EMI TEST REPORT

Test Report No. : 12717479H-B-R2

Applicant	:	**Mitsubishi Electric Corporation Himeji works**
Type of Equipment	:	**Smart Keyless System Smart Unit**
Model No.	:	**SKESAD-01**
FCC ID	:	**WAZSKESAD01**
Test regulation	:	**FCC Part 15 Subpart B: 2018 Class B**
Test Result	:	**Complied (Refer to SECTION 3.2)**

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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.
9. This report is a revised version of 12717479H-B-R!. 12717479H-B-R1 is replaced with this report.

Date of test: May 22, 2019

Representative test engineer:

Akihiko Maeda
Engineer
Consumer Technology Division

Approved by:

Motoya Imura
Leader
Consumer Technology Division

NVLAP TESTING
NVLAP LAB CODE: 200572-0

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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http://japan.ul.com/resources/emc_accredited/

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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REVISION HISTORY

Original Test Report No.: 12717479H-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12717479H-B	March 14, 2019	-	-
1	12717479H-B-R1	May 24, 2019	P. 1	<Correction with retesting> Date of test; from February 7, 2019 to May 22, 2019
1	12717479H-B-R1	May 24, 2019	P. 5	<Correction with retesting> Worst margin; from 18.87 dB, 912.900 MHz, Vertical to 20.05 dB, 945.840 MHz, Horizontal
1	12717479H-B-R1	May 24, 2019	P. 9	<Correction with retesting> Frequency range; from 1000 MHz - 4000 MHz to 1000 MHz - 10000 MHz
1	12717479H-B-R1	May 24, 2019	P. 9, 10	<Correction with retesting> Distance Factor; from 20 x log (3.65 m / 3 m) = 1.82 dB to 20 x log (3.9 m / 3 m) = 2.28 dB
1	12717479H-B-R1	May 24, 2019	P. 10	<Correction with retesting> Test Volume; From 1.5 m to 2.0 m
1	12717479H-B-R1	May 24, 2019	P. 11, 12	<Correction with retesting> Test data
1	12717479H-B-R1	May 24, 2019	P. 13	<Correction with retesting> Test Instruments
2	12717479H-B-R2	May 27, 2019	P.12	Correction of CALCULATION for above 1 GHz.

CONTENTS PAGE

SECTION 1: Customer information

Company Name	:	Mitsubishi Electric Corporation Himeji works
Address	:	840 Chiyoda-machi, Himeji, Hyogo 670-8677, Japan
Telephone Number	:	+81-79-298-9580
Facsimile Number	:	+81-79-298-9929
Contact Person	:	Shinichi Furuta

The information provided from the customer is as follows;
- Applicant, Type of Equipment, Model No. on the cover and other 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	:	Smart Keyless System Smart Unit
Model No.	:	SKESAD-01
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0 V
Receipt Date of Sample (Information from test lab.)	:	February 4, 2019
Country of Mass-production	:	Japan
Condition of EUT	:	Engineering 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: SKESAD-01 (referred to as the EUT in this report) is a Smart Keyless System Smart Unit.

Radio Specification

LF Part *

Equipment Type	:	Transmitter
Type of modulation	:	ASK
Frequency of operation	:	125 kHz
Other clock frequency	:	-
Antenna Type	:	Inductive
Clock frequency	:	8 MHz

RF Part

Type of Receiver	:	Receiver
Frequency of operation	:	315 MHz
Other clock frequency	:	30.32 MHz
Intermediate frequency	:	280 kHz
Antenna Type	:	Bar Antenna

* The test of transmiter part was performed separately from this test report, and the conformability is confirmed.
LF Part test report No. 12717479H-A (FCC15C).

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

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	20.05 dB 945.840 MHz, Horizontal, 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 following 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 $k = 2$.

Test distance	Radiated emission (+/-)
	9 kHz to 30 MHz
3 m	3.3 dB
10 m	3.2 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 (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

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	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 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.

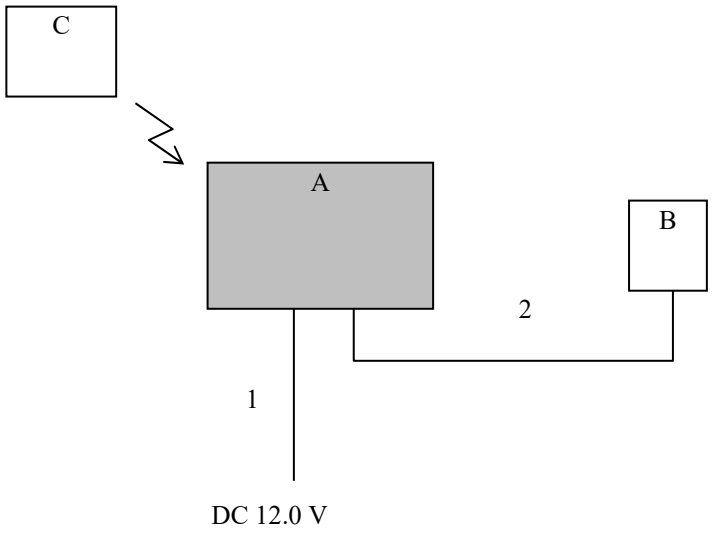
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Mode	Remarks
1) Receiving mode (315 MHz)	-

