

FCC TEST REPORT

FCC ID: 2A2PN-V8PRO

Report No. : SSP24060133-1E

Applicant : Ekoo Electronic Co., Ltd

Product Name : Robot Vacuum Cleaner

Model Name : Saturn01

Test Standard : FCC Part 15.247

Date of Issue : 2024-07-01



Shenzhen CCUT Quality Technology Co., Ltd.

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This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen CCUT Quality Technology Co., Ltd.

Test Report Basic Information

Applicant:	Ekoo Electronic Co., Ltd B09, Block B, F2, Bldg.B, Runfeng Pioneer Park, No.973, Minzhi Avenue, Address of Applicant.....: Minzhi St., Longhua, Shenzhen, China
Manufacturer:	Ekoo Electronic Co., Ltd B09, Block B, F2, Bldg.B, Runfeng Pioneer Park, No.973, Minzhi Avenue, Address of Manufacturer.....: Minzhi St., Longhua, Shenzhen, China
Product Name:	Robot Vacuum Cleaner
Brand Name:	-
Main Model:	Saturn01
Series Models:	-
Test Standard:	FCC Part 15 Subpart C KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.4-2014 ANSI C63.10-2013
Date of Test	2024-06-17 to 2024-06-28
Test Result:	PASS
Tested By	<u>Lorzix Luo</u> (Lorzix Luo)
Reviewed By:	<u>Lieber Ouyang</u> (Lieber Ouyang)
Authorized Signatory:	<u>Lahm Peng</u> (Lahm Peng)
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Revision History

Revision	Issue Date	Description	Revised By
V1.0	2024-07-01	Initial Release	Lahm Peng

1. General Information

1.1 Product Information

Product Name:	Robot Vacuum Cleaner
Trade Name:	-
Main Model:	Saturn01
Series Models:	-
Rated Voltage:	DC 14.4V by battery, DC 20V Charging from Charging Base Charging Base Input: AC 100-240V~50/60Hz, Output: DC 20V/0.8A
Battery:	DC 14.4V, 2600mAh
Hardware Version:	V1.0
Software Version:	V1.0
Note 1: The test data is gathered from a production sample, provided by the manufacturer.	

Wireless Specification	
Wireless Standard:	Bluetooth BLE, 802.11b/g/n
Operating Frequency:	BLE: 2402MHz ~ 2480MHz ,2.4G WiFi: 2412MHz ~ 2462MHz for 802.11b/g/n(HT20) 2422MHz ~ 2452MHz for 802.11n(HT40)
Number of Channel:	Bluetooth BLE: 40, 2.4G WiFi:11/7
Channel Separation:	Bluetooth BLE: 2MHz, 2.4G WiFi:5MHz
Modulation:	BLE: GFSK, 2.4G WiFi: CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM
Antenna Gain:	3.46dBi
Type of Antenna:	FPCB Antenna
Type of Device:	☐ Portable Device ☒ Mobile Device ☐ Modular Device

1.2 Test Setup Information

List of Test Modes			
Test Mode	Description	Remark	
TM1	BLE_1Mbps	2402/2440/2480MHz	
TM2	802.11b	2412MHz/2437MHz/2462MHz	
TM3	802.11g	2412MHz/2437MHz/2462MHz	
TM4	802.11n(H20)	2412MHz/2437MHz/2462MHz	
TM5	802.11n(H40)	2422MHz/2437MHz/2452MHz	
List and Details of Auxiliary Cable			
Description	Length (cm)	Shielded/Unshielded	With/Without Ferrite
-	-	-	-
-	-	-	-
List and Details of Auxiliary Equipment			
Description	Manufacturer	Model	Serial Number
-	-	-	-
-	-	-	-

List of Channels (Bluetooth BLE)							
No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)
01	2402	11	2422	21	2442	31	2462
02	2404	12	2424	22	2444	32	2464
03	2406	13	2426	23	2446	33	2466
04	2408	14	2428	24	2448	34	2468
05	2410	15	2430	25	2450	35	2470
06	2412	16	2432	26	2452	36	2472
07	2414	17	2434	27	2454	37	2474
08	2416	18	2436	28	2456	38	2476
09	2418	19	2438	29	2458	39	2478
10	2420	20	2440	30	2460	40	2480

List of Channels (802.11b/g/n)							
No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)
01	2412	05	2432	09	2452	13	--
02	2417	06	2437	10	2457	14	--
03	2422	07	2442	11	2462	15	--
04	2427	08	2447	12	--	16	--

1.3 Compliance Standards

Compliance Standards	
FCC Part 15 Subpart C	FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators
All measurements contained in this report were conducted with all above standards	
According to standards for test methodology	
FCC Part 15 Subpart C	FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators
KDB 558074 D01 15.247 Meas Guidance v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Maintenance of compliance is the responsibility of the manufacturer or applicant. Any modification of the product, which result is lowering the emission, should be checked to ensure compliance has been maintained.	

1.4 Test Facilities

Laboratory Name:	Shenzhen CCUT Quality Technology Co., Ltd. 1F, Building 35, Changxing Technology Industrial Park, Yutang Street, Guangming District, Shenzhen, Guangdong, China
CNAS Laboratory No.:	L18863
A2LA Certificate No.:	6893.01
FCC Registration No:	583813
ISED Registration No.:	CN0164
All measurement facilities used to collect the measurement data are located at 1F, Building 35, Changxing Technology Industrial Park, Yutang Street, Guangming District, Shenzhen, Guangdong, China.	

