



RADIO TEST REPORT

Test Report No. : 12551237H

Applicant : Japan Radio Co., Ltd.
Type of EUT : C-Band Weather Radar Radio Module
Model Number of EUT : GKP-2794
FCC ID : CKEGKP2794
Test regulation : FCC part 90 Subpart I: 2019
Test Result : Complied (Refer to Section 3.2)

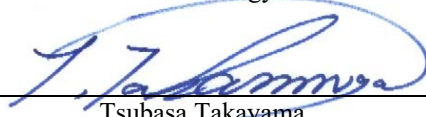
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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
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. Ise 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.

Date of test: April 1 and June 11, 2020

Representative test engineer:


Ken Fujita
Engineer
Consumer Technology Division

Approved by:


Tsubasa Takayama
Leader
Consumer Technology Division



CERTIFICATE 5107.02

- ☐ 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.: 12551237H

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12551237H	June 29, 2020	-	-

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Reference: Abbreviations (Including words undescribed in this report)

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

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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 EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT) other than the Receipt Date
- SECTION 4: Operation of EUT during testing

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

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type	:	C-Band Weather Radar Radio Module
Model Number	:	GKP-2794
Serial Number	:	Refer to Section 4, Clause 4.2
Rating	:	DC 48 V (PA Unit: CAH-5658) DC 12 V (TRX Unit: CMN-856, Signal Processor: CDC-1450, CDC1451, STALO)
Receipt Date	:	April ,1 2020 for Antenna Terminal Conducted test June 11, 2020 for Radiated Emission test
Country of Mass-production	:	Japan
Condition	:	Production model
Modification	:	No Modification by the test lab

2.2 Product Description

Model: GKP-2794 (referred to as the EUT in this report) is a C-Band Weather Radar Radio Module.

Radio Specification

Radio Type	:	Transceiver
Emission designator	:	8M00V0N
Frequency of Operation	:	Center Frequency: 5600 MHz, 5800 MHz Long Pulse: 5598.86 MHz, 5798.86 MHz Short Pulse: 5601.14 MHz, 5801.14 MHz
Clock frequency(ies) in the system	:	12 MHz, 20 MHz, 96 MHz, 192 MHz, 640 MHz
RF output power (specification)	:	400 W
RF output power limit	:	None
Modulation type	:	Non-chirp pulse: CW Chirp pulse: Frequency Modulation
Antenna Connector Type	:	Waveguide
Intermediate frequency	:	60 MHz
Operating Temperature	:	0 deg.C to +60 deg.C
(Antenna information)	(* The antenna of the antenna gain maximum in the antenna with a used possibility.)	
Model No.	:	CAY-104
Antenna type	:	Φ4.3m Parabolic Antenna
Antenna Gain	:	44.5 dBi

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 90: 2019, final revised on April 1, 2020
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	1.80 dB (7687.000 MHz)	Complied d)
5	Field Strength of Spurious Emission	FCC section 2.1053	FCC section 90.210	Radiated	N/A	22.5 dB (4900.000 MHz, Vertical, 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.

UL Japan, Inc.

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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) (Vertical)	4.8 dB
		5.0 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.2 dB
		6.3 dB
10 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		4.9 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.0 dB
		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

UL Japan, Inc. Ise EMC Lab.

*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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Test site	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	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	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	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	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.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
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 x 2.0 m 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.

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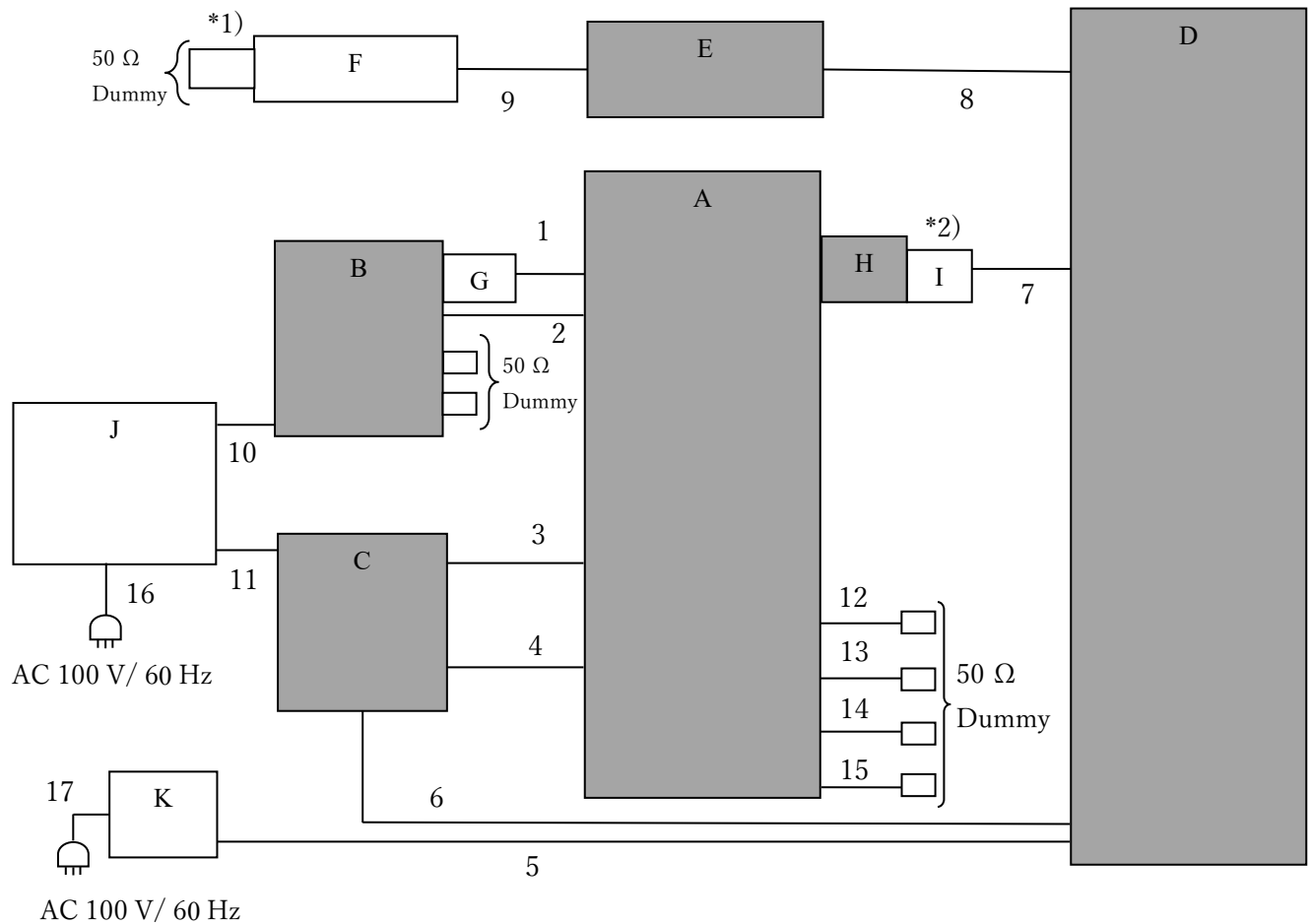
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Test item	Operating mode	Tested frequency
RF output power, Modulation Characteristics, Frequency Stability, Emission masks	Transmitting mode	5601.14 MHz 5598.86 MHz 5801.14 MHz 5798.86 MHz
Occupied Bandwidth, Spurious Emission at Antenna Terminals, Field Strength of Spurious Emission	Transmitting mode	5600 MHz 5800 MHz

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

4.2 Configuration and peripherals



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

*1) Used for Radiated Emission test only

*2) Used for 5800MHz test only

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	TRX Unit	CMN-856	WA74952	Japan Radio Co., Ltd.	EUT *1)
B	Frequency Synthesizer	DCN-DC922-102IR	FSY18-002	Japan Radio Co., Ltd.	EUT *1)
C	Signal Processor	CDC-1450	WA74954	Japan Radio Co., Ltd.	EUT *1)
D	PA Unit	CAH-5658	WA74953	Japan Radio Co., Ltd.	EUT *1)
E	Harmonics Filter	NFH-5659	S7X6772001	Japan Radio Co., Ltd.	EUT *1)
F	Attenuator (30dB)	48-30-34	CA2888	Aeroflex	-
G	10dB ATT	AT-110(40)	000314	HIROSE ELECTRIC CO., LTD.	-
H	HighPass Filter	SCHPF-5600/T5100-0/0	0575C	Sogo Electronics, Inc.	EUT
I	6dB ATT	AT-106(40)	039866	HIROSE ELECTRIC CO., LTD.	-
J	DC 12 V Power supply	PAN16-18A	UD001728	KIKUSUI Electronics corp.	-
K	DC 48 V Power supply	PAN60-10A	SD002896	KIKUSUI Electronics corp.	-

*1) C-Band Weather Radar Radio Module is composed of these items and the system model number is GKP-2794.

