TEST REPORT

Dt&C

Dt&C Co., Ltd.

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Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2409-0110

2. Customer

   • Name (FCC) : MAGO technology

   • Address (FCC) : 1112, Seoultechnopark, 232, Gongneung-ro, Nowon-gu, Seoul, Korea

3. Use of Report : FCC Original Grant

4. Product Name / Model Name : Smart Vehicle Sensor / CARDET-501

   FCC ID : 2BHMO-CARDET-501

5. Test Method Used : ANSI C63.10-2013

   Test Specification : Part 15.255

6. Date of Test : 2024.06.21 ~ 2024.07.18

7. Testing Environment : Refer to appended test report.

8. Test Result : Refer to the attached test result.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by Name : Seokho Han (Signature)	Technical Manager Name : JaeJin Lee (Signature)

2024 . 09 . 04 .

Dt&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

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Test Report Version

Test Report No.	Date	Description	Revised By	Reviewed By
DRTFCC2409-0110	Sep. 04, 2024	Initial issue	Seokho Han	JaeJin Lee

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1. EUT DESCRIPTION

FCC Equipment Class	Part 15 Field Disturbance Sensor (FDS)
Product	Smart Vehicle Sensor
Model Name(s)	CARDET-501, CARDET-501S, CARDET-502, CARDET-502S, CARDET-503, CARDET-601, RA-500, RA-600, CP100, CT100, VG-100, DMS-100, KD-100
EUT Serial Number	No Specified
Power Supply	DC 12 V
Frequency Range	57.0 ~ 64.0 GHz
Max. RF Output Power (EIRP)	1.86 dBm
Modulation Type	Pulse Modulation
Antenna Specification	**Antenna type**: Folded dipole antenna **Antenna gain(Max)**: 6.00 dBi

RADAR CERTIFICATION OPTIONS

☐ a. Any terrestrial radar transmitting in the 57-71 GHz frequency band can be certified under §15.255(c)(2) with a peak conducted output power limit of -10 dBm and a peak EIRP limit of 10 dBm.
☐ b. Any terrestrial radar transmitting within the 61.0-61.5 GHz ISM band segment, with a maximum EIRP output of 40 dBm (average) and 43 dBm (peak), can be certified under the §15.255(c)(2)(v) rules.
☐ c. Radars intended for operation onboard unmanned aircraft in the 60.0-64.0 GHz band segment can be certified under §15.255(b)(3) with a peak EIRP limit of 20 dBm and a required off-time of at least 16.5 milliseconds within any contiguous 33.0 millisecond interval.
☐ d. Terrestrial, including vehicular (in-cabin) radar devices in the 57.0-59.4 GHz band segment, can be certified under §15.255(c)(2)(i), with peak EIRP limits of 20 dBm for indoor operation and 30 dBm for outdoor operation.
☐ e. All terrestrial radar within the 57.0-61.56 GHz band segment can be certified under §15.255(c)(2)(ii), with a peak EIRP limit of 3 dBm with no off-time requirement, or 20 dBm with a corresponding off-time requirement of 16.5 milliseconds within any 33.0-millisecond interval.
☐ f. Any terrestrial radar operating within the 57.0-64.0 GHz band segment can be certified under §15.255(c)(2)(iii)(A), with a peak EIRP limit of 14 dBm and a corresponding off-time requirement of 25.5 milliseconds within any 33.0-millisecond interval.
☐ g. Permanent or temporary fixed radar intended solely for outdoor or other than in-cabin vehicular applications can be certified under §15.255(c)(2)(iii)(B) with a peak EIRP limit of 20 dBm and a corresponding off-time requirement of 16.5 milliseconds within any contiguous 33.0 millisecond interval.
☒ **h. Pulsed radar applications with a maximum pulse duration of 6 nanoseconds and transmitting within the 57-64 GHz band segment can be certified under §15.255(c)(3), with an average EIRP limit of 13 dBm, a peak EIRP limit of 33 dBm, and a transmit duty cycle limit of 10%; in addition, the average integrated EIRP within the 61.5-64.0 GHz band must not exceed 5 dBm in any 0.3-microsecond interval.**

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2. INFORMATION ABOUT TESTING

2.1. Transmitting configuration of EUT

Test Mode	Description	Test Frequency(GHz)
Pulse Modulation	Transmitting	60.44
-	-	-

2.2. Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
CONTROLLER	RELAY CONTROLLER	No Specified	MAGO technology	-
-	-	-	-	-

Note: The above equipment was supported by manufacturer.

2.3. Tested environment

Temperature	:	21 ºC ~ 23 ºC
Relative humidity content	:	40 % ~ 44 %
Details of power supply	:	DC 12 V

2.4. EMI suppression Device(s) / Modifications

EMI suppression device(s) added and/or modifications made during testing
→ None

2.5. Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C 63.4-2014 and ANSI C 63.10-2013. All measurement uncertainty values are shown with a coverage factor of *k* = 2 to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
AC conducted emission	3.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz Below)	5.0 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	4.8 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.0 dB (The confidence level is about 95 %, k = 2)

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3. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Status Note 1
15.215(c)(3)	10 dB Bandwidth	NA	Radiated	C Note2
15.215(c)(3)	Equivalent Isotropic Radiated Power	Peak < 33 dBm Average < 13 dBm		C Note2
15.255(d) 15.209	Radiated Spurious Emissions	Refer to the section 8.3		C Note2
15.255(f)	Frequency Stability	Within the frequency band		C
15.207	AC Power-Line Conducted Emissions	< Part 15.207 limits (Refer to the section 8.5)	AC Line Conducted	C
15.203	Antenna Requirements	Part 15.203 (Refer to the section 7)	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable
Note 2: This test item was performed in three orthogonal EUT positions and the worst case data was reported.

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4. TEST METHODOLOGY

The measurement procedures described in the ANSI C63.10-2013 was used in measurement of the EUT.

4.1. EUT configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

4.2. EUT exercise

The EUT was operated in the test mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.255 under the FCC Rules Part 15 Subpart C.

4.3. General test procedures

Conducted Emissions

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector

Radiated Emissions

The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axes.

4.4. Description of test modes

The EUT has been tested with all modes of operating conditions to determine the worst case emission characteristics. A test program is used to control the EUT for staying in continuous transmitting mode.

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5. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

6. FACILITIES AND ACCREDITATIONS

6.1. Facilities

Dt&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014. **- FCC & ISED MRA Designation No.: KR0034** **- ISED#: 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

6.2. Equipment

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, loop, horn. Spectrum analyzers with pre-selectors and peak, quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

7. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203

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 antenna is permanently embedded in the device.

