



RADIO TEST REPORT

Test Report No. : 11970995S-A-R1

Applicant : TAMIYA, INC.
Type of Equipment : RF Module
Model No. : 2.4GTU-02
FCC ID : GHL0005
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 11970995S-A. 11970995S-A is replaced with this report.

Date of test: October 5 to 29, 2017

Representative test engineer:

Kenichi Adachi
Engineer
Consumer Technology Division

Approved by:

Akio Hayashi
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".



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13-EM-F0429

Original Test Report No.: 11970995S-A

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SECTION 1: Customer information

Company Name	:	TAMIYA, INC.
Address	:	3-7 Ondawara, Suruga-ku, Shizuoka 422-8610 Japan
Telephone Number	:	+81-54-286-5105
Facsimile Number	:	+81-54-287-2192
Contact Person	:	Yasuhiko Osa

*TAMIYA, INC. is on behalf of the applicant: TAMIYA AMERICA, INC.

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

2.1 Identification of E.U.T.

Type of Equipment	:	RF Module
Model No.	:	2.4GTU-02
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 6 V
Receipt Date of Sample	:	October 5, 2017
Country of Mass-production	:	China
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: 2.4GTU-02 (referred to as the EUT in this report) is an RF Module.

General Specification

Clock frequency(ies) in the system	:	16 MHz
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Radio Specification

Radio Type	:	Transmitter
Frequency of Operation	:	2404.5 MHz - 2452.0 MHz
Channel spacing	:	1.5 MHz
Modulation	:	FHSS
Power Supply (radio part input)	:	DC 3.3 V
Antenna type	:	Pattern Antenna by the copper foils (P.C.B. (MSA Antenna))
Antenna Gain	:	2.14 dBi

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.

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	16.6 dB 0.24752 MHz, AV, L1 (Tx, 2404.5 MHz)	Complied	-
Carrier Frequency Separation	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (b)	See data.	Complied	Conducted
20dB Bandwidth	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1) IC: RSS-247 5.1 (a)		-	Conducted
Number of Hopping Frequency	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (d)		Complied	Conducted
Dwell time	FCC: FCC Public Notice DA 00-705 IC: -	FCC: Section15.247(a)(1)(iii) IC: RSS-247 5.1 (d)		Complied	Conducted
Maximum Peak Output Power	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.12	FCC: Section15.247(a)(b)(1) IC: RSS-247 5.4 (b)		Complied	Conducted
Spurious Emission & Band Edge Compliance	FCC: FCC Public Notice DA 00-705 IC: RSS-Gen 6.13	FCC: Section15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	3.4 dB 2388.525 MHz, AV, Horizontal (Tx 2404.5 MHz)	Complied	Conducted/ Radiated (above 30 MHz) *1)

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

*1) Radiated test was selected over 30 MHz based on section 15.247(d).

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

FCC Part 15.31 (e)

The RF Module has its own regulator. The RF Module is constantly provided voltage (DC 3.3 V) through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The antenna is not removable from the EUT. Therefore, the equipment complies with the antenna requirement.

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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

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	-	-
	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
Radiated emission (Measurement distance: 1 m)	13 GHz-18 GHz	4.6 dB	4.6 dB	4.6 dB	-	-
	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 %

Conducted Emission test

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

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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JAB Accreditation No. RTL02610

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	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)

Test item	Operating mode	Tested frequency
Carrier frequency separation	Transmitting (Hopping ON)	Hopping pattern 1
20 dB bandwidth	Transmitting (Hopping OFF)	2404.5 MHz, 2428.5 MHz, 2452 MHz
Number of hopping frequency	Transmitting (Hopping ON)	Hopping pattern 1
Dwell time	Transmitting (Hopping ON)	Hopping pattern 1
Maximum peak output power	Transmitting (Hopping OFF)	2404.5 MHz, 2428.5 MHz, 2452 MHz
Band edge compliance & Spurious emission (Conducted)	Transmitting -Hopping ON -Hopping OFF	Band edge compliance: 2404.5 MHz, 2452 MHz (Hopping pattern 1, 5) Spurious emission: 2404.5 MHz, 2428.5 MHz, 2452 MHz
(Radiated) & Conducted emission	Transmitting -Hopping OFF	
99 % occupied bandwidth	Transmitting -Hopping ON -Hopping OFF	2404.5 MHz, 2428.5 MHz, 2452 MHz

* Payload data pattern was [10101010 10101010 10101010 10101010] (4 bytes) was used at all tests.
Because this data pattern became the maximum radiated emissions.

The operation program of EUT was operated by the software for the test in EUT. (This software: TTU-10_V1UL version 1.1.0.) The EUT's output power setting cannot be changed.

Hopping patterns of this EUT:

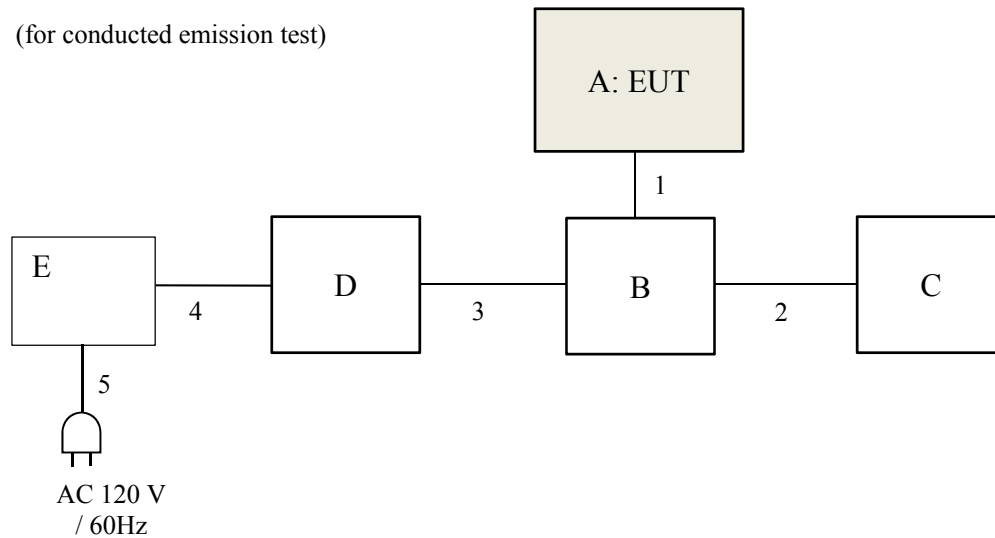
Hopping pattern 1: 2404.5 MHz to 2448.0 MHz	Hopping pattern 6: 2404.5 MHz to 2448.0 MHz
Hopping pattern 2: 2405.0 MHz to 2448.5 MHz	Hopping pattern 7: 2405.0 MHz to 2448.5 MHz
Hopping pattern 3: 2407.5 MHz to 2451.0 MHz	Hopping pattern 8: 2407.5 MHz to 2451.0 MHz
Hopping pattern 4: 2408.0 MHz to 2451.5 MHz	Hopping pattern 9: 2408.0 MHz to 2451.5 MHz
Hopping pattern 5: 2408.5 MHz to 2452.0 MHz	

There are 9 hopping stream patterns in this product. When defined stream pattern, random hopping will start within 30 ch with 1.5 MHz channel spacing. There is no random hopping between hopping stream patterns. The specification of one channel of each pattern is the same. The hopping pattern was using the pattern 1 as a representative.

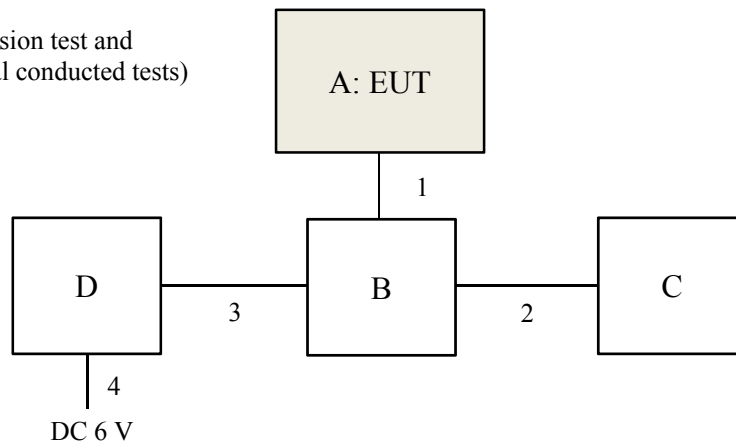
Justification: The system was configured in typical fashion (as customer would normally use it) for testing.

4.2 Configuration and peripherals

(for conducted emission test)



(for radiated emission test and
Antenna terminal conducted tests)



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	RF Module	2.4GTU-02	1 *1) 2 *2)	TAMIYA, INC.	EUT
B	Jig PWB	-	-	TAMIYA, INC.	-
C	Switch PWB	-	-	TAMIYA, INC.	-
D	Power Switch PWB	-	-	TAMIYA, INC.	-
E	DC power supply	PAN35-10A	NA000955	Kikusui	-

*1) Used for Antenna Terminal conducted test

*2) Used for Radiated Emission test and Conducted emission test.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal	0.11	Unshielded	Unshielded	-
2	Signal	0.06	Unshielded	Unshielded	-
3	Signal	0.05	Unshielded	Unshielded	-
4	DC	1.00	Unshielded	Unshielded	-
5	AC	2.00	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a platform of nominal size, 1.0 m by 2.0 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 rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT via DC power supply in a shielded room. The EUT via DC power supply was connected to a LISN (AMN). An overview sweep with peak detection has been performed.

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

Detector	: QP and CISPR AV
Measurement range	: 0.15 MHz - 30 MHz
Test data	: APPENDIX
Test result	: Pass

SECTION 6: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[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 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 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	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz *1)	RBW: 100 kHz VBW: 300 kHz
Test Distance	3 m	3.97 m*2) (1 GHz – 13 GHz), 1 m*3) (13 GHz – 26.5 GHz),		3.97 m*2) (1 GHz – 13 GHz), 1 m*3) (13 GHz – 26.5 GHz),

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

*2) Distance Factor: $20 \times \log(3.97 \text{ m}/3.0 \text{ m}) = 2.44 \text{ dB}$

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

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Antenna polarization	Carrier	Spurious (Below 1 GHz)	Spurious (1 GHz -13 GHz)	Spurious (13 GHz -18 GHz)	Spurious (18 GHz -26.5 GHz)
Horizontal	X	X	X	X	X
Vertical	Y	Y	Y	X	X

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

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SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
20 dB Bandwidth	3 MHz	30 kHz	100 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Sample	Max Hold *1)	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak Average *2)	-	Power Meter (Sensor: 50MHz BW)
Carrier Frequency Separation	5 MHz	51 kHz	160 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Number of Hopping Frequency	30 MHz	300 kHz	1 MHz	Auto	Peak	Max Hold	Spectrum Analyzer
Dwell Time	Zero Span	100 kHz, 1 MHz	300 kHz, 3 MHz	As necessary capture the entire dwell time per hopping channel	Peak	Clear Write	Spectrum Analyzer
Conducted Spurious Emission *3)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				
	30 MHz to 25 GHz	100 kHz	300 kHz				
Conducted Spurious Emission Band Edge compliance	20 MHz or 39 MHz	200 kHz or 390 kHz	620 kHz or 1.2 MHz	Auto	Peak	Max Hold	Spectrum Analyzer
*1) The measurement was performed with Max Hold since the duty cycle was not 100 %. *2) Reference data *3) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.							

