RADIO TEST REPORT

Test Report No. : 12311663H-A-R1

Applicant	:	**Sumitomo Wiring Systems, Ltd.**
Type of Equipment	:	**BCM(Body Control Module)**
Model No.	:	**K68PB**
FCC ID	:	**2AKB8K68PB**
Test regulation	:	**FCC Part 15 Subpart C: 2018**
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. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
8. This report is a revised version of 12311663H-A. 12311663H-A is replaced with this report.

Date of test: June 7 to August 23, 2018

Representative test engineer:

Tomoki Matsui
Engineer
Consumer Technology Division

Approved by:

Shinichi Miyazono
Engineer
Consumer Technology Division

NVLAP TESTING
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/

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

REVISION HISTORY

Original Test Report No.: 12311663H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12311663H-A	July 5, 2018	-	-
1	12311663H-A-R1	August 28, 2018	P.1	Addition of test date
1	12311663H-A-R1	August 28, 2018	P.4	Correction of Operating temperature range [LF Transmitter] in Clause 2.2; From: -40 deg. C to +90 deg. C to : -40 deg. C to +85 deg. C
1	12311663H-A-R1	August 28, 2018	P.5	Correction of "FCC Part 15.31(e) requirement" in Clause 3.2.
1	12311663H-A-R1	August 28, 2018	P.8	Addition of note sentence in Clause 4.1.
1	12311663H-A-R1	August 28, 2018	P.13, 14	Addition of additional test data
1	12311663H-A-R1	August 28, 2018	P.13, 14, 17, 18, 19, 20	Addition of note sentence.

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SECTION 1: Customer information

Company Name	:	Sumitomo Wiring Systems, Ltd.
Address	:	1820 Nakanoike, Mikkaichi-cho, Suzuka-City, Mie Pref. 513-8631 JAPAN
Telephone Number	:	+81-59-340-1137
Facsimile Number	:	+81-59-383-3943
Contact Person	:	Toshiyuki Sonoda

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

2.1 Identification of E.U.T.

Type of Equipment	:	BCM (Body Control Module)
Model No.	:	K68PB
Serial No.	:	Refer to Clause 4.2
Rating	:	DC 12 V
Receipt Date of Sample	:	May 18, 2018
Country of Mass-production	:	Japan
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: K68PB (referred to as the EUT in this report) is the BCM (Body Control Module).

Radio Specification

[LF Transmitter]

Radio Type	:	Transmitter
Frequency of Operation	:	125 kHz
Modulation	:	OOK (ASK)
Method of Frequency Generation	:	Ceramic resonator
Operating temperature range	:	-40 deg. C to +85 deg. C
Clock Frequency (maximum)	:	4.002 MHz

[RF Receiver]*

Radio Type	:	Receiver
Frequency of Operation	:	433.92 MHz
Method of Frequency Generation	:	Crystal
Operating temperature range	:	-40 deg. C to +85 deg. C
Receiver Bandwidth	:	60.06 kHz
Clock Frequency (maximum)	:	21.948717 MHz

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

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.209 Radiated emission limits; general requirements.

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	Conducted Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 8.8	<FCC> Section 15.207 <IC> RSS-Gen 8.8	-	N/A *1)	N/A	N/A
2	Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.4, 6.12	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	6.5 dB 125 kHz 0 deg., PK with Duty factor	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.4, 6.13	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	12.9 dB 64.031MHz, Horiozntal, QP	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> -	<FCC> Reference data <IC> -	Radiated	N/A	N/A	N/A

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 is not the device that is designed to be connected to the public utility (AC) power line.

FCC Part 15.31 (e)
The battery voltage (DC 12V) is provided to the EUT. Input voltage to RF part doesn't go through the regulator. So the test was performed with the supply voltage varied between 85 % and 115% of the nominal rated supply voltage (DC 12 V) and the variation of the input power does not affect the test result, 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 vehicle. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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	Complied

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 distance	Radiated emission (+/-)
	9 kHz to 30 MHz
3 m	3.8 dB
10 m	3.6 dB

*Measurement distance

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*)(+/-)		(10 m*)(+/-)	
	30 MHz to 200 MHz	200 MHz to 1000 MHz	30 MHz to 200 MHz	200 MHz to 1000 MHz
Horizontal	4.8 dB	5.2 dB	4.8 dB	5.0 dB
Vertical	5.0 dB	6.3 dB	4.9 dB	5.0 dB

*Measurement distance

Radiated emission test(3 m)
The data listed in this test report has enough margin, more than the site margin.

