RADIO TEST REPORT

Test Report No.: 14295596S-A-R2

Customer	**Sony Global Manufacturing & Operations Corporation**
Description of EUT	**Contactless IC Card Reader/Writer**
Model Number of EUT	**RC-S660/S**
FCC ID	**AK8RCS660S**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**July 28, 2022**
Remarks	**-**

Representative test engineer	Approved by
T. Kawakami	T. Imamura
Takahiro Kawakami Engineer	Toyokazu Imamura 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# 21.0

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REVISION HISTORY

Original Test Report No.: 14295596S-A

This report is a revised version of 14295596S-A-R1. 14295596S-A-R1 is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14295596S-A	July 20, 2022	-
1	14295596S-A-R1	July 25, 2022	Added comment on page 23. Added data on page 24 to 26.
2	14295596S-A-R2	July 28, 2022	Corrected the FCC Part 15.31 (e) “nominal rated voltage” on page 7. From: 85 % and 110 % To: 85 % and 115 %
			Deleted the following comment on page 10. “*This EUT provides stable voltage constantly to RF Part regardless of input voltage”
			Corrected the number of decimal places on page 20.

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS **PAGE**

SECTION 1: Customer Information

Company Name	Sony Global Manufacturing & Operations Corporation
Address	8-4, Shiomi Kisarazu-shi, Chiba, 292-0834 Japan.
Telephone Number	+81-438-37-4704
Contact Person	Youhei Hisano

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	Contactless IC Card Reader/Writer
Model Number	RC-S660/S
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 9999019: June 17, 2022 S/N 9999032: June 27, 2022
Test Date	June 21 to 29, 2022

2.2 Product Description

General Specification

Rating	DC 3.3 V
Clock frequency (ies) in the system	84 MHz (Max)
Operating temperature	-10 deg.C to +40 deg.C (20 %RH to 90 %RH) +40deg.C to +60 deg.C (less than 50 %RH)

Radio Specification

Equipment Type	Transceiver
Frequency of Operation	13.56 MHz
Type of Modulation	ASK
Antenna Gain	-85.17 dBi

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C FCC Part 15 final revised on April 1, 2022 and effective May 2, 2022
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.

* 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	<FCC> Section 15.207	17.0 dB, 27.11998 MHz, QP, N With Tag type F	Complied a)	-
	<ISED> RSS-Gen 8.8	<ISED> RSS-Gen 8.8			
Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section 15.225(a)	59.5 dB, 13.560 MHz, QP, 0 deg.	Complied b)	Radiated
	<ISED> RSS-Gen 6.4, 6.12	<ISED> RSS-210 B.6			
Spectrum Mask	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section 15.225(b)(c)	40.4 dB, 13.553 MHz, 13.567 MHz, QP, 0 deg.	Complied b)	Radiated
	<ISED> RSS-Gen 6.4, 6.13	<ISED> RSS-210 B.6			
20 dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section15.215(c)	See data	Complied# c)	Radiated
	<ISED> -	<ISED> -			
Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> Section 15.209, Section 15.225 (d)	4.2 dB 311.880 MHz, Horizontal, QP	Complied# d)	Radiated
	<ISED> RSS-Gen 6.4, 6.13	<ISED> RSS-210 B.6 RSS-Gen 8.9			
Frequency Tolerance	<FCC> ANSI C63.10:2013 6 Standard test methods	<FCC> 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: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

a) Refer to APPENDIX 1 (data of Conducted Emission)
b) Refer to APPENDIX 1 (data of Fundamental emission and Spectrum Mask)
c) Refer to APPENDIX 1 (data of 20 dB Bandwidth and 99% Occupied Bandwidth)
d) Refer to APPENDIX 1 (data 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 stable voltage was supplied by the end product which was required to have a power supply regulator. Therefore, the EUT complies with the requirement.
However, the supply voltage was varied and tested at 95 % and 105 % of the nominal rated supply voltage during frequency tolerance test according to Section 15.225(e). since EUT cannot operated by at 85 % and 115 % of the nominal rated voltage (the EUT will be damaged if a voltage of 85 % and 115 % rated voltage is supplied), tested of 95 % and 105 %.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % emission bandwidth	<ISED>RSS-Gen 6.7	-	N/A	- 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 $k = 2$.

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 to 30 MHz	2.9 dB	2.9 dB	3.0 dB	2.9 dB
Radiated emission	9 kHz to 30 MHz	3.2 dB	3.1 dB	3.1 dB	-
(Measurement distance: 3 m)	30 MHz to 200 MHz	4.6 dB	4.6 dB	4.6 dB	-
	200 MHz to 1 GHz	6.0 dB	6.1 dB	6.1 dB	-
	1 GHz to 6 GHz	4.7 dB	4.7 dB	4.7 dB	-
	6 GHz to 18 GHz	5.2 dB	5.3 dB	5.3 dB	-
	18 GHz to 40 GHz	5.4 dB	5.5 dB	5.5 dB	-
Radiated emission	1 GHz to 18 GHz	5.6 dB	5.6 dB	5.6 dB	-
(Measurement distance: 1 m)	18 GHz to 40 GHz	5.8 dB	5.8 dB	5.8 dB	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector) SPM-06	1.2 dB
Power Measurement above 1 GHz (Peak Detector) SPM-06	2.0 dB
Power Measurement above 1 GHz (Average Detector) SPM-07	1.2 dB
Power Measurement above 1 GHz (Peak Detector) SPM-07	1.3 dB
Power Measurement above 1 GHz (Average Detector) SPM-13	1.3 dB
Power Measurement above 1 GHz (Peak Detector) SPM-13	1.3 dB
Spurious emission (Conducted) below 1 GHz	0.93 dB
Conducted emissions Power Density Measurement 1 GHz to 3 GHz	0.92 dB
Conducted emissions Power Density Measurement 3 GHz to 18 GHz	2.3 dB
Spurious emission (Conducted) 18 GHz to 26.5 GHz	2.3 dB
Spurious emission (Conducted) 26.5 GHz to 40 GHz	2.3 dB
Bandwidth Measurement	0.012 %
Duty cycle and Time Measurement	0.27 %
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 %

