RADIO TEST REPORT

Test Report No. : 13204004M-A-R1

Applicant	:	**DENSO CORPORATION**
Type of EUT	:	**Cockpit Control Unit**
Model Number of EUT	:	**DNNS114**
FCC ID	:	**HYQDNNS114**
Test regulation	:	**FCC Part 15 Subpart C: 2019** ***WLAN part**
Test Items	:	**Except Radiated Spurious Emission test**
Test Result	:	**Complied (Refer to SECTION 3.2)**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by any agency of the Federal Government.
6. This test report covers Radio technical requirements.
   It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Kashima EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 13204004M-A. 13204004M-A is replaced with this report.

Date of test: March 13, 2020

Representative test engineer:
K. Ando
Kazuhiro Ando
Engineer
Consumer Technology Division

Approved by:
T. Yamashita
Tomoyuki Yamashita
Leader
Consumer Technology Division

ACCREDITED
CERTIFICATE 1266.01

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

UL Japan, Inc.
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REVISION HISTORY

Original Test Report No.: 13204004M-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13204004M-A	April 17, 2020	-	-
1	13204004M-A-R1	May 18, 2020	P.6	Modify The maximum clock frequencies used in the EUT from 1.8 GHz to 40 MHz (Radio part).
1	13204004M-A-R1	May 18, 2020	P.7	Modify the reference test report number from 13274648H-A to 13274648H-A-R1
1	13204004M-A-R1	May 18, 2020	P.8	Delete the test item “Co-location & Co-operation” from the table in Section 3.3
1	13204004M-A-R1	May 18, 2020	P.10	Modify The WLAN Power Setting from 11 dBm to 9 dBm.
1	13204004M-A-R1	May 18, 2020	P.10	Modify the Date of the software from March 8, 2020 to January 10, 2020
1	13204004M-A-R1	May 18, 2020	P.10	Add A’ and A” in a figure. Also connect the antenna to the BT/WiFi cables.
1	13204004M-A-R1	May 18, 2020	P.11	Add A’ and A” (the WiFi/ASSEMBLY Bluetooth antenna) in the table of “Description of EUT and Support equipment”.

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
Address	:	1-1 Showa-cho, Kariya-shi, Aichi ken, 448-8661 Japan
Telephone Number	:	+81-566-20-3304
Facsimile Number	:	+81-566-25-4920
Contact Person	:	Naoto Makino

The information provided from the customer is as follows;
- Applicant, Type 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 Receipt Date
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type	:	Cockpit Control Unit
Model Number	:	DNNS114
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 13.2 V
Receipt Date	:	January 8, 2020
Country of Mass-production	:	JAPAN
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: DNNS114 (referred to as the EUT in this report) is a Cockpit Control Unit.

General Specification

The maximum clock frequencies used in the EUT: 40 MHz (Radio part)

Radio Specification

*Wireless LAN and Bluetooth do not transmit simultaneously.
*This test report applies to Wireless LAN (2.4 GHz band).

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

	IEEE802.11b	IEEE802.11g/n (20 M band)
Radio Type	Transceiver	
Frequency of operation	2412 MHz - 2462 MHz	
Type of modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM (64QAM, 16QAM, QPSK, BPSK)
Channel spacing	5 MHz	
Antenna type	ASSEMBLY WiFi Antenna	
Antenna Connector type	MHF PLUG	
Antenna Gain	-6.40 dBi (max)	

[Bluetooth (BDR / EDR function)]

	Bluetooth Ver.4.2 with EDR function
Radio Type	Transceiver
Frequency of operation	2402 MHz - 2480 MHz
Type of modulation	FHSS (GFSK, π/4-DQPSK, 8-DPSK)
Channel spacing	1 MHz
Antenna type	ASSEMBLY BT Antenna
Antenna Connector type	MHF PLUG
Antenna Gain	-4.52 dBi (max)

[Broadcast]

	AM	FM	XM	RBDS
Radio Type	Receiver			
Frequency of operation	522 kHz – 1629 kHz	87.5 MHz – 108.0 MHz	2333.465 MHz – 2344.045 MHz	87.5 MHz – 108.0 MHz
Antenna Connector type	GT13	GT13	GT13	GT13

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258

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

* Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.10-2013 6. Standard test methods	**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 a)	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 b)	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 c)	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)	3.4 dB 2090.00 MHz, PK	Complied d)	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 No. 13-EM-W0420 and 13-EM-W0422.
*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.
*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, and refer to the test report 13274648H-A-R1.

a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)
b) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
c) Refer to APPENDIX 1 (data of Power Density)
d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)

Symbols:
Complied The data of this test item has enough margin, more than the measurement uncertainty.
Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

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

FCC Part 15.31 (e)
The EUT provides stable voltage constantly to the wireless transmitter 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 vehicle. 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	- a)	Conducted
a) Refer to APPENDIX 1 (data of 6 dB Bandwidth and 99 % Occupied Bandwidth)					

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

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether laboratory uncertainty is applied.

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

Conducted emission

Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
0.15 MHz to 30 MHz	3.4 dB	3.3 dB

Radiated emission

Measurement distance	Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	Not Defined	2.9 dB
	30 MHz to 200 MHz	6.3 dB	6.1 dB
	200 MHz to 1000 MHz		6.2 dB
	1 GHz to 6 GHz	5.2 dB	5.0 dB
	6 GHz to 18 GHz	5.5 dB	5.4 dB
	18 GHz to 40 GHz	Not Defined	5.5 dB
1 m	1 GHz to 18 GHz	Not Defined	5.4 dB
	18 GHz to 40 GHz		5.6 dB

Antenna Terminal test

Test Item	Required Uncertainty (+/-)	Uncertainty (+/-)
6 dB Bandwidth / 99 % Occupied Bandwidth	Not Defined	1.6 %
Maximum Output Power	0.75 dB	0.73 dB
Burst Rate	Not Defined	0.256 %
Power Density	4 dB	2.2 dB
Conducted Spurious Emission (9 kHz to 30 MHz)	4 dB	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, Facsimile: +81 478 82 3373
A2LA Certificate Number: 1266.01/FCC Test Firm Registration Number: 910230 / ISED Lab Company Number: 4659A

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	-	-
No.3 Measurement room	4.5 x 5.3 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)

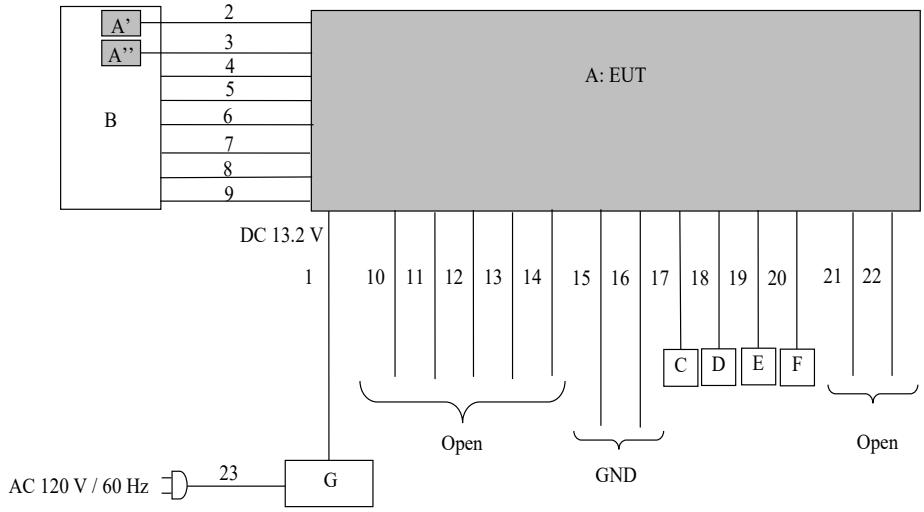
Test operating mode was determined as follows according to "Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - " of TCB Council Workshop October 2009

