

Certification Test Report

**FCC ID: SK9AMI-4
IC: 864G-AMI4**

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

ACS Report Number: 09-0210-15C-DTS

**Manufacturer: Itron Electricity Metering, Inc.
Model: AMI4**


**Test Begin Date: June 11, 2009
Test End Date: June 16, 2009**


Report Issue Date: July 6, 2009



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.

Prepared by: 
Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

Reviewed by: 
Sam Wismer
Vice President, Technology
ACS, Inc.

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This report contains 16 pages

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Additional Exhibits Included In Filing

Test Setup Photographs

External Photos

Internal Photos

1.0 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 class II permissive change. This permissive change is to address the addition of a Pole Top Repeater form factor host device.

1.2 Product Description

1.2.1 General

The AMI4 module is a utility meter register board designed to be integrated into a variety of electric meter form factors. The AMI4 contains (1) 900 MHz LAN frequency hopping spread spectrum radio and (1) 2.4 GHz direct sequence spread spectrum Zigbee radio.

Manufacturer Information:

Itron Electricity Metering, Inc.
313 North Highway 11
West Union, SC 29696

Test Sample Serial Number(s):

902.25 MHz	4110000488
914.75 MHz	4110005790
927.75 MHz	4110004524
2405 MHz	4110000454
2440 MHz	4110001317
2475 MHz	4110000934

Test Sample Condition:

The test samples were provided in good working order with no visible defects.

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

1.2.2 Intended Use

The AMI4 module is intended to be used in electric utility meters to provide automated meter reading capabilities.

1.3 Test Methodology and Considerations

This AMI4 module is considered a composite device by definition. The 900 MHz LAN radio and the 2.4 GHz Zigbee radio operate under CFR 47 Part 15.247 and IC RSS-210. Line conducted, unintentional and intentional radiated emissions were measured with AMI4 integrated into a Pole Top Repeater host. This report addresses the 2.4 GHz Zigbee radio only. A separate report will be issued to address the 900 MHz LAN radio.

The Pole Top Repeater host was tested in two orientations, face down and face forward, to represent the two orientations of expected installation. Data for both orientations is presented in this report.

Radiated intermodulation products for all simultaneously transmitting radios were also evaluated and found in compliance.

2.0 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

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. In addition, ACS is compliant to ISO/IEC 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 894540

Industry Canada Lab Code: IC 4175A-1

VCCI Member Number: 1831

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

NVLAP Lab Code: 200612-0

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 2.3.1-1 below:

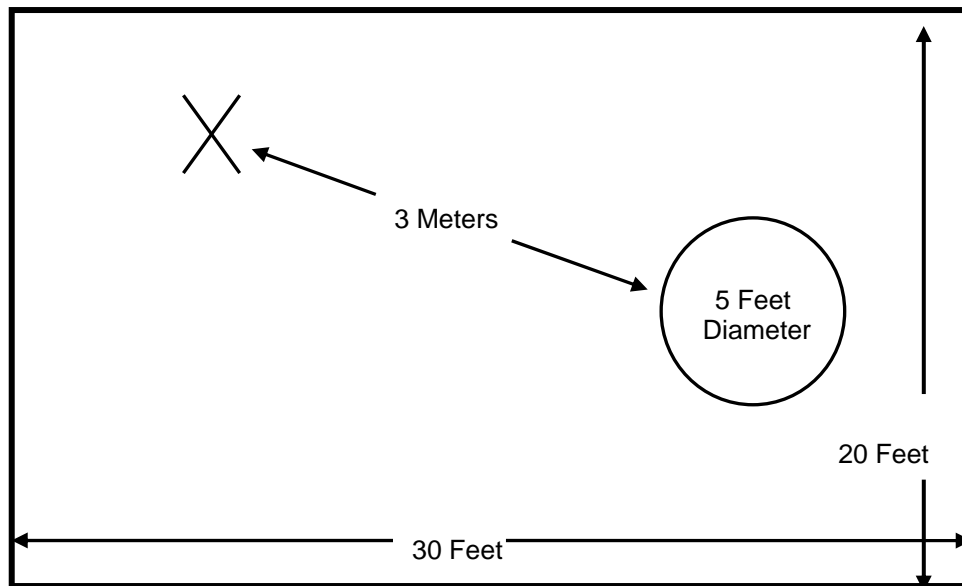


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

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 2.3.2-2 below:

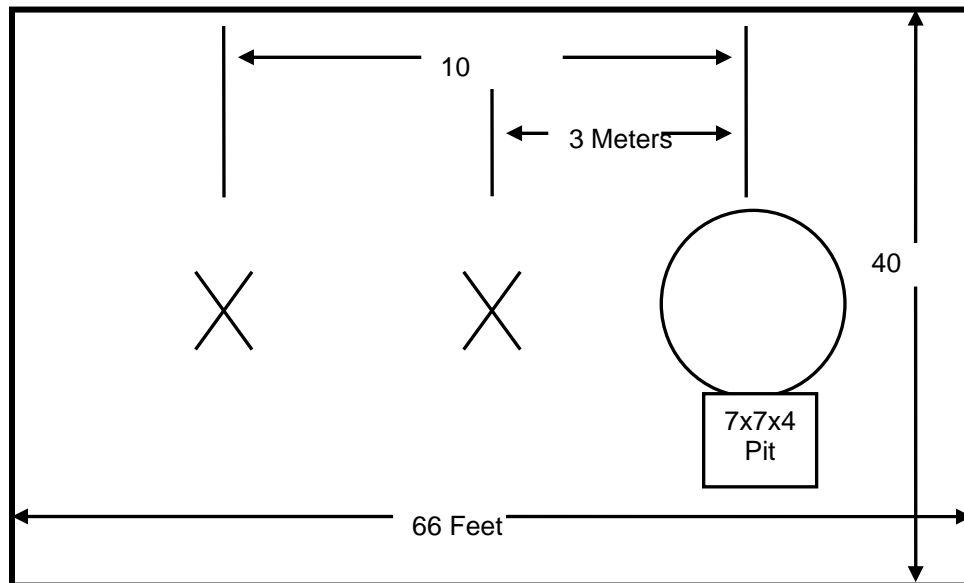


Figure 2.3.2-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

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

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

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

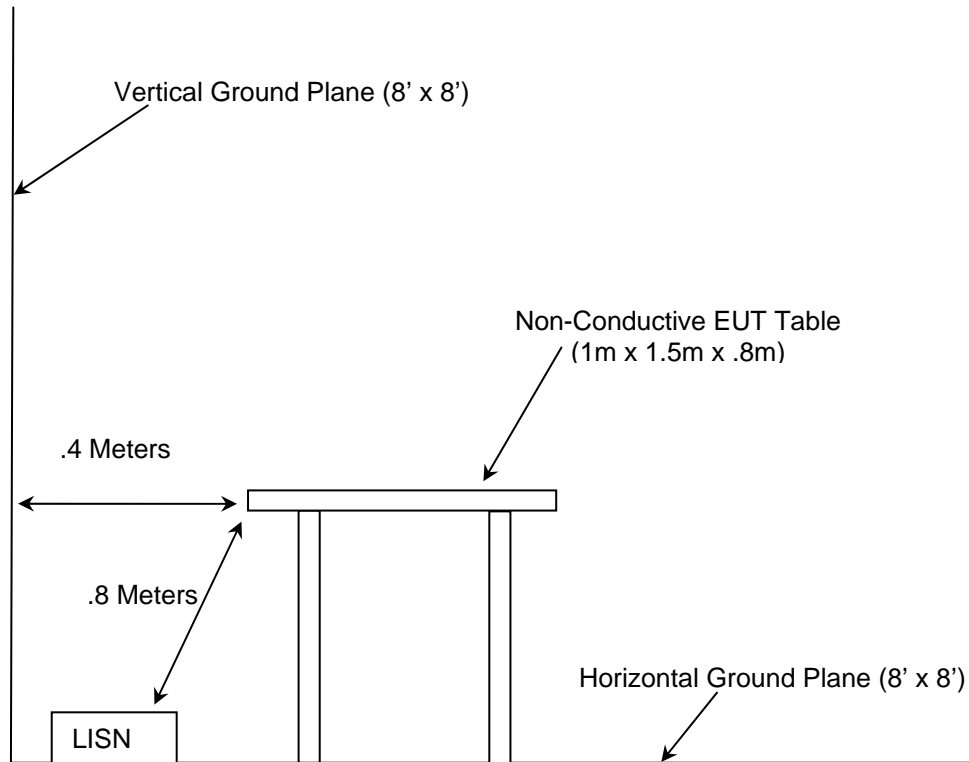


Figure 2.4-1: AC Mains Conducted EMI Site

3.0 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, 2009
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2009
- ❖ 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 7 June 2007
- ❖ Industry Canada Radio Standards Specification: RSS-GEN - General Requirements and Information for the Certification of Radiocommunication Equipment, Issue2, June 2007.

4.0 LIST OF TEST EQUIPMENT

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

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	Mfg.	Eq. type	Model	S/N	Cal. Due
1	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	833771/007	09-19-2009
2	Rohde & Schwarz	Spectrum Analyzers	ESMI-Receiver	839587/003	09-19-2009
22	Agilent	Amplifiers	8449B	3008A00526	10-22-2009
