RADIO TEST REPORT

Test Report No.: 10569798S

Applicant	:	**Sony Engineering Corporation**
Type of Equipment	:	**RF Transmitter**
Model No.	:	**FFS-TH**
FCC ID	:	**2AADJFFS-TH**
Test regulation	:	**FCC Part15 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 limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.

Date of test: January 20 to 29, 2015

Tested by:

Makoto Hosaka
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.
☒ There is no testing item of "Non-accreditation".

RTL02610

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Shonan EMC Lab.
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REVISION HISTORY

Original Test Report No.: 10569798S

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10569798S	February 3, 2015	-	-
1	10569798S	February 10, 2015	9	Addition of Remark about ferrite core

Contents

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SECTION 1: Customer information

Company Name	:	Sony Engineering Corporation
Address	:	3-3-1 Tsujido-Shinmachi Fujisawa-shi, Kanagawa, 251-0042 Japan
Telephone Number	:	+81-466-38-3428
Facsimile Number	:	+81-466-38-3771
Contact Person	:	Masayuki Okada

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

2.1 Identification of E.U.T.

Type of Equipment	:	RF Transmitter
Model No.	:	FFS-TH
Serial No.	:	Refer to 4.2 of this report.
Rating	:	DC5V
Receipt Date of Sample	:	January 20, 2015
Country of Mass-production	:	Japan
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: FFS-TH (referred to as the EUT in this report) is a RF Transmitter.

Clock frequency(ies) in the system : MCU: 30MHz(X3), 25MHz(X1), 32.768kHz

Radio specification:

Equipment type	:	Transmitter
Frequency of operation	:	902.2-926.7MHz
Type of modulation	:	GFSK
Antenna type	:	Whip
Antenna connector type	:	Reverse polarity SMA Connector
Antenna gain	:	2 dBi
Operation temperature range	:	+5 to +35 deg.C.
ITU code	:	F1D

FCC 15.31 (e)
The stable voltage of DC3.3V is provided constantly to RF transmitter regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC 15.203
The EUT has a unique coupling/antenna connector. Therefore, the equipment complies with the antenna requirement.

SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : FCC Part 15 Subpart C: 2015, final revised on January 21, 2015
Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.209 Radiated emission limits, general requirements
Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

* The revision on January 21, 2015 does not affect the test specification applied to the EUT.

3.2 Procedures & Results

Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
Conducted emission	ANSI C63.4:2009 7. AC powerline conducted emission measurements	FCC 15.207	-	N/A	15.0dB Freq.: 0.54180MHz Detector: Quasi-Peak Phase: N Mode: Transmitting 902.2MHz	Complied
Carrier frequency separation	FCC Public Notice DA 00-705 & ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (a)(1)	Conducted	N/A	*See data.	Complied
20dB bandwidth	FCC Public Notice DA 00-705 & ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (a)(1)	Conducted	N/A		-
Number of hopping frequency	FCC Public Notice DA 00-705 & ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (a)(1)(iii)	Conducted	N/A		Complied
Dwell time	FCC Public Notice DA 00-705 & ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (a)(1)(iii)	Conducted	N/A		Complied
Maximum peak output power	FCC Public Notice DA 00-705 & ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (b)(1)	Conducted	N/A		Complied
Band edge compliance & Spurious emission	FCC Public Notice DA 00-705 & ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.247 (d) 15.209	Conducted/ Radiated	N/A	1.0 dB Freq.: 50.000 MHz Detection: Quasi-Peak Polarization: Vertical Mode: Tx, 914.2 MHz	Complied
Note: UL Japan's Work Procedures No. 13-EM-W0420 and 13-EM-W0422						

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99%)	ANSI C63.4:2009 13. Measurement of intentional radiators, RSS-Gen 6.6	-	Conducted	-	-
Note: UL Japan's Work Procedures No. 13-EM-W0420 and 13-EM-W0422					

* 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.

Item	Frequency range	No.1 SAC*1/SR*2 (±)	No.2 SAC/SR (±)	No.3 SAC/SR (±)
Conducted emission (AC Mains) AMN/LISN	150kHz-30MHz	3.6 dB	3.4 dB	3.4 dB
Radiated emission (Measurement distance: 3m)	30MHz-300MHz	4.9 dB	4.9 dB	4.7 dB
	300MHz-1GHz	5.0 dB	5.0 dB	4.8 dB
	1GHz-18GHz	4.9 dB	4.9 dB	4.9 dB

*1: SAC=Semi-Anechoic Chamber
*2: SR= Shielded Room is applied besides radiated emission

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

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

Antenna port conducted test
Power Measurement uncertainty below 1GHz for this test was: (±) 0.71dB
Conducted emissions, Power Density Measurement (below 1GHz) uncertainty for this test was: (±) 1.5dB
Frequency Measurement uncertainty for this test was: (±) 5.3 x 10^-6
Bandwidth Measurement uncertainty for this test was: (±) 0.66%
Time Measurement uncertainty for this test was: (±) 0.012%

3.5 Test location

UL Japan, Inc. Shonan EMC Lab.
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Telephone number : +81 463 50 6400
Facsimile number: +81 463 50 6401
JAB Accreditation No. : RTL02610

	IC Registration No.	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.7 Shielded room	-	2.76 x 3.76 x 2.4	2.76 x 3.76	-
☐ 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	2.55 x 4.1	-

3.6 Test setup, Data of test & Test instruments

Refer to APPENDIX 1 to 3.

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

4.1 Operating mode

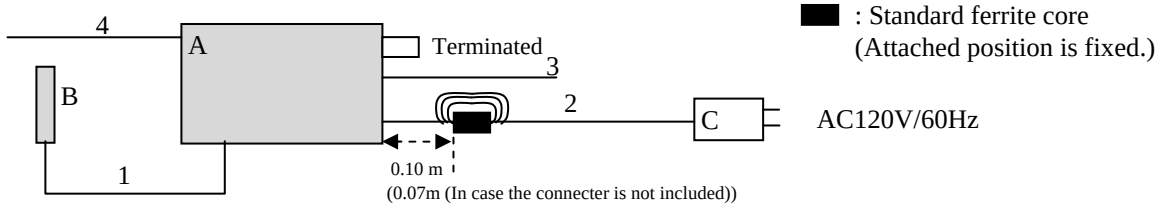
The EUT exercise program used during testing was designed to exercise the various system components in a manner similar to typical use.

Test item	Operating mode	Tested frequency
Carrier frequency separation	Transmitting Hopping ON Payload: PN9	-
20dB bandwidth	Transmitting Hopping OFF Payload: PN9	902.2MHz, 914.2MHz, 926.7MHz
Number of hopping frequency	Transmitting Hopping ON Payload: PN9	-
Dwell time	Transmitting (Hopping ON), Payload: PN9	-
Maximum peak output power	Transmitting Hopping OFF , Payload: PN9	902.2MHz, 914.2MHz, 926.7MHz
Band edge compliance, Spurious emission	Transmitting, Payload: PN9 -Hopping OFF	Band edge compliance: 902.2MHz, 926.7MHz Spurious emission: 902.2MHz, 914.2MHz, 926.7MHz
99% occupied bandwidth	Transmitting, Payload: PN9 -Hopping ON -Hopping OFF	902.2MHz, 914.2MHz, 926.7MHz

Software: Node1_USA_V0.010
Power setting: 7(Max)

Justification: The system was configured in typical fashion (as customer would normally use it) for testing.

4.2 Configuration and peripherals



* Test data was taken under worse case conditions.

Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	RF transmitter	FFS-TH	No.0021	Sony Engineering	EUT
B	Antenna	MEGHX-467XSAXX-920	-	MAP ELECTRONICS	EUT
C	AC Adaptor	SU10-102	08459031 1329	Sinpro Electronics	-

List of cables used

No.	Cable	Length (m)	Shield-Cable	Shield-Connector	Remarks
1	Coaxial	3.0	Shielded	Shielded	-
2	DC	0.8	Unshielded	Unshielded	with Ferrite core: ZCAT2017-0930(TDK), 4 turn
3	Canon	1.5	Shielded	Shielded	-
4	USB	1.5	Shielded	Shielded	-

SECTION 5: Conducted emission

5.1 Operating environment

Test place : See test data (APPENDIX 1)
Temperature : See test data (APPENDIX 1)
Humidity : See test data (APPENDIX 1)

5.2 Test configuration

EUT was placed on a platform of nominal size, 1m by 1.5m, raised 0.8m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity.
The rear of tabletop was located 40cm to the vertical conducting plane. The rear of peripheral was aligned and was flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80cm from LISN. Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the input power source. All unused 50ohm connectors of the LISN were resistively terminated in 50ohm when not connected to the measuring equipment.
Photographs of the set up are shown in APPENDIX 3.

5.3 Test conditions

Frequency range : 0.15 - 30MHz
EUT position : Table top

5.4 Test procedure

The AC Mains Terminal Continuous disturbance Voltage had been measured with the EUT within a Shielded room. The EUT was connected to a Line Impedance Stabilization Network (LISN).
An overview sweep with peak detection has been performed.
The measurements had been performed with a quasi-peak detector and if required, a CISPR average detector.
The conducted emission measurements were made with the following detection of the test receiver.

Detection Type : Quasi-Peak/ CISPR Average
IF Bandwidth : 9kHz

5.5 Results

Summary of the test results : Pass
Refer to APPENDIX 1

SECTION 6: Carrier frequency separation

Test procedure
The carrier frequency separation was measured with a spectrum analyzer connected to the antenna port.

Summary of the test results: Pass
Refer to APPENDIX 1.

SECTION 7: 20dB bandwidth & Occupied bandwidth (99%)

Test procedure
The bandwidth was measured with a spectrum analyzer connected to the antenna port.

Summary of the test results: Pass
Refer to APPENDIX 1.

SECTION 8: Number of hopping frequency

Test procedure
The Number of Hopping Frequency was measured with a spectrum analyzer connected to the antenna port.

Summary of the test results: Pass
Refer to APPENDIX 1.

