RADIO TEST REPORT

Test Report No. : 10300014H-A-R1

Applicant	:	**Murata Manufacturing Co., Ltd.**
Type of Equipment	:	**Communication Module**
Model No.	:	**ZS**
FCC ID	:	**VPYLBZY**
Test regulation	:	**FCC Part 15 Subpart C: 2014**
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 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 report is a revised version of 10300014H-A. 10300014H-A is replaced with this report.

Date of test: April 22 to 26, 2014

Representative test engineer:
T. Nakagawa
Tomohisa Nakagawa
Engineer
Consumer Technology Division

Approved by:
Takayuki Shimada
Engineer
Consumer Technology Division

NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address, http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap

REVISION HISTORY

Original Test Report No.: 10300014H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10300014H-A	May 23, 2014	-	-
1	10300014H-A-R1	June 4, 2014	P13, 14	Correction of test engineer.
1	10300014H-A-R1	June 4, 2014	P4	Correction of voltage from “ZY: DC 2.3 to 3.3V” to “ZY: DC 2.2 to 3.3V”

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SECTION 1: Customer information

Company Name	:	Murata Manufacturing Co., Ltd.
Address	:	10-1, Higashikotari 1-chome Nagaokakyo-shi, Kyoto, 617-8555, Japan
Telephone Number	:	+81-75-955-6708
Facsimile Number	:	+81-75-955-6634
Contact Person	:	Yuichi Ito

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

2.1 Identification of E.U.T.

Type of Equipment	:	Communication Module
Model No.	:	ZS
Serial No.	:	Refer to Clause 4.2
Rating	:	DC 1.5V
Receipt Date of Sample	:	April 14, 2014
Country of Mass-production	:	Japan and China
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

General Specification

Clock frequency(ies) in the system	:	16MHz

Radio Specification

[Bluetooth (Ver. 4.0)]

Radio Type	:	Transceiver
Frequency of Operation	:	2402-2480MHz
Modulation	:	GFSK
Power Supply (inner)	:	DC 1.41V
Antenna type	:	Monopole antenna
Antenna Gain	:	-0.6dBi

Variant model

ZS has valiant model: ZY.
The difference between these models are shown below;

- ZS: DC 0.9 to 3.3V
- ZY: DC 2.2 to 3.3V

They have their own regulator and they are constantly provided voltage (DC 1.41V) through the regulator regardless of input voltage. So the test in this report was performed only with Model number: ZS as a representative.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C: 2014, final revised on May 1, 2014 and effective June 2, 2014
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

* The revision on May 1, 2014 does not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.4:2003 7. AC powerline Conducted Emission measurements	**FCC:** Section 15.207	**QP** 25.0dB, 0.15697MHz, N/L **AV** 18.2dB, 24.93722MHz, N	Complied	-
	IC: RSS-Gen 7.2.4	**IC:** RSS-Gen 7.2.4			
6dB Bandwidth	**FCC:** "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)"	**FCC:** Section 15.247(a)(2)	See data.	Complied	Conducted
	IC: RSS-Gen 4.6.2	**IC:** RSS-210 A8.2(a)			
Maximum Peak Output Power	**FCC:** "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)"	**FCC:** Section 15.247(b)(3)		Complied	Conducted
	IC: RSS-Gen 4.8	**IC:** RSS-210 A8.4(4)			
Power Density	**FCC:** "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)"	**FCC:** Section 15.247 (e)		Complied	Conducted
	IC: -	**IC:** RSS-210 A8.2(b)			
Spurious Emission Restricted Band Edges	**FCC:** "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)"	**FCC:** Section15.247(d)	6.6dB 9920.000MHz AV, Horizontal	Complied	Conducted/ Radiated
	IC: RSS-Gen 4.9	**IC:** RSS-210 A8.5 RSS-Gen 7.2.3			
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.					

* In case any questions arise about test procedure, ANSI C63.4: 2003 is also referred.

FCC 15.31 (e)
The RF Module has its own regulator.
The RF Module is constantly provided voltage (DC 1.41V) through the regulator regardless of input voltage.
Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement
It is impossible for end users to replace the antenna, because it is embedded in the circuit board. Therefore, the equipment complies with the antenna requirement of Section 15.203/212.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	**IC:** RSS-Gen 4.6.1	**IC:** RSS-Gen 4.6.1	N/A	-	Conducted

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 room (semi-anechoic chamber)	**Conducted emission (±dB)**
	150kHz-30MHz
No.1	3.5dB
No.2	3.5dB
No.3	3.6dB
No.4	3.5dB

Test room (semi-anechoic chamber)	**Radiated emission**						
	(3m*)(±dB)				**(1m*)(±dB)**		**(0.5m*)(±dB)**
	9kHz -30MHz	30MHz -300MHz	300MHz -1GHz	1GHz -10GHz	10GHz -18GHz	18GHz -26.5GHz	26.5GHz -40GHz
No.1	4.0dB	5.1dB	5.0dB	5.1dB	6.0dB	4.9dB	4.3dB
No.2	3.9dB	5.2dB	5.0dB	4.9dB	5.9dB	4.7dB	4.2dB
No.3	4.3dB	5.1dB	5.2dB	5.2dB	6.0dB	4.8dB	4.2dB
No.4	4.6dB	5.2dB	5.0dB	5.2dB	6.0dB	5.7dB	4.2dB

*3m/1m/0.5m = Measurement distance

Power meter (±dB)	
Below 1GHz	Above 1GHz
0.7dB	1.5dB

Antenna terminal conducted emission and Power density (±dB)			**Antenna terminal conducted emission (±dB)**		**Channel power (±dB)**
Below 1GHz	1GHz-3GHz	3GHz-18GHz	18GHz-26.5GHz	26.5GHz-40GHz	
1.5dB	1.7dB	2.8dB	2.8dB	2.9dB	2.6dB

Conducted Emission test

The data listed in this test report has enough margin, more than the site margin.

Radiated emission test(3m)

The data listed in this test report has enough margin, more than the site margin.

