



RADIO TEST REPORT

Test Report No. : 12408998H-E-R3

Applicant : Keyence Corporation
Type of Equipment : Safety Door Sensor (Lock type)
Model No. : GS-73PC
FCC ID : RF41477A
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied

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3. This sample tested is in compliance with above regulation.
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7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. This report is a revised version of 12408998H-E-R2. 12408998H-E-R2 is replaced with this report.

Date of test: July 26 to 29, 2018

Representative test engineer:

Shinya Watanabe
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Approved by:

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Engineer
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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12408998H-E

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12408998H-E	August 20, 2018	-	-
1	12408998H-E-R1	September 13, 2018	P.6	Correction of Test Procedure <IC> for No. 2, 3 in Clause 3.2
1	12408998H-E-R1	September 13, 2018	P.7	Correction of Test Procedure in Clause 3.3
1	12408998H-E-R1	September 13, 2018	P.9	Addition of“(Tx 123 kHz)” for test mode of Clause 4.1.
1	12408998H-E-R1	September 13, 2018	P.9	Addition of note sentence in Clause 4.2.
1	12408998H-E-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 5.3 m.
1	12408998H-E-R1	September 13, 2018	P.10	Correction of Configuration for Radiated emission test in Clause 4.2.
1	12408998H-E-R1	September 13, 2018	P.10	Addition of note sentences in Clause 4.2.
1	12408998H-E-R1	September 13, 2018	P.11	Correction of "Tag" notation to "Actuator" notation in SECTION 5.
1	12408998H-E-R1	September 13, 2018	P.15	Correction of mode notation for Conducted emission test data.
2	12408998H-E-R2	September 19, 2018	P.6	Correction of Test Procedure <IC> for No. 3 in Clause 3.2
2	12408998H-E-R2	September 19, 2018	P.9	Correction of note sentences in Clause 4.1.
2	12408998H-E-R2	September 19, 2018	P.9	Deletion of “*2)” in Description of EUT table of Clause 4.2.
2	12408998H-E-R2	September 19, 2018	P.11	Deletion of explanation about worst case from SECTION 5.
3	12408998H-E-R3	September 20, 2018	P.11	Addition of figure (Test Setup)
3	12408998H-E-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	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results	6
SECTION 4: Operation of E.U.T. during testing.....	9
SECTION 5: Conducted Emission.....	11
SECTION 6: Radiated emission (Fundamental and Spurious Emission).....	12
SECTION 7: -26dB Bandwidth.....	15
SECTION 8: 99% Occupied Bandwidth.....	15
APPENDIX 1: Test data	16
Conducted Emission.....	16
Radiated Emission below 30 MHz (Fundamental and Spurious Emission)	17
Radiated Emission above 30 MHz (Spurious Emission).....	19
-26 dB Bandwidth and 99 % Occupied Bandwidth	20
APPENDIX 2: Test instruments	21
APPENDIX 3: Photographs of test setup	22
Conducted Emission.....	22
Radiated Emission.....	23
Worst Case Position	24

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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 (Lock type)
Model No. : GS-73PC
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-73PC (referred to as the EUT in this report) is the Safety Door Sensor (Lock 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-73PC has variant models. Details are as follows;

Model name	Standard										Advanced	
	GS -51P5	GS -71P5	GS -51N5	GS -71N5	GS -51P10	GS -71P10	GS -51N10	GS -71N10	GS -51PC	GS -71PC	GS -53PC	GS -73PC (Tested model)
I/O numbers	6										10	
Connection type	Cable								Cable with connector M12			
Cable length	5 m				10 m				0.3 m			
Semiconductor type	PNP		NPN		PNP		NPN		PNP			
guard locking principle	spring	solenoid	spring	solenoid	spring	solenoid	spring	solenoid	spring	solenoid	spring	solenoid

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GS series (Lock 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

5: spring: The locking element of Actuator is locked during power off and is released during power on.

7: solenoid: The locking element of Actuator is released during power off and is locked during power on.

III: 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.

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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] 14.7 dB 0.43565 MHz, N [AV] 9.9 dB 0.43565 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	38.4 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	16.6 dB 576.001 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.

