RADIO TEST REPORT

Test Report No. 15200443S-A-R3

Customer	**TOKAI RIKA CO., LTD.**
Description of EUT	**UWB ECU (UWB Transceiver System)**
Model Number of EUT	**TRUM21A1**
FCC ID	**MOZTRUM21A1**
Test Regulation	**FCC Part 15 Subpart F**
Test Result	**Complied**
Issue Date	**September 2, 2024**
Remarks	**UWB part(s)**

Representative Test Engineer	Approved By
Y. Murakami	T. imamura
Yosuke Murakami Engineer	Toyokazu Imamura Engineer

CERTIFICATE 1266.03

☐ 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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- The information provided from the customer for this report is identified in Section 1.
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REVISION HISTORY

Original Test Report No. 15200443S-A

This report is a revised version of 15200443S-A-R2. 15200443S-A-R2 is replaced with this report.

Revision	Test Report No.	Date	Revised Contents
- (Original)	15200443S-A	June 27, 2024	-
1	15200443S-A-R1	August 1, 2024	p.9, The description of the software used was clearly rewritten. (before): - Main, Serial No. 6M6 … (after): - Main, Serial No.0616156 … - Main, Serial No. 6M6 … p.9, Additional EUT type (“(main)”). p.15, Correction OBW value. p.16, p.18, The comment of "(* For RBW less than 960 MHz was set according to FCC 15.209, Above 960 MHz was set to 1 MHz .)" was moved under the table. Additional the comment of "(* There were no detect UWB emissions in the range that below 960 MHz)". p.19-22, Additional plot chart. p.23, p.24, The column that was written incorrectly was written on the correct column, and additional the name of engineer. p.23, Correction OBW value. p.25, Additional the data of occupied bandwidth with correct RBW setting. p.26, Correction timeout value. ((incorrect): 68.20 ms, (correct): 98.48 ms)
2	15200443S-A-R2	August 27, 2024	p.25, Correction value. (500 kHz -> 500 MHz) Deleted 10 dB bandwidth value of RBW 10 MHz data. p.26, Additional mark of “AE power off”. Additional comment for description of this test. “* Although no transmission signal was seen after the companion device was turned off, the transmitter timeout result was assumed to be the time for one period transmission, assuming that the time for one period transmission that EUT may transmit. * This EUT was stopped transmit unless there is a second trigger at the Transmitter timeout of the UWB after the Trigger (LF transmission). The start of this chart is the time when the EUT and companion device powered up and started communicating. The transmission signal was no longer displayed when the companion device performed power off. This EUT is stopped transmit unless there is a second trigger at the Transmitter timeout of the UWB after the Trigger (LF transmission). The transmitter timeout result was within 10 seconds, including the transmission time with one cycle.”

Revision	Test Report No.	Date	Revised Contents
3	15200443S-A-R3	September 2, 2024	p.25, p.26, Deleted a value of 99 % occupied bandwidth in 10 dB bandwidth data, and Deleted a value of Center frequency of 99 % occupied bandwidth data. p.27, It has rewritten the disunified words into unified words. (AE -> companion device, period -> sequence)

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
APD	Absorbed Power Density	LAN	Local Area Network
ASK	Amplitude Shift Keying	LIMS	Laboratory Information Management System
Atten., ATT	Attenuator	MCS	Modulation and Coding Scheme
AV	Average	MRA	Mutual Recognition Arrangement
BPSK	Binary Phase-Shift Keying	N/A	Not Applicable
BR	Bluetooth Basic Rate	NIST	National Institute of Standards and Technology
BT	Bluetooth	NS	No signal detect.
BT LE	Bluetooth Low Energy	NSA	Normalized Site Attenuation
BW	BandWidth	NVLAP	National Voluntary Laboratory Accreditation Program
Cal Int	Calibration Interval	OBW	Occupied Band Width
CCK	Complementary Code Keying	OFDM	Orthogonal Frequency Division Multiplexing
Ch., CH	Channel	P/M	Power meter
CISPR	Comite International Special des Perturbations Radioelectriques	PCB	Printed Circuit Board
CW	Continuous Wave	PER	Packet Error Rate
DBPSK	Differential BPSK	PHY	Physical Layer
DC	Direct Current	PK	Peak
D-factor	Distance factor	PN	Pseudo random Noise
DFS	Dynamic Frequency Selection	PRBS	Pseudo-Random Bit Sequence
DQPSK	Differential QPSK	PSD	Power Spectral Density
DSSS	Direct Sequence Spread Spectrum	QAM	Quadrature Amplitude Modulation
EDR	Enhanced Data Rate	QP	Quasi-Peak
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QPSK	Quadri-Phase Shift Keying
EMC	ElectroMagnetic Compatibility	RBW	Resolution Band Width
EMI	ElectroMagnetic Interference	RDS	Radio Data System
EN	European Norm	RE	Radio Equipment
ERP, e.r.p.	Effective Radiated Power	RF	Radio Frequency
EU	European Union	RMS	Root Mean Square
EUT	Equipment Under Test	RSS	Radio Standards Specifications
Fac.	Factor	Rx	Receiving
FCC	Federal Communications Commission	SA, S/A	Spectrum Analyzer
FHSS	Frequency Hopping Spread Spectrum	SAR	Specific Absorption Rate
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
HPF	High-Pass Filter	WPT	Wireless Power Transmit

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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 by 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

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	UWB ECU (UWB Transceiver System)
Model Number	TRUM21A1
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	S/N. 0616156: May 24, 2024 S/N. 6M6: June 4, 2024
Test Date	May 24 to August 1, 2024

2.2 Product Description

General Specification

Rating	DC 12 V (DC 8 V to 16 V)
Operating temperature	-40 deg.C to +110 deg.C

Radio Specification

[UWB]

Equipment Type	Transmitter
Frequency of Operation	6489.6 MHz (CH5)
Type of Modulation	Burst Position Modulation and Binary Phase-Shift Keying
Antenna Gain	1.51 dBi (for 6239.6 MHz), 1.47 dBi (for 6489.6 MHz), 1.93 dBi (for 6739.6 MHz)

SECTION 3: Test specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart F The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart F Ultra-Wideband Operation Section 15.207 Conducted limits Section 15.503 Definitions Section 15.505 Cross reference Section 15.519 Technical requirements for hand held UWB systems Section 15.521 Technical requirements applicable to all UWB devices

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 Section 15.505(a) Section 15.521(j)	-	N/A	*1)
	ISED: RSS-Gen 8.8	**ISED:** RSS-220 5.2.1(b)			
UWB Bandwidth	**FCC:** Section 15.503(a) ANSI C63.10: 2013 6 Standard test methods, 10 Procedures for measuring ultra-wideband devices	**FCC:** Section 15.503(d) Section 15.519 (b)	See data.	Complied	Radiated
	ISED: RSS-220 Annex 2	**ISED:** RSS-220 2, RSS-220 5.1			
Radiated emission	**FCC:** Section 15.503(a) ANSI C63.10: 2013 6 Standard test methods, 10 Procedures for measuring ultra-wideband devices	**FCC:** Section 15.209, Section 15.505, Section 15.519 (c) (d),Section 521(c)	0.06 dB 25958.400 MHz AV, Horizontal (Transmitting)	Complied	Radiated
	ISED: RSS-Gen 6.5 RSS-220 Annex 4	**ISED:** RSS-220 5.3.1(c)(d)(e)			
Peak level of the Emission	**FCC:** Section 15.521(e)(g) ANSI C63.10: 2013 6 Standard test methods, 10 Procedures for measuring ultra-wideband devices	**FCC:** Section 15.519 (e)	-	Complied	Radiated
	ISED: RSS-220 Annex 4	**ISED:** RSS-220 5.3.1(g)			
Transmitter timeout	**FCC:** Section 15.519(a)(1) ANSI C63.10: 2013 6 Standard test methods, 10 Procedures for measuring ultra-wideband devices	**FCC:** Section 15.519 (a)(1)	-	Complied	Conducted
	ISED: RSS-220 Annex 4	**ISED:** RSS-220 5.3.1(b)			
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. *1) This test not applicable since the EUT does not have AC Mains.					

FCC Part 15.31 (e)
The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result. 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 % Occupied Bandwidth	**ISED:** RSS-Gen 6.7	**ISED:** -	N/A	-	Radiated

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.