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 mode is used :

Mode	Operating mode	Tested frequency
All items except for frequency tolerance, with tag	Communication	13.56 MHz
All items except for frequency tolerance, without tag	Transmitting	13.56 MHz
Frequency tolerance	Transmitting (Unmodulated)	13.56 MHz
The EUT was operated in a manner similar to typical use during the tests. *Power of the EUT was set by the software as follows;		
Power Setting: Fixed Software: Version: 0000F006 (Date: 2022.05 13, Storage location: Driven by connected PC) Test tool: NFCPortPoll.exe Ver.: 0.9.10.3 (Date: 2022.05 16, Storage location: Driven by connected PC) *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.		

Combinations of the worst case:

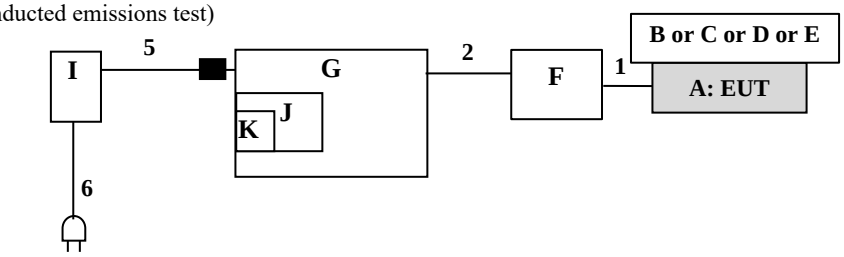
Conducted emission	Radiated emission (carrier)	Radiated emission (below 30 MHz)	Radiated emission (above 30 MHz)
with tag (type F)	without tag (type F)	with tag (type F)	with tag (type F)

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

Frequency Tolerance:	
Temperature	-20 deg. C to +50 deg. C, Step 10 deg. C
Voltage	Normal Voltage: DC 3.3 V Maximum Voltage DC 3.465 V (DC 3.3 V +5 %), Minimum Voltage DC 3.135 V (DC 3.3 V -5 %)

4.2 Configuration and peripherals

(for Conducted emissions test)

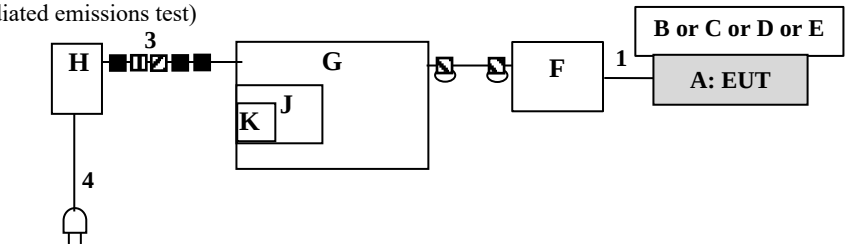


AC 120 V / 60Hz

■: Standard ferrite core

2

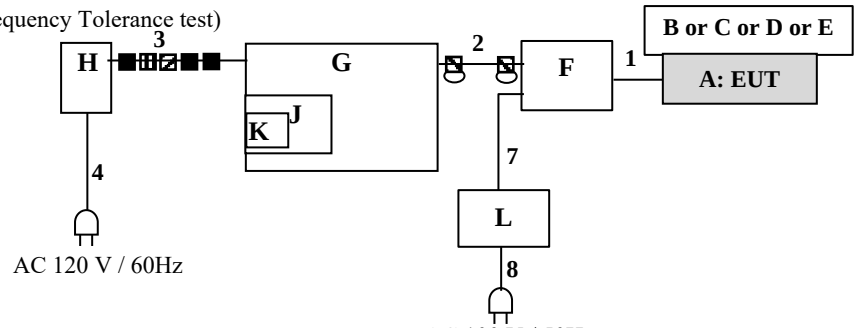
(for Radiated emissions test)



AC 120 V / 60Hz

▨: Ferrite Core (2 turn) (ZCAT2035-0930)
▨: Ferrite Core (1 turn) (ZCAT2035-0930)
▮: Ferrite Core (1 turn) (ZCAT1730-0730)
■: Ferrite Core (1 turn) (ZCAT1325-0530)

(for Frequency Tolerance test)



AC 120 V / 60Hz

AC 100 V / 50Hz

* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.
* The ferrite core attached to DC cable is not used to reduce the noise from the EUT. Therefore, that does not affect the emission level of the EUT.
*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.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Contactless IC Card Reader/Writer	RC-S660/S	9999019, 9999032 *1)	Sony	EUT
B	IC Card	-	-	-	type F *2)
C	IC Card	-	-	-	type A
D	IC Card	-	-	-	type B
E	IC Card	-	-	-	type V
F	Relay jig	-	-	Sony	-
G	Laptop PC	VGN-G1	J001YGP3	Sony	-
H	AC Adapter	PCGA-AC16V6	147774951 0795514	Sony	-
I	AC Adapter	VGP-AC16V8	147886061 0000512	Sony	-
J	PC Card Adapter	RHA1P	SN0001	TDK	-
K	CompactFlash 256 MB	TS256MCF	76355 KTN3 256MCP 0328 QC:65	Transcend	-
L	DC power supply	PW16-5ADP	19100034	TEXIO	-