3.5 Test Location

UL Japan, Inc. Ise HQ EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999 Facsimile : +81 596 24 8124

	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 Data of EMI, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

Bluetooth (BT): Transmitting (Tx), Payload: PRBS9

Mode	Remarks*
Bluetooth(BT) LE(Low Energy)	Maximum Packet Size, PN9
*EUT has the power settings by the software as follows; Power settings: Same as production model Software: Protest.exe Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

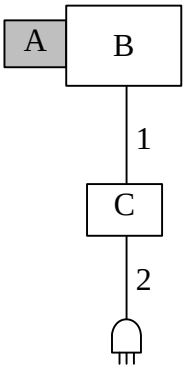
*Details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Conducted Emission 6dB Bandwidth Maximum Peak Output Power Spurious Emission (Radiated/Conducted) Power Density 99% Occupied Bandwidth	BT LE	2402MHz 2440MHz 2480MHz

*The tests were performed with the worst model (Model number: ZS) which had higher peak output power.

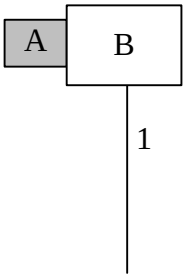
4.2 Configuration and peripherals

< Conducted Emission test>



AC 120V/60Hz

< Radiated Emission test >



DC3.0V

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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Communication Module	ZS	22	Murata Manufacturing Co., Ltd.	EUT
B	Mother board	P2ML2720	12	Murata Manufacturing Co., Ltd.	-
C	Power Supply	PW8-3ATP	0906754	KENWOOD	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.3 for CE* 2.8 for RE*	Unshielded	Unshielded	-
2	AC Cable	1.8	Unshielded	Unshielded	-

*CE: Conducted Emission test
RE: Radiated Emission test

SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0m by 1.5m, raised 0.8m above the conducting ground plane.
The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

1) For the tests on EUT with other peripherals (as a whole system)
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane. All unused 50ohm connectors of the LISN(AMN) were resistivity terminated in 50ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.
The EUT was connected to a LISN (AMN).
An overview sweep with peak detection has been performed.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Detector	**: QP and CISPR AV**
Measurement range	**: 0.15-30MHz**
Test data	**: APPENDIX**
Test result	**: Pass**

SECTION 6: Radiated Spurious Emission

Test Procedure
EUT was placed on a urethane platform of nominal size, 1.0m by 1.5m, raised 0.8m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.
The height of the measuring antenna varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
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 30MHz	30MHz to 300MHz	300MHz to 1GHz	Above 1GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

In any 100kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

20dBc was applied to the frequency over the limit of FCC 15.209 / Table 5 of RSS-Gen 7.2.5(IC) and outside the restricted band of FCC15.205 / Table 3 of RSS-Gen 7.2.2 (IC).

Frequency	Below 1GHz	Above 1GHz		20dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120kHz(T/R)	RBW: 1MHz VBW: 3MHz	Average Power Method: 12.2.5.1 RBW: 1MHz VBW: 3MHz Trace: Free Run Detector: Power Averaging (RMS)	RBW: 100kHz VBW: 300kHz (S/A)
Test Distance	3m	3m (below 10GHz), 1m *2) (above 10GHz)		3m (below 10GHz), 1m *2) (above 10GHz)

*1) Average Power Measurement was performed based on 6.0 & 12.2.5 of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (Issued on April 9, 2013)"
*2) Distance Factor: 20 x log (3.0m/1.0m) = 9.5dB

- 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 : 30M-26.5GHz
Test data : APPENDIX
Test result : Pass

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	3MHz	100kHz	300kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth	Enough width to display 20dB Bandwidth	1 to 3% of Span	Three times of RBW	Auto	Sample	Clear Write	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *1)	-	Power Meter (Sensor: 50MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3kHz	10kHz	Auto	Peak	Max Hold	Spectrum Analyzer *2)
Conducted Spurious Emission *3)	9kHz to 150kHz	200Hz	620Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1kHz	30kHz				

*1) Reference data
*2) Section 10.2 Method PKPSD (peak PSD) of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (Issued on April 9, 2013)".
*3) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.(9kHz-150kHz:RBW=200Hz, 150kHz-30MHz:RBW=9.1kHz)

The test results and limit are rounded off to two decimals place, so some differences might be observed.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Data of EMI test

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

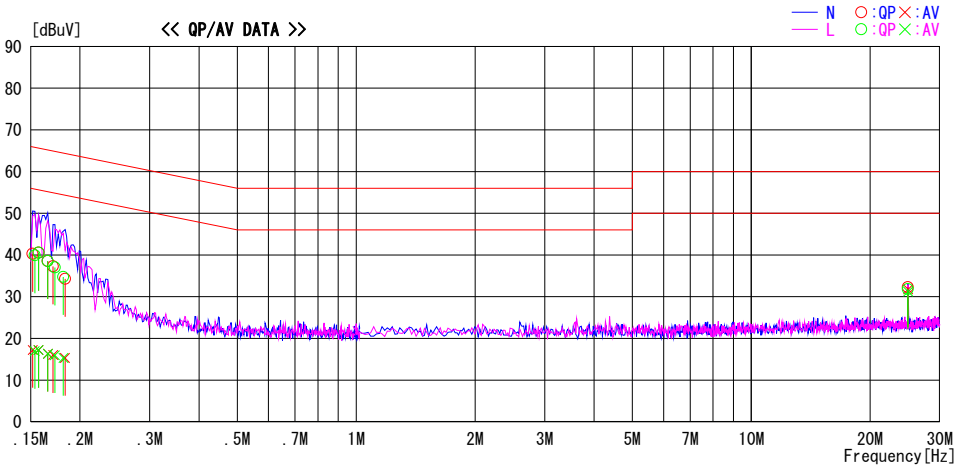
UL Japan, Inc. Ise HQ EMC Lab. No.4 Semi Anechoic Chamber
Date: 2014/04/26

