RADIO TEST REPORT

Test Report No. 15163575M-A

Customer	**ALPS ALPINE CO., LTD.**
Description of EUT	**Connected Unit for EV**
Model Number of EUT	**AH00EV**
FCC ID	**A269ZUA172**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**July 9, 2024**
Remarks	**Wireless LAN (2.4 GHz band) and Bluetooth Low Energy part(s)**

Representative Test Engineer	Approved By
Hiromitsu Tanabe Engineer	Kenichi Suda Manager

CERTIFICATE 1266.01

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.
☒ There is no testing item of "Non-accreditation".

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 23.0

ANNOUNCEMENT

- This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
- The results in this report apply only to the sample tested. (Laboratory was not involved in sampling.)
- This sample tested is in compliance with the limits of the above regulation.
- The test results in this test report are traceable to the national or international standards.
- This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
- This test report covers Radio technical requirements.
  It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
- The all test items in this test report are conducted by UL Japan, Inc. Kashima EMC Lab.
- The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
- The information provided by the customer for this report is identified in SECTION 1.
- The laboratory is not responsible for information provided by the customer which can impact the validity of the results.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 15163575M-A

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15163575M-A	July 9, 2024	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	ICES	Interference-Causing Equipment Standard
AC	Alternating Current	IEC	International Electrotechnical Commission
AFH	Adaptive Frequency Hopping	IEEE	Institute of Electrical and Electronics Engineers
AM	Amplitude Modulation	IF	Intermediate Frequency
Amp, AMP	Amplifier	ILAC	International Laboratory Accreditation Conference
ANSI	American National Standards Institute	ISED	Innovation, Science and Economic Development Canada
Ant, ANT	Antenna	ISO	International Organization for Standardization
AP	Access Point	JAB	Japan Accreditation Board
ASK	Amplitude Shift Keying	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	N/A	Not Applicable
BT	Bluetooth	NIST	National Institute of Standards and Technology
BT LE	Bluetooth Low Energy	NS	No signal detect.
BW	BandWidth	NSA	Normalized Site Attenuation
Cal Int	Calibration Interval	NVLAP	National Voluntary Laboratory Accreditation Program
CCK	Complementary Code Keying	OBW	Occupied Band Width
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	P/M	Power meter
CW	Continuous Wave	PCB	Printed Circuit Board
DBPSK	Differential BPSK	PER	Packet Error Rate
DC	Direct Current	PHY	Physical Layer
D-factor	Distance factor	PK	Peak
DFS	Dynamic Frequency Selection	PN	Pseudo random Noise
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SG	Signal Generator
Freq.	Frequency	SVSWR	Site-Voltage Standing Wave Ratio
FSK	Frequency Shift Keying	TR	Test Receiver
GFSK	Gaussian Frequency-Shift Keying	Tx	Transmitting
GNSS	Global Navigation Satellite System	VBW	Video BandWidth
GPS	Global Positioning System	Vert.	Vertical
Hori.	Horizontal	WLAN	Wireless LAN

CONTENTS PAGE

SECTION 1: Customer Information

Company Name	ALPS ALPINE CO., LTD.
Address	20-1 Yoshima Industrial Park, Iwaki, Fukushima, 970-1192 Japan
Telephone Number	+81-246-36-4111
Contact Person	Nobuyuki Omi

The information provided by the customer is as follows;
- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Connected Unit for EV
Model Number	AH00EV
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	February 16, 2024
Test Date	April 12 to June 12, 2024

2.2 Product Description

General Specification

Rating	DC 13.2 V
Operating temperature	-20 deg. C to 60 deg. C

Radio Specification

This report contains data provided by the customer which can impact the validity of results. UL Japan, Inc. is only responsible for the validity of results after the integration of the data provided by the customer. The data provided by the customer is marked “a)” in the table below.

WLAN (IEEE802.11b/11g/11n-20)

Equipment Type	Transceiver
Frequency of Operation	2412 MHz to 2462 MHz
Type of Modulation	DSSS, OFDM
Antenna Gain[a)]	-7.76 dBi

Bluetooth (BR / EDR / Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	BT: FHSS (GFSK, π/4 DQPSK, 8 DPSK) BT LE: GFSK
Antenna Gain[a)]	-3.33 dBi

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

*The customer has declared that the EUT has complies with FCC Part 15 Subpart B as SDoC.

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**FCC:** Section 15.207	-	N/A	-*1)
	ISED: RSS-Gen 8.8	**ISED:** RSS-Gen 8.8			
6dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(a)(2)	See data.	Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.2(a)			
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(b)(3)		Complied	Conducted
	ISED: RSS-Gen 6.12	**ISED:** RSS-247 5.4(d)			
Power Density	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section 15.247(e)		Complied	Conducted
	ISED: -	**ISED:** RSS-247 5.2(b)			
Spurious Emission Restricted Band Edges	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02	**FCC:** Section15.247(d)	3.0 dB 2483.5 MHz, AV, Vertical Tx 11n-20 2462 MHz	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *2)
	ISED: RSS-Gen 6.13	**ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.
* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

*1) The test is not applicable since the EUT does not have AC Mains.
*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.

FCC Part 15.31 (e)
The EUT provides stable voltage constantly to the RF Part regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.

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

3.3 Addition to Standard

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
99% Occupied Bandwidth	**ISED:** RSS-Gen 6.7	**ISED:** -	N/A	-	Conducted

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

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.2 dB
	30 MHz to 200 MHz	6.2 dB
	200 MHz to 1000 MHz	6.3 dB
	1 GHz to 6 GHz	4.7 dB
	6 GHz to 18 GHz	5.1 dB
	18 GHz to 40 GHz	5.5 dB
1 m	1 GHz to 18 GHz	5.2 dB
	18 GHz to 40 GHz	5.6 dB
0.5 m	26.5 GHz to 40 GHz	5.8 dB

Antenna Terminal test

Test Item	Uncertainty (+/-)
6 dB Bandwidth / 99 % Occupied Bandwidth	1.2 %
Maximum Output Power	0.58 dB
Burst Rate	0.20 %
Power Density	2.0 dB
Conducted Spurious Emission (9 kHz to 30 MHz)	2.2 dB

3.5 Test Location

UL Japan, Inc. Kashima EMC Lab.
1614 Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan
Telephone: +81-478-88-6500
A2LA Certificate Number: 1266.01 / FCC Test Firm Registration Number: 910230
ISED Lab Company Number: 4659A / CAB identifier: JP0006

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Open site	6.0 x 5.5 x 2.5	20 x 40	10 m
No.5 Open site	8.6 x 7.1 x 2.4	18 x 23	10 m
No.1 Shielded room	5.4 x 4.5 x 2.3	-	-
No.5 Shielded Room	4.2 x 3.1 x 2.5	-	-
No.9 Shielded Room	6.1 x 3.6 x 2.8	-	-
No.6 Semi-anechoic Chamber	8.5 x 5.5 x 5.2	-	3 m
No.10 Semi-anechoic Chamber	18.4 x 9.9 x 7.7	-	10 m
No.11 Semi-anechoic Chamber	9.0 x 6.5 x 5.2	-	3 m
No.1 Measurement room	5.0 x 3.7 x 2.6	-	-
No.2 Measurement room	4.3 x 4.4 x 2.7	-	-

