



# RADIO TEST REPORT

## Test Report No.: 11641334S-A-R2

**Applicant** : ART Finex Co., Ltd.

**Type of Equipment** : RFID Reader/Writer Unit

**Model No.** : AMG3002

**FCC ID** : 2AM8P-3680

**Test regulation** : FCC Part15 Subpart C: 2017

**Test result** : Complied

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. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
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. This report is a revised version of 11641334S-A-R1.

**Date of test:** March 21 to June 22, 2017

**Representative test engineer:** M. Hosaka  
Makoto Hosaka  
Engineer  
Consumer Technology Division

**Approved by :** S. Takano  
Shinichi Takano  
Engineer  
Consumer Technology Division



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

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**Shonan EMC Lab.**

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13-EM-F0429

## REVISION HISTORY

## Original Test Report No.: 11641334S-A

**UL Japan, Inc.**  
**Shonan EMC Lab.**  
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## **SECTION 1: Customer information**

Company Name : ART Finex Co., Ltd.  
Address : 6-1-33 Kamikoubata-cho, Sabae-shi, Fukui-ken, 916-0037 Japan  
Telephone Number : +81-0778-54-8085  
Facsimile Number : +81-0778-54-8089  
Contact Person : Akio Yamamoto

## **SECTION 2: Equipment under test (E.U.T.)**

### **2.1 Identification of E.U.T.**

Type of Equipment : RFID Reader/Writer Unit  
Model No. : AMG3002  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC 12 V - 24 V  
Receipt Date of Sample : March 18, 2017  
Country of Mass-production : Japan  
Condition of EUT : Engineering prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)  
Modification of EUT : No Modification by the test lab

### **2.2 Product description**

Model: AMG3002 (referred to as the EUT in this report) is a RFID Reader/Writer Unit.

#### **General Specification**

Clock frequency(ies) in the system : 27.12 MHz, 18.432 MHz

#### **Radio Specification**

##### **NFC**

Radio Type : Transceiver  
Frequency of Operation : 13.56 MHz  
Modulation : ASK  
ITU code : A1D

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## **SECTION 3: Test specification, procedures & results**

### **3.1 Test specification**

Test specification : FCC Part 15 Subpart  
 FCC Part 15 final revised on September 1, 2017 and effective October 2, 2017

Title : FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators  
 Section 15.207 Conducted limits  
 Section 15.209 Radiated emission limits, general requirements  
 Section 15.215 Additional provisions to the general radiated emission limitations.  
 Section 15.225 Operation within the bands 13.110 - 14.010 MHz.

\* All the revisions made after testing date do not affect the test specification applied to the EUT.

### **3.2 Procedures & Results**

Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
Conducted emission	ANSI C63.10:2013 6 Standard test methods <IC>RSS-Gen 8.8	FCC 15.207 <IC> RSS-Gen 8.8	-	N/A	1.4 dB (13.56000 MHz, AV, N, ANT1 Terminated)	Complied
Electric field strength of Fundamental emission	ANSI C63.10:2013 6 Standard test methods <IC>RSS-Gen 6.4, 6.12	FCC 15.225 (a) <IC> RSS-210 B.6	Radiated	N/A	75.6 dB (Vertical)	Complied
Electric field strength of Spurious emission (within the 13.110-14.010 MHz band)	ANSI C63.10:2013 6 Standard test methods <IC>RSS-Gen 6.4, 6.13	FCC 15.225 (b)(c) <IC> RSS-210 B.6	Radiated	N/A	45.3 dB (13.110 MHz, Vertical) (14.010 MHz, Vertical)	Complied
Electric field strength of Spurious emission (outside of the 13.110-14.010 MHz band)	ANSI C63.10:2013 6 Standard test methods <IC>RSS-Gen 6.4, 6.13	FCC 15.209 FCC 15.225 (d) <IC> RSS-210 B.6	Radiated	N/A	5.6 dB (40.68 MHz, Vertical)	Complied
20dB bandwidth	ANSI C63.10:2013 6 Standard test methods <IC> -	FCC 15.215 (c) <IC> -	Radiated	N/A	-	-
Frequency tolerance	ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.11, 8.11	FCC 15.225 (e) <IC> RSS-210 B.6	Radiated	N/A	-	Complied

Note: UL Japan's Work Procedures No. 13-EM-W0420

### **FCC Part 15.31 (e)**

This EUT provides stable voltage (DC 5 V) constantly to RF part regardless of input voltage. Therefore, this EUT complies with the requirement.

### **FCC Part 15.203 Antenna requirement**

Type of Equipment complies with the requirement of 15.203, because the antenna that uses a unique coupling (indicate the name of a unique antenna connector) to the intentional radiator in this equipment is used.

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### 3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99 %)	ANSI C63.10:2013 6.Standard test methods RSS-Gen 6.6	RSS-Gen 4.6.1	Conducted	-	-

Note: UL Japan's EMI Work Procedures No.13-EM-W0420.

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

### 3.4 Uncertainty

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 SAC / SR	No. 5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.5 dB	2.6 dB	2.5 dB	2.5 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.1 dB	3.1 dB	3.1 dB	-	-
	30 MHz-200 MHz	4.6 dB	4.4 dB	4.6 dB	-	-
	200 MHz-1 GHz	5.8 dB	5.7 dB	5.8 dB	-	-
	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Bandwidth Measurement	1.01 %
Duty cycle and Time Measurement	0.012 %
Temperature uncertainty	0.95 deg.C
Voltage uncertainty	0.24 %

#### Conducted emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

#### Radiated emission test

The data listed in this test report has enough margin, more than site margin.

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### 3.5 Test location

UL Japan, Inc. Shonan EMC Lab.

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Telephone number : +81 463 50 6400

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JAB Accreditation No. : RTL02610

	IC Registration No.	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 setup, Data of EMI & Test instruments

Refer to APPENDIX.