*1) Used for Conducted emissions test (Antenna terminated)
*2) *RC-S660/S is used with Type-F (FeliCa), Type-A, Type-B, Type V.
IC Card was determined type-F base on the pre-check.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Flexible flat cable	0.07	Unshielded	Unshielded	-
2	USB	0.3	Shielded	Shielded	-
3	DC	1.8	Unshielded	Unshielded	-
4	AC	0.8	Unshielded	Unshielded	-
5	DC	1.8	Unshielded	Unshielded	-
6	AC	2.0	Unshielded	Unshielded	-
7	DC	0.07 + 2.0	Unshielded	Unshielded	-
8	AC	2.0	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

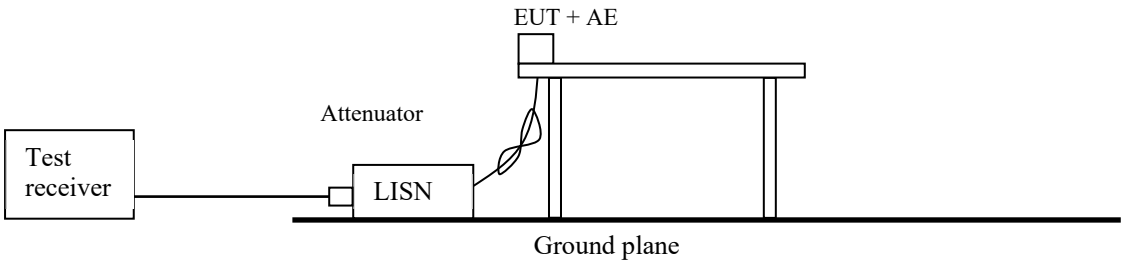
Test Procedure and conditions

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.

1) For the tests on EUT with other peripherals (as a whole system)
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 AE (PC's AC adapter) in a Shieled room.
The EUT via AE (PC's AC adapter) 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

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

Test Procedure

[For below 1GHz]
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
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.,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.

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.

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

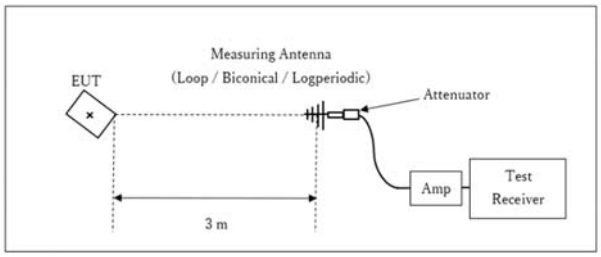
*1) Distance Factor: 40 x log (3 m / 300 m) = -80 dB
*2) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

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 Ohmes. 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 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.

[Test Setup]
Below 1 GHz



Test Distance: 3 m

- 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.

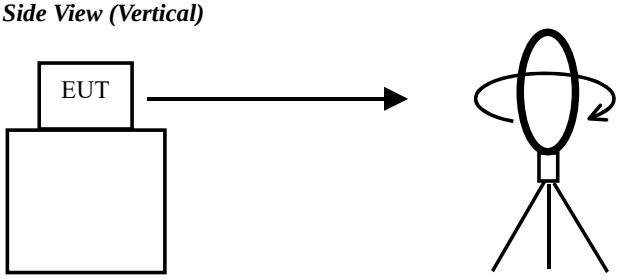
Antenna polarization	Spurious (Below 30 MHz)	Spurious (Above 30 MHz)
Horizontal	Y	X
Vertical	Y	X

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

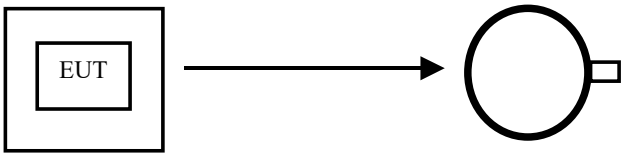
Measurement range : **9 kHz to 1 GHz**
Test data : **APPENDIX 1**
Test result : **Pass**

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

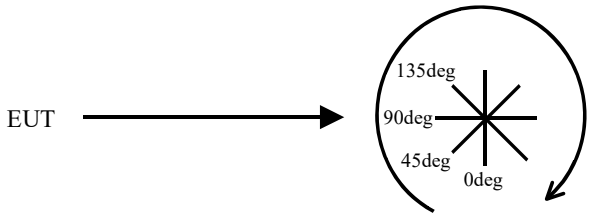


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 7: Other test

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	-	-	-	-	-	-	Frequency counter
*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %.							

