RADIO TEST REPORT

Test Report No. : 11527591H-B-R1

Applicant	:	**TandD Corporation**
Type of Equipment	:	**Thermo Recorder**
Model No.	:	**TR41**
FCC ID	:	**SRD50070**
Test regulation	:	**FCC Part 15 Subpart C: 2016**
Test Result	:	**Complied**

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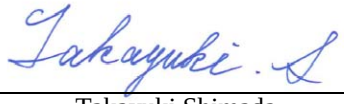
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 11527591H-B. 11527591H-B is replaced with this report.

Date of test: November 16 to 18, 2016

Representative test engineer:

Masafumi Niwa
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.
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http://japan.ul.com/resources/emc_accredited/

REVISION HISTORY

Original Test Report No.: 11527591H-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	11527591H-B	December 9, 2016	-	-
1	11527591H-B-R1	January 16, 2017	P23-25	Deletion of explanatory note for antenna gain

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SECTION 1: Customer information

Company Name	:	TandD Corporation
Address	:	817-1 Shimadachi, Matsumoto City Nagano, 390-0852 Japan
Telephone Number	:	+81-263-40-0027
Facsimile Number	:	+81-263-40-3152
Contact Person	:	Masaya Futatsugi

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

2.1 Identification of E.U.T.

Type of Equipment	:	Thermo Recorder
Model No.	:	TR41
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.6 V (DC 2.6 V to 3.7 V)
Receipt Date of Sample	:	November 10, 2016
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: TR41 (referred to as the EUT in this report) is a Thermo Recorder.

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Power Supply (radio part input)	:	DC 1.8 V
Antenna type	:	Inverted F Antenna
Antenna Gain	:	2.14 dBi
Clock frequency (Crystal)	:	16 MHz

Variant models

The EUT has variant models: TR42 and TR45.
The difference of these models is only sensor and they are completely identical in radio characteristic.
Model No: TR41 was tested as a representative, because it had the worst result compared with TR42 and TR45.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on November 14, 2016 and effective December 14, 2016
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 November 14, 2016, does not affect the test specification applied to the EUT.
* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods **IC:** RSS-Gen 8.8	**FCC:** Section 15.207 **IC:** RSS-Gen 8.8	-	N/A *1)	-
6dB Bandwidth	**FCC:** KDB 558074 D01 DTS Meas Guidance v03r05 **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 v03r05 **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 v03r05 **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 v03r05 **IC:** RSS-Gen 6.13	**FCC:** Section15.247(d) **IC:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	6.2 dB 7320.000MHz, Horizontal, AV	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 was not performed since the EUT was battery-powered equipment.
*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v03r05 12.2.7.

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

FCC Part 15.31 (e)
The test was performed with the New Battery (DC 3.6V) and the EUT constantly provides the stable voltage to RF part through the regulator regardless of input voltage from New Battery. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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

EMI

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

Ise EMC Lab.

Antenna terminal test Uncertainty (+/-)							
Power meter		Conducted emission and Power density			Conducted emission		Channel power
Below 1 GHz	Above 1 GHz	Below 1 GHz	1 GHz -3 GHz	3 GHz -18 GHz	18 GHz -26.5 GHz	26.5 GHz -40 GHz	
0.9 dB	1.0 dB	1.4 dB	1.5 dB	2.8 dB	2.8 dB	2.9 dB	2.6 dB

Polarity	Radiated emission (Below 1GHz)			
	(3 m*) (+/-)		(10 m*) (+/-)	
	30 – 200 MHz	200 – 1000MHz	30 – 200 MHz	200 – 1000MHz
Horizontal	5.0 dB	5.3 dB	5.0 dB	5.0 dB
Vertical	4.7 dB	5.9 dB	5.0 dB	5.1 dB

Radiated emission (Above 1GHz)				
(3 m*) (+/-)		(1 m*) (+/-)		(10 m*) (+/-)
1 – 6GHz	6 – 18GHz	10 – 26.5 GHz	26.5 – 40GHz	1 -18 GHz
5.2 dB	5.4 dB	5.5 dB	5.5 dB	5.4 dB

*Measurement distance

Radiated emission test

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

3.5 Test Location

UL Japan, Inc. Ise 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

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	N/A	-	-
No.9 measurement room	-	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m 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 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Remarks*
Bluetooth Low Energy (BT LE)	Maximum Packet Size, PRBS9
*Power of the EUT was set by the software as follows; Power settings: 4 dBm Software: T&D Corp. nRF51822/422 Radio Test, Ver.1.0.0.0 *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.	

*The details of Operating mode(s)

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

4.2 Configuration and peripherals

* Setup were taken into consideration and test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Thermo Recorder	TR41	1	TandD Corporation	EUT

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 v03r05".

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 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.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 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 200 MHz	200 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 *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces If duty cycle was less than 98%, a duty factor was added to the results.	RBW: 100 kHz VBW: 300kHz
Test Distance	3 m	3.75 m *2) (1 GHz - 10 GHz), 1 m *3) (10 GHz - 26.5 GHz)		3.75 m *2) (1 GHz - 10 GHz), 1 m *3) (10 GHz - 26.5 GHz)

*1) Average Power Measurement was performed based on 6. 0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v03r05".
*2) Distance Factor: 20 x log (3.75 m / 3.0 m) = 1.94 dB
*3) Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 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 : 30 MHz - 26.5 GHz
Test data : APPENDIX
Test result : Pass

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	3 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	10 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1 kHz	27 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 v03r05".
*4) 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

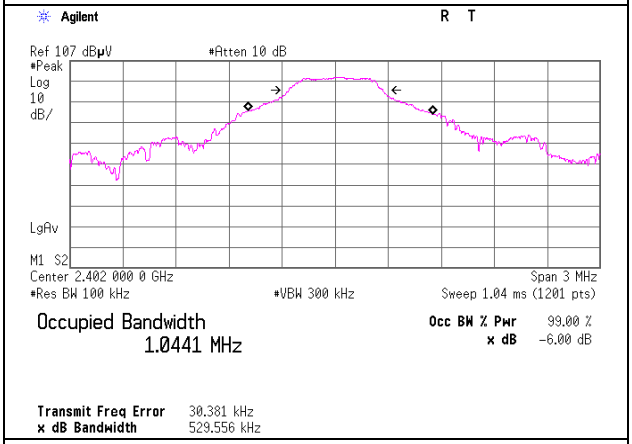
Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE

Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2402	0.530	> 500
2440	0.534	> 500
2480	0.535	> 500

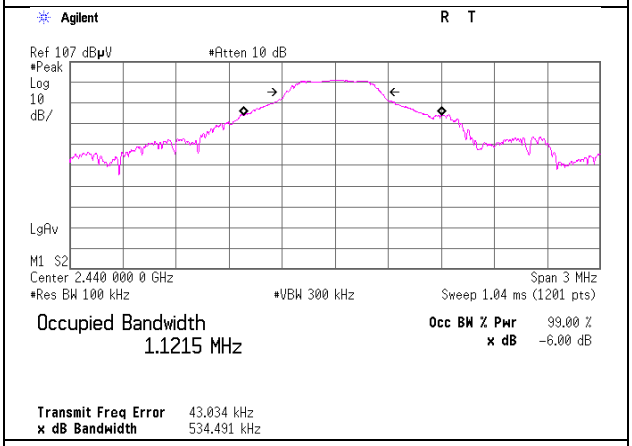
6dB Bandwidth

BT LE

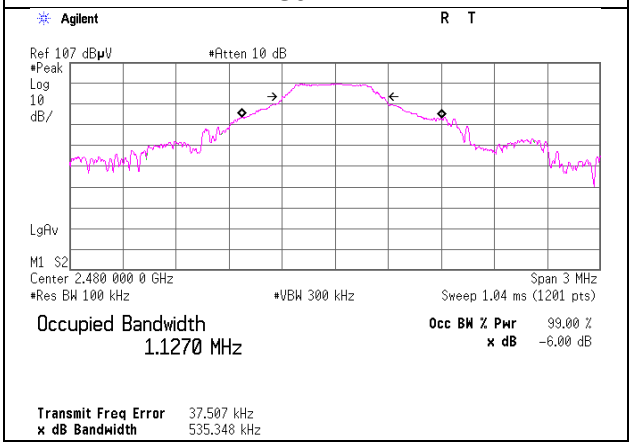
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE

Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-8.05	1.38	10.09	3.42	2.20	30.00	1000	26.58
2440	-8.80	1.39	10.09	2.68	1.85	30.00	1000	27.32
2480	-9.95	1.40	10.09	1.54	1.43	30.00	1000	28.46

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

Average Output Power
(Reference data for RF Exposure)

Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-8.45	1.38	10.09	3.02	2.00	0.05	3.07	2.03
2440	-9.17	1.39	10.09	2.31	1.70	0.05	2.36	1.72
2480	-10.41	1.40	10.09	1.08	1.28	0.05	1.13	1.30

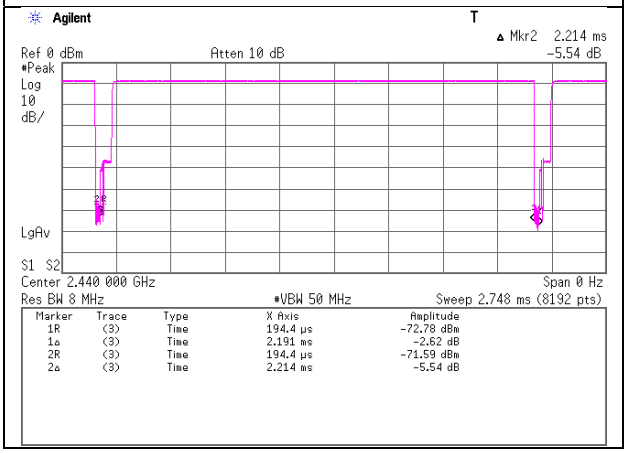
Sample Calculation:
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

Burst rate confirmation

Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE

BT LE

Tx on / (Tx on + Tx off) =	**0.990**
Tx on / (Tx on + Tx off) * 100 =	**99.0 %**
Duty factor = 10 * log (2.214 / 2.191) =	**0.05 dB**



Radiated Spurious Emission

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber	
Report No.	11527591H	
Date	November 16, 2016	November 16, 2016
Temperature / Humidity	23 deg. C / 33 % RH	22 deg. C / 35 % RH
Engineer	Takumi Shimada (Above 1GHz)	Masafumi Niwa (Below 1GHz)
Mode	Tx BT LE 2402 MHz	

