TEST REPORT

Product	:	DREO BABY MONITOR
Trade mark	:	DREO
Model/Type reference	:	DR-BBM001, WDR-BM001
Serial Number	:	N/A
Report Number	:	EED32N81477103
FCC ID	:	2A3SY-BBM001B
Date of Issue	:	Mar. 04, 2022
Test Standards	:	47 CFR Part 15 Subpart C
Test result	:	PASS

Prepared for:

Hesung Innovation Limited
Room 803, Chevalier House, 45-51 Chatham Road South, Tsim Sha Tsui, Kowloon

Prepared by:

Centre Testing International Group Co., Ltd.
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Reviewed by: Aaron Ma Aaron Ma

Approved by: David Wang David Wang

Date: Mar. 04, 2022

Check No.:4425311221

1 Contents

2 Version

Version No.	Date	Description
00	Mar. 04, 2022	Original

3 Test Summary

Test Item	Test Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203/15.247 (c)	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	PASS
Maximum Conducted Output Power	47 CFR Part 15, Subpart C Section 15.247 (b)(1)	PASS
20dB Emission Bandwidth	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	PASS
Carrier Frequency Separation	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	PASS
Number of Hopping Channels	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	PASS
Time of Occupancy	47 CFR Part 15, Subpart C Section 15.247 (a)(1)	PASS
Pseudorandom Frequency Hopping Sequence	47 CFR Part 15, Subpart C Section 15.247(b)(4)	PASS
Band Edge Measurements	47 CFR Part 15, Subpart C Section 15.247(d)	PASS
Conducted Spurious Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	PASS
Radiated Spurious emissions	47 CFR Part 15, Subpart C Section 15.205/15.209	PASS
Restricted bands around fundamental frequency	47 CFR Part 15, Subpart C Section 15.205/15.209	PASS

Remark:
Company Name and Address shown on Report, the sample(s) and sample Information was/ were provided by the applicant who should be responsible for the authenticity which CTI hasn't verified.
Model No.: DR-BBM001, WDR-BM001
Only the model DR-BBM001 was tested, The difference between each model is only for the product name is different, the color is different, the rest circuit principle, the internal structure, the PCB Layout and the safety key parts are the same, does not affect the EMC and safety test.

4 General Information

4.1 Client Information

Applicant:	Hesung Innovation Limited
Address of Applicant:	Room 803, Chevalier House, 45-51 Chatham Road South, Tsim Sha Tsui, Kowloon
Manufacturer:	Shenzhen Hesung Innovation Technology Co., LTD
Address of Manufacturer:	26th Floor, Building A7, Chuangzhiyuncheng, Liuxian Avenue, Nanshan District, Shenzhen
Factory:	Power7 Technology (Dong Guan) Co., Ltd.
Address of Factory:	No.28 Binjiang Street. Shishuikou Village, Qiaotou Town, Dongguan City, GuangDong Province P.R.China

4.2 General Description of EUT

Product Name:	DREO BABY MONITOR	
Model No.(EUT):	DR-BBM001, WDR-BM001	
Test Model No:	DR-BBM001	
Trade Mark:	DREO	
Power Supply:	Adapter:(Monitor)	Model: TPA285-10050-US Input:100-240V~50/60Hz 0.6A Max Output: 5V ⎓ 2.0A
Operation Frequency:	2410MHz - 2477MHz	
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)	
Test Power Grade:	Default	
Test Software of EUT:	N/A(manufacturer declare)	
Modulation Type:	GFSK	
Number of Channel:	20	
Hopping Channel Type:	Adaptive Frequency Hopping systems	
Antenna Type and Gain:	Dipole Antenna, 2dBi	
Test Voltage:	AC 120V,60Hz	
Sample Received Date:	Dec. 31, 2021	
Sample tested Date:	Dec. 31, 2021 to Feb. 27, 2022	

Operation Frequency each of channel

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2410MHz	6	2427.5MHz	11	2445MHz	16	2462.5MHz
2	2413.5MHz	7	2431MHz	12	2448.5MHz	17	2466MHz
3	2417MHz	8	2434.5MHz	13	2452MHz	18	2469.5MHz
4	2420.5MHz	9	2438MHz	14	2455.5MHz	19	2473MHz
5	2424MHz	10	2441.5MHz	15	2459MHz	20	2477MHz

4.3 Test Environment

Operating Environment:	
Radiated Spurious Emissions:	
Temperature:	22~25.0 °C
Humidity:	50~55 % RH
Atmospheric Pressure:	1010mbar
Conducted Emissions:	
Temperature:	22~25.0 °C
Humidity:	50~55 % RH
Atmospheric Pressure:	1010mbar
RF Conducted:	
Temperature:	22~25.0 °C
Humidity:	50~55 % RH
Atmospheric Pressure:	1010mbar

4.4 Description of Support Units

The EUT has been tested independently

4.5 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd
Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China
Telephone: +86 (0) 755 33683668 Fax:+86 (0) 755 33683385
No tests were sub-contracted.
FCC Designation No.: CN1164

4.6 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.9×10^{-8}
2	RF power, conducted	0.46dB (30MHz-1GHz)
		0.55dB (1GHz-40GHz)
3	Radiated Spurious emission test	3.3dB (9kHz-30MHz)
		4.3dB (30MHz-1GHz)
		4.5dB (1GHz-18GHz)
		3.4dB (18GHz-40GHz)
4	Conduction emission	3.5dB (9kHz to 150kHz)
		3.1dB (150kHz to 30MHz)
5	Temperature test	0.64°C
6	Humidity test	3.8%
7	DC power voltages	0.026%

4.7 Equipment List

RF test system					
Equipment	**Manufacturer**	**Mode No.**	**Serial Number**	**Cal. Date (mm-dd-yyyy)**	**Cal. Due date (mm-dd-yyyy)**
Spectrum Analyzer	Keysight	N9010A	MY54510339	12-24-2021	12-23-2022
Signal Generator	Keysight	N5182B	MY53051549	12-24-2021	12-23-2022
Signal Generator	Agilent	N5181A	MY46240094	12-24-2021	12-23-2022
DC Power	Keysight	E3642A	MY56376072	12-24-2021	12-23-2022
Power unit	R&S	OSP120	101374	12-24-2021	12-23-2022
RF control unit	JS Tonscend	JS0806-2	158060006	12-24-2021	12-23-2022
Communication test set	R&S	CMW500	120765	08-04-2021	08-03-2022
high-low temperature test chamber	Dong Guang Qin Zhuo	LK-80GA	QZ20150611879	12-24-2021	12-23-2022
Temperature/ Humidity Indicator	biaozhi	HM10	1804186	06-23-2021	06-22-2022
BT&WI-FI Automatic test software	JS Tonscend	JS1120-3	2.6.77.0518	---	---