Item	Frequency range	Uncertainty (+/-)
Conducted Emission (AC Mains) LISN	150 kHz-30 MHz	3.2 dB
Radiated Emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.3 dB
	30 MHz-200 MHz	4.9 dB
	200 MHz-1 GHz	6.2 dB
	1 GHz-6 GHz	4.7 dB
	6 GHz-18 GHz	5.3 dB
	18 GHz-40 GHz	5.5 dB
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.6 dB
	18 GHz-40 GHz	5.8 dB

Radiated Emission (Substitution measurement)

Substitution measurement (EUT height: 1.5 m, Distance: 3 m)	
Frequency range	Uncertainty (+/-)
30 MHz - 200 MHz	4.3 dB
200 MHz - 1000 MHz	3.5 dB
1 GHz - 13 GHz	4.1 dB

Substitution measurement (EUT height: 1.5 m, Distance: 1 m)	
Frequency range	Uncertainty (+/-)
1 GHz - 13 GHz	4.7 dB
13 GHz - 18 GHz	5.4 dB
18 GHz - 26.5 GHz	3.8 dB
26.5 GHz - 40 GHz	3.9 dB

Substitution measurement (EUT height: 1.5 m, Distance: 0.5 m)	
Frequency range	Uncertainty (+/-)
1 GHz - 13 GHz	4.7 dB
13 GHz - 18 GHz	5.3 dB
18 GHz - 26.5 GHz	3.8 dB
26.5 GHz - 40 GHz	3.8 dB

Substitution measurement (EUT height: 1.5 m, Distance: 0.3 m)	
Frequency range	Uncertainty (+/-)
1 GHz - 13 GHz	4.8 dB
13 GHz - 18 GHz	5.3 dB
18 GHz - 26.5 GHz	3.8 dB
26.5 GHz - 40 GHz	3.8 dB

Substitution measurement (EUT height: 1.5 m, Distance: 0.1 m)	
Frequency range	Uncertainty (+/-)
13 GHz - 18 GHz	5.6 dB
18 GHz - 26.5 GHz	4.2 dB
26.5 GHz - 40 GHz	4.2 dB

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 Japan
Telephone: +81-463-50-6400
A2LA Certificate Number: 1266.03
(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test room	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber (SAC1)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber (SAC2)	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber (SAC3)	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber (SAC4)	8.1 x 5.1 x 3.55	8.1 x 5.1	-
Wireless anechoic chamber 1 (WAC1)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
Wireless anechoic chamber 2 (WAC2)	9.5 x 6.0 x 5.4	9.5 x 6.0	3 m
No.1 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 Shielded room	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	2.55 x 4.1 x 2.5	-	-
No.2 Measurement room	4.5 x 3.5 x 2.5	-	-
Wireless shielded room 1	3.0 x 4.5 x 2.7	3.0 x 4.5	-
Wireless shielded room 2	3.0 x 4.5 x 2.7	3.0 x 4.5	-

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 Item	Operating Mode	Tested frequency
Other than Transmitter timeout test	Transmitting (Tx) ch5 (6489.6 MHz)	6489.6 MHz
Transmitter timeout test	Normal transmitting (Tx) ch5 (6489.6 MHz)	6489.6 MHz

*Power of the EUT was set by the software as follows;
Power Setting: Fixed
Software: - Main
Serial No.0616156
software for UWB/Version: TY_UWBSLAVE_410 + TY_UWBMASTER_310
Date: 2022/3/15
Storage location: EUT memory

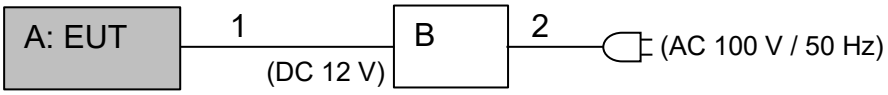
- Main
Serial No.6M6
software for UWB/Version: TY_UWBSLAVE_410 + TY_UWBMASTER_310
Date: 2022/3/15
Storage location: Driven by connected PC

- Secondary
Serial No.6S6
software for UWB/Version: TY_UWBSLAVE_410
Date: 2022/3/15
Storage location: Driven by connected PC

* “Secondary” sample was used for Transmitter timeout test only.
*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.

4.2 Configuration and Peripherals

[Other than Transmitter timeout test]



*Test data was taken under worse case conditions.

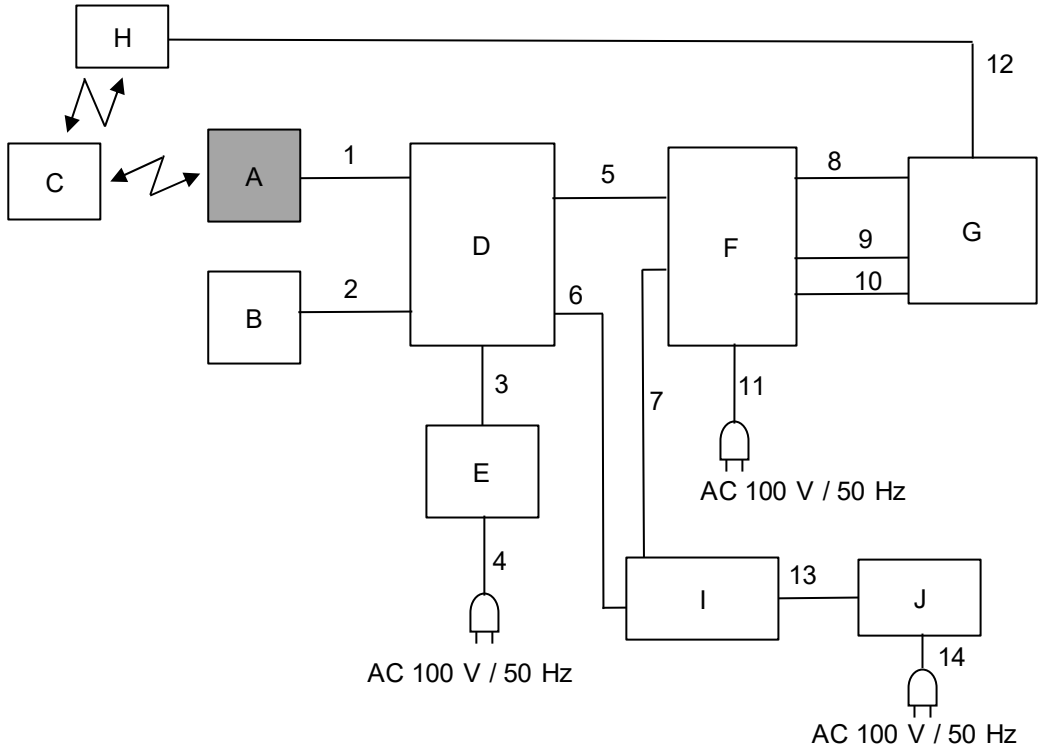
Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	UWB ECU (UWB Transceiver System)	TRUM21A1	0616156	TOKAI RIKA CO., LTD.	EUT (main)
B	DC power supply	PAN35-10A	DE001677	KIKUSUI	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC	1.0 + 1.5	Unshielded	Unshielded	-
2	AC	2..0	Unshielded	Unshielded	-

[Transmitter timeout test]



Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	UWB ECU (UWB Transceiver System)	TRUM21A1	6M6	TOKAI RIKA CO., LTD.	EUT (main)
B	UWB ECU (UWB Transceiver System)	TRUM21A1	6S6	TOKAI RIKA CO., LTD.	- (secondary)
C	UWB Electric Key	B3S2P2Z	926	TOKAI RIKA CO., LTD.	Companion device
D	UWB checker	UWB_Emulator_PC_ Tool_V205	SS2-495	TOKAI RIKA CO., LTD.	-
E	AC adapter	AD-A120P300	2109	Xiamen UME Electronics Co., Ltd.	-
F	Smart key checker	Ver.2.61	-	TOKAI RIKA CO., LTD.	-
G	LF driver	Ver.2.12	1902001	TOKAI RIKA CO., LTD.	-
H	LF antenna	D33151	000072	TOKAI RIKA CO., LTD.	-
I	Laptop computer	PB552HEAP27A71	7D47661H	Toshiba	-
J	AC adapter	PA3755U-1ACA	671C000A5210	Toshiba	-

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC & signal cable	2.9	Unshieled	Unshieled	-
2	DC & signal cable	13.0	Unshieled	Unshieled	-
3	DC	1.8	Unshielded	Unshielded	-
4	AC	1.7	Unshielded	Unshielded	-
5	Signal cable (UWB trigger)	0.8	Unshielded	Unshielded	-
6	USB	1.8	Shielded	Shielded	-
7	USB	1.1	Shielded	Shielded	-
8	Signal cable (LF put)	0.6	Unshielded	Unshielded	-
9	DC (+12 V) cable	1.0	Unshielded	Unshielded	-
10	GND (0 V) cable	1.0	Unshielded	Unshielded	-
11	AC	1.9	Unshielded	Unshielded	-
12	LF antenna cable	2.9	Unshielded	Unshielded	-
13	DC	1.8	Unshielded	Unshielded	-
14	AC	0.8	Unshielded	Unshielded	-

SECTION 5: Radiated Emission

Test Procedure

[For below 30 MHz]
EUT was placed on a platform of nominal size, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene. That has very low permittivity.
The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., and 135 deg.) and horizontal polarization.
*Refer to Figure 1 about Direction of the Loop Antenna.