3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

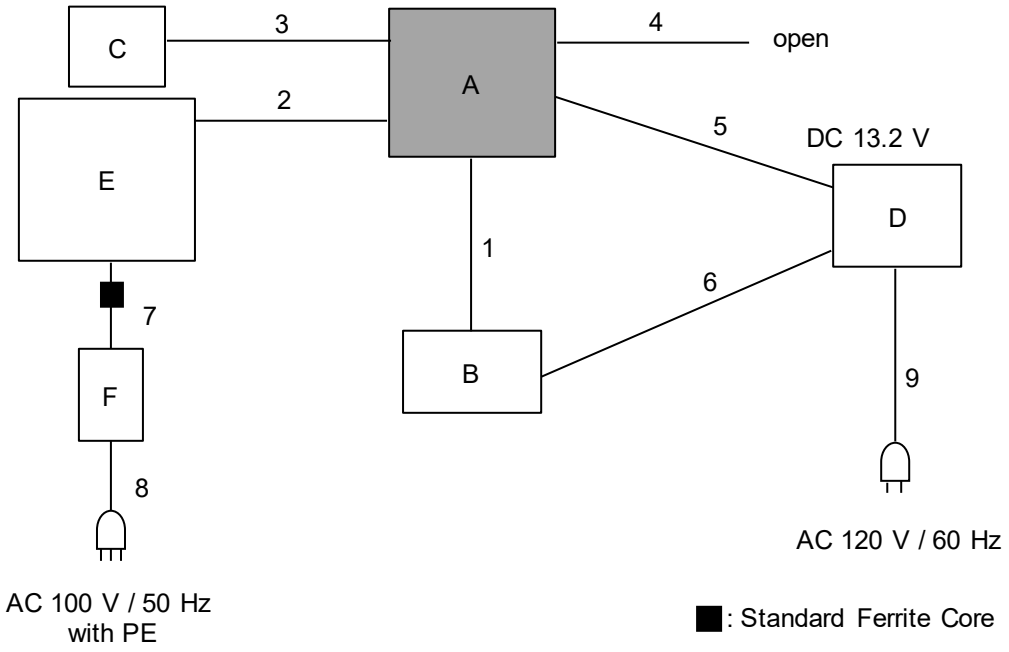
4.1 Operating Mode(s)

Mode	Remarks*
IEEE 802.11b (11b)	5.5 Mbps, PN9
IEEE 802.11g (11g)	36 Mbps, PN9
IEEE 802.11n (11n-20)	MCS 6, PN9
Bluetooth Low Energy (BT LE)	1M-PHY Uncoded PHY (1M-PHY), Maximum Packet Size, PRBS9
	2M-PHY Uncoded PHY (2M-PHY), Maximum Packet Size, PRBS9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*Power of the EUT was set by the software as follows; Power Setting: 11b:13, 11g:12/11n-20:12 BT LE: 8 Software: WLAN: Powershell Version 5.1.19041.1682 (Date: 2024.02.21, Storage location: Driven by connected PC) BT LE: Scrcpy Version 2.3.1 (Date: 2024.02.21, Storage location: Driven by connected PC) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product. Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009 and also was judged the necessity of 802.11ac/ax mode by the pre-test.	

*The Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Radiated Spurious Emission (Below 1 GHz) Conducted Spurious Emission	Tx 11n-20 *1)	2462 MHz
	Tx BT LE, 1M-PHY *1)	2480 MHz
Radiated Spurious Emission (Above 1 GHz), 6dB Bandwidth, Maximum Peak Output Power, Power Density, 99% Occupied Bandwidth	Tx 11b Tx 11g Tx 11n-20	2412 MHz 2437 MHz 2462 MHz
	Tx BT LE, 1M-PHY Tx BT LE, 2M-PHY	2402 MHz 2440 MHz 2480 MHz
*1) The mode was tested as a representative, because it had the highest power at antenna terminal test.		

4.2 Configuration and Peripherals



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

Description of EUT and Support Equipment

No.	Item	Model Number	Serial Number	Manufacturer	Remarks
A	Connected Unit for EV	AH00EV	31 *1) 40 *2)	ALPS ALPINE CO., LTD.	EUT
B	Display	AH00314A	No.6	ALPSALPINE Co., LTD.	-
C	GPS Antenna	C391120	-	ALPSALPINE Co., LTD.	-
D	DC Power Supply	GSV3000	60646702	DIAMOND ANTENNA	-
E	Laptop PC	Vostro3590	2474696559	DELL	-
F	AC Adapter	HA45NM140	CN-00285K-CH200-03H-0MGU-A07	DELL	-

*1) Used for Antenna Terminal conducted test
*2) Used for Radiated Emission test

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Monitor Cable	0.6	Shielded	Shielded	-
2	USB Cable	2.0	Shielded	Shielded	-
3	GPS Antenna	0.5	Shielded	Shielded	-
4	Debug Cable	2.0	Unshielded	Unshielded	-
5	DC Cable	2.2	Unshielded	Unshielded	-
6	DC Cable	2.2	Unshielded	Unshielded	-
7	DC Cable	1.8	Unshielded	Unshielded	-
8	AC Cable	0.9	Unshielded	Unshielded	3 wires
9	AC Cable	1.6	Unshielded	Unshielded	2 wires

SECTION 5: Radiated Spurious Emission

Test Procedure

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 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. Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

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 1 GHz	Above 1 GHz
Antenna Type	Hybrid	Horn

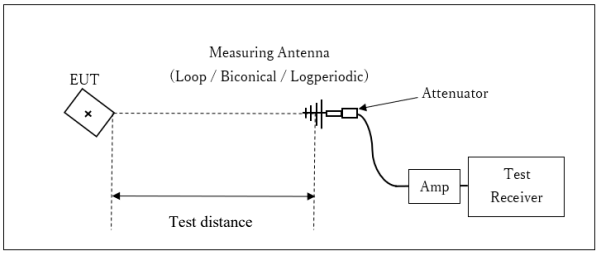
In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired 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(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

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	11.12.2.5.1 RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces 11.12.2.5.2 The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results.	RBW: 100 kHz VBW: 300 kHz

Figure 2: Test Setup

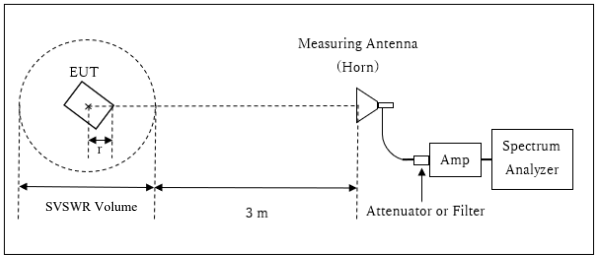
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



r : Radius of an outer periphery of EUT
× : Center of turn table

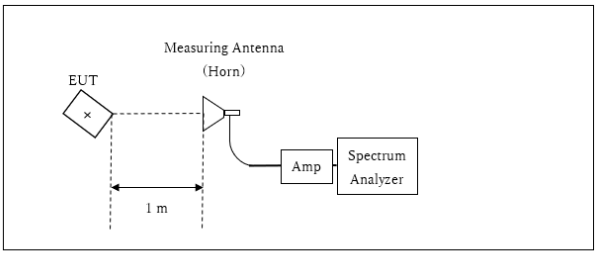
[10 site]
Distance Factor: 20 x log (4.38 m / 3.0 m) = 3.29 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 4.38 m

SVSWR Volume : 3.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.12 m

[11 site]
Distance Factor: 20 x log (3.88 m / 3.0 m) = 2.23 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.88 m

SVSWR Volume : 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.12 m

10 GHz to 26.5 GHz



× : Center of turn table

Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.54 dB
*Test Distance: 1 m

The carrier level and noise levels were confirmed at each position of 6 deg, 20 deg and 34 deg 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 (30 MHz – 1 GHz)	Spurious (1 GHz – 2.8 GHz)	Spurious (2.8 GHz – 10 GHz)	Spurious (10 GHz – 18 GHz)	Spurious (18 GHz – 26.5 GHz)
WLAN	Horizontal	34 deg	6 deg	34 deg	20 deg	34 deg	34 deg
WLAN	Vertical	34 deg	6 deg	34 deg	20 deg	34 deg	34 deg
BT LE	Horizontal	6 deg	6 deg	6 deg	20 deg	6 deg	6 deg
BT LE	Vertical	6 deg	6 deg	6 deg	20 deg	6 deg	6 deg

Test results are rounded off and limit are rounded down, so some differences might be observed.

Measurement Range : 30 MHz to 26.5 GHz
Test Data : APPENDIX
Test Result : Pass

SECTION 6: Antenna Terminal Conducted Tests

Test Procedure

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

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument Used
6dB Bandwidth	Enough width to display emission skirts	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 160 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4) *5)	9 kHz to 150 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150 kHz to 30 MHz	10 kHz	30 kHz				

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013".
*4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)
*5) The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to 45.5 - 51.5 = -6.0 dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

Test results are rounded off and limit are rounded down, so some differences might be observed.
The equipment and cables were not used for factor 0 dB of the data sheets.

