

## **Certification Test Report**

**FCC ID: HSW-2410NF  
IC: 4492A-2410NF**

**FCC Rule Part: 15.247  
ISED Canada Radio Standards Specification: RSS-247**

**ACS Report Number: 16-0403.W04.1A**

**Manufacturer: Murata Electronics North America  
Models: WIT2410NF**

**Test Begin Date: September 21, 2016  
Test End Date: September 26, 2016**

**Report Issue Date: October 11, 2016**



FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: AT-2021

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

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**This report contains 16 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 ISED Canada's Radio Standards Specification RSS-247 for a Class II Permissive Change.

The purpose of this class II permissive change is due to a modification to the transmitter that will allow for adjustment of the RF output power during production. This change should eliminate need to modify the Bill of Materials to set the output power to nominal values. RF output power will be set to the levels defined during FCC Certification.

### 1.2 Product description

The WIT2410NF is a 2.4 GHz frequency hopping transceiver. Basic operating parameters of the radio are:

|                             |                                     |
|-----------------------------|-------------------------------------|
| Band of operation:          | 2401.6896 – 2469.888 MHz            |
| Number of hopping channels: | 75                                  |
| Channel spacing             | 921.6 kHz                           |
| Output power (maximum):     | 18.01 dBm                           |
| Over the air data rates:    | 460 kbps                            |
| Modulation format:          | FSK                                 |
| Antennas:                   | 2 dBi Dipole Antenna, Model–RWA249R |
| RF connector:               | MMCX                                |

Manufacturer Information:  
Murata Electronics North America  
2200 Lake Park Drive  
Smyrna, GA 30080

EUT Serial Numbers: 33 69 17

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

### 1.3 Test Methodology and Considerations

A test evaluation board was utilized to supply power and program the EUT for test modes. See Section 5.0 – 6.0 for additional details.

For radiated emissions, the EUT was programmed to generate a continuously modulated carrier on the lowest, middle, and highest channels. The EUT was tested in three orthogonal orientations. The worst case orientation was the X-orientation. See the test setup photos for more information.

For RF Conducted emissions, the EUT was programmed to generate a continuously modulated carrier on the lowest, middle, and highest channels. The EUT was evaluated for amplitude related tests including conducted output power, conducted spurious emissions, and conducted band-edges.

Power setting during test: Not set in software

## **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 ANSI-ASQ National Accreditation Board/ANAB accreditation program, and has been issued certificate number AT-2021 in recognition of this accreditation. 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: 391271

ISED 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:

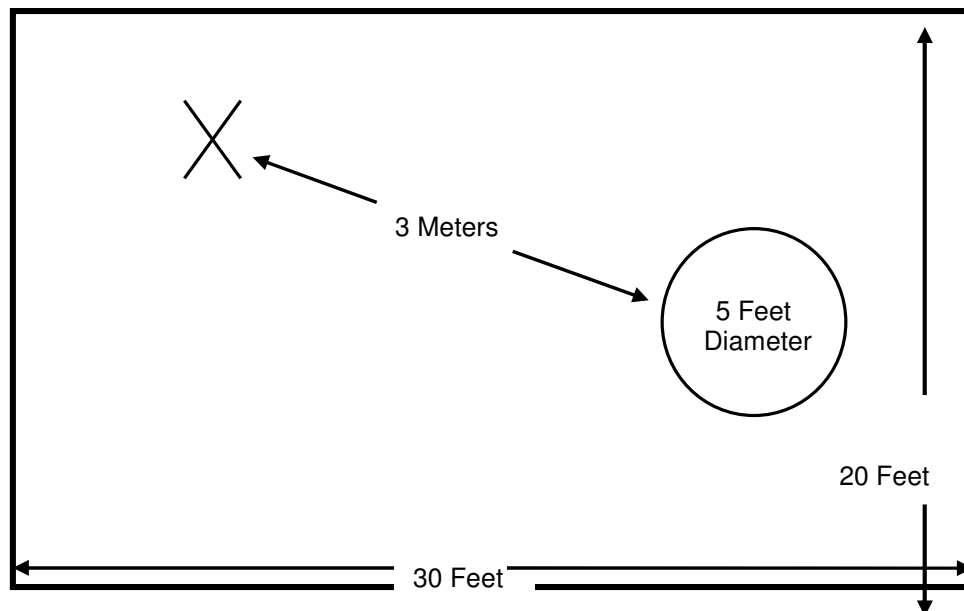


Figure 2.3-1: Semi-Anechoic Chamber Test Site

### 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:

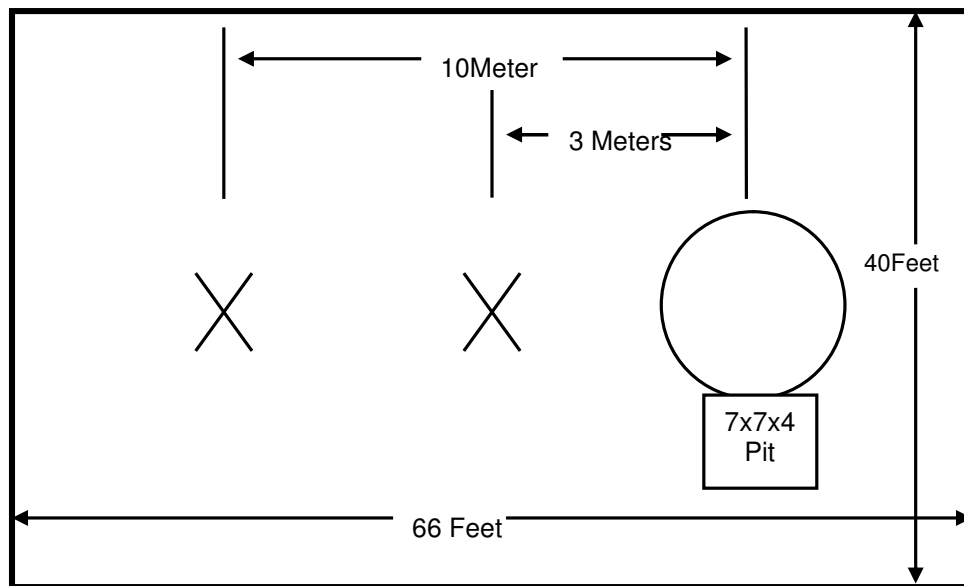


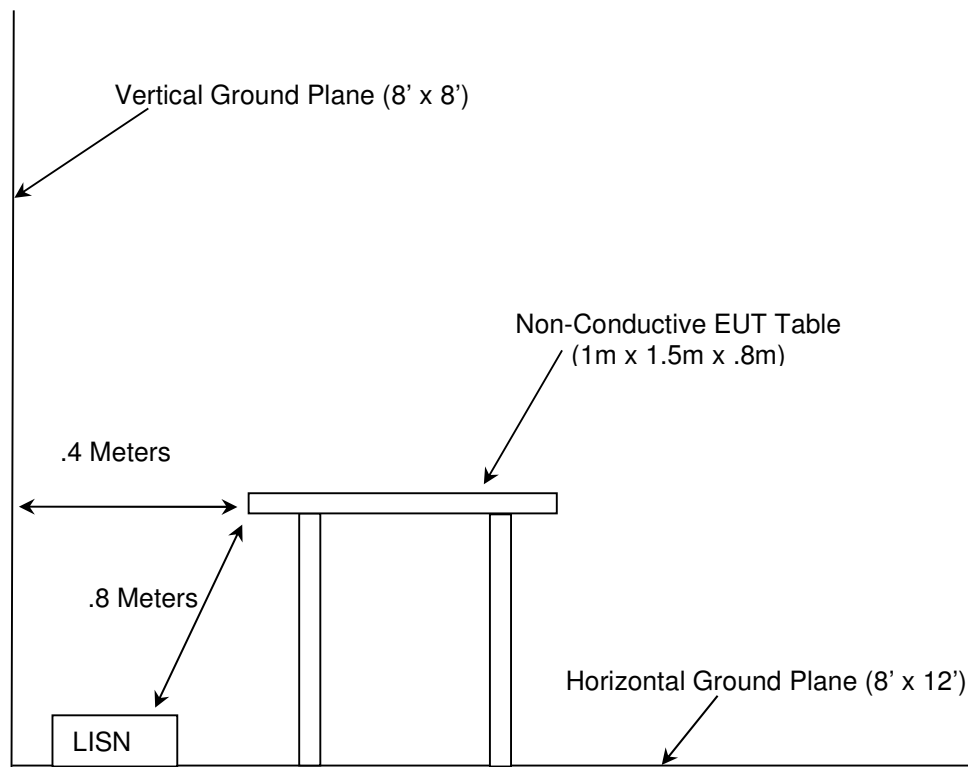
Figure 2.3-2: Open Area Test Site

## 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 C63.10.

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, 2016
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- ❖ ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015.
- ❖ ISED 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**