1.5 List of Measurement Instruments

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Conducted Emissions					
AMN	ROHDE&SCHWARZ	ENV216	101097	2023-10-21	2024-10-20
EMI Test Receiver	ROHDE&SCHWARZ	ESPI	100242	2023-07-31	2024-07-30
Radiated Emissions					
EMI Test Receiver	ROHDE&SCHWARZ	ESPI	100154	2023-07-31	2024-07-30
Spectrum Analyzer	KEYSIGHT	N9020A	MY48030972	2023-07-31	2024-07-30
Spectrum Analyzer	ROHDE&SCHWARZ	FSV40-N	101692	2023-07-31	2024-07-30
Amplifier	SCHWARZBECK	BBV 9743B	00251	2023-07-31	2024-07-30
Amplifier	HUABO	YXL0518-2.5-45	--	2023-07-31	2024-07-30
Amplifier	COM-MW	DLAN-18G-4G-02	10229104	2023-07-31	2024-07-30
Loop Antenna	DAZE	ZN30900C	21104	2023-08-07	2024-08-06
Broadband Antenna	SCHWARZBECK	VULB 9168	01320	2023-08-07	2024-08-06
Horn Antenna	SCHWARZBECK	BBHA 9120D	02553	2023-08-07	2024-08-06
Horn Antenna	COM-MW	ZLB7-18-40G-950	12221225	2023-08-07	2024-08-06
Conducted RF Testing					
RF Test System	MWRFTest	MW100-RFCB	220418SQS-37	2023-07-31	2024-07-30
Spectrum Analyzer	KEYSIGHT	N9020A	ATO-90521	2023-07-31	2024-07-30

1.6 Measurement Uncertainty

Test Item	Conditions	Uncertainty
Conducted Emissions	9kHz ~ 30MHz	±1.64 dB
Radiated Emissions	9kHz ~ 30MHz	±2.88 dB
	30MHz ~ 1GHz	±3.32 dB
	1GHz ~ 18GHz	±3.50 dB
	18GHz ~ 40GHz	±3.66 dB
Conducted Output Power	9kHz ~ 26GHz	±0.50 dB
Occupied Bandwidth	9kHz ~ 26GHz	±4.0 %
Conducted Spurious Emission	9kHz ~ 26GHz	±1.32 dB
Power Spectrum Density	9kHz ~ 26GHz	±0.62 dB

2. Summary of Test Results

FCC Rule	Description of Test Item	Result
FCC Part 15.207	Conducted Emissions	Passed
FCC Part 15.209, 15.247(d)	Radiated Emissions	Passed
Passed: The EUT complies with the essential requirements in the standard Failed: The EUT does not comply with the essential requirements in the standard N/A: Not applicable		

3. Conducted Emissions

3.1 Standard and Limit

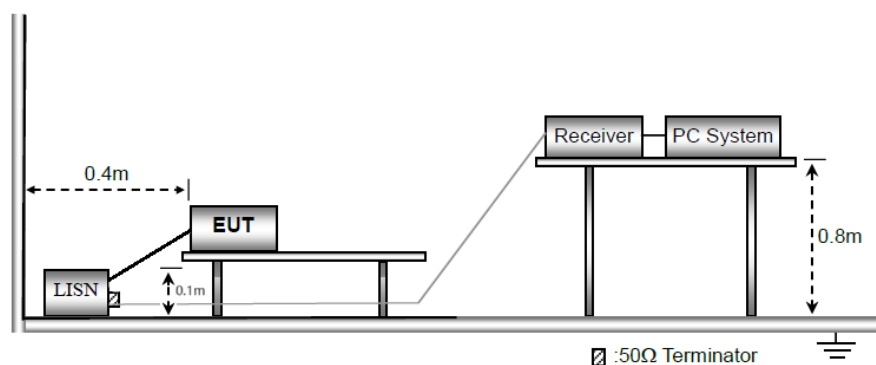
According to the rule FCC Part 15.207, Conducted emissions limit, the limit for a wireless device as below:

Frequency of Emission (MHz)	Conducted emissions (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz
 Note 2: The lower limit applies at the band edges

3.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.2.



Test Setup Block Diagram

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

b) The following is the setting of the receiver

Attenuation: 10dB

Start Frequency: 0.15MHz

Stop Frequency: 30MHz

IF Bandwidth: 9kHz

c) The EUT was placed 0.1 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

d) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

e) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

f) LISN is at least 80 cm from nearest part of EUT chassis.

g) For the actual test configuration, please refer to the related Item - photographs of the test setup.

3.3 Test Data and Results

Based on all tested data, the EUT complied with the FCC Part 15.207 standard limit for a wireless device, and with the worst case as below:

Remark: Level = Reading + Factor, Margin = Level - Limit

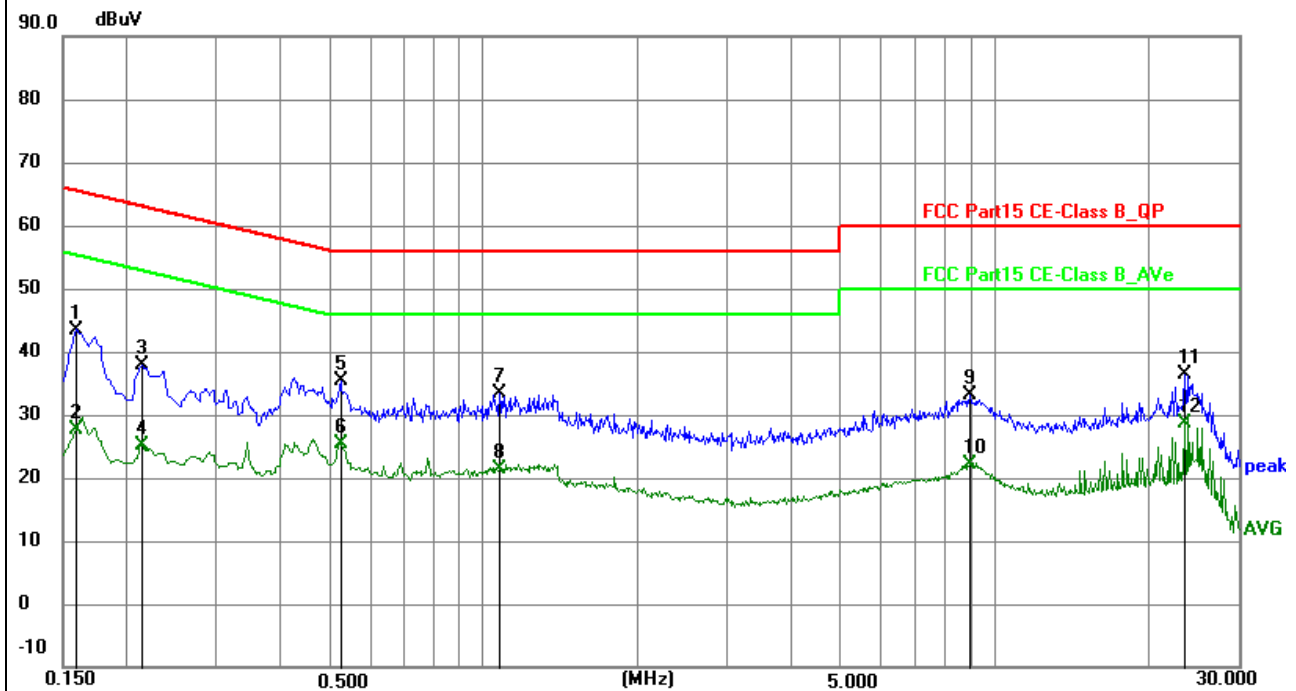
Test Plots and Data of Conducted Emissions

