TEST REPORT

Product	:	uKit Robot
Trade mark	:	UBTECH
Model/Type reference	:	ERUB101, ERUwxyy
Serial Number	:	N/A
Report Number	:	EED32L00034201
FCC ID	:	2AHJX-UKITERU
Date of Issue	:	Apr. 02, 2019
Test Standards	:	47 CFR Part 15 Subpart C
Test result	:	PASS

Prepared for:

UBTECH ROBOTICS CORP LTD
16th and 22nd Floor, Block C1, Nanshan I Park, No.1001 Xueyuan Road, Nanshan District, Shenzhen City, P.R.CHINA

Prepared by:

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Date: Apr. 02, 2019

Check No.: 3096316262

2 Version

Version No.	Date	Description
00	Apr. 02, 2019	Original

3 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	PASS
Conducted Peak Output Power	47 CFR Part 15 Subpart C Section 15.247 (b)(1)	ANSI C63.10-2013	PASS
20dB Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Carrier Frequencies Separation	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Hopping Channel Number	47 CFR Part 15 Subpart C Section 15.247 (b)	ANSI C63.10-2013	PASS
Dwell Time	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Pseudorandom Frequency Hopping Sequence	47 CFR Part 15 Subpart C Section 15.247(b)(4)&TCB Exclusion List (7 July 2002)	ANSI C63.10-2013	PASS
RF Conducted Spurious Emissions	47 CFR Part 15 Subpart C Section 15.247(d)	ANSI C63.10-2013	PASS
Radiated Spurious emissions	47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013	PASS

Remark:
Test according to ANSI C63.4-2014 & ANSI C63.10-2013.
The tested samples and the sample information are provided by the client.
Model No.: ERUB101, ERUwxyy
Only the model ERUB101 was tested, ERUwxyy(" w "can be a-z, indicating the product version; "x" can be 0-9, indicating the product category; "y" can be 0-9， indicating the product attributes.).All models are identical in interior structure, electrical circuits and components, only different from model name and color.

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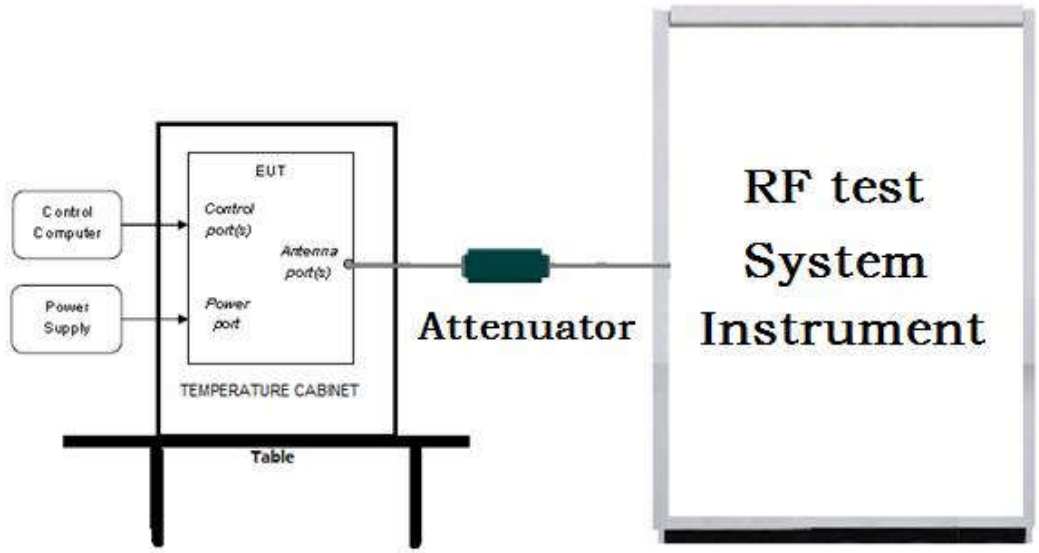
5 Test Requirement

5.1 Test setup

5.1.1 For Conducted test setup



5.1.2 For Radiated Emissions test setup

Radiated Emissions setup:

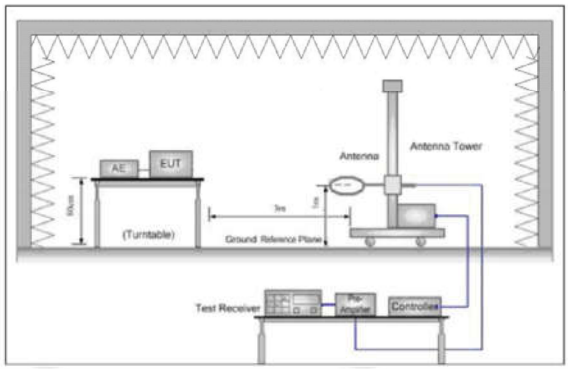


Figure 1. Below 30MHz

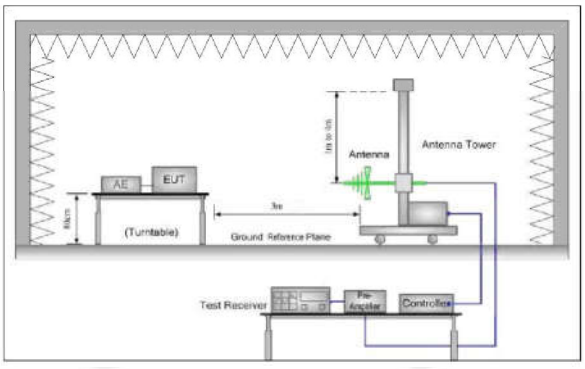


Figure 2. 30MHz to 1GHz

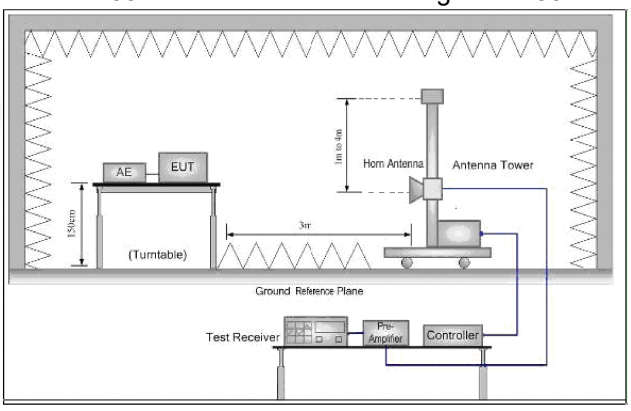
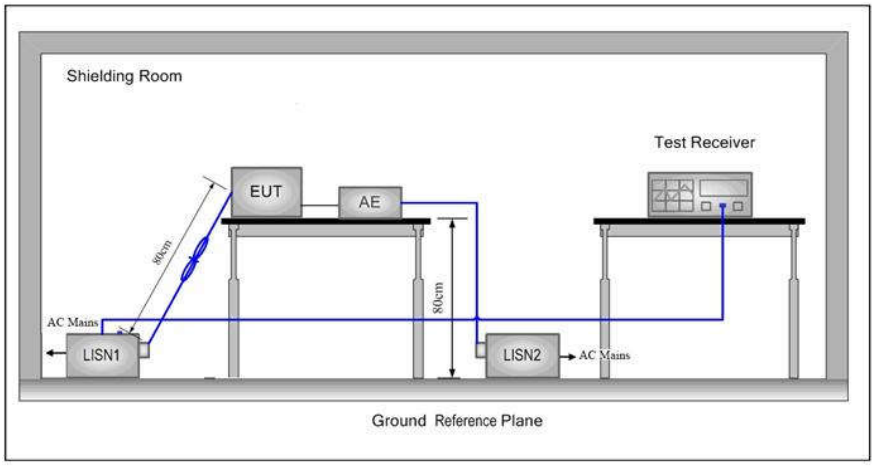


Figure 3. Above 1GHz

5.1.3 For Conducted Emissions test setup

Conducted Emissions setup



5.2 Test Environment

Operating Environment for RF test:	
Temperature:	26°C
Humidity:	54% RH
Atmospheric Pressure:	101kPa

5.3 Test Condition

Test Mode	Tx	RF Channel		
		Low(L)	Middle(M)	High(H)
GFSK/π/4DQPSK/ 8DPSK(DH1,DH3, DH5)	2402MHz~2480MHz	Channel 1	Channel 40	Channel79
		2402MHz	2441MHz	2480MHz
TX mode: The EUT transmitted the continuous signal at the specific channel(s). Charging mode: Charging the EUT through charger.				

Test mode:

Pre-scan under all rate at Lowest channel 1

Mode	**GFSK**		
packets	**1-DH1**	**1-DH3**	**1-DH5**
Power(dBm)	-1.987	-1.980	-1.971

Mode	π/4DQPSK		
packets	**2-DH1**	**2-DH3**	**2-DH5**
Power(dBm)	-1.701	-1.694	-1.690
Mode	8DPSK		
packets	**3-DH1**	**3-DH3**	**3-DH5**
Power(dBm)	-1.519	-1.512	-1.503

Through Pre-scan, 1-DH5 packet the power is the worst case of GFSK, 2-DH5 packet the power is the worst case of π/4DQPSK, 3-DH5 packet the power is the worst case of 8DPSK.

6 General Information

6.1 Client Information

Applicant:	UBTECH ROBOTICS CORP LTD
Address of Applicant:	16th and 22nd Floor, Block C1, Nanshan I Park, No.1001 Xueyuan Road, Nanshan District, Shenzhen City, P.R.CHINA
Manufacturer:	UBTECH ROBOTICS CORP LTD
Address of Manufacturer:	16th and 22nd Floor, Block C1, Nanshan I Park, No.1001 Xueyuan Road, Nanshan District, Shenzhen City, P.R.CHINA
Factory:	UBTECH ROBOTICS CORP LTD BAOAN BRANCH
Address of Factory:	1-2 Floor, B Block, Huilongda Industry Park, Shilongzai, Shiyan Street, Baoan District, Shenzhen City, P.R.CHINA

6.2 General Description of EUT

Product Name:	uKit Robot	
Model No.:	ERUB101, ERUwxyy	
Test Model No.:	ERUB101	
Trade mark:	UBTECH	
EUT Supports Radios application:	BT 4.0 Dual mode, 2402-2480MHz	
Power Supply:	AC Adapter	Model: PS1012-096HIB100 Input: 100-240V~ 50/60Hz, 0.4A Output: 9.6V⎓1.0A
	Battery	Lithium-ion Ploymer Battery:1200mAh 7.4V
Sample Received Date:	Feb. 28, 2019	
Sample tested Date:	Mar. 13, 2019 to Mar. 28, 2019	

6.3 Product Specification subjective to this standard

Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	3.0+EDR
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Modulation Type:	GFSK, π/4DQPSK, 8DPSK
Number of Channel:	79
Hopping Channel Type:	Adaptive Frequency Hopping systems
Hardware Version:	1.5(manufacturer declare)
Software Version:	1.77(manufacturer declare)
Test Power Grade:	N/A
Test Software of EUT:	ISRT_V2.1.26.4392(manufacturer declare)
Antenna Type:	PCB antenna
Antenna Gain:	1dBi
Test Voltage:	AC 120V, 60Hz

Operation Frequency each of channel

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	21	2422MHz	41	2442MHz	61	2462MHz
2	2403MHz	22	2423MHz	42	2443MHz	62	2463MHz

3	2404MHz	23	2424MHz	43	2444MHz	63	2464MHz
4	2405MHz	24	2425MHz	44	2445MHz	64	2465MHz
5	2406MHz	25	2426MHz	45	2446MHz	65	2466MHz
6	2407MHz	26	2427MHz	46	2447MHz	66	2467MHz
7	2408MHz	27	2428MHz	47	2448MHz	67	2468MHz
8	2409MHz	28	2429MHz	48	2449MHz	68	2469MHz
9	2410MHz	29	2430MHz	49	2450MHz	69	2470MHz
10	2411MHz	30	2431MHz	50	2451MHz	70	2471MHz
11	2412MHz	31	2432MHz	51	2452MHz	71	2472MHz
12	2413MHz	32	2433MHz	52	2453MHz	72	2473MHz
13	2414MHz	33	2434MHz	53	2454MHz	73	2474MHz
14	2415MHz	34	2435MHz	54	2455MHz	74	2475MHz
15	2416MHz	35	2436MHz	55	2456MHz	75	2476MHz
16	2417MHz	36	2437MHz	56	2457MHz	76	2477MHz
17	2418MHz	37	2438MHz	57	2458MHz	77	2478MHz
18	2419MHz	38	2439MHz	58	2459MHz	78	2479MHz
19	2420MHz	39	2440MHz	59	2460MHz	79	2480MHz
20	2421MHz	40	2441MHz	60	2461MHz		

6.4 Description of Support Units

The EUT has been tested independently.

