



EMI TEST REPORT

Test Report No. : 12967063H-B


Applicant : SUBARU CORPORATION
Type of Equipment : Keyless Access with Push-Button Start System
Model No. : SU19S-3
FCC ID : Y8PSU19S-3
Test regulation : FCC Part 15 Subpart B: 2019
Test Result : Complied (Refer to SECTION 3.2)

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers EMC technical requirements. It does not cover administrative issues such as Manual or non-EMC test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
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. The information provided from the customer for this report is identified in SECTION 1.

Date of test:

July 22, 2019

Representative test engineer:



Takumi Shimada

Engineer

Consumer Technology Division

Approved by:



Motoya Imura

Leader

Consumer Technology Division



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.

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REVISION HISTORY

Original Test Report No.: 12967063H-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12967063H-B	September 3, 2019	-	-

Reference: Abbreviations (Including words undescribed in this report)

AAN	Asymmetric Artificial Network	ISED	Innovation, Science and Economic Development Canada
AC	Alternating Current	ISN	Impedance Stabilization Network
AM	Amplitude Modulation	ISO	International Organization for Standardization
AMN	Artificial Mains Network	JAB	Japan Accreditation Board
Amp, AMP	Amplifier	LAN	Local Area Network
ANSI	American National Standards Institute	LCL	Longitudinal Conversion Loss
Ant, ANT	Antenna	LIMS	Laboratory Information Management System
AP	Access Point	LISN	Line Impedance Stabilization Network
ASK	Amplitude Shift Keying	MRA	Mutual Recognition Arrangement
Atten., ATT	Attenuator	NIST	National Institute of Standards and Technology
AV	Average	NS	No signal detect.
BPSK	Binary Phase-Shift Keying	NSA	Normalized Site Attenuation
BR	Bluetooth Basic Rate	NVLAP	National Voluntary Laboratory Accreditation Program
BT	Bluetooth	OBW	Occupied Band Width
BT LE	Bluetooth Low Energy	OFDM	Orthogonal Frequency Division Multiplexing
BW	BandWidth	OOK	On Off Keying
C.F	Correction Factor	PK	Peak
Cal Int	Calibration Interval	P _{LT}	long-term flicker severity
CAV	CISPR AV	POHC(A)	Partial Odd Harmonic Current
CCK	Complementary Code Keying	Pol., Pola.	Polarization
CDN	Coupling Decoupling Network	PR-ASK	Phase Reversal ASK
Ch., CH	Channel	P _{ST}	short-term flicker severity
CISPR	Comite International Special des Perturbations Radioelectriques	QAM	Quadrature Amplitude Modulation
Corr.	Correction	QP	Quasi-Peak
CPE	Customer premise equipment	QPSK	Quadri-Phase Shift Keying
CW	Continuous Wave	r.m.s., RMS	Root Mean Square
DBPSK	Differential BPSK	RBW	Resolution Band Width
DC	Direct Current	RE	Radio Equipment
DET	Detector	REV	Reverse
Dmax	maximum absolute voltage change during an observation period	RF	Radio Frequency
DQPSK	Differential QPSK	RFID	Radio Frequency Identifier
DSSS	Direct Sequence Spread Spectrum	RSS	Radio Standards Specifications
EDR	Enhanced Data Rate	Rx	Receiving
e.i.r.p., EIRP	Equivalent Isotropically Radiated Power	SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
EM clamp	Electromagnetic clamp	S/N	Signal to Noise ratio
EMC	ElectroMagnetic Compatibility	SA, S/A	Spectrum Analyzer
EMI	ElectroMagnetic Interference	SG	Signal Generator
EMS	ElectroMagnetic Susceptibility	SVSWR	Site-Voltage Standing Wave Ratio
EN	European Norm	THC(A)	Total Harmonic Current
e.r.p., ERP	Effective Radiated Power	THD(%)	Total Harmonic Distortion
EU	European Union	TR	Test Receiver
EUT	Equipment Under Test	Tx	Transmitting
Fac.	Factor	VBW	Video BandWidth
FCC	Federal Communications Commission	Vert.	Vertical
FHSS	Frequency Hopping Spread Spectrum	WLAN	Wireless LAN
FM	Frequency Modulation	xDSL	Generic term for all types of DSL technology (DSL: Digital Subscriber Line)
Freq.	Frequency		
FSK	Frequency Shift Keying		
Fund	Fundamental		
FWD	Forward		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
I/O	Input/Output		
IEC	International Electrotechnical Commission		
IEEE	Institute of Electrical and Electronics Engineers		
IF	Intermediate Frequency		
ILAC	International Laboratory Accreditation Conference		

