

## **Certification Test Report**

**FCC ID: SDBZIGMOD20  
IC: 2220A-ZIGMOD20**

**FCC Rule Part: 15.247  
IC Radio Standards Specification: RSS-210**

**ACS Report Number: 11-0215.W06.11.A**

**Manufacturer: Sensus Metering Systems, Inc.  
Model: ZigMod20**

**Test Begin Date: June 20, 2011  
Test End Date: June 21, 2011**

**Report Issue Date: July 26, 2011**



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.

A handwritten signature in black ink, appearing to read "Kirby Munroe".

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

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**This report contains 22 pages**

## TABLE OF CONTENTS

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>GENERAL .....</b>   | <b>3</b>  |
| 1.1      | PURPOSE.....   | 3         |
| 1.2      | GENERAL.....   | 3         |
| 1.3      | TEST METHODOLOGY AND CONSIDERATIONS .....  | 3         |
| <b>2</b> | <b>TEST FACILITIES.....</b>  | <b>4</b>  |
| 2.1      | LOCATION .....   | 4         |
| 2.2      | LABORATORY ACCREDITATIONS/RECOGNITIONS/CERTIFICATIONS .....                        | 4         |
| 2.3      | RADIATED EMISSIONS TEST SITE DESCRIPTION .....                                     | 5         |
| 2.3.1    | <i>Semi-Anechoic Chamber Test Site.....</i>  | 5         |
| 2.3.2    | <i>Open Area Tests Site (OATS) .....</i>   | 6         |
| 2.4      | CONDUCTED EMISSIONS TEST SITE DESCRIPTION .....                                    | 7         |
| <b>3</b> | <b>APPLICABLE STANDARD REFERENCES.....</b>   | <b>7</b>  |
| <b>4</b> | <b>LIST OF TEST EQUIPMENT.....</b>   | <b>8</b>  |
| <b>5</b> | <b>SUPPORT EQUIPMENT .....</b>   | <b>9</b>  |
| <b>6</b> | <b>EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM .....</b>                              | <b>9</b>  |
| <b>7</b> | <b>SUMMARY OF TESTS.....</b>   | <b>10</b> |
| 7.1      | ANTENNA REQUIREMENT – FCC: SECTION 15.203 .....                                    | 10        |
| 7.2      | POWER LINE CONDUCTED EMISSIONS – FCC: SECTION 15.207 IC: RSS-GEN 7.2.4.....        | 10        |
| 7.2.1    | <i>Measurement Procedure.....</i>  | 10        |
| 7.2.2    | <i>Measurement Results.....</i>  | 10        |
| 7.3      | 6dB / 99% BANDWIDTH – FCC: SECTION 15.247(A)(2) IC: RSS-210 A8.2(A) .....          | 12        |
| 7.3.1    | <i>Measurement Procedure.....</i>  | 12        |
| 7.3.2    | <i>Measurement Results.....</i>  | 12        |
| 7.4      | PEAK OUTPUT POWER REQUIREMENT - FCC SECTION 15.247(B)(3) IC: RSS-210 A8.4(4) ..... | 14        |
| 7.4.1    | <i>Measurement Procedure.....</i>  | 14        |
| 7.4.2    | <i>Measurement Results.....</i>  | 14        |
| 7.5      | BAND-EDGE COMPLIANCE AND SPURIOUS EMISSIONS-FCC 15.247D IC:RSS-210 2.2, A8.5 ..... | 15        |
| 7.5.1    | <i>Band-Edge Compliance .....</i>  | 15        |
| 7.5.1.1  | Measurement Procedure.....   | 15        |
| 7.5.1.2  | Measurement Results .....  | 15        |
| 7.5.2    | <i>RF Conducted Spurious Emissions.....</i>  | 17        |
| 7.5.2.1  | Measurement Procedure.....   | 17        |
| 7.5.2.2  | Measurement Results .....  | 17        |
| 7.5.3    | <i>Radiated Spurious Emissions (Restricted Bands).....</i>                         | 19        |
| 7.5.3.1  | Measurement Procedure.....   | 19        |
| 7.5.3.2  | Duty Cycle Correction .....  | 19        |
| 7.5.3.3  | Measurement Results .....  | 19        |
| 7.5.3.4  | Sample Calculation: .....  | 20        |
| 7.6      | PEAK POWER SPECTRAL DENSITY- FCC SECTION 15.247(E) IC: RSS-210 A8.2(B).....        | 21        |
| 7.6.1    | <i>Measurement Procedure.....</i>  | 21        |
| 7.6.2    | <i>Measurement Results.....</i>  | 21        |
| <b>8</b> | <b>CONCLUSION .....</b>  | <b>22</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 for a single modular approval.

### 1.2 General

The Sensus ZigBee Module ZigMod20 is a self contained Modular Transmitter. This module is designed to interface between the Electric Meter and the Home Area Network (HAN) and will reside within the Electric Meter.

#### **Technical Information:**

Band of Operation: 2405 – 2480 MHz

Number of Channels: 16

Modulation Format: O-QPSK

Antenna Type/Gain: Printed Monopole Antenna – 0dBi Gain

Operating Voltage: 26 VDC (Host Supplied)

#### **Manufacturer Information:**

Sensus Metering Systems, Inc.

400 Perimeter Park Drive, Suite K

Morrisville, NC 27560

**Test Sample Serial Number(s):** ABCDE324, ABCDE322, ABCDE326

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

### 1.3 Test Methodology and Considerations

For radiated emissions, including band edge, multiple orientations of the EUT were evaluated. Data representing the worst case orientation is provided in this report. AC power line conducted emissions testing was performed with the module installed in a representative host device.

For the purpose of RF conducted measurements, the module was modified with a temporary 50 ohm antenna port.

The EUT can be collocated with Sensus Metering Systems module model IDTB002 FCC ID: SDBIDTB002, IC: 2220A-IDTB002 when integrated in electric utility meters. Radiated intermodulation testing was performed with both modules simultaneously transmitting when integrated in a representative host utility meter. All spurious emission levels were below the specified limit.

