RADIO TEST REPORT

Test Report No. : 12104474H-R2

Applicant	:	**KEYCOM CORPORATION**
Type of Equipment	:	**Imaging Radar**
Model No.	:	**RCS05**
FCC ID	:	**2AON3-RCS05**
Test regulation	:	**FCC Part 95 Subpart M: 2017**
Test Result	:	**Complied (Refer to SECTION 3.2)**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12104474H-R1. 12104474H-R1 is replaced with this report.

Date of test: October 2 to November 9, 2018

Representative test engineer:
Ryota Yamanaka
Engineer
Consumer Technology Division

Approved by:
Tsubasa Takayama
Leader
Consumer Technology Division

NVLAP TESTING
NVLAP LAB CODE: 200572-0

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☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 12104474H

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12104474H	December 13, 2018	-	-
1	12104474H-R1	February 26, 2019	P.1	Correction of Date of test of cover sheet
1	12104474H-R1	February 26, 2019	P.1	Addition of note No.8
1	12104474H-R1	February 26, 2019	P.4	Addition of note in SECTION 1.
1	12104474H-R1	February 26, 2019	P.4	Addition of a word to Receipt Date of Sample
1	12104474H-R1	February 26, 2019	P.5	Addition of notes from a) to d)
1	12104474H-R1	February 26, 2019	P.5	Addition of "Section 2.1046 to 2.1057" to Specification in the table of Clause 3.2
1	12104474H-R1	February 26, 2019	P.6	Addition of note in Clause 3.4
1	12104474H-R1	February 26, 2019	P.8	Addition of "Modulation characteristics" in Test Item of Clause 4.1
1	12104474H-R1	February 26, 2019	P.8	Correction of Configuration and peripherals of Clause 4.2
1	12104474H-R1	February 26, 2019	P.10	Correction of Test Distance of Radiated emission test in SECTION 5.
1	12104474H-R1	February 26, 2019	P.14	- Correction of RBW Correction Factor; From 10log to 20log - Correction of peak power value with modification of RBW Correction Factor; From 25.272 dB to 50.544 dB
1	12104474H-R1	February 26, 2019	P.14	Addition of the following sentence under the Radiated Power test data; The test method referred to KDB653005.
1	12104474H-R1	February 26, 2019	P.19	Deletion of note sentence under the Field strength of spurious radiation (above 40 GHz) test data
1	12104474H-R1	February 26, 2019	P.23	Correction of upper result value of 10.2 V in Frequency Stability test; From 76.676 GHz to 76.666 GHz
1	12104474H-R1	February 26, 2019	P.24	Correction of voltage of 20 deg. C; From DC 10.8 V to DC 10.2 V
1	12104474H-R1	February 26, 2019	P.27	Deletion of LIMS ID: 141806 and 141841 from Test Instruments
1	12104474H-R1	February 26, 2019	P.29	Replacement of setup photo for Field strength of spurious radiation.
2	12104474H-R2	April 9, 2019	P.4	Correction of Radio Specification in Clause 2.2
2	12104474H-R2	April 9, 2019	P.5	Correction of "Procedures and results" table in Clause 3.2
2	12104474H-R2	April 9, 2019	P.10	Correction of the description of [Test setup] 1 GHz - 10 GHz

CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	KEYCOM CORPORATION
Address	:	Otsuka Minami Bldg, 3-39-14, Minamiotsuka, Toshimaku, Tokyo , 170-0005, Japan
Telephone Number	:	+81-3-5950-3101
Facsimile Number	:	+81-3-5950-3380
Contact Person	:	HIROHIDE YAMASHITA

The information provided from the customer is as follows;
- Applicant, Type of Equipment, Model No. on the cover and other relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Imaging Radar
Model No.	:	RCS05
Serial No.	:	Refer to Section 4, Clause 4.2
Rating Voltage	:	DC 12.0 V
Receipt Date of Sample (Information from test lab.)	:	October 2, 2018
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: RCS05 (referred to as the EUT in this report) is a Imaging Radar.

Radio Specification

Radio Type	:	Transceiver
Frequency Band	:	76 GHz - 77 GHz
Frequency of Operation	:	76.5 GHz
Occupied frequency bandwidth	:	1 GHz
FCC Identifier	:	337MP0N
RF Output Power	:	Typ. 6 dBm (8 dBm to 4 dBm)
Modulation	:	Pulse modulation
Antenna Type	:	Internal Antenna
Antenna Connector	:	None (Internal Antenna)
Antenna Gain	:	35 dBi
EIRP	:	Typ. 41 dBm (43 dBm to 39 dBm)
Steerable Antenna	:	Mechanically (Both Transmitting & Receiving Part)
Usage location	:	Vehicle-mounted
Clock Frequency (maximum)	:	124.875 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 95 Subpart M
FCC Part 95 final revised on September 20, 2017

Title : FCC 47CFR Part95 - PERSONAL RADIO SERVICES
Subpart M - The 76-81 GHz Band Radar Service

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted emission	**FCC:** N/A	**FCC:** N/A	N/A	N/A	-
Occupied bandwidth	**FCC:** ANSI C63.26-2015 5.4 Occupied bandwidth	**FCC:** Section 2.1049	See data.	Complied a)	Radiated
Radiated Power Modulation characteristics	**FCC:** ANSI C63.26-2015 5.5 Radiated emissions testing ANSI C63.10-2013 6. Standard test methods 9. Procedures for testing millimeter-wave systems	**FCC:** Section 95.3367 Section 2.1046 Section 2.1047		Complied b)	Radiated
Field strength of spurious radiation	**FCC:** ANSI C63.26-2015 5.5 Radiated emissions testing	**FCC:** Section 95.3379 (a) Section 2.1053 Section 2.1057	5.58 dB 228.633 GHz	Complied c)	Radiated
Frequency stability	**FCC:** ANSI C63.26-2015 5.6 Frequency stability testing	**FCC:** Section 95.3379 (b) Section 2.1055	See data.	Complied d)	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

a) Refer to APPENDIX 1 (data of Occupied bandwidth)
b) Refer to APPENDIX 1 (data of Radiated Power and Modulation characteristics)
c) Refer to APPENDIX 1 (data of Field strength of spurious radiation)
d) Refer to APPENDIX 1 (data of Frequency Stability)

Symbols:
Complied The data of this test item has enough margin, more than the measurement uncertainty.
Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

* In case any questions arise about test procedure, ANSI C63.26-2015 and C63.10-2013 are also referred.

Supplied Voltage Information
The EUT provides the stable voltage constantly to RF Part regardless of input voltage.
DC power supply was used for the test.

Antenna Information
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.

3.3 Addition to standard

No addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

There is no applicable rule of uncertainty in this applied standard. Therefore, the following results are derived depending on whether or not laboratory uncertainty is applied.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k = 2$.

Ise EMC Lab.

Test distance	Radiated emission (+/-) 9 kHz - 30 MHz
3 m	3.3 dB
10 m	3.2 dB

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*) (+/-)		(10 m*) (+/-)	
	30 MHz - 200 MHz	200 MHz - 1000 MHz	30 MHz - 200 MHz	200 MHz - 1000 MHz
Horizontal	4.8 dB	5.2 dB	4.8 dB	5.0 dB
Vertical	4.9 dB	6.3 dB	4.9 dB	5.0 dB

Radiated emission (Above 1 GHz)				
(3 m*) (+/-)		(1 m*) (+/-)		(10 m*) (+/-)
1 GHz - 6 GHz	6 GHz - 18 GHz	10 GHz - 26.5 GHz	26.5 GHz - 40 GHz	1 GHz - 18 GHz
5.2 dB	5.5 dB	5.9 dB	5.9 dB	5.5 dB

*Measurement distance

Radiated emission (+/-)	
40 GHz - 50 GHz	4.1 dB
50 GHz - 75 GHz	5.5 dB
75 GHz - 110 GHz	5.8 dB
110 GHz - 170 GHz	5.0 dB
170 GHz - 260 GHz	5.0 dB

Radiated emission (+/-) With Block downconverter	
75 GHz - 83 GHz	4.6 dB

3.5 Test Location

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Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124
NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	-	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

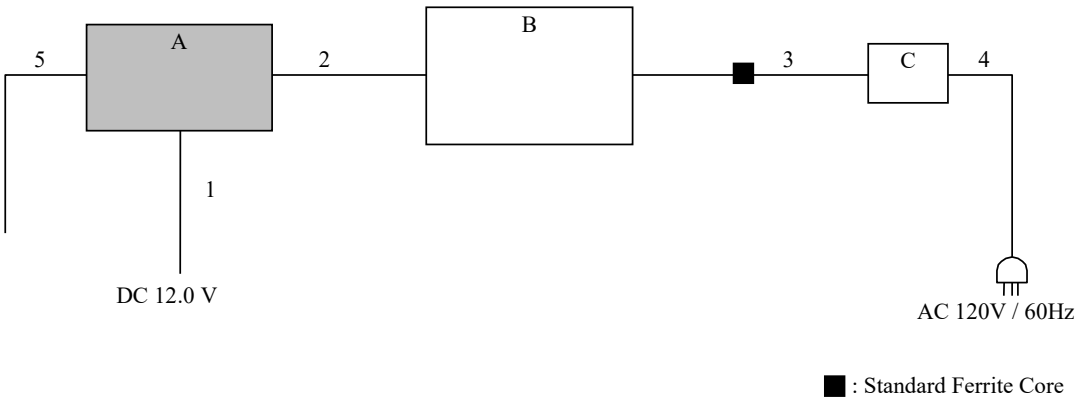
Refer to APPENDIX.

SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Mode	Test Item
Normal operating mode	Occupied bandwidth Radiated Power Modulation characteristics Field strength of spurious radiation Frequency stability
Power of the EUT was set by the software as follows; Power settings: Same as production model Software: Ver. 1.33 This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

4.2 Configuration and peripherals



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Imaging Radar	RCS05	14418F28-02	KEYCOM CORPORATION	EUT
B	Laptop PC	CF-N8HWCDP5	9LKSA04L58	Panasonic	-
C	AC Adapter	CF-AA63720	6372BM409X1490B	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	USB Cable	1.4	Shielded	Shielded	-
3	DC Cable	1.0	Unshielded	Unshielded	-
4	AC Cable	0.8	Unshielded	Unshielded	-
5	Coaxial Cable	0.5	Shielded	Shielded	-

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz, up to 40 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 1.5 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 m and 4 m (frequency range 9 kHz – 30 MHz: loop antenna was fixed height at 1.0 m) and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear voltage average mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

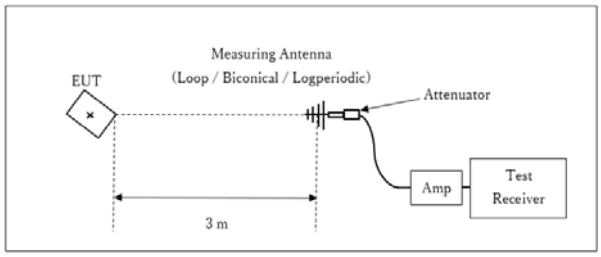
Frequency	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

Frequency	9 kHz to 150 kHz	150 kHz to 30 MHz	30 MHz to 1 GHz	1 GHz to 40 GHz	
Instrument used	Test Receiver	Test Receiver	Test Receiver	Spectrum Analyzer	
Detector	CISPR QP, Average	CISPR QP, Average	CISPR QP	Peak	Average *1)
IF Bandwidth	200 Hz	9 kHz	120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 3 MHz

*1) An RMS average mode was used: 1 ms or less averaging time (integration time period for each spectrum analyzer bin; spectrum analyzer sweeptime / number-of-bins not exceeding one millisecond)

[Test setup]

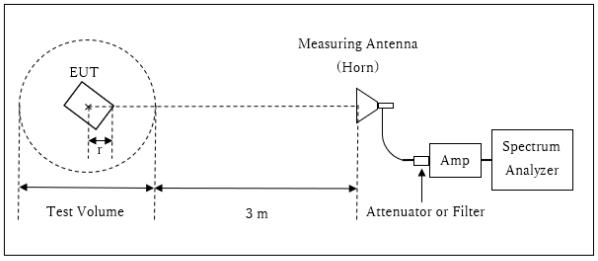
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

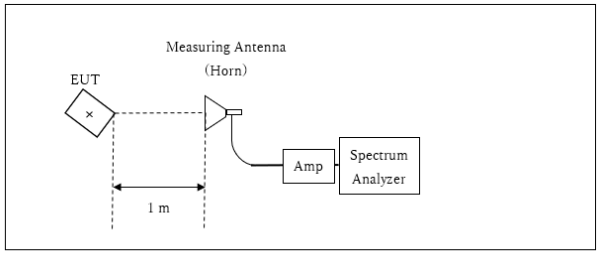
× : Center of turn table

Distance Factor: 20 x log (4.0 m*/3.0 m) = 2.5 dB
* Test Distance: (3 + Test Volume /2) - r = 4.0 m

Test Volume: 2 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.0 m

* The test was performed with r = 0.0 m since that yielded the worst emission levels from the EUT.

10 GHz - 40 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m* / 3.0 m) = -9.54 dB
*Test Distance: 1 m

[Above 40 GHz]
The test was performed based on "Procedures for testing millimeter-wave systems" of ANSI C63.10-2013. The EUT was placed on a urethane platform, raised 1.5 m above the conducting ground plane. The measurements were performed on handheld method.

Set spectrum analyzer RBW, VBW, span, etc., to the proper values. Note these values. Enable two traces—one set to "clear write," and the other set to "max hold." Begin hand-held measurements with the test antenna (horn) at a distance of 1 m from the EUT in a horizontally polarized position. Slowly adjust its position, entirely covering the plane 1 m from the EUT. Observation of the two active traces on the spectrum analyzer will allow refined horn positioning at the point(s) of maximum field intensity. Repeat with the horn in a vertically polarized position. If the emission cannot be detected at 1 m, reduce the RBW to increase system sensitivity. Note the value. If the emission still cannot be detected, move the horn closer to the EUT, noting the distance at which a measurement is made.

Note the maximum level indicated on the spectrum analyzer. Adjust this level, if necessary, by the antenna gain, conversion loss of the external mixer and gain of LNA used, at the frequency under investigation. Calculate the field strength of the emission at the measurement distance from the Friis' transmission equation.

Frequency	40 GHz to 50 GHz	50 GHz to 76 GHz	77 GHz to 83 GHz	83 GHz to 110 GHz	110 GHz to 170 GHz	170 GHz to 231 GHz
Final measurement distance with 1 MHz Peak detector	1.0 m	1.0 m	1.0 m	1.0 m	0.02 m	0.02 m

[About fundamental measurement]
The carrier levels were confirmed at maximum direction of transmission. The maximum direction was searched under carefully since beam-widths are extremely narrow.

The carrier levels were measured in the far field. The distance of the far field was calculated from follow equation.

$$r = \frac{2D^2}{\lambda}$$

where

r is the distance from the radiating element of the EUT to the edge of the far field, in m
D is the largest dimension of both the radiating element and the test antenna (horn), in m
(The antenna aperture size of test antenna was used for this caluculation.)
Lambda is the wavelength of the emission under investigation [300/f (MHz)], in m

Frequency	Wavelength	Maximum Dimention			Far Field Boundary
		EUT	Test Antenna	Maximum	
	Lambda			*D*	*r*
[GHz]	[mm]	[m]	[m]	[m]	[m]
76.5	3.9	0.088000	0.026162	0.088000	3.950

The test was made on EUT at the normal use position.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 9 kHz - 231 GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: Frequency Stability

Test Procedure
The block downconverter was placed in side of the temperature chamber's drain hole.

The power supply was set to nominal operating voltage (100 %), and the spectrum mask was measured at 20 deg. C. After that, EUT power supply was varied between 85 % and 115 % of nominal voltage and the frequency excursion of the EUT emission mask was recorded.

The EUT operating temperature was raised to 50 deg. C, and the frequency excursion of the EUT emission mask was recorded. Measurements were repeated at each 10 deg. C decrement down to –20 deg. C.