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SECTION 1: Customer information

Company Name	: SUBARU CORPORATION
Address	: 1-1, Subaru-cho, ota-shi, Gunma-ken, 373-8555, Japan
Telephone Number	: +81-276-26-3064
Facsimile Number	: +81-276-26-3878
Contact Person	: Kenichi Hanamata

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No. FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

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

2.1 Identification of E.U.T.

Type of Equipment	: Keyless Access with Push-Button Start System
Model No.	: SU19S-3
Serial No.	: Refer to Section 4, Clause 4.2
Rating	: DC 12.0 V
Receipt Date of Sample (Information from test lab.)	: July 16, 2019
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: SU19S-3 (referred to as the EUT in this report) is a Keyless Access with Push-Button Start System.

Radio Specification

[Transmitter]

Radio Type	:	Transmitter
Frequency of Operation	:	134.2 kHz
Oscillator Frequency	:	4.2944 MHz
Type of Modulation	:	OOK (A1D)
Oscillation circuit	:	Crystal
Power Supply	:	DC 12.0 V
Antenna	:	Antenna (TYPE 1) (*1) (*3) / (TYPE 2) (*2) *1: Maximum number of this antenna is 2. *2: Maximum number of this antenna is 4.
Antenna Specification	:	Ferrite antenna coil
Clock frequency (maximum)	:	8.000 MHz (CPU)

*3) The Antennas (TYPE 1) of this system have variations of model 1 and model 2.

The difference of these variations is only the outer shell, and the test was performed with the representative model 1.

[Receiver]

Radio Type	:	Receiver
Frequency of Operation	:	433.92 MHz
Oscillator frequency	:	30.265 MHz (Crystal)
Intermediate frequency	:	280 kHz
Type of Modulation	:	FSK
Type of receiving system	:	Super-heterodyne
Power Supply	:	DC 5.0 V
Antenna Type	:	Internal antenna (Inverted F antenna)
Voltage Controlled Oscillator	:	1734.54 MHz

FCC15.111(b)

The receiving antenna (of this EUT) is installed inside the EUT and cannot be removed (permanently attached). Therefore, Radiated emission test was performed.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart B
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258

Title : FCC 47CFR Part15 Radio Frequency Device
Subpart B Unintentional Radiators

* The revisions made after testing date do not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Limits	Deviation	Worst margin	Result	Remarks
Conducted emission	FCC: ANSI C63.4: 2014 7. AC power - line conducted emission measurements	FCC:Part 15 Subpart B 15.107(a)	N/A	N/A	N/A	*1)
	IC: RSS-Gen 8.8	IC: RSS-Gen 8.8				
Radiated emission	FCC: ANSI C63.4: 2014 8. Radiated emission measurements	FCC: Part 15 Subpart B 15.109(a)	N/A	22.07 dB 55.827 MHz, Vertical, QP	Complied a)	-
	IC: RSS-Gen 7	IC: RSS-Gen 7.1.2				
*Note: UL Japan, Inc’s EMI Work Procedure 13-EM-W0420.						
*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.						
a) Refer to APPENDIX 1 (data of Radiated Emission)						
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.				

3.3 Addition to standard

No addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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

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

Radiated emission (Above 1 GHz)				
(3 m*)(+/-)		(1 m*)(+/-)		(10 m*)(+/-)
1 GHz to 6 GHz	6 GHz to 18 GHz	10 GHz to 26.5 GHz	26.5 GHz to 40 GHz	1 GHz to 18 GHz
5.0 dB	5.3 dB	5.8 dB	5.8 dB	5.2 dB

* Measurement distance

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3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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Test site	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	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	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	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	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.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
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	3.1 x 5.0	-	-
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 x 2.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

