



RADIO TEST REPORT

Test Report No. : 11343374H-A-R1

Applicant : DENSO WAVE INCORPORATED
Type of Equipment : Fixed Type IC Card 2D Code Scanner
Model No. : QK30-IC
Test regulation : FCC Part 15 Subpart C: 2016
FCC ID : PZWQK301C
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with above regulation.
4. The test results in this report are traceable to the national or international standards.
5. 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.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 11343374H-A. 11343374H-A is replaced with this report.

Date of test: July 14 to 16, 2016

Representative test engineer:


Ken Fujita
Engineer
Consumer Technology Division

Approved by:


Tsubasa Takayama
Engineer
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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13-EM-F0429

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SECTION 1: Customer information

Company Name : DENSO WAVE INCORPORATED
Address : 1 Yoshiike, Kusagi, Agui-cho Chita-gun, Aichi 470-2297 Japan
Telephone Number : +81-569-49-5352
Facsimile Number : +81-569-49-5488
Contact Person : Hidekazu Kishi

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

2.1 Identification of E.U.T.

Type of Equipment : Fixed Type IC Card 2D Code Scanner
Model No. : QK30-IC
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 5.0 V
Receipt Date of Sample : July 13, 2016
Country of Mass-production : Japan
Condition of EUT : Production model
Modification of EUT : No Modification by the test lab

2.2 Product Description

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 13.56 MHz
Modulation : ASK
Power Supply (radio part input) : DC 4.1 V / DC 3.3 V
Antenna Type : Loop coil
Antenna Connector Type : FFC connector
Clock Frequency : 27.12 MHz
Method of Frequency Generation : Quartz Crystal

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC part 15 final revised on April 6, 2016.

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.225 : Operation within the band 13.110-14.010MHz

* 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	Section 15.207	[QP] 15.3 dB 4.74825 MHz, L	Complied	-
	<IC>RSS-Gen 8.8	<IC>RSS-Gen 8.8	[AV] 8.3 dB 0.40084 MHz, N		
Electric Field Strength of Fundamental Emission	ANSI C63.10:2013 6 Standard test methods	Section 15.225(a)	39.7 dB, 13.56000 MHz, QP, 0 deg.	Complied	Radiated
	<IC> RSS-Gen 6.4, 6.12	<IC>RSS-210 A2.6			
Spectrum Mask	ANSI C63.10:2013 6 Standard test methods	Section 15.225(b)(c)	20.1 dB, 13.55300 MHz, QP, 0 deg.	Complied	Radiated
	<IC>RSS-Gen 6.4, 6.13	<IC> RSS-210 A2.6			
20dB Bandwidth	ANSI C63.10:2013 6 Standard test methods	Section15.215(c)	See data	Complied	Radiated
	<IC> -	<IC> -			
Electric Field Strength of Spurious Emission	ANSI C63.10:2013 6 Standard test methods	Section 15.209, Section 15.225 (d)	5.2 dB 40.680 MHz, Horizontal, QP	Complied	Radiated
	<IC>RSS-Gen 6.4, 6.13	<IC>RSS-210 A2.6			
Frequency Tolerance	ANSI C63.10:2013 6 Standard test methods	Section 15.225(e)	See data	Complied	Radiated
	<IC>RSS-Gen 6.11, 8.11	<IC> RSS-210 A2.6			
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422					

FCC 15.31 (e)

This EUT provides stable voltage (DC 4.1 V / DC 3.3 V) constantly to RF part regardless of input voltage. Therefore, this EUT complies with the requirement.

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.

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3.3 Addition to standard

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99 % Occupied Band Width	RSS-Gen 6.6	-	Radiated	N/A	N/A	N/A

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

3.4 Uncertainty

EMI

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

Frequency range	Conducted emission using AMN(LISN) ($\pm$ dB)
0.009 – 0.15MHz	3.5 dB
0.15 – 30MHz	2.9 dB

Test distance	Radiated emission ($\pm$ dB)
	9 kHz - 30 MHz
3m	3.8 dB
10m	3.7 dB

*Measurement distance

Polarity	Radiated emission (Below 1GHz)			
	(3 m*)($\pm$ dB)		(10 m*)($\pm$ dB)	
	30 – 200 MHz	200 – 1000MHz	30 – 200 MHz	200 – 1000MHz
Horizontal	4.9 dB	5.2 dB	4.9 dB	5.0 dB
Vertical	4.6 dB	5.9 dB	5.0 dB	5.0 dB

* Measurement distance

Frequency counter ($\pm$)	
Normal condition	Extreme condition
7×10^{-6}	9×10^{-6}

Conducted emission test

The data listed in this test report has enough margin, more than the site margin.

Radiated emission test (3 m)

The data listed in this test report has enough margin, more than the site margin.

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3.5 Test Location

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	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	4.0 x 4.5 x 2.7m	4.0 x 4.5 m	-
No.6 measurement room	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	8.0 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	6.2 x 4.7 x 3.0m	4.8 x 4.6m	-

* Size of vertical conducting plane (for Conducted Emission test): 2.0 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 set up, Test data, and Test instruments

Refer to APPENDIX.

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

4.1 Operating Modes

The mode is used :

Mode	Remarks*
Transmitting mode (Tx) 13.56MHz Mod on	The EUT Transmits and Receives at the same time and there is no receiving mode.
Any condition 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 without Tag Tx terminated
Electric Field Strength of Fundamental Emission	Tx without Tag Tx with Tag
Spectrum Mask	Tx without Tag *1)
20dB Bandwidth	Tx without Tag Tx with Tag
Electric Field Strength of Spurious Emission	Tx without Tag *1)
Frequency Tolerance	Tx without Tag

*1) After the comparison of the test data between with Tag and without Tag, the tests were performed without Tag which was the worst case.

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

Frequency Tolerance:

Temperature : -30deg.C to +50deg.C Step 10deg.C
Voltage : Normal Voltage DC 5 V
Maximum Voltage DC 5.75 V
Minimum Voltage DC 4.25 V
(DC 5 V $\pm$ 15%)

*This EUT provides stable voltage (DC 4.1 V / DC 3.3 V) constantly to RF Part regardless of input voltage.

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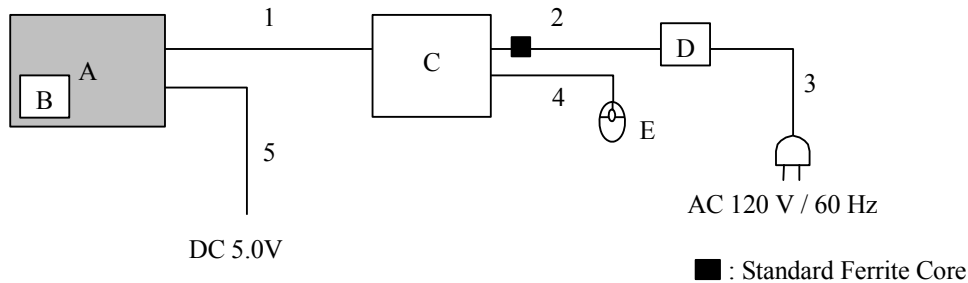
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4.2 Configuration and peripherals



* Cabling and setup 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	Remark
A	Fixed Type IC Card 2D Code Scanner	QK30-IC	601352 *1) 601354 *2)	DENSO WAVE INCORPORATED	EUT
B	Tag	MIFARE Standard 1K (Type A)	-	-	-
		Xaica (Type B)			
		FeliCa RC-S860 (Type C (FeliCa))			
C	Laptop PC	PC-VAIOJRXEADFG	2500034EA	NEC	-
D	AC Adapter	ADP-60HN	2510177DAA	NEC	-
E	Mouse	M-S48a	HCA20801217	Logitech	-

*1) Used for other tests except for Frequency Tolerance test.

