RADIO TEST REPORT

Test Report No. : 11029313H-A-R2

Applicant	:	**Mitsubishi Electric Corporation Himeji works**
Type of Equipment	:	**Keyless System Hand Unit**
Model No.	:	**SKE13D-02**
Test regulation	:	**FCC Part 15 Subpart C: 2015**
FCC ID	:	**WAZSKE13D02**
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 11029313H-A-R1. 11029313H-A-R1 is replaced with this report.

Date of test: November 11, 2015

Representative test engineer:
Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:
Motoya Imura
Engineer
Consumer Technology Division

NVLAP LAB CODE: 200572-0

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/

REVISION HISTORY

Original Test Report No.: 11029313H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	11029313H-A	December 8, 2015	-	-
1	11029313H-A-R1	December 14, 2015	P.5	Correction of “FCC Part 15.203 Antenna requirement”
2	11029313H-A-R2	December 15, 2015	P.9	Move "Configuration and peripherals" on page to Clause 4.2.

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SECTION 1: Customer information

Company Name	:	Mitsubishi Electric Corporation Himeji works
Address	:	840 Chiyoda-machi Himeji Hyogo, 670-8677, Japan
Telephone Number	:	+81-79-298-8994
Facsimile Number	:	+81-79-298-9929
Contact Person	:	Toshio Koga

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

2.1 Identification of E.U.T.

Type of Equipment	:	Keyless System Hand Unit
Model No.	:	SKE13D-02
Serial No.	:	Refer to Clause 4.2
Rating	:	DC 3.0 V
Receipt Date of Sample	:	November 5, 2015
Country of Mass-production	:	Thailand
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model No: SKE13D-02 (referred to as the EUT in this report) is the Keyless System Hand Unit.
The clock frequency of EUT is 27.6 MHz.

Radio Specification

RF Part

Equipment Type	:	Transmitter
Type of modulation	:	FSK
Frequency of operation	:	315 MHz
Antenna Type	:	PCB Pattern
Method of Frequency Generation	:	Crystal
Operating voltage (inner)	:	DC 3.0 V

LF Part *

Type of Receiver	:	Receiver
Frequency of operation	:	125 kHz
Intermediate frequency	:	-
Antenna Type	:	Inductive
Method of Frequency Generation	:	Crystal
Operating voltage (inner)	:	DC 3.0 V

* The test of receiver part was performed separately from this test report, and the conformability is confirmed.
LF Part test report No. 11029313H-B (FCC15B).

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C: 2015, final revised on November 23, 2015 *Some parts are effective on and after December 17, 2015 or December 23, 2015. The revision does not affect the test specification applied to the EUT.
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

* The EUT complies with FCC Part 15 Subpart B: 2015, final revised on June 12, 2015 and effective July 13, 2015

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)	0.9 dB 314.930 MHz Horizontal, PK(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)	2.9 dB 629.858 MHz Horizontal, PK(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 15.31 (e)
This test was performed with the New Battery (DC 3.0 V) 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.

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	5.1 dB	6.2 dB	5.5 dB	5.8 dB	5.8 dB	4.3 dB
No.2	4.2 dB	5.1 dB	6.2 dB	5.4 dB	5.7 dB	5.9 dB	5.6 dB
No.3	4.4 dB	5.1 dB	6.3 dB	5.2 dB	5.5 dB	5.8 dB	5.5 dB
No.4	4.7 dB	5.3 dB	6.3 dB	5.3 dB	5.7 dB	5.9 dB	5.5 dB

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

Radiated emission test(3 m)
The data listed in this report meets the limits unless the uncertainty is taken into consideration.

3.5 Test Location

UL Japan, Inc. Ise EMC Lab. *NVLAP Lab. code: 200572-0
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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 data, Test instruments, and Test set up.

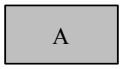
Refer to APPENDIX.

