

FCC Part 15C Measurement and Test Report

For

LYRobotix Co., Ltd.

15B, 12F, Building 3, No.48, North Third Ring West Road, Haidian Area,

Beijing City

FCC ID: 2ALY6NOLOMTSC-1705

FCC Rule(s):	<u>FCC Part 15.249</u>	
Product Description:	<u>NOLO CV1 Controller</u>	
Tested Model:	<u>CV1</u>	
Report No.:	<u>STR17048253I</u>	
Tested Date:	<u>2017-04-20 to 2017-06-01</u>	
Issued Date:	<u>2017-06-05</u>	
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Note: 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 SEM.Test Technology Co., Ltd.

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: LYRobotix Co., Ltd.
Address of applicant: 15B, 12F, Building 3, No.48, North Third Ring West Road, Haidian Area, Beijing City

Manufacturer: LYRobotix Co., Ltd.
Address of manufacturer: 15B, 12F, Building 3, No.48, North Third Ring West Road, Haidian Area, Beijing City

General Description of EUT	
Product Name:	NOLO CV1 Controller
Trade Name:	NOLO
Model No.:	CV1
Adding Model(s):	/
Rated Voltage:	DC 3.7V by Li-ion Battery; USB 5 charging purpose only
Power Adapter Model:	/
Note: The test data is gathered from a production sample, provided by the manufacturer.	

Technical Characteristics of EUT	
Frequency Range:	2402-2475MHz
Max. Field Strength:	102.49dBuV/m(3m)
Modulation:	GFSK
Antenna Type:	PCB
Antenna Gain:	1.0dBi
Lowest Internal Frequency of EUT:	8MHz

1.2 Test Standards

The following report is prepared on behalf of the LYRobotix Co., Ltd. in accordance with FCC Part 15, Subpart B, Subpart C, and section 15.107, 15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.107, 15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which results in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices, and 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.

1.4 Test Facility

FCC – Registration No.: 934118

Shenzhen SEM.Test Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files and the Registration is 934118.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Shenzhen SEM.Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

CNAS Registration No.: L4062

Shenzhen SEM.Test Technology Co., Ltd. is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L4062. All measurement facilities used to collect the measurement data are located at 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C (518101).

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low Channel	2402MHz
TM2	Middle Channel	2441MHz
TM3	High Channel	2475MHz

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	$\pm 0.42\text{dB}$
Occupied Bandwidth	Conducted	$\pm 1.5\%$
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$
Conducted Emissions	Conducted	$\pm 2.88\text{dB}$
Transmitter Spurious Emissions	Radiated	$\pm 5.1\text{dB}$

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2016-06-04	2017-06-03
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2016-06-04	2017-06-03
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2016-06-04	2017-06-03
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2016-06-04	2017-06-03
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2016-06-04	2017-06-03
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2016-06-04	2017-06-03
SEMT-1042	Horn Antenna	ETS	3117	00086197	2016-06-04	2017-06-03
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2016-06-04	2017-06-03
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2016-06-04	2017-06-03
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2016-06-04	2017-06-03
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2016-06-04	2017-06-03
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2016-06-04	2017-06-03

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§ 15.207(a)	Conducted Emission	Compliant
§ 15.209(a)(f)	Radiated Spurious Emissions	Compliant
§15.249(a)	Field Strength of Emissions	Compliant
§15.249(d)	Out of Band Emission	Compliant
§15.215 (c)	Emission Bandwidth	Compliant

3. Antenna Requirements

3.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

3.2 Test Result

This product has a PCB antenna, fulfill the requirement of this section.

4. Radiated Emissions

4.1 Standard Applicable

According to §15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field strength of fundamental (milli-volts/meter)	Field strength of Harmonics (micro-volts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

(d) 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 §15.209, whichever is the lesser attenuation.

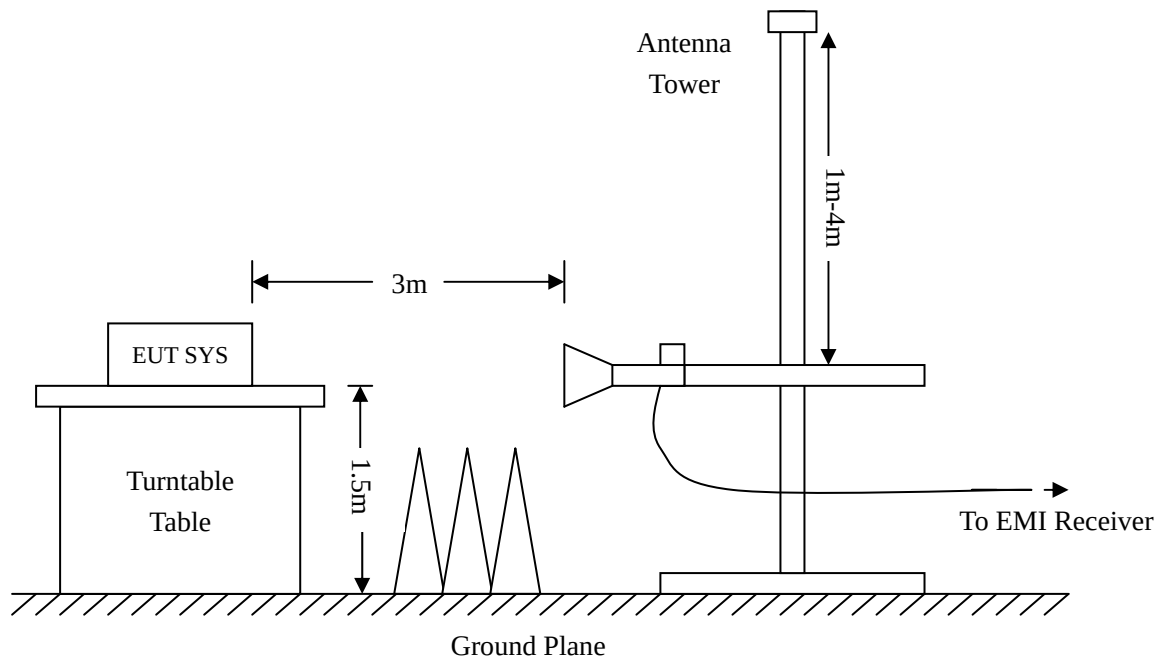
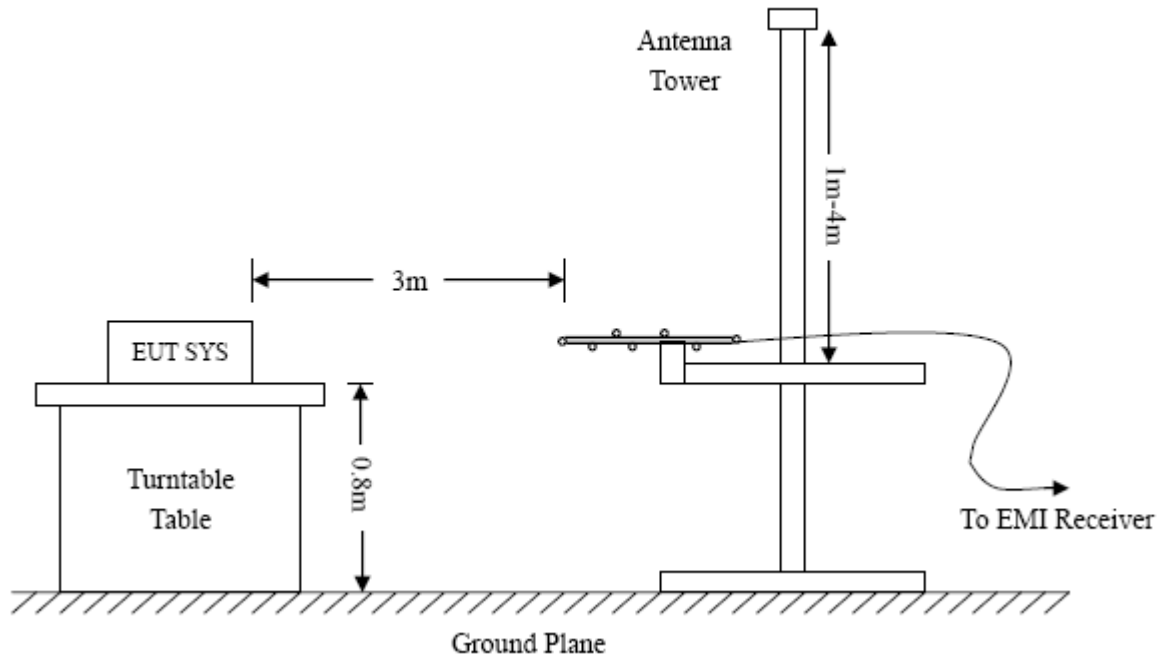
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