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	5.0	Shielded	Shielded	-
4	Signal Cable	5.0	Unshielded	Unshielded	-
5	DC Cable	5.0	Unshielded	Unshielded	-
6	Signal Cable	5.0	Unshielded	Unshielded	-
7	Signal Cable	0.5	Shielded	Shielded	-
8	Signal Cable	0.3	Shielded	Shielded	-
9	Signal Cable	0.5	Shielded	Shielded	-
10	DC Cable	1.5	Unshielded	Unshielded	-
11	DC Cable	1.5	Unshielded	Unshielded	-
12	Signal Cable	1.0	Shielded	Shielded	-
13	Signal Cable	1.0	Shielded	Shielded	-
14	Signal Cable	1.0	Shielded	Shielded	-
15	Signal Cable	1.0	Shielded	Shielded	-
16	AC Cable	1.8	Unshielded	Unshielded	-
17	AC Cable	1.8	Unshielded	Unshielded	-

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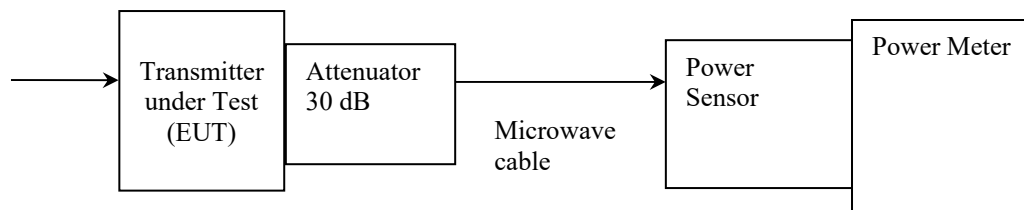
SECTION 5: RF Output power

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)

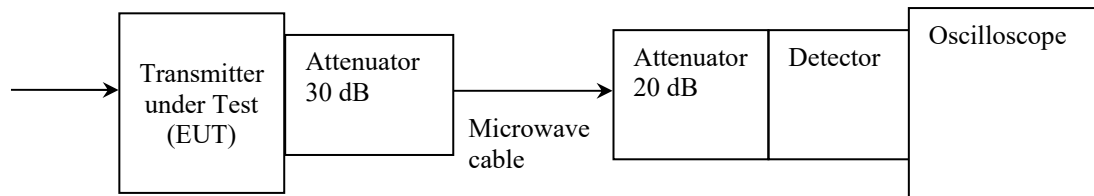
SECTION 6: Modulation Characteristics

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)

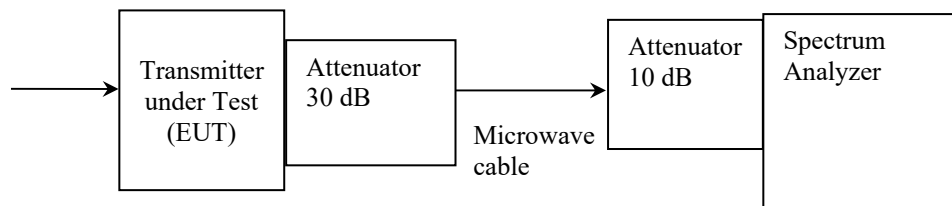
SECTION 7: Occupied Bandwidth and Emission masks

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.

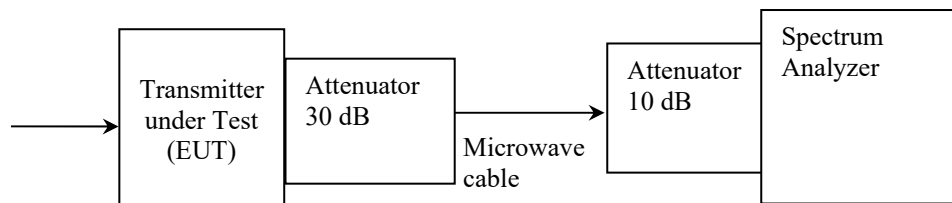
Frequency	RBW	VBW	Sweep time	Detector	Trace	Instrument used
9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
150kHz to 30MHz	9.1 kHz	27 kHz				
Below 1 GHz	100 kHz	300 kHz				
Above 1 GHz	1 MHz	3 MHz				

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 x log (Average power [W] = Peak power x Duty))

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

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

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

E = measurement electric field strength, in dBuV/m

F = measurement electric field strength, in V/m

P = EIRP, in dBm

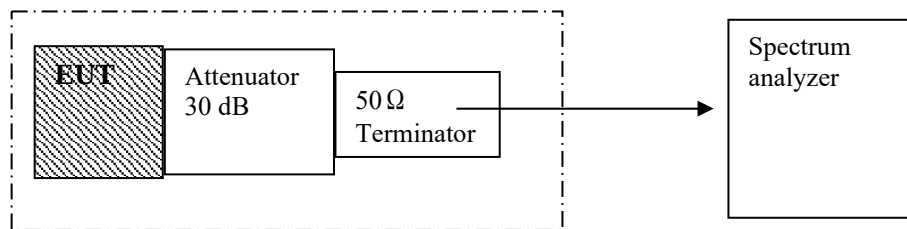
d = measurement distance, in meters = 3 [m]

g = numeric antenna gain (=1)

9.2 Test Data : APPENDIX 1

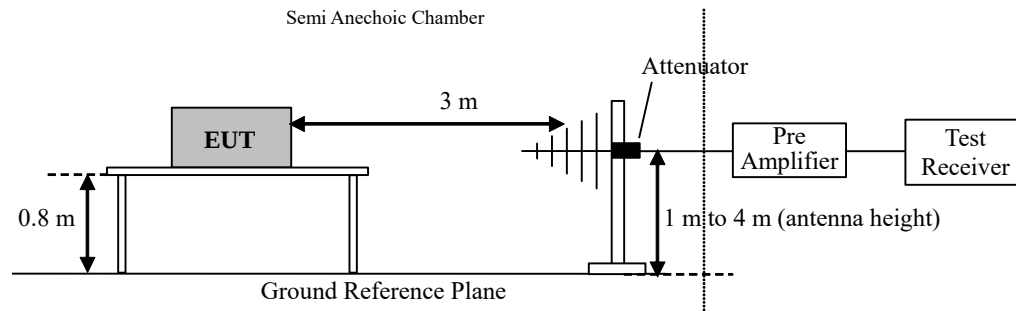
9.3 Test Result : Pass

9.4 Measurement Block Diagram

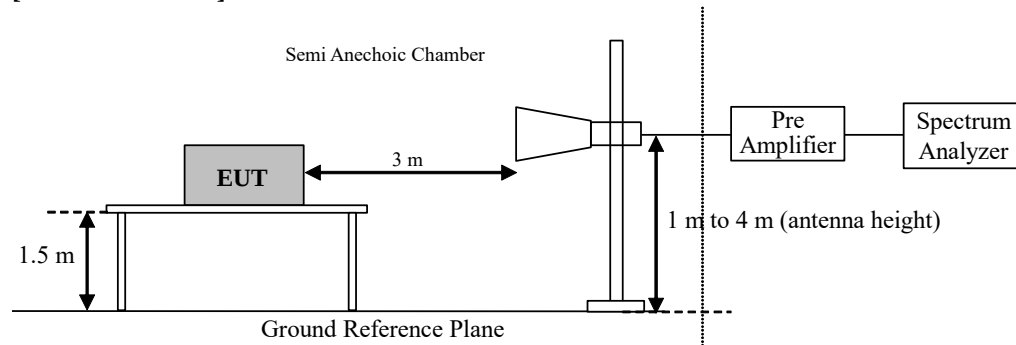


Field Strength of Spurious Emission (FCC section 2.1053)

