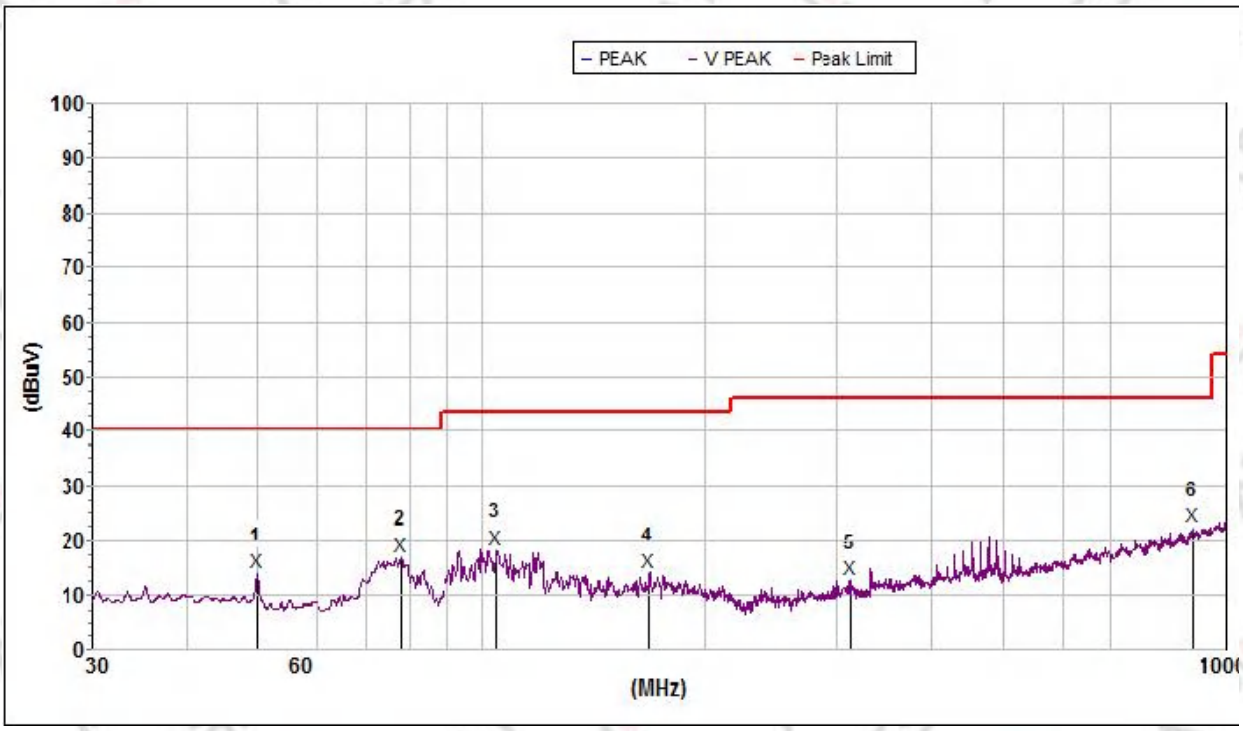
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	49.881404	21.3	40.0	18.7	13.5	32.6	0.8	H
2	78.001995	16.7	40.0	23.3	9.6	32.9	0.9	H
3	125.886356	11.9	43.5	31.6	12.6	32.9	1.4	H
4	196.165587	22.2	43.5	21.3	10.1	32.8	2.3	H
5	311.632553	16.3	46.0	29.7	12.9	32.7	2.7	H
6	479.685845	21.8	46.0	24.2	14.6	32.4	2.8	H

(30MHz-1000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode		

Remark:
11. Margin = Result (Result =Reading + Factor)–Limit
12. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2480 Vertical



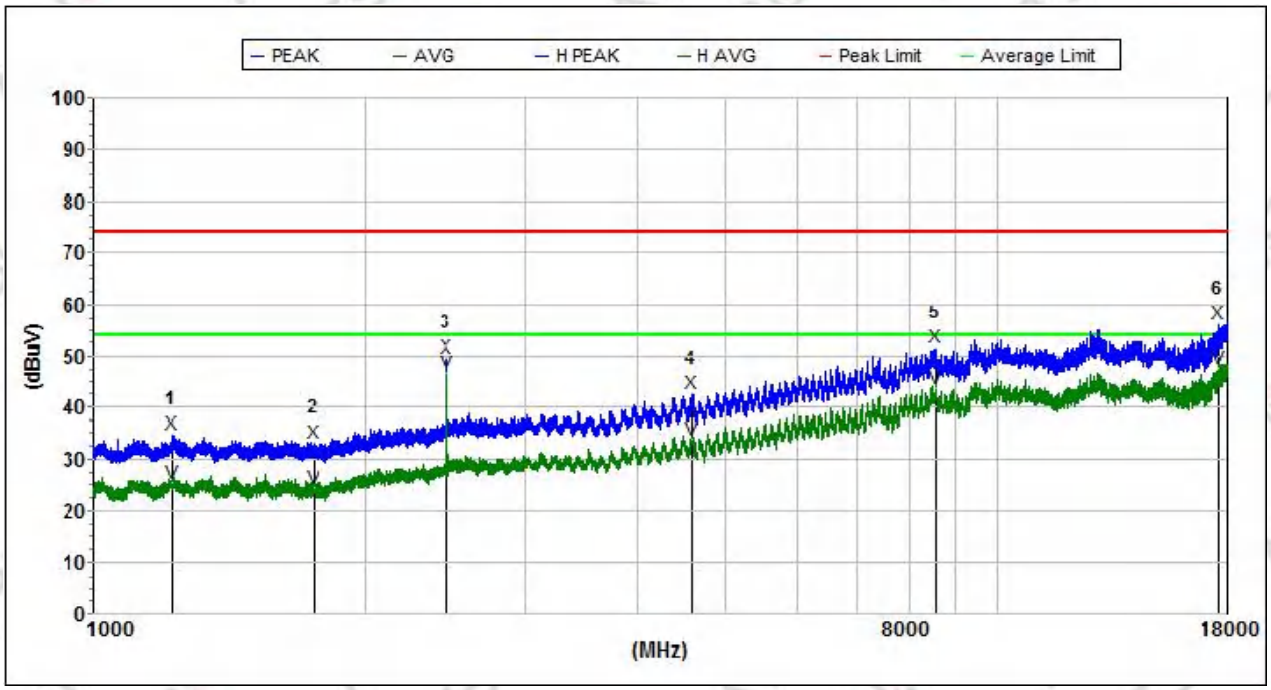
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	49.881404	14.1	40.0	25.9	13.5	32.6	0.8	V
2	78.001995	17.0	40.0	23.0	9.6	32.9	0.9	V
3	104.536051	18.3	43.5	25.2	10.6	32.9	1.4	V
4	167.530266	14.2	43.5	29.3	13.4	32.9	1.7	V
5	312.179411	12.8	46.0	33.2	13.1	32.7	2.7	V
6	896.996522	22.4	46.0	23.6	21.6	31.6	3.6	V

1000MHz-18000MHz

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode		

Remark:
13. Margin = Result (Result =Reading + Factor)–Limit
14. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2402 Horizontal



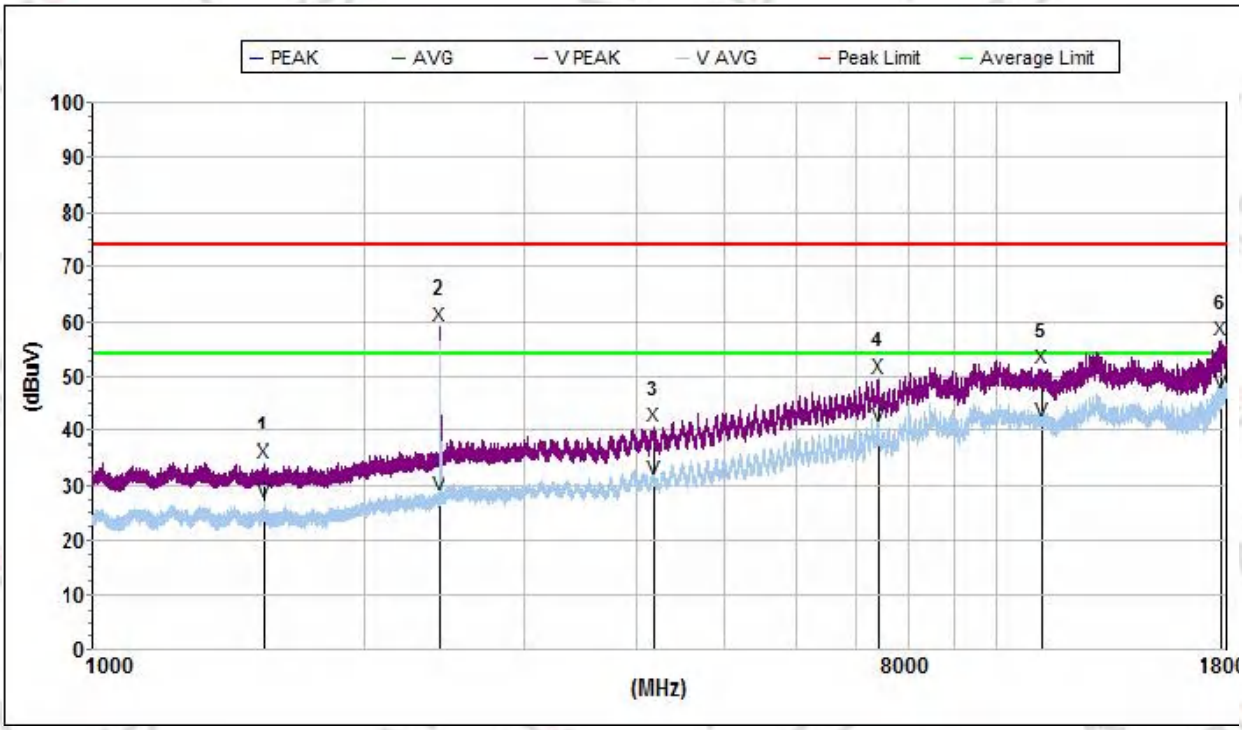
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak:								
1	1217.100000	35.0	74.0	39.0	25.7	60.9	2.3	H
2	1749.600000	33.1	74.0	40.9	25.1	61.3	2.6	H
3	2459.500000	49.8	74.0	24.2	27.6	59.1	2.8	H
4	4584.000000	42.7	74.0	31.3	31.6	57.9	3.6	H
5	8529.750000	51.7	74.0	22.3	37.7	56.1	5.1	H
6	17588.250000	56.3	74.0	17.7	39.8	58.0	6.9	H
Avg								
1	1217.100000	25.2	54.0	28.8	25.7	60.9	2.3	H
2	1749.600000	24.5	54.0	29.5	25.1	61.3	2.6	H
3	2459.500000	46.7	54.0	7.3	27.6	59.1	2.8	H
4	4584.000000	33.9	54.0	20.1	31.6	57.9	3.6	H
5	8529.750000	43.9	54.0	10.1	37.7	56.1	5.1	H
6	17588.250000	47.6	54.0	6.4	39.8	58.0	6.9	H

(1000MHz-18000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode		

Remark:
15. Margin = Result (Result =Reading + Factor)–Limit
16. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2402 Vertical



