



# **RADIO TEST REPORT**

**Test Report No. : 11818213M**

**Applicant** : TAIYO YUDEN CO., LTD.  
**Type of Equipment** : Bluetooth Smart / ANT Module  
**Model No.** : EYSHSN  
**Test standard** : EN 300 328 V2.1.1  
(Except radiated emission tests)  
**Test Result** : Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
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)

**Date of test:** June 19 - 21, 2017

**Representative  
test operator:**

Kazuhiro Ando  
Engineer  
Consumer Technology Division

**Approved by :**

Tomoyuki Yamashita  
Engineer  
Consumer Technology Division



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

**UL Japan, Inc.**

**Kashima EMC Lab.**

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## REVISION HISTORY

**Original Test Report No.: 11818213M**

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## **SECTION 1: Customer information**

Company Name : TAIYO YUDEN CO., LTD.  
Address : 8-1 Sakaecho, Takasaki-Shi, Gunma, 370-8522, Japan  
Telephone Number : +81- 27-324-2313  
Facsimile Number : +81- 27-324-2314  
Contact Person : Mitsuo Takagi

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

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

Type of Equipment : Bluetooth Smart / ANT Module  
Model No. : EYSHSN  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC 3 V, 1.7 V - 3.6 V, 0.02 A, 0.1 W  
Receipt Date of Sample : June 19, 2017  
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: EYSHSN (referred to as the EUT in this report) is a Bluetooth Smart / ANT Module.

### **General Specification**

Clock frequency(ies) in the system : 32 MHz

## **Radio Specification**

### **<Bluetooth(BT) Low Energy (LE)>**

Radio Type : Transceiver  
Frequency of Operation : 2402 MHz - 2480 MHz  
Modulation : GFSK  
Power Supply (radio part input) : DC 1.3 V  
Antenna type : Monopole Antenna  
Antenna Gain : -3.7 dBi  
Operation temperature range : -40 deg.C. to +105 deg.C.

### **<Bluetooth (Ver. 5.0)>**

Radio Type : Transceiver  
Frequency of Operation : 2402 MHz - 2480 MHz  
Modulation : GFSK  
Power Supply (radio part input) : DC 1.3 V  
Antenna type : Monopole Antenna  
Antenna Gain : -3.7 dBi  
Operation temperature range : -40 deg.C. to +105 deg.C.

### **<ANT>**

Radio Type : Transceiver  
Frequency of Operation : 2402 MHz - 2480 MHz  
Modulation : GFSK  
Power Supply (radio part input) : DC 1.3 V  
Antenna type : Monopole Antenna  
Antenna Gain : -3.7 dBi  
Operation temperature range : -40 deg.C. to +105 deg.C.

### **<Nordic Original>**

Radio Type : Transceiver  
Frequency of Operation : 2402 MHz - 2480 MHz  
Modulation : GFSK  
Power Supply (radio part input) : DC 1.3 V  
Antenna type : Monopole Antenna  
Antenna Gain : -3.7 dBi  
Operation temperature range : -40 deg.C. to +105 deg.C.

## **SECTION 3: Test specification, procedures & results**

### **3.1 Test Specification**

Radio : EN 300 328 V2.1.1

Title : Wideband transmission systems; Data transmission equipment operating in the 2.4GHz ISM band and using wide band modulation techniques;  
Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

Purpose of test : Compliance with the harmonized RE directive 2014/53/EU.

### **3.2 Procedures and results**

No.	Item	Test Procedure	Limit	Remarks	Worst margin	Exclusions	Results
1	RF output power	Clause 5.4.2	Clause 4.3.2.2	Conducted	See Data	N/A	Complied
2	Power Spectral Density	Clause 5.4.3	Clause 4.3.2.3	Conducted	See Data	N/A	Complied
3	Duty cycle, Tx-sequence, Tx-gap	Clause 5.4.2	Clause 4.3.2.4	Conducted	-	N/A	N/A *1)
4	Medium Utilisation (MU) factor	Clause 5.4.2	Clause 4.3.2.5	Conducted	-	N/A	N/A *1)
5	Adaptivity (adaptive equipment using modulations other than FHSS)	Clause 5.4.6	Clause 4.3.2.6	Conducted	-	N/A	N/A *1)
6	Occupied Channel Bandwidth	Clause 5.4.7	Clause 4.3.2.7	Conducted	See Data	N/A	Complied
7	Transmitter unwanted emissions in the out-of-band domain	Clause 5.4.8	Clause 4.3.2.8	Conducted	See Data	N/A	Complied
8	Transmitter unwanted emissions in the spurious domain	Clause 5.4.9	Clause 4.3.2.9	Radiated	-	N/A	N/A *2)
9	Receiver Spurious emissions	Clause 5.4.10	Clause 4.3.2.10	Radiated	-	N/A	N/A *2)
10	Transmitter unwanted emissions in the spurious domain	Clause 5.4.9	Clause 4.3.2.9	Conducted	-	N/A	N/A *3)
11	Receiver Spurious emissions	Clause 5.4.10	Clause 4.3.2.10	Conducted	-	N/A	N/A *3)
12	Receiver Blocking	Clause 5.4.11	Clause 4.3.2.11	Conducted	-	N/A	Complied
13	Geo-location capability	-	Clause 4.3.2.12	-	-	N/A	N/A *4)
Note: UL Japan, Inc.'s EMI Work Procedure 13-EM-W0420. *1) The test is not applicable since the RF output power of the EUT is less than 10 dBm (e.i.r.p.). *2) This test is not applicable since customer request. *3) The EUT does not have antenna connector. *4) The EUT does not have Geo-location capability.							

### **3.3 Additions or deviations to standards**

No addition, exclusion nor deviation has been made from the standard.

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### 3.4 Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor  $k = 2$ .

