

FCC TEST REPORT

Product Name: Bluetooth Low Engerey Finders
Trade Mark: 
Model No.: PLX-SW-BT01
Report Number: 171115001RFC-1
Test Standards: FCC 47 CFR Part 15 Subpart C
FCC ID: 2AO9T-PLXBT
Test Result: PASS
Date of Issue: March 23, 2018

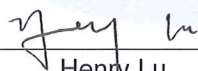
Prepared for:

Plox Inc
Level 14, 535 Mission Street, San Francisco, CA 94103, USA

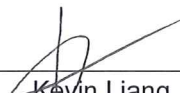
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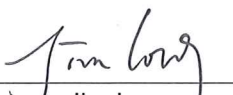
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March 23, 2018



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Version

Version No.	Date	Description
V1.0	March 23, 2018	Original

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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Plox Inc
Address of Applicant:	Level 14, 535 Mission Street, San Francisco, CA 94103, USA

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	Bluetooth Low Engerey Finders		
Model No.:	PLX-SW-BT01		
Add. Model No.:	PLX-SW-BT02,PLX-SW-BT03,PLX-SW-BT04,PLX-SW-BT05,PLX-SW-BT06		
Trade Mark:			
DUT Stage:	Identical Prototype		
EUT Supports Function:	2.4 GHz ISM Band:	Bluetooth: V4.0 LE	
Sample Received Date:	December 5, 2017		
Sample Tested Date:	December 7, 2017 to December 7, 2017		
Note: The test data is gathered from a production sample, provided by the manufacturer. The appearance of others models listed in the report is different from main-test model PLX-SW-BT01, but the circuit and the electronic construction do not change, declared by the manufacturer.			

1.2.2 Description of Accessories

None.

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Operational Band	Frequency	2400 MHz to 2483.5 MHz
Frequency Range:	2402 MHz to 2480 MHz	
Bluetooth Version:	Bluetooth V4.0 LE	
Type of Modulation:	GFSK	
Number of Channels:	40	
Channel Separation:	2 MHz	
Antenna Type:	PCB Antenna	
Antenna Gain:	-3 dBi	
Normal Test Voltage:	CR2450 Battery 3.0 Vdc	

1.4 OTHER INFORMATION

Operation Frequency Each of Channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402 MHz	10	2422 MHz	20	2442 MHz	30	2462 MHz
1	2404 MHz	11	2424 MHz	21	2444 MHz	31	2464 MHz
2	2406 MHz	12	2426 MHz	22	2446 MHz	32	2466 MHz
3	2408 MHz	13	2428 MHz	23	2448 MHz	33	2468 MHz
4	2410 MHz	14	2430 MHz	24	2450 MHz	34	2470 MHz
5	2412 MHz	15	2432 MHz	25	2452 MHz	35	2472 MHz
6	2414 MHz	16	2434 MHz	26	2454 MHz	36	2474 MHz
7	2416 MHz	17	2436 MHz	27	2456 MHz	37	2476 MHz
8	2418 MHz	18	2438 MHz	28	2458 MHz	38	2478 MHz
9	2420 MHz	19	2440 MHz	29	2460 MHz	39	2480 MHz

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1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
Notebook	Lenovo	E450	SL10G10780	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	USB Cable	USB2.0 Micro	1.0 Meter	UnionTrust

1.6 TEST LOCATION

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1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

IC-Registration No.: 21600-1

The 3m Semi-anechoic chamber of Shenzhen UnionTrust Quality and Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 21600-1.

A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC Accredited Lab.

Designation Number: CN1194

Test Firm Registration Number: 259480

1.8 DEVIATION FROM STANDARDS

None.

1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

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1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
3	Radiated emission 9KHz-30MHz	±4.9 dB
4	Radiated emission 30MHz-1GHz	±4.7 dB
5	Radiated emission 1GHz-18GHz	±5.1 dB
6	Radiated emission 18GHz-26GHz	±5.2 dB
7	Radiated emission 26GHz-40GHz	±5.2 dB

2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart C Test Cases			
Test Item	Test Requirement	Test Method	Result
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	N/A ^{NOTE2}
Conducted Peak Output Power	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3)	KDB 558074 D01 v04, Section 9.1.3	N/A ^{NOTE2}
6dB Bandwidth	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2)	KDB 558074 D01 v04, Section 8.1	N/A ^{NOTE2}
Power Spectral Density	FCC 47 CFR Part 15 Subpart C Section 15.247 (e)	KDB 558074 D01 v04, Section 10.2	N/A ^{NOTE2}
Conducted Out of Band Emission	FCC 47 CFR Part 15 Subpart C Section 15.247(d)	KDB 558074 D01 v04, Section 11	N/A ^{NOTE2}
Radiated Spurious Emissions	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	KDB 558074 D01 v04, Section 12.1	PASS
Band Edge Measurements (Radiated)	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	KDB 558074 D01 v04, Section 12.1	PASS
Note: 1) N/A: In this whole report not application. 2) Refer to Report No. 50103122 001 for RF Report.			

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☒	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 20, 2015	Dec. 19, 2018
☒	Receiver	R&S	ESIB26	100114	Dec. 10, 2017	Dec. 10, 2018
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	Jun. 24, 2015	Jun. 23, 2018
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Jul. 24, 2015	Jul. 23, 2018
☒	Preamplifier	HP	8447F	2805A02960	Dec.10, 2017	Dec. 10, 2018
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	Dec. 17, 2017	Dec. 17, 2018
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☒	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	Jun. 21, 2017	Jun. 20, 2018
☒	Test Software	Audix	e3	Software Version: 9.160323		

4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
NT/NV	+15 to +35	3	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (Kpa)	Tested by
Radiated Spurious Emissions	24.7	46	100.07	Tony Kang
Band Edge Measurements (Radiated)	24.7	46	100.07	Tony Kang

4.2 TEST CHANNELS

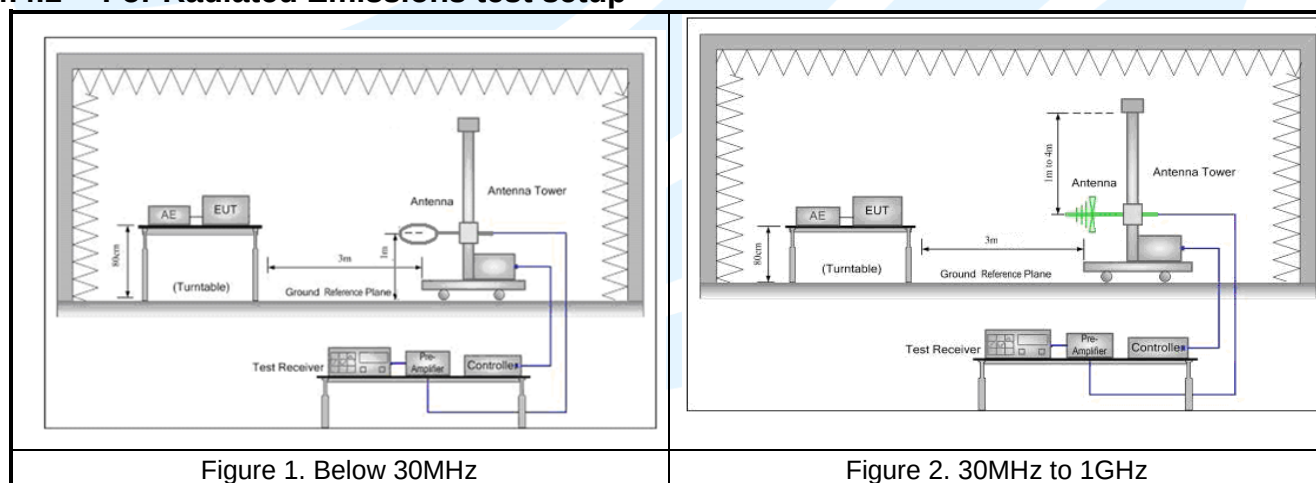
Type of Modulation	Tx/Rx Frequency	Test RF Channel Lists		
GFSK	2402 MHz to 2480 MHz	Lowest(L)	Middle(M)	Highest(H)
		Channel 0	Channel 19	Channel 39
		2402 MHz	2440 MHz	2480 MHz

4.3 EUT TEST STATUS

Type of Modulation	Tx Function	Description
GFSK	1Tx	1. Keep the EUT in continuously transmitting with modulation test single.

