




RADIO TEST REPORT

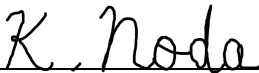
Test Report No. : 13981495S-A-R1

Applicant : TOPPAN FORMS CO., LTD
Type of EUT : Contactless IC Card Reader/Writer
Model Number of EUT : TR63303(E)
Test regulation : FCC Part 15 Subpart C: 2021
FCC ID : ORKTR63303-E
Test Result : Complied (Refer to SECTION 3)

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
9. The information provided from the customer for this report is identified in Section 1.
10. This report is a revised version of 13981495S-A. 13981495S-A is replaced with this report.

Date of test: November 29 to December 10, 2021

Representative test engineer: 
Hiromasa Sato
Engineer

Approved by: 
Kazuya Noda
Leader



CERTIFICATE 5107.02

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

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

REVISION HISTORY

Original Test Report No.: 13981495S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13981495S-A	February 1, 2022	-	-
1	13981495S-A-R1	February 28, 2022	P.5	Clock frequency in the system of Section 2.2 From: 8 MHz (Maximum) To: 27.12 MHz (Maximum)
			P.6	Test Specification of Section 3.1, delete “* Also the EUT complied with FCC Part 15 Subpart B”.
			P.8	Test Item of Section 3.3 From: 99 % Occupied Band Width To: 99 % Occupied bandwidth
			P.11	Test voltage of Section 4.2 From: * As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 120 V of the worst voltage as representative. To: * As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 240 V of the worst voltage as representative.

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

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS	PAGE
SECTION 1: Customer information.....	5
SECTION 2: Equipment under test (EUT).....	5
SECTION 3: Test specification, procedures & results.....	6
SECTION 4: Operation of EUT during testing.....	10
SECTION 5: Conducted Emission.....	13
SECTION 6: Radiated emission (Fundamental, Spurious Emission and Spectrum Mask).....	14
SECTION 7: Other test.....	17
APPENDIX 1: Test data	18
Conducted Emission.....	18
Data of Electric field strength of Fundamental emission and Spurious emission within the band	20
Radiated Spurious emission	21
20 dB Bandwidth and 99 % Occupied Bandwidth.....	23
Frequency Tolerance	27
APPENDIX 2: Test instruments	28
APPENDIX 3: Photographs of test setup	30
Conducted Emission.....	30
Radiated Emission	31
Pre-check of Worst Case Position	32
Frequency Tolerance	33
Tag appearance.....	34

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 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.225 Operation within the band 13.110-14.010 MHz.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	ANSI C63.10:2013 6 Standard test methods	Section 15.207	19.4 dB, 0.150 MHz, QP, N, with Tag(14443B)	Complied a)	-
	<ISED>RSS-Gen 8.8	<ISED>RSS-Gen 8.8			
Electric Field Strength of Fundamental Emission	ANSI C63.10:2013 6 Standard test methods	Section 15.225(a)	48.1 dB, 13.560 MHz, QP,Vertical, 0 deg. with Tag(14443A)	Complied b)	Radiated
	<ISED> RSS-Gen 6.4, 6.12	<ISED>RSS-210 B.6			
Spectrum Mask	ANSI C63.10:2013 6 Standard test methods	Section 15.225(b)(c)	27.1 dB, 14.196 MHz, QP,Vertical, 0 deg. with Tag(14443A).	Complied b)	Radiated
	<ISED>RSS-Gen 6.4, 6.13	<ISED> RSS-210 B.6			
20 dB Bandwidth	ANSI C63.10:2013 6 Standard test methods	Section15.215(c)	See data	Complied c)	Radiated
	<ISED> -	<ISED> -			
Electric Field Strength of Spurious Emission	ANSI C63.10:2013 6 Standard test methods	Section 15.209, Section 15.225 (d)	1.3 dB 40.681 MHz, Vertical, QP, with Tag(14443A).	Complied# d)	Radiated
	<ISED>RSS-Gen 6.4, 6.13	<ISED>RSS-210 B.6			
Frequency Tolerance	ANSI C63.10:2013 6 Standard test methods	Section 15.225(e)	See data	Complied e)	Radiated
	<ISED>RSS-Gen 6.11, 8.11	<ISED> RSS-210 B.6			

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422

a) Refer to APPENDIX 1 (data of Conducted Emission)
b) Refer to APPENDIX 1 (data of Electric Field Strength of Fundamental Emission)
c) Refer to APPENDIX 1 (data of 20 dB Bandwidth and 99 % Occupied Bandwidth)
d) Refer to APPENDIX 1 (data of Electric Field Strength of Spurious Emission)
e) Refer to APPENDIX 1 (data of Frequency Tolerance)

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)

The RF Module has its own regulator.

The RF Module is constantly provided voltage through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

However, the supply voltage was varied and tested at 85 % and 105 % of the nominal rated supply voltage during frequency tolerance test according to Section 15.225(e), since EUT cannot operated by at 115 % of the nominal rated voltage (the EUT will be damaged if a voltage of 115 % rated voltage is supplied).

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because it is printed pattern circuit on the circuit board. Therefore the equipment complies with the requirement of 15.203.

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

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % Occupied bandwidth	<ISED>RSS-Gen 6.7	-	N/A	Complied c)	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

c) Refer to APPENDIX 1 (data of 20 dB Bandwidth and 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 following 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	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Other test	Uncertainty (+/-)
Bandwidth Measurement	0.012 %
Temperature_SCH-01	0.93 deg.C.
Humidity_SCH-01	4.1 %
Temperature_SCH-02	2.0 deg.C.
Humidity_SCH-02	6.6 %
Voltage	0.97 %
Frequency Measurement (Spectrum Analyzer)	1.2×10^{-8}
Frequency Measurement (Frequency Counter)	8.3×10^{-8}

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)

The EUT exercise program used during testing was designed to exercise the various system components in a manner similar to typical use.

