



# **EMI TEST REPORT**

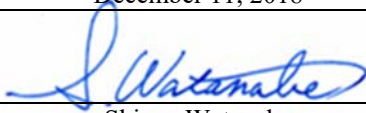
**Test Report No. : 12598914H-A**

**Applicant** : DENSO CORPORATION  
**Type of Equipment** : Remote Keyless Entry System (Receiver)  
**Model No.** : AD-BC03  
**FCC ID** : HYQAD-BC03  
**Test regulation** : FCC Part 15 Subpart B: 2018  
**Test Result** : Complied

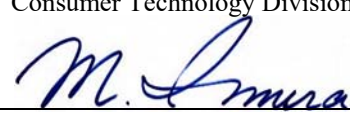
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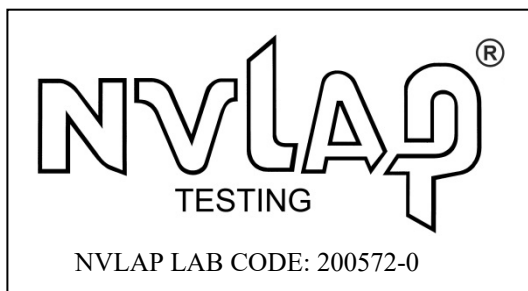
**Date of test:** December 11, 2018

**Representative test engineer:**

  
Shinya Watanabe  
Engineer  
Consumer Technology Division

**Approved by:**

  
Motoya Imura  
Leader  
Consumer Technology Division



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13-EM-F0429

## REVISION HISTORY

**Original Test Report No.: 12598914H-A**

[illegible]

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## **SECTION 1: Customer information**

|                  |   |                                                        |
|------------------|---|--------------------------------------------------------|
| Company Name     | : | DENSO CORPORATION                                      |
| Address          | : | 1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661, Japan |
| Telephone Number | : | +81-566-73-0133                                        |
| Facsimile Number | : | +81-566-73-0229                                        |
| Contact Person   | : | TAKASHI TAKAHAGI                                       |

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

### **2.1 Identification of E.U.T.**

|                            |   |                                                                                            |
|----------------------------|---|--------------------------------------------------------------------------------------------|
| Type of Equipment          | : | Remote Keyless Entry System (Receiver)                                                     |
| Model No.                  | : | AD-BC03                                                                                    |
| Serial No.                 | : | Refer to Section 4, Clause 4.2                                                             |
| Receipt Date of Sample     | : | December 4, 2018                                                                           |
| Country of Mass-production | : | Japan                                                                                      |
| Condition of EUT           | : | Engineering prototype<br>(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: AD-BC03 (referred to as the EUT in this report) is the Remote Keyless Entry System (Receiver).

|                          |   |                                      |
|--------------------------|---|--------------------------------------|
| Type of receiving system | : | Super-heterodyne                     |
| Frequency of Operation   | : | 433.92 MHz                           |
| Oscillator Frequency     | : | 21.948717 MHz Crystal                |
| Type of Modulation       | : | ASK (A1D)                            |
| Power Supply             | : | DC 12.0 V                            |
| Antenna Type             | : | Internal antenna (Inverse F antenna) |
| Mixer Input Frequency    | : | 444.62 MHz                           |

## 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   |
|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------|------------------------------------------------------|----------|
| Conducted emission                                                                                                                     | FCC: ANSI C63.4: 2014<br>7. AC power - line<br>conducted emission<br>measurements                           | FCC:Part 15 Subpart B<br>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<br>8. Radiated<br>emission measurements                                               | FCC: Part 15 Subpart B<br>15.109(a) | N/A       | 26.1 dB<br>1333.860 MHz, AV<br>Horizontal / Vertical | 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. |                                                                                                             |                                     |           |                                                      |          |
| 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

#### 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 | 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

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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            | 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.

