FCC TEST REPORT

Product	:	Relay Box
Trade mark	:	Ring
Model/Type reference	:	RSUCPU
Serial Number	:	N/A
Report Number	:	EED32L00265001
FCC ID	:	2AUOBRSUCPU
Date of Issue	:	Aug. 10, 2020
Test Standards	:	47 CFR Part 15 Subpart C
Test result	:	PASS

Prepared for:

Ring Automotive
GelderdRoad, Leeds, LS12 6NA, UK.

Prepared by:

Centre Testing International Group Co., Ltd.
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Date:	Aug. 10, 2020		Check No.:3915681977

CENTRE TESTING INTERNATIONAL GROUP CO.,LTD. CTI Report Seal

2 Version

Version No.	Date	Description
00	Jan. 14, 2020	Original
01	Aug. 10, 2020	Retest Field Strength Of The Fundamental Signal

3 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203	ANSI C63.10-2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	N/A
Field Strength of the Fundamental Signal	47 CFR Part 15 Subpart C Section 15.249 (a)	ANSI C63.10-2013	PASS
Spurious Emissions	47 CFR Part 15 Subpart C Section 15.249 (a)/15.209	ANSI C63.10-2013	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15 Subpart C Section 15.249(a)/15.205	ANSI C63.10-2013	PASS
20dB Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.215 (c)	ANSI C63.10-2013	PASS

Remark:
The tested sample(s) and the sample information are provided by the client.
N/A:The product supplies power to DC.

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5 General Information

5.1 Client Information

Applicant:	Ring Automotive
Address of Applicant:	GelderdRoad, Leeds, LS12 6NA, UK.
Manufacturer:	Zhejiang Leiya Elect「onicsCo., Ltd.
Address of Manufacturer:	No.519,Fifteen Road, Binhai Park, Econ and Technological Development Zone, Wenzhou City, P.R. China
Factory:	Zhejiang Leiya Electronics Co., Ltd.
Address of Factory:	No.519,Fifteen Road, Binhai Park, Econ and Technological Development Zone, Wenzhou City, P.R. China

5.2 General Description of EUT

Product Name:	Relay Box
Model No.(EUT):	RSUCPU
Trade Mark:	Ring
EUT Supports Radios application:	2401MHz to 2479MHz
Power Supply:	DC12V

5.3 Product Specification subjective to this standard

Frequency Range:	2401MHz~2479MHz
Modulation Type:	GFSK
Number of Channels:	28 (declared by the client)
Test Power Grade:	Defualt
Test Software of EUT:	Defualt
Antenna Type:	PCB antenna
Antenna Gain:	-5 dBi
Test voltage:	DC12V
Sample Received Date:	Sep. 17, 2019
Sample tested Date:	Sep. 17, 2019 to Aug. 10, 2020

Operation Frequency each of channel					
Channel	Frequency	Channel	Frequency	Channel	Frequency
1CH	2401 MHz	14CH	2440 MHz	27CH	2476 MHz
2CH	2404 MHz	15CH	2443 MHz	28CH	2479 MHz
3CH	2407 MHz	16CH	2446 MHz		
4CH	2410 MHz	17CH	2449 MHz		
5CH	2413 MHz	18CH	2452 MHz		
6CH	2416 MHz	19CH	2453 MHz		
7CH	2419 MHz	20CH	2456MHz		
8CH	2422 MHz	21CH	2459 MHz		
9CH	2425 MHz	22CH	2462 MHz		
10CH	2428 MHz	23CH	2465 MHz		
11CH	2431 MHz	24CH	2467 MHz		
12CH	2434 MHz	25CH	2470 MHz		
13CH	2437 MHz	26CH	2473 MHz		

Note:

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

Channel	Frequency
The Lowest channel(CH1)	2401MHz
The Middle channel(CH14)	2440MHz
The Highest channel(CH28)	2479MHz

5.4 Test Environment and Mode

Operating Environment:	
Temperature:	24.0 (C
Humidity:	52 % RH
Atmospheric Pressure:	1010 mbar
Test mode:	
Transmitting mode:	Keep the EUT in transmitting mode with modulation.

5.5 Description of Support Units

The EUT has been tested with associated equipment below.

Description	Manufacturer	Model No.	Serial No.	Supplied by
DC power supply	Qie kesi	10209898	10209898	CTI

5.6 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

5.7 Deviation from Standards

None.

5.8 Abnormalities from Standard Conditions

None.

5.9 Other Information Requested by the Customer

None.

5.10 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%

6 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	03-01-2019 02-17-2020	02-29-2020 02-16-2021
Signal Generator	Keysight	N5182B	MY53051549	03-01-2019 02-17-2020	02-29-2020 02-16-2021
Temperature/ Humidity Indicator	biaozhi	HM10	1804186	07-26-2019 06-29-2020	07-25-2020 06-28-2021
High-pass filter	Sinoscite	FL3CX03WG18N M12-0398-002	---	---	---
High-pass filter	MICRO-TRONICS	SPA-F-63029-4	---	---	---
DC Power	Keysight	E3642A	MY56376072	03-01-2019 02-17-2020	02-29-2020 02-16-2021
PC-1	Lenovo	R4960d	---	---	---
BT&WI-FI Automatic control	R&S	OSP120	101374	03-01-2019 02-17-2020	02-29-2020 02-16-2021
RF control unit	JS Tonscend	JS0806-2	158060006	03-01-2019 02-17-2020	02-29-2020 02-16-2021
BT&WI-FI Automatic test software	JS Tonscend	JS1120-3	---	---	---

