



**FCC CFR47 PART 15 SUBPART C
RSS-GEN / RSS-210**

Keyless Entry System

CERTIFICATION TEST REPORT

FOR

433.92 MHz Security/Remote Control Transmitter

MODEL NUMBER : 1WG15R-AM

FCC ID: VA5REH500-1WAM

IC ID: 7087A-1WREH500AM

REPORT NUMBER: 4788072727-E1V1

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Prepared for
SEGI LIMITED

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Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
-	-	Initial issue	-

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SEGI LIMITED
EUT DESCRIPTION: Keyless Entry System
MODEL NUMBER: 1WG15R-AM
DATE TESTED: Aug 02, 2017 - Aug 29, 2017 (Original Test)

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
RSS-GEN / RSS-210	

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 15.231
3. IC RSS-GEN Issue 4
4. IC RSS-210 Issue 9
5. ANSI C63.10-2013.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

218 Maeyeong-ro	
☒	Chamber 1
☐	Chamber 2

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.pdf>.

FCC lab number: KR0161

IC test site registration number: 2324M-1

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned}\text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m}\end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	2.32 dB
Radiated Disturbance, Below 1GHz	4.14 dB
Radiated Disturbance, Above 1 GHz	5.97 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Keyless Entry System and operating under FCC Part 15.231 & RSS-210 Annex A

5.2. WORST-CASE CONFIGURATION AND MODE

Radiated emission below 1GHz was performed with the EUT set to transmit at the single frequency(433.92 MHz).

Radiated emission above 1GHz was performed with the EUT set to transmit single frequency(433.92 MHz).

Power line conducted emission was not performed since this device using un-rechargeable battery.

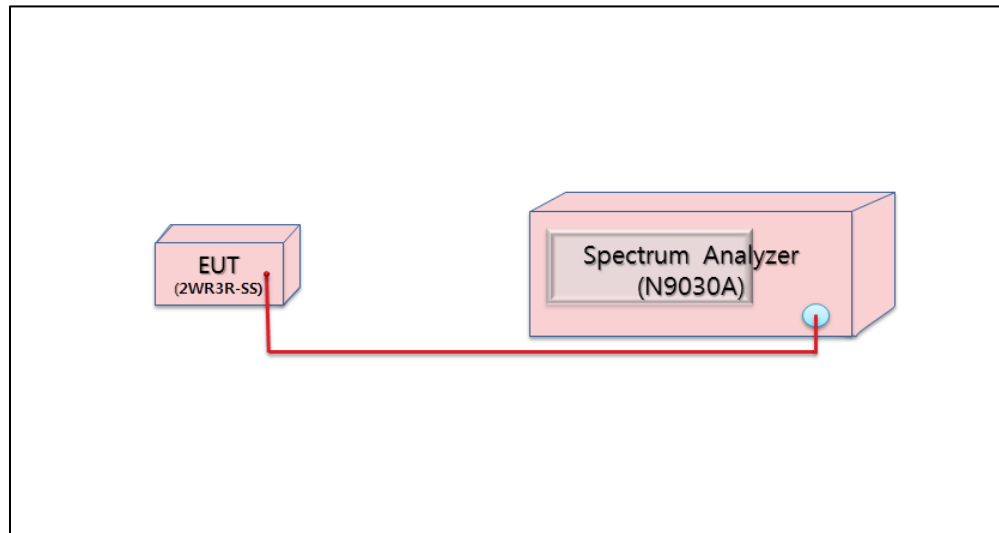
The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

5.3. DESCRIPTION OF TEST SETUP

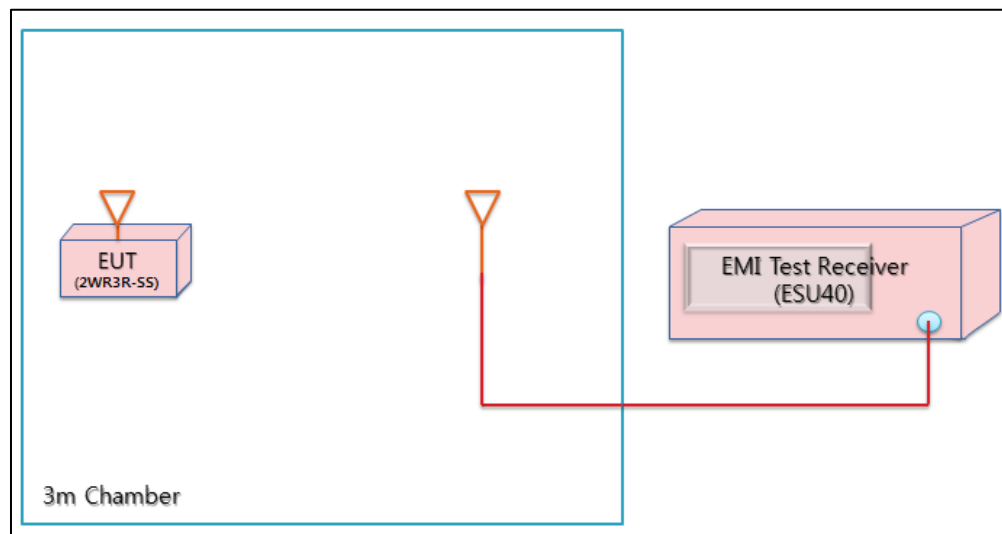
TEST SETUP

The EUT is a stand-alone unit during the tests.