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

Conducted Emission DATA OF CONDUCTED EMISSION TEST

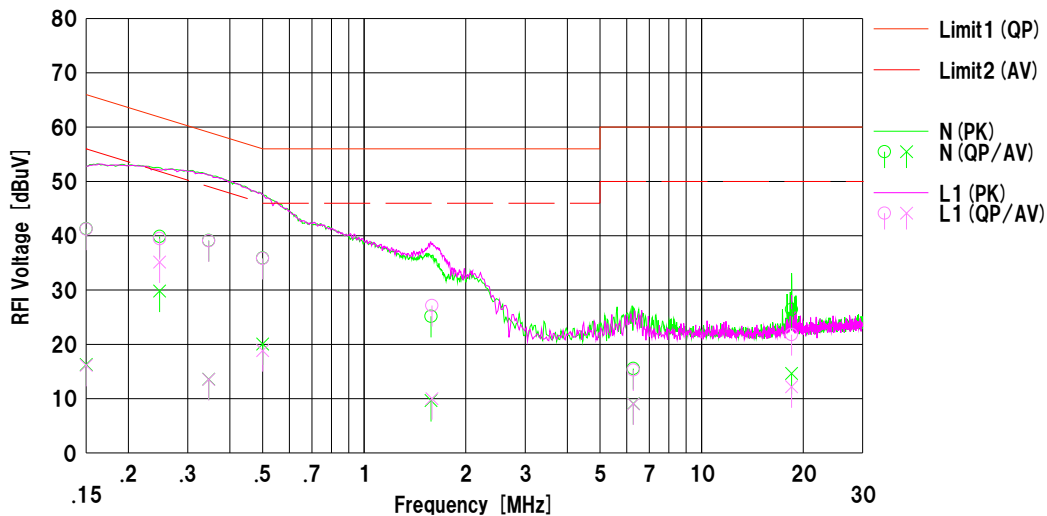
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/10/29

Company : TAMIYA, INC.
Kind of EUT : Controller
Model No. : 2.4GTU-02
Serial No. : 2
Remarks :

Mode : Transmitting 2404.5 MHz
Order No. : 11970995S
Power : DC 6 V (AC adapter input AC 120V)
Temp./Humi. : 24 deg.C / 53 %RH

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.89	3.88	12.41	41.30	16.29	66.00	56.00	24.7	39.7	N	
2	0.24752	27.46	17.42	12.41	39.87	29.83	61.84	51.84	21.9	22.0	N	
3	0.34600	26.69	1.17	12.43	39.12	13.60	59.06	49.06	19.9	35.4	N	
4	0.50001	23.43	7.63	12.44	35.87	20.07	56.00	46.00	20.1	25.9	N	
5	1.57842	12.65	-2.86	12.52	25.17	9.66	56.00	46.00	30.8	36.3	N	
6	6.27812	2.79	-3.65	12.75	15.54	9.10	60.00	50.00	44.4	40.9	N	
7	18.47772	13.12	1.33	13.31	26.43	14.64	60.00	50.00	33.5	35.3	N	
8	0.15000	28.81	3.72	12.41	41.22	16.13	66.00	56.00	24.7	39.8	L1	
9	0.24752	27.06	22.75	12.41	39.47	35.16	61.84	51.84	22.3	16.6	L1	
10	0.34600	26.65	1.12	12.43	39.06	13.55	59.06	49.06	19.9	35.5	L1	
11	0.50001	23.38	6.41	12.44	35.82	18.85	56.00	46.00	20.1	27.1	L1	
12	1.58920	14.64	-2.53	12.52	27.16	9.99	56.00	46.00	28.8	36.0	L1	
13	6.27812	2.53	-3.71	12.75	15.28	9.04	60.00	50.00	44.7	40.9	L1	
14	18.47772	8.49	-1.11	13.31	21.80	12.20	60.00	50.00	38.2	37.8	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN (AMN) + Cable + ATT) [dB]
LISN (AMN) = SLS-05

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Conducted Emission DATA OF CONDUCTED EMISSION TEST

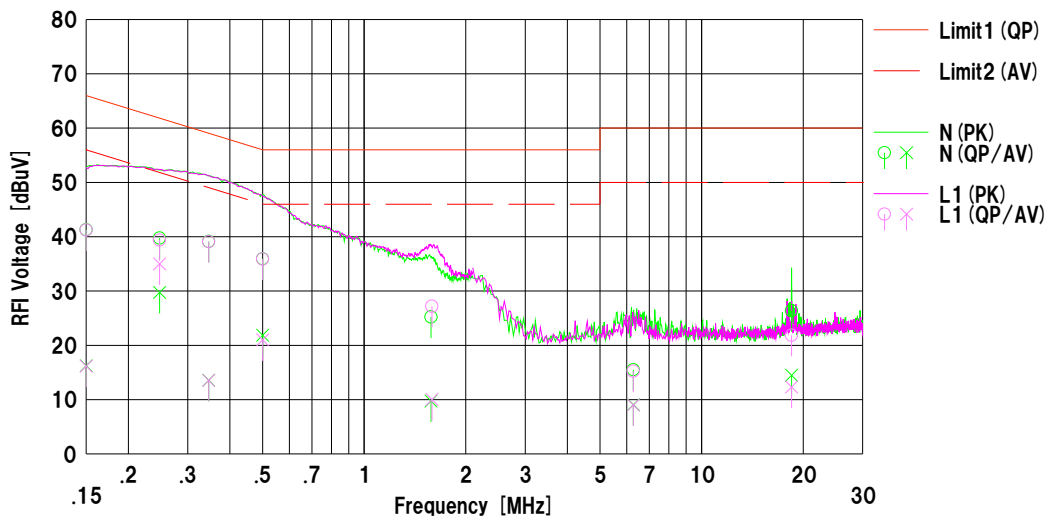
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/10/29

Company : TAMIYA, INC.
Kind of EUT : Controller
Model No. : 2.4GTU-02
Serial No. : 2
Remarks :

Mode : Transmitting 2428.5 MHz
Order No. : 11970995S
Power : DC 6 V (AC adapter input AC 120V)
Temp./Humi. : 24 deg.C / 53 %RH

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.89	3.84	12.41	41.30	16.25	66.00	56.00	24.7	39.7	N	
2	0.24754	27.34	17.33	12.41	39.75	29.74	61.84	51.84	22.0	22.1	N	
3	0.34600	26.69	1.14	12.43	39.12	13.57	59.06	49.06	19.9	35.4	N	
4	0.50001	23.49	9.41	12.44	35.93	21.85	56.00	46.00	20.0	24.1	N	
5	1.57829	12.69	-2.78	12.52	25.21	9.74	56.00	46.00	30.7	36.2	N	
6	6.27822	2.75	-3.67	12.75	15.50	9.08	60.00	50.00	44.5	40.9	N	
7	18.47728	13.06	1.19	13.31	26.37	14.50	60.00	50.00	33.6	35.5	N	
8	0.15000	28.82	3.76	12.41	41.23	16.17	66.00	56.00	24.7	39.8	L1	
9	0.24754	26.97	22.58	12.41	39.35	34.95	61.84	51.84	22.4	16.8	L1	
10	0.34600	26.66	1.12	12.43	39.09	13.55	59.06	49.06	19.9	35.5	L1	
11	0.50001	23.46	8.57	12.44	35.90	21.01	56.00	46.00	20.1	24.9	L1	
12	1.58919	14.67	-2.51	12.52	27.19	10.01	56.00	46.00	28.8	35.9	L1	
13	6.27822	2.49	-3.74	12.75	15.24	9.01	60.00	50.00	44.7	40.9	L1	
14	18.47776	8.55	-0.98	13.31	21.86	12.33	60.00	50.00	38.1	37.6	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN (AMN) + Cable + ATT) [dB]
LISN (AMN) = SLS-05

UL Japan, Inc.

Shonan EMC Lab.

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

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Conducted Emission DATA OF CONDUCTED EMISSION TEST

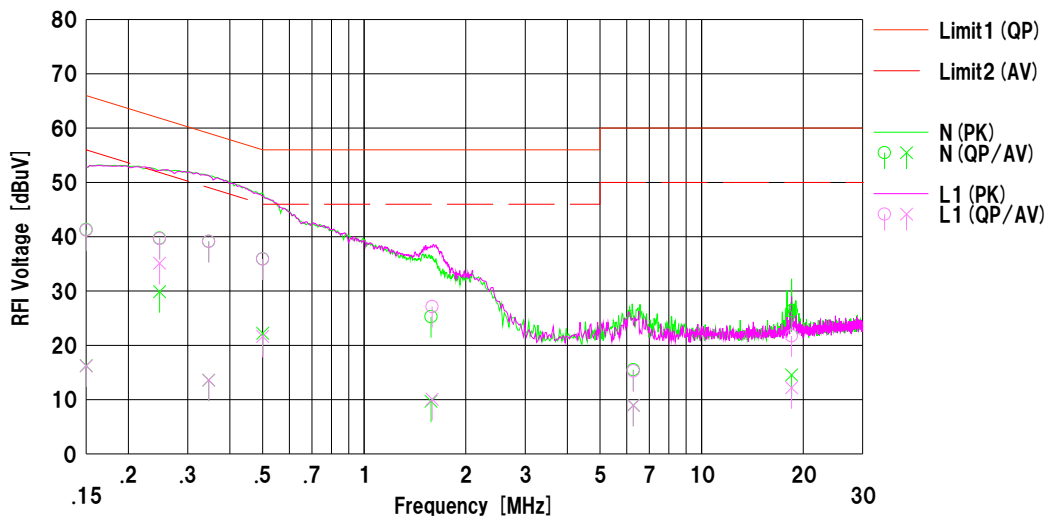
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/10/29

Company : TAMIYA, INC.
Kind of EUT : Controller
Model No. : 2.4GTU-02
Serial No. : 2
Remarks :

Mode : Transmitting 2452 MHz
Order No. : 11970995S
Power : DC 6 V (AC adapter input AC 120V)
Temp./Humi. : 24 deg.C / 53 %RH

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

Engineer : Kenichi Adachi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.90	3.86	12.41	41.31	16.27	66.00	56.00	24.6	39.7	N	
2	0.24757	27.33	17.47	12.41	39.74	29.88	61.84	51.84	22.1	21.9	N	
3	0.34600	26.72	1.17	12.43	39.15	13.60	59.06	49.06	19.9	35.4	N	
4	0.50001	23.48	9.78	12.44	35.92	22.22	56.00	46.00	20.0	23.7	N	
5	1.57826	12.75	-2.81	12.52	25.27	9.71	56.00	46.00	30.7	36.2	N	
6	6.27828	2.75	-3.79	12.75	15.50	8.96	60.00	50.00	44.5	41.0	N	
7	18.47725	13.04	1.22	13.31	26.35	14.53	60.00	50.00	33.6	35.4	N	
8	0.15000	28.80	3.80	12.41	41.21	16.21	66.00	56.00	24.7	39.7	L1	
9	0.24757	27.24	22.71	12.41	39.65	35.12	61.84	51.84	22.1	16.7	L1	
10	0.34600	26.69	1.16	12.43	39.12	13.59	59.06	49.06	19.9	35.4	L1	
11	0.50001	23.45	9.22	12.44	35.89	21.66	56.00	46.00	20.1	24.3	L1	
12	1.58926	14.61	-2.45	12.52	27.13	10.07	56.00	46.00	28.8	35.9	L1	
13	6.27828	2.55	-3.83	12.75	15.30	8.92	60.00	50.00	44.7	41.0	L1	
14	18.47725	8.42	-1.11	13.31	21.73	12.20	60.00	50.00	38.2	37.8	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN (AMN) + Cable + ATT) [dB]
LISN (AMN) = SLS-05