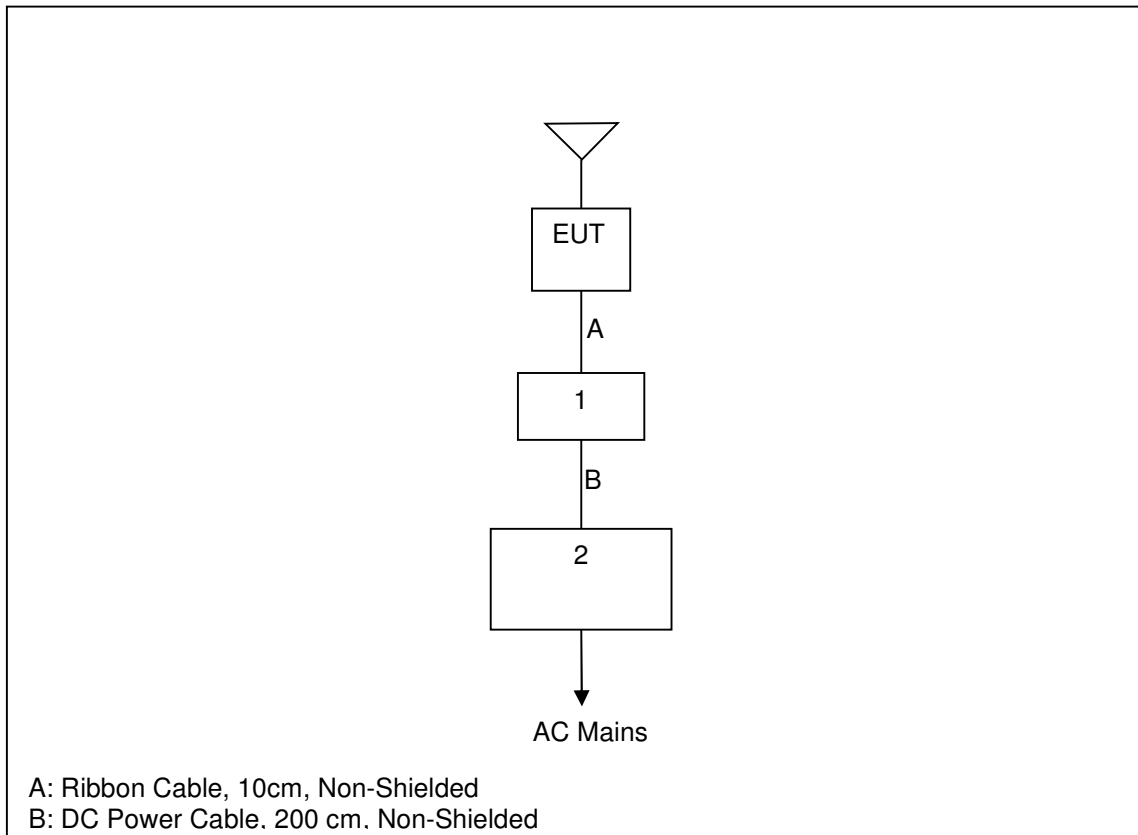
| AssetID | Manufacturer          | Model #            | Equipment Type     | Serial #                    | Last Calibration Date | Calibration Due Date |
|---------|-----------------------|--------------------|--------------------|-----------------------------|-----------------------|----------------------|
| 30      | Spectrum Technologies | DRH-0118           | Antennas           | 970102                      | 4/30/2015             | 4/30/2017            |
| 40      | EMCO                  | 3104               | Antennas           | 3211                        | 2/10/2015             | 2/10/2017            |
| 73      | Agilent               | 8447D              | Amplifiers         | 2727A05624                  | 7/21/2016             | 7/21/2017            |
| 167     | ACS                   | Hammer EMI Cable S | Cable Set          | 167                         | 10/20/2015            | 10/20/2016           |
| 267     | Agilent               | N1911A             | Meters             | MY45100129                  | 8/24/2015             | 8/24/2017            |
| 268     | Agilent               | N1921A             | Sensors            | MY45240184                  | 8/13/2015             | 8/13/2017            |
| 338     | Hewlett Packard       | 8449B              | Amplifiers         | 3008A01111                  | 8/21/2015             | 8/21/2017            |
| 340     | Aeroflex/Weinschel    | AS-20              | Attenuators        | 7136                        | 7/12/2016             | 7/12/2017            |
| 422     | Florida RF            | MS-200AW-72.0-SM   | Cables             | 805                         | 10/30/2015            | 10/30/2016           |
| 432     | Microwave Circuits    | H3G020G4           | Filters            | 264066                      | 5/13/2016             | 5/13/2017            |
| 616     | Florida RF Cables     | SMRE               | Cables             | N/A                         | 9/2/2016              | 9/2/2017             |
| 622     | Rohde & Schwarz       | FSV40              | Analyzers          | 101338                      | 7/15/2016             | 7/15/2018            |
| 676     | Florida RF Labs       | 480.0-SMS          | Cables             | MFR2Y194                    | 9/2/2016              | 9/2/2017             |
| 412     | Electro Metrics       | LPA-25             | Antennas           | 1241                        | 8/8/2016              | 8/8/2018             |
| RE112   | Rohde & Schwarz       | ESIB26             | Receiver           | 836119/012                  | 7/13/2016             | 7/13/2017            |
| RE619   | Rhode & Schwarz       | ESU26              | Spectrum Analyzers | 1302.6005K26 Ser.<br>100190 | 11/5/2014             | 11/5/2016            |

