



RADIO TEST REPORT

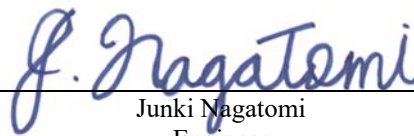
Test Report No. : 13092632H-R1

Applicant : **DENSO CORPORATION**
Type of Equipment : **Electronic Key**
Model No. : **14FFC**
FCC ID : **HYQ14FFC**
Test regulation : **FCC Part 15 Subpart C: 2019**
Test Result : **Complied (Refer to SECTION 3.2)**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
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 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 13092632H. 13092632H is replaced with this report.

Date of test: October 23, 2019

Representative test engineer:


Junki Nagatomi
Engineer
Consumer Technology Division

Approved by:


Motoya Imura
Leader
Consumer Technology Division



This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 13092632H

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13092632H	November 6, 2019	-	-
1	13092632H-R1	November 11, 2019	P.17	Correction of horizontal axis in Plot data; From 4 GHz to 4.4 GHz

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SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
Address	:	1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661, Japan
Telephone Number	:	+81-566-20-3955
Facsimile Number	:	+81-566-25-4837
Contact Person	:	TAKAYUKI HATTORI

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No. 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 (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	:	Electronic Key
Model No.	:	14FFC
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.0 V
Receipt Date of Sample (Information from test lab.)	:	October 18, 2019
Country of Mass-production	:	Japan, United States of America, China
Condition of EUT	:	Engineering 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: 14FFC (referred to as the EUT in this report) is a Electronic Key.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	433.58 MHz / 434.42 MHz*
		*These two different frequencies are not emitted simultaneously.
Modulation	:	FSK (F1D)
Type of Battery	:	One lithium battery
Antenna type	:	Built-in type (Fixed)
Clock frequency (Maximum)	:	13.08 MHz Crystal
Radio Type	:	Receiver
Frequency of Operation	:	134.2 kHz *1)

*1) The test of receiver part was performed separately from this test report, and the conformability is confirmed.

* Original model: 14FFC has two types; Type A and Type B.
The worst case was confirmed with Type A and Type B at pre check.
The test was performed with Type B, which had the worst result.

*Original model No.: 14FFC has 4 switches.
Variation model have 3 switches and 2 switches.

The difference of Original model and Variation models is only the number and / or location of switches.
They are completely identical in RF characteristics.
Therefore the test was performed with the representative original type which was the worst one.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted emission	FCC: ANSI C63.10:2013 6 Standard test methods ----- ISED: RSS-Gen 8.8	FCC: Section 15.207 ----- ISED: RSS-Gen 8.8	N/A	N/A	*1)
Automatically Deactivate	FCC: ANSI C63.10:2013 6 Standard test methods ----- ISED: -	FCC: Section 15.231(a)(1) ----- ISED: RSS-210 A1.1	N/A	Complied a)	Radiated
Electric Field Strength of Fundamental Emission	FCC: ANSI C63.10:2013 6 Standard test methods ----- ISED: RSS-Gen 6.12	FCC: Section 15.231(b) ----- ISED: RSS-210 A1.2	4.4 dB 433.58 MHz Vertical PK with Duty Factor	Complied# b)	Radiated
Electric Field Strength of Spurious Emission	FCC: ANSI C63.10:2013 6 Standard test methods ----- ISED: RSS-Gen 6.13	FCC: Section 15.205 Section 15.209 Section 15.231(b) ----- ISED: RSS-210 A1.2, 4.4 RSS-Gen 8.9	3.60 dB 4335.80 MHz Horizontal PK with Duty Factor	Complied b)	Radiated
-20dB Bandwidth	FCC: ANSI C63.10:2013 6 Standard test methods ----- ISED: -	FCC: Section 15.231(c) ----- ISED: Reference data	N/A	Complied c)	Radiated

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

*1) The test is not applicable since the EUT does not have AC Mains.

a) Refer to APPENDIX 1 (data of Automatically deactivate)

b) Refer to APPENDIX 1 (data of Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission))

c) Refer to APPENDIX 1 (data of -20dB and 99% Occupied Bandwidth)

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 test was performed with the New Battery (DC 3.0 V) and the constant voltage was supplied to the EUT during the tests. Therefore, the 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

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % Occupied Bandwidth	ISED: RSS-Gen 6.7	ISED: RSS-210 A1.3	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 $k = 2$.

