Excellence in Compliance Testing

Certification Test Report

FCC ID: KCH510R2
IC: 2220A-510R2

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

ACS Report Number: 11-2077.W04.11.A

Manufacturer: Sensus Metering Systems
Model: 510R2

Test Begin Date: **September 7, 2011**
Test End Date: **September 26, 2011**

Report Issue Date: October 10, 2011

ACCREDITED
TESTING

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ACLASS, ANSI, or any agency of the Federal Government.

Project Manager:

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EMC Engineer
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Kirby Munroe
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This report contains 27 pages

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1 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. The Class II permissive change is for the replacement of obsolete PLL IC and charge pump voltage doubler (SC1462) for new VCO/PLL Synthesizer IC (LMX2531LQ1742) and charge pump voltage doubler (LM2660MMX).

1.2 Product description

The Sensus Radio Read Meter Transceiver Unit 510R2 is a Direct Sequence Spread Spectrum Transmitter operating in the 902 to 928 MHz ISM band for remote water meter reading. The 510R2 is used for non water pit applications (i.e. side of the house installations). The product receives a wake-up signal from a vehicle mounted or hand-held mobile data collection device. The product transmits meter readings as short bursts of data to the mobile collection system.

Table 1.2-1: Product Description

Mode of Operation	Frequency Range (MHz)	Data Rates Supported (kbps)
DBPSK	904.6 – 925.4	15.625

Manufacturer Information:
Sensus Metering Systems
8609 Six Forks Road
Raleigh, NC 27615

Test Sample Serial Number(s): 501, 503

Test Sample Condition: The EUT was in good physical conditions with no noticeable defects.

1.3 Test Methodology and Considerations

The 510R2 was evaluated for radiated and RF conducted emissions for the low, middle and high channels in the 904.6 MHz to 925.4 MHz frequency band of operation.

For the radiated emisisons measurements, the EUT was evaluated in the orientation of typical installation. The RF conducted measurements were performed on a 510R2 unit modified to provide a temporary SMA connector at the antenna output port.

The 510R2 is a battery operated device only and it is not meant be connected either directly or indirectly to the public utility line. Consequently, the 510R2 is exempted from power line conducted emissions evaluation.

The compliance of the digital and receiver portions of the device is documented separately in a verification report.

2 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 #: 587595
Industry Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ACLASS program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test 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 a continuous metallic loaded spring. An EMCO Model 1050 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:

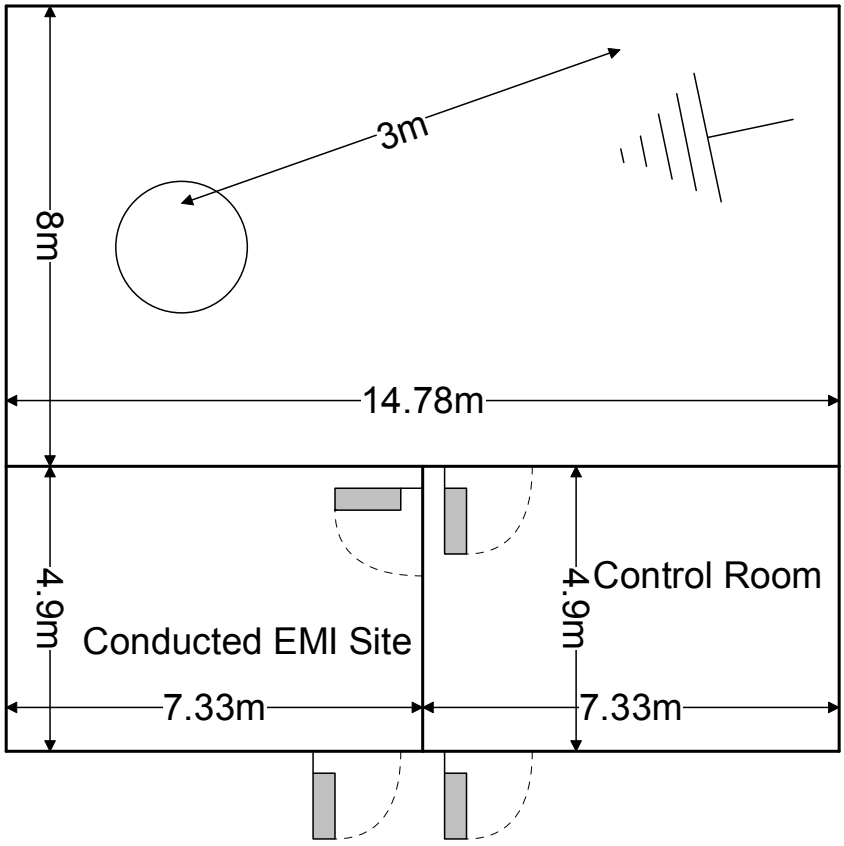

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 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:

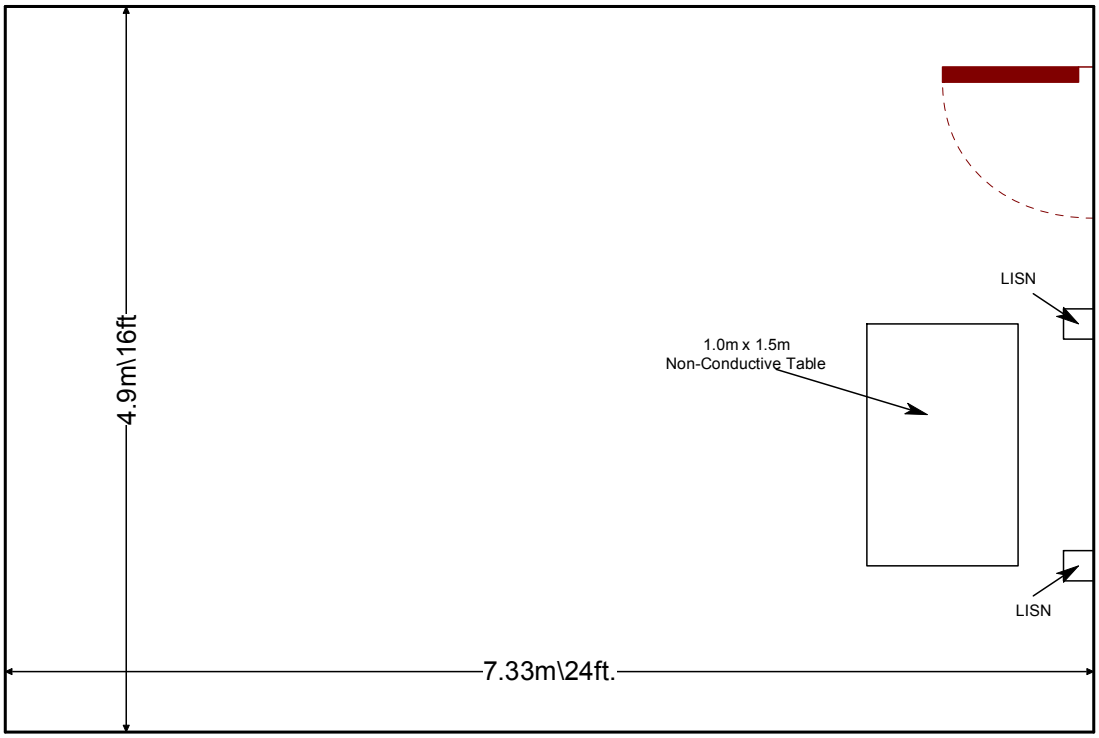

Figure 2.3.2-1: AC Mains Conducted EMI Site

3 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, 2011
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2011
- KDB Publication No. 558074 - Measurement of Digital Transmission Systems Operating under Section 15.247, March 23, 2005
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8, December 2010.
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, December 2010.

4 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
523	Agilent	E7405	Spectrum Analyzers	MY45103293	1/5/2011	1/5/2013
524	Chase	CBL6111	Antennas	1138	1/7/2011	1/7/2013
2006	EMCO	3115	Antennas	2573	3/2/2011	3/2/2013
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
2014	Hewlett Packard	HP 85650A	Quasi Peak Adapter	2430A00559	8/5/2010	8/5/2012
2037	ACS Boca	Chamber EMI Cable Set	Cable Set	2037	1/7/2011	1/7/2012
2044	QMI	N/A	Cables	2044	1/7/2011	1/7/2012
2071	Trilithic, Inc.	4HC1400-1-KK	Filter	9643263	2/3/2011	2/3/2012
2088	Hewlett Packard	11170B	Cables	2088	7/4/2011	7/4/2012
2069	Trilithic, Inc.	7NM867/122-X1-AA	Notch Filter	200315126	2/3/2011	2/3/2012
2075	Hewlett Packard	8495B	Attenuators	2626A11012	12/10/2010	12/10/2011

NCR=No Calibration Required

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Register Meter	Sensus Metering Systems	N/A	N/A
2	DC Power Supply	MPJA	HY5003	003700278

