



RADIO TEST REPORT

Test Report No. : 10955210S-A

Applicant : Panasonic Corporation
Type of Equipment : BLE Unit
Model No. : HU100010A
FCC ID : ACJ932HU100010A
Test regulation : FCC Part 15 Subpart C: 2015
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
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: September 11, 2015

Representative test engineer:

Tomohiro Hara
Engineer
Consumer Technology Division

Approved by:

Ichiro Isozaki
Manager
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.

Shonan EMC Lab.

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13-EM-F0429

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SECTION 1: Customer information

Company Name	:	Panasonic Corporation
Address	:	600 Saedo-cho, Tsuzuki-ku, Yokohama City, Kanagawa 224-8539, Japan
Telephone Number	:	+81-45-939-1665
Facsimile Number	:	+81-45-939-1917
Contact Person	:	Masahiro Yoshii

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

2.1 Identification of E.U.T.

Type of Equipment	:	BLE Unit
Model No.	:	HU100010A
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 8 V to 16 V
Receipt Date of Sample	:	September 11, 2015
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab.

2.2 Product Description

Model: HU100010A (referred to as the EUT in this report) is a BLE Unit.

General Specification

Clock frequency(ies) in the system	:	32.768 kHz, 8 MHz, 26 MHz
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Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Power Supply (radio part input)	:	DC 3.3 V
Antenna type	:	Metal Plate Internal Loop
Antenna Gain	:	2.54 dBi

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2015, final revised on September 8, 2015
 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 C63.4-2009 7. AC powerline Conducted Emission measurements IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	-	-	*1)
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v03r03 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(1)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v03r03 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(4)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v03r03 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(2)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v03r03 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	11.0 dB 2483.500 MHz, AV, Vertical Tx 2480 MHz	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

*1) The test is not applicable since the EUT has no AC mains.

*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v03r03 12.2.7.

* In case any questions arise about test procedure, ANSI C63.4: 2009 is also referred.

FCC 15.31 (e)

The RF part is constantly provided voltage (DC 3.3 V) through the regulator regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

FCC 15.203

The equipment and its antenna comply with the requirement since the antenna is built in the equipment and it cannot be replaced by end users.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: -	N/A	-	Conducted

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

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

Item	Frequency range	Uncertainty (+/-)		
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	3.6 dB	3.4 dB	3.4 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.7 dB	3.5 dB	3.5 dB
	30 MHz-300 MHz	4.9 dB	4.9 dB	4.7 dB
	300 MHz-1 GHz	5.0 dB	5.0 dB	4.8 dB
	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB
Radiated emission (Measurement distance: 1 m)	13 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB
	18 GHz-40 GHz	4.5 dB	4.3 dB	4.3 dB

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.76 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.79 dB
Spurious emission (Conducted) below 1GHz	1.5 dB

Radiated emission test

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

3.5 Test Location

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Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401
JAB Accreditation No. RTL02610

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
No.1 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 shielded room	-	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	-	2.55 x 4.1 x 2.5	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

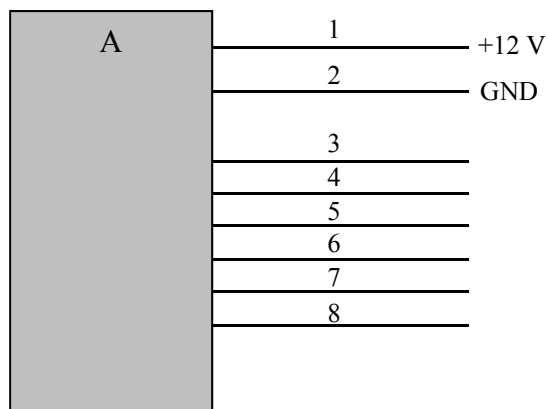
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Bluetooth Low Energy (BT LE): Transmitting (Tx), Payload: PRBS9

Test Item	Operating Mode	Tested frequency
6dB Bandwidth Maximum Peak Output Power Power Density Spurious Emission 99% Occupied Bandwidth	BT LE	2402MHz 2440MHz 2480MHz
*Transmitting duty was 100% on all tests *Power of the EUT was set by the software as follows; Power settings: Fixed Software: HCI Tester2, Version 0.99le *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.		

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	Bluetooth LE Unit	HU100010A	A12 *1) A21 *2)	Panasonic	EUT

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC (+12 V)	2.2	Unshielded	Unshielded	-
2	DC (GND)	2.2	Unshielded	Unshielded	-
3	Signal	1.5	Unshielded	Unshielded	-
4	Signal	1.5	Unshielded	Unshielded	-
5	Signal	1.5	Unshielded	Unshielded	-
6	Signal	1.5	Unshielded	Unshielded	-
7	Signal	1.5	Unshielded	Unshielded	-

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SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "558074 D01 DTS Meas Guidance v03r03".

EUT was placed on a polystyrene platform of nominal size, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

The height of the measuring antenna varied between 1 m and 4 m 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	30 MHz to 300 MHz	300 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *3)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: 12.2.5.1 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	3 m (below 13 GHz), 1 m *1) (above 13GHz)		3 m (below 13 GHz), 1 m *2) (above 13 GHz)

*1) Distance Factor: $20 \times \log(3.0 \text{ m} / 1.0 \text{ m}) = 9.5 \text{ dB}$

*2) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r03"

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.

Worst axis:

Antenna polarization	Carrier	Spurious (Below 1 GHz)	Spurious (1-2.8 GHz)	Spurious (2.8-25 GHz)
Horizontal	Z	Z	Z	Z
Vertical	Y	Z	Y	Z

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

Measurement range : 30 M - 25 GHz
Test data : APPENDIX
Test result : Pass

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SECTION 6: 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	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3) *4)
Conducted Spurious Emission *5)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	10 kHz	30 kHz				
*1) Peak hold was applied as Worst-case measurement. *2) Reference data *3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v03r03". *4) The test was not performed at RBW:3 kHz however the measurement is to be performed with RBW:3kHz in the regulation, because the measurement value with RBW:3 kHz is less than the value of RBW:30 kHz and the test data met the limit with RBW:30 kHz. *5) 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. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 9.1 kHz)							