Report No. : 10300014H

Temp./Humi. : 22deg. C / 48% RH
Engineer : Tomohisa Nakagawa

Mode / Remarks : LE Tx 2402MHz

LIMIT : FCC15.207 QP
FCC15.207 AV



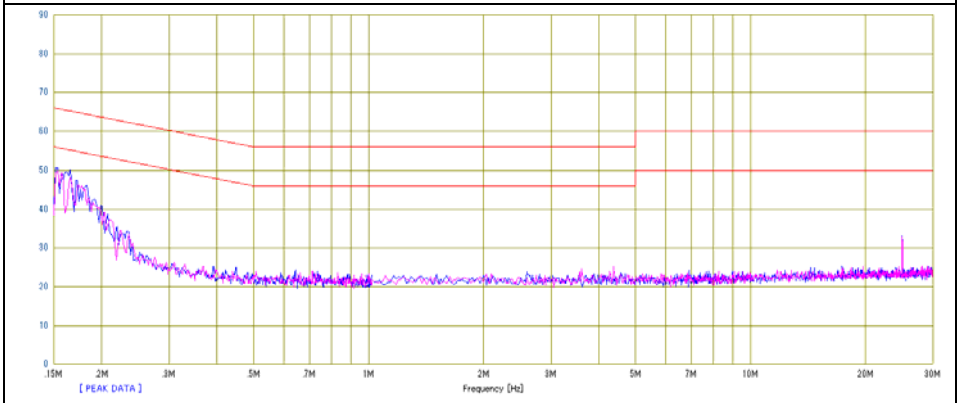
Frequency	Reading Level		Corr.	Results		Limit		Margin		Phase	Comment
	QP	AV	Factor	QP	AV	QP	AV	QP	AV		
[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
0.15174	27.0	4.0	13.3	40.3	17.3	65.9	55.9	25.6	38.6	N	
0.15697	27.3	4.0	13.3	40.6	17.3	65.6	55.6	25.0	38.3	N	
0.16569	25.3	3.1	13.3	38.6	16.4	65.2	55.2	26.6	38.8	N	
0.17092	24.0	2.7	13.3	37.3	16.0	64.9	54.9	27.6	38.9	N	
0.18313	21.0	2.0	13.3	34.3	15.3	64.3	54.3	30.0	39.0	N	
24.93722	17.4	16.9	14.9	32.3	31.8	60.0	50.0	27.7	18.2	N	
0.15349	26.6	3.7	13.3	39.9	17.0	65.8	55.8	25.9	38.8	L	
0.15697	27.3	4.0	13.3	40.6	17.3	65.6	55.6	25.0	38.3	L	
0.16569	25.3	3.1	13.3	38.6	16.4	65.2	55.2	26.6	38.8	L	
0.17267	23.7	2.7	13.3	37.0	16.0	64.8	54.8	27.8	38.8	L	
0.18138	21.4	2.0	13.3	34.7	15.3	64.4	54.4	29.7	39.1	L	
24.93722	16.9	16.4	14.9	31.8	31.3	60.0	50.0	28.2	18.7	L	

CHART:WITH FACTOR,Peak hold data. CALCULATION:RESULT[dBuV]=READING[dBuV]+C.F[dB](LISN+CABLE+ATTEN.)
Except for the above table : adequate margin data below the limits.

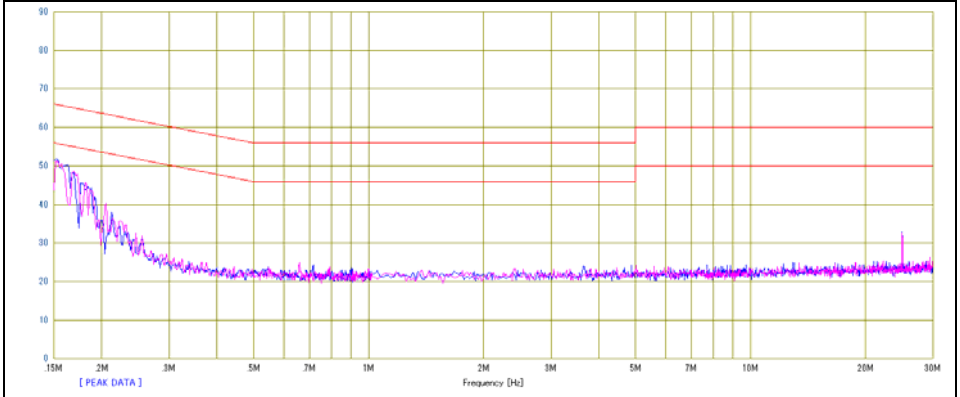
Conducted Emission

Test place	Ise HQ EMC Lab. No.4 Semi Anechoic Chamber
Report No.	10300021H
Date	04/26/2014
Temperature/ Humidity	22 deg.C / 48% RH
Engineer	Tomohisa Nakagawa
Mode	BT LE Tx

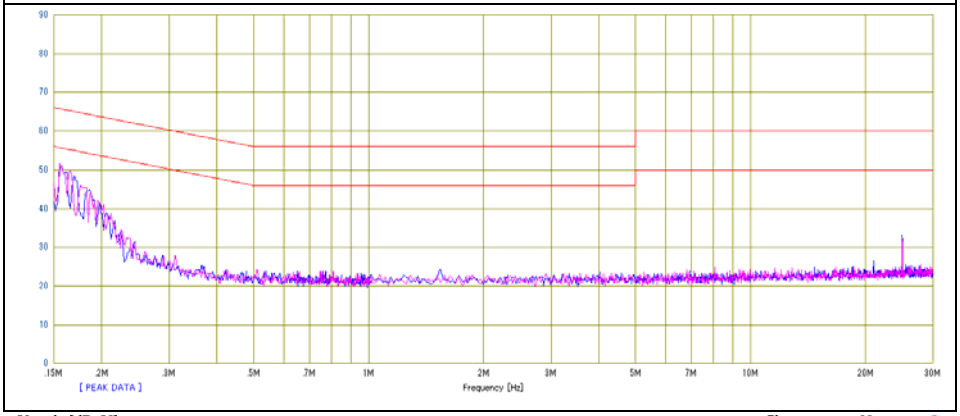
2402MHz



2440MHz



2480MHz



Y scale [dBuV] Chart — N — L

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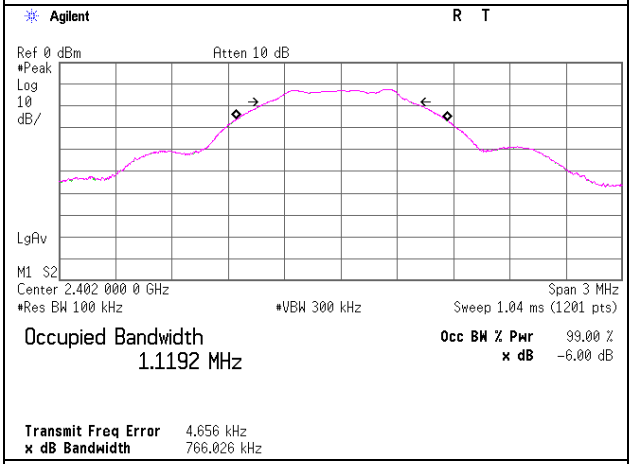
6dB Bandwidth

