Excellence in Compliance Testing

Transmitter Certification

Test Report

FCC ID: SDBFPGMR

FCC Rule Part: CFR 47 Part 15.209

ACS Report Number: 07-0270 – 15C

Applicant: Sensus Metering Systems
Model(s): FPGMR

Test Begin Date: June 18, 2007
Test End Date: June 26, 2007

Report Issue Date: July 17, 2007

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.

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This report contains 12 pages

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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.

1.2 Product Description

1.2.1 General
The FLEXNET Field Programmer (FPGMR) is a handheld device used for utility meter installations. The FPGMR provides initial set up instructions, as well as post installation re-programming, to electric, gas and water meters that reside in the SMS fixed wireless telemetry network.

The FPGMR incorporates an 896 kHz low frequency inductive transmitter for near field communication to the field devices. The FPGMR also includes a certified licensed transceiver module (FCC ID: SDBTXCVRBB01) as well a GPS receiver.

Manufacturer:
Sensus Metering Systems
8601 six forks Road
Raleigh, NC 27615

Factory Contact:
Bob Davis
Sensus Metering Systems
114 Northpark Blvd
Suite 10
Covington, LA 70433
985-773-1236

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

1.2.2 Intended Use
The FLEXNET Field Programmer (FPGMR) is a handheld device used for utility meter installations.

1.3 Test Methodology and Considerations
For testing purposes, the FPGMR was connected to a Sensus model AR5000. This is a typical system configuration and represents a worst case data.

Although the FPGMR utilizes both the 896 kHz transmitter and pre-approved TXCVRBB01 transceiver (FCC ID: SDBTXCVRBB01), there are no provisions for operating these radios simultaneously and therefore testing for inter-modulation products was not required.

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 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: 89450
Industry Canada Lab Code: IC 4175
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 below:

