



EMI TEST REPORT

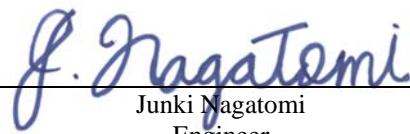
Test Report No. : 13893268H-R3

Applicant : Art Finex Co.,Ltd.
Type of EUT : RFID reader/writer with security function
Model Number of EUT : NEX5000S(LCP)
Test regulation : FCC Part 15 Subpart C: 2021
FCC ID : 2AM8PNEX5000SLCP
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. Ise 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 13893268H-R2. 13893268H-R2 is replaced with this report.

Date of test: September 30 to December 9, 2021

Representative test engineer:



Junki Nagatomi
Engineer

Approved by:



Satofumi Matsuyama
Engineer



CERTIFICATE 5107.02

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

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REVISION HISTORY

Original Test Report No.: 13893268H

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13893268H	November 8, 2021	-	-
1	13893268H-R1	November 29, 2021	P.1	Correction of "Date of test" in cover page by retest.
1	13893268H-R1	November 29, 2021	P.6	Correction of the worst margin for Conducted emission by retest. From 1.59 dB, 13.56000 MHz, AV, Phase N To 0.17 dB, 27.14000 MHz, QP, Phase L
1	13893268H-R1	November 29, 2021	P.7	Correction of <u>FCC Part 15.31</u> and <u>FCC Part 15.203</u> Antenna requirement in Clause 3.2
1	13893268H-R1	November 29, 2021	P.9	Correction of Operating mode for Conducted emission by retest in Clause 4.1.
1	13893268H-R1	November 29, 2021	P.11, 12	Correction from "*)" to "*)a)" for the explanation of <Notes for Ferrite cores>.
1	13893268H-R1	November 29, 2021	P 10, 11	Description of the Conducted emission and Radiated emission block diagram separately for each test.
1	13893268H-R1	November 29, 2021	P 10, 11, 12	Addition of AC Adapter in block diagram. Correction of Cable Name for No.6.
1	13893268H-R1	November 29, 2021	P.17, 18	Replacement of the data by retest.
1	13893268H-R1	November 29, 2021	P.20	Replacement of the data by correction.
1	13893268H-R1	November 29, 2021	P.22	Correction of result table.
1	13893268H-R1	November 29, 2021	P.24	Correction of Test instruments for Conducted emission by retest.
1	13893268H-R1	November 29, 2021	P.26	Replacement of the setup photo for Conducted emission by retest.
2	13893268H-R2	December 1, 2021	P.11	Correction of Radiated emission block diagram.
3	13893268H-R3	December 9, 2021	P.1	Correction of "Date of test" in cover page by retest.
3	13893268H-R3	December 9, 2021	P.6	Correction of the worst margin for Conducted emission by retest. From 0.17 dB, 27.14000 MHz, QP, Phase L to 1.05 dB, 13.56000 MHz, AV, Phase N
3	13893268H-R3	December 9, 2021	P.10	Correction of Conducted emission block diagram by retest.
3	13893268H-R3	December 9, 2021	P.17, 18	Replacement of the data by retest.
3	13893268H-R3	December 9, 2021	P.24	Correction of Test instruments for Conducted emission by retest.
3	13893268H-R3	December 9, 2021	P.26	Replacement of the setup photo for Conducted emission by retest.

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		

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	<u>PAGE</u>
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.....	9
SECTION 5: Conducted Emission.....	13
SECTION 6: Radiated emission (Fundamental, Spurious Emission and Spectrum Mask).....	14
SECTION 7: Other test.....	16
APPENDIX 1: Test data	17
Conducted Emission	17
Fundamental emission and Spectrum Mask.....	19
Spurious emission	20
20 dB Bandwidth and 99% Occupied Bandwidth.....	22
Frequency Tolerance	23
APPENDIX 2: Test instruments	24
APPENDIX 3: Photographs of test setup	26
Conducted Emission	26
Radiated Emission.....	27
Worst Case Position	28
Frequency Tolerance	30

SECTION 1: Customer information

Company Name : Art Finex Co.,Ltd.
Address : 6-1-33, Kamikobatacho, Sabae-shi, Fukui, 916-0037, Japan
Telephone Number : +81-778-54-8085
Contact Person : Toshikazu Kamei

The information provided from the customer is as follows;

- Applicant, Type 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
- 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

Type : RFID reader/writer with security function
Model Number : NEX5000S(LCP)
Serial Number : Refer to SECTION 4.2
Receipt Date : August 26, 2021
Condition : Production model
Modification : No Modification by the test lab

2.2 Product Description

Model: NEX5000S(LCP) (referred to as the EUT in this report) is a RFID reader/writer with security function.

General Specification

Rating : DC 5.0 V

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 13.56 MHz
Modulation : ASK
Antenna type : Loop Coil Antenna
Antenna Connector Type : JST ZH CONNECTOR
Clock frequency (Maximum) : 27.12 MHz (Crystal)
Operating Temperature : -20 deg. C. to +70 deg. C
Supported Tag : ISO/IEC 14443 Type-A

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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.

* The customer has declared that the EUT has complies with FCC Part 15 Subpart B as SDoC.

