

RADIO TEST REPORT

Test Report No. 13806752S-A-R2

Customer	NITTOKU CO., LTD.
Description of EUT	LF-Band RFID READER/WRITER
Model Number of EUT	ITS-LRW210
FCC ID	2A29T-ITSLRW210V11
Test Regulation	FCC Part 15 Subpart C: 2021
Test Result	Complied (Refer to SECTION 3)
Issue Date	March 31, 2022
Remarks	-

Representative Test Engineer

Yosuke Murakami
Engineer

Approved By

Kazuya Noda
Leader

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".

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 20.0

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- The information provided from the applicant 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.: 13806752S-A

This report is a revised version of 13806752S-A-R1. 13806752S-A-R1 is replaced with this report.

Revision	Test Report No.	Date	Revised Contents																																																																																																																																																																						
- (Original)	13806752S-A	March 18, 2022	-																																																																																																																																																																						
1	13806752S-A-R1	March 28, 2022	<p>SECTION 3.2: Correction of worst margin for “Electric Field Strength of Fundamental Emission”.</p> <p>From: Without magnetic sheet PK with DCCF 4.3 dB, 0.1342 MHz, Vertical</p> <p>To: Without magnetic sheet 2.2 dB, 0.1342 MHz, Vertical</p> <p>With magnetic sheet PK with DCCF 3.5 dB, 0.1342 MHz, Vertical</p> <p>With magnetic sheet 1.3 dB, 0.1342 MHz, Vertical</p> <p>SECTION 3.4: Correction of Uncertainty.</p> <p>From:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Item</th> <th rowspan="2">Frequency range</th> <th colspan="4">Uncertainty (%)</th> </tr> <tr> <th>No. 1 SAC / SR</th> <th>No. 2 SAC / SR</th> <th>No. 3 SAC / SR</th> <th>No. 4.5.6.8 SR</th> </tr> </thead> <tbody> <tr> <td>Conducted emission (AC Mass) LSN</td> <td>150 kHz-10 MHz</td> <td>2.7 dB</td> <td>2.9 dB</td> <td>2.9 dB</td> <td>2.7 dB</td> </tr> <tr> <td>Radiated emission (Measurement distance: 3 m)</td> <td>9 kHz-10 MHz</td> <td>2.9 dB</td> <td>2.9 dB</td> <td>2.9 dB</td> <td>-</td> </tr> <tr> <td></td> <td>30 MHz-200 MHz</td> <td>4.6 dB</td> <td>4.6 dB</td> <td>4.6 dB</td> <td>-</td> </tr> <tr> <td></td> <td>200 MHz-1 GHz</td> <td>6.0 dB</td> <td>6.0 dB</td> <td>6.0 dB</td> <td>-</td> </tr> <tr> <td></td> <td>1 GHz-6 GHz</td> <td>4.8 dB</td> <td>4.8 dB</td> <td>4.8 dB</td> <td>-</td> </tr> <tr> <td></td> <td>6 GHz-18 GHz</td> <td>5.4 dB</td> <td>5.4 dB</td> <td>5.4 dB</td> <td>-</td> </tr> <tr> <td></td> <td>18 GHz-40 GHz</td> <td>5.6 dB</td> <td>5.7 dB</td> <td>5.7 dB</td> <td>-</td> </tr> <tr> <td>Radiated emission (Measurement distance: 1 m)</td> <td>1 GHz-18 GHz</td> <td>5.7 dB</td> <td>5.7 dB</td> <td>5.7 dB</td> <td>-</td> </tr> <tr> <td></td> <td>18 GHz-40 GHz</td> <td>5.9 dB</td> <td>5.9 dB</td> <td>5.9 dB</td> <td>-</td> </tr> </tbody> </table> <p>SAC=Semi-Anechoic Chamber SR=Shielded Room is applied besides radiated emission</p> <table border="1" style="width: 100%; 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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 Radioélectriques	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 Compatiblity	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	NITTOKU CO., LTD.
Address	330-0841 2-292-1 Azuma-cho, Omiya-ku, Saitama-city, Saitama-pref, Japan
Telephone Number	+81-048-615-2117
Contact Person	Akitomo Kiriyama

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	LF-Band RFID READER/WRITER
Model Number	ITS-LRW210
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	February 20, 2022
Test Date	February 21 to March 4, 2022

2.2 Product Description

General Specification

Rating	DC 24 V
Operating temperature	0 deg. C to 40 deg. C

Radio Specification

LF-Band RFID

Equipment Type	Transceiver
Frequency of Operation	134.2 kHz
Antenna Type	Loop Antenna

SECTION 3: Test Specification, Procedures & Results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.209 Radiated emission Limits; general requirements.

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

3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods ISED: RSS-Gen 8.8	FCC: Section 15.207 ISED: RSS-Gen 8.8	Without magnetic sheet QP 12.2 dB, 5.49610 MHz, N AV 5.0 dB, 7.50599 MHz, N With magnetic sheet QP 8.0 dB, 26.38174 MHz, L AV 1.9 dB, 23.5652 MHz, N	Complied# a)	-
Electric Field Strength of Fundamental Emission	FCC: ANSI C63.10:2013 6 Standard test methods ISED: RSS-Gen 6.5, 6.12	FCC: Section 15.209 ISED: RSS-210 4.4 RSS-Gen 8.9	Without magnetic sheet 2.2 dB, 0.1342 MHz, Vertical With magnetic sheet 1.3 dB, 0.1342 MHz, Vertical	Complied b)	Radiated
Electric Field Strength of Spurious Emission	FCC: ANSI C63.10:2013 6 Standard test methods ISED: RSS-Gen 6.5, 6.6, 6.13	FCC: Section 15.209 ISED: RSS-210 4.4 RSS-Gen 8.9	Without magnetic sheet QP 1.1 dB, 61.263 MHz, Vertical With magnetic sheet QP 2.2 dB, 31.179 MHz, Vertical	Complied# b)	Radiated
-26 dB Bandwidth	FCC: ANSI C63.10:2013 6 Standard test methods ISED: -	FCC: Reference data ISED: -	N/A	Complied c)	Radiated
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.					
a) Refer to APPENDIX 1 (data of Conducted Emission)					
b) Refer to APPENDIX 1 (data of Radiated Emission)					
c) Refer to APPENDIX 1 (data of -26 dB Bandwidth / 99 % Occupied Bandwidth)					
Symbols: Complied The data of this test item has enough margin, more than the measurement uncertainty. Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration					

FCC Part 15.31 (e)

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

FCC Part 15.203 Antenna requirement

The EUT has a unique coupling/antenna connector (RP-SMA).
Therefore the equipment complies with the requirement of 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	Complied a)	Radiated
a) Refer to APPENDIX 1 (data of -26 dB Bandwidth / 99 % Occupied Bandwidth)					

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the results are derived depending on whether or not laboratory uncertainty is applied.

