RADIO TEST REPORT

Test Report No. : 12408998H-F-R3

Applicant	:	**Keyence Corporation**
Type of Equipment	:	**Safety Door Sensor (Non-contact type)**
Model No.	:	**GS-13P5**
FCC ID	:	**RF41477B**
Test regulation	:	**FCC Part 15 Subpart C: 2018**
Test Result	:	**Complied**

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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)
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8. This report is a revised version of 12408998H-F-R2. 12408998H-F-R2 is replaced with this report.

Date of test: July 26 to 29, 2018

Representative test engineer:
Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:
Satofumi Matsuyama
Engineer
Consumer Technology Division

NVLAP TESTING
NVLAP LAB CODE: 200572-0

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☒ There is no testing item of "Non-accreditation".

REVISION HISTORY

Original Test Report No.: 12408998H-F

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12408998H-F	August 20, 2018	-	-
1	12408998H-F-R1	September 13, 2018	P.6	Correction of Test Procedure <IC> for No. 2, 3 in Clause 3.2
1	12408998H-F-R1	September 13, 2018	P.7	Correction of Test Procedure in Clause 3.3
1	12408998H-F-R1	September 13, 2018	P.9	Addition of "(Tx 123 kHz)" for test mode of Clause 4.1.
1	12408998H-F-R1	September 13, 2018	P.9	Addition of note sentence in Clause 4.2.
1	12408998H-F-R1	September 13, 2018	P.9	Correction of Cable length (No.1) for Conducted emission test in Clause 4.2; From 5.7 m to 5.0 m.
1	12408998H-F-R1	September 13, 2018	P.10	Addition of note sentences in Clause 4.2.
1	12408998H-F-R1	September 13, 2018	P.11	Correction of "Tag" notation to "Actuator" notation in SECTION 5.
1	12408998H-F-R1	September 13, 2018	P.15	Correction of mode notation for Conducted emission test data
2	12408998H-F-R2	September 19, 2018	P.6	Correction of Test Procedure <IC> for No. 3 in Clause 3.2
2	12408998H-F-R2	September 19, 2018	P.9	Correction of note sentences in Clause 4.1.
2	12408998H-F-R2	September 19, 2018	P.11	Deletion of explanation about worst case from SECTION 5.
3	12408998H-F-R3	September 20, 2018	P.11	Addition of figure (Test Setup)
3	12408998H-F-R3	September 20, 2018	P.14	Addition of figure (Direction of the Biconical Antenna and Logperiodic Antenna, Test Setup)

CONTENTS PAGE

SECTION 1: Customer information

Company Name	:	Keyence Corporation
Address	:	1-3-14, Higashinakajima, Higashiyodogawa-ku, Osaka, 533-8555, Japan
Telephone Number	:	+81-6-6379-1197
Facsimile Number	:	+81-6-6325-6818
Contact Person	:	Kazuhiko Morishita

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

2.1 Identification of E.U.T.

Type of Equipment	:	Safety Door Sensor (Non-contact type)
Model No.	:	GS-13P5
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 24 V
Receipt Date of Sample	:	July 25, 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: GS-13P5 (referred to as the EUT in this report) is the Safety Door Sensor (Non-contact type).
Safety Door Sensor is composed of the Sensor and Actuator.

General Specification

Clock frequency(ies) in the system	:	32 MHz (CPU)
Operating Temperature	:	-20 deg. C to +55 deg. C

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	123 kHz
Modulation	:	ASK
Antenna type	:	chip Antenna

*Model No. GS-13P5 has variant models. Details are as follows;

	Basic					Standard	Advanced	
Model name	GS-11P5	GS-11N5	GS-11P10	GS-11N10	GS-10PC	GS-11PC	GS-13PC	GS-13P5 (Tested model)
I/O numbers	5				3	5	7	7
Connection type	Cable				Cable with connector M12			Cable
Cable length	5 m		10m		0.3 m			5m
Semiconductor type	PNP	NPN	PNP	NPN	PNP			

GS series (Non-contact type)

1. Door Switch (sensor and actuator set)

GS - 1 0 P C 5
I II III IV V VI

I: Basic designation

II: Guard locking principle
1: non-contact type

III: Function
0: Basic function
1: Standard function
3: Advanced function

IV: Semiconductor Type
P: PNP
N: NPN

V: Cable Type
Blank: Cable
C: Cable with M12 connector

VI: Cable length
Blank: 0.3 m
5: 5 m
10: 10 m
*Cable lengths other than the above are also available. (The above is an example.)