SETUP DIAGRAM FOR CONDUCTION TESTS



SETUP DIAGRAM FOR RADIATION TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	Manufacturer	Model	S/N	Cal Due
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	10-14-18
Antenna, Horn, 18 GHz	ETS	3117	00168724	05-31-19
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-09-18
Preamplifier	ETS	3115-PA	00167475	08-09-18
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-07-18
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-18-08
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-18-08
Spectrum Analyzer	R&S	FSW40	101237	08-17-18
Filter	MICRO-TRONICS	HPM50108-02	G005	08-09-18
Attenuator / Switch driver	HP	11713A	3748A04272	N/A
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	11-25-17
UL Software				
Description	Manufacturer	Model	Version	
Radiated software	UL	UL EMC	Ver 9.5	

7. SUMMARY TABLE

FCC Part Section	IC Section	Test Description	Test Condition	Test Result	Worst Case
15.231 (c)	-	20 dB bandwidth	Conducted	Pass	62.94 kHz
-	RSS-210[A1.3]	Occupied bandwidth		Pass	71.63 kHz
15.231 (a)	RSS-210[A1.1]	Automatically deactivate		Pass	838 ms
15.231 (b)	RSS-210 [A1.2]	Field strength of fundamental and spurious emissions	Radiated	Pass	89.87 dBuV/m
15.205 15.209	RSS-GEN[8.9] RSS-GEN[8.10]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)		Pass	44.68 dBuV/m
15.207	RSS-GEN[8.8]	AC Power Line Conducted Emission	-	N/A	-

8. RADIATED TEST RESULTS

8.1. 99% & 20 dB BANDWIDTH

LIMITS

The bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than

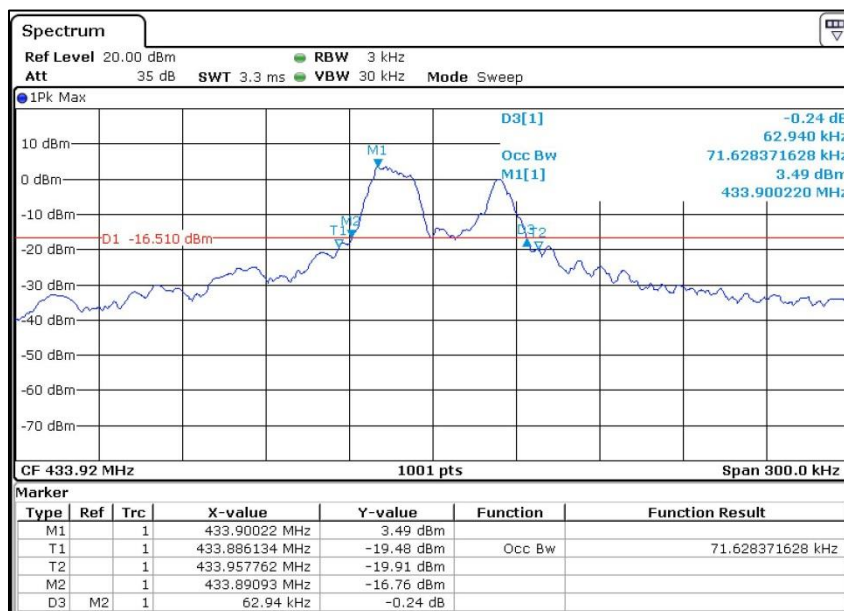
TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Channel	Frequency [MHz]	20 dB Bandwidth [kHz]	99 % Bandwidth [kHz]	Limit [kHz]
Single channel	433.92	62.94	71.63	1084.80

20 dB & 99% BANDWIDTH PLOTS



8.2. AUTOMATICALLY DEACTIVATE

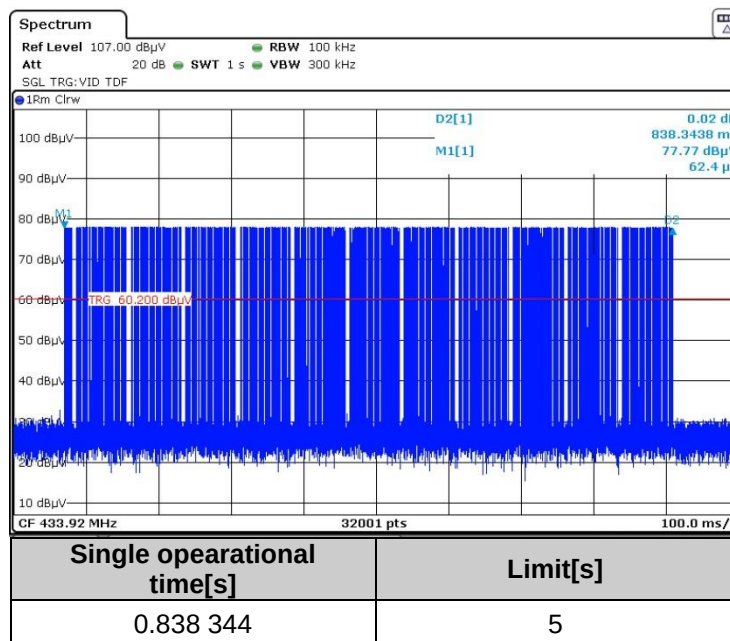
LIMITS

FCC §15.231 (a) & RSS-210 Annex A.1.1

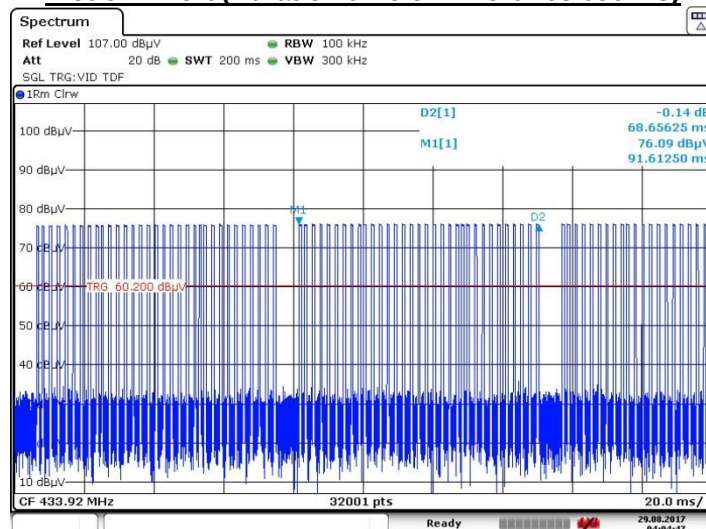
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

