Certification Test Report

FCC ID: SDBBTXCVR
IC: 2220A-BTXCVR

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

ACS Report Number: 08-0041-LD

Manufacturer: Sensus Metering Systems Inc.
Model: BTXCVR

Test Begin Date: July 23, 2008
Test End Date: March 13, 2009

Report Issue Date: May 15, 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.

Prepared by: Ken Rivers
Ken Rivers
Wireless Certifications Technician
ACS, Inc.

Reviewed by: ______________________
Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 31 pages

Table of Content

Additional Exhibits Included In Filing

Internal Photographs
Tune-up Procedure
Product Labeling
Installation/Users Guide
Theory of Operation
Schematics
External Photographs
Test Setup Photographs
RF Exposure
System Block Diagram
Parts List

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.

1.2 Product Description

The BTXCVR is a Bluetooth Micro-Transceiver for use within a 2-way fixed AMR network where RF modules communicate directly to base stations or other endpoint modules. The BTXCVR is used to remotely communicate to endpoint devices and send setup or status commands via licensed frequency bands contained in FCC rule parts 24, 90, 101 and IC RSS-119, RSS-134.

The Bluetooth Micro- Transceiver model BTXCVR also contains a Bluetooth pre-approved single modular device FCC ID: ED9LMX9838.

Only the Bluetooth Micro- Transceiver model BTXCVR is included in this report. A separate filing will be made for any other models that may be described in the documentation accompanying this report.

Manufacturer Information:
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

Test Sample Serial Numbers: SMSUT00518, SMSUT00542, SMSUT00349

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 Configurations

1.3.1 Test Configurations and Justification

For RF conducted measurements, the BTXCVR was modified with an external RF connector to the PCB. The BTXCVR utilizes non-detachable antennas for normal operation but for RF conducted testing the antennas were disconnected and a 50-Ohm test cable soldered (with the appropriate ground connection) to the PCB.

The BTXCVR was evaluated for radiated emissions in multiple orientations with data for the worst case position presented in this report.

The BTXCVR was also evaluated for radiated intermodulation products for simultaneous transmission with Bluetooth module FCC ID: ED9LMX9838. Radiated intermodulation products were below the permissible limit.

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 USBXCVR 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 / IC Radio Standards Specification	Frequency Band of Operation (MHz)
24D / RSS-134	901.0 - 902.0
24D / RSS-134	930.0 - 931.0
24D / RSS-134	940.0 - 941.0
90 / RSS-119	896.0 - 901.0
90 / RSS-119	935.0 - 940.0
101 / RSS-119	928.85 - 929.0
101 / RSS-119	932.0 - 932.5
101 / RSS-119	941.0 - 941.5

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 bands of operation is outlined in the following table.

<table>
<tr><th>CFR Title 47 Rule Part / IC Radio Standards Specification</th><th>Frequency Band of Operation
(MHz)</th><th>Location in the Range of Operation</th></tr>
<tr><td>90 / RSS-119</td><td>896.0 - 901.0</td><td rowspan="2">1 near top and 1 near bottom</td></tr>
<tr><td>24D / RSS-134</td><td>901.0 - 902.0</td></tr>
<tr><td>101 / RSS-119</td><td>928.85 - 929.0</td><td>Middle</td></tr>
<tr><td>24D / RSS-134</td><td>930.0 - 931.0</td><td>Middle</td></tr>
<tr><td>101 / RSS-119</td><td>932.0 - 932.5</td><td>Middle</td></tr>
<tr><td>90 / RSS-119</td><td>935.0 - 940.0</td><td rowspan="3">1 near top and 1 near bottom</td></tr>
<tr><td>24D / RSS-134</td><td>940.0 - 941.0</td></tr>
<tr><td>101 / RSS-119</td><td>941.0 - 941.5</td></tr>
</table>

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

1.4 Emission Designators

The BTXCVR produces one distinct modulation format. The emission designator for this modulation format is as follows:

MPass Mode: 5K90F1D

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 4175A
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:

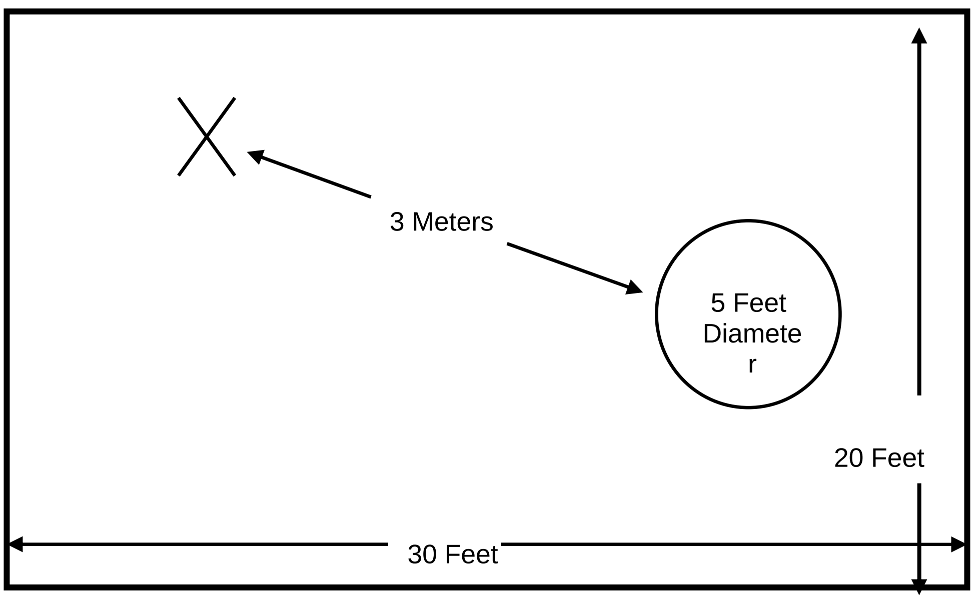

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

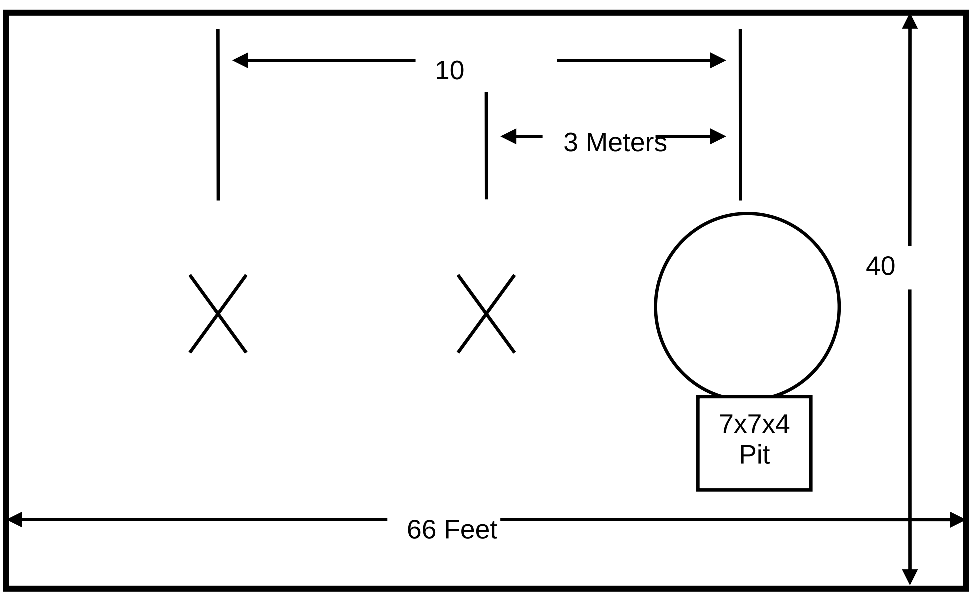

Figure 2.3-2: Open Area Test Site

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:

