



Engineering and Testing for EMC and Safety Compliance

**FCC Part 15.247  
Certification Application Report**

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<b>FCC ID:</b>	U3M-SCM2007	<b>Test Report Date:</b>	December 26, 2006
<b>Platform:</b>	N/A	<b>RTL Work Order #:</b>	2006164
<b>Model Name/Number:</b>	Sensors Communication Module/SCM1001	<b>RTL Quote #:</b>	QRTL06-376
<b>American National Standard Institute:</b>	ANSI C63.4-2003: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
<b>FCC Classification:</b>	DTS – Digital Transmission System		
<b>FCC Rule Part(s):</b>	FCC Rules Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System October 1, 2006		
<b>Digital Interface Information</b>	Digital Interface was found to be compliant		
<b>Frequency Range (MHz)</b>	<b>Output Power (W)</b>	<b>Frequency Tolerance</b>	<b>Emission Designator</b>
2442	0.4	N/A	27M5FXD

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, FCC 97-114, and ANSI C63.4.

Signature: 

Date: December 26, 2006

Typed/Printed Name: Desmond A. Fraser

Position: President

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## **1 General Information**

### **1.1 Scope**

FCC Rules Part 15.247: Operation within the bands 902–928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

### **1.2 Test Facility**

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4-2003).

### **1.3 Related Submittal(s)/Grant(s)**

This is an original application for certification for Alion Science and Technology Center for Electromagnetic Science, Model Name: Sensors Communication Module, Model Number: SCM1001, FCC ID: U3M-SCM2007.

### **1.4 Modifications**

No modifications were required to achieve compliance.

## 2 Test Information

### 2.1 Test Justification

The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. Only one channel is available for testing at 2442 MHz which was investigated from 9 kHz to 24 GHz.

The EUT contains an externally mounted antenna. The antenna both transmits and receives transmissions.

### 2.2 Exercising the EUT

The EUT was programmed to transmit for testing. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standard(s) and/or methods.

### 2.3 Test Result Summary

**Table 2-1: Test Result Summary for FCC Rules and Regulations**

Standard	Test	Pass/Fail or N/A
FCC 15.205	Compliance with the Restricted Band Edge	Pass
FCC 15.207	Conducted Emissions	Pass
FCC 15.209	Radiated Emissions	Pass
FCC 15.247(a)(2)	Occupied Bandwidth	Pass
FCC 15.247(b)(3)	Power Output	Pass
FCC 15.247(c)	Antenna Conducted Spurious Emissions	Pass

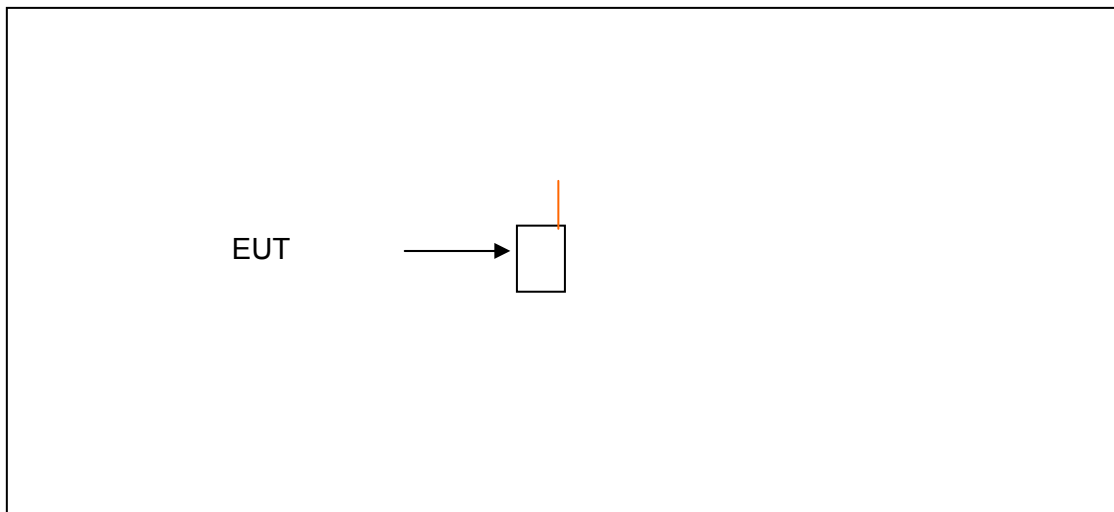
## 2.4 Test System Details

The test sample was received on October 13, 2006. The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system, are identified in Table 2-2.