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

4.2 Configuration and peripherals



* Cabling and setup(s) 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 Keyless System Smart Unit	SKESAD-01	20190131-E2 (No.2)	Mitsubishi Electric Corporation Himeji works	EUT
B	SW BOX	SW BOX2	No.16	Mitsubishi Electric Corporation Himeji works	-
C	Smart Keyless System Hand Unit	SKESAD-02	20190131-T2 (No.2)	Mitsubishi Electric Corporation Himeji works	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.5	Unshielded	Unshielded	-
2	DC and Signal cable	1.0	Unshielded	Unshielded	(No.1)

SECTION 5: Radiated Emission

5.1. Operating environment

Test place : No.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 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

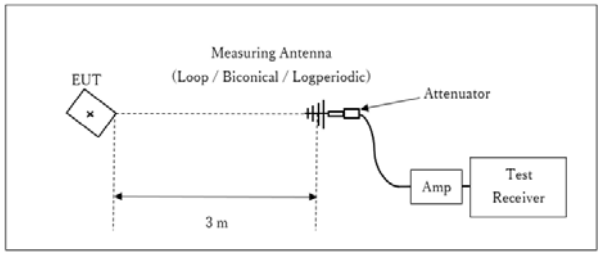
The height of the measuring antenna varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver.
The radiated emission 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 x log (3.9 m / 3 m) = 2.28 dB

Figure 2: Test Setup

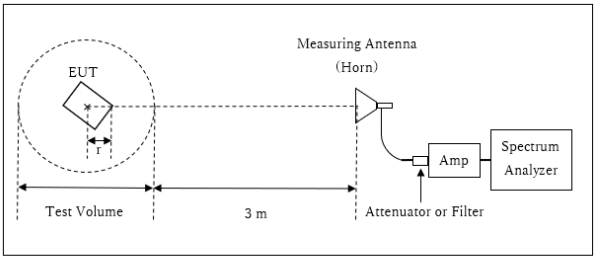
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.9 m*/3.0 m) = 2.28 dB
* Test Distance: (3 + Test Volume /2) - r = 3.9 m
Test Volume: 2.0 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.1 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.

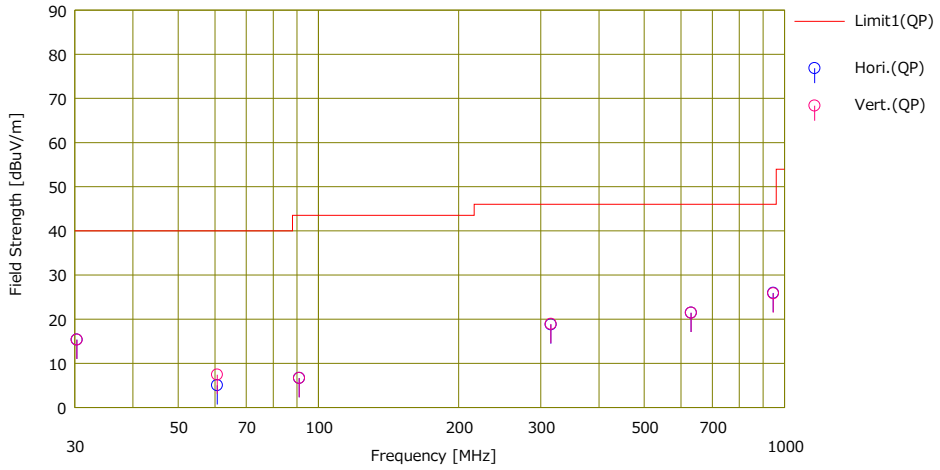
Date: May 22, 2019 Test engineer: Akihiko Maeda

APPENDIX 1: Test data

Radiated emission

Report No.	12717479H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	May 22, 2019
Temperature / Humidity	25 deg. C / 38 % RH
Engineer	Akihiko Maeda
	(Below 1 GHz)
Mode	Mode 1