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## **SECTION 4: Operation of E.U.T. during testing**

### **4.1 Operating mode**

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

Test item	Operating mode	Tested frequency
All items except for Frequency Tolerance	NFC Transmitting	13.56 MHz
Frequency Tolerance	Transmitting (Unmodulated)	13.56 MHz

Software : Ver 1.0

Power setting: Fixed

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

Combinations of the worst case:

Conducted emission (Carrier)	Radiated emission (Carrier)	Radiated emission (Below 30MHz)	Radiated emission (Above 30MHz)
With Tag (ANT1)	With Tag (ANT2)	With Tag (ANT2)	With Tag (ANT2)

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

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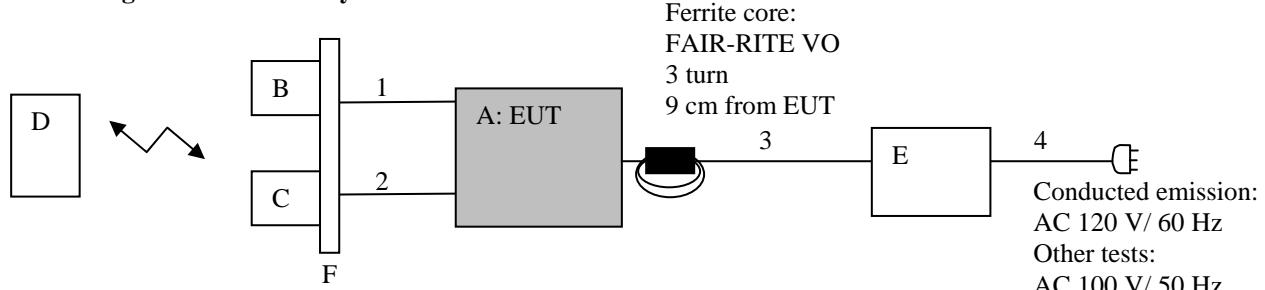
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#### 4.2 Configuration of tested system



\* Test data was taken under worse case conditions.

#### Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	RFID Reader/Writer Unit	AMG3002	H030001 *1) H030002 *2) H030003 *3)	ART FINEX Co., Ltd.	EUT
B	Antenna	AT1M12-300R	No.5	ART FINEX Co., Ltd.	ANT1
C	Antenna	AT1M12-300R	No.3 *3) No.10 *4)	ART FINEX Co., Ltd.	ANT2
D	ISO15693 tag	ACS-EG-CS-SLI	0C-002	E-Garde Incorporated	-
E	DC power supply	PAN35-10A	DE001677	KIKUSUI ELECTRONICS CORP.	-
F	Jig	-	-	ART FINEX Co., Ltd.	*5)

\*1) Frequency Tolerance

\*2) Conducted emission, Radiated emission, Frequency Tolerance

\*3) Frequency Tolerance, Bandwidth

\*4) Conducted emission, Radiated emission

\*5) This item was used to fix the antenna and that does not affect the test result.

#### List of cables used

No.	Cable Name	Length (m)	Shield Cable	Connector	Remark
1	Antenna	3.0	Shielded	Shielded	-
2	Antenna	3.0	Shielded	Shielded	-
3	DC	1.1 *6) 2.0 *7)	Unshielded	Unshielded	-
4	AC	2.0	Unshielded	Unshielded	-

\*6) Conducted emission, Radiated emission

\*7) Frequency Tolerance, Bandwidth

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## **SECTION 5: Conducted emission**

### **5.1 Operating environment**

Test place : See test data (APPENDIX 1)  
Temperature : See test data (APPENDIX 1)  
Humidity : See test data (APPENDIX 1)

### **5.2 Test configuration**

EUT was placed on a platform of nominal size, 1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and was flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from LISN and excess AC cable was bundled in center. I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the input power source. Photographs of the set up are shown in APPENDIX 3.

### **5.3 Test conditions**

Frequency range : 0.15 MHz - 30 MHz  
EUT position : Table top

### **5.4 Test procedure**

The AC Mains Terminal Continuous disturbance Voltage had been measured with the EUT via DC power supply within a Shielded room. The EUT via DC power supply was connected to a Line Impedance Stabilization Network (LISN).

An overview sweep with peak detection has been performed.

The measurements had been performed with a quasi-peak detector and if required, an average detector.

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

Detection Type : Quasi-Peak/ Average  
IF Bandwidth : 9 kHz

### **5.5 Results**

Summary of the test results : Pass  
Refer to APPENDIX 1

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## **SECTION 6: Radiated emission**

### **6.1 Operating environment**

Test place : See test data (APPENDIX 1)  
Temperature : See test data (APPENDIX 1)  
Humidity : See test data (APPENDIX 1)

### **6.2 Test configuration**

EUT was placed on a platform of normal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. Photographs of the set up are shown in Appendix 3..

### **6.3 Test procedure**

The Radiated Electric Field Strength intensity has been measured on a semi-anechoic chamber with a ground plane at a distance of 3 m.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are 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 KDB414788. 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 Radiated Electric Field Strength intensity has been measured with a ground plane and at a distance of 3 m.

Frequency: From 9 kHz to 30 MHz at distance 3 m (Refer to Figure 2)

The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg. and 135 deg.) and horizontal polarization. Drawing of the antenna direction is shown in Figure 1.

Frequency: From 30 MHz to 1 GHz at distance 3 m (Refer to Figure 2).

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

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

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

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

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

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

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

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

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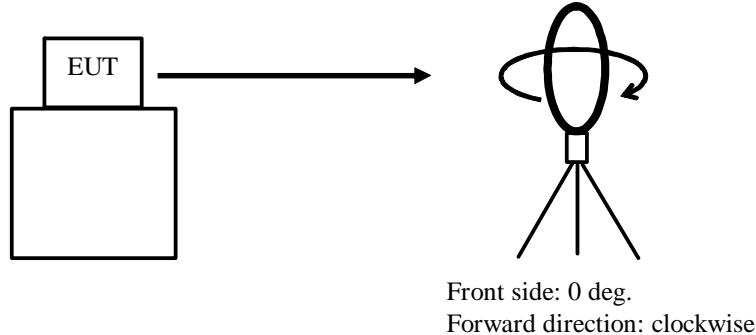
The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Combinations of the worst case