Tested Mode: TM1(2402MHz)

Test Voltage: AC 120V/60Hz

Test Power Line: Neutral

Remark:



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1590	34.16	9.34	43.50	65.52	-22.02	QP	P	
2	0.1590	18.18	9.34	27.52	55.52	-28.00	AVG	P	
3	0.2130	28.20	9.62	37.82	63.09	-25.27	QP	P	
4	0.2130	15.55	9.62	25.17	53.09	-27.92	AVG	P	
5	0.5235	25.48	9.90	35.38	56.00	-20.62	QP	P	
6 *	0.5235	15.53	9.90	25.43	46.00	-20.57	AVG	P	
7	1.0725	23.55	9.80	33.35	56.00	-22.65	QP	P	
8	1.0725	11.56	9.80	21.36	46.00	-24.64	AVG	P	
9	8.9295	22.89	10.24	33.13	60.00	-26.87	QP	P	
10	8.9295	11.78	10.24	22.02	50.00	-27.98	AVG	P	
11	23.6265	25.85	10.43	36.28	60.00	-23.72	QP	P	
12	23.6265	18.09	10.43	28.52	50.00	-21.48	AVG	P	

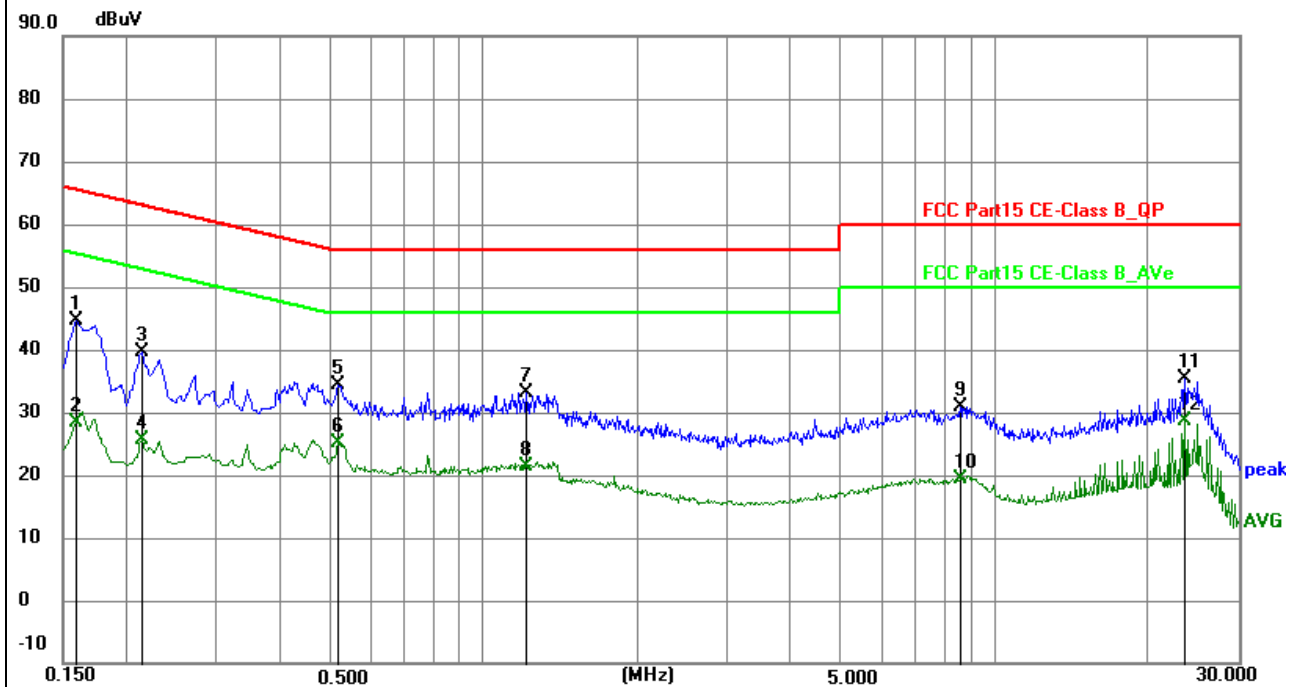
Test Plots and Data of Conducted Emissions

Tested Mode: TM1(2402MHz)

Test Voltage: AC 120V/60Hz

Test Power Line: Live

Remark:



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1590	35.37	9.17	44.54	65.52	-20.98	QP	P	
2	0.1590	19.30	9.17	28.47	55.52	-27.05	AVG	P	
3	0.2130	30.46	9.10	39.56	63.09	-23.53	QP	P	
4	0.2130	16.49	9.10	25.59	53.09	-27.50	AVG	P	
5	0.5190	24.49	9.94	34.43	56.00	-21.57	QP	P	
6 *	0.5190	15.20	9.94	25.14	46.00	-20.86	AVG	P	
7	1.2120	23.15	10.03	33.18	56.00	-22.82	QP	P	
8	1.2120	11.43	10.03	21.46	46.00	-24.54	AVG	P	
9	8.5515	20.82	10.16	30.98	60.00	-29.02	QP	P	
10	8.5515	9.30	10.16	19.46	50.00	-30.54	AVG	P	
11	23.6040	24.97	10.36	35.33	60.00	-24.67	QP	P	
12	23.6040	18.32	10.36	28.68	50.00	-21.32	AVG	P	

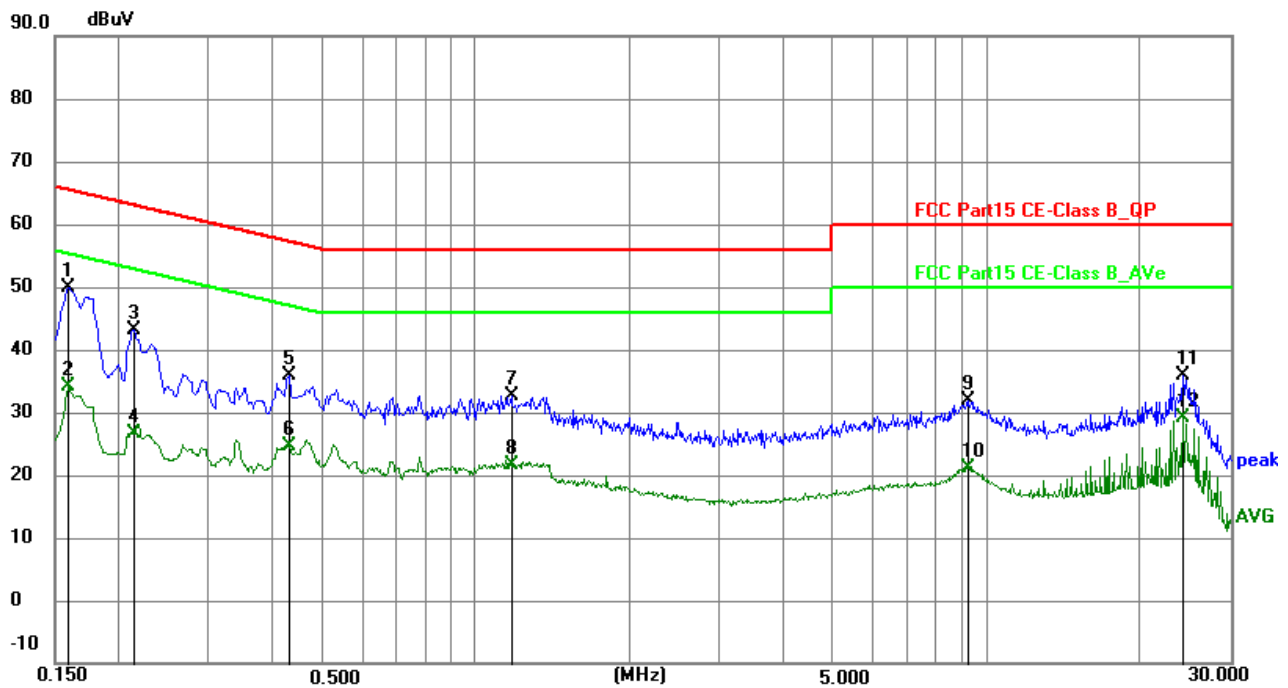
Test Plots and Data of Conducted Emissions

Tested Mode: TM2(2412MHz)

Test Voltage: AC 120V/60Hz

Test Power Line: Neutral

Remark:



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1 *	0.1590	40.65	9.34	49.99	65.52	-15.53	QP	P	
2	0.1590	24.73	9.34	34.07	55.52	-21.45	AVG	P	
3	0.2130	33.59	9.62	43.21	63.09	-19.88	QP	P	
4	0.2130	16.99	9.62	26.61	53.09	-26.48	AVG	P	
5	0.4290	25.85	9.94	35.79	57.27	-21.48	QP	P	
6	0.4290	14.77	9.94	24.71	47.27	-22.56	AVG	P	
7	1.1760	22.58	9.96	32.54	56.00	-23.46	QP	P	
8	1.1760	11.62	9.96	21.58	46.00	-24.42	AVG	P	
9	9.1995	21.52	10.25	31.77	60.00	-28.23	QP	P	
10	9.1995	10.81	10.25	21.06	50.00	-28.94	AVG	P	
11	24.1980	25.50	10.44	35.94	60.00	-24.06	QP	P	
12	24.1980	18.69	10.44	29.13	50.00	-20.87	AVG	P	

