



RADIO TEST REPORT

Test Report No. : 10156279H-A-R2

Applicant : SHARP Corporation
Type of Equipment : Radio module
Model No. : RUITZ0001MPZZ
FCC ID : APY-RUITZ0001MP
Test regulation : FCC Part 15 Subpart C: 2013
Test Result : Complied

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2. The results in this report apply only to the sample tested.
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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 10156279H-A-R1. 10156279H-A-R1 is replaced with this report.

Date of test: December 17 to 26, 2013

Representative test engineer:

S. Matsuyama

Satofumi Matsuyama
Engineer of WiSE Japan,
UL Verification Service

Approved by:

M. Nishiyama

Masanori Nishiyama
Manager of WiSE Japan,
UL Verification Service



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.
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<http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap>

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13-EM-F0429

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SECTION 1: Customer information

Company Name : SHARP Corporation
Address : 492 Minosho-cho, Yamatokoriyama-shi, Nara 639-1186 Japan
Telephone Number : +81-743-55-4011
Facsimile Number : +81-743-53-6505
Contact Person : Nobuo Manabe

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

2.1 Identification of E.U.T.

Type of Equipment : Radio module
Model No. : RUITZ0001MPZZ
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC2.1-3.6V
Receipt Date of Sample : December 13, 2013
Country of Mass-production : Japan
Condition of EUT : Production model
Modification of EUT : No Modification by the test lab

2.2 Product Description

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 2405-2480MHz
Bandwidth & Channel spacing : 2MHz & 5MHz/CH
Modulation : DSSS
Power Supply (radio part input) : DC 3.3V
Antenna type : Chip Antenna
Antenna gain : 1.8dBi

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2013, final revised on September 30, 2013 and effective October 30, 2013

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

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 ----- IC: RSS-Gen 7.2.4	FCC: Section 15.207 ----- IC: RSS-Gen 7.2.4	QP 13.7dB, 0.20320MHz, L AV 13.5dB, 0.40709MHz, L	Complied	-
6dB Bandwidth	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)" ----- IC: RSS-Gen 4.6.2	FCC: Section 15.247(a)(2) ----- IC: RSS-210 A8.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)" ----- IC: RSS-Gen 4.8	FCC: Section 15.247(b)(3) ----- IC: RSS-210 A8.4(4)		Complied	Conducted
Power Density	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)" ----- IC: -	FCC: Section 15.247 (e) ----- IC: RSS-210 A8.2(b)		Complied	Conducted
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)" ----- IC: RSS-Gen 4.9	FCC: Section15.247(d) ----- IC: RSS-210 A8.5 RSS-Gen 7.2.3	3.8dB 2483.500MHz PK with Duty Factor Horizontal	Complied	Conducted/ Radiated

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.

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FCC 15.31 (e)

The stable voltage (DC3.3V) is constantly provided to the EUT by the end product. 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 soldered on the circuit board. Therefore the equipment complies with the requirement of 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 report meets the limits unless the uncertainty is taken into consideration.

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3.5 Test Location

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	FCC Registration Number	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	313583	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	655103	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	148738	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	134570	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	2.4 x 3.4m	-

* 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)

Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.

Mode	Tested frequency
Zigbee Transmitting (Tx)	2405MHz 2440MHz 2480MHz
*Transmitting duty was 100% for Antenna terminal conducted test. Other tests were performed with the worst duty of normal transmission. *The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*Power of the EUT was set by the software as follows; - Power settings: 0 (default value) - Software: SimpleMACstd_cert_C.s37 This setting of software is the worst case. 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.	

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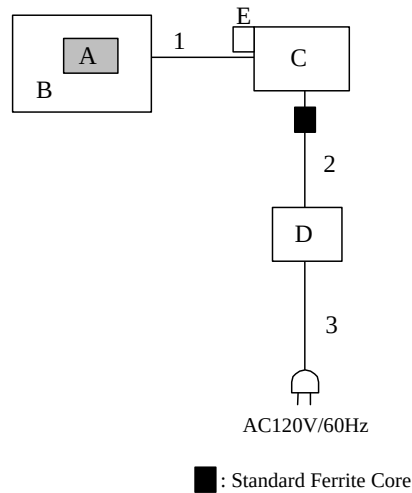
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4.2 Configuration and peripherals



*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	Radio module	RUITZ0001MPZZ	C	SHARP Corporation	EUT
B	Jig	AM20SEB	-	AirMicro	-
C	Laptop PC	2373-L3Z	L3-NHT3H	IBM	-
D	AC Adaptor	92P1021	11S92P1020Z1Z9R M64CH86	IBM	-
E	Receiver	QDWBN1194MPD2	C	SHARP Corporation	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	1.7	Unshielded	Unshielded	-
2	DC Cable	1.8	Unshielded	Unshielded	-
3	AC Cable	1.0	Unshielded	Unshielded	-

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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.

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

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SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (Issued on April 9, 2013)".

EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m, 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: <u>WLAN: 12.2.5</u> RBW: 1MHz VBW: 3MHz Detector: Power Averaging (RMS) Trace: Free Run	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: $20 \times \log(3.0\text{m}/1.0\text{m}) = 9.5\text{dB}$

- 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

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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	5MHz	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	Peak	Max Hold	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	27kHz				
*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

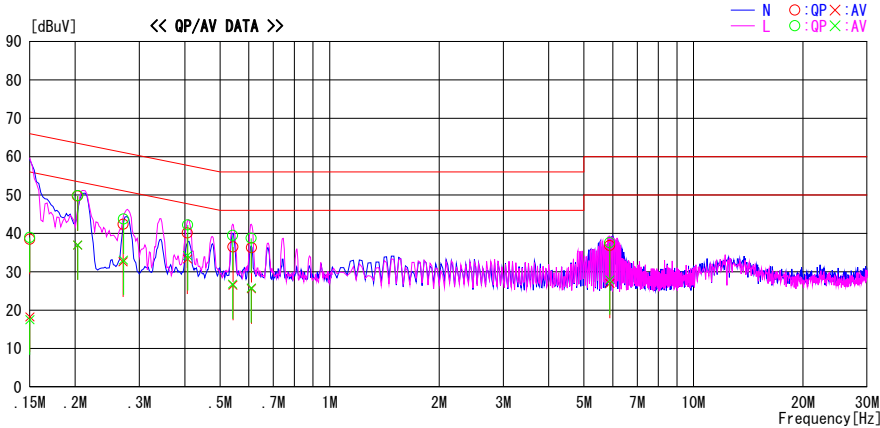
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
Date : 2013/12/26

