



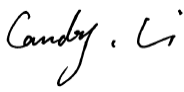
FCC PART 15.249 TEST REPORT

For

Plenom A/S

Pi 2, Soften Hinnerup Favrskov 8382 Denmark

FCC ID: 2AYIK-1582

Report Type: Original Report	Product Type: kuando® Busylight
Report Number: RTZ201026003-00B	
Report Date: 2020-12-21	
Reviewed By: RF Engineer	Candy Li 
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	kuando® Busylight
Tested Model	kuando® Busylight IoT – For LoRaWAN networks
Multiple Model	Flowscape Busylight
Model Difference	Only model name is different.
Frequency Range	903.9~923.4MHz
Transmit Power	94.00dBuV/m@3m
Modulation Technique	Lora
Antenna Specification	2.0dBi
Voltage Range	DC 5V
Date of Test	2020-11-14 to 2020-12-15
Sample serial number	RTZ201026003-00B –S1(Assigned by ATC, Shenzhen)
Received date	2020-10-26
Sample/EUT Status	Good condition
Adapter information	Model: XSC-0501000SU Input: AC 100-240V, 50/60Hz, 0.4A Output: DC 5V, 1A

Notes: This series products model: Flowscape Busylight and kuando® Busylight IoT – For LoRaWAN networks are identical schematics, Model kuando® Busylight IoT – For LoRaWAN networks was selected for fully testing, the detailed information can be referred to the declaration which was stated and guaranteed by the applicant.

Objective

This type approval report is prepared on behalf of *Plenom A/S* in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 rules.

Test Methodology

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

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
AC Power Lines Conducted Emissions		±2.72dB
Emissions, Radiated	30MHz - 1GHz	±4.28dB
	1GHz- 18GHz	±4.98dB
	18GHz- 26.5GHz	±5.06dB

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

The test site has been registered with ISED Canada under ISED Canada Registration Number 5077A-2,

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing by manufacturer.

98 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	903.9	34	910.5	67	917.2
2	904.1	35	910.7	68	917.4
3	904.3	36	910.9	69	917.6
4	904.5	37	911.1	70	917.8
5	904.7	38	911.3	71	918.0
6	904.9	39	911.5	72	918.2
7	905.1	40	911.7	73	918.4
8	905.3	41	911.9	74	918.6
9	905.5	42	912.1	75	918.8
10	905.7	43	912.3	76	919.0
11	905.9	44	912.5	77	919.2
12	906.1	45	912.7	78	919.4
13	906.3	46	912.9	79	919.6
14	906.5	47	913.1	80	919.8
15	906.7	48	913.3	81	920.0
16	906.9	49	913.5	82	920.2
17	907.1	50	913.7	83	920.4
18	907.3	51	913.9	84	920.6
19	907.5	52	914.1	85	920.8
20	907.7	53	914.3	86	921.0
21	907.9	54	914.5	87	921.2
22	908.1	55	914.7	88	921.4
23	908.3	56	914.9	89	921.6
24	908.5	57	915.1	90	921.8
25	908.7	58	915.3	91	922.0
26	908.9	59	915.5	92	922.2
27	909.1	60	915.7	93	922.4
28	909.3	61	915.9	94	922.6
29	909.5	62	916.1	95	922.8

30	909.7	63	916.3	96	923.0
31	909.9	64	916.5	97	923.2
32	910.1	65	916.8	98	923.4
33	910.3	66	917.0		

Channel 1, Channel 65 and Channel 98 were selected for testing.

EUT Exercise Software

Software: CRT and the power level is 0.

Equipment Modifications

No modifications were made to the unit tested.

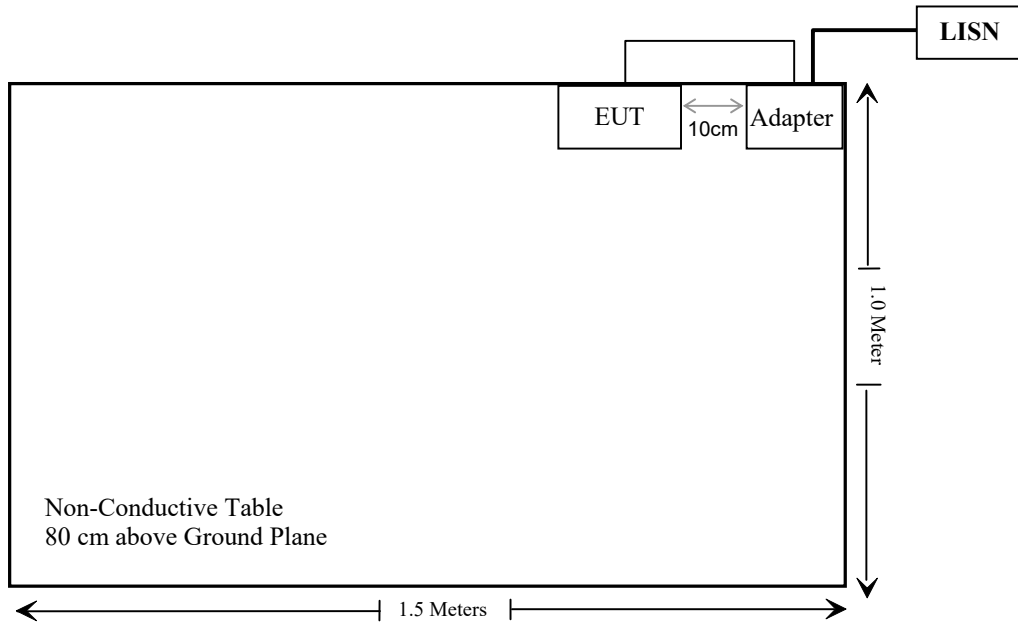
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Lenovo	Laptop	P48F	Unknown
Shenzhen Sunshine	Adapter	XCS-0501000SU	/

Support Cable Descriptions

Cable Description	Length (m)	From/Port	To
/	/	/	/

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Compliance
15.205, §15.209, §15.249(d)	Radiated Emissions& Outside of Band Emission	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	100307	2020-01-04	2020-01-03
Rohde & Schwarz	LISN	NLSK8126	8126431	2020-01-04	2020-01-03
Rohde & Schwarz	Pulse Limiter	ESH3-Z2	100815	2020-01-04	2020-01-03
RF Coaxial Cable	Schwarzbeck	N-2m	No.2	2020-01-04	2020-01-03
Radiated Emission Test					
Rohde& Schwarz	Test Receiver	ESR	101817	2020-01-04	2020-01-03
Rohde&Schwarz	Spectrum Analyzer	FSV40	101495	2020-01-04	2020-01-03
Agilent	Pre-Amplifier	8447D	2944A10619	2020-01-04	2020-01-03
Rohde&Schwarz	Pre-Amplifier	CBLU11835 40-01	3791	2020-01-04	2020-01-03
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2020-01-04	2020-01-03
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2020-01-04	2020-01-03
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020-01-04	2020-01-03
OREGON SCIENTIFIC	Temperature & Humidity Meter	JB913R	GZ-WS004	2020-01-04	2020-01-03
Schwarzbeck	Log-periodic antenna	VULB9163	9163-194	2020-01-04	2020-01-03
SCHWARZBECK	HORN ANTENNA	BBHA9120D	9120D-655	2020-01-04	2020-01-03
ROHDE& SCHWARZ	EMI TEST RECEIVER	ESPI	101526/003	2020-01-04	2020-01-03
RF Coaxial Cable	Schwarzbeck	N-5m	No.1	2020-01-04	2020-01-03
RF Coaxial Cable	Schwarzbeck	N-1m	No.6	2020-01-04	2020-01-03
RF Coaxial Cable	SUHNER	N-6m	No.10	2020-01-04	2020-01-03
RF Coaxial Cable	SUHNER	N-0.5m	No.15	2020-01-04	2020-01-03

***Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

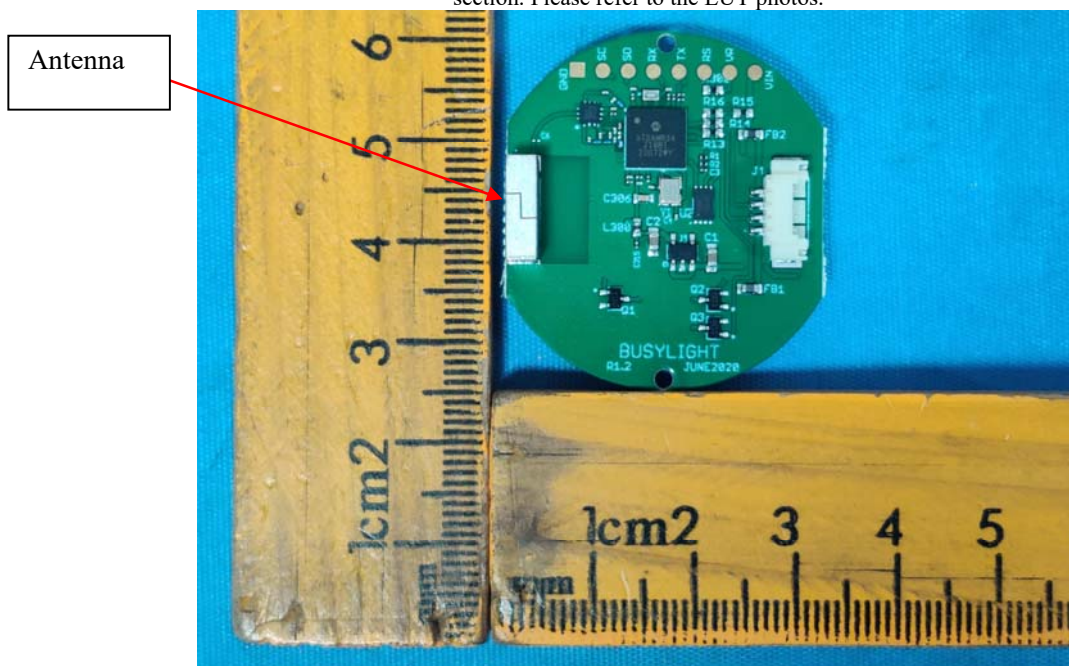
FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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. 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.

Antenna Connector Construction

The EUT has one ceramic antenna which was permanently attached and the antenna gain is 2 dBi, fulfill the requirement of this section. Please refer to the EUT photos.



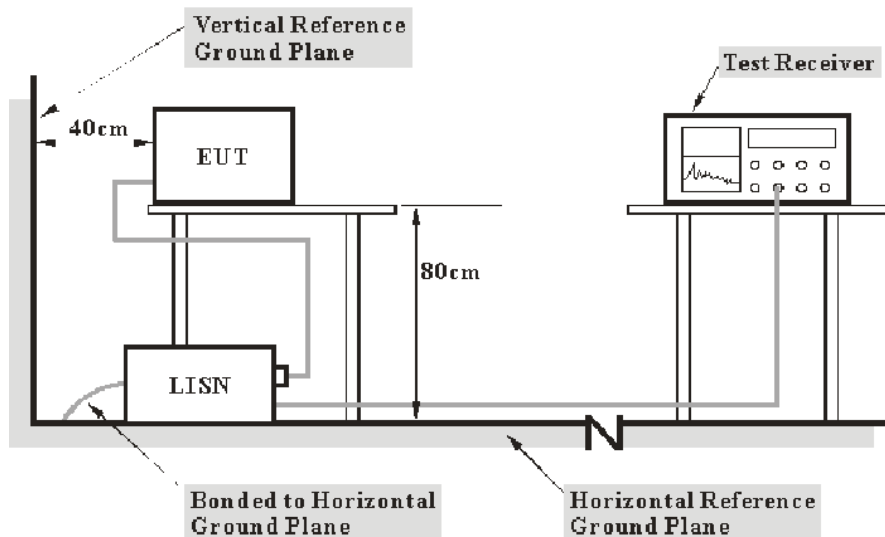
Result: Compliance.

FCC §15.207 – AC LINE CONDUCTED EMISSIONS

Applicable Standard

According to FCC §15.207

EUT Setup



- Note: 1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with per ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

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

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{level}$$

Test Results Summary

According to the EUT complied with the FCC Part 15.207,

Test Data

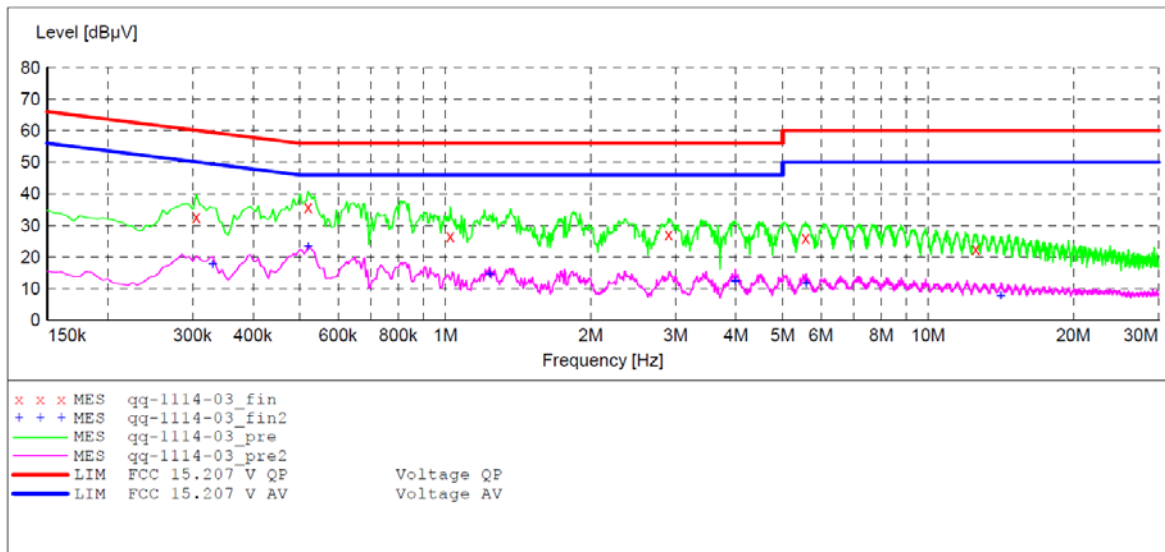
Environmental Conditions

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

*The testing was performed by Black Ding on 2020-11-14.
All modes were tested ,worst case is recorder as bellow.*

EUT Operation Mode: Transmitting

AC 120V/60 Hz, Line



MEASUREMENT RESULT: "qq-1114-03_fin"

