RADIO TEST REPORT

Test Report No. 15106908H-C-R1

Customer	**Audio-Technica Corporation**
Description of EUT	**UNIPAK® TRANSMITTER**
Model Number of EUT	**ATW-T210cS**
FCC ID	**JFZT210CS**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**June 28, 2024**
Remarks	**-**

Representative test engineer	Approved by
T. Noguchi	S. Matsuyama
Takafumi Noguchi Engineer	Satofumi Matsuyama Engineer

CERTIFICATE 5107.02

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☒ There is no testing item of "Non-accreditation".

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- The information provided from the customer for this report is identified in SECTION 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No. 15106908H-C

This report is a revised version of 15106908H-C. 15106908H-C is replaced with this report .

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15106908H	May 31, 2024	-
1	15106908H-C-R1	June 28, 2024	**SECTION 3.2** -Corrected the specification for RF output power in the table. FCC: Section 15.236 (d) (1) (2) →FCC: Section 15.236 (d) (1) -Deleted FCC Part 15.203 Antenna requirement. **SECTION 2.1** -Corrected the test date. April 4 to 18, 2024 → April 4 to 17, 2024 **SECTION 4** *The details of Operating mode(s) -Corrected the modulation for necessary bandwidth in the table. See SECTION 8 → See SECTION 7 -Deleted the below sentence in the table. *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. **SECTION 6** -Corrected the sentence of frequency stability. [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. → [Frequency stability] The power supply set to 100 % nominal setting, raise to the maximum operating temperature of the EUT. Record the frequency of the EUT. Repeat measurements at each 10 deg. C decrement up to minimum operating temperature of EUT. EUT power supply was 100 % 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.

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS PAGE

SECTION 1: Customer Information

Company Name	Audio-Technica Corporation
Address	2-46-1 Nishi-naruse, Machida, Tokyo 194-8666, Japan
Telephone Number	+81-42-739-9121
Contact Person	Hirohisa Yamamoto

The information provided from the customer is as follows;
- Customer, Description 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 and Test 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

Description	UNIPAK® TRANSMITTER
Model Number	ATW-T210cS
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	April 1, 2024
Test Date	April 4 to 17, 2024

2.2 Product Description

General Specification

Rating	DC 3.0 V (Battery (2 x Alkaline AA Batteries))
Operating temperature	5deg. C to 45 deg. C

Radio Specification

Radio type	Transmitter
Modulation type	FM
Necessary bandwidth	110 kHz = 2M + 2D where M: Maximum modulation frequency = 15 kHz D: Peak deviation = 40 kHz
Declared Channel Bandwidth (B)	200 kHz
Frequency of operation	508.125 MHz to 526.825 MHz
RF power	10 mW, 30 mW
Antenna gain	0 dBi max

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.236 Operation of wireless microphones in the bands 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz.

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

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	ANSI C63.10-2013 6. Standard test methods	FCC: Section 15.207	-	N/A	*1)
RF Output Power	ANSI C63.10:2013 Clause 11.9.2.3	FCC: Section 15.236 (d) (1)	See data.	Complied	Conducted
Occupied Bandwidth	ANSI C63.10:2013 Clause 6.9	FCC: Section 15.236 (f) (1) (2)	See data.	Complied	Conducted
Necessary bandwidth	EN 300 422-1 V1.4.2 Clause 8.3 KDB 206256 IV (d)	FCC: Section 15.236 (g)	See data.	Complied	Conducted
Field strength of spurious radiation	EN 300 422-1 V1.4.2 Clause 8.4 KDB 206256 IV (d)	FCC: Section 15.236 (g)	16.4 dB 2593.88 MHz, Horizonta	Complied	Radiated
Frequency stability	ANSI C63.10:2013 Clause 6.8	FCC: Section 15.236 (f) (3)	See data.	Complied	Conducted

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.
* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

*1) The test was not performed on since the EUT does not have AC Power ports.

FCC Part 15.31 (e)

This EUT provides the stable voltage constantly to RF Module regardless of input voltage.
Therefore, this EUT complies with the requirement.

3.3 Addition to standard

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

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Field strength of spurious radiation (EUT height: 1.5 m) (Measurement Distance 3 m)	Unit	Calculated Uncertainty (+/-)
25 MHz to 200 MHz	dB	6.0
200 MHz to 1000 MHz	dB	3.9
1 GHz to 12.75 GHz	dB	4.7

Antenna Terminal Conducted tests

Item	Unit	Calculated Uncertainty (+/-)
Antenna terminated conducted emission / Power density / Burst power	dB	3.47
Adjacent channel power (ACP)	dB	2.28
Bandwidth (OBW)	%	0.96
Time readout (time span upto 100 msec)	%	0.11
Time readout (time span upto 1000 msec)	%	0.11
Time readout (time span upto 60 sec)	%	0.02
Power measurement (Power meter < 8 GHz)	dB	1.46
Power measurement (Call box < 6 GHz)	dB	1.69
Frequency readout (Frequency counter)	ppm	0.67
Frequency readout (Spectrum analyzer frequency readout function)	ppm	2.13
Temperature (constant temperature bath)	deg.C	0.69
Humidity (constant temperature bath)	%RH	2.98
Modulation characteristics	%	6.93
Frequency for mobile	ppm	0.08
Contention-based protocol	dB	2.26

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan
Telephone: +81-596-24-8999
*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919
ISED Lab Company Number: 2973C / CAB identifier: JP0002

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	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

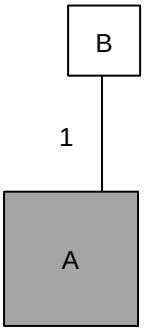
Mode	Remarks*
Transmitting (Tx),	-
*Transmitting duty was 100 % on all tests.	
*Power of the EUT was set by the software as follows;	
Power Setting: 10mW, 30mW Software: Ver1.0 (Date: 2024.04 01, Storage location: EUT memory) *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting.	

*The details of Operating mode(s)

Test Item	Tested frequency	Power setting	Modulation	Remarks
RF power output	508.125 MHz (Low) 518.775 MHz (Mid) 526.825 MHz (High)	10 mW, 30 mW	None (No modulation)	-
Occupied Bandwidth	508.125 MHz (Low) 518.775 MHz (Mid) 526.825 MHz (High)	10 mW, 30 mW	1 dBV, 2.5 kHz tone *2)	-
Necessary bandwidth	508.125 MHz (Low) 518.775 MHz (Mid) 526.825 MHz (High)	10 mW, 30 mW	See SECTION 7.	-
Field strength of spurious radiation	508.125 MHz (Low) 518.775 MHz (Mid) 526.825 MHz (High)	30 mW *1)	None (No modulation)	-
Frequency stability	508.125 MHz (Low) 518.775 MHz (Mid) 526.825 MHz (High)	30 mW *1)	None (No modulation)	-
*1) After the comparison between 10 mW and 30 mW as pre-check, test was performed with worst case 30 mW setting. *2) When modulated by a 2.5 kHz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation.				