25	Chase	Antennas	CBL6111	1043	08-22-2009
30	Spectrum Technologies	Antennas	DRH-0118	970102	05-08-2010
152	EMCO	LISN	Feb-25	9111-1905	03-25-2010
153	EMCO	LISN	Feb-25	9411-2268	01-27-2010
167	ACS	Cable Set	Chamber EMI Cable Set	167	02-06-2010 (See Note1)
168	Hewlett Packard	Attenuators	11947A	44829	02-10-2010 (See Note2)
282	Microwave Circuits	Filters	H2G020G4	74541	02-04-2010 (See Note1)
291	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	None	11-24-2009 (See Note1)
292	Florida RF Cables	Cables	SMR-290AW-480.0-SMR	None	11-24-2009 (See Note1)
321	Hewlett Packard	Amplifiers	HPC 8447D	1937A02809	10-08-2009
324	ACS	Cables	Belden	8214	07-28-2009
338	Hewlett Packard	Amplifiers	8449B	3008A01111	10-22-2009
339	Aeroflex/Weinschel	Attenuators	AS-18	7142	07-08-2009 (See Note2)
422	Florida RF	Cables	SMS-200AW-72.0-SMR	805	02-05-2010 (See Note1)

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

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

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Pole Top Repeater Enclosure (Host)	Itron Electricity Metering, Inc.	RFLAN Range Extender	NA