3.5 Test Location

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
NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	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	2973C-1	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	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	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	2973C-4	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.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 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m 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.

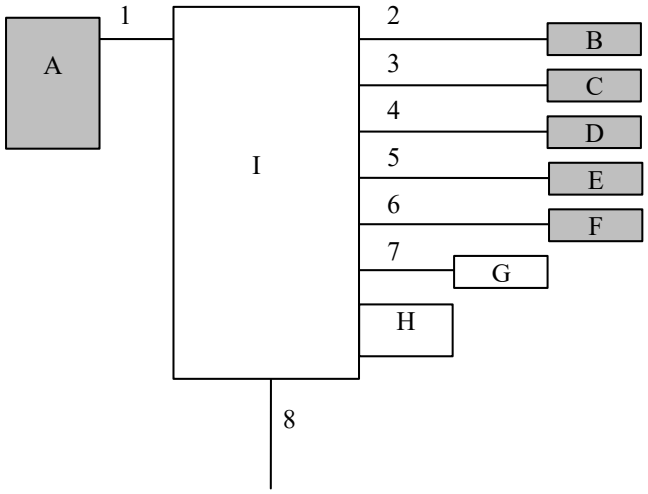
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

Test mode	Remarks
Transmitting mode (Tx) 125kHz	-

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

4.2 Configuration and peripherals



DC 12.0V

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

* The input voltage (DC 12 V) passes through Item No. I without affecting it and is supplied to the LF antennas (Item No. B to F) without any drop in voltage.
* The EUT does not transmit simultaneously from multiple antennas.
* Antenna was evaluated with the worst duty respectively.
* The EUT was set to transmit the data continuously from one antenna as a worst case, not to transmit it randomly from each antenna.
* According to the result of pre-check to LF Antenna (AND), LF Antenna (ANA) and LF Antenna (ANL), it was confirmed that there was no difference in RF characteristics among antennas. So the test was performed with one antenna F (LF Antenna (ANL)) as a representative.
* According to the result of pre-check to LF Antenna (ANB) and LF Antenna (ANI), it was confirmed that there was no difference in RF characteristics among antennas. So the test was performed with one antenna D (LF Antenna (ANB)) as a representative.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	BCM (Body Control Module)	K68PB	002	Sumitomo Wiring Systems, Ltd.	EUT
B	LF Antenna (AND)	LF Antenna B	001	Sumitomo Wiring Systems, Ltd.	EUT
C	LF Antenna (ANA)	LF Antenna B	002	Sumitomo Wiring Systems, Ltd.	EUT
D	LF Antenna (ANB)	LF Antenna C	003	Sumitomo Wiring Systems, Ltd.	EUT
E	LF Antenna (ANI)	LF Antenna C	004	Sumitomo Wiring Systems, Ltd.	EUT
F	LF Antenna (ANL)	LF Antenna A	005	Sumitomo Wiring Systems, Ltd.	EUT
G	Steering Lock	-	001	-	-
H	Push SW	-	001	-	-
I	Checker BOX	-	1	-	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Signal & DC Cable	1.5	Unshielded	Unshielded	-
2	Antenna Cable	2.0	Unshielded	Unshielded	-
3	Antenna Cable	2.0	Unshielded	Unshielded	-
4	Antenna Cable	2.0	Unshielded	Unshielded	-
5	Antenna Cable	2.0	Unshielded	Unshielded	-
6	Antenna Cable	2.0	Unshielded	Unshielded	-
7	Signal Cable	0.3	Unshielded	Unshielded	-
8	DC Cable	1.8	Unshielded	Unshielded	-

SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

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

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.
*Refer to Figure 1 about Direction of the Loop Antenna.

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

The test was made with the detector (RBW / VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

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

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

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

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

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

- The 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.