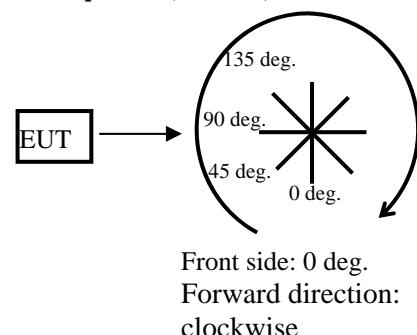
	Frequency Antenna polarization	Below 30 MHz	Above 30 MHz
Unit	Horizontal	X	Y
	Vertical		X
Antenna	Horizontal	X	X
	Vertical		X

Figure 1. Direction of the Loop Antenna

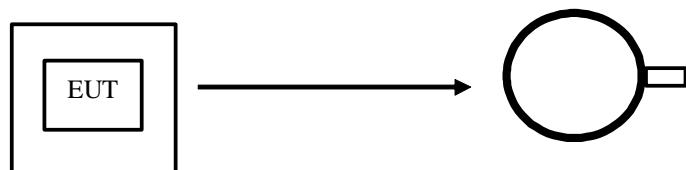
*Side View (Vertical)*



*Top View (Vertical)*



*Top View (Horizontal)*



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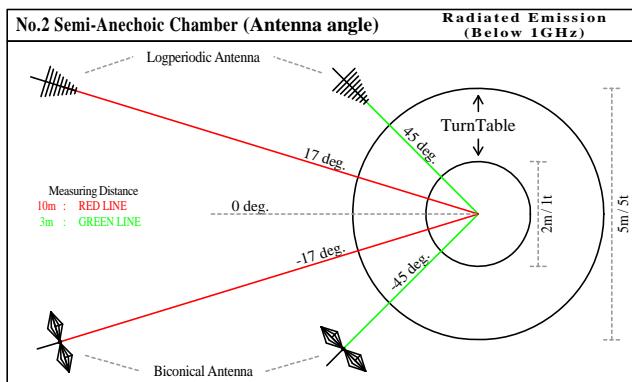
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**Figure 2. Antenna angle**



#### 6.4 Results

Summary of the test results : Pass

Refer to APPENDIX 1

## **SECTION 7: 20 dB bandwidth & Occupied bandwidth (99 %)**

### **Test procedure**

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

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 20 dB Bandwidth	1 to 5 % of Span	Three times of RBW	Auto (Single)	Sample	Max Hold *1)	Spectrum Analyzer

\*1) Peak hold was applied as Worst-case measurement.

Summary of the test results: Pass

Refer to APPENDIX 1

## **SECTION 8: Frequency Tolerance**

### **Test procedure**

The test was measured with a frequency counter using a test fixture.

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

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

Summary of the test results: Pass

Refer to APPENDIX 1

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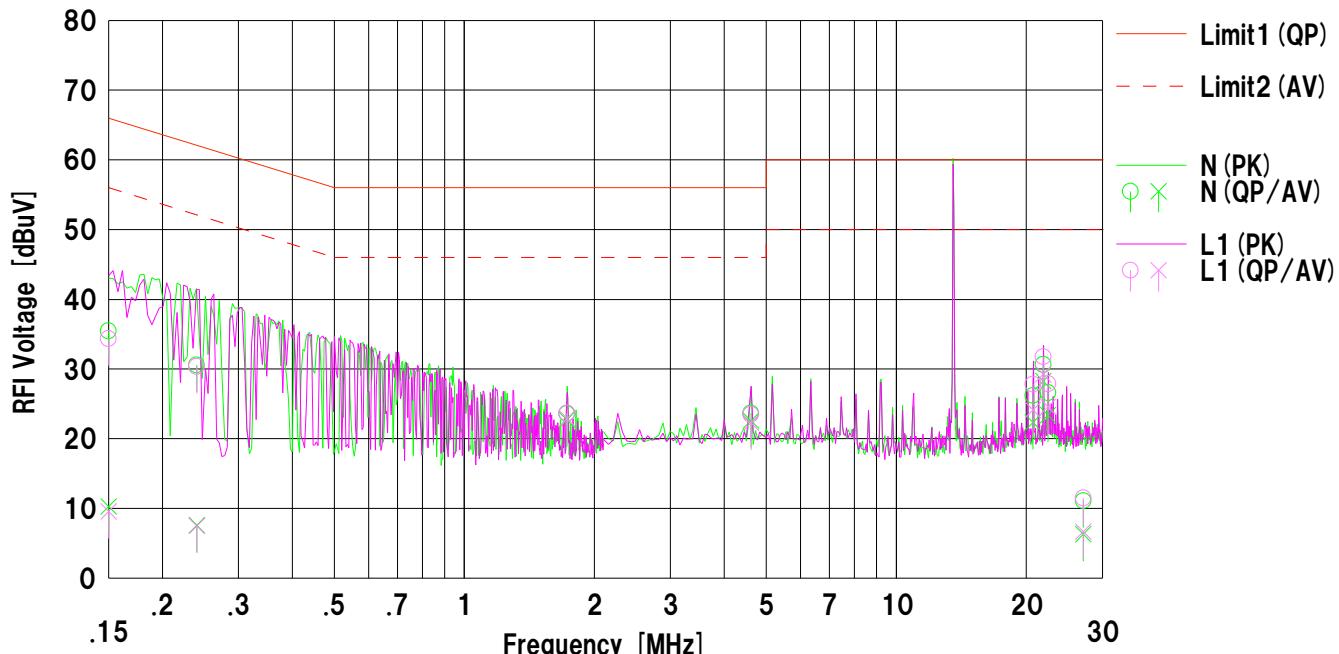
# DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room  
Date : 2017/06/15

Company	: ART Finex Co., Ltd.	Mode	: Communication (ISO15693) 13.56 MHz
Kind of EUT	: RFID Reader/Writer Unit	Order No.	: 11641334S
Model No.	: AMG3002	Power	: DC 24 V (AC 120V/ 60 Hz)
Serial No.	: H030002	Temp./Humi.	: 22 deg.C / 58 %RH
Remarks	: ANT1 with Tag		