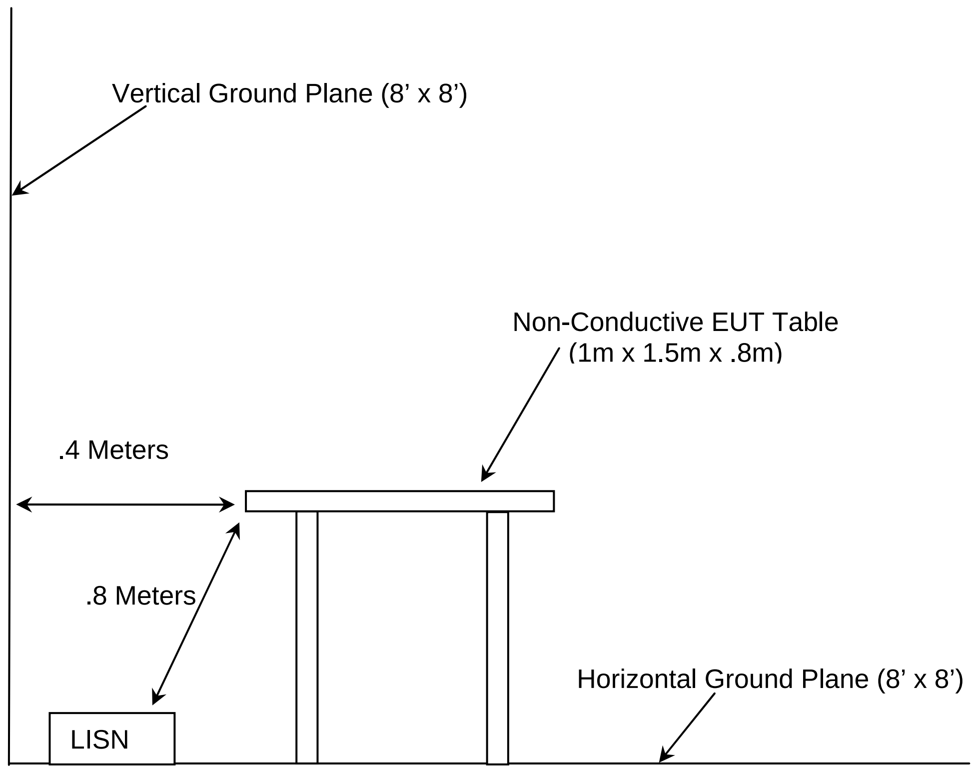

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

1 - ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz - 2003
2 - US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures - 2008
3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communication Service - 2008
4 - US Code of Federal Regulations (CFR): Title 47, Part 90, Subpart I: Private Land Mobile Radio Services - 2008
5 - US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services – 2007
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 9, June 2007
8 - Industry Canada Radio Standards Specification: RSS-134 - 900 MHz Narrowband Personal Communications Services - Issue 1, Revision 1, March 25, 2000

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

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
3	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	839379/011	02-02-2010
4	Rohde & Schwarz	Spectrum Analyzers	ESMI - Receiver	833827/003	02-02-2010
22	Agilent	Amplifiers	8449B	3008A00526	10-22-2009
25	Chase	Antennas	CBL6111	1043	08-22-2009
30	Spectrum Technologies	Antennas	DRH-0118	970102	05-07-2009
222	Andrew	Cables	F1-SMSM	473703-A0138A	08-07-2009 (See Note1)
140	Thermotron	Environmental Chamber	SM-16C	19639	08-30-2009
153	EMCO	LISN	3825/2	9411-2268	01-27-2010
167	ACS	Cable Set	Chamber EMI Cable Set	167	02-06-2010 (See Note1)
168	Hewlett Packard	Attenuators	11947A	44829	02-10-2010 (See Note2)
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	09-19-2009
291	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	None	11-24-2009 (See Note1)
292	Florida RF Cables	Cables	SMR-290AW-480.0-SMR	None	11-24-2009 (See Note1)
321	Hewlett Packard	Amplifiers	HPC 8447D	1937A02809	06-16-2009
324	ACS	Cables	Belden	8214	07-28-2009 (See Note1)
337	Microwave Circuits	Filters	H1G513G1	282706	08-04-2009 (See Note1)
338	Hewlett Packard	Amplifiers	8449B	3008A01111	10-22-2009
339	Aeroflex/Weinschel	Attenuators	AS-18	7142	07-08-2009 (See Note2)
422	Florida RF	Cables	SMS-200AW-72.0-SMR	805	02-05-2010 (See Note1)
NA	Agilent	Signal Generator	E8257D	MY46521977	02-23-2010

Note1: Items characterized on an annual cycle. The date shown indicates the next characterization due date.
Note2: Items verified on an annual cycle. The date shown indicates the next verification due date.

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	AC Adapter	Jameco	SYS1193-1005-W2	NA

6.0 EQUIPMENT UNDER TEST SETUP AND BLOCK DIAGRAM

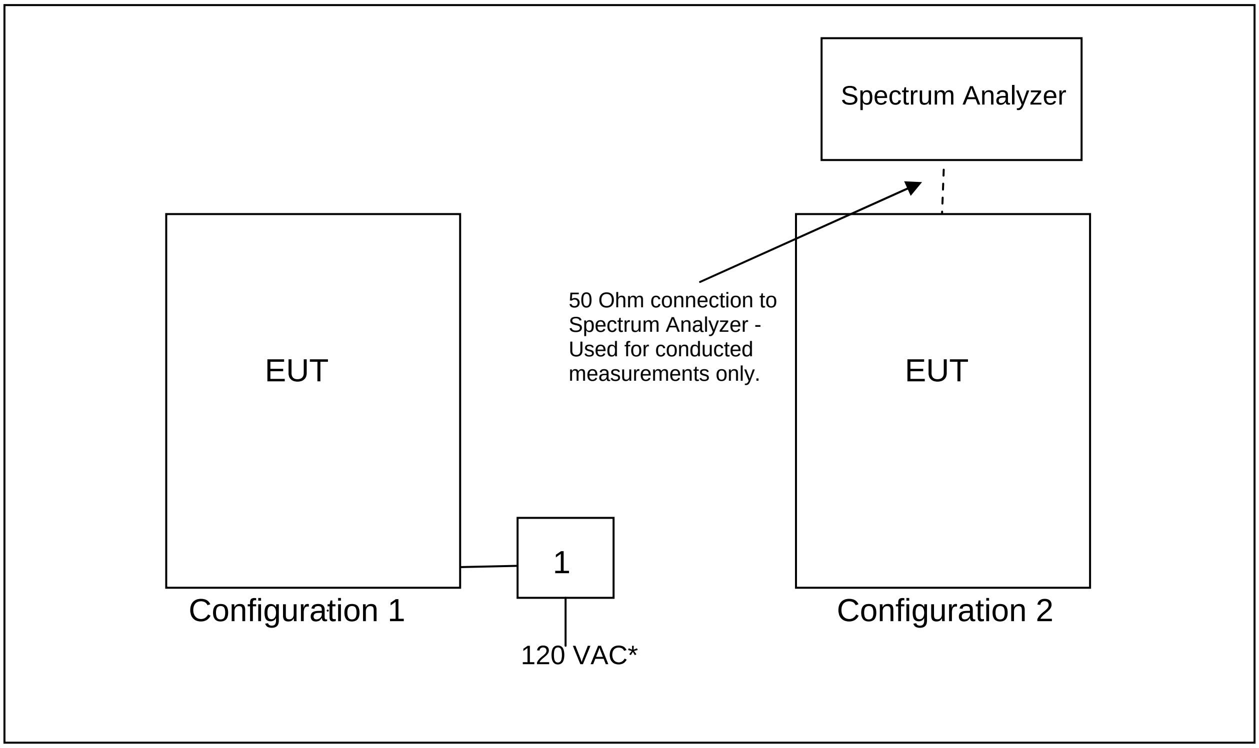

Figure 6-1: EUT Test Setup

For RF conducted measurements, the BTXCVR was modified with an external RF connector to the PCB. The BTXCVR utilizes a non-detachable antenna for normal operation but for RF conducted testing the antenna were disconnected and a 50-Ohm test cable soldered (with the appropriate ground connection) to the PCB. For RF conducted measurements the 50-Ohm test cable was directly connected to spectrum analyzer via an attenuator.

*Note: The AC adaptor was only included for AC power line conducted emissions. The device could not transmit when the AC adaptor was connected therefore it was not included in the evaluation of radio parameters.

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 RF Power Output

7.1.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 10 dB passive attenuator. The resolution and video bandwidths of the spectrum analyzer were set at sufficient levels, >> signal bandwidth, to produce accurate results. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results are shown below in Table 7.1.2-1 and Figure 7.1.2-1 through 7.1.2-7.

7.1.2 Measurement Results

Table 7.1.2-1: Peak Output Power

Frequency (MHz)	Rule Section (FCC / IC)	Output Power (dBm)
901.9875	Part 24.132 / RSS-134 5.4(a)	18.28
930.5000	Part 24.132 / RSS-134 5.4(a)	18.15
896.0875	Part 90.635(d) / RSS-119 5.41	18.66
935.0125	Part 90.635(d) / RSS-119 5.41	18.28
928.9250	Part 101.113(a) / RSS-119 5.41	18.73
932.2500	Part 101.113(a) / RSS-119 5.41	18.37
941.4875	Part 101.113(a) / RSS-119 5.41	18.16

Part 24.132 / RSS-134 5.4(a)