Therefore this E.U.T Complies with the requirement of §15.203

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8. TEST RESULTS

8.1. 10 dB Bandwidth

▣ Test Requirements and limit

Part 15.215(c)(3)

For pulsed field disturbance sensors/radars operating in the 57-64 GHz band that have a maximum pulse duration of 6 ns, the average EIRP shall not exceed 13 dBm and the transmit duty cycle shall not exceed 10% during any 0.3 µs time window. In addition, the average integrated EIRP within the frequency band 61.5-64.0 GHz shall not exceed 5 dBm in any 0.3 µs time window. Peak emissions shall not exceed 20 dB above the maximum permitted average emission limit applicable to the equipment under test. **The radar bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna.**

▣ Test Configuration:

Refer to the APPENDIX I.

▣ Test Procedure:

ANSI C63.10-2013 – Section 9.3

The following procedure was used for measurement of the bandwidth for millimeter-wave devices;

- Spectrum analyzer settings:
  1) Span equal to approximately two times to three times the EBW, centered on the carrier frequency.
  2) RBW, as specified in the requirement.
  3) VBW, as specified in the requirement, or VBW ≥ RBW if not specified.
  4) Sweep = auto.
  5) Detector function = peak.
  6) Trace = max hold. Allow the trace to stabilize.
  7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

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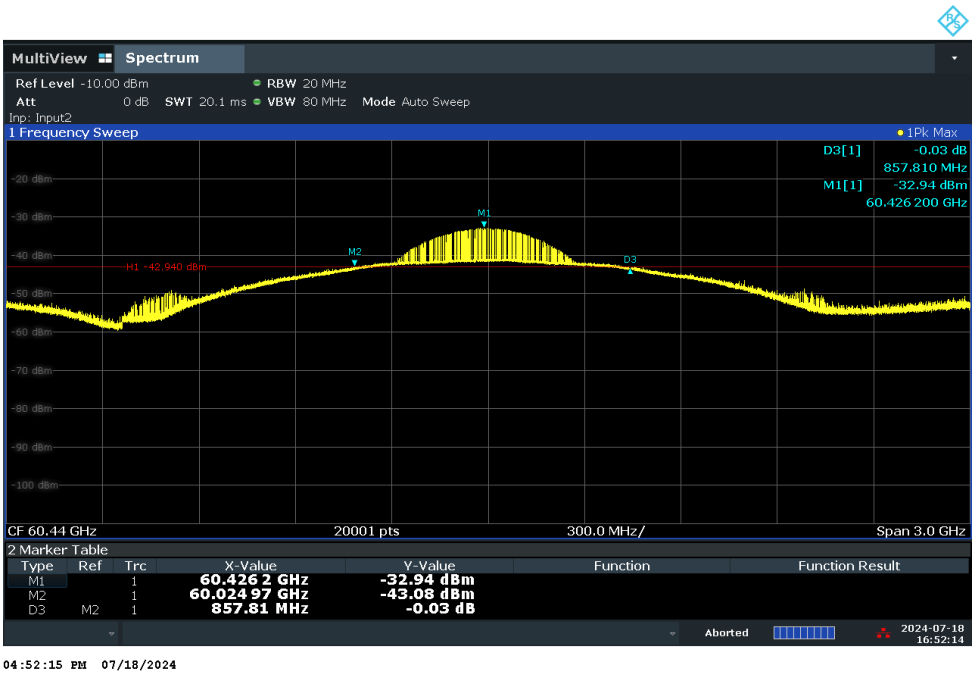
▣ Test Results: Comply

Frequency[GHz]	10 dB Bandwidth(MHz)
60.44	857.81

▣ Result plots

10 dB Bandwidth Tested Frequency: 60.44 GHz



8.2. Equivalent Isotropic Radiated Power

▣ Test Requirements and limit

Part 15.215(c)(3)

For pulsed field disturbance sensors/radars operating in the 57-64 GHz band that have a maximum pulse duration of 6 ns, the average EIRP shall not exceed 13 dBm and the transmit duty cycle shall not exceed 10% during any 0.3 μs time window. In addition, the average integrated EIRP within the frequency band 61.5-64.0 GHz shall not exceed 5 dBm in any 0.3 μs time window. Peak emissions shall not exceed 20 dB above the maximum permitted average emission limit applicable to the equipment under test. The radar bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna.

▣ Test Configuration:

Refer to the APPENDIX I.

▣ Test Procedure:

ANSI C63.10-2013 – Section 9.11

The following procedure was used for measurement of the output power for millimeter-wave devices;

1) The measurements were performed at 3m test site.
2) The EUT is placed on a non-conductive table is 1.5 meter above test site ground plane.
3) The measurement procedure described in ANSI C63.10-2013 Section 9.9 was followed, to find maximum signal.
4) The average and peak voltages was recorded from the DSO.
5) Replace the EUT with mm-wave source to the RF input port of the instrumentation system.
6) The mm-wave source is unmodulated.
7) Adjust the amplitude of the mm-wave source such that the DSO indicates a voltage equal to the peak voltage recorded in step 4).
8) Without changing any settings, replace the DSO with the mm-wave power meter.
9) Measure and note the power.

Note: Spectrum analyzer was used instead of power meter when measuring power in step 8~9.

Far field distance (R_m)

$R_m = 2D^2 / \lambda$,

Where, D=the largest dimension of the antenna / λ=the wavelength of the emissions

Frequency Range(GHz)	λ (cm)	D (cm)	Rm (m)	Measurement Distance(m)
57.00 ~ 64.00	0.469	5.68	1.38	1.60

▣ Test Results: Comply

Peak e.i.r.p

Measurement distance(D)	Frequency (GHz)	ANT Pol	DSO Reading (mV)	Spectrum Analyzer Level(dBm)	Antenna Gain (dBi)	E (dBuV/m)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1.6 m	60.44	H	207	-45.96	24.44	102.48	1.86	33.00	31.14

Average e.i.r.p

Peak e.i.r.p	Duty cycle(%)	Pulse desensitization factor(dB)	Average e.i.r.p (dBm)	Limit (dBm)
1.86	1.16	-19.36	-17.50	13.00

Note.

1. Average e.i.r.p was determined form the peak e.i.r.p after correcting for the duty cycle.
   Please refer to the next page for transmit duty cycle.
2. Sample calculation.

$E = 126.8 – 20\log(\lambda) + P – G$

where

E is the field strength of the emission at the measurement distance, in dBμV/m

P is the power measured at the output of the test antenna, in dBm

λ is the wavelength of the emission under investigation [300/fMHz], in m

G is the gain of the test antenna, in dBi

$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$

where

EIRP is the equivalent isotropically radiated power, in dBm

E_{Meas} is the field strength of the emission at the measurement distance, in dBμV/m

d_{Meas} is the measurement distance, in m

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Maximum pulse duration

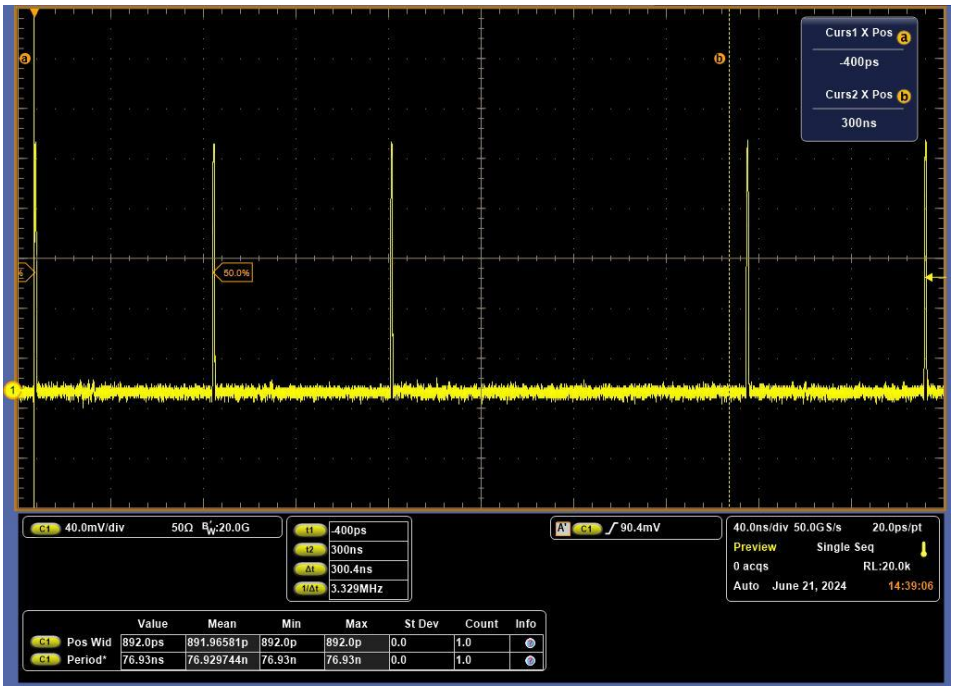
Maximum pulse duration (ns)	Limit (ns)
0.892	6

Pulse duration(ns)	Pulse Repetition Interval(ns)	Duty cycle(%)
0.892	76.93	1.16

Number of pulses in 0.3 us	Total pulse on time(ns) in 0.3us	Transmit duty cycle within 0.3us (%)	Limit (%)
3	2.676	0.892	10

Note: Total pulse on time(ns) in 0.3us = Maximum pulse duration(ns) x Number of pulses in 0.3 us
Transmit duty cycle within 0.3us (%) = Total pulse on time(ns) in 0.3us / 0.3us

Transmit duty cycle

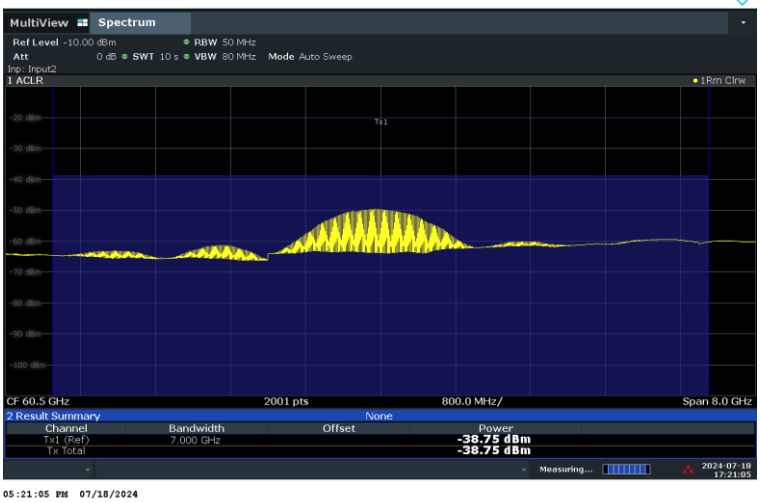


Average integrated EIRP within the frequency band 61.5 - 64.0 GHz and within 0.3us Calculation

Measurement		Note
Channel power full band (57 - 64 GHz)	-14.42 dBm	-
Channel power 61.5 – 64 GHz	-19.69 dBm	-
Difference	5.27 dBm	-
Average EIRP of EUT within 0.3us	-17.50 dBm	From RF detector measurement
Average EIRP of EUT within 0.3us and within 61.5 – 64 GHz	-22.77 dBm	Limit: 5dBm

Note: Difference = [Channel power full band (57 - 64 GHz)] – [Channel power 61.5 – 64 GHz]
Average EIRP of EUT within 0.3us and within 61.5 – 64 GHz = [Average EIRP of EUT within 0.3us] – [Difference]

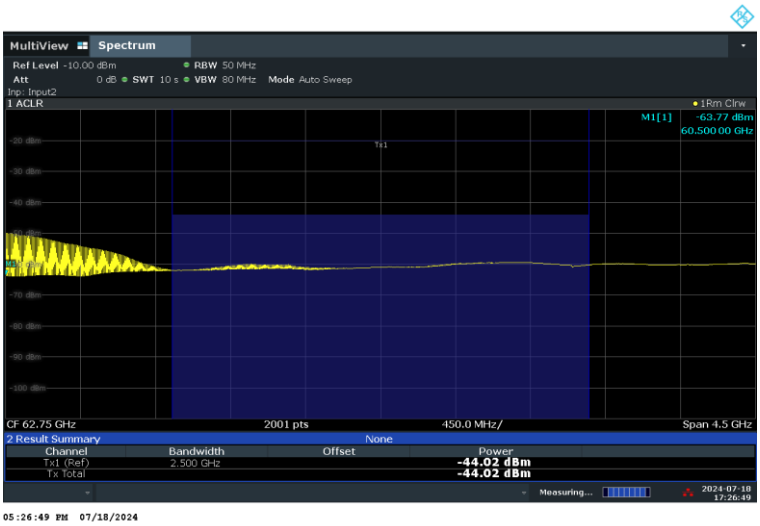
Channel power full band (57 - 64 GHz) **Measured Level**



Measurement distance(m)	Center Frequency (GHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)
1.6 m	60.50	H	-38.75	17.95	86.20	-14.42

Note: Please refer to the test note on page 19 for sample calculation.

Channel power 61.5 – 64 GHz **Measured Level**



Measurement distance(m)	Center Frequency (GHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)
1.6 m	62.75	H	-44.02	18.07	80.93	-19.69

8.3. Unwanted emissions

▣ Test Requirements and limit

FCC Part 15.255(d): Limits on spurious emissions

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

▪ **FCC Part 15.209(a):** the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 – 0.490	2 400/F (kHz)	300
0.490 – 1.705	2 4000/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 15.209(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.

▣ Test Configuration:

Refer to the APPENDIX I.

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▣ Test Procedure:

ANSI C63.10-2013 – Section 9.12 & 9.13

The following procedure was used for measurement of the radiated spurious emissions.

1) The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements at above 1 GHz, the table height is 1.5 m

2) The table was rotated 360 degrees to determine the position of the highest radiation.

3) During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 0.5 ~ 3 meter away from the interference-receiving antenna.

4) For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.

5) The antenna is a broadband antenna, and its 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.

6) 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 and the table was turned from 0 degrees to 360 degrees to find the maximum reading.

7) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

- Spectrum analyzer settings:

1. Frequency Range: Below 1GHz
RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak

2. Frequency Range: ≤ 40GHz
Peak Measurement
RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

Average Measurement> 1GHz
RBW = 1 MHz, VBW ≥ Reduce the video bandwidth until no significant variations in the displayed signal are observed in subsequent traces, provided the video bandwidth is no less than 1 Hz.
Detector = Peak, Sweep Time = Auto, Trace Mode = Max Hold until the trace stabilizes
Note: For pulsed emissions, the average measurement shall be determined from the peak field strength after correcting for the worst-case duty cycle.

Far field distance (R_m)

$R_m = 2D^2 / \lambda$,

Where, D=the largest dimension of the measurement antenna / λ=the wavelength of the emissions

Frequency Range(GHz)	λ (cm)	D(cm)	Rm (m)	Measurement Distance(m)
40 ~ 60	0.500	6.24	1.56	1.60
60 ~ 90	0.333	4.82	1.39	1.60
90 ~ 140	0.214	2.74	0.70	0.70
140 ~ 200	0.150	1.89	0.48	0.50

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▣ Test Results: Comply

Frequency Range: 9 kHz ~ 1 GHz
Test Note.

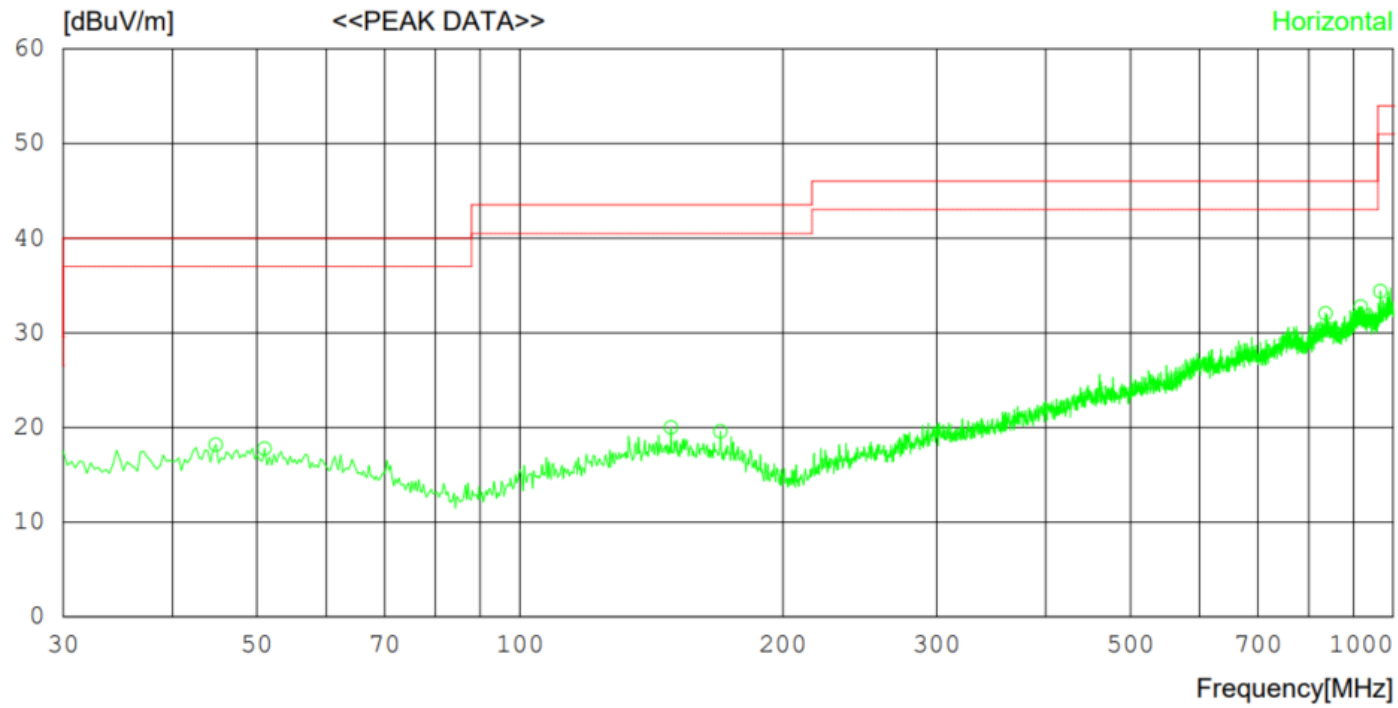
1. The worst case data was reported.
   Radiated emissions below 30 MHz below 30 MHz were greater than 20 dB below limit.
2. Information of DCF(Distance Correction Factor)
   For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.
   In this case, the distance factor is applied to the result.
   - Calculation of distance correction factor
   At frequencies below 30 MHz = 40 log(tested distance / specified distance)
   At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)
   When distance factor is "NA", the measurements were performed at the specified distance and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Measured Level + TF + Distance factor / TF = AF + CL – AG
   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain
4. * Noise floor.

Test Frequency: 60.44 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*44.87	H	PK	26.70	-8.53	NA	18.17	40.00	21.83
*51.02	H	PK	26.20	-8.44	NA	17.76	40.00	22.24
*148.99	H	PK	26.90	-6.90	NA	20.00	43.50	23.50
*169.68	H	PK	26.60	-7.01	NA	19.59	43.50	23.91
*836.04	H	PK	25.90	6.16	NA	32.06	46.00	13.94
*917.84	H	PK	25.20	7.58	NA	32.78	46.00	13.22
*966.66	H	PK	25.90	8.49	NA	34.39	54.00	19.61
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Worst data plot (Measured Level)

Tested frequency: 60.44 GHz
Y axis & Hor & Peak



Frequency Range: 1 ~ 40 GHz

Test Note.

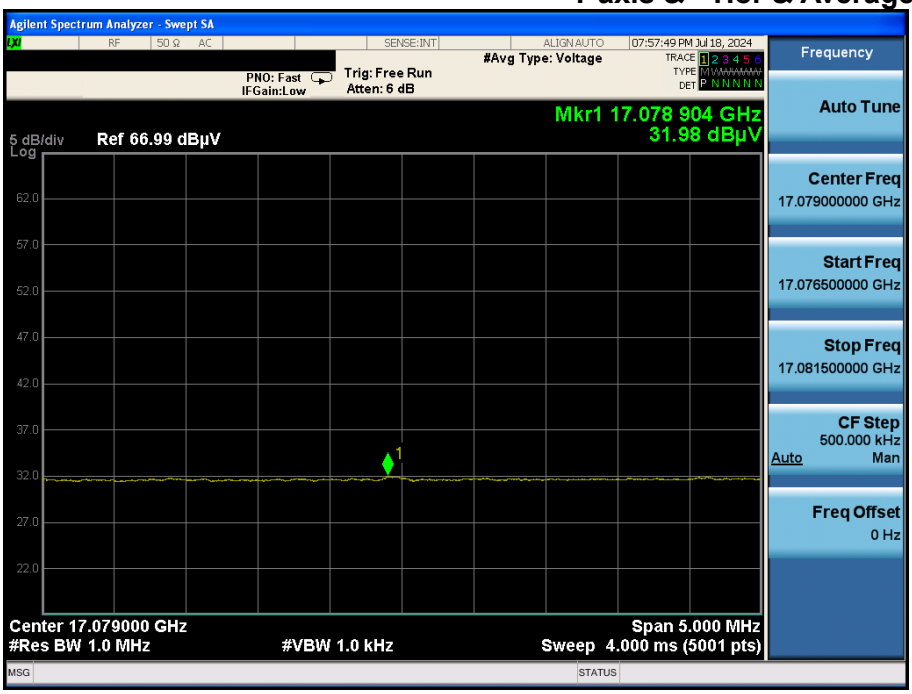
1. No other spurious and harmonic emissions were found above listed frequencies.
2. Information of DCF(Distance Factor)
   For finding emissions, the test distance might be reduced. In this case, the distance factor is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance)
   When distance factor is "N/A", the distance is 3 m and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Measured Level + TF + Distance factor / TF = AF + CL – AG
   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain
4. * Noise floor.