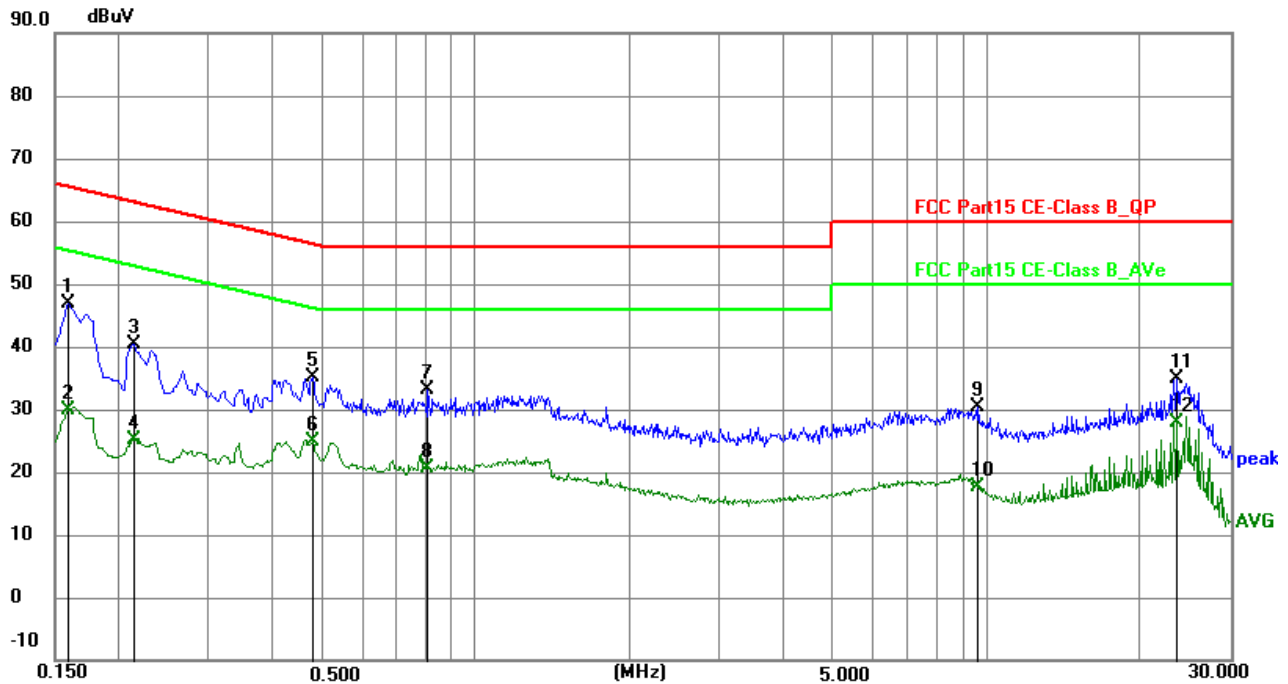
Test Plots and Data of Conducted Emissions

Tested Mode: TM2(2412MHz)

Test Voltage: AC 120V/60Hz

Test Power Line: Live

Remark:



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1 *	0.1590	37.83	9.17	47.00	65.52	-18.52	QP	P	
2	0.1590	20.65	9.17	29.82	55.52	-25.70	AVG	P	
3	0.2130	31.38	9.10	40.48	63.09	-22.61	QP	P	
4	0.2130	16.09	9.10	25.19	53.09	-27.90	AVG	P	
5	0.4785	25.27	9.93	35.20	56.37	-21.17	QP	P	
6	0.4785	14.85	9.93	24.78	46.37	-21.59	AVG	P	
7	0.8070	23.27	9.92	33.19	56.00	-22.81	QP	P	
8	0.8070	10.81	9.92	20.73	46.00	-25.27	AVG	P	
9	9.6180	20.35	10.09	30.44	60.00	-29.56	QP	P	
10	9.6180	7.49	10.09	17.58	50.00	-32.42	AVG	P	
11	23.5770	24.47	10.37	34.84	60.00	-25.16	QP	P	
12	23.5770	17.57	10.37	27.94	50.00	-22.06	AVG	P	

4. Radiated Emissions

4.1 Standard and Limit

According to §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

According to the rule FCC Part 15.209, Radiated emission limit for a wireless device as below:

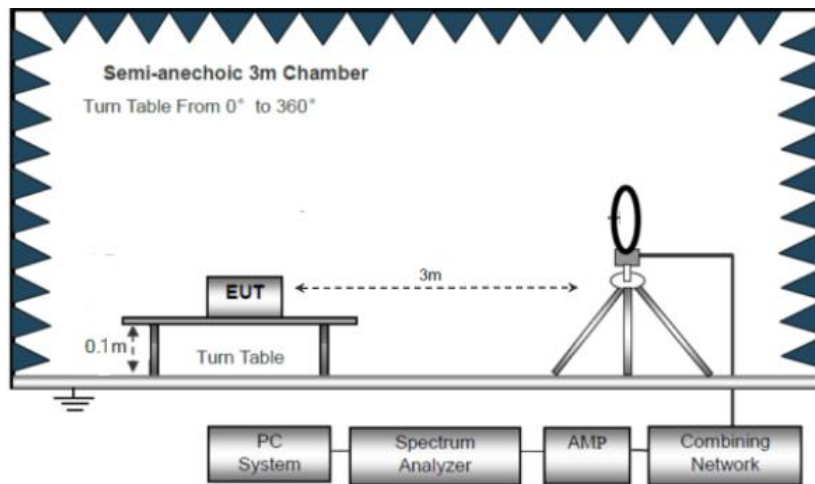
Frequency of Emission (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3
Note: The more stringent limit applies at transition frequencies.		

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

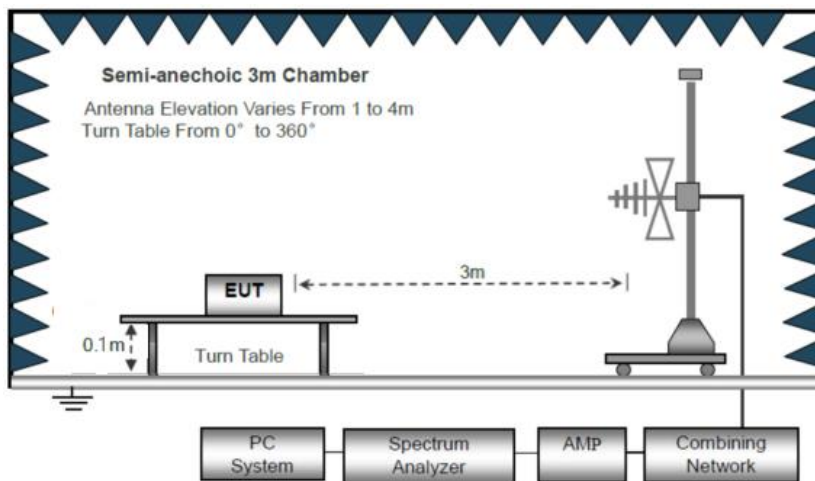
Note: Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