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

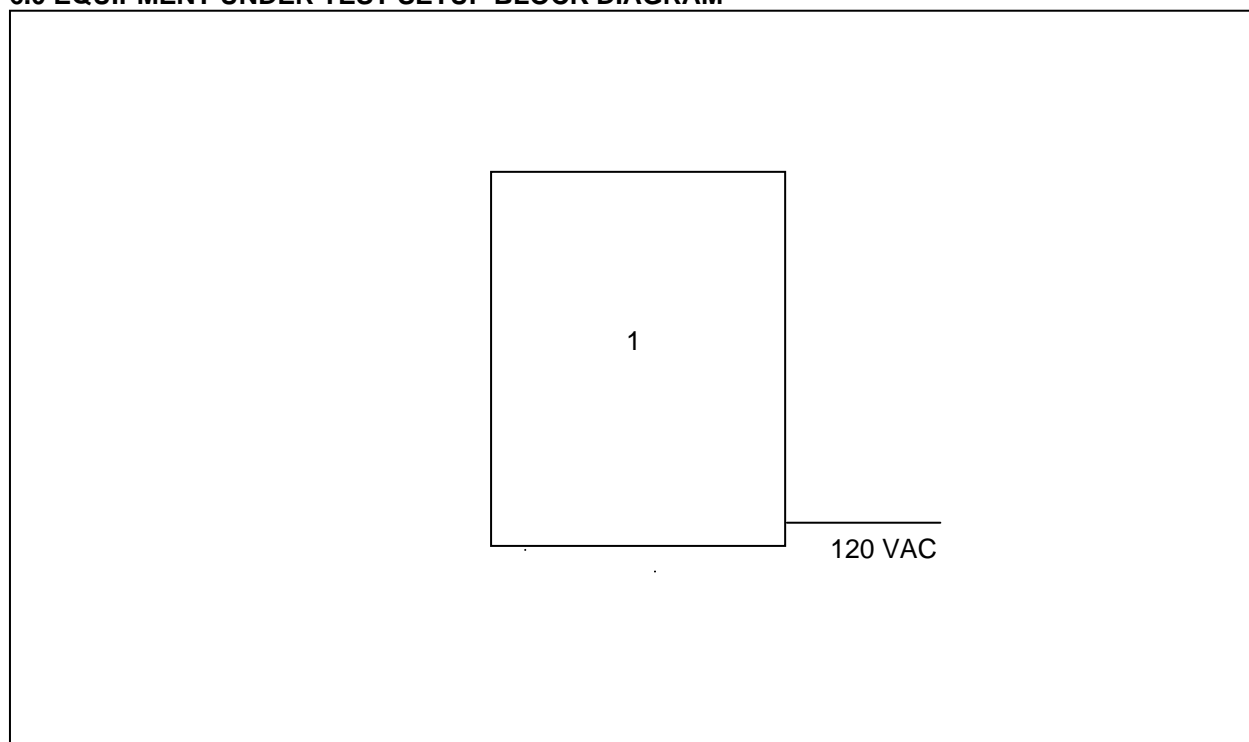


Figure 6-1: EUT Test Setup

Note1: The AMI4 was integrated into the Pole Top Repeater meter form for showing compliance for radiated emissions and AC power line conducted emissions.

7.0 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 is a quarter wave embedded slot antenna in the ground plane with a measured gain of 4.4dBi.

7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.2

7.2.1 Test Methodology

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

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss

Margin = Applicable Limit - Corrected Reading

7.2.2 Test Results

Results of the test are shown below in and Table 7.2.2-1.

Table 7.2.2-1: Line 1 Conducted EMI Results – Quasi Peak

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.510000	10.60	10.0	56	45.4	L1	GND
0.804000	10.50	10.1	56	45.5	L1	GND
1.302000	10.30	10.0	56	45.7	L1	GND
3.090000	9.70	9.9	56	46.3	L1	GND
4.194000	34.00	9.9	56	22.0	L1	GND
6.876000	9.30	10.0	60	50.7	L1	GND
7.116000	9.20	10.0	60	50.8	L1	GND
13.800000	9.60	9.9	60	50.4	L1	GND
21.540000	9.10	9.3	60	50.9	L1	GND
29.622000	9.80	9.2	60	50.2	L1	GND

Table 7.2.2-2: Line 1 Conducted EMI Results – Average

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.504000	7.70	10.0	46	38.4	L1	GND
0.894000	7.40	10.0	46	38.6	L1	GND
1.362000	7.40	10.0	46	38.6	L1	GND
3.102000	6.90	9.9	46	39.1	L1	GND
4.194000	30.20	9.9	46	15.8	L1	GND
6.864000	6.70	10.0	50	43.3	L1	GND
7.098000	6.70	10.0	50	43.3	L1	GND
13.716000	7.00	9.9	50	43.0	L1	GND
21.444000	6.20	9.3	50	43.8	L1	GND
29.220000	6.80	9.2	50	43.2	L1	GND