## **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-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:

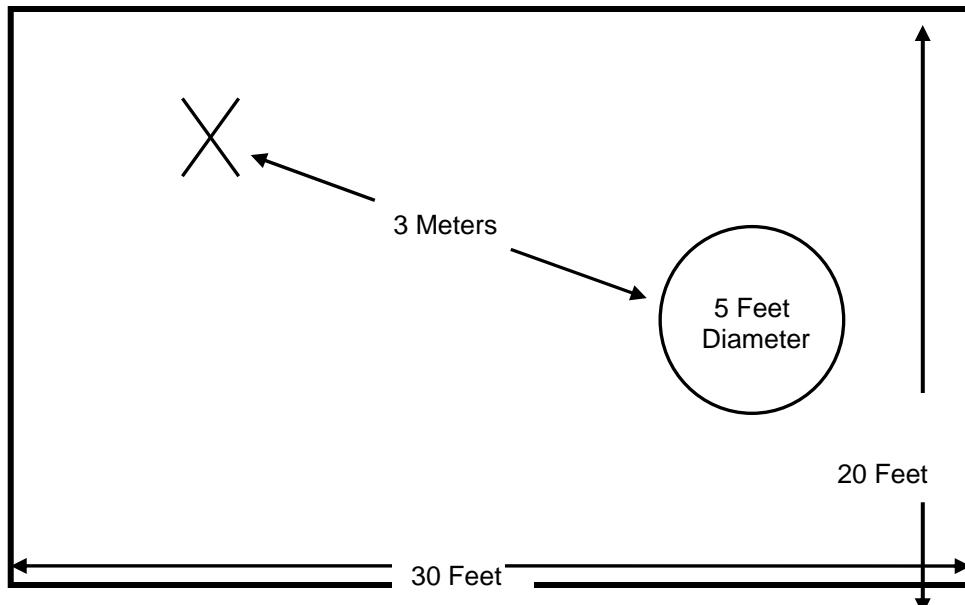


Figure 2.3-1: Semi-Anechoic Chamber Test Site

### 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:

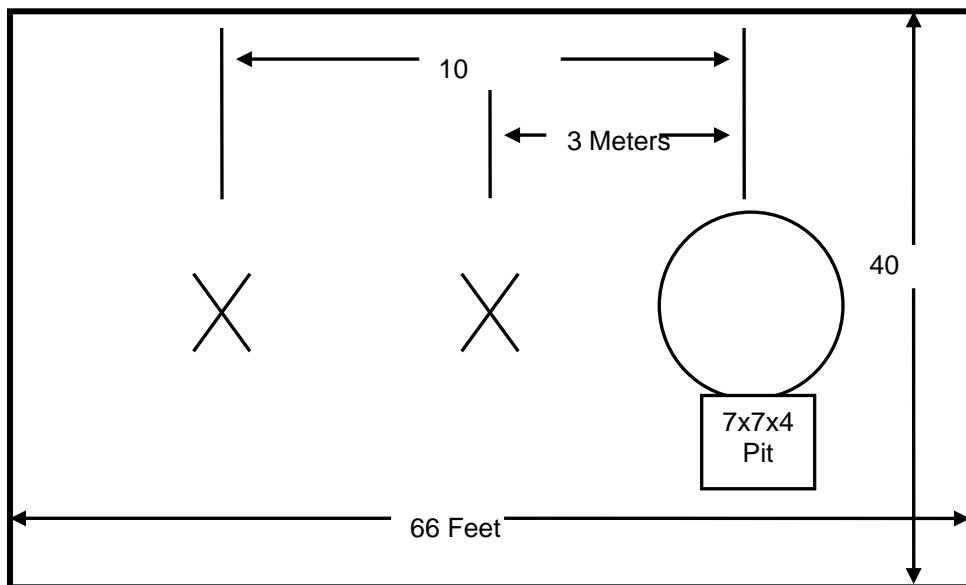


Figure 2.3-2: Open Area Test Site

## 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 4.1.3-1:

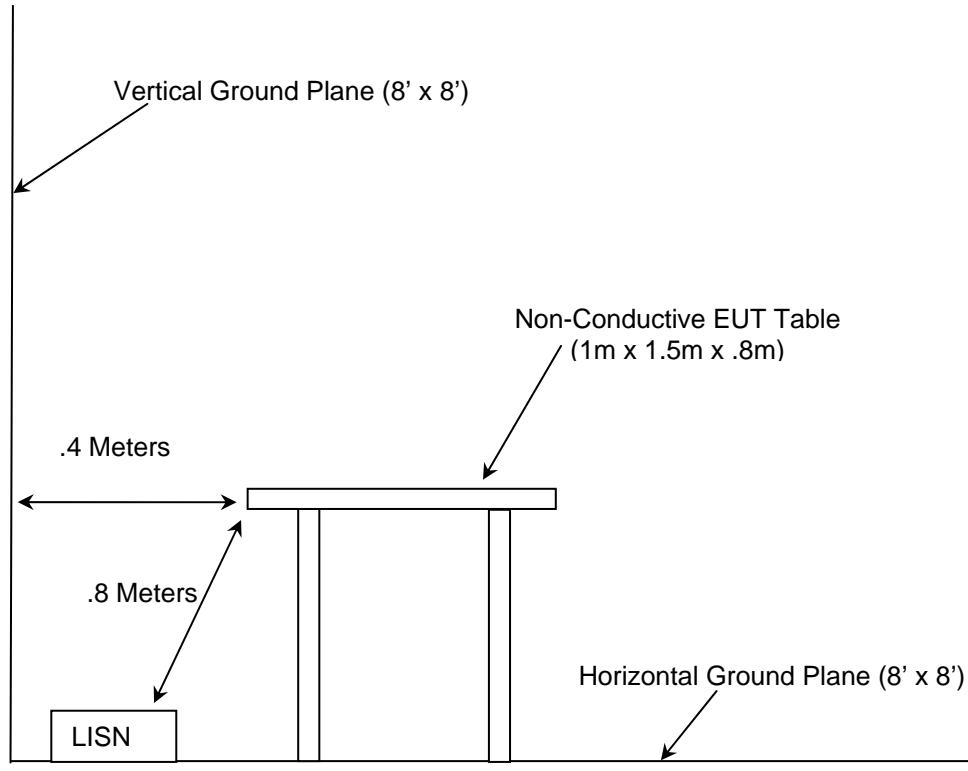


Figure 2.4-1: AC Mains Conducted EMI Site

## 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
- ❖ FCC KDB Publication No. 558074 - Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), March 2005
- ❖ Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8 Dec 2010
- ❖ Industry Canada Radio Standards Specification: RSS-GEN - General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, Dec 2010.