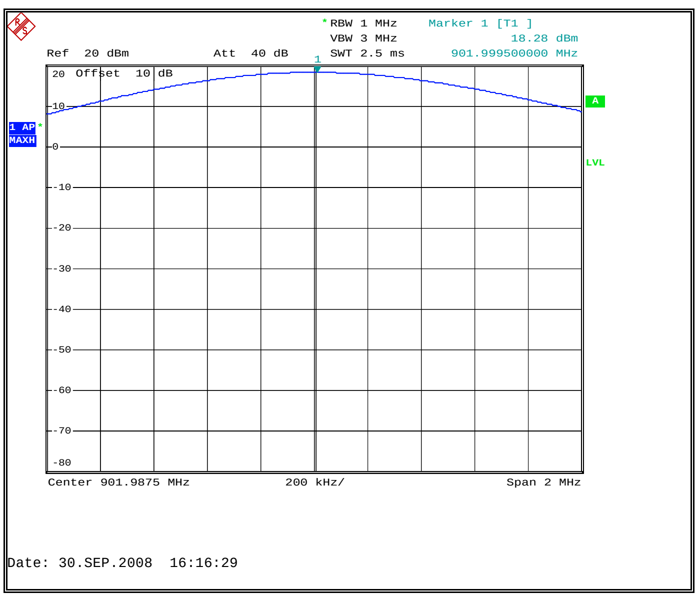

Figure 7.1.2-1: Peak Output Power 901.9875 MHz

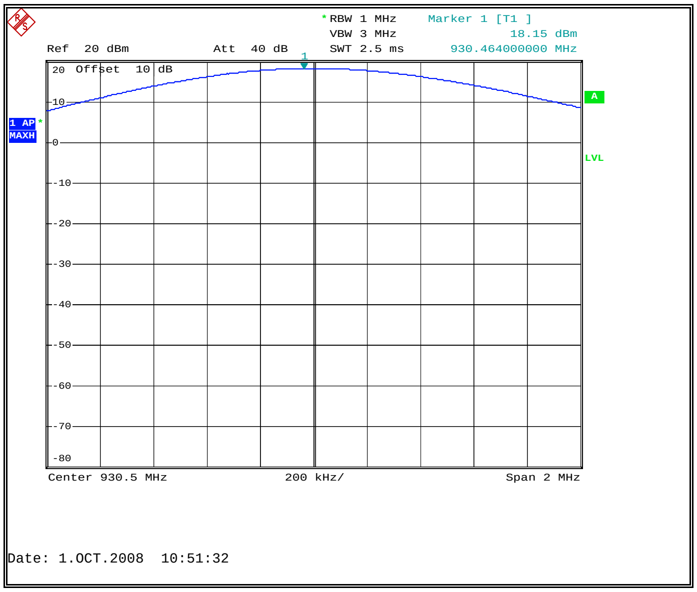

Figure 7.1.2-2: Peak Output Power 930.5 MHz

Part 90.635(d) / RSS-119 5.41

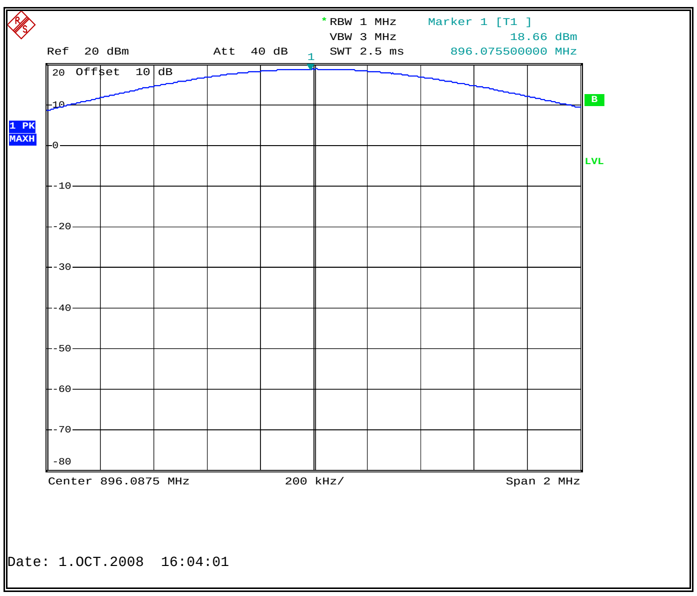

Figure 7.1.2-3: Peak Output Power 896.0875 MHz

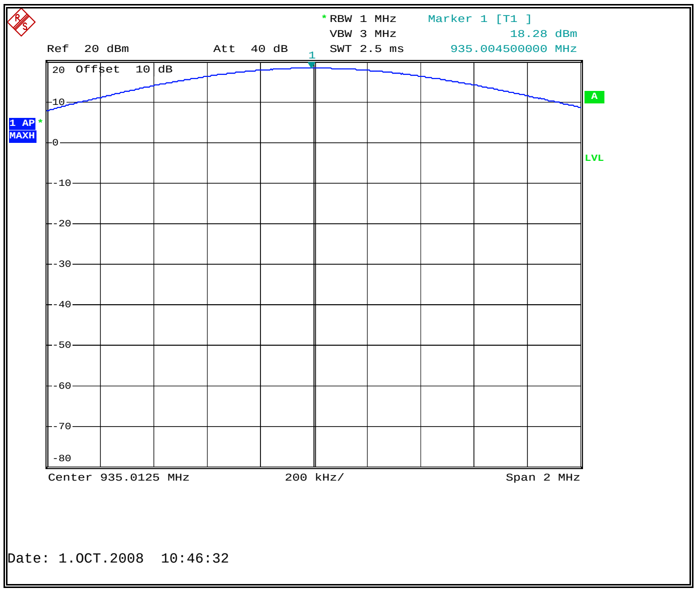

Figure 7.1.2-4: Peak Output Power 935.0125 MHz

Part 101.113(a) / RSS-119 5.41

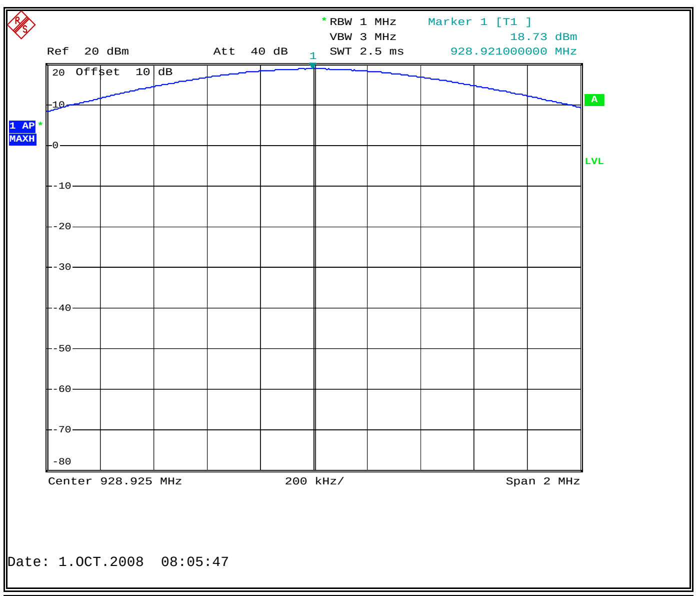

Figure 7.1.2-5: Peak Output Power 928.925 MHz

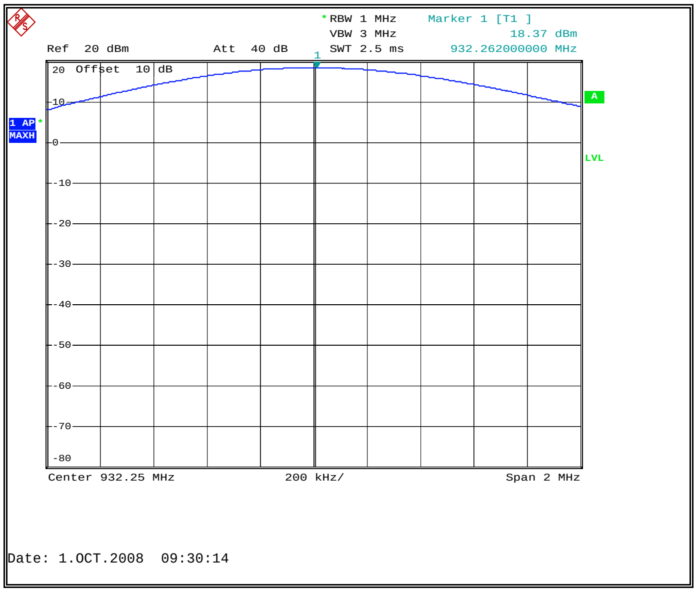

Figure 7.1.2-6: Peak Output Power 932.25 MHz

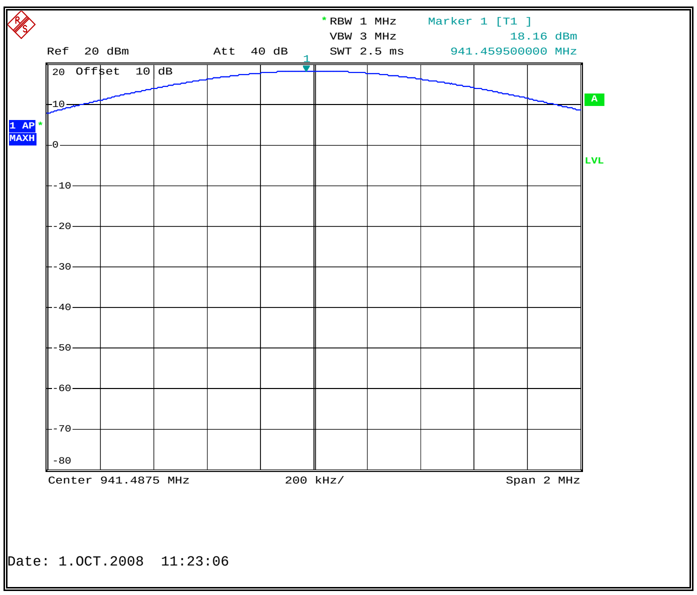

Figure 7.1.2-7: Peak Output Power 941.4875 MHz

7.2 Occupied Bandwidth (Emission Limits)

7.2.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 10 dB passive attenuator. The spectrum analyzer resolution and video bandwidths were set to 300 Hz and 3 kHz respectively. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results are shown below in Figures 7.2.2-1 through 7.2.2-9.