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

4.1 Operating Modes

Test Item*	Mode
Automatically Deactivate	Normal use mode 315 MHz
Electric Field Strength of Fundamental Emission Electric Field Strength of Spurious Emission -20dB & 99% Occupied Bandwidth Duty Cycle	Transmitting mode (Tx) 315 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, EUT stops to transmit in a given time, even if transceiver button is being pressed.) End users cannot change the settings of the output power of the product.	

4.2 Configuration and peripherals



* Test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Keyless System Hand Unit	SKE13D-02	20151104-T2 *1) 20151104-T1 *2)	Mitsubishi Electric Corporation Himeji works	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

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

(Above 30 MHz)
The Radiated Electric Field Strength has been measured on Semi anechoic chamber with a ground plane and at a distance of 3 m.
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.
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 300 MHz	300 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	9.1 kHz	9.1 kHz	120 kHz	PK: S/A: RBW 1 MHz, VBW: 3 MHz

- 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 without mechanical key was the worst case. Therefore the test without 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 - 3.2 GHz
Test data : APPENDIX
Test result : Pass

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	1 MHz	10 kHz	30 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
*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.							

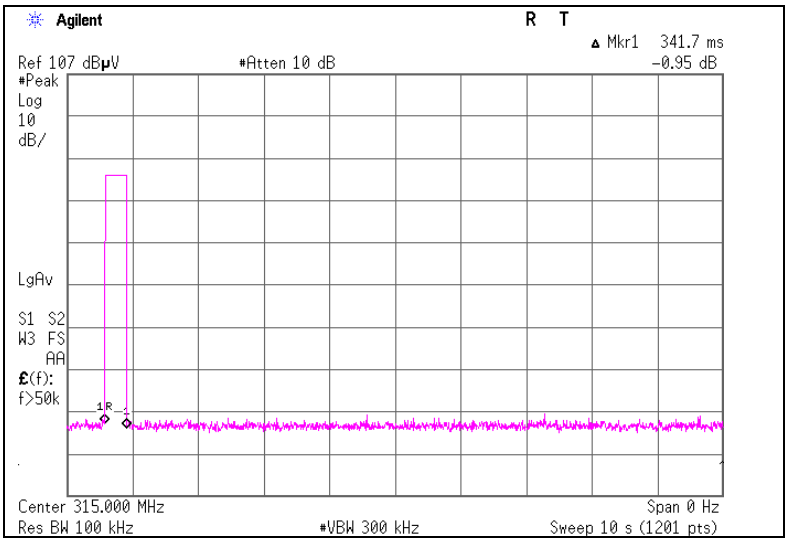
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Automatically deactivate

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11029313H
Date	11/11/2015
Temperature/ Humidity	21 deg. C / 46% RH
Engineer	Shinya Watanabe
Mode	Normal use mode 315 MHz

Time of Transmitting [sec]	Limit [sec]	Result
0.3417	5.00	Pass



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

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11029313H
Date	11/11/2015
Temperature/ Humidity	21 deg. C / 46% RH
Engineer	Shinya Watanabe
Mode	Transmitting mode 315 MHz

PK

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m] Hor	Result [dBuV/m] Ver	Limit [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark Inside or Outside of Restricted Bands
314.930	PK	87.0	82.8	15.0	10.1	32.0	-	80.1	75.9	95.6	15.5	19.7	Carrier
629.858	PK	58.6	57.5	19.7	11.9	32.1	-	58.1	57.0	75.6	17.5	18.6	Outside
944.782	PK	35.2	34.4	22.8	13.5	30.8	-	40.7	39.9	75.6	34.9	35.7	Outside
1260.000	PK	49.0	49.1	24.5	2.0	33.9	-	41.6	41.7	75.6	34.0	33.9	Outside
1575.000	PK	44.8	46.7	25.5	2.2	33.2	-	39.3	41.2	73.9	34.6	32.7	Inside
3150.000	PK	44.1	43.8	28.6	3.1	31.5	-	44.3	44.0	95.6	51.3	51.6	Outside

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

AV (PK with Duty factor)

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m] Hor	Result [dBuV/m] Ver	Limit [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark
314.930	PK	87.0	82.8	15.0	10.1	32.0	-5.4	74.7	70.5	75.6	0.9	5.1	Carrier
629.858	PK	58.6	57.5	19.7	11.9	32.1	-5.4	52.7	51.6	55.6	2.9	4.0	Outside
944.782	PK	35.2	34.4	22.8	13.5	30.8	-5.4	35.3	34.5	55.6	20.3	21.1	Outside
1260.000	PK	49.0	49.1	24.5	2.0	33.9	0.0	41.6	41.7	55.6	14.0	13.9	Outside
1575.000	PK	44.8	46.7	25.5	2.2	33.2	0.0	39.3	41.2	53.9	14.6	12.7	Inside
3150.000	PK	44.1	43.8	28.6	3.1	31.5	0.0	44.3	44.0	75.6	31.3	31.6	Outside

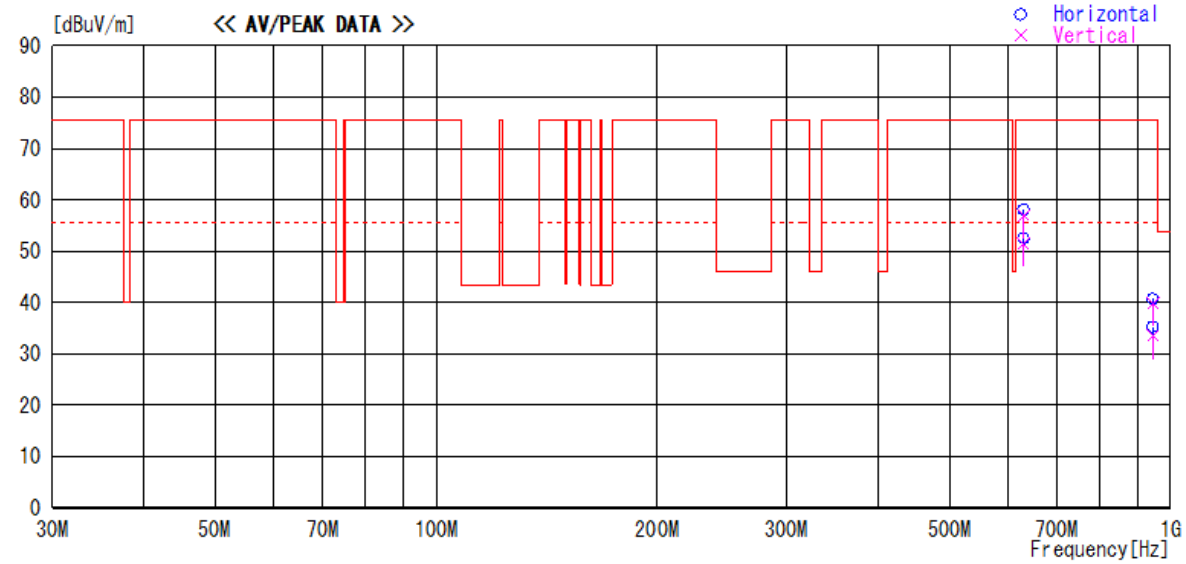
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amprifier) + Duty factor (Refer to Duty factor data sheet)
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

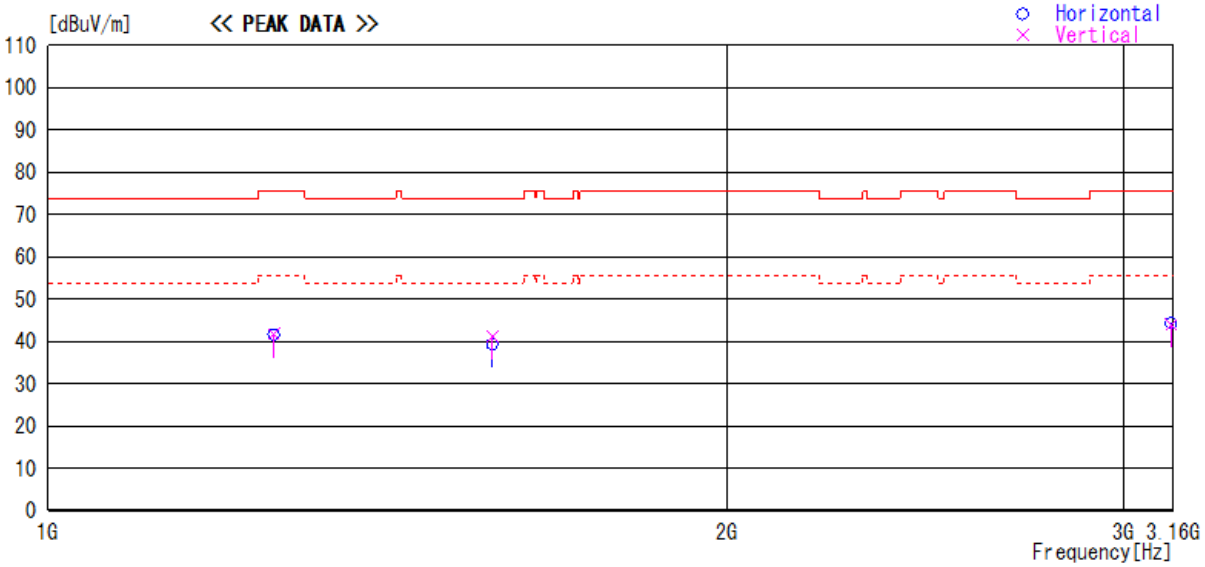
* Other harmonics were not detected.
As for Average value, the measured duty factor obtained by tuning to noise peak was applied since fundamental and harmonic (below 1GHz) are bigger than 120 kHz (RBW bandwidth).

Harmonic test (Above 1GHz) was applied to worst 100% (Duty factor = 0) although Duty Factor was applied in harmonic test which peak to peak frequency bandwidth of FSK modulation is equal to or more than measurement bandwidth (1MHz).

Radiated Spurious Emission
(Plot data, Worst case)

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11029313H
Date	11/11/2015
Temperature/ Humidity	21 deg. C / 46% RH
Engineer	Shinya Watanabe
Mode	Transmitting mode 315 MHz





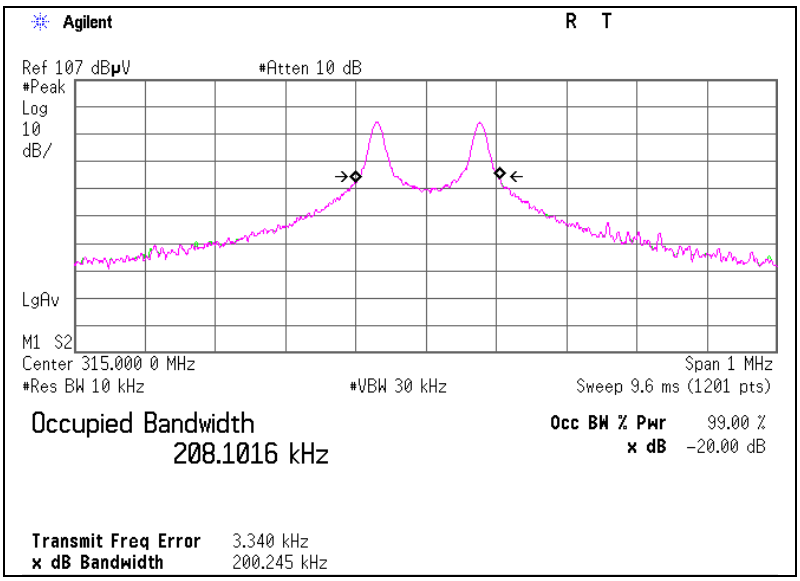
*These plots data contains sufficient number to show the trend of characteristic features for EUT.

-20dB and 99% Occupied Bandwidth

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11029313H
Date	11/11/2015
Temperature/ Humidity	21 deg. C / 46% RH
Engineer	Shinya Watanabe
Mode	Transmitting mode 315 MHz

-20dB Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
200.25	787.50	Pass

99% Occupied Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
208.10	787.50	Pass



Duty Cycle

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11029313H
Date	11/11/2015
Temperature/ Humidity	21 deg. C / 46% RH
Engineer	Shinya Watanabe
Mode	Transmitting mode 315 MHz

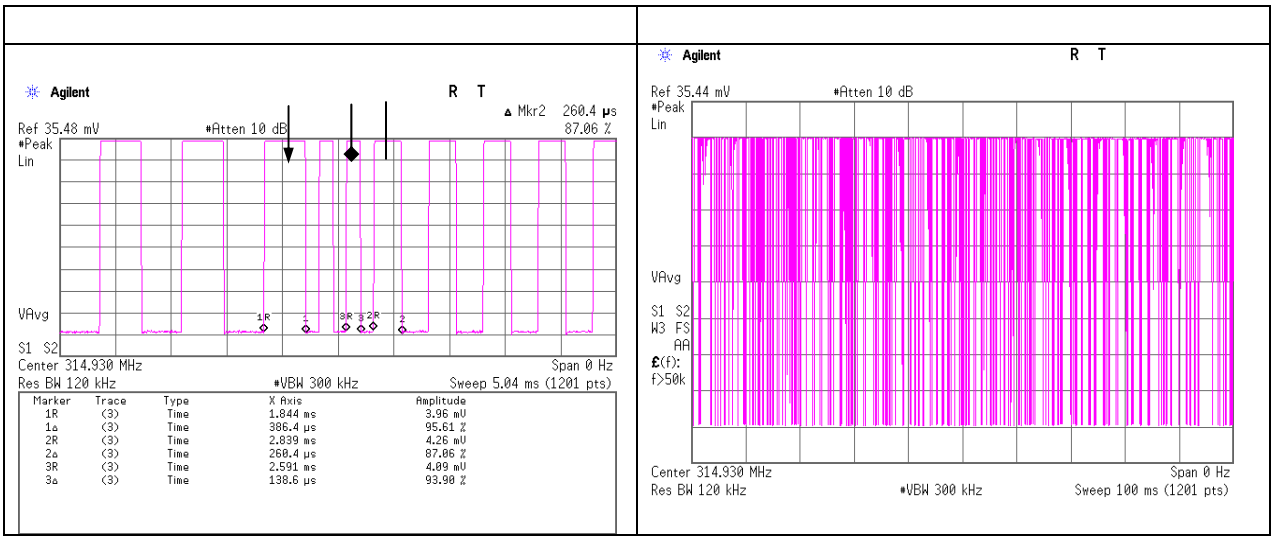
Type	Times	ON time(One pulse) [ms]	ON time(in One cycle) [ms]
A	4	0.3864	1.5456
B	94	0.2604	24.4776
C	198	0.1386	27.4428

*1)ON time(in One cycle) = Times * ON time(One pulse)

(Total)

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty [dB]
53.47	100.00	0.53	-5.4

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



: Type A
: Type B
: Type C

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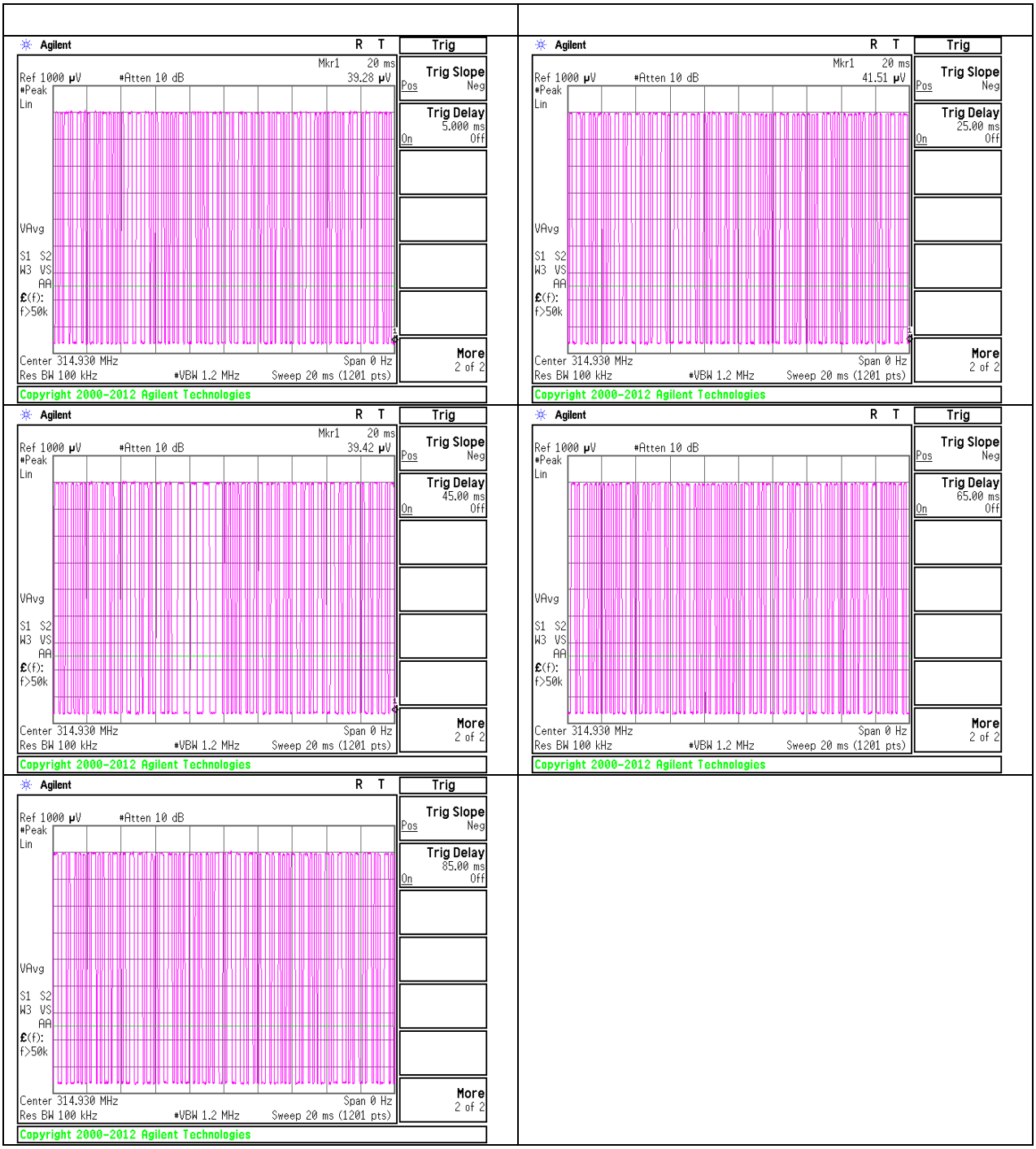
Duty Cycle

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	11029313H
Date	11/11/2015
Temperature/ Humidity	21 deg. C / 46% RH
Engineer	Shinya Watanabe
Mode	Transmitting mode 315 MHz



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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-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2015/10/01 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2015/01/13 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2015/05/18 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2015/09/02 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2015/10/11 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2015/10/11 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2015/07/13 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2015/04/08 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2015/03/10 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	RE	2015/01/16 * 12
MHA-20	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	RE	2015/05/18 * 12
MPA-11	MicroWave System Amplifier	Agilent	83017A	MY39500779	RE	2015/03/19 * 12
MCC-167	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	RE	2015/05/21 * 12
MLPA-07	Loop Antenna	UL Japan	-	-	RE	Pre Check

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