[For 30 MHz to 960 MHz]
EUT was placed on a platform of nominal size, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene. That has very low permittivity.

[For 960 MHz to 1000 MHz]
EUT was placed on a urethane platform of nominal size, 0.15 m by 0.05 m, raised 1.5 m above the conducting ground plane.

[For above 1000 MHz]
EUT was placed on a urethane platform of nominal size, 0.15 m by 0.05 m, raised 1.5 m above the conducting ground plane.

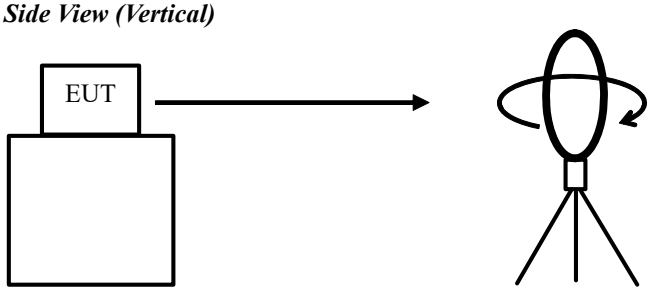
UWB emissions and other emissions:
1) The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.
The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.
The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

(UWB emissions only) (refer to ANSI C63.10 (reference ANSI C63.26))
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.

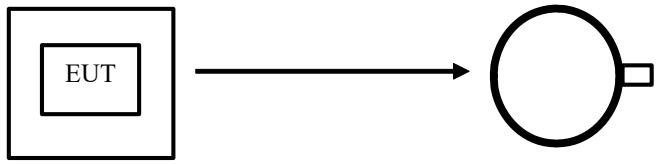
3) Equivalent isotropic radiated power was calculated by subtracting the cable loss and the attenuator loss connected between the signal generator and the substitution antenna from the output power of the signal generator recorded in 2).
For the usage of the antenna (horn antenna) for the substitution antenna, the equivalent isotropic radiated power was calculated by compensating the finite substitution antenna.

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

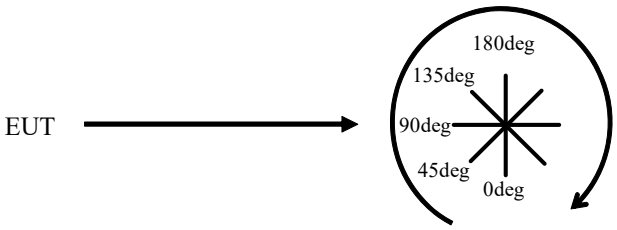


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

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	Below 30 MHz	30 to 960 MHz	Above 960 MHz	
Instrument used	Test Receiver	Test Receiver	Spectrum Analyzer	
Detector	Quasi-Peak	Quasi-Peak	Peak	RMS (AV) *2)
IF Bandwidth	BW 9 kHz	BW 120 kHz	UWB spurious emission: RBW: 1 MHz, VBW: 3 MHz Carrier emission: RBW: 50 MHz, VBW: 80 MHz	UWB spurious emission: RBW: 1 MHz, VBW: 3 MHz GPS band emission: RBW: 1 kHz, VBW: 3 kHz
Test Distance	3 m	3 m	3.0 m (960 MHz to 1 GHz) 0.5 m (1 GHz to 10.6 GHz) *1) 0.3 m (10.6 GHz to 18 GHz) *1) 0.1 m (above 18 GHz) *1)	

*1) For section 10.3.2 of ANSI C63.10: 2013. This measurement was performed at less than 3 m due to the small radiation emission of EUT. In addition, this measurement was performed by the substitution measurement.
Since there are frequencies that are the distance of the near field condition with respect to the measurement distance, we have verified the measurement results in the near field condition and the far field condition and confirmed that there was no difference in the test results.

*2) For section 10.3.7 of ANSI C63.10: 2013. This measurement was set the sweep time so that there is no more than a 1 ms integration period over each measurement bin.

- 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.

Polarity	Frequency [GHz]							
	Below 0.030	0.030 to 0.96	0.96 to 1	1 to 2	2 to 10.6	10.6 to 18	18 to 26.5	26.5 to 40
Horizontal	X	X	X	X	X	Y	Y	Z
Vertical	X	X	X	X	Y	Z	Y	X

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

Measurement range : 9 kHz to 40 GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: UWB bandwidth and 99 % occupied bandwidth

Test Procedure

The tests were made with below setting by a radiated electric field in semi-anechoic chamber.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
UWB Bandwidth, 99 % Occupied Bandwidth	1 GHz	1 MHz or 10 MHz	3 MHz or 40 MHz	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX
Test result : Pass

SECTION 7: Transmitter timeout

Test Procedure

The test was made with spectrum analyzer.

Test Data : APPENDIX
Test Result : Pass

APPENDIX 1: Test Data

Radiated emission

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	15200443S-A-R3
Date	May 24, 2024
Temperature / Humidity	25 deg. C / 43 % RH
Engineer	Makoto Hosaka
Mode	Transmitting ch5

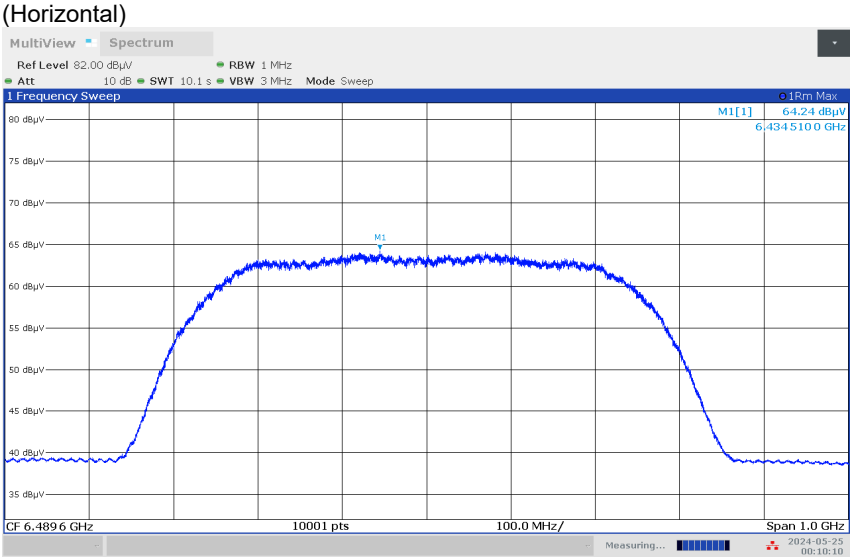
(UWB emission, RBW 1 MHz)

(*SA: Spectrum analyzer, SG: Signal generator, Ant.: substitution antenna)

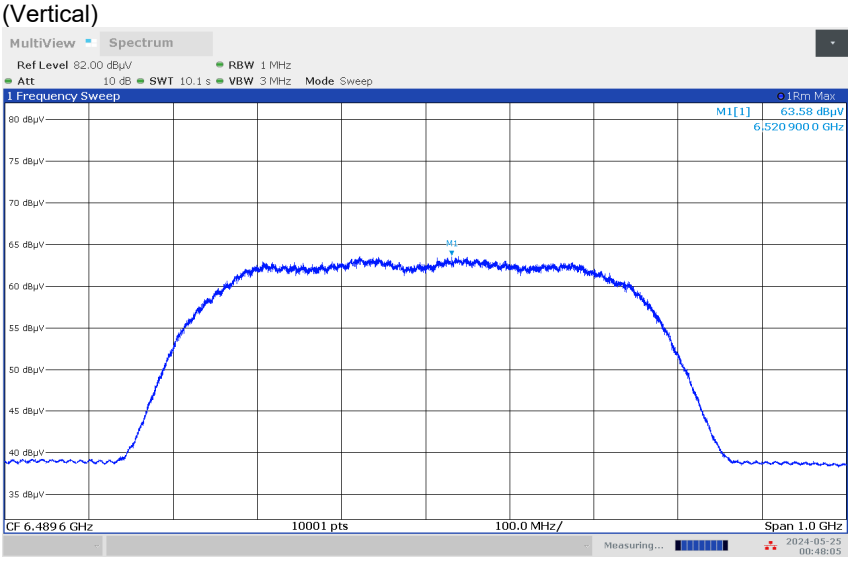
Band	Pol.	Frequency [MHz]	SA Reading [dBuV/MHz]	SG level [dBm]	Tx Ant.Gain [dBi]	Tx Loss [dB]	-	EIRP Result [dBm/MHz]	EIRP Limit [dBm/MHz]	Margin [dB]	Remarks	Height [cm]	Angle [deg.]
3.1 GHz - 10.6 GHz	Hor.	6434.510	64.24	-47.21	10.55	10.23	-	-46.89	-41.30	5.59	carrier	150	174
3.1 GHz - 10.6 GHz	Ver.	6520.900	63.58	-48.26	10.46	10.31	-	-48.11	-41.30	6.81	carrier	151	202

Sample Calculation :
EIRP Result [dBm/MHz] = SG level [dBm] + Tx Ant.Gain [dBi] - Tx Loss [dB]

(Horizontal)



(Vertical)



* For RF Exposure evaluation
Maximum RMS power measured: -46.89 dBm/MHz (refer to upper table value) / 10 ^(-46.89 [dBm/MHz]/ 10) = 0.00002046 mW/MHz
The bandwidth of this equipment was 588.941 MHz (99 % occupied bandwidth, refer to the data of bandwidth sheet)
Total RMS output power was 0.01204973 mW = 0.00002046 mW/MHz x 588.941 MHz
* There were no detect UWB emissions in the range that below 5000 MHz.