Report No. : 10156279H
Temp./Humi. : 23deg. C / 35% RH
Engineer : Satofumi Matsuyama

Mode / Remarks : Tx 2480MHz

LIMIT : FCC15. 207 QP
FCC15. 207 AV

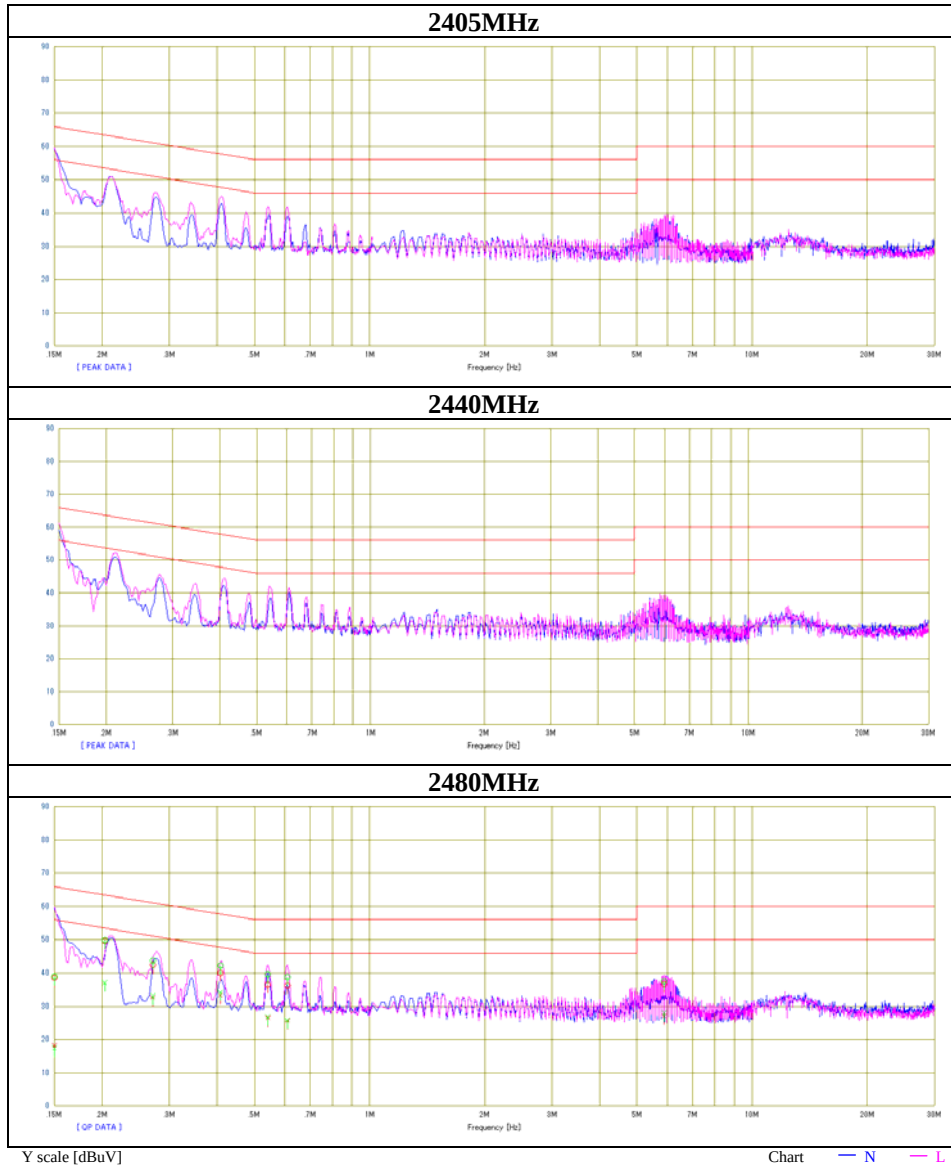


Frequency	Reading Level		Corr. Factor	Results		Limit		Margin		Phase	Comment
	QP	AV		QP	AV	QP	AV	QP	AV		
[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
0.15000	25.3	5.0	13.2	38.5	18.2	66.0	56.0	27.5	37.8	N	
0.20311	36.5	23.8	13.2	49.7	37.0	63.5	53.5	13.8	16.5	N	
0.27076	29.2	19.4	13.2	42.4	32.6	61.1	51.1	18.7	18.5	N	
0.40689	26.9	20.1	13.2	40.1	33.3	57.7	47.7	17.6	14.4	N	
0.54242	23.3	13.3	13.2	36.5	26.5	56.0	46.0	19.5	19.5	N	
0.60979	23.0	12.3	13.3	36.3	25.6	56.0	46.0	19.7	20.4	N	
5.89099	22.8	13.0	14.0	36.8	27.0	60.0	50.0	23.2	23.0	N	
0.15000	25.7	4.3	13.2	38.9	17.5	66.0	56.0	27.1	38.5	L	
0.20320	36.6	23.8	13.2	49.8	37.0	63.5	53.5	13.7	16.5	L	
0.27138	30.5	19.9	13.2	43.7	33.1	61.1	51.1	17.4	18.0	L	
0.40709	29.0	21.0	13.2	42.2	34.2	57.7	47.7	15.5	13.5	L	
0.54165	26.3	13.6	13.2	39.5	26.8	56.0	46.0	16.5	19.2	L	
0.60939	25.4	12.5	13.3	38.7	25.8	56.0	46.0	17.3	20.2	L	
5.89078	23.6	13.9	14.0	37.6	27.9	60.0	50.0	22.4	22.1	L	

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

Conducted Emission

Test place	Head Office EMC Lab. No.2 Semi Anechoic Chamber
Report No.	10156279H
Date	12/26/2013
Temperature/ Humidity	23 deg.C./ 35% RH
Engineer	Satofumi Matsuyama
Mode	Tx Zigbee