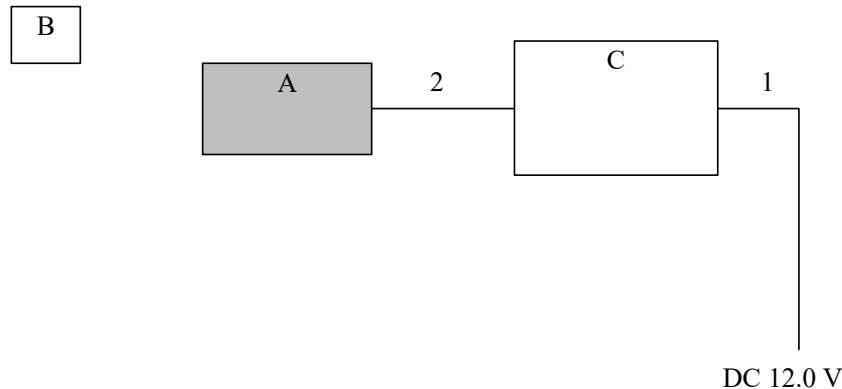
## SECTION 4: Operation of E.U.T. during testing

### 4.1 Operating modes

The mode used: 1. Receiving mode (433.92 MHz)

\* 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   | Remote Keyless Entry System (Receiver) | AD-BC03      | 001           | DENSO CORPORATION | EUT     |
| B   | Key                                    | -            | -             | -                 | -       |
| C   | Checker Box                            | -            | -             | -                 | -       |

#### List of cables used

| No. | Name                | Length (m) | Shield     |            | Remarks |
|-----|---------------------|------------|------------|------------|---------|
|     |                     |            | Cable      | Connector  |         |
| 1   | DC Cable            | 2.0        | Unshielded | Unshielded | -       |
| 2   | DC and Signal Cable | 1.5        | Unshielded | Unshielded | -       |

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## **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.

The checkerbox was placed at 0.7 m height so it was not become obstacles.

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.

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

|                 |                |                                                                |
|-----------------|----------------|----------------------------------------------------------------|
| Frequency       | Below 1 GHz    | Above 1 GHz *1)                                                |
| Instrument used | Test Receiver  | Spectrum Analyzer                                              |
| IF Bandwidth    | QP: BW 120 kHz | PK: RBW: 1 MHz / VBW: 3 MHz<br>AV *2): RBW: 1 MHz / VBW: 10 Hz |

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

Distance Factor:  $20 \times \log(3.7 \text{ m} / 3 \text{ m}) = 1.83 \text{ dB}$

\*2) When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

- 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 representative X-axis since no difference was found among each position.

### **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 11, 2018

Test engineer:

Shinya Watanabe

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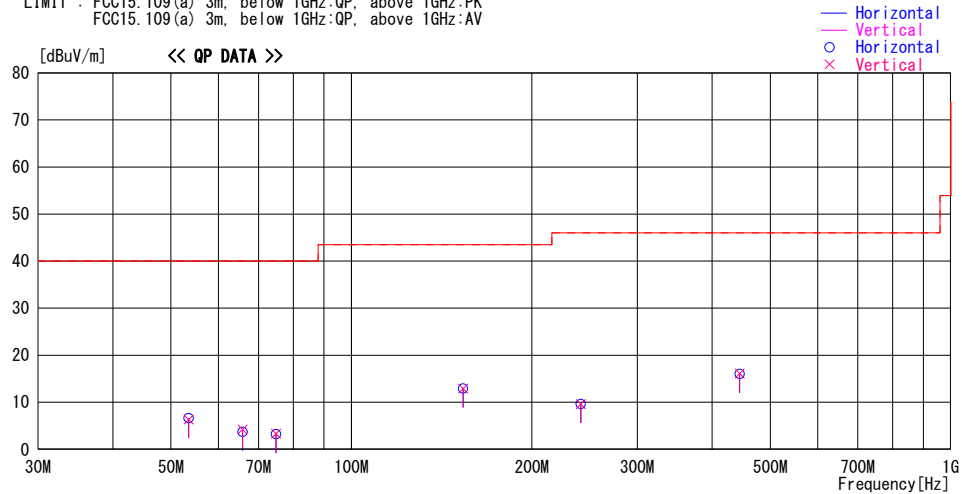
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## APPENDIX 1: Test data