6.5 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

6.6 Deviation from Standards

None.

6.7 Abnormalities from Standard Conditions

None.

6.8 Other Information Requested by the Customer

None.

6.9 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-18GHz)
3	Radiated Spurious emission test	4.3dB (30MHz-1GHz)
		4.5dB (1GHz-12.75GHz)
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%

7 Equipment List

RF test system					
Equipment	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. Date (mm-dd-yyyy)**	**Cal. Due date (mm-dd-yyyy)**
Signal Generator	Keysight	E8257D	MY53401106	03-01-2019	02-29-2020
Spectrum Analyzer	Keysight	N9010A	MY54510339	03-01-2019	02-29-2020
Signal Generator	Keysight	N5182B	MY53051549	03-01-2019	02-29-2020
High-pass filter	Sinoscite	FL3CX03WG18NM12-0398-002	---	01-09-2019	01-08-2020
High-pass filter	MICRO-TRONICS	SPA-F-63029-4	---	01-09-2019	01-08-2020
DC Power	Keysight	E3642A	MY54426035	03-01-2019	02-29-2020
PC-1	Lenovo	R4960d	---	03-01-2019	02-29-2020
BT&WI-FI Automatic control	R&S	OSP120	101374	03-01-2019	02-29-2020
RF control unit	JS Tonscend	JS0806-2	15860006	03-01-2019	02-29-2020
RF control unit	JS Tonscend	JS0806-1	15860004	03-01-2019	02-29-2020
RF control unit	JS Tonscend	JS0806-4	158060007	03-01-2019	02-29-2020
BT&WI-FI Automatic test software	JS Tonscend	JS1120-2	---	03-01-2019	02-29-2020
Temperature/ Humidity Indicator	biaozhi	HM10	1804186	10-12-2018	10-11-2019

Conducted disturbance Test					
Equipment	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm-dd-yyyy)**	**Cal. Due date (mm-dd-yyyy)**
Receiver	R&S	ESCI	100435	05-25-2018	05-24-2019
Temperature/ Humidity Indicator	Defu	TH128	/	07-02-2018	07-01-2019
Communication test set	Agilent	E5515C	GB47050534	03-01-2019	02-29-2020
Communication test set	R&S	CMW500	102898	01-18-2019	01-17-2020
LISN	R&S	ENV216	100098	05-10-2018	05-10-2019
LISN	schwarzbeck	NNLK8121	8121-529	05-10-2018	05-10-2019
Voltage Probe	R&S	ESH2-Z3 0299.7810.56	100042	06-13-2017	06-11-2020
Current Probe	R&S	EZ-17 816.2063.03	100106	05-30-2018	05-29-2019
ISN	TESEQ	ISN T800	30297	01-06-2019	01-15-2020

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	---	06-04-2016	06-03-2019
TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-401	12-21-2018	12-20-2019
TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-618	07-30-2018	07-29-2019
Microwave Preamplifier	Agilent	8449B	3008A02425	08-21-2018	08-20-2019
Microwave Preamplifier	Tonscend	EMC051845SE	980380	01-16-2019	01-15-2020
Horn Antenna	Schwarzbeck	BBHA 9120D	9120D-1869	04-25-2018	04-23-2021
Horn Antenna	ETS-LINDGREN	3117	00057410	06-05-2018	06-03-2021
Double ridge horn antenna	A.H.SYSTEMS	SAS-574	374	06-05-2018	06-04-2021
Pre-amplifier	A.H.SYSTEMS	PAP-1840-60	6041.6041	08-08-2018	08-07-2019
Loop Antenna	ETS	6502	00071730	06-22-2017	06-21-2019
Spectrum Analyzer	R&S	FSP40	100416	05-11-2018	05-10-2019
Receiver	R&S	ESCI	100435	05-25-2018	05-24-2019
Receiver	R&S	ESCI7	100938-003	11-23-2018	11-22-2019
Multi device Controller	maturo	NCD/070/10711112	---	01-09-2019	01-08-2020
LISN	schwarzbeck	NNBM8125	81251547	05-11-2018	05-10-2019
LISN	schwarzbeck	NNBM8125	81251548	05-11-2018	05-10-2019
Signal Generator	Agilent	E4438C	MY45095744	03-01-2019	02-29-2020
Signal Generator	Keysight	E8257D	MY53401106	03-01-2019	02-29-2020
Temperature/ Humidity Indicator	Shanghai qixiang	HM10	1804298	10-12-2018	10-11-2019
Communication test set	Agilent	E5515C	GB47050534	03-01-2019	02-29-2020
Cable line	Fulai(7M)	SF106	5219/6A	01-09-2019	01-08-2020
Cable line	Fulai(6M)	SF106	5220/6A	01-09-2019	01-08-2020
Cable line	Fulai(3M)	SF106	5216/6A	01-09-2019	01-08-2020
Cable line	Fulai(3M)	SF106	5217/6A	01-09-2019	01-08-2020
Communication test set	R&S	CMW500	104466	01-18-2019	01-17-2020
High-pass filter	Sinoscite	FL3CX03WG18NM12-0398-002	---	01-09-2019	01-08-2020
High-pass filter	MICRO-TRONICS	SPA-F-63029-4	---	01-09-2019	01-08-2020
band rejection filter	Sinoscite	FL5CX01CA09CL12-0395-001	---	01-09-2019	01-08-2020
band rejection filter	Sinoscite	FL5CX01CA08CL12-0393-001	---	01-09-2019	01-08-2020
band rejection filter	Sinoscite	FL5CX02CA04CL12-0396-002	---	01-09-2019	01-08-2020
band rejection filter	Sinoscite	FL5CX02CA03CL12-0394-001	---	01-09-2019	01-08-2020

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	06-20-2018	06-19-2019
Receiver	Keysight	N9038A	MY57290136	03-28-2018 03-27-2019	03-27-2019 03-25-2020
Spectrum Analyzer	Keysight	N9020B	MY57111112	03-28-2018 03-27-2019	03-27-2019 03-25-2020
Spectrum Analyzer	Keysight	N9030B	MY57140871	03-28-2018 03-27-2019	03-27-2019 03-25-2020
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-075	04-25-2018	04-23-2021
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-076	04-25-2018	04-23-2021
TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	9163-1148	04-25-2018	04-23-2021
Horn Antenna	Schwarzbeck	BBHA 9170	9170-832	04-25-2018	04-23-2021
Horn Antenna	Schwarzbeck	BBHA 9170	9170-829	04-25-2018	04-23-2021
Communication Antenna	Schwarzbeck	CLSA 0110L	1014	02-15-2018	02-14-2019
Biconical antenna	Schwarzbeck	VUBA 9117	9117-381	04-25-2018	04-23-2021
Horn Antenna	ETS-LINDGREN	3117	00057407	07-10-2018	07-08-2021
Preamplifier	EMCI	EMC184055SE	980596	06-20-2018	06-19-2019
Communication test set	R&S	CMW500	102898	01-18-2019	01-17-2020
Preamplifier	EMCI	EMC001330	980563	06-20-2018	06-19-2019
Preamplifier	Agilent	8449B	3008A02425	08-21-2018	08-20-2019
Temperature/ Humidity Indicator	biaozhi	GM1360	EE1186631	05-02-2018	05-01-2019
Signal Generator	KEYSIGHT	E8257D	MY53401106	03-13-2018	03-12-2019
Fully Anechoic Chamber	TDK	FAC-3	---	01-17-2018	01-15-2021
Filter bank	JS Tonscend	JS0806-F	188060094	04-10-2018	04-08-2021
Cable line	Times	SFT205-NMSM-2.50M	394812-0001	01-09-2019	01-08-2020
Cable line	Times	SFT205-NMSM-2.50M	394812-0002	01-09-2019	01-08-2020
Cable line	Times	SFT205-NMSM-2.50M	394812-0003	01-09-2019	01-08-2020
Cable line	Times	SFT205-NMSM-2.50M	393495-0001	01-09-2019	01-08-2020
Cable line	Times	EMC104-NMNM-1000	SN160710	01-09-2019	01-08-2020
Cable line	Times	SFT205-NMSM-3.00M	394813-0001	01-09-2019	01-08-2020
Cable line	Times	SFT205-NMNM-1.50M	381964-0001	01-09-2019	01-08-2020
Cable line	Times	SFT205-NMSM-7.00M	394815-0001	01-09-2019	01-08-2020
Cable line	Times	HF160-KMKM-3.00M	393493-0001	01-09-2019	01-08-2020

8 Radio Technical Requirements Specification

Reference documents for testing:

No.	Identity	Document Title
1	FCC Part15C	Subpart C-Intentional Radiators
2	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices

Test Results List:

Test requirement	Test method	Test item	Verdict	Note
Part15C Section 15.247 (a)(1)	ANSI 63.10	20dB Occupied Bandwidth	PASS	Appendix A)
Part15C Section 15.247 (a)(1)	ANSI 63.10	Carrier Frequencies Separation	PASS	Appendix B)
Part15C Section 15.247 (a)(1)	ANSI 63.10	Dwell Time	PASS	Appendix C)
Part15C Section 15.247 (b)	ANSI 63.10	Hopping Channel Number	PASS	Appendix D)
Part15C Section 15.247 (b)(1)	ANSI 63.10	Conducted Peak Output Power	PASS	Appendix E)
Part15C Section 15.247(d)	ANSI 63.10	Band-edge for RF Conducted Emissions	PASS	Appendix F)
Part15C Section 15.247(d)	ANSI 63.10	RF Conducted Spurious Emissions	PASS	Appendix G)
Part15C Section 15.247 (a)(1)	ANSI 63.10	Pseudorandom Frequency Hopping Sequence	PASS	Appendix H)
Part15C Section 15.203/15.247 (c)	ANSI 63.10	Antenna Requirement	PASS	Appendix I)
Part15C Section 15.207	ANSI 63.10	AC Power Line Conducted Emission	PASS	Appendix J)
Part15C Section 15.205/15.209	ANSI 63.10	Restricted bands around fundamental frequency (Radiated) Emission)	PASS	Appendix K)
Part15C Section 15.205/15.209	ANSI 63.10	Radiated Spurious Emissions	PASS	Appendix L)

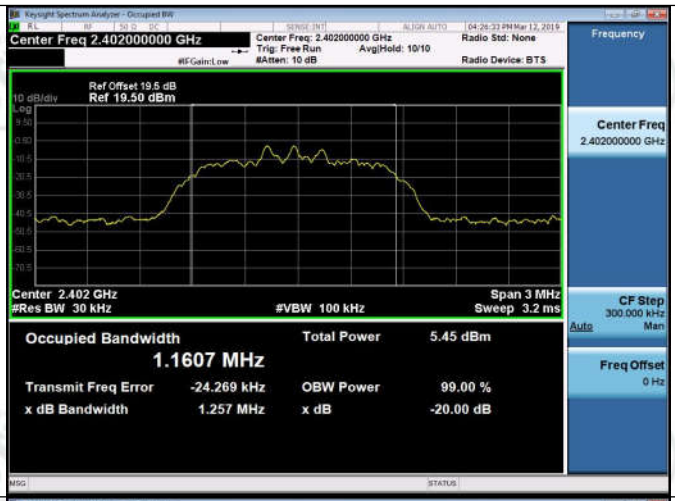
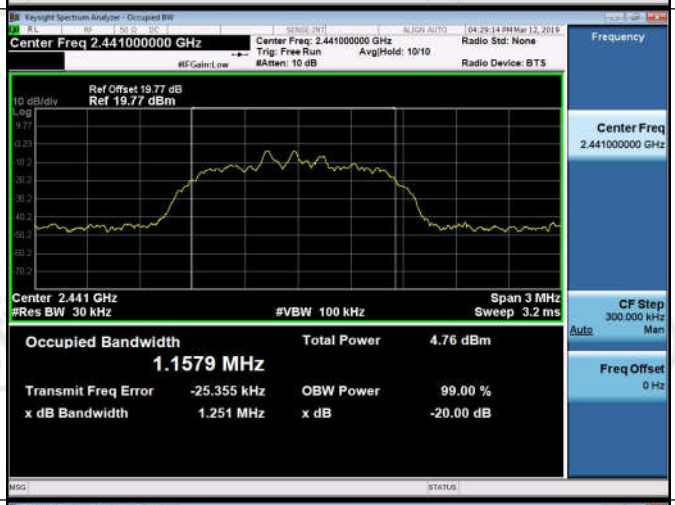
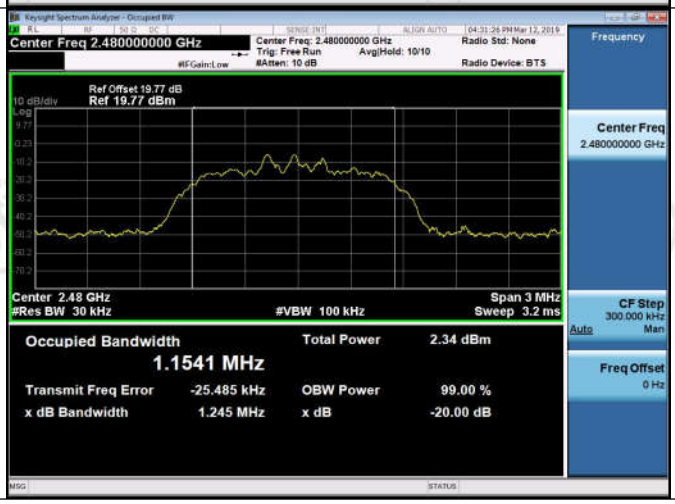
Appendix A): 20dB Occupied Bandwidth