Table 7.2.2-3: Line 2 Conducted EMI Results – Quasi Peak

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.150000	25.30	9.9	66	40.7	L2	GND
0.462000	10.80	10.0	57	45.9	L2	GND
0.528000	10.80	10.0	56	45.2	L2	GND
1.014000	10.20	10.0	56	45.8	L2	GND
1.638000	10.50	10.0	56	45.5	L2	GND
2.172000	9.80	10.0	56	46.2	L2	GND
4.194000	33.70	9.9	56	22.3	L2	GND
9.396000	9.40	9.9	60	50.6	L2	GND
10.692000	9.20	9.9	60	50.8	L2	GND
27.486000	9.40	9.3	60	50.6	L2	GND

Table 7.2.2-4: Line 2 Conducted EMI Results – Average

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.228000	8.50	9.9	53	44.0	L2	GND
0.462000	7.60	10.0	47	39.0	L2	GND
0.522000	7.60	10.0	46	38.4	L2	GND
1.062000	7.40	10.0	46	38.6	L2	GND
1.662000	7.40	10.0	46	38.6	L2	GND
2.226000	7.10	10.0	46	38.9	L2	GND
4.194000	27.30	9.9	46	18.7	L2	GND
9.288000	6.80	9.9	50	43.2	L2	GND
10.614000	6.80	9.9	50	43.2	L2	GND
27.258000	6.70	9.4	50	43.3	L2	GND

7.3 Radiated Emissions – FCC: Section 15.109(Unintentional Radiation) IC: RSS-210 2.6**7.3.1 Test Methodology**

Radiated emissions tests were performed over the frequency range of 30MHz to 12.5GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements above 30MHz and below 1GHz were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz using a Quasi-peak detector. Above 1GHz, peak and average measurements are taken with the RBW and VBW were set to 1MHz and 3MHz respectively.

7.3.2 Test Results

Results of the test are given in Table 7.3.2-1.

Table 7.3.2-1: Radiated Emissions Tabulated Data

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
264.238		45.82	H	-12.07	-----	33.75	-----	46.0	-----	12.25
293.583		44.02	H	-11.83	-----	32.19	-----	46.0	-----	13.81
301.994		43.41	H	-11.66	-----	31.75	-----	46.0	-----	14.25
318.749		47.24	V	-10.73	-----	36.51	-----	46.0	-----	9.49
402.638		41.30	V	-7.84	-----	33.46	-----	46.0	-----	12.54
545.994		41.30	V	-3.64	-----	37.66	-----	46.0	-----	8.34
909.5		20.35	V	1.28	-----	21.63	-----	46.0	-----	24.37
928.9		20.15	H	1.46	-----	21.61	-----	46.0	-----	24.39

* Note: All emissions above 928.9 MHz were attenuated below the permissible limit.

7.4 Band-Edge Compliance and Spurious Emissions

7.4.1 Band-Edge Compliance of RF Emissions - FCC Section 15.247(d) IC: RSS-210 2.6, A8.5

7.4.1.1 Test Methodology

The EUT was investigated at the low and high channels of operation to determine band-edge compliance. All antenna types were evaluated. Because the upper band-edge coincides with a restricted band, band-edge compliance for the upper band-edge was determined using the radiated mark-delta method as outlined in FCC DA 00-705. The radiated field strength of the fundamental emission was first determined and then the mark-delta method was used to determine the field strength of the band-edge emissions.

The band-edge measurements provided are worst case for all orientations.

7.4.1.2 Test Results

Band-edge compliance is displayed in Table 7.4.1.2-1 and Figure 7.4.1.2-1 – 7.4.1.2-2. The worst case orientation (side) is shown.

