



RADIO TEST REPORT

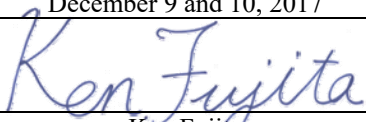
Test Report No. : 12047159H-R1

Applicant : SUBARU CORPORATION
Type of Equipment : Immobilizer
Model No. : FJ18-3
FCC ID : Y8PFJ18-3
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. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 12047159H. 12047159H is replaced with this report.

Date of test: December 9 and 10, 2017

Representative test engineer:


Ken Fujita
Engineer
Consumer Technology Division

Approved by:


Motoya Imura
Leader
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

UL Japan, Inc.

Ise EMC Lab.

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12047159H

[illegible]

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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 : +81-276-26-3515
Facsimile Number : +81-276-26-3878
Contact Person : Hayato Ooya

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

2.1 Identification of E.U.T.

Type of Equipment : Immobilizer
Model No. : FJ18-3
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 12.0 V
Receipt Date of Sample : December 7, 2017
Country of Mass-production : United States of America
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: FJ18-3 (referred to as the EUT in this report) is the Immobilizer.

General Specification

Clock frequencies in the system : 4.000 MHz

Radio Specification

[Transmitter]

Radio Type : Transmitter
Frequency of Operation : 134.2 kHz
Oscillator Frequency : 4 MHz
Type of Modulation : ASK (A1D)
Oscillation circuit : Ceramic Resonator
Power Supply : DC 12.0 V
Antenna Type : Coil antenna

[Receiver]

Radio Type : Receiver
Frequency of Operation : 128.7 kHz
Oscillator frequency : 4 MHz (Crystal)
Type of Modulation : FSK (F1D)
Type of receiving system : Direct conversion
Power Supply : DC 12.0 V
Antenna Type : Coil antenna

* The antenna (Refer to Section 4, Clause 4.2; item No. B) has model 1 and model 2.
The test was performed with the representative model 1.

The difference between model 1 and model 2 is the outer appearance.

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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.

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

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	34.7 dB 134.2 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	19.9 dB 160.035 MHz Horizontal, 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 test was performed with the New Battery (DC 12.0 V) and the EUT constantly provides the stable voltage to RF part through the regulator regardless of input voltage from New Battery. 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 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	N/A

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

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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

Radiated emission test(10 m)

The data listed in this test report has enough margin, more than the site margin.

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 2.0 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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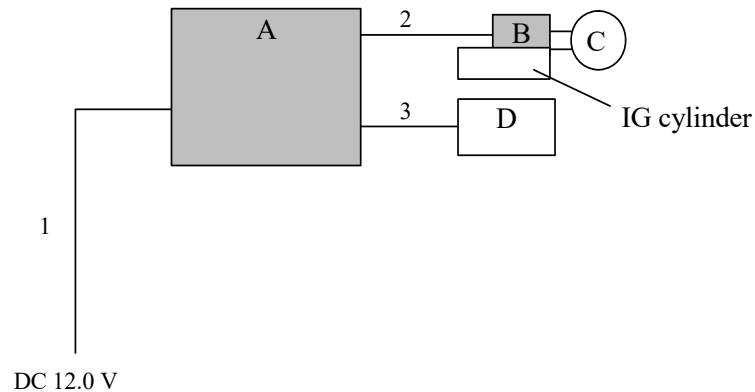
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

The mode is used : Transmitting mode (Tx) 134.2 kHz

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

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	Joint Box	S18J3	001	-	EUT
B	Antenna	F16A1	001	-	EUT
C	Key	-	001	-	-
D	Evaluation Bench	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	Antenna Cable	3.0	Unshielded	Unshielded	-
3	Signal Cable	3.0	Unshielded	Unshielded	-

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SECTION 5: 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 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: $40 \times \log(3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

*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.

This EUT has two modes which a mechanical key is inserted or not. The worst case was confirmed with and without a mechanical key, as a result, the test with a mechanical key was the worst case. Therefore the test with a mechanical key was performed only.

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: December 9 and 10, 2017 Test engineer: Ken Fujita

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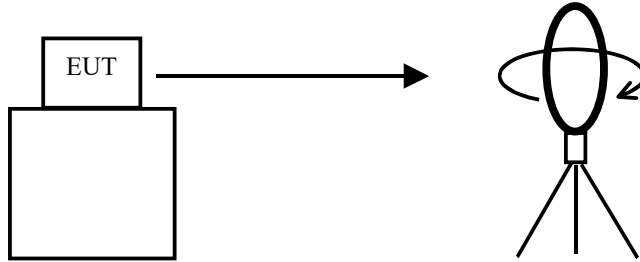
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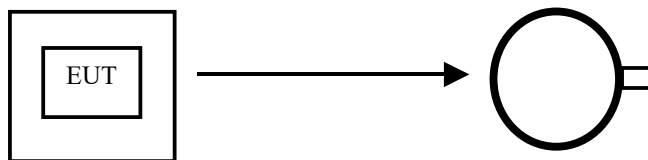
Facsimile : +81 596 24 8124