11/14/2020 9:55AM

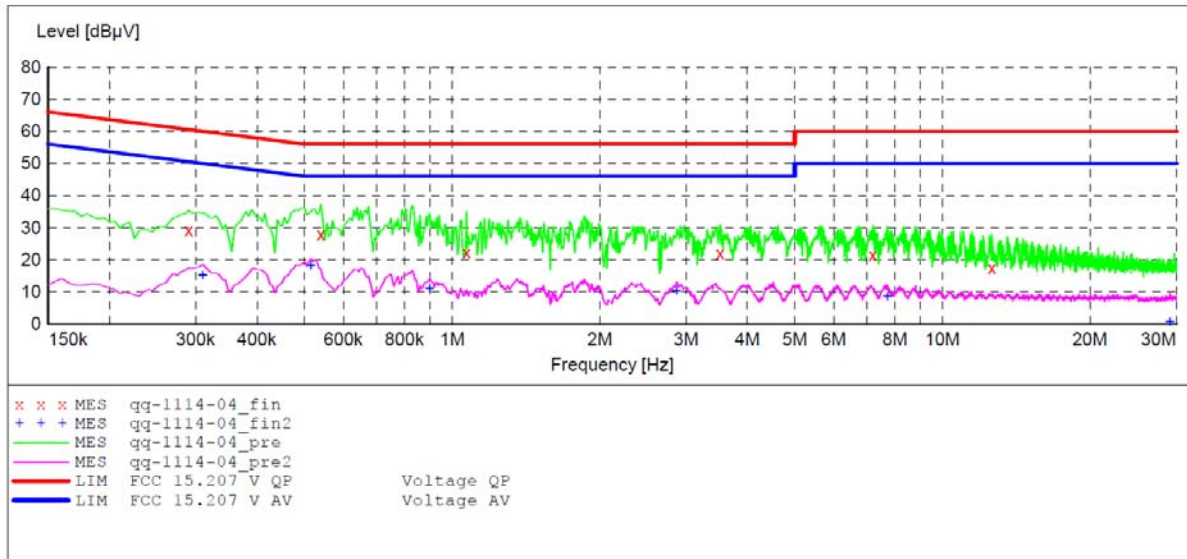
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.305000	32.70	10.5	60	27.3	QP	L1	GND
0.520000	35.80	10.5	56	20.2	QP	L1	GND
1.025000	26.60	10.6	56	29.4	QP	L1	GND
2.900000	27.20	10.7	56	28.8	QP	L1	GND
5.570000	26.20	10.7	60	33.8	QP	L1	GND
12.550000	22.50	10.8	60	37.5	QP	L1	GND

MEASUREMENT RESULT: "qq-1114-03_fin2"

11/14/2020 9:55AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.330000	17.70	10.5	50	32.3	AV	L1	GND
0.520000	23.20	10.5	46	22.8	AV	L1	GND
1.235000	14.70	10.6	46	31.3	AV	L1	GND
3.990000	12.30	10.7	46	33.7	AV	L1	GND
5.590000	11.50	10.7	50	38.5	AV	L1	GND
14.155000	7.80	10.8	50	42.2	AV	L1	GND

AC 120V/60 Hz, Neutral



MEASUREMENT RESULT: "qq-1114-04_fin"

11/14/2020 10:05AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.290000	29.10	10.5	61	31.9	QP	N	GND
0.540000	27.80	10.5	56	28.2	QP	N	GND
1.070000	22.30	10.6	56	33.7	QP	N	GND
3.520000	21.90	10.7	56	34.1	QP	N	GND
7.210000	21.50	10.8	60	38.5	QP	N	GND
12.610000	17.30	10.8	60	42.7	QP	N	GND

MEASUREMENT RESULT: "qq-1114-04_fin2"

11/14/2020 10:05AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.310000	15.10	10.5	50	34.9	AV	N	GND
0.515000	18.30	10.5	46	27.7	AV	N	GND
0.900000	10.90	10.6	46	35.1	AV	N	GND
2.870000	10.40	10.7	46	35.6	AV	N	GND
7.720000	8.40	10.8	50	41.6	AV	N	GND
29.095000	0.50	10.9	50	49.5	AV	N	GND

Note:

Transducer value = Insertion loss of LISN + Cable Loss

Margin = Limit - level

FCC§15.205, §15.209 & §15.249(d) - RADIATED EMISSIONS**Applicable Standard**

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

As per FCC§15.249 (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.

Test Equipment Setup

The spectrum analyzer or receiver is set as:

Below 1000MHz:

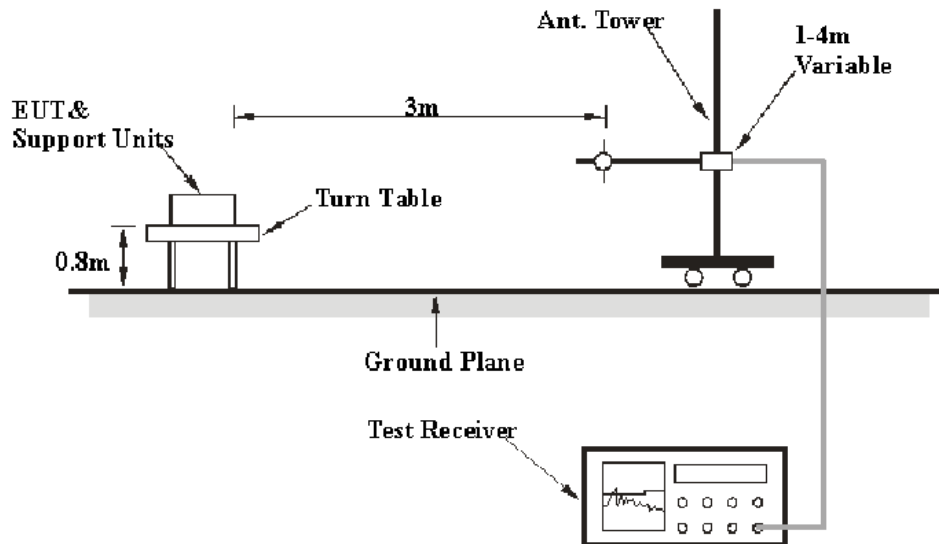
$$\text{RBW} = 100 \text{ kHz} / \text{VBW} = 300 \text{ kHz} / \text{Sweep} = \text{Auto}$$

Above 1000MHz:

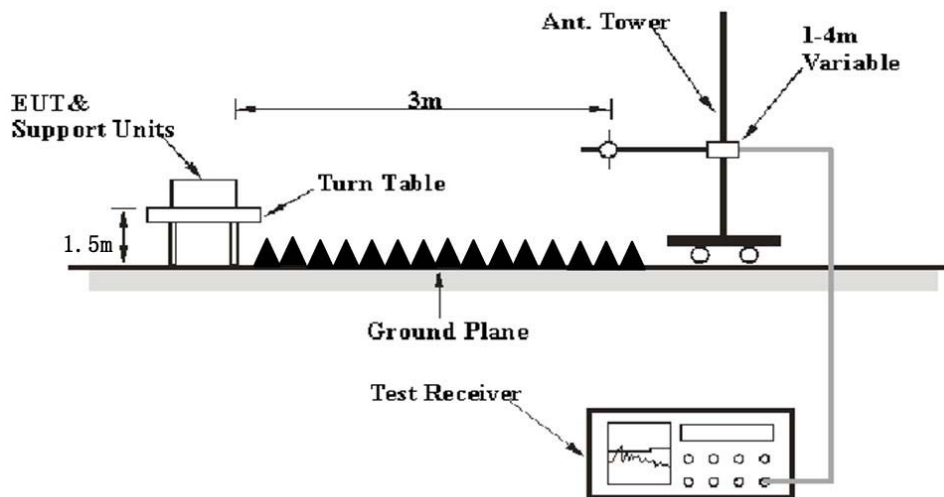
$$\begin{aligned} \text{Peak: RBW} &= 1\text{MHz} / \text{VBW} = 1\text{MHz} / \text{Sweep} = \text{Auto} \\ \text{Average: RBW} &= 1\text{MHz} / \text{VBW} = 10\text{Hz} / \text{Sweep} = \text{Auto} \end{aligned}$$

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 mete, and the EUT is placed on a turntable, which is 0.8 meter above ground plane for below 1GHz or 1.5 meter for above 1GHz, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