The mode is used :

Mode	Operating mode	Tested frequency
All items, with tag	NFC Communication	13.56 MHz
All items, without tag	NFC Transmitting	13.56 MHz
<p>The EUT was operated in a manner similar to typical use during the tests.</p> <p>* EUT was set by the software as follows; Software : Polling Tool Ver.0.9.9.0 (Date: 2021.9.17, Storage location: Driven by Driven by connected PC) Power setting : Fixed</p> <p>*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.</p>		

* After the comparison of the test data between with Tag and without Tag, the tests were performed with the worst case.
This setting under 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.

The carrier level and noise levels were confirmed with and without Tag, and the test was mode with the condition that has the maximum noise.

Combinations of the worst case:

Conducted emission	Radiated emission (carrier)	Radiated emission (below 30 MHz)	Radiated emission (above 30 MHz)
with tag (14443B)	with tag (14443A)	with tag (14443A)	with tag (14443A)

Justification: The system was configured in typical fashion (as a user would normally use it) for testing.

Frequency Tolerance:

Temperature : -20 deg. C to +60 deg. C
Voltage : Normal Voltage DC 5 V
Maximum Voltage DC 5.25 V (DC 5 V +5 %)
(the EUT will be damaged if a voltage of 115 % rated voltage is supplied)
Minimum Voltage DC 4.25 V (DC 5 V -15 %)
*This EUT provides stable voltage constantly to RF Part regardless of input voltage

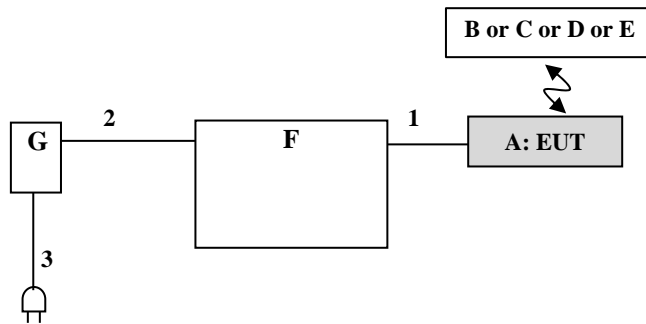
UL Japan, Inc.

Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN
Telephone : +81 463 50 6400
Facsimile : +81 463 50 6401

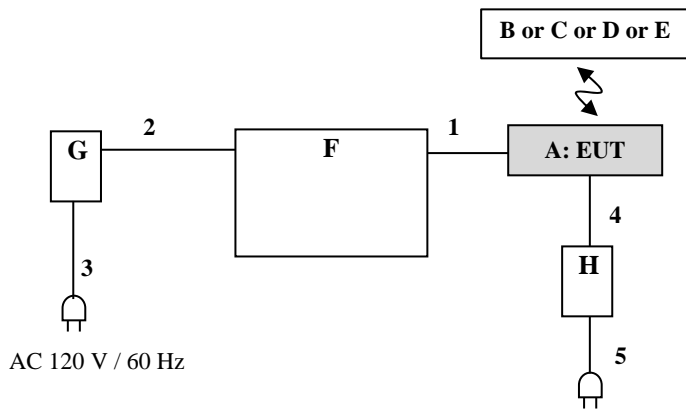
4.2 Configuration and peripherals

[Radiated Emission test and Conducted Emission test]



AC 120 V / 60 Hz or AC 240 V / 60 Hz

[Other test]



AC 120 V / 60 Hz

AC 120 V / 60 Hz

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

* As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 240 V of the worst voltage as representative.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Contactless IC Card Reader/Writer	TR63303(E)	CS03 CS29 *1) CS05 *2)	TOPPAN FORMS	EUT
B	IC Card	Smart Lack	10151	TOPPAN FORMS	14443A
C	IC Card	CEPAS	10010	TOPPAN FORMS	14443B
D	IC Card	FeliCa Lite-S	10141	TOPPAN FORMS	FeliCa
E	IC Card	Tag-it HF-I Pro SQ	10224	TOPPAN FORMS	15693
F	Laptop Computer	ThinkPad L580	PF-1PMM0X	LENOVO	-
G	AC Adapter	ADLX45YLC2A	8SSA10E75842L1C Z9480J61	LENOVO	-
H	Power Supply(DC)	PAN35-10A	NA000955	KIKUSUI	-

*1) Used for Conducted emissions test (Antenna terminated).

*2) Used for Other test.

List of cables used

No.	Cable name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB	0.8 + 2.0	Shielded	Shielded	-
2	DC	1.8	Unshielded	Unshielded	-
3	AC	0.9	Unshielded	Unshielded	-
4	DC	1.9	Unshielded	Unshielded	-
5	AC	1.8	Unshielded	Unshielded	-

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

SECTION 5: Conducted Emission

Test Procedure and conditions

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 rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

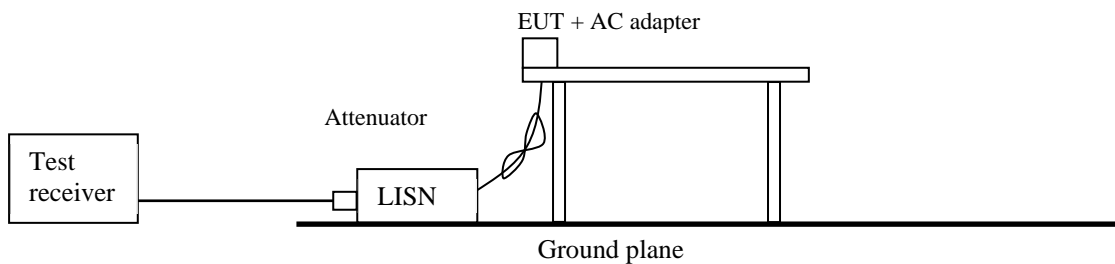
I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. All unused 50 ohm connectors of the LISN (AMN) were resistivity terminated in 50 ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT via AC adapter of PC in a Shielded room.

