

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.

Head office: #371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea

Open site: #499-1, Sagot-ri, Seosin-myeon, Hwaseong-si, Gyeonggi-do, 445-882, Korea

Tel: 82-2-858-0786 Fax: 82-2-858-0788

The test report merely corresponds to the test sample(s).

This report shall not be reproduced, in whole or in part without the written approval of ETL Inc.

Table of Contents

FCC Measurement Report

- 1. Introduction**
- 2. Product Information**
- 3. Description of Tests**
- 4. Test Condition**
- 5. Test Results**
 - 5.1 Summary of Test Results**
 - 5.2 Conducted Emissions**
 - 5.3 Radiated Emissions**
 - 5.4 13.56 MHz Carrier Field Strength within the Bands**
 - 5.5 Occupied Bandwidth**
 - 5.6 Frequency Tolerance**
- 6. Sample Calculation**
- 7. List of test Equipment used for Measurement**

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

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

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)

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.

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

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 microvolts/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 [μ V/m] @ 30 m | Field Strength Limit [dB(μ V/m)] @ 30 m | Field Strength Limit [dB(μ V/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 $\pm 0.01\%$ of the operating frequency over a temperature variation of -20°C to $+50^{\circ}\text{C}$ 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°C . For battery-operated equipment, the equipment tests shall be performed using a new battery.

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.

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.

4. TEST CONDITION

4.1 Test Configuration

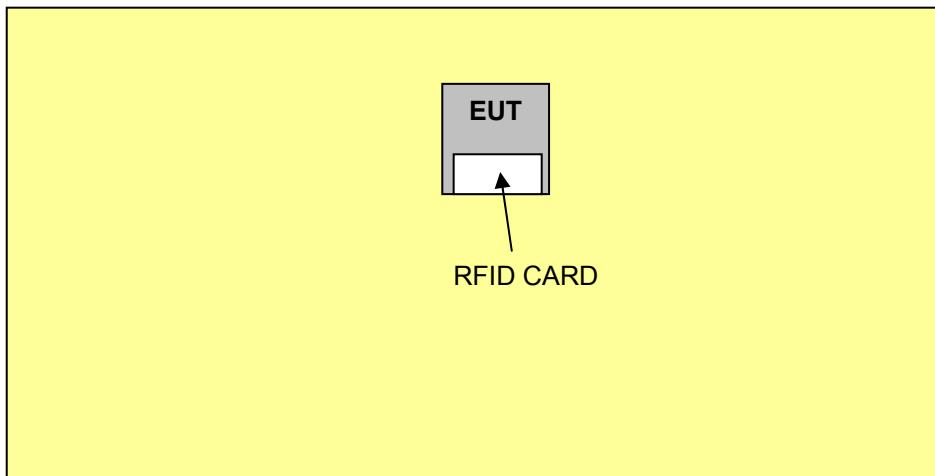
The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following conditions and configurations were used.

* 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

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.

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 μ H/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(μ V)] | |
|--------------------------------|-----------------------------------|------------|
| | 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***

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 [μ V/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.

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.

- Below 1 GHz (30 MHz to 1 GHz)

| | | | | | | | | |
|-----------------------|--|--|--|--|--|--|--|--|
| Test Date | September 13, 2016 | | | | | | | |
| Environmental of Test | $(30.0 \pm 0.4) ^\circ\text{C}$, $(63 \pm 2) \%$ R.H., $(101.8 \pm 0.0) \text{kPa}$ | | | | | | | |

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($\mu\text{V}/\text{m}$)] | Limit [dB($\mu\text{V}/\text{m}$)] | 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.

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 | $(29.4 \pm 0.6)^\circ\text{C}$, $(62 \pm 3)\%$ R.H., (101.8 ± 0.0) kPa | | | | | | |
| Operating Condition | RF transmitting continuously during the tested | | | | | | |
| Result | Passed | | | | | | |

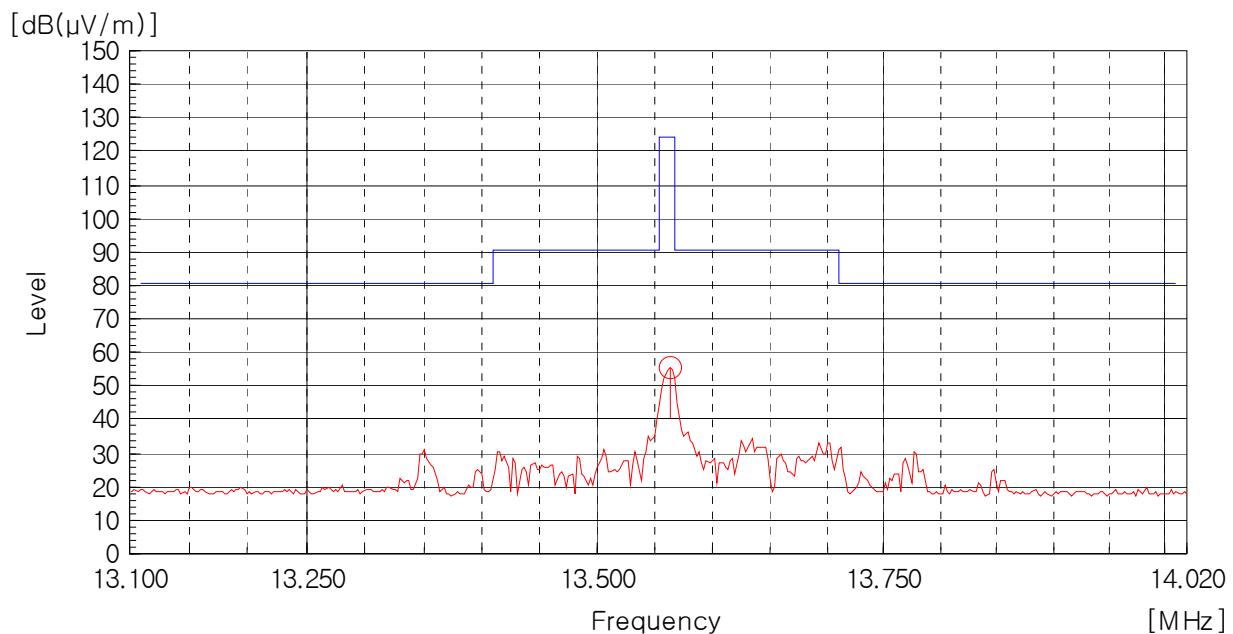
Radiated Emission Test Data

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($\mu\text{V}/\text{m}$) @ 3 m] | Limit [dB($\mu\text{V}/\text{m}$) @ 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)



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 |

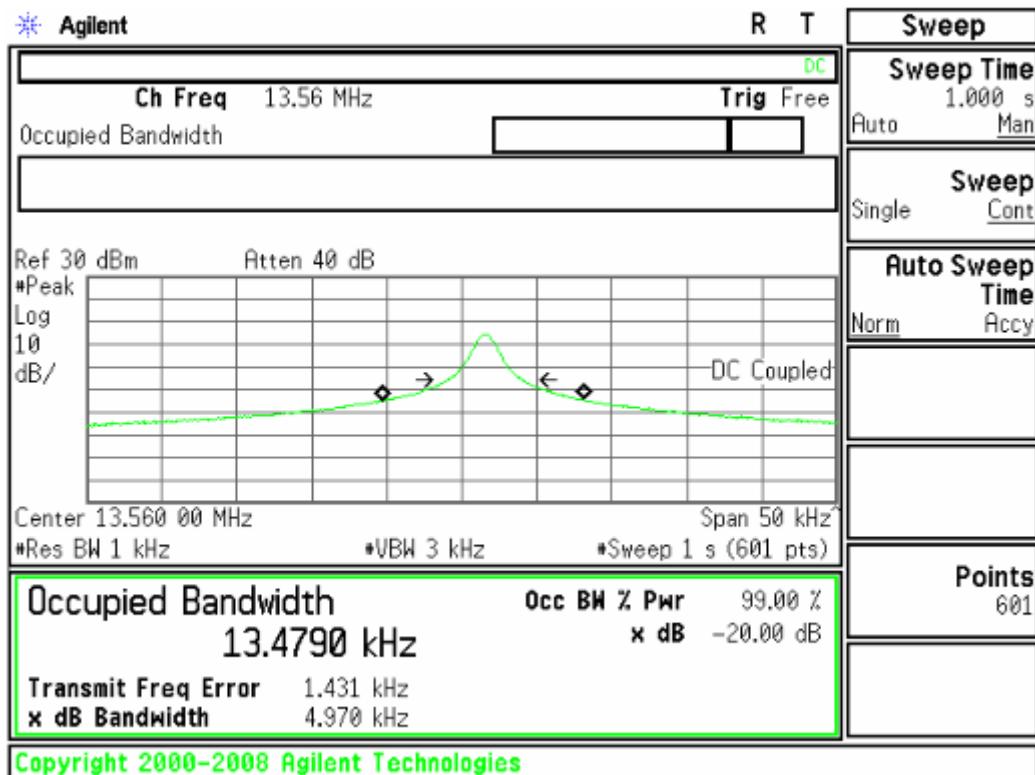
5.5.1 Occupied Bandwidth

| 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



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 °C to +50 °C 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 °C.

- 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 °C ~ -20 °C)

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

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

| 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 |
| 3.83 | 13.561 534 | 0.000 534 | 13.561 535 | 0.000 535 | 13.561 551 | 0.000 551 | 13.561 535 |
| 4.50 | 13.561 533 | 0.000 533 | 13.561 532 | 0.000 532 | 13.561 534 | 0.000 534 | 13.561 532 |
| 5.18 | 13.561 543 | 0.000 543 | 13.561 546 | 0.000 546 | 13.561 549 | 0.000 549 | 13.561 533 |

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

$$dB(\mu V) = 20 \log_{10} (\mu V) : \text{Equation}$$

$$dB(\mu V) = dBm + 107$$

Example : @ 353.03 MHz

$$\text{Limit} = 46.00 \text{ dB}(\mu V/m)$$

$$\text{Reading} = 55.40 \text{ dB}(\mu V)$$

$$\text{Antenna Factor + (Cable Loss - Amp. Gain)} = 14.81 + (-27.56) = -12.75 \text{ dB}(\mu V/m)$$

$$\text{Total} = 42.65 \text{ dB}(\mu V/m)$$

$$\text{Margin} = 46.00 - 42.65 = 3.35 \text{ dB}$$

$$= 3.35 \text{ dB below Limit}$$

7. List of test equipments used for measurements

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