Excellence in Compliance Testing

Certification Test Report

FCC ID: SDB100A
IC: 2220A-100A

FCC Rule Part: 15.209
IC Radio Standards Specification: RSS-210

ACS Report Number: 09-0031 - 15C

Manufacturer: **Sensus Metering Systems, Inc.**
Model: **100A**

Test Begin Date: **January 30, 2009**
Test End Date: **February 4, 2009**

Report Issue Date: **February 17, 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.

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This report contains 13 pages

Table of Contents

Additional Exhibits Included In Filing

Internal Photos
External Photos
Test Setup Photos
Label Information
Schematics
Manual
Theory of Operation
System Block Diagram

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.

1.2 Product Description

1.2.1 General

The Sensus OMNI Communicator model 100A undertakes the task of bidirectional communications between a computer (Handheld, PC etc.) and an electronic water register based on Sensus communication protocol.

Manufacturer Information:
Sensus Metering Systems, Inc.
450 North Gallatin Ave
PO Box 487
Uniontown, PA 15401
USA

Test Sample Serial Number(s):ACS#1, ACS#2, ACS#3 and ACS#4

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.

1.3 Test Methodology and Considerations

The 100A can be provided with USB or RS-232 Serial cable interfaces for operation with handheld terminals or computers. Typical installations consist of USB configurations used with laptop or desktop computers and RS-232 Serial configurations with handheld terminals in the field. Both configurations were tested and data presented in this report.

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 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:

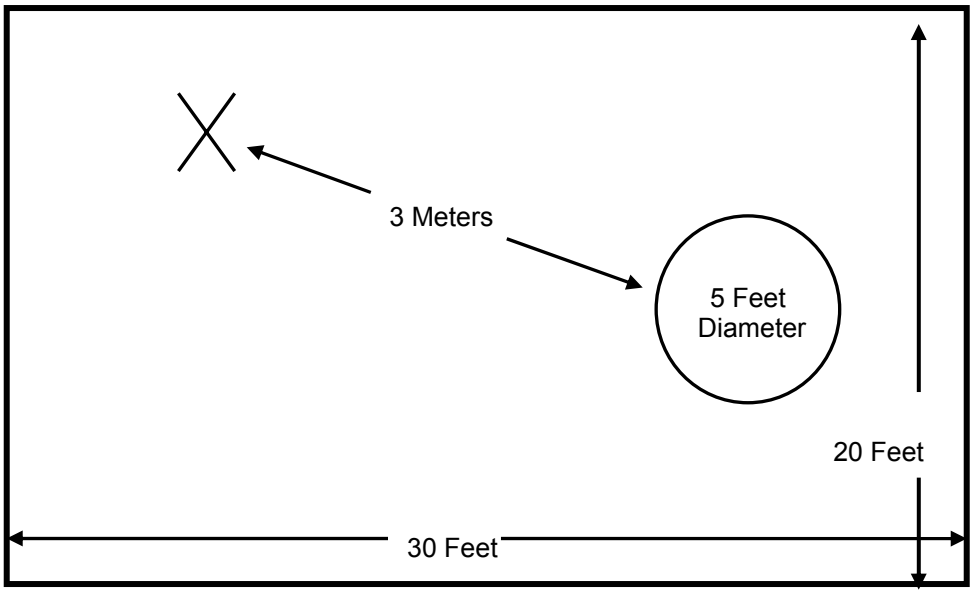

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

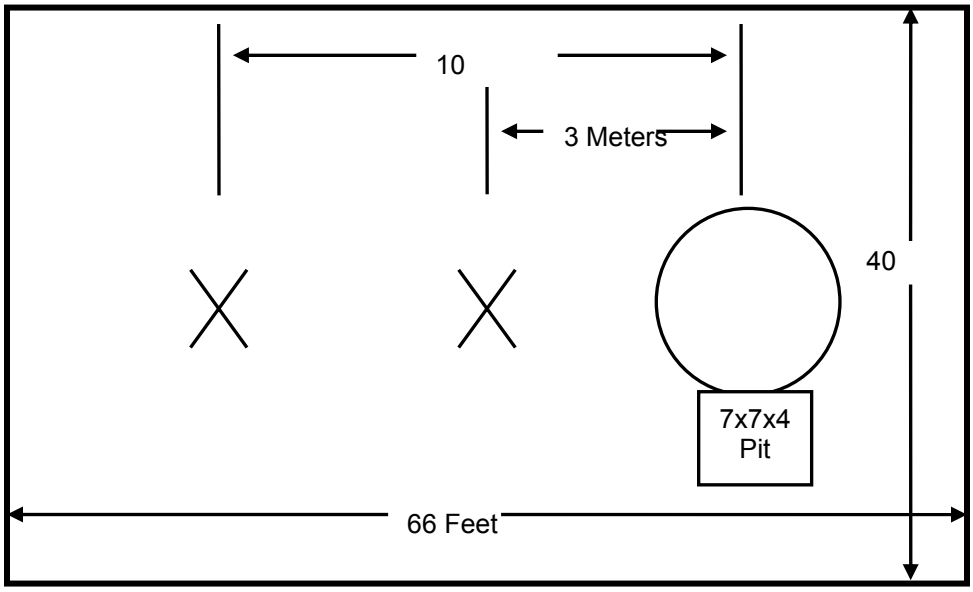

Figure 2.3-2: Open Area Test Site

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:

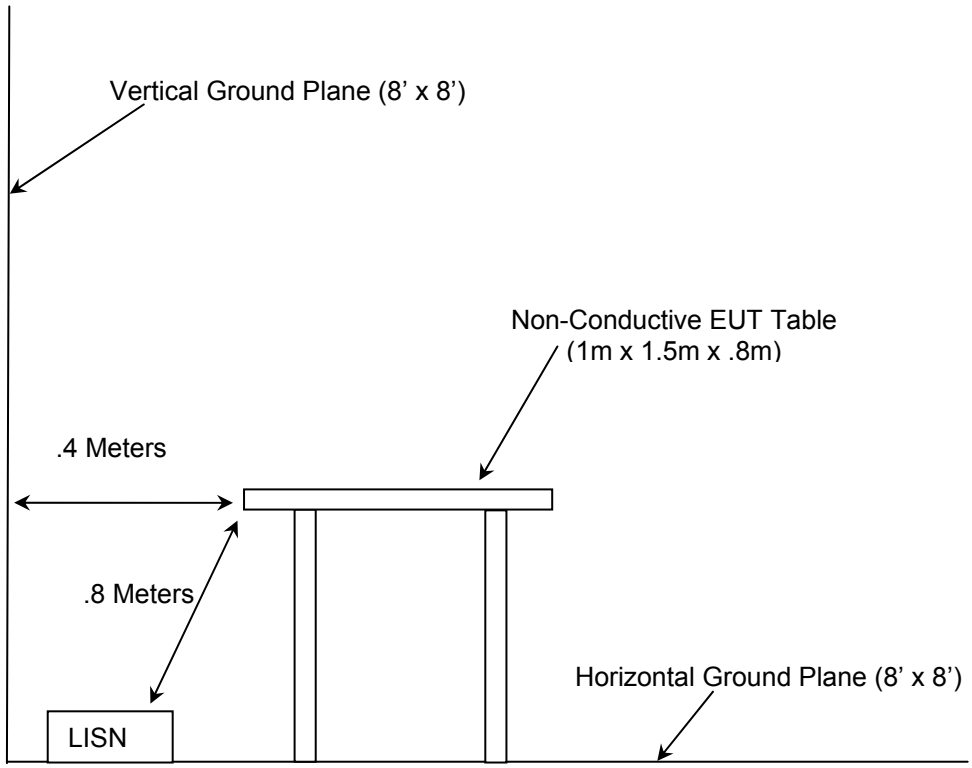

Figure 2.4-1: AC Mains Conducted EMI Site

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, 2008
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2008
- RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 7, June 2007
- RSS-Gen - General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 2, June 2007

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					
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
25	Chase	Antennas	CBL6111	1043	08-22-2009
78	EMCO	Antennas	6502	9104-2608	01-20-2010
152	EMCO	LISN	Feb-25	9111-1905	03-26-2009
167	ACS	Cable Set	Chamber EMI Cable Set	167	02-06-2009
168	Hewlett Packard	Attenuators	11947A	44829	02-18-2009
193	ACS	Cable Set	OATS cable Set	193	01-05-2010
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	09-19-2009
321	Hewlett Packard	Amplifiers	HPC 8447D	1937A02809	10-08-2009
324	ACS	Cables	Belden	8214	07-28-2009
RE03	Polarad	Measurement Receiver	ESH-3	872318/049	06-11-2009