Mode	Remarks*
IEEE 802.11b (11b)	5.5 Mbps, PN9
IEEE 802.11g (11g)	9 Mbps, PN9
IEEE 802.11n SISO 20 MHz BW (11n-20)	MCS 4, PN9
*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 settings : 9 dBm Software : MSoC Ver : F41CMM006-007 (Date: January 10, 2020, Storage: EUT Memory) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.	

*The details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Spurious Emission (Conducted)	11n-20 Tx	2462 MHz
6dB Bandwidth Maximum Peak Output Power Power Density 99% Occupied Bandwidth	11b Tx 11g Tx 11n-20 Tx	2412 MHz 2437 MHz 2462 MHz

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	**Cockpit Control Unit**	**DNNS114**	**4687263540001933 5909016010000000**	**DENSO CORPORATION**	**EUT**
A'	**WiFi Antenna**	**2314128-2**	***1)**	**TE Connectivity Ltd.**	**EUT**
A''	**ASSEMBLY Bluetooth Antenna**	**2462810-0140**	***1)**	**TE Connectivity Ltd.**	**EUT**
B	Center Information Display	DNNS105	1911290020	DENSO CORPORATION	-
C	8 Ω Speaker	K50	17	VISATON	-
D	8 Ω Speaker	K50	18	VISATON	-
E	8 Ω Speaker	K50	19	VISATON	-
F	8 Ω Speaker	K50	20	VISATON	-
G	DC Power Supply	GSV3000	1708192900	DIAMOND ANTENNA	-

*1) The number is under the control of the equipment B.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.7	Unshielded	Unshielded	-
2	WiFi Cable	0.2	Shielded	Shielded	-
3	BT Cable	0.2	Shielded	Shielded	-
4	DC + Signal Cable	0.2	Unshielded	Unshielded	-
5	LVDS Cable	0.2	Shielded	Shielded	-
6	FG Cable	0.1	Unshielded	Unshielded	-
7	FG Cable	0.1	Unshielded	Unshielded	-
8	FG Cable	0.1	Unshielded	Unshielded	-
9	FG Cable	0.1	Unshielded	Unshielded	-
10	AM/FM Cable	2.0	Shielded	Shielded	-
11	USB Cable	0.9	Shielded	Shielded	-
12	XM Cable	1.6	Unshielded	Unshielded	-
13	Mic Cable	1.6	Shielded	Shielded	-
14	AUX Box Cable	1.0	Shielded	Shielded	-
15	GND Cable	1.6	Unshielded	Unshielded	-
16	GND Cable	1.6	Unshielded	Unshielded	-
17	Speaker Cable	1.9	Unshielded	Unshielded	-
18	Speaker Cable	1.9	Unshielded	Unshielded	-
19	Speaker Cable	1.9	Unshielded	Unshielded	-
20	Speaker Cable	1.9	Unshielded	Unshielded	-
21	Meter Cable	3.0	Shielded	Shielded	-
22	Meter Cable	1.6	Unshielded	Unshielded	-
23	AC Cable	1.7	Unshielded	Unshielded	-

SECTION 5: Antenna Teminal 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	50 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 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)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	10 kHz	30 kHz				

*1) Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) Section 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 low enough 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.

The test results and limit are rounded off to two decimals place, 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

6 dB Bandwidth and 99 % Occupied Bandwidth

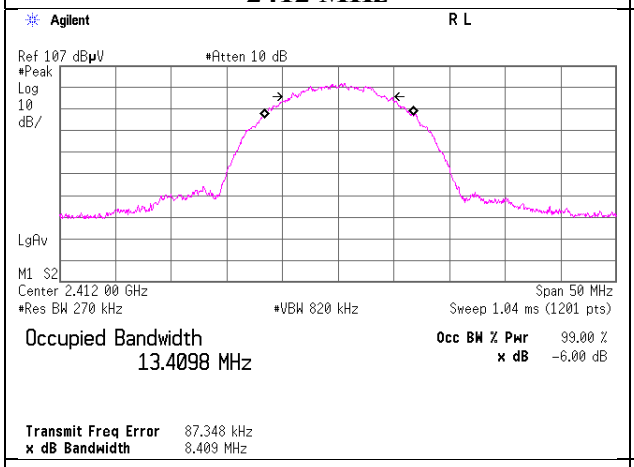
Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
Mode	Tx

Mode	Frequency [MHz]	99% Occupied Bandwidth [kHz]	6dB Bandwidth [MHz]	Limit for 6dB Bandwidth [MHz]
11b	2412	13409.8	9.082	> 0.5000
	2437	13415.5	9.088	> 0.5000
	2462	13414.5	9.088	> 0.5000
11g	2412	18320.9	15.179	> 0.5000
	2437	18440.3	15.179	> 0.5000
	2462	18355.9	15.179	> 0.5000
11n-20	2412	19082.0	16.960	> 0.5000
	2437	19094.7	16.904	> 0.5000
	2462	19133.1	16.970	> 0.5000