The EUT via AC adapter of PC was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

[Test Setup]



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

Detector : QP and CISPR AV
Measurement range : 0.15 MHz - 30 MHz
Test data : APPENDIX
Test result : Pass

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

SECTION 6: Radiated emission (Fundamental, Spurious Emission and Spectrum Mask)

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m or 0.5 m by 0.5 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

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

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.

Test Antennas are used as below;

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

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
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)	3 m *2)	3 m

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

*2) 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 a 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.

UL Japan, Inc.

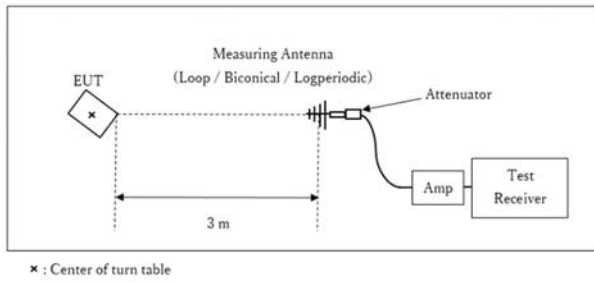
Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

[Test Setup]
 Below 1 GHz

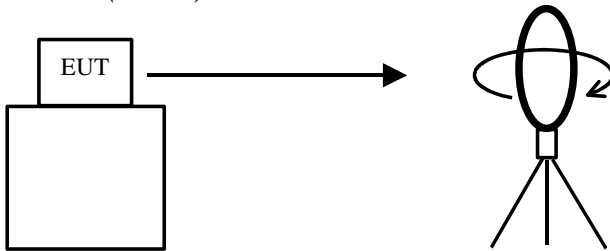


Test Distance: 3 m

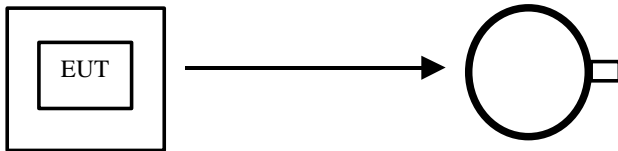
* : Center of turn table

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

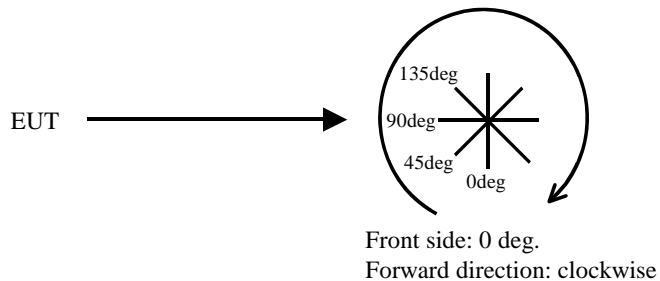


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



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.

Combinations of the worst case

	Frequency	Below 30 MHz	Above 30 MHz
	Antenna polarization		
Module	Horizontal	X	X
	Vertical	Y	Y

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

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

SECTION 7: Other test

Test Procedure

The test was measured with a spectrum analyzer (with marker frequency counter function) using a test fixture.

The temperature test was started after the temperature stabilization time of 30 minutes.

At the request of our customers, the test was begun from 60 deg.C and the temperature was lowered each 10 deg.C.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	100 kHz	1 kHz	3 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
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
Frequency Tolerance	-	-	-	-	-	-	Spectrum Analyzer *2)

*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

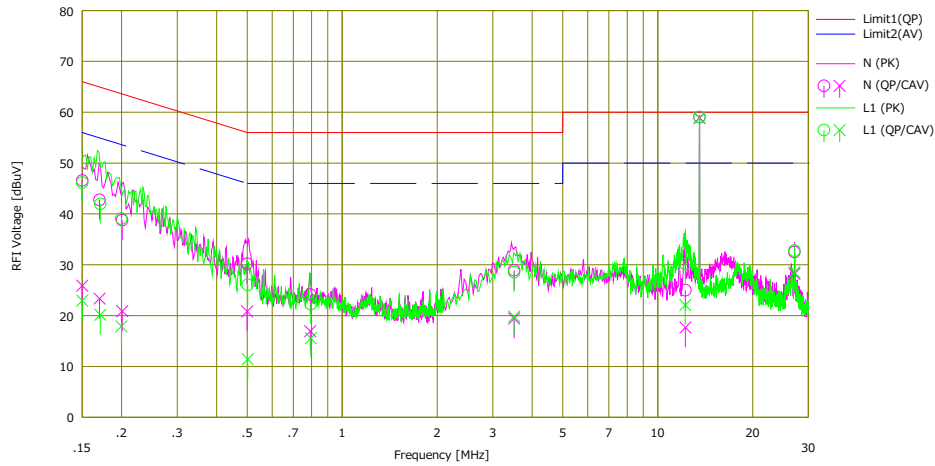
UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2021/12/04

Mode : NFC Communication
 Power : AC 240 V / 60 Hz (DC 5 V)
 Temp./Humi. : 25 deg.C / 31 %RH

