



RADIO TEST REPORT

Test Report No. : 12012868S-G-R1

Applicant : Sony Corporation
Type of Equipment : Wireless Noise Canceling Stereo Headset
Model No. : WF-SP700N
FCC ID : AK8WFSP700N
Test regulation : FCC Part 15 Subpart C: 2017
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)
7. This report is a revised version of 12012868S-G. 12012868S-G is replaced with this report.

Date of test: November 1 to 8, 2017

Representative test engineer:

Shiro Kobayashi
Engineer
Consumer Technology Division

Approved by:

Toyokazu Imamura
Leader
Consumer Technology Division



- The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
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13-EM-F0429

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SECTION 1: Customer information

Company Name : Sony Corporation
Address : 1-7-1 Konan Minato-ku, Tokyo, 108-0075, Japan
Telephone Number : +81-50-3141-6224
Contact Person : Kohei Akane

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

2.1 Identification of E.U.T.

Type of Equipment : Wireless Noise Canceling Stereo Headset
Model No. : WF-SP700N
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 3.7 V: Built-in lithium-ion rechargeable battery
DC 5 V: When charged using BC-WFSP700N
Receipt Date of Sample : October 18, 2017
Country of Mass-production : Malaysia
Condition of EUT : Engineering prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT : No Modification by the test lab

2.2 Product Description

Model: WF-SP700N (referred to as the EUT in this report) is a Wireless Noise Canceling Stereo Headset.

General Specification

Clock frequency(ies) in the system : 26 MHz

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 2402 MHz - 2480 MHz
Modulation : GFSK, $\pi/4$ -DQPSK, 8DQPSK
Power Supply (radio part input) : DC 1.35 V
Antenna type : FPC Antenna
Antenna Gain : -1.43 dBi (Lch), -2.08 dBi (Rch)

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on November 2, 2017

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 2, 2017, does not affect the test specification applied to the EUT.

* Also the EUT complies with FCC Part 15 Subpart B. Refer to the test report: 12012868S-J.

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 v04 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	0.1 dB 4960.000 MHz, AV, Hori. Tx BT LE 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 EUT operates with a battery. AC Line can be connected to the EUT via other device's USB port; however, the EUT stops transmission during recharging. Therefore, the test is not applicable to the EUT.

*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v04 12.2.7.

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

FCC Part 15.31 (e)

The EUT is a battery-operated device and test was performed with the full-charged 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.

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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 $k=2$.

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Item	Frequency range	Uncertainty (+/-)				
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR	No. 5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.5 dB	2.6 dB	2.5 dB	2.5 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.1 dB	3.1 dB	3.1 dB	-	-
	30 MHz-200 MHz	4.6 dB	4.4 dB	4.6 dB	-	-
	200 MHz-1 GHz	5.8 dB	5.7 dB	5.8 dB	-	-
Radiated emission (Measurement distance: 1 m)	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
	13 GHz-18 GHz	4.6 dB	4.6 dB	4.6 dB	-	-
Radiated emission (Measurement distance: 1 m)	18 GHz-40 GHz	4.9 dB	4.9 dB	4.9 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	0.72 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.85 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.74 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	0.91 dB
Spurious emission (Conducted) below 1GHz	1.6 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.3 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.2 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.3 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	1.01 %
Duty cycle and Time Measurement	0.012 %

Radiated emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

3.5 Test Location

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1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
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JAB Accreditation No. RTL02610
FCC Test Firm Registration Number: 839876

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	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
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

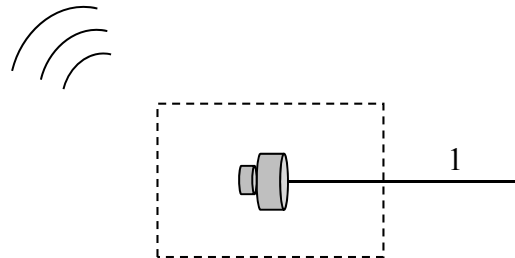
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Frequency	Remarks*
Bluetooth Low Energy	2402 MHz, 2440 MHz, 2480 MHz	PRBS9
*Power of the EUT was set by the software as follows; - Power Setting: Fixed - Software: CSR BlueSuite BlueTest3 Version 2.6.6 *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



A: EUT

* 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	Wireless Noise Canceling Stereo Headset *1)	WF-SP700N	ET00063 *2) ET00062 *3)	Sony	EUT

*1) EUT has two sides: L side and R side. The test had been pre-checked and performed with the worst side.

*2) Used for Antenna Terminal conducted test

*3) Used for Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal	0.01	Unshielded	Unshielded	*4)

*4) Cable for test operation

SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "KDB 558074 D01 DTS Meas Guidance v04".

[For below 1 GHz]

EUT was placed on a platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity. 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: <u>12.2.5.2</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz
Test Distance	3 m	3.98 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)		3.98 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)

*1) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v04".

*2) Distance Factor: $20 \times \log(3.98 \text{ m}/3.0 \text{ m}) = 2.47 \text{ dB}$

*3) Distance Factor: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

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- 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.

Antenna polarization	Frequency				
	Below 1 GHz	1 GHz - 2.8 GHz	2.8 GHz - 13 GHz	13 GHz - 18 GHz	18 GHz - 26.5 GHz
Horizontal	X	Y	Y	X	Y
Vertical	X	Z	X	X	Y

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 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	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	Sample	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/Average *2)	-	Power Meter (Sensor: 160 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	9.1 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	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 v04". *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 = 10 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

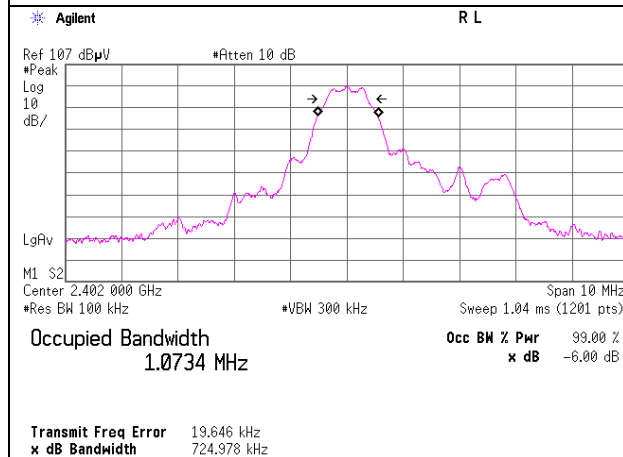
Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 12012868S-G-R1
Date November 2, 2017
Temperature / Humidity 22 deg. C / 41 % RH
Engineer Makoto Hosaka
Mode Tx BT LE