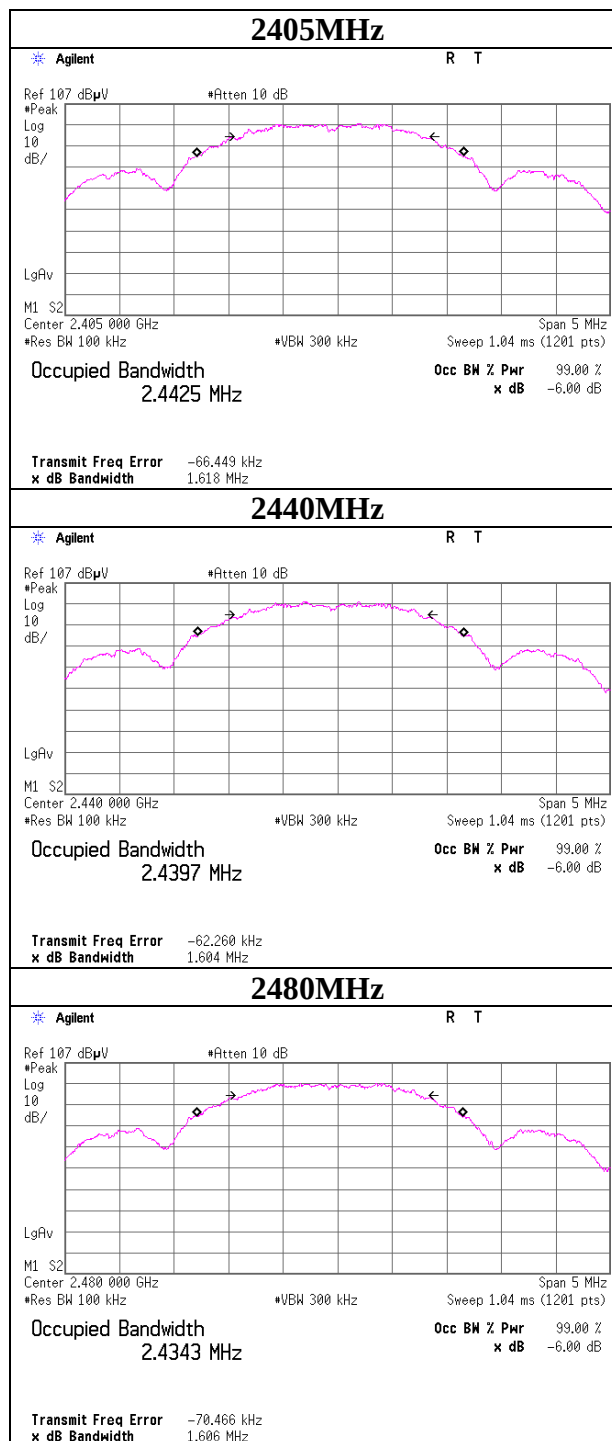


6dB Bandwidth

Test place Head Office EMC Lab. No.3 Measurement Room
Report No. 10156279H
Date 12/17/2013
Temperature/ Humidity 23 deg.C./ 34%
Engineer Satofumi Matsuyama
Mode Zigbee Tx

Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2405	1.618	>500
2440	1.604	>500
2480	1.606	>500

6dB Bandwidth



Maximum Peak Output Power

Test place Head Office EMC Lab. No.3 Measurement Room
Report No. 10156279H
Date 12/17/2013
Temperature/ Humidity 23 deg.C./ 34%
Engineer Satofumi Matsuyama
Mode Zigbee Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2405	-5.54	0.50	10.01	4.97	3.14	30.00	1000	25.03
2440	-5.69	0.50	10.01	4.82	3.03	30.00	1000	25.18
2480	-5.90	0.50	10.01	4.61	2.89	30.00	1000	25.39

Sample Calculation:

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

Maximum Average Output Power (Reference data for RF Exposure)

Test place Head Office EMC Lab. No.3 Measurement Room
Report No. 10156279H
Date 12/17/2013
Temperature/ Humidity 23 deg.C./ 34%
Engineer Satofumi Matsuyama
Mode Zigbee Tx

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2405	-5.67	0.50	10.01	4.84	3.05	30.00	1000	25.16
2440	-5.83	0.50	10.01	4.68	2.94	30.00	1000	25.32
2480	-6.06	0.50	10.01	4.45	2.79	30.00	1000	25.55

Sample Calculation:

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

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Radiated Spurious Emission

Test place	Head Office EMC Lab. No.3 Semi Anechoic Chamber
Report No.	10156279H
Date	12/24/2013
Temperature/ Humidity	23 deg.C./ 31%
Engineer	Tomohisa Nakagawa
Mode	Zigbee Tx 2405MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	92.571	QP	36.7	8.6	7.9	32.2	-	21.0	43.5	22.5	
Hori	196.605	QP	37.3	16.5	9.0	32.1	-	30.7	43.5	12.8	
Hori	200.558	QP	35.5	16.6	9.1	32.1	-	29.1	43.5	14.4	
Hori	364.504	QP	34.6	16.4	10.3	32.0	-	29.3	46.0	16.7	
Hori	458.630	QP	40.1	17.9	10.9	32.0	-	36.9	46.0	9.1	
Hori	729.000	QP	36.6	20.8	12.4	32.0	-	37.8	46.0	8.2	
Hori	2390.000	PK	46.0	28.2	3.1	32.4	-	44.9	73.9	29.0	
Hori	4810.000	PK	54.5	30.5	5.3	31.4	-	58.9	73.9	15.0	
Hori	7215.000	PK	52.7	35.8	6.7	32.3	-	62.9	73.9	11.0	
Vert	92.571	QP	51.2	8.6	7.9	32.2	-	35.5	43.5	8.0	
Vert	196.605	QP	40.3	16.5	9.0	32.1	-	33.7	43.5	9.8	
Vert	200.558	QP	40.6	16.6	9.1	32.1	-	34.2	43.5	9.3	
Vert	364.504	QP	37.2	16.4	10.3	32.0	-	31.9	46.0	14.1	
Vert	458.630	QP	39.5	17.9	10.9	32.0	-	36.3	46.0	9.7	
Vert	729.000	QP	37.3	20.8	12.4	32.0	-	38.5	46.0	7.5	
Vert	2390.000	PK	47.0	28.2	3.1	32.4	-	45.9	73.9	28.0	
Vert	4810.000	PK	55.0	30.5	5.3	31.4	-	59.4	73.9	14.5	
Vert	7215.000	PK	54.0	35.8	6.7	32.3	-	64.2	73.9	9.7	