*2) Used for Frequency Tolerance test only.

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	USB Cable	1.8	Shielded	Shielded	-
2	DC Cable	1.9	Unshielded	Unshielded	-
3	AC Cable	1.8	Unshielded	Unshielded	-
4	PS2 Cable	1.7	Shielded	Shielded	-
5	DC Cable	2.0	Unshielded	Unshielded	*1)

*1) Used for Frequency Tolerance test only.

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SECTION 5: Conducted emission

Test Procedure and conditions

EUT was placed on a wooden table 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.

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: 0 deg., 45 deg., 90 deg., and 135 deg.) and horizontal polarization. After pre check by antenna angle, test was performed by worst antenna angles.

*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	Above 1 GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

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	Above 1 GHz	
Instrument used	Test Receiver					Spectrum Analyzer	
Detector	PK / AV	QP	PK / AV	QP	QP	PK	AV
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz
Test Distance	3 m *1)	3 m *1)	3 m *1)	3 m *2)	3 m	3 m	3 m

*1) Distance Factor: $40 \times \log(3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

*2) Distance Factor: $40 \times \log(3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

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 937606.

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.

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- 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

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SECTION 7: Other test

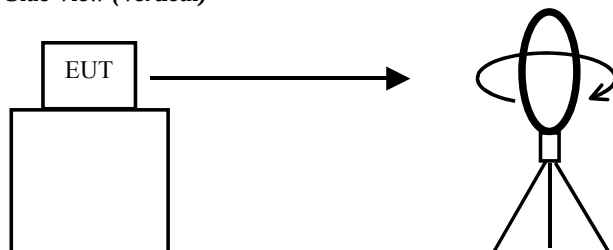
Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	50 kHz	1 kHz	3 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak *1)	Max Hold *1)	Spectrum Analyzer
Frequency Tolerance	-	-	-	-	-	-	Frequency counter

*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.

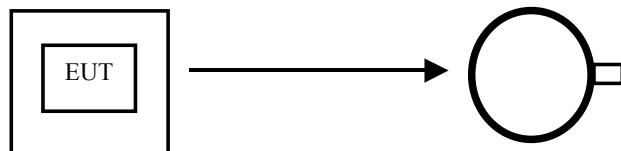
Test data : APPENDIX
Test result : Pass

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

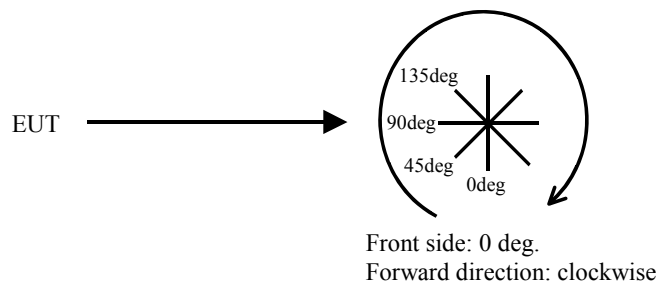


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



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APPENDIX 1: Test data

Conducted emission (Type A)

DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/15

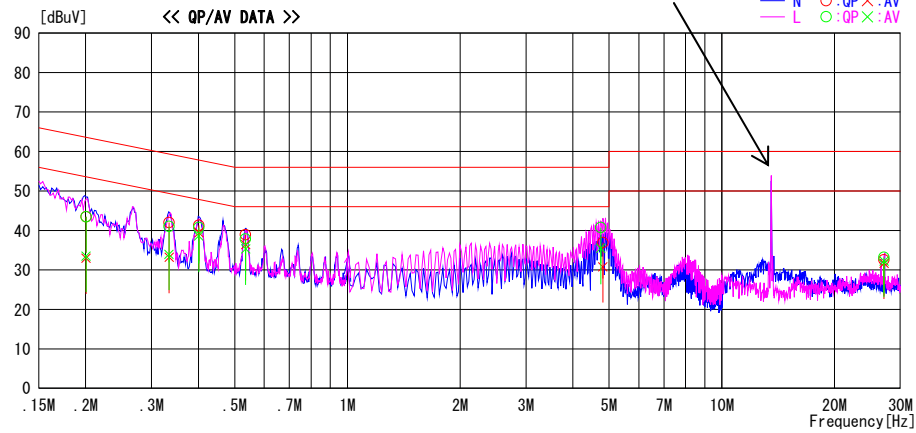
Report No. : 11343374H

Temp./Humi. : 22deg. C / 65% RH
Engineer : Masafumi Niwa

Mode / Remarks : Tx 13.56MHz TypeA without tag

LIMIT : FCC15.207 QP
FCC15.207 AV

13.56MHz Carrier



Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.20050	30.3	20.3	13.2	43.5	33.5	63.6	53.6	20.1	20.1	L	
0.20060	30.3	19.8	13.2	43.5	33.0	63.6	53.6	20.1	20.6	N	
0.33386	27.7	20.7	13.3	41.0	34.0	59.4	49.4	18.4	15.4	L	
0.33412	28.7	19.9	13.3	42.0	33.2	59.3	49.3	17.3	16.1	N	
0.40111	27.4	25.3	13.3	40.7	38.6	57.8	47.8	17.1	9.2	L	
0.40162	28.0	26.1	13.3	41.3	39.4	57.8	47.8	16.5	8.4	N	
0.53464	24.5	22.0	13.3	37.8	35.3	56.0	46.0	18.2	10.7	L	
0.53491	25.6	23.1	13.3	38.9	36.4	56.0	46.0	17.1	9.6	N	
4.74825	26.9	21.7	13.8	40.7	35.5	56.0	46.0	15.3	10.5	L	
4.81364	23.1	17.0	13.8	36.9	30.8	56.0	46.0	19.1	15.2	N	
27.12000	17.5	16.6	15.1	32.6	31.7	60.0	50.0	27.4	18.3	N	
27.12000	18.1	17.1	15.1	33.2	32.2	60.0	50.0	26.8	17.8	L	

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

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Conducted emission (Type A Terminated)