SECTION 9: Dwell time

Test procedure
The Dwell time was measured with a spectrum analyzer connected to the antenna port.

Summary of the test results: Pass
Refer to APPENDIX 1.

SECTION 10: Maximum peak output power

Test procedure
The Maximum Peak Output Power was measured with a power meter connected to the antenna port.

Summary of the test results: Pass
Refer to APPENDIX 1.

SECTION 11: Radiated emission

10.1 Operating environment

Test room : See test data (APPENDIX 1)
Temperature : See test data (APPENDIX 1)
Humidity : See test data (APPENDIX 1)

10.2 Test configuration

EUT was placed on a platform of nominal size, 0.5m by 1.0m, raised 0.8m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. The rear of EUT, including its peripherals was aligned and flushed with rear of tabletop. I/O cables that were connected to the peripherals were bundled in center. They were folded back and for the forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane.
Photographs of the set up are shown in APPENDIX 3.

10.3 Test conditions

Frequency range : 30MHz - 10GHz
EUT position : Table top

10.4 Test procedure

The Radiated Electric Field Strength intensity has been measured on a semi-anechoic chamber with a ground plane and at a distance of 3m (Refer to Figure 1). Measurements were performed with quasi-peak, peak and average detector. The measuring antenna height was varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity. The measurements were performed for both vertical and horizontal antenna polarization.

The radiated emission measurements were made with the following detection.

Frequency		30 - 1000MHz	1 - 10GHz		20dBc
Detection Type	:	Quasi-Peak	Peak	* Average	Peak
IF Bandwidth	:	120kHz	RBW:1MHz VBW:3MHz	RBW:1MHz VBW:10Hz	RBW: 100kHz VBW: 300kHz

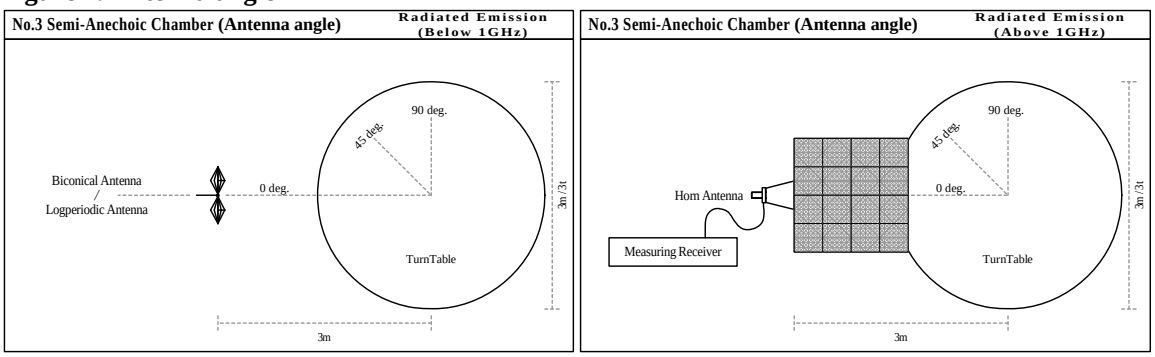
* When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.
Although 00-705 accepts VBW=10Hz for AV measurements, confirmed that superfluous smoothing was not performed.

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.

Combinations of the worst case

	Frequency / Antenna polarization	Carrier	Spurious	
			30-1000MHz	1-10GHz
Transmitter	Horizontal	Y	X	Y
	Vertical	Y	X	X
Antenna	Horizontal	X	X	Y
	Vertical	Y	Y	X

Figure 1. Antenna angle



10.5 Band edge

Band edge level at 902MHz and 928MHz is below the 20dBc. Refer to the data.

10.6 Results

Summary of the test results: Pass *No noise was detected above the 9th order harmonics.

Refer to APPENDIX 1.

SECTION 12: Spurious emissions (Antenna port conducted)

Test procedure

The Out of Band Emissions was measured with a spectrum analyzer connected to the antenna port.
The radio frequency power that is produced by the intentional radiator confirmed 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.
In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9kHz-150kHz:RBW=200Hz, 150kHz-30MHz:RBW=10kHz)

Summary of the test results: Pass
Refer to APPENDIX 1

Contents of APPENDIXES

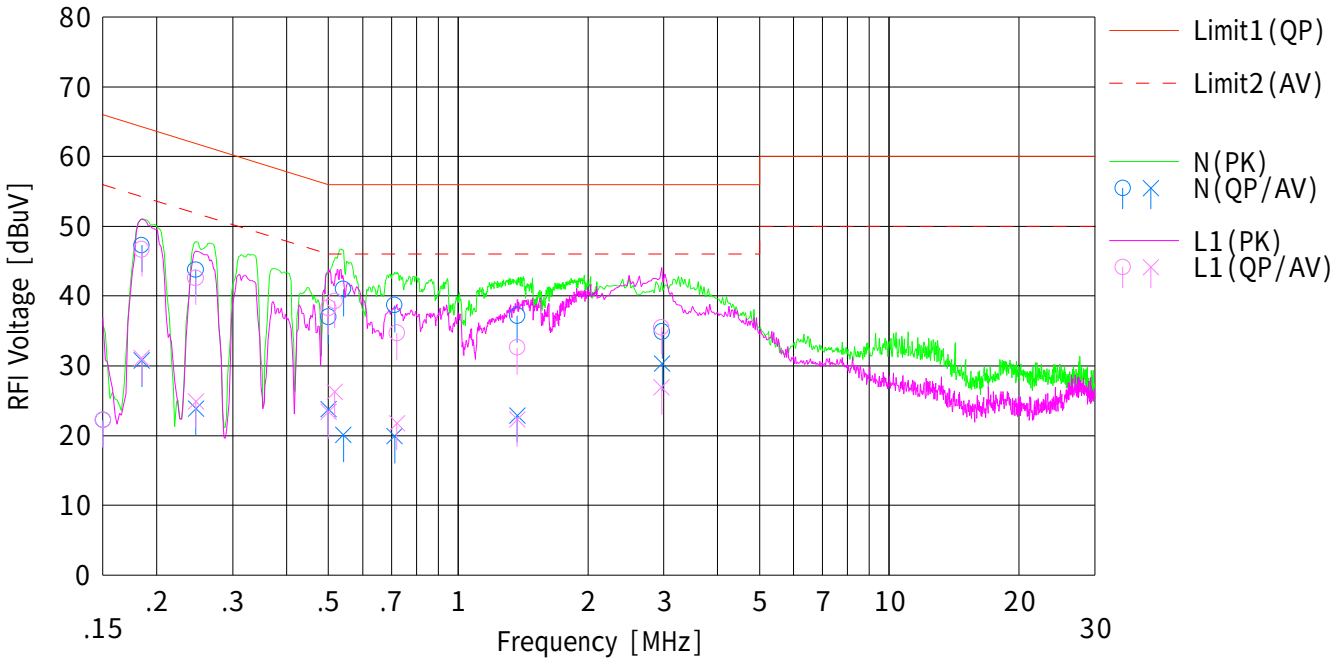
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2015/01/27

Company	: Sony Engineering Corporation	Mode	: Transmitting 902.2MHz
Kind of EUT	: RF Transmitter	Order No.	: 10569798S
Model No.	: FFS-TH	Power	: AC120V/60Hz
Serial No.	: 0021	Temp./Humi.	: 23deg.C / 33%RH
Remarks	: -		

Limit1 : FCC 15C(15.207) QP
Limit2 : FCC 15C(15.207) AV

Engineer : Makoto Hosaka



No.	Freq.	Reading <QP>	Reading <AV>	C.Fac	Results <QP>	Results <AV>	Limit <QP>	Limit <AV>	Margin <QP>	Margin <AV>	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	9.5	---	12.7	22.2	---	66.0	56.0	43.8	---	N	
2	0.18463	34.6	18.1	12.7	47.3	30.8	64.2	54.2	16.9	23.4	N	
3	0.24631	31.1	11.2	12.7	43.8	23.9	61.8	51.8	18.0	27.9	N	
4	0.50038	24.3	11.1	12.7	37.0	23.8	56.0	46.0	19.0	22.2	N	
5	0.54180	28.3	7.4	12.7	41.0	20.1	56.0	46.0	15.0	25.9	N	
6	0.71240	26.0	7.2	12.7	38.7	19.9	56.0	46.0	17.3	26.1	N	
7	1.37222	24.4	10.1	12.8	37.2	22.9	56.0	46.0	18.8	23.1	N	
8	2.97360	21.9	17.3	13.0	34.9	30.3	56.0	46.0	21.1	15.7	N	
9	0.15000	9.5	---	12.7	22.2	---	66.0	56.0	43.8	---	L1	
10	0.18463	34.0	18.4	12.7	46.7	31.1	64.2	54.2	17.5	23.1	L1	
11	0.24631	29.9	12.2	12.7	42.6	24.9	61.8	51.8	19.2	26.9	L1	
12	0.50038	25.6	10.7	12.7	38.3	23.4	56.0	46.0	17.7	22.6	L1	
13	0.51730	26.6	13.6	12.7	39.3	26.3	56.0	46.0	16.7	19.7	L1	
14	0.72140	22.0	9.1	12.7	34.7	21.8	56.0	46.0	21.3	24.2	L1	
15	1.37222	19.8	9.5	12.8	32.6	22.3	56.0	46.0	23.4	23.7	L1	
16	2.96407	22.5	13.9	13.0	35.5	26.9	56.0	46.0	20.5	19.1	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-02