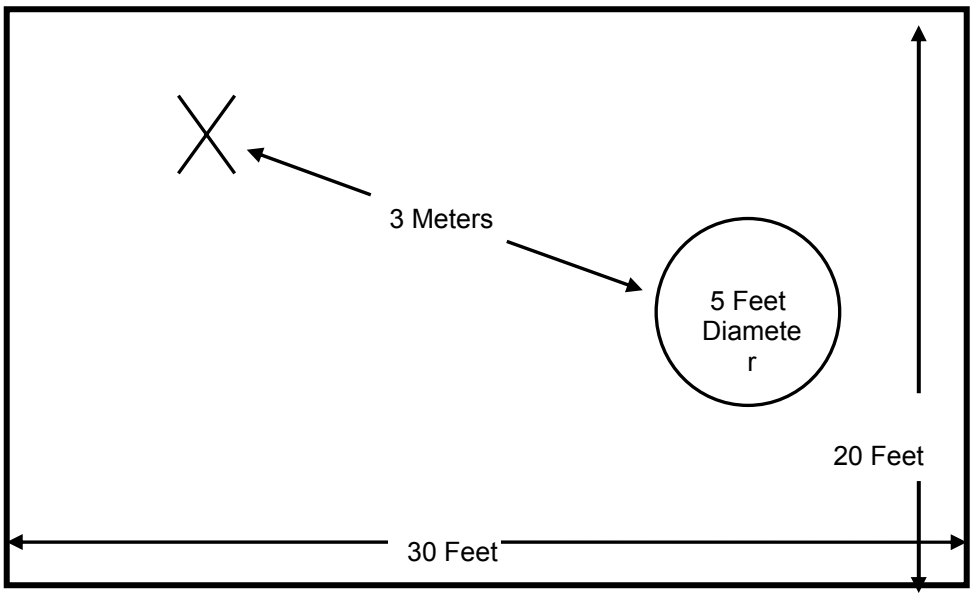

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

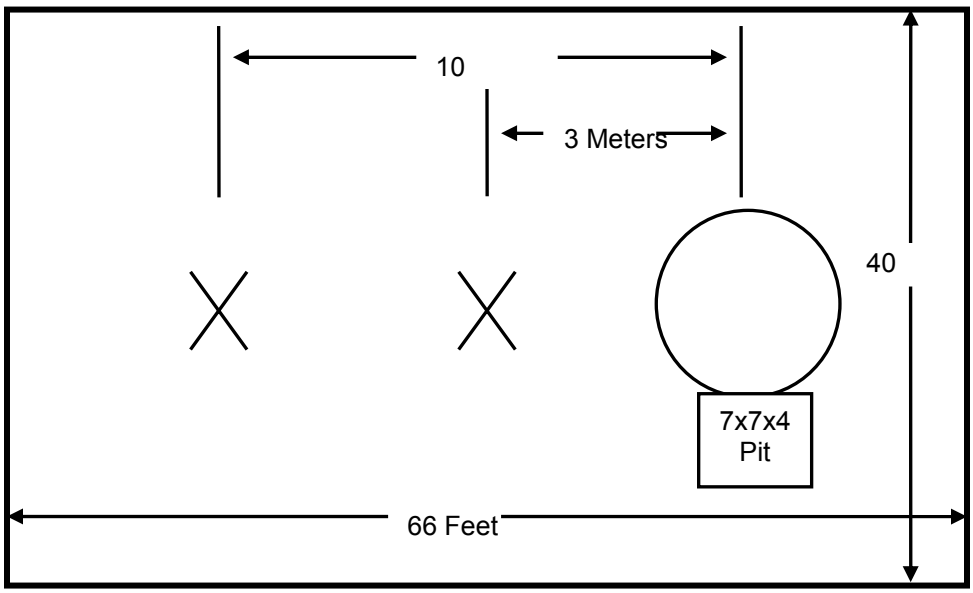

Figure 2.3-2: Open Area Test Site

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:

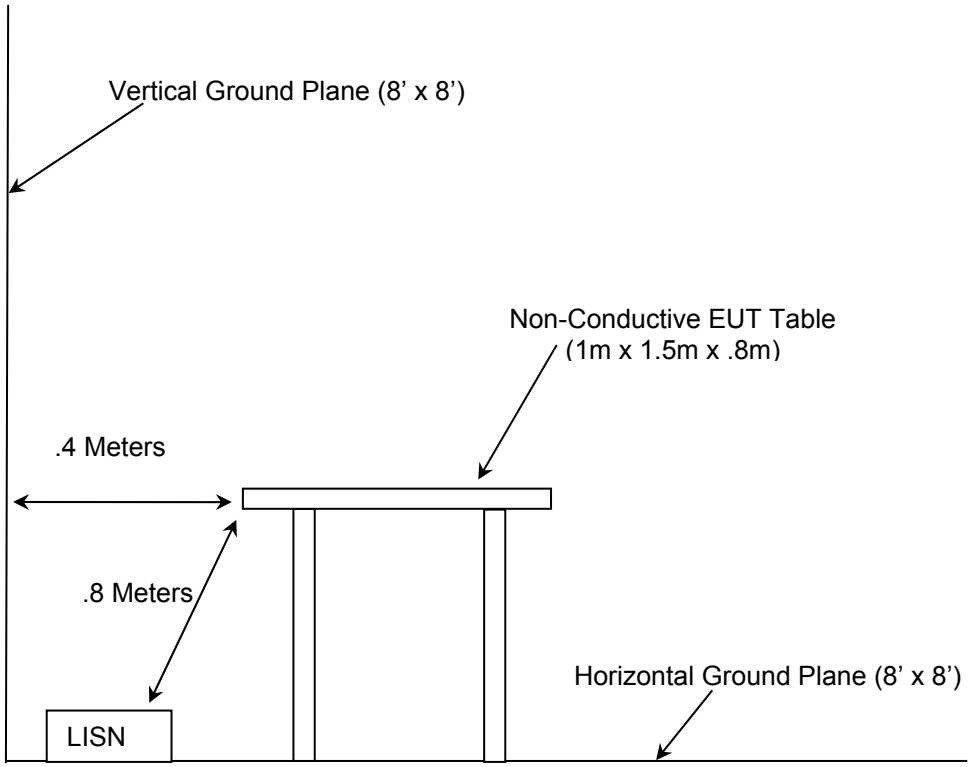

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 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, 2006
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2006