Antenna terminal test	Uncertainty (+/-)
Power measurement above 1GHz	0.7dB
Spurious emissions, Power density measurement (below 1GHz)	1.6dB
Spurious emissions, Power density measurement (1G-3GHz)	1.4dB
Spurious emissions, Power density measurement (3G-18GHz)	2.8dB
Frequency measurement	$5.3 \times 10^{-6}$
Bandwidth measurement	5.4%
Duty cycle and Time measurement	0.012%
Receiver Blocking	3.1 dB

### 3.5 Test Location

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Telephone: +81 478 88 6500, Facsimile: +81 478 82 3373  
JAB Accreditation No. : RTL02610

Test site	ISED Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Open site	4659A-1	6.0 x 5.5 x 2.5	20 x 40	10 m
No.2 Open site	4659A-2	4.4 x 4.4 x 2.15	18 x 20	10 m
No.5 Open site	4659A-5	8.6 x 7.1 x 2.4	18 x 23	10 m
No.1 Shielded room	4659A-1	5.4 x 4.5 x 2.3	-	-
No.2 Shielded room	4659A-2	3.6 x 2.7 x 2.3	-	-
No.3 Shielded room	-	5.4 x 3.6 x 2.3	-	-
No.4 Shielded Room	-	6.1 x 6.1 x 3.1	-	-
No.5 Shielded Room	4659A-5	4.2 x 3.1 x 2.5	-	-
No.3 Fully Anechoic Chamber	-	7.0 x 3.5 x 3.5	-	-
No.6 Semi-anechoic Chamber	4659A-6	8.5 x 5.5 x 5.2	-	3 m
No.10 Semi-anechoic Chamber	4659A-10	18.4 x 9.9 x 7.7	-	10 m
No.11 Semi-anechoic Chamber	4659A-7	9.0 x 6.5 x 5.2	-	3 m
No.1 Measurement room	-	5.0 x 3.7 x 2.6	-	-
No.2 Measurement room	-	4.3 x 4.4 x 2.7	-	-
No.3 Measurement room	-	4.3 x 4.4 x 2.7	-	-

### 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*
Bluetooth(BT) Low Energy (LE), 1Mbps	1Mbps, Maximum Packet Size, PRBS9
Bluetooth(BT) Low Energy (LE), 2Mbps	2Mbps, Maximum Packet Size, PRBS9
ANT	1Mbps
Nordic Original	2Mbps
<p>*EUT has the power settings by the software as follows;</p> <p>- Power Setting: +4dBm</p> <p>- Software: Radio_test_BLE2M available (except for Receiver blocking)</p> <p>Blocking_tool_20170317 (Receiver blocking only)</p> <p>This setting of software is the worst case.</p> <p>Any conditions under the normal use do not exceed the condition of setting.</p> <p>In addition, end users cannot change the settings of the output power of the product.</p>	

#### Details of Operating Mode(s)

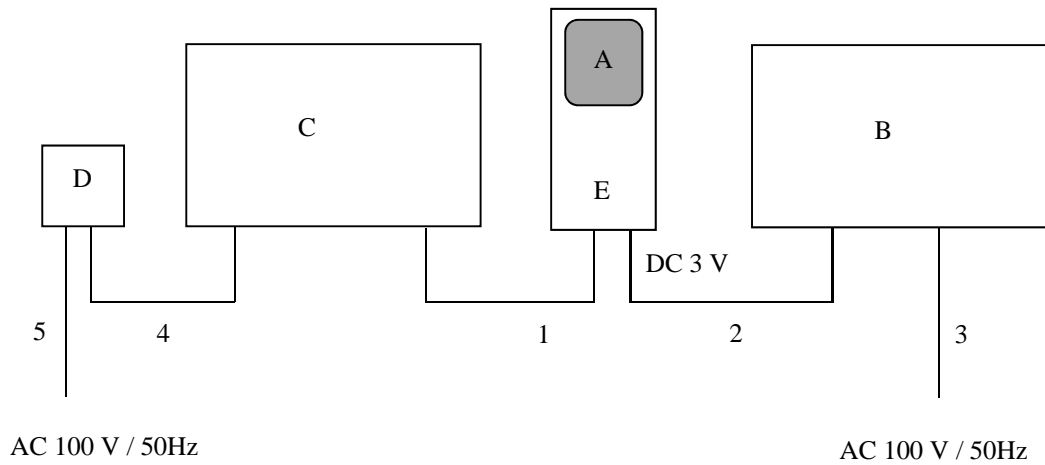
Test item	Operating mode	Tested frequency
RF output power, Power Spectral Density	BT LE (1Mbps) Tx	2402 MHz
	BT LE (2Mbps) Tx	2440 MHz
		2480 MHz
	ANT Tx	2402 MHz
	Nordic Original Tx	2441 MHz
		2480 MHz
Occupied channel bandwidth, Transmitter unwanted emissions in the out-of-band domain	BT LE (1Mbps) Tx	2402 MHz
	BT LE (2Mbps) Tx	2480 MHz
	ANT Tx	
	Nordic Original Tx	
Receiver blocking	ANT Rx	2402 MHz
	(Direct test mode)	2480 MHz

Extreme test condition	
Temperature	-40 deg. C to + 85 deg. C : operating temperature range of EUT
Voltage	Vnom: DC 3.0 V, Vmin: DC 1.7 V, Vmax: DC 3.6 V: operating voltage range of EUT



## 4.2 Configuration and peripherals

Except for Receiver blocking test



\* 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	Bluetooth Smart / ANT Module	EYSHSN	1	TAIYO YUDEN	EUT
B	DC Power Supply	GSV3000	1303141419	DIAMOND ANTENNA	-
C	PC	FMV-B8230	R7200268	FUJITSU	-
D	AC Adaptor	SEB55N2-16.0	08X01013A	FUJITSU	-
E	Evaluation Board	EBSHSNZWZ	1	TAIYO YUDEN	-

### List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	1.0	Shielded	Shielded	-
2	DC Cable	0.5 + 1.5	Unshielded	Unshielded	-
3	AC Cable	1.7	Unshielded	Unshielded	-
4	DC Cable	1.2	Unshielded	Unshielded	-
5	AC Cable	1.9	Unshielded	Unshielded	-