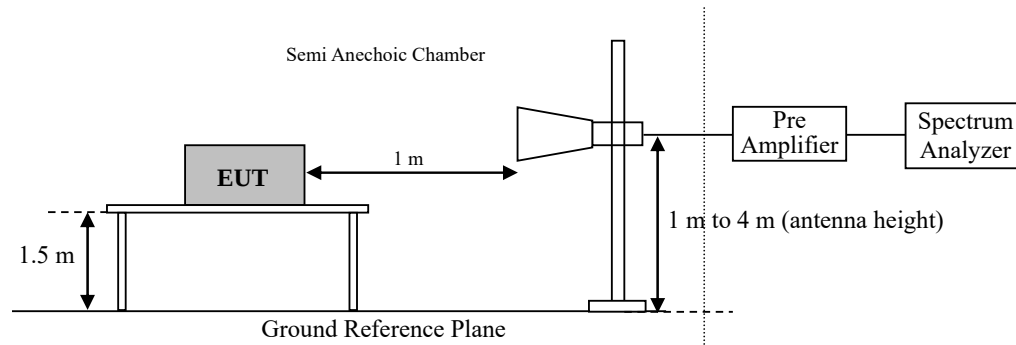
[Below 1 GHz]



[1 GHz to 10 GHz]



[10 GHz to 40 GHz]



SECTION 10: Frequency Stability

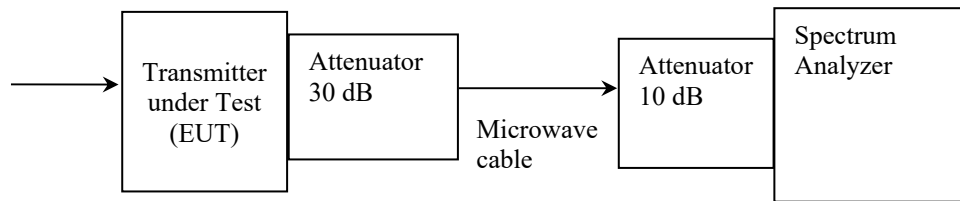
10.1 Test Procedure : FCC part 2 section 2.1055

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. 12551237H
Test place Ise EMC Lab. No.6 Shielded Room
Date April ,1 2020
Temperature / Humidity 23 deg. C / 49 % 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]
5601.14	13.14	2.69	40.17	30.236	25.76	0.38	56.00	398.11
5598.86	12.63	2.68	40.17	15.274	40.21	10.49	55.48	353.18
5801.14	13.14	2.73	40.18	30.100	25.95	0.39	56.05	402.72
5798.86	12.92	2.73	40.18	15.210	40.62	11.53	55.83	382.82

Sample Calculation:

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

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

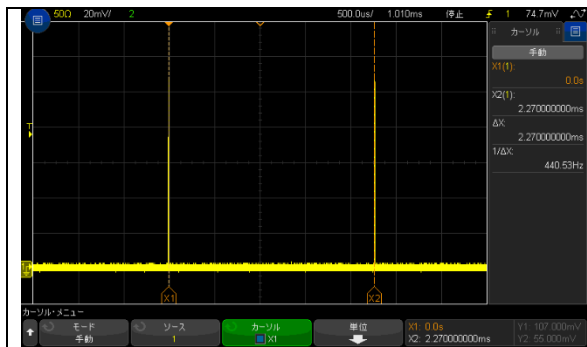
Modulation Characteristics (Pulse chart)

Report No.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting

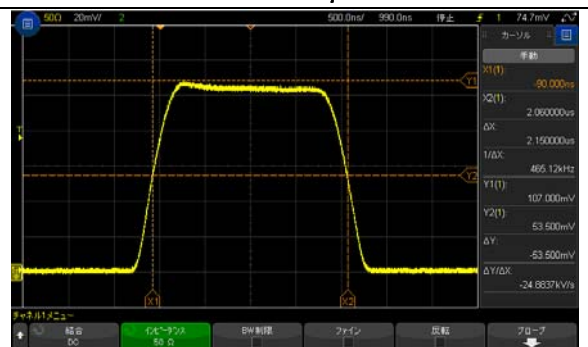
5601.14 MHz Short Pulse

Pulse range table	Pulse 1 cycle time [ms]	Pulse Repetition rate [Hz]	Pulse 50 % length [us]	Duty [%]	Duty factor [dB]	Rise Time [μ s]	Fall Time [μ s]
5601.14 MHz Short Pulse	2.270	440.530	2.150	0.095	30.236	0.340	0.372

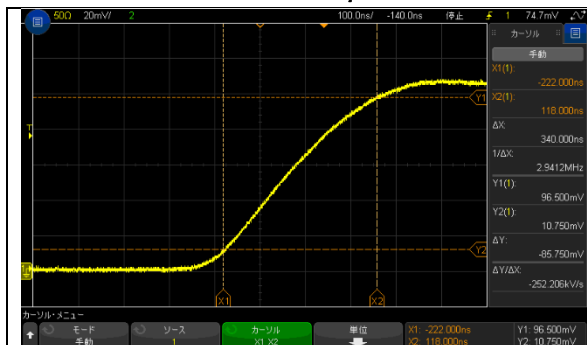
Pulse 1 cycle time
⇒ 2.27 ms



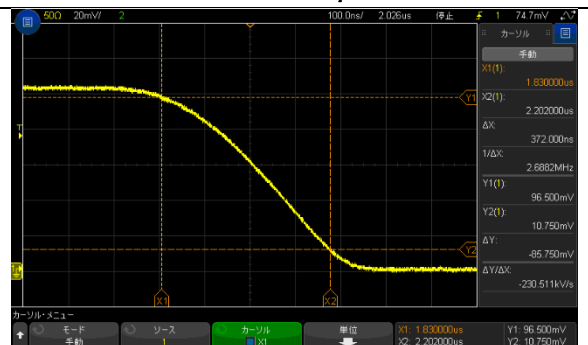
Pulse 50 % length
⇒ 2.15 μ s



Rise time
⇒ 0.340 μ s



Fall time
⇒ 0.372 μ s



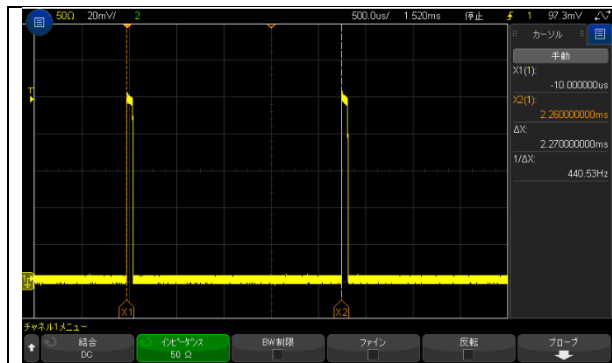
Modulation Characteristics (Pulse chart)

Report No.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting

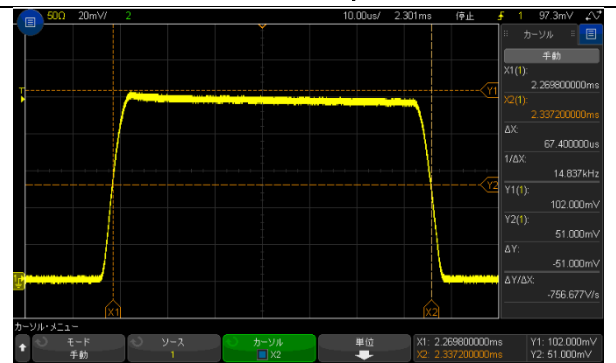
5598.86 MHz Long Pulse

Pulse range table	Pulse 1 cycle time [ms]	Pulse Repetition rate [Hz]	Pulse 50 % length [us]	Duty [%]	Duty factor [dB]	Rise Time [μs]	Fall Time [μs]
5598.86 MHz Long Pulse	2.270	440.530	67.400	2.969	15.274	3.940	4.500

