

CERTIFICATION TEST REPORT

Report Number. : 4791253687-FR1V2

Applicant : SEGI LIMITED
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Shatin, New Territories

Model : 2WG18R-FM

FCC ID : VA5REN510-2WFX

IC : 7087A-2WREN510FX

EUT Description : Keyless Entry System

Test Standard(s) : FCC Part 15.231, RSS-210 issue 10

Test Method Used : ANSI C63.10-2013

Date Of Issue:

May 20, 2024

Prepared by:

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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	May-08-2024	Initial issue	Jaehyeok Bang
V2	May-20-2024	Updated to address TCB`s question	Jaehyeok Bang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SEGI LIMITED
EUT DESCRIPTION: Keyless Entry System
MODEL NUMBER: 2WG18R-FM
SERIAL NUMBER: Identical prototype
DATE TESTED: April-19 ~ May-08-2024, May-17-2024

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.

Approved & Released For
UL Korea, Ltd. By:

Tested By:



Changmin Kim
Senior Laboratory Engineer
UL Korea, Ltd.



Jaehyeok Bang
Laboratory Test Engineer
UL Korea, Ltd.

2. TEST METHODOLOGY

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

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 42, Obongsandan 1-ro, Uiwang-si, Gyeonggi-do, Republic of 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.

42, Obongsandan 1-ro	
<input type="checkbox"/>	Chamber 1
<input checked="" type="checkbox"/>	Chamber 2

Used ISED Test Site Reg.(company number): 32001
CAB Identifier: KR0161

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-1087. The full scope of accreditation can be viewed at <https://www.iasonline.org/wp-content/uploads/2022/05/TL-1087-Cert-New.pdf>

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:

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Occupied Bandwidth	0.07 %
Conducted Emissions	2.32 dB
Radiated Disturbance, 9 kHz to 30 MHz	1.66 dB
Radiated Disturbance, 30 MHz to 1 GHz	3.67 dB
Radiated Disturbance, 1 GHz to 18 GHz	5.39 dB

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

4.4. DECISION RULE

Decision rule for statement(s) of conformity is based on Clause 4.3.3 in IEC Guide 115:2023. Measurement Uncertainty is not applied when providing statements of conformity in accordance with IEC Guide 115:2023, 4.3.3

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

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

5.2. MAXIMUM FIELD STRENGTH

The transmitter has a maximum fundamental field strength power as follows:

Frequency [MHz]	Maximum Fundamental field strength Power [dBuV/m]	
	PEAK	AVERAGE
433.92	96.97	77.39

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 internal antenna was Permanently attached.
Therefore this E.U.T Complies with the requirement of §15.203.**

The radio utilizes an internal antenna, with a maximum gain of -4.09 dBi

5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission was performed with the EUT set to transmit at the single frequency (433.92 MHz). Power line conducted emission was not performed since this device using un-rechargeable battery.

The fundamental and radiated spurious emission were investigated in three orthogonal orientations X, Y and Z. It was determined that below orientation was worst-case orientation for each antenna.

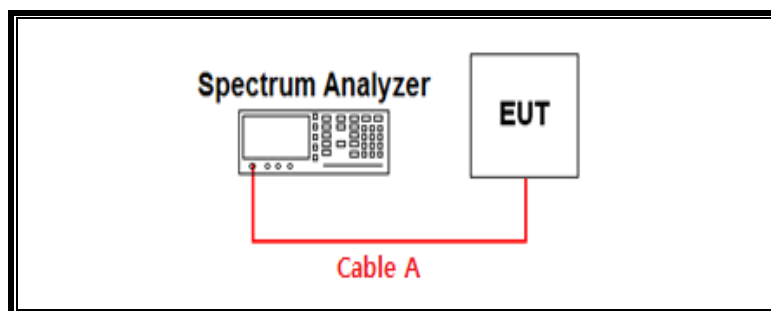
Antenna	Worst Case		
	X	Y	Z
Fundamental(433.92MHz)	O	-	-
Radiated spurious emission	Please see the tested data		