3M Semi/full-anechoic Chamber					
Equipment	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm-dd-yyyy)**	**Cal. Due date (mm-dd-yyyy)**
3M Chamber & Accessory Equipment	TDK	SAC-3	---	05-24-2019	05-23-2022
Receiver	R&S	ESCI7	100938-003	10-14-2021	10-13-2022
TRILOG Broadband Antenna	schwarzbeck	VULB 9163	9163-618	05-23-2019	05-22-2022
Multi device Controller	maturo	NCD/070/10711112	---	---	---
Horn Antenna	ETS-LINGREN	BBHA 9120D	9120D-1869	04-15-2021	04-14-2024
Spectrum Analyzer	R&S	FSP40	100416	04-29-2021	04-28-2022
Microwave Preamplifier	Agilent	8449B	3008A02425	06/23/2021	06/22/2022

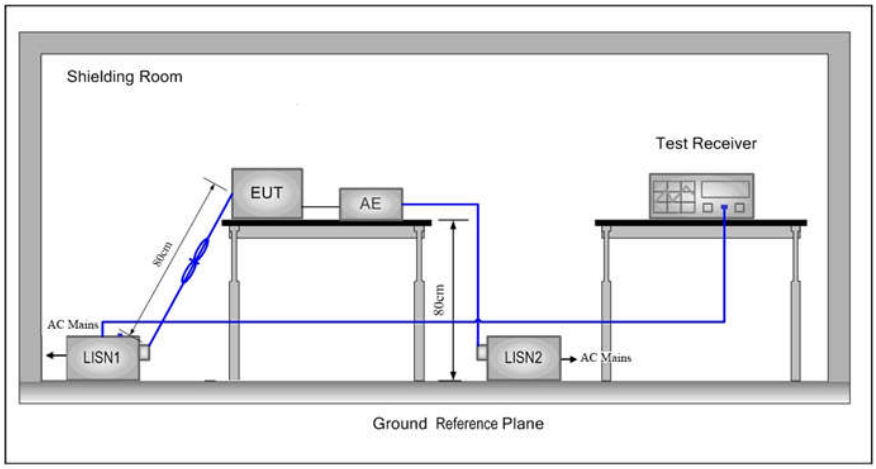
3M full-anechoic Chamber					
Equipment	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm-dd-yyyy)**	**Cal. Due date (mm-dd-yyyy)**
RSE Automatic test software	JS Tonscend	JS36-RSE	10166	---	---
Receiver	Keysight	N9038A	MY57290136	03-04-2021	03-03-2022
Spectrum Analyzer	Keysight	N9020B	MY57111112	03-04-2021	03-03-2022
Spectrum Analyzer	Keysight	N9030B	MY57140871	03-04-2021	03-03-2022
TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	9163-1148	04-28-2021	04-27-2024
Horn Antenna	Schwarzbeck	BBHA 9170	9170-832	04-15-2021	04-14-2024
Horn Antenna	ETS-LINDGREN	3117	57407	07-04-2021	07-03-2024
Preamplifier	EMCI	EMC184055SE	980597	05-20-2021	05-19-2022
Preamplifier	EMCI	EMC001330	980563	04-21-2021	04-20-2022
Preamplifier	JS Tonscend	980380	EMC051845 SE	12-24-2021	12-23-2022
Communication test set	R&S	CMW500	102898	12-24-2021	12-23-2022
Temperature/ Humidity Indicator	biaozhi	GM1360	EE1186631	04-16-2021	04-15-2022
Fully Anechoic Chamber	TDK	FAC-3	---	01-09-2021	01-08-2024
Cable line	Times	SFT205-NMSM-2.50M	394812-0001	---	---
Cable line	Times	SFT205-NMSM-2.50M	394812-0002	---	---
Cable line	Times	SFT205-NMSM-2.50M	394812-0003	---	---
Cable line	Times	SFT205-NMSM-2.50M	393495-0001	---	---
Cable line	Times	EMC104-NMNM-1000	SN160710	---	---
Cable line	Times	SFT205-NMSM-3.00M	394813-0001	---	---
Cable line	Times	SFT205-NMNM-1.50M	381964-0001	---	---
Cable line	Times	SFT205-NMSM-7.00M	394815-0001	---	---
Cable line	Times	HF160-KMKM-3.00M	393493-0001	---	---

5 Test results and Measurement Data

5.1 Antenna Requirement

Standard requirement:	47 CFR Part 15C 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(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	
EUT Antenna:	Please see Internal photos
The antenna is Dipole antenna. The best case gain of the antenna is 2dBi.	

