RADIO TEST REPORT

Test Report No. : 12987093S-A-R3

Applicant	:	**Yokogawa Electric Corporation**
Type of Equipment	:	**Wireless Vibration Sensor**
Model No.	:	**XS770A**
FCC ID	:	**SGJ-WFC016**
Test regulation	:	**FCC Part 15 Subpart C: 2019**
Test result	:	**Complied (Refer to SECTION 3.2)**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. 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. Shonan 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 12987093S-A-R2. 12987093S-A-R2 is replaced with this report.

Date of test: August 2 to September 24, 2019

Representative test engineer:
Makoto Hosaka
Engineer
Consumer Technology Division

Approved by:
Kazutaka Takeyama
Engineer
Consumer Technology Division

CERTIFICATE 1266.03

☐ 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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REVISION HISTORY

Original Test Report No.: 12987093S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12987093S-A	September 2, 2019	-	-
1	12987093S-A-R1	September 12, 2019	P6	Update in 3.2: **IC** => **ISED** Correction of Specification in 3.2: 20 dB Bandwidth: "**FCC:** Section15.247(a)(1)" to "**FCC:** Section15.247(a)(1)(i)" Number of Hopping Frequency and Dwell time: "**FCC:** Section15.247(a)(1)(iii), **IC:** RSS-247 5.1 (d)" to "**FCC:** Section15.247(a)(1)(i), **ISED:** RSS-247 5.1 (c)" Maximum Peak Output Power: "**FCC:** Section15.247(a)(b)(1), **IC:** RSS-247 5.4 (b)" to "**FCC:** Section15.247(a)(b)(2), **ISED:** RSS-247 5.4 (a)"
			P11	Addition 10 Hz to VBW. Update: IC => ISED
			P14	Correction of OBW value of SF8 "127.687" => "127.657" "127.432" => "127.687"
2	12987093S-A-R2	September 18, 2019	P1	Update of Date of test
			P6	Addition of Items: 6 dB Bandwidth and Power Density Addition of "The EUT was tested as the hybrid system equipment in accordance with KDB 558074 D01 15.247 Meas Guidance v05r02 Section 10."
			P10,P14	Addition of Items: 6 dB Bandwidth and Power Density
			P39-44	Addition of data: 6 dB Bandwidth and Power Density
3	12987093S-A-R3	September 24, 2019	P1	Update of Date of test
			P6	Correction of Specification in 3.2: Dwell time: "**FCC:** Section15.247(a)(1)(i)" to "**FCC:** Section15.247(f)" Power Density: "**FCC:** Section15.247(e)" to "**FCC:** Section15.247(f)"
			P4,P6,P9,P14	Deletion of Item: Number of Hopping Frequency
			(P21-22)	Deletion of data: Number of Hopping Frequency
			P24,P25,P40,P43	Update of data

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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
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
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

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SECTION 1: Customer information

Company Name	:	Yokogawa Electric Corporation
Address	:	2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750 Japan
Telephone Number	:	+81-422-52-5885
Facsimile Number	:	+81-422-52-2102
Contact Person	:	Yuuji Aono

The information provided from the customer is as follows;
- Applicant, Type of Equipment, Model No., 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 (E.U.T.)
- SECTION 4: Operation of E.U.T. 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 (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Wireless Vibration Sensor
Model No.	:	XS770A
Serial No.	:	Refer to SECTION 4.2
Rating	:	DC 3.6 V
Receipt Date of Sample (Information from test lab.)	:	August 2, 2019
Country of Mass-production	:	Japan
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab.

2.2 Product Description

Model: XS770A (referred to as the EUT in this report) is a Wireless Vibration Sensor.

General Specification

Clock frequencies in the system	:	32.768 kHz (RTC), 11 MHz (CPU), 32 MHz (Transceiver IC)

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	902.3 MHz – 914.9 MHz
Modulation	:	LoRa, CSS
Antenna type	:	Built-in omni-directinal antenna
Antenna gain	:	-1.5 dBi
Operating temperature range	:	-20 deg.C to +85 deg.C

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 47CFR 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 revision on July 19, 2019, does not affect the test specification applied to the EUT.

* 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 **ISED:** RSS-Gen 8.8	**FCC:** Section 15.207 **ISED:** RSS-Gen 8.8	-	N/A	*1)
Carrier Frequency Separation	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section15.247(a)(1) **ISED:** RSS-247 5.1 (b)	See data.	Complied a)	Conducted
20 dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section15.247(a)(1)(i) **ISED:** RSS-247 5.1 (a)		Complied a)	Conducted
Dwell time	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section15.247(f) **ISED:** RSS-247 5.1 (c)		Complied b)	Conducted
Maximum Peak Output Power	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** RSS-Gen 6.12	**FCC:** Section15.247(a)(b)(2) **ISED:** RSS-247 5.4 (a)		Complied c)	Conducted
Spurious Emission & Band Edge Compliance	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** RSS-Gen 6.13	**FCC:** Section15.247(d) **ISED:** RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	2.4 dB 1804.600 MHz, AV, Vertical Mode: Tx 125 kHz mode, SF10, 902.3 MHz	Complied# d) / e)	Conducted/ Radiated (above 30 MHz) *2)
6 dB Bandwidth	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section 15.247(a)(2) **ISED:** RSS-247 5.2(a)	See data.	N/A f)	Conducted
Power Density	**FCC:** KDB 558074 D01 15.247 Meas Guidance v05r02 **ISED:** -	**FCC:** Section 15.247(f) **ISED:** RSS-247 5.2(b)		Complied g)	Conducted

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 has no AC mains.
*2) Radiated test was selected over 30 MHz based on section 15.247(d).

a) Refer to APPENDIX 1 (data of 20 dB Bandwidth, 99 %Occupied Bandwidth and Carrier Frequency Separation)
b) Refer to APPENDIX 1 (data of Dwell time)
c) Refer to APPENDIX 1 (data of Maximum Peak Output Power)
d) Refer to APPENDIX 1 (data of Conducted Spurious Emission)
e) Refer to APPENDIX 1 (data of Radiated Spurious Emission)
f) Refer to APPENDIX 1 (data of 6 dB Bandwidth)
g) Refer to APPENDIX 1 (data of Power Density)

The EUT was tested as the hybrid system equipment in accordance with KDB 558074 D01 15.247 Meas Guidance v05r02 Section 10.

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

FCC Part 15.31 (e)
The EUT is a battery-operated device and test was performed with the full-charged battery. Therefore, this EUT complies with the requirement.

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

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % Occupied Bandwidth	RSS-Gen 6.7	**ISED:** -	N/A	- a)	Conducted
a) Refer to APPENDIX 1 (data of 20 dB Bandwidth, 99 %Occupied Bandwidth and Carrier Frequency Separation)					

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 or not laboratory uncertainty is applied.

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

Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.8 dB	2.9 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.0 dB	3.0 dB	3.1 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.7 dB	-
	200 MHz-1 GHz	6.0 dB	6.0 dB	6.1 dB	-
	1 GHz-6 GHz	4.8 dB	4.8 dB	4.8 dB	-
	6 GHz-18 GHz	5.4 dB	5.4 dB	5.4 dB	-
	18 GHz-40 GHz	5.6 dB	5.6 dB	5.6 dB	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.7 dB	5.7 dB	5.7 dB	-
	18 GHz-40 GHz	5.9 dB	5.9 dB	5.9 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	0.81 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	1.53 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.95 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	1.21 dB
Power Measurement above 1 GHz (Average Detector)_SPM-13	0.90 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-13	1.04 dB
Spurious emission (Conducted) below 1GHz	1.8 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.7 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.3 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.4 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	0.61 %
Duty cycle and Time Measurement	0.012 %

3.5 Test Location

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A2LA Certificate Number: 1266.03 (FCC Test Firm Registration Number: 626366, ISED Lab Company Number: 2973D)

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	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)

Details of Operating Mode(s)

Test Item	Mode	Tested frequency
Spurious Emission (Conducted/Radiated)	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF10 *1)	902.3 MHz 908.5 MHz 914.9 MHz
Carrier Frequency Separation	Tx (Transmitting) (Hopping On), 125 kHz mode, SF10	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping On), 125 kHz mode, SF9	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping On), 125 kHz mode, SF8	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping On), 125 kHz mode, SF7	902.3 MHz 908.5 MHz 914.9 MHz
20 dB Bandwidth	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF10	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF9	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF8	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF7	902.3 MHz 908.5 MHz 914.9 MHz
Dwell time	Tx (Transmitting) (Hopping On), 125 kHz mode, SF10	-
	Tx (Transmitting) (Hopping On), 125 kHz mode, SF9	-
	Tx (Transmitting) (Hopping On), 125 kHz mode, SF8	-
	Tx (Transmitting) (Hopping On), 125 kHz mode, SF7	-
Maximum Peak Output Power	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF10	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF9	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF8	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF7	902.3 MHz 908.5 MHz 914.9 MHz
Band Edge Compliance (Conducted)	Tx (Transmitting),125 kHz mode, SF10 -Hopping On -Hopping Off	902.3 MHz 914.9 MHz

99 % Occupied Bandwidth	Tx (Transmitting),125 kHz mode, SF10 -Hopping On -Hopping Off	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting),125 kHz mode, SF9 -Hopping On -Hopping Off	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting),125 kHz mode, SF8 -Hopping On -Hopping Off	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting),125 kHz mode, SF7 -Hopping On -Hopping Off	902.3 MHz 908.5 MHz 914.9 MHz
6 dB Bandwidth	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF10	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF9	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF8	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF7	902.3 MHz 908.5 MHz 914.9 MHz
Power Density	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF10	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF9	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF8	902.3 MHz 908.5 MHz 914.9 MHz
	Tx (Transmitting) (Hopping Off), 125 kHz mode, SF7	902.3 MHz 908.5 MHz 914.9 MHz
*1) As a result of preliminary test, the formal test was performed with the above modes, which had the maximum payload length (except Dwell time test) *EUT has the power settings by the software as follows; Power settings: fixed Software: ModbusAccessToolForEMCTest.exe Ver. 1.0.0.0 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.		

4.2 Configuration and peripherals

* Test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless Vibration Sensor	XS770A	TH002	Yokogawa Electric Corporation	EUT

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 1 GHz]
EUT was placed on a platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
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 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.

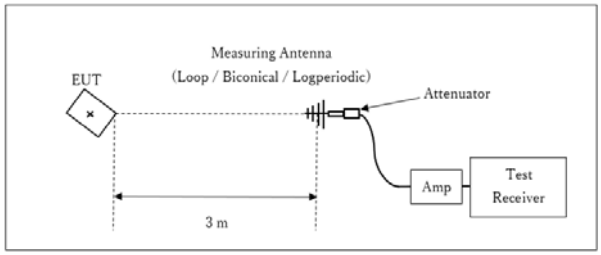
20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9 (ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz 1/T (T: burst length, refer to Burst rate confirmation sheet (duty 100 %)) Detector: Peak	RBW: 100 kHz VBW: 300 kHz

*1) Average Power Measurement was performed based on KDB 558074 D01 15.247 Meas Guidance v05r02.

Figure 1: Test Setup

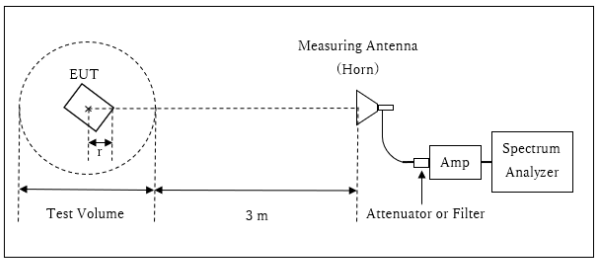
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



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

Distance Factor: 20 x log (3.976 m / 3.0 m) = 2.45 dB
* Test Distance: (3 + Test Volume /2) - r = 3.976 m

Test Volume : 2.0 m
(Test Volume has been calibrated based on CISPR 16-1-4.)
r = 0.024 m

The EUT was tested in the direction normally used.

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

Measurement range : 30 MHz - 10 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
20 dB Bandwidth	500 kHz	5.1 kHz	16 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 *1)	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Carrier Frequency Separation	600 kHz	30 kHz	91 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Dwell Time	Zero Span	100 kHz	300 kHz	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	5 MHz or 40 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
6 dB Bandwidth	3 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Peak Power Density	1.5 times the 6 dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *4)

*1) The measurement was performed with Max Hold. Peak hold was applied as Worst-case measurement.
*2) Reference data
*3) In the frequency range below 30 MHz, 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)
*4) Section 11.10.2 Method PKPSD (peak PSD) of "ANSI C63.10-2013"

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

20 dB Bandwidth, 99 %Occupied Bandwidth and Carrier Frequency Separation

Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 8, 2019
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping Off, Tx, Hopping On

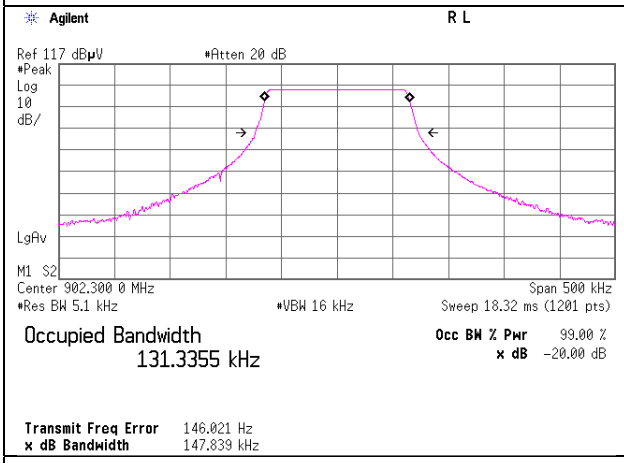
Mode	Freq. [MHz]	20 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]	Carrier Frequency Separation [kHz]	Limit for Carrier Frequency separation [MHz]
SF10	902.400	147.839	131.336	200.000	>= 147.839
SF10	908.500	147.714	131.164	200.000	>= 147.714
SF10	914.900	147.586	131.273	200.000	>= 147.586
SF10	Hopping On	-	12892.900	-	-
SF9	902.400	146.530	129.600	200.000	>= 146.530
SF9	908.500	146.626	129.605	200.000	>= 146.626
SF9	914.900	146.393	129.590	200.000	>= 146.393
SF9	Hopping On	-	12911.800	-	-
SF8	902.400	146.341	127.733	200.000	>= 146.341
SF8	908.500	146.270	127.657	200.000	>= 146.270
SF8	914.900	146.221	127.687	200.000	>= 146.221
SF8	Hopping On	-	12909.700	-	-
SF7	902.400	145.157	128.221	200.000	>= 145.157
SF7	908.500	144.961	128.121	200.000	>= 144.961
SF7	914.900	145.143	128.257	200.000	>= 145.143
SF7	Hopping On	-	12871.100	-	-

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

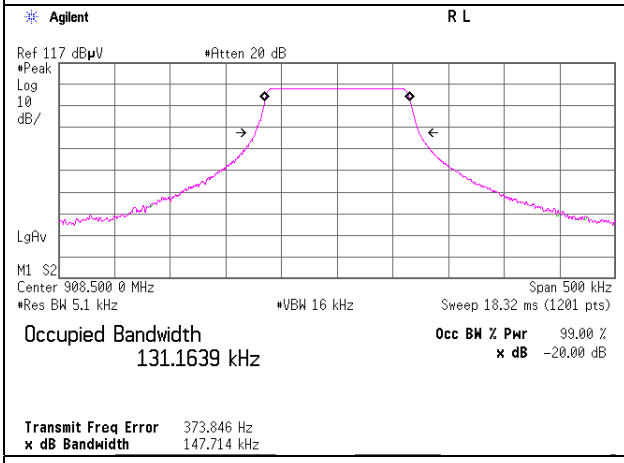
20 dB Bandwidth and 99 % Occupied Bandwidth