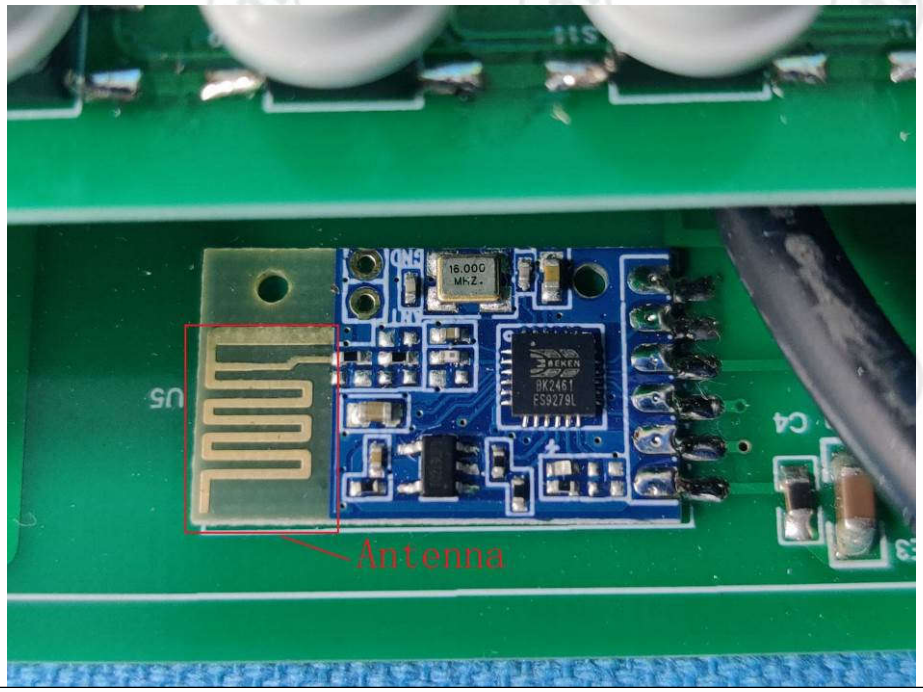
3M Semi/full-anechoic Chamber					
Equipment	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm-dd-yyyy)**	**Cal. Due date (mm-dd-yyyy)**
3M Chamber & Accessory Equipment	TDK	SAC-3	---	05-24-2019	05-23-2022
TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-618	07-26-2019 05-16-2020	07-25-2020 05-15-2021
Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-076	04-25-2018	04-24-2021
Receiver	R&S	ESCI7	100938-003	11-23-2018 10-21-2019	11-22-2019 10-20-2020
Multi device Controller	maturo	NCD/070/107 11112	---	---	---
Temperature/ Humidity Indicator	Shanghai qixiang	HM10	1804298	07-26-2019 06-29-2020	07-25-2020 06-28-2021
Cable line	Fulai(7M)	SF106	5219/6A	---	---
Cable line	Fulai(6M)	SF106	5220/6A	---	---
Cable line	Fulai(3M)	SF106	5216/6A	---	---
Cable line	Fulai(3M)	SF106	5217/6A	---	---

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	03-27-2019 03-05-2020	03-26-2020 03-04-2021
Spectrum Analyzer	Keysight	N9020B	MY57111112	03-27-2019 03-05-2020	03-26-2020 03-04-2021
Spectrum Analyzer	Keysight	N9030B	MY57140871	03-27-2019 03-05-2020	03-26-2020 03-04-2021
TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	9163-1148	04-25-2018	04-24-2021
Horn Antenna	Schwarzbeck	BBHA 9170	9170-832	04-25-2018	04-24-2021
Horn Antenna	ETS-LINDGREN	3117	00057407	07-10-2018	07-09-2021
Preamplifier	EMCI	EMC184055SE	980596	05-22-2019 05-20-2020	05-21-2020 05-19-2021
Preamplifier	EMCI	EMC001330	980563	05-08-2019 04-22-2020	05-07-2020 04-21-2021
Preamplifier	JS Tonscend	980380	EMC051845 SE	01-16-2019 01-09-2020	01-15-2020 01-08-2021
Temperature/ Humidity Indicator	biaozhi	GM1360	EE1186631	04-30-2019 04-27-2020	04-29-2020 04-26-2021
Fully Anechoic Chamber	TDK	FAC-3	---	01-17-2018	01-16-2021
Filter bank	JS Tonscend	JS0806-F	188060094	04-10-2018	04-09-2021
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	---	---

7 Test results and Measurement Data

Antenna Requirement

Standard requirement:	47 CFR Part 15C Section 15.203
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.	
EUT Antenna:	
The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is -5dBi.	



7.1 Radiated Spurious Emissions

Test Requirement: 47 CFR Part 15C Section 15.249 and 15.209

Test Method: ANSI C63.10

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	Quasi-peak	120kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Test Setup:

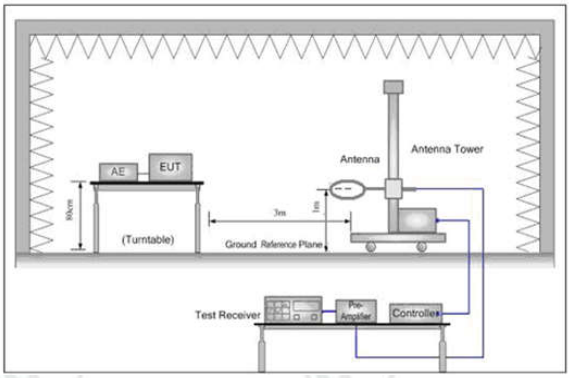


Figure 1. Below 30MHz

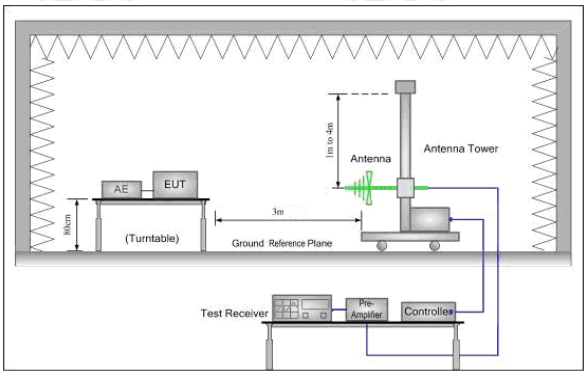


Figure 2. 30MHz to 1GHz

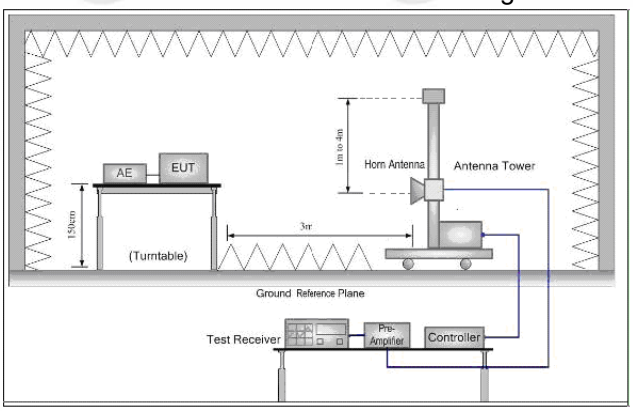


Figure 3. Above 1GHz

Test Procedure:

Below 1GHz test procedure as below:

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.