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	1.05 dB 13.56000 MHz AV, Phase N	Complied# a)	-
Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 6.4, 6.12	<FCC> Section 15.225(a) <ISED> RSS-210 B.6	56.03 dB, 13.56000 MHz, QP, 0 deg.	Complied b)	Radiated
Spectrum Mask	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 6.4, 6.13	<FCC> Section 15.225(b)(c) <ISED> RSS-210 B.6	37.55 dB, 13.56700 MHz, QP, 0 deg.	Complied b)	Radiated
20 dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> -	<FCC> Section15.215(c) <ISED> -	See data	Complied c)	Radiated
Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 6.4, 6.13	<FCC> Section 15.209, Section 15.225 (d) <ISED> RSS-210 B.6 RSS-Gen 8.9	1.90 dB 230.520 MHz, Horizontal, QP	Complied# d)	Radiated
Frequency Tolerance	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 6.11, 8.11	<FCC> Section 15.225(e) <ISED> RSS-210 B.6	See data	Complied e)	Radiated

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 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.

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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 115 % of the nominal rated supply voltage during frequency tolerance test according to Section 15.225(e).

FCC Part 15.203 Antenna requirement

The EUT has a unique coupling/antenna connector.

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 Band Width	<ISED>RSS-Gen 6.7	-	N/A	-	Radiated

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

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 $k = 2$.

Conducted emission

using Item	Frequency range	Uncertainty (+/-)
AMN (LISN)	0.009 MHz to 0.15 MHz	3.4 dB
	0.15 MHz to 30 MHz	2.9 dB

Radiated emission

Measurement distance	Frequency range	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	3.3 dB
		3.2 dB
3 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	5.0 dB
	200 MHz to 1000 MHz (Horizontal)	5.2 dB
	(Vertical)	6.3 dB
10 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
	(Vertical)	4.8 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
	(Vertical)	5.0 dB
3 m	1 GHz to 6 GHz	4.9 dB
	6 GHz to 18 GHz	5.2 dB
1 m	10 GHz to 26.5 GHz	5.5 dB
	26.5 GHz to 40 GHz	5.5 dB

Antenna Terminal test

Test Item	Uncertainty (+/-)
Frequency Tolerance	0.0154 ppm
20 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %

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3.5 Test Location

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*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

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Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

The mode is used :

Mode	Remarks*
1) Transmitting mode (Tx)	The EUT Transmits and Receives at the same time and there is no receiving mode. The EUT was operated in a manner similar to typical use during the tests. * EUT was set by the software as follows; Software: ASI&AMI&NEX Series Operation Program Version 3.5.9.0 (Date: 2021.6.21, 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.

Test Item	Operating mode*
Conducted Emission	Tx Mod on, without Tag Tx Mod on, without Tag, with 50 ohm termination
Electric Field Strength of Fundamental Emission	Tx Mod on, without Tag
Spectrum Mask	Tx Mod on, without Tag
20 dB Bandwidth and 99 % Occupied Bandwidth	Tx Mod on, with Tag / without Tag
Electric Field Strength of Spurious Emission	Tx Mod on, without Tag
Frequency Tolerance	Tx Mod off

* After the comparison of the test data between with Tag and without Tag at pre-check, the tests were performed with the worst case.

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 5 V
 Maximum Voltage DC 5.75 V,
 Minimum Voltage DC 4.25 V (DC 5 V ±15 %)

*This EUT provides stable voltage constantly to RF Part regardless of input voltage

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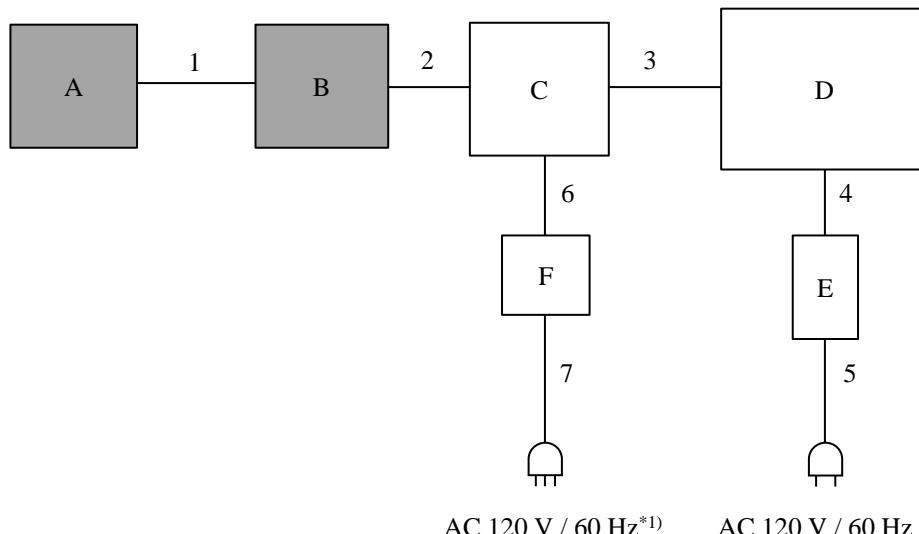
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4.2 Configuration and peripherals

[Conducted emission tests]



*1) Conducted emission test was performed on this port.

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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Antenna	AT3040	00001	Art Finex Co.,Ltd.	EUT *2)
B	Module	NEX5000S(LCP)	00001	Art Finex Co.,Ltd.	EUT *2)
C	Jig Board	RS-232CIFPCB	00001	Art Finex Co.,Ltd.	-
D	Laptop PC	PR63PBAA337AD7X	6F053913H	TOSHIBA	-
E	AC Adapter	PA51770-1ACA	FX10800NSKACC	TOSHIBA	-
F	DC Power Supply	PMC35-2A	13090501	KIKUSUI	-

*2) EUT (NEX5000S(LCP)) is composed of the Antenna (AT3040) and Module (NEX5000S(LCP)).