RESULTS

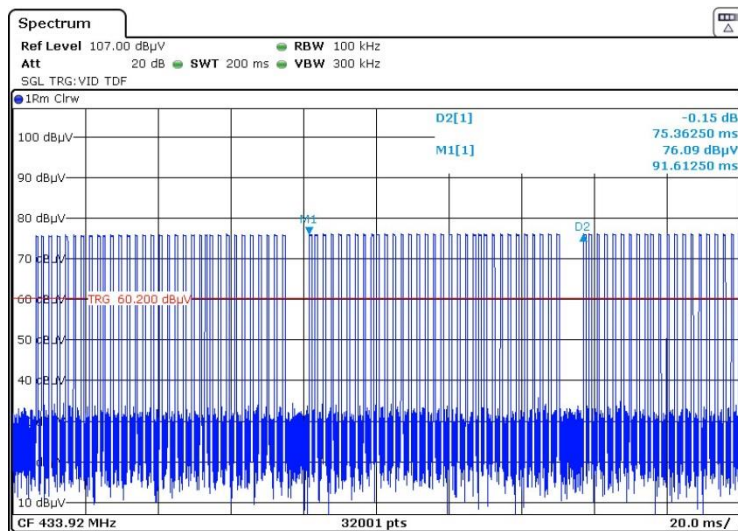
Single operational time(11 words)



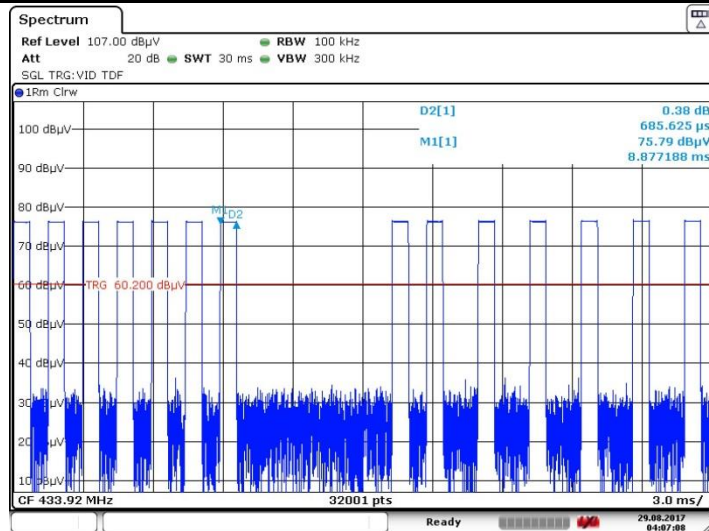
Plot of 1 word(Duration time of 1 word: 68.656 ms)



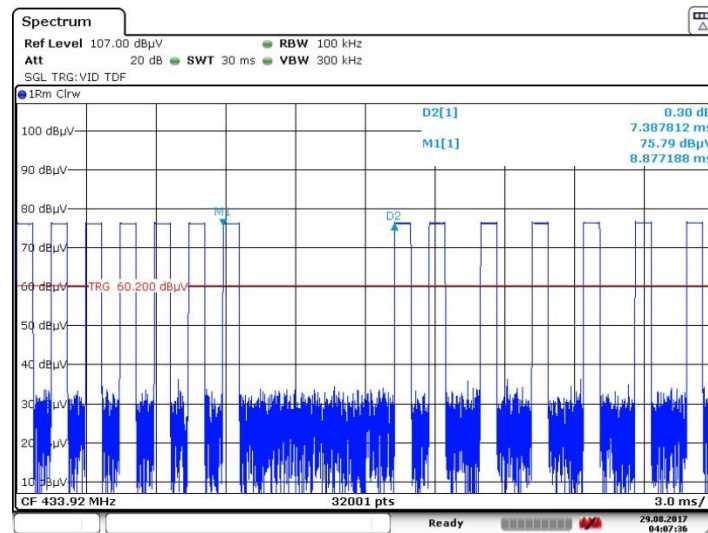
Plot of 1 word(Period time of 1 word: 75.363 ms)



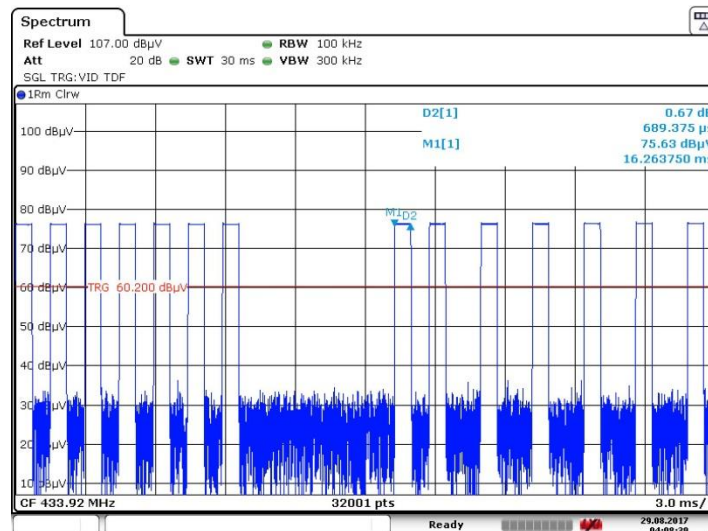
Plot of Data Format Type 1 – SYNC(Duration time of Type 1: 685.625 us)