### Radiated Emission

Report No. 12598914H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date December 11, 2018  
Temperature / Humidity 23 deg. C / 34 % RH  
Engineer Shinya Watanabe  
(Below 1GHz)  
Mode Mode 1

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



| Frequency | Reading | DET | Antenna |       | Level    | Angle | Height | Polar. | Limit    | Margin |
|-----------|---------|-----|---------|-------|----------|-------|--------|--------|----------|--------|
|           |         |     | Factor  | Gain  |          |       |        |        |          |        |
| [MHz]     | [dBuV]  |     | [dB/m]  | [dB]  | [dBuV/m] | [Deg] | [cm]   |        | [dBuV/m] | [dB]   |
| 53.500    | 21.3    | QP  | 9.8     | -24.5 | 6.6      | 0     | 300    | Hori.  | 40.0     | 33.4   |
| 53.500    | 21.0    | QP  | 9.8     | -24.5 | 6.3      | 0     | 100    | Vert.  | 40.0     | 33.7   |
| 65.846    | 21.0    | QP  | 7.0     | -24.3 | 3.7      | 0     | 300    | Hori.  | 40.0     | 36.3   |
| 65.846    | 21.5    | QP  | 7.0     | -24.3 | 4.2      | 0     | 100    | Vert.  | 40.0     | 35.8   |
| 74.900    | 21.2    | QP  | 6.2     | -24.2 | 3.2      | 0     | 300    | Hori.  | 40.0     | 36.8   |
| 74.900    | 21.3    | QP  | 6.2     | -24.2 | 3.3      | 0     | 100    | Vert.  | 40.0     | 36.7   |
| 153.641   | 21.0    | QP  | 15.1    | -23.2 | 12.9     | 0     | 300    | Hori.  | 43.5     | 30.6   |
| 153.641   | 21.0    | QP  | 15.1    | -23.2 | 12.9     | 0     | 100    | Vert.  | 43.5     | 30.6   |
| 241.436   | 20.5    | QP  | 11.6    | -22.5 | 9.6      | 0     | 100    | Hori.  | 46.0     | 36.4   |
| 241.436   | 20.5    | QP  | 11.6    | -22.5 | 9.6      | 0     | 100    | Vert.  | 46.0     | 36.4   |
| 444.620   | 20.4    | QP  | 16.7    | -21.1 | 16.0     | 0     | 100    | Hori.  | 46.0     | 30.0   |
| 444.620   | 20.5    | QP  | 16.7    | -21.1 | 16.1     | 0     | 100    | Vert.  | 46.0     | 29.9   |

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))

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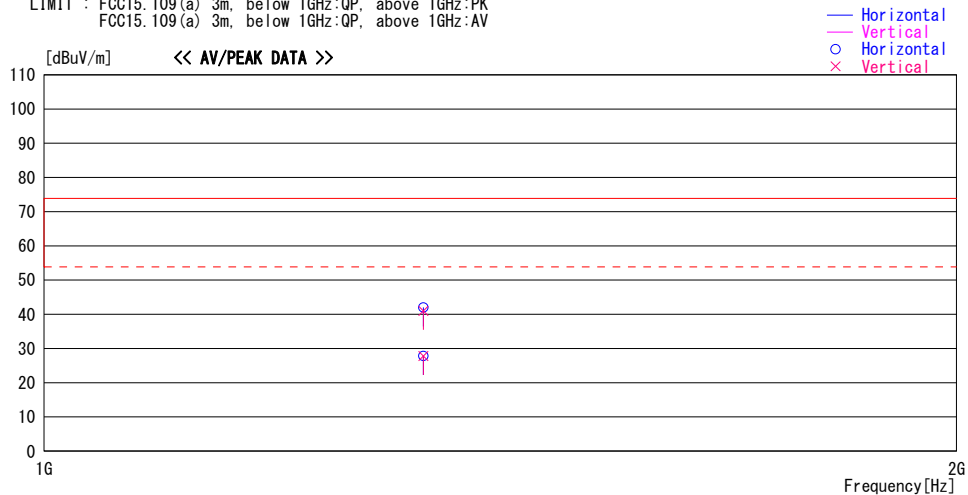
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## Radiated Emission