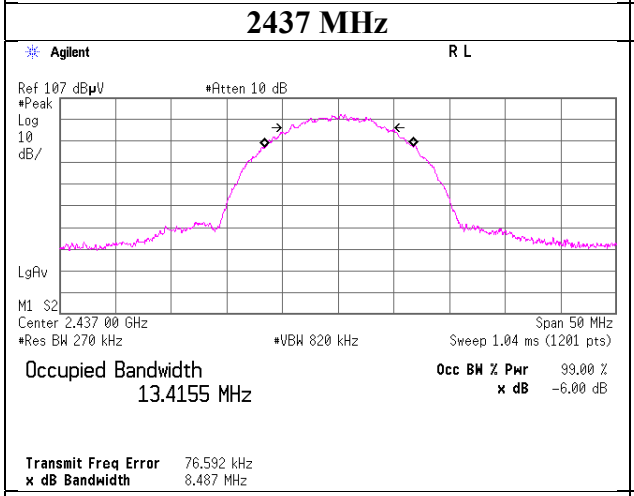
99%Occupied Bandwidth

11b

2412 MHz



2437 MHz



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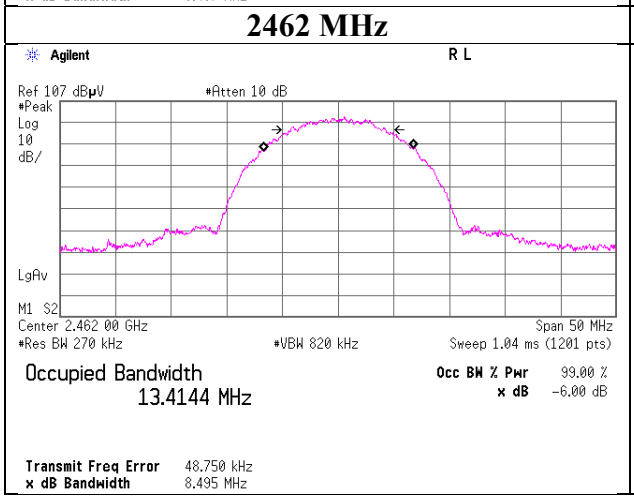
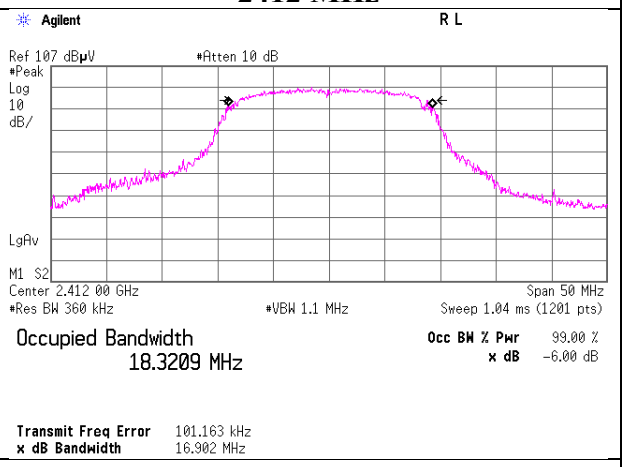


11g

2412 MHz



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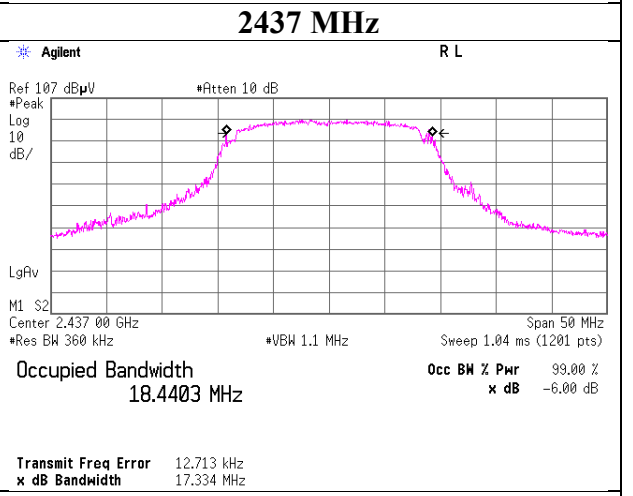

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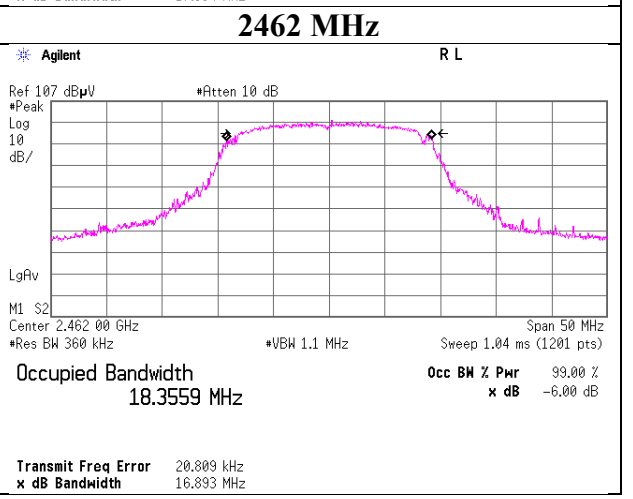
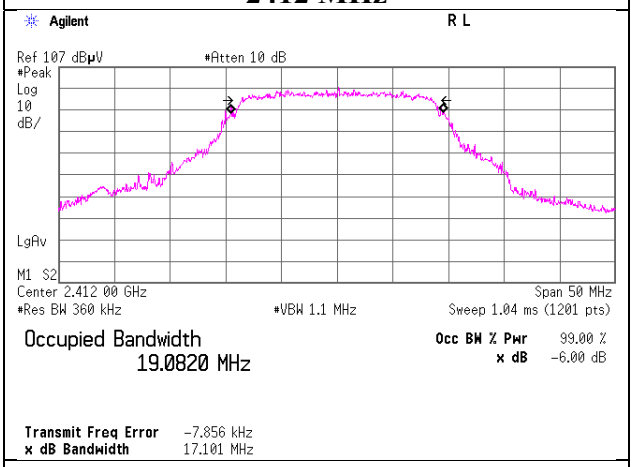


