



RADIO TEST REPORT

Test Report No. : 12514551H-R3

Applicant : Japan Radio Co., Ltd.
Type of Equipment : X-Band Compact Weather Radar Radio Module
Model No. : GKP-2781
FCC ID : CKEGKP2781
Test regulation : FCC part 90 Subpart I: 2019
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 above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12514551H-R2. 12514551H-R2 is replaced with this report.

Date of test: September 21, 2018 to June 5, 2019

Representative test engineer:


Ken Fujita
Engineer
Consumer Technology Division

Approved by:


Tsubasa Takayama
Leader
Consumer Technology Division



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

- ☐ 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.: 12514551H

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12514551H	December 13, 2018	-	-
1	12514551H-R1	March 14, 2019	P 1	Addition of note No.8.
1	12514551H-R1	March 14, 2019	P 1	Correction of Test regulation
1	12514551H-R1	March 14, 2019	P.4	Addition of note in SECTION 1.
1	12514551H-R1	March 14, 2019	P.4	Addition of note for receipt date of sample in SECTION 2.1.
1	12514551H-R1	March 14, 2019	P.5	Correction of Clock frequency(ies) in the system in SECTION 2.2. From 9.000 MHz, 9.100 MHz to 9,000 MHz, 9,100 MHz
1	12514551H-R1	March 14, 2019	P.6	Addition of note in SECTION 3.2.
1	12514551H-R1	March 14, 2019	P.6	Correction of Test Specification
1	12514551H-R1	March 14, 2019	P.6	Correction of Specification of Occupied Bandwidth and Emission masks in SECTION 3.2.
1	12514551H-R1	March 14, 2019	P 6	Addition of note for ANSI C63.26
1	12514551H-R1	March 14, 2019	P 7	Addition of note in SECTION 3.5.
1	12514551H-R1	March 14, 2019	P10	Correction of frequency in Clause 4.2; From 50 Hz to 60 Hz.
1	12514551H-R1	March 14, 2019	P16	Correction of test data of duty factor (9801.1 MHz) in APPENDIX 1; From 29.65 dB to 29.17 dB.
1	12514551H-R1	March 14, 2019	P19, 20	Correction of frequency of Modulation Characteristics test data in APPENDIX 1
1	12514551H-R1	March 14, 2019	P 21	Correction of Occupied Bandwidth test data in APPENDIX 1
1	12514551H-R1	March 14, 2019	P 22	Addition of Emission masks test data in APPENDIX 1
1	12514551H-R1	March 14, 2019	P 23, 26	Correction of Spurious Emission at Antenna Terminals test data in APPENDIX 1
1	12514551H-R1	March 14, 2019	P 31	Correction of Frequency Stability test data in APPENDIX 1
1	12514551H-R1	March 14, 2019	P 32	Addition of test instruments for RE (Below 1 GHz) in APPENDIX 2
1	12514551H-R1	March 14, 2019	P 32	Correction of Last Calibration Date of LIMS ID: 142013 in APPENDIX 2; From - to 4/6/2018
2	12514551H-R2	May 30, 2019	P 5	Addition of Emission designator in SECTION 2.2.
2	12514551H-R2	May 30, 2019	P 5	Correction of Frequency of Operation in SECTION 2.2.
2	12514551H-R2	May 30, 2019	P 5	Correction of Clock frequency(ies) in the system in SECTION 2.2.
2	12514551H-R2	May 30, 2019	P 5	Correction of RF output power in SECTION 2.2. From 125 W to 130 W
2	12514551H-R2	May 30, 2019	P 9	Correction of Tested frequency for Emission masks in SECTION 4.1.
2	12514551H-R2	May 30, 2019	P 21, 22	Correction of test data (Occupied Bandwidth and Emission masks tests) in APPENDIX 1
2	12514551H-R2	May 30, 2019	P 23 to 28	Correction of test data (Spurious Emission at Antenna Terminals) in APPENDIX 1
2	12514551H-R2	May 30, 2019	P 32	Addition of LIMS ID: 141885 and 151897 in APPENDIX 2: Test Instruments
3	12514551H-R3	June 6, 2019	P 6	Correction of worst margin of Spurious Emission at Antenna Terminals and Field Strength of Spurious Emission tests in SECTION 3.2.
3	12514551H-R3	June 6, 2019	P 23 to 30	Correction of test data of Spurious Emission at Antenna Terminals and Field Strength of Spurious Emission tests in APPENDIX 1
3	12514551H-R3	June 6, 2019	P32	Correction of Test Instruments for Radiated Emission test in APPENDIX 2

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SECTION 1: Customer information

Company Name	:	Japan Radio Co., Ltd.
Address	:	834, Inasatomachi, Nagano-shi, Nagano, 381-2289, Japan
Telephone Number	:	+81-26-214-7697
Facsimile Number	:	+81-26-214-7492
Contact Person	:	Masanori Endo

The information provided from the customer is as follows;

- Applicant, Type of Equipment, Model No. on the cover and other 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	:	X-Band Compact Weather Radar Radio Module
Model No.	:	GKP-2781
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 24 V (Transmitter/Receiver: CMN-827) DC 12 V (Signal Processor: CMJ-569, STALO)
Receipt Date of Sample (Information from test lab.)	:	September 17, 2018
Country of Mass-production	:	Japan
Condition of EUT	:	Production model
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: GKP-2781 (referred to as the EUT in this report) is a X-Band Compact Weather Radar Radio Module.

Radio Specification

Radio Type	:	Transceiver
Emission designator	:	8M00V0N
Frequency of Operation	:	Center Frequency: 9700 MHz, 9800 MHz Long Pulse: 9798.9 MHz, 9698.9 MHz Short Pulse: 9801.1 MHz, 9701.1 MHz
Clock frequency(ies) in the system	:	12 MHz, 20 MHz, 96 MHz, 192 MHz, 640 MHz
RF output power (specification)	:	130 W
RF output power limit	:	None
Modulation type	:	Non-chirp pulse: CW Chirp pulse: Frequency Modulation
Antenna Connector Type	:	Coaxial
Intermediate frequency	:	60 MHz
Operating Temperature	:	-20 deg.C to +50 deg.C
(Antenna information)	(* The antenna of the antenna gain maximum in the antenna with a used possibility.)	
Model No.	:	CAY-78
Antenna type	:	Φ 1.2m Parabolic Antenna
Antenna Gain	:	38 dBi

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 90: 2019, final revised on February 13, 2019
Title : PRIVATE LAND MOBILE RADIO SERVICES

3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	RF Output Power	FCC section 2.1046	FCC section 90.205(r)	-	N/A	-	N/A *1) a)
2	Modulation Characteristics	FCC section 2.1047	FCC section 90.207 *2)	-	N/A	-	N/A b)
3	Occupied Bandwidth and Emission masks	FCC section 2.1049	FCC section 90.209, 90.210(n), 90.210(o)	-	N/A	-	Complied c)
4	Spurious Emission at Antenna Terminals	FCC section 2.1051	FCC section 90.210	-	N/A	4.15 dB (8958.000 MHz)	Complied d)
5	Field Strength of Spurious Emission	FCC section 2.1053	FCC section 90.210	Radiated	N/A	9.8 dB (39200.000 MHz, Horizontal, Peak)	Complied e)
6	Frequency Stability	FCC section 2.1055	FCC section 90.213	-	N/A	-	N/A *3) f)

Note: UL Japan, Inc.'s EMI Work Test Procedure 13-EM-W0420.

*1) Since RF output power no limit.

*2) Refer to 90.207 (no accreditation matter).

*3) Since Frequency Stability no limit.

a) Refer to APPENDIX 1 (data of RF Output Power)

b) Refer to APPENDIX 1 (data of Modulation Characteristics)

c) Refer to APPENDIX 1 (data of Occupied Bandwidth and Emission masks)

d) Refer to APPENDIX 1 (data of Spurious Emission at Antenna Terminals)

e) Refer to APPENDIX 1 (data of Field Strength of Spurious Emission)

f) Refer to APPENDIX 1 (data of Frequency Stability)

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 C63.26: 2015 is also referred.

3.3 Addition to standard

No addition, exclusion nor deviation has been made from the standard.

3.4 Confirmation

UL Japan, Inc. hereby confirms that E.U.T., in the configuration tested, complies with the specifications FCC part 90.

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3.5 Uncertainty

EMI

There is no applicable rule of uncertainty in this applied standard. Therefore, the following 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 $k=2$.