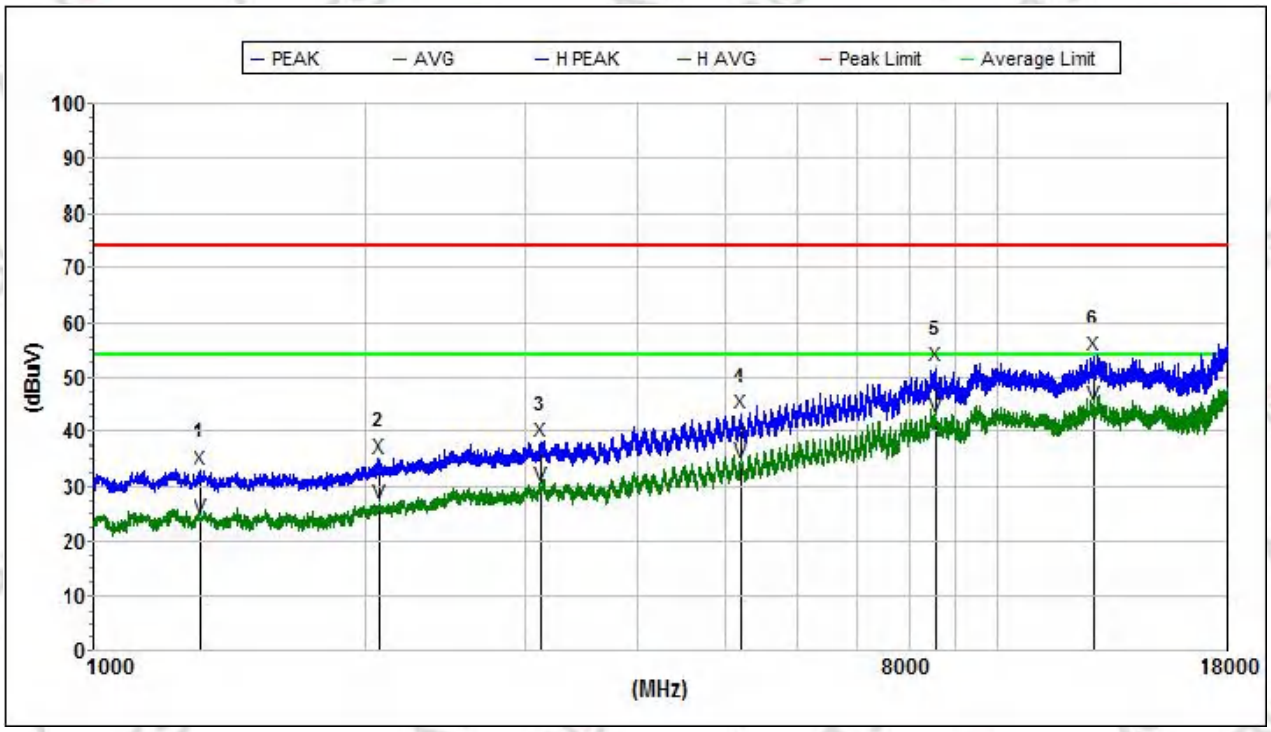
Mk.	Freq.(MHz)	Level (dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak:								
1	1549.900000	34.1	74.0	39.9	25.3	61.3	2.5	V
2	2416.200000	59.3	74.0	14.7	27.4	59.4	2.8	V
3	4175.250000	40.9	74.0	33.1	31.0	58.2	3.4	V
4	7399.500000	49.6	74.0	24.4	36.5	57.5	4.6	V
5	11229.750000	51.3	74.0	22.7	39.0	61.1	5.7	V
6	17799.000000	56.5	74.0	17.5	41.1	57.8	7.0	V
Avg								
1	1549.900000	26.9	54.0	27.1	25.3	61.3	2.5	V
2	2416.200000	28.2	54.0	25.8	27.4	59.4	2.8	V
3	4175.250000	31.4	54.0	22.6	31.0	58.2	3.4	V
4	7399.500000	40.7	54.0	13.3	36.5	57.5	4.6	V
5	11229.750000	41.9	54.0	12.1	39.0	61.1	5.7	V
6	17799.000000	47.0	54.0	7.0	41.1	57.8	7.0	V

(1000MHz-18000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode		

Remark:
17. Margin = Result (Result =Reading + Factor)–Limit
18. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2441 Horizontal



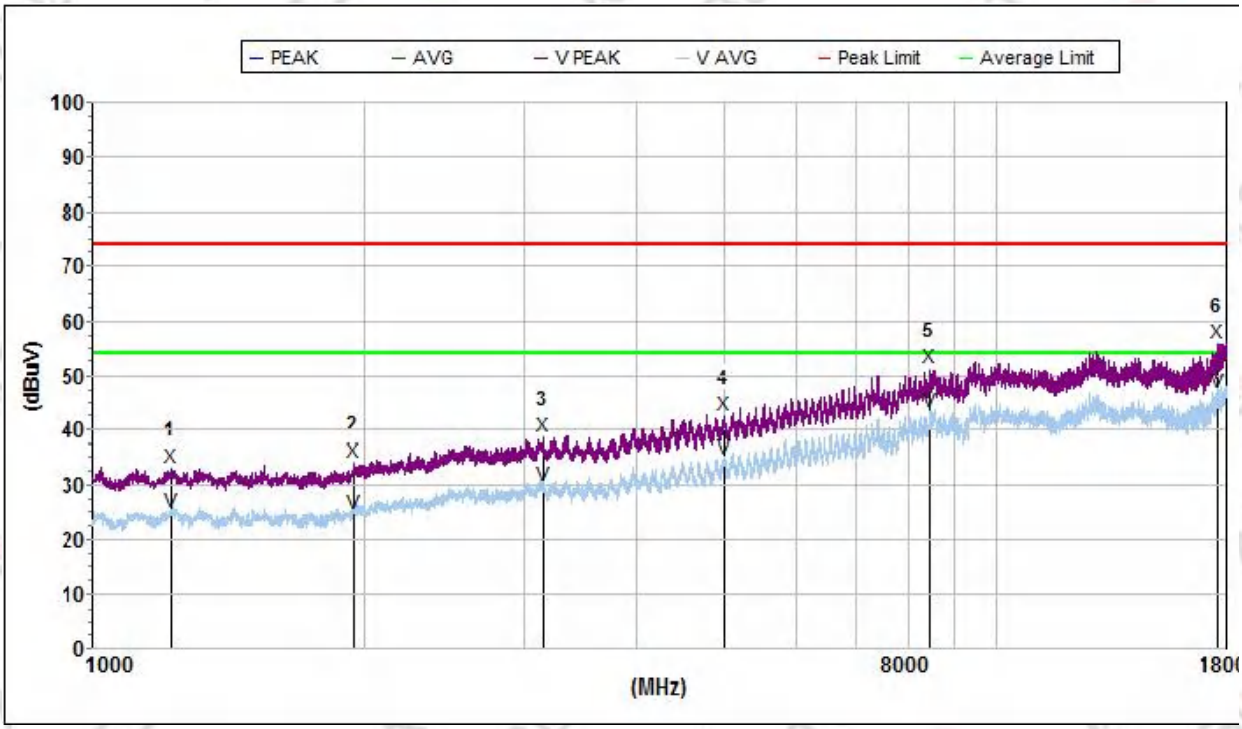
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak:								
1	1312.800000	33.1	74.0	40.9	25.8	61.1	2.3	H
2	2068.450000	35.2	74.0	38.8	26.9	60.9	2.7	H
3	3121.600000	38.1	74.0	35.9	29.7	58.7	3.0	H
4	5203.250000	43.5	74.0	30.5	32.9	57.6	3.8	H
5	8531.000000	52.0	74.0	22.0	37.7	56.1	5.1	H
6	12807.350000	54.0	74.0	20.0	39.5	57.9	6.1	H
Avg								
1	1312.800000	24.4	54.0	29.6	25.8	61.1	2.3	H
2	2068.450000	27.0	54.0	27.0	26.9	60.9	2.7	H
3	3121.600000	30.1	54.0	23.9	29.7	58.7	3.0	H
4	5203.250000	34.5	54.0	19.5	32.9	57.6	3.8	H
5	8531.000000	42.9	54.0	11.1	37.7	56.1	5.1	H
6	12807.350000	45.1	54.0	8.9	39.5	57.9	6.1	H

(1000MHz-18000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode		

Remark:
19. Margin = Result (Result =Reading + Factor)–Limit
20. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2441 Vertical



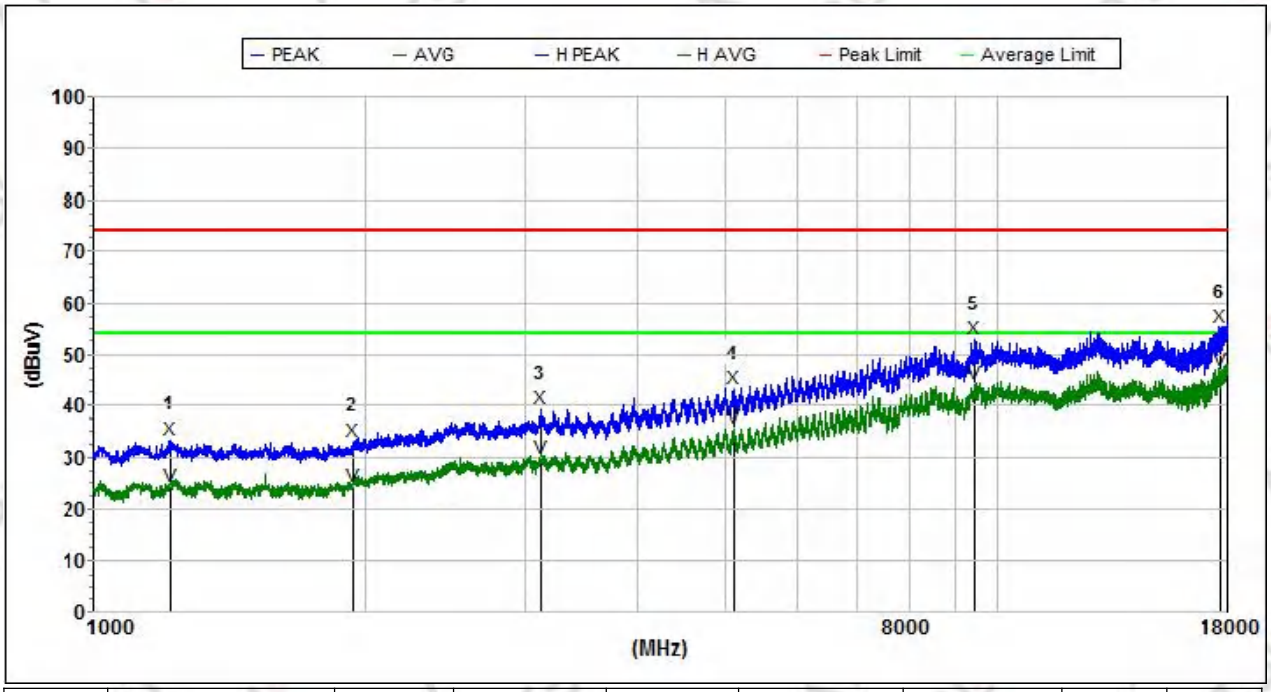
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1221.850000	33.2	74.0	40.8	25.7	60.9	2.3	V
2	1945.200000	34.2	74.0	39.8	26.0	60.9	2.6	V
3	3150.500000	38.7	74.0	35.3	29.7	58.6	3.0	V
4	5002.650000	42.6	74.0	31.4	33.0	57.4	3.6	V
5	8438.350000	51.3	74.0	22.7	37.5	56.3	5.1	V
6	17575.000000	56.0	74.0	18.0	39.7	58.1	6.9	V
Avg								
1	1221.850000	24.9	54.0	29.1	25.7	60.9	2.3	V
2	1945.200000	24.6	54.0	29.4	26.0	60.9	2.6	V
3	3150.500000	29.8	54.0	24.2	29.7	58.6	3.0	V
4	5002.650000	34.8	54.0	19.2	33.0	57.4	3.6	V
5	8438.350000	43.4	54.0	10.6	37.5	56.3	5.1	V
6	17575.000000	47.1	54.0	6.9	39.7	58.1	6.9	V

(1000MHz-18000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	TX Mode		

Remark:
21. Margin = Result (Result =Reading + Factor)–Limit
22. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2480 Horizontal