Table 7.4.1.2-1: Upper Band-edge Marker Delta Method - Side

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Fundamental Field Strength (dBuV/m)		Delta- Marker (dB)	Band-edge Field Strength (dBuV/m)		Margin to Limit (dBuV/m)	
	pk	avg			pk	avg		pk	avg	pk	avg
Fundamental Frequency											
2475	116.62	110.81	H	-4.21	112.41	95.22	51.02	61.39	44.20	12.61	9.80
2475	114.66	114.39	V	-4.21	110.45	98.80	50.21	60.24	48.59	13.76	5.41

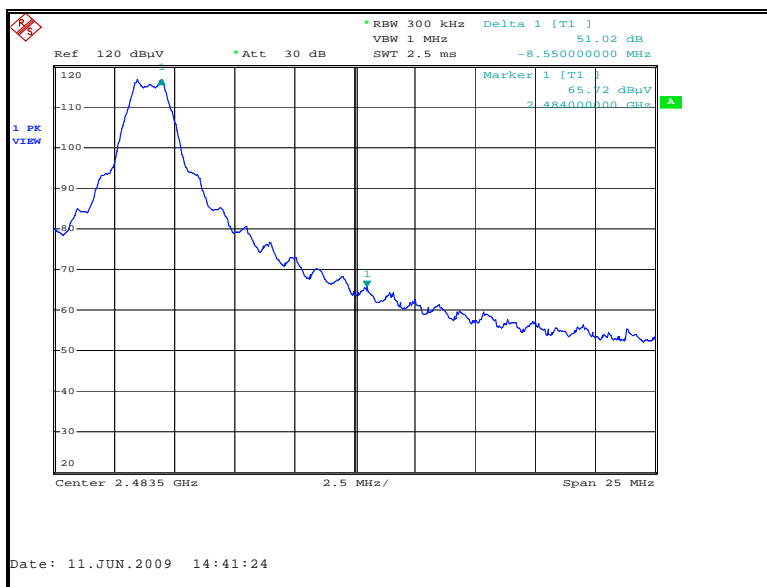


Figure 7.4.1.2-1: Upper Band-edge (Radiated) – Horizontal Polarization

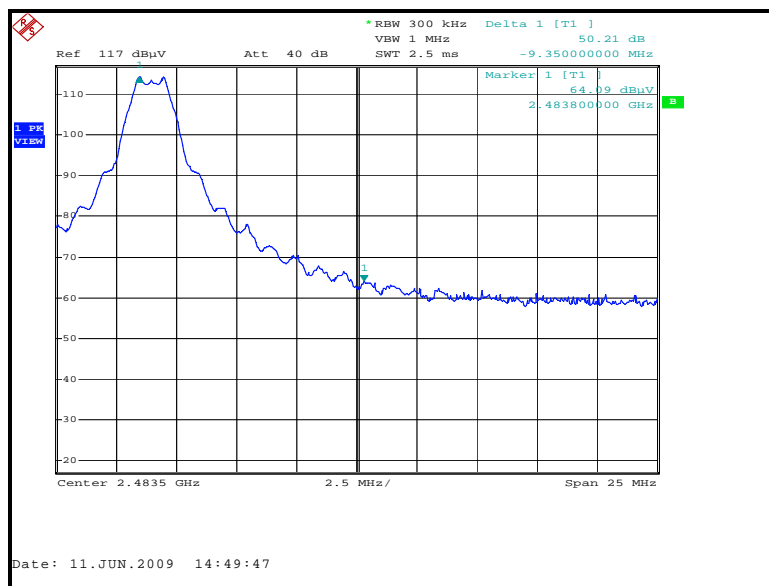


Figure 7.4.1.2-2: Upper Band-edge (Radiated) – Vertical Polarization

7.4.2 Radiated Spurious Emissions (Restricted Bands) - FCC Section 15.205 IC: RSS-210 2.6

7.4.2.1 Test Methodology

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 made with RBW and VBW of 1 MHz. The average emissions were further corrected by applying the duty cycle correction of the EUT to the average measurements for comparison to the average limit.

Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits as defined in section 15.209.

7.4.2.2 Duty Cycle Correction

For average radiated measurements, the measured level was reduced by a factor 11.37dB to account for the duty cycle of the EUT. The packet transmissions length is 27ms. The duty cycle correction factor is determined using the formula: $20\log(.27/100) = 11.37\text{dB}$. A detailed analysis of the duty cycle timing is provided in the Theory of Operation of the original filing.

7.4.2.3 Test Results

Radiated spurious emissions found in the band of 30MHz to 25GHz for the Pole Top Repeater Meter Form are reported in Tables 7.4.2.3-1 to 7.4.2.3-2. Emissions not reported were below the noise floor of the measurement instrumentation.

Table 7.4.2.3-1: Radiated Spurious Emissions – Face Down Orientation

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
Low Channel										
4810	56.21	49.27	H	3.20	59.41	41.09	74.0	54.0	14.59	12.91
4810	60.96	54.91	V	3.20	64.16	46.73	74.0	54.0	9.84	7.27
12025	50.57	41.10	H	16.39	66.96	46.11	83.5	63.5	16.58	17.43
12025	57.43	48.92	V	16.39	73.82	53.93	83.5	63.5	9.72	9.61
Mid Channel										
4880	58.92	52.25	H	3.46	62.38	44.33	74.0	54.0	11.62	9.67
4880	62.66	56.21	V	3.46	66.12	48.29	74.0	54.0	7.88	5.71
7320	55.52	47.62	H	8.31	63.83	44.56	74.0	54.0	10.17	9.44
7320	61.54	54.18	V	8.31	69.85	51.12	74.0	54.0	4.15	2.88
12200	50.21	38.81	V	17.53	67.74	44.96	83.5	63.5	15.81	18.58
High Channel										
4950	55.88	47.93	H	3.71	59.59	40.27	74.0	54.0	14.41	13.73
4950	61.36	54.94	V	3.71	65.07	47.28	74.0	54.0	8.93	6.72
7425	56.79	49.02	H	8.41	65.20	46.06	74.0	54.0	8.80	7.94
7425	62.78	55.22	V	8.41	71.19	52.26	74.0	54.0	2.81	1.74

Table 7.4.2.3-2: Radiated Spurious Emissions – Side Orientation

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
Low Channel										
4810	61.72	55.50	H	3.20	64.92	47.32	74.0	54.0	9.08	6.68
4810	58.77	51.81	V	3.20	61.97	43.63	74.0	54.0	12.03	10.37
12025	49.88	38.00	H	16.39	66.27	43.01	83.5	63.5	17.27	20.53
12025	47.55	36.50	V	16.39	63.94	41.51	83.5	63.5	19.60	22.03
Mid Channel										
4880	59.48	53.49	H	3.46	62.94	45.57	74.0	54.0	11.06	8.43
4880	60.07	53.72	V	3.46	63.53	45.80	74.0	54.0	10.47	8.20
7320	61.54	53.95	H	8.31	69.85	50.89	74.0	54.0	4.15	3.11
7320	59.43	51.84	V	8.31	67.74	48.78	74.0	54.0	6.26	5.22
High Channel										
4950	58.52	51.64	H	3.71	62.23	43.98	74.0	54.0	11.77	10.02
4950	58.65	52.07	V	3.71	62.36	44.41	74.0	54.0	11.64	9.59
7425	59.64	51.81	H	8.41	68.05	48.85	74.0	54.0	5.95	5.15
7425	59.92	52.30	V	8.41	68.33	49.34	74.0	54.0	5.67	4.66

7.4.2.4 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: PeakCorrected Level: $56.21 + 3.20 = 59.41 \text{ dBuV/m}$ Margin: $74 \text{ dBuV/m} - 59.41 \text{ dBuV/m} = 14.59 \text{ dB}$ **Example Calculation: Average**Corrected Level: $49.27 + 3.20 - 11.37 = 41.09 \text{ dBuV}$ Margin: $54 \text{ dBuV} - 41.09 \text{ dBuV} = 12.91 \text{ dB}$ **8.0 CONCLUSION**

In the opinion of ACS, Inc. the AMI4 module, manufactured by Itron Electricity Metering, Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT