

RADIO TEST REPORT

Test Report No. 15100905H-A-R2

Customer	Tokai Rika Co Ltd
Description of EUT	UWB Electronic Key
Model Number of EUT	B3S2P2Z
FCC ID	MOZB3S2P2Z
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	August 20, 2024
Remarks	-

Representative test engineerTetsuro Yoshida
Engineer**Approved by**Akihiko Maeda
Leader

CERTIFICATE 5107.02

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.
- ☒ There is no testing item of "Non-accreditation".

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- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No. 15100905H-A

This report is a revised version of 15100905H-A-R1. 15100905H-A-R1 is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15100905H-A	December 27, 2023	-
1	15100905H-A-R1	July 22, 2024	Correction of the following items in Clause 2.2; - Rating (from "DC 3.0 V" to "DC 3.0 V (battery (DC 2.5 V to 3.3 V))") - Operating temperature (from "-30 deg. C to 60 deg. C" to "-20 deg. C to 60 deg. C") - Frequency of Operation (from "Channel 1(CH 1): 312.10 MHz / Channel 2(CH 2): 314.35 MHz" to "Channel 1(CH 1): 314.35 MHz / Channel 2(CH 2): 312.10 MHz" - Operating voltage range (deletion)
2	15100905H-A-R2	August 20, 2024	Addition of the variation models in Clause 2.2.

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

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SECTION 1: Customer Information

Company Name	Tokai Rika Co Ltd
Address	3-260 Toyota, Oguchi-cho, Niwa-gun, Aichi 480-0195, Japan
Telephone Number	+81-587-95-0093
Contact Person	Tetsuhiro Okuoka

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	UWB Electronic Key
Model Number	B3S2P2Z
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	December 7, 2023
Test Date	December 7 and 10, 2023

2.2 Product Description

General Specification

Rating	DC 3.0 V (battery (DC 2.5 V to 3.3 V))
Operating temperature	-20 deg. C to 60 deg. C

Radio Specification

[UHF]

Equipment Type	Transmitter
Frequency of Operation	Channel 1(CH 1): 314.35 MHz Channel 2(CH 2): 312.10 MHz
Type of Modulation	FSK

*Tested model has variation models: original (4 switches), Variation A (3 switches) and Variation B (2 switches).

The differences of these variations are appearance and the number of switches.

Therefore the test was performed with original models as representative.

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 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted emission	FCC: ANSI C63.10:2013 6 Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	N/A	N/A	*1)
Automatically Deactivate	FCC: ANSI C63.10:2013 6 Standard test methods ISED: -	FCC: Section 15.231(a)(1) ISED: RSS-210 A1.1	N/A	Complied	Radiated
Electric Field Strength of Fundamental Emission	FCC: ANSI C63.10:2013 6 Standard test methods ISED: RSS-Gen 6.12	FCC: Section 15.231(b) ISED: RSS-210 A1.2	3.9 dB 312.100 MHz Horizontal, AV (Mode 2)	Complied	Radiated
Electric Field Strength of Spurious Emission	FCC: ANSI C63.10:2013 6 Standard test methods ISED: RSS-Gen 6.13	FCC: Section 15.205 Section 15.209 Section 15.231(b) ISED: RSS-210 A1.2 RSS-Gen 8.9	2.4 dB 1560.500 MHz Horizontal, AV (Mode 2)	Complied	Radiated
-20 dB Bandwidth	FCC: ANSI C63.10:2013 6 Standard test methods ISED: -	FCC: Section 15.231(c) ISED: Reference data	N/A	Complied	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

*1) The test is not applicable since the EUT does not have AC Mains.

FCC Part 15.31 (e)

The test was performed with the New Battery and the stable voltage was supplied to the EUT during the tests.

Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.

Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to Standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% emission bandwidth	ANSI C63.10:2013 6 Standard test methods	Reference data	N/A	-	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

Other than above, 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 $k = 2$.