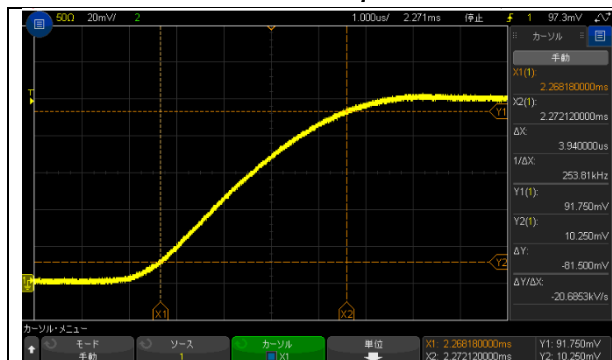
Pulse 1 cycle time
⇒ 2.270 ms



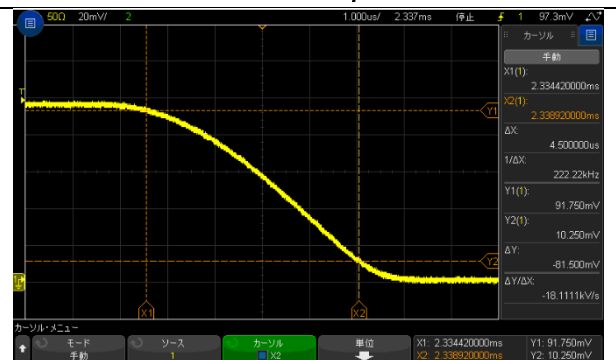
Pulse 50 % length
⇒ 67.40 μs



Rise time
⇒ 3.940 μs



Fall time
⇒ 4.500 μs



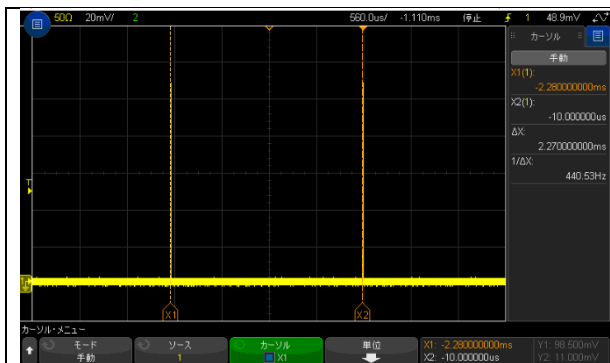
Modulation Characteristics (Pulse chart)

Report No.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting

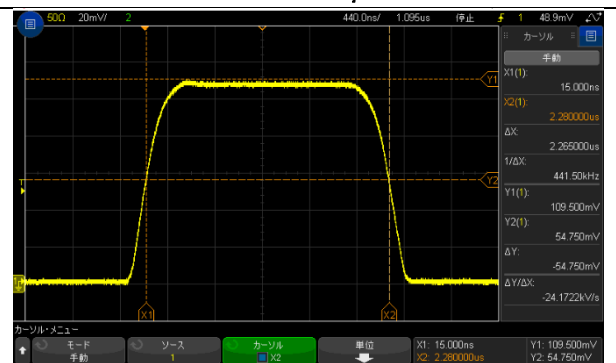
5801.14 MHz Short Pulse

Pulse range table	Pulse 1 cycle time [ms]	Pulse Repetition rate [Hz]	Pulse 50 % length [us]	Duty [%]	Duty factor [dB]	Rise Time [μs]	Fall Time [μs]
5801.14 MHz Short Pulse	2.270	440.530	2.265	0.100	30.010	0.310	0.325

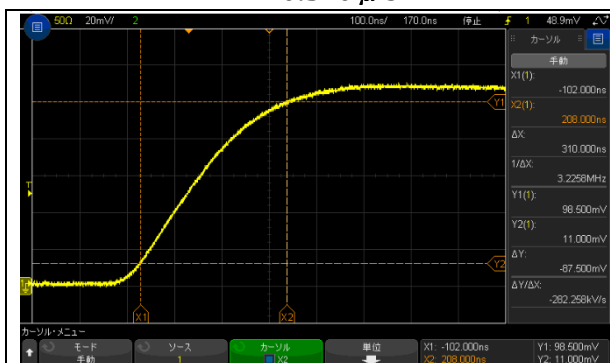
Pulse 1 cycle time
⇒ 2.270 ms



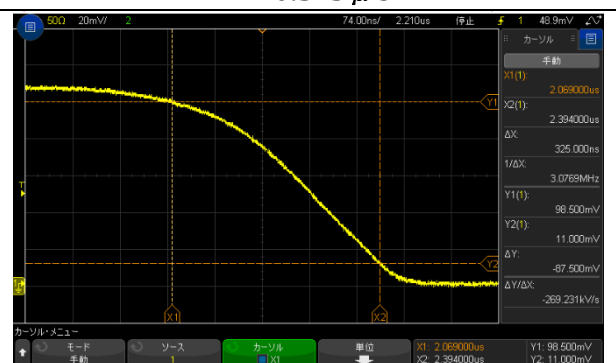
Pulse 50 % length
⇒ 2.265 μs



Rise time
⇒ 0.310 μs



Fall time
⇒ 0.325 μs



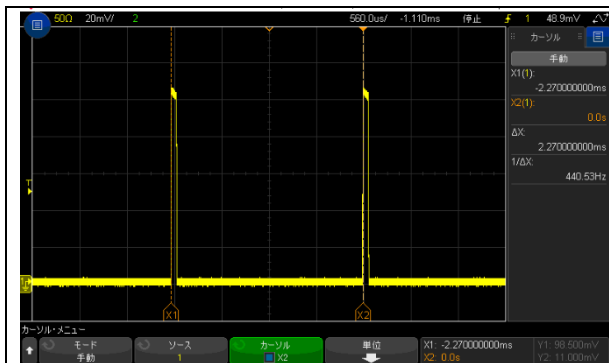
Modulation Characteristics (Pulse chart)

Report No.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting

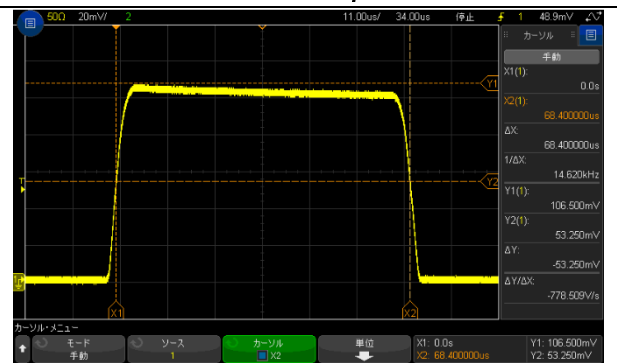
5798.86 MHz Long Pulse

Pulse range table	Pulse 1 cycle time [ms]	Pulse Repetition rate [Hz]	Pulse 50 % length [us]	Duty [%]	Duty factor [dB]	Rise Time [μ s]	Fall Time [μ s]
5798.86 MHz Long Pulse	2.270	440.530	68.400	3.013	15.210	3.660	4.220