4.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.249(a) and FCC Part 15.209 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.



Frequency :9kHz-30MHz
 RBW=10KHz,
 VBW =30KHz
 Sweep time= Auto
 Trace = max hold
 Detector function = peak

Frequency :30MHz-1GHz
 RBW=120KHz,
 VBW=300KHz
 Sweep time= Auto
 Trace = max hold
 Detector function = peak, QP

Frequency :Above 1GHz
 RBW=1MHz,
 VBW=3MHz(Peak), 10Hz(AV)
 Sweep time= Auto
 Trace = max hold
 Detector function = peak, AV

4.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB μ V means the emission is 6dB μ V below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15C Limit}$$

4.4 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

4.5 Summary of Test Results/Plots

According to the data below, the [FCC Part 15.205](#), [15.209](#) and [15.249](#) standards, and had the worst margin of:

-8.25 dB at 4960 MHz in the Horizontal polarization, High Channel, 9 kHz to 25 GHz, 3Meters

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Plot of Radiated Emissions Test Data (30MHz to 1GHz)

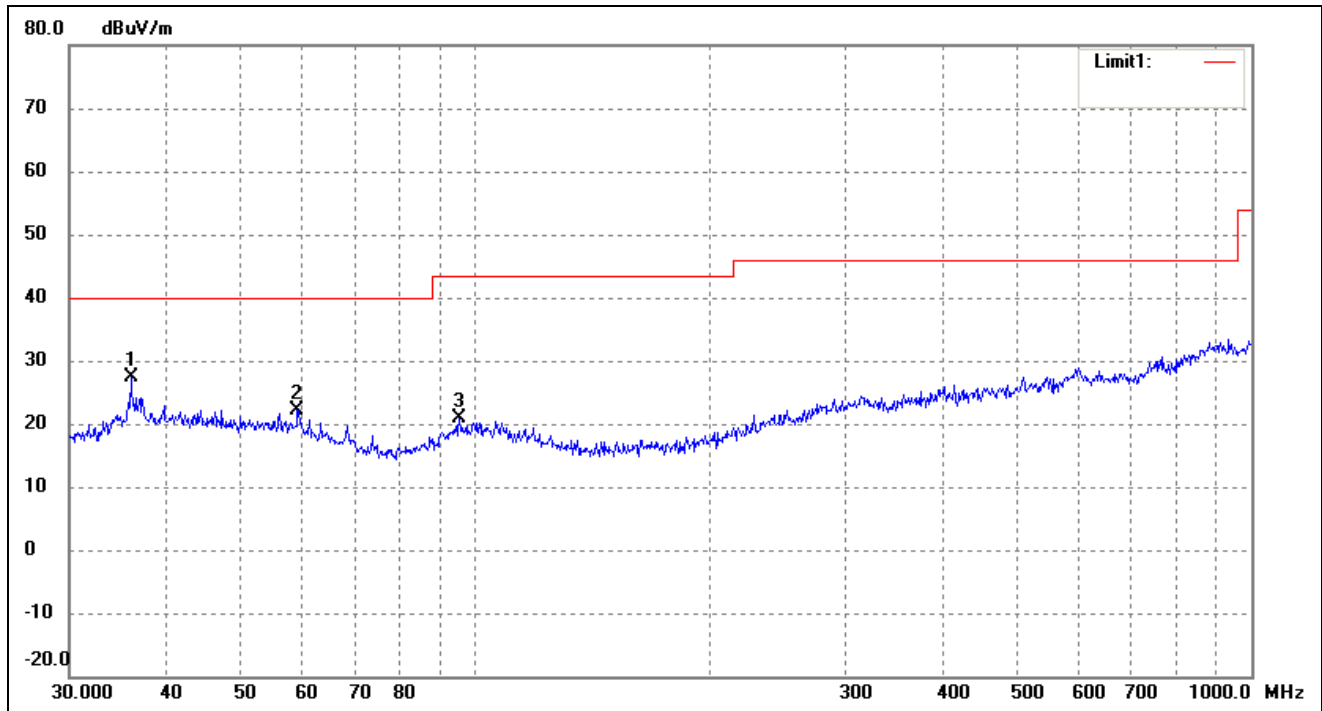
EUT: NOLO CV1 Controller

Tested Model: CV1

Operating Condition: Transmitting Low Channel (2402MHz)