Tested Frequency: 60.59 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*15 199.00	H	PK	46.03	11.42	-	57.45	74.00	16.55
*15 201.11	H	AV	34.62	11.42	-	46.04	54.00	7.96
*16 360.00	H	PK	43.77	15.27	-	59.04	74.00	14.96
*16 359.86	H	AV	32.78	15.27	-	48.05	54.00	5.95
*17 079.00	H	PK	43.47	16.96	-	60.43	74.00	13.57
*17 078.90	H	AV	31.98	16.96	-	48.94	54.00	5.06

Worst data plot (Measured Level – Noise floor)

Tested frequency: 60.44 GHz
Y axis & Hor & Average



Frequency Range: 40 ~ 90 GHz

Test Note.

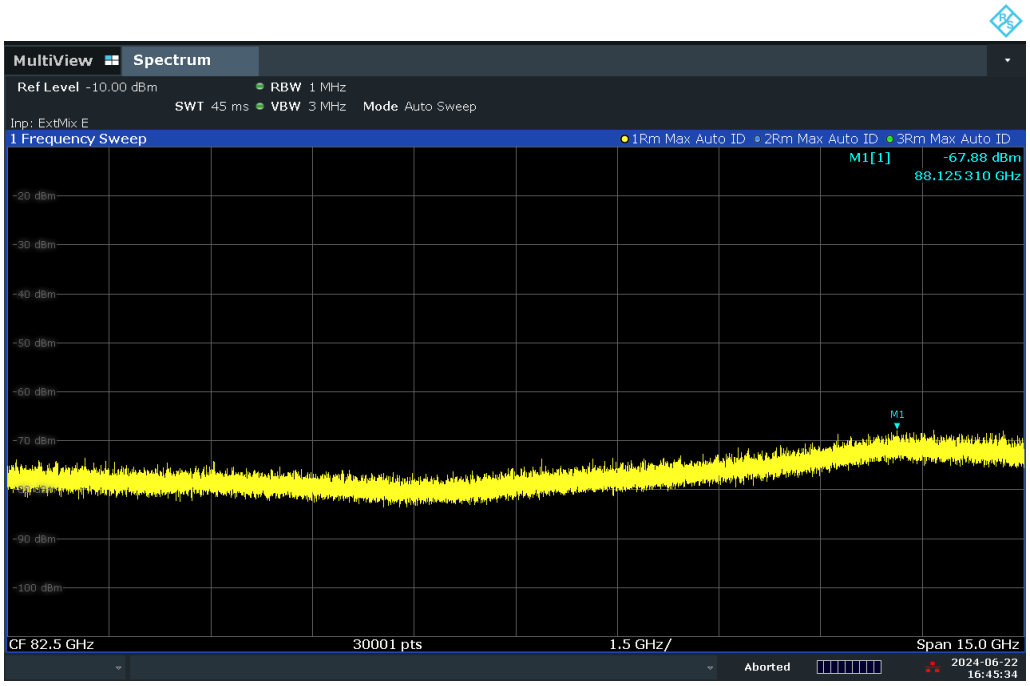
1. The radiated emissions were investigated up to 200GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Information of DCF(Distance Factor)
   For finding emissions, the test distance might be reduced. In this case, the distance factor is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance)
   When distance factor is "N/A", the distance is 3 m and distance factor is not applied.
3. Sample Calculation.
   E(dBuV/m) = Measured level (dBm) + 107 + TF(dB/m)
   where, E=field strength / TF(Total Factor) = Antenna Factor(dB/m) + Cable Loss(dB/m) + Attenuator Loss(dB) – Amplifier Gain(dB)
   EIRP(dBm) = E(dBuV/m) + 20log(D) - 104.7; where, D is measurement distance (in the far field region) in m.
   $PD = EIRP_{Linear} / 4\pi d^2$
   Where, PD = the power density at the distance specified by the limit, in W/m^2
   $EIRP_{Linear}$ = EIRP, in watts
   D = is the distance at which the power density limit is specified, in m
   If the mixer is used, mixer loss was applied to the measured level by SA correction factor.
4. * Noise floor.

Tested Frequency: 60.44 GHz

Measurement distance(m)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
1.6 m	*59 903.25	H	-73.30	13.43	47.13	-53.49	0.004	90.00
1.6 m	*88 125.31	H	-67.88	45.98	85.10	-15.52	24.805	90.00
-	-	-	-	-	-	-	-	-

Worst data plot (Measured Level – Noise floor)

Tested frequency: 60.440 0 GHz
Y axis & Hor



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Frequency Range: 90 ~ 200 GHz

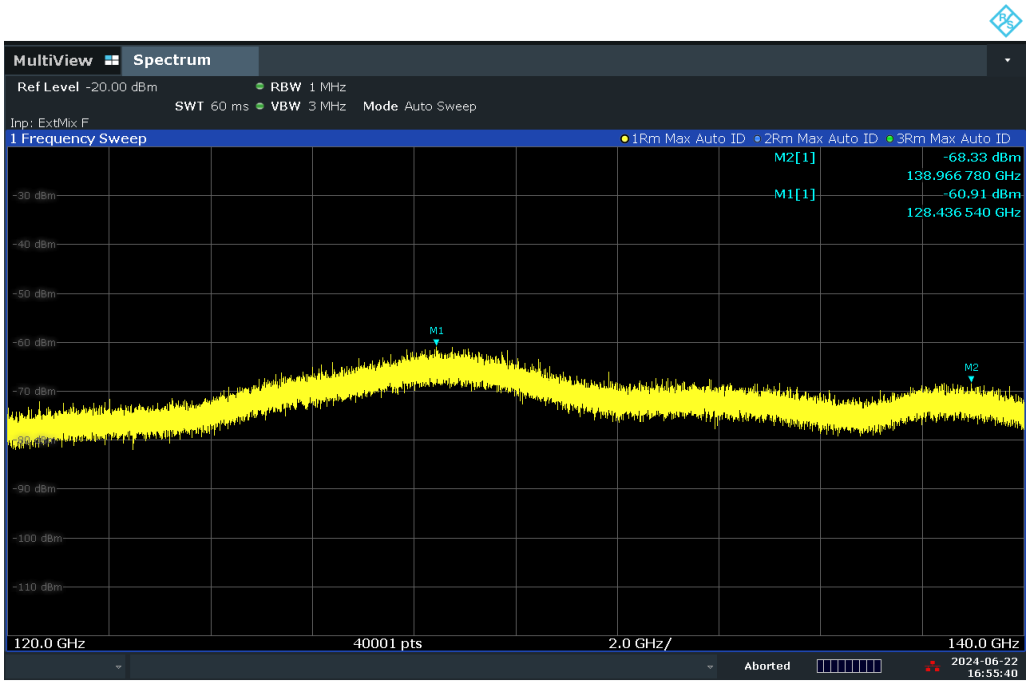
Test Note.