Table 5-2: Support Equipment

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

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

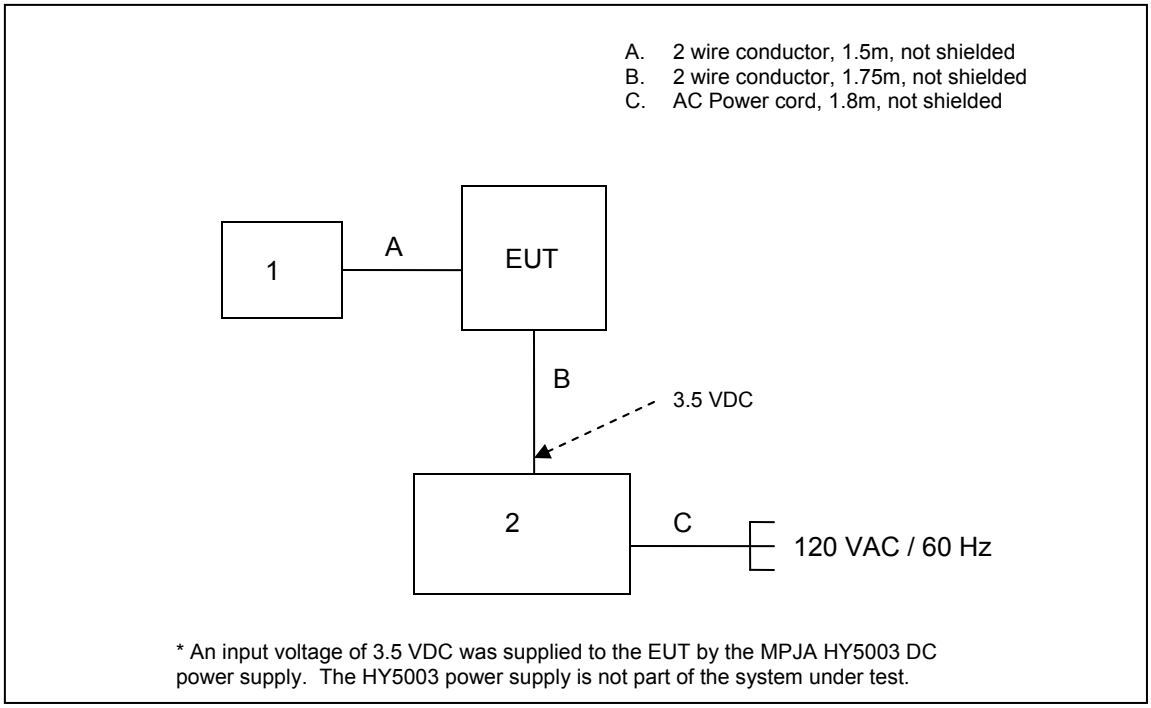

Figure 6-1: Radiated Emissions Test Setup

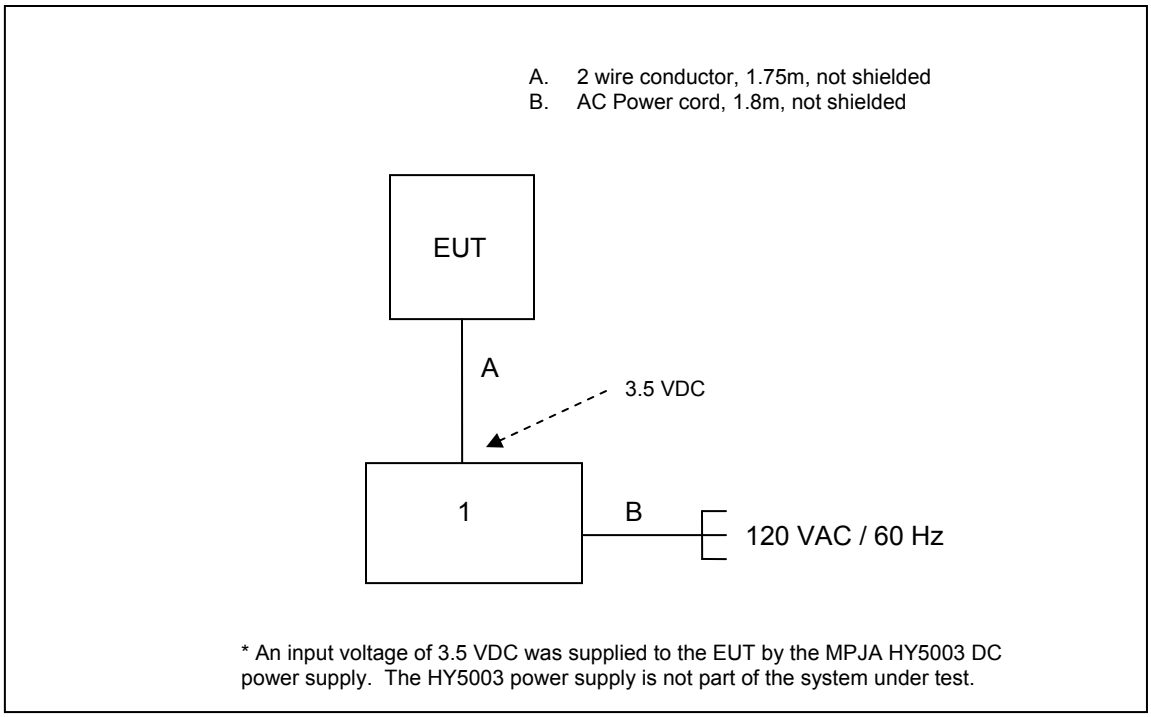

Figure 6-2: RF Conducted Measurements Test Setup

7 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 510R2 uses a printed circuit folded dipole antenna.

7.2 6 dB Bandwidth - FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a)

7.2.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the entire emissions and >> RBW.

7.2.2 Measurement Results

Results are shown below in Table 7.2.2-1 and Figures 7.2.2-1 through 7.2.2-6.

Table 7.2.2-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [kHz]	99% Bandwidth (kHz)
904.6	1130	6360
915.0	1130	6390
925.4	1130	6360