5.5. DESCRIPTION OF TEST SETUP

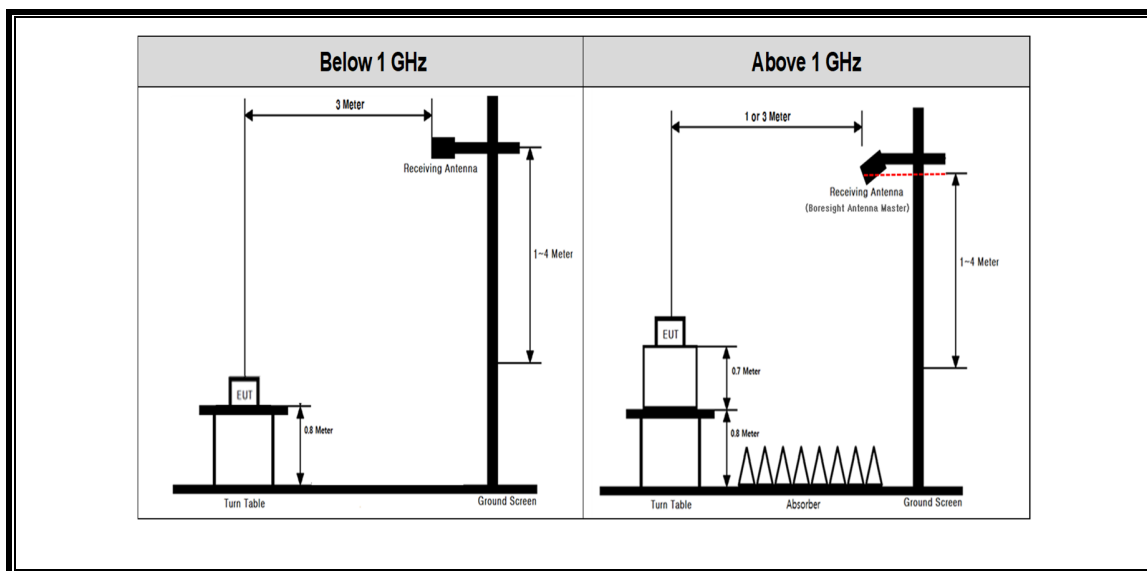
TEST SETUP

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

SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)



SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)



6. TEST AND MEASUREMENT EQUIPMENT

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

Description	Manufacturer	Model	Identifier	Cal. Due	Next Cal. Due
Spectrum Analyzer	Rohde & Schwarz	FSW50	101567	2023-08-08	2024-08-08
DC Power Supply	KIKUSUI	PWR1201ML	DN002200	2023-07-28	2024-07-28
Signal Generator	Rohde & Schwarz	SMB100A	184060	2023-07-26	2024-07-26
EMI test Receiver	Rohde & Schwarz	ESW44	103313	2024-01-29	2025-01-29
Loop Antenna	TESEQ	HLA6121	65111	2024-08-01	2025-08-01
TRILOG BROADBAND ANTENNA	Schwarzbeck	VULB9163	1661	2024-03-18	2026-03-18
Signal Conditioning Unit	Rohde & Schwarz	SCU01F	100316	2024-03-22	2025-03-22
Double-Ridged Guide Antenna	ETS Lindgren	3117	261463	2023-10-04	2024-10-04
Amplifier	BNZ	BZR-01001800-231040-182020	28452	2024-04-08	2025-04-08
High Pass Filter	Micro-Tronics	HPM50115-02	G41	2024-03-22	2025-03-22
High Pass Filter	Mini-Circuits	NHP-800+	VUU47701636	2024-01-02	2025-01-02
Humidity/Baro/Temp DATA RECORDER	Lutron	MHB-382SD	AL.92208	2023-10-20	2024-10-20
Humidity/Baro/Temp DATA RECORDER	Lutron	MHB-382SD	AM.00227	2024-01-11	2025-01-11
Attn Switch	Agilent	11713A	3748A09520	N/A	N/A
Toyo EMI Software	Toyo	EP5RE	Version 6.0.130	N/A	N/A

7. SUMMARY TABLE

FCC Part Section	IC Section	Test Description	Test Limit	Test Condition	Test Result
15.231 (c)	-	20dB bandwidth	no wider than 0.25% of the center frequency for device	Conducted	PASS
-	RSS-210 [A1.3]	Occupied bandwidth(99%)	no wider than 0.25% of the center frequency for device		PASS
15.231 (a)(1)	RSS-210 [A1.1]	Automatically deactivate	< 5s		PASS
15.231 (b)	RSS-210 [A1.2]	Field strength of fundamental and spurious emissions	Fundamental: < 100.82 dBuV/m(Pk) < 80.82 dBuV/m(Av)	Radiated	PASS
			Spurious emission: < 80.82 dBuV/m(Pk) < 60.82 dBuV/m(Av)		
15.205, 15.209	RSS-GEN [8.9] & [8.10]	General field strength limits(restricted bands and radiated emission limits)	Spurious emission: < 74 dBuV/m(PK) < 54 dBuV/m(AV)		PASS
15.207 (a)	RSS-GEN [8.8]	AC Power Line conducted emissions	Section 11	Power Line conducted	N/P ^(Note1)

Note1. AC Power line conducted emission was not performed since this device using un-rechargeable battery.