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	38.130	QP	23.1	14.7	6.8	28.2	-	16.4	40.0	23.6	
Hori	60.621	QP	22.9	7.4	7.1	28.1	-	9.3	40.0	30.7	
Hori	130.376	QP	22.5	13.6	7.7	27.8	-	16.0	43.5	27.5	
Hori	316.243	QP	21.6	13.9	8.9	27.3	-	17.1	46.0	28.9	
Hori	408.023	QP	22.1	15.8	9.5	27.8	-	19.6	46.0	26.4	
Hori	726.665	QP	21.9	20.0	10.5	27.5	-	24.9	46.0	21.1	
Hori	2383.835	PK	58.4	27.6	5.0	34.8	-	56.2	73.9	17.7	
Hori	2390.000	PK	50.1	27.6	5.0	34.8	-	47.9	73.9	26.0	
Hori	4804.000	PK	45.0	31.5	7.2	34.1	-	49.6	73.9	24.3	
Hori	9608.000	PK	43.6	38.5	9.0	34.8	-	56.3	73.9	17.6	Floor noise
Hori	2383.835	AV	41.8	27.6	5.0	34.8	-	39.6	53.9	14.3	
Hori	2390.000	AV	36.8	27.6	5.0	34.8	-	34.6	53.9	19.3	
Hori	4804.000	AV	37.0	31.5	7.2	34.1	-	41.6	53.9	12.3	
Hori	9608.000	AV	34.8	38.5	9.0	34.8	-	47.5	53.9	6.4	Floor noise
Vert	38.130	QP	23.2	14.7	6.8	28.2	-	16.5	40.0	23.5	
Vert	60.621	QP	22.8	7.4	7.1	28.1	-	9.2	40.0	30.8	
Vert	130.376	QP	22.5	13.6	7.7	27.8	-	16.0	43.5	27.5	
Vert	316.243	QP	21.6	13.9	8.9	27.3	-	17.1	46.0	28.9	
Vert	408.023	QP	22.1	15.8	9.5	27.8	-	19.6	46.0	26.4	
Vert	726.665	QP	21.9	20.0	10.5	27.5	-	24.9	46.0	21.1	
Vert	2383.835	PK	59.8	27.6	5.0	34.8	-	57.6	73.9	16.3	
Vert	2390.000	PK	51.7	27.6	5.0	34.8	-	49.5	73.9	24.4	
Vert	4804.000	PK	42.0	31.5	7.2	34.1	-	46.6	73.9	27.3	
Vert	9608.000	PK	43.1	38.5	9.0	34.8	-	55.8	73.9	18.1	Floor noise
Vert	2383.835	AV	41.6	27.6	5.0	34.8	-	39.4	53.9	14.5	
Vert	2390.000	AV	37.4	27.6	5.0	34.8	-	35.2	53.9	18.7	
Vert	4804.000	AV	34.3	31.5	7.2	34.1	-	38.9	53.9	15.0	
Vert	9608.000	AV	34.8	38.5	9.0	34.8	-	47.5	53.9	6.4	Floor noise

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

20dBc Data Sheet

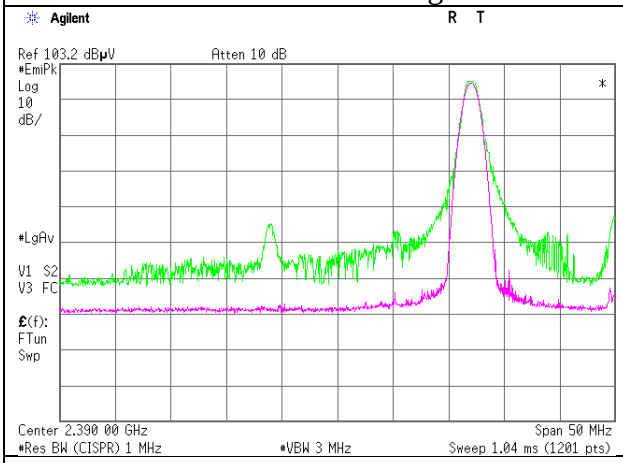
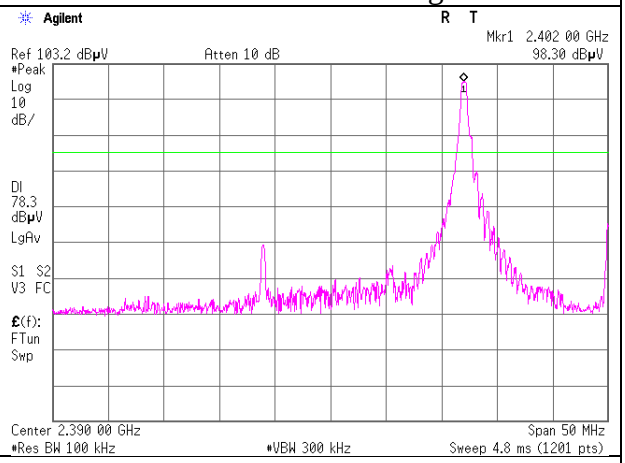
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	98.3	27.6	5.1	34.8	96.2	-	-	Carrier
Hori	2298.778	PK	52.7	27.5	4.9	34.8	50.3	76.2	25.9	
Hori	2400.000	PK	56.5	27.6	5.1	34.8	54.4	76.2	21.8	
Hori	7206.000	PK	40.3	36.1	8.5	34.1	50.8	76.2	25.4	
Vert	2402.000	PK	97.5	27.6	5.1	34.8	95.4	-	-	Carrier
Vert	2298.778	PK	53.2	27.5	4.9	34.8	50.8	75.4	24.6	
Vert	2400.000	PK	57.6	27.6	5.1	34.8	55.5	75.4	19.9	
Vert	7206.000	PK	38.5	36.1	8.5	34.1	49.0	75.4	26.4	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

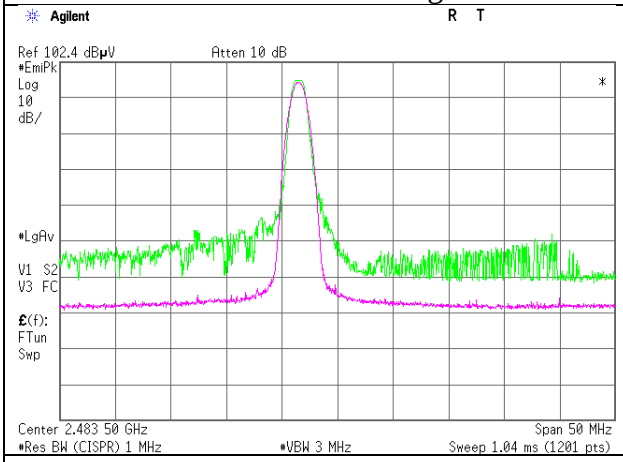
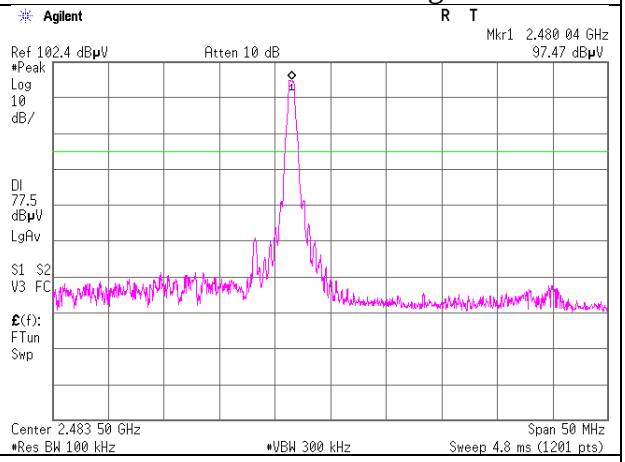
Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11527591H
Date	November 16, 2016
Temperature / Humidity	23 deg. C / 33 % RH
Engineer	Takumi Shimada (Above 1GHz)
Mode	Tx BT LE 2402 MHz