**Table 2-2: Equipment Under Test (EUT)**

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
Module	Alion Science and Technology Center for Electromagnetic Science	Sensors Communication Module	1002	U3M-SCM2007	N/A	17546

## 2.5 Configuration of Tested System



**Figure 2-1: Worst Case Configuration of System under Test**

### 3 Peak Output Power - FCC §15.247(b)(3)

#### 3.1 Power Output Test Procedure

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 2725-5850 MHz bands:  
 1 Watt.

A conducted power measurement of the EUT was taken using an Agilent 4416A EPM-P Series Power Meter with an E9323A Peak and Average Power Sensor.

#### 3.2 Power Output Test Equipment

**Table 3-1: Power Output Test Equipment**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901356	Agilent Technologies	E9323A	Power Sensor	31764-264	10/3/07
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	10/3/07


#### 3.3 Power Output Test Data

**Table 3-2: Power Output Test Data**

Frequency (MHZ)	Channel	Peak Power Conducted Output (dBm)	Peak Power Conducted Output (mW)
2442	Low	26	400

#### Test Personnel:

Daniel W. Baltzell  
 EMC Test Engineer



Signature

October 16, 2006  
 Date Of Test



#### 4 Compliance with the Restricted Band Edge – FCC §15.205

##### 4.1 Compliance with the Band Edge Test Procedure

Compliance with the band edges was performed using the FCC’s “Radiated Measurement at a Band Edge” guidance document.

##### 4.2 Band Edge Test Equipment

**Table 4-1: Band Edge Test Equipment**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	5/20/07
900913	Hewlett Packard	85462A	Spectrum Analyzer (9 kHz – 6.5 GHz)	3325A00159	2/28/07
901425	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	12/12/07

##### 4.3 Compliance with the Restricted Band Edge Test Data

###### Calculation of Lower Band Edge

The level 89.3 dBuV/m is the field strength measurement, from which the delta measurement of 38.7 dB is subtracted (reference plots), which is equivalent to a level of 50.6 dBuV/m. This level has a margin of -3.4 dB below the limit of 54 dBuV/m.

Calculation:  $89.3 \text{ dBuV/m} - 38.7 \text{ dB} - 54.0 \text{ dBuV/m} = -3.4 \text{ dB}$