8. CONDUCTED 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 0.5% of the center frequency.

TEST PROCEDURE

The transmitter Output is connected to the Spectrum Analyzer and used following test procedure of ANSI 63.10-2013.

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 5% 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	103.90	205.73	1084.80

20 dB & 99% BANDWIDTH PLOTS



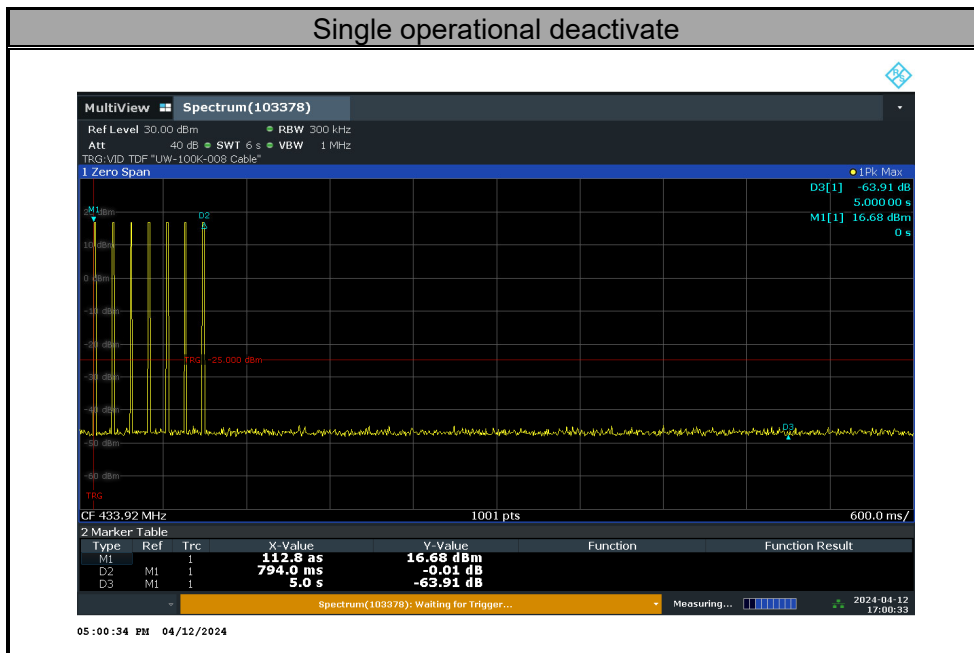
8.2. AUTOMATICALLY DEACTIVATE

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[s]	Limit[s]
0.794	5

9. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §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 Part 15.205 (a) : Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.52525	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	156.7 ~ 156.9	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	162.0125 ~ 167.17	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	167.72 ~ 173.2	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	240 ~ 285	2655 ~ 2900		
8.291 ~ 8.294	37.5 ~ 38.25	322 ~ 335.4	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	399.90 ~ 410	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	608 ~ 614	3345.8 ~ 3358		
		960 ~ 1240	3600 ~ 4400		

▪ FCC Part 15.205(b) : The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

FCC §15.231 & RSS-210 Annex A1.2			
Fundamental Frequency (MHz)		Field strength of fundamental (μV/m)	Field strength of spurious Emissions (μV/m)
For FCC	For IC(RSS-Gen)		
40.66-40.70	-	2,250	225
70-130	70-130	1,250	125
130-174	130-174	1,250 to 3,750*	125 to 375
174-260	174-260	3,750	375
260-470	260-470	3,750 to 12,500*	375 to 1,250
Above 470	Above 470	12,500	1,250

* Linear interpolation with Frequency, f, in MHz;

- For 130-174 MHz: field Strength (uV/m) = (56.82 x f)-6136
- For 260-470 MHz: field Strength (uV/m) = (41.67 x f)-7083

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1 GHz and 150 cm for above 1 GHz. 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.