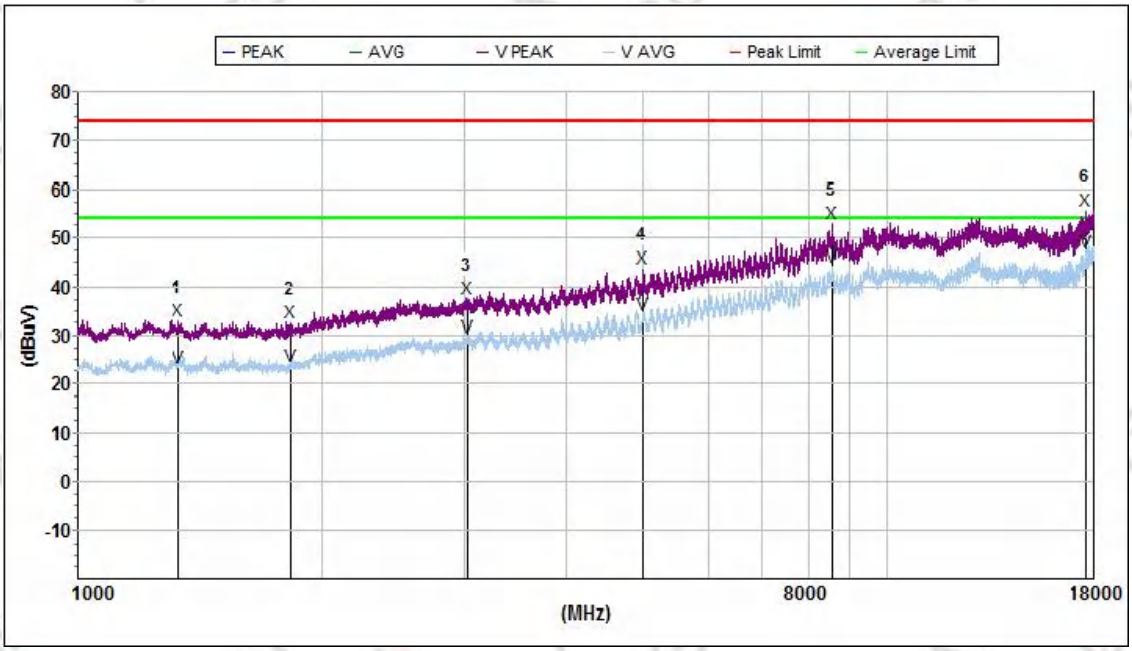
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak:								
1	1211.650000	33.6	74.0	40.4	25.7	60.9	2.3	H
2	1940.950000	33.2	74.0	40.8	26.0	60.9	2.6	H
3	3123.300000	39.5	74.0	34.5	29.7	58.7	3.0	H
4	5108.900000	43.5	74.0	30.5	33.1	57.5	3.7	H
5	9458.350000	52.9	74.0	21.1	38.6	59.6	5.4	H
6	17681.250000	55.2	74.0	18.8	40.4	57.9	6.9	H
Avg								
1	1211.650000	24.3	54.0	29.7	25.7	60.9	2.3	H
2	1940.950000	24.5	54.0	29.5	26.0	60.9	2.6	H
3	3123.300000	29.9	54.0	24.1	29.7	58.7	3.0	H
4	5108.900000	35.9	54.0	18.1	33.1	57.5	3.7	H
5	9458.350000	44.3	54.0	9.7	38.6	59.6	5.4	H
6	17681.250000	47.0	54.0	7.0	40.4	57.9	6.9	H

(1000MHz-18000MHz)

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	TX Mode		

Remark:
23. Margin = Result (Result =Reading + Factor)–Limit
24. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

DH5 2480 Vertical



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1332.350000	32.9	74.0	41.1	25.8	61.2	2.3	V
2	1836.400000	32.6	74.0	41.4	25.3	61.2	2.6	V
3	3024.700000	37.7	74.0	36.3	29.5	58.8	3.0	V
4	4994.150000	43.7	74.0	30.3	32.9	57.4	3.6	V
5	8532.700000	53.1	74.0	20.9	37.7	56.1	5.1	V
6	17585.200000	55.5	74.0	18.5	39.8	58.1	6.9	V
Avg								
1	1332.350000	23.5	54.0	30.5	25.8	61.2	2.3	V
2	1836.400000	23.8	54.0	30.2	25.3	61.2	2.6	V
3	3024.700000	29.7	54.0	24.3	29.5	58.8	3.0	V
4	4994.150000	34.4	54.0	19.6	32.9	57.4	3.6	V
5	8532.700000	44.0	54.0	10.0	37.7	56.1	5.1	V
6	17585.200000	47.2	54.0	6.8	39.8	58.1	6.9	V

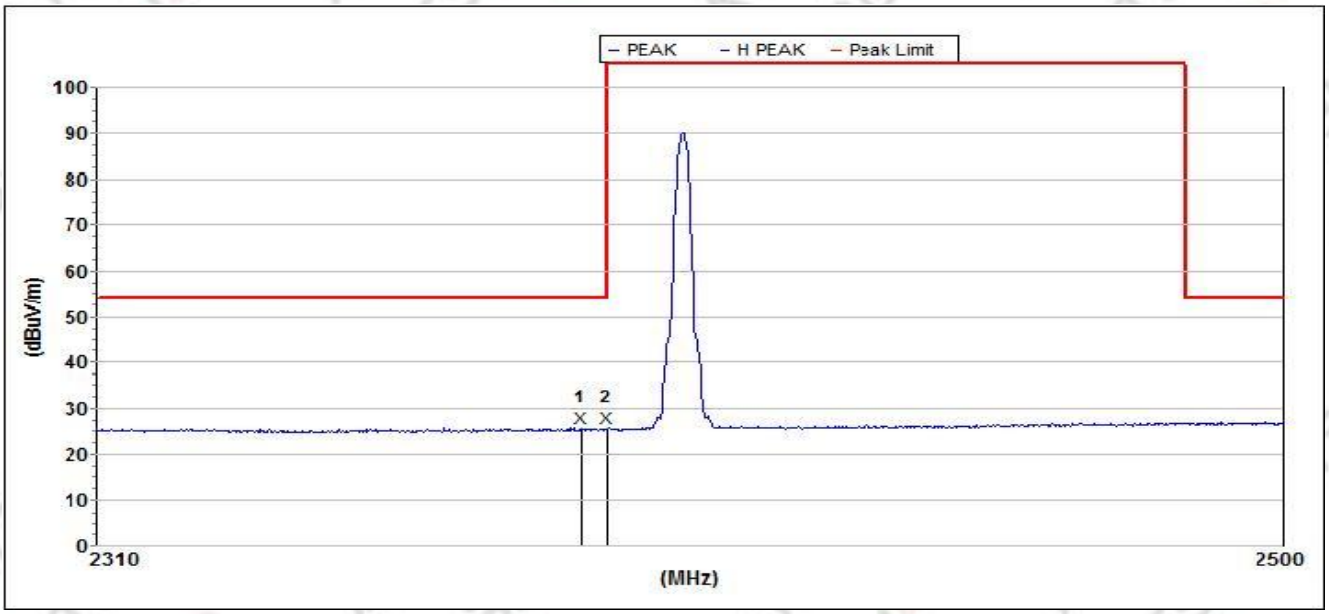
Note: 1.All TX Mode, the worst case is mode1,2&3, only show the worst case.

2.Other 18G-25G Emission detected are more than 20dB below the limit.

3.2.6 TEST RESULTS (BAND EDGE REQUIREMENTS)

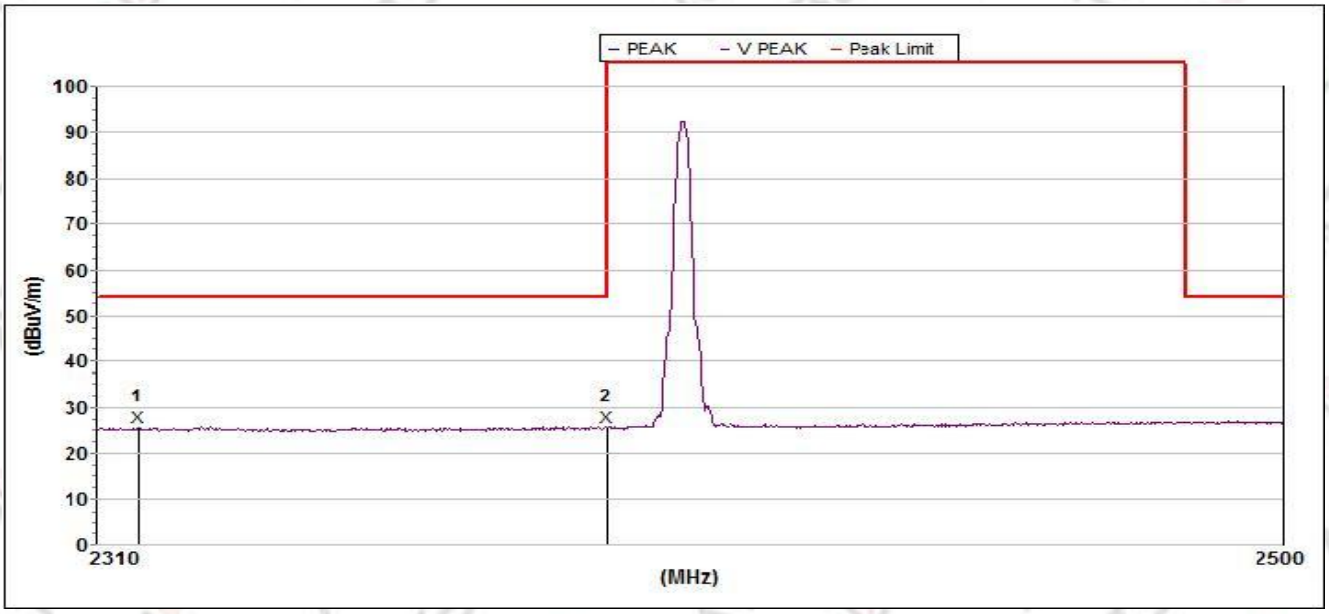
DH5-Low

Horizontal



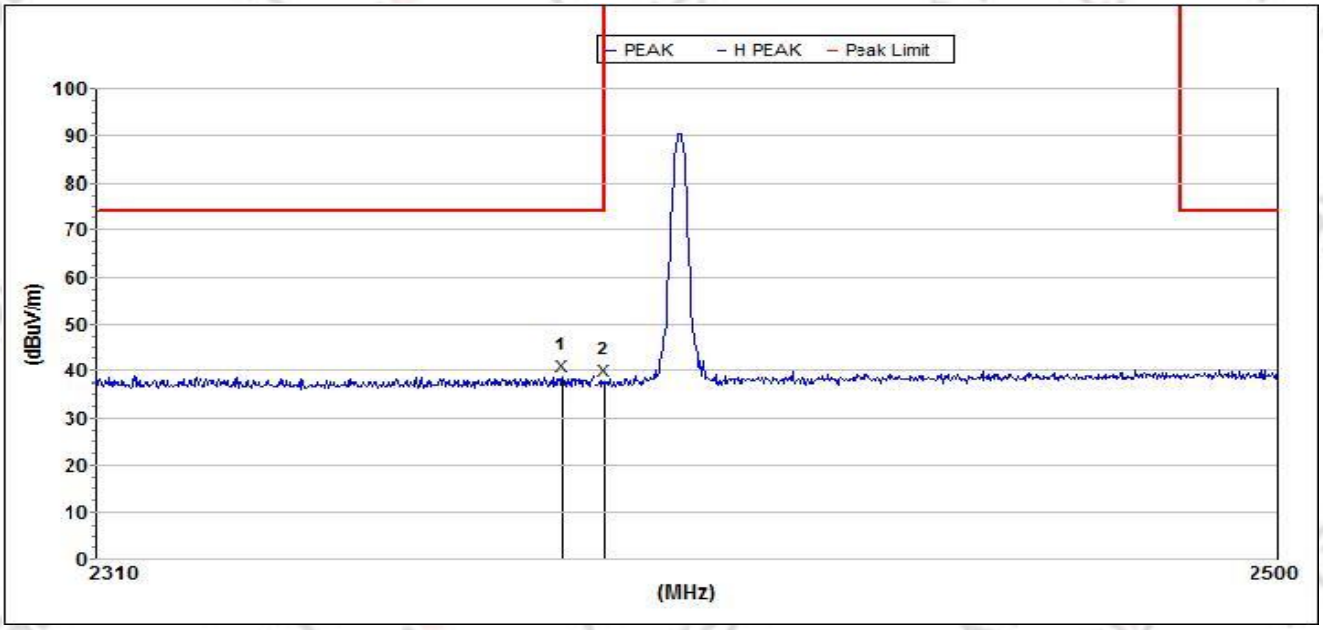
Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
AVG								
1	2385.522338	25.8	54.0	28.2	27.3	59.6	2.8	H
2	2390.000000	25.6	54.0	28.4	27.3	59.6	2.8	H