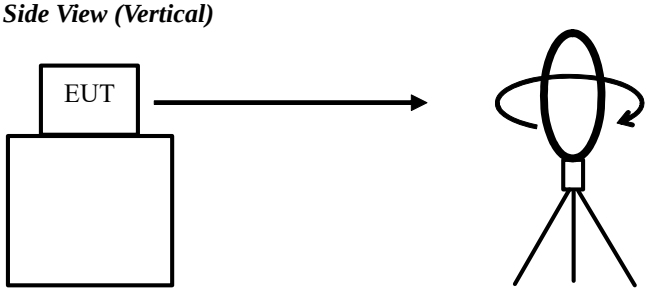
The test results and limit are rounded off to one decimal place, so some differences might be observed.

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

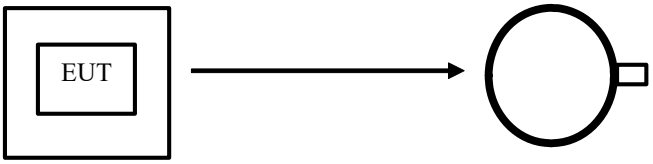
Date: June 7, 2018 Test engineer: Tomoki Matsui, Hiroyuki Furutaka

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

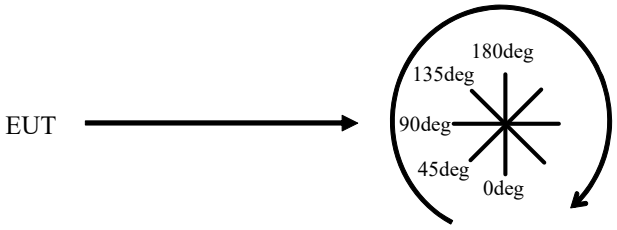


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 6: -26dB Bandwidth

Test Procedure

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

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26 dB Bandwidth	50 kHz	510 Hz	1.6 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1
Test result : Pass

SECTION 7: 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
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 1
Test result : Pass

APPENDIX 1: Test data

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Test place	Ise EMC Lab. No.4 and No.3 Semi Anechoic Chamber	
Order No.	12316663H	
Date	06/07/2018	08/23/2018
Temperature/ Humidity	23 deg. C / 67 % RH	24 deg. C / 65 % RH
Engineer	Tomoki Matsui	Takumi Shimada
Mode	Tx 125 kHz LF Antenna (ANL)	

LF Antenna(ANL)

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	105.3	19.8	-74.0	32.3	-	18.8	45.6	26.8	Fundamental (DC 10.2V)
0	0.12500	PK	105.2	19.8	-73.9	32.2	-	18.9	45.6	26.7	Fundamental (DC 12.0V)
0	0.12500	PK	105.4	19.8	-74.0	32.3	-	18.9	45.6	26.7	Fundamental (DC 13.8V)
0	0.25000	PK	80.1	19.7	-73.9	32.2	-	-6.3	39.6	45.9	
0	0.37500	PK	65.8	19.7	-73.9	32.2	-	-20.6	36.1	56.7	
0	0.50000	QP	42.8	19.7	-33.8	32.1	-	-3.4	33.6	37.0	
0	0.62500	QP	41.9	19.7	-33.8	32.2	-	-4.4	31.7	36.1	
0	0.75000	QP	38.1	19.7	-33.8	32.2	-	-8.2	30.1	38.3	
0	0.87500	QP	36.7	19.7	-33.8	32.2	-	-9.6	28.7	38.3	
0	1.00000	QP	37.0	19.7	-33.8	32.2	-	-9.3	27.6	36.9	
0	1.12500	QP	37.2	19.7	-33.8	32.2	-	-9.1	26.5	35.6	
0	1.25000	QP	37.5	19.7	-33.8	32.2	-	-8.8	25.6	34.4	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	105.3	19.8	-74.0	32.3	0.0	18.8	25.6	6.8	Fundamental (DC 10.2V)
0	0.12500	PK	105.2	19.8	-73.9	32.2	0.0	18.9	25.6	6.7	Fundamental (DC 12.0V)
0	0.12500	PK	105.4	19.8	-74.0	32.3	0.0	18.9	25.6	6.7	Fundamental (DC 13.8V)
0	0.25000	PK	80.1	19.7	-73.9	32.2	0.0	-6.3	19.6	25.9	
0	0.37500	PK	65.8	19.7	-73.9	32.2	0.0	-20.6	16.1	36.7	

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

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

Result of the fundamental emission at 3m without Distance factor

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	105.2	19.8	6.1	32.2	-	98.9	-	-	Fundamental

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

* All spurious emissions lower than this result.