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.1	Unshielded	Unshielded	-
2	Signal Cable	0.1	Unshielded	Unshielded	-
3	USB Cable	1.8	Shielded	Shielded	-
4	DC Cable	1.7	Unshielded	Unshielded	-
5	AC Cable	0.8	Unshielded	Unshielded	-
6	DC Cable	1.6	Unshielded	Unshielded	-
7	AC Cable	1.0	Unshielded	Unshielded	-

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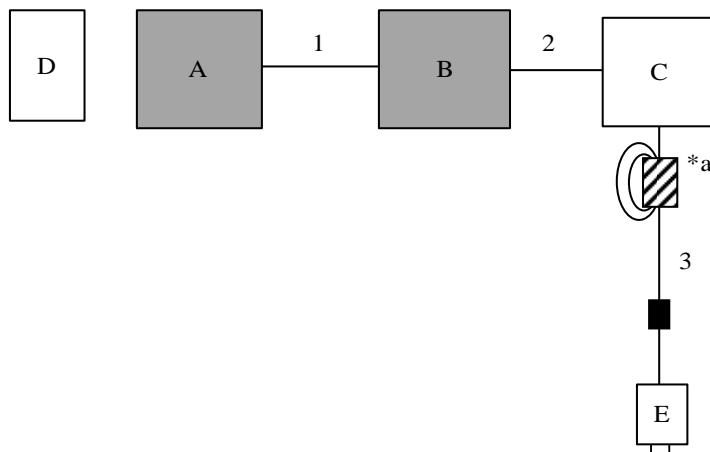
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[Radiated emission tests]



■ : Standard Ferrite Core

■ : Non-Standard Ferrite Core

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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Antenna	AT3040	00001	Art Finex Co.,Ltd.	EUT *1)
B	Module	NEX5000S(LCP)	00001	Art Finex Co.,Ltd.	EUT *1)
C	Jig Board	RS-232CIFPCB	00001	Art Finex Co.,Ltd.	-
D	Tag	TypeA	TU-C1-B52594	-	-
E	AC Adapter	STD-05015U	0813	Art Technology Inc.	-

*1) EUT (NEX5000S(LCP)) is composed of the Antenna (AT3040) and Module (NEX5000S(LCP)).

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.1	Unshielded	Unshielded	-
2	Signal Cable	0.1	Unshielded	Unshielded	-
3	DC Cable	1.6	Unshielded	Unshielded	-

<Notes for Ferrite cores>

*a) 1 Ferrite Core, Model No. 0431164181 (Manufacturer: Fair-Rite), 5cm from Item C, 3 turns

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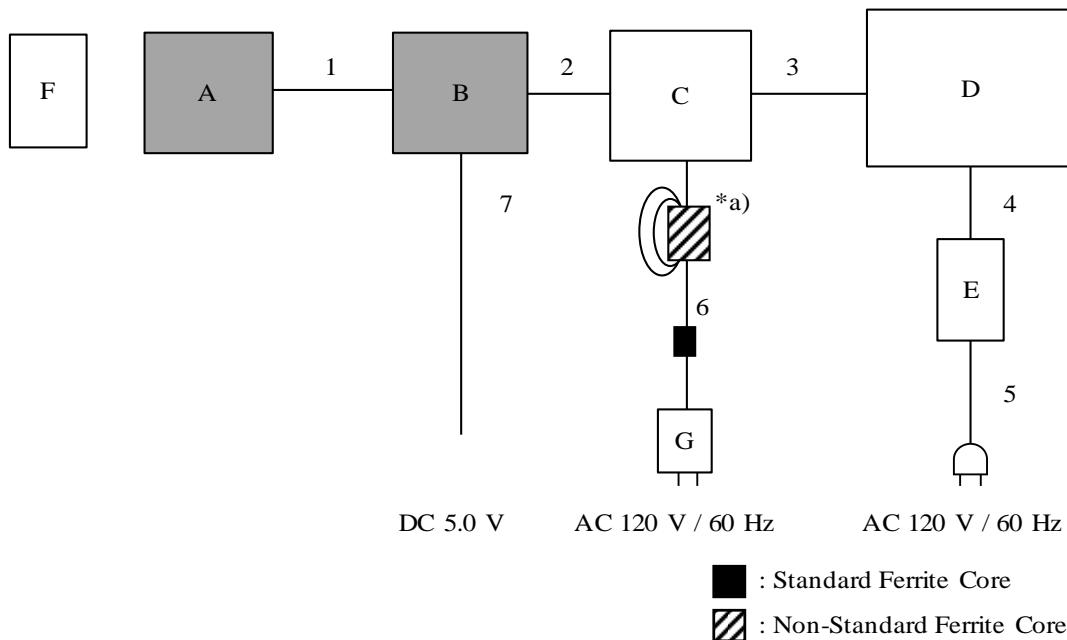
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[Frequency Tolerance test]



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Antenna	AT3040	00001	Art Finex Co.,Ltd.	EUT *1)
B	Module	NEX5000S(LCP)	00001	Art Finex Co.,Ltd.	EUT *1)
C	Jig Board	RS-232CIFPCB	00001	Art Finex Co.,Ltd.	-
D	Laptop PC	PR63PBAA337AD7X	6F053913H	TOSHIBA	-
E	AC Adapter	PA51770-1ACA	FX10800NSKACC	TOSHIBA	-
F	Tag	TypeA	TU-C1-B52594	-	-
G	AC Adapter	STD-05015U	0813	Art Technology Inc.	-

*1) EUT (NEX5000S(LCP)) is composed of the Antenna (AT3040) and Module (NEX5000S(LCP)).