4.4 TEST SETUP

4.4.1 For Radiated Emissions test setup



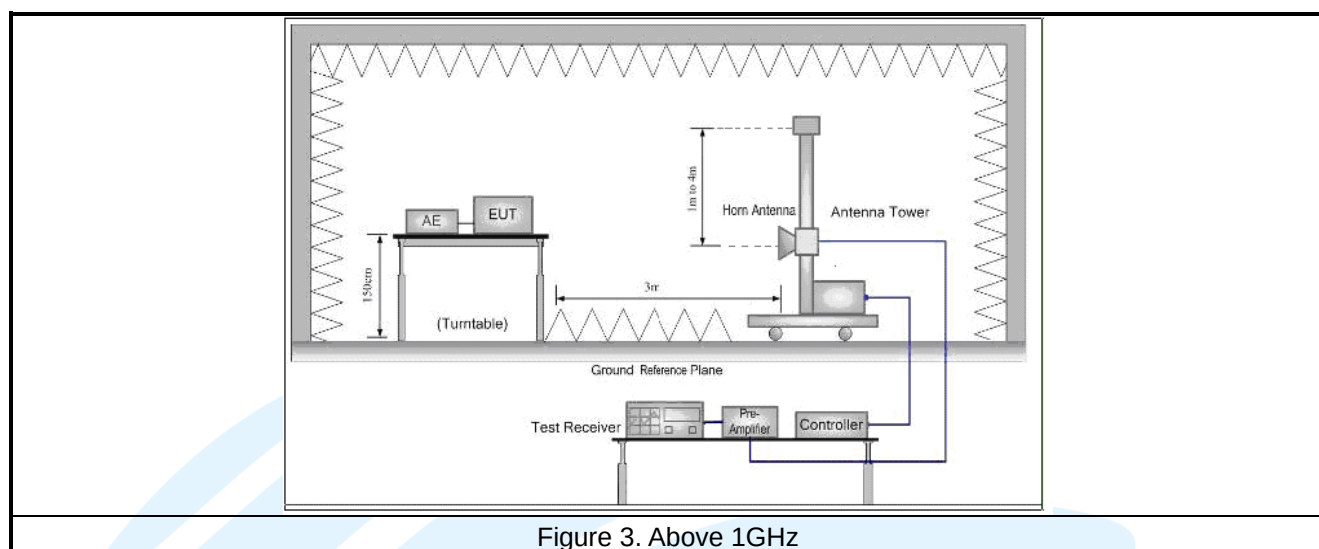


Figure 3. Above 1GHz

4.5 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by a 3.0Vdc CR2450 Lithium battery. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	Y axis

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

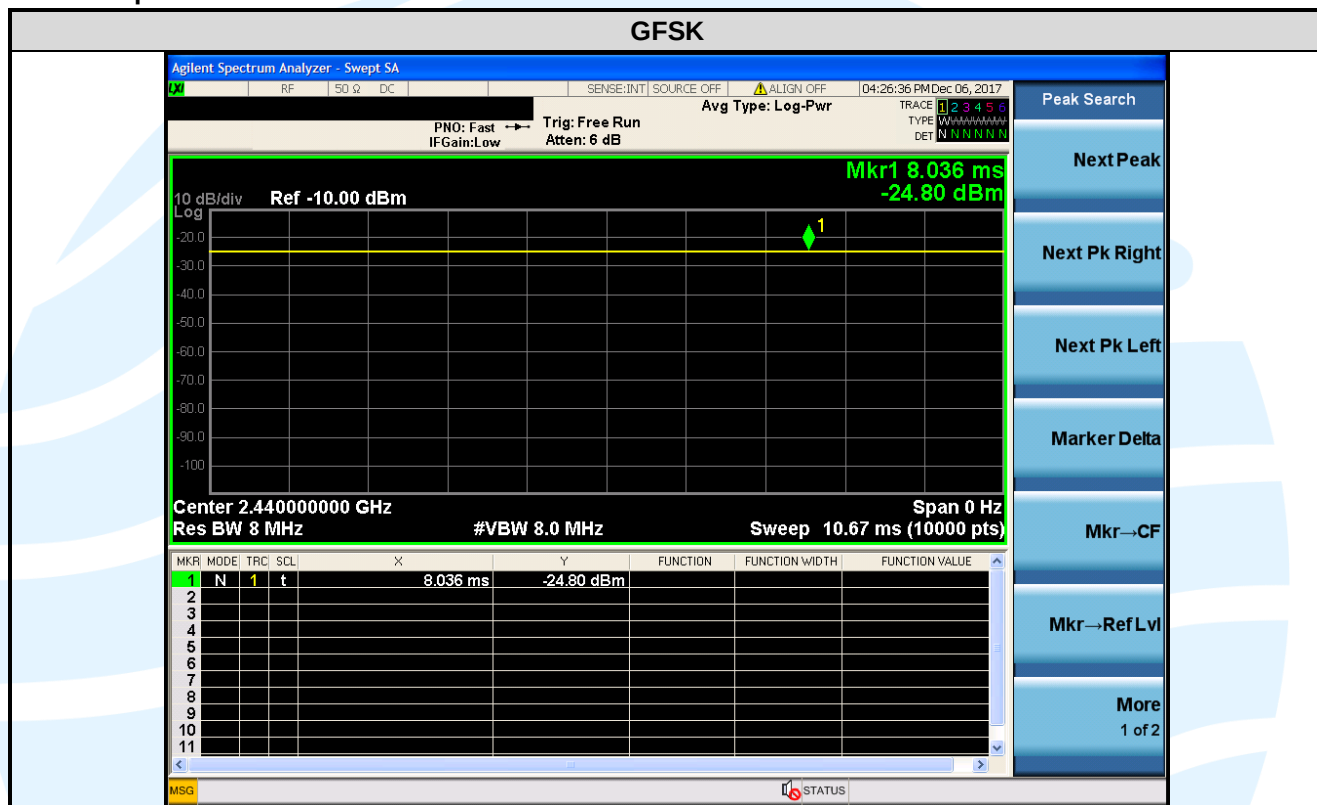
4.6 DUTY CYCLE

Type of Modulation	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
GFSK	1.00	1.00	1.00	100.00	0.00	0.01	0.00

Remark:

- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor = $10 * \log(1/ \text{Duty cycle})$;
- 3) Average factor = $20 \log_{10} \text{Duty Cycle}$.

The test plot as follows



5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB 558074 D01 DTS Meas Guidance v04	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

5.2 ANTENNA REQUIREMENT

Standard 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: Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is -3 dBi.