4.2 Configuration and peripherals

Field strength of spurious radiation test



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

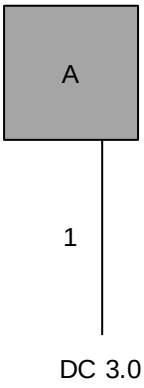
Description of EUT and Support equipment

No.	Item	Model number	Serial Number	Manufacturer	Remark
A	UNIPAK® TRANSMITTER	ATW-T210cS	No.8	Audio-Technica Corporation	EUT
B	Microphone	AT831cW	001	Audio-Technica Corporation	-

List of Cables Used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Audio Cable	1.4	Shielded	Shielded	-

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	Remark
A	UNIPAK® TRANSMITTER	ATW-T210cS	No.2	Audio-Technica Corporation	EUT

List of Cables Used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-

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.

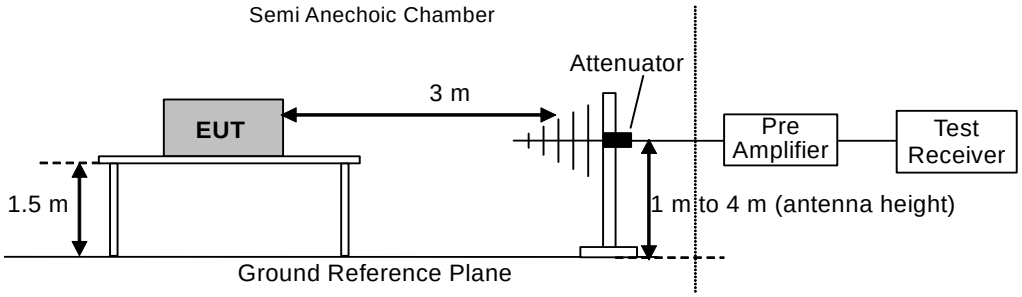
3) Effective radiated power was calculated by subtracting the cable loss and the attenuator loss connected between the Signal Generator and the Substitution Antenna from the Output power of the Signal Generator recorded in 2).
For the usage of the Antenna (Horn Antenna) except for the Half wave dipole Antenna (2.15dBi) 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

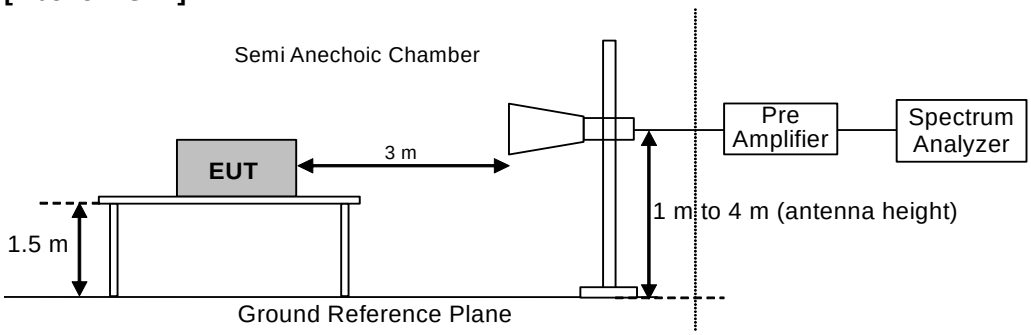
Frequency	25 MHz to 30 MHz	30 MHz to 1 GHz	Above 1 GHz
Instrument used	Spectrum Analyzer		
Detector	QP		RMS Average
IF Bandwidth	RBW: 10 kHz VBW: 30 kHz	RBW: 100 kHz VBW: 300 kHz	RBW: 1 MHz VBW: 3 MHz
Test Distance	3 m		

Figure 2: Test Setup

[25 MHz to 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.

Test results are rounded off and limit are rounded down, so some differences might be observed.

Measurement range : 25 MHz to 6 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
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
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. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)							

[Frequency stability]
The power supply set to 100 % nominal setting, raise to the maximum operating temperature of the EUT.
Record the frequency of the EUT.
Repeat measurements at each 10 deg. C decrement up to minimum operating temperature of EUT.

EUT power at 100 % 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.

Test results are rounded off and limit are rounded down, so some differences might be observed.

Test data : APPENDIX
Test result : Pass

SECTION 7: Necessary bandwidth

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

[For Analog Modulation Device]
In accordance with section 8.3 of ETSI EN 300 422-1, a weighted noise source through a weighting filter based on ITU-R Recommendation BS.559-2 was applied to the audio input of transmitter.
The transmitter RF output spectrums were measured at each channel using a receiving antenna and a spectrum analyzer with settings specified in the section 8.3.1 of ETSI EN 300 422-1.
The input level of both white noise and filter to EUT was 10 dBV according to the following result.

	lim-8dB	lim	lim+12dB	Difference of Demodulation level lim-8dB and lim+12dB	White noise +Filter input level
EUT input level	-10 dBV	-2 dBV	10 dBV		10 dBV
Demodulation level	-3.1 dBV	-	4.4 dBV	7.5 dB < 10 dB	
"lim" means "audio limiting threshold" declared by manufacturer.					