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
10 m	1 GHz to 18 GHz	5.2 dB

Antenna Terminal test

Test Item	Uncertainty (+/-)
Automatically Deactivate	0.10 %
-20dB Emission Bandwidth / 99 % Occupied Bandwidth	0.96 %

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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

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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.

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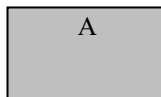
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SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Test Item*	Mode
Automatically Deactivate	Normal use mode
Electric Field Strength of Fundamental Emission Electric Field Strength of Spurious Emission -20 dB & 99 % Occupied Bandwidth Duty Cycle	Transmitting mode (Tx)
* The system was configured in typical fashion (as a user would normally use it) for testing. End users cannot change the settings of the output power of the product.	

4.2 Configuration and peripherals



* Setup was taken into consideration and test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Electronic Key	14FFC	No.1 *1) No.2 *2)	DENSO CORPORATION	EUT

*1) Used for Normal use mode

*2) Used for Transmitting mode

SECTION 5: Radiated emission (Electric Field Strength of Fundamental and Spurious Emission)

Test Procedure and conditions

[For below 30 MHz]

The noise level was checked by moving a search-coil (Loop Antenna) close to the EUT.

[For 30 MHz to 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 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]

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.

The measuring antenna height was varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The measurements were performed for both vertical and horizontal antenna polarization.

The radiated emission measurements were made with the following detector function of the test receiver / spectrum analyzer.

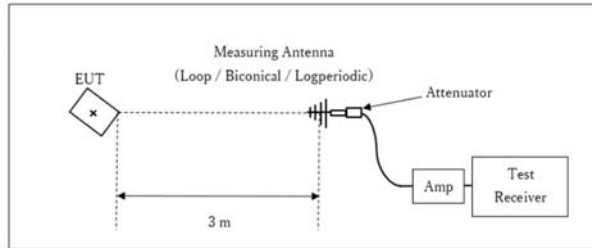
Test Antennas are used as below;

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

	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
Detector Type	Peak	Peak	Peak	Peak	Peak and Peak with Duty factor	Peak and Peak with Duty factor
IF Bandwidth	200 Hz	200 Hz	9.0 kHz	9.0 kHz	120 kHz	PK: S/A: RBW 1 MHz, VBW: 3 MHz

[Test Setup]

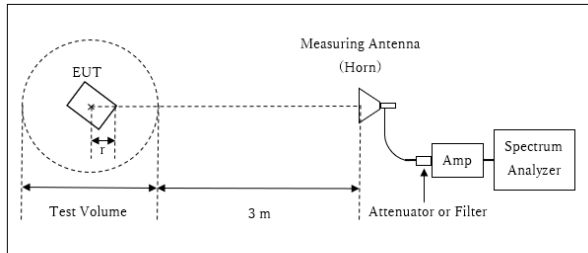
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz – 3.2 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor: $20 \times \log (4.0 \text{ m} / 3.0 \text{ m}) = 2.5 \text{ dB}$

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 4.0 \text{ m}$

Test Volume : 2.0 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.0 \text{ m}$

* The test was performed with $r = 0.0 \text{ m}$ since EUT is small and it was the rather conservative condition.

- The carrier level (or, noise levels) was (or were) measured at each position of all three axes X, Y and Z, and the position that has the maximum noise was determined.

Noise levels of all the frequencies were measured at the position.

This EUT has two modes which mechanical key is inserted or not. The worst case was confirmed with and without mechanical key, as a result, the test with mechanical key was the worst case. Therefore the test with mechanical key was performed only.

*The result is rounded off to the second decimal place, so some differences might be observed.

Measurement range : 9 kHz - 4.4 GHz

Test data : APPENDIX

Test result : Pass

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SECTION 6: Automatically deactivate

Test Procedure

The measurement was performed with Electric field strength using a spectrum analyzer.

Test data : APPENDIX
Test result : Pass

SECTION 7: -20 dB and 99 % Occupied Bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	150 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	Max Hold	Spectrum Analyzer
Peak hold was applied as Worst-case measurement.							