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: Test data

6dB Bandwidth

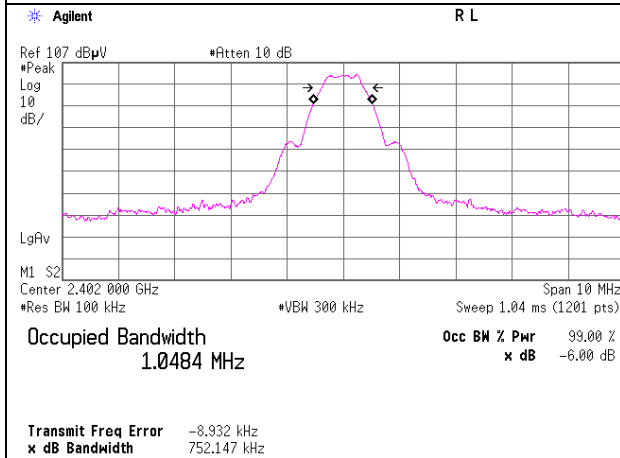
Test place	Shonan EMC Lab. No.6 Shielded Room
Report No.	10955210S-A
Date	September 11, 2015
Temperature / Humidity	21 deg. C / 50 % RH
Engineer	Tomohiro Hara
Mode	Tx BT LE

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
BTLE	2402	0.752	> 500
	2440	0.728	> 500
	2480	0.744	> 500

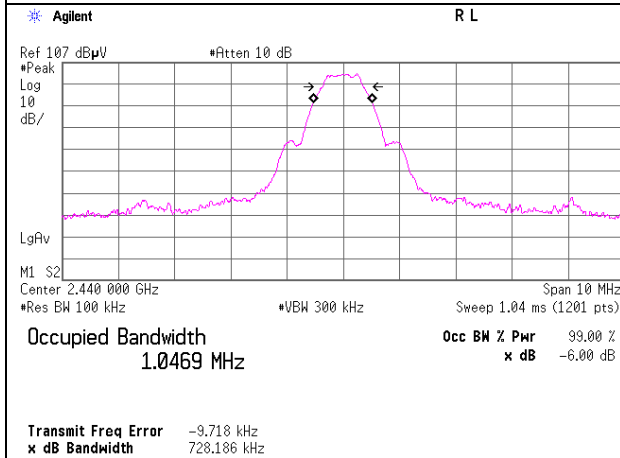
6dB Bandwidth

BTLE

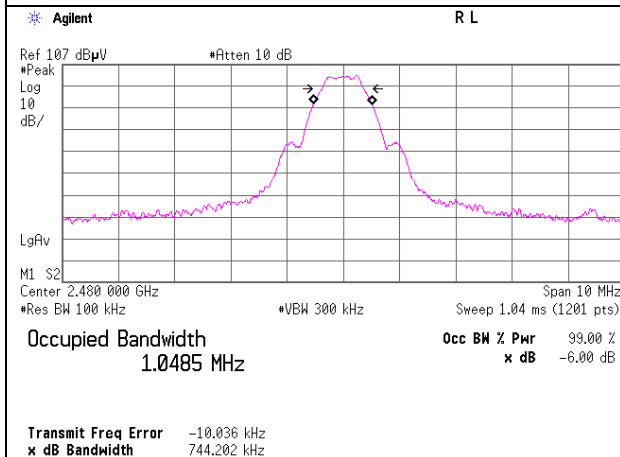
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place Shonan EMC Lab. No.6 Shielded Room
Report No. 10955210S-A
Date September 11, 2015
Temperature / Humidity 21 deg. C / 50 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-4.99	0.95	9.93	5.89	3.88	30.00	1000	24.11
2440	-4.55	0.90	9.93	6.28	4.25	30.00	1000	23.72
2480	-4.50	0.87	9.93	6.30	4.27	30.00	1000	23.70

Average Output Power
(Reference data)

Test place	Shonan EMC Lab. No.6 Shielded Room
Report No.	10955210S-A
Date	September 11, 2015
Temperature / Humidity	21 deg. C / 50 % RH
Engineer	Tomohiro Hara
Mode	Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Frame power)		Duty factor [dB]	Result (Burst power)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-5.17	0.95	9.93	5.71	3.72	0.00	5.71	3.72
2440	-4.71	0.90	9.93	6.12	4.09	0.00	6.12	4.09
2480	-4.67	0.87	9.93	6.13	4.10	0.00	6.13	4.10

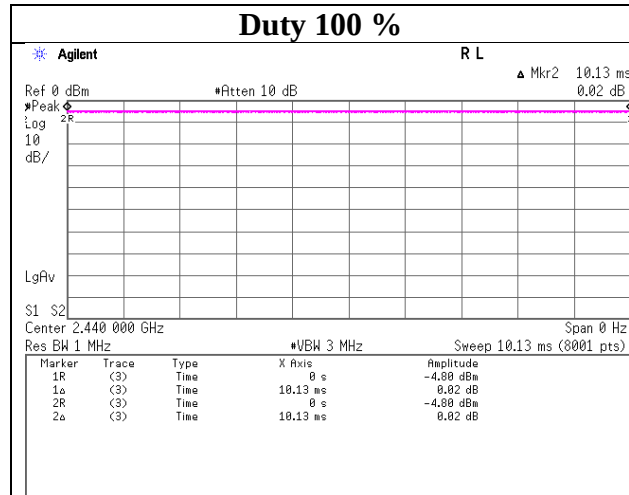
Sample Calculation:

Result (Frame power) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuate

Result (Burst power) = Frame power + Duty factor

Burst rate confirmation

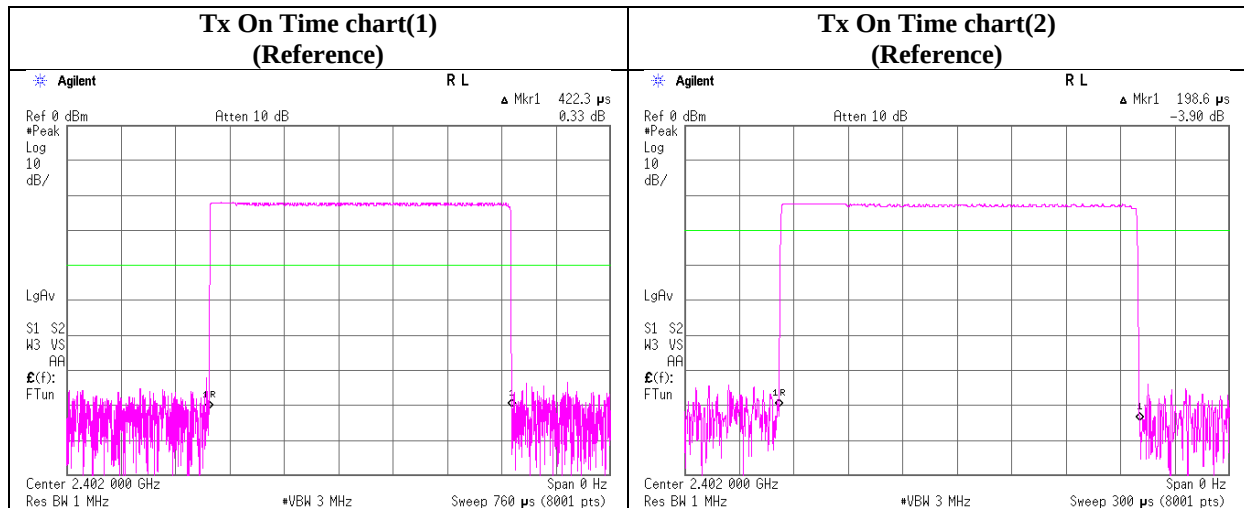
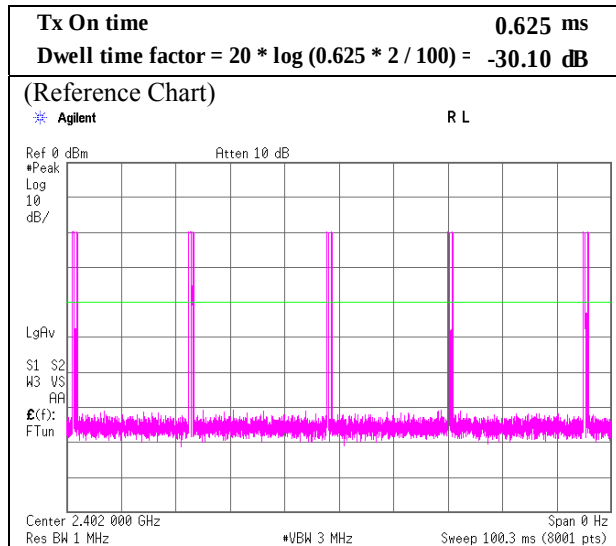
Test place Shonan EMC Lab. No.6 Shielded Room
Report No. 10955210S-A
Date September 11, 2015
Temperature / Humidity 21 deg. C / 50 % RH
Engineer Tomohiro Hara
Mode Tx BT LE



Dwell time factor

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	10955210S-A
Date	September 11, 2015
Temperature / Humidity	25 deg. C / 55 % RH
Engineer	Shinichi Takano
Mode	Tx, Hopping On

* Worst TX Duty cycle on BLE is Advertising mode which max on time is 0.625 (0.425 + 0.200) msec and Min interval is 20msec (Refer to “HU100010A(BLE UNIT) Communication Sequence”).



Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 10955210S-A
Date : September 11, 2015
Temperature / Humidity : 25 deg. C / 55 % RH
Engineer : Shinichi Takano
Mode : Tx BT LE 2402 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	432.293	QP	22.0	16.9	9.3	31.9	0.0	16.3	46.0	29.7	100	0	
Hori.	2390.000	PK	46.7	27.2	13.7	41.0	3.5	50.1	73.9	23.8	100	293	
Hori.	4804.000	PK	49.0	32.0	5.7	39.6	3.5	50.6	73.9	23.3	132	281	
Hori.	7206.000	PK	48.6	36.2	7.1	40.1	3.5	55.3	73.9	18.6	136	234	
Hori.	9608.000	PK	45.2	38.4	8.2	39.6	3.5	55.7	73.9	18.2	100	261	
Hori.	12010.000	PK	44.9	40.8	9.3	39.3	3.5	59.2	73.9	14.7	100	0	
Hori.	2390.000	AV	37.3	27.2	13.7	41.0	3.5	40.7	53.9	13.2	100	293	
Vert.	77.997	QP	32.6	6.3	7.6	32.1	0.0	14.4	40.0	25.6	100	158	
Vert.	91.759	QP	27.9	8.5	7.7	32.1	0.0	12.0	43.5	31.5	100	348	
Vert.	104.869	QP	25.9	10.7	7.4	32.1	0.0	11.9	43.5	31.6	100	359	
Vert.	111.427	QP	25.5	11.7	7.4	32.1	0.0	12.5	43.5	31.0	100	267	
Vert.	117.988	QP	28.2	12.6	7.4	32.1	0.0	16.1	43.5	27.4	100	327	
Vert.	2390.000	PK	45.7	27.2	13.7	41.0	3.5	49.1	73.9	24.8	100	240	
Vert.	4804.000	PK	48.8	32.0	5.7	39.6	3.5	50.4	73.9	23.5	130	89	
Vert.	7206.000	PK	49.2	36.2	7.1	40.1	3.5	55.9	73.9	18.0	106	67	
Vert.	9608.000	PK	46.0	38.4	8.2	39.6	3.5	56.5	73.9	17.4	123	270	
Vert.	12010.000	PK	45.3	40.8	9.3	39.3	3.5	59.6	73.9	14.3	100	0	
Vert.	2390.000	AV	37.3	27.2	13.7	41.0	3.5	40.7	53.9	13.2	100	240	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (4.47 m / 3.0 m) = 3.5 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.5 dB

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Dwell Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4804.000	AV	42.5	32.0	5.7	39.6	-30.1	3.5	14.0	53.9	39.9	
Hori.	7206.000	AV	40.0	36.2	7.1	40.1	-30.1	3.5	16.6	53.9	37.3	
Hori.	9608.000	AV	37.1	38.4	8.2	39.6	-30.1	3.5	17.5	53.9	36.4	
Hori.	12010.000	AV	36.1	40.8	9.3	39.3	-30.1	3.5	20.3	53.9	33.6	
Vert.	4804.000	AV	42.3	32.0	5.7	39.6	-30.1	3.5	13.8	53.9	40.1	
Vert.	7206.000	AV	40.3	36.2	7.1	40.1	-30.1	3.5	16.9	53.9	37.0	
Vert.	9608.000	AV	36.8	38.4	8.2	39.6	-30.1	3.5	17.2	53.9	36.7	
Vert.	12010.000	AV	36.0	40.8	9.3	39.3	-30.1	3.5	20.2	53.9	33.7	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Dwell(time)factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (4.47 m / 3.0 m) = 3.5 dB

Dwell (time) factor refer to "Dwell time factor Calculation chart" sheet.