Radiated emission

Report No.	15200443S-A-R3			
Test place	Shonan EMC Lab.			
Semi Anechoic Chamber	SAC 3	SAC 3	SAC 3	SAC 3
Date	May 31, 2024	May 29, 2024	May 24, 2024	May 29, 2024
Temperature / Humidity	22 deg. C / 44 % RH	20 deg. C / 55 % RH	25 deg. C / 43 % RH	20 deg. C / 55 % RH
Engineer	Yuta Shiba (9 kHz to 30 MHz)	Yuta Shiba (30 MHz to 2 GHz)	Makoto Hosaka (2 GHz to 10.6 GHz)	Yuta Shiba (10.6 GHz to 18 GHz)
Mode	Transmitting ch5			

(UWB emission except carrier emission)

9 kHz to 18 GHz

No.	Freq.	Reading (PK)	SG Level	TX Ant.Gain	TX Loss	EIRP Result	EIRP Limit	Margin	Pola.	Height	Angle	TX Ant.Type	Comment
	[MHz]	[dBuV]	[dBm]	[dBi]	[dB]	[dBm]	[dBm]	[dB]		[cm]	[deg]		
1	12979.200	40.34	-66.68	13.52	14.64	-67.80	-61.30	6.5	Hori.	147	267	Horn	RMS
2	12979.200	40.92	-65.21	13.52	14.64	-66.33	-61.30	5.0	Vert.	153	298	Horn	RMS

Calculation:Result [dBm] = SG level [dBm] + Tx Ant Gain [dBi] - Tx Loss (Cable)[dB]
Tx Antenna: Horn(1 GHz-40 GHz) / Rx-Antenna: Horn(1 GHz-40 GHz)

* For RBW less than 960 MHz was set according to FCC 15.209, Above 960 MHz was set to 1 MHz .
(* There were no detect UWB emissions in the range that below 960 MHz)

Radiated emission

Report No.	15200443S-A-R3	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	SAC 3	SAC 3
Date	May 24, 2024	May 24, 2024
Temperature / Humidity	23 deg. C / 51 % RH	25 deg. C / 43 % RH
Engineer	Yosuke Murakami (18 GHz to 26.5 GHz)	Makoto Hosaka (26.5 GHz to 40 GHz)
Mode	Transmitting ch5	

18 GHz to 26.5 GHz

No.	Freq.	Reading (PK)	SG Level	TX Ant.Gain	TX Loss	ERP		Margin	Pola.	Height	Angle	TX Ant.Type	Comment
						Result	Limit						
	[MHz]	[dBuV]	[dBm]	[dBi]	[dB]	[dBm]	[dBm]	[dB]		[cm]	[deg]		
1	19468.801	32.32	-82.00	9.93	18.28	-90.35	-61.30	29.0	Hori.	150	0	Horn	Floor noies
2	25958.400	40.37	-52.26	12.05	21.15	-61.36	-61.30	0.0	Hori.	150	214	Horn	RMS
3	19468.801	32.40	-82.00	9.93	18.28	-90.35	-61.30	29.0	Vert.	150	0	Horn	Floor noies
4	25958.400	39.45	-52.51	12.05	21.15	-61.61	-61.30	0.3	Vert.	153	264	Horn	RMS

Calculation:Result [dBm] = SG level [dBm] + Tx Ant Gain [dBi] - Tx Loss (Cable)[dB]
Tx Antenna: Horn(1 GHz-40 GHz) / Rx-Antenna: Horn(1 GHz-40 GHz)

26.5 GHz to 40 GHz

No.	Freq.	Reading (PK)	SG Level	TX Ant.Gain	TX Loss	ERP		Margin	Pola.	Height	Angle	TX Ant.Type	Comment
						Result	Limit						
	[MHz]	[dBuV]	[dBm]	[dBi]	[dB]	[dBm]	[dBm]	[dB]		[cm]	[deg]		
1	32448.000	40.51	-79.60	17.03	24.32	-86.89	-61.30	25.5	Hori.	150	0	Horn	Z, RMS, Floor noise
2	38937.359	51.50	-55.89	18.15	27.04	-64.78	-61.30	3.4	Hori.	151	264	Horn	Z, RMS
3	32448.000	40.60	-81.30	17.03	24.32	-88.59	-61.30	27.2	Vert.	100	0	Horn	X, RMS, Floor noise
4	38937.359	46.31	-63.79	18.15	27.04	-72.68	-61.30	11.3	Vert.	150	82	Horn	X, RMS

Calculation:Result [dBm] = SG level [dBm] + Tx Ant Gain [dBi] - Tx Loss (Cable)[dB]
Tx Antenna: Horn(1 GHz-40 GHz) / Rx-Antenna: Horn(1 GHz-40 GHz)

Radiated emission

Report No.	15200443S-A-R3
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	SAC 3
Date	May 29, 2024
Temperature / Humidity	20 deg. C / 55 % RH
Engineer	Yuta Shiba
Mode	Transmitting ch5

(Other emission)

No.	Freq.	Reading (QP)	Ant.Fac	Loss	Gain	Result (QP)	Limit (QP)	Margin (QP)	Pola.	Height	Angle	Ant. Type	Comment
	[MHz]	[dBuV]	[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[H/V]	[cm]	[deg]		
1	33.783	21.40	17.19	6.40	32.16	12.83	40.00	27.1	Hori.	300	359	BC	
2	57.687	22.30	8.71	6.51	32.15	5.37	40.00	34.6	Hori.	150	1	BC	
3	751.399	20.60	20.45	10.38	31.67	19.76	46.00	26.2	Hori.	100	359	LP	
4	31.190	22.20	18.15	6.34	32.16	14.53	40.00	25.4	Vert.	100	1	BC	
5	74.800	23.10	6.27	7.05	32.14	4.28	40.00	35.7	Vert.	100	359	BC	
6	324.641	20.60	13.36	8.59	31.92	10.63	46.00	35.3	Vert.	150	1	LP	
7	519.698	21.10	17.18	9.47	31.90	15.85	46.00	30.1	Vert.	100	210	LP	
8	650.998	20.80	19.55	9.99	31.86	18.48	46.00	27.5	Vert.	150	359	LP	

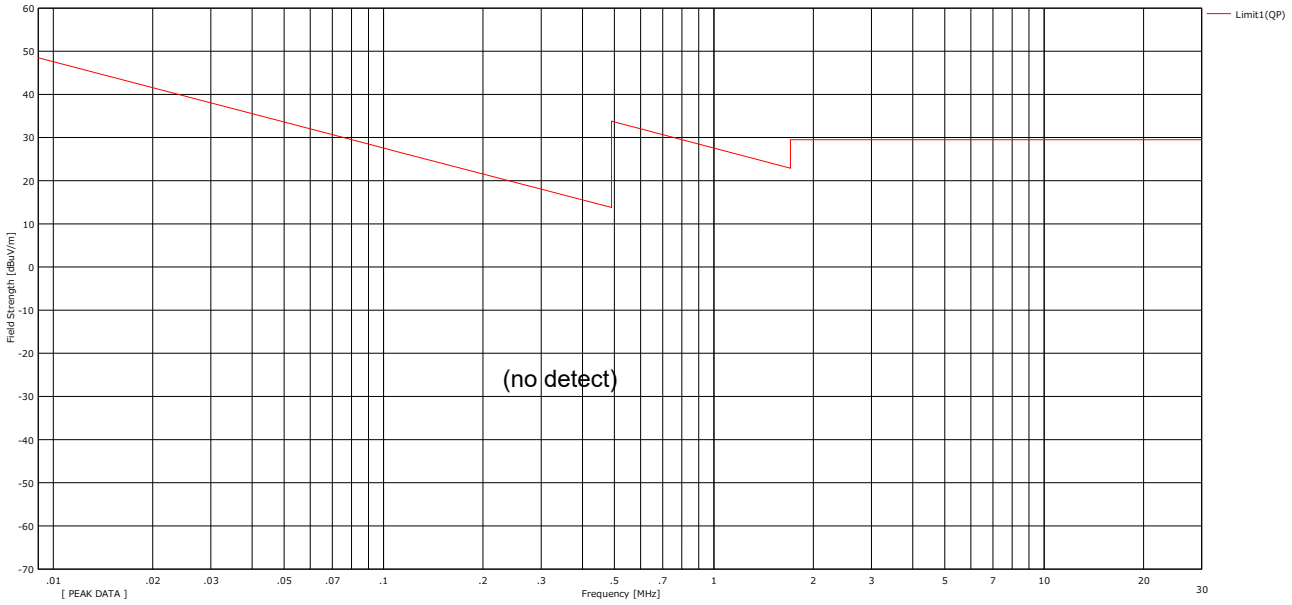
Calculation Result [dBuV/m] = Reading [dBuV/m] + Ant.Fac [dB/m] + Loss (Cable + ATT + ΔAF)[dB] - Gain (AMP)[dB]
Ant.Type = BC: Biconical antenna, LP: Logperiodic antenna, **SH*: Horn antenna