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

RF Output Power

Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 4, 2024
Temperature / Humidity	23 deg. C / 55 % RH
Engineer	Takafumi Noguchi
Mode	Tx

Power Setting	Channel	Freq. [MHz]	Reading Average [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Ant Gain [dB]	Result [EIRP] [dBm]	Result [EIRP] [mW]	Limit [EIRP] [mW]	Margin [dB]	Remarks
10 mW	Low	508.125	-1.02	0.36	9.90	0.00	9.24	8.39	50	7.75	
	Mid	518.775	-0.79	0.37	9.90	0.00	9.48	8.87	50	7.51	
	High	526.825	-0.82	0.37	9.90	0.00	9.45	8.81	50	7.54	
30 mW	Low	508.125	3.84	0.36	9.90	0.00	14.10	25.70	50	2.89	
	Mid	518.775	4.09	0.37	9.90	0.00	14.36	27.29	50	2.63	
	High	526.825	4.08	0.37	9.90	0.00	14.35	27.23	50	2.64	

Calculation formula: Result = Reading + Cable Loss + Atten. Loss + Ant Gain

Occupied Bandwidth

Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 8, 2024
Temperature/ Humidity	23 deg. C / 61 % RH
Engineer	Tetsuro Yoshida
Mode	Tx

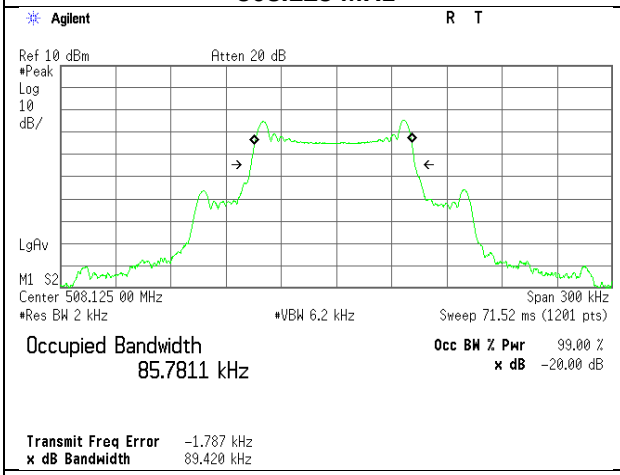
Power Setting	Channel	Freq. [MHz]	99% Occupied Bandwidth [kHz]	Limit [kHz]	Margin [kHz]
10 mW	Low	508.125	85.7811	200	114.2190
	Mid	518.775	83.3146	200	116.6854
	High	526.825	80.6282	200	119.3718
30 mW	Low	508.125	85.8670	200	114.1330
	Mid	518.775	83.3878	200	116.6122
	High	526.825	80.7143	200	119.2857

Occupied Bandwidth

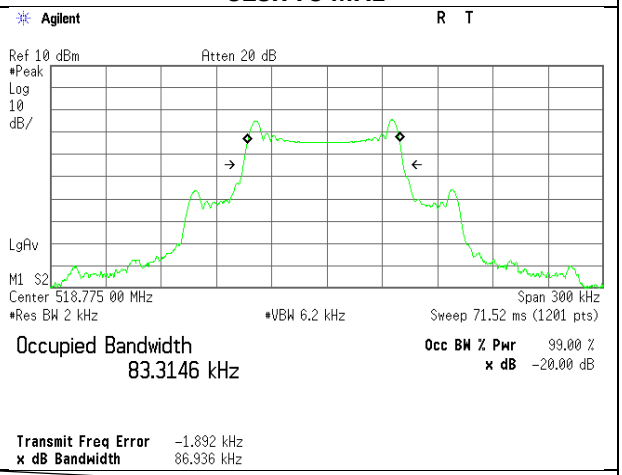
Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 8, 2024
Temperature/ Humidity	23 deg. C / 61 % RH
Engineer	Tetsuro Yoshida
Mode	Tx

Power setting: 10 mW

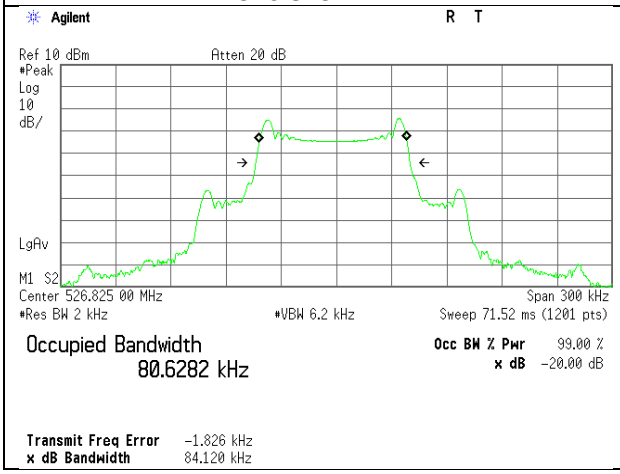
508.125 MHz



518.775 MHz



526.825 MHz

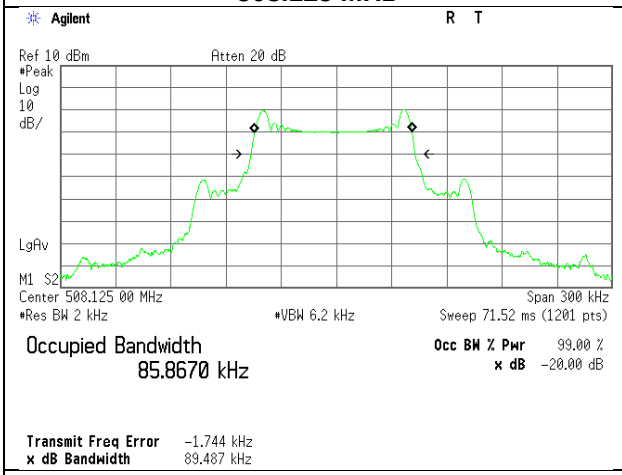


Occupied Bandwidth

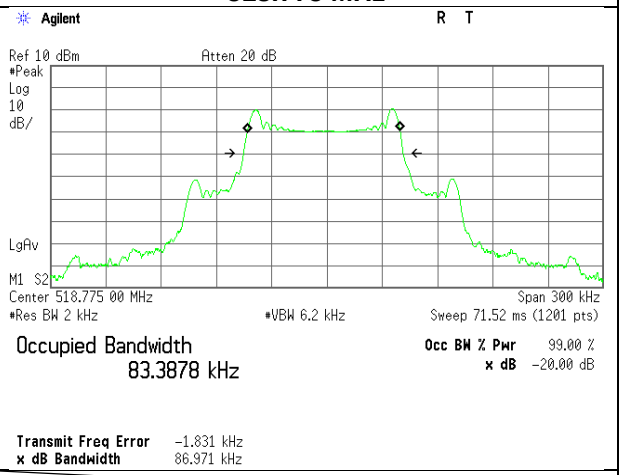
Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 8, 2024
Temperature/ Humidity	23 deg. C / 61 % RH
Engineer	Tetsuro Yoshida
Mode	Tx