Horizontal

Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

Vertical

Restricted-band band-edge Plot	Authorized-band band-edge Plot
	
Trace Green : Peak Plot Trace Purple : Average Plot	20dBc Plot

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

Radiated Spurious Emission

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber	
Report No.	11527591H	
Date	November 16, 2016	November 16, 2016
Temperature / Humidity	23 deg. C / 33 % RH	22 deg. C / 35 % RH
Engineer	Takumi Shimada (Above 1GHz)	Masafumi Niwa (Below 1GHz)
Mode	Tx BT LE 2440 MHz	

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	38.133	QP	23.1	14.7	6.8	28.2	-	16.4	40.0	23.6	
Hori	60.620	QP	22.9	7.4	7.1	28.1	-	9.3	40.0	30.7	
Hori	130.325	QP	22.4	13.6	7.7	27.8	-	15.9	43.5	27.6	
Hori	316.241	QP	21.6	13.9	8.9	27.3	-	17.1	46.0	28.9	
Hori	408.033	QP	22.0	15.8	9.5	27.8	-	19.5	46.0	26.5	
Hori	726.661	QP	21.9	20.0	10.5	27.5	-	24.9	46.0	21.1	
Hori	4880.000	PK	45.2	31.7	7.2	34.1	-	50.0	73.9	23.9	
Hori	7320.000	PK	44.4	36.3	8.5	34.1	-	55.1	73.9	18.8	
Hori	9760.000	PK	42.1	38.5	9.0	34.8	-	54.8	73.9	19.1	Floor noise
Hori	4880.000	AV	36.4	31.7	7.2	34.1	-	41.2	53.9	12.7	
Hori	7320.000	AV	37.0	36.3	8.5	34.1	-	47.7	53.9	6.2	
Hori	9760.000	AV	33.6	38.5	9.0	34.8	-	46.3	53.9	7.6	Floor noise
Vert	38.133	QP	23.2	14.7	6.8	28.2	-	16.5	40.0	23.5	
Vert	60.620	QP	22.8	7.4	7.1	28.1	-	9.2	40.0	30.8	
Vert	130.325	QP	22.5	13.6	7.7	27.8	-	16.0	43.5	27.5	
Vert	316.241	QP	21.6	13.9	8.9	27.3	-	17.1	46.0	28.9	
Vert	408.033	QP	22.1	15.8	9.5	27.8	-	19.6	46.0	26.4	
Vert	726.661	QP	21.9	20.0	10.5	27.5	-	24.9	46.0	21.1	
Vert	4880.000	PK	42.8	31.7	7.2	34.1	-	47.6	73.9	26.3	
Vert	7320.000	PK	44.6	36.3	8.5	34.1	-	55.3	73.9	18.6	
Vert	9760.000	PK	41.8	38.5	9.0	34.8	-	54.5	73.9	19.4	Floor noise
Vert	4880.000	AV	34.7	31.7	7.2	34.1	-	39.5	53.9	14.4	
Vert	7320.000	AV	36.3	36.3	8.5	34.1	-	47.0	53.9	6.9	
Vert	9760.000	AV	33.6	38.5	9.0	34.8	-	46.3	53.9	7.6	Floor noise

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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	2440.000	PK	97.0	27.7	5.1	34.7	95.1	-	-	Carrier
Hori	2546.036	PK	53.2	27.8	5.1	34.6	51.5	75.1	23.6	
Vert	2440.000	PK	97.9	27.7	5.1	34.7	96.0	-	-	Carrier
Vert	2546.036	PK	51.1	27.8	5.1	34.6	49.4	76.0	26.6	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Radiated Spurious Emission

Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber	
Report No.	11527591H	
Date	November 16, 2016	November 16, 2016
Temperature / Humidity	23 deg. C / 33 % RH	22 deg. C / 35 % RH
Engineer	Takumi Shimada (Above 1GHz)	Masafumi Niwa (Below 1GHz)
Mode	Tx BT LE 2480 MHz	

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	38.111	QP	23.1	14.7	6.8	28.2	-	16.4	40.0	23.6	
Hori	60.689	QP	22.9	7.4	7.1	28.1	-	9.3	40.0	30.7	
Hori	130.355	QP	22.4	13.6	7.7	27.8	-	15.9	43.5	27.6	
Hori	316.271	QP	21.6	13.9	8.9	27.3	-	17.1	46.0	28.9	
Hori	408.133	QP	22.1	15.8	9.5	27.8	-	19.6	46.0	26.4	
Hori	726.763	QP	21.8	20.0	10.5	27.5	-	24.8	46.0	21.2	
Hori	2483.500	PK	54.5	27.7	5.1	34.7	-	52.6	73.9	21.3	
Hori	4960.000	PK	41.4	32.0	7.3	34.2	-	46.5	73.9	27.4	
Hori	7440.000	PK	43.4	36.4	8.5	34.1	-	54.2	73.9	19.7	
Hori	9920.000	PK	41.4	38.6	9.1	34.9	-	54.2	73.9	19.7	Floor noise
Hori	2483.500	AV	36.6	27.7	5.1	34.7	-	34.7	53.9	19.2	
Hori	4960.000	AV	31.2	32.0	7.3	34.2	-	36.3	53.9	17.6	
Hori	7440.000	AV	32.6	36.4	8.5	34.1	-	43.4	53.9	10.5	
Hori	9920.000	AV	31.6	38.6	9.1	34.9	-	44.4	53.9	9.5	Floor noise
Vert	38.111	QP	23.2	14.7	6.8	28.2	-	16.5	40.0	23.5	
Vert	60.689	QP	23.0	7.4	7.1	28.1	-	9.4	40.0	30.6	
Vert	130.355	QP	22.5	13.6	7.7	27.8	-	16.0	43.5	27.5	
Vert	316.271	QP	21.6	13.9	8.9	27.3	-	17.1	46.0	28.9	
Vert	408.133	QP	22.0	15.8	9.5	27.8	-	19.5	46.0	26.5	
Vert	726.763	QP	21.9	20.0	10.5	27.5	-	24.9	46.0	21.1	
Vert	2483.500	PK	53.7	27.7	5.1	34.7	-	51.8	73.9	22.1	
Vert	4960.000	PK	41.9	32.0	7.3	34.2	-	47.0	73.9	26.9	
Vert	7440.000	PK	44.0	36.4	8.5	34.1	-	54.8	73.9	19.1	
Vert	9920.000	PK	42.2	38.6	9.1	34.9	-	55.0	73.9	18.9	Floor noise
Vert	2483.500	AV	36.7	27.7	5.1	34.7	-	34.8	53.9	19.1	
Vert	4960.000	AV	31.5	32.0	7.3	34.2	-	36.6	53.9	17.3	
Vert	7440.000	AV	33.2	36.4	8.5	34.1	-	44.0	53.9	9.9	
Vert	9920.000	AV	31.7	38.6	9.1	34.9	-	44.5	53.9	9.4	Floor noise

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz 20log (3.75 m / 3.0 m) = 1.94 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

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	2480.000	PK	97.5	27.7	5.1	34.7	95.6	-	-	Carrier
Hori	2510.414	PK	54.6	27.7	5.1	34.7	52.7	75.6	22.9	
Hori	2546.107	PK	46.5	27.8	5.1	34.6	44.8	75.6	30.8	
Vert	2480.000	PK	97.4	27.7	5.1	34.7	95.5	-	-	Carrier
Vert	2510.414	PK	57.0	27.7	5.1	34.7	55.1	75.5	20.4	
Vert	2546.107	PK	53.2	27.8	5.1	34.6	51.5	75.5	24.0	

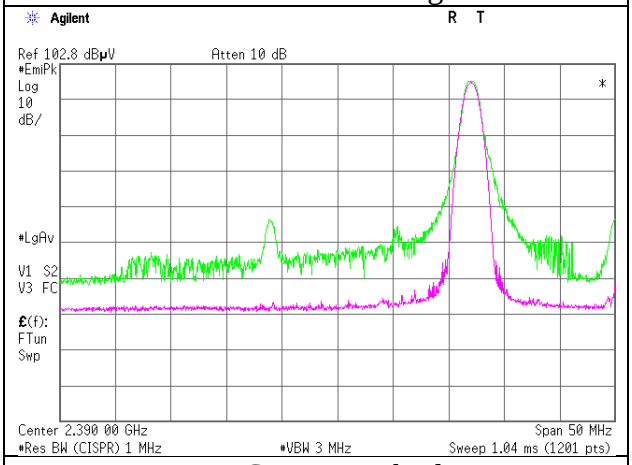
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amprifier)

Radiated Spurious Emission
(Reference Plot for band-edge)

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	11527591H
Date	November 16, 2016
Temperature / Humidity	23 deg. C / 33 % RH
Engineer	Takumi Shimada
	(1 GHz -10 GHz)
Mode	Tx BT LE 2480 MHz

Horizontal

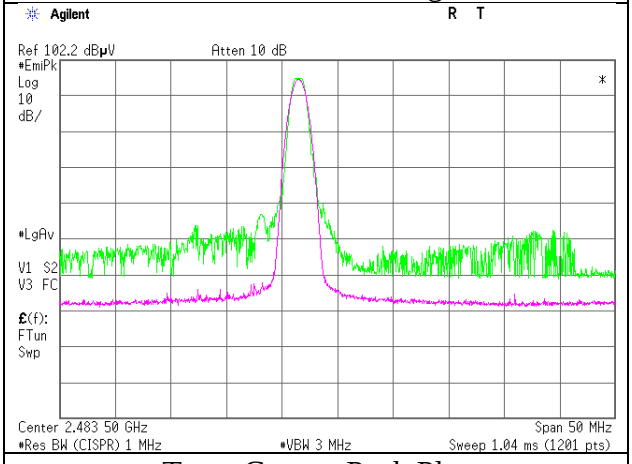
Restricted-band band-edge Plot



Trace Green : Peak Plot
Trace Purple : Average Plot

Vertical

Restricted-band band-edge Plot

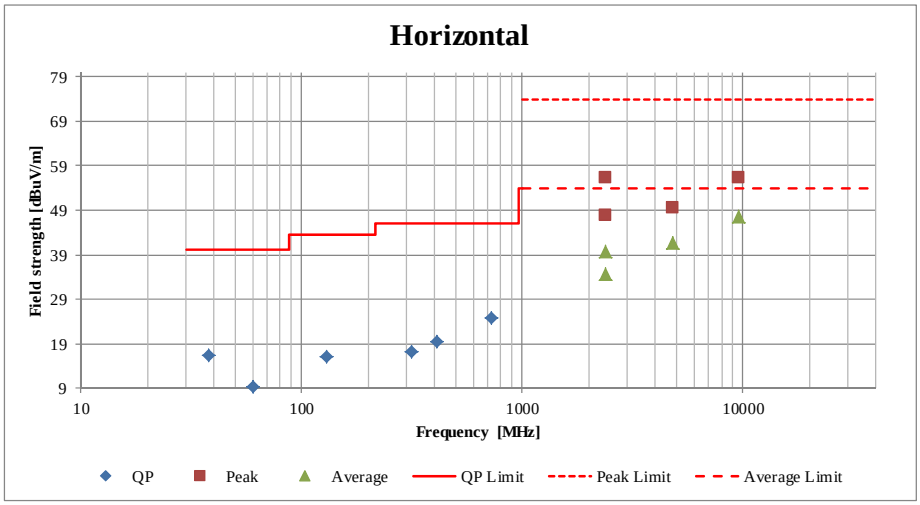


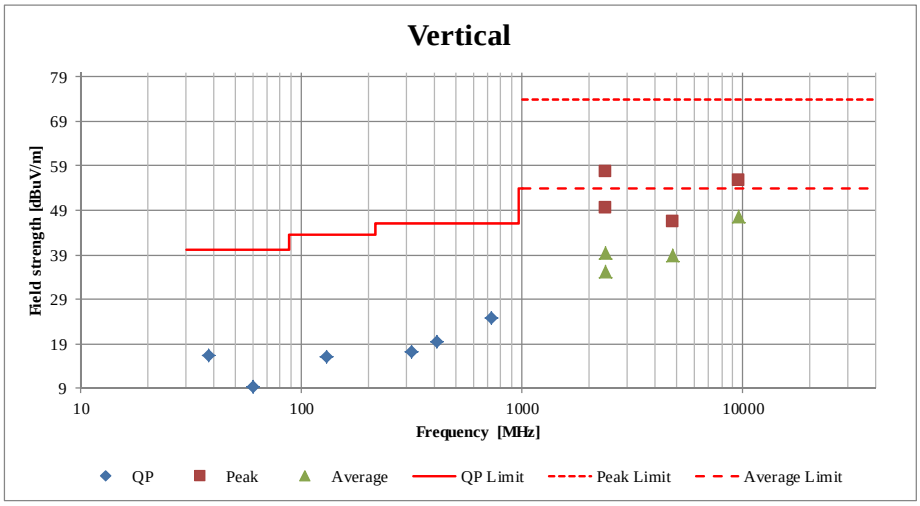
Trace Green : Peak Plot
Trace Purple : Average Plot

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

Radiated Spurious Emission
(Plot data, Worst case)

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber	
Report No.	11527591H	
Date	November 16, 2016	November 16, 2016
Temperature / Humidity	23 deg. C / 33 % RH	22 deg. C / 35 % RH
Engineer	Takumi Shimada (Above 1GHz)	Masafumi Niwa (Below 1GHz)
Mode	Tx BT LE 2402 MHz	



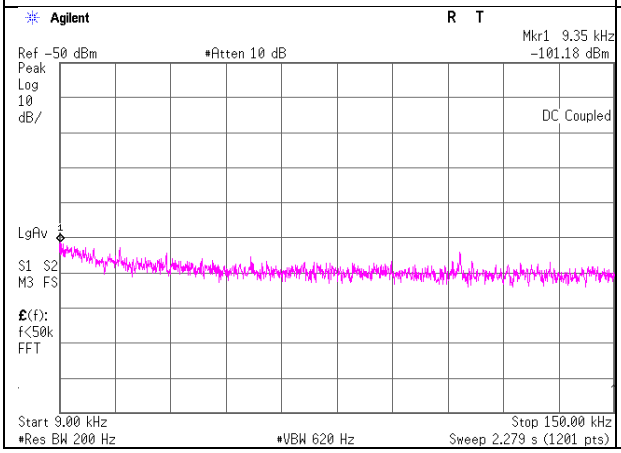


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

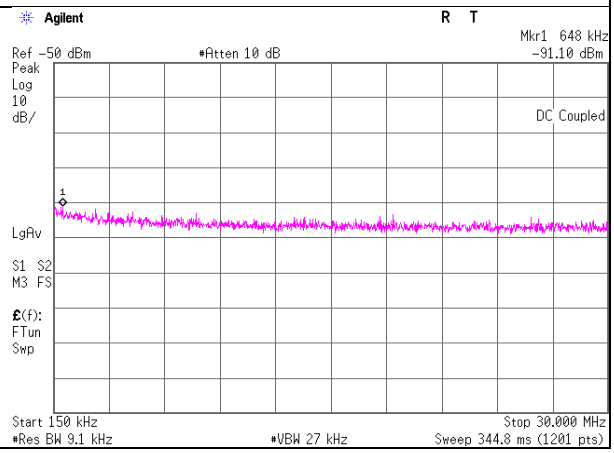
Conducted Spurious Emission

Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE 2402 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



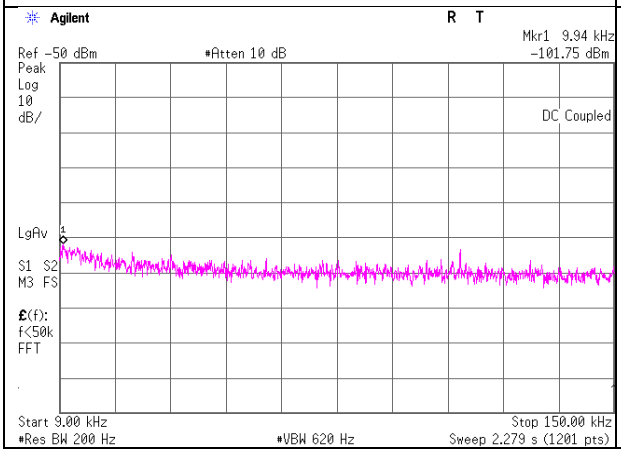
Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
9.35	-101.2	0.01	9.8	2.14	1	-89.2	300	6.0	-28.0	48.1	76.1	
648.00	-91.1	0.01	9.9	2.14	1	-79.1	30	6.0	2.2	31.3	29.1	

E [dBuV/m] = EIRP [dBm] - 20 log (Distance [m]) + Ground bounce [dB] + 104.8 [dBuV/m]
EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)
N: Number of output

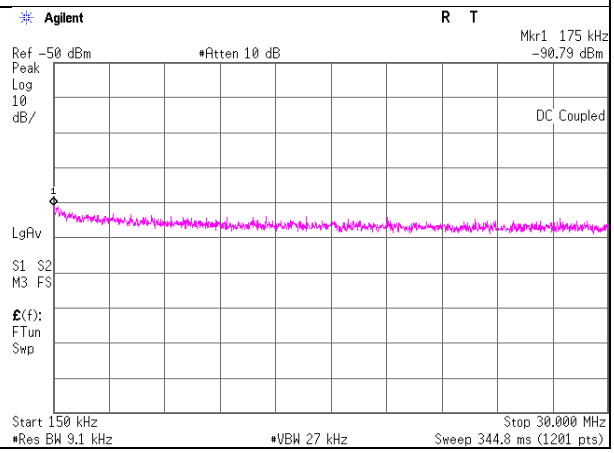
Conducted Spurious Emission

Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE 2440 MHz

9 kHz - 150 kHz



150 kHz - 30 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
9.94	-101.8	0.01	9.8	2.14	1	-89.8	300	6.0	-28.5	47.6	76.1	
175.00	-90.8	0.01	9.9	2.14	1	-78.7	300	6.0	-17.5	22.7	40.2	

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

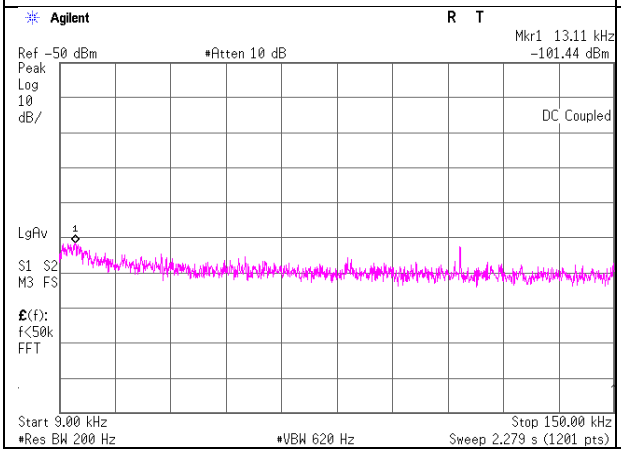
EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

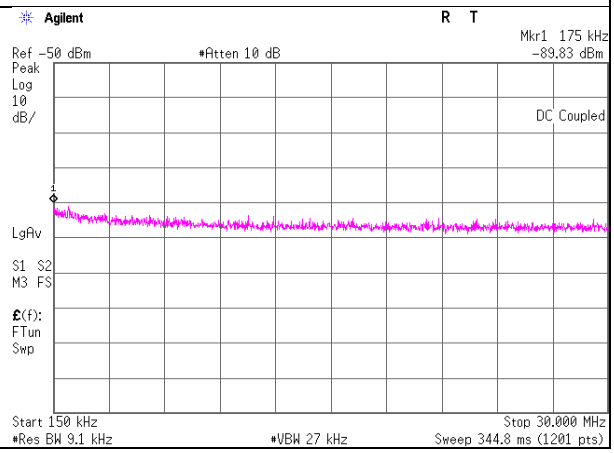
Conducted Spurious Emission

Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE 2480 MHz

9 kHz - 150 kHz



150 kHz - 30 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
13.11	-101.4	0.01	9.8	2.14	1	-89.5	300	6.0	-28.2	45.2	73.4	
175.00	-89.8	0.01	9.9	2.14	1	-77.8	300	6.0	-16.5	22.7	39.2	

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

EIRP[dBm] = Reading [dBm] + Cable loss [dB] + Attenuator Loss [dB] + Antenna gain [dBi] + 10 * log (N)

N: Number of output

Power Density

Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE

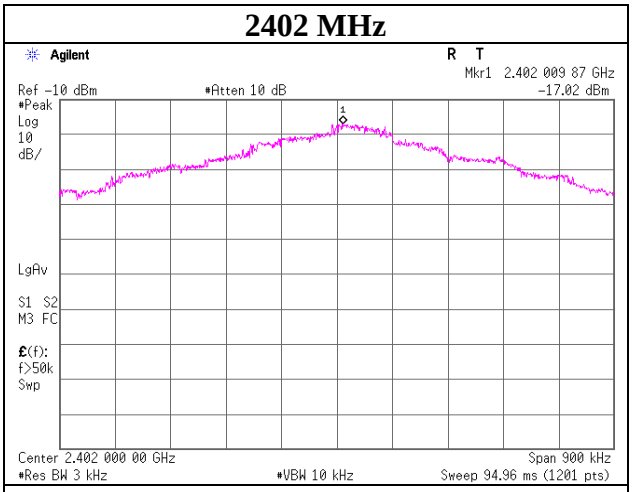
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-17.02	1.38	10.09	-5.55	8.00	13.55
2440.00	-18.14	1.39	10.09	-6.66	8.00	14.66
2480.00	-20.11	1.40	10.09	-8.62	8.00	16.62

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

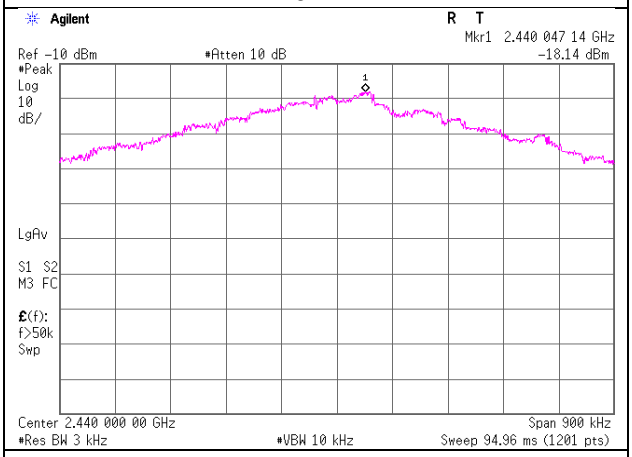
Power Density

BT LE

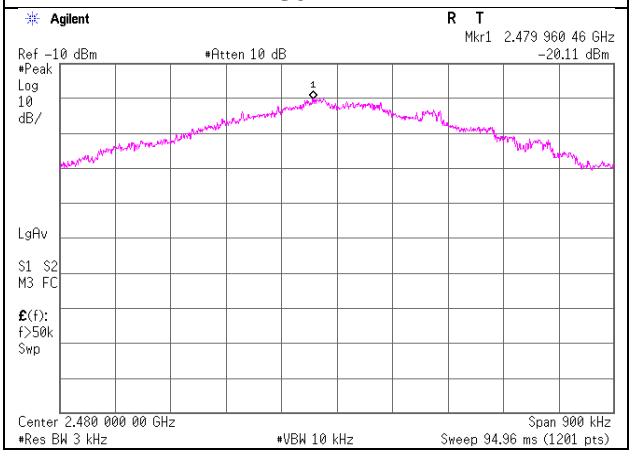
2402 MHz



2440 MHz



2480 MHz

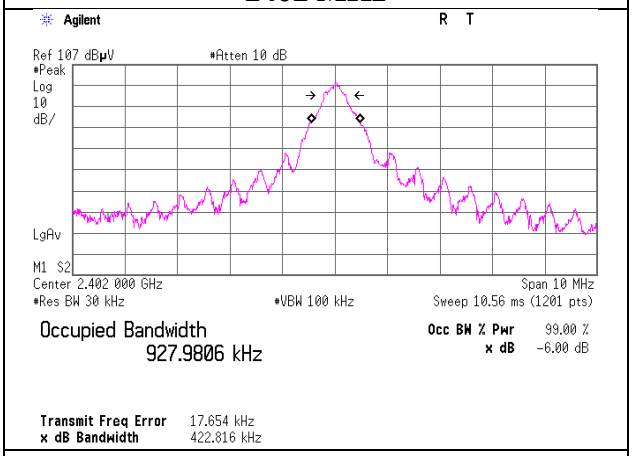


99%Occupied Bandwidth

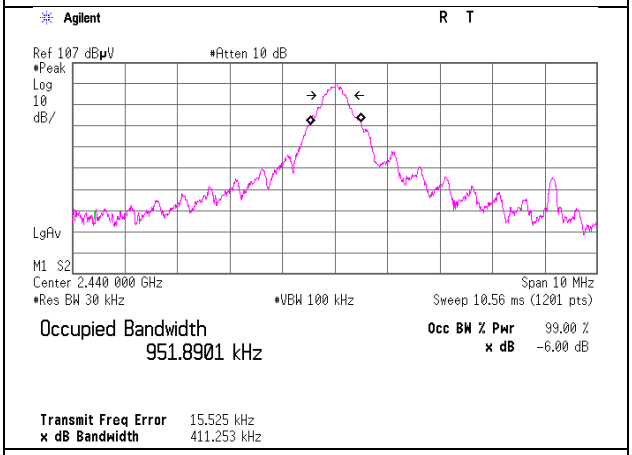
Test place	Ise EMC Lab. No.2 Measurement Room
Report No.	11527591H
Date	November 18, 2016
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Masafumi Niwa
Mode	Tx BT LE

BT LE

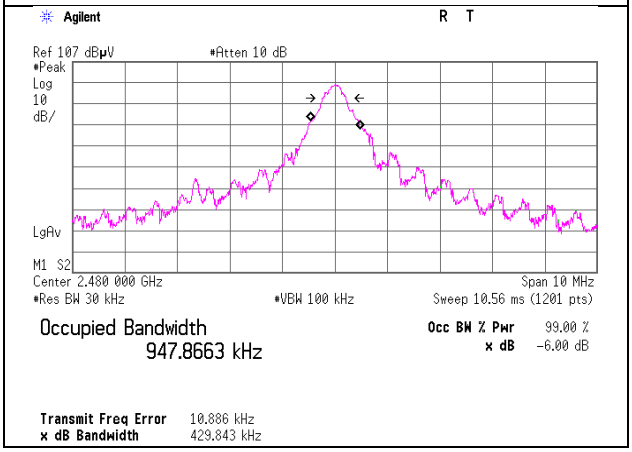
2402 MHz



2440 MHz



2480 MHz



APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE	2016/08/02 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE/AT	2016/01/21 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2016/05/19 * 12
MHA-06	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	RE	2016/02/29 * 12
MCC-216	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 1608S087(5 m)	RE	2016/08/29 * 12
MPA-10	Pre Amplifier	Agilent	8449B	3008A02142	RE	2016/01/19 * 12
MHA-02	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	RE	2016/02/29 * 12
MMM-01	Digital Tester	Fluke	FLUKE 26-3	78030611	RE/AT	2016/08/23 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2016/09/21 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	RE	2016/10/21 * 12
MBA-08	Biconical Antenna	Schwarzbeck	VHA9103B	08031	RE	2016/09/29 * 12
MLA-21	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	RE	2016/01/30 * 12
MCC-12	Coaxial Cable	Fujikura/Agilent	-	-	RE	2016/02/08 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2015/11/10 * 12
MPA-09	Pre Amplifier	Agilent	8447D	2944A10845	RE	2016/09/13 * 12
MSA-14	Spectrum Analyzer	Agilent	E4440A	MY48250080	AT	2016/10/14 * 12
MPM-14	Power meter	Virginia Diodes, Inc.	PM4	137V	AT	2016/09/30 * 12
MPSE-17	Power sensor	Anritsu	MA2411B	0738285	AT	2016/06/06 * 12
MCC-66	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	AT	2016/04/18 * 12
MAT-23	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2016/03/18 * 12
MCC-64	Coaxial Cable	UL Japan	-	-	AT	2016/03/10 * 12
MAT-10	Attenuator(10dB)	Weinschel Corp	2	BL1173	AT	2015/11/10 * 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