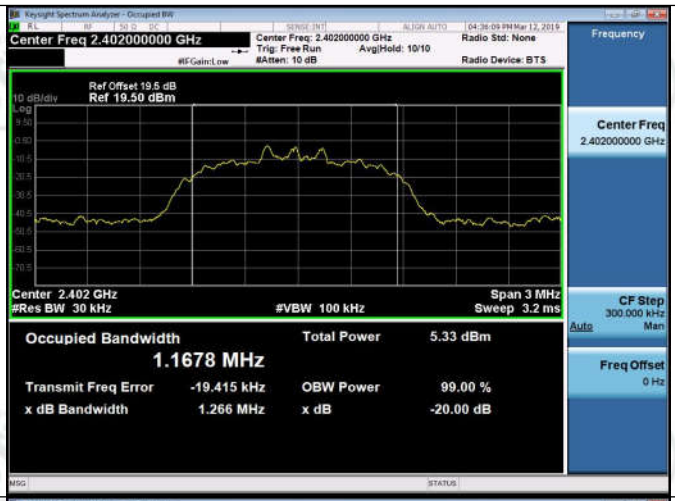
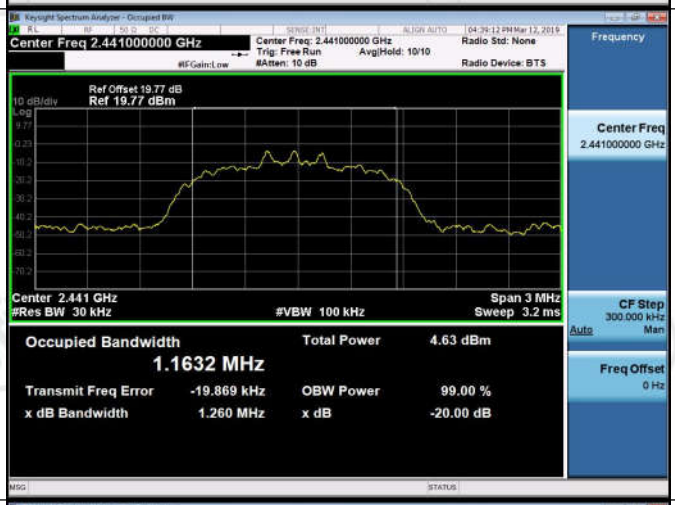
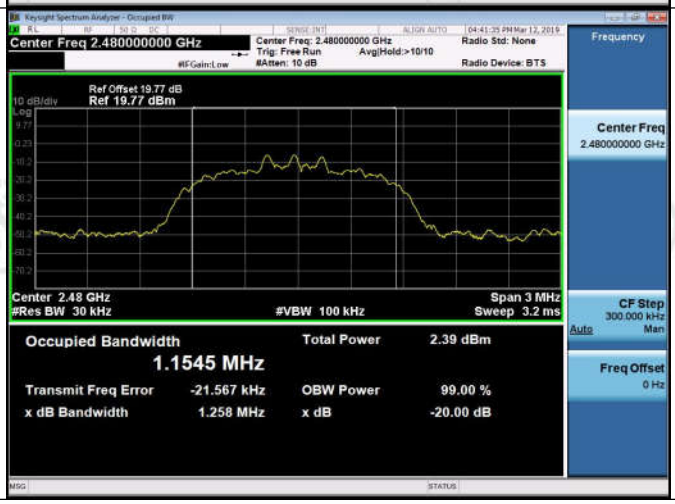
Test Result

Mode	Channel.	20dB Bandwidth [MHz]	99% OBW [MHz]	Verdict
GFSK	LCH	0.9555	0.88974	PASS
GFSK	MCH	0.9514	0.88634	PASS
GFSK	HCH	0.9530	0.87991	PASS
π/4DQPSK	LCH	1.257	1.1607	PASS
π/4DQPSK	MCH	1.251	1.1579	PASS
π/4DQPSK	HCH	1.245	1.1541	PASS
8DPSK	LCH	1.266	1.1678	PASS
8DPSK	MCH	1.260	1.1632	PASS
8DPSK	HCH	1.258	1.1545	PASS

Test Graph

Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/HCH			

8DPSK/LCH			
8DPSK/MCH			
8DPSK/HCH			

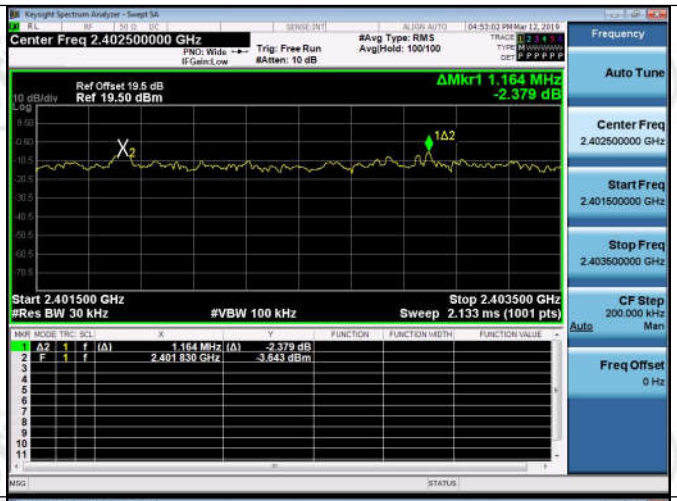
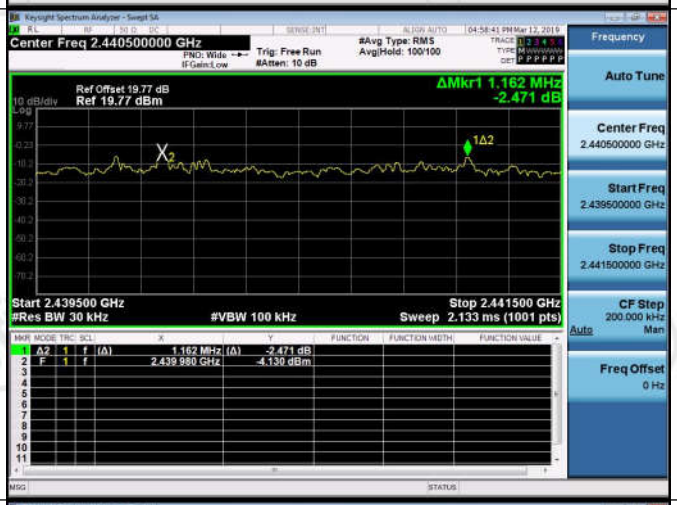
Appendix B): Carrier Frequency Separation

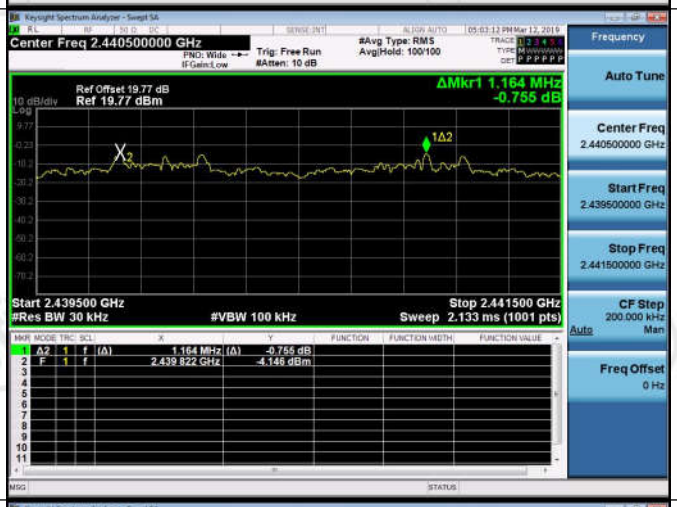
Result Table

Mode	Channel.	Carrier Frequency Separation [MHz]	Verdict
GFSK	LCH	1.152	PASS
GFSK	MCH	0.990	PASS
GFSK	HCH	1.162	PASS
π/4DQPSK	LCH	1.164	PASS
π/4DQPSK	MCH	1.162	PASS
π/4DQPSK	HCH	1.126	PASS
8DPSK	LCH	0.986	PASS
8DPSK	MCH	1.164	PASS
8DPSK	HCH	1.000	PASS

Test Graph

Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/HCH			

8DPSK/LCH			
8DPSK/MCH			
8DPSK/HCH			

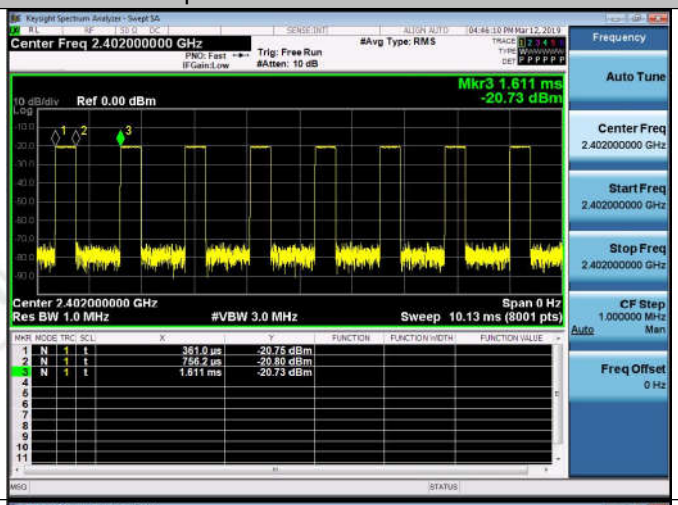
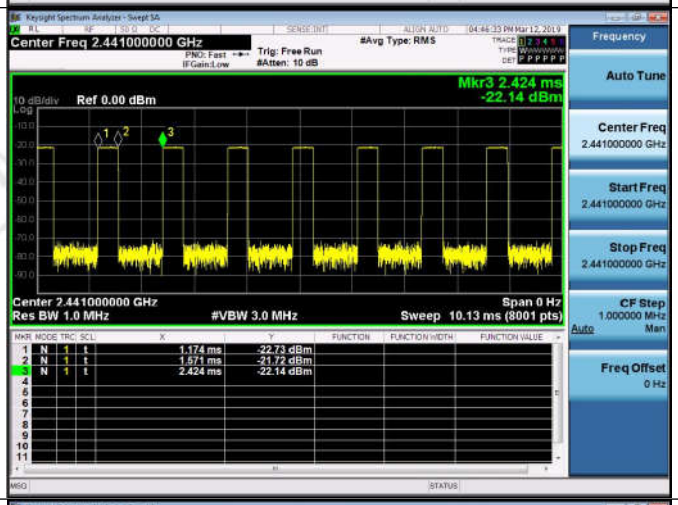
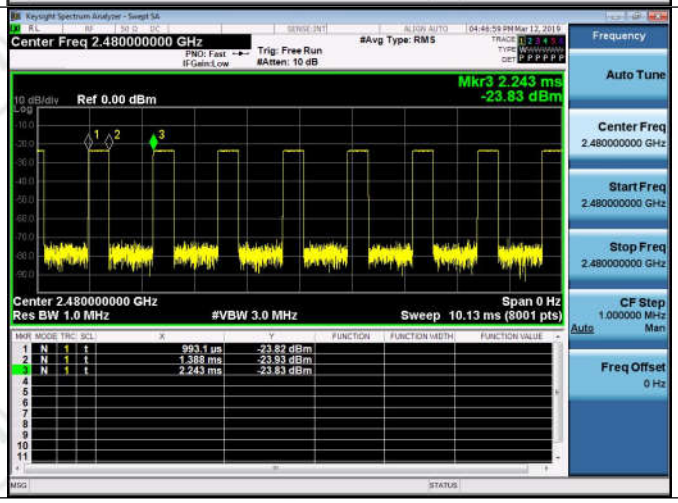
Appendix C): Dwell Time