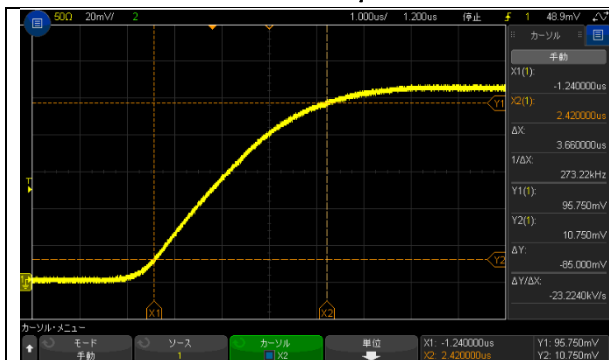
Pulse 1 cycle time
⇒ 2.270 ms



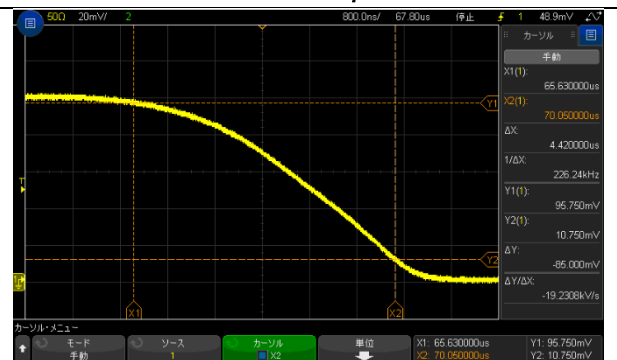
Pulse 50 % length
⇒ 68.4 μ s



Rise time
⇒ 3.660 μ s



Fall time
⇒ 4.420 μ s



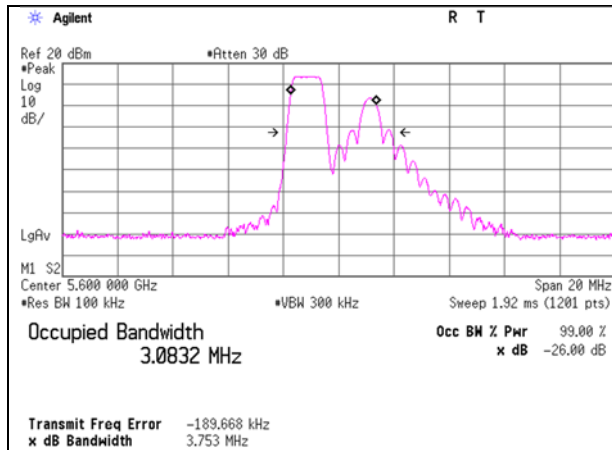
Occupied Bandwidth and Emission masks

Report No.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting

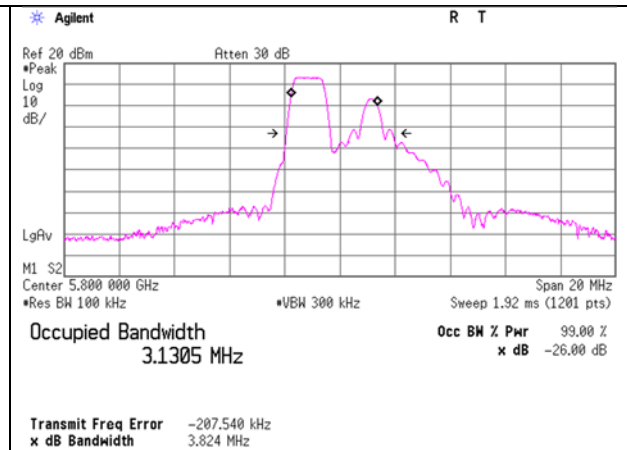
Occupied Bandwidth

Mode	Frequency	99% Occupied Bandwidth	-26dB Bandwidth
	[MHz]	[MHz]	[MHz]
Tx	5600	3.083	3.753
	5800	3.131	3.824

5600 MHz

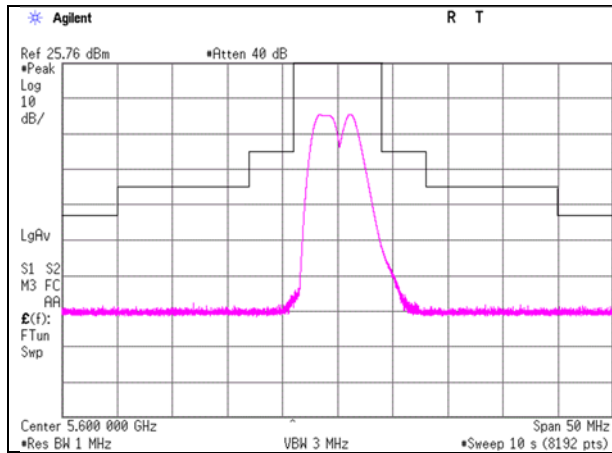


5800 MHz

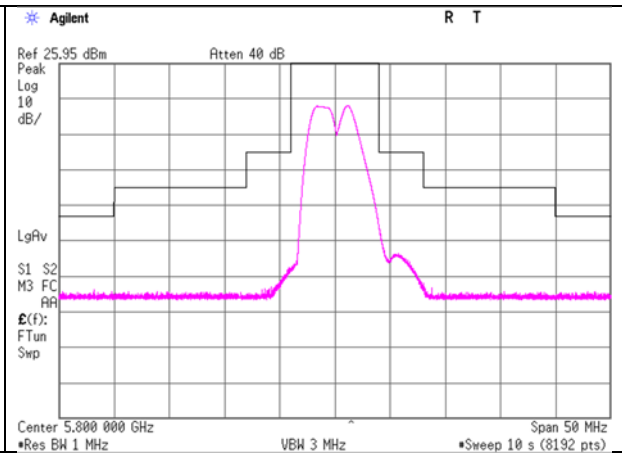


Emission masks

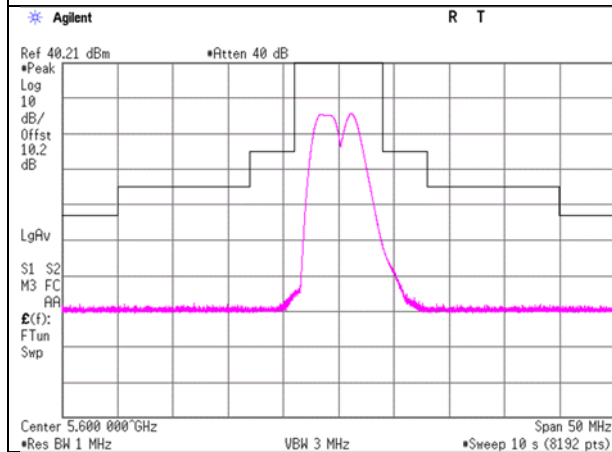
5601.14 MHz



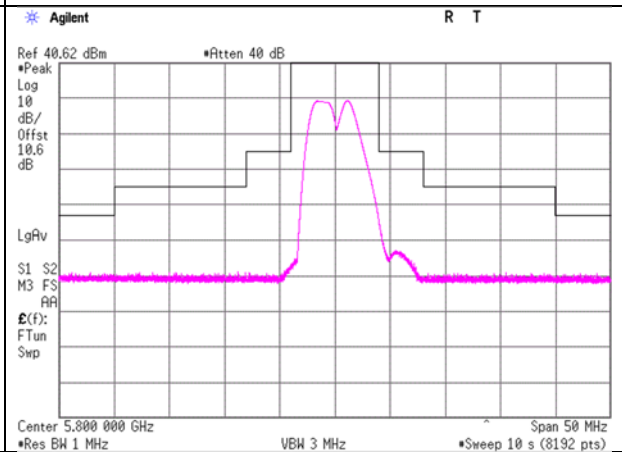
5801.14 MHz



5598.86 MHz



5798.86 MHz



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

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Spurious Emission at Antenna Terminals

Report No. 12551237H
Test place Ise EMC Lab. No.6 Shielded Room
Date April ,1 2020
Temperature / Humidity 23 deg. C / 49 % RH
Engineer Ken Fujita
Mode Transmitting 5600 MHz

Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten.Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]	Remark
0.013	-96.36	0.00	40.05	-56.31	-13.00	43.31	-
0.200	-88.28	0.01	40.06	-48.21	-13.00	35.21	-
632.200	-80.84	0.60	40.07	-40.17	-13.00	27.17	-
3057.000	-68.68	1.97	40.06	-26.65	-13.00	13.65	-
5393.900	-63.03	2.63	40.12	-20.28	-13.00	7.28	-
9657.600	-58.83	3.58	40.28	-14.98	-13.00	1.98	-
14140.000	-64.30	4.30	40.48	-19.52	-13.00	6.52	-
24948.000	-60.73	5.95	0.00	-54.78	-13.00	41.78	-
26083.000	-58.66	6.05	0.00	-52.61	-13.00	39.61	-
33512.000	-56.55	7.01	0.00	-49.54	-13.00	36.54	-
39692.000	-51.97	7.66	0.00	-44.31	-13.00	31.31	-