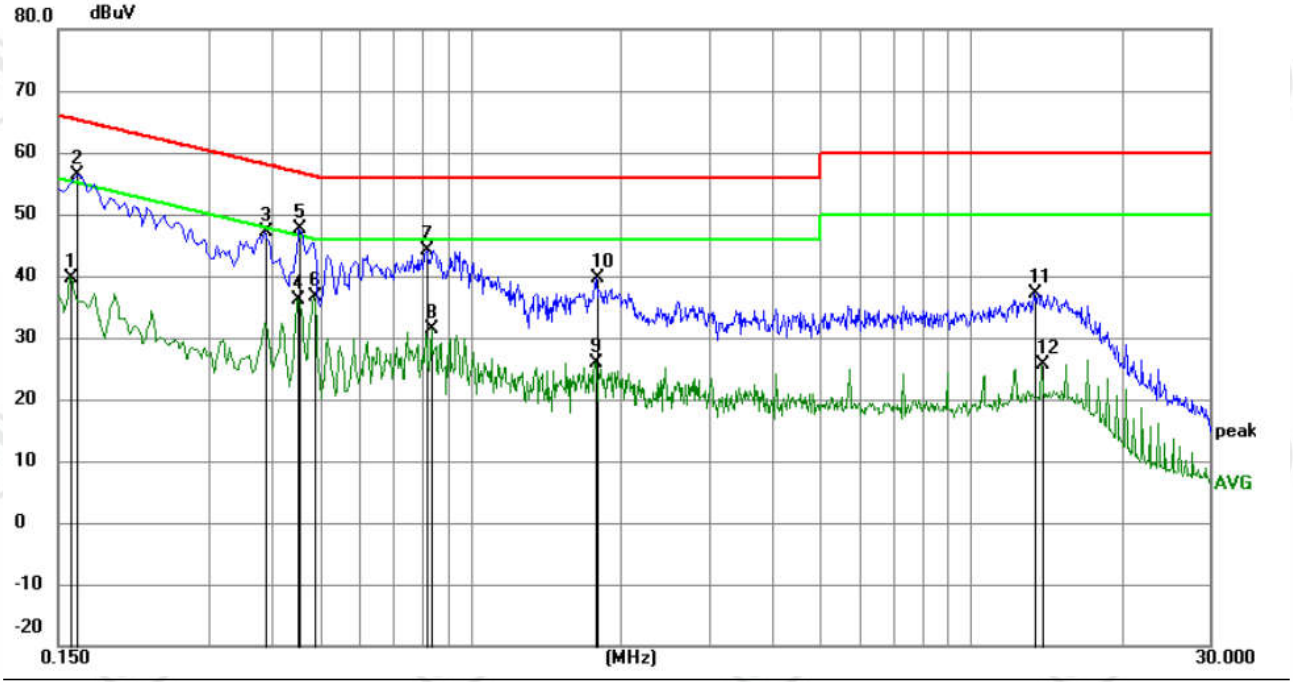
5.2 AC Power Line Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.207
Test Method:	ANSI C63.10: 2013
Test Frequency Range:	150kHz to 30MHz
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto
Limit:	Frequency range (MHz) / Limit (dBuV): Quasi-peak / Average 0.15-0.5: 66 to 56* / 56 to 46* 0.5-5: 56 / 46 5-30: 60 / 50 * Decreases with the logarithm of the frequency.
Test Setup:	
Test Procedure:	1) The mains terminal disturbance voltage test was conducted in a shielded room. 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded. 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2. 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type at the lowest, middle, high channel.
Final Test Mode:	Through Pre-scan, find the GFSK modulation at the lowest channel is the worst case. Only the worst case is recorded in the report.
Test Results:	Pass

Adapter:(Monitor)

Measurement Data

Live line:

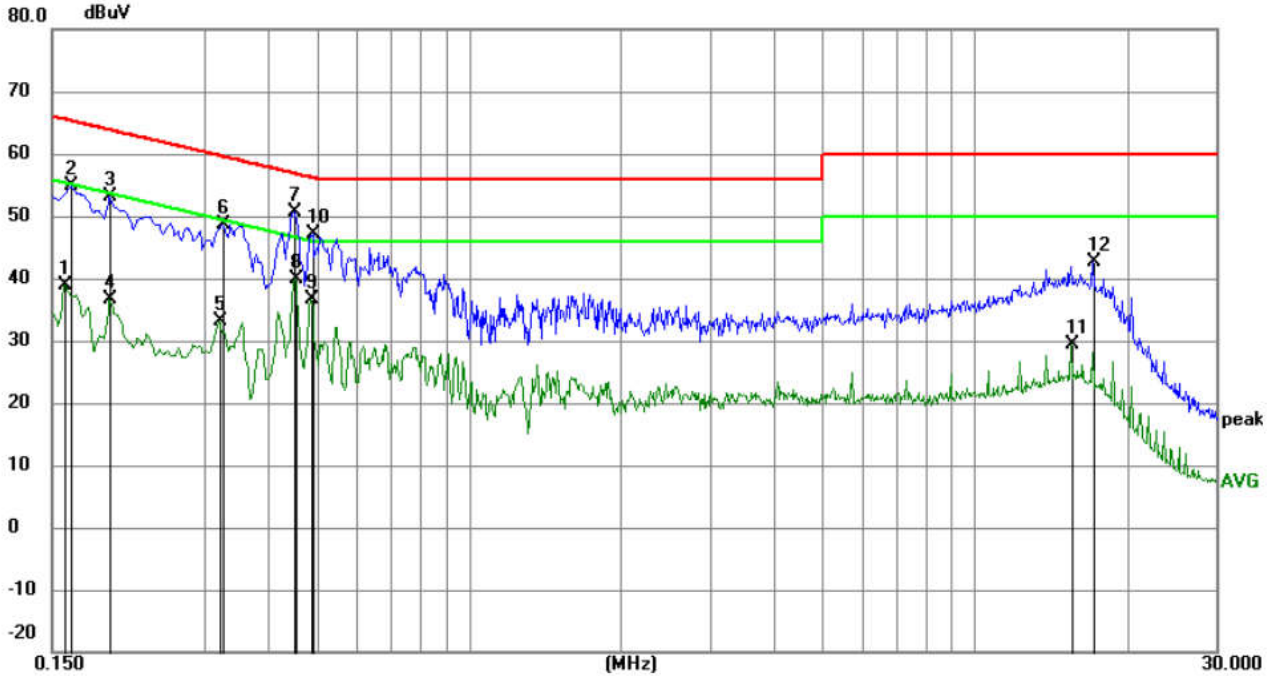


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1590	29.88	9.87	39.75	55.52	-15.77	AVG	
2	*	0.1635	46.55	9.87	56.42	65.28	-8.86	QP	
3		0.3885	37.19	9.98	47.17	58.10	-10.93	QP	
4		0.4515	26.09	9.96	36.05	46.85	-10.80	AVG	
5		0.4560	37.77	9.96	47.73	56.77	-9.04	QP	
6		0.4875	26.74	9.95	36.69	46.21	-9.52	AVG	
7		0.8205	34.30	9.85	44.15	56.00	-11.85	QP	
8		0.8385	21.63	9.85	31.48	46.00	-14.52	AVG	
9		1.7790	16.17	9.80	25.97	46.00	-20.03	AVG	
10		1.7835	29.94	9.80	39.74	56.00	-16.26	QP	
11		13.3440	27.21	9.88	37.09	60.00	-22.91	QP	
12		13.8885	15.81	9.90	25.71	50.00	-24.29	AVG	

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

Neutral line:

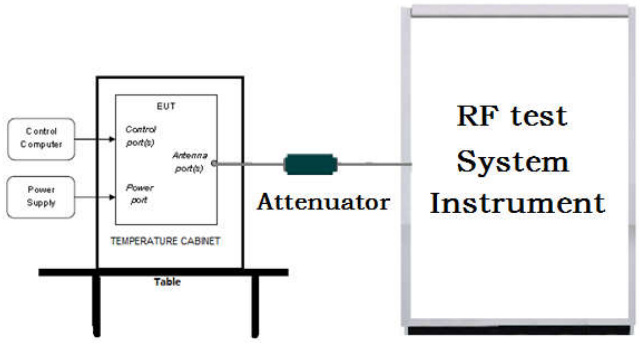


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1590	29.13	9.87	39.00	55.52	-16.52	AVG	
2		0.1635	45.05	9.87	54.92	65.28	-10.36	QP	
3		0.1949	43.26	9.87	53.13	63.83	-10.70	QP	
4		0.1949	26.80	9.87	36.67	53.83	-17.16	AVG	
5		0.3209	23.10	10.05	33.15	49.68	-16.53	AVG	
6		0.3255	38.69	10.04	48.73	59.57	-10.84	QP	
7	*	0.4515	40.69	9.96	50.65	56.85	-6.20	QP	
8		0.4560	29.86	9.96	39.82	46.77	-6.95	AVG	
9		0.4875	26.60	9.95	36.55	46.21	-9.66	AVG	
10		0.4920	37.19	9.95	47.14	56.13	-8.99	QP	
11		15.5400	19.48	9.93	29.41	50.00	-20.59	AVG	
12		17.1689	32.57	9.95	42.52	60.00	-17.48	QP	

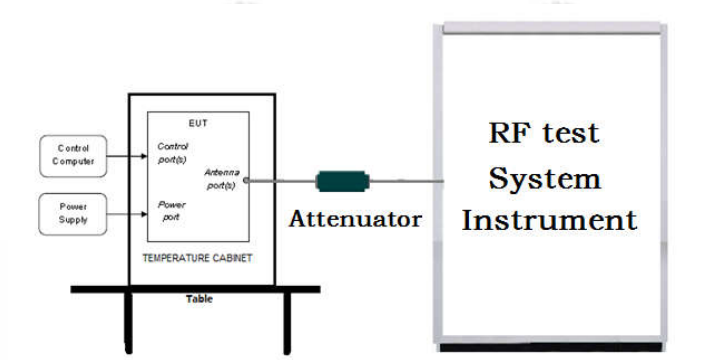
Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

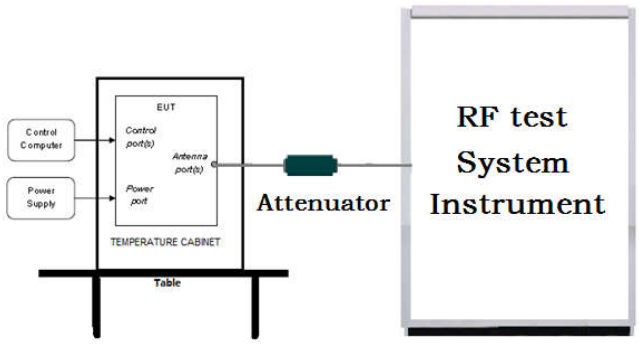
5.3 Maximum Conducted Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 Remark: Offset=Cable loss+ attenuation factor.
Test Procedure:	Use the following spectrum analyzer settings: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.
Limit:	21dBm
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type
Test Results:	Refer to Appendix A

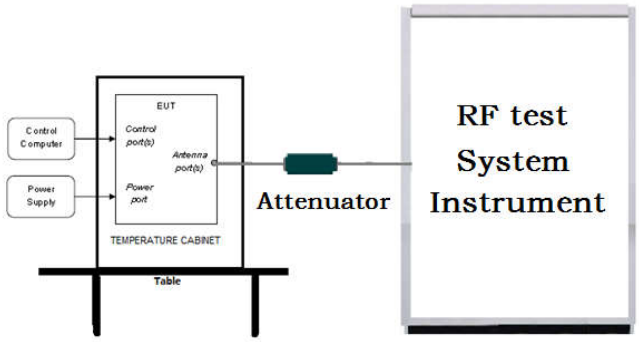
5.4 20dB Emission Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 Remark: Offset=Cable loss+ attenuation factor.
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel; 1%≤RBW ≤5% of the 20 dB bandwidth; VBW≥3RBW; Sweep = auto; Detector function = peak; Trace = max hold. 4. Measure and record the results in the test report.
Limit:	NA
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type
Test Results:	Refer to Appendix A

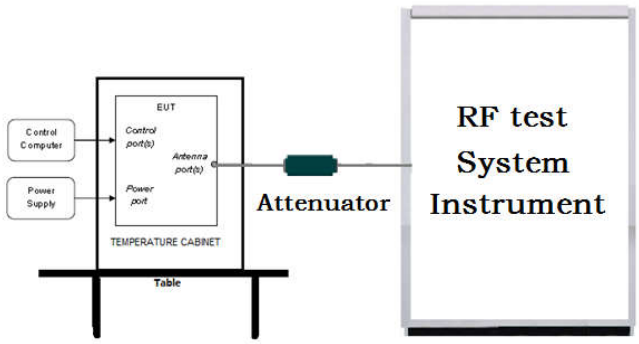
5.5 Carrier Frequency Separation

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 Remark: Offset=Cable loss+ attenuation factor.
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = wide enough to capture the peaks of two adjacent channels; RBW is set to approximately 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 5. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Record the value in report.
Limit:	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.
Exploratory Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type
Test Results:	Refer to Appendix A

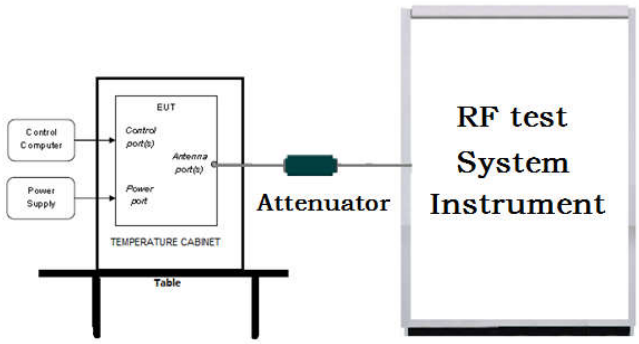
5.6 Number of Hopping Channel

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 Remark: Offset=Cable loss+ attenuation factor.
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = the frequency band of operation; set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller; VBW≥RBW; Sweep= auto; Detector function = peak; Trace = max hold. 5. The number of hopping frequency used is defined as the number of total channel. 6. Record the measurement data in report.
Limit:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode:	Hopping transmitting with all kind of modulation
Test Results:	Refer to Appendix A