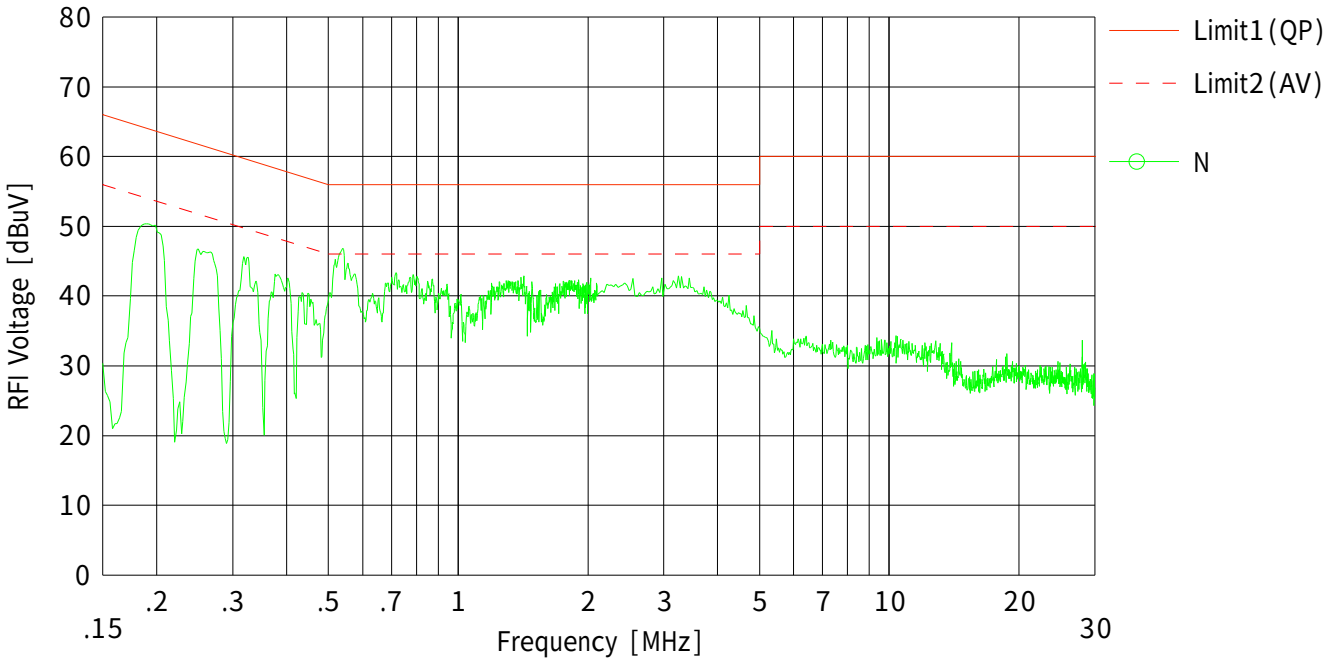
DATA OF CONDUCTED EMISSION TEST

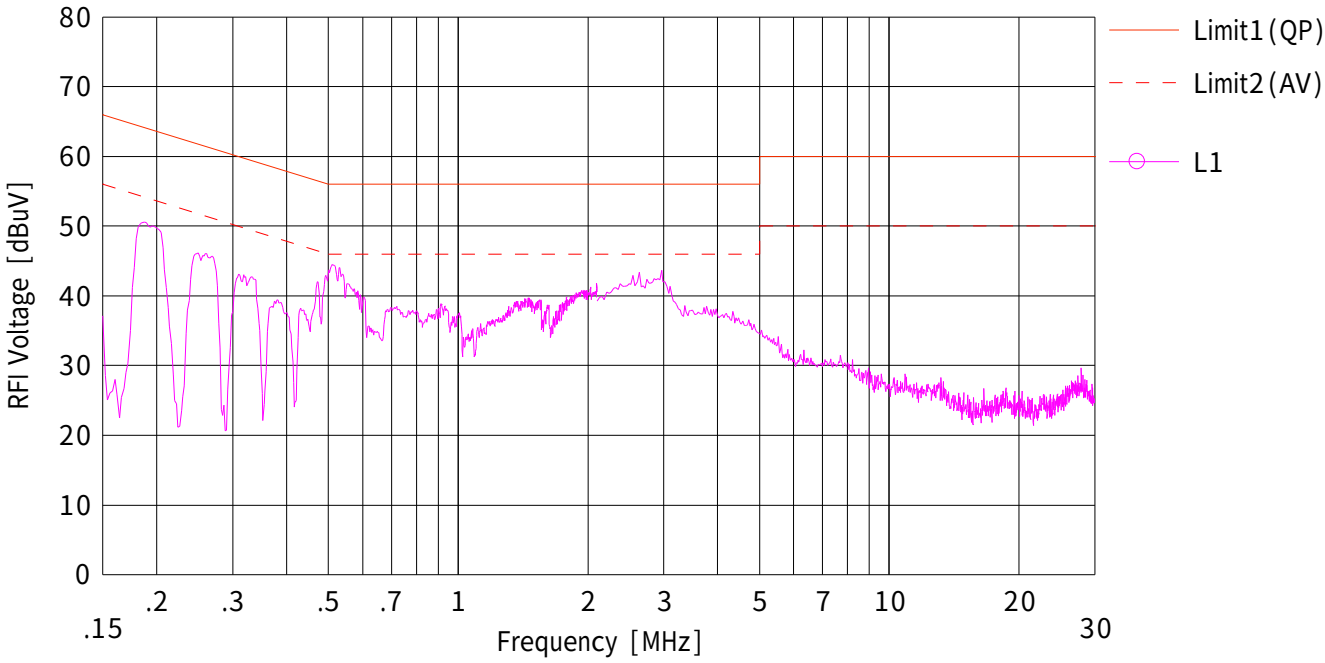
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2015/01/27

Company	: Sony Engineering Corporation	Mode	: Transmitting 914.2MHz
Kind of EUT	: RF Transmitter	Order No.	: 10569798S
Model No.	: FFS-TH	Power	: AC120V/60Hz
Serial No.	: 0021	Temp./Humi.	: 23deg.C / 33%RH
Remarks	: -		

