



FCC Part 15 Subpart C

Direct Sequence Spread Spectrum Transmitter

Certification Test Report

Manufacturer: SchlumbergerSema, Inc.

**Model: CENTRON OOK RF MODULE
WITH CENTRON 2S METER**

FCC ID: F9CC1C-3

Rules Section: 15.247(Modular Approval)

Test Begin Date: March 20, 2002

Test End Date: March 21, 2002

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1.0 GENERAL

1.1 Introduction

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 Equipment Under Test (EUT), is the Model CENTRON OOK RF Module with the Centron 2S Meter manufactured by SchlumbergerSema, Inc. Located at the following address:

SchlumbergerSema, Inc.
313-B North Highway 11
West Union, South Carolina 29696

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

1.2.2 Intended Use

The EUT is intended to transmit power usage to a data collection point via a Direct Sequence Spread Spectrum RF link. The power meters are fixed devices typically installed outdoors on the sides of buildings, or otherwise greater than 2 meters from nearby persons.

1.2.3 Technical Specifications

Table 1.2.3-1: Specifications

Frequency Band	902-928
Number of Channels	1
Channel Bandwidth	1.200 MHz
Channel Spacing	N/A
Output power	23.83dBm nominal
Antenna Type	Folded Dipole
Antenna Gain	2dBi
Antenna Connector Type	Permanently Attached to PCB

1.2.4 Antennas

Table 1.2.4-1 below gives the antennas that will be employed with the CENTRON OOK RF Module with the Centron 2S Meter. Photographs are submitted separately as appendix B with this filing.

Table 1.2.4-1: Antennas

Mfg.	Mfg. Model No.	Antenna Type	Gain (dBi)	Connector Type	System EIRP (dBm)
Schlumberger		Dipole	2	Soldered to Board	25.83

2.0 LOCATION OF TEST FACILITY

All testing was performed by qualified ACS personnel located at the following address:

ACS, Inc.
5015 B.U. Bowman Drive
Buford, GA 30518

2.1 DESCRIPTION OF TEST FACILITY

Radiated and conducted emissions were conducted at an ACS facility specifically prepared for this testing. Both sites have been fully described and submitted to, and accepted by the FCC and Industry Canada. FCC registration number 89450 and Industry Canada Lab Code IC 4175 have been assigned in recognition of the sites. Both sites are also in conformance with publication CISPR16.

2.1.1 Open Area Test Site

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' fush 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 3.2-1 below:

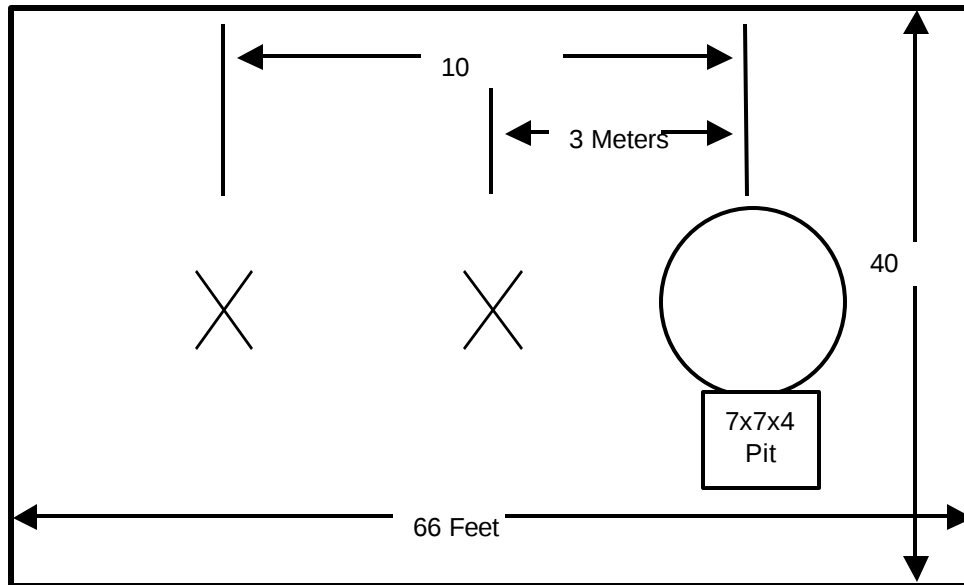


Figure 3.2-1: Open Area Test Site

2.1.2 Conducted Emissions Test Site Description

The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof Corporation.

The room 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 2.1.2-1:

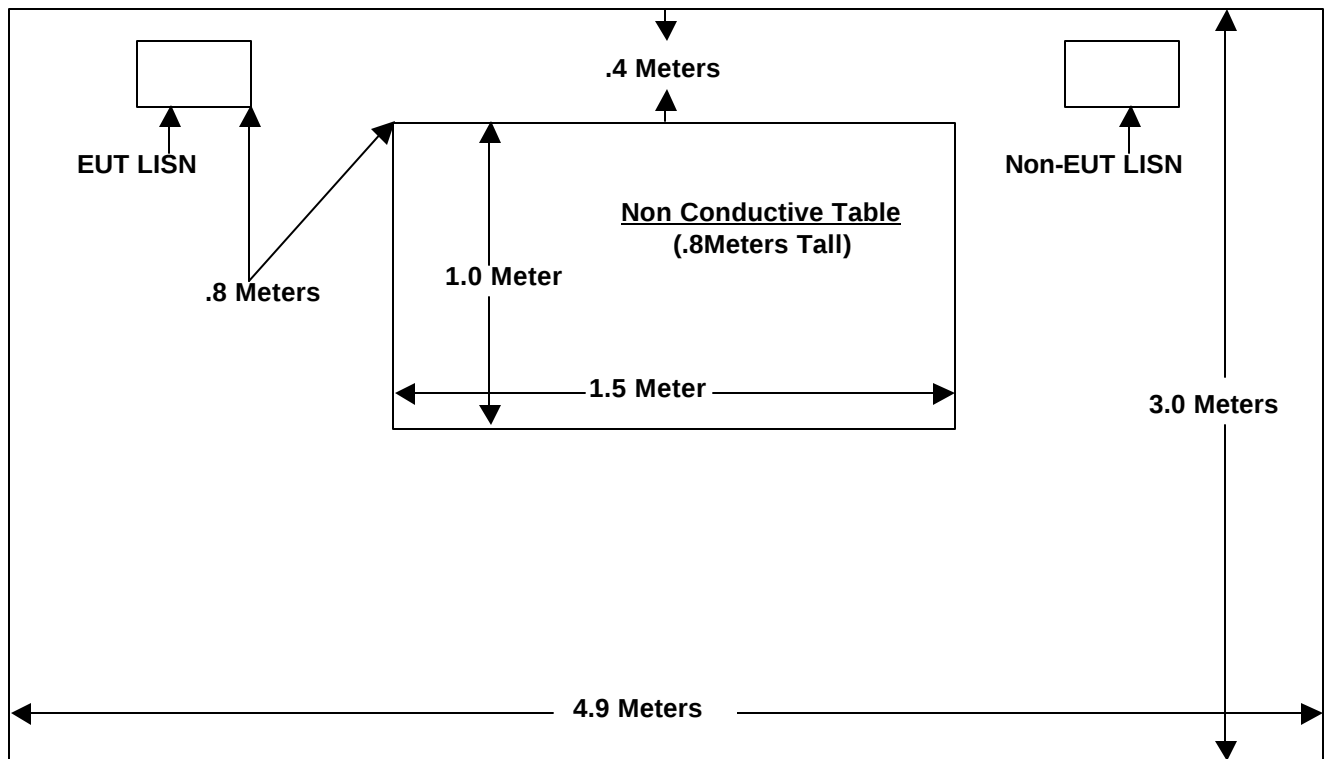


Figure 3.3-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- 1 - ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- 2 - US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators (October 2000)
- 3 - FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

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

MFG Name	Item Name	Model #:	Serial #	Recal Date:
Hewlett Packard	Amp, .01-26.5 GHz	8449D	3008A00526	9/24/02
	High-Pass Filter			
Hewlett Packard	Spectrum Analyzer	8560E	3240A00285	9/06/02
Rohde & Schwarz	Spectrum Analyzer	ESMI	83371/007	12/26/02
	RF Cables (High Freq. Short)	None	Copper	3/18/03
	RF Cables (High Freq. Double)	7015/6986	MFR-57500	3/18/03
Chase	Bi-Log Antenna	CBL6111	1043	10/23/02