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
BTLE	2402	0.725	> 500
	2440	0.722	> 500
	2480	0.730	> 500

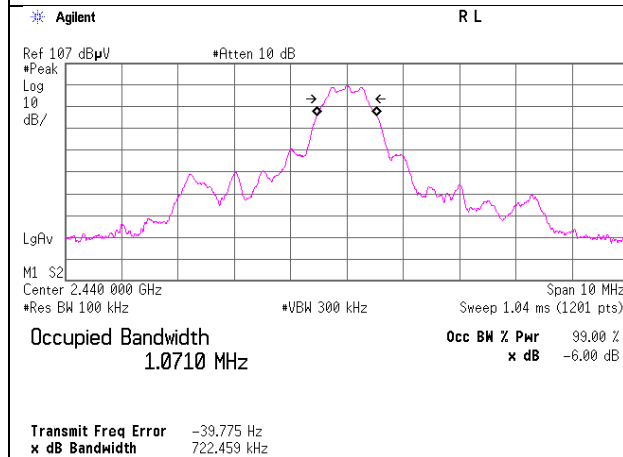
6dB Bandwidth

BTLE

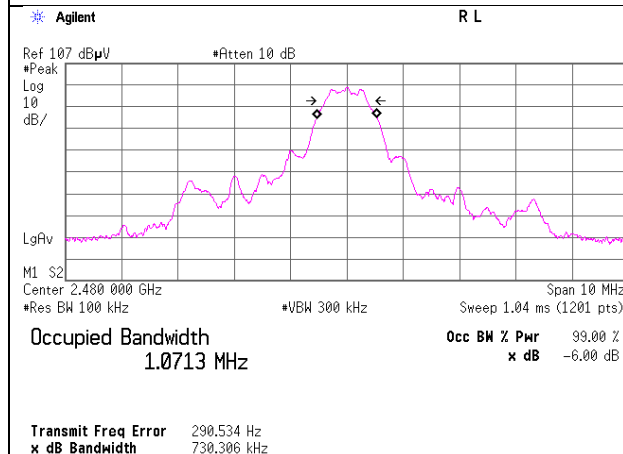
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 12012868S-G-R1
Date : November 1, 2017
Temperature / Humidity : 23 deg. C / 37 % RH
Engineer : Tatsuya Arai
Mode : Tx BT LE

L side

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-9.38	1.63	9.85	2.10	1.62	30.00	1000	27.90
2440	-9.97	1.64	9.84	1.51	1.42	30.00	1000	28.49
2480	-10.71	1.65	9.84	0.78	1.20	30.00	1000	29.22

Sample Calculation:

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

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

R side

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-10.45	1.63	9.85	1.03	1.27	30.00	1000	28.97
2440	-10.72	1.64	9.84	0.76	1.19	30.00	1000	29.24
2480	-11.29	1.65	9.84	0.20	1.05	30.00	1000	29.80

Sample Calculation:

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

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

Average Output Power
(Reference data for SAR testing)

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 12012868S-G-R1
Date November 1, 2017
Temperature / Humidity 23 deg. C / 37 % RH
Engineer Tatsuya Arai
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-12.00	1.63	9.85	-0.52	0.89	1.63	1.11	1.29
2440	-12.61	1.64	9.84	-1.13	0.77	1.63	0.50	1.12
2480	-13.37	1.65	9.84	-1.88	0.65	1.63	-0.25	0.94

Sample Calculation:

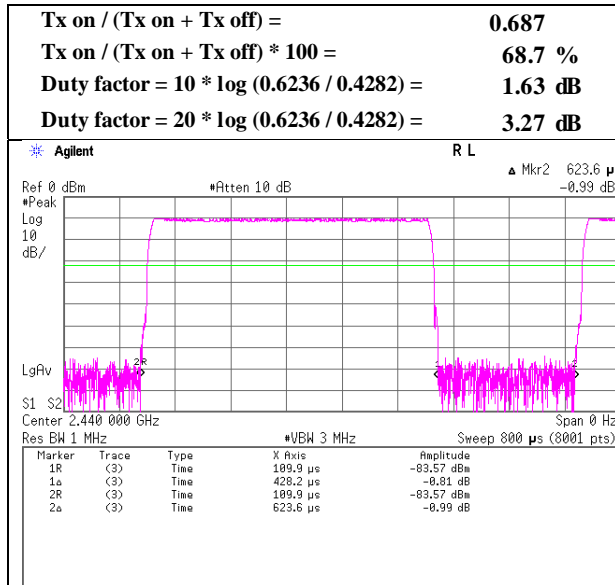
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

Result (Burst power average) = Time average + Duty factor

Burst rate confirmation

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	12012868S-G-R1
Date	November 2, 2017
Temperature / Humidity	22 deg. C / 41 % RH
Engineer	Makoto Hosaka
Mode	Tx BT LE