Test data : **APPENDIX**
Test result : **Pass**

APPENDIX 1: Test data

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2022/06/23

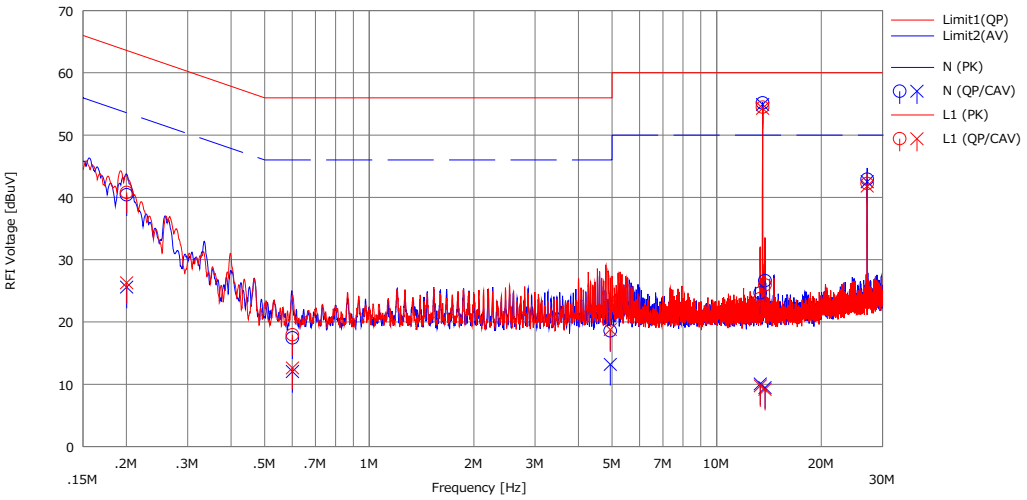
Mode : Communication (13.56 MHz)

Power : DC 3.3 V (AC Adapter: 120 V / 60 Hz)
Temp./Humi. : 24 deg.C / 63 %RH

Remarks : With Tag type F

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Kenichi Adachi



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		〈QP〉	〈CAV〉		〈QP〉	〈CAV〉	〈QP〉	〈AV〉	〈QP〉	〈AV〉		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.20031	27.98	13.15	12.43	40.41	25.58	63.60	53.60	23.1	28.0	N	
2	0.60086	4.98	-0.42	12.47	17.45	12.05	56.00	46.00	38.5	33.9	N	
3	4.94092	5.86	0.48	12.72	18.58	13.20	56.00	46.00	37.4	32.8	N	
4	13.34753	11.58	-3.02	13.07	24.65	10.05	60.00	50.00	35.3	39.9	N	
5	13.55999	42.08	41.85	13.08	55.16	54.93	60.00	50.00	4.8	-5.0	N	Reference, carrier
6	13.77229	13.55	-3.62	13.09	26.64	9.47	60.00	50.00	33.3	40.5	N	
7	27.11998	29.34	28.94	13.58	42.92	42.52	60.00	50.00	17.0	7.4	N	
8	0.20031	28.35	13.86	12.44	40.79	26.30	63.60	53.60	22.8	27.3	L1	
9	0.60086	5.48	0.14	12.48	17.96	12.62	56.00	46.00	38.0	33.3	L1	
10	4.94092	9.86	6.08	12.71	22.57	18.79	56.00	46.00	33.4	27.2	L1	
11	13.34753	10.78	-3.22	12.97	23.75	9.75	60.00	50.00	36.2	40.2	L1	
12	13.55999	41.52	41.33	12.97	54.49	54.30	60.00	50.00	5.5	-4.3	L1	Reference, carrier
13	13.77229	12.96	-3.80	12.98	25.94	9.18	60.00	50.00	34.0	40.8	L1	
14	27.11998	28.98	28.56	13.25	42.23	41.81	60.00	50.00	17.7	8.1	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-05

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.5 Shielded Room
Date : 2022/06/29

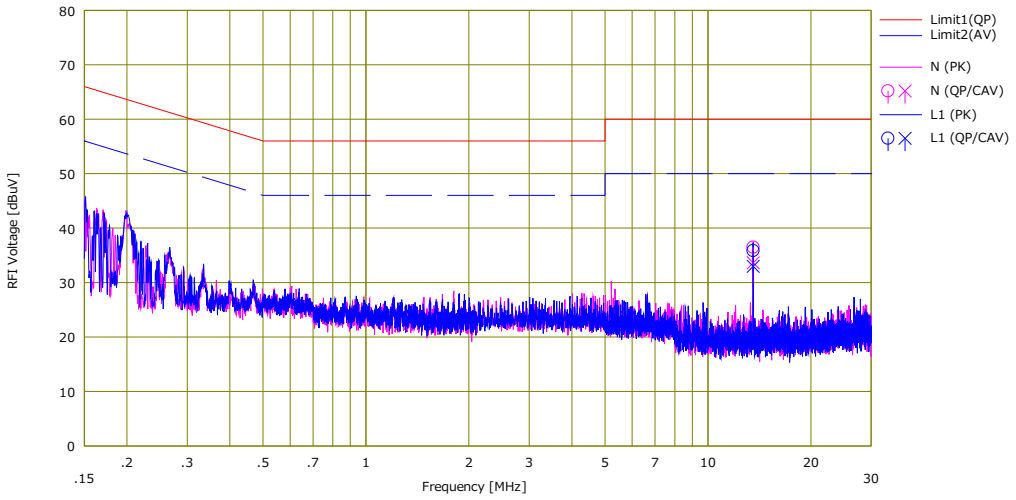
Mode : Transmitting (13.56 MHz)

Power : DC 3.3 V (AC Adapter: 120 V / 60 Hz)
Temp./Humi. : 25 deg.C / 45 %RH

Remarks : antenna terminated

Limit : FCC_Part 15 Subpart C(15.207)

Engineer : Miku Ikudome



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		〈QP〉	〈CAV〉		〈QP〉	〈CAV〉	〈QP〉	〈AV〉	〈QP〉	〈AV〉		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	13.56000	23.31	20.50	13.14	36.45	33.64	60.00	50.00	23.5	16.3	N	
2	13.56000	22.83	19.95	13.03	35.86	32.98	60.00	50.00	24.1	17.0	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN)=SLS-05

Fundamental emission and Spectrum Mask

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.3
Date	June 22, 2022
Temperature / Humidity	23 deg. C / 47 % RH
Engineer	Takahiro Suzuki
Mode	Communication (13.56 MHz) (NFC type F (Felica))
	Loop: Vertical 0 deg