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

20dB Bandwidth and Carrier Frequency Separation

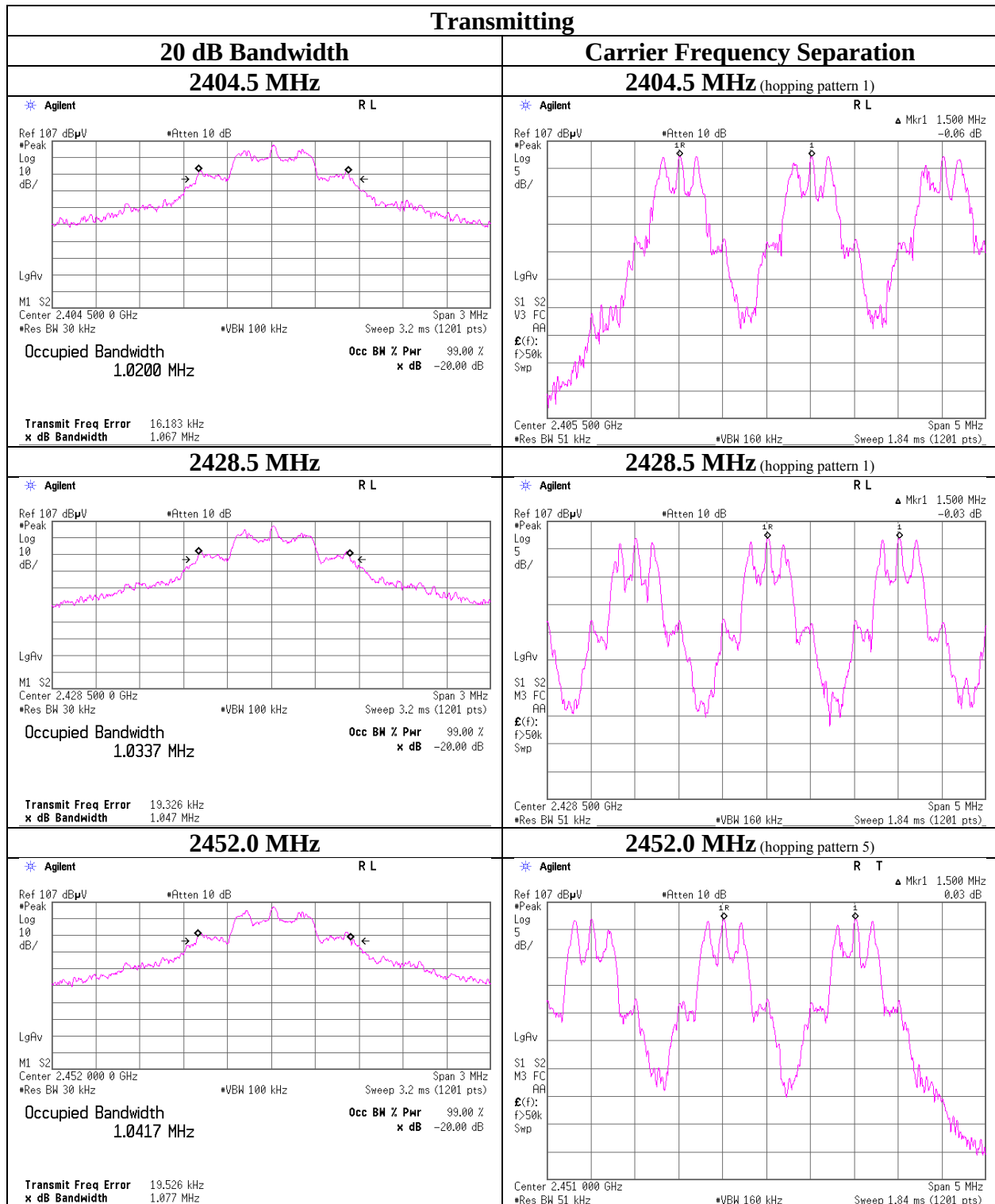
Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 11970995S-A-R1
Date October 5, 2017
Temperature / Humidity 25 deg. C / 41 % RH
Engineer Kenichi Adachi
Mode Transmitting

Mode	Freq. [MHz]	20 dB Bandwidth [MHz]	Carrier Frequency Separation [MHz]	Limit for Carrier Frequency separation [MHz]
Transmitting	2404.5	1.067	1.500	≥ 0.711
Transmitting	2428.5	1.047	1.500	≥ 0.698
Transmitting	2452.0	1.077	1.500	≥ 0.718

Limit: Two-thirds of 20 dB Bandwidth or 25 kHz (whichever is greater).

No limit applies to 20 dB Bandwidth.

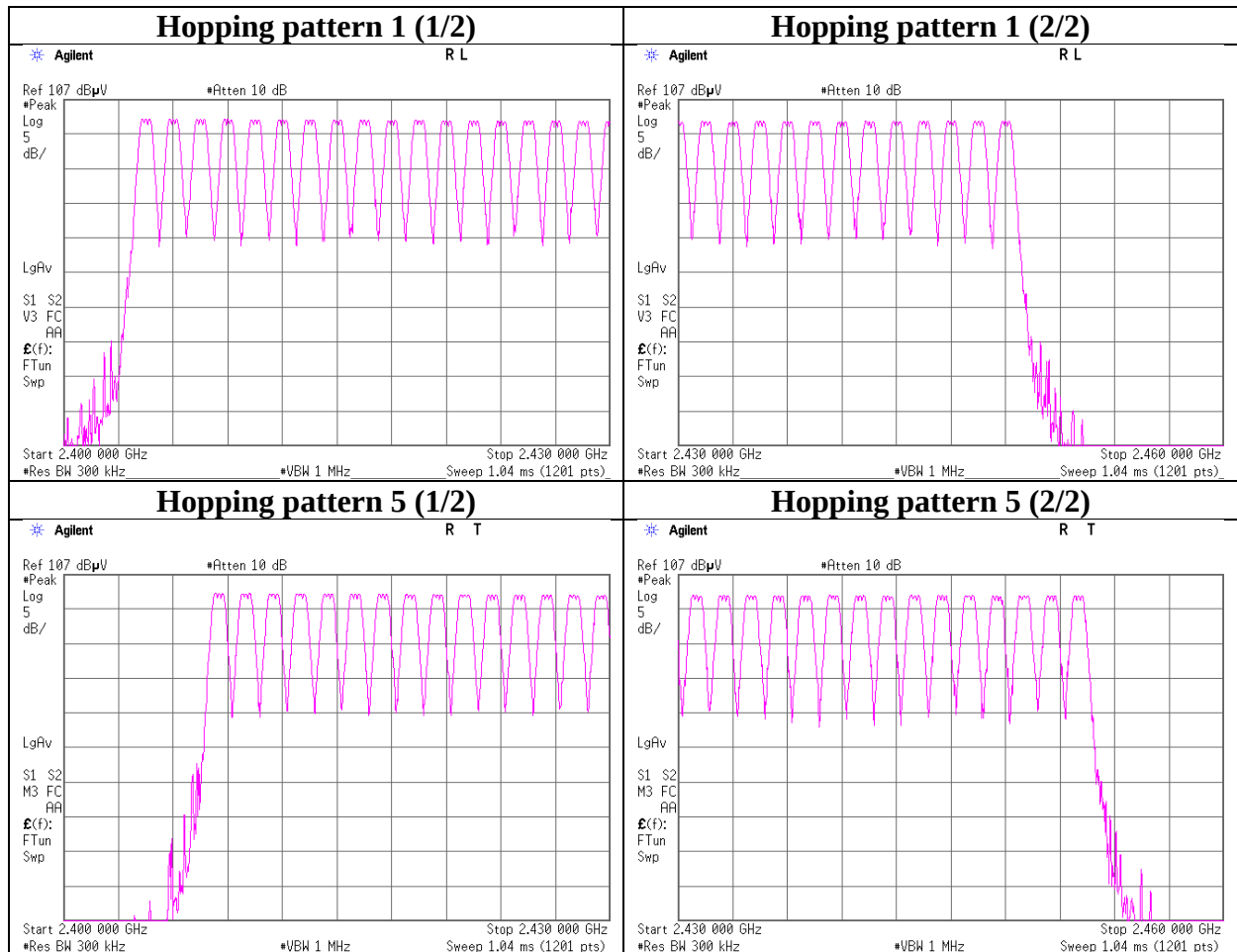
20 dB Bandwidth and Carrier Frequency Separation



Number of Hopping Frequency

Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11970995S-A-R1
Date	October 5, 2017
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Kenichi Adachi
Mode	Transmitting

Mode	Number of channel [channels]	Limit [channels]
Tx hopping pattern 1	30	≥ 15
Tx hopping pattern 5	30	≥ 15



Dwell time

Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 11970995S-A-R1
Date October 5, 2017
Temperature / Humidity 25 deg. C / 41 % RH
Engineer Kenichi Adachi
Mode Transmitting hopping pattern 1

Mode	Number of transmission in a 12 (= 30 Hopping x 0.4)	Length of transmission [ms]	Result [ms]	Limit [ms]
Transmitting	7.0 times / 5 s x 12.0 s = 17 times	4.756	81	400

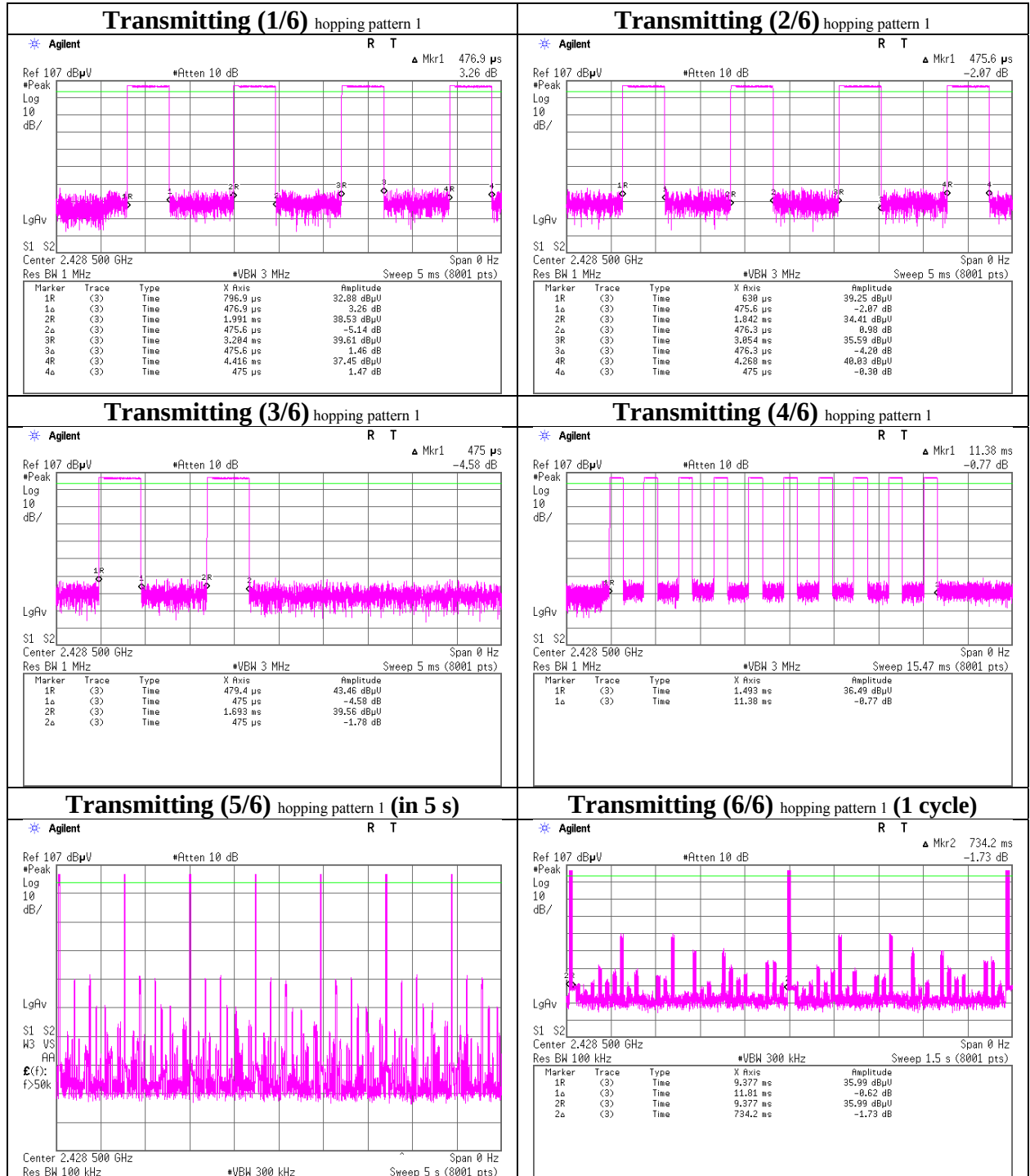
Sample Calculation

Result = Number of transmission x Length of transmission

Length of transmission [ms] = 4.7563 [ms]

= 0.4769 + 0.4756 + 0.4756 + 0.4750 + 0.4756 + 0.4763 + 0.4763 + 0.4750 + 0.4750 + 0.4750

Dwell time



Maximum Peak Output Power

Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11970995S-A-R1
Date	October 5, 2017
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Kenichi Adachi
Mode	Transmitting

Mode	Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
Transmitting	2404.5	-2.45	1.62	9.80	8.97	7.89	20.96	125	11.99
Transmitting	2428.5	-2.71	1.63	9.80	8.72	7.45	20.96	125	12.24
Transmitting	2452.0	-2.77	1.66	9.80	8.69	7.40	20.96	125	12.27

Sample Calculation:

Result = Reading + Cable Loss + Attenuator Loss

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

Average Output Power (Reference data for RF Exposure / SAR testing)

Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11970995S-A-R1
Date	October 5, 2017
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Kenichi Adachi
Mode	Transmitting

Mode	Freq.	Reading *1)	Cable Loss	Atten. Loss	Result (Burst power average)		Duty factor *2)	Result (Time average)	
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
Transmitting	2404.5	-2.56	1.62	9.80	8.86	7.69	7.11	1.75	1.50
Transmitting	2428.5	-2.88	1.63	9.80	8.55	7.16	7.11	1.44	1.39
Transmitting	2452.0	-2.92	1.66	9.80	8.54	7.14	7.11	1.43	1.39

Sample Calculation:

Result (Burst power average) = Reading + Cable Loss + Attenuator Loss

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

*1) Power was measured with using the gate function of power meter.