5.3 RADIATED SPURIOUS EMISSIONS

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.205/15.209

Test Method: KDB 558074 D01 v04, Section 12.1

Receiver Setup:

Frequency	RBW
0.009 MHz-0.150 MHz	200/300 kHz
0.150 MHz -30 MHz	9/10 kHz
30 MHz-1 GHz	100/120 kHz
Above 1 GHz	1 MHz

Limits:

Spurious Emissions

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

Remark:

- The lower limit shall apply at the transition frequencies.
- Emission level (dBuV/m) = 20 log Emission level (uV/m).
- For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

Test Setup: Refer to section 4.4.1 for details.

Test Procedures:

- From 30 MHz to 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 chamber. 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 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).
 - 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

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the Y axis positioning which it is worse case.

4) Repeat above procedures until all frequencies measured was complete.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

The measurement data as follows:

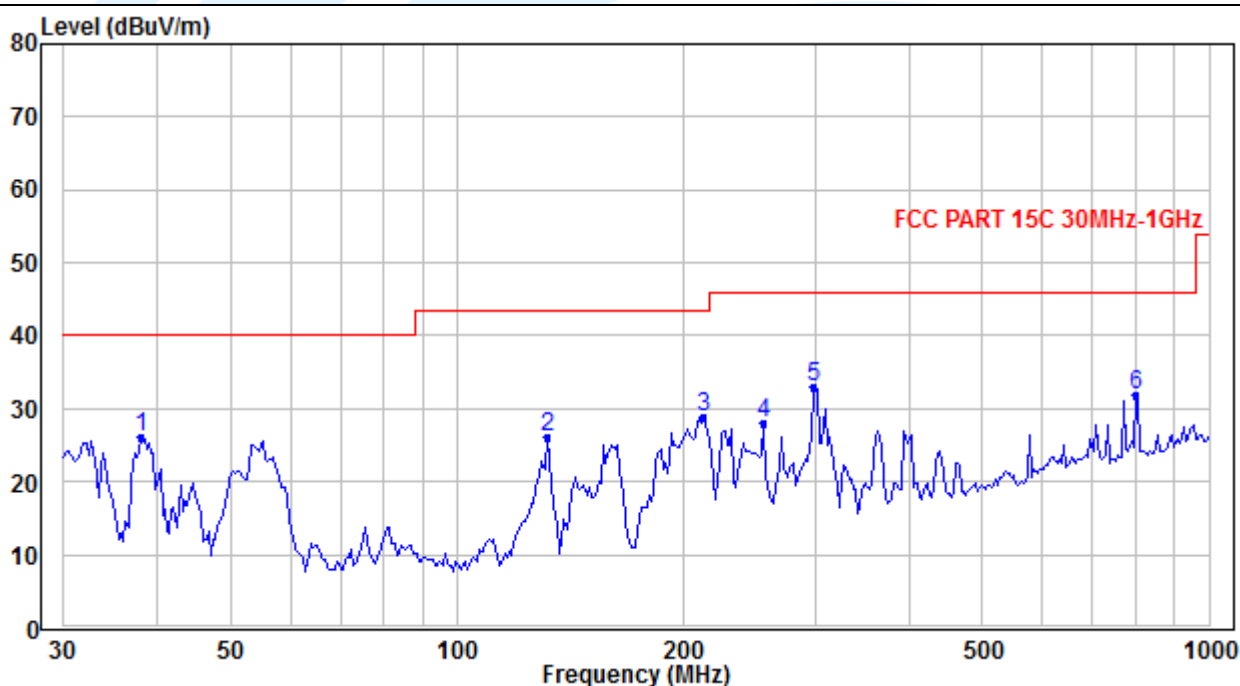
Radiated Emission Test Data (9 KHz ~ 30 MHz):

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

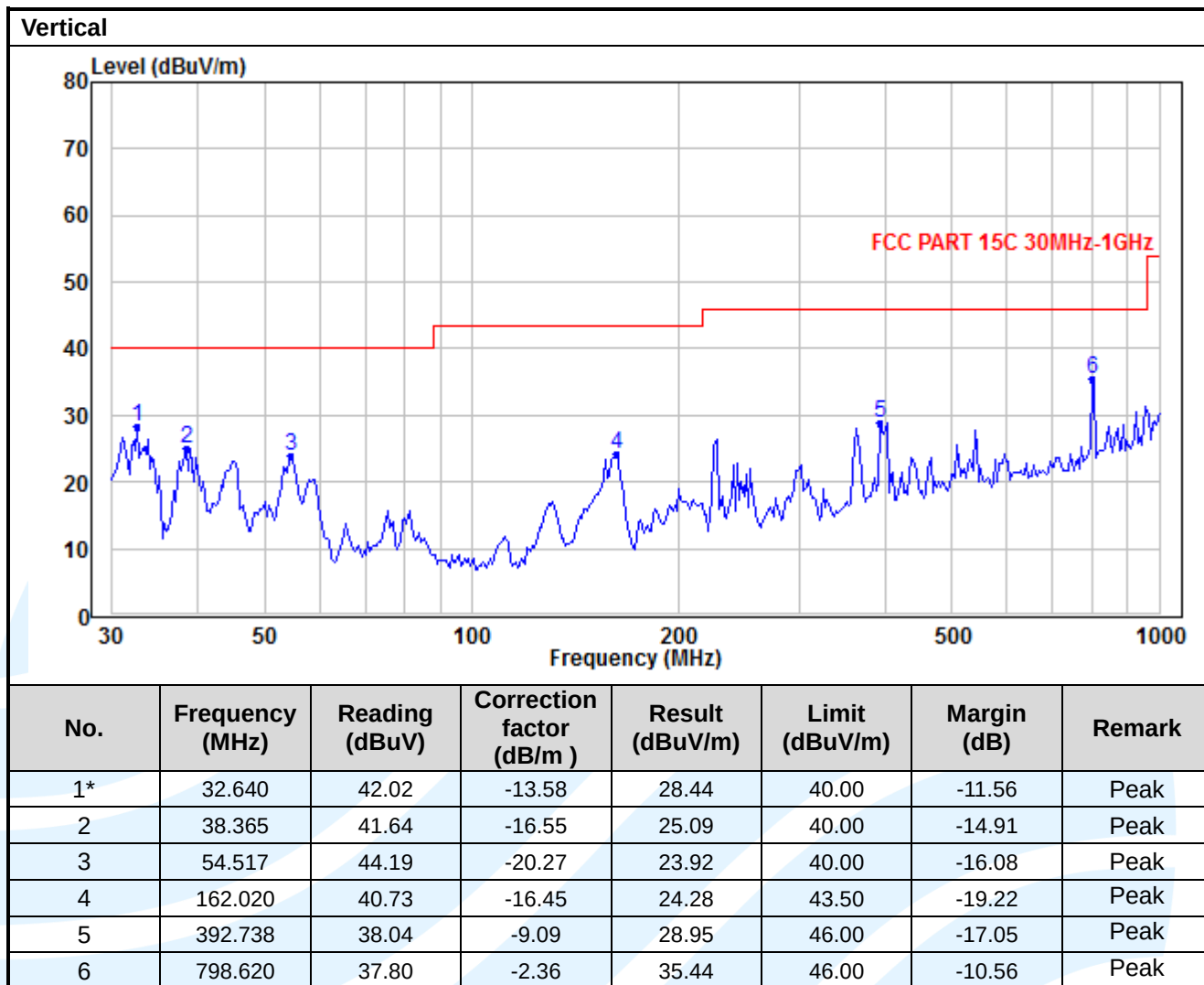
Radiated Emission Test Data (30 MHz ~ 1 GHz):