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

PK

Polarity [Hori/Ver]	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
Hori	2390.000	PK	46.0	28.2	3.1	32.4	-	44.9	73.9	29.0	
Hori	4810.000	PK	54.5	30.5	5.3	31.4	-	58.9	73.9	15.0	
Hori	7215.000	PK	52.7	35.8	6.7	32.3	-	62.9	73.9	11.0	
Vert	2390.000	PK	47.0	28.2	3.1	32.4	-	45.9	73.9	28.0	
Vert	4810.000	PK	55.0	30.5	5.3	31.4	-	59.4	73.9	14.5	
Vert	7215.000	PK	54.0	35.8	6.7	32.3	-	64.2	73.9	9.7	

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

PK with Duty factor

Polarity [Hori/Ver]	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
Hori	2390.000	PK	46.0	28.2	3.1	32.4	-14.9	30.0	53.9	23.9	Not Out of band emission(Leakage Power)
Hori	4810.000	PK	54.5	30.5	5.3	31.4	-14.9	44.0	53.9	9.9	
Hori	7215.000	PK	52.7	35.8	6.7	32.3	-14.9	48.0	53.9	5.9	
Vert	2390.000	PK	47.0	28.2	3.1	32.4	-14.9	31.0	53.9	22.9	Not Out of band emission(Leakage Power)
Vert	4810.000	PK	55.0	30.5	5.3	31.4	-14.9	44.5	53.9	9.4	
Vert	7215.000	PK	54.0	35.8	6.7	32.3	-14.9	49.3	53.9	4.6	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

Radiated Spurious Emission

Test place Head Office EMC Lab. No.3 Semi Anechoic Chamber
Report No. 10156279H
Date 12/24/2013
Temperature/ Humidity 23 deg.C./ 31%
Engineer Tomohisa Nakagawa
Mode Zigbee Tx 2405MHz

20dBc Data Sheet

Polarity	Frequency	Detector	Reading	Ant Factor	Loss	Gain	Result	Limit	Margin	Remark
	[MHz]		[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
Hori	2405.000	PK	98.9	28.2	3.1	32.4	97.8	-	-	Carrier
Hori	2400.000	PK	55.9	28.2	3.1	32.4	54.8	77.8	23.0	
Vert	2405.000	PK	99.0	28.2	3.1	32.4	97.9	-	-	Carrier
Vert	2400.000	PK	55.6	28.2	3.1	32.4	54.5	77.9	23.4	

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

Radiated Spurious Emission

Test place Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No. 10156279H
Date 12/21/2013
Temperature/ Humidity 23 deg.C./ 31%
Engineer Masatoshi Nishiguchi
Mode Zigbee Tx 2440MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	196.596	QP	36.7	16.5	9.1	31.9	-	30.4	43.5	13.1	
Hori	200.442	QP	32.7	16.5	9.1	31.9	-	26.4	43.5	17.1	
Hori	364.500	QP	38.6	17.1	10.3	32.0	-	34.0	46.0	12.0	
Hori	458.623	QP	38.0	18.6	10.9	32.0	-	35.5	46.0	10.5	
Hori	729.262	QP	35.9	22.6	12.4	32.1	-	38.8	46.0	7.2	
Hori	4880.000	PK	57.6	32.5	5.4	31.6	-	63.9	73.9	10.0	
Hori	7320.000	PK	53.9	36.6	6.6	32.7	-	64.4	73.9	9.5	
Vert	92.508	QP	51.2	8.8	8.0	32.0	-	36.0	43.5	7.5	
Vert	196.596	QP	42.4	16.5	9.1	31.9	-	36.1	43.5	7.4	
Vert	200.442	QP	39.2	16.5	9.1	31.9	-	32.9	43.5	10.6	
Vert	364.500	QP	40.0	17.1	10.3	32.0	-	35.4	46.0	10.6	
Vert	458.623	QP	38.4	18.6	10.9	32.0	-	35.9	46.0	10.1	
Vert	729.262	QP	36.1	22.6	12.4	32.1	-	39.0	46.0	7.0	
Vert	4880.000	PK	58.5	32.5	5.4	31.6	-	64.8	73.9	9.1	
Vert	7320.000	PK	53.5	36.6	6.6	32.7	-	64.0	73.9	9.9	

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

PK

Polarity [Hori/Ver]	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
Vert	4880.000	PK	58.5	32.5	5.4	31.6	-	64.8	73.9	9.1	
Hori	4880.000	PK	57.6	32.5	5.4	31.6	-	63.9	73.9	10.0	
Hori	7320.000	PK	53.9	36.6	6.6	32.7	-	64.4	73.9	9.5	
Vert	7320.000	PK	53.5	36.6	6.6	32.7	-	64.0	73.9	9.9	

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

PK with Duty factor

Polarity [Hori/Ver]	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
Vert	4880.000	PK	58.5	32.5	5.4	31.6	-14.9	49.9	53.9	4.0	
Hori	4880.000	PK	57.6	32.5	5.4	31.6	-14.9	49.0	53.9	4.9	
Hori	7320.000	PK	53.9	36.6	6.6	32.7	-14.9	49.5	53.9	4.4	
Vert	7320.000	PK	53.5	36.6	6.6	32.7	-14.9	49.1	53.9	4.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