Limit1 : FCC 15C(15.207) QP  
Limit2 : FCC 15C(15.207) AV

Engineer : Takahiro Suzuki



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	23.00	-2.20	12.46	35.46	10.26	66.00	56.00	30.5	45.7	N	
2	0.24000	18.10	-4.90	12.47	30.57	7.57	62.10	52.10	31.5	44.5	N	
3	1.72840	10.90	10.00	12.70	23.60	22.70	56.00	46.00	32.4	23.3	N	
4	4.60900	10.70	9.60	12.98	23.68	22.58	56.00	46.00	32.3	23.4	N	
5	20.74140	12.10	8.20	14.11	26.21	22.31	60.00	50.00	33.7	27.6	N	
6	21.89320	16.50	14.10	14.16	30.66	28.26	60.00	50.00	29.3	21.7	N	
7	22.46980	12.40	9.20	14.19	26.59	23.39	60.00	50.00	33.4	26.6	N	
8	27.12000	-3.30	-8.10	14.39	11.09	6.29	60.00	50.00	48.9	43.7	N	
9	0.15000	21.90	-2.90	12.46	34.36	9.56	66.00	56.00	31.6	46.4	L1	
10	0.24000	17.90	-5.00	12.47	30.37	7.47	62.10	52.10	31.7	44.6	L1	
11	1.72900	11.00	10.20	12.70	23.70	22.90	56.00	46.00	32.3	23.1	L1	
12	4.61120	10.50	9.30	12.98	23.48	22.28	56.00	46.00	32.5	23.7	L1	
13	20.74650	13.70	10.00	14.11	27.81	24.11	60.00	50.00	32.1	25.8	L1	
14	21.89920	17.60	15.10	14.16	31.76	29.26	60.00	50.00	28.2	20.7	L1	
15	22.47430	13.70	10.40	14.19	27.89	24.59	60.00	50.00	32.1	25.4	L1	
16	27.12000	-2.90	-7.70	14.39	11.49	6.69	60.00	50.00	48.5	43.3	L1	

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

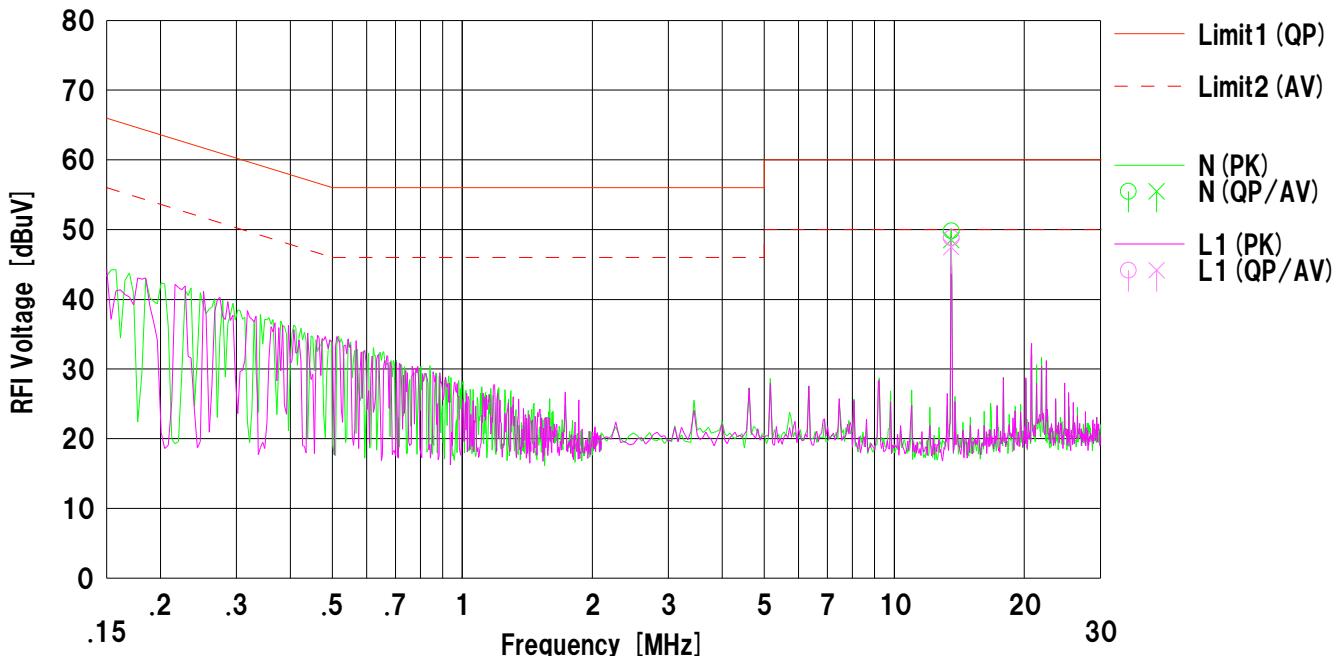
# DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.1 Shielded Room  
Date : 2017/06/15

Company	: ART Finex Co., Ltd.	Mode	: Communication (ISO15693) 13.56 MHz
Kind of EUT	: RFID Reader/Writer Unit	Order No.	: 11641334S
Model No.	: AMG3002	Power	: DC 24 V (AC 120 V/ 60 Hz)
Serial No.	: H030002	Temp./Humi.	: 22 deg.C / 58 %RH
Remarks	: ANT1 Terminated		

Limit1 : FCC 15C(15.207) QP  
Limit2 : FCC 15C(15.207) AV

Engineer : Takahiro Suzuki



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
		[MHz]	[dBuV]		[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dB]		
1	13.56000	36.20	34.90	13.61	49.81	48.51	60.00	50.00	10.1	1.4	N	
2	13.56000	35.20	33.90	13.61	48.81	47.51	60.00	50.00	11.1	2.4	L1	

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

## Data of Electric field strength of Fundamental emission and Spurious emission within the band: FCC15.225(a)(b)(c)

UL Japan, Inc.  
Shonan EMC Lab. No.2 Semi Anechoic Chamber

Company:	ART Finex Co., Ltd.	Regulation:	FCC Part15 Subpart C 15.225
Equipment:	RFID Reader/Writer Unit	Test Distance:	3m
Model:	AMG3002	Date:	June 22, 2017
Sample No.:	H030002	Temperature:	24 deg C
Power:	DC 24 V	Humidity:	59 %RH
Mode:	Transmitting 13.56 MHz	ENGINEER:	Makoto Hosaka

