



RADIO TEST REPORT

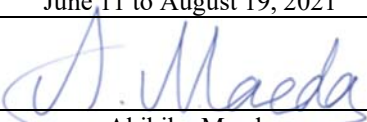
Test Report No. : 13720501H-A

Applicant : Sound Devices, LLC
Type of EUT : Digital Wireless Microphone Transmitter
Model Number of EUT : A20-MINI
FCC ID : 2AKLX-9295
Test regulation : FCC Part 74: 2018
Test Result : Complied (Refer to SECTION 3)

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2. The results in this report apply only to the sample tested.
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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. Ise EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
9. The information provided from the customer for this report is identified in Section 1.

Date of test: June 11 to August 19, 2021

Representative test engineer:


Akihiko Maeda
Engineer

Approved by:


Tsubasa Takayama
Leader



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.: 13720501H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13720501H-A	October 20, 2021	-	-

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Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	NS	No signal detect.
AC	Alternating Current	NSA	Normalized Site Attenuation
AFH	Adaptive Frequency Hopping	NVLAP	National Voluntary Laboratory Accreditation Program
AM	Amplitude Modulation	OBW	Occupied Band Width
Amp, AMP	Amplifier	OFDM	Orthogonal Frequency Division Multiplexing
ANSI	American National Standards Institute	P/M	Power meter
Ant, ANT	Antenna	PCB	Printed Circuit Board
AP	Access Point	PER	Packet Error Rate
Atten., ATT	Attenuator	PHY	Physical Layer
AV	Average	PK	Peak
BPSK	Binary Phase-Shift Keying	PN	Pseudo random Noise
BR	Bluetooth Basic Rate	PRBS	Pseudo-Random Bit Sequence
BT	Bluetooth	PSD	Power Spectral Density
BT LE	Bluetooth Low Energy	QAM	Quadrature Amplitude Modulation
BW	BandWidth	QP	Quasi-Peak
Cal Int	Calibration Interval	QPSK	Quadri-Phase Shift Keying
CCK	Complementary Code Keying	RBW	Resolution Band Width
Ch., CH	Channel	RDS	Radio Data System
CISPR	Comite International Special des Perturbations Radioelectriques	RE	Radio Equipment
CW	Continuous Wave	RF	Radio Frequency
DBPSK	Differential BPSK	RMS	Root Mean Square
DC	Direct Current	RSS	Radio Standards Specifications
DFS	Dynamic Frequency Selection	Rx	Receiving
DQPSK	Differential QPSK	SA, S/A	Spectrum Analyzer
DSSS	Direct Sequence Spread Spectrum	SG	Signal Generator
EDR	Enhanced Data Rate	SVSWR	Site-Voltage Standing Wave Ratio
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	TR	Test Receiver
EMC	ElectroMagnetic Compatibility	Tx	Transmitting
EMI	ElectroMagnetic Interference	VBW	Video BandWidth
EN	European Norm	Vert.	Vertical
ERP, e.r.p.	Effective Radiated Power	WLAN	Wireless LAN
EU	European Union		
EUT	Equipment Under Test		
Fac.	Factor		
FCC	Federal Communications Commission		
FHSS	Frequency Hopping Spread Spectrum		
FM	Frequency Modulation		
Freq.	Frequency		
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		

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SECTION 1: Customer information

Company Name	:	Sound Devices, LLC
Address	:	PO Box 576, E7556 State Rd 23 and 33, Reedsburg, WI, 53959, US
Telephone Number	:	+1 608 524 0625
Contact Person	:	Lee Stone of Audio Ltd (E-mail: lee.stone@audioltd.com)

The information provided from the customer is as follows;

- Applicant, Type of EUT, Model Number of EUT, FCC ID 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	:	Digital Wireless Microphone Transmitter
Model Number	:	A20-MINI
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 3.6 V to 4.5 V
Receipt Date	:	May 14, 2021
Country of Mass-production	:	Taiwan
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: A20-MINI (referred to as the EUT in this report) is a Digital Wireless Microphone Transmitter.

General Specification

Clock frequency(ies) in the system
(Maximum) : 11.296 MHz, 16 MHz, 32 MHz, 52 MHz

Radio Specification (Radio microphone) *1)

Radio type	: Transmitter
Modulation type	: COFDM
Emission designator	: 200KG2E
Necessary bandwidth	: 200 kHz
Channel spacing	: 400 kHz
Frequency of operation	: 470 MHz to 608 MHz 653 MHz to 657 MHz
RF power	: 2 mW (470 MHz to 608 MHz, 653 MHz to 657 MHz) 10 mW (470 MHz to 608 MHz, 653 MHz to 657 MHz) 20 mW (470 MHz to 608 MHz) 40 mW (470 MHz to 608 MHz)
Antenna type	: External 1/4-wave antenna
Antenna gain	: 2.14 dBi
Operating temperature	: 0 deg. C to 55 deg. C

Radio Specification (Bluetooth Low Energy)

Equipment Type	: Transceiver
Frequency of Operation	: 2402 MHz to 2480MHz
Type of Modulation	: GFSK
Antenna Type	: 2.4 GHz SMD Antenna
Antenna Gain	: 1.8 dBi

*1) This test report applies for Radio microphone part (470 MHz to 608 MHz, 653 MHz to 657 MHz).

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 74: 2018

Title : FCC 47CFR Part74
EXPERIMENTAL RADIO, AUXILIARY, SPECIAL BROADCAST AND OTHER
PROGRAM DISTRIBUTIONAL SERVICES

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods	FCC: Section 15.207	N/A	N/A	*1)
RF power output	FCC: Section 2.1046	FCC: Section 74.861 (e) (1)	See data.	Complied a)	Conducted
Occupied Bandwidth	FCC: Section 2.1049	FCC: Section 74.861 (e) (5)	See data.	Complied b)	Conducted
Spurious emissions at antenna terminals	EN 300 422-1 V 1.4.2 Clause 8.4	FCC: Section 74.861 (e) (6)	See data.	Complied c)	Conducted
Emission Mask	EN 300 422-1 V 1.4.2 Clause 8.3	FCC: Section 74.861 (e) (7)	See data.	Complied d)	Conducted
Field strength of spurious radiation	EN 300 422-1 V 1.4.2 Clause 8.4	FCC: Section 74.861 (e) (7)	8.5 dB 120.09 MHz, Vertical	Complied e)	Radiated
Frequency stability	FCC: Section 2.1055	FCC: Section 74.861 (e) (4)	See data.	Complied f)	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 operates in RF mode only by battery and not by USB power supply.

- a) Refer to APPENDIX 1 (data of RF power output)
- b) Refer to APPENDIX 1 (data of Spurious emissions at antenna terminals)
- c) Refer to APPENDIX 1 (data of Occupied Bandwidth)
- d) Refer to APPENDIX 1 (data of Emission mask)
- e) Refer to APPENDIX 1 (data of Field strength of spurious radiation)
- 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, KDB 206256 D01 Wireless Microphones v02 and ANSI C63.26: 2015 are also referred.

3.3 Addition to standard

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

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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 $k=2$.
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Spurious Emission (EUT height: 1.5m)	dB
Mesurment Distance 3m	
•25 MHz - 200 MHz	5.6
•200 MHz - 1000 MHz	4.0
•1 GHz - 12.75 GHz	4.6

Antenna terminal test	Uncertainty (+/-)
RF output power	1.3 dB
Occupied bandwidth	
Span 1 MHz	0.96%
Emission mask	1.9 dB
Frequency stability	0.0154 ppm
Spurious emissions at antenna terminals	2.3 dB

3.5 Test Location

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*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

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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.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-

* 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.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	Remarks*
Transmitting (Tx), Power setting: 2 mW	Typ. 2 mW
Transmitting (Tx), Power setting: 10 mW	Typ. 10 mW
Transmitting (Tx), Power setting: 20 mW	Typ. 20 mW
Transmitting (Tx), Power setting: 40 mW	Typ. 40 mW
*Transmitting duty was 100 % on all tests.	
*Power of the EUT was set by the software as follows; Power settings: 2 mW, 10 mW, 20 mW, 40 mW Software: RealTerm: Serial Capture program 2.0.0.69 (Date: 2021.04.01 Storage location: Driven by connected PC)	
*This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product except 2mW, 10mW, 20mW and 40mW settings.	

*The details of Operating mode(s)

Test Item	Tested frequency		Power setting	Modulation	Remarks
RF power output	470.100 MHz (Low)		2 mW,	Digital modulation (PN9 data packet)	-
	539.000 MHz (Mid)		10 mW,		
	607.900 MHz (High)		20 mW		
			40 mW		
	653.100 MHz (Low)		10 mW		
	655.000 MHz (Mid)				
	656.900 MHz (High)				
Occupied Bandwidth	470.100 MHz (Low)		40 mW	Digital modulation (PN9 data packet)	-
	539.000 MHz (Mid)				
	607.900 MHz (High)				
	653.100 MHz (Low)		10 mW		
	655.000 MHz (Mid)				
	656.900 MHz (High)				
Spurious emissions at antenna terminals	470.100 MHz (Low)		40 mW	Digital modulation (PN9 data packet)	-
	539.000 MHz (Mid)				
	607.900 MHz (High)				
	653.100 MHz (Low)		10 mW		
	655.000 MHz (Mid)				
	656.900 MHz (High)				
Emission Mask	470.100 MHz (Low)		2 mW	Digital modulation (PN9 data packet)	-
	539.000 MHz (Mid)		40 mW		
	607.900 MHz (High)				
	653.100 MHz (Low)		2 mW		
	655.000 MHz (Mid)		40 mW		
	656.900 MHz (High)				
Field strength of spurious radiation	470.100 MHz (Low)		40 mW	Digital modulation (PN9 data packet)	-
	539.000 MHz (Mid)				
	607.900 MHz (High)				
	653.100 MHz (Low)		10 mW		
	655.000 MHz (Mid)				
	656.900 MHz (High)				
Frequency stability	539.000 MHz (Mid)		40 mW	No modulation	*1)
	655.000 MHz (Mid)		10 mW		
*The isolator of RF filter circuit is consisted of passive component. It does not contain non-linear component. Therefore the test was performed on lowest, near middle and highest frequency that was chosen from available frequency band. *1) There is no difference in frequency generating method on each frequency. Therefore the test was performed on Mid channel as a representative.					

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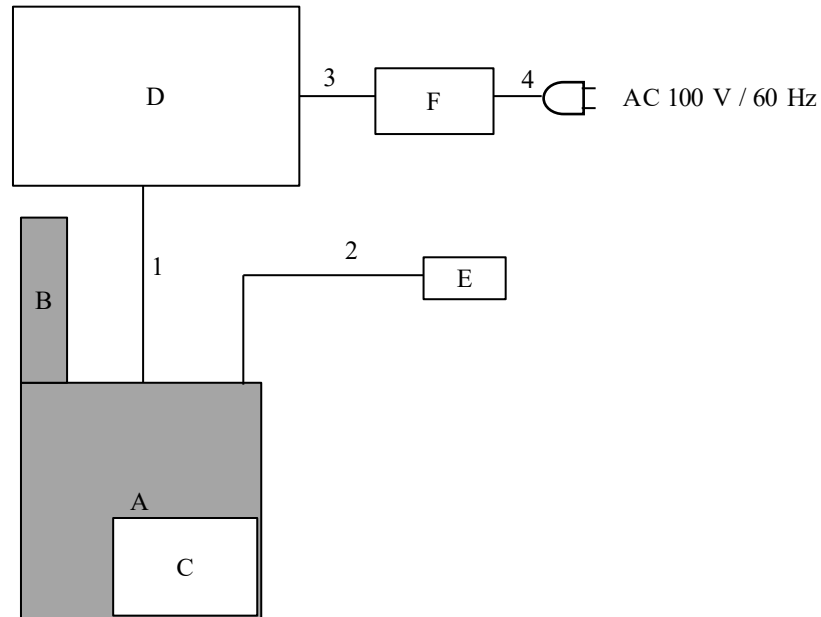
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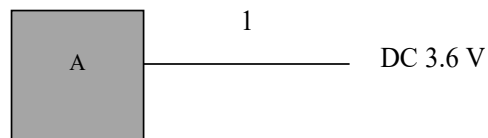
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4.2 Configuration and peripherals

【Radiated Emission test】



【Antenna Terminal Conducted test】



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Digital Wireless Microphone Transmitter	A20-MINI	GE0521099001 For *RE GE0521099000 For *AT	Sound Devices LLC	EUT
B	SMA Antenna Straight: 470 MHz - 548 MHz 548 MHz - 638 MHz	9162.000 11225.000	-	Sound Devices LLC	EUT *1)
C	Battery	NP-BX1	3852248	DuraPro	EUT
D	Laptop PC	184223	X1 Carbon	LENOVO	-
E	Lavalier Microphone Black	VT 506	-	Voice Technologies	-
F	AC Adapter	ADLX45NCC2A	8SSA10E75794C1SG 59R0GHF	LENOVO	-

*1) Used for RE tests.

*RE: Radiated Emission test

*AT: Antenna Terminal Conducted test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	1.6	Shielded	Shielded	-
2	Audio Cable	1.3	Unshielded	Unshielded	-
3	Signal Cable	1.5	Unshielded	Unshielded	-
4	DC Cable	1.2	Unshielded	Unshielded	-

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SECTION 5: Field strength of spurious radiation

Test Procedure

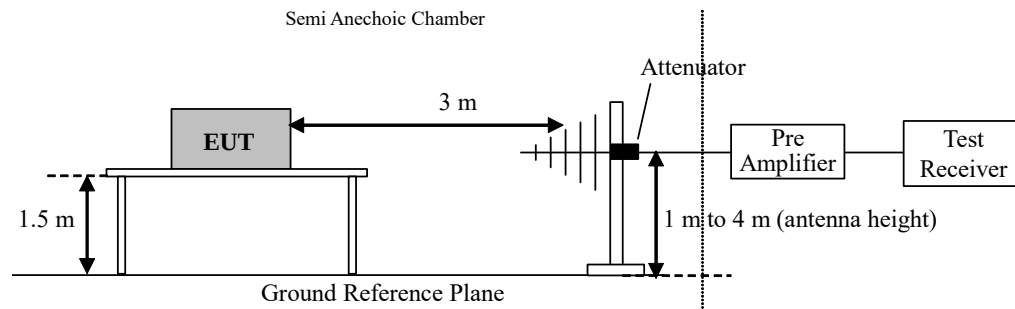
- 1) EUT was placed on a platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The Radiated Electric Field Strength has been measured in semi anechoic chamber at a distance of 3 m. The measuring antenna height was varied between 1 to 4 m and the turn table was rotated a full revolution in order to obtain the maximum value of the electric field strength. The measurements were performed for both vertical and horizontal antenna polarization.
- 2) Exchanged the EUT to the Substitution Antenna, the measurement was set for the same height 1.5 m as the EUT. The frequency below 1 GHz of the Substitution Antenna was used the Half wave dipole Antenna, which was tuned the measured frequency in 1). The frequency above 1 GHz of the Substitution Antenna was used Horn Antenna. The Substitution Antenna was connected to the Signal Generator, and the polarized electromagnetic radiation of the Substitution Antenna was matched with the one of the measuring Antenna, which was set with the Signal Generator to the measured frequency in 1). Then, we set with the Output power (CW) of the Signal Generator where the measuring electromagnetic field strength is equal to the measured value in 1) by means of varying the measuring antenna height between 1 to 4 m to obtain maximum receiving level. Its Output power of Signal Generator was recorded.
- 3) Effective radiated power was calculated by subtracting the cable loss and the attenuator loss connected between the Signal Generator and the Substitution Antenna from the Output power of the Signal Generator recorded in 2). For the usage of the Antenna (Horn Antenna) except for the Half wave dipole Antenna (2.15 dBi) for the Substitution Antenna, the Effective radiated power was calculated by compensating the finite difference in the Antenna gain of the Half wave dipole Antenna, and Substitution Antenna.

Frequency	25 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

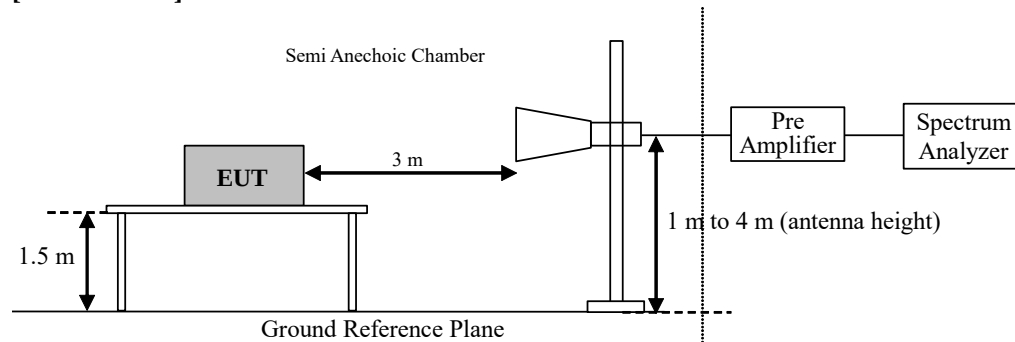
Frequency	25 MHz to 30 MHz	30 MHz to 1 GHz	Above 1 GHz
Instrument used	Spectrum Analyzer		
Detector	RMS Average		
IF Bandwidth	RBW: 10 kHz VBW: 30 kHz	RBW: 100 kHz VBW: 300 kHz	RBW: 1 MHz VBW: 3 MHz
Test Distance	3 m		

Figure 2: Test Setup

[25 MHz - 1 GHz]



[Above 1 GHz]



- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

Measurement range	: 25 MHz - 10 GHz
Test data	: APPENDIX
Test result	: Pass

SECTION 6: Antenna Terminal 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
RF power output	-	-	-	Auto	Average	-	Power Meter (Sensor: 50 MHz BW)
Occupied Bandwidth	Enough width to display emission skirts	1 to 5% of Occupied bandwidth	Three times of RBW	Auto	Peak *1)	Max Hold *1)	Spectrum Analyzer
Spurious emissions at antenna terminals *2)	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 1 GHz	100 kHz	300 kHz				
	Above 1 GHz	1 MHz	3 MHz				
Frequency stability	-	-	-	-	-	-	Frequency Counter

*1) The measurement was performed with Peak and Max Hold since the modulation method was FM.
 *2) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
 Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.

[Side band spectrum measurement (Emission mask)]

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

Test procedure

The EUT was modulated with PN9 audio data packet.

The spectrum mask was measured in accordance with section 8.3.2 of EN 300 422-1.

The measurements were made under normal condition.

