

## Test Report

Test Report Number	EOTEL029
Applied Standard(s)	FCC Part15 Subpart C, ANSI C63.4-2003
Date of Issue	7th, April 2014
Testing Laboratory Address	Astronaut Noborito Laboratory 294 Noborito, Tama-ku Kawasaki-shi, Kanagawa, 214-0014 Japan
Test Date(s)	1th, April 2014
Product Name	Environmental sensor
Model Number	CM401
Serial Number	-
Applicant (Client) Address	GM3 Co.,Ltd. 3-15-1804, Kanda-Neribeicyo, Chiyoda-Ku, Tokyo, 101-0022 Japan
Manufacturer Address	GM3 Co.,Ltd. 3-15-1804, Kanda-Neribeicyo, Chiyoda-Ku, Tokyo, 101-0022 Japan
FCC ID	2ABSUCM401

## Test Result

The test result for the electromagnetic compatibility tests as described in the section 1 to 2 and in this page was:

**Pass**

Tested by: Katsutoshi Hatanaka  
Katsutoshi Hatanaka  
Test Enginner

Approved by: Koji Imai  
Koji Imai  
Testing Group Leader

Checked box (☒) indicates that the listed condition, standard or equipment is applicable for this Report.  
Blank box (☐) indicates that the listed condition, standard or equipment is not applicable for this Report.  
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Test results of this report refer only to the EUT tested here.

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## **1. Summary**

### **1.1 Terms and definitions**

**AV**  
Average

**DoC**  
Declaration of Conformity

**EUT**  
Equipment Under Test

**PK**  
Peak

**QP**  
Quasi-peak

## 1.2 Standard(s) and Result

Applied Standard(s)	Normative Reference(s)	Classification	Result	Note
FCC Part15 Subpart C	20dB Bandwidth(FHSS only)	15.247(a)(1)	N/A	
	6dB Bandwidth(Digital only)	15.247(a)(2)	Pass	
	Carrier Frequency Separation (FHSS only)	15.247(a)(1)	N/A	
	Number of Hopping Frequencies (FHSS only)	15.247(a)(1)	N/A	
	Time of Occupancy(Dwell Time) (FHSS only)	15.247(a)(1)	N/A	
	Maximum Peak Output Power	15.247(b)(1)(2)FHSS 15.247(b)(3) Digital	Pass	
	Band Edge of Compliance of RF Conducted Emissions	15.247(d)	Pass	
	Restricted Bands of Operation	15.247(d)	Pass	
	Peak Power Spectral Density (Digital only)	15.247(e)	Pass	
	Conducted emissions	15.207	N/A	
	Radiated emissions	15.209 15.205	Pass	
	Maximum Permissible Exposure	1.1310 Safety code6, 2.2.1	N/A	

Note1 : This test measured according to the following procedure:FCC publication KDB558074 Measurement of Digital Transmission Systems Operating under Section 15.247 April 9, 2013

## 1.3 Deviations from Standard(s)

There was no deviation from the standard.

## 2. Equipment Under Test (EUT)

### 2.1 General Descriptions

Compact wireless thermo sensor for overhead line, distribution line, substation and others.

### 2.2 Detailed Descriptions

Product Name	Environmental sensor
Model Number	CM401
Serial Number	-
Power Supply	1.5V (Coin Battery CR2450)
Dimension	23.0 x 16.5 x 18.5mm
Operating Frequency	2432MHz
Normal Placement	Convenience store
Condition of the EUT	Prototype

### 2.3 WORST-CASE CONFIGURATION AND MODE

(a) EUT axes

The fundamental was measured in three different orientations X, Y and Z to find worst-case orientation, and it was found that Y orientation is worst-case; therefore final testing for radiated emissions was performed with EUT in X orientation with Cable.

### 2.4 Operation Mode(s) of the EUT for EMC during the Test(s)

Operation Mode Name	Description
TX mode	Normal operation TX mode

### 2.5 Peripheral Devices

Mark	Description	Model Number	Serial Number	FCC ID Code or DoC status	Manufacturer
N/A					

### 2.6 Interconnecting Cables

Mark	Description	Length (m)	Shielded Cable	Connector	Tested Port(s) (Note:1)
					Applicable Interface
N/A					

## 2.7 System Configuration

Unless otherwise specified in the following sections, the test configuration described here is applied for the tests.  
The configuration was choice by the applicant.