Radiated Spurious Emission

Test place : Head Office EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 10156279H
Date : 12/24/2013
Temperature/ Humidity : 23 deg.C./ 31%
Engineer : Tomohisa Nakagawa
Mode : Zigbee Tx 2480MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	92.570	QP	36.9	8.6	7.9	32.2	-	21.2	43.5	22.3	
Hori	196.602	QP	37.6	16.5	9.0	32.1	-	31.0	43.5	12.5	
Hori	200.549	QP	35.3	16.6	9.1	32.1	-	28.9	43.5	14.6	
Hori	364.166	QP	34.9	16.4	10.3	32.0	-	29.6	46.0	16.4	
Hori	458.630	QP	40.3	17.9	10.9	32.0	-	37.1	46.0	8.9	
Hori	729.008	QP	36.9	20.8	12.4	32.0	-	38.1	46.0	7.9	
Hori	2483.500	PK	65.8	28.4	3.1	32.3	-	65.0	73.9	8.9	
Hori	4960.000	PK	54.8	30.7	5.4	31.4	-	59.5	73.9	14.4	
Hori	7440.000	PK	44.0	36.2	6.7	32.4	-	54.5	73.9	19.4	
Vert	92.570	QP	51.3	8.6	7.9	32.2	-	35.6	43.5	7.9	
Vert	196.602	QP	43.5	16.5	9.0	32.1	-	36.9	43.5	6.6	
Vert	200.549	QP	40.7	16.6	9.1	32.1	-	34.3	43.5	9.2	
Vert	364.166	QP	37.4	16.4	10.3	32.0	-	32.1	46.0	13.9	
Vert	458.630	QP	39.9	17.9	10.9	32.0	-	36.7	46.0	9.3	
Vert	729.008	QP	36.7	20.8	12.4	32.0	-	37.9	46.0	8.1	
Vert	2483.500	PK	64.8	28.4	3.1	32.3	-	64.0	73.9	9.9	
Vert	4960.000	PK	54.2	30.7	5.4	31.4	-	58.9	73.9	15.0	
Vert	7440.000	PK	47.1	36.2	6.7	32.4	-	57.6	73.9	16.3	

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

PK

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
Hori	2483.50	PK	65.8	28.4	3.1	32.3	-	65.0	73.9	8.9	
Hori	4960.00	PK	54.8	30.7	5.4	31.4	-	59.5	73.9	14.4	
Hori	7440.00	PK	44.0	36.2	6.7	32.4	-	54.5	73.9	19.4	
Vert	2483.50	PK	64.8	28.4	3.1	32.3	-	64.0	73.9	9.9	
Vert	4960.00	PK	54.2	30.7	5.4	31.4	-	58.9	73.9	15.0	
Vert	7440.00	PK	47.1	36.2	6.7	32.4	-	57.6	73.9	16.3	

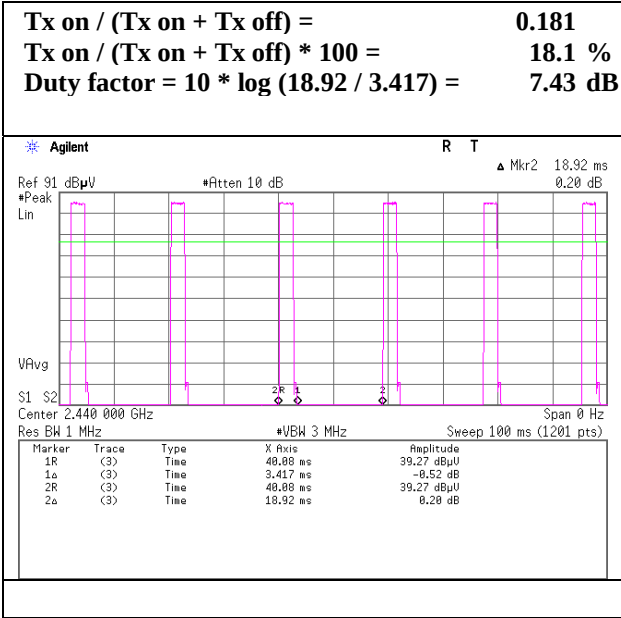
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier)

PK with Duty factor

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
Hori	2483.500	PK	65.8	28.4	3.1	32.3	-14.9	50.1	53.9	3.8	Not Out of band emission(Leakage Power)
Hori	4960.000	PK	54.8	30.7	5.4	31.4	-14.9	44.6	53.9	9.3	
Hori	7440.000	PK	44.0	36.2	6.7	32.4	-14.9	39.6	53.9	14.3	
Vert	2483.500	PK	64.8	28.4	3.1	32.3	-14.9	49.1	53.9	4.8	Not Out of band emission(Leakage Power)
Vert	4960.000	PK	54.2	30.7	5.4	31.4	-14.9	44.0	53.9	9.9	
Vert	7440.000	PK	47.1	36.2	6.7	32.4	-14.9	42.7	53.9	11.2	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor (Refer to Duty factor data sheet)

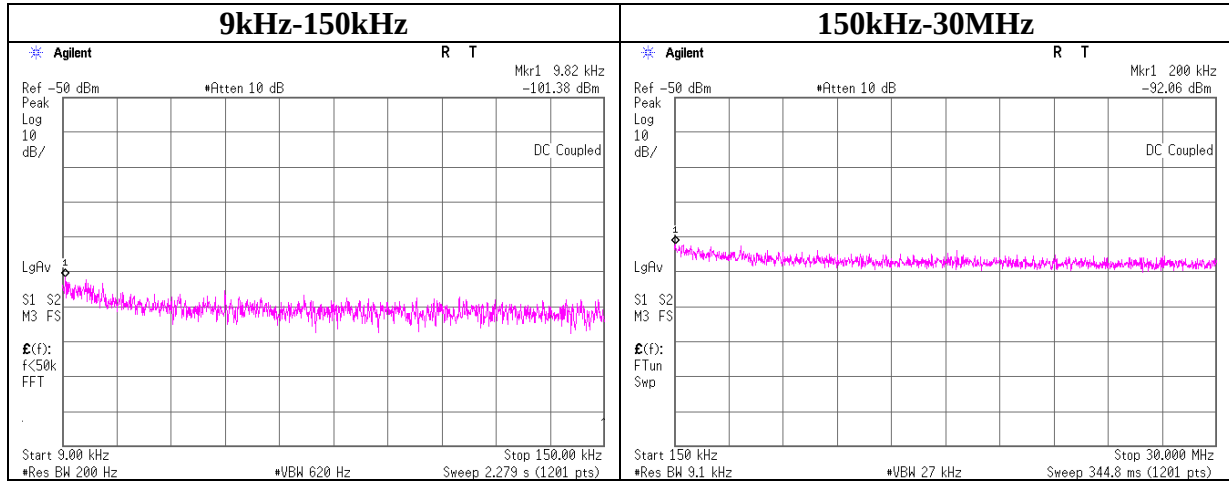
Burst rate confirmation



Duty Factor for PK with duty factor : 20log(3.417/18.92)= -14.86

Conducted Spurious Emission

Test place	Head Office EMC Lab. No.3 Measurement Room
Report No.	10156279H
Date	12/17/2013
Temperature/ Humidity	23 deg.C./ 34%
Engineer	Satofumi Matsuyama
Mode	Zigbee Tx 2405MHz



