



Excellence in Compliance Testing

Certification Test Report

**FCC ID: SDBGFL2CI
IC: 2220A-GFL2CI**

**FCC Rule Part: CFR 47 Part 24 Subpart D, Part 90 Subpart I, Part 101
Subpart C
IC Radio Standards Specification: RSS 119, RSS 134**

ACS Report Number: 11-2014.W06.11.A

This report contains data that are not covered by the NVLAP accreditation

Applicant: Sensus Metering Systems, Inc.
Model: GFL2CI

Test Begin Date: March 21, 2011
Test End Date: March 22, 2011

Report Issue Date: August 3, 2011



FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200897-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

Project Manager:

**Thierry Jean-Charles
EMC Engineer
Advanced Compliance Solutions, Inc.**

Reviewed by:

**Kirby Munroe
Director, Wireless Certifications
Advanced Compliance Solutions, Inc.**

This test report shall not be reproduced except in full. This report may be reproduced in part with prior written consent of ACS, Inc. The results contained in this report are representative of the sample(s) submitted for evaluation.

This report contains 17 pages

Table of Content

1.0 GENERAL-----	3
1.1 PURPOSE -----	3
1.2 PRODUCT DESCRIPTION-----	3
1.3 TEST METHODOLOGY-----	3
1.3.1 TEST CONFIGURATIONS AND JUSTIFICATION-----	3
1.3.2 IN-BAND TESTING METHODOLOGY -----	3
1.4 EMISSIONS DESIGNATORS-----	4
2.0 TEST FACILITIES-----	5
2.0 TEST FACILITIES-----	5
2.1 LOCATION -----	5
2.2 LABORATORY ACCREDITATIONS/RECOGNITIONS/CERTIFICATIONS -----	5
2.3 RADIATED & CONDUCTED EMISSIONS TEST SITE DESCRIPTION-----	6
3.0 APPLICABLE STANDARD REFERENCES -----	8
4.0 LIST OF TEST EQUIPMENT -----	9
6.0 EQUIPMENT UNDER TEST SETUP AND BLOCK DIAGRAM -----	10
7.0 SUMMARY OF TESTS -----	11
7.1 FIELD STRENGTH OF SPURIOUS EMISSIONS – FCC PART 2.1053, PART 90.210, PART 24.133, PART 101.111; RSS-119, RSS-134 -----	11
8.0 CONCLUSION -----	16

1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 2 Subpart J, Part 24 Subpart D, Part 90 Subpart I and Part 101 Subpart C of the FCC's Code of Federal Regulations; and RSS 119 and RSS 134 of Industry Canada's Radio Standard Specifications.

1.2 Product Description

The GFL2CI meter module is a battery-powered module that provides wireless communication capability to a variety of gas meters.

Manufacturer Information:
Sensus Metering Systems, Inc.
400 Perimeter Park Drive, Suite K
Morrisville, NC 27560

Test Sample Serial Numbers: NACI23003188

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

1.3 Test Methodology

1.3.1 Test Configurations and Justification

The EUT was evaluated for radiated spurious emissions up to the 10th harmonics of the fundamental TX frequency. The EUT was positioned in the orientation of typical installation.

The GFL2CI operates using various modulation formats/modes all of which were evaluated and worst case data presented where applicable.

1.3.2 In-Band Testing Methodology

For testing in accordance with 47 CFR 2.1046-2.1057, OET/Lab recommends that the following be used to select test frequencies for licensed devices:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
10 to 100 MHz	3	1 near top, 1 near middle and 1 near bottom

The GFL2CI module is designed to operate in multiple bands under the requirements of CFR 47 Parts 24, 90, and 101. The following is a list of the frequency bands of operation sorted based on the FCC rule parts in which the band is associated.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)
24D	901.0 - 902.0
24D	930.0 - 931.0
24D	940.0 - 941.0
90	896.01875 - 901.0*
90	935.0 - 940.0
101	928.85 - 929.0
101	932.0 - 932.5
101	941.0 - 941.5
101	959.85 - 959.95*

