



RADIO TEST REPORT

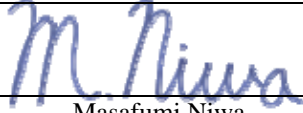
Test Report No. : 11840085H-A-R1

Applicant : OMRON Automotive Electronics Co. Ltd.
Type of Equipment : UNIT ASSY
Model No. : GHR-H015-R
FCC ID : OUCGHR-H015R
Test regulation : FCC Part 15 Subpart C: 2017
Test Result : Complied

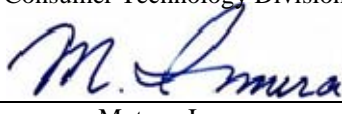
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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be 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 11840085H-A.

Date of test: June 28, 2017

Representative test engineer:


Masafumi Niwa
Engineer
Consumer Technology Division

Approved by:


Motoya Imura
Engineer
Consumer Technology Division



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13-EM-F0429

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SECTION 1: Customer information

Company Name : OMRON Automotive Electronics Co. Ltd.
Address : 6368 NENJOZAKA OKUSA KOMAKI AICHI, 485-0802 JAPAN
Telephone Number : +81-568-78-6159
Facsimile Number : +81-568-78-7659
Contact Person : Takashi Betsui

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

2.1 Identification of E.U.T.

Type of Equipment : UNIT ASSY
Model No. : GHR-H015-R
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 12 V
Receipt Date of Sample : May 30, 2017
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 No: GHR-H015-R (referred to as the EUT in this report) is the UNIT ASSY.

General Specification

Clock frequencies in the system : 8 MHz, 10 MHz (CPU)
21.948717 MHz (Crystal)

Radio Specification

[Transmitter part]

Radio Type : Transmitter
Frequency of Operation : 125 kHz
Modulation : FSK
Method of Frequency Generation : Crystal resonator
Antenna type : Inverted L antenna

[Receiver part]*

Radio Type : Receiver
Frequency of Operation : 433.92 MHz
Method of Frequency Generation : Crystal

*The test of receiver part was performed separately from this test report, and the conformability is confirmed.

UNIT ASSY (model: GHR-H015-R) consists of the following parts:

- BCM (included UHF Receiver)
- LF ANT (Front)
- LF ANT (Rear)

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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 June 14, 2017 and effective July 14, 2017

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted Emission
Section 15.209 Radiated emission limits, general requirements

* The revision on June 14, 2017, does not affect the test specification applied to the EUT.

* Also the EUT complies with FCC Part 15 Subpart B.

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 | 11.1 dB 125 kHz 0 deg. PK with Duty factor <LF ANT (Rear)> | 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 | 18.1 dB 42.225 MHz Vertical, QP <LF ANT (Rear)> | 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 EUT provides stable voltage (DC 6 V) constantly to the wireless transmitter regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the 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.

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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.

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 | 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 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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| | IC Registration Number | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms |
|----------------------------|------------------------|----------------------------|--|------------------------|
| No.1 semi-anechoic chamber | 2973C-1 | 19.2 x 11.2 x 7.7m | 7.0 x 6.0m | No.1 Power source room |
| No.2 semi-anechoic chamber | 2973C-2 | 7.5 x 5.8 x 5.2m | 4.0 x 4.0m | - |
| No.3 semi-anechoic chamber | 2973C-3 | 12.0 x 8.5 x 5.9m | 6.8 x 5.75m | No.3 Preparation room |
| No.3 shielded room | - | 4.0 x 6.0 x 2.7m | N/A | - |
| No.4 semi-anechoic chamber | 2973C-4 | 12.0 x 8.5 x 5.9m | 6.8 x 5.75m | No.4 Preparation room |
| No.4 shielded room | - | 4.0 x 6.0 x 2.7m | N/A | - |
| No.5 semi-anechoic chamber | - | 6.0 x 6.0 x 3.9m | 6.0 x 6.0m | - |
| No.6 shielded room | - | 4.0 x 4.5 x 2.7m | 4.0 x 4.5 m | - |
| No.6 measurement room | - | 4.75 x 5.4 x 3.0m | 4.75 x 4.15 m | - |
| No.7 shielded room | - | 4.7 x 7.5 x 2.7m | 4.7 x 7.5m | - |
| No.8 measurement room | - | 3.1 x 5.0 x 2.7m | N/A | - |
| No.9 measurement room | - | 8.0 x 4.6 x 2.8m | 2.4 x 2.4m | - |
| No.11 measurement room | - | 6.2 x 4.7 x 3.0m | 4.8 x 4.6m | - |