Remarks: : [EUT] Horizontal: X-axis, Vertical: X-axis/ [Antenna]Horizontal: X-axis, Vertical: X-axis, with Tag, ANT2  
Vertical polarization (antenna angle) of the worst case: 90 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	51.6	54.7	18.9	6.7	31.9	-40.0	5.2	8.3	83.9	78.7	75.6

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	13.110	30.3	30.5	19.0	6.6	31.9	-40.0	-16.0	-15.8	29.5	45.5	45.3
2	13.410	30.3	30.2	18.9	6.7	31.9	-40.0	-16.1	-16.16	40.5	56.6	56.7
3	13.553	38.5	41.3	18.9	6.7	31.9	-40.0	-7.9	-5.1	50.4	58.3	55.5
4	13.567	38.5	41.4	18.9	6.7	31.9	-40.0	-7.9	-5.0	50.4	58.3	55.4
5	13.710	30.1	30.3	18.8	6.7	31.9	-40.0	-16.3	-16.13	40.5	56.8	56.6
6	14.010	30.4	30.7	18.8	6.7	31.9	-40.0	-16.1	-15.79	29.5	45.6	45.3

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)

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## Radiated Emission

UL Japan, Inc.  
Shonan EMC Lab. No.2 Semi Anechoic Chamber

Company:	ART Finex Co., Ltd.	Regulation:	FCC Part15 Subpart C 15.225
Equipment:	RFID Reader/Writer Unit	Test Distance:	3m
Model:	AMG3002	Date:	June 22, 2017
Sample No.:	H030002	Temperature:	24 deg.C
Power:	DC 24 V	Humidity:	59 %RH
Mode:	Transmitting 13.56 MHz	ENGINEER:	Makoto Hosaka
EUT axis:	Below 30 MHz([EUT] Horizontal: X-axis, Vertical: X-axis/ [Antenna]Horizontal: X-axis, Vertical: X-axis), with Tag, ANT2		
	Above 30 MHz([EUT] Horizontal: Y-axis, Vertical: X-axis/ [Antenna]Horizontal: X-axis, Vertical: X-axis), with Tag, ANT2		
Remarks:			

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	29.9	18.6	7.0	31.9	-40.0	-16.5	29.5	46.0	-	30	* Limit: 30m
Hori.	40.68	QP	39.3	14.2	7.1	31.9	0.0	28.6	40.0	11.4	256	301	
Hori.	67.80	QP	36.1	6.6	7.2	31.9	0.0	18.0	40.0	22.0	284	279	
Hori.	77.880	QP	43.8	6.3	8.0	31.9	0.0	26.2	40.0	13.8	400	129	
Hori.	88.163	QP	45.2	7.8	8.2	31.9	0.0	29.4	43.5	14.1	362	70	
Hori.	170.149	QP	39.1	15.7	8.8	31.8	0.0	31.9	43.5	11.6	198	8	
Hori.	176.287	QP	39.6	16.0	8.8	31.8	0.0	32.6	43.5	10.9	182	354	
Hori.	216.962	QP	47.3	11.5	6.0	31.7	0.0	33.0	46.0	13.0	160	121	
Vert.	27.12	QP	30.3	18.6	7.0	31.9	-40.0	-16.1	29.5	45.6	-	221	* Limit: 30m
Vert.	40.68	QP	45.1	14.2	7.1	31.9	0.0	34.4	40.0	5.6	100	219	
Vert.	67.80	QP	40.0	6.6	7.2	31.9	0.0	21.9	40.0	18.1	100	59	
Vert.	84.063	QP	41.6	7.0	8.2	31.9	0.0	25.0	40.0	15.0	100	105	
Vert.	88.163	QP	49.9	7.8	8.2	31.9	0.0	34.1	43.5	9.4	100	208	

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= 45.2 dBuV/m, Ver= 48.3 dBuV/m

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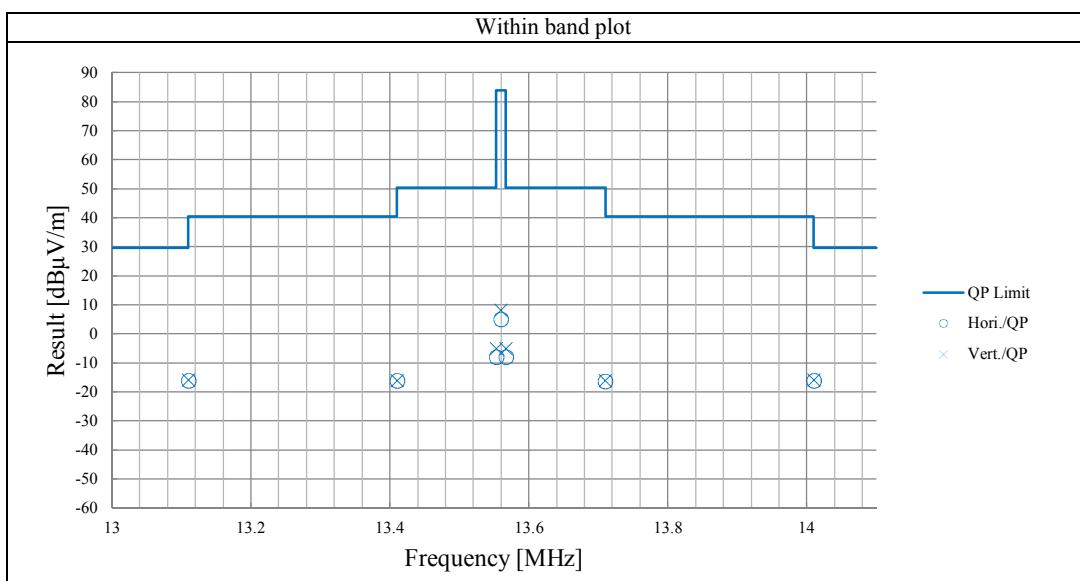
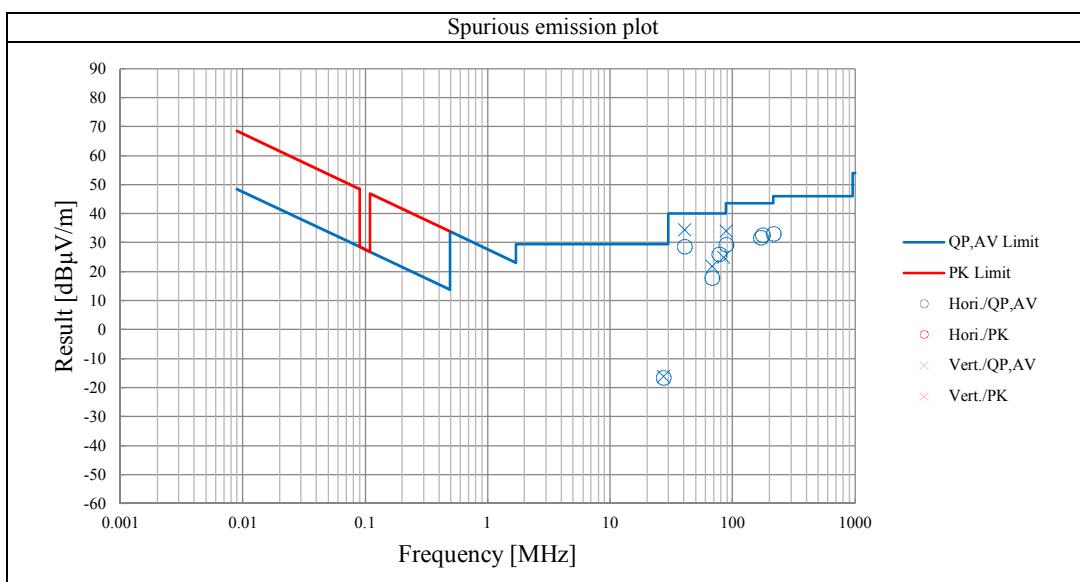
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## Radiated Emission (Worst mode plot)