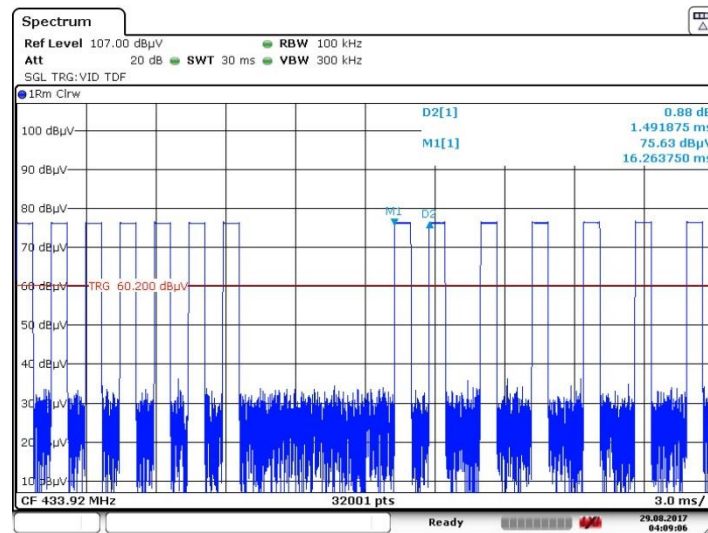
Plot of Data Format Type 1 – SYNC(Period time of Type 1: 7 388 us)



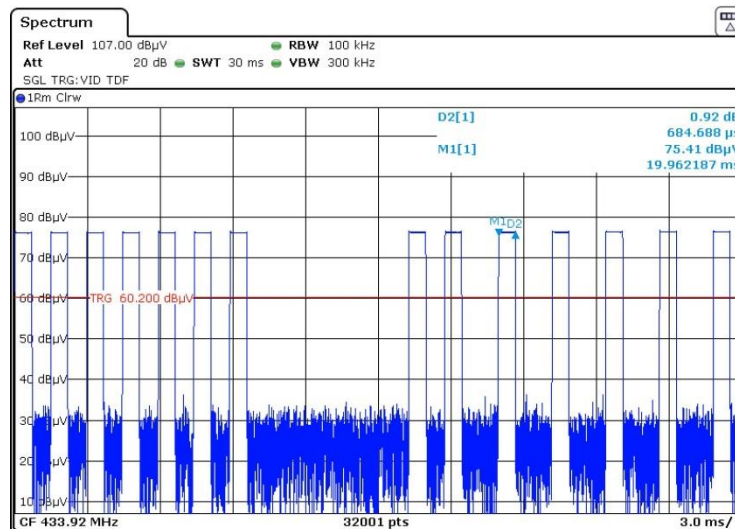
Plot of Data Format Type 2 – Bit 0(Duration time of Type 2: 689.375 us)



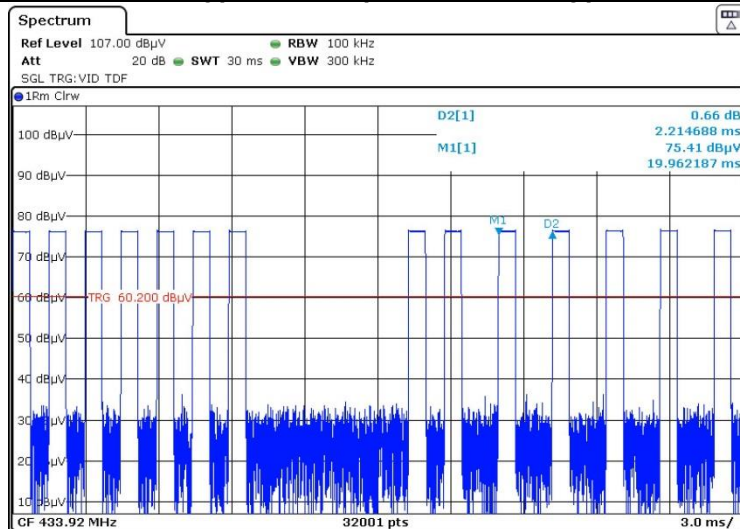
Plot of Data Format Type 2 – Bit 0(Period time of Type 2: 1 491 us)



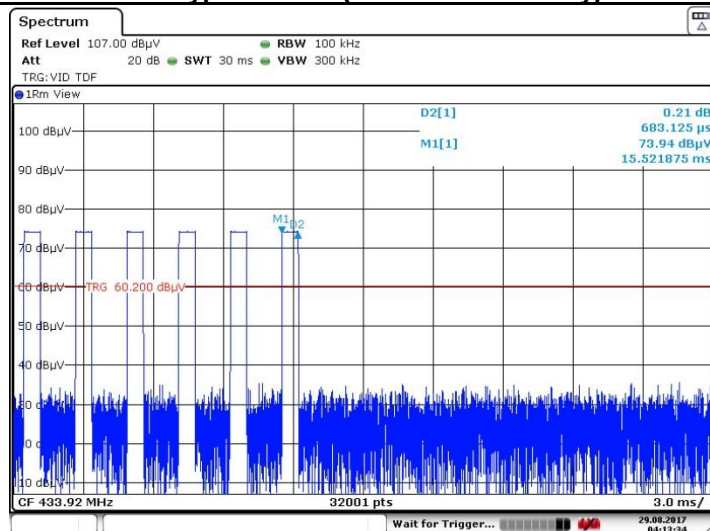
Plot of Data Format Type 3 – Bit 1(Duration time of Type 3: 684.688 us)



Plot of Data Format Type 3 – Bit 1(Period time of Type 3: 2 214.688 us)