SF10

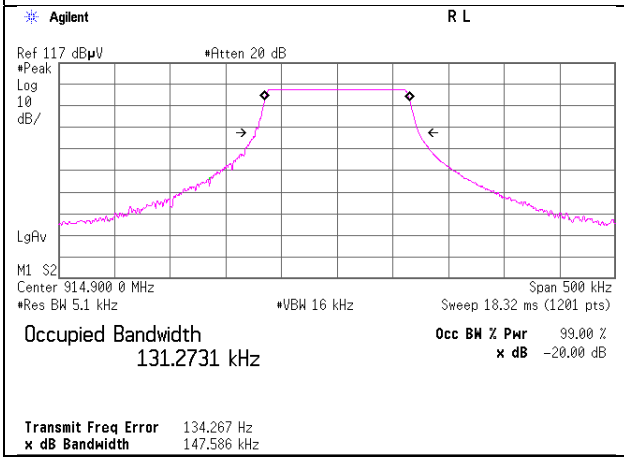
902.300 MHz



908.500 MHz

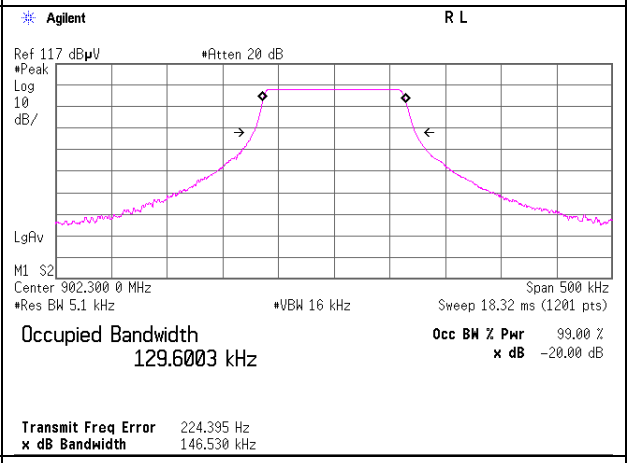


914.900 MHz

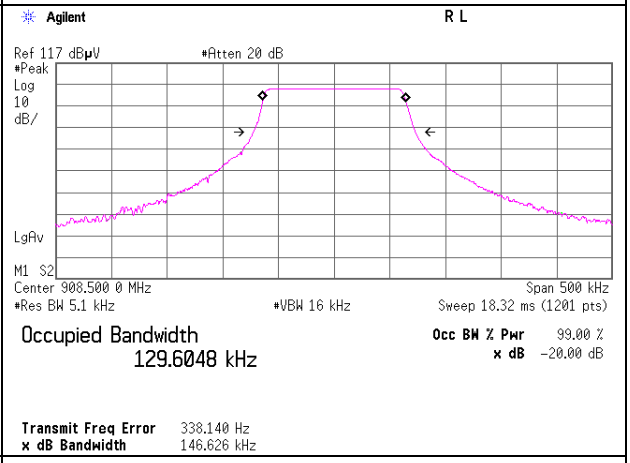


SF9

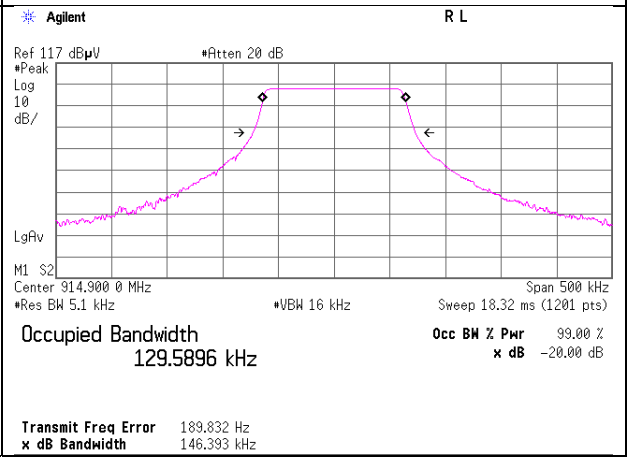
902.300 MHz



908.500 MHz



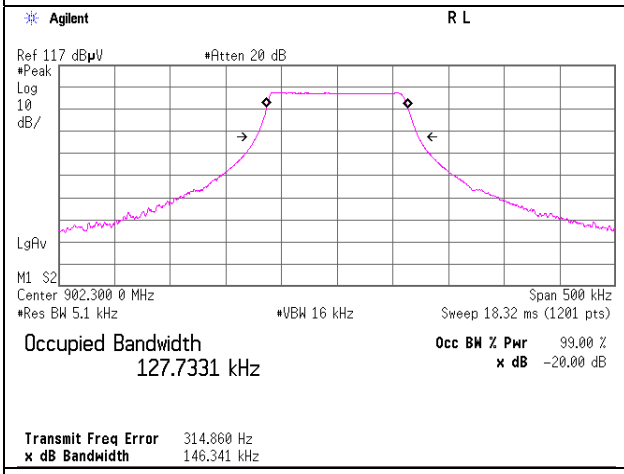
914.900 MHz



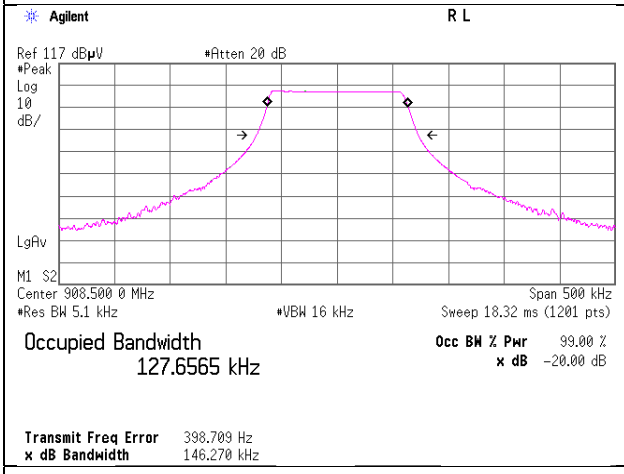
20 dB Bandwidth and 99 % Occupied Bandwidth