Radiated emission

Measurement distance	Frequency range		Unit	Calculated Uncertainty (+/-)
3 m	9 kHz to 30 MHz		dB	3.3
10 m			dB	3.1
3 m	30 MHz to 200 MHz	Horizontal	dB	4.8
		Vertical	dB	5.0
	200 MHz to 1000 MHz	Horizontal	dB	5.1
		Vertical	dB	6.2
10 m	30 MHz to 200 MHz	Horizontal	dB	4.8
		Vertical	dB	4.8
	200 MHz to 1000 MHz	Horizontal	dB	4.9
		Vertical	dB	5.0
3 m	1 GHz to 6 GHz	Test Receiver	dB	5.1
		Spectrum Analyzer	dB	4.9
	6 GHz to 18 GHz	Test Receiver	dB	5.4
		Spectrum Analyzer	dB	5.2
1 m	10 GHz to 18 GHz	Spectrum analyzer	dB	5.0
	18 GHz to 26.5 GHz	Spectrum analyzer	dB	5.6
	26.5 GHz to 40 GHz	Spectrum analyzer	dB	4.9
0.5 m	26.5 GHz to 40 GHz	Spectrum analyzer	dB	4.9
10 m	1 GHz to 18 GHz	Test Receiver	dB	5.4

Automatically Deactivate, -20 dB Bandwidth and 99% Occupied Bandwidth

Item	Unit	Calculated Uncertainty (+/-)
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

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

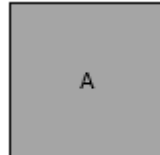
4.1 Operating Mode(s)

Test mode	Remarks
1) Normal use mode (Tx 312.10 MHz / 314.35 MHz)	-
2) Transmitting mode (Tx 312.10 MHz) *1)	-
3) Transmitting mode (Tx 314.35 MHz) *1)	-
* The system was configured in typical fashion (as a user would normally use it) for testing.	
*Power of the EUT was set by the software as follows; Software: Mass production software for UWB Version: 2305 (Date: 2023.05.24, 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. In addition, end users cannot change the settings of the output power of the product.	
Justification: The system was configured in typical fashion (as a user would normally use it) for testing.	

*1) The software of this mode is the same as one of normal product, except that EUT continues to transmit (For Normal use mode, EUT stops to transmit in a given time, even if transceiver button is being pressed.).

This EUT has two modes which mechanical key is inserted or not. The worst case was confirmed with and without mechanical key inserted, as a result, the test without mechanical key inserted was the worst case. Therefore, the test without mechanical key inserted was performed only.

4.2 Configuration and Peripherals



* Setup was taken into consideration and test data was taken under worse case conditions.

Description of EUT

No.	Item	Model number	Serial Number	Manufacturer	Remark
A	UWB Electronic Key	B3S2P2Z	No.888 *1) No.889 *2)	Tokai Rika Co Ltd	EUT

*1) Used for Normal use mode

*2) Used for Transmitting mode

SECTION 5: Radiated Spurious Emission

Test Procedure

[For below 30 MHz]

The noise level was checked by moving a search-coil (Loop Antenna) close to the EUT.

[For 30 MHz to 1 GHz]

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

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

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

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The measurements were performed for both vertical and horizontal antenna polarization.

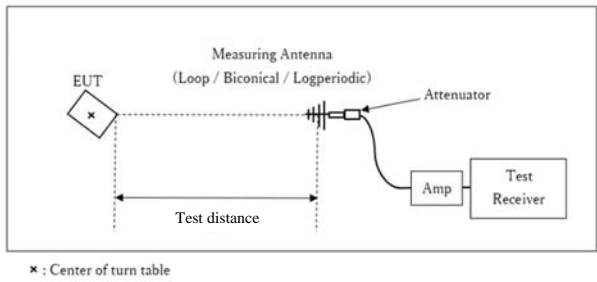
The radiated emission measurements were made with the following detector function of the test receiver / spectrum analyzer.

Test Antennas are used as below;

Frequency	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

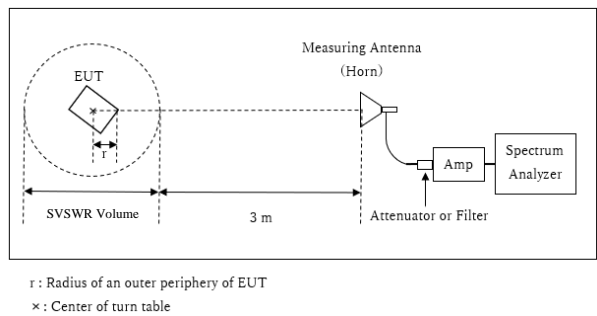
Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz	Above 1 GHz
Detector Type	Peak	Peak	Peak	Peak	Peak and Peak with Duty factor	Peak and Peak with Duty factor
IF Bandwidth	200 Hz	200 Hz	9.1 kHz	9.1 kHz	120 kHz	PK: S/A: RBW: 1 MHz, VBW: 3 MHz