Plot of Data Format Type 4 – END(Duration time of Type 4: 683.125 us)



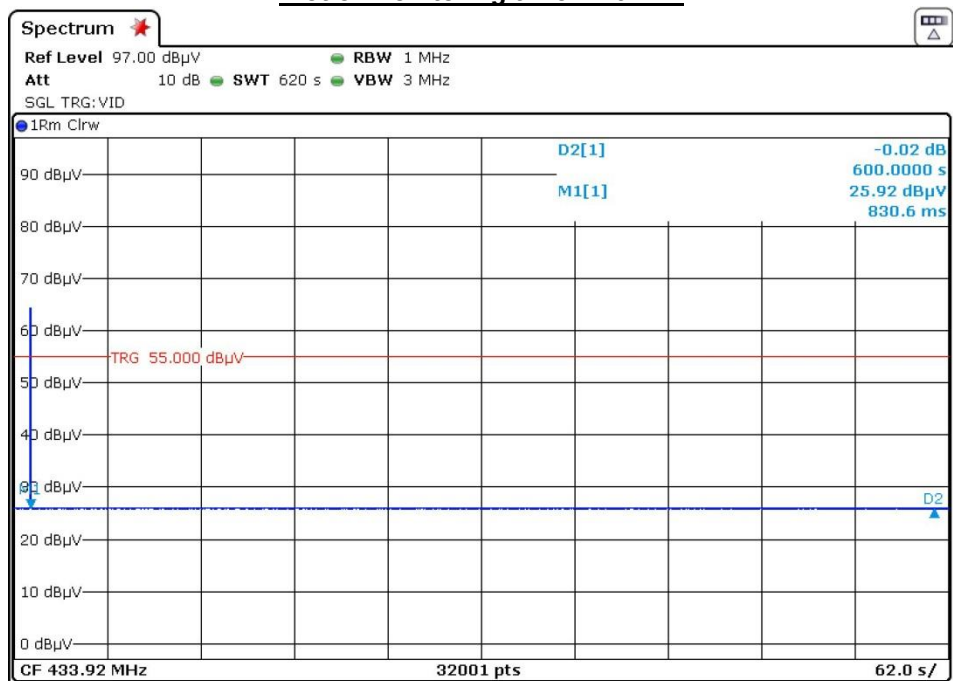
Data Format of 1 Word

Data Type	Format	Duration Time(us)	
SYNC	(SYNC) x 1	685.625 x 1	685.625
Data	(Bit 0 x 3) + (Bit 1 x 28)	(689.375 x 3) + (684.688 x 28)	21 239.390
END	(END) x 1	683.125 x 1	683.125

$$\text{Total Average Factor} = 20 \log \frac{685.625 + 21239.390 + 683.125}{75363.25} \text{ dB}$$

$$= -11.0 \text{ dB}$$

Plot of Monitoring time – 10 min



9. RADIATED SPURIOUS TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205, §15.209, §15.231 (b), RSS-210 Annex A1.2

Limits for radiated disturbance of an intentional radiator		
Frequency range (MHz)	Limits (μV/m)	Measurement Distance (m)
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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g. §§ 15.231 and 15.241.

FCC §15.231 & RSS-210 Annex A1.2		
Fundamental Frequency (MHz)		Field strength of fundamental (μV/m)
For FCC	For IC(RSS-Gen)	
40.66-40.70	-	2,250
70-130	70-130	1,250
130-174	130-174	1,250 to 3,750*
174-260	174-260	3,750
260-470	260-470	3,750 to 12,500*
Above 470	Above 470	12,500

* Linear interpolation.

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz and 150 cm for above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and add duty cycle factor for average measurements(See the APPENDIX I in this test report).

Pre-scans to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

The spectrum from 30MHz to 1GHz is investigated with the transmitter set to 433.92 MHz.

(From 1 GHz to 5 GHz, test was performed with the EUT set to transmit at the position with highest output power)

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Unwanted emissions within Restricted Bands are measured using traditional radiated procedures.

Note : Emission was pre-scanned from 9KHz to 30MHz; No emissions were detected which was at least 20dB below the specification limit (consider distance correction factor).
Per FCC part 15.31(o), test results were not reported.

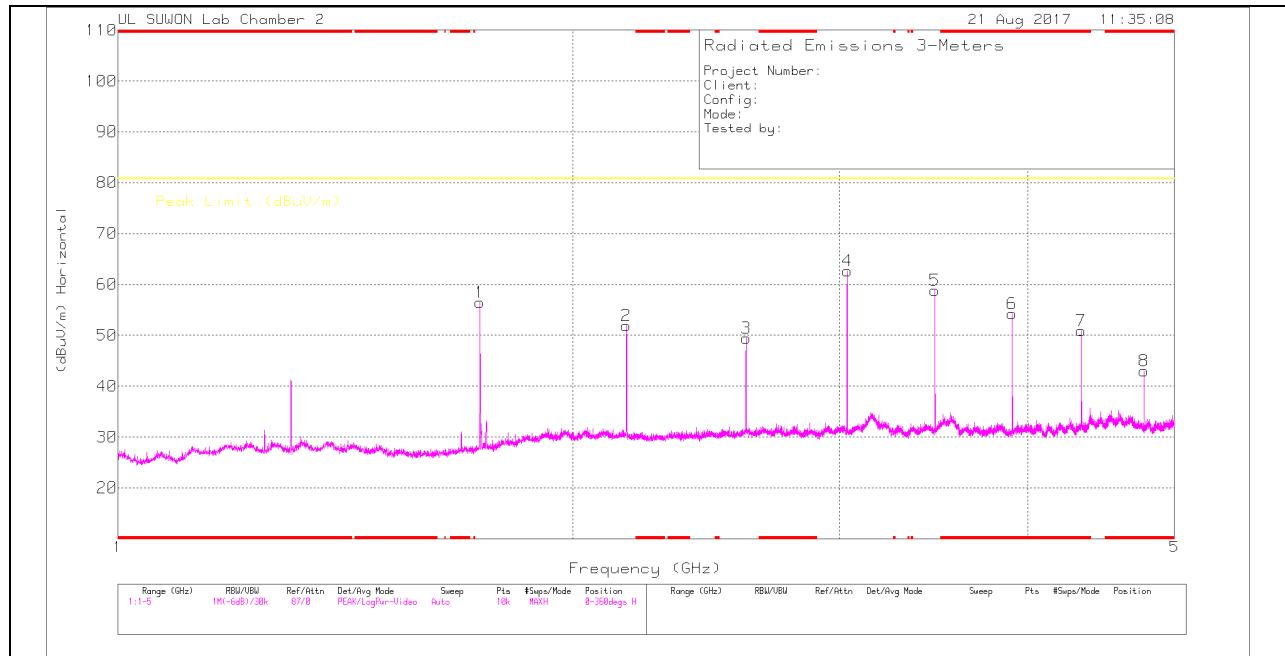
Formula for converting the field strength from uV/m to dBuV/m is:
 $\text{Limit (dBuV/m)} = 20 \log \text{limit (uV/m)}$