###### Calculation of Upper Band Edge

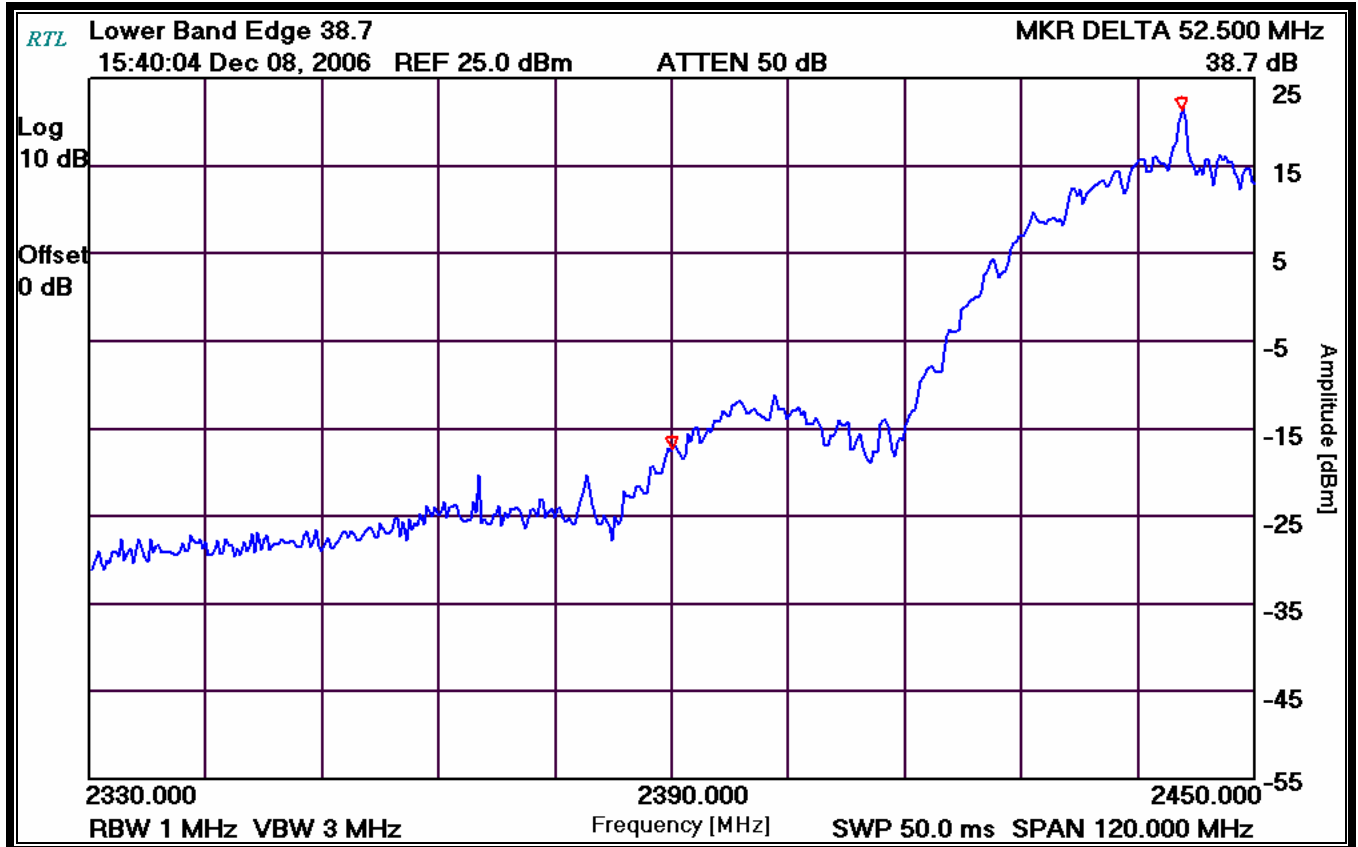
The level 89.3 dBuV/m is the field strength measurement, from which the delta measurement of 36.2 dB is subtracted (reference plots), which is equivalent to a level of 53.1 dBuV/m. This level has a margin of 0.9 dB below the limit of 54.0 dBuV/m.

Calculation:  $89.3 \text{ dBuV/m} - 36.2 \text{ dB} - 54.0 \text{ dBuV/m} = -0.9 \text{ dB}$

