TEST REPORT

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

1. Report No : DRTFCC2204-0082
2. Customer
   - Name : Smart Radar System, Inc.
   - Address : 3rd Floor, Fine Venture Bldg, 41, Seongnam-daero 925gil, Bundang-gu, Seongnam-si South Korea 13496
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Radar module / RM68-51
   FCC ID : 2AVKZRM68-51
5. Test Method Used : ANSI C63.10-2013
   Test Specification : Part 15.255
6. Date of Test : 2022.03.02 ~ 2022.04.08
7. Testing Environment : Refer to appended test report.
8. Testing Environment : See appended test report.
9. 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	Reviewed by
	Name : JaeHyeok Bang (Signature)	Name : JaeJin Lee (Signature)

2022 . 04 . 08 .

DT&C Co., Ltd.

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

Test Report Version

Test Report No.	Date	Description	Revised By	Reviewed By
DRTFCC2204-0082	Apr. 08, 2022	Initial issue	JaeHyeok Bang	JaeJin Lee

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1. EUT DESCRIPTION

FCC Equipment Class	DXX - Part 15 Low Power Communication Device Transmitter
Product	Radar module
Model Name	RM68-51
Add Model Name	-
Serial Number	A121F1600011
Power Supply	DC 5 V
Frequency Range	60 ~ 64 GHz
Max. RF Output Power (EIRP)	-4.63 dBm
Modulation Type	FMCW
Antenna Specification	**Antenna type**: Patch Antenna **Max Antenna gain**: 7.1 dBi

2. INFORMATION ABOUT TESTING

2.1. Transmitting configuration of EUT

Test Mode	Description	Test Frequency(GHz)
Sweep Stop	Lowest Frequency	60.00
	Middle Frequency	62.00
	Highest Frequency	64.00

Note: This device is swept frequency equipment. The sweep is stopped during the test in accordance with part 15.31(c).

2.2. Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
-	-	-	-	-
-	-	-	-	-

2.3. Tested environment

Temperature	:	21 ºC ~ 24 ºC
Relative humidity content	:	40 % ~ 45 %
Details of power supply	:	DC 5.0 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)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, k = 2)

3. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Status Note 1
15.255(e)(1)	6 dB Bandwidth	NA	Radiated	C
15.255(c)(3)	Peak EIRP, Peak Conducted Output power	< 10 dBm (Peak EIRP) < -10 dBm (Peak Conducted Output Power)		C Note2
15.255(d) 15.209	Radiated Spurious Emissions	Part 15.255(d), 15.209 (Refer to the section 8.3)		C Note2
15.255(f)	Frequency Stability	Within the 57 ~71 GHz band		C
15.207	AC Line Conducted Emissions	Part 15.207 limits (Refer to the section 8.3)	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.

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.

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 Part 2.948 according to ANSI C63.4-2014. **- FCC & IC 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

7.1 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 attached on the main PCB.

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

8. TEST RESULTS

8.1. 6dB Bandwidth

▣ Test Requirements and limit

Part 15.255(e)(1)

For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer.

▣ 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 = 100 kHz
3) VBW = 300 kHz
4) Sweep = auto.
5) Detector function = peak.
6) Trace = max hold. Allow the trace to stabilize.
7) Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure the specified dB down one side of the emission.
8) Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker- delta frequency reading at this point is the specified emission bandwidth.

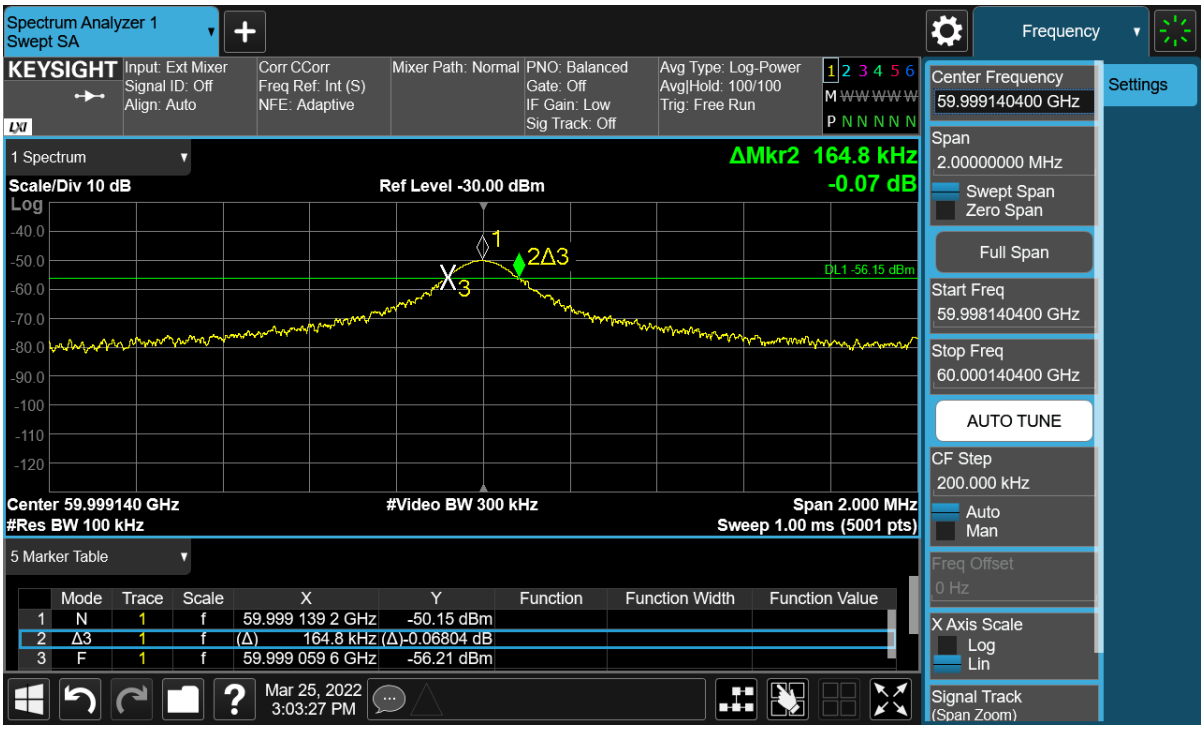
▣ Test Results: Comply

Test Mode	Frequency(GHz)	Test Results(MHz)
Sweep Stop	60.00	0.165
	62.00	0.175
	64.00	0.175
Sweep Enable	62.00	3 814.02

▣ Result plots

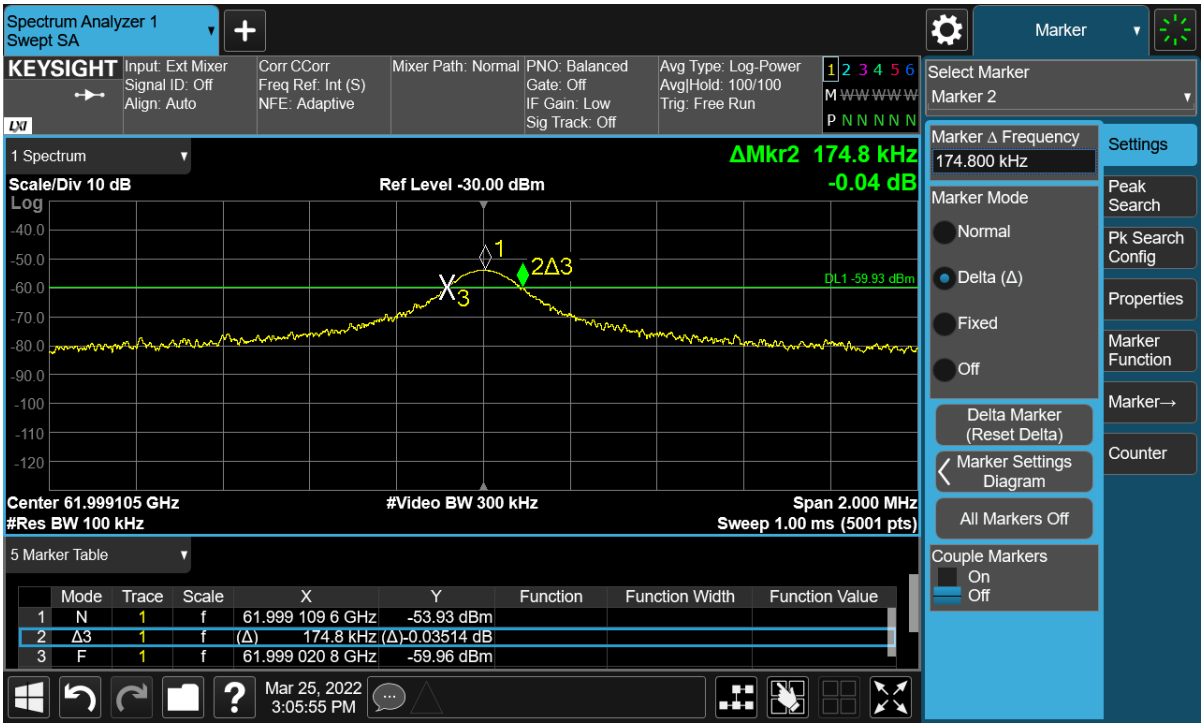
6 dB Bandwidth

Tested Frequency: 60.00 GHz



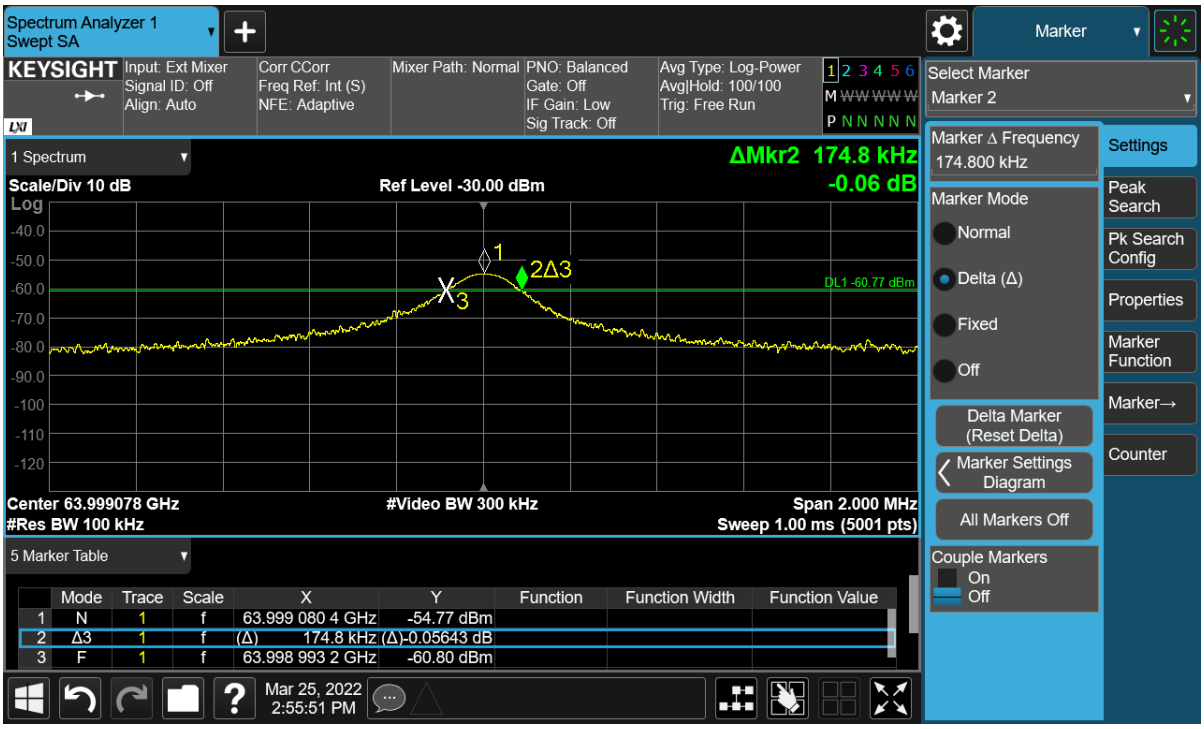
6 dB Bandwidth

Tested Frequency: 62.00 GHz



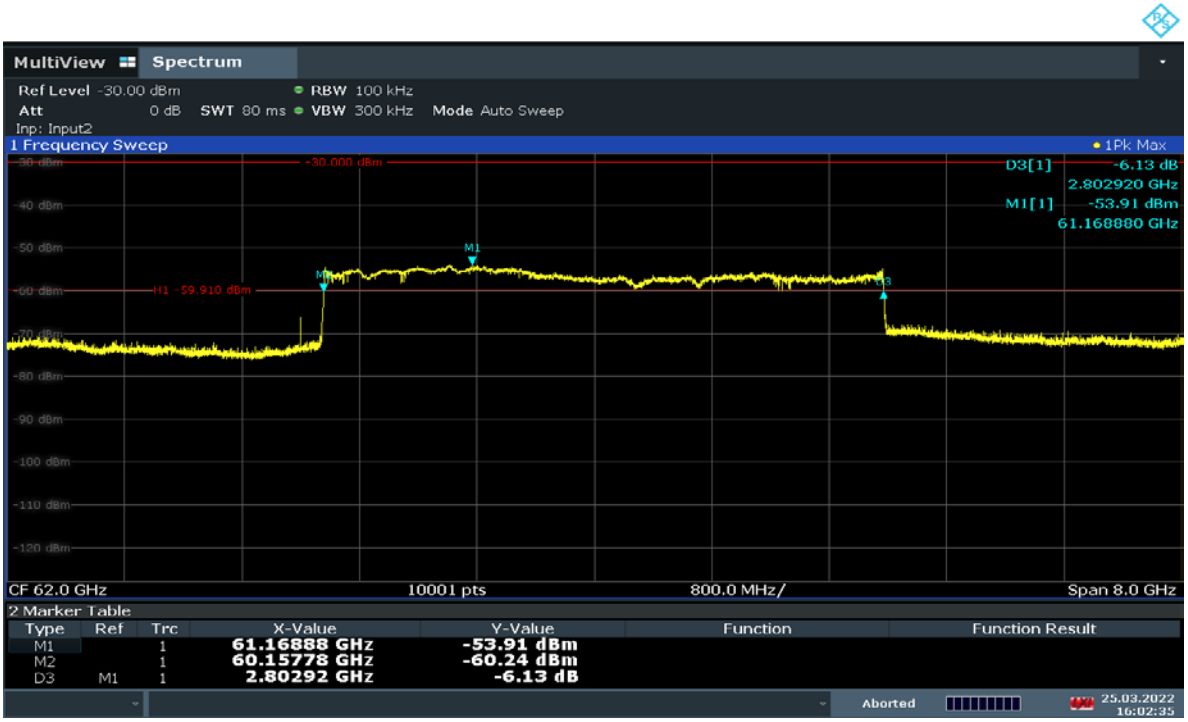
6 dB Bandwidth

Tested Frequency: 64.00 GHz



6 dB Bandwidth

Tested Frequency: 62.00 GHz (Sweep enable)



Note:
Result : M2 Frequency(60 157.78 MHz) – D3 Frequency(63 971.80) = 3 814.02 MHz

8.2. Peak EIRP & Peak Conducted Output Power

▣ Test Requirements and limit

FCC Part 15.255(c): Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

Part 15.255(C)(2): For fixed field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0-61.5 GHz band, measured during the transmit interval, but still within the 57-71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

Part 15.255(C)(3): For fixed field disturbance sensors other than those operating under the provisions of paragraph **(c)(2) of this section, and short-range devices for interactive motion sensing, the peak transmitter conducted output power shall not exceed −10 dBm and the peak EIRP level shall not exceed 10 dBm.**

▣ 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.

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)
60.0 ~ 64.0	0.469	5.68	1.38	2.00

▣ Test Results: Comply

Peak EIRP:

Measurement distance(D)	Frequency (GHz)	ANT Pol	DSO Reading (mV)	Power Meter Level(dBm)	Antenna Gain (dBi)	E (dBuV/m)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2 m	60.00	H	36.40	-55.49	24.98	92.35	-6.33	10.00	16.33
2 m	62.00	H	34.80	-55.32	25.07	92.72	-5.96	10.00	15.96
2 m	64.00	H	41.20	-54.09	25.24	94.05	-4.63	10.00	14.63

Note.

1. 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

Peak Conducted Output Power:

Frequency (GHz)	EIRP(dBm)	EUT Antenna Gain(dBi)	Conducted Output Power(dBm)	Limit (dBm)	Margin (dB)
60.00	-6.33	7.10	-13.43	-10.00	3.43
62.00	-5.96	7.10	-13.06	-10.00	3.06
64.00	-4.63	7.10	-11.73	-10.00	1.73

Note. Calculate the conducted output power (in watts) from the EIRP using Equation:

$P_{cond} = EIRP_{Linear} / G_{EUT}$

Where

P_{cond} is the conducted output power, in W

$EIRP_{Linear}$ is the equivalent isotropically radiated power, in W

G_{EUT} is numeric gain of the EUT radiating element (antenna)

8.3. Radiated spurious emissions

▣ Test Requirements and limit, §15.255(d), §15.209, §15.255(c)(2)

▪ **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.

▣ 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 1 GHz
RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak

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

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

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 ~ 50	0.60	6.20	1.28	1.60
50 ~ 70	0.43	5.70	1.52	1.60
70 ~ 90	0.33	4.60	1.27	1.60
90 ~ 140	0.21	2.60	0.63	1.00
140 ~ 200	0.15	1.90	0.48	1.00

▣ Test Results: Comply

Frequency Range: 9 kHz ~ 1 GHz
Sweep Stop & 62.00 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
43.28	V	QP	45.70	-7.79	NA	37.91	40.00	2.09
70.74	H	QP	42.30	-10.33	NA	31.97	40.00	8.03
71.71	V	QP	44.00	-10.44	NA	33.56	40.00	6.44
83.90	V	QP	48.40	-12.39	NA	36.01	40.00	3.99
84.32	H	QP	45.40	-12.40	NA	33.00	40.00	7.00
145.43	H	QP	44.70	-6.62	NA	38.08	43.50	5.42
147.03	V	QP	41.80	-6.56	NA	35.24	43.50	8.26

Note.

1. The worst case data was reported. No other spurious and harmonic emissions were found above listed frequencies.
2. Information of DCF(Distance Correction Factor)

   For finding emissions, the test distance might be reduced. In this case, the distance factor is applied to the result.

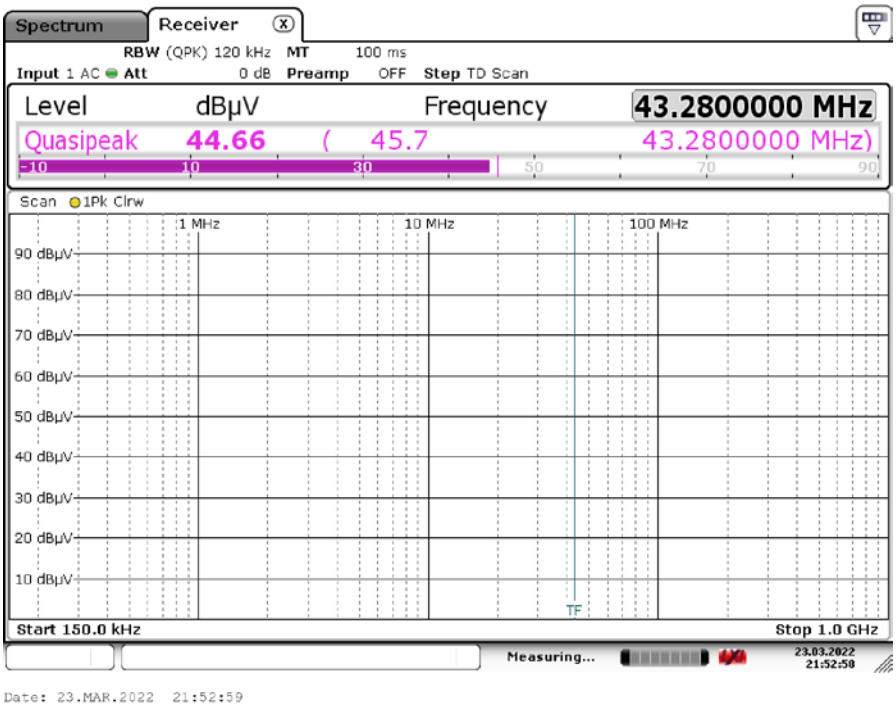
   - Calculation of distance factor = 20 log(applied distance / required distance)

   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 + DCF / TF = AF + CL – AG

   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

Worst data plot (Measured Level), Tested frequency: 60.00 GHz
X axis & Ver



Frequency Range: 1 ~ 40 GHz
Sweep Stop & Tested frequency: 60.00 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*12 063.83	H	PK	38.48	21.32	-6.02	53.78	74.00	20.22
*12 063.82	H	AV	27.12	21.32	-6.02	42.42	54.00	11.58
28 799.66	H	PK	50.63	9.40	-6.02	54.01	74.00	19.99
28 799.60	H	AV	48.33	9.40	-6.02	51.71	54.00	2.29
39 999.28	V	PK	49.73	15.97	-6.02	59.68	74.00	14.32
39 999.39	V	AV	42.55	15.97	-6.02	52.50	54.00	1.50
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Sweep Stop & Tested frequency: 62.00 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*10 309.34	Z	PK	39.15	18.21	-6.02	51.34	74.00	22.66
*10 309.34	Z	AV	27.30	18.21	-6.02	39.49	54.00	14.51
28 799.72	Z	PK	50.90	9.40	-6.02	54.28	74.00	19.72
28 799.61	Z	AV	48.30	9.40	-6.02	51.68	54.00	2.32
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

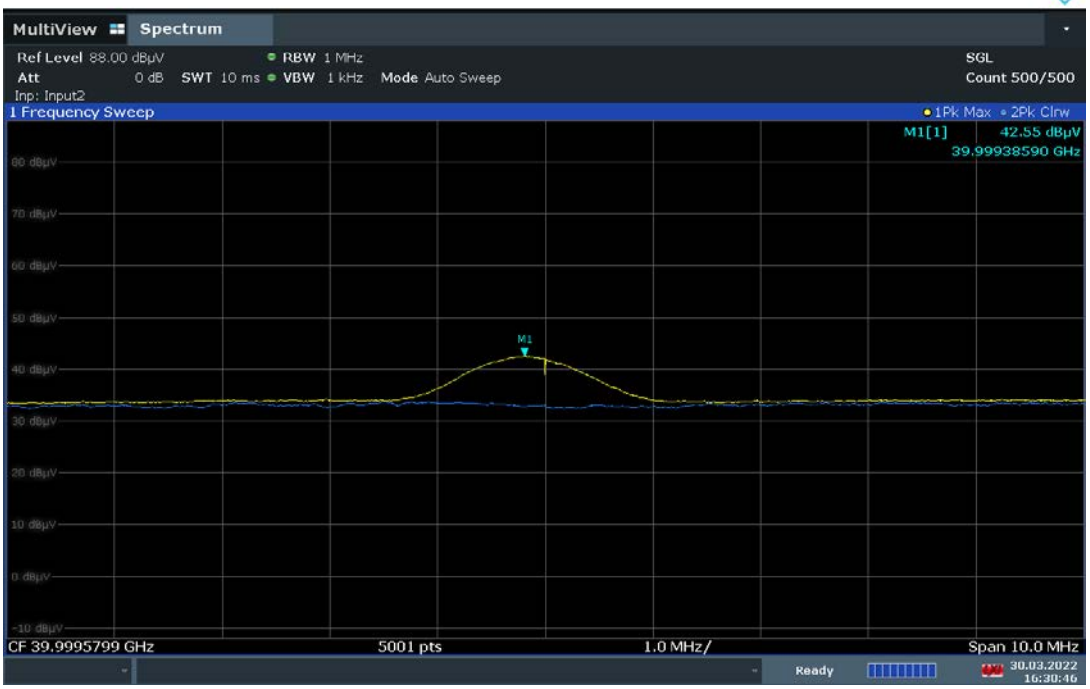
Sweep Stop & Tested frequency: 64.00 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
*16 187.13	H	PK	39.94	25.89	-6.02	59.81	74.00	14.19
*16 187.13	H	AV	28.08	25.89	-6.02	47.95	54.00	6.05
28 799.67	H	PK	50.79	9.40	-6.02	54.17	74.00	19.83
28 799.61	H	AV	48.15	9.40	-6.02	51.53	54.00	2.47
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Note.

1. No other spurious and harmonic emissions were found above listed frequencies.
2. Information of DCF(Distance Correction 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 + DCF / TF = AF + CL – AG
   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain
4. ***** Noise floor.

Worst data plot (Measured Level) **Tested frequency: 60.00 GHz**
Y axis & Ver



Frequency Range: 40 ~ 200 GHz
Sweep Stop & Tested frequency: 60.00 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	AFCLAG (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
1.0 m	*90 254.75	H	-65.18	47.62	89.44	-15.26	26.34	90.00
1.0 m	*130 022.55	H	-63.33	49.76	93.43	-11.27	66.00	90.00
1.0 m	*151 125.39	H	-66.56	51.52	91.96	-12.74	47.05	90.00
1.0 m	*160 614.09	H	-69.68	51.66	88.98	-15.72	23.69	90.00
1.0 m	*191 159.39	H	-70.82	52.06	88.24	-16.46	19.98	90.00

Sweep Stop & Tested frequency: 62.00 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	AFCLAG (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
1.0 m	*90 181.25	H	-65.77	47.61	88.84	-15.86	22.94	90.00
1.0 m	*130 087.35	H	-63.95	49.75	92.80	-11.90	57.09	90.00
1.0 m	*150 711.79	H	-67.13	51.50	91.37	-13.33	41.07	90.00
1.0 m	*171 876.78	H	-70.37	51.76	88.39	-16.31	20.68	90.00
1.0 m	*184 287.06	H	-70.41	51.96	88.55	-16.15	21.46	90.00

Sweep Stop & Tested frequency: 64.00 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	AFCLAG (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
1.0 m	*90 114.15	H	-65.20	47.59	89.39	-15.31	26.03	90.00
1.0 m	*130 314.95	H	-63.84	49.73	92.89	-11.81	58.28	90.00
1.0 m	*151 073.39	H	-67.09	51.51	91.42	-13.28	41.55	90.00
1.0 m	*171 884.98	H	-70.20	51.76	88.56	-16.14	21.51	90.00
1.0 m	*181 148.49	H	-71.11	51.86	87.75	-16.95	17.85	90.00

Note.

1. The radiated emissions were investigated up to 200GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Sample Calculation.

   E(dBuV/m) = Measured level (dBuV) + 107 + AFCLAG(dB/m)

   The mixer loss was applied to the measured level by SA correction factor.

   where, E=field strength / AFCLAG = Antenna Factor(dB/m) + Cable Loss(dB/m) – Amplifier Gain(dB)

   EIRP(dBm) = E(dBuV/m) + 20log(D) - 104.7; where, D is measurement distance (in the far field region) in m.

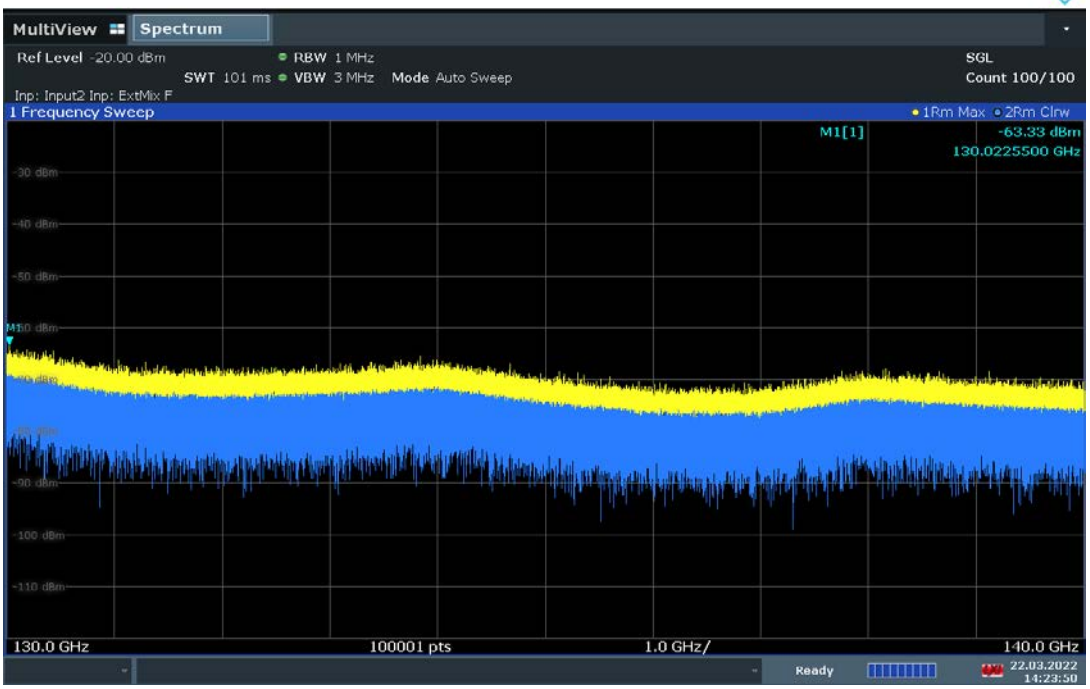
   $PD = EIRP_{Linear} / 4\pi d^2$

   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
3. ***** Noise floor

Worst data plot (Measured Level) **Tested frequency: 60.00 GHz**
Z axis & Hor



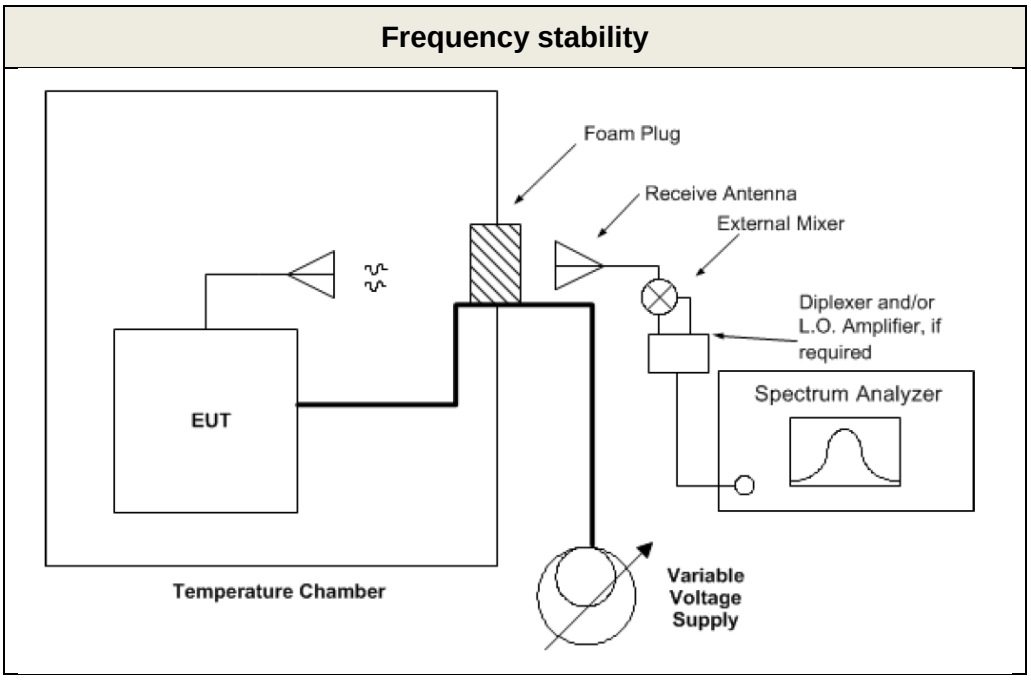
8.4. Frequency stability

▣ 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.

▣ **Test Results: Comply**

VOLTAGE (%)	POWER (V DC)	TEMP (℃)	Tested Frequency : 60.00 GHz	Tested Frequency : 64.00 GHz
			Measured low frequency(F_L)(GHz), 20dBC	Measured high frequency(F_L)(GHz), 20dBC
100%	5.00	+20(Ref)	59.998 928	63.999 266
100%		-30	59.998 939	63.999 287
100%		-20	59.998 923	63.999 296
100%		-10	59.998 939	63.999 279
100%		0	59.998 924	63.999 284
100%		+10	59.998 929	63.999 279
100%		+20	59.998 928	63.999 266
100%		+30	59.998 938	63.999 310
100%		+40	59.998 943	63.999 278
100%		+50	59.998 937	63.999 297
115%	5.75	+20	59.998 947	63.999 283
85%	4.25	+20	59.998 938	63.999 278

Note: Fundamental emissions were contained within the 57 ~ 71 GHz band.

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:

ANSI C63.10-2013 – Section 6.2

1) The EUT is placed on a wooden table 80 cm above the reference ground plane.
2) The EUT is connected via LISN to the test power supply.
3) The measurement results are obtained as described below:
4) Detectors – Quasi Peak and Average Detector.

▣ Test Results: Comply

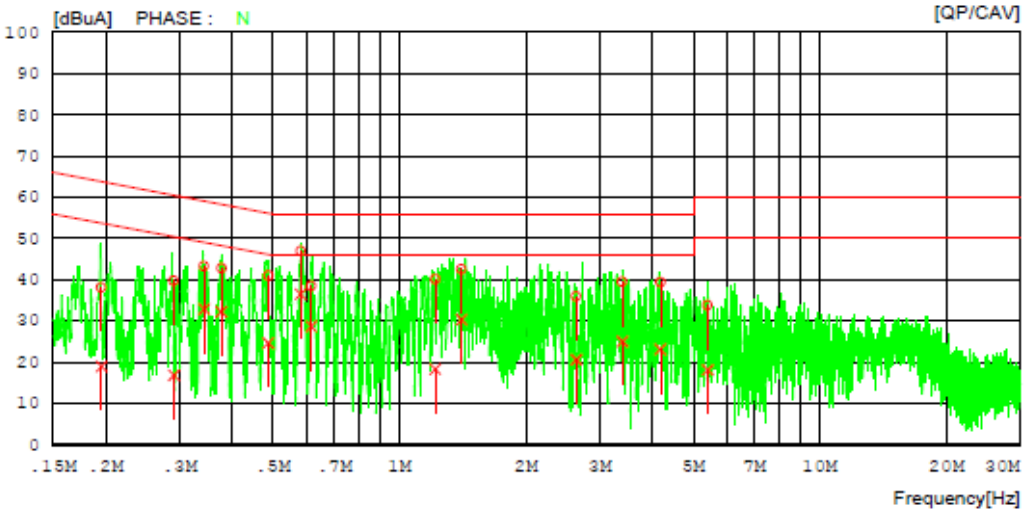
AC Line Conducted Emissions (Graph) Tested Frequency: 64.00 GHz

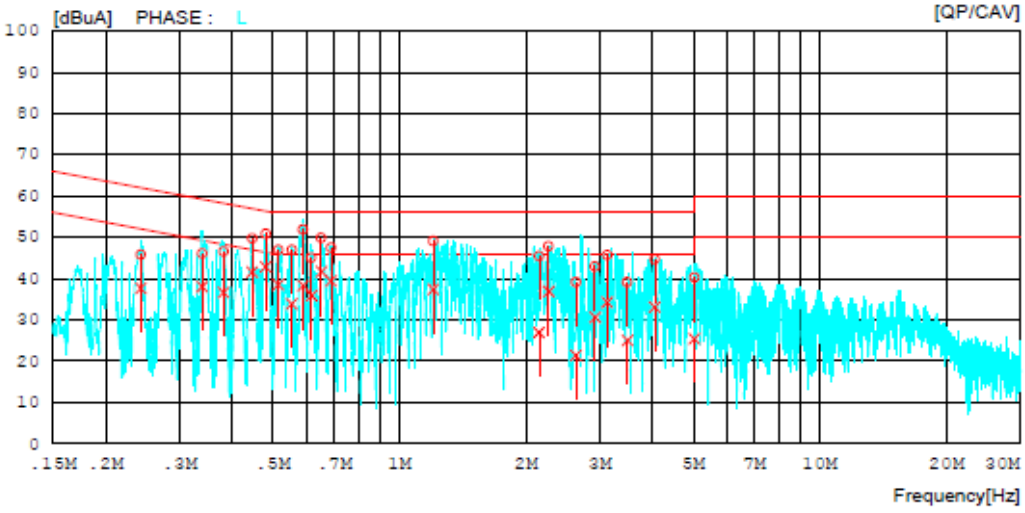
Results of Conducted Emission

DTNC Date 2022-04-08

Order No.	DTNC2203-01652	Referrence No.	
Model No.	RM68-51	Power Supply	
Serial No.		Temp/Humi.	22 'C / 43 %
Test Condition	FMCW	Operator	JaeHyeok Bang
Memo	64 GHz		

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





AC Line Conducted Emissions (List)

Tested Frequency: 64.00 GHz

Results of Conducted Emission

DTNC

Date 2022-04-08

Order No.	DTNC2203-01652	Referrence No.	
Model No.	RM68-51	Power Supply	
Serial No.		Temp/Humi.	22 'C / 43 %
Test Condition	FMCW	Operator	JaeHyeok Bang
Memo	64 GHz		

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

NO	FREQ	READING		C.FACTOR	RESULT		LIMIT		MARGIN		PHASE
		QP	CAV		QP	CAV	QP	CAV	QP	CAV	
	[MHz]	[dBuA]	[dBuA]	[dB]	[dBuA]	[dBuA]	[dBuA]	[dBuA]	[dBuA]	[dBuA]	
1	0.19527	28.16	9.02	10.00	38.16	19.02	63.81	53.81	25.65	34.79	N
2	0.29050	29.76	6.90	10.00	39.76	16.90	60.51	50.51	20.75	33.61	N
3	0.34277	33.36	22.89	10.00	43.36	32.89	59.14	49.14	15.78	16.25	N
4	0.37674	32.79	22.31	10.01	42.80	32.32	58.35	48.35	15.55	16.03	N
5	0.48717	31.05	14.72	10.01	41.06	24.73	56.22	46.22	15.16	21.49	N
6	0.58218	36.97	26.54	10.01	46.98	36.55	56.00	46.00	9.02	9.45	N
7	0.61662	28.55	18.68	10.01	38.56	28.69	56.00	46.00	17.44	17.31	N
8	1.21617	30.05	8.25	10.13	40.18	18.38	56.00	46.00	15.82	27.62	N
9	1.40335	32.45	20.25	10.14	42.59	30.39	56.00	46.00	13.41	15.61	N
10	2.63267	25.79	10.51	10.17	35.96	20.68	56.00	46.00	20.04	25.32	N
11	3.38896	29.31	14.91	10.18	39.49	25.09	56.00	46.00	16.51	20.91	N
12	4.17590	29.16	12.99	10.20	39.36	23.19	56.00	46.00	16.64	22.81	N
13	5.41140	23.61	7.95	10.22	33.83	18.17	60.00	50.00	26.17	31.83	N
14	0.24235	35.82	27.70	10.00	45.82	37.70	62.02	52.02	16.20	14.32	L
15	0.33943	36.04	28.00	10.00	46.04	38.00	59.22	49.22	13.18	11.22	L
16	0.38156	36.56	26.68	10.01	46.57	36.69	58.25	48.25	11.68	11.56	L
17	0.44614	39.75	31.59	10.01	49.76	41.60	56.95	46.95	7.19	5.35	L
18	0.48048	40.85	32.79	10.01	50.86	42.80	56.33	46.33	5.47	3.53	L
19	0.51500	36.96	28.56	10.01	46.97	38.57	56.00	46.00	9.03	7.43	L
20	0.55417	36.96	23.87	10.01	46.97	33.88	56.00	46.00	9.03	12.12	L
21	0.58942	41.87	28.26	10.01	51.88	38.27	56.00	46.00	4.12	7.73	L
22	0.61727	35.01	25.85	10.01	45.02	35.86	56.00	46.00	10.98	10.14	L
23	0.65197	39.81	31.65	10.01	49.82	41.66	56.00	46.00	6.18	4.34	L
24	0.68629	37.42	29.43	10.01	47.43	39.44	56.00	46.00	8.57	6.56	L
25	1.20303	38.97	27.21	10.13	49.10	37.34	56.00	46.00	6.90	8.66	L
26	2.14859	35.22	16.71	10.16	45.38	26.87	56.00	46.00	10.62	19.13	L
27	2.26496	37.71	26.76	10.16	47.87	36.92	56.00	46.00	8.13	9.08	L
28	2.62835	29.00	11.22	10.17	39.17	21.39	56.00	46.00	16.83	24.61	L
29	2.91872	32.72	20.34	10.18	42.90	30.52	56.00	46.00	13.10	15.48	L
30	3.12132	35.54	24.00	10.18	45.72	34.18	56.00	46.00	10.28	11.82	L
31	3.48753	28.88	14.83	10.18	39.06	25.01	56.00	46.00	16.94	20.99	L
32	4.04900	34.45	22.88	10.19	44.64	33.07	56.00	46.00	11.36	12.93	L
33	5.02582	30.04	15.18	10.21	40.25	25.39	60.00	50.00	19.75	24.61	L

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	21/06/24	22/06/24	US47360812
Spectrum Analyzer	Rohde Schwarz	FSW85	21/12/16	22/12/16	101530
Spectrum Analyzer	KEYSIGHT	N9030B	21/12/16	22/12/16	MY55480168
Thermohygrometer	XIAOMI	MHO-C201	21/12/16	22/12/16	00089675
Thermohygrometer	BODYCOM	BJ5478	21/12/16	22/12/16	120612-2
Loop Antenna	ETS-Lindgren	6502	21/01/28	23/01/28	00226186
BILOG ANTENNA	Schwarzbeck	VULB 9160	21/12/16	22/12/16	3362
HORN ANT	ETS	3117	21/12/16	22/12/16	00140394
HORN ANT	A.H.Systems	SAS-574	21/06/24	22/06/24	155
Horn Antenna	MI Wave	RX ANT-5 261U+410U	21/06/24	22/06/24	108
Horn Antenna	MI Wave	RX ANT-6 261V+410V	21/06/24	22/06/24	110
Horn Antenna	MI Wave	RX ANT-7 261E	21/06/24	22/06/24	112
Horn Antenna	MI Wave	261W-25/387	21/06/24	22/06/24	743
Horn Antenna	MI Wave	RX ANT-8 261F	21/06/24	22/06/24	114
Horn Antenna	MI Wave	RX ANT-9 261G	21/06/24	22/06/24	116
PreAmplifier	H.P	8447D	21/12/16	22/12/16	2944A07774
PreAmplifier	Agilent	8449B	21/06/24	22/06/24	3008A02108
PreAmplifier	tsj	MLA-1840-J02-45	21/06/24	22/06/24	16966-10728
*PreAmplifier	Norden Millimeter Inc.	NA4060G50N8P12	21/02/18	23/02/18	1003
PreAmplifier	ERAVABT	SBL-5037533550-151-E1-ET	22/02/11	23/02/11	10394-01
*PreAmplifier	Norden Millimeter Inc.	NN6090G40N5P-2	21/02/18	23/02/18	1001
Harmonic mixer	KEYSIGHT	M1971W	21/12/16	22/12/16	MY56390126
Harmonic mixer	Rohde Schwarz	FS-Z140	21/08/20	22/08/20	101009
*Harmonic mixer	Rohde Schwarz	FS-Z220	21/10/07	23/10/07	101012
RF Detector	Millitech	DET-15-RPFW0	21/12/03	23/12/03	3000
DIGITAL Phosphor OSCILLOSCOPE	Tektronix	DPO2024B	21/12/16	22/12/16	C012114
Power meter & Power sensor	Rohde Schwarz	NRP2, NRP110T	21/12/16	22/12/16	106060 101002
mmW Multiplier	OML, Inc.	S15MS	21/08/19	22/08/19	170821-1
DC Power Supply	SM techno	SDP30-5D	21/06/24	22/06/24	305DMG305
Multimeter	FLUKE	17B+	21/12/16	22/12/16	36390701WS
Temp & Humi Test Chamber	ESPEC	SH-641	21/12/14	22/12/14	92003317
EMI Receiver	ROHDE&SCHWARZ	ESU	21/11/12	22/11/12	100469
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	21/08/23	22/08/23	101333
LISN	SCHWARZBECK	NSLK 8128 RC	21/10/22	22/10/22	8128 RC-387
HYGROMETER	TESTO	608-H1	22/01/14	23/01/14	34862883
Cable	HUBER+SUHNER	SUCOFLEX100	22/01/04	23/01/04	M-01
Cable	HUBER+SUHNER	SUCOFLEX100	22/01/04	23/01/04	M-02
Cable	JUNFLON	MWX241	22/01/04	23/01/04	M-03
Cable	JUNFLON	MWX221	22/01/04	23/01/04	M-04
Cable	JUNFLON	MWX221	22/01/04	23/01/04	M-05
Cable	DTNC	Cable	22/01/04	23/01/04	M-06
Cable	JUNFLON	J12J101757-00	22/01/04	23/01/04	M-07
Cable	HUBER+SUHNER	SUCOFLEX106	22/01/04	23/01/04	M-08
Cable	HUBER+SUHNER	SUCOFLEX106	22/01/04	23/01/04	M-09

Cable	DT&C	Cable	22/01/04	23/01/04	RFC-69
Cable	Junkosha	MWX241	22/01/04	23/01/04	mmW-1
Cable	Junkosha	MWX241	22/01/04	23/01/04	mmW-4
Cable	HUBER+SUHNER	SUCOFLEX 104	22/01/04	23/01/04	mmW-8
Cable	HUBER+SUHNER	SUCOFLEX 104	22/01/04	23/01/04	mmW-9
Cable	SAGE MILLIMETER Inc	SCW-1M1M024-F1	22/01/04	23/01/04	mmW-10
Cable	TOTOKU	TCF219HSTU2000	22/01/04	23/01/04	mmW-15
Test Software	tsj	Radiated Emission Measurement	NA	NA	Version 2.00.0177
Test Software	tsj	Noise Terminal Measurement	NA	NA	Version 2.00.0170

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.

APPENDIX I

Test set up diagrams

Below 1GHz	Above 1GHz