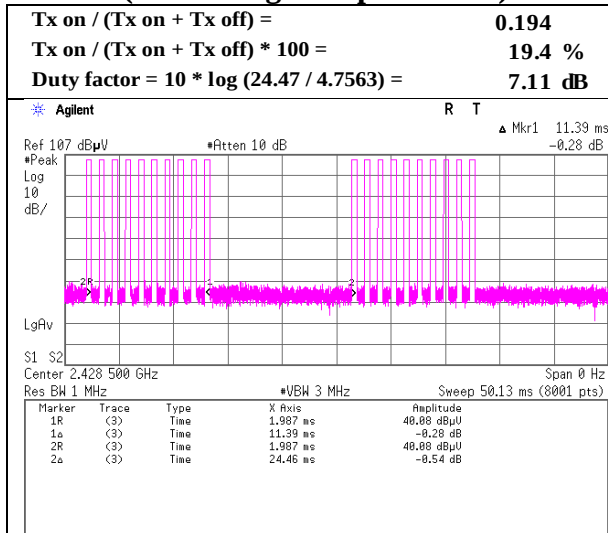
*2) Refer to Dwell time factor sheet.

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

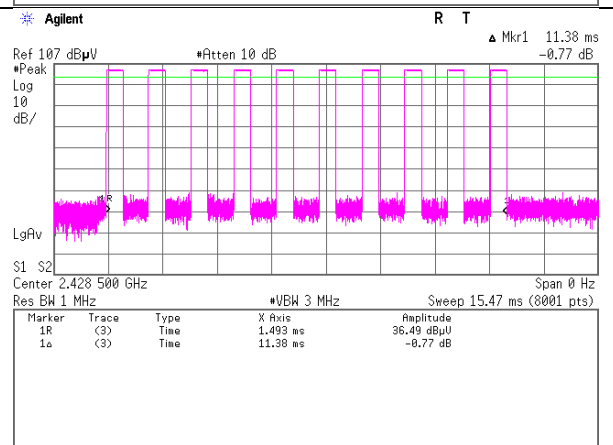
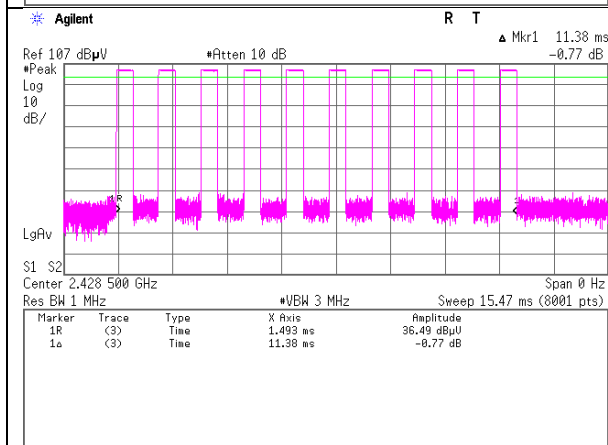
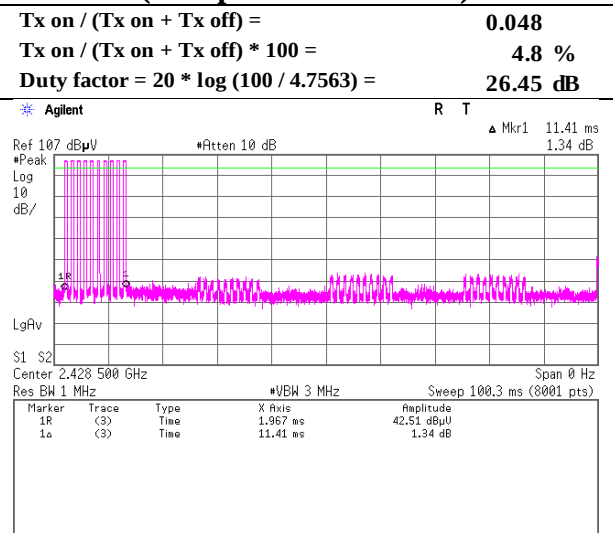
Dwell time factor

Test place	Shonan EMC Lab. No.1 Measurement Room
Report No.	11970995S-A-R1
Date	October 5, 2017
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Kenichi Adachi
Mode	Transmitting

(for Average Output Power)



(for Spurious emissions)



* Length of transmission [ms] = 4.7563 [ms]
= 0.4769 + 0.4756 + 0.4756 + 0.4750 + 0.4756 + 0.4763 + 0.4763 + 0.4750 + 0.4750 + 0.4750
(* Refer to “Dwell Time” data chart)

Radiated Spurious Emission

Report No. 11970995S-A-R1
Test place Shonan EMC Lab. No.1 Semi Anechoic Chamber
Date October 11, 2017 October 8, 2017
Temperature / Humidity 22 deg. C / 62 % RH 23 deg. C / 59 % RH
Engineer Shiro Kobayashi Shiro Kobayashi
(18 GHz – 26.5 GHz, 30 MHz - 1000 MHz) (1 GHz -18 GHz)
Mode Transmitting, 2404.5 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.	186.735	QP	28.32	16.36	8.99	31.77	0.00	21.90	43.50	21.6	100	136	
Hori.	575.998	QP	41.71	18.80	8.50	31.96	0.00	37.05	46.00	8.9	171	23	
Hori.	2116.479	PK	57.42	26.25	13.88	40.97	2.44	59.02	73.90	14.9	153	104	
Hori.	2148.484	PK	59.47	26.35	13.91	40.95	2.44	61.22	73.90	12.7	142	100	
Hori.	2180.483	PK	57.35	26.46	13.95	40.94	2.44	59.26	73.90	14.6	143	107	
Hori.	2212.429	PK	51.73	26.56	13.97	40.93	2.44	53.77	73.90	20.1	144	102	
Hori.	2356.159	PK	52.32	27.03	14.13	40.86	2.44	55.06	73.90	18.8	100	162	
Hori.	2372.471	PK	55.20	27.08	14.14	40.86	2.44	58.00	73.90	15.9	100	140	
Hori.	2388.525	PK	58.66	27.14	14.15	40.85	2.44	61.54	73.90	12.4	121	118	
Hori.	2628.486	PK	50.64	27.79	14.41	40.96	2.44	54.32	73.90	19.6	124	115	
Hori.	2660.479	PK	52.56	27.86	14.45	41.00	2.44	56.31	73.90	17.6	119	131	
Hori.	2692.445	PK	50.20	27.93	14.47	41.04	2.44	54.00	73.90	19.9	112	132	
Hori.	4809.000	PK	57.88	31.14	6.68	41.86	2.44	56.28	73.90	17.6	267	60	
Hori.	7213.500	PK	53.54	36.36	8.35	41.19	2.44	59.50	73.90	14.4	111	334	
Hori.	9618.000	PK	45.07	38.13	9.25	40.59	2.44	54.30	73.90	19.6	150	0	
Hori.	2116.479	AV	45.38	26.25	13.88	40.97	2.44	46.98	53.90	6.9	153	104	
Hori.	2148.484	AV	47.36	26.35	13.91	40.95	2.44	49.11	53.90	4.8	142	100	
Hori.	2180.483	AV	45.58	26.46	13.95	40.94	2.44	47.49	53.90	6.4	143	107	
Hori.	2212.429	AV	39.91	26.56	13.97	40.93	2.44	41.95	53.90	12.0	144	102	
Hori.	2356.159	AV	40.39	27.03	14.13	40.86	2.44	43.13	53.90	10.8	100	162	
Hori.	2372.471	AV	43.40	27.08	14.14	40.86	2.44	46.20	53.90	7.7	100	140	
Hori.	2388.525	AV	47.62	27.14	14.15	40.85	2.44	50.50	53.90	3.4	121	118	
Hori.	2628.486	AV	39.34	27.79	14.41	40.96	2.44	43.02	53.90	10.9	124	115	
Hori.	2660.479	AV	40.43	27.86	14.45	41.00	2.44	44.18	53.90	9.7	119	131	
Hori.	2692.445	AV	38.73	27.93	14.47	41.04	2.44	42.53	53.90	11.4	112	132	
Hori.	4809.000	AV	44.01	31.14	6.68	41.86	2.44	42.41	53.90	11.5	267	60	
Hori.	7213.500	AV	39.76	36.36	8.35	41.19	2.44	45.72	53.90	8.2	111	334	
Hori.	9618.000	AV	33.94	38.13	9.25	40.59	2.44	43.17	53.90	10.7	150	0	
Vert.	36.650	QP	29.44	15.62	7.18	31.83	0.00	20.41	40.00	19.5	100	355	
Vert.	447.998	QP	37.19	16.70	7.90	31.84	0.00	29.95	46.00	16.0	100	156	
Vert.	2116.518	PK	56.74	26.25	13.88	40.97	2.44	58.34	73.90	15.6	120	261	
Vert.	2148.476	PK	58.84	26.35	13.91	40.95	2.44	60.59	73.90	13.3	120	256	
Vert.	2180.447	PK	56.39	26.46	13.95	40.94	2.44	58.30	73.90	15.6	103	256	
Vert.	2212.449	PK	51.40	26.56	13.97	40.93	2.44	53.44	73.90	20.5	105	252	
Vert.	2388.436	PK	57.13	27.14	14.15	40.85	2.44	60.01	73.90	13.9	103	218	
Vert.	2628.442	PK	50.79	27.79	14.41	40.96	2.44	54.47	73.90	19.4	100	217	
Vert.	2661.210	PK	51.54	27.86	14.45	41.00	2.44	55.29	73.90	18.6	100	232	
Vert.	2692.531	PK	50.17	27.94	14.47	41.04	2.44	53.98	73.90	19.9	100	221	
Vert.	4809.000	PK	58.84	31.14	6.68	41.86	2.44	57.24	73.90	16.7	181	347	
Vert.	7213.500	PK	53.80	36.36	8.35	41.19	2.44	59.76	73.90	14.1	202	55	
Vert.	9618.000	PK	44.49	38.13	9.25	40.59	2.44	53.72	73.90	20.2	150	0	
Vert.	2116.518	AV	44.82	26.25	13.88	40.97	2.44	46.42	53.90	7.5	120	261	
Vert.	2148.476	AV	46.68	26.35	13.91	40.95	2.44	48.43	53.90	5.5	120	256	
Vert.	2180.447	AV	44.56	26.46	13.95	40.94	2.44	46.47	53.90	7.4	103	256	
Vert.	2212.449	AV	39.71	26.56	13.97	40.93	2.44	41.75	53.90	12.2	105	252	
Vert.	2388.436	AV	44.97	27.14	14.15	40.85	2.44	47.85	53.90	6.1	103	218	
Vert.	2628.442	AV	38.86	27.79	14.41	40.96	2.44	42.54	53.90	11.4	100	217	
Vert.	2661.210	AV	39.65	27.86	14.45	41.00	2.44	43.40	53.90	10.5	100	232	
Vert.	2692.531	AV	38.37	27.94	14.47	41.04	2.44	42.18	53.90	11.7	100	221	
Vert.	4809.000	AV	44.45	31.14	6.68	41.86	2.44	42.85	53.90	11.1	181	347	
Vert.	7213.500	AV	39.70	36.36	8.35	41.19	2.44	45.66	53.90	8.2	202	55	
Vert.	9618.000	AV	34.02	38.13	9.25	40.59	2.44	43.25	53.90	10.7	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.97 m / 3.0 m) = 2.44 dB

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

* These results have sufficient margin without taking account Dwell time factor.