7.2.2 Measurement Results

Part 24.133 a(1), a(2), IC RSS-134 6.3(i), (ii)

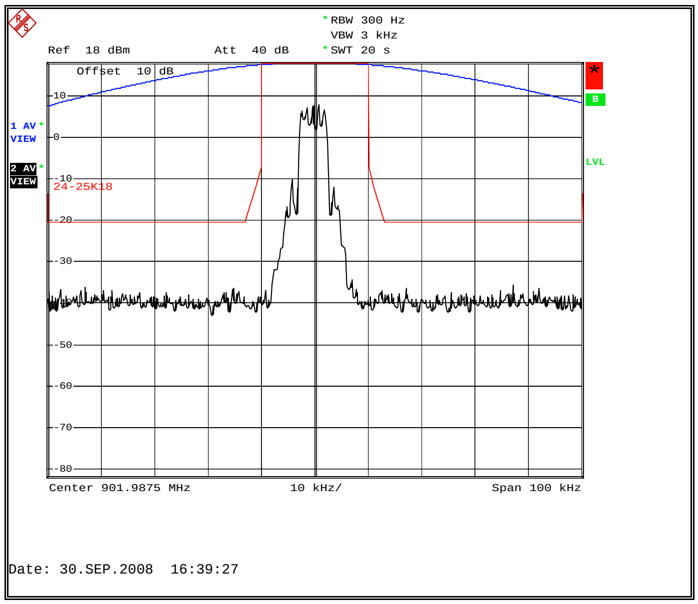

Figure 7.2.2-1: Emission Limits - 901.9875 MHz – 25 kHz Channel

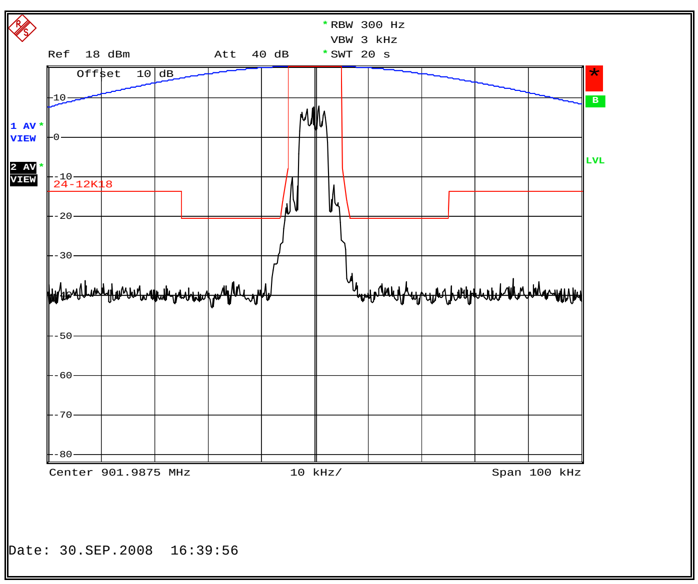

Figure 7.2.2-2: Emission Limits – 901.9875 MHz – 12.5 kHz Channel

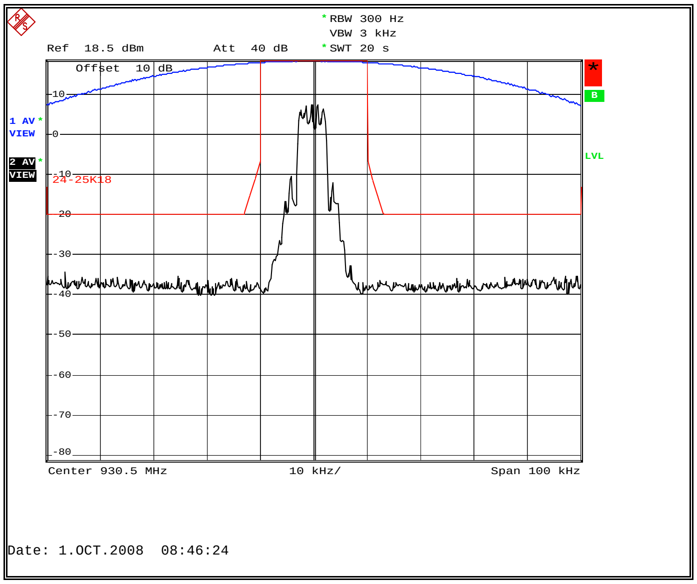

Figure 7.2.2-3: Emission Limits – 930.5 MHz – 25 kHz Channel

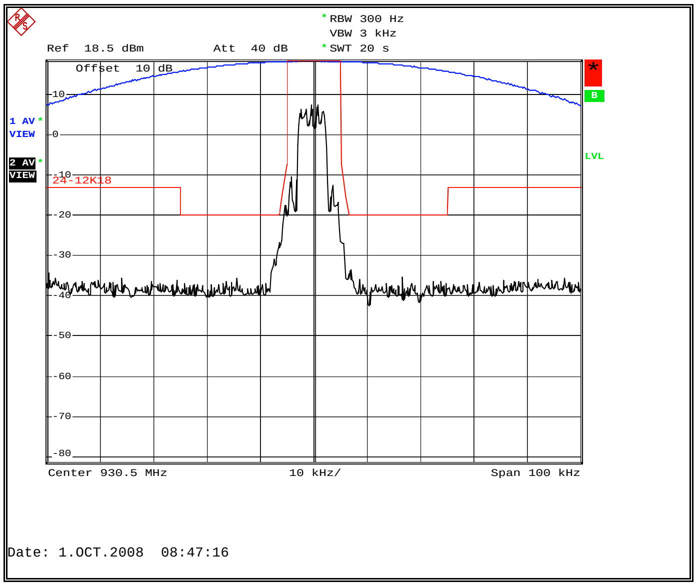

Figure 7.2.2-4: Emission Limits – 930.5 MHz – 12.5 kHz Channel

Part 90.210 (j), RSS-119 5.8.8

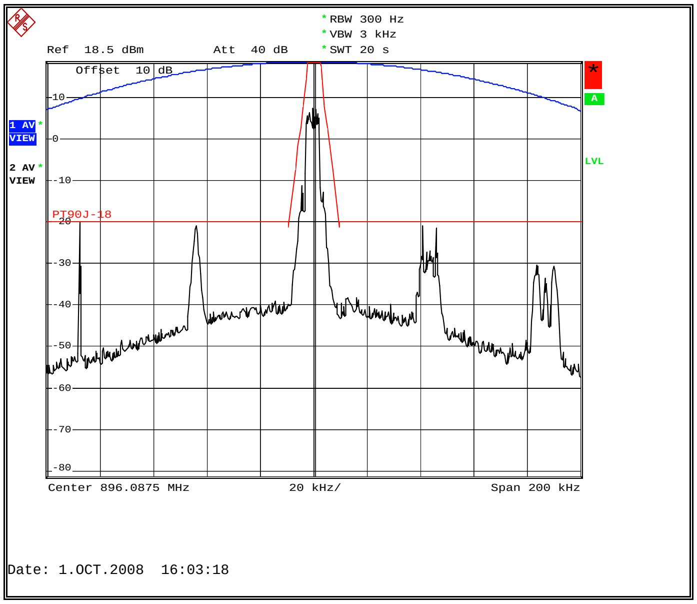

Figure 7.2.2-5: Emission Limits – 896.0875 MHz

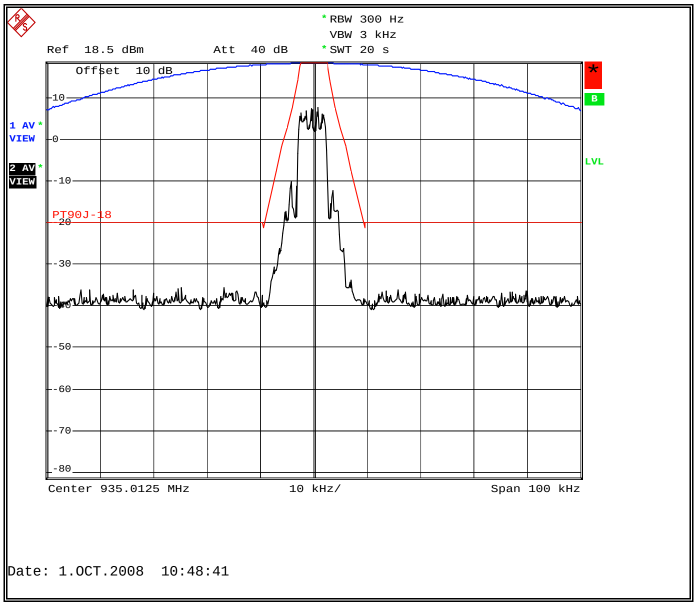

Figure 7.2.2-6: Emission Limits – 935.0125 MHz

<u>Part 101.111 a(6), RSS-119 5.8.6*</u>