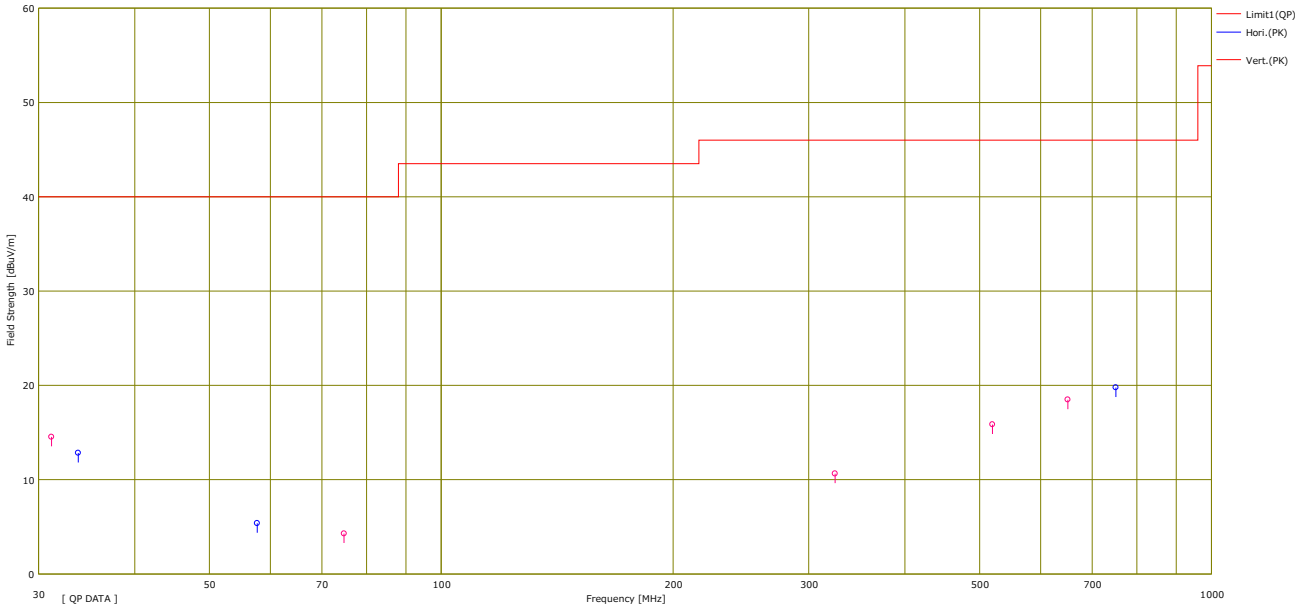
(* There were no detect other emissions in the range that below 30 MHz and above 960 MHz)

Radiated emission

(Plot data)

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	SAC 3	SAC 3
Date	May 31, 2024	May 29, 2024
Temperature / Humidity	22 deg. C / 44 % RH	20 deg. C / 55 % RH
Engineer	Yuta Shiba (9 kHz to 30 MHz)	Yuta Shiba (30 MHz to 2 GHz)
Mode	Transmitting ch5	

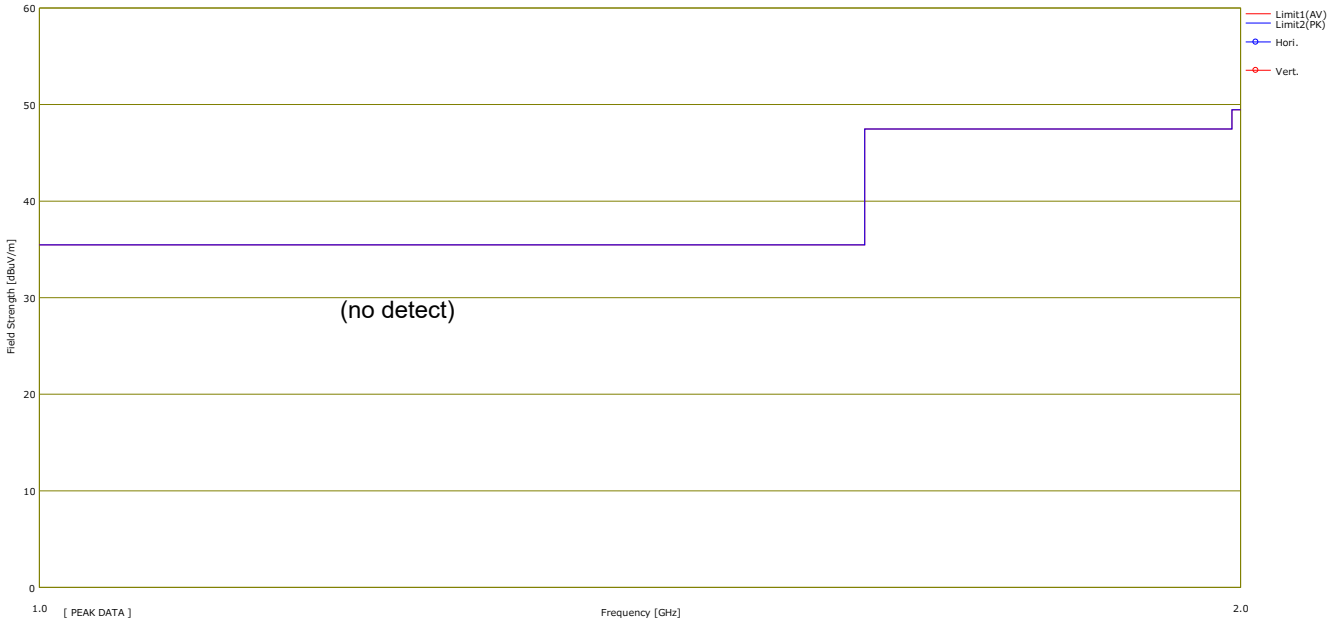


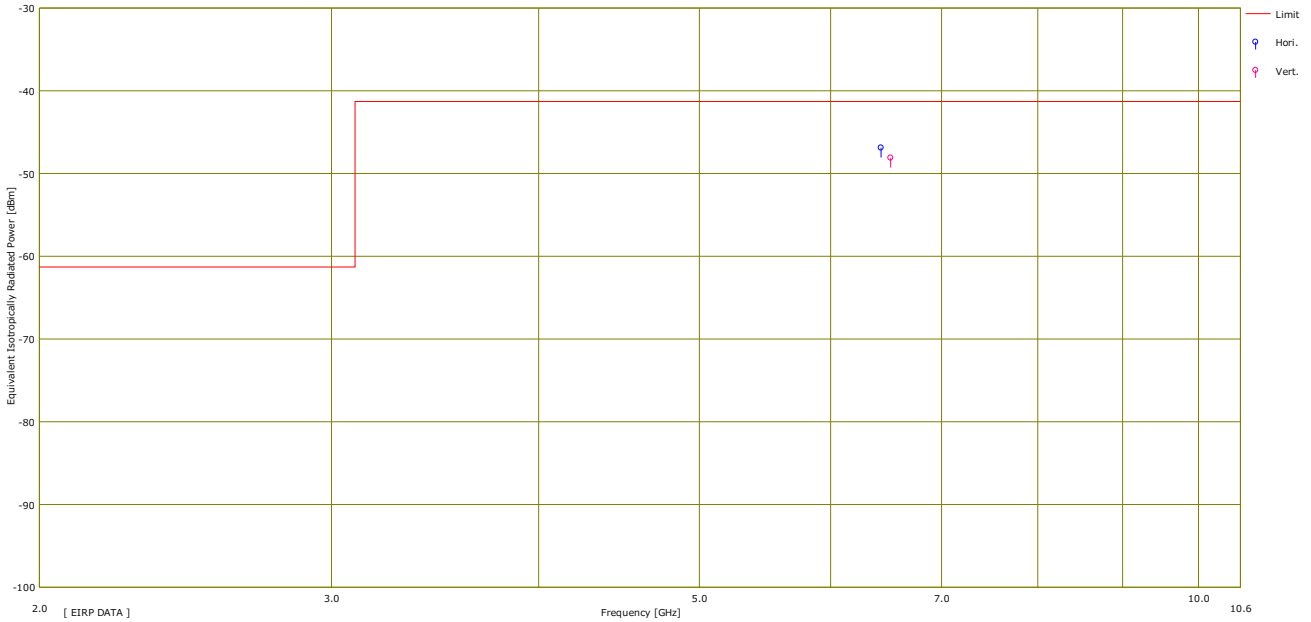


Radiated emission

(Plot data)