DATA OF CONDUCTED EMISSION TEST

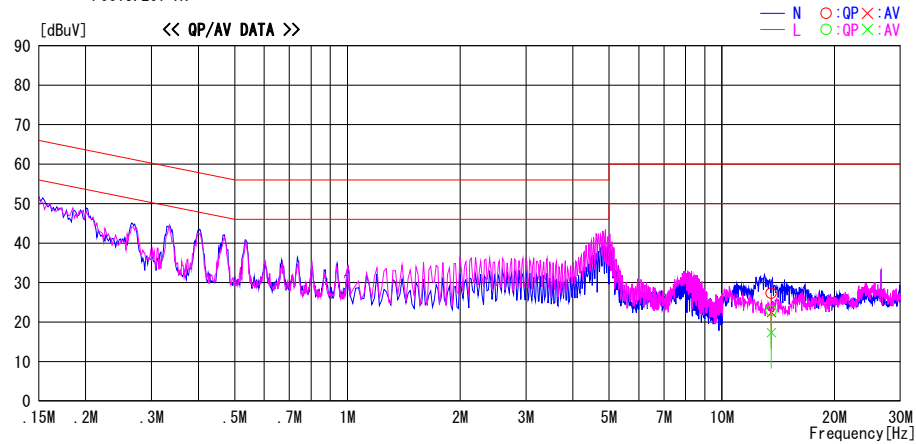
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/15

Report No. : 11343374H

Temp./Humi. : 22deg. C / 65% RH
Engineer : Masafumi Niwa

Mode / Remarks : Tx 13.56MHz TypeA terminated

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor [dB]	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
13.56000	12.8	7.9	14.5	27.3	22.4	60.0	50.0	32.7	27.6	N	terminated
13.56000	8.3	2.8	14.5	22.8	17.3	60.0	50.0	37.2	32.7	L	terminated

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

Conducted emission
(Type B)

DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/15

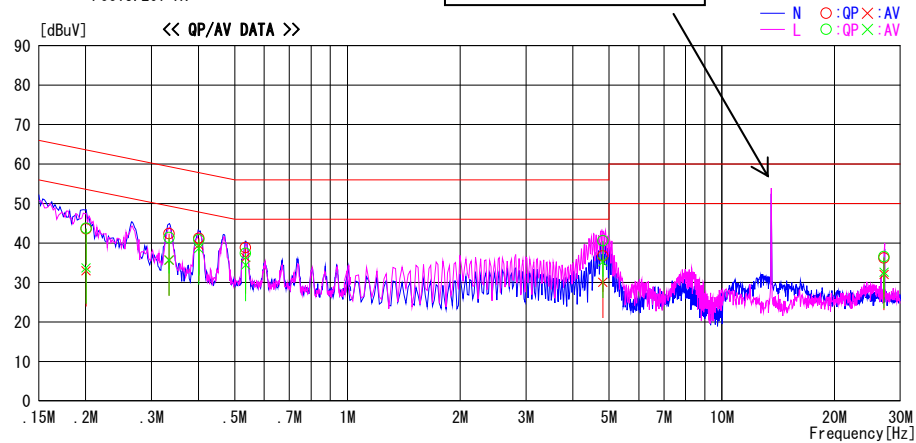
Report No. : 11343374H

Temp./Humi. : 22deg. C / 65% RH
Engineer : Masafumi Niwa

Mode / Remarks : Tx 13.56MHz TypeB without tag

LIMIT : FCC15.207 QP
FCC15.207 AV

13.56MHz Carrier



Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.20046	30.5	20.5	13.2	43.7	33.7	63.6	53.6	19.9	19.9	L	
0.20060	30.4	19.8	13.2	43.6	33.0	63.6	53.6	20.0	20.6	N	
0.33383	28.1	22.4	13.3	41.4	35.7	59.4	49.4	18.0	13.7	L	
0.33412	29.1	22.4	13.3	42.4	35.7	59.3	49.3	16.9	13.6	N	
0.40084	27.9	26.2	13.3	41.2	39.5	57.8	47.8	16.6	8.3	N	
0.40099	27.5	25.3	13.3	40.8	38.6	57.8	47.8	17.0	9.2	L	
0.53468	25.5	23.0	13.3	38.8	36.3	56.0	46.0	17.2	9.7	N	
0.53491	24.1	21.1	13.3	37.4	34.4	56.0	46.0	18.6	11.6	L	
4.81290	22.9	16.3	13.8	36.7	30.1	56.0	46.0	19.3	15.9	N	
4.81341	26.8	21.4	13.8	40.6	35.2	56.0	46.0	15.4	10.8	L	
27.12000	21.1	17.0	15.1	36.2	32.1	60.0	50.0	23.8	17.9	N	
27.12000	21.5	17.5	15.1	36.6	32.6	60.0	50.0	23.4	17.4	L	

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

Conducted emission (Type B Terminated)

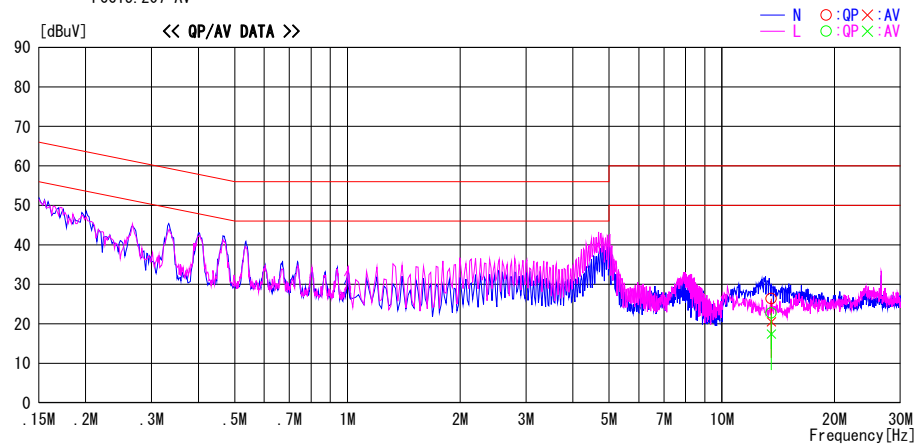
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/15

Report No. : 11343374H
Temp./Humi. : 22deg. C / 65% RH
Engineer : Masafumi Niwa

Mode / Remarks : Tx 13.56MHz TypeB terminated

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
13.56000	11.9	6.0	14.5	26.4	20.5	60.0	50.0	33.6	29.5	N	terminated
13.56000	8.2	2.9	14.5	22.7	17.4	60.0	50.0	37.3	32.6	L	terminated

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

Conducted emission
(Type C)

DATA OF CONDUCTED EMISSION TEST

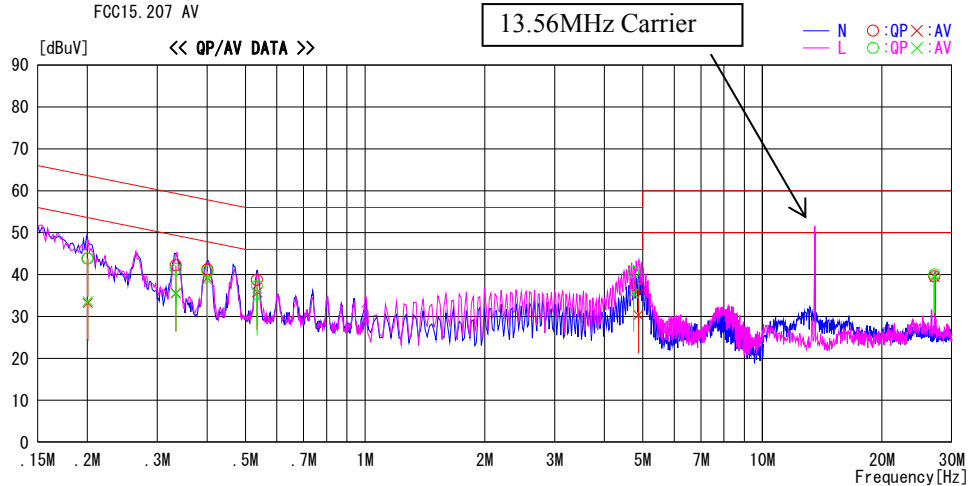
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/15