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	99.2	27.2	13.7	41.0	3.5	102.6	-	-	Carrier
Hori.	2400.000	PK	45.0	27.2	13.7	41.0	3.5	48.4	82.6	34.2	
Vert.	2402.000	PK	98.5	27.2	13.7	41.0	3.5	101.9	-	-	Carrier
Vert.	2400.000	PK	42.9	27.2	13.7	41.0	3.5	46.3	81.8	35.5	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (4.47 m / 3.0 m) = 3.5 dB

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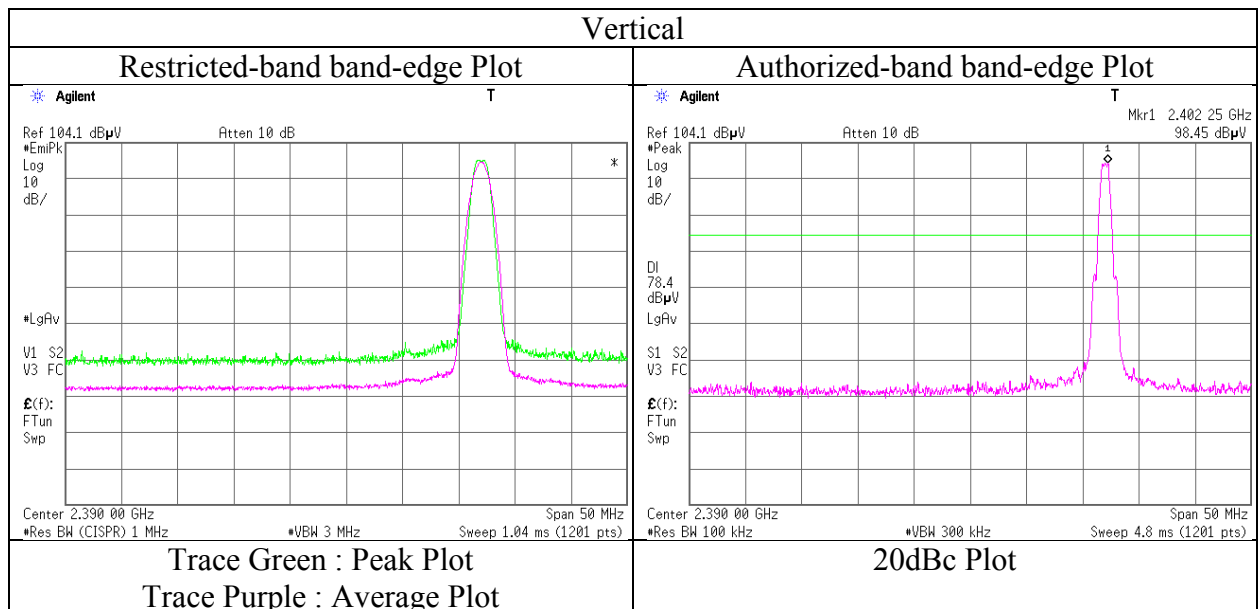
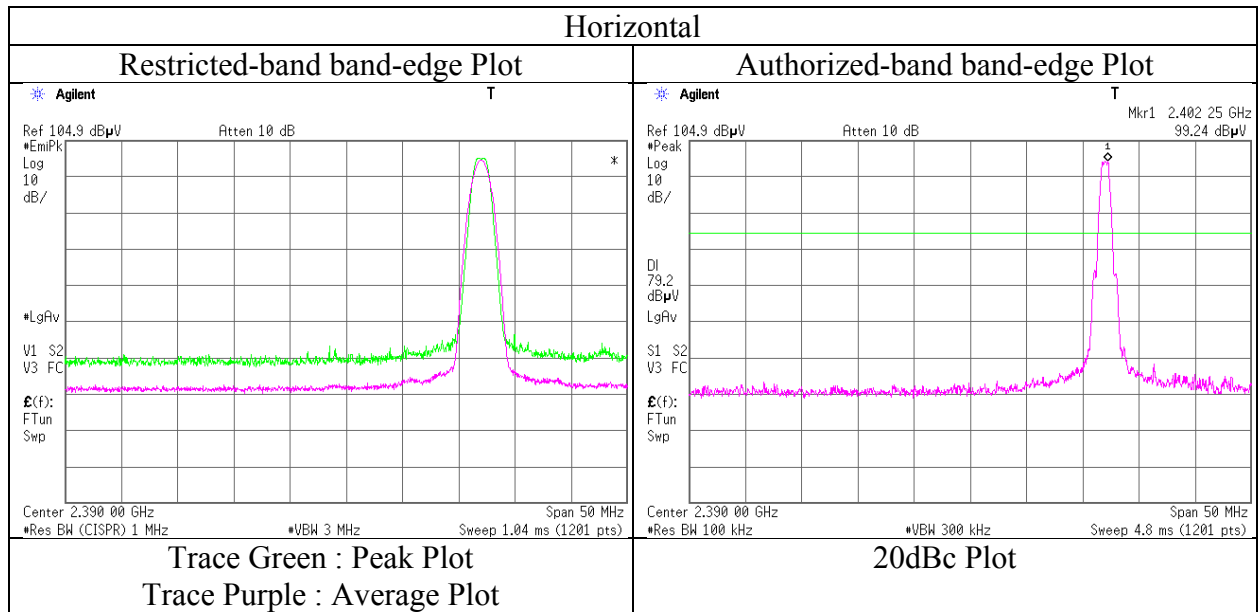
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	10955210S-A
Date	September 11, 2015
Temperature / Humidity	25 deg. C / 55 % RH
Engineer	Shinichi Takano
Mode	Tx BT LE 2402 MHz



* Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 10955210S-A
Date : September 11, 2015
Temperature / Humidity : 25 deg. C / 55 % RH
Engineer : Shinichi Takano
Mode : Tx BT LE 2440 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	520.000	QP	22.2	18.1	9.6	32.0	0.0	17.9	46.0	28.1	100	0	
Hori.	4880.000	PK	51.2	32.2	5.8	39.5	3.5	53.2	73.9	20.7	103	279	
Hori.	7320.000	PK	48.3	36.3	7.2	40.2	3.5	55.1	73.9	18.8	100	10	
Hori.	9760.000	PK	45.0	38.3	8.2	39.5	3.5	55.5	73.9	18.4	117	238	
Hori.	12200.000	PK	43.8	40.7	9.4	39.4	3.5	58.0	73.9	15.9	100	0	
Vert.	78.003	QP	32.7	6.3	7.6	32.1	0.0	14.5	40.0	25.5	100	219	
Vert.	91.777	QP	27.8	8.5	7.7	32.1	0.0	11.9	43.5	31.6	100	2	
Vert.	104.882	QP	26.5	10.7	7.4	32.1	0.0	12.5	43.5	31.0	100	359	
Vert.	111.432	QP	27.3	11.7	7.4	32.1	0.0	14.3	43.5	29.2	100	13	
Vert.	117.988	QP	28.2	12.6	7.4	32.1	0.0	16.1	43.5	27.4	100	281	
Vert.	4880.000	PK	50.4	32.2	5.8	39.5	3.5	52.4	73.9	21.5	100	84	
Vert.	7320.000	PK	48.7	36.3	7.2	40.2	3.5	55.5	73.9	18.4	102	67	
Vert.	9760.000	PK	46.2	38.3	8.2	39.5	3.5	56.7	73.9	17.2	208	272	
Vert.	12200.000	PK	43.7	40.7	9.4	39.4	3.5	57.9	73.9	16.0	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(4.47\text{ m} / 3.0\text{ m}) = 3.5\text{ dB}$