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area test site.
Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the one of tests made in an open field based on KDB 414788.

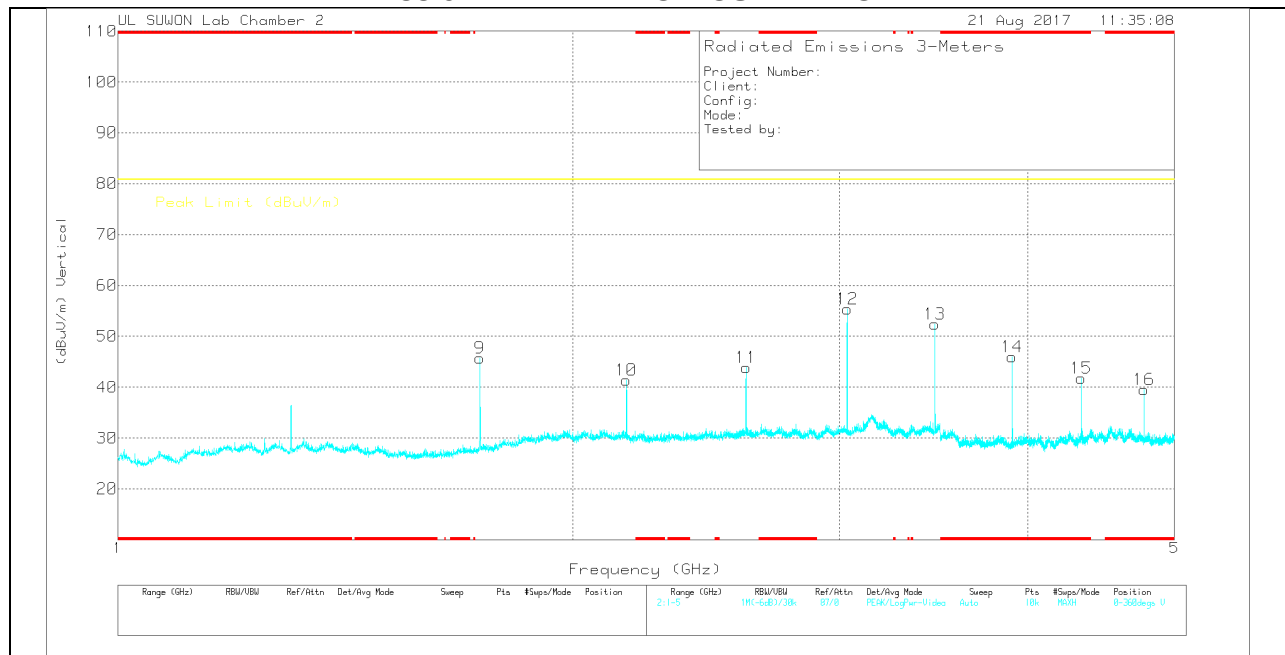
9.2. TRANSMITTER ABOVE 1 GHz

HARMONICS AND SPURIOUS EMISSIONS

433.92 MHz HARMONICS HORIZONTAL



433.92 MHz HARMONICS VERTICAL



Note: Emission was scanned up to 5 GHz

433.92 MHz HARMONICS DATA

Pre-Scan

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00168717	1-18GHz(dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.736	63.69	Pk	29	-36.2	56.49	80.8	-24.31	0-360	250	H
2	2.17	55.86	Pk	31.4	-35.4	51.86	80.8	-28.94	0-360	150	H
3	2.604	52.38	Pk	31.9	-34.8	49.48	80.8	-31.32	0-360	150	H
4	3.038	64.26	Pk	32.4	-34	62.66	80.8	-18.14	0-360	250	H
5	3.472	59.85	Pk	32.5	-33.5	58.85	80.8	-21.95	0-360	150	H
6	* 3.906	53.91	Pk	33.1	-32.8	54.21	80.8	-26.59	0-360	150	H
7	* 4.34	50.13	Pk	33.4	-32.6	50.93	80.8	-29.87	0-360	150	H
8	* 4.774	41.48	Pk	33.7	-32.2	42.98	80.8	-37.82	0-360	150	H
9	1.736	52.97	Pk	29	-36.2	45.77	80.8	-35.03	0-360	250	V
10	2.17	45.35	Pk	31.4	-35.4	41.35	80.8	-39.45	0-360	150	V
11	2.604	46.79	Pk	31.9	-34.8	43.89	80.8	-36.91	0-360	150	V
12	3.038	56.92	Pk	32.4	-34	55.32	80.8	-25.48	0-360	250	V
13	3.472	53.42	Pk	32.5	-33.5	52.42	80.8	-28.38	0-360	250	V
14	* 3.906	48.19	Pk	33.1	-35.3	45.99	80.8	-34.81	0-360	250	V
15	* 4.34	43.13	Pk	33.4	-34.8	41.73	80.8	-39.07	0-360	250	V
16	* 4.774	40.18	Pk	33.7	-34.3	39.58	80.8	-41.22	0-360	150	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	20170531_3117_00168717	1-18G(dB)	Duty Cycle Reduction Factor(dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.736	64.42	Pk	29.0	-36.2	-	57.22	80.8	-23.58	271	246	H