5.0 SUPPORT EQUIPMENT

Table 5-3: Support Equipment

Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
	EUT Was Self Supporting			

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

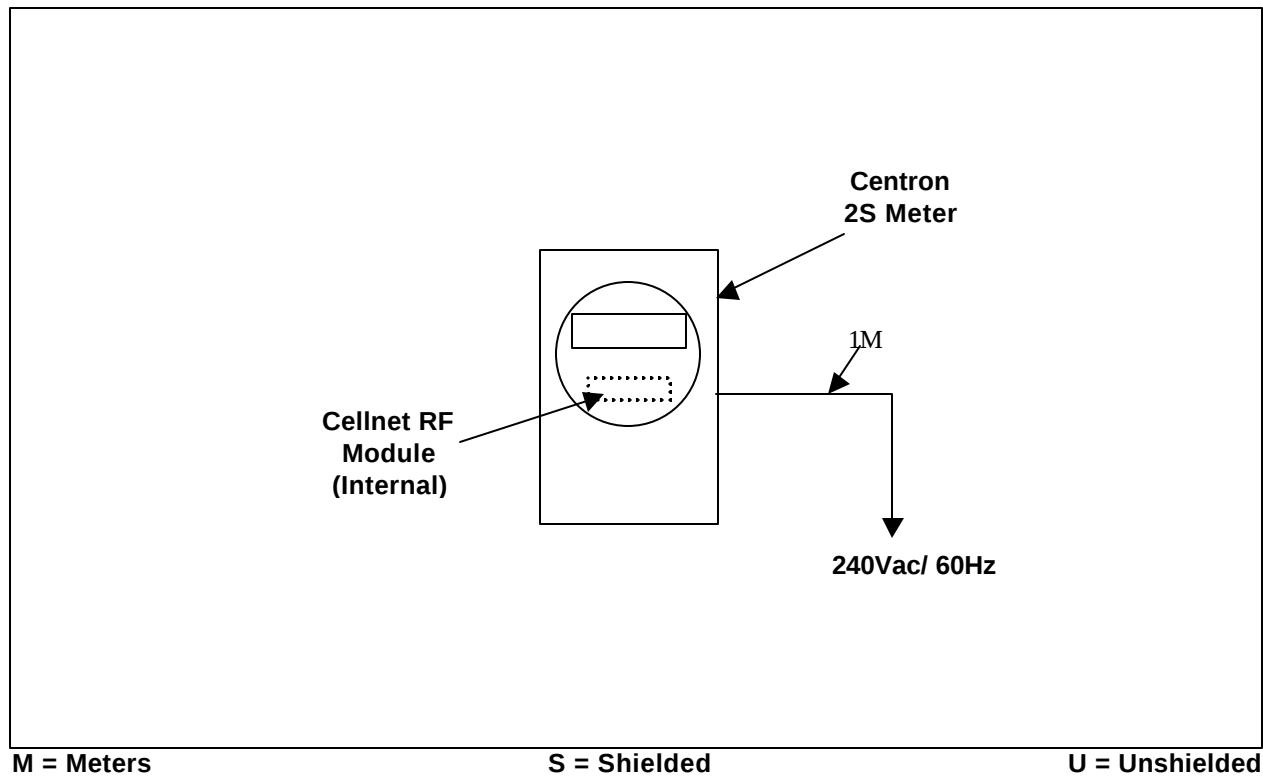


Figure 6-1: EUT Test Setup

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 Antenna Requirement - FCC Section 15.203

The antenna used with the RF Module is soldered to the board and would require electrical modification to change. The antenna is specifically tuned for optimum performance and unauthorized modification would result in poor performance.

7.2 Power Line Conducted Emissions - FCC Section 15.207

Conducted emissions were performed from 450kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. Results of the test are shown below in tables 7.2-1 and 7.2-2.

Table 7.2-1: Line 1 Conducted EMI Results

LINE 1					
Frequency (MHz)	Uncorrected Reading (dBuV)	Cable + LISN loss (dB)	Corrected Reading (dBuV)	FCC Limit (dBuV)	Margin (dB)
0.736	40.4	2	42.4	48	5.6
4.2	24.1	2	26.1	48	21.9
6.3	22.6	2	24.6	48	23.4
10.3	30.1	2	32.1	48	15.9
14.6	27.2	2	29.2	48	18.8
16.9	26.5	2	28.5	48	19.5
17.1	25.6	2	27.6	48	20.4
21	27	2	29	48	19
25.2	25.4	2	27.4	48	20.6
29.4	31.4	2	33.4	48	14.6

Table 7.2-2: Line 2 Conducted EMI Results

LINE 2					
Frequency (MHz)	Uncorrected Reading (dBuV)	Cable + LISN loss (dB)	Corrected Reading (dBuV)	FCC Limit (dBuV)	Margin (dB)
0.736	41.4	2	43.4	48	4.6
4.2	30.6	2	32.6	48	15.4
6.3	33	2	35	48	13
10.3	31	2	33	48	15
14.6	25	2	27	48	21
16.9	27	2	29	48	19
17.1	25.6	2	27.6	48	20.4
21	26	2	28	48	20
25.2	24.8	2	26.8	48	21.2
29.4	31.6	2	33.6	48	14.4

The calculation for the conducted emissions is as follows:

$$\begin{aligned}\text{Corrected Reading} &= \text{Analyzer Reading} + \text{LISN Loss} + \text{Cable Loss} \\ \text{Margin} &= \text{Corrected Reading} - \text{Applicable Limit}\end{aligned}$$

Test setup photographs are shown below in figure 7.2-1:



Figure 7.2-1: Conducted Emissions Test Setup

7.3 Radiated Emissions - FCC Section 15.209

Radiated emissions tests were performed over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements above 30MHz.

The EUT was caused to go into a "Receive Only" mode of operation for this test. Results of the test are given in Table 7.3-1 below:

Table 7.3-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Antenna Polarity (H/V)	Uncorrected Reading (dBμV)	Cable Loss + Antenna Factor - Amplifier Gain (dB)	Corrected Reading (dBμV)	Limit (dBμV)	Margin (dB)	Results
95.74	V	53.04	-14.90	38.14	43.5	5.4	Pass
106.5	V	53.64	-13.58	40.06	43.5	3.4	Pass

Radiated emissions test setup photographs are shown below in figure 7.3-1:



Figure 7.3-1: Unintentional Radiated Emission Test Setup

7.4 Peak Output Power Requirement - FCC Section 15.247(b)

The peak output power of the EUT was made at the antenna connector using an 8560E Spectrum Analyzer. The 6dB bandwidth of the device was measured to be 1.2MHz, therefore a spectrum analyzer with the RBW set to 2MHz was used to measure the output power of the device. For the measurement, the EUT was caused to generate a constant carrier. Results are shown below in Table 7.4-1 and Figure 7.4-1.

Table 7.4-1: Peak Output Power

Frequency (MHz)	Output Power (dBm)
917.58	23.83

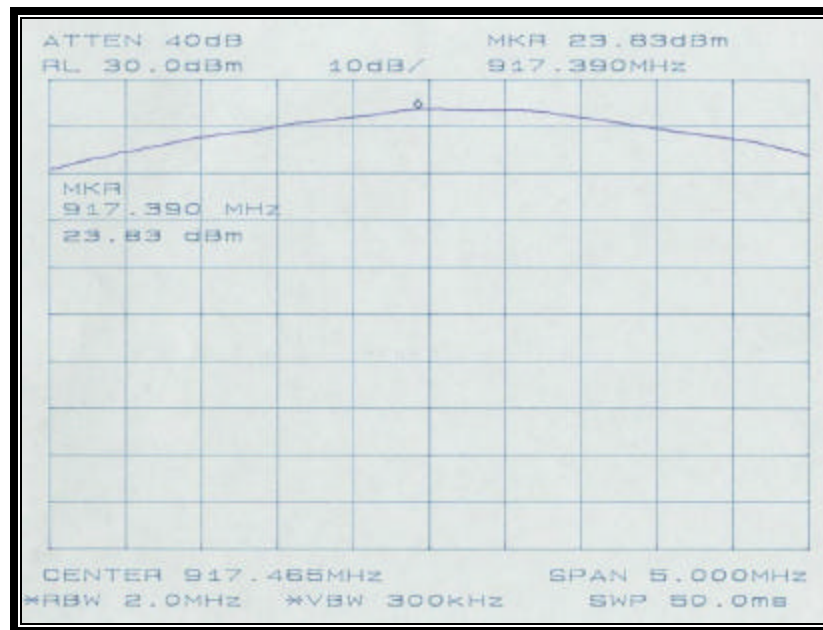


Figure 7.4-1: Output power

7.5 6dB Bandwidth

For the 6dB bandwidth test, the EUT was caused to generate a continuous carrier on the fundamental frequency. The result is shown below in table 7.5-1:

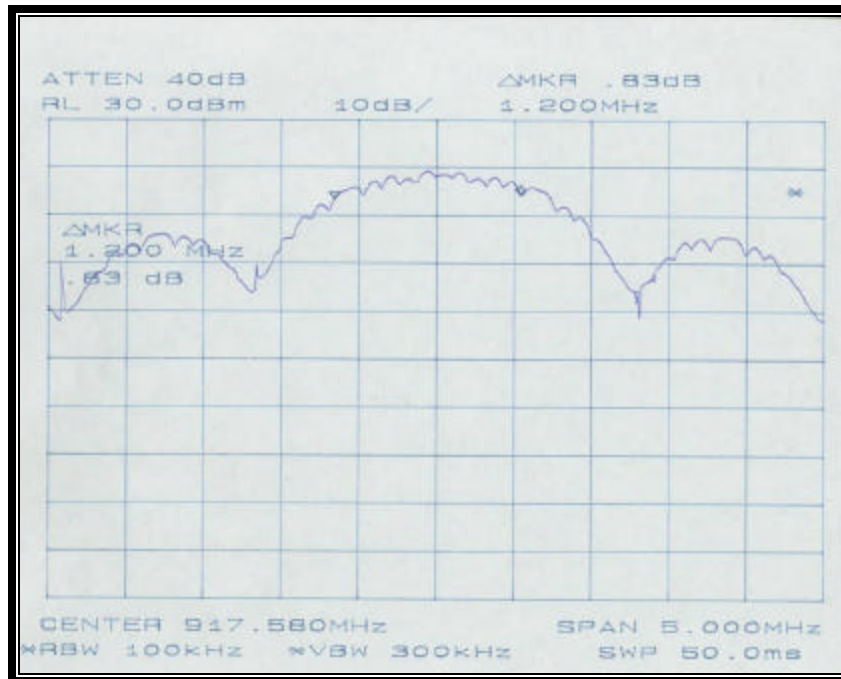
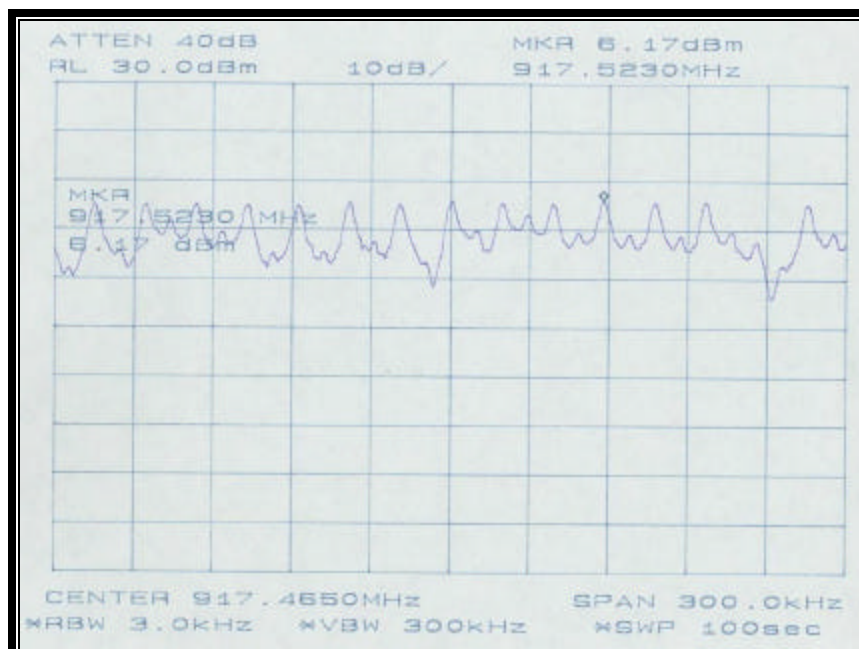


Figure 7.5.1-1: 6dB Bandwidth

7.6 Power Spectral Density

The power spectral density was measured in accordance with OET bulletin 97-114, appendix C. The EUT was caused to generate a constant carrier on the fundamental frequency. The results are recorded in figure 7.6-1 below.



7.7 Spurious Emissions - FCC Section 15.247(c)

7.7.1 RF Conducted Spurious Emissions

The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. For each measurement, the spectrum analyzer's VBW was set to 100kHz and the RBW was set to 1MHz.