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.	2404.500	PK	103.98	27.19	14.17	40.84	2.44	106.94	-	-	Carrier
Hori.	2395.842	PK	50.72	27.16	14.16	40.85	2.44	53.63	86.94	33.3	
Hori.	2400.000	PK	56.26	27.17	14.16	40.84	2.44	59.19	86.94	27.8	
Vert.	2404.500	PK	102.45	27.19	14.17	40.84	2.44	105.41	-	-	Carrier
Vert.	2395.668	PK	47.98	27.16	14.16	40.85	2.44	50.89	85.41	34.5	
Vert.	2400.000	PK	51.09	27.17	14.16	40.84	2.44	54.02	85.41	31.4	

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

Distance factor : 1 GHz - 13 GHz : 20log(3.97 m / 3.0 m) = 2.44 dB

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

UL Japan, Inc.

Shonan EMC Lab.

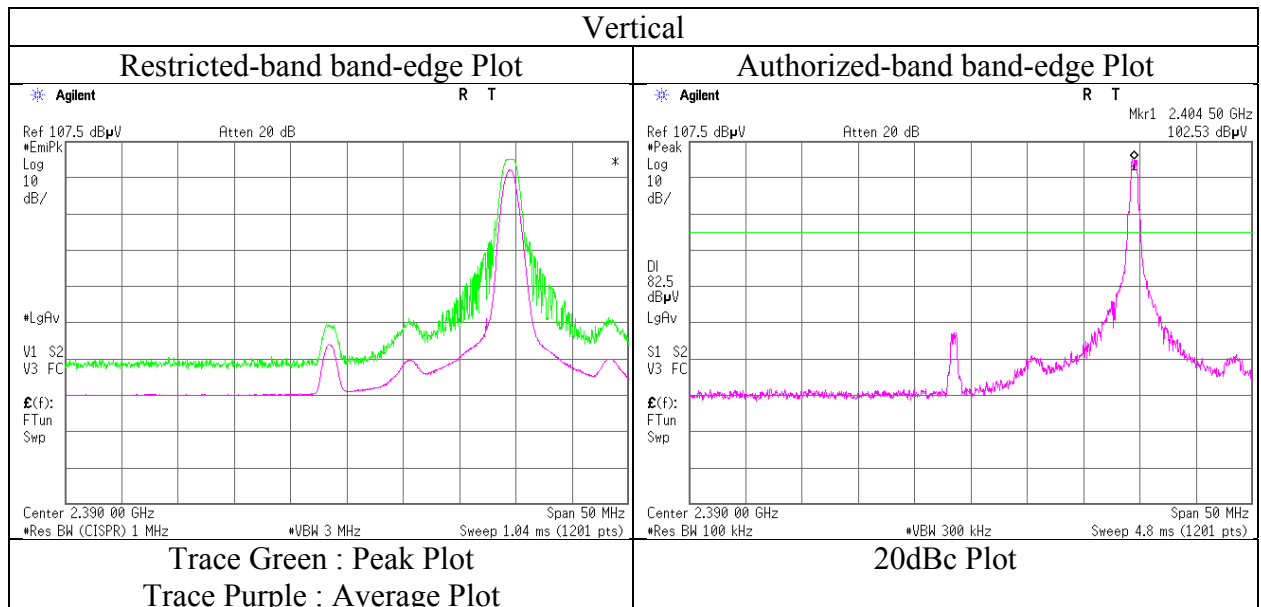
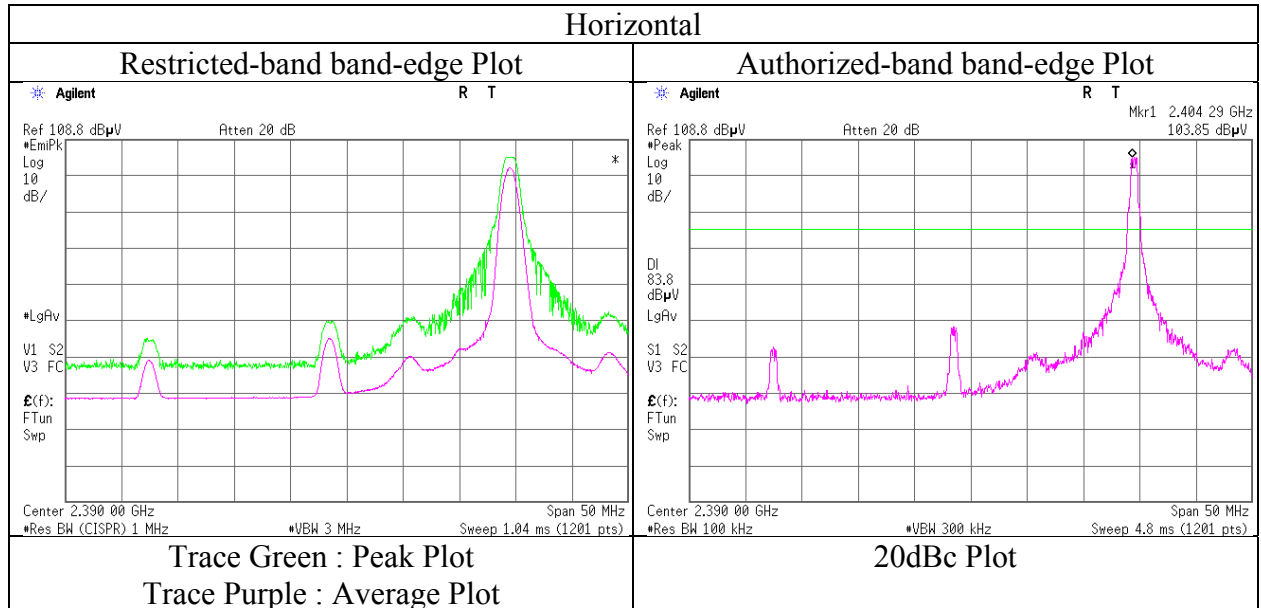
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Report No.	11970995S-A-R1
Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber
Date	October 8, 2017
Temperature / Humidity	23 deg. C / 59 % RH
Engineer	Shiro Kobayashi
	(1 GHz -2.8 GHz)
Mode	Transmitting, 2404.5 MHz



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

Radiated Spurious Emission

Report No. 11970995S-A-R1
Test place Shonan EMC Lab. No.1 Semi Anechoic Chamber
Date October 11, 2017
Temperature / Humidity 23 deg. C / 62 % RH
Engineer Shiro Kobayashi
(18 GHz ~ 26.5 GHz, 30 MHz - 1000 MHz)
Mode Transmitting, 2428.5 MHz
October 8, 2017
23 deg. C / 59 % RH
Shiro Kobayashi
(1 GHz -18 GHz)

(* 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.	185.774	QP	29.19	16.36	8.99	31.77	0.00	22.77	43.50	20.7	100	329	
Hori.	447.997	QP	39.11	16.70	7.90	31.84	0.00	31.87	46.00	14.1	100	188	
Hori.	575.999	QP	40.24	18.80	8.50	31.96	0.00	35.58	46.00	10.4	163	24	
Hori.	2140.485	PK	57.97	26.33	13.90	40.96	2.44	59.68	73.90	14.2	185	105	
Hori.	2172.503	PK	58.40	26.43	13.94	40.94	2.44	60.27	73.90	13.6	171	116	
Hori.	2204.495	PK	56.58	26.54	13.97	40.93	2.44	58.60	73.90	15.3	170	115	
Hori.	2364.460	PK	51.06	27.06	14.13	40.86	2.44	53.83	73.90	20.1	109	227	
Hori.	2380.531	PK	52.63	27.11	14.15	40.85	2.44	55.48	73.90	18.4	109	227	
Hori.	2652.500	PK	51.05	27.84	14.44	40.99	2.44	54.78	73.90	19.1	153	235	
Hori.	2684.494	PK	51.86	27.92	14.46	41.03	2.44	55.65	73.90	18.3	129	227	
Hori.	2716.518	PK	51.00	27.99	14.50	41.07	2.44	54.86	73.90	19.0	129	227	
Hori.	4857.000	PK	54.97	31.25	6.74	41.79	2.44	53.61	73.90	20.3	146	87	
Hori.	7285.500	PK	54.57	36.46	8.47	41.24	2.44	60.70	73.90	13.2	101	324	
Hori.	9714.000	PK	45.95	38.29	9.32	40.61	2.44	55.39	73.90	18.5	150	0	
Hori.	2140.485	AV	45.32	26.33	13.90	40.96	2.44	47.03	53.90	6.9	185	105	
Hori.	2172.503	AV	46.49	26.43	13.94	40.94	2.44	48.36	53.90	5.5	171	116	
Hori.	2204.495	AV	45.82	26.54	13.97	40.93	2.44	47.84	53.90	6.1	170	115	
Hori.	2364.460	AV	39.28	27.06	14.13	40.86	2.44	42.05	53.90	11.9	109	227	
Hori.	2380.531	AV	40.86	27.11	14.15	40.85	2.44	43.71	53.90	10.2	109	227	
Hori.	2652.500	AV	39.32	27.84	14.44	40.99	2.44	43.05	53.90	10.9	153	235	
Hori.	2684.494	AV	39.88	27.92	14.46	41.03	2.44	43.67	53.90	10.2	129	227	
Hori.	2716.518	AV	38.70	27.99	14.50	41.07	2.44	42.56	53.90	11.3	129	227	
Hori.	4857.000	AV	41.44	31.25	6.74	41.79	2.44	40.08	53.90	13.8	146	87	
Hori.	7285.500	AV	40.22	36.46	8.47	41.24	2.44	46.35	53.90	7.6	101	324	
Hori.	9714.000	AV	32.70	38.29	9.32	40.61	2.44	42.14	53.90	11.8	150	0	
Vert.	36.630	QP	29.53	15.63	7.18	31.83	0.00	20.51	40.00	19.4	100	342	
Vert.	159.999	QP	31.85	15.32	8.94	31.77	0.00	24.34	43.50	19.1	100	310	
Vert.	399.998	QP	32.28	15.77	7.64	31.80	0.00	23.89	46.00	22.1	117	144	
Vert.	2140.490	PK	56.90	26.33	13.90	40.96	2.44	58.61	73.90	15.3	127	253	
Vert.	2172.431	PK	57.98	26.43	13.94	40.94	2.44	59.85	73.90	14.1	118	254	
Vert.	2204.480	PK	56.94	26.54	13.97	40.93	2.44	58.96	73.90	14.9	119	248	
Vert.	2364.663	PK	48.37	27.06	14.13	40.86	2.44	51.14	73.90	22.8	106	222	
Vert.	2380.484	PK	50.86	27.11	14.15	40.85	2.44	53.71	73.90	20.2	108	218	
Vert.	2652.335	PK	51.14	27.84	14.44	40.99	2.44	54.87	73.90	19.0	106	219	
Vert.	2684.484	PK	52.27	27.92	14.46	41.03	2.44	56.06	73.90	17.8	103	222	
Vert.	2716.496	PK	50.97	27.99	14.50	41.07	2.44	54.83	73.90	19.1	107	222	
Vert.	4857.000	PK	54.08	31.25	6.74	41.79	2.44	52.72	73.90	21.2	103	305	
Vert.	7285.500	PK	52.32	36.46	8.47	41.24	2.44	58.45	73.90	15.5	144	303	
Vert.	9714.000	PK	44.99	38.29	9.32	40.61	2.44	54.43	73.90	19.5	150	0	
Vert.	2140.490	AV	44.87	26.33	13.90	40.96	2.44	46.58	53.90	7.3	127	253	
Vert.	2172.431	AV	46.05	26.43	13.94	40.94	2.44	47.92	53.90	6.0	118	254	
Vert.	2204.480	AV	44.72	26.54	13.97	40.93	2.44	46.74	53.90	7.2	119	248	
Vert.	2364.663	AV	36.16	27.06	14.13	40.86	2.44	38.93	53.90	15.0	106	222	
Vert.	2380.484	AV	38.69	27.11	14.15	40.85	2.44	41.54	53.90	12.4	108	218	
Vert.	2652.335	AV	39.04	27.84	14.44	40.99	2.44	42.77	53.90	11.1	106	219	
Vert.	2684.484	AV	39.74	27.92	14.46	41.03	2.44	43.53	53.90	10.4	103	222	
Vert.	2716.496	AV	38.67	27.99	14.50	41.07	2.44	42.53	53.90	11.4	107	222	
Vert.	4857.000	AV	40.57	31.25	6.74	41.79	2.44	39.21	53.90	14.7	103	305	
Vert.	7285.500	AV	38.63	36.46	8.47	41.24	2.44	44.76	53.90	9.1	144	303	
Vert.	9714.000	AV	33.57	38.29	9.32	40.61	2.44	43.01	53.90	10.9	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.97 m / 3.0 m) = 2.44 dB