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
10 m		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	5.0 dB
	200 MHz to 1000 MHz (Horizontal)	5.2 dB
	(Vertical)	6.3 dB
10 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	4.9 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
	(Vertical)	5.0 dB
3 m	1 GHz to 6 GHz	5.0 dB
	6 GHz to 18 GHz	5.3 dB
1 m	10 GHz to 26.5 GHz	5.8 dB
	26.5 GHz to 40 GHz	5.8 dB
10 m	1 GHz to 18 GHz	5.2 dB

Antenna terminal test	Uncertainty (+/-)
RF output power	1.3 dB
Occupied bandwidth	0.96%
Emission mask	1.9 dB
Frequency stability	0.0001 ppm
Spurious emissions at antenna terminals	2.7 dB

3.6 Test Location

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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	-	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.6 shielded room	-	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	-	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	-	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	-	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	-	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	-	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 m x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.7 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

Test item	Operating mode	Tested frequency
RF output power, Modulation Characteristics, Frequency Stability, Emission masks	Transmitting mode	9701.1 MHz 9698.9 MHz 9801.1 MHz 9798.9 MHz
Occupied Bandwidth, Spurious Emission at Antenna Terminals, Field Strength of Spurious Emission	Transmitting mode	9700 MHz 9800 MHz

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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Transmitter/Receiver	CMN-827	WA74558	Japan Radio Co., Ltd.	EUT
B	Frequency Synthesizer	DCN-DC922-102IR	WA74568	Japan Radio Co., Ltd.	EUT
C	Signal Processor	CMJ-569	WA74559	Japan Radio Co., Ltd.	EUT
D	DC 24 V Power supply	PAN60-10A	SD002896	KIKUSUI Electronics corp.	-
E	Laptop PC	CF-MX5	7EKSA50912	Panasonic	-
F	DC 24 V Power supply	PAN16-18A	UD001728	KIKUSUI Electronics corp.	-
G	Attenuator (30dB)	48-30-34	CA2888	Aeroflex	-
H	AC Adapter	CF-AA6212C	62J2CM316X109 503SA	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.5	Shielded	Shielded	-
2	Signal Cable	0.5	Shielded	Shielded	-
3	Signal Cable	1.0	Shielded	Shielded	-
4	Signal Cable	5.0	Unshielded	Unshielded	-
5	DC Cable	5.0	Unshielded	Unshielded	-
6	DC Cable	1.3	Unshielded	Unshielded	-
7	DC Cable	1.3	Unshielded	Unshielded	-
8	LAN Cable	5.0	Unshielded	Unshielded	-
9	Signal Cable	1.0	Shielded	Shielded	-
10	Signal Cable	1.0	Shielded	Shielded	-
11	Signal Cable	1.0	Shielded	Shielded	-
12	DC Cable	1.6	Unshielded	Unshielded	-
13	AC Cable	0.9	Unshielded	Unshielded	-
14	AC Cable	1.8	Unshielded	Unshielded	-
15	AC Cable	1.8	Unshielded	Unshielded	-

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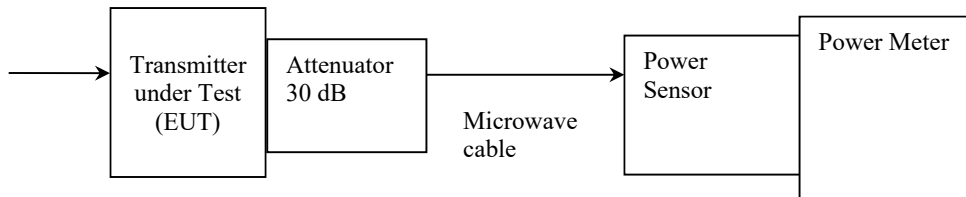
SECTION 5: RF Output power

5.1 Test Procedure : FCC part 2 section 2.1046
The RF output power was measured with a Power meter connected to the antenna port.

5.2 Test data : APPENDIX 1

5.3 Test result : Pass

5.4 Measurement Block Diagram of RF power output



RF Power Measurement (FCC section 2.1046)

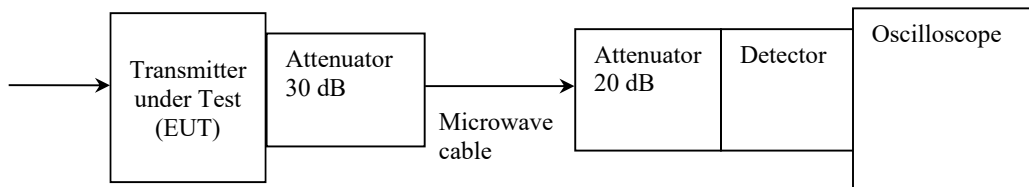
SECTION 6: Modulation Characteristics

6.1 Test Procedure : FCC Part 2 section 2.1047
The modulation characteristics were measured with an oscilloscope with radio signal detector connected to the antenna port.

6.2 Test Data : APPENDIX 1

6.3 Test Result : Pass

6.4 Measurement Block Diagram



Modulation Characteristics (FCC section 2.1047)

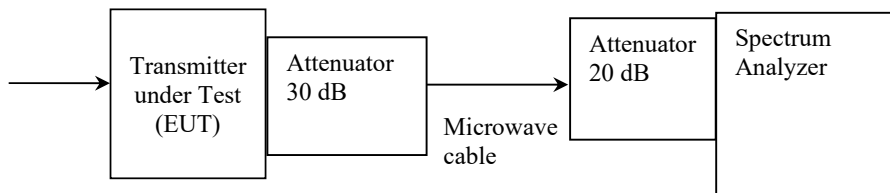
SECTION 7: Occupied Bandwidth and Emission masks

7.1 Test Procedure : FCC Part 2 section 2.1049
The Occupied Bandwidth and Emission masks was measured with a spectrum analyzer connected to the antenna port.

7.2 Test Data : APPENDIX 1

7.3 Test Result : Pass

7.4 Measurement Block Diagram



Occupied Bandwidth (FCC section 2.1049)

SECTION 8: Spurious emission at Antenna Terminals

8.1 Test Procedure : FCC part 2 section 2.1051
The spurious emission at Antenna Terminals was measured with a spectrum analyzer connected to the antenna port.

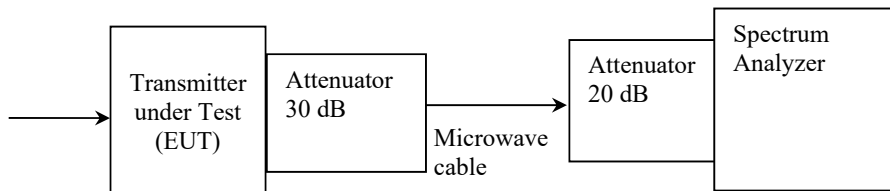
Frequency	Below 1 GHz	Above 1 GHz
Instrument used	Spectrum Analyzer	Spectrum Analyzer
IF Bandwidth	Peak: RBW: 100 kHz/VBW: 300 kHz	Peak: RBW: 1 MHz/VBW: 3 MHz

Transmitter spurious Limit: $-13 \text{ dBm} = 10 \times \log (\text{mean power (W)} \times 10^3) - (43 + 10 \times \log (\text{mean power (W)}))$

8.2 Test Data : APPENDIX 1

8.3 Test result : Pass

8.4 Measurement Block Diagram



Spurious Emission at Antenna Terminals (FCC section 2.1051)

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SECTION 9: Field Strength of Spurious Emission

9.1 Test Procedure : FCC part 2 section 2.1053

EUT was placed on a polystyrene platform of nominal size, 1.5 m by 1.0 m, raised 0.8 m above the conducting ground plane.

The Radiated Electric Field Strength intensity has been measured on a semi-anechoic chamber with a ground plane and at a distance of 1 m (above 10 GHz) (Refer to Figure 1). Measurements were performed with quasi-peak, peak and average detector. The measuring antenna height was varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity. The measurements were performed for both vertical and horizontal antenna polarization.

The radiated emission measurements were made with the following detection of the test receiver.

Frequency	Below 1 GHz	Above 1 GHz
Instrument used	Spectrum Analyzer	Spectrum Analyzer
IF Bandwidth	Peak: RBW: 100 kHz/VBW: 300 kHz	Peak: RBW: 1 MHz/VBW: 3 MHz

Transmitter Spurious Limit (General emissions): refer to FCC part 15 subpart C section 15.209

Transmitter Spurious Limit (Harmonics emissions): Carrier Level - $(43 + 10 \times \log(\text{Average power [W]} = \text{Peak power} \times \text{Duty}))$

The Result is converted from electric field strength in dBuV/m to EIRP in Watts using the following formula

$$F [\text{V/m}] = 10^{((E [\text{dBuV/m}] - 120) / 20)}$$

$$P = ((F \times d [\text{m}])^2) / (30 \times g)$$

E = measurement electric field strength, in dBuV/m

F = measurement electric field strength, in V/m

P = EIRP, in dBm

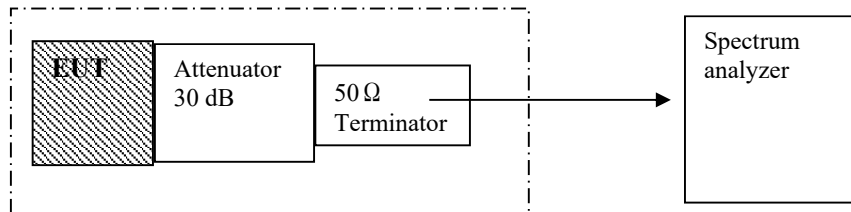
d = measurement distance, in meters = 3 [m]

g = numeric antenna gain (=1)

9.2 Test Data : APPENDIX 1

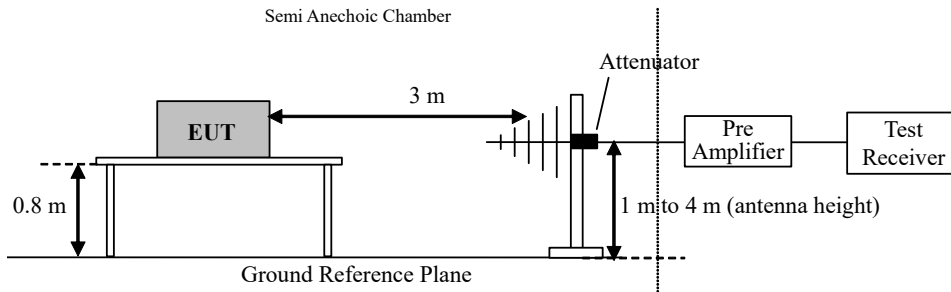
9.3 Test Result : Pass

9.4 Measurement Block Diagram

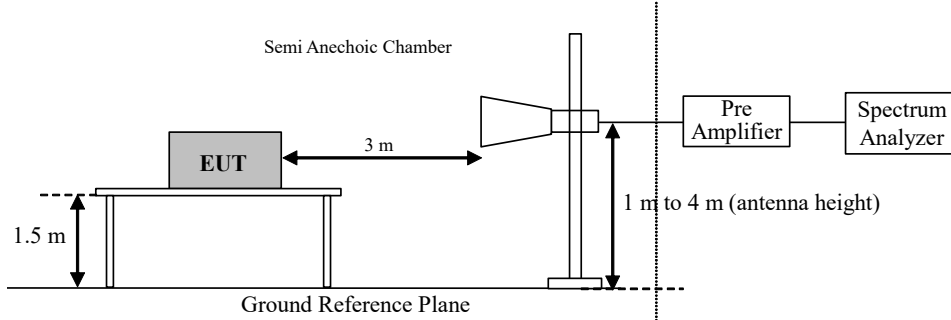


Field Strength of Spurious Emission (FCC section 2.1053)

[Below 1 GHz]



[Above 1 GHz]



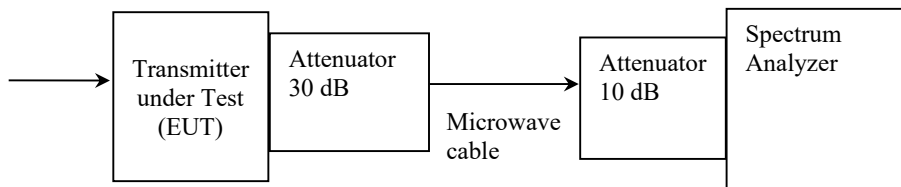
SECTION 10: Frequency Stability

10.1 Test Procedure : FCC part 2 section 2.1055
Refer to FCC part 2, section 2.1055.

10.2 Test Data : APPENDIX 1

10.3 Test Result : Pass

10.4 Measurement Block Diagram



Frequency Stability (FCC section 2.1055)

APPENDIX 1: Test data

RF output power (Conducted)(mean power)

Report No. 12514551H
Test place Ise EMC Lab. No.6 Semi Anechoic Chamber
Date September ,21 2018
Temperature / Humidity 23 deg. C / 47 % RH
Engineer Ken Fujita
Mode Transmitting

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Duty factor [dB]	Result (mean power)		Result (Peak power)	
					[dBm]	[W]	[dBm]	[W]
9701.1	19.83	2.03	30.00	29.03	22.83	0.19	51.86	153.46
9698.9	19.54	2.03	30.00	12.74	38.83	7.64	51.57	143.55
9801.1	19.22	2.03	30.00	29.17	22.09	0.16	51.25	133.35
9798.9	19.14	2.03	30.00	12.76	38.41	6.94	51.17	130.92

Sample Calculation:

Result (mean power) = Reading + Cable Loss + Attenuator Loss - Duty factor

Result (Peak power) = Reading + Cable Loss + Attenuator Loss

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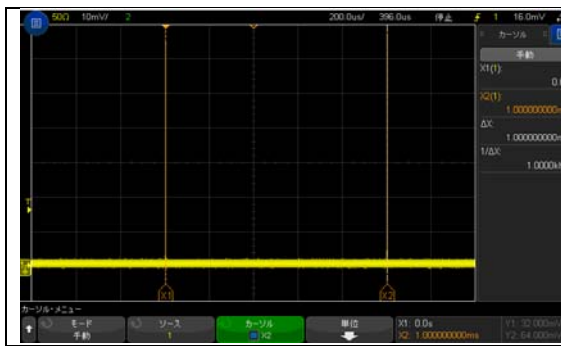
Modulation Characteristics (Pulse chart)

Report No. 12514551H
Test place Ise EMC Lab. No.6 Semi Anechoic Chamber
Date September 21, 2018
Temperature / Humidity 23 deg. C / 47 % RH
Engineer Ken Fujita
Mode Transmitting

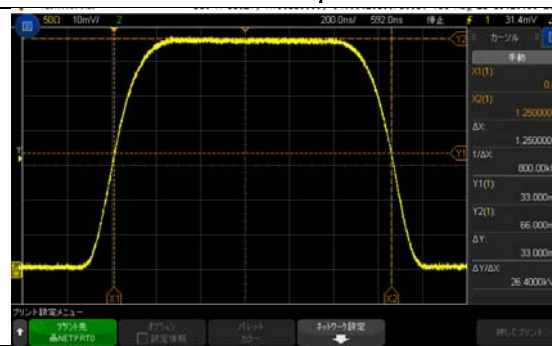
9701.1 MHz Short Pulse

Pulse range table	Pulse 1 cycle time [ms]	Pulse Repetition rate [kHz]	Pulse 50 % length [us]	Duty [%]	Duty factor [dB]	Rise Time [μ s]	Fall Time [μ s]
9701.1 MHz Short Pulse	1.00	1.00	1.250	0.125	29.031	0.215	0.240

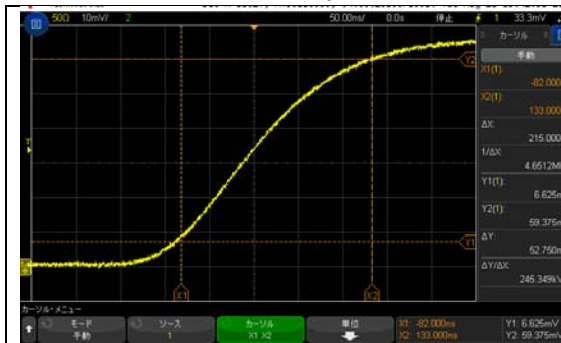
Pulse 1 cycle time
 $\Rightarrow 1.00$ ms



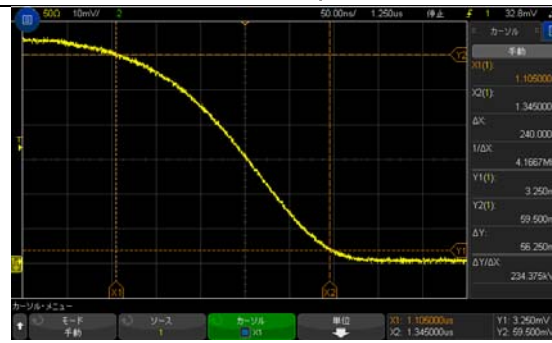
Pulse 50 % length
 $\Rightarrow 1.250$ μ s



Rise time
 $\Rightarrow 0.215$ μ s



Fall time
 $\Rightarrow 0.240$ μ s



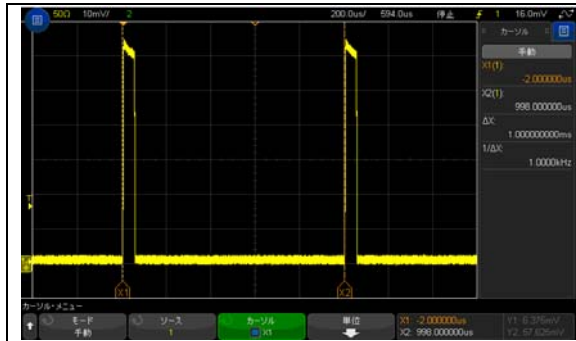
Modulation Characteristics (Pulse chart)

Report No. 12514551H
Test place Ise EMC Lab. No.6 Semi Anechoic Chamber
Date September 21, 2018
Temperature / Humidity 23 deg. C / 47 % RH
Engineer Ken Fujita
Mode Transmitting

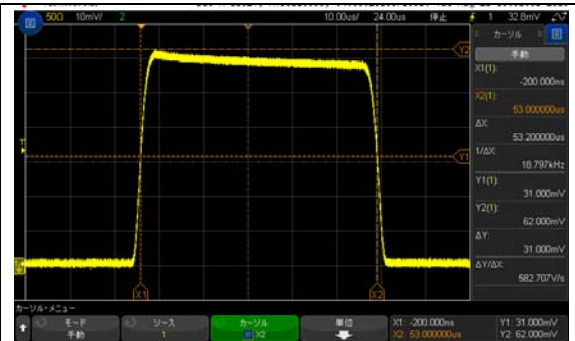
9698.9 MHz Long Pulse

Pulse range table	Pulse 1 cycle time [ms]	Pulse Repetition rate [kHz]	Pulse 50 % length [us]	Duty [%]	Duty factor [dB]	Rise Time [μs]	Fall Time [μs]
9698.9 MHz Long Pulse	1.00	1.00	53.200	5.320	12.741	2.720	3.440

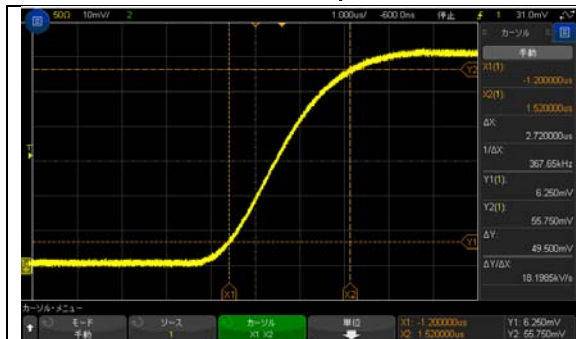
Pulse 1 cycle time
⇒ 1.00 ms



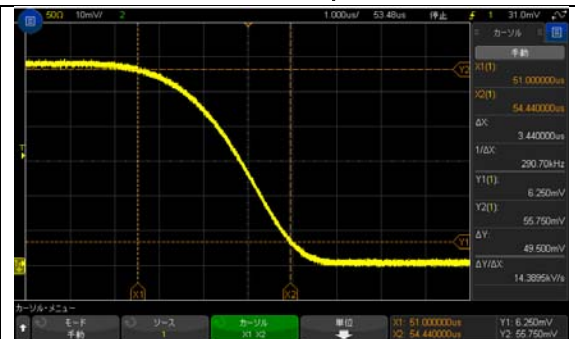
Pulse 50 % length
⇒ 53.20 μs



Rise time
⇒ 2.720 μs



Fall time
⇒ 3.440 μs



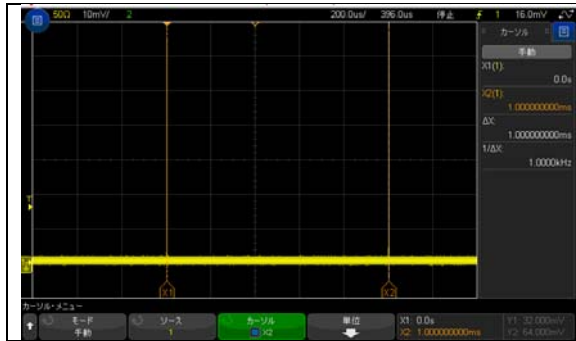
Modulation Characteristics (Pulse chart)

Report No. 12514551H
Test place Ise EMC Lab. No.6 Semi Anechoic Chamber
Date September 21, 2018
Temperature / Humidity 23 deg. C / 47 % RH
Engineer Ken Fujita
Mode Transmitting

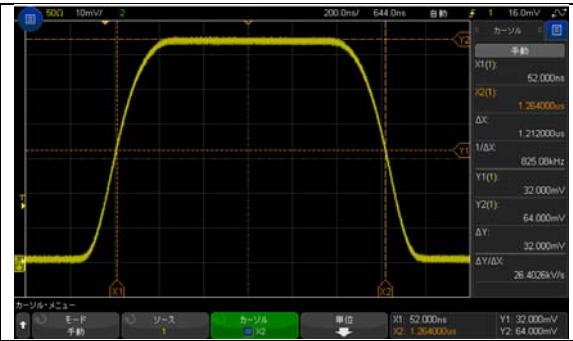
9801.1 MHz Short Pulse

Pulse range table	Pulse 1 cycle time [ms]	Pulse Repetition rate [kHz]	Pulse 50 % length [us]	Duty [%]	Duty factor [dB]	Rise Time [μs]	Fall Time [μs]
9801.1 MHz Short Pulse	1.00	1.00	1.212	0.121	29.165	0.221	0.221

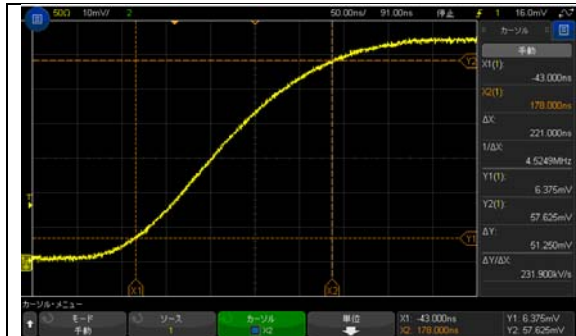
Pulse 1 cycle time
⇒ 1.00 ms



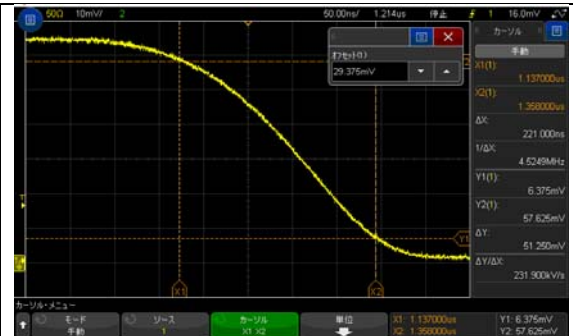
Pulse 50 % length
⇒ 1.212 μs



Rise time
⇒ 0.221 μs



Fall time
⇒ 0.221 μs



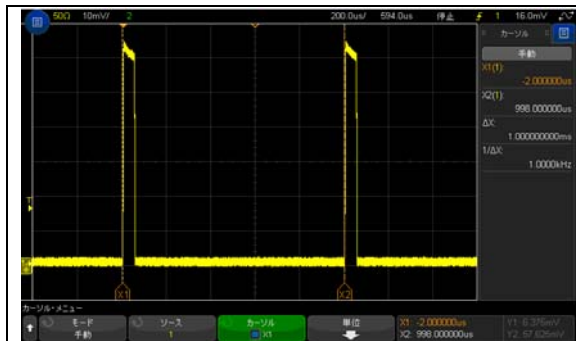
Modulation Characteristics (Pulse chart)

Report No. 12514551H
Test place Ise EMC Lab. No.6 Semi Anechoic Chamber
Date September 21, 2018
Temperature / Humidity 23 deg. C / 47 % RH
Engineer Ken Fujita
Mode Transmitting

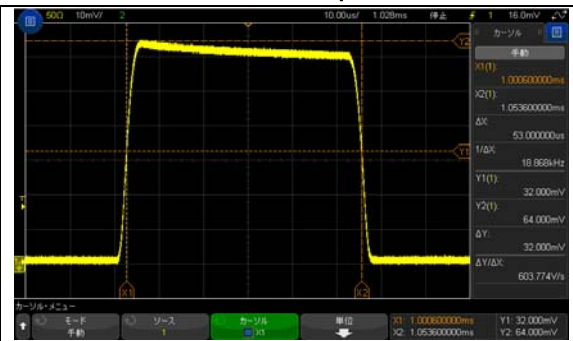
9798.9 MHz Long Pulse

Pulse range table	Pulse 1 cycle time [ms]	Pulse Repetition rate [kHz]	Pulse 50 % length [us]	Duty [%]	Duty factor [dB]	Rise Time [μ s]	Fall Time [μ s]
9798.9 MHz Long Pulse	1.00	1.00	53.000	5.300	12.757	2.800	3.440

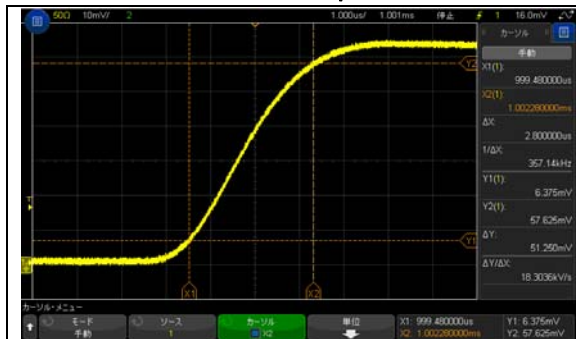
Pulse 1 cycle time
⇒ 1.00 ms



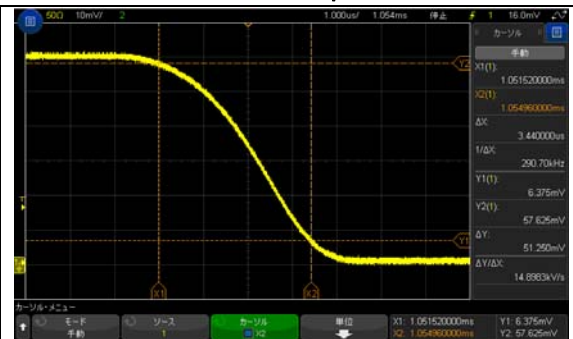
Pulse 50 % length
⇒ 53.00 μ s



Rise time
⇒ 2.800 μ s



Fall time
⇒ 3.440 μ s



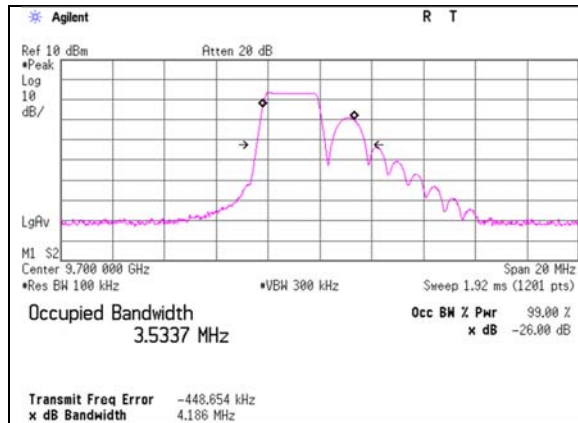
Occupied Bandwidth and Emission masks

Report No.	12514551H
Test place	Ise EMC Lab. No.6 Semi Anechoic Chamber
Date	May 28, 2019
Temperature / Humidity	23 deg. C / 47 % RH
Engineer	Ken Fujita
Mode	Transmitting

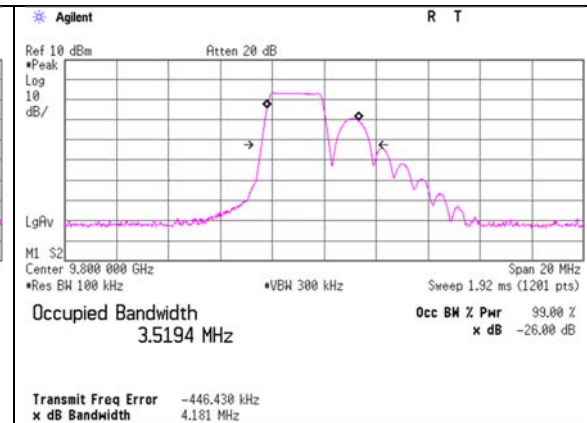
Occupied Bandwidth

Mode	Frequency	99% Occupied Bandwidth	-26dB Bandwidth
	[MHz]	[MHz]	[MHz]
Tx	9700	3.534	4.186
	9800	3.519	4.181

9700 MHz



9800 MHz



UL Japan, Inc.

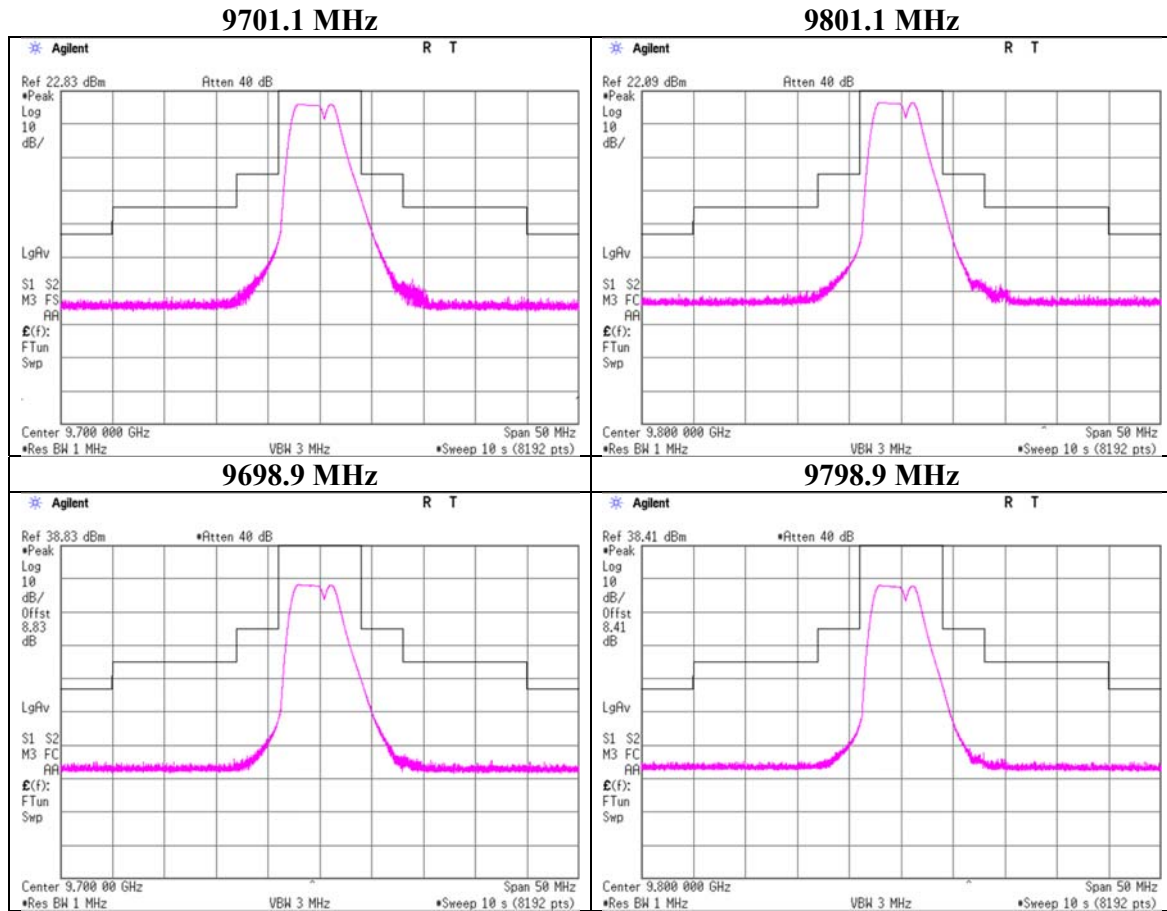
Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Emission masks



* The reference level value in this test uses the value of mean power from 「RF output power (Conducted)(mean power)」

Spurious Emission at Antenna Terminals

Report No. 12514551H
Test place Ise EMC Lab. No.6 Semi Anechoic Chamber
Date June 5, 2019
Temperature / Humidity 23 deg. C / 43 % RH
Engineer Ken Fujita
Mode Transmitting 9700 MHz

Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten.Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]	Remark
0.014	-99.74	0.00	29.65	-70.09	-13.00	57.09	-
0.175	-90.86	0.01	29.65	-61.20	-13.00	48.20	-
814.900	-80.91	0.91	29.96	-50.04	-13.00	37.04	-
3100.000	-68.09	1.74	30.03	-36.32	-13.00	23.32	-
8958.000	-50.17	2.96	30.06	-17.15	-13.00	4.15	-
13746.000	-63.35	4.29	30.65	-28.41	-13.00	15.41	-
16371.000	-63.92	4.72	30.76	-28.44	-13.00	15.44	-
24746.000	-60.28	5.86	0.00	-54.42	-13.00	41.42	-
25629.000	-58.53	5.98	0.00	-52.55	-13.00	39.55	-
33362.000	-58.07	7.12	0.00	-50.95	-13.00	37.95	-
37475.000	-52.04	7.65	0.00	-44.39	-13.00	31.39	-

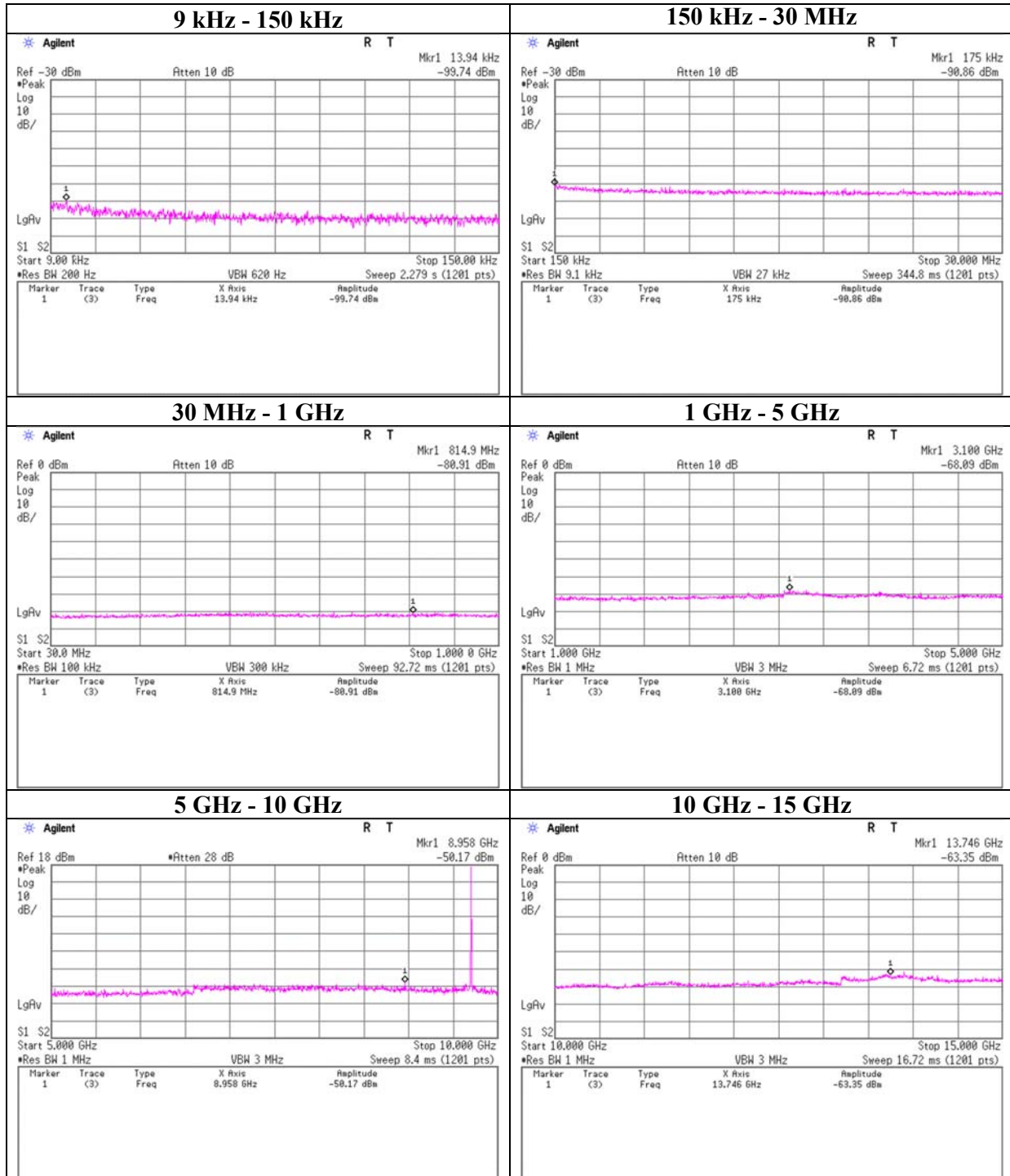
Result[dBm] = Reading[dBm] + Cable Loss[dB] + Attenuator[dB]

*A waveguide was utilized for measurements of frequencies above 18GHz

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

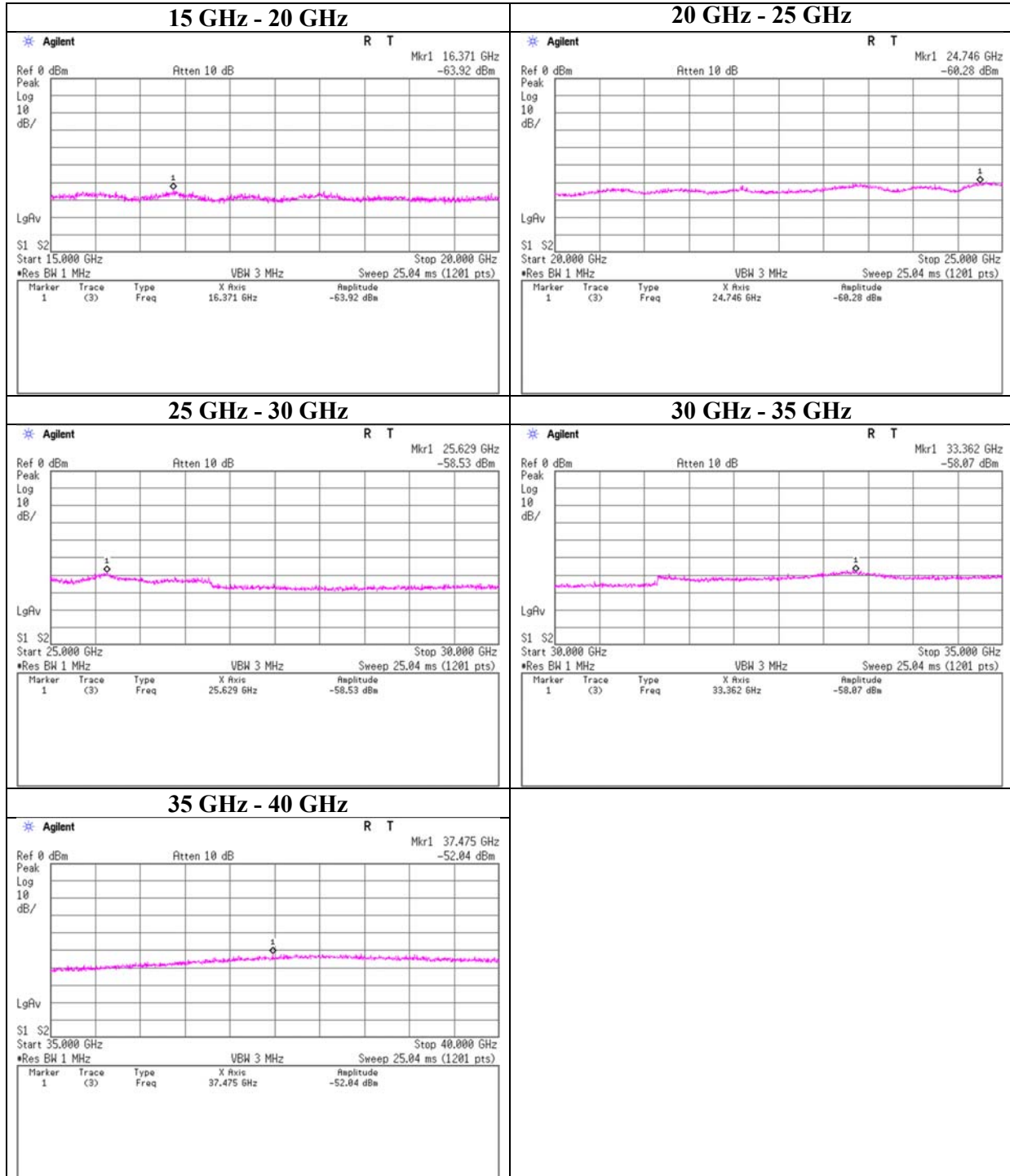
Spurious Emission at Antenna Terminals

Report No.	12514551H
Test place	Ise EMC Lab. No.6 Semi Anechoic Chamber
Date	June 5, 2019
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Ken Fujita
Mode	Transmitting 9700 MHz



Spurious Emission at Antenna Terminals

Report No.	12514551H
Test place	Ise EMC Lab. No.6 Semi Anechoic Chamber
Date	June 5, 2019
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Ken Fujita
Mode	Transmitting 9700 MHz



Spurious Emission at Antenna Terminals

Report No. 12514551H
Test place Ise EMC Lab. No.6 Semi Anechoic Chamber
Date June 5, 2019
Temperature / Humidity 23 deg. C / 43 % RH
Engineer Ken Fujita
Mode Transmitting 9800 MHz

Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten.Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]	Remark
0.012	-99.42	0.00	29.65	-69.77	-13.00	56.77	-
1.046	-91.47	0.00	29.65	-61.82	-13.00	48.82	-
813.300	-80.68	0.91	29.95	-49.82	-13.00	36.82	-
3093.000	-68.41	1.74	30.04	-36.63	-13.00	23.63	-
7383.000	-51.61	2.96	30.10	-18.55	-13.00	5.55	-
13692.000	-63.48	4.28	30.68	-28.52	-13.00	15.52	-
16329.000	-64.07	4.71	31.07	-28.29	-13.00	15.29	-
24808.000	-60.39	5.87	0.00	-54.52	-13.00	41.52	-
25583.000	-59.04	5.97	0.00	-53.07	-13.00	40.07	-
33229.000	-57.96	7.10	0.00	-50.86	-13.00	37.86	-
38762.000	-51.64	7.72	0.00	-43.92	-13.00	30.92	-

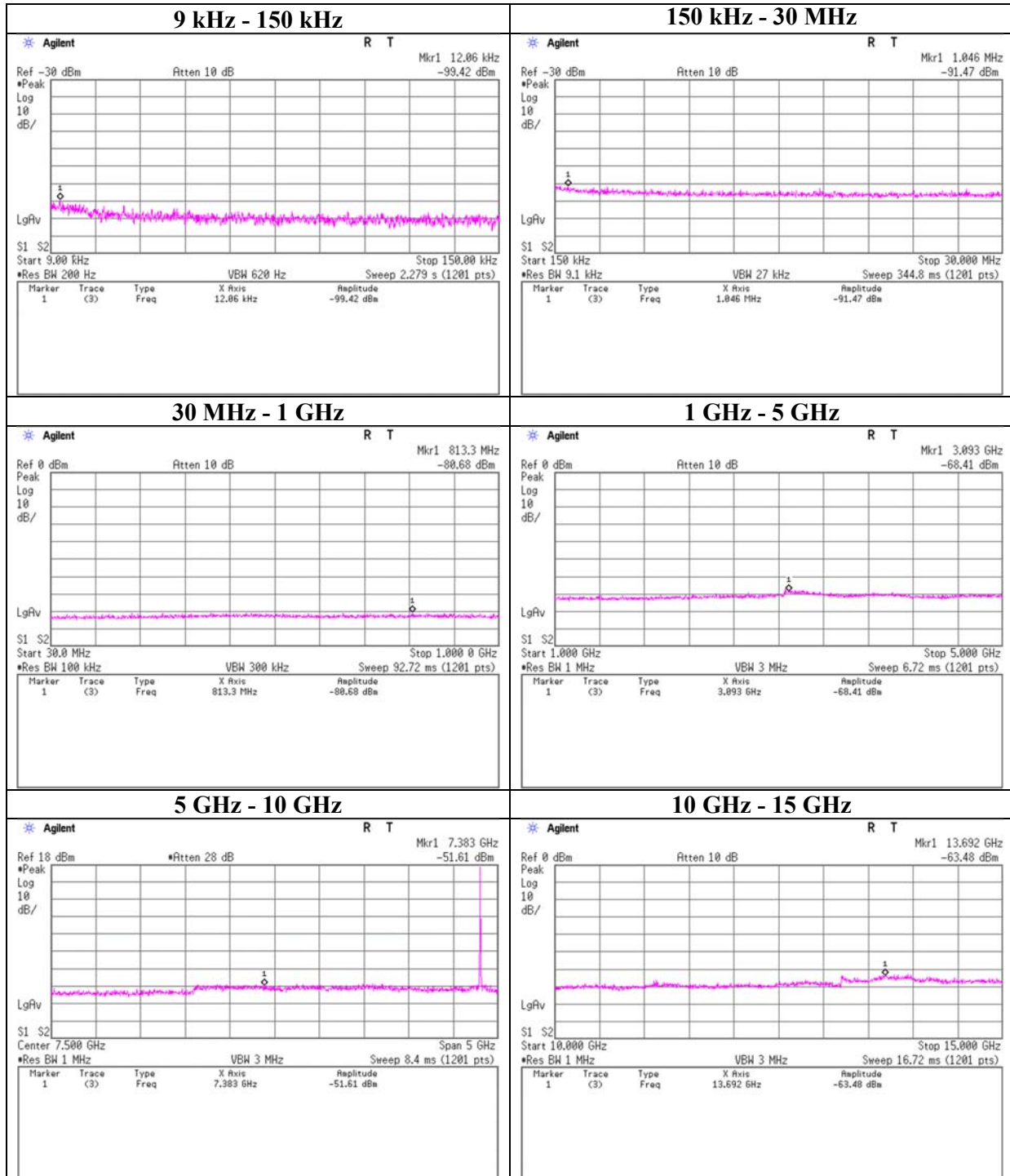
Result[dBm] = Reading[dBm] + Cable Loss[dB] + Attenuator[dB]

*A waveguide was utilized for measurements of frequencies above 18GHz

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

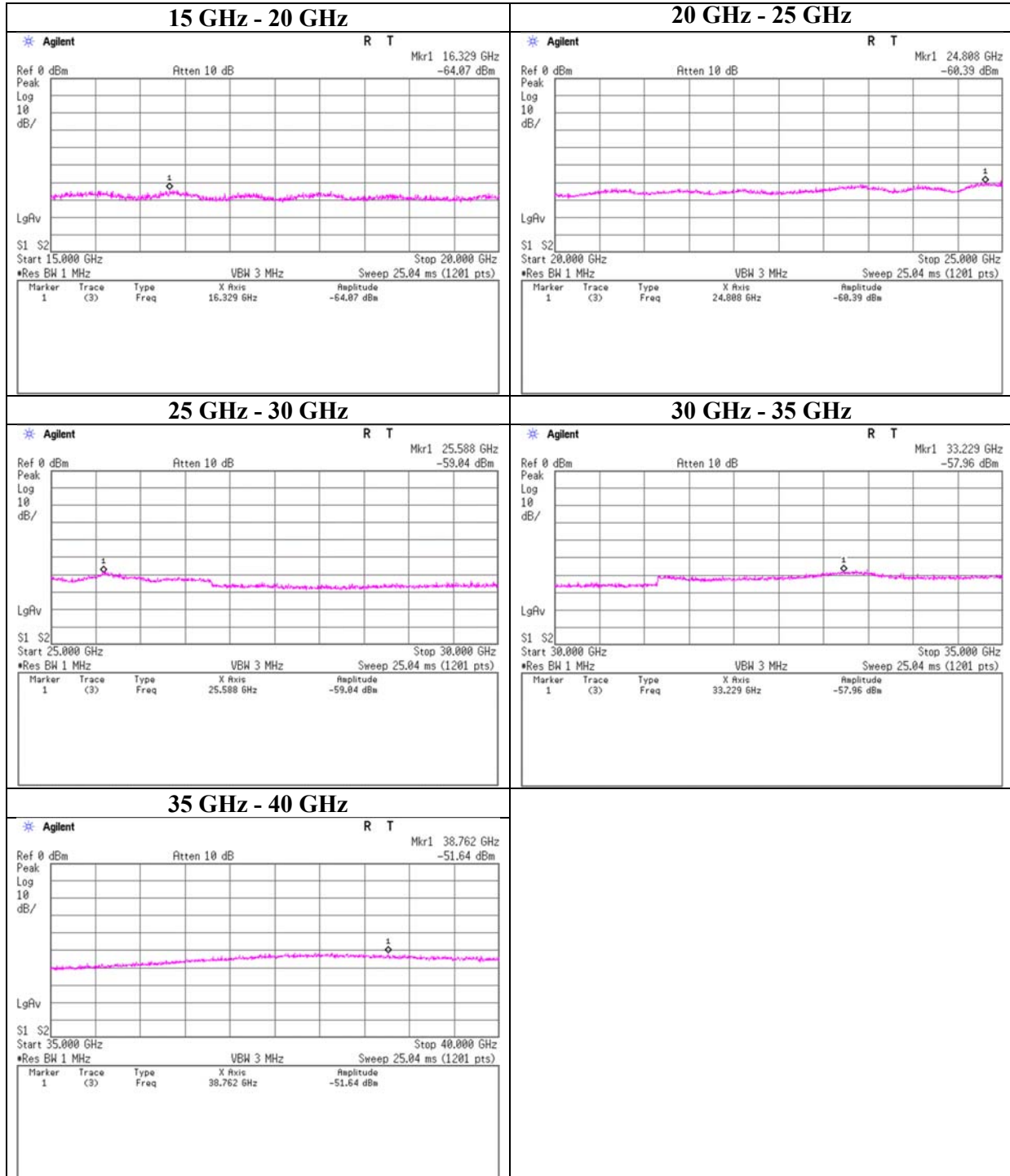
Spurious Emission at Antenna Terminals

Report No.	12514551H
Test place	Ise EMC Lab. No.6 Semi Anechoic Chamber
Date	June 5, 2019
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Ken Fujita
Mode	Transmitting 9800 MHz



Spurious Emission at Antenna Terminals

Report No.	12514551H
Test place	Ise EMC Lab. No.6 Semi Anechoic Chamber
Date	June 5, 2019
Temperature / Humidity	23 deg. C / 43 % RH
Engineer	Ken Fujita
Mode	Transmitting 9800 MHz



Field Strength of Spurious Emission

Report No. 12514551H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date June 5, 2019
Temperature / Humidity 23 deg. C / 43 % RH
Engineer Yuta Moriya
Mode Transmitting 9700 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Result [dBm]	Limit [dBm]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	374.981	PK	57.0	15.1	10.6	31.9	50.8	-44.4	-13.0	31.4	100	49	
Hori.	499.939	PK	49.8	17.6	11.5	32.0	46.8	-48.4	-13.0	35.4	200	231	
Hori.	576.171	PK	53.2	18.6	11.9	32.0	51.7	-43.5	-13.0	30.5	111	288	
Hori.	624.936	PK	62.2	19.5	12.2	32.0	61.9	-33.3	-13.0	20.3	175	253	
Hori.	749.906	PK	57.4	20.2	12.9	31.7	58.7	-36.5	-13.0	23.5	133	48	
Hori.	874.802	PK	56.0	22.1	13.5	31.2	60.4	-34.8	-13.0	21.8	197	296	
Hori.	1124.805	PK	62.3	24.3	3.2	33.8	56.0	-39.2	-13.0	26.2	137	159	
Hori.	1624.700	PK	60.9	25.1	3.6	32.5	57.1	-38.2	-13.0	25.2	136	249	
Hori.	9000.000	PK	49.5	37.6	6.5	31.8	61.9	-33.4	-13.0	20.4	191	233	
Hori.	19400.000	PK	60.9	37.6	-2.0	32.3	64.2	-31.0	-13.0	18.0	150	88	
Hori.	27000.000	PK	80.0	43.4	2.4	77.5	48.3	-46.9	-13.0	33.9	209	189	
Hori.	29100.000	PK	95.0	43.5	2.8	73.7	67.6	-27.6	-13.0	14.6	206	226	
Hori.	36000.000	PK	85.0	43.7	4.4	75.6	57.5	-37.7	-13.0	24.7	204	235	
Hori.	38800.000	PK	89.0	44.2	4.9	74.0	64.1	-31.2	-13.0	18.2	209	191	
Vert.	374.981	PK	60.8	15.1	10.6	31.9	54.5	-40.7	-13.0	27.7	131	212	
Vert.	499.939	PK	52.5	17.6	11.5	32.0	49.6	-45.6	-13.0	32.6	100	328	
Vert.	576.171	PK	54.2	18.6	11.9	32.0	52.8	-42.5	-13.0	29.5	100	20	
Vert.	624.936	PK	64.2	19.5	12.2	32.0	63.9	-31.3	-13.0	18.3	100	11	
Vert.	749.906	PK	54.2	20.2	12.9	31.7	55.5	-39.8	-13.0	26.8	197	223	
Vert.	874.802	PK	53.2	22.0	13.6	31.1	57.7	-37.5	-13.0	24.5	100	321	
Vert.	1124.805	PK	62.2	24.3	3.2	33.8	55.9	-39.3	-13.0	26.3	137	237	
Vert.	1624.700	PK	63.1	25.1	3.6	32.5	59.2	-36.0	-13.0	23.0	141	200	
Vert.	9000.000	PK	55.2	37.6	6.5	31.8	67.5	-27.7	-13.0	14.7	163	156	
Vert.	19400.000	PK	63.0	37.6	-2.0	32.3	66.2	-29.0	-13.0	16.0	147	97	
Vert.	27000.000	PK	83.7	43.4	2.4	77.5	52.0	-43.2	-13.0	30.2	221	166	
Vert.	29100.000	PK	92.4	43.5	2.8	73.7	65.0	-30.3	-13.0	17.3	220	160	
Vert.	36000.000	PK	86.1	43.7	4.4	75.6	58.6	-36.7	-13.0	23.7	223	229	
Vert.	38800.000	PK	92.0	44.2	4.9	74.0	67.1	-28.2	-13.0	15.2	221	163	

Result [dBuV/m] = Reading[dBuV] + Ant Factor [dB/m] + Loss (Cable+Attenuator+Filter-Distance factor(above))[dB] - Gain(Amplifier) [dB]

Distance factor : 10 GHz- 40 GHz : 20 log (1.0 m / 3.0 m) = -9.5 dB

Result [dBm] = 10 x log(((10 ^ ((Result [dBuV/m] -120) / 20)) [V/m]) ^ 2) / (30 x 10 ^ ((Gain = 0 [dBi]) / 10)) x 10 ^ 3)

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

*Below 1 GHz was not signal detected.