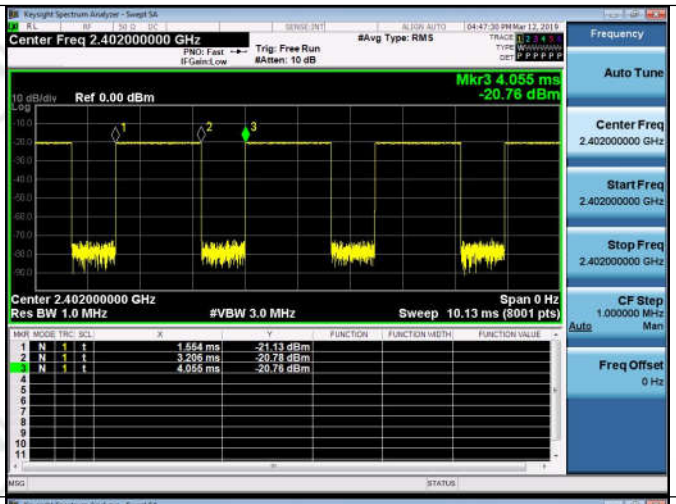
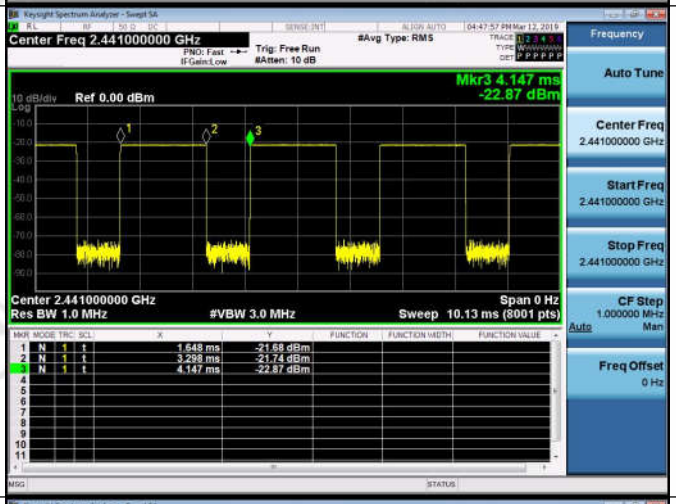
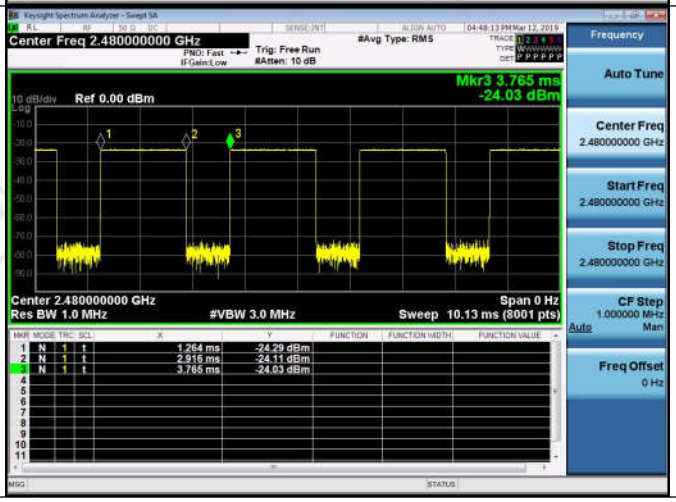
Result Table

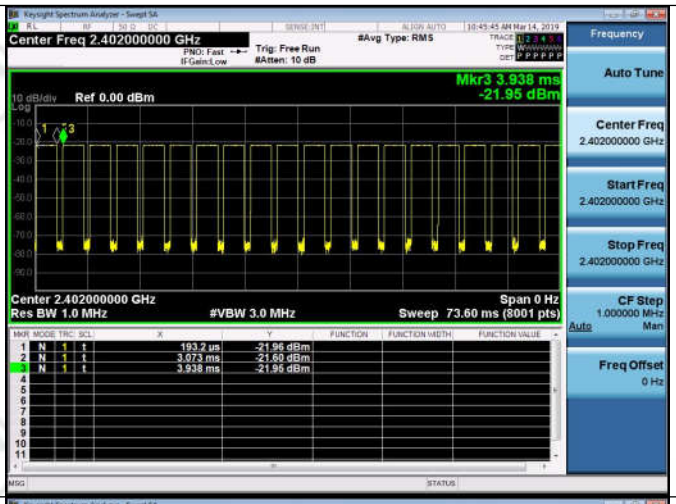
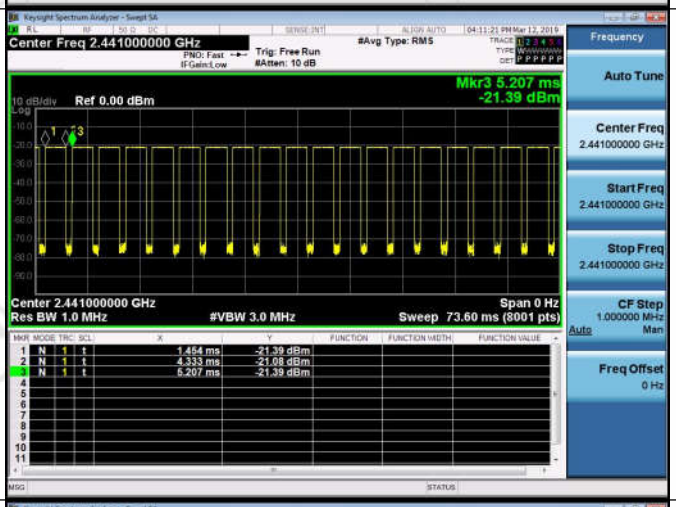
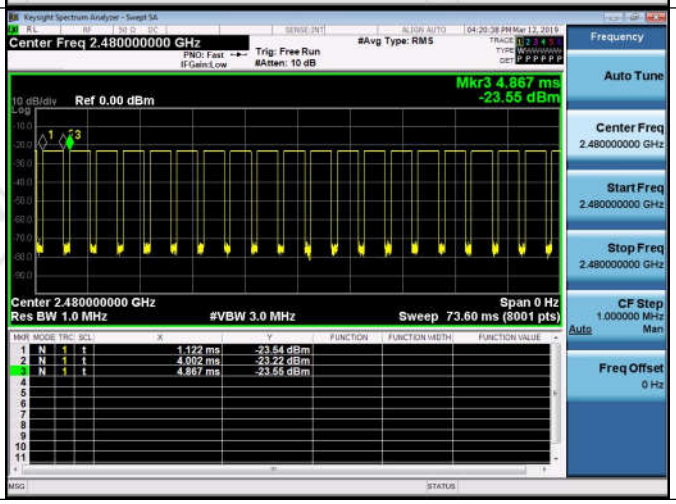
Mode	Packet	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Duty Cycle [%]	Verdict
GFSK	DH1	LCH	0.3952	320	0.126	0.32	PASS
GFSK	DH1	MCH	0.39647	320	0.127	0.32	PASS
GFSK	DH1	HCH	0.395203	320	0.126	0.32	PASS
GFSK	DH3	LCH	1.65173	160	0.264	0.66	PASS
GFSK	DH3	MCH	1.65047	160	0.264	0.66	PASS
GFSK	DH3	HCH	1.65174	160	0.264	0.66	PASS
GFSK	DH5	LCH	2.8796	106.7	0.307	0.77	PASS
GFSK	DH5	MCH	2.8796	106.7	0.307	0.77	PASS
GFSK	DH5	HCH	2.8796	106.7	0.307	0.77	PASS

Remark : All modes are tested, only the worst mode GFSK is reported.

Test Graph

Graphs		
GFSK_DH1/LCH		
GFSK_DH1/MCH		
GFSK_DH1/HCH		

GFSK_DH3/LCH		
GFSK_DH3/MCH		
GFSK_DH3/HCH		

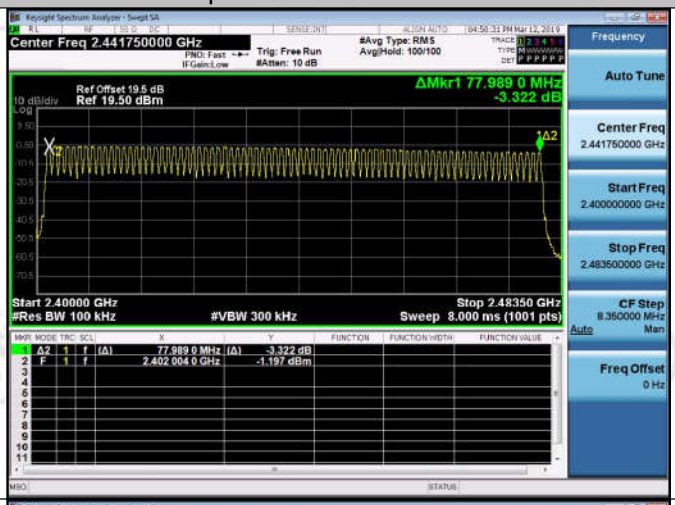
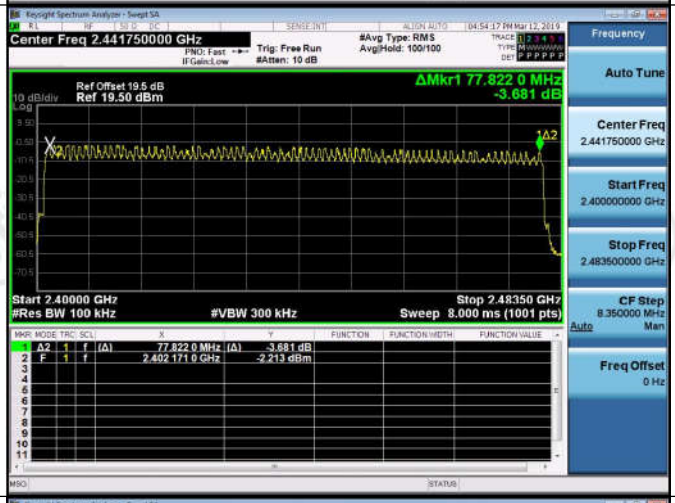
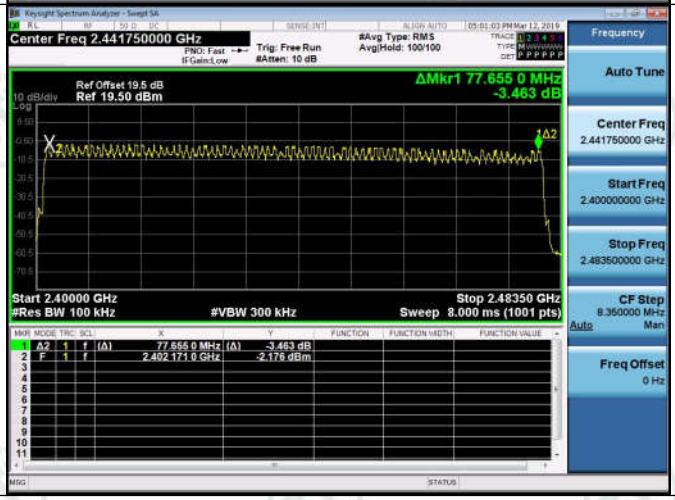
GFSK_DH5/LCH		
GFSK_DH5/MCH		
GFSK_DH5/HCH		

Appendix D): Hopping Channel Number

Result Table

Mode	Channel.	Number of Hopping Channel	Verdict
GFSK	Hop	79	PASS
π/4DQPSK	Hop	79	PASS
8DPSK	Hop	79	PASS

Test Graph

Graphs			
GFSK/Hop			
π/4DQPSK/Hop			
8DPSK/Hop			

Appendix E): Conducted Peak Output Power

Result Table

Mode	Channel.	Maximum Peak Output Power [dBm]	Verdict
GFSK	LCH	-1.971	PASS
GFSK	MCH	-1.008	PASS
GFSK	HCH	-3.035	PASS
π/4DQPSK	LCH	-1.690	PASS
π/4DQPSK	MCH	-2.274	PASS
π/4DQPSK	HCH	-4.550	PASS
8DPSK	LCH	-1.503	PASS
8DPSK	MCH	-2.188	PASS
8DPSK	HCH	-4.447	PASS