*** FCC Part 101.111a(6) provides worst case**

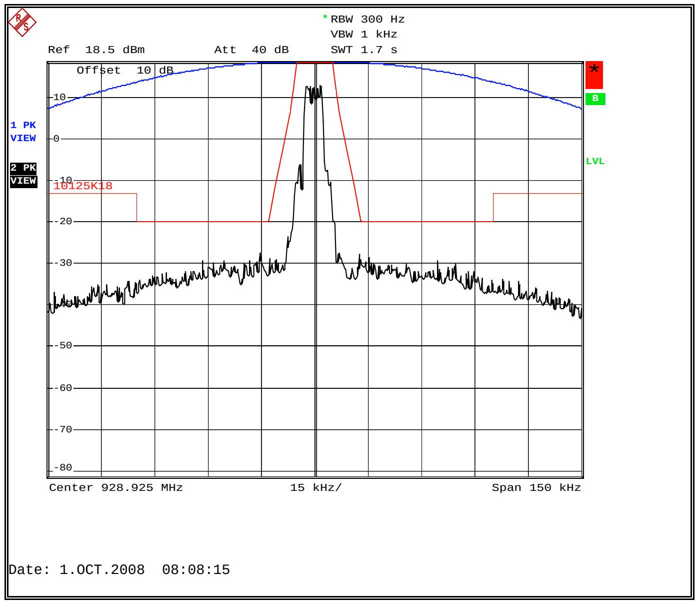

Figure 7.2.2-7: Emission Limits – 928.925 MHz

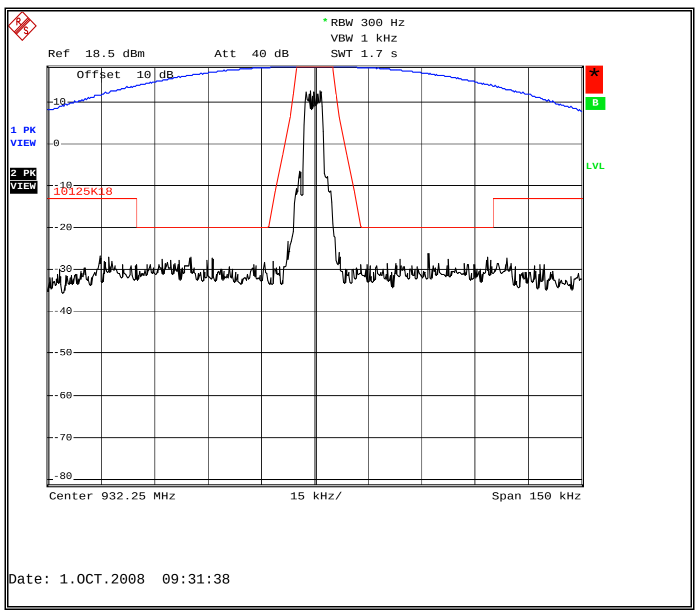

Figure 7.2.2-8: Emission Limits – 932.25 MHz

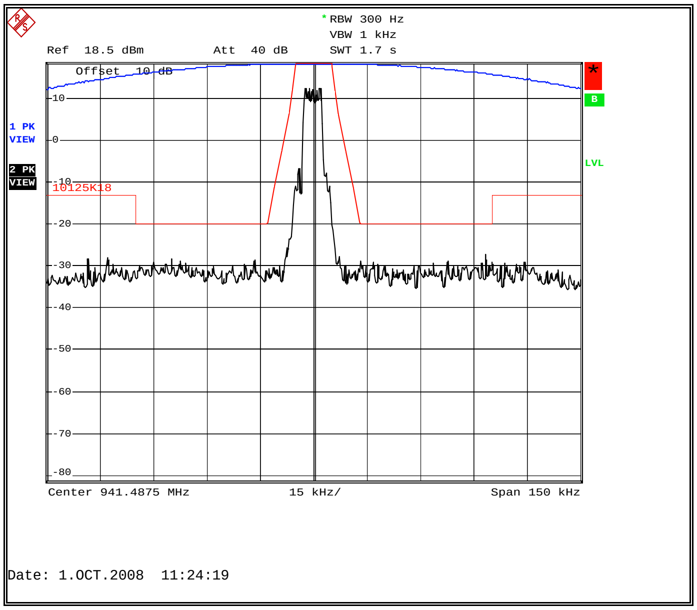

Figure 7.2.2-9: Emission Limits – 941.4875 MHz

7.3 Spurious Emissions at Antenna Terminals

7.3.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 10 dB passive attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz below 1000 MHz and 1 MHz above 1000 MHz. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. The spectrum was investigated in accordance to CFR 47 Part 2.1057. Measurement results are shown below in Figures 7.3.2-1 through 7.3.2.14.

7.3.2 Measurement Results

Part 24.133 a(1), a(2), IC RSS-134 6.3(i), (ii)