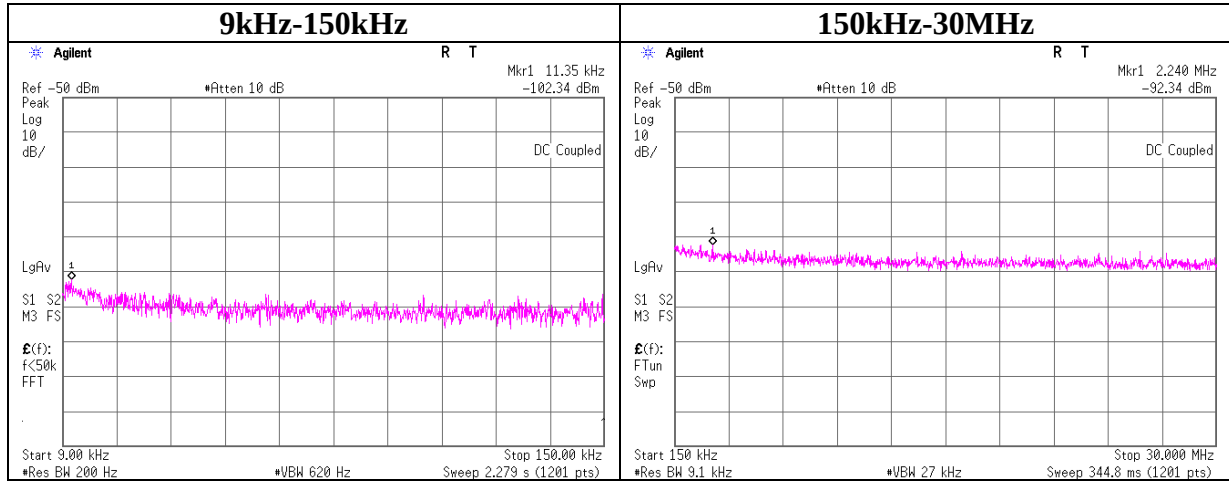
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator [dB]	Antenna Gain [dBi]	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]
9.82	-101.4	0.5	10.0	1.8	-89.1	300.0	6.0	-27.8	47.8
200	-92.1	0.5	10.0	1.8	-79.8	300.0	6.0	-18.5	21.6

$E = \text{EIRP} - 20 \log(D) + \text{Ground bounce} + 104.8 [\text{dBuV/m}]$

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator} + \text{Antenna Gain}$

Conducted Spurious Emission

Test place	Head Office EMC Lab. No.3 Measurement Room
Report No.	10156279H
Date	12/17/2013
Temperature/ Humidity	23 deg.C./ 34%
Engineer	Satofumi Matsuyama
Mode	Zigbee Tx 2440MHz



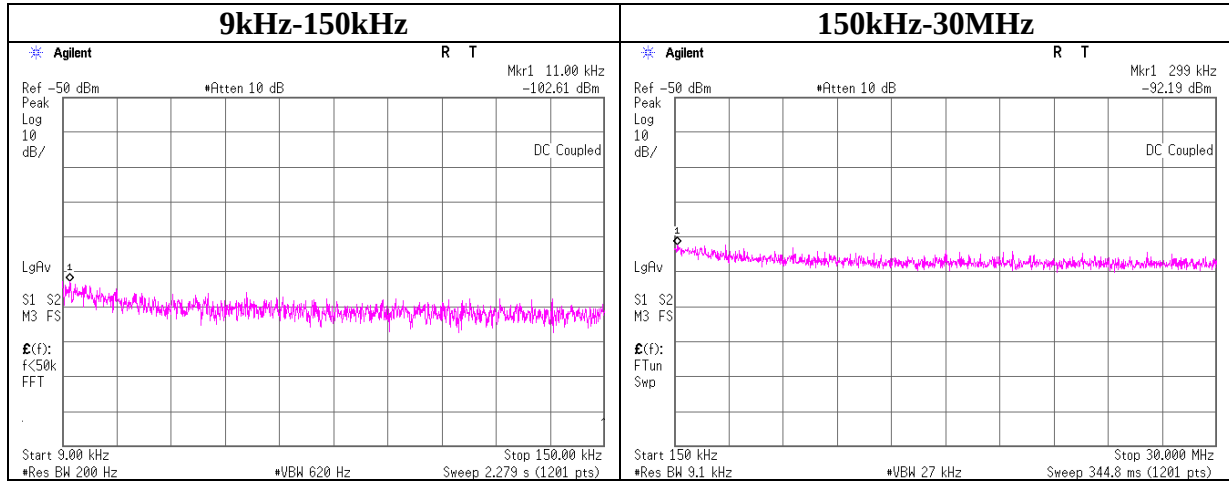
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator [dB]	Antenna Gain [dBi]	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]
11.35	-102.3	0.5	10.0	1.8	-90.0	300.0	6.0	-28.8	46.5
2240	-92.3	0.5	10.0	1.8	-80.0	300.0	6.0	-18.8	0.6

$E = \text{EIRP} - 20 \log(D) + \text{Ground bounce} + 104.8 [\text{dBuV/m}]$

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator} + \text{Antenna Gain}$