Step 1: Measure the "Carrier Power" with the spectrum analyzer setup:

- Center Frequency = f_c
- Span = Zero span
- Detector = RMS
- Trace Mode = Average
- RBW&VBW = $5 \times B$
- Sweep time ≥ 2 s

Step 2: Measure the "Maximum Relative Level (dBc) at Specified Carrier Offsets" with the following spectrum analyzer setup:

- Center Frequency = f_c
- Span $\geq 5 \times B$
- Detector = RMS
- Trace Mode = Peak Hold
- RBW&VBW = 1 kHz
- Sweep time ≥ 2 s

Step 3: Measure the "transmitter wide band noise floor":

- Start Frequency = $f_c + 1,75B$ and $f_c - 1$ MHz
- Stop Frequency = $f_c + 1$ MHz and $f_c - 1,75 B$
- Detector = RMS
- Trace Mode = Average
- RBW&VBW = 1 kHz
- Sweep time ≥ 2 s

[Frequency stability]

The power supply set to 100 % nominal setting, raise EUT operating temperature to 50 deg. C.

Record the frequency of the EUT.

Repeat measurements at each 10 deg. C decrement to -30 deg. C.

EUT power supply was varied between 85 % and 115 % of nominal and the frequency of the EUT was recorded when temperature is 20 deg. C. The additional test was performed at battery end point voltage.

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

Test data : APPENDIX

Test result : Pass

APPENDIX 1: Test data

RF Output Power

Report No.	13720501H
Test place	Ise EMC Lab. No.3 Measurement Room
Date	June 11, 2021
Temperature / Humidity	24 deg. C / 65 % RH
Engineer	Akihiko Maeda
Mode	Tx

Power Setting	Channel	Freq. [MHz]	Reading	Cable Loss [dB]	Atten. Loss [dB]	Result Average [Conducted]		Limit [Conducted] [mW]	Margin [dB]	Remarks
			Average [dBm]			[dBm]	[mW]			
2 mW	Low ch	470.100	-7.50	0.71	9.76	2.97	1.982	250	21.01	-
	Mid ch	539.000	-7.52	0.73	9.76	2.97	1.982	250	21.01	-
	High ch	607.900	-7.48	0.73	9.77	3.02	2.004	250	20.96	-
10 mW	Low ch	470.100	-0.30	0.71	9.76	10.17	10.399	250	13.81	-
	Mid ch	539.000	-0.52	0.73	9.76	9.97	9.931	250	14.01	-
	High ch	607.900	-0.63	0.73	9.77	9.87	9.705	250	14.11	-
20 mW	Low ch	470.100	2.76	0.71	9.76	13.23	21.04	250	10.75	-
	Mid ch	539.000	2.51	0.73	9.76	13.00	19.95	250	10.98	-
	High ch	607.900	2.32	0.73	9.77	12.82	19.14	250	11.16	-
40 mW	Low ch	470.100	5.60	0.71	9.76	16.07	40.46	250	7.91	-
	Mid ch	539.000	5.38	0.73	9.76	15.87	38.64	250	8.11	-
	High ch	607.900	5.34	0.73	9.77	15.84	38.37	250	8.14	-

Calculation formula:

$$\text{Result} = \text{Reading} + \text{Cable Loss} + \text{Atten. Loss}$$

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RF Output Power

Report No. 13720501H
Test place Ise EMC Lab. No.3 Measurement Room
Date June 11, 2021
Temperature / Humidity 24 deg. C / 65 % RH
Engineer Akihiko Maeda
Mode Tx

Power Setting	Channel	Freq.	Reading Average	Cable Loss	Atten. Loss	Ant Gain	Result [EIRP]		Limit [EIRP]	Margin	Remarks
		[MHz]	[dBm]	[dB]	[dB]	[dB]	[dBm]	[mW]	[mW]	[dB]	
10 mW	Low ch	653.100	-0.53	0.74	9.77	2.14	12.12	16.29	20	0.89	
	Mid ch	655.000	-0.60	0.74	9.77	2.14	12.05	16.03	20	0.96	
	High ch	656.900	-0.65	0.74	9.77	2.14	12.00	15.85	20	1.01	

Calculation formula:

$$\text{Result} = \text{Reading} + \text{Cable Loss} + \text{Atten. Loss} + \text{Ant Gain}$$

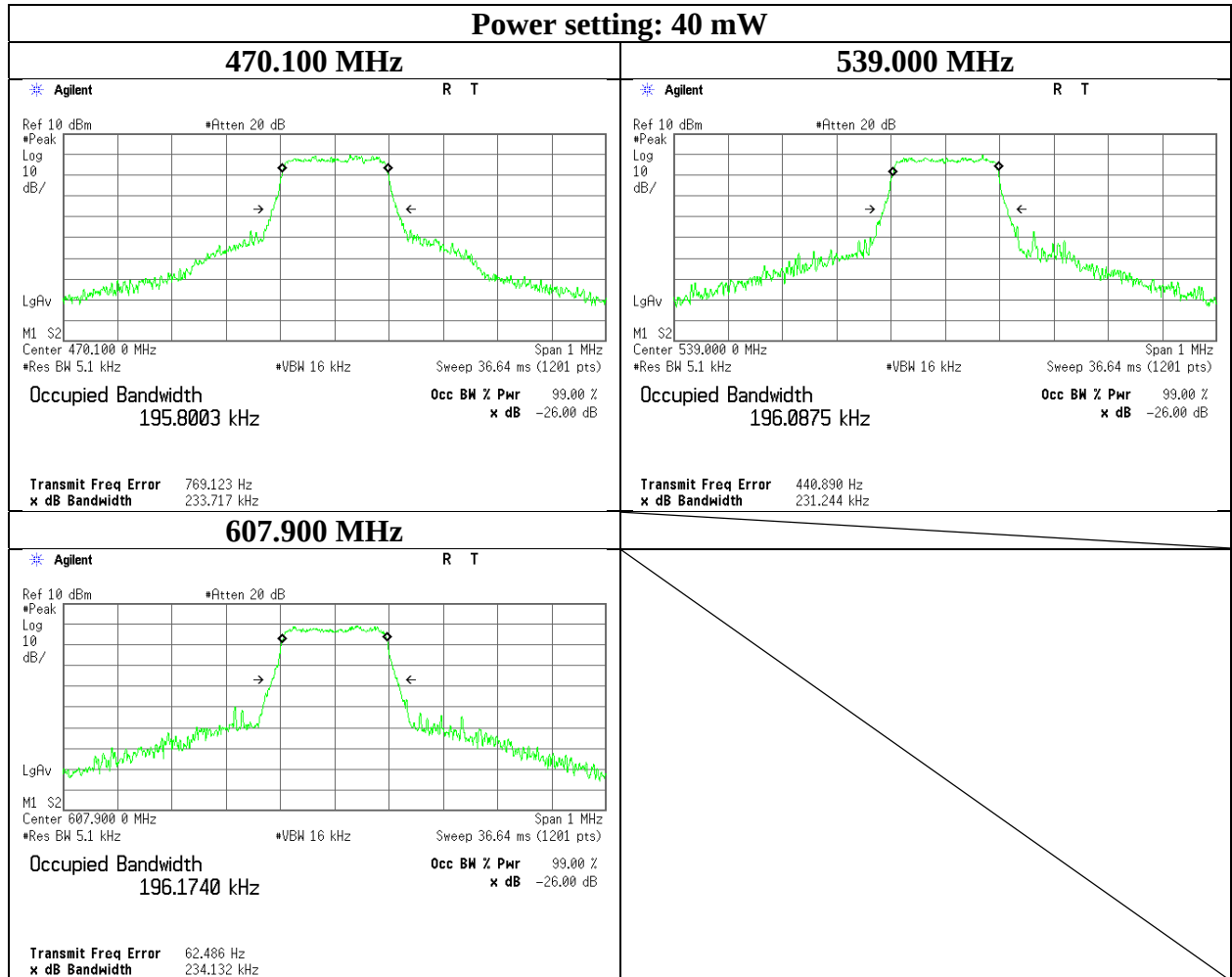
Occupied Bandwidth

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx

Power Setting	Channel	Frequency [MHz]	Bandwidth [kHz]	Frequency Error [Hz]	Result Bandedge [MHz]	Limit Bandwidth [kHz]	Limit Bandedge [MHz]
40mW	Low	470.100	195.8003	769.123	470.0029	200.000	> 470.000
40mW	Mid	539.000	196.0875	440.890	539.0985	200.000	< 608.000
40mW	High	607.900	196.1740	62.486	607.9981	200.000	< 608.000
10mW	Low	653.100	195.3352	102.707	653.0024	200.000	> 653.000
10mW	Mid	655.000	195.8663	604.339	655.0985	200.000	< 657.000
10mW	High	656.900	196.0115	569.622	656.9986	200.000	< 657.000

Occupied Bandwidth

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx (470.100 MHz to 607.900 MHz)



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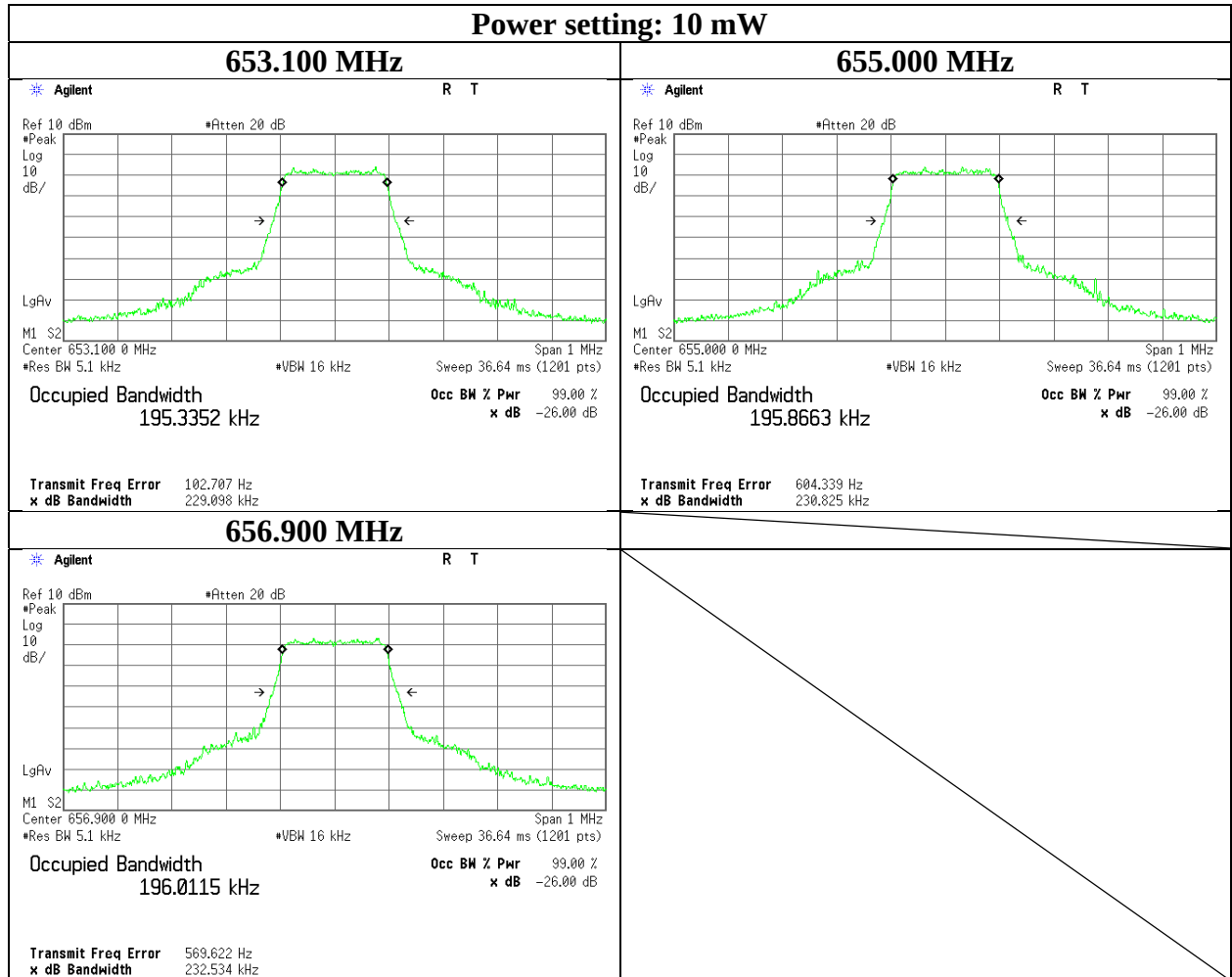
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Occupied Bandwidth

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx (653.100 MHz to 656.900 MHz)



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Spurious emissions at antenna terminals

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx

Power Setting	Channel	Tested Freq. [MHz]	Reading		Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
			Freq. [MHz]	Level [dBm]					
40 mW	Low	470.100	0.011	-81.45	0.00	9.68	-71.77	-13	58.77
			0.15	-72.15	0.01	9.68	-62.46	-13	49.46
			940.2	-44.31	0.90	9.79	-33.62	-13	20.62
			1410	-52.04	1.04	9.48	-41.52	-13	28.52
			1880	-58.92	1.19	9.50	-48.23	-13	35.23
			2350	-57.18	1.34	9.53	-46.31	-13	33.31
			7112	-56.00	2.38	9.71	-43.91	-13	30.91
	Mid	539.000	0.011	-80.28	0.00	9.68	-70.60	-13	57.60
			0.15	-73.34	0.01	9.68	-63.65	-13	50.65
			1077	-43.98	0.90	9.46	-33.62	-13	20.62
			1617	-51.97	1.11	9.49	-41.37	-13	28.37
			2156	-59.87	1.28	9.52	-49.07	-13	36.07
			10000	-55.36	2.83	9.77	-42.76	-13	29.76
	High	607.900	0.03744	-82.12	0.00	9.68	-72.44	-13	59.44
			0.15	-72.55	0.01	9.68	-62.86	-13	49.86
			1217	-45.30	0.96	9.47	-34.87	-13	21.87
			1823	-55.56	1.17	9.50	-44.89	-13	31.89
			2432	-60.99	1.37	9.53	-50.09	-13	37.09
			8712	-55.45	2.63	9.70	-43.12	-13	30.12

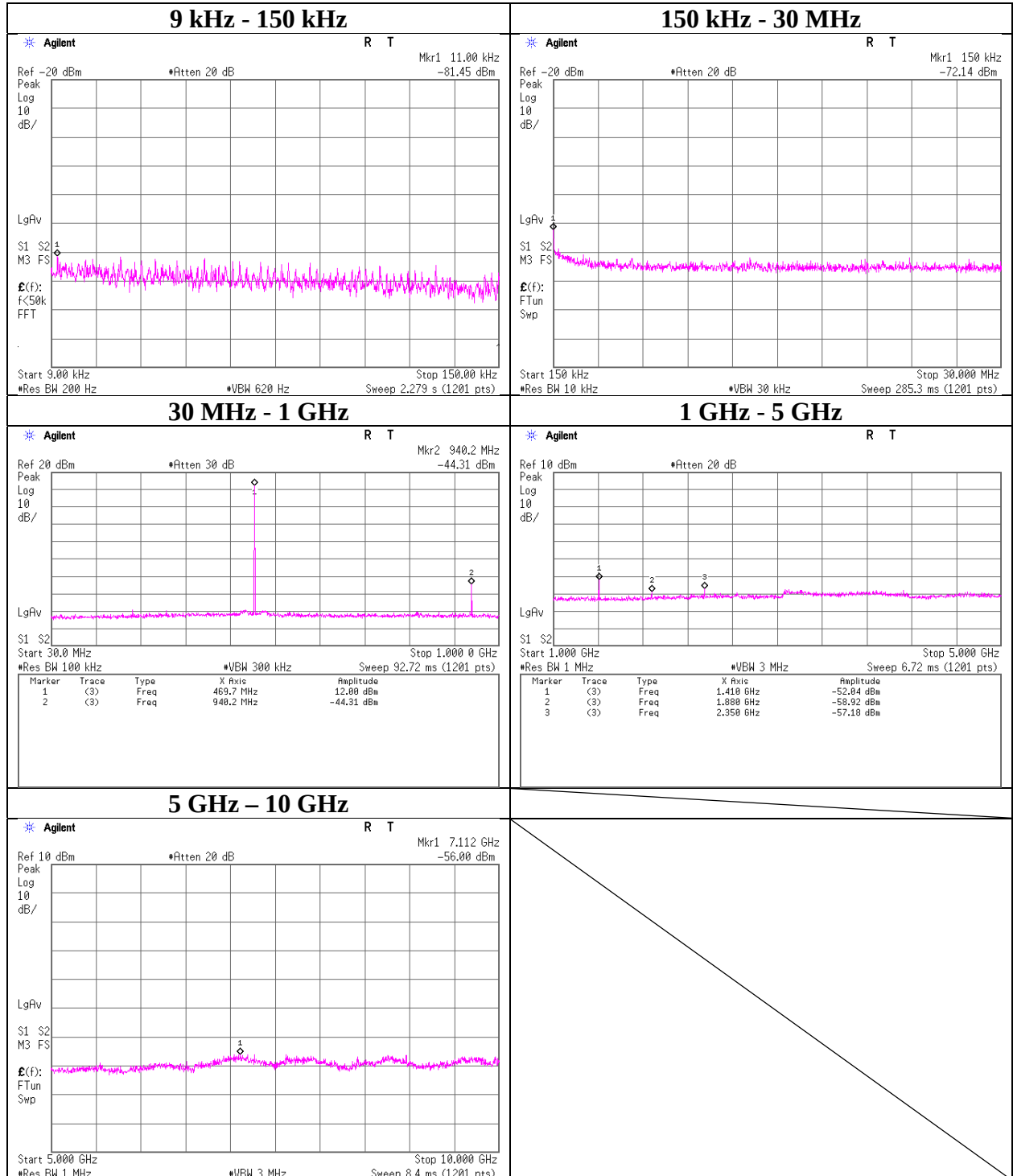
Calculation formula:

Result = Reading + Cable Loss + Attenuator Loss

Limit = mean output power in dBm - (43+10log10 (mean output power in watts)) dB = -13dBm