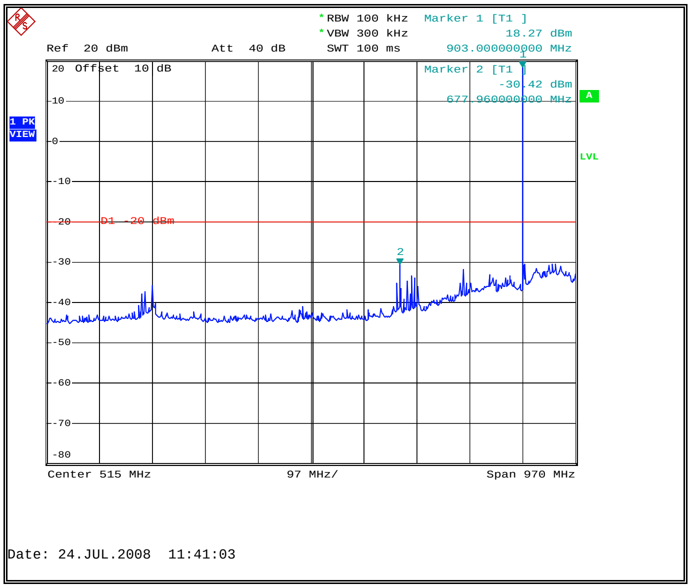

Figure 7.3.2-1: Conducted Spurious Emissions – 901.9875 MHz – 30MHz to 1GHz

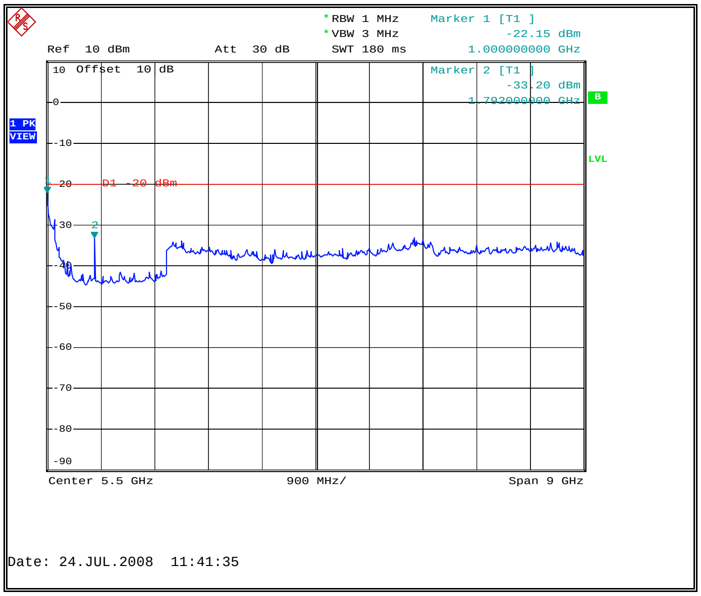

Figure 7.3.2-2: Conducted Spurious – 901.9875 MHz – 1GHz to 10GHz

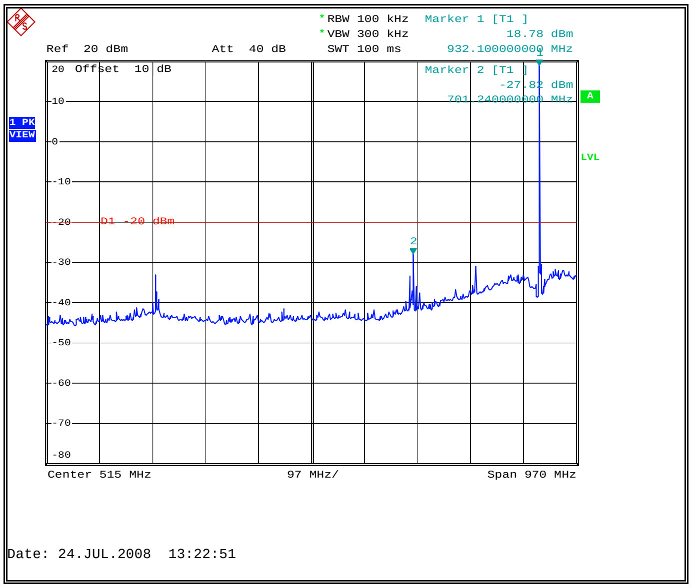

Figure 7.3.2-3: Conducted Spurious Emissions – 930.5 MHz – 30MHz to 1GHz

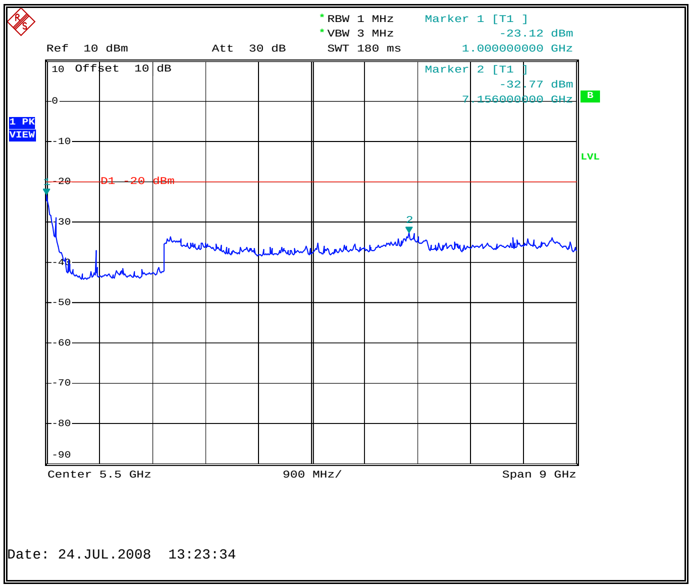

Figure 7.3.2-4: Conducted Spurious Emissions – 930.5 MHz – 1GHz to 10GHz

<u>Part 90.210 (j), RSS-119 5.8.8</u>

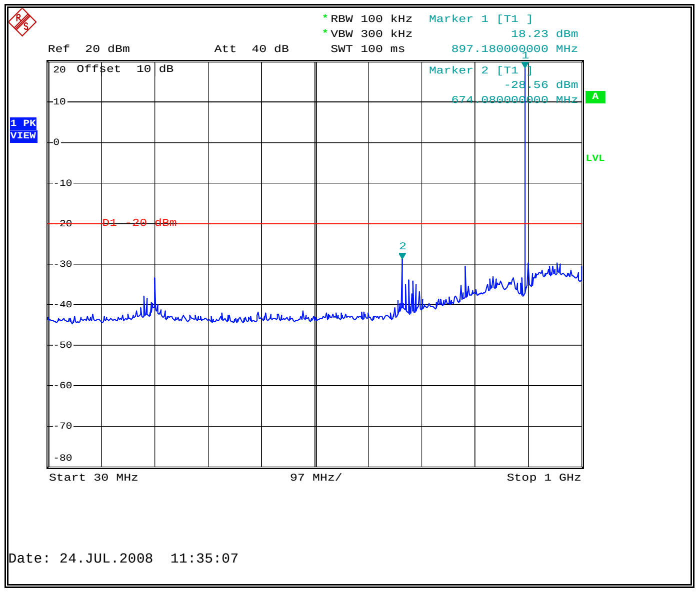

Figure 7.3.2-5: Conducted Spurious Emissions – 896.0125 MHz – 30MHz to 1GHz

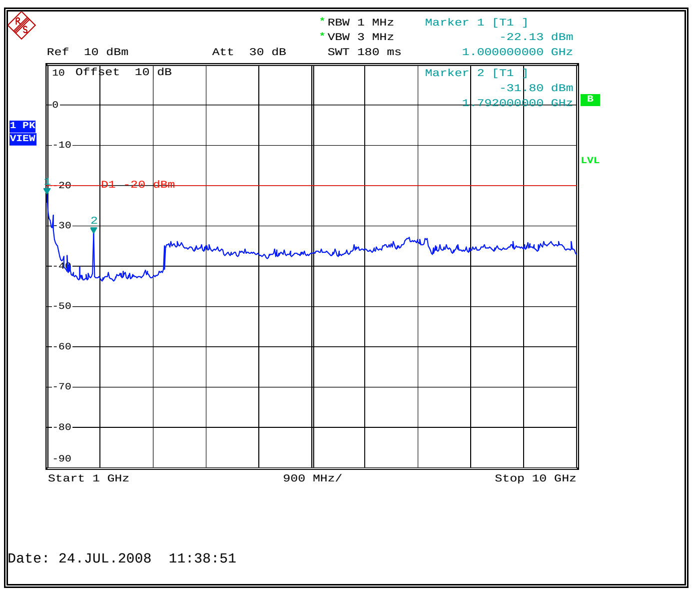

Figure 7.3.2-6: Conducted Spurious Emissions – 896.0125 MHz – 1GHz to 10GHz

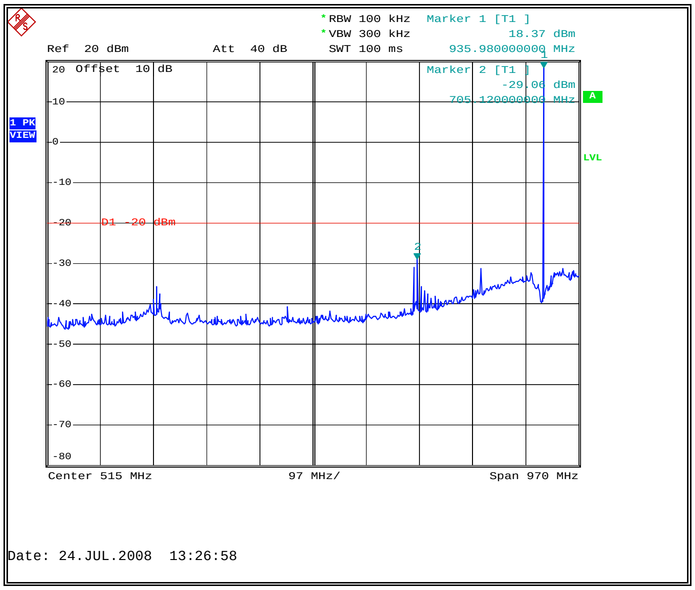

Figure 7.3.2-7: Conducted Spurious Emissions – 935.0125 MHz – 30MHz to 1GHz

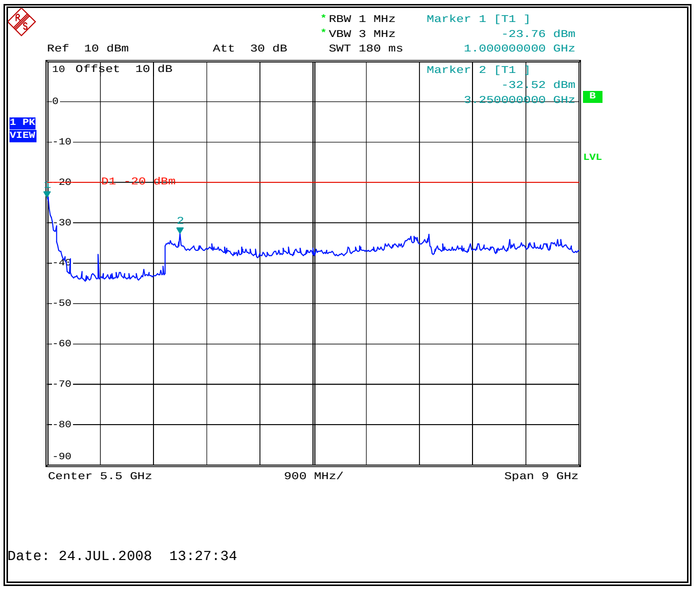

Figure 7.3.2-8: Conducted Spurious Emissions – 935.0125 MHz – 1GHz to 10GHz

Part 101.111 a(6), RSS-119 5.8.6

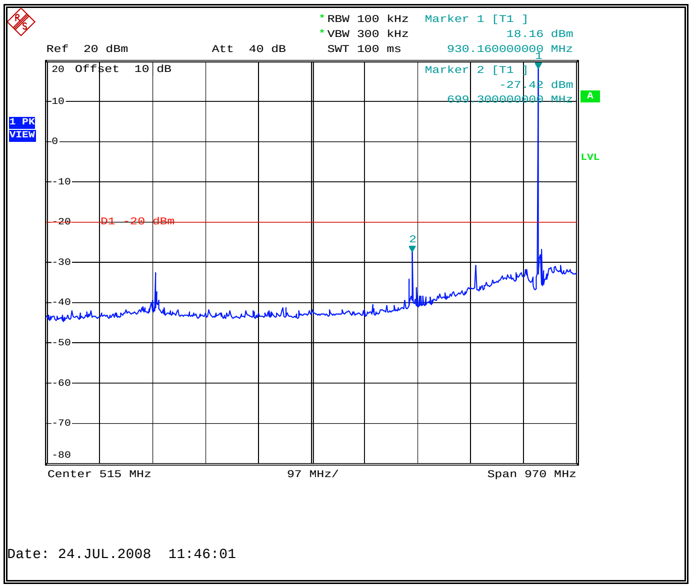

Figure 7.3.2-9: Conducted Spurious Emissions – 928.925 MHz – 30MHz to 1GHz

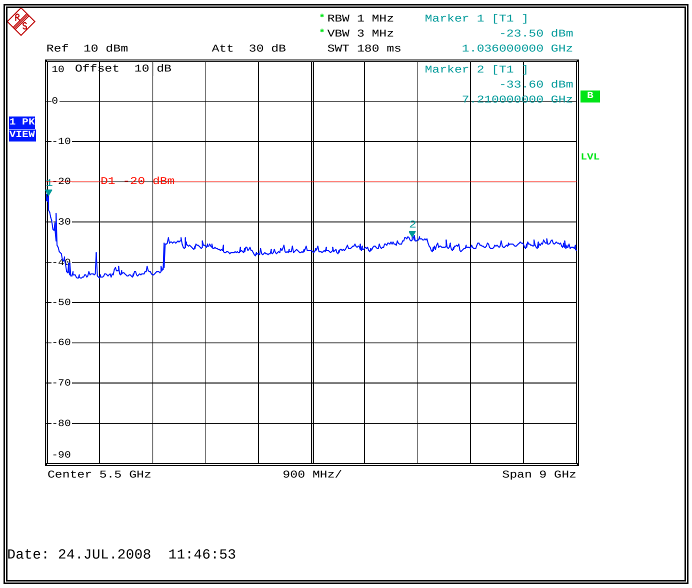

Figure 7.3.2-10: Conducted Spurious Emissions – 928.925 MHz – 1GHz to 10GHz

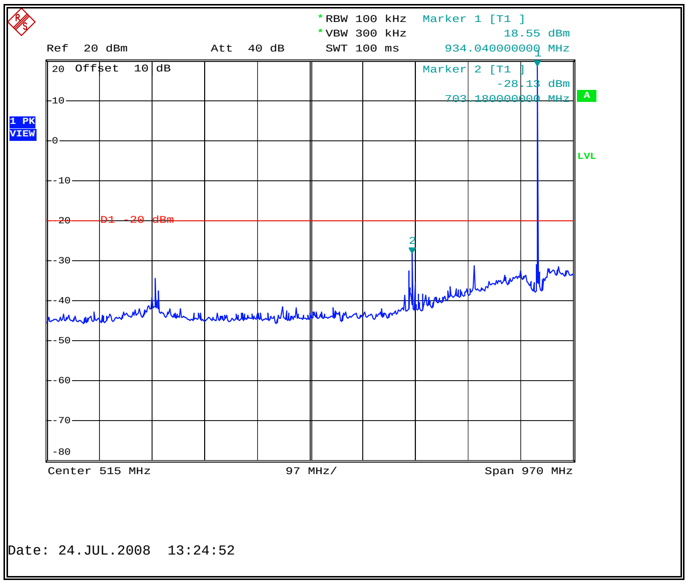