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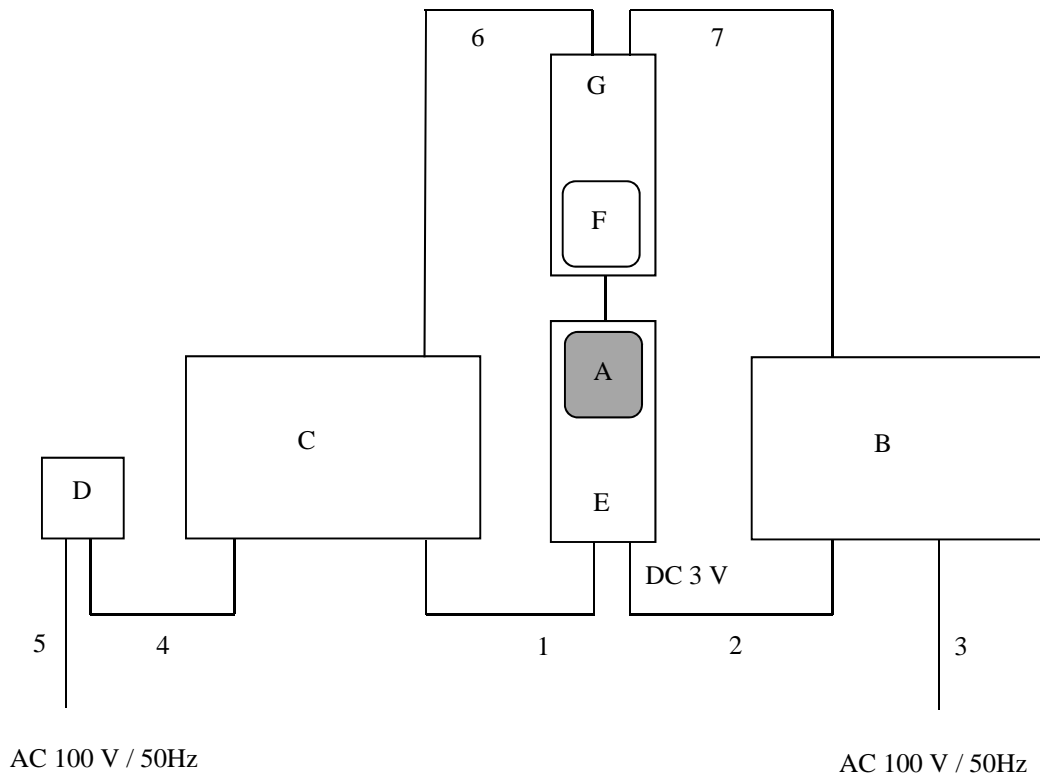
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# Receiver blocking test



\* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

## Description of EUTand Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Bluetooth Smart / ANT Module	EYSHSN	2	TAIYO YUDEN	EUT
B	DC Power Supply	PAL35-10	CE001899	KIKUSUI	-
C	PC	CF-T2	4CKSA46826	Panasonic	-
D	AC Adaptor	CF-AA1625A	1625AM406Z21913F	Panasonic	-
E	Evaluation Board	EBSHSNZWZ	2	TAIYO YUDEN	-
F	Bluetooth Smart / ANT Module	EYSHSN	3	TAIYO YUDEN	-
G	Evaluation Board	EBSHSNZWZ	3	TAIYO YUDEN	-

## List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	1.0	Shielded	Shielded	-
2	DC Cable	0.5	Unshielded	Unshielded	-
3	AC Cable	1.7	Unshielded	Unshielded	-
4	DC Cable	1.2	Unshielded	Unshielded	-
5	AC Cable	0.8	Unshielded	Unshielded	-
6	USB Cable	2.0	Shielded	Shielded	-
7	DC Cable	0.5 + 1.5	Unshielded	Unshielded	-

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## **SECTION 5: Antenna Terminal Conducted Tests**

### **Test Procedure**

The tests were made with below setting connected to the antenna port.

<b>Test</b>	<b>Instrument used</b>	<b>Remark</b>
RF Output Power	Power Meter	Normal and Extreme conditions
Power Spectral Density	Spectrum Analyzer	Normal condition
Occupied Channel Bandwidth	Spectrum Analyzer	Normal condition
Transmitter unwanted emissions in the out-of band domain	Spectrum Analyzer	Normal conditions  - Detector mode: RMS - Trace: Max Hold - Band power was used on behalf of the time domain power function. - Filter mode: Gaussian Filter Since the data in this test report has enough margin
Receiver Blocking	Spectrum Analyzer	Normal condition

The test results are rounded off to two decimals place, so some differences might be observed.  
The equipment and cables were not used for factor 0.0 dB of the data sheets.

**Test data** : APPENDIX  
**Test result** : Pass

## APPENDIX 1: Test data

### RF Output Power

Test place Kashima EMC Lab. No.2 Measurement Room  
Report No. 11818213M  
Date June 21, 2017  
Temperature / Humidity 24 deg. C / 51 % RH  
Engineer Kazuhiro Ando  
Mode Tx

BT LE 1Mbps

Test Condition		Freq.	P/M (AV)	Cable	Atten.	Antenna	Result	Limit	Margin
Temp.	Volt.	[MHz]	Reading [dBm]	Loss [dB]	Loss [dB]	Gain [dBi]	[dBm]	[dBm]	[dB]
nom	nom	2402.0	-7.95	1.06	10.04	-3.70	-0.55	20.00	20.55
		2440.0	-7.85	1.07	10.04	-3.70	-0.44	20.00	20.44
		2480.0	-7.85	1.08	10.04	-3.70	-0.43	20.00	20.43
min	min	2402.0	-7.10	1.06	10.04	-3.70	0.30	20.00	19.70
		2440.0	-6.95	1.07	10.04	-3.70	0.46	20.00	19.54
		2480.0	-6.93	1.08	10.04	-3.70	0.49	20.00	19.51
min	max	2402.0	-6.90	1.06	10.04	-3.70	0.50	20.00	19.50
		2440.0	-6.76	1.07	10.04	-3.70	0.65	20.00	19.35
		2480.0	-6.74	1.08	10.04	-3.70	0.68	20.00	19.32
max	min	2402.0	-9.40	1.06	10.04	-3.70	-2.00	20.00	22.00
		2440.0	-9.37	1.07	10.04	-3.70	-1.96	20.00	21.96
		2480.0	-9.41	1.08	10.04	-3.70	-1.99	20.00	21.99
max	max	2402.0	-9.11	1.06	10.04	-3.70	-1.71	20.00	21.71
		2440.0	-9.06	1.07	10.04	-3.70	-1.65	20.00	21.65
		2480.0	-9.09	1.08	10.04	-3.70	-1.67	20.00	21.67