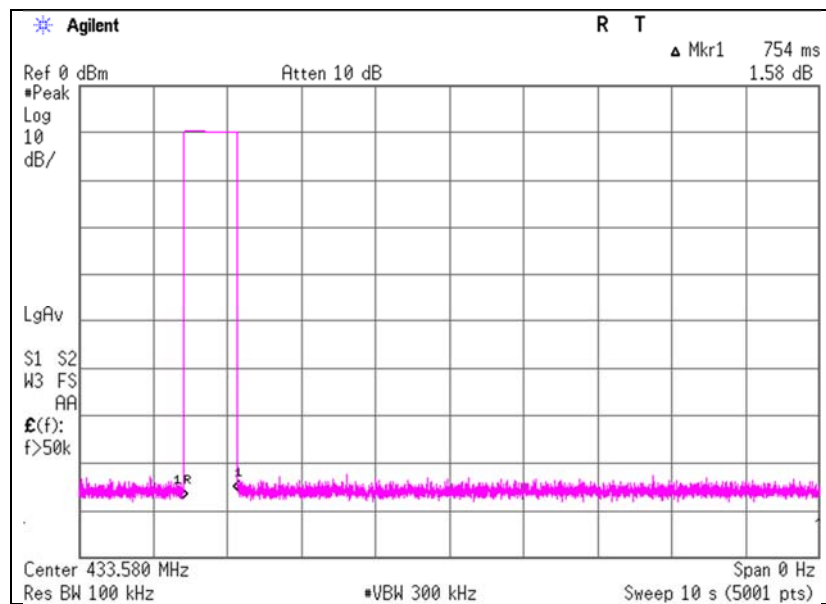
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Automatically deactivate

Report No.	13092632H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	October 23, 2019
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Junki Nagatomi
Mode	Normal use mode 433.58 MHz

Time of Transmitting [sec]	Limit [sec]	Result
0.754	5.00	Pass



* The EUT transmits UHF when LF signal is received from a car or a button on the EUT is pressed. In both cases, the UHF transmission is stopped within 5 seconds. So the test was performed by a button-pressed operation as the worst case. Please refer to the “Theory of Operation” for details.

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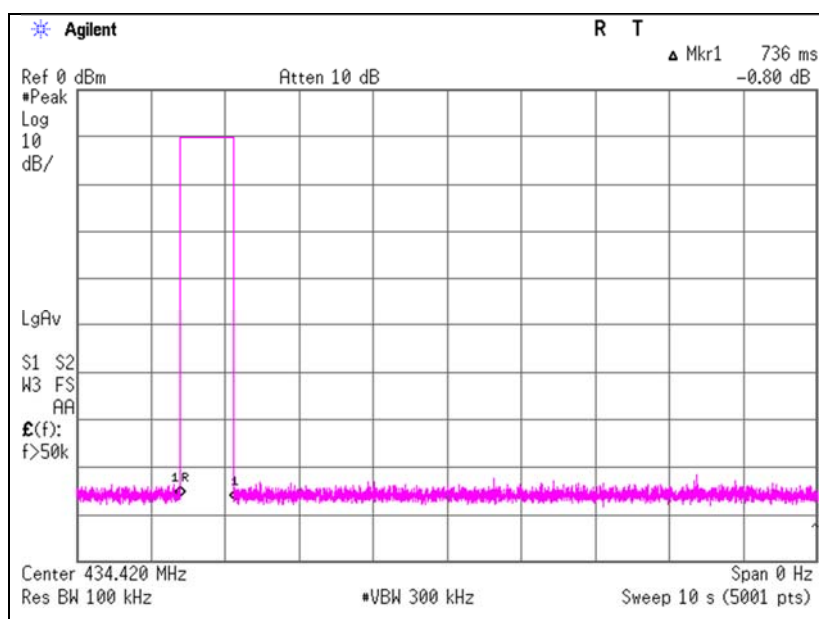
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Automatically deactivate

Report No.	13092632H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	October 23, 2019
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Junki Nagatomi
Mode	Normal use mode 434.42 MHz

Time of Transmitting [sec]	Limit [sec]	Result
0.736	5.00	Pass



* The EUT transmits UHF when LF signal is received from a car or a button on the EUT is pressed. In both cases, the UHF transmission is stopped within 5 seconds. So the test was performed by a button-pressed operation as the worst case. Please refer to the “Theory of Operation” for details.

Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)

Report No. 13092632H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date October 23, 2019
Temperature / Humidity 22 deg. C / 64 % RH
Engineer Junya Okuno
Mode Transmitting mode 433.58 MHz

QP or PK

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 Inside or Outside of Restricted Bands
		Hor	Ver					Hor	Ver		Hor	Ver	
433.58	PK	78.2	81.2	16.2	10.9	32.0	-	73.4	76.4	100.8	27.4	24.4	Carrier
867.16	PK	27.9	28.6	21.8	13.3	31.1	-	31.9	32.6	80.8	48.9	48.2	Outside
1300.74	PK	44.7	44.4	25.4	6.0	34.6	-	41.5	41.2	73.9	32.4	32.7	Inside
1734.32	PK	51.3	51.6	25.0	5.5	33.6	-	48.3	48.6	80.8	32.5	32.2	Outside
2167.90	PK	44.5	43.9	28.0	5.6	32.9	-	45.3	44.6	80.8	35.5	36.2	Outside
2601.48	PK	43.3	44.0	27.7	5.7	32.7	-	44.1	44.7	80.8	36.7	36.1	Outside
3035.06	PK	43.3	42.8	28.7	5.9	32.4	-	45.4	44.9	80.8	35.4	35.9	Outside
3468.64	PK	45.6	45.6	28.7	6.0	32.3	-	48.1	48.0	80.8	32.7	32.8	Outside
3902.22	PK	45.1	45.3	29.7	6.2	32.1	-	49.0	49.2	73.9	24.9	24.7	Inside
4335.80	PK	45.6	45.3	30.3	6.4	31.9	-	50.3	50.1	73.9	23.6	23.9	Inside

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

PK with Duty factor

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
		Hor	Ver					Hor	Ver		Hor	Ver	
433.58	PK	78.2	81.2	16.2	10.9	32.0	0.0	73.4	76.4	80.8	7.4	4.4	Carrier
867.16	PK	27.9	28.6	21.8	13.3	31.1	0.0	31.9	32.6	60.8	28.9	28.2	Outside
1300.74	PK	44.7	44.4	25.4	6.0	34.6	0.0	41.5	41.2	53.9	12.4	12.7	Inside
1734.32	PK	51.3	51.6	25.0	5.5	33.6	0.0	48.3	48.6	60.8	12.5	12.2	Outside
2167.90	PK	44.5	43.9	28.0	5.6	32.9	0.0	45.3	44.6	60.8	15.5	16.2	Outside
2601.48	PK	43.3	44.0	27.7	5.7	32.7	0.0	44.1	44.7	60.8	16.7	16.1	Outside
3035.06	PK	43.3	42.8	28.7	5.9	32.4	0.0	45.4	44.9	60.8	15.4	15.9	Outside
3468.64	PK	45.6	45.6	28.7	6.0	32.3	0.0	48.1	48.0	60.8	12.7	12.8	Outside
3902.22	PK	45.1	45.3	29.7	6.2	32.1	0.0	49.0	49.2	53.9	4.9	4.7	Inside
4335.80	PK	45.6	45.3	30.3	6.4	31.9	0.0	50.3	50.1	53.9	3.6	3.9	Inside

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

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

Sample calculation:

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

Result of PK with Duty factor = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1 GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier) + Duty factor

For above 1GHz : Distance Factor: $20 \times \log(4.0 \text{ m}/3.0 \text{ m}) = 2.5 \text{ dB}$

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

Since the peak emission result satisfied the average limit, duty factor was omitted.

Although Duty of this product was 100% or less, the result of AV (PK with Duty factor) was calculated by applying Duty 100% as worst.

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Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)

Report No. 13092632H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date October 23, 2019
Temperature / Humidity 22 deg. C / 64 % RH
Engineer Junya Okuno
Mode Transmitting mode 434.42 MHz

QP or PK

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 Inside or Outside of Restricted Bands
		Hor	Ver					Hor	Ver		Hor	Ver	
434.42	PK	79.3	80.6	16.3	10.9	32.0	-	74.5	75.8	100.8	26.3	25.0	Carrier
868.84	PK	27.3	26.9	21.8	13.4	31.1	-	31.3	30.9	80.8	49.5	49.9	Outside
1303.26	PK	44.4	44.2	25.4	6.0	34.6	-	41.2	41.0	73.9	32.7	32.9	Inside
1737.68	PK	51.3	51.1	25.1	5.5	33.6	-	48.3	48.1	80.8	32.5	32.7	Outside
2172.10	PK	44.9	43.3	28.1	5.6	32.9	-	45.7	44.1	80.8	35.1	36.8	Outside
2606.52	PK	43.8	43.5	27.7	5.7	32.7	-	44.5	44.3	80.8	36.3	36.5	Outside
3040.94	PK	43.3	43.8	28.7	5.9	32.4	-	45.4	45.9	80.8	35.4	34.9	Outside
3475.36	PK	45.8	45.6	28.7	6.0	32.3	-	48.3	48.1	80.8	32.5	32.7	Outside
3909.78	PK	45.0	44.9	29.7	6.2	32.1	-	48.9	48.7	73.9	25.0	25.2	Inside
4344.20	PK	45.1	45.2	30.3	6.4	31.9	-	49.8	49.9	73.9	24.1	24.0	Inside

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

PK with Duty factor

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
		Hor	Ver					Hor	Ver		Hor	Ver	
434.42	PK	79.3	80.6	16.3	10.9	32.0	0.0	74.5	75.8	80.8	6.3	5.0	Carrier
868.84	PK	27.3	26.9	21.8	13.4	31.1	0.0	31.3	30.9	60.8	29.5	29.9	Outside
1303.26	PK	44.4	44.2	25.4	6.0	34.6	0.0	41.2	41.0	53.9	12.7	12.9	Inside
1737.68	PK	51.3	51.1	25.1	5.5	33.6	0.0	48.3	48.1	60.8	12.5	12.7	Outside
2172.10	PK	44.9	43.3	28.1	5.6	32.9	0.0	45.7	44.1	60.8	15.1	16.8	Outside
2606.52	PK	43.8	43.5	27.7	5.7	32.7	0.0	44.5	44.3	60.8	16.3	16.5	Outside
3040.94	PK	43.3	43.8	28.7	5.9	32.4	0.0	45.4	45.9	60.8	15.4	14.9	Outside
3475.36	PK	45.8	45.6	28.7	6.0	32.3	0.0	48.3	48.1	60.8	12.5	12.7	Outside
3909.78	PK	45.0	44.9	29.7	6.2	32.1	0.0	48.9	48.7	53.9	5.0	5.2	Inside
4344.20	PK	45.1	45.2	30.3	6.4	31.9	0.0	49.8	49.9	53.9	4.1	4.0	Inside

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

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

Sample calculation:

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

Result of PK with Duty factor = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1 GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier) + Duty factor

For above 1GHz : Distance Factor: $20 \times \log(4.0 \text{ m}/3.0 \text{ m}) = 2.50 \text{ dB}$

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

Since the peak emission result satisfied the average limit, duty factor was omitted.

Although Duty of this product was 100% or less, the result of AV (PK with Duty factor) was calculated by applying Duty 100% as worst.

UL Japan, Inc.

Ise EMC Lab.

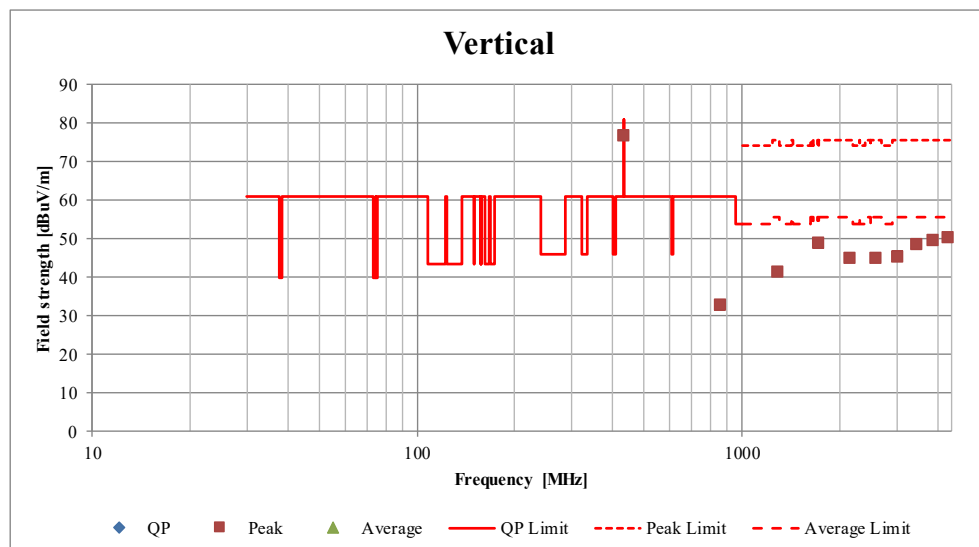
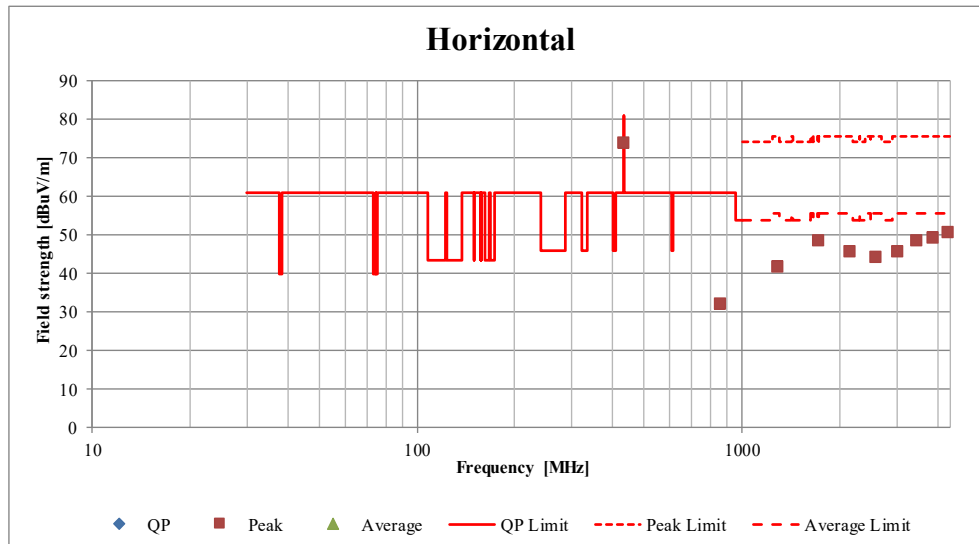
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Radiated Spurious Emission (Plot data, Worst case)

Report No. 13092632H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date October 23, 2019
Temperature / Humidity 22 deg. C / 64 % RH
Engineer Junya Okuno
Mode Transmitting mode 433.58 MHz



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

-20dB and 99% Occupied Bandwidth

Report No.	13092632H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	October 23, 2019
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Junki Nagatomi
Mode	Transmitting mode 433.58 MHz / 434.42 MHz

Bandwidth Limit : Fundamental Frequency **433.58** MHz x 0.25% = 1083.95 kHz

* The above limit was calculated from more stringent nominal frequency.

* Method of KDB 926416 for systems employing non sweeping frequencies was referred.

433.58 MHz

-20dB Bandwidth [kHz]
37.227

434.42 MHz

-20dB Bandwidth [kHz]
37.130

-20dB Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
74.357	1083.95	Pass

Bandwidth Limit : Fundamental Frequency **433.58** MHz x 0.25% = 1083.95 kHz

99% Occupied Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
37.7860	1083.95	Pass

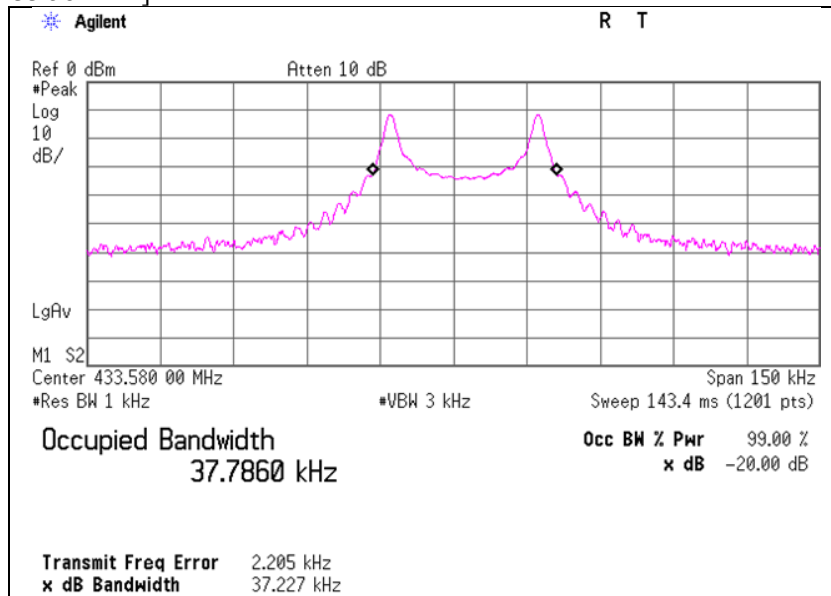
Bandwidth Limit : Fundamental Frequency **434.42** MHz x 0.25% = 1086.05 kHz

99% Occupied Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
37.8983	1086.05	Pass

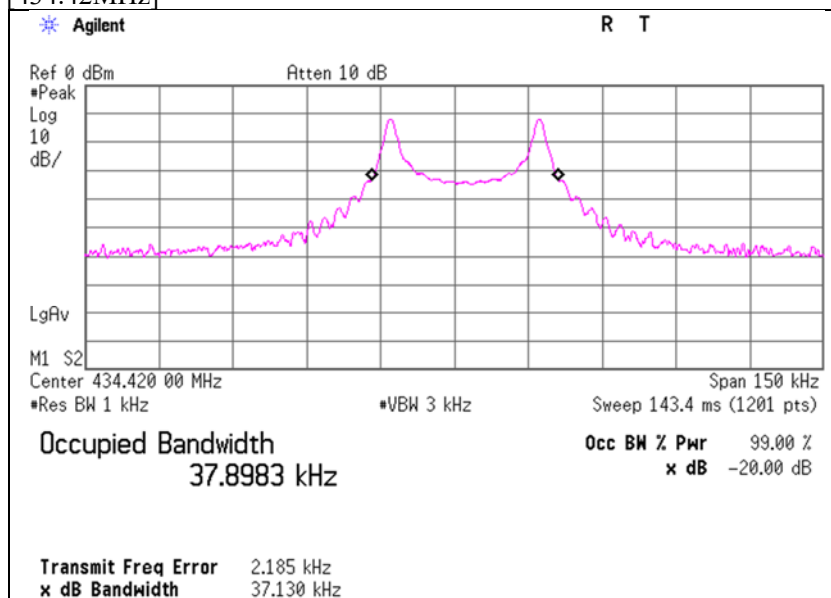
-20dB and 99% Occupied Bandwidth

Report No. 13092632H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date October 23, 2019
Temperature / Humidity 23 deg. C / 52 % RH
Engineer Junki Nagatomi
Mode Transmitting mode 433.58 MHz / 434.42 MHz

[433.58 MHz]



[434.42MHz]



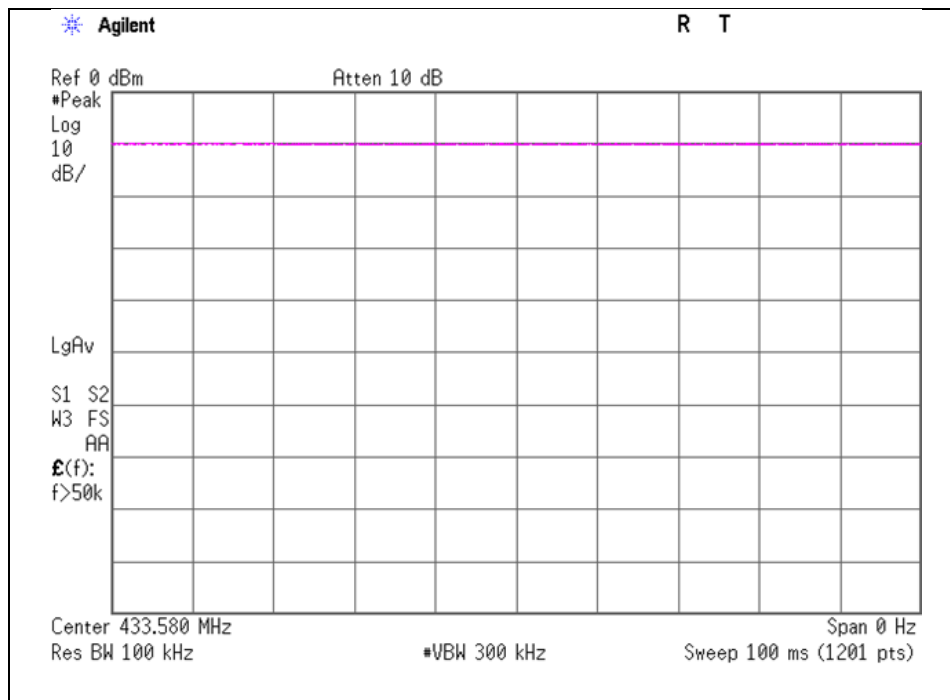
Duty Cycle

Report No.	13092632H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	October 23, 2019
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Junki Nagatomi
Mode	Transmitting mode 433.58 MHz

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty factor [dB]
100.00	100.00	1.00	0.0

Duty factor= 20log10(ON time/Cycle)

*The test was performed by a button-pressed operation as the worst case.
Please refer to the “Theory of Operation” for details.



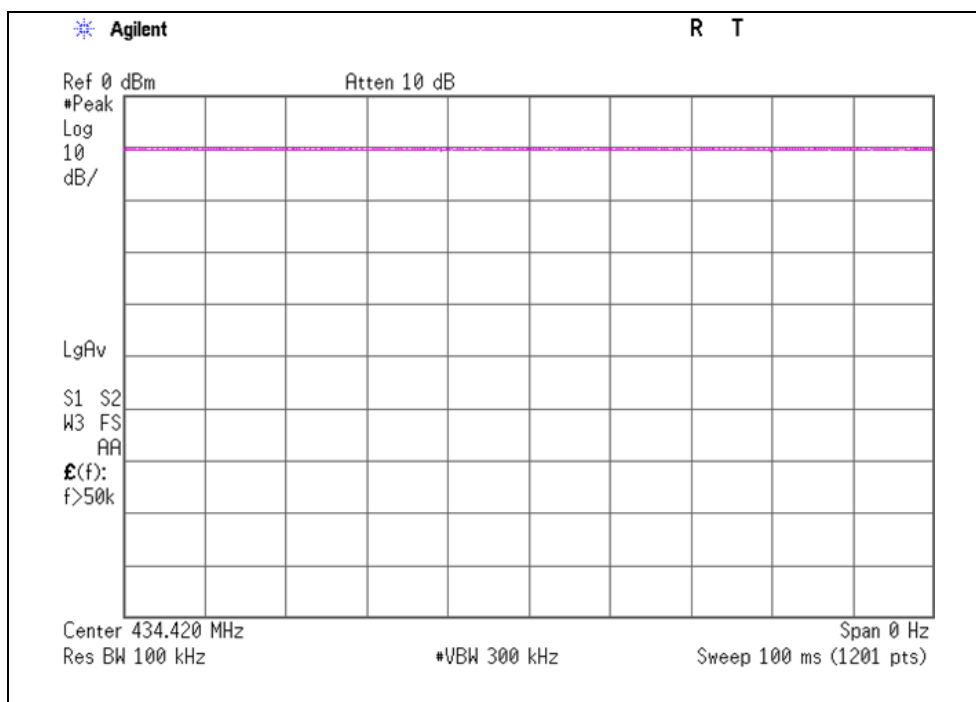
Duty Cycle

Report No.	13092632H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	October 23, 2019
Temperature / Humidity	23 deg. C / 52 % RH
Engineer	Junki Nagatomi
Mode	Transmitting mode 434.42 MHz

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty factor [dB]
100.00	100.00	1.00	0.0

Duty factor = $20 \log_{10}(\text{ON time/Cycle})$

*The test was performed by a button-pressed operation as the worst case.
Please refer to the "Theory of Operation" for details.



APPENDIX 2: Test instruments

Test Instruments

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/08/2019	04/30/2021	24
RE	141855	Spectrum Analyzer	AGILENT	E4440A	MY46187750	11/09/2018	11/30/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141507	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	09/26/2019	09/30/2020	12
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	141580	MicroWave System Amplifier	AGILENT	83017A	MY39500779	03/05/2019	03/31/2020	12
RE	177964	Microwave Cable	Junkosha INC.	MMX221	1901S329(1m)/ 1902S579(5m)	03/05/2019	03/31/2020	12
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/26/2018	06/30/2020	24
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	01/11/2019	01/31/2020	12
RE	148897	Attenuator	KEYSIGHT	8491A	MY52462349	12/20/2018	12/31/2019	12
RE	141424	Biconical Antenna	Schwarzbeck	VHA9103+BBA9106	1915	08/24/2019	08/31/2020	12
RE	141323	Coaxial cable	UL Japan	-	-	07/02/2019	07/31/2020	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/29/2019	01/31/2020	12
RE	141266	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	9111B-191	08/24/2019	08/31/2020	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/08/2019	02/29/2020	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/02/2019	08/31/2020	12
RE	141297	High Pass Filter(1.1-10GHz)	TOKYO KEIKI	TF219CD1	1001	01/10/2019	01/31/2020	12
RE	142645	Loop Antenna	UL Japan	-	-	-	-	-

*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.

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, 99 % Occupied Bandwidth, -20 dB bandwidth, Automatically deactivate and Duty cycle tests

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