Power setting: 30 mW

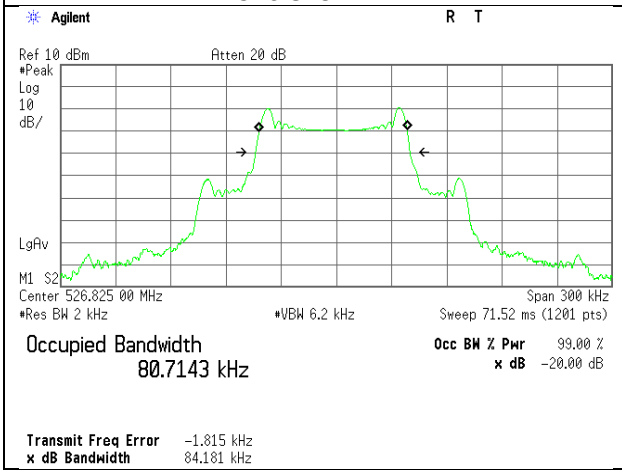
508.125 MHz



518.775 MHz



526.825 MHz

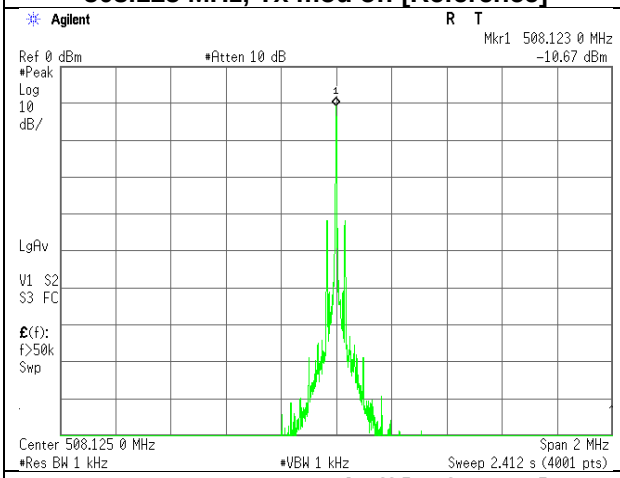


Necessary bandwidth

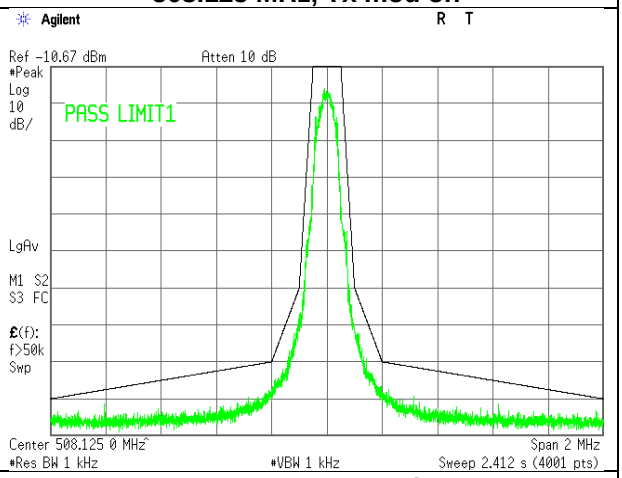
Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 5, 2024
Temperature/ Humidity	24 deg. C / 49 % RH
Engineer	Takafumi Noguchi
Mode	Tx

Power setting: 10 mW

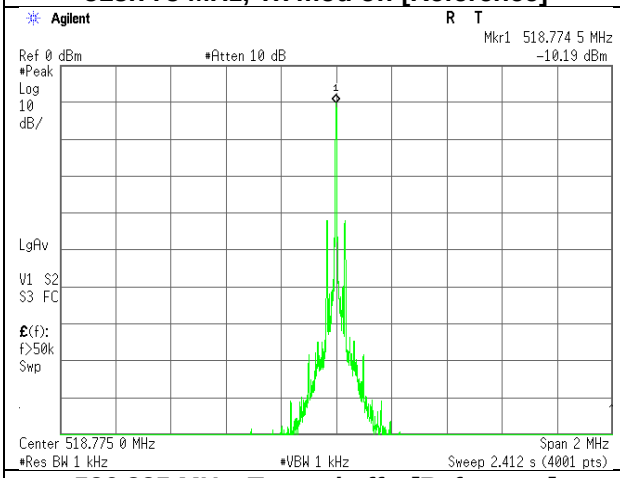
508.125 MHz, Tx mod off [Reference]



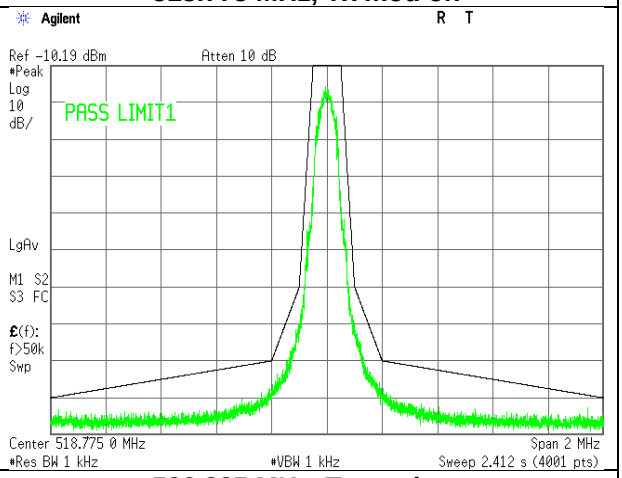
508.125 MHz, Tx mod on



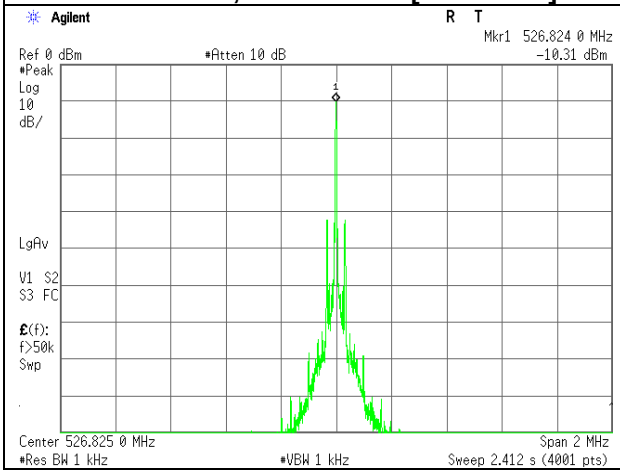
518.775 MHz, Tx mod off [Reference]