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss + Antenna Gain

BT LE 2Mbps

Test Condition		Freq.	P/M (AV)	Cable	Atten.	Antenna	Result	Limit	Margin
Temp.	Volt.	[MHz]	Reading [dBm]	Loss [dB]	Loss [dB]	Gain [dBi]	[dBm]	[dBm]	[dB]
nom	nom	2402.0	-7.95	1.06	10.04	-3.70	-0.55	20.00	20.55
		2440.0	-7.85	1.07	10.04	-3.70	-0.44	20.00	20.44
		2480.0	-7.86	1.08	10.04	-3.70	-0.44	20.00	20.44
min	min	2402.0	-7.10	1.06	10.04	-3.70	0.30	20.00	19.70
		2440.0	-6.95	1.07	10.04	-3.70	0.46	20.00	19.54
		2480.0	-6.93	1.08	10.04	-3.70	0.49	20.00	19.51
min	max	2402.0	-6.90	1.06	10.04	-3.70	0.50	20.00	19.50
		2440.0	-6.76	1.07	10.04	-3.70	0.65	20.00	19.35
		2480.0	-6.75	1.08	10.04	-3.70	0.67	20.00	19.33
max	min	2402.0	-9.39	1.06	10.04	-3.70	-1.99	20.00	21.99
		2440.0	-9.36	1.07	10.04	-3.70	-1.95	20.00	21.95
		2480.0	-9.41	1.08	10.04	-3.70	-1.99	20.00	21.99
max	max	2402.0	-9.10	1.06	10.04	-3.70	-1.70	20.00	21.70
		2440.0	-9.06	1.07	10.04	-3.70	-1.65	20.00	21.65
		2480.0	-9.10	1.08	10.04	-3.70	-1.68	20.00	21.68

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss + Antenna Gain

## RF Output Power

Test place Kashima EMC Lab. No.2 Measurement Room  
Report No. 11818213M  
Date June 21, 2017  
Temperature / Humidity 24 deg. C / 51 % RH  
Engineer Kazuhiro Ando  
Mode Tx

ANT

Test Condition		Freq.	P/M (AV)	Cable	Atten.	Antenna	Result	Limit	Margin
Temp.	Volt.	[MHz]	Reading [dBm]	Loss [dB]	Loss [dB]	Gain [dBi]	[dBm]	[dBm]	[dB]
nom	nom	2402.0	-7.95	1.06	10.04	-3.70	-0.55	20.00	20.55
		2441.0	-7.85	1.07	10.04	-3.70	-0.44	20.00	20.44
		2480.0	-7.86	1.08	10.04	-3.70	-0.44	20.00	20.44
min	min	2402.0	-7.10	1.06	10.04	-3.70	0.30	20.00	19.70
		2441.0	-6.95	1.07	10.04	-3.70	0.46	20.00	19.54
		2480.0	-6.93	1.08	10.04	-3.70	0.49	20.00	19.51
min	max	2402.0	-6.90	1.06	10.04	-3.70	0.50	20.00	19.50
		2441.0	-6.76	1.07	10.04	-3.70	0.65	20.00	19.35
		2480.0	-6.74	1.08	10.04	-3.70	0.68	20.00	19.32
max	min	2402.0	-9.40	1.06	10.04	-3.70	-2.00	20.00	22.00
		2441.0	-9.37	1.07	10.04	-3.70	-1.96	20.00	21.96
		2480.0	-9.41	1.08	10.04	-3.70	-1.99	20.00	21.99
max	max	2402.0	-9.11	1.06	10.04	-3.70	-1.71	20.00	21.71
		2441.0	-9.06	1.07	10.04	-3.70	-1.65	20.00	21.65
		2480.0	-9.10	1.08	10.04	-3.70	-1.68	20.00	21.68

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss + Antenna Gain

Nordic original

Test Condition		Freq.	P/M (AV)	Cable	Atten.	Antenna	Result	Limit	Margin
Temp.	Volt.	[MHz]	Reading [dBm]	Loss [dB]	Loss [dB]	Gain [dBi]	[dBm]	[dBm]	[dB]
nom	nom	2402.0	-7.95	1.06	10.04	-3.70	-0.55	20.00	20.55
		2441.0	-7.85	1.07	10.04	-3.70	-0.44	20.00	20.44
		2480.0	-7.86	1.08	10.04	-3.70	-0.44	20.00	20.44
min	min	2402.0	-7.10	1.06	10.04	-3.70	0.30	20.00	19.70
		2441.0	-6.95	1.07	10.04	-3.70	0.46	20.00	19.54
		2480.0	-6.93	1.08	10.04	-3.70	0.49	20.00	19.51
min	max	2402.0	-6.90	1.06	10.04	-3.70	0.50	20.00	19.50
		2441.0	-6.76	1.07	10.04	-3.70	0.65	20.00	19.35
		2480.0	-6.75	1.08	10.04	-3.70	0.67	20.00	19.33
max	min	2402.0	-9.40	1.06	10.04	-3.70	-2.00	20.00	22.00
		2441.0	-9.36	1.07	10.04	-3.70	-1.95	20.00	21.95
		2480.0	-9.41	1.08	10.04	-3.70	-1.99	20.00	21.99
max	max	2402.0	-9.10	1.06	10.04	-3.70	-1.70	20.00	21.70
		2441.0	-9.05	1.07	10.04	-3.70	-1.64	20.00	21.64
		2480.0	-9.10	1.08	10.04	-3.70	-1.68	20.00	21.68

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss + Antenna Gain

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## Power Spectral Density

Test place Kashima EMC Lab. No.2 Measurement Room  
Report No. 11818213M  
Date June 20, 2017  
Temperature / Humidity 24 deg. C / 45 % RH  
Engineer Kazuhiro Ando  
Mode Tx

### BT LE 1Mbps

Test Condition Temp.	Volt.	Ch Freq.	S/A Maximum Reading	S/A Total Power Reading	RF Output Power	Result	Limit	Margin
		[MHz]	[dBm/MHz]	[dBm]	[dBm]	[dBm/MHz]	[dBm/MHz]	[dB]
nom	nom	2402.00	-7.58	-7.50	-0.55	-0.62	10.00	10.62
		2440.00	-7.49	-7.41	-0.44	-0.52	10.00	10.52
		2480.00	-7.48	-7.40	-0.43	-0.51	10.00	10.51

Result [dBm/MHz] = S/A Maximum Reading [dBm/MHz] - S/A Total Power Reading [dBm] (\*1) + RF Output Power [dBm] (\*2)