Remarks : With tag 14443B

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yusuke Tanikawara



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<CAV> [dBuV]		<QP> [dBuV]	<CAV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	34.10	13.40	12.47	46.57	25.87	66.00	56.00	19.4	30.1	N	
2	0.17020	30.30	10.90	12.45	42.75	23.35	64.95	54.95	22.2	31.6	N	
3	0.20084	26.30	8.40	12.47	38.77	20.87	63.58	53.58	24.8	32.7	N	
4	0.49966	17.70	8.30	12.51	30.21	20.81	56.01	46.01	25.8	25.2	N	
5	0.79182	11.60	4.40	12.54	24.14	16.94	56.00	46.00	31.8	29.0	N	
6	3.50872	16.20	6.70	12.72	28.92	19.42	56.00	46.00	27.0	26.5	N	
7	12.23824	11.80	4.50	13.18	24.98	17.68	60.00	50.00	35.0	32.3	N	
8	13.56000	45.80	45.70	13.24	59.04	58.94	60.00	50.00	0.9	-9.0	N	Reference data
9	27.12000	18.70	14.40	13.79	32.49	28.19	60.00	50.00	27.5	21.8	N	
10	0.15000	33.70	10.50	12.46	46.16	22.96	66.00	56.00	19.8	33.0	L1	
11	0.17117	29.50	7.70	12.47	41.97	20.17	64.90	54.90	22.9	34.7	L1	
12	0.19971	26.60	5.40	12.48	39.08	17.88	63.62	53.62	24.5	35.7	L1	
13	0.50208	13.50	-1.10	12.53	26.03	11.43	56.00	46.00	29.9	34.5	L1	
14	0.79563	9.70	3.00	12.55	22.25	15.55	56.00	46.00	33.7	30.4	L1	
15	3.50680	15.80	7.10	12.73	28.53	19.83	56.00	46.00	27.4	26.1	L1	
16	12.21764	16.90	8.80	13.27	30.17	22.07	60.00	50.00	29.8	27.9	L1	
17	13.56000	45.70	45.50	13.33	59.03	58.83	60.00	50.00	0.9	-8.9	L1	Reference data
18	27.12000	18.70	14.50	14.06	32.76	28.56	60.00	50.00	27.2	21.4	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN))+Cable[dB]
 LISN(AMN):SLS-02

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

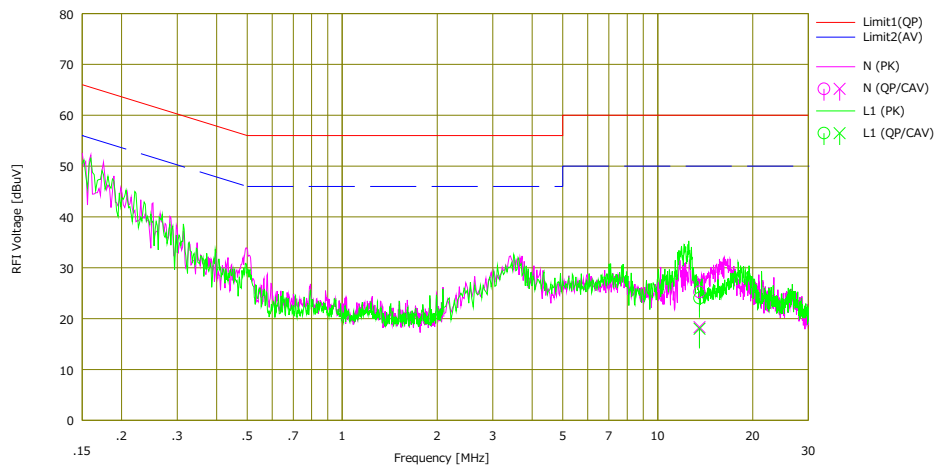
UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
 Date : 2021/12/04

Mode : NFC Communication
 Power : AC 240 V / 60 Hz (DC 5 V)
 Temp./Humi. : 25 deg.C / 31 %RH

Remarks : Without tag, Antenna Terminated

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Yusuke Tanikawara



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	13.56000	12.00	5.10	13.24	25.24	18.34	60.00	50.00	34.7	31.6	N	
2	13.56000	10.70	4.70	13.33	24.03	18.03	60.00	50.00	35.9	31.9	L1	

Calculation: Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable)[dB]
 LISN(AMN):SLS-02

Data of Electric field strength of Fundamental emission and Spurious emission within the band

Report No. 13981495S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.1
Date December 5, 2021
Temperature / Humidity 20 deg. C / 30 % RH
Engineer Yasumasa Owaki
Mode NFC Communication
with Tag 14443A,
Vertical polarization (antenna angle) of the worst case: 0 deg.

Fundamental emission

No.	FREQ [MHz]	Test Receiver Reading		Antenna Factor [dB/m]	Loss [dB]	AMP GAIN [dB]	Distance factor [dB]	RESULT		LIMIT (30m) [dBuV/m]	MARGIN	
		Hor [dBuV]	Ver [dBuV]					Hor [dBuV/m]	Ver [dBuV/m]		Hor [dB]	Ver [dB]
1	13.560	68.0	80.5	20.6	6.6	31.8	-40.0	23.3	35.8	83.9	60.6	48.1

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]+Distance factor[dB]

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

Limits (30 m)

• 13.553 MHz to 13.567 MHz : 83.9 dBuV/m (FCC 15.225(a))