[Test Setup]
Below 1 GHz



Test Distance: 3 m

1 GHz to 3.2 GHz



Distance Factor: $20 \times \log (3.75 \text{ m} / 3.0 \text{ m}) = 1.94 \text{ dB}$

* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.75 \text{ m}$

SVSWR Volume : 1.5 m

(SVSWR Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.0 \text{ m}$

* The test was performed with $r = 0.0 \text{ m}$ since EUT is small and it was the rather conservative condition.

- 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 : 9 kHz to 3.2 GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: Automatically deactivate

Test Procedure

The measurement was performed with Electric field strength using a spectrum analyzer.

Test data : APPENDIX
Test result : Pass

SECTION 7: -20 dB Bandwidth and 99% emission bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-20 dB Bandwidth / 99% emission bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak *1)	Max Hold *1)	Spectrum Analyzer
*1) Peak hold was applied as Worst-case measurement.							

Test data : APPENDIX
Test result : Pass

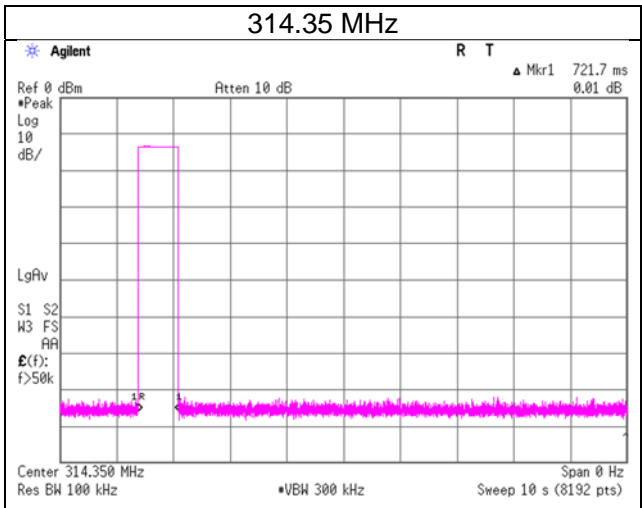
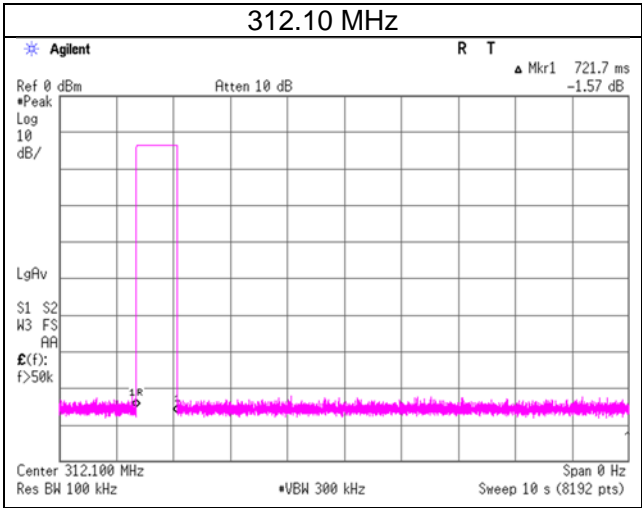
APPENDIX 1: Test Data

Automatically deactivate

Test place
Semi Anechoic Chamber
Date
Temperature / Humidity
Engineer
Mode

Ise EMC Lab.
No.2
December 7, 2023
19 deg. C / 40 % RH
Tomoya Sone
Mode 1

Frequency	Time of Transmitting	Limit	Result
[MHz]	[s]	[s]	
312.10	0.7217	5.000	Pass
314.35	0.7217	5.000	Pass



Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	December 10, 2023
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Tetsuro Yoshida
Mode	Mode 2

Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (PK) [dBuV/m]	Result (PK with Duty Factor) [dBuV/m]	Limit (PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (PK) [dB]	Margin (AV) [dB]	Inside or Outside of Restricted Bands	Remarks
Hori.	312.100	76.4	14.1	8.8	27.8	0.0	71.5	71.5	95.4	75.4	23.9	3.9	Carrier	
Hori.	624.200	41.1	19.5	10.2	29.3	0.0	41.5	41.5	75.4	55.4	33.9	13.9	Outside	
Hori.	936.300	35.7	22.0	11.4	28.8	0.0	40.3	40.3	75.4	55.4	35.1	15.1	Outside	
Hori.	1248.400	56.5	25.9	5.4	35.8	0.0	52.0	52.0	75.4	55.4	23.4	3.4	Outside	
Hori.	1560.500	57.0	25.4	4.6	35.5	0.0	51.5	51.5	73.9	53.9	22.4	2.4	Inside	
Hori.	1872.600	49.3	25.6	4.7	35.2	0.0	44.4	44.4	75.4	55.4	31.0	11.0	Outside	
Hori.	2184.700	44.7	28.3	4.7	35.0	0.0	42.7	42.7	75.4	55.4	32.7	12.7	Outside	
Hori.	2496.800	48.2	27.5	4.8	34.9	0.0	45.6	45.6	73.9	53.9	28.3	8.3	Inside	
Hori.	2808.900	44.4	28.5	5.0	34.8	0.0	43.1	43.1	73.9	53.9	30.8	10.8	Inside	
Hori.	3121.000	46.8	28.7	5.2	34.6	0.0	46.1	46.1	75.4	55.4	29.3	9.3	Outside	
Vert.	312.100	74.4	14.1	8.8	27.8	0.0	69.5	69.5	95.4	75.4	25.9	5.9	Carrier	
Vert.	624.200	41.6	19.5	10.2	29.3	0.0	42.0	42.0	75.4	55.4	33.4	13.4	Outside	
Vert.	936.300	33.8	22.0	11.4	28.8	0.0	38.4	38.4	75.4	55.4	37.0	17.0	Outside	
Vert.	1248.400	57.2	25.9	5.4	35.8	0.0	52.7	52.7	75.4	55.4	22.7	2.7	Outside	
Vert.	1560.500	56.8	25.4	4.6	35.5	0.0	51.3	51.3	73.9	53.9	22.6	2.6	Inside	
Vert.	1872.600	49.9	25.6	4.7	35.2	0.0	45.0	45.0	75.4	55.4	30.4	10.4	Outside	
Vert.	2184.700	44.9	28.3	4.7	35.0	0.0	42.9	42.9	75.4	55.4	32.5	12.5	Outside	
Vert.	2496.800	48.4	27.5	4.8	34.9	0.0	45.8	45.8	73.9	53.9	28.1	8.1	Inside	
Vert.	2808.900	44.1	28.5	5.0	34.8	0.0	42.8	42.8	73.9	53.9	31.1	11.1	Inside	
Vert.	3121.000	46.9	28.7	5.2	34.6	0.0	46.2	46.2	75.4	55.4	29.2	9.2	Outside	

Sample calculation:

Result of PK = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1 GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier)

Result of PK with Duty factor (PK / W) = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1 GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier) + Duty factor.

For above 1 GHz: Distance Factor: $20 \times \log (3.75 \text{ m}/3.0 \text{ m}) = 1.94 \text{ dB}$

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

Since the peak emission result satisfied the average limit, duty factor was omitted.

Although Duty of this product was 100% or less, the result of AV (PK with Duty factor) was calculated by applying Duty 100 % as worst.

If Gain 0.0 dB shown in the above table, pre-amplifier was not used to avoid the influence of carrier power. The pre-amplifier used for carrier frequency measurement was not saturated.