Spurious emissions at antenna terminals

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx 470.100 MHz, 40 mW



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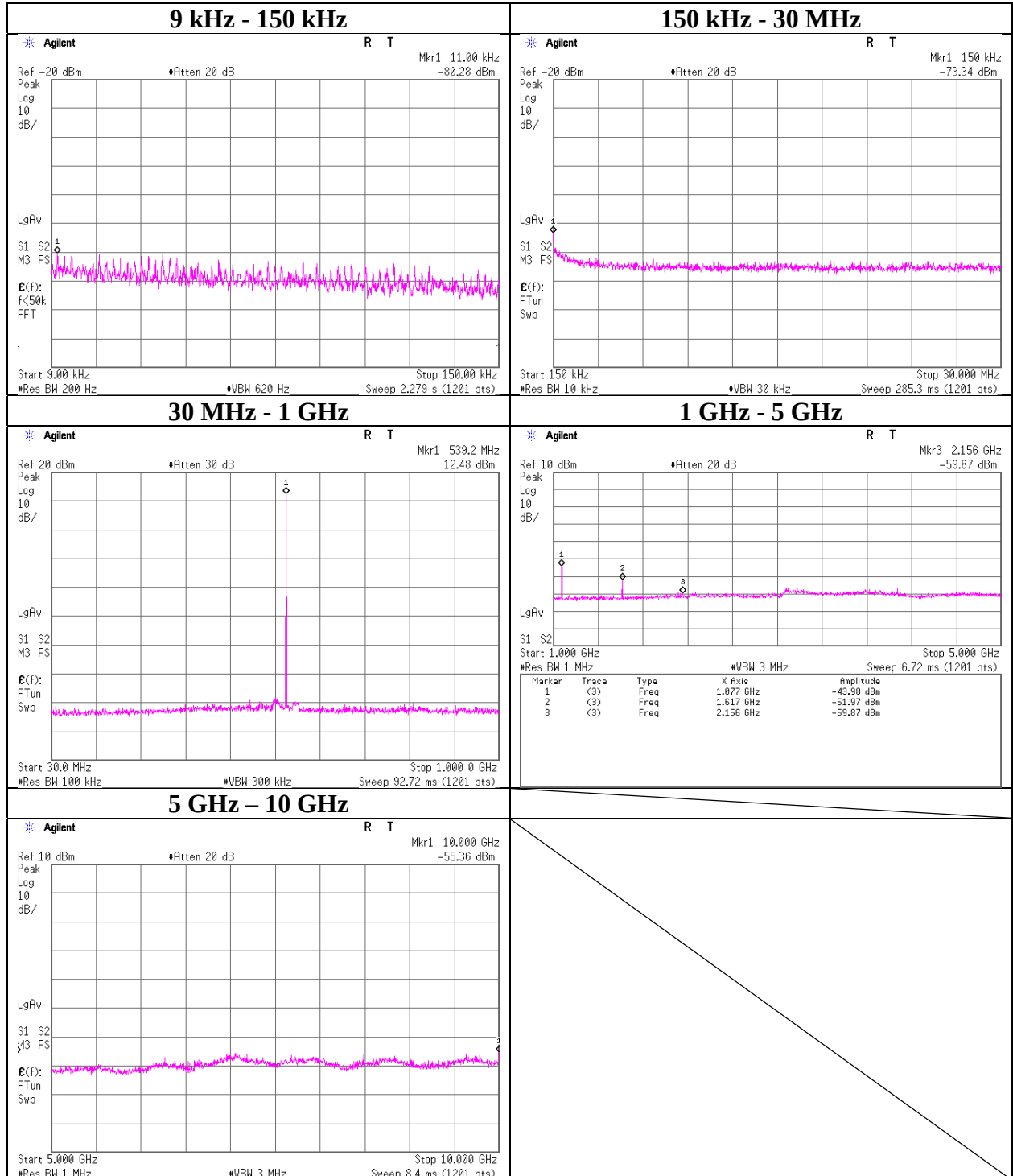
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Spurious emissions at antenna terminals

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx 539.000 MHz, 40 mW



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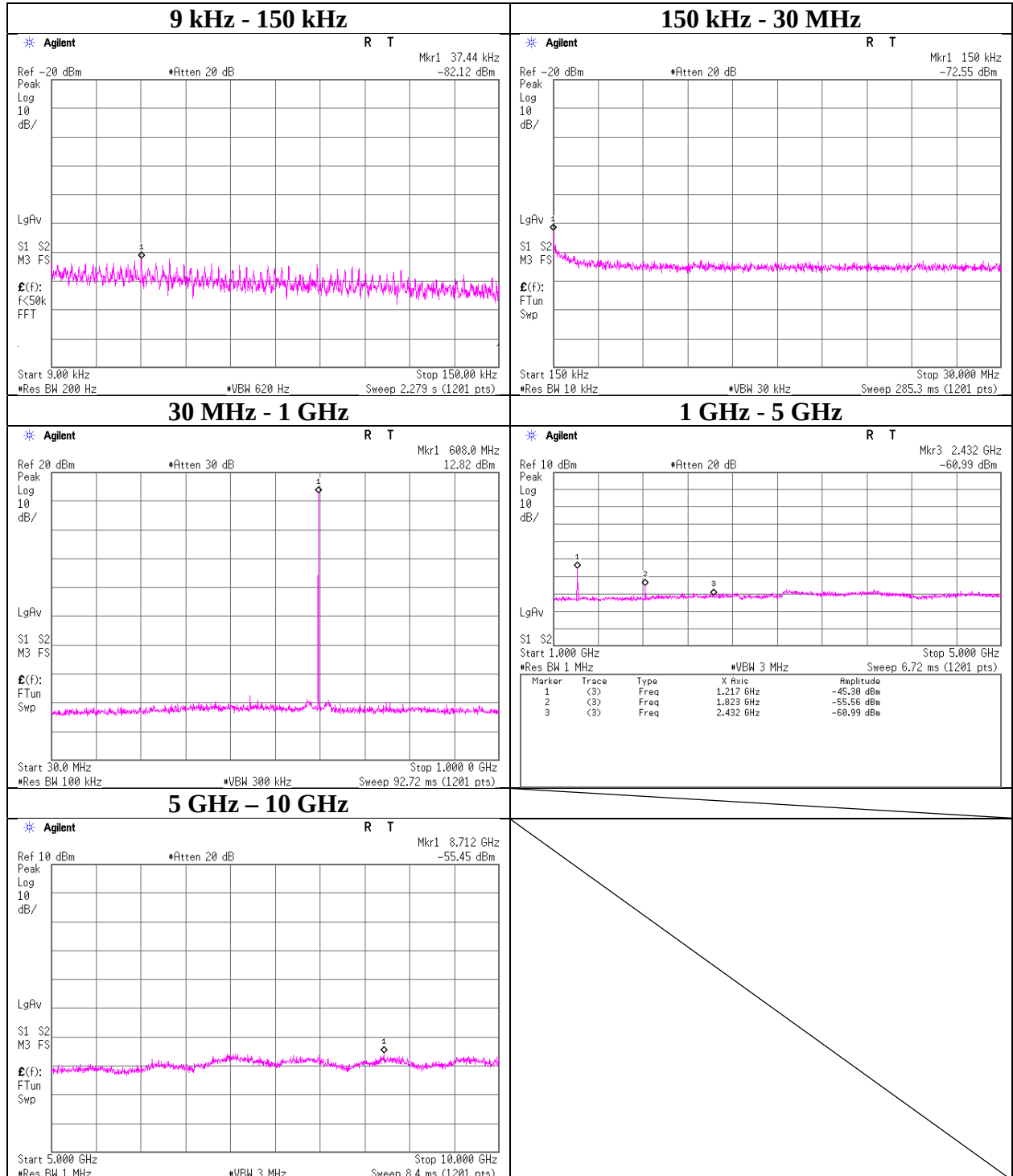
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Spurious emissions at antenna terminals

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx 607.900 MHz, 40 mW



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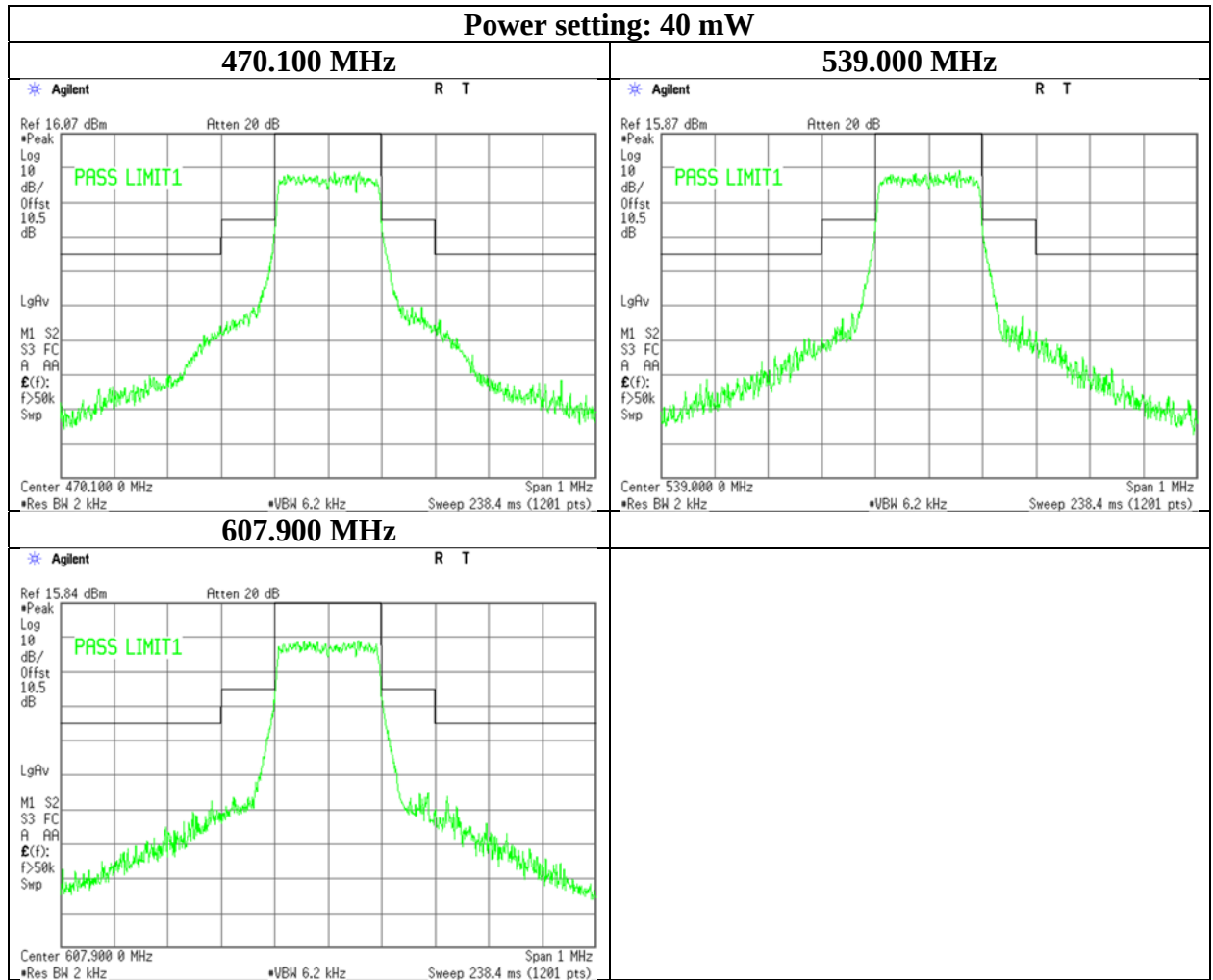
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Spurious emissions at antenna terminals

[Side band spectrum measurement]

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	June 14, 2021
Temperature/ Humidity	24 deg. C / 60 % RH
Engineer	Akihiko Maeda
Mode	Tx, 40 mW



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Spurious emissions at antenna terminals

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx

Power Setting	Channel	Tested Freq. [MHz]	Reading		Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
			Freq. [MHz]	Level [dBm]					
10 mW	Low	653.100	0.00912	-86.23	0.00	9.68	-76.55	-13	63.55
			0.15	-76.88	0.01	9.68	-67.19	-13	54.19
			1307	-54.87	0.61	9.48	-44.78	-13	31.78
			8738	-55.23	1.74	9.70	-43.79	-13	30.79
	Mid	655.000	0.0117	-86.25	0.00	9.68	-76.57	-13	63.57
			0.225	-76.05	0.01	9.68	-66.36	-13	53.36
			1310	-57.01	0.61	9.48	-46.92	-13	33.92
			7083	-54.67	1.57	9.71	-43.39	-13	30.39
	High	656.900	0.01182	-86.38	0.00	9.68	-76.70	-13	63.70
			0.15	-76.75	0.01	9.68	-67.06	-13	54.06
			1313	-55.99	0.61	9.48	-45.90	-13	32.90
			7017	-54.64	1.57	9.71	-43.36	-13	30.36

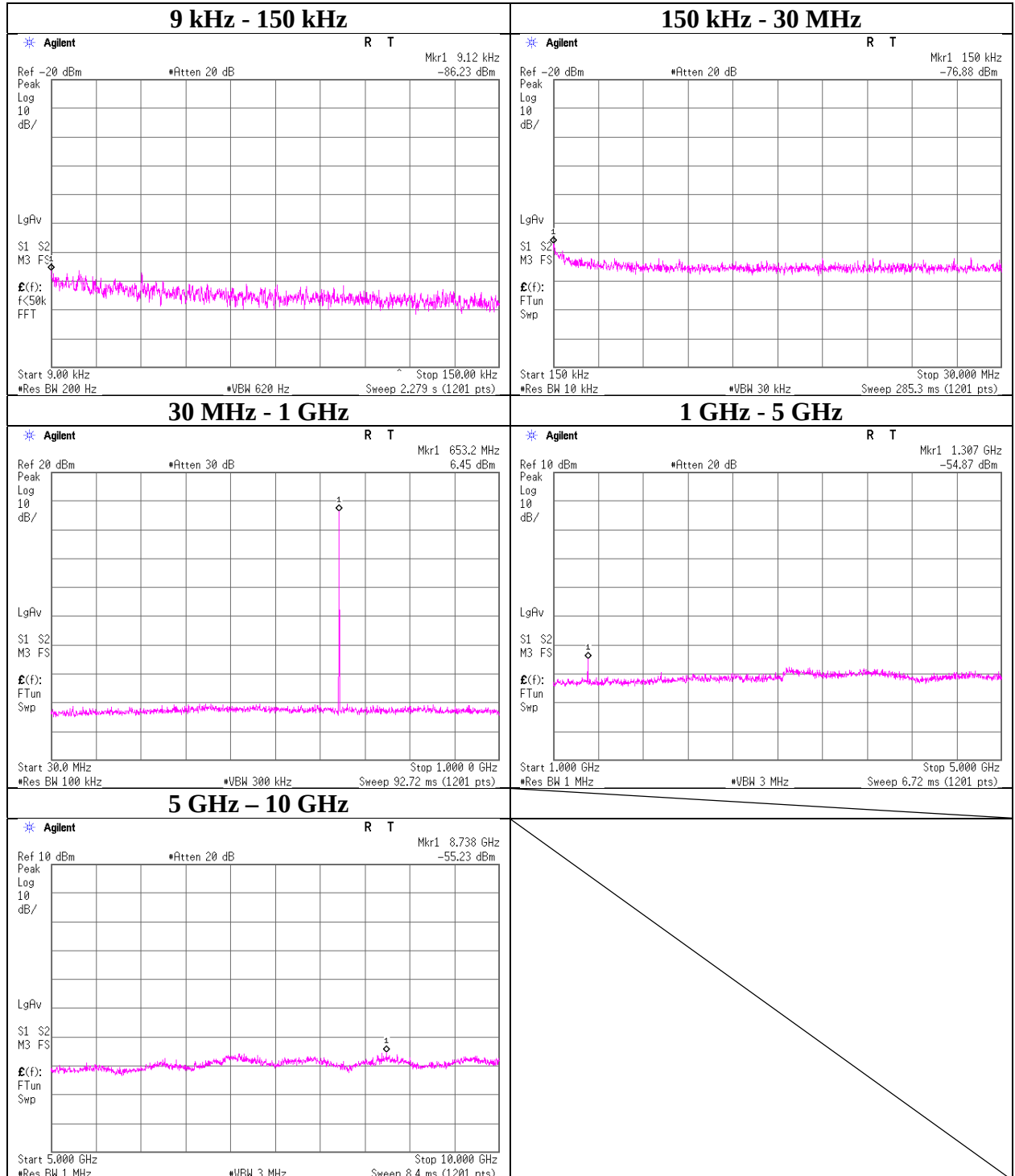
Calculation formula:

$$\text{Result} = \text{Reading} + \text{Cable Loss} + \text{Attenuator Loss}$$

$$\text{Limit} = \text{mean output power in dBm} - (43 + 10 \log_{10} (\text{mean output power in watts})) \text{ dB} = -13 \text{ dBm}$$

Spurious emissions at antenna terminals

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	June 14, 2021
Temperature/ Humidity	24 deg. C / 60 % RH
Engineer	Akihiko Maeda
Mode	Tx 653.100 MHz, 10 mW



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Ise EMC Lab.

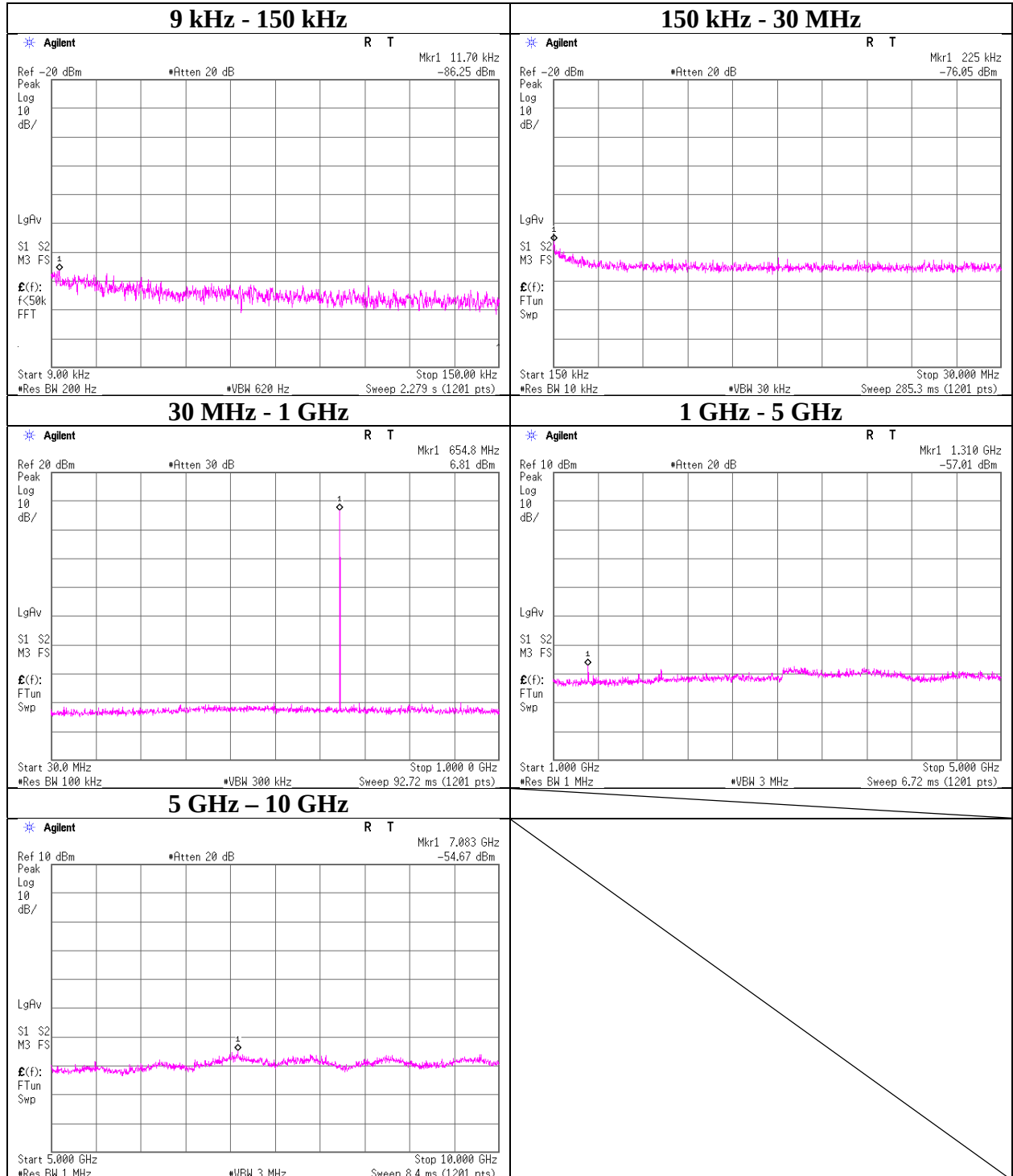
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Spurious emissions at antenna terminals

Report No. 13720501H
Test place Ise EMC Lab. No.6 Shielded Room
Date June 14, 2021
Temperature/ Humidity 24 deg. C / 60 % RH
Engineer Akihiko Maeda
Mode Tx 655.000 MHz, 10 mW



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Ise EMC Lab.