#### 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**

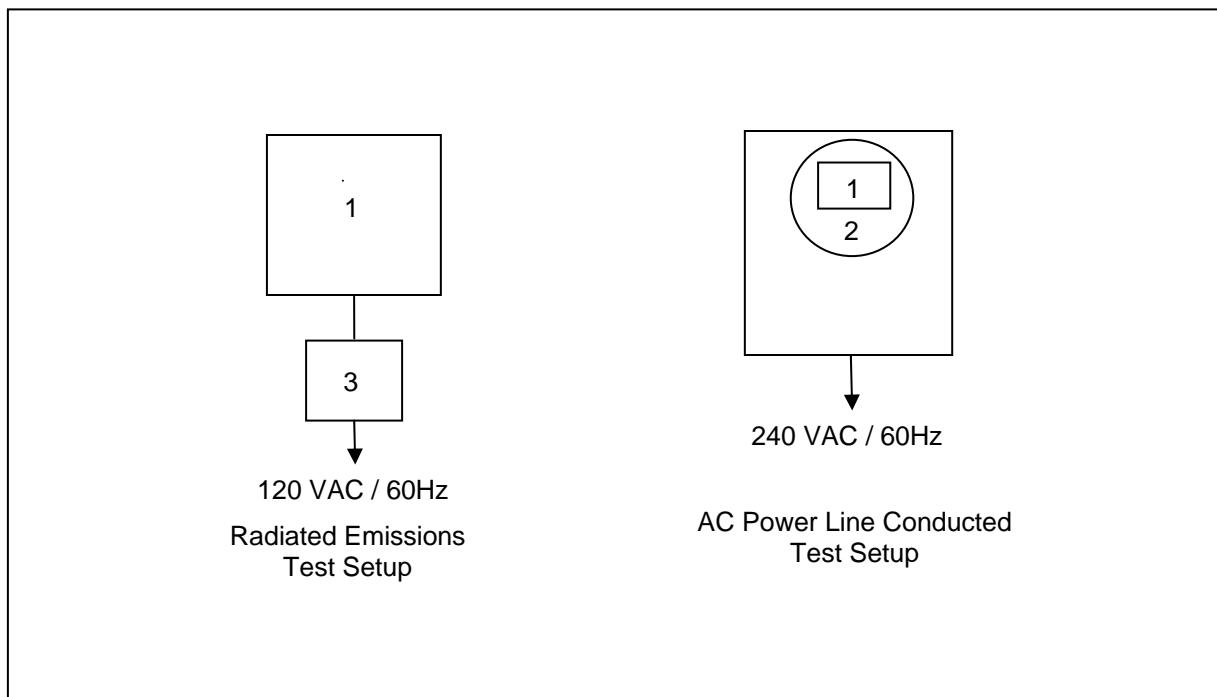
| AssetID | Manufacturer          | Model #               | Equipment Type     | Serial #   | Last Calibration Date | Calibration Due Date |
|---------|-----------------------|-----------------------|--------------------|------------|-----------------------|----------------------|
| 1       | Rohde & Schwarz       | ESMI - Display        | Spectrum Analyzers | 833771/007 | 9/23/2010             | 9/23/2012            |
| 2       | Rohde & Schwarz       | ESMI-Receiver         | Spectrum Analyzers | 839587/003 | 9/23/2010             | 9/23/2012            |
| 3       | Rohde & Schwarz       | ESMI - Display        | Spectrum Analyzers | 839379/011 | 5/26/2011             | 5/26/2013            |
| 4       | Rohde & Schwarz       | ESMI - Receiver       | Spectrum Analyzers | 833827/003 | 5/26/2011             | 5/26/2013            |
| 25      | Chase                 | CBL6111               | Antennas           | 1043       | 9/13/2010             | 9/13/2012            |
| 30      | Spectrum Technologies | DRH-0118              | Antennas           | 970102     | 4/27/2011             | 4/27/2013            |
| 73      | Agilent               | 8447D                 | Amplifiers         | 2727A05624 | 3/21/2011             | 3/21/2012            |
| 153     | EMCO                  | 3825/2                | LISN               | 9411-2268  | 1/13/2011             | 1/13/2012            |
| 167     | ACS                   | Chamber EMI Cable Set | Cable Set          | 167        | 1/26/2011             | 1/26/2012            |
| 168     | Hewlett Packard       | 11947A                | Attenuators        | 44829      | 2/4/2011              | 2/4/2012             |
| 283     | Rohde & Schwarz       | FSP40                 | Spectrum Analyzers | 1000033    | 8/31/2010             | 8/31/2011            |
| 291     | Florida RF Cables     | SMRE-200W-12.0-SMRE   | Cables             | None       | 12/7/2010             | 12/7/2011            |
| 292     | Florida RF Cables     | SMR-290AW-480.0-SMR   | Cables             | None       | 4/11/2011             | 4/11/2012            |
| 324     | ACS                   | Belden                | Cables             | 8214       | 7/9/2010              | 7/9/2011             |
| 329     | AH Systems            | SAS-571               | Antennas           | 721        | 8/4/2009              | 8/4/2011             |
| 334     | Rohde&Schwarz         | 3160-10               | Antennas           | 45576      | 11/4/2010             | NCR                  |
| 335     | Suhner                | SF-102A               | Cables             | 882/2A     | 10/29/2010            | 10/29/2011           |
| 338     | Hewlett Packard       | 8449B                 | Amplifiers         | 3008A01111 | 3/24/2011             | 3/24/2012            |
| 340     | Aeroflex/Weinschel    | AS-20                 | Attenuators        | 7136       | 10/5/2010             | 10/5/2011            |
| 345     | Suhner Sucoflex       | 102A                  | Cables             | 1077/2A    | 10/29/2010            | 10/29/2011           |
| 422     | Florida RF            | SMS-200AW-72.0-SMR    | Cables             | 805        | 12/29/2010            | 12/29/2011           |

## 5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

| Item | Equipment Type | Manufacturer                  | Model Number | Serial Number                      |
|------|----------------|-------------------------------|--------------|------------------------------------|
| 1    | EUT            | Sensus Metering Systems, Inc. | ZIGMOD20     | ABCDE324,<br>ABCDE322,<br>ABCDE326 |
| 2    | Electric Meter | Sensus Metering Systems, Inc. | CL200 FM2S   | 29 388 962                         |
| 3    | Power Supply   | TryGon Electronics            | DL40-1       | 489512                             |

## 6 EQUIPMENT UNDER 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 antenna used for the ZigMod20 is a printed monopole antenna with 0dBi gain, and therefore meets the requirements of Section 15.203.

### 7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.4

#### 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

Results of the test are shown below in and Tables 7.2.2-1 to 7.2.2.2.