## 5 SUPPORT EQUIPMENT

**Table 5-1: Support Equipment**

| Item | Equipment Type         | Manufacturer           | Model Number                       | Serial Number |
|------|------------------------|------------------------|------------------------------------|---------------|
| 1    | Evaluation Board       | Digital Wireless Corp. | WIT2410E Power and Interface Board | ACS #3        |
| 2    | Wall Wart Power Supply | CUI Inc.               | EPAS-101W-05                       | 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: Section 15.203

The EUT utilizes an MMCX connector therefore satisfying the requirements of Section 15.203.

### 7.2 Peak Output Power - FCC 15.247(b)(1) ISED Canada: RSS-247 5.4(2)

#### 7.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of a power meter using suitable attenuation. The device employs 75 channels at any given time, therefore the power is limited to 1 Watt.

#### 7.2.2 Measurement Results

**Table 7.2.2-1: Maximum Conducted Peak Output Power**

| Frequency<br>[MHz] | Level<br>[dBm] |
|--------------------|----------------|
| 2401.6896          | 17.13          |
| 2435.7888          | 18.01          |
| 2469.888           | 16.90          |

## 7.3 Band-Edge Compliance and Spurious Emissions

### 7.3.1 Band-Edge Compliance of RF Conducted Emissions - FCC 15.247(d); ISED Canada RSS-247 5.5

#### 7.3.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. 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.

#### 7.3.1.2 Measurement Results

##### Single Channel Mode

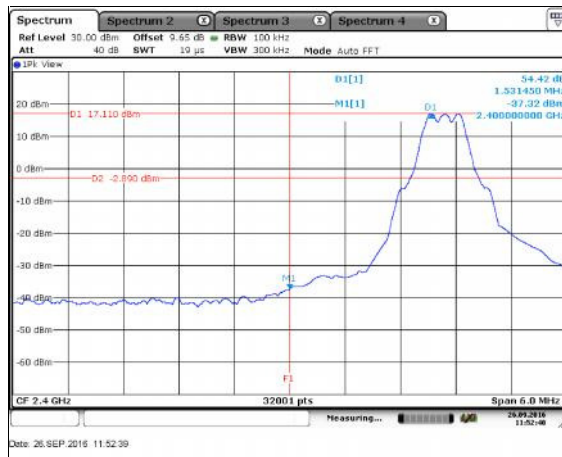


Figure 7.3.1.2-1: Lower Band Edge

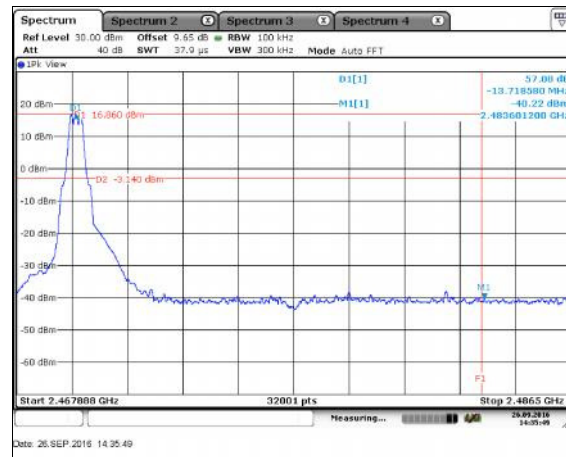


Figure 7.3.1.2-2: Upper Band Edge

##### Hopping Mode

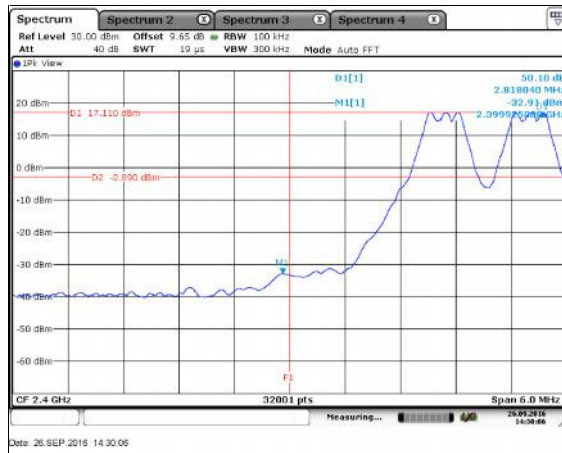


Figure 7.3.1.2-3: Lower Band Edge - Hopping

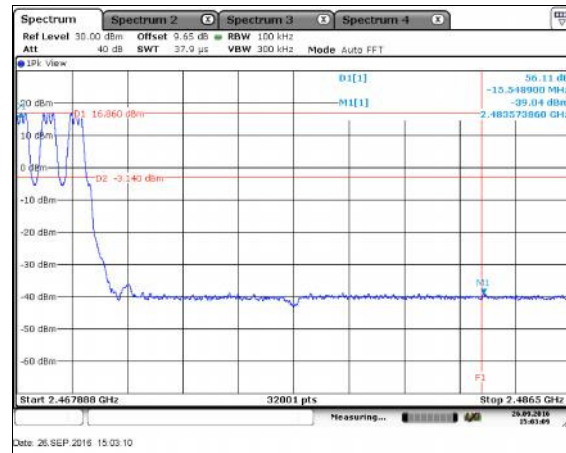


Figure 7.3.1.2-4: Upper Band Edge - Hopping

## 7.3.2 RF Conducted Spurious Emissions - FCC 15.247(d); ISED Canada RSS-247 5.5

### 7.3.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The EUT was investigated for conducted spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. Measurements were made at the low, middle, 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.