2.17	56.08	Pk	31.4	-35.4	-	52.08	80.8	-28.72	123	151	H
2.604	52.70	Pk	31.9	-34.8	-	49.80	80.8	-31.00	124	153	H
3.038	64.80	Pk	32.4	-34.0	-	63.20	80.8	-17.60	264	151	H
3.038	64.80	Pk	32.4	-34.0	-11.0	52.20	60.8	-8.60	268	244	H
3.472	60.51	Pk	32.5	-33.5	-	59.51	80.8	-21.29	130	150	H
* 3.906	54.42	Pk	33.1	-32.8	-	54.72	74	-19.28	128	154	H
* 3.906	54.42	Pk	33.1	-32.8	-11.0	43.72	54	-10.28	128	154	H
* 4.34	50.27	Pk	33.4	-32.6	-	51.07	74	-22.93	131	153	H
* 4.34	50.27	Pk	33.4	-32.6	-11.0	40.07	54	-13.93	131	153	H
* 4.774	41.64	Pk	33.7	-32.2	-	43.14	74	-30.86	132	155	H
* 4.774	41.64	Pk	33.7	-32.2	-11.0	32.14	54	-21.86	132	155	H
1.736	53.60	Pk	29.0	-36.2	-	46.40	80.8	-34.40	266	248	V
2.17	45.85	Pk	31.4	-35.4	-	41.85	80.8	-38.95	127	146	V
2.604	47.18	Pk	31.9	-34.8	-	44.28	80.8	-36.52	126	147	V
3.038	57.31	Pk	32.4	-34.0	-	55.71	80.8	-25.09	270	151	V
3.472	53.95	Pk	32.5	-33.5	-	52.95	80.8	-27.85	266	151	V
* 3.906	48.88	Pk	33.1	-35.3	-	46.68	74	-27.32	267	244	V
* 3.906	48.88	Pk	33.1	-35.3	-11.0	35.68	54	-18.32	267	244	V
* 4.34	43.46	Pk	33.4	-34.8	-	42.06	74	-31.94	273	246	V
* 4.34	43.46	Pk	33.4	-34.8	-11.0	31.06	54	-22.94	273	246	V
* 4.774	40.33	Pk	33.7	-34.3	-	39.73	74	-34.27	132	242	V
* 4.774	40.33	Pk	33.7	-34.3	-11.0	28.73	54	-25.27	132	242	V
1.736	64.42	Pk	29.0	-36.2	-	57.22	80.8	-23.58	271	246	H

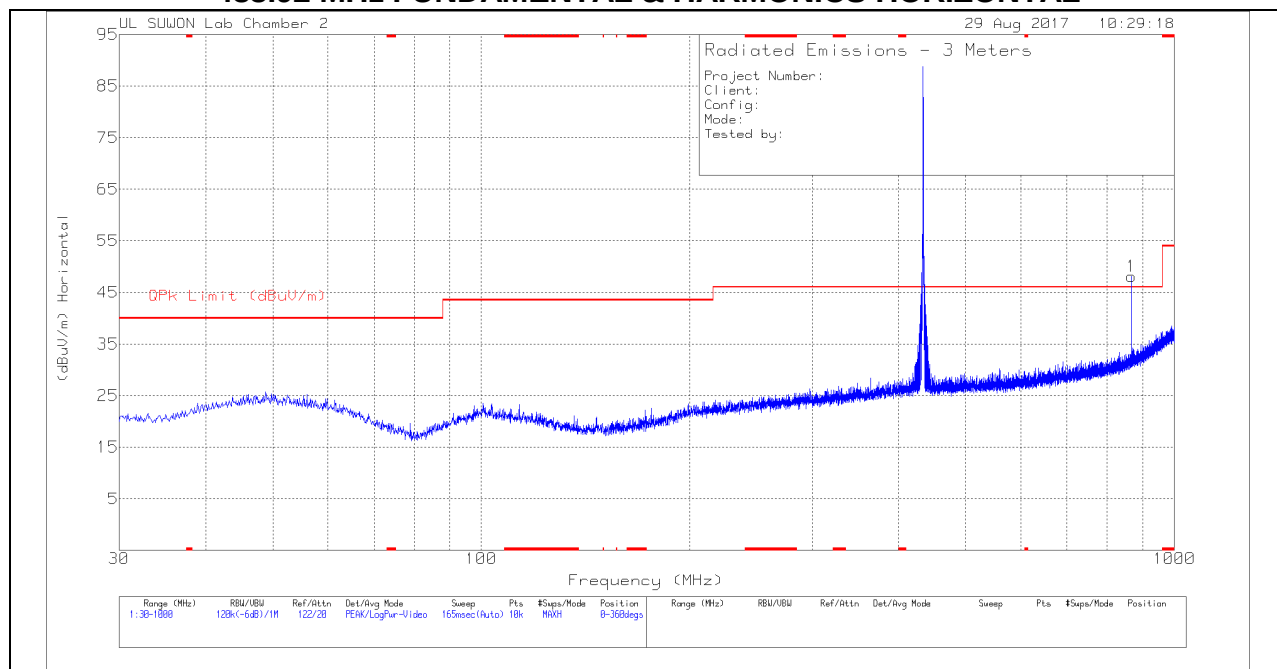
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Note. If non-restricted band's Peak measurement data meet the average limit(60.8 dBuV/m), average data was omitted(if peak data exceed average limit, average data was noted).