Figure 7.3.2-11: Conducted Spurious Emissions – 932.25 MHz – 30MHz to 1GHz

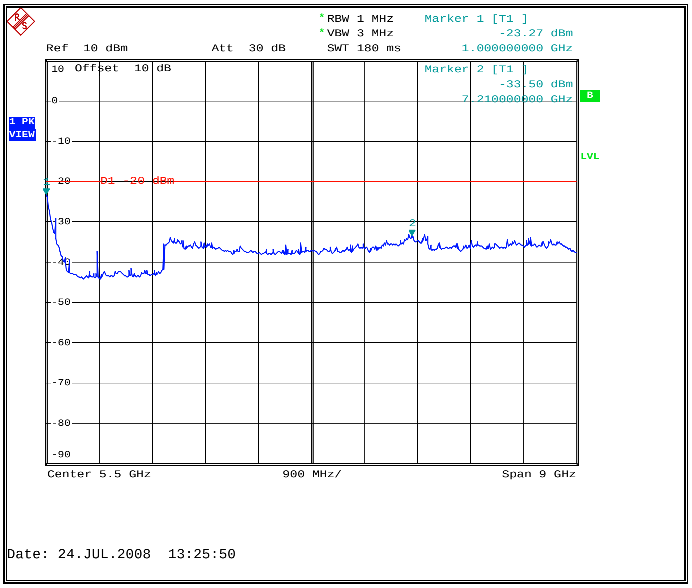

Figure 7.3.2-12: Conducted Spurious Emissions – 932.25 MHz – 1GHz to 10GHz

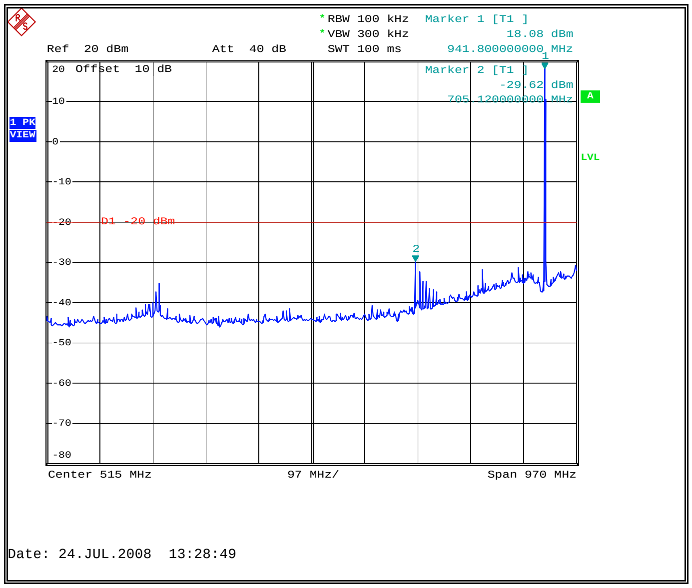

Figure 7.3.2-13: Conducted Spurious Emissions – 941.4875 MHz – 30MHz to 1GHz

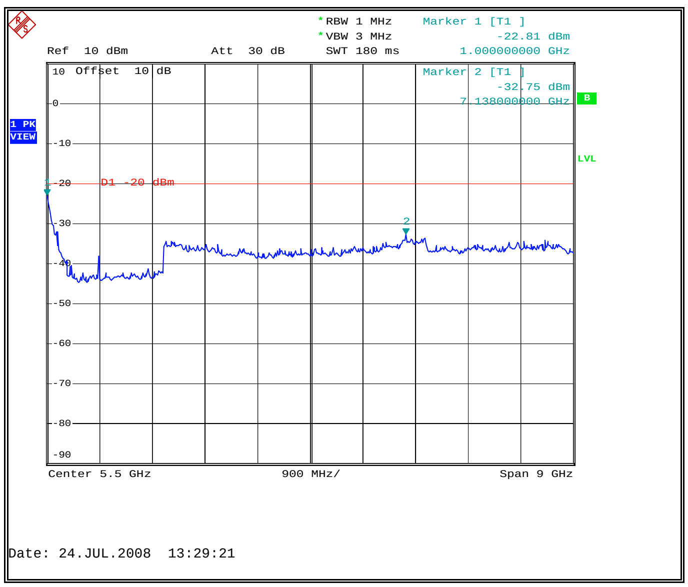

Figure 7.3.2-14: Conducted Spurious Emissions – 941.4875 MHz – 1GHz to 10GHz

7.4 Field Strength of Spurious Emissions

7.4.1 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 360º 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 up to 10 times the fundamental emission.

Data was collected at frequencies according to Section 1.3.2. Results of the test are shown below. 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.

The equipment under test was evaluated to multiple FCC rule parts with the most stringent limit applied to all measurements.

The BTXCVR was also evaluated for radiated intermodulation products for simultaneous transmission with Bluetooth module FCC ID: ED9LMX9838. Radiated intermodulation products were below the permissible limit.

Measurement results are shown below in Tables 7.4.2-1 through 7.4.2.7.
Note: Frequencies not reported were below the noise floor of the measurement system.