Limit1 : FCC 15C(15.207) QP
Limit2 : FCC 15C(15.207) AV

Engineer : Makoto Hosaka





Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-02

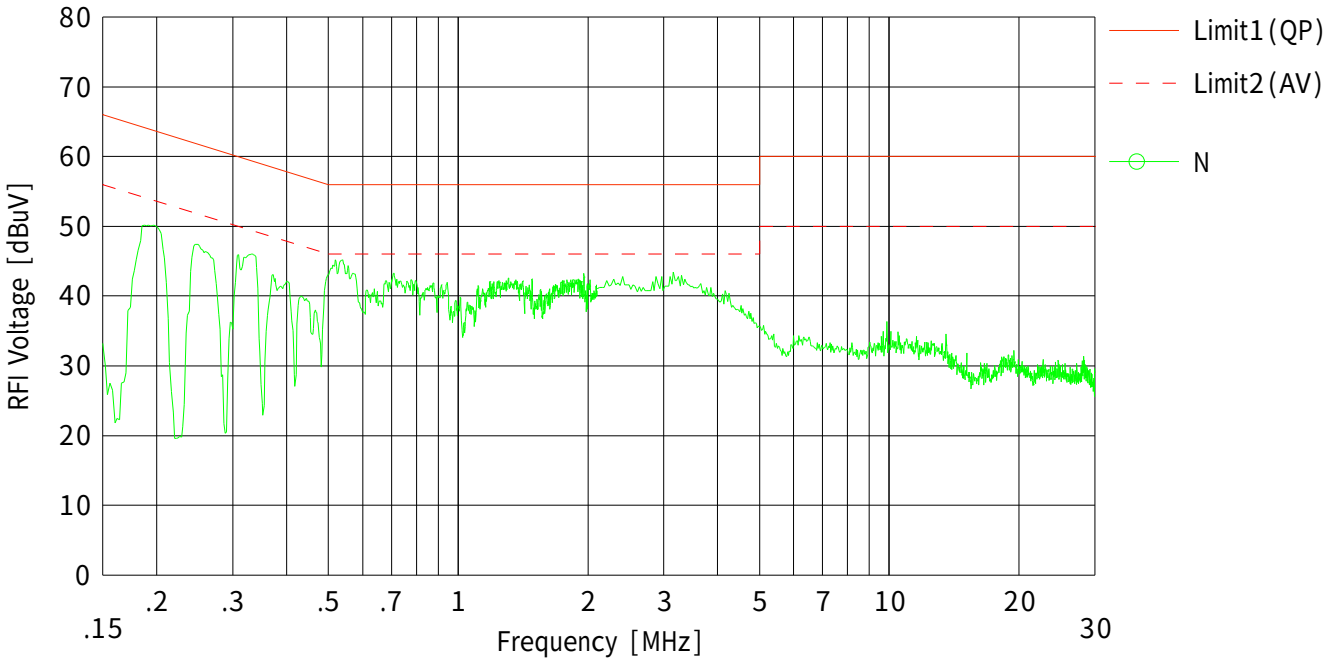
DATA OF CONDUCTED EMISSION TEST

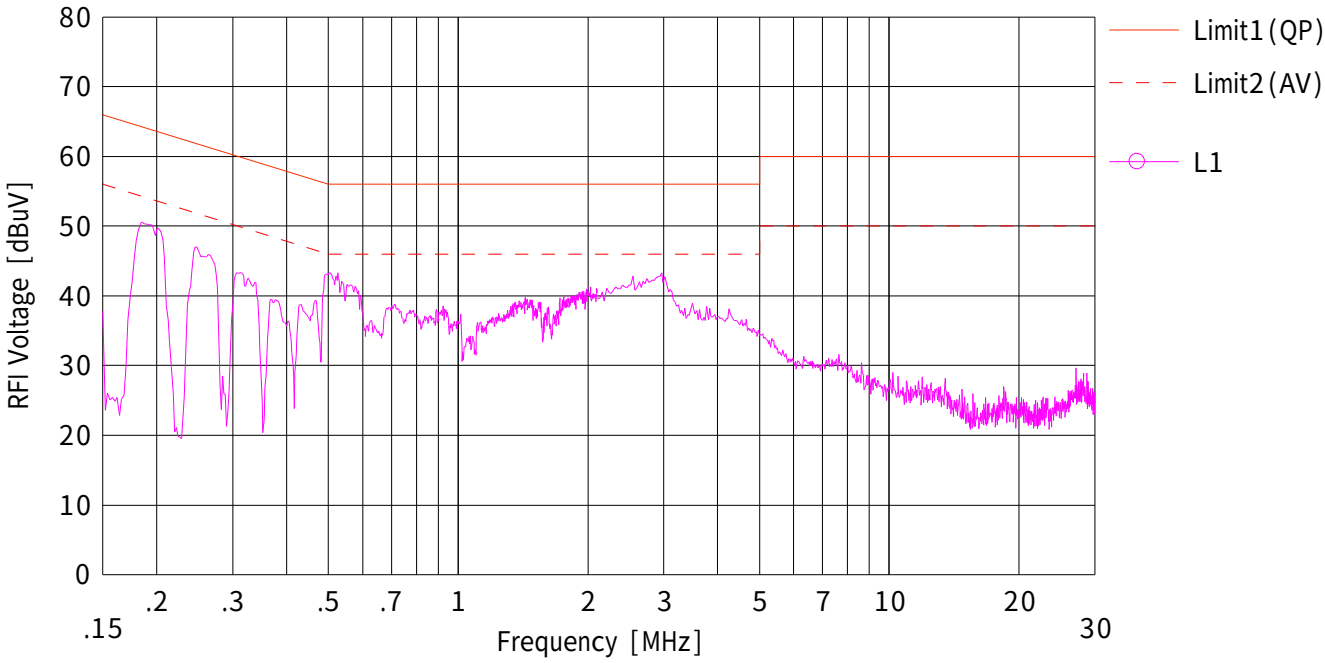
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2015/01/27

Company	: Sony Engineering Corporation	Mode	: Transmitting 926.7MHz
Kind of EUT	: RF Transmitter	Order No.	: 10569798S
Model No.	: FFS-TH	Power	: AC120V/60Hz
Serial No.	: 0021	Temp./Humi.	: 24deg.C / 30%RH
Remarks	: -		

Limit1 : FCC 15C(15.207) QP
Limit2 : FCC 15C(15.207) AV

Engineer : Makoto Hosaka





Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-02

20dB Bandwidth and Carrier Frequency Separation

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	January 20, 2015	
Temperature / Humidity	24 deg.C , 33 %RH	
Engineer	Shinichi Takano	
Mode	Tx, FHSS, PN9	

	Freq. [MHz]	20dB Bandwidth [MHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency Separation [MHz]
	902.2	0.151	0.500	>= 0.151
	914.2	0.150	0.500	>= 0.150
	926.7	0.151	0.500	>= 0.151

Limit: 20dB Bandwidth or 25kHz (whichever is greater).
20dB Bandwidth limit is 500kHz or less than. (for 902MHz to 928MHz)

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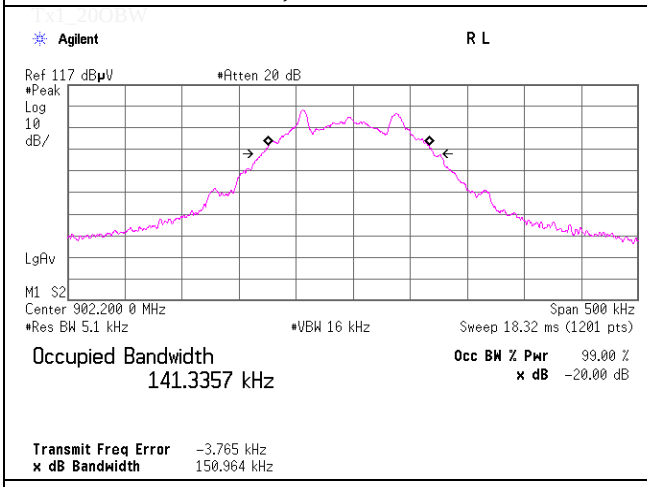
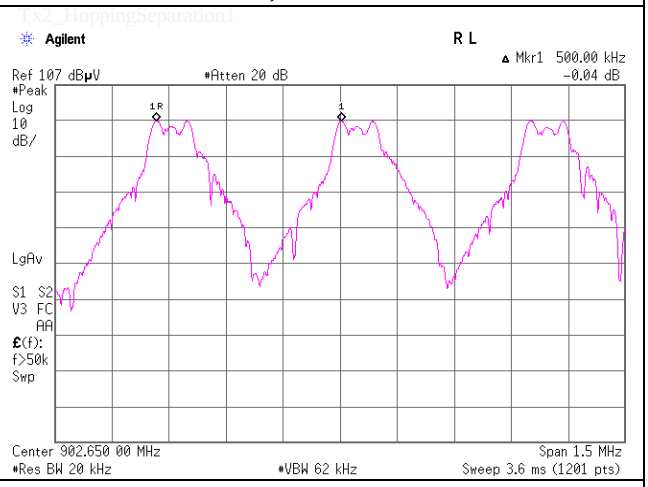
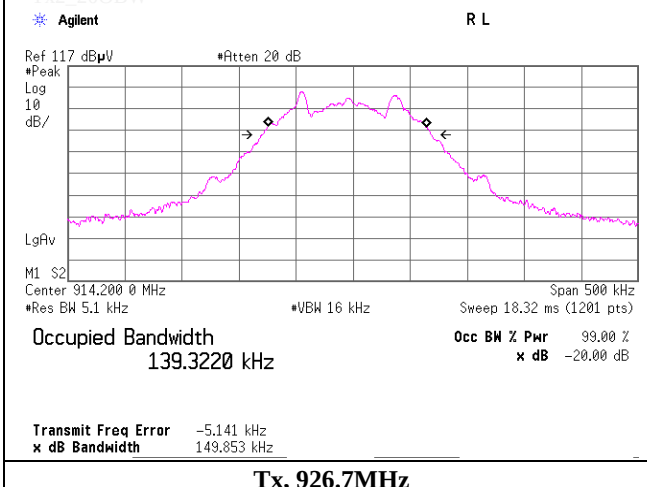
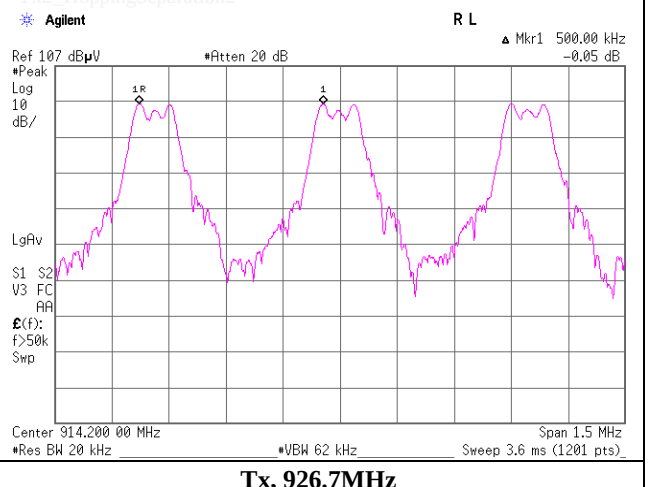
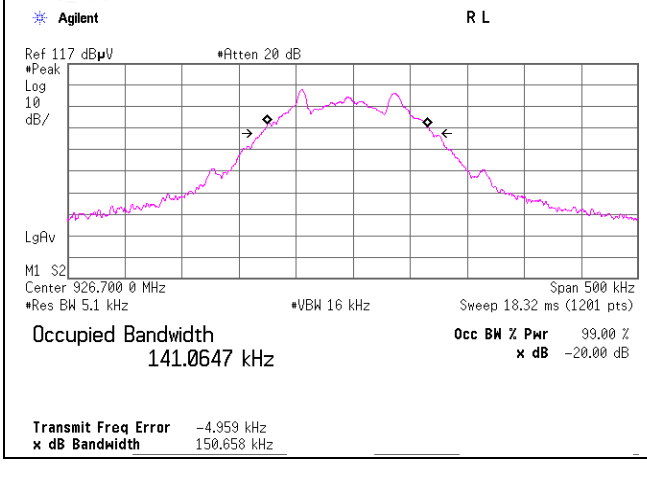
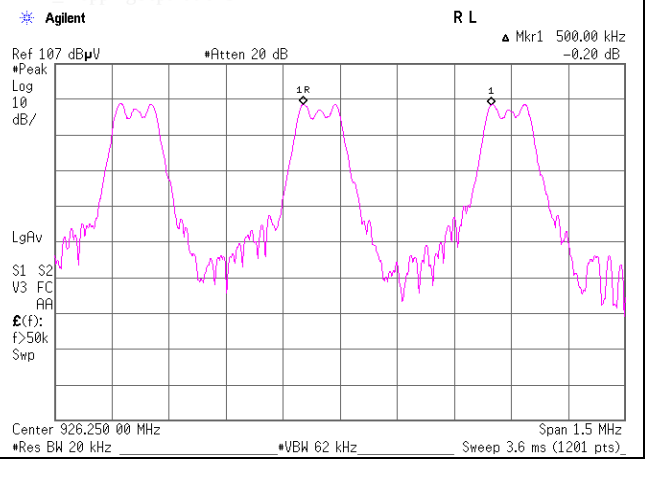
20dB Bandwidth and Carrier Frequency Separation