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	December 10, 2023
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Tetsuro Yoshida
Mode	Mode 3

Polarity [Hori/Vert]	Frequency [MHz]	Reading (PK) [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (PK) [dBuV/m]	Result (PK with Duty Factor) [dBuV/m]	Limit (PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (PK) [dB]	Margin (AV) [dB]	Inside or Outside of Restricted Bands	Remarks
Hori.	314.350	76.0	14.2	8.8	27.8	0.0	71.2	71.2	95.5	75.5	24.3	4.3	Carrier	
Hori.	628.700	41.0	19.5	10.2	29.3	0.0	41.4	41.4	75.5	55.5	34.1	14.1	Outside	
Hori.	943.050	36.8	22.1	11.4	28.7	0.0	41.6	41.6	75.5	55.5	33.9	13.9	Outside	
Hori.	1257.400	55.9	25.9	5.4	35.8	0.0	51.4	51.4	75.5	55.5	24.1	4.1	Outside	
Hori.	1571.750	56.1	25.3	4.6	35.5	0.0	50.5	50.5	73.9	53.9	23.4	3.4	Inside	
Hori.	1886.100	48.1	25.7	4.7	35.2	0.0	43.3	43.3	75.5	55.5	32.2	12.2	Outside	
Hori.	2200.450	43.8	28.3	4.7	35.0	0.0	41.8	41.8	73.9	53.9	32.1	12.1	Inside	
Hori.	2514.800	46.9	27.5	4.8	34.9	0.0	44.3	44.3	75.5	55.5	31.2	11.2	Outside	
Hori.	2829.150	43.0	28.5	5.0	34.7	0.0	41.8	41.8	73.9	53.9	32.1	12.1	Inside	
Hori.	3143.500	44.9	28.7	5.2	34.6	0.0	44.2	44.2	75.5	55.5	31.3	11.3	Outside	
Vert.	314.350	73.5	14.2	8.8	27.8	0.0	68.7	68.7	95.5	75.5	26.8	6.8	Carrier	
Vert.	628.700	40.9	19.5	10.2	29.3	0.0	41.3	41.3	75.5	55.5	34.2	14.2	Outside	
Vert.	943.050	34.4	22.1	11.4	28.7	0.0	39.2	39.2	75.5	55.5	36.3	16.3	Outside	
Vert.	1257.400	56.2	25.9	5.4	35.8	0.0	51.7	51.7	75.5	55.5	23.8	3.8	Outside	
Vert.	1571.750	56.0	25.3	4.6	35.5	0.0	50.4	50.4	73.9	53.9	23.5	3.5	Inside	
Vert.	1886.100	48.8	25.7	4.7	35.2	0.0	44.0	44.0	75.5	55.5	31.5	11.5	Outside	
Vert.	2200.450	44.0	28.3	4.7	35.0	0.0	42.0	42.0	73.9	53.9	31.9	11.9	Inside	
Vert.	2514.800	46.7	27.5	4.8	34.9	0.0	44.1	44.1	75.5	55.5	31.4	11.4	Outside	
Vert.	2829.150	43.0	28.5	5.0	34.7	0.0	41.8	41.8	73.9	53.9	32.1	12.1	Inside	
Vert.	3143.500	45.2	28.7	5.2	34.6	0.0	44.5	44.5	75.5	55.5	31.0	11.0	Outside	

Sample calculation:

Result of PK = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1 GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier)

Result of PK with Duty factor (PK / W) = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1 GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier) + Duty factor.

For above 1 GHz: Distance Factor: $20 \times \log (3.75 \text{ m}/3.0 \text{ m}) = 1.94 \text{ dB}$