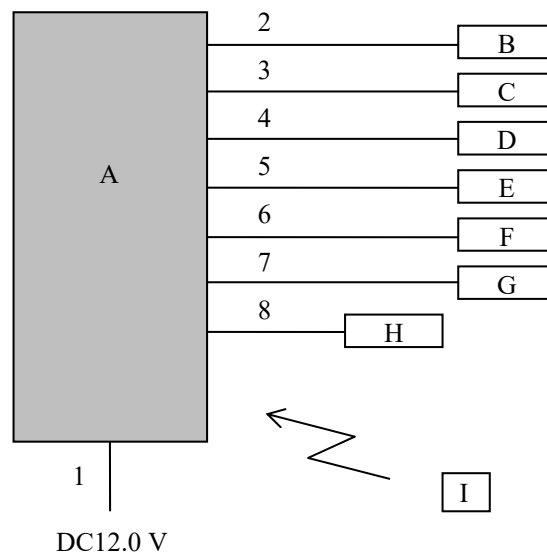
4.1 Operating Mode(s)

The mode is used: Receiving mode (Rx) 433.92 MHz

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

* It was confirmed by using checker that the EUT receives the signal from the transmitter (pair of EUT).

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Keyless Access with Push-Button Start System	SU19S-3	SU19S-3-8	SUBARU CORPORATION	EUT
B	Antenna	TYPE1 (No.1)	G1234 9F7-1 2DF0	SUBARU CORPORATION	-
C	Antenna	TYPE1 (No.2)	G1234 9F7-3 2DF0	SUBARU CORPORATION	-
D	Antenna	TYPE2 INSIDE 1	8RA-189	SUBARU CORPORATION	-
E	Antenna	TYPE2 INSIDE 2	8RA-190	SUBARU CORPORATION	-
F	Antenna	TYPE2 LUGGAGE 1	8RA-191	SUBARU CORPORATION	-
G	Antenna	TYPE2 LUGGAGE 2	8RA-192	SUBARU CORPORATION	-
H	Low Frequency & Radio Frequency Bench(TYPE1)	-	SU19S-3-SB4	SUBARU CORPORATION	-
I	Transmitter	-	SU19S-3-S4	SUBARU CORPORATION	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	Antenna Cable	3.0	Unshielded	Unshielded	-
3	Antenna Cable	3.0	Unshielded	Unshielded	-
4	Antenna Cable	3.0	Unshielded	Unshielded	-
5	Antenna Cable	3.0	Unshielded	Unshielded	-
6	Antenna Cable	3.0	Unshielded	Unshielded	-
7	Antenna Cable	3.0	Unshielded	Unshielded	-
8	Signal cable	3.0	Unshielded	Unshielded	-

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SECTION 5: Radiated Emission

5.1. Operating environment

Test place : No. 1 semi anechoic chamber
Temperature : See data
Humidity : See data

5.2. Test configuration

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 EUT was set on the edge 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.

5.3. Test conditions

Frequency range : 30 MHz - 200 MHz (Biconical antenna) / 200 MHz - 1000 MHz (Logperiodic antenna)
1000 MHz - 10000 MHz (Horn antenna)
Test distance : 3 m
EUT position : Table top
EUT operation mode : See Clause 4.1

5.4. Test procedure

The height of the measuring antenna 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 with the Test Receiver.

The radiated emission measurements were made with the following detector function of the Test Receiver.

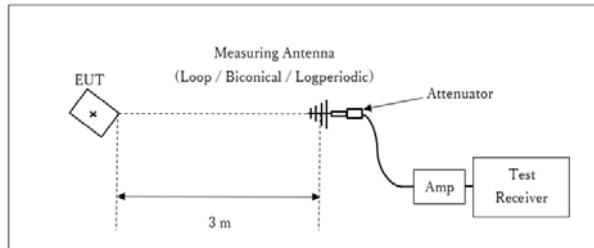
Frequency	Below 1GHz	Above 1GHz *1)
Instrument used	Test Receiver	Test Receiver
IF Bandwidth	QP: BW 120 kHz	PK: BW 1 MHz, CISPR AV: BW 1 MHz

*1) The measurement data was adjusted to a 3 m distance using the following Distance Factor.

Distance Factor: $20 \times \log (3.5 \text{ m} / 3.0 \text{ m}) = 1.34 \text{ dB}$

Figure 2: Test Setup

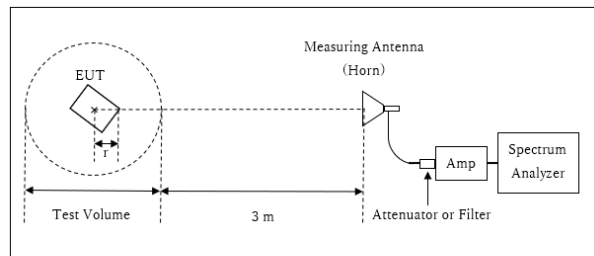
Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

x : Center of turn table

Distance Factor: $20 \times \log (3.5 \text{ m}^*/3.0 \text{ m}) = 1.34 \text{ dB}$

* Test Distance: $(3 + \text{Test Volume} / 2) - r = 3.5 \text{ m}$

Test Volume: 2 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.5 \text{ m}$

- The 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.

5.5. Test result

Summary of the test results: Pass

The limit is rounded down to one decimal place.

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

Date: July 22, 2019

Test engineer:

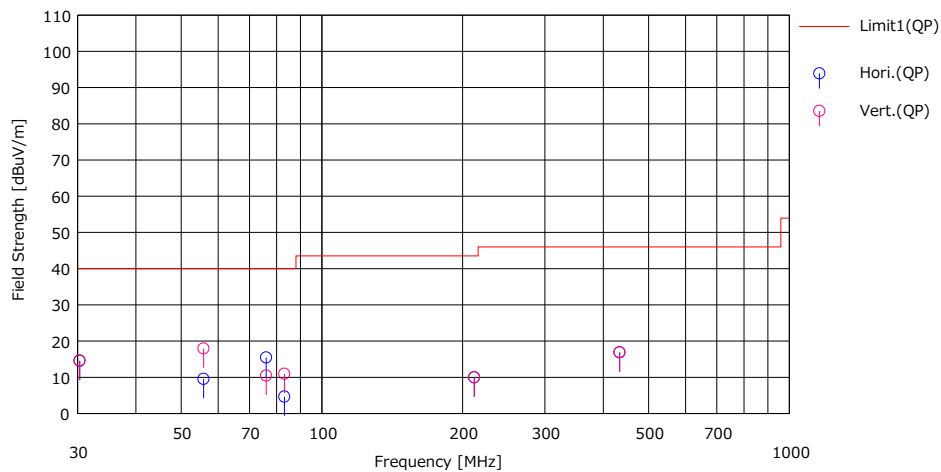
Takumi Shimada

APPENDIX 1: Test data

Radiated Emission

Report No. 12967063H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date July 22, 2019
Temperature / Humidity 22 deg. C / 60 % RH
Engineer Takumi Shimada
(Below 1 GHz)
Mode Mode 1

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading (QP)	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margin (QP)	Pola. (H/V)	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBuV]				[dBuV/m]	[dBuV/m]	[dB]					
1	30.312	28.40	17.68	7.37	38.94	14.51	40.00	25.49	Hori.	262	0	BA	
2	55.827	32.00	8.61	7.88	38.96	9.53	40.00	30.47	Hori.	337	328	BA	
3	76.002	40.10	6.13	8.24	39.02	15.45	40.00	24.55	Hori.	251	0	BA	
4	83.134	28.40	6.93	8.35	39.04	4.64	40.00	35.36	Hori.	100	0	BA	
5	211.855	28.10	11.03	9.90	39.08	9.95	43.50	33.55	Hori.	100	0	LA20	
6	433.640	27.50	16.18	11.78	38.59	16.87	46.00	29.13	Hori.	100	0	LA20	
7	30.312	28.50	17.68	7.37	38.94	14.61	40.00	25.39	Vert.	200	0	BA	
8	55.827	40.40	8.61	7.88	38.96	17.93	40.00	22.07	Vert.	100	238	BA	
9	76.002	35.10	6.13	8.24	39.02	10.45	40.00	29.55	Vert.	199	116	BA	
10	83.134	34.70	6.93	8.35	39.04	10.94	40.00	29.06	Vert.	100	65	BA	
11	211.855	28.10	11.03	9.90	39.08	9.95	43.50	33.55	Vert.	100	0	LA20	
12	433.640	27.50	16.18	11.78	38.59	16.87	46.00	29.13	Vert.	100	0	LA20	

* Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

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 (CABLE + ATT) - GAIN(AMP)

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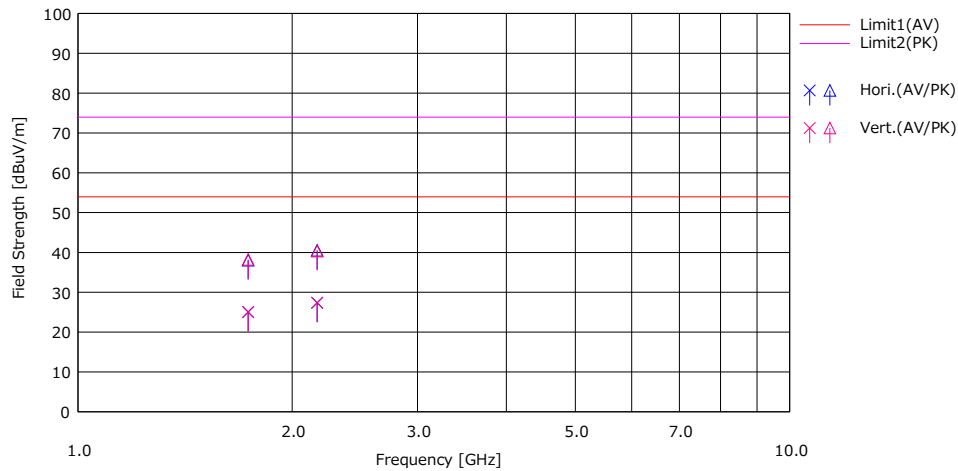
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Radiated Emission

Report No. 12967063H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date July 22, 2019
Temperature / Humidity 22 deg. C / 60 % RH
Engineer Takumi Shimada
(Above 1 GHz)
Mode Mode 1

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq. [MHz]	Reading		Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(AV) [dBuV]	(PK) [dBuV]				(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dBuV/m]	(PK) [dBuV/m]	(AV) [dB]	(PK) [dB]					
1	1734.540	33.00	46.00	25.46	3.38	36.80	25.04	38.04	54.00	74.00	28.96	35.96	Hori.	100	0	HA5	
2	2168.200	32.40	45.60	27.90	3.65	36.62	27.33	40.53	54.00	74.00	26.67	33.47	Hori.	100	0	HA5	
3	1734.540	33.00	46.20	25.46	3.38	36.80	25.04	38.24	54.00	74.00	28.96	35.76	Vert.	100	0	HA5	
4	2168.200	32.40	45.40	27.90	3.65	36.62	27.33	40.33	54.00	74.00	26.67	33.67	Vert.	100	0	HA5	

* Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

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 (CABLE + D-Factor) - GAIN(AMP)

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APPENDIX 2: Test instruments

Test Instruments

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	142226	Measure	KOMELON	KMC-36	-	-	-	-
RE	141994	AC1_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 10m	DA-06881	04/16/2019	04/30/2021	24
RE	141198	Biconical Antenna	Schwarzbeck	BBA9106	2513	04/12/2019	04/30/2020	12
RE	141213	Attenuator(6dB)	Weinschel Corp	2	BK7971	11/05/2018	11/30/2019	12
RE	141585	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	02/08/2019	02/29/2020	12
RE	141350	Coaxial Cable	Suhner/storm/Agilent/TSJ	-	-	06/27/2019	06/30/2020	12
RE	141393	Microwave Cable	Junkosha	MWX221	1604S254(1 m) / 1608S088(5 m)	08/08/2018	08/31/2019	12
RE	141576	Pre Amplifier	AGILENT	8449B	3008A01671	02/08/2019	02/29/2020	12
RE	141511	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	253	04/12/2019	04/30/2020	12
RE	141530	Digital Tester	Fluke Corporation	FLUKE 26-3	78030621	08/21/2018	08/31/2019	12
RE	178648	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141950	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	06/27/2019	06/30/2020	12
RE	141566	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	01/11/2019	01/31/2020	12
RE	141998	AC1_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	06/18/2018	06/30/2020	24
RE	141264	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-189	03/21/2019	03/30/2020	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:

RE: Radiated emission

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