7.7.1.1 Test Setup Photographs

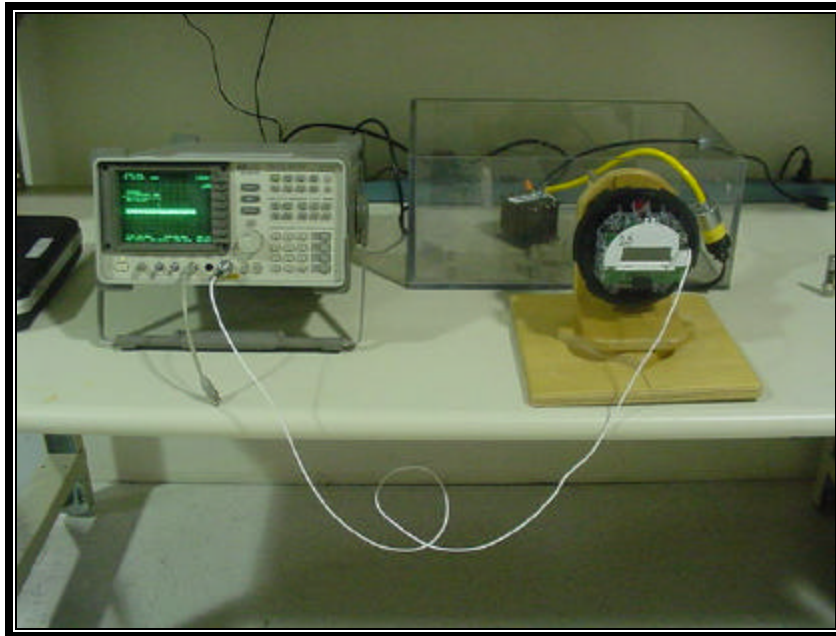


Figure 7.7.1-1: Conducted Spurious Emissions Test Setup

7.7.1.2 Test Results

The RF conducted spurious emissions found in the band of 30MHz to 10GHz are reported in Figures 7.7.1.2-1 through 7.7.1.2-7 below. Each emission was compared to the fundamental reference level to determine if they were at least 20dB below the reference level.