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

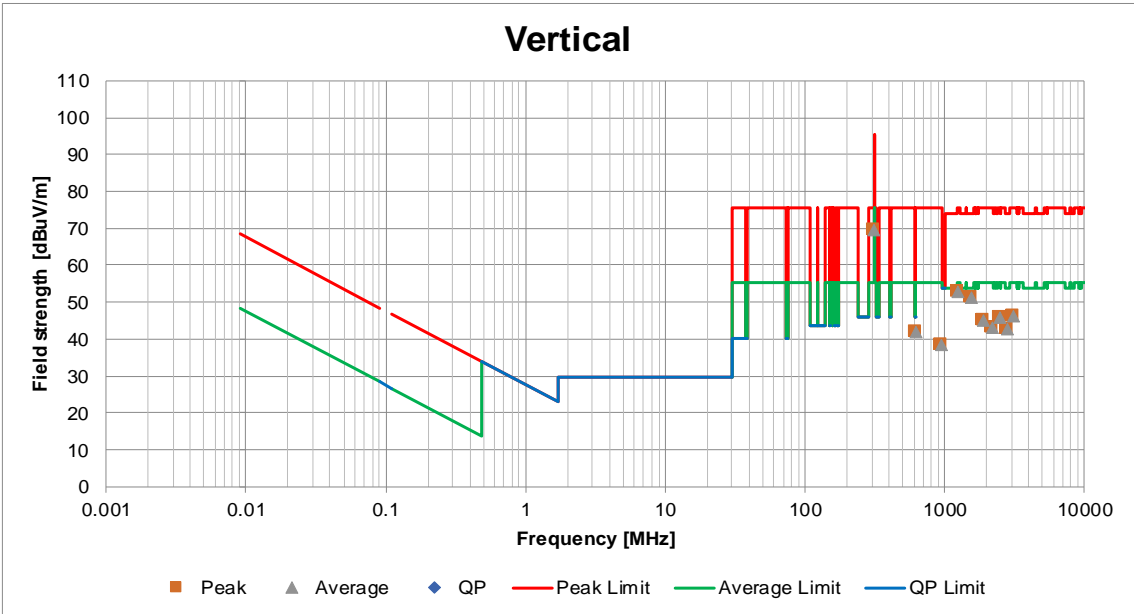
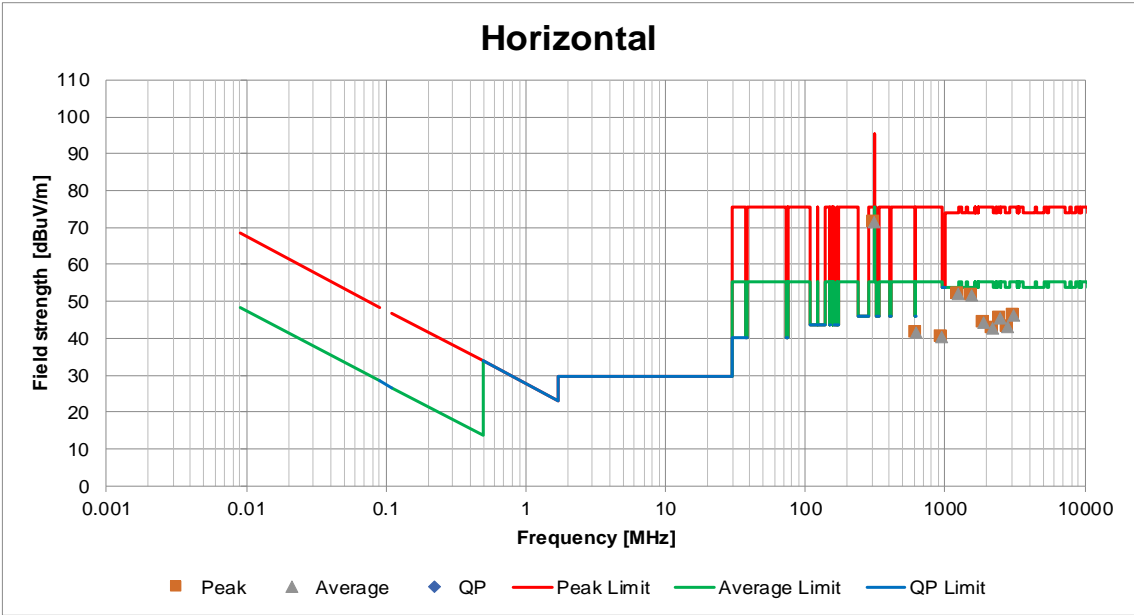
Since the peak emission result satisfied the average limit, duty factor was omitted.

Although Duty of this product was 100% or less, the result of AV (PK with Duty factor) was calculated by applying Duty 100 % as worst.

If Gain 0.0 dB shown in the above table, pre-amplifier was not used to avoid the influence of carrier power. The pre-amplifier used for carrier frequency measurement was not saturated.

Radiated Spurious Emission
(Plot data, Worst case for Spurious Emission)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	December 10, 2023
Temperature / Humidity	20 deg. C / 30 % RH
Engineer	Tetsuro Yoshida
Mode	Mode 2



-20 dB Bandwidth / 99% emission bandwidth

Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date December 10, 2023
Temperature / Humidity 20 deg. C / 30 % RH
Engineer Tetsuro Yoshida
Mode Mode 2, 3

Bandwidth Limit : Fundamental Frequency $312.10 \text{ MHz} \times 0.25 \% = 780.250 \text{ kHz}$

* The above limit was calculated from more stringent nominal frequency.