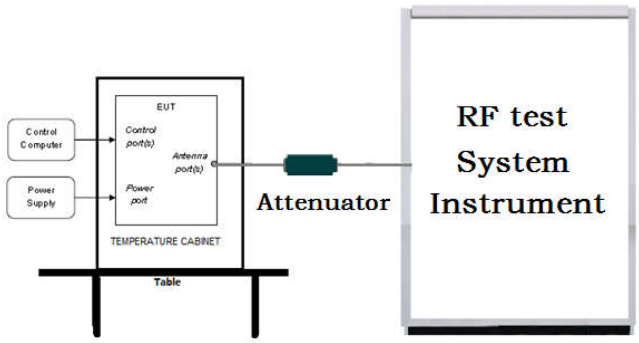
5.7 Time of Occupancy

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 Remark: Offset=Cable loss+ attenuation factor.
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Enable the EUT hopping function. 4. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel; VBW≥RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold. 5. Measure and record the results in the test report.
Limit:	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.
Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type.
Test Results:	Refer to Appendix A

5.8 Band edge Measurements

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Test Setup:	 Remark: Offset=Cable loss+ attenuation factor.
Test Procedure:	1. Set to the maximum power setting and enable the EUT transmit continuously. 2. Set RBW = 100 kHz, VBW = 300 kHz (≥RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used. 3. Enable hopping function of the EUT and then repeat step 2 and 3. 4. Measure and record the results in the test report.
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.
Exploratory Test Mode:	Hopping and Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type
Test Results:	Refer to Appendix A

5.9 Conducted Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Test Setup:	 Remark: Offset=Cable loss+ attenuation factor.
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. 4. Measure and record the results in the test report. 5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
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.
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type
Test Results:	Refer to Appendix A

5.10 Pseudorandom Frequency Hopping Sequence

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1) requirement:
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the 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.	
EUT Pseudorandom Frequency Hopping Sequence	
Hopping Mechanism DR-BBM001 family use adaptive frequency hopping. There are at 20 radio non-overlap channels (above 20dBc) in the 2.4GHz ISM band. The channel transmission bandwidth is about 3.5MHz. We can allocate 20 non-overlap channels between 2410MHz to 2477MHz. Like AFH of Bluetooth, DR-BBM001 provide smart channel selection algorithm to avoid radio interference from other 2.4GHz devices. The system will generate a pseudorandom ordered list base on: 1) A 8 bit factory ID(8 bit) 2) A 6 bit set number ID(6 bit)	

5.11 Radiated Spurious Emission & Restricted bands

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10: 2013
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Peak	100 kHz	300kHz	Peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10kHz	Average

Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Test Setup:	