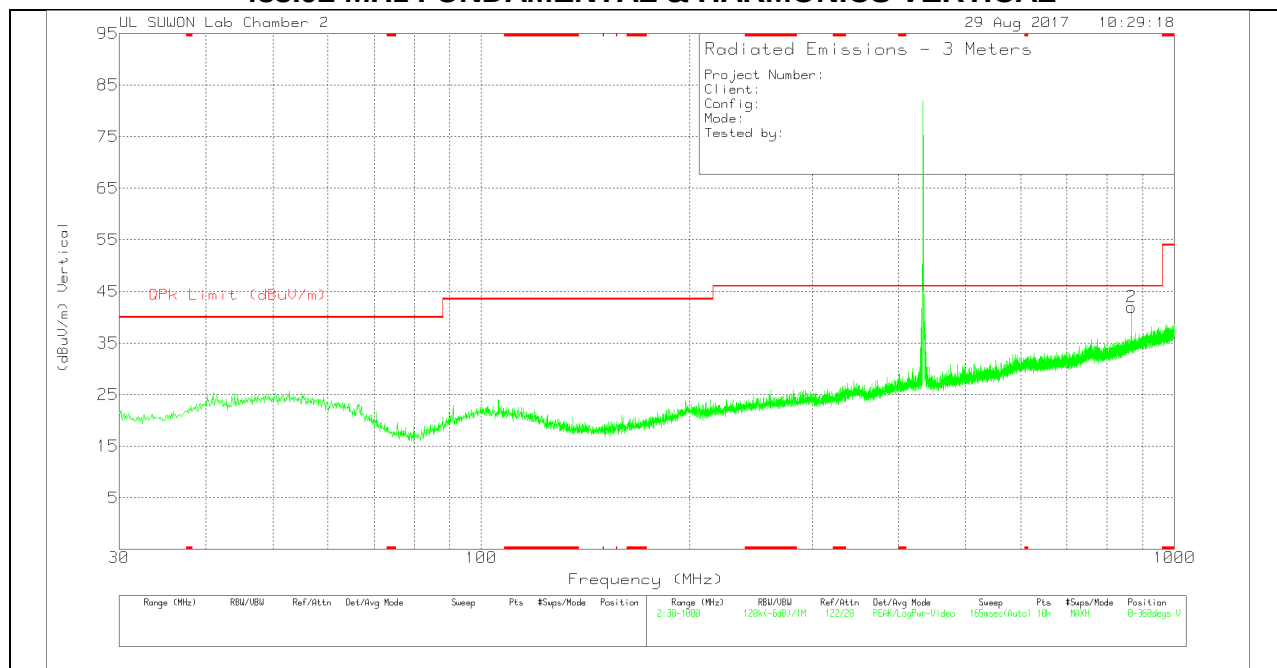
9.3. TRANSMITTER BELOW 1 GHz

FUNDAMENTAL AND SPURIOUS EMISSIONS

433.92 MHz FUNDAMENTAL & HARMONICS HORIZONTAL



433.92 MHz FUNDAMENTAL & HARMONICS VERTICAL



BELOW 1 GHz TABLE

Fundamental measurement data

Axis	Frequency (MHz)	Meter Reading (dBuV)	Det	VULB9163 _750(dB)	30-1000MHz[dB]	Duty Cycle Reduction Factor(dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
X	433.953	67.97	Pk	15.9	6	-	89.87	100.8	-10.93	275	224	H
	433.953	67.97	Pk	15.9	6	-11	78.87	80.8	-1.93	275	224	H
	433.95	60.67	Pk	15.9	6	-	82.57	100.8	-18.23	357	225	V
	433.95	60.67	Pk	15.9	6	-11	71.57	80.8	-9.23	357	225	V
Y	433.95	66.51	Pk	15.9	6	-	88.41	100.8	-12.39	359	225	H
	433.95	66.51	Pk	15.9	6	-11	77.41	80.8	-3.39	359	225	H
	433.956	58.64	Pk	15.9	6	-	80.54	100.8	-20.26	274	104	V
	433.956	58.64	Pk	15.9	6	-11	69.54	80.8	-11.26	274	104	V
Z	433.95	54.62	Pk	15.9	6	-	76.52	100.8	-24.28	135	100	H
	433.95	54.62	Pk	15.9	6	-11	65.52	80.8	-15.28	135	100	H
	433.952	67.73	Pk	15.9	6	-	89.63	100.8	-11.17	129	124	V
	433.952	67.73	Pk	15.9	6	-11	78.63	80.8	-2.17	129	124	V

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	VULB9163-749	30-1000MHz[dB]	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	867.983	57.28	Pk	19	-28.2	48.08	46.02	2.06	0-360	100	H
2	867.983	48.39	Pk	21.8	-28.2	41.99	46.02	-4.03	0-360	200	V

Pk - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	VULB9163-749	30-1000MHz[dB]	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
867.983	53.88	Qp	19	-28.2	44.68	46.02	-1.34	262	100	H
867.983	49.05	Qp	21.8	-28.2	42.62	46.02	-3.37	263	100	V

Qp - Quasi-Peak detector

Note1: Only peak measurement was performed. Because peak measurement result of unwanted emission is less than Quasi-Peak limit.

Note2: The test was processed 433.92 MHz

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS: N/A

Note. EUT use Non-rechargeable battery.