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.1	Unshielded	Unshielded	-
2	Signal Cable	0.1	Unshielded	Unshielded	-
3	USB Cable	1.8	Shielded	Shielded	-
4	DC Cable	1.7	Unshielded	Unshielded	-
5	AC Cable	0.8	Unshielded	Unshielded	-
6	DC Cable	1.6	Unshielded	Unshielded	-
7	DC Cable	2.0	Unshielded	Unshielded	-

<Notes for Ferrite cores>

*a) 1 Ferrite Core, Model No. 0431164181 (Manufacturer: Fair-Rite), 5cm from Item C, 3 turns

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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.

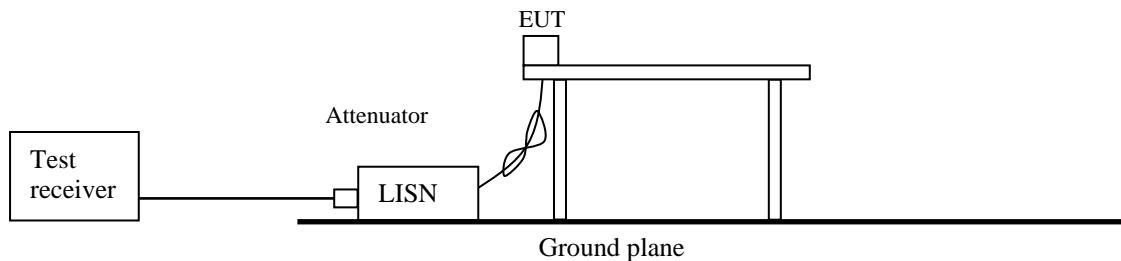
For the tests on EUT with other peripherals (as a whole system)

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 in a Semi Anechoic Chamber. The EUT 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

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

Test Procedure

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 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.) 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: $40 \times \log(3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

*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 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0 \text{ dBuA/m}$, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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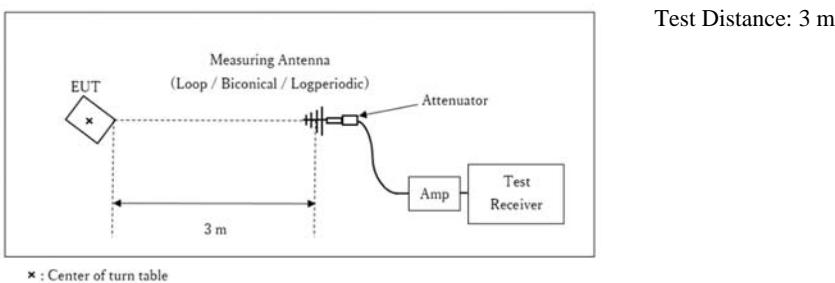
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[Test Setup]

Below 1 GHz



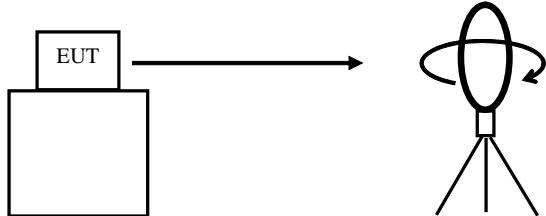
- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

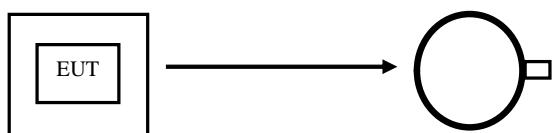
Measurement range : 9 kHz - 1 GHz
Test data : APPENDIX 1
Test result : Pass

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

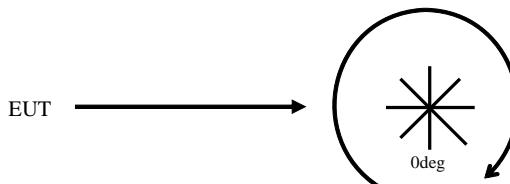


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

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SECTION 7: Other test

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
20 dB Bandwidth	5 MHz	15 kHz	47 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.
*2) The measurement was performed with Marker Frequency Counter Function.

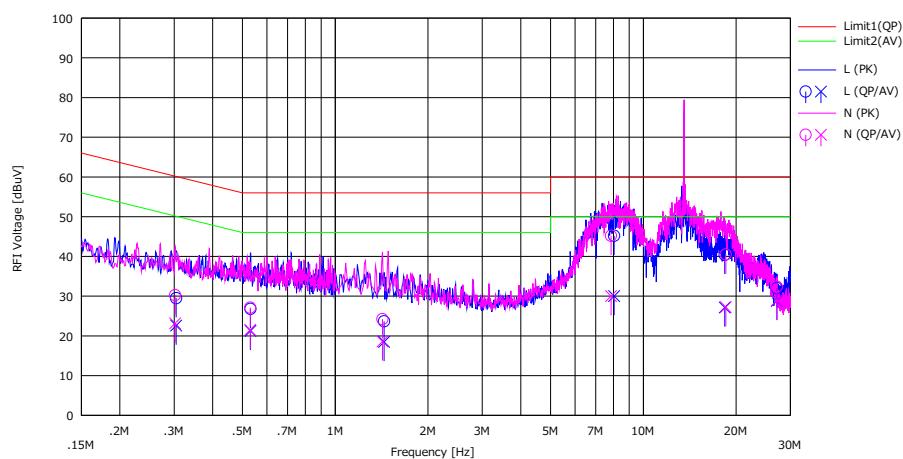
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