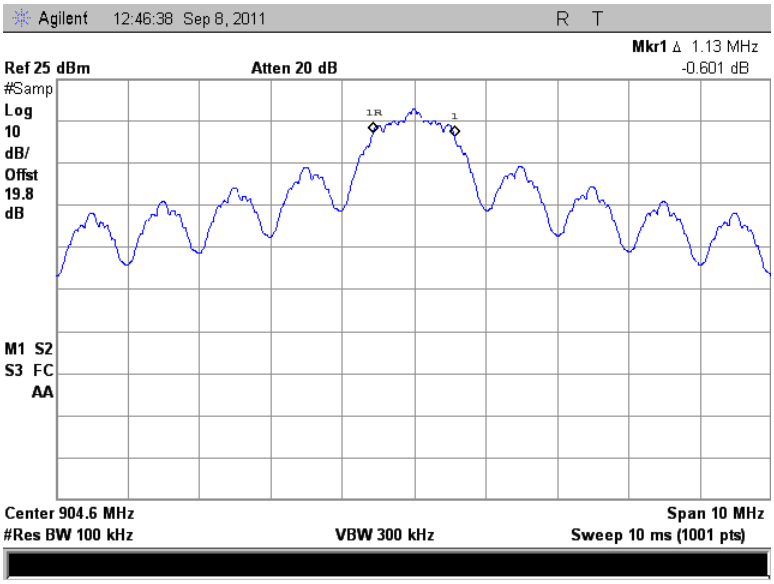

Figure 7.2.2-1: 6dB BW - Low Channel

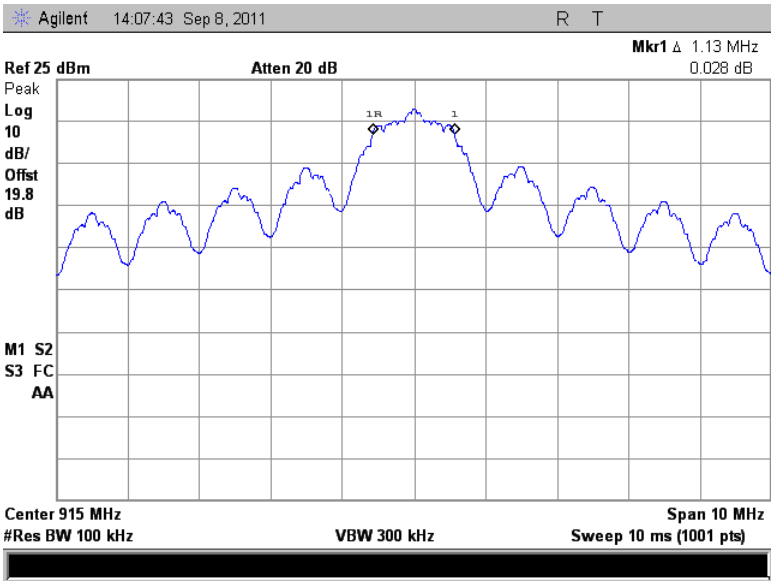

Figure 7.2.2-2: 6dB BW - Middle Channel

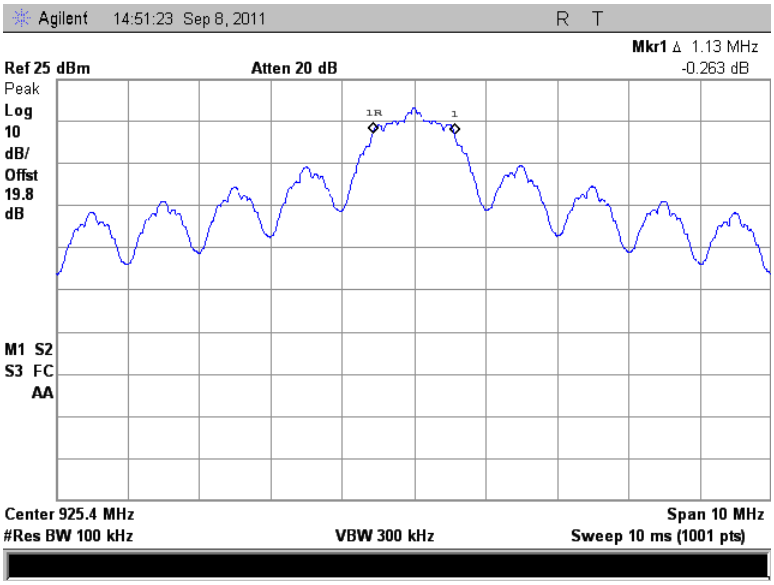

Figure 7.2.2-3: 6dB BW - High Channel

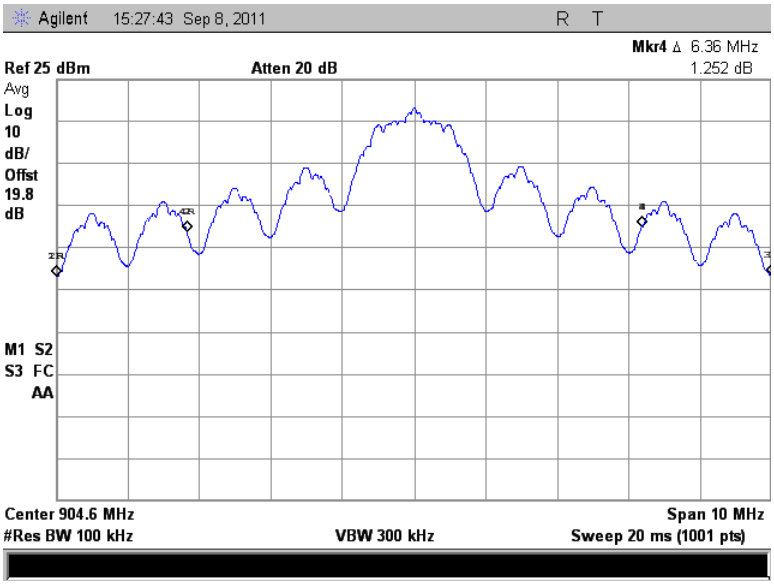

Figure 7.2.2-4: 99% OBW - Low Channel

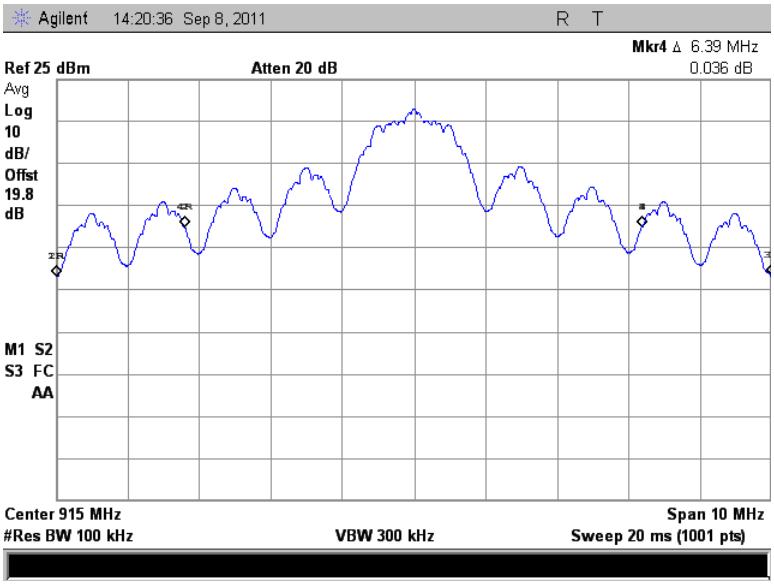

Figure 7.2.2-5: 99% OBW - Middle Channel

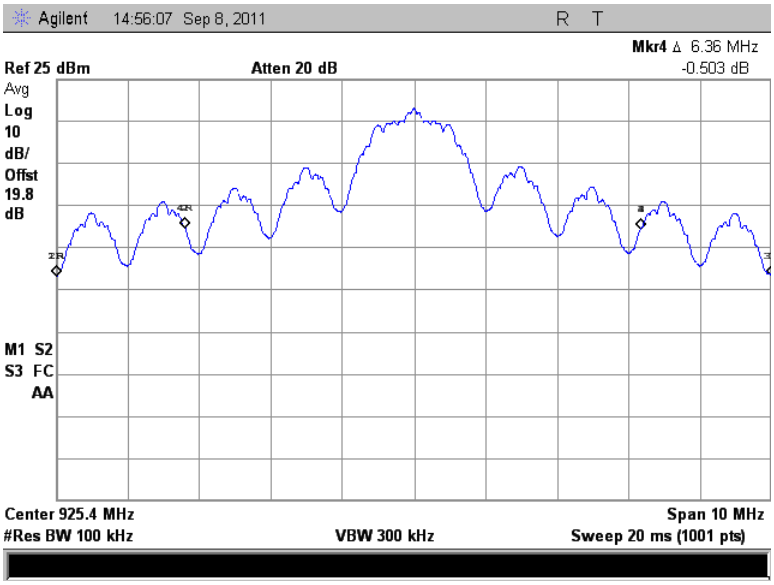

Figure 7.2.2-6: 99% OBW - High Channel

7.3 Peak Output Power - FCC Section 15.247(b)(3) IC: RSS-210 A8.4(4)

7.3.1 Measurement Procedure (Conducted Method)

The Peak Output Power was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" Power Option 1. The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. Data was collected with the EUT operating at maximum power per channelization.

7.3.2 Measurement Results

Results are shown below in Table 7.3.2-1 and Figures 7.3.2-1 to 7.3.2-3 below:

Table 7.3.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
904.6	20.3
915.0	20.42
925.4	20.49

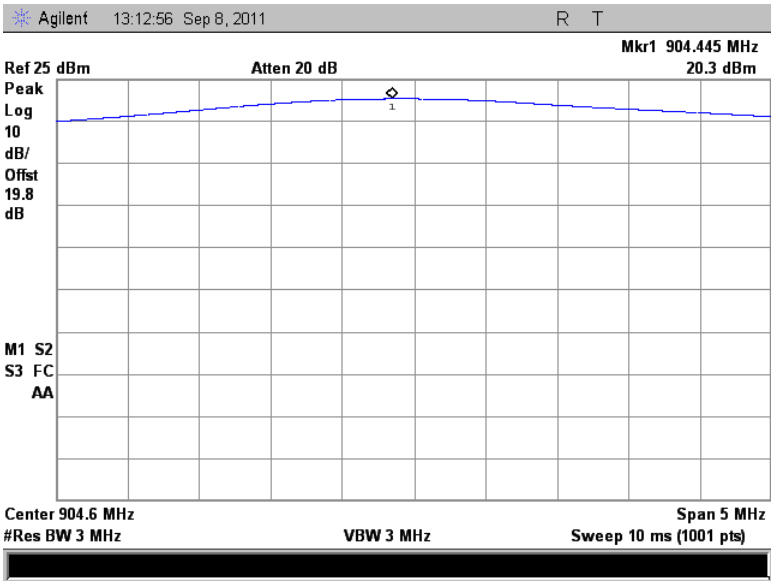

Figure 7.3.2-1: RF Output Power - Low Channel

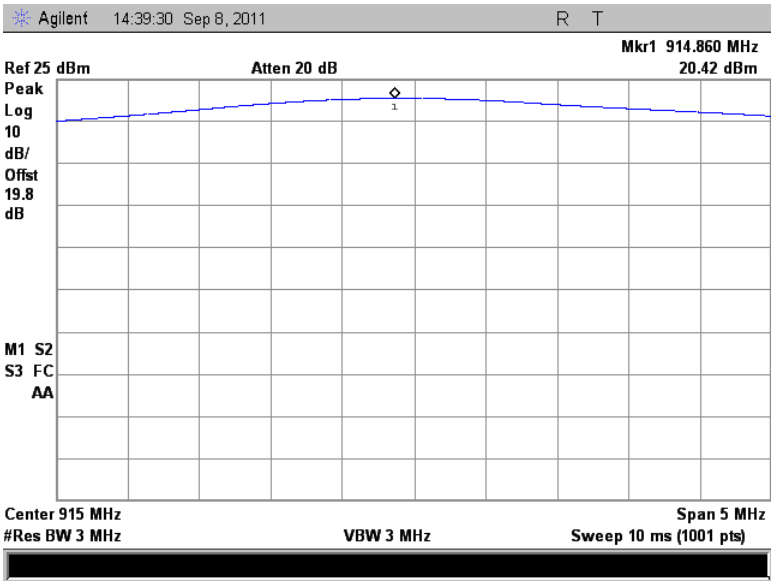

Figure 7.3.2-2: RF Output Power - Middle Channel

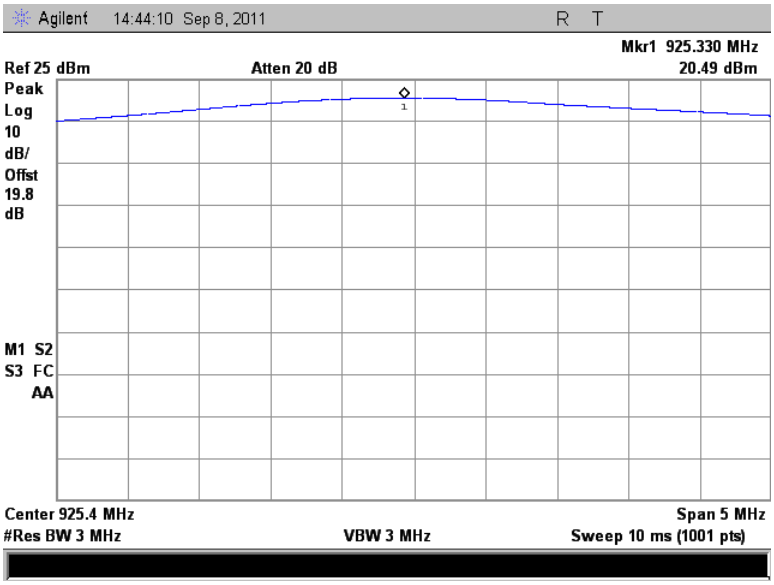

Figure 7.3.2-3: RF Output Power - High Channel

7.4 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC:RSS-210 2.2, A8.5

7.4.1 Band-Edge Compliance of RF Conducted Emissions

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to 300 kHz.

7.4.1.2 Measurement Results

Results are shown in the figures 7.4.1.2-1 to 7.4.1.2-2 below.