*It was confirmed that there was no difference by the input voltage in the spurious emission.

*The test result is rounded off to one or two decimal places, so some differences might be observed.

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Test place	Ise EMC Lab. No.4 and No.3 Semi Anechoic Chamber	
Order No.	12316663H	
Date	06/07/2018	08/23/2018
Temperature/ Humidity	23 deg. C / 67 % RH	24 deg. C / 65 % RH
Engineer	Tomoki Matsui	Takumi Shimada
Mode	Tx 125 kHz LF Antenna (ANB)	

LF Antenna(ANB)

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	105.6	19.8	-74.0	32.3	-	19.1	45.6	26.5	Fundamental (DC 10.2V)
0	0.12500	PK	105.4	19.8	-73.9	32.2	-	19.1	45.6	26.5	Fundamental (DC 12.0V)
0	0.12500	PK	105.6	19.8	-74.0	32.3	-	19.1	45.6	26.5	Fundamental (DC 13.8V)
0	0.25000	PK	80.0	19.7	-73.9	32.2	-	-6.4	39.6	46.0	
0	0.37500	PK	66.6	19.7	-73.9	32.2	-	-19.8	36.1	55.9	
0	0.50000	QP	43.9	19.7	-33.8	32.1	-	-2.3	33.6	35.9	
0	0.62500	QP	38.3	19.7	-33.8	32.2	-	-8.0	31.7	39.7	
0	0.75000	QP	31.7	19.7	-33.8	32.2	-	-14.6	30.1	44.7	
0	0.87500	QP	31.3	19.7	-33.8	32.2	-	-15.0	28.7	43.7	
0	1.00000	QP	31.0	19.7	-33.8	32.2	-	-15.3	27.6	42.9	
0	1.12500	QP	31.3	19.7	-33.8	32.2	-	-15.0	26.5	41.5	
0	1.25000	QP	30.8	19.7	-33.8	32.2	-	-15.5	25.6	41.1	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	105.6	19.8	-74.0	32.3	0.0	19.1	25.6	6.5	Fundamental (DC 10.2V)
0	0.12500	PK	105.4	19.8	-73.9	32.2	0.0	19.1	25.6	6.5	Fundamental (DC 12.0V)
0	0.12500	PK	105.6	19.8	-74.0	32.3	0.0	19.1	25.6	6.5	Fundamental (DC 13.8V)
0	0.25000	PK	80.0	19.7	-73.9	32.2	0.0	-6.4	19.6	26.0	
0	0.37500	PK	66.6	19.7	-73.9	32.2	0.0	-19.8	16.1	35.9	

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

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

Result of the fundamental emission at 3m without Distance factor

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	105.4	19.8	6.1	32.2	-	99.1	-	-	Fundamental

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

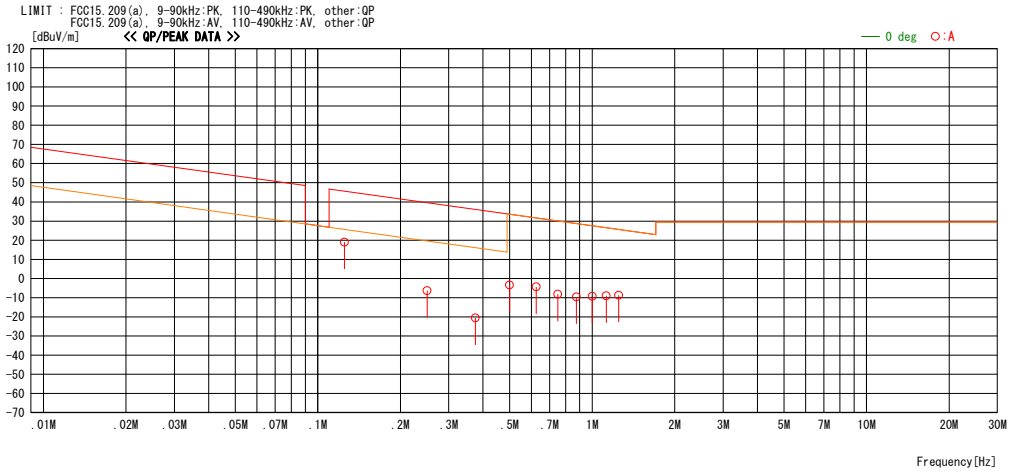
* All spurious emissions lower than this result.