Lowest Channel

Horizontal

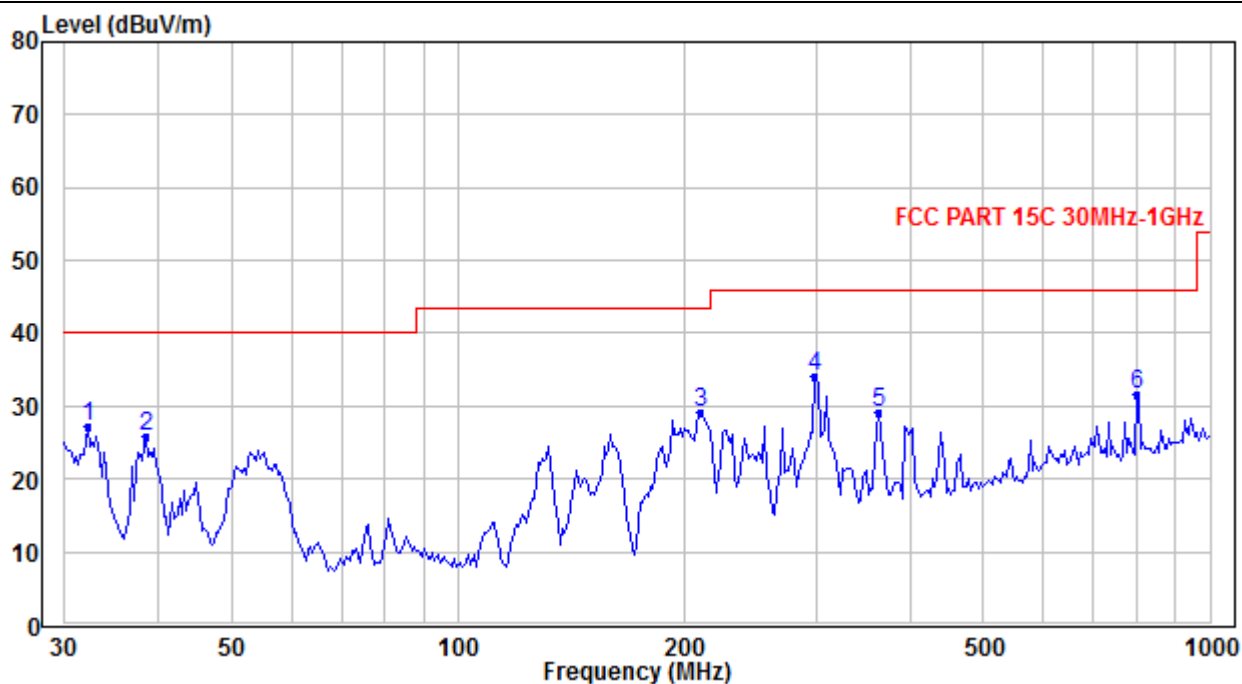


No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	38.096	41.63	-15.49	26.14	40.00	-13.86	Peak
2	132.149	44.27	-18.13	26.14	43.50	-17.36	Peak
3	213.103	43.83	-14.85	28.98	43.50	-14.52	Peak
4	255.823	40.37	-12.43	27.94	46.00	-18.06	Peak
5	298.593	44.15	-11.19	32.96	46.00	-13.04	Peak
6	798.620	33.26	-1.43	31.83	46.00	-14.17	Peak