Based on the requirements set forth in accordance 47 CFR 2.1046-2.1057 as stated above, the methodology in selecting the places to test in the available bands of operation is outlined in the following table.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)	Location in the Range of Operation
90	896.01875 - 901.0*	1 near top and 1 near bottom
24D	901.0 - 902.0	
101	928.85 - 929.0	Middle
24D	930.0 - 931.0	Middle
101	932.0 - 932.5	Middle
90	935.0 - 940.0	
24D	940.0 - 941.0	1 near top and 1 near bottom
101	941.0 - 941.5	
101	959.85 - 959.95*	Middle

The data provided in this report is sorted based on the rule part.

*NOTE: The EUT does not comply at the extreme lower channel within the 896-901 MHz frequency band and the extreme upper channel in the 959.85 – 960 MHz frequency band therefore the lowest and highest channel for showing compliance was evaluated at 896.01875 MHz and 959.95 MHz, respectively.

1.4 Emissions Designators

The GFL2CI transceiver produces (7) distinct modulation formats. The emissions designators for the nine modulation types used by the GFL2CI transceiver are as follows:

EMISSIONS DESIGNATORS:

Normal Mode:	9K60F2D (7-FSK)
Double Density Mode:	9K60F2D (13-FSK)
C&I Mode:	4K80F2D (7-FSK)
Priority Mode:	4K80F2D (13-FSK)
Boost Mode:	1K10F2D (7-FSK)
MPass Mode (5K):	5K90F1D (2-GFSK)
MPass Mode (10K):	11K8F1D (2-GFSK)

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 581606

Industry Canada Lab Code: 4175C

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 200897-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl floor.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flushed with the chamber floor which it is connected to, around its circumference, with metallic loaded springs. An EMCO Model 1051 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

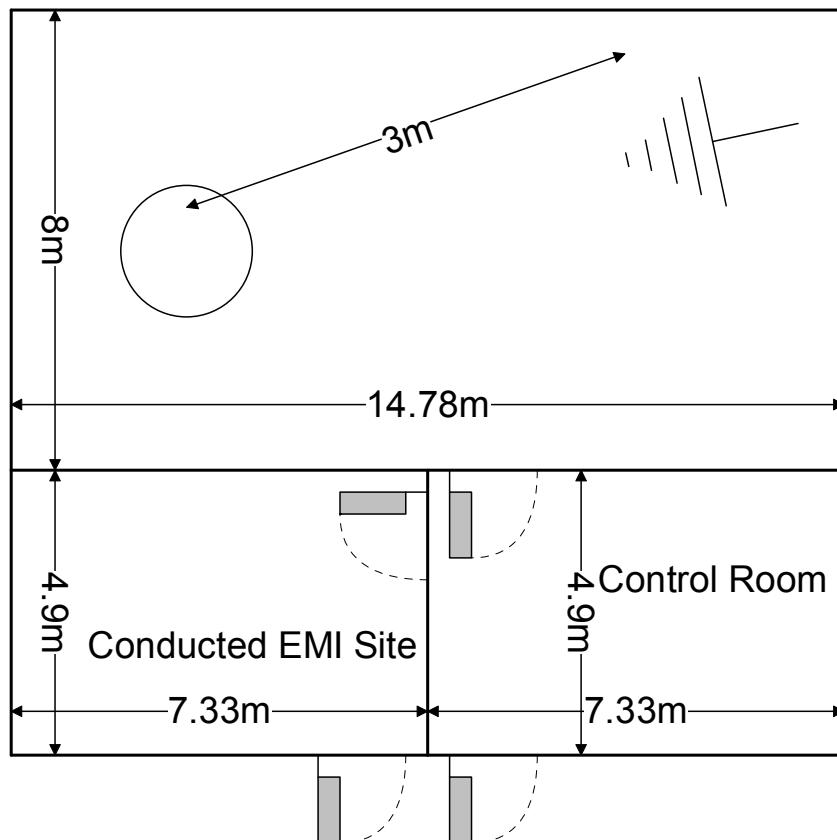


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are $7.3 \times 4.9 \times 3 \text{ m}^3$. As per ANSI C63.4 2003 requirements, the data were taken using two LISNs; a Solar Model 8028-50 50 Ω /50 μH and an EMCO Model 3825, which are installed as shown in Photograph 3. For 220 V, 50 Hz, a Polarad LISN (S/N 879341/048) is used in conjunction with a 1 kVA, 50 Hz/220 V EDGAR variable frequency generator, Model 1001B, to filter conducted noise from the generator.

A diagram of the room is shown below in figure 2.3.2-1:

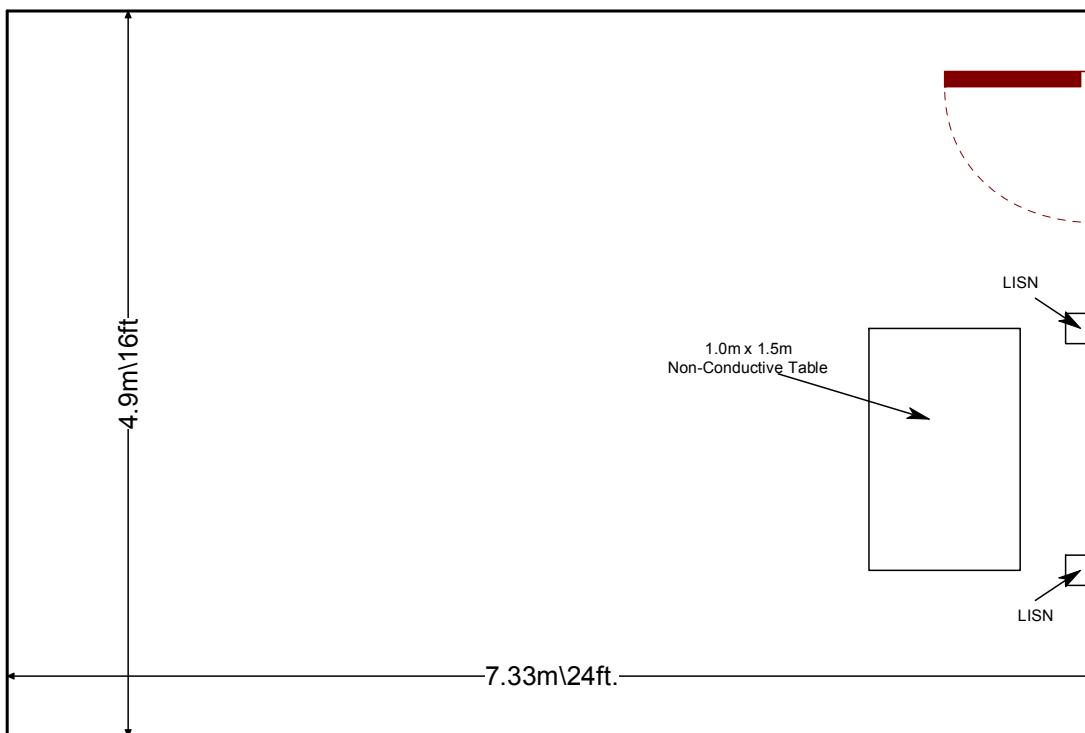


Figure 2.3.2-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- 1 - ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40GHz - 2003
- 2 - US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures - 2010
- 3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2010¹
- 4 - US Code of Federal Regulations (CFR): Title 47, Part 90, Subpart I: Private Land Mobile Radio Services – 2010
- 5 - US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services - 2010¹
- 6 – TIA-603-C: Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards – 2004
- 7 - Industry Canada Radio Standards Specification: RSS-119 - Land Mobile and Fixed Radio Transmitters and Receivers Operating in the Frequency Range 27.41- 960 MHz, Issue 11, June 2011
- 8 - Industry Canada Radio Standards Specification: RSS-134 - 900 MHz Narrowband Personal Communication Service - Issue 1, March 2000