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m 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.

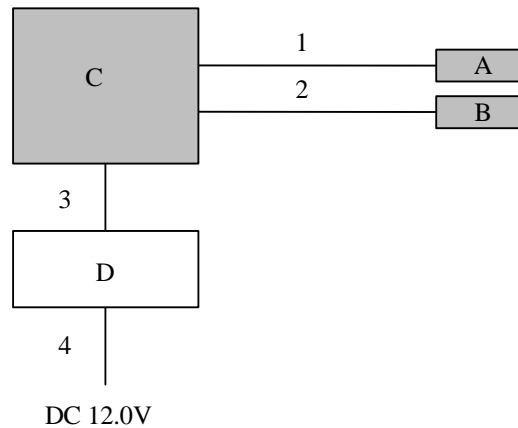
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

| Test mode | Remarks |
|--------------------------------|---------|
| Transmitting mode (Tx) 125 kHz | - |

Justification : The system was configured in typical fashion (as a user 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.

* The EUT does not transmit simultaneously from multiple antennas.

* Antennas were evaluated with the worst duty respectively.

Description of EUT and Support equipment

| No. | Item | Model number | Serial number | Manufacturer | Remark |
|-----|--------------------|---------------|---------------|---------------------------------------|--------|
| A | LF Antenna (Rear) | CGF-H003-0010 | No.1 | OMRON Automotive Electronics Co. Ltd. | EUT |
| B | LF Antenna (Front) | CGF-H001-0010 | No.1 | OMRON Automotive Electronics Co. Ltd. | EUT |
| C | ECU | GHR-H015-R01 | No.19 | OMRON Automotive Electronics Co. Ltd. | EUT |
| D | ECU Simulator | - | No.9 | OMRON Automotive Electronics Co. Ltd. | - |

List of cables used

| No. | Name | Length (m) | Shield | | Remark |
|-----|---------------|------------|------------|------------|--------|
| | | | Cable | Connector | |
| 1 | Antenna Cable | 0.70 | Unshielded | Unshielded | - |
| 2 | Antenna Cable | 0.55 | Unshielded | Unshielded | - |
| 3 | Signal Cable | 0.60 | Unshielded | Unshielded | - |
| 4 | DC Cable | 2.00 | 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.

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: June 28, 2017

Test engineer: Masafumi Niwa

UL Japan, Inc.

Ise EMC Lab.

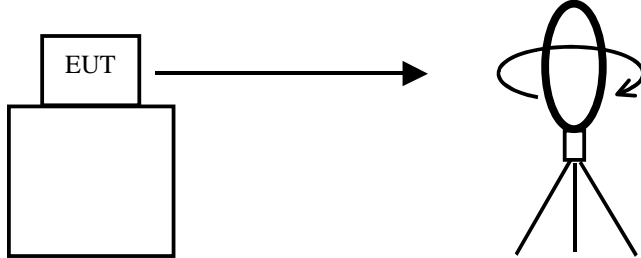
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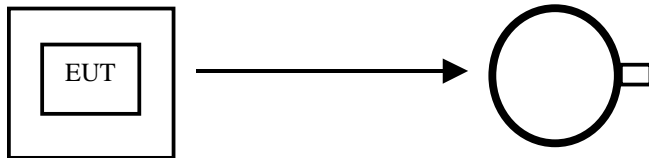
Figure 1: Direction of the Loop Antenna

Side View (Vertical)



.....

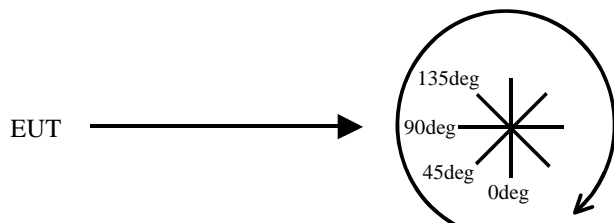
Top View (Horizontal)



Antenna was not rotated.

.....

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

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 | 50 kHz | 510 Hz | 1.5 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 *1) | Max Hold *1) | Spectrum Analyzer |

*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %.
Peak hold was applied as Worst-case measurement.

Test data : APPENDIX 1

Test result : Pass

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APPENDIX 1: Test data

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)
LF ANT (Front)

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber
Order No. : 11840085H
Date : 06/28/2017
Temperature/ Humidity : 22 deg. C / 54 % RH
Engineer : Masafumi Niwa
Mode : Tx 125 kHz LF ANT (Front)

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 | 0.12500 | PK | 100.7 | 19.7 | -73.9 | 32.2 | - | 14.3 | 45.6 | 31.3 | Fundamental |
| 0 | 0.25000 | PK | 62.9 | 19.6 | -73.9 | 32.2 | - | -23.6 | 39.6 | 63.2 | |
| 0 | 0.37500 | PK | 58.9 | 19.6 | -73.9 | 32.2 | - | -27.6 | 36.1 | 63.7 | |
| 0 | 0.50000 | QP | 44.9 | 19.5 | -33.8 | 32.1 | - | -1.5 | 33.6 | 35.1 | |
| 0 | 0.62500 | QP | 43.3 | 19.5 | -33.8 | 32.2 | - | -3.2 | 31.7 | 34.9 | |
| 0 | 0.75000 | QP | 40.2 | 19.5 | -33.8 | 32.2 | - | -6.3 | 30.1 | 36.4 | |
| 0 | 0.87500 | QP | 34.8 | 19.5 | -33.8 | 32.2 | - | -11.7 | 28.7 | 40.4 | |
| 0 | 1.00000 | QP | 36.9 | 19.5 | -33.8 | 32.2 | - | -9.6 | 27.6 | 37.2 | |
| 0 | 1.12500 | QP | 31.1 | 19.5 | -33.8 | 32.2 | - | -15.4 | 26.5 | 41.9 | |
| 0 | 1.25000 | QP | 34.4 | 19.5 | -33.7 | 32.2 | - | -12.0 | 25.6 | 37.6 | |

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

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 | 0.125 | PK | 100.7 | 19.7 | -73.9 | 32.2 | 0.0 | 14.3 | 25.6 | 11.3 | |
| 0 | 0.250 | PK | 62.9 | 19.6 | -73.9 | 32.2 | 0.0 | -23.6 | 19.6 | 43.2 | |
| 0 | 0.375 | PK | 58.9 | 19.6 | -73.9 | 32.2 | 0.0 | -27.6 | 16.1 | 43.7 | |

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

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

Result of the fundamental emission at 3m 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 | 0.12500 | PK | 100.7 | 19.7 | 6.1 | 32.2 | - | 94.3 | - | - | Fundamental |

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

* 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.

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Radiated Emission below 30 MHz (Fundamental and Spurious Emission)
LF ANT (Rear)

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber
Order No. : 11840085H
Date : 06/28/2017
Temperature/ Humidity : 22 deg. C / 54 % RH
Engineer : Masafumi Niwa
Mode : Tx 125 kHz LF ANT (Rear)