Report No. 13893268H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.4
 Date December 09, 2021
 Temperature / Humidity 23 deg. C / 42 % RH
 Engineer Hiroki Numata
 Mode Mode 1, without Tag

Limit : FCC_Part 15 Subpart C(15.207)



No.	Freq. [MHz]	Reading		LISN [dB]	LOSS [dB]	Results		Limit		Margin		Phase	Comment
		(QP) [dBuV]	(AV) [dBuV]			(QP) [dBuV]	(AV) [dBuV]	(QP) [dBuV]	(AV) [dBuV]	(QP) [dB]	(AV) [dB]		
1	0.30470	16.24	9.34	0.05	13.21	29.50	22.60	60.11	50.11	30.61	27.51	L	
2	0.53080	13.51	7.98	0.05	13.23	26.79	21.26	56.00	46.00	29.21	24.74	L	
3	1.44100	10.29	5.11	0.06	13.31	23.66	18.48	56.00	46.00	32.34	27.52	L	
4	8.03800	31.39	16.22	0.18	13.61	45.18	30.01	60.00	50.00	14.82	19.99	L	
5	18.38000	26.14	12.89	0.38	13.88	40.40	27.15	60.00	50.00	19.60	22.85	L	
6	27.12000	17.41	14.20	0.55	14.07	32.03	28.82	60.00	50.00	27.97	21.18	L	
7	0.30215	16.96	9.89	0.06	13.21	30.23	23.16	60.18	50.18	29.95	27.02	N	
8	0.52995	13.82	8.21	0.06	13.23	27.11	21.50	56.00	46.00	28.89	24.50	N	
9	1.42300	10.82	5.23	0.07	13.31	24.20	18.61	56.00	46.00	31.80	27.39	N	
10	7.85600	31.41	16.21	0.18	13.61	45.20	30.00	60.00	50.00	14.80	20.00	N	
11	18.52000	26.23	12.99	0.35	13.88	40.46	27.22	60.00	50.00	19.54	22.78	N	
12	27.12000	17.78	14.35	0.52	14.07	32.37	28.94	60.00	50.00	27.63	21.06	N	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
 Except for the above table: adequate margin data below the limits.

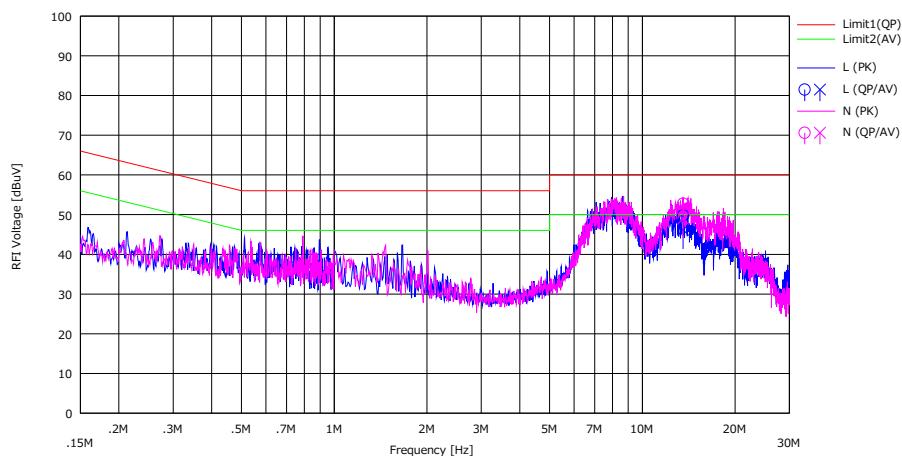
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Conducted Emission

Report No. 13893268H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.4
 Date December 09, 2021
 Temperature / Humidity 23 deg. C / 42 % RH
 Engineer Hiroki Numata
 Mode Mode 1, without Tag, with 50 ohm termination

Limit : FCC_Part 15 Subpart C(15.207)



No.	Freq. [MHz]	Reading		LISN [dB]	LOSS [dB]	Results		Limit		Margin		Phase	Comment
		(OP) [dBuV]	(AV) [dBuV]			(Q/P) [dBuV]	(AV) [dBuV]	(Q/P) [dBuV]	(AV) [dBuV]	(Q/P) [dB]	(AV) [dB]		
1	13.56000	35.78	32.11	0.29	13.77	49.84	46.17	60.00	50.00	10.16	3.83	L	
2	13.56000	38.72	34.91	0.27	13.77	52.76	48.95	60.00	50.00	7.24	1.05	N	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + LISN + LOSS (CABLE + ATT)
 Except for the above table: adequate margin data below the limits.