Conducted Spurious Emission

Test place	Head Office EMC Lab. No.3 Measurement Room
Report No.	10156279H
Date	12/17/2013
Temperature/ Humidity	23 deg.C./ 34%
Engineer	Satofumi Matsuyama
Mode	Zigbee Tx 2480MHz



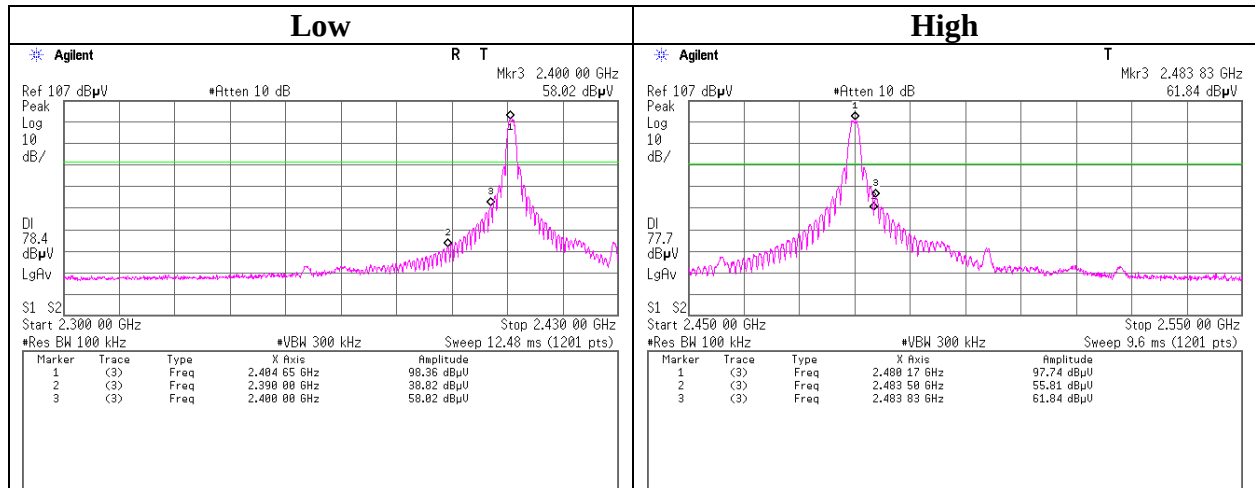
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator [dB]	Antenna Gain [dBi]	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]
11.00	-102.6	0.5	10.0	1.8	-90.3	300.0	6.0	-29.0	46.8
299	-92.2	0.5	10.0	1.8	-79.9	300.0	6.0	-18.6	18.1

$E = \text{EIRP} - 20 \log(D) + \text{Ground bounce} + 104.8 [\text{dBuV/m}]$

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator} + \text{Antenna Gain}$

Conducted Emission Band Edge compliance

Test place	Head Office EMC Lab. No.3 Measurement Room
Report No.	10156279H
Date	12/17/2013
Temperature/ Humidity	23 deg.C./ 34%
Engineer	Satofumi Matsuyama
Mode	Zigbee Tx 2405MHz
	Zigbee Tx 2480MHz



Power Density

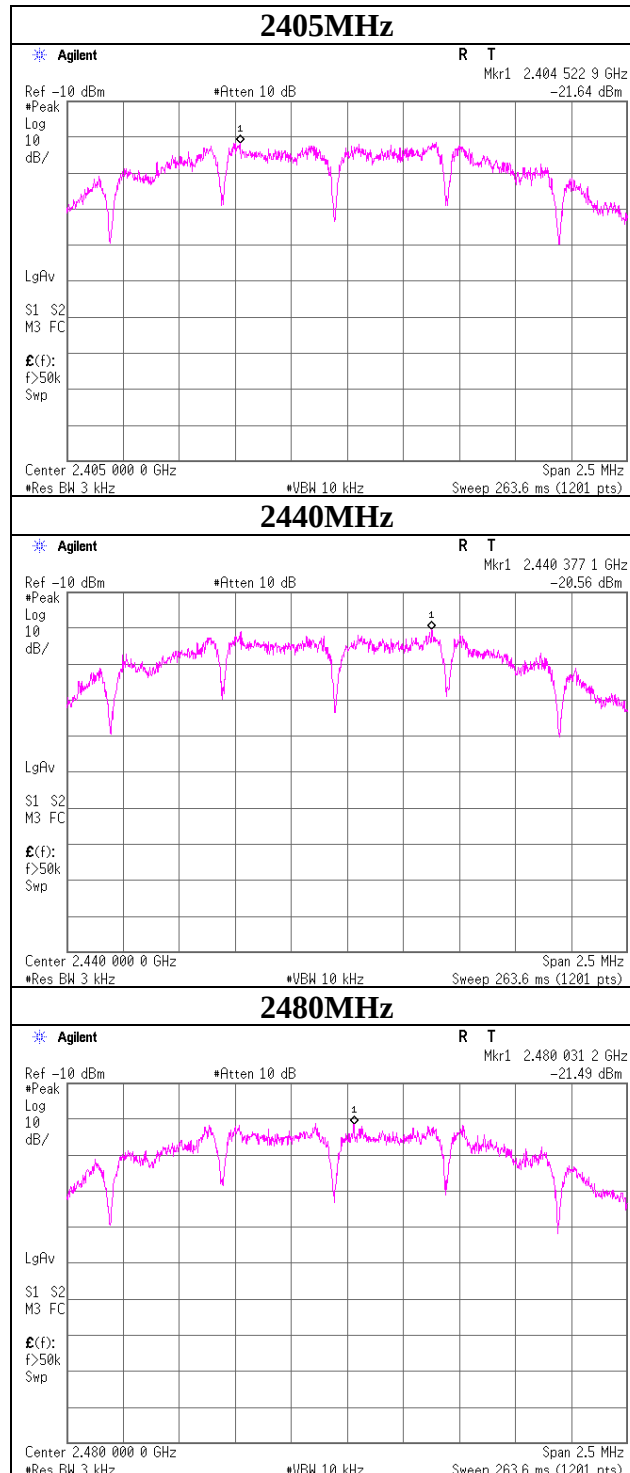
Test place Head Office EMC Lab. No.3 Measurement Room
Report No. 10156279H
Date 12/17/2013
Temperature/ Humidity 23 deg.C./ 34%
Engineer Satofumi Matsuyama
Mode Zigbee Tx