(\*1) Integrated value of 2400 MHz to 2483.5 MHz

(\*2) Refer to RF Output Power

### BT LE 1Mbps

Test Condition Temp.	Volt.	Ch Freq.	S/A Maximum Reading	S/A Total Power Reading	RF Output Power	Result	Limit	Margin
		[MHz]	[dBm/MHz]	[dBm]	[dBm]	[dBm/MHz]	[dBm/MHz]	[dB]
nom	nom	2402.00	-9.00	-7.82	-0.55	-1.74	10.00	11.74
		2440.00	-8.96	-7.73	-0.44	-1.67	10.00	11.67
		2480.00	-8.92	-7.71	-0.44	-1.65	10.00	11.65

Result [dBm/MHz] = S/A Maximum Reading [dBm/MHz] - S/A Total Power Reading [dBm] (\*1) + RF Output Power [dBm] (\*2)

(\*1) Integrated value of 2400 MHz to 2483.5 MHz

(\*2) Refer to RF Output Power

### ANT

Test Condition Temp.	Volt.	Ch Freq.	S/A Maximum Reading	S/A Total Power Reading	RF Output Power	Result	Limit	Margin
		[MHz]	[dBm/MHz]	[dBm]	[dBm]	[dBm/MHz]	[dBm/MHz]	[dB]
nom	nom	2402.00	-7.55	-7.52	-0.55	-0.57	10.00	10.57
		2441.00	-7.37	-7.34	-0.44	-0.46	10.00	10.46
		2480.00	-7.43	-7.41	-0.44	-0.46	10.00	10.46

Result [dBm/MHz] = S/A Maximum Reading [dBm/MHz] - S/A Total Power Reading [dBm] (\*1) + RF Output Power [dBm] (\*2)

(\*1) Integrated value of 2400 MHz to 2483.5 MHz

(\*2) Refer to RF Output Power

### Nordic original

Test Condition Temp.	Volt.	Ch Freq.	S/A Maximum Reading	S/A Total Power Reading	RF Output Power	Result	Limit	Margin
		[MHz]	[dBm/MHz]	[dBm]	[dBm]	[dBm/MHz]	[dBm/MHz]	[dB]
nom	nom	2402.00	-8.18	-7.81	-0.55	-0.92	10.00	10.92
		2441.00	-8.08	-7.69	-0.44	-0.84	10.00	10.84
		2480.00	-8.17	-7.77	-0.44	-0.84	10.00	10.84

Result [dBm/MHz] = S/A Maximum Reading [dBm/MHz] - S/A Total Power Reading [dBm] (\*1) + RF Output Power [dBm] (\*2)

(\*1) Integrated value of 2400 MHz to 2483.5 MHz

(\*2) Refer to RF Output Power

**UL Japan, Inc.**

**Kashima EMC Lab.**

1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

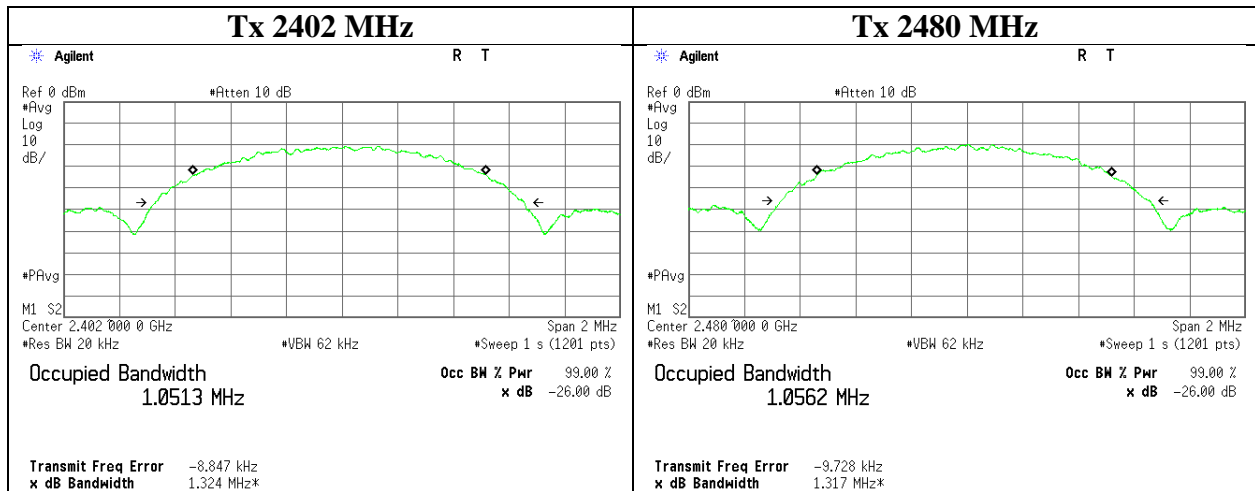
Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

## Occupied Channel Bandwidth

Test place	Kashima EMC Lab. No.2 Measurement Room
Report No.	11818213M
Date	June 20, 2017
Temperature / Humidity	24 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE 1Mbps

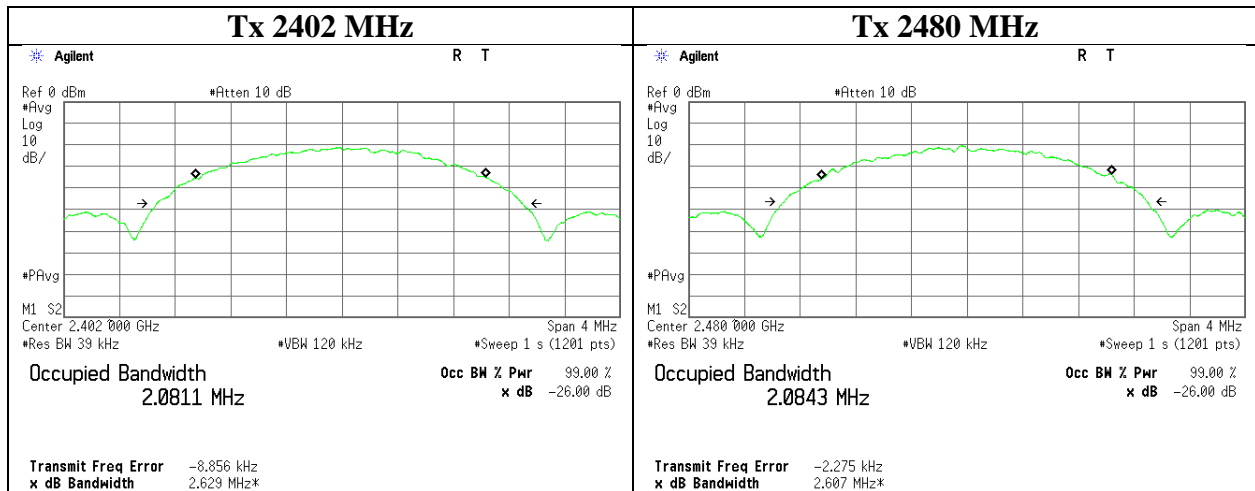
Frequency [MHz]	Bandwidth [MHz]	Result [MHz]	Limit [MHz]
2402	1.051	2401.4745	> 2400
2480	1.056	2480.5280	< 2483.5