SF8

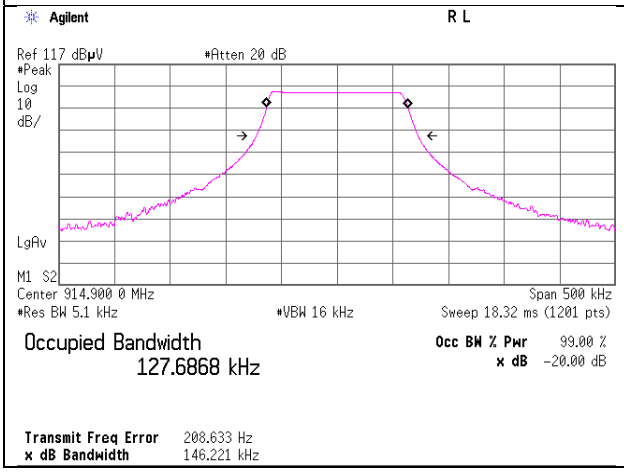
902.300 MHz



908.500 MHz

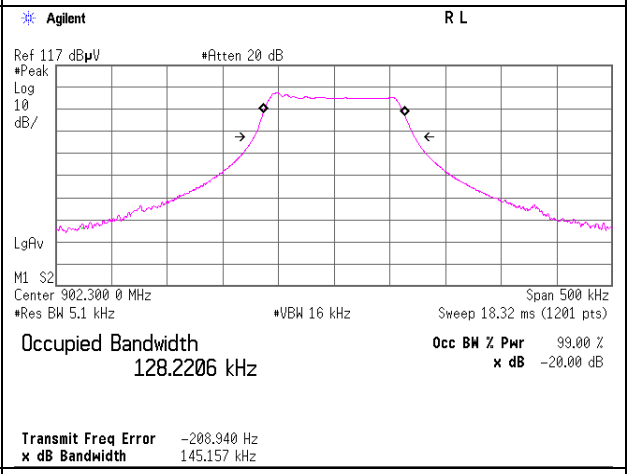


914.900 MHz

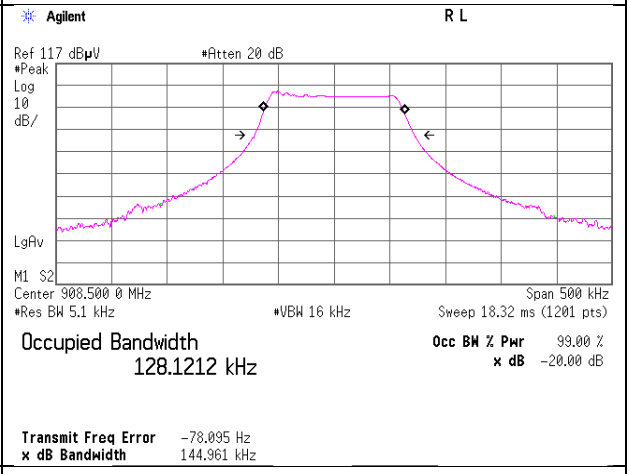


SF7

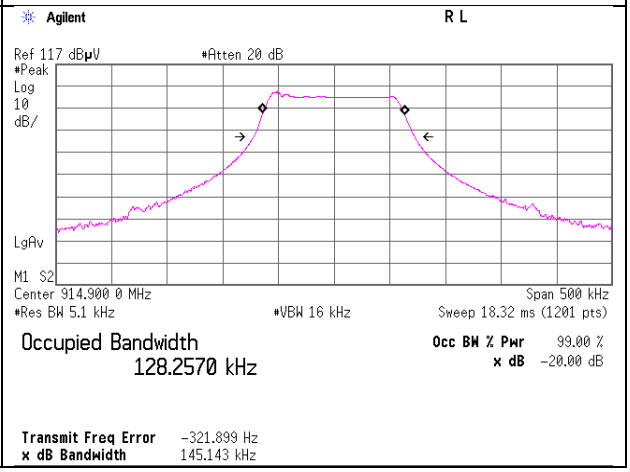
902.300 MHz



908.500 MHz

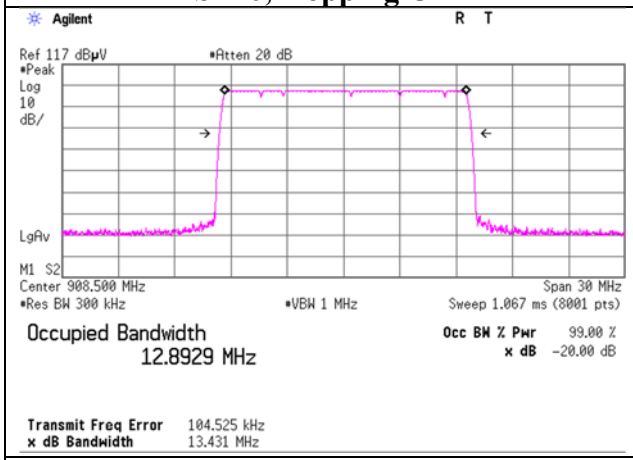


914.900 MHz

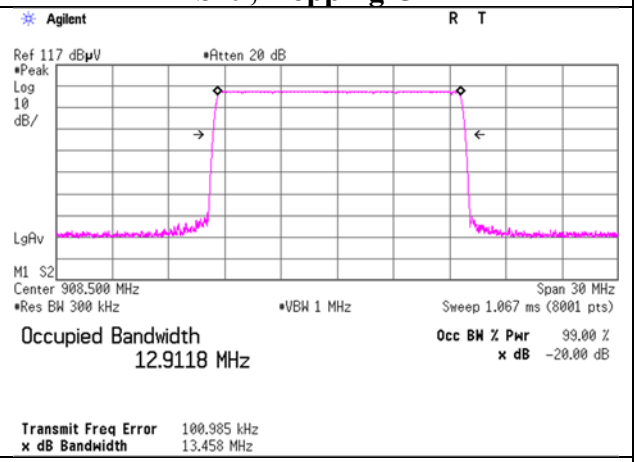


99 % Occupied Bandwidth

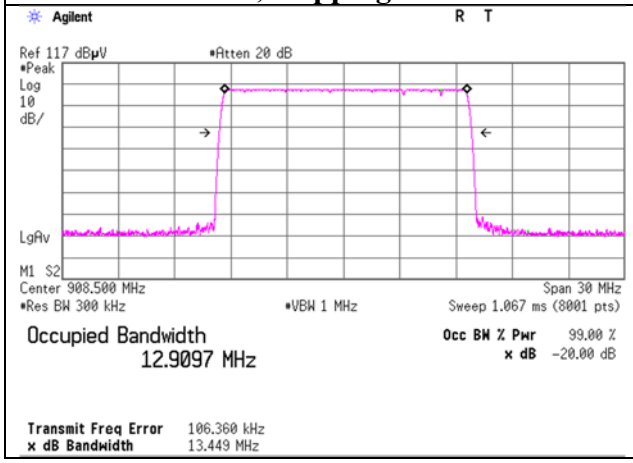
SF10, Hopping On



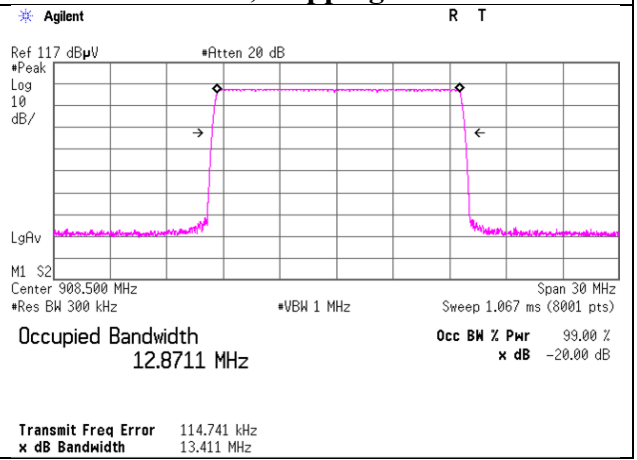
SF9, Hopping On



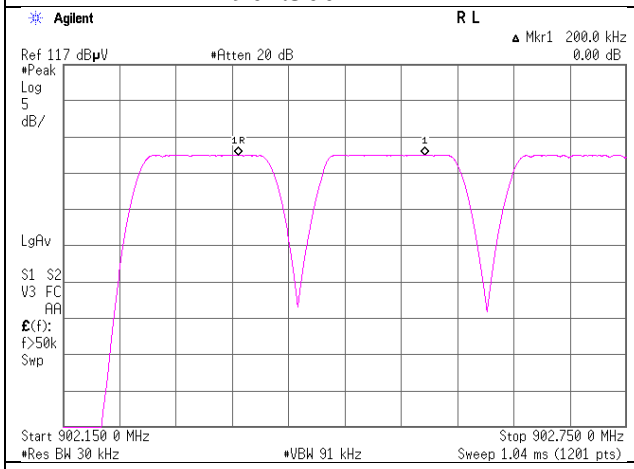
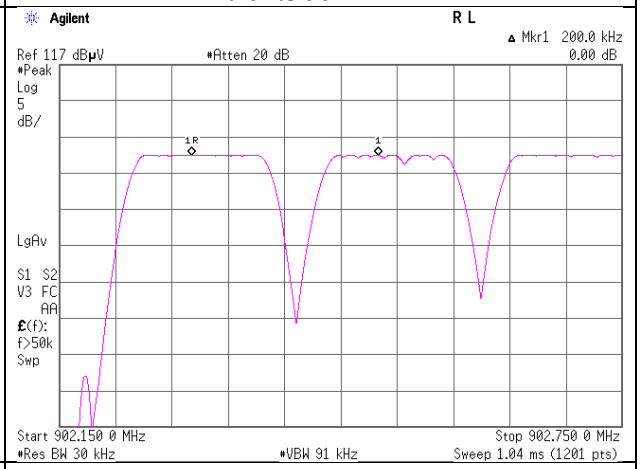
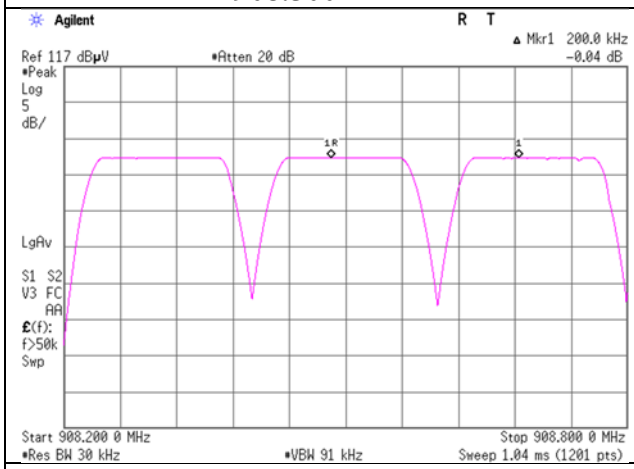
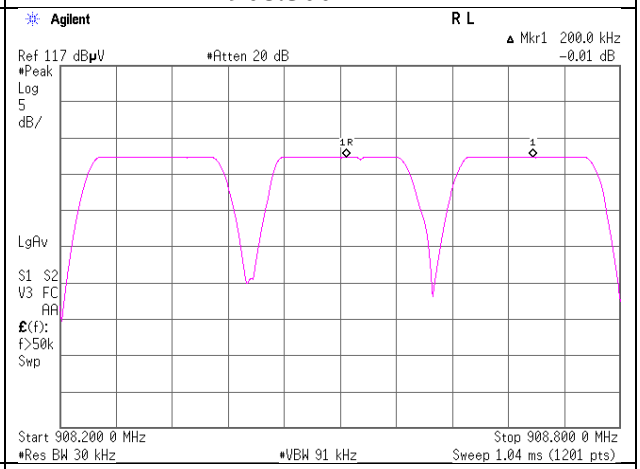
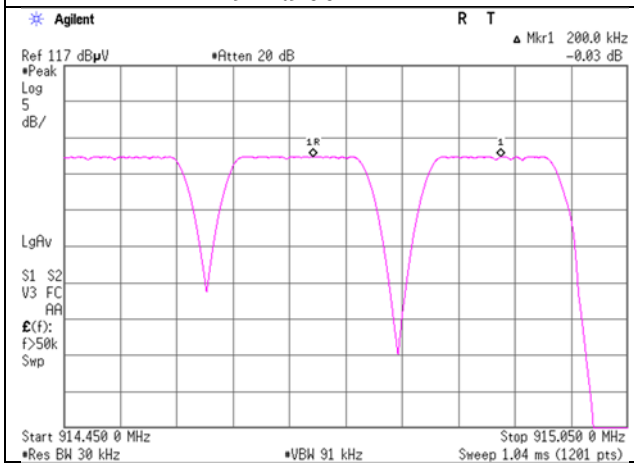
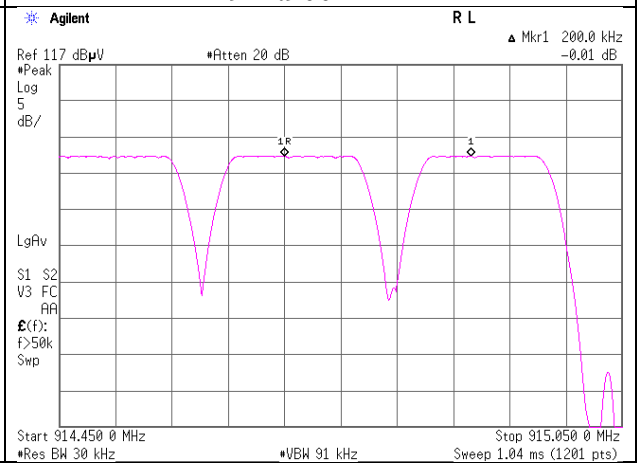
SF8, Hopping On



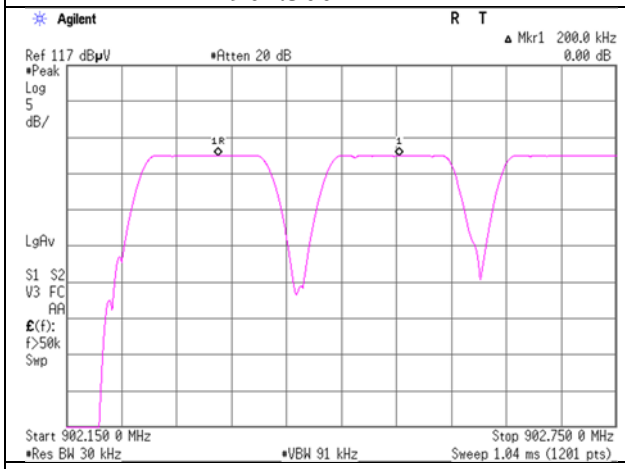
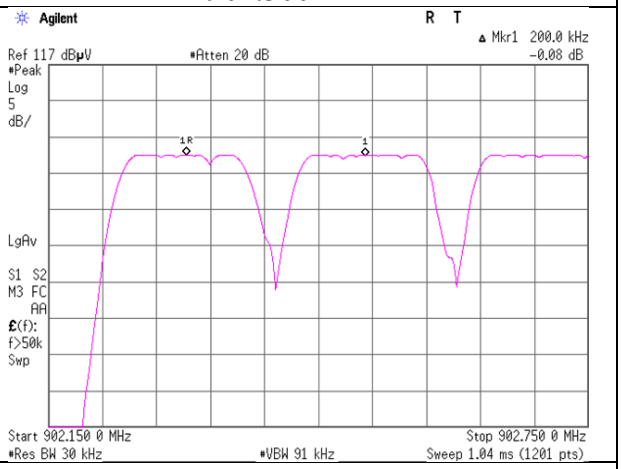
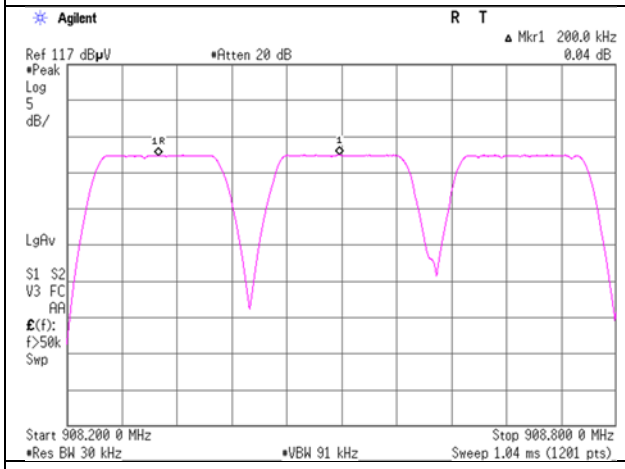
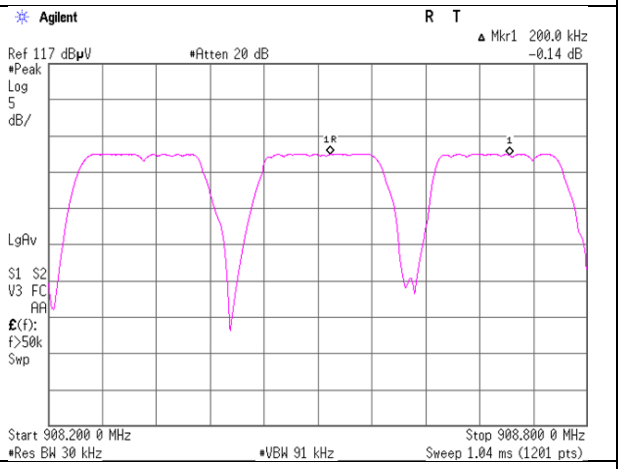
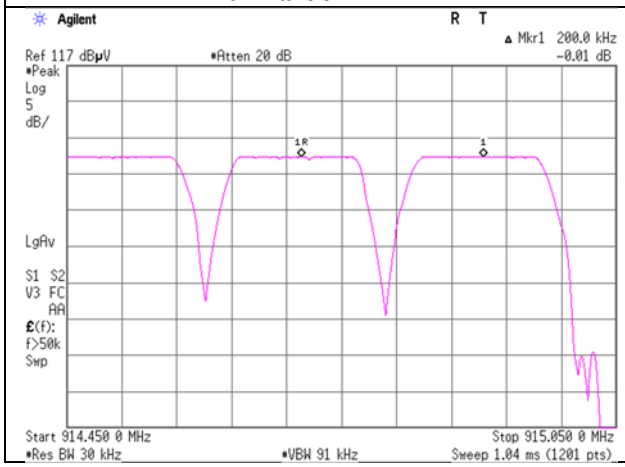
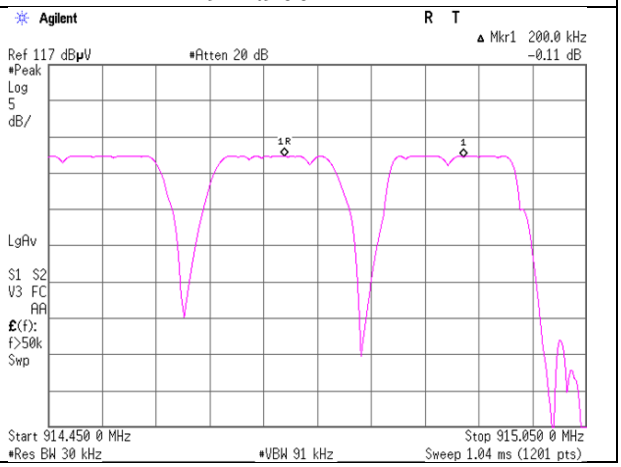
SF7, Hopping On



Carrier Frequency Separation

SF10	SF9
902.300 MHz	**902.300 MHz**
	
908.500 MHz	**908.500 MHz**
	
914.900 MHz	**914.900 MHz**
	

Carrier Frequency Separation

SF8	SF7
902.300 MHz	902.300 MHz
	
908.500 MHz	908.500 MHz
	
914.900 MHz	914.900 MHz
	

Dwell time

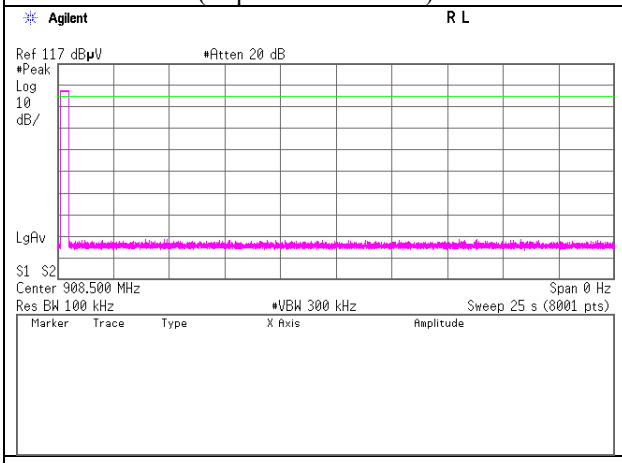
Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 8, 2019
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping On

Mode	Number of transmission in a 20 second period				Length of transmission [msec]	Result [msec]	Limit [msec]
SF10	1.0 times /	20 sec. x	20.0 sec. =	1 times	371.093	371	400
SF9	1.0 times /	20 sec. x	20.0 sec. =	1 times	206.198	206	400
SF8	1.0 times /	20 sec. x	20.0 sec. =	1 times	113.350	113	400
SF7	1.0 times /	20 sec. x	20.0 sec. =	1 times	61.839	62	400

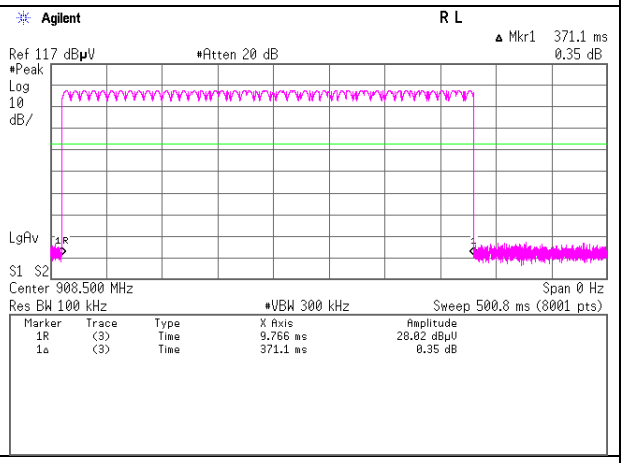
Sample Calculation
Result = Number of transmission x Length of transmission

Dwell time

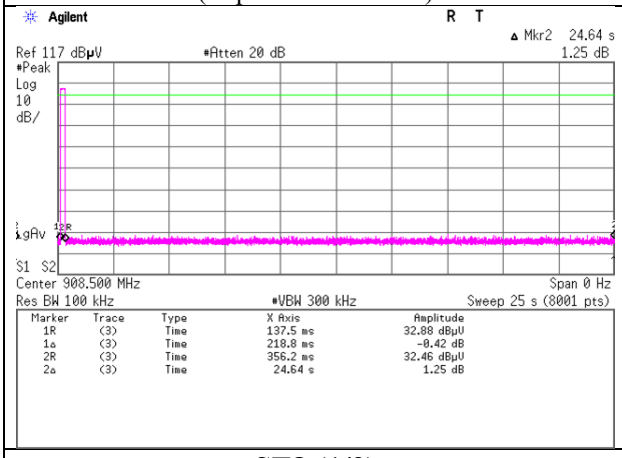
SF10 (1/2)
(Representative chart)



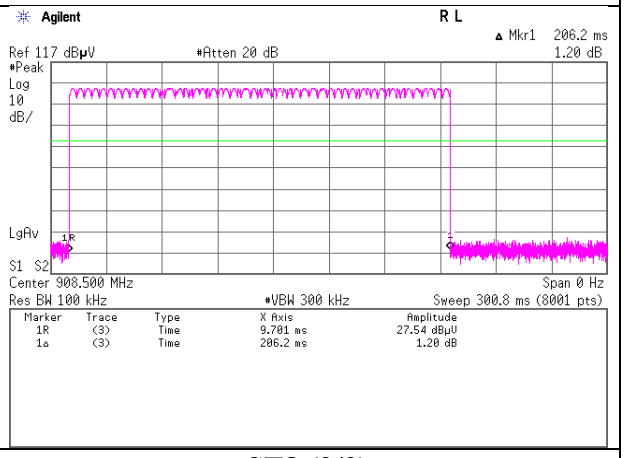
SF10 (2/2)



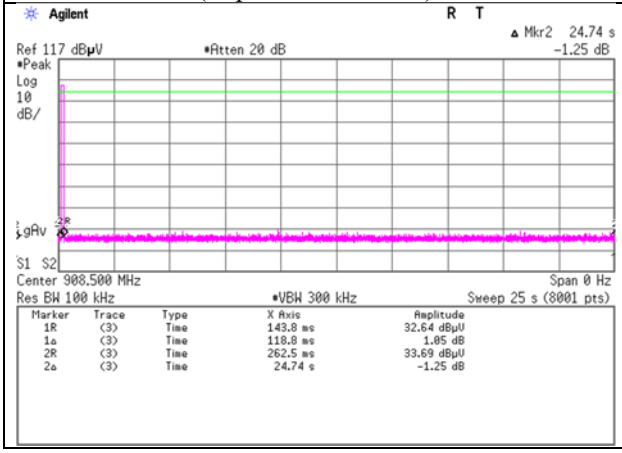
SF9 (1/2)
(Representative chart)



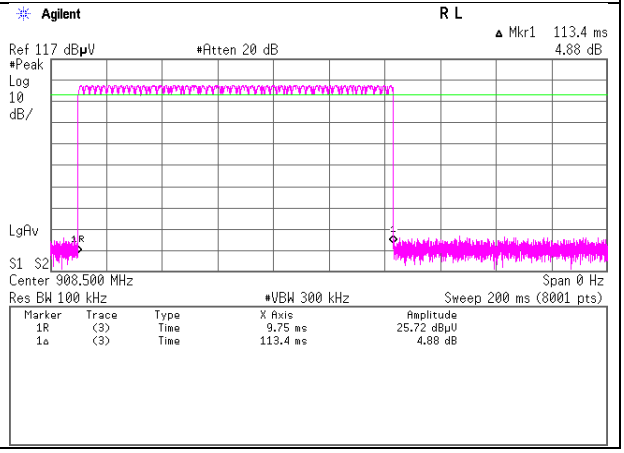
SF9 (2/2)