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Manufacturer	Equipment Type	Model Number	Serial Number
1	Sensus	EUT - USB	100A	ACS#1 and ACS#3
2	Sensus	EUT – RS-232	100A	ACS#2 and ACS#4
3	Dell	Computer	Latitude D610	CN-0D4571-48643-61Q-8314
4	Dell	AC/DC Adapter	DA65NS0-00	CN-0CF745-48661-63C-4Z2Y
5	Sensus	Handheld Programer	5001	45254
6	OK Industries	Power Supply	PS732	36095
7	Sensus	RS-232 Interface Power adapter	N/A	N/A

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

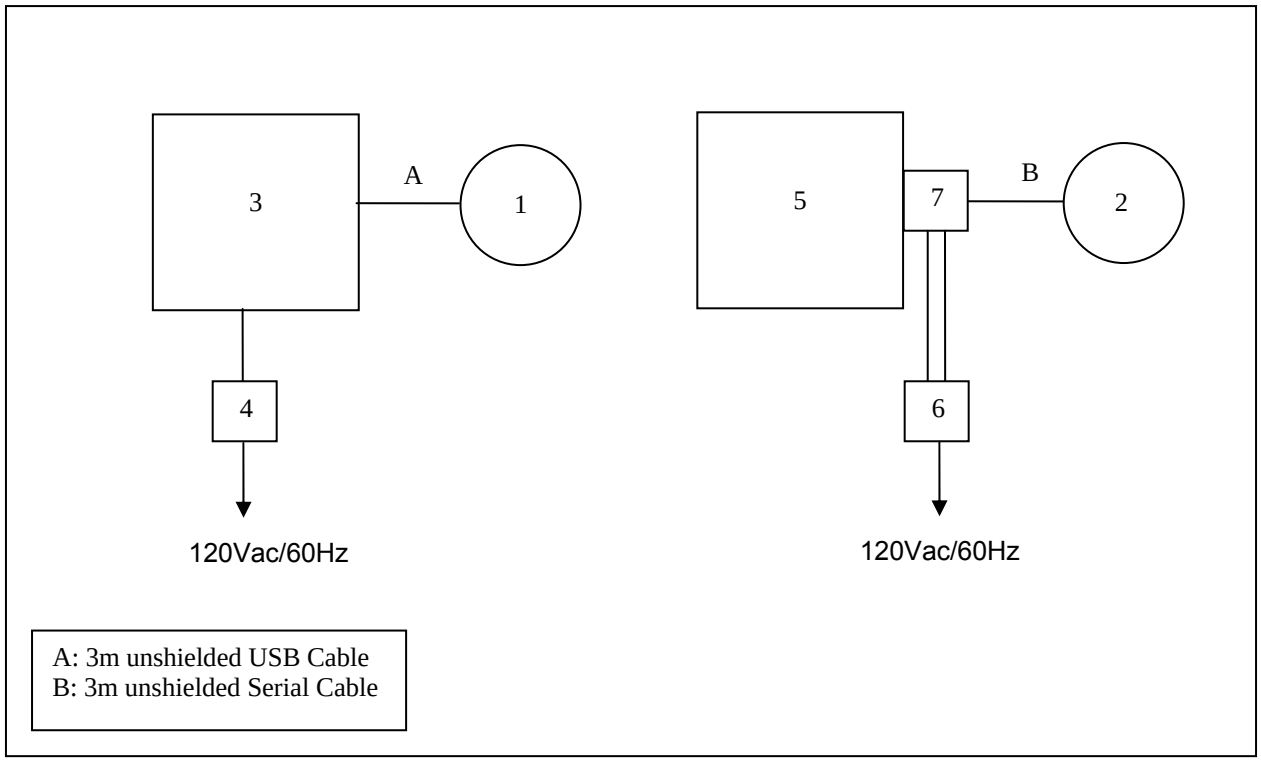

Figure 6-1: EUT Test Setup

See Test Setup photographs for additional detail.
Note: Power is normally supplied to the EUT from the host device however the Handheld host device used with the RS-232 Serial configuration could not provide power due to software limitations for the test configuration. An external power supply was used to provide +5 VDC to the RS-232 Serial EUT thru an adapter provided by Sensus.

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

The 100A uses a permanent, non-removable, magnetic coupling coil antenna. This antenna satisfies the requirement of 15.203.

7.2 Power Line Conducted Emissions – FCC CFR 47 Part 15.207 / 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

Power line conducted emissions testing was performed on the USB configuration only with data presented below in section 7.2.2. The RS-232 Serial configuration is not operational when the host device is connected to the mains supply for charging.