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

| Frequency (MHz) | Detector | Level (dBuV) | Correction Factor (dB) | Limit (dBuV) | Margin (dB) |
|-----------------|----------|--------------|------------------------|--------------|-------------|
| 0.192000        | QP       | 45.60        | 9.9                    | 64           | 18.4        |
| 0.240000        | QP       | 40.10        | 9.9                    | 62           | 22.0        |
| 0.426000        | QP       | 16.20        | 10.0                   | 57           | 41.1        |
| 0.480000        | QP       | 18.70        | 10.0                   | 56           | 37.6        |
| 1.458000        | QP       | 40.10        | 10.0                   | 56           | 15.9        |
| 1.782000        | QP       | 23.50        | 10.0                   | 56           | 32.5        |
| 3.612000        | QP       | 22.40        | 9.9                    | 56           | 33.6        |
| 4.986000        | QP       | 22.40        | 10.0                   | 56           | 33.6        |
| 7.158000        | QP       | 28.20        | 10.0                   | 60           | 31.8        |
| 20.592000       | QP       | 21.00        | 9.7                    | 73           | 39.0        |
| 0.192000        | AV       | 41.90        | 9.9                    | 54           | 12.0        |
| 0.240000        | AV       | 39.40        | 9.9                    | 52           | 12.7        |
| 0.414000        | AV       | 23.80        | 10.1                   | 48           | 23.7        |
| 0.480000        | AV       | 14.10        | 10.0                   | 46           | 32.2        |
| 1.458000        | AV       | 36.20        | 10.0                   | 46           | 9.8         |
| 1.818000        | AV       | 15.60        | 10.0                   | 46           | 30.4        |
| 3.558000        | AV       | 17.40        | 9.9                    | 46           | 28.6        |
| 4.992000        | AV       | 17.60        | 10.0                   | 46           | 28.4        |
| 7.158000        | AV       | 24.90        | 10.0                   | 50           | 25.1        |
| 20.640000       | AV       | 16.30        | 9.7                    | 50           | 33.7        |

Table 7.2.2-2: Line 2 Conducted EMI Results

| Frequency (MHz) | Detector | Level (dBuV) | Correction Factor (dB) | Limit (dBuV) | Margin (dB) |
|-----------------|----------|--------------|------------------------|--------------|-------------|
| 0.192000        | QP       | 40.00        | 9.9                    | 64           | 23.9        |
| 0.240000        | QP       | 36.40        | 9.9                    | 62           | 25.7        |
| 0.390000        | QP       | 25.40        | 10.1                   | 58           | 32.7        |
| 1.458000        | QP       | 36.70        | 10.0                   | 56           | 19.3        |
| 3.522000        | QP       | 22.30        | 9.9                    | 56           | 33.7        |
| 4.272000        | QP       | 24.10        | 9.9                    | 56           | 31.9        |
| 4.308000        | QP       | 24.30        | 9.9                    | 56           | 31.7        |
| 4.944000        | QP       | 21.50        | 10.0                   | 56           | 34.5        |
| 20.682000       | QP       | 24.00        | 9.6                    | 60           | 36.0        |
| 20.802000       | QP       | 27.30        | 9.5                    | 60           | 32.7        |
| 0.192000        | AV       | 38.40        | 9.9                    | 54           | 15.6        |
| 0.240000        | AV       | 35.90        | 9.9                    | 52           | 16.2        |
| 0.396000        | AV       | 16.60        | 10.1                   | 48           | 31.3        |
| 1.458000        | AV       | 32.40        | 10.0                   | 46           | 13.6        |
| 3.534000        | AV       | 18.00        | 9.9                    | 46           | 28.0        |
| 4.290000        | AV       | 19.00        | 9.9                    | 46           | 27.0        |
| 4.368000        | AV       | 18.20        | 10.0                   | 46           | 27.8        |
| 4.956000        | AV       | 17.00        | 10.0                   | 46           | 29.0        |
| 20.574000       | AV       | 15.70        | 9.7                    | 50           | 34.3        |
| 20.640000       | AV       | 16.40        | 9.7                    | 50           | 33.6        |

### 7.3 6dB / 99% Bandwidth – FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a)

#### 7.3.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the entire emissions and >> RBW.

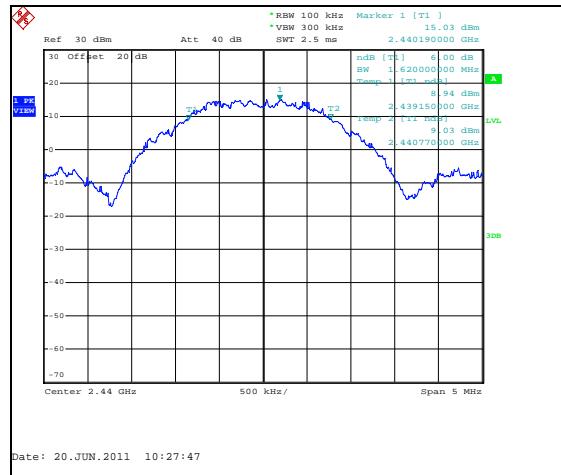
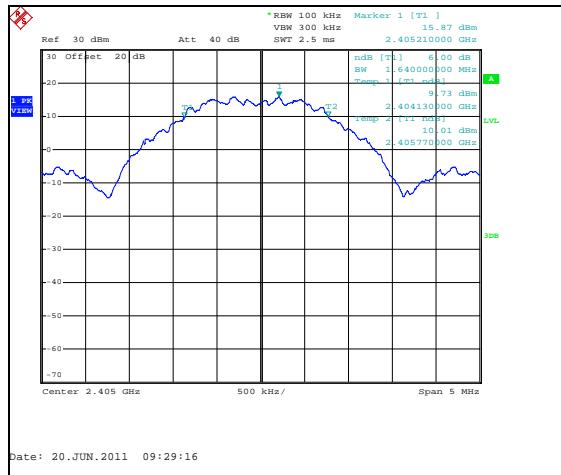
The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth.