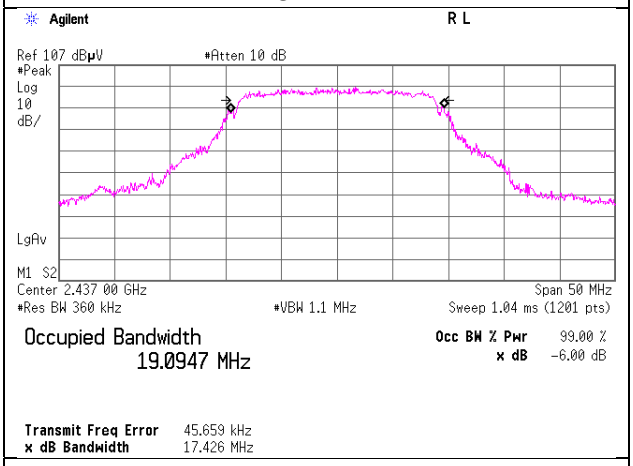
99% Occupied Bandwidth

11n-20

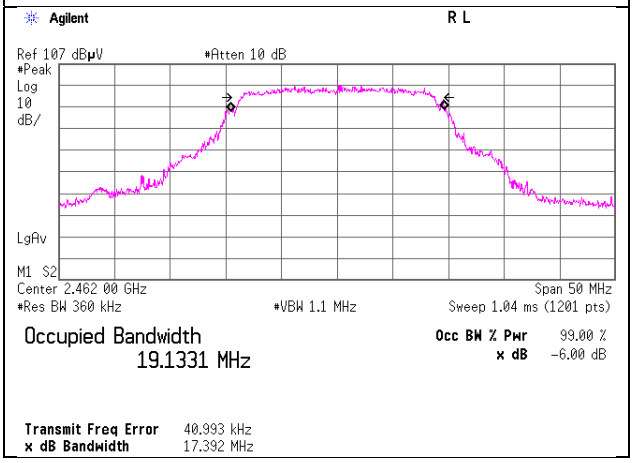
2412 MHz



2437 MHz



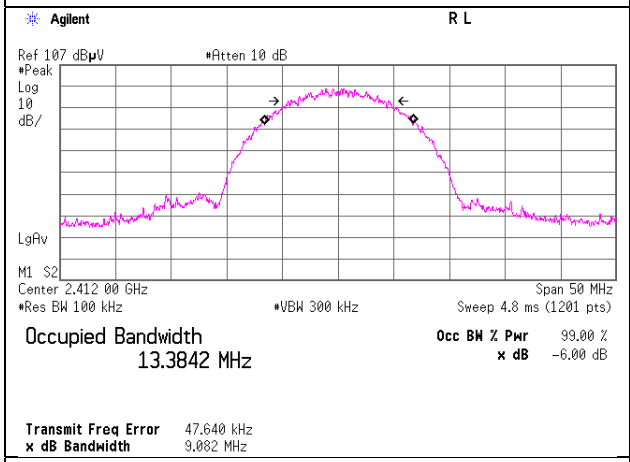
2462 MHz



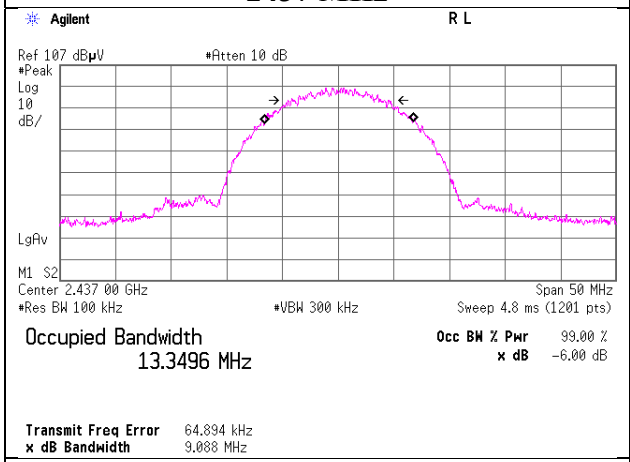
6dB Bandwidth

11b

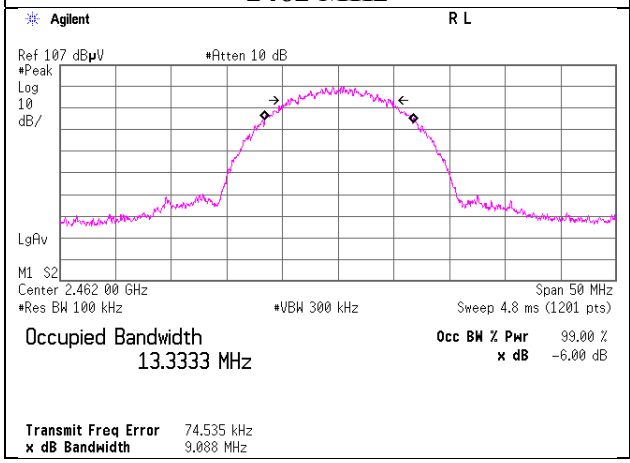
2412 MHz



2437 MHz

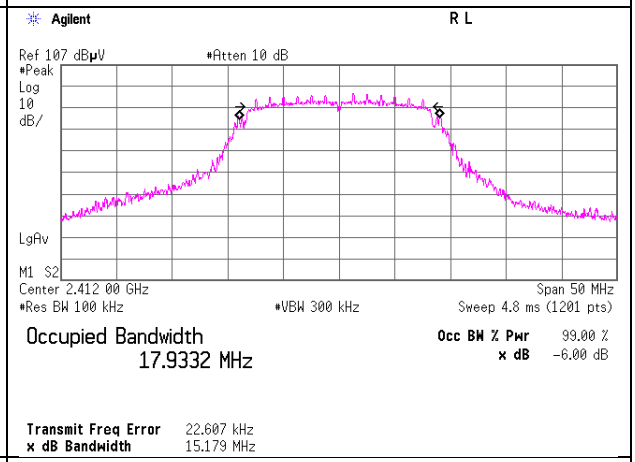


2462 MHz

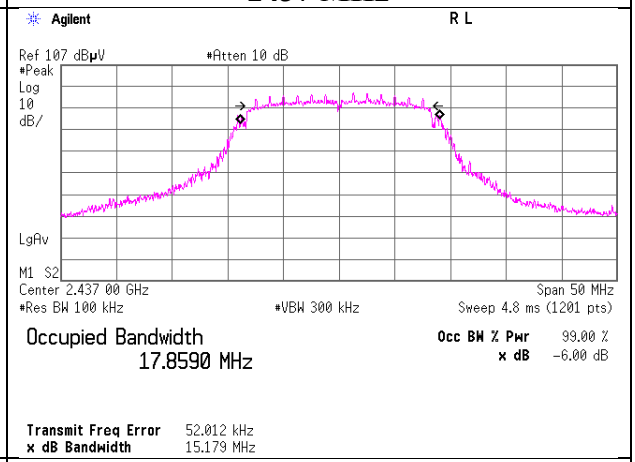


11g

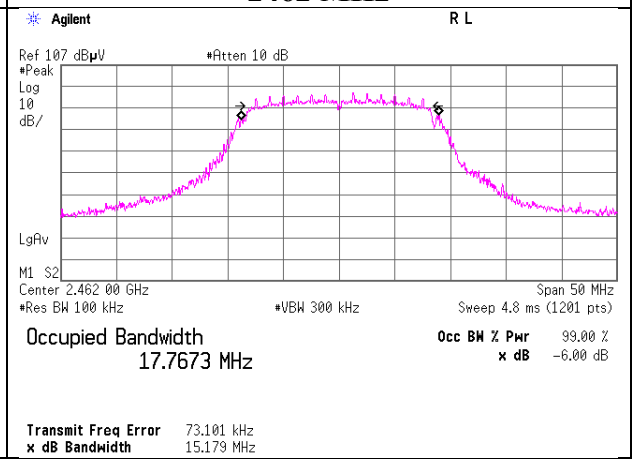
2412 MHz



2437 MHz



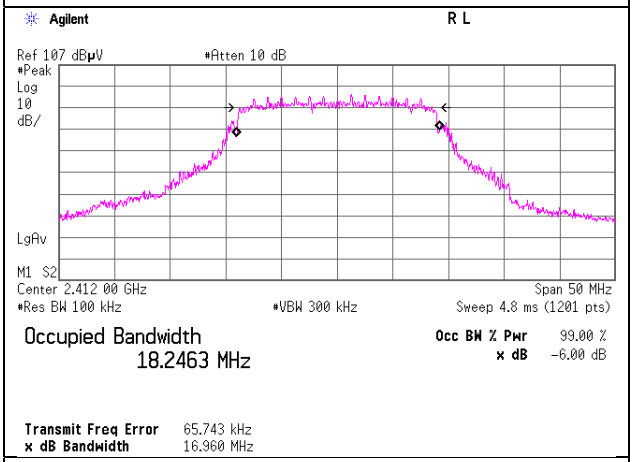
2462 MHz



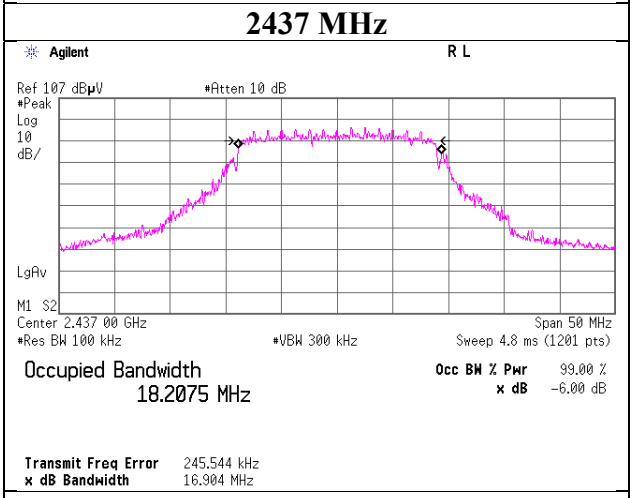
6dB Bandwidth

11n-20

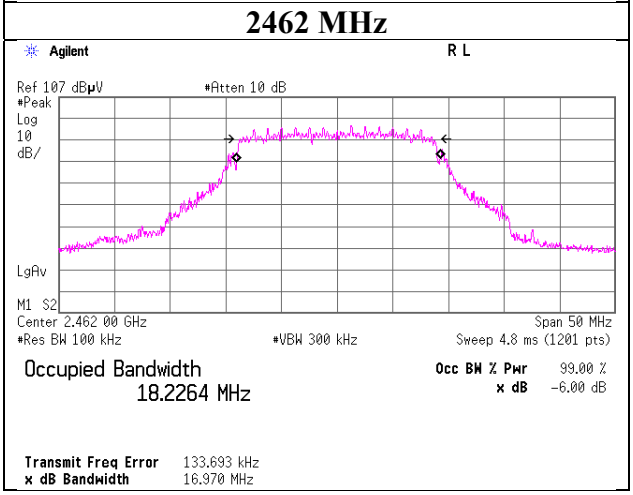
2412 MHz



2437 MHz



2462 MHz



Maximum Peak Output Power

Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
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	0.02	1.11	10.04	11.17	13.09	30.00	1000	18.83	-6.40	4.77	3.00	36.02	4000	31.25
2437	0.52	1.02	10.04	11.58	14.38	30.00	1000	18.42	-6.40	5.18	3.29	36.02	4000	30.84
2462	0.28	1.07	10.04	11.39	13.77	30.00	1000	18.61	-6.40	4.99	3.15	36.02	4000	31.03

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain
*The equipment and cables were not used for factor 0 dB of the data sheets.

Rate	Reading	Remark
[Mbps]	[dBm]	
1	0.46	
2	0.50	
5.5	0.52	*
11	0.45	

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

Maximum Peak Output Power

Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
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	5.99	1.11	10.04	17.14	51.75	30.00	1000	12.86	-6.40	10.74	11.85	36.02	4000	25.28
2437	6.14	1.02	10.04	17.20	52.46	30.00	1000	12.80	-6.40	10.80	12.02	36.02	4000	25.22
2462	6.24	1.07	10.04	17.35	54.30	30.00	1000	12.65	-6.40	10.95	12.44	36.02	4000	25.07

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain
*The equipment and cables were not used for factor 0 dB of the data sheets.

Rate	Reading	Remark
[Mbps]	[dBm]	
6	6.11	
9	6.14	*
12	6.02	
18	5.71	
24	5.68	
36	5.92	
48	6.12	
54	5.99	

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

Maximum Peak Output Power

Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
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	5.74	1.11	10.04	16.89	48.85	30.00	1000	13.11	-6.40	10.49	11.19	36.02	4000	25.53
2437	6.27	1.02	10.04	17.33	54.05	30.00	1000	12.67	-6.40	10.93	12.38	36.02	4000	25.09
2462	6.31	1.07	10.04	17.42	55.18	30.00	1000	12.58	-6.40	11.02	12.64	36.02	4000	25.00

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
e.i.r.p. Result = Conducted Power Result + Antenna Gain
*The equipment and cables were not used for factor 0 dB of the data sheets.

MCS Number	Reading [dBm]	Remark
0	6.22	
1	6.16	
2	5.84	
3	6.20	
4	6.27	*
5	6.14	
6	5.71	
7	6.09	

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

Average Output Power
(Reference data for RF Exposure)

Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
Mode	Tx

11b **1 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	-2.46	1.11	10.04	8.69	7.39	0.13	8.82	7.62
2437	-2.21	1.02	10.04	8.85	7.67	0.13	8.98	7.90
2462	-2.34	1.07	10.04	8.77	7.53	0.13	8.90	7.76

11g **6 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	-3.63	1.11	10.04	7.52	5.65	0.81	8.33	6.81
2437	-3.43	1.02	10.04	7.63	5.79	0.81	8.44	6.98
2462	-3.25	1.07	10.04	7.86	6.11	0.81	8.67	7.36

11n-20 **MCS 0**

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	-3.62	1.11	10.04	7.53	5.66	0.78	8.31	6.77
2437	-3.42	1.02	10.04	7.64	5.81	0.78	8.42	6.95
2462	-3.31	1.07	10.04	7.80	6.02	0.78	8.58	7.21

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

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

The average output power was measured with the lowest order modulation and lowest data rate configuration in each IEEE 802.11 mode based on KDB 248227 D01.

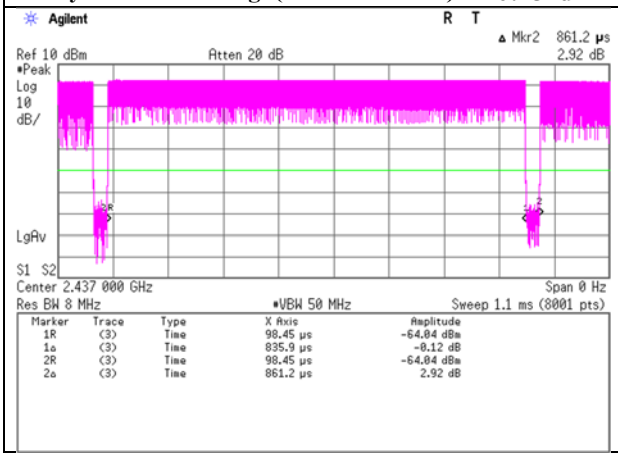
Burst rate confirmation (for average output power)

Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
Mode	Tx

Lowest Rate

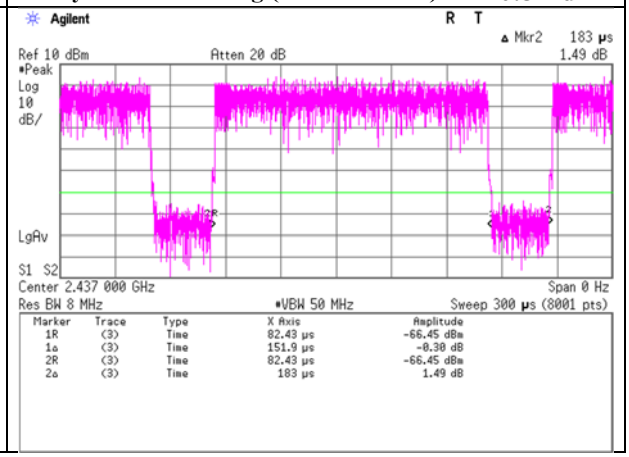
11b 1 Mbps

Tx on / (Tx on + Tx off) =	0.971
Tx on / (Tx on + Tx off) * 100 =	97.1 %
Duty factor = 10 * log (0.8612 / 0.8359) =	0.13 dB