1. The radiated emissions were investigated up to 200GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Information of DCF(Distance Factor)
   For finding emissions, the test distance might be reduced. In this case, the distance factor is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance)
   When distance factor is "N/A", the distance is 3 m and distance factor is not applied.
3. Sample Calculation.
   E(dBuV/m) = Measured level (dBm) + 107 + TF(dB/m)
   where, E=field strength / TF(Total Factor) = Antenna Factor(dB/m) + Cable Loss(dB/m) + Attenuator Loss(dB) – Amplifier Gain(dB)
   EIRP(dBm) = E(dBuV/m) + 20log(D) - 104.7; where, D is measurement distance (in the far field region) in m.
   $PD = EIRP_{Linear} / 4\pi d^2$
   Where, PD = the power density at the distance specified by the limit, in W/m^2
   $EIRP_{Linear}$ = EIRP, in watts
   D = is the distance at which the power density limit is specified, in m
   If the mixer is used, mixer loss was applied to the measured level by SA correction factor.
4. * Noise floor.

Tested Frequency: 60.44 GHz

Measurement distance(m)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
0.70 m	*128 436.54	H	-60.91	47.87	93.96	-13.84	36.52	90.00
0.50 m	*191 531.89	H	-66.41	51.95	92.54	-18.18	13.44	90.00
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Worst data plot (Measured Level) **Tested frequency: 60.44 GHz Y axis & Hor**



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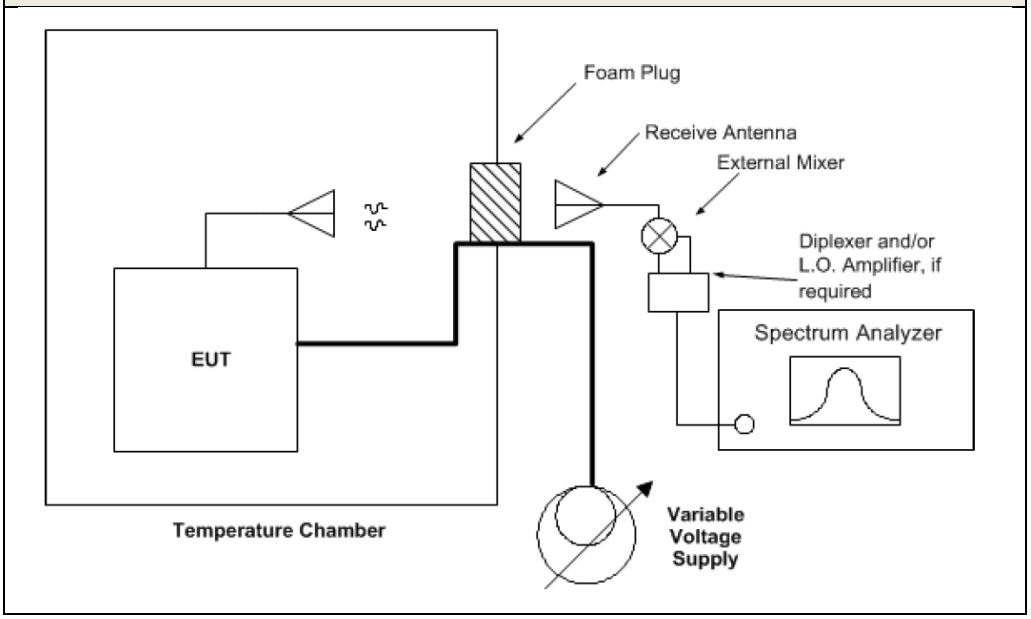
8.4. Frequency stability

▣ Test Requirements and limit

- **FCC Part 15.255(f):** Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85 % to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

▣ Test Configuration:

Frequency stability



▣ Test Procedure:

ANSI C63.10-2013 – Section 9.14

1) With the EUT at ambient temperature (approximately 25 °C) and voltage source set to the EUT nominal operating voltage (100 %), record the spectrum mask of the EUT emission on the spectrum analyzer.

2) Vary EUT power supply between 85% and 115% of nominal, and record the frequency excursion of the EUT emission mask.

3) Set the power supply to 100 % nominal setting, and raise EUT operating temperature to 50 °C. Record the frequency excursion of the EUT emission mask.

4) Repeat step 3) at each 10 °C increment down to −20 °C.

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▣ Test Results: Comply

VOLTAGE (%)	POWER (V DC)	TEMP (℃)	Measured low frequency(F_L)(GHz)	Measured high frequency(F_H)(GHz)
100%	12.00	+20(Ref)	60.024970	60.882780
100%		-30	60.021360	60.848320
100%		-20	60.017240	60.854220
100%		-10	60.014700	60.880370
100%		0	60.023910	60.846430
100%		+10	60.015540	60.880760
100%		+20	60.024970	60.882780
100%		+30	60.012580	60.864870
100%		+40	60.204070	60.877490
100%		+50	60.237210	60.860470
115%	13.80	+20	60.015070	60.868830
85%	10.20	+20	60.010720	60.823380

Note: The frequency stability was measured based on10dB bandwidth. And fundamental emission was contained within the frequency bands.

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8.5. AC line conducted emissions

▣ Test Requirements and limit, §15.207

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range (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

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

▣ Test Configuration:

See test photographs for the actual connections between EUT and support equipment.