* Method of KDB 926416 for systems employing non sweeping frequencies was referred.

312.10 MHz

-20 dB Bandwidth [kHz]
37.985

314.35 MHz

-20 dB Bandwidth [kHz]
38.113

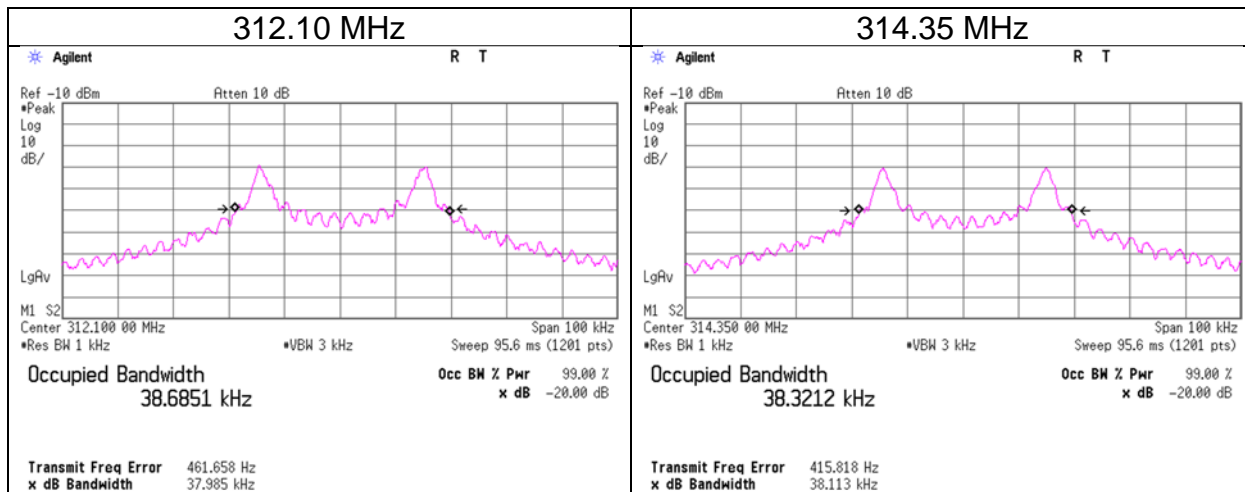
-20 dB Bandwidth [kHz]	Bandwidth Limit [kHz]	Result
76.098	780.250	Pass

Bandwidth Limit : Fundamental Frequency $312.10 \text{ MHz} \times 0.25 \% = 780.250 \text{ kHz}$

99% emission bandwidth [kHz]	Bandwidth Limit [kHz]	Result
38.6851	780.250	Pass

Bandwidth Limit : Fundamental Frequency $314.35 \text{ MHz} \times 0.25 \% = 785.875 \text{ kHz}$

99% emission bandwidth [kHz]	Bandwidth Limit [kHz]	Result
38.3212	785.875	Pass



APPENDIX 2: Test Instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	141884	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY44020357	03/13/2023	12
RE	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/17/2022	12
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/01/2023	12
RE	141557	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	70900530	01/18/2023	12
RE	202511	Loop Antenna	UL Japan	-	-	-	-
RE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/30/2022	24
RE	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	10/20/2023	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	04/10/2023	12
RE	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	01/16/2023	12
RE	141427	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103B+BBA9106	08031	07/11/2023	12
RE	141265	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/11/2023	12
RE	220646	Attenuator	Huber+Suhner	6806_N-50-1	-	03/17/2023	12
RE	141317	Coaxial Cable	UL Japan	-	-	09/12/2023	12
RE	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/02/2023	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	254	10/17/2023	12
RE	240023	Microwave Cable	Huber+Suhner	SF126E/11PC35/11PC35/1000MM,5000MM	537060/126E / 537075/126E	09/08/2023	12
RE	141579	Pre Amplifier	Keysight Technologies Inc	8449B	3008A02142	02/14/2023	12
RE	141403	High Pass Filter 1.22-4.60GHz	Mini-Circuits	VHF-1200	10435	08/02/2023	12
RE	142645	Loop Antenna	UL Japan	-	-	-	-

*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