*It was confirmed that there was no difference by the input voltage in the spurious emission.

*The test result is rounded off to one or two decimal places, so some differences might be observed.

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)
(Plot data, Worst case)

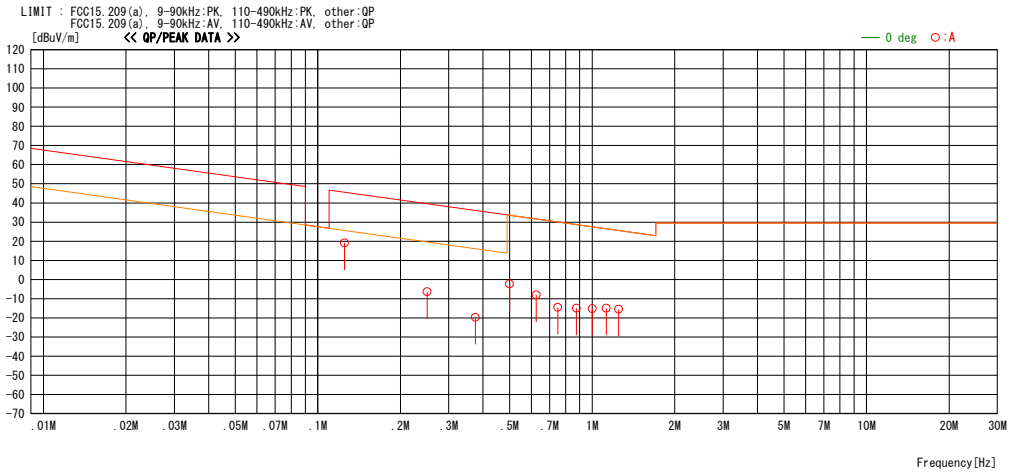
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Order No.	12316663H
Date	06/07/2018
Temperature/ Humidity	23 deg. C / 67 % RH
Engineer	Tomoki Matsui
Mode	Tx 125 kHz LF Antenna (ANL)



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

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)
(Plot data, Worst case)

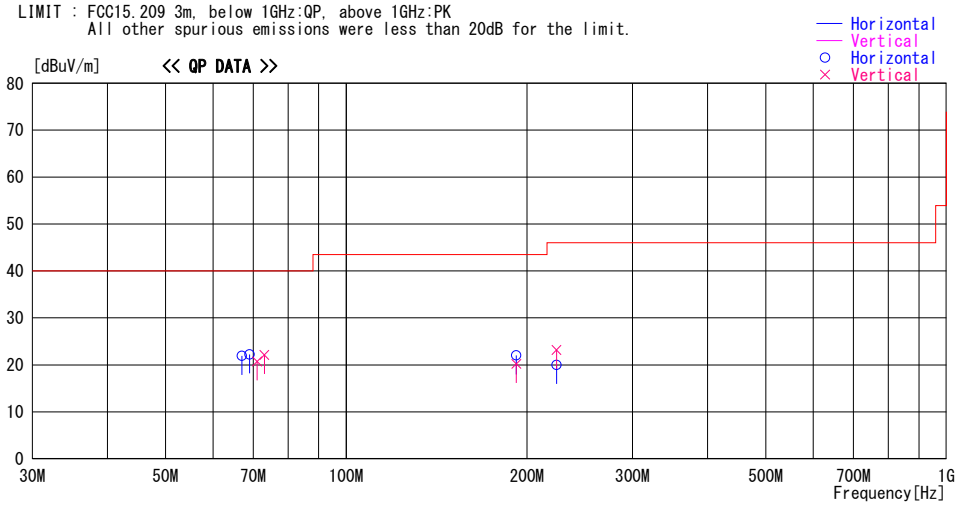
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Order No.	12316663H
Date	06/07/2018
Temperature/ Humidity	23 deg. C / 67 % RH
Engineer	Tomoki Matsui
Mode	Tx 125 kHz LF Antenna (ANB)



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

Radiated Emission above 30 MHz (Spurious Emission)