Field Strength of Spurious Emission

Report No. 12514551H
Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Date June 5, 2019
Temperature / Humidity 23 deg. C / 43 % RH
Engineer Yuta Moriya
Mode Transmitting 9800 MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Result [dBm]	Limit [dBm]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori	374.981	PK	56.3	15.1	10.6	31.9	50.1	-45.2	-13.0	32.2	100	50	
Hori	499.939	PK	49.5	17.6	11.5	32.0	46.6	-48.7	-13.0	35.7	210	235	
Hori	576.171	PK	53.2	18.6	11.9	32.0	51.8	-43.5	-13.0	30.5	111	285	
Hori	624.936	PK	61.2	19.5	12.2	32.0	60.9	-34.3	-13.0	21.3	169	254	
Hori	749.906	PK	57.9	20.2	12.9	31.7	59.2	-36.0	-13.0	23.0	134	50	
Hori	874.802	PK	53.9	22.0	13.6	31.1	58.4	-36.8	-13.0	23.8	100	302	
Hori	1124.805	PK	62.1	24.3	3.2	33.8	55.8	-39.4	-13.0	26.4	137	159	
Hori	1624.700	PK	61.1	25.1	3.6	32.5	57.3	-38.0	-13.0	25.0	136	249	
Hori	9100.494	PK	50.3	38.0	6.5	31.8	63.1	-32.2	-13.0	19.2	119	200	
Hori	19600.000	PK	57.3	37.6	-2.0	32.3	60.6	-34.6	-13.0	21.6	150	88	
Hori	27300.000	PK	84.0	43.5	2.4	77.4	52.6	-42.6	-13.0	29.6	221	200	
Hori	29400.000	PK	93.0	43.2	2.9	73.9	65.2	-30.1	-13.0	17.1	198	200	
Hori	36400.000	PK	86.2	43.5	4.5	75.1	59.1	-36.1	-13.0	23.1	212	158	
Hori	39200.000	PK	97.0	44.2	4.9	73.7	72.4	-22.8	-13.0	9.8	200	182	
Vert	374.981	PK	61.1	15.1	10.6	31.9	54.9	-40.4	-13.0	27.4	131	212	
Vert	499.939	PK	53.2	17.6	11.5	32.0	50.3	-45.0	-13.0	32.0	100	325	
Vert	576.171	PK	54.8	18.6	11.9	32.0	53.3	-41.9	-13.0	28.9	100	22	
Vert	624.936	PK	64.0	19.5	12.2	32.0	63.7	-31.5	-13.0	18.5	100	14	
Vert	749.906	PK	53.1	20.2	12.9	31.7	54.4	-40.8	-13.0	27.8	198	226	
Vert	874.802	PK	53.4	22.0	13.6	31.1	58.0	-37.3	-13.0	24.3	100	323	
Vert	1124.805	PK	62.1	24.3	3.2	33.8	55.8	-39.4	-13.0	26.4	137	237	
Vert	1624.700	PK	63.5	25.1	3.6	32.5	59.7	-35.6	-13.0	22.6	141	200	
Vert	9100.494	PK	55.4	38.0	6.5	31.8	68.2	-27.1	-13.0	14.1	206	180	
Vert	19600.000	PK	58.4	37.6	-2.0	32.3	61.7	-33.6	-13.0	20.6	150	98	
Vert	27300.000	PK	83.3	43.5	2.4	77.4	51.9	-43.3	-13.0	30.3	222	151	
Vert	29400.000	PK	94.0	43.2	2.9	73.9	66.2	-29.1	-13.0	16.1	223	152	
Vert	36400.000	PK	79.2	43.5	4.5	75.1	52.1	-43.1	-13.0	30.1	225	177	
Vert	39200.000	PK	92.3	44.2	4.9	73.7	67.7	-27.5	-13.0	14.5	188	164	

Result [dBuV/m] = Reading[dBuV] + Ant Factor [dB/m]+ Loss (Cable+Attenuator+Filter-Distance factor(above))[dB] - Gain(Amplifier) [dB]

Distance factor : 10 GHz- 40 GHz : $20 \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

Result [dBm] = $10 \times \log (((10 ^ { (\text{Result [dBuV/m]} - 120) / 20 }) [\text{V/m}]) ^ 2) / (30 \times 10 ^ { (\text{Gain} = 0 \text{ [dB]}) / 10 }) \times 10 ^ 3)$

*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

*Below 1 GHz was not signal detected.

Frequency Stability

Report No. 12514551H
Test place Ise EMC Lab. No.6 Semi Anechoic Chamber
Date September 21, 2018
Temperature / Humidity 23 deg. C / 47 % RH
Engineer Ken Fujita
Mode Transmitting

Test frequency [MHz]	Power Supply [V]	Test temperature [°C]	Measured frequency [MHz]	Frequency error [MHz]	Result [ppm]
9701.1	24.0	50	9701.082173	-0.017827	-1.84
	24.0	40	9701.110282	0.010282	1.06
	24.0	30	9701.123289	0.023289	2.40
	27.6	20	9701.103282	0.003282	0.34
	24.0	20	9701.102188	0.002188	0.23
	20.4	20	9701.103718	0.003718	0.38
	24.0	10	9701.103684	0.003684	0.38
	24.0	0	9701.094281	-0.005719	-0.59
	24.0	-10	9701.080832	-0.019168	-1.98
	24.0	-20	9701.074400	-0.025600	-2.64
	24.0	-30	9701.107528	0.007528	0.78
9698.9	24.0	50	9697.986104	-0.913896	-94.21
	24.0	40	9698.016917	-0.883083	-91.03
	24.0	30	9698.048689	-0.851311	-87.75
	27.6	20	9698.015721	-0.884279	-91.15
	24.0	20	9698.011544	-0.888456	-91.58
	20.4	20	9698.029038	-0.870962	-89.78
	24.0	10	9698.032005	-0.867995	-89.47
	24.0	0	9698.023688	-0.876312	-90.33
	24.0	-10	9697.979571	-0.920429	-94.88
	24.0	-20	9698.001087	-0.898913	-92.66
	24.0	-30	9698.137737	-0.762263	-78.57
9801.1	24.0	50	9801.122641	0.022641	2.33
	24.0	40	9801.103398	0.003398	0.35
	24.0	30	9801.120629	0.020629	2.13
	27.6	20	9801.119213	0.019213	1.98
	24.0	20	9801.106033	0.006033	0.62
	20.4	20	9801.101893	0.001893	0.20
	24.0	10	9801.101343	0.001343	0.14
	24.0	0	9801.093364	-0.006636	-0.68
	24.0	-10	9801.077055	-0.022945	-2.37
	24.0	-20	9801.113581	0.013581	1.40
	24.0	-30	9801.106729	0.006729	0.69
9798.9	24.0	50	9797.998044	-0.901956	-92.97
	24.0	40	9798.012794	-0.887206	-91.45
	24.0	30	9798.024281	-0.875719	-90.27
	27.6	20	9798.024998	-0.875002	-90.20
	24.0	20	9798.025509	-0.874491	-90.14
	20.4	20	9798.024912	-0.875088	-90.20
	24.0	10	9798.026430	-0.873570	-90.05
	24.0	0	9798.017049	-0.882951	-91.02
	24.0	-10	9798.008309	-0.891691	-91.92
	24.0	-20	9797.999597	-0.900403	-92.81
	24.0	-30	9798.008651	-0.891349	-91.88

APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141885	Spectrum Analyzer	AGILENT	E4448A	US44300523	11/07/2018	11/30/2019	12
RE	151897	Microwave Cable	RINEI SEIKI	SF101EA/11PC24/11PC24/2.5M	SN MY1726/1EA	04/17/2019	04/30/2020	12
RE	141266	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	03/25/2019	03/31/2020	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/08/2019	02/29/2020	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/06/2018	08/31/2019	12
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	01/11/2019	01/31/2020	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	01/29/2019	01/31/2020	12
RE	141507	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	05/10/2019	05/31/2020	12
RE	141417	Microwave Cable	Junkosha	MWX221	1404S374(1m) / 1405S074(5m)	05/07/2018	05/31/2019	12
RE	141581	MicroWave System Amplifier	AGILENT	83017A	650	10/04/2018	10/31/2019	12
RE	141513	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	05/10/2019	05/31/2020	12
RE	141517	Horn Antenna 26.5-40GHz	ETS LINDGREN	3160-10	152399	05/16/2019	05/31/2020	12
RE	160324	Coaxial Cable	Huber+Suhner	SUCOFLEX 102A	MY009/2A	11/08/2018	11/30/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/26/2018	06/30/2020	24
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/08/2019	04/30/2020	12
RE	148897	Attenuator	KEYSIGHT	8491A	MY52462349	12/20/2018	12/31/2019	12
RE	141588	Pre Amplifier	MITEQ, Inc	AMF-6F-2600400-33-8P / AMF-4F-2600	1871355 / 1871328	09/21/2018	09/30/2019	12
RE	141323	Coaxial cable	UL Japan	-	-	07/03/2018	07/31/2019	12
RE	141424	Biconical Antenna	Schwarzbeck	BBA9106	1915	05/24/2019	05/31/2020	12
AT	141428	Temperature and Humidity Chamber	TABAI ESPEC	PH-4KT	14005347	12/22/2017	12/31/2018	12
AT	141547	DIGITAL HiTESTER	HIOKI	3805	60500120	02/25/2019	02/29/2020	12
AT	141561	Thermo-Hygrometer	CUSTOM	CTH-201	1401	01/11/2019	01/31/2020	12
AT	141414	Microwave Cable	Junkosha	MWX221	1207S407	08/21/2018	08/31/2019	12
AT	150449	Probe, Electrical, Oscilloscope	KEYSIGHT	DSOX3102T, N2750A	MY56310068, US53331022	11/22/2018	11/30/2019	12
AT	141809	Power Meter	ANRITSU	ML2495A	825002	05/16/2019	05/31/2020	12
AT	141830	Power sensor	ANRITSU	MA2411B	738285	05/16/2019	05/31/2020	12
AT	141174	Attenuator(20dB) (above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-120	901247	01/10/2019	01/31/2020	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

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