Spurious emission within the band

No.	FREQ [MHz]	Test Receiver Reading		Antenna Factor [dB/m]	Loss [dB]	AMP GAIN [dB]	Distance factor [dB]	RESULT		LIMIT (30m) [dBuV/m]	MARGIN	
		Hor [dBuV]	Ver [dBuV]					Hor [dBuV/m]	Ver [dBuV/m]		Hor [dB]	Ver [dB]
1	13.036	29.4	31.3	20.5	6.6	31.8	-40.0	-15.4	-13.5	29.5	44.9	43.0
2	13.110	29.4	29.6	20.5	6.6	31.8	-40.0	-15.3	-15.1	29.5	44.8	44.6
3	13.137	30.8	39.5	20.5	6.6	31.8	-40.0	-13.9	-5.2	40.5	54.4	45.7
4	13.348	36.6	47.8	20.6	6.6	31.8	-40.0	-8.1	3.1	40.5	48.6	37.4
5	13.410	31.4	41.0	20.6	6.6	31.8	-40.0	-13.3	-3.7	40.5	53.8	44.2
6	13.468	37.2	49.4	20.6	6.6	31.8	-40.0	-7.5	4.7	50.4	57.9	45.7
7	13.553	53.8	66.2	20.6	6.6	31.8	-40.0	9.1	21.5	50.4	41.3	28.9
8	13.567	53.2	65.7	20.6	6.6	31.8	-40.0	8.5	21.02	50.4	41.9	29.4
9	13.651	39.0	52.5	20.6	6.6	31.8	-40.0	-5.7	7.8	50.4	56.1	42.6
10	13.710	34.1	45.3	20.6	6.6	31.8	-40.0	-10.6	0.6	40.5	51.1	39.9
11	13.772	41.9	53.8	20.6	6.6	31.8	-40.0	-2.8	9.1	40.5	43.3	31.4
12	13.984	40.7	52.7	20.6	6.6	31.8	-40.0	-3.9	8.1	40.5	44.4	32.4
13	14.010	29.5	34.4	20.6	6.6	31.8	-40.0	-15.1	-10.2	29.5	44.6	39.7
14	14.086	33.1	43.7	20.6	6.6	31.8	-40.0	-11.6	-1.0	29.5	41.1	30.5
15	14.196	35.8	47.1	20.6	6.6	31.8	-40.0	-8.9	2.4	29.5	38.4	27.1

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]+Distance factor[dB]

Outside filed strength frequencies

- $F_c \pm 7 \text{ kHz}$: 13.553 MHz to 13.567 MHz
- $F_c \pm 150 \text{ kHz}$: 13.410 MHz to 13.710 MHz
- $F_c \pm 450 \text{ kHz}$: 13.110 MHz to 14.010 MHz

$F_c = 13.56 \text{ MHz}$

Limits (30 m)

- 13.410 MHz to 13.553 MHz and 13.567 MHz to 13.710 MHz: 50.4 dBuV/m (FCC 15.225(b))
- 13.110 MHz to 13.410 MHz and 13.710 MHz to 14.010 MHz: 40.5 dBuV/m (FCC 15.225(c))
- Below 13.110 MHz and Above 14.010 MHz: 29.5 dBuV/m (FCC 15.225(d)and FCC 15.209)

Radiated Spurious emission

Report No. 13981495S-A-R1
Test place Shonan EMC Lab.
Semi Anechoic Chamber No.1 No.1
Date November 29, 2021 December 5, 2021
Temperature / Humidity 23 deg. C / 31 % RH 20 deg. C / 30 % RH
Engineer Shunsaku Yumi Yasumasa Owaki
Mode NFC Communication
[Below 30 MHz]: with Tag 14443A,
Vertical polarization (antenna angle) of the worst case: 90 deg.
[Above 30 MHz]: with Tag 14443A

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.	27.12	QP	30.7	21.6	6.9	31.8	-40.0	-12.6	29.5	42.1	-	201	* Limit: 30 m
Hori.	40.681	QP	38.5	14.6	7.3	31.8	0.0	28.6	40.0	11.4	195	322	
Hori.	324.201	QP	48.9	14.4	6.7	31.8	0.0	38.2	46.0	7.8	100	51	
Hori.	336.136	QP	48.6	14.8	6.8	31.8	0.0	38.4	46.0	7.6	100	43	
Vert.	27.12	QP	28.1	21.6	6.9	31.8	-40.0	-15.2	29.5	44.7	-	21	* Limit: 30 m
Vert.	40.681	QP	48.6	14.6	7.3	31.8	0.0	38.7	40.0	1.3	100	39	
Vert.	59.996	QP	42.7	8.2	7.3	31.8	0.0	26.4	40.0	13.7	100	226	
Vert.	63.328	QP	47.9	7.5	7.2	31.8	0.0	30.9	40.0	9.1	100	247	
Vert.	67.799	QP	55.4	6.8	7.4	31.8	0.0	37.8	40.0	2.2	100	49	
Vert.	69.067	QP	43.9	6.6	7.5	31.8	0.0	26.2	40.0	13.8	100	274	
Vert.	189.84	QP	41.1	16.5	9.0	31.8	0.0	34.8	43.5	8.7	100	55	
Vert.	359.98	QP	45.5	15.1	7.0	31.8	0.0	35.8	46.0	10.2	132	128	