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

Item	Frequency range	Uncertainty (+/-)			
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4,5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.9 dB	2.9 dB	3.0 dB	2.9 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.2 dB	3.1 dB	3.1 dB	-
	30 MHz-200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz-1 GHz	6.0 dB	6.1 dB	6.1 dB	-
	1 GHz-6 GHz	4.7 dB	4.7 dB	4.7 dB	-
	6 GHz-18 GHz	5.2 dB	5.3 dB	5.3 dB	-
	18 GHz-40 GHz	5.4 dB	5.5 dB	5.5 dB	-
Radiated emission (Measurement distance: 1 m)	1 GHz-18 GHz	5.6 dB	5.6 dB	5.6 dB	-
	18 GHz-40 GHz	5.8 dB	5.8 dB	5.8 dB	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Other test	Uncertainty (+/-)
Bandwidth Measurement	0.012 %

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, Facsimile: +81 463 50 6401
 A2LA Certificate Number: 1266.03
 (FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
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	-	-

3.6 Test Data, Test Instruments, and Test Set Up

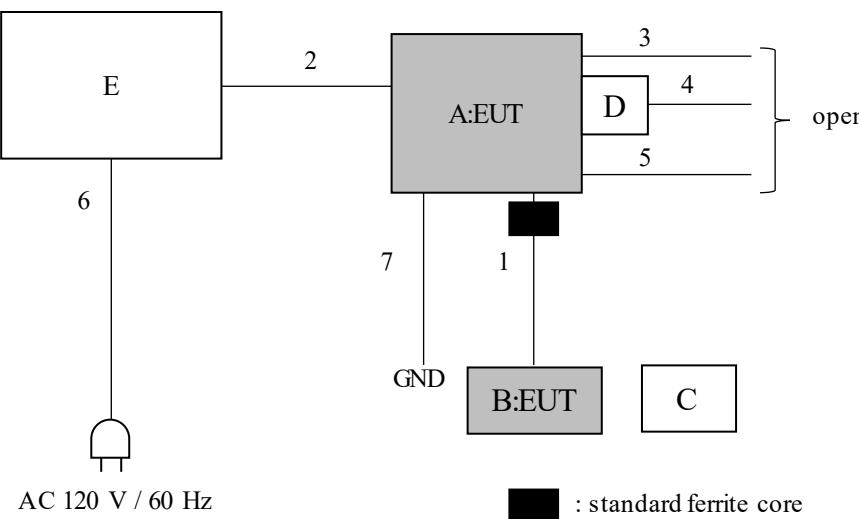
Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	Remarks*
Tx 134.2 kHz mode	- *Power of the EUT was set by the software as follows; Power Setting: Fixed Software: V1.10 (Date: 2022.01 10, 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.

4.2 Configuration and Peripherals



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

*It was preliminary confirmed that there was no difference in emission level due to a standard ferrite core.

*Pre-check has been performed all antenna and with/without Tag, and measurement was conducted with the worst combination of two types of antennas and with/without Tag.

Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remarks
A	LF-Band RFID READER/WRITER	ITS-LRW210	11000001	NITTOKU CO., LTD.	EUT
B	Antenna	ITS-LANT30S-1	2220001	NITTOKU CO., LTD.	EUT *1)
		ITS-LANT30S-3	2226001	NITTOKU CO., LTD.	EUT *1)
		ITS-LANT30S-2U	2229001	NITTOKU CO., LTD.	EUT *2)
		ITS-LANT30S-3U	2223001	NITTOKU CO., LTD.	EUT *2)
C	Tag	RI-TRP-DR2B	00000999	NITTOKU CO., LTD.	-
D	RS232C-USB Converter	CBL-USB(NR)232	-	Yukioka Manufactory Co.Ltd.	-
E	DC Power Supply	STEP-PS/1AC/24DC/2.5	2868651032037P5959	Phoenix Contact	-

*1) With magnetic sheet

*2) Without magnetic sheet

List of Cables Used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	RF	1.0	Shielded	Shielded	ITS-LANT30S-1
		2.0	Shielded	Shielded	ITS-LANT30S-2U
		3.0	Shielded	Shielded	ITS-LANT30S-3/ ITS-LANT30S-3U
2	DC	1.2	Unshielded	Unshielded	-
3	LAN	1.1	Shielded	Shielded	-
4	USB	0.8	Shielded	Shielded	-
5	RS485	1.2	Unshielded	Unshielded	-
6	AC	1.8	Unshielded	Unshielded	-
7	GND	1.2	Unshielded	Unshielded	-

SECTION 5: Conducted emission

Test conditions

Frequency range	0.15 MHz to 30 MHz
EUT position	Table top

Test configuration

The EUT was placed on a platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and was flushed with rear of tabletop. All other surfaces of tabletop were at least 0.8 m from any other grounded conducting surface. The EUT was located 0.8 m from Line Impedance Stabilization Network (LISN) and excess AC Cable was bundled in center. I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane.

Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the input power source.

Photographs of the set up are shown in Appendix 3.

Test procedure

The emission had been measured with the EUT in the shielded room. An overview sweep with peak detection has been performed. The measurements had been performed with a quasi-peak detector and if required, with a CISPR average detector (CAV).

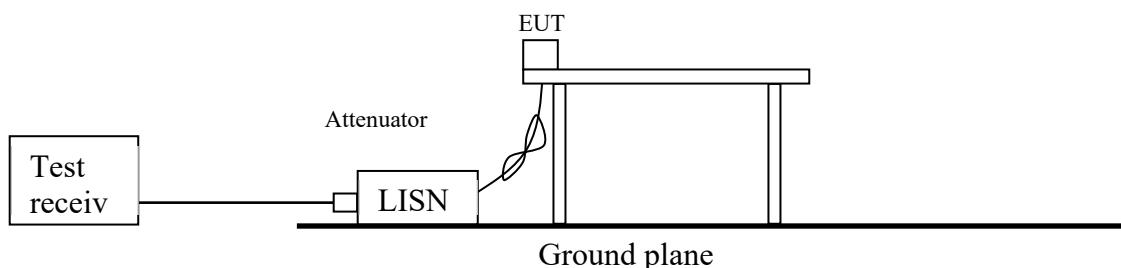
The conducted emission measurements were made with the following detector function of the test receiver.