Test Data : APPENDIX
Test Result : Pass

APPENDIX 1: Test Data

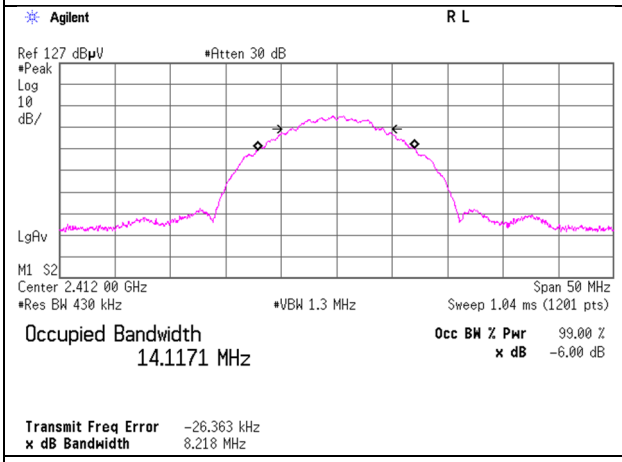
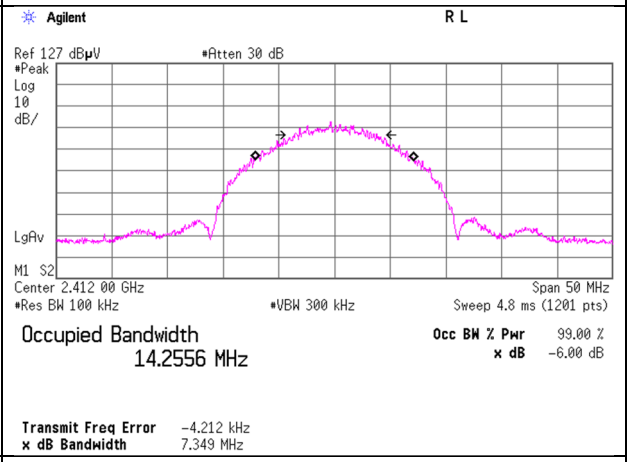
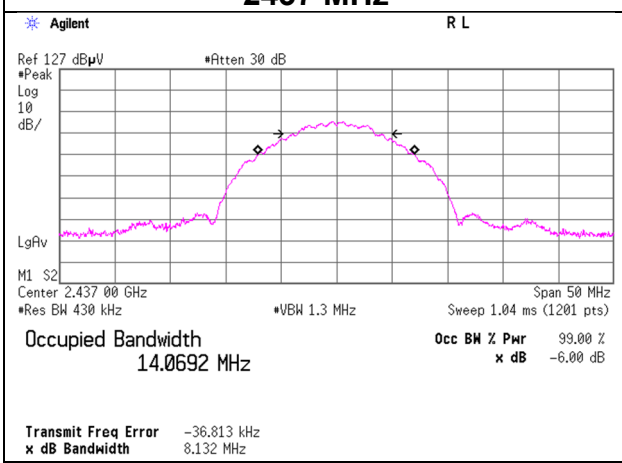
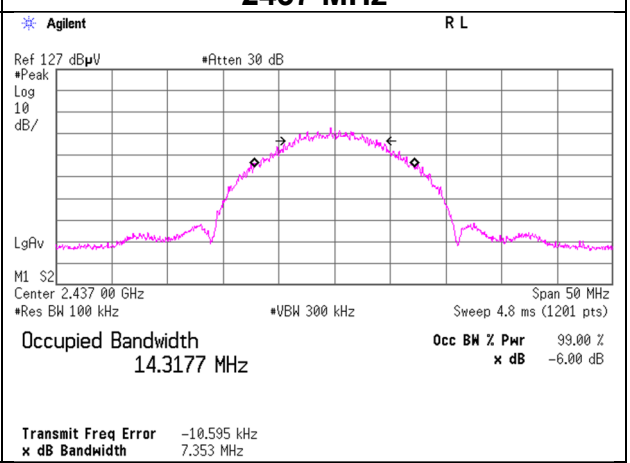
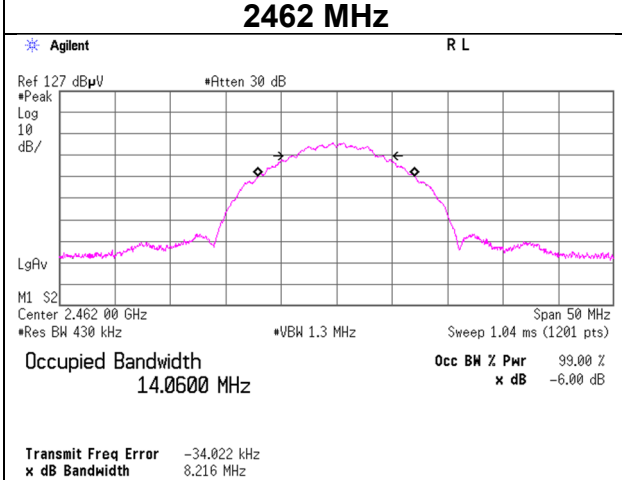
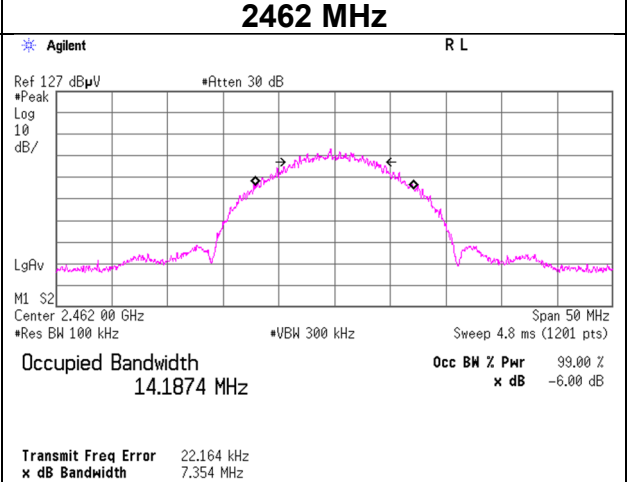
99 % Occupied Bandwidth and 6 dB Bandwidth

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	May 7, 2024
Temperature / Humidity	23 deg. C / 53 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	***14117.1***	7.349	> 0.5000
	2437	14069.2	7.353	> 0.5000
	2462	14060.0	7.354	> 0.5000
11g	2412	17279.5	16.527	> 0.5000
	2437	17279.8	16.528	> 0.5000
	2462	***17280.1***	16.524	> 0.5000
11n-20	2412	18281.8	17.772	> 0.5000
	2437	18275.0	17.768	> 0.5000
	2462	***18286.9***	17.774	> 0.5000
BT LE 1M-PHY	2402	1024.5	0.682	> 0.5000
	2440	1019.1	0.684	> 0.5000
	2480	1028.0	0.685	> 0.5000
BT LE 2M-PHY	2402	2003.7	1.391	> 0.5000
	2440	***2010.0***	1.391	> 0.5000
	2480	2004.6	1.374	> 0.5000