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 | 0.12500 | PK | 100.9 | 19.7 | -73.9 | 32.2 | - | 14.5 | 45.6 | 31.1 | Fundamental |
| 0 | 0.25000 | PK | 61.5 | 19.6 | -73.9 | 32.2 | - | -25.0 | 39.6 | 64.6 | |
| 0 | 0.37500 | PK | 59.0 | 19.6 | -73.9 | 32.2 | - | -27.5 | 36.1 | 63.6 | |
| 0 | 0.50000 | QP | 43.7 | 19.5 | -33.8 | 32.1 | - | -2.7 | 33.6 | 36.3 | |
| 0 | 0.62500 | QP | 43.9 | 19.5 | -33.8 | 32.2 | - | -2.6 | 31.7 | 34.3 | |
| 0 | 0.75000 | QP | 39.1 | 19.5 | -33.8 | 32.2 | - | -7.4 | 30.1 | 37.5 | |
| 0 | 0.87500 | QP | 35.3 | 19.5 | -33.8 | 32.2 | - | -11.2 | 28.7 | 39.9 | |
| 0 | 1.00000 | QP | 35.7 | 19.5 | -33.8 | 32.2 | - | -10.8 | 27.6 | 38.4 | |
| 0 | 1.12500 | QP | 31.3 | 19.5 | -33.8 | 32.2 | - | -15.2 | 26.5 | 41.7 | |
| 0 | 1.25000 | QP | 33.4 | 19.5 | -33.7 | 32.2 | - | -13.0 | 25.6 | 38.6 | |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + 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 | 0.125 | PK | 100.9 | 19.7 | -73.9 | 32.2 | 0.0 | 14.5 | 25.6 | 11.1 | |
| 0 | 0.250 | PK | 61.5 | 19.6 | -73.9 | 32.2 | 0.0 | -25.0 | 19.6 | 44.6 | |
| 0 | 0.375 | PK | 59.0 | 19.6 | -73.9 | 32.2 | 0.0 | -27.5 | 16.1 | 43.6 | |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + 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 3m 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 | 0.12500 | PK | 100.9 | 19.7 | 6.1 | 32.2 | - | 94.5 | - | - | Fundamental |

Result = Reading + Ant Factor + Loss (Cable + Attenuator) - 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 above 30 MHz (Spurious Emission)
LF ANT (Front)

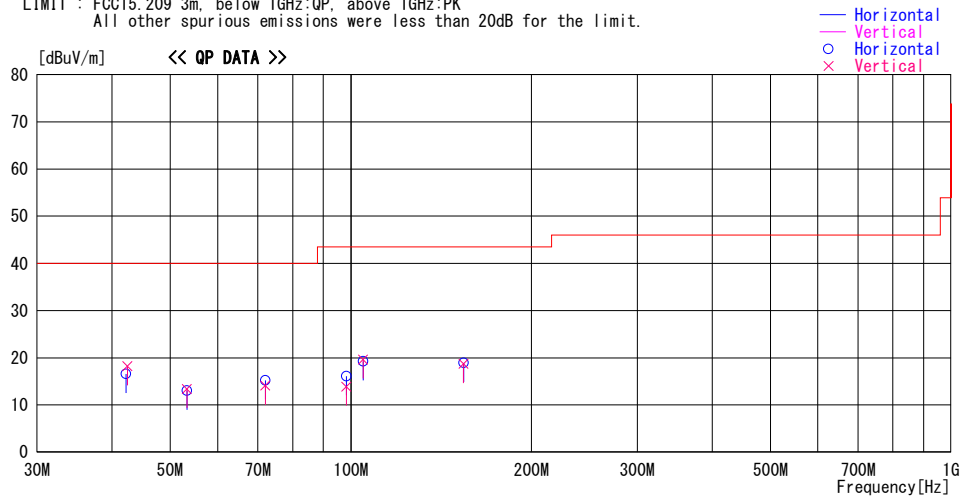
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.2 Semi Anechoic Chamber
Date : 2017/06/28

Report No. : 11840085H
Temp./Humi. : 23deg. C / 54% RH
Engineer : Masafumi Niwa

Mode / Remarks : Tx 125 kHz LF ANT (Front) Worst Axis (Ant Hori: X, Vert: X / ECU: Hori: Z, Vert: Z)