4.2 Test Procedure

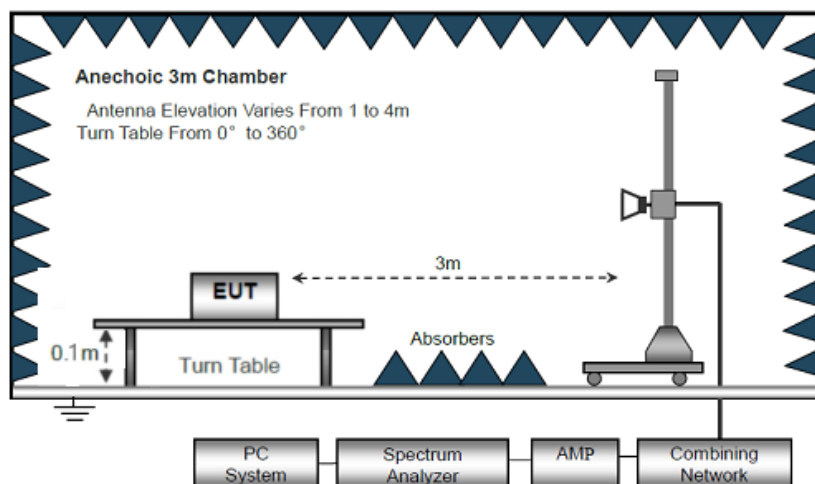
Test is conducting under the description of ANSI C63.10 - 2013 section 6.3 to 6.6.



Block Diagram of Radiated Emission Below 30MHz



Block Diagram of Radiated Emission From 30MHz to 1GHz



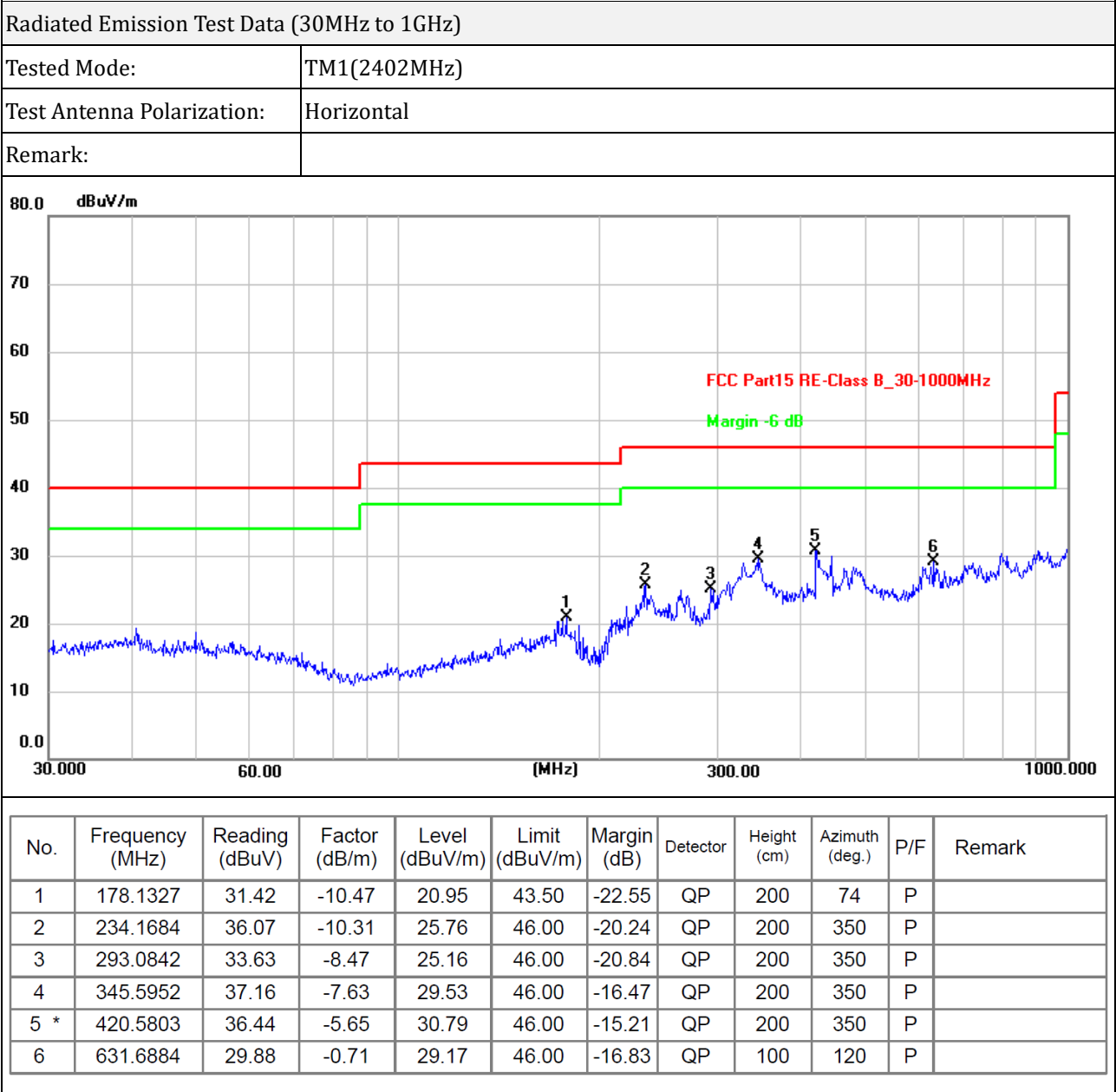
Block Diagram of Radiated Emission Above 1GHz