BT LE



* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Radiated Spurious Emission

Report No.	12012868S-G-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	November 8, 2017	November 4, 2017
Temperature / Humidity	23 deg. C / 53 % RH	22 deg. C / 48 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi
	(30 MHz - 1 GHz)	(1 GHz - 26.5 GHz)
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.	193.045	QP	21.35	16.53	9.02	31.77	0.00	15.13	43.50	28.3	100	0	
Hori.	623.392	QP	21.54	19.29	8.70	31.99	0.00	17.54	46.00	28.4	100	359	
Hori.	929.210	QP	20.50	22.20	10.08	31.09	0.00	21.69	46.00	24.3	100	0	
Hori.	2390.000	PK	45.76	27.14	14.23	40.85	2.47	48.75	73.90	25.1	155	335	
Hori.	4804.000	PK	56.57	31.13	6.72	41.86	2.47	55.03	73.90	18.8	141	354	
Hori.	7206.000	PK	46.87	36.35	8.21	41.18	2.47	52.72	73.90	21.1	150	0	
Hori.	9608.000	PK	47.20	38.11	9.37	40.59	2.47	56.56	73.90	17.3	150	0	
Hori.	19220.000	PK	45.52	40.44	12.83	45.28	-9.54	43.97	73.90	29.9	139	74	
Vert.	32.636	QP	22.06	16.76	7.08	31.83	0.00	14.07	40.00	25.9	100	0	
Vert.	146.364	QP	21.40	14.54	8.75	31.77	0.00	12.92	43.50	30.5	100	359	
Vert.	174.372	QP	21.48	15.73	8.97	31.77	0.00	14.41	43.50	29.0	100	359	
Vert.	715.802	QP	21.34	19.90	9.16	31.96	0.00	18.44	46.00	27.5	100	0	
Vert.	2390.000	PK	46.92	27.14	14.23	40.85	2.47	49.91	73.90	23.9	165	71	
Vert.	4804.000	PK	53.25	31.13	6.72	41.86	2.47	51.71	73.90	22.1	138	324	
Vert.	7206.000	PK	46.97	36.35	8.21	41.18	2.47	52.82	73.90	21.0	150	0	
Vert.	9608.000	PK	47.35	38.11	9.37	40.59	2.47	56.71	73.90	17.1	150	0	
Vert.	19220.000	PK	45.81	40.44	12.83	45.28	-9.54	44.26	73.90	29.6	133	227	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.47 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant. Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	36.08	27.14	14.23	40.85	3.27	2.47	42.34	53.90	11.6	*1)
Hori.	4804.000	AV	50.63	31.13	6.72	41.86	3.27	2.47	52.36	53.90	1.5	
Hori.	7206.000	AV	37.81	36.35	8.21	41.18	3.27	2.47	46.93	53.90	7.0	
Hori.	9608.000	AV	36.95	38.11	9.37	40.59	3.27	2.47	49.58	53.90	4.3	
Hori.	19220.000	AV	39.00	40.44	12.83	45.28	3.27	-9.54	40.72	53.90	13.2	
Vert.	2390.000	AV	36.68	27.14	14.23	40.85	3.27	2.47	42.94	53.90	11.0	*1)
Vert.	4804.000	AV	45.55	31.13	6.72	41.86	3.27	2.47	47.28	53.90	6.6	
Vert.	7206.000	AV	37.49	36.35	8.21	41.18	3.27	2.47	46.61	53.90	7.3	
Vert.	9608.000	AV	37.34	38.11	9.37	40.59	3.27	2.47	49.97	53.90	3.9	
Vert.	19220.000	AV	38.63	40.44	12.83	45.28	3.27	-9.54	40.35	53.90	13.6	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.47 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

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	86.27	27.18	14.24	40.84	2.47	89.32	-	-	Carrier
Hori.	2400.000	PK	41.62	27.17	14.23	40.84	2.47	44.65	69.32	24.7	
Vert.	2402.000	PK	83.38	27.18	14.24	40.84	2.47	86.43	-	-	Carrier
Vert.	2400.000	PK	41.46	27.17	14.23	40.84	2.47	44.49	66.43	21.9	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.47 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

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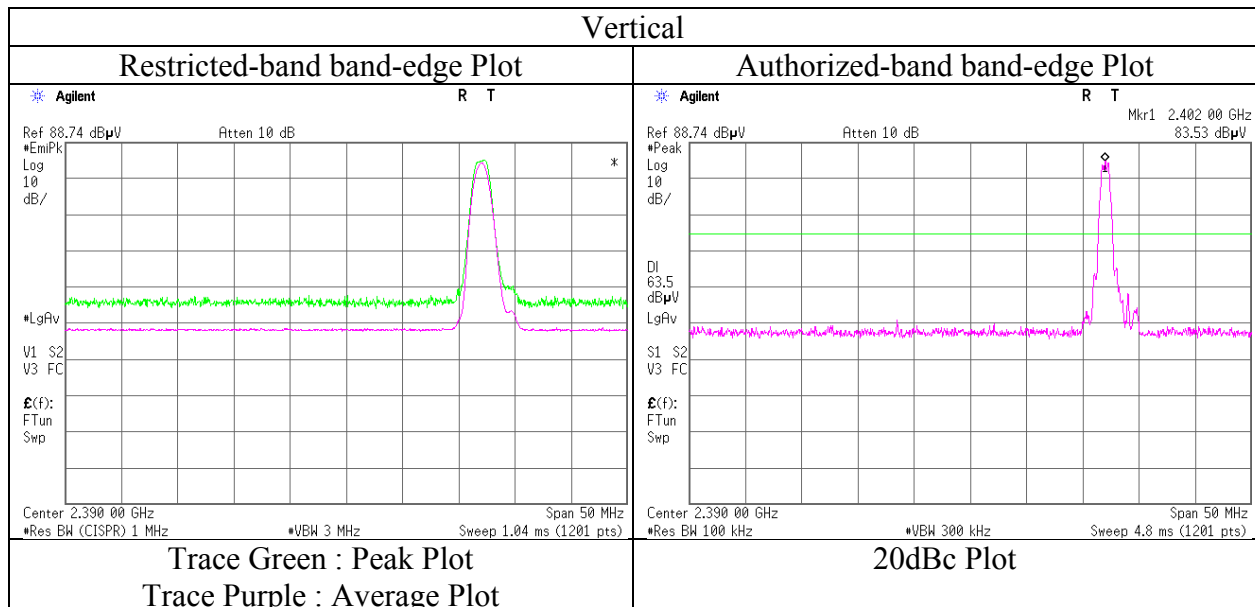
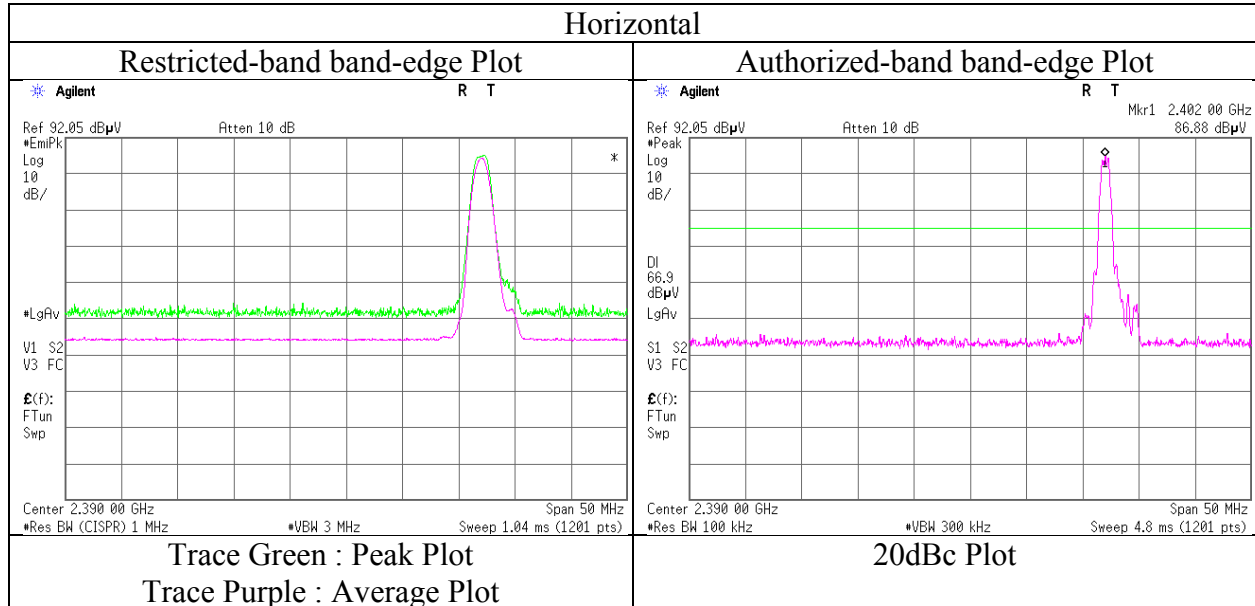
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	12012868S-G-R1
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.1
Date	November 4, 2017
Temperature / Humidity	22 deg. C / 48 % RH
Engineer	Shiro Kobayashi
	(1 GHz – 2.8 GHz)
Mode	Tx BT LE 2402 MHz