Figure 1: Direction of the Loop Antenna

Side View (Vertical)



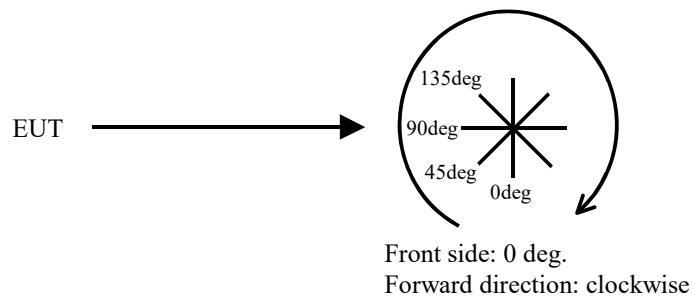
.....
Top View (Horizontal)



Antenna was not rotated.

.....

Top View (Vertical)



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	100 kHz	1 kHz	3 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.2 Semi Anechoic Chamber
Order No. 12047159H
Date 12/09/2017
Temperature/ Humidity 23 deg. C / 34 % RH
Engineer Ken Fujita
Mode Tx 134.2 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	0.13420	PK	76.9	19.7	-74.0	32.3	-	-9.7	45.0	54.7	Fundamental
0	0.26840	PK	35.8	19.7	-74.0	32.3	-	-50.8	39.0	89.8	
0	0.40260	PK	37.5	19.7	-73.9	32.3	-	-49.0	35.5	84.5	
0	0.53680	QP	32.5	19.7	-33.9	32.3	-	-14.0	33.0	47.0	
0	0.67100	QP	31.7	19.7	-33.9	32.2	-	-14.7	31.1	45.8	
0	0.80520	QP	31.2	19.7	-33.9	32.2	-	-15.2	29.5	44.7	
0	0.93940	QP	31.2	19.7	-33.9	32.2	-	-15.2	28.1	43.3	
0	1.07360	QP	30.7	19.7	-33.9	32.2	-	-15.7	26.9	42.6	
0	1.20780	QP	30.7	19.7	-33.9	32.2	-	-15.7	25.9	41.6	
0	1.34200	QP	30.3	19.7	-33.9	32.2	-	-16.1	25.0	41.1	

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

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	0.13420	PK	76.9	19.7	-74.0	32.3	0.0	-9.7	25.0	34.7	
0	0.26840	PK	35.8	19.7	-74.0	32.3	0.0	-50.8	19.0	69.8	
0	0.40260	PK	37.5	19.7	-73.9	32.3	0.0	-49.0	15.5	64.5	

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

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

Result of the fundamental emission at 3 m 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	0.13420	PK	76.9	19.7	6.0	32.3	-	70.3	-	-	Fundamental

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

* 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)

DATA OF RADIATED EMISSION TEST

Date : 2017/12/09

Report No. : 12047159H
Temp./Humi. : 23 deg. C / 37 % RH
Engineer : Ken Fujita

Mode / Remarks : Tx 134.2kHz

LIMIT : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15.209(a), 9-90kHz:AV, 110-490kHz:AV, other:QP