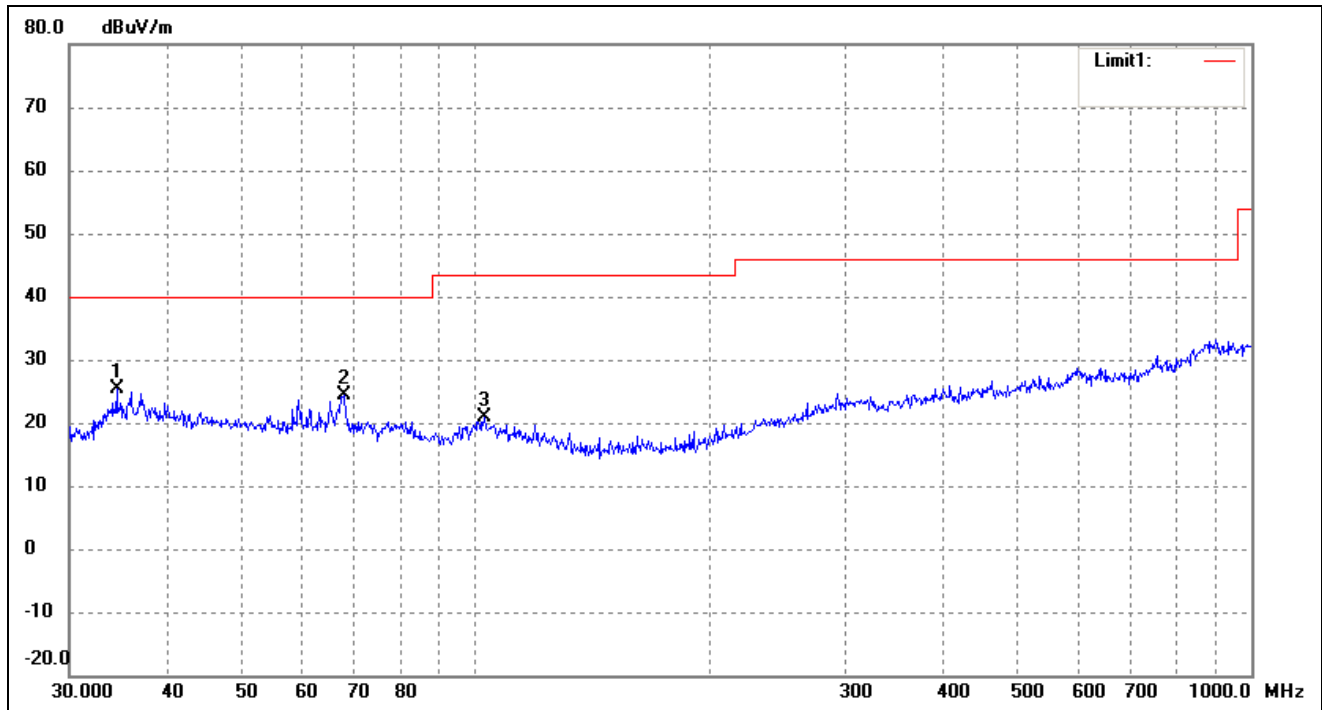
Comment: DC 3.7V

Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Detector
1*	36.0007	21.31	6.16	27.47	40.00	-12.53	81	100	peak
2	59.0251	16.62	5.47	22.09	40.00	-17.91	161	100	peak
3	95.4270	15.94	4.98	20.92	43.50	-22.58	56	100	peak

Test Specification: Vertical

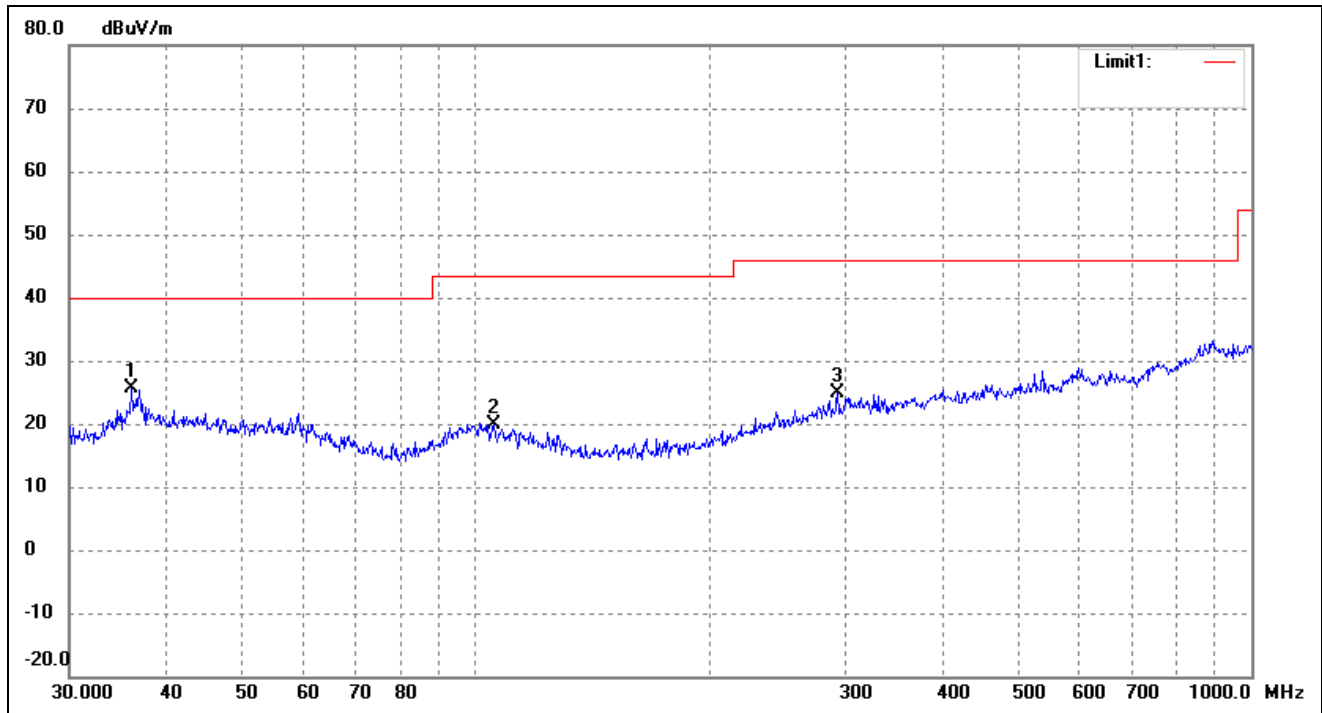


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Detector
1*	34.5173	17.17	8.32	25.49	40.00	-14.51	129	100	peak
2	67.6751	21.39	2.93	24.32	40.00	-15.68	162	100	peak
3	102.7192	15.04	5.85	20.89	43.50	-22.61	100	100	peak

Operating Condition: Transmitting Middle Channel (2441MHz)