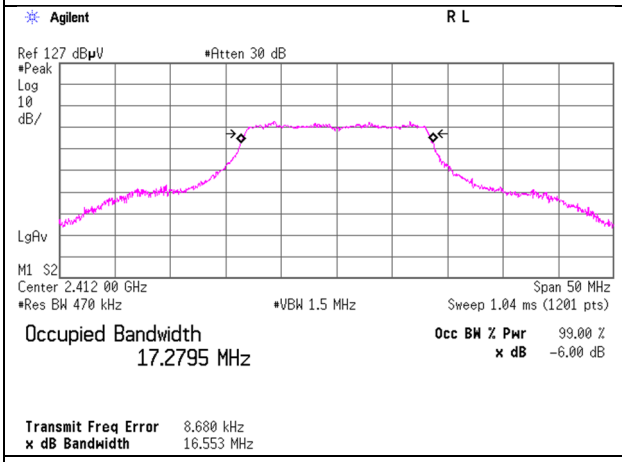
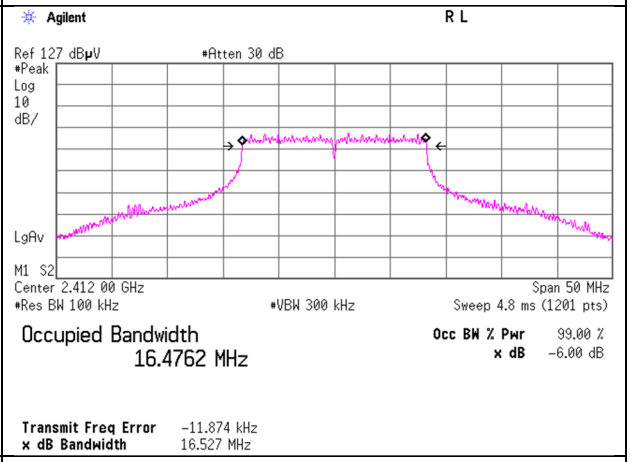
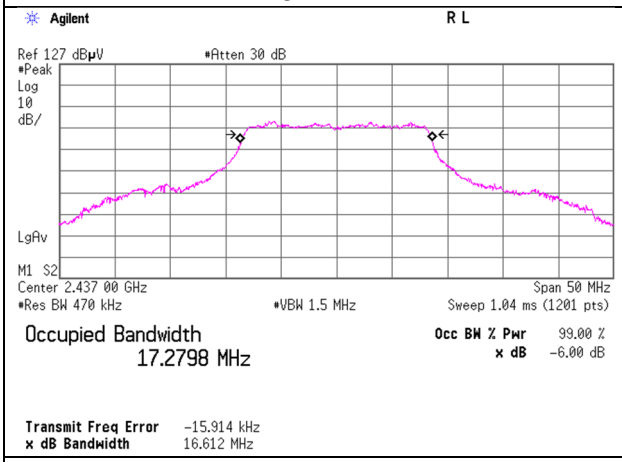
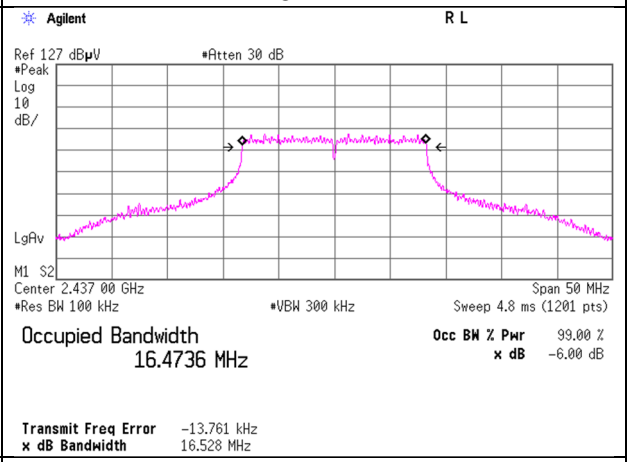
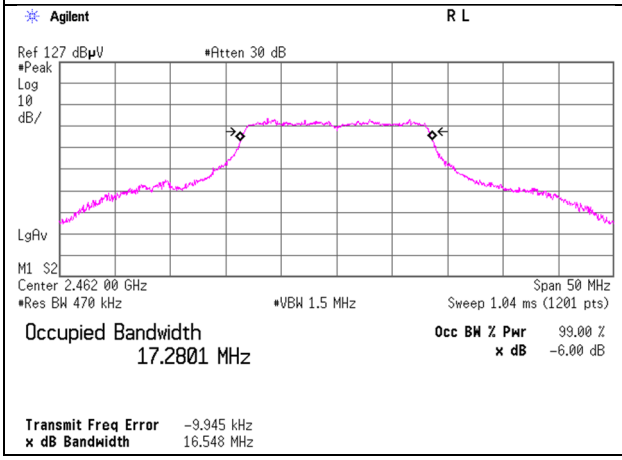
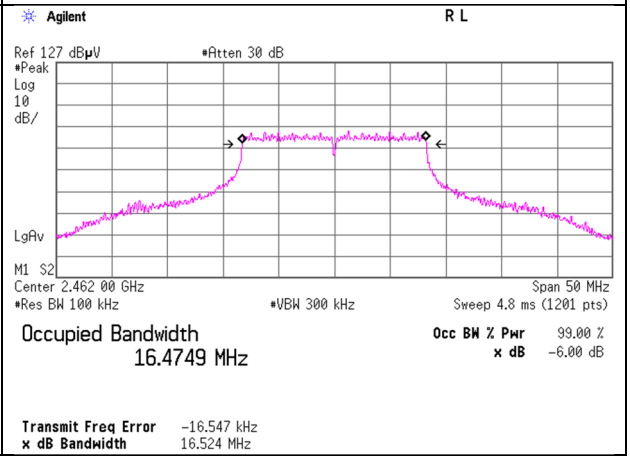
99 % Occupied Bandwidth and 6 dB Bandwidth

11b

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

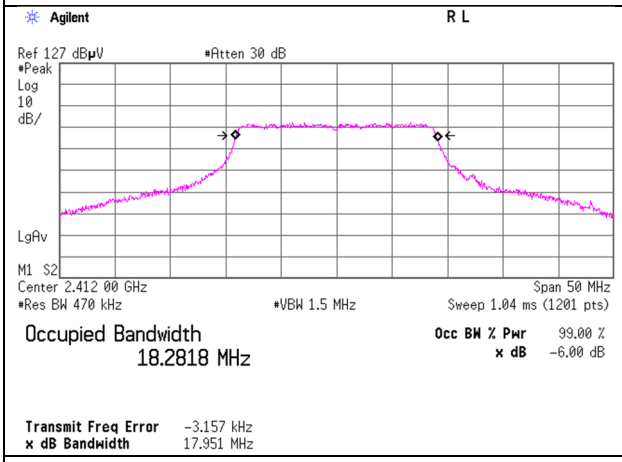
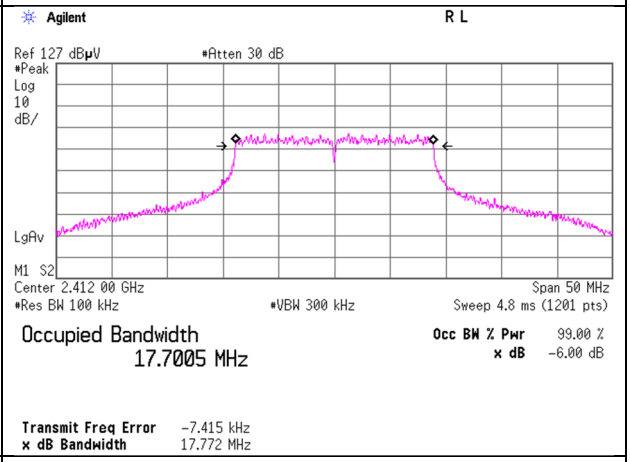
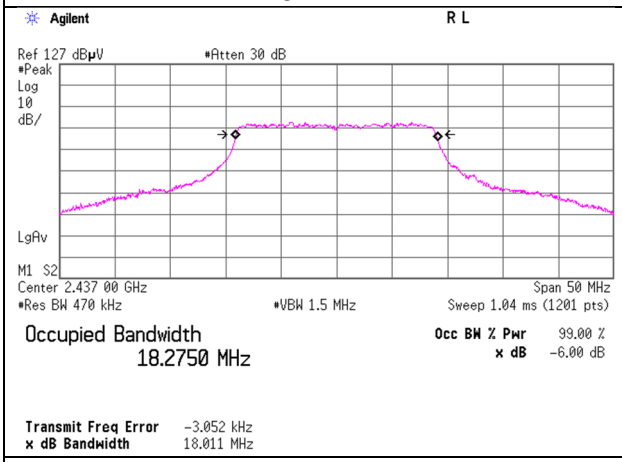
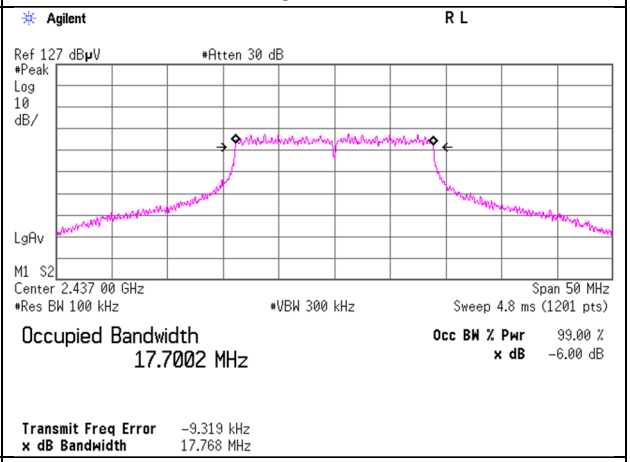
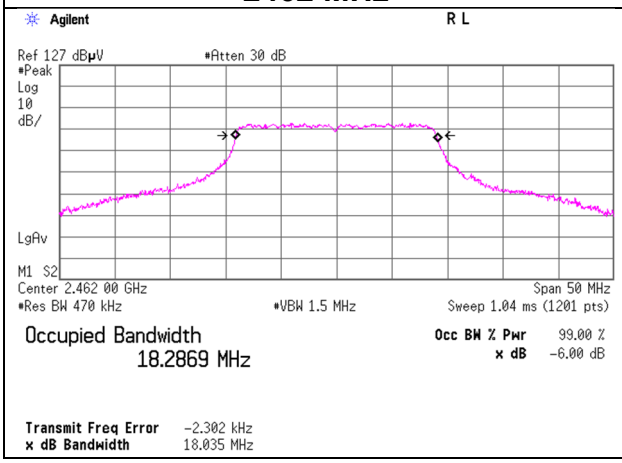
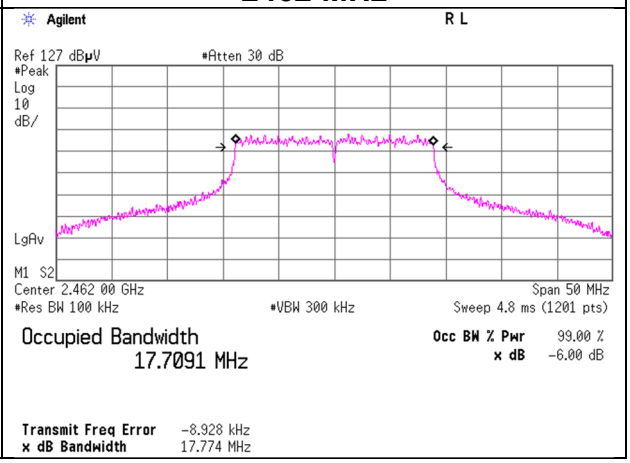
99 % Occupied Bandwidth and 6 dB Bandwidth