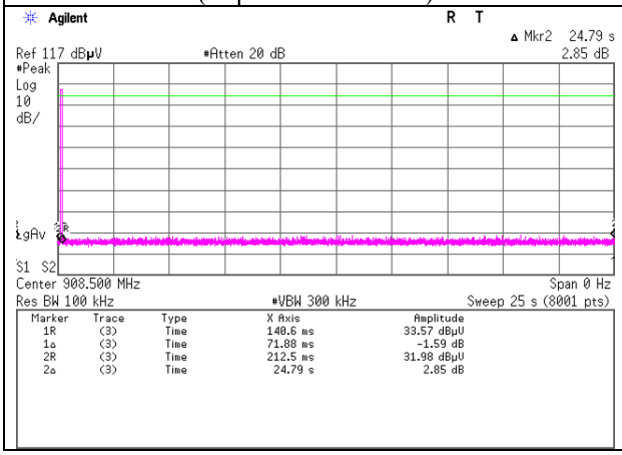
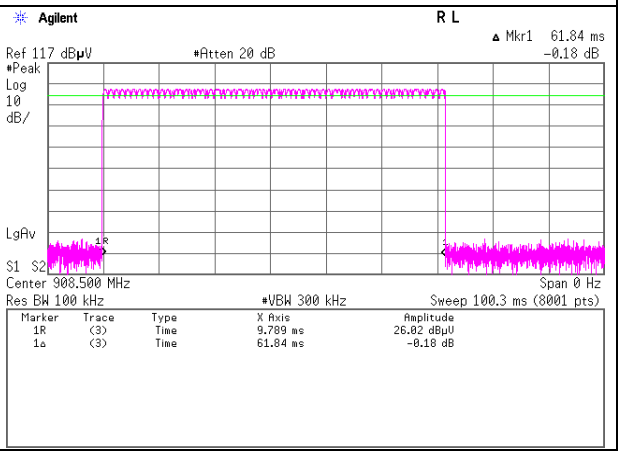
SF8 (1/2)
(Representative chart)



SF8 (2/2)



Dwell time

SF7 (1/2) (Representative chart)	SF7 (2/2)
	

Maximum Peak Output Power

Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 24, 2019
Temperature / Humidity	25 deg. C / 65 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping Off

					Conducted Power					e.i.r.p. for RSS-247					
Mode	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]
SF10	902.3	-2.33	0.90	9.58	8.15	6.53	30.00	1000	21.85	-1.50	6.65	4.62	36.02	4000	29.37
SF10	908.5	-2.40	0.90	9.58	8.08	6.43	30.00	1000	21.92	-1.50	6.58	4.55	36.02	4000	29.44
SF10	914.9	-2.47	0.91	9.58	8.02	6.34	30.00	1000	21.98	-1.50	6.52	4.49	36.02	4000	29.50
SF9	902.3	-2.36	0.90	9.58	8.12	6.49	30.00	1000	21.88	-1.50	6.62	4.59	36.02	4000	29.40
SF9	908.5	-2.40	0.90	9.58	8.08	6.43	30.00	1000	21.92	-1.50	6.58	4.55	36.02	4000	29.44
SF9	914.9	-2.48	0.91	9.58	8.01	6.32	30.00	1000	21.99	-1.50	6.51	4.48	36.02	4000	29.51
SF8	902.3	-2.41	0.90	9.58	8.07	6.41	30.00	1000	21.93	-1.50	6.57	4.54	36.02	4000	29.45
SF8	908.5	-2.43	0.90	9.58	8.05	6.38	30.00	1000	21.95	-1.50	6.55	4.52	36.02	4000	29.47
SF8	914.9	-2.48	0.91	9.58	8.01	6.32	30.00	1000	21.99	-1.50	6.51	4.48	36.02	4000	29.51
SF7	902.3	-2.41	0.90	9.58	8.07	6.41	30.00	1000	21.93	-1.50	6.57	4.54	36.02	4000	29.45
SF7	908.5	-2.43	0.90	9.58	8.05	6.38	30.00	1000	21.95	-1.50	6.55	4.52	36.02	4000	29.47
SF7	914.9	-2.48	0.91	9.58	8.01	6.32	30.00	1000	21.99	-1.50	6.51	4.48	36.02	4000	29.51

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)

Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.5 Shielded Room
Date	September 24, 2019
Temperature / Humidity	25 deg. C / 65 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping Off

Mode	Freq.	Reading	Cable Loss	Atten. Loss	Result (Time average)		Duty factor	Result (Burst power average)	
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dB]	[dBm]	[mW]
SF10	902.3	-2.50	0.90	9.58	7.98	6.28	0.00	7.98	6.28
SF10	908.5	-2.57	0.90	9.58	7.91	6.18	0.00	7.91	6.18
SF10	914.9	-2.61	0.91	9.58	7.88	6.14	0.00	7.88	6.14
SF9	902.3	-2.53	0.90	9.58	7.95	6.24	0.00	7.95	6.24
SF9	908.5	-2.57	0.90	9.58	7.91	6.18	0.00	7.91	6.18
SF9	914.9	-2.62	0.91	9.58	7.87	6.12	0.00	7.87	6.12
SF8	902.3	-2.53	0.90	9.58	7.95	6.24	0.00	7.95	6.24
SF8	908.5	-2.58	0.90	9.58	7.90	6.17	0.00	7.90	6.17
SF8	914.9	-2.62	0.91	9.58	7.87	6.12	0.00	7.87	6.12
SF7	902.3	-2.53	0.90	9.58	7.95	6.24	0.00	7.95	6.24
SF7	908.5	-2.58	0.90	9.58	7.90	6.17	0.00	7.90	6.17
SF7	914.9	-2.61	0.91	9.58	7.88	6.14	0.00	7.88	6.14

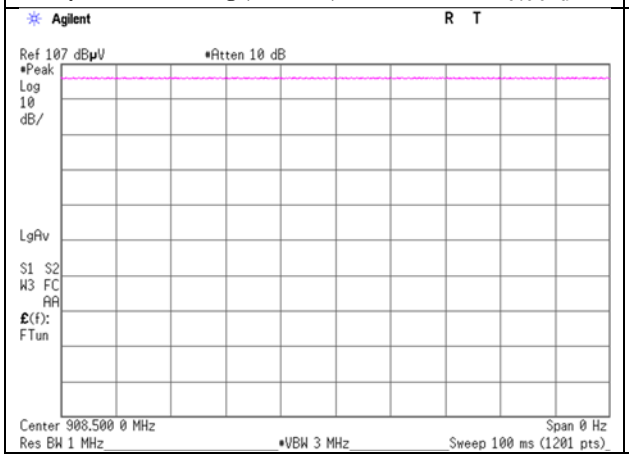
Sample Calculation:
Result (Time average) = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss
Result (Burst power average) = Time average + Duty factor

Burst Rate Confirmation

Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 8, 2019
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping Off

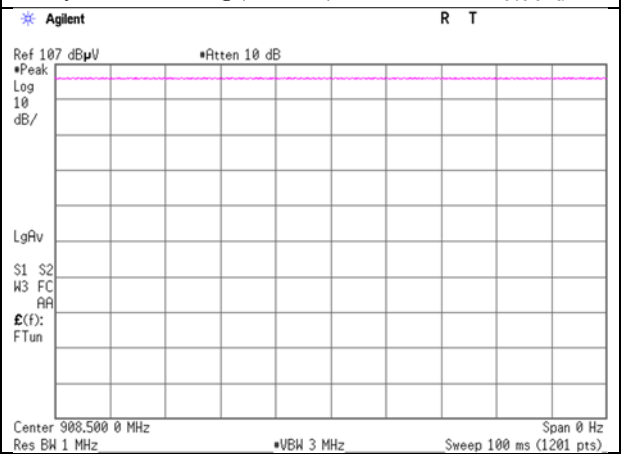
SF10

Tx on / (Tx on + Tx off) =	1.000
Tx on / (Tx on + Tx off) * 100 =	100.0 %
Duty factor = 10 * log (100 / 100) =	0.00 dB



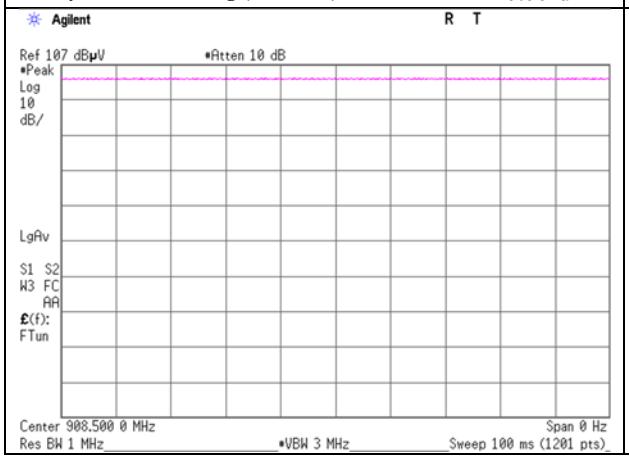
SF9

Tx on / (Tx on + Tx off) =	1.000
Tx on / (Tx on + Tx off) * 100 =	100.0 %
Duty factor = 10 * log (100 / 100) =	0.00 dB



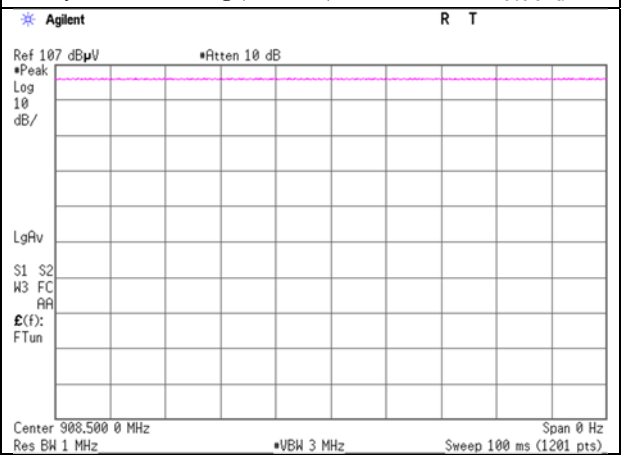
SF8

Tx on / (Tx on + Tx off) =	1.000
Tx on / (Tx on + Tx off) * 100 =	100.0 %
Duty factor = 10 * log (100 / 100) =	0.00 dB



SF7

Tx on / (Tx on + Tx off) =	1.000
Tx on / (Tx on + Tx off) * 100 =	100.0 %
Duty factor = 10 * log (100 / 100) =	0.00 dB



Radiated Spurious Emission

Report No.	12987093S-A-R3	
Test place (Semi-Anechoic Chamber)	No.1	No.3
Date	August 13, 2019	August 2, 2019
Temperature / Humidity	25 deg. C / 65 % RH	24 deg. C / 69 % RH
Engineer	Makoto Hosaka (30 MHz - 1 GHz)	Kenichi Adachi (1 GHz - 10 GHz)
Mode	Tx, Hopping Off, 125 kHz mode, SF10, 902.3 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.	855.122	QP	23.00	21.65	19.81	31.56	0.00	32.90	46.00	13.1	100	301	
Hori.	1804.600	PK	54.33	25.61	4.86	41.30	2.45	45.95	73.90	27.9	148	98	
Hori.	2706.900	PK	57.19	28.42	5.34	41.70	2.45	51.70	73.90	22.2	129	141	
Hori.	3609.200	PK	51.64	29.52	6.05	42.12	2.45	47.54	73.90	26.3	197	223	
Hori.	4511.500	PK	53.69	30.91	6.70	42.81	2.45	50.94	73.90	22.9	203	21	
Hori.	5413.800	PK	52.56	32.21	7.40	43.26	2.45	51.36	73.90	22.5	229	254	
Hori.	6316.100	PK	53.09	34.04	8.11	43.39	2.45	54.30	73.90	19.6	209	238	
Hori.	7218.400	PK	48.94	37.23	8.55	42.95	2.45	54.22	73.90	19.6	136	289	
Hori.	8120.700	PK	49.76	37.91	9.10	43.10	2.45	56.12	73.90	17.7	144	265	
Hori.	9023.000	PK	50.95	38.07	9.76	43.09	2.45	58.14	73.90	15.7	113	202	
Hori.	1804.600	AV	49.79	25.61	4.86	41.30	2.45	41.41	53.90	12.4	148	98	
Hori.	2706.900	AV	53.38	28.42	5.34	41.70	2.45	47.89	53.90	6.0	129	141	
Hori.	3609.200	AV	42.86	29.52	6.05	42.12	2.45	38.76	53.90	15.1	197	223	
Hori.	4511.500	AV	46.55	30.91	6.70	42.81	2.45	43.80	53.90	10.1	203	21	
Hori.	5413.800	AV	42.16	32.21	7.40	43.26	2.45	40.96	53.90	12.9	229	254	
Hori.	6316.100	AV	42.28	34.04	8.11	43.39	2.45	43.49	53.90	10.4	209	238	
Hori.	7218.400	AV	35.08	37.23	8.55	42.95	2.45	40.36	53.90	13.5	136	289	
Hori.	8120.700	AV	34.89	37.91	9.10	43.10	2.45	41.25	53.90	12.6	144	265	
Hori.	9023.000	AV	36.66	38.07	9.76	43.09	2.45	43.85	53.90	10.0	113	202	
Vert.	859.132	QP	23.00	21.76	19.82	31.54	0.00	33.04	46.00	12.9	100	358	
Vert.	1804.600	PK	61.91	25.61	4.86	41.30	2.45	53.53	73.90	20.3	154	174	
Vert.	2706.900	PK	56.75	28.42	5.34	41.70	2.45	51.26	73.90	22.6	156	42	
Vert.	3609.200	PK	52.59	29.52	6.05	42.12	2.45	48.49	73.90	25.4	254	314	
Vert.	4511.500	PK	52.86	30.91	6.70	42.81	2.45	50.11	73.90	23.7	188	279	
Vert.	5413.800	PK	52.76	32.21	7.40	43.26	2.45	51.56	73.90	22.3	177	340	
Vert.	6316.100	PK	50.66	34.04	8.11	43.39	2.45	51.87	73.90	22.0	110	249	
Vert.	7218.400	PK	48.53	37.23	8.55	42.95	2.45	53.81	73.90	20.0	226	177	
Vert.	8120.700	PK	49.55	37.91	9.10	43.10	2.45	55.91	73.90	17.9	124	108	
Vert.	9023.000	PK	49.92	38.07	9.76	43.09	2.45	57.11	73.90	16.7	184	268	
Vert.	1804.600	AV	59.82	25.61	4.86	41.30	2.45	51.44	53.90	**2.4**	154	174	
Vert.	2706.900	AV	53.43	28.42	5.34	41.70	2.45	47.94	53.90	5.9	156	42	
Vert.	3609.200	AV	45.60	29.52	6.05	42.12	2.45	41.50	53.90	12.4	254	314	
Vert.	4511.500	AV	45.85	30.91	6.70	42.81	2.45	43.10	53.90	10.8	188	279	
Vert.	5413.800	AV	44.22	32.21	7.40	43.26	2.45	43.02	53.90	10.8	177	340	
Vert.	6316.100	AV	37.86	34.04	8.11	43.39	2.45	39.07	53.90	14.8	110	249	
Vert.	7218.400	AV	34.98	37.23	8.55	42.95	2.45	40.26	53.90	13.6	226	177	
Vert.	8120.700	AV	35.29	37.91	9.10	43.10	2.45	41.65	53.90	12.2	124	108	
Vert.	9023.000	AV	36.23	38.07	9.76	43.09	2.45	43.42	53.90	10.4	184	268	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.976 m / 3.0 m) = 2.45 dB