EUT

### 3. Test Data

#### 3.1 Test specification

Standard	FCC Part15 Subpart C 15.205 15.207 15.209 15.247, ANSI C63.4-2003
Frequency Range	2432MHz
Test Date	1th April, 2014
Test Location	Astronaut Noborito Laboratory
Test Engineer	Katsutoshi Hatanaka
Temperature	19.0 °C
Humidity	45% RH
Pressure	1005 hPa
Power Supply	1.5V (Coin Battery CR2450)
Operation Mode Name	TX mode (Normal operation TX mode)
Tested TX modulation	F1D
Tested channel	2432MHz

Remark: \*1 : Equivalent isotropic radiated power and Frequency Range only.

## 3.2 6dB Bandwidth

### 3.2.1 Test Result

Center Frequency (MHz)	6dB Bandwidth(kHz)			Limit(kHz)	Margin(kHz)
	Lower	Upper	Total		
2431.797	95.190	438.370	533.560	500	33.560

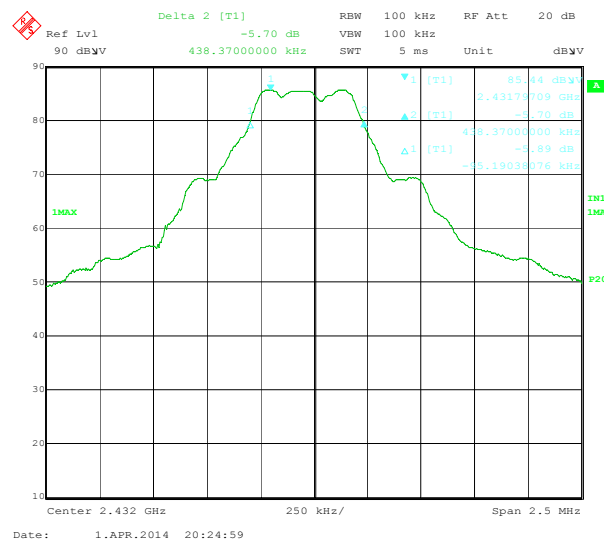
**Pass**

### 3.2.2 Test Detail

EUT was tested based on FCC 15.247(a)(2)  
with temporally antenna port.

The RBW is set to 100kHz and the VBW is set to 100kHz. The sweep time is coupled.

### 3.2.3 Test data



**Figure 1 6dB Bandwidth(2432.0MHz)**



### 3.3 Maximum Peak Output Power

#### 3.3.1 Test Result

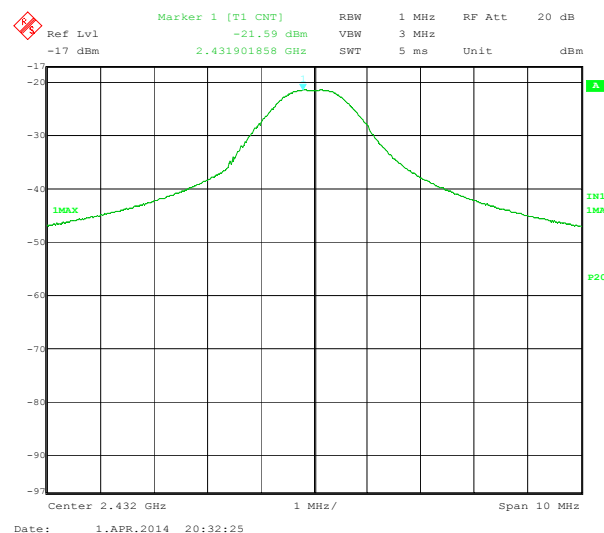
Frequency (MHz)	S/A Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
2431.902	-21.59	20.38	-1.21	30	31.21

**Pass**

#### 3.3.2 Test Detail

EUT was tested based on FCC 15.247(b)(1)(2)FHSS 15.247(b)(3)DHSS with temporally antenna port. The bandwidth of the RF frequency is measured with the spectrum analyzer using 1MHz RBW and 3MHz VBW.

#### 3.3.3 Test data



**Figure 2 Maximum Peak Output Power(2432.0MHz)**

### 3.4 Band Edge of Compliance of RF Conducted Emissions

#### 3.4.1 Test Result

Table1 Band Edge of Compliance of RF Conducted Emissions(926.8MHz)