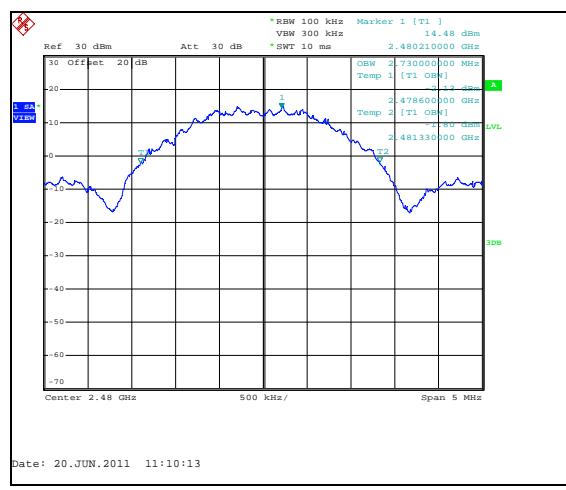
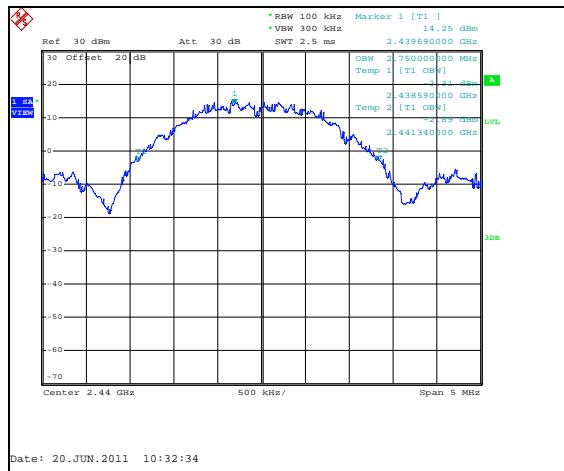
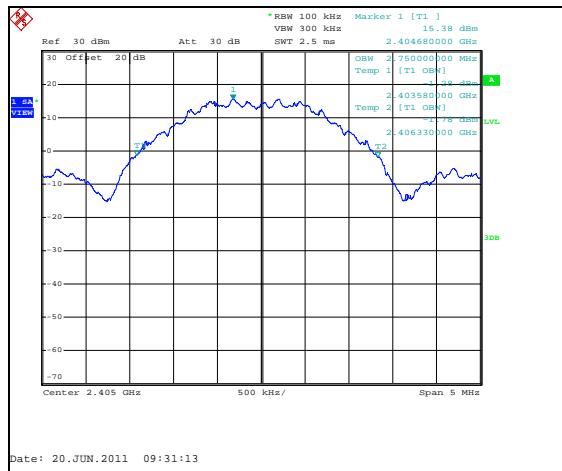
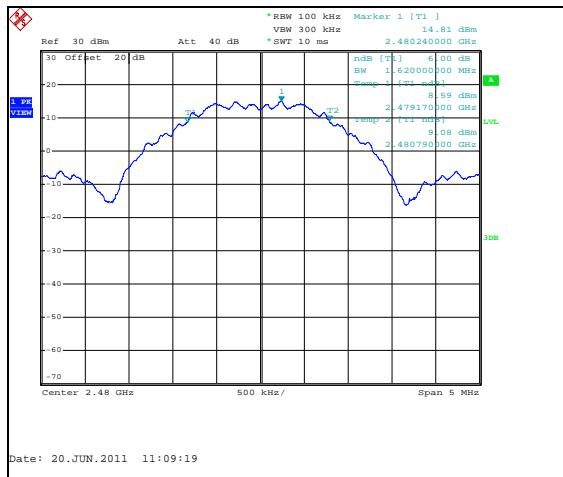
#### 7.3.2 Measurement Results

Results are shown below in table 7.3.2-1 and figure 7.3.2-1 to 7.3.2-6:

Table 7.3.2-1: 6dB / 99% Bandwidth

| Frequency [MHz] | 6dB Bandwidth [MHz] | 99% Bandwidth [MHz] |
|-----------------|---------------------|---------------------|
| 2405            | 1.64                | 2.75                |
| 2440            | 1.62                | 2.75                |
| 2480            | 1.62                | 2.73                |





## 7.4 Peak Output Power Requirement - FCC Section 15.247(b)(3) IC: RSS-210 A8.4(4)

### 7.4.1 Measurement Procedure

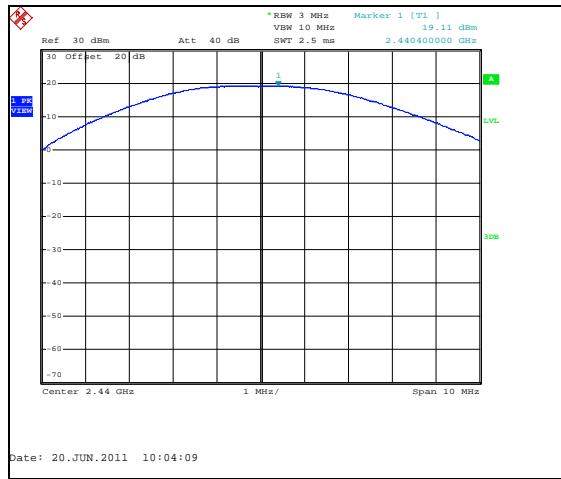
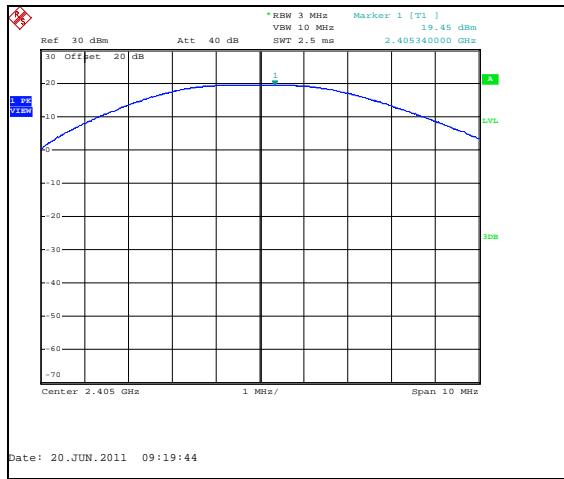
The Peak Output Power was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" Power Option 1. The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. Data was collected with the EUT operating at maximum power per channelization.

### 7.4.2 Measurement Results

Results are shown below in Table 7.4.2-1 and Figures 7.4.2-1 to 7.4.2-3.

**Table 7.4.2-1: Peak Output Power**

| Frequency (MHz) | Output Power (dBm) |
|-----------------|--------------------|
| 2405            | 19.45              |
| 2440            | 19.11              |
| 2480            | 18.47              |



## 7.5 Band-Edge Compliance and Spurious Emissions-FCC 15.247d IC:RSS-210 2.2, A8.5

### 7.5.1 Band-Edge Compliance

#### 7.5.1.1 Measurement Procedure

The EUT was investigated at the low and high channels of operation to determine band-edge compliance. Because the upper band-edge coincides with a restricted band, band-edge compliance for the upper band-edge was determined based on the marker-delta method.

The lower band-edge compliance was determined using the conducted marker-delta method in which the radio frequency power that is produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

#### 7.5.1.2 Measurement Results

Band-edge compliance is displayed in Table 7.5.1.2-1 and Figures 7.5.1.2-1 to 7.5.1.2-3.