Detector Type	QP / CAV
IF Bandwidth	9 kHz / 9 kHz

Results

Summary of the test results : Pass

Figure 1. Test Setup



SECTION 6: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

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.

Frequency: From 9 kHz to 30 MHz (Refer to Figure 2)

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.

Frequency: From 30 MHz to 1 GHz (Refer to Figure 3)

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

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

Measurements were performed with QP, PK, and AV detector.

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

	9 kHz to 90 kHz & 110 kHz to 150 kHz	90 kHz to 110 kHz	150 kHz to 490 kHz	490 kHz to 30 MHz	30 MHz to 1 GHz
Detector Type	PK/AV	QP	PK/AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	10 kHz	9 kHz	120 kHz
Distance factor *1)	-80 dB	-80 dB	-80 dB	-40 dB	-
Measuring antenna	Loop antenna				Biconical (30 MHz - 199.99 MHz) Logperiodic (200 MHz - 1 GHz)

*1) FCC 15.31 (f)(2) (9 kHz-30 MHz)

Distance Factor: $40 \times \log(3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

Distance Factor: $40 \times \log(3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore, sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

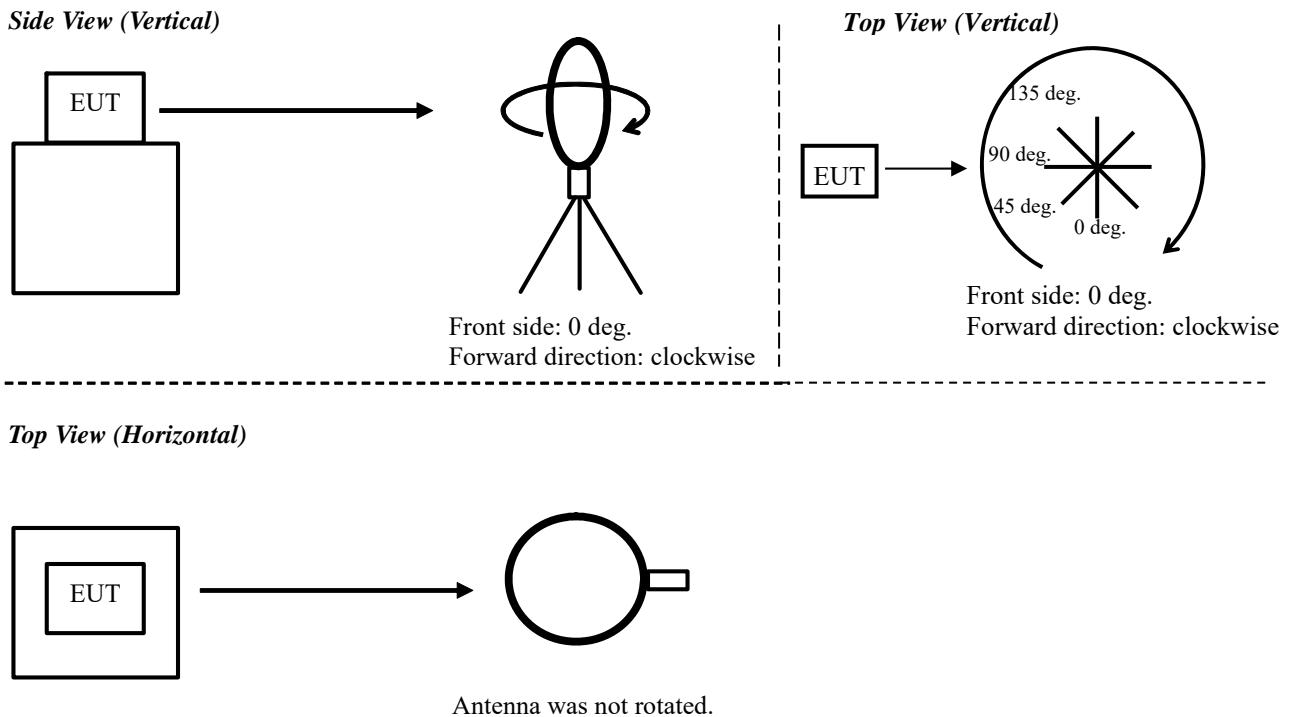
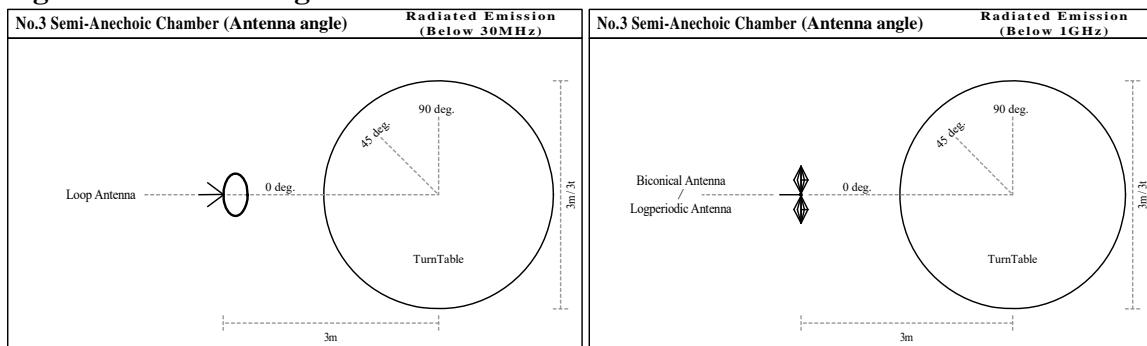
These tests were performed in semi anechoic chamber. Therefore, the measured level of emissions may be higher than if measurements were made without ground plane.

However, test results were confirmed to pass against standard limit.

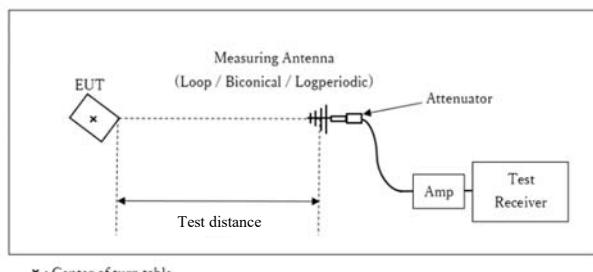
The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0 \text{ dBuA/m}$, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

The test was made on EUT at the normal use position.