*These differences cause no influence to radio specification.
There was no degradation of EMI characteristic.

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	[QP] 17.9 dB 0.50577 MHz, N [AV] 12.2 dB 0.50577 MHz, N	Complied
2	Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.5, 6.12	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	40.7 dB 123 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 6.5, 6.6, 6.13	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	20.8 dB 49.145 MHz, QP Vertical	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> -	<FCC> Reference data <IC> -	Radiated	N/A	N/A	Complied
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.							
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 EUT provides stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99 % Occupied Band Width	RSS-Gen 6.7	-	Radiated	N/A	N/A	Complied

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.

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

3.4 Uncertainty

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

Frequency range	Conducted emission using AMN(LISN) (+/-)
0.009 MHz to 0.15 MHz	3.8 dB
0.15 MHz to 30 MHz	3.4 dB

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

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

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

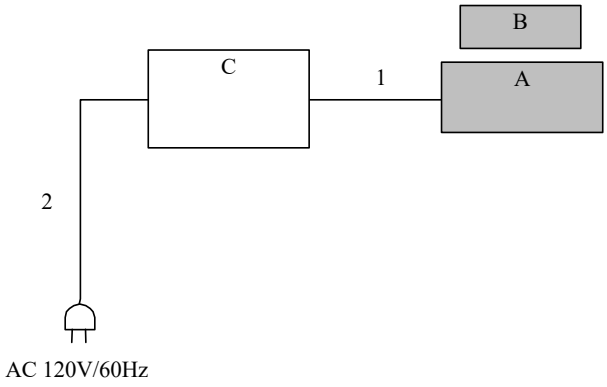
Test mode	Remarks
Transmitting mode (Tx 123 kHz)	-

*The pre-test was conducted both with and without the Actuator.
As a result of the pre-test,
- the Conducted emission test was performed with the Actuator, which had the worst result.
- the Radiated emission test was performed without the Actuator, which had the worst result.

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

4.2 Configuration and peripherals

[Conducted emission test]



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

Description of EUT

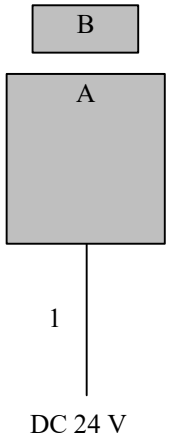
No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Sensor	GS-13P5	#CS1BC040	Keyence Corporation	EUT *1)
B	Actuator	GS-A01	#CS1B0042	Keyence Corporation	EUT *1)
C	DC Power supply	MS2-H50	#F3681A079	Keyence Corporation	-

*1) Safety Door Sensor (GS-13P5) is composed the these items.
Although the Actuator and Sensor together function as a single component, the Actuator is also part of GS-13P5.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC + Signal Cable	5.0	Unshielded	Unshielded	-
2	AC Cable	1.0	Unshielded	Unshielded	-

[Radiated emission test]



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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Sensor	GS-13P5	#CS1BC040	Keyence Corporation	EUT *1)
B	Actuator	GS-A01	#CS1B0042	Keyence Corporation	EUT *1), *2)

*1) Safety Door Sensor (GS-13P5) is composed the these items.
Although the Actuator and Sensor together function as a single component, the Actuator is also part of GS-13P5.
*2) Used for pre-test only.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC + Signal Cable	5.0	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.
*Refer to Figure 1 about Test Setup.

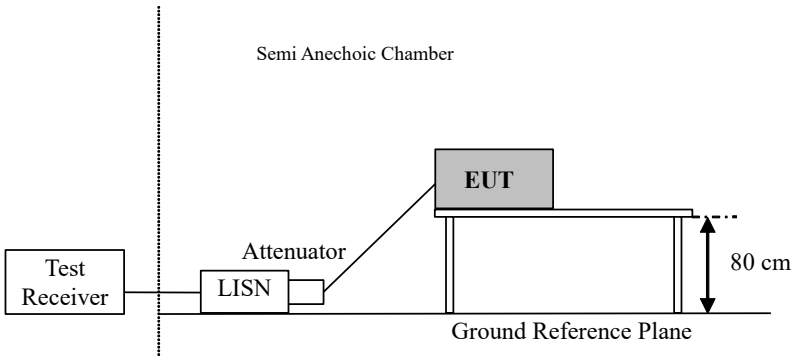
For the tests on EUT with other peripherals (as a whole system)
I/O cable and AC cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN(AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber or a Measurement Room.
The EUT was connected to a LISN (AMN).
An overview sweep with peak detection has been performed.