The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

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.

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 rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.

The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

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.

Above 1GHz test procedure as below:

Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 metre to 1.5 metre(Above 18GHz the distance is 1 meter and table is 1.5 metre).

Test the EUT in the lowest channel ,middle channel, the Highest channel

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.

Repeat above procedures until all frequencies measured was complete.

Limit:
(Spurious Emissions)

Frequency	Field strength (microvolt/meter)	Limit (dBμV/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.

Limit:
(Field strength of the fundamental signal)

Frequency	Limit (dBμV/m @3m)	Remark
2400MHz-2483.5MHz	94.0	Average Value
	114.0	Peak Value

Test Setup:

Exploratory Test Mode: Transmitting mode,Charge +Transmitting mode

Final Test Mode: Pretest the EUT at Transmitting mode and Charge +Transmitting mode, found the Charge +Transmitting mode which it is worse case
Only the worst case is recorded in the report.

Instruments Used: Refer to section 6 for details

Test Results: Pass

Measurement Data

Field Strength Of The Fundamental Signal

NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	2401	32.26	3.46	-42.43	98.97	92.26	114	21.74	Pass	H	PK
2	2401	32.26	3.46	-42.43	98.92	92.21	94	1.79	Pass	H	AV
3	2401	32.26	3.46	-42.43	98.76	92.05	114	21.95	Pass	V	PK
4	2401	32.26	3.46	-42.43	98.68	91.97	94	2.03	Pass	V	AV
5	2440	32.32	3.35	-42.42	98.66	91.91	114	22.09	Pass	H	PK
6	2440	32.32	3.46	-42.43	98.6	91.95	94	2.05	Pass	H	AV
7	2440	32.32	3.35	-42.42	98.34	91.59	114	22.41	Pass	V	PK
8	2440	32.32	3.46	-42.43	98.28	91.63	94	2.37	Pass	V	AV
9	2479	32.37	3.44	-42.4	97.72	91.13	114	22.87	Pass	H	PK
10	2479	32.37	3.46	-42.43	97.65	91.05	94	2.95	Pass	H	AV
11	2479	32.37	3.44	-42.4	97.71	91.12	114	22.88	Pass	V	PK
12	2479	32.37	3.44	-42.4	97.63	91.04	94	2.96	Pass	V	AV

Spurious Emissions

Below 1GHz

Mode:			GFSK Transmitting					Channel:		2401	
NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	70.7441	8.86	0.96	-32.05	31.82	9.59	40.00	30.41	Pass	H	PK
2	137.0987	7.35	1.37	-32.00	37.62	14.34	43.50	29.16	Pass	H	PK
3	208.8859	11.13	1.71	-31.94	39.49	20.39	43.50	23.11	Pass	H	PK
4	319.9620	13.64	2.12	-31.83	38.79	22.72	46.00	23.28	Pass	H	PK
5	687.5318	19.70	3.14	-32.06	37.19	27.97	46.00	18.03	Pass	H	PK
6	934.4214	22.31	3.66	-31.32	28.84	23.49	46.00	22.51	Pass	H	PK
7	56.8717	12.10	0.86	-32.06	37.35	18.25	40.00	21.75	Pass	V	PK
8	137.0987	7.35	1.37	-32.00	39.58	16.30	43.50	27.20	Pass	V	PK
9	208.8859	11.13	1.71	-31.94	47.69	28.59	43.50	14.91	Pass	V	PK
10	539.9800	17.80	2.79	-31.95	32.83	21.47	46.00	24.53	Pass	V	PK
11	750.1030	20.35	3.29	-32.04	30.20	21.80	46.00	24.20	Pass	V	PK
12	921.5192	22.23	3.65	-31.39	29.16	23.65	46.00	22.35	Pass	V	PK

Mode:			GFSK Transmitting					Channel:		2440	
NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	54.7375	12.44	0.84	-32.08	37.04	18.24	40.00	21.76	Pass	H	PK
2	120.0250	9.20	1.30	-32.07	38.05	16.48	43.50	27.02	Pass	H	PK
3	208.8859	11.13	1.71	-31.94	47.73	28.63	43.50	14.87	Pass	H	PK
4	539.9800	17.80	2.79	-31.95	33.37	22.01	46.00	23.99	Pass	H	PK
5	687.5318	19.70	3.14	-32.06	35.20	25.98	46.00	20.02	Pass	H	PK
6	937.6228	22.33	3.67	-31.29	29.14	23.85	46.00	22.15	Pass	H	PK
7	88.4969	9.05	1.09	-32.08	30.88	8.94	43.50	34.56	Pass	V	PK

8	137.0987	7.35	1.37	-32.00	38.10	14.82	43.50	28.68	Pass	V	PK
9	208.8859	11.13	1.71	-31.94	39.05	19.95	43.50	23.55	Pass	V	PK
10	319.9620	13.64	2.12	-31.83	38.88	22.81	46.00	23.19	Pass	V	PK
11	687.5318	19.70	3.14	-32.06	36.43	27.21	46.00	18.79	Pass	V	PK
12	933.8394	22.30	3.66	-31.32	28.82	23.46	46.00	22.54	Pass	V	PK

Mode:			GFSK Transmitting					Channel:		2479	
NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	54.6405	12.46	0.84	-32.09	37.02	18.23	40.00	21.77	Pass	H	PK
2	120.0250	9.20	1.30	-32.07	37.73	16.16	43.50	27.34	Pass	H	PK
3	208.8859	11.13	1.71	-31.94	47.39	28.29	43.50	15.21	Pass	H	PK
4	360.0270	14.52	2.27	-31.84	31.26	16.21	46.00	29.79	Pass	H	PK
5	539.9800	17.80	2.79	-31.95	33.58	22.22	46.00	23.78	Pass	H	PK
6	937.6228	22.33	3.67	-31.29	29.97	24.68	46.00	21.32	Pass	H	PK
7	97.0337	10.53	1.14	-32.07	31.56	11.16	43.50	32.34	Pass	V	PK
8	137.0987	7.35	1.37	-32.00	37.94	14.66	43.50	28.84	Pass	V	PK
9	208.8859	11.13	1.71	-31.94	40.17	21.07	43.50	22.43	Pass	V	PK
10	360.0270	14.52	2.27	-31.84	36.40	21.35	46.00	24.65	Pass	V	PK
11	687.5318	19.70	3.14	-32.06	36.78	27.56	46.00	18.44	Pass	V	PK
12	922.0042	22.23	3.65	-31.39	28.74	23.23	46.00	22.77	Pass	V	PK