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

Figure 2: Direction of the Loop Antenna**Figure 3. Antenna angle**

[Test Setup]
Below 1 GHz



Test Distance: 3 m

Measurement range**: 9 kHz - 1 GHz****Test data****: APPENDIX 1****Test result****: Pass**

SECTION 7: -26 dB Bandwidth

Test Procedure

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

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26 dB Bandwidth	15 kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1

Test result : Pass

SECTION 8: 99 % Bandwidth

Test Procedure

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

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99 % Occupied 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) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %.
Peak hold was applied as Worst-case measurement.

Test data : APPENDIX 1

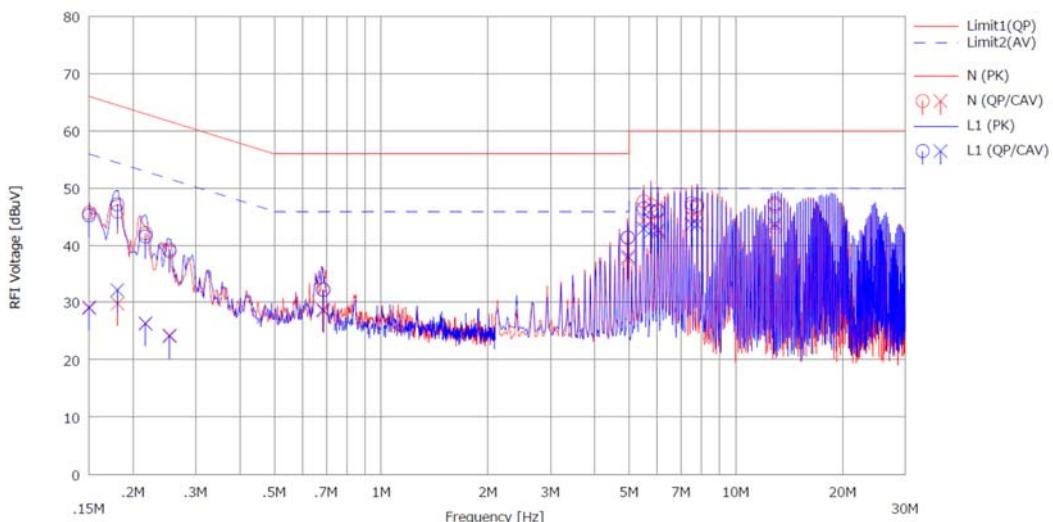
Test result : Pass

APPENDIX 1: Test Data**Conducted Emission****DATA OF CONDUCTED EMISSION TEST**UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2022/03/01

Mode : Tx 134.2 kHz
 Power : DC 24 V
 Temp./Humi. : 23 deg.C / 32 %RH
 Remarks : Antenna : ITS-LANT30S-2U, with TAG

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Shiro Kobayashi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		$\langle QP \rangle$ [dBuV]	$\langle CAV \rangle$ [dBuV]		$\langle QP \rangle$ [dBuV]	$\langle CAV \rangle$ [dBuV]	$\langle QP \rangle$ [dBuV]	$\langle AV \rangle$ [dBuV]	$\langle QP \rangle$ [dB]	$\langle AV \rangle$ [dB]		
1	0.15000	33.25	16.65	12.45	45.70	29.10	66.00	56.00	20.3	26.9	N	
2	0.18069	33.47	17.28	12.46	45.93	29.74	64.45	54.45	18.5	24.7	N	
3	0.21658	29.71	13.84	12.46	42.17	26.30	62.95	52.95	20.7	26.6	N	
4	0.25348	26.54	11.78	12.47	39.01	24.25	61.64	51.64	22.6	27.3	N	
5	0.68799	19.62	15.94	12.52	32.14	28.46	56.00	46.00	23.8	17.5	N	
6	4.95884	28.58	24.82	12.84	41.42	37.66	56.00	46.00	14.5	8.3	N	
7	5.49610	34.88	31.59	12.86	47.74	44.45	60.00	50.00	12.2	5.5	N	
8	5.76374	34.14	31.49	12.88	47.02	44.37	60.00	50.00	12.9	5.6	N	
9	6.03214	33.03	29.41	12.89	45.92	42.30	60.00	50.00	14.0	7.7	N	
10	7.50599	33.80	32.01	12.97	46.77	44.98	60.00	50.00	13.2	5.0	N	
11	7.77525	33.77	31.90	12.98	46.75	44.88	60.00	50.00	13.2	5.1	N	
12	12.86808	33.70	30.05	13.19	46.89	43.24	60.00	50.00	13.1	6.7	N	
13	0.15000	32.81	16.52	12.47	45.28	28.99	66.00	56.00	20.7	27.0	L1	
14	0.18023	34.74	19.63	12.46	47.20	32.09	64.48	54.48	17.2	22.3	L1	
15	0.21665	29.16	13.78	12.48	41.64	26.26	62.95	52.95	21.3	26.6	L1	
16	0.25285	26.85	11.59	12.47	39.32	24.06	61.66	51.66	22.3	27.6	L1	
17	0.68586	19.63	16.19	12.51	32.14	28.70	56.00	46.00	23.8	17.3	L1	
18	4.96150	28.62	25.30	12.81	41.43	38.11	56.00	46.00	14.5	7.8	L1	
19	5.49775	33.68	30.17	12.82	46.50	42.99	60.00	50.00	13.5	7.0	L1	
20	5.76576	33.18	29.73	12.84	46.02	42.57	60.00	50.00	13.9	7.4	L1	
21	6.03333	33.33	29.86	12.85	46.18	42.71	60.00	50.00	13.8	7.2	L1	
22	7.50819	34.44	30.84	12.92	47.36	43.76	60.00	50.00	12.6	6.2	L1	
23	7.77461	34.17	30.75	12.92	47.09	43.67	60.00	50.00	12.9	6.3	L1	
24	12.86820	34.24	30.68	13.06	47.30	43.74	60.00	50.00	12.7	6.2	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN):SLS-03