Table 7.5.1.2-1: Upper Band-edge Radiated Emissions - 2480MHz

| Frequency (MHz) | Uncorrected Level (dBuV) |         | Antenna Factor (H/V) | Correction Factors (dB) | Fundamental Level (dBuV/m) |         | Marker-Delta (dB) | Band-Edge Level (dBuV/m) |         | Limit (dBuV/m) |         | Margin (dB) |         |
|-----------------|--------------------------|---------|----------------------|-------------------------|----------------------------|---------|-------------------|--------------------------|---------|----------------|---------|-------------|---------|
|                 | pk                       | Qpk/Avg |                      |                         | pk                         | Qpk/Avg |                   | pk                       | Qpk/Avg | pk             | Qpk/Avg | pk          | Qpk/Avg |
| 2480            | 121.75                   | 119.11  | H                    | -5.06                   | 116.69                     | 96.20   | 44.57             | 72.12                    | 51.63   | 74.0           | 54.0    | 1.88        | 2.37    |
| 2480            | 117.25                   | 114.61  | V                    | -5.06                   | 112.19                     | 91.70   | 45.48             | 66.71                    | 46.22   | 74.0           | 54.0    | 7.29        | 7.78    |



7.5.1.2-1: Upper Band-edge - HPol

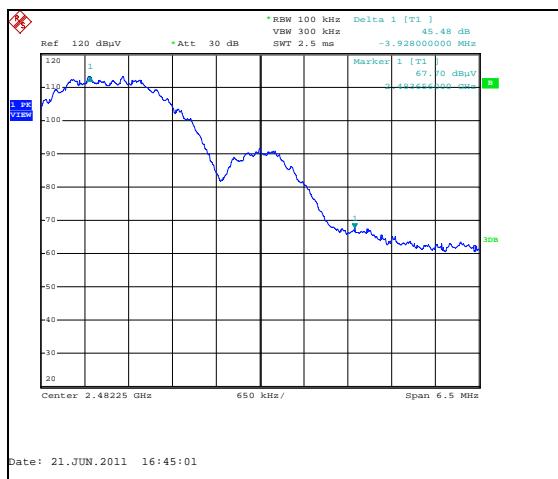


Figure 7.5.1.2-2: Upper Band-edge - VPol

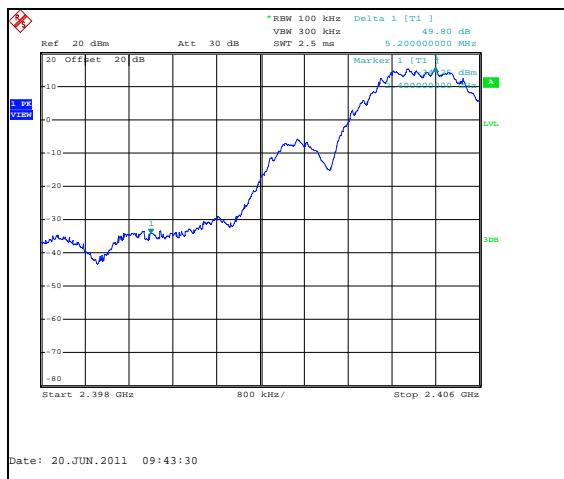


Figure 7.5.1.2-3: Lower Band-edge (Conducted)

## 7.5.2 RF Conducted Spurious Emissions

### 7.5.2.1 Measurement Procedure

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak detector and Max Hold function of the analyzer were utilized.

### 7.5.2.2 Measurement Results

RF Conducted Emissions are displayed in Figures 7.5.2.2-1 through 7.5.2.2-9.