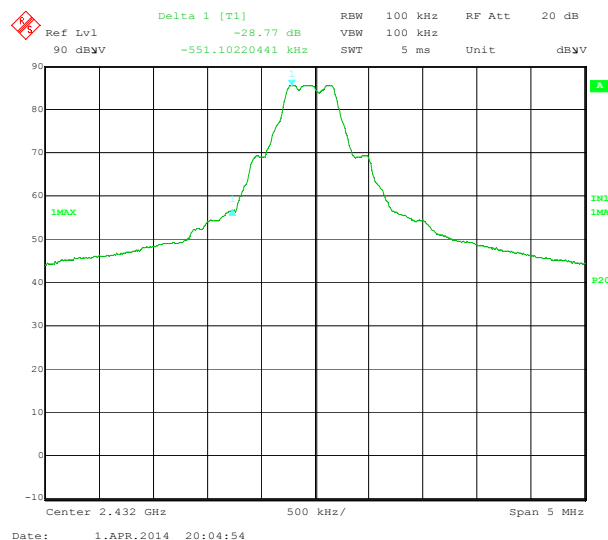
Edge	Frequency (MHz)	Deference (dB)	Limit (dB)	Margin (dB)
Lower	2431.449	28.77	>20	8.77
Higher	2433.202	31.06	>20	11.06

**Pass**

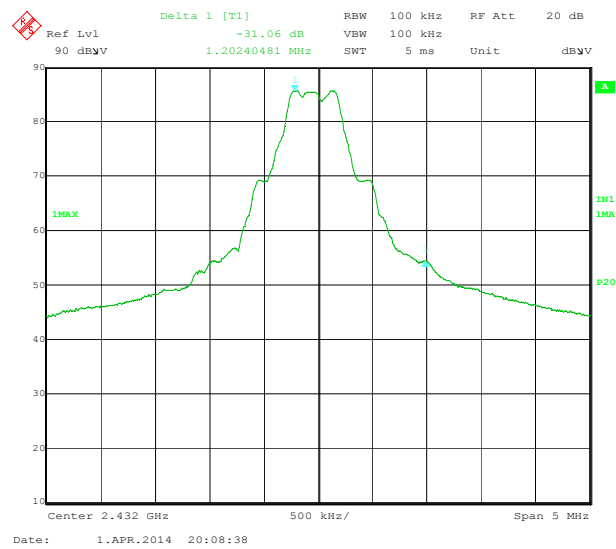
#### 3.4.2 Test Detail

EUT was tested based on FCC 15.247(d) with temporally antenna port. The spectrum analyzer is set to RBW=100kHz, VBW=100kHz, Detector function=Peak.

#### 3.4.3 Test data



**Figure 3 Band Edge of Compliance of RF Conducted Emissions (2432.0MHz/Lower)**



**Figure 4 Band Edge of Compliance of RF Conducted Emissions (2432.0MHz/Higher)**

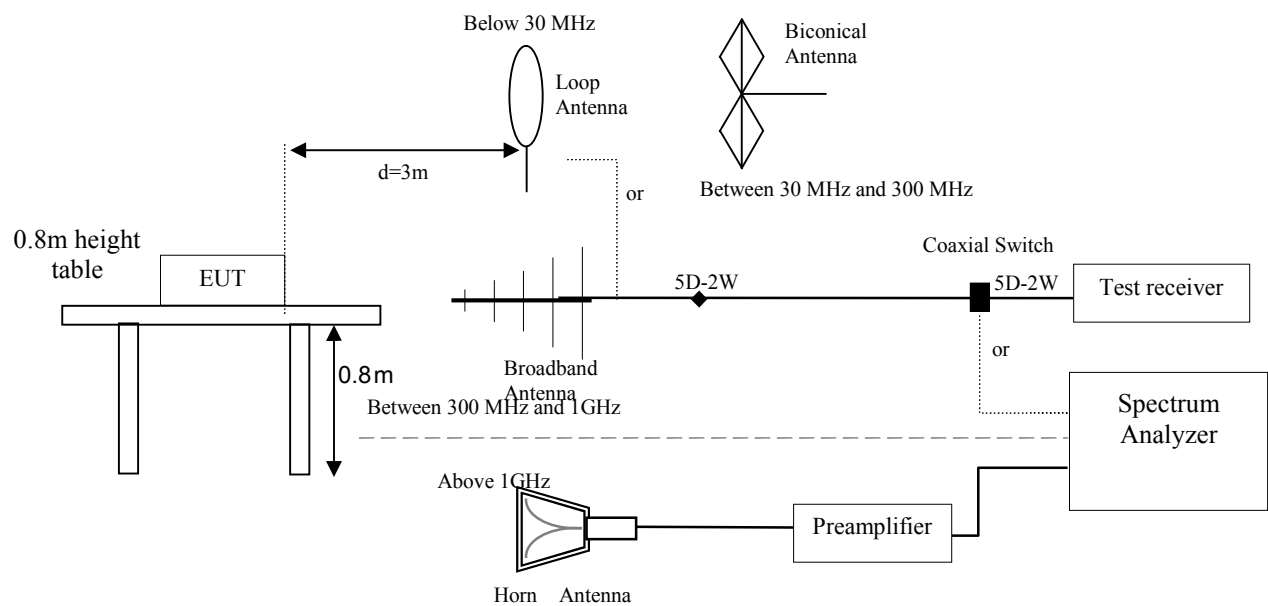
### 3.5 Radiated emission

#### 3.5.1 Test Result

Pass

#### 3.5.2 Test Detail

EUT was tested based on FCC 15.209 with antenna. See Annex B.