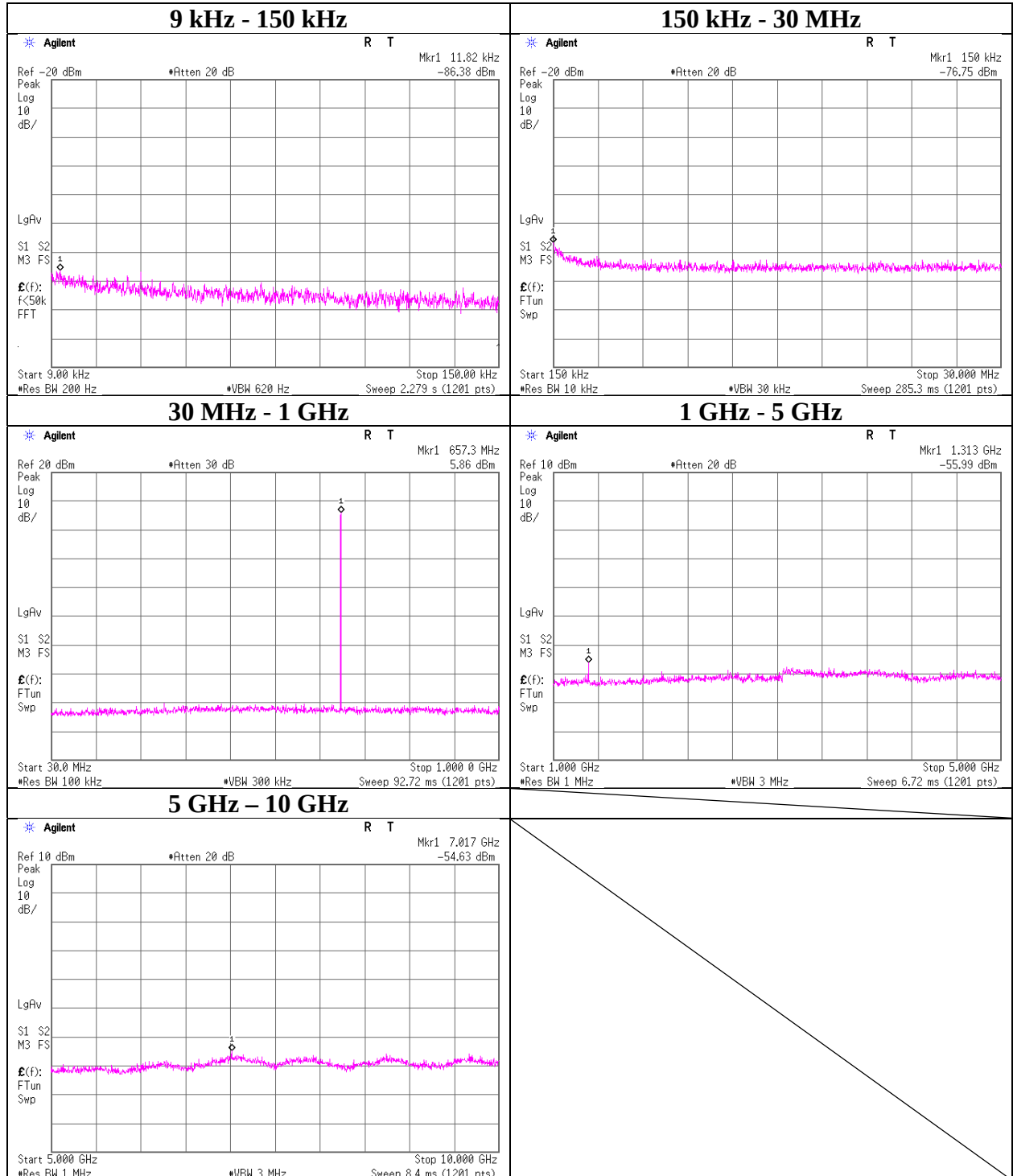
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Facsimile : +81 596 24 8124

Spurious emissions at antenna terminals

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	June 14, 2021
Temperature/ Humidity	24 deg. C / 60 % RH
Engineer	Akihiko Maeda
Mode	Tx 656.900 MHz, 10 mW



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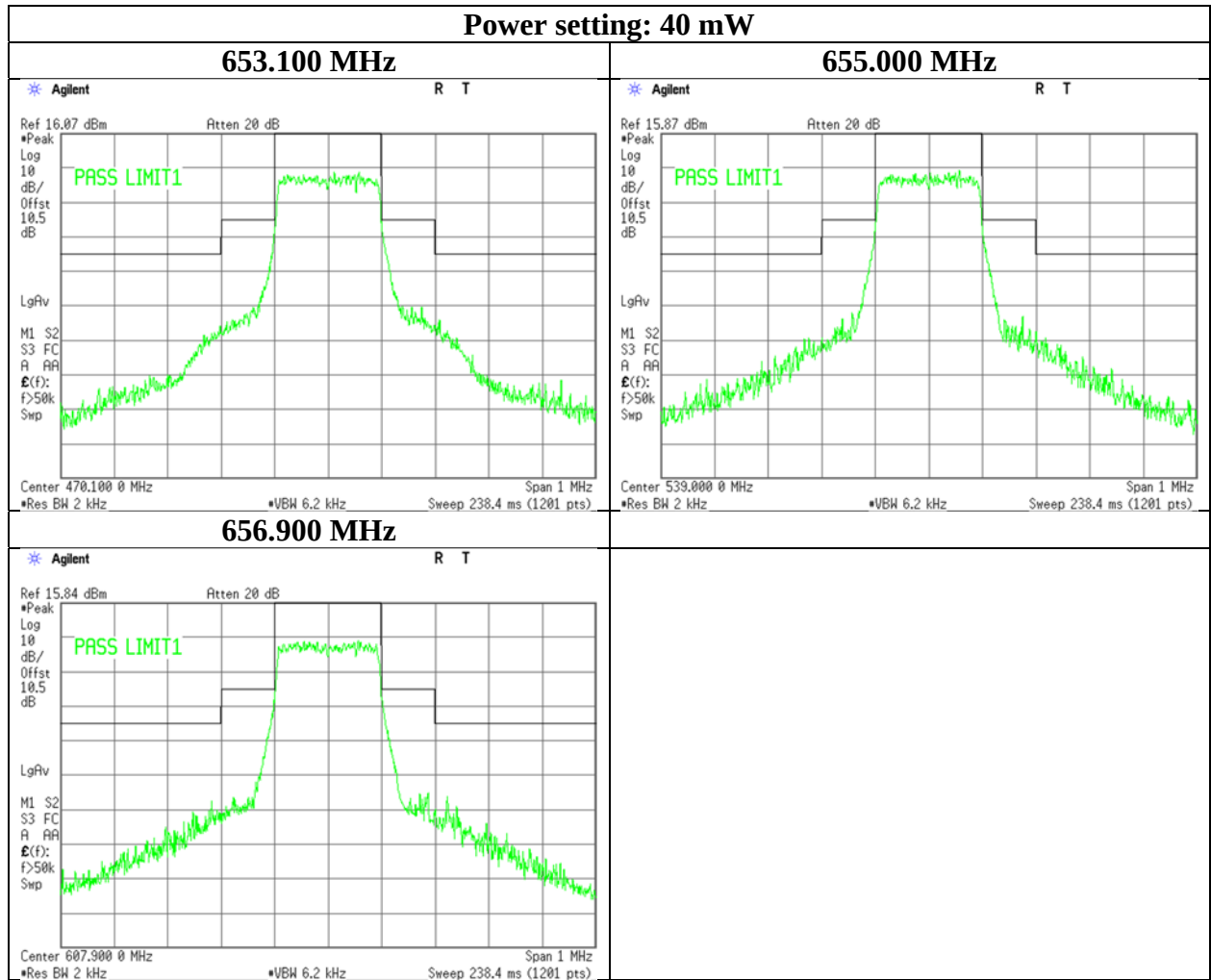
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Spurious emissions at antenna terminals

[Side band spectrum measurement]

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Shielded Room
Date	June 14, 2021
Temperature/ Humidity	24 deg. C / 60 % RH
Engineer	Akihiko Maeda
Mode	Tx, 10 mW



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Ise EMC Lab.

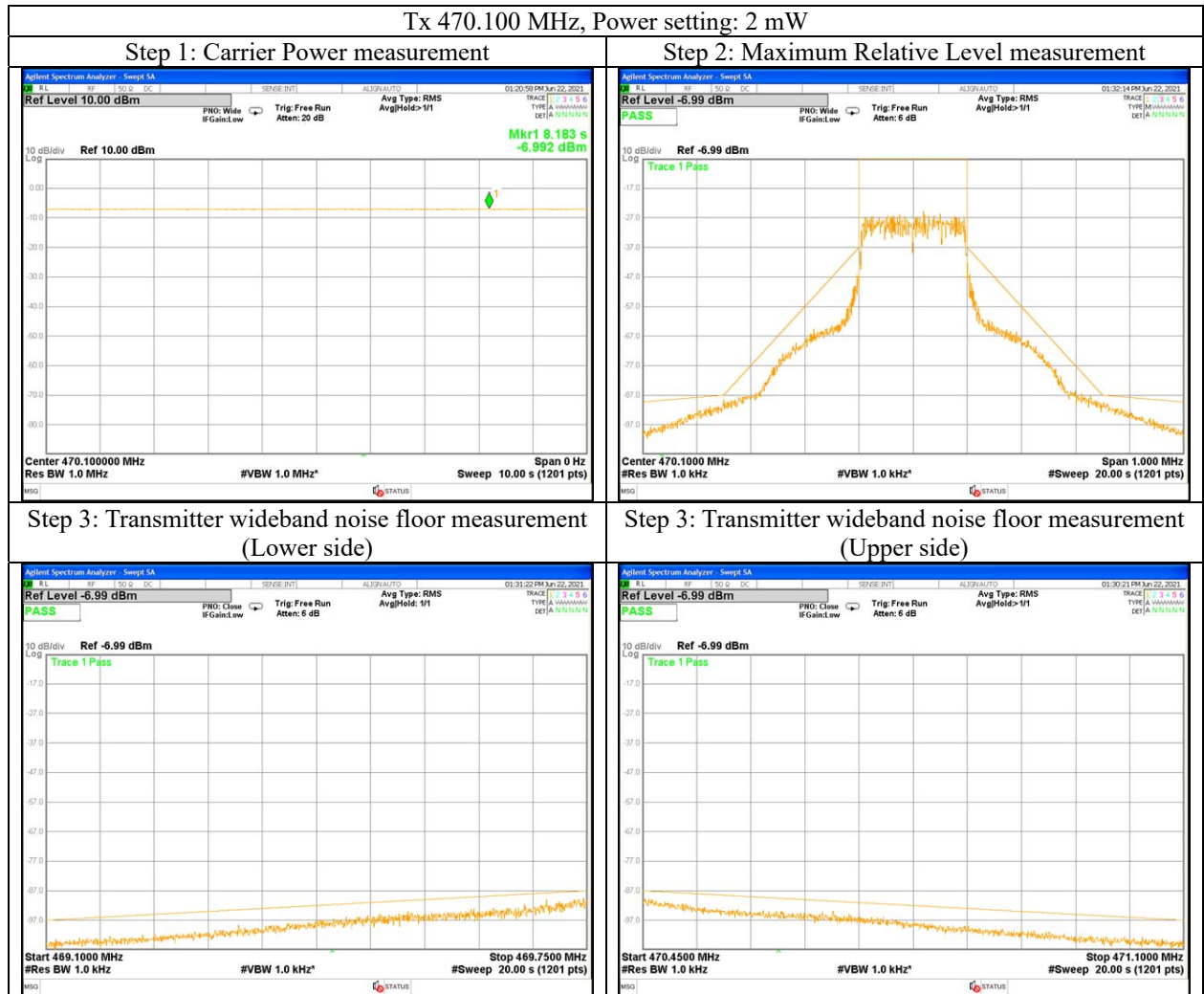
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Emission Mask

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 22, 2021
Temperature/ Humidity	24 deg. C / 52 % RH
Engineer	Kiyoshiro Okazaki
Mode	Tx 470.100 MHz, 2 mW



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Ise EMC Lab.

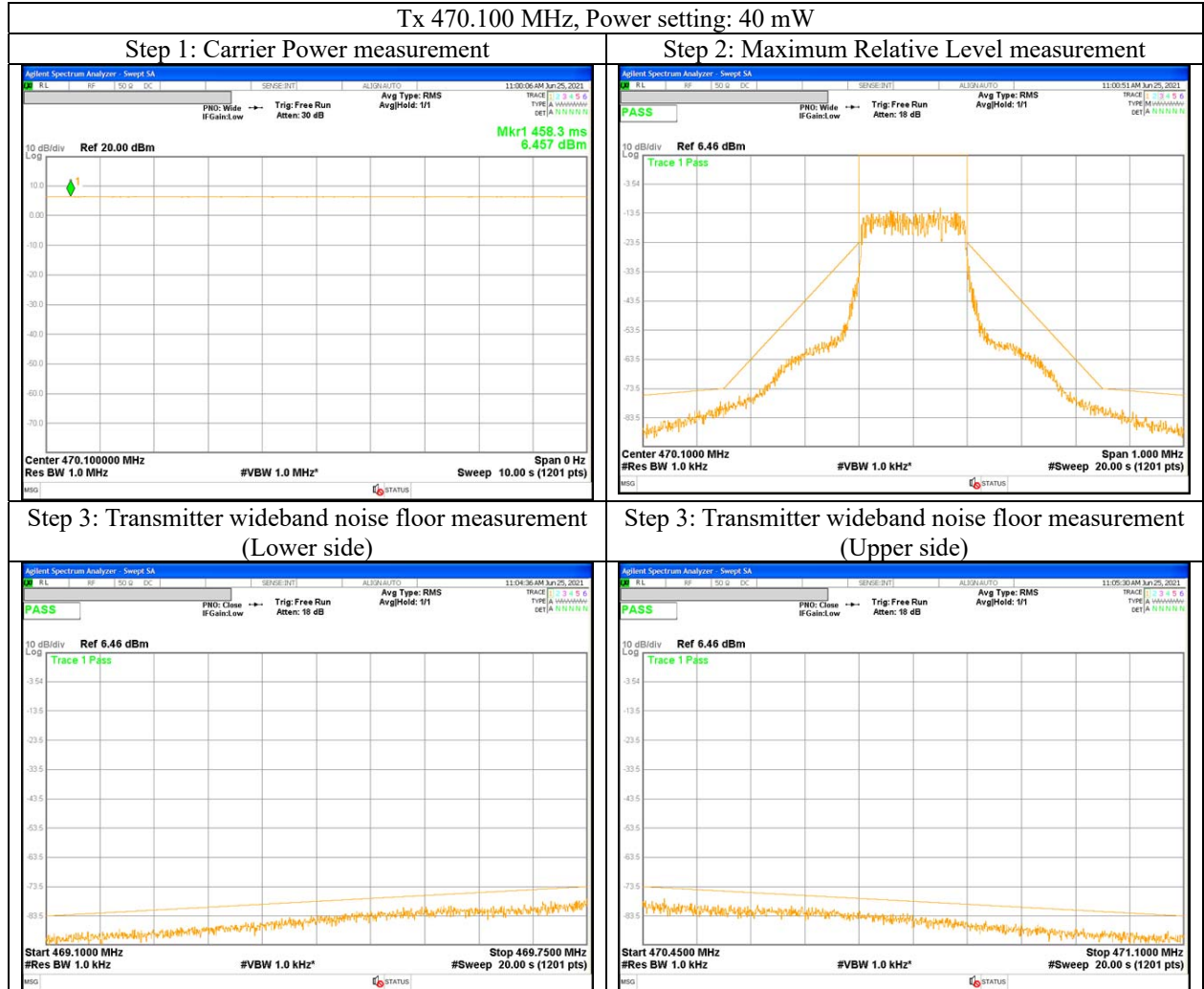
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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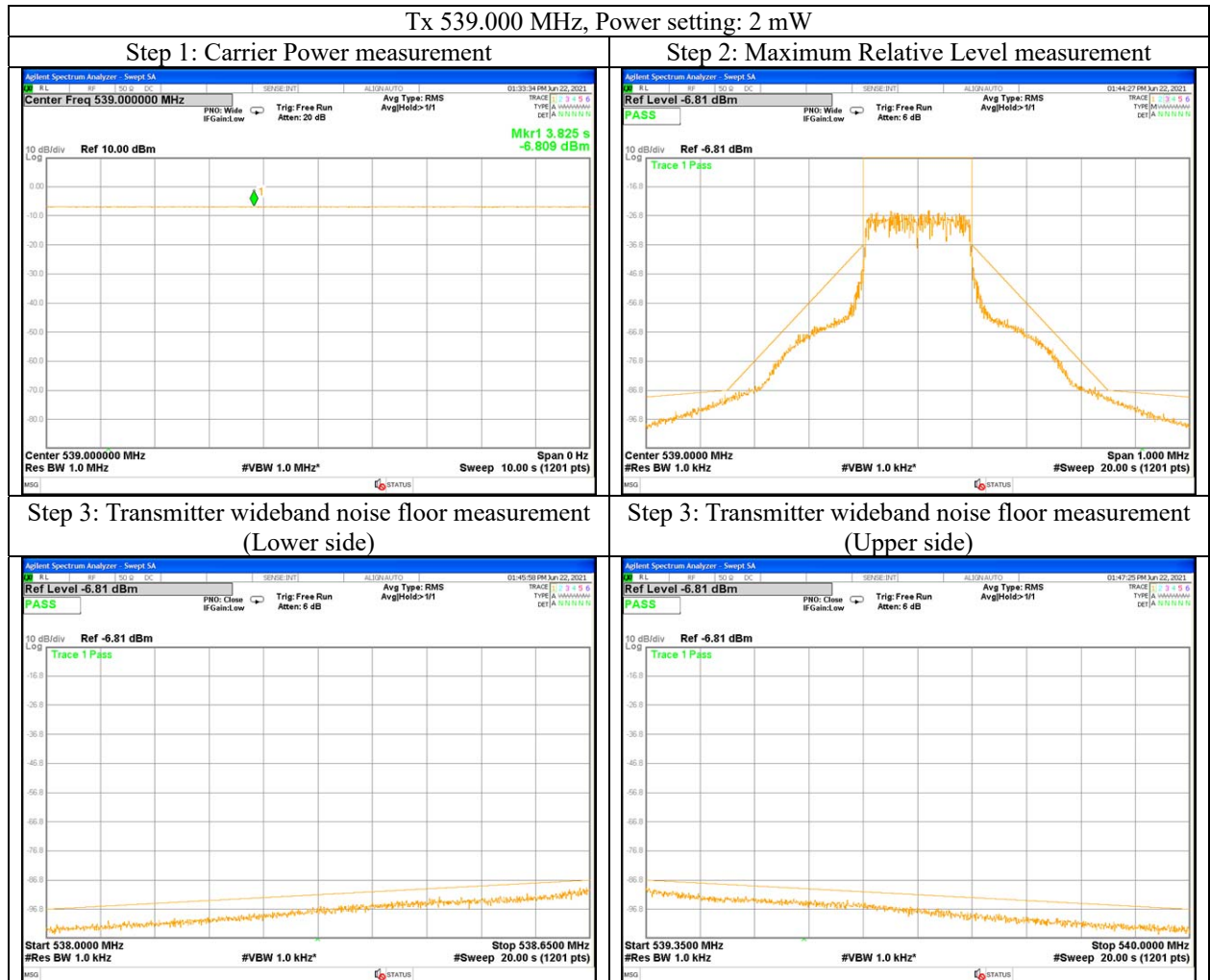
Emission Mask