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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

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3.5 Test Location

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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 with the representative two models (GS-73PC and GS-53PC) out of 12 models per the customer's request.

After the test results of these models were compared, the test was performed only with model GS-73PC as its result was the worst one.

Also, the pre-test was conducted both with and without the Actuator.

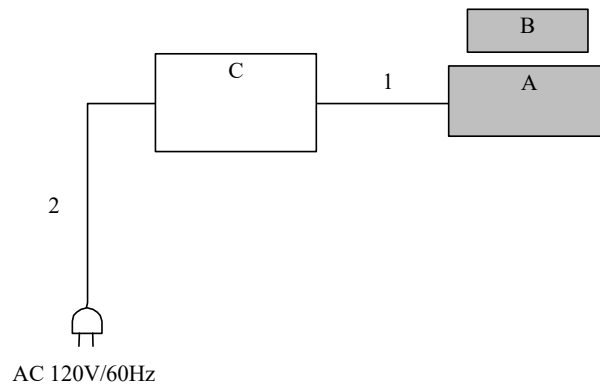
As a result of the pre-test,

- 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-73PC	#CS1AM017	Keyence Corporation	EUT *1)
B	Actuator	GS-A21	003	Keyence Corporation	EUT *1)
C	DC Power supply	MS2-H50	#F3681A079	Keyence Corporation	-

*1) Safety Door Sensor (GS-73PC) is composed of the these items.

Although the Actuator and Sensor together function as a single component, the Actuator is also part of GS-73PC.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC + Signal Cable	5.3	Unshielded	Unshielded	-
2	AC Cable	1.0	Unshielded	Unshielded	-

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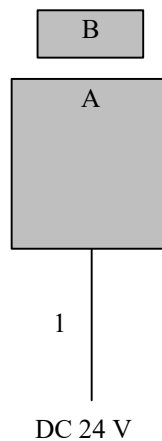
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[Radiated emission test]



* 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-73PC	#CS1AM017	Keyence Corporation	EUT *1)
B	Actuator	GS-A21	003	Keyence Corporation	EUT *1), *2)

*1) Safety Door Sensor (GS-73PC) is composed of the these items.

Although the Actuator and Sensor together function as a single component, the Actuator is also part of GS-73PC.

*2) Used for pre-test only.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC + Signal Cable	5.3	Unshielded	Unshielded	-

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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).

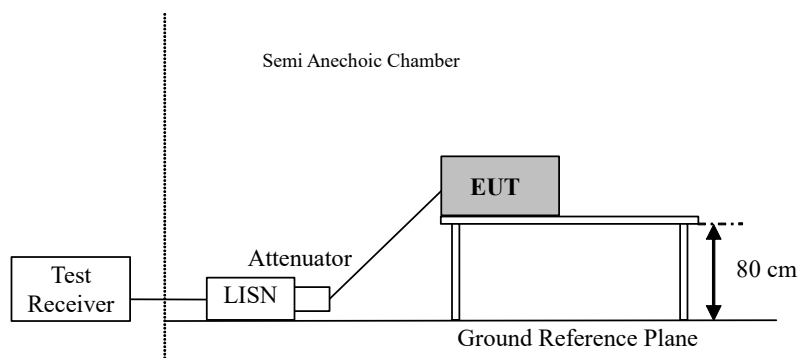
An overview sweep with peak detection has been performed.

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



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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: $40 \times \log(3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

*2) Distance Factor: $40 \times \log(3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

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

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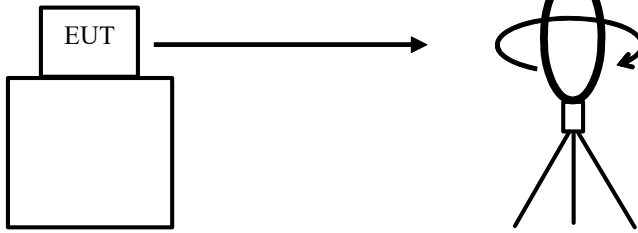
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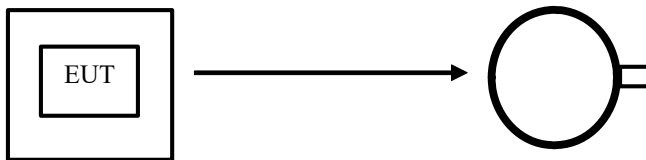
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Figure 2: Direction of the Loop Antenna

Side View (Vertical)

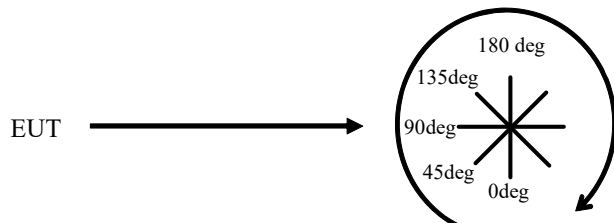


.....
Top View (Horizontal)



Antenna was not rotated.

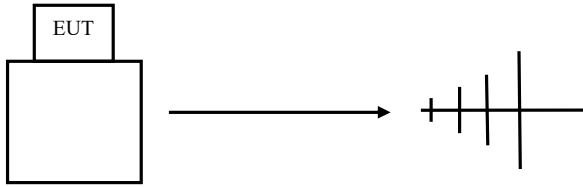
.....
Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

Figure 3: Direction of the Biconical Antenna and Logperiodic Antenna

Side view (Vertical)



Top view (Horizontal)

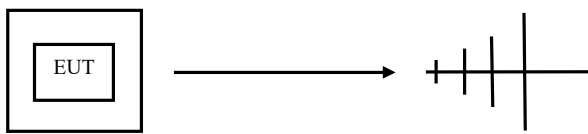
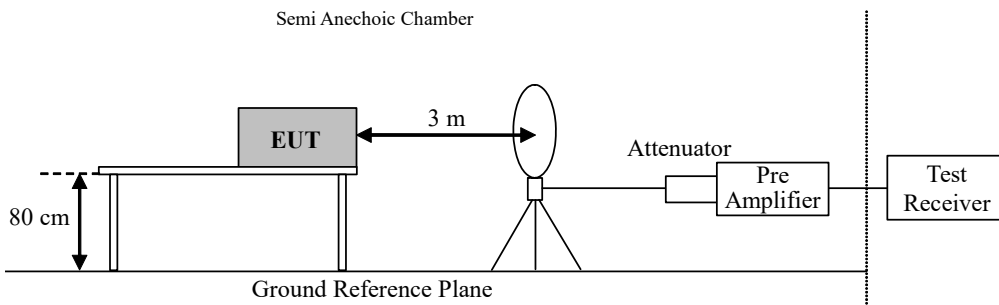
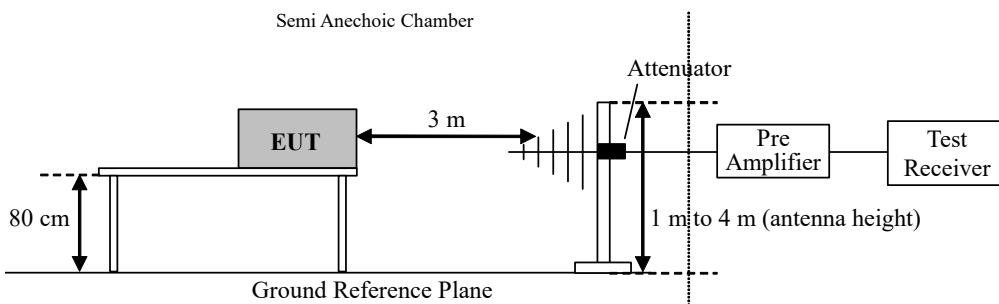


Figure 4: Test Setup

[Below 30 MHz]



[30 MHz - 1 GHz]



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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

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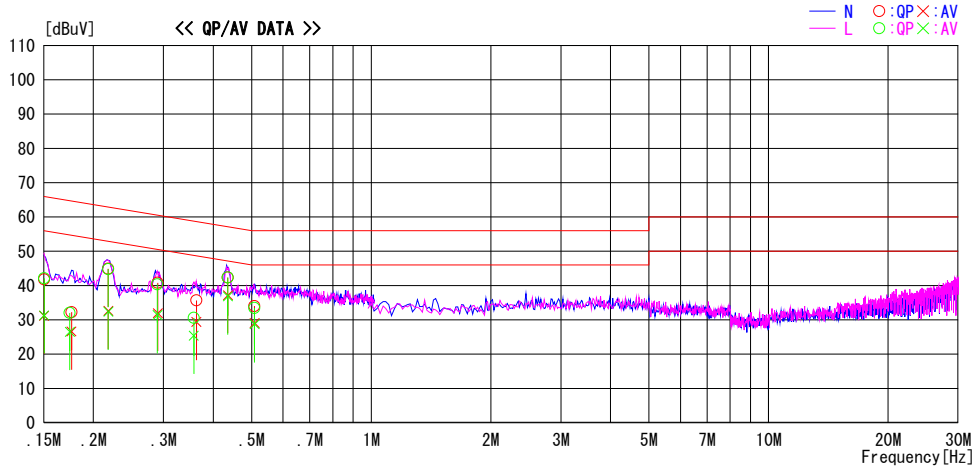
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APPENDIX 1: Test data

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

LIMIT : FCC15.207 QP
FCC15.207 AV



Frequency [MHz]	Reading Level		Corr. Factor [dB]	Results		Limit		Margin		Phase	Comment
	QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dB]	AV [dB]		
0.15020	17.9	7.3	23.9	41.8	31.2	66.0	56.0	24.2	24.8	N	
0.17615	8.9	3.3	23.3	32.2	26.6	64.7	54.7	32.5	28.1	N	
0.21775	22.1	9.8	22.8	44.9	32.6	62.9	52.9	18.0	20.3	N	
0.29038	18.0	9.2	22.8	40.8	32.0	60.5	50.5	19.7	18.5	N	
0.36302	12.8	6.5	22.9	35.7	29.4	58.7	48.7	23.0	19.3	N	
0.43565	19.5	14.3	22.9	42.4	37.2	57.1	47.1	14.7	9.9	N	
0.50836	11.2	6.3	22.8	34.0	29.1	56.0	46.0	22.0	16.9	N	
0.15020	18.2	7.4	23.9	42.1	31.3	66.0	56.0	23.9	24.7	L	
0.17441	8.7	3.2	23.3	32.0	26.5	64.7	54.7	32.7	28.2	L	
0.21775	22.0	9.6	22.8	44.8	32.4	62.9	52.9	18.1	20.5	L	
0.28948	17.6	8.6	22.8	40.4	31.4	60.5	50.5	20.1	19.1	L	
0.35748	7.7	2.5	22.9	30.6	25.4	58.8	48.8	28.2	23.4	L	
0.43575	19.4	13.9	22.9	42.3	36.8	57.1	47.1	14.8	10.3	L	
0.50836	10.7	5.9	22.8	33.5	28.7	56.0	46.0	22.5	17.3	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	73.8	19.8	-74.0	32.3	-	-12.7	45.7	58.4	Fundamental
0	0.24600	PK	46.5	19.7	-74.0	32.3	-	-40.1	39.8	79.9	
0	0.36900	PK	44.5	19.7	-74.0	32.3	-	-42.1	36.2	78.3	
0	0.49200	QP	32.6	19.7	-33.9	32.2	-	-13.8	33.8	47.6	
0	0.61500	QP	34.5	19.7	-33.9	32.2	-	-11.9	31.8	43.7	
0	0.73800	QP	31.4	19.7	-33.9	32.2	-	-15.0	30.2	45.2	
0	0.86100	QP	32.2	19.7	-33.9	32.2	-	-14.2	28.9	43.1	
0	0.98400	QP	30.8	19.7	-33.9	32.2	-	-15.6	27.7	43.3	
0	1.10700	QP	31.3	19.7	-33.9	32.2	-	-15.1	26.7	41.8	
0	1.23000	QP	30.6	19.7	-33.9	32.2	-	-15.8	25.8	41.6	

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

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	73.8	19.8	-74.0	32.3	0.0	-12.7	25.7	38.4	
0	0.24600	PK	46.5	19.7	-74.0	32.3	0.0	-40.1	19.8	59.9	
0	0.36900	PK	44.5	19.7	-74.0	32.3	0.0	-42.1	16.2	58.3	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Ampriifier) + 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	73.8	19.8	6.0	32.3	-	67.3	-	-	Fundamental

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

* 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.