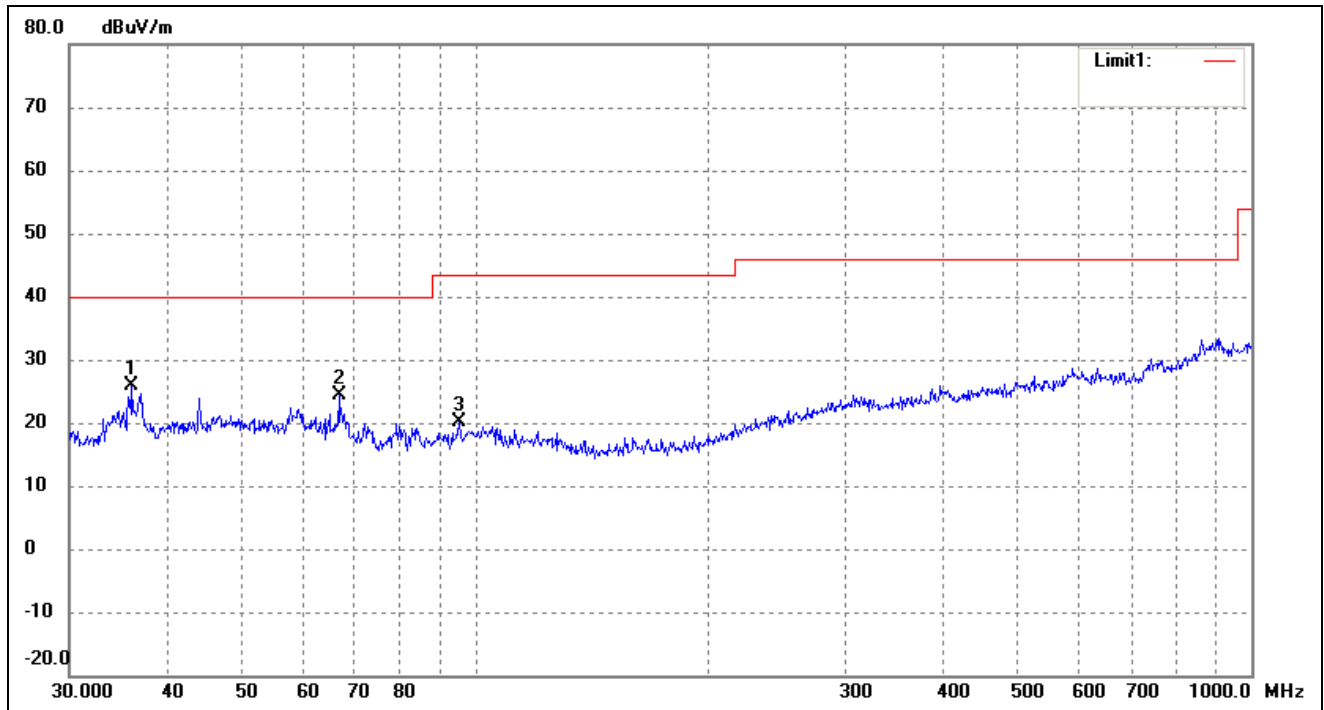
Comment: DC 3.7V

Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Detector
1*	36.1272	19.34	6.19	25.53	40.00	-14.47	64	100	peak
2	105.6415	14.44	5.53	19.97	43.50	-23.53	114	100	peak
3	293.0842	16.02	8.90	24.92	46.00	-21.08	130	100	peak

Test Specification: Vertical

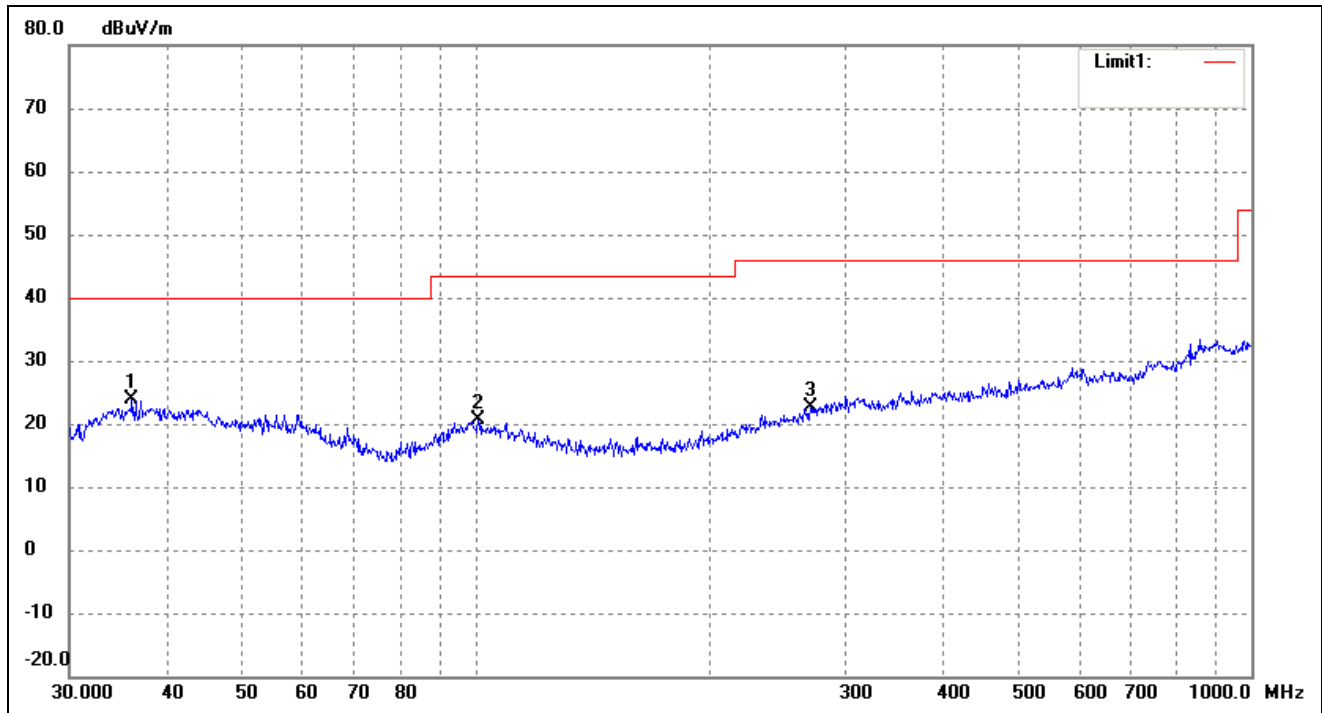


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Detector
1*	36.1272	17.22	8.58	25.80	40.00	-14.20	337	100	peak
2	66.7325	21.09	3.24	24.33	40.00	-15.67	166	100	peak
3	95.4270	15.13	4.98	20.11	43.50	-23.39	127	101	peak

Operating Condition: Transmitting High Channel (2475MHz)