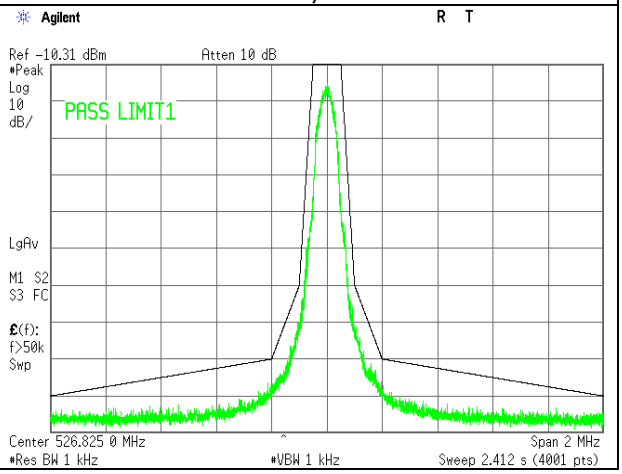
518.775 MHz, Tx mod on



526.825 MHz, Tx mod off [Reference]



526.825 MHz, Tx mod on

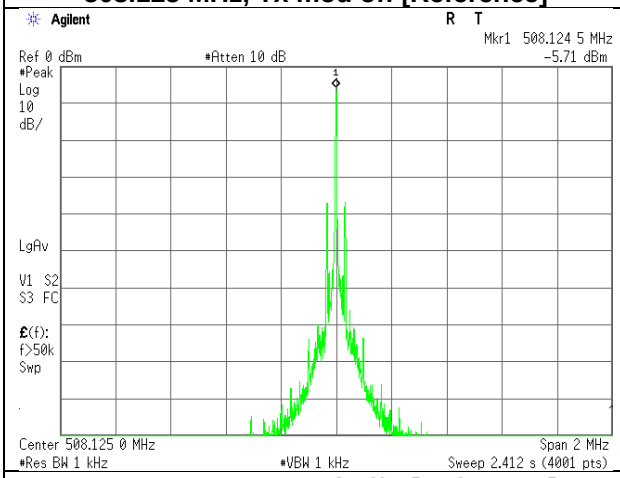


Necessary bandwidth

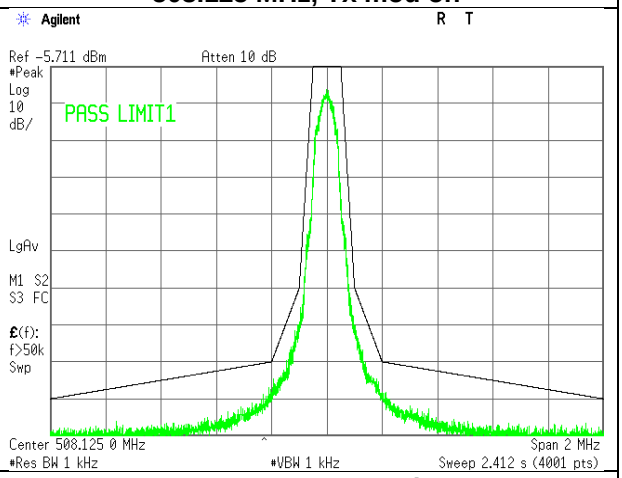
Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 4, 2024
Temperature/ Humidity	24 deg. C / 49 % RH
Engineer	Takafumi Noguchi
Mode	Tx

Power setting: 30 mW

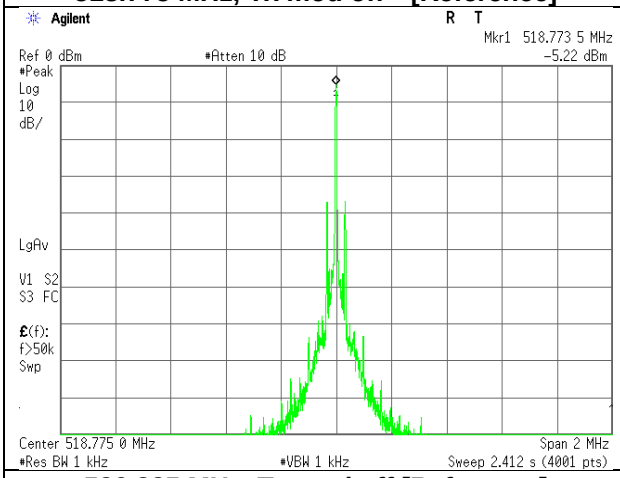
508.125 MHz, Tx mod off [Reference]



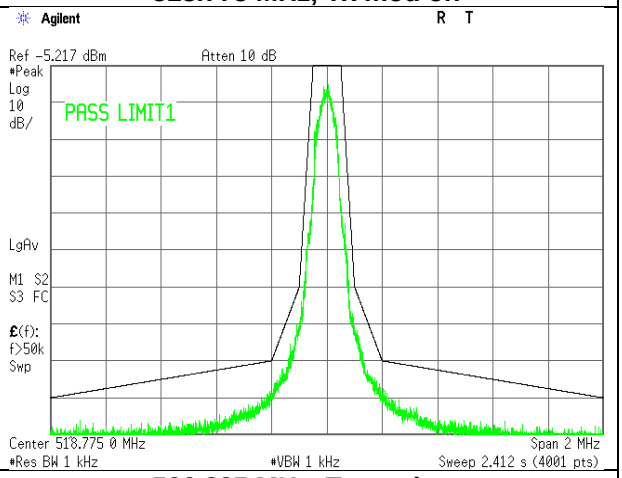
508.125 MHz, Tx mod on



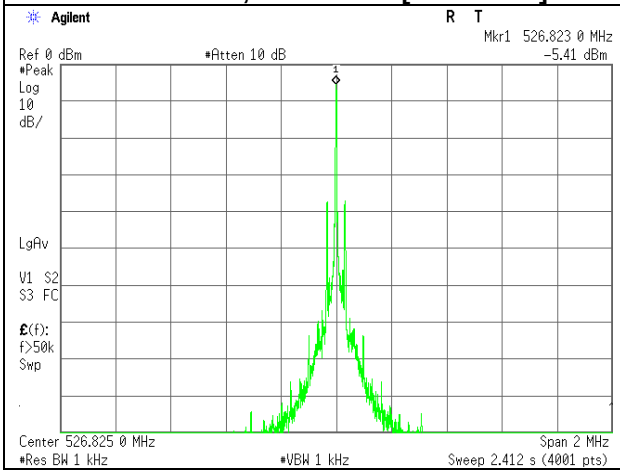
518.775 MHz, Tx mod off [Reference]



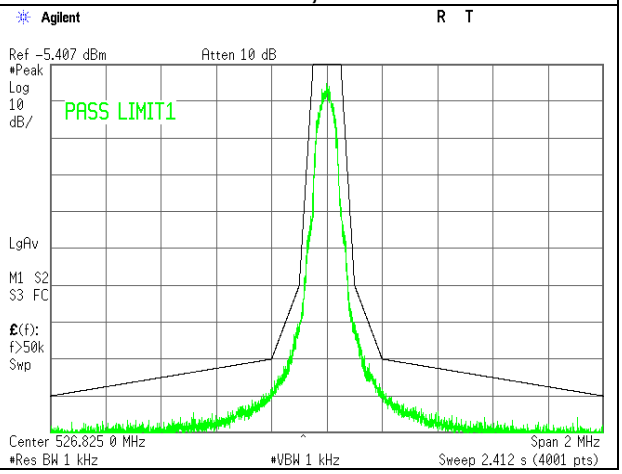
518.775 MHz, Tx mod on



526.825 MHz, Tx mod off [Reference]



526.825 MHz, Tx mod on



Field strength of spurious radiation

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	April 16, 2024	April 17, 2024
Temperature / Humidity	20 deg. C / 43 % RH	20 deg. C / 60 % RH
Engineer	Shousei Hamaguchi (Below 1 GHz)	Kiyoshiro Okazaki (Above 1 GHz)
Mode	Tx 508.125 MHz, 30 mW	

Frequency	Rx SA/TR Reading [dBuV]		Tx SG Reading [dBm]		Tx Cable Loss	Tx Ant. Gain	Result (ERP) [dBm]		Limit (ERP) [dBm]	Margin [dB]		Horizontal		Vertical		Remarks
												Rx Ant. Height	Turn Table	Rx Ant. Height	Turn Table	
[MHz]	Hori.	Vert.	Hori.	Vert.	[dB]	[dBi]	Hori.	Vert.		Hori.	Vert.	[cm]	[deg.]	[cm]	[deg.]	
1016.25	52.4	50.0	-57.5	-62.3	2.8	5.9	-56.5	-61.3	-30.0	26.5	31.3	124	117	100	278	
1524.38	44.5	43.2	-63.1	-63.1	3.4	8.6	-60.1	-60.1	-30.0	30.1	30.1	130	278	161	104	
2032.50	48.3	49.1	-59.1	-57.1	3.9	9.9	-55.2	-53.3	-30.0	25.2	23.3	154	88	139	231	
2540.63	53.4	49.6	-51.4	-56.2	4.4	10.8	-47.1	-51.9	-30.0	***17.1***	21.9	118	344	203	2	
3048.75	49.3	50.3	-55.0	-55.0	4.8	11.3	-50.7	-50.6	-30.0	20.7	20.6	149	207	150	306	
3556.88	36.8	39.4	-66.3	-64.1	5.2	12.3	-61.4	-59.1	-30.0	31.4	29.1	135	14	196	11	
4065.00	41.9	38.0	-59.2	-63.6	5.6	12.6	-54.3	-58.7	-30.0	24.3	28.7	118	16	147	87	
4573.13	38.1	40.6	-61.6	-58.9	6.0	12.6	-57.1	-54.4	-30.0	27.1	24.4	114	67	162	11	
5081.25	37.8	38.1	-59.4	-58.7	6.3	12.5	-55.3	-54.7	-30.0	25.3	24.7	114	34	128	204	

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

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	April 16, 2024	April 17, 2024
Temperature / Humidity	20 deg. C / 43 % RH	20 deg. C / 60 % RH
Engineer	Shousei Hamaguchi (Below 1 GHz)	Kiyoshiro Okazaki (Above 1 GHz)
Mode	Tx 518.775 MHz, 30 mW	

Frequency	Rx SA/TR Reading [dBuV]		Tx SG Reading [dBm]		Tx Cable Loss	Tx Ant. Gain	Result (ERP) [dBm]		Limit (ERP) [dBm]	Margin [dB]		Horizontal		Vertical		Remarks
												Rx Ant. Height	Turn Table	Rx Ant. Height	Turn Table	
[MHz]	Hori.	Vert.	Hori.	Vert.	[dB]	[dBi]	Hori.	Vert.		Hori.	Vert.	[cm]	[deg.]	[cm]	[deg.]	
1037.55	49.7	46.5	-59.3	-64.9	2.8	5.9	-58.3	-64.0	-30.0	28.3	34.0	122	236	131	221	
1556.33	42.9	42.2	-67.1	-67.4	3.5	8.9	-63.8	-64.1	-30.0	33.8	34.1	128	284	162	101	
2075.10	49.9	49.6	-56.1	-57.2	3.9	9.7	-52.6	-53.6	-30.0	22.6	23.6	152	84	132	217	
2593.88	53.8	50.4	-50.8	-54.8	4.4	11.0	-46.4	-50.4	-30.0	***16.4***	20.4	105	128	167	177	
3112.65	45.2	46.7	-58.6	-57.1	4.9	11.3	-54.3	-52.8	-30.0	24.3	22.8	146	290	180	308	
3631.43	37.1	38.6	-66.1	-65.3	5.3	12.3	-61.2	-60.4	-30.0	31.2	30.4	135	246	206	6	
4150.20	40.3	37.7	-61.0	-64.5	5.6	12.7	-56.1	-59.6	-30.0	26.1	29.6	115	24	168	163	
4668.98	37.5	41.5	-62.2	-59.1	6.0	12.5	-57.9	-54.7	-30.0	27.9	24.7	150	243	176	20	
5187.75	39.9	43.4	-58.1	-55.4	6.3	12.8	-53.7	-51.1	-30.0	23.7	21.1	105	31	178	347	

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

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	April 16, 2024	April 17, 2024
Temperature / Humidity	20 deg. C / 43 % RH	20 deg. C / 60 % RH
Engineer	Shousei Hamaguchi (Below 1 GHz)	Kiyoshiro Okazaki (Above 1 GHz)
Mode	Tx 526.825 MHz, 30 mW	