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

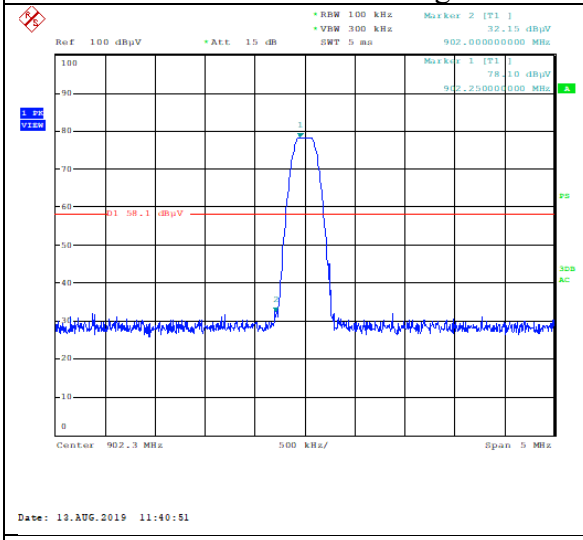
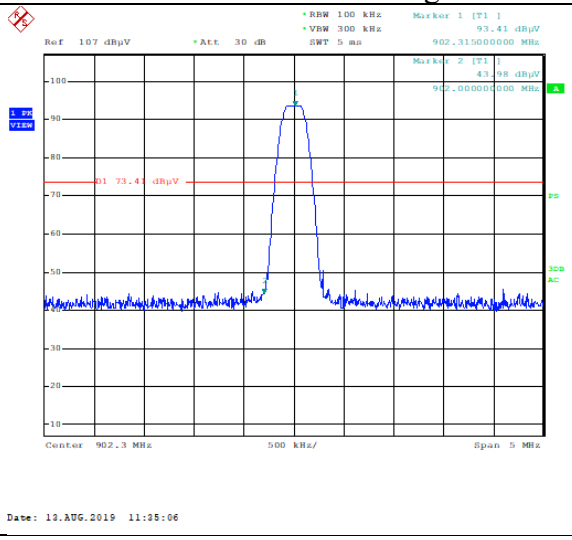
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	902.300	QP	78.12	22.10	19.99	31.33	0.00	88.88	-	-	Carrier
Hori.	902.000	QP	37.07	22.10	19.99	31.33	0.00	47.83	68.88	21.0	
Vert.	902.300	QP	93.42	22.10	19.99	31.33	0.00	104.18	-	-	Carrier
Vert.	902.000	QP	49.78	22.10	19.99	31.33	0.00	60.54	84.18	23.6	

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

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for band-edge)

Report No.	12987093S-A-R3
Test place (Semi-Anechoic Chamber)	No.1
Date	August 13, 2019
Temperature / Humidity	25 deg. C / 65 % RH
Engineer	Makoto Hosaka (30 MHz - 1 GHz)
Mode	Tx, Hopping Off, 125 kHz mode, SF10, 902.3 MHz

Horizontal	Vertical
Authorized-band band-edge Plot	Authorized-band band-edge Plot
	
20 dBc Plot	20 dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Report No.	12987093S-A-R3	
Test place (Semi-Anechoic Chamber)	No.1	No.3
Date	August 13, 2019	August 2, 2019
Temperature / Humidity	25 deg. C / 65 % RH	24 deg. C / 69 % RH
Engineer	Makoto Hosaka	Kenichi Adachi
	(30 MHz - 1 GHz)	(1 GHz - 10 GHz)
Mode	Tx, Hopping Off, 125 kHz mode, SF10, 908.5 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.	180.774	QP	22.90	16.20	19.21	31.79	0.00	26.52	43.50	16.9	150	293	
Hori.	902.000	QP	22.90	22.10	19.99	31.33	0.00	33.66	46.00	12.3	105	243	
Hori.	928.000	QP	22.80	22.00	20.09	31.11	0.00	33.78	46.00	12.2	105	243	
Hori.	1817.000	PK	53.76	25.68	4.86	41.31	2.45	45.44	73.90	28.4	193	127	
Hori.	2725.500	PK	54.09	28.47	5.34	41.71	2.45	48.64	73.90	25.2	100	147	
Hori.	3634.000	PK	53.85	29.58	6.06	42.12	2.45	49.82	73.90	24.0	198	223	
Hori.	4542.500	PK	53.66	30.96	6.74	42.82	2.45	50.99	73.90	22.9	206	23	
Hori.	5451.000	PK	50.66	32.30	7.42	43.29	2.45	49.54	73.90	24.3	221	251	
Hori.	6359.500	PK	53.39	34.22	8.14	43.40	2.45	54.80	73.90	19.1	208	246	
Hori.	7268.000	PK	49.84	37.30	8.58	43.05	2.45	55.12	73.90	18.7	136	288	
Hori.	8176.500	PK	49.74	37.61	9.16	43.15	2.45	55.81	73.90	18.0	141	263	
Hori.	9085.000	PK	50.25	38.34	9.83	43.11	2.45	57.76	73.90	16.1	114	204	
Hori.	1817.000	AV	48.96	25.68	4.86	41.31	2.45	40.64	53.90	13.2	193	127	
Hori.	2725.500	AV	49.75	28.47	5.34	41.71	2.45	44.30	53.90	9.6	100	147	
Hori.	3634.000	AV	48.45	29.58	6.06	42.12	2.45	44.42	53.90	9.4	198	223	
Hori.	4542.500	AV	47.68	30.96	6.74	42.82	2.45	45.01	53.90	8.8	206	23	
Hori.	5451.000	AV	39.24	32.30	7.42	43.29	2.45	38.12	53.90	15.7	221	251	
Hori.	6359.500	AV	45.59	34.22	8.14	43.40	2.45	47.00	53.90	6.9	208	246	
Hori.	7268.000	AV	35.74	37.30	8.58	43.05	2.45	41.02	53.90	12.8	136	288	
Hori.	8176.500	AV	35.34	37.61	9.16	43.15	2.45	41.41	53.90	12.4	141	263	
Hori.	9085.000	AV	37.34	38.34	9.83	43.11	2.45	44.85	53.90	9.0	114	204	
Vert.	180.774	QP	22.90	16.20	19.21	31.79	0.00	26.52	43.50	16.9	100	110	
Vert.	902.000	QP	23.30	22.10	19.99	31.33	0.00	34.06	46.00	11.9	120	132	
Vert.	928.000	QP	23.00	22.00	20.09	31.11	0.00	33.98	46.00	12.0	120	132	
Vert.	1817.000	PK	58.82	25.68	4.86	41.31	2.45	50.50	73.90	23.4	156	178	
Vert.	2725.500	PK	53.75	28.47	5.34	41.71	2.45	48.30	73.90	25.6	182	91	
Vert.	3634.000	PK	53.89	29.58	6.06	42.12	2.45	49.86	73.90	24.0	203	312	
Vert.	4542.500	PK	54.48	30.96	6.74	42.82	2.45	51.81	73.90	22.0	201	286	
Vert.	5451.000	PK	52.26	32.30	7.42	43.29	2.45	51.14	73.90	22.7	172	345	
Vert.	6359.500	PK	51.28	34.22	8.14	43.40	2.45	52.69	73.90	21.2	117	253	
Vert.	7268.000	PK	49.37	37.30	8.58	43.05	2.45	54.65	73.90	19.2	224	175	
Vert.	8176.500	PK	50.48	37.61	9.16	43.15	2.45	56.55	73.90	17.3	124	112	
Vert.	9085.000	PK	50.16	38.34	9.83	43.11	2.45	57.67	73.90	16.2	184	273	
Vert.	1817.000	AV	55.79	25.68	4.86	41.31	2.45	47.47	53.90	**6.4**	156	178	
Vert.	2725.500	AV	48.34	28.47	5.34	41.71	2.45	42.89	53.90	11.0	182	91	
Vert.	3634.000	AV	48.06	29.58	6.06	42.12	2.45	44.03	53.90	9.8	203	312	
Vert.	4542.500	AV	48.94	30.96	6.74	42.82	2.45	46.27	53.90	7.6	201	286	
Vert.	5451.000	AV	41.59	32.30	7.42	43.29	2.45	40.47	53.90	13.4	172	345	
Vert.	6359.500	AV	39.59	34.22	8.14	43.40	2.45	41.00	53.90	12.9	117	253	
Vert.	7268.000	AV	35.68	37.30	8.58	43.05	2.45	40.96	53.90	12.9	224	175	
Vert.	8176.500	AV	35.28	37.61	9.16	43.15	2.45	41.35	53.90	12.5	124	112	
Vert.	9085.000	AV	36.55	38.34	9.83	43.11	2.45	44.06	53.90	9.8	184	273	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.976 m / 3.0 m) = 2.45 dB

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission

Report No.	12987093S-A-R3	
Test place (Semi-Anechoic Chamber)	No.1	No.3
Date	August 13, 2019	August 2, 2019
Temperature / Humidity	25 deg. C / 65 % RH	24 deg. C / 69 % RH
Engineer	Makoto Hosaka (30 MHz - 1 GHz)	Kenichi Adachi (1 GHz - 10 GHz)
Mode	Tx, Hopping Off, 125 kHz mode, SF10, 914.9 MHz	

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

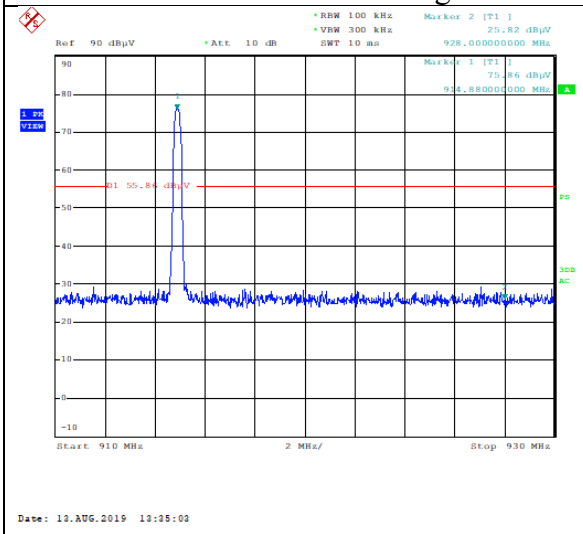
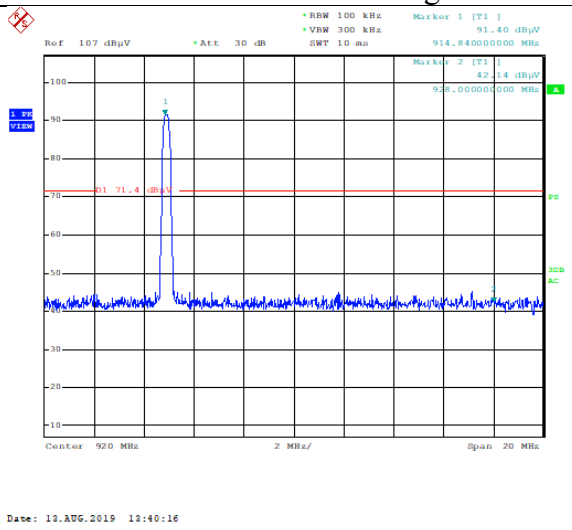
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	768.077	QP	23.30	20.38	19.41	31.88	0.00	31.21	46.00	14.7	100	58	
Hori.	928.000	QP	22.80	22.00	20.09	31.11	0.00	33.78	46.00	12.2	160	66	
Hori.	1829.800	PK	54.97	25.75	4.85	41.32	2.45	46.70	73.90	27.2	143	110	
Hori.	2744.700	PK	52.84	28.53	5.35	41.72	2.45	47.45	73.90	26.4	130	97	
Hori.	3659.600	PK	55.49	29.64	6.07	42.12	2.45	51.53	73.90	22.3	196	224	
Hori.	4574.500	PK	56.19	31.02	6.75	42.83	2.45	53.58	73.90	20.3	205	26	
Hori.	5489.400	PK	53.19	32.36	7.46	43.32	2.45	52.14	73.90	21.7	222	249	
Hori.	6404.300	PK	55.58	34.38	8.17	43.40	2.45	57.18	73.90	16.7	210	242	
Hori.	7319.200	PK	51.82	37.38	8.60	43.15	2.45	57.10	73.90	16.8	138	292	
Hori.	8234.100	PK	49.03	37.36	9.23	43.21	2.45	54.86	73.90	19.0	143	265	
Hori.	9149.000	PK	50.55	38.66	9.91	43.14	2.45	58.43	73.90	15.4	116	201	
Hori.	1829.800	AV	50.34	25.75	4.85	41.32	2.45	42.07	53.90	11.8	143	110	
Hori.	2744.700	AV	46.60	28.53	5.35	41.72	2.45	41.21	53.90	12.6	130	97	
Hori.	3659.600	AV	50.18	29.64	6.07	42.12	2.45	46.22	53.90	7.6	196	224	
Hori.	4574.500	AV	51.29	31.02	6.75	42.83	2.45	48.68	53.90	5.2	205	26	
Hori.	5489.400	AV	43.92	32.36	7.46	43.32	2.45	42.87	53.90	11.0	222	249	
Hori.	6404.300	AV	48.16	34.38	8.17	43.40	2.45	49.76	53.90	**4.1**	210	242	
Hori.	7319.200	AV	37.39	37.38	8.60	43.15	2.45	42.67	53.90	11.2	138	292	
Hori.	8234.100	AV	35.79	37.36	9.23	43.21	2.45	41.62	53.90	12.2	143	265	
Hori.	9149.000	AV	37.58	38.66	9.91	43.14	2.45	45.46	53.90	8.4	116	201	
Vert.	676.797	QP	23.20	19.58	19.04	31.99	0.00	29.83	46.00	16.1	100	0	
Vert.	928.000	QP	23.00	22.00	20.09	31.11	0.00	33.98	46.00	12.0	119	136	
Vert.	1829.800	PK	58.09	25.75	4.85	41.32	2.45	49.82	73.90	24.0	157	179	
Vert.	2744.700	PK	53.21	28.53	5.35	41.72	2.45	47.82	73.90	26.0	185	92	
Vert.	3659.600	PK	57.08	29.64	6.07	42.12	2.45	53.12	73.90	20.7	269	326	
Vert.	4574.500	PK	55.73	31.02	6.75	42.83	2.45	53.12	73.90	20.7	202	283	
Vert.	5489.400	PK	54.21	32.36	7.46	43.32	2.45	53.16	73.90	20.7	174	348	
Vert.	6404.300	PK	52.26	34.38	8.17	43.40	2.45	53.86	73.90	20.0	115	253	
Vert.	7319.200	PK	49.82	37.38	8.60	43.15	2.45	55.10	73.90	18.8	227	178	
Vert.	8234.100	PK	50.02	37.36	9.23	43.21	2.45	55.85	73.90	18.0	126	109	
Vert.	9149.000	PK	50.86	38.66	9.91	43.14	2.45	58.74	73.90	15.1	187	272	
Vert.	1829.800	AV	55.49	25.75	4.85	41.32	2.45	47.22	53.90	6.6	157	179	
Vert.	2744.700	AV	47.62	28.53	5.35	41.72	2.45	42.23	53.90	11.6	185	92	
Vert.	3659.600	AV	52.82	29.64	6.07	42.12	2.45	48.86	53.90	5.0	269	326	
Vert.	4574.500	AV	50.20	31.02	6.75	42.83	2.45	47.59	53.90	6.3	202	283	
Vert.	5489.400	AV	46.50	32.36	7.46	43.32	2.45	45.45	53.90	8.4	174	348	
Vert.	6404.300	AV	41.85	34.38	8.17	43.40	2.45	43.45	53.90	10.4	115	253	
Vert.	7319.200	AV	37.39	37.38	8.60	43.15	2.45	42.67	53.90	11.2	227	178	
Vert.	8234.100	AV	35.58	37.36	9.23	43.21	2.45	41.41	53.90	12.4	126	109	
Vert.	9149.000	AV	36.65	38.66	9.91	43.14	2.45	44.53	53.90	9.3	187	272	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)) - Gain(Amprifier) + Distance factor
Distance factor : 1 GHz - 10 GHz : 20log (3.976 m / 3.0 m) = 2.45 dB

*These results have sufficient margin without taking account Duty cycle correction factor.