Above 1GHz

Mode:			GFSK Transmitting					Channel:		2401	
NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	2103.1103	31.84	3.58	-42.56	50.33	43.19	74.00	30.81	Pass	H	PK
2	3913.0609	33.73	4.34	-40.96	49.77	46.88	74.00	27.12	Pass	H	PK
3	4802.1201	34.50	4.55	-40.67	52.81	51.19	74.00	22.81	Pass	H	PK
4	7000.2667	36.10	5.68	-41.19	49.77	50.36	74.00	23.64	Pass	H	PK
5	7743.3162	36.50	6.24	-40.88	49.21	51.07	74.00	22.93	Pass	H	PK
6	9108.4072	37.68	6.44	-40.72	49.82	53.22	74.00	20.78	Pass	H	PK
7	1939.4939	31.30	3.42	-42.64	50.04	42.12	74.00	31.88	Pass	V	PK
8	2937.7938	33.10	4.40	-42.16	50.76	46.10	74.00	27.90	Pass	V	PK
9	5014.1343	34.51	4.84	-40.50	50.87	49.72	74.00	24.28	Pass	V	PK
10	7203.2802	36.30	5.82	-41.02	49.15	50.25	74.00	23.75	Pass	V	PK
11	9079.4053	37.68	6.46	-40.71	49.69	53.12	74.00	20.88	Pass	V	PK
12	10333.4889	38.27	6.90	-40.92	49.38	53.63	74.00	20.37	Pass	V	PK

Mode:			GFSK Transmitting					Channel:		2440	
NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	2060.9061	31.79	3.56	-42.58	50.34	43.11	74.00	30.89	Pass	H	PK
2	3298.0199	33.32	4.57	-41.94	49.38	45.33	74.00	28.67	Pass	H	PK
3	4880.1253	34.50	4.80	-40.60	51.65	50.35	74.00	23.65	Pass	H	PK
4	6026.2017	35.81	5.27	-41.10	48.90	48.88	74.00	25.12	Pass	H	PK
5	7527.3018	36.59	5.90	-40.78	48.93	50.64	74.00	23.36	Pass	H	PK
6	9129.4086	37.67	6.45	-40.73	49.62	53.01	74.00	20.99	Pass	H	PK
7	2215.9216	32.00	3.69	-42.51	50.22	43.40	74.00	30.60	Pass	V	PK
8	3179.0119	33.27	4.62	-42.01	49.52	45.40	74.00	28.60	Pass	V	PK
9	4343.0895	34.28	4.49	-40.86	49.02	46.93	74.00	27.07	Pass	V	PK
10	4880.1253	34.50	4.80	-40.60	51.17	49.87	74.00	24.13	Pass	V	PK
11	5567.1711	35.11	5.14	-40.71	50.04	49.58	74.00	24.42	Pass	V	PK
12	7320.2880	36.42	5.85	-40.92	50.66	52.01	74.00	21.99	Pass	V	PK

Mode:			GFSK Transmitting					Channel:		2479	
NO	Freq. [MHz]	Ant Factor [dB]	Cable loss [dB]	Pream gain [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Result	Polarity	Remark
1	1648.2648	29.38	3.14	-42.79	51.26	40.99	74.00	33.01	Pass	H	PK
2	3067.0045	33.23	4.79	-42.08	50.34	46.28	74.00	27.72	Pass	H	PK
3	4958.1305	34.50	4.82	-40.53	53.29	52.08	74.00	21.92	Pass	H	PK
4	5932.1955	35.69	5.23	-41.03	49.52	49.41	74.00	24.59	Pass	H	PK
5	7437.2958	36.54	5.85	-40.83	52.89	54.45	74.00	19.55	Pass	H	PK
6	9029.4020	37.69	6.42	-40.69	49.86	53.28	74.00	20.72	Pass	H	PK
7	7436.2458	36.54	5.85	-40.82	45.06	46.63	54.00	7.37	Pass	H	AV
8	1728.2728	29.91	3.22	-42.68	51.22	41.67	74.00	32.33	Pass	V	PK
9	2928.1928	33.09	4.39	-42.16	50.59	45.91	74.00	28.09	Pass	V	PK
10	4958.1305	34.50	4.82	-40.53	53.25	52.04	74.00	21.96	Pass	V	PK
11	6330.2220	35.87	5.46	-41.16	49.51	49.68	74.00	24.32	Pass	V	PK
12	7436.2958	36.54	5.85	-40.83	55.03	56.59	74.00	17.41	Pass	V	PK
13	10410.4940	38.37	7.16	-41.03	49.17	53.67	74.00	20.33	Pass	V	PK
14	7436.3558	36.54	5.85	-40.82	49.07	50.64	54.00	3.36	Pass	V	AV

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 - Correct Factor
   Correct Factor = *Preamplifier Factor– Antenna Factor–Cable Factor*

2) Scan from 9kHz to 25GHz,The disturbance above 13GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported .

7.2 Restricted bands around fundamental frequency

Test Requirement: 47 CFR Part 15C Section 15.209 and 15.205

Test Method: ANSI C63.10

Test Site: Measurement Distance: 3m (Semi-Anechoic Chamber)

Limit(band edge): Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

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 Setup:

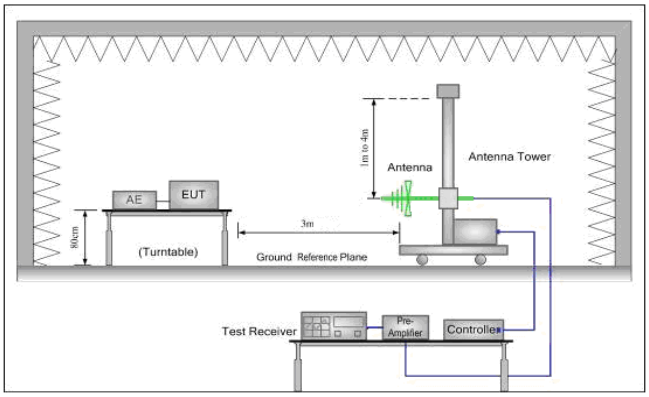


Figure 1. 30MHz to 1GHz

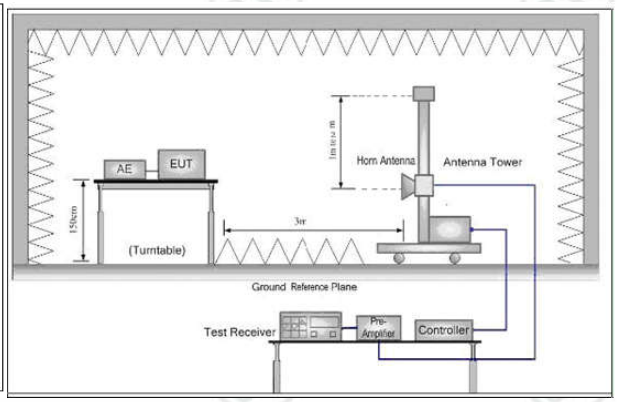


Figure 2. Above 1 GHz

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 (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.