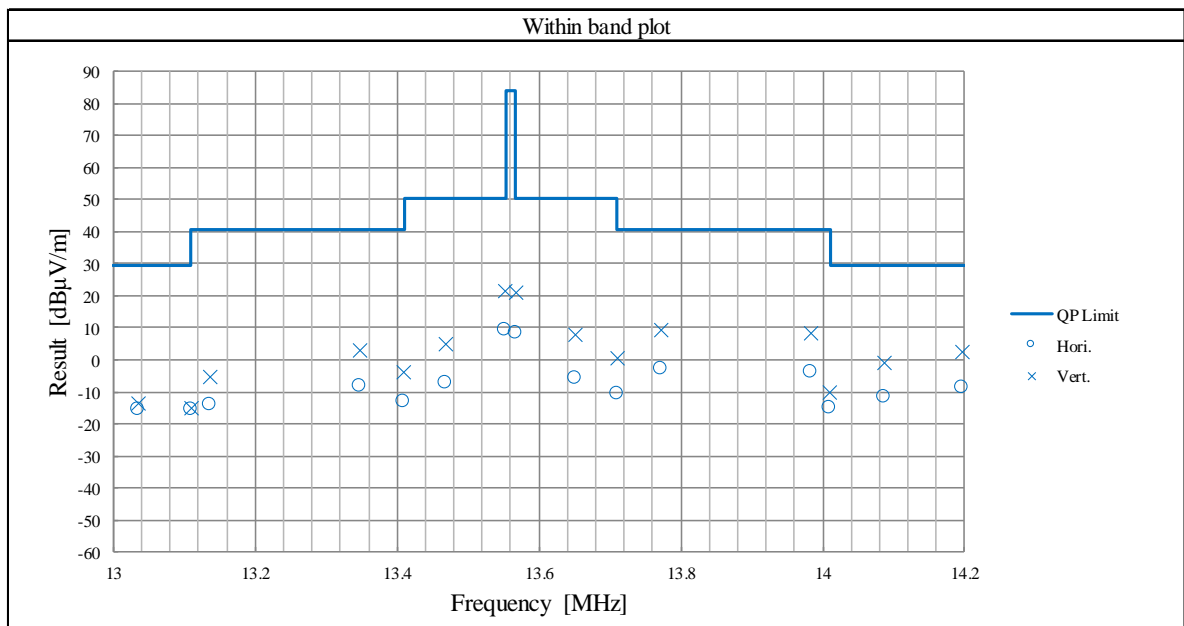
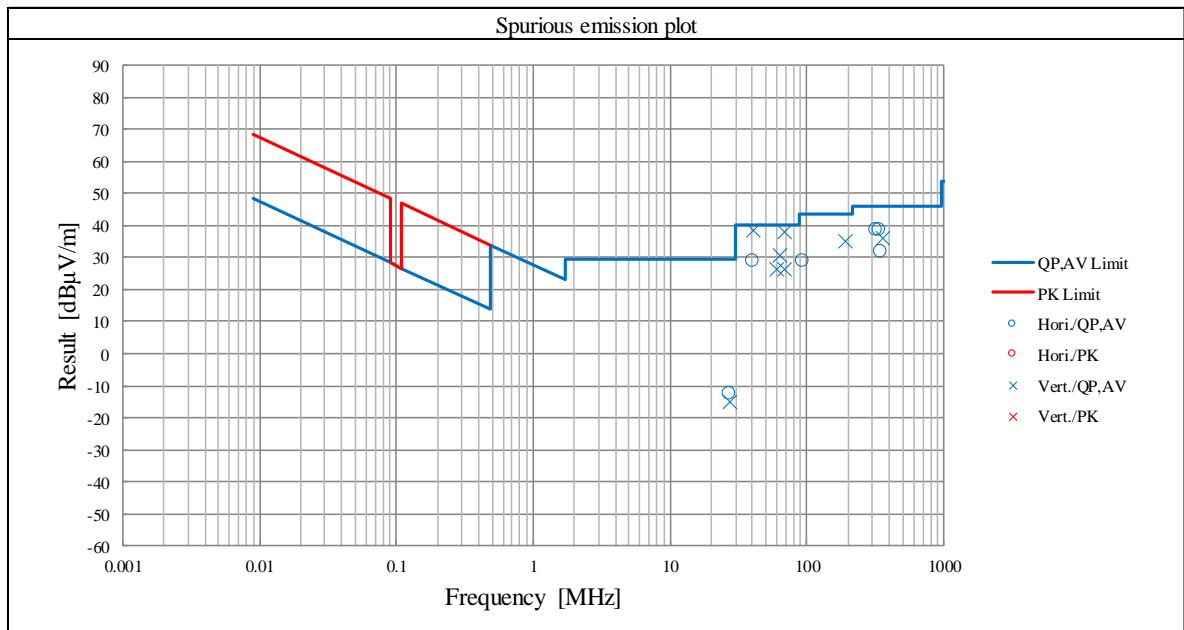
Result = Reading + Ant Factor + Loss (Cable+ATT+ΔAF(above 30 MHz)) - Gain(Amplifier) + Distance factor(below 30 MHz)

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

* Carrier level (Result at 3 m): Hor= 63.3 dBuV/m, Ver= 75.8 dBuV/m

Radiated Emission Plot data, Worst case

Report No. 13981495S-A-R1
 Test place Shonan EMC Lab.
 Semi Anechoic Chamber No.1 No.1
 Date November 29, 2021 December 5, 2021
 Temperature / Humidity 23 deg. C / 31 % RH 20 deg. C / 30 % RH
 Engineer Shunsaku Yumi Yasumasa Owaki
 Mode NFC Communication
 [Below 30 MHz]: with Tag 14443A,
 Vertical polarization (antenna angle) of the worst case: 90 deg.
 [Above 30 MHz]: with Tag 14443A

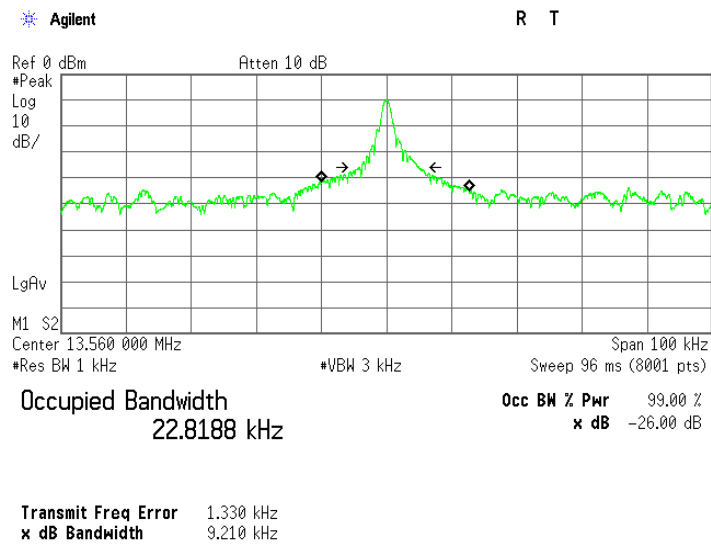


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

20 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	13981495S-A-R1
Test place	Shonan EMC Lab.
Shielded room	No.5
Date	December 10, 2021
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Hirosasa Sato
Mode	NFC communication with Tag 14443A

FREQ [MHz]	20 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
13.56	9.21	22.82

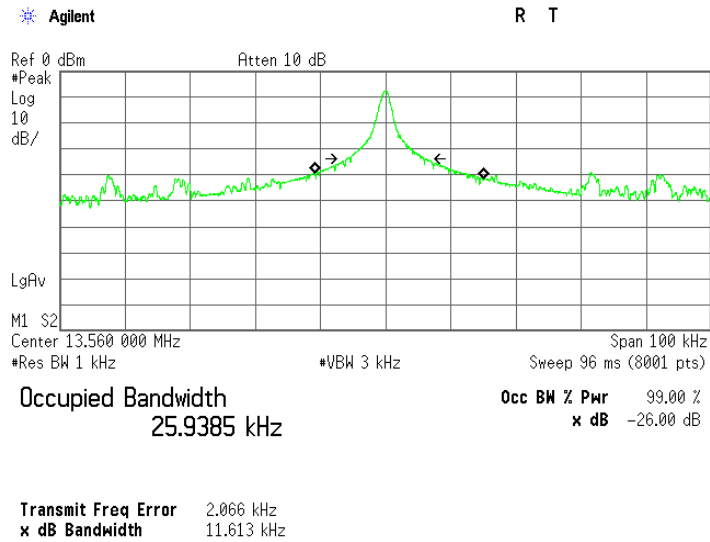


*Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

20 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	13981495S-A-R1
Test place	Shonan EMC Lab.
Shielded room	No.5
Date	December 10, 2021
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Hiromasa Sato
Mode	NFC communication with Tag 14443B

FREQ [MHz]	20 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
13.56	11.61	25.94

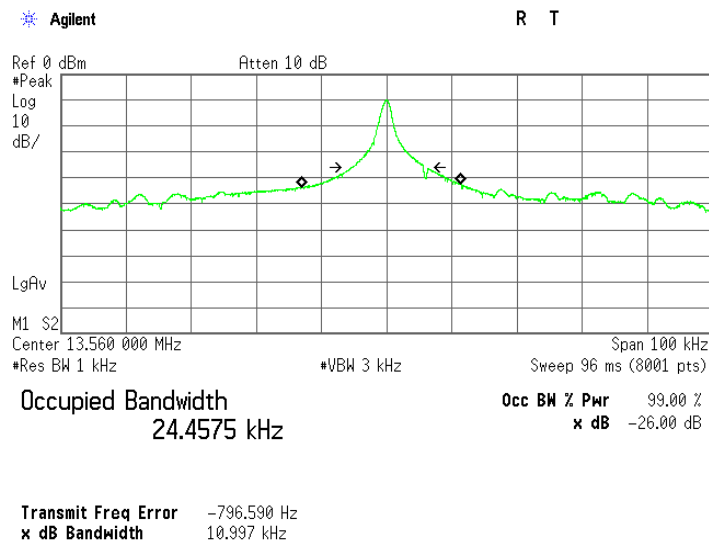


*Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

20 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	13981495S-A-R1
Test place	Shonan EMC Lab.
Shielded room	No.5
Date	December 10, 2021
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Hiromasa Sato
Mode	NFC communication with Tag Felica

FREQ [MHz]	20 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
13.56	11.00	24.46

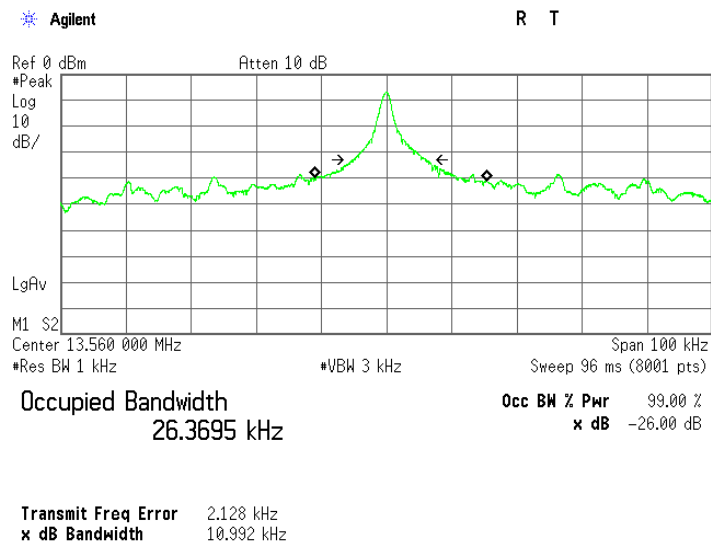


*Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

20 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	13981495S-A-R1
Test place	Shonan EMC Lab.
Shielded room	No.5
Date	December 10, 2021
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Hiromasa Sato
Mode	NFC communication with Tag 15693

FREQ [MHz]	20 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
13.56	10.99	26.37



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

Frequency Tolerance

Report No. 13981495S-A-R1
Test place Shonan EMC Lab.
Shielded room No.5
Date December 10, 2021
Temperature / Humidity 21 deg. C / 34 % RH
Engineer Yasumasa Owaki
Mode NFC Transmitting

Test condition		Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit [+/- %]
Temp. [deg. C]	Voltage [V]				[%]	[ppm]	
60 (Reference Data)	5.0	Power on	13.559991	-0.000009	-0.00007	-0.7	0.01
		+ 2 min.	13.559998	-0.000002	-0.00001	-0.1	0.01
		+ 5 min.	13.559969	-0.000031	-0.00023	-2.3	0.01
		+ 10 min.	13.559999	-0.000001	-0.00001	-0.1	0.01
50	5.0	Power on	13.559982	-0.000018	-0.00013	-1.3	0.01
		+ 2 min.	13.559982	-0.000018	-0.00013	-1.3	0.01
		+ 5 min.	13.559982	-0.000018	-0.00014	-1.4	0.01
		+ 10 min.	13.559982	-0.000018	-0.00013	-1.3	0.01
40	5.0	Power on	13.559992	-0.000008	-0.00006	-0.6	0.01
		+ 2 min.	13.559989	-0.000011	-0.00008	-0.8	0.01
		+ 5 min.	13.559989	-0.000011	-0.00008	-0.8	0.01
		+ 10 min.	13.559989	-0.000011	-0.00008	-0.8	0.01
30	5.0	Power on	13.560015	0.000015	0.00011	1.1	0.01
		+ 2 min.	13.560011	0.000011	0.00008	0.8	0.01
		+ 5 min.	13.560010	0.000010	0.00007	0.7	0.01
		+ 10 min.	13.560010	0.000010	0.00007	0.7	0.01
20	5.0	Power on	13.560039	0.000039	0.00028	2.8	0.01
		+ 2 min.	13.560028	0.000028	0.00020	2.0	0.01
		+ 5 min.	13.560037	0.000037	0.00027	2.7	0.01
		+ 10 min.	13.560037	0.000037	0.00027	2.7	0.01
20 (5V -15 %)	4.25	Power on	13.560076	0.000076	0.00056	5.6	0.01
		+ 2 min.	13.560027	0.000027	0.00020	2.0	0.01
		+ 5 min.	13.560102	0.000102	0.00075	7.5	0.01
		+ 10 min.	13.559987	-0.000013	-0.00009	-0.9	0.01
20 (5V +5 %)	5.25	Power on	13.560080	0.000080	0.00059	5.9	0.01
		+ 2 min.	13.560034	0.000034	0.00025	2.5	0.01
		+ 5 min.	13.560033	0.000033	0.00025	2.5	0.01
		+ 10 min.	13.560033	0.000033	0.00024	2.4	0.01
10	5.0	Power on	13.560061	0.000061	0.00045	4.5	0.01
		+ 2 min.	13.560059	0.000059	0.00044	4.4	0.01
		+ 5 min.	13.560050	0.000050	0.00037	3.7	0.01
		+ 10 min.	13.560059	0.000059	0.00044	4.4	0.01
0	5.0	Power on	13.560073	0.000073	0.00054	5.4	0.01
		+ 2 min.	13.560072	0.000072	0.00053	5.3	0.01
		+ 5 min.	13.560072	0.000072	0.00053	5.3	0.01
		+ 10 min.	13.560071	0.000071	0.00053	5.3	0.01
-10	5.0	Power on	13.560055	0.000055	0.00041	4.1	0.01
		+ 2 min.	13.560065	0.000065	0.00048	4.8	0.01
		+ 5 min.	13.560065	0.000065	0.00048	4.8	0.01
		+ 10 min.	13.560066	0.000066	0.00048	4.8	0.01
-20	5.0	Power on	13.560018	0.000018	0.00013	1.3	0.01
		+ 2 min.	13.560031	0.000031	0.00023	2.3	0.01
		+ 5 min.	13.560031	0.000031	0.00023	2.3	0.01
		+ 10 min.	13.560032	0.000032	0.00023	2.3	0.01

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

APPENDIX 2: Test instruments

Test equipment (1/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
BW,FT	KTS-07	145111	Digital Tester	SANWA	PC500	7019232	2021/09/14	12
BW,FT	SOS-19	175823	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/10/14	12
BW,FT	SSA-02	145800	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY48250106	2021/04/13	12
BW,FT	SSCA-01	146178	Search coil	Langer	RF-R 400-1	02-0634	-	-
FT	SCH-01	145200	Temperature and Humidity Chamber	Espec	PL-1KT	14020837	2021/04/02	12
CE	SAT3-13	150923	Attenuator	JFW	50HF-003N	-	2021/01/26	12
CE	SCC-A12/A13/SRSE-01	144966	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-269(RF Selector)	2021/04/12	12
CE	SLS-01	145538	LISN	Rohde & Schwarz	ENV216	100511	2021/02/24	12
CE	SLS-02	145539	LISN	Rohde & Schwarz	ENV216	100512	2021/02/24	12
CE	SOS-16	167990	Humidity Indicator	CUSTOM. Inc	CTH-202	708Q08R	2021/10/14	12
CE	STM-06	145763	Terminator	TME	CT-01 BP	-	2020/12/07	12
CE,RE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
CE,RE	SJM-21	207278	Measuring Tool, Tape Measure	ASKUL	-	-	-	-
CE,RE	STR-02	145791	Test Receiver	Rohde & Schwarz	ESCI	100575	2021/06/02	12
CE,RE	STS-01	145792	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997812	2021/09/14	12
RE	KAT6-04	144899	Attenuator	Inmet	18N-6dB	-	2020/12/10	12
RE	SAEC-01(NSA)	145597	Semi-Anechoic Chamber	TDK	SAEC-01(NSA)	1	2021/04/30	12
RE	SAF-01	145003	Pre Amplifier	SONOMA	310N	290211	2021/02/10	12
RE	SAT3-09	144959	Attenuator	JFW	50HF-003N	-	2021/08/16	12
RE	SAT6-15	167096	Attenuator	JFW	50HF-006N	-	2021/02/10	12
RE	SBA-01	145161	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032664	2021/04/10	12

Test equipment (2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	SCC-A1/A3/A5/A7/A8/A13/SRSE-01	144967	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/NS4906	-/0901-269(RF Selector)	2021/04/13	12
RE	SCC-A2/A4/A6/A7/A8/A13/SRSE-01	144968	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/NS4906	-/0901-269(RF Selector)	2021/04/12	12
RE	SCC-M1	194601	Coaxial Cable	Fujikura	5D-2W	-	2020/12/10	12
RE	SLA-05	145527	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	193	2021/04/10	12
RE	SLP-02	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2021/04/06	12
RE	SOS-20	191837	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	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
- FT: Frequency Tolerance
- BW: Bandwidth