Fundamental emission

No.	FREQ	Test Receiver Reading		Antenna Factor	Loss	AMP GAIN	Distance factor	RESULT		LIMIT (30m)	MARGIN	
		Hor	Ver					Hor	Ver		Hor	Ver
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]
1	13.560	62.2	70.2	20.0	6.4	32.2	-40.0	16.4	24.4	83.9	67.5	59.5

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

Distance factor: 40 x log (3m/30m) = -40 dB

Limits (30m)

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

Spurious emission within the band

No.	FREQ	Test Receiver Reading		Antenna Factor	Loss	AMP GAIN	Distance factor	RESULT		LIMIT (30m)	MARGIN	
		Hor	Ver					Hor	Ver		Hor	Ver
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]
1	13.110	30.4	30.4	20.0	6.4	32.2	-40.0	-15.4	-15.5	29.5	44.9	45.0
2	13.410	30.4	31.9	20.0	6.4	32.2	-40.0	-15.4	-13.9	40.5	55.9	54.4
3	13.553	47.1	55.8	20.0	6.4	32.2	-40.0	1.3	10.0	50.4	49.1	40.4
4	13.567	47.1	55.8	20.0	6.4	32.2	-40.0	1.3	10.0	50.4	49.1	40.4
5	13.710	30.3	31.5	20.0	6.4	32.2	-40.0	-15.5	-14.3	40.5	56.0	54.8
6	14.010	30.3	30.4	20.1	6.4	32.2	-40.0	-15.5	-15.4	29.5	45.0	44.9

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

Outside filed strength frequencies

・Fc±7kHz:13.553MHz to 13.567MHz

・Fc±150kHz:13.410MHz to 13.710MHz

・Fc±450kHz:13.110MHz to 14.010MHz

Fc = 13.56MHz

Limits (30m)

・13.410MHz to 13.553MHz and 13.567MHz to 13.710MHz : 50.4dBuV/m (FCC 15.225(b))

・13.110MHz to 13.410MHz and 13.710MHz to 14.010MHz : 40.5dBuV/m (FCC 15.225(c))

・Below 13.110MHz and Above 14.010MHz : 29.5dBuV/m (FCC 15.225(d)and FCC 15.209)

Spurious emission

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	
Date	June 22, 2022	June 21, 2022
Temperature / Humidity	23 deg. C / 47 % RH	23 deg. C / 42 % RH
Engineer	Takahiro Suzuki	
	(Below 30 MHz)	(Above 30 MHz)
Mode	Communication (13.56 MHz) (NFC type F (Felica))	
	Loop: Vertical 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.	27.12	QP	32.1	21.2	6.6	32.2	-40.0	-12.2	29.5	41.7	-	4	* Limit: 30m
Hori.	40.676	QP	34.6	14.6	6.7	32.2	0.0	23.7	40.0	16.3	239	171	-
Hori.	67.800	QP	51.5	6.9	6.7	32.1	0.0	32.9	40.0	7.1	276	194	
Hori.	122.037	QP	40.0	13.3	7.3	32.1	0.0	28.5	43.5	15.0	262	357	
Hori.	149.163	QP	39.3	14.8	7.8	32.1	0.0	29.8	43.5	13.7	237	3	
Hori.	257.641	QP	50.1	12.1	8.4	32.0	0.0	38.6	46.0	7.4	124	200	
Hori.	284.759	QP	49.4	13.5	8.5	32.0	0.0	39.5	46.0	6.5	100	209	
Hori.	311.880	QP	51.2	13.9	8.7	31.9	0.0	41.8	46.0	**4.2**	100	221	
Hori.	339.000	QP	49.6	14.8	8.8	31.9	0.0	41.3	46.0	4.7	100	329	
Hori.	720.000	QP	34.7	20.2	10.4	31.8	0.0	33.4	46.0	12.6	134	135	
Vert.	27.12	QP	36.7	21.2	6.6	32.2	-40.0	-7.7	29.5	37.2	-	352	* Limit: 30m
Vert.	40.678	QP	32.8	14.6	6.7	32.2	0.0	21.9	40.0	18.1	100	18	-
Vert.	67.800	QP	44.5	6.9	6.7	32.1	0.0	25.9	40.0	14.1	100	298	
Vert.	646.098	QP	36.3	19.3	10.1	31.9	0.0	33.8	46.0	12.2	160	350	

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

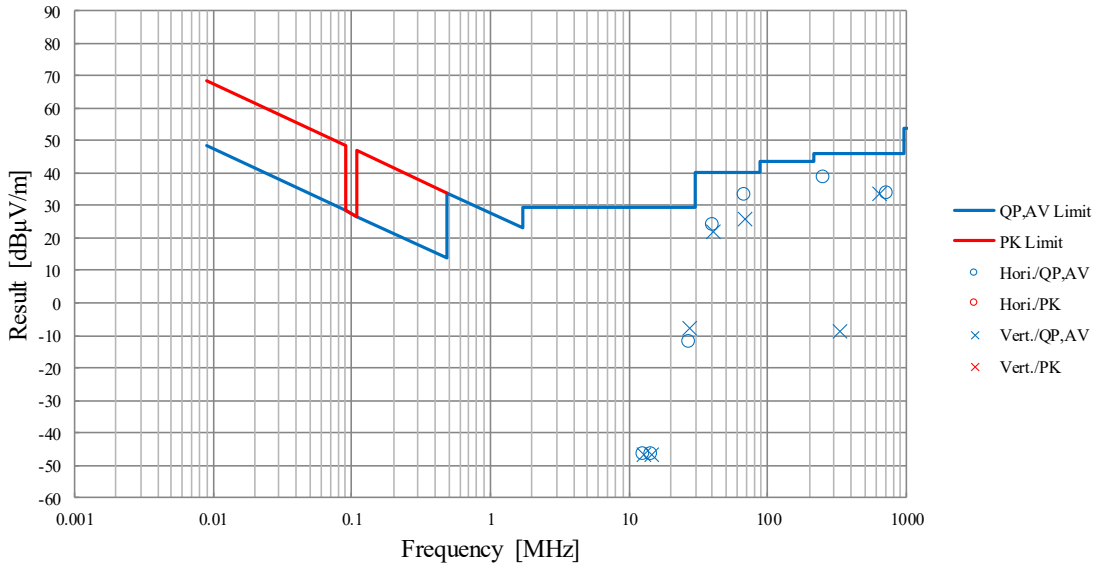
* Other frequency noises omitted in this report were not seen or have enough margin (more than 20 dB).