11g

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

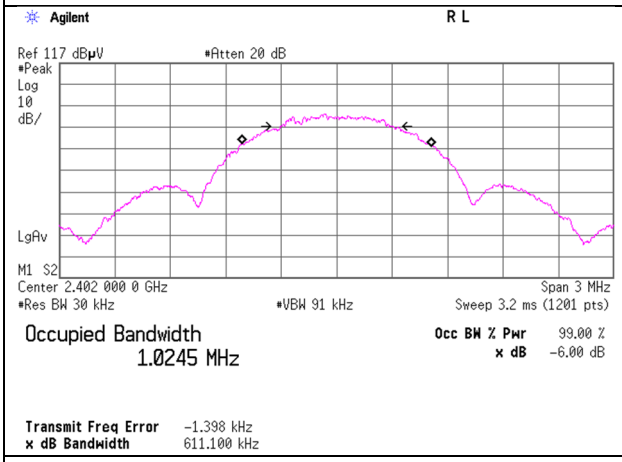
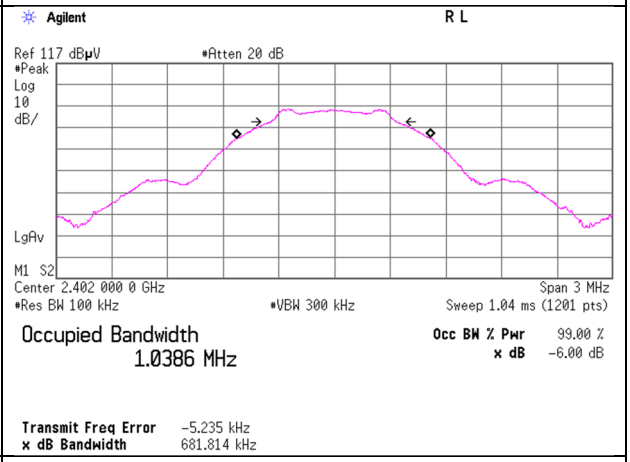
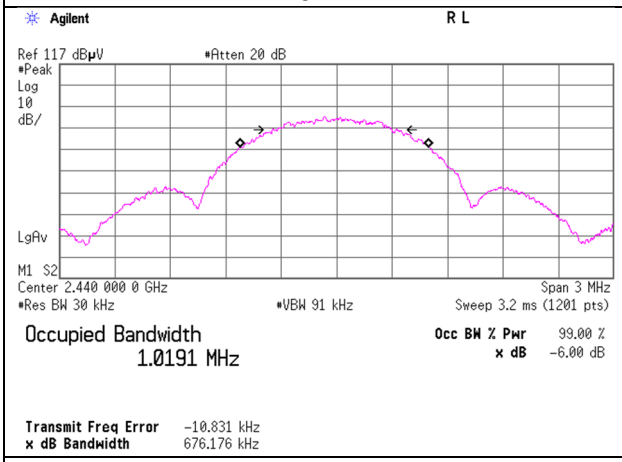
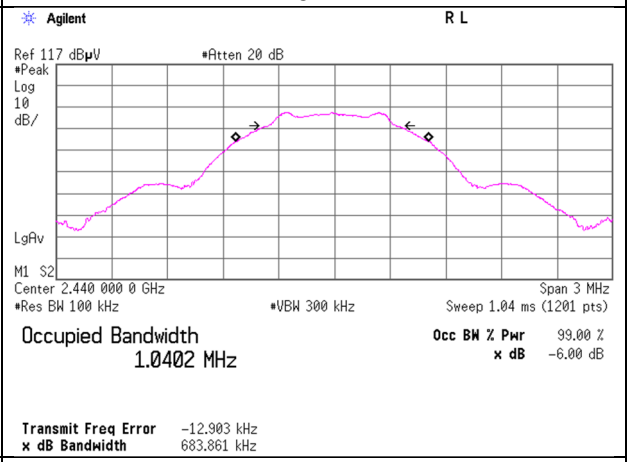
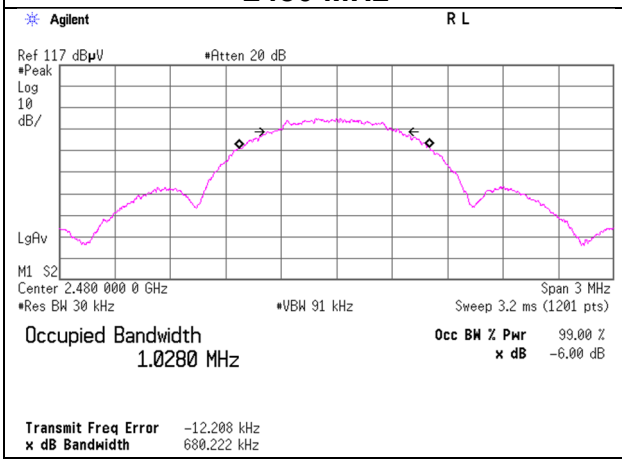
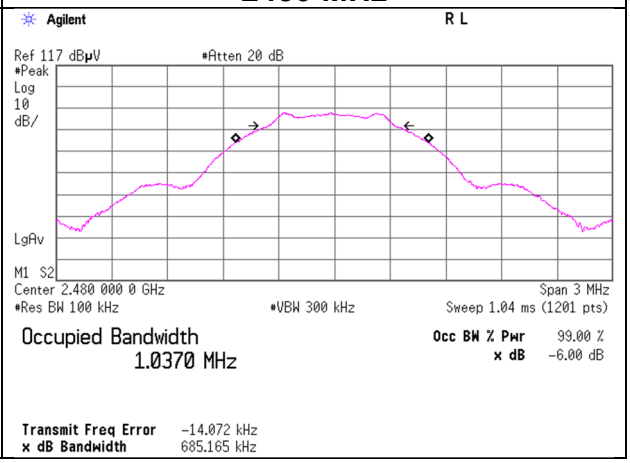
99 % Occupied Bandwidth and 6 dB Bandwidth