**Plot 4-1: Lower Band Edge Delta Measurement**

Peak Field strength (1M RBW/3 MHz VBW) = 120.9 dBuV/m

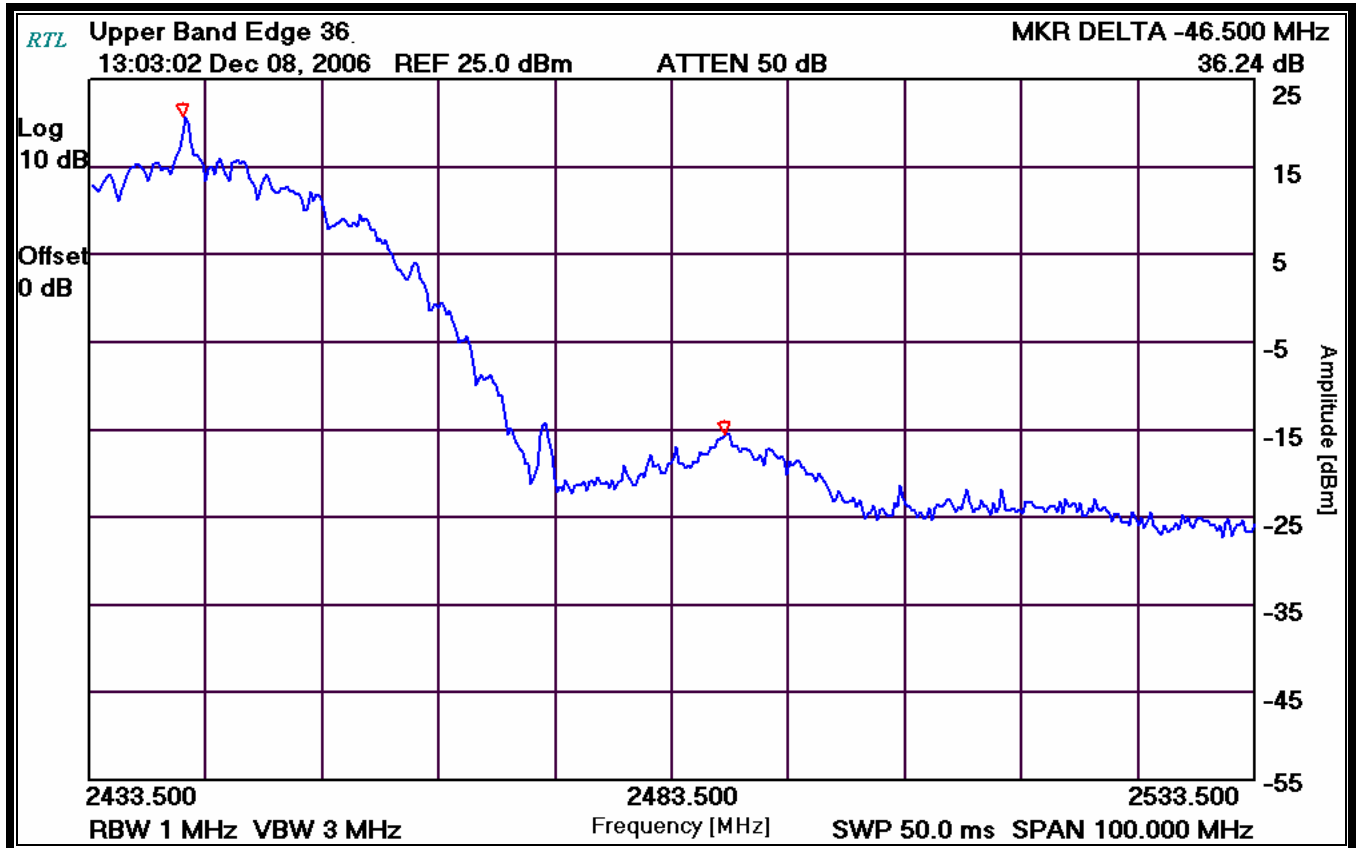
Delta measurement: 38.7 dB



**Plot 4-2: Upper Band Edge Delta Measurement**

Peak Field strength (1 MHz RBW/3 MHz VBW) = 120.9 dBuV/m

Delta measurement = 36.2 dB



**Test Personnel:**

Daniel W. Baltzell  
EMC Test Engineer

Signature

December 8, 2006  
Date Of Test

## **5 Conducted Limits – FCC §15.207**

### **5.1 Test Methodology for Conducted Emissions Measurements**

The device is battery operated; therefore, no AC conducted testing was done.

## 6 Radiated Emission Limits Receiver/Digital Interface – FCC §15.209

### 6.1 Receiver/Digital Interface Radiated Emission Limits Test Procedure

Emissions from the digital portion of the EUT were tested and found to comply with the requirements of FCC Part 15.209.

### 6.2 Receiver/Digital Interface Radiated Emissions Test Equipment

**Table 6-1: Receiver/Digital Interface Radiated Emissions Test Equipment**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B or 8568B (20 Hz - 2 GHz)	3146A01309	4/12/07
900811	Rhein Tech Labs	PR-1040	Amplifier	900811	3/15/07
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	9/13/07
900969	Hewlett Packard	85650A	Quasi-Peak Adapter	2412A00414	9/13/07
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna (20 MHz - 2 GHz)	2648	11/01/06

### 6.3 Receiver/Digital Interface Radiated Emission Limits Test Data

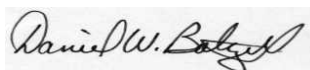
**Table 6-2: Receiver/Digital Interface Radiated Emissions**

Temperature: 64°F Humidity: 30%									
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
37.329	Qp	V	90	1.0	39.7	-15.9	23.8	40.0	-16.2
65.113	Qp	V	0	1.0	44.0	-23.9	20.1	40.0	-19.9
137.700	Qp	V	0	1.0	37.5	-16.3	21.2	43.5	-22.3
179.400	Qp	V	0	1.0	37.7	-18.3	19.4	43.5	-24.1
200.850	Qp	V	0	1.0	37.6	-17.7	19.9	43.5	-23.6
288.942	Qp	V	0	1.0	37.5	-14.0	23.5	46.0	-22.5