Report No. 13720501H
Test place Ise EMC Lab. No.6 Measurement Room
Date June 25, 2021
Temperature/ Humidity 23 deg. C / 63 % RH
Engineer Hiroki Numata
Mode Tx 470.100 MHz, 40 mW



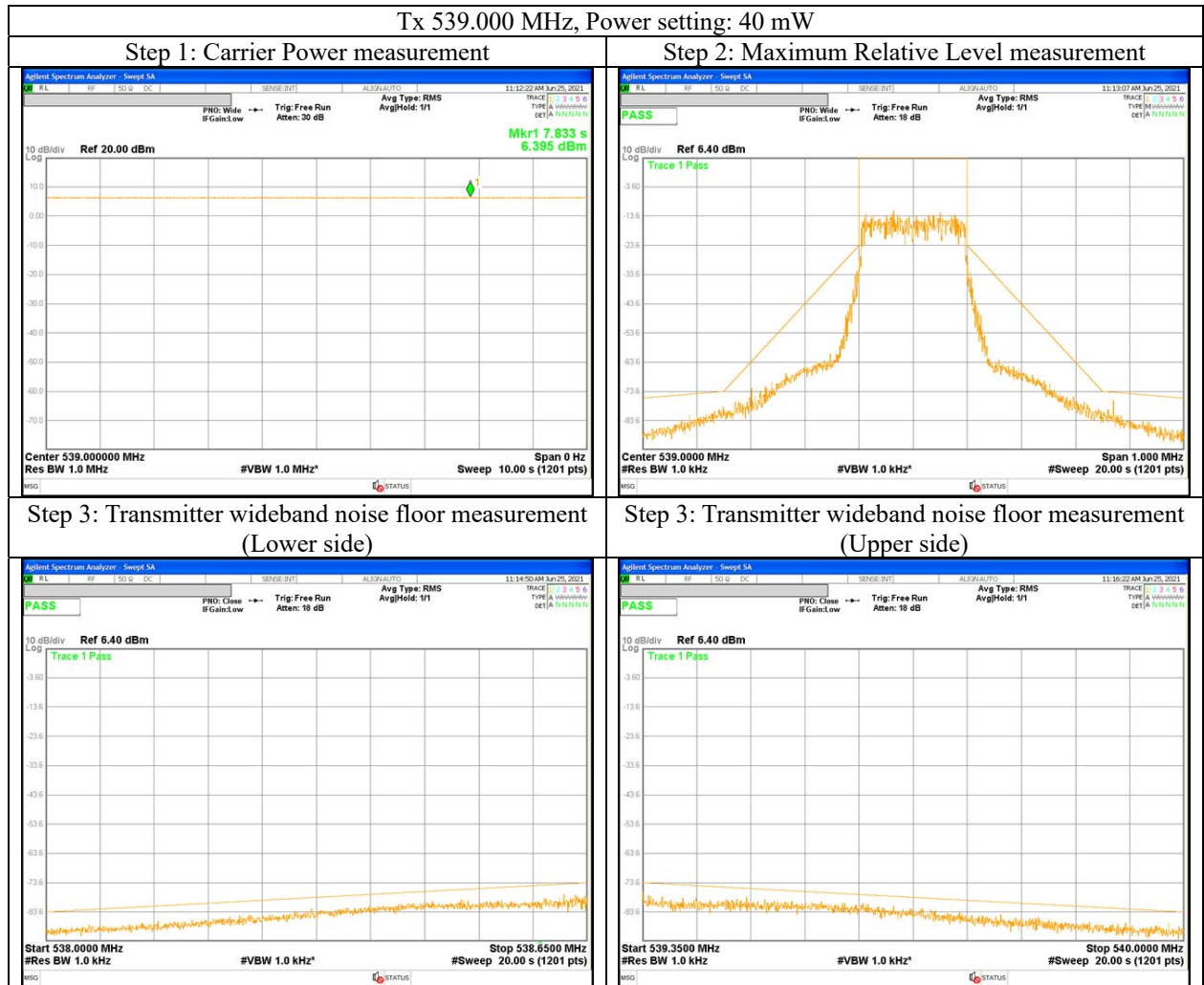
Emission Mask

Report No. 13720501H
Test place Ise EMC Lab. No.6 Measurement Room
Date June 22, 2021
Temperature/ Humidity 24 deg. C / 52 % RH
Engineer Kiyoshiro Okazaki
Mode Tx 539.000 MHz, 2 mW



Emission Mask

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 25, 2021
Temperature/ Humidity	23 deg. C / 63 % RH
Engineer	Hiroki Numata
Mode	Tx 539.000 MHz, 40 mW



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Ise EMC Lab.

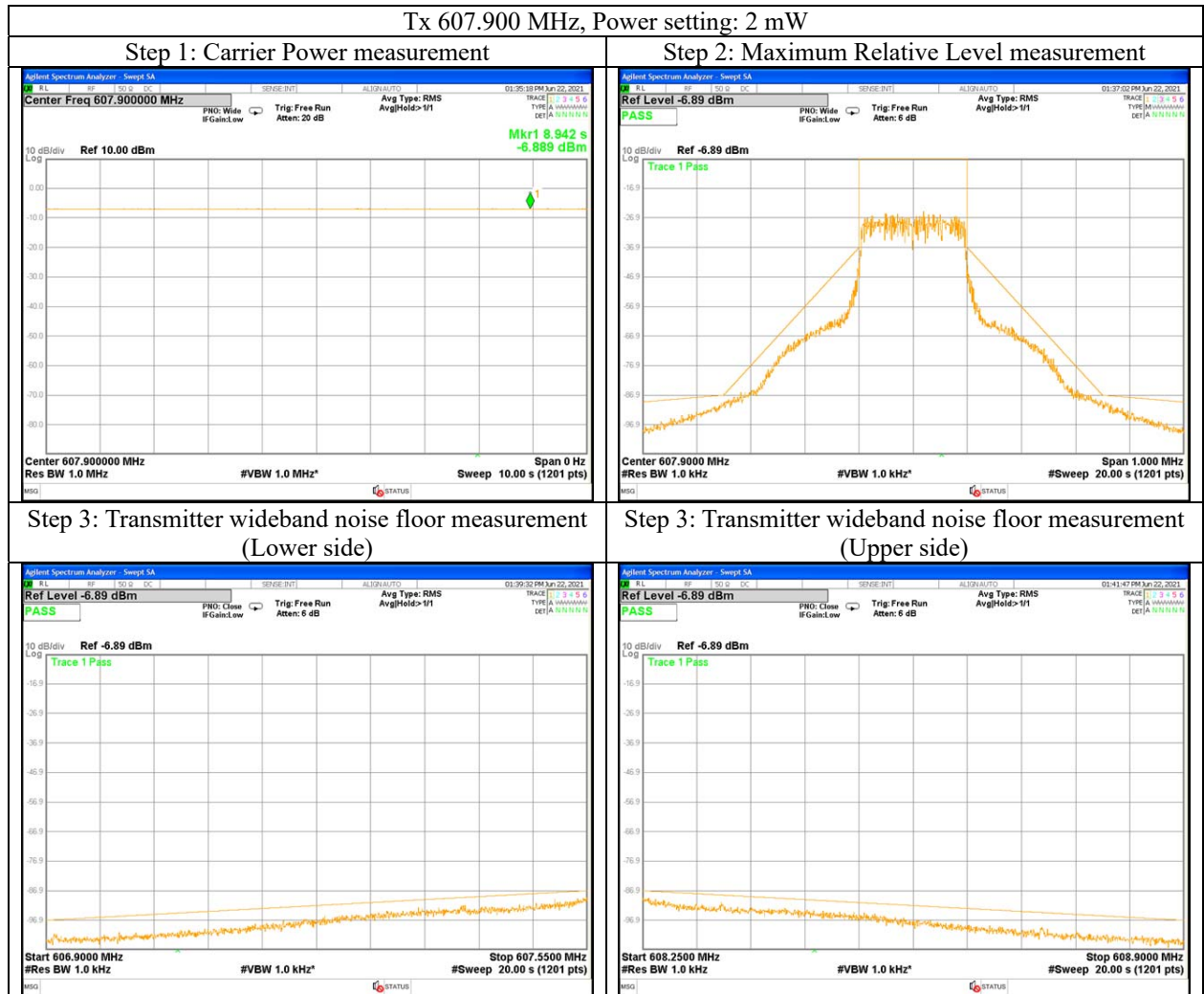
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Emission Mask

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 22, 2021
Temperature/ Humidity	24 deg. C / 52 % RH
Engineer	Kiyoshiro Okazaki
Mode	Tx 607.900 MHz, 2 mW



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Ise EMC Lab.

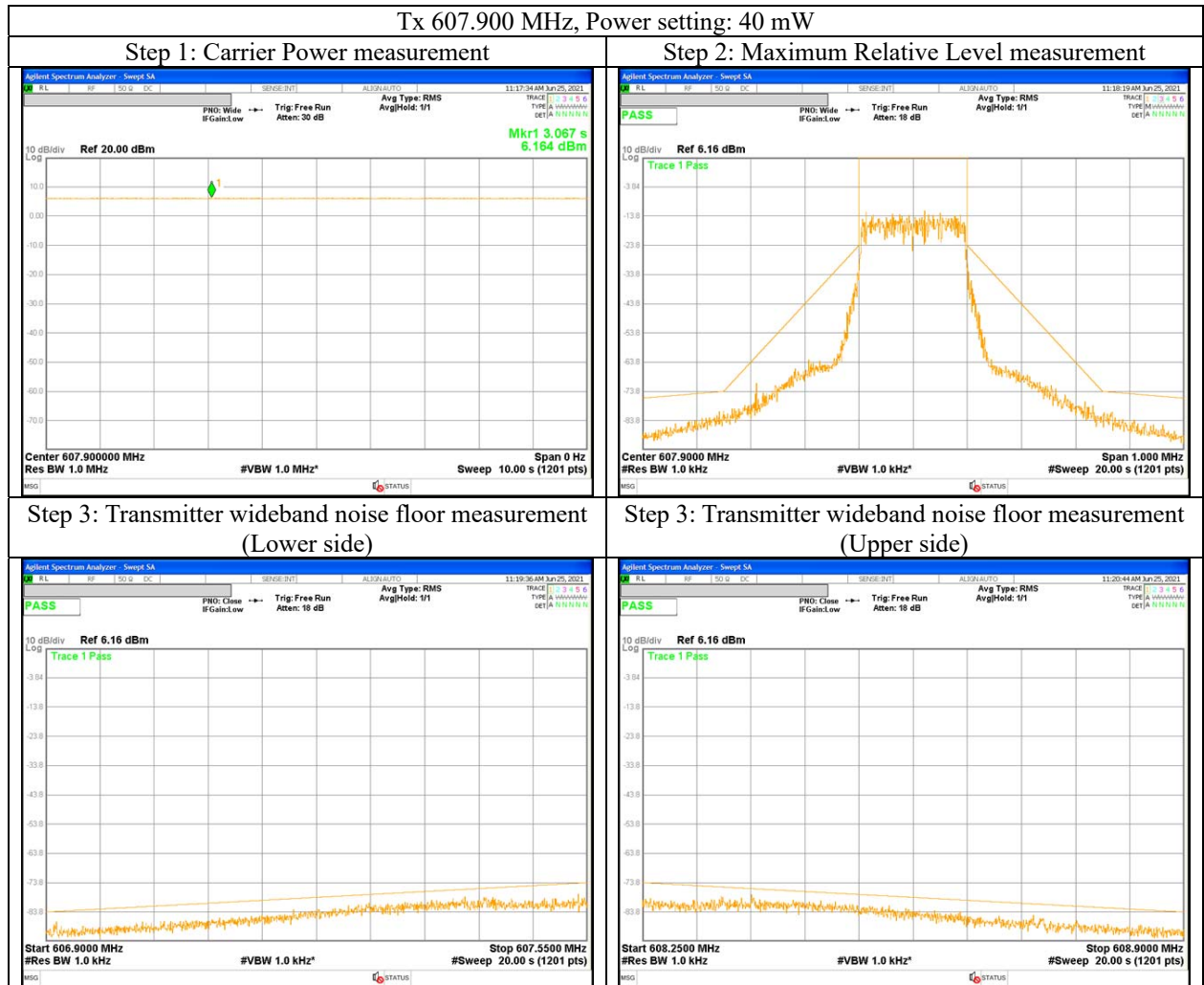
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Emission Mask

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 25, 2021
Temperature/ Humidity	23 deg. C / 63 % RH
Engineer	Hiroki Numata
Mode	Tx 607.900 MHz, 40 mW



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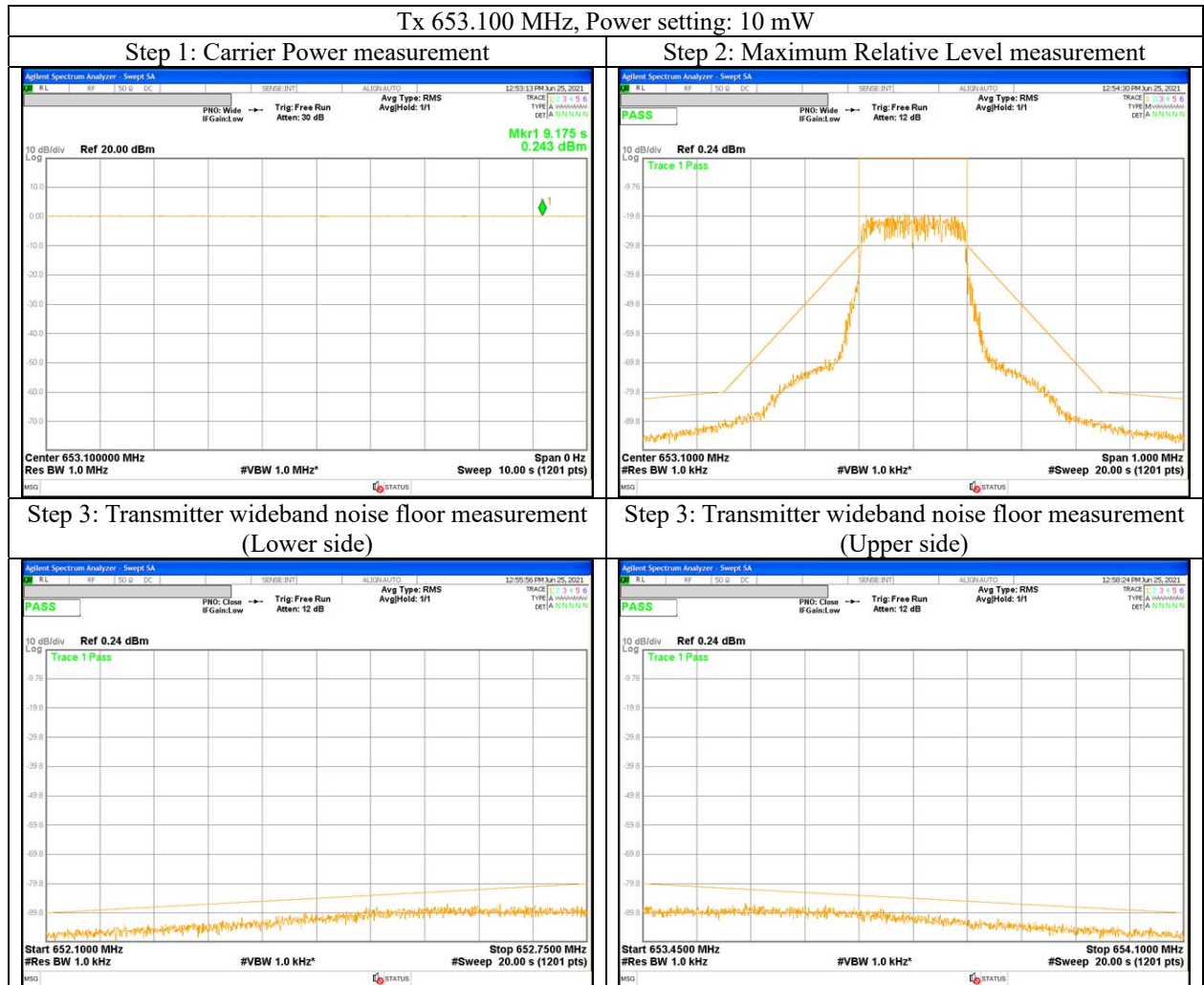
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Facsimile : +81 596 24 8124

Emission Mask

Report No. 13720501H
Test place Ise EMC Lab. No.6 Measurement Room
Date June 25, 2021
Temperature/ Humidity 23 deg. C / 63 % RH
Engineer Hiroki Numata
Mode Tx 653.100 MHz, 10 mW