Freq.	Reading	Cable Loss	Atten.	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2405.00	-21.64	0.50	10.01	-11.13	8.00	19.13
2440.00	-20.56	0.50	10.01	-10.05	8.00	18.05
2480.00	-21.49	0.50	10.01	-10.98	8.00	18.98

Sample Calculation:

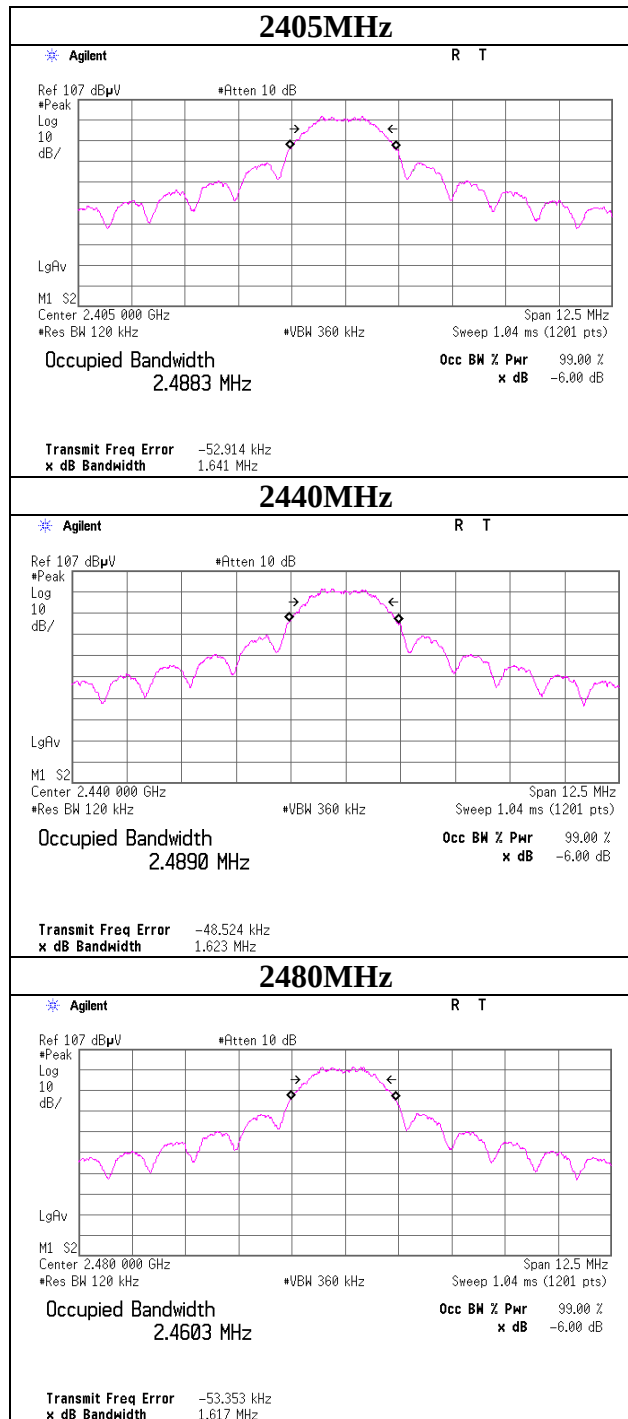
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

Power Density



99%Occupied Bandwidth

Test place	Head Office EMC Lab. No.3 Measurement Room
Report No.	10156279H
Date	12/17/2013
Temperature/ Humidity	23 deg.C./ 34%
Engineer	Satofumi Matsuyama
Mode	Zigbee Tx



APPENDIX 2: Test instruments

EMI test equipment (1/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MPM-08	Power Meter	Anritsu	ML2495A	6K00003338	AT	2013/10/15 * 12
MPSE-11	Power sensor	Anritsu	MA2411B	011737	AT	2013/10/15 * 12
MRENT-112	Spectrum Analyzer	Agilent	E4440A	MY48250080	AT	2013/10/04 * 12
MAT-22	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2013/03/21 * 12
MOS-12	Thermo-Hygrometer	Custom	CTH-180	-	AT	2013/01/17 * 12
MOTS-MAT	Antenna terminal tests program	Matsuura Denkosha	MAC-793	1	AT	-
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2013/02/28 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	-	RE	2013/02/26 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-05	Spectrum Analyzer	Advantest	R3273	160400285	RE	2013/11/08 * 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	2013/03/12 * 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	2013/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	-	RE	2013/02/26 * 12
MJM-09	Measure	KDS	E19-55	-	RE	-
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2013/08/12 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1204S062(5m)	RE	2013/05/28 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	MY39500780	RE	2013/03/19 * 12
MRENT-95	Spectrum Analyzer	Agilent	E4440A	MY46185823	RE	2013/06/14 * 12
MTR-01	Test Receiver	Rohde & Schwarz	ES140	100084	RE	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

UL Japan, Inc.

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EMI test equipment (2/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2013/03/12 * 12
MHF-26	High Pass Filter 3.5- 18.0GHz	UL Japan	HPF SELECTOR	002	RE	2013/09/01 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2013/08/20 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2013/10/13 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2013/10/13 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2013/07/23 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2013/04/05 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2013/03/12 * 12
MRENT-112	Spectrum Analyzer	Agilent	E4440A	MY48250080	RE	2013/10/04 * 12
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	CE	2013/06/30 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	CE	2013/02/26 * 12
MJM-14	Measure	KOMELON	KMC-36	-	CE	-
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	CE	2013/11/25 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	CE	2013/06/11 * 12
MLS-06	LISN(AMN)	Schwarzbeck	NSLK8127	8127363	CE	2013/01/07 * 12
MCC-13	Coaxial Cable	Fujikura	3D-2W(12m)/5D- 2W(5m)/5D- 2W(0.8m)/5D- 2W(1m)	-	CE	2013/02/06 * 12
MAT-65	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	CE	2013/01/09 * 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

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