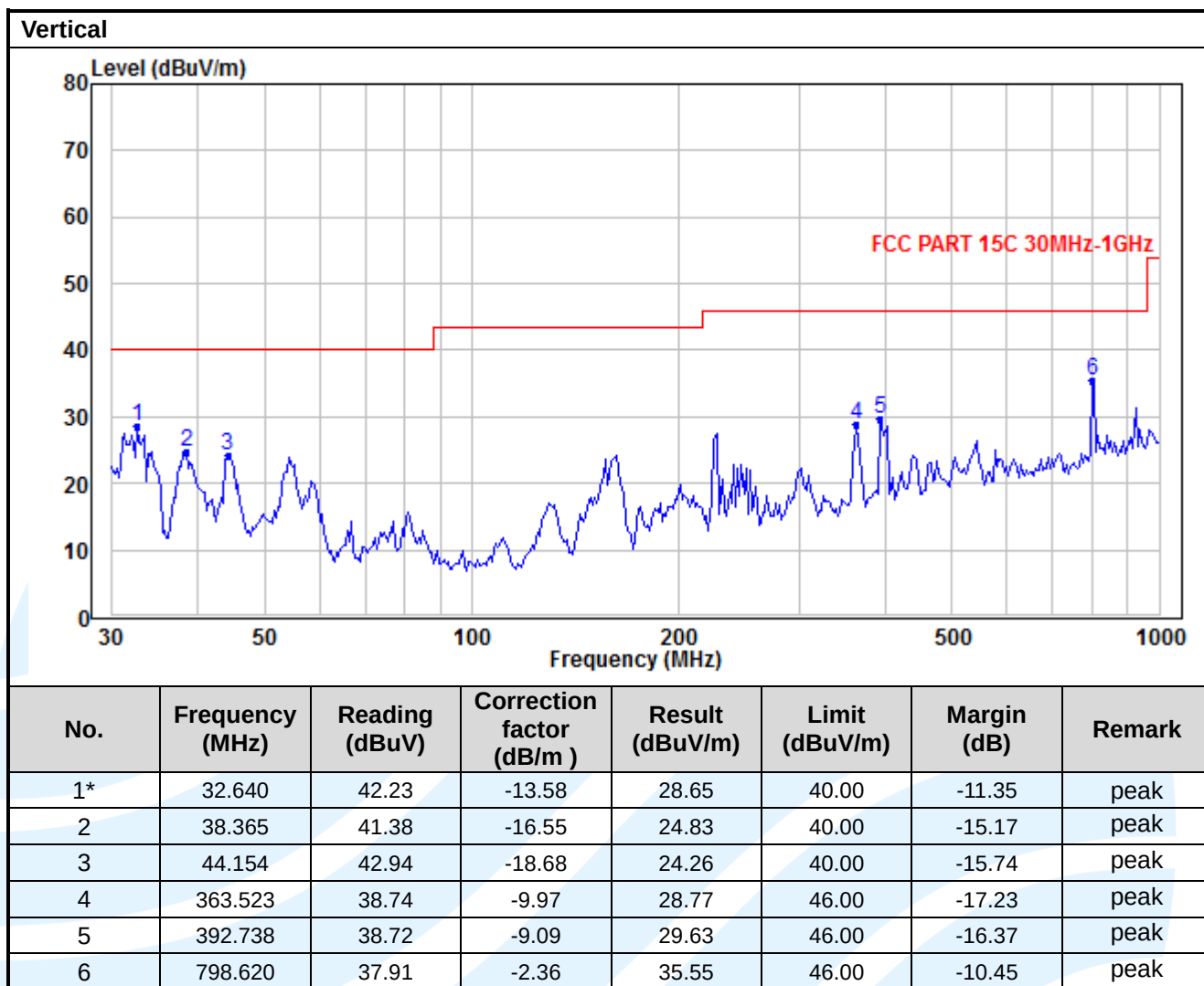


Middle Channel

Horizontal

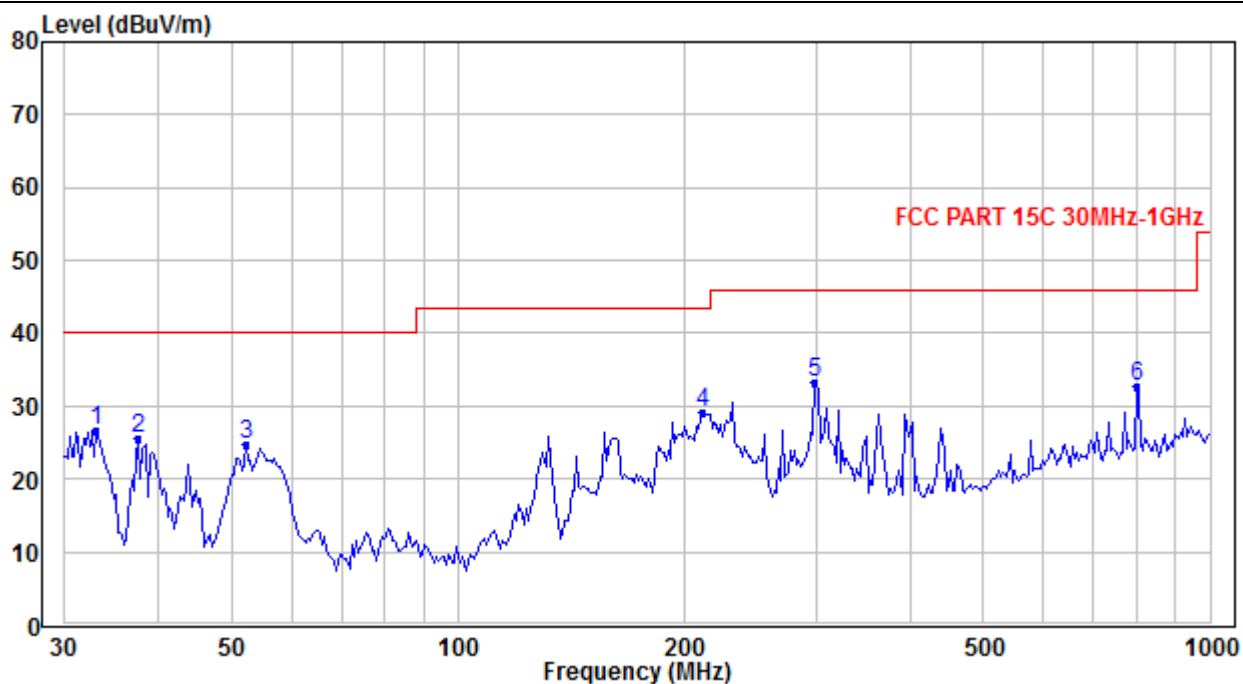


No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	32.184	39.47	-12.37	27.10	40.00	-12.90	Peak
2	38.365	41.55	-15.63	25.92	40.00	-14.08	Peak
3	210.129	44.17	-15.00	29.17	43.50	-14.33	Peak
4	298.593	45.16	-11.19	33.97	46.00	-12.03	Peak
5	363.523	38.99	-9.72	29.27	46.00	-16.73	Peak
6	798.620	33.11	-1.43	31.68	46.00	-14.32	Peak

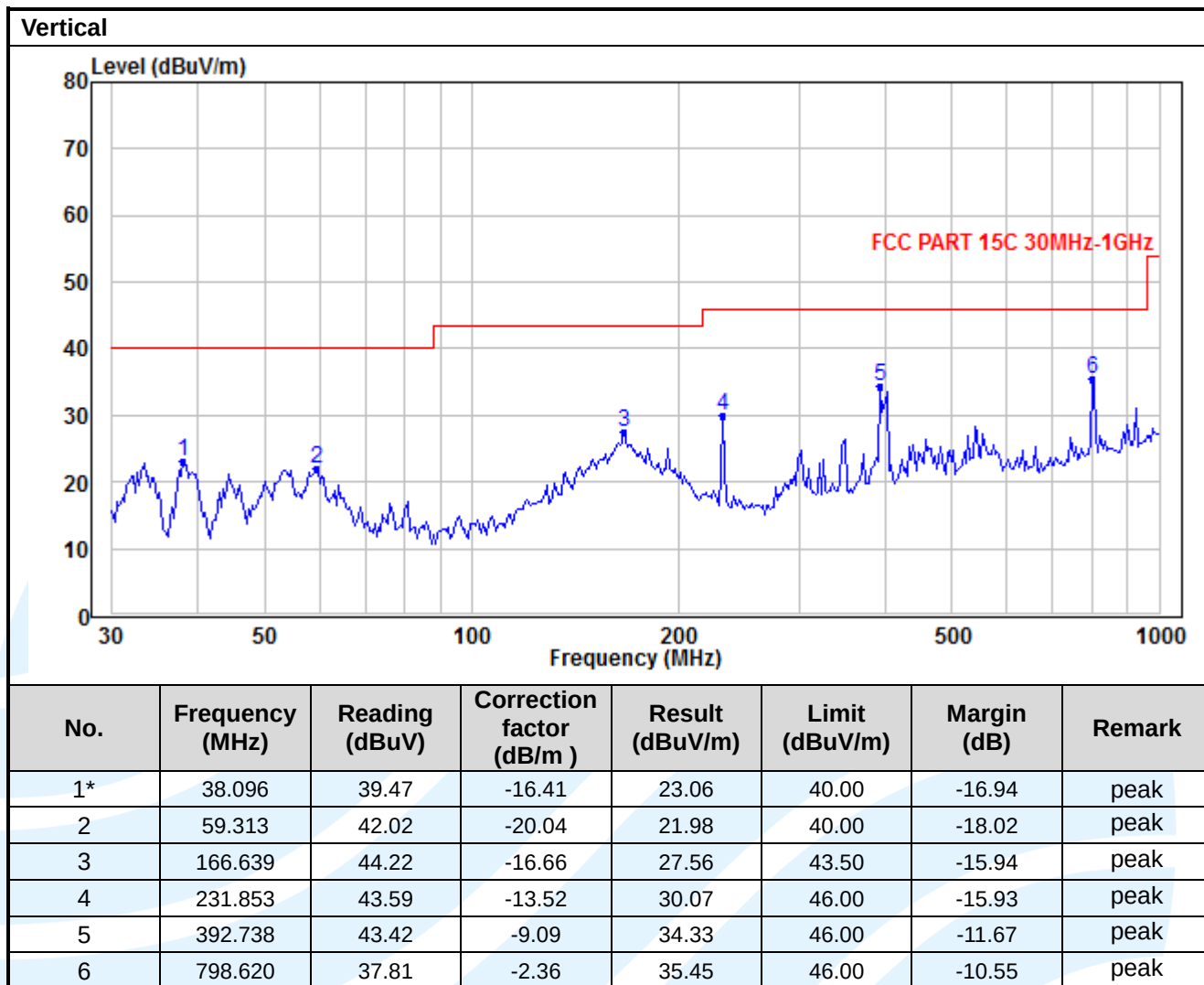


Highest Channel

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	33.101	39.42	-12.85	26.57	40.00	-13.43	peak
2	37.565	40.80	-15.21	25.59	40.00	-14.41	peak
3	52.266	45.02	-20.32	24.70	40.00	-15.30	peak
4	211.611	44.12	-14.93	29.19	43.50	-14.31	peak
5	298.593	44.45	-11.19	33.26	46.00	-12.74	peak
6	798.620	34.03	-1.43	32.60	46.00	-13.40	peak