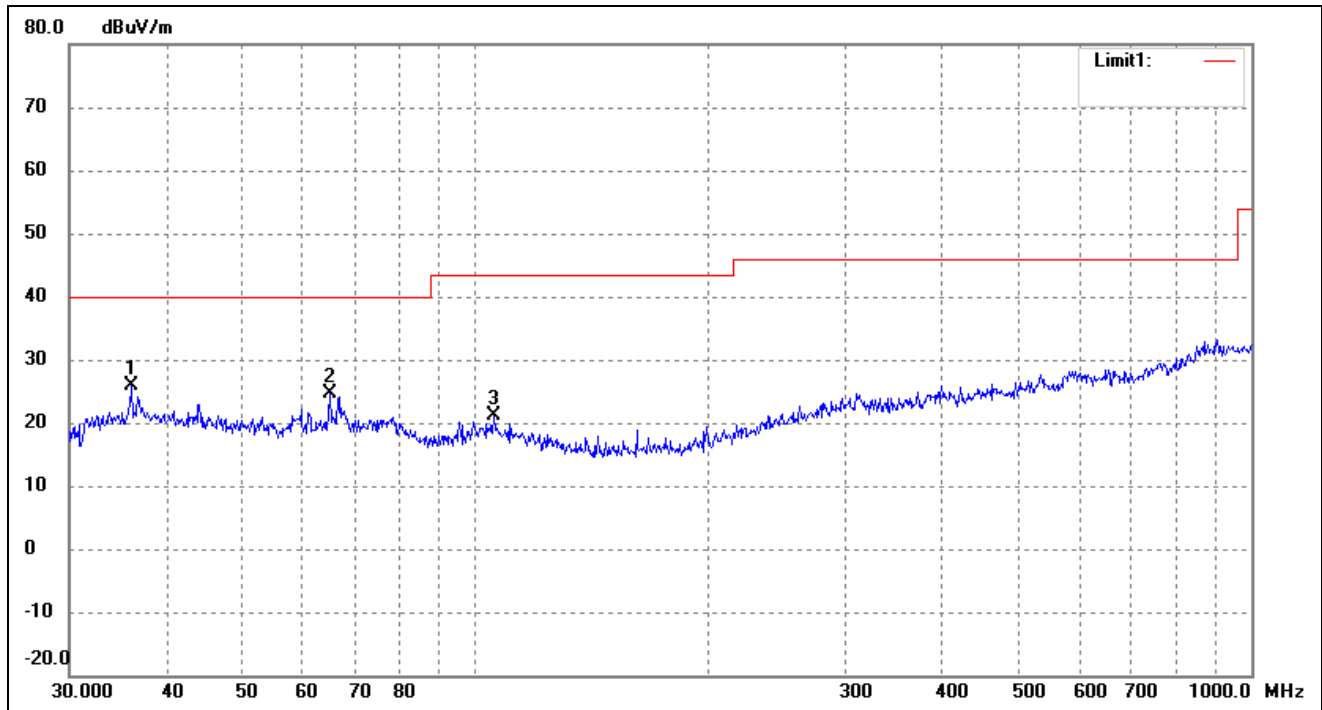
Comment: DC 3.7V

Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Detector
1*	36.1272	17.74	6.19	23.93	40.00	-16.07	339	100	peak
2	100.9340	14.56	6.03	20.59	43.50	-22.91	124	100	peak
3	270.3748	14.98	7.74	22.72	46.00	-23.28	82	100	peak

Test Specification: Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	()	(cm)	
1*	36.1272	17.37	8.58	25.95	40.00	-14.05	46	100	peak
2	64.8865	20.73	3.82	24.55	40.00	-15.45	330	100	peak
3	105.6415	15.70	5.53	21.23	43.50	-22.27	90	100	peak

Spurious Emissions Above 1GHz

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz							
2402	105.98	-3.5	102.48	114	-11.52	H	PK
2402	94.77	-3.5	91.27	94	-2.73	H	AV
4804	59.83	0.55	60.38	74	-13.62	H	PK
4804	44.53	0.55	45.08	54	-8.92	H	AV
7206	36.98	3.67	40.65	74	-33.35	H	PK
7206	24.52	3.67	28.19	54	-25.81	H	AV
2402	105.92	-3.5	102.42	114	-11.58	V	PK
2402	94.58	-3.5	91.08	94	-2.92	V	AV
4804	59.57	0.55	60.12	74	-13.88	V	PK
4804	44.63	0.55	45.18	54	-8.82	V	AV
7206	36.52	3.67	40.19	74	-33.81	V	PK
7206	24.52	3.67	28.19	54	-25.81	V	AV
Middle Channel-2441MHz							
2441	105.78	-3.43	102.35	114	-11.65	H	PK
2441	94.74	-3.43	91.31	94	-2.69	H	AV
4882	59.80	0.66	60.46	74	-13.54	H	PK
4882	44.66	0.66	45.32	54	-8.68	H	AV
7323	36.62	3.75	40.37	74	-33.63	H	PK
7323	24.75	3.75	28.50	54	-25.50	H	AV
2441	105.60	-3.43	102.17	114	-11.83	V	PK
2441	94.75	-3.43	91.32	94	-2.68	V	AV
4882	59.77	0.66	60.43	74	-13.57	V	PK
4882	44.59	0.66	45.25	54	-8.75	V	AV
7323	36.68	3.75	40.43	74	-33.57	V	PK
7323	24.84	3.75	28.59	54	-25.41	V	AV

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2480MHz							
2480	105.83	-3.34	102.49	114	-11.51	H	PK
2480	94.85	-3.34	91.51	94	-2.49	H	AV
4960	59.85	0.78	60.63	74	-13.37	H	PK
4960	44.97	0.78	45.75	54	-8.25	H	AV
7440	36.71	3.85	40.56	74	-33.44	H	PK
7440	24.64	3.85	28.49	54	-25.51	H	AV
2480	105.68	-3.34	102.34	114	-11.66	V	PK
2480	94.82	-3.34	91.48	94	-2.52	V	AV
4960	59.90	0.77	60.67	74	-13.33	V	PK
4960	44.89	0.77	45.66	54	-8.34	V	AV
7440	36.86	3.85	40.71	74	-33.29	V	PK
7440	24.68	3.85	28.53	54	-25.47	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, which above 3th Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

The measurements greater than 20dB below the limit from 9kHz to 30MHz.

5. Out of Band Emissions

5.1 Standard Applicable

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 §15.209, whichever is the lesser attenuation.

5.2 Test Procedure

As the radiation test, set the Lowest and Highest Transmitting Channel, observed the outside band of 2400MHz to 2483.5MHz, than mark the higher-level emission for comparing with the FCC rules.