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. 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.

Exploratory Test Mode: Transmitting mode,Charge +Transmitting mode

Final Test Mode: Pretest the EUT at Transmitting mode and Charge +Transmitting mode, found the Charge +Transmitting mode which it is worse case
Only the worst case is recorded in the report.

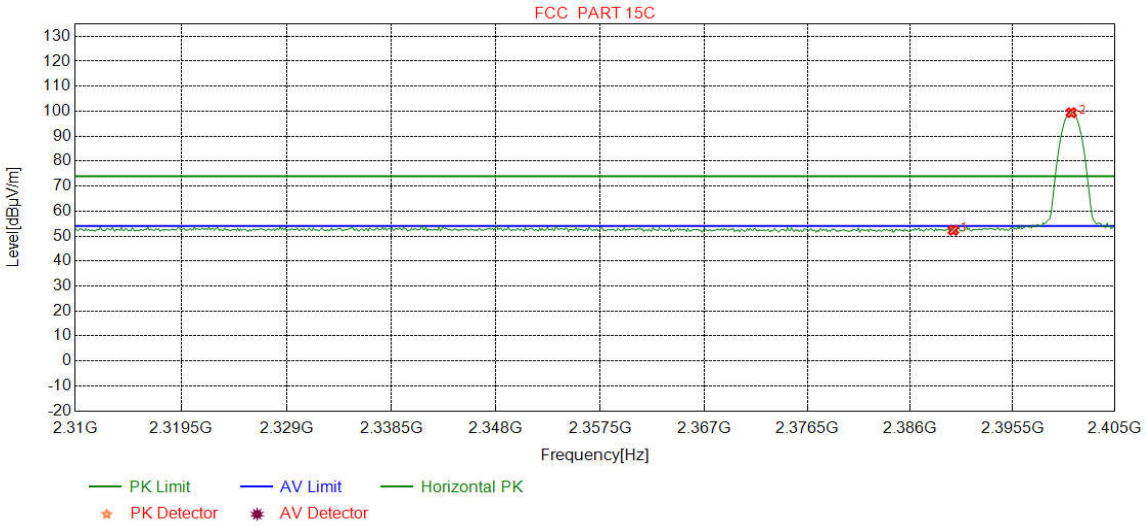
Instruments Used: Refer to section 6 for details

Test Results: Pass

Test plot as follows:

Mode:	GFSK Transmitting	Channel:	2401
Remark:	PK		

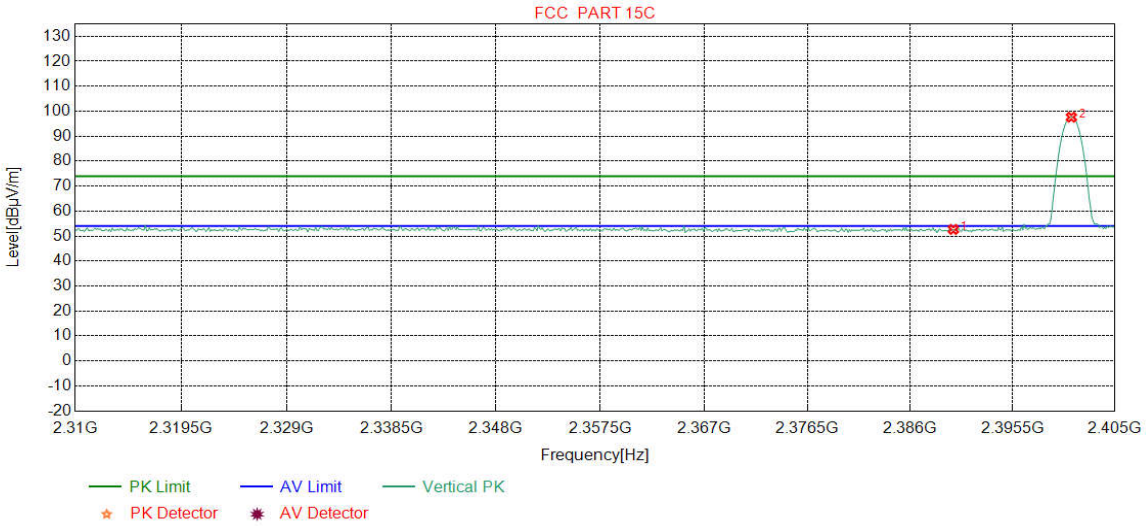
Test Graph



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	49.18	52.36	74.00	21.64	Pass	Horizontal
2	2400.9574	32.26	13.30	-42.43	96.27	99.40	74.00	-25.40	Pass	Horizontal