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

UL Japan, Inc.

Shonan EMC Lab.

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

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission

Report No.	12012868S-G-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	November 8, 2017	November 4, 2017
Temperature / Humidity	23 deg. C / 53 % RH	22 deg. C / 48 % RH
Engineer	Shiro Kobayashi (30 MHz - 1 GHz)	Shiro Kobayashi (1 GHz - 26.5 GHz)
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.	191.585	QP	21.60	16.47	9.01	31.77	0.00	15.31	43.50	28.1	100	0	
Hori.	661.421	QP	21.36	19.51	8.90	32.01	0.00	17.76	46.00	28.2	100	359	
Hori.	954.255	QP	20.42	22.34	10.16	30.88	0.00	22.04	46.00	23.9	100	0	
Hori.	4880.000	PK	56.31	31.30	6.74	41.76	2.47	55.06	73.90	18.8	124	36	
Hori.	7320.000	PK	47.67	36.51	8.24	41.27	2.47	53.62	73.90	20.2	150	0	
Hori.	9760.000	PK	46.02	38.36	9.41	40.62	2.47	55.64	73.90	18.2	150	0	
Hori.	19516.000	PK	45.50	40.34	12.97	45.29	-9.54	43.98	73.90	29.9	139	77	
Vert.	30.510	QP	21.55	17.32	7.03	31.83	0.00	14.07	40.00	25.9	100	0	
Vert.	188.063	QP	21.53	16.34	8.99	31.77	0.00	15.09	43.50	28.4	100	0	
Vert.	356.396	QP	21.30	14.78	7.26	31.75	0.00	11.59	46.00	34.4	100	359	
Vert.	711.016	QP	21.25	19.85	9.14	31.96	0.00	18.28	46.00	27.7	100	359	
Vert.	4880.000	PK	52.23	31.30	6.74	41.76	2.47	50.98	73.90	22.9	183	318	
Vert.	7320.000	PK	47.42	36.51	8.24	41.27	2.47	53.37	73.90	20.5	150	0	
Vert.	9760.000	PK	45.65	38.36	9.41	40.62	2.47	55.27	73.90	18.6	150	0	
Vert.	19516.000	PK	45.80	40.34	12.97	45.29	-9.54	44.28	73.90	29.6	138	51	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.47 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	51.55	31.30	6.74	41.76	3.27	2.47	53.57	53.90	0.3	
Hori.	7320.000	AV	38.08	36.51	8.24	41.27	3.27	2.47	47.30	53.90	6.6	
Hori.	9760.000	AV	36.61	38.36	9.41	40.62	3.27	2.47	49.50	53.90	4.4	
Hori.	19516.000	AV	38.18	40.34	12.97	45.29	3.27	-9.54	39.93	53.90	14.0	
Vert.	4880.000	AV	45.77	31.30	6.74	41.76	3.27	2.47	47.79	53.90	6.1	
Vert.	7320.000	AV	38.31	36.51	8.24	41.27	3.27	2.47	47.53	53.90	6.4	
Vert.	9760.000	AV	36.81	38.36	9.41	40.62	3.27	2.47	49.70	53.90	4.2	
Vert.	19516.000	AV	39.79	40.34	12.97	45.29	3.27	-9.54	41.54	53.90	12.4	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.47 dB