Corrected Amplitude & Margin Calculation

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

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Results Summary

According to the EUT complied with the FCC Part 15.205, 15.209 & §15.249

Test Data

Environmental Conditions

Temperature:	24~25 °C
Relative Humidity:	52~60 %
ATM Pressure:	100.9~101.0 kPa

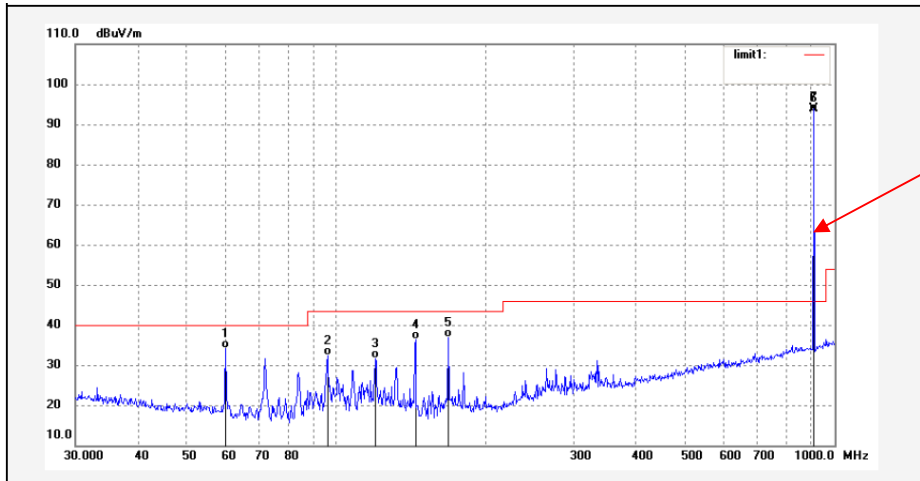
The testing was performed by Black Ding on 2020-12-08 for below 1GHz and 2020-12-09 for above 1GHz.

Test Mode: Transmitting

LOW Channel

30MHz – 1 GHz:

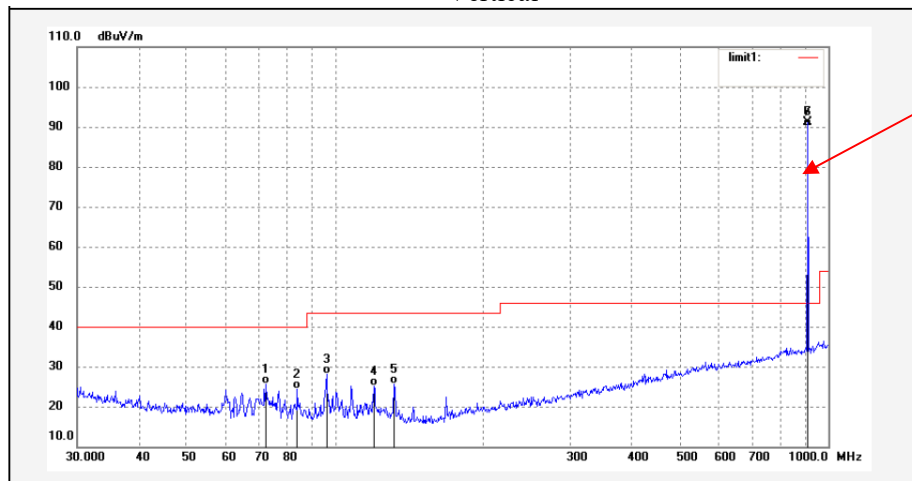
Horizontal



Fundamental

No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	60.0690	42.14	-7.97	34.17	40.00	5.83	QP	143	346	
2	96.0986	40.75	-8.44	32.31	43.50	11.19	QP	128	251	
3	119.8555	38.74	-7.15	31.59	43.50	11.91	QP	164	224	
4	144.3348	45.59	-9.23	36.36	43.50	7.14	QP	121	102	
5	167.8241	44.91	-8.02	36.89	43.50	6.61	QP	113	34	
6	903.9000	86.63	7.34	93.97	114.00	20.03	peak	102	74	
7	903.9000	85.73	7.34	93.07	94.00	0.93	AVG	102	74	

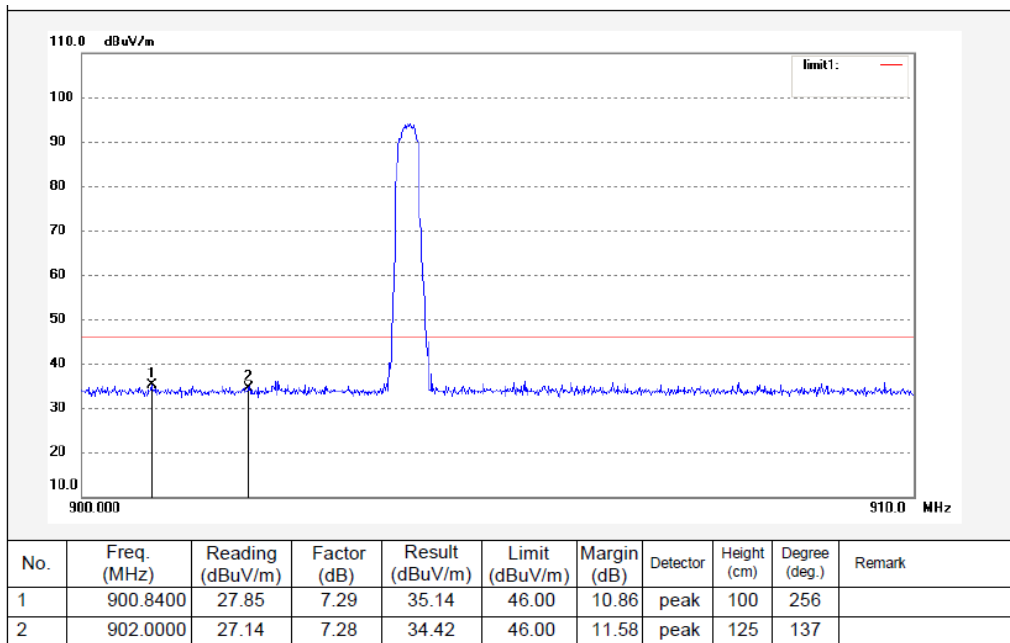
Vertical



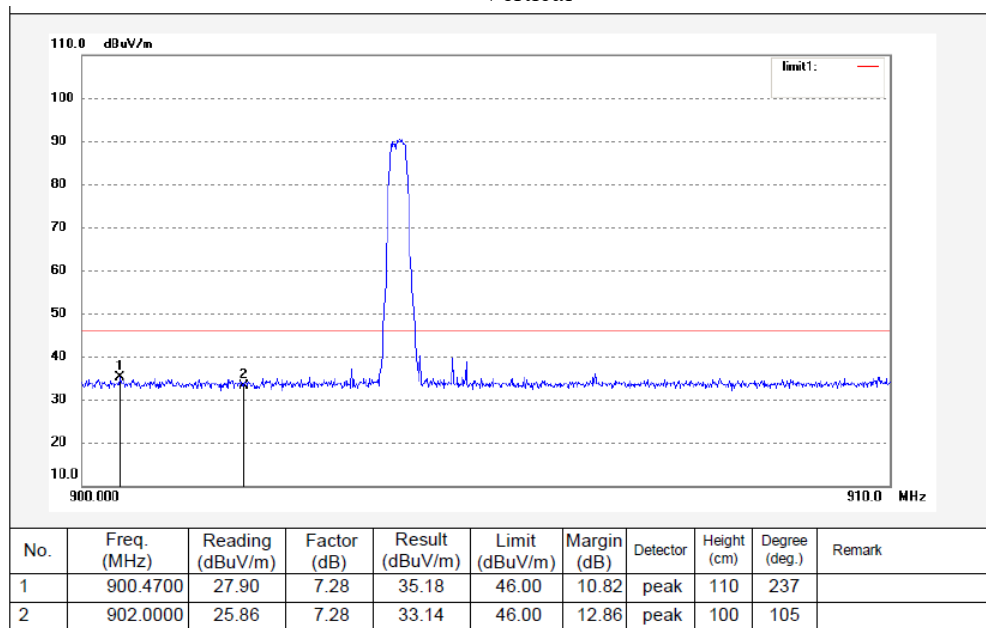
Fundamental

No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	72.3376	36.09	-10.42	25.67	40.00	14.33	QP	121	34	
2	83.8156	34.07	-9.65	24.42	40.00	15.58	QP	156	353	
3	96.0986	36.49	-8.44	28.05	43.50	15.45	QP	104	241	
4	119.8556	32.38	-7.15	25.23	43.50	18.27	QP	112	268	
5	131.7577	33.48	-7.94	25.54	43.50	17.96	QP	136	120	
6	903.9000	83.70	7.34	91.04	114.00	22.96	peak	101	117	
7	903.9000	82.69	7.34	90.03	94.00	3.97	AVG	101	117	