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

* These results have sufficient margin without taking account Dwell time factor.

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.	2428.500	PK	104.75	27.27	14.21	40.83	2.44	107.84	-	-	Carrier
Hori.	2396.482	PK	51.16	27.16	14.16	40.85	2.44	54.07	87.84	33.8	
Vert.	2428.500	PK	103.22	27.27	14.21	40.83	2.44	106.31	-	-	Carrier
Vert.	2396.478	PK	51.78	27.16	14.16	40.85	2.44	54.69	86.31	31.6	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.97 m / 3.0 m) = 2.44 dB

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

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Radiated Spurious Emission

Report No.	11970995S-A-R1	
Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber	
Date	October 11, 2017	October 8, 2017
Temperature / Humidity	22 deg. C / 62 % RH	23 deg. C / 59 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi
	(18 GHz – 26.5 GHz, 30 MHz - 1000 MHz)	(1 GHz -18 GHz)
Mode	Transmitting, 2452.0 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.	186.681	QP	28.92	16.36	8.99	31.77	0.00	22.50	43.50	21.0	169	147	
Hori.	447.999	QP	38.92	16.70	7.90	31.84	0.00	31.68	46.00	14.3	100	195	
Hori.	575.999	QP	42.04	18.80	8.50	31.96	0.00	37.38	46.00	8.6	162	21	
Hori.	2163.962	PK	57.84	26.40	13.93	40.95	2.44	59.66	73.90	14.2	100	0	
Hori.	2227.983	PK	57.05	26.61	14.00	40.92	2.44	59.18	73.90	14.7	150	115	
Hori.	2259.983	PK	51.89	26.72	14.02	40.91	2.44	54.16	73.90	19.7	146	117	
Hori.	2388.006	PK	51.09	27.13	14.15	40.85	2.44	53.96	73.90	19.9	100	159	
Hori.	2483.500	PK	53.90	27.45	14.27	40.81	2.44	57.25	73.90	16.7	117	127	
Hori.	2483.959	PK	54.62	27.45	14.27	40.81	2.44	57.97	73.90	15.9	117	127	
Hori.	2499.959	PK	51.58	27.50	14.28	40.80	2.44	55.00	73.90	18.9	100	141	
Hori.	2675.969	PK	50.35	27.90	14.46	41.02	2.44	54.13	73.90	19.8	121	134	
Hori.	2707.978	PK	51.06	27.97	14.48	41.06	2.44	54.89	73.90	19.0	120	135	
Hori.	2739.984	PK	51.37	28.04	14.51	41.10	2.44	55.26	73.90	18.6	114	135	
Hori.	4904.000	PK	55.05	31.35	6.80	41.72	2.44	53.92	73.90	20.0	193	33	
Hori.	7356.000	PK	50.78	36.56	8.56	41.29	2.44	57.05	73.90	16.9	103	327	
Hori.	9808.000	PK	43.36	38.44	9.40	40.63	2.44	53.01	73.90	20.9	150	0	
Hori.	2163.962	AV	45.86	26.40	13.93	40.95	2.44	47.68	53.90	6.2	100	0	
Hori.	2195.972	AV	46.11	26.51	13.96	40.93	2.44	48.09	53.90	5.8	144	107	
Hori.	2227.983	AV	45.15	26.61	14.00	40.92	2.44	47.28	53.90	6.6	150	115	
Hori.	2259.983	AV	40.21	26.72	14.02	40.91	2.44	42.48	53.90	11.4	146	117	
Hori.	2388.006	AV	36.31	27.13	14.15	40.85	2.44	39.18	53.90	14.7	100	159	
Hori.	2483.500	AV	40.50	27.45	14.27	40.81	2.44	43.85	53.90	10.1	117	127	
Hori.	2483.959	AV	43.08	27.45	14.27	40.81	2.44	46.43	53.90	7.5	117	127	
Hori.	2499.959	AV	40.43	27.50	14.28	40.80	2.44	43.85	53.90	10.1	100	141	
Hori.	2675.969	AV	38.96	27.90	14.46	41.02	2.44	42.74	53.90	11.2	121	134	
Hori.	2707.978	AV	39.43	27.97	14.48	41.06	2.44	43.26	53.90	10.6	120	135	
Hori.	2739.984	AV	39.03	28.04	14.51	41.10	2.44	42.92	53.90	11.0	114	135	
Hori.	4904.000	AV	41.73	31.35	6.80	41.72	2.44	40.60	53.90	13.3	193	33	
Hori.	7356.000	AV	37.09	36.56	8.56	41.29	2.44	43.36	53.90	10.5	103	327	
Hori.	9808.000	AV	32.25	38.44	9.40	40.63	2.44	41.90	53.90	12.0	150	0	
Vert.	36.625	QP	28.98	15.63	7.18	31.83	0.00	19.96	40.00	20.0	100	354	
Vert.	448.000	QP	35.79	16.70	7.90	31.84	0.00	28.55	46.00	17.4	137	327	
Vert.	2163.987	PK	57.16	26.40	13.93	40.95	2.44	58.98	73.90	14.9	115	254	
Vert.	2195.981	PK	57.14	26.51	13.96	40.93	2.44	59.12	73.90	14.8	116	252	
Vert.	2227.945	PK	55.22	26.61	14.00	40.92	2.44	57.35	73.90	16.6	112	233	
Vert.	2483.500	PK	51.37	27.45	14.27	40.81	2.44	54.72	73.90	19.2	145	160	
Vert.	2483.993	PK	52.09	27.45	14.27	40.81	2.44	55.44	73.90	18.5	145	160	
Vert.	2499.958	PK	50.67	27.50	14.28	40.80	2.44	54.09	73.90	19.8	151	166	
Vert.	2675.986	PK	49.89	27.90	14.46	41.02	2.44	53.67	73.90	20.2	153	167	
Vert.	2707.999	PK	50.96	27.97	14.48	41.06	2.44	54.79	73.90	19.1	156	173	
Vert.	2739.970	PK	50.82	28.04	14.51	41.10	2.44	54.71	73.90	19.2	153	180	
Vert.	4904.026	PK	58.37	31.36	6.80	41.72	2.44	57.25	73.90	16.7	183	13	
Vert.	7356.000	PK	49.57	36.56	8.56	41.29	2.44	55.84	73.90	18.1	186	60	
Vert.	9808.000	PK	43.14	38.44	9.40	40.63	2.44	52.79	73.90	21.1	150	0	
Vert.	2163.987	AV	45.17	26.40	13.93	40.95	2.44	46.99	53.90	6.9	115	254	
Vert.	2195.981	AV	45.39	26.51	13.96	40.93	2.44	47.37	53.90	6.5	116	252	
Vert.	2227.945	AV	43.55	26.61	14.00	40.92	2.44	45.68	53.90	8.2	112	233	
Vert.	2483.500	AV	38.68	27.45	14.27	40.81	2.44	42.03	53.90	11.9	145	160	
Vert.	2483.993	AV	40.48	27.45	14.27	40.81	2.44	43.83	53.90	10.1	145	160	
Vert.	2499.958	AV	38.58	27.50	14.28	40.80	2.44	42.00	53.90	11.9	151	166	
Vert.	2675.986	AV	38.32	27.90	14.46	41.02	2.44	42.10	53.90	11.8	153	167	
Vert.	2707.999	AV	39.01	27.97	14.48	41.06	2.44	42.84	53.90	11.1	156	173	
Vert.	2739.970	AV	38.58	28.04	14.51	41.10	2.44	42.47	53.90	11.4	153	180	
Vert.	4904.026	AV	44.62	31.36	6.80	41.72	2.44	43.50	53.90	10.4	183	13	
Vert.	7356.000	AV	36.28	36.56	8.56	41.29	2.44	42.55	53.90	11.4	186	60	
Vert.	9808.000	AV	32.12	38.44	9.40	40.63	2.44	41.77	53.90	12.1	150	0	

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

Distance factor : 1 GHz - 13 GHz : 20log (3.97 m / 3.0 m) = 2.44 dB

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

* These results have sufficient margin without taking account Dwell time factor.

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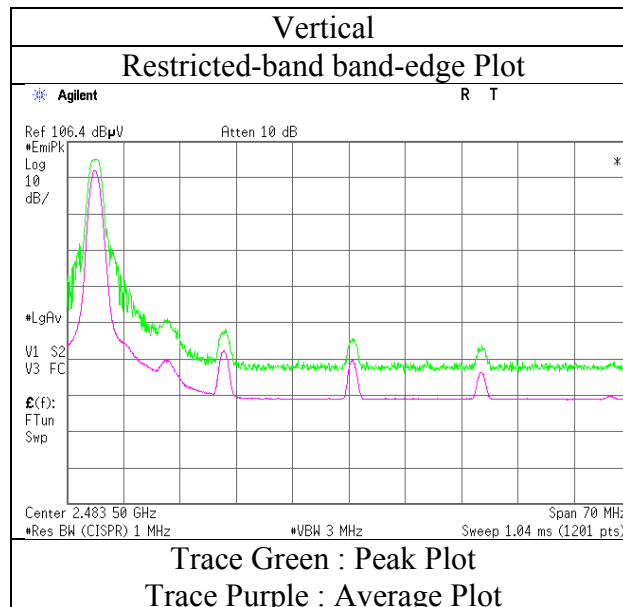
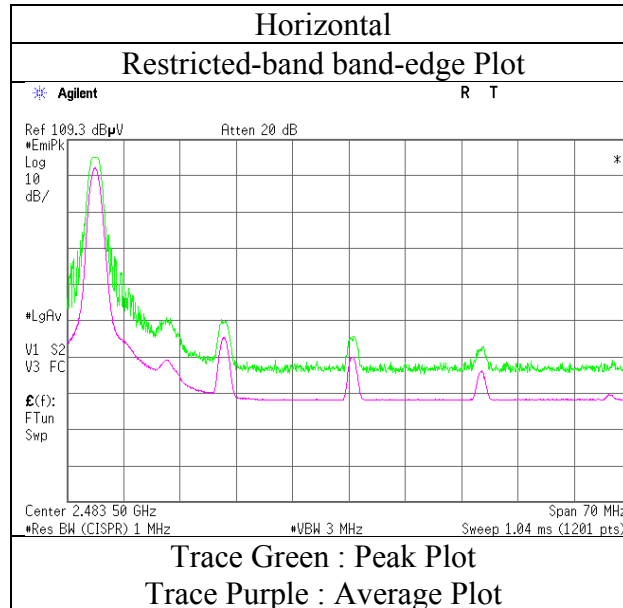
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Radiated Spurious Emission (Reference Plot for band-edge)

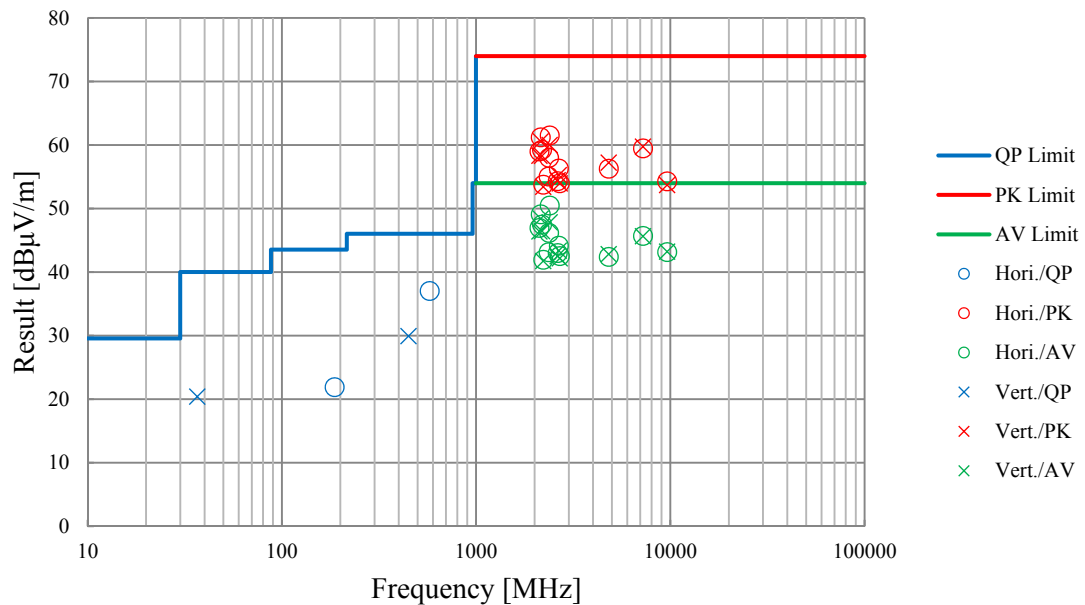
Report No.	11970995S-A-R1
Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber
Date	October 8, 2017
Temperature / Humidity	23 deg. C / 59 % RH
Engineer	Shiro Kobayashi
	(1 GHz -2.8 GHz)
Mode	Transmitting, 2452.0 MHz



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

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	11970995S-A-R1	
Test place	Shonan EMC Lab. No.1 Semi Anechoic Chamber	
Date	October 11, 2017	October 8, 2017
Temperature / Humidity	22 deg. C / 62 % RH	23 deg. C / 59 % RH
Engineer	Shiro Kobayashi	Shiro Kobayashi
	(18 GHz - 25 GHz, 30 MHz - 1000 MHz)	(1 GHz - 18 GHz)
Mode	Transmitting, 2404.5 MHz	

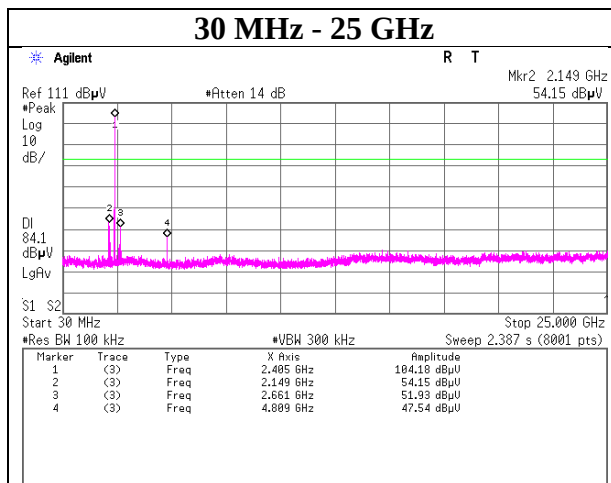
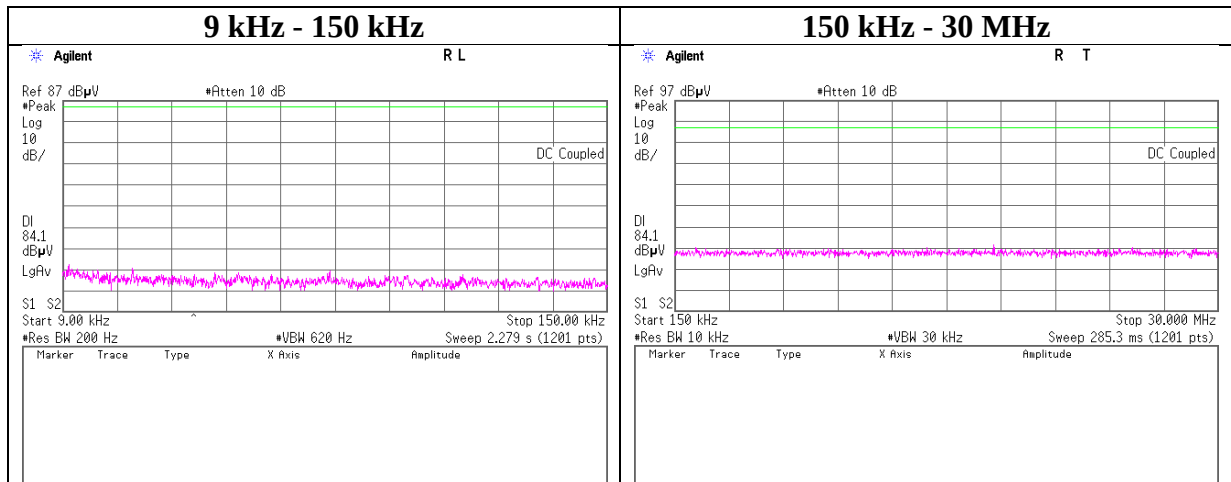


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 11970995S-A-R1
Date October 5, 2017
Temperature / Humidity 25 deg. C / 41 % RH
Engineer Kenichi Adachi
Mode Transmitting

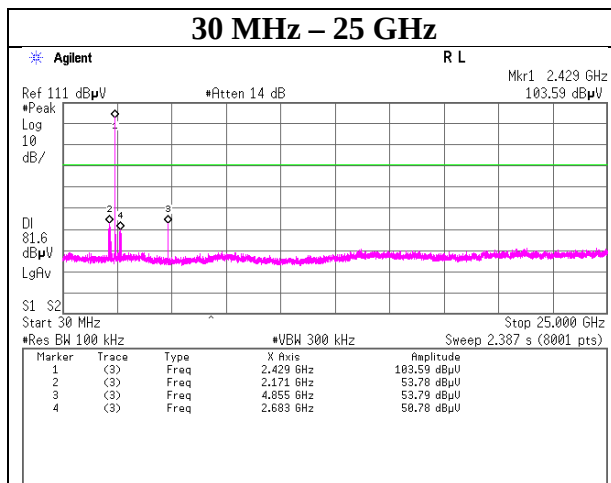
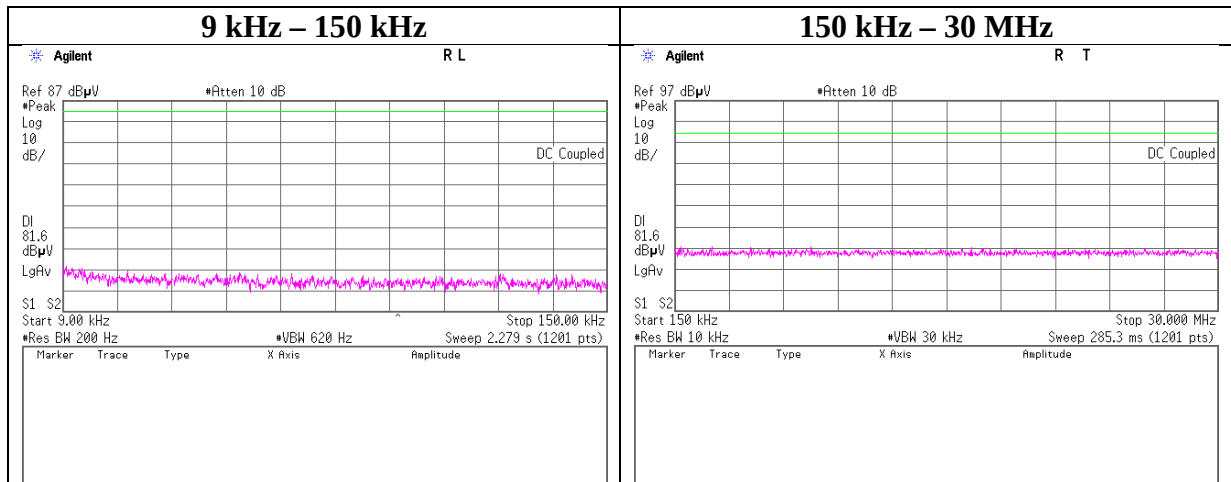
2404.5 MHz



Conducted Spurious Emission

Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 11970995S-A-R1
Date October 5, 2017
Temperature / Humidity 25 deg. C / 41 % RH
Engineer Kenichi Adachi
Mode Transmitting

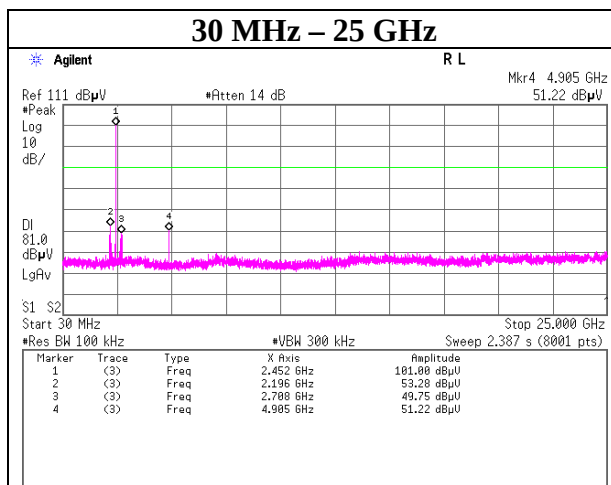
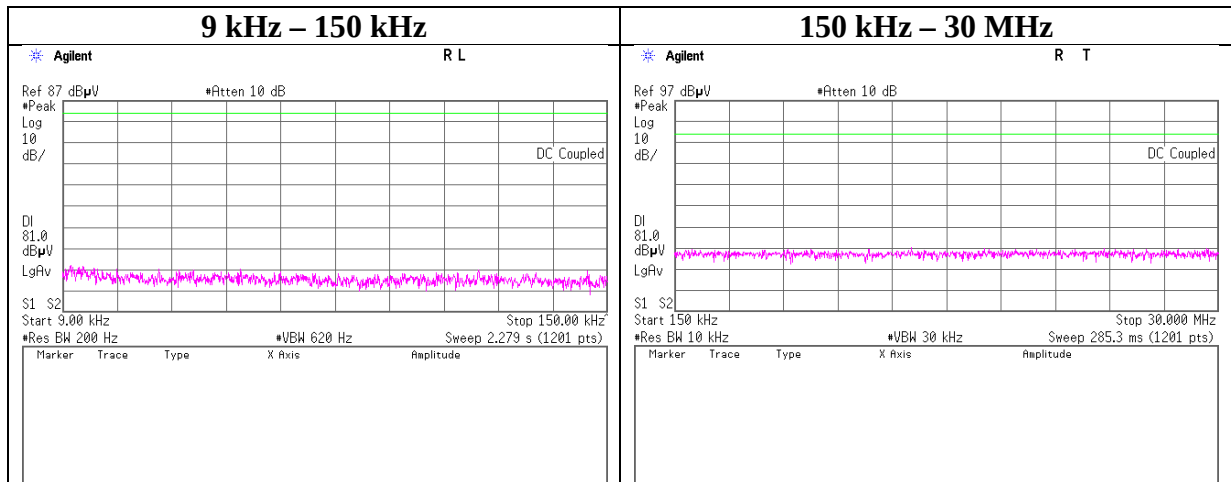
2428.5 MHz



Conducted Spurious Emission

Test place : Shonan EMC Lab. No.1 Measurement Room
Report No. : 11970995S-A-R1
Date : October 5, 2017
Temperature / Humidity : 25 deg. C / 41 % RH
Engineer : Kenichi Adachi
Mode : Transmitting

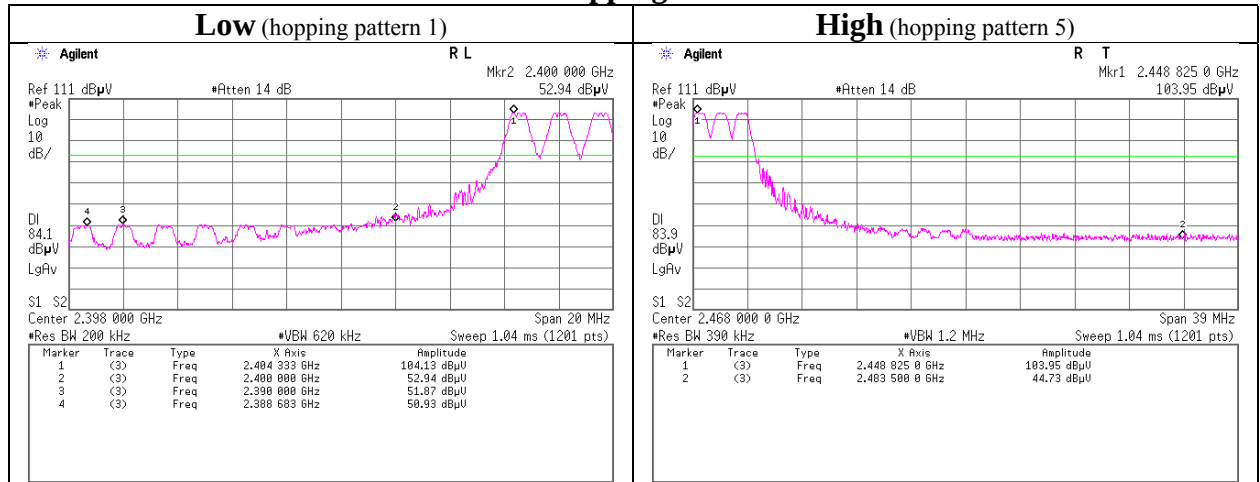
2452.0 MHz



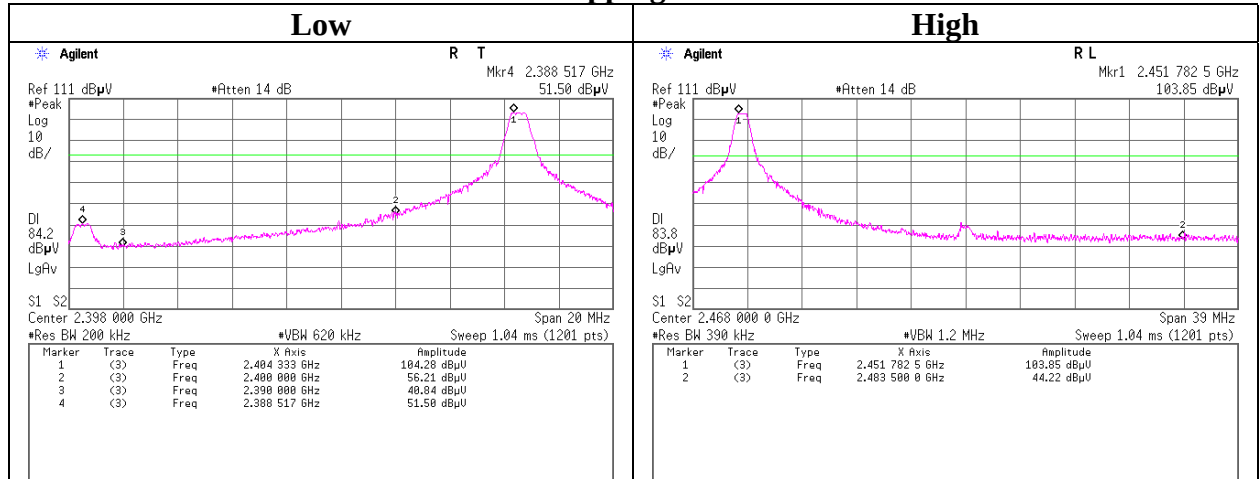
Conducted Emission Band Edge compliance

Test place : Shonan EMC Lab. No.1 Measurement Room
Report No. : 11970995S-A-R1
Date : October 5, 2017
Temperature / Humidity : 25 deg. C / 41 % RH
Engineer : Kenichi Adachi
Mode : Transmitting

Hopping On



Hopping Off

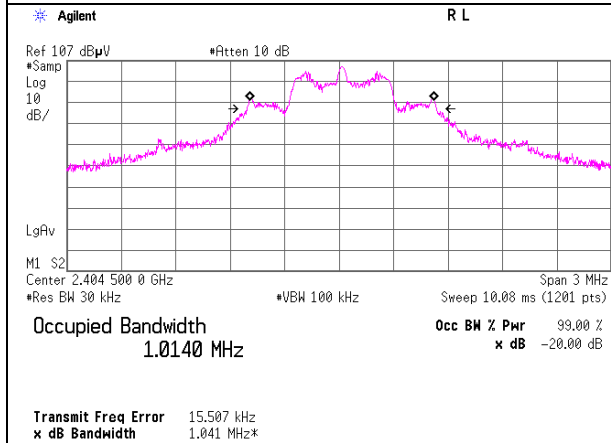


99 % Occupied Bandwidth

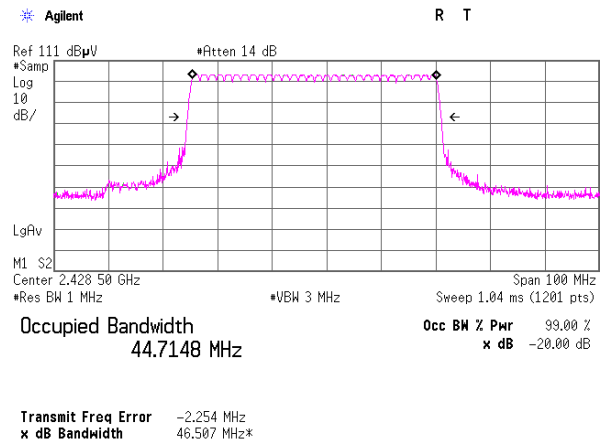
Test place Shonan EMC Lab. No.1 Measurement Room
Report No. 11970995S-A-R1
Date October 5, 2017
Temperature / Humidity 25 deg. C / 41 % RH
Engineer Kenichi Adachi
Mode Transmitting

Hopping Off

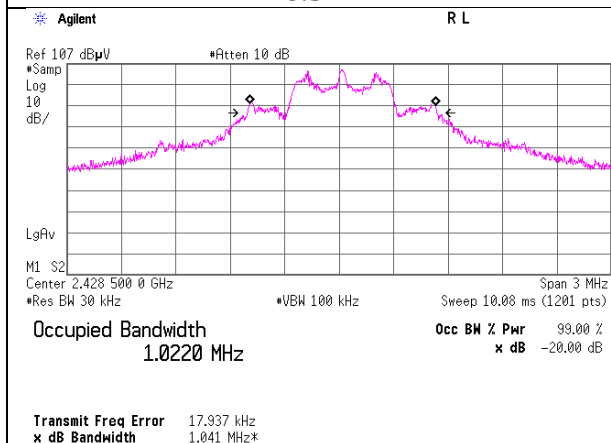
2404.5 MHz



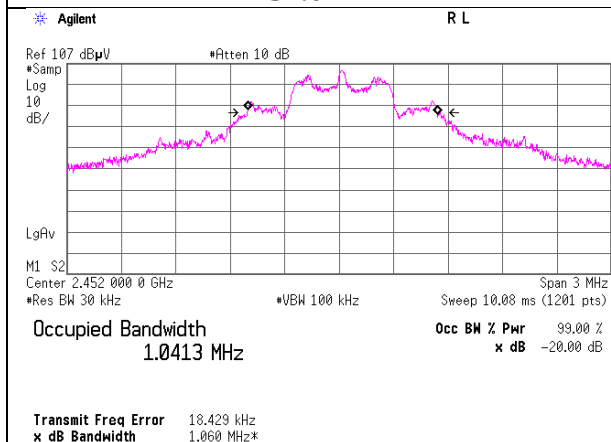
Hopping On



2428.5 MHz



2452.0 MHz



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APPENDIX 2: Test instruments

Test equipment (1/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2017/04/25 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2017/04/25 * 12
SRENT-09	Spectrum Analyzer	Agilent	E4440A	MY46186392	AT	2016/11/01 * 12
SAT10-14	Attenuator	Weinschel Corp.	54A-10	81595	AT	2017/04/20 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2017/03/23 * 12
SCC-H16	Microwave cable	RS Pro	R-132G7210 100CO	-	AT	2017/06/13 * 12
SOS-13	Humidity Indicator	Custom	CTH-202	Q.C.17	AT	2016/12/13 * 12
KTS-08	Digital Tester	SANWA	PC500	7019224	AT	2017/03/08 * 12
SAF-04	Pre Amplifier	TOYO Corporation	TPA0118-36	1440489	RE	2017/03/17 * 12
SCC-G06	Coaxial Cable	Junkosha	J12J102207-00	MAY-23-16-091	RE	2017/06/13 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2017/05/08 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01000N FSNMS/B	1612S005	RE	2017/01/08 * 12
SHA-01	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-725	RE	2017/08/14 * 12
SOS-01	Humidity Indicator	A&D	AD-5681	4062555	RE	2016/10/12 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2017/03/07 * 12
KJM-09	Measure	KOMELON	KMC-36	-	RE	-
SAEC-01(SVSWR)	Semi-Anechoic Chamber	TDK	SAEC-01(SVSWR)	1	RE	2017/07/20 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,C E,RFL,MF)	-	RE	-
STS-01	Digital Hitester	Hioki	3805-50	080997812	RE	2016/10/17 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2016/11/07 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2016/11/29 * 12
STR-07	Test Receiver	Rohde & Schwarz	ESU26	100484	RE	2017/09/26 * 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-G20	Coaxial Cable	Junkosha	J12J102518-00	APR-15-15-003	RE	2017/04/20 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000K MSKMS	-	RE	2017/04/20 * 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	2016/10/15 * 12
SCC-A1/A3/A5/A7/A8/A13/SRS E-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/SRS E-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
SLA-05	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	193	RE	2017/01/05 * 12
SAEC-01(NSA)	Semi-Anechoic Chamber	TDK	SAEC-01(NSA)	1	RE	2017/06/09 * 12

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

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

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

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

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Test equipment (2/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SCC-C9/C10/SR SE-03	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/N S4906	-/0901-271(RF Selector)	CE	2017/04/07 * 12
SAT3-07	Attenuator	JFW	50HF-003N	-	CE	2017/09/08 * 12
SLS-05	LISN	Rohde & Schwarz	ENV216	100516	CE	2017/02/27 * 12
SOS-06	Humidity Indicator	A&D	AD-5681	4062118	CE	2016/12/13 * 12
STM-05	Terminator	TME	CT-01 BP	-	CE	2016/12/15 * 12
STR-08	Test Receiver	Rohde & Schwarz	ESW44	101581	CE	2016/11/08 * 12
SJM-02	Measure	KOMELON	KMC-36	-	CE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,C E,RFI,MF)	-	CE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	CE	2017/10/16 * 12

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

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

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

Test Item: CE: Conducted Emission test,
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