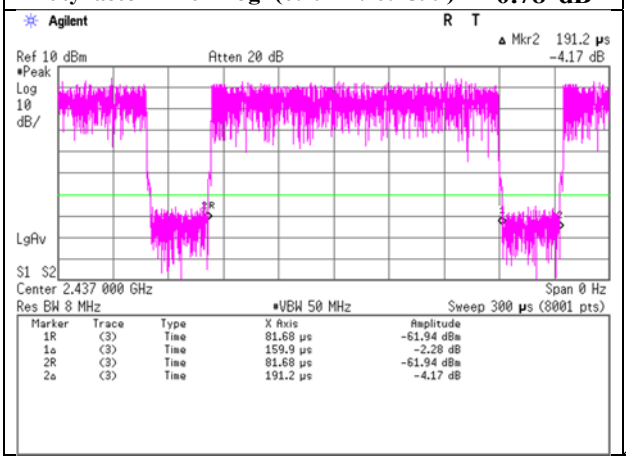
11g 6 Mbps

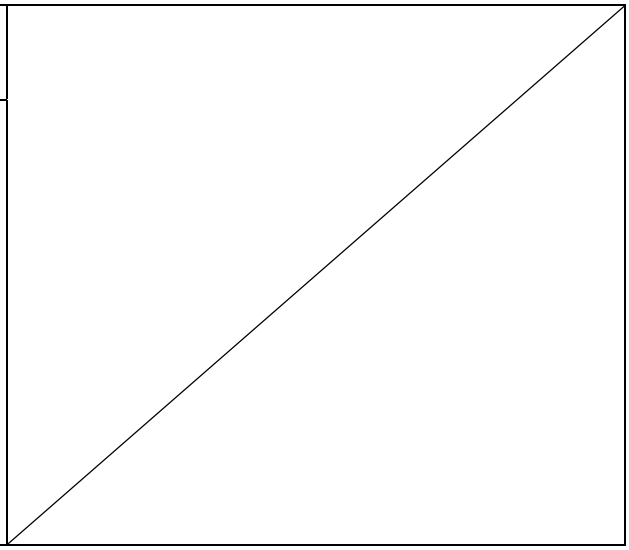
Tx on / (Tx on + Tx off) =	0.830
Tx on / (Tx on + Tx off) * 100 =	83.0 %
Duty factor = 10 * log (0.183 / 0.1519) =	0.81 dB



11n-20 MCS 0

Tx on / (Tx on + Tx off) =	0.836
Tx on / (Tx on + Tx off) * 100 =	83.6 %
Duty factor = 10 * log (0.1912 / 0.1599) =	0.78 dB





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

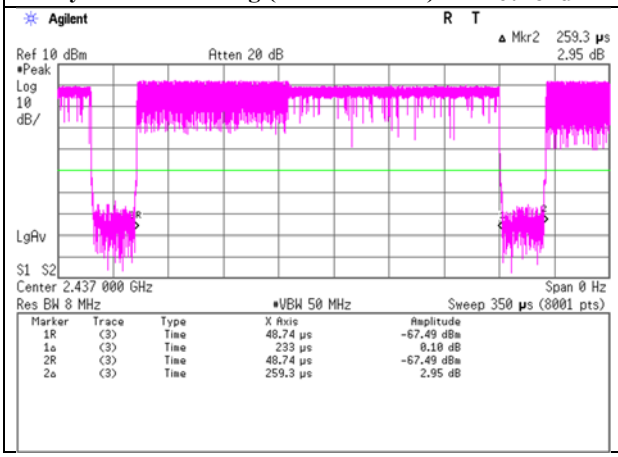
Burst rate confirmation (for radiated spurious emission)

Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
Mode	Tx

Worst Rate

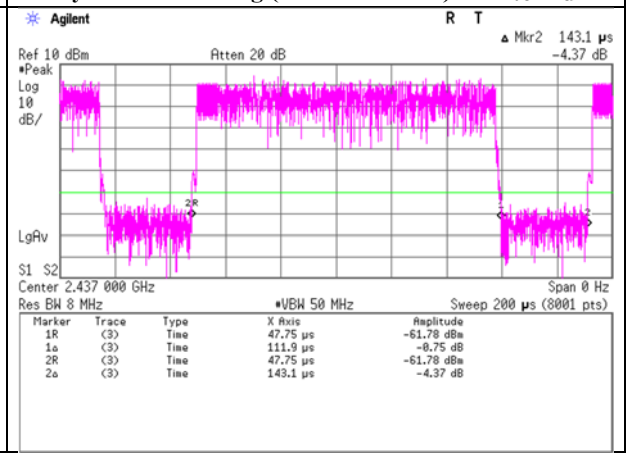
11b 5.5 Mbps

Tx on / (Tx on + Tx off) = 0.899
Tx on / (Tx on + Tx off) * 100 = 89.9 %
Duty factor = 10 * log (0.2593 / 0.233) = 0.46 dB



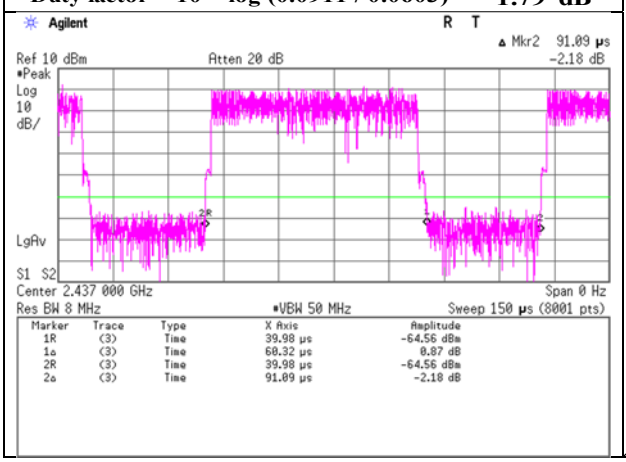
11g 9 Mbps

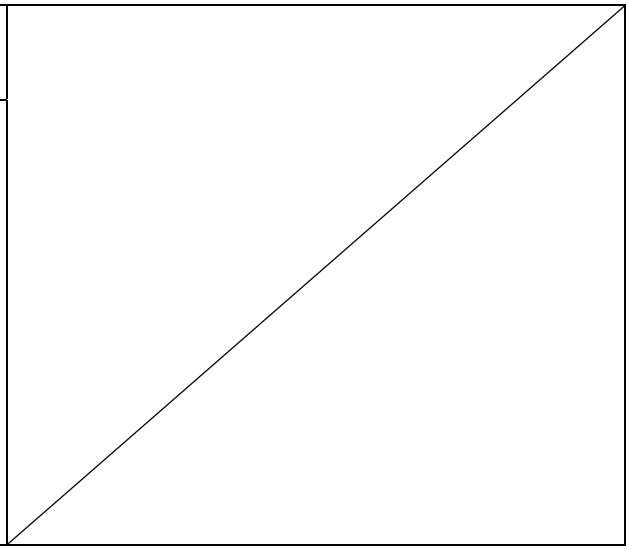
Tx on / (Tx on + Tx off) = 0.782
Tx on / (Tx on + Tx off) * 100 = 78.2 %
Duty factor = 10 * log (0.1431 / 0.1119) = 1.07 dB