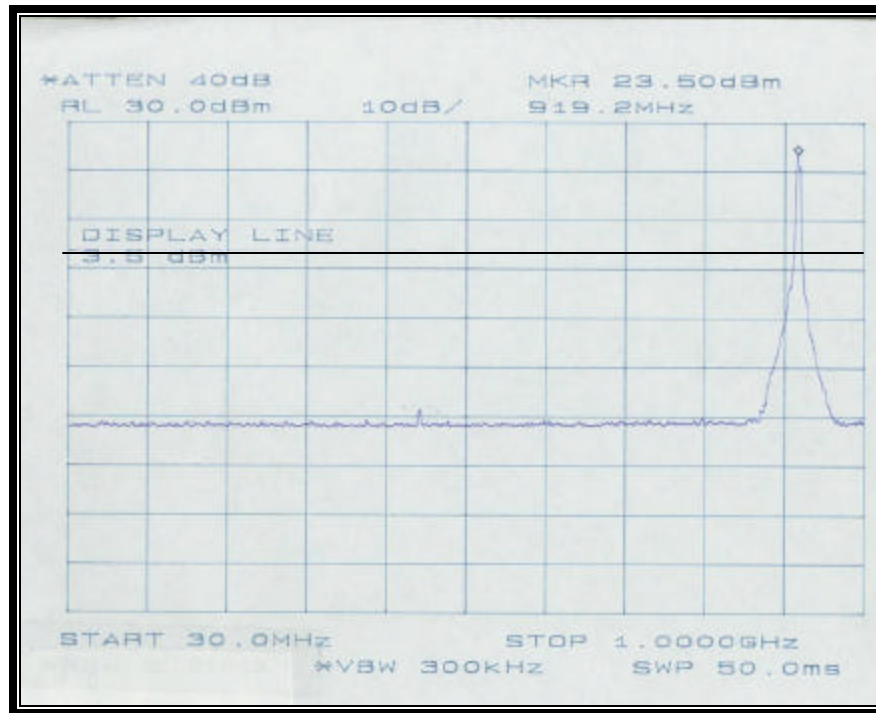


Figure 7.7.1.2-1: Conducted spurious from 30MHz to 1000MHz

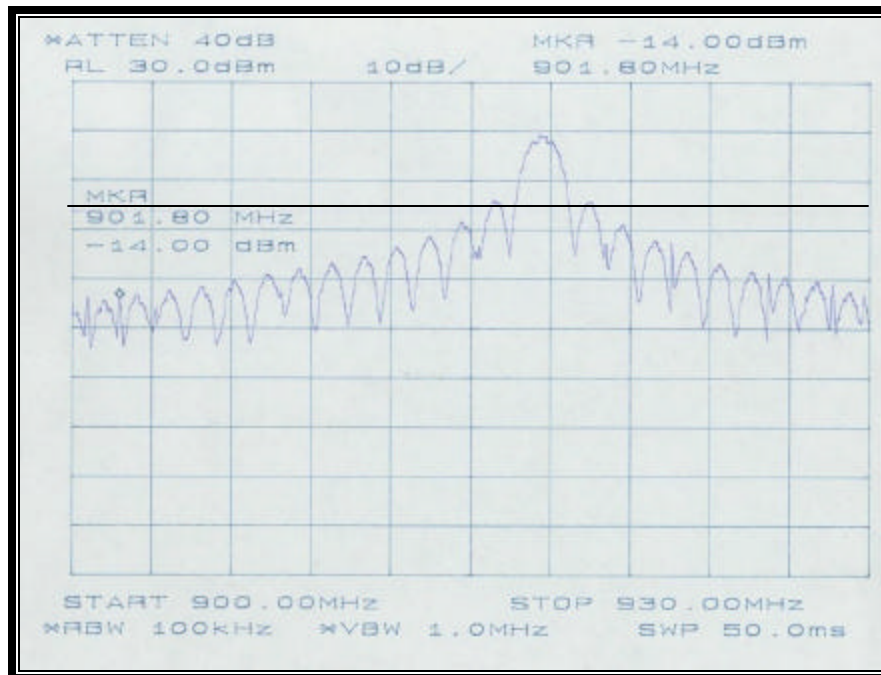


Figure 7.7.1.2-2 Conducted spurious at lower band edge

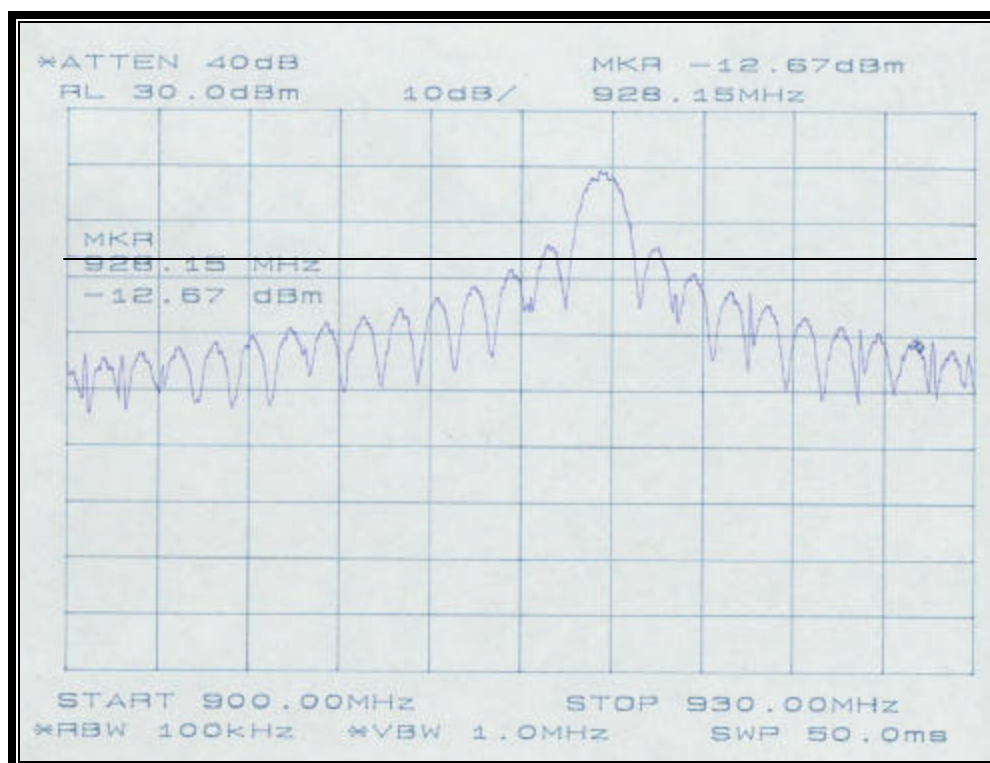


Figure 7.7.1.2-3: Conducted spurious at upper band edge

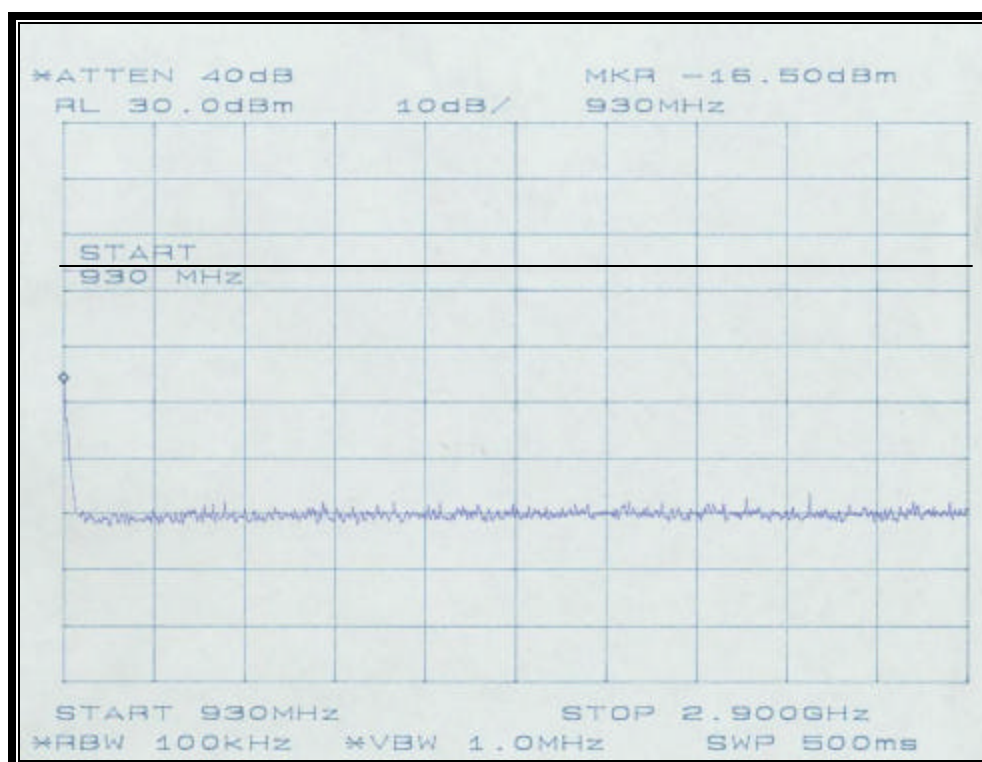


Figure 7.7.1.2-4: Conducted spurious emissions from 930MHz to 2.9GHz

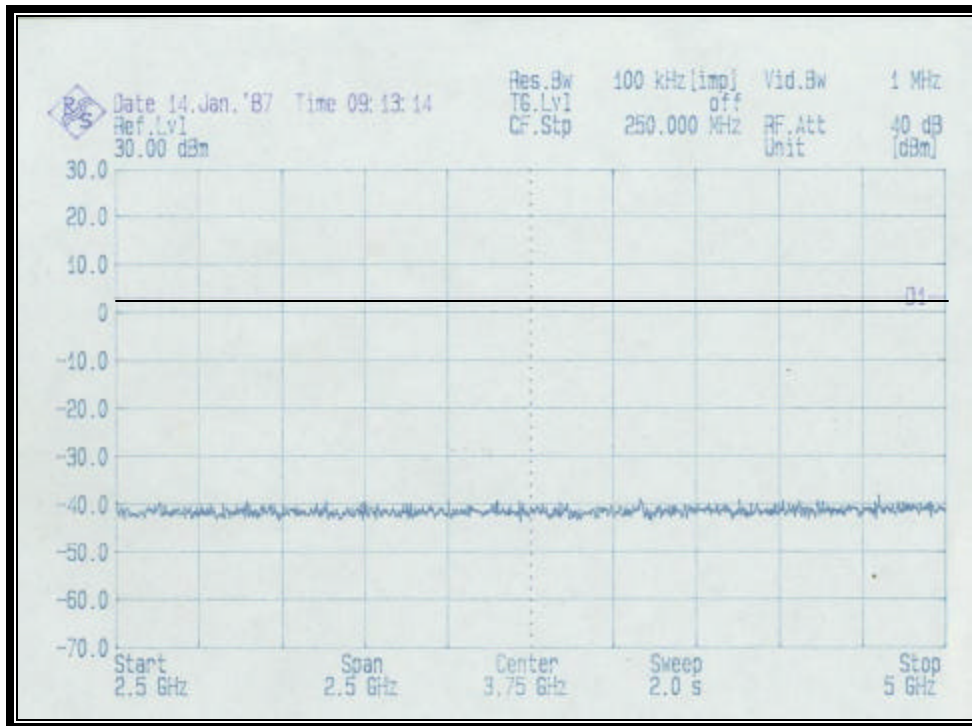


Figure 7.7.1.2-5: Conducted spurious from 2.5 to 5.0 GHz

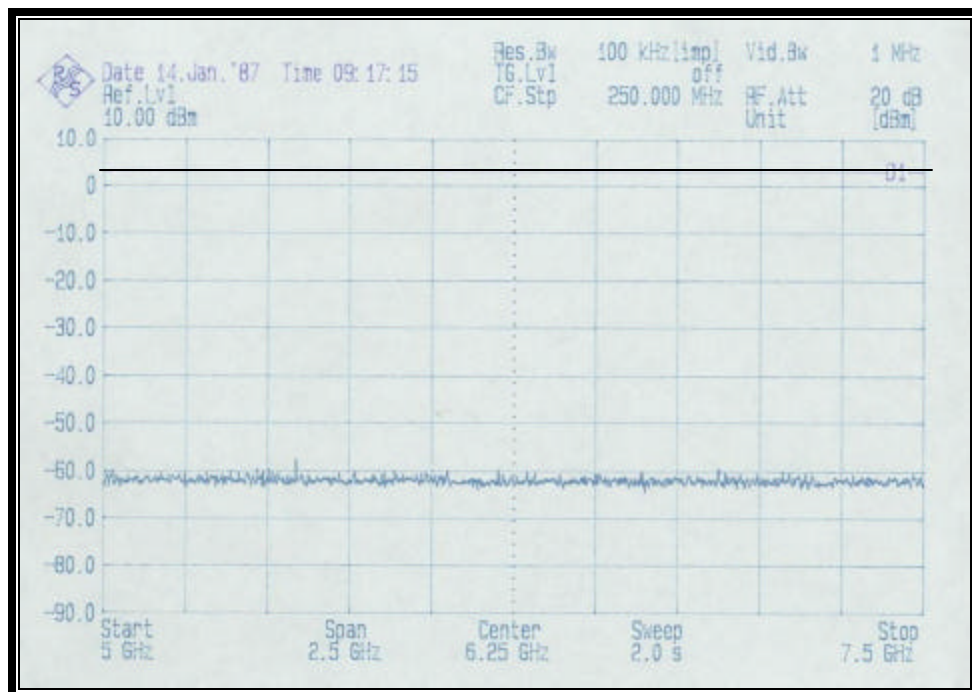


Figure 7.7.1.2-6: Conducted spurious from 5.0 to 7.5GHz

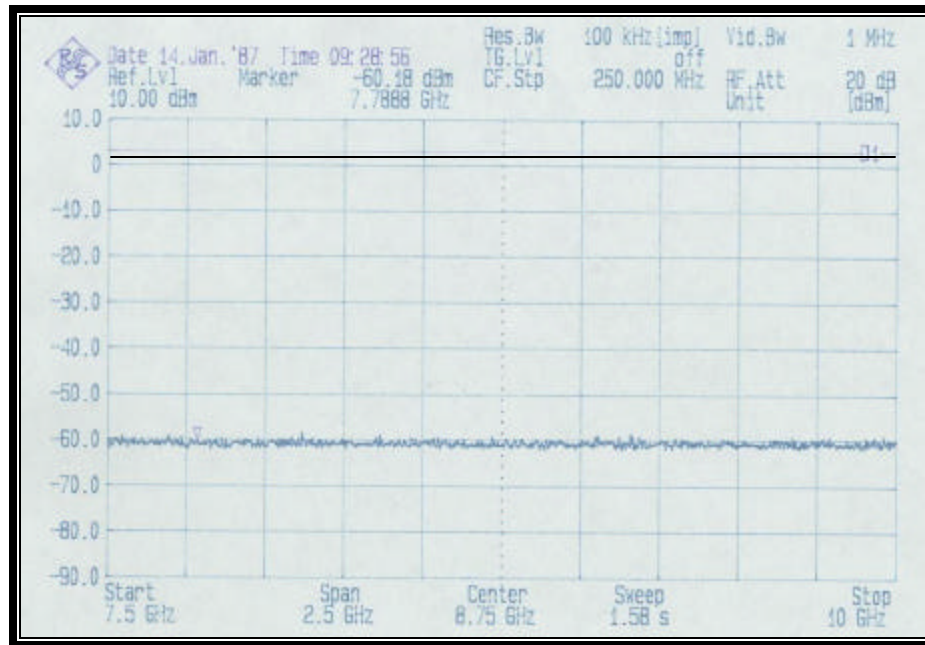


Figure 7.7.1.2-7: Conducted spurious emissions from 7.5GHz to 10.0GHz

7.7.2 Radiated Spurious Emissions(Restricted Bands) - FCC Section 15.205

Radiated emissions tests were made over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency on each antenna given in section 1.2.3.

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 of 120kHz and a video bandwidth of 300kHz. For frequencies above 1000MHz, average measurements were made using a resolution bandwidth of 1MHz and a video bandwidth of 10Hz.

The EUT was caused to generate a constant carrier on the high, mid and low channels of operation.

7.7.2.1 Test Setup Photographs

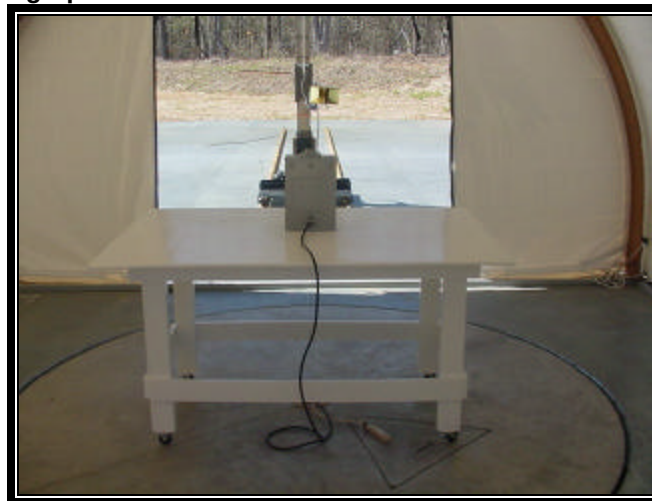


Figure 7.7.2.1-1: Radiated Spurious Emissions Test Setup

7.7.2.2 Test Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in Table 7.7.2.2-1. Plots of these emissions are also presented separately in Appendix A of this filing. Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits for a class B device defined in section 15.209.

Table 7.7.2.2-1: Radiated Spurious Emissions

Frequency (MHz)	Antenna Distance (m)	Level (dBm)	Correction Factors (dB)	Corrected Level (dBm)	Corrected Level (uV/m)	Limit (uV/m)	Margin (uV)	Final Result (Pass/Fail)
1093	3	-68.90	-3.98	-72.88	50.82	500	449.18	PASS
1796	3	-73.3	0.45	-72.85	50.99	500	449.01	PASS
1836	3	-74.7	0.69	-74.01	44.63	500	455.37	PASS
2755	3	-63.7	4.80	-58.90	254.11	500	245.89	PASS
3676	3	-62.23	7.56	-54.67	413.61	500	86.39	PASS
4588	3	-66.6	9.31	-57.29	305.96	500	194.04	PASS
5506	3	-68.5	12.29	-56.21	346.53	500	153.47	PASS
6423	3	-74.5	12.64	-61.86	180.73	500	319.27	PASS
7340	3	-72.18	15.51	-56.67	328.38	500	171.62	PASS