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.2 Shielded Room

Date : 2022/03/01

Mode : Tx 134.2 kHz

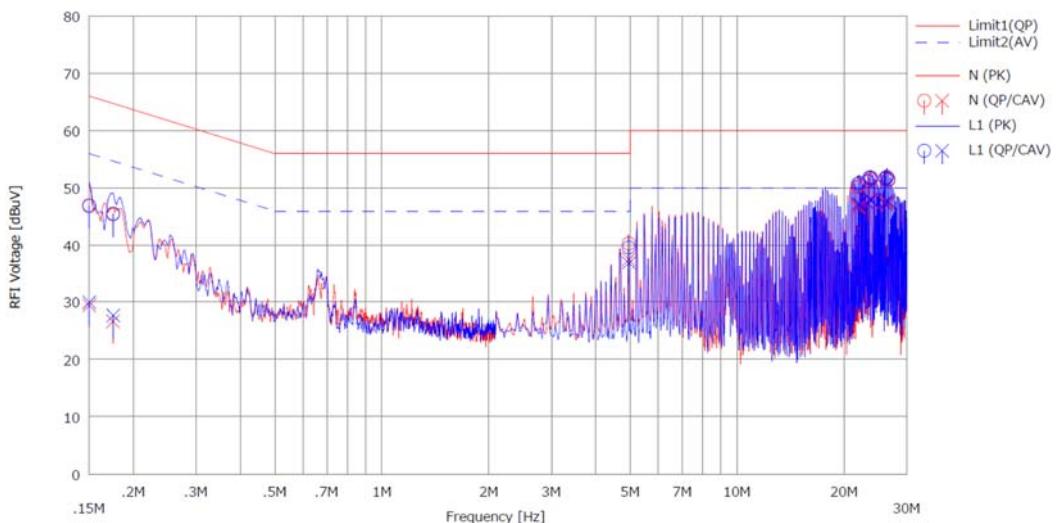
Power : DC 24 V

Temp./Humi. : 23 deg.C / 32 %RH

Remarks : Antenna : ITS-LANT30S-1, with TAG

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Shiro Kobayashi



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		(QP) [dBuV]	(CAV) [dBuV]		(QP) [dBuV]	(CAV) [dBuV]	(QP) [dBuV]	(AV) [dBuV]	(QP) [dB]	(AV) [dB]		
1	0.15000	34.42	16.89	12.45	46.87	29.34	66.00	56.00	19.1	26.6	N	
2	0.17508	32.91	14.16	12.46	45.37	26.62	64.72	54.72	19.3	28.1	N	
3	4.95416	27.45	24.69	12.84	40.29	37.53	56.00	46.00	15.7	8.4	N	
4	21.82340	36.65	33.17	13.55	50.20	46.72	60.00	50.00	9.8	3.2	N	
5	22.09277	36.83	33.15	13.55	50.38	46.70	60.00	50.00	9.6	3.3	N	
6	23.29320	37.57	33.81	13.62	51.19	47.43	60.00	50.00	8.8	2.5	N	
7	23.56520	38.05	34.39	13.62	51.67	48.01	60.00	50.00	8.3	1.9	N	
8	23.83315	37.84	34.12	13.64	51.48	47.76	60.00	50.00	8.5	2.2	N	
9	26.10807	37.92	33.86	13.76	51.68	47.62	60.00	50.00	8.3	2.3	N	
10	26.37729	37.97	33.98	13.78	51.75	47.76	60.00	50.00	8.2	2.2	N	
11	26.64673	37.52	33.41	13.79	51.31	47.20	60.00	50.00	8.6	2.8	N	
12	0.15000	34.47	17.44	12.47	46.94	29.91	66.00	56.00	19.0	26.0	L1	
13	0.17532	33.07	15.16	12.46	45.53	27.62	64.70	54.70	19.1	27.0	L1	
14	4.95465	26.82	24.08	12.81	39.63	36.89	56.00	46.00	16.3	9.1	L1	
15	21.83744	37.48	34.03	13.21	50.69	47.24	60.00	50.00	9.3	2.7	L1	
16	22.10683	37.67	33.91	13.21	50.88	47.12	60.00	50.00	9.1	2.8	L1	
17	23.30531	37.92	34.13	13.25	51.17	47.38	60.00	50.00	8.8	2.6	L1	
18	23.57603	38.62	34.79	13.25	51.87	48.04	60.00	50.00	8.1	1.9	L1	
19	23.84177	38.51	34.64	13.26	51.77	47.90	60.00	50.00	8.2	2.1	L1	
20	26.12068	38.27	33.87	13.35	51.62	47.22	60.00	50.00	8.3	2.7	L1	
21	26.38174	38.58	34.48	13.36	51.94	47.84	60.00	50.00	8.0	2.1	L1	
22	26.64952	38.17	34.18	13.37	51.54	47.55	60.00	50.00	8.4	2.4	L1	

Calculation: Result[dBuV] = Reading[dBuV] + C.Fac(LISN(AMN) + Cable + ATT)[dB]
 LISN(AMN): SLS-03

Radiated Emission (Fundamental and Spurious Emission)

Report No.	13806752S-A-R2											
Test place	Shonan EMC Lab.											
Semi Anechoic Chamber	No.3											
Date	February 24, 2022											
Temperature / Humidity	24 deg. C / 32 % RH											
Engineer	Yosuke Murakami (Below 30 MHz)											
Antenna type	without magnetic sheet antenna											
EUT and Antenna axis	Below 30 MHz (EUT X-axis, Antenna Y-axis), with Tag Above 30 MHz (EUT Y-axis, Antenna Y-axis), without Tag											
Antenna	Below 30 MHz (ITS-LANT30S-3U) Above 30 MHz (ITS-LANT30S-2U)											
Remarks	Below 30 MHz Vertical polarization (Antenna Angle) of the worst case: 0 deg.											