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] | | | | | | | |
| 42.235 | 24.6 | QP | 13.3 | -21.3 | 16.6 | 0 | 300 | Hori. | 40.0 | 23.4 | |
| 42.435 | 26.2 | QP | 13.3 | -21.3 | 18.2 | 0 | 100 | Vert. | 40.0 | 21.8 | |
| 53.324 | 24.5 | QP | 9.6 | -21.1 | 13.0 | 0 | 300 | Hori. | 40.0 | 27.0 | |
| 53.325 | 24.9 | QP | 9.6 | -21.1 | 13.4 | 0 | 100 | Vert. | 40.0 | 26.6 | |
| 72.024 | 28.8 | QP | 6.2 | -20.9 | 14.1 | 20 | 146 | Vert. | 40.0 | 25.9 | |
| 72.025 | 29.9 | QP | 6.2 | -20.9 | 15.2 | 47 | 147 | Hori. | 40.0 | 24.8 | |
| 98.303 | 24.7 | QP | 9.8 | -20.6 | 13.9 | 0 | 100 | Vert. | 43.5 | 29.6 | |
| 98.323 | 26.9 | QP | 9.8 | -20.6 | 16.1 | 140 | 191 | Hori. | 43.5 | 27.4 | |
| 104.823 | 29.2 | QP | 10.8 | -20.4 | 19.6 | 0 | 100 | Vert. | 43.5 | 23.9 | |
| 104.899 | 28.9 | QP | 10.8 | -20.4 | 19.3 | 24 | 180 | Hori. | 43.5 | 24.2 | |
| 154.000 | 23.6 | QP | 15.0 | -19.9 | 18.7 | 204 | 100 | Vert. | 43.5 | 24.8 | |
| 154.238 | 23.8 | QP | 15.0 | -19.9 | 18.9 | 0 | 300 | Hori. | 43.5 | 24.6 | |

CHART: WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-200MHz:BICONICAL, 200MHz-1000MHz:LOGPERIODIC, 1000MHz--:HORN
CALCULATION : RESULT = READING + ANT FACTOR + LOSS & GAIN (GABLE + ATTEN - GAIN(AMP))

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

Radiated Emission above 30 MHz (Spurious Emission)
LF ANT (Rear)

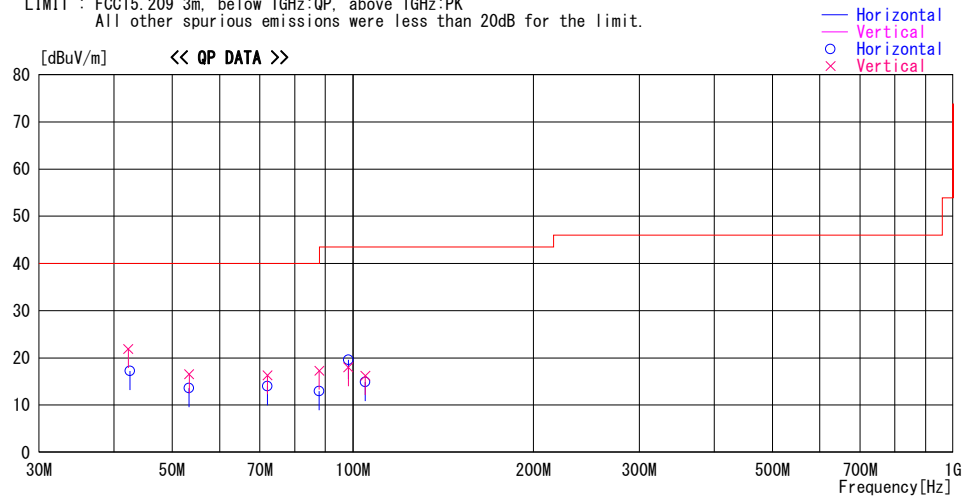
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.2 Semi Anechoic Chamber
Date : 2017/06/28