UL Japan, Inc.  
Shonan EMC Lab. No.2 Semi Anechoic Chamber

Company: ART Finex Co., Ltd.  
Equipment: RFID Reader/Writer Unit  
Model: AMG3002  
Sample No.: H030002  
Power: DC 24 V  
Mode: Transmitting 13.56 MHz  
EUT axis: Below 30 MHz([EUT] Horizontal: X-axis, Vertical: X-axis/ [Antenna]Horizontal: X-axis, Vertical: X-axis), with Tag, ANT2  
Above 30 MHz([EUT] Horizontal: Y-axis, Vertical: X-axis/ [Antenna]Horizontal: X-axis, Vertical: X-axis), with Tag, ANT2  
Remarks: These plots data contains sufficient number to show the trend of characteristic features for EUT.

Regulation:	FCC Part15 Subpart C 15.225
Test Distance:	3m
Date:	June 22, 2017
Temperature:	24 deg.C
Humidity:	59 %RH
ENGINEER:	Makoto Hosaka



## Data of Frequency Tolerance

UL Japan, Inc.  
Shonan EMC Lab. No.5 Shielded room

Company	ART Finex Co., Ltd.	Regulation	FCC Part15 Subpart C 15.225 (e)
Equipment	RFID Reader/Writer Unit	Date	March 21, 2017
Model	AMG3002	Temperature	24 deg.C
Serial No.	H030001	Humidity	30 %RH
Power	DC 24 V	ENGINEER	Yosuke Ishikawa
Mode	Transmitting 13.56 MHz		

■ ANT1

### Temperature Variation: -20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560090	0.000090	0.00066	0.010
after 2minutes	13.56	13.560125	0.000125	0.00092	0.010
after 5minutes	13.56	13.560133	0.000133	0.00098	0.010
after 10minutes	13.56	13.560134	0.000134	0.00099	0.010

### Temperature Variation: -10 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560140	0.000140	0.00103	0.010
after 2minutes	13.56	13.560141	0.000141	0.00104	0.010
after 5minutes	13.56	13.560140	0.000140	0.00103	0.010
after 10minutes	13.56	13.560140	0.000140	0.00103	0.010

### Temperature Variation: 0 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560143	0.000143	0.00105	0.010
after 2minutes	13.56	13.560135	0.000135	0.00100	0.010
after 5minutes	13.56	13.560131	0.000131	0.00097	0.010
after 10minutes	13.56	13.560128	0.000128	0.00094	0.010

### Temperature Variation: 10 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560112	0.000112	0.00083	0.010
after 2minutes	13.56	13.560106	0.000106	0.00078	0.010
after 5minutes	13.56	13.560103	0.000103	0.00076	0.010
after 10minutes	13.56	13.560099	0.000099	0.00073	0.010

### Temperature Variation: 20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560099	0.000099	0.00073	0.010
after 2minutes	13.56	13.560077	0.000077	0.00057	0.010
after 5minutes	13.56	13.560071	0.000071	0.00053	0.010
after 10minutes	13.56	13.560066	0.000066	0.00048	0.010

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## Data of Frequency Tolerance

### **Temperature Variation: 30 deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560071	0.000071	0.00053	0.010
after 2minutes	13.56	13.560044	0.000044	0.00032	0.010
after 5minutes	13.56	13.560036	0.000036	0.00027	0.010
after 10minutes	13.56	13.560034	0.000034	0.00025	0.010

### **Temperature Variation: 40 deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560037	0.000037	0.00027	0.010
after 2minutes	13.56	13.560018	0.000018	0.00013	0.010
after 5minutes	13.56	13.560014	0.000014	0.00010	0.010
after 10minutes	13.56	13.560013	0.000013	0.00010	0.010

### **Temperature Variation: 50 deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560012	0.000012	0.00009	0.010
after 2minutes	13.56	13.560011	0.000011	0.00008	0.010
after 5minutes	13.56	13.560012	0.000012	0.00009	0.010
after 10minutes	13.56	13.560013	0.000013	0.00009	0.010

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## Data of Frequency Tolerance

UL Japan, Inc.  
Shonan EMC Lab. No.5 Shielded room

Company	ART Finex Co., Ltd.	Regulation	FCC Part15 Subpart C 15.225 (e)
Equipment	RFID Reader/Writer Unit	Date	March 27, 2017
Model	AMG3002	Temperature	21 deg.C
Serial No.	H030003	Humidity	30 %RH
Power	DC 24 V	ENGINEER	Yosuke Ishikawa
Mode	Transmitting 13.56 MHz		

■ ANT2

**Temperature Variation: -20deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560066	0.000066	0.00049	0.010
after 2minutes	13.56	13.560099	0.000099	0.00073	0.010
after 5minutes	13.56	13.560102	0.000102	0.00075	0.010
after 10minutes	13.56	13.560105	0.000105	0.00077	0.010

**Temperature Variation: -10deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560104	0.000104	0.00077	0.010
after 2minutes	13.56	13.560116	0.000116	0.00086	0.010
after 5minutes	13.56	13.560119	0.000119	0.00088	0.010
after 10minutes	13.56	13.560119	0.000119	0.00088	0.010

**Temperature Variation: 0deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560120	0.000120	0.00088	0.010
after 2minutes	13.56	13.560116	0.000116	0.00085	0.010
after 5minutes	13.56	13.560113	0.000113	0.00083	0.010
after 10minutes	13.56	13.560111	0.000111	0.00082	0.010

**Temperature Variation: 10deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560093	0.000093	0.00069	0.010
after 2minutes	13.56	13.560091	0.000091	0.00067	0.010
after 5minutes	13.56	13.560090	0.000090	0.00066	0.010
after 10minutes	13.56	13.560088	0.000088	0.00065	0.010

**Temperature Variation: 20deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560082	0.000082	0.00060	0.010
after 2minutes	13.56	13.560072	0.000072	0.00053	0.010
after 5minutes	13.56	13.560063	0.000063	0.00047	0.010
after 10minutes	13.56	13.560061	0.000061	0.00045	0.010

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## Data of Frequency Tolerance

### **Temperature Variation: 30deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560059	0.000059	0.00044	0.010
after 2minutes	13.56	13.560046	0.000046	0.00034	0.010
after 5minutes	13.56	13.560038	0.000038	0.00028	0.010
after 10minutes	13.56	13.560036	0.000036	0.00027	0.010

### **Temperature Variation: 40deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560020	0.000020	0.00015	0.010
after 2minutes	13.56	13.560020	0.000020	0.00015	0.010
after 5minutes	13.56	13.560020	0.000020	0.00015	0.010
after 10minutes	13.56	13.560020	0.000020	0.00015	0.010

### **Temperature Variation: 50deg.C**

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560022	0.000022	0.00016	0.010
after 2minutes	13.56	13.560018	0.000018	0.00013	0.010
after 5minutes	13.56	13.560019	0.000019	0.00014	0.010
after 10minutes	13.56	13.560020	0.000020	0.00015	0.010

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## Data of Frequency Tolerance

UL Japan, Inc.  
Shonan EMC Lab. No.5 Shielded room

Company	ART Finex Co., Ltd.	Regulation	FCC Part15 Subpart C 15.225 (e)
Equipment	RFID Reader/Writer Unit	Date	March 27, 2017
Model	AMG3002	Temperature	21 deg.C
Serial No.	H030003	Humidity	30 %RH
Power	DC 24 V	ENGINEER	Yosuke Ishikawa
Mode	Transmitting 13.56 MHz		

■ ANT1

Voltage Variation: DC 10.2 V

Temperature Variation: 20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560065	0.000065	0.00048	0.010
after 2minutes	13.56	13.560062	0.000062	0.00046	0.010
after 5minutes	13.56	13.560059	0.000059	0.00044	0.010
after 10minutes	13.56	13.560059	0.000059	0.00043	0.010

Voltage Variation: DC 27.6 V

Temperature Variation: 20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560069	0.000069	0.00051	0.010
after 2minutes	13.56	13.560063	0.000063	0.00047	0.010
after 5minutes	13.56	13.560060	0.000060	0.00044	0.010
after 10minutes	13.56	13.560058	0.000058	0.00043	0.010

■ ANT2

Voltage Variation: DC 10.2 V

Temperature Variation: 20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560065	0.000065	0.00048	0.010
after 2minutes	13.56	13.560063	0.000063	0.00046	0.010
after 5minutes	13.56	13.560062	0.000062	0.00046	0.010
after 10minutes	13.56	13.560062	0.000062	0.00046	0.010

Voltage Variation: DC 27.6 V

Temperature Variation: 20 deg.C

Test Conditions	Original Frequency (MHz)	Measure Frequency (MHz)	Frequency Error (MHz)	Frequency tolerance (%)	Limit (%)
startup	13.56	13.560069	0.000069	0.00051	0.010
after 2minutes	13.56	13.560066	0.000066	0.00049	0.010
after 5minutes	13.56	13.560063	0.000063	0.00046	0.010
after 10minutes	13.56	13.560062	0.000062	0.00045	0.010

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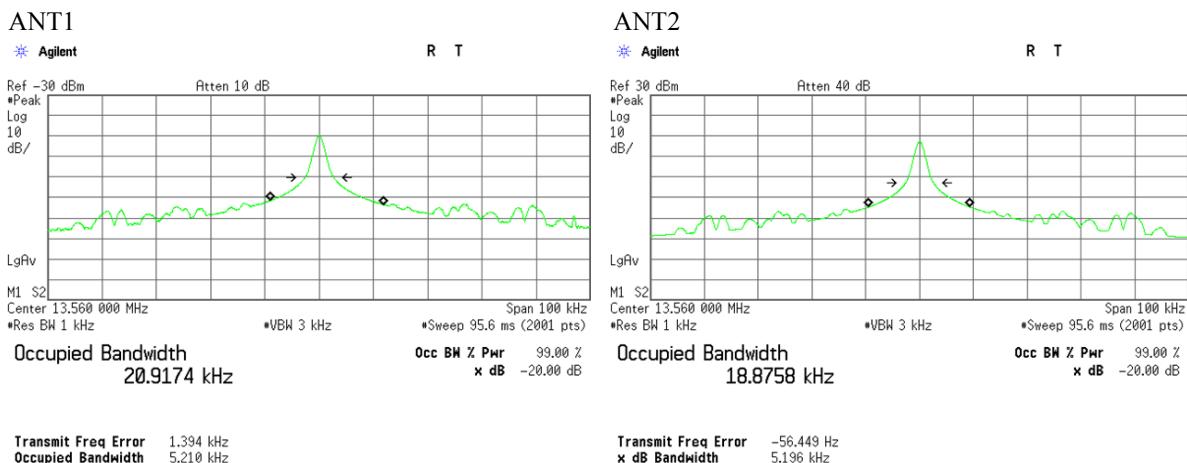
Faxsimile : +81 463 50 6401