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 – USB Cable Interface – Transmit Mode

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										
0.16	28.4	14.5	9.81	38.21	24.31	65.46	55.46	27.3	31.2	FLO
0.2	36.7	23.4	9.80	46.50	33.20	63.61	53.61	17.1	20.4	FLO
0.26	26.8	15.6	9.81	36.61	25.41	61.43	51.43	24.8	26.0	FLO
0.32	23.3	11.8	9.80	33.10	21.60	59.71	49.71	26.6	28.1	FLO
0.39	18.5	10.5	9.82	28.32	20.32	58.06	48.06	29.7	27.7	FLO
1.25	16.2	14.4	9.90	26.10	24.30	56.00	46.00	29.9	21.7	FLO
Line 2										
0.16	29.9	13.8	9.81	39.71	23.61	65.46	55.46	25.8	31.9	FLO
0.2	36.6	22.7	9.80	46.40	32.50	63.61	53.61	17.2	21.1	FLO
0.26	26.7	16.8	9.81	36.51	26.61	61.43	51.43	24.9	24.8	FLO
0.33	22.3	13.6	9.81	32.11	23.41	59.45	49.45	27.3	26.0	FLO
0.39	17.3	14.2	9.82	27.12	24.02	58.06	48.06	30.9	24.0	FLO
1.25	16.6	15.7	9.90	26.50	25.60	56.00	46.00	29.5	20.4	FLO

7.3 Radiated Emissions – Intentional Radiation – FCC CFR 47 Part 15.209 / RSS-210 Section 2.6

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 10^{th} harmonic of the fundamental frequency. The upper frequency range measured was 1000MHz.

Measurements below 30MHz were performed in a semi-anechoic chamber with a 3 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 100 Hz and 300 Hz respectively for frequencies below 150 kHz and 9 kHz and 30 kHz respectively for frequencies above 150 kHz and below 30 MHz. 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. The final measurements were then corrected by a distance correction factor, antenna correction factors, and cable loss for comparison to the limits.

Measurements above 30 MHz 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 1000 MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz.

Radiated emission testing was performed on all available configurations (USB and Serial interfaces) with data presented below in section 7.3.3.

7.3.2 Distance Correction for Measurements Below 30 MHz – Part 15.31

Radiated measurements were performed at a distance closer than 300 meters and 30m 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 is shown below for limits expressed at a 300m measurement distance and a 30m measurement distance.

Distance correction factor (300m Specified Test Distance) = 40*Log (Test Distance/300)
= 40*Log (3/300)
= - 80 dB

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (3/30)
= - 40 dB

7.3.3 Test Results

Radiated spurious emissions found are reported in Tables 7.3-1 and 7.3-2.

Table 7.3-1: Radiated Spurious Emissions – USB Cable Interface

Frequency (MHz)	Level (dBuV)	Turntable Position (o)	Correction Factors (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
0.025	46.96	182	14.30	61.26	119.6	58.34
37.54	37.92	0	-12.57	25.35	40.0	14.65
72.03	45.82	180	-20.06	25.76	40.0	14.24
132.38	31.06	0	-12.74	18.32	43.5	25.18
143.67	40.51	270	-13.10	27.41	43.5	16.09
167.95	43.53	0	-14.82	28.71	43.5	14.79
400.75	44.37	0	-7.48	36.89	46.0	9.11
798.45	34.08	302	0.24	34.32	46.0	11.68

Note: Spurious emissions not reported in the table above are below the noise floor of the measurement system.

Table 7.3-2: Radiated Spurious Emissions – Serial Cable Interface

Frequency (MHz)	Level (dBuV)	Turntable Position (o)	Correction Factors (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
0.025	46.62	165	14.30	60.92	119.6	58.73
62.33	49.09	108	-20.23	28.86	40.0	11.14
87.12	46.60	135	-16.82	29.78	40.0	10.22
100.05	45.82	0	-13.90	31.93	43.5	11.58
299.44	50.72	243	-11.02	39.70	46.0	6.30
381.35	43.69	135	-8.52	35.17	46.0	10.83
497.75	44.09	260	-5.79	38.30	46.0	7.70

Note: Spurious emissions not reported in the table above are below the noise floor of the measurement system.