### 3.5.3 Test data

Table2 Radiated Emission (9kHz-1000MHz)

Frequency (MHz)	Reading (dBμV)	Correction factor (dB/m)	Noise level (dBμV/m)	Ant height (m)	Ant Pol (H/V)	Turn table angle (digree)	Limit (dBμV/m)	Margin (dB)
674.49	-1.2	30.4	29.2	285	V	315	46.0	16.8
218.002	-3.6	26.0	22.4	382	V	130	46.0	23.6
771.879	-2.2	31.0	28.8	119	H	129	46.0	17.2
872.811	-1.3	33.0	31.7	101	V	247	46.0	14.3

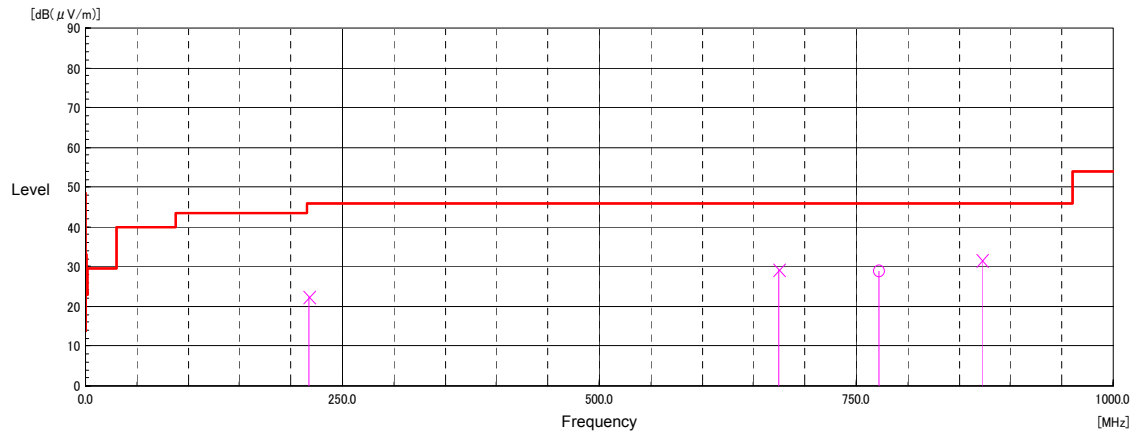


Figure 5 Radiated Emission (9kHz-1000MHz)

Table3 Radiated Emission (1GHz-25GHz)

Frequency (MHz)	Reading (dBμV)	Correction factor (dB/m)	Noise level (dBμV/m)	Ant height (m)	Ant Pol (H/V)	Turn table angle (digree)	Limit (dBμV/m)	Margin (dB)
1294.660	50.9	-30.2	20.7	100	V	111	54.0	33.3
3647.868	52.4	-21.5	30.9	104	V	45	54.0	23.1
4863.959	67.9	-16.9	51.0	101	V	2	54.0	3.0
7296.284	56.7	-13.7	43.0	101	V	120	54.0	11.0

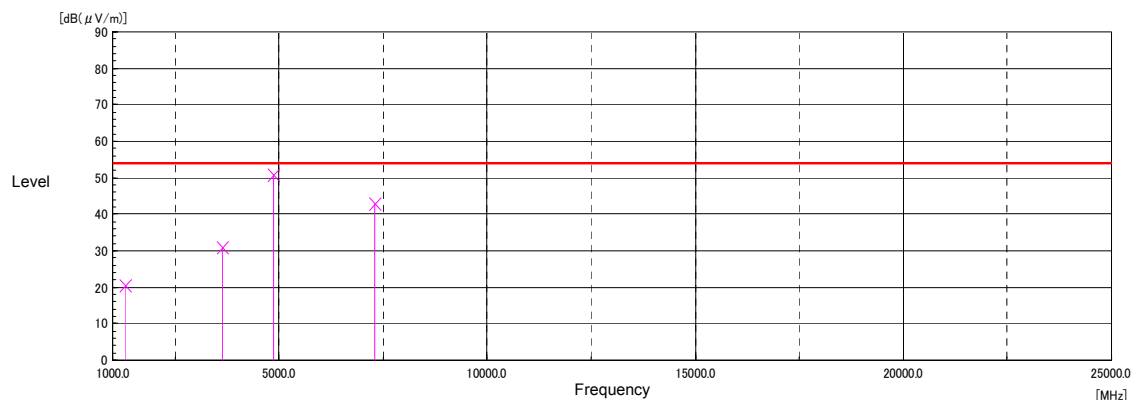


Figure 6 Radiated Emission (1GHz-25GHz)