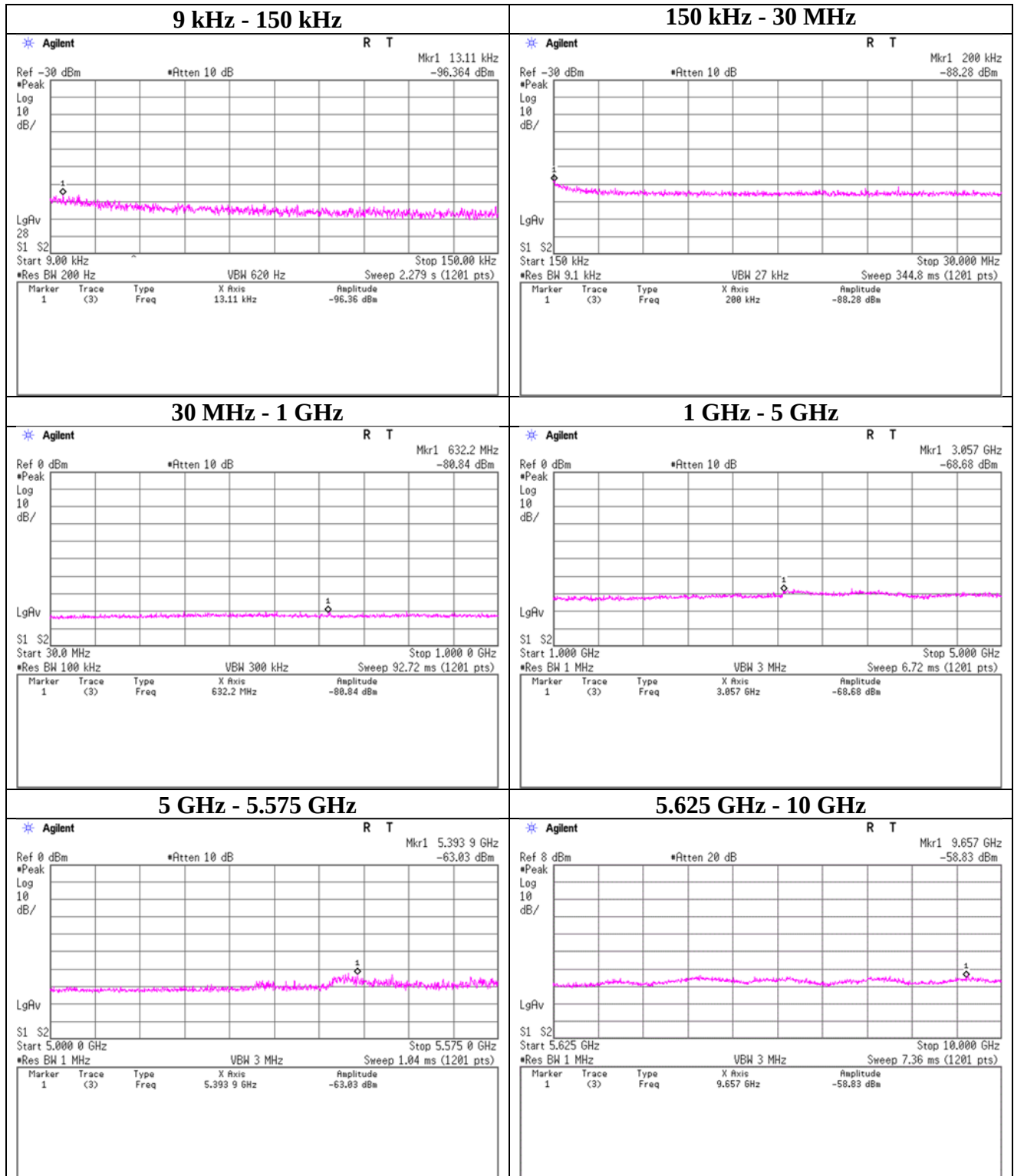
Result[dBm] = Reading[dBm] + Cable Loss[dB] + Attenuator[dB]

*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.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting 5600MHz



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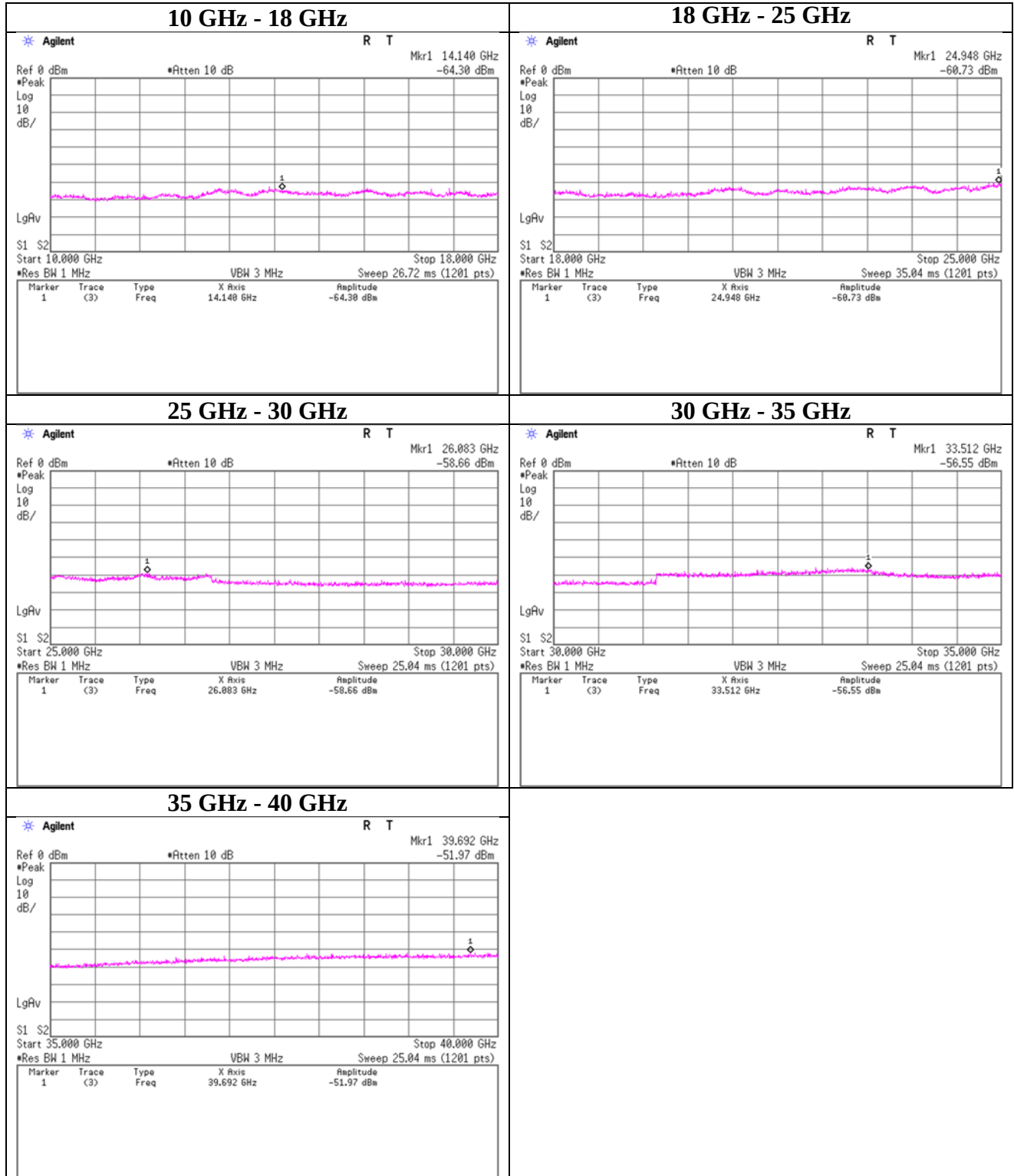
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Spurious Emission at Antenna Terminals

Report No.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting 5600MHz



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Spurious Emission at Antenna Terminals

Report No. 12551237H
Test place Ise EMC Lab. No.6 Shielded Room
Date April ,1 2020
Temperature / Humidity 23 deg. C / 49 % RH
Engineer Ken Fujita
Mode Transmitting 5800MHz

Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten.Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]	Remark
0.012	-93.87	0.00	40.05	-53.82	-13.00	40.82	-
0.150	-88.88	0.01	40.06	-48.81	-13.00	35.81	-
848.000	-80.28	0.60	40.07	-39.61	-13.00	26.61	-
3073.000	-67.27	1.97	40.06	-25.24	-13.00	12.24	-
5740.100	-63.23	2.63	40.12	-20.48	-13.00	7.48	-
7867.000	-58.65	3.58	40.28	-14.80	-13.00	1.80	-
15580.000	-62.58	4.30	40.48	-17.80	-13.00	4.80	-
24982.000	-60.39	5.95	0.00	-54.44	-13.00	41.44	-
26088.000	-58.94	6.05	0.00	-52.89	-13.00	39.89	-
33179.000	-55.37	7.01	0.00	-48.36	-13.00	35.36	-
39392.000	-51.06	7.66	0.00	-43.40	-13.00	30.40	-