11n-20

99 % Occupied Bandwidth	6 dB Bandwidth
2412 MHz	**2412 MHz**
	
2437 MHz	**2437 MHz**
	
2462 MHz	**2462 MHz**
	

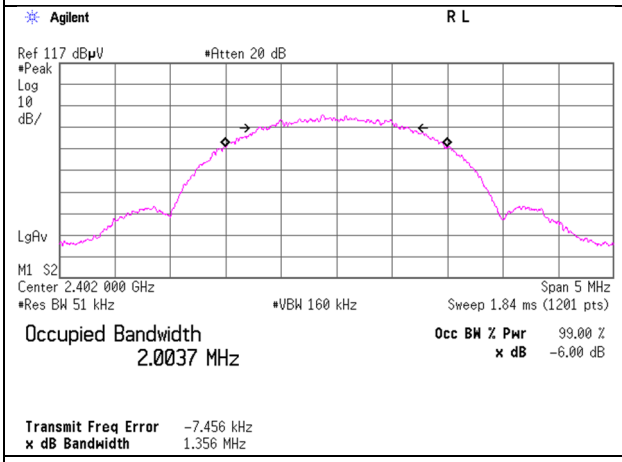
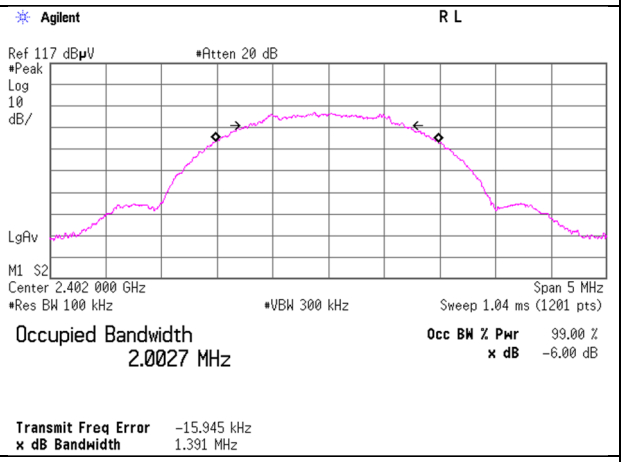
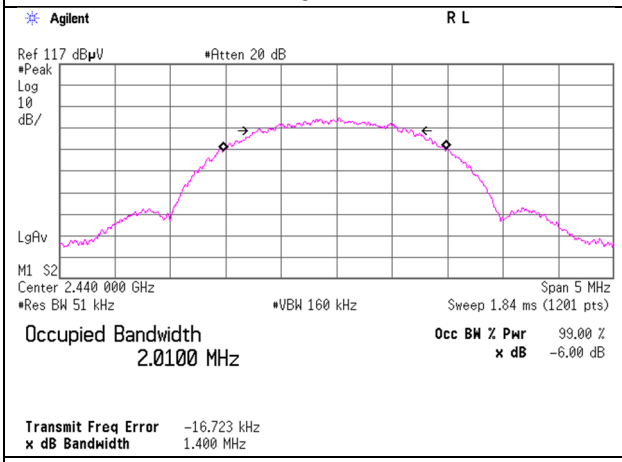
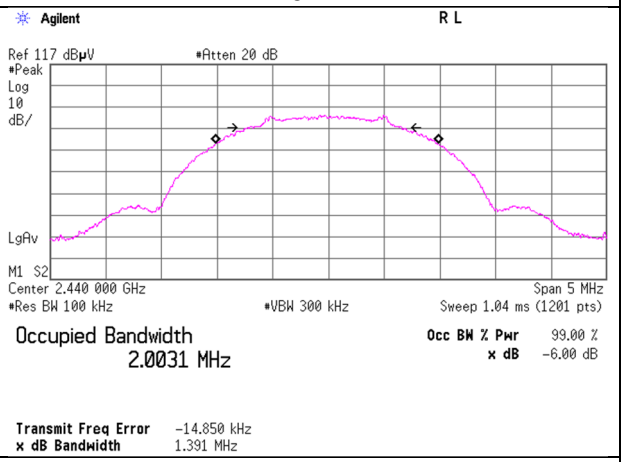
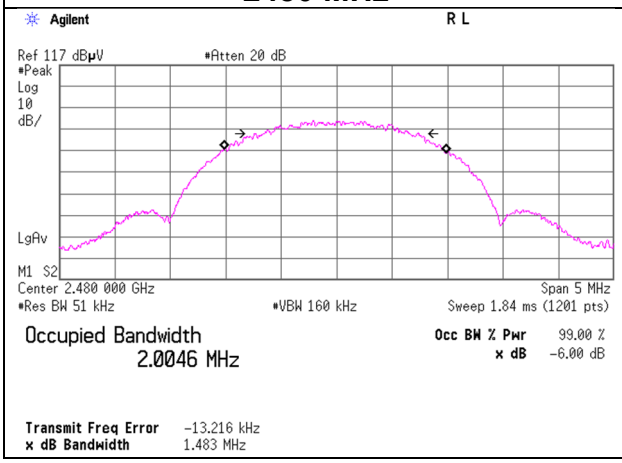
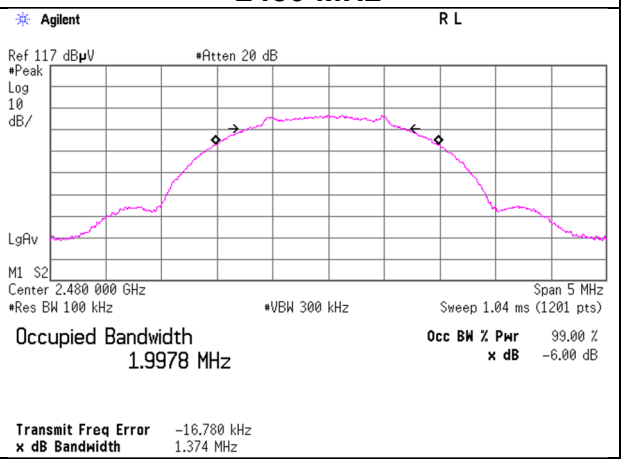
99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 1M-PHY

99 % Occupied Bandwidth	6 dB Bandwidth
2402 MHz	2402 MHz
	
2440 MHz	2440 MHz
	
2480 MHz	2480 MHz
	

99 % Occupied Bandwidth and 6 dB Bandwidth

BT LE 2M-PHY

99 % Occupied Bandwidth	6 dB Bandwidth
2402 MHz	2402 MHz
	
2440 MHz	2440 MHz
	
2480 MHz	2480 MHz
	

Maximum Peak Output Power

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	April 15, 2024
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx 11b

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	2.65	2.66	10.05	15.36	34.36	30.00	1000	14.64	-7.76	7.60	5.75	36.02	4000	28.42
2437	2.75	2.66	10.05	15.46	35.16	30.00	1000	14.54	-7.76	7.70	5.89	36.02	4000	28.32
2462	2.79	2.67	10.05	***15.51***	***35.56***	30.00	1000	14.49	-7.76	***7.75***	***5.96***	36.02	4000	28.27

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
1	2.58	
2	2.62	
5.5	2.75	*
11	2.63	

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	April 15, 2024
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx 11g

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	7.37	2.66	10.05	20.08	101.86	30.00	1000	9.92	-7.76	12.32	17.06	36.02	4000	23.70
2437	7.52	2.66	10.05	20.23	105.44	30.00	1000	9.77	-7.76	12.47	17.66	36.02	4000	23.55
2462	7.71	2.67	10.05	***20.43***	***110.41***	30.00	1000	9.57	-7.76	***12.67***	***18.49***	36.02	4000	23.35

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
6	3.95	
9	3.96	
12	3.95	
18	5.60	
24	5.60	
36	7.52	*
48	7.40	
54	7.43	

*: Worst Rate
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	April 16, 2024
Temperature / Humidity	21 deg. C / 50 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx 11n-20

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	7.80	2.66	10.05	20.51	112.46	30.00	1000	9.49	-7.76	12.75	18.84	36.02	4000	23.27
2437	8.01	2.66	10.05	20.72	118.03	30.00	1000	9.28	-7.76	12.96	19.77	36.02	4000	23.06
2462	8.20	2.67	10.05	***20.92***	***123.59***	30.00	1000	9.08	-7.76	***13.16***	***20.70***	36.02	4000	22.86

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

2437 MHz

MCS Number	Reading [dBm]	Remark
0	3.95	
1	3.99	
2	5.62	
3	5.57	
4	7.92	
5	7.58	
6	8.01	*
7	7.35	

*: Worst MCS
All comparison were carried out on same frequency and measurement factors.