### 3.6 Peak Power Spectral Density

#### 3.6.1 Test Result

Table4 Peak Power Spectral Density (926.8MHz)

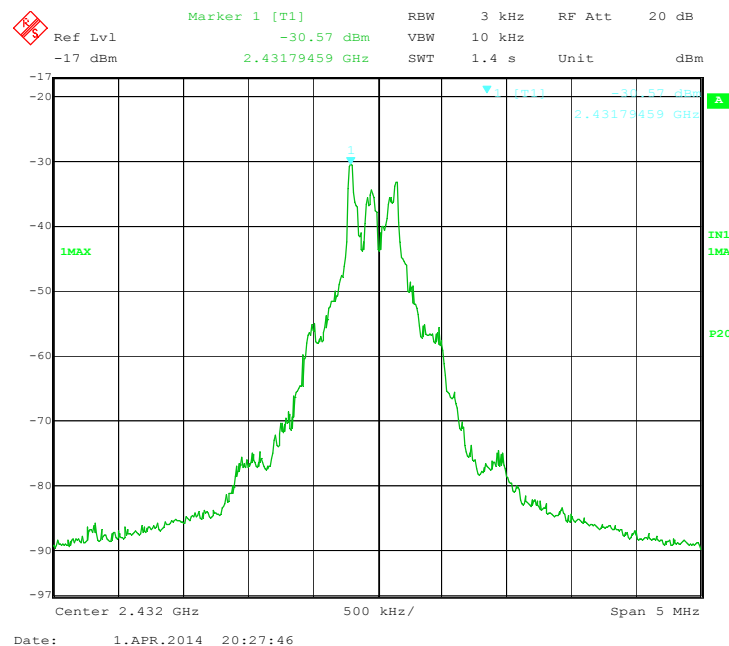
Frequency (MHz)	S/A Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
2431.795	-30.57	20.38	-10.19	8	18.19

**Pass**

#### 3.6.2 Test Detail

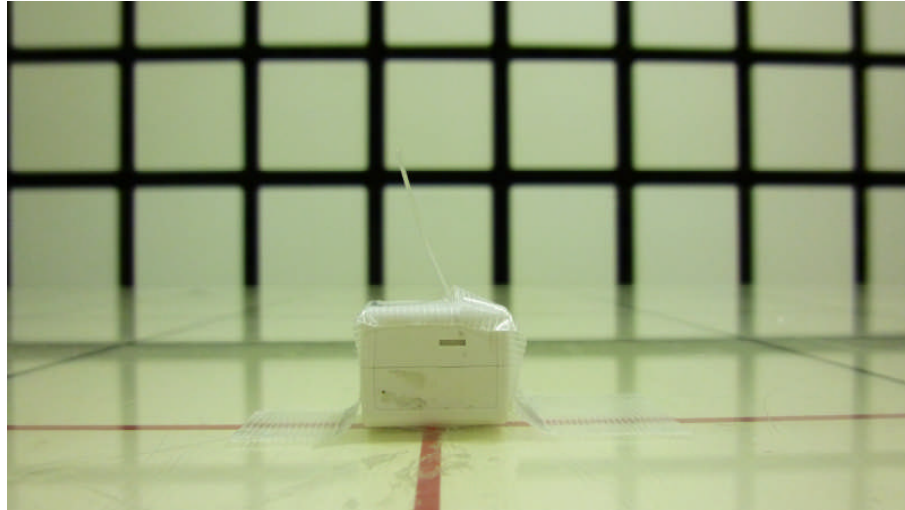
EUT was tested based on FCC 15.247(e) with temporally antenna port. The spectrum analyzer is set to RBW=3kHz, VBW=10kHz, Detector function=Peak.