Vertical



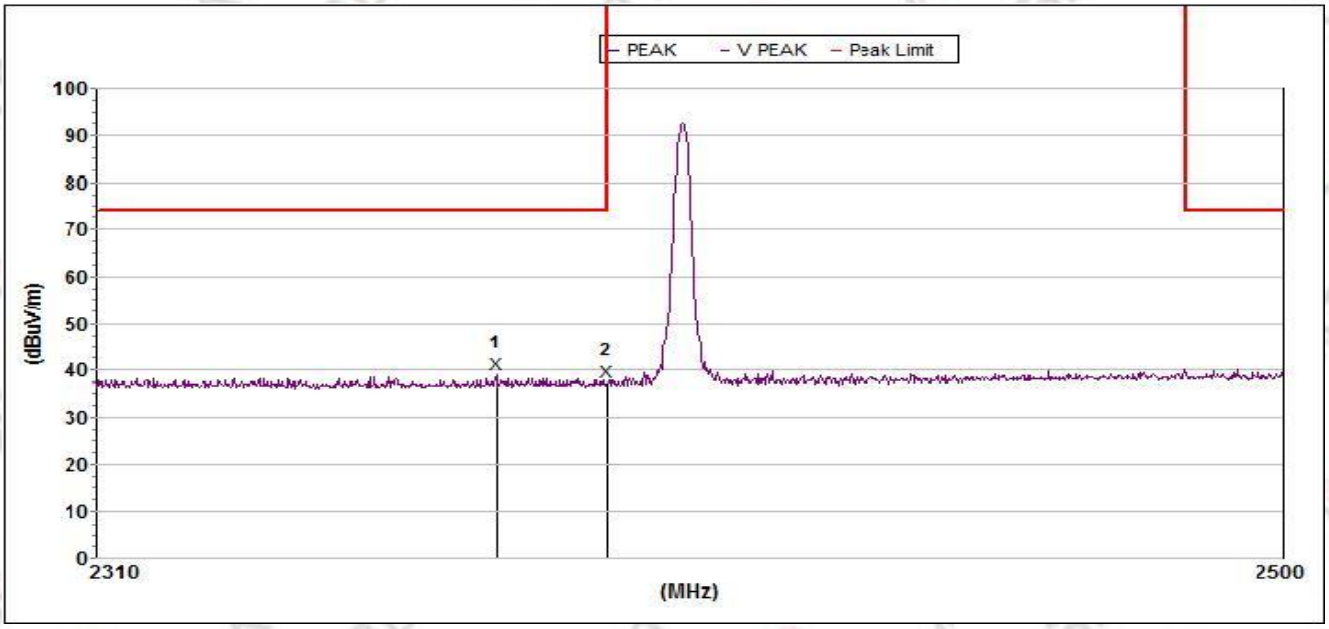
Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
AVG								
1	2316.399491	25.6	54.0	28.4	27.2	59.9	2.8	V
2	2390.000000	25.6	54.0	28.4	27.3	59.6	2.8	V

Horizontal



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak								
1	2383.072325	38.8	74.0	35.2	27.3	59.6	2.8	H
2	2390.000000	37.9	74.0	36.1	27.3	59.6	2.8	H

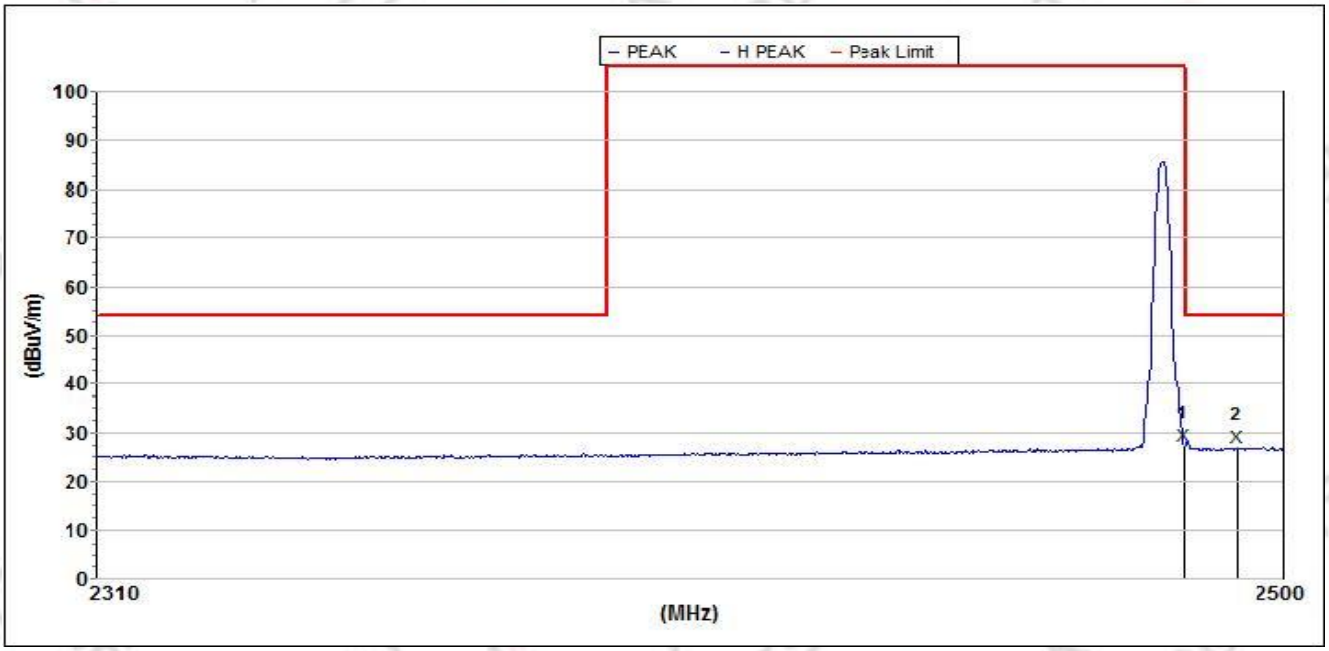
Vertical



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak								
1	2372.359633	39.0	74.0	35.0	27.3	59.6	2.8	V
2	2390.000000	37.5	74.0	36.5	27.3	59.6	2.8	V

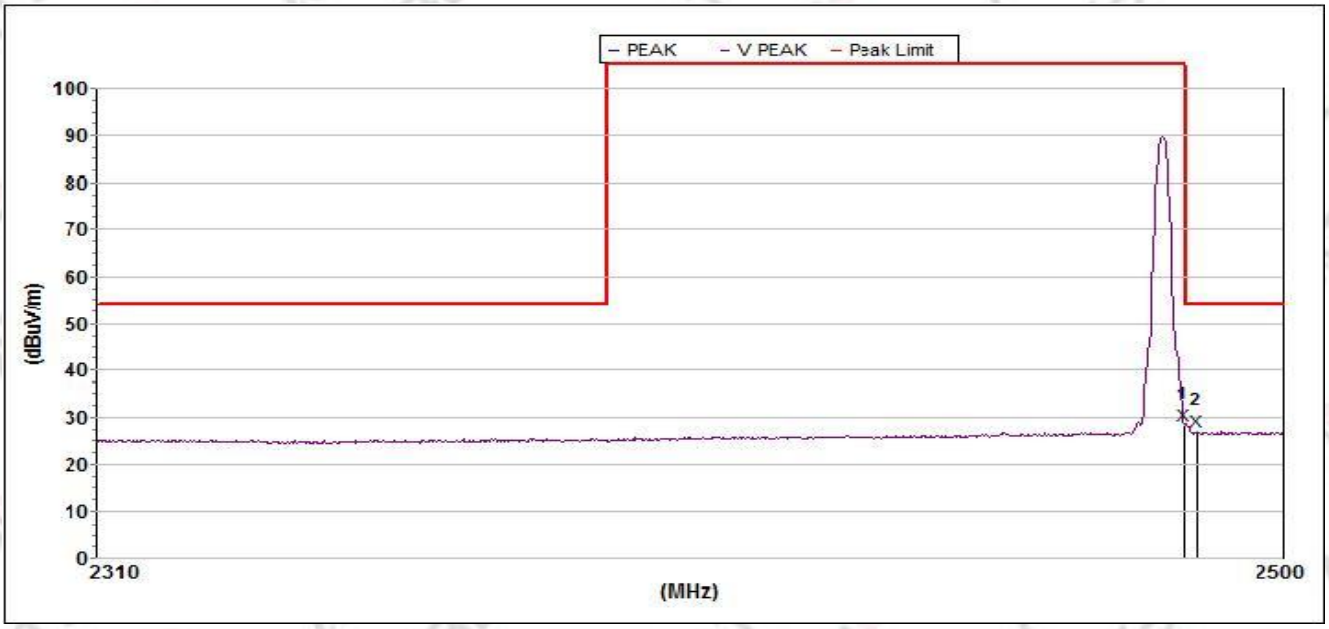
DH5-High

Horizontal



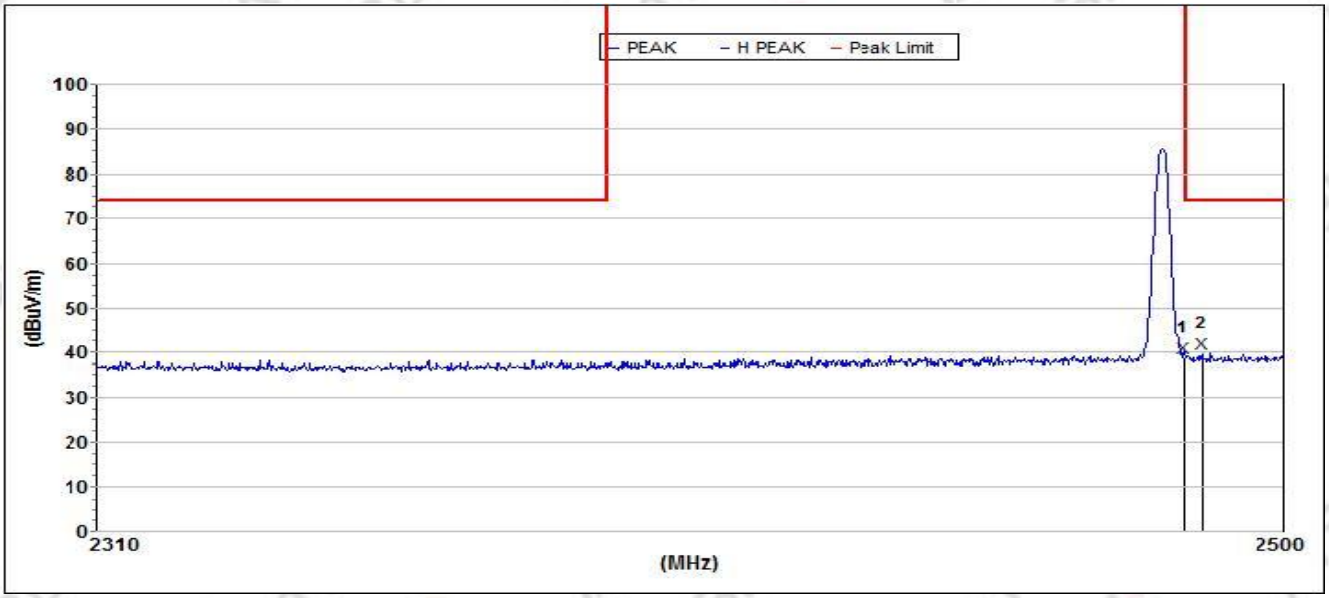
Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
AVG								
1	2483.501000	27.2	54.0	26.8	27.7	58.9	2.8	H
2	2492.305154	26.9	54.0	27.1	27.7	58.8	2.8	H