5.3 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

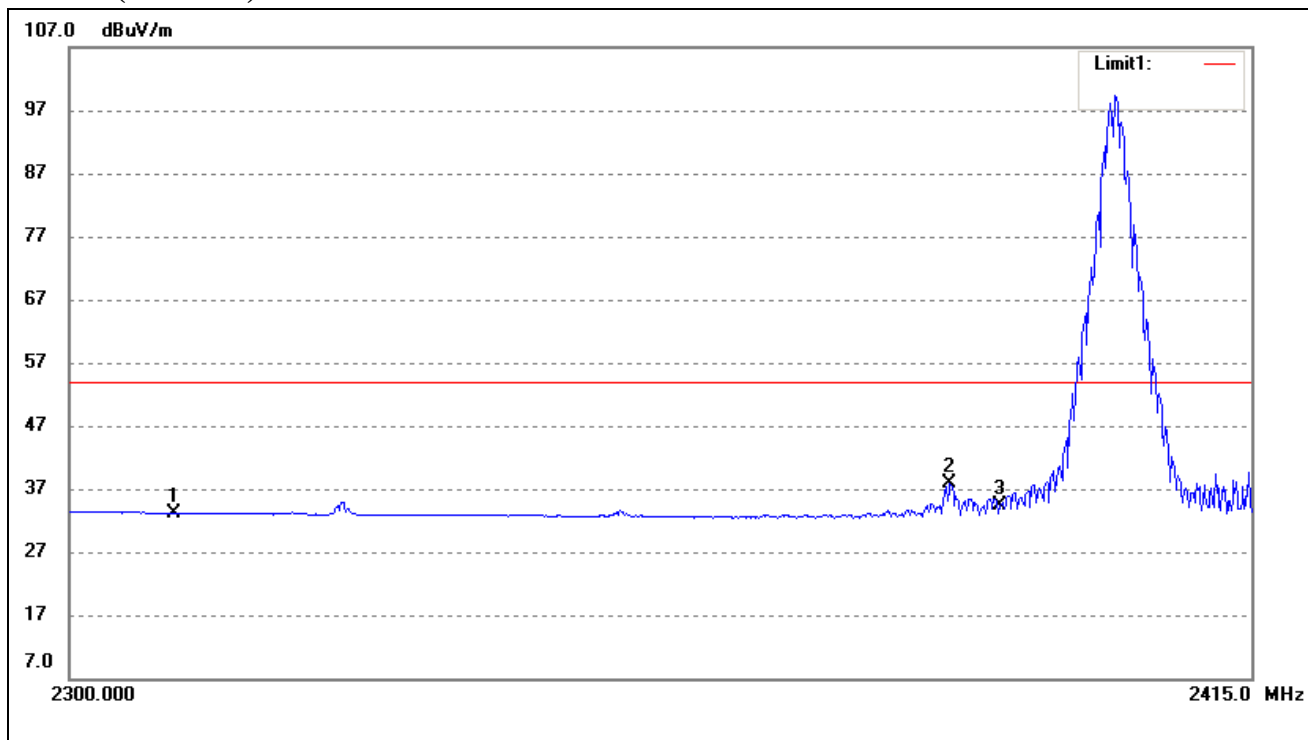
5.4 Summary of Test Results/Plots

Test mode	Frequency	Limit	Result
	MHz	dBuV / dBc	
Lowest	2310.00	<54 dBuV	Pass
	2390.00	<54 dBuV	Pass
	2400.00	<54 dBuV	Pass
Highest	2483.50	<54 dBuV	Pass
	2500.00	<54 dBuV	Pass

The edge emissions are below the FCC 15.209 Limits or complies with the 15.249 requirements.

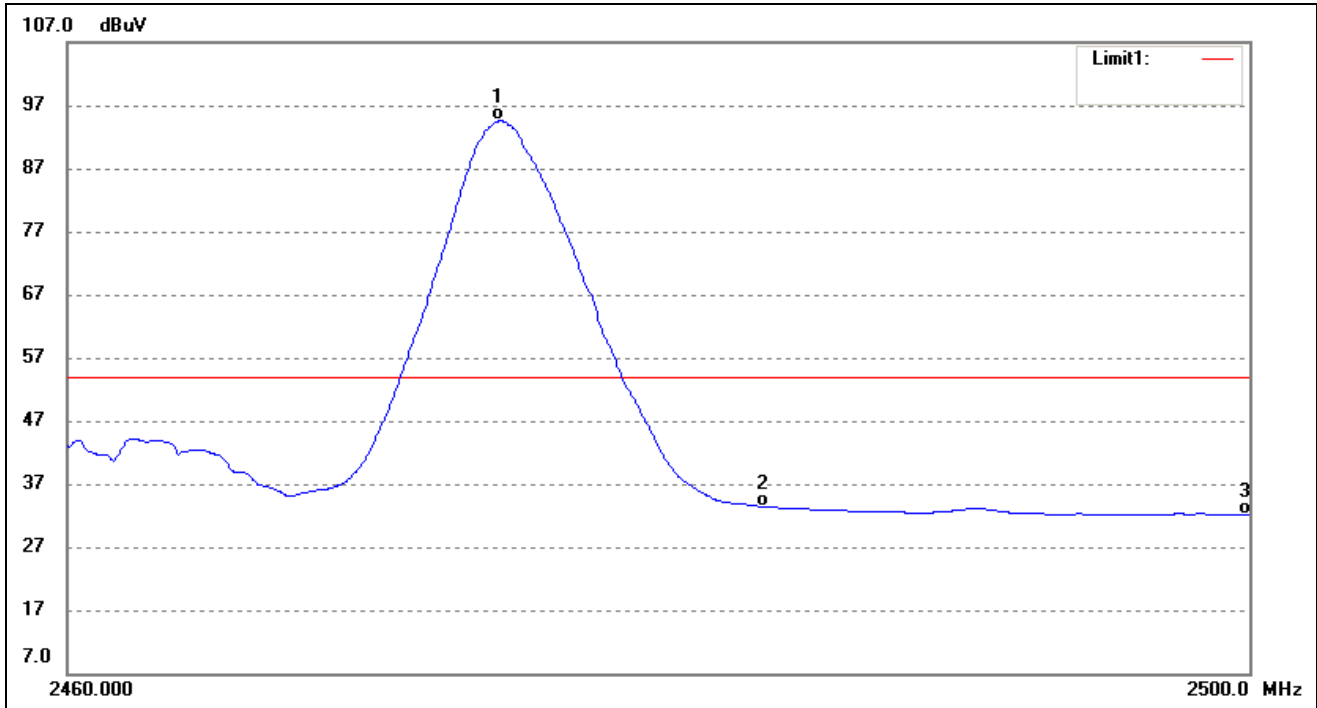
Please refer to the test plots as below.

Lowest Bandedge
Vertical (Worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	36.54	-3.35	33.19	54.00	-20.81	Ave Detector
	2310.000	54.48	-3.35	51.13	74.00	-22.87	Peak Detector
2	2385.140	42.01	-4.22	37.79	54.00	-16.21	Ave Detector
	2385.140	73.06	-4.22	68.84	74.00	-5.16s	Peak Detector
3	2390.000	38.65	-4.29	34.36	54.00	-19.64	Ave Detector
	2390.000	75.03	-4.29	70.74	74.00	-3.26	Peak Detector

Highest Bandedge
Vertical (Worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2474.525	98.93	-4.36	94.57	/	/	Ave Detector
	2474.445	104.77	-4.36	100.41	/	/	Peak Detector
2	2483.500	37.75	-4.36	33.39	54.00	-20.61	Ave Detector
	2483.500	72.65	-4.36	68.29	74.00	-5.71	Peak Detector
3	2500.000	36.56	-4.34	32.22	54.00	-21.78	Ave Detector
	2500.000	60.55	-4.34	56.21	74.00	-17.79	Peak Detector

6. Emission Bandwidth

6.1 Standard Applicable

According to 15.215 (c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

6.2 Test Procedure

According to the ANSI 63.10-2013, the emission bandwidth test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Set span = 1MHz, centered on a transmitting channel

RBW $\geq$ 1% 20dB Bandwidth, VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down and 99% bandwidth of the emission.