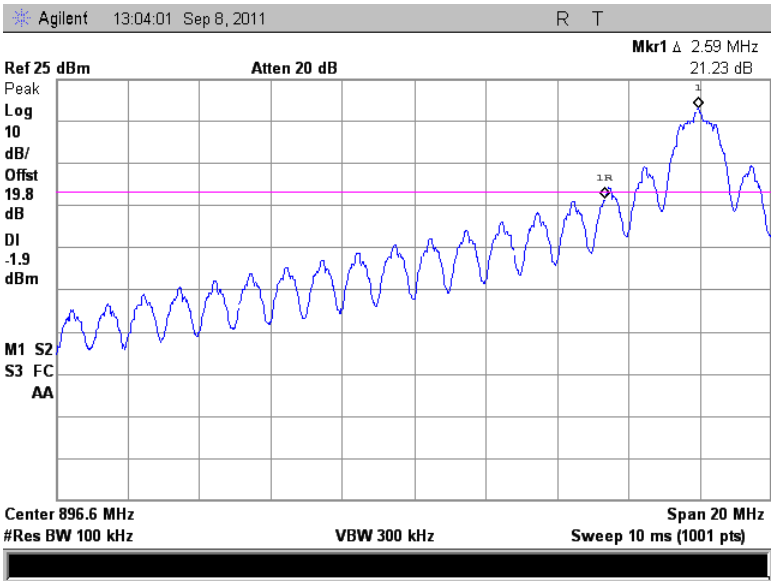

Figure 7.4.1.2-1: Lower Band-edge

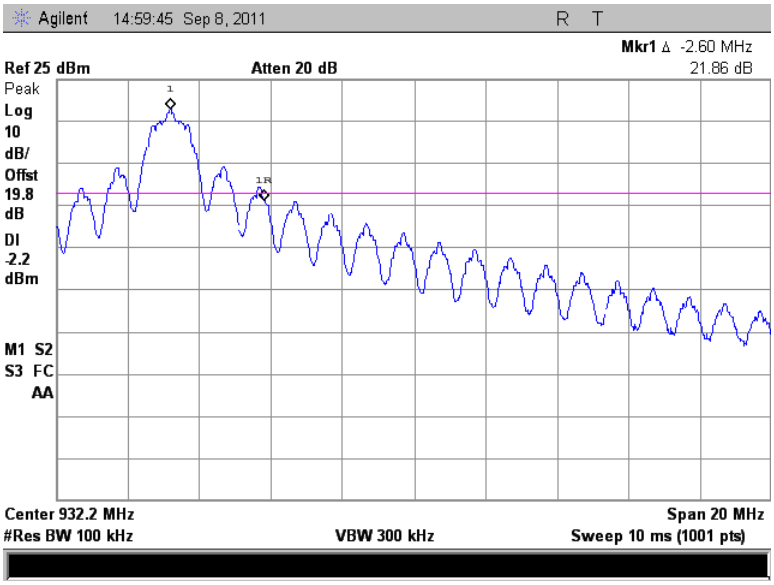

Figure 7.4.1.2-2: Upper Band-edge

7.4.2 RF Conducted Spurious Emissions

7.4.2.1 Measurement Procedure

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak Max Hold function of the analyzer was utilized.

7.4.2.2 Measurement Results

Results are shown below in Figures 7.4.2.2-1 to 7.4.2.2-6:

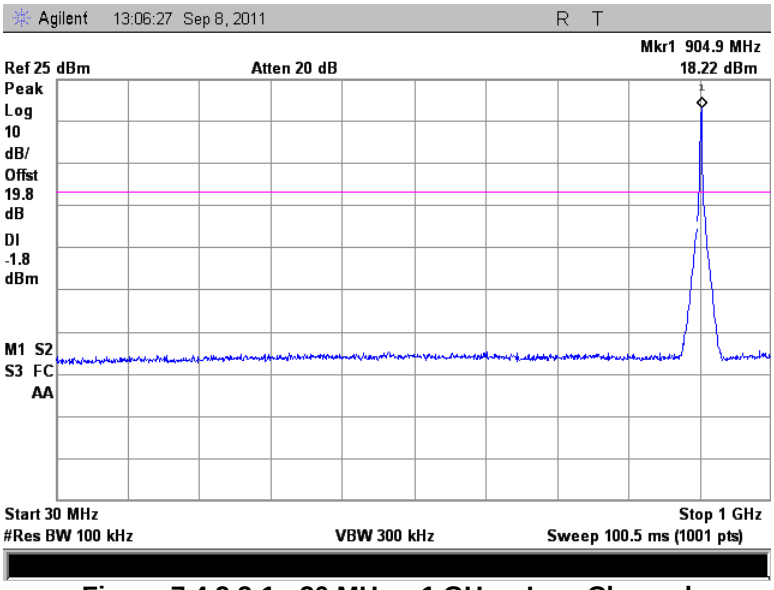

Figure 7.4.2.2-1: 30 MHz – 1 GHz – Low Channel

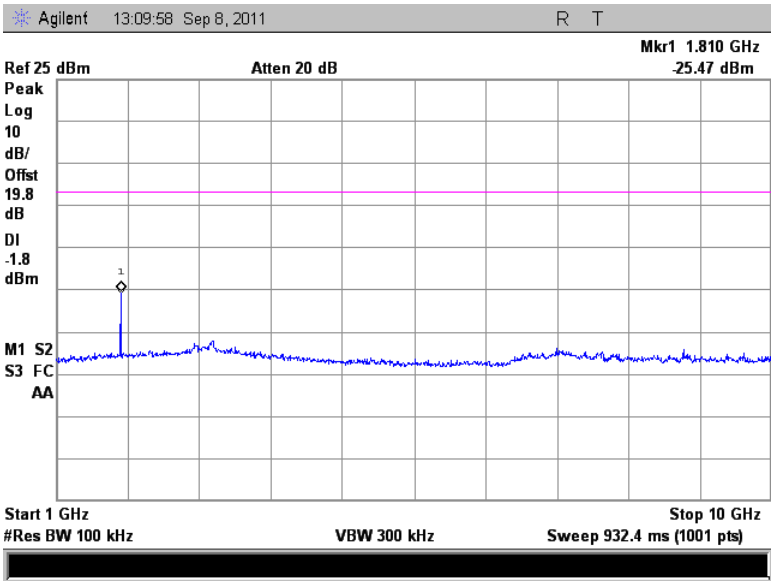

Figure 7.4.2.2-2: 1 GHz – 10 GHz – Low Channel

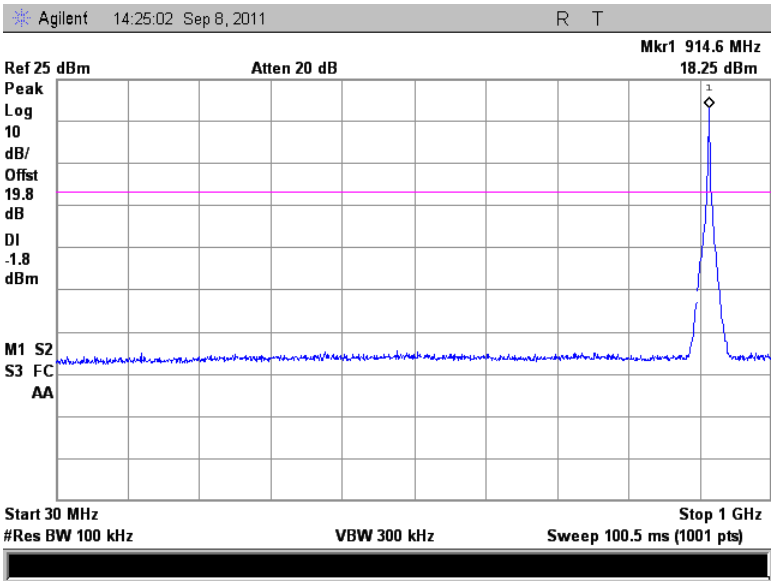

Figure 7.4.2.2-3: 30 MHz – 1 GHz –Middle Channel

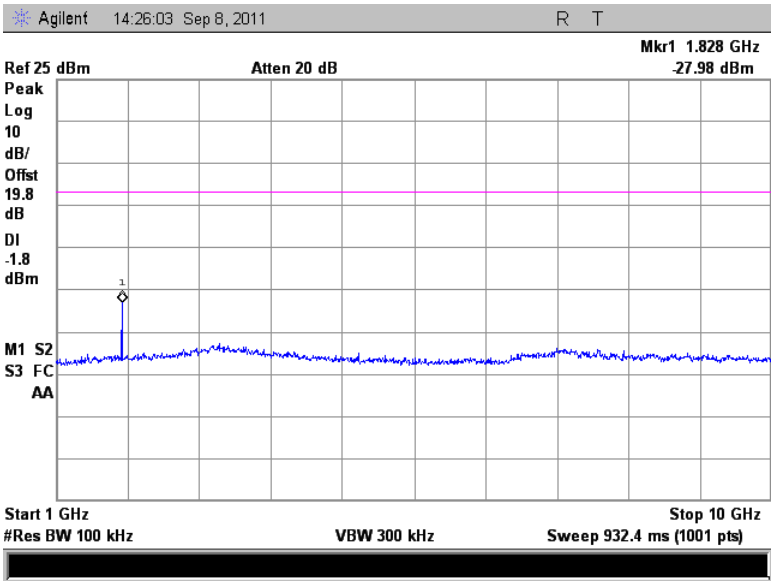

Figure 7.4.2.2-4: 1 GHz – 10 GHz – Middle Channel

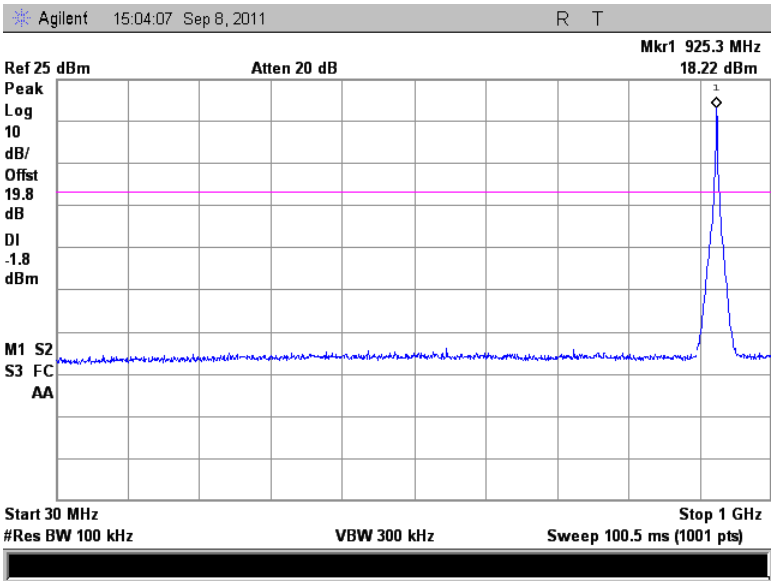

Figure 7.4.2.2-5: 30 MHz – 1 GHz – High Channel

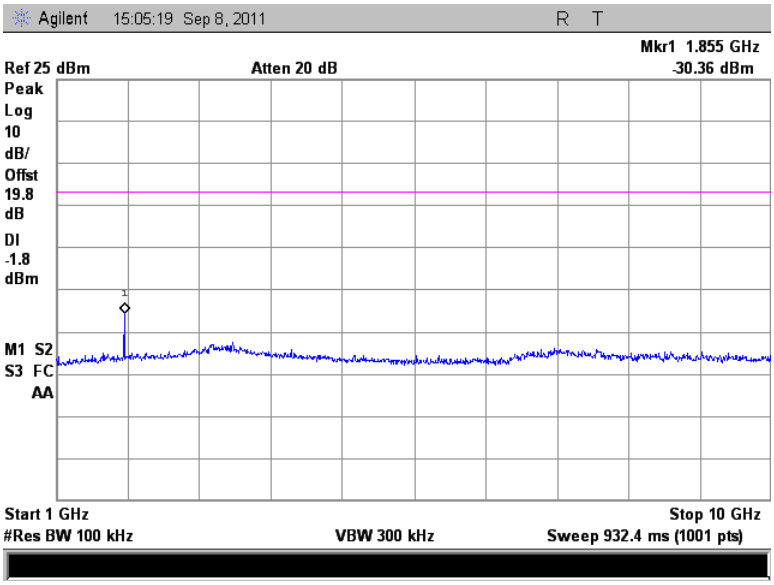

Figure 7.4.2.2-6: 1 GHz – 10 GHz –High Channel

7.4.3 Radiated Spurious Emissions - FCC Section 15.205 IC: RSS-210 2.6

7.4.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 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 of 1 MHz and VBW of 3MHz and 10 Hz respectively.

Each emission found to be in a restricted band was compared to the applicable radiated limits.

7.4.3.2 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in the Table 7.4.3.2-1 below.

Table 7.4.3.2-1: Radiated Spurious Emissions Tabulated Data

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
Low Channel 904.6 MHz										
Noise Floor										
Middle Channel 915 MHz										
2745	50.92	47.73	V	-2.45	48.47	45.28	74.0	54.0	25.50	8.70
2745	49.66	46.14	H	-2.45	47.21	43.69	74.0	54.0	26.80	10.30
3660	47.44	43.34	V	0.85	48.29	44.19	74.0	54.0	25.70	9.80
9150	42.70	34.52	H	10.26	52.96	44.78	74.0	54.0	21.00	9.20
High Channel 925.4 MHz										
2776.2	51.75	45.92	H	-1.98	49.77	43.94	74.0	54.0	24.20	10.10
2776.2	49.95	44.49	V	-1.98	47.97	42.51	74.0	54.0	26.00	11.50
3701.6	46.96	42.12	H	1.35	48.30	43.47	74.0	54.0	25.70	10.50
3701.6	54.40	52.28	V	1.35	55.75	53.63	74.0	54.0	18.30	0.40

*Note:

- All emissions above 9150 MHz were attenuated below the permissible limit.