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac.	Loss [dB/m]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	0.1342	PK	100.46	20.06	5.89	32.00	-80.0	14.41	45.04	30.6	-	184	Fundamental
Hori.	0.6710	QP	51.60	20.06	5.94	32.19	-40.0	5.41	31.06	25.6	-	184	-
Hori.	0.9349	QP	45.40	20.07	5.96	32.19	-40.0	-0.76	28.18	28.9	-	188	-
Hori.	1.0736	QP	42.50	20.06	5.96	32.19	-40.0	-3.67	26.98	30.6	-	188	-
Hori.	321.4880	QP	43.60	14.31	8.70	31.95	0.0	34.66	46.02	11.3	100	122	-
Hori.	537.3150	QP	41.10	17.63	9.66	31.95	0.0	36.44	46.02	9.5	100	129	-
Hori.	549.9510	QP	42.60	17.91	9.72	31.96	0.0	38.27	46.02	7.7	100	121	-
Hori.	849.9240	QP	35.40	21.48	10.79	31.33	0.0	36.34	46.02	9.6	100	163	-
Hori.	949.9140	QP	34.20	22.07	11.11	30.59	0.0	36.79	46.02	9.2	164	173	-
Vert.	0.1342	PK	108.89	20.06	5.89	32.00	-80.0	22.84	45.04	22.2	-	183	Fundamental
Vert.	0.6710	QP	59.00	20.06	5.94	32.19	-40.0	12.81	31.06	18.2	-	183	-
Vert.	0.9394	QP	52.40	20.07	5.96	32.19	-40.0	6.24	28.14	21.9	-	184	-
Vert.	1.2078	QP	47.70	20.07	5.97	32.19	-40.0	1.55	25.96	24.4	-	178	-
Vert.	30.8970	QP	38.70	18.53	6.47	32.18	0.0	31.52	40.00	8.4	100	38	-
Vert.	47.2100	QP	44.10	12.26	6.77	32.17	0.0	30.96	40.00	9.0	100	74	-
Vert.	58.7230	QP	55.40	8.51	6.59	32.16	0.0	38.34	40.00	1.6	100	21	-
Vert.	61.2630	QP	56.50	7.96	6.52	32.16	0.0	38.82	40.00	1.1	100	30	-
Vert.	197.5370	QP	41.50	16.47	7.84	32.05	0.0	33.76	43.52	9.7	100	296	-
Vert.	549.9440	QP	40.80	17.91	9.72	31.96	0.0	36.47	46.02	9.5	116	171	-
Vert.	649.9420	QP	39.20	19.15	10.08	31.92	0.0	36.51	46.02	9.5	100	271	-
Vert.	799.9280	QP	38.20	20.74	10.61	31.55	0.0	38.00	46.02	8.0	141	182	-

Result = Reading + Ant.Fac. + Loss (Cable+ATT+ΔAF(above 30MHz)) - Gain(Amprifier) + Distance factor(below 30MHz)

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

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac.	Loss [dB/m]	Gain [dB]	Distance Factor [dB]	DCCF [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	0.1342	PK	100.46	20.06	5.89	32.00	-80.0	0.00	14.41	25.04	10.6	Fundamental
Vert.	0.1342	PK	108.89	20.06	5.89	32.00	-80.0	0.00	22.84	25.04	2.2	Fundamental

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator) - Gain(Amprifier) + Distance factor + DCCF

* Since the peak emission result satisfied the average limit, DCCF was omitted.

Result of the fundamental emission at 3 m without Distance factor

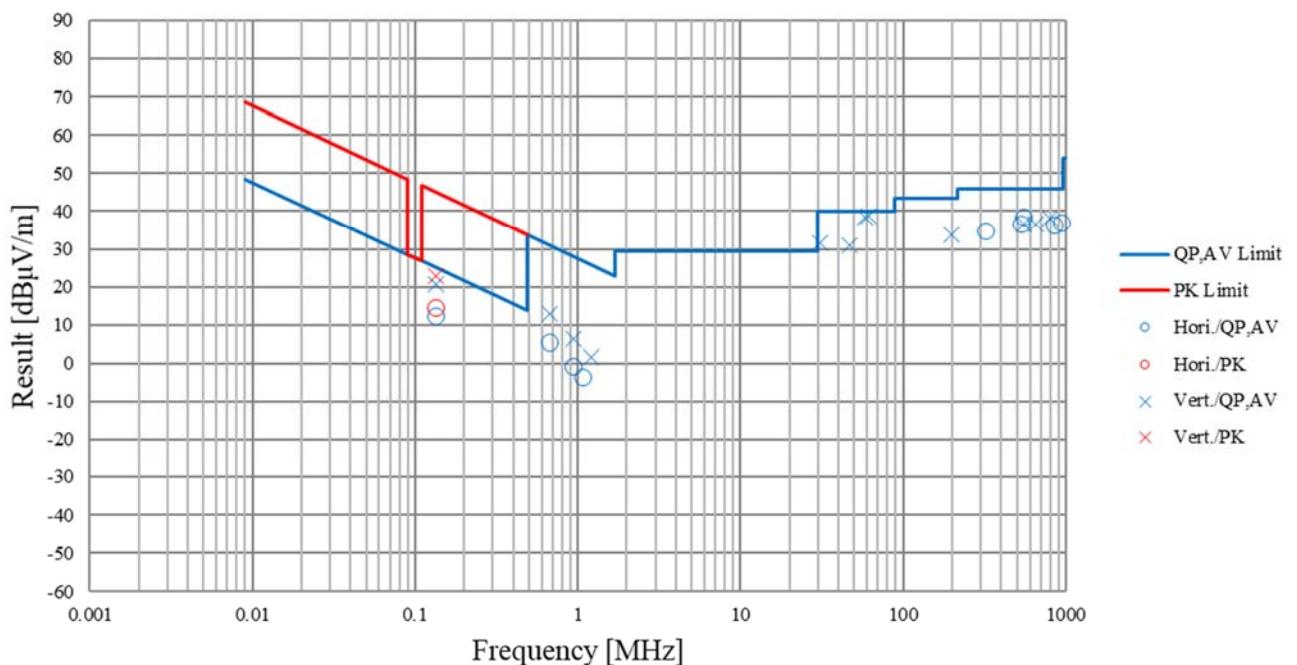
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac.	Loss [dB/m]	Gain [dB]	Distance Factor [dB]	-	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	0.1342	PK	100.46	20.06	5.89	32.00	0.0	-	94.41	-	-	Fundamental
Vert.	0.1342	PK	108.89	20.06	5.89	32.00	0.0	-	102.84	-	-	Fundamental

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator) - Gain(Amprifier)

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

Radiated Spurious Emission (Plot data)

Report No. 13806752S-A-R2
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.3
Date February 24, 2022 February 25, 2022
Temperature / Humidity 24 deg. C / 32 % RH 24 deg. C / 33 % RH
Engineer Yosuke Murakami Yosuke Murakami
(Below 30 MHz) (Above 30 MHz)
Antenna type without magnetic sheet antenna
EUT and Antenna axis Below 30 MHz (EUT X-axis, Antenna Y-axis), with Tag
Above 30 MHz (EUT Y-axis, Antenna Y-axis), without Tag
Antenna Below 30 MHz (ITS-LANT30S-3U)
Above 30 MHz (ITS-LANT30S-2U)
Remarks Below 30 MHz Vertical polarization (Antenna Angle) of the worst case: 0 deg.