Test place	Ise HQ EMC Lab. No.11 Measurement Room
Report No.	10300014H
Date	04/23/2014
Temperature/ Humidity	25 deg.C / 30% RH
Engineer	Tomohisa Nakagawa
Mode	BT LE Tx

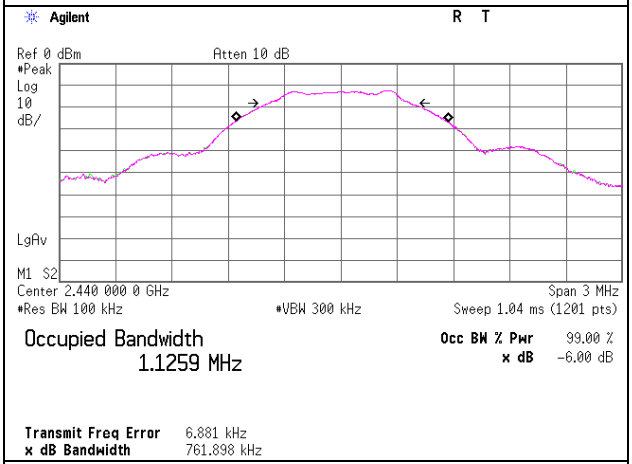
Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2402	0.7660	>500
2440	0.7619	>500
2480	0.7700	>500

6dB Bandwidth

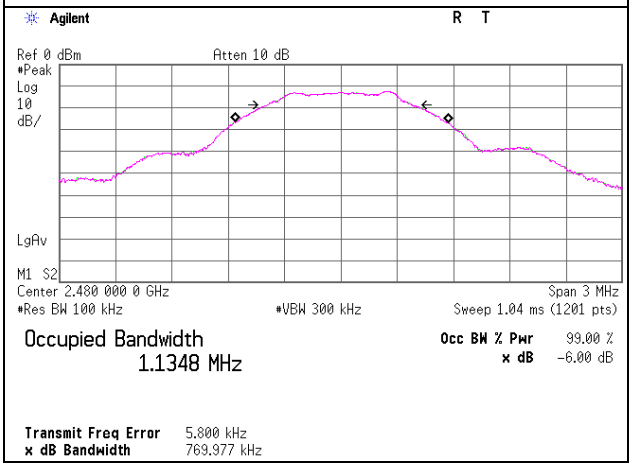
2402MHz



2440MHz



2480MHz



Maximum Peak Output Power

Test place	Ise HQ EMC Lab. No.11 Measurement Room
Report No.	10300014H
Date	04/23/2014
Temperature/ Humidity	25 deg.C / 30% RH
Engineer	Tomohisa Nakagawa
Mode	BT LE Tx

PK

Freq.	Reading	Cable Loss	Atten.	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-10.87	1.00	9.97	0.10	1.02	30.00	1000	29.90
2440	-10.92	1.00	9.97	0.05	1.01	30.00	1000	29.95
2480	-11.02	1.00	9.97	-0.05	0.99	30.00	1000	30.05

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

AV reference data

Freq.	Reading	Cable Loss	Atten.	Result	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]
2402	-11.11	1.00	9.97	-0.14	0.97
2440	-11.17	1.00	9.97	-0.20	0.95
2480	-11.30	1.00	9.97	-0.33	0.93

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

2440MHz

Model number	Reading	Remark
	[dBm]	
ZS	-10.92	*
ZY	-10.95	

*: Worst Rate
All comparizon were carried out on same frequency and measurement factors.

Radiated Spurious Emission

Test place	Ise HQ EMC Lab. No.3 and No.4 Semi Anechoic Chamber		
Report No.	10300014H		
Date	04/22/2014	04/23/2014	04/26/2014
Temperature/ Humidity	20 deg.C / 48% RH	20 deg.C / 48% RH	22 deg.C / 48% RH
Engineer	Hiroshi Kukita (1-10GHz)	Hiroshi Kukita (10-26.5GHz)	Satofumi Matsuyama (Below 1GHz)
Mode	BT LE Tx 2402MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	32.000	QP	23.4	17.0	7.1	32.1	15.4	40.0	24.6	
Hori	43.527	QP	23.2	13.1	7.3	32.1	11.5	40.0	28.5	
Hori	48.000	QP	23.0	11.6	7.4	32.1	9.9	40.0	30.1	
Hori	64.000	QP	23.4	7.4	7.6	32.1	6.3	40.0	33.7	
Hori	85.818	QP	23.3	7.6	7.9	32.1	6.7	40.0	33.3	
Hori	539.880	QP	23.2	19.6	11.4	32.1	22.1	46.0	23.9	
Hori	2390.000	PK	41.5	28.2	3.1	32.7	40.1	73.9	33.8	
Hori	4804.000	PK	44.3	30.5	5.3	31.8	48.3	73.9	25.6	
Hori	7206.000	PK	41.4	35.8	6.7	32.7	51.2	73.9	22.7	
Hori	9608.000	PK	41.4	39.0	7.3	33.3	54.4	73.9	19.5	
Hori	2390.000	AV	33.2	28.2	3.1	32.7	31.8	53.9	22.1	
Hori	4804.000	AV	38.2	30.5	5.3	31.8	42.2	53.9	11.7	
Hori	7206.000	AV	32.9	35.8	6.7	32.7	42.7	53.9	11.2	
Hori	9608.000	AV	33.3	39.0	7.3	33.3	46.3	53.9	7.6	
Vert	32.000	QP	23.3	17.0	7.1	32.1	15.3	40.0	24.7	
Vert	44.068	QP	24.5	12.9	7.3	32.1	12.6	40.0	27.4	
Vert	48.000	QP	23.4	11.6	7.4	32.1	10.3	40.0	29.7	
Vert	64.000	QP	23.2	7.4	7.6	32.1	6.1	40.0	33.9	
Vert	85.818	QP	23.4	7.6	7.9	32.1	6.8	40.0	33.2	
Vert	541.283	QP	23.3	19.6	11.4	32.1	22.2	46.0	23.8	
Vert	2390.000	PK	42.4	28.2	3.1	32.7	41.0	73.9	32.9	
Vert	4804.000	PK	41.9	30.5	5.3	31.8	45.9	73.9	28.0	
Vert	7206.000	PK	41.0	35.8	6.7	32.7	50.8	73.9	23.1	
Vert	9608.000	PK	42.0	39.0	7.3	33.3	55.0	73.9	18.9	
Vert	2390.000	AV	33.7	28.2	3.1	32.7	32.3	53.9	21.6	
Vert	4804.000	AV	31.4	30.5	5.3	31.8	35.4	53.9	18.5	
Vert	7206.000	AV	32.9	35.8	6.7	32.7	42.7	53.9	11.2	
Vert	9608.000	AV	33.0	39.0	7.3	33.3	46.0	53.9	7.9	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	95.0	28.2	3.1	32.7	93.6	-	-	Carrier
Hori	2400.000	PK	44.5	28.2	3.1	32.7	43.1	73.6	30.5	
Vert	2402.000	PK	91.8	28.2	3.1	32.7	90.4	-	-	Carrier
Vert	2400.000	PK	43.9	28.2	3.1	32.7	42.5	70.4	27.9	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amprifier)