Detector : CISPR quasi-peak and average detector (IF BW 9 kHz)
Measurement range : 0.15 MHz - 30 MHz
Test data : APPENDIX 1
Test result : Pass

Date: July 29, 2018 Test engineer: Shinya Watanabe

Figure 1: Test Setup



SECTION 6: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

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 2 about Direction of the Loop Antenna, and Figure 4 Test Setup.

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.
*Refer to Figure 3 about Direction of the Biconical Antenna and Logperiodic Antenna, and Figure 4 Test Setup.

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.

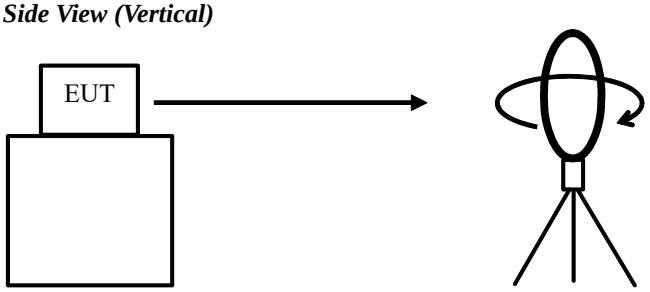
The test results and limit are rounded off to one decimal place, so some differences might be observed.

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

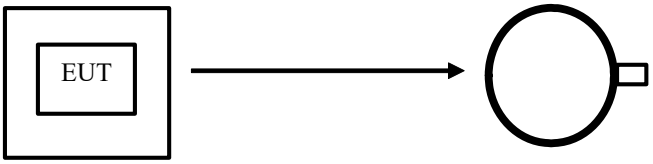
Date: July 29, 2018 Test engineer: Ken Fujita, Shuichi Ohyama

Figure 2: Direction of the Loop Antenna

Side View (Vertical)

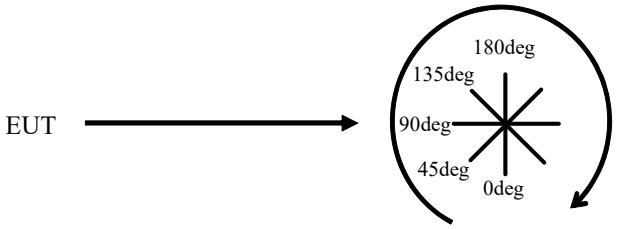


Top View (Horizontal)



Antenna was not rotated.

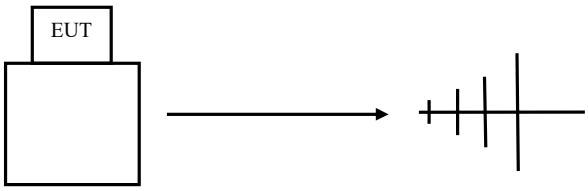
Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

Figure 3: Direction of the Biconical Antenna and Logperiodic Antenna

Side view (Vertical)



Top view (Horizontal)