Radiated Spurious Emission
(Reference Plot for band-edge)

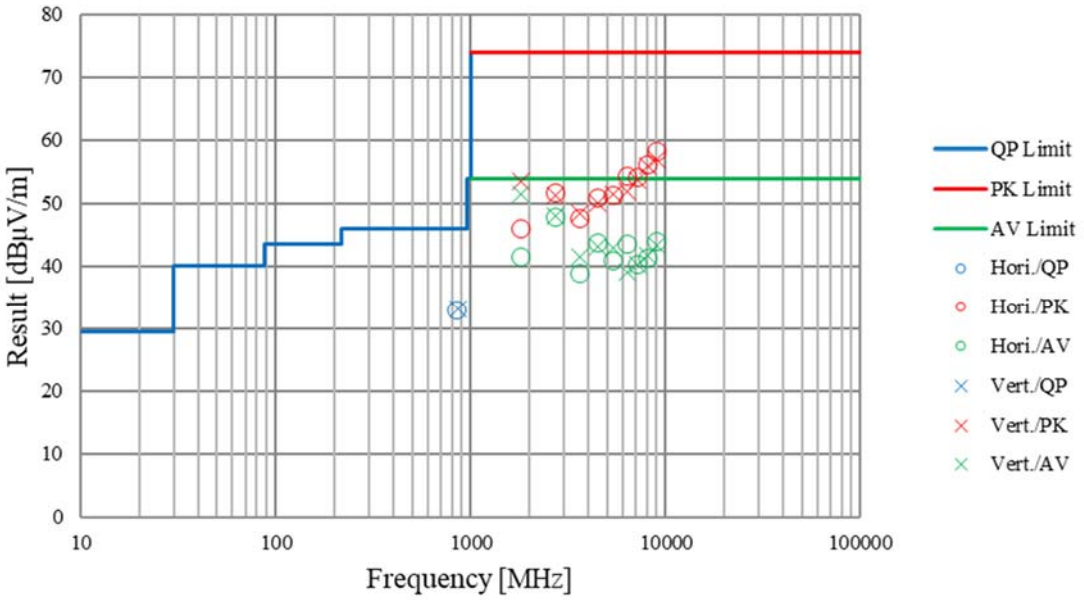
Report No.	12987093S-A-R3
Test place (Semi-Anechoic Chamber)	No.1
Date	August 13, 2019
Temperature / Humidity	25 deg. C / 65 % RH
Engineer	Makoto Hosaka (30 MHz - 1 GHz)
Mode	Tx, Hopping Off, 125 kHz mode, SF10, 914.9 MHz

Horizontal	Vertical
Authorized-band band-edge Plot	Authorized-band band-edge Plot
	
20 dBc Plot	20 dBc Plot

* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.
Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case)

Report No.	12987093S-A-R3	
Test place (Semi-Anechoic Chamber)	No.1	No.3
Date	August 13, 2019	August 2, 2019
Temperature / Humidity	25 deg. C / 65 % RH	24 deg. C / 69 % RH
Engineer	Makoto Hosaka (30 MHz - 1 GHz)	Kenichi Adachi (1 GHz - 10 GHz)
Mode	Tx, Hopping Off, 125 kHz mode, SF10, 902.3 MHz	



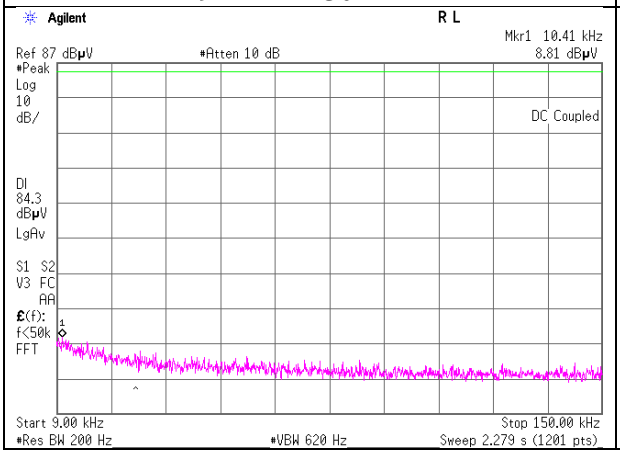
*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

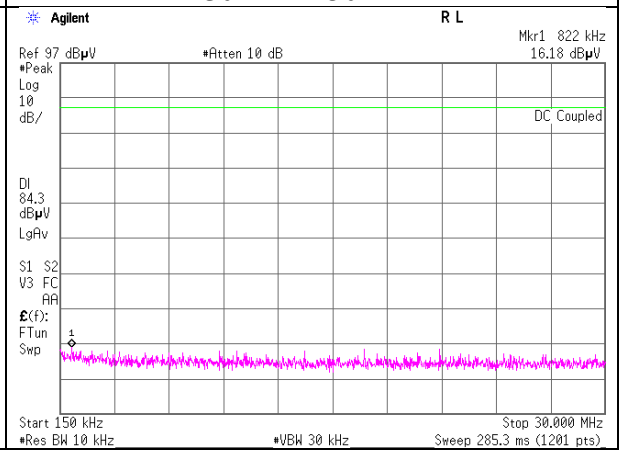
Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 8, 2019
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping Off, 125 kHz mode, SF10

902.400 MHz

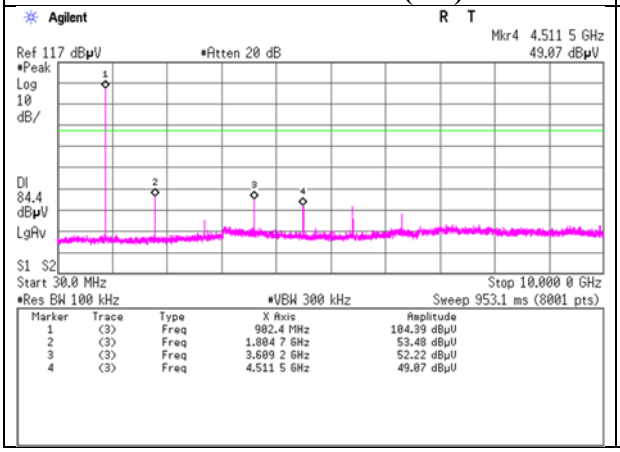
9 kHz - 150 kHz



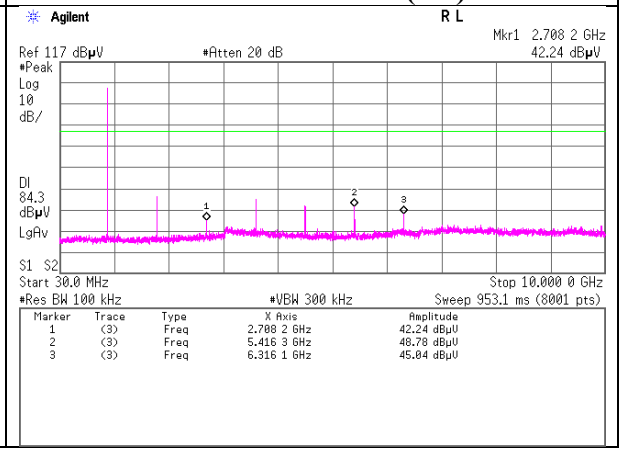
150 kHz - 30 MHz



30 MHz - 10 GHz (1/2)



30 MHz - 10 GHz (2/2)

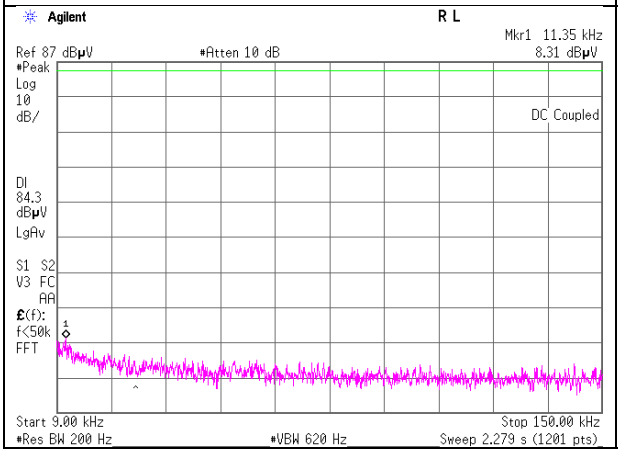


Conducted Spurious Emission

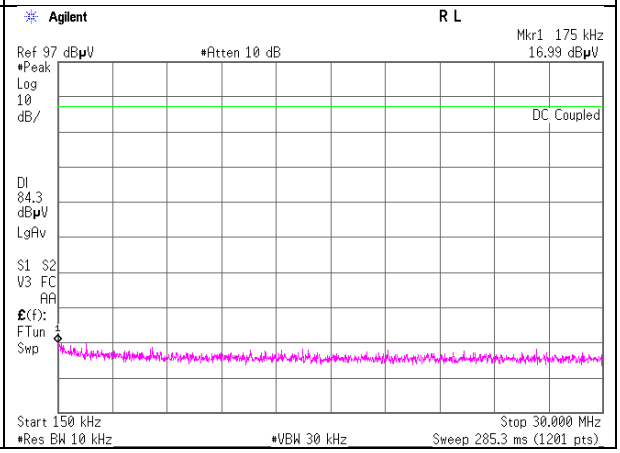
Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 8, 2019
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping Off, 125 kHz mode, SF10

908.500 MHz

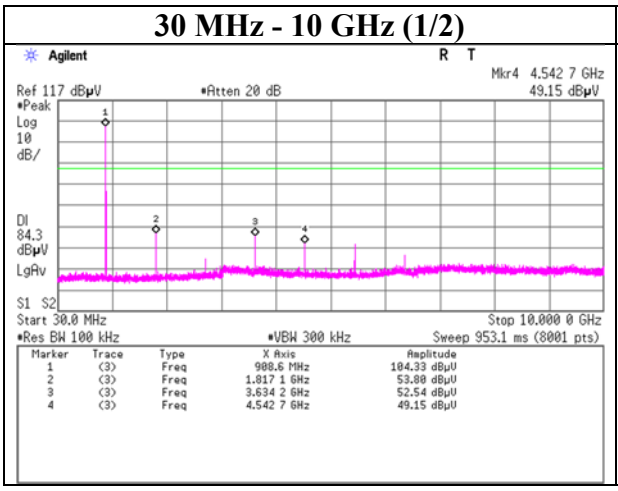
9 kHz - 150 kHz



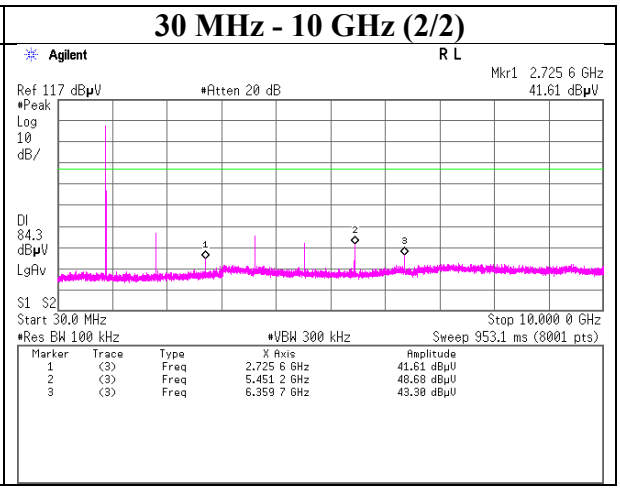
150 kHz - 30 MHz



30 MHz - 10 GHz (1/2)



30 MHz - 10 GHz (2/2)

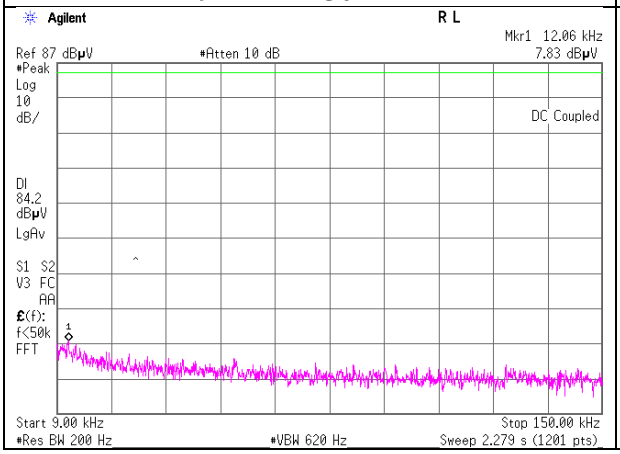


Conducted Spurious Emission

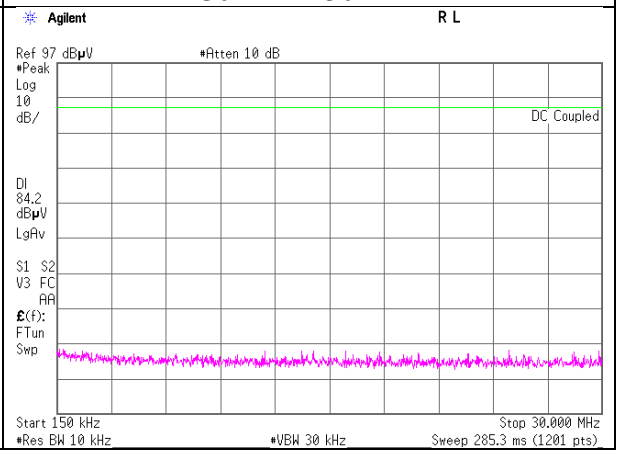
Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 8, 2019
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping Off, 125 kHz mode, SF10

914.900 MHz

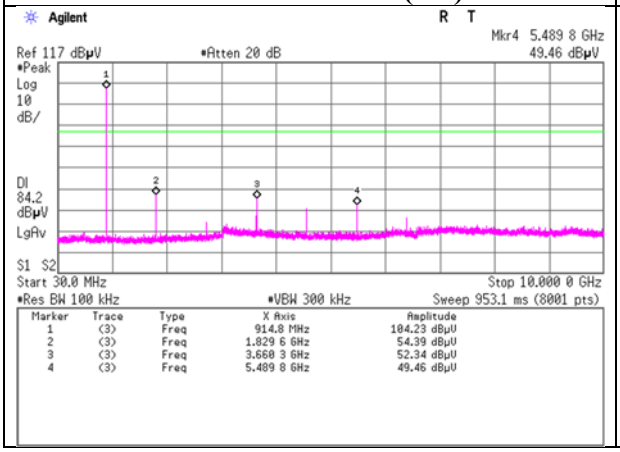
9 kHz - 150 kHz



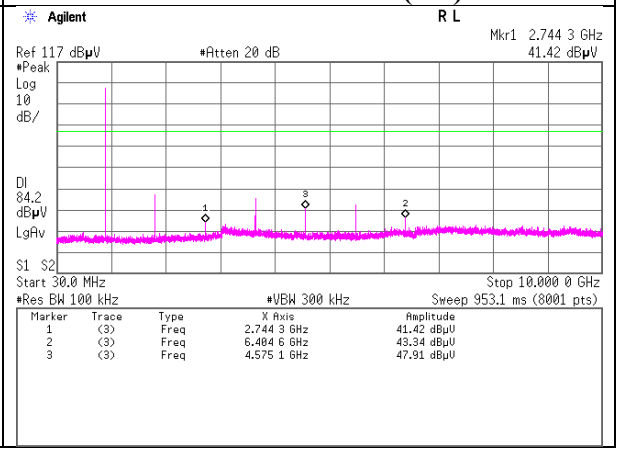
150 kHz - 30 MHz



30 MHz - 10 GHz (1/2)



30 MHz - 10 GHz (2/2)

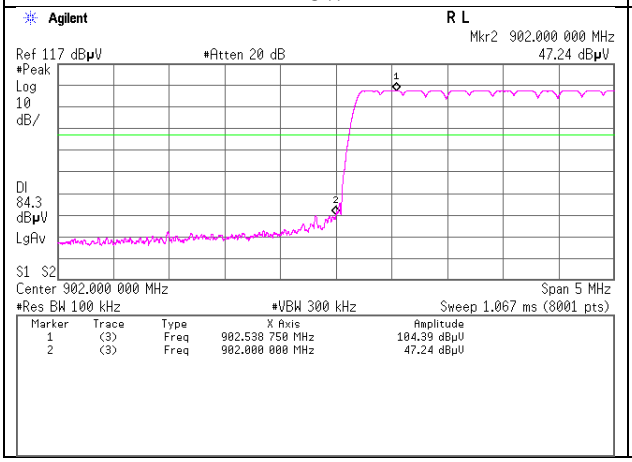


Conducted Emission Band Edge compliance

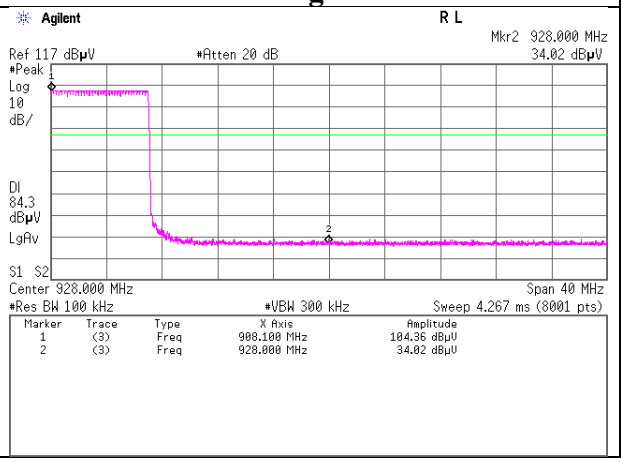
Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	August 8, 2019
Temperature / Humidity	27 deg. C / 51 % RH
Engineer	Hiromasa Sato
Mode	Tx, Hopping Off, 125 kHz mode, SF10

Hopping On

Low

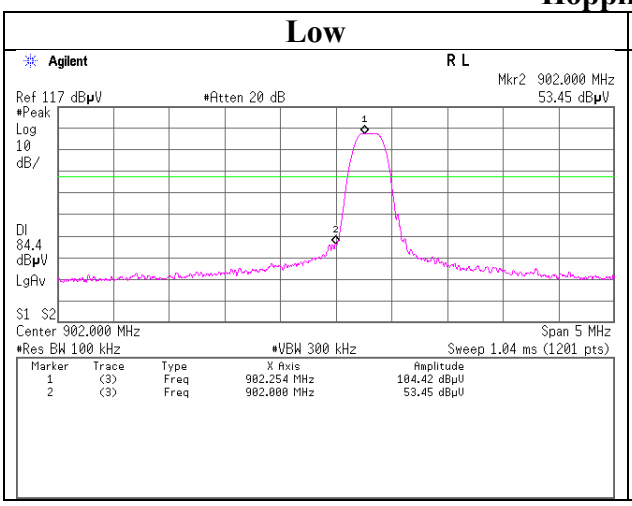


High

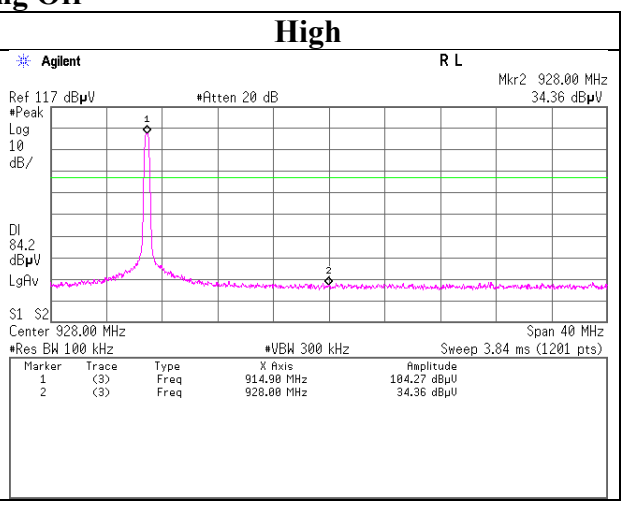


Hopping Off

Low



High



6 dB Bandwidth
(Reference data for Power Density testing)

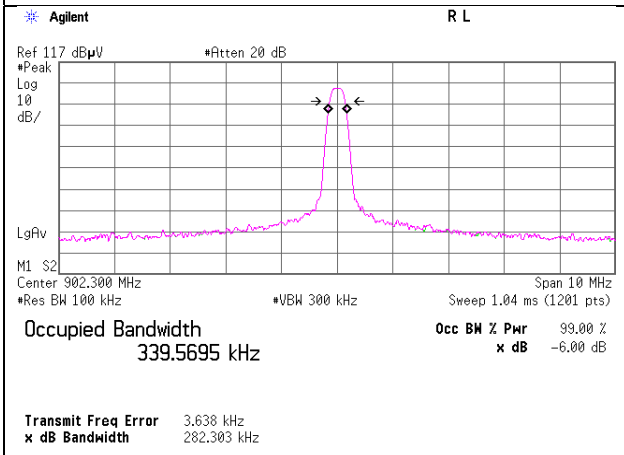
Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	September 17, 2019
Temperature / Humidity	26 deg. C / 50 % RH
Engineer	Hiromasa Sato
Mode	Tx

Mode	Frequency [MHz]	6 dB Bandwidth [MHz]
SF10	902.3	0.282
SF10	908.5	0.282
SF10	914.9	0.282
SF9	902.3	0.283
SF9	908.5	0.283
SF9	914.9	0.283
SF8	902.3	0.280
SF8	908.5	0.280
SF8	914.9	0.280
SF7	902.3	0.278
SF7	908.5	0.278
SF7	914.9	0.278

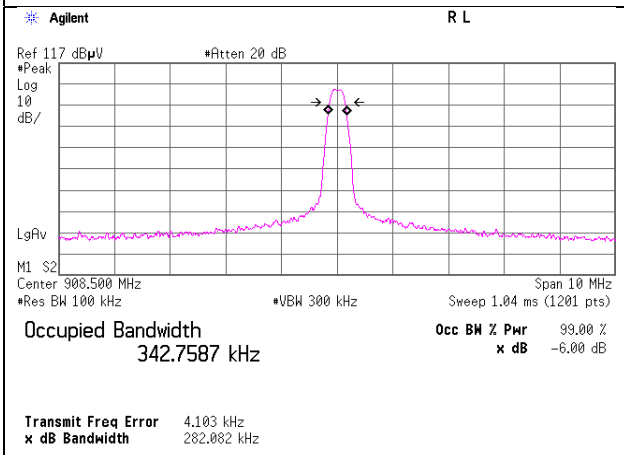
6 dB Bandwidth

SF10

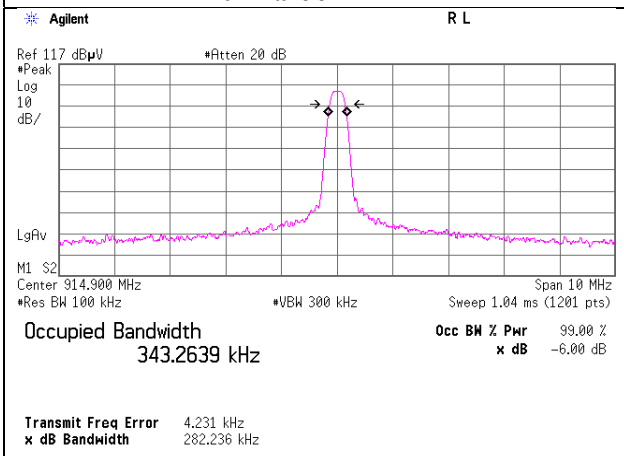
902.300 MHz



908.500 MHz

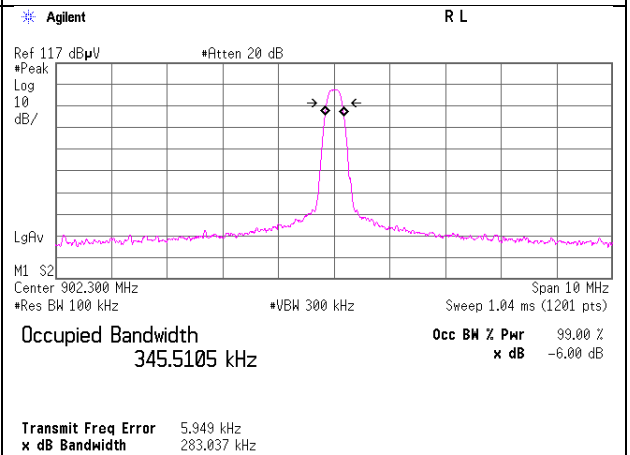


914.900 MHz

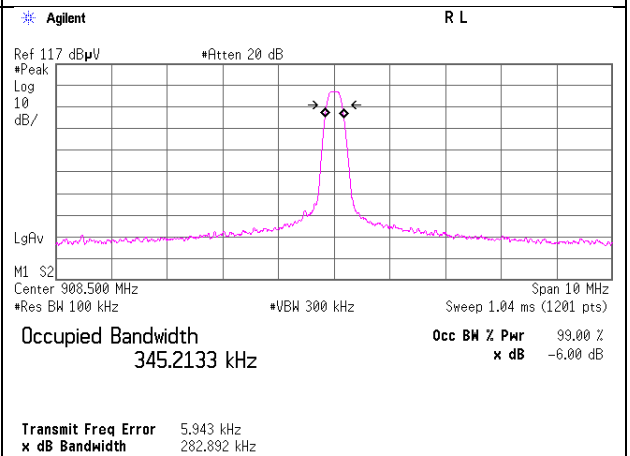


SF9

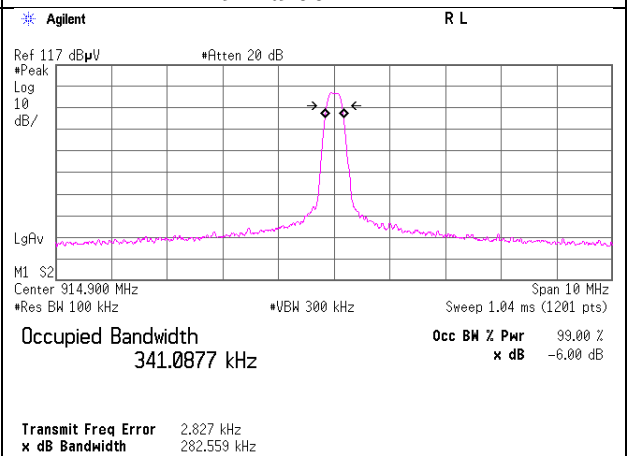
902.300 MHz



908.500 MHz



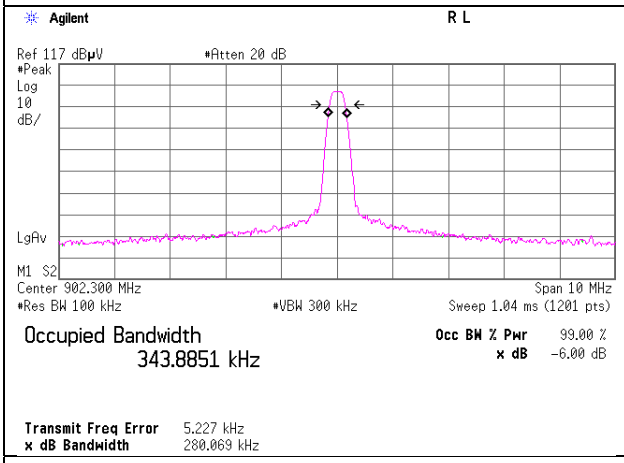
914.900 MHz



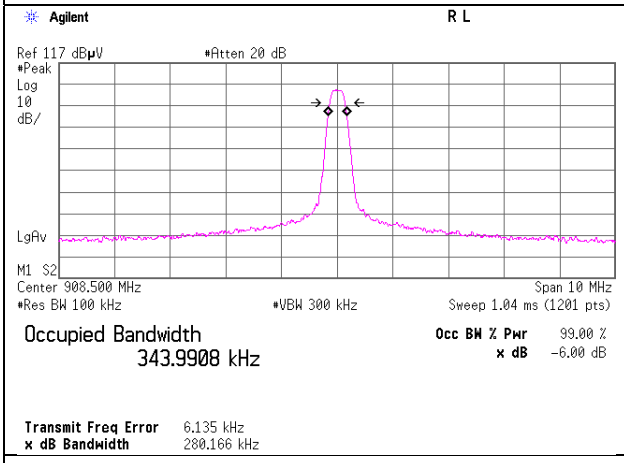
6 dB Bandwidth

SF8

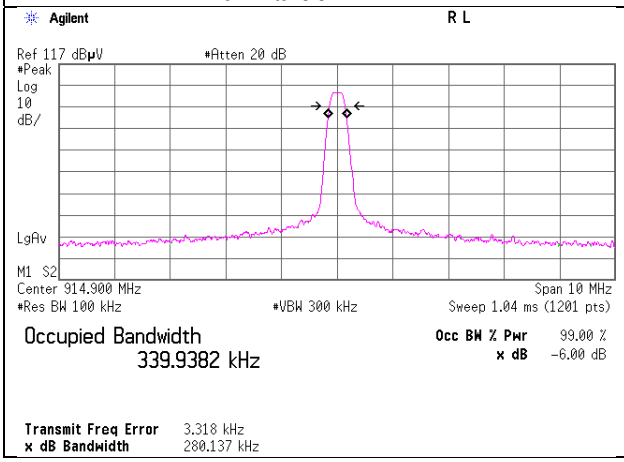
902.300 MHz



908.500 MHz

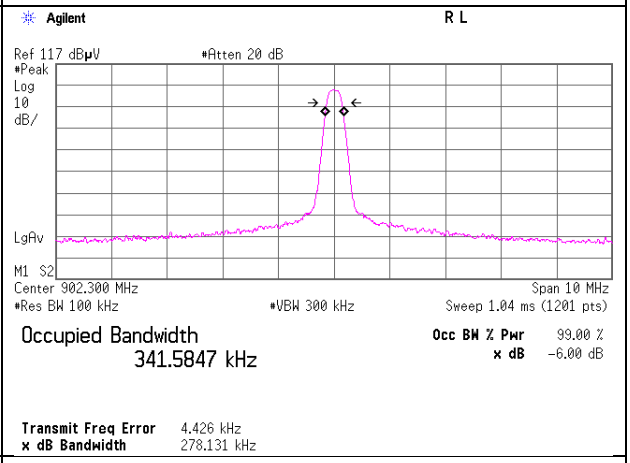


914.900 MHz

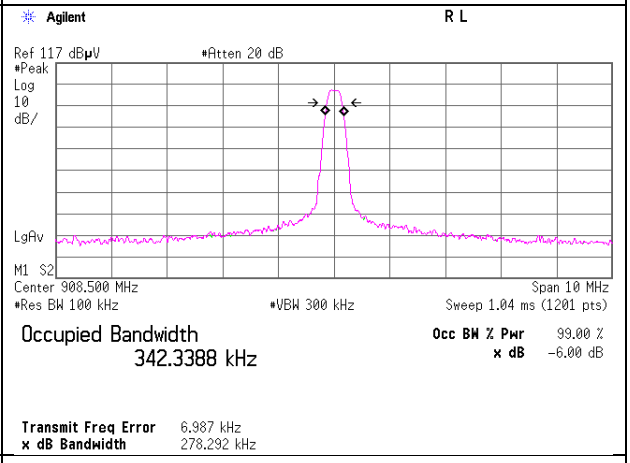


SF7

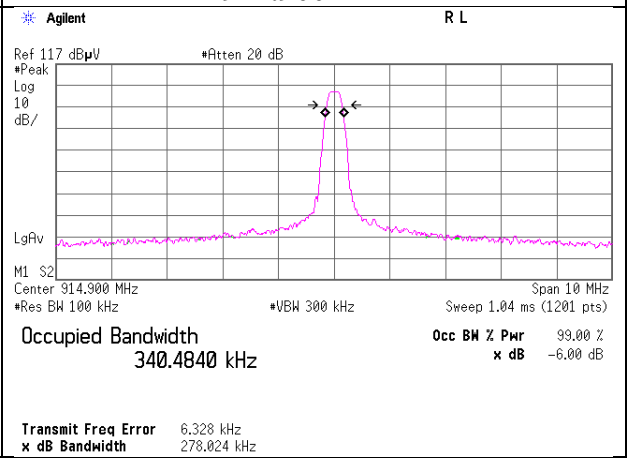
902.300 MHz



908.500 MHz



914.900 MHz



Power Density

Report No.	12987093S-A-R3
Test place	Shonan EMC Lab. No.1 Measurement Room
Date	September 17, 2019
Temperature / Humidity	26 deg. C / 50 % RH
Engineer	Hiromasa Sato
Mode	Tx