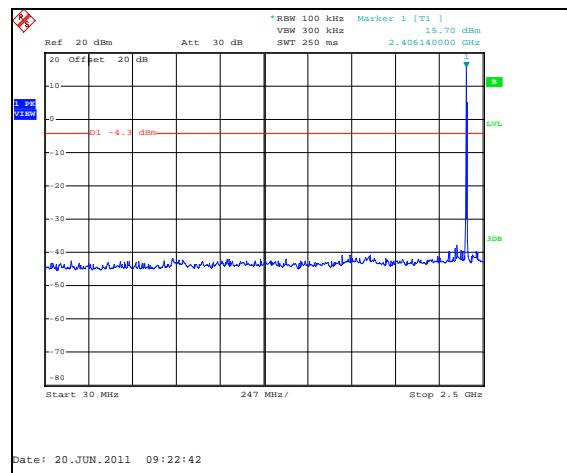


Figure 7.5.2.2-1: 30 MHz – 2.5 GHz – 2405MHz

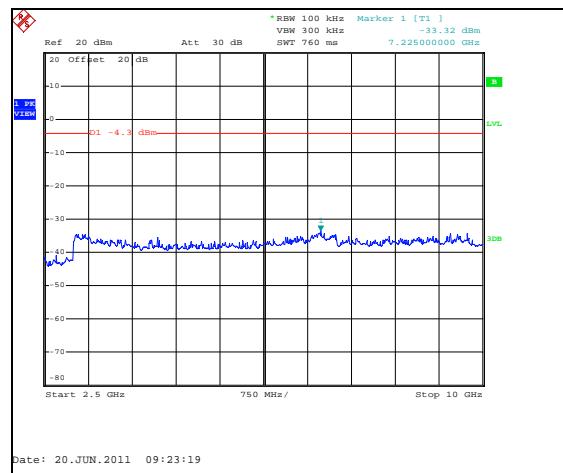


Figure 7.5.2.2-2: 2.5 GHz – 10 GHz – 2405MHz

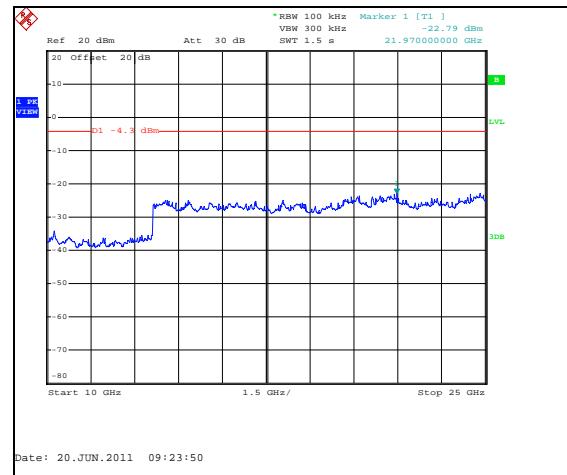


Figure 7.5.2.2-3: 10 GHz – 25 GHz – 2405MHz

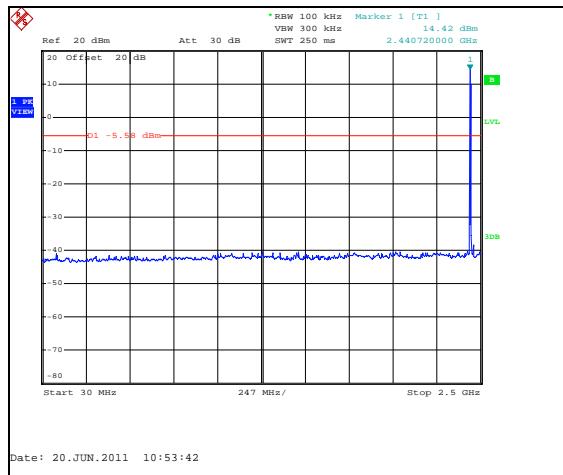


Figure 7.5.2.2-4: 30 MHz – 2.5 GHz – 2440MHz

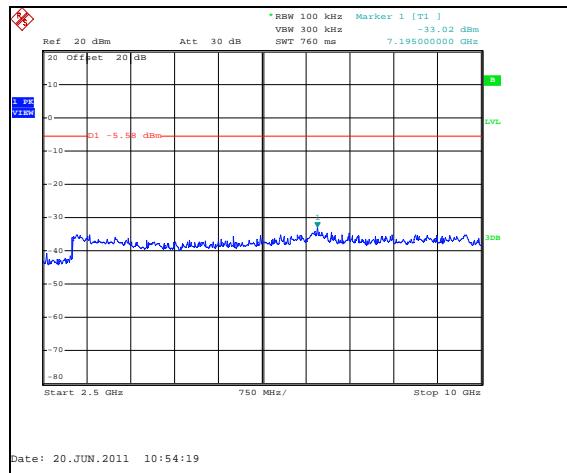


Figure 7.5.2.2-5: 2.5 GHz – 10 GHz – 2440MHz

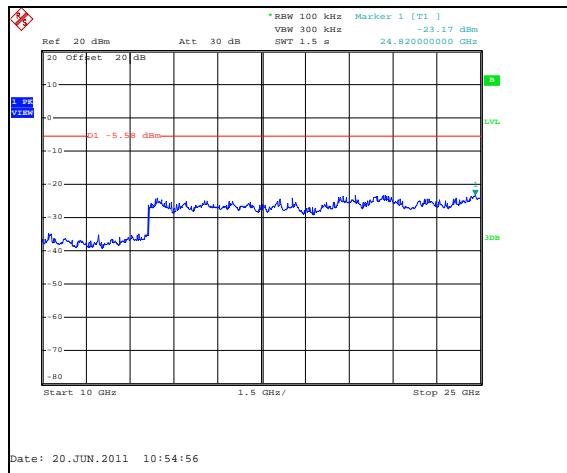
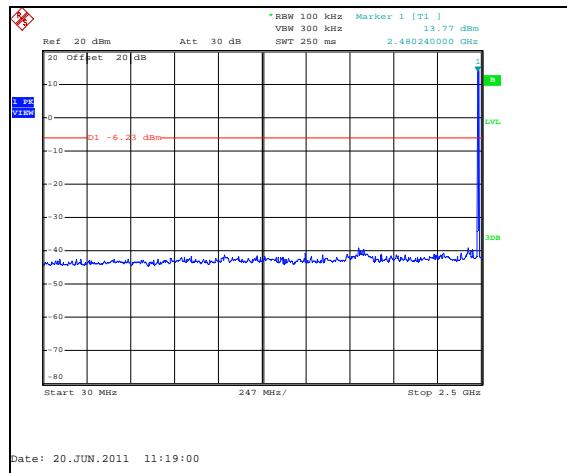
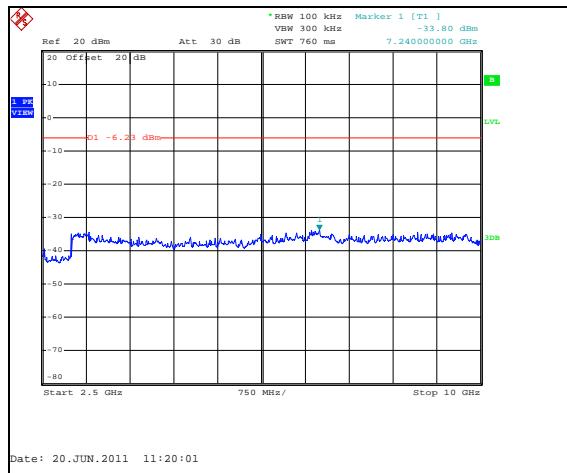


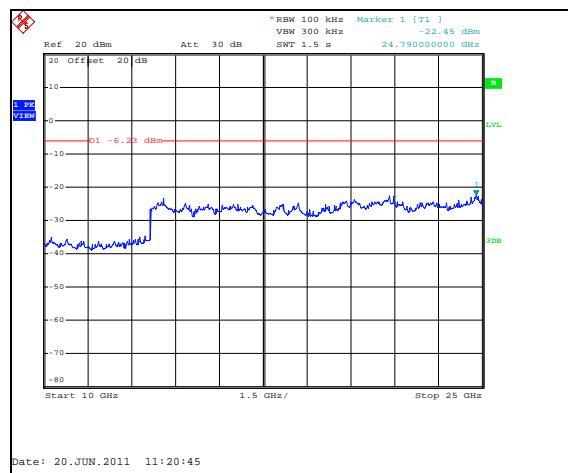
Figure 7.5.2.2-6: 10 GHz – 25 GHz – 2440MHz



**Figure 7.5.2.2-7: 30 MHz – 2.5 GHz – 2480MHz**



**Figure 7.5.2.2-8: 2.5 GHz – 10 GHz – 2480MHz**



**Figure 7.5.2.2-9: 10 GHz – 25 GHz – 2480MHz**

### 7.5.3 Radiated Spurious Emissions (Restricted Bands)

#### 7.5.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 25 GHz, 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 3 MHz respectively. The average emissions were further corrected by applying the duty cycle correction of the EUT for comparison to the average limit.

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

#### 7.5.3.2 Duty Cycle Correction

For average radiated measurements, using a 12.8% duty cycle, the measured level was reduced by a factor -17.85dB. The duty cycle correction factor is determined using the formula:  $20\log(12.8/100) = -17.85\text{dB}$ .

A detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying this report.

#### 7.5.3.3 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 25GHz are reported in the tables below.

**Table 7.5.3.3-1: Radiated Spurious Emissions Tabulated Data – 2405MHz**

| 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 |
| 4810            | 53.16        | 45.03   | H                      | 1.93                    | 55.09                    | 29.10   | 74.0           | 54.0    | 18.9        | 24.9    |
| 4810            | 54.38        | 47.16   | V                      | 1.93                    | 56.31                    | 31.23   | 74.0           | 54.0    | 17.7        | 22.8    |
| 12025           | 50.19        | 40.54   | H                      | 14.29                   | 64.48                    | 36.97   | 83.5           | 63.5    | 19.0        | 26.6    |
| 12025           | 51.13        | 40.51   | V                      | 14.29                   | 65.42                    | 36.94   | 83.5           | 63.5    | 18.1        | 26.6    |

\* Note: All emissions above 12025 MHz were attenuated below the permissible limit.