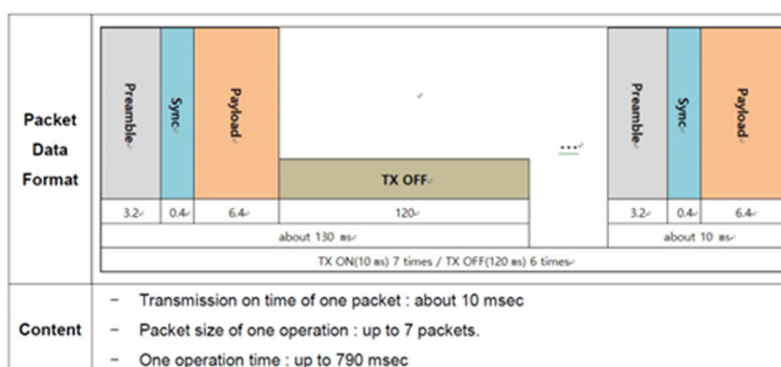
For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

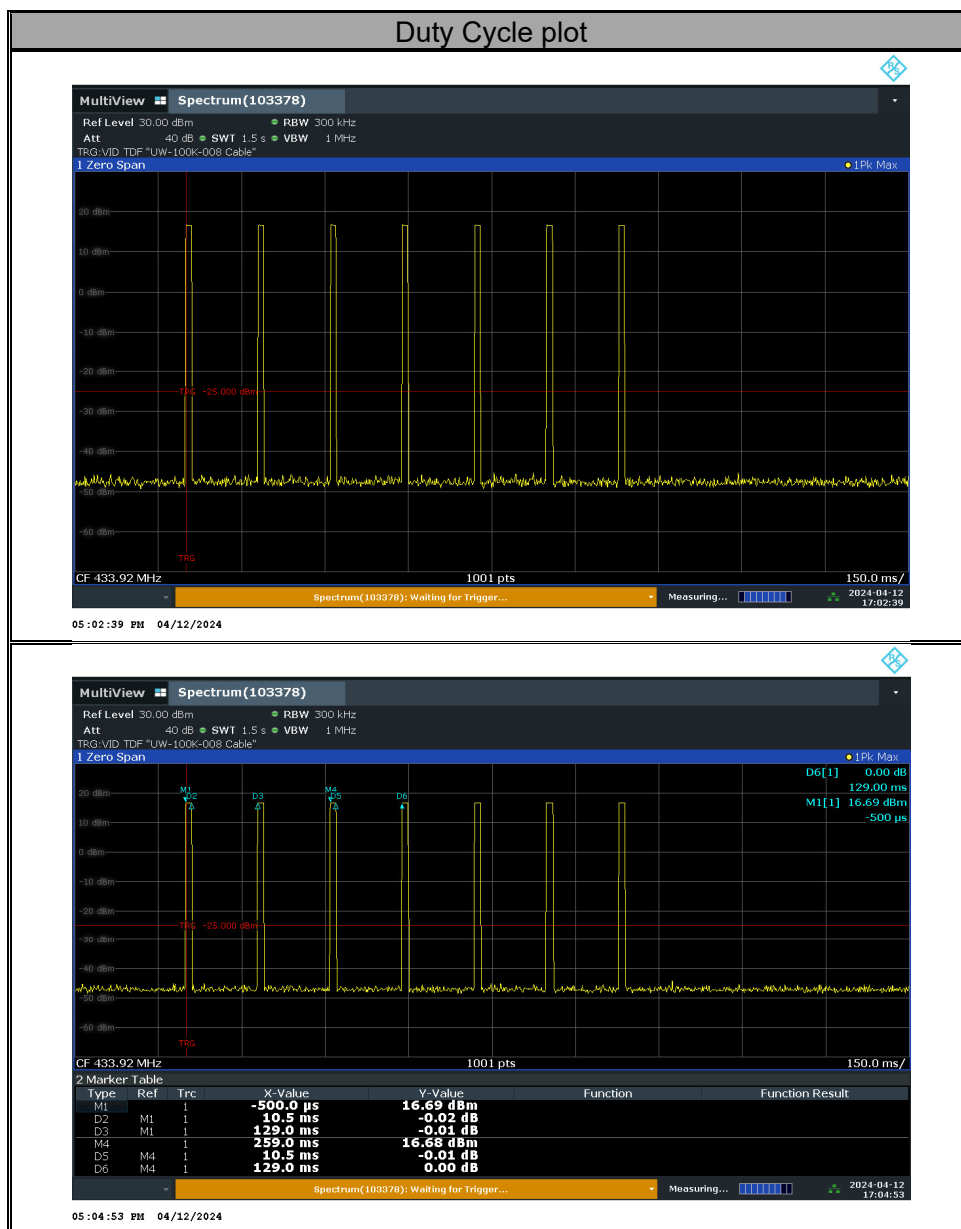
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and add duty cycle factor for average calculations.