Test Graph

Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/HCH			

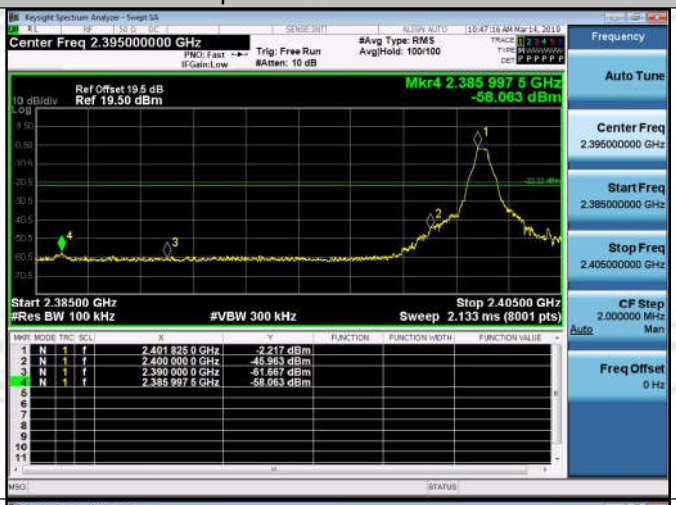
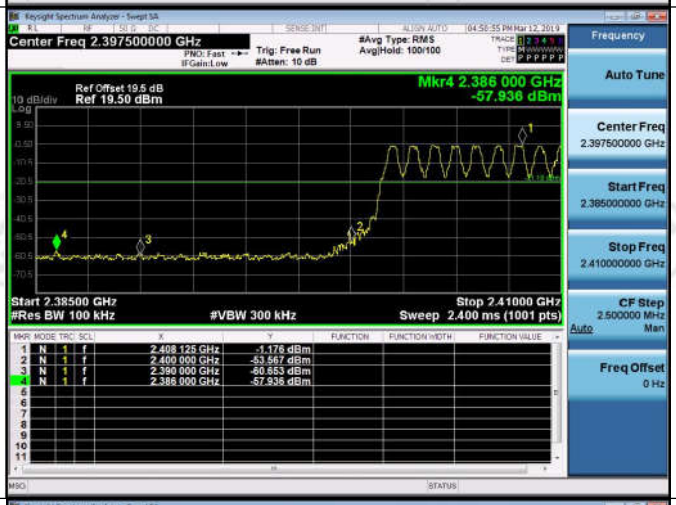
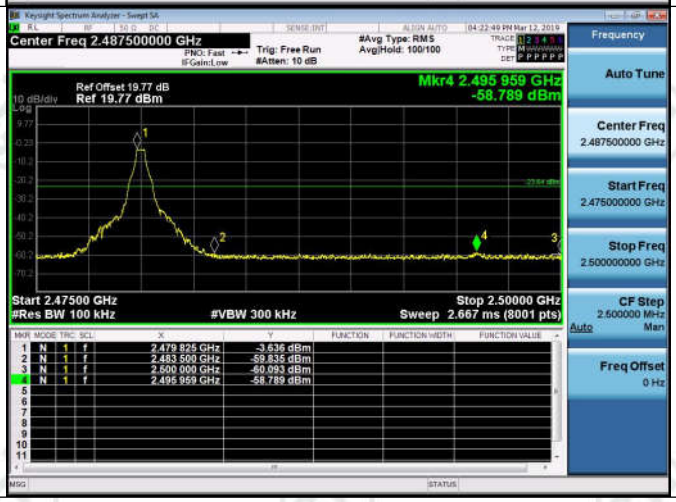
8DPSK/LCH			
8DPSK/MCH			
8DPSK/HCH			

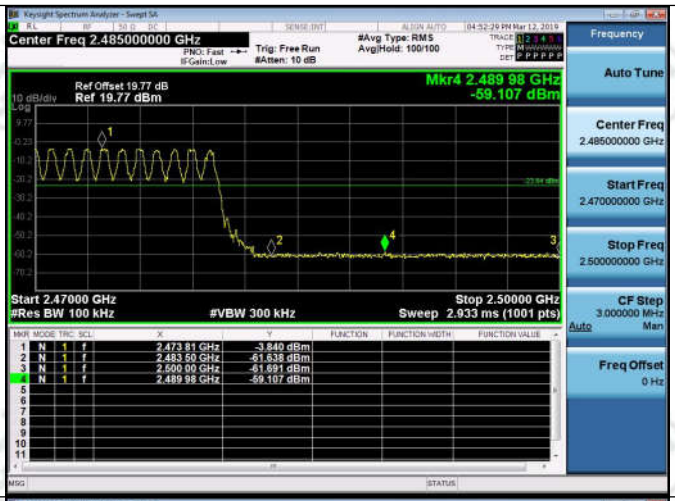
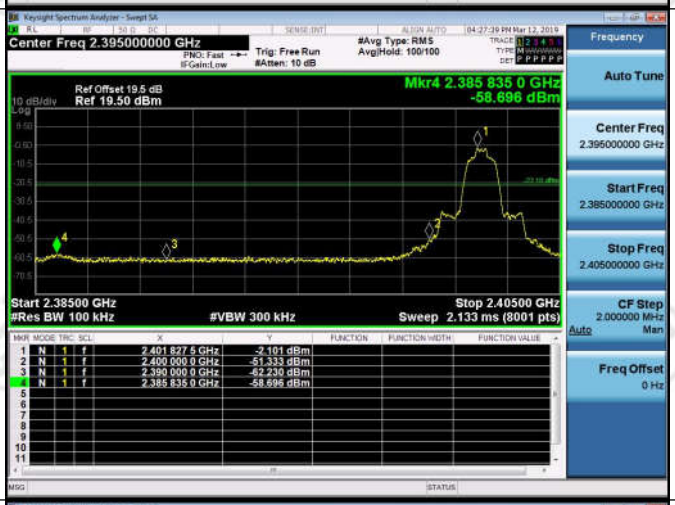
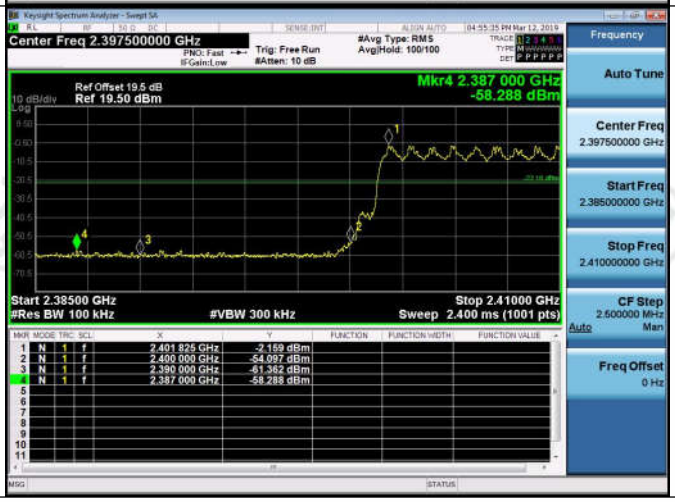
Appendix F): Band-edge for RF Conducted Emissions

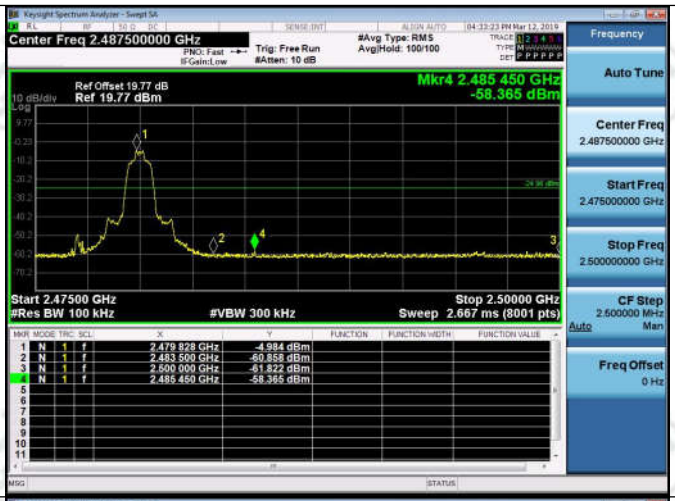
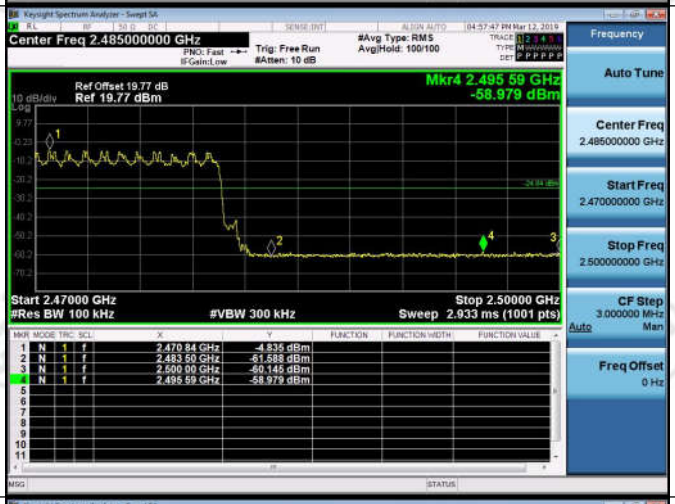
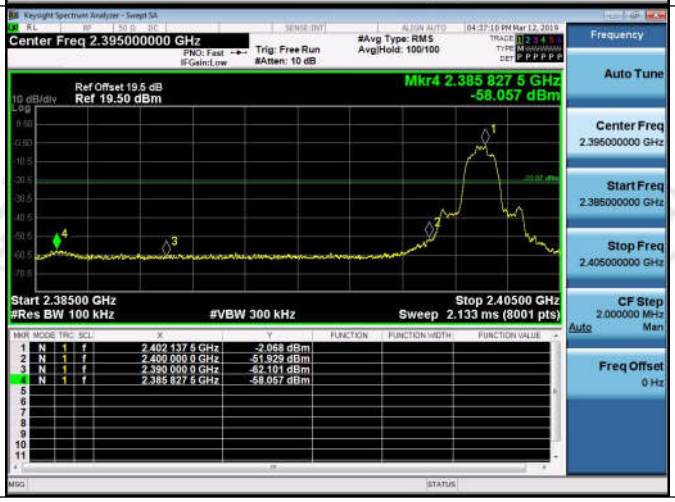
Result Table

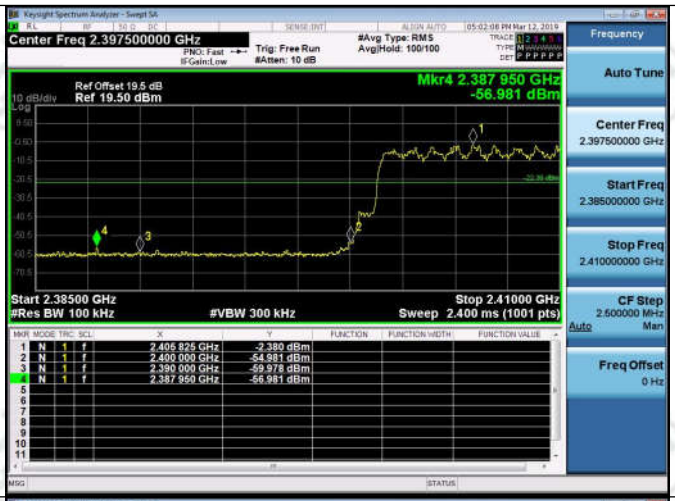
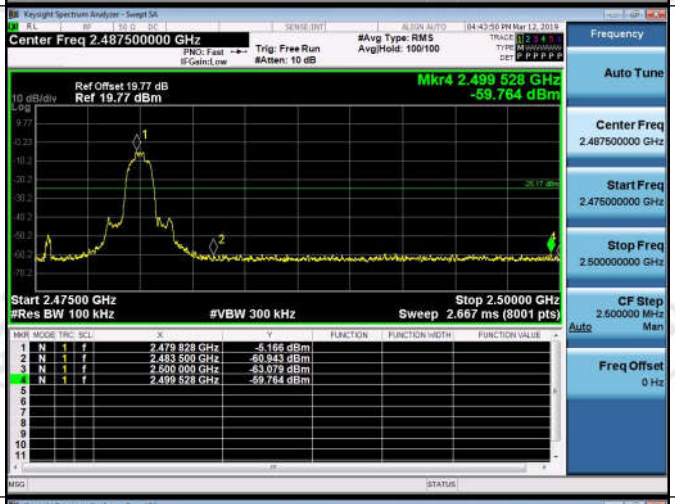
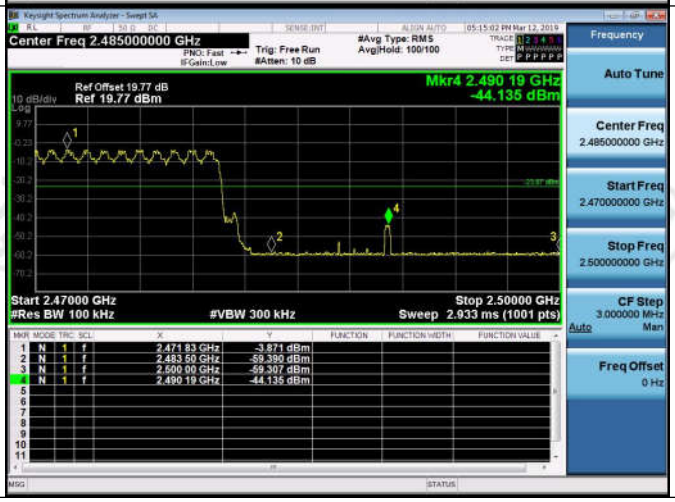
Mode	Channel	Carrier Frequency [MHz]	Carrier Power [dBm]	Frequency Hopping	Max Spurious Level [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2402	-2.217	Off	-58.063	-22.22	PASS
			-1.176	On	-57.936	-21.18	PASS
GFSK	HCH	2480	-3.636	Off	-58.789	-23.64	PASS
			-3.840	On	-59.107	-23.84	PASS
π/4DQPSK	LCH	2402	-2.101	Off	-58.696	-22.1	PASS
			-2.159	On	-58.288	-22.16	PASS
π/4DQPSK	HCH	2480	-4.984	Off	-58.365	-24.98	PASS
			-4.835	On	-58.979	-24.84	PASS
8DPSK	LCH	2402	-2.068	Off	-58.057	-22.07	PASS
			-2.380	On	-56.981	-22.38	PASS
8DPSK	HCH	2480	-5.166	Off	-59.764	-25.17	PASS
			-3.871	On	-44.135	-23.87	PASS