### 7.3.2.2 Measurement Results

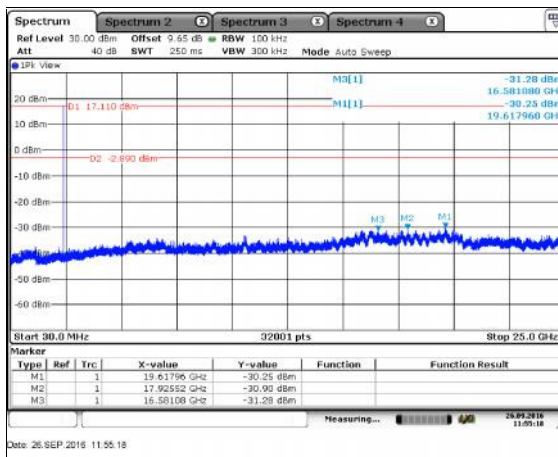


Figure 7.3.2.2-1: 30 MHz – 25 GHz – LCH

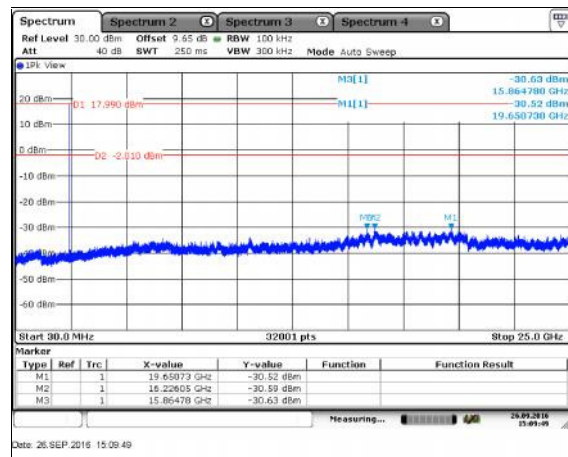


Figure 7.3.2.2-2: 30 MHz – 25 GHz – MCH

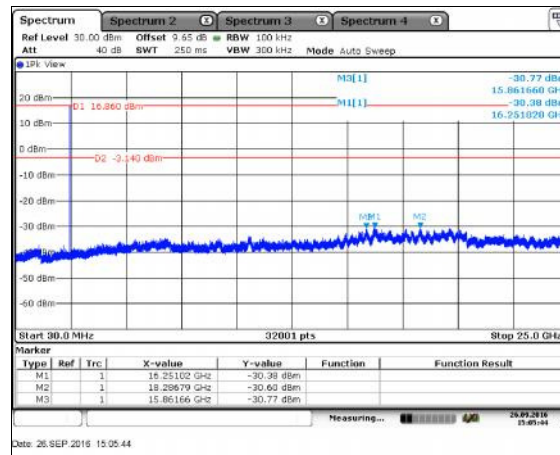


Figure 7.3.2.2-3: 30 MHz – 25 GHz – HCH

### 7.3.3 Radiated Spurious Emissions - FCC 15.205, 15.209; ISD Canada RSS-Gen 8.9/8.10

#### 7.3.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 25GHz, 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.

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

#### 7.3.3.2 Duty Cycle Correction

For average radiated measurements, using a 5.56% duty cycle, the measured level was reduced by a factor 25.10dB. The duty cycle correction factor is determined using the formula:  $20\log(5.56/100)$ .

A detail explanation of the duty cycle is provided in the original certification report.

#### 7.3.3.3 Measurement Results

**Table 7.3.3.3-1: Radiated Spurious Emissions Tabulated Data**

| 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        |                 |         |                              |                               |                             |         |                   |         |                |         |
| 4803.3792          | 58.90           | 26.00   | H                            | 1.70                          | 60.60                       | 2.60    | 74.0              | 54.0    | 13.4           | 51.4    |
| 4803.3792          | 58.10           | 26.50   | V                            | 1.70                          | 59.80                       | 3.10    | 74.0              | 54.0    | 14.2           | 50.9    |
| 12008.448          | 51.20           | 25.60   | H                            | 14.12                         | 65.32                       | 14.62   | 83.5              | 63.5    | 18.2           | 48.9    |
| 12008.448          | 46.50           | 24.90   | V                            | 14.12                         | 60.62                       | 13.92   | 83.5              | 63.5    | 22.9           | 49.6    |
| Mid Channel        |                 |         |                              |                               |                             |         |                   |         |                |         |
| 4871.57776         | 59.10           | 42.00   | H                            | 1.91                          | 61.01                       | 18.81   | 74.0              | 54.0    | 13.0           | 35.2    |
| 4871.57776         | 56.20           | 39.30   | V                            | 1.91                          | 58.11                       | 16.11   | 74.0              | 54.0    | 15.9           | 37.9    |
| 7307.36664         | 51.40           | 31.40   | H                            | 7.56                          | 58.96                       | 13.86   | 74.0              | 54.0    | 15.0           | 40.1    |
| 7307.36664         | 49.20           | 29.40   | V                            | 7.56                          | 56.76                       | 11.86   | 74.0              | 54.0    | 17.2           | 42.1    |
| 12178.9444         | 43.90           | 25.70   | H                            | 15.15                         | 59.05                       | 15.75   | 83.5              | 63.5    | 24.4           | 47.8    |
| 12178.9444         | 45.30           | 27.10   | V                            | 15.15                         | 60.45                       | 17.15   | 83.5              | 63.5    | 23.0           | 46.4    |
| High Channel       |                 |         |                              |                               |                             |         |                   |         |                |         |
| 4939.776           | 63.40           | 51.20   | H                            | 2.53                          | 65.93                       | 28.63   | 74.0              | 54.0    | 8.1            | 25.4    |
| 4939.776           | 62.60           | 52.40   | V                            | 2.53                          | 65.13                       | 29.83   | 74.0              | 54.0    | 8.9            | 24.2    |
| 7409.664           | 59.70           | 46.30   | H                            | 8.28                          | 67.98                       | 29.48   | 74.0              | 54.0    | 6.0            | 24.5    |
| 7409.664           | 62.20           | 48.80   | V                            | 8.28                          | 70.48                       | 31.98   | 74.0              | 54.0    | 3.5            | 22.0    |

**7.3.3.4 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**

Corrected Level:  $58.9 + 1.70 = 60.60\text{dBuV/m}$

Margin:  $74\text{dBuV/m} - 60.60\text{dBuV/m} = 13.4\text{dB}$

**Example Calculation: Average**

Corrected Level:  $26.00 + 1.70 - 25.10 = 2.60\text{dBuV}$

Margin:  $54\text{dBuV} - 2.60\text{dBuV} = 51.4\text{dB}$

## **8 CONCLUSION**

In the opinion of ACS, Inc. the WIT2410NF, manufactured by Murata Electronics North America meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented in this test report.

**END REPORT**