Maximum Peak Output Power

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	April 12, 2024
Temperature / Humidity	22 deg. C / 45 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx BT LE, 1M-PHY

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-10.32	2.66	10.05	2.39	1.73	30.00	1000	27.61	-3.33	-0.94	0.81	36.02	4000	36.96
2440	-9.63	2.67	10.05	3.09	2.04	30.00	1000	26.91	-3.33	-0.24	0.95	36.02	4000	36.26
2480	-7.92	2.68	10.05	***4.81***	***3.03***	30.00	1000	25.19	-3.33	***1.48***	***1.41***	36.02	4000	34.54

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

Maximum Peak Output Power

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	April 12, 2024
Temperature / Humidity	22 deg. C / 45 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx BT LE, 2M-PHY

				Conducted Power					e.i.r.p. for RSS-247					
Freq.	Reading	Cable Loss	Atten. Loss	Result		Limit		Margin	Antenna Gain	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]	[dBi]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2402	-10.06	2.66	10.05	2.65	1.84	30.00	1000	27.35	-3.33	-0.68	0.86	36.02	4000	36.70
2440	-9.33	2.67	10.05	3.39	2.18	30.00	1000	26.61	-3.33	0.06	1.01	36.02	4000	35.96
2480	-8.93	2.68	10.05	***3.80***	***2.40***	30.00	1000	26.20	-3.33	***0.47***	***1.11***	36.02	4000	35.55

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain

Average Output Power
(Reference data for RF Exposure)

Test place	Kashima EMC Lab. No.2 Measurement Room		
Date	April 12, 2024	April 15, 2024	April 16, 2024
Temperature / Humidity	22 deg. C / 45 % RH	23 deg. C / 43% RH	21 deg. C / 50 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Hiromitsu Tanabe
Mode	Tx		

11b **5.5 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	0.10	2.66	10.05	12.81	19.10	0.05	12.86	19.33
2437	0.22	2.66	10.05	12.93	19.63	0.05	12.98	19.87
2462	0.34	2.67	10.05	***13.06***	***20.23***	0.05	***13.11***	***20.47***

11g **18 Mbps**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-0.28	2.66	10.05	12.43	17.50	0.21	12.64	18.37
2437	-0.04	2.66	10.05	12.67	18.49	0.21	12.88	19.41
2462	0.06	2.67	10.05	***12.78***	***18.97***	0.21	***12.99***	***19.91***

11n-20 **MCS 2**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2412	-0.53	2.66	10.05	12.18	16.52	0.22	12.40	17.38
2437	-0.17	2.66	10.05	12.54	17.95	0.22	12.76	18.88
2462	-0.12	2.67	10.05	***12.60***	***18.20***	0.22	***12.82***	***19.14***

BT LE **1M-PHY**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-11.04	2.66	10.05	1.67	1.47	0.00	1.67	1.47
2440	-10.27	2.67	10.05	2.45	1.76	0.00	2.45	1.76
2480	-9.88	2.68	10.05	***2.85***	***1.93***	0.00	***2.85***	***1.93***

BT LE **2M-PHY**

Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
2402	-10.89	2.66	10.05	1.82	1.52	0.00	1.82	1.52
2440	-10.18	2.67	10.05	2.54	1.79	0.00	2.54	1.79
2480	-9.83	2.68	10.05	***2.90***	***1.95***	0.00	***2.90***	***1.95***

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

Average Output Power
(Reference data for RF Exposure)

Test place	Kashima EMC Lab. No.2 Measurement Room	
Date	April 15, 2024	April 16, 2024
Temperature / Humidity	23 deg. C / 43% RH	21 deg. C / 50 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe
Mode	Tx	

2437 MHz

Mode	Rate Mbps	Reading [dBm]	Duty factor [dB]	Burst power [dBm]	Remarks
11b	1	0.01	0.01	0.02	
	2	0.06	0.02	0.08	
	5.5	0.22	0.05	0.27	*
	11	0.03	0.10	0.13	
11g	6	-0.40	0.07	-0.33	
	9	-0.51	0.11	-0.40	
	12	-0.56	0.14	-0.42	
	18	-0.04	0.21	0.17	*
	24	-0.31	0.27	-0.04	
	36	-1.10	0.38	-0.72	
	48	-1.19	0.50	-0.69	
	54	-1.28	0.55	-0.73	

* Worst rate
Sample Calculation:
Burst power = Reading (timed average) + Duty factor
All comparison were carried out on same frequency and measurement factors.

2437 MHz

Mode	Rate MCS	Reading [dBm]	Duty factor [dB]	Burst power [dBm]	Remarks
11n-20	0	-0.58	0.07	-0.51	
	1	-0.80	0.15	-0.65	
	2	-0.17	0.22	0.05	*
	3	-0.34	0.29	-0.05	
	4	-1.05	0.40	-0.65	
	5	-1.18	0.51	-0.67	
	6	-1.21	0.57	-0.64	
	7	-1.28	0.61	-0.67	

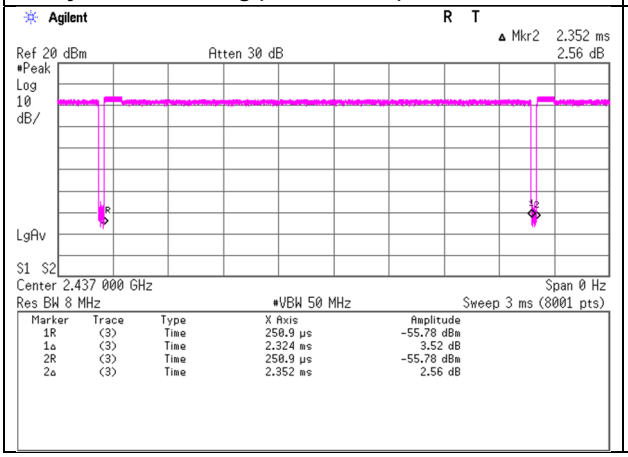
* Worst rate
Sample Calculation:
Burst power = Reading (timed average) + Duty factor
All comparison were carried out on same frequency and measurement factors.