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Facsimile : +81 596 24 8124

Radiated Spurious Emission

Test place	Ise HQ EMC Lab. No.3 and No.4 Semi Anechoic Chamber		
Report No.	10300014H		
Date	04/22/2014	04/23/2014	04/26/2014
Temperature/ Humidity	20 deg.C / 48% RH	20 deg.C / 48% RH	22 deg.C / 48% RH
Engineer	Hiroshi Kukita (1-10GHz)	Hiroshi Kukita (10-26.5GHz)	Satofumi Matsuyama (Below 1GHz)
Mode	BT LE Tx 2440MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	32.000	QP	23.5	17.0	7.1	32.1	15.5	40.0	24.5	
Hori	43.442	QP	23.1	13.1	7.3	32.1	11.4	40.0	28.6	
Hori	48.000	QP	23.2	11.6	7.4	32.1	10.1	40.0	29.9	
Hori	64.000	QP	23.6	7.4	7.6	32.1	6.5	40.0	33.5	
Hori	90.000	QP	23.8	8.3	8.0	32.1	8.0	43.5	35.5	
Hori	539.991	QP	23.1	19.6	11.4	32.1	22.0	46.0	24.0	
Hori	4880.000	PK	43.6	30.6	5.3	31.7	47.8	73.9	26.1	
Hori	7320.000	PK	42.0	36.0	6.8	32.7	52.1	73.9	21.8	
Hori	9760.000	PK	43.6	39.4	7.3	33.4	56.9	73.9	17.0	
Hori	4880.000	AV	36.8	30.6	5.3	31.7	41.0	53.9	12.9	
Hori	7320.000	AV	33.6	36.0	6.8	32.7	43.7	53.9	10.2	
Hori	9760.000	AV	33.9	39.4	7.3	33.4	47.2	53.9	6.7	
Vert	32.000	QP	23.4	17.0	7.1	32.1	15.4	40.0	24.6	
Vert	44.055	QP	24.4	12.9	7.3	32.1	12.5	40.0	27.5	
Vert	48.000	QP	23.3	11.6	7.4	32.1	10.2	40.0	29.8	
Vert	64.000	QP	23.4	7.4	7.6	32.1	6.3	40.0	33.7	
Vert	90.000	QP	23.9	8.3	8.0	32.1	8.1	43.5	35.4	
Vert	541.112	QP	23.3	19.6	11.4	32.1	22.2	46.0	23.8	
Vert	4880.000	PK	42.0	30.6	5.3	31.7	46.2	73.9	27.7	
Vert	7320.000	PK	42.2	36.0	6.8	32.7	52.3	73.9	21.6	
Vert	9760.000	PK	42.1	39.4	7.3	33.4	55.4	73.9	18.5	
Vert	4880.000	AV	32.3	30.6	5.3	31.7	36.5	53.9	17.4	
Vert	7320.000	AV	32.3	36.0	6.8	32.7	42.4	53.9	11.5	
Vert	9760.000	AV	33.8	39.4	7.3	33.4	47.1	53.9	6.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

Radiated Spurious Emission

Test place	Ise HQ EMC Lab. No.3 and No4 Semi Anechoic Chamber		
Report No.	10300014H		
Date	04/22/2014	04/23/2014	04/26/2014
Temperature/ Humidity	20 deg.C / 48% RH	20 deg.C / 48% RH	22 deg.C / 48% RH
Engineer	Hiroshi Kukita (1-10GHz)	Hiroshi Kukita (10-26.5GHz)	Satofumi Matsuyama (Below 1GHz)
Mode	BT LE Tx 2480MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	32.000	QP	23.2	17.0	7.1	32.1	15.2	40.0	24.8	
Hori	43.443	QP	23.3	13.1	7.3	32.1	11.6	40.0	28.4	
Hori	48.000	QP	23.1	11.6	7.4	32.1	10.0	40.0	30.0	
Hori	64.000	QP	23.5	7.4	7.6	32.1	6.4	40.0	33.6	
Hori	90.000	QP	23.5	8.3	8.0	32.1	7.7	43.5	35.8	
Hori	539.993	QP	23.2	19.6	11.4	32.1	22.1	46.0	23.9	
Hori	2483.500	PK	50.9	28.4	3.1	32.7	49.7	73.9	24.2	
Hori	4960.000	PK	44.7	30.7	5.4	31.7	49.1	73.9	24.8	
Hori	7440.000	PK	42.8	36.2	6.7	32.7	53.0	73.9	20.9	
Hori	9920.000	PK	42.0	39.8	7.4	33.5	55.7	73.9	18.2	
Hori	2483.500	AV	41.5	28.4	3.1	32.7	40.3	53.9	13.6	
Hori	4960.000	AV	37.2	30.7	5.4	31.7	41.6	53.9	12.3	
Hori	7440.000	AV	33.9	36.2	6.7	32.7	44.1	53.9	9.8	
Hori	9920.000	AV	33.6	39.8	7.4	33.5	47.3	53.9	6.6	
Vert	32.000	QP	23.1	17.0	7.1	32.1	15.1	40.0	24.9	
Vert	44.052	QP	24.3	12.9	7.3	32.1	12.4	40.0	27.6	
Vert	48.000	QP	23.1	11.6	7.4	32.1	10.0	40.0	30.0	
Vert	64.000	QP	23.3	7.4	7.6	32.1	6.2	40.0	33.8	
Vert	90.000	QP	23.8	8.3	8.0	32.1	8.0	43.5	35.5	
Vert	541.122	QP	23.5	19.6	11.4	32.1	22.4	46.0	23.6	
Vert	2483.500	PK	47.4	28.4	3.1	32.7	46.2	73.9	27.7	
Vert	4960.000	PK	41.3	30.7	5.4	31.7	45.7	73.9	28.2	
Vert	7440.000	PK	42.6	36.2	6.7	32.7	52.8	73.9	21.1	
Vert	9920.000	PK	41.6	39.8	7.4	33.5	55.3	73.9	18.6	
Vert	2483.500	AV	37.6	28.4	3.1	32.7	36.4	53.9	17.5	
Vert	4960.000	AV	33.0	30.7	5.4	31.7	37.4	53.9	16.5	
Vert	7440.000	AV	33.9	36.2	6.7	32.7	44.1	53.9	9.8	
Vert	9920.000	AV	33.5	39.8	7.4	33.5	47.2	53.9	6.7	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

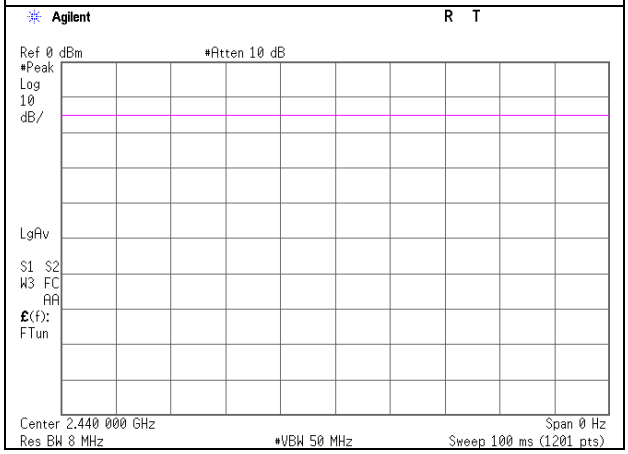
*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

Burst rate confirmation

Test place	Ise HQ EMC Lab. No.3 Measurement Room
Report No.	10300014H
Date	04/22/2014
Temperature/ Humidity	20 deg.C / 48% RH
Engineer	Hiroshi Kukita
Mode	BT LE Tx

Tx on / (Tx on + Tx off) =	**1.000**
Tx on / (Tx on + Tx off) * 100 =	**100.0 %**
Duty factor = 10 * log (100 / 100) =	**0.00 dB**

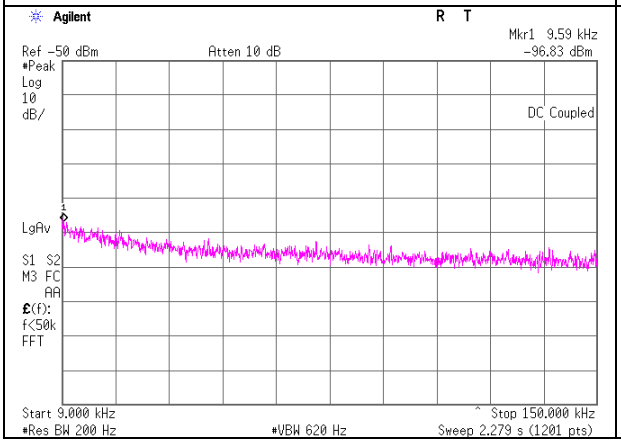


Conducted Spurious Emission

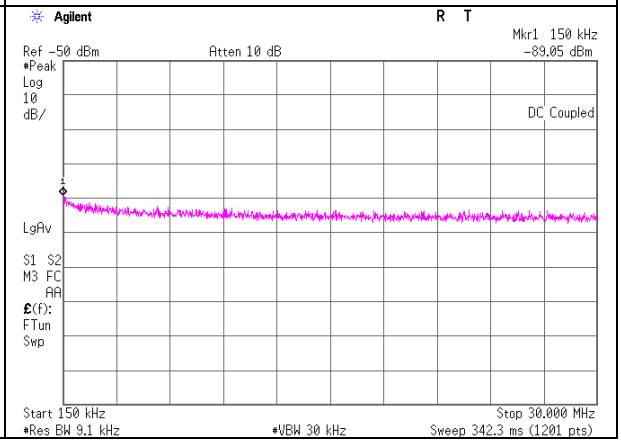
Test place	Ise HQ EMC Lab. No.11 Measurement Room
Report No.	10300014H
Date	04/24/2014
Temperature/ Humidity	25 deg.C / 20% RH
Engineer	Tomohisa Nakagawa
Mode	BT LE Tx

Tx 2402MHz

9kHz-150kHz



150kHz-30MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenator [dB]	Antenna Gain [dBi]	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]
9.59	-96.8	1.25	9.97	2.0	-83.6	300.0	6.0	-22.4	47.9
150	-89.1	1.25	9.97	2.0	-75.8	300.0	6.0	-14.6	24.0

E=EIRP-20log(D)+Ground bounce +104.8[dBuV/m]

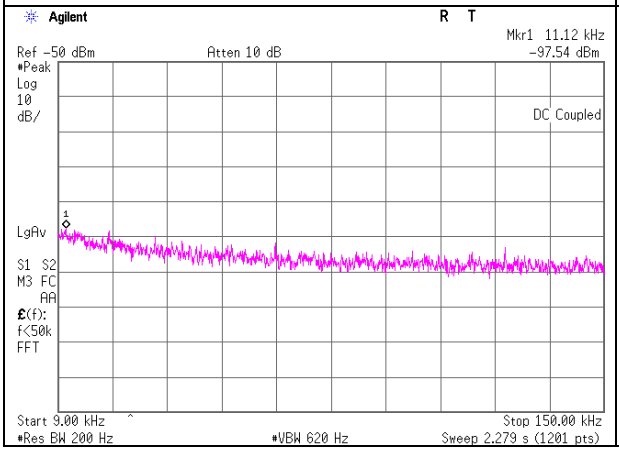
EIRP=Reading+Cable Loss+Attenator+Antenna Gain