Radiated Emission (Fundamental and Spurious Emission)

Report No.	13806752S-A-R2											
Test place	Shonan EMC Lab.											
Semi Anechoic Chamber	No.3											
Date	February 21, 2022											
Temperature / Humidity	21 deg. C / 30 % RH											
Engineer	Yosuke Murakami (Below 30 MHz) Yosuke Murakami (Above 30 MHz)											
Antenna type	with Magnetic sheet antenna											
EUT and Antenna axis	Below 30 MHz (EUT X-axis, Antenna Y-axis), with Tag Above 30 MHz (EUT Y-axis, Antenna Y-axis), without Tag											
Antenna	Below 30 MHz (ITS-LANT30S-3) Above 30 MHz (ITS-LANT30S-1)											
Remarks	Below 30 MHz Vertical polarization (Antenna Angle) of the worst case: 0 deg.											

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	0.1342	PK	100.95	20.06	5.89	32.00	-80.00	14.90	45.04	30.1	-	188	Fundamental
Hori.	0.6710	QP	60.90	20.06	5.94	32.19	-40.00	14.71	31.06	16.3	-	188	-
Hori.	0.9394	QP	53.20	20.07	5.96	32.19	-40.00	7.04	28.14	21.1	-	186	-
Hori.	1.2078	QP	45.90	20.07	5.97	32.19	-40.00	-0.25	25.96	26.2	-	180	-
Hori.	243.6340	QP	53.10	12.06	8.26	31.99	0.00	41.43	46.02	4.5	124	77	-
Hori.	312.9100	QP	48.90	13.99	8.65	31.96	0.00	39.58	46.02	6.4	106	68	-
Hori.	537.2980	QP	40.20	17.63	9.66	31.95	0.00	35.54	46.02	10.4	100	149	-
Hori.	549.9510	QP	42.00	17.91	9.72	31.96	0.00	37.67	46.02	8.3	100	141	-
Hori.	649.9420	QP	39.50	19.15	10.08	31.92	0.00	36.81	46.02	9.2	116	329	-
Hori.	849.9240	QP	37.00	21.48	10.79	31.33	0.00	37.94	46.02	8.0	100	93	-
Hori.	949.9150	QP	34.90	22.07	11.11	30.59	0.00	37.49	46.02	8.5	166	66	-
Vert.	0.1342	PK	109.71	20.06	5.89	32.00	-80.00	23.66	45.04	21.3	-	186	Fundamental
Vert.	0.6710	QP	68.70	20.06	5.94	32.19	-40.00	22.51	31.06	8.5	-	188	-
Vert.	0.9394	QP	61.20	20.07	5.96	32.19	-40.00	15.04	28.14	13.1	-	188	-
Vert.	1.2078	QP	54.20	20.07	5.97	32.19	-40.00	8.05	25.96	17.9	-	191	-
Vert.	31.1790	QP	45.00	18.45	6.47	32.18	0.00	37.74	40.00	2.2	100	52	-
Vert.	32.8200	QP	44.00	17.82	6.50	32.18	0.00	36.14	40.00	3.8	100	41	-
Vert.	61.3130	QP	51.50	7.95	6.52	32.16	0.00	33.81	40.00	6.1	100	339	-
Vert.	103.8390	QP	47.40	10.91	7.30	32.13	0.00	33.48	43.52	10.0	100	129	-
Vert.	312.7090	QP	44.60	13.98	8.65	31.96	0.00	35.27	46.02	10.7	147	129	-
Vert.	549.9510	QP	40.70	17.91	9.72	31.96	0.00	36.37	46.02	9.6	100	19	-
Vert.	649.9410	QP	41.10	19.15	10.08	31.92	0.00	38.41	46.02	7.6	100	246	-
Vert.	749.9330	QP	38.20	20.16	10.45	31.75	0.00	37.06	46.02	8.9	100	338	-

Result = Reading + Ant.Fac. + Loss (Cable+ATT+ΔAF(above 30 MHz)) - Gain(Amprifier) + Distance factor(below 30 MHz)

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

Peak measurement value with Duty cycle correction factor (DCCF)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	DCCF [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	0.1342	PK	100.95	20.06	5.89	32.00	-80.0	0.00	14.90	25.04	10.1	Fundamental
Vert.	0.1342	PK	109.71	20.06	5.89	32.00	-80.0	0.00	23.66	25.04	1.3	Fundamental

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator) - Gain(Amprifier) + Distance factor + DCCF

* Since the peak emission result satisfied the average limit, DCCF was omitted.

Result of the fundamental emission at 3 m without Distance factor

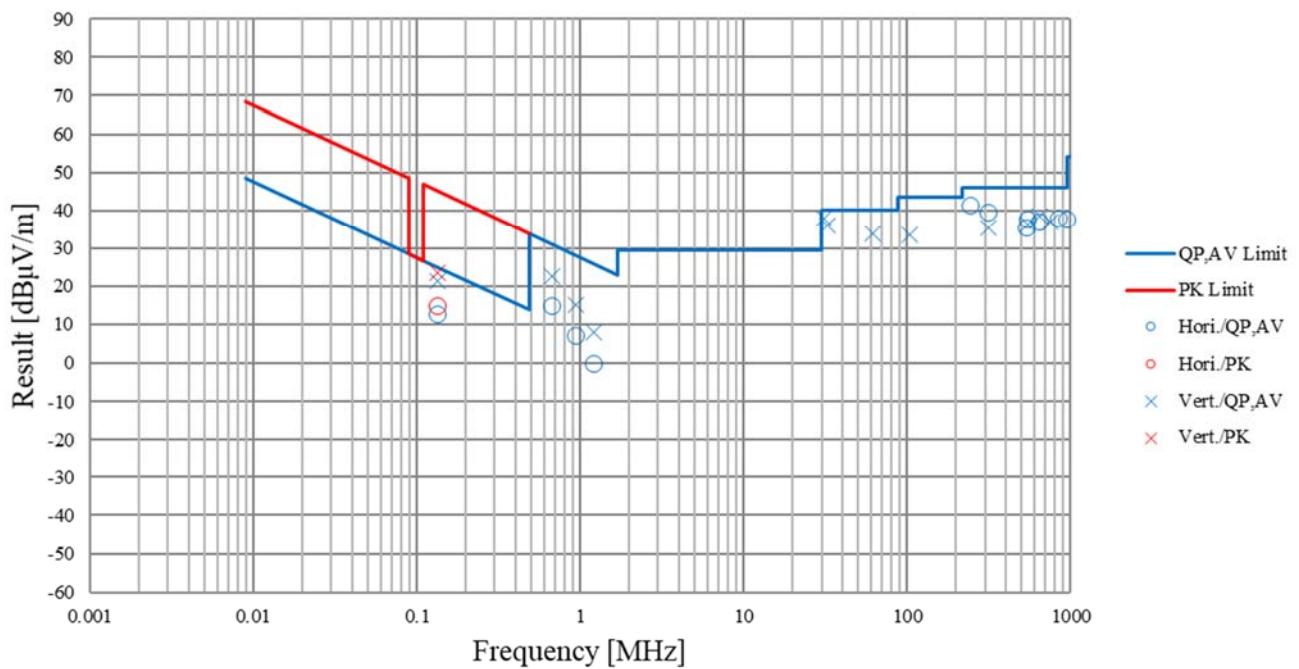
Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	-	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	0.1342	PK	100.95	20.06	5.89	32.00	0.0	-	94.90	-	-	Fundamental
Vert.	0.1342	PK	109.71	20.06	5.89	32.00	0.0	-	103.66	-	-	Fundamental