Burst rate confirmation

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	April 16, 2024
Temperature / Humidity	21 deg. C / 50 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx

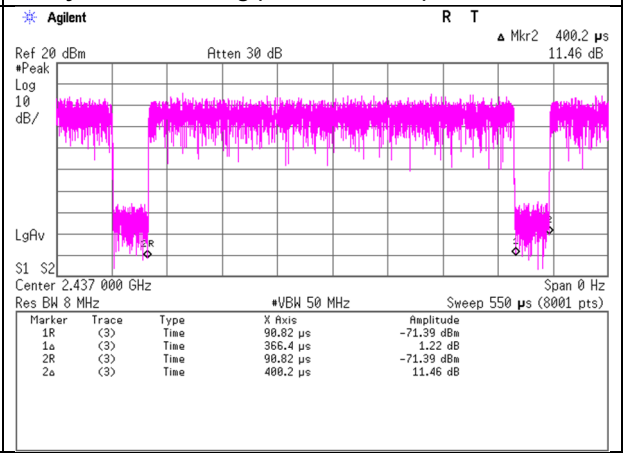
11b 5.5 Mbps

Tx on / (Tx on + Tx off) =	0.988
Tx on / (Tx on + Tx off) * 100 =	98.8 %
Duty factor = 10 * log (2.352 / 2.324) =	0.05 dB



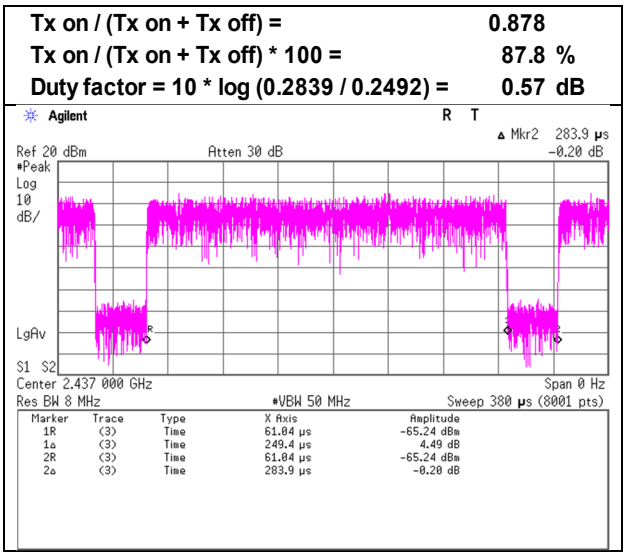
11g 36 Mbps

Tx on / (Tx on + Tx off) =	0.916
Tx on / (Tx on + Tx off) * 100 =	91.6 %
Duty factor = 10 * log (0.4002 / 0.3664) =	0.38 dB



11n-20 MCS 6

Tx on / (Tx on + Tx off) =	0.878
Tx on / (Tx on + Tx off) * 100 =	87.8 %
Duty factor = 10 * log (0.2839 / 0.2492) =	0.57 dB



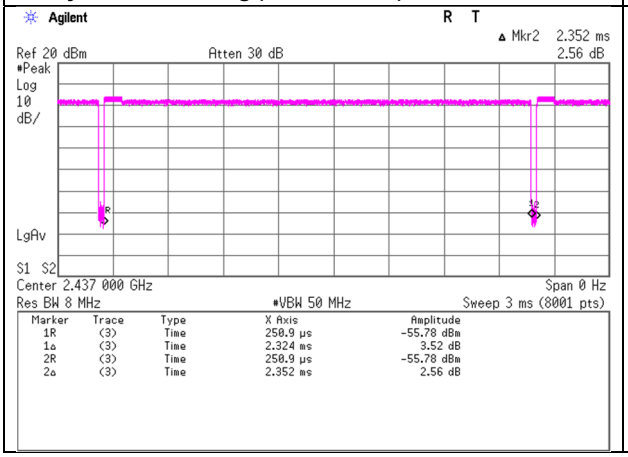
* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Burst rate confirmation

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	April 16, 2024
Temperature / Humidity	21 deg. C / 50 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx

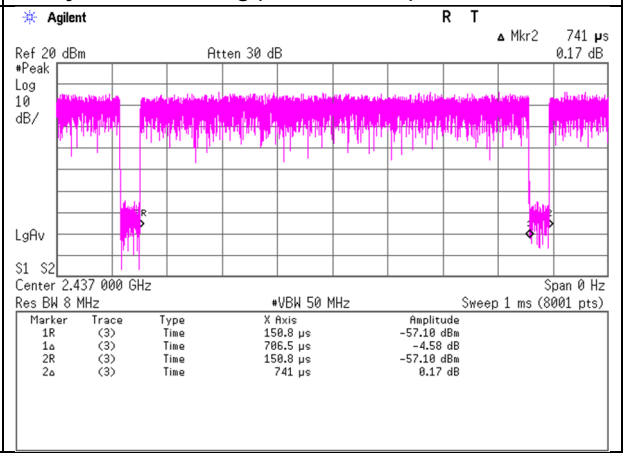
11b 5.5 Mbps

Tx on / (Tx on + Tx off) =	0.988
Tx on / (Tx on + Tx off) * 100 =	98.8 %
Duty factor = 10 * log (2.352 / 2.324) =	0.05 dB



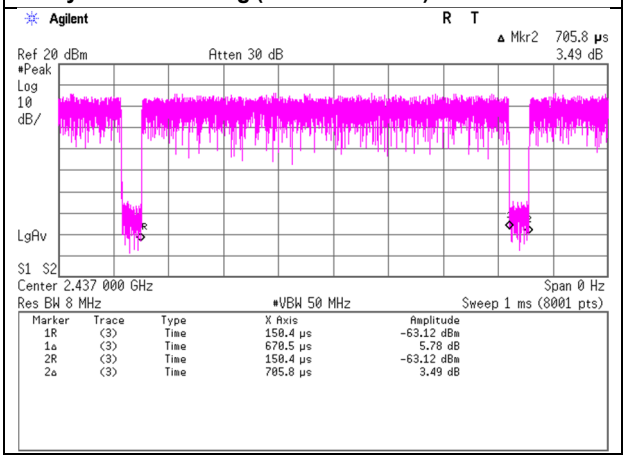
11g 18 Mbps

Tx on / (Tx on + Tx off) =	0.953
Tx on / (Tx on + Tx off) * 100 =	95.3 %
Duty factor = 10 * log (0.741 / 0.7065) =	0.21 dB



11n-20 MCS 2

Tx on / (Tx on + Tx off) =	0.950
Tx on / (Tx on + Tx off) * 100 =	95.0 %
Duty factor = 10 * log (0.7058 / 0.6705) =	0.22 dB



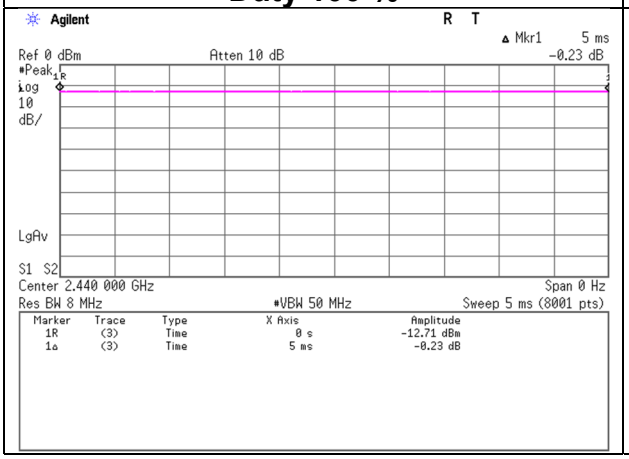
* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

Burst rate confirmation

Test place	Kashima EMC Lab. No.2 Measurement Room
Date	April 16, 2024
Temperature / Humidity	21 deg. C / 50 % RH
Engineer	Hiromitsu Tanabe
Mode	Tx

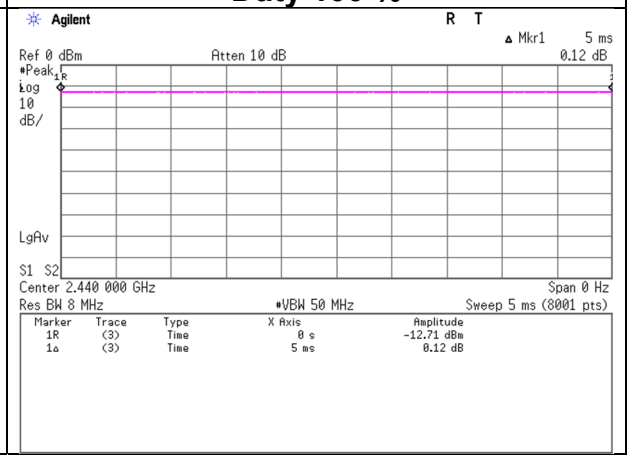
BT LE 1M-PHY

Duty 100 %



BT LE 2M-PHY

Duty 100 %



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