

## **Certification Test Report**

**FCC ID: QZC-ILC24FI**

**FCC Rule Part: 15.247**

**ACS Report Number: 15-0013.W03.2C**

Manufacturer: Elster Solutions, LLC  
Model: ILC24FI

Test Begin Date: January 28, 2015  
Test End Date: January 29, 2015

Report Issue Date: March 31, 2015



FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

Reviewed by:

A handwritten signature in black ink, appearing to read "Kirby Munroe", is positioned above the printed name.

**Kirby Munroe**  
**Director, Wireless Certifications**  
**ACS, Inc.**

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**This report contains 24 pages**

# TABLE OF CONTENTS

|          |                                                                                                 |           |
|----------|-------------------------------------------------------------------------------------------------|-----------|
| <b>1</b> | <b>GENERAL .....</b>                                                                            | <b>3</b>  |
| 1.1      | PURPOSE.....                                                                                    | 3         |
| 1.2      | PRODUCT DESCRIPTION .....                                                                       | 3         |
| 1.3      | TEST METHODOLOGY AND CONSIDERATIONS .....                                                       | 4         |
| <b>2</b> | <b>TEST FACILITIES.....</b>                                                                     | <b>5</b>  |
| 2.1      | LOCATION .....                                                                                  | 5         |
| 2.2      | LABORATORY ACCREDITATIONS/RECOGNITIONS/CERTIFICATIONS .....                                     | 5         |
| 2.3      | RADIATED EMISSIONS TEST SITE DESCRIPTION .....                                                  | 6         |
| 2.3.1    | <i>Semi-Anechoic Chamber Test Site</i> .....                                                    | 6         |
| 2.3.2    | <i>Open Area Tests Site (OATS)</i> .....                                                        | 7         |
| 2.4      | CONDUCTED EMISSIONS TEST SITE DESCRIPTION .....                                                 | 8         |
| <b>3</b> | <b>APPLICABLE STANDARD REFERENCES.....</b>                                                      | <b>8</b>  |
| <b>4</b> | <b>LIST OF TEST EQUIPMENT.....</b>                                                              | <b>9</b>  |
| <b>5</b> | <b>SUPPORT EQUIPMENT.....</b>                                                                   | <b>10</b> |
| <b>6</b> | <b>EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM .....</b>                                           | <b>10</b> |
| <b>7</b> | <b>SUMMARY OF TESTS.....</b>                                                                    | <b>11</b> |
| 7.1      | ANTENNA REQUIREMENT – FCC 15.203 .....                                                          | 11        |
| 7.2      | POWER LINE CONDUCTED EMISSIONS – FCC 15.207, IC: RSS-GEN 8.8 .....                              | 11        |
| 7.2.1    | <i>Measurement Procedure</i> .....                                                              | 11        |
| 7.2.2    | <i>Measurement Results</i> .....                                                                | 11        |
| 7.3      | PEAK OUTPUT POWER - FCC 15.247(B)(2) IC: RSS-210 A8.4(1) .....                                  | 13        |
| 7.3.1    | <i>Measurement Procedure (Conducted Method)</i> .....                                           | 13        |
| 7.3.2    | <i>Measurement Results</i> .....                                                                | 13        |
| 7.4      | CHANNEL USAGE REQUIREMENTS .....                                                                | 14        |
| 7.4.1    | <i>Carrier Frequency Separation – FCC 15.247(a)(1) IC: RSS-210 A8.1(b)</i> .....                | 14        |
| 7.4.1.1  | <i>Measurement Procedure</i> .....                                                              | 14        |
| 7.4.1.2  | <i>Measurement Results</i> .....                                                                | 14        |
| 7.4.2    | <i>Number of Hopping Channels – FCC 15.247(a)(1)(i) IC: RSS-210 A8.1(c)</i> .....               | 15        |
| 7.4.2.1  | <i>Measurement Procedure</i> .....                                                              | 15        |
| 7.4.2.2  | <i>Measurement Results</i> .....                                                                | 15        |
| 7.4.3    | <i>Channel Dwell Time – FCC 15.247(a)(1)(i) IC: RSS-210 A8.1(c)</i> .....                       | 16        |
| 7.4.4    | <i>20dB / 99% Bandwidth - FCC 15.247(a)(1)(i) IC: RSS-210 A8.2(a)</i> .....                     | 17        |
| 7.4.4.1  | <i>Measurement Procedure</i> .....                                                              | 17        |
| 7.4.4.2  | <i>Measurement Results</i> .....                                                                | 17        |
| 7.5      | BAND-EDGE COMPLIANCE AND SPURIOUS EMISSIONS .....                                               | 19        |
| 7.5.1    | <i>Band-Edge Compliance of RF Conducted Emissions - FCC 15.247(d); IC RSS-210 A8.5..</i> 19     |           |
| 7.5.1.1  | <i>Measurement Procedure</i> .....                                                              | 19        |
| 7.5.1.2  | <i>Measurement Results</i> .....                                                                | 19        |
| 7.5.2    | <i>RF Conducted Spurious Emissions - FCC 15.247(d); IC RSS-210 A8.5</i> .....                   | 20        |
| 7.5.2.1  | <i>Measurement Procedure</i> .....                                                              | 20        |
| 7.5.2.2  | <i>Measurement Results</i> .....                                                                | 20        |
| 7.5.3    | <i>Radiated Spurious Emissions - FCC 15.205, 15.209; IC RSS-210 2.2, RSS-Gen 8.9/8.10 ..</i> 22 |           |
| 7.5.3.1  | <i>Measurement Procedure</i> .....                                                              | 22        |
| 7.5.3.2  | <i>Measurement Results</i> .....                                                                | 22        |
| 7.5.3.3  | <i>Sample Calculation:</i> .....                                                                | 23        |
| <b>8</b> | <b>CONCLUSION.....</b>                                                                          | <b>24</b> |

## 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 Certification for modular approval.

### 1.2 Product description

The ILC24FI module contains a frequency hopping spread spectrum radio operating in the 916.0 – 927.6 MHz ISM frequency band. The ILC24FI forms a complete electricity meter when installed in a housing and meter base.

#### Technical Details:

| Detail             | Description           |
|--------------------|-----------------------|
| Frequency Range    | 916.0 – 927.6 MHz     |
| Number of Channels | 25                    |
| Modulation Format  | FSK                   |
| Data Rates         | 35.5 kbps /142.2 kbps |
| Operating Voltage  | 12 VDC                |

#### Antenna Details:

| Item # | Antenna                                              | Gain     | Internal / External |
|--------|------------------------------------------------------|----------|---------------------|
| 1      | PCTEL(MAXRAD) MFB9153 3dB Fiberglass Omnidirectional | 5.15 dBi | External            |
| 2      | PCTEL(MAXRAD) MFB9150 3dB Fiberglass Omnidirectional | 2.15 dBi | External            |
| 3      | Antenex TRA9023P(NP)* [white body] 3dB Gain          | 3 dBi    | External            |
| 4      | Antenex TRAB9023P(NP)* [black body] 3dB Gain         | 3 dBi    | External            |
| 5      | Inverted F-Type                                      | 3.49 dBi | Internal            |

#### Manufacturer Information:

Elster Solutions, LLC  
208 South Rogers Lane  
Raleigh, NC 27610

Test Sample Serial Numbers: 5D26152G0301 0 1144600047 (Radiated), 5D26152G0301 0 1144600021 (Conducted)

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

### 1.3 Test Methodology and Considerations

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable.

For radiated emissions the EUT was tested in an orientation representative of final installation.

The highest gain of each antenna type was evaluated for radiated emissions.

The EUT utilizes 25 hopping channels in the range from 902.4 MHz to 927.6 MHz using multiple hopping tables. Data was collected using multiple hopping tables to show compliance for all possible operating conditions (i.e. hopping band-edge at extreme operating band-edges).

For use with external antennas, the EUT utilizes a passive isolation board between the RF output and antenna. The isolation board was used in the test setup for testing external antennas and will be included in the final installation.

Software power setting during test: 0X69

## **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: 511277

Industry Canada Lab Code: IC 4175A

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:

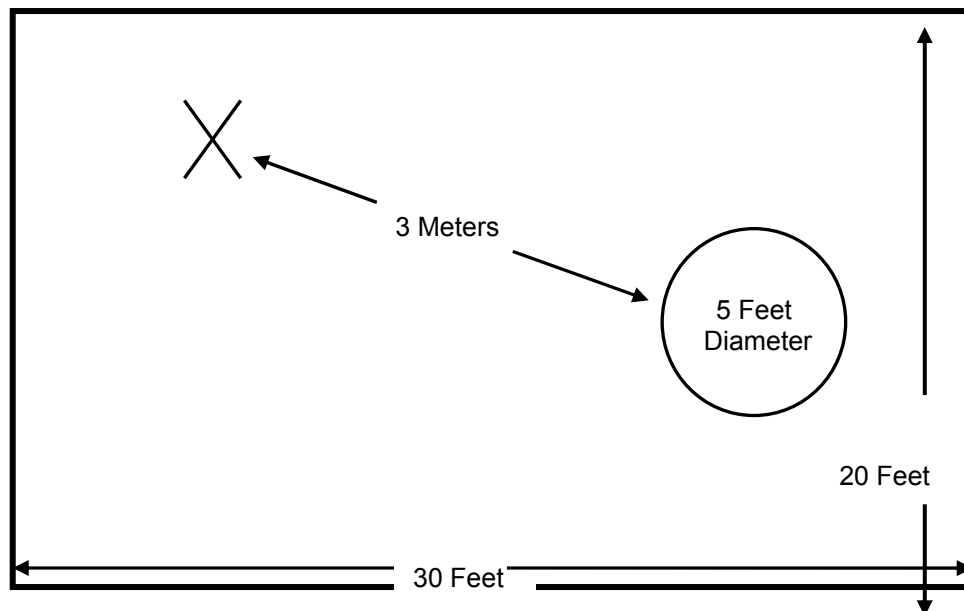


Figure 2.3-1: Semi-Anechoic Chamber Test Site

### 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:

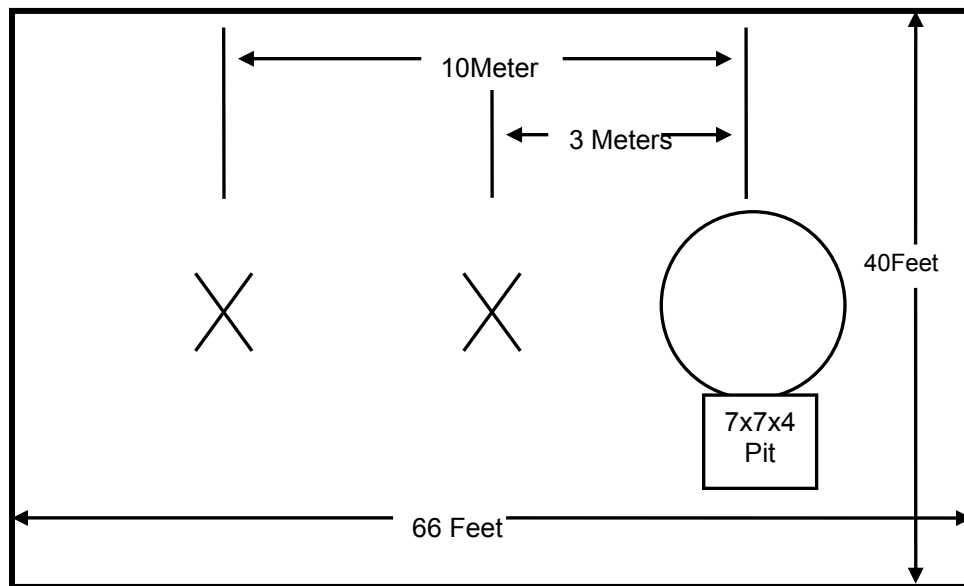


Figure 2.3-2: Open Area Test Site

## 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 ground 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:

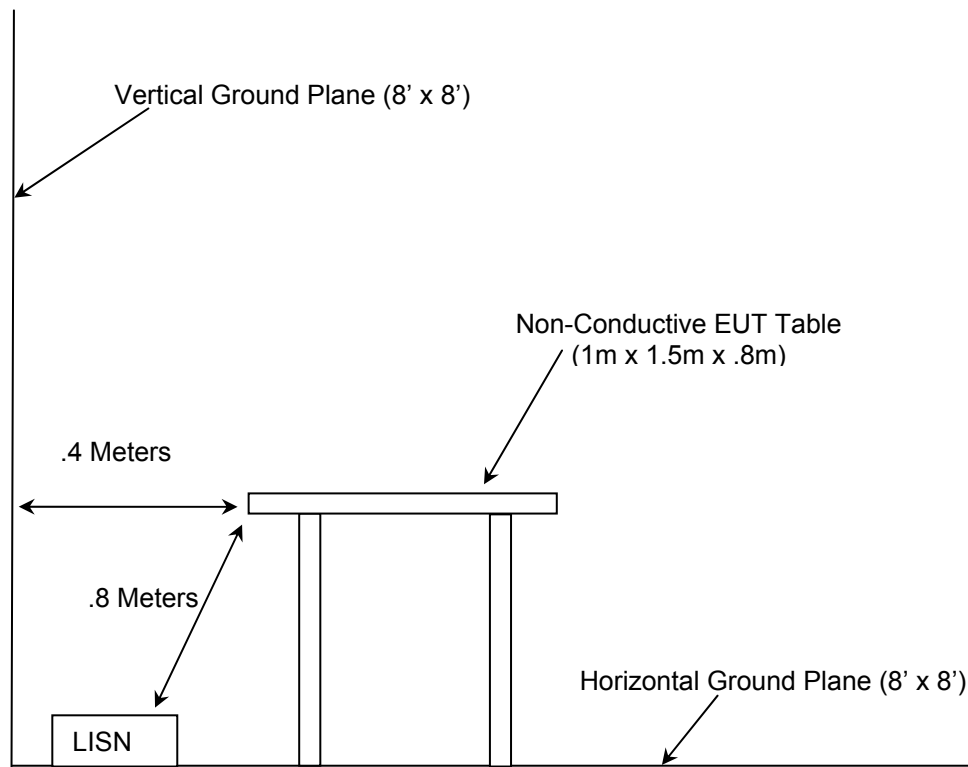


Figure 2.4-1: AC Mains Conducted EMI Site

## 3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2015
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2015
- ❖ FCC Public Notice DA 00-705 – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems, March 30, 2000
- ❖ Industry Canada Radio Standards Specification: RSS-210 – Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8, December 2010
- ❖ Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 4, Nov 2014.