13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission

Report No.	12012868S-G-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	No.1
Date	November 8, 2017	November 4, 2017
Temperature / Humidity	23 deg. C / 53 % RH	22 deg. C / 48 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi
	(30 MHz - 1 GHz)	(1 GHz - 26.5 GHz)
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.	190.614	QP	21.28	16.44	9.01	31.77	0.00	14.96	43.50	28.5	100	259	
Hori.	509.398	QP	21.26	17.84	8.21	31.89	0.00	15.42	46.00	30.5	100	0	
Hori.	777.414	QP	21.41	20.55	9.40	31.86	0.00	19.50	46.00	26.5	100	0	
Hori.	876.612	QP	21.06	21.75	9.89	31.46	0.00	21.24	46.00	24.7	100	359	
Hori.	2483.500	PK	45.98	27.45	14.32	40.81	2.47	49.41	73.90	24.4	117	59	
Hori.	4960.000	PK	58.31	31.48	6.76	41.65	2.47	57.37	73.90	16.5	137	27	
Hori.	7440.000	PK	47.39	36.68	8.29	41.36	2.47	53.47	73.90	20.4	150	0	
Hori.	9920.000	PK	45.75	38.63	9.45	40.66	2.47	55.64	73.90	18.2	150	0	
Hori.	19836.000	PK	44.72	40.24	13.31	45.36	-9.54	43.37	73.90	30.5	135	210	
Vert.	32.082	QP	21.74	16.91	7.08	31.83	0.00	13.90	40.00	26.1	100	359	
Vert.	178.280	QP	21.55	15.95	8.97	31.77	0.00	14.70	43.50	28.8	100	0	
Vert.	755.790	QP	21.55	20.32	9.31	31.93	0.00	19.25	46.00	26.7	100	0	
Vert.	2483.500	PK	46.51	27.45	14.32	40.81	2.47	49.94	73.90	23.9	200	83	
Vert.	4960.000	PK	53.56	31.48	6.76	41.65	2.47	52.62	73.90	21.2	192	37	
Vert.	7440.000	PK	47.16	36.68	8.29	41.36	2.47	53.24	73.90	20.6	150	0	
Vert.	9920.000	PK	45.29	38.63	9.45	40.66	2.47	55.18	73.90	18.7	150	0	
Vert.	19836.000	PK	45.82	40.24	13.31	45.36	-9.54	44.47	73.90	29.4	134	63	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor
Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.47 dB
13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	36.82	27.45	14.32	40.81	3.27	2.47	43.52	53.90	10.4	*1)
Hori.	4960.000	AV	51.44	31.48	6.76	41.65	3.27	2.47	53.77	53.90	0.1	
Hori.	7440.000	AV	38.32	36.68	8.29	41.36	3.27	2.47	47.67	53.90	6.2	
Hori.	9920.000	AV	36.19	38.63	9.45	40.66	3.27	2.47	49.35	53.90	4.5	
Hori.	19836.000	AV	37.39	40.24	13.31	45.36	3.27	-9.54	39.31	53.90	14.6	
Vert.	2483.500	AV	36.91	27.45	14.32	40.81	3.27	2.47	43.61	53.90	10.3	*1)
Vert.	4960.000	AV	47.64	31.48	6.76	41.65	3.27	2.47	49.97	53.90	3.9	
Vert.	7440.000	AV	38.29	36.68	8.29	41.36	3.27	2.47	47.64	53.90	6.3	
Vert.	9920.000	AV	36.27	38.63	9.45	40.66	3.27	2.47	49.43	53.90	4.5	
Vert.	19836.000	AV	39.60	40.24	13.31	45.36	3.27	-9.54	41.52	53.90	12.4	

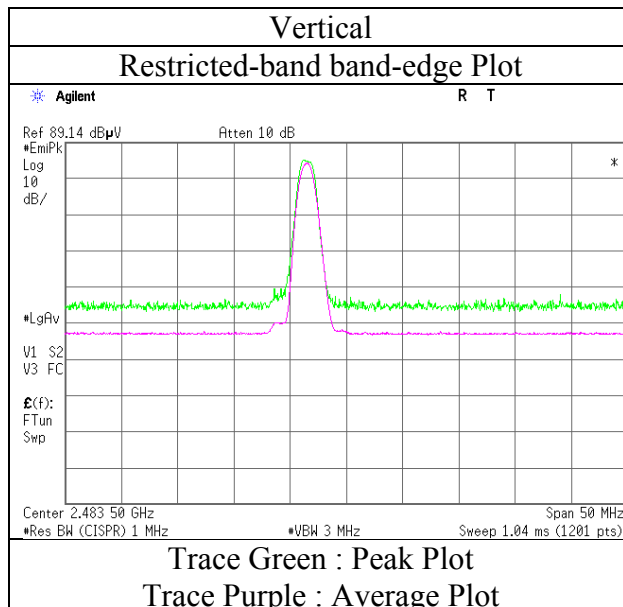
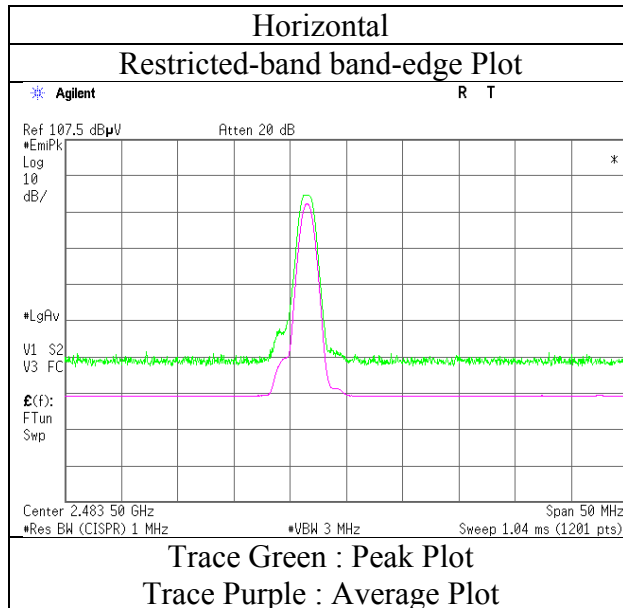
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor
Distance factor : 1 GHz - 13 GHz : 20log(3.98 m / 3.0 m) = 2.47 dB
13 GHz - 40 GHz : 20log(1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission
(Reference Plot for band-edge)

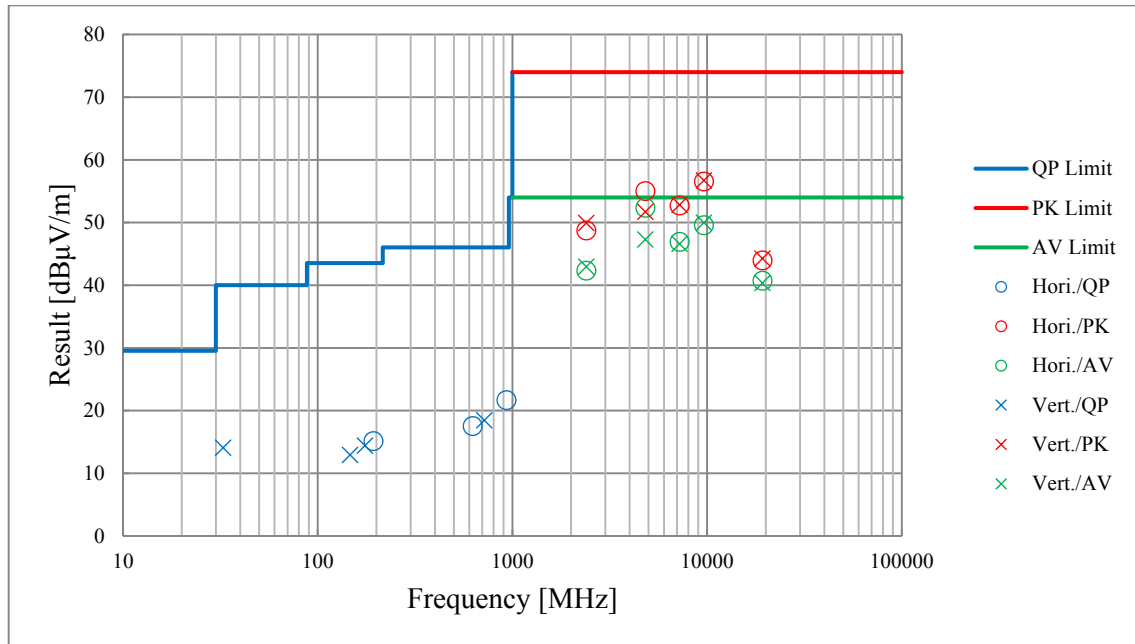
Report No. 12012868S-G-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.1
Date November 4, 2017
Temperature / Humidity 22 deg. C / 48 % RH
Engineer Shiro Kobayashi
(1 GHz – 2.8 GHz)
Mode Tx BT LE 2480 MHz