## Occupied Channel Bandwidth

Test place	Kashima EMC Lab. No.2 Measurement Room
Report No.	11818213M
Date	June 20, 2017
Temperature / Humidity	24 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx BT LE 2Mbps

Frequency [MHz]	Bandwidth [MHz]	Result [MHz]	Limit [MHz]
2402	2.081	2400.9595	> 2400
2480	2.084	2481.0420	< 2483.5

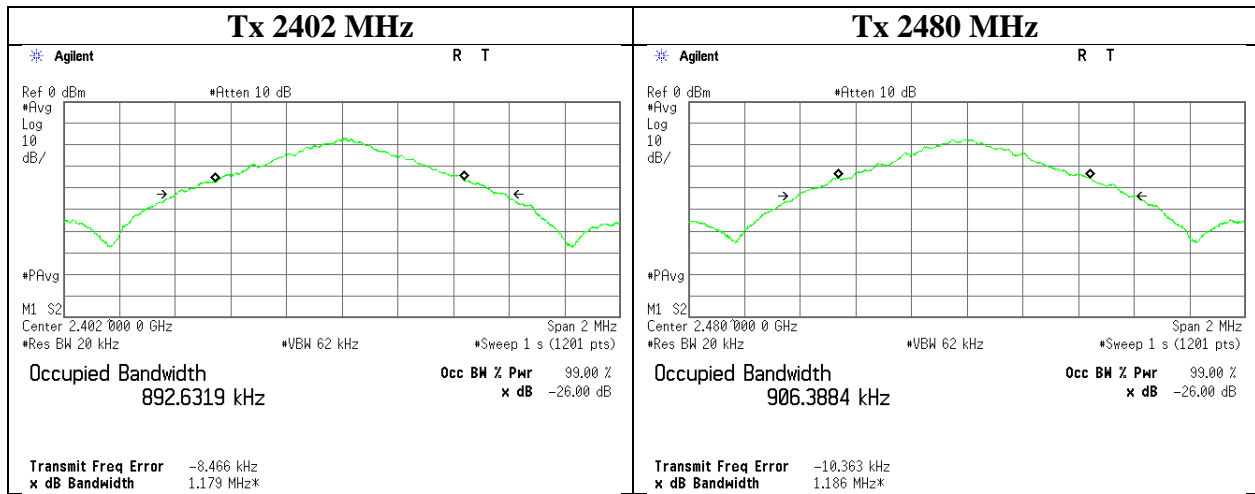




## Occupied Channel Bandwidth

Test place	Kashima EMC Lab. No.2 Measurement Room
Report No.	11818213M
Date	June 20, 2017
Temperature / Humidity	24 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx ANT

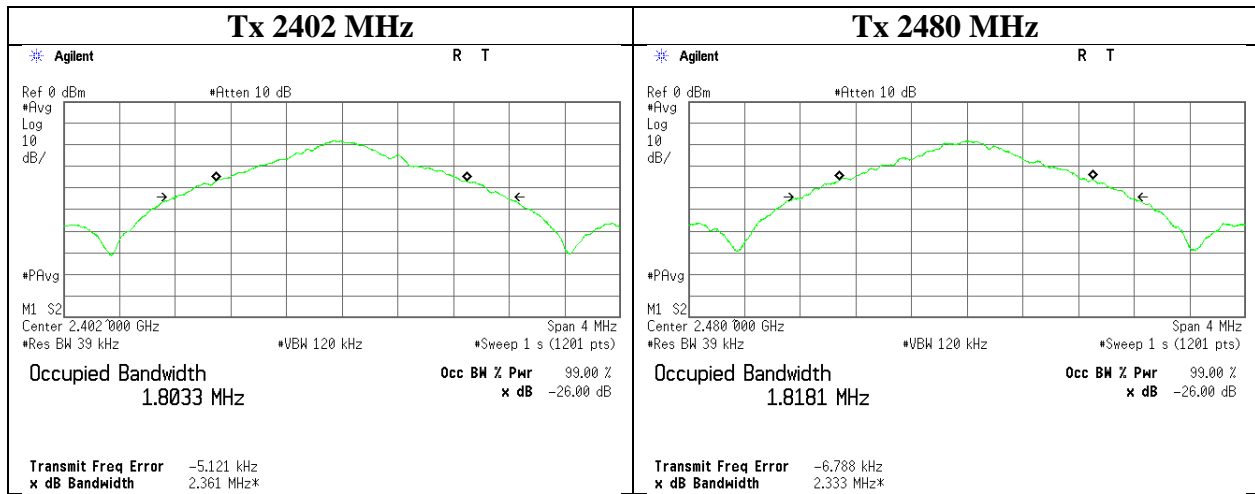
Frequency [MHz]	Bandwidth [MHz]	Result [MHz]	Limit [MHz]
2402	0.893	2401.5535	> 2400
2480	0.906	2480.4530	< 2483.5



## Occupied Channel Bandwidth

Test place	Kashima EMC Lab. No.2 Measurement Room
Report No.	11818213M
Date	June 20, 2017
Temperature / Humidity	24 deg. C / 45 % RH
Engineer	Kazuhiro Ando
Mode	Tx Nordic original

Frequency [MHz]	Bandwidth [MHz]	Result [MHz]	Limit [MHz]
2402	1.803	2401.0985	> 2400
2480	1.818	2480.9090	< 2483.5



## Transmitter unwanted emissions in the out-of-band domain

Test place Kashima EMC Lab. No.2 Measurement Room  
Report No. 11818213M  
Date June 20, 2017  
Temperature / Humidity 24 deg. C / 45 % RH  
Engineer Kazuhiro Ando  
Mode Tx