* Carrier level (Result at 3m): Hor= 56.4 dBuV/m, Ver= 64.4 dBuV/m

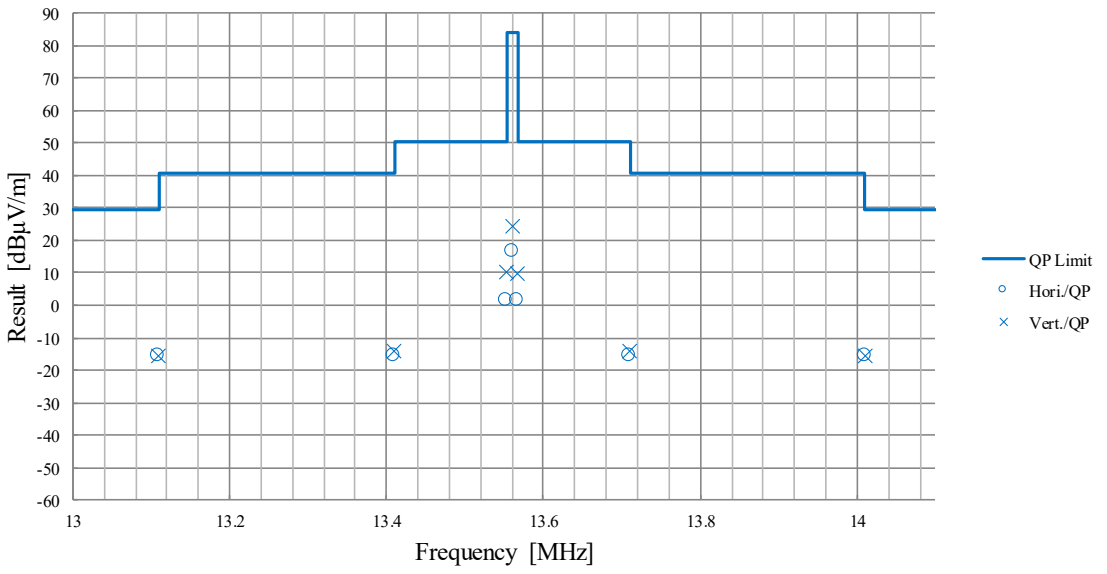
Radiated Spurious Emission

Test place	Shonan EMC Lab.	
Semi Anechoic Chamber	No.3	
Date	June 22, 2022	June 21, 2022
Temperature / Humidity	23 deg. C / 47 % RH	23 deg. C / 42 % RH
Engineer	Takahiro Suzuki	Takahiro Suzuki
	(Below 30 MHz)	(Above 30 MHz)
Mode	Communication (13.56 MHz) (NFC type F (Felica))	
	Loop: Vertical 0 deg	

Spurious emission plot



Within band plot

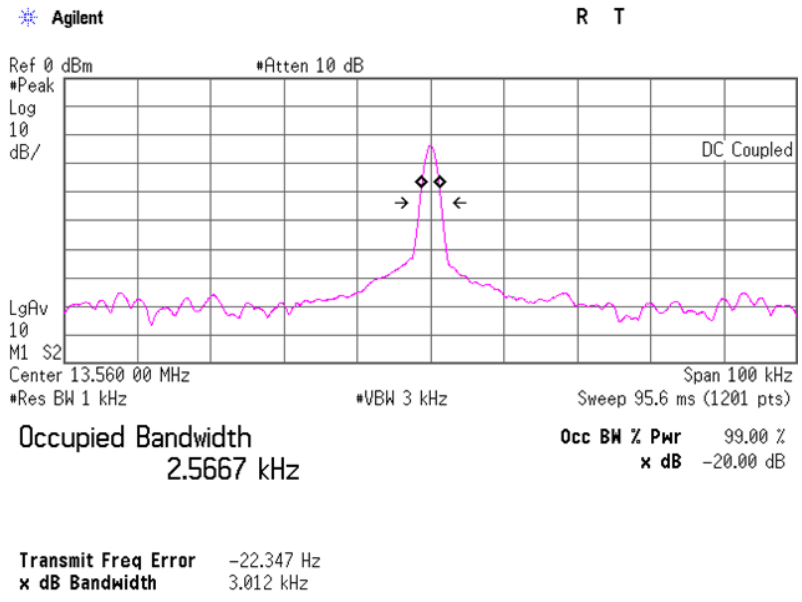


*These plots data contains sufficient number to show the trend of characteristic features for EUT.