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

Radiated Spurious Emission (Plot data, Worst case)

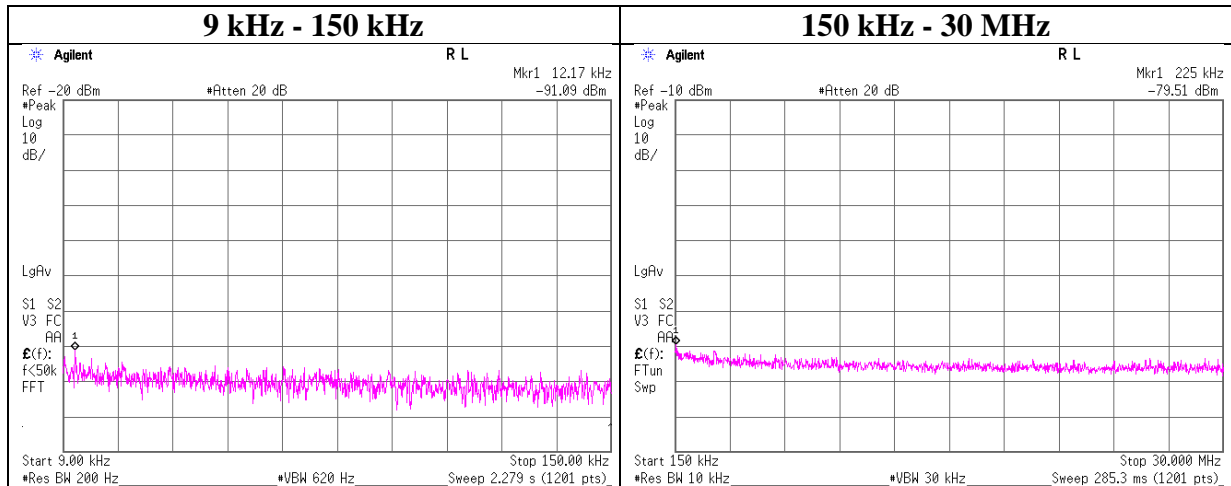
Report No.	12012868S-G-R1	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.1	
Date	November 8, 2017	November 4, 2017
Temperature / Humidity	23 deg. C / 53 % RH	22 deg. C / 48 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi
	(30 MHz - 1 GHz)	(1 GHz - 26.5 GHz)
Mode	Tx BT LE 2402 MHz	



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

Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	12012868S-G-R1
Date	November 2, 2017
Temperature / Humidity	22 deg. C / 41 % RH
Engineer	Makoto Hosaka
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
12.17	-91.1	0.01	9.8	2.0	1	-79.2	300	6.0	-18.0	45.8	63.8	
225.00	-79.5	0.01	9.8	2.0	1	-67.7	300	6.0	-6.4	20.5	26.9	

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

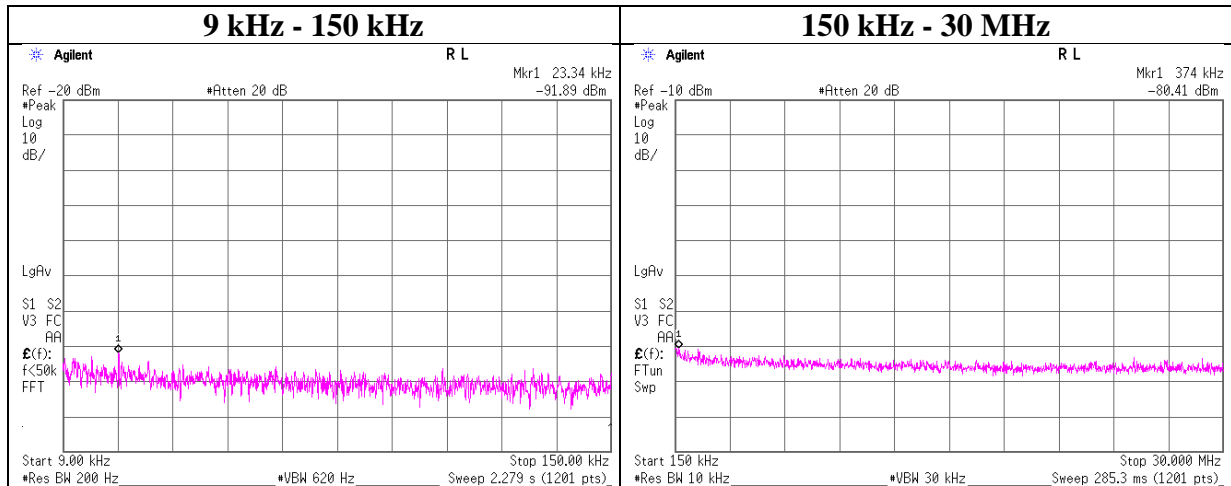
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	12012868S-G-R1
Date	November 2, 2017
Temperature / Humidity	22 deg. C / 41 % RH
Engineer	Makoto Hosaka
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
23.34	-91.9	0.01	9.8	2.0	1	-80.0	300	6.0	-18.8	40.2	59.0	
374.00	-80.4	0.02	9.8	2.0	1	-68.6	300	6.0	-7.3	16.1	23.4	

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

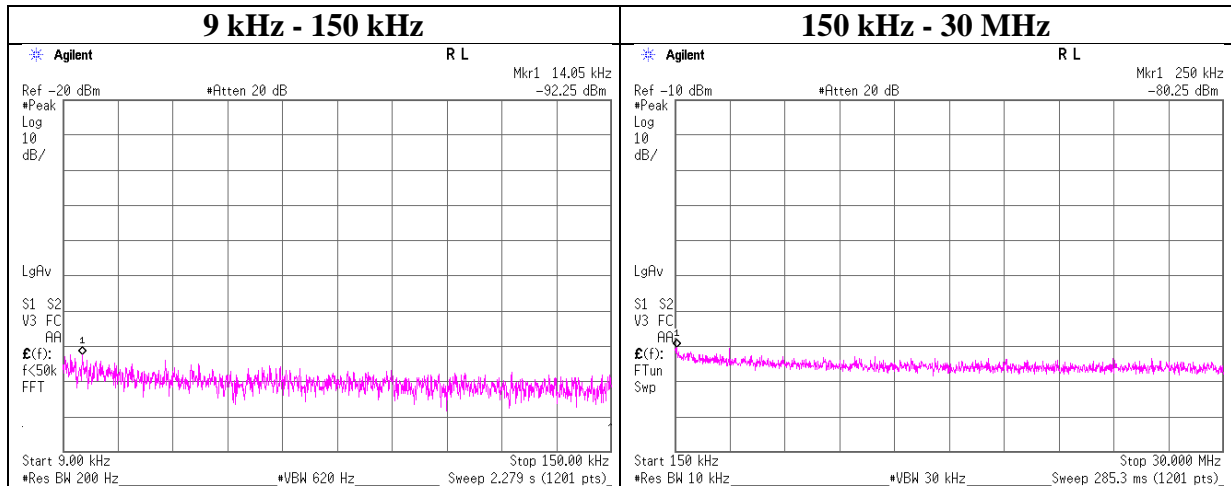
$$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

Conducted Spurious Emission

Test place	Shonan EMC Lab. No.5 Shielded Room
Report No.	12012868S-G-R1
Date	November 2, 2017
Temperature / Humidity	22 deg. C / 41 % RH
Engineer	Makoto Hosaka
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
14.05	-92.3	0.01	9.8	2.0	1	-80.4	300	6.0	-19.1	44.6	63.7	
250.00	-80.3	0.02	9.8	2.0	1	-68.4	300	6.0	-7.1	19.6	26.7	

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

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

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

Power Density

Test place Shonan EMC Lab. No.5 Shielded Room
Report No. 12012868S-G-R1
Date November 2, 2017
Temperature / Humidity 22 deg. C / 41 % RH
Engineer Makoto Hosaka
Mode Tx BT LE

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.00	-25.55	1.63	9.85	-14.07	8.00	22.07
2440.00	-25.65	1.64	9.84	-14.17	8.00	22.17
2480.00	-26.57	1.65	9.84	-15.08	8.00	23.08

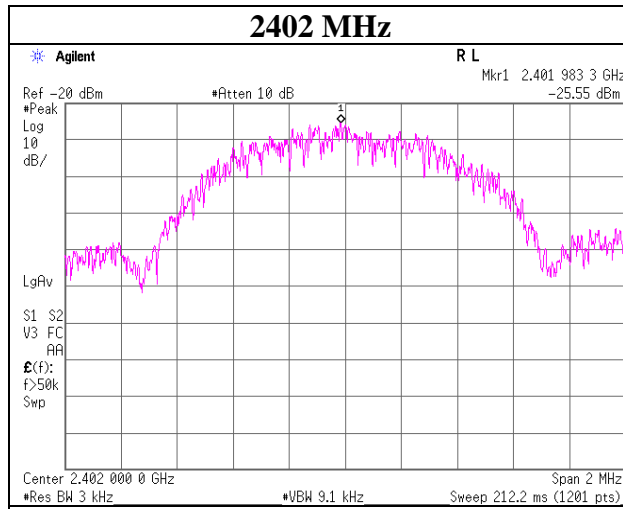
Sample Calculation:

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

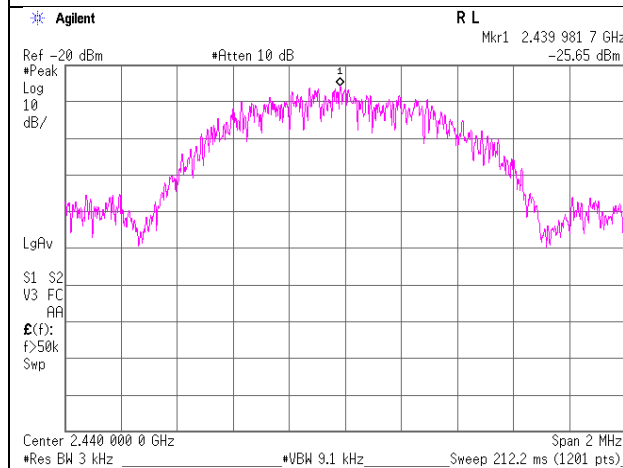
Power Density

BT LE

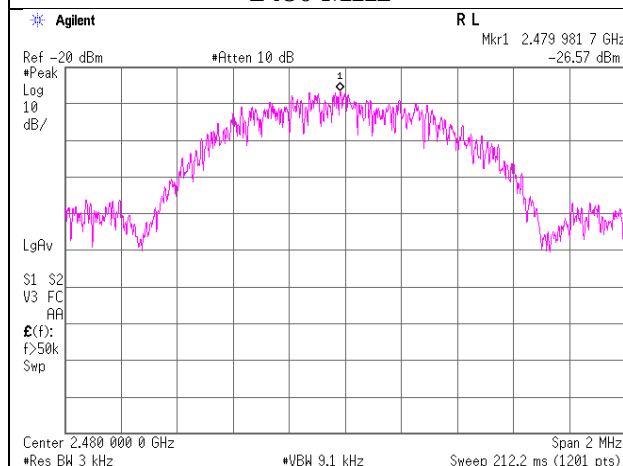
2402 MHz



2440 MHz



2480 MHz



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Shonan EMC Lab.

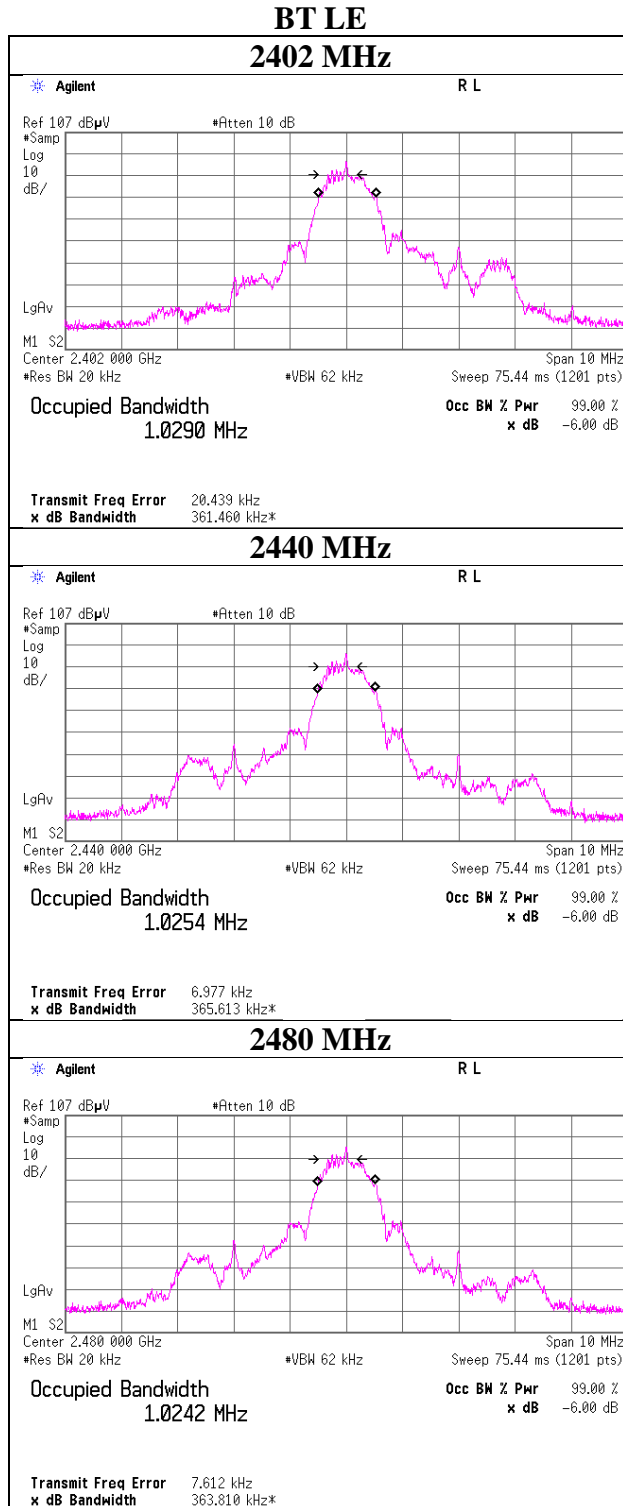
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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99%Occupied Bandwidth

Test place : Shonan EMC Lab. No.5 Shielded Room
Report No. : 12012868S-G-R1
Date : November 2, 2017
Temperature / Humidity : 22 deg. C / 41 % RH
Engineer : Makoto Hosaka
Mode : Tx BT LE



UL Japan, Inc.

Shonan EMC Lab.

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

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Facsimile : +81 463 50 6401

APPENDIX 2: Test instruments

Test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2017/03/23 * 12
SAT10-12	Attenuator	Weinschel Corp.	54A-10	81601	AT	2017/03/23 * 12
SPM-07	Power Meter	Agilent	8990B	MY5100272	AT	2017/05/01 * 12
SPSS-05	Power sensor	Agilent	N1923A	MY5349008	AT	2017/05/01 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	AT	2017/03/07 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2016/12/13 * 12
SAEC-01(NSA)	Semi-Anechoic Chamber	TDK	SAEC-01(NSA)	1	RE	2017/06/09 * 12
SAF-04	Pre Amplifier	TOYO Corporation	TPA0118-36	1440489	RE	2017/03/17 * 12
SCC-G05	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-03 7	RE	2017/01/08 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2017/05/08 * 12
SHA-01	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	RE	2017/08/14 * 12
SOS-15	Humidity Indicator	A&D	AD-5681	7478311	RE	2017/02/21 * 12
SRENT-08	Spectrum Analyzer	Agilent	E4448A	MY50180019	RE	2017/10/12 * 12
KJM-09	Measure	KOMELON	KMC-36	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,MF)	-	RE	-
STS-01	Digital Hitester	Hioki	3805-50	080997812	RE	2017/10/16 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01000NF SNMS/B	1612S005	RE	2017/01/08 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2016/11/07 * 12
SFL-18	Highpass Filter	MICRO-TRONICS	HPM50111	119	RE	2017/04/20 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2017/03/15 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2017/09/22 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000KM SKMS	-	RE	2017/04/20 * 12
SCC-G19	Coaxial Cable	Suhner	SUCOFLEX 102A	1188/2A	RE	2017/03/23 * 12
SAEC-01(SVSWR)	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	RE	2017/07/20 * 12
SRENT-10	Spectrum Analyzer	Agilent	E4440A	US41421511	RE	2016/12/05 * 12
SAF-01	Pre Amplifier	SONOMA	310N	290211	RE	2017/02/09 * 12
KAT6-04	Attenuator	INMET	18N-6dB	-	RE	2016/12/15 * 12
SAT3-09	Attenuator	JFW	50HF-003N	-	RE	2017/08/24 * 12
SBA-01	Biconical Antenna	Schwarzbeck	BBA9106	91032664	RE	2017/10/21 * 12
SCC-A1/A3/A5/A7/A8/A13/SRSE-01	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-269(RF Selector)	RE	2017/04/07 * 12
SCC-A2/A4/A6/A7/A8/A13/SRSE-01	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-269(RF Selector)	RE	2017/04/07 * 12
SLA-05	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	193	RE	2017/01/05 * 12
SOS-01	Humidity Indicator	A&D	AD-5681	4062555	RE	2017/10/30 * 12
STR-01	Test Receiver	Rohde & Schwarz	ESU40	100093	RE	2017/04/12 * 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

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