## 20dB bandwidth & 99% Occupied bandwidth: FCC 15.215 / RSS-Gen

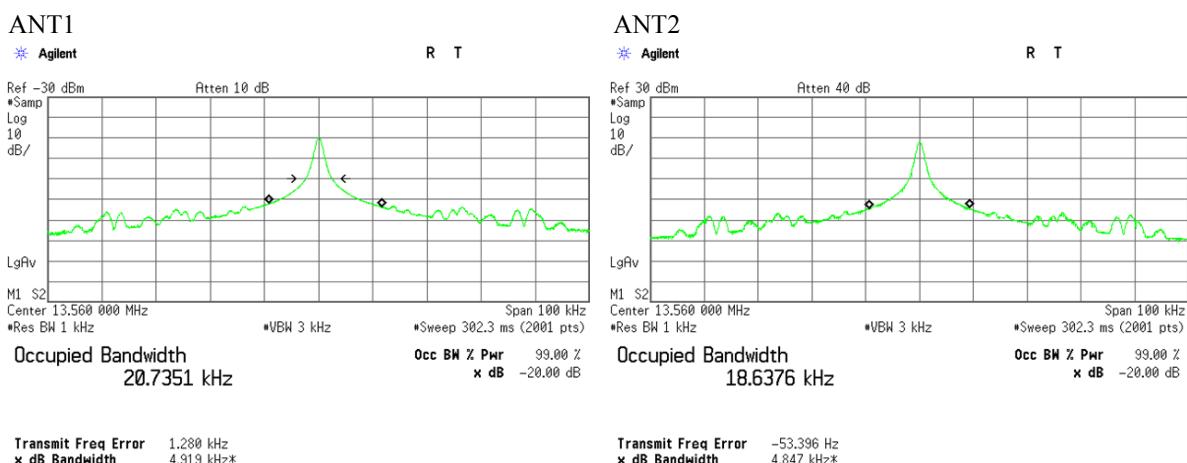
UL Japan, Inc.  
Shonan EMC Lab. No.5 Shielded Room

Company:	ART Finex Co., Ltd.	Regulation:	FCC Part15 Subpart C 15.225 (e)
Equipment:	RFID Reader/Writer Unit	Date:	March 27, 2017
Model:	AMG3002	Temperature:	21 deg.C
Sample No.:	H030003	Humidity:	30 %RH
Power:	DC 24 V	ENGINEER:	Yosuke Ishikawa
Mode:	Transmitting 13.56 MHz		

**ANT1** 5.210 kHz      **ANT2** 5.196 kHz



**99% Occupied Bandwidth:** **ANT1** 20.735 kHz      **ANT2** 18.638 kHz



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## APPENDIX 2: Test instruments

### EMI test equipment

Control No.	Instrument	Manufacturer	Model No.	Serial No.	Test Item	Calibration Date * Interval(month)
SCC-C9/C10/SRSE-03	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-271(RF Selector)	CE	2017/04/07 * 12
SLS-05	LISN	Rohde & Schwarz	ENV216	100516	CE	2017/02/27 * 12
SAT3-07	Attenuator	JFW	50HF-003N	-	CE	2016/09/23 * 12
SOS-06	Humidity Indicator	A&D	AD-5681	4062118	CE	2016/12/13 * 12
STM-05	Terminator	TME	CT-01 BP	-	CE	2016/12/15 * 12
STR-02	Test Receiver	Rohde & Schwarz	ESCI	100575	CE	2016/09/15 * 12
SJM-02	Measure	KOMELON	KMC-36	-	CE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,MF)	-	CE/RE	-
STS-03	Digital Hitester	Hioki	3805-50	80997823	CE	2016/10/17 * 12
SCC-05	Coaxial Cable	Fujikura	5D2W	-	CE	2017/04/07 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2017/02/09 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2017/02/09 * 12
KAT3-10	Attenuator	JFW IND. INC.	50HF-003N	-	RE	2016/07/26 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2016/11/23 * 12
SCC-B1/B3/B5/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TO YO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SCC-B2/B4/B6/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TO YO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SLA-06	Logperiodic	Schwarzbeck	VUSLP9111B	195	RE	2017/01/05 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2016/10/12 * 12
STR-07	Test Receiver	Rohde & Schwarz	ESU26	100484	RE	2016/09/28 * 12
SJM-09	Measure	PROMART	SEN1935	-	RE	-
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2017/06/08 * 12
STS-02	Digital Hitester	Hioki	3805-50	80997819	RE	2017/03/08 * 12
SLP-02	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	RE	2016/10/28 * 12
SAT6-08	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	RE	2016/08/04 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	FT/BW	2016/12/13 * 12
KTS-07	Digital Tester	SANWA	PC500	7019232	FT/BW	2016/10/17 * 12
SSA-03	Spectrum Analyzer	Agilent	E4448A	MY48250152	BW	2016/09/26 * 12
SCH-01	Temperature and Humidity Chamber	Espec	PL-1KT	14020837	FT	2016/04/14 * 12 *1)
SSCA-01	Search coil	LANGER	RF-R 400-1	02-0634	FT/BW	Pre Check
SFC-01	Microwave Counter	Agilent	53151A	US40511493	FT	2016/04/13 * 12 *1)

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

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

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

### Test Item:

CE: Conducted emission

RE: Radiated emission

FT: Frequency Tolerance

BW: Bandwidth

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