Excellence in Compliance Testing

# Certification Test Report

**FCC ID: U4A-SCYICLS0**
**IC: 6982A-SCYICLS0**

**FCC Rule Part: 15.225**
**IC Specification: RSS-210**

**ACS Report Number: 10-0199.W06.11.A**

Manufacturer: Assa Abloy, Inc.
Model(s): S1-IA/IK, S2-IA/IK

Test Begin Date: June 22, 2010
Test End Date: July 19, 2010

Report Issue Date: September 27, 2010

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

**Reviewed by:** _____
**Kirby Munroe**
**Director, Wireless Certifications**
**ACS, Inc.**



**This report contains 20 pages**

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# 1 GENERAL

## 1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210.

## 1.2 Product Description

The models listed are electronic door locks. These door locks contain an ICLASS 13.56MHz RFID reader and may be configured with various other options listed below. All model variants are electrically identical with respect to the ICLASS 13.56MHz RFID reader and differ only peripheral options as stated below.

S1 Series are Power over Ethernet (PoE) and S2 Series can include a preapproved 802.11b/g module and can be hardwired or battery powered only. Model variants include the following:

S1-IA/IK, S2-IA/IK

Model Suffixes/Prefixes to describe options:

| | |
|---|---|
| IA | 13.56MHz ICLASS Prox Only |
| IK | 13.56MHz ICLASS Prox and Keypad |

Operating Voltage:
S2-IA/IK - 9VDC nominal (6 – AA batteries) OR (Aux power supply)
S1-IA/IK - Power supplied through Ethernet (per standard 802.3af); Power Souring Equipment (PSE) = 44 – 57VDC

Applicant Information:
Assa Abloy Inc.
110 Sargent Dr.
New Haven, CT 06511

Test Sample Serial Number(s):ACS #7. ACS#1, ACS#11

Test Sample Condition:
The test sample was provided in good working order with no visible defects.

Detailed photographs of the EUT are filed separately with this filing.

## 1.3 Test Methodology and Considerations

The model variants are electrically identical with respect to the 13.56MHz RFID and differ only in options described above.

The model variants evaluated for final data include:
S1-IA/IK - POE with 13.56MHz RFID, Key Pad
S2-IA/IK - Battery Powered with 13.56MHz RFID, Key Pad
S2-IA/IK - AUX Powered with 13.56MHz RFID, Key Pad

S2 variants include a collocated Quatech 802.11 radio module FCC ID: F4AWLNG1. Collocation was evaluated and found to be incompliance.

# 2 TEST FACILITIES

## 2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

## 2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175A-1
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

## 2.3 Radiated Emissions Test Site Description

### 2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

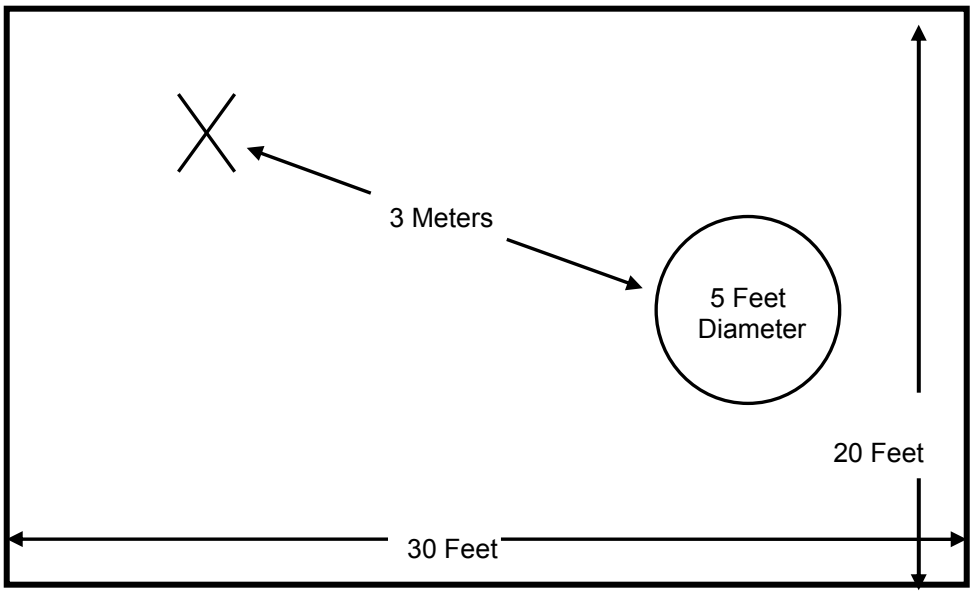


**Figure 2.3-1: Semi-Anechoic Chamber Test Site**

### 2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

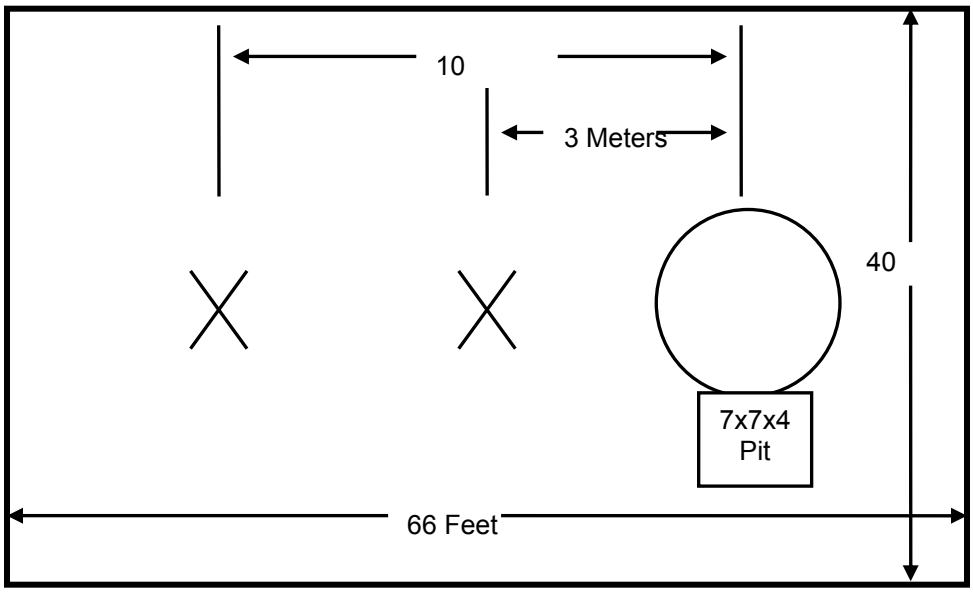


**Figure 2.3-2: Open Area Test Site**

### 2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 2.4-1:

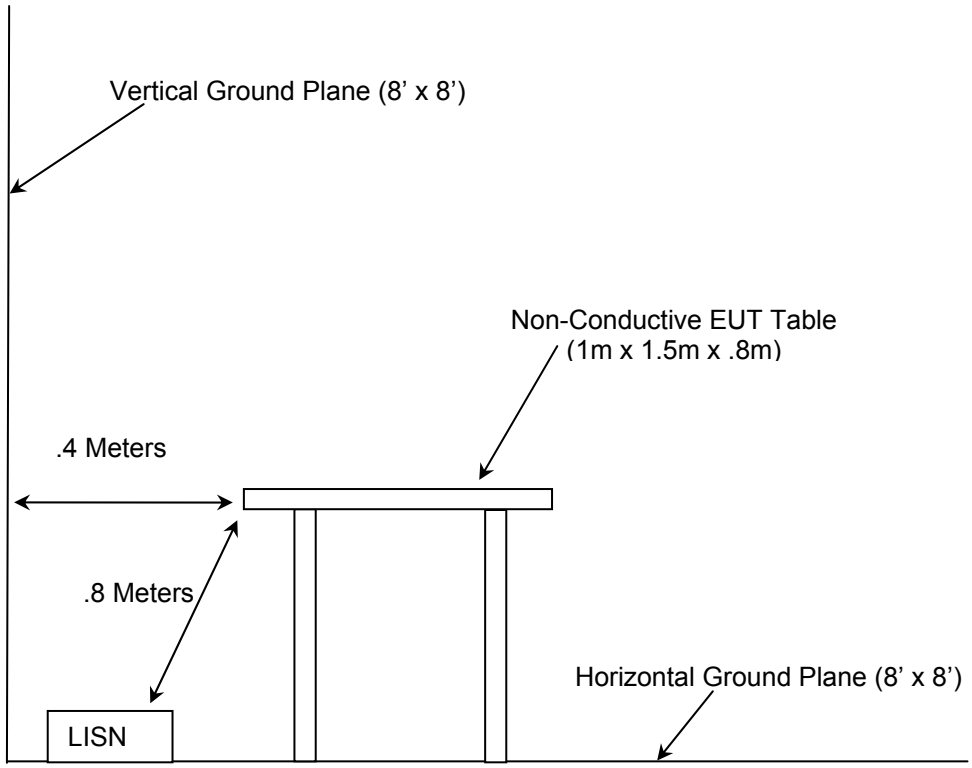


**Figure 2.4-1: AC Mains Conducted EMI Site**

## 3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2010
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2010
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 7 June 2007
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue2, June 2007.

## 4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

**Table 4-1: Test Equipment**

| Equipment Calibration Information | | | | | |
|---|---|---|---|---|---|
| **ACS#** | **Mfg.** | **Eq. type** | **Model** | **S/N** | **Cal. Due** |
| 1 | Rohde & Schwarz | Spectrum Analyzers | ESMI - Display | 833771/007 | 09-21-2010 |
| 2 | Rohde & Schwarz | Spectrum Analyzers | ESMI-Receiver | 839587/003 | 09-21-2010 |
| 3 | Rohde & Schwarz | Spectrum Analyzers | ESMI - Display | 839379/011 | 02-02-2011 |
| 4 | Rohde & Schwarz | Spectrum Analyzers | ESMI-Receiver | 833827/003 | 02-02-2011 |
| 324 | ACS | Cables | 324 | Conducted EMI Cable | 07-09-2011 (See Note1) |
| 25 | Chase | Antennas | CBL6111 | 1043 | 09-02-2010 |
| 78 | EMCO | Antennas | 6502 | 9104-2608 | 01-11-2011 |
| 140 | Thermotron | Environmental Chamber | SM-16C | 19639 | 08-30-2010 |
| 73 | Agilent | Amplifier | 8447D | 2727A05624 | 05-26-2011 |
| 153 | EMCO | LISN | 3825/2 | 9411-2268 | 01-11-2011 |
| 167 | ACS | Cables | Chamber EMI Cable Set | 167 | 01-25-2011 (See Note1) |
| 168 | Hewlett Packard | Attenuators | 11947A | 44829 | 02-04-2011 (See Note2) |
| 283 | Rohde & Schwarz | Spectrum Analyzers | FSP40 | 1000033 | 09-21-2010 |
| 213 | TEC | Amplifier | PA 102 | 44927 | 12-21-2010 |
| 41 | Electro-Metrics | Antenna | BIA-25 | 2925 | 12-14-2010 |
| 277 | EMCO | Antenna | 93146 | 9904-5199 | 09-18-2010 |
| 193 | ACS | Cables | OATS Cable Set | 0193 | 01-05-2011 |

**Note1:** Items characterized on an annual cycle. The date shown indicates the next characterization due date.
**Note2:** Items verified on an annual cycle. The date shown indicates the next verification due date.

## 5 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

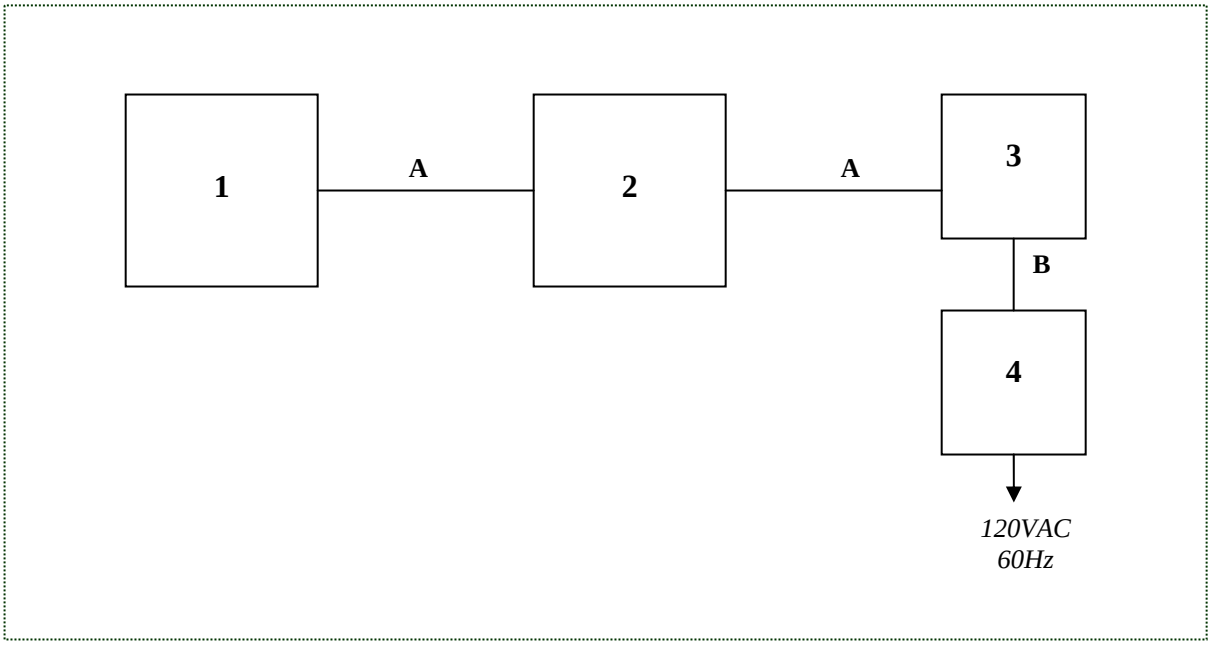


**Figure 5-1: EUT and Support Equipment Block Diagram (POE)**

**Table 5-1: EUT and Support Equipment Description**

| Item # | Type Device | Manufacturer | Model/Part # | Serial # |
|---|---|---|---|---|
| 1 | EUT | Assa Abloy | PoE | N/A |
| 2 | Hinge | Assa Abloy | N/A | N/A |
| 3 | Switch | Netgear | FS108P | 1DL16C2T001 C3 |
| 4 | Switch Power Supply | D-Link | VAN90C-480B | 10053805331-2A |

**Table 5-2: Cable Description**

| Cable # | Cable Type | Length | Shield | Termination |
|---|---|---|---|---|
| A | PoE Cable | 14' | No | 1 & 2<br>2 & 3 |
| B | Power Cable | 6' | No | 3 & 4 |

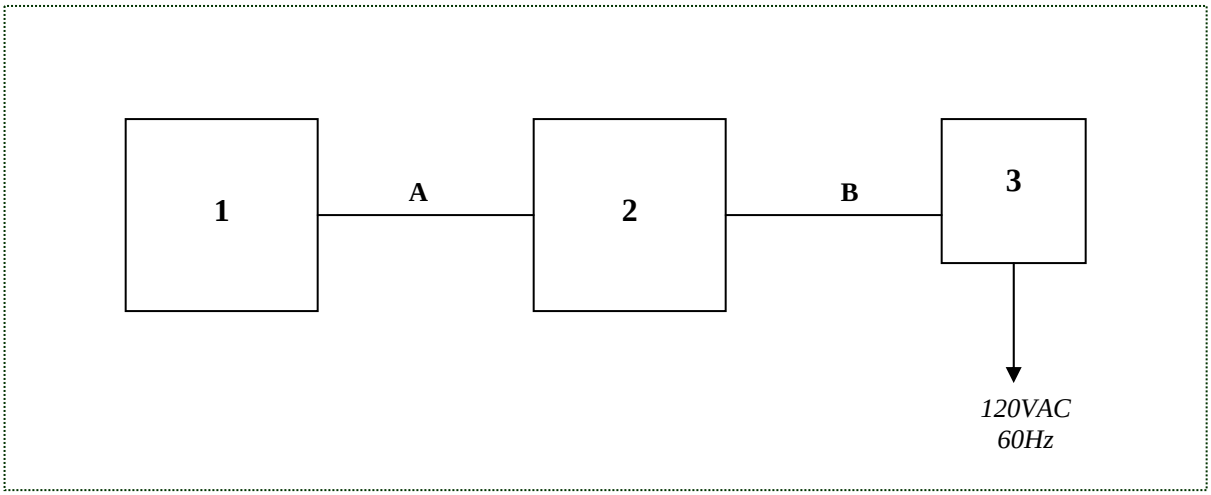


**Figure 5-2: EUT and Support Equipment Block Diagram (AUX Power)**

**Table 5-3: EUT and Support Equipment Description**

| Item # | Type Device | Manufacturer | Model/Part # | Serial # |
|---|---|---|---|---|
| 1 | EUT | Assa Abloy | AUX Power | N/A |
| 2 | Aux Power Box | Assa Abloy | N/A | N/A |
| 3 | Wall Charger | N/A | E193069 | RT-G1640SL/M |

**Table 5-4: Cable Description**

| Cable # | Cable Type | Length | Shield | Termination |
|---|---|---|---|---|
| A | Aux Power Cable | 3' | No | 1 & 2 |
| B | Aux Power Cable | 15' | No | 2 & 3 |

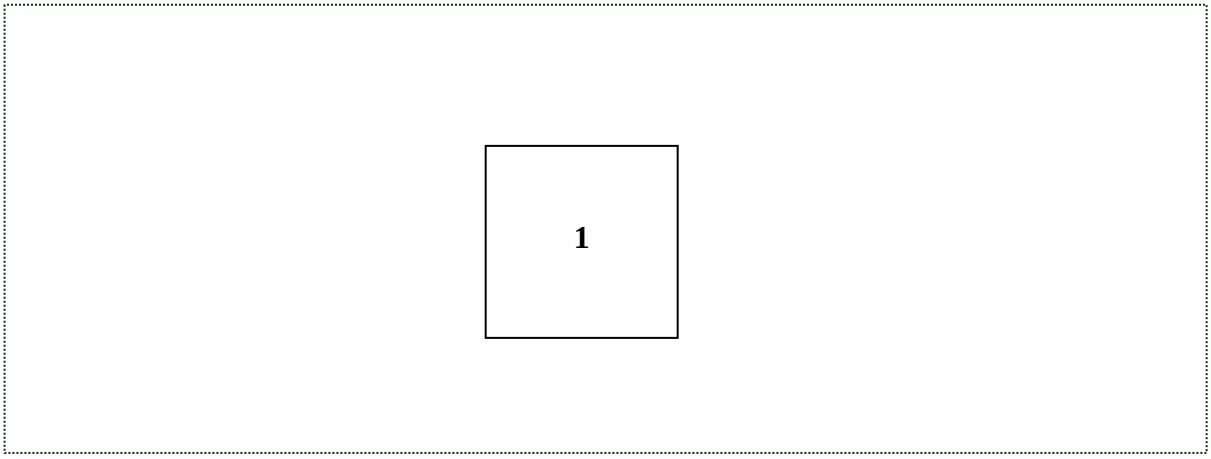


**Figure 5-3: EUT and Support Equipment Block Diagram (Battery Power)**

**Table 5-5: EUT and Support Equipment Description**

| Item # | Type Device | Manufacturer | Model/Part # | Serial # |
|---|---|---|---|---|
| 1 | EUT | Assa Abloy | Battery Power | N/A |

See Test Setup photographs for additional detail.

# 6 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

## 6.1 Antenna Requirement

The S1-IA/Ik and S2-IA/IK utilize a PCb etched loop antenna thus satisfying the requirements of 15.203.

## 6.2 Power Line Conducted Emissions – FCC Part 15.207 / IC RSS-Gen 7.2.2

### 6.2.1 Test Methodology

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**
**Margin = Applicable Limit - Corrected Reading**

### 6.2.2 Test Results

Results of the test are shown below in and Table 6.2.2-1 to 6.2.2-2.

**Table 6.2.2-1: Conducted EMI Results – Line 1**

| Frequency [MHz] | Level [dBµV] | Transd [dB] | Limit [dBµV] | Margin [dB] | Line | PE | Detector |
|---|---|---|---|---|---|---|---|
| 0.156000 | 48.90 | 9.9 | 66 | 16.7 | L1 | GND | QP |
| 0.294000 | 29.60 | 10.0 | 60 | 30.8 | L1 | GND | QP |
| 0.330000 | 26.00 | 10.0 | 60 | 33.5 | L1 | GND | QP |
| 0.492000 | 14.30 | 10.0 | 56 | 41.9 | L1 | GND | QP |
| 2.118000 | 9.40 | 10.0 | 56 | 46.6 | L1 | GND | QP |
| 3.006000 | 9.10 | 9.9 | 56 | 46.9 | L1 | GND | QP |
| 4.542000 | 9.50 | 10.0 | 56 | 46.5 | L1 | GND | QP |
| 13.236000 | 9.80 | 9.9 | 60 | 50.2 | L1 | GND | QP |
| 13.560000 | 48.90 | 9.9 | 60 | 11.1 | L1 | GND | QP |
| 13.776000 | 14.20 | 9.9 | 60 | 45.8 | L1 | GND | QP |
| 0.198000 | 15.30 | 9.9 | 54 | 38.4 | L1 | GND | AVG |
| 0.294000 | 9.70 | 10.0 | 50 | 40.7 | L1 | GND | AVG |
| 0.330000 | 8.80 | 10.0 | 50 | 40.6 | L1 | GND | AVG |
| 0.492000 | 7.60 | 10.0 | 46 | 38.5 | L1 | GND | AVG |
| 2.130000 | 6.80 | 10.0 | 46 | 39.2 | L1 | GND | AVG |
| 3.018000 | 6.60 | 9.9 | 46 | 39.4 | L1 | GND | AVG |
| 4.608000 | 6.80 | 10.0 | 46 | 39.2 | L1 | GND | AVG |
| 13.326000 | 7.00 | 9.9 | 50 | 43.0 | L1 | GND | AVG |
| 13.566000 | 33.30 | 9.9 | 50 | 16.7 | L1 | GND | AVG |
| 13.770000 | 7.30 | 9.9 | 50 | 42.7 | L1 | GND | AVG |

**Table 6.2.2-2: Conducted EMI Results – Line 2**

| Frequency MHz | Level [dBµV] | Transd [dB] | Limit [dBµV] | Margin [dB] | Line | PE | Detector |
|---|---|---|---|---|---|---|---|
| 0.150000 | 48.80 | 9.9 | 66 | 17.3 | L2 | GND | QP |
| 0.330000 | 23.20 | 10.0 | 60 | 36.2 | L2 | GND | QP |
| 0.510000 | 10.70 | 10.0 | 56 | 45.3 | L2 | GND | QP |
| 0.870000 | 10.10 | 10.0 | 56 | 45.9 | L2 | GND | QP |
| 1.614000 | 10.00 | 10.0 | 56 | 46.0 | L2 | GND | QP |
| 1.680000 | 9.90 | 10.0 | 56 | 46.1 | L2 | GND | QP |
| 2.466000 | 9.20 | 10.0 | 56 | 46.8 | L2 | GND | QP |
| 4.530000 | 9.50 | 10.0 | 56 | 46.5 | L2 | GND | QP |
| 4.644000 | 9.40 | 10.0 | 56 | 46.6 | L2 | GND | QP |
| 13.560000 | 48.20 | 9.9 | 60 | 11.8 | L2 | GND | QP |
| 0.198000 | 14.90 | 9.9 | 54 | 38.8 | L2 | GND | AVG |
| 0.330000 | 8.50 | 10.0 | 50 | 41.0 | L2 | GND | AVG |
| 0.516000 | 7.30 | 10.0 | 46 | 38.7 | L2 | GND | AVG |
| 0.930000 | 7.10 | 10.0 | 46 | 39.0 | L2 | GND | AVG |
| 1.626000 | 7.10 | 10.0 | 46 | 38.9 | L2 | GND | AVG |
| 1.698000 | 7.10 | 10.0 | 46 | 38.9 | L2 | GND | AVG |
| 2.460000 | 6.50 | 10.0 | 46 | 39.5 | L2 | GND | AVG |
| 4.572000 | 6.60 | 10.0 | 46 | 39.4 | L2 | GND | AVG |
| 4.686000 | 6.70 | 10.0 | 46 | 39.3 | L2 | GND | AVG |
| 13.560000 | 39.90 | 9.9 | 50 | 10.1 | L2 | GND | AVG |

## 6.3 Radiated Emissions – Intentional Radiation

### 6.3.1 In-Band Emissions Limitations – FCC Part 15.225(a),(b),(c) / IC RSS-210 A2.6

#### *6.3.1.1* Test Methodology

Measurements below 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated about the vertical axis to maximize each emission. The magnetic loop receiving antenna was positioned with its center 1 meter above the ground.

The spectrum analyzer's resolution and video bandwidths were set to 9 kHz and 30 kHz respectively. A peak detector was used which shows worst case. The measurements were corrected by a distance correction factor, antenna correction factors, and cable loss for comparison to the limits. Sample correction factors and calculations can be found section 6.3.2.2 and 6.3.2.4.

#### *6.3.1.2* Test Results

Compliance with the emissions levels are shown in figure 6.3.1.2-1 through 6.3.1.2-3 below.

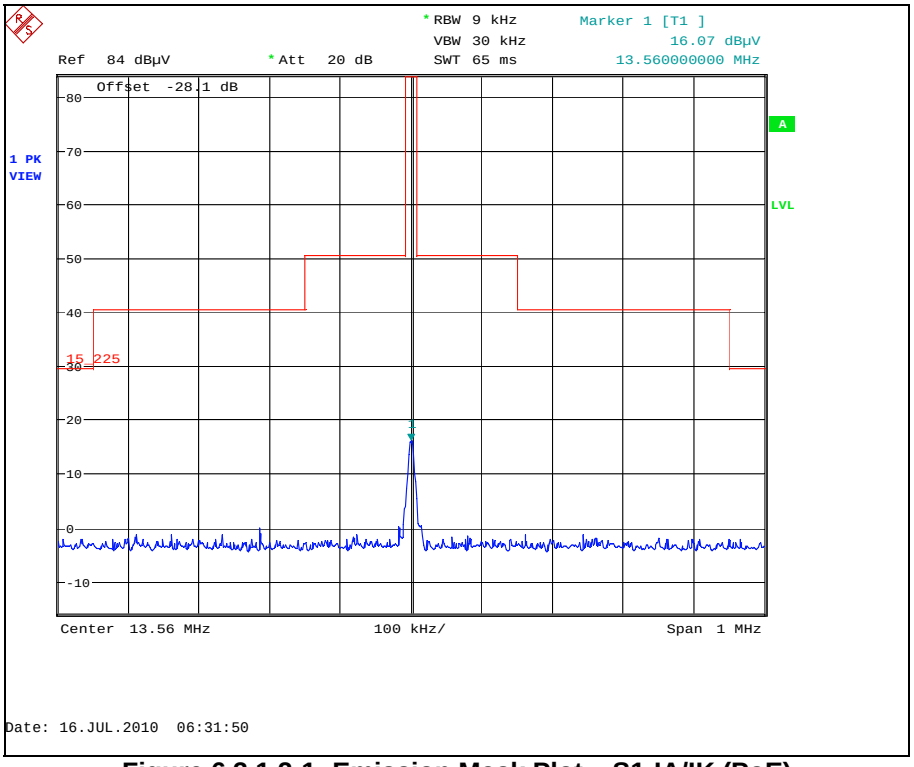


**Figure 6.3.1.2-1: Emission Mask Plot – S1-IA/IK (PoE)**

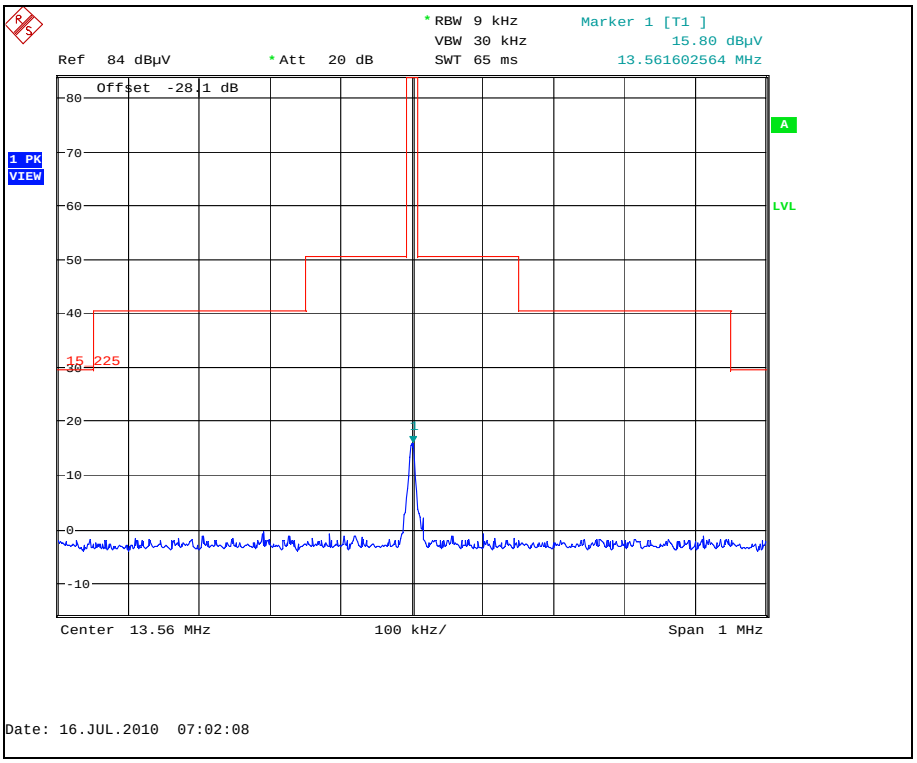


**Figure 6.3.1.2-2: Emission Mask Plot – S2-IA/IK (AUX Power)**

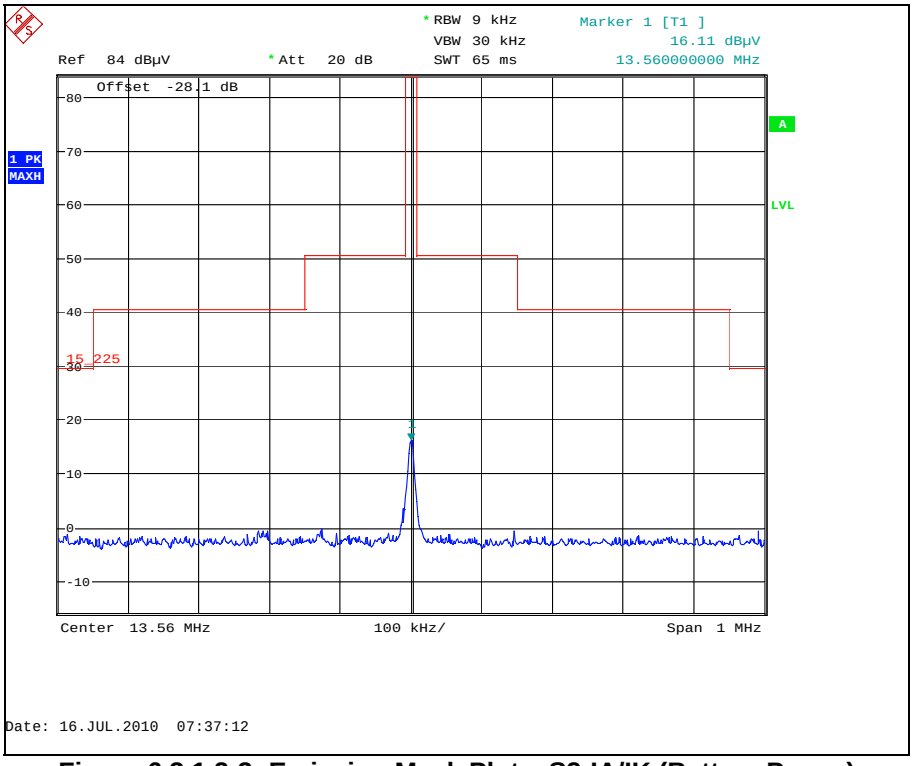


**Figure 6.3.1.2-3: Emission Mask Plot – S2-IA/IK (Battery Power)**

### 6.3.2 Out-of-Band Emissions – FCC Part 15.225(d), 15.209, 15.109 / IC RSS-210 2.6

#### *6.3.2.1* Test Methodology

Section 15.33(a)(4) specifies, if the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to frequency specified in 15.33(b)(1) for unintentional radiators. The upper frequency range for the digital device is 1000MHz which greater than the 10$^{th}$ harmonic of the fundamental frequency. The upper frequency range measured was 1000MHz.

Additionally 15.209(f) states, In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device. In this case the applicable limits are the Class A limits of 15.109(b) for emissions greater than 135.6 MHz (10*13.56 MHz)

Measurements below 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated about the vertical axis to maximize each emission. The magnetic loop receiving antenna was positioned with its center 1 meter above the ground.

For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an average detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a Quasi-peak detector. The final measurements were then corrected by a distance correction factor, antenna correction factors, and cable loss for comparison to the limits.

Measurements from 30MHz to 135.6 MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made.

Measurements from 135.6MHz to 1 GHz were performed on the OATS with a 10 meter separation distance between the EUT and measurement antenna unless otherwise noted. The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made.

The spectrum analyzer's resolution bandwidth was set to equal to or greater than 100 Hz from 9 kHz to 150 kHz, 9 kHz from 150 kHz to 30 MHz, 120 kHz from 30 MHz to 1000 MHz, and 1 MHz from 1 GHz to 40 GHz.

### *6.3.2.2* Distance Correction for Measurements Below 30 MHz – Part 15.31

Radiated measurements were performed at a distance closer than 30m as required according to Part 15.209. Therefore a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor is shown below for limits expressed at a 30m measurement distance.

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (3/30)
= - 40 dB

Distance correction factor (10m Specified Test Distance) = 40*Log (Test Distance/10)
= 40*Log (3/10)
= - 21 dB

### *6.3.2.3* Test Results

Radiated spurious emissions found are reported in Tables 6.3.2.3-1 through 6.3.2.3-3.

**Table 6.3.2.3-1: Radiated Spurious Emissions – S1-IA/IK (PoE)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity (H/V) | Correction Factors (dB) | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | | | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **19.56** | --------- | 18.78 | H | 11.36 | --------- | 30.14 | -------- | 69.5 | --------- | 39.4 |
| **27.12** | --------- | 21.05 | H | 10.18 | --------- | 31.23 | -------- | 69.5 | --------- | 38.3 |
| **27.16** | --------- | 31.03 | H | 10.17 | --------- | 41.20 | -------- | 69.5 | --------- | 28.3 |
| **40.68** | --------- | 29.36 | V | -11.85 | --------- | 17.51 | -------- | 40.0 | --------- | 22.5 |
| **49.852** | --------- | 47.02 | V | -13.53 | --------- | 33.49 | -------- | 39.1 | --------- | 5.6 |
| **67.8** | --------- | 30.86 | H | -19.38 | --------- | 11.48 | -------- | 40.0 | --------- | 28.5 |
| **67.8** | --------- | 41.09 | V | -19.38 | --------- | 21.71 | -------- | 40.0 | --------- | 18.3 |
| **68.716** | --------- | 49.61 | V | -14.29 | --------- | 35.32 | -------- | 39.1 | --------- | 3.8 |
| **81.36** | --------- | 28.24 | H | -17.48 | --------- | 10.76 | -------- | 40.0 | --------- | 29.2 |
| **81.36** | --------- | 45.30 | V | -17.48 | --------- | 27.82 | -------- | 40.0 | --------- | 12.2 |
| **94.92** | --------- | 27.45 | H | -15.31 | --------- | 12.14 | -------- | 43.5 | --------- | 31.4 |
| **94.92** | --------- | 40.38 | V | -15.31 | --------- | 25.07 | -------- | 43.5 | --------- | 18.4 |
| **99.003** | --------- | 13.24 | V | 13.86 | --------- | 27.10 | -------- | 43.5 | --------- | 16.4 |
| **105.44** | --------- | 16.18 | V | 15.68 | --------- | 31.86 | -------- | 43.5 | --------- | 11.6 |
| **108.48** | --------- | 28.70 | H | -13.83 | --------- | 14.87 | -------- | 43.5 | --------- | 28.6 |
| **108.48** | --------- | 35.88 | V | -13.83 | --------- | 22.05 | -------- | 43.5 | --------- | 21.5 |
| **122.04** | --------- | 26.11 | H | -13.30 | --------- | 12.81 | -------- | 43.5 | --------- | 30.7 |
| **122.04** | --------- | 36.11 | V | -13.30 | --------- | 22.81 | -------- | 43.5 | --------- | 20.7 |
| **135.6** | --------- | 27.38 | H | -13.47 | --------- | 13.91 | -------- | 43.5 | --------- | 29.6 |
| **135.6** | --------- | 36.42 | V | -13.47 | --------- | 22.95 | -------- | 43.5 | --------- | 20.6 |
| **250.004** | --------- | 46.54 | V | -10.50 | --------- | 36.04 | -------- | 46.4 | --------- | 10.4 |
| **650.874** | --------- | 31.40 | V | -2.07 | --------- | 29.33 | -------- | 56.9 | --------- | 27.6 |

Note: Spurious emissions associated with the digital device and all spurious emissions above the 10$^{th}$ harmonic of the fundamental emission were measured at 10m and compared to the Part 15.109 Class A emission limits as described in section 6.3.2.1 above.

Note2: The spurious emission at 650.9 MHz was measured at a distance of 3m in the Semi-Anechoic chamber due to ambient noise on the Open Area Test Site. Distance correction was applied to the limit for comparison to the Class A limits.

**Table 6.3.2.3-2: Radiated Spurious Emissions - S2-IA/IK (AUX Power)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity (H/V) | Correction Factors (dB) | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | | | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **27.12** | --------- | 8.27 | H | 10.18 | --------- | 18.45 | -------- | 69.5 | --------- | 51.1 |
| **40.68** | --------- | 29.66 | V | -11.85 | --------- | 17.81 | -------- | 40.0 | --------- | 22.2 |
| **67.8** | --------- | 34.31 | H | -19.38 | --------- | 14.93 | -------- | 40.0 | --------- | 25.1 |
| **67.8** | --------- | 33.8 | V | -19.38 | --------- | 14.42 | -------- | 40.0 | --------- | 25.6 |
| **81.36** | --------- | 25.09 | H | -17.48 | --------- | 7.61 | -------- | 40.0 | --------- | 32.4 |
| **81.36** | --------- | 28.37 | V | -17.48 | --------- | 10.89 | -------- | 40.0 | --------- | 29.1 |
| **108.48** | --------- | 21.92 | H | -13.83 | --------- | 8.09 | -------- | 43.5 | --------- | 35.4 |
| **122.04** | --------- | 24.10 | H | -13.30 | --------- | 10.80 | -------- | 43.5 | --------- | 32.7 |
| **122.04** | --------- | 33.50 | V | -13.30 | --------- | 20.20 | -------- | 43.5 | --------- | 23.3 |
| **135.6** | --------- | 29.26 | H | -13.47 | --------- | 15.79 | -------- | 43.5 | --------- | 27.7 |
| **135.6** | --------- | 26.21 | V | -13.47 | --------- | 12.74 | -------- | 43.5 | --------- | 30.8 |
| **244.093** | --------- | 51.06 | V | -10.85 | --------- | 40.21 | -------- | 46.4 | --------- | 6.2 |
| **542.411** | --------- | 37.78 | V | -4.01 | --------- | 33.77 | -------- | 46.4 | --------- | 12.6 |
| **569.96** | --------- | 20.72 | V | -3.40 | --------- | 17.32 | -------- | 46.4 | --------- | 29.1 |
| **596.649** | --------- | 29.63 | V | -2.80 | --------- | 26.83 | -------- | 46.4 | --------- | 19.6 |
| **623.86** | --------- | 43.90 | V | -2.06 | --------- | 41.84 | -------- | 46.4 | --------- | 4.6 |
| **650.311** | --------- | 44.53 | V | -1.51 | --------- | 43.02 | -------- | 46.4 | --------- | 3.4 |

Note: Spurious emissions associated with the digital device and all spurious emissions above the 10th harmonic of the fundamental emission were measured at 10m and compared to the Part 15.109 Class A emission limits as described in section 6.3.2.1 above.

**Table 6.3.2.3-3: Radiated Spurious Emissions - S2-IA/IK (Battery Power)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity (H/V) | Correction Factors (dB) | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | | | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **27.12** | --------- | 7.16 | H | 10.18 | --------- | 17.34 | -------- | 69.5 | --------- | 52.2 |
| **40.68** | --------- | 23.82 | V | -11.85 | --------- | 11.97 | -------- | 40.0 | --------- | 28.0 |
| **67.8** | --------- | 21.03 | V | -19.38 | --------- | 1.65 | -------- | 40.0 | --------- | 38.3 |
| **108.48** | --------- | 24.89 | H | -13.83 | --------- | 11.06 | -------- | 43.5 | --------- | 32.4 |
| **122** | --------- | 52.56 | V | -12.40 | --------- | 40.16 | -------- | 43.5 | --------- | 3.34 |
| **135.6** | --------- | 26.54 | H | -13.47 | --------- | 13.07 | -------- | 43.5 | --------- | 30.4 |
| **488.05** | --------- | 43.73 | H | -4.58 | --------- | 39.15 | -------- | 46.4 | --------- | 7.3 |
| **569.97** | --------- | 20.74 | V | -3.40 | --------- | 17.34 | -------- | 46.4 | --------- | 29.1 |
| **582.9** | --------- | 20.66 | V | -3.01 | --------- | 17.65 | -------- | 46.4 | --------- | 28.8 |
| **596.649** | --------- | 30.52 | V | -2.80 | --------- | 27.72 | -------- | 46.4 | --------- | 18.7 |
| **623.86** | --------- | 31.89 | V | -2.06 | --------- | 29.83 | -------- | 46.4 | --------- | 16.6 |
| **952.724** | --------- | 39.41 | H | 2.87 | --------- | 42.28 | -------- | 46.4 | --------- | 4.1 |

Note: Spurious emissions associated with the digital device and all spurious emissions above the 10th harmonic of the fundamental emission were measured at 10m and compared to the Part 15.109 Class A emission limits as described in section 6.3.2.1 above.

### *6.3.2.4* Sample Calculation:

**Example Calculation – Average/Quasi-Peak Limit < 30MHz**

*Limit (dBuV/m)* = 20*log(30) - Distance Correction Factor (Section 7.3.2.2)
*Limit (dBuV/m)* = 29.5 + 40
*Limit (dBuV/m)* = 69.5

$R_C = R_U + CF_T$

Where:
$CF_T$ = Total Correction Factor (AF+CA+AG)
$R_U$ = Uncorrected Reading
$R_C$ = Corrected Level
AF = Antenna Factor
CA = Cable Attenuation
AG = Amplifier Gain

*Corrected Level: 21.05 + 10.18 = 31.23dBuV*
*Margin: 69.5dBuV – 31.23dBuV = 38.3dB*

## 6.4 Occupied Bandwidth – FCC Part 15.215(c) / IC RSS-Gen 4.6.1

### 6.4.1 Measurement Procedure

The spectrum analyzer span was set to encompass the peak emission and at least 20dB below the peak. The RBW was to 1% - 3% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The measurement function of the analyzer was utilized to determine the 99% occupied bandwidth.

### 6.4.2 Measurement Results

Results are shown below in Table 6.4.2-1 and Figures 6.4.2-1 and 6.4.2-2.

**Table 6.4.2-1 – Occupied Bandwidth**

| Frequency (MHz) | 20 dB BW (kHz) | 99% Bandwidth (kHz) |
|---|---|---|
| **13.56** | 1.38 | 1.48 |

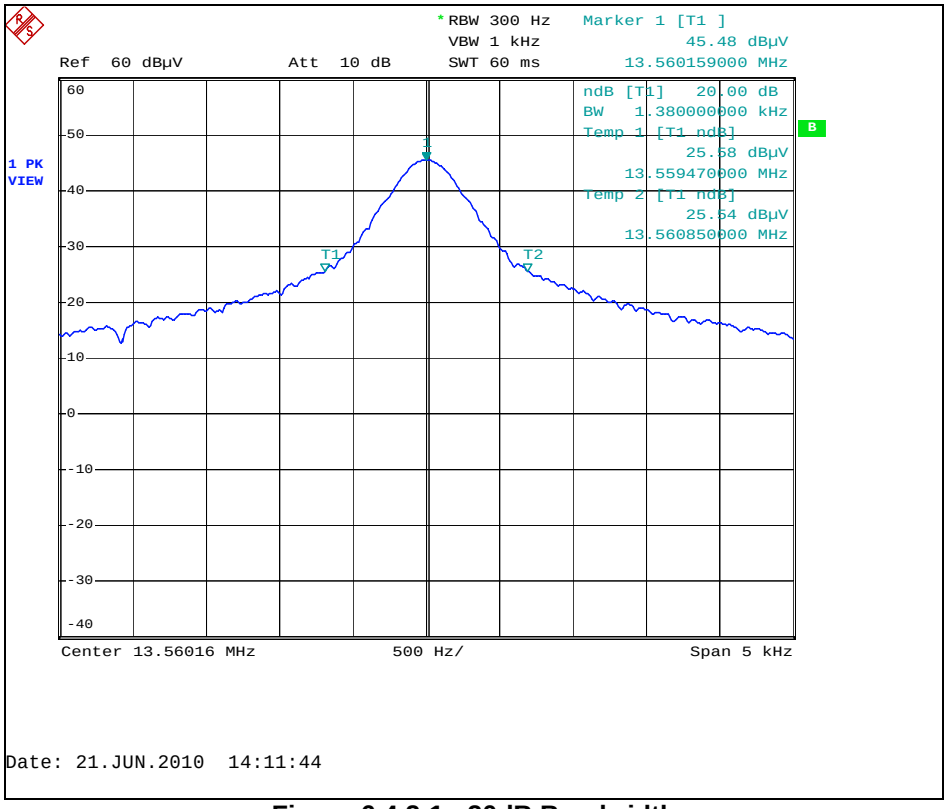


**Figure 6.4.2-1: 20dB Bandwidth**

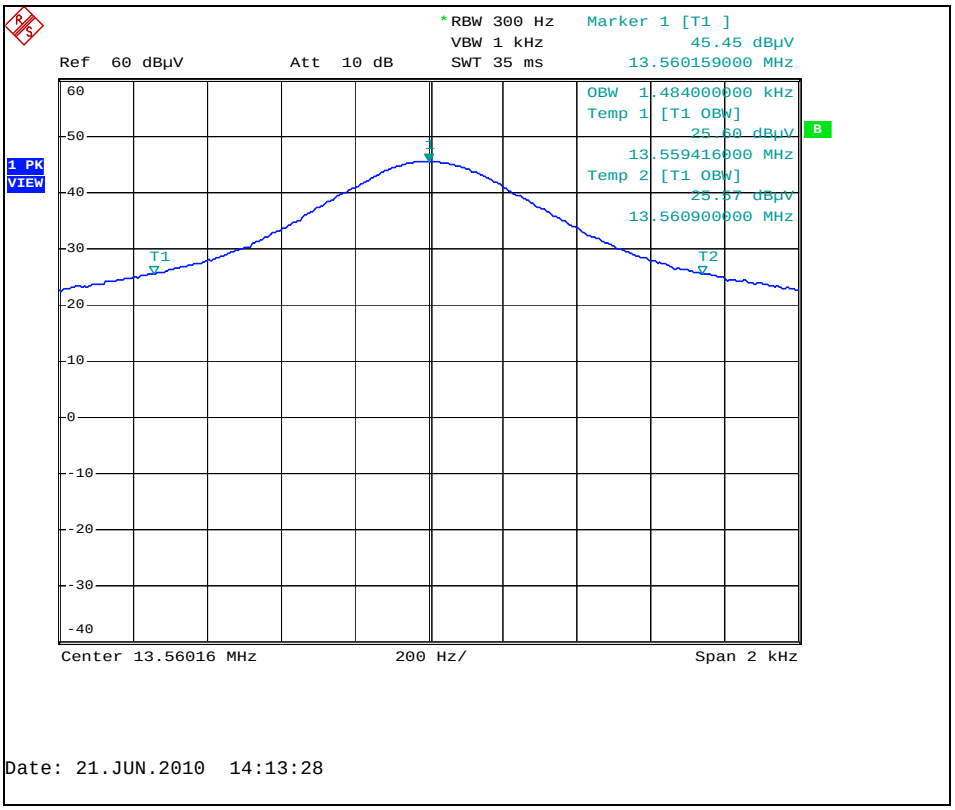


**Figure 6.4.2-2: 99% Bandwidth**

## 6.5 Frequency Stability – FCC Part 15.225(e) / IC RSS-210 A2.6

### 6.5.1 Test Methodology

The equipment under test is placed inside an environmental chamber. The RF output is coupled to the input of the measurement equipment via a near field probe.

Frequency measurements were made at the extremes of the of temperature range -20º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. At a temperature 20º C the supply voltage was varied from 85% to 115% from the normal. The maximum variation of frequency was recorded.

The limit from rule part 15.225 is 0.01% or 100ppm.

### 6.5.2 Test Results

Results of the test are shown below in Figure 6.5.2-1.

# Frequency Stability

**Frequency (MHz):** 13.56
**Deviation Limit (PPM):** 100ppm

| Temperature | Frequency | Frequency Error | Voltage | Voltage |
|---|---|---|---|---|
| C | MHz | (PPM) | (%) | (VDC) |
| | | | | |
| -20 C | **13.560204** | **15.044** | 100% | 9.00 |
| -10 C | **13.560192** | **14.159** | 100% | 9.00 |
| 0 C | **13.560244** | **17.994** | 100% | 9.00 |
| 10 C | **13.560256** | **18.879** | 100% | 9.00 |
| 20 C | **13.560288** | **21.239** | 100% | 9.00 |
| 30 C | **13.560260** | **19.174** | 100% | 9.00 |
| 40 C | **13.560286** | **21.091** | 100% | 9.00 |
| 50 C | **13.560280** | **20.649** | 100% | 9.00 |
| | | | | |
| 20 C | **13.560288** | **21.239** | 85% | 7.65 |
| 20 C | **13.560288** | **21.239** | 100% | 10.35 |

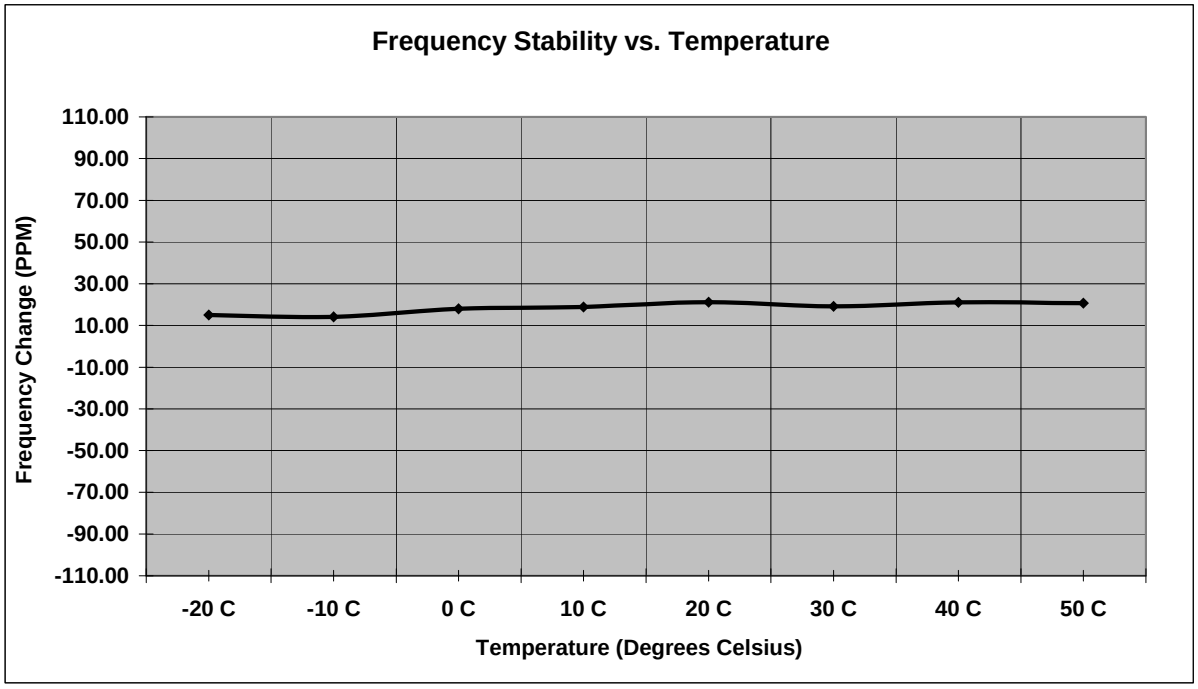


**Figure 6.5.2-1: Frequency Stability**

## 7 CONCLUSION

In the opinion of ACS, Inc. the S1-IA/IK, S2-IA/IK models manufactured by Assa Abloy, Inc. meet the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

# END REPORT