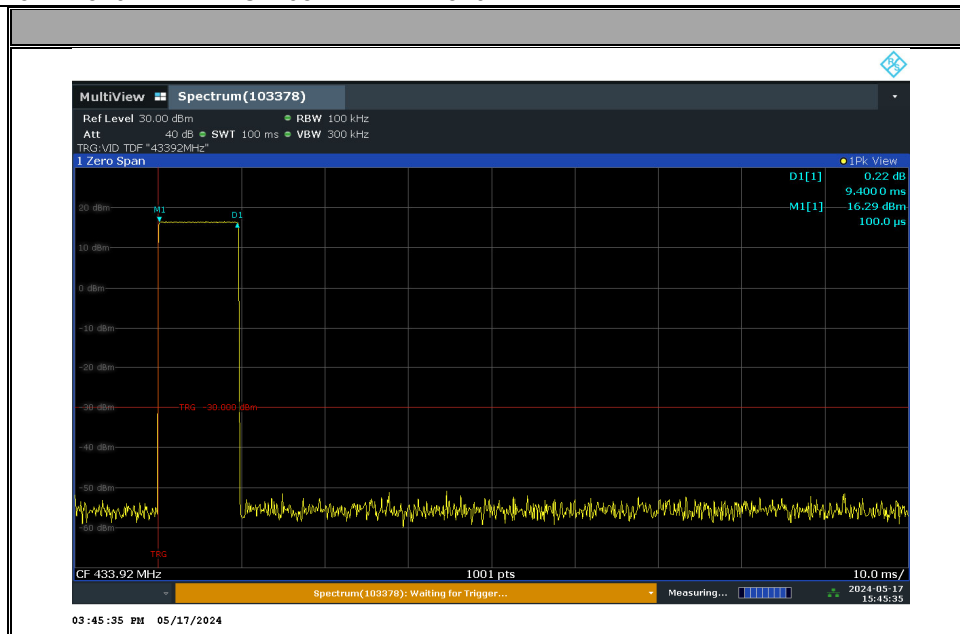
$$\text{Total Average Factor} = 20 \log \frac{10.5}{100} \text{dB} \\ = \underline{\underline{-19.58 \text{ dB}}}$$

Total Average Factor = -19.58 dB

Declared Worst Data Format of 1 Word







Pre-scans to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz 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.

Note : Emission was pre-scanned from 9 kHz to 30 MHz; 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.

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field 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.

9.1. Field strength of fundamental and spurious emissions

Radiated Emissions data

Note 1. The result of Average measurement was calculated using PK result and duty cycle reduction factor.

Note 2. * is fundamental frequency. And # is spurious emission at restricted band.

The spurious emission was confirmed to be related to the fundamental emissions.

Note 3. No other spurious and harmonic emissions were reported greater than listed emissions above table.

Note 4. Sample calculation

$T.F = AF + CL - AG$ / $\text{Field Strength} = \text{Reading} + T.F + DCF$

Margin = Limit – Field Strength

Where, T.F = Total Factor, AF= Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

DCF = Duty cycle reduction factor

Frequency [MHz]	Detector Mode	EUT Position	ANT Pol	Reading [dBuV]	T.F [dB/m]	DCF [dB]	Field Strength [dBuV/m]	Limit [dBuV/m]	Margin [dB]
433.94*	PK	X	H	72.34	24.63	N/A	96.97	100.82	3.85
433.94*	AV	X	H	72.34	24.63	-19.58	77.39	80.82	3.43
867.84	PK	X	H	52.59	3.93	N/A	56.52	80.82	24.30
867.84	AV	X	H	52.59	3.93	-19.58	36.94	60.82	23.88
1 301.07#	PK	X	H	53.48	-9.78	N/A	43.70	74.00	30.30
1 301.07#	AV	X	H	53.48	-9.78	-19.58	24.12	54.00	29.88
1 735.86	PK	Y	V	49.49	-7.78	N/A	41.71	80.82	39.11
1 735.86	AV	Y	V	49.49	-7.78	-19.58	22.13	60.82	38.69
2 169.91	PK	Z	V	48.03	-5.41	N/A	42.62	80.82	38.20
2 169.91	AV	Z	V	48.03	-5.41	-19.58	23.04	60.82	37.78
2 603.74	PK	Z	V	55.39	-3.92	N/A	51.47	80.82	29.35
2 603.74	AV	Z	V	55.39	-3.92	-19.58	31.89	60.82	28.93
3 037.51	PK	Z	V	51.51	-2.68	N/A	48.83	80.82	31.99
3 037.51	AV	Z	V	51.51	-2.68	-19.58	29.25	60.82	31.57
3 471.61	PK	Z	V	55.39	-2.09	N/A	53.30	80.82	27.52
3 471.61	AV	Z	V	55.39	-2.09	-19.58	33.72	60.82	27.10
3 904.92#	PK	Y	H	52.48	-0.38	N/A	52.10	74.00	21.90
3 904.92#	AV	Y	H	52.48	-0.38	-19.58	32.52	54.00	21.48
4 339.23#	PK	Z	V	45.77	1.20	N/A	46.97	74.00	27.03
4 339.23#	AV	Z	V	45.77	1.20	-19.58	27.39	54.00	26.61

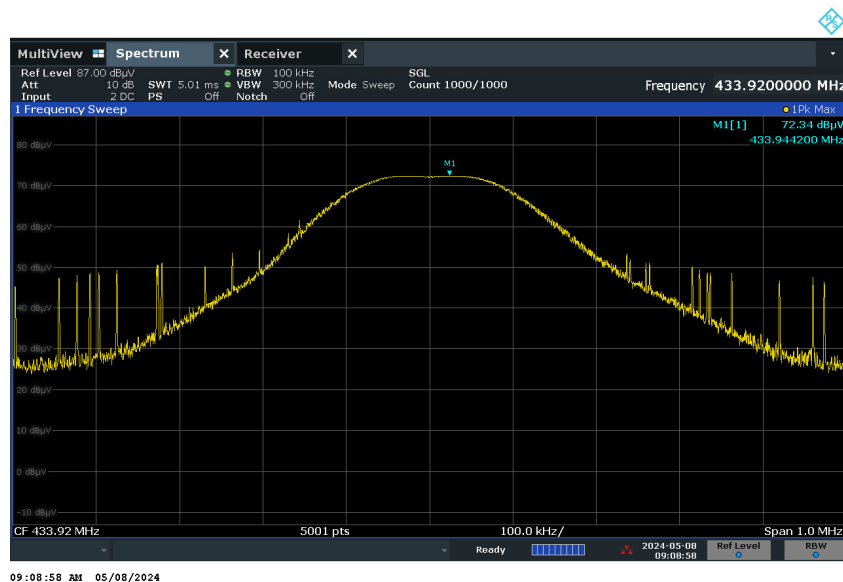
Worst data plot of radiated test

Note: The offset was not include in test plot(Reading value).
The results refer to the Section 9.1

Field strength of fundamental

X axis & Hor

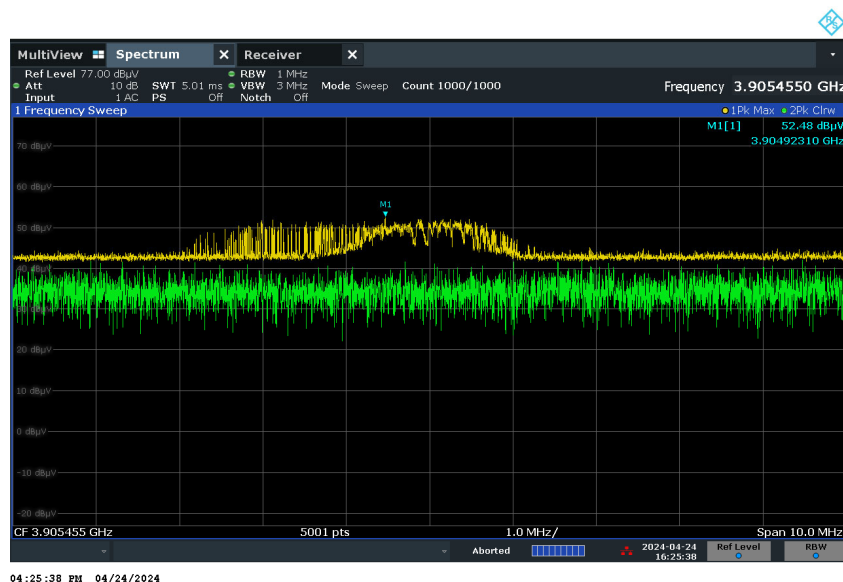
Detector Mode : PK



Spurious emission

Y axis & Hor

Detector Mode : PK



10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a) & RSS-GEN[8.8]

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/P

Note. EUT use Non-rechargeable battery.

END OF TEST REPORT