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Equipment Calibration Information					
Asset ID	Manufacturer	Model Number	Serial Number	Equipment Type	Cal Due
1	Rohde & Schwarz	ESMI - Display	833771/007	Spectrum Analyzers	3/5/2008
2	Rohde & Schwarz	ESMI-Receiver	839587/003	Spectrum Analyzers	3/5/2008
16	ACS	Cable	16	Cables	5/21/2008
25	Chase	CBL6111	1043	Antennas	6/6/2008
73	Agilent	8447D	2727A05624	Amplifiers	5/9/2008
78	EMCO	6502	9104-2608	Antennas	1/15/2008
152	EMCO	3825/2	9111-1905	LISN	2/20/2008
153	EMCO	3825/2	9411-2268	LISN	11/16/2007
167	ACS	Chamber EMI Cable Set	167	Cables	1/5/2008
168	Hewlett Packard	11947A	44829	Attenuators	3/13/2008
193	ACS	OATS cable Set	193	Cable Set	2/16/2008
211	Eagle	C7RFM3NFNM	HLC-700	Filters	1/8/2008
213	TEC	PA 102	44927	Amplifiers	2/27/2008
283	Rohde & Schwarz	FSP40	1000033	Spectrum Analyzers	11/9/2008

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
Sensus	Handheld Field Programmer	AR5000	32412	NA

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

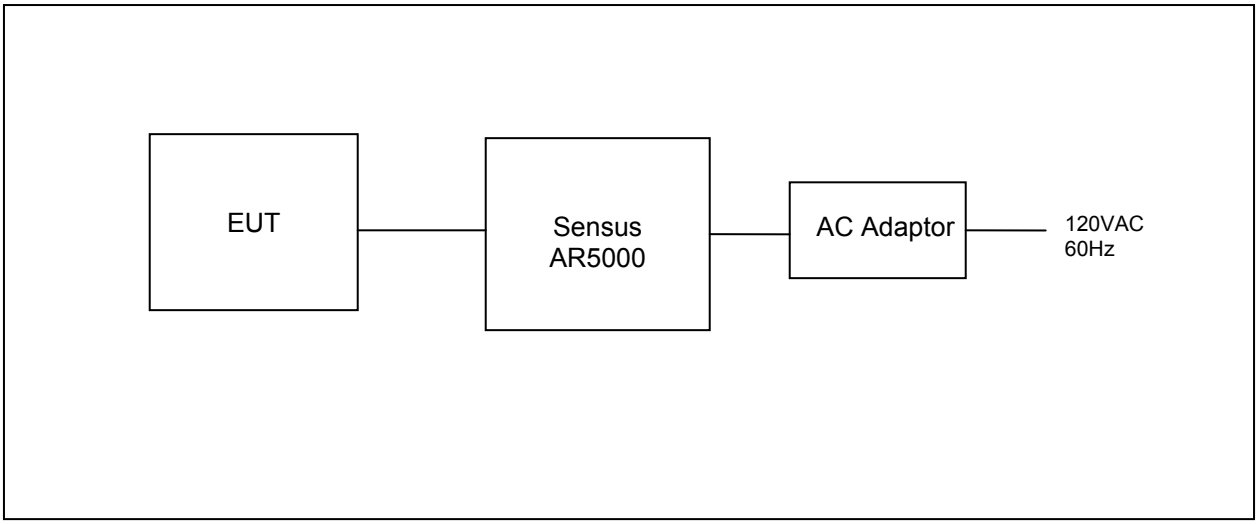

Figure 6-1: EUT Test Setup

*See Test Setup photographs for additional detail.