▣ Test Procedure:

Conducted emissions from the EUT were measured according to the ANSI C63.10-2013.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

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▣ Test Results: Comply

AC Line Conducted Emissions (Graph) Tested Frequency: 60.44 GHz

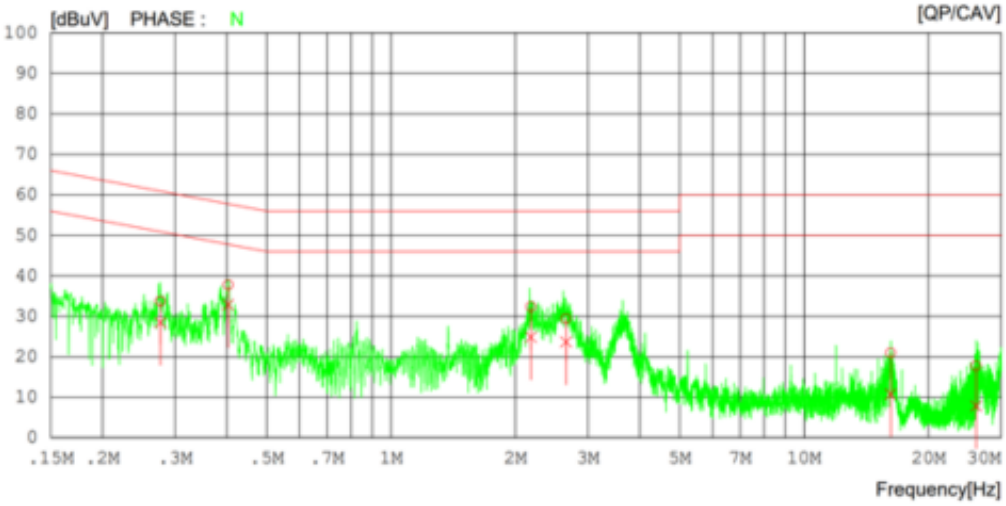
Results of Conducted Emission

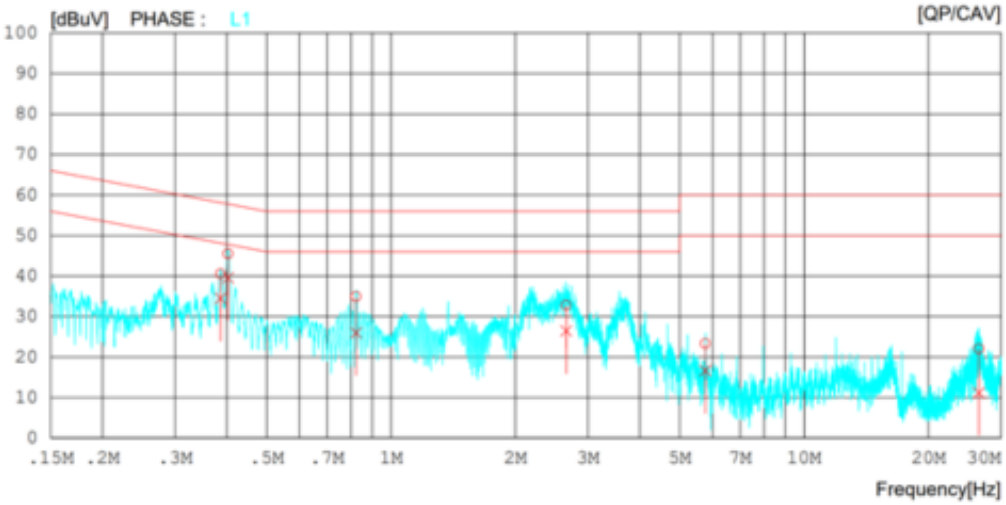
Date 2024-07-17

Order No.
Model Name CARDET-501
Temp/Humi/Atm 21 °C / 42%
Test Condition mmW

LIMIT : FCC P15.207 AV
FCC P15.207 QP

Lisn Factor
1. NSLK 8128 RC-387_N_23.10.26
2. NSLK 8128 RC-387_L1_23.10.26
Cable Loss
1. C1_LISN TO RECIVER_2023-12-11
Pulse Lmitter
1. PULSE LIMITER_ESH3-Z2_101333_2023.08.21





AC Line Conducted Emissions (List) Tested Frequency: 60.44 GHz

Results of Conducted Emission

Date 2024-07-17

Order No.
Model Name CARDET-501
Temp/Humi/Atm 21 °C / 42%
Test Condition mmW

LIMIT : FCC P15.207 AV
FCC P15.207 QP

Lisn Factor
1. NSLK 8128 RC-387_N_23.10.26
2. NSLK 8128 RC-387_L1_23.10.26
Cable Loss
1. C1_LISN TO RECIVER_2023-12-11
Pulse Lmitter
1. PULSE LIMITER_ESH3-Z2_101333_2023.08.21

NO	FREQ	READING		C.FACTOR	RESULT		LIMIT		MARGIN		PHASE
		QP	CAV		QP	CAV	QP	CAV	QP	CAV	
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.27640	23.72	18.48	9.99	33.71	28.47	60.92	50.92	27.21	22.45	N
2	0.40305	27.77	22.83	10.00	37.77	32.83	57.79	47.79	20.02	14.96	N
3	2.18000	22.29	14.82	10.06	32.35	24.88	56.00	46.00	23.65	21.12	N
4	2.65240	19.38	13.58	10.07	29.45	23.65	56.00	46.00	26.55	22.35	N
5	16.20200	10.44	0.21	10.54	20.98	10.75	60.00	50.00	39.02	39.25	N
6	26.09720	7.14	-2.73	10.60	17.74	7.87	60.00	50.00	42.26	42.13	N
7	0.38653	30.58	24.50	10.00	40.58	34.50	58.14	48.14	17.56	13.64	L1
8	0.40289	35.50	29.57	10.00	45.50	39.57	57.79	47.79	12.29	8.22	L1
9	0.82273	24.86	15.90	10.11	34.97	26.01	56.00	46.00	21.03	19.99	L1
10	2.65360	22.65	16.27	10.17	32.82	26.44	56.00	46.00	23.18	19.56	L1
11	5.76800	13.08	6.36	10.27	23.35	16.63	60.00	50.00	36.65	33.37	L1
12	26.49140	11.39	0.50	10.66	22.05	11.16	60.00	50.00	37.95	38.84	L1