Horizontal

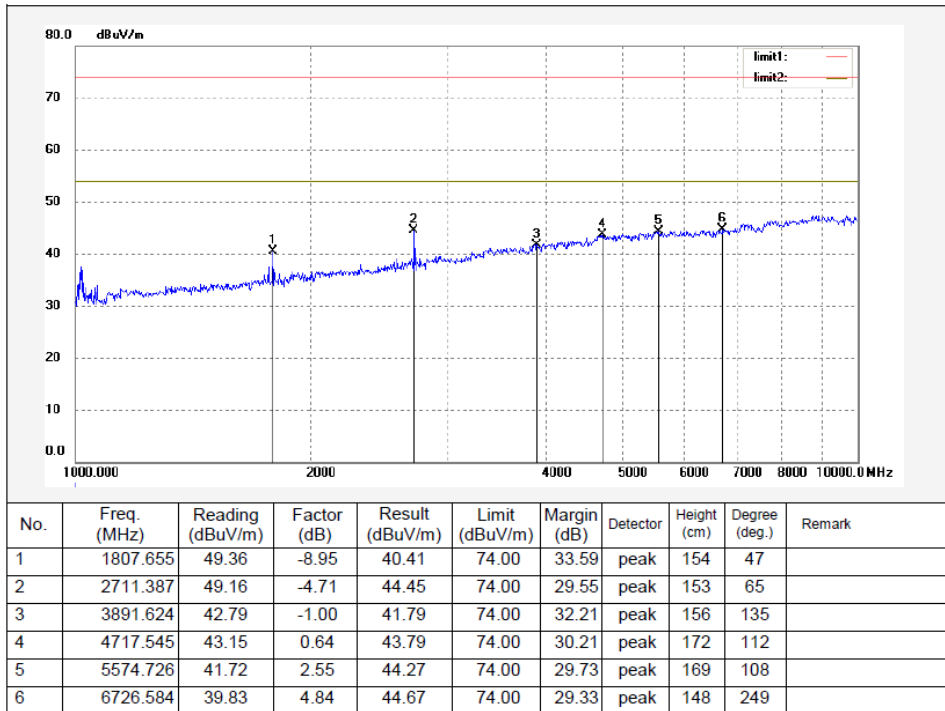


Vertical

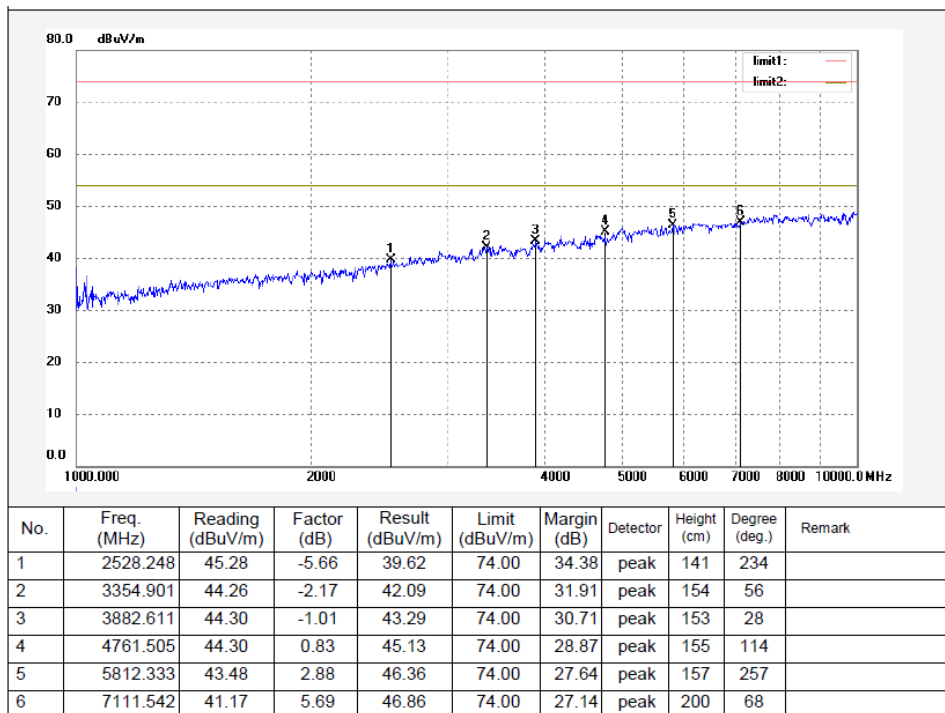


1 GHz - 10 GHz:

Horizontal



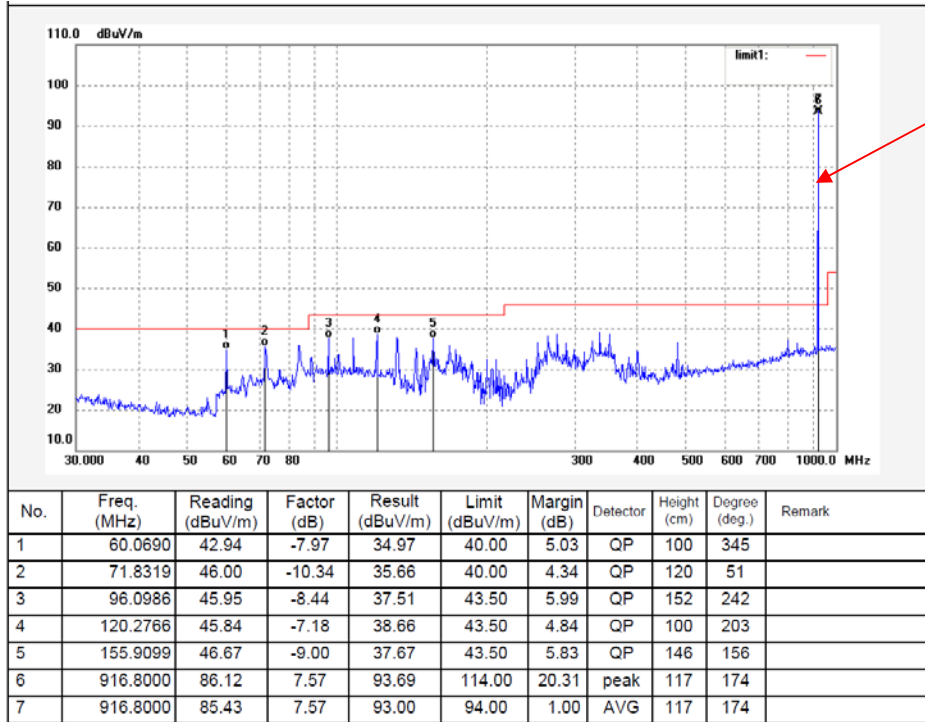
Vertical



Middle Channel

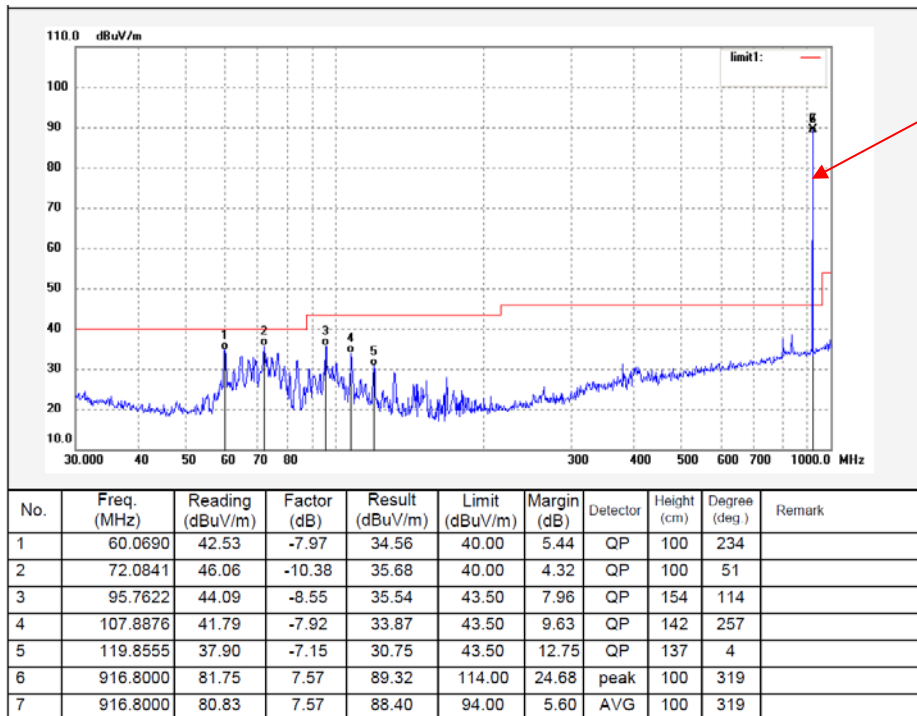
30MHz – 1 GHz:

Horizontal



Fundamental

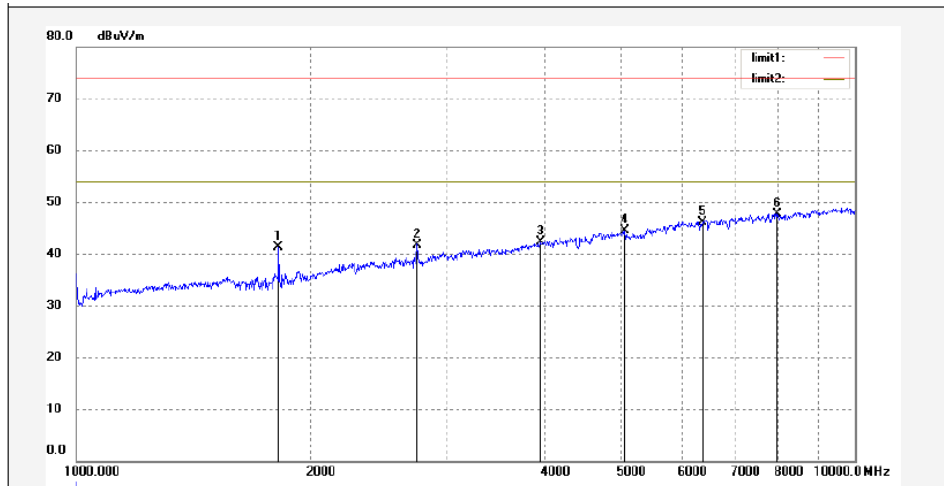
Vertical



Fundamental

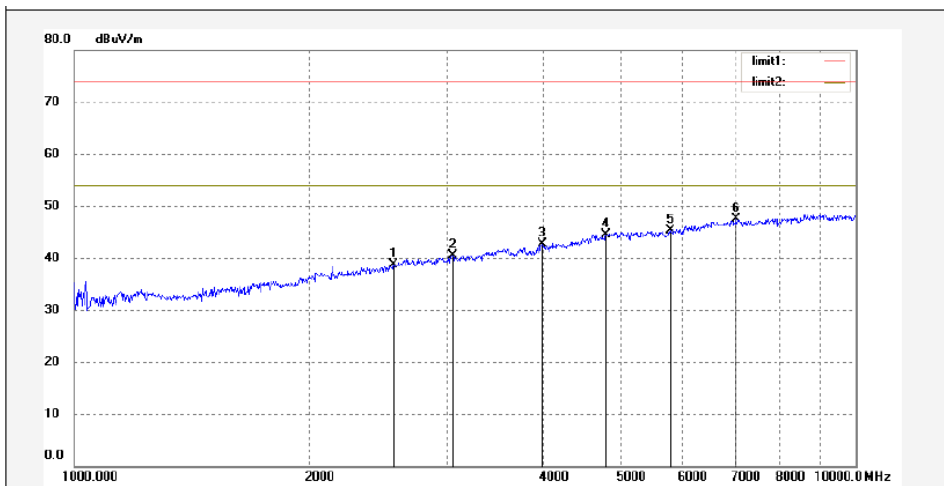
1 GHz - 10 GHz:

Horizontal



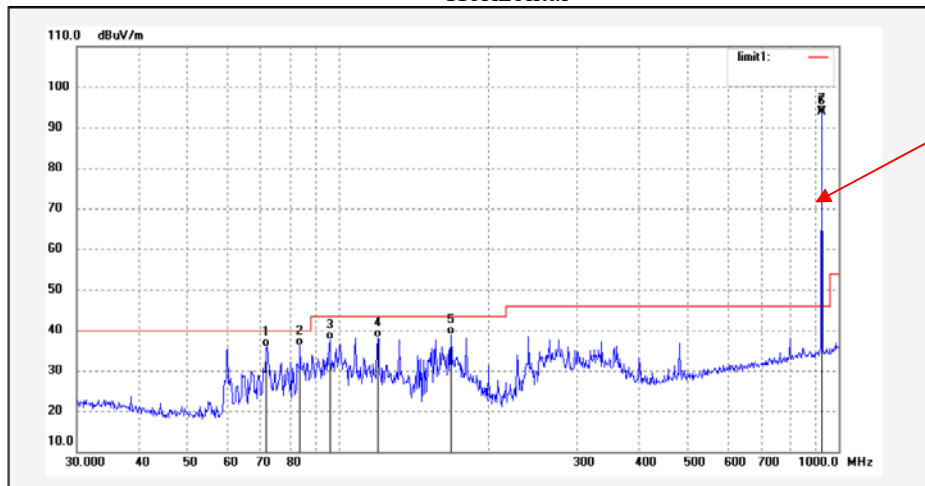
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	1833.941	50.04	-8.83	41.21	74.00	32.79	peak	153	64	
2	2751.994	46.35	-4.55	41.80	74.00	32.20	peak	168	173	
3	3955.308	43.19	-0.87	42.32	74.00	31.68	peak	157	226	
4	5069.143	42.52	1.96	44.48	74.00	29.52	peak	163	289	
5	6377.235	42.18	4.02	46.20	74.00	27.80	peak	158	146	
6	7967.263	40.37	7.29	47.66	74.00	26.34	peak	189	203	

Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	2563.669	44.14	-5.48	38.66	74.00	35.34	peak	155	334	
2	3050.638	43.48	-3.05	40.43	74.00	33.57	peak	169	269	
3	3973.693	43.59	-0.84	42.75	74.00	31.25	peak	174	245	
4	4794.743	43.56	0.98	44.54	74.00	29.46	peak	156	153	
5	5798.870	42.52	2.86	45.38	74.00	28.62	peak	172	127	
6	7045.885	41.91	5.57	47.48	74.00	26.52	peak	186	59	