Conducted Spurious Emission

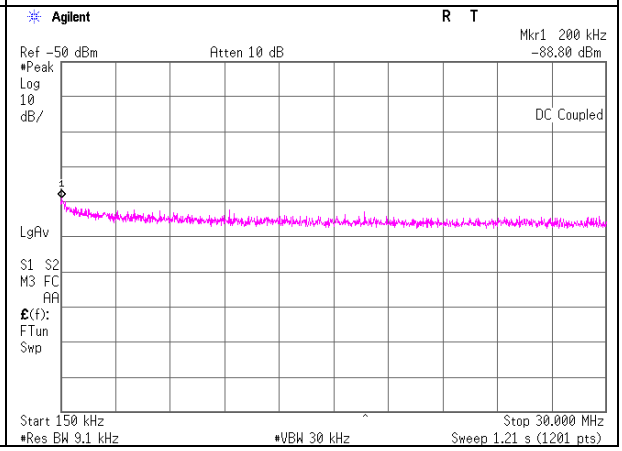
Test place	Ise HQ EMC Lab. No.11 Measurement Room
Report No.	10300014H
Date	04/23/2014
Temperature/ Humidity	25 deg.C / 30% RH
Engineer	Tomohisa Nakagawa
Mode	BT LE Tx

Tx 2440MHz

9kHz-150kHz



150kHz-30MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenator [dB]	Antenna Gain [dBi]	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]
11.12	-97.5	1.26	9.97	2.0	-84.3	300.0	6.0	-23.1	46.6
200	-88.8	1.26	9.97	2.0	-75.6	300.0	6.0	-14.3	21.5

E=EIRP-20log(D)+Ground bounce +104.8[dBuV/m]

EIRP=Reading+Cable Loss+Attenator+Antenna Gain

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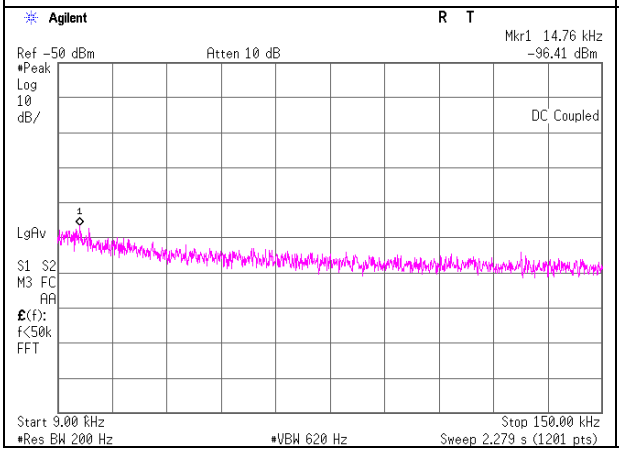
Conducted Spurious Emission

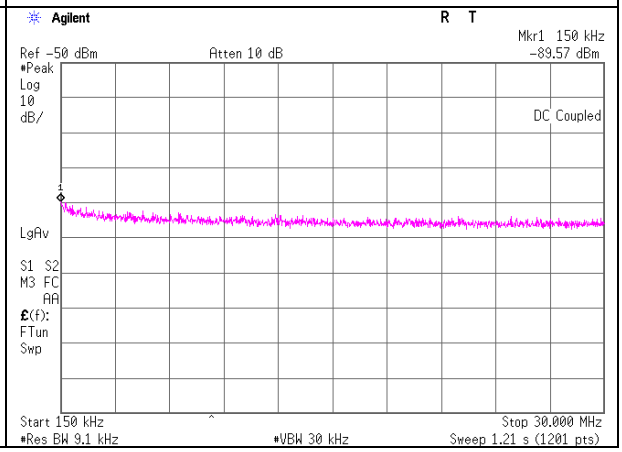
Test place	Ise HQ EMC Lab. No.11 Measurement Room
Report No.	10300014H
Date	04/23/2014
Temperature/ Humidity	25 deg.C / 30% RH
Engineer	Tomohisa Nakagawa
Mode	BT LE Tx

Tx 2480MHz

9kHz-150kHz



150kHz-30MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenator [dB]	Antenna Gain [dBi]	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]
14.76	-96.4	1.26	9.97	2.0	-83.2	300.0	6.0	-21.9	44.2
150	-89.6	1.26	9.97	2.0	-76.3	300.0	6.0	-15.1	24.0

E=EIRP-20log(D)+Ground bounce +104.8[dBuV/m]

EIRP=Reading+Cable Loss+Attenator+Antenna Gain

Power Density

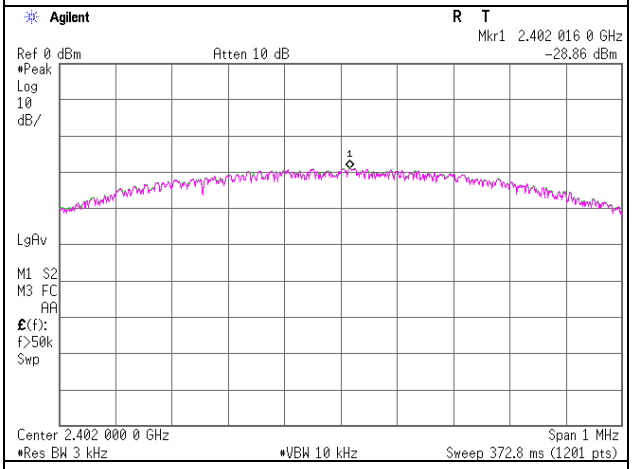
Test place	Ise HQ EMC Lab. No.11 Measurement Room
Report No.	10300014H
Date	04/23/2014
Temperature/ Humidity	25 deg.C / 30% RH
Engineer	Tomohisa Nakagawa
Mode	BT LE Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-28.86	1.25	9.97	-17.64	8.00	25.64
2440.00	-28.20	1.26	9.97	-16.97	8.00	24.97
2480.00	-27.79	1.26	9.97	-16.56	8.00	24.56

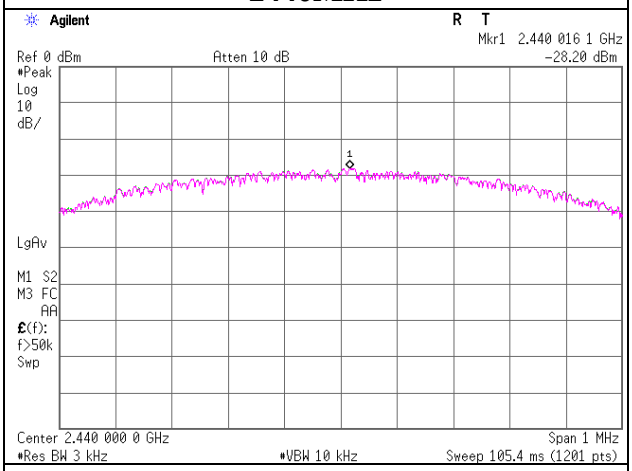
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

Power Density

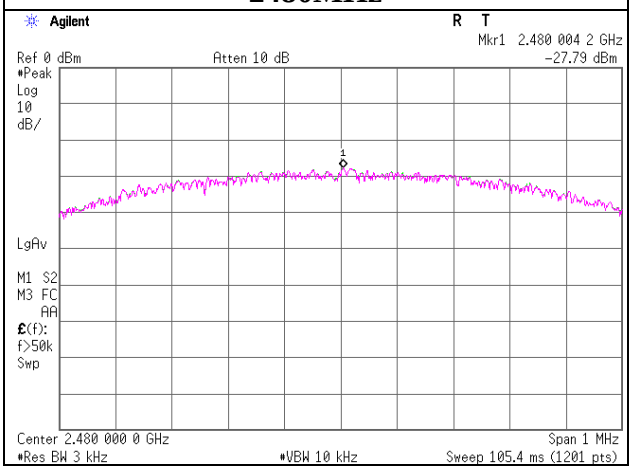
2402MHz



2440MHz



2480MHz

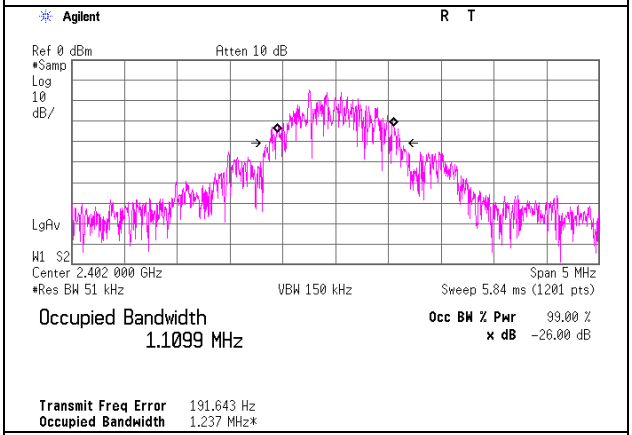


99%Occupied Bandwidth

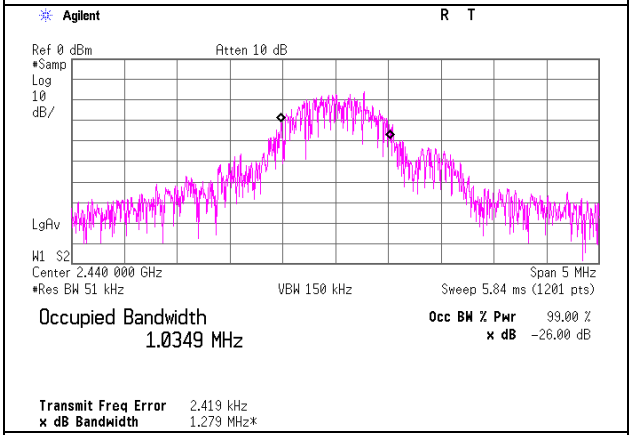
Test place	Ise HQ EMC Lab. No.11 Measurement Room
Report No.	10300014H
Date	04/23/2014
Temperature/ Humidity	25 deg.C / 30% RH
Engineer	Tomohisa Nakagawa
Mode	BT LE Tx

Tx

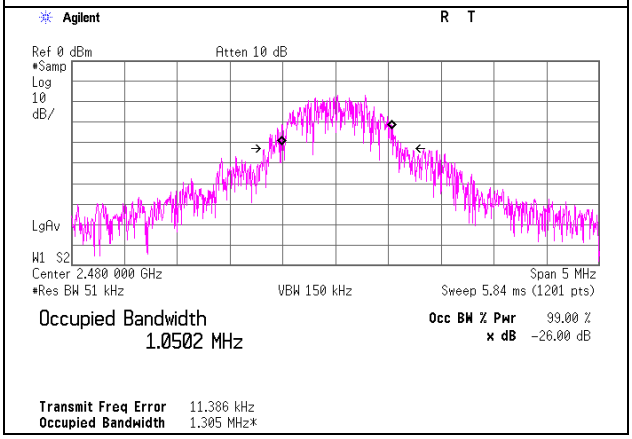
2402MHz



2440MHz



2480MHz



APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2014/02/27 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2014/02/20 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2014/04/08 * 12
MHA-20	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	RE	2013/05/17 * 12
MCC-133	Microwave Cable	HUBER+SUHNER	SUCOFLEX104	336164/4(1m) / 340640(5m)	RE	2013/09/27 * 12
MPA-11	MicroWave System Amplifier	Agilent	83017A	MY39500779	RE	2014/03/24 * 12
MHA-16	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	RE	2013/05/17 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2013/09/01 * 12
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE/CE	2014/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE/CE	2014/02/20 * 12
MJM-09	Measure	KDS	E19-55	-	RE/CE	-
MTR-01	Test Receiver	Rohde & Schwarz	ESI40	100084	RE/CE	2013/11/12 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2013/11/24 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2013/11/24 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2013/06/18 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2013/11/26 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2014/03/14 * 12
MSA-05	Spectrum Analyzer	Advantest	R3273	160400285	CE	2013/11/08 * 12
MLS-07	LISN(AMN)	Schwarzbeck	NSLK8127	8127364	CE(EUT)	2014/01/27 * 12
MAT-67	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	CE	2014/01/29 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(5m)/421-010(1m)/sucoform141-PE(1m)/RFM-E121(Switcher)	-/04178	CE	2013/07/23 * 12
MRENT-114	Spectrum Analyzer	Agilent	E4440A	MY46187105	AT	2013/11/11 * 12
MPM-12	Power Meter	Anritsu	ML2495A	0825002	AT	2013/06/12 * 12
MPSE-17	Power sensor	Anritsu	MA2411B	0738285	AT	2013/06/12 * 12
MAT-24	Attenuator(10dB)(above1 GHz)	Agilent	8493C	71389	AT	2013/06/05 * 12
MCC-76	Microwave Cable 1G-26.5GHz	Suhner	SUCOFLEX104	278967/4	AT	2013/12/24 * 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: CE: Conducted Emission
RE: Radiated Emission
AT: Antenna Terminal Conducted test