Tx, FHSS, PN9

20dB Bandwidth	Carrier Frequency Separation
Tx, 902.2MHz	**Tx, 902.2MHz**
	
Tx, 914.2MHz	**Tx, 914.2MHz**
	
Tx, 926.7MHz	**Tx, 926.7MHz**
	

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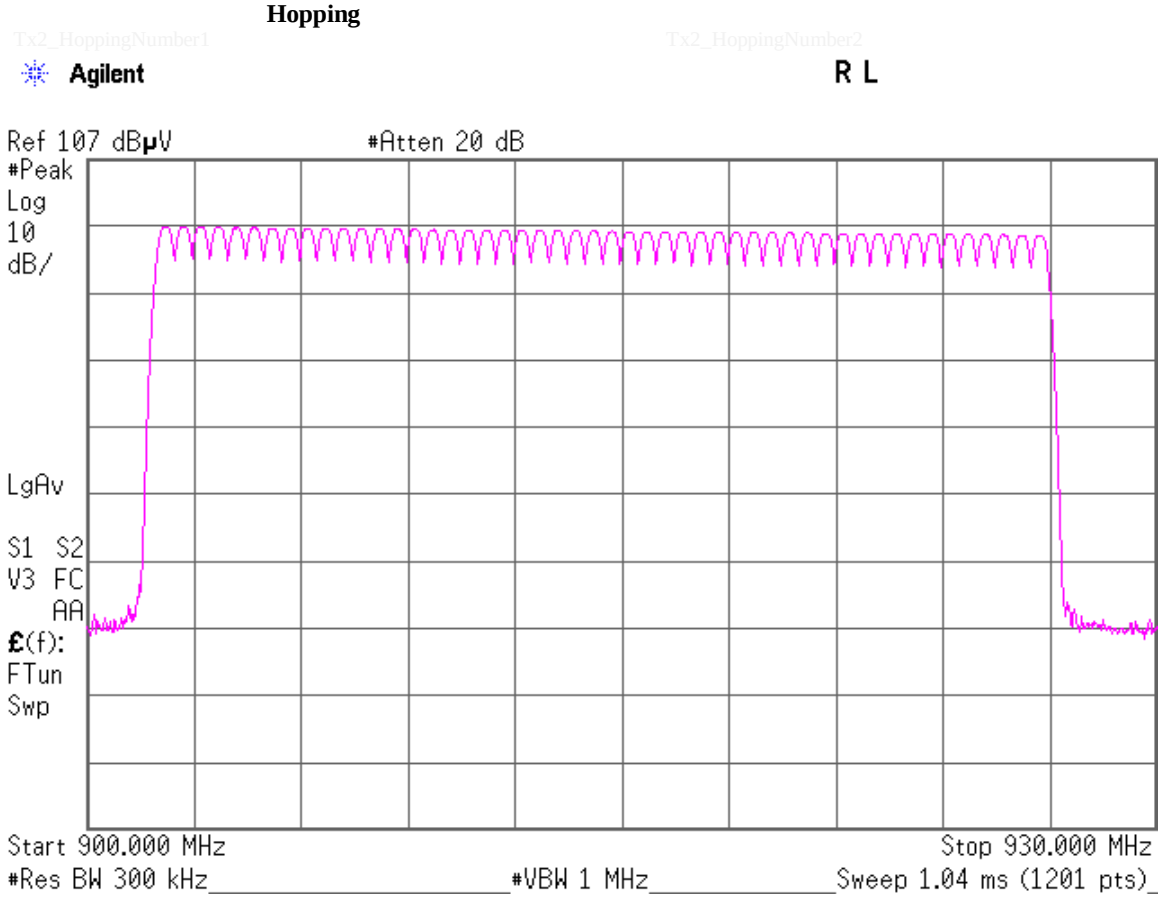
Number of Hopping Frequency

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	January 20, 2015	
Temperature / Humidity	24 deg.C , 33 %RH	
Engineer	Shinichi Takano	
Mode	Tx, FHSS, PN9	

Mode	Number of Channel [times]	Limit [times]
other	50	>= 50

Hopping



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Dwell Time

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	January 20, 2015	
Temperature / Humidity	24 deg.C , 33 %RH	
Engineer	Shinichi Takano	
Mode	Tx, FHSS, PN9	

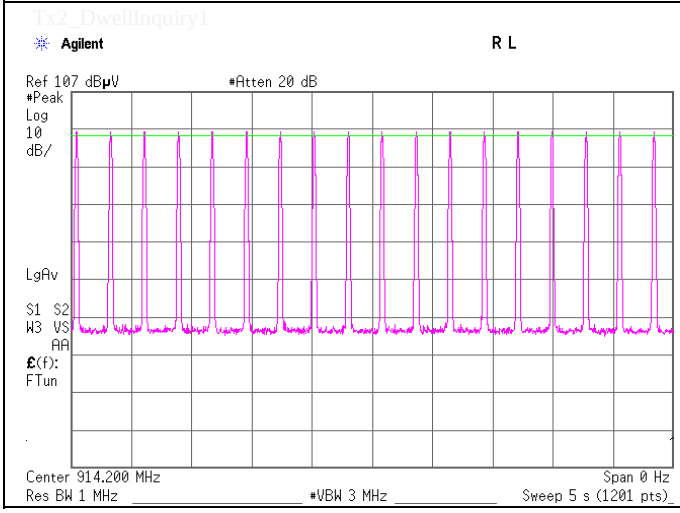
	Number of transmission in a 20 second period	Length of transmission time [msec]	Result [msec]	Limit [msec]
	18.0 / 5.0 sec. x 20.0 sec. = 72 times	2.789	201	400

Sample Calculation

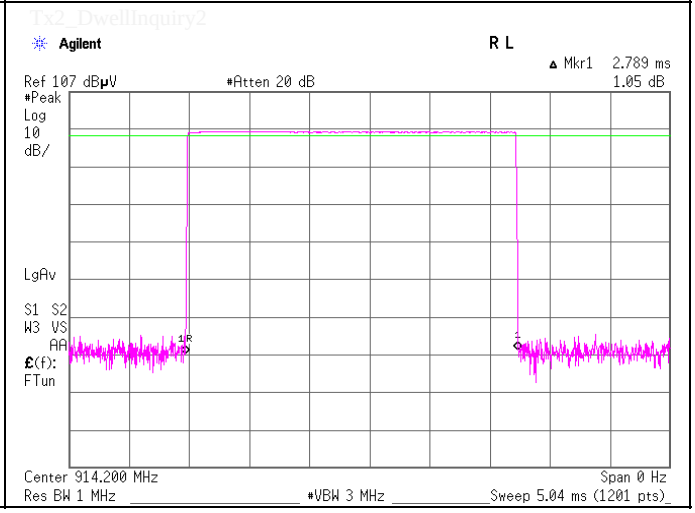
Result = Number of transmission x Length of transmition time

Hopping

Hopping (1/2)



Hopping (2/2)



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Maximum Peak Conducted Output Power (Conducted)

Test place	UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
Date	January 20, 2015
Temperature / Humidity	24 deg.C , 33 %RH
Engineer	Shinichi Takano
Mode	Tx, FHSS

(* P/M: Power Meter with power sensor)

	Freq.	P/M (Peak) Reading	Cable Loss	Atten. Loss	Result		Limit		Margin
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
	902.2	-0.75	0.43	19.88	19.56	90.36	30.00	1000	10.44
	914.2	-0.97	0.43	19.88	19.34	85.90	30.00	1000	10.66
	926.7	-0.99	0.44	19.88	19.33	85.70	30.00	1000	10.67

Sample Calculation:
Result = Reading + Cable Loss + Atten. Loss

(Reference maximum conducted power (average))

(* P/M: Power Meter with power sensor)

	Freq.	P/M (Average) Reading	Cable Loss	Atten. Loss	Duty factor	Result	
	[MHz]	[dBm]	[dB]	[dB]	[dB]	[dBm]	[mW]
	902.2	-0.82	0.43	19.88	0.00	19.49	88.92
	914.2	-1.04	0.43	19.88	0.00	19.27	84.53
	926.7	-1.08	0.44	19.88	0.00	19.24	83.95

Sample Calculation:
Result = Reading + Cable Loss + Atten. Loss + Duty factor
* Duty factor is refer to the page of "(Reference) duty chart for Maximum conducted power"

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Radiated Emission

UL Japan, Inc. Shonan EMC Lab.

Test place	No.3 Semi Anechoic Chamber	
Date	January 27, 2015	January 29, 2015
Temperature / Humidity	23 deg.C, 33 %RH	20 deg.C, 31 %RH
Engineer	Makoto Hosaka	
Mode	Tx, 902.2 MHz	
	Tx, PN9	

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	240.001	QP	30.0	16.8	18.4	32.0	33.2	46.0	12.8	135	69	
Hori.	329.998	QP	33.7	14.7	18.8	32.0	35.2	46.0	10.8	100	72	
Hori.	1804.400	PK	59.8	25.4	4.3	41.2	48.3	73.9	25.6	113	160	
Hori.	2706.600	PK	68.0	27.0	5.3	40.9	59.4	73.9	14.5	122	94	
Hori.	3608.800	PK	72.7	28.4	5.4	40.9	65.6	73.9	8.3	114	62	
Hori.	4511.000	PK	61.7	29.5	6.0	40.1	57.1	73.9	16.8	143	22	
Hori.	5413.200	PK	63.7	31.6	7.0	38.9	63.4	73.9	10.5	100	116	
Hori.	7217.600	PK	53.1	36.7	7.4	40.2	57.0	73.9	16.9	100	56	
Vert.	44.979	QP	29.3	12.5	17.0	32.2	26.6	40.0	13.4	100	240	
Vert.	49.999	QP	41.9	10.6	17.1	32.2	37.4	40.0	**2.6**	100	162	
Vert.	54.733	QP	30.6	9.2	17.0	32.2	24.6	40.0	15.4	100	91	
Vert.	60.003	QP	32.9	7.7	16.8	32.2	25.2	40.0	14.8	100	209	
Vert.	120.000	QP	31.1	12.8	17.4	32.1	29.2	43.5	14.3	100	287	
Vert.	209.999	QP	30.6	16.4	18.2	32.1	33.1	43.5	10.4	100	1	
Vert.	1804.400	PK	59.2	25.4	4.3	41.2	47.7	73.9	26.2	111	123	
Vert.	2706.600	PK	63.1	27.0	5.3	40.9	54.5	73.9	19.4	100	193	
Vert.	3608.800	PK	73.7	28.4	5.4	40.9	66.6	73.9	7.3	100	132	
Vert.	4511.000	PK	59.8	29.5	6.0	40.1	55.2	73.9	18.7	100	45	
Vert.	5413.200	PK	63.0	31.6	7.0	38.9	62.7	73.9	11.2	110	80	
Vert.	7217.600	PK	52.0	36.7	7.4	40.2	55.9	73.9	18.0	111	58	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter) - Gain(Amprifier))

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Dwell * Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	1804.400	AV	54.4	25.4	4.3	41.2	-31.1	11.8	53.9	42.1	
Hori.	2706.600	AV	67.2	27.0	5.3	40.9	-31.1	27.5	53.9	26.4	
Hori.	3608.800	AV	72.0	28.4	5.4	40.9	-31.1	33.8	53.9	20.1	
Hori.	4511.000	AV	59.6	29.5	6.0	40.1	-31.1	23.9	53.9	30.0	
Hori.	5413.200	AV	62.1	31.6	7.0	38.9	-31.1	30.7	53.9	23.2	
Hori.	7217.600	AV	46.5	36.7	7.4	40.2	-31.1	19.3	53.9	34.6	
Vert.	1804.400	AV	56.8	25.4	4.3	41.2	-31.1	14.2	53.9	39.7	
Vert.	2706.600	AV	61.7	27.0	5.3	40.9	-31.1	22.0	53.9	31.9	
Vert.	3608.800	AV	73.0	28.4	5.4	40.9	-31.1	34.8	53.9	**19.1**	
Vert.	4511.000	AV	57.3	29.5	6.0	40.1	-31.1	21.6	53.9	32.3	
Vert.	5413.200	AV	60.9	31.6	7.0	38.9	-31.1	29.5	53.9	24.4	
Vert.	7217.600	AV	44.3	36.7	7.4	40.2	-31.1	17.1	53.9	36.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)- Gain(Amprifier) + Dwell(time)factor)
* Dwell (time) factor refer to "Dwell time factor Calculation chart" sheet

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	902.200	QP	87.2	22.5	10.8	0.0	120.5	-	-	
Hori.	902.000	QP	63.1	22.5	10.8	0.0	96.4	100.5	4.1	
Vert.	902.200	QP	84.7	22.5	10.8	0.0	118.0	-	-	
Vert.	902.000	QP	61.0	22.5	10.8	0.0	94.3	98.0	3.7	

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator)

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Radiated Emission

UL Japan, Inc. Shonan EMC Lab.

Test place	No.3 Semi Anechoic Chamber	
Date	January 27, 2015	January 29, 2015
Temperature / Humidity	23 deg.C, 33 %RH	20 deg.C, 31 %RH
Engineer	Makoto Hosaka	
Mode	Tx, 914.2 MHz	
	Tx, PN9	

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	150.005	QP	28.3	14.8	18.0	32.1	29.0	43.5	14.5	228	318	
Hori.	240.002	QP	30.7	16.8	18.4	32.0	33.9	46.0	12.1	144	61	
Hori.	329.998	QP	33.7	14.7	18.8	32.0	35.2	46.0	10.8	100	76	
Hori.	1828.400	PK	58.5	25.4	4.3	41.2	47.0	73.9	26.9	116	156	
Hori.	2742.600	PK	69.0	27.0	5.3	40.9	60.4	73.9	13.5	117	92	
Hori.	3656.800	PK	74.6	28.5	5.4	40.9	67.6	73.9	6.3	100	75	
Hori.	4571.000	PK	59.8	29.7	6.1	40.0	55.6	73.9	18.3	100	23	
Hori.	5485.200	PK	62.6	31.6	7.0	38.8	62.4	73.9	11.5	100	110	
Hori.	7313.600	PK	51.8	36.8	7.4	40.3	55.7	73.9	18.2	100	57	
Vert.	44.547	QP	30.7	12.7	17.0	32.2	28.2	40.0	11.8	100	210	
Vert.	50.000	QP	43.5	10.6	17.1	32.2	39.0	40.0	**1.0**	100	157	
Vert.	54.811	QP	30.2	9.2	17.0	32.2	24.2	40.0	15.8	100	191	
Vert.	60.002	QP	33.0	7.7	16.8	32.2	25.3	40.0	14.7	100	199	
Vert.	120.001	QP	28.8	12.9	17.5	32.1	27.1	43.5	16.4	100	308	
Vert.	210.003	QP	27.8	16.4	18.2	32.1	30.3	43.5	13.2	100	194	
Vert.	1828.400	PK	54.1	25.4	4.3	41.2	42.6	73.9	31.3	149	177	
Vert.	2742.600	PK	63.1	27.0	5.3	40.9	54.5	73.9	19.4	100	51	
Vert.	3656.800	PK	75.2	28.5	5.4	40.9	68.2	73.9	5.7	100	121	
Vert.	4571.000	PK	58.1	29.7	6.1	40.0	53.9	73.9	20.0	100	43	
Vert.	5485.200	PK	58.9	31.6	7.0	38.8	58.7	73.9	15.2	100	80	
Vert.	7313.600	PK	50.4	36.8	7.4	40.3	54.3	73.9	19.6	100	5	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter) - Gain(Amprifier))

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Dwell * Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	1828.400	AV	51.3	25.4	4.3	41.2	-31.1	8.7	53.9	45.2	
Hori.	2742.600	AV	68.2	27.0	5.3	40.9	-31.1	28.5	53.9	25.4	
Hori.	3656.800	AV	73.9	28.5	5.4	40.9	-31.1	35.8	53.9	18.1	
Hori.	4571.000	AV	57.1	29.7	6.1	40.0	-31.1	21.8	53.9	32.1	
Hori.	5485.200	AV	60.8	31.6	7.0	38.8	-31.1	29.5	53.9	24.4	
Hori.	7313.600	AV	43.7	36.8	7.4	40.3	-31.1	16.5	53.9	37.4	
Vert.	1828.400	AV	44.9	25.4	4.3	41.2	-31.1	2.3	53.9	51.6	
Vert.	2742.600	AV	61.5	27.0	5.3	40.9	-31.1	21.8	53.9	32.1	
Vert.	3656.800	AV	74.6	28.5	5.4	40.9	-31.1	36.5	53.9	**17.4**	
Vert.	4571.000	AV	55.0	29.7	6.1	40.0	-31.1	19.7	53.9	34.2	
Vert.	5485.200	AV	56.1	31.6	7.0	38.8	-31.1	24.8	53.9	29.1	
Vert.	7313.600	AV	40.3	36.8	7.4	40.3	-31.1	13.1	53.9	40.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter) - Gain(Amprifier) + Dwell(time)factor)
* Dwell (time) factor refer to "Dwell time factor Calculation chart" sheet

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Radiated Emission

UL Japan, Inc. Shonan EMC Lab.

Test place	No.3 Semi Anechoic Chamber	
Date	January 27, 2015	January 29, 2015
Temperature / Humidity	23 deg.C, 33 %RH	20 deg.C, 31 %RH
Engineer	Makoto Hosaka	
Mode	Tx, 926.7 MHz	
	Tx, PN9	

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	210.002	QP	30.4	16.4	18.2	32.1	32.9	43.5	10.6	155	39	
Hori.	329.998	QP	34.2	14.7	18.8	32.0	35.7	46.0	10.3	100	75	
Hori.	1853.400	PK	58.8	25.5	4.3	41.2	47.4	73.9	26.5	106	168	
Hori.	2780.100	PK	68.1	27.1	5.3	40.9	59.6	73.9	14.3	111	92	
Hori.	3706.800	PK	74.1	28.6	5.4	40.8	67.3	73.9	6.6	163	81	
Hori.	4633.500	PK	54.7	30.0	6.1	40.0	50.8	73.9	23.1	128	66	
Hori.	5560.200	PK	63.0	31.8	7.1	38.8	63.1	73.9	10.8	100	107	
Hori.	7413.600	PK	51.5	37.0	7.4	40.4	55.5	73.9	18.4	100	30	
Vert.	44.651	QP	31.3	12.7	17.0	32.2	28.8	40.0	11.2	100	235	
Vert.	50.003	QP	42.6	10.6	17.1	32.2	38.1	40.0	**1.9**	100	155	
Vert.	54.770	QP	30.3	9.2	17.0	32.2	24.3	40.0	15.7	100	355	
Vert.	59.999	QP	33.6	7.7	16.8	32.2	25.9	40.0	14.1	100	279	
Vert.	119.999	QP	31.4	12.8	17.4	32.1	29.5	43.5	14.0	100	318	
Vert.	1853.400	PK	59.4	25.5	4.3	41.2	48.0	73.9	25.9	100	125	
Vert.	2780.100	PK	63.6	27.1	5.3	40.9	55.1	73.9	18.8	100	151	
Vert.	3706.800	PK	75.5	28.6	5.4	40.8	68.7	73.9	5.2	100	125	
Vert.	4633.500	PK	52.5	30.0	6.1	40.0	48.6	73.9	25.3	100	114	
Vert.	5560.200	PK	61.1	31.8	7.1	38.8	61.2	73.9	12.7	100	86	
Vert.	7413.600	PK	50.8	37.0	7.4	40.4	54.8	73.9	19.1	100	4	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter) - Gain(Amprifier))

Dwell time factor relaxation

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Dwell * Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	1853.400	AV	54.0	25.5	4.3	41.2	-31.1	11.5	53.9	42.4	
Hori.	2780.100	AV	67.2	27.1	5.3	40.9	-31.1	27.6	53.9	26.3	
Hori.	3706.800	AV	73.5	28.6	5.4	40.8	-31.1	35.6	53.9	18.3	
Hori.	4633.500	AV	49.5	30.0	6.1	40.0	-31.1	14.5	53.9	39.4	
Hori.	5560.200	AV	61.1	31.8	7.1	38.8	-31.1	30.1	53.9	23.8	
Hori.	7413.600	AV	43.3	37.0	7.4	40.4	-31.1	16.2	53.9	37.7	
Vert.	1853.400	AV	56.9	25.5	4.3	41.2	-31.1	14.4	53.9	39.5	
Vert.	2780.100	AV	62.1	27.1	5.3	40.9	-31.1	22.5	53.9	31.4	
Vert.	3706.800	AV	74.9	28.6	5.4	40.8	-31.1	37.0	53.9	**16.9**	
Vert.	4633.500	AV	46.3	30.0	6.1	40.0	-31.1	11.3	53.9	42.6	
Vert.	5560.200	AV	58.7	31.8	7.1	38.8	-31.1	27.7	53.9	26.2	
Vert.	7413.600	AV	42.3	37.0	7.4	40.4	-31.1	15.2	53.9	38.7	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter) - Gain(Amprifier) + Dwell(time)factor)
* Dwell (time) factor refer to "Dwell time factor Calculation chart" sheet.

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	926.700	QP	87.2	22.7	10.9	0.0	120.8	-	-	
Hori.	928.000	QP	34.9	22.7	10.9	0.0	68.5	100.8	32.3	
Vert.	926.700	QP	86.8	22.7	10.9	0.0	120.4	-	-	
Vert.	928.000	QP	29.0	22.7	10.9	0.0	62.6	100.4	37.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator))

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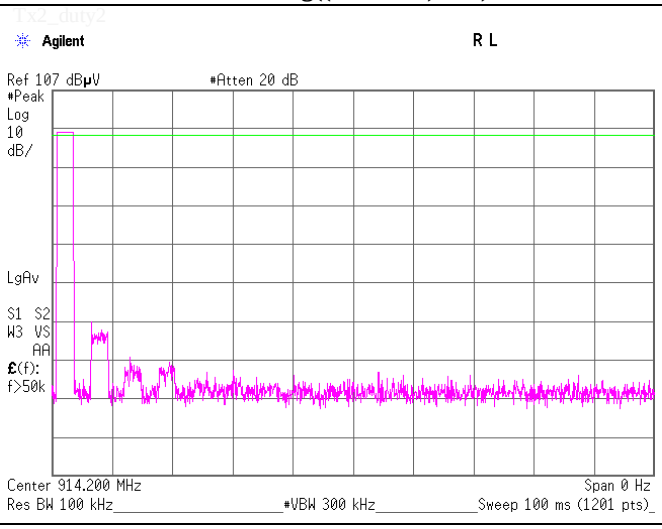
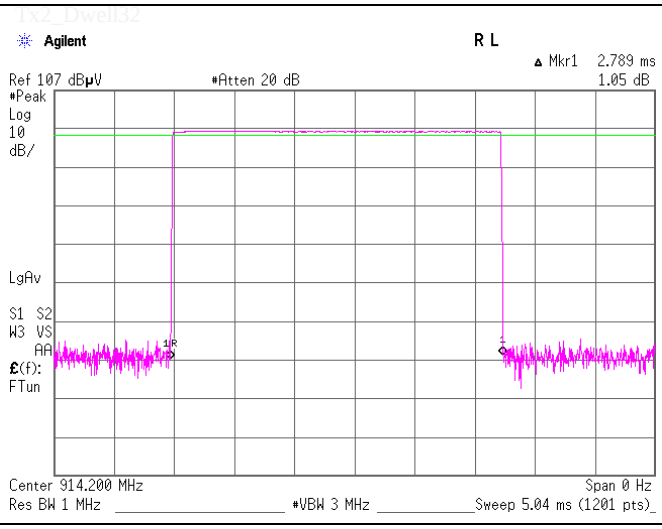
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	January 20, 2015	
Temperature / Humidity	24 deg.C , 33 %RH	
Engineer	Shinichi Takano	

Dwell time factor Calculation chart

Dwell time factor Calculation

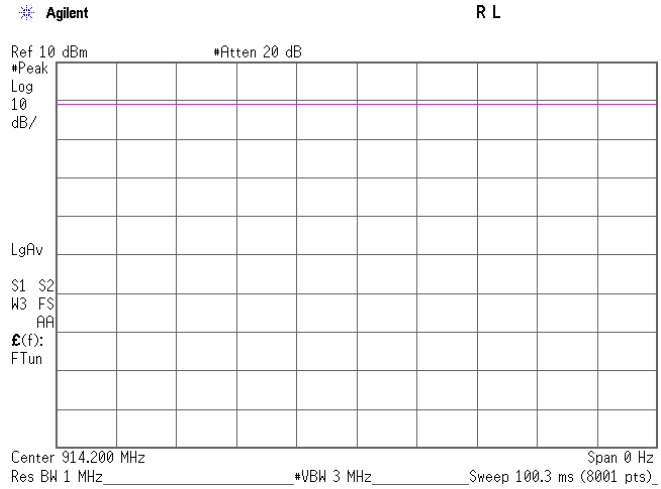
Tx, FHSS, PN9	
Worst 100ms **Dwell time factor =20log((2.789 x 1)/100) = -31.09dB**	**1cycle On time :** **2.789ms**
	

VBW (Average) setting

***Although 00-705 accepts VBW=10Hz for AV measurements, confirmed that superfluous smoothing was not performed.**

(Reference) duty chart for Maximum conducted power

(Reference duty chart for Maximum conducted power)



on time [ms] 100.3 1cycle[ms] 100.3 duty 1.00

duty factor [dB] 0

* caliculation: duty factor [dB] = 10 x log (1cycle [ms] / on time [ms])

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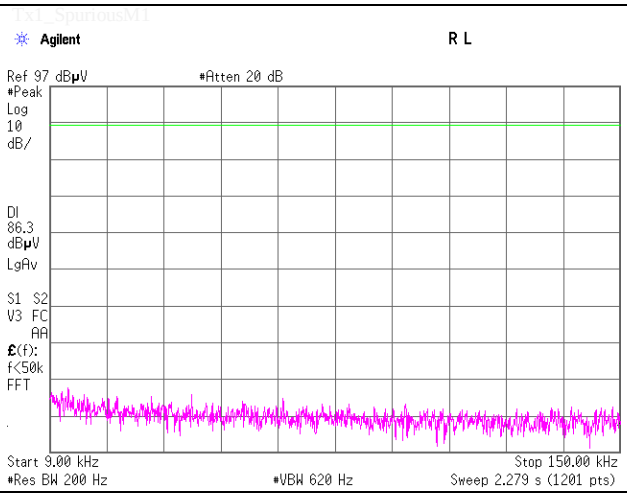
Spurious emission (Conducted)

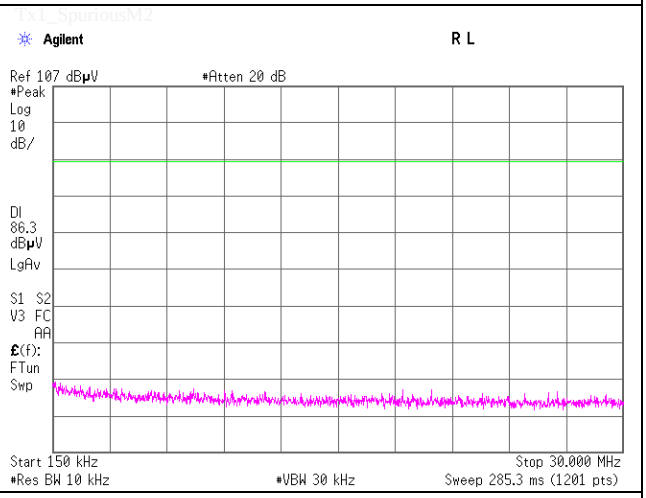
Tx, FHSS, PN9

Tx, 902.2MHz (below 30MHz)

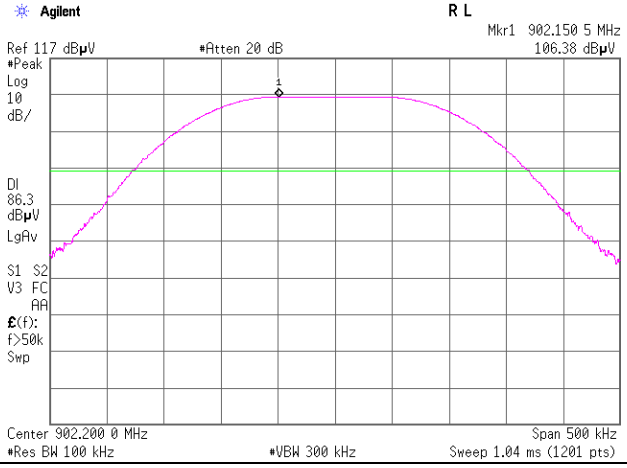
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc Limit



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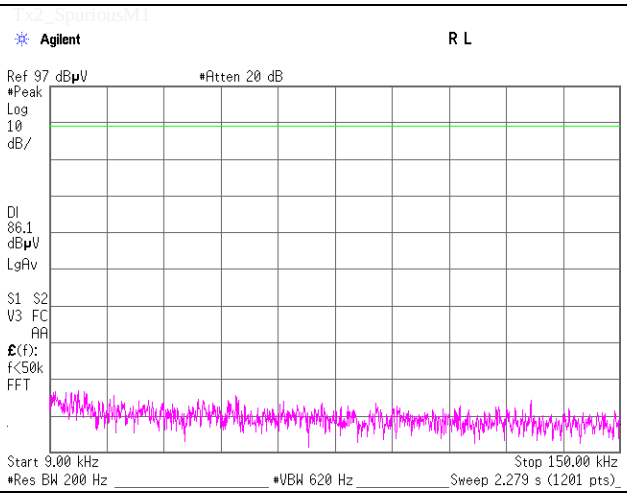
Spurious emission (Conducted)

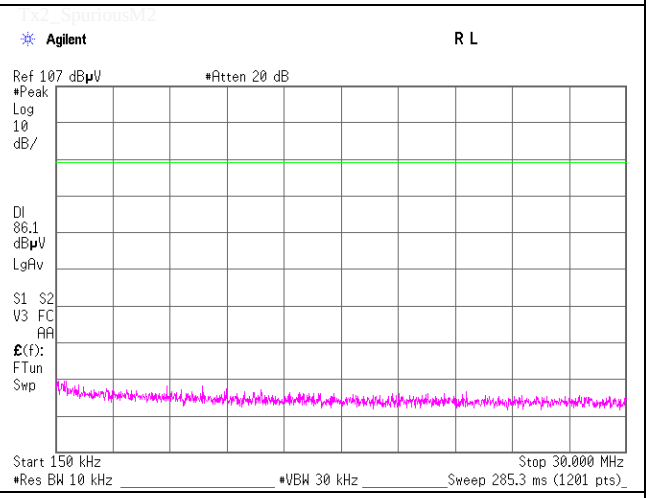
Tx, FHSS, PN9

Tx, 914.2MHz (below 30MHz)

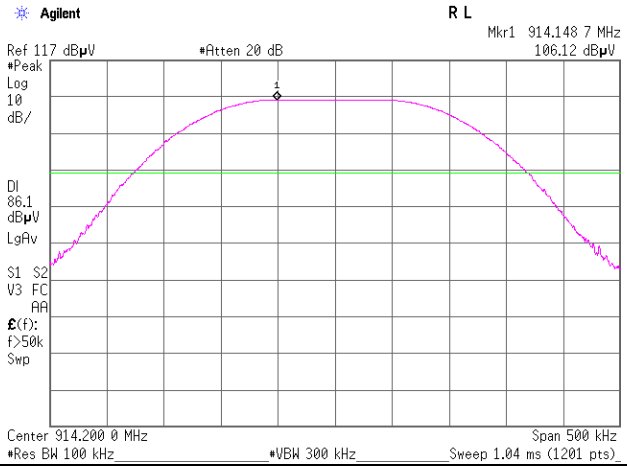
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc Limit



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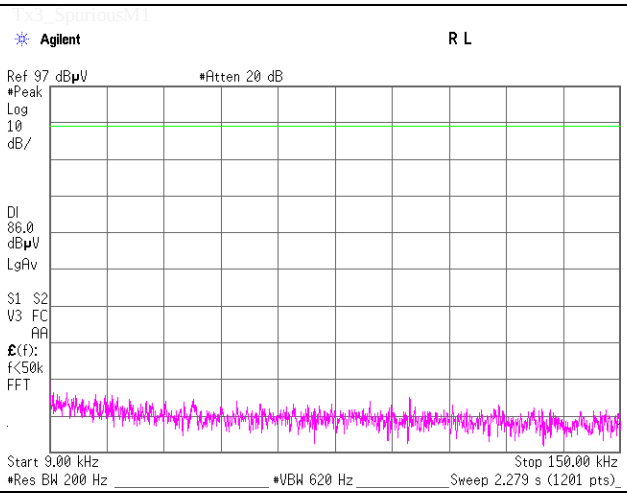
Engineer	Shinichi Takano	

Spurious emission (Conducted)

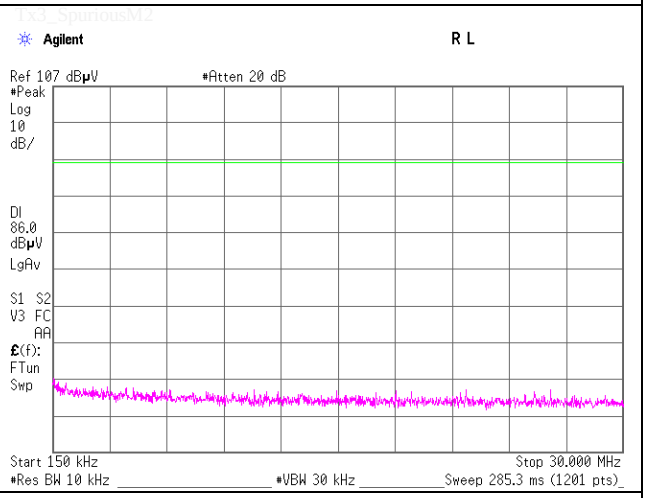
Tx, FHSS, PN9

Tx, 926.7MHz (below 30MHz)

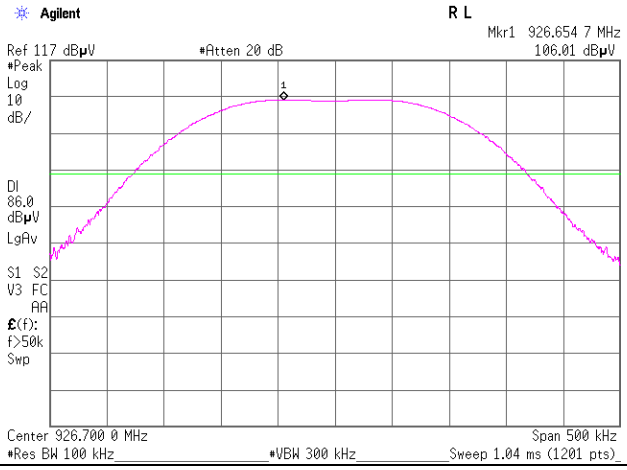
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc Limit



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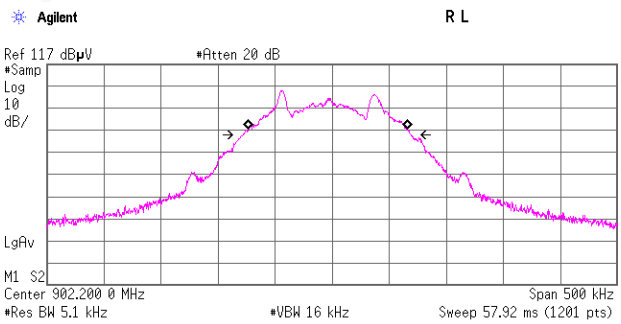
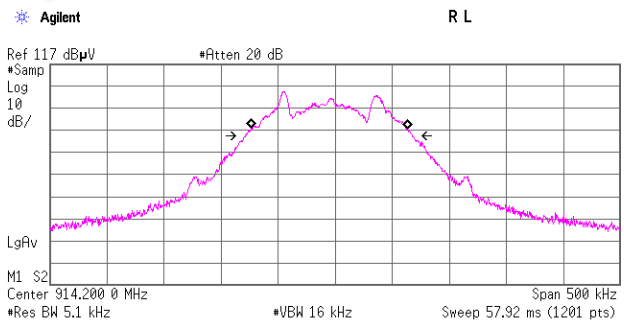
99% Occupied Bandwidth

Tx, FHSS, PN9

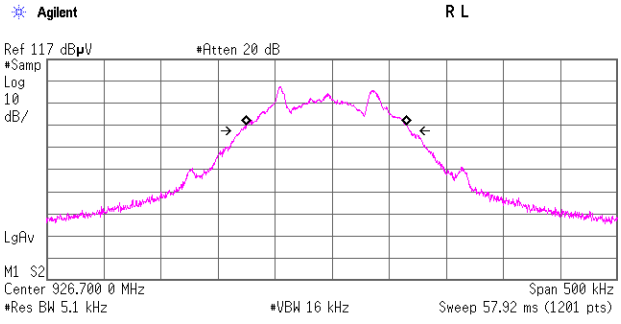
Tx, 902.2MHz



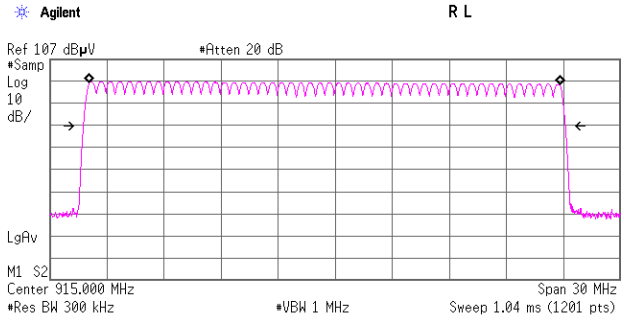
Tx, 914.2MHz



Tx, 926.7MHz



Tx, Hopping On



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APPENDIX 2
Test Instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	AT	2014/03/17 * 12
SAT20-06	Attenuator	Weinschel Corp.	54A-20	31506	AT	2014/04/22 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000KMSKMS	-	AT	2014/05/15 * 12
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2014/04/08 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2014/04/08 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2014/12/24 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2014/07/14 * 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	2014/08/27 * 12
SAT10-01	Attenuator	JFW	50HF-010N	-	RE	2014/02/17 * 12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	RE	2014/04/25 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2014/02/14 * 12
STR-06	Test Receiver	Rohde & Schwarz	ESCI	101259	RE/CE	2014/03/04 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,MF)	-	RE/CE	-
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2014/10/30 * 12
SJM-15	Measure	ASKUL	-	-	RE/CE	-
SCC-C9/C10/SRSE-03	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-271(RF Selector)	CE	2014/04/25 * 12
SLS-02	LISN	Rohde & Schwarz	ENV216	100512	CE	2014/03/05 * 12
SAT3-06	Attenuator	JFW	50HF-003N	-	CE	2014/02/17 * 12
SOS-06	Humidity Indicator	A&D	AD-5681	4062118	CE	2014/12/24 * 12
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	1440491	RE	2014/05/23 * 12
SCC-G04	Coaxial Cable	Junkosha	J12J102207-00	JUN-12-14-018	RE	2014/06/24 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2014/05/15 * 12
SFL-01	Highpass Filter	MICRO-TRONICS	HPM50115	001	RE	2014/11/21 * 12
KFL-21	Highpass Filter	MICRO-TRONICS	HPM50115	002	RE	2014/04/10 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2014/08/12 * 12
SSA-01	Spectrum Analyzer	Agilent	N9010A-526	MY48031482	RE	2014/04/07 * 12

The expiration date of the calibration is the end of the expired month .
As for some calibrations performed after the tested dates , those test equipment have been controlled by means of an unbroken chains of calibrations .

All equipment is calibrated with valid calibrations . Each measurement data is traceable to the national or international standards.
Test Item :
CE: Conducted emission ,
RE: Radiated emission ,
AT: Antenna terminal conducted test