Result = Reading + Ant.Fac. + Loss (Cable+Attenuator) - Gain(Amprifier)

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

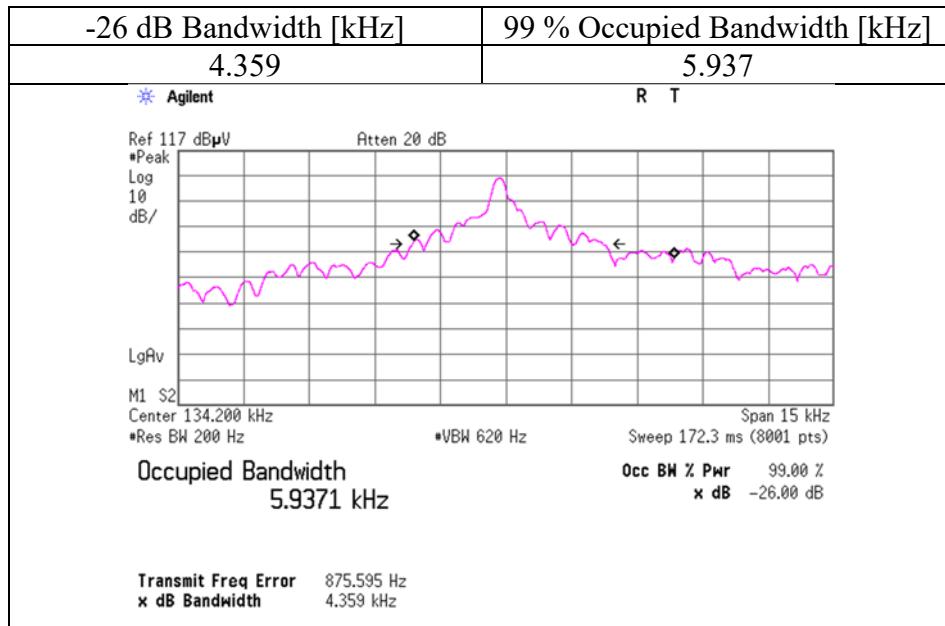
Radiated Spurious Emission (Plot data)

Report No.	13806752S-A-R2	
Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	No.3
Date	February 21, 2022	February 25, 2022
Temperature / Humidity	21 deg. C / 30 % RH	24 deg. C / 33 % RH
Engineer	Yosuke Murakami (Below 30 MHz)	Yosuke Murakami (Above 30 MHz)
Antenna type	with Magnetic sheet antenna	
EUT and Antenna axis	Below 30 MHz (EUT X-axis, Antenna Y-axis), with Tag Above 30 MHz (EUT Y-axis, Antenna Y-axis), without Tag	
Antenna	Below 30 MHz (ITS-LANT30S-3) Above 30 MHz (ITS-LANT30S-1)	
Remarks	Below 30 MHz Vertical polarization (Antenna Angle) of the worst case: 0 deg.	



-26 dB Bandwidth / 99 % Occupied Bandwidth

Report No. 13806752S-A-R2
 Test place Shonan EMC Lab. No.2 Shielded room
 Date March 4, 2022
 Temperature / Humidity 22 deg. C / 23 % RH
 Engineer Yosuke Murakami



*Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth.

APPENDIX 2: Test Instruments

Test Equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	KAT3-12	144896	Attenuator	JFW IND. INC.	50HF-003N	-	2021/07/12	12
CE	SCC-B12/B13/SRSE-02	144969	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/N S4906	-/0901-270(RF Selector)	2021/04/12	12
CE	SJM-20	207277	Measuring	ASKUL	-	-	-	-
CE	SLS-03	145540	LISN	Rohde & Schwarz	ENV216	100513	2022/02/23	12
CE	STR-07	146209	Test Receiver	Rohde & Schwarz	ESU26	100484	2021/09/17	12
CE	SOS-22	191839	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/10/14	12
CE	STS-02	145793	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997819	2021/04/28	12
CE,RE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
DCCF,BW	SSA-02	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2021/04/13	12
DCCF,BW	SSCA-01	146178	Search coil	Langer	RF-R 400-1	02-0634	-	-
DCCF,BW	SOS-24	191841	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/10/14	12
RE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE	SAEC-03(NSA)	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2021/04/27	12
RE	SAEC-ALL	145568	Semi-Anechoic Chamber(ME)	TDK	Semi-Anechoic Chamber 3m/10m	1, 2, 3	2021/12/25	12
RE	SAF-03	145126	Pre Amplifier	SONOMA	310N	290213	2022/02/24	12
RE	SAT6-13	167094	Attenuator	JFW	50HF-006N	-	2022/02/21	12
RE	SAT6-15	167096	Attenuator	JFW	50HF-006N	-	2022/02/21	12
RE	SBA-03	145023	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032666	2021/05/15	12
RE	SCC-C1/C2/C3/C4/C5/C10/SRS E-03	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2021/04/12	12
RE	SCC-M1	194601	Coaxial Cable	Fjikura	5D-2W	-	2021/12/10	12
RE	SLA-07	145529	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	196	2021/05/15	12
RE	SLP-02	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2021/04/06	12
RE	SOS-23	191840	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
RE	STR-09	213530	Test Receiver	Rohde & Schwarz	ESW44	103068	2022/01/17	12
RE,DCCF,BW	STS-03	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2021/09/14	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: CE: Conducted Emission

RE: Radiated Emission

DCCF: Duty Cycle Correction Factor

BW: -26 dB Bandwidth / 99 % Occupied Bandwidth