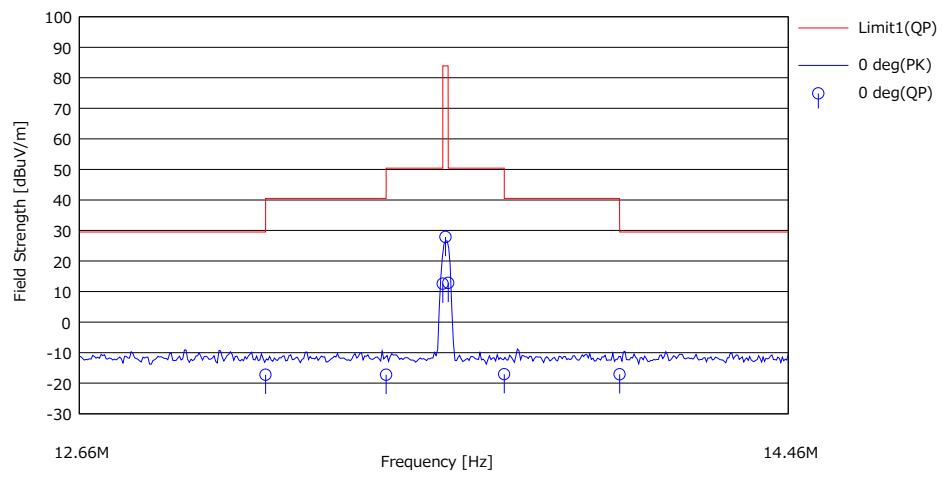
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Fundamental emission and Spectrum Mask

Report No. 13893268H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.3
 Date September 30, 2021
 Temperature / Humidity 24 deg. C / 55 % RH
 Engineer Hiroki Numata
 Mode Mode 1 without Tag

Limit : FCC15.225(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



No.	Freq. [MHz]	Reading (QP)	Ant.Foc [dB/m]	Loss [dB]	Gain [dB]	Result (QP)	Limit (QP)	Margin [dB]	Antenna [deg]	Table [deg]	Comment
		[dBuV]	[dBuV/m]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]			
1	13.11000	29.12	19.26	-33.32	32.32	-17.26	29.50	46.76	0 deg	2	
2	13.41000	29.11	19.27	-33.31	32.32	-17.25	40.50	57.75	0 deg	2	
3	13.55300	58.90	19.27	-33.31	32.32	12.54	50.40	37.86	0 deg	2	
4	13.56000	74.23	19.27	-33.31	32.32	27.87	83.90	56.03	0 deg	2	
5	13.56700	59.21	19.27	-33.31	32.32	12.85	50.40	37.55	0 deg	2	
6	13.71000	29.28	19.27	-33.30	32.32	-17.07	40.50	57.57	0 deg	2	
7	14.01000	29.25	19.28	-33.29	32.32	-17.08	29.50	46.58	0 deg	2	

RESULT = READING + ANT FACTOR + LOSS (CABLE + Attenuator + Distance Factor*) - GAIN(AMP))

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

Result of the fundamental emission at 3 m without Distance factor

QP											
Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	13.56000	QP	74.23	19.27	6.69	32.32	-	67.87	83.90	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amprifier)

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Spurious emission

Report No. 13893268H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.3
 Date September 30, 2021
 Temperature / Humidity 24 deg. C / 55 % RH
 Engineer Hiroki Numata
 Mode Mode 1 without Tag

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	27.120	QP	36.10	19.43	-32.96	32.28	-	-9.71	29.5	39.21	
0deg	29.489	QP	43.89	19.44	-32.91	32.27	-	-1.85	29.5	31.35	
Hori.	67.800	QP	49.40	6.56	7.76	32.26	-	31.46	40.0	8.54	
Hori.	149.160	QP	43.21	15.02	8.73	32.21	-	34.75	43.5	8.77	
Hori.	203.400	QP	46.54	11.76	9.25	32.17	-	35.38	43.5	8.14	
Hori.	230.520	QP	54.80	11.99	9.48	32.15	-	44.12	46.0	1.90	
Hori.	257.640	QP	50.70	12.33	9.71	32.12	-	40.62	46.0	5.40	
Hori.	284.760	QP	49.51	13.87	9.94	32.10	-	41.22	46.0	4.80	
Vert.	67.800	QP	49.32	6.56	7.76	32.26	-	31.38	40.0	8.62	
Vert.	149.160	QP	34.46	15.02	8.73	32.21	-	26.00	43.5	17.52	
Vert.	203.400	QP	38.12	11.76	9.25	32.17	-	26.96	43.5	16.56	
Vert.	230.520	QP	46.22	11.99	9.48	32.15	-	35.54	46.0	10.48	
Vert.	257.640	QP	41.12	12.33	9.71	32.12	-	31.04	46.0	14.98	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor) - Gain(Amplifier)

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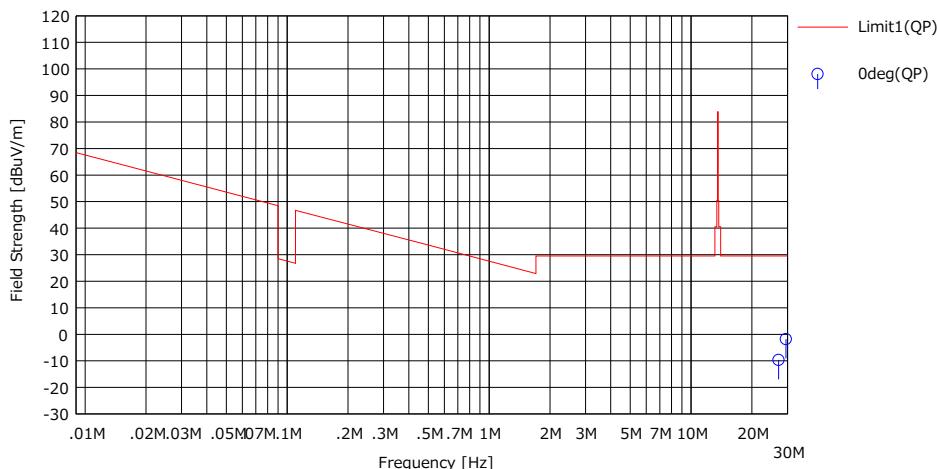
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Radiated Emission Plot data, Worst case