**Table 7.5.3.3-2: Radiated Spurious Emissions Tabulated Data – 2440MHz**

| 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 |
| 4880            | 55.01        | 48.34   | H                      | 2.09                    | 57.10                    | 32.58   | 74.0           | 54.0    | 16.9        | 21.4    |
| 4880            | 55.06        | 47.93   | V                      | 2.09                    | 57.15                    | 32.17   | 74.0           | 54.0    | 16.8        | 21.8    |
| 7320            | 55.06        | 43.92   | H                      | 7.57                    | 62.63                    | 33.63   | 74.0           | 54.0    | 11.4        | 20.4    |
| 7320            | 57.40        | 46.74   | V                      | 7.57                    | 64.97                    | 36.45   | 74.0           | 54.0    | 9.0         | 17.5    |
| 12200           | 54.76        | 43.03   | H                      | 15.59                   | 70.35                    | 40.76   | 83.5           | 63.5    | 13.2        | 22.8    |
| 12200           | 55.78        | 44.58   | V                      | 15.59                   | 71.37                    | 42.31   | 83.5           | 63.5    | 12.1        | 21.2    |

\* Note: All emissions above 12200 MHz were attenuated below the permissible limit.

**Table 7.5.3.3-3: Radiated Spurious Emissions Tabulated Data – 2480MHz**

| 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 |
| 4960               | 53.16           | 44.90   | H                            | 2.28                          | 55.44                       | 29.32   | 74.0              | 54.0    | 18.6           | 24.7    |
| 4960               | 52.41           | 44.12   | V                            | 2.28                          | 54.69                       | 28.54   | 74.0              | 54.0    | 19.3           | 25.5    |
| 7440               | 54.30           | 45.72   | H                            | 7.57                          | 61.87                       | 35.44   | 74.0              | 54.0    | 12.1           | 18.6    |
| 7440               | 58.12           | 49.91   | V                            | 7.57                          | 65.69                       | 39.63   | 74.0              | 54.0    | 8.3            | 14.4    |
| 12400              | 51.68           | 41.70   | H                            | 17.07                         | 68.75                       | 40.91   | 83.5              | 63.5    | 14.8           | 22.6    |
| 12400              | 53.26           | 43.74   | V                            | 17.07                         | 70.33                       | 42.95   | 83.5              | 63.5    | 13.2           | 20.6    |

\* Note: All emissions above 12400 MHz were attenuated below the permissible limit.

#### 7.5.3.4 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:  $53.16 + 1.93 = 55.09$  dBuV/m

Margin:  $74$  dBuV/m –  $55.09$  dBuV/m =  $18.9$  dB

#### Example Calculation: Average

Corrected Level:  $45.03 + 1.93 - 17.85 = 29.1$  dBuV

Margin:  $54$  dBuV –  $29.1$  dBuV =  $24.9$  dB

## 7.6 Peak Power Spectral Density- FCC Section 15.247(e) IC: RSS-210 A8.2(b)

### 7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The emission peaks within the pass band were located and zoomed in on. The spectrum analyzer RBW was set to 3 kHz and VBW 10 kHz. Span was adjusted to 500 kHz and the sweep time was calculated to be 167s ~ (Span/3 kHz).

### 7.6.2 Measurement Results

Results are shown below in table 7.6.2-1 and figures 7.6.2-1 – 7.6.2-3:

**Table 7.6.2-1: Peak Power Spectral Density**

| Frequency (MHz) | PSD Level (dBm) |
|-----------------|-----------------|
| 2405            | 6.97            |
| 2440            | 6.21            |
| 2480            | 3.50            |

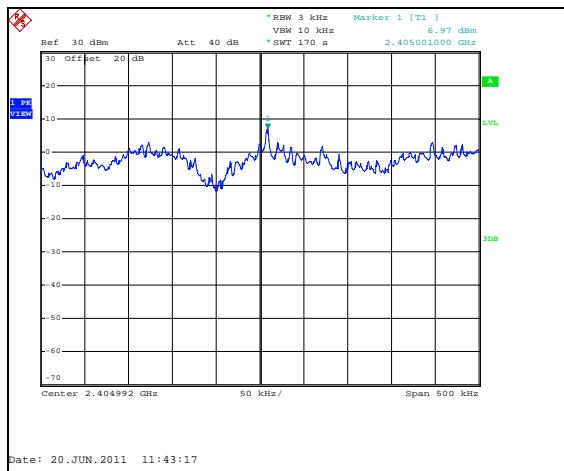


Figure 7.6.2-1: Power Spectral Density Plot – 2405MHz

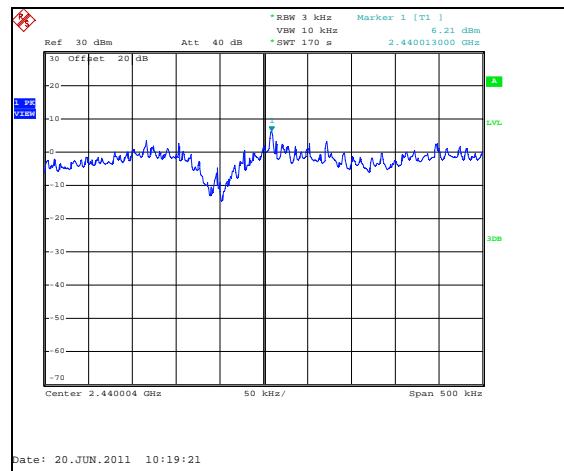


Figure 7.6.2-2: Power Spectral Density Plot – 2440MHz

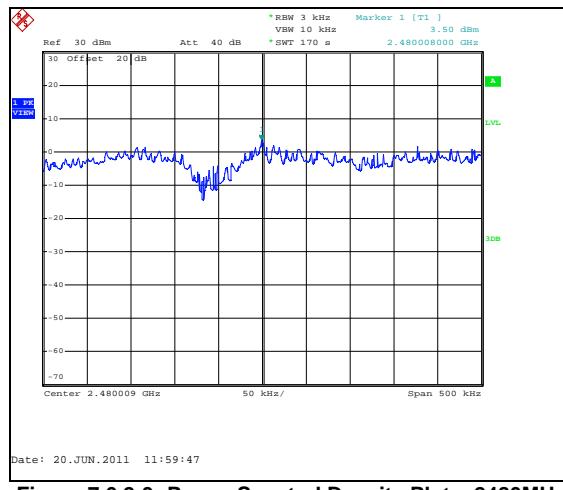


Figure 7.6.2-3: Power Spectral Density Plot – 2480MHz

**8 CONCLUSION**

In the opinion of ACS, Inc. the ZigMod20, manufactured by Sensus Metering Systems, Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

**END REPORT**