Both lower and upper frequencies of the 99 % OBW were recorded.

Test data : APPENDIX
Test result : Pass

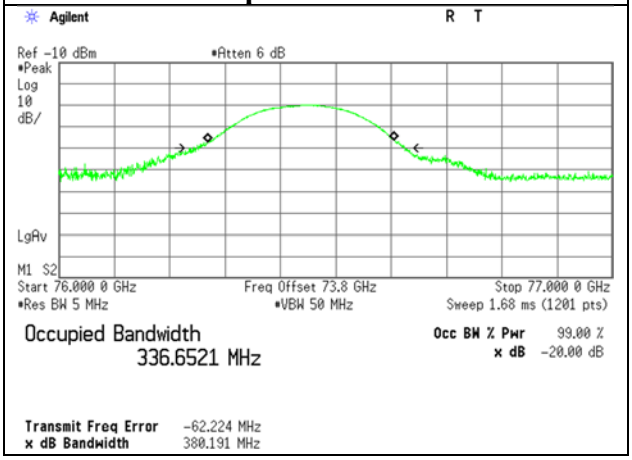
APPENDIX 1: Test data

Occupied bandwidth

Report No.	12104474H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	November 6, 2018
Temperature / Humidity	22 deg. C / 50 % RH
Engineer	Ryota Yamanaka
Mode	Normal operating mode

Frequency [GHz]	99 % Occupied bandwidth [MHz]
76.5	336.6521

Occupied bandwidth



The measurement was performed with Peak detector and Max Hold since the duty cycle was not 100 %.

Radiated Power

Report No.	12104474H
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Date	November 7, 2018
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Ryota Yamanaka
Mode	Normal operating mode

Measured data in Test modes

Mode	Power	Freq. [GHz]	Measured Power [dBm]	Tested Distance [m]	Rx Antenna Gain [dBi]	Down Converter Gain [dB]	IF Cable Loss [dB]	FSL [dB]	EIRP [dBm]	EIRP [mW]
Spectrum	Average	76.5	-36.19	3.95	22.33	14.80	1.42	82.05	10.15	10.34
Analyzer	Peak	76.5	-55.48	3.95	22.33	14.80	1.42	82.05	-9.14	0.12

Calculating formula:

FSL (Free Space path Loss) = 10 * log10((4 * Pi * Tested Distance / Lambda) ^2)

EIRP = Measured Power - Rx Antenna Gain - Down Converter Gain + IF Cable Loss + FSL

These calculation results are same as results which were calculated with formulas described in the Section 9 of ANSI C63.10-2013.

Final result in Normal operation mode

	Spectrum Analyzer [dBm]	Duty Factor [dB]	EIRP Result [mW]	EIRP Result [dBm]	Limit [dBm]	Margin [dB]
Average power	10.15	23.565	2350.68	33.71	50	16.29
Peak power	-9.14	-	0.12	-9.14	55	64.14

Reference data of peak power.

	Spectrum Analyzer [dBm]	OBW [MHz]	RBW Correction Factor *1 [dB]	EIRP Result [mW]	EIRP Result [dBm]	Limit [dBm]	Margin [dB]
Peak power	-9.14	336.652	50.544	13805.65	41.40	55	13.60

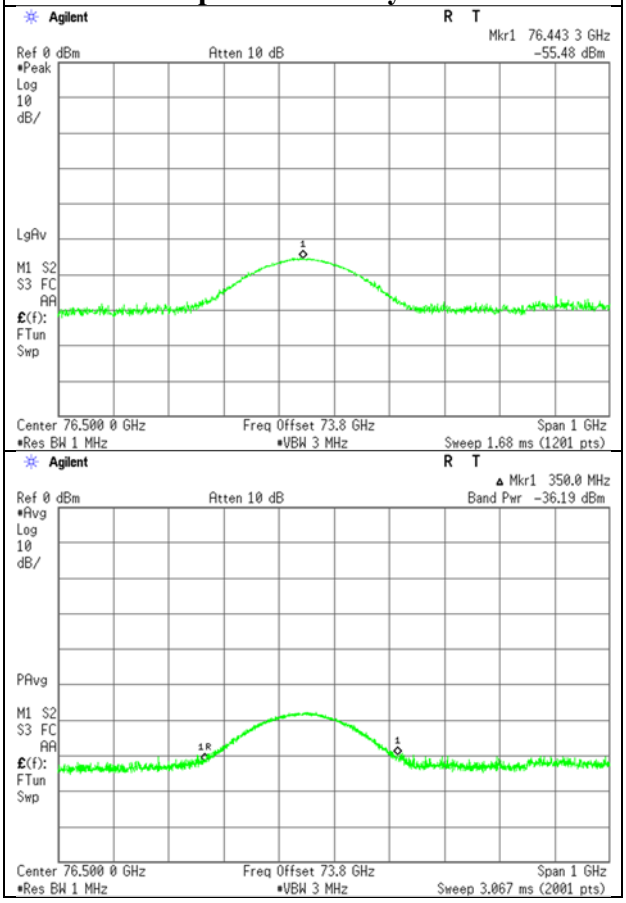
*1 RBW Correction Factor = 20log * (OBW)

For the peak power result, it is a maximum power.
The test method referred to KDB653005.

Radiated Power

Report No.	12104474H
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Date	November 7, 2018
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Ryota Yamanaka
Mode	Normal operating mode

Spectrum Analyzer



Modulation characteristics

Report No.	12104474H
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Date	November 7, 2018
Temperature / Humidity	23 deg. C / 50 % RH
Engineer	Ryota Yamanaka
Mode	Normal operating mode

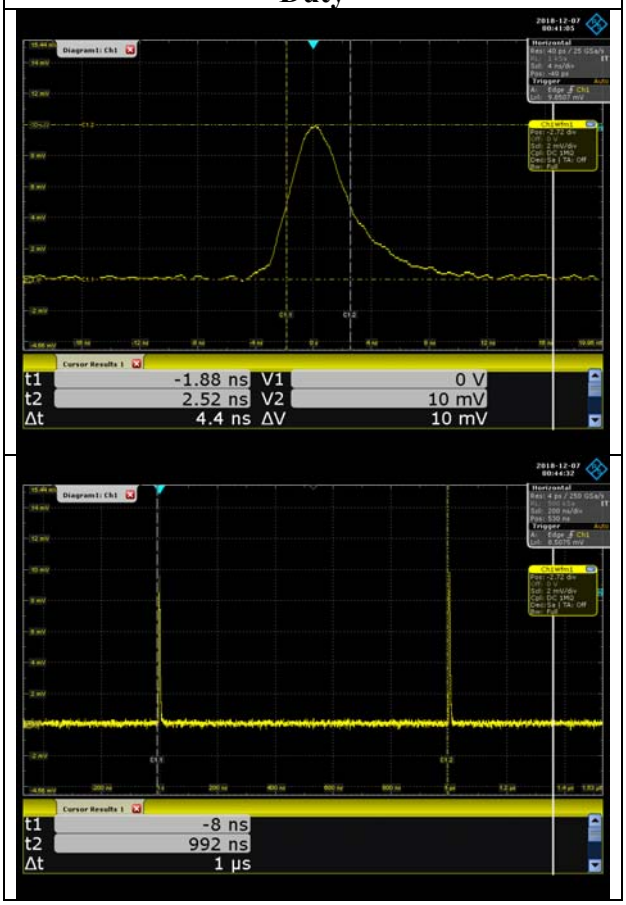
[Duty Factor]

	Tx On time [µs]	Tx On + Off time [µs]	Duty factor [dB]
Measured	0.0044	1.000	-23.565
Declared *	0.005	1.000	-23.010

Duty factor = 10 * log (Tx On time / Tx On + Off time)
* See the application document.

[Data]

Duty



* This Duty Cycle is the worst case. Transmitting time does not exceed it.