Radiated Emission Test Data (Above 1GHz):
Lowest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4804.00	53.59	74.00	-20.41	Peak	Horizontal
2	4804.00	50.31	54.00	-3.69	Average	Horizontal
3	7206.00	47.32	74.00	-26.68	Peak	Horizontal
4	7206.00	39.94	54.00	-14.06	Average	Horizontal
5	4804.00	53.01	74.00	-20.99	Peak	Vertical
6	4804.00	49.12	54.00	-4.88	Average	Vertical
7	7206.00	49.18	74.00	-24.82	Peak	Vertical
8	7206.00	39.74	54.00	-14.26	Average	Vertical

Middle Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4880.00	54.46	74.00	-19.54	Peak	Horizontal
2	4880.00	50.65	54.00	-3.35	Average	Horizontal
3	7320.00	45.10	74.00	-28.90	Peak	Horizontal
4	7320.00	39.22	54.00	-14.78	Average	Horizontal
5	4880.00	53.04	74.00	-20.96	Peak	Vertical
6	4880.00	50.63	54.00	-3.37	Average	Vertical
7	7320.00	50.08	74.00	-23.92	Peak	Vertical
8	7320.00	41.89	54.00	-12.11	Average	Vertical

Highest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4960.00	55.80	74.00	-18.20	Peak	Horizontal
2	4960.00	50.47	54.00	-3.53	Average	Horizontal
3	7440.00	48.36	74.00	-25.64	Peak	Horizontal
4	7440.00	39.83	54.00	-14.17	Average	Horizontal
5	4960.00	54.39	74.00	-19.61	Peak	Vertical
6	4960.00	48.64	54.00	-5.36	Average	Vertical
7	7440.00	49.11	74.00	-24.89	Peak	Vertical
8	7440.00	37.93	54.00	-16.07	Average	Vertical

5.4 BAND EDGE MEASUREMENTS (RADIATED)

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.205/15.209

Test Method: KDB 558074 D01 v04, Section 12.1

Limits:

Radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

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

Test Setup: Refer to section 4.4.1 for details.

Test Procedures:

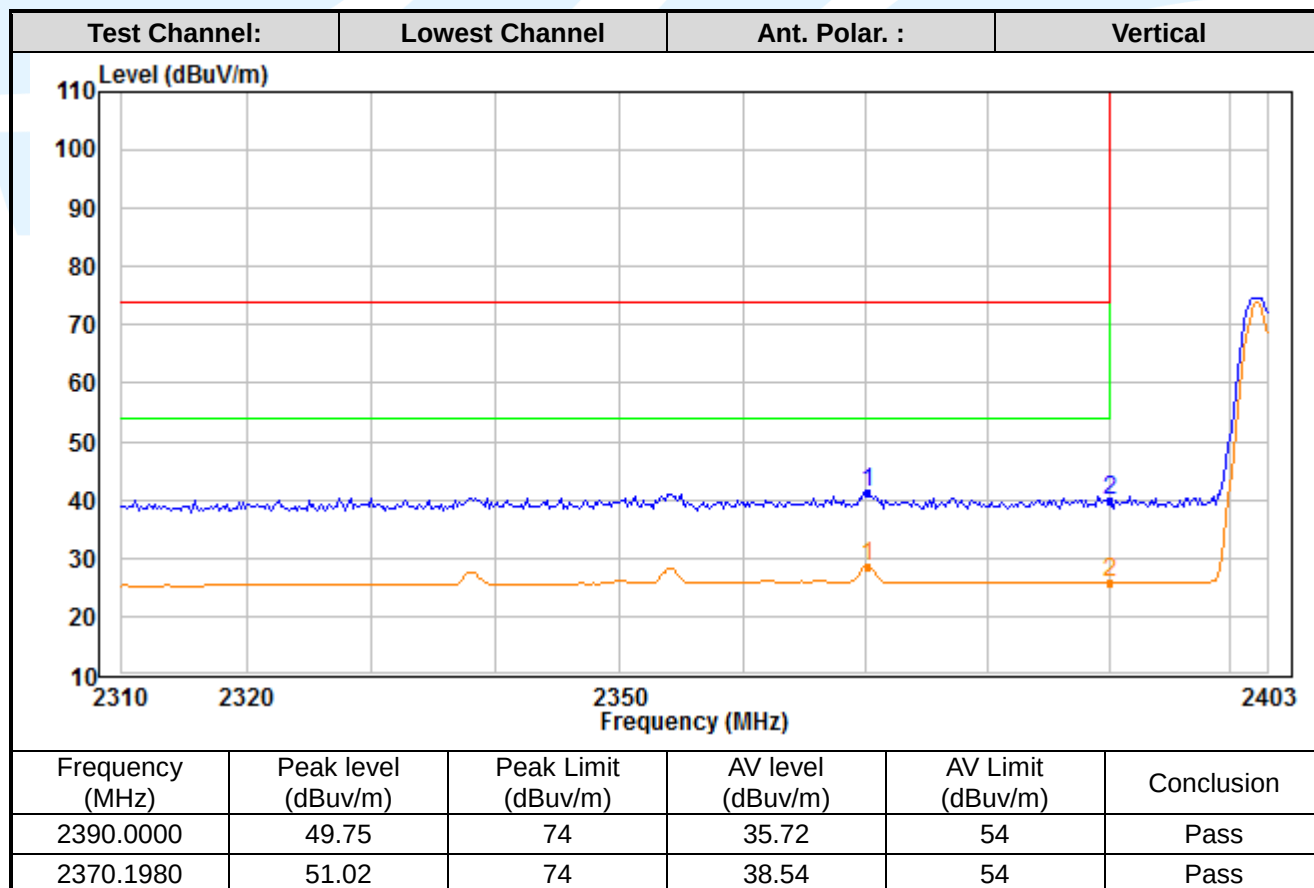
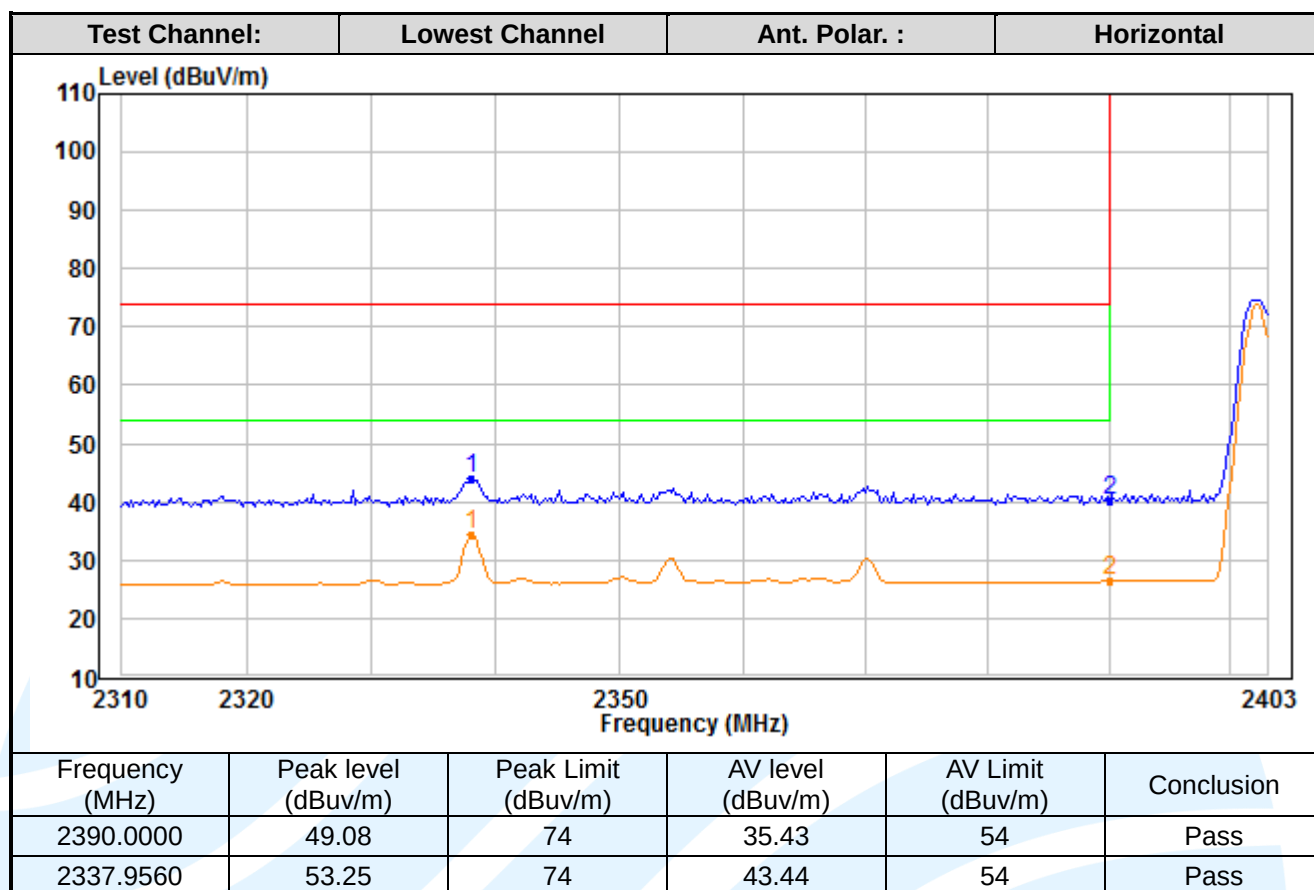
Radiated band edge measurements at 2390 MHz and 2483.5 MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (VBW) = 3 MHz for peak levels and RBW = 1 MHz and VBW = 10 Hz or 1/T for average levels).