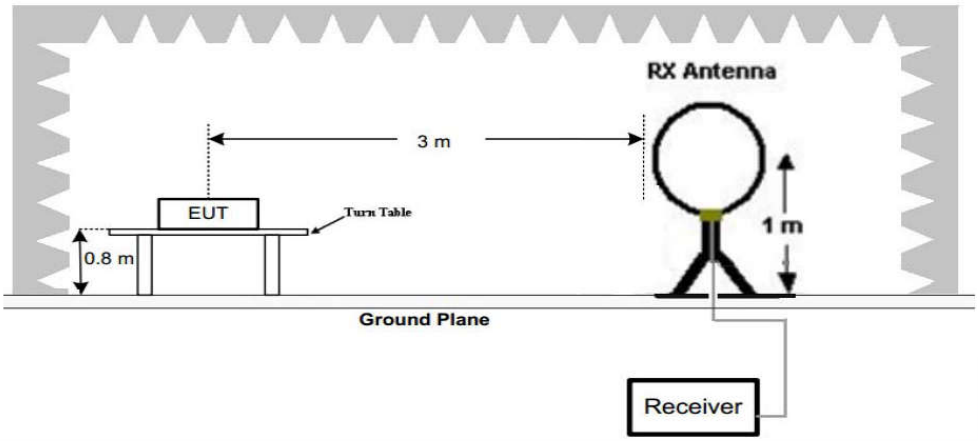


Figure 1. Below 30MHz

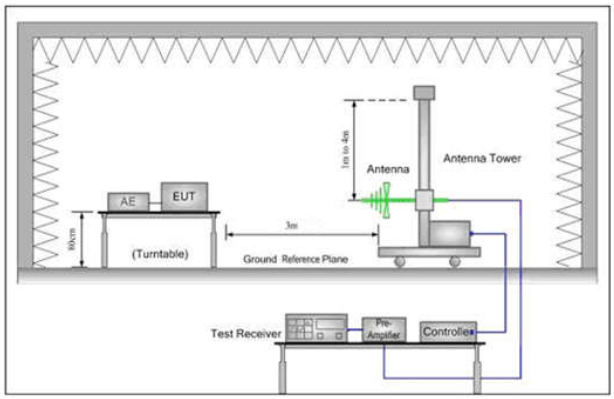


Figure 2. 30MHz to 1GHz

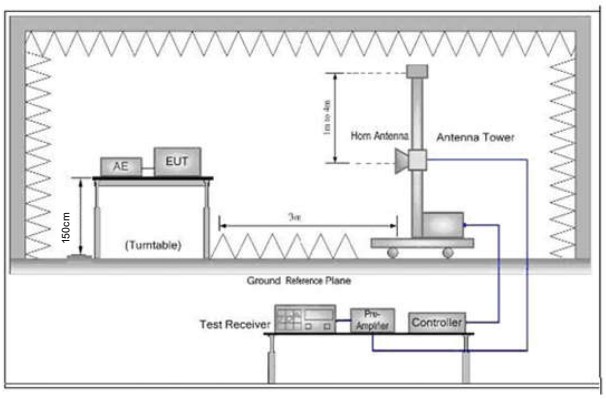


Figure 3. Above 1 GHz

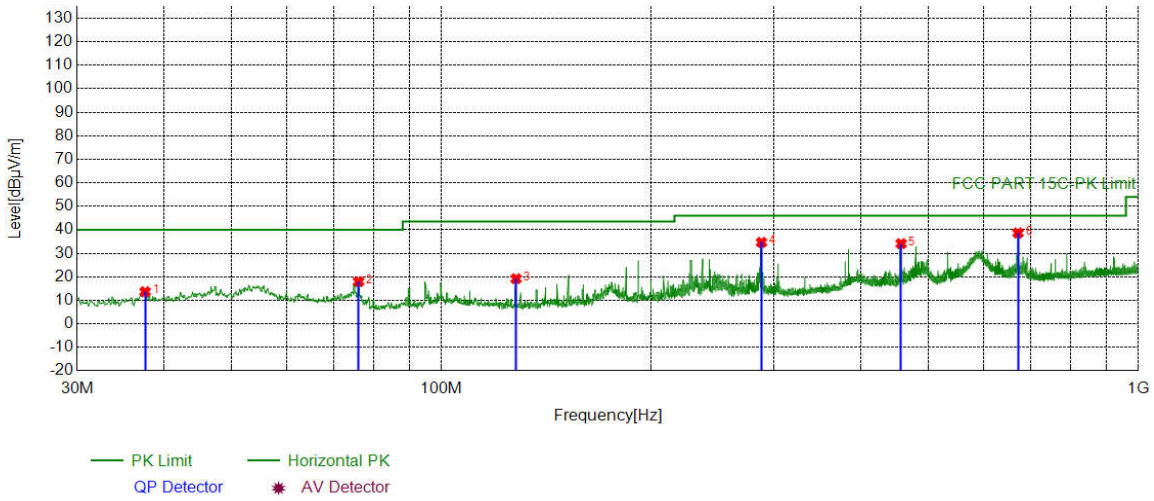
Test Procedure:	a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. Note: For the radiated emission test above 1GHz: Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. c. 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. d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. f. 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. g. Test the EUT in the lowest channel (2402MHz),the middle channel (2441MHz),the Highest channel (2480MHz) h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. i. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the DH5 of data type and GFSK modulation with adapter VSD0500120VU was the worst case. Pretest the EUT at Transmitting mode, For below 1GHz part, through pre-scan, the worst case was the lowest channel. Only the worst case was recorded in the report.
Test Results:	Pass

Radiated Spurious Emission below 1GHz:

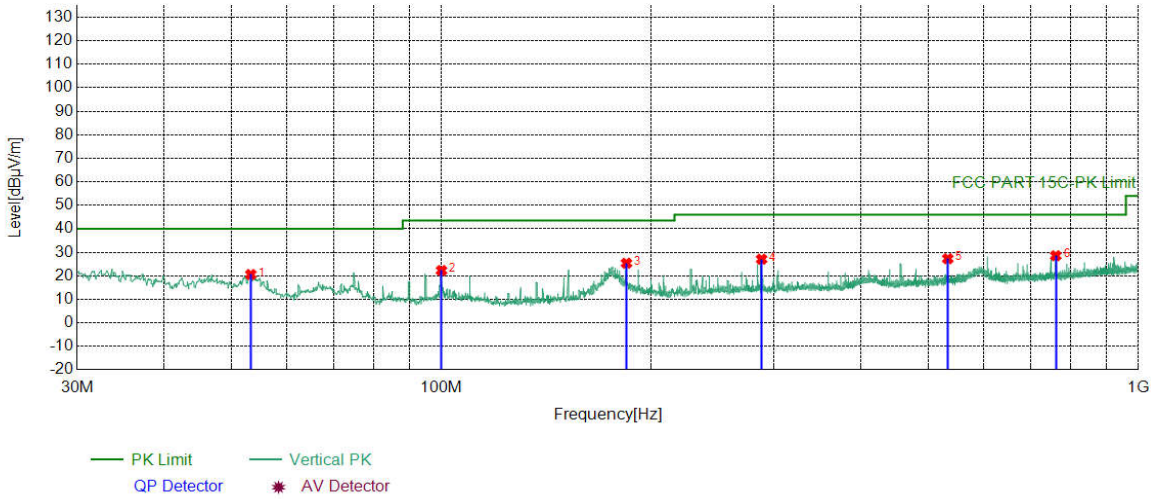
During the test, the Radiates Emission from 30MHz to 1GHz was performed in all modes, only the worst case lowest channel of DH5 for GFSK was recorded in the report.

Test Graph



Suspected List									
NO	Freq. [MHz]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity	Remark
1	37.5668	-18.80	32.47	13.67	40.00	26.33	PASS	Horizontal	PK
2	76.0796	-21.87	39.83	17.96	40.00	22.04	PASS	Horizontal	PK
3	127.9798	-21.27	40.47	19.20	43.50	24.30	PASS	Horizontal	PK
4	287.9488	-15.76	50.43	34.67	46.00	11.33	PASS	Horizontal	PK
5	456.8427	-11.60	45.73	34.13	46.00	11.87	PASS	Horizontal	PK
6	672.0102	-8.01	46.67	38.66	46.00	7.34	PASS	Horizontal	PK

Test Graph



Suspected List									
NO	Freq. [MHz]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity	Remark
1	53.2823	-17.61	38.18	20.57	40.00	19.43	PASS	Vertical	PK
2	100.0410	-18.40	40.66	22.26	43.50	21.24	PASS	Vertical	PK
3	184.3424	-19.36	44.73	25.37	43.50	18.13	PASS	Vertical	PK
4	288.0458	-15.76	42.83	27.07	46.00	18.93	PASS	Vertical	PK
5	532.9953	-10.19	37.46	27.27	46.00	18.73	PASS	Vertical	PK
6	761.4531	-6.90	35.46	28.56	46.00	17.44	PASS	Vertical	PK

Radiated Spurious Emission above 1GHz:

Mode:		2.4G Transmitting			Channel:	2410			
NO	Freq. [MHz]	Factor [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	1160.0160	0.82	42.56	43.38	74.00	30.62	PASS	Horizontal	PK
2	1849.8850	3.65	44.23	47.88	74.00	26.12	PASS	Horizontal	PK
3	3238.0159	-20.14	59.73	39.59	74.00	34.41	PASS	Horizontal	PK
4	4820.1213	-16.22	57.01	40.79	74.00	33.21	PASS	Horizontal	PK
5	7750.3167	-11.21	52.80	41.59	74.00	32.41	PASS	Horizontal	PK
6	12419.6280	-4.72	51.28	46.56	74.00	27.44	PASS	Horizontal	PK
7	1118.4118	0.84	42.84	43.68	74.00	30.32	PASS	Vertical	PK
8	1849.8850	3.65	41.79	45.44	74.00	28.56	PASS	Vertical	PK
9	3300.0200	-19.80	57.28	37.48	74.00	36.52	PASS	Vertical	AV
10	5389.1593	-14.57	53.70	39.13	74.00	34.87	PASS	Vertical	PK
11	8773.3849	-9.64	52.57	42.93	74.00	31.07	PASS	Vertical	PK
12	14372.7582	0.77	48.89	49.66	74.00	24.34	PASS	Vertical	PK

Mode:		2.4G Transmitting			Channel:	2441.5			
NO	Freq. [MHz]	Factor [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	1152.4152	0.82	42.31	43.13	74.00	30.87	PASS	Horizontal	PK
2	1619.0619	2.41	42.63	45.04	74.00	28.96	PASS	Horizontal	PK
3	3469.0313	-20.08	58.09	38.01	74.00	35.99	PASS	Horizontal	PK
4	6296.2197	-12.93	53.98	41.05	74.00	32.95	PASS	Horizontal	PK
5	10850.5234	-6.30	51.90	45.60	74.00	28.40	PASS	Horizontal	PK
6	14928.7953	-0.71	49.29	48.58	74.00	25.42	PASS	Horizontal	PK
7	1239.0239	0.90	41.91	42.81	74.00	31.19	PASS	Vertical	PK
8	1849.6850	3.65	48.16	51.81	74.00	22.19	PASS	Vertical	PK
9	3931.0621	-19.03	59.10	40.07	74.00	33.93	PASS	Vertical	PK
10	7785.3190	-11.33	53.02	41.69	74.00	32.31	PASS	Vertical	AV
11	11195.5464	-6.42	51.97	45.55	74.00	28.45	PASS	Vertical	PK
12	14395.7597	1.15	48.72	49.87	74.00	24.13	PASS	Vertical	PK

Mode:		2.4G Transmitting			Channel:	2477			
NO	Freq. [MHz]	Factor [dB]	Reading [dB μ V]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Result	Polarity	Remark
1	1148.6149	0.83	42.17	43.00	74.00	31.00	PASS	Horizontal	PK
2	1618.6619	2.41	42.89	45.30	74.00	28.70	PASS	Horizontal	PK
3	3846.0564	-19.18	56.47	37.29	74.00	36.71	PASS	Horizontal	PK
4	5621.1747	-14.20	54.94	40.74	74.00	33.26	PASS	Horizontal	PK
5	9283.4189	-7.94	51.89	43.95	74.00	30.05	PASS	Horizontal	PK
6	13822.7215	-1.71	49.53	47.82	74.00	26.18	PASS	Horizontal	PK
7	1223.0223	0.86	41.64	42.50	74.00	31.50	PASS	Vertical	PK
8	1849.8850	3.65	47.46	51.11	74.00	22.89	PASS	Vertical	PK
9	3238.0159	-20.14	60.08	39.94	74.00	34.06	PASS	Vertical	PK
10	5246.1497	-14.64	54.34	39.70	74.00	34.30	PASS	Vertical	PK
11	9306.4204	-7.95	51.99	44.04	74.00	29.96	PASS	Vertical	PK
12	13754.7170	-1.69	49.03	47.34	74.00	26.66	PASS	Vertical	PK

Remark:

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

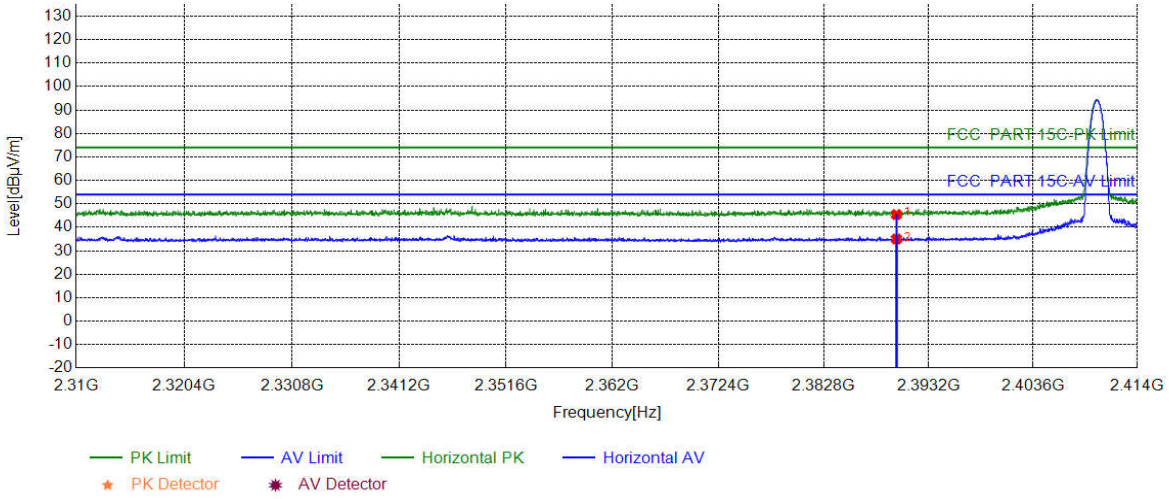
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

2) Scan from 9kHz to 25GHz, the disturbance above 10GHz and below 30MHz was very low. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

Restricted bands:

Mode:	2.4G Transmitting	Channel:	2410
Remark:	Monitor		

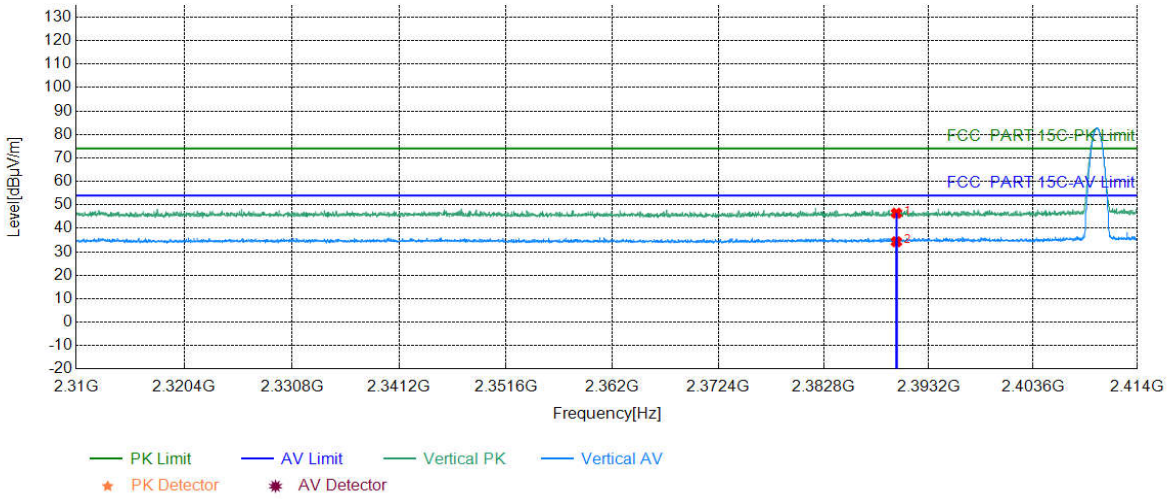
Test Graph



Suspected List									
NO	Freq. [MHz]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity	Remark
1	2390.0000	5.77	39.67	45.44	74.00	28.56	PASS	Horizontal	PK
2	2390.0000	5.77	29.25	35.02	54.00	18.98	PASS	Horizontal	AV

Mode:	2.4G Transmitting	Channel:	2410
Remark:	Monitor		

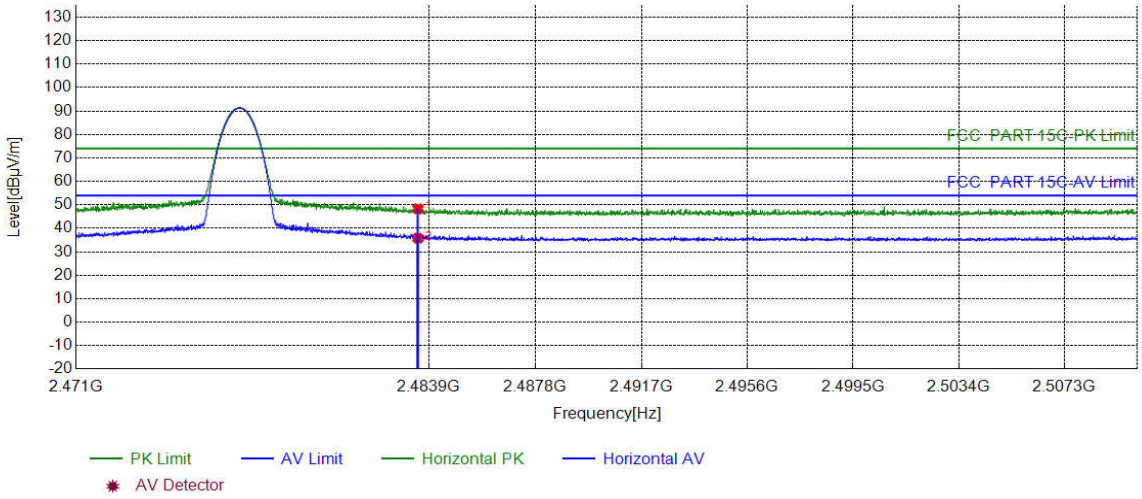
Test Graph



Suspected List									
NO	Freq. [MHz]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity	Remark
1	2390.0000	5.77	40.69	46.46	74.00	27.54	PASS	Vertical	PK
2	2390.0000	5.77	28.52	34.29	54.00	19.71	PASS	Vertical	AV

Mode:	2.4G Transmitting	Channel:	2477
Remark:	Monitor		

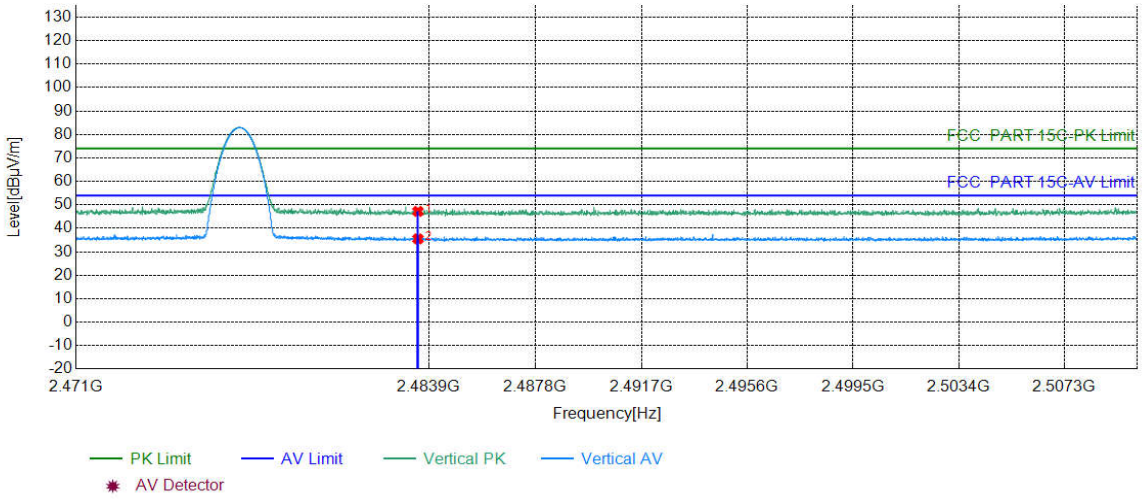
Test Graph



Suspected List									
NO	Freq. [MHz]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity	Remark
1	2483.5000	6.57	41.76	48.33	74.00	25.67	PASS	Horizontal	PK
2	2483.5000	6.57	29.25	35.82	54.00	18.18	PASS	Horizontal	AV

Mode:	2.4G Transmitting	Channel:	2477
Remark:	Monitor		

Test Graph



Suspected List									
NO	Freq. [MHz]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity	Remark
1	2483.5000	6.57	40.66	47.23	74.00	26.77	PASS	Vertical	PK
2	2483.5000	6.57	28.95	35.52	54.00	18.48	PASS	Vertical	AV

Note:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level =Receiver Reading - Correct Factor
Correct Factor = Preamplifier Factor– Antenna Factor–Cable Factor

6 Appendix A

Refer to Appendix: 2.4G of EED32N81477103.