Qp: Res. = 120 kHz, Vid = 120 kHz; Pk: Res. = 1 MHz, Vid = 1 MHz; Av: Res. = 1 MHz, Vid = 10 Hz

#### Test Personnel:

Daniel W. Baltzell  
 EMC Test Engineer



Signature

October 16, 2006  
 Date Of Test

## 7 Radiated Emission Limits; Spurious and Harmonics – FCC §15.247

### 7.1 Radiated Spurious Emission Limits Test Procedure

Radiated Spurious Emissions applies to harmonics and spurious emissions that fall in the restricted and non-restricted bands. The restricted bands are listed in Part 15.205. The maximum permitted average field strength for the restricted band is listed in Part 15.209. The EUT was tested in the X-Y, X-Z, and Y-Z orthogonal planes.

### 7.2 Radiated Spurious Test Equipment

**Table 7-1: Radiated Spurious Emissions Test Equipment**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	5/20/07
900323	EMCO	3160-7	Horn Antennas (8.2 - 12.4 GHz)	9605-1054	5/20/07
900356	EMCO	3160-08	Horn Antennas (12.4 – 18 GHz)	9607-1044	5/20/07
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	5/20/07
901053	Schaffner Chase	CBL6112B	Bi-Log Antenna (20 MHz - 2 GHz)	2648	11/01/07
900811	Rhein Tech Labs	PR-1040	Amplifier	900811	3/15/07
900325	EMCO	3160-9	Horn Antennas (18 - 26.5 GHz)	9605-1051	5/20/07
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B or 8568B (20 Hz - 2 GHz)	3146A01309	4/12/07
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	9/13/07
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	9/13/07
901365	MITEQ	JS4-00102600-41-5P	Amplifier (0.1 - 26 GHz), 28 dB gain	1094152	3/24/07
900969	Hewlett Packard	85650A	Quasi-Peak Adapter	2412A00414	9/13/07

### 7.3 Radiated Emissions Harmonics/Spurious Test Data

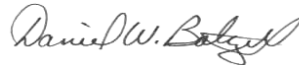
**Table 7-2: Radiated Emissions Harmonics/Spurious (Low Channel; 2442 MHz)**

Emission Frequency (MHz)	Analyzer Reading (Pk) (dBuV)	Analyzer Reading (Av) (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.850	36.6	5.0	-11.1	-6.1	69.8	-75.9
61.044	44.5	12.9	-24.1	-11.2	69.8	-81.0
91.700	39.6	8.0	-20.6	-12.6	69.8	-82.4
122.100	35.3	3.7	-17.7	-14.0	69.8	-83.8
976.690	55.0	23.4	-5.7	17.7	54.0	-36.3
1922.900	62.6	31.0	1.8	32.8	69.8	-37.0
1953.405	67.0	35.4	2.2	37.6	69.8	-32.2
1983.928	63.6	32.0	2.5	34.5	69.8	-35.3
2930.095	70.6	39.0	-4.7	34.3	69.8	-35.5
4883.620	47.9	16.3	0.2	16.5	54.0	-37.5
7325.432	57.3	25.7	3.6	29.3	54.0	-24.7
9768.000	55.7	24.1	8.5	32.6	69.8	-37.2
12204.200	43.2	11.6	10.2	21.8	54.0	-32.2
14650.400	40.8	9.2	15.7	24.9	69.8	-44.9

Peak: Res. = 1 MHz, Vid = 1 MHz; Average: Res. = 1 MHz, Vid = 10 Hz

**Test Personnel:**

Daniel W. Baltzell  
 EMC Test Engineer



Signature

October 16, 2006  
 Date Of Test

**8 Modulated Bandwidth - §15.247(a)(2)**

**8.1 Modulated Bandwidth Test Procedure – Minimum 6 db Bandwidth**

The minimum 6 dB bandwidths per FCC 15.247(a)(2) were measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at  $\geq 1$  MHz. The minimum 6 dB bandwidths are presented in Table 7-2.

**8.2 Bandwidth Test Equipment**

**Table 8-1: Bandwidth Test Equipment**

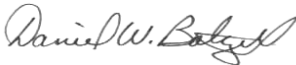
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900913	Hewlett Packard	8546A	Spectrum Analyzer (9 kHz – 6.5 GHz)	3325A00159	2/28/07

**8.3 Bandwidth Test Data**

**Table 8-2: Minimum 6 dB Bandwidth Test Data**

Channel	6 dB Bandwidth (MHz)
2442 MHz	27.5

**Test Personnel:**

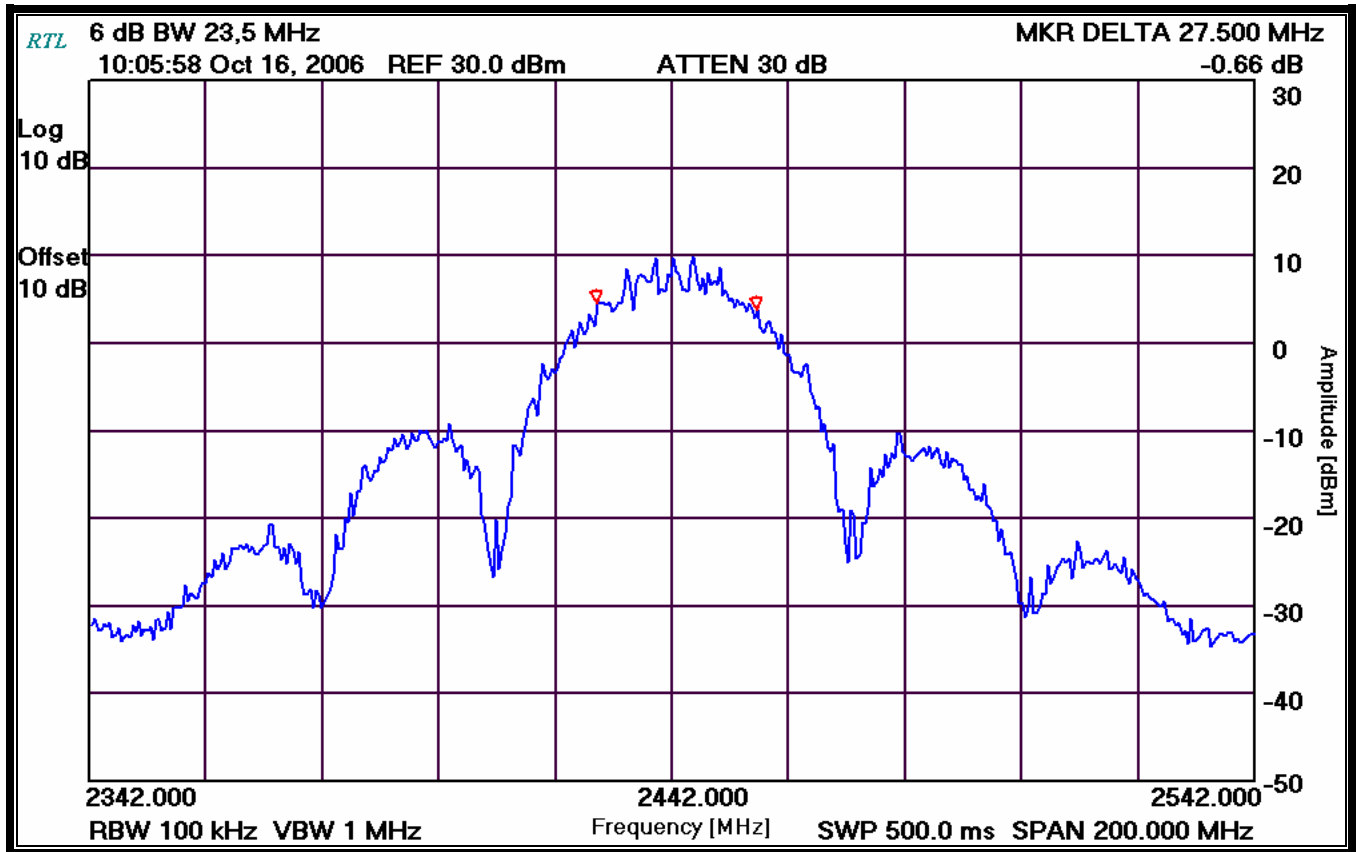
Daniel W. Baltzell EMC Test Engineer	 Signature	October 16, 2006 Date Of Test
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### 8.4 Modulated Bandwidth Plot