Report No. : 11343374H

Temp./Humi. : 22deg. C / 65% RH
Engineer : Masafumi Niwa

Mode / Remarks : Tx 13.56MHz TypeC without tag

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor [dB]	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.20041	30.6	20.5	13.2	43.8	33.7	63.6	53.6	19.8	19.9	L	
0.20051	30.6	20.0	13.2	43.8	33.2	63.6	53.6	19.8	20.4	N	
0.33375	28.9	22.3	13.3	42.2	35.6	59.4	49.4	17.2	13.8	N	
0.33385	28.0	22.1	13.3	41.3	35.4	59.4	49.4	18.1	14.0	L	
0.40084	27.4	25.4	13.3	40.7	38.7	57.8	47.8	17.1	9.1	L	
0.40100	27.9	25.9	13.3	41.2	39.2	57.8	47.8	16.6	8.6	N	
0.53478	24.0	21.3	13.3	37.3	34.6	56.0	46.0	18.7	11.4	L	
0.53481	25.4	22.5	13.3	38.7	35.8	56.0	46.0	17.3	10.2	N	
4.74434	26.8	21.7	13.8	40.6	35.5	56.0	46.0	15.4	10.5	L	
4.87677	23.2	16.5	13.8	37.0	30.3	56.0	46.0	19.0	15.7	N	
27.12000	24.5	24.3	15.1	39.6	39.4	60.0	50.0	20.4	10.6	N	
27.12000	24.9	24.8	15.1	40.0	39.9	60.0	50.0	20.0	10.1	L	

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

Conducted emission (Type C Terminated)

DATA OF CONDUCTED EMISSION TEST

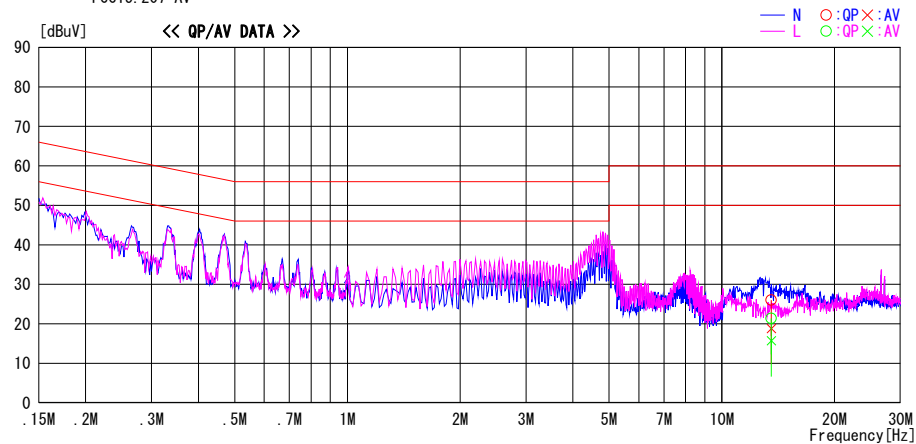
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/15

Report No. : 11343374H

Temp./Humi. : 22deg. C / 65% RH
Engineer : Masafumi Niwa

Mode / Remarks : Tx 13.56MHz TypeC terminated

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
13.56000	11.5	4.3	14.5	26.0	18.8	60.0	50.0	34.0	31.2	N	terminated
13.56000	6.9	1.2	14.5	21.4	15.7	60.0	50.0	38.6	34.3	L	terminated

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

Fundamental emission and Spectrum Mask (Type A)

DATA OF RADIATED EMISSION TEST

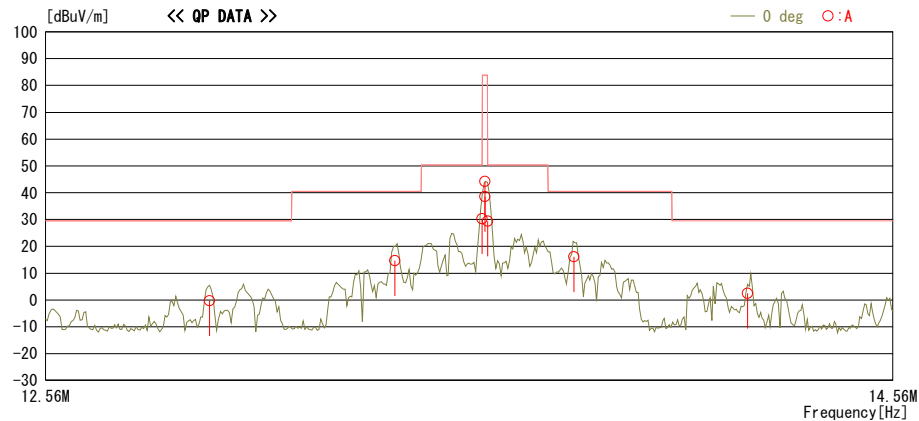
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/14

Report No. : 11343374H

Temp./ Humi. : 23deg. C / 43% RH
Engineer : Koji Yamamoto

Mode / Remarks : Tx 13.56 MHz TypeA, Y-Axis, Without Tag

LIMIT : FCC15_225_PKQP, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15_225_AVQP, 9-90kHz:AV, 110-490kHz:AV, other:QP



Freq.	Reading	DET	Ant. Fac	Loss	Gain	Result	Limit	Margin	Antenna	Table	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[deg]	[deg]	
12.92472	45.7	QP	19.2	-32.9	32.3	-0.3	29.5	29.8	0	A	181
13.34866	60.6	QP	19.2	-32.9	32.3	14.6	40.5	25.9	0	A	181
13.55300	76.3	QP	19.2	-32.9	32.3	30.3	50.4	20.1	0	A	181
13.56000	90.2	QP	19.2	-32.9	32.3	44.2	83.9	39.7	0	A	181
13.56000	84.5	QP	19.2	-32.9	32.3	38.5	83.9	45.4	0	A	181
13.56700	75.4	QP	19.2	-32.9	32.3	29.4	50.4	21.0	0	A	181
13.77177	62.1	QP	19.2	-32.9	32.3	16.1	40.5	24.4	0	A	181
14.19560	48.5	QP	19.2	-32.9	32.3	2.5	29.5	27.0	0	A	181

CHART: WITH FACTOR. ANT TYPE: LOOP. Except for the data below: adequate margin data below the limits.
CALCULATION : RESULT = READING + ANT FACTOR + LOSS (CABLE + ATTN + D. FACTOR) - GAIN (AMP)

Result of the fundamental emission at 3 m without Distance factor

QP

Ant Deg [deg]	Frequency	Detector	Reading	Ant Factor	Loss	Gain	Duty Factor	Result	Limit	Margin	Remark
	[MHz]		[dBuV]	[dB/m]	[dB]	[dB]		[dBuV/m]	[dBuV/m]	[dB]	
0	13.56000	QP	90.2	19.2	7.1	32.3	-	84.2	-	-	Fundamental

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

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Fundamental emission and Spectrum Mask (Type B)

DATA OF RADIATED EMISSION TEST

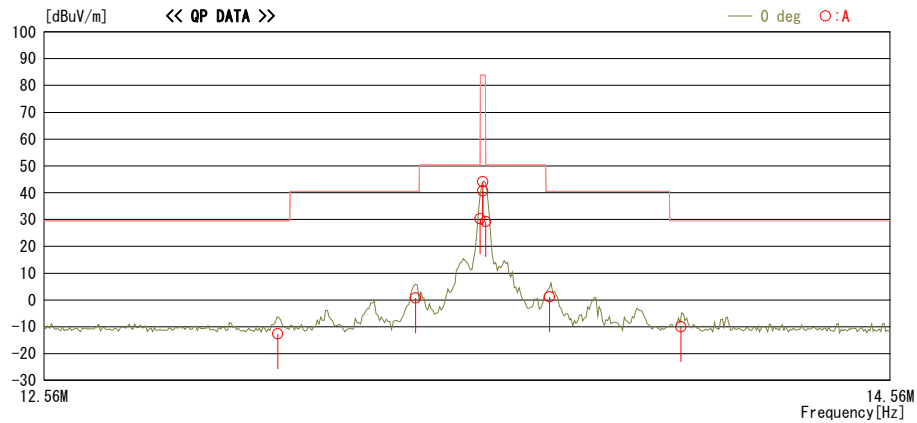
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/14

Report No. : 11343374H

Temp./ Humi. : 23deg. C / 43% RH
Engineer : Koji Yamamoto

Mode / Remarks : Tx 13.56 MHz TypeB, Y-Axis, Without Tag

LIMIT : FCC15_225_PKQP, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15_225_AVQP, 9-90kHz:AV, 110-490kHz:AV, other:QP



Freq.	Reading	DET	Ant. Fac	Loss	Gain	Result	Limit	Margin	Antenna	Table	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[deg]	[deg]	
13.08291	33.3	QP	19.2	-32.9	32.3	-12.7	29.5	42.2	0	A	181
13.40122	46.7	QP	19.2	-32.9	32.3	0.7	40.5	39.8	0	A	181
13.55300	76.3	QP	19.2	-32.9	32.3	30.3	50.4	20.1	0	A	181
13.56000	90.1	QP	19.2	-32.9	32.3	44.1	83.9	39.8	0	A	181
13.56000	86.7	QP	19.2	-32.9	32.3	40.7	83.9	43.2	0	A	181
13.56700	75.3	QP	19.2	-32.9	32.3	29.3	50.4	21.1	0	A	181
13.71884	47.1	QP	19.2	-32.9	32.3	1.1	40.5	39.4	0	A	181
14.03700	36.0	QP	19.2	-32.9	32.3	-10.0	29.5	39.5	0	A	181

CHART: WITH FACTOR, ANT TYPE: LOOP Except for the data below: adequate margin data below the limits.
CALCULATION : RESULT = READING + ANT FACTOR + LOSS (CABLE + ATTEN + D. FACTOR) - GAIN (AMP)

Result of the fundamental emission at 3 m without Distance factor

QP

Ant Deg [deg]	Frequency	Detector	Reading	Ant Factor	Loss	Gain	Duty Factor	Result	Limit	Margin	Remark
	[MHz]		[dBuV]	[dB/m]	[dB]	[dB]		[dBuV/m]	[dBuV/m]	[dB]	
0	13.56000	QP	90.1	19.2	7.1	32.3	-	84.1	-	-	Fundamental

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

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Fundamental emission and Spectrum Mask (Type C)

DATA OF RADIATED EMISSION TEST

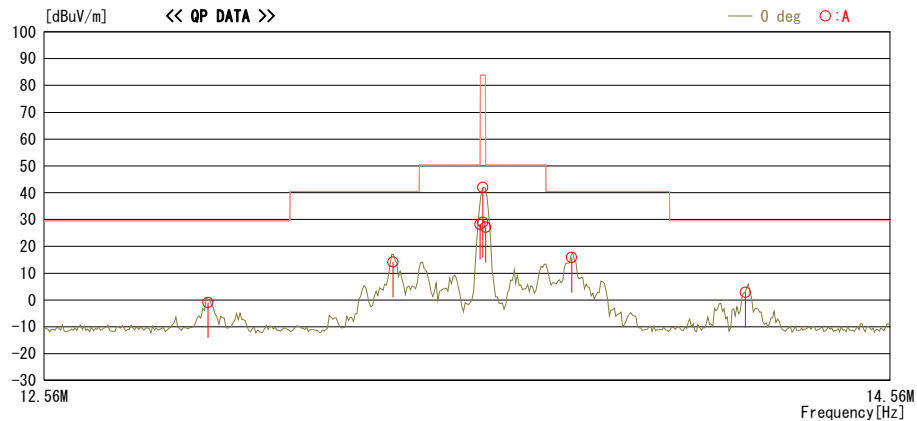
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/14

Report No. : 11343374H

Temp./ Humi. : 23deg. C / 43% RH
Engineer : Koji Yamamoto

Mode / Remarks : Tx 13.56 MHz TypeC (Felica 212kbps), Y-Axis, Without Tag

LIMIT : FCC15_225_PKQP, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15_225_AVQP, 9-90kHz:AV, 110-490kHz:AV, other:QP



Freq.	Reading	DET	Ant. Fac	Loss	Gain	Result	Limit	Margin	Antenna	Table	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[deg]	[deg]	
12.92463	45.1	QP	19.2	-32.9	32.3	-0.9	29.5	30.4	0	A	181
13.34880	60.1	QP	19.2	-32.9	32.3	14.1	40.5	26.4	0	A	181
13.55300	74.2	QP	19.2	-32.9	32.3	28.2	50.4	22.2	0	A	181
13.56000	88.0	QP	19.2	-32.9	32.3	42.0	83.9	41.9	0	A	181
13.56000	75.0	QP	19.2	-32.9	32.3	29.0	83.9	54.9	0	A	181
13.56700	73.2	QP	19.2	-32.9	32.3	27.2	50.4	23.2	0	A	181
13.77224	61.8	QP	19.2	-32.9	32.3	15.8	40.5	24.7	0	A	181
14.19604	48.9	QP	19.2	-32.9	32.3	2.9	29.5	26.6	0	A	181

CHART: WITH FACTOR, ANT TYPE: LOOP Except for the data below: adequate margin data below the limits.
CALCULATION : RESULT = READING + ANT FACTOR + LOSS (CABLE + ATTN + D. FACTOR) - GAIN (AMP)

Result of the fundamental emission at 3 m without Distance factor

QP

Ant Deg [deg]	Frequency	Detector	Reading	Ant Factor	Loss	Gain	Duty Factor	Result	Limit	Margin	Remark
	[MHz]		[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
0	13.56000	QP	88.0	19.2	7.1	32.3	-	82.0	-	-	Fundamental

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

UL Japan, Inc.

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Spurious emission
Below 30MHz (Type B)

DATA OF RADIATED EMISSION TEST

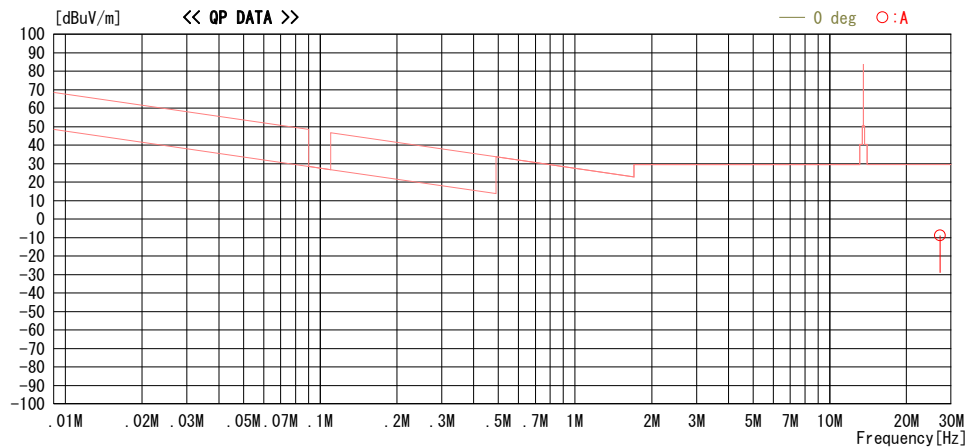
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/14

Report No. : 11343374H

Temp. / Humi. : 23deg. C / 43% RH
Engineer : Koji Yamamoto

Mode / Remarks : Tx 13.56 MHz TypeB, Y-Axis, Without Tag

LIMIT : FCC15_225_PKQP, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15_225_AVQP, 9-90kHz:AV, 110-490kHz:AV, other:QP



Freq.	Reading	DET	Ant. Fac	Loss	Gain	Result	Limit	Margin	Antenna	Table	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[deg]	[deg]	
27.12000	36.7	QP	19.2	-32.5	32.3	-8.9	29.5	38.4	0	A	180

CHART: WITH FACTOR, ANT TYPE: LOOP. Except for the data below: adequate margin data below the limits.
CALCULATION : RESULT = READING + ANT FACTOR + LOSS (CABLE + ATTEN + D.FACTOR) - GAIN (AMP)

Spurious emission
Below 30MHz (Type C)

DATA OF RADIATED EMISSION TEST

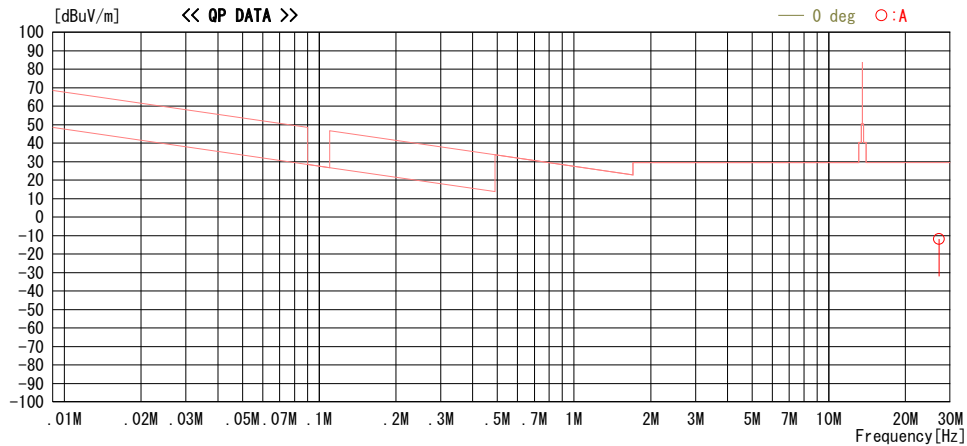
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/14

Report No. : 11343374H

Temp. / Humi. : 23deg. C / 43% RH
Engineer : Koji Yamamoto

Mode / Remarks : Tx 13.56 MHz TypeC (Felica 212kbps), Y-Axis, Without Tag

LIMIT : FCC15_225_PKQP, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15_225_AVQP, 9-90kHz:AV, 110-490kHz:AV, other:QP



Freq.	Reading	DET	Ant. Fac	Loss	Gain	Result	Limit	Margin	Antenna	Table	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[deg]	[deg]	
27.12000	33.8	QP	19.2	-32.5	32.3	-11.8	29.5	41.3	0	A	179

CHART: WITH FACTOR, ANT TYPE: LOOP, Except for the data below: adequate margin data below the limits.
CALCULATION : RESULT = READING + ANT FACTOR + LOSS (CABLE + ATTEN + D.FACTOR) - GAIN (AMP)

Spurious emission
Above 30MHz

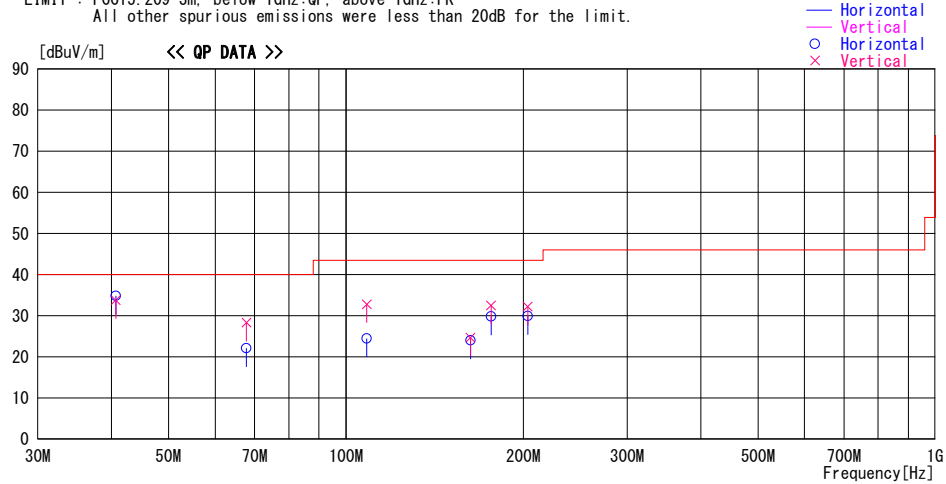
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2016/07/14

Report No. : 11343374H
Temp./Humi. : 24deg. C / 66% RH
Engineer : Koji Yamamoto

Mode / Remarks : Tx 13.56 MHz TypeA, Without Tag, Worst-Axis (Hori: Y / Vert: Y)

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
All other spurious emissions were less than 20dB for the limit.



Frequency [MHz]	Reading [dBuV]	DET	Antenna	Loss&	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit	Margin	Comment
			Factor [dB/m]	Gain [dB]					[dBuV/m]	[dB]	
40.680	45.5	QP	14.0	-24.7	34.8	130	300	Hori.	40.0	5.2	
40.680	44.5	QP	14.0	-24.7	33.8	230	100	Vert.	40.0	6.2	
67.800	39.9	QP	6.4	-24.2	22.1	0	300	Hori.	40.0	17.9	
67.800	46.1	QP	6.4	-24.2	28.3	226	100	Vert.	40.0	11.7	
108.480	36.9	QP	11.2	-23.6	24.5	216	300	Hori.	43.5	19.0	
108.480	45.2	QP	11.2	-23.6	32.8	182	100	Vert.	43.5	10.7	
162.720	31.5	QP	15.3	-22.8	24.0	141	300	Hori.	43.5	19.5	
162.720	32.2	QP	15.3	-22.8	24.7	111	100	Vert.	43.5	18.8	
176.280	36.7	QP	15.8	-22.7	29.8	208	300	Hori.	43.5	13.7	
176.280	39.4	QP	15.8	-22.7	32.5	131	100	Vert.	43.5	11.0	
203.400	40.8	QP	11.4	-22.3	29.9	152	131	Hori.	43.5	13.6	
203.400	43.1	QP	11.4	-22.3	32.2	226	100	Vert.	43.5	11.3	

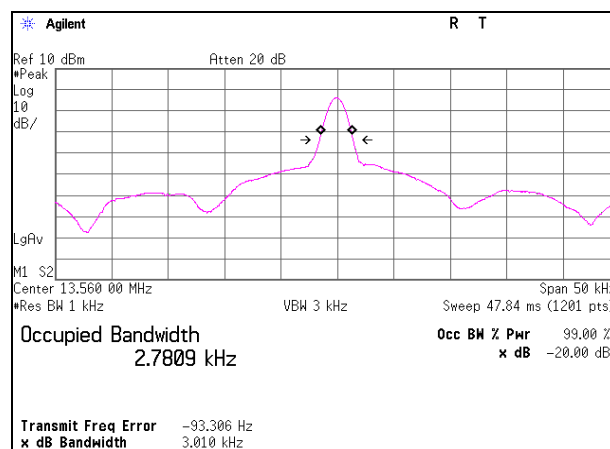
CHART:WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-200MHz:BICONICAL, 200MHz-1000MHz:LOGPERIODIC, 1000MHz-:HORN
CALCULATION : RESULT = READING + ANT FACTOR + LOSS & GAIN(CABLE + ATTEN - GAIN(AMP))

20dB Bandwidth and 99% Occupied Bandwidth (Type A)

Test place	Ise EMC Lab. No.6 measurement room
Report No.	11343374H
Date	07/16/2016
Temperature/ Humidity	24 deg. C / 42 RH
Engineer	Ken Fujita
Mode	Tx Mod on

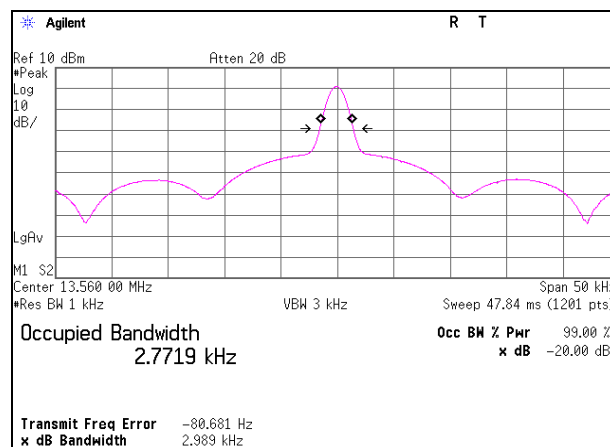
<With Tag>

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	3.01	2.78



<Without Tag>

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	2.99	2.77



UL Japan, Inc.

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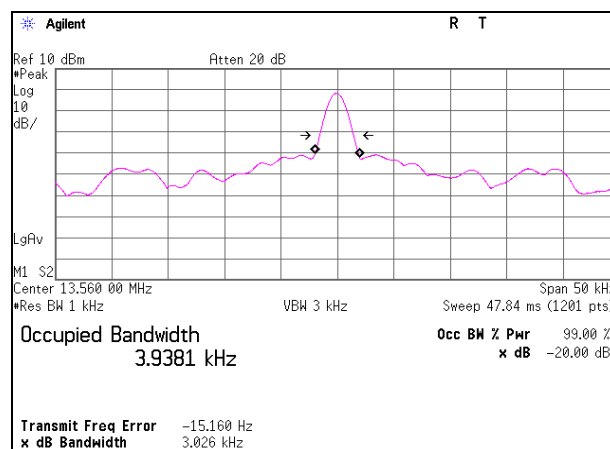
Facsimile : +81 596 24 8124

20dB Bandwidth and 99% Occupied Bandwidth (Type B)

Test place	Ise EMC Lab. No.6 measurement room
Report No.	11343374H
Date	07/16/2016
Temperature/ Humidity	24 deg. C / 42 RH
Engineer	Ken Fujita
Mode	Tx Mod on

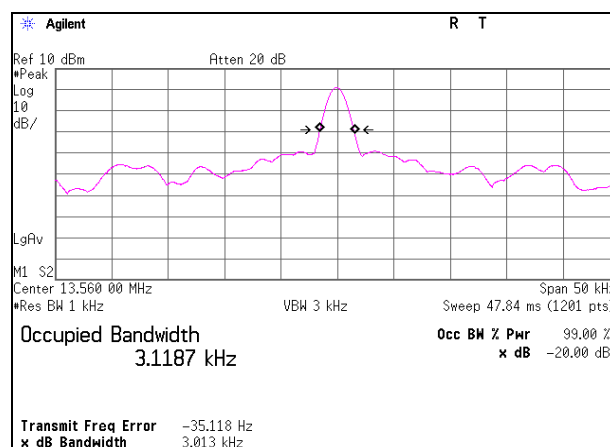
<With Tag>

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	3.03	3.94



<Without Tag>

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	3.01	3.12

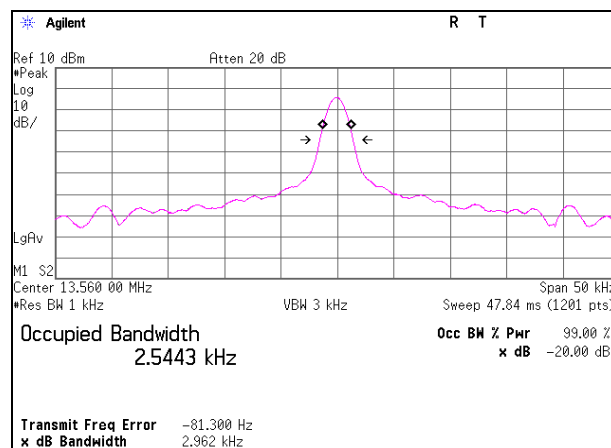


20dB Bandwidth and 99% Occupied Bandwidth (Type C)

Test place	Ise EMC Lab. No.6 measurement room
Report No.	11343374H
Date	07/16/2016
Temperature/ Humidity	24 deg. C / 42 RH
Engineer	Ken Fujita
Mode	Tx Mod on