¹ The FCC Rule Parts 24 and 101 are not covered under the NVLAP scope of accreditation

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

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
524	Chase	CBL6111	Antennas	1138	1/7/2011	1/7/2013
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	1/3/2011	1/3/2012
2012	Hewlett-Packard	HP83017A	Amplifiers	3123A00324	2/25/2011	2/25/2012
2013	Hewlett Packard	HP8566B	Spectrum Analyzers	2407A03233	8/5/2010	8/5/2012
2037	ACS Boca	Chamber EM Cable Set	Cable Set	2037	1/7/2011	1/7/2012
2071	Trilithic, Inc.	4HC1400-1-KK	Filter	9643263	2/3/2011	2/3/2012
2006	EMOO	3115	Antennas	2573	3/2/2011	3/2/2013
2078	ACS Boca	Substitution Cable Set	Cable Set	2078	2/2/2011	2/2/2012
RE563	Hewlett Packard	8673D	Signal Generators	3034A01078	2/22/2011	2/22/2013
RE564	Hewlett Packard	8657A	Generator	3323A05764	NCR	NCR
2069	Trilithic, Inc.	7NMB67/122-X1-AA	Notch Filter	200315126	2/3/2011	2/3/2012
2002	EMOO	3108	Antennas	2147	9/10/2009	9/10/2011
2004	EMOO	3146	Antennas	1385	9/10/2009	9/10/2011
2007	EMOO	3115	Antennas	2419	1/12/2010	1/12/2012

NCR=No Calibration Required

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	DC Power Supply	MPJA	HY5003	003700278