8258	3	-72.84	15.00	-57.84	286.95	500	213.05	PASS
9183	3	-82	15.90	-66.10	110.91	500	389.09	PASS

Sample Calculation:

$$R_C = R_U + CF_T$$

Where:

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

Example Calculation:

$$-68.9\text{dBm} + (-3.98\text{dB}) = -72.88\text{dBm} \text{ or } 50.82 \text{ uV/m}$$

$$\text{Conversion from dBm to uV/m} = \text{Antilog}((-72.88+107/20))$$

$$\text{Margin} = 500\text{uV/m} - 50.82 \text{ uV}$$

8.0 RF EXPOSURE SECTION 15.247(b)(4)

Although Table 1 of OET Bulletin 65, Supplement C, does not cover 915MHz devices operating at less than 2.5 Watts where nearby persons are normally **greater** than 20cm from the device, the EUT satisfies the "Applicable Methods to Ensure Compliance" for devices operating at 915MHz at less than 2.5 Watts where nearby persons are normally **less** than 20cm from the device. Routine environmental evaluation is not required and special instructions and/or warnings are not warranted.

9.0 CONCLUSION

In the opinion of ACS, Inc. the CENTRON OOK RF Module with the Centron 2S Meter Direct Sequence spread spectrum module, manufactured by SchlumbergerSema, Inc., meets the requirements of FCC Part 15 subpart C.