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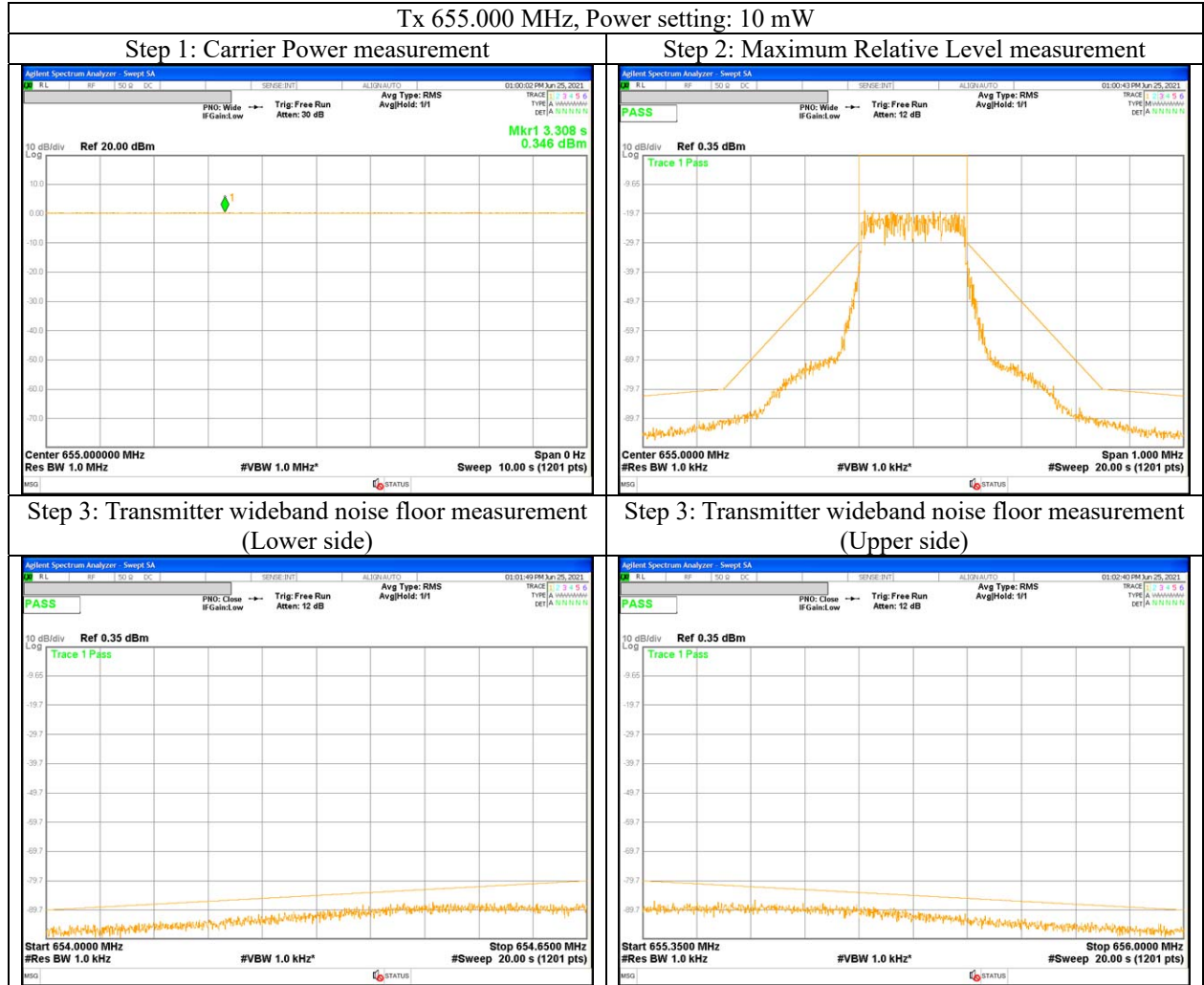
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Emission Mask

Report No. 13720501H
Test place Ise EMC Lab. No.6 Measurement Room
Date June 25, 2021
Temperature/ Humidity 23 deg. C / 63 % RH
Engineer Hiroki Numata
Mode Tx 655.000 MHz, 10 mW



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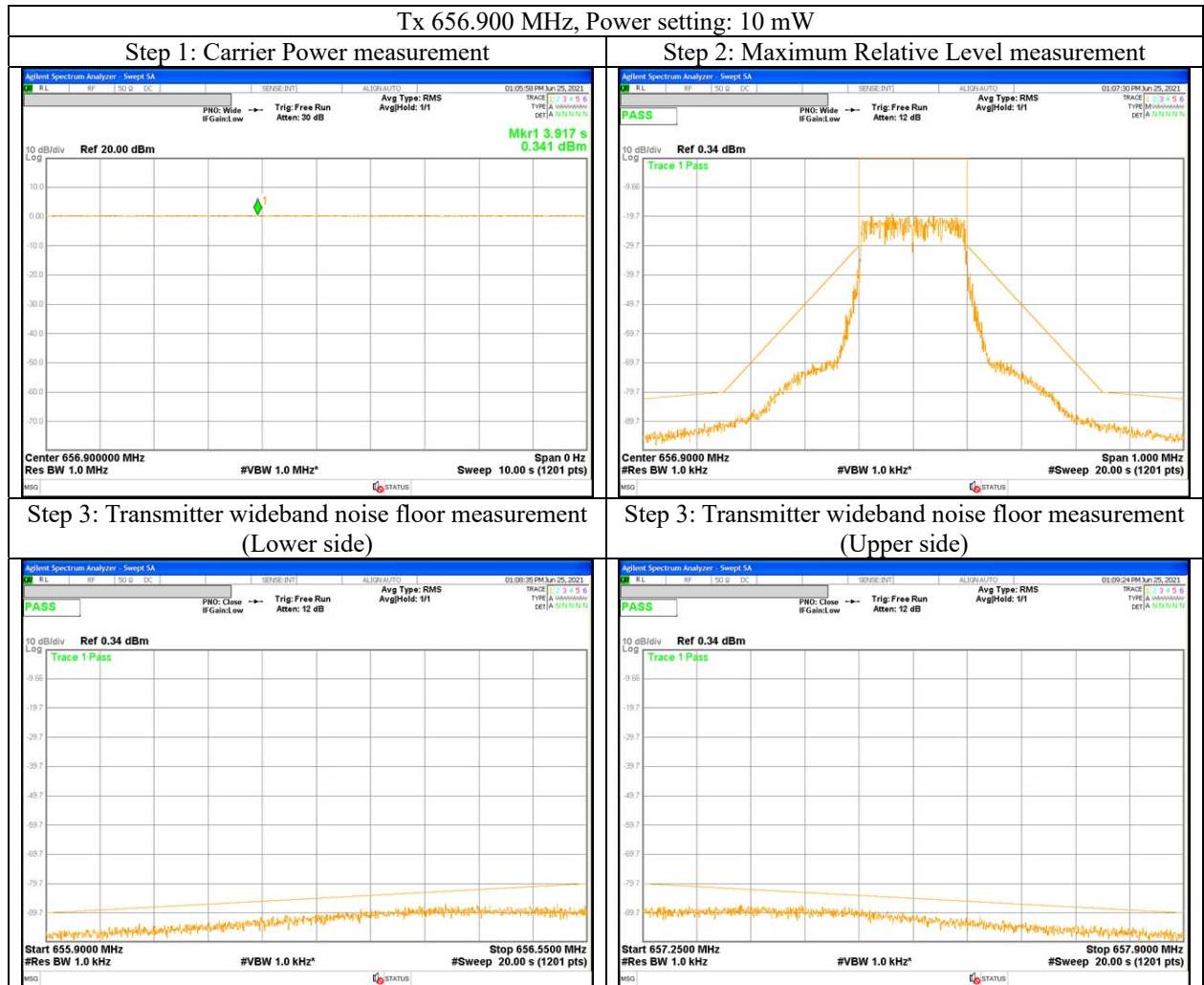
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Emission Mask

Report No.	13720501H
Test place	Ise EMC Lab. No.6 Measurement Room
Date	June 25, 2021
Temperature/ Humidity	23 deg. C / 63 % RH
Engineer	Hiroki Numata
Mode	Tx 656.900 MHz, 10 mW



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Field strength of spurious radiation

Report No. 13720501H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date August 19, 2021(Day) August 19, 2021(Night)
Temperature / Humidity 21 deg. C / 57 % RH 22 deg. C / 70 % RH
Engineer Akihiko Maeda Nachi Konegawa
(25 MHz - 1000 MHz) (1 GHz - 10 GHz)
Mode Tx 470.100 MHz, 40 mW

Frequency [MHz]	Rx SA/TR		Tx SG		Tx	Tx	Result		Limit	Margin		Horizontal		Vertical		Remarks
	Reading [dBuV]		Reading [dBm]		Cable Loss [dB]	Ant. Gain [dBi]	(ERP) [dBm]		(ERP) [dBm]	[dB]		Rx Ant. Height [cm]	Turn Table [deg.]	Rx Ant. Height [cm]	Turn Table [deg.]	
	Hori.	Vert.	Hori.	Vert.			Hori.	Vert.		Hori.	Vert.					
72.01	32.50	43.60	-68.3	-49.2	1.3	-21.7	-93.5	-74.4	-54.0	39.5	20.4	293	291	100	236	
108.02	34.51	43.66	-67.4	-52.7	1.6	-9.8	-81.0	-66.4	-54.0	27.0	12.4	165	67	100	5	
120.09	35.31	44.40	-69.4	-51.0	1.7	-8.2	-81.4	-63.1	-54.0	27.4	9.1	161	145	100	254	
216.56	33.12	31.29	-74.0	-73.6	2.4	-7.8	-86.4	-86.0	-54.0	32.4	32.0	125	275	100	11	
313.00	42.21	41.32	-54.7	-54.0	3.0	-7.6	-67.4	-66.7	-36.0	31.4	30.7	103	55	190	221	
337.00	42.00	36.98	-53.7	-57.9	3.1	-7.4	-66.4	-70.6	-36.0	30.4	34.6	100	45	158	99	
940.20	NS	NS	-	-	-	-	-	-	-36.0	-	-	-	-	-	-	
1410.30	57.08	55.03	-49.5	-52.8	4.3	7.2	-48.7	-52.0	-30.0	18.7	22.0	166	186	120	88	
1880.40	45.00	45.28	-68.1	-69.8	3.2	10.1	-63.4	-65.1	-30.0	33.4	35.1	120	127	117	152	
2350.50	43.56	NS	-72.0	-	3.3	9.8	-67.6	-	-30.0	37.6	-	110	226	-	-	
2820.60	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
3290.70	44.81	44.20	-66.60	-68.10	3.9	11.9	-60.8	-62.3	-30.0	30.8	32.3	100	33	150	30	
3760.80	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
4230.90	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
4701.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	

Calculation Result = SG Reading - Tx Cable Loss + Tx Antenna Gain - 2.15

Rx-ANTENNA : Biconical Antenna(25 MHz - 200 MHz), Logperiodic Antenna(200 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

Tx-ANTENNA : 120 MHz tuned Dipole Antenna(30 MHz - 120 MHz), Dipole Antenna(120 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

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

NS : No signal detect.

Detector : 25 MHz to 30 MHz: Spectrum Analyzer RMS Average (RBW: 10 kHz / VBW: 30 kHz)

30 MHz to 1 GHz: Spectrum Analyzer RMS Average (RBW: 100 kHz / VBW: 300 kHz), Above 1 GHz: Spectrum Analyzer RMS Average (RBW: 1 MHz / VBW: 3 MHz)

*Emissions were investigated up to the 10th harmonic of the fundamental.

Field strength of spurious radiation

Report No. 13720501H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date August 19, 2021(Day) August 19, 2021(Night)
Temperature / Humidity 21 deg. C / 57 % RH 22 deg. C / 70 % RH
Engineer Akihiko Maeda Nachi Konegawa
(25 MHz - 1000 MHz) (1 GHz - 10 GHz)
Mode Tx 539.000 MHz, 40 mW

Frequency [MHz]	Rx SA/TR		Tx SG		Tx	Tx	Result		Limit (ERP) [dBm]	Margin		Horizontal		Vertical		Remarks
	Reading [dBuV]		Reading [dBm]		Cable Loss [dB]	Ant. Gain [dBi]	(ERP) [dBm]			(ERP) [dBm]	[dB]	Rx Ant. Height [cm]	Turn Table [deg.]	Rx Ant. Height [cm]	Turn Table [deg.]	
	Hori.	Vert.	Hori.	Vert.			Hori.	Vert.								
72.00	32.80	43.40	-67.7	-49.6	1.3	-21.7	-92.9	-74.8	-54.0	38.9	20.8	295	291	100	233	
108.02	34.10	43.50	-68.3	-53.1	1.6	-9.8	-81.9	-66.7	-54.0	27.9	12.7	160	64	100	3	
120.08	35.30	44.61	-69.4	-50.6	1.7	-8.2	-81.5	-62.6	-54.0	27.5	8.6	165	144	100	255	
216.00	33.41	32.00	-73.4	-72.2	2.4	-7.8	-85.8	-84.6	-54.0	31.8	30.6	125	276	100	11	
313.04	42.23	41.40	-54.7	-53.8	3.0	-7.6	-67.4	-66.5	-36.0	31.4	30.5	104	54	194	222	
337.10	41.49	36.78	-54.7	-58.3	3.1	-7.4	-67.4	-71.0	-36.0	31.4	35.0	100	45	158	99	
1078.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
1617.00	53.44	51.97	-56.1	-59.0	3.8	9.2	-52.9	-55.8	-30.0	22.9	25.8	125	201	147	134	
2156.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
2695.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
3234.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
3773.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
4312.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
4851.00	45.76	44.83	-58.20	-60.20	4.8	12.4	-52.7	-54.7	-30.0	22.7	24.7	126	355	145	357	
5390.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-

Calculation Result = SG Reading - Tx Cable Loss + Tx Antenna Gain - 2.15

Rx-ANTENNA : Biconical Antenna(25 MHz - 200 MHz), Logperiodic Antenna(200 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

Tx-ANTENNA : 120 MHz tuned Dipole Antenna(30 MHz - 120 MHz), Dipole Antenna(120 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

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

NS : No signal detect.

Detector : 25 MHz to 30 MHz: Spectrum Analyzer RMS Average (RBW: 10 kHz / VBW: 30 kHz)

30 MHz to 1 GHz: Spectrum Analyzer RMS Average (RBW: 100 kHz / VBW: 300 kHz), Above 1 GHz: Spectrum Analyzer RMS Average (RBW: 1 MHz / VBW: 3 MHz)

*Emissions were investigated up to the 10th harmonic of the fundamental.

Field strength of spurious radiation

Report No. 13720501H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date August 19, 2021(Day) August 19, 2021(Night)
Temperature / Humidity 21 deg. C / 57 % RH 22 deg. C / 70 % RH
Engineer Akihiko Maeda Nachi Konegawa
(25 MHz - 1000 MHz) (1 GHz - 10 GHz)
Mode Tx 607.900 MHz, 40 mW

Frequency [MHz]	Rx SA/TR		Tx SG		Tx Cable Loss [dB]	Tx Ant. Gain [dBi]	Result (ERP) [dBm]		Limit (ERP) [dBm]	Margin [dB]		Horizontal		Vertical		Remarks
	Reading [dBuV]		Reading [dBm]									Rx Ant. Height [cm]	Turn Table [deg.]	Rx Ant. Height [cm]	Turn Table [deg.]	
	Hori.	Vert.	Hori.	Vert.			Hori.	Vert.		Hori.	Vert.					
72.01	32.50	43.60	-67.8	-49.2	1.3	-21.7	-93.1	-74.5	-54.0	39.1	20.5	293	291	100	236	
108.78	34.60	43.70	-69.8	-53.0	1.6	-9.7	-83.3	-66.5	-54.0	29.3	12.5	165	63	100	5	
120.09	35.31	44.40	-69.5	-50.4	1.7	-8.2	-81.6	-62.5	-54.0	27.6	8.5	161	145	100	254	
216.56	33.12	31.29	-73.6	-72.9	2.4	-7.8	-85.9	-85.3	-54.0	31.9	31.3	125	275	100	11	
313.00	42.21	41.32	-54.3	-53.6	3.0	-7.6	-67.0	-66.3	-36.0	31.0	30.3	103	55	190	221	
337.00	42.00	36.98	-54.7	-57.8	3.1	-7.4	-67.4	-70.5	-36.0	31.4	34.5	100	45	158	99	
1215.80	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
1823.70	47.70	46.71	-64.4	-66.9	3.3	10.0	-59.8	-62.3	-30.0	29.8	32.3	148	134	156	48	
2431.60	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
3039.50	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
3647.40	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
4255.30	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
4863.20	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
5471.10	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
6079.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-

Calculation Result = SG Reading - Tx Cable Loss + Tx Antenna Gain - 2.15

Rx-ANTENNA : Biconical Antenna(25 MHz - 200 MHz), Logperiodic Antenna(200 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

Tx-ANTENNA : 120 MHz tuned Dipole Antenna(30 MHz - 120 MHz), Dipole Antenna(120 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

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

NS : No signal detect.

Detector : 25 MHz to 30 MHz: Spectrum Analyzer RMS Average (RBW: 10 kHz / VBW: 30 kHz)

30 MHz to 1 GHz: Spectrum Analyzer RMS Average (RBW: 100 kHz / VBW: 300 kHz), Above 1 GHz: Spectrum Analyzer RMS Average (RBW: 1 MHz / VBW: 3 MHz)

*Emissions were investigated up to the 10th harmonic of the fundamental.

Field strength of spurious radiation

Report No.	13720501H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	August 18, 2021(Night)	August 19, 2021(Day)
Temperature / Humidity	21 deg. C / 57 % RH	21 deg. C / 57 % RH
Engineer	Nachi Konegawa	Akihiko Maeda
	(1 GHz - 10 GHz)	(25 MHz - 1000 MHz)
Mode	Tx 653.100 MHz, 10 mW	

Frequency [MHz]	Rx SA/TR		Tx SG		Tx Cable Loss [dB]	Tx Ant. Gain [dBi]	Result (ERP) [dBm]		Limit (ERP) [dBm]	Margin		Horizontal		Vertical		Remarks
	Reading [dBuV]		Reading [dBm]							Rx Ant. Height [cm]	Turn Table [deg.]	Rx Ant. Height [cm]	Turn Table [deg.]			
	Hori.	Vert.	Hori.	Vert.			Hori.	Vert.								
72.03	32.98	43.67	-68.0	-49.4	1.3	-21.7	-93.2	-74.6	-54.0	39.2	20.6	289	291	100	230	
108.02	36.50	43.91	-67.8	-52.9	1.6	-9.8	-81.4	-66.5	-54.0	27.4	12.5	166	67	100	4	
120.00	35.67	44.29	-69.4	-50.8	1.7	-8.2	-81.4	-62.8	-54.0	27.4	8.8	160	145	100	355	
216.02	32.10	31.19	-73.7	-72.9	2.4	-7.8	-86.1	-85.3	-54.0	32.1	31.3	126	270	100	9	
312.82	41.99	40.76	-54.7	-53.9	3.0	-7.6	-67.4	-66.6	-36.0	31.4	30.6	105	56	189	213	
337.70	42.15	36.98	-54.2	-58.1	3.1	-7.4	-66.9	-70.8	-36.0	30.9	34.8	100	46	157	99	
1306.20	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
1959.30	47.54	46.13	-63.5	-66.2	3.1	10.1	-58.7	-61.4	-30.0	28.7	31.4	154	10	204	78	
2612.40	44.30	NS	-61.6	-	3.4	10.9	-56.3	-	-30.0	26.3	-	101	161	-	-	
3265.50	47.16	45.01	-61.7	-66.4	3.9	11.9	-55.9	-60.6	-30.0	25.9	30.6	121	305	203	44	
3918.60	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
4571.70	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
5224.80	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
5877.90	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-
6531.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	-

Calculation Result = SG Reading - Tx Cable Loss + Tx Antenna Gain - 2.15

Rx-ANTENNA : Biconical Antenna(25 MHz - 200 MHz), Logperiodic Antenna(200 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

Tx-ANTENNA : 120 MHz tuned Dipole Antenna(30 MHz - 120 MHz), Dipole Antenna(120 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

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

NS : No signal detect.