6.3 Environmental Conditions

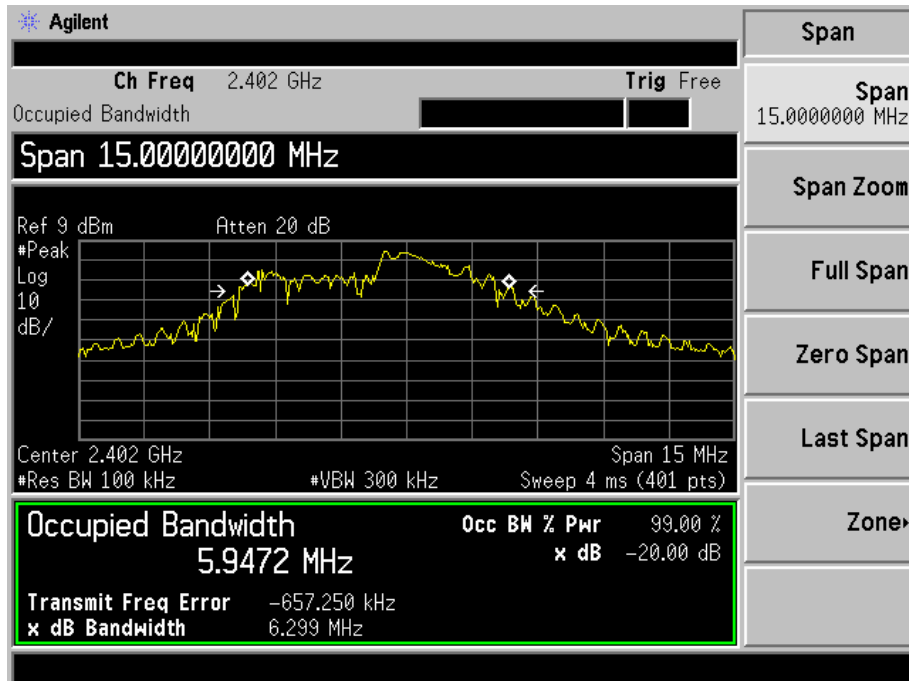
Temperature:	25 °C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

6.4 Summary of Test Results/Plots

Channel	Frequency MHz	20dB Bandwidth kHz	99% Bandwidth kHz
Low Channel	2402	6299	5947.2
Middle Channel	2441	5279	5070.8
High Channel	2475	4177	3816.9

Please refer to the following test plots

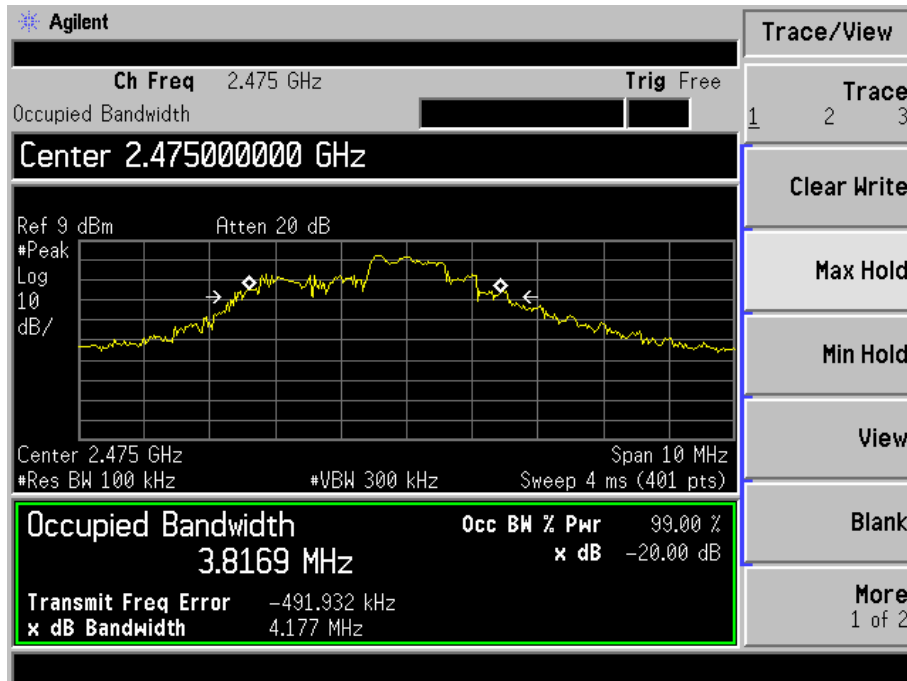
Low Channel:



Middle Channel:



High Channel:



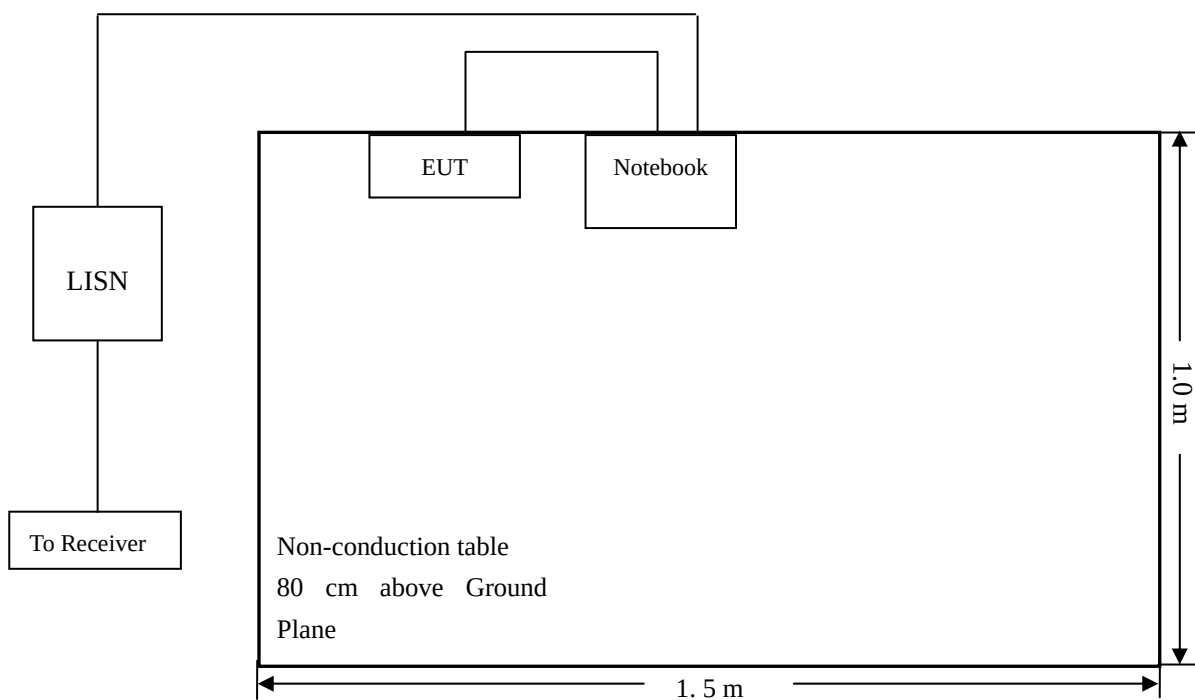
7. Conducted Emissions

7.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.