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No.	12316663H
Date	06/09/2018
Temperature/ Humidity	24 deg. C / 53 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx 125 kHz LF Antenna (ANL)



Frequency [MHz]	Reading [dBuV]	DET	Antenna Factor [dB/m]	Loss& Gain [dB]	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
67.028	39.7	QP	6.7	-24.5	21.9	0	400	Hori.	40.0	18.1	
69.034	40.2	QP	6.4	-24.4	22.2	174	400	Hori.	40.0	17.8	
71.040	38.8	QP	6.3	-24.4	20.7	250	100	Vert.	40.0	19.3	
73.035	40.2	QP	6.3	-24.4	22.1	249	100	Vert.	40.0	17.9	
192.110	28.4	QP	16.6	-23.0	22.0	139	170	Hori.	43.5	21.5	
192.096	26.6	QP	16.6	-23.0	20.2	338	100	Vert.	43.5	23.3	
224.112	31.3	QP	11.4	-22.7	20.0	147	144	Hori.	46.0	26.0	
224.098	34.5	QP	11.4	-22.7	23.2	178	100	Vert.	46.0	22.8	

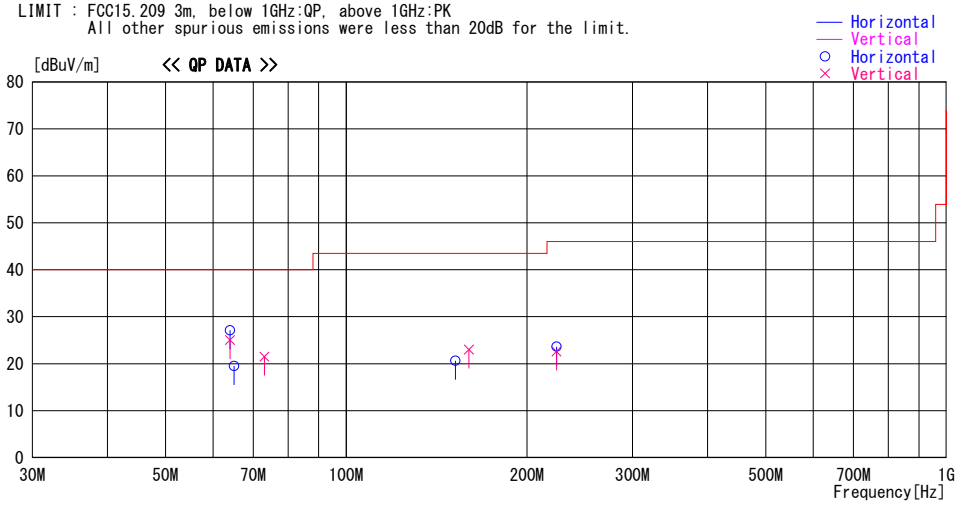
CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATT - GAIN(AMP))

*It was confirmed that there was no difference by the input voltage in the spurious emission.

*The test result is rounded off to one or two decimal places, so some differences might be observed.

Radiated Emission above 30 MHz (Spurious Emission)

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No.	12316663H
Date	06/09/2018
Temperature/ Humidity	24 deg. C / 53 % RH
Engineer	Hiroyuki Furutaka
Mode	Tx 125 kHz LF Antenna (ANB)



Frequency	Reading	DET	Antenna Factor	Loss& Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
64.030	42.4	QP	7.1	-24.5	25.0	263	100	Vert.	40.0	15.0	
64.031	44.5	QP	7.1	-24.5	27.1	7	298	Hori.	40.0	12.9	
65.031	37.0	QP	7.0	-24.5	19.5	353	293	Hori.	40.0	20.5	
73.041	39.6	QP	6.3	-24.4	21.5	249	100	Vert.	40.0	18.5	
152.078	29.1	QP	15.0	-23.5	20.6	235	118	Hori.	43.5	22.9	
160.074	31.0	QP	15.4	-23.4	23.0	199	100	Vert.	43.5	20.5	
224.112	33.9	QP	11.4	-22.7	22.6	166	100	Vert.	46.0	23.4	
224.114	34.9	QP	11.4	-22.7	23.6	340	140	Hori.	46.0	22.4	

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.