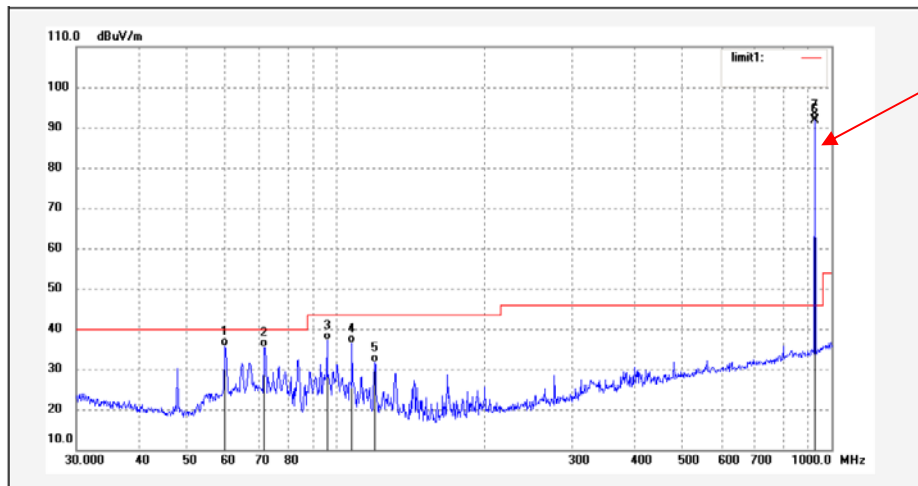
High Channel Horizontal



Fundamental

No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	71.8319	46.30	-10.34	35.96	40.00	4.04	QP	102	236	
2	83.8156	45.82	-9.65	36.17	40.00	3.83	QP	104	254	
3	96.0986	46.13	-8.44	37.69	43.50	5.81	QP	113	153	
4	119.8555	45.34	-7.15	38.19	43.50	5.31	QP	152	28	
5	167.8242	47.00	-8.02	38.98	43.50	4.52	QP	142	224	
6	923.4000	86.26	7.74	94.00	114.00	20.00	peak	101	183	
7	923.4000	85.61	7.74	93.35	94.00	0.65	AVG	101	183	

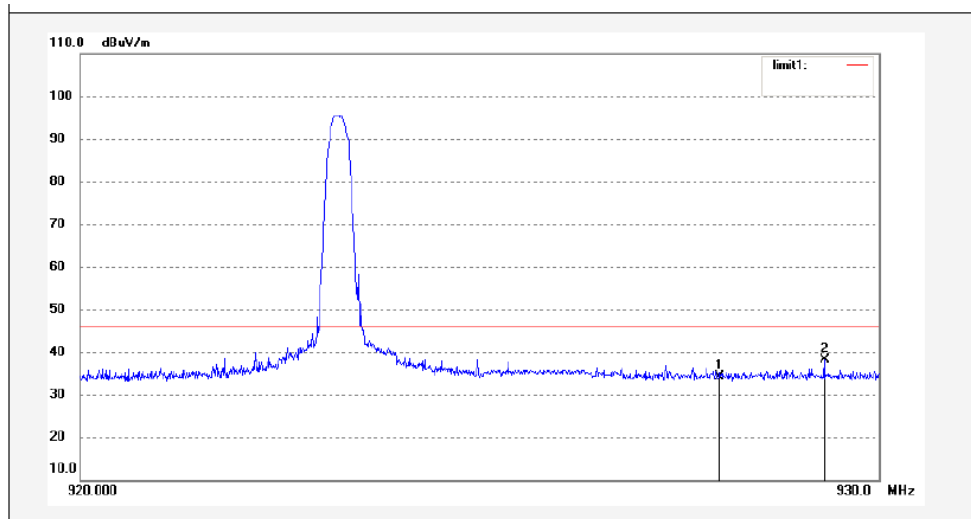
Vertical



Fundamental

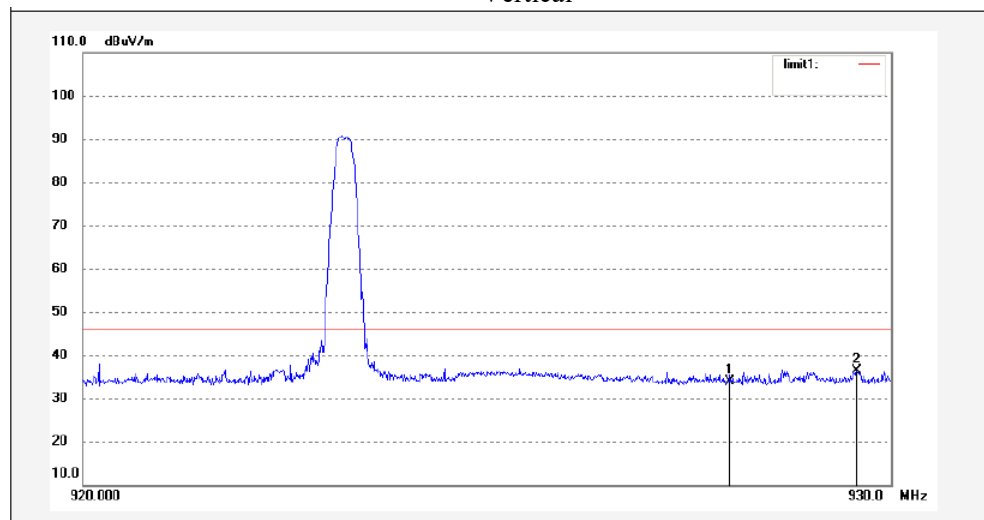
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	59.8588	43.61	-7.91	35.70	40.00	4.30	QP	135	168	
2	71.8319	45.78	-10.34	35.44	40.00	4.56	QP	142	34	
3	96.0986	45.66	-8.44	37.22	43.50	6.28	QP	103	153	
4	107.8876	44.18	-7.92	36.26	43.50	7.24	QP	152	76	
5	119.8555	38.78	-7.15	31.63	43.50	11.87	QP	164	258	
6	923.4000	84.07	7.74	91.81	114.00	22.19	peak	106	34	
7	923.4000	83.57	7.74	91.31	94.00	2.69	AVG	106	34	

Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	928.0000	26.35	7.80	34.15	46.00	11.85	peak	100	257	
2	929.3200	30.39	7.83	38.22	46.00	7.78	peak	100	69	