7.4.3.3 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: Peak
Corrected Level: 50.92 + (-2.45) = 48.47dBµV/m
Margin: 74dBuV/m – 48.47dBµV/m = 25.5 dB

Example Calculation: Average
Corrected Level: 47.73 + (-2.45) - 0= 45.28 dBµV
Margin: 54dBuV – 45.28dBµV = 8.7dB

7.5 Power Spectral Density - FCC Section 15.247(e) IC: RSS-210 A8.2(b)

7.5.1 PSD Measurement Procedure (Conducted Method)

The power spectral density was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" PSD Option 1. The RF output port of the EUT was directly connected to the input of the spectrum analyzer. Offset values were input for cable and attenuation. The spectrum analyzer RBW was set to 3 kHz and VBW 10 kHz. Span was adjusted to 1500 kHz and the sweep time was set to 500 s = (Span/3 kHz).

7.5.2 Measurement Results

Results are shown below in Table 7.5.2-1 and Figures 7.5.2-1 to 7.5.2-3 below:

Table 7.5.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
904.6	6.177
915.0	6.154
925.4	6.159

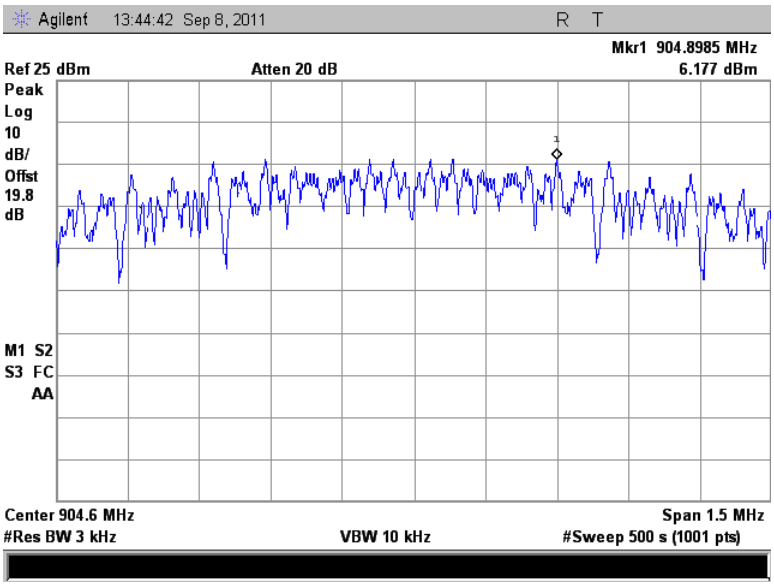

Figure 7.5.2-1: Power Spectral Density - Low Channel

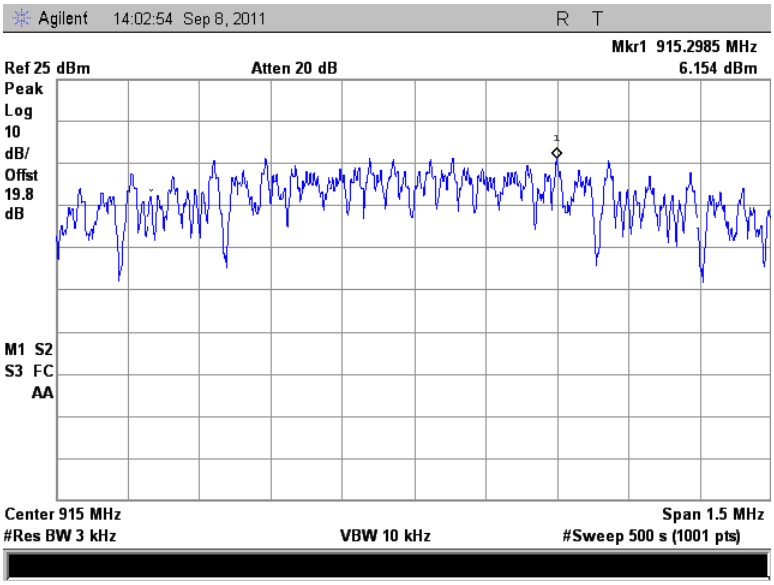

Figure 7.5.2-2: Power Spectral Density - Middle Channel

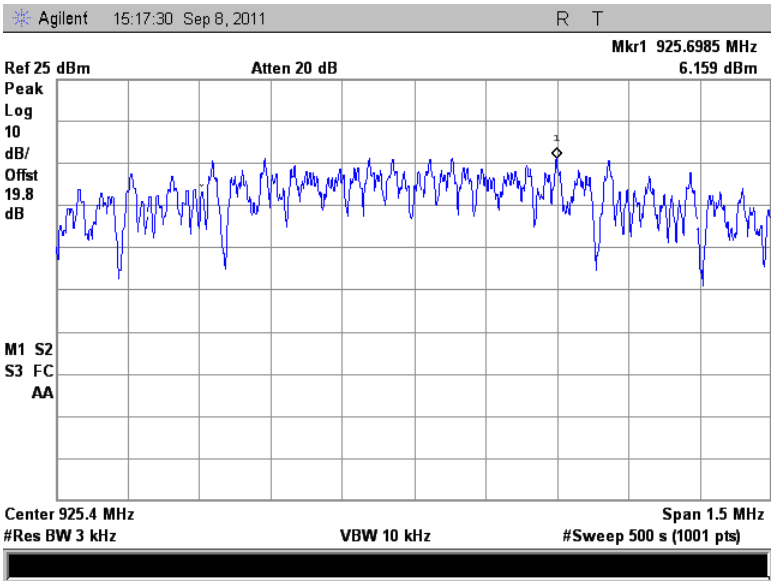

Figure 7.5.2-3: Power Spectral Density – High Channel

8 CONCLUSION

In the opinion of ACS, Inc. the 510R2, manufactured by Sensus Metering Systems meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT