Electromagnetic Emission

FCC MEASUREMENT REPORT

CERTIFICATION OF COMPLIANCE

FCC Part 15 Certification Measurement

PRODUCT	:	Digital Locker Lock
MODEL/Serial No.	:	LL94AR-7 / NONE
MULTIPLE MODEL	:	-
FCC ID	:	2AJUHLL94AR-7
APPLICANT	:	ASSA ABLOY KOREA Co., Ltd Unilock 5F iRevo Bldg., 205-29 Gasan Digital 1-ro, Geumcheon-gu, Seoul 08503, Republic of Korea Attn.: Park Sangjin / Director Manager
MANUFACTURER	:	ASSA ABLOY KOREA Co., Ltd Unilock 5F iRevo Bldg., 205-29 Gasan Digital 1-ro, Geumcheon-gu, Seoul 08503, Republic of Korea
EQUIPMENT CLASS	:	DXX - Part 15 Low Power Communication Device Transmitter
TYPE OF MODULATION	:	ASK
FREQUENCY CHANNEL	:	1 CH
ANTENNA TYPE	:	PCB Pattern Antenna (Integral)
RULE PART(S)	:	FCC Part 15 Subpart C
FCC PROCEDURE	:	ANSI C63.10-2013
TEST REPORT No.	:	ETLT160826.0103
DATES OF TEST	:	September 13, 2016 to September 20, 2016
REPORT ISSUE DATE	:	September 22, 2016
TEST LABORATORY	:	ETL Inc. (FCC Designation Number : KR0022)

The Digital Locker Lock, Model LL94AR-7 has been tested in accordance with the measurement procedures specified in ANSI C63.10-2013 at the ETL Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart C section 15.247.
I attest to the accuracy of data. All measurement herein was performed by me or was made under my supervision and is correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.
The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Prepared by:
Dong Jin, Seo (Test Engineer)
September 22, 2016

Reviewed by:
Kug Kyoung, Yoon (Chief Engineer)
September 22, 2016

ETL Inc.
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Open site: #499-1, Sagot-ri, Seosin-myeon, Hwaseong-si, Gyeonggi-do, 445-882, Korea
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FCC MEASUREMENT REPORT

Scope – *Measurement and determination of electromagnetic emission (EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)*

General Information

Applicant Name : ASSA ABLOY KOREA Co., Ltd Unilock

Address : 5F iRevo Bldg., 205-29 Gasan Digital 1-ro,
Geumcheon-gu, Seoul 08503, Republic of Korea

Attention : Park Sangjin / Director Manager

- **EUT Type** : Digital Locker Lock
- **Model Number** : LL94AR-7
- **S/N** : NONE
- **Freq. Range** : 13.561 MHz
- **Modulation Technique** : ASK
- **Antenna Type** : PCB Pattern Antenna (Integral)
- **Environmental of Tests** : Temperature: (25.4 ± 5.1) °C
  Humidity: (53 ± 13) % R.H.
  Atmospheric Pressure: (101.6 ± 0.2) kPa
- **FCC Rule Part(s)** : FCC Part 15 Subpart C
- **Test Procedure** : ANSI C63.10-2013
- **EQUIPMENT CLASS** : DXX - Part 15 Low Power Communication Device Transmitter
- **Place of Tests** : ETL Inc. Testing Lab. (FCC Designation Number : KR0022)

  Radiated Emission test 1;
  #499-1, Sagot-ri, Seosin-myeon, Hwaseong-si,
  Gyeonggi-do, 445-882, Korea

  Radiated Emission test 2 and Conducted Emission test;
  #371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea

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1. INTRODUCTION

The measurement test for radiated and conducted emission test was conducted at the ETL Inc. The site is constructed in conformance with the requirements of the ANSI C63.10-2013 and CISPR Publication 16. The ETL has site descriptions on file with the FCC for 3 m and 10 m site configurations. Detailed description of test facility was found to be in compliance with FCC Rules according to the ANSI C63.10-2013 and registered to the Federal Communications Commission (FCC Designation Number : KR0022).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.10-2013) was used in determining radiated and conducted emissions from the ASSA ABLOY KOREA Co., Ltd Unilock, Model: LL94AR-7

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2. PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the Digital Locker Lock (model: LL94AR-7).

The model LL94AR-7 is basic model that was tested.

2.2 General Specification

NFC	ASK
	13.561 MHz
	PCB Pattern Antenna
High Internal Frequency	NFC PN512 → 27.120 MHz

- Power supply form battery DC 4.5 V
  (Battery type: DC 1.5 V 'LR6' type battery 3 EA)

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3. DESCRIPTION OF TESTS

The tests documented in this report were performed in accordance with ANSI C63.10-2013 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

3.1 Radiated Emission Measurement

Radiated emission measurements were made in accordance with § 13 in ANSI C63.10-2013 "Measurement of Intentional radiators" The measurements were performed over the frequency range of 30 MHz to 40 GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak, Quasi-peak, Average" within a bandwidth of 120 kHz and above 1 GHz is 1 MHz.

Preliminary measurements were made at 3 m using broadband antennas, and spectrum analyzer to determine the frequency producing the maximum emission in shielded room. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 MHz to 1 000 MHz using Log-Bicon antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made open site or SVSWR chamber at 3 m. The test equipment was placed on a styrofoam table. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a table height for below 1GHz is 0.8 m, and for above 1GHz is 1.5 m. nonmetallic 1.0 m x 1.5 m table. The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 m to 4 m and stopped at the azimuth or height producing the maximum emission.

Varying the mode of operating frequencies of the EUT maximized each emission. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst-case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20 dB/decade) as per section 15.31(f).

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

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3.1.1 Radiated Emission Limits:

(1) According to §15.209 Radiated emission limits, general requirements

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequencies [MHz]	Field Strength [μV/m]	Measurement Distance [m]
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 MHz - 72 MHz, 76 MHz - 88 MHz, 174 MHz - 216 MHz or 470 MHz - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241

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3.2 Carrier field strength and field strength outside 13.110 MHz - 14.010 MHz and occupied bandwidth

(1) According to §15.225 Operation within the band 13.110 MHz - 14.010 MHz

(a) The field strength of any emissions within the band 13.553 MHz - 13.567 MHz shall not exceed 15 848 micro volts/meter at 30 meters
(b) Within the bands 13.410 MHz - 13.553 MHz and 13.567 MHz - 13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters
(c) Within the bands 13.110 MHz - 13.410 MHz and 13.710 MHz - 14.010 MHz, the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters
(d) The field strength of any emissions appearing outside of the 13.110 MHz - 14.010 MHz band shall not exceed the general radiated emission limits in § 15.209

Frequency [MHz]	Field Strength Limit [μV/m] @ 30 m	Field Strength Limit [dB(μV/m)] @ 30 m	Field Strength Limit [dB(μV/m)] @ 3 m
13.110 - 13.410	106	40.5	80.5
13.410 - 13.553	334	50.5	90.5
13.553 - 13.567	15 848	84.0	124.0
13.567 - 13.710	334	50.5	90.5
13.710 - 14.010	106	40.5	80.5

(2) According to §15.215(c) Occupied bandwidth

(a) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

3.3 Frequency tolerance

(1) According to §15.225 Operation within the band 13.110 MHz - 14.010 MHz

(e) The frequency tolerance of the carrier signal shall be maintained within ± 0.01 % of the operating frequency over a temperature variation of -20 ℃ to +50 ℃ at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 ℃. For battery-operated equipment, the equipment tests shall be performed using a new battery.

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3.4 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section § 13 in ANSI C63.10-2013 "measurement of intentional radiators" The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to a Spectrum Analyzer or a Test Receiver. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 9 kHz or for "quasi-peak" within a bandwidth of 9 kHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1 m x 1.5 m x 0.8 m wooden table which is placed 0.4 m away from the vertical wall and 1.5 m away from the side wall of the chamber room. Two LISN are bonded to the shielded room. The EUT is powered from the LISN and the support equipment is powered from the other LISN. Power to the LISNs are filtered by a noise cut power line filters. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the LISN. Non-inductive bundling to a 1 m length shortened all interconnecting cables more than 1 m. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the EMI Test Receiver to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using to set Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.15 MHz to 30 MHz. The bandwidth of the spectrum analyzer was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission.

Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

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3.5 FCC Part 15.205 Restricted Bands of Operations

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 - 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 - 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 - 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 - 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 - 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 - 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 - 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 - 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 - 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 - 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 - 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 - 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 - 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 - 4 400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490 MHz - 0.510 MHz.
[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1 000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

3.6 Antenna connection requirement

(1) According to §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

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4. TEST CONDITION

4.1 Test Configuration

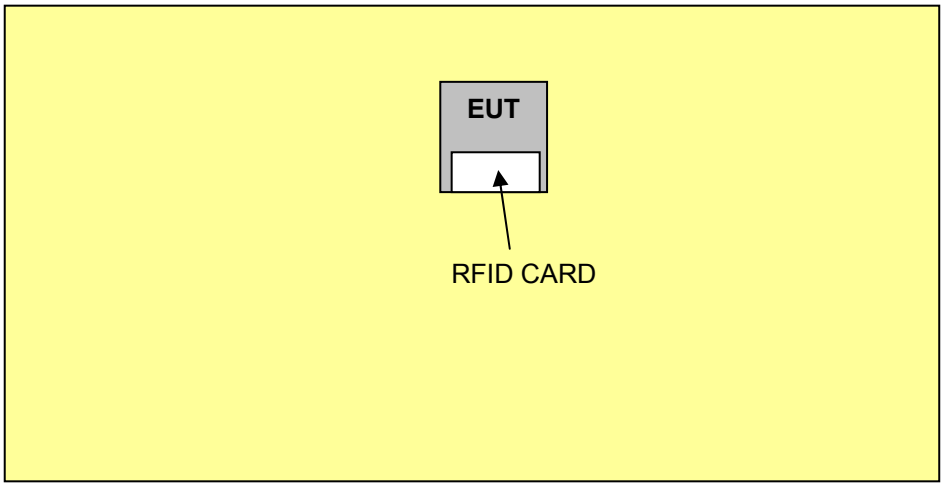
The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following conditions and configurations were used.

* This test was applied to X, Y, Z. and the worst result were investigated and reported.

4.2 Description of Test modes

Digital Locker Lock that has the control software.

4.3 The setup drawing(s)



: Signal Line

: Power Line

: Standard Adapter

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5. TEST RESULTS

5.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

Test Rule Parts	Measurement Required	Result
15.207(a),(d)	Conducted emissions	**N/A ***
15.209 15.225(d)	Radiated emissions Field strength outside 13.110 MHz - 14.010 MHz	**Pass**
15.225(a)(b)(c)	13.56 MHz carrier field strength within the bands	**Pass**
15.215	Occupied Bandwidth	**Pass**
15.225(e)	Frequency Tolerance	**Pass**
15.203	Antenna connection requirement	Integral antenna which is permanently attached and cannot be replaced.

**** This test was not applied. Because, EUT Power supplies from an battery***

The data collected shows that the **ASSA ABLOY KOREA Co., Ltd Unilock / Digital Locker Lock / LL94AR-7** complied with technical requirements of above rules part 15.207, 209 and 15.247 Limits.

The equipment is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

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5.2 Conducted Emissions Measurement

EUT	Digital Locker Lock / LL94AR-7
Limit apply to	FCC Part 15.207
Test Date	-
Environmental of Test	-
Operating Condition	-
Result	-

Limit

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission [MHz]	Conducted limit [dB(μV)]	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency.

Test Results

- ***This test was not applied. Because, EUT Power supplies from an battery***

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5.3 Spurious Emissions

EUT	Digital Locker Lock / LL94AR-7
Limit apply to	FCC Part 15.209
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

Limit

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequencies [MHz]	Field Strength [μV/m]	Measurement Distance [m]
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 MHz - 72 MHz, 76 MHz - 88 MHz, 174 MHz - 216 MHz or 470 MHz - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

Test Results

- Refer to see the measured plot in next page.

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Radiated Emissions Test data

- 9 kHz to 30 MHz

Test Date	September 13, 2016
Environmental of Test	(30.0 ± 0.4) °C, (63 ± 2) % R.H., (101.8 ± 0.0) kPa

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi-Peak mode (100 Hz, 9 kHz)

Frequency [MHz]	Reading [dB(μV)]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
	Emission attenuated more than 20 dB below the limit are not reported.						

Result: All emissions below noise floor of 20 dB(μV/m).

NOTES:

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Result = Reading + Antenna factor + Cable loss
3. Margin = Limit - Result
4. The measurement was performed for the frequency range 9 kHz to 30 MHz according to FCC Part 15.209.

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- Below 1 GHz (30 MHz to 1 GHz)

Test Date	September 13, 2016
Environmental of Test	(30.0 ± 0.4) °C, (63 ± 2) % R.H., (101.8 ± 0.0) kPa

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)

Frequency [MHz]	Reading [dB(μV)]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB(μV)]	Height [cm]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
40.91	50.80	V	12.89	-30.78	105	32.91	40.00	7.09
244.07	47.20	H	11.40	-28.42	400	30.18	46.00	15.82
298.61	50.80	H	13.49	-28.02	300	36.27	46.00	9.73
353.03	55.40	H	14.81	-27.56	194	42.65	46.00	3.35
407.82	49.10	H	16.11	-27.11	105	38.10	46.00	7.90
561.59	39.40	V	19.35	-25.87	230	32.88	46.00	13.12

NOTES:

1. * H : Horizontal polarization , ** V : Vertical polarization
2. The cable loss value was included the Amp. Gain.
3. Result = Reading + Antenna factor + Cable loss
4. Margin value = Limit - Result
5. The measurement was performed for the frequency range above 30 MHz according to FCC Part 15.209.

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5.4 13.56 MHz carrier field strength within bands

EUT	Digital Locker Lock / LL94AR-7
Limit apply to	FCC Part 15.225(a)(b)(c)
Test Date	September 13, 2016
Environmental of Test	(29.4 ± 0.6) °C, (62 ± 3) % R.H., (101.8 ± 0.0) kPa
Operating Condition	RF transmitting continuously during the tested
Result	Passed

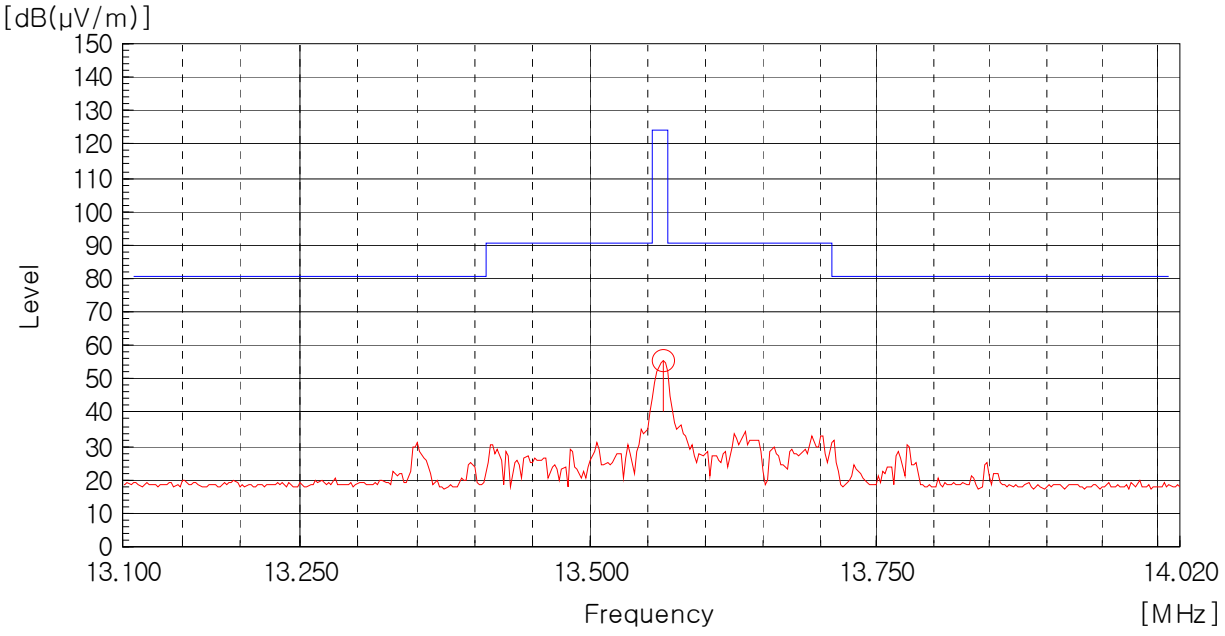
Radiated Emission Test Data

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 9 kHz)

Frequency [MHz]	Reading [dB(μV) @ 3 m]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dB]	Result [dB(μV/m) @ 3 m]	Limit [dB(μV/m) @ 3 m]	Margin [dB]
13.56	44.60	H	10.27	0.61	55.48	124.00	68.52

NOTES:

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Result = Reading + Antenna factor + Cable loss
3. Margin value = Limit - Result
4. The measurement was performed for the frequency range 13.56 MHz according to FCC Part 15.225(a)(b)(c)



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5.5 Occupied Bandwidth

EUT	Digital Locker Lock / LL94AR-7
Limit apply to	FCC Part 15.215
Test Date	September 19, 2016
Environmental of Test	(23.3 ± 0.0) °C, (42 ± 0) % R.H., (101.6 ± 0.0) kPa
Operating Condition	RF transmitting continuously during the tested.
Result	Passed

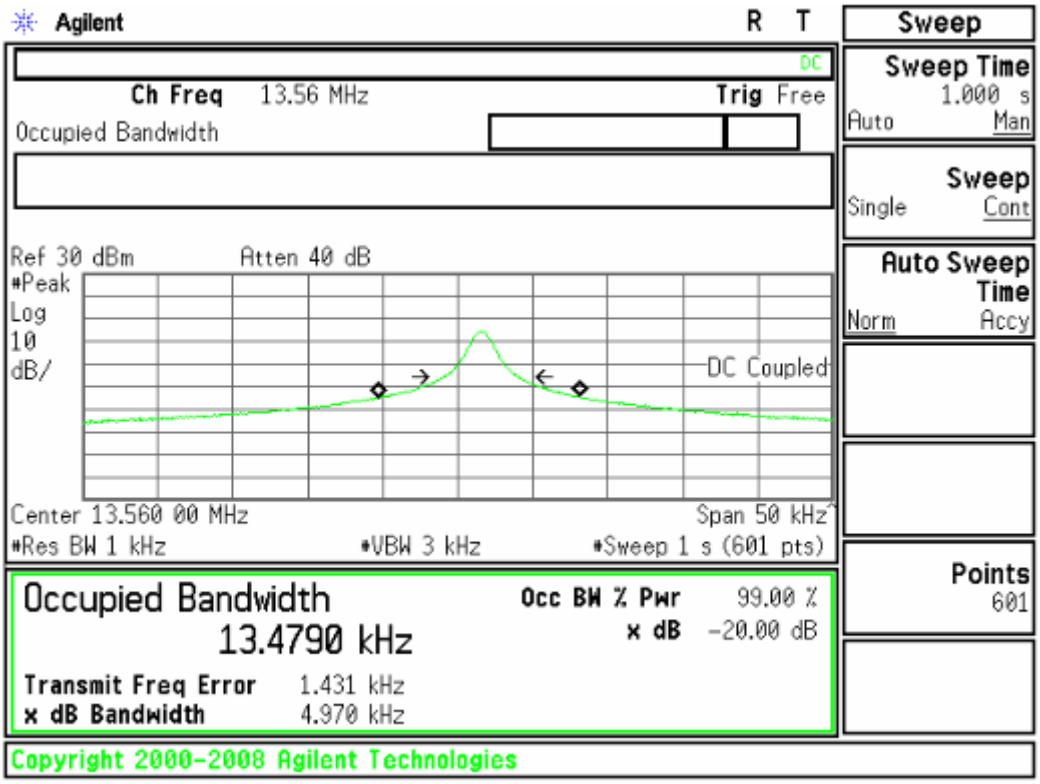
5.5.1 Occupied Bandwidth

Frequency [MHz]	20 dB Bandwidth [kHz]
13.56	4.97

NOTES:

1. Measure frequency separation of relevant channel using spectrum analyzer.

Plots of 20 dB Bandwidth



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5.6 Frequency Tolerance

EUT	Digital Locker Lock / LL94AR-7 (S/N: N/A)
Limit apply to	FCC Part 15.215(e)
Test Date	September 20, 2016
Environmental of Test	(23.1 ± 2.8) °C, (45 ± 5) % R.H., (101.5 ± 0.1) kPa
Operating Condition	RF transmitting continuously during the tested
Result	Passed

Frequency Tolerance Test Data

The Frequency Tolerance of the carrier signal shall be maintained within ± 0.01 % of operating frequency over a temperature variation of -20 ℃ to +50 ℃ at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 ℃.

- Operating frequency: 13.561 MHz
- Limit: ± 1 356 Hz
- Within the band: 13.559 644 MHz - 13.562 356 MHz

Frequency Stability Versus Environment Temperature (+50 ℃ ~ -20 ℃)

Reference Frequency: 13.56 MHz					Limit: ± 1 356 Hz			
Environment Temperature [℃]	Frequency Measure with Time Elapsed							
	Start up		2 Minute		5 Minute		10 Minute	
	MHz	Deviation	MHz	Deviation	MHz	Deviation	MHz	Deviation
50	13.561 509	0.000 509	13.561 509	0.000 509	13.561 509	0.000 509	13.561 509	0.000 509
40	13.561 518	0.000 518	13.561 514	0.000 514	13.561 510	0.000 510	13.561 511	0.000 511
30	13.561 356	0.000 356	13.561 534	0.000 534	13.561 534	0.000 534	13.561 533	0.000 533
20	13.561 553	0.000 553	13.561 552	0.000 552	13.561 552	0.000 552	13.561 552	0.000 552
10	13.561 566	0.000 566	13.561 559	0.000 559	13.561 556	0.000 556	13.561 565	0.000 565
0	13.561 557	0.000 557	13.561 565	0.000 565	13.561 563	0.000 563	13.561 562	0.000 562
-10	13.561 539	0.000 539	13.561 539	0.000 539	13.561 539	0.000 539	13.561 539	0.000 539
-20	13.561 481	0.000 481	13.561 477	0.000 477	13.561 487	0.000 487	13.561 477	0.000 477

Frequency Stability Versus Input Power (± 15 %): Environment Temperature: 20 ℃

Reference Frequency: 13.56 MHz					Limit: ± 1 356 Hz			
Power Supplied [Vdc]	Frequency Measure with Time Elapsed							
	Start up		2 Minute		5 Minute		10 Minute	
	MHz	Deviation	MHz	Deviation	MHz	Deviation	MHz	Deviation
3.83	13.561 534	0.000 534	13.561 535	0.000 535	13.561 551	0.000 551	13.561 535	0.000 535
4.50	13.561 533	0.000 533	13.561 532	0.000 532	13.561 534	0.000 534	13.561 532	0.000 532
5.18	13.561 543	0.000 543	13.561 546	0.000 546	13.561 549	0.000 549	13.561 533	0.000 533

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6. SAMPLE CALCULATION

Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor - Preamplifier Factor

$dB(\mu V) = 20 \log_{10} (\mu V)$: Equation
dB(μV) = dBm + 107

Example : @ 353.03 MHz

Limit	= 46.00 dB(μV/m)	
Reading	= 55.40 dB(μV)	
Antenna Factor + (Cable Loss - Amp. Gain)		= 14.81 + (-27.56) = -12.75 dB(μV/m)
Total		= 42.65 dB(μV/m)
Margin	= 46.00 – 42.65 = 3.35 dB	
	= 3.35 dB below Limit	

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7. List of test equipments used for measurements

Test Equipment		Model	Mfg.	Serial No.	Cal. Date	Cal. Due Date
☒	EMI Test Receiver	ESCS30	R&S	100087	16.03.15	17.03.15
☒	Amplifier	310N	Sonoma Instrument	284750	16.09.02	17.09.02
☒	Loop Antenna	6502	EMCO	00033743	16.09.05	17.09.05
☒	LogBicon Antenna	VULB9160	Schwarzbeck	3164	15.06.08	17.06.08
☒	TEMP.&HUMID. Chamber	PL-1KP	Tabai Espec Corp.	14006754	16.03.15	17.03.15
☒	Spectrum Analyzer	FSW43	R&S	103794	16.09.06	17.09.06
☒	PSA Series Spectrum Analyzer	E4440A	Agilent	US40420382	16.09.05	17.09.05
☒	Attenuator	33-30-34	Weinschel	BG9487	16.09.01	17.09.01
☒	DC Power Supply	SDP 60-5D	Smtechno	605D0D 002	16.03.14	17.03.14
☒	DC Block	NONE	NONE	NONE	16.03.14	17.03.14
☒	Turn-Table	TT 1.35 SI	SES	-	N/A	N/A
☒	Antenna Master	AM 4.5	SES	-	N/A	N/A

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