Frequency	Rx SA/TR Reading [dBuV]		Tx SG Reading [dBm]		Tx Cable Loss	Tx Ant. Gain	Result (ERP) [dBm]		Limit (ERP) [dBm]	Margin [dB]		Horizontal		Vertical		Remarks
												Rx Ant. Height	Turn Table	Rx Ant. Height	Turn Table	
[MHz]	Hori.	Vert.	Hori.	Vert.	[dB]	[dBi]	Hori.	Vert.		Hori.	Vert.	[cm]	[deg.]	[cm]	[deg.]	
1053.65	48.6	46.1	-59.5	-66.3	2.8	5.9	-58.5	-65.4	-30.0	28.5	35.4	157	244	129	231	
1580.48	40.0	40.1	-70.3	-71.2	3.5	9.1	-66.8	-67.7	-30.0	36.8	37.7	100	287	132	92	
2107.30	50.2	50.5	-58.1	-56.6	4.0	9.4	-54.8	-53.3	-30.0	24.8	23.3	110	87	131	202	
2634.13	53.3	50.7	-51.8	-54.0	4.5	11.0	-47.4	-49.6	-30.0	***17.4***	19.6	117	246	197	169	
3160.95	41.7	41.8	-60.9	-59.9	4.9	11.4	-56.5	-55.6	-30.0	26.5	25.6	117	24	163	292	
3687.78	NS	35.5	-	-67.9	5.3	12.3	-	-63.1	-30.0	-	33.1	-	-	131	12	
4214.60	38.8	38.1	-61.9	-63.0	5.7	12.7	-57.0	-58.1	-30.0	27.0	28.1	121	26	152	5	
4741.43	35.0	35.0	-64.8	-65.2	6.1	12.5	-60.5	-60.9	-30.0	30.5	30.9	100	329	124	159	
5268.25	41.2	41.9	-57.5	-54.7	6.4	13.2	-52.8	-50.0	-30.0	22.8	20.0	148	48	120	358	

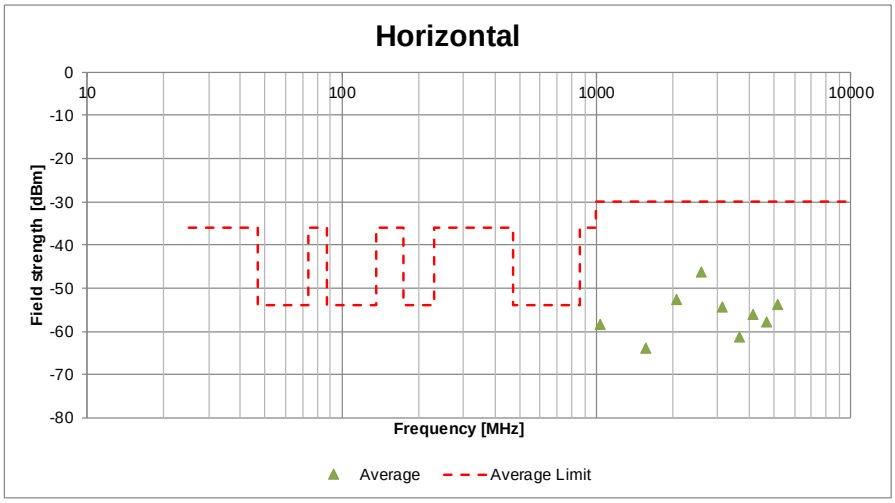
Calculation Result = SG Reading - Tx Cable Loss + Tx Antenna Gain - 2.15
Rx-ANTENNA : Biconical Antenna(25 MHz - 200 MHz), Logperiodic Antenna(200 MHz - 1000 MHz), Horn Antenna(1 GHz - the tenth harmonic)
Tx-ANTENNA : 120 MHz tuned Dipole Antenna(30 MHz - 120 MHz), Dipole Antenna(120 MHz - 1000 MHz), 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.

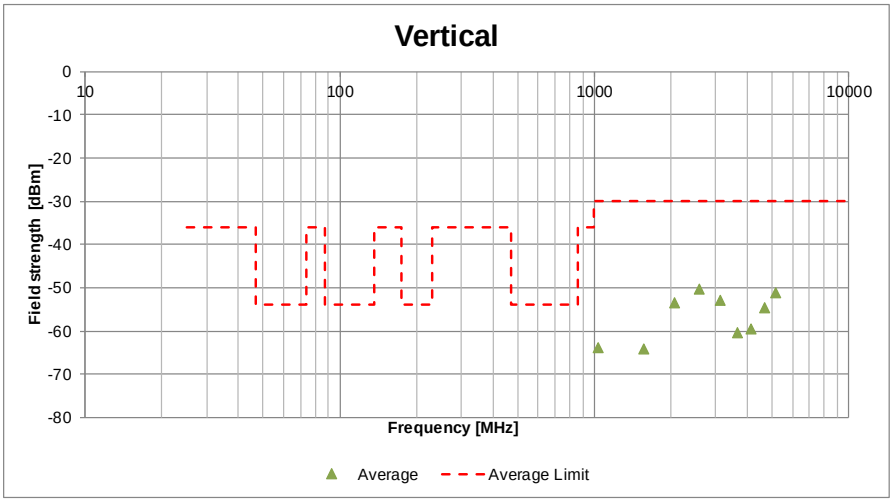
Detector: 25 MHz to 30 MHz: Spectrum Analyzer RMS Average (RBW: 10 kHz / VBW: 30 kHz)
30 MHz to 1 GHz: Spectrum Analyzer RMS Average (RBW: 100 kHz / VBW: 300 kHz),
Above 1 GHz: Spectrum Analyzer RMS Average (RBW: 1 MHz / VBW: 3 MHz)

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

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

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.2	No.2
Date	April 16, 2024	April 17, 2024
Temperature / Humidity	20 deg. C / 43 % RH	20 deg. C / 60 % RH
Engineer	Shousei Hamaguchi (Below 1 GHz)	Kiyoshiro Okazaki (Above 1 GHz)
Mode	Tx 518.775 MHz, 30 mW	





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

Frequency stability

Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 9, 2024
Temperature / Humidity	24 deg. C / 48 % RH
Engineer	Shousei Hamaguchi
Mode	Tx 508.125 MHz, 30 mW

Varying Temperature

Test condition		Tested	Measured	Frequency	Result	Limit
Temp. [deg. C]	Voltage [V]	frequency [MHz]	frequency [MHz]	error [MHz]	[%]	[+/- %]
45	3.00	508.125	508.121387	-0.003613	-0.00071	0.005
35	3.00	508.125	508.122920	-0.002080	-0.00041	0.005
25	3.00	508.125	508.123896	-0.001104	-0.00022	0.005
15	3.00	508.125	508.125309	0.000309	0.00006	0.005
5	3.00	508.125	508.126454	0.001454	0.00029	0.005