Test Graph

Graphs			
GFSK/LCH/No Hop			
GFSK/LCH/Hop			
GFSK/HCH/No Hop			

GFSK/HCH/Hop			
π/4DQPSK/LCH/ No Hop			
π/4DQPSK/LCH/ Hop			

π/4DQPSK/HCH/ No Hop			
π/4DQPSK/HCH/ Hop			
8DPSK/LCH/No Hop			

8DPSK/LCH/Hop			
8DPSK/HCH/No Hop			
8DPSK/HCH/Hop			

Appendix G): RF Conducted Spurious Emissions

Result Table

Mode	Channel	Pref [dBm]	Puw[dBm]	Verdict
GFSK	LCH	-2.02	<Limit	PASS
GFSK	MCH	-1.462	<Limit	PASS
GFSK	HCH	-3.653	<Limit	PASS
π/4DQPSK	LCH	-2.118	<Limit	PASS
π/4DQPSK	MCH	-2.725	<Limit	PASS
π/4DQPSK	HCH	-5.09	<Limit	PASS
8DPSK	LCH	-2.126	<Limit	PASS
8DPSK	MCH	-2.858	<Limit	PASS
8DPSK	HCH	-5.156	<Limit	PASS

Test Graph

GFSK_LCH_Graphs		
Pref		
Puw		

GFSK_MCH_Graphs		
Pref		

Puw	

GFSK_HCH_Graphs	
Pref	
Puw	

π/4DQPSK_LCH_Graphs		
Pref		
Puw		

π/4DQPSK_MCH_Graphs		
Pref		

Puw	

π/4DQPSK_HCH_Graphs	
Pref	
Puw	

8DPSK_LCH_Graphs		
Pref		
Puw		

8DPSK_MCH_Graphs		
Pref		

Puw	

8DPSK_HCH_Graphs	
Pref	
Puw	

Appendix H): Pseudorandom Frequency Hopping Sequence

Test Requirement:	47 CFR Part 15**C Section 15.247 (a)(1) requirement:**

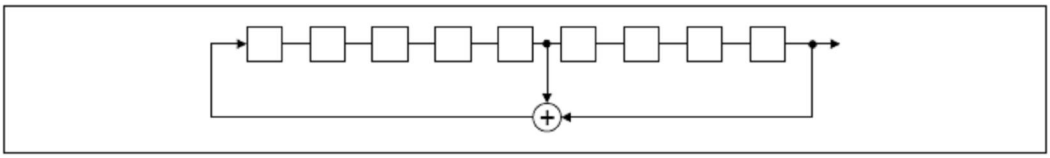
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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

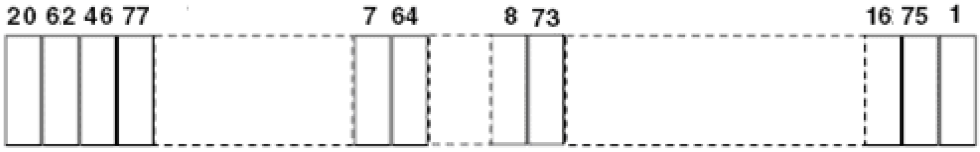
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized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

- Number of shift register stages: 9
- Length of pseudo-random sequence: 2^9 -1 = 511 bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



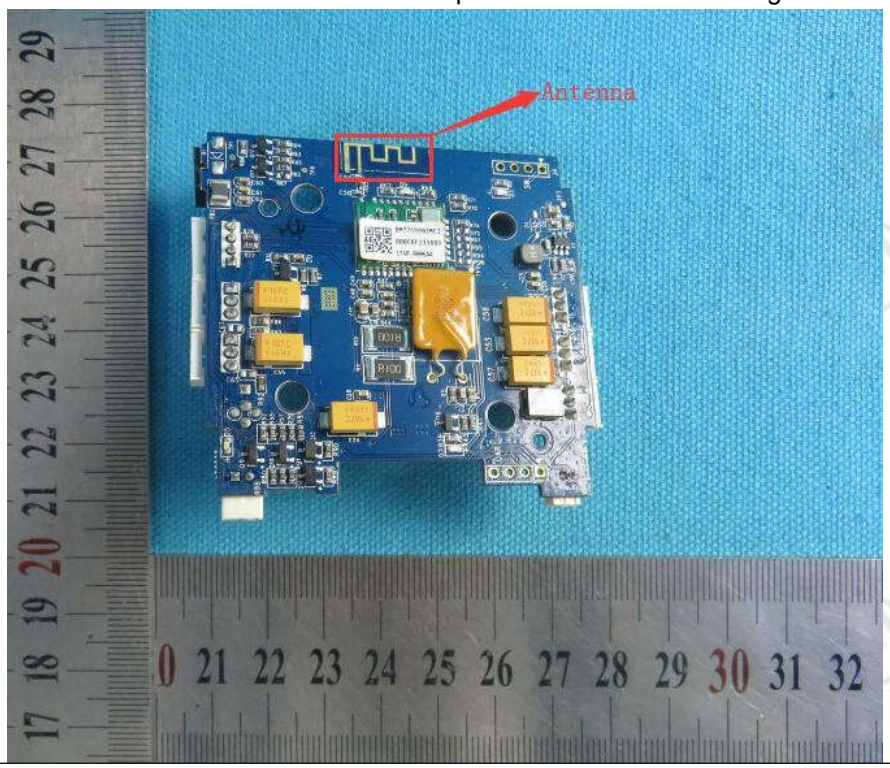
Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

The device does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

Appendix I): Antenna Requirement

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:
The antenna is PCB antenna and no consideration of replacement. The best case gain of the antenna is 1dBi.



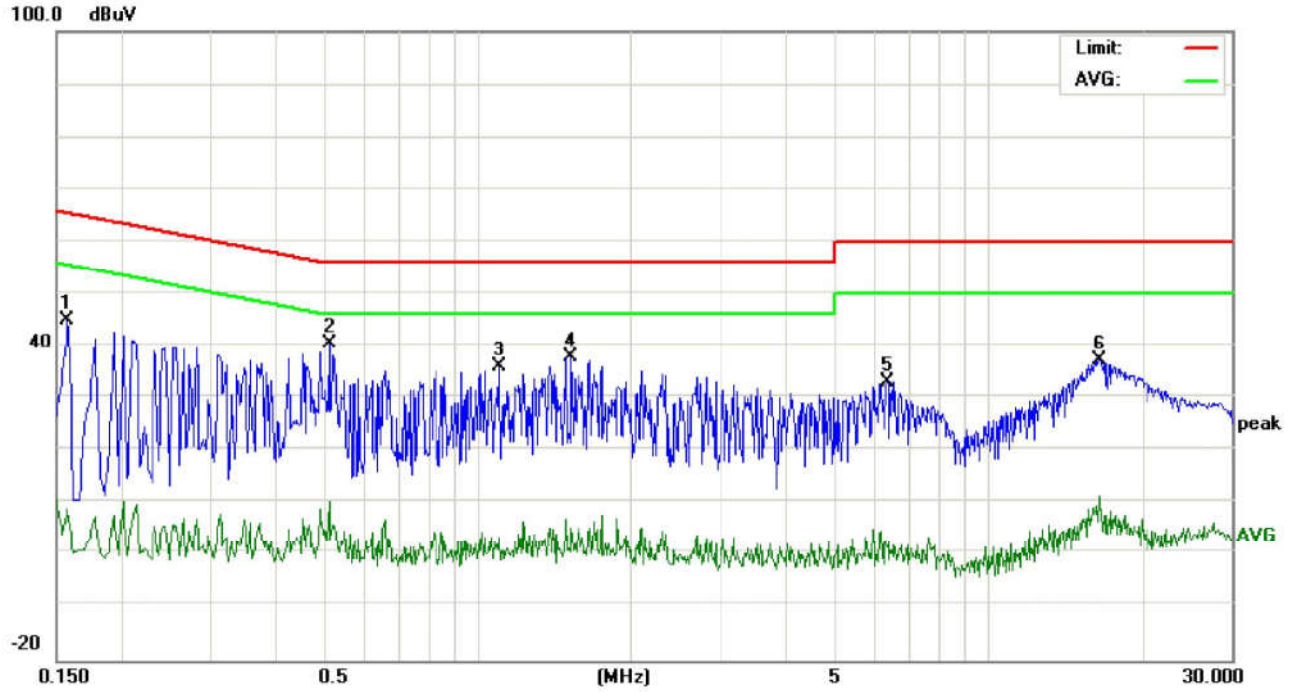
Appendix J): AC Power Line Conducted Emission

<table>
<tr><td>Test Procedure:</td><td colspan="3">Test frequency range :150KHz-30MHz
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 on conducted measurement.</td></tr>
<tr><td>Limit:</td><td colspan="3"><table><tr><td rowspan="2">Frequency range (MHz)</td><td colspan="2">Limit (dBμV)</td></tr><tr><td>Quasi-peak</td><td>Average</td></tr><tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr><tr><td>0.5-5</td><td>56</td><td>46</td></tr><tr><td>5-30</td><td>60</td><td>50</td></tr></table>* The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.
NOTE : The lower limit is applicable at the transition frequency</td></tr>
<tr><td>Charging mode:</td><td colspan="3">Charging the EUT through charger.</td></tr>
<tr><td>Test Ambient:</td><td>Temp.: 22°C</td><td>Humid.: 53%</td><td>Press.: 101kPa</td></tr>
</table>

Measurement Data

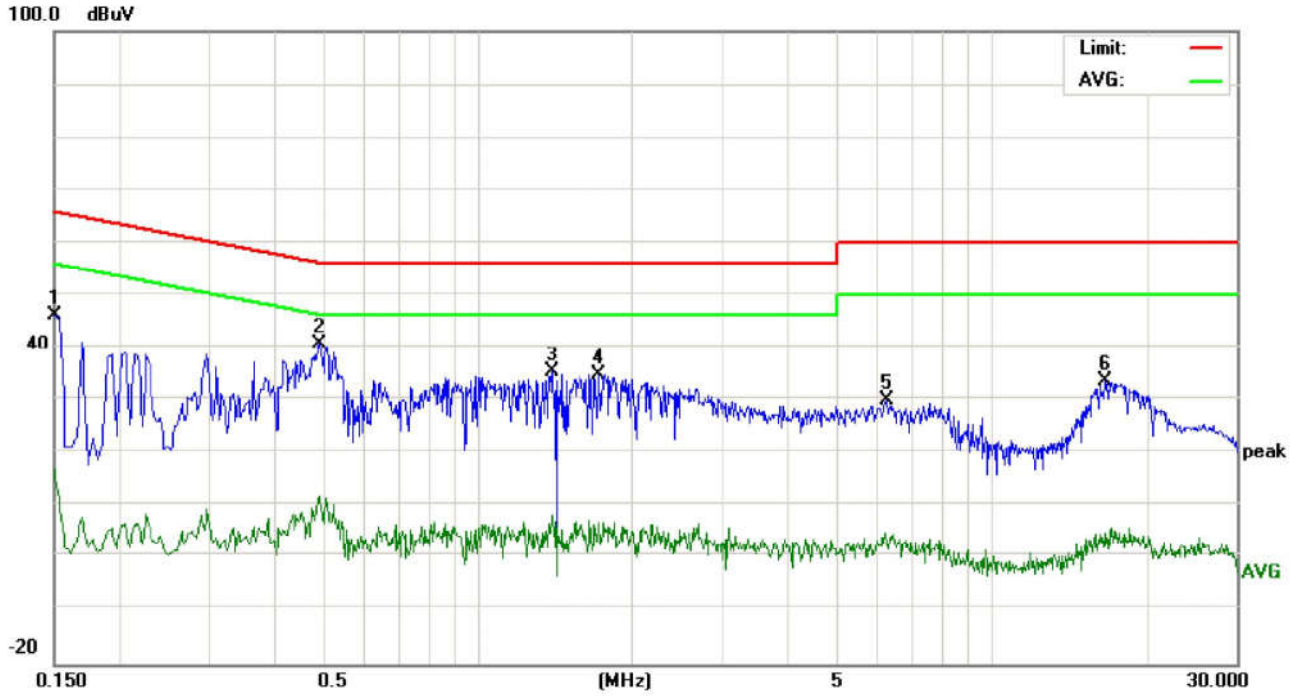
An initial pre-scan was performed on the live and neutral lines with peak detector.
Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live line:



No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	0.1580	34.98		-1.01	9.91	44.89		8.90	65.56	55.56	-20.67	-46.66	P	
2	0.5140	30.48		0.41	9.91	40.39		10.32	56.00	46.00	-15.61	-35.68	P	
3	1.1019	26.16		-6.66	9.80	35.96		3.14	56.00	46.00	-20.04	-42.86	P	
4	1.5220	27.91		-4.79	9.76	37.67		4.97	56.00	46.00	-18.33	-41.03	P	
5	6.3700	23.27		-8.18	9.74	33.01		1.56	60.00	50.00	-26.99	-48.44	P	
6	16.4860	27.27		1.26	9.96	37.23		11.22	60.00	50.00	-22.77	-38.78	P	

Neutral line:



No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	0.1500	36.34		7.03	9.91	46.25		16.94	65.99	55.99	-19.74	-39.05	P	
2	0.4940	31.01		1.93	9.89	40.90		11.82	56.10	46.10	-15.20	-34.28	P	
3	1.3900	25.49		-2.66	9.77	35.26		7.11	56.00	46.00	-20.74	-38.89	P	
4	1.7180	25.04		-3.90	9.75	34.79		5.85	56.00	46.00	-21.21	-40.15	P	
5	6.2900	20.17		-6.84	9.74	29.91		2.90	60.00	50.00	-30.09	-47.10	P	
6	16.6500	23.51		-5.31	9.96	33.47		4.65	60.00	50.00	-26.53	-45.35	P	

Notes:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.

Appendix K): Restricted bands around fundamental frequency (Radiated)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
30MHz-1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Test Procedure:

Below 1GHz test procedure as below:

a. 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.
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 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. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel

Above 1GHz test procedure as below:

g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).
h. b. Test the EUT in the lowest channel , the Highest channel
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is worse case.
j. Repeat above procedures until all frequencies measured was complete.

Limit:

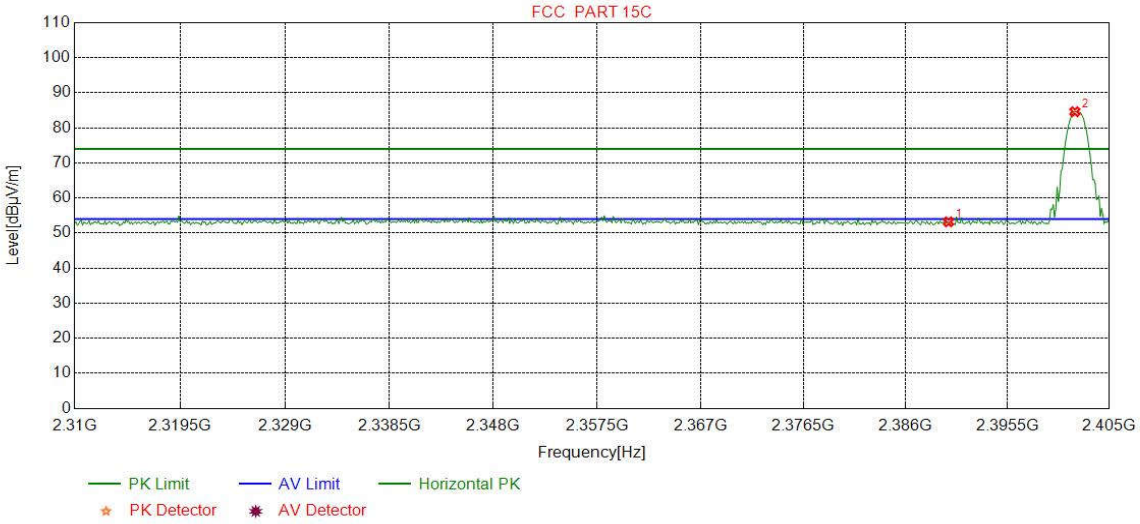
Frequency	Limit (dBμV/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
	74.0	Peak Value

Test Ambient:	Temp.: 24°C	Humid.: 56%	Press.: 101kPa

Test plot as follows:

Mode:	GFSK Transmitting	Channel:	2402
Remark:	Peak		

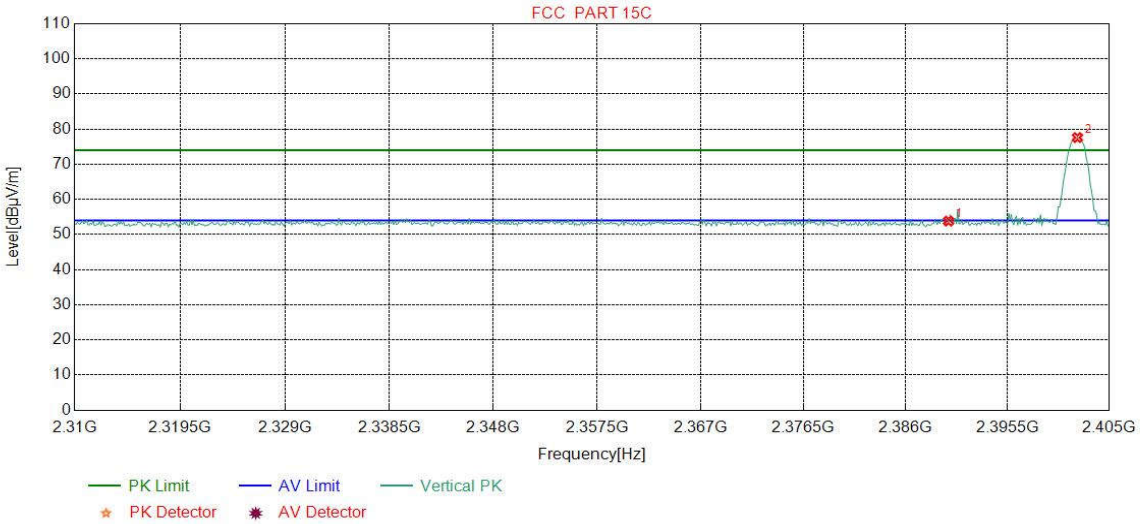
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity
1	2390.0000	32.25	13.37	-42.44	50.02	53.20	74.00	20.80	Pass	Horizontal
2	2401.7897	32.26	13.31	-42.43	81.47	84.61	74.00	-10.61	Pass	Horizontal

Mode:	GFSK Transmitting	Channel:	2402
Remark:	Peak		

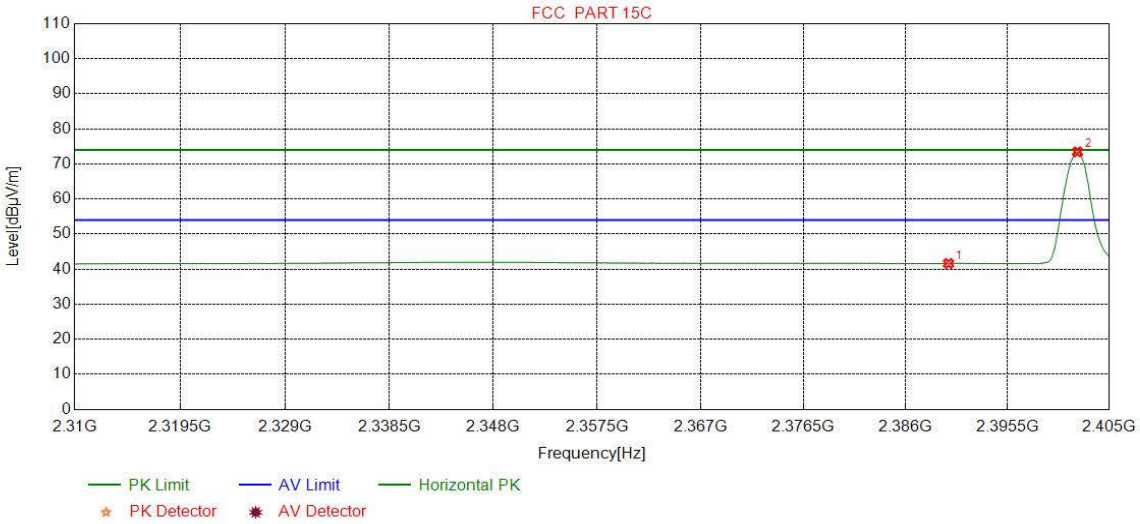
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity
1	2390.0000	32.25	13.37	-42.44	50.64	53.82	74.00	20.18	Pass	Vertical
2	2402.0275	32.26	13.31	-42.43	74.46	77.60	74.00	-3.60	Pass	Vertical

Mode:	GFSK Transmitting	Channel:	2402
Remark:	AV		

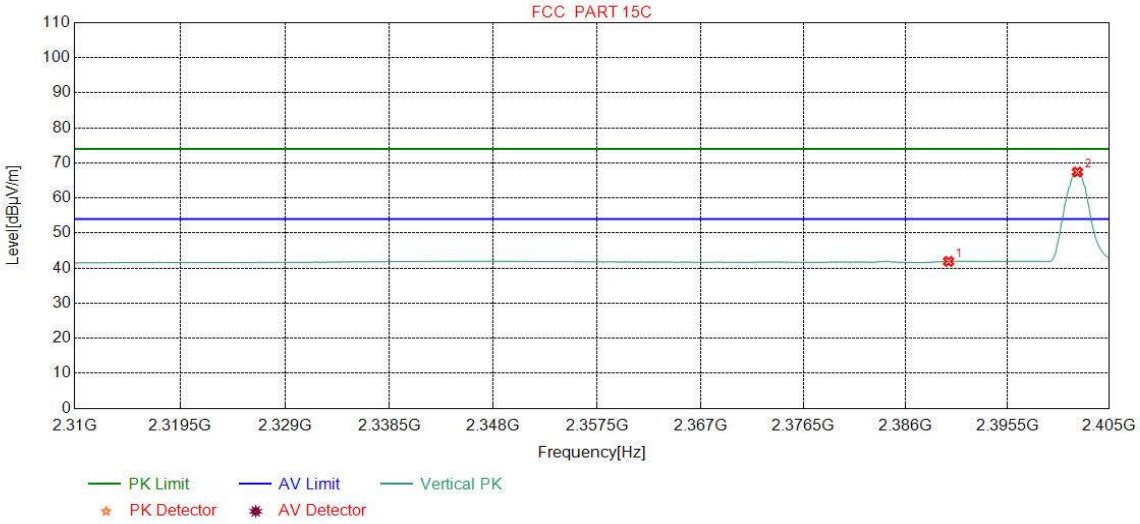
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity
1	2390.0000	32.25	13.37	-42.44	38.44	41.62	54.00	12.38	Pass	Horizontal
2	2402.0275	32.26	13.31	-42.43	70.31	73.45	54.00	-19.45	Pass	Horizontal

Mode:	GFSK Transmitting	Channel:	2402
Remark:	AV		

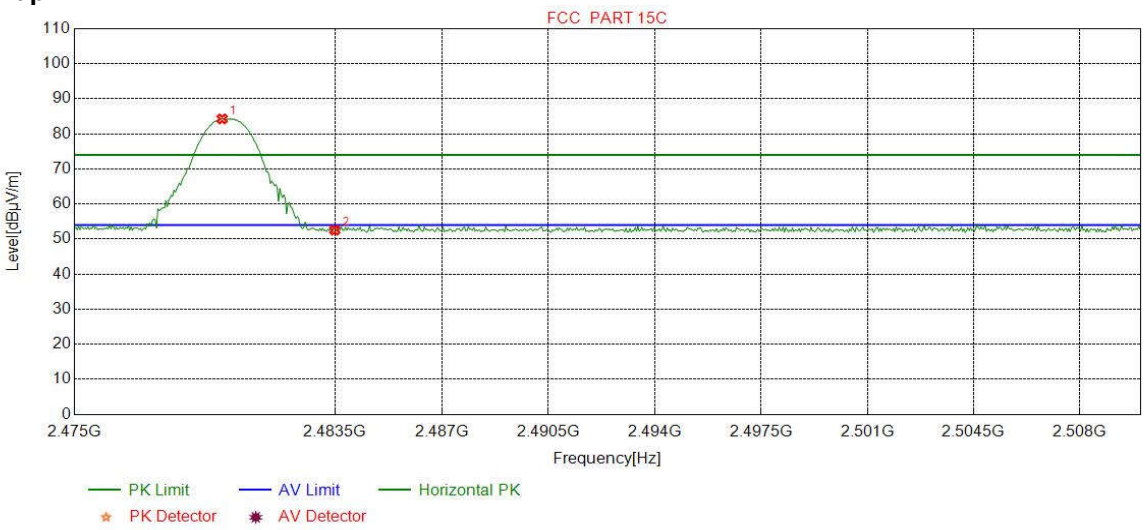
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity
1	2390.0000	32.25	13.37	-42.44	38.73	41.91	54.00	12.09	Pass	Vertical
2	2402.0275	32.26	13.31	-42.43	64.28	67.42	54.00	-13.42	Pass	Vertical