### BT LE 1Mbps

Frequency [MHz]	S/A (AV) Reading [dBm/MHz]	Cable Loss [dB]	Atten. Loss [dB]	Antenna Gain [dBi]	Result [dBm/MHz]	Limit [dBm/MHz]	Margin [dB]	Remarks
2398.4	-63.15	1.06	10.04	-3.70	-55.75	-20.00	35.75	Lowest ch 2400 MHz - 2 BW
2399.5	-58.85	1.06	10.04	-3.70	-51.45	-10.00	41.45	Lowest ch 2400 MHz - BW
2484.0	-63.45	1.08	10.04	-3.70	-56.03	-10.00	46.03	Highest ch 2483.5 MHz + BW
2485.1	-64.85	1.08	10.04	-3.70	-57.43	-20.00	37.43	Highest ch 2483.5 MHz + 2 BW

### BT LE 2Mbps

Frequency [MHz]	S/A (AV) Reading [dBm/MHz]	Cable Loss [dB]	Atten. Loss [dB]	Antenna Gain [dBi]	Result [dBm/MHz]	Limit [dBm/MHz]	Margin [dB]	Remarks
2397.4	-61.34	1.06	10.04	-3.70	-53.94	-20.00	33.94	Lowest ch 2400 MHz - 2 BW
2399.5	-43.70	1.06	10.04	-3.70	-36.30	-10.00	26.30	Lowest ch 2400 MHz - BW
2484.0	-58.73	1.08	10.04	-3.70	-51.31	-10.00	41.31	Highest ch 2483.5 MHz + BW
2487.2	-56.04	1.08	10.04	-3.70	-48.62	-20.00	28.62	Highest ch 2483.5 MHz + 2 BW

### ANT

Frequency [MHz]	S/A (AV) Reading [dBm/MHz]	Cable Loss [dB]	Atten. Loss [dB]	Antenna Gain [dBi]	Result [dBm/MHz]	Limit [dBm/MHz]	Margin [dB]	Remarks
2398.5	-63.06	1.06	10.04	-3.70	-55.66	-20.00	35.66	Lowest ch 2400 MHz - 2 BW
2399.5	-59.42	1.06	10.04	-3.70	-52.02	-10.00	42.02	Lowest ch 2400 MHz - BW
2484.0	-63.52	1.08	10.04	-3.70	-56.10	-10.00	46.10	Highest ch 2483.5 MHz + BW
2485.0	-64.70	1.08	10.04	-3.70	-57.28	-20.00	37.28	Highest ch 2483.5 MHz + 2 BW

### Nordic original

Frequency [MHz]	S/A (AV) Reading [dBm/MHz]	Cable Loss [dB]	Atten. Loss [dB]	Antenna Gain [dBi]	Result [dBm/MHz]	Limit [dBm/MHz]	Margin [dB]	Remarks
2397.7	-61.31	1.06	10.04	-3.70	-53.91	-20.00	33.91	Lowest ch 2400 MHz - 2 BW
2399.5	-48.38	1.06	10.04	-3.70	-40.98	-10.00	30.98	Lowest ch 2400 MHz - BW
2484.0	-59.26	1.08	10.04	-3.70	-51.84	-10.00	41.84	Highest ch 2483.5 MHz + BW
2486.6	-61.18	1.08	10.04	-3.70	-53.76	-20.00	33.76	Highest ch 2483.5 MHz + 2 BW

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss + Antenna Gain

\*Above test result was maximum value on each 1 BW.

## Receiver Blocking

Report No. 11818213M  
Test place Kashima EMC Lab. No.2 Measurement Room (Shielded Room)  
Date June 19, 2017  
Temperature / Humidity 24 deg. C / 40 % RH  
Engineer Kazuhiro Ando  
Mode ANT

Wanted signal mean power from companion device (dBm)	Measured Receiver Sensitivity (corrected by the actual antenna assembly gain) (dBm)	
	Lowest Channel	Highest Channel
P <sub>min</sub>	-91.05	-94.05
P <sub>min</sub> + 6 dB	-85.05	-88.05

Receiver Category 2 equipment

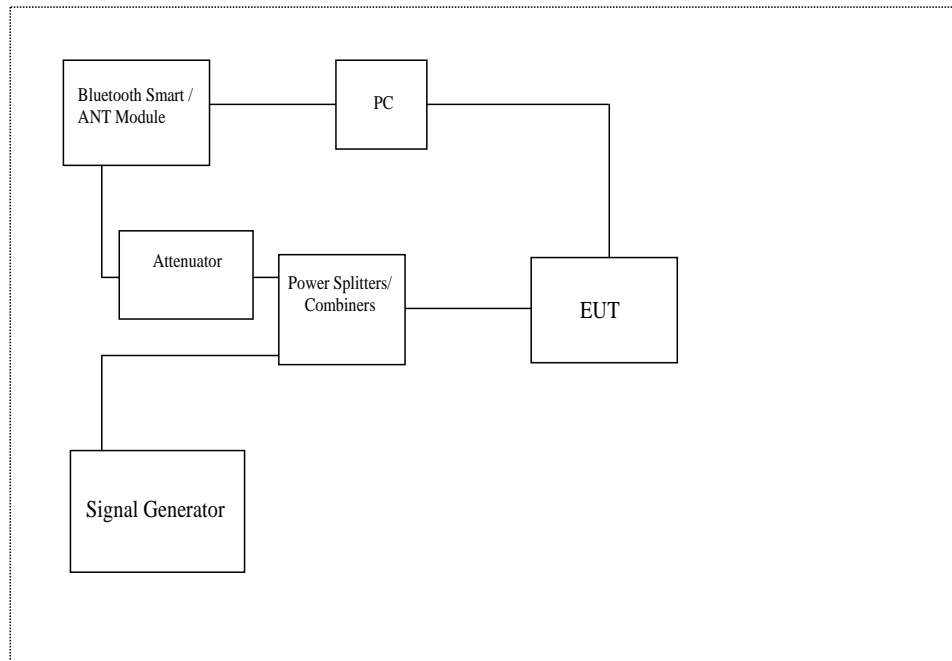
Operating Channel	Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)	Blocking signal power (corrected by the actual)	Result PER (%)	Limit PER (%)
Lowest Channel	P <sub>min</sub> + 6 dB	2380	-57	-57	0.0	≤ 10
		2503.5			0.0	
	P <sub>min</sub> + 6 dB	2300	-47	-47	0.0	
		2583.5			0.0	
Highest Channel	P <sub>min</sub> + 6 dB	2380	-57	-57	0.0	≤ 10
		2503.5			0.0	
	P <sub>min</sub> + 6 dB	2300	-47	-47	0.0	
		2583.5			0.0	

\*P<sub>min</sub> is the minimum level of wanted signal (in dBm) required to meet the minimum performance criterion a PER less than or equal to 10 % in the absence of any blocking signal.