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9. LIST OF TEST EQUIPMENT

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal. Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent	N9020A	23/12/15	24/12/15	MY50110097
Spectrum Analyzer	Rohde Schwarz	FSW85	23/06/23 24/06/14	24/06/23 25/06/14	101778
Thermohygrometer	XIAOMI	MHO-C201	23/12/15	24/12/15	00089675
Thermohygrometer	BODYCOM	BJ5478	23/12/15	24/12/15	120612-2
Multimeter	FLUKE	17B+	23/12/15	24/12/15	36390701WS
Signal Generator	Rohde Schwarz	SMBV100A	23/12/15	24/12/15	255571
Signal Generator	ANRITSU	MG3695C	23/12/15	24/12/15	173501
DC Power Supply	Agilent Technologies	6654A	23/06/23 24/06/05	24/06/23 25/06/05	MY40000801
DC Power Supply	SM techno	SDP30-5D	23/06/23 24/06/05	24/06/23 25/06/05	305DMG291
Loop Antenna	ETS-Lindgren	6502	23/11/09	24/11/09	00060496
Hybrid Antenna	Schwarzbeck	VULB 9160	23/12/15	24/12/15	3362
PreAmplifier	H.P	8447D	23/12/15	24/12/15	2944A07774
HORN ANT	ETS	3117	23/12/15	24/12/15	00140394
PreAmplifier	Agilent	8449B	23/12/15	24/12/15	3008A02108
HORN ANT	A.H.Systems	SAS-574	23/06/23 24/06/11	24/06/23 25/06/11	155
PreAmplifier	tsj	MLA-1840-J02-45	23/06/23 24/06/03	24/06/23 25/06/03	16966-10728
Horn Antenna	MI Wave	RX ANT-5 261U+410U	23/06/23 24/06/18	24/06/23 25/06/18	108
PreAmplifier	Norden Millimeter Inc.	NA4060G50N8P12	22/12/15	24/12/15	1003
Horn Antenna	MI Wave	RX ANT-6 261V+410V	23/06/23 24/06/18	24/06/23 25/06/18	110
PreAmplifier	ERAVABT	SBL-5037533550-151-E1-ET	23/12/15	24/12/15	10394-01
Horn Antenna	MI Wave	RX ANT-7 261E	23/06/23 24/06/18	24/06/23 25/06/18	112
PreAmplifier	Norden Millimeter Inc.	NN6090G40N5P-2	23/12/15	25/12/15	1001
Harmonic mixer	Rohde Schwarz	FS-Z90	23/06/23 24/06/14	24/06/23 25/06/14	101714
Horn Antenna	MI Wave	RX ANT-8 261F	23/06/23 24/06/18	24/06/23 25/06/18	114
Harmonic mixer	Rohde Schwarz	FS-Z140	23/06/23 24/06/14	24/06/23 25/06/14	101009
Horn Antenna	MI Wave	RX ANT-9 261G	23/06/23 24/06/18	24/06/23 25/06/18	116
Harmonic mixer	Rohde Schwarz	FS-Z220	23/06/23 24/06/14	24/06/23 25/06/14	101012
RF Detector	SAGE Millimeter	SFD-503753-15SF-P1	23/12/15	24/12/15	17841-01
Digital Phosphor	Tektronix	DPO2024B	23/12/15	24/12/15	C012114
Digital Phosphor	Tektronix	DPO72304SX	23/12/15	24/12/15	8320256
Level setting Attenuator	SAGE Millimeter	STA-30-15-M1	23/12/15	24/12/15	10390-01
Level setting Attenuator	SAGE Millimeter	STA-30-12-M3-2	23/12/15	24/12/15	10391-01
Temp & Humi Test Chamber	SJ Science	SJ-TH-S50	23/12/14	24/12/14	SJ-TH-S50-140205
Multiplier	OML, Inc.	S15MS	23/06/23 24/06/14	24/06/23 25/06/14	170821-1
EMI Test Receiver	ROHDE&SCHWARZ	ESCI7	24/01/29	25/01/29	100910
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	23/08/21	24/08/21	101333
LISN	SCHWARZBECK	NNLK 8128 RC	23/10/26	24/10/26	8128 RC-387
High-pass filter	Wainwright	WHKX12-935-1000-15000-40SS	23/12/15	24/12/15	7
High-pass filter	Wainwright	WHKX10-2838-3300-18000-60SS	23/12/15	24/12/15	2

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High-pass filter	Wainwright	WHKX6-6320-8000-26500-40CC	23/12/15	24/12/15	2
Cable	HUBER+SUHNER	SUCOFLEX100	24/01/03	25/01/03	M-1
Cable	HUBER+SUHNER	SUCOFLEX100	24/01/03	25/01/03	M-2
Cable	Junkosha	MWX241/B	24/01/03	25/01/03	M-3
Cable	Junkosha	MWX221	24/01/03	25/01/03	M-4
Cable	Junkosha	MWX221	24/01/03	25/01/03	M-5
Cable	JUNFLON	J12J101757-00	24/01/03	25/01/03	M-7
Cable	HUBER+SUHNER	SUCOFLEX104	24/01/03	25/01/03	M-8
Cable	HUBER+SUHNER	SUCOFLEX106	24/01/03	25/01/03	M-9
Cable	Junkosha	MWX315	24/01/03	25/01/03	M-10
Cable	DTNC	Cable	24/01/03	25/01/03	RFC-69
Cable	Junkosha	MWX241	24/01/03	25/01/03	mmW-1
Cable	Junkosha	MWX241	24/01/03	25/01/03	mmW-4
Cable	Junkosha	MWX261	24/01/03	25/01/03	mmW-6
Cable	Junkosha	MWX261	24/01/03	25/01/03	mmW-7
Cable	Junkosha	MWX261	24/01/03	25/01/03	mmW-15
Cable	SAGE MILLIMETER Inc	SCW-1M1M024-F1	24/01/03	25/01/03	mmW-10
Cable	HUBER+SUHNER	SUCOFLEX 104	24/01/03	25/01/03	mmW-8
Cable	HUBER+SUHNER	SUCOFLEX 104	24/01/03	25/01/03	mmW-9
Test Software	tsj	Radiated Emission Measurement	NA	NA	Version 2.00.0185
Test Software	tsj	Noise Terminal Measurement	NA	NA	Version 2.00.0190

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.
Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

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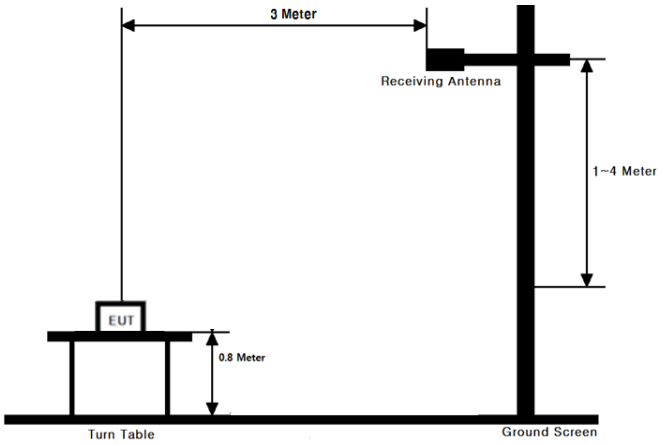
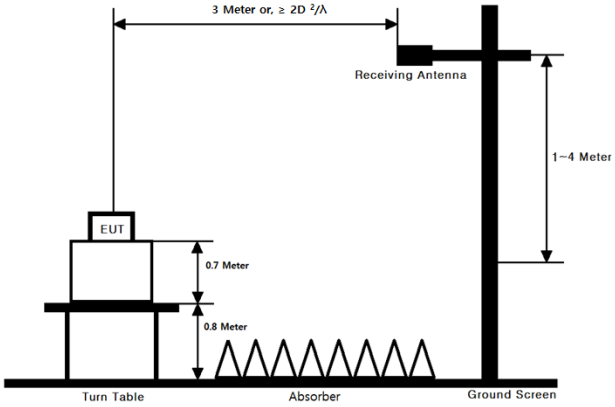
APPENDIX I

Test set up diagrams

Below 1GHz	Above 1GHz