6.0 EQUIPMENT UNDER TEST SETUP AND BLOCK DIAGRAM

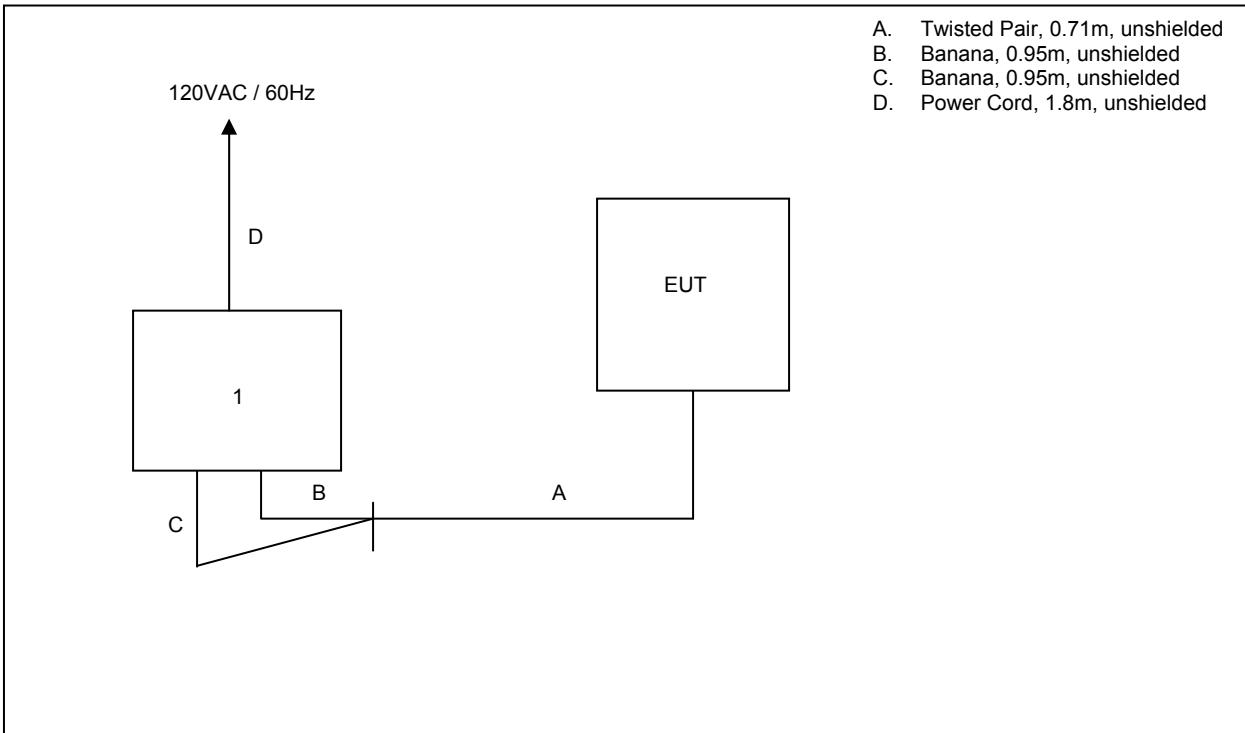


Figure 6-1: EUT Test Setup

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 Field Strength of Spurious Emissions – FCC Part 2.1053, Part 90.210, Part 24.133, Part 101.111²; RSS-119, RSS-134

7.1.1 Measurement Procedure

The equipment under test is placed in the Semi-Anechoic Chamber (described in section 2.3.1) on a wooden table at the turntable center. For each spurious emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360° and the maximum reading on the spectrum analyzer is recorded. This was repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. The signal generator's frequency is set to that of the spurious emission recorded from the equipment under test. The antenna mast is raised and lowered from one (1) to four (4) meters to obtain a maximum reading on the spectrum analyzer. The output of the signal generator is then adjusted until the reading on the spectrum analyzer matches that obtained from the equipment under test. The signal generator level is recorded. The power in dBm of each spurious emission is calculated by correcting the signal generator level for the cable loss and gain of the substitution antenna referenced to a dipole. The spectrum was investigated in accordance to CFR 47 Part 2.1057.

The magnitude of all spurious emissions not reported were attenuated below the noise floor of the measurement system and therefore not specified in this report. Results are shown below in Tables 7.1.2-1 through 7.1.2-9.

7.1.2 Measurement Results

Table 7.1.2-1: Field Strength of Spurious Emissions – 896.01875 MHz

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
1792.038	-44.15	H	-36.33	-20.00	16.33
2688.056	-61.60	H	-56.42	-20.00	36.42
<hr/>					
1792.038	-41.55	V	-33.98	-20.00	13.98
2688.056	-58.65	V	-49.52	-20.00	29.52

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

² The FCC Rule Parts 24 and 101 are not covered under the NVLAP Scope of Accreditation

Table 7.1.2-2: Field Strength of Spurious Emissions – 896.0375 MHz

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1792.075	-44.95	H	-37.23	-20.00	17.23
2688.113	-61.55	H	-56.67	-20.00	36.67
1792.075	-41.20	V	-33.68	-20.00	13.68
2688.113	-61.60	V	-55.52	-20.00	35.52

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.1.2-3: Field Strength of Spurious Emissions – 901.9875 MHz³

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1803.975	-43.90	H	-35.84	-20.00	15.84
2705.963	-61.25	H	-54.17	-20.00	34.17
1803.975	-43.00	V	-35.24	-20.00	15.24
2705.963	-54.00	V	-42.57	-20.00	22.57