Field strength of spurious radiation

Report No.	12104474H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	October 2, 2018	October 3, 2018	October 29, 2018
Temperature / Humidity	23 deg. C / 51 % RH	23 deg. C / 48 % RH	22 deg. C / 55 % RH
Engineer	Ryota Yamanaka	Junki Nagatomi	Ryota Yamanaka
	(1 GHz - 40 GHz)	(9 kHz - 30 MHz)	(30 MHz - 1 GHz)
Mode	Normal operating mode		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	168.882	QP	33.0	15.8	8.9	32.0	25.7	43.5	17.8	
Hori	295.610	QP	42.9	13.5	9.9	32.0	34.3	46.0	11.7	
Hori	499.501	QP	33.2	18.1	11.3	32.0	30.6	46.0	15.4	
Hori	528.000	QP	35.3	17.9	11.4	32.1	32.5	46.0	13.5	
Hori	624.000	QP	31.4	19.6	11.9	32.1	30.8	46.0	15.2	
Hori	874.122	QP	34.1	22.1	13.1	31.3	38.0	46.0	8.0	
Hori	12750.050	PK	49.2	38.9	-3.2	33.3	51.6	73.9	22.3	
Hori	12750.050	AV	45.0	38.9	-3.2	33.3	47.4	53.9	6.5	
Vert	168.882	QP	35.6	15.8	8.9	32.0	28.3	43.5	15.2	
Vert	299.311	QP	42.3	13.5	10.0	32.0	33.8	46.0	12.2	
Vert	499.500	QP	32.9	18.1	11.3	32.0	30.3	46.0	15.7	
Vert	528.000	QP	31.0	17.9	11.4	32.1	28.2	46.0	17.8	
Vert	624.000	QP	30.1	19.6	11.9	32.1	29.5	46.0	16.5	
Vert	874.122	QP	34.5	22.1	13.1	31.3	38.4	46.0	7.6	
Vert	12750.050	PK	46.9	38.9	-3.2	33.3	49.3	73.9	24.6	
Vert	12750.050	AV	40.2	38.9	-3.2	33.3	42.6	53.9	11.3	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

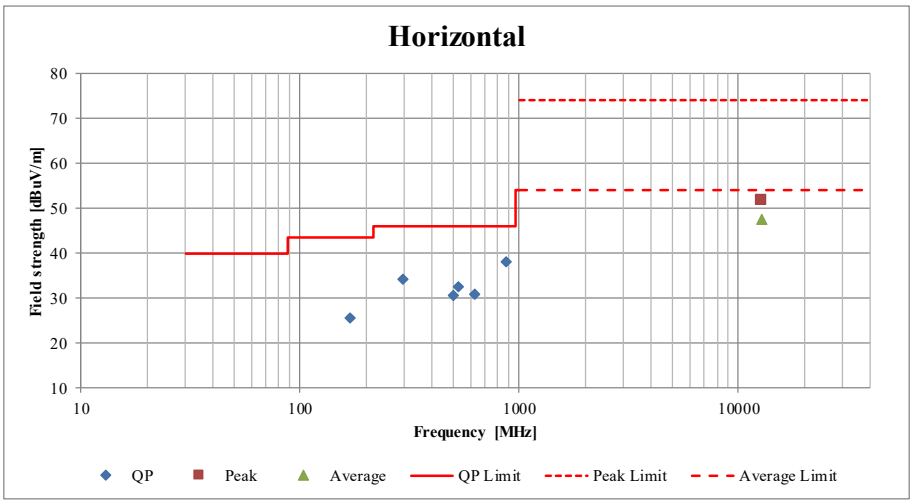
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

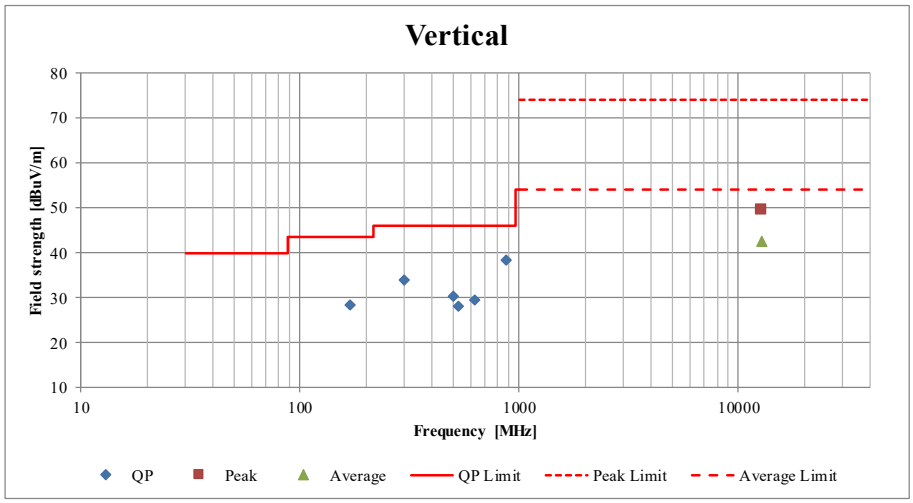
*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB
10 GHz - 40 GHz 20log (1.0 m / 3.0 m) = -9.54 dB

Field strength of spurious radiation
(Plot data, Worst case)

Report No.	12104474H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.3	No.3	No.3
Date	October 2, 2018	October 3, 2018	October 29, 2018
Temperature / Humidity	23 deg. C / 51 % RH	23 deg. C / 48 % RH	22 deg. C / 55 % RH
Engineer	Ryota Yamanaka (1 GHz - 40 GHz)	Junki Nagatomi (9 kHz - 30 MHz)	Ryota Yamanaka (30 MHz - 1 GHz)
Mode	Normal operating mode		





*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Field strength of spurious radiation (above 40 GHz)

Report No.	12104474H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No. 3
Date	October 4, 2018
Temperature / Humidity	23 deg. C / 63 % RH
Engineer	Ryota Yamanaka
	50 GHz - 231 GHz
Mode	Normal operating mode

Freq.	Reading	Rx ant. gain	Filter loss	LNA gain	Mixer loss	IF amp. gain	IF cable loss	Meas. range *D*	FSL	EIRP		Power density at 3 m			Remarks
												Result	Limit	Margin	
[GHz]	[dBm]	[dBi]	[dB]	[dB]	[dB]	[dB]	[dB]	[m]	[dB]	[dBm]	[mW]	[pW/cm^2]	[pW/cm^2]	[dB]	
49.974	-57.66	22.64	0.00	22.91	0.00	0.00	9.19	1.0	66.42	-27.60	0.001739	1.54	600	25.91	
50.852	-78.30	22.73	0.00	25.72	46.70	32.07	0.10	1.0	66.57	-45.45	0.000028	0.03	600	43.77	
75.915	-68.76	22.26	0.00	0.00	-14.73	0.00	1.24	1.0	70.05	-34.46	0.000358	0.32	600	32.78	
82.354	-68.94	22.94	0.00	0.00	-12.33	0.00	2.62	1.0	70.76	-30.83	0.000825	0.73	600	29.15	
83.639	-71.01	23.11	2.59	0.00	42.24	32.07	0.10	1.0	70.89	-10.37	0.091875	81.24	600	8.68	
101.449	-74.08	24.76	0.31	0.00	44.43	32.07	0.10	1.0	72.57	-13.50	0.044686	39.51	600	11.81	
116.969	-91.58	22.53	0.00	0.00	57.10	0.00	0.00	0.02	39.82	-17.18	0.019124	16.91	600	15.50	
131.297	-93.29	22.98	0.00	0.00	52.72	0.00	0.00	0.02	40.83	-22.72	0.005341	4.72	600	21.04	
153.066	-88.32	23.35	0.00	0.00	57.14	0.00	0.00	0.02	42.16	-12.37	0.057928	51.2	600	10.69	
154.770	-94.13	23.37	0.00	0.00	56.57	0.00	0.00	0.02	42.26	-18.67	0.013574	12.0	600	16.99	
172.654	-92.08	22.46	0.00	0.00	59.24	0.00	0.00	0.02	43.21	-12.10	0.061715	54.6	600	10.41	
192.168	-93.31	22.88	0.00	0.00	59.41	0.00	0.00	0.02	44.14	-12.64	0.054413	48.1	600	10.96	
211.923	-93.84	23.19	0.00	0.00	60.59	0.00	0.00	0.02	44.99	-11.45	0.071564	63.3	1000	11.99	
228.633	-89.42	23.34	0.00	0.00	62.07	0.00	0.00	0.02	45.65	-5.05	0.312761	276.5	1000	5.58	