\*The test was performed Blocking signal power levels corrected by the actual antenna assembly gain.

\*1) Blocking signal power was adjusted by assumed antenna gain 0.0 dBi since it was more severe condition.

## **CONDUCTED METHODS SYSTEM BLOCK DIAGRAM of Receiver Blocking**



## **APPENDIX 2: Test instruments**

### **Test Equipment**

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
CSA-07	Spectrum Analyzer	Agilent	E4448A	MY52490024 Version A.11.21	AT	2017/05/31 * 12
CAT10-17	10dB Fixed Atten.	Weinschel	54A-10	56251	AT	2017/05/19 * 12
CCC-W01	Micro Wave Cable	SUHNER	SUCOFLEX102	MY3662/2	AT	2017/05/19 * 12
CCH-04	Temperature and Humidity Chamber	ESPEC	PL-1J	15004059	AT	2016/06/30 * 12
CPM-16	Peak Power Analyzer	Agilent	8990B	MY51000276	AT	2017/06/09 * 12
CPSO-24	Power Sensor	Agilent	N1923A	MY54070024	AT	2017/06/09 * 12
COS-05	Temperature & Humidity Indicator	A&D	AD-5681	6975761	AT	2016/07/21 * 12
CTS-18	Digital Multimeter	FLUKE	87-3	85220051	AT	2016/09/26 * 12
CSG-11	Signal Generator	Agilent	N5173B	MY53270188 Version B.01.50	AT	2017/05/29 * 12
CAT20-04	20dB Fixed Atten.	Weinschel	54A-20	41994	AT	2017/05/19 * 12
CATS-07	Step Attenuator	Agilent	8495B	MY41110308	AT	2016/09/23 * 12
CATS-08	Step Attenuator	Agilent	8494B	2550A11724	AT	2016/09/23 * 12
CPSC-02	Power Splitters /Combiners	Mini-Circuits	ZFSC-2-10G+	-	AT	2017/06/13 * 12
CCC-G01	Micro Wave Cable	SUHNER	SUCOFLEX104	144691/4	AT	2016/06/07 * 12
CCC-W07	Micro Wave Cable	Junkosha	MWX221	MRA-12-14-14 8	AT	2017/05/19 * 12
CCC-W14	Micro Wave Cable	Suhner	SUCOFLEX104PE	36186	AT	Pre Check

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:**

**AT: Antenna Terminal Conducted test**

**UL Japan, Inc.**

**Kashima EMC Lab.**

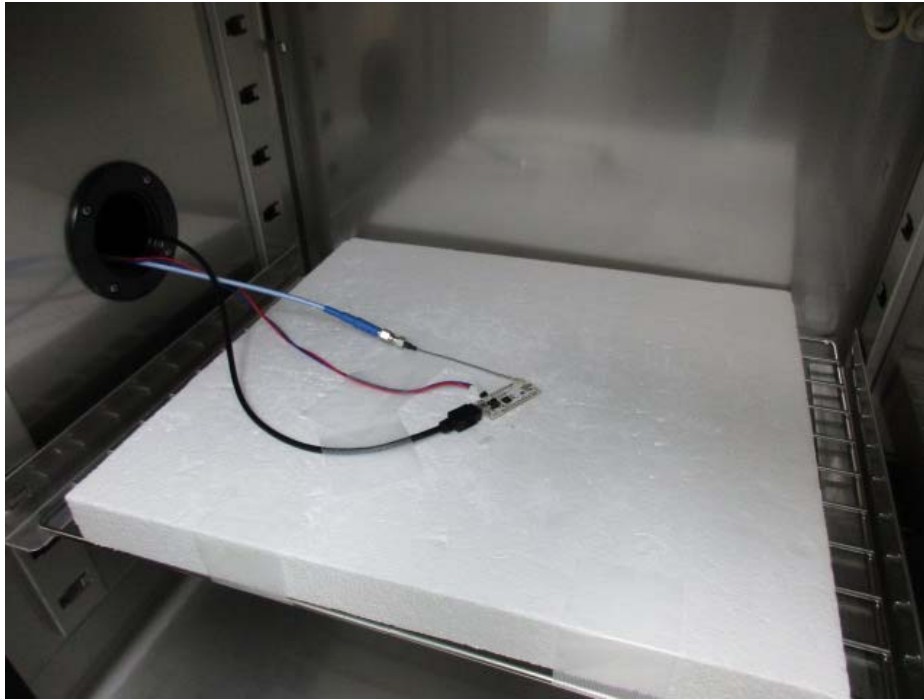
1614, Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan

Telephone : +81 478 88 6500

Facsimile : +81 478 82 3373

### **APPENDIX 3: Photographs of test setup**

#### **Antenna terminal conducted tests**



**Photo 1**

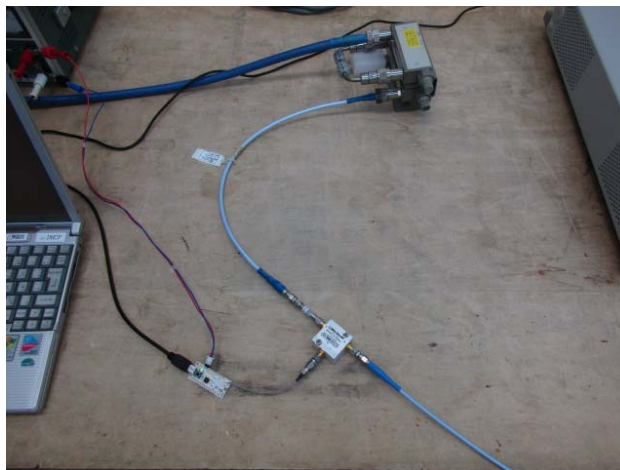
### **Receiver Blocking**



**Photo 1**



**Photo 2**



**Photo 3**

**End of Report**