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

³ FCC Rule Part 24 is not covered by the NVLAP scope of Accreditation

Table 7.1.2-4: Field Strength of Spurious Emissions – 928.925 MHz⁴

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1857.85	-42.25	H	-34.29	-20.00	14.29
2786.775	-65.75	H	-64.37	-20.00	44.37
4644.625	-66.05	H	-54.42	-20.00	34.42
<hr/>					
1857.85	-41.95	V	-33.69	-20.00	13.69
2786.775	-59.20	V	-49.02	-20.00	29.02
4644.625	-66.65	V	-54.67	-20.00	34.67

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.1.2-5: Field Strength of Spurious Emissions – 930.5 MHz⁵

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1861	-41.90	H	-33.29	-20.00	13.29
2791.5	-60.80	H	-53.57	-20.00	33.57
4652.5	-66.60	H	-54.22	-20.00	34.22
<hr/>					
1861	-42.60	V	-33.74	-20.00	13.74
2791.5	-60.20	V	-51.12	-20.00	31.12
4652.5	-67.10	V	-53.77	-20.00	33.77

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

⁴ FCC Rule Part 101 is not covered under the NVLAP Scope of Accreditation

⁵ FCC Rule Part 24 is not covered under the NVLAP Scope of Accreditation

Table 7.1.2-6: Field Strength of Spurious Emissions – 932.25 MHz⁶

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1864.5	-42.45	H	-34.09	-20.00	14.09
2796.75	-64.30	H	-61.67	-20.00	41.67
4661.25	-64.45	H	-49.22	-20.00	29.22
<hr/>					
1864.5	-42.65	V	-34.04	-20.00	14.04
2796.75	-60.85	V	-51.82	-20.00	31.82
4661.25	-66.55	V	-54.17	-20.00	34.17

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.1.2-7: Field Strength of Spurious Emissions – 935.0125 MHz⁷

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1870.025	-41.40	H	-33.24	-20.00	13.24
2805.038	-63.30	H	-58.55	-20.00	38.55
4675.063	-65.00	H	-50.67	-20.00	30.67
<hr/>					
1870.025	-41.85	V	-33.49	-20.00	13.49
2805.038	-60.50	V	-51.45	-20.00	31.45
4675.063	-65.30	V	-51.47	-20.00	31.47

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

⁶ FCC Rule Part 101 is not covered under the NVLAP scope of Accreditation

⁷ FCC Rule Part 24 is not covered under the NVLAP scope of Accreditation

Table 7.1.2-8: Field Strength of Spurious Emissions – 941.4875 MHz⁸

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1882.975	-41.85	H	-33.34	-20.00	13.34
2824.463	-63.60	H	-57.05	-20.00	37.05
4707.438	-64.80	H	-50.41	-20.00	30.41
1882.975	-42.55	V	-34.09	-20.00	14.09
2824.463	-61.45	V	-52.20	-20.00	32.20
3765.95	-64.90	V	-54.39	-20.00	34.39
4707.438	-65.60	V	-52.46	-20.00	32.46
5648.925	-66.40	V	-51.40	-20.00	31.40

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.1.2-9: Field Strength of Spurious Emissions – 959.925 MHz⁸

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1919.85	-43.25	H	-34.39	-20.00	14.39
2879.775	-61.25	H	-54.60	-20.00	34.60
3839.7	-66.75	H	-57.97	-20.00	37.97
4799.625	-62.70	H	-45.76	-20.00	25.76
1919.85	-44.90	V	-35.84	-20.00	15.84
2879.775	-60.05	V	-51.30	-20.00	31.30
3839.7	-63.20	V	-48.77	-20.00	28.77
4799.625	-62.70	V	-45.06	-20.00	25.06
5759.55	-67.70	V	-53.80	-20.00	33.80

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

⁸ FCC Rule Part 101 is not covered under the NVLAP scope of Accreditation

8.0 CONCLUSION

In the opinion of ACS, Inc. the model GFL2CI, manufactured by Sensus Metering Systems, meets all the requirements of FCC Part 90, Part 24 and Part 101 as well as IC RSS-119 and RSS 134 as applicable.

End Report