11n-20 MCS 4

Tx on / (Tx on + Tx off) = 0.662
Tx on / (Tx on + Tx off) * 100 = 66.2 %
Duty factor = 10 * log (0.0911 / 0.0603) = 1.79 dB



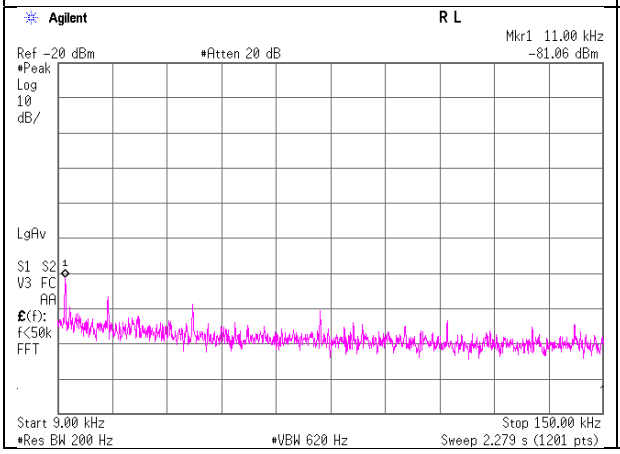


* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

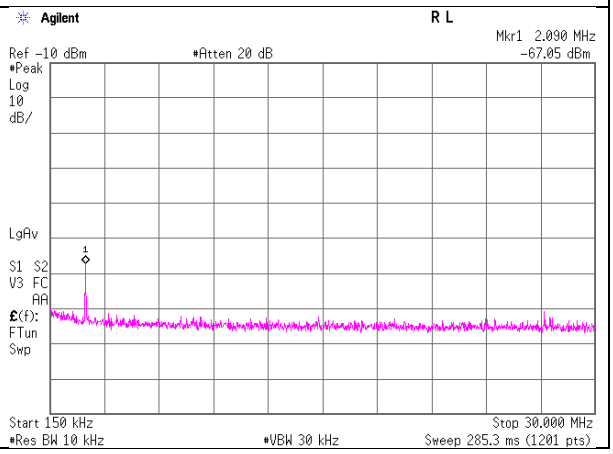
Conducted Spurious Emission

Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
Mode	Tx 11n-20 2462 MHz

9 kHz - 150 kHz



150 kHz - 30 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
11.00	-81.1	0.01	9.9	2.0	1	-69.1	300	6.0	-7.9	46.7	54.6	
2090.00	-67.1	0.02	9.9	2.0	1	-55.1	30	6.0	26.2	29.5	3.4	

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

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

N: Number of output

*2.0 dBi was applied to the test result based on ANSI C63.10 since antenna gain was less than 2.0 dBi.

Power Density

Report No.	13204004M-A-R1
Test place	Kashima EMC Lab. No.2 Measurement Room
Date	March 13, 2020
Temperature / Humidity	21 deg. C / 47 % RH
Engineer	Kazuhiro Ando
Mode	Tx

11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412	-20.94	1.11	10.04	-9.79	8.00	17.79
2437	-20.26	1.02	10.04	-9.21	8.00	17.21
2462	-19.77	1.07	10.04	-8.66	8.00	16.66

11g

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412	-27.19	1.11	10.04	-16.04	8.00	24.04
2437	-27.30	1.02	10.04	-16.24	8.00	24.24
2462	-27.16	1.07	10.04	-16.05	8.00	24.05

11n-20

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412	-26.01	1.11	10.04	-14.86	8.00	22.86
2437	-25.64	1.02	10.04	-14.58	8.00	22.58
2462	-25.42	1.07	10.04	-14.31	8.00	22.31

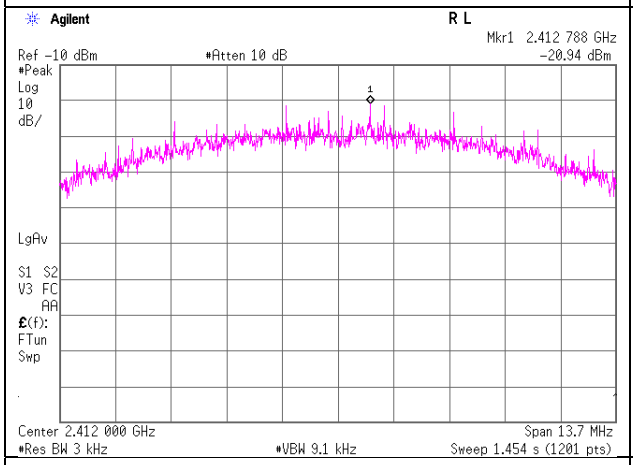
Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