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Dwell Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	45.6	32.2	5.8	39.5	-30.1	3.5	17.5	53.9	36.4	
Hori.	7320.000	AV	39.9	36.3	7.2	40.2	-30.1	3.5	16.6	53.9	37.3	
Hori.	9760.000	AV	37.0	38.3	8.2	39.5	-30.1	3.5	17.4	53.9	36.5	
Hori.	12200.000	AV	36.1	40.7	9.4	39.4	-30.1	3.5	20.2	53.9	33.7	
Vert.	4880.000	AV	44.5	32.2	5.8	39.5	-30.1	3.5	16.4	53.9	37.5	
Vert.	7320.000	AV	40.9	36.3	7.2	40.2	-30.1	3.5	17.6	53.9	36.3	
Vert.	9760.000	AV	36.6	38.3	8.2	39.5	-30.1	3.5	17.0	53.9	36.9	
Vert.	12200.000	AV	36.0	40.7	9.4	39.4	-30.1	3.5	20.1	53.9	33.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Dwell(time)factor + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(4.47\text{ m} / 3.0\text{ m}) = 3.5\text{ dB}$

Dwell (time) factor refer to "Dwell time factor Calculation chart" sheet.

Radiated Spurious Emission

Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 10955210S-A
Date : September 11, 2015
Temperature / Humidity : 25 deg. C / 55 % RH
Engineer : Shinichi Takano
Mode : Tx BT LE 2480 MHz

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	520.000	QP	22.1	18.1	9.6	32.0	0.0	17.8	46.0	28.2	100	0	
Hori.	2483.500	PK	50.2	27.3	13.7	41.0	3.5	53.7	73.9	20.2	100	297	
Hori.	4960.000	PK	49.5	32.4	5.8	39.4	3.5	51.8	73.9	22.1	100	244	
Hori.	7440.000	PK	48.1	36.3	7.2	40.4	3.5	54.7	73.9	19.2	106	46	
Hori.	9920.000	PK	45.8	38.3	8.2	39.4	3.5	56.4	73.9	17.5	161	231	
Hori.	12400.000	PK	45.4	40.6	9.6	39.6	3.5	59.5	73.9	14.4	100	0	
Hori.	2483.500	AV	39.0	27.3	13.7	41.0	3.5	42.5	53.9	11.4	100	297	
Vert.	77.996	QP	33.0	6.3	7.6	32.1	0.0	14.8	40.0	25.2	100	141	
Vert.	91.745	QP	27.1	8.5	7.7	32.1	0.0	11.2	43.5	32.3	100	356	
Vert.	104.869	QP	26.0	10.7	7.4	32.1	0.0	12.0	43.5	31.5	100	308	
Vert.	111.420	QP	26.6	11.7	7.4	32.1	0.0	13.6	43.5	29.9	100	11	
Vert.	117.993	QP	28.2	12.6	7.4	32.1	0.0	16.1	43.5	27.4	100	191	
Vert.	2483.500	PK	50.4	27.3	13.7	41.0	3.5	53.9	73.9	20.0	100	264	
Vert.	4960.000	PK	48.9	32.4	5.8	39.4	3.5	51.2	73.9	22.7	104	95	
Vert.	7440.000	PK	49.4	36.3	7.2	40.4	3.5	56.0	73.9	17.9	100	285	
Vert.	9920.000	PK	46.4	38.3	8.2	39.4	3.5	57.0	73.9	16.9	100	283	
Vert.	12400.000	PK	45.3	40.6	9.6	39.6	3.5	59.4	73.9	14.5	100	0	
Vert.	2483.500	AV	39.4	27.3	13.7	41.0	3.5	42.9	53.9	11.0	100	264	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(4.47\text{ m} / 3.0\text{ m}) = 3.5\text{ dB}$

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Dwell Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4960.000	AV	42.6	32.4	5.8	39.4	-30.1	3.5	14.8	53.9	39.1	
Hori.	7440.000	AV	39.3	36.3	7.2	40.4	-30.1	3.5	15.8	53.9	38.1	
Hori.	9920.000	AV	35.6	38.3	8.2	39.4	-30.1	3.5	16.1	53.9	37.8	
Hori.	12400.000	AV	36.0	40.6	9.6	39.6	-30.1	3.5	20.0	53.9	33.9	
Vert.	4960.000	AV	41.5	32.4	5.8	39.4	-30.1	3.5	13.7	53.9	40.2	
Vert.	7440.000	AV	40.6	36.3	7.2	40.4	-30.1	3.5	17.1	53.9	36.8	
Vert.	9920.000	AV	37.2	38.3	8.2	39.4	-30.1	3.5	17.7	53.9	36.2	
Vert.	12400.000	AV	36.2	40.6	9.6	39.6	-30.1	3.5	20.2	53.9	33.7	

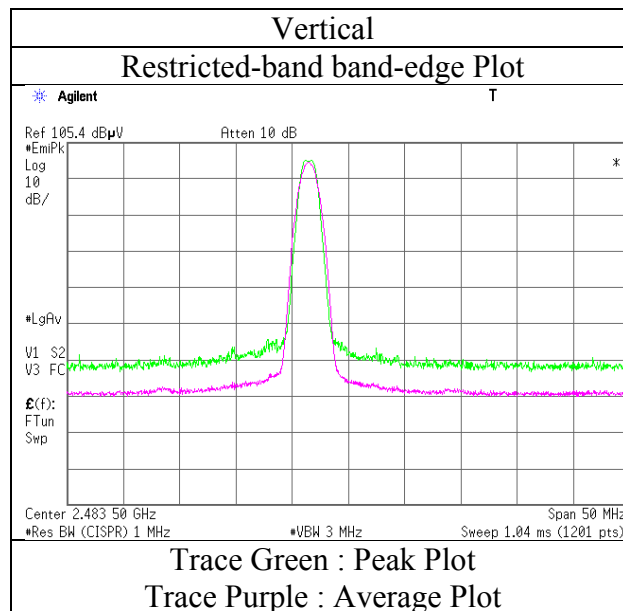
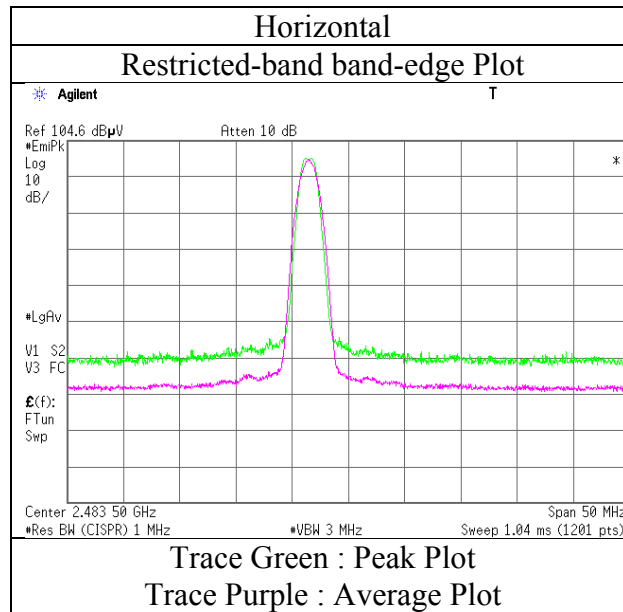
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Dwell(time)factor + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(4.47\text{ m} / 3.0\text{ m}) = 3.5\text{ dB}$

Dwell (time) factor refer to "Dwell time factor Calculation chart" sheet.

Radiated Spurious Emission
(Reference Plot for band-edge)

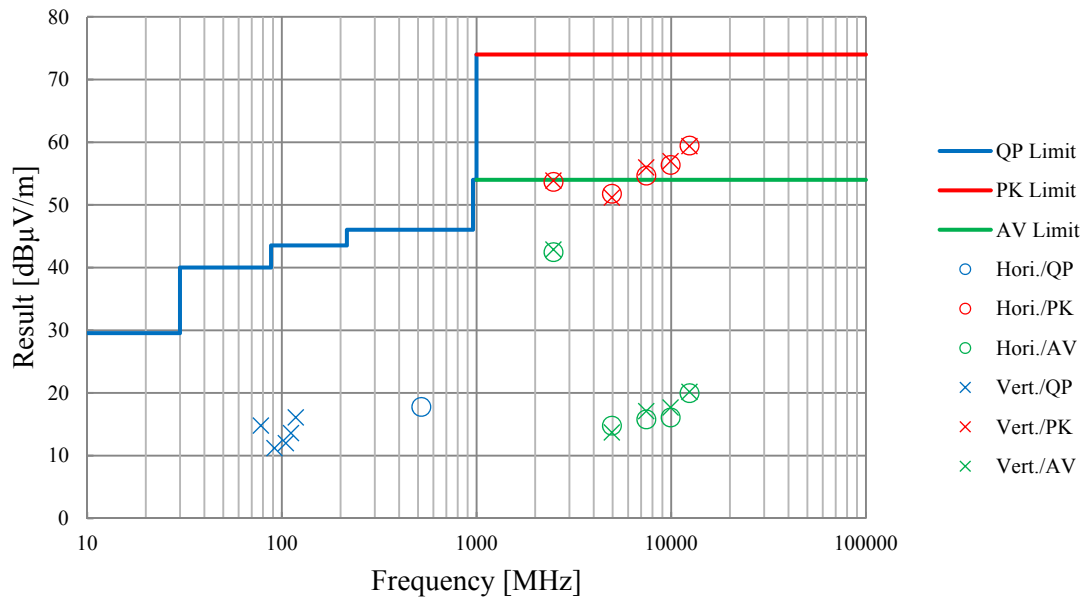
Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 10955210S-A
Date : September 11, 2015
Temperature / Humidity : 25 deg. C / 55 % RH
Engineer : Shinichi Takano
Mode : Tx BT LE 2480 MHz



* Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case)

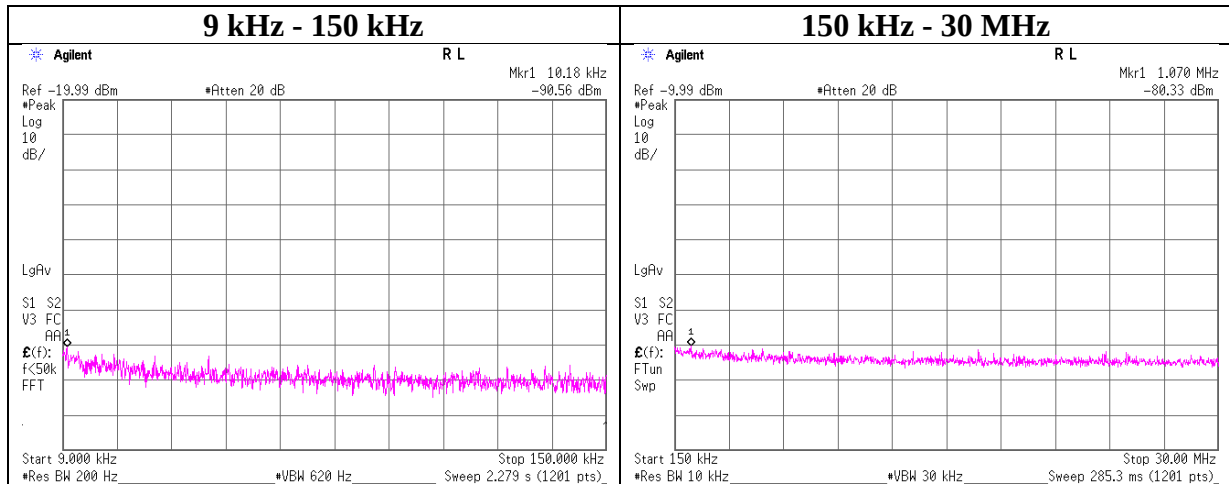
Test place : Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 10955210S-A
Date : September 11, 2015
Temperature / Humidity : 25 deg. C / 55 % RH
Engineer : Shinichi Takano
Mode : Tx BT LE 2480 MHz



*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.6 Shielded Room
Report No. : 10955210S-A
Date : September 11, 2015
Temperature / Humidity : 21 deg. C / 50 % RH
Engineer : Tomohiro Hara
Mode : Tx BT LE 2402 MHz



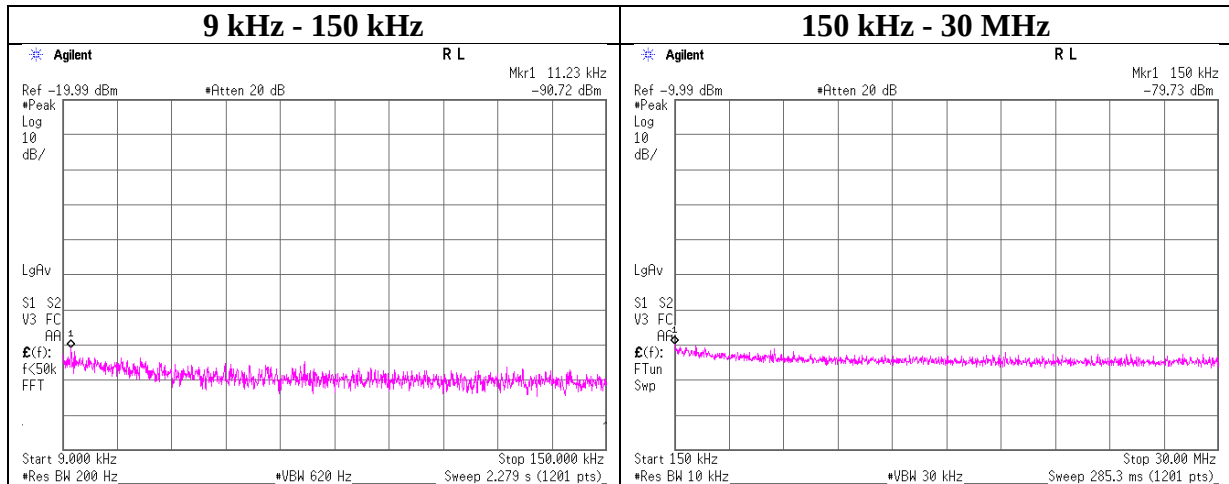
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.18	-90.6	1.02	9.8	2.5	1	-77.2	300	6.0	-15.9	47.4	63.3	
1070.00	-80.3	1.02	9.8	2.5	1	-66.9	30	6.0	14.3	27.0	12.7	

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

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.6 Shielded Room
Report No. : 10955210S-A
Date : September 11, 2015
Temperature / Humidity : 21 deg. C / 50 % RH
Engineer : Tomohiro Hara
Mode : Tx BT LE 2440 MHz



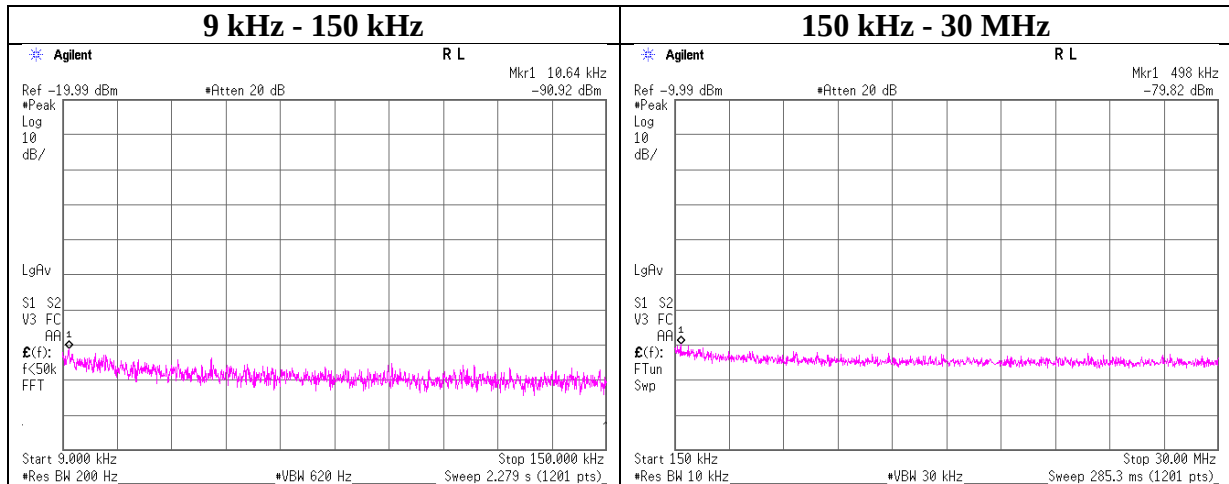
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.23	-90.7	1.02	9.8	2.5	1	-77.3	300	6.0	-16.1	46.5	62.6	
150.00	-79.7	1.02	9.8	2.5	1	-66.3	300	6.0	-5.1	24.0	29.1	

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

$$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$$

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.6 Shielded Room
Report No. : 10955210S-A
Date : September 11, 2015
Temperature / Humidity : 21 deg. C / 50 % RH
Engineer : Tomohiro Hara
Mode : Tx BT LE 2480 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
10.64	-90.9	1.02	9.8	2.5	1	-77.5	300	6.0	-16.3	47.0	63.3	
498.00	-79.8	1.02	9.8	2.5	1	-66.4	30	6.0	14.8	33.6	18.8	

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

$$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss} + \text{Antenna Gain} + 10 * \log(N)$$

Power Density

Test place Shonan EMC Lab. No.6 Shielded Room
Report No. 10955210S-A
Date September 11, 2015
Temperature / Humidity 21 deg. C / 50 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

BTLE

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402.00	-21.09	0.95	9.93	-10.21	8.00	18.21
2440.00	-20.63	0.90	9.93	-9.80	8.00	17.80
2480.00	-20.51	0.87	9.93	-9.71	8.00	17.71

Sample Calculation:

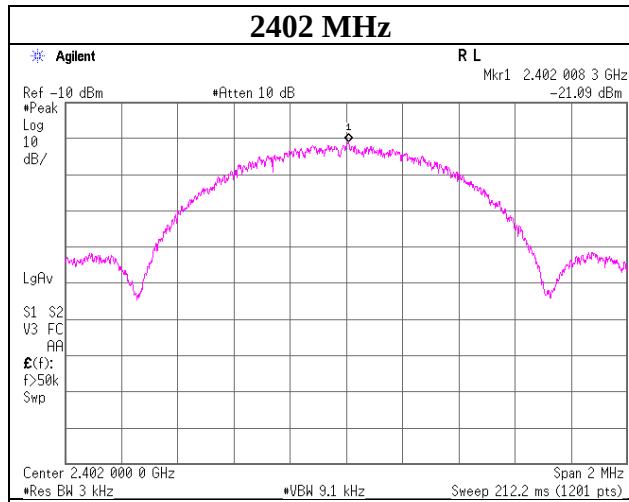
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

*The equipment and cables were not used for factor 0 dB of the data sheets.

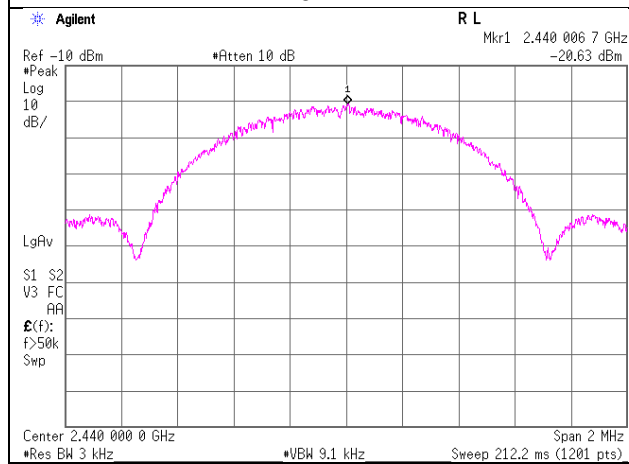
Power Density

BTLE

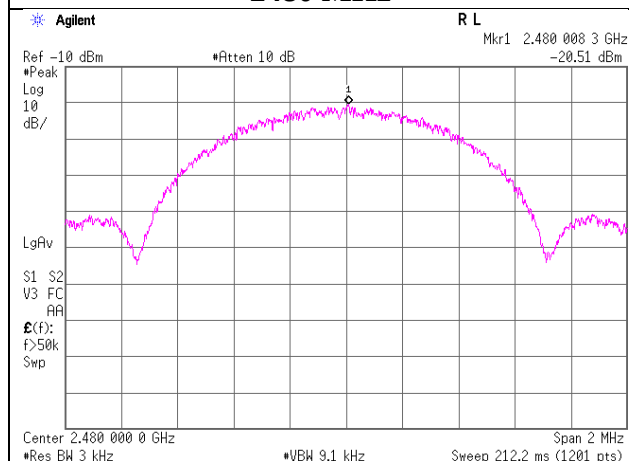
2402 MHz



2440 MHz



2480 MHz



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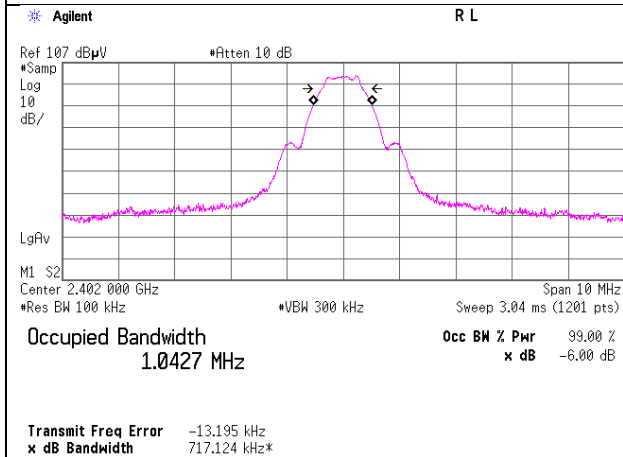
Facsimile : +81 463 50 6401

99%Occupied Bandwidth

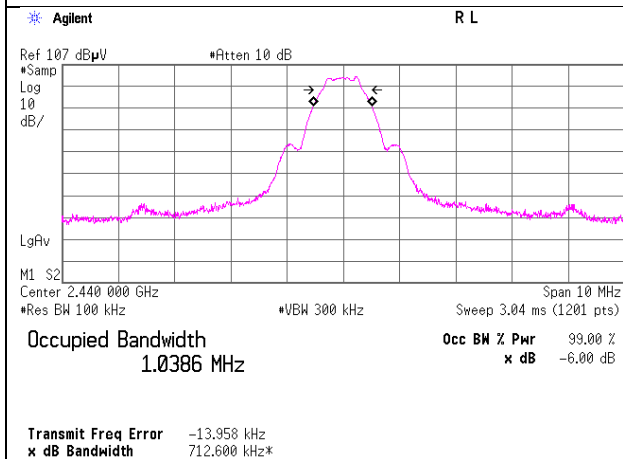
Test place Shonan EMC Lab. No.6 Shielded Room
Report No. 10955210S-A
Date September 11, 2015
Temperature / Humidity 21 deg. C / 50 % RH
Engineer Tomohiro Hara
Mode Tx BT LE

BTLE

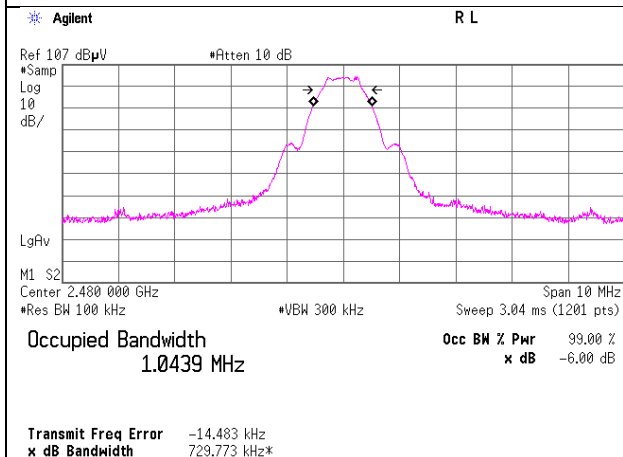
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	1440491	RE	2015/05/27 * 12
SCC-G04	Coaxial Cable	Junkosha	J12J102207-00	JUN-12-14-018	RE	2015/06/08 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2015/05/19 * 12
KHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	230	RE	2015/05/18 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2014/10/30 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2015/03/23 * 12
SJM-15	Measure	ASKUL	-	-	RE	-
SAEC-03(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-03(SV SWR)	3	RE	2015/08/28 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,M F)	-	RE	-
SAT10-05	Attenuator(above1GHz)	Agilent	8493C-010	74864	RE	2014/11/21 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2014/11/21 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM3640	RE	2015/03/17 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2015/03/23 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2015/07/16 * 12
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2014/10/18 * 12
SLA-03	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0901	RE	2014/10/18 * 12
SAT6-08	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	RE	2015/08/31 * 12
SCC-C1/C2/C3/C4/C5/C10/SR SE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSF A/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	RE	2015/04/17 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2015/02/18 * 12
STR-06	Test Receiver	Rohde & Schwarz	ESCI	101259	RE	2015/03/24 * 12
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE	2014/11/11 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	AT	2015/03/26 * 12
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2015/04/07 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2015/04/07 * 12
SOS-10	Humidity Indicator	A&D	AD-5681	4064561	AT	2014/10/30 * 12
SAT10-10	Attenuator	Weinschel Corp.	54A-10	37584	AT	2015/04/09 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2015/03/11 * 12
STS-06	Digital Hitester	Hioki	3805-50	080997830	AT	2015/03/10 * 12

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test Item: RE: Radiated Emission test
AT: Antenna Terminal Conducted test

UL Japan, Inc.

Shonan EMC Lab.

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