Mode:	GFSK Transmitting	Channel:	2401
Remark:	PK		

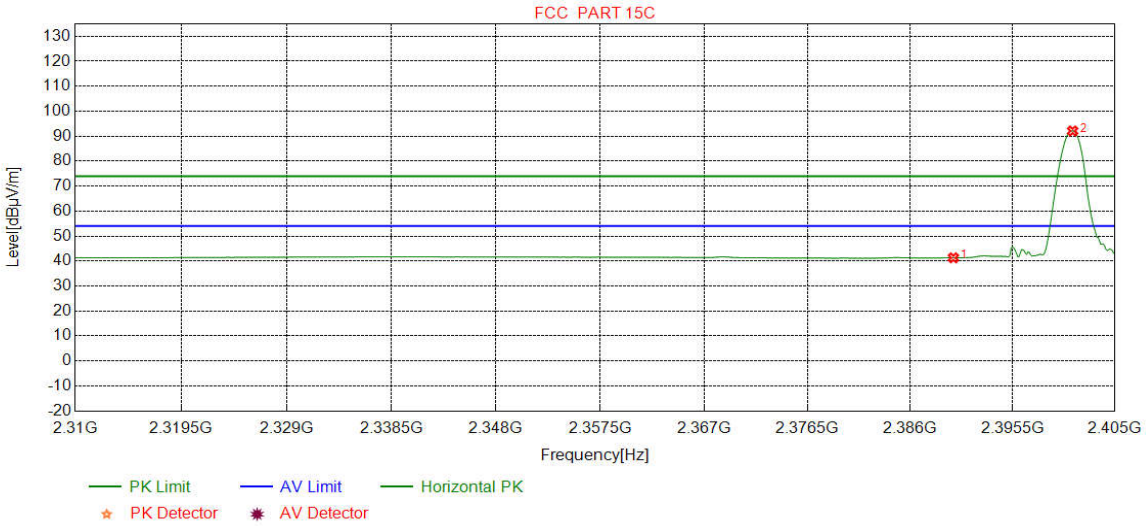
Test Graph



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	49.47	52.65	74.00	21.35	Pass	Vertical
2	2400.9574	32.26	13.30	-42.43	94.46	97.59	74.00	-23.59	Pass	Vertical

Mode:	GFSK Transmitting	Channel:	2401
Remark:	AV		

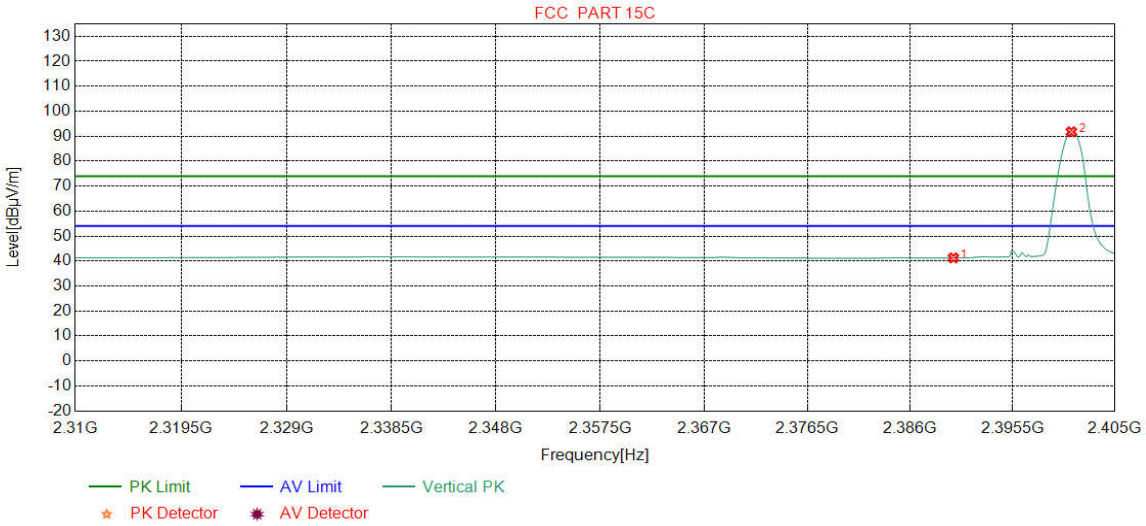
Test Graph



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	38.11	41.29	54.00	12.71	Pass	Horizontal
2	2401.0763	32.26	13.30	-42.43	88.96	92.09	54.00	-38.09	Pass	Horizontal

Mode:	GFSK Transmitting	Channel:	2401
Remark:	AV		

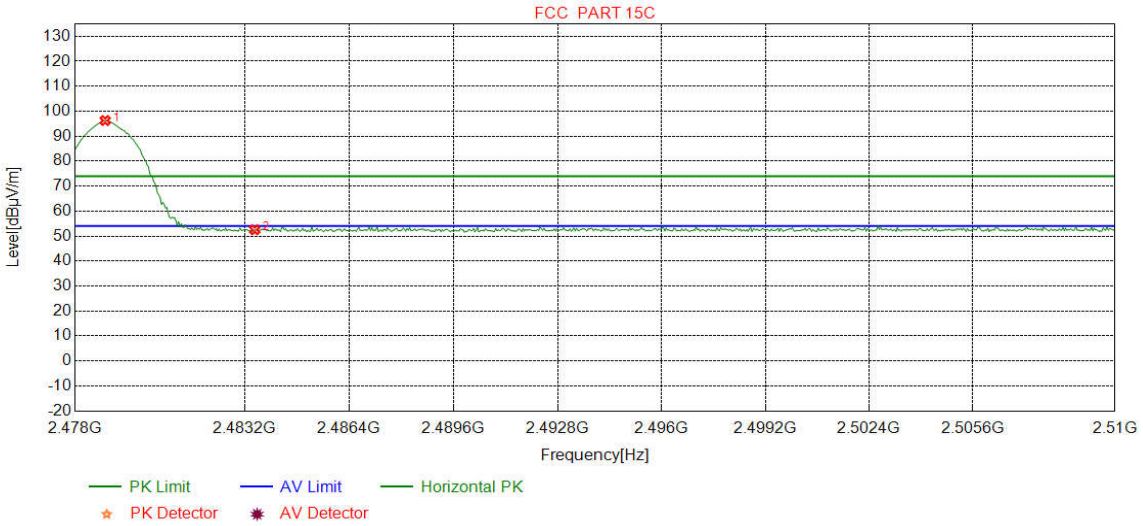
Test Graph



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	38.08	41.26	54.00	12.74	Pass	Vertical
2	2400.9574	32.26	13.30	-42.43	88.62	91.75	54.00	-37.75	Pass	Vertical