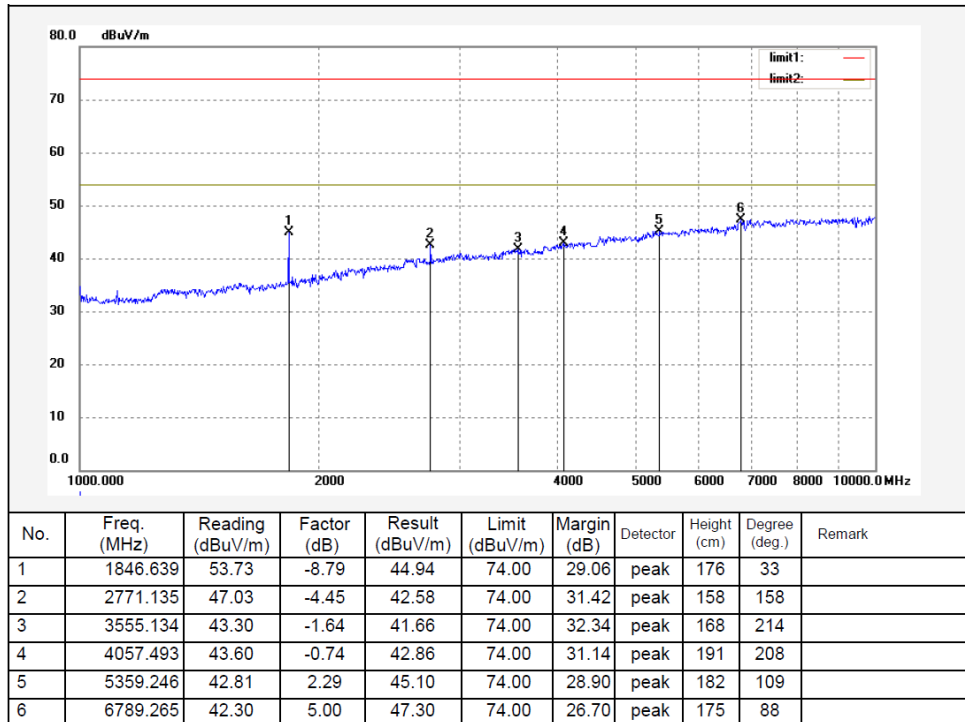
Vertical



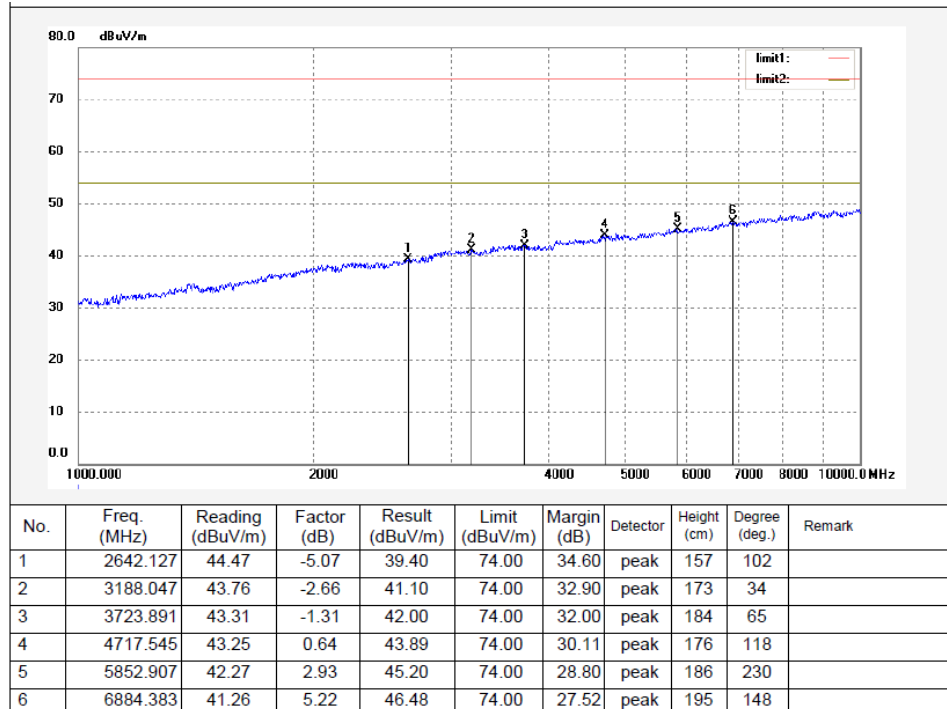
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Degree (deg.)	Remark
1	928.0000	26.01	7.80	33.81	46.00	12.19	peak	113	34	
2	929.5800	28.64	7.84	36.48	46.00	9.52	peak	100	45	

1 GHz - 10 GHz:

Horizontal



Vertical



Note:

- 1) Result = Reading + Factor
- 3) Margin = Limit- Result

FCC§15.215(c) - 20dB EMISSION BANDWIDTH

Applicable Standard

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.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that indicated 20dB bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

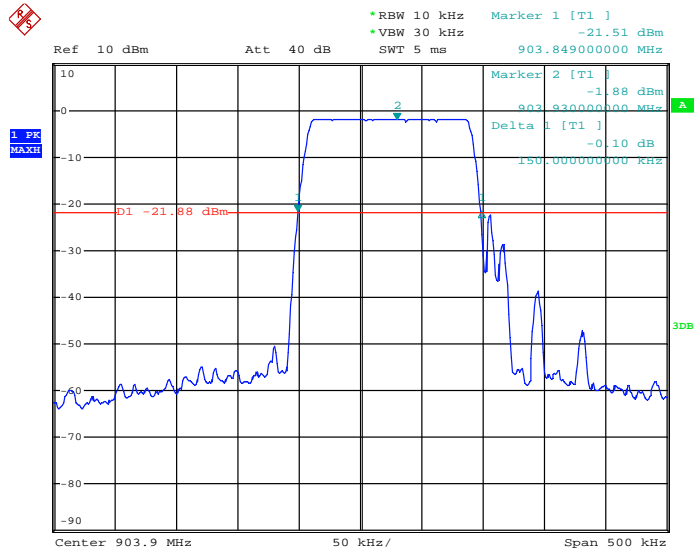
The testing was performed by Black Ding on 2020-12-11.

Test Mode: Transmitting

Please refer to the following table and plots.

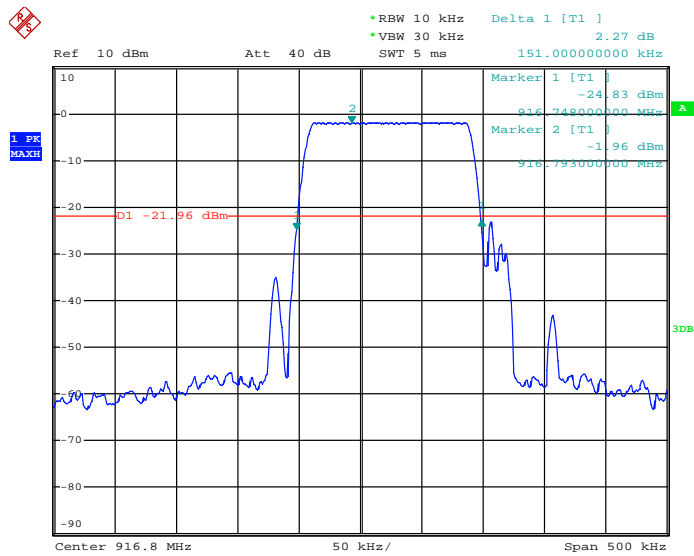
Channel	Frequency (MHz)	20dB Bandwidth (KHz)
Low	903.9	150.0
Middle	916.8	151.0
High	923.4	152.0

Low Channel



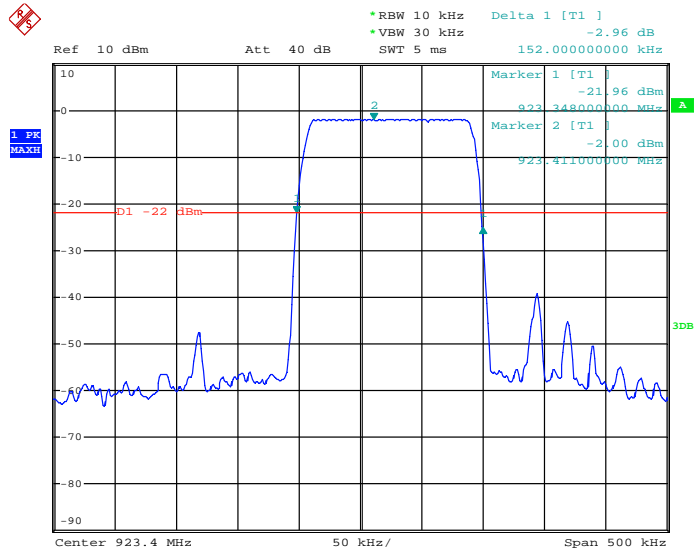
Date: 11.DEC.2020 16:25:31

Middle Channel



Date: 11.DEC.2020 16:27:13

High Channel



Date: 11.DEC.2020 16:35:34

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