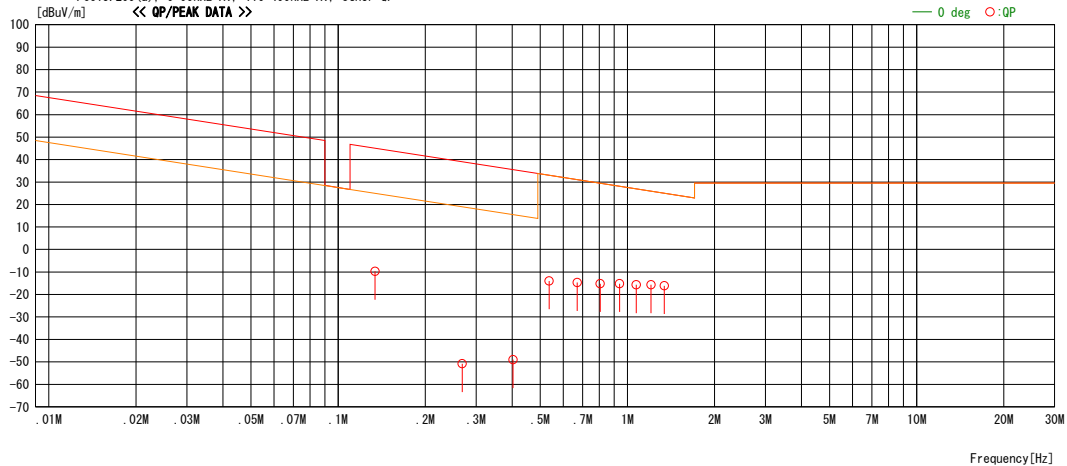


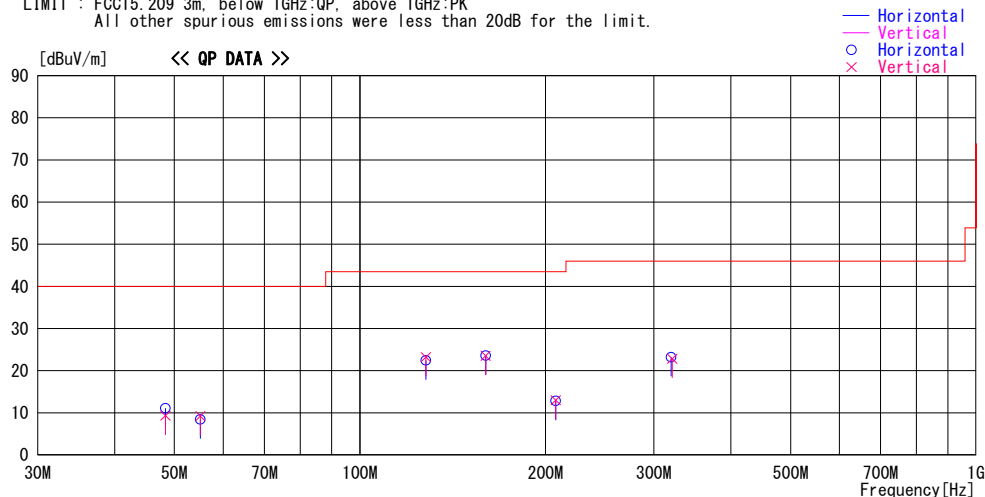
CHART: WITH FACTOR, ANT TYPE: LOOP. Except for the data below: adequate margin data below the limits.
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATTEN) - GAIN(AMP)

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

Radiated Emission above 30 MHz (Spurious Emission)

Report No. 12047159H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date 12/10/2017
Temperature / Humidity 23 deg. C / 37 % RH
Engineer Ken Fujita
Mode Tx 134.2 kHz

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
All other spurious emissions were less than 20dB for the limit.



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]							
48.344	24.7	QP	11.2	-24.8	11.1	0	400	Hori.	40.0	28.9	
48.344	22.9	QP	11.2	-24.8	9.3	359	100	Vert.	40.0	30.7	
55.112	24.1	QP	8.9	-24.6	8.4	0	400	Hori.	40.0	31.6	
55.112	24.9	QP	8.9	-24.6	9.2	359	100	Vert.	40.0	30.8	
128.014	32.7	QP	13.4	-23.7	22.4	124	400	Hori.	43.5	21.1	
128.014	33.5	QP	13.4	-23.7	23.2	241	100	Vert.	43.5	20.3	
160.035	31.4	QP	15.5	-23.3	23.6	133	400	Hori.	43.5	19.9	
160.035	31.3	QP	15.5	-23.3	23.5	221	100	Vert.	43.5	20.0	
208.000	24.3	QP	11.5	-22.8	13.0	113	112	Vert.	43.5	30.5	
208.000	24.1	QP	11.5	-22.8	12.8	112	136	Hori.	43.5	30.7	
320.000	31.1	QP	13.9	-21.8	23.2	156	136	Hori.	46.0	22.8	
321.334	30.7	QP	13.9	-21.8	22.8	143	134	Vert.	46.0	23.2	

CHART: WITH FACTOR

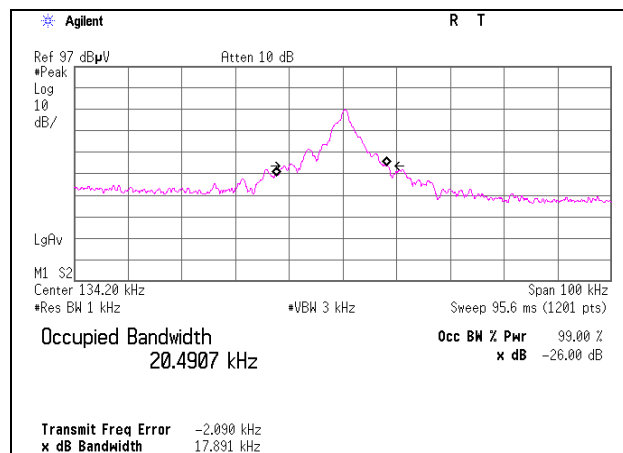
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + Filter - GAIN(AMP) + D-factor)

*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. 12047159H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date 12/09/2017
Temperature / Humidity 23 deg. C / 34 % RH
Engineer Ken Fujita
Mode Tx 134.2 kHz

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
17.891	20.4907



APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-02	Semi Anechoic Chamber (NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2017/10/31 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2017/01/20 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE	2017/08/22 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2017/08/22 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2017/10/11 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(3m)/ suoform141-PE(1m)/ 421-010(1.5m)/ RFM-E321(Switcher)	-/00640	RE	2017/07/12 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2017/06/12 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2017/03/27 * 12
MAT-98	Attenuator	KEYSIGHT	8491A	MY52462349	RE	2016/12/05 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	RE	2017/01/19 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2017/10/02 * 12
MLA-22	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	RE	2017/01/26 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2017/07/12 * 12

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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