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Varying Supply Voltage

Test condition		Tested	Measured	Frequency	Result	Limit	Remarks
Temp. [deg. C]	Voltage [V]	frequency [MHz]	frequency [MHz]	error [MHz]	[%]	[+/- %]	
20	3.00	508.125	508.124126	-0.000874	-0.00017	0.005	Battery Power
20	2.40	508.125	508.123577	-0.001423	-0.00028	0.005	Battery End Point

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Frequency stability

Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 9, 2024
Temperature / Humidity	24 deg. C / 48 % RH
Engineer	Shousei Hamaguchi
Mode	Tx 518.775 MHz

Varying Temperature

Test condition		Tested	Measured	Frequency	Result	Limit
Temp. [deg. C]	Voltage [V]	frequency [MHz]	frequency [MHz]	error [MHz]	[%]	[+/- %]
45	3.00	518.775	518.771358	-0.003642	-0.00070	0.005
35	3.00	518.775	518.772849	-0.002151	-0.00041	0.005
25	3.00	518.775	518.773823	-0.001177	-0.00023	0.005
15	3.00	518.775	518.775601	0.000601	0.00012	0.005
5	3.00	518.775	518.776545	0.001545	0.00030	0.005

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Varying Supply Voltage

Test condition		Tested	Measured	Frequency	Result	Limit	Remarks
Temp. [deg. C]	Voltage [V]	frequency [MHz]	frequency [MHz]	error [MHz]	[%]	[+/- %]	
20	3.00	518.775	518.774109	-0.000891	-0.00017	0.005	Battery Power
20	2.40	518.775	518.773592	-0.001408	-0.00027	0.005	Battery End Point

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Frequency stability

Test place	Ise EMC Lab. No.6 Measurement Room
Date	April 9, 2024
Temperature / Humidity	24 deg. C / 48 % RH
Engineer	Shousei Hamaguchi
Mode	Tx 526.825 MHz

Varying Temperature

Test condition		Tested	Measured	Frequency	Result	Limit
Temp. [deg. C]	Voltage [V]	frequency [MHz]	frequency [MHz]	error [MHz]	[%]	[+/- %]
45	3.00	526.825	526.821378	-0.003622	-0.00069	0.005
35	3.00	526.825	526.822851	-0.002149	-0.00041	0.005
25	3.00	526.825	526.823717	-0.001283	-0.00024	0.005
15	3.00	526.825	526.825553	0.000553	0.00010	0.005
5	3.00	526.825	526.826537	0.001537	0.00029	0.005

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

Varying Supply Voltage

Test condition		Tested	Measured	Frequency	Result	Limit	Remarks
Temp. [deg. C]	Voltage [V]	frequency [MHz]	frequency [MHz]	error [MHz]	[%]	[+/- %]	
20	3.00	526.825	526.824407	-0.000593	-0.00011	0.005	Battery Power
20	2.40	526.825	526.823653	-0.001347	-0.00026	0.005	Battery End Point

Calculation formula: Frequency error = Measured frequency - Tested frequency
Result [%] = Frequency error / Tested frequency * 100

APPENDIX 2: Test instruments

Test Equipment (1/2)

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	141265	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/11/2023	12
RE	141279	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S303	03/04/2024	12
RE	141317	Coaxial Cable	UL Japan	-	-	09/12/2023	12
RE	141369	Band Pass Filter	M-City	BPF0950-01	UL0002	02/09/2024	12
RE	141427	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103B+ BBA9106	08031	07/11/2023	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	254	10/17/2023	12
RE	141514	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	01611	06/22/2023	12
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/01/2023	12
RE	141579	Pre Amplifier	Keysight Technologies Inc	8449B	3008A02142	02/17/2024	12
RE	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/17/2024	12
RE	141892	Signal Generator	Keysight Technologies Inc	E8257D	US49280311	11/24/2023	12
RE	141903	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186390	01/26/2024	12
RE	142004	AC2_Semi Anechoic Chamber (NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	12/12/2023	24
RE	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	214065	Microwave cable	Huber+Suhner	SF-126E/11PC35/ 11PC35/10000	550489/126E	01/22/2024	12
RE	220646	Attenuator	Huber+Suhner	6806_N-50-1	-	03/12/2024	12
RE	240023	Microwave Cable	Huber+Suhner	SF126E/ 11PC35/11PC35/ 1000MM,5000MM	537060/126E / 537075/126E	09/08/2023	12
RE	242978	High Pass Filter 1-13 GHz	Pasternak	PE87FL1018	D.C. 2215	02/02/2024	12
RE	244707	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202102	01/25/2024	12
AT	141156	Attenuator(10dB)	Weinschel Corp	2	BL1173	11/17/2023	12
AT	141171	Attenuator (20dB) _DC-1GHz_N	Weinschel Corp	MODEL 1	BG0143	12/06/2023	12
AT	141174	Attenuator (20dB) (above1GHz)	HIROSE ELECTRIC CO., LTD.	AT-120	901247	01/15/2024	12
AT	141414	Microwave Cable	Junkosha	MWX221	1207S407	08/01/2023	12
AT	141415	Microwave Cable	Murata Manufacturing Company, Ltd.	MXGS83RK3000	1	10/05/2023	12
AT	141429	Temperature and Humidity Chamber	Espec	PL-2KP	14015723	08/09/2023	12
AT	141498	Microwave Counter	ADVANTEST	R5373	120100309	07/24/2023	12
AT	141558	Digital Tester (TRUE RMS MULTIMETER)	Fluke Corporation	115	17930030	05/29/2023	12
AT	141810	Power Meter	Anritsu Corporation	ML2495A	824014	12/12/2023	12
AT	141832	Power sensor	Anritsu Corporation	MA2411B	738174	12/12/2023	12
AT	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	01/26/2024	12
AT	142606	ITU-R BS, 559-2 Colored Noise Filter	UL Japan	-	-	-	-
AT	142607	Video Amplifier	UNITEK ELECTROBICS INC.	UTK-200	505001	-	-
AT	142764	Radio communication Service Monitor	Rohde & Schwarz	CMS54	829000/009	10/06/2023	12
AT	179541	Software	AUDIO PRECISION	Software for Audio Precision APx500	-	-	-
AT	184490	Microwave Cable	Murata Manufacturing Company, Ltd.	MXHS83QE3000	-	09/12/2023	12
AT	244712	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202106	01/25/2024	12
AT	89845	Audio Analyzer	AUDIO PRECISION	APx525	APX2-27079	10/17/2023	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: Field strength of spurious radiation
AT: Antenna Terminal Conducted