Calculation:

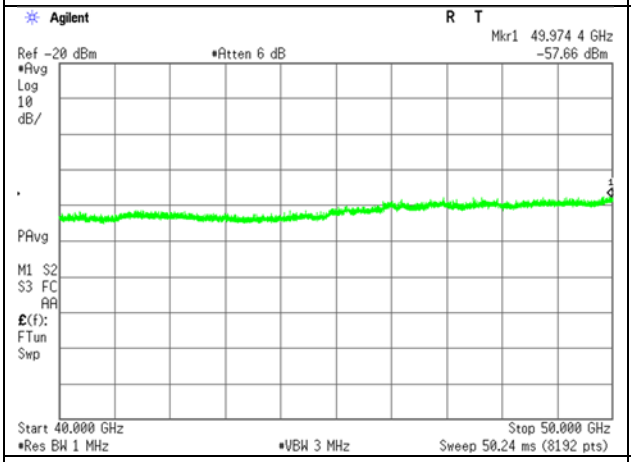
FSL (Free Space path Loss) = $10 * \log ((4 * Pi * D / \lambda)^2)$
EIRP = Reading - Rx ant. gain + Filter loss - LNA gain + Mixer loss - IF amp. gain + IF cable loss + FSL
Power density Result at 3 m = EIRP / ($4 * Pi * 300^2$)

These calculation results are same as results which were calculated with formulas described in the Section 9 of ANSI C63.10-2013.
The equipment were not used for factor 0 dB of the data sheets.

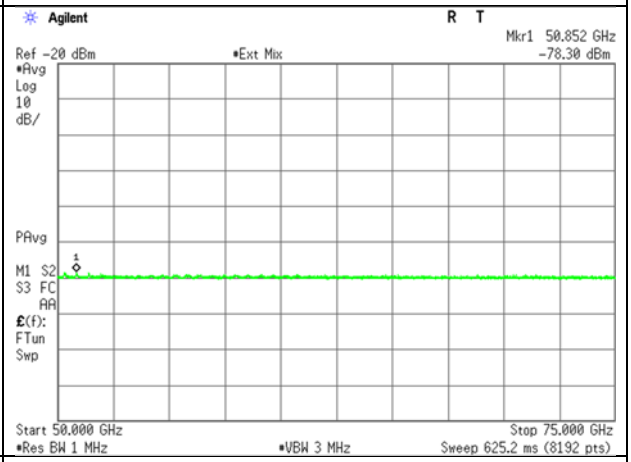
There is no spurious emission from 40 GHz to 231 GHz except for operating band.

Field strength of spurious radiation (above 40 GHz)

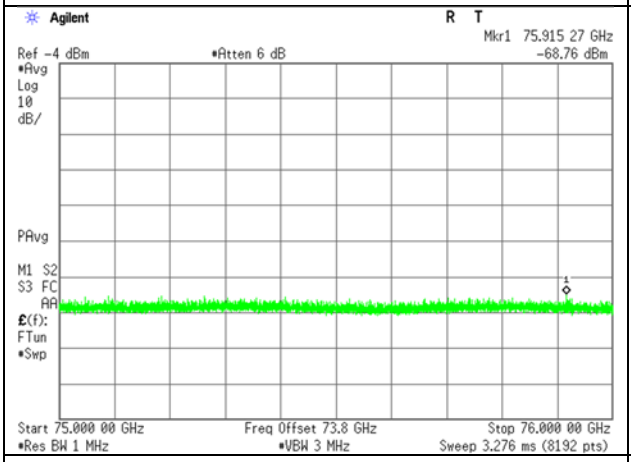
40 GHz – 50 GHz



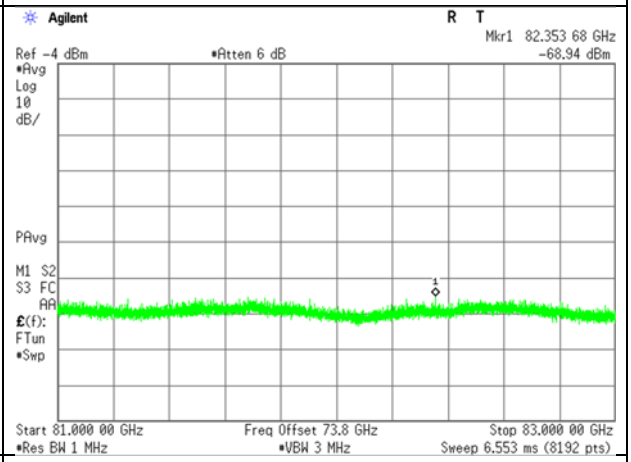
50 GHz – 75 GHz



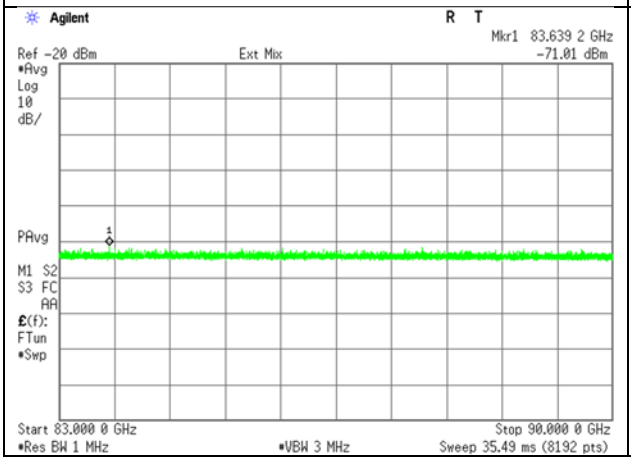
75 GHz – 76 GHz



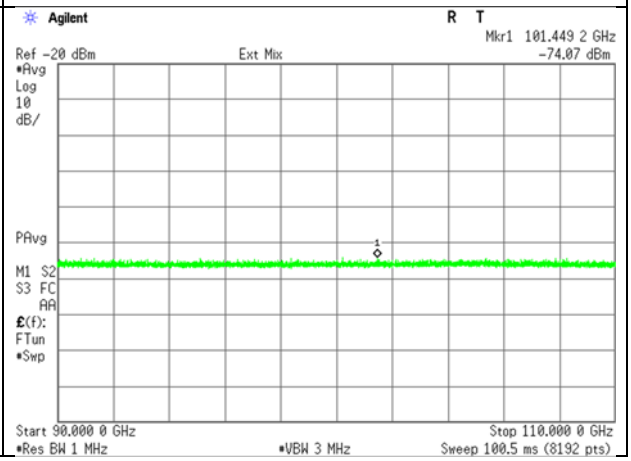
81 GHz – 83 GHz



83 GHz – 90 GHz

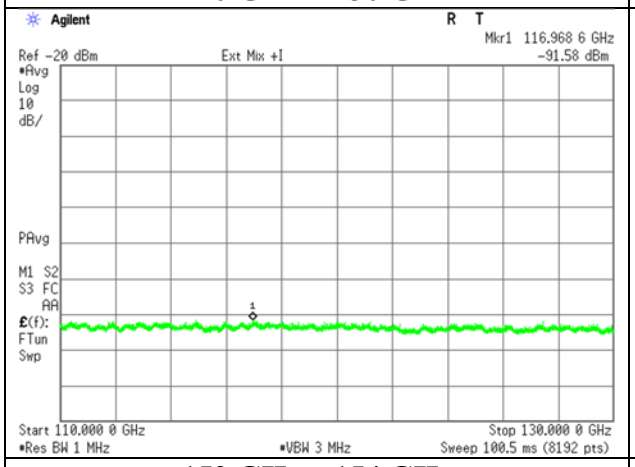


90 GHz – 110 GHz

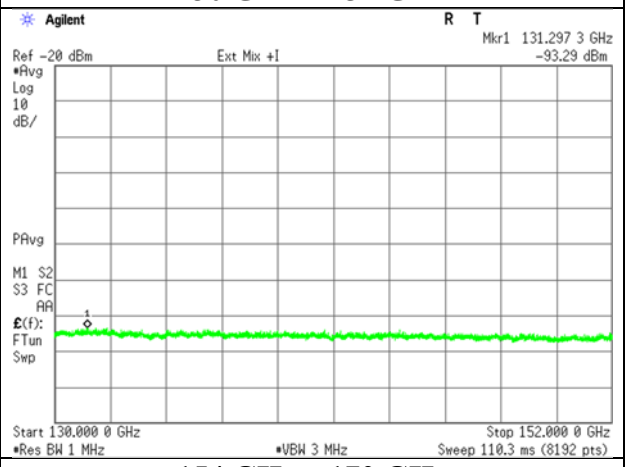


Field strength of spurious radiation (above 40 GHz)

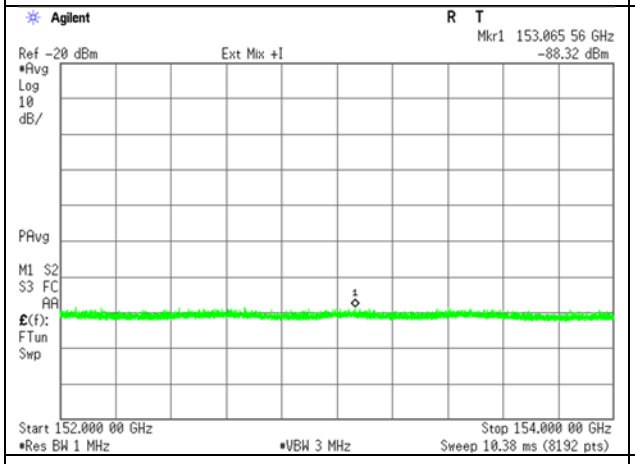
110 GHz – 130 GHz



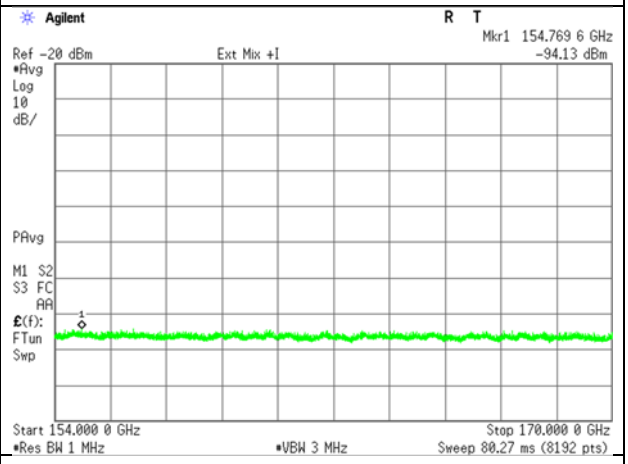
130 GHz – 152 GHz



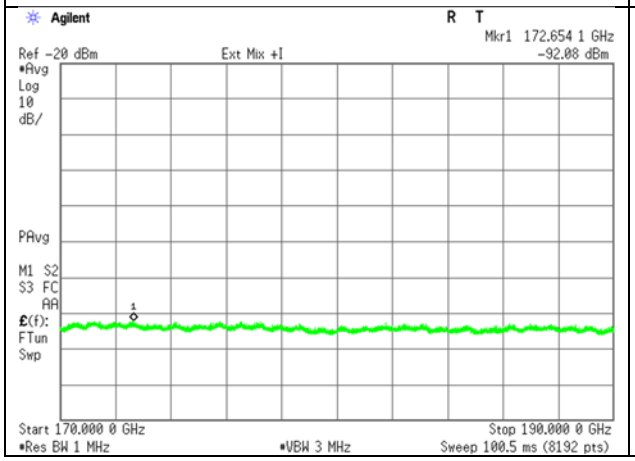
152 GHz – 154 GHz



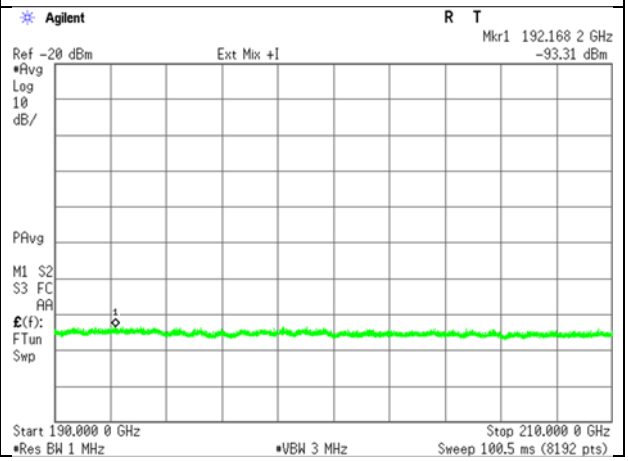
154 GHz – 170 GHz



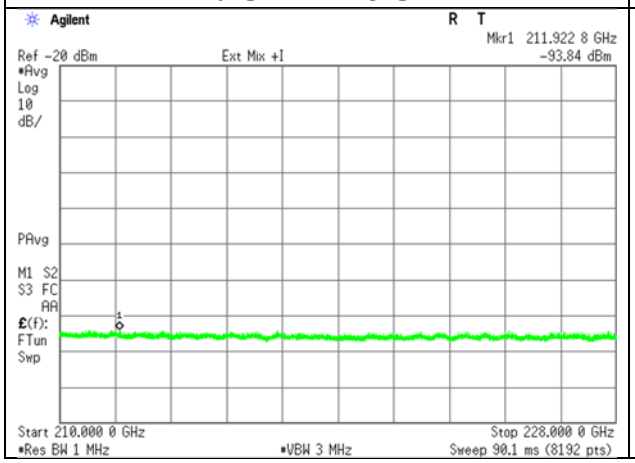
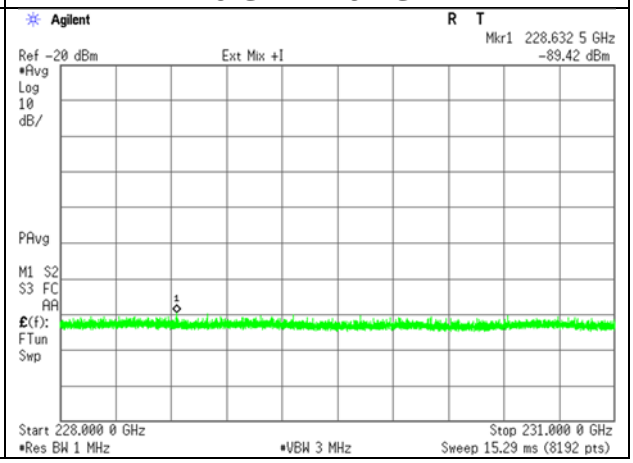
170 GHz – 190 GHz



190 GHz – 210 GHz



Field strength of spurious radiation (above 40 GHz)

210 GHz – 228 GHz	228 GHz – 231 GHz
	

Frequency Stability

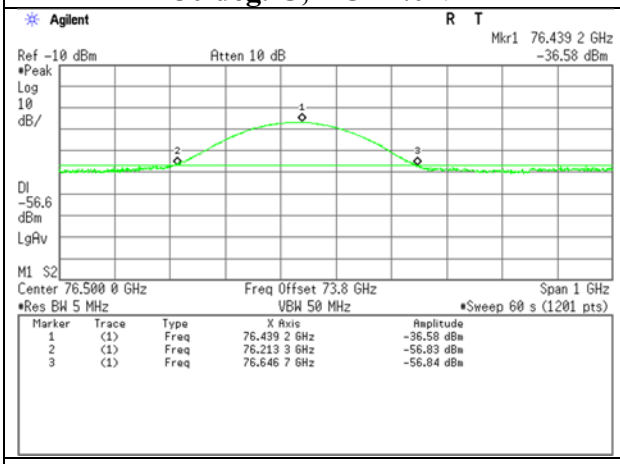
Report No.	12104474H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	November 9, 2018
Temperature / Humidity	22 deg. C / 51 % RH
Engineer	Ryota Yamanaka
Mode	Normal operating mode

Test Condition		Measured -20 dBc Frequency		Remarks
Temperature [deg. C]	Power Supply [V]	Lower Result [GHz]	Upper Result [GHz]	
50	12.0	76.213	76.647	
40	12.0	76.217	76.650	
30	12.0	76.232	76.646	
20	12.0	76.194	76.650	
20	10.2	76.232	76.666	85 % of the minimum operating voltage, DC 12V * 0.85
20	13.8	76.230	76.653	115 % of the maximum operating voltage, DC 12 V * 1.15
10	12.0	76.157	76.670	
0	12.0	76.098	76.673	
-10	12.0	76.088	76.675	
-20	12.0	76.027	76.767	

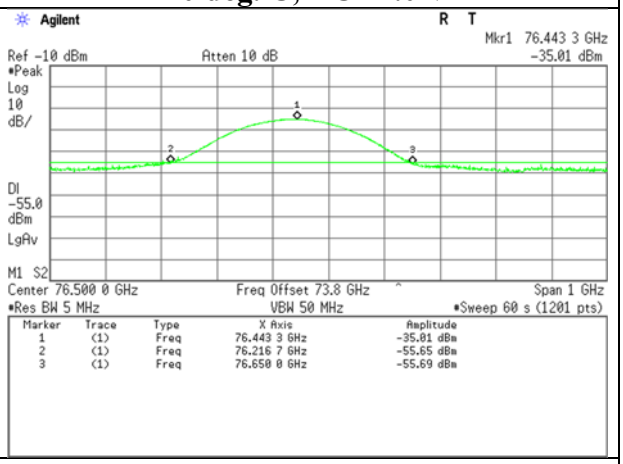
Fundamental emissions were contained within the frequency band 76 GHz - 77 GHz during all conditions of operation.