20 dB Bandwidth and 99% Occupied Bandwidth

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.5 Shielded room
Date	June 27, 2022
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Takahiro Kawakami
Mode	Communication (13.56 MHz) (NFC type F (Felica))

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	3.01	2.57

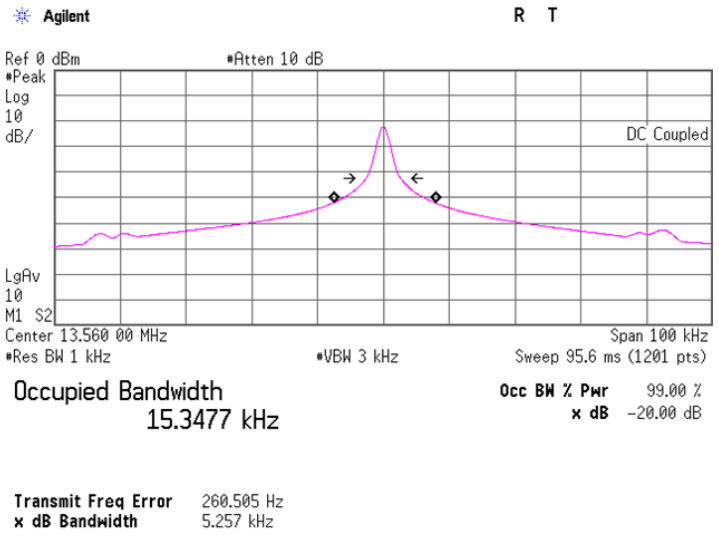


*Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

20 dB Bandwidth and 99% Occupied Bandwidth

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.5 Shielded room
Date	June 27, 2022
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Takahiro Kawakami
Mode	Communication (13.56 MHz) (NFC type A)

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	5.26	15.35

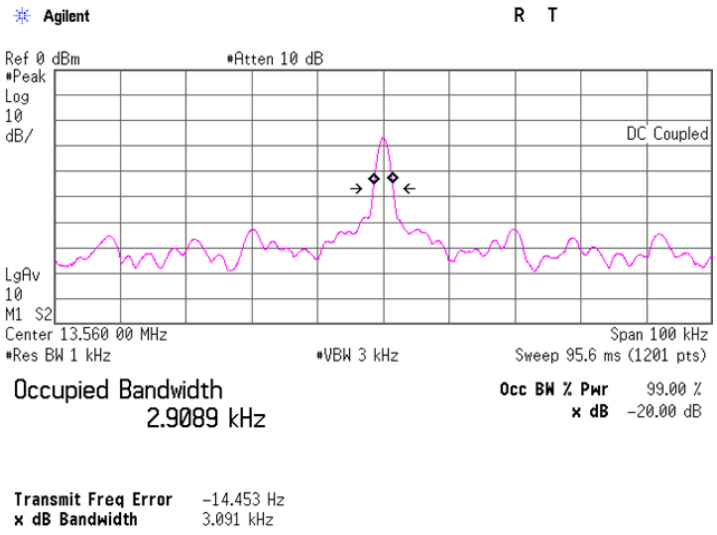


*Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

20 dB Bandwidth and 99% Occupied Bandwidth

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.5 Shielded room
Date	June 27, 2022
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Takahiro Kawakami
Mode	Communication (13.56 MHz) (NFC type B)

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	3.09	2.91

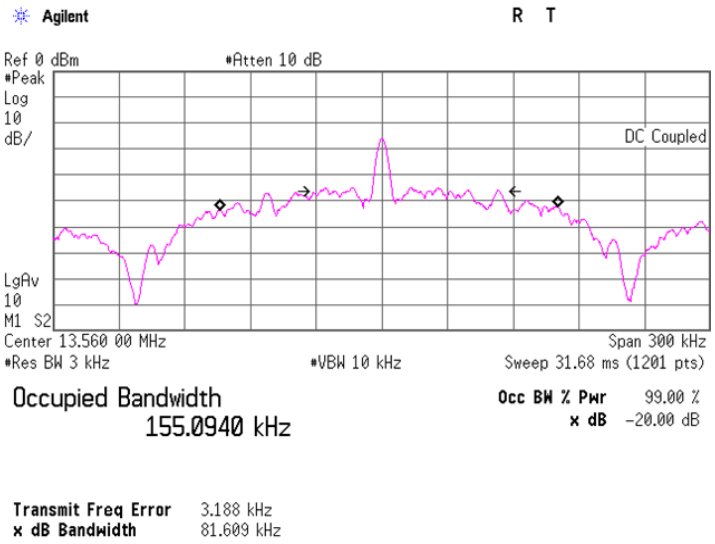


*Since the transmitter signal is CW-like it is impractical to use a RBW setting of 1 – 5% of the emission bandwidth since the emission bandwidth will be proportional to the RBW.