Vertical



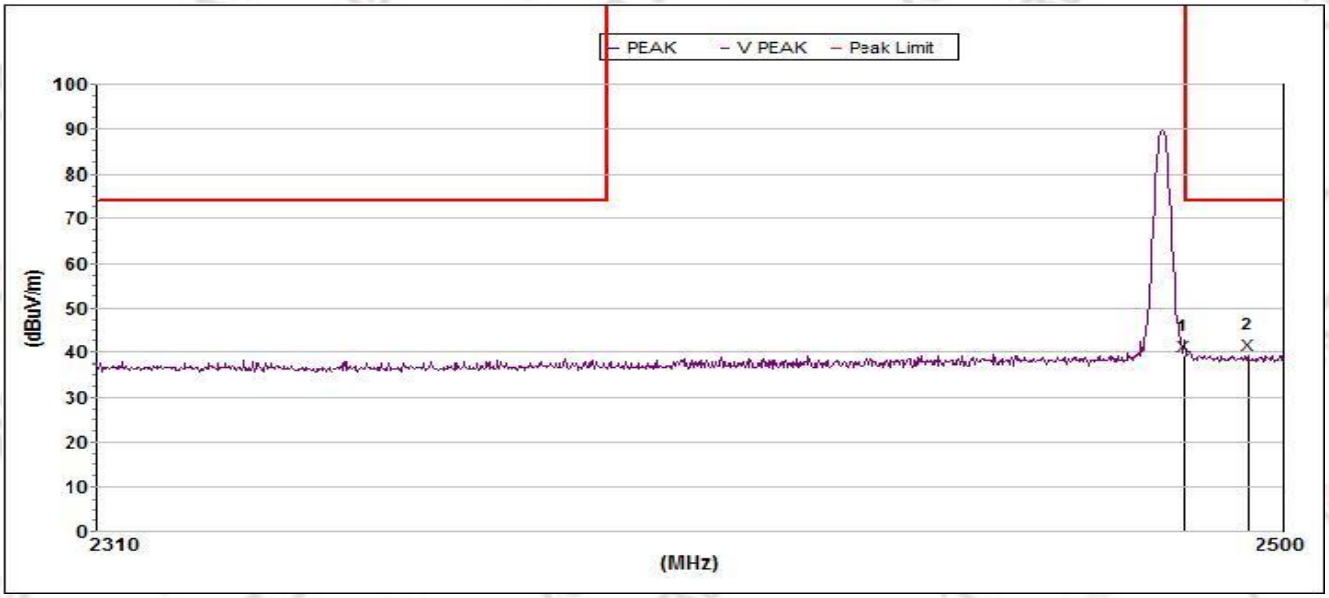
Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
AVG								
1	2483.501000	28.4	54.0	25.6	27.7	58.9	2.8	V
2	2485.616153	27.0	54.0	27.0	27.7	58.9	2.8	V

Horizontal



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Peak								
1	2483.501000	38.9	74.0	35.1	27.7	58.9	2.8	H
2	2486.402162	39.9	74.0	34.1	27.7	58.9	2.8	H

Vertical



Mk.	Frequency	Level	Limit	Margin	Ant.F/G.	Amp.G.	Cbl.L.	Pol.
	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(dB)	(dB)	
Peak								
1	2483.501000	39.2	74.0	34.8	27.7	58.9	2.8	V
2	2493.881651	39.5	74.0	34.5	27.7	58.8	2.8	V

Note: 1.All mode all have been tested, the worst case is DH5, only show the worst case.

2.Other 18G-25G Emission detected are more than 20dB below the limit.

4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

4.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 kHz/300 kHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2395– 2405 MHz Upper Band Edge: 2477.5 – 2489.5 MHz
RB / VB (emission in restricted band)	100 kHz/300 kHz
Trace-Mode:	Max hold

For Hopping Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2395– 2405 MHz Upper Band Edge: 2477.5 – 2489.5 MHz
RB / VB (emission in restricted band)	100 kHz/300 kHz
Trace-Mode:	Max hold

4.3 TEST SETUP

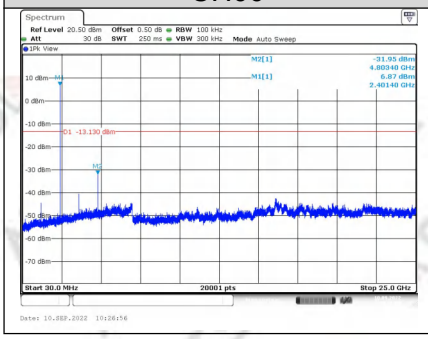
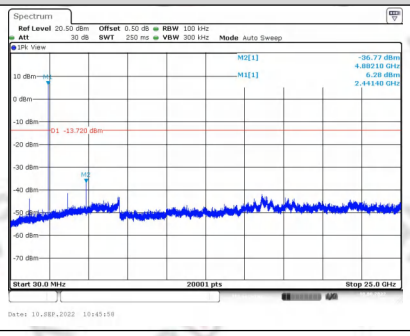
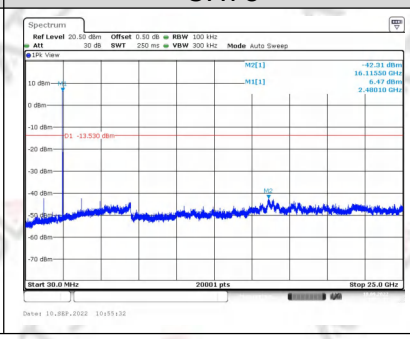
The EUT is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. Tune the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, the span is set to be greater than RBW.

4.4 EUT OPERATION CONDITIONS

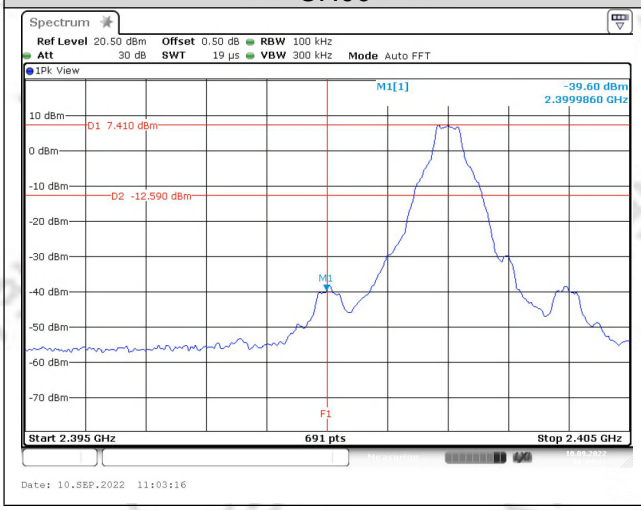
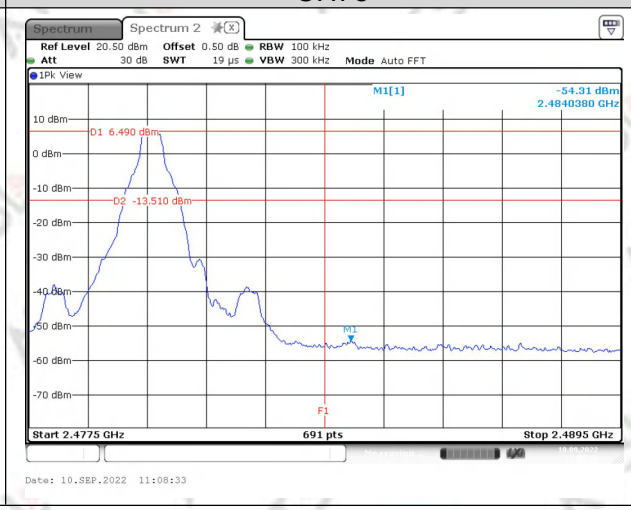
Please refer to section 3.1.4 of this report.

4.5 TEST RESULTS

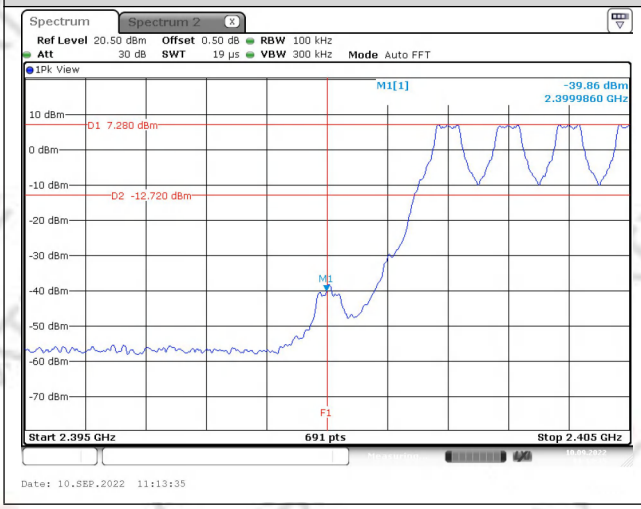
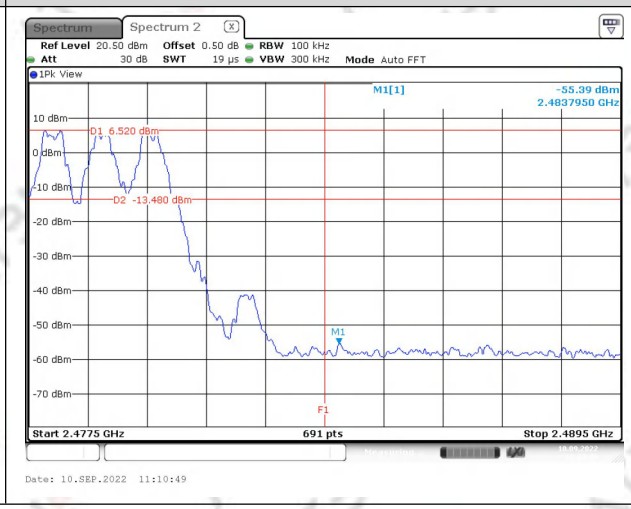
Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	GFSK(1Mbps)-00/39/78 CH	Test Voltage:	DC 5V

CH00	CH39	CH78
		

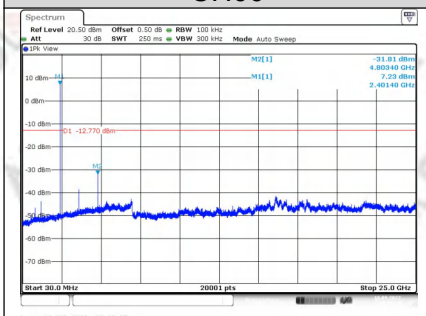
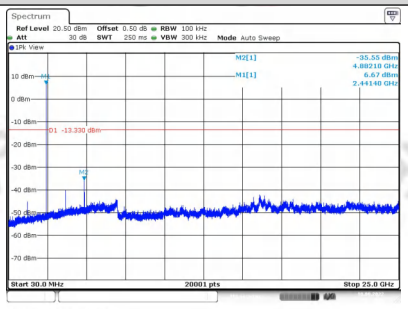
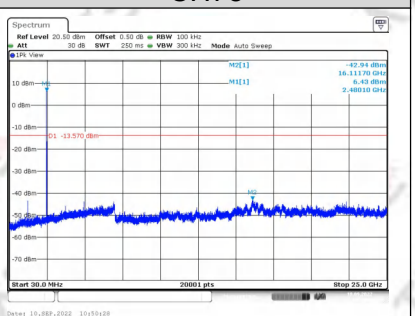
For Band edge(it's also the reference level for conducted spurious emission)