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

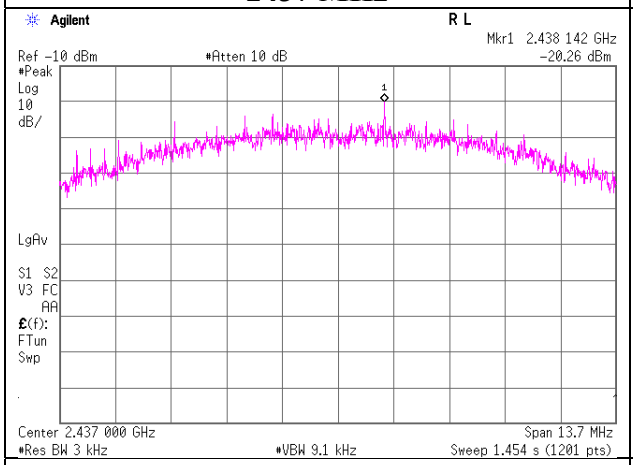
Power Density

11b

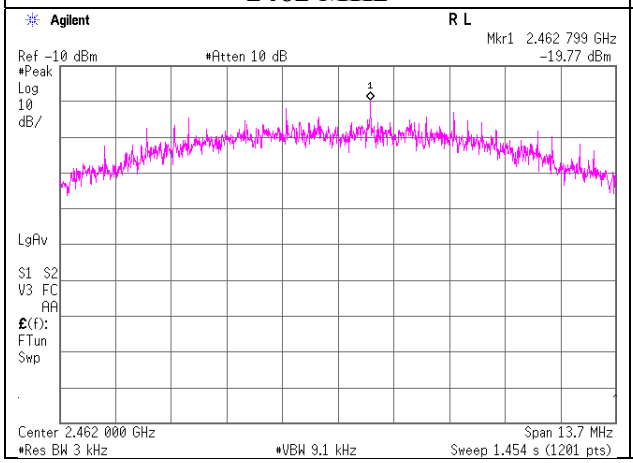
2412 MHz



2437 MHz

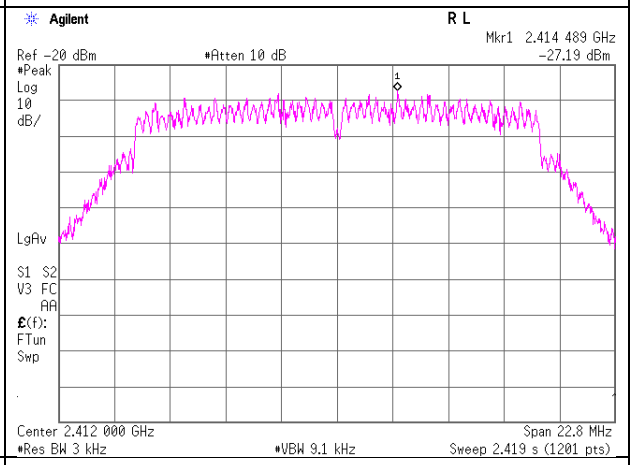


2462 MHz

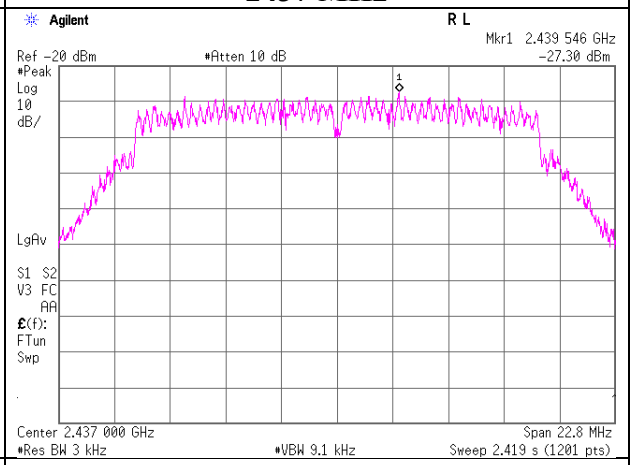


11g

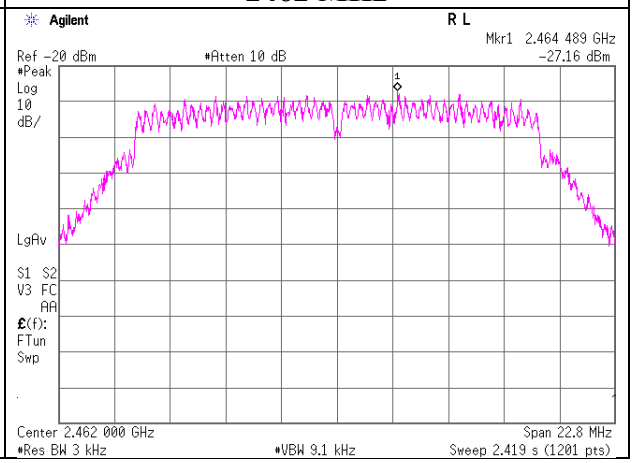
2412 MHz



2437 MHz



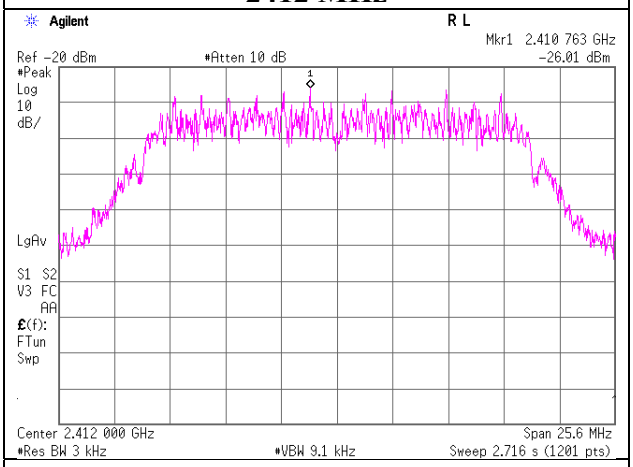
2462 MHz



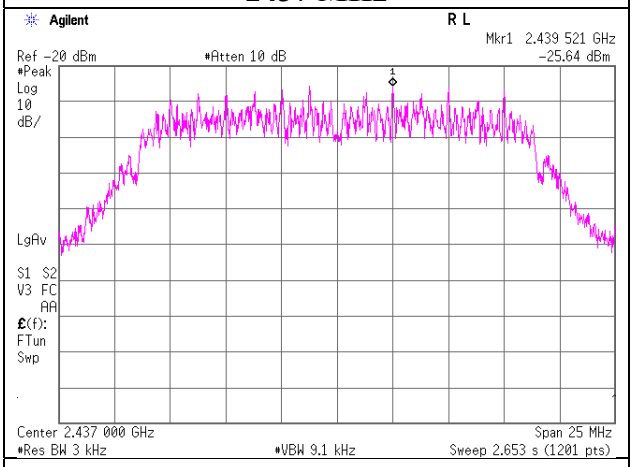
Power Density

11n-20

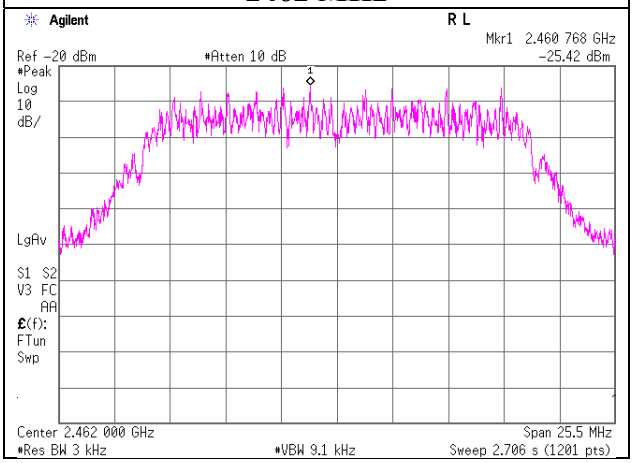
2412 MHz



2437 MHz



2462 MHz



APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	CSA-07	143643	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY52490024	2019/06/01	12
AT	CAT10-17	143023	10dB Fixed Atten.	Weinschel - API Technologies Corp	54A-10	56251	2019/05/23	12
AT	CCC-W01	143109	Micro Wave Cable	Suhner	SUCOFLEX102	MY3662/2	2019/05/23	12
AT	CPM-16	143588	Peak Power Analyzer	Keysight Technologies Inc	8990B	MY51000276	2019/06/21	12
AT	CPSO-24	143606	Power Sensor	Keysight Technologies Inc	N1923A	MY54070024	2019/06/21	12
AT	CTS-18	144220	Digital Multimeter	Fluke Corporation	87-3	85220051	-	-
AT	COS-02	143534	Temperature & Humidity Indicator	A&D	AD-5681	6878345	2019/07/24	12

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

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

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

Test item: AT: Antenna Terminal Conducted test