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

This product design incorporates an integrated inductive coupler.

7.2 Power Line Conducted Emissions - FCC Section 15.207

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 7.2-1.

Table 7.2-1: Conducted EMI Results

Frequency (MHz)	Uncorrected Reading (dBuV)		Total Correction Factor (dB)	Corrected Level (dBuV)		Limit (dBuV)		Margin (dB)		Line
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
Line 1										
0.18	36.8	24.7	9.80	46.60	34.50	64.49	54.49	17.9	20.0	GND
0.24	27.2	13.7	9.80	37.00	23.50	62.10	52.10	25.1	28.6	GND
0.3	21.5	14.4	9.80	31.30	24.20	60.24	50.24	28.9	26.0	GND
0.36	19	9.6	9.80	28.80	19.40	58.73	48.73	29.9	29.3	GND
0.49	9.9	1.4	9.80	19.70	11.20	56.17	46.17	36.5	35.0	GND
13.11	17.1	11.1	10.00	27.10	21.10	60.00	50.00	32.9	28.9	GND
Line 2										
0.18	21.9	11	9.80	31.70	20.80	64.49	54.49	32.8	33.7	GND
0.24	17.2	7.9	9.80	27.00	17.70	62.10	52.10	35.1	34.4	GND
0.3	20.7	12.4	9.80	30.50	22.20	60.24	50.24	29.7	28.0	GND
0.4	19.2	14.1	9.80	29.00	23.90	57.85	47.85	28.9	24.0	GND
0.5	21.9	14.6	9.80	31.70	24.40	56.00	46.00	24.3	21.6	GND
13.52	11.3	6	10.01	21.31	16.01	60.00	50.00	38.7	34.0	GND

7.3 Radiated Emissions - FCC Section 15.109(Unintentional Radiation)

7.3.1 Test Methodology

Section 15.33(a)(4) specifies, if the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to frequency specified in 15.33(b)(1) for unintentional radiators. The upper frequency range for the digital device is 1000MHz which greater than the 10th harmonic of the fundamental frequency. The upper frequency range measured was 1000MHz.

The EUT was placed in a continuous transmission mode for the 896kHz transmitter with the digital device and receivers fully exercised. The worst case data is provided in section 7.5 for spurious emissions from the intentional radiator.

7.3.2 Test Results

Included in section 7.5.

7.4 99% Occupied Bandwidth

7.4.1 Test Methodology

The RBW was to ≥ 1% of the estimated bandwidth. The trace was set to max hold with a peak detector active. The 99% Occupied Bandwidth measurement function of the analyzer was utilized to determine the 99% bandwidth of the emission.

7.4.2 Test Results

The maximum 99% bandwidth was found to be approximately 15.2kHz. Results are shown below in Table 7.4.2-1 and Figure 7.4.2-1.