Report No. 13893268H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.3
 Date September 30, 2021
 Temperature / Humidity 24 deg. C / 55 % RH
 Engineer Hiroki Numata
 Mode Mode 1

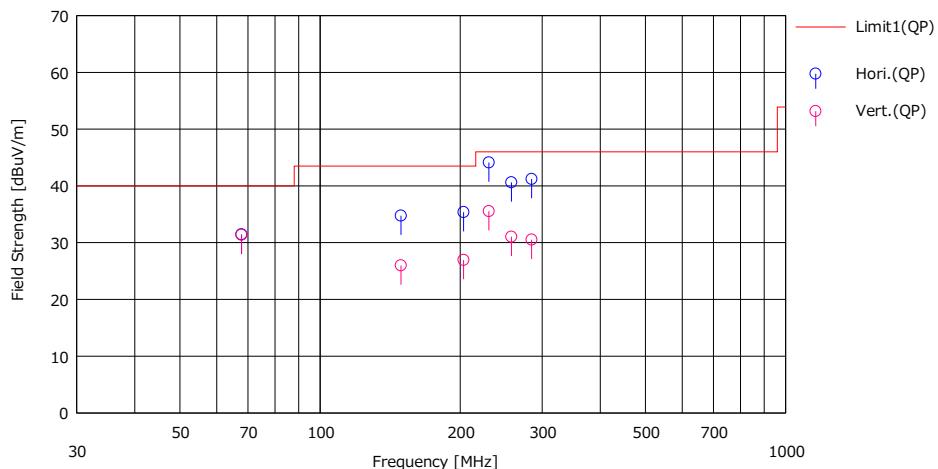
(below 30MHz)

Limit : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



* Data above 490 kHz were measured using a QP detector.

(above 30MHz)



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

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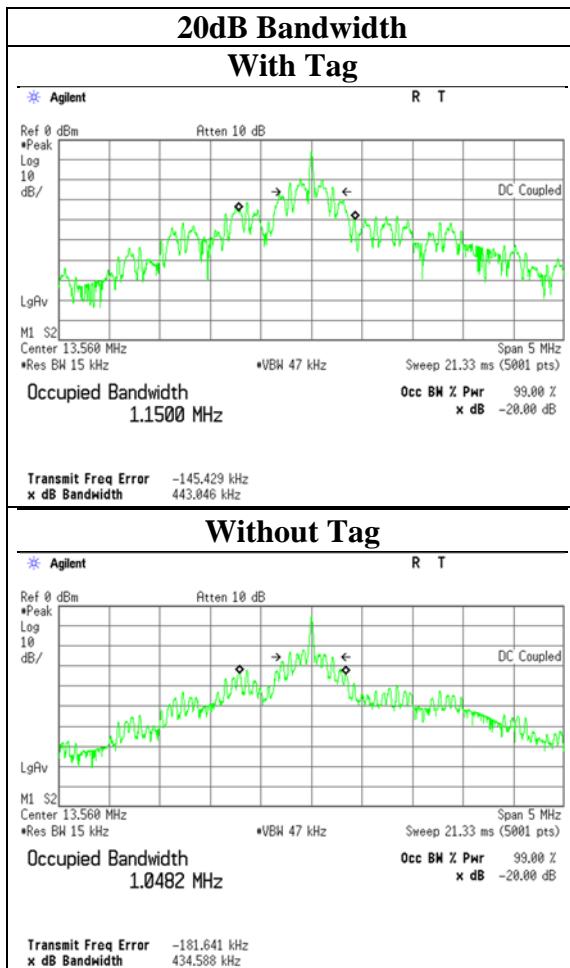
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20 dB Bandwidth and 99% Occupied Bandwidth

Report No. 13893268H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.6
 Date October 19, 2021
 Temperature / Humidity 24 deg. C / 43 % RH
 Engineer Junki Nagatomi
 Mode Mode 1

FREQ [MHz]	Mode	99% Occupied Bandwidth [MHz]	20dB Bandwidth [kHz]
13.56	With Tag	1.1500	443.046
	Without Tag	1.0482	434.588



Frequency Tolerance

Report No. 13893268H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.6
 Date October 19, 2021 October 20, 2021
 Temperature / Humidity 24 deg. C / 43 % RH 21 deg. C / 42 % RH
 Engineer Junki Nagatomi Junki Nagatomi
 Mode Mode 1

Temp. [deg. C]	Voltage [V]	Tested timing	Measured frequency [MHz]	Frequency error [MHz]	Result		Limit [+/- %]
					[%]	[ppm]	
50	5	Power on	13.559960	-0.000040	-0.00030	-3.0	0.01
		+ 2 min.	13.559959	-0.000041	-0.00031	-3.1	0.01
		+ 5 min.	13.559958	-0.000042	-0.00031	-3.1	0.01
		+ 10 min.	13.559958	-0.000042	-0.00031	-3.1	0.01
40	5	Power on	13.559974	-0.000026	-0.00019	-1.9	0.01
		+ 2 min.	13.559971	-0.000029	-0.00021	-2.1	0.01
		+ 5 min.	13.559969	-0.000031	-0.00023	-2.3	0.01
		+ 10 min.	13.559969	-0.000031	-0.00023	-2.3	0.01
30	5	Power on	13.560001	0.000001	0.00001	0.1	0.01
		+ 2 min.	13.559997	-0.000003	-0.00002	-0.2	0.01
		+ 5 min.	13.559995	-0.000005	-0.00003	-0.3	0.01
		+ 10 min.	13.559994	-0.000006	-0.00004	-0.4	0.01
20	5	Power on	13.560006	0.000006	0.00005	0.5	0.01
		+ 2 min.	13.560006	0.000006	0.00004	0.4	0.01
		+ 5 min.	13.560006	0.000006	0.00004	0.4	0.01
		+ 10 min.	13.560005	0.000005	0.00004	0.4	0.01
20	4.25 (5V -15%)	Power on	13.560007	0.000007	0.00005	0.5	0.01
		+ 2 min.	13.560007	0.000007	0.00005	0.5	0.01
		+ 5 min.	13.560007	0.000007	0.00005	0.5	0.01
		+ 10 min.	13.560007	0.000007	0.00005	0.5	0.01
20	5.75 (5V +15%)	Power on	13.560011	0.000011	0.00008	0.8	0.01
		+ 2 min.	13.560008	0.000008	0.00006	0.6	0.01
		+ 5 min.	13.560006	0.000006	0.00004	0.4	0.01
		+ 10 min.	13.560005	0.000005	0.00004	0.4	0.01
10	5	Power on	13.560056	0.000056	0.00041	4.1	0.01
		+ 2 min.	13.560053	0.000053	0.00039	3.9	0.01
		+ 5 min.	13.560053	0.000053	0.00039	3.9	0.01
		+ 10 min.	13.560053	0.000053	0.00039	3.9	0.01
0	5	Power on	13.560067	0.000067	0.00050	5.0	0.01
		+ 2 min.	13.560067	0.000067	0.00049	4.9	0.01
		+ 5 min.	13.560066	0.000066	0.00049	4.9	0.01
		+ 10 min.	13.560066	0.000066	0.00049	4.9	0.01
-10	5	Power on	13.560049	0.000049	0.00036	3.6	0.01
		+ 2 min.	13.560053	0.000053	0.00039	3.9	0.01
		+ 5 min.	13.560054	0.000054	0.00040	4.0	0.01
		+ 10 min.	13.560054	0.000054	0.00040	4.0	0.01
-20	5	Power on	13.560017	0.000017	0.00013	1.3	0.01
		+ 2 min.	13.560020	0.000020	0.00015	1.5	0.01
		+ 5 min.	13.560021	0.000021	0.00016	1.6	0.01
		+ 10 min.	13.560022	0.000022	0.00016	1.6	0.01

Calculation formula:

Frequency error = Measured frequency - Tested frequency

Result [%] = Frequency error / Tested frequency * 100

Tested frequency:

13.56 MHz

Limit (+/-):

0.01 % (+/- 100ppm)

*The test was begun from 50 deg.C and the temperature was lowered each 10 deg.C.

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APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/05/2021	12
CE	MCC-113	141217	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM141/421-010/sucoform141-PE/RFM-E121(SW)	-/04178	06/02/2021	12
CE	MAT-67	141248	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	12/07/2020	12
CE	MLS-24	141358	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-730	07/18/2021	12
CE	MLS-23	141357	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-729	07/18/2021	12
CE	MTA-56	141938	Terminator	TME	CT-01BP	-	12/04/2020	12
CE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/25/2020	24
CE	MOS-15	141562	Thermo-Hygrometer	CUSTOM, Inc	CTH-201	0010	01/15/2021	12
CE	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/07/2021	12
CE	MJM-29	142230	Measure	KOMELON	KMC-36	-	-	-
CE	COTS-ME MI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MSA-04	141885	Spectrum Analyzer	Keysight Technologies Inc	E4448A	US44300523	11/09/2020	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/18/2021	12
RE	MAT-07	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/13/2020	12
RE	MLPA-01	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	04/17/2021	12
RE	MCC-255	207745	Coaxial Cable	UL Japan Inc.	-	-	05/17/2021	12
RE	MCC-112	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/sucoform141-PE/421-010/RFM-E321(SW)	-/00640	07/19/2021	12
RE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2020	24
RE	MOS-13	141554	Thermo-Hygrometer	CUSTOM, Inc	CTH-201	1301	01/15/2021	12
RE	COTS-ME MI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAT-95	142314	Attenuator	Pasternack Enterprises	PE7390-6	D/C 1504	06/09/2021	12
RE	MBA-03	141424	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	1915	08/21/2021	12
RE	MCC-51	141323	Coaxial cable	UL Japan	-	-	07/19/2021	12
RE	MLA-22	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-191	08/21/2021	12
RE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/05/2021	12
FT	MOS-14	141561	Thermo-Hygrometer	CUSTOM, Inc	CTH-201	1401	01/15/2021	12
FT	MMM-18	141558	Digital Tester(TRUE RMS MULTIMETER)	Fluke Corporation	115	17930030	05/24/2021	12
FT	MJM-24	142225	Measure	ASKUL	-	-	-	-
FT	MSA-14	141901	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY48250080	12/18/2020	12
FT	MLPA-07	142645	Loop Antenna	UL Japan	-	-	-	-
FT	MCH-04	141429	Temperature and Humidity Chamber	Espec	PL-2KP	14015723	08/05/2021	12

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*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