CH00	CH78
	

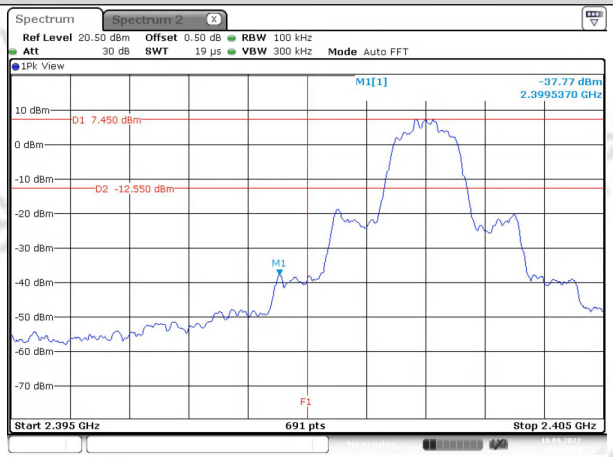
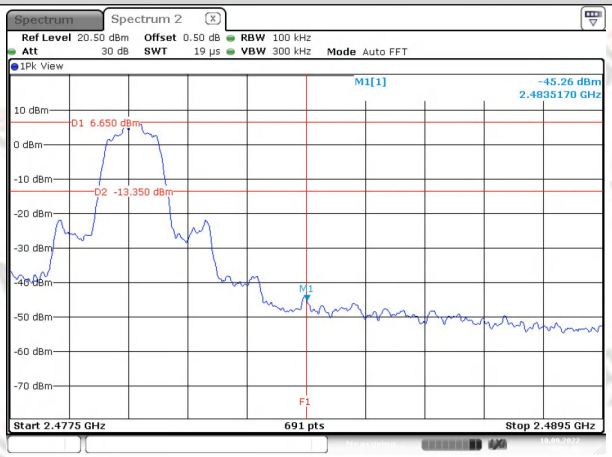
For Hopping Band edge

GFSK CH00	GFSK CH78
	

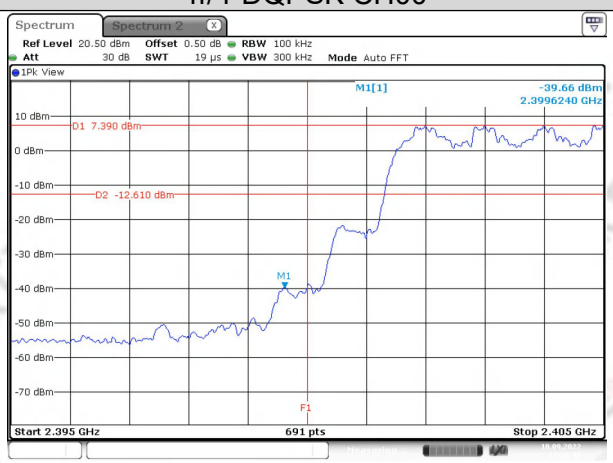
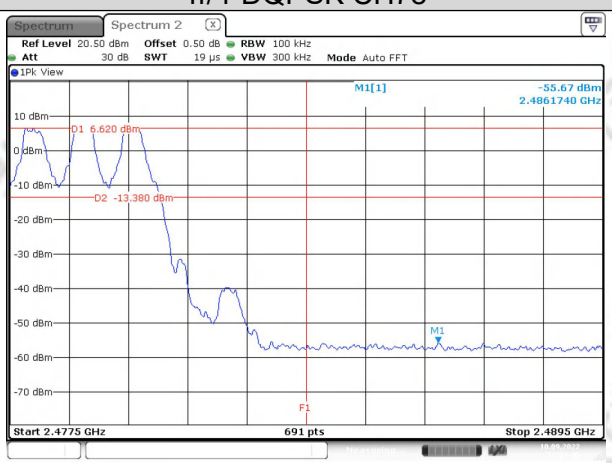
Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	π/4-DQPSK(2Mbps)–00/39/78 CH	Test Voltage:	DC 5V

CH00	CH39	CH78
		

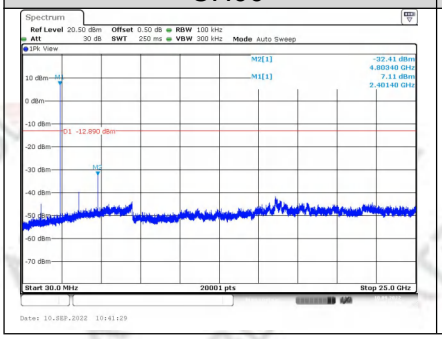
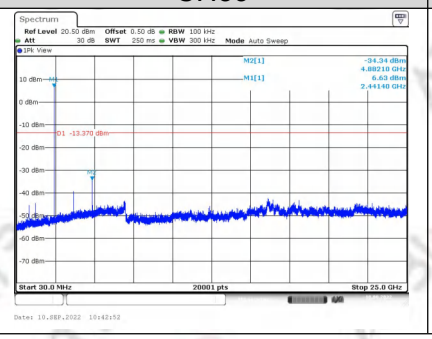
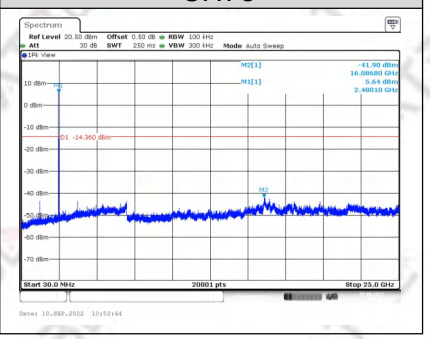
For Band edge(it's also the reference level for conducted spurious emission)

CH00	CH78
	

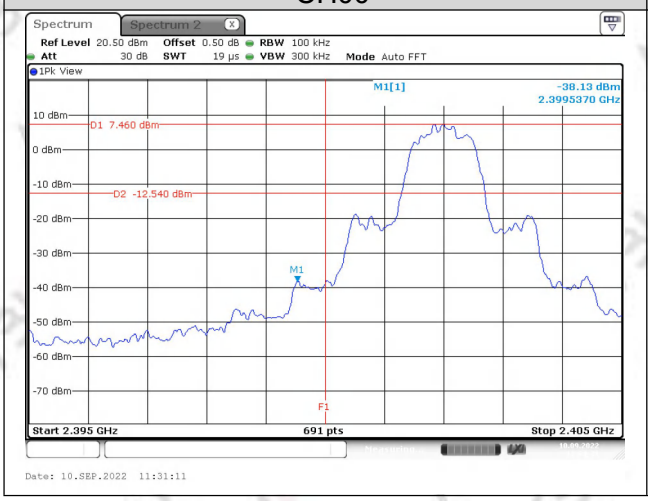
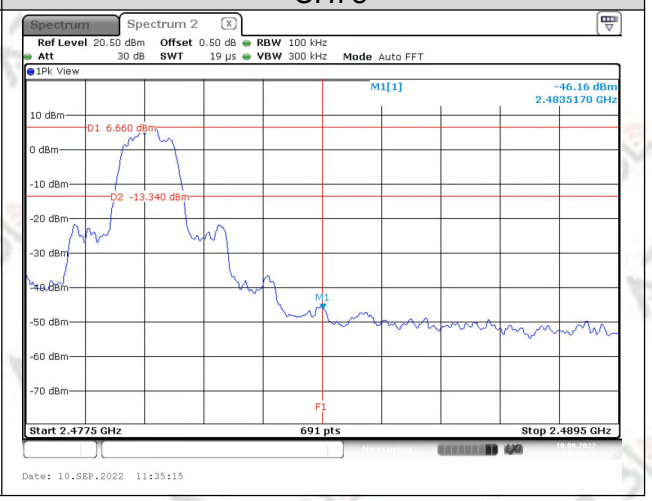
For Hopping Band edge

π/4-DQPSK CH00	π/4-DQPSK CH78
	

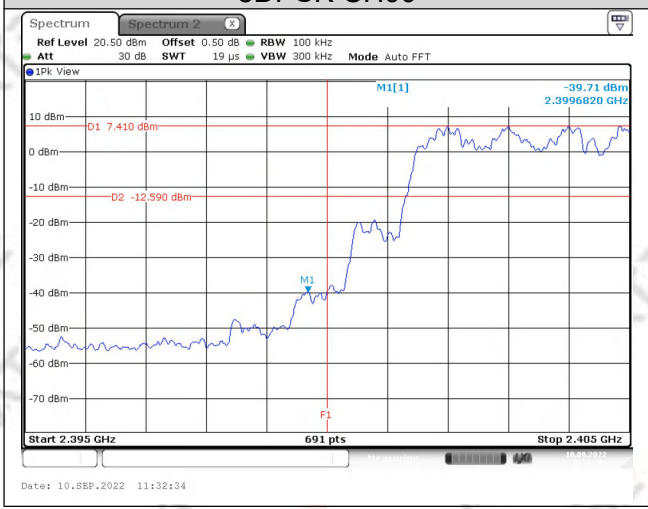
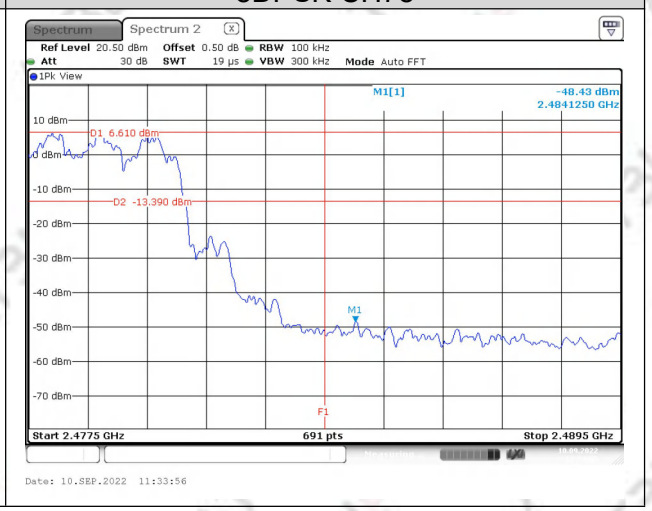
Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	8DPSK(3Mbps) -00/39/78 CH	Test Voltage:	DC 5V

CH00	CH39	CH78
		

For Band edge(it's also the reference level for conducted spurious emission)

CH00	CH78
	

For Hopping Band edge

8DPSK CH00	8DPSK CH78
	

5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(1)(iii)	Number of Hopping Channel	≥15	2400-2483.5	PASS

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating Frequency Range
RB	300kHz
VB	300kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 300kHz, VBW=300kHz, Sweep time = Auto.

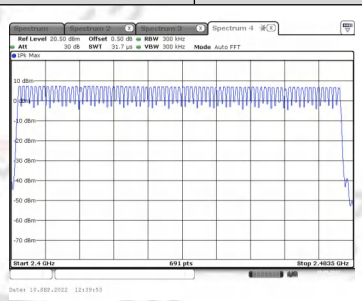
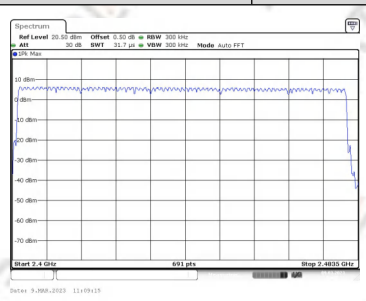
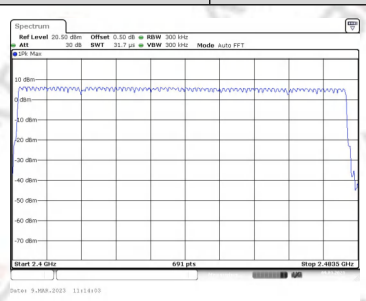
5.3 TEST SETUP

5.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

5.5 TEST RESULTS

Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	Hopping Mode 1M/2M/3M	Test Voltage:	DC 5V

Number of Hopping Channel		Number of Hopping Channel		Number of Hopping Channel	
GFSK(1Mbps)	79	π/4-DQPSK(2Mbps)	79	8DPSK(3Mbps)	79
					

6. AVERAGE TIME OF OCCUPANCY

6.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(1)(iii)	Average Time of Occupancy	0.4sec	2400-2483.5	PASS

6.2 TEST PROCEDURE

a. The transmitter output (antenna port) was connected to the spectrum analyzer.
b. Set RBW =1MHz/VBW =3MHz.
c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
d. Sweep Time is more than once pulse time.
e. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
f. Measure the maximum time duration of one single pulse.
g. Set the EUT for DH5, DH3 and DH1 packet transmitting.
h. Measure the maximum time duration of one single pulse.
i. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.
j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.
k. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.

6.3 TEST SETUP

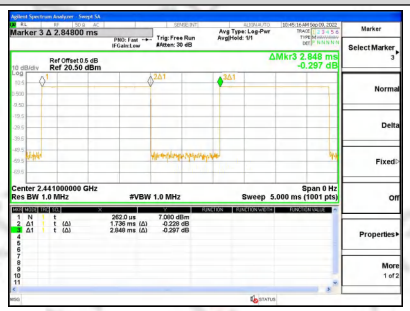
6.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

6.5 TEST RESULTS

Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	GFSK(1Mbps)-DH1/DH3/DH5	Test Voltage:	DC 5V

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	2441	0.471	0.151	0.4
DH3	2441	1.736	0.278	0.4
DH5	2441	2.976	0.315	0.4

DH1 CH39	DH3 CH39	DH5 CH39
		

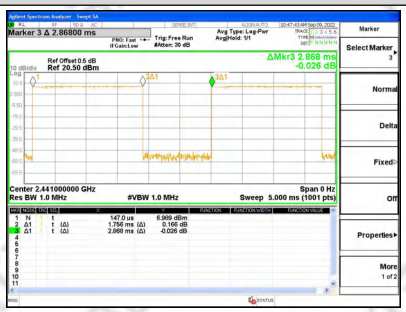
Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	π/4-DQPSK(2Mbps)–2DH1/2DH3/2DH5	Test Voltage:	DC 5V

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	2441	0.486	0.156	0.4
2DH3	2441	1.756	0.281	0.4
2DH5	2441	2.996	0.318	0.4

2DH1 CH39	2DH3 CH39	2DH5 CH39
		

Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	8DPSK(3Mbps)–3DH1/3DH3/3DH5	Test Voltage:	DC 5V

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	2441	0.483	0.155	0.4
3DH3	2441	1.756	0.281	0.4
3DH5	2441	2.996	0.318	0.4

3DH1 CH39	3DH3 CH39	3DH5 CH39
		

7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

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.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> 20 dB Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

7.2 TEST PROCEDURE

a. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
b. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for 20 dB bandwidth measurement.
c. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for channel separation measurement.

7.3 TEST SETUP

7.4 EUT OPERATION CONDITIONS

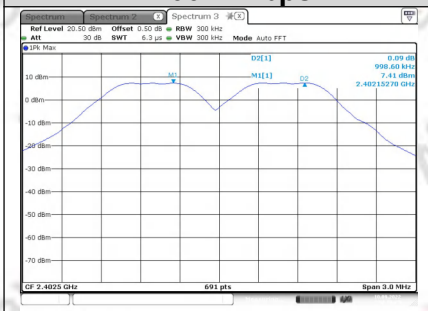
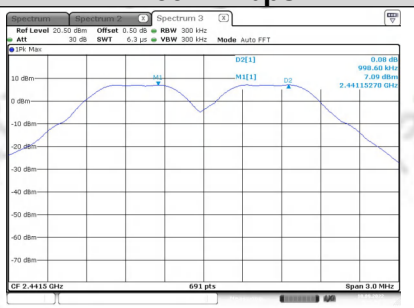
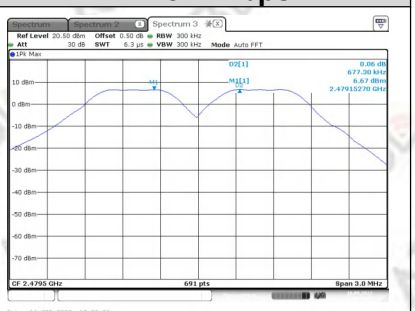
The EUT was programmed to be in continuously transmitting mode.

7.5 TEST RESULTS

Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	CH00 / CH39 / CH78 (GFSK(1Mbps) Mode)	Test Voltage:	DC 5V

Frequency	Mark1 Frequency （MHz）	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.990	0.999	0.544	Complies
2441 MHz	2441.149	0.999	0.547	Complies
2480 MHz	2478.993	0.677	0.544	Complies

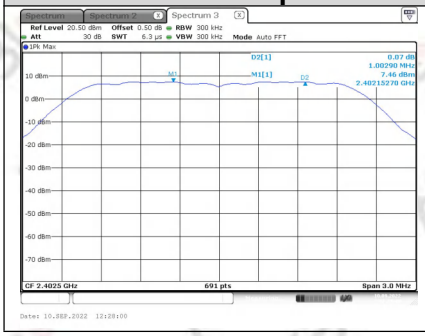
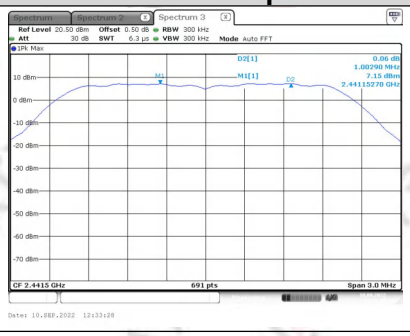
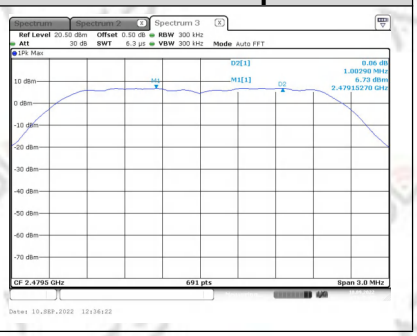
For GFSK: Ch. Separation Limits: >two-thirds 20dB bandwidth

CH00 -1Mbps	CH39 -1Mbps	CH78 -1Mbps
		

Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	CH00 / CH39 /CH78 (π/4-DQPSK(2Mbps) Mode)	Test Voltage:	DC 5V

Frequency	Mark1 Frequency （MHz）	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.83570	1.003	0.831	Complies
2441 MHz	2440.9920	1.003	0.834	Complies
2480 MHz	2478.8357	1.003	0.831	Complies

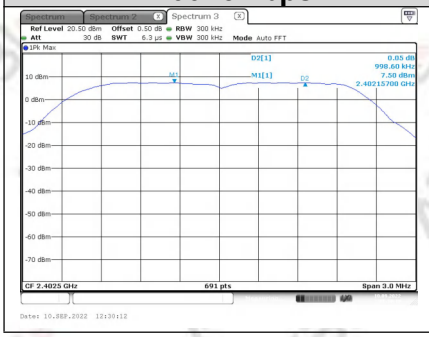
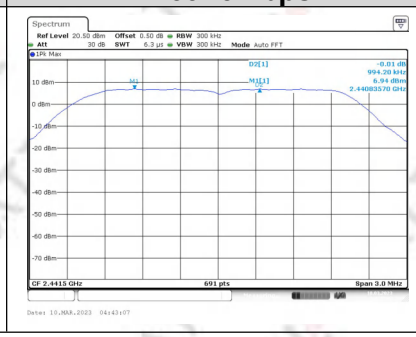
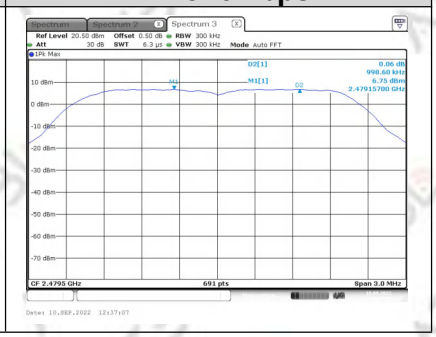
For π/4-DQPSK(2Mbps): Ch. Separation Limits: > two-thirds 20dB bandwidth

CH00 -2Mbps	CH39 -2Mbps	CH78 -2Mbps
		

Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	CH00 / CH39 /CH78 (8DPSK(3Mbps)Mode)	Test Voltage:	DC 5V

Frequency	Mark1 Frequency （MHz）	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2402.8314	0.999	0.842	Complies
2441 MHz	2441.1483	0.994	0.842	Complies
2480 MHz	2479.1440	0.999	0.842	Complies

For 8DPSK(3Mbps):Ch. Separation Limits: > two-thirds 20dB bandwidth

CH00 -3Mbps	CH39 -3Mbps	CH78 -3Mbps
		

8. BANDWIDTH TEST

8.1 LIMIT

FCC Part15 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(1)	Bandwidth	N/A	2400-2483.5	PASS

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

8.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 30kHz, VBW=100kHz, Sweep time = Auto.

8.3 TEST SETUP

8.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

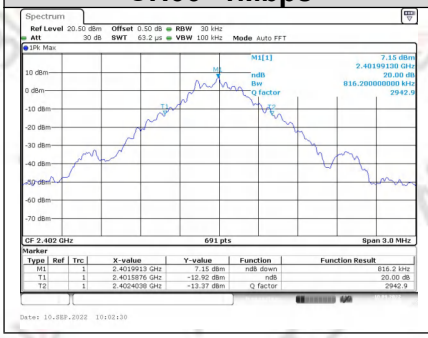
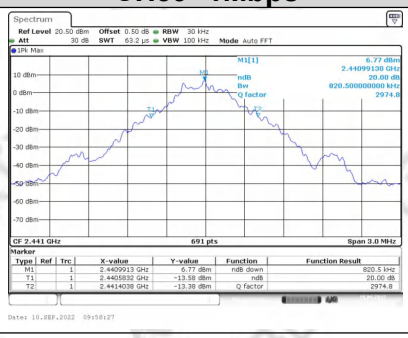
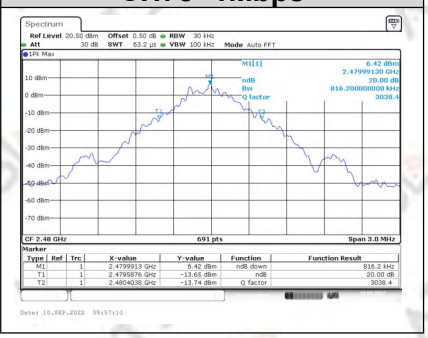
8.5 TEST RESULTS

Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	GFSK(1Mbps) CH00 / CH39 /CH78	Test Voltage:	DC 5V

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	0.816	0.868	PASS
2441 MHz	0.821	0.873	PASS
2480 MHz	0.816	0.873	PASS

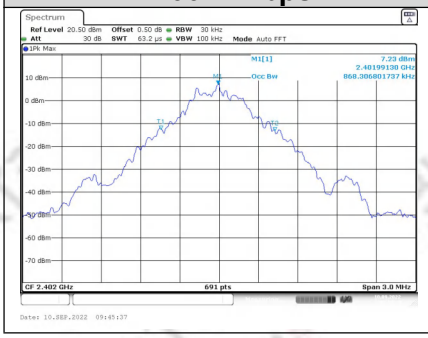
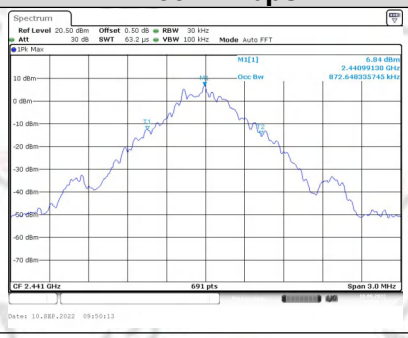
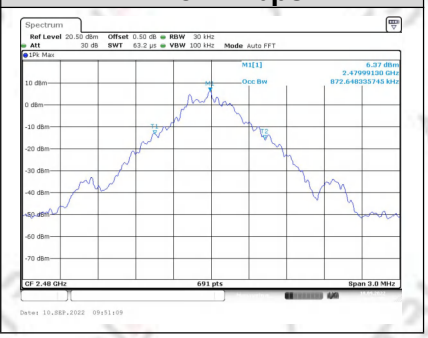
20dB Bandwidth

(MHz)

CH00 -1Mbps	CH39 -1Mbps	CH78 -1Mbps
		

99% Bandwidth

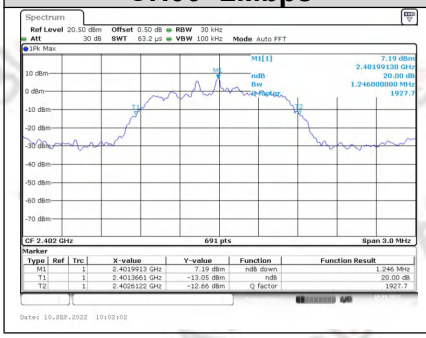
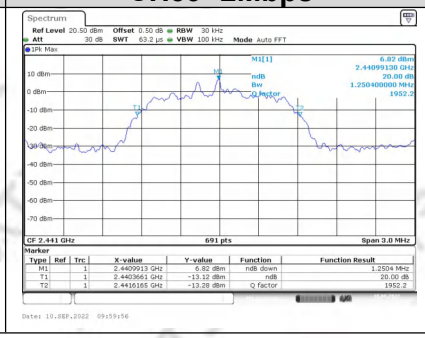
(MHz)

CH00 -1Mbps	CH39 -1Mbps	CH78 -1Mbps
		

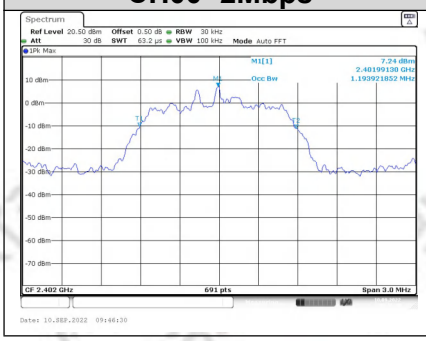
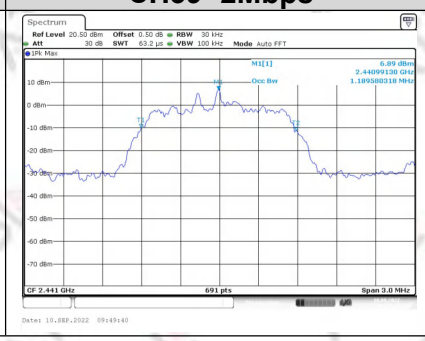
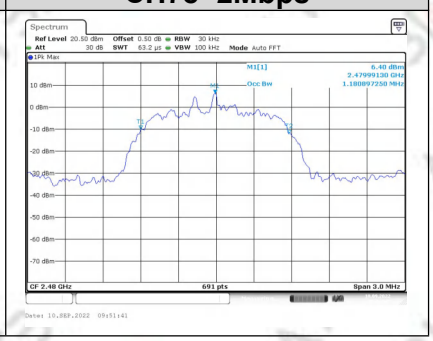
Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	π/4-DQPSK(2Mbps) CH00 / CH39 / CH78	Test Voltage:	DC 5V

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.246	1.194	PASS
2441 MHz	1.250	1.190	PASS
2480 MHz	1.246	1.181	PASS

20dB Bandwidth (MHz)

CH00 -2Mbps	CH39 -2Mbps	CH78 -2Mbps
		

99% Bandwidth (MHz)

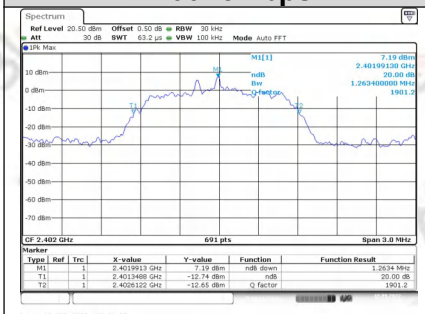
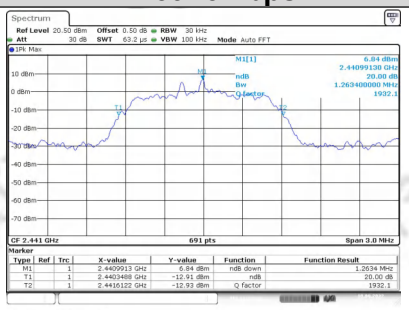
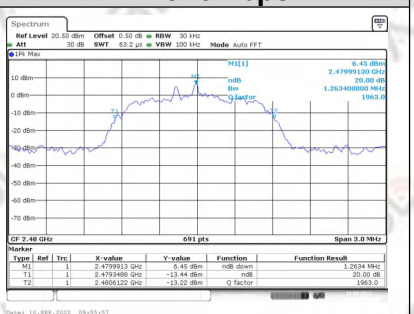
CH00 -2Mbps	CH39 -2Mbps	CH78 -2Mbps
		

Temperature:	22.3℃	Relative Humidity:	51%
Test Mode:	8DPSK(3Mbps) CH00 / CH39 / CH78	Test Voltage:	DC 5V

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.263	1.220	PASS
2441 MHz	1.263	1.216	PASS
2480 MHz	1.263	1.203	PASS

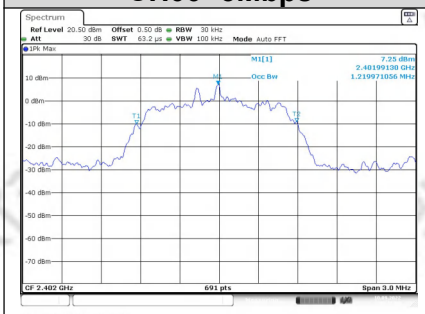
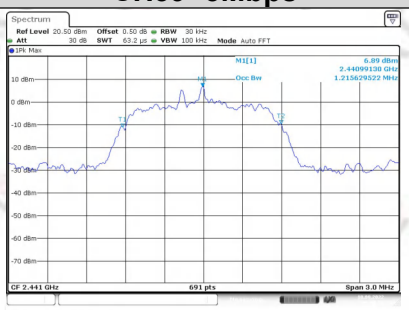
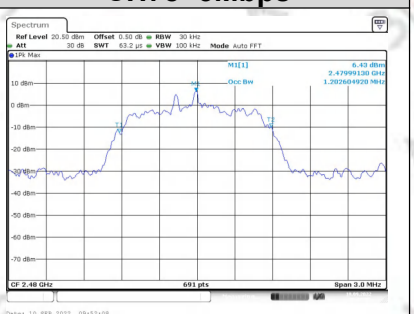
20dB Bandwidth

(MHz)

CH00 -3Mbps	CH39 -3Mbps	CH78 -3Mbps
		

99% Bandwidth

(MHz)

CH00 -3Mbps	CH39 -3Mbps	CH78 -3Mbps
		

9. OUTPUT POWER TEST

9.1 LIMIT

FCC Part 15.247				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(1)&(b)(1)	Output Power	1 W or 0.125W if channel separation > 2/3 ban dwidhprovided the systems operate with an output power no greater than125 mW(20.97dBm)	2400-2483.5	PASS

9.2 TEST PROCEDURE

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:
1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
2) RBW > 20 dB bandwidth of the emission being measured.
3) VBW ≥ RBW.
4) Sweep: Auto.
5) Detector function: Peak.
6) Trace: Max hold.
b) Allow trace to stabilize.
c) Use the marker-to-peak function to set the marker to the peak of the emission.
d) The indicated level is the peak output power, after any corrections for external attenuator and cables.
e) A plot of the test results and setup description shall be included in the test report.
NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.
PKPM1 Peak power meter method:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DSS bandwidth and shall use a fast-responding diode detector.

9.3 TEST SETUP

9.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

9.5 TEST RESULTS

Temperature:	22.3℃	Relative Humidity:	51%
Test Voltage:	DC 5V		

Mode	Channel Number	Frequency (MHz)	Peak Power (dBm)	Average Power (dBm)	Limit (dBm)
GFSK(1M)	0	2402	-0.11	-0.17	30.00
	39	2441	-0.52	-0.56	30.00
	78	2480	-1.30	-1.33	30.00

Note:the channel separation >20dB bandwidth

Mode	Channel Number	Frequency (MHz)	Peak Power (dBm)	Average Power (dBm)	Limit (dBm)
π/4-DQPSK (2M)	0	2402	1.81	-0.54	20.97
	39	2441	1.33	-1.62	20.97
	78	2480	0.57	-1.95	20.97

Note:the channel separation >2/3 20dB bandwidth

Mode	Channel Number	Frequency (MHz)	Peak Power (dBm)	Average Power (dBm)	Limit (dBm)
8-DPSK(3M)	0	2402	2.35	-0.55	20.97
	39	2441	1.88	-1.06	20.97
	78	2480	1.17	-1.77	20.97

Note:the channel separation >2/3 20dB bandwidth

10. ANTENNA REQUIREMENT

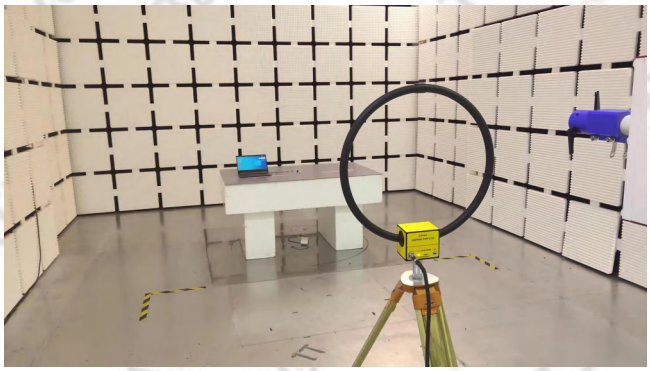
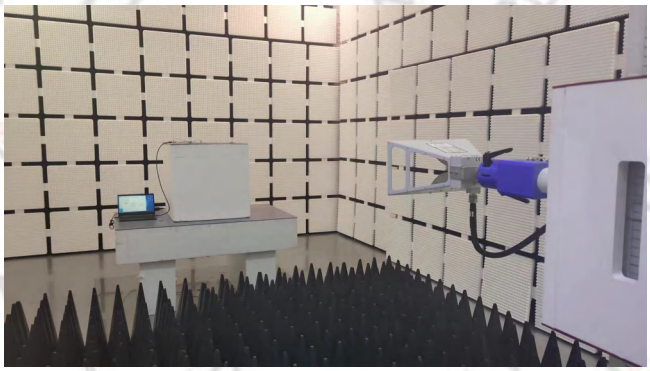
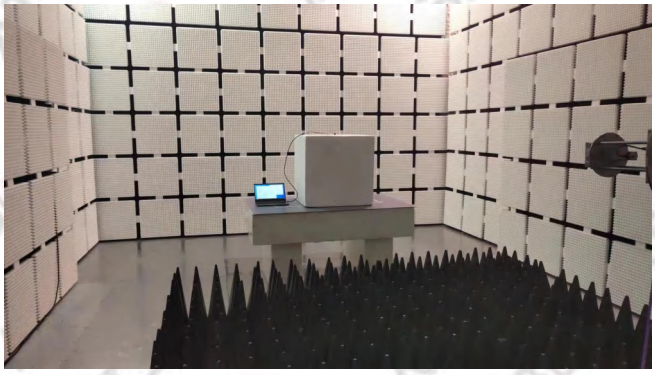
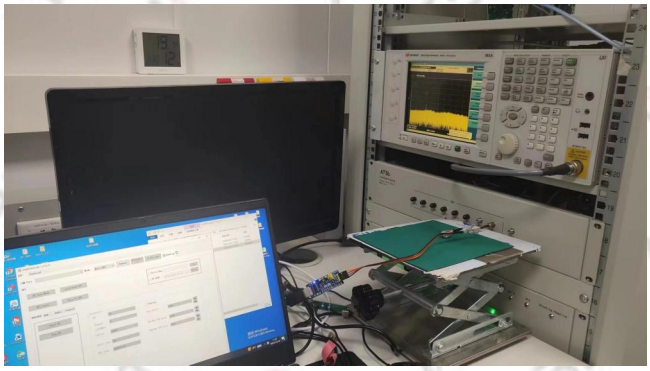
10.1 STANDARD REQUIREMENT

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

10.2 EUT ANTENNA

The EUT antenna is FPC. It comply with the standard requirement.

11.APPENDIX-PHOTOS OF TEST SETUP

AC Power Line Conducted Emissions	Radiated Emissions for 9kHz~30MHz
	
Radiated Emissions for 30MHz~1GHz	**Radiated Emissions for 1GHz~18GHz**
	
Radiated Emissions for above 18GHz	**Conducted for RF**
	

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