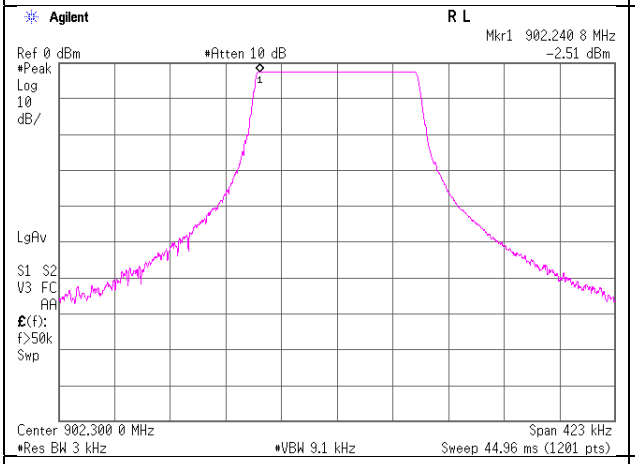
Mode	Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
SF10	902.3	-2.51	0.90	9.58	7.97	8.00	0.03
SF10	908.5	-2.59	0.90	9.58	7.89	8.00	0.11
SF10	914.9	-2.66	0.91	9.58	7.83	8.00	0.17
SF9	902.3	-2.83	0.90	9.58	7.65	8.00	0.35
SF9	908.5	-2.76	0.90	9.58	7.72	8.00	0.28
SF9	914.9	-3.15	0.91	9.58	7.34	8.00	0.66
SF8	902.3	-3.62	0.90	9.58	6.86	8.00	1.14
SF8	908.5	-4.05	0.90	9.58	6.43	8.00	1.57
SF8	914.9	-3.72	0.91	9.58	6.77	8.00	1.23
SF7	902.3	-4.86	0.90	9.58	5.62	8.00	2.38
SF7	908.5	-5.04	0.90	9.58	5.44	8.00	2.56
SF7	914.9	-5.02	0.91	9.58	5.47	8.00	2.53

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

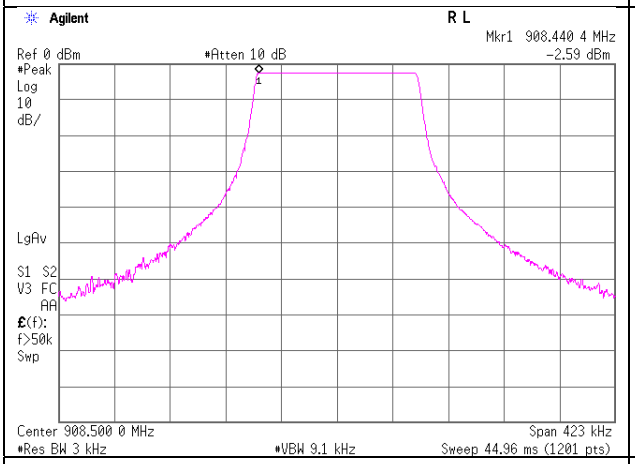
Power Density

SF10

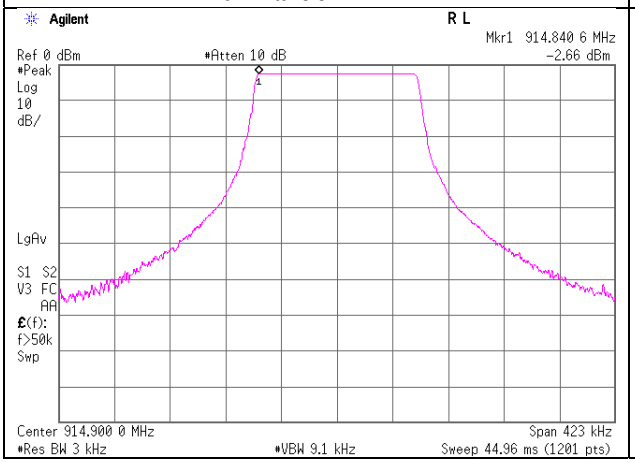
902.300 MHz



908.500 MHz

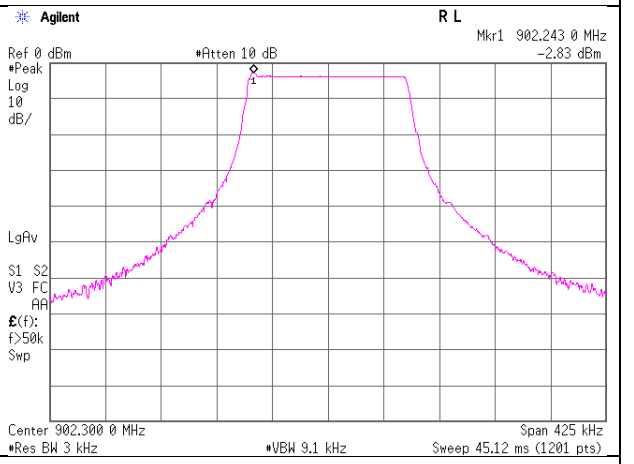


914.900 MHz

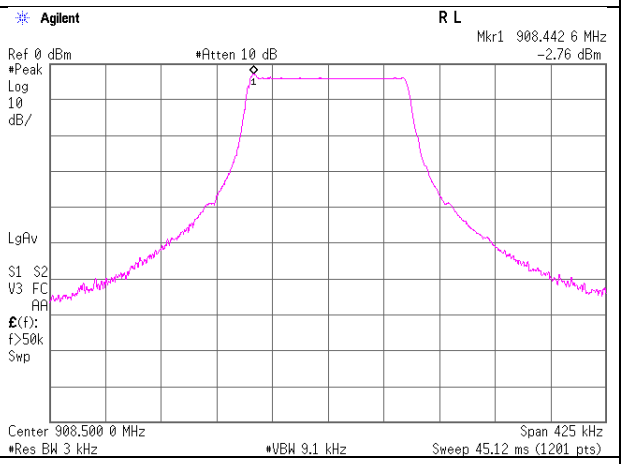


SF9

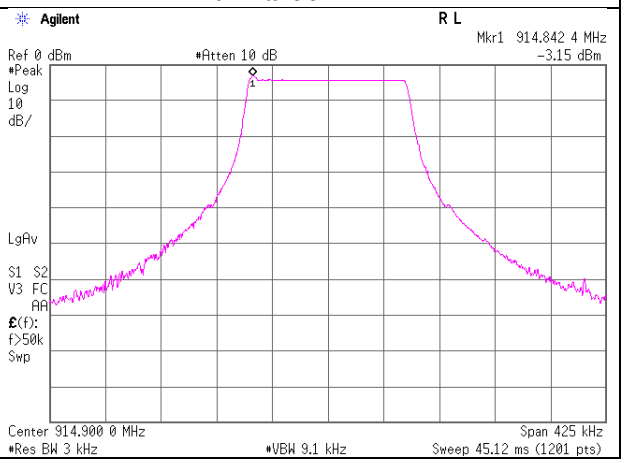
902.300 MHz



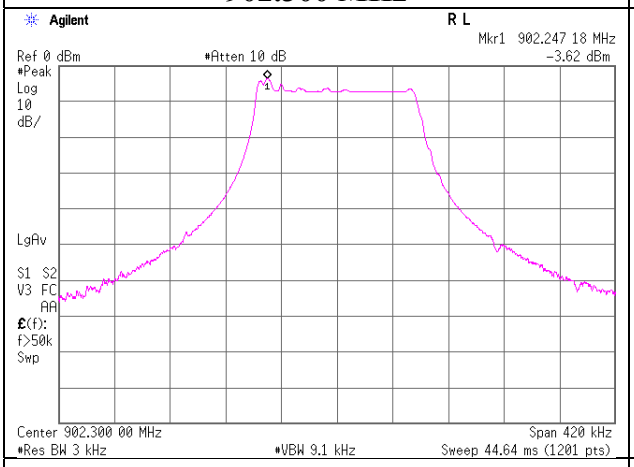
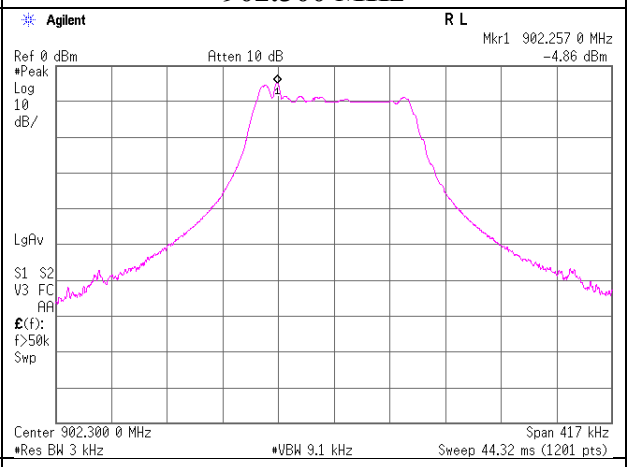
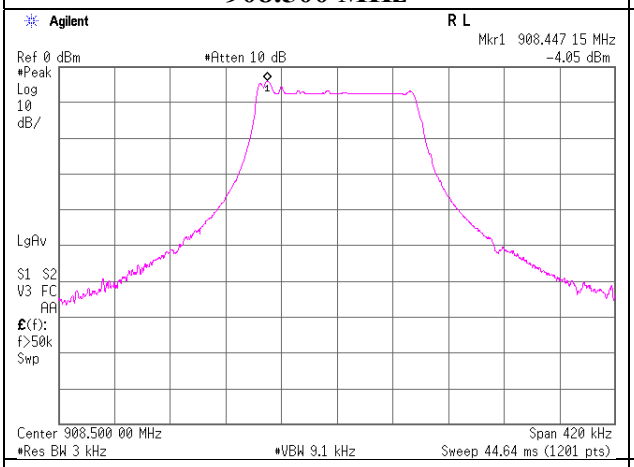
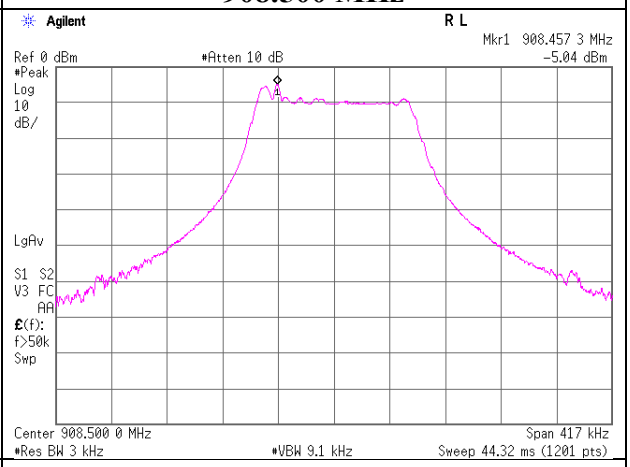
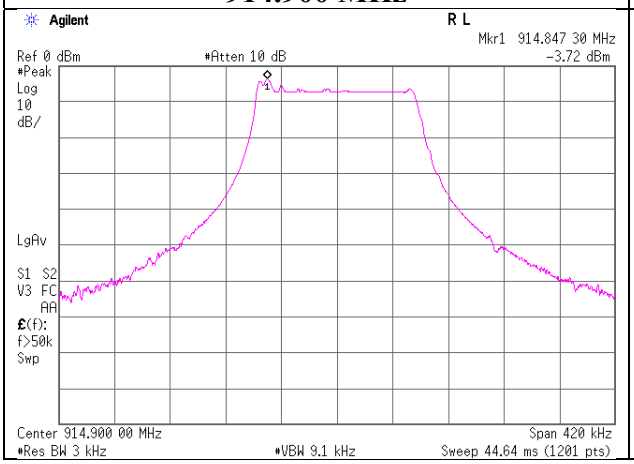
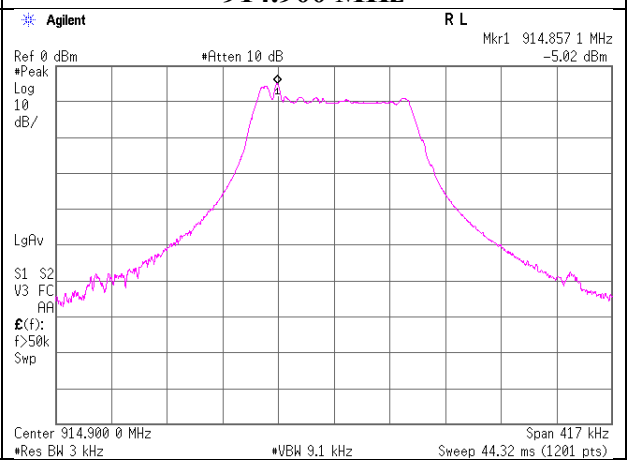
908.500 MHz



914.900 MHz



Power Density

SF8	SF7
902.300 MHz	902.300 MHz
	
908.500 MHz	908.500 MHz
	
914.900 MHz	914.900 MHz
	

APPENDIX 2: Test instruments

Test Instruments

Local ID	Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Calibration Interval (Month)
SAT10-09	AT	145132	Attenuator	Weinschel Corp.	54A-10	W5692	2018/11/25	2019/11/30	12
SCC-G12	AT	145040	Coaxial Cable	Suhner	SUCOFLEX 102	30790/2	2019/3/27	2020/3/31	12
SOS-13	AT	146321	Humidity Indicator	CUSTOM	CTH-202	Q.C.17	2018/12/5	2019/12/31	12
SPM-13	AT	169910	Power Meter	EMC Instruments Corporation	8990B	MY51000 448	2019/3/6	2020/3/31	12
SPSS-06	AT	169911	Power sensor	EMC Instruments Corporation	N1923A	MY57270 004	2019/3/6	2020/3/31	12
SRENT-09	AT	150461	Spectrum Analyzer	AGILENT (KEYSIGHT)	E4440A	MY46186 392	2019/1/3	2020/1/31	12
COTS-SEMI-5	RE	170932	EMI Software	TSJ	TEPTO-DV3(RE,CE,ME,PE)	-	-	-	-
KAT6-04	RE	144899	Attenuator	Inmet	18N-6dB	-	2018/12/25	2019/12/31	12
KJM-02	RE	146432	Measure	TAJIMA	GL19-55	-	-	-	-
KJM-09	RE	145929	Measure	KOMELON	KMC-36	-	-	-	-
SAEC-01(NSA)	RE	145597	Semi-Anechoic Chamber	TDK	SAEC-01(NSA)	1	2019/4/2	2020/4/30	12
SAEC-03(SVSWR)	RE	145566	Semi-Anechoic Chamber	TDK	SAEC-03(SVSWR)	3	2019/5/3	2020/5/31	12
SAF-01	RE	145003	Pre Amplifier	SONOMA	310N	290211	2019/2/5	2020/2/29	12
SAF-06	RE	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	1440491	2019/2/8	2020/2/29	12
SAJ-03	RE	146105	Antenna Tilt Jig	Intelligent System Engineering Co., Ltd	Antenna Tilt Jig	T-S003	-	-	-
SAT10-01	RE	145133	Attenuator	JFW	50HF-010N	-	2019/2/5	2020/2/29	12
SAT10-05	RE	145136	Attenuator(above1GHz)	AGILENT	8493C-010	74864	2018/11/25	2019/11/30	12
SAT3-09	RE	144959	Attenuator	JFW	50HF-003N	-	2019/8/6	2020/8/31	12
SBA-01	RE	145161	Biconical Antenna	Schwarzbeck	BBA9106	91032664	2019/4/1	2020/4/30	12
SCC-A1/A3/A5/A7/A8/A13/SRSE-01	RE	144967	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141P	-/0901-269(RF Selector)	2019/4/19	2020/4/30	12
SCC-A2/A4/A6/A7/A8/A13/SRSE-01	RE	144968	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141P	-/0901-269(RF Selector)	2019/4/19	2020/4/30	12
SCC-G40	RE	166491	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S005	2019/1/25	2020/1/31	12
SCC-G43	RE	156380	Coaxial Cable	HUBER+SUNER	SUCOFLEX_104_E	SN MY 13406/4E	2019/7/3	2020/7/31	12
SCC-G58	RE	183047	Coaxial Cable	HUBER+SUNER	SUCOFLEX 104	800287/4A	2019/7/23	2020/7/31	12
SFL-22	RE	168802	Highpass Filter	MICRO-TRONICS	HPM50114	G035	2019/4/16	2020/4/30	12
SHA-03	RE	145501	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	2019/6/26	2020/6/30	12
SLA-05	RE	145527	Logperiodic Antenna	Schwarzbeck	VUSLP9111B	193	2019/4/1	2020/4/30	12
SOS-01	RE	146316	Humidity Indicator	A&D	AD-5681	4062555	2018/10/25	2019/10/31	12
SOS-05	RE	146293	Humidity Indicator	A&D	AD-5681	4062518	2018/10/25	2019/10/31	12
STR-01	RE	145790	Test Receiver	Rohde & Schwarz	ESU40	100093	2019/4/14	2020/4/30	12
STR-08	RE	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2018/11/28	2019/11/30	12

***Hyphens for Last Calibration Date, Calibration Due 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.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.
Test item: RE: Radiated Emission test, AT: Antenna Terminal Conducted test