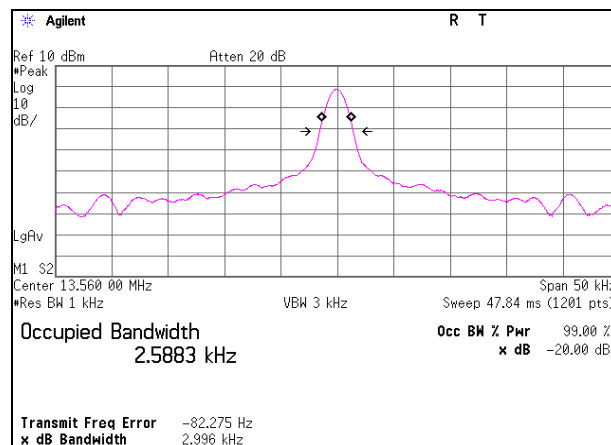
<With Tag>

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	2.96	2.54



<Without Tag>

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	3.00	2.59



Frequency Tolerance

Test place : Ise EMC Lab. No.6 measurement room
Report No. : 11343374H
Date : 07/16/2016
Temperature/ Humidity : 24 deg. C / 42 RH
Engineer : Ken Fujita
Mode : Tx Mod off

Test condition Temp. [deg. C]	Voltage [V]	Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit [+/- %]
					[%]	[ppm]	
50	5	Power on	13.560016	0.000016	0.00012	1.2	0.01
		+ 2 min.	13.560022	0.000022	0.00016	1.6	0.01
		+ 5 min.	13.560025	0.000025	0.00018	1.8	0.01
		+ 10 min.	13.560028	0.000028	0.00021	2.1	0.01
40	5	Power on	13.559979	-0.000021	-0.00015	-1.5	0.01
		+ 2 min.	13.559991	-0.000009	-0.00007	-0.7	0.01
		+ 5 min.	13.559990	-0.000010	-0.00007	-0.7	0.01
		+ 10 min.	13.559994	-0.000006	-0.00004	-0.4	0.01
30	5	Power on	13.559956	-0.000044	-0.00032	-3.2	0.01
		+ 2 min.	13.559955	-0.000045	-0.00033	-3.3	0.01
		+ 5 min.	13.559952	-0.000048	-0.00035	-3.5	0.01
		+ 10 min.	13.559957	-0.000043	-0.00032	-3.2	0.01
20	5	Power on	13.559940	-0.000060	-0.00044	-4.4	0.01
		+ 2 min.	13.559931	-0.000069	-0.00051	-5.1	0.01
		+ 5 min.	13.559932	-0.000068	-0.00050	-5.0	0.01
		+ 10 min.	13.559929	-0.000071	-0.00052	-5.2	0.01
20	4.25 (5V -15%)	Power on	13.559945	-0.000055	-0.00041	-4.1	0.01
		+ 2 min.	13.559944	-0.000056	-0.00041	-4.1	0.01
		+ 5 min.	13.559941	-0.000059	-0.00044	-4.4	0.01
		+ 10 min.	13.559943	-0.000057	-0.00042	-4.2	0.01
20	5.75 (5V +15%)	Power on	13.559942	-0.000058	-0.00043	-4.3	0.01
		+ 2 min.	13.559943	-0.000057	-0.00042	-4.2	0.01
		+ 5 min.	13.559945	-0.000055	-0.00041	-4.1	0.01
		+ 10 min.	13.559946	-0.000054	-0.00040	-4.0	0.01
10	5	Power on	13.559945	-0.000056	-0.00041	-4.1	0.01
		+ 2 min.	13.559949	-0.000051	-0.00037	-3.7	0.01
		+ 5 min.	13.559946	-0.000054	-0.00040	-4.0	0.01
		+ 10 min.	13.559944	-0.000056	-0.00041	-4.1	0.01
0	5	Power on	13.559956	-0.000044	-0.00032	-3.2	0.01
		+ 2 min.	13.559958	-0.000042	-0.00031	-3.1	0.01
		+ 5 min.	13.559954	-0.000046	-0.00034	-3.4	0.01
		+ 10 min.	13.559951	-0.000049	-0.00036	-3.6	0.01
-10	5	Power on	13.559954	-0.000046	-0.00034	-3.4	0.01
		+ 2 min.	13.559955	-0.000045	-0.00033	-3.3	0.01
		+ 5 min.	13.559958	-0.000042	-0.00031	-3.1	0.01
		+ 10 min.	13.559957	-0.000043	-0.00032	-3.2	0.01
-20	5	Power on	13.559967	-0.000033	-0.00024	-2.4	0.01
		+ 2 min.	13.559958	-0.000042	-0.00031	-3.1	0.01
		+ 5 min.	13.559960	-0.000040	-0.00029	-2.9	0.01
		+ 10 min.	13.559961	-0.000039	-0.00029	-2.9	0.01
-30	5	Power on	13.559966	-0.000034	-0.00025	-2.5	0.01
		+ 2 min.	13.559963	-0.000037	-0.00027	-2.7	0.01
		+ 5 min.	13.559962	-0.000038	-0.00028	-2.8	0.01
		+ 10 min.	13.559964	-0.000036	-0.00027	-2.7	0.01

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

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

*The test was performed at more stringent -30 degrees.

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APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-01	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	RE,CE	2015/09/19 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	RE,CE	2016/01/21 * 12
MJM-25	Measure	KOMELON	KMC-36	-	RE,CE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE,CE	-
MTR-09	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	RE,CE	2016/06/25 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2015/10/24 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2016/06/20 * 12
MCC-03	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W(20m)/3D-2W(7.5m)/RG400u(1.5m)/RFM-E421(Switcher)	-/01068 (Switcher)	RE,CE	2016/06/29 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2016/03/24 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2015/11/10 * 12
MMM-03	Digital Tester	Fluke	FLUKE 26-3	78030621	RE	2015/08/19 * 12
KBA-05	Biconical Antenna	Schwarzbeck	BBA9106	2513	RE	2015/11/02 * 12
MLA-20	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-189	RE	2016/01/30 * 12
MCC-02	Coaxial Cable	Suhner/storm/Agilent /TSJ	-	-	RE	2015/09/29 * 12
MPA-19	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	RE	2016/02/25 * 12
MLS-25	LISN(AMN)	Schwarzbeck	NSLK8127	8127-731	CE	2015/07/17 * 12
MAT-64	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	CE	2016/01/14 * 12
MFC-01	Microwave Counter	Advantest	R5373	120100309	RE	2016/06/01 * 12
MAT-23	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	RE	2016/03/18 * 12
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE/FT	2015/11/06 * 12
MCH-04	Temperature and Humidity Chamber	Tabai Espec	PL-2KP	14015723	RE/FT	2015/08/02 * 12
MOS-14	Thermo-Hygrometer	Custom	CTH-201	1401	RE/FT	2016/01/21 * 12
MMM-12	DIGITAL HiTESTER	Hioki	3805	060500120	RE/FT	2016/02/23 * 12

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.

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

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