Frequency (MHz): 2442  
Resolution Bandwidth (kHz): 100  
Video Bandwidth (MHz): 1  
Sweep Time (ms): 500

Plot 8-1: Modulated Bandwidth Low Channel



#### Test Personnel:

Daniel W. Baltzell  
EMC Test Engineer

Signature

October 16, 2006  
Date Of Test

## 9 Antenna Conducted Spurious Emissions - §15.247(c)

### 9.1 Antenna Conducted Spurious Emissions Test Procedure

Antenna spurious emissions per FCC 15.247(c) were measured from the EUT antenna port using a 50  $\Omega$  spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. A modulated carrier was used at 2442 MHz. No other harmonics or spurs were found within 20 dB of the carrier level from 9 kHz to the carrier 10<sup>th</sup> harmonic.

### 9.2 Antenna Conducted Spurious Test Equipment

**Table 9-1: Antenna Conducted Spurious Test Equipment**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771	9/13/07

### 9.3 Antenna Conducted Spurious Emissions Test Data

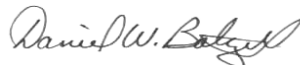
**Operating Frequency (MHz):** 2442  
**Measured Power Level (dBm):** 26.0  
**Limit (dBm):** 6.0

**Table 9-2: Antenna Conducted Spurious Emissions Low Channel**

Frequency (MHz)	Measured Level (dBm)	Measured Level (dBc)	Limit (dBc)	Margin (dB)
22.400	-62.1	48.1	20.0	-28.1
30.531	-42.4	28.4	20.0	-8.4
34.520	-59.8	45.8	20.0	-25.8
38.700	-58.1	44.1	20.0	-24.1
61.050	-51.6	37.6	20.0	-17.6
91.700	-60.5	46.5	20.0	-26.5
122.100	-63.6	49.6	20.0	-29.6
976.690	-66.2	52.2	20.0	-32.2
1922.900	-63.1	49.1	20.0	-29.1
1953.420	-57.0	43.0	20.0	-23.0
1984.020	-63.0	49.0	20.0	-29.0
2930.095	-60.5	46.5	20.0	-26.5
4883.620	-54.2	80.2	20.0	-60.2
7325.432	-60.3	86.3	20.0	-66.3
9736.400	-53.1	79.1	20.0	-59.1
9767.000	-42.3	68.3	20.0	-48.3
9797.500	-52.4	78.4	20.0	-58.4
12204.200	-40.5	66.5	20.0	-46.5
14650.400	-64.2	90.2	20.0	-70.2
17095.600	-62.3	88.3	20.0	-68.3
19534.000	-57.8	83.8	20.0	-63.8
21975.600	-61.7	87.7	20.0	-67.7

**Test Personnel:**

Daniel W. Baltzell  
 EMC Test Engineer



Signature

October 16, 2006  
 Date Of Test

## 10 Power Spectral Density - §15.247(d)

### 10.1 Power Spectral Density Test Procedure

The power spectral density per FCC 15.247(d) was measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 3 kHz, the video bandwidth set at  $\geq 30$  kHz, and the sweep time set at span/3k seconds. The test was performed as a conducted test. The spectral lines were resolved for the modulated carriers at 2.442 GHz. These levels are below the +8 dBm limit. See the power spectral density table and plots that follow.

### 10.2 Power Spectral Density Test Equipment

**Table 10-1: Power Spectral Density Test Equipment**

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900913	Hewlett Packard	8546A	Spectrum Analyzer (9 kHz – 6.5 GHz)	3325A00159	2/28/07

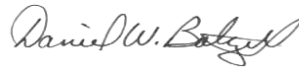
### 10.3 Power Spectral Density Test Data

**Table 10-2: Power Spectral Density Test Data**

Channel	Power Spectral Density (dBm) (Limit = +8dBm)
2442	2.4

#### Test Personnel:

Daniel W. Baltzell  
 EMC Test Engineer



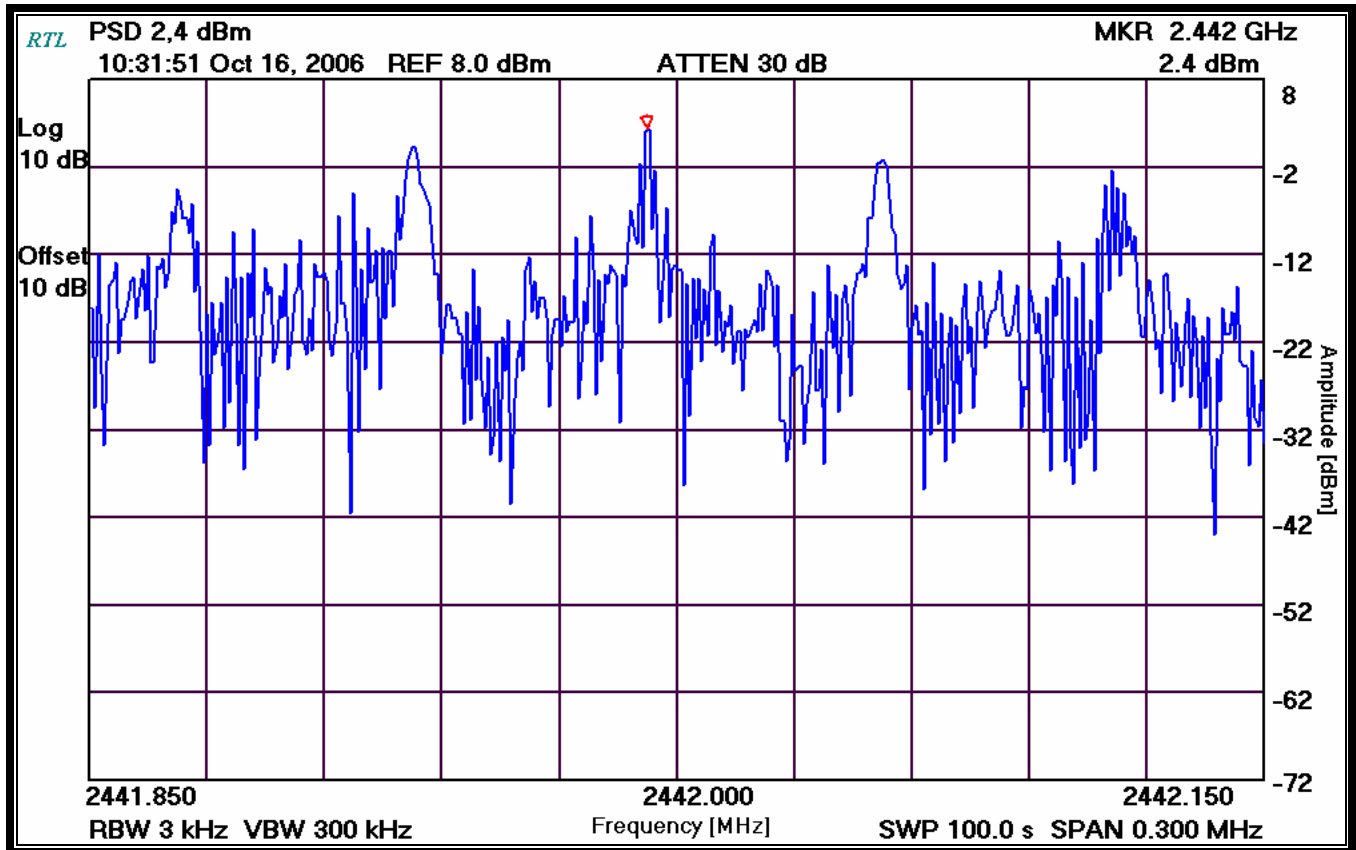
Signature

October 16, 2006  
 Date Of Test

### 10.4 Power Spectral Density Plot

Operating Frequency (MHz): 2442  
Bandwidth Resolution (kHz): 3  
Bandwidth Video (kHz): 300  
Sweep Time (s): 100

Plot 10-1: Power Spectral Density Low Channel



### Test Personnel:

Daniel W. Baltzell  
EMC Test Engineer

Signature

October 16, 2006  
Date Of Test

## **11 Conclusion**

The data in this measurement report shows that the Alion Science and Technology Center for Electromagnetic Science, Model: Sensors Communication Module, FCC ID: U3M-SCM2007, complies with all the applicable requirements of Parts 2 and 15 of the FCC Rules.