



RADIO TEST REPORT

Test Report No. : 10817935H

Applicant : DENSO CORPORATION
Type of Equipment : Electronic Key
Model No. : 14AHB
Test regulation : FCC Part 15 Subpart C: 2015
FCC ID : HYQ14AHB
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.
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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)

Date of test: June 6, 2015

Representative test engineer:

K. Yamamoto

Koji Yamamoto
Engineer

Consumer Technology Division

Approved by:

M. Imura

Motoya Imura
Engineer

Consumer Technology Division



NVLAP LAB CODE: 200572-0

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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

13-EM-F0429

REVISION HISTORY

Original Test Report No.: 10817935H

[illegible]

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Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

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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 : +81-566-61-5242
Facsimile Number : +81-566-25-4837
Contact Person : MASAYUKI YAMAMOTO

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

2.1 Identification of E.U.T.

Type of Equipment : Electronic Key
Model No. : 14AHB
Serial No. : Refer to Clause 4.2
Rating : DC 3.0V
Receipt Date of Sample : May 30, 2015
Country of Mass-production : Japan
Condition of EUT : Production model
Modification of EUT : No Modification by the test lab

2.2 Product Description

Model No: 14AHB (referred to as the EUT in this report) is the Electronic Key.

Radio Type : Transceiver
Frequency of Operation : 433.92 MHz
Oscillator frequency : 8 MHz (IC Clock)
433.92 MHz SAW resonator (RF)
Modulation : FSK (F1D)
Power Supply (radio part input) : DC 3.0V
Type of Battery : One lithium battery
Antenna type : Built-in type (Fixed)
Receiving frequency of Operation : 134.2kHz *1)

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

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2015, final revised on January 21, 2015

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted emission	FCC: ANSI C63.4:2009 7. AC powerline conducted emission measurements	FCC: Section 15.207	N/A	N/A*1)	-
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8			
Automatically Deactivate	FCC: ANSI C63.4:2009 13. Measurement of intentional radiators	FCC: Section 15.231(a)(1)	N/A	Complied	Radiated
	IC: -	IC: RSS-210 A1.1.1			
Electric Field Strength of Fundamental Emission	FCC: ANSI C63.4:2009 13. Measurement of intentional radiators	FCC: Section 15.231(b)	7.4 dB Vertical, Horizontal PK with Duty factor	Complied	Radiated
	IC: RSS-Gen 6.12	IC: RSS-210 A1.1.2			
Electric Field Strength of Spurious Emission	FCC: ANSI C63.4:2009 13. Measurement of intentional radiators	FCC: Section 15.205 Section 15.209 Section 15.231(b)	8.4 dB 4339.200 MHz Vertical PK with Duty factor	Complied	Radiated
	IC: RSS-Gen 6.13	IC: RSS-210 A1.1.2, 2.5.1 RSS-Gen 8.9			
-20dB Bandwidth	FCC: ANSI C63.4:2009 13. Measurement of intentional radiators	FCC: Section 15.231(c)	N/A	Complied	Radiated
	IC: -	IC: Reference data			
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.					

FCC Part 15.31 (e)

This test was performed with the New Battery (DC 3.0V) 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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Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Facsimile : +81 596 24 8124

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: RSS-210 A1.1.3	N/A	Complied	Radiated

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 $k = 2$.

Test room (semi-anechoic chamber)	Radiated emission						
	(3 m*) (+dB)				(1 m*) (+dB)		(0.5 m*) (+dB)
	9 kHz - 30 MHz	30 MHz - 300 MHz	300 MHz - 1 GHz	1 GHz - 10 GHz	10 GHz - 18 GHz	18 GHz - 26.5 GHz	26.5 GHz - 40 GHz
No.1	4.3 dB	5.5 dB	6.3 dB	5.5 dB	5.8 dB	5.8 dB	4.3 dB
No.2	4.2 dB	5.4 dB	6.3 dB	5.4 dB	5.7 dB	5.9 dB	5.6 dB
No.3	4.4 dB	5.4 dB	6.4 dB	5.2 dB	5.5 dB	5.8 dB	5.5 dB
No.4	4.7 dB	5.6 dB	6.4 dB	5.3 dB	5.7 dB	5.9 dB	5.5 dB

*3m/1m/0.5m = Measurement distance

Radiated emission test (3 m)

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

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Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

3.5 Test Location

UL Japan, Inc. Ise EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999 Facsimile : +81 596 24 8124

	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 7.7	7.0 x 6.0	No.1 Power source room
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	N/A	-
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 3.0m	4.8 x 4.6	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m 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 E.U.T. during testing

4.1 Operating Modes

Test Item	Mode
Automatically Deactivate	Normal use mode, 433.92 MHz
Electric Field Strength of Fundamental Emission Electric Field Strength of Spurious Emission -20dB & 99% Occupied Bandwidth	Transmitting mode (Tx), 433.92 MHz *1)
* The system was configured in typical fashion (as a customer would normally use it) for testing. *1) The software of this mode is the same as one of normal product, except that EUT continues to transmit when transmitter button is being pressed (For Normal use mode, the EUT transmits when it receives 134.2kHz radio signal and transmitter button is being pressed.) End users cannot change the settings of the output power of the product.	

4.2 Configuration and peripherals

A

* 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	14AHB	001 *1) 002 *2)	DENSO CORPORATION	EUT

*1) Used for Transmitting mode only.

*2) Used for Normal use mode only.

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

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

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m, raised 0.8m above the conducting ground plane. The EUT was set on the center of the tabletop.
Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.
Photographs of the set up are shown in Appendix 3.

[Transmitting mode]

(Below 30MHz)

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

(Above 30MHz)

The Radiated Electric Field Strength has been measured on Semi anechoic chamber with a ground plane and at a distance of 3m.

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

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

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 30MHz	30MHz to 300MHz	300MHz to 1GHz	Above 1GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

	From 9kHz to 90kHz and From 110kHz to 150kHz	From 90kHz to 110kHz	From 150kHz to 490kHz	From 490kHz to 30MHz	From 30MHz to 1GHz	Above 1GHz
Detector Type	Peak	Peak	Peak	Peak	Peak and Peak with Duty factor	Peak and Peak with Duty factor
IF Bandwidth	200Hz	200Hz	9.1kHz	9.1kHz	120kHz	PK: S/A:RBW 1MHz, VBW 3MHz

- The carrier level was 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 - 4.5 GHz

Test data : APPENDIX

Test result : Pass

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Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Facsimile : +81 596 24 8124

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: -20dB and 99% Occupied Bandwidth

Test Procedure

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20dB Bandwidth	150kHz	1.5kHz	5.1kHz	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
*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.							

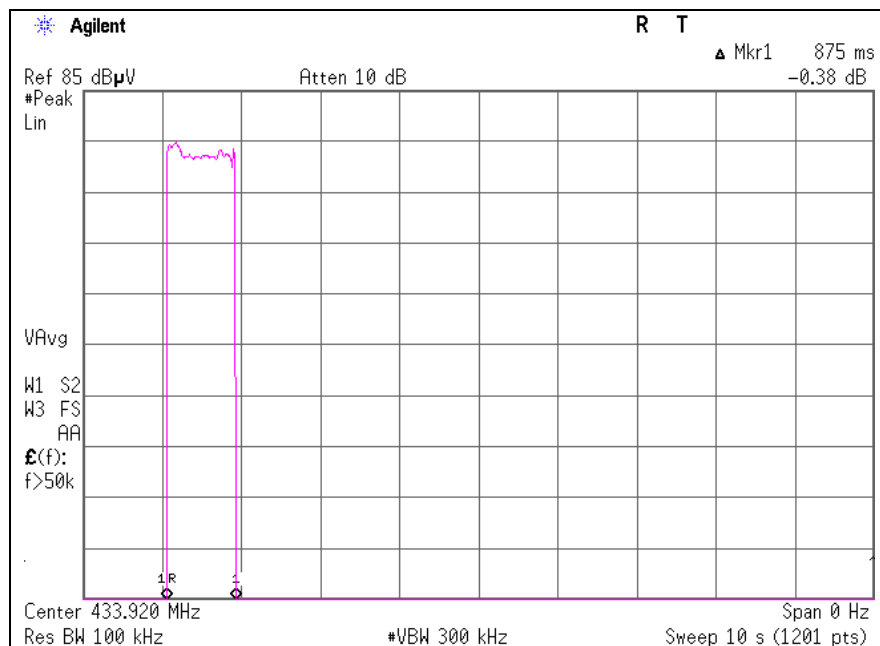
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Automatically deactivate

Test place : Ise EMC Lab. No.2 measurement room
Report No. : 10817935H
Date : 06/06/2015
Temperature/ Humidity : 23 deg. C / 39% RH
Engineer : Koji Yamamoto
Mode : Normal use mode 433.92 MHz

Time of Transmitting [sec]	Limit [sec]	Result
0.875	5.00	Pass



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

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No. : 10817935H
Date : 06/06/2015
Temperature/ Humidity : 25 deg. C / 41% RH
Engineer : Koji Yamamoto
Mode : Transmitting mode 433.92 MHz

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	
433.920	PK	74.3	74.3	18.0	9.5	28.4	-	73.4	73.4	100.8	27.4	27.4	Carrier
867.840	PK	32.3	31.8	22.3	11.2	27.3	-	38.5	38.0	80.8	42.3	42.8	Outside
1301.760	PK	43.5	46.3	25.9	3.9	35.7	-	37.6	40.4	73.9	36.3	33.5	Inside
1735.680	PK	49.9	50.2	27.9	3.4	35.3	-	45.9	46.2	80.8	34.9	34.6	Outside
2169.600	PK	44.2	44.7	29.3	3.5	35.0	-	42.0	42.5	80.8	38.8	38.3	Outside
2603.520	PK	45.3	43.9	29.4	3.6	34.9	-	43.4	42.0	80.8	37.4	38.8	Outside
3037.440	PK	43.5	44.5	29.7	3.7	34.7	-	42.2	43.2	80.8	38.6	37.6	Outside
3471.360	PK	44.5	45.2	29.9	4.1	34.3	-	44.2	44.9	80.8	36.6	35.9	Outside
3905.280	PK	43.7	43.8	30.8	4.3	34.0	-	44.8	44.9	73.9	29.1	29.0	Inside
4339.200	PK	43.1	43.2	31.7	4.6	34.0	-	45.4	45.5	73.9	28.5	28.4	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	
433.920	PK	74.3	74.3	18.0	9.5	28.4	0.0	73.4	73.4	80.8	7.4	7.4	Carrier
867.840	PK	32.3	31.8	22.3	11.2	27.3	0.0	38.5	38.0	60.8	22.3	22.8	Outside
1301.760	PK	43.5	46.3	25.9	3.9	35.7	0.0	37.6	40.4	53.9	16.3	13.5	Inside
1735.680	PK	49.9	50.2	27.9	3.4	35.3	0.0	45.9	46.2	60.8	14.9	14.6	Outside
2169.600	PK	44.2	44.7	29.3	3.5	35.0	0.0	42.0	42.5	60.8	18.8	18.3	Outside
2603.520	PK	45.3	43.9	29.4	3.6	34.9	0.0	43.4	42.0	60.8	17.4	18.8	Outside
3037.440	PK	43.5	44.5	29.7	3.7	34.7	0.0	42.2	43.2	60.8	18.6	17.6	Outside
3471.360	PK	44.5	45.2	29.9	4.1	34.3	0.0	44.2	44.9	60.8	16.6	15.9	Outside
3905.280	PK	43.7	43.8	30.8	4.3	34.0	0.0	44.8	44.9	53.9	9.1	9.0	Inside
4339.200	PK	43.1	43.2	31.7	4.6	34.0	0.0	45.4	45.5	53.9	8.5	8.4	Inside

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

*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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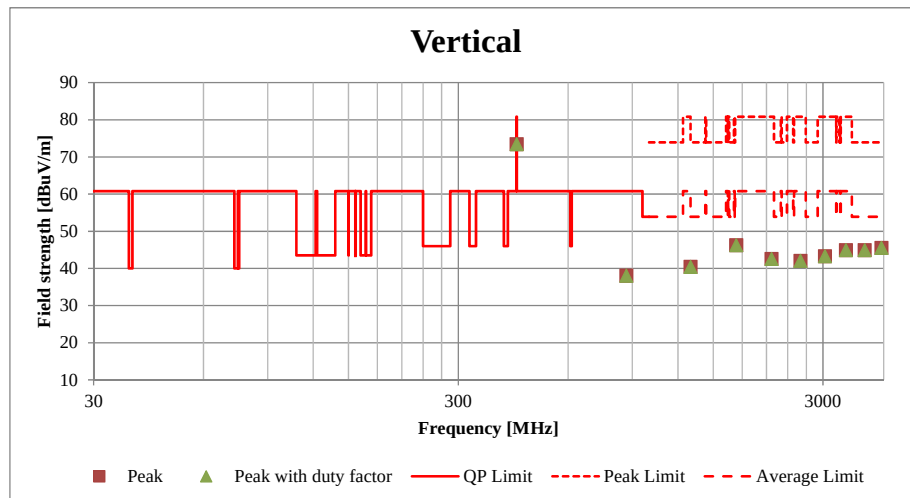
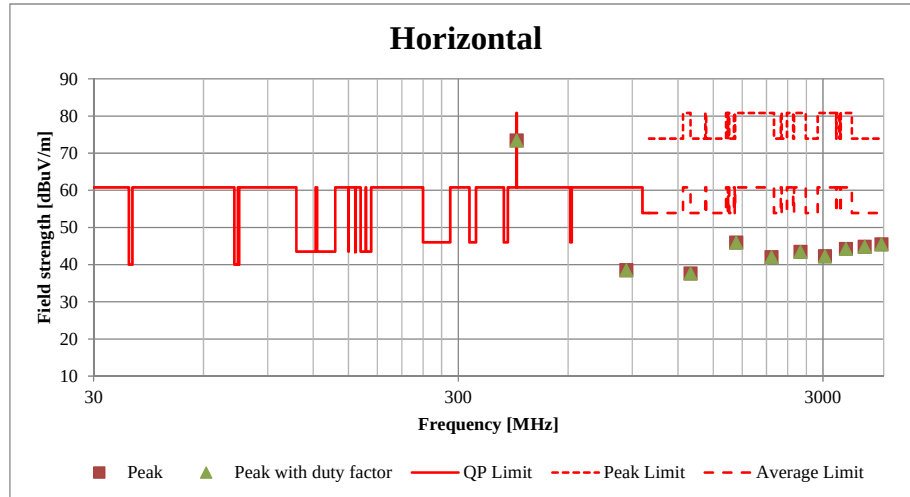
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Facsimile : +81 596 24 8124

Radiated Spurious Emission **(Plot data, Worst case)**

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	10817935H
Date	06/06/2015
Temperature/ Humidity	25 deg. C / 41% RH
Engineer	Koji Yamamoto
Mode	Transmitting mode 433.92 MHz



-20dB and 99% Occupied Bandwidth

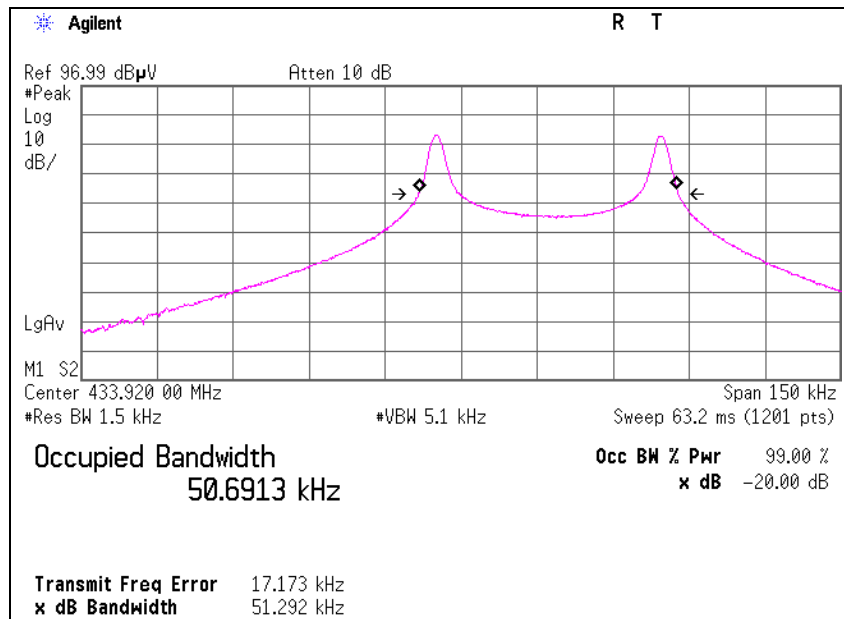
Test place : Ise EMC Lab. No.2 measurement room
Report No. : 10817935H
Date : 06/06/2015
Temperature/ Humidity : 23 deg. C / 39% RH
Engineer : Koji Yamamoto
Mode : Transmitting mode 433.92 MHz

Bandwidth Limit : Fundamental Frequency **433.92** MHz x 0.25% = 1084.80 kHz

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

-20dB Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
51.29	1084.80	Pass

99% Occupied Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
50.69	1084.80	Pass



APPENDIX 2: Test Instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE	2014/06/25 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE	2015/01/13 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-16	Spectrum Analyzer	Agilent	E4440A	MY46186390	RE	2015/02/16 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	RE	2014/06/03 * 12
MBA-02	Biconical Antenna	Schwarzbeck	BBA9106	VHA91032008	RE	2014/10/18 * 12
MLA-02	Logperiodic Antenna	Schwarzbeck	USLP9143	201	RE	2014/10/18 * 12
MCC-12	Coaxial Cable	Fujikura/Agilent	-	-	RE	2015/02/06 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2014/11/11 * 12
MPA-09	Pre Amplifier	Agilent	8447D	2944A10845	RE	2014/09/26 * 12
MHA-06	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	RE	2015/02/05 * 12
MCC-166	Microwave Cable	Junkosha	MWX221	1303S120(1m) / 1311S167(5m)	RE	2014/09/24 * 12
MPA-10	Pre Amplifier	Agilent	8449B	3008A02142	RE	2015/01/28 * 12
MHF-27	High Pass Filter(1.1-10GHz)	TOKYO KEIKI	TF219CD1	1001	RE	2015/01/23 * 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:

RE: Radiated emission, 99% Occupied Bandwidth, -20dB bandwidth , Automatically deactivate and Duty cycle tests

UL Japan, Inc.

Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

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