Limit : FCC_Part 15 Subpart B(15.109)_Class B



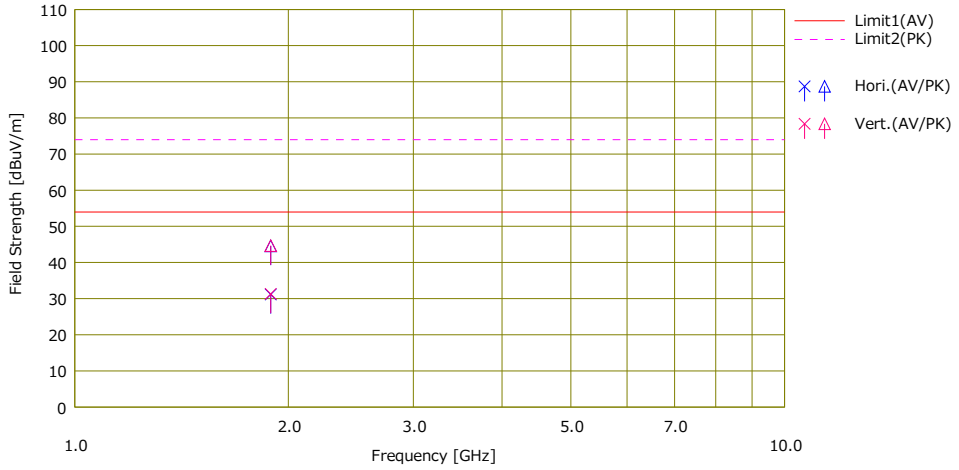
No.	Freq. [MHz]	Reading (QP) [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result (QP) [dBuV/m]	Limit (QP) [dBuV/m]	Margin (QP) [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	30.320	22.20	18.16	7.20	32.21	15.35	40.00	24.65	Hori.	300	8	BC	
2	60.640	22.00	7.49	7.70	32.15	5.04	40.00	34.96	Hori.	300	352	BC	
3	90.960	22.10	8.60	8.09	32.12	6.67	43.50	36.83	Hori.	300	321	BC	
4	315.280	26.60	14.07	10.05	31.92	18.80	46.00	27.20	Hori.	100	352	LA23	
5	630.560	22.20	19.37	11.95	32.08	21.44	46.00	24.56	Hori.	100	215	LA23	
6	945.840	21.40	21.99	13.45	30.89	25.95	46.00	20.05	Hori.	100	341	LA23	
7	30.320	22.20	18.16	7.20	32.21	15.35	40.00	24.65	Vert.	100	0	BC	
8	60.640	24.40	7.49	7.70	32.15	7.44	40.00	32.56	Vert.	100	259	BC	
9	90.960	22.10	8.60	8.09	32.12	6.67	43.50	36.83	Vert.	100	288	BC	
10	315.280	26.70	14.07	10.05	31.92	18.90	46.00	27.10	Vert.	100	14	LA23	
11	630.560	22.20	19.37	11.95	32.08	21.44	46.00	24.56	Vert.	100	96	LA23	
12	945.840	21.30	21.99	13.45	30.89	25.85	46.00	20.15	Vert.	100	171	LA23	

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))

Radiated emission

Report No.	12717479H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	May 22, 2019
Temperature / Humidity	25 deg. C / 38 % RH
Engineer	Akihiko Maeda
	(Above 1 GHz)
Mode	Mode 1

Limit : FCC_Part 15 Subpart B(15.109)_Class B



No.	Freq.	Reading		Ant.Fac	Loss	Gain	Result		Limit		Margin		Pola.	Height	Angle	Ant. Type	Comment
		(AV)	(PK)				(AV)	(PK)	(AV)	(PK)	(AV)	(PK)					
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	[H/V]	[cm]	[deg]		
1	1888.320	31.50	44.90	25.97	5.49	31.80	31.16	44.56	54.00	74.00	22.84	29.44	Hori.	100	0	H21	
2	1888.320	31.60	45.00	25.97	5.49	31.80	31.26	44.66	54.00	74.00	22.74	29.34	Vert.	100	0	H21	

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)

APPENDIX 2: Test instruments

Test Instruments

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141425	Biconical Antenna	Schwarzbeck	BBA9106	1302	2018/6/1	2019/6/30	12
RE	141267	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-192	2019/3/21	2020/3/31	12
RE	148898	Attenuator	KEYSIGHT	8491A	MY52462282	2018/10/3	2019/10/31	12
RE	141397	Coaxial Cable	UL Japan	-	-	2018/6/13	2019/6/30	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	2019/2/8	2020/2/29	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	2018/8/6	2019/8/31	12
RE	141581	MicroWave System Amplifier	AGILENT	83017A	650	2018/10/4	2019/10/31	12
RE	141297	High Pass Filter(1.1-10GHz)	TOKYO KEIKI	TF219CD1	1001	2019/1/10	2020/1/31	12
RE	141412	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	2018/6/14	2019/6/30	12
RE	141508	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	2018/6/8	2019/6/30	12
RE	141902	Spectrum Analyzer	AGILENT	E4440A	MY46187105	2018/10/4	2019/10/31	12
RE	178648	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	142227	Measure	KOMELON	KMC-36	-	-	-	-
RE	141545	DIGITAL HiTESTER	HIOKI	3805	51201148	2019/1/29	2020/1/31	12
RE	142017	AC4_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	2019/4/4	2020/4/30	12
RE	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	2018/6/28	2020/6/30	24
RE	141562	Thermo-Hygrometer	CUSTOM	CTH-201	10	2019/1/11	2020/1/31	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