Mode:	GFSK Transmitting	Channel:	2479
Remark:	PK		

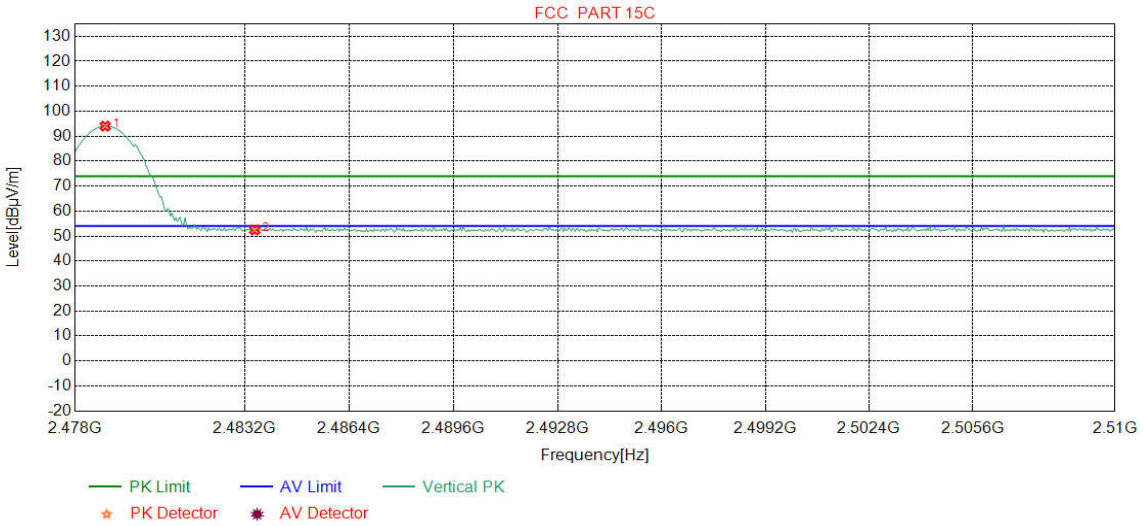
Test Graph



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	2478.9212	32.37	13.40	-42.40	92.88	96.25	74.00	-22.25	Pass	Horizontal
2	2483.5000	32.38	13.38	-42.40	49.16	52.52	74.00	21.48	Pass	Horizontal

Mode:	GFSK Transmitting	Channel:	2479
Remark:	PK		

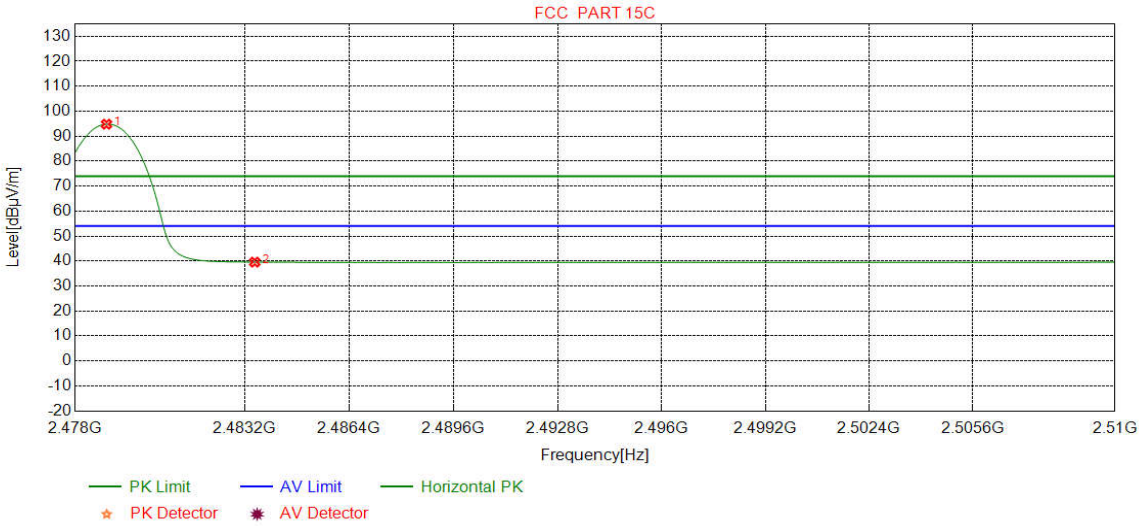
Test Graph



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	2478.9212	32.37	13.40	-42.40	90.65	94.02	74.00	-20.02	Pass	Vertical
2	2483.5000	32.38	13.38	-42.40	49.09	52.45	74.00	21.55	Pass	Vertical

Mode:	GFSK Transmitting	Channel:	2479
Remark:	AV		

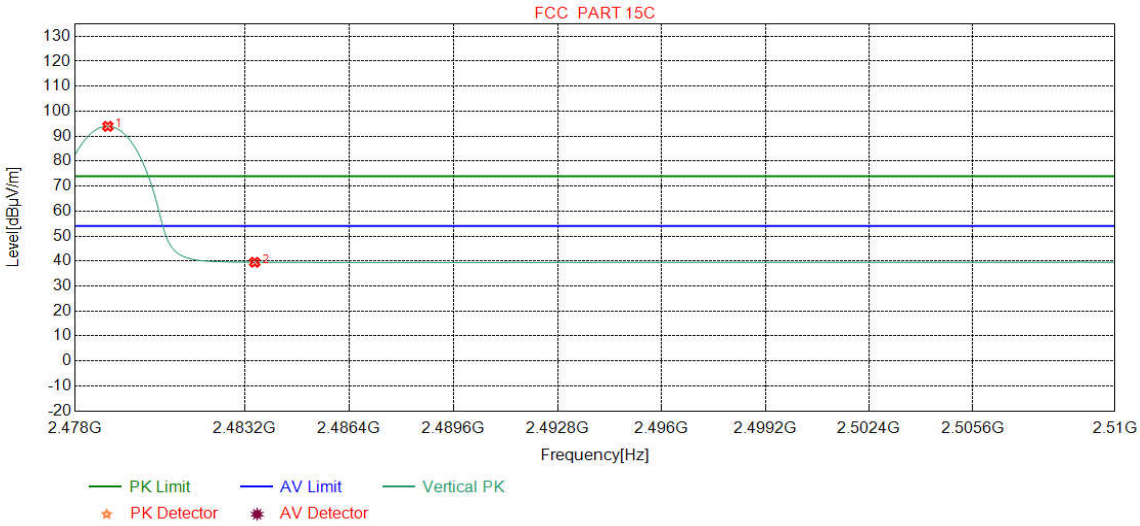
Test Graph



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	2478.9612	32.37	13.40	-42.40	91.43	94.80	54.00	-40.80	Pass	Horizontal
2	2483.5000	32.38	13.38	-42.40	36.20	39.56	54.00	14.44	Pass	Horizontal

Mode:	GFSK Transmitting	Channel:	2479
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	2479.0013	32.37	13.40	-42.40	90.56	93.93	54.00	-39.93	Pass	Vertical
2	2483.5000	32.38	13.38	-42.40	36.14	39.50	54.00	14.50	Pass	Vertical