Report No. 12598914H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date December 11, 2018  
Temperature / Humidity 23 deg. C / 34 % RH  
Engineer Shinya Watanabe  
(Above 1GHz)  
Mode Mode 1

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



| Frequency<br>[MHz] | Reading<br>[dBuV] | DET | Antenna          | Loss&        | Level<br>[dBuV/m] | Angle<br>[Deg] | Height<br>[cm] | Polar. | Limit<br>[dBuV/m] | Margin<br>[dB] |
|--------------------|-------------------|-----|------------------|--------------|-------------------|----------------|----------------|--------|-------------------|----------------|
|                    |                   |     | Factor<br>[dB/m] | Gain<br>[dB] |                   |                |                |        |                   |                |
| 1333.860           | 45.6              | PK  | 25.6             | -29.2        | 42.0              | 0              | 100            | Hori.  | 73.9              | 31.9           |
| 1333.860           | 44.6              | PK  | 25.6             | -29.2        | 41.0              | 0              | 100            | Vert.  | 73.9              | 32.9           |
| 1333.860           | 31.4              | AV  | 25.6             | -29.2        | 27.8              | 0              | 100            | Hori.  | 53.9              | 26.1           |
| 1333.860           | 31.4              | AV  | 25.6             | -29.2        | 27.8              | 0              | 100            | Vert.  | 53.9              | 26.1           |

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)

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## **APPENDIX 2: Test instruments**

### **Test equipment**

| Test Item | LIMS ID | Description                      | Manufacturer      | Model      | Serial                       | Last Calibration Date | Calibration Due Date | Cal Int |
|-----------|---------|----------------------------------|-------------------|------------|------------------------------|-----------------------|----------------------|---------|
| RE        | 141562  | Thermo-Hygrometer                | CUSTOM            | CTH-180    | 1501                         | 1/24/2018             | 1/31/2019            | 12      |
| RE        | 141152  | EMI measurement program          | TSJ               | TEPTO-DV   | -                            | -                     | -                    | -       |
| RE        | 141885  | Spectrum Analyzer                | AGILENT           | E4448A     | US44300523                   | 11/7/2018             | 11/30/2019           | 12      |
| RE        | 141508  | Horn Antenna 1-18GHz             | Schwarzbeck       | BBHA9120D  | 9120D-557                    | 6/8/2018              | 6/30/2019            | 12      |
| RE        | 141581  | MicroWave System Amplifier       | AGILENT           | 83017A     | 650                          | 10/4/2018             | 10/31/2019           | 12      |
| RE        | 141583  | Pre Amplifier                    | SONOMA INSTRUMENT | 310        | 260833                       | 2/27/2018             | 2/28/2019            | 12      |
| RE        | 148898  | Attenuator                       | KEYSIGHT          | 8491A      | MY52462282                   | 10/3/2018             | 10/31/2019           | 12      |
| RE        | 141267  | Logperiodic Antenna(200-1000MHz) | Schwarzbeck       | VUSLP9111B | 911B-192                     | 6/1/2018              | 6/30/2019            | 12      |
| RE        | 141425  | Biconical Antenna                | Schwarzbeck       | BBA9106    | 1302                         | 6/1/2018              | 6/30/2019            | 12      |
| RE        | 141397  | Coaxial Cable                    | UL Japan          | -          | -                            | 6/13/2018             | 6/30/2019            | 12      |
| RE        | 141412  | Microwave Cable                  | Junkosha          | MWX221     | 1305S002R(1m) / 1405S146(5m) | 6/14/2018             | 6/30/2019            | 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:

RE: Radiated emission

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