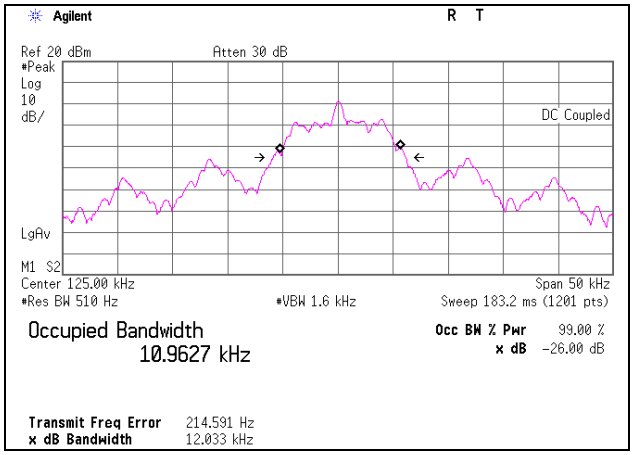
*The test result is rounded off to one or two decimal places, so some differences might be observed.

-26 dB Bandwidth and 99% Occupied Bandwidth

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Order No.	12316663H
Date	06/07/2018
Temperature/ Humidity	23 deg. C / 67 % RH
Engineer	Tomoki Matsui
Mode	Tx 125 kHz LF Antenna (ANL)

LF Antenna(ANL)

-26 dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
12.033	10.9627



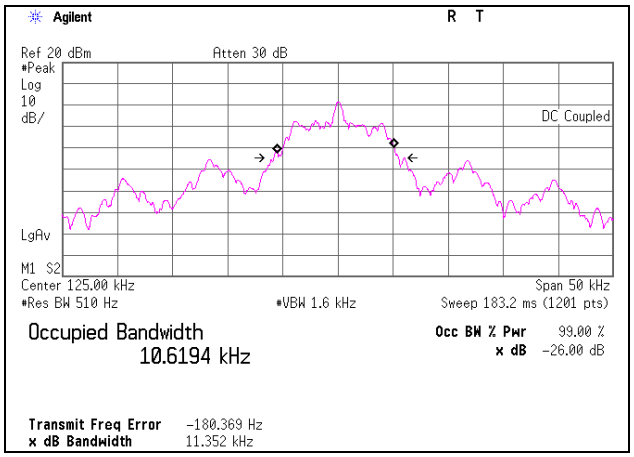
*It was confirmed that there was no difference by the input voltage.

-26 dB Bandwidth and 99% Occupied Bandwidth

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Order No.	12316663H
Date	06/07/2018
Temperature/ Humidity	23 deg. C / 67 % RH
Engineer	Tomoki Matsui
Mode	Tx 125kHz LF Antenna (ANB)

LF Antenna (ANB)

-26 dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
11.352	10.6194



*It was confirmed that there was no difference by the input voltage.

APPENDIX 2: Test instruments

Test equipment

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	10/12/2017	10/31/2018	12
RE	141413	Coaxial Cable	UL Japan	-	-	6/12/2018	6/30/2019	12
RE	141217	Coaxial cable	Fujikura/Suhner/ TSJ	5D-2W/SFM141/ 421-010/ sucoform141-P	-/04178	6/13/2018	6/30/2019	12
RE	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/11/2017	10/31/2018	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	11/5/1900	260833	2/27/2018	2/28/2019	12
RE	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	10/30/2017	10/31/2018	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	1/30/2018	1/31/2019	12
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	1/9/2018	1/31/2019	12
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-180	1501	1/24/2018	1/31/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141901	Spectrum Analyzer	AGILENT	E4440A	MY48250080	10/18/2017	10/31/2018	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	8/22/2017	8/31/2018	12
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	1/24/2018	1/31/2019	12
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	10/31/2017	10/31/2018	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	11/5/1900	260834	2/27/2018	2/28/2019	12
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	141266	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	1/30/2018	1/31/2019	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	1/9/2018	1/31/2019	12
RE	141323	Coaxial cable	UL Japan	-	-	7/12/2017	7/31/2018	12 *1)
RE	141424	Biconical Antenna	Schwarzbeck	BBA9106	1915	10/2/2017	10/31/2018	12
RE	148897	Attenuator	KEYSIGHT	8491A	MY52462349	12/18/2017	12/31/2018	12

***1) This test equipment was used for the tests before the expiration date of the calibration.**

***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: Spurious emission