#### 3.6.3 Test data

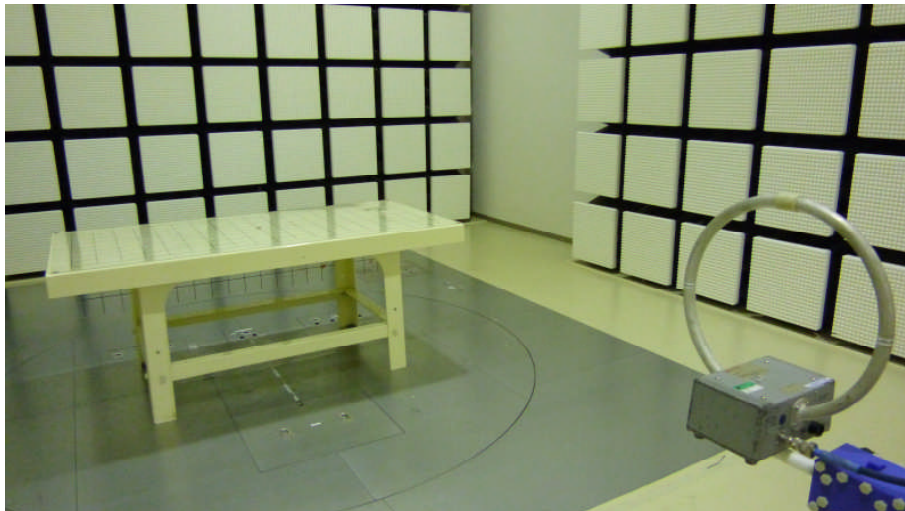


**Figure 7 Peak Power Spectral Density 2432.0MHz)**

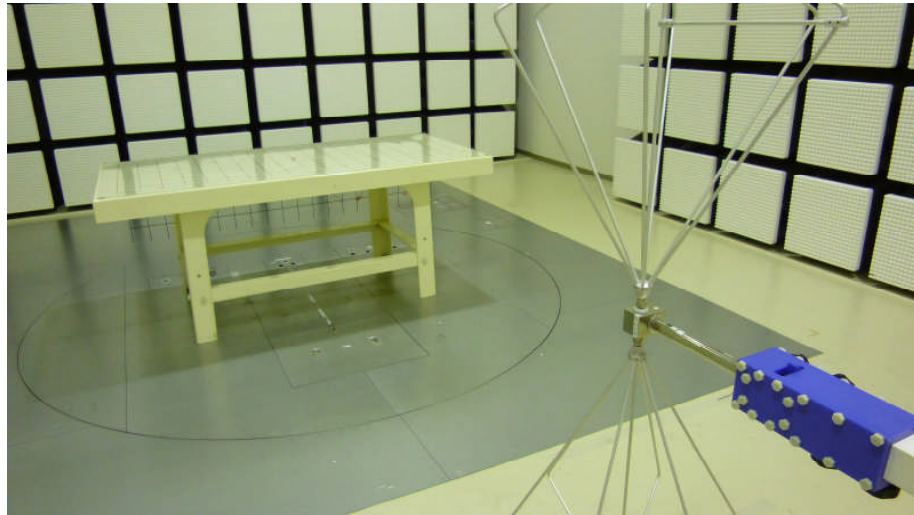
#### 4. Test Setup Photographs



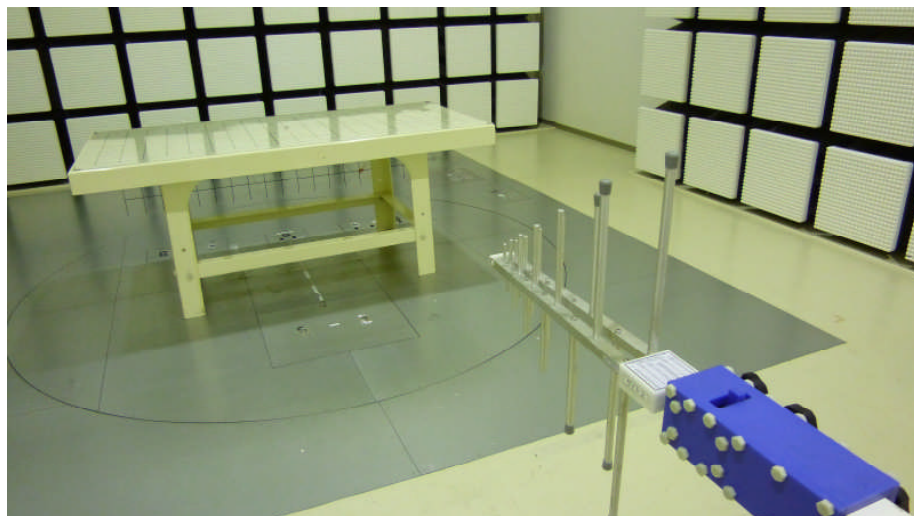
**Photo1 EUT setup**



**Photo2 Test setup for radiated**

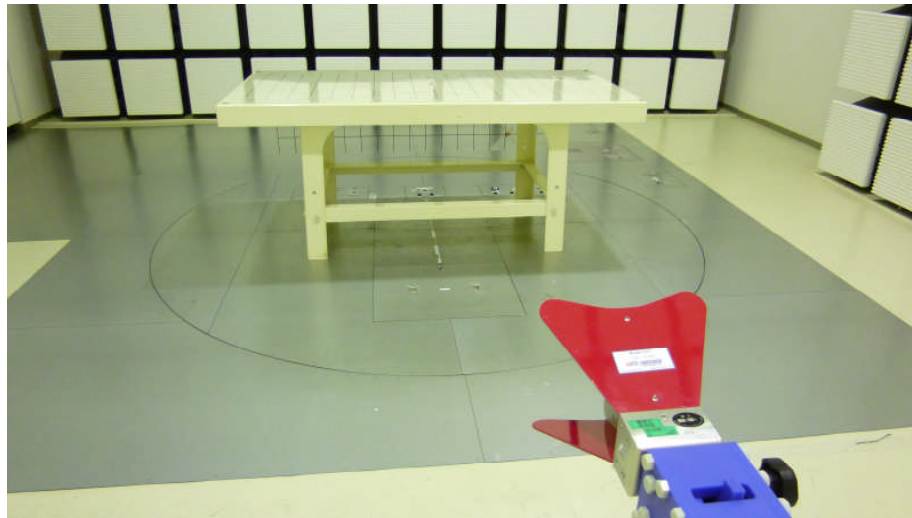


**Photo3** Test setup for radiated

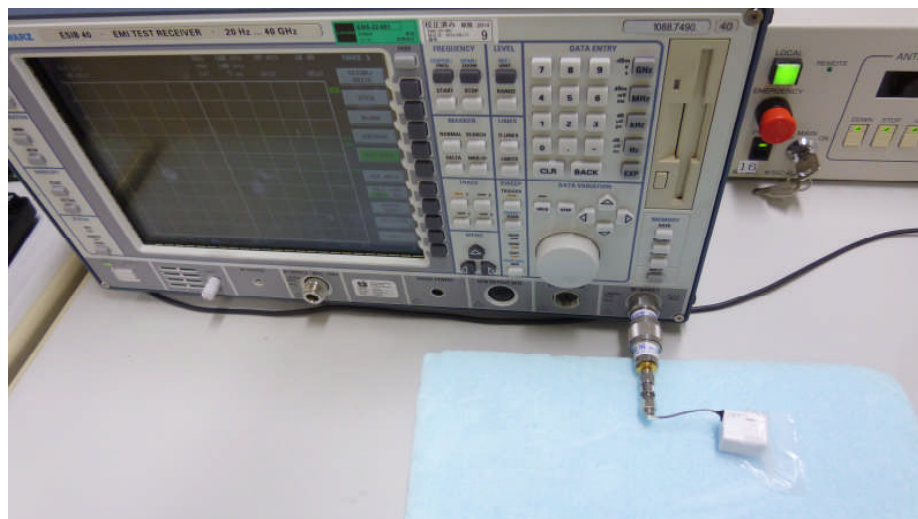


**Photo4** Test setup for radiated





**Photo5** Test setup for radiated



**Photo6** Test setup for conducted

## 5. Test facility

### 5.1 Test Instruments

Product Name	Manufacturer	Model Number	Serial Number	Calibration Date	Due Date
EMI Test Receiver	Rohde & Schwarz	ESIB40	100263	2013/09/17	2014/09/30
Pre-Amplifier	SONOMA	310N	270610	2013/7/11	2014/7/31
Pre-Amplifier	TOYO Corporation	TPA0108-40	0707	2013/7/8	2014/7/31
Pre amplifier	Hewlett Packard	8449B	3008A0079	2013/07/1	2014/07/31
Loop Antenna	EMCO	6507	9108-1268	2013/04/03	2014/04/30
Biconical Log Antenna	Schwarzbeck	VULB9160	9160-3189	2013/06/10	2014/06/30
Horn Antenna	ETS-LINDGREN	3117	00146463	2013/05/01	2014/05/31
Horn Antenna	ETS-LINDGREN	3116C	00146359	2014/01/28	2015/01/31

### 5.2 Test equipment

Dimension	Material	Measurement
1.5m (W) X 0.8m (H) X 1.0m (D)	Polystyrene	Radiated Emissions
0.69m(W) × 0.70m(H) × 0.43m(D)	Foamed Styrol	Conducted

### 5.3 Normalized Site Attenuation

Site Name	Laboratory	Calibration Date	Due Date
No.2 test room	Astronaut Noborito Laboratory	2013/10/23	2014/10/31