#### 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**

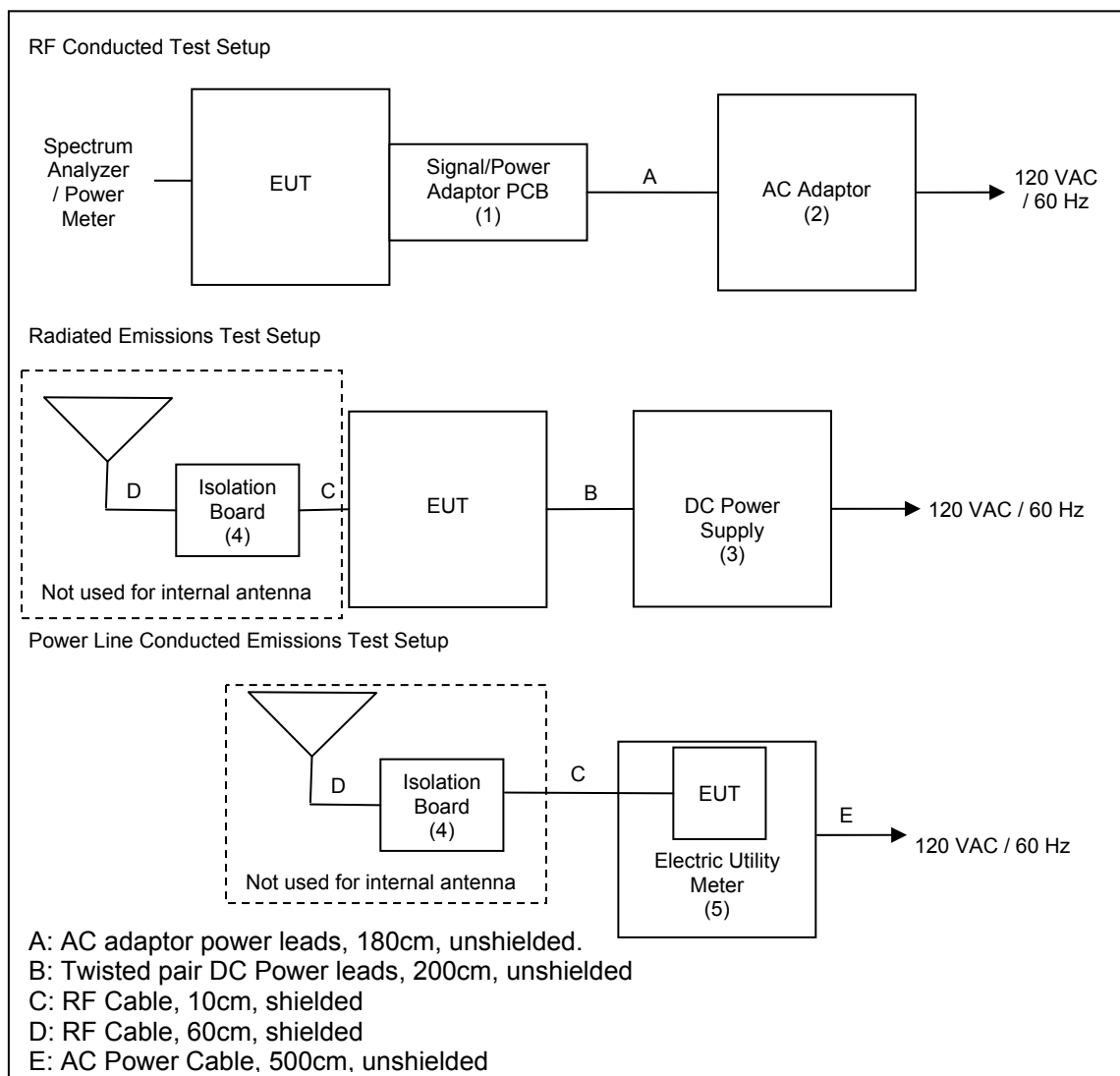
| AssetID | Manufacturer          | Model #               | Equipment Type     | Serial #   | Last Calibration Date | Calibration Due Date |
|---------|-----------------------|-----------------------|--------------------|------------|-----------------------|----------------------|
| 1       | Rohde & Schwarz       | ESMI - Display        | Spectrum Analyzers | 833771/007 | 7/11/2014             | 7/11/2016            |
| 2       | Rohde & Schwarz       | ESMI-Receiver         | Spectrum Analyzers | 839587/003 | 7/11/2014             | 7/11/2016            |
| 30      | Spectrum Technologies | DRH-0118              | Antennas           | 970102     | 4/23/2013             | 4/23/2015            |
| 40      | EMCO                  | 3104                  | Antennas           | 3211       | 2/14/2013             | 2/14/2015            |
| 73      | Agilent               | 8447D                 | Amplifiers         | 2727A05624 | 7/15/2014             | 7/15/2015            |
| 167     | ACS                   | Chamber EMI Cable Set | Cable Set          | 167        | 10/28/2014            | 10/28/2015           |
| 168     | Hewlett Packard       | 11947A                | Attenuators        | 44829      | 1/19/2015             | 1/19/2016            |
| 267     | Agilent               | N1911A                | Meters             | MY45100129 | 7/30/2013             | 7/30/2015            |
| 268     | Agilent               | N1921A                | Sensors            | MY45240184 | 7/30/2013             | 7/30/2015            |
| 292     | Florida RF Cables     | SMR-290AW-480.0-SMR   | Cables             | None       | 3/17/2014             | 3/17/2015            |
| 316     | Rohde Schwarz         | ESH3-Z5               | LISN               | 861189-010 | 8/15/2013             | 8/15/2015            |
| 324     | ACS                   | Belden                | Cables             | 8214       | 6/4/2014              | 6/4/2015             |
| 331     | Microwave Circuits    | H1G513G1              | Filters            | 31417      | 6/2/2014              | 6/2/2015             |
| 338     | Hewlett Packard       | 8449B                 | Amplifiers         | 3008A01111 | 7/30/2013             | 7/30/2015            |
| 340     | Aeroflex/Weinschel    | AS-20                 | Attenuators        | 7136       | 7/14/2014             | 7/14/2015            |
| 412     | Electro Metrics       | LPA-25                | Antennas           | 1241       | 7/24/2014             | 7/24/2016            |
| 422     | Florida RF            | SMS-200AW-72.0-SMR    | Cables             | 805        | 11/5/2014             | 11/5/2015            |
| 616     | Florida RF Cables     | SMRE-200W-12.0-SMRE   | Cables             | N/A        | 9/10/2014             | 9/10/2015            |
| 622     | Rohde & Schwarz       | FSV40                 | Analyzers          | 101338     | 7/12/2014             | 7/12/2015            |
| RE361   | Agilent               | AT/E7405A             | Analyzers          | MY42000089 | 5/30/2014             | 5/30/2016            |

## 5 SUPPORT EQUIPMENT

**Table 5-1: Support Equipment**

| Item | Equipment Type           | Manufacturer          | Model Number       | Serial Number |
|------|--------------------------|-----------------------|--------------------|---------------|
| 1    | Signal/Power Adaptor PCB | Elster Solutions, LLC | N/A                | N/A           |
| 2    | AC Adaptor               | V-Infinity            | EMSA150120K-P5P-SZ | N/A           |
| 3    | DC Power Supply          | Hewlett Packard       | E3630A             | KR64308603    |
| 4    | Isolation Board          | Elster                | 1B12154G02         | N/A           |
| 5    | Electric Utility Meter   | Milbank MFG.          | Type 3R            | N/A           |

## 6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



**Figure 6-1: Test Setup Block Diagram**

## 7 SUMMARY OF TESTS

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

### 7.1 Antenna Requirement – FCC 15.203

The EUT utilizes a MCX on-board connector. The MCX connector is considered unique thus meeting the requirements of Section 15.203.

### 7.2 Power Line Conducted Emissions – FCC 15.207, IC: RSS-Gen 8.8

#### 7.2.1 Measurement Procedure

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**

#### 7.2.2 Measurement Results

**Table 7.2.2-1: Conducted EMI Results Line 1 – Antenna 1**

| Frequency (MHz) | Uncorrected Reading |         | Total Correction Factor (dB) | Corrected Level |         | Limit      |         | Margin (dB) |         |
|-----------------|---------------------|---------|------------------------------|-----------------|---------|------------|---------|-------------|---------|
|                 | Quasi-Peak          | Average |                              | Quasi-Peak      | Average | Quasi-Peak | Average | Quasi-Peak  | Average |
| 17.6954         | 23.487              | 23.287  | 11.102                       | 34.589          | 34.39   | 60         | 50      | 25.411      | 15.61   |
| 16.2294         | 24.477              | 24.24   | 10.97                        | 35.446          | 35.21   | 60         | 50      | 24.554      | 14.79   |
| 0.51235         | 18.119              | 12.632  | 10.202                       | 28.321          | 22.834  | 56         | 46      | 27.679      | 23.166  |
| 0.395413        | 22.009              | 15.153  | 10.179                       | 32.188          | 25.332  | 58.988     | 48.988  | 26.8        | 23.656  |
| 0.199175        | 31.543              | 23.405  | 10.16                        | 41.703          | 33.565  | 64.595     | 54.595  | 22.892      | 21.03   |
| 0.166177        | 27.246              | 19.535  | 10.16                        | 37.406          | 29.695  | 65.538     | 55.538  | 28.132      | 25.842  |

**Table 7.2.2-2: Conducted EMI Results Line 2 – Antenna 1**

| Frequency (MHz) | Uncorrected Reading |         | Total Correction Factor (dB) | Corrected Level |         | Limit      |         | Margin (dB) |         |
|-----------------|---------------------|---------|------------------------------|-----------------|---------|------------|---------|-------------|---------|
|                 | Quasi-Peak          | Average |                              | Quasi-Peak      | Average | Quasi-Peak | Average | Quasi-Peak  | Average |
| 2.44749         | 23.124              | 16.391  | 10.22                        | 33.344          | 26.611  | 56         | 46      | 22.656      | 19.389  |
| 1.7963          | 22.756              | 18.033  | 10.22                        | 32.976          | 28.253  | 56         | 46      | 23.024      | 17.747  |
| 0.50845         | 23.399              | 18.861  | 10.201                       | 33.6            | 29.062  | 56         | 46      | 22.4        | 16.938  |
| 0.455456        | 24.373              | 20.794  | 10.196                       | 34.568          | 30.989  | 57.273     | 47.273  | 22.704      | 16.283  |
| 0.197838        | 33.845              | 27.081  | 10.179                       | 44.024          | 37.26   | 64.633     | 54.633  | 20.609      | 17.373  |
| 0.154106        | 27.537              | 19.331  | 10.17                        | 37.707          | 29.501  | 65.883     | 55.883  | 28.176      | 26.382  |

Table 7.2.2-3: Conducted EMI Results Line 1 – Antenna 3

| Frequency (MHz) | Uncorrected Reading |         | Total Correction Factor (dB) | Corrected Level |         | Limit      |         | Margin (dB) |         |
|-----------------|---------------------|---------|------------------------------|-----------------|---------|------------|---------|-------------|---------|
|                 | Quasi-Peak          | Average |                              | Quasi-Peak      | Average | Quasi-Peak | Average | Quasi-Peak  | Average |
| 18.2443         | 22.449              | 22.175  | 11.099                       | 33.548          | 33.274  | 60         | 50      | 26.452      | 16.726  |
| 17.6951         | 21.989              | 21.884  | 11.102                       | 33.091          | 32.986  | 60         | 50      | 26.909      | 17.014  |
| 0.505999        | 18.042              | 13.391  | 10.201                       | 28.243          | 23.593  | 56         | 46      | 27.757      | 22.407  |
| 0.460175        | 21.089              | 15.543  | 10.192                       | 31.281          | 25.735  | 57.138     | 47.138  | 25.857      | 21.402  |
| 0.264119        | 29.642              | 19.46   | 10.163                       | 39.805          | 29.623  | 62.739     | 52.739  | 22.935      | 23.116  |
| 0.199025        | 30.018              | 22.898  | 10.16                        | 40.178          | 33.058  | 64.599     | 54.599  | 24.422      | 21.541  |

Table 7.2.2-4: Conducted EMI Results Line 2 – Antenna 3

| Frequency (MHz) | Uncorrected Reading |         | Total Correction Factor (dB) | Corrected Level |         | Limit      |         | Margin (dB) |         |
|-----------------|---------------------|---------|------------------------------|-----------------|---------|------------|---------|-------------|---------|
|                 | Quasi-Peak          | Average |                              | Quasi-Peak      | Average | Quasi-Peak | Average | Quasi-Peak  | Average |
| 1.91056         | 23.105              | 17.45   | 10.22                        | 33.325          | 27.67   | 56         | 46      | 22.675      | 18.33   |
| 1.85649         | 23.13               | 17.969  | 10.22                        | 33.35           | 28.189  | 56         | 46      | 22.65       | 17.811  |
| 0.51325         | 23.967              | 18.95   | 10.201                       | 34.168          | 29.151  | 56         | 46      | 21.832      | 16.849  |
| 0.502938        | 24.551              | 20.273  | 10.2                         | 34.751          | 30.474  | 56         | 46      | 21.249      | 15.526  |
| 0.196687        | 33.44               | 27.86   | 10.179                       | 43.619          | 38.039  | 64.666     | 54.666  | 21.047      | 16.627  |
| 0.170919        | 27.827              | 22.038  | 10.17                        | 37.997          | 32.209  | 65.402     | 55.402  | 27.405      | 23.194  |

Table 7.2.2-5: Conducted EMI Results Line 1 – Antenna 5

| Frequency (MHz) | Uncorrected Reading |         | Total Correction Factor (dB) | Corrected Level |         | Limit      |         | Margin (dB) |         |
|-----------------|---------------------|---------|------------------------------|-----------------|---------|------------|---------|-------------|---------|
|                 | Quasi-Peak          | Average |                              | Quasi-Peak      | Average | Quasi-Peak | Average | Quasi-Peak  | Average |
| 18.245          | 22.295              | 21.991  | 11.099                       | 33.394          | 33.09   | 60         | 50      | 26.606      | 16.91   |
| 16.2298         | 23.569              | 23.289  | 10.97                        | 34.538          | 34.259  | 60         | 50      | 25.462      | 15.741  |
| 16.1686         | 22.578              | 22.254  | 10.961                       | 33.539          | 33.215  | 60         | 50      | 26.461      | 16.785  |
| 14.2137         | 20.063              | 19.356  | 10.919                       | 30.982          | 30.275  | 60         | 50      | 29.018      | 19.725  |
| 0.501349        | 15.092              | 10.195  | 10.2                         | 25.292          | 20.395  | 56         | 46      | 30.708      | 25.605  |
| 0.196875        | 24.696              | 18.257  | 10.16                        | 34.856          | 28.417  | 64.661     | 54.661  | 29.805      | 26.244  |

Table 7.2.2-6: Conducted EMI Results Line 2 – Antenna 5

| Frequency (MHz) | Uncorrected Reading |         | Total Correction Factor (dB) | Corrected Level |         | Limit      |         | Margin (dB) |         |
|-----------------|---------------------|---------|------------------------------|-----------------|---------|------------|---------|-------------|---------|
|                 | Quasi-Peak          | Average |                              | Quasi-Peak      | Average | Quasi-Peak | Average | Quasi-Peak  | Average |
| 18.2453         | 21.065              | 20.581  | 10.615                       | 31.679          | 31.196  | 60         | 50      | 28.321      | 18.804  |
| 2.35627         | 17.361              | 11.665  | 10.22                        | 27.581          | 21.885  | 56         | 46      | 28.419      | 24.115  |
| 2.31334         | 17.51               | 11.82   | 10.22                        | 27.73           | 22.04   | 56         | 46      | 28.27       | 23.96   |
| 1.90685         | 17.458              | 12.797  | 10.22                        | 27.678          | 23.017  | 56         | 46      | 28.322      | 22.983  |
| 0.49155         | 16.058              | 12.109  | 10.199                       | 26.257          | 22.308  | 56.241     | 46.241  | 29.985      | 23.933  |
| 0.154464        | 25.418              | 18.796  | 10.17                        | 35.588          | 28.966  | 65.872     | 55.872  | 30.285      | 26.906  |

### 7.3 Peak Output Power - FCC 15.247(b)(2) IC: RSS-210 A8.4(1)

#### 7.3.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of a power meter. The device employs < 50 channels at any given time therefore the power is limited to 0.25 Watt.

#### 7.3.2 Measurement Results

**Table 7.3.2-1: RF Output Power**

| <b>Frequency<br/>[MHz]</b> | <b>Level<br/>[dBm]</b> |
|----------------------------|------------------------|
| 916.0                      | 23.52                  |
| 921.6                      | 23.53                  |
| 927.6                      | 23.53                  |

## 7.4 Channel Usage Requirements

### 7.4.1 Carrier Frequency Separation – FCC 15.247(a)(1) IC: RSS-210 A8.1(b)

#### 7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks. The RBW and VBW were set to 10 kHz and 30 kHz respectively.

#### 7.4.1.2 Measurement Results

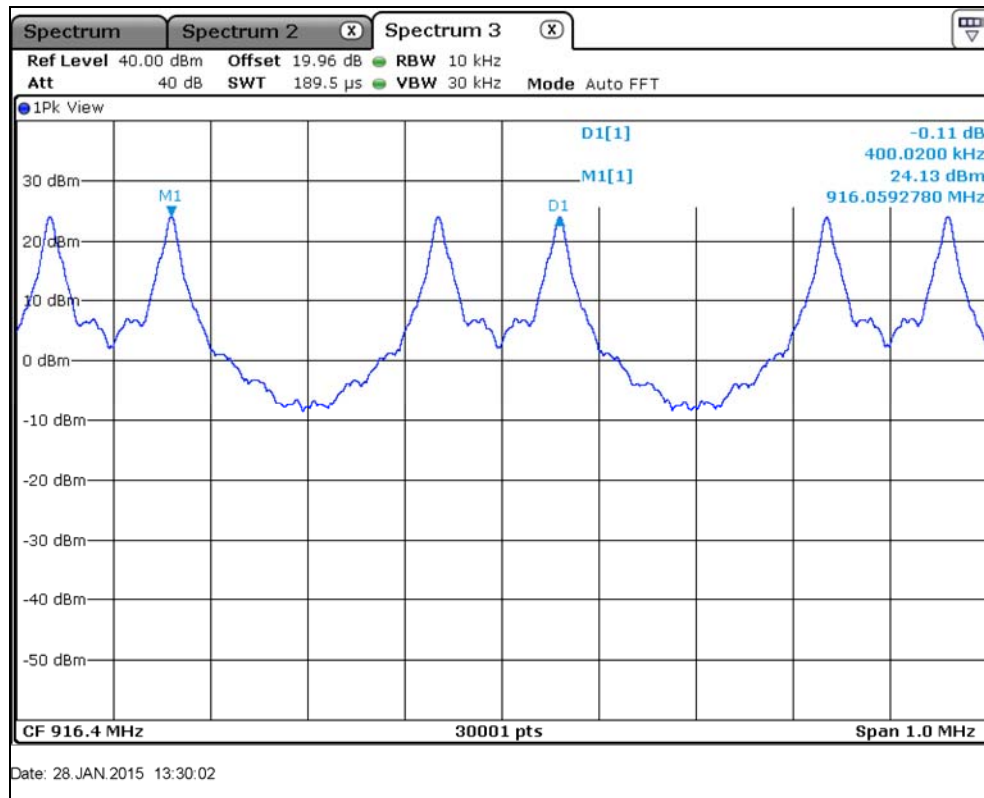


Figure 7.4.1.2-1: Carrier Frequency

## 7.4.2 Number of Hopping Channels – FCC 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

### 7.4.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture the frequency band of operation. The RBW was set to 200kHz and VBW set to  $\geq$  RBW.

### 7.4.2.2 Measurement Results

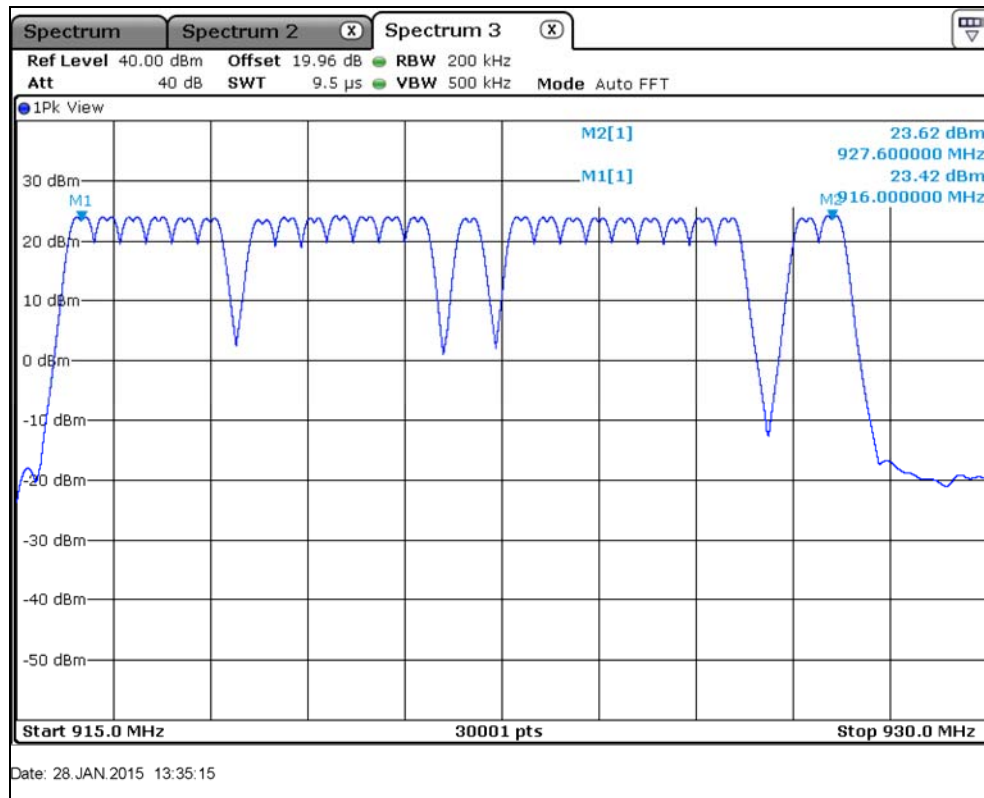


Figure 7.4.2.2-1: Number of Hopping Channels

#### **7.4.3 Channel Dwell Time – FCC 15.247(a)(1)(i) IC: RSS-210 A8.1(c)**

The EUT test mode does not generate a worst case channel dwell time therefore a detailed engineering analysis is provided in the theory of operation.

As described in the theory of operation, the maximum channel transmitter dwell time is 200ms within a 10s period thus meeting the limit of 400ms for all modes of operation.

**7.4.4 20dB / 99% Bandwidth - FCC 15.247(a)(1)(i) IC: RSS-210 A8.2(a)****7.4.4.1 Measurement Procedure**

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The marker delta measurement function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth. A peak detector was used.

**7.4.4.2 Measurement Results****Table 7.4.4.2-1: 20dB / 99% Bandwidth**

| <b>Frequency<br/>[MHz]</b> | <b>20dB Bandwidth<br/>[kHz]</b> | <b>99% Bandwidth<br/>[kHz]</b> |
|----------------------------|---------------------------------|--------------------------------|
| 916.0                      | 314.76                          | 409.55                         |
| 921.6                      | 314.42                          | 434.15                         |
| 927.6                      | 314.39                          | 405.21                         |

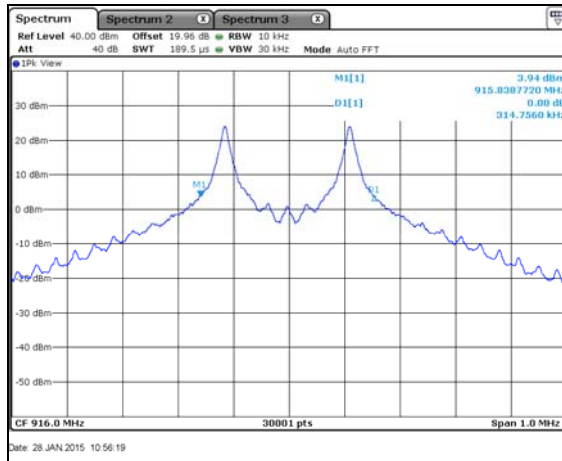


Figure 7.4.4.2-1: 20dB BW Low Channel

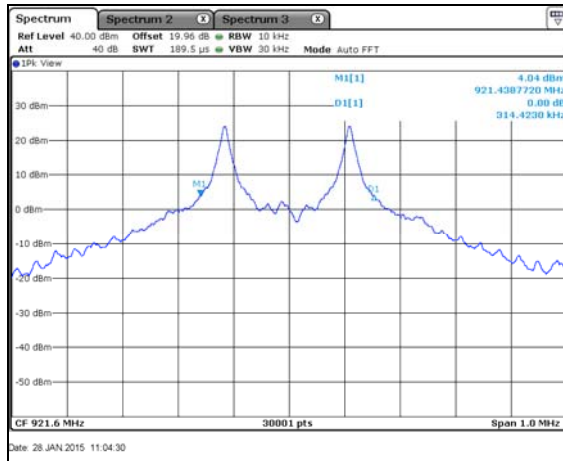


Figure 7.4.4.2-2: 20dB BW Mid Channel

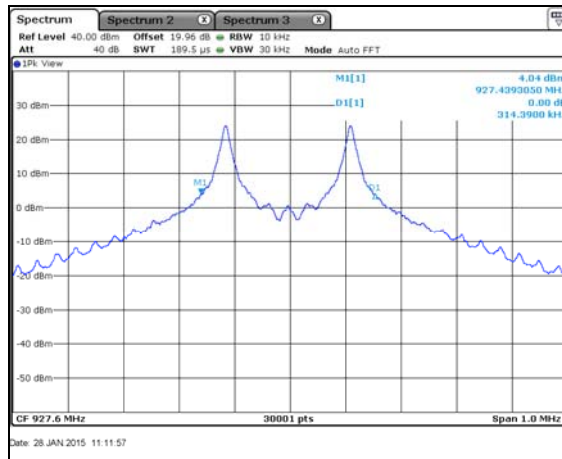


Figure 7.4.4.2-3: 20dB BW High Channel

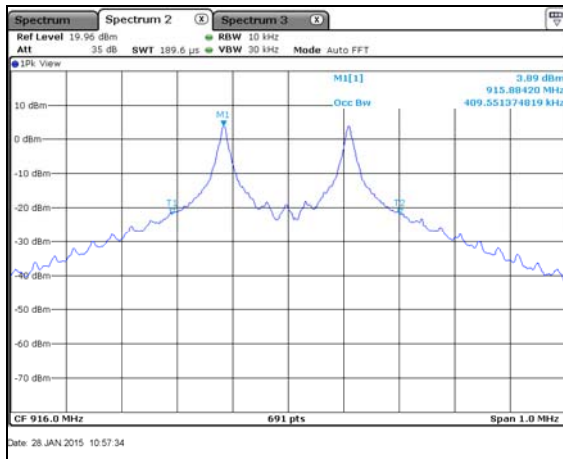


Figure 7.4.4.2-4: 99% BW Low Channel

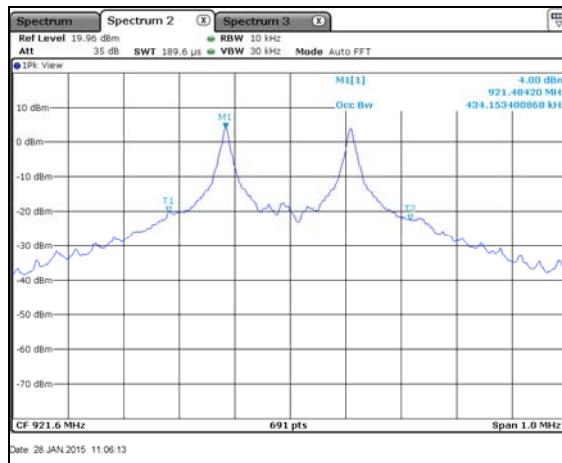


Figure 7.4.4.2.5: 99% BW Mid Channel

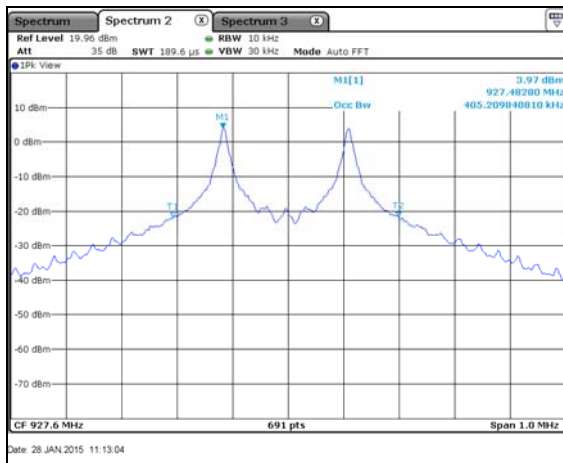


Figure 7.4.4.2-6: 99% BW High Channel

## 7.5 Band-Edge Compliance and Spurious Emissions

### 7.5.1 Band-Edge Compliance of RF Conducted Emissions - FCC 15.247(d); IC RSS-210 A8.5

#### 7.5.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to 300 kHz.

#### 7.5.1.2 Measurement Results

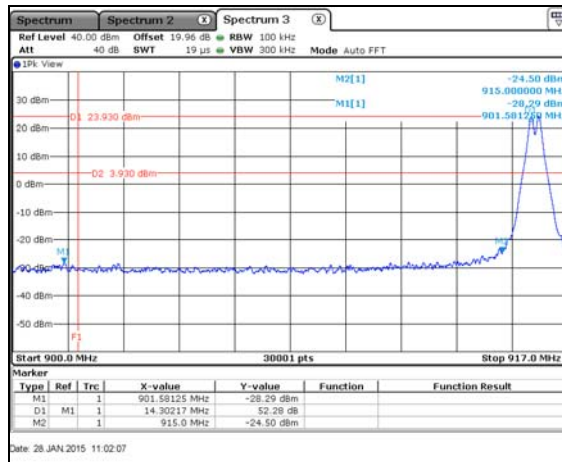


Figure 7.5.1.2-1: Lower Band-edge

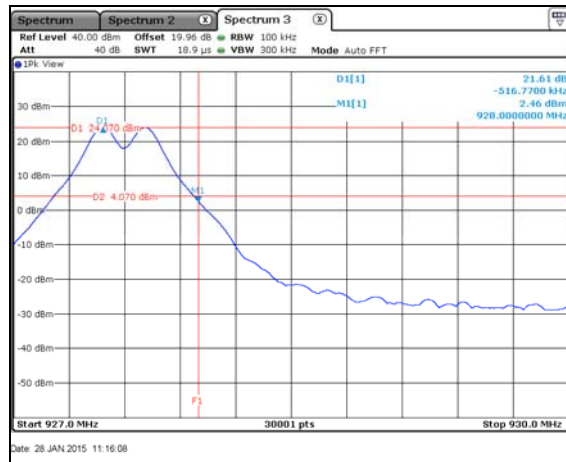


Figure 7.5.1.2-2: Upper Band-edge

#### HOPPING MODE:

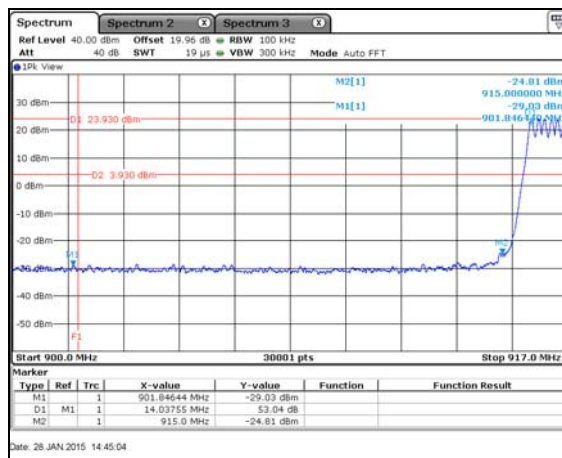


Figure 7.5.1.2-3: Lower Band-edge – Hopping



Figure 7.5.1.2-4: Upper Band-edge – Hopping

## 7.5.2 RF Conducted Spurious Emissions - FCC 15.247(d); IC RSS-210 A8.5

### 7.5.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100kHz. A peak detector function was used with the trace set to max hold.

### 7.5.2.2 Measurement Results

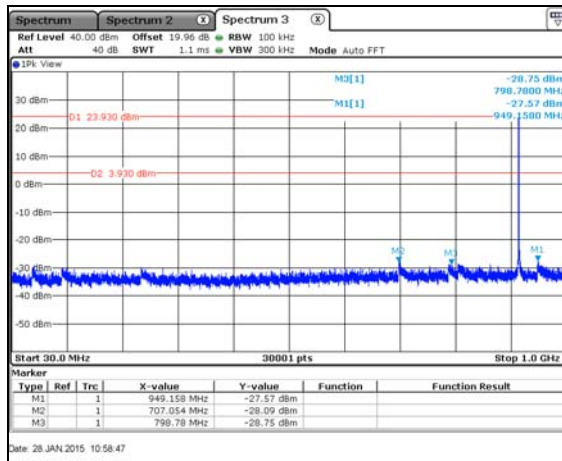


Figure 7.5.2.2-1: 30 MHz – 1 GHz – Low Channel

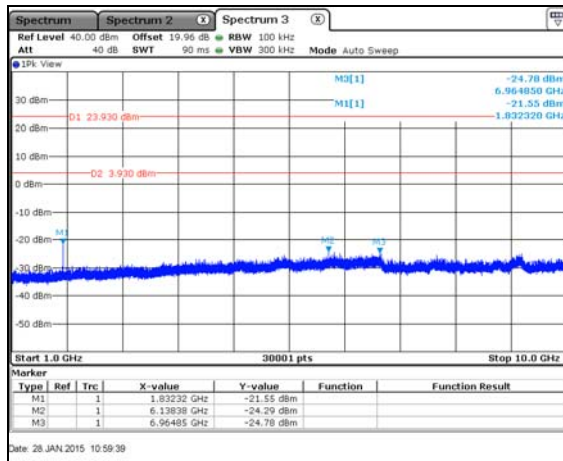


Figure 7.5.2.2-2: 1 GHz – 10 GHz – Low Channel

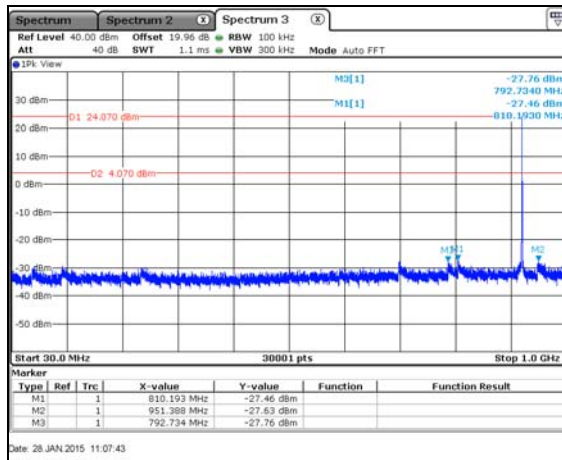


Figure 7.5.2.2-3: 30 MHz – 1 GHz – Mid Channel

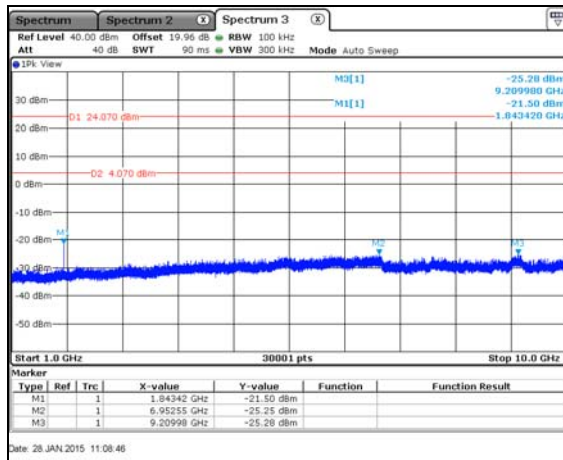


Figure 7.5.2.2-4: 1 GHz – 10 GHz – Mid Channel

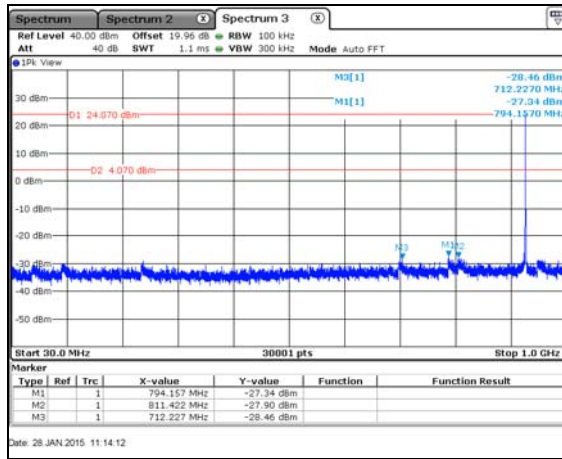


Figure 7.5.2.2-5: 30 MHz – 1 GHz – High Channel

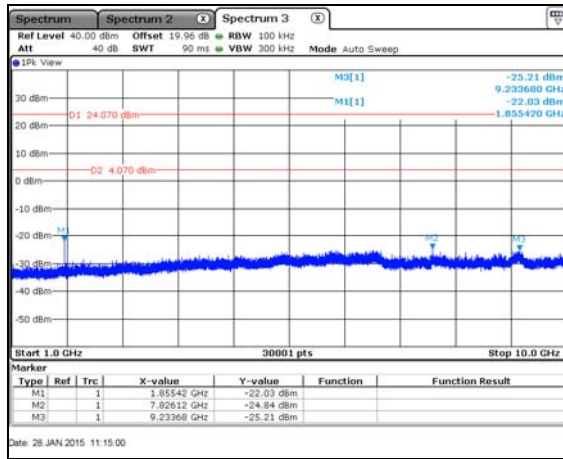


Figure 7.5.2.2-6: 1 GHz – 10 GHz –High Channel

### 7.5.3 Radiated Spurious Emissions - FCC 15.205, 15.209; IC RSS-210 2.2, RSS-Gen 8.9/8.10

#### 7.5.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency.

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 using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3MHz respectively.

The EUT was caused to generate a continuous modulated carrier on the hopping channel.

Each emission found to be in a restricted band was compared to the applicable radiated emission limits.

#### 7.5.3.2 Measurement Results

**Table 7.5.3.2-1: Radiated Spurious Emissions Tabulated Data – Antenna 1**

| Frequency<br>(MHz)                                                    | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|-----------------------------------------------------------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                                                                       | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel                                                           |                 |         |                              |                               |                             |         |                   |         |                |         |
| No emissions detected above the noise floor of the measurement system |                 |         |                              |                               |                             |         |                   |         |                |         |
| Middle Channel                                                        |                 |         |                              |                               |                             |         |                   |         |                |         |
| No emissions detected above the noise floor of the measurement system |                 |         |                              |                               |                             |         |                   |         |                |         |
| High Channel                                                          |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2782.8                                                                | 45.73           | 33.91   | H                            | -4.37                         | 41.36                       | 29.54   | 74.0              | 54.0    | 32.6           | 24.5    |

**Table 7.5.3.2-2: Radiated Spurious Emissions Tabulated Data – Antenna 3**

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel        |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2748               | 46.31           | 34.52   | V                            | -4.51                         | 41.80                       | 30.01   | 74.0              | 54.0    | 32.2           | 24.0    |
| Middle Channel     |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2764.8             | 46.65           | 35.82   | V                            | -4.44                         | 42.21                       | 31.38   | 74.0              | 54.0    | 31.8           | 22.6    |
| High Channel       |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2782.8             | 46.14           | 35.36   | H                            | -4.37                         | 41.77                       | 30.99   | 74.0              | 54.0    | 32.2           | 23.0    |
| 2782.8             | 47.63           | 37.57   | V                            | -4.37                         | 43.26                       | 33.20   | 74.0              | 54.0    | 30.7           | 20.8    |

**Table 7.5.3.2-3: Radiated Spurious Emissions Tabulated Data – Antenna 5**

| Frequency<br>(MHz)                                                     | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|------------------------------------------------------------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                                                                        | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel                                                            |                 |         |                              |                               |                             |         |                   |         |                |         |
| No emissions detected above the noise floor of the measurement system. |                 |         |                              |                               |                             |         |                   |         |                |         |
| Middle Channel                                                         |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2764.8                                                                 | 46.18           | 35.61   | H                            | -4.44                         | 41.74                       | 31.17   | 74.0              | 54.0    | 32.3           | 22.8    |
| 2764.8                                                                 | 46.37           | 35.79   | V                            | -4.44                         | 41.93                       | 31.35   | 74.0              | 54.0    | 32.1           | 22.6    |
| High Channel                                                           |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2782.8                                                                 | 47.22           | 37.29   | H                            | -4.37                         | 42.85                       | 32.92   | 74.0              | 54.0    | 31.1           | 21.1    |
| 2782.8                                                                 | 46.07           | 36.20   | V                            | -4.37                         | 41.70                       | 31.83   | 74.0              | 54.0    | 32.3           | 22.2    |

**7.5.3.3 Sample Calculation:**

$$R_C = R_U + CF_T$$

Where:

|        |   |                                                                   |
|--------|---|-------------------------------------------------------------------|
| $CF_T$ | = | Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only) |
| $R_U$  | = | Uncorrected Reading                                               |
| $R_C$  | = | Corrected Level                                                   |
| AF     | = | Antenna Factor                                                    |
| CA     | = | Cable Attenuation                                                 |
| AG     | = | Amplifier Gain                                                    |
| DC     | = | Duty Cycle Correction Factor                                      |

**Example Calculation: Peak – Antenna 3**

Corrected Level: 46.31 - 4.51 = 41.80dBuV/m

Margin: 74dBuV/m – 41.80dBuV/m = 32.2dB

**Example Calculation: Average**

Corrected Level: 34.52 - 4.51 - 0 = 30.01dBuV

Margin: 54dBuV – 30.01dBuV = 24.0dB

## **8 CONCLUSION**

In the opinion of ACS, Inc. the ILC24FI, manufactured by Elster Solutions, LLC meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

**END REPORT**