RADIO TEST REPORT

Test Report No. : 13350488H-A-R1

Applicant	:	**IDEC Corporation**
Type of EUT	:	**RFID smart reader**
Model Number of EUT	:	**KW2D-R100Q4E**
Test regulation	:	**FCC Part 15 Subpart C: 2020**
FCC ID	:	**2AWS4KW2D**
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 limits of the above regulation.
4. The test results in this test 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 U.S. Government.
8. The information provided from the customer for this report is identified in Section 1.
9. This report is a revised version of 13350488H-A. 13350488H-A is replaced with this report.

Date of test: June 16 to July 14, 2020

Representative test engineer:
Akihiko Maeda
Engineer
Consumer Technology Division

Approved by:
Shinichi Miyazono
Engineer
Consumer Technology Division

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☐ This report contains data that are not covered by the NVLAP accreditation.

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

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REVISION HISTORY

Original Test Report No.: 13350488H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13350488H-A	August 3, 2020	-	-
1	13350488H-A-R1	August 5, 2020	P.35	Addition of Local ID: MCH-04 in the Test equipment table of APPENDIX 2.

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation
AC	Alternating Current
AFH	Adaptive Frequency Hopping
AM	Amplitude Modulation
Amp, AMP	Amplifier
ANSI	American National Standards Institute
Ant, ANT	Antenna
AP	Access Point
ASK	Amplitude Shift Keying
Atten., ATT	Attenuator
AV	Average
BPSK	Binary Phase-Shift Keying
BR	Bluetooth Basic Rate
BT	Bluetooth
BT LE	Bluetooth Low Energy
BW	BandWidth
Cal Int	Calibration Interval
CCK	Complementary Code Keying
Ch., CH	Channel
CISPR	Comite International Special des Perturbations Radioelectriques
CW	Continuous Wave
DBPSK	Differential BPSK
DC	Direct Current
D-factor	Distance factor
DFS	Dynamic Frequency Selection
DQPSK	Differential QPSK
DSSS	Direct Sequence Spread Spectrum
EDR	Enhanced Data Rate
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EN	European Norm
ERP, e.r.p.	Effective Radiated Power
EU	European Union
EUT	Equipment Under Test
Fac.	Factor
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
FM	Frequency Modulation
Freq.	Frequency
FSK	Frequency Shift Keying
GFSK	Gaussian Frequency-Shift Keying
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
Hori.	Horizontal
ICES	Interference-Causing Equipment Standard
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
ILAC	International Laboratory Accreditation Conference
ISED	Innovation, Science and Economic Development Canada
ISO	International Organization for Standardization
JAB	Japan Accreditation Board
LAN	Local Area Network
LIMS	Laboratory Information Management System
MCS	Modulation and Coding Scheme
MRA	Mutual Recognition Arrangement
N/A	Not Applicable
NIST	National Institute of Standards and Technology
NS	No signal detect.
NSA	Normalized Site Attenuation
NVLAP	National Voluntary Laboratory Accreditation Program
OBW	Occupied Band Width
OFDM	Orthogonal Frequency Division Multiplexing
P/M	Power meter
PCB	Printed Circuit Board
PER	Packet Error Rate
PHY	Physical Layer
PK	Peak
PN	Pseudo random Noise
PRBS	Pseudo-Random Bit Sequence
PSD	Power Spectral Density
QAM	Quadrature Amplitude Modulation
QP	Quasi-Peak
QPSK	Quadri-Phase Shift Keying
RBW	Resolution Band Width
RDS	Radio Data System
RE	Radio Equipment
RF	Radio Frequency
RMS	Root Mean Square
RSS	Radio Standards Specifications
Rx	Receiving
SA, S/A	Spectrum Analyzer
SG	Signal Generator
SVSWR	Site-Voltage Standing Wave Ratio
TR	Test Receiver
Tx	Transmitting
VBW	Video BandWidth
Vert.	Vertical
WLAN	Wireless LAN

CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	IDEC Corporation
Address	:	6-64 NISHIMIYAHARA 2-CHOME, YODOGAWA-KU, OSAKA 532-0004 JAPAN
Telephone Number	:	+81-6-6398-2513
Facsimile Number	:	+81-6-6398-2544
Contact Person	:	Takashi Honda

The information provided from the customer is as follows;
- Applicant, Type of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT) other than the Receipt Date
- SECTION 4: Operation of EUT 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 (EUT)

2.1 Identification of EUT

Type	:	RFID smart reader
Model Number	:	KW2D-R100Q4E
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 24.0 V
Receipt Date	:	June 13 and 16, 2020
Country of Mass-production	:	Japan
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab

2.2 Product Description

Model: KW2D-R100Q4E (referred to as the EUT in this report) is a RFID smart reader.

Radio Specification

Equipment Type	:	Transceiver
Frequency of Operation	:	13.56 MHz
Type of Modulation	:	ASK
Antenna Type	:	Loop antenna
Antenna Connector Type	:	PIN HEADER
Operating Temperature	:	-25 deg. C to +55 deg. C
Clock frequency (Maximum)	:	CPU: 24 MHz, RF: 27.12 MHz

Variant model

Tested model: KW2D-R100Q4E has a variant model: KW2D-RH100Q4E.
The difference of these models is only with or without tag holder, they are completely identical in Radio characteristics.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on May 26, 2020 and effective July 27, 2020 except 15.258
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.225 Operation within the band 13.110-14.010 MHz.

* The revision does not affect the test result conducted before its effective date.
* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted emission	ANSI C63.10:2013 6 Standard test methods ---------- <ISED>RSS-Gen 8.8	Section 15.207 ---------- <ISED>RSS-Gen 8.8	0.97 dB 1.18500 MHz AV, Phase L <Mode 4>	Complied# a)	-
Electric Field Strength of Fundamental Emission	ANSI C63.10:2013 6 Standard test methods ---------- <ISED> RSS-Gen 6.4, 6.12	Section 15.225(a) ---------- <ISED>RSS-210 B.6	65.04 dB, 13.56000 MHz, QP, 45 deg. <Mode 2>	Complied b)	Radiated
Spectrum Mask	ANSI C63.10:2013 6 Standard test methods ---------- <ISED>RSS-Gen 6.4, 6.13	Section 15.225(b)(c) ---------- <ISED> RSS-210 B.6	38.84 dB, 13.35070 MHz, QP, 45 deg. <Mode 2>	Complied b)	Radiated
20 dB Bandwidth	ANSI C63.10:2013 6 Standard test methods ---------- <ISED> -	Section15.215(c) ---------- <ISED> -	See data	Complied c)	Radiated
Electric Field Strength of Spurious Emission	ANSI C63.10:2013 6 Standard test methods ---------- <ISED>RSS-Gen 6.4, 6.13	Section 15.209, Section 15.225 (d) ---------- <ISED>RSS-210 B.6	6.82 dB 125.001 MHz, Vertical, QP <Mode 2>	Complied d)	Radiated
Frequency Tolerance	ANSI C63.10:2013 6 Standard test methods ---------- <ISED>RSS-Gen 6.11, 8.11	Section 15.225(e) ---------- <ISED> RSS-210 B.6	See data	Complied e)	Radiated

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

a) Refer to APPENDIX 1 (data of Conducted Emission)
b) Refer to APPENDIX 1 (data of Fundamental emission and Spectrum Mask)
c) Refer to APPENDIX 1 (data of 20dB Bandwidth and 99% Occupied Bandwidth)
d) Refer to APPENDIX 1 (data of Spurious emission)
e) Refer to APPENDIX 1 (data of Frequency Tolerance)

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.

FCC Part 15.31 (e)

This EUT provides stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.
However, the supply voltage was varied and tested at 85 % and 115 % of the nominal rated supply voltage during frequency tolerance test according to Section 15.225(e).

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % Occupied Band Width	<ISED>RSS-Gen 6.7	-	N/A	-	Radiated
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.					

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

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 $k = 2$.

Conducted emission

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.4 dB
	0.15 MHz to 30 MHz	2.9 dB

Radiated emission

Measurement distance	Frequency range		Uncertainty (+/-)
3 m	9 kHz to 30 MHz		3.3 dB
10 m			3.2 dB
3 m	30 MHz to 200 MHz	(Horizontal)	4.8 dB
		(Vertical)	5.0 dB
	200 MHz to 1000 MHz	(Horizontal)	5.2 dB
		(Vertical)	6.3 dB
10 m	30 MHz to 200 MHz	(Horizontal)	4.8 dB
		(Vertical)	4.8 dB
	200 MHz to 1000 MHz	(Horizontal)	5.0 dB
		(Vertical)	5.0 dB
3 m	1 GHz to 6 GHz		4.9 dB
	6 GHz to 18 GHz		5.2 dB
1 m	10 GHz to 26.5 GHz		5.5 dB
	26.5 GHz to 40 GHz		5.5 dB

Antenna Terminal test

Test Item	Uncertainty (+/-)
Frequency Tolerance	0.0154 ppm
20 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

Test site	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	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	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	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	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.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
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 x 2.0 m 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 EUT during testing

4.1 Operating Mode(s)

The mode is used :

Mode	Remarks*
1) Transmitting mode (Tx)	Mode 1 -Without Tag Mode 2 -Tag Type A ISO/IEC14443A (106 kbps) Mode 3 -Tag Type F FeliCa (212 kbps) Mode 4 -Tag Type V ISO15693 (26.5 kbps)
The EUT was operated in a manner similar to typical use during the tests. The EUT Transmits and Receives at the same time and there is no receiving mode. * EUT was set by the software as follows; Software: F0746 Version V0.58.9 (Date: 2020/6/9, Storage location: EUT memory) *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.	