Detector : 25 MHz to 30 MHz: Spectrum Analyzer RMS Average (RBW: 10 kHz / VBW: 30 kHz)

30 MHz to 1 GHz: Spectrum Analyzer RMS Average (RBW: 100 kHz / VBW: 300 kHz), Above 1 GHz: Spectrum Analyzer RMS Average (RBW: 1 MHz / VBW: 3 MHz)

*Emissions were investigated up to the 10th harmonic of the fundamental.

Field strength of spurious radiation

Report No.	13720501H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	
Date	August 18, 2021(Night)	August 19, 2021(Day)	
Temperature / Humidity	21 deg. C / 57 % RH	21 deg. C / 57 % RH	
Engineer	Nachi Konegawa	Akihiko Maeda	
	(1 GHz - 10 GHz)	(25 MHz - 1000 MHz)	
Mode	Tx 655.000 MHz, 10 mW		

Frequency [MHz]	Rx SA/TR		Tx SG		Tx Cable Loss [dB]	Tx Ant. Gain [dBi]	Result		Limit (ERP) [dBm]	Margin		Horizontal		Vertical		Remarks
	Reading [dBuV]		Reading [dBm]				(ERP) [dBm]			(ERP) [dBm]	[dB]	Rx Ant. Height [cm]	Turn Table [deg.]	Rx Ant. Height [cm]	Turn Table [deg.]	
	Hori.	Vert.	Hori.	Vert.			Hori.	Vert.								
72.06	33.00	43.43	-68.0	-49.6	1.3	-21.7	-93.2	-74.9	-54.0	39.2	20.9	290	291	100	230	
108.01	36.21	43.90	-68.1	-52.9	1.6	-9.8	-81.7	-66.5	-54.0	27.7	12.5	166	67	100	5	
120.00	34.00	44.33	-71.1	-50.8	1.7	-8.2	-83.1	-62.8	-54.0	29.1	8.8	161	145	100	351	
216.51	32.11	31.00	-73.7	-73.1	2.4	-7.8	-86.1	-85.5	-54.0	32.1	31.5	126	271	100	9	
312.22	41.58	40.76	-55.1	-53.9	3.0	-7.6	-67.8	-66.6	-36.0	31.8	30.6	105	52	191	218	
337.66	42.50	36.91	-53.9	-58.2	3.1	-7.4	-66.6	-70.9	-36.0	30.6	34.9	100	44	157	99	
1310.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
1965.00	47.48	47.19	-63.6	-65.1	3.1	10.1	-58.7	-60.3	-30.0	28.7	30.3	156	10	153	81	
2620.00	44.05	NS	-61.9	-	3.5	10.9	-56.6	-	-30.0	26.6	-	102	163	-	-	
3275.00	47.29	47.41	-61.6	-64.0	3.9	11.9	-55.7	-58.2	-30.0	25.7	28.2	140	14	121	352	
3930.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
4585.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
5240.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
5895.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
6550.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	

Calculation Result = SG Reading - Tx Cable Loss + Tx Antenna Gain - 2.15

Rx-ANTENNA : Biconical Antenna(25 MHz - 200 MHz), Logperiodic Antenna(200 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

Tx-ANTENNA : 120 MHz tuned Dipole Antenna(30 MHz - 120 MHz), Dipole Antenna(120 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

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

NS : No signal detect.

Detector : 25 MHz to 30 MHz: Spectrum Analyzer RMS Average (RBW: 10 kHz / VBW: 30 kHz)

30 MHz to 1 GHz: Spectrum Analyzer RMS Average (RBW: 100 kHz / VBW: 300 kHz), Above 1 GHz: Spectrum Analyzer RMS Average (RBW: 1 MHz / VBW: 3 MHz)

*Emissions were investigated up to the 10th harmonic of the fundamental.

Field strength of spurious radiation

Report No.	13720501H	
Test place	Ise EMC Lab.	No.4
Semi Anechoic Chamber		
Date	August 18, 2021(Night)	August 19, 2021(Day)
Temperature / Humidity	21 deg. C / 57 % RH	21 deg. C / 57 % RH
Engineer	Nachi Konegawa	Akihiko Maeda
	(1 GHz - 10 GHz)	(25 MHz - 1000 MHz)
Mode	Tx 656.900 MHz, 10 mW	

Frequency [MHz]	Rx SA/TR		Tx SG		Tx Cable Loss [dB]	Tx Ant. Gain [dBi]	Result (ERP) [dBm]		Limit (ERP) [dBm]	Margin		Horizontal		Vertical		Remarks
	Reading [dBuV]		Reading [dBm]							Rx Ant. Height [cm]	Turn Table [deg.]	Rx Ant. Height [cm]	Turn Table [deg.]			
	Hori.	Vert.	Hori.	Vert.			Hori.	Vert.						Hori.	Vert.	
72.34	32.33	43.44	-68.7	-49.4	1.3	-21.6	-93.8	-74.5	-54.0	39.8	20.5	291	290	100	233	
108.04	36.60	43.76	-67.4	-53.0	1.6	-9.8	-81.0	-66.7	-54.0	27.0	12.7	163	66	100	6	
120.09	35.43	44.01	-68.0	-51.1	1.7	-8.2	-80.0	-63.2	-54.0	26.0	9.2	161	144	100	355	
216.56	33.00	31.29	-72.8	-72.6	2.4	-7.8	-85.2	-85.0	-54.0	31.2	31.0	126	278	100	10	
313.00	41.79	41.01	-54.5	-53.7	3.0	-7.6	-67.2	-66.4	-36.0	31.2	30.4	103	54	190	222	
337.00	42.48	36.66	-54.2	-58.4	3.1	-7.4	-66.9	-71.1	-36.0	30.9	35.1	100	46	157	99	
1313.80	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
1970.70	46.77	47.90	-64.3	-64.4	3.1	10.1	-59.4	-59.6	-30.0	29.4	29.6	152	9	155	80	
2627.60	43.66	NS	-62.2	-	3.5	10.9	-57.0	-	-30.0	27.0	-	102	160	-	-	
3284.50	48.15	47.51	-60.7	-63.9	3.9	11.9	-54.9	-58.1	-30.0	24.9	28.1	116	346	120	3	
3941.40	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
4598.30	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
5255.20	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
5912.10	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	
6569.00	NS	NS	-	-	-	-	-	-	-30.0	-	-	-	-	-	-	

Calculation Result = SG Reading - Tx Cable Loss + Tx Antenna Gain - 2.15

Rx-ANTENNA : Biconical Antenna(25 MHz - 200 MHz), Logperiodic Antenna(200 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

Tx-ANTENNA : 120 MHz tuned Dipole Antenna(30 MHz - 120 MHz), Dipole Antenna(120 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)

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

NS : No signal detect.

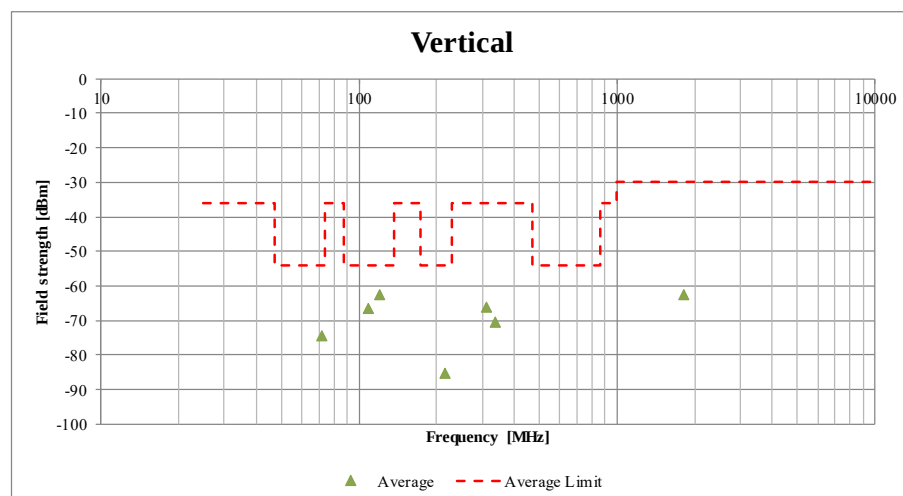
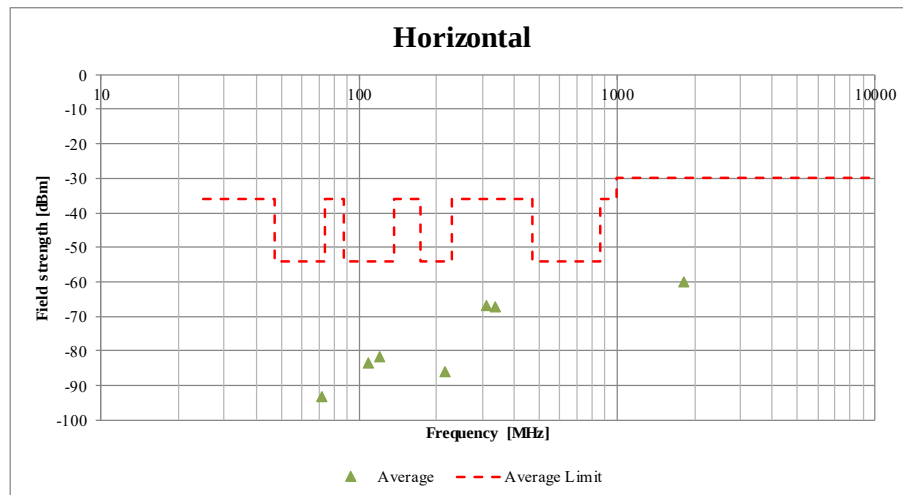
Detector : 25 MHz to 30 MHz: Spectrum Analyzer RMS Average (RBW: 10 kHz / VBW: 30 kHz)

30 MHz to 1 GHz: Spectrum Analyzer RMS Average (RBW: 100 kHz / VBW: 300 kHz), Above 1 GHz: Spectrum Analyzer RMS Average (RBW: 1 MHz / VBW: 3 MHz)

*Emissions were investigated up to the 10th harmonic of the fundamental.

Field strength of spurious radiation
(Plot data, Worst case)

Report No.	13720501H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	August 19, 2021(Day)	August 19, 2021(Night)
Temperature / Humidity	21 deg. C / 57 % RH	22 deg. C / 70 % RH
Engineer	Akihiko Maeda	Nachi Konegawa
	(25 MHz - 1000 MHz)	(1 GHz - 10 GHz)
Mode	Tx 607.900 MHz, 10 mW	



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

Frequency Stability

Report No.	13720501H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	June 15, 2021
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Junki Nagatomi
Mode	Tx 539.000 MHz 40 mW

Varying Temperature

Test condition		Tested frequency [MHz]	Frequency error [MHz]	Result [%]	Limit [+/- %]	Remarks
Temp. [deg. C]	Voltage [V]					
55	3.60	539.000	0.000424	0.00008	0.005	Customer requested temperature
50	3.60	539.000	0.000253	0.00005	0.005	
40	3.60	539.000	0.000414	0.00008	0.005	
30	3.60	539.000	0.000337	0.00006	0.005	
20	3.60	539.000	0.000339	0.00006	0.005	
10	3.60	539.000	0.000356	0.00007	0.005	
0	3.60	539.000	0.000356	0.00007	0.005	
-10	3.60	539.000	0.000586	0.00011	0.005	
-20	3.60	539.000	0.000631	0.00012	0.005	
-30	3.60	539.000	0.000450	0.00008	0.005	

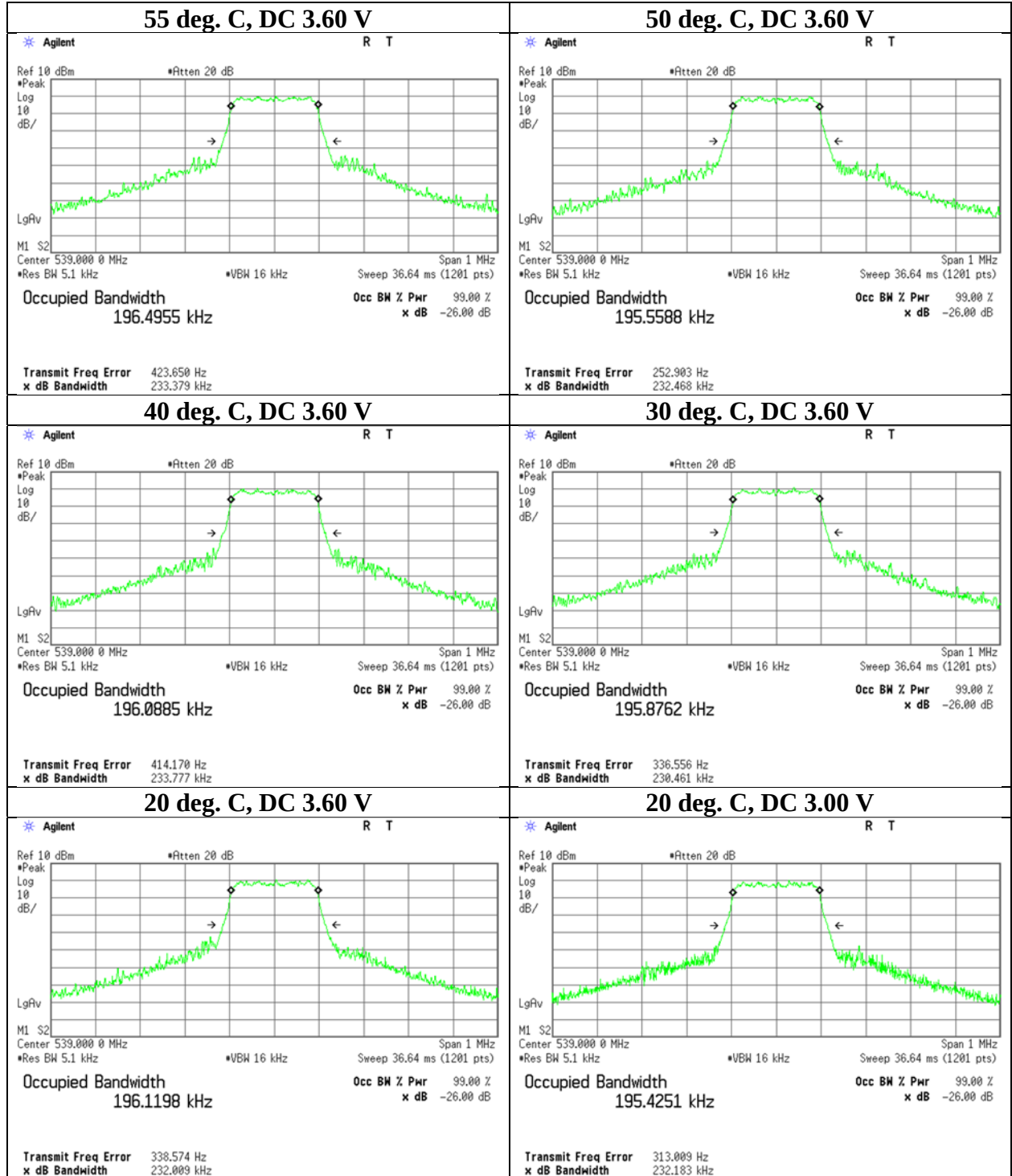
Result [%] = Frequency error / Tested frequency * 100

Varying Supply Voltage

Test condition		Tested frequency [MHz]	Frequency error [MHz]	Result [%]	Limit [+/- %]	Remarks
Temp. [deg. C]	Voltage [V]					
20	3.60	539.000	0.000339	0.00006	0.005	Nominal
20	3.06	539.000	0.000212	0.00004	0.005	Norminal (-15%)
20	4.14	539.000	0.000385	0.00007	0.005	Norminal (+15%)
20	3.00	539.000	0.000313	0.00006	0.005	Minimum operating Voltage
20	4.80	539.000	-0.000007	0.00000	0.005	Maximum operating Voltage

Result [%] = Frequency error / Tested frequency * 100

Frequency Stability



UL Japan, Inc.

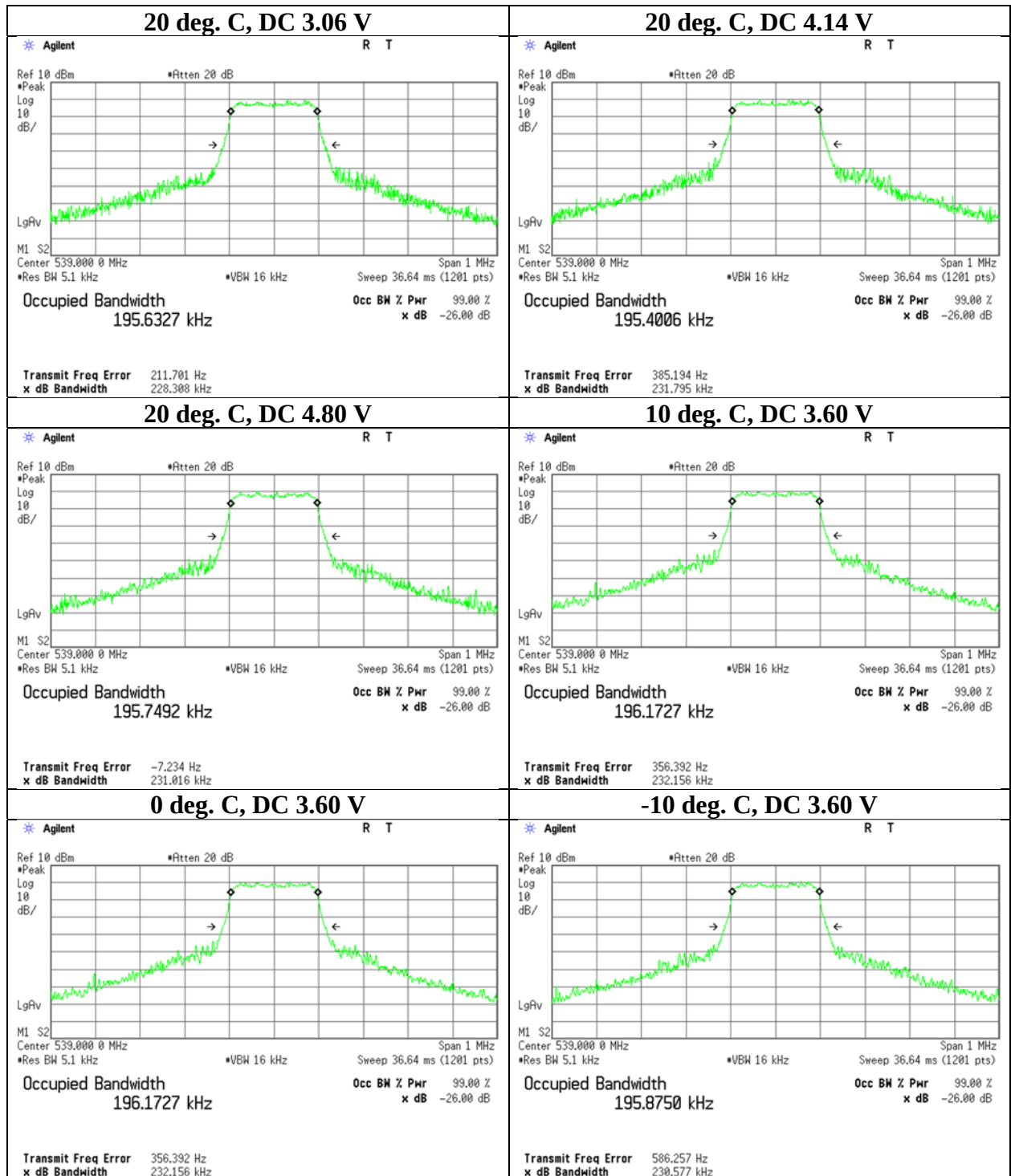
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Frequency Stability



UL Japan, Inc.

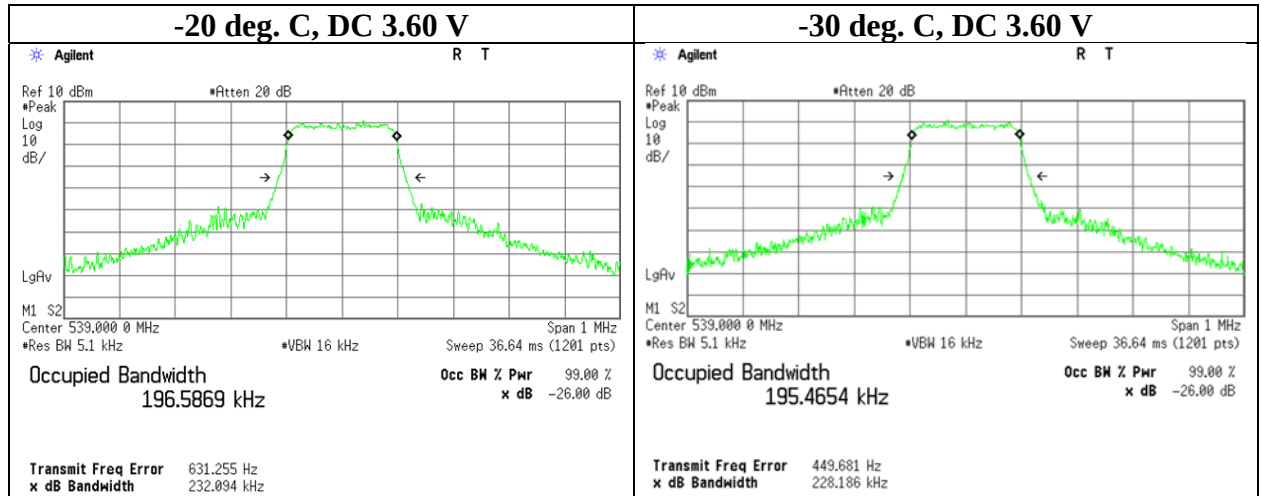
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Frequency Stability

Report No.	13720501H
Test place	Ise EMC Lab. No.8 Measurement Room
Date	June 15, 2021
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Junki Nagatomi
Mode	Tx 655.000 MHz 10 mW

Varying Temperature

Test condition		Tested frequency [MHz]	Frequency error [MHz]	Result [%]	Limit [+/- %]	Remarks
Temp. [deg. C]	Voltage [V]					
55	3.60	655.000	0.000591	0.00009	0.005	Customer requested temperature
50	3.60	655.000	0.000496	0.00008	0.005	
40	3.60	655.000	0.000504	0.00008	0.005	
30	3.60	655.000	0.000501	0.00008	0.005	
20	3.60	655.000	0.000355	0.00005	0.005	
10	3.60	655.000	0.000914	0.00014	0.005	
0	3.60	655.000	0.000867	0.00013	0.005	
-10	3.60	655.000	0.000804	0.00012	0.005	
-20	3.60	655.000	0.000650	0.00010	0.005	
-30	3.60	655.000	0.001126	0.00017	0.005	

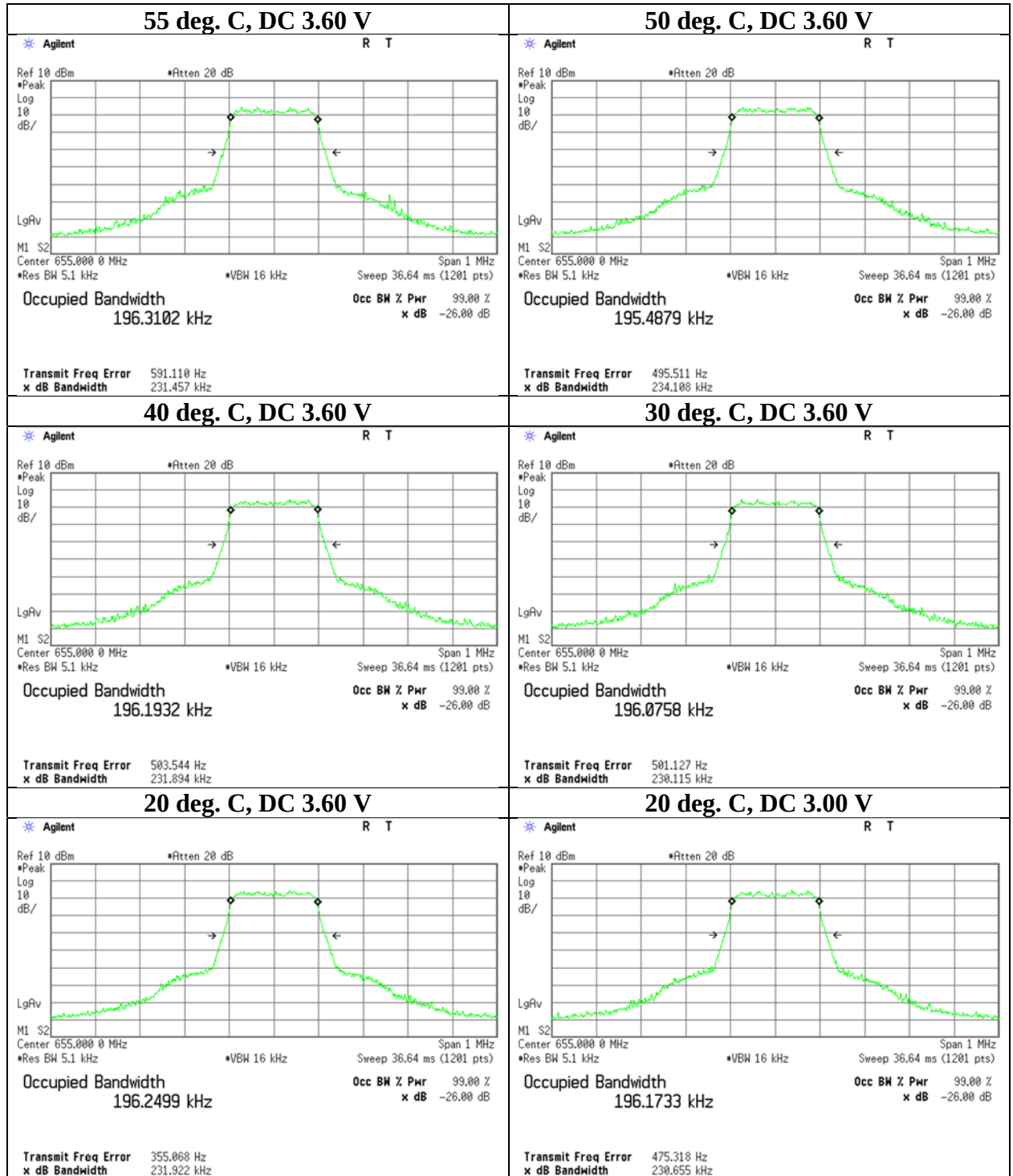
Result [%] = Frequency error / Tested frequency * 100

Varying Supply Voltage

Test condition		Tested frequency [MHz]	Frequency error [MHz]	Result [%]	Limit [+/- %]	Remarks
Temp. [deg. C]	Voltage [V]					
20	3.60	655.000	0.000355	0.00005	0.005	Nominal
20	3.06	655.000	0.000558	0.00009	0.005	Norminal (-15%)
20	4.14	655.000	0.000604	0.00009	0.005	Norminal (+15%)
20	3.00	655.000	0.000475	0.00007	0.005	Minimum operating Voltage
20	4.80	655.000	0.000477	0.00007	0.005	Maximum operating Voltage

Result [%] = Frequency error / Tested frequency * 100

Frequency Stability



UL Japan, Inc.

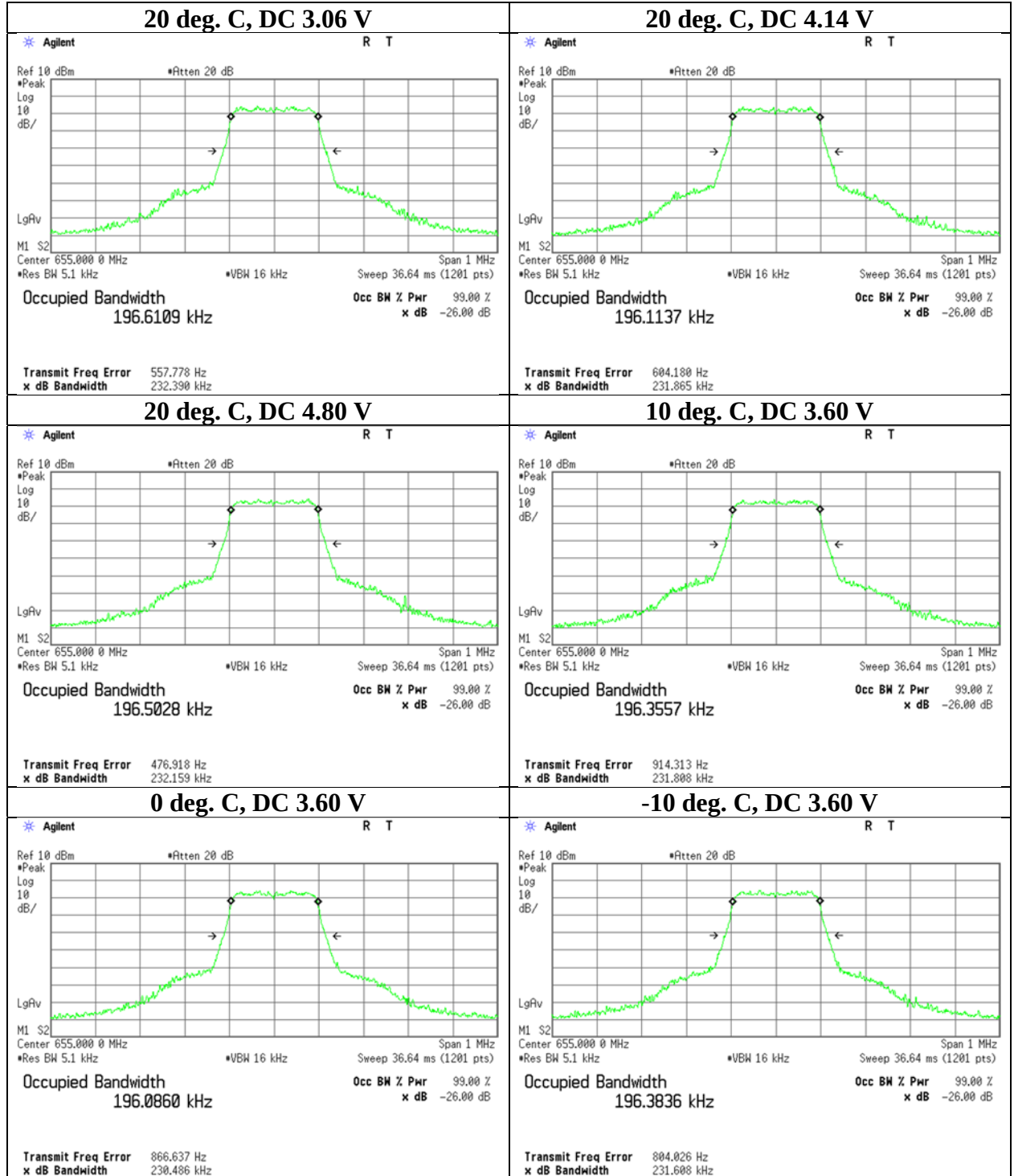
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Frequency Stability



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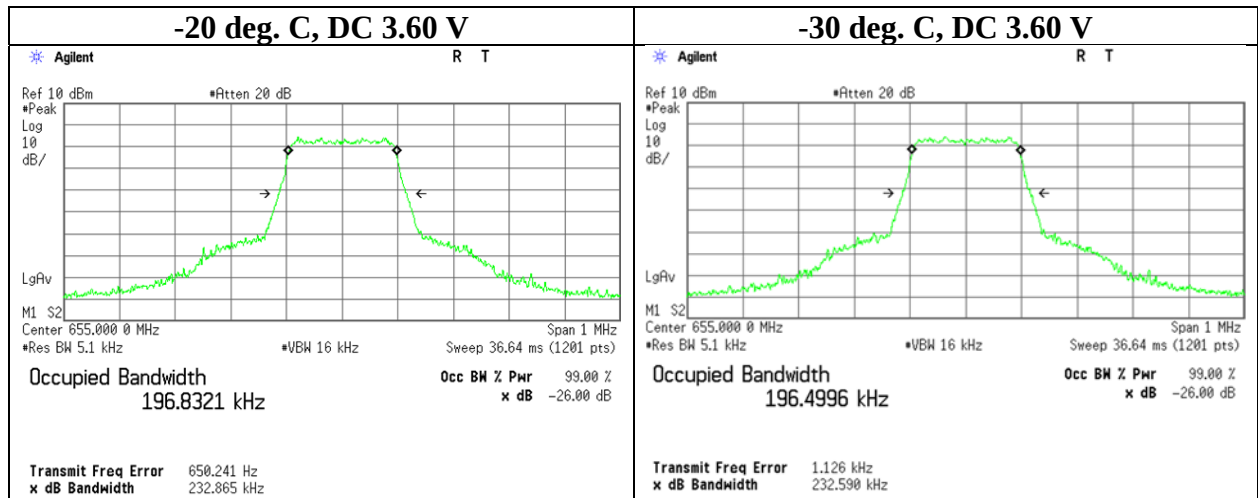
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APPENDIX 2: Test instruments

Test equipment(1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
AT	MSA-04	141885	Spectrum Analyzer	Keysight Technologies Inc	E4448A	US44300523	11/09/2020	12
AT	MPM-12	141809	Power Meter	Anritsu Corporation	ML2495A	825002	05/19/2021	12
AT	MPSE-17	141830	Power sensor	Anritsu Corporation	MA2411B	738285	05/19/2021	12
AT	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/15/2021	12
AT	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	01/07/2021	12
AT	MAT-26	141244	Attenuator(10dB)	Weinschel - API Technologies Corp	WA8-10-34	A198	02/24/2021	12
AT	MCC-64	141327	Coaxial Cable	UL Japan	-	-	02/03/2021	12
AT	MCC-244	197219	Microwave cable	Huber+Suhner	SF126E/11PC35/11PC35/2000MM	536999/126E	03/04/2021	12
AT	MAT-90	141223	Attenuator	Weinschel Associates	WA56-10	56100306	05/14/2021	12
AT	MAT-66	141247	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	-	-
AT	MCH-05	141440	Temperature and Humidity Chamber	Espec	PL-1KP	14019569	04/25/2021	12
AT	MOS-28	141567	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0008	01/15/2021	12
AT	MCC-128	141221	Coaxial Cable	Suhner	NRG180	-	08/11/2021	12
AT	MCC-144	141414	Microwave Cable	Junkosha	MWX221	1207S407	08/11/2021	12
AT	MAT-22	141269	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	03/01/2021	12
AT	MSA-17	141904	Spectrum Analyzer	Keysight Technologies Inc	N9030A	US51350215	09/23/2020	12
AT	MCH-04	141429	Temperature and Humidity Chamber	Espec	PL-2KP	14015723	08/05/2021	12
RE	MAEC-04	142011	AC4 Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/25/2020	24
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/15/2021	12
RE	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/07/2021	12
RE	MJM-29	142230	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MSA-15	141902	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46187105	10/15/2020	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	10/19/2020	12
RE	MCC-257	208936	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000M,5000M	537061/126E / 537076/126E	07/18/2021	12
RE	MHF-27	141297	High Pass Filter(1.1-10GHz)	TOKYO KEIKI	TF219CD1	1001	01/14/2021	12
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	557	05/10/2021	12
RE	MHA-30	141514	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	01611	06/01/2021	12
RE	TSG-09	175056	Signal Generator	Keysight Technologies Inc	N5183B	MY57280292	08/08/2020	12
RE	MCC-169	141320	Microwave Cable	Junkosha	J12J102239-00	J12J102239-00	04/02/2021	12
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/02/2021	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	VHA 91031302	08/31/2020	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	11/06/2020	12
RE	MLA-23	141267	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-192	09/02/2020	12

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Test equipment(2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/18/2021	12
RE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/05/2021	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/18/2020	12
RE	YTSSG03	141967	Signal Generator	Rohde & Schwarz	SMT02	51400043	08/18/2021	12
RE	MDA-01	141464	Dipole Antenna	Schwarzbeck Mess-Elektronik OHG	VHAP	1018	11/30/2020	12
RE	MDA-03	141454	Dipole Antenna	Schwarzbeck Mess-Elektronik OHG	UHAP	991	11/30/2020	12
RE	MCC-127	141220	Coaxial Cable	UL Japan	-	-	07/21/2021	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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