## Annex A (Miscellaneous Information)

### A.1 Test Locations

Unless otherwise described in this report, the tests were carried out at the following e · OHTAMA, LTD.,  
Astronaut Noborito Laboratory  
294 Noborito, Tama-ku Kawasaki-shi, Kanagawa, Japan  
TEL: +81-44-819-8601  
FAX: +81-44-819-8603  
FCC Registration Number: 946479

### A.2 Uncertainty

Emissions

Measurement	Uncertainty (k = 2)
	U <sub>lab</sub>
RF Conducted Emissions (150kHz-30MHz )	
AMN	3.5dB
Radiated Electromagnetic Field	
30-1000MHz	5.0dB
1-18GHz	5.3dB

Tests not listed above

Uncertainty for other tests which are reported in this test report, if any, would be available on request.  
Furthermore, component and process variability of devices similar to that tested may result in additional deviation.  
The manufacturer has the sole responsibility of continued compliance of the device.

## Annex B (Description of Test Method)

Unless otherwise described in this report, tests are carried out using the methods which are described in the applied standards and summarized in this section.

### B.1 Radiated Electric-Field Emissions (25MHz to 1000MHz)

EUT is placed on a turn-table in a test site, on a wooden table 1.5 m height or on the floor unless otherwise specified in the standard.

Receiving antenna ---usually biconical, log-periodic or biconical/log-periodic hybrid---is positioned at the specified distance from the EUT.

For each polarization (horizontal and vertical), a spectrum analyzer is used to pre-scan the emissions while rotating the turn-table.

For each of the significant electromagnetic field detected, the test personnel discriminates EUT's emissions from the ambient noises.

For each of the significant emissions, maximum level of the emission is searched while rotating the turn-table and varying the antenna height between 1 m and 4 m, and the maximum signal level is read using a measuring receiver having CISPR 16 quasi-peak (QP) detector function and 120 kHz nominal bandwidth.

Then, appropriate correction factor ---consists of antenna factor, amplifier gain and transmission loss (due to the attenuator and the cable loss) in the system--- is applied to the receiver reading to calculate the corresponding field strength.

*For example, if reading on the receiver is 33.0 dBμV, the antenna factor is 9.4 dB (1/m), the amplifier gain is 25.6 dB, and transmission loss (attenuation) in the coaxial cable and the attenuator is 6.5 dB, the field strength is calculated as:  $33.0 \text{ dB}\mu\text{V} + 9.4 \text{ dB (1/m)} - 25.6 \text{ dB} + 6.5 \text{ dB} = 23.3 \text{ dB}\mu\text{V/m}$ .*

Finally, the calculated field strength is compared with the upper limit specified in the standard.

Actual measurement will be carried out according to the appropriate edition of CISPR 16-2-3, CISPR 22.

### B.2 Radiated Electric-Field Emissions above 1000MHz

EUT is placed on a turn-table in a test site, on a wooden table 1.5 m height or on the floor unless otherwise specified in the standard.

Receiving antenna ---usually double ridge waveguide horn or standard horn--- is positioned at the specified distance from the EUT.

For each polarization (horizontal and vertical), a spectrum analyzer is used to pre-scan the emissions while rotating the turn-table.

For each of the significant electromagnetic field detected, the test personnel discriminates EUT's emissions from the ambient noises.

For each of the significant emissions, maximum level of the emission is searched while rotating the turn-table and varying the antenna height if it is required, and the maximum signal level is read using a spectrum analyzer or a measuring receiver having peak detector function and 1 MHz nominal bandwidth, unless otherwise specified in the standard. To obtain average readings with spectrum analyzers, video averaging (usually with VBW = 10 Hz) may be used.

As specified in the applicable standard, the antenna height would be (1) varied between 1 m and 4 m, or (2) varied so that the whole height of the EUT is covered by the main lobe of the receiving antenna, or (3) fixed to the approximate radiation center of the EUT.

Then, appropriate correction factor ---consists of antenna factor, amplifier gain and transmission loss (due to the attenuator and the cable loss) in the system--- is applied to the spectrum analyzer/receiver reading to calculate the corresponding field strength, and the result is compared with the upper limit specified in the standard.

Actual measurement will be carried out according to the appropriate edition of CISPR 16-2-3, CISPR 22, ANSI C63.4 and/or other standards whichever applicable.

Specifically for 47 CFR 15 Subpart B, section 6 of ANSI C63.4-2003 is to be used for EUT arrangements and operations, and section 8 of the standard is to be used for radiated emissions measurement procedures.