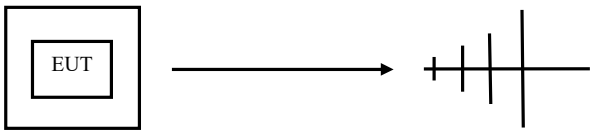
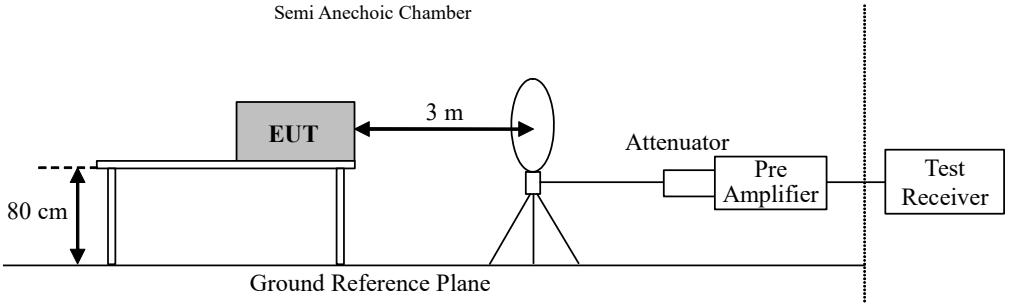
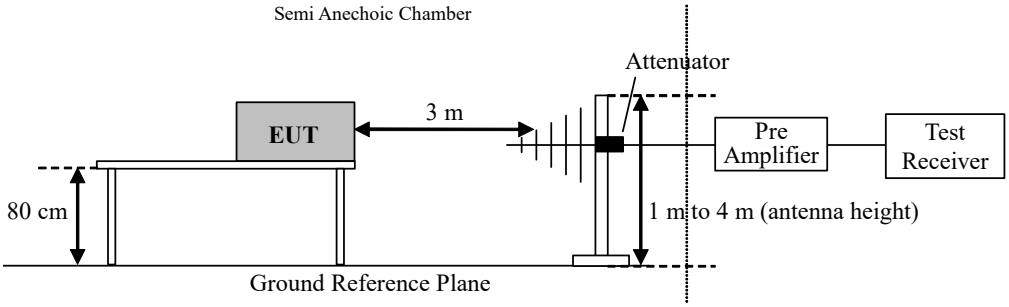


Figure 4: Test Setup

[Below 30 MHz]



[30 MHz - 1 GHz]



SECTION 7: -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	Between 2.0 times and 5.0 times of the OBW	1 kHz	3 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1
Test result : Pass

SECTION 8: 99% Occupied Bandwidth

Test Procedure

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

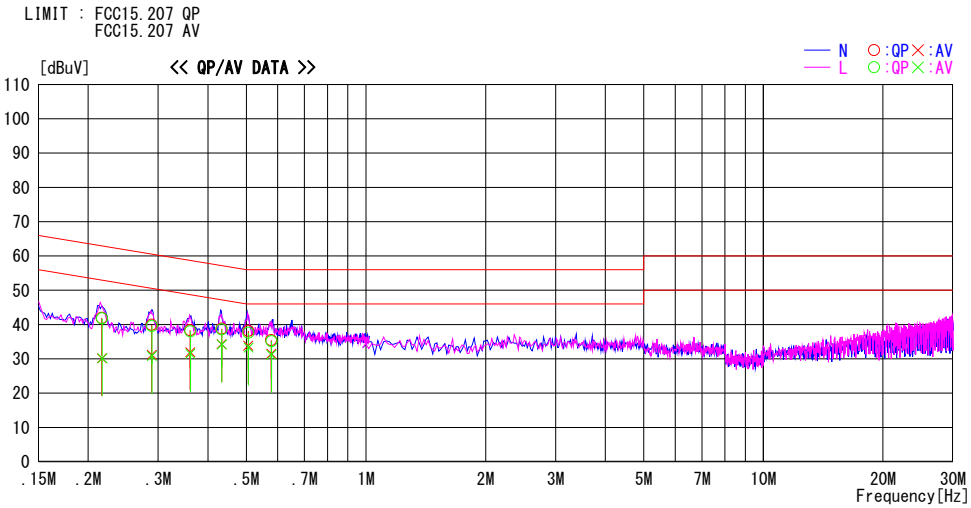
Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak *1)	Max Hold *1)	Spectrum Analyzer
*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %. Peak hold was applied as Worst-case measurement.							

Test data : APPENDIX 1
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

Report No.	12408998H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	July 26, 2018
Temperature / Humidity	21 deg. C / 60 % RH
Engineer	Shinya Watanabe
Mode	Tx 123 kHz



Frequency	Reading Level		Corr.	Results		Limit		Margin		Phase	Comment
	QP	AV	Factor	QP	AV	QP	AV	QP	AV		
[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
0.21647	19.1	7.4	22.8	41.9	30.2	63.0	53.0	21.1	22.8	N	
0.28888	17.1	8.4	22.8	39.9	31.2	60.6	50.6	20.7	19.4	N	
0.36112	15.4	9.1	22.9	38.3	32.0	58.7	48.7	20.4	16.7	N	
0.43340	15.9	11.4	22.9	38.8	34.3	57.2	47.2	18.4	12.9	N	
0.50577	15.3	11.0	22.8	38.1	33.8	56.0	46.0	17.9	12.2	N	
0.57806	12.7	8.7	22.8	35.5	31.5	56.0	46.0	20.5	14.5	N	
0.21681	19.0	7.4	22.8	41.8	30.2	62.9	52.9	21.1	22.7	L	
0.28914	16.8	8.0	22.8	39.6	30.8	60.5	50.5	20.9	19.7	L	
0.36152	15.1	8.6	22.9	38.0	31.5	58.7	48.7	20.7	17.2	L	
0.43385	15.7	11.3	22.9	38.6	34.2	57.2	47.2	18.6	13.0	L	
0.50627	14.8	10.5	22.8	37.6	33.3	56.0	46.0	18.4	12.7	L	
0.57866	12.3	8.4	22.8	35.1	31.2	56.0	46.0	20.9	14.8	L	

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

Report No.	12408998H
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Date	07/29/2018
Temperature/ Humidity	24 deg. C / 56 % RH
Engineer	Ken Fujita
Mode	Tx 123 kHz

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	0.12300	PK	71.5	19.8	-74.0	32.3	-	-15.0	45.7	60.7	Fundamental
0	0.24600	PK	45.5	19.7	-74.0	32.3	-	-41.1	39.8	80.9	
0	0.36900	PK	43.3	19.7	-74.0	32.3	-	-43.3	36.2	79.5	
0	0.49200	QP	32.4	19.7	-33.9	32.2	-	-14.0	33.8	47.8	
0	0.61500	QP	33.7	19.7	-33.9	32.2	-	-12.7	31.8	44.5	
0	0.73800	QP	31.3	19.7	-33.9	32.2	-	-15.1	30.2	45.3	
0	0.86100	QP	31.9	19.7	-33.9	32.2	-	-14.5	28.9	43.4	
0	0.98400	QP	30.8	19.7	-33.9	32.2	-	-15.6	27.7	43.3	
0	1.10700	QP	30.7	19.7	-33.9	32.2	-	-15.7	26.7	42.4	
0	1.23000	QP	30.7	19.7	-33.9	32.2	-	-15.7	25.8	41.5	

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	0.12300	PK	71.5	19.8	-74.0	32.3	0.0	-15.0	25.7	40.7	
0	0.24600	PK	45.5	19.7	-74.0	32.3	0.0	-41.1	19.8	60.9	
0	0.36900	PK	43.3	19.7	-74.0	32.3	0.0	-43.3	16.2	59.5	

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	0.12300	PK	71.5	19.8	6.0	32.3	-	65.0	-	-	Fundamental

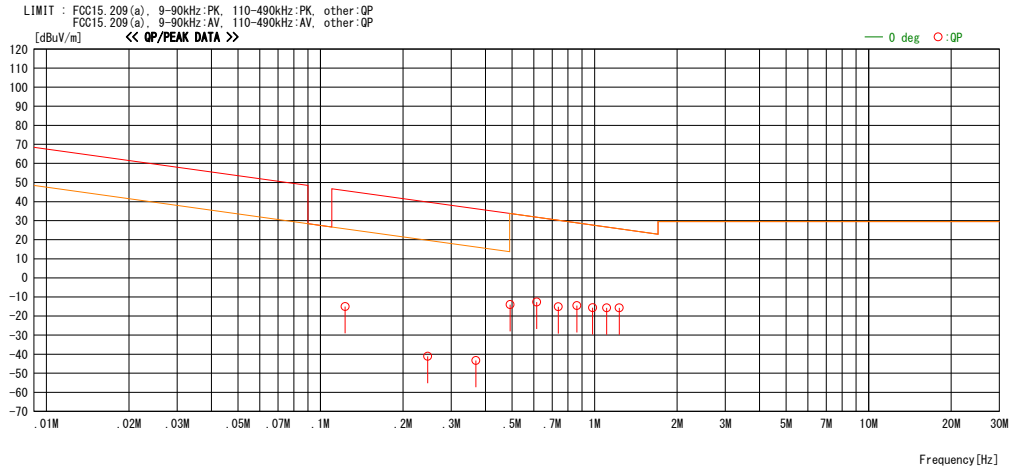
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amprifier)

* All spurious emissions lower than this result.