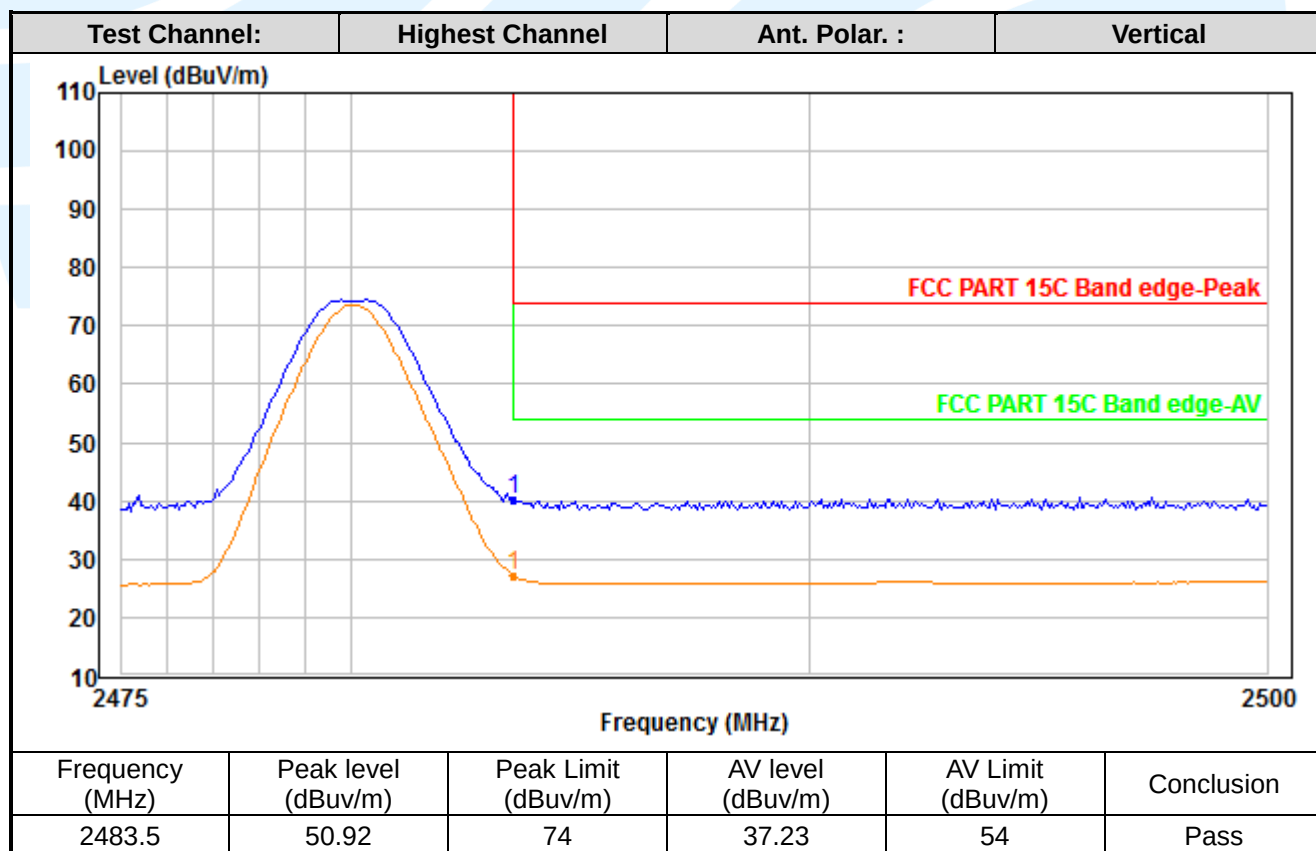
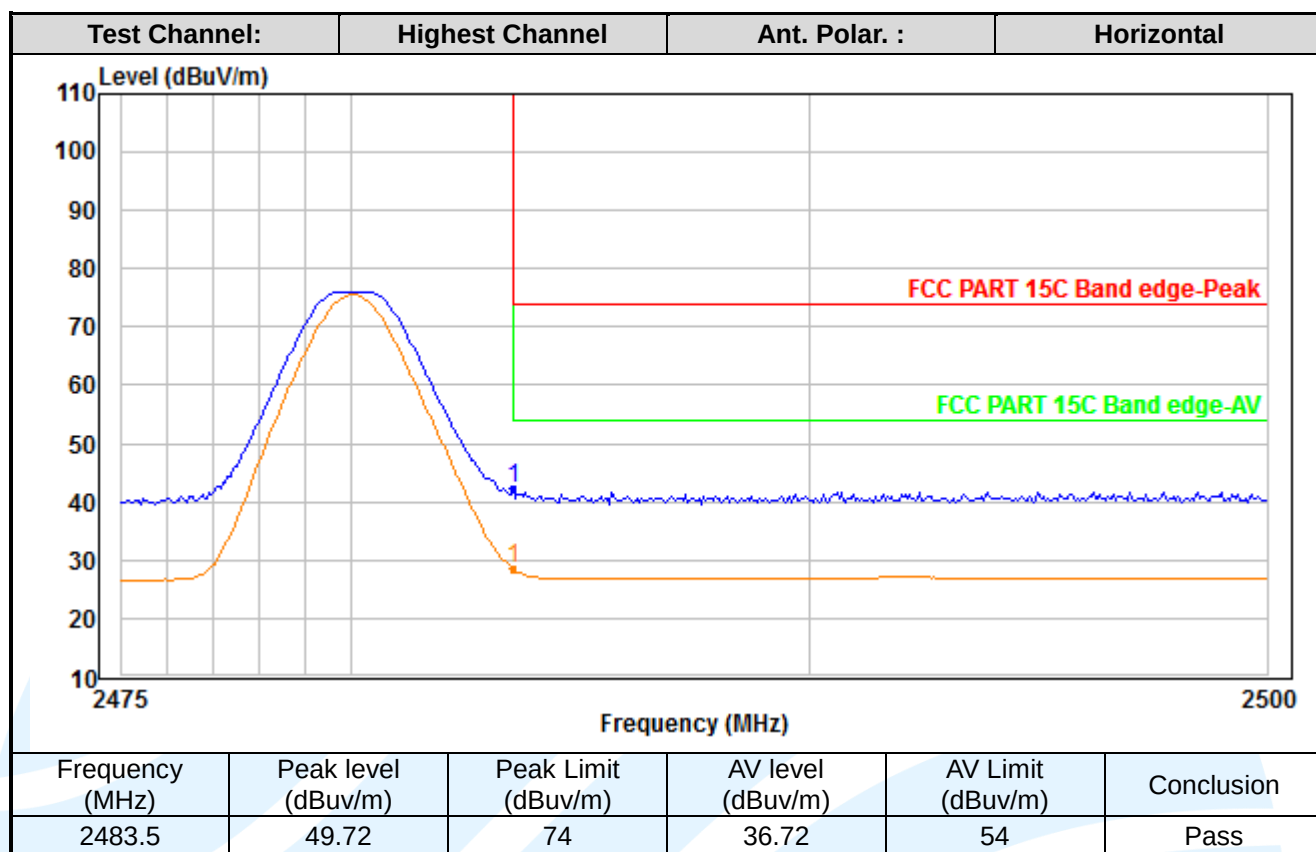
1. Use radiated spurious emission test procedure described in clause 5.10. The transmitter output (antenna port) was connected to the test receiver.
2. Set the PK and AV limit line.
3. Record the fundamental emission and emissions out of the band-edge.
4. Determine band-edge compliance as required.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