7.2 Basic Test Setup Block Diagram



7.3 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

7.4 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency 150 kHz
Stop Frequency..... 30 MHz
Sweep Speed Auto
IF Bandwidth..... 10 kHz
Quasi-Peak Adapter Bandwidth 9 kHz
Quasi-Peak Adapter Mode Normal

7.5 Summary of Test Results/Plots

According to the data in section 7.6, the EUT complied with the FCC Part 15.207 Conducted margin for this device, with the *worst* margin reading of:

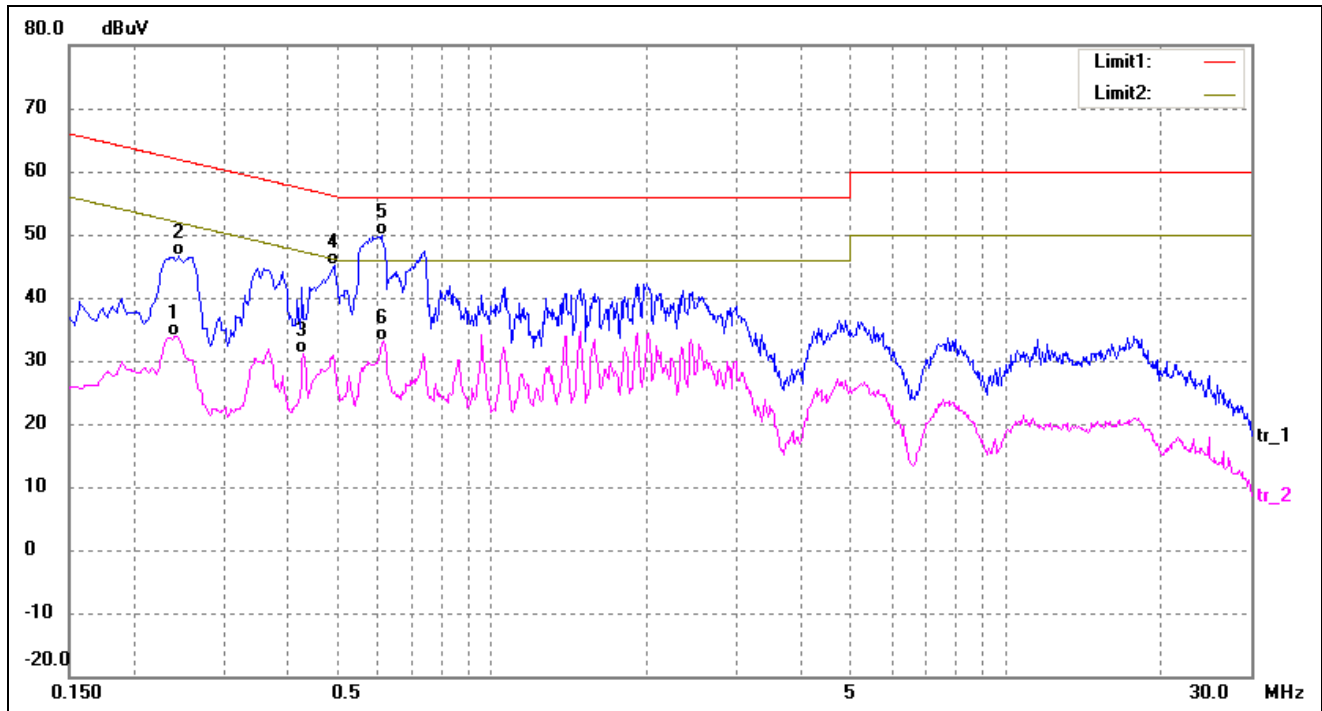
-6.22 dB at 0.6100 MHz in the Neutral mode, QP detector, 0.15-30MHz

7.6 Conducted Emissions Test Data

Plot of Conducted Emissions Test Data

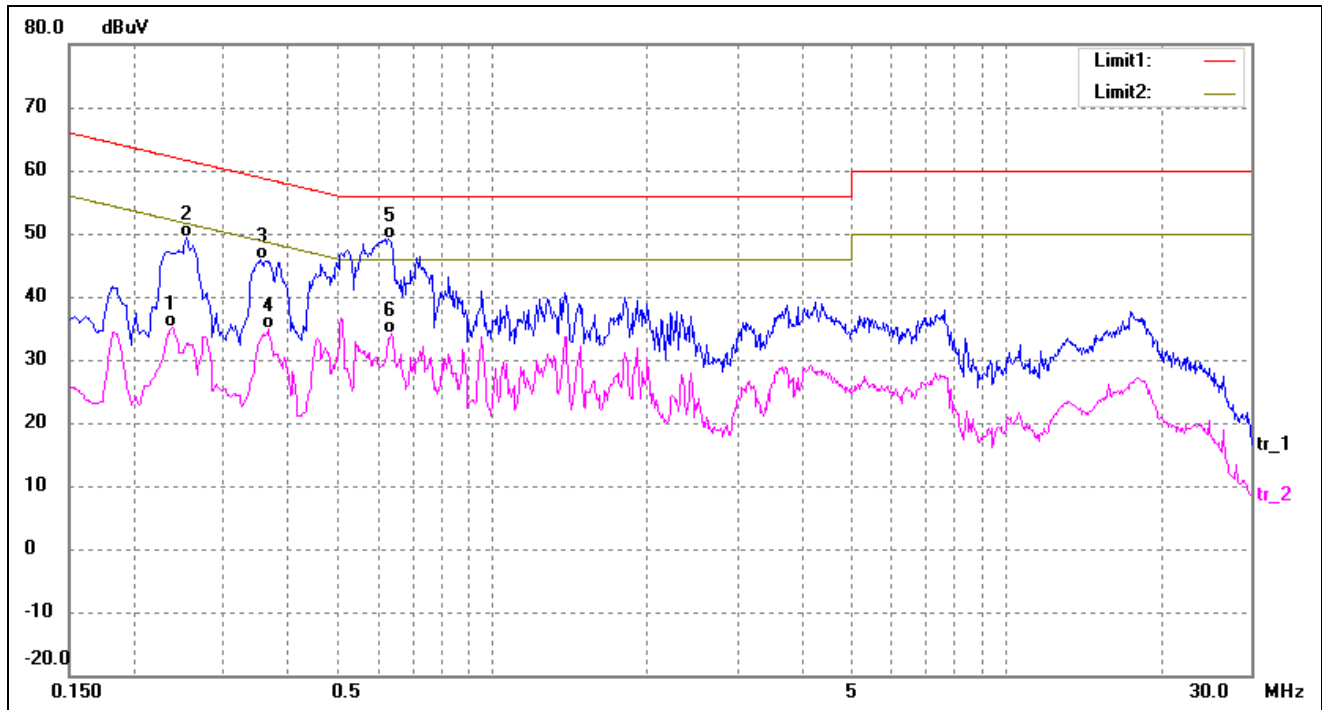
EUT: NOLO CV1 Controller
Tested Model: CV1
Operating Condition: Charging & Transmitting
Comment: AC 120V/60Hz; USB 5V

Test Specification: Neutral



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.2420	24.19	9.80	33.99	52.03	-18.04	AVG
2	0.2460	36.75	9.80	46.55	61.89	-15.34	QP
3	0.4300	21.36	9.80	31.16	47.25	-16.09	AVG
4	0.4940	35.26	9.80	45.06	56.10	-11.04	QP
5*	0.6100	39.99	9.79	49.78	56.00	-6.22	QP
6	0.6140	23.30	9.79	33.09	46.00	-12.91	AVG

Test Specification: Line



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.2380	25.35	9.80	35.15	52.17	-17.02	AVG
2	0.2540	39.69	9.80	49.49	61.63	-12.14	QP
3	0.3540	36.00	9.80	45.80	58.87	-13.07	QP
4	0.3660	25.08	9.80	34.88	48.59	-13.71	AVG
5*	0.6300	39.38	9.79	49.17	56.00	-6.83	QP
6	0.6340	24.41	9.79	34.20	46.00	-11.80	AVG

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