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

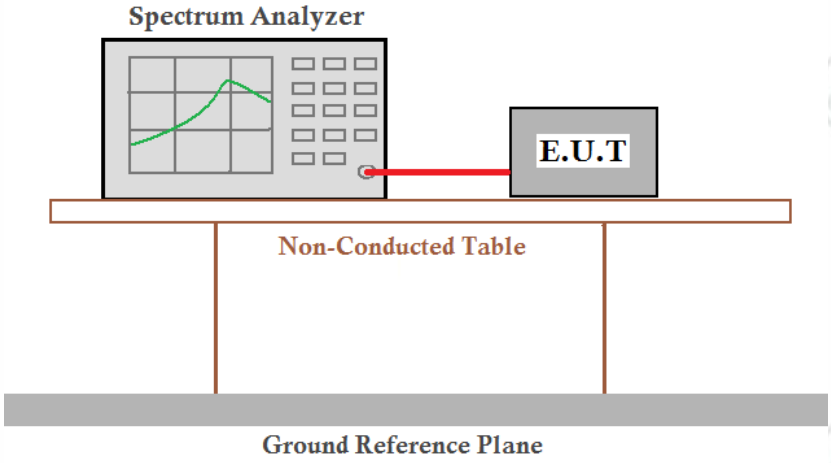
Correct Factor = *Preamplifier Factor– Antenna Factor–Cable Factor*

7.3 20dB Bandwidth

Test Requirement: 47 CFR Part 15C Section 15.215

Test Method: ANSI C63.10

Test Setup:



Limit: N/A

Exploratory Test Mode: Transmitter mode

Instruments Used: Refer to section 6 for details

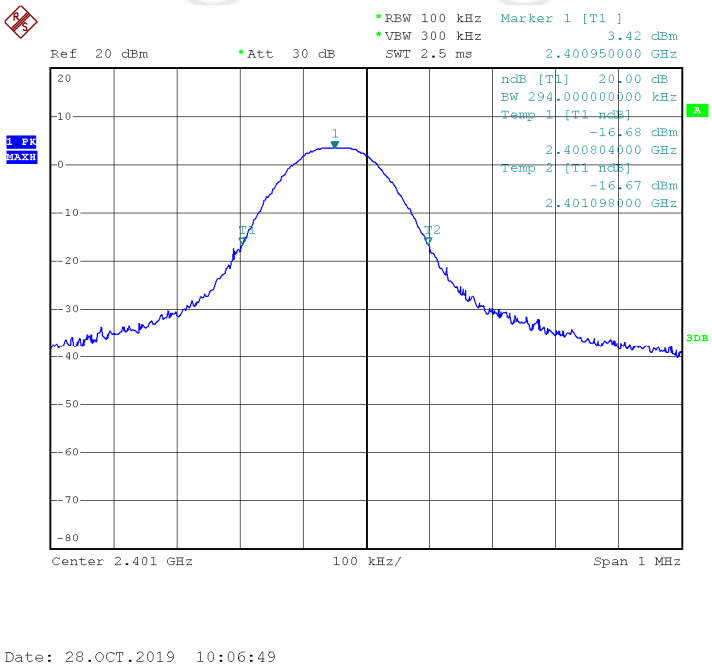
Test Results: Pass

Measurement Data

Test Channel	20dB bandwidth (MHz)	Results
Lowest	0.294	Pass
Middle	0.294	Pass
Highest	0.292	Pass

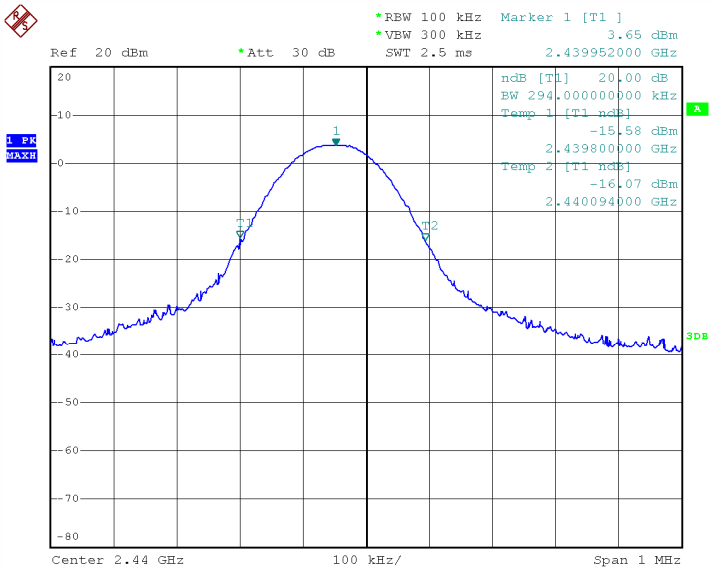
Test plot as follows:

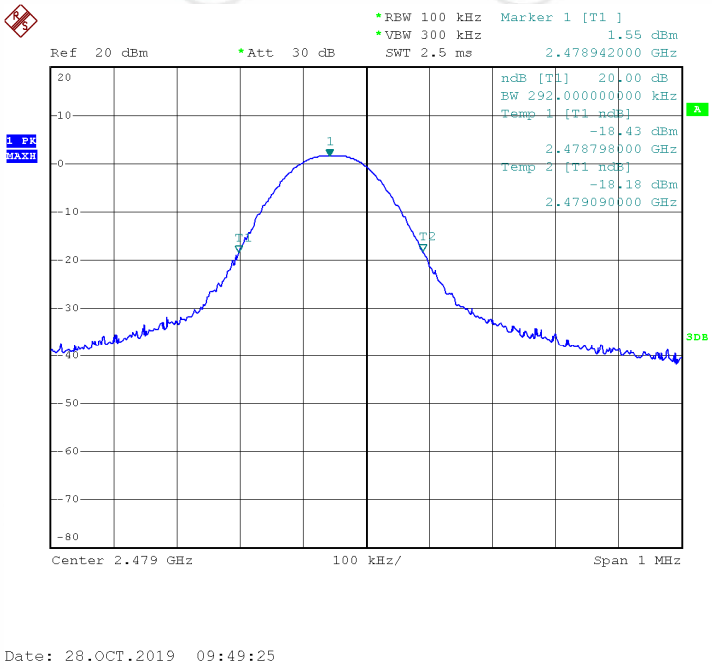
Test channel:	Lowest



Date: 28.OCT.2019 10:06:49

Test channel:	Middle



Date: 28.OCT.2019 09:54:19

Test channel:	Highest