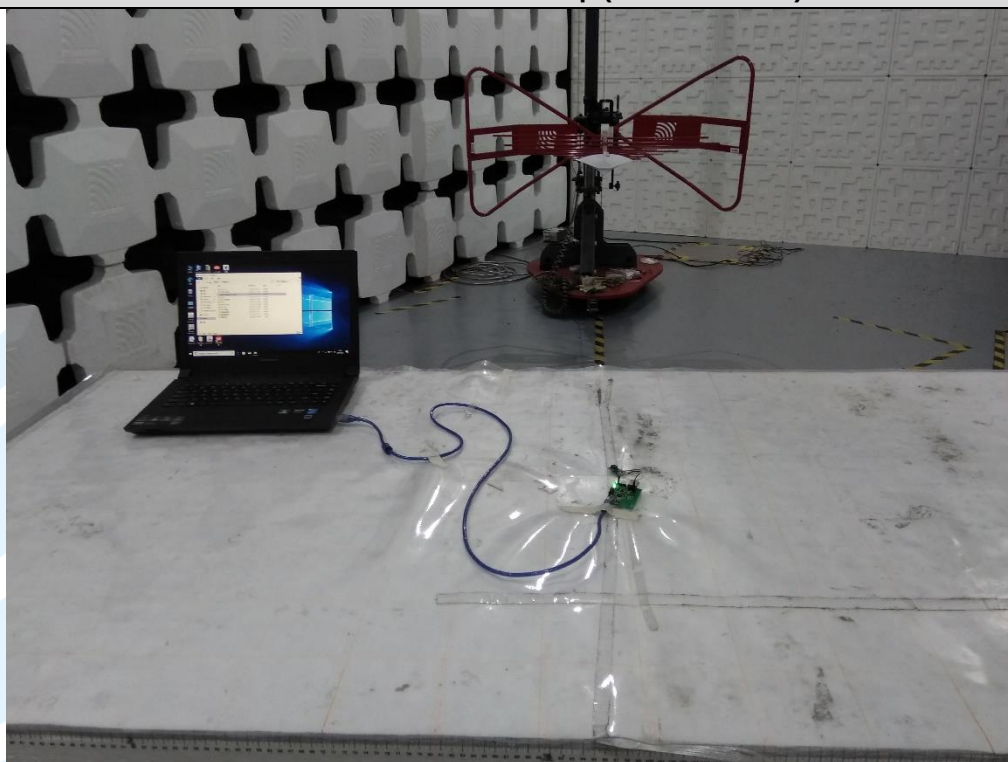
The measurement data as follows:



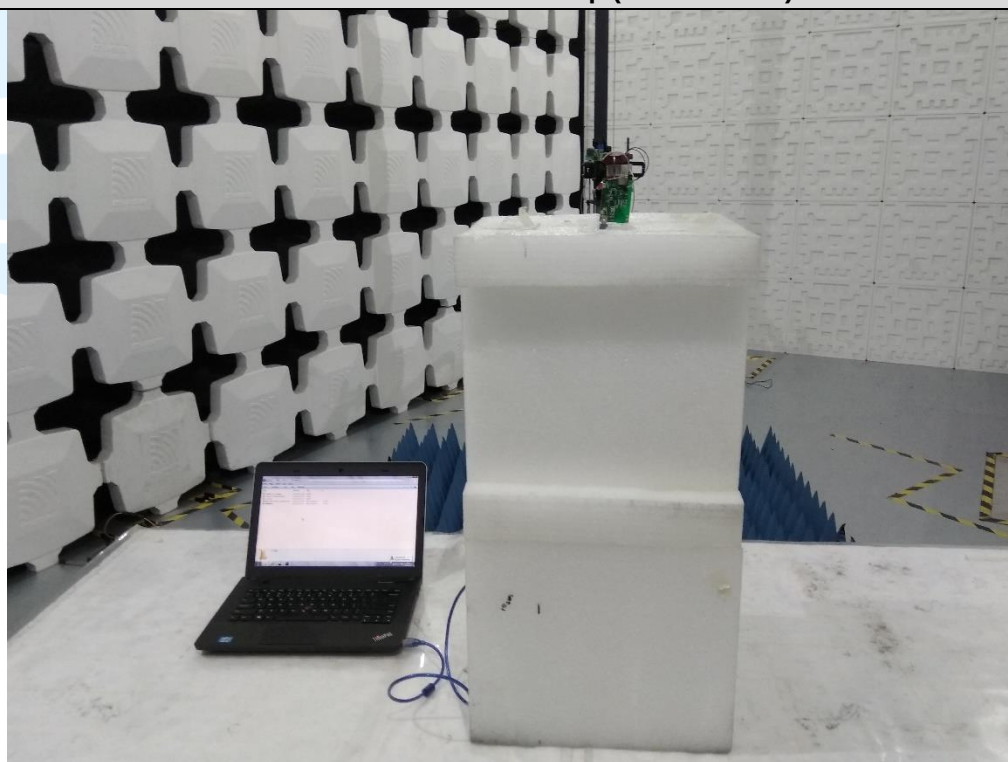


APPENDIX 1 PHOTOS OF TEST SETUP

Radiated emission Test Setup (30 MHz~1 GHz)



Radiated emission Test Setup (Above 1 GHz)



APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.
