



EMI TEST REPORT


Test Report No. : 12047157H-B-R1

Applicant : SUBARU CORPORATION
Type of Equipment : Keyless Access with Push-Button Start System
Model No. : FJ18-2
FCC ID : Y8PFJ18-2
Test regulation : FCC Part 15 Subpart B: 2018
Test Result : Complied

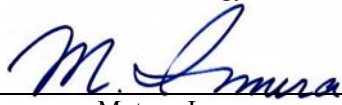
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6. This test report covers EMC technical requirements. It does not cover administrative issues such as Manual or non-EMC test related Requirements. (if applicable)
7. This report is a revised version of 12047157H-B. 12047157H-B is replaced with this report.

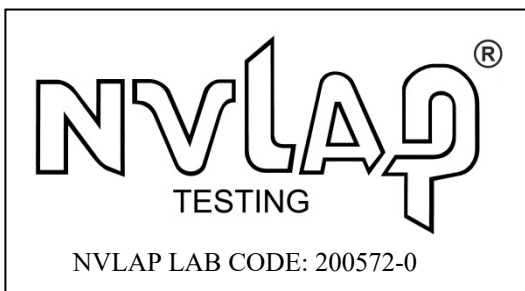
Date of test: December 20, 2017 and March 12, 2018

Representative test engineer:


Tomoki Matsui
Engineer
Consumer Technology Division

Approved by:


Motoya Imura
Engineer
Consumer Technology Division



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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 : Yuji Kobayashi

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. : FJ18-2
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: FJ18-2 (referred to as the EUT in this report) is the Keyless Access with Push-Button Start System.

General Specification

Clock frequencies in the system : 8.000 MHz(CPU)

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

[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)

*3) The Antenna (TYPE 1) of this system has 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.

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SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : FCC Part 15 Subpart B
FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

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
Conducted emission	FCC: ANSI C63.4: 2014 7. AC power - line conducted emission measurements	FCC:Part 15 Subpart B 15.107(a)	N/A *1)	N/A	N/A
	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	17.8 dB 68.710 MHz Vertical, QP	Complied
	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.

3.3 Addition to standard

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 $k = 2$

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	5.0 dB	5.3 dB	5.0 dB	5.0 dB
Vertical	5.2 dB	6.3 dB	5.0 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
5.2 dB	5.5 dB	5.5 dB	5.4 dB	5.5 dB

* Measurement distance

Radiated emission test(3 m)

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

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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 2.0 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.

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

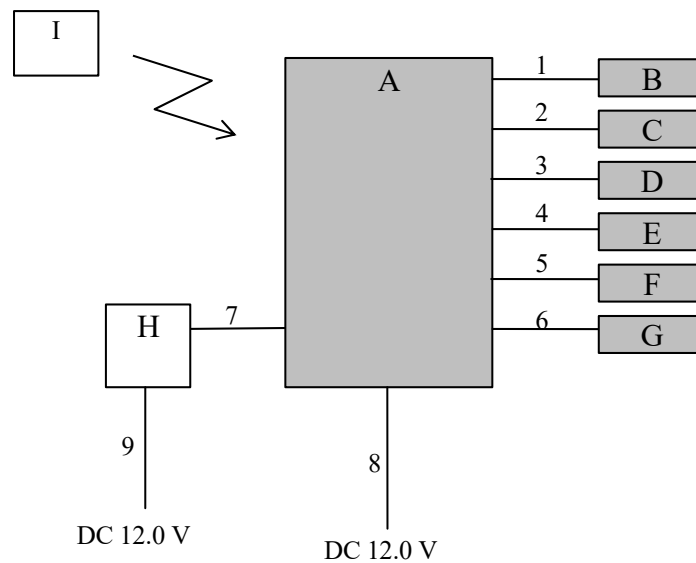
4.1 Operating modes

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 LED of Jig 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	Smart ECU	-	1	-	EUT
B	Antenna (Type 1) No.1	-	1-1	-	EUT
C	Antenna (Type 1) No.2	-	1-2	-	EUT
D	Antenna (Type 2) No.1	-	1-1	-	EUT
E	Antenna (Type 2) No.2	-	1-2	-	EUT
F	Antenna (Type 2) No.3	-	1-3	-	EUT
G	Antenna (Type 2) No.4	-	1-4	-	EUT
H	Jig	-	-	-	-
I	Smart Key	-	001	-	-

List of cables used

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

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SECTION 5: Radiated Emission

5.1 Operating environment

Test place : No. 3 and 4 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 center 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 - 2000 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, or the Spectrum Analyzer.