Test Item	Operating mode
Conducted Emission	Tx Mod on Antenna Terminated
Electric Field Strength of Fundamental Emission	Tx Mod on
Spectrum Mask	Tx Mod on
20 dB Bandwidth and 99 % Occupied Bandwidth	Tx Mod on
Electric Field Strength of Spurious Emission	Tx Mod on
Frequency Tolerance (Mode 1 only)	Tx CW

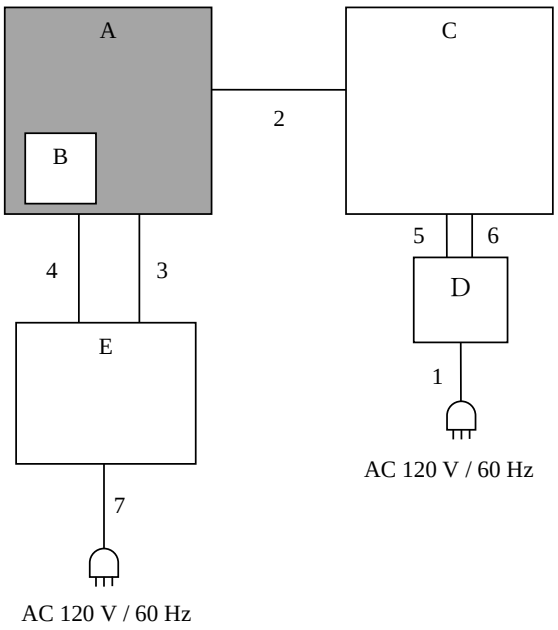
Justification: The system was configured in typical fashion (as a user would normally use it) for testing.

Frequency Tolerance:

Temperature : -20 deg. C to +50 deg. C: Step 10 deg. C
Voltage : Normal Voltage DC 24 V
Maximum Voltage DC 27.6 V (DC 24 V +15 %)
Minimum Voltage DC 20.4 V (DC 24 V -15 %)
*This EUT provides stable voltage constantly to RF Part regardless of input voltage

4.2 Configuration and peripherals

[Conducted emission test]



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

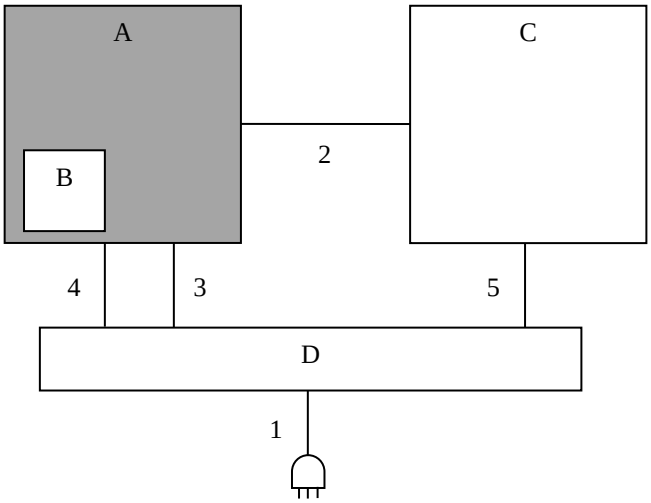
Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	RFID smart reader	KW2D-R100Q4E	1	IDEC Corporation	EUT
B	Tag	Tag	Tag A	EGarde	ISO/IEC14443A (106 kbps)
			Tag F		FeliCa (212 kbps)
			Tag V		ISO15693 (26.5 kbps)
C	PLC	FC6A-D16R1CEE	9M401-00141	IDEC Corporation	-
D	DC Power Supply	PL330QMD	48943	THURLBY-THANDAR INSTRUMENTS LTD	-
E	DC Power Supply	RPE-4323	824B168G2	RS PRO	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	AC Cable	1.5	Unshielded	Unshielded	-
2	LAN Cable	3.0	Shielded	Shielded	-
3	FG Cable	3.0	Unshielded	Unshielded	-
4	DC Cable	3.0	Unshielded	Unshielded	-
5	DC Cable	1.0	Unshielded	Unshielded	-
6	FG Cable	1.0	Unshielded	Unshielded	-
7	AC Cable	1.8	Unshielded	Unshielded	-

[Radiated emission test]



AC 120 V / 60 Hz

* 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	RFID smart reader	KW2D-R100Q4E	1	IDEC Corporation	EUT
B	Tag	Tag	Tag A	EGarde	ISO/IEC14443A (106 kbps)
			Tag F		FeliCa (212 kbps)
			Tag V		ISO15693 (26.5 kbps)
C	PLC	FC6A-D16R1CEE	9M401-00141	IDEC Corporation	-
D	DC Power Supply	PMC35-2A	13090501	KIKUSUI	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	AC Cable	1.4	Unshielded	Unshielded	-
2	LAN Cable	3.0	Shielded	Shielded	-
3	FG Cable	3.0	Unshielded	Unshielded	-
4	DC Cable	3.0	Unshielded	Unshielded	-
5	DC Cable	1.0	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

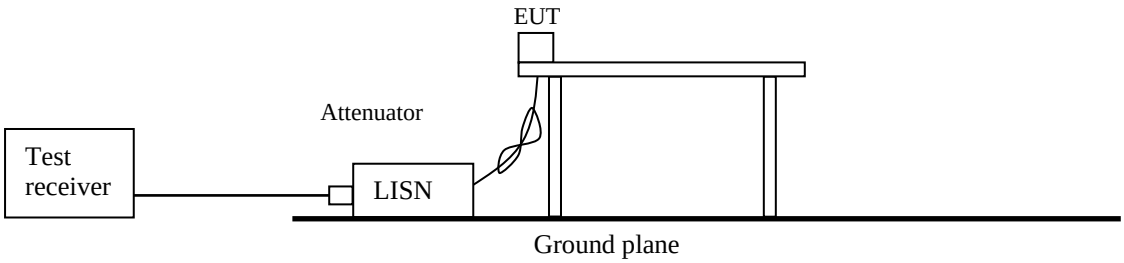
Test Procedure and conditions

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 rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber. The EUT was connected to a LISN (AMN).
An overview sweep with peak detection has been performed.

[Test Setup]



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

Detector **: QP and CISPR AV**
Measurement range **: 0.15 MHz - 30 MHz**
Test data **: APPENDIX**
Test result **: Pass**

SECTION 6: Radiated emission (Fundamental , Spurious Emission and Spectrum Mask)

Test Procedure

[For below 1GHz]
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 1GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 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.

Frequency: From 9 kHz to 30 MHz
The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for vertical polarization (antenna angle: 45 deg. to 225 deg.) and horizontal polarization.
*Refer to Figure 1 about Direction of the Loop Antenna.

Frequency: From 30 MHz to 1 GHz
The measuring antenna height varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for both vertical and horizontal antenna polarization.

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
Antenna Type	Loop	Biconical	Logperiodic

Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)	3 m *2)	3 m

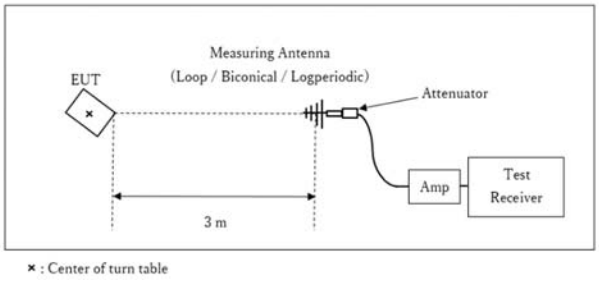
*1) Distance Factor: 40 x log (3 m / 300 m) = -80 dB
*2) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

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

These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane.
However test results were confirmed to pass against standard limit.