7.3.4 Sample Calculation:

Example Calculation – Average/Quasi-Peak Limit < 30MHz

Measurement Distance 300m @ 25kHz

Limit (dBuV/m) = 20*Log(2400/F(kHz)) - Distance Correction Factor (Section 7.3.2)
Limit (dBuV/m) = 20*Log(2400/25) + 80
Limit (dBuV/m) = 119.6

Example Calculation - 25kHz Fundamental (See Table 7.3-1)

$R_C = R_U + CF_T$

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

AVERAGE:
Corrected Level: 46.96 + 14.30 = 61.26dBuV
Margin: 119.6dBuV – 61.26dBuV = 58.34dB

7.4 20dB and 99% Occupied Bandwidth – FCC CFR 47 Part 15.215(c) / RSS-210 Section 4.6.1

7.4.1 Test Methodology

The spectrum analyzer span was set to 2 to 3 times the estimated 20 dB bandwidth of the emission. The RBW was to ≥ 1% of the estimated 20 dB bandwidth. The trace was set to max hold with a peak detector active. The measurement function of the analyzer was utilized to determine the 20 dB and 99% occupied bandwidths.

7.4.2 Test Results

Results are shown below in Table 7.4-1 and Figures 7.4-1 through 7.4-2.

Table 7.4-1 – Occupied Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
0.025	3.54	3.71

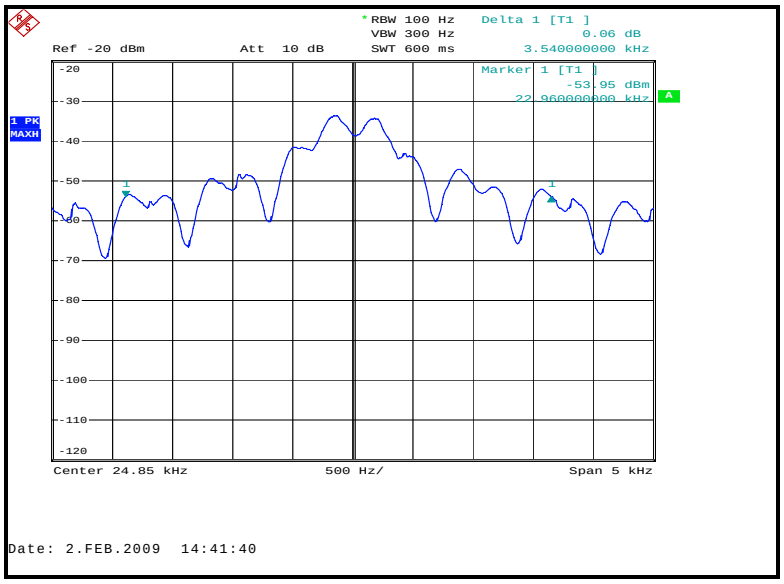

Figure 7.4-1: 20dB Bandwidth

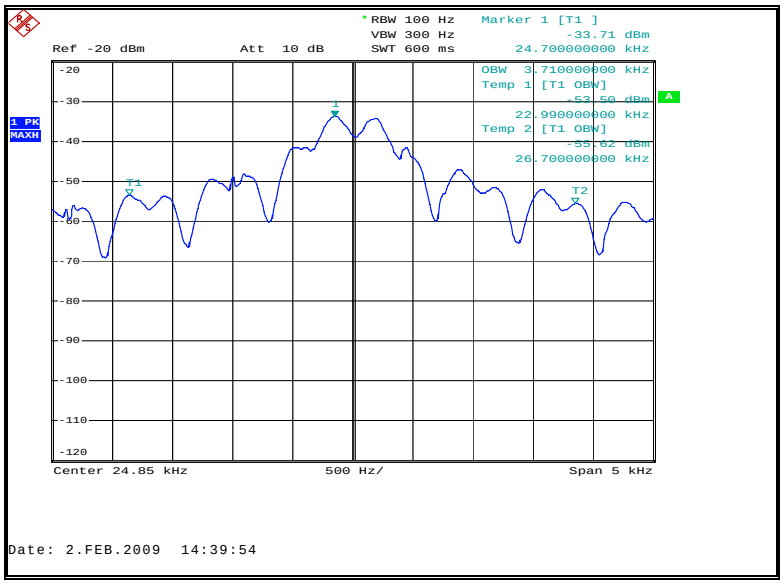

Figure 7.4-2: 99% Bandwidth

8.0 CONCLUSION

In the opinion of ACS, Inc. the Sensus Metering Systems, Inc. 100A meets the requirements of FCC Part 15 Subpart C and Industry Canada's Radio Standards Specification RSS-210.

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END REPORT