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

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: $20 \times \log(3.4 \text{ m} / 3 \text{ m}) = 1.09 \text{ dB}$

- 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.

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: December 20, 2017
March 12, 2018

Test engineer: Tomoki Matsui
Koji Yamamoto

UL Japan, Inc.

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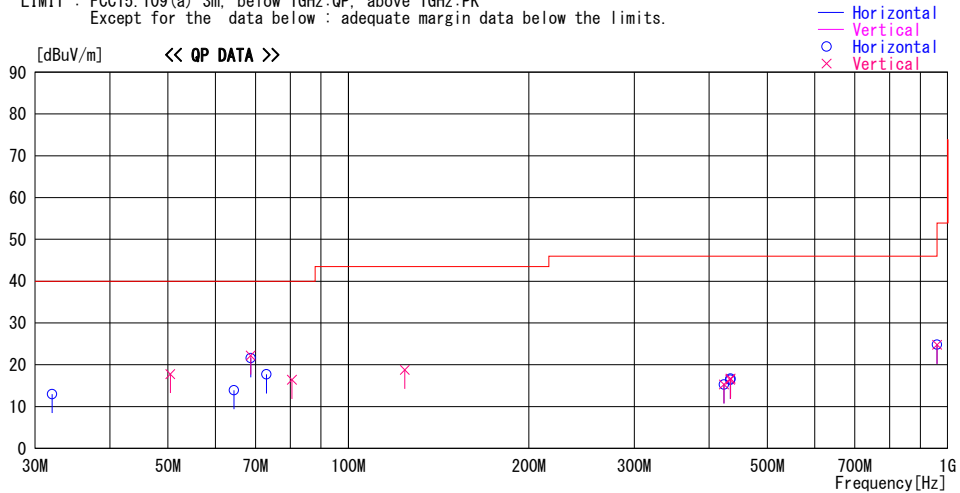
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APPENDIX 1: Test date

Radiated Emission

Report No. 12047157H
Test place Ise EMC Lab
Semi Anechoic Chamber No.3
Date March 12, 2018
Temperature / Humidity 22 deg. C / 34 % RH
Engineer Koji Yamamoto
(Below 1 GHz)
Mode Receiving mode (Rx) 433.92MHz

LIMIT : FCC15.109(a) 3m, below 1GHz:QP, above 1GHz:PK
Except for the data below : adequate margin data below the limits.



Frequency [MHz]	Reading [dBuV]	DET	Antenna		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
32.044	21.5	QP	16.6	-25.1	13.0	0	100	Hori.	40.0	27.0	
50.459	32.0	QP	10.5	-24.7	17.8	232	100	Vert.	40.0	22.2	
64.418	31.6	QP	6.8	-24.5	13.9	357	400	Hori.	40.0	26.1	
68.710	40.4	QP	6.2	-24.4	22.2	90	100	Vert.	40.0	17.8	
68.710	39.8	QP	6.2	-24.4	21.6	358	400	Hori.	40.0	18.4	
73.004	35.9	QP	6.2	-24.4	17.7	0	400	Hori.	40.0	22.3	
80.521	33.9	QP	6.8	-24.3	16.4	95	100	Vert.	40.0	23.6	
124.180	29.4	QP	13.1	-23.7	18.8	264	100	Vert.	43.5	24.7	
423.220	20.4	QP	16.0	-21.1	15.3	0	100	Hori.	46.0	30.7	
423.220	20.4	QP	16.0	-21.1	15.3	0	100	Vert.	46.0	30.7	
433.640	21.3	QP	16.2	-21.1	16.4	0	100	Hori.	46.0	29.6	
433.640	21.3	QP	16.2	-21.1	16.4	0	100	Vert.	46.0	29.6	
434.200	21.6	QP	16.2	-21.1	16.7	0	100	Hori.	46.0	29.3	
434.200	21.6	QP	16.2	-21.1	16.7	0	100	Vert.	46.0	29.3	
960.000	19.6	QP	22.1	-16.9	24.8	0	100	Hori.	46.0	21.2	
960.000	19.6	QP	22.1	-16.9	24.8	0	100	Vert.	46.0	21.2	

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 + ATT - GAIN(AMP))

*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.