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 - 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

[Test Setup]
Below 1 GHz



Test Distance: 3 m

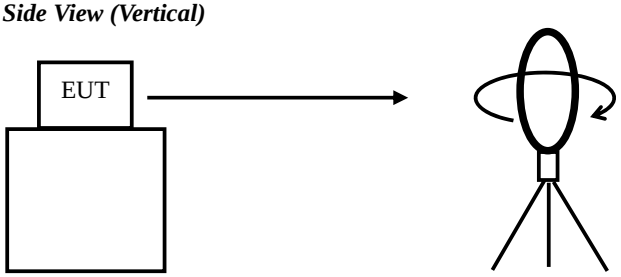
- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

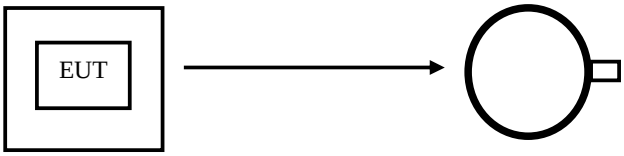
Measurement range : 9 kHz - 1 GHz
Test data : APPENDIX 1
Test result : Pass

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

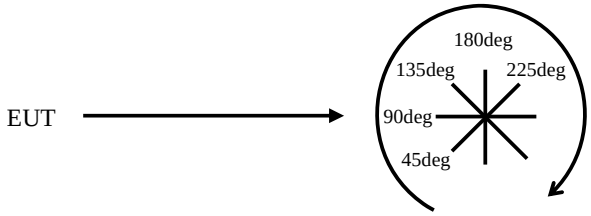


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 7: Other test

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak *1)	Max Hold *1)	Spectrum Analyzer
Frequency Tolerance	-	-	-	-	-	-	Spectrum Analyzer *2)
*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %. Peak hold was applied as Worst-case measurement. *2) The measurement was performed with Marker Frequency Counter Function.							

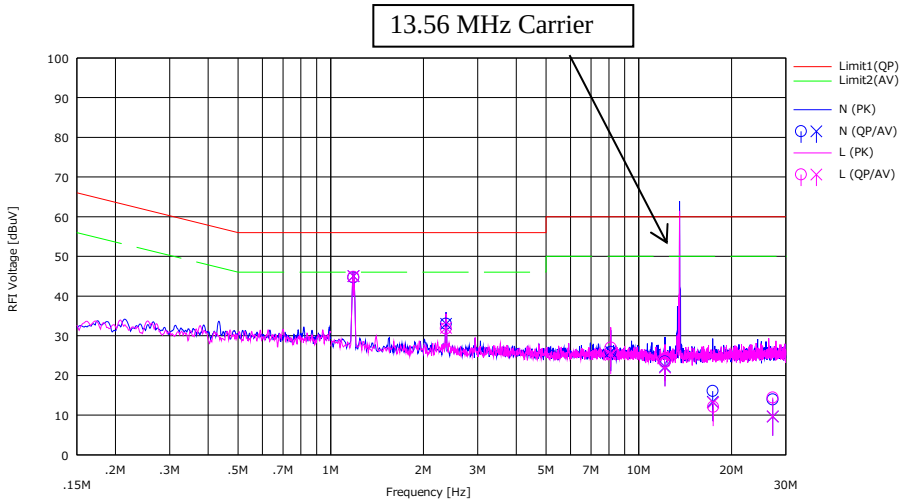
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 14, 2020
Temperature / Humidity	22 deg. C / 60 % RH
Engineer	Yuta Moriya
Mode	Mode 1

Limit : FCC_Part 15 Subpart C(15.207)



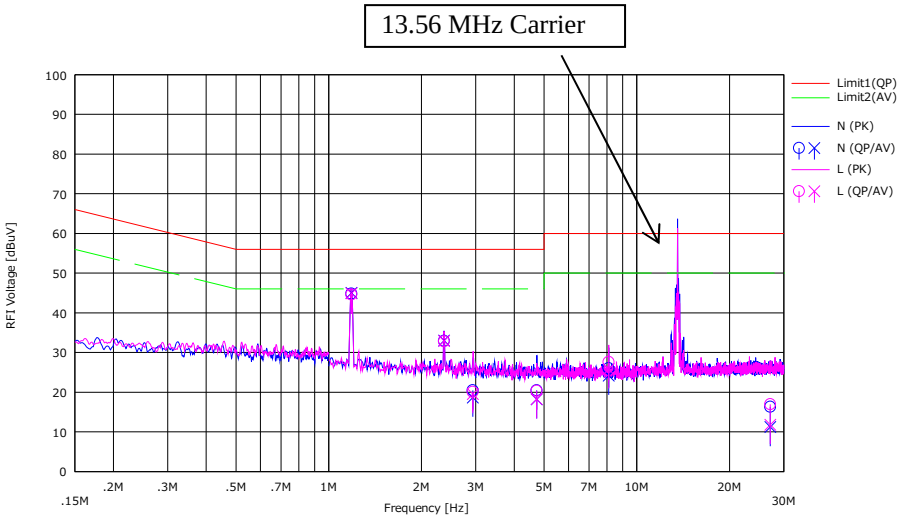
No.	Freq.	Reading ⟨QP⟩	Reading ⟨AV⟩	LISN	LOSS	Results ⟨QP⟩	Results ⟨AV⟩	Limit ⟨QP⟩	Limit ⟨AV⟩	Margin ⟨QP⟩	Margin ⟨AV⟩	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	1.18500	31.40	31.70	0.06	13.23	44.69	44.99	56.00	46.00	11.31	1.01	N	
2	2.36800	19.60	19.60	0.08	13.31	32.99	32.99	56.00	46.00	23.01	13.01	N	
3	8.11000	12.22	12.30	0.17	13.53	25.92	26.00	60.00	50.00	34.08	24.00	N	
4	12.16000	9.60	8.30	0.23	13.65	23.48	22.18	60.00	50.00	36.52	27.82	N	
5	17.38000	2.00	-0.70	0.29	13.77	16.06	13.36	60.00	50.00	43.94	36.64	N	
6	27.22000	-0.50	-4.80	0.48	13.96	13.94	9.64	60.00	50.00	46.06	40.36	N	
7	1.18500	31.50	31.70	0.06	13.23	44.79	44.99	56.00	46.00	11.21	1.01	L	
8	2.36640	18.40	18.60	0.08	13.31	31.79	31.99	56.00	46.00	24.21	14.01	L	
9	8.11000	13.30	11.50	0.16	13.53	26.99	25.19	60.00	50.00	33.01	24.81	L	
10	12.16000	9.40	8.10	0.22	13.65	23.27	21.97	60.00	50.00	36.73	28.03	L	
11	17.44000	-1.98	-0.90	0.30	13.77	12.09	13.17	60.00	50.00	47.91	36.83	L	
12	27.22000	-0.10	-4.80	0.53	13.96	14.39	9.69	60.00	50.00	45.61	40.31	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

Conducted Emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 14, 2020
Temperature / Humidity	22 deg. C / 60 % RH
Engineer	Yuta Moriya
Mode	Mode 2

Limit : FCC_Part 15 Subpart C(15.207)



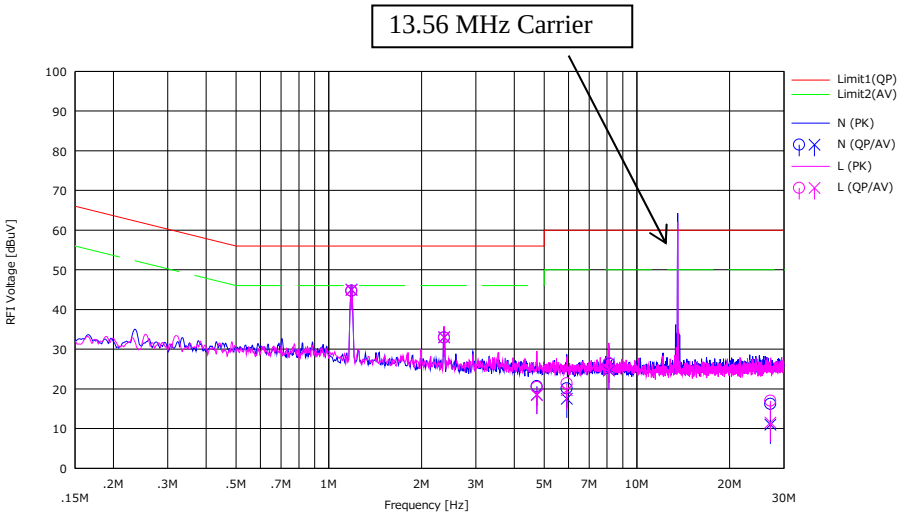
No.	Freq.	Reading		LISN	LOSS	Results		Limit		Margin		Phase	Comment
		(QP)	(AV)			(QP)	(AV)	(QP)	(AV)	(QP)	(AV)		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	1.18500	31.50	31.70	0.06	13.23	44.79	44.99	56.00	46.00	11.21	1.01	N	
2	2.36800	19.51	19.60	0.08	13.31	32.90	32.99	56.00	46.00	23.10	13.01	N	
3	2.93600	7.02	5.22	0.09	13.34	20.45	18.65	56.00	46.00	35.55	27.35	N	
4	4.73500	6.91	4.66	0.12	13.42	20.45	18.20	56.00	46.00	35.55	27.80	N	
5	8.11000	12.30	10.45	0.17	13.53	26.00	24.15	60.00	50.00	34.00	25.85	N	
6	27.12000	1.85	-3.22	0.48	13.96	16.29	11.22	60.00	50.00	43.71	38.78	N	
7	1.18500	31.30	31.60	0.06	13.23	44.59	44.89	56.00	46.00	11.41	1.11	L	
8	2.36800	19.40	19.50	0.08	13.31	32.79	32.89	56.00	46.00	23.21	13.11	L	
9	2.93600	6.60	6.10	0.09	13.34	20.03	19.53	56.00	46.00	35.97	26.47	L	
10	4.73500	6.80	4.70	0.11	13.42	20.33	18.23	56.00	46.00	35.67	27.77	L	
11	8.11000	13.90	12.10	0.16	13.53	27.59	25.79	60.00	50.00	32.41	24.21	L	
12	27.12000	2.45	-2.71	0.53	13.96	16.94	11.78	60.00	50.00	43.06	38.22	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

Conducted Emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 14, 2020
Temperature / Humidity	22 deg. C / 60 % RH
Engineer	Yuta Moriya
Mode	Mode 3

Limit : FCC_Part 15 Subpart C(15.207)



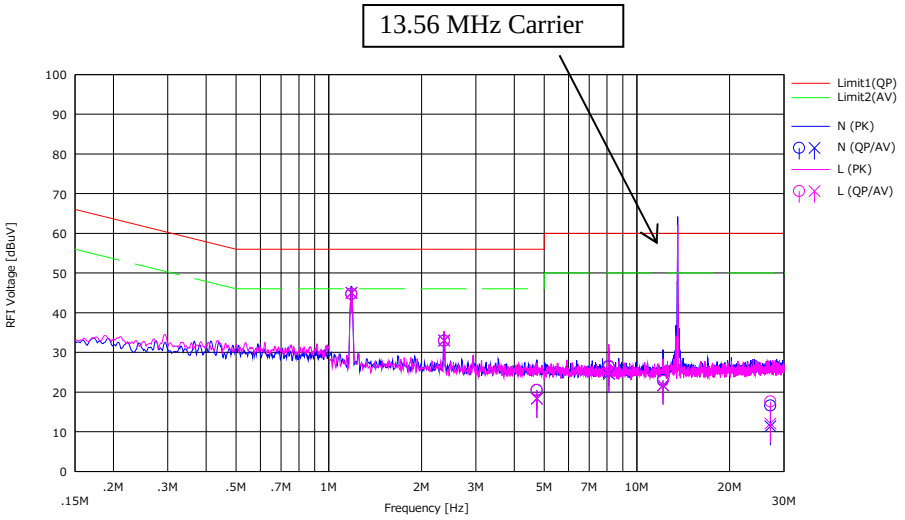
No.	Freq.	Reading		LISN	LOSS	Results		Limit		Margin		Phase	Comment
		〈QP〉	〈AV〉			〈QP〉	〈AV〉	〈QP〉	〈AV〉	〈QP〉	〈AV〉		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	1.18500	31.40	31.70	0.06	13.23	44.69	44.99	56.00	46.00	11.31	1.01	N	
2	2.36800	19.54	19.60	0.08	13.31	32.93	32.99	56.00	46.00	23.07	13.01	N	
3	4.73500	7.10	5.00	0.12	13.42	20.64	18.54	56.00	46.00	35.36	27.46	N	
4	5.92300	6.50	3.90	0.14	13.46	20.10	17.50	60.00	50.00	39.90	32.50	N	
5	8.11000	12.65	10.90	0.17	13.53	26.35	24.60	60.00	50.00	33.65	25.40	N	
6	27.12000	1.76	-3.44	0.48	13.96	16.20	11.00	60.00	50.00	43.80	39.00	N	
7	1.18500	31.40	31.65	0.06	13.23	44.69	44.94	56.00	46.00	11.31	1.06	L	
8	2.36800	19.50	19.60	0.08	13.31	32.89	32.99	56.00	46.00	23.11	13.01	L	
9	4.73500	6.90	4.90	0.11	13.42	20.43	18.43	56.00	46.00	35.57	27.57	L	
10	5.92300	7.80	6.05	0.13	13.46	21.39	19.64	60.00	50.00	38.61	30.36	L	
11	8.11000	12.80	11.00	0.16	13.53	26.49	24.69	60.00	50.00	33.51	25.31	L	
12	27.12000	2.50	-3.00	0.53	13.96	16.99	11.49	60.00	50.00	43.01	38.51	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

Conducted Emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 14, 2020
Temperature / Humidity	22 deg. C / 60 % RH
Engineer	Yuta Moriya
Mode	Mode 4

Limit : FCC_Part 15 Subpart C(15.207)



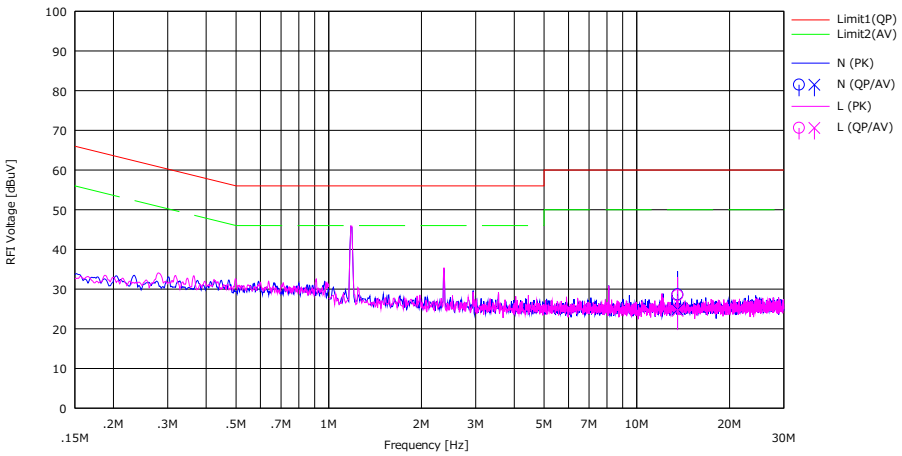
No.	Freq.	Reading		LISN	LOSS	Results		Limit		Margin		Phase	Comment
		〈QP〉	〈AV〉			〈QP〉	〈AV〉	〈QP〉	〈AV〉	〈QP〉	〈AV〉		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	1.18500	31.42	31.73	0.06	13.23	44.71	45.02	56.00	46.00	11.29	0.98	N	
2	2.36800	19.51	19.60	0.08	13.31	32.90	32.99	56.00	46.00	23.10	13.01	N	
3	4.73500	6.93	4.81	0.12	13.42	20.47	18.35	56.00	46.00	35.53	27.65	N	
4	8.11000	12.71	10.86	0.17	13.53	26.41	24.56	60.00	50.00	33.59	25.44	N	
5	12.16000	9.13	7.83	0.23	13.65	23.01	21.71	60.00	50.00	36.99	28.29	N	
6	27.12000	2.13	-3.04	0.48	13.96	16.57	11.40	60.00	50.00	43.43	38.60	N	
7	1.18500	31.40	31.74	0.06	13.23	44.69	45.03	56.00	46.00	11.31	0.97	L	
8	2.36800	19.50	19.60	0.08	13.31	32.89	32.99	56.00	46.00	23.11	13.01	L	
9	4.73500	7.00	4.80	0.11	13.42	20.53	18.33	56.00	46.00	35.47	27.67	L	
10	8.11000	12.90	11.05	0.16	13.53	26.59	24.74	60.00	50.00	33.41	25.26	L	
11	12.16000	8.90	7.80	0.22	13.65	22.77	21.67	60.00	50.00	37.23	28.33	L	
12	27.12000	3.10	-2.44	0.53	13.96	17.59	12.05	60.00	50.00	42.41	37.95	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

Conducted Emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 14, 2020
Temperature / Humidity	22 deg. C / 60 % RH
Engineer	Yuta Moriya
Mode	Antenna Terminated

Limit : FCC_Part 15 Subpart C(15.207)



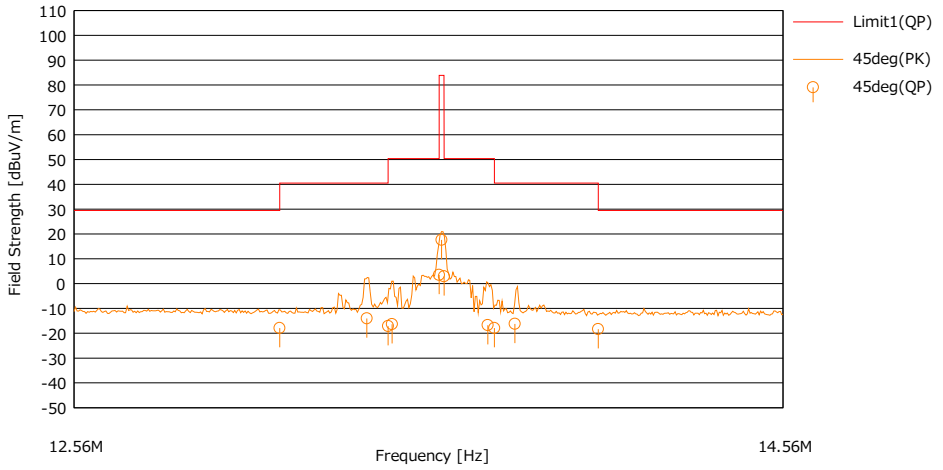
No.	Freq.	Reading		LISN	LOSS	Results		Limit		Margin		Phase	Comment
		(QP)	(AV)			(QP)	(AV)	(QP)	(AV)	(QP)	(AV)		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	13.56000	14.70	10.90	0.24	13.68	28.62	24.82	60.00	50.00	31.38	25.18	N	
2	13.56000	14.50	10.60	0.24	13.68	28.42	24.52	60.00	50.00	31.58	25.48	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
Except for the above table: adequate margin data below the limits.

Fundamental emission and Spectrum Mask

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 1

Limit : FCC15.225(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



No.	Freq.	Reading	Ant.Fac	Loss	Gain	Result	Limit	Margin	Antenna	Table	Comment
		〈QP〉				〈QP〉	〈QP〉	〈QP〉			
	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]		[deg]	
1	13.11000	28.20	19.46	-33.36	32.24	-17.94	29.50	47.44	45deg	322	
2	13.35070	32.10	19.45	-33.35	32.24	-14.04	40.50	54.54	45deg	322	
3	13.41000	29.00	19.45	-33.35	32.24	-17.14	40.50	57.64	45deg	322	
4	13.42085	29.80	19.45	-33.35	32.24	-16.34	50.40	66.74	45deg	322	
5	13.55300	49.60	19.45	-33.35	32.24	3.46	50.40	46.94	45deg	322	
6	13.56000	63.70	19.45	-33.35	32.24	17.56	83.90	66.34	45deg	322	
7	13.56700	49.00	19.45	-33.35	32.24	2.86	50.40	47.54	45deg	322	
8	13.69116	29.40	19.44	-33.34	32.24	-16.74	50.40	67.14	45deg	322	
9	13.71000	28.20	19.44	-33.34	32.24	-17.94	40.50	58.44	45deg	322	
10	13.76889	29.90	19.44	-33.34	32.24	-16.24	40.50	56.74	45deg	322	
11	14.01000	27.80	19.43	-33.34	32.24	-18.35	29.50	47.85	45deg	322	

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attnuator + Distance Factor*) - GAIN(AMP))
*) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Result of the fundamental emission at 3 m without Distance factor

QP

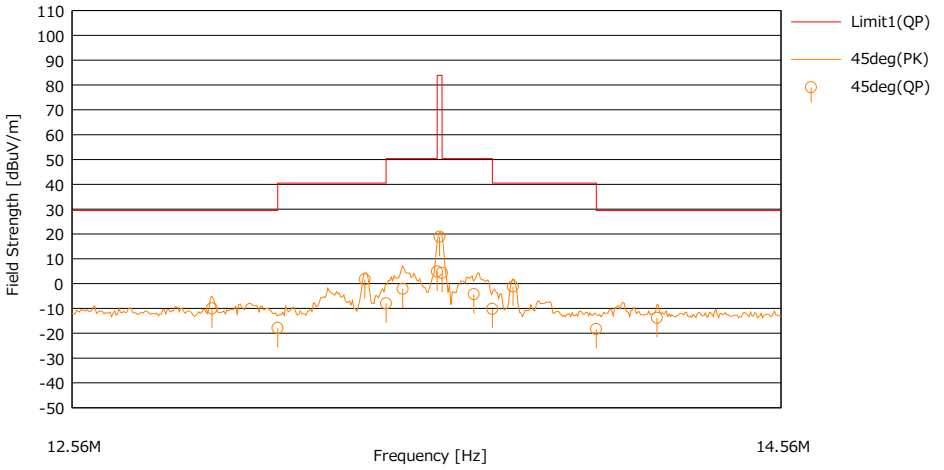
Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	13.56000	QP	63.70	19.45	6.65	32.24	-	57.56	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amprifier)

Fundamental emission and Spectrum Mask

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 2

Limit : FCC15.225(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



No.	Freq. [MHz]	Reading 〈QP〉 [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result 〈QP〉 [dBuV/m]	Limit 〈QP〉 [dBuV/m]	Margin 〈QP〉 [dB]	Antenna	Table [deg]	Comment
1	12.93188	36.10	19.47	-33.36	32.24	-10.03	29.50	39.53	45deg	322	
2	13.11000	28.20	19.46	-33.36	32.24	-17.94	29.50	47.44	45deg	322	
3	13.35070	47.80	19.45	-33.35	32.24	1.66	40.50	38.84	45deg	322	
4	13.41000	38.10	19.45	-33.35	32.24	-8.04	40.50	48.54	45deg	322	
5	13.45653	44.00	19.45	-33.35	32.24	-2.14	50.40	52.54	45deg	322	
6	13.55300	51.00	19.45	-33.35	32.24	4.86	50.40	45.54	45deg	322	
7	13.56000	65.00	19.45	-33.35	32.24	18.86	83.90	65.04	45deg	322	
8	13.56700	50.40	19.45	-33.35	32.24	4.26	50.40	46.14	45deg	322	
9	13.65723	41.80	19.44	-33.34	32.24	-4.34	50.40	54.74	45deg	322	
10	13.71000	35.90	19.44	-33.34	32.24	-10.24	40.50	50.74	45deg	322	
11	13.76938	44.90	19.44	-33.34	32.24	-1.24	40.50	41.74	45deg	322	
12	14.01000	27.80	19.43	-33.34	32.24	-18.35	29.50	47.85	45deg	322	
13	14.18862	32.30	19.42	-33.33	32.24	-13.85	29.50	43.35	45deg	322	

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attnuator + Distance Factor*) - GAIN(AMP))
*) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Result of the fundamental emission at 3 m without Distance factor

QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	13.56000	QP	65.00	19.45	6.65	32.24	-	58.86	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amprifier)

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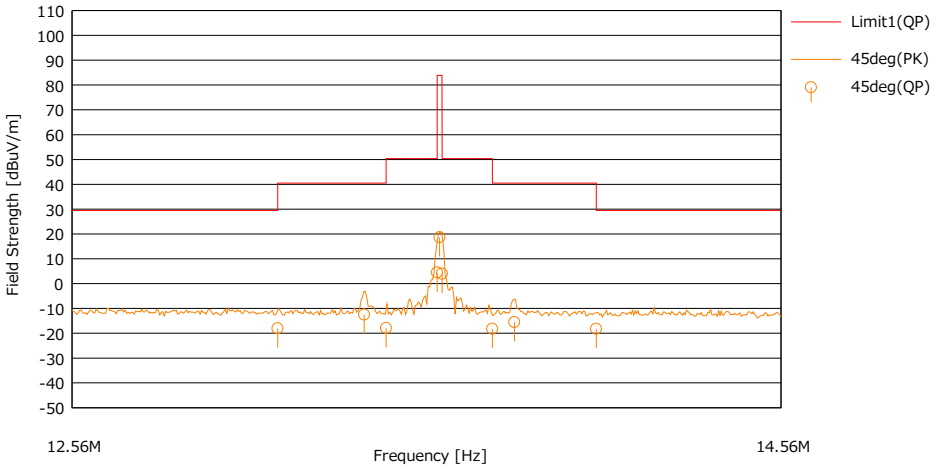
Fundamental emission and Spectrum Mask

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 3

Limit : FCC15.225(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



No.	Freq. [MHz]	Reading 〈QP〉 [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result 〈QP〉 [dBuV/m]	Limit 〈QP〉 [dBuV/m]	Margin 〈QP〉 [dB]	Antenna	Table [deg]	Comment
1	13.11000	28.10	19.46	-33.36	32.24	-18.04	29.50	47.54	45deg	328	
2	13.34881	33.60	19.45	-33.35	32.24	-12.54	40.50	53.04	45deg	328	
3	13.41000	28.20	19.45	-33.35	32.24	-17.94	40.50	58.44	45deg	328	
4	13.55300	50.60	19.45	-33.35	32.24	4.46	50.40	45.94	45deg	328	
5	13.56000	64.80	19.45	-33.35	32.24	18.66	83.90	65.24	45deg	328	
6	13.56700	50.10	19.45	-33.35	32.24	3.96	50.40	46.44	45deg	328	
7	13.71000	27.90	19.44	-33.34	32.24	-18.24	40.50	58.74	45deg	328	
8	13.77332	30.60	19.44	-33.34	32.24	-15.54	40.50	56.04	45deg	328	
9	14.01000	27.90	19.43	-33.34	32.24	-18.25	29.50	47.75	45deg	328	

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attnuator + Distance Factor*) - GAIN(AMP))
*) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Result of the fundamental emission at 3 m without Distance factor

QP

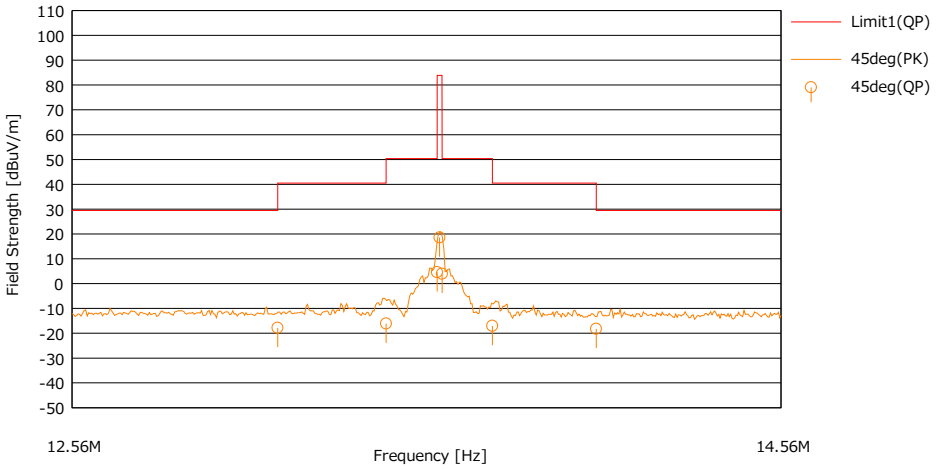
Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	13.56000	QP	64.80	19.45	6.65	32.24	-	58.66	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amprifier)

Fundamental emission and Spectrum Mask

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 4

Limit : FCC15.225(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



No.	Freq. [MHz]	Reading 〈QP〉 [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result 〈QP〉 [dBuV/m]	Limit 〈QP〉 [dBuV/m]	Margin 〈QP〉 [dB]	Antenna	Table [deg]	Comment
1	13.11000	28.30	19.46	-33.36	32.24	-17.84	29.50	47.34	45deg	328	
2	13.41000	30.00	19.45	-33.35	32.24	-16.14	40.50	56.64	45deg	328	
3	13.55300	50.70	19.45	-33.35	32.24	4.56	50.40	45.84	45deg	328	
4	13.56000	64.70	19.45	-33.35	32.24	18.56	83.90	65.34	45deg	328	
5	13.56700	50.10	19.45	-33.35	32.24	3.96	50.40	46.44	45deg	328	
6	13.71000	29.10	19.44	-33.34	32.24	-17.04	40.50	57.54	45deg	328	
7	14.01000	27.90	19.43	-33.34	32.24	-18.25	29.50	47.75	45deg	328	

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attnuator + Distance Factor*) - GAIN(AMP))
*) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Result of the fundamental emission at 3 m without Distance factor

QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	13.56000	QP	64.70	19.45	6.65	32.24	-	58.56	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amprifier)

UL Japan, Inc.
Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

Spurious emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 1

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
45deg	27.120	QP	20.30	19.19	-33.02	32.22	-	-25.75	29.5	55.25	
Hori.	45.570	QP	26.90	12.78	7.39	32.17	-	14.90	40.0	25.10	
Hori.	60.001	QP	37.60	7.88	7.63	32.16	-	20.95	40.0	19.05	
Hori.	89.677	QP	34.00	8.44	8.06	32.15	-	18.35	43.5	25.15	
Hori.	94.920	QP	24.30	9.33	8.11	32.15	-	9.59	43.5	33.91	
Hori.	125.001	QP	32.80	13.44	8.45	32.11	-	22.58	43.5	20.92	
Hori.	447.480	QP	36.50	16.49	11.08	31.99	-	32.08	46.0	13.92	
Vert.	45.570	QP	33.60	12.78	7.39	32.17	-	21.60	40.0	18.40	
Vert.	60.001	QP	43.80	7.88	7.63	32.16	-	27.15	40.0	12.85	
Vert.	89.677	QP	42.00	8.44	8.06	32.15	-	26.35	43.5	17.15	
Vert.	94.920	QP	36.60	9.33	8.11	32.15	-	21.89	43.5	21.61	
Vert.	125.001	QP	46.80	13.44	8.45	32.11	-	36.58	43.5	6.92	
Vert.	447.480	QP	38.30	16.49	11.08	31.99	-	33.88	46.0	12.12	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor) - Gain(Amprifier)

Spurious emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 2

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
45deg	27.120	QP	20.40	19.19	-33.02	32.22	-	-25.65	29.5	55.15	
Hori.	90.314	QP	29.70	8.53	8.06	32.15	-	14.14	43.5	29.36	
Hori.	94.920	QP	24.00	9.33	8.11	32.15	-	9.29	43.5	34.21	
Hori.	125.001	QP	33.90	13.44	8.45	32.11	-	23.68	43.5	19.82	
Hori.	325.440	QP	26.20	14.32	10.24	31.98	-	18.78	46.0	27.22	
Hori.	420.360	QP	32.10	16.09	10.90	31.99	-	27.10	46.0	18.90	
Hori.	474.600	QP	31.60	17.11	11.27	31.99	-	27.99	46.0	18.01	
Vert.	90.314	QP	41.60	8.53	8.06	32.15	-	26.04	43.5	17.46	
Vert.	94.920	QP	34.80	9.33	8.11	32.15	-	20.09	43.5	23.41	
Vert.	125.001	QP	46.90	13.44	8.45	32.11	-	36.68	43.5	6.82	
Vert.	325.440	QP	27.90	14.32	10.24	31.98	-	20.48	46.0	25.52	
Vert.	420.360	QP	36.30	16.09	10.90	31.99	-	31.30	46.0	14.70	
Vert.	474.600	QP	39.30	17.11	11.27	31.99	-	35.69	46.0	10.31	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor) - Gain(Amprifier)

Spurious emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 3

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
45deg	27.120	QP	20.30	19.19	-33.02	32.22	-	-25.75	29.5	55.25	
Hori.	90.313	QP	29.80	8.53	8.06	32.15	-	14.24	43.5	29.26	
Hori.	94.920	QP	23.80	9.33	8.11	32.15	-	9.09	43.5	34.41	
Hori.	125.002	QP	33.40	13.44	8.45	32.11	-	23.18	43.5	20.32	
Hori.	325.440	QP	26.00	14.32	10.24	31.98	-	18.58	46.0	27.42	
Hori.	447.480	QP	35.70	16.49	11.08	31.99	-	31.28	46.0	14.72	
Hori.	474.600	QP	29.90	17.11	11.27	31.99	-	26.29	46.0	19.71	
Vert.	90.313	QP	42.20	8.53	8.06	32.15	-	26.64	43.5	16.86	
Vert.	94.920	QP	36.50	9.33	8.11	32.15	-	21.79	43.5	21.71	
Vert.	125.002	QP	46.80	13.44	8.45	32.11	-	36.58	43.5	6.92	
Vert.	325.440	QP	27.90	14.32	10.24	31.98	-	20.48	46.0	25.52	
Vert.	447.480	QP	36.90	16.49	11.08	31.99	-	32.48	46.0	13.52	
Vert.	474.600	QP	37.50	17.11	11.27	31.99	-	33.89	46.0	12.11	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor) - Gain(Amprifier)

Spurious emission

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 4

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
45deg	27.120	QP	20.30	19.19	-33.02	32.22	-	-25.75	29.5	55.25	
Hori.	90.324	QP	29.80	8.54	8.06	32.15	-	14.25	43.5	29.25	
Hori.	94.920	QP	24.40	9.33	8.11	32.15	-	9.69	43.5	33.81	
Hori.	125.001	QP	33.90	13.44	8.45	32.11	-	23.68	43.5	19.82	
Hori.	325.440	QP	26.10	14.32	10.24	31.98	-	18.68	46.0	27.32	
Hori.	447.480	QP	36.80	16.49	11.08	31.99	-	32.38	46.0	13.62	
Hori.	474.600	QP	26.60	17.11	11.27	31.99	-	22.99	46.0	23.01	
Vert.	90.324	QP	42.10	8.54	8.06	32.15	-	26.55	43.5	16.95	
Vert.	94.920	QP	37.80	9.33	8.11	32.15	-	23.09	43.5	20.41	
Vert.	125.001	QP	46.80	13.44	8.45	32.11	-	36.58	43.5	6.92	
Vert.	325.440	QP	27.80	14.32	10.24	31.98	-	20.38	46.0	25.62	
Vert.	447.480	QP	38.40	16.49	11.08	31.99	-	33.98	46.0	12.02	
Vert.	474.600	QP	33.80	17.11	11.27	31.99	-	30.19	46.0	15.81	

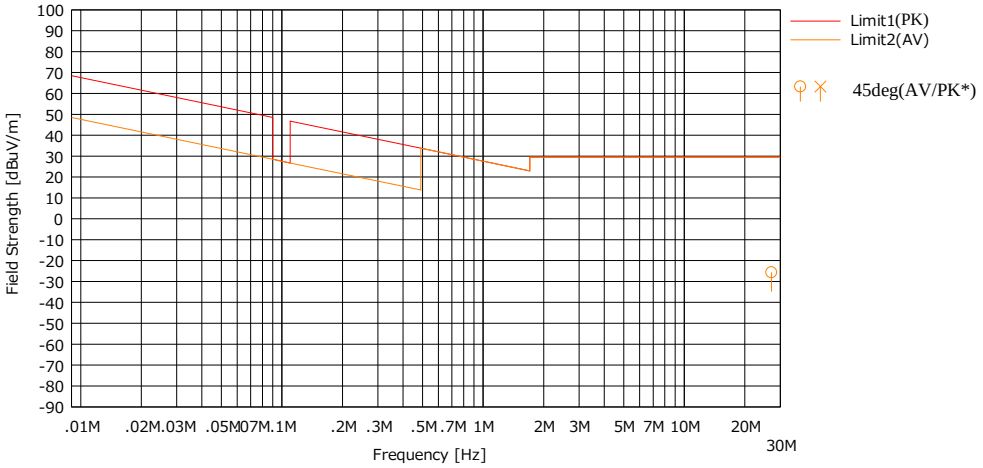
Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor) - Gain(Amprifier)

Radiated Emission Plot data, Worst case

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	July 8, 2020
Temperature / Humidity	22 deg. C / 74 % RH
Engineer	Akihiko Maeda
Mode	Mode 2

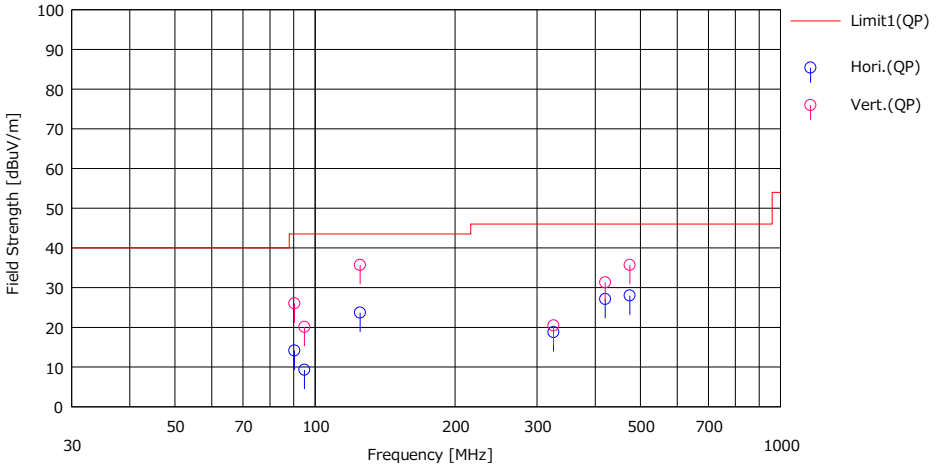
(below 30MHz)

Limit : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



* Data above 490 kHz were measured using a QP detector.

(above 30MHz)



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

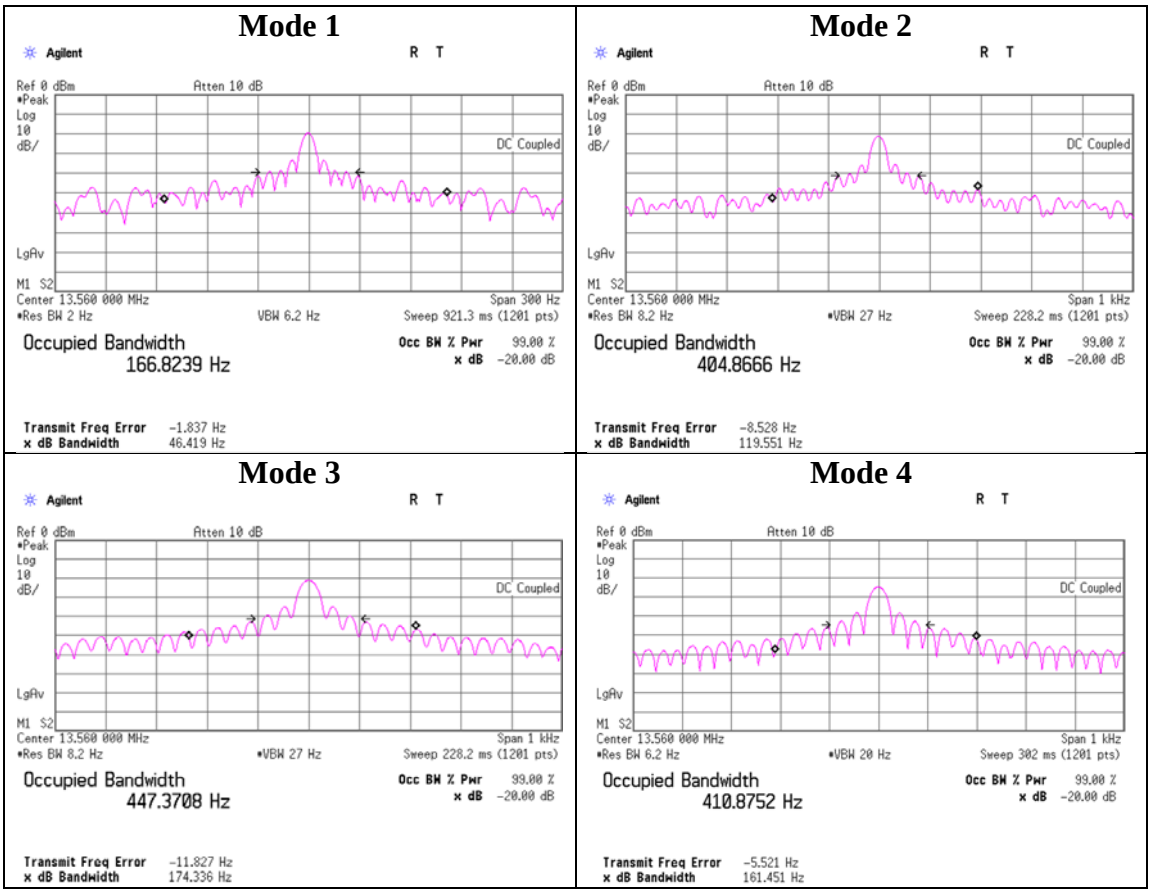
20 dB Bandwidth and 99% Occupied Bandwidth

Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	July 9, 2020
Temperature / Humidity	23 deg. C / 70 % RH
Engineer	Ken Fujita
Mode	Mode 1 to 4

Mode	FREQ [MHz]	20dB Bandwidth [Hz]	99% Occupied Bandwidth [kHz]
Mode 1	13.56	46.419	1.4844
Mode 2	13.56	119.551	2.0734
Mode 3	13.56	174.336	1.1244
Mode 4	13.56	161.451	0.9537

20 dB Bandwidth

Mode 1



Mode 2

Mode 3

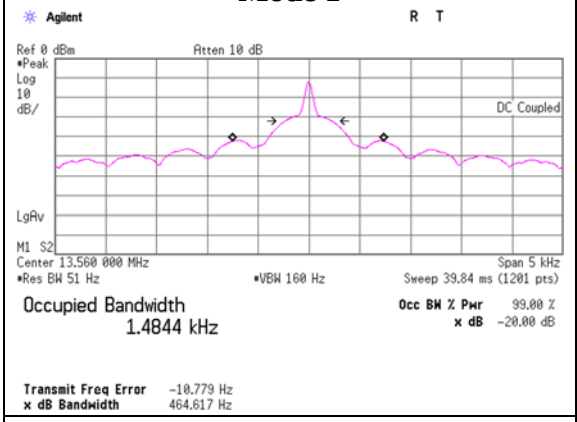
Mode 4

20 dB Bandwidth and 99% Occupied Bandwidth

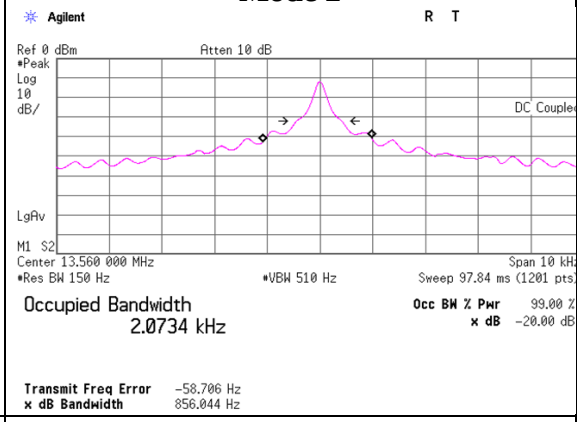
Report No.	13350488H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	July 9, 2020
Temperature / Humidity	23 deg. C / 70 % RH
Engineer	Ken Fujita
Mode	Mode 1 to 4

99% Occupied Bandwidth

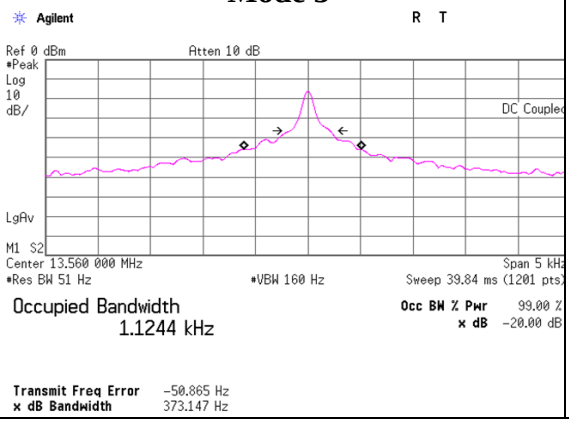
Mode 1



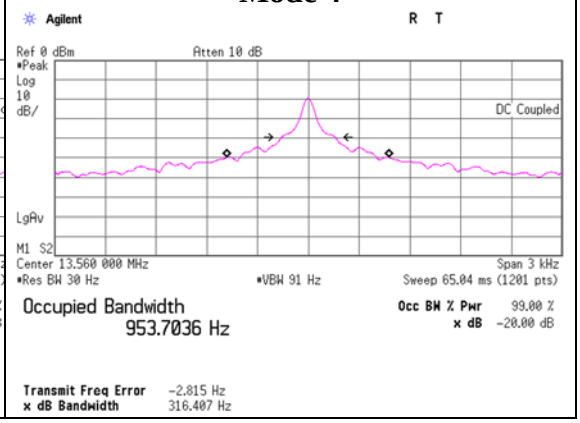
Mode 2



Mode 3



Mode 4



Frequency Tolerance

Report No.	13350488H
Test place	Ise EMC Lab.
Measurement Room	No.6
Date	June 16, 2020
Temperature / Humidity	22 deg. C / 50 % RH
Engineer	Akihiko Maeda
Mode	Mode 1, CW

Test condition		Tested	Measured	Frequency	Result		Limit
Temp.	Voltage	timing	frequency	error			
[deg. C]	[V]		[MHz]	[MHz]	[%]	[ppm]	[+/- %]
50	24	Power on	13.560055	0.000055	0.00041	4.1	0.01
		+ 2 min.	13.560064	0.000064	0.00047	4.7	0.01
		+ 5 min.	13.560088	0.000088	0.00065	6.5	0.01
		+ 10 min.	13.560099	0.000099	0.00073	7.3	0.01
40	24	Power on	13.560055	0.000055	0.00041	4.1	0.01
		+ 2 min.	13.560061	0.000061	0.00045	4.5	0.01
		+ 5 min.	13.560068	0.000068	0.00050	5.0	0.01
		+ 10 min.	13.560075	0.000075	0.00056	5.6	0.01
30	24	Power on	13.560059	0.000059	0.00044	4.4	0.01
		+ 2 min.	13.560055	0.000055	0.00041	4.1	0.01
		+ 5 min.	13.560058	0.000058	0.00043	4.3	0.01
		+ 10 min.	13.560059	0.000059	0.00044	4.4	0.01
20	24	Power on	13.560057	0.000057	0.00042	4.2	0.01
		+ 2 min.	13.560057	0.000057	0.00042	4.2	0.01
		+ 5 min.	13.560056	0.000056	0.00042	4.2	0.01
		+ 10 min.	13.560056	0.000056	0.00041	4.1	0.01
20	20.4	Power on	13.560061	0.000061	0.00045	4.5	0.01
	(24V -15%)	+ 2 min.	13.560058	0.000058	0.00043	4.3	0.01
		+ 5 min.	13.560058	0.000058	0.00042	4.2	0.01
		+ 10 min.	13.560055	0.000055	0.00041	4.1	0.01
20	27.6	Power on	13.560056	0.000056	0.00041	4.1	0.01
	(24V +15%)	+ 2 min.	13.560055	0.000055	0.00041	4.1	0.01
		+ 5 min.	13.560056	0.000056	0.00041	4.1	0.01
		+ 10 min.	13.560056	0.000056	0.00041	4.1	0.01
10	24	Power on	13.560072	0.000072	0.00053	5.3	0.01
		+ 2 min.	13.560069	0.000069	0.00051	5.1	0.01
		+ 5 min.	13.560067	0.000067	0.00050	5.0	0.01
		+ 10 min.	13.560067	0.000067	0.00049	4.9	0.01
0	24	Power on	13.560078	0.000078	0.00058	5.8	0.01
		+ 2 min.	13.560078	0.000078	0.00058	5.8	0.01
		+ 5 min.	13.560078	0.000078	0.00058	5.8	0.01
		+ 10 min.	13.560077	0.000077	0.00057	5.7	0.01
-10	24	Power on	13.560062	0.000062	0.00046	4.6	0.01
		+ 2 min.	13.560073	0.000073	0.00054	5.4	0.01
		+ 5 min.	13.560077	0.000077	0.00057	5.7	0.01
		+ 10 min.	13.560078	0.000078	0.00057	5.7	0.01
-20	24	Power on	13.560062	0.000062	0.00046	4.6	0.01
		+ 2 min.	13.560072	0.000072	0.00053	5.3	0.01
		+ 5 min.	13.560074	0.000074	0.00055	5.5	0.01
		+ 10 min.	13.560078	0.000078	0.00057	5.7	0.01

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Tested frequency: 13.56 MHz
Limit (+/-): 0.01 % (+/- 100ppm)

*The test was begun from 50 deg.C and the temperature was lowered each 10 deg.C.

APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	MLS-23	141357	LISN(AMN)	Schwarzbeck Mess - Elektronik	NSLK8127	8127-729	07/05/2019	12
CE	MLS-24	141358	LISN(AMN)	Schwarzbeck Mess - Elektronik	NSLK8127	8127-730	07/05/2019	12
CE	MTA-55	141937	Terminator	TME	CT-01BP	-	12/02/2019	12
CE	MAT-67	141248	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	12/02/2019	12
CE	MTA-52	141934	Terminator	TME	CT-01BP	-	12/02/2019	12
CE/RE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2020	24
CE/RE	MOS-13	141554	Thermo-Hygrometer	CUSTOM	CTH-201	1301	01/07/2020	12
CE/RE	MMM-08	141532	DIGITAL HiTESTER	Hioki	3805	51201197	01/06/2020	12
CE/RE	MJM-16	142183	Measure	KOMELON	KMC-36	-	-	-
CE/RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
CE/RE	MCC-112	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/ sucoform141-PE/421-010/ RFM-E321(SW)	-/00640	07/06/2020	12
CE/RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/02/2019	12
RE	MAT-95	142314	Attenuator	Pasternack	PE7390-6	D/C 1504	06/17/2020	12
RE	MLPA-01	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/04/2019	12
RE	MCC-143	141413	Coaxial Cable	UL Japan	-	-	06/18/2020	12
RE	MSA-15	141902	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187105	10/09/2019	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/10/2020	12
RE	MBA-03	141424	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHA9103+BBA9106	1915	08/24/2019	12
RE	MCC-51	141323	Coaxial cable	UL Japan	-	-	07/06/2020	12
RE	MLA-22	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess - Elektronik	VUSLP9111B	9111B-191	08/24/2019	12
FT	MOS-14	141561	Thermo-Hygrometer	CUSTOM	CTH-201	1401	01/07/2020	12
FT	MMM-12	141547	DIGITAL HiTESTER	Hioki	3805	60500120	02/03/2020	12
FT	MJM-24	142225	Measure	ASKUL	-	-	-	-
FT	MLPA-07	142645	Loop Antenna	UL Japan	-	-	-	-
FT	MSA-17	141904	Spectrum Analyzer	Keysight Technologies Inc	N9030A	US51350215	09/20/2019	12
FT	MSA-14	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	10/06/2019	12
FT	MCH-04	141429	Temperature and Humidity Chamber	ESPEC	PL-2KP	14015723	2019/08/02	12

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

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item:

CE: Conducted Emission
RE: Radiated Emission
FT: Frequency Tolerance