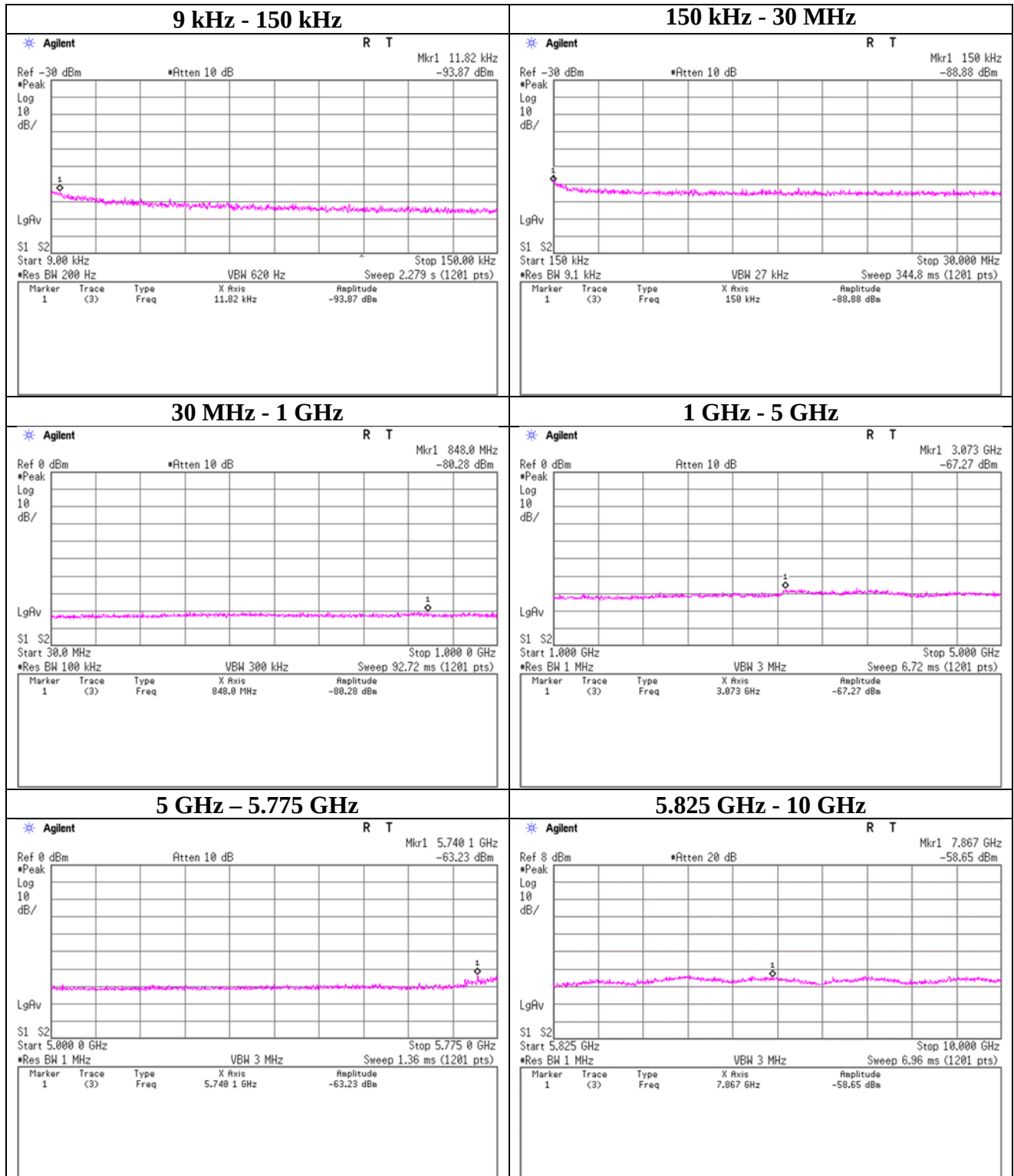
Result[dBm] = Reading[dBm] + Cable Loss[dB] + Attenuator[dB]

*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.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting 5800MHz



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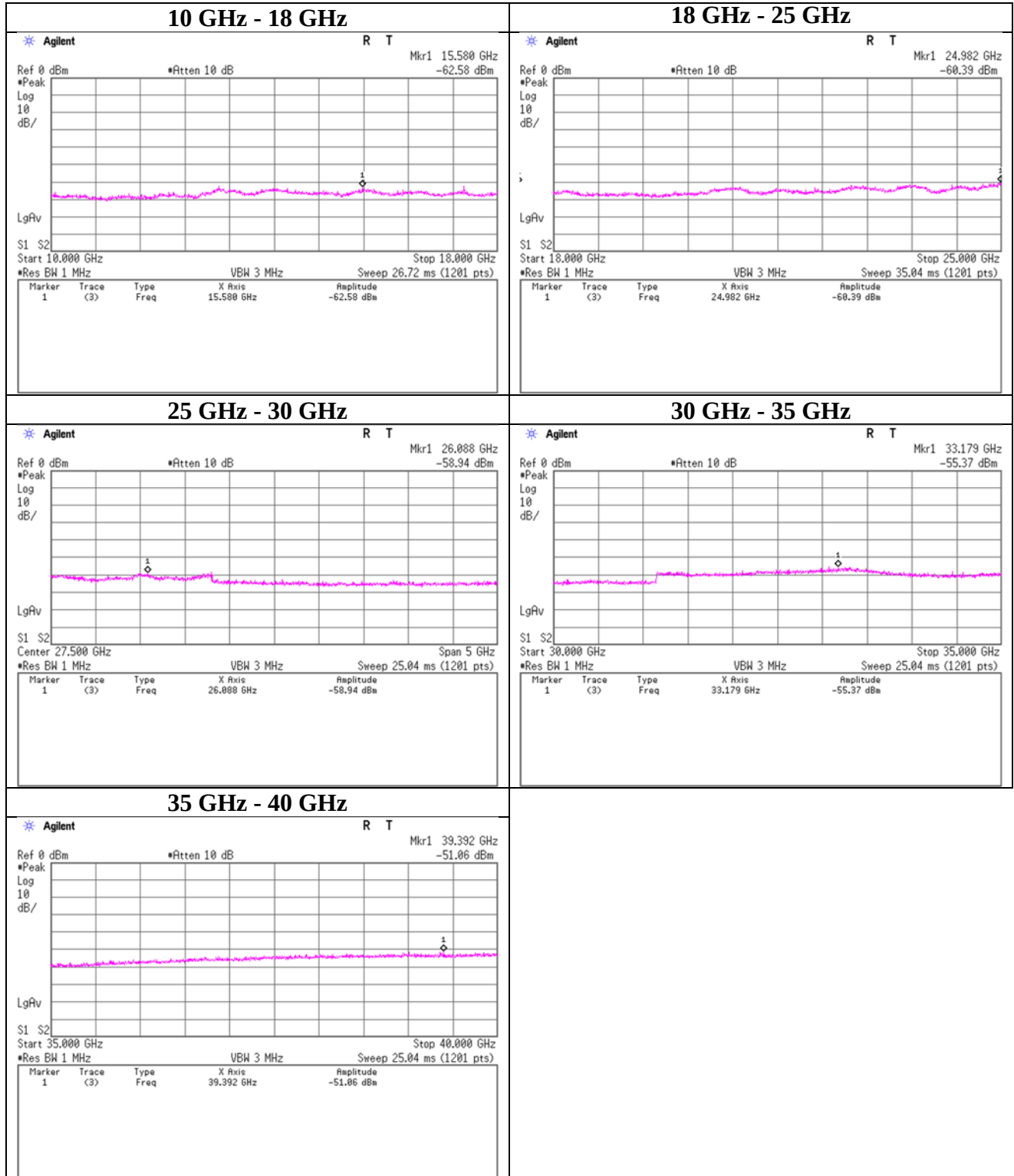
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Spurious Emission at Antenna Terminals

Report No.	12551237H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	April ,1 2020
Temperature / Humidity	23 deg. C / 49 % RH
Engineer	Ken Fujita
Mode	Transmitting 5800MHz



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Field Strength of Spurious Emission