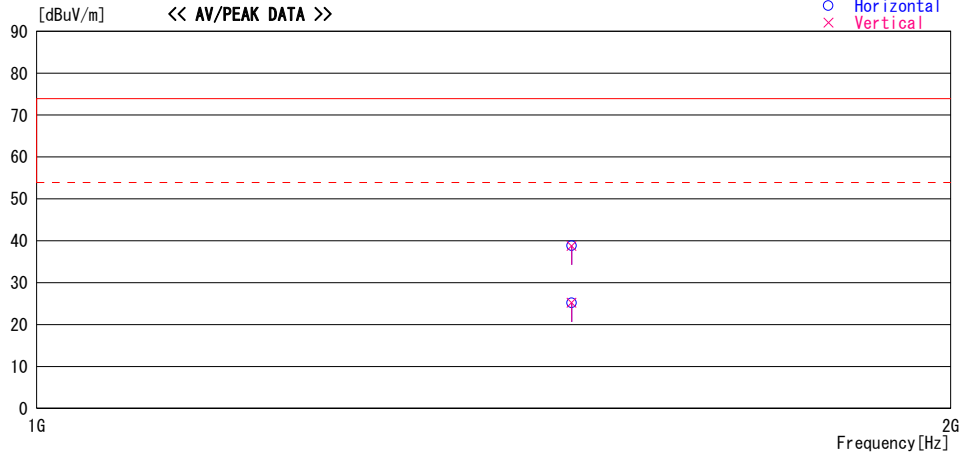
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Radiated Emission

Report No. 12047157H
Test place Ise EMC Lab
Semi Anechoic Chamber No.4
Date December 20, 2017
Temperature / Humidity 23 deg. C / 34 % RH
Engineer Tomoki Matsui
(Above 1 GHz)
Mode Receiving mode (Rx) 433.92MHz

LIMIT : FCC15.109(a) 3m, below 1GHz:QP, above 1GHz:PK
FCC15.109(a) 3m, below 1GHz:QP, above 1GHz:AV



Frequency [MHz]	Reading [dBuV]	DET	Antenna	Loss&	Level	Angle	Height	Polar.	Limit	Margin	Comment
			Factor	Gain							
			[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
1500.000	44.2	PK	24.8	-30.2	38.8	0	100	Hori.	73.9	35.1	
1500.000	44.2	PK	24.8	-30.2	38.8	0	100	Vert.	73.9	35.1	
1500.000	30.6	AV	24.8	-30.2	25.2	0	100	Hori.	53.9	28.7	
1500.000	30.6	AV	24.8	-30.2	25.2	0	100	Vert.	53.9	28.7	

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 - GAIN(AMP) + D-factor)

*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.

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APPENDIX 2: Test instruments

EMI test equipment

Tested on December 20, 2017

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-04	Semi Anechoic Chamber (NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2017/10/30 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE	2017/01/20 * 12
MJM-26	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-10	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	RE	2017/01/12 * 12 *1)
MMM-10	DIGITAL HiTESTER	Hioki	3805	051201148	RE	2017/01/19 * 12 *1)
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2017/09/15 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	RE	2017/06/23 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	00650	RE	2017/10/06 * 12

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

Tested on March 12, 2018

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-03	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	2018/01/24 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2017/11/07 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2017/08/22 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2017/10/02 * 12
MLA-22	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	RE	2018/01/30 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2017/07/12 * 12
MAT-98	Attenuator	KEYSIGHT	8491A	MY52462349	RE	2017/12/14 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2017/03/27 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	RE	2018/01/09 * 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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