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	SAC 3	SAC 3
Date	May 29, 2024	May 24, 2024
Temperature / Humidity	20 deg. C / 55 % RH	25 deg. C / 43 % RH
Engineer	Yuta Shiba (30 MHz to 2 GHz)	Makoto Hosaka (2 GHz to 10.6 GHz)
Mode	Transmitting ch5	

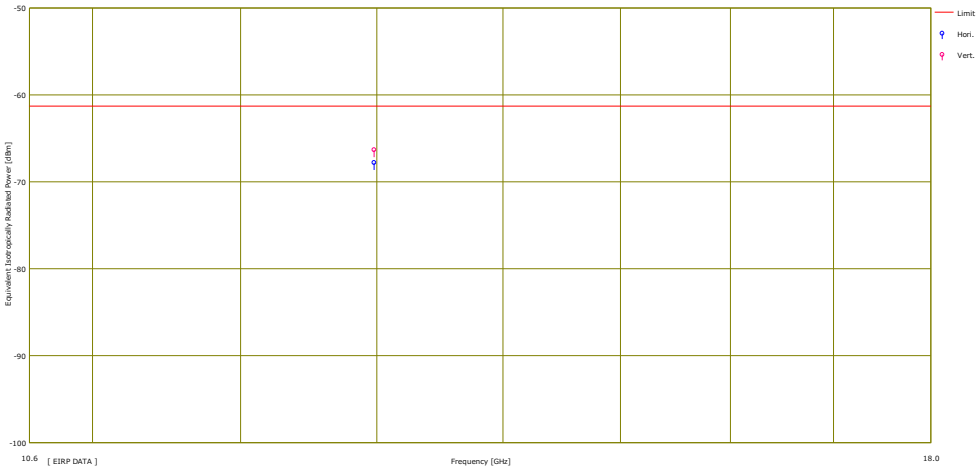


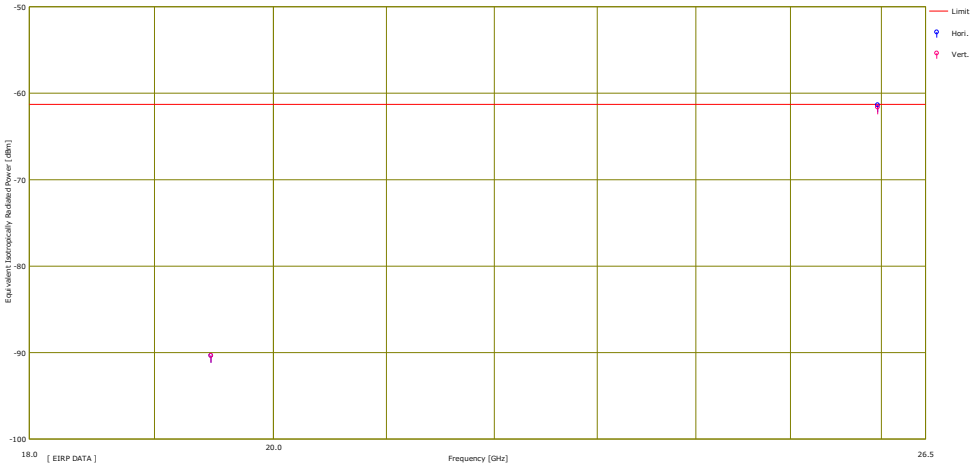


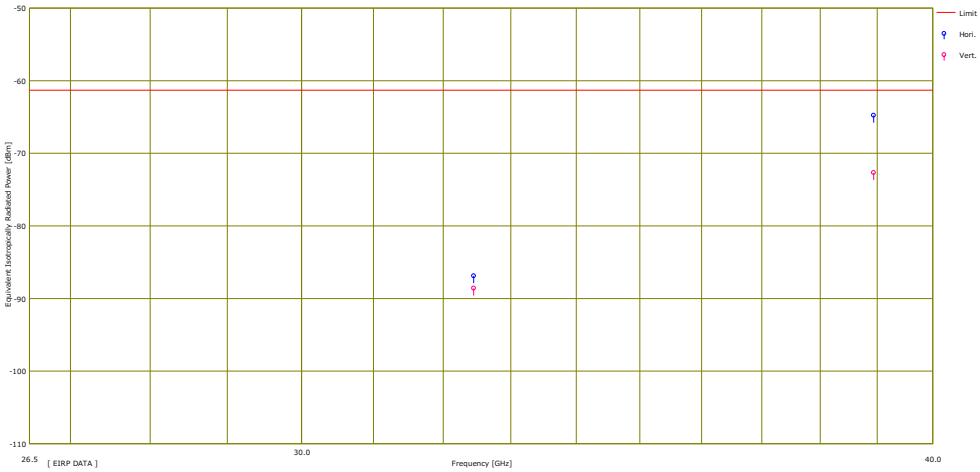
Radiated emission

(Plot data)

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	SAC 3	SAC 3	SAC 3
Date	May 29, 2024	May 24, 2024	May 24, 2024
Temperature / Humidity	20 deg. C / 55 % RH	23 deg. C / 51 % RH	25 deg. C / 43 % RH
Engineer	Yuta shiba (10.6 GHz to 18 GHz)	Yosuke Murakami (18 GHz to 26.5 GHz)	Makoto Hosaka (26.5 GHz to 40 GHz)
Mode	Transmitting ch5		







Radiated emission (GPS band)

Report No.	15200443S-A-R3
Test place	Shonan EMC Lab.
Semi Anechoic Chamber	SAC 3
Date	May 29, 2024
Temperature / Humidity	20 deg. C / 55 % RH
Engineer	Yuta Shiba
Mode	Transmitting ch5

(GPS bands emission)

c

No.	Freq. [MHz]	Reading (PK) [dBuV]	SG Level [dBm]	TX Ant.Gain [dBi]	TX Loss [dB]	EIRP Result [dBm]	EIRP Limit [dBm]	Margin [dB]	Pola.	Height [cm]	Angle [deg]	TX Ant.Type	Comment
1	1202.000	16.07	-110.00	7.00	4.27	-107.27	-85.30	21.9	Hori.	150	0	Horn	RBW:1 kHz, Floor noise
2	1584.500	15.03	-110.00	9.29	4.94	-105.65	-85.30	20.3	Hori.	150	0	Horn	RBW:1 kHz, Floor noise
3	1202.000	15.24	-110.00	7.00	4.27	-107.27	-85.30	21.9	Vert.	150	0	Horn	RBW:1 kHz, Floor noise
4	1584.500	15.60	-110.00	9.29	4.94	-105.65	-85.30	20.3	Vert.	150	0	Horn	RBW:1 kHz, Floor noise

Calculation:Result [dBm] = SG level [dBm] + Tx Ant Gain [dBi] - Tx Loss (Cable)[dB]
Tx Antenna: Horn(1 GHz-40 GHz) / Rx-Antenna: Horn(1 GHz-40 GHz)

Peak level of the emission

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	15200443S-A-R3
Date	May 24, 2024
Temperature / Humidity	25 deg. C / 43 % RH
Engineer	Makoto Hosaka
Mode	Transmitting ch5