*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)

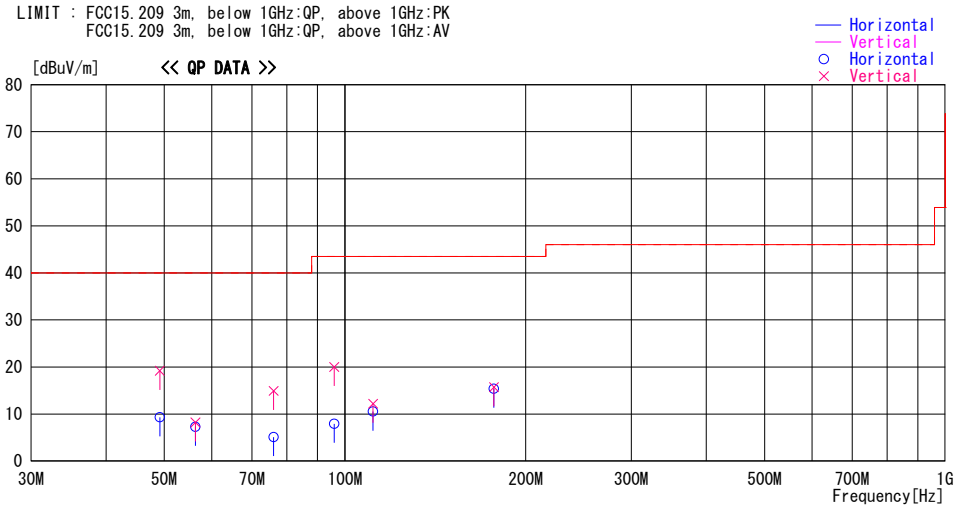
Report No.	12408998H
Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Date	07/29/2018
Temperature/ Humidity	24 deg. C / 56 % RH
Engineer	Ken Fujita
Mode	Tx 123 kHz



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

Radiated Emission above 30 MHz (Spurious Emission)

Report No.	12408998H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	07/29/2018
Temperature/ Humidity	24 deg. C / 56 % RH
Engineer	Shuichi Ohyama
Mode	Tx 123 kHz



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
49.145	32.3	QP	11.6	-24.7	19.2	8	103	Vert.	40.0	20.8	
49.145	22.4	QP	11.6	-24.7	9.3	0	100	Hori.	40.0	30.7	
56.350	23.0	QP	8.9	-24.6	7.3	359	100	Hori.	40.0	32.7	
56.350	23.9	QP	8.9	-24.6	8.2	187	100	Vert.	40.0	31.8	
76.060	32.6	QP	6.6	-24.3	14.9	289	100	Vert.	40.0	25.1	
76.060	22.8	QP	6.6	-24.3	5.1	359	100	Hori.	40.0	34.9	
96.002	34.6	QP	9.5	-24.1	20.0	210	100	Vert.	43.5	23.5	
96.002	22.5	QP	9.5	-24.1	7.9	2	100	Hori.	43.5	35.6	
111.416	24.2	QP	11.9	-23.9	12.2	321	100	Vert.	43.5	31.3	
111.416	22.5	QP	11.9	-23.9	10.5	138	100	Hori.	43.5	33.0	
177.116	22.5	QP	16.3	-23.1	15.7	32	100	Vert.	43.5	27.8	
177.116	22.2	QP	16.3	-23.1	15.4	40	100	Hori.	43.5	28.1	

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))

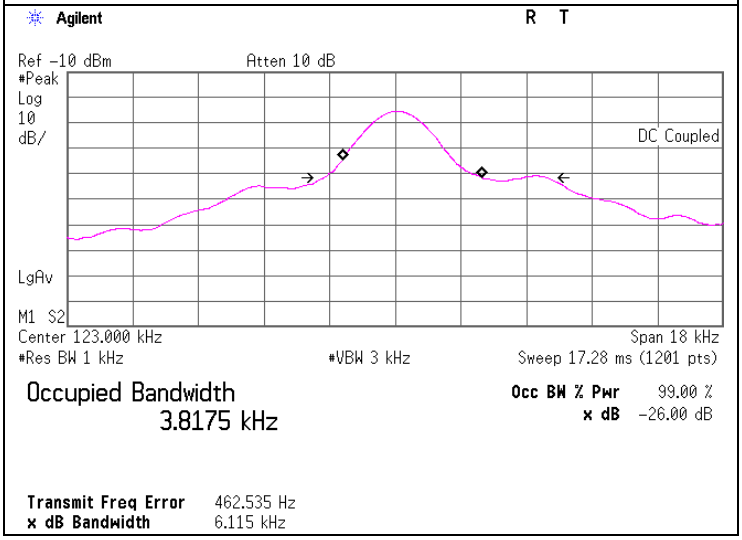
*The test result is rounded off to one or two decimal places, so some differences might be observed.