Frequency Stability

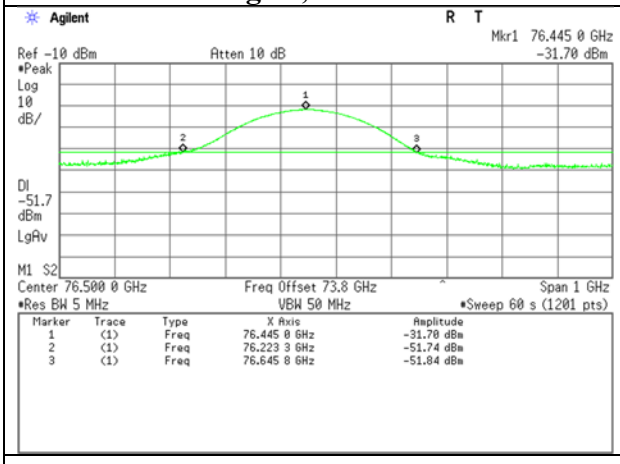
50 deg. C, DC 12.0 V



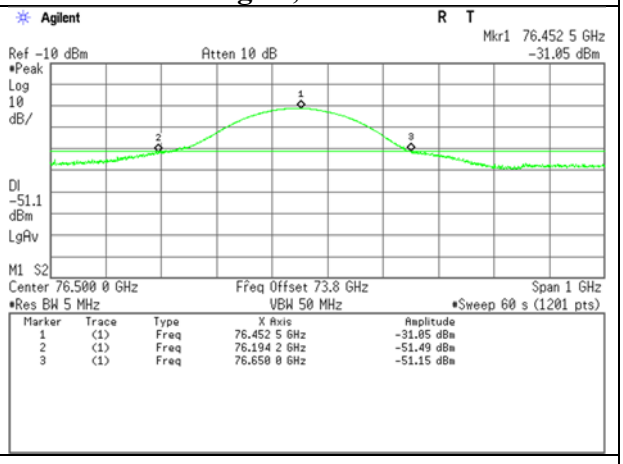
40 deg. C, DC 12.0 V



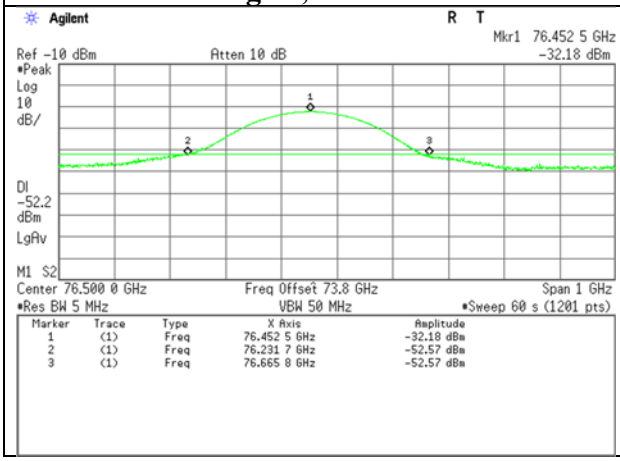
30 deg. C, DC 12.0 V



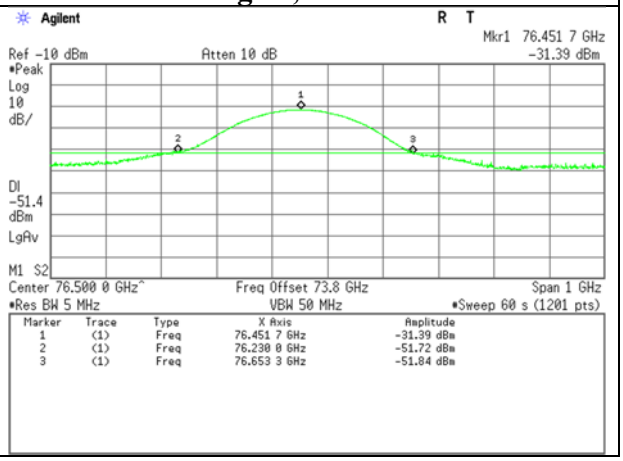
20 deg. C, DC 12.0 V



20 deg. C, DC 10.2 V

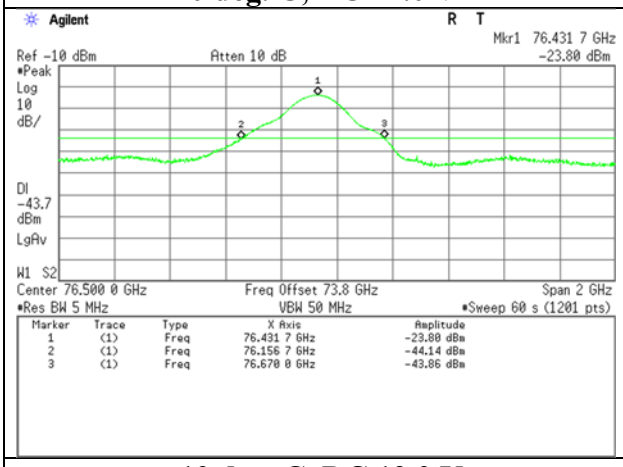


20 deg. C, DC 13.8 V

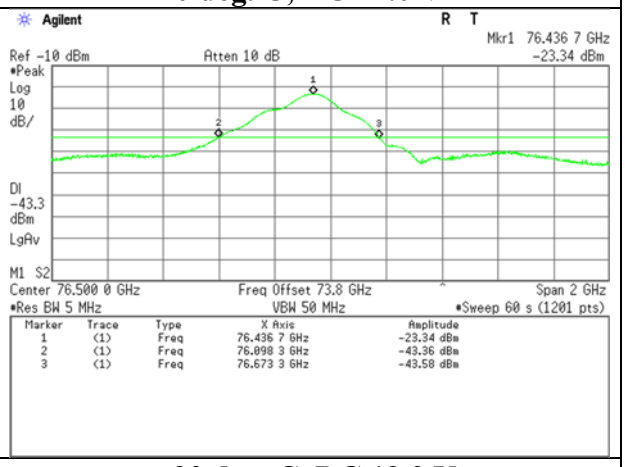


Frequency Stability

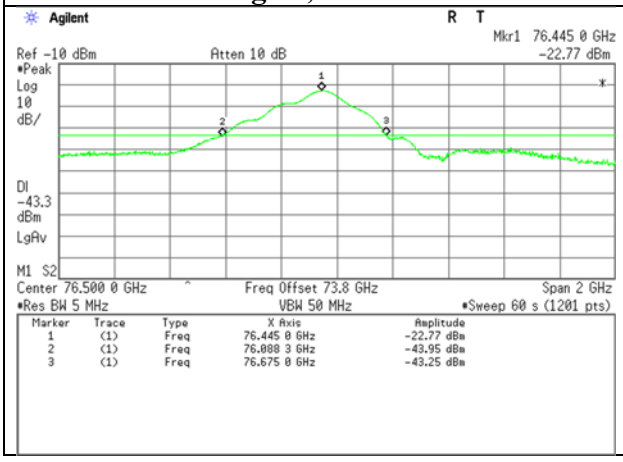
10 deg. C, DC 12.0 V



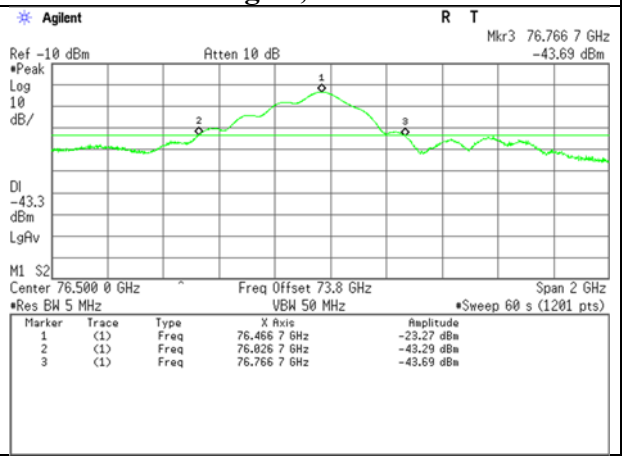
0 deg. C, DC 12.0 V



-10 deg. C, DC 12.0 V



-20 deg. C, DC 12.0 V



APPENDIX 2: Test instruments

Test Instruments (1/2)

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141265	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	5/31/2018	5/31/2019	12
RE	141317	Coaxial Cable	Fujikura/Agilent	-	-	2/23/2018	2/28/2019	12
RE	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/5/2018	11/30/2019	12
RE	141578	Pre Amplifier	AGILENT	8447D	2944A10845	9/19/2018	9/30/2019	12
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	8/21/2018	8/31/2019	12
RE	141427	Biconical Antenna	Schwarzbeck	VHA9103B	8031	5/31/2018	5/31/2019	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	2/27/2018	2/28/2019	12
RE	141222	Coaxial Cable	FUJIKURA	3D-2W(12m)/ 5D-2W(5m)/ 5D-2W(0.8m)/5	-	2/23/2018	2/28/2019	12
RE	159670	Coaxial Cable	UL Japan Inc.	-	-	11/7/2018	11/30/2019	12
RE	142152	Loop Antenna	Rohde & Schwarz	HFH2-Z2	836553/009	11/22/2017	11/30/2018	12
RE	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	8/8/2018	8/31/2019	12
RE	141885	Spectrum Analyzer	AGILENT	E4448A	US44300523	11/7/2018	11/30/2019	12
RE	142182	Measure	KOMELON	KMC-36	-	-	-	-
RE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	6/29/2018	6/30/2020	24
RE	141556	Thermo-Hygrometer	CUSTOM	CTH-201	0003	12/21/2017	12/31/2018	12
RE	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	4/6/2018	4/30/2019	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	1/9/2018	1/31/2019	12
RE	141507	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	6/7/2018	6/30/2019	12
RE	141513	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	6/7/2018	6/30/2019	12
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	141580	MicroWave System Amplifier	AGILENT	83017A	MY39500779	3/13/2018	3/31/2019	12
RE	141417	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	5/7/2018	5/31/2019	12
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	6/26/2018	6/30/2020	24
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	1/24/2018	1/31/2019	12
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	10/3/2018	10/31/2019	12
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	6/1/2018	6/30/2019	12
RE	141397	Coaxial Cable	UL Japan	-	-	6/13/2018	6/30/2019	12
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	1/9/2018	1/31/2019	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	1/30/2018	1/31/2019	12
RE	141267	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	6/1/2018	6/30/2019	12
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	2/27/2018	2/28/2019	12
RE	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	6/28/2018	6/30/2020	24
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	1/24/2018	1/31/2019	12
RE	142041	Horn Antenna	Oshima Prototype Engineering Co.	A16-186	1	9/11/2018	9/30/2019	12
RE	142029	Horn Antenna	WiseWave	ARH1523-02	10766-01	10/30/2017	10/31/2018	12

Test Instruments (2/2)

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	142055	Power Amplifier	SAGE Millimeter, Inc.	SBP-5037532015-1515-N1	11599-01	12/22/2017	12/31/2018	12
RE	142047	Preselected Millimeter Mixer	AGILENT	11974V-E01	3001A00412	7/13/2018	7/31/2019	12
RE	142032	Microwave Cable	Huber+Suhner	SUCOFLEX102	37511/2	9/4/2018	9/30/2019	12
RE	142033	Microwave Cable	Huber+Suhner	SUCOFLEX102	37512/2	9/4/2018	9/30/2019	12
RE	142031	Horn Antenna	WiseWave	ARH1023-02	10766-01	10/30/2017	10/31/2018	12
RE	141329	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28635/2	4/11/2018	4/30/2019	12
RE	142050	Block Downconverter	KEYSIGHT	PS-X30-W10117A	13715	2/1/2018	2/28/2019	12
RE	142048	Harmonic Mixer	AGILENT	11970W	2521 A01909	7/9/2018	7/31/2019	12
RE	142042	High Pass Filter 81-110GHz	VCSS	HPF-10-778030	201	8/22/2018	8/31/2019	12
RE	142036	Horn Antenna	Custom Microwave Inc.	HO6R	-	9/11/2018	9/30/2019	12
RE	142049	Harmonic Mixer	OML INC.	M06HWD	D100709-1	10/31/2018	10/31/2019	12
RE	142026	Diplexer	OML INC.	DPL26	-	10/17/2017	10/31/2018	12
RE	142038	Horn Antenna	Custom Microwave Inc.	HO5R	-	9/11/2018	9/30/2019	12
RE	142039	Horn Antenna	Custom Microwave Inc.	HO4R	-	9/11/2018	9/30/2019	12
RE	142053	Harmonic Mixer	OML INC.	M04HWD	Y100709-1	10/31/2018	10/31/2019	12
RE	141962	Digital Oscilloscope	Rohde & Schwarz	RTO1004	200355	8/30/2018	8/31/2019	12
RE	141440	Temperature and Humidity Chamber	TABAI ESPEC	PL-1KP	14019569	4/10/2018	4/29/2019	12
RE	141567	Thermo-Hygrometer	CUSTOM	CTH-201	0008	1/24/2018	1/31/2019	12
RE	142529	Detector	HEROTEK, INC.	DT1840P	484823	-	-	-
RE	151897	Microwave Cable	RINEI SEIKI	SF101EA/11PC24/11PC24/2.5M	SN MY1726/1EA	4/19/2018	4/30/2019	12

***Hyphens for Last Calibration Date, Calibration Due Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

The expiration date of the calibration is the end of the expired month.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

[Below 40 GHz]
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

[Above 40 GHz]
Acceptance criteria for untraceable equipment was formulated according to ISO/IEC 17025 5.6.2.2.2, and the regular inspection was performed based on it annually.
For 40 GHz – 110 GHz, power sensor is calibrated by manufacturer, and the measured calibration data is used as in-house reference. The calibration data by manufacturer is checked for acceptance by a calorie meter except for some frequency bands.
For above 110 GHz, output level of millimeter wave source module is used as the reference, and inspection by the calorie meter is performed.
Electric power is checked with the calorie meter by measuring resistance and voltage of reference resistor.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test Item: RE: Radiated Emission test