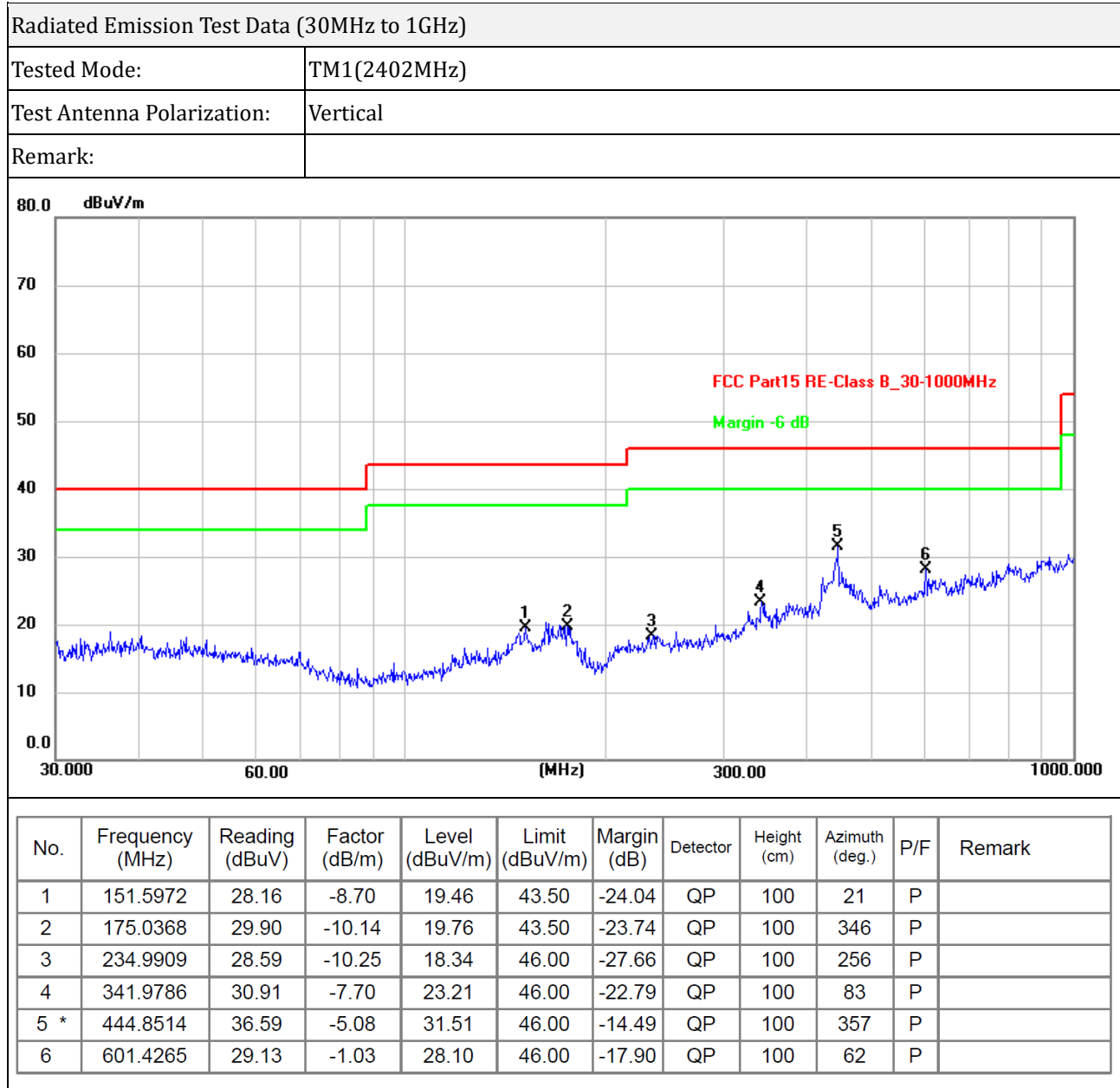
- a) The EUT is placed on a turntable, which is 0.1m above ground plane for test frequency range below 1GHz, and 1.5m above ground plane for test frequency range above 1GHz.
- b) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- c) Use the following spectrum analyzer settings:
Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for $f \geq 1\text{GHz}$, 100 kHz for $f < 1\text{GHz}$, 10kHz for $f < 30\text{MHz}$
VBW $\geq$ RBW, Sweep = auto
Detector function = peak
Trace = max hold
- d) Follow the guidelines in ANSI C63.4-2014 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- e) The peak level, once corrected, must comply with the limit specified in Section 15.209. Set the RBW = 1MHz, VBW = 10Hz, Detector = PK for AV value, while maintaining all of the other instrument settings.
- f) For the actual test configuration, please refer to the related item - EUT test photos.

4.3 Test Data and Results

Based on all tested data, the EUT complied with the FCC Part 15.247 standard limit for a wireless device, and with the worst case as below:

Remark: Level = Reading + Factor, Margin = Level - Limit



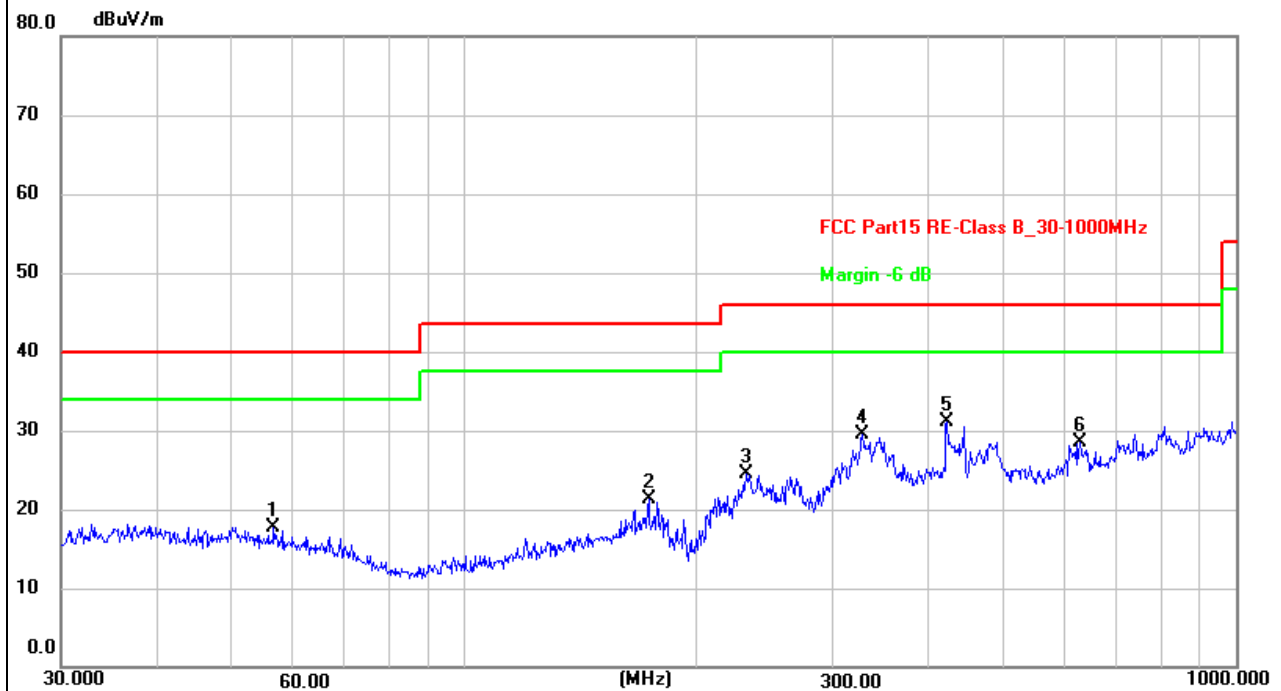


Radiated Emission Test Data (30MHz to 1GHz)

Tested Mode: TM2(2412MHz)

Test Antenna Polarization: Horizontal

Remark:



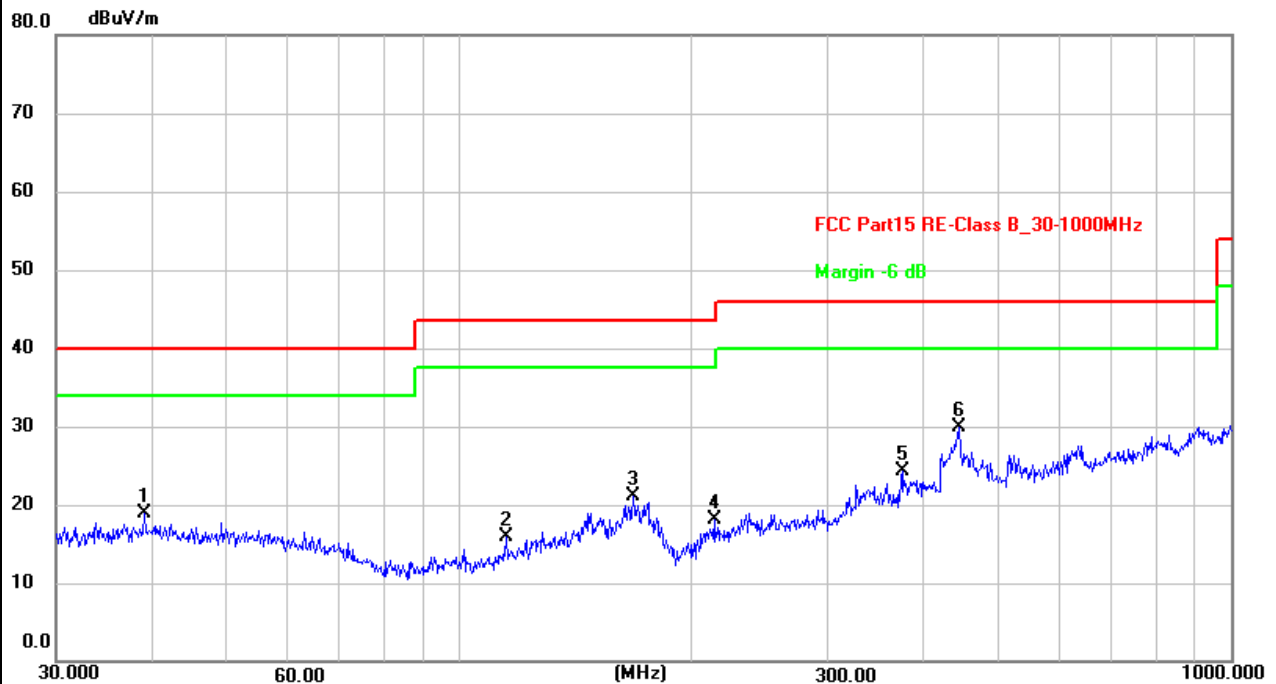
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	56.5929	27.20	-9.44	17.76	40.00	-22.24	QP	100	214	P	
2	173.2051	31.17	-9.95	21.22	43.50	-22.28	QP	200	286	P	
3	231.7179	34.94	-10.47	24.47	46.00	-21.53	QP	200	348	P	
4	327.8873	37.46	-8.03	29.43	46.00	-16.57	QP	200	348	P	
5 *	422.0577	36.81	-5.64	31.17	46.00	-14.83	QP	200	348	P	
6	627.2738	29.25	-0.76	28.49	46.00	-17.51	QP	100	133	P	

Radiated Emission Test Data (30MHz to 1GHz)

Tested Mode: TM2(2412MHz)

Test Antenna Polarization: Vertical

Remark:



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	39.0245	27.00	-8.10	18.90	40.00	-21.10	QP	100	0	P	
2	114.9169	27.20	-11.22	15.98	43.50	-27.52	QP	100	348	P	
3	167.8243	30.50	-9.45	21.05	43.50	-22.45	QP	100	205	P	
4	213.7634	29.54	-11.50	18.04	43.50	-25.46	QP	100	13	P	
5	374.6225	31.14	-6.91	24.23	46.00	-21.77	QP	100	247	P	
6 *	444.8514	35.04	-5.08	29.96	46.00	-16.04	QP	100	348	P	

***** END OF REPORT *****