Report No. 12551237H
Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Date June ,11, 2019
Temperature / Humidity 20 deg. C / 48 % RH
Engineer Ken Fujita
Mode Transmitting 5600 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.	374.402	PK	58.4	15.0	11.3	38.5	46.2	-49.1	-13.0	36.1	110	293	
Hori.	5100.000	PK	45.3	32.0	14.2	36.0	55.6	-39.6	-13.0	26.6	190	191	
Hori.	10199.490	PK	45.4	39.8	-2.3	36.7	46.2	-49.0	-13.0	36.0	142	145	
Hori.	15300.000	PK	42.1	38.2	-0.8	35.9	43.6	-51.7	-13.0	38.7	161	152	
Hori.	22400.000	PK	45.9	38.4	-0.4	35.5	48.4	-46.8	-13.0	33.8	0	0	Floor Noise
Hori.	28000.000	PK	69.5	43.6	2.7	76.9	38.8	-56.4	-13.0	43.4	0	0	Floor Noise
Hori.	33600.000	PK	65.9	43.7	3.9	76.0	37.5	-57.8	-13.0	44.8	0	0	Floor Noise
Hori.	39200.000	PK	65.2	44.0	5.4	73.6	40.9	-54.3	-13.0	41.3	0	0	Floor Noise
Vert.	374.402	PK	60.3	15.0	11.3	38.5	48.1	-47.2	-13.0	34.2	223	237	
Vert.	5100.000	PK	47.4	32.0	14.2	36.0	57.7	-37.5	-13.0	24.5	156	172	
Vert.	10199.490	PK	50.6	39.8	-2.3	36.7	51.4	-43.9	-13.0	30.9	180	129	
Vert.	15300.000	PK	42.6	38.2	-0.8	35.9	44.1	-51.2	-13.0	38.2	156	163	
Vert.	22400.000	PK	45.9	38.4	-0.4	35.5	48.4	-46.8	-13.0	33.8	0	0	Floor Noise
Vert.	28000.000	PK	69.4	43.6	2.7	76.9	38.7	-56.5	-13.0	43.5	0	0	Floor Noise
Vert.	33600.000	PK	66.3	43.7	3.9	76.0	37.9	-57.3	-13.0	44.3	0	0	Floor Noise
Vert.	39200.000	PK	65.0	44.0	5.4	73.6	40.7	-54.5	-13.0	41.5	0	0	Floor Noise

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

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

Field Strength of Spurious Emission

Report No. 12551237H
Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Date June ,11, 2019
Temperature / Humidity 20 deg. C / 48 % RH
Engineer Ken Fujita
Mode Transmitting 5800 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.	374.367	PK	58.7	15.0	11.3	38.5	46.5	-48.8	-13.0	35.8	100	279	
Hori.	4900.000	PK	45.3	31.4	14.1	36.0	54.9	-40.4	-13.0	27.4	113	287	
Hori.	10199.490	PK	45.4	39.8	-2.3	36.7	46.2	-49.0	-13.0	36.0	181	252	
Hori.	15300.000	PK	42.1	38.2	-0.8	35.9	43.6	-51.7	-13.0	38.7	161	152	
Hori.	23200.000	PK	37.6	38.8	-0.2	35.4	40.8	-54.4	-13.0	41.4	0	0	Floor Noise
Hori.	29000.000	PK	66.9	43.7	2.9	73.4	40.1	-55.2	-13.0	42.2	0	0	Floor Noise
Hori.	34800.000	PK	66.8	43.6	4.2	76.4	38.1	-57.1	-13.0	44.1	0	0	Floor Noise
Vert.	374.367	PK	60.4	15.0	11.3	38.5	48.2	-47.1	-13.0	34.1	150	294	
Vert.	4900.000	PK	50.2	31.4	14.1	36.0	59.7	-35.5	-13.0	22.5	164	186	
Vert.	10199.490	PK	50.6	39.8	-2.3	36.7	51.4	-43.9	-13.0	30.9	165	134	
Vert.	15300.000	PK	42.6	38.2	-0.8	35.9	44.1	-51.2	-13.0	38.2	156	163	
Vert.	23200.000	PK	37.1	38.8	-0.2	35.4	40.3	-54.9	-13.0	41.9	0	0	Floor Noise
Vert.	29000.000	PK	66.9	43.7	2.9	73.4	40.0	-55.2	-13.0	42.2	0	0	Floor Noise
Vert.	34800.000	PK	66.6	43.6	4.2	76.4	38.0	-57.3	-13.0	44.3	0	0	Floor Noise

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

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

Frequency Stability

Report No. 12551237H
Test place Ise EMC Lab. No.6 Shielded Room
Date April ,1 2020
Temperature / Humidity 23 deg. C / 49 % RH
Engineer Ken Fujita
Mode Transmitting

Test frequency [MHz]	Power Supply [V]	Test temperature * [°C]	Measured frequency [MHz]	Frequency error [MHz]	Result [ppm]
5601.14	48	50	5601.112281	-0.027719	-4.95
	48	40	5601.128910	-0.011090	-1.98
	48	30	5601.139187	-0.000813	-0.15
	55.2	20	5601.159560	0.019560	3.49
	48	20	5601.142462	0.002462	0.44
	40.8	20	5601.143113	0.003113	0.56
	48	10	5601.151230	0.011230	2.00
5598.86	48	0	5601.151340	0.011340	2.02
	48	50	5598.412800	-0.447200	-79.87
	48	40	5598.421900	-0.438100	-78.25
	48	30	5598.429900	-0.430100	-76.82
	55.2	20	5598.427900	-0.432100	-77.18
	48	20	5598.427054	-0.432946	-77.33
	40.8	20	5598.427714	-0.432286	-77.21
5801.14	48	10	5598.431120	-0.428880	-76.60
	48	0	5598.431231	-0.428769	-76.58
	48	50	5801.127891	-0.012109	-2.09
	48	40	5801.128876	-0.011124	-1.92
	48	30	5801.128930	-0.011070	-1.91
	55.2	20	5801.134890	-0.005110	-0.88
	48	20	5801.137782	-0.002218	-0.38
5798.86	40.8	20	5801.139953	-0.000047	-0.01
	48	10	5801.140289	0.000289	0.05
	48	0	5801.141329	0.001329	0.23
	48	50	5798.431209	-0.428791	-73.94
	48	40	5798.453129	-0.406871	-70.16
	48	30	5798.454551	-0.405449	-69.92
	55.2	20	5798.457190	-0.402810	-69.46
	48	20	5798.457140	-0.402860	-69.47
	40.8	20	5798.456129	-0.403871	-69.65
	48	10	5798.456713	-0.403287	-69.55
	48	0	5798.468129	-0.391871	-67.58

*The test was performed from the lowest temperature (0deg.C) of the equipment specifications.
Since the EUT does not operate at less than 0 deg.C.

APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MAEC-01	141998	AC1 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	2020/06/08	24
RE	MOS-27	141566	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	2020/01/07	12
RE	MMM-03	141530	Digital Tester	Fluke Corporation	FLUKE 26-3	78030621	2019/08/20	12
RE	MJM-25	142226	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-01-SVSWR	141994	AC1 Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 10m	DA-06881	2019/04/16	24
RE	MAT-08	141213	Attenuator(6dB)	Weinschel Corp	2	BK7971	2019/11/14	12
RE	KBA-05	141198	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHA9103 +BBA9106	2513	2020/04/22	12
RE	MCC-02	141350	Coaxial Cable	Suhner/storm/Agilent/T SJ	-	-	2020/06/25	12
RE	MTR-09	141950	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	2020/06/03	12
RE	MLA-20	141264	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess - Elektronik	VUSLP9111B	9111B-189	2020/04/22	12
RE	MPA-19	141585	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	2020/02/10	12
RE	MHA-05	141511	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	253	2019/09/03	12
RE	MCC-217	141393	Microwave Cable	Junkosha	MWX221	1604S254(1 m) / 1608S088(5 m)	2019/08/06	12
RE	MPA-01	141576	Pre Amplifier	Keysight Technologies Inc	8449B	3008A01671	2020/02/20	12
RE	MHA-02	141503	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	2020/06/15	12
RE	MHA-29	141517	Horn Antenna 26.5-40GHz	ETS LINDGREN	3160-10	152399	2019/09/19	12
RE/AT	MCC-224	160324	Coaxial Cable	Huber+Suhner	SUCOFLEX 102A	MY009/2A	2019/11/22	12
RE	MPA-22	141588	Pre Amplifier	MITEQ, Inc	AMF-6F-2600400-33-8P / AMF-4F-2600400-33-8P	1871355 /1871328	2019/09/27	12
RE	MCC-54	141325	Microwave Cable	Suhner	SUCOFLEX101	2873(1m) / 2876(5m)	2020/03/24	12
RE/AT	MAT-56	141214	Attenuator(10dB)	Suhner	6810.19.A	-	-	-
RE/AT	MAT-21	141174	Attenuator(20dB) (above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-120	901247	2020/01/07	12
RE/AT	MSA-03	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	2020/03/04	12
AT	MOS-14	141561	Thermo-Hygrometer	CUSTOM	CTH-201	1401	2020/01/07	12
AT	MMM-12	141547	DIGITAL HiTESTER	Hioki	3805	60500120	2020/02/03	12
AT	MCH-04	141429	Temperature and Humidity Chamber	ESPEC	PL-2KP	14015723	2019/08/02	12

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

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

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

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

Test item: RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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