-26 dB Bandwidth and 99 % Occupied Bandwidth

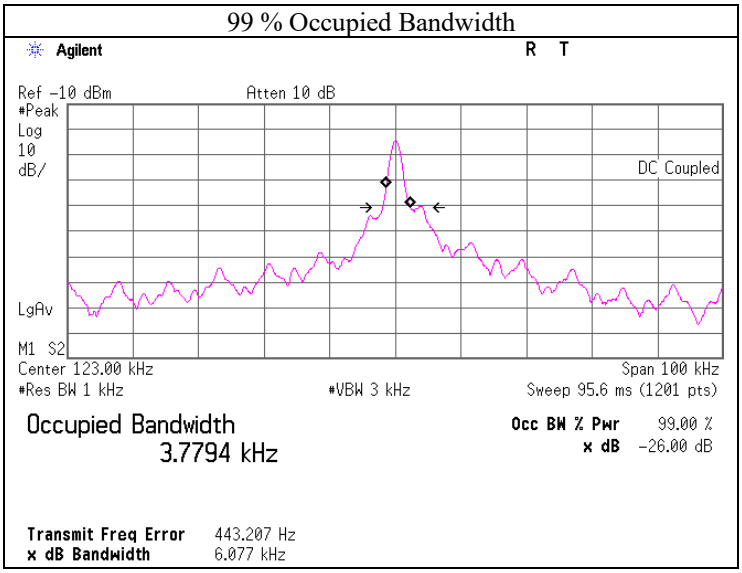
Report No.	12408998H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	07/29/2018
Temperature/ Humidity	24 deg. C / 56 % RH
Engineer	Shuichi Ohyama
Mode	Tx 123 kHz

Frequency [kHz]	-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
123	6.115	3.7794

-26 dB Bandwidth



99 % Occupied Bandwidth



APPENDIX 2: Test instruments

Test Instruments

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
CE	141998	AC1_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	6/18/2018	6/30/2019	12
CE/RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
CE	141566	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	1/24/2018	1/31/2019	12
CE	141950	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	6/15/2018	6/30/2019	12
CE	141537	LISN(AMN)	Schwarzbeck	NSLK8127	8127-731	7/12/2018	7/31/2019	12
CE	141215	Coaxial Cable	Fujikura/Suhner/ TSJ	5D-2W/3D-2W/ RG400u/ RFM-E421(SW)	-/01068 (Switcher)	6/4/2018	6/30/2019	12
CE	141246	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	12/19/2017	12/31/2018	12
CE	141295	High Pass Filter 0.15-30MHz	Rohde & Schwarz	EZ-25/3	100041	2/20/2018	2/28/2019	12
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	6/26/2018	6/30/2020	24
RE	141323	Coaxial cable	UL Japan	-	-	7/3/2018	7/31/2019	12
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	141903	Spectrum Analyzer	AGILENT	E4440A	MY46186390	9/20/2017	9/30/2018	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	8/22/2017	8/31/2018	12
RE	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/11/2017	10/31/2018	12
RE	141216	Coaxial cable	Fujikura/Suhner/ TSJ	5D-2W/SFM14/ sucoform141-PE/ 421-010	-/00640	7/3/2018	7/31/2019	12
RE	141413	Coaxial Cable	UL Japan	-	-	6/12/2018	6/30/2019	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	11/5/1900	260834	2/27/2018	2/28/2019	12
RE	148897	Attenuator	KEYSIGHT	8491A	MY52462349	12/18/2017	12/31/2018	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	1/9/2018	1/31/2019	12
RE	141424	Biconical Antenna	Schwarzbeck	BBA9106	1915	6/4/2018	6/30/2019	12
RE	141266	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	6/4/2018	6/30/2019	12
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	1/24/2018	1/31/2019	12

***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:

CE: Conducted emission
RE: Radiated emission