Report No. : 11840085H
Temp./Humi. : 23deg. C / 54% RH
Engineer : Masafumi Niwa

Mode / Remarks : Tx 125 kHz LF ANT (Rear) Worst Axis (Ant Hori: X, Vert: X / ECU: Hori: Z, Vert: Z)

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 | | Level [dBuV/m] | Angle [Deg] | Height [cm] | Polar. | Limit [dBuV/m] | Margin [dB] | Comment |
|--------------------|-------------------|-----|------------------|-----------------------|-------------------|----------------|----------------|--------|-------------------|----------------|---------|
| | | | Factor [dB/m] | Loss& Gain [dB] | | | | | | | |
| 42.255 | 29.9 | QP | 13.3 | -21.3 | 21.9 | 0 | 100 | Vert. | 40.0 | 18.1 | |
| 42.529 | 25.3 | QP | 13.2 | -21.3 | 17.2 | 172 | 120 | Hori. | 40.0 | 22.8 | |
| 53.365 | 25.1 | QP | 9.6 | -21.1 | 13.6 | 0 | 300 | Hori. | 40.0 | 26.4 | |
| 53.375 | 28.0 | QP | 9.6 | -21.1 | 16.5 | 51 | 100 | Vert. | 40.0 | 23.5 | |
| 72.078 | 28.7 | QP | 6.2 | -20.9 | 14.0 | 0 | 162 | Hori. | 40.0 | 26.0 | |
| 72.089 | 30.9 | QP | 6.3 | -20.9 | 16.3 | 10 | 146 | Vert. | 40.0 | 23.7 | |
| 87.874 | 25.7 | QP | 7.9 | -20.7 | 12.9 | 0 | 192 | Hori. | 40.0 | 27.1 | |
| 87.875 | 30.1 | QP | 7.9 | -20.7 | 17.3 | 207 | 111 | Vert. | 40.0 | 22.7 | |
| 98.303 | 30.4 | QP | 9.8 | -20.6 | 19.6 | 145 | 190 | Hori. | 43.5 | 23.9 | |
| 98.303 | 28.8 | QP | 9.8 | -20.6 | 18.0 | 0 | 100 | Vert. | 43.5 | 25.5 | |
| 104.899 | 24.5 | QP | 10.8 | -20.4 | 14.9 | 0 | 300 | Hori. | 43.5 | 28.6 | |
| 104.899 | 25.8 | QP | 10.8 | -20.4 | 16.2 | 0 | 100 | Vert. | 43.5 | 27.3 | |

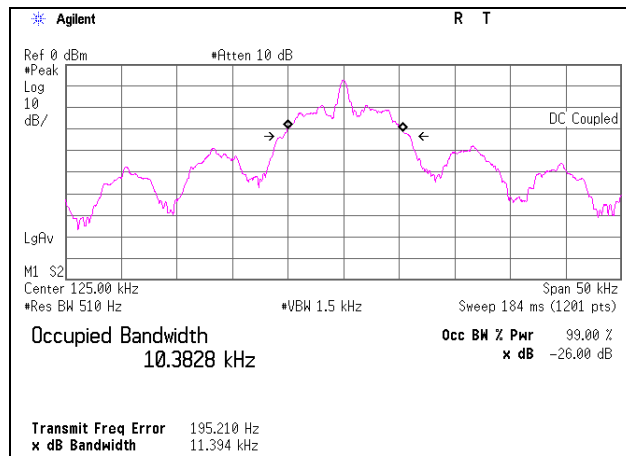
CHART: WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-200MHz:BICONICAL, 200MHz-1000MHz:LOGPERIODIC, 1000MHz--:HORN
CALCULATION : RESULT = READING + ANT FACTOR + LOSS & GAIN(CABLE + ATTEN - GAIN(AMP))

*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
 LF ANT (Front)

| | |
|-----------------------|---|
| Test place | Ise EMC Lab. No.2 Semi Anechoic Chamber |
| Order No. | 11840085H |
| Date | 06/28/2017 |
| Temperature/ Humidity | 22 deg. C / 54 % RH |
| Engineer | Masafumi Niwa |
| Mode | Tx 125 kHz LF ANT (Front) |