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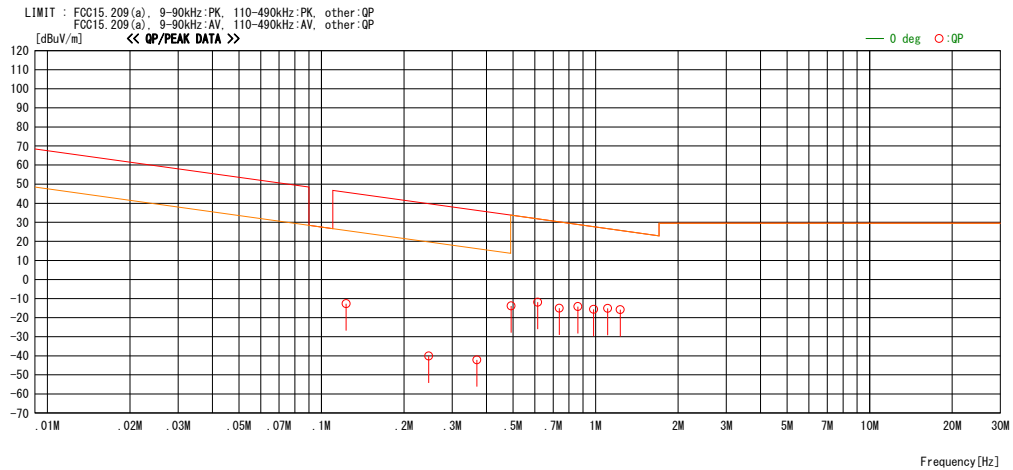
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Radiated Emission below 30 MHz (Fundamental and Spurious Emission)
(Plot data, Worst case)

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

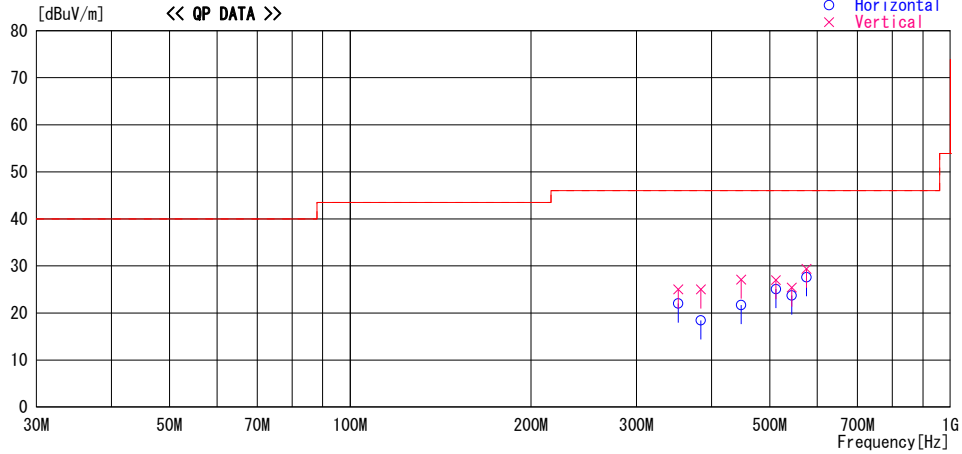


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

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

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
FCC15.209 3m, below 1GHz:QP, above 1GHz:AV



Frequency [MHz]	Reading [dBuV]	DET	Antenna	Loss&	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Gain [dB]							
352.002	31.6	QP	15.1	-21.7	25.0	236	100	Vert.	46.0	21.0	
352.002	28.6	QP	15.1	-21.7	22.0	345	400	Hori.	46.0	24.0	
383.999	24.4	QP	15.4	-21.4	18.4	315	292	Hori.	46.0	27.6	
383.999	31.0	QP	15.4	-21.4	25.0	240	121	Vert.	46.0	21.0	
448.000	25.9	QP	16.8	-21.0	21.7	325	200	Hori.	46.0	24.3	
448.000	31.3	QP	16.8	-21.0	27.1	234	100	Vert.	46.0	18.9	
512.002	28.0	QP	17.7	-20.6	25.1	281	177	Hori.	46.0	20.9	
512.002	29.9	QP	17.7	-20.6	27.0	220	100	Vert.	46.0	19.0	
544.001	26.4	QP	17.7	-20.4	23.7	277	167	Hori.	46.0	22.3	
544.001	28.1	QP	17.7	-20.4	25.4	352	100	Vert.	46.0	20.6	
576.001	29.2	QP	18.6	-20.2	27.6	269	167	Hori.	46.0	18.4	
576.001	31.0	QP	18.6	-20.2	29.4	217	100	Vert.	46.0	16.6	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz - 200 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.

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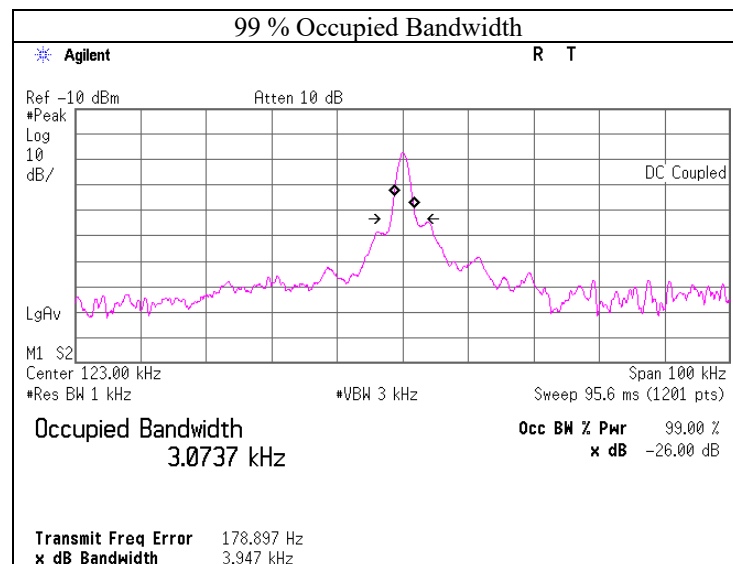
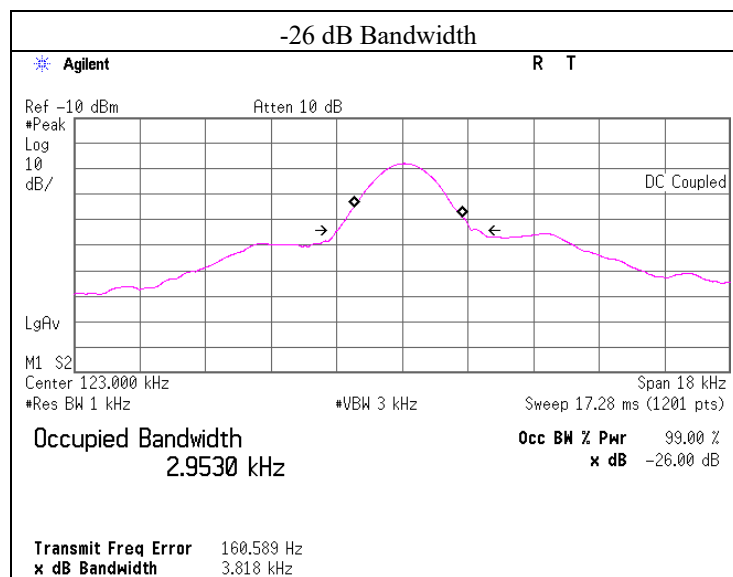
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-26 dB Bandwidth and 99 % Occupied Bandwidth

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	3.818	3.0737



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

UL Japan, Inc.

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