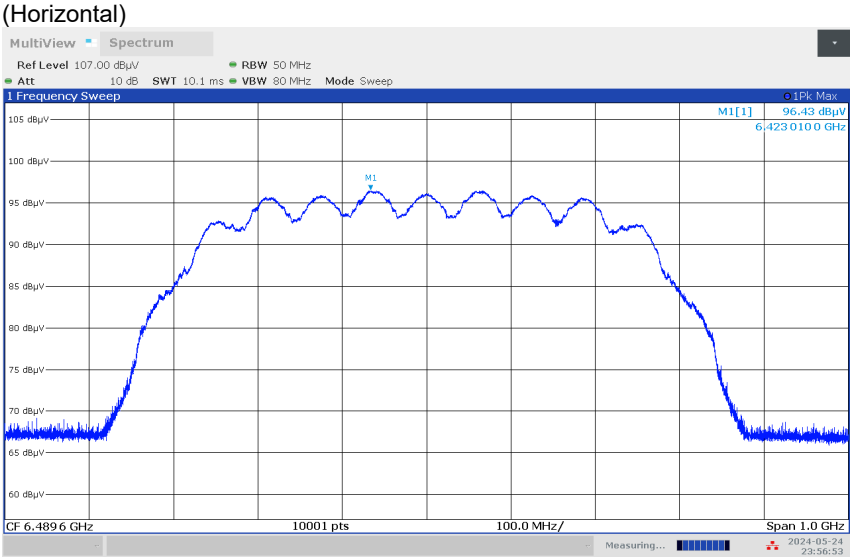
(Peak level of the emission)

(*SA: Spectrum analyzer, SG: Signal generator, Ant.: substitution antenna)

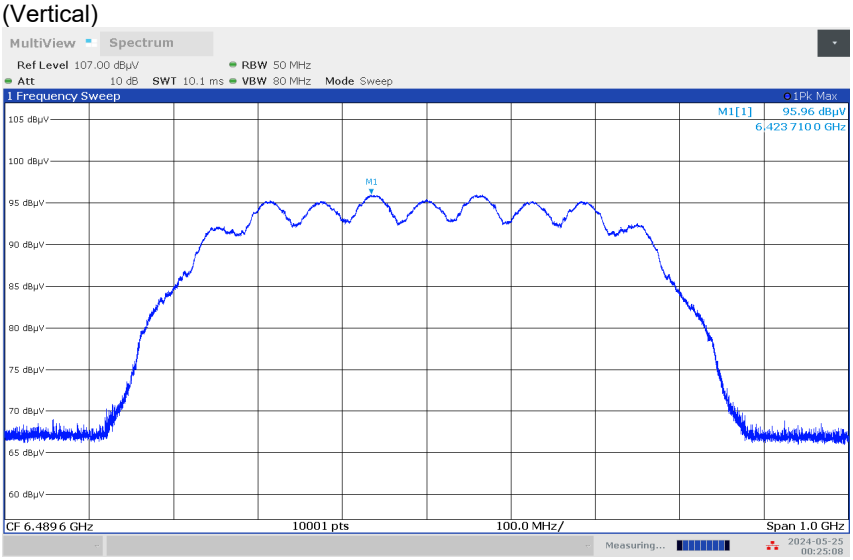
Band	Pol.	Frequency [MHz]	SA Reading [dBuV/50 MHz]	SG level [dBm]	Tx Ant.Gain [dBi]	Tx Loss [dB]	RBW converted factor [dB]	EIRP Result [dBm/50 MHz]	EIRP Limit [dBm/50 MHz]	Margin [dB]	Remarks	Height [cm]	Angle [deg.]
3.1 GHz - 10.6 GHz	Hor.	6423.010	96.43	-15.94	10.57	10.23	0.50	-15.10	0.00	15.10	carrier	150	174
3.1 GHz - 10.6 GHz	Ver.	6423.710	95.96	-16.67	10.57	10.23	0.50	-15.83	0.00	15.83	carrier	151	202

Sample Calculation :
EIRP Result [dBm/MHz] = SG level [dBm] + Tx Ant.Gain [dBi] - Tx Loss [dB] + RBW converted factor [dB]
RBW converted factor [dB] = 20 x log (50 / (3 dB measured bandwidth = 47.1834 [MHz]))

(Horizontal)



(Vertical)



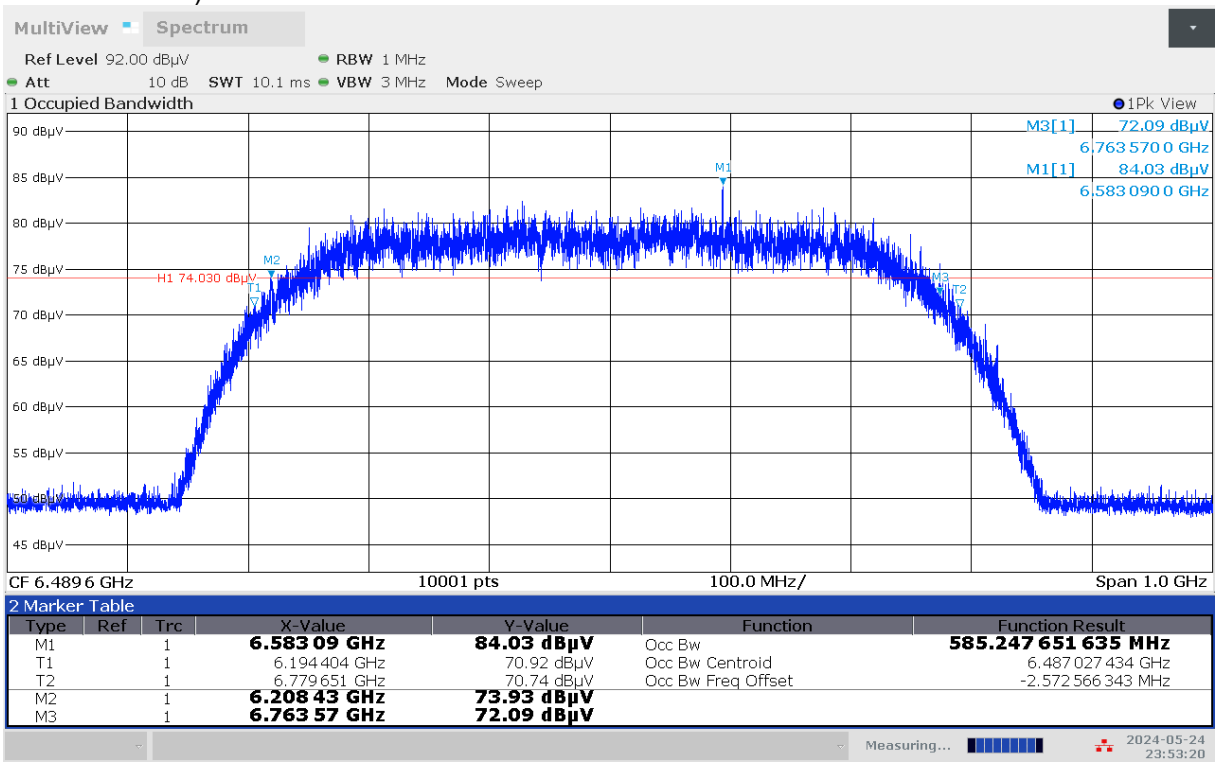
* For RSP-100 Annex B
Maximum peak power measured: -15.1 dBm/50 MHz (refer to upper table value) / 10 ^ (-15.1 [dBm/50 MHz]/ 10) = 0.030903 mW/50 MHz
The bandwidth of this equipment was 588.941 MHz (99 % occupied bandwidth, refer to the data of bandwidth sheet)
Total peak output power was 0.364001 mW = 0.030903 [mW/50 MHz] x 588.941 [MHz] / 50 [MHz]

UWB Bandwidth

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	15200443S-A-R3
Date	May 24, 2024
Temperature / Humidity	25 deg. C / 43 % RH
Engineer	Makoto Hosaka
Mode	Transmitting ch5
10 dB Bandwidth:	**555.140 MHz (Limit: >= 500 MHz)**

Center Frequency **6486.000 MHz (= (fH + fL) / 2)**

(worst: Horizontal)

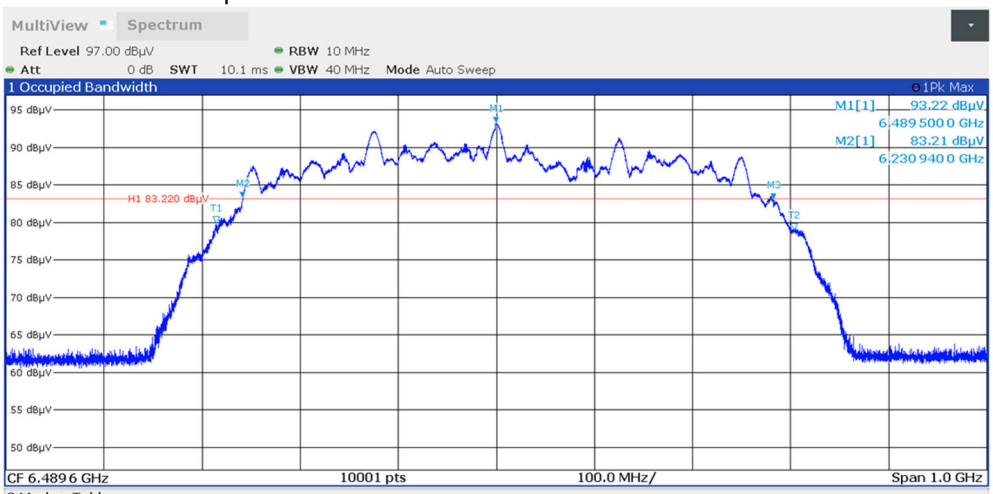


Start Frequency:	5989.600 **MHz**	**f L:**	6208.430 **MHz**
Stop Frequency:	6989.600 **MHz**	**f H:**	6763.570 **MHz**

UWB Bandwidth

Test place	Shonan EMC Lab. No.3 Semi Anechoic Chamber
Report No.	15200443S-A-R3
Date	August 1, 2024
Temperature / Humidity	23 deg. C / 34 % RH
Engineer	Kenichi Adachi
Mode	Transmitting ch5

99 % Occupied Bandwidth 588.9407 MHz



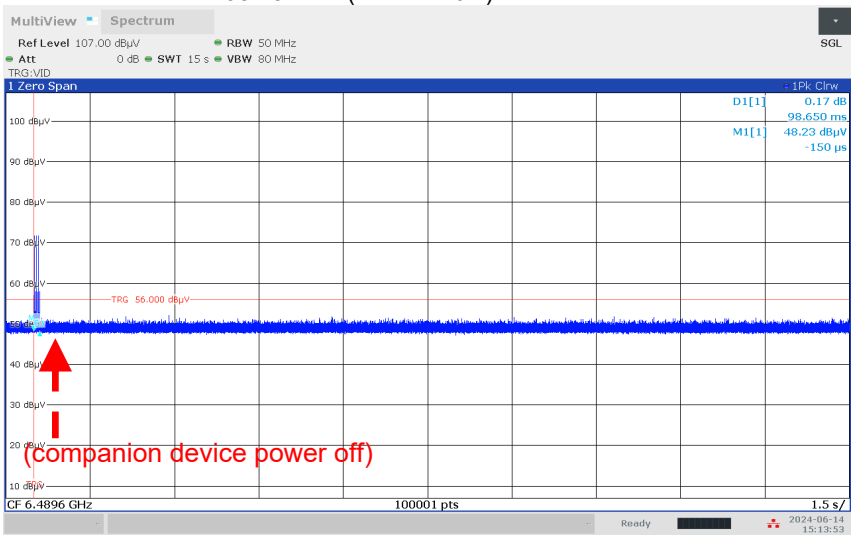
2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**6.489 5 GHz**	**93.22 dBµV**	Occ Bw	**588.940 664 118 MHz**
T1		1	6.204 209 GHz	79.84 dBµV	Occ Bw Centroid	6.498 678 982 GHz
T2		1	6.793 149 GHz	78.96 dBµV	Occ Bw Freq Offset	9.078 982 05 MHz
M2		1	**6.230 94 GHz**	**83.21 dBµV**		
M3		1	**6.772 09 GHz**	**83.01 dBµV**		

Transmitter timeout

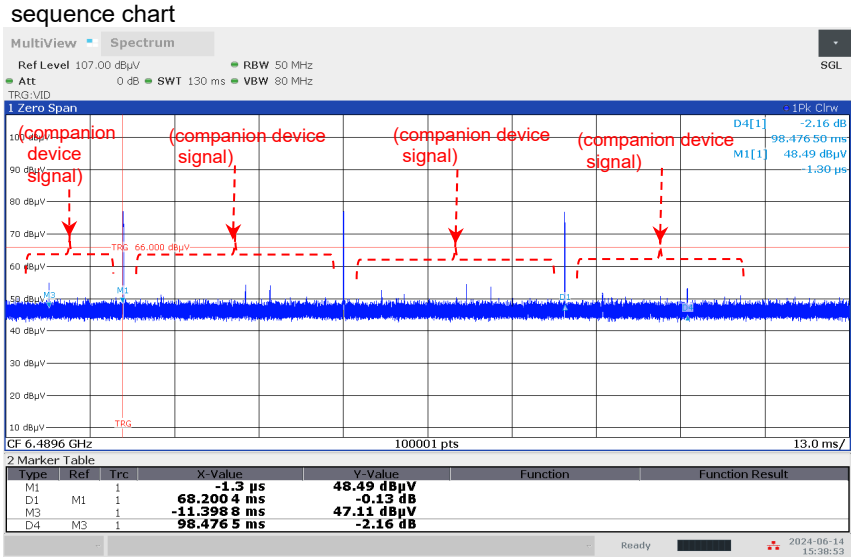
Test place	Shonan EMC Lab. No.1 Shielded Room
Date	June 14, 2024
Temperature / Humidity	26 deg. C / 46 % RH
Engineer	Kenichi Adachi
Mode	Normal Transmitting ch5

Transmitter Timeout: 98.48 ms (Limit: < 10 s)



* Although no transmission signal was seen after the companion device was turned off, the transmitter timeout result was assumed to be the time for one sequence transmission, assuming that the time for one sequence transmission that EUT may transmit.
* This EUT was stopped transmit unless there is a second trigger at the Transmitter timeout of the UWB after the Trigger (LF transmission).

(Reference data) 1 sequence chart



The start of this chart is the time when the EUT and companion device powered up and started communicating.
The transmission signal was no longer displayed when the companion device performed power off.
This EUT is stopped transmit unless there is a second trigger at the Transmitter timeout of the UWB after the Trigger (LF transmission).
The transmitter timeout result was within 10 seconds, including the transmission time with one cycle.

APPENDIX 2: Test instruments

Test Instruments (1/2)

Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int (Month)
RE	145005	Pre Amplifier	Toyo Corporation	TPA0118-36	2046104	2024/02/16	12
RE	145007	Pre Amplifier	Toyo Corporation	HAP18-26W	19	2024/03/05	12
RE	145023	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032666	2024/05/10	12
RE	145126	Pre Amplifier	SONOMA	310N	290213	2024/02/07	12
RE	145129	Pre Amplifier	Toyo Corporation	HAP26-40W	B3208602403-176	2024/05/09	12
RE	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2024/04/01	12
RE	145176	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	2023/08/23	12
RE	145384	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-726	2024/03/11	12
RE	145501	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-739	2024/03/20	12
RE	145512	Horn Antenna	ETS-Lindgren	3160-09	00094868	2023/06/12	12
RE	145514	Horn Antenna	ETS-Lindgren	3160-10	00092383	2023/06/12	12
RE	145515	Horn Antenna	ETS-Lindgren (Cedar Park, Texas)	3116	108256	2024/05/13	12
RE	145529	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	196	2024/05/10	12
RE	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2024/04/10	12
RE	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2024/04/03	12
RE	145568	Semi Anechoic Chamber(ME)	TDK	Semi Anechoic Chamber 3m/10m	1, 2, 3	2022/12/24	24
RE	145792	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997812	2023/09/25	12
RE	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2023/09/25	12
RE	146226	Signal Generator	Keysight Technologies Inc	E8257D-540	MY48051404	2024/01/10	12
RE	146432	Tape Measure	TAJIMA	GL19-55	-	-	-
RE	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2023/08/25	12
RE	156380	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	SN MY 13406/4E	2024/05/09	12
RE	167096	Attenuator	JFW	50HF-006N	-	2024/02/13	12
RE	167990	Thermo-Hygrometer	CUSTOM. Inc	CTH-202	708Q08R	2023/08/01	12
RE	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	Ver 3.1.0546	-	-
RE	179540	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	802815/2	2024/03/05	12
RE	191840	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2023/08/03	12
RE	194601	Coaxial Cable	Fjikura	5D-2W	-	2023/12/08	12
RE	194683	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	694	2024/03/04	12
RE	194684	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	695	2024/03/11	12
RE	194685	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	711	2024/03/20	12
RE	196945	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803414/2	2024/03/12	12
RE	196985	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	803650/2	2024/03/05	12
RE	200010	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	575618/4	2024/06/05	12
RE	202959	Highpass Filter	Micro-Tronics	HPM50107	G077	2023/10/11	12

Test Instruments (2/2)

Test Name	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int (Month)
RE	221966	Coaxial Cable	Huber+Suhner	SUCOFLEX 102	2000703/2	2023/06/06	12
RE	235269	Spectrum Analyzer	Rohde & Schwarz	FSW43	102488	2023/12/18	12
RE	236869	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	200084/4A	2023/06/06	12
RE	248302	Attenuator	JFW	50HFFA-006-2/18N	-	2024/05/06	12

***1) This test equipment was used for the tests before the expiration date of the calibration.**

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

The expiration date of the calibration is the end of the expired month.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

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

Test item: RE: Radiated Emission test