Table 7.4.2-1

Frequency (kHz)	99% Bandwidth (kHz)
896	15.2

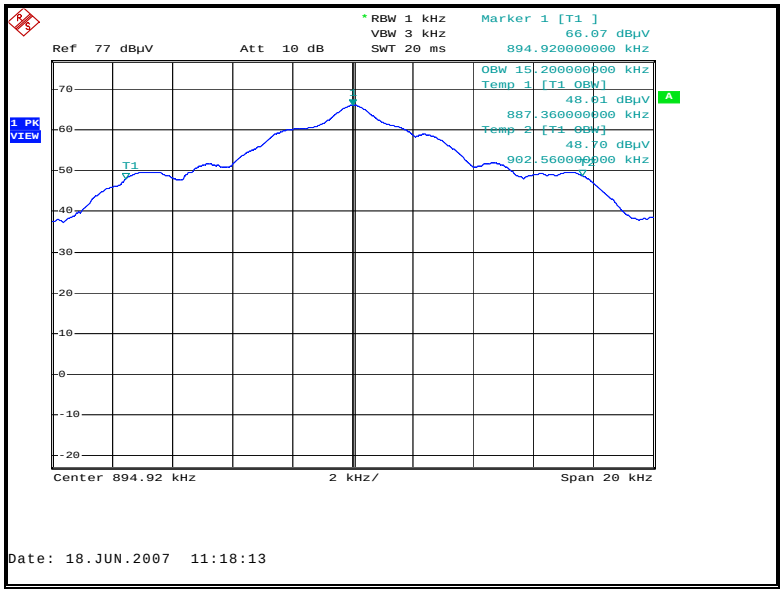

Figure 7.4.2-1: 99% Bandwidth

7.5 Spurious Emissions - FCC Section 15.209

7.5.1 Test Methodology

Measurements below 30MHz were performed on the Open Area Test Site with a 10 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated about the vertical axis to maximize each emission. The magnetic loop receiving antenna was positioned with its center 1 meter above the ground. The spectrum analyzer's resolution and video bandwidth was set to 100Hz and 300Hz respectively for frequencies below 150kHz and 9 kHz and 30 kHz respectively for frequencies above 150kHz and below 30MHz. For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an average detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a Quasi-peak detector.

Measurements above 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. 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, average measurements were made using an RBW of 1 MHz and a VBW of 10 Hz and peak measurements were made with RBW of 1 MHz and a VBW of 1 MHz.

The upper frequency range measured was 1000MHz. See Section 7.3.

7.5.2 Distance Correction for Measurements Below 30 MHz – Part 15.31

Radiated measurements were performed at a distance closer than the 30 meters as required according to Part 15.209. Therefore a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor for limits expressed at a 30m measurement distance is as follows:

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (10/30)
= - 19.08 dB

7.5.3 Test Results

Radiated spurious emissions found are reported in Table 7.5.3-1.

Table 7.5.3-1: Radiated Spurious Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Frequency										
0.896	---------	27.10	---------	10.40	---------	37.50	--------	47.6	--------	10.14
Spurious Emissions										
1.792	---------	17.20	---------	10.32	---------	27.52	--------	48.6	---------	21.06
43.77	---------	46.08	V	-15.01	---------	31.07	--------	40.0	---------	8.93
45.09	---------	46.03	V	-15.64	---------	30.39	--------	40.0	---------	9.61
84.97	---------	45.80	V	-17.01	---------	28.79	--------	40.0	---------	11.21
128.08	---------	32.85	V	-12.88	---------	19.97	--------	43.5	---------	23.53
199.21	---------	39.43	H	-14.58	---------	24.85	--------	43.5	---------	18.65
238.01	---------	47.40	H	-13.00	---------	34.40	--------	46.0	---------	11.60
262.8	---------	49.56	H	-11.14	---------	38.42	--------	46.0	---------	7.58

***** The magnitude of all emissions not reported were below the noise floor of the measurement system.

7.5.4 Sample Calculation:

Example Calculation < 30MHz

Measurement Distance 30m @ 896kHz

Limit (dBuV/m) = 20*Log(24000/F(kHz)) - Distance Correction Factor (Section 7.5.2)
Limit (dBuV/m) = 20*Log(24000/896) + 19.08
Limit (dBuV/m) = 47.6

Example Calculation - 896kHz Fundamental

$R_C = R_U + CF_T$

Where:
CF_T = Total Correction Factor (AF+CA+AG)
R_U = Uncorrected Reading
R_C = Corrected Level
AF = Antenna Factor
CA = Cable Attenuation
AG = Amplifier Gain

Corrected Level: 27.10 + 10.40 = 37.50dBuV
Margin: 47.6dBuV – 37.5dBuV = 10.1dB

8.0 CONCLUSION
In the opinion of ACS, Inc. models FPGMR, manufactured by Sensus Metering Systems meet the requirements of FCC Part 15 subpart C.

END REPORT