20 dB Bandwidth and 99% Occupied Bandwidth

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.5 Shielded room
Date	June 27, 2022
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Takahiro Kawakami
Mode	Communication (13.56 MHz) (NFC type V)

FREQ [MHz]	20dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
13.56	81.61	155.09



*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

Test place	Shonan EMC Lab.
Semi Anechoic Chamber	No.5 Shielded room
Date	June 27, 2022
Temperature / Humidity	25 deg. C / 41 % RH
Engineer	Takahiro Kawakami
Mode	Transmitting (Unmodulated)(13.56 MHz)

Test condition		Tested	Measured	Frequency	Result		Limit
Temp.	Voltage	timing	frequency	error			
[deg. C]	[V]		[MHz]	[MHz]	[%]	[ppm]	[+/- %]
50	3.3	Power on	13.559972	-0.000028	-0.00021	-2.1	0.01
		+ 2 min.	13.559969	-0.000031	-0.00023	-2.3	0.01
		+ 5 min.	13.559969	-0.000031	-0.00023	-2.3	0.01
		+ 10 min.	13.559970	-0.000030	-0.00022	-2.2	0.01
40	3.3	Power on	13.559987	-0.000013	-0.00010	-1.0	0.01
		+ 2 min.	13.559986	-0.000014	-0.00010	-1.0	0.01
		+ 5 min.	13.559988	-0.000012	-0.00009	-0.9	0.01
		+ 10 min.	13.559988	-0.000012	-0.00009	-0.9	0.01
30	3.3	Power on	13.560039	0.000039	0.00029	2.9	0.01
		+ 2 min.	13.560020	0.000020	0.00015	1.5	0.01
		+ 5 min.	13.560018	0.000018	0.00013	1.3	0.01
		+ 10 min.	13.560017	0.000017	0.00013	1.3	0.01
20	3.3	Power on	13.560065	0.000065	0.00048	4.8	0.01
		+ 2 min.	13.560058	0.000058	0.00043	4.3	0.01
		+ 5 min.	13.560057	0.000057	0.00042	4.2	0.01
		+ 10 min.	13.560056	0.000056	0.00041	4.1	0.01
20	3.135	Power on	13.560061	0.000061	0.00045	4.5	0.01
		+ 2 min.	13.560053	0.000053	0.00039	3.9	0.01
		+ 5 min.	13.560052	0.000052	0.00038	3.8	0.01
		+ 10 min.	13.560051	0.000051	0.00038	3.8	0.01
20	3.465	Power on	13.560058	0.000058	0.00043	4.3	0.01
		+ 2 min.	13.560048	0.000048	0.00035	3.5	0.01
		+ 5 min.	13.560047	0.000047	0.00035	3.5	0.01
		+ 10 min.	13.560047	0.000047	0.00035	3.5	0.01
10	3.3	Power on	13.560087	0.000087	0.00064	6.4	0.01
		+ 2 min.	13.560086	0.000086	0.00063	6.3	0.01
		+ 5 min.	13.560085	0.000085	0.00063	6.3	0.01
		+ 10 min.	13.560086	0.000086	0.00063	6.3	0.01
0	3.3	Power on	13.560108	0.000108	0.00080	8.0	0.01
		+ 2 min.	13.560108	0.000108	0.00080	8.0	0.01
		+ 5 min.	13.560107	0.000107	0.00079	7.9	0.01
		+ 10 min.	13.560108	0.000108	0.00080	8.0	0.01
-10	3.3	Power on	13.560096	0.000096	0.00071	7.1	0.01
		+ 2 min.	13.560102	0.000102	0.00075	7.5	0.01
		+ 5 min.	13.560102	0.000102	0.00075	7.5	0.01
		+ 10 min.	13.560102	0.000102	0.00075	7.5	0.01
-20	3.3	Power on	13.560058	0.000058	0.00043	4.3	0.01
		+ 2 min.	13.560067	0.000067	0.00049	4.9	0.01
		+ 5 min.	13.560068	0.000068	0.00050	5.0	0.01
		+ 10 min.	13.560068	0.000068	0.00050	5.0	0.01

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

APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	SAT3-10	144960	Attenuator	JFW	50HF-003N	-	2021/08/16	12
CE	SCC-05	145033	Coaxial Cable	Fujikura Shoji Co., LTD	5D2W	-	2022/04/20	12
CE	SCC-C9/C10/SRSE-03	145036	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-271(RF Selector)	2022/04/20	12
CE	SLS-01	145538	LISN	Rohde & Schwarz	ENV216	100511	2022/02/23	12
CE	SLS-05	145542	LISN	Rohde & Schwarz	ENV216	100516	2022/02/24	12
CE	SOS-24	191841	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/10/14	12
CE	SOS-27	191845	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
CE	STM-02	145746	Terminator	TME	CT-01 BP	-	2021/12/10	12
CE	STR-07	146209	Test Receiver	Rohde & Schwarz	ESU26	100484	2021/09/17	12
CE,TF	STS-05	146212	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997828	2021/09/14	12
RE	SAEC-03(NSA)	145565	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	2022/04/15	12
RE	SAEC-ALL	145568	Semi Anechoic Chamber(ME)	TDK	Semi Anechoic Chamber 3m/10m	1, 2, 3	2020/12/25	24
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	2022/05/14	12
RE	SCC-C1/C2/C3/C4/C5/C10/SRSE-03	145171	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	2022/04/20	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	2022/05/14	12
RE	SLP-02	145536	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	2022/04/07	12
RE	SOS-23	191840	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/08/02	12
RE, CE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
RE, CE	KJM-02	146432	Measure	TAJIMA	GL19-55	-	-	-
RE, CE	STR-09	213530	Test Receiver	Rohde & Schwarz	ESW44	103068	2022/01/17	12
RE, CE	STS-03	146210	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997823	2021/09/14	12
TF	SCH-01	145200	Temperature and Humidity Chamber	Espec	PL-1KT	14020837	2022/04/05	12
TF	SFC-03	183119	Microwave Counter	Keysight Technologies Inc	53151A	US40511493	2021/11/12	12
TF	SOS-19	175823	Humidity Indicator	CUSTOM. Inc	CTH-201	-	2021/10/14	12
TF	SRENT-22	202830	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250036	2021/12/01	12
TF	SSCA-01	146178	Search coil	Langer	RF-R 400-1	02-0634	-	-

***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
TF: Test Fixture