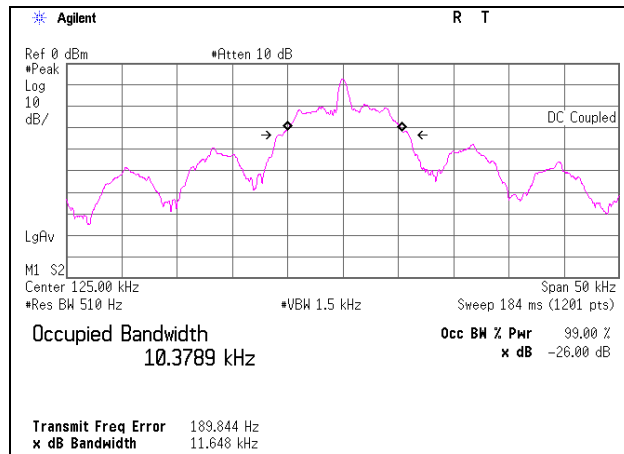
| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---------------------------|----------------------------------|
| 11.394 | 10.3828 |



-26 dB Bandwidth and 99 % Occupied Bandwidth
LF ANT (Rear)

| | |
|-----------------------|---|
| Test place | Ise EMC Lab. No.2 Semi Anechoic Chamber |
| Order No. | 11840085H |
| Date | 06/28/2017 |
| Temperature/ Humidity | 22 deg. C / 54 % RH |
| Engineer | Masafumi Niwa |
| Mode | Tx 125 kHz LF ANT (Rear) |

| -26 dB Bandwidth [kHz] | 99 % Occupied Bandwidth [kHz] |
|---------------------------|----------------------------------|
| 11.648 | 10.3789 |



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-06902 | RE | 2016/08/02 * 12 |
| MOS-22 | Thermo-Hygrometer | Custom | CTH-201 | 0003 | RE | 2016/12/13 * 12 |
| MJM-14 | Measure | KOMELON | KMC-36 | - | RE | - |
| COTS-MEMI | EMI measurement program | TSJ | TEPTO-DV | - | RE | - |
| MRENT-130 | Spectrum Analyzer | Agilent | E4440A | MY46187750 | RE | 2017/06/20 * 12 |
| MTR-03 | Test Receiver | Rohde & Schwarz | ESCI | 100300 | RE | 2016/10/21 * 12 |
| MBA-08 | Biconical Antenna | Schwarzbeck | VHA9103B | 08031 | RE | 2016/09/29 * 12 |
| MLA-21 | Logperiodic Antenna(200-1000MHz) | Schwarzbeck | VUSLP9111B | 911B-190 | RE | 2017/01/05 * 12 |
| MCC-12 | Coaxial Cable | Fujikura/Agilent | - | - | RE | 2017/02/24 * 12 |
| MAT-07 | Attenuator(6dB) | Weinschel Corp | 2 | BK7970 | RE | 2016/11/28 * 12 |
| MPA-09 | Pre Amplifier | Agilent | 8447D | 2944A10845 | RE | 2016/09/13 * 12 |
| MMM-01 | Digital Tester | Fluke | FLUKE 26-3 | 78030611 | RE | 2016/08/23 * 12 |
| MLPA-01 | Loop Antenna | Rohde & Schwarz | HFH2-Z2 | 100017 | RE | 2016/10/14 * 12 |
| MCC-13 | Coaxial Cable | Fujikura | 3D-2W(12m)/ 5D-2W(5m)/ 5D-2W(0.8m)/ 5D-2W(1m) | - | RE | 2017/02/24 * 12 |
| MCC-143 | Coaxial Cable | UL Japan | - | - | RE | 2017/06/12 * 12 |
| MPA-14 | Pre Amplifier | SONOMA INSTRUMENT | 310 | 260833 | RE | 2017/03/27 * 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: Spurious emission

UL Japan, Inc.

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