Mode:	GFSK Transmitting	Channel:	2480
Remark:	Peak		

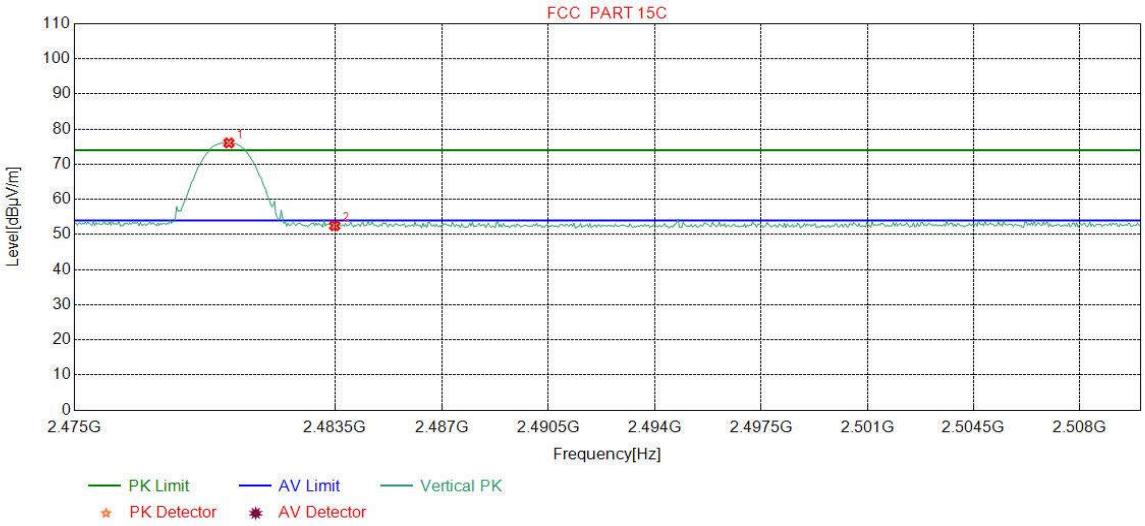
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity
1	2479.8185	32.37	13.39	-42.39	80.90	84.27	74.00	-10.27	Pass	Horizontal
2	2483.5000	32.38	13.38	-42.40	49.17	52.53	74.00	21.47	Pass	Horizontal

Mode:	GFSK Transmitting	Channel:	2480
Remark:	Peak		

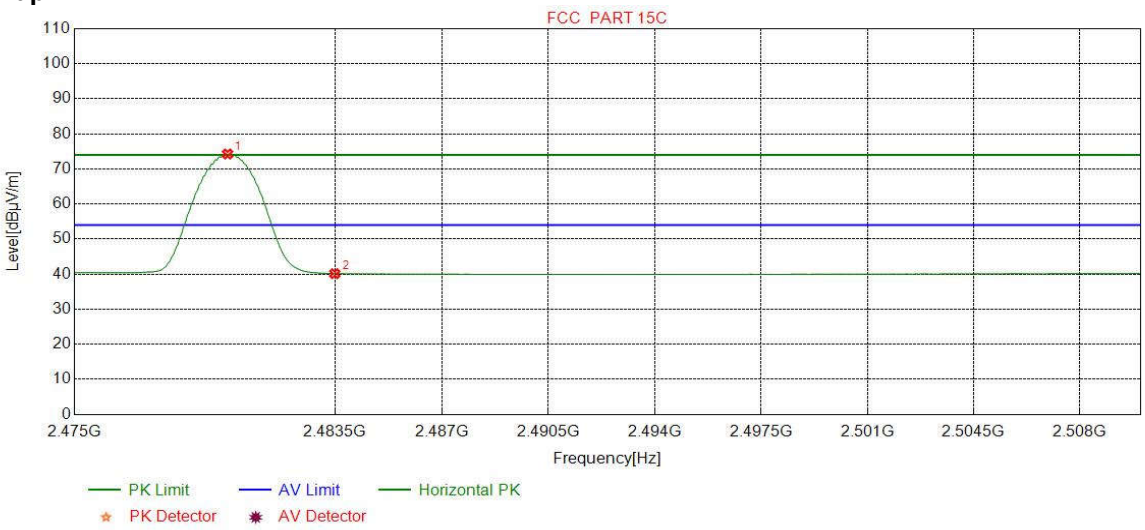
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity
1	2480.0375	32.37	13.39	-42.39	72.69	76.06	74.00	-2.06	Pass	Vertical
2	2483.5000	32.38	13.38	-42.40	49.12	52.48	74.00	21.52	Pass	Vertical

Mode:	GFSK Transmitting	Channel:	2480
Remark:	AV		

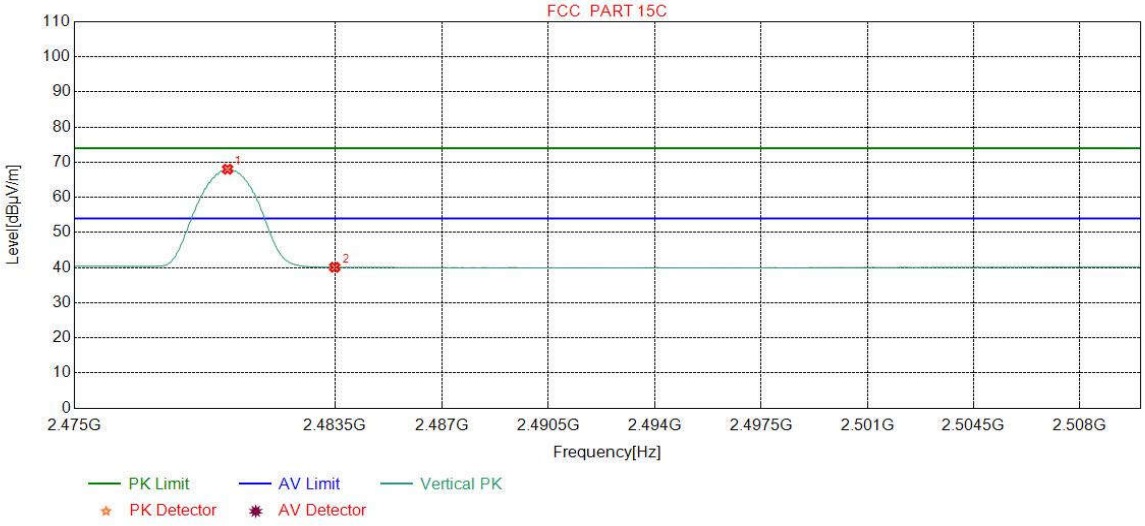
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Preamp gain [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity
1	2479.9937	32.37	13.39	-42.39	70.89	74.26	54.00	-20.26	Pass	Horizontal
2	2483.5000	32.38	13.38	-42.40	36.77	40.13	54.00	13.87	Pass	Horizontal

Mode:	GFSK Transmitting	Channel:	2480
Remark:	AV		

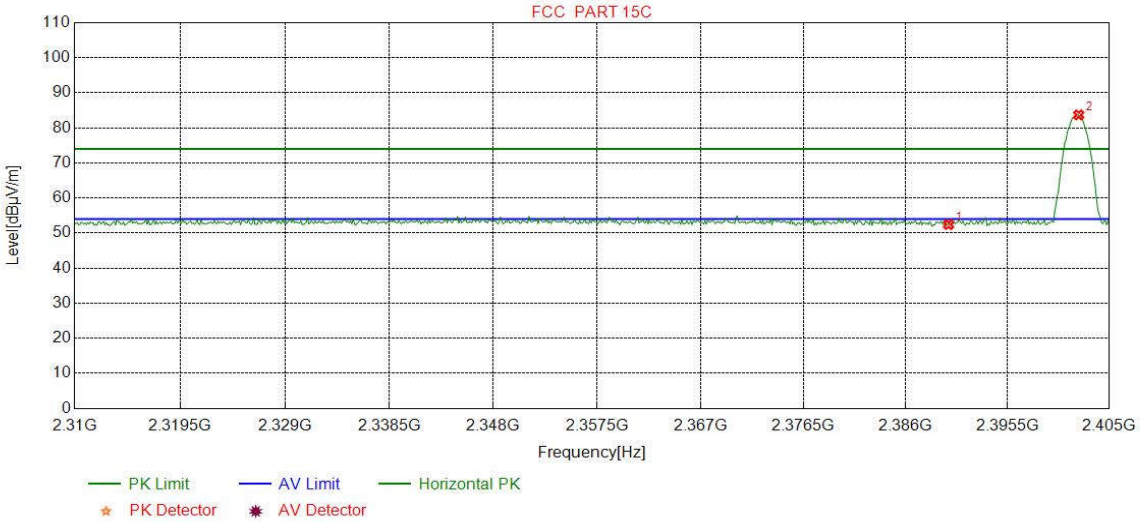
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Preamp gain [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Result	Polarity
1	2479.9937	32.37	13.39	-42.39	64.65	68.02	54.00	-14.02	Pass	Vertical
2	2483.5000	32.38	13.38	-42.40	36.74	40.10	54.00	13.90	Pass	Vertical

Mode:	π/4DQPSK Transmitting	Channel:	2402
Remark:	Peak		

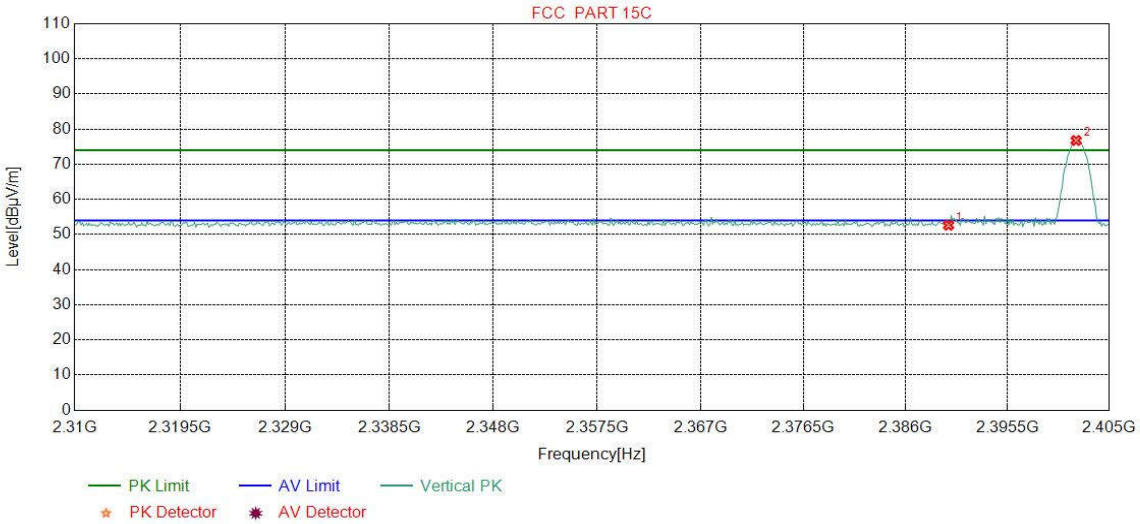
Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity
1	2390.0000	32.25	13.37	-42.44	49.24	52.42	74.00	21.58	Pass	Horizontal
2	2402.1464	32.26	13.31	-42.43	80.56	83.70	74.00	-9.70	Pass	Horizontal

Mode:	π/4DQPSK Transmitting	Channel:	2402
Remark:	Peak		

Test Graph



NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity
1	2390.0000	32.25	13.37	-42.44	49.44	52.62	74.00	21.38	Pass	Vertical
2	2401.9086	32.26	13.31	-42.43	73.63	76.77	74.00	-2.77	Pass	Vertical