7.4.2 Measurement Results

Part 24.133 a(1), a(2), IC RSS-134 6.3(i), (ii)

Table 7.4.2-1: Field Strength of Spurious Emissions – 901.9875 MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1803.975	-46.35	-46.00	H	5.16	-40.84	-20.00	20.84
1803.975	-39.64	-40	V	5.12	-34.88	-20.00	14.88
2705.9625	-60.29	-55	H	5.13	-49.87	-20.00	29.87
2705.9625	-55.64	-54	V	5.29	-48.71	-20.00	28.71
5411.925	-58.49	-48	H	6.77	-41.23	-20.00	21.23
5411.925	-59.12	-55	V	6.55	-48.45	-20.00	28.45

Table 7.4.2-2: Field Strength of Spurious Emissions – 930.5 MHz – MPass Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1803.975	-47.77	-47.00	H	5.04	-41.96	-20.00	21.96
1803.975	-43.61	-43	V	5.02	-37.98	-20.00	17.98
2705.9625	-52.62	-52	H	5.21	-46.79	-20.00	26.79
2705.9625	-49.95	-48	V	5.35	-42.65	-20.00	22.65

Part 90.210 (j), RSS-119 5.8.8

Table 7.4.2-3: Field Strength of Spurious Emissions – 896.0125MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1792.025	-46.98	-46.00	H	5.18	-40.82	-20.00	20.82
1792.025	-40.53	-40	V	5.14	-34.86	-20.00	14.86
2688.0375	-60.77	-57	H	5.11	-51.89	-20.00	31.89
2688.0375	-54.96	-53	V	5.28	-47.72	-20.00	27.72
5376.075	-59.05	-50	H	6.72	-43.28	-20.00	23.28
5376.075	-59.53	-49	V	6.50	-42.50	-20.00	22.50
6272.0875	-59.65	-48	H	6.49	-41.51	-20.00	21.51

Table 7.4.2-4: Field Strength of Spurious Emissions – 935.0125MHz – MPass Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1803.975	-48.56	-49.00	H	5.03	-43.97	-20.00	23.97
1803.975	-42.44	-42	V	5.00	-37.00	-20.00	17.00
2705.9625	-54.68	-55	H	5.22	-49.78	-20.00	29.78
2705.9625	-50.69	-48	V	5.36	-42.64	-20.00	22.64

Part 101.111 a(6), RSS-119 5.8.6

Table 7.4.2-5: Field Strength of Spurious Emissions – 928.925MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1857.85	-47.54	-48.00	H	5.05	-42.95	-20.00	22.95
1857.85	-43.71	-44	V	5.02	-38.98	-20.00	18.98
2786.775	-53.74	-52	H	5.20	-46.80	-20.00	26.80
2786.775	-51.2	-47	V	5.34	-41.66	-20.00	21.66
5573.55	-58.59	-49	H	6.84	-42.16	-20.00	22.16
5573.55	-59.45	-51	V	6.63	-44.37	-20.00	24.37
6502.475	-60.29	-47	H	6.40	-40.60	-20.00	20.60

Table 7.4.2-6: Field Strength of Spurious Emissions – 932.25MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1864.5	-47.95	-47.00	H	5.04	-41.96	-20.00	21.96
1864.5	-43.02	-43	V	5.01	-37.99	-20.00	17.99
2796.75	-52.98	-52	H	5.21	-46.79	-20.00	26.79
2796.75	-50.26	-48	V	5.35	-42.65	-20.00	22.65

Table 7.4.2-7: Field Strength of Spurious Emissions – 941.4875MHz – MPass Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1882.975	-52.42	-52.00	H	5.00	-47.00	-20.00	27.00
1882.975	-44.6	-44	V	4.98	-39.02	-20.00	19.02
2824.4625	-53.53	-53	H	5.24	-47.76	-20.00	27.76
2824.4625	-51.38	-49	V	5.37	-43.63	-20.00	23.63

7.5 Frequency Stability

7.5.1 Measurement Procedure

The equipment under test is placed inside an environmental chamber. The RF output is directly coupled to the input of the measurement equipment.

Frequency measurements were made at the extremes of the of temperature range -30º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. The EUT receives its supply voltage from 2 AA rechargeable batteries. For the purpose of this test the EUT was connected to a DC power supply and at a temperature 20º C the supply voltage to was varied from the normal to the battery operating endpoint. The maximum variation of frequency was recorded. The most stringent limit from all rule parts of 1ppm was applied.

Data was collected at a single channel within the frequency band of operation. Results are shown below in Figure 7.5.2-1.

7.5.2 Measurement Results

Part 24.135, IC RSS-134 (7), Part 90.213 (a), RSS-119 5.3, Part 101.107 (a)

Frequency Stability

Frequency (MHz): 930.49998
Deviation Limit (PPM): 1ppm

Temperature C	Frequency MHz	Frequency Error (PPM)	Voltage (%)	Battery Voltage (VDC)
-30 C	930.499870	-0.118	100%	2.60
-20 C	930.499820	-0.172	100%	2.60
-10 C	930.500130	0.161	100%	2.60
0 C	930.500171	0.205	100%	2.60
10 C	930.500105	0.134	100%	2.60
20 C	930.49998	0.000	100%	2.60
30 C	930.499877	-0.111	100%	2.60
40 C	930.499940	-0.043	100%	2.60
50 C	930.499851	-0.139	100%	2.60
20 C	930.499965	-0.016	Battery End Point	2.300

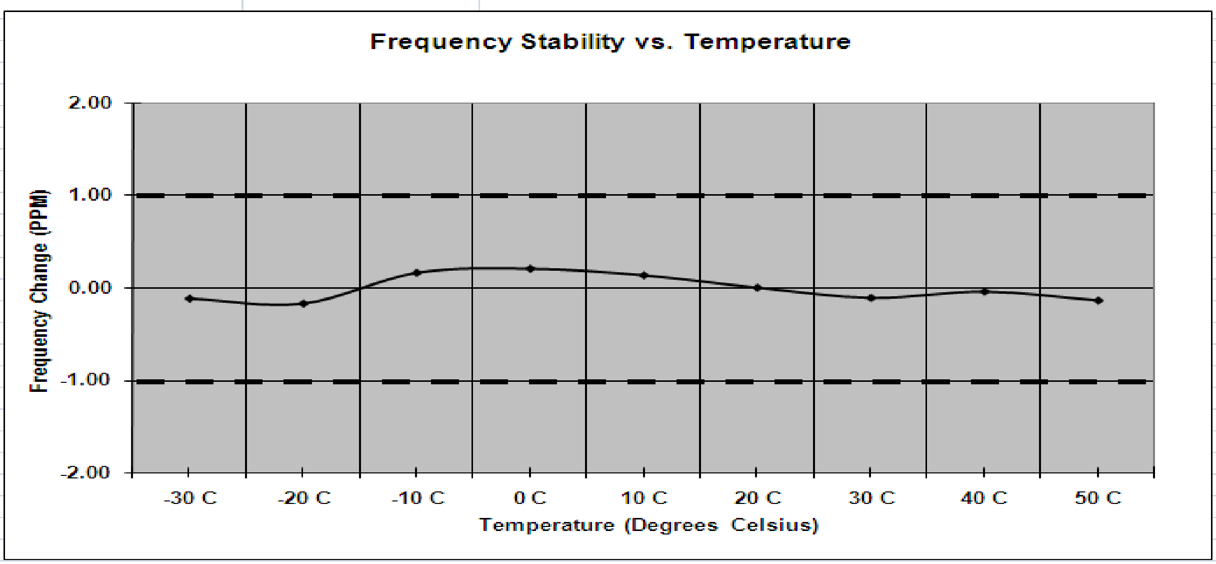

Figure 7.5.2-1: Frequency Stability – 930.5MHz

7.6 Radiated Emissions (Unintentional Radiators)

7.6.1 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. Radiated emissions tests were performed over the frequency range of 30MHz to *5* GHz. 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 above 30MHz and below 1GHz were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz using a Quasi-peak detector. Above 1GHz, peak and average measurements are taken with the RBW and VBW were set to 1MHz and 3MHz respectively.

The field strength of each radiated emission is calculated by correcting the EMI receiver level for cable loss, amplifier gain, and antenna correction factors.

Field Strength (dBuV/m) = EMI Receiver Level (dBuV) + Cable Loss (dB) – Amplifier Gain (dB) + Antenna Correction Factor (1/m)

Results of the test are shown below in Table 7.6.2-1.

7.6.2 Measurement Results - Part 15.109, RSS-119 5.11, RSS-134 8(i)

Table 7.6.2-1: Radiated 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
147.455	---------	49.13	H	-13.60	---------	35.53	--------	43.5	---------	7.97
463.116	---------	40.73	V	-6.67	---------	34.06	--------	46.0	---------	11.94
60.216	---------	44.23	V	-19.93	---------	24.30	--------	40.0	---------	15.70
117.222	---------	32.88	V	-12.57	---------	20.31	--------	43.5	---------	23.19
230.683	---------	34.40	H	-13.54	---------	20.86	--------	46.0	---------	25.14
948.388	---------	20.06	V	3.84	---------	23.90	--------	46.0	---------	22.10

Note: Emissions above 948.338 MHz were below the noise floor of the measurement equipment.

7.7 Power Line Conducted Emissions

7.7.1 Measurement Procedure

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

The USBXCVR module was integrated into a representative host device for the purpose of showing compliance. See section 6.0 for test setup details.

Measurement results are shown below in Table 7.7.2-1.

7.7.2 Measurement Results – Part 15.107

Table 7.7.2-1: 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	37.1	29.6	9.82	46.92	39.42	64.49	54.49	17.6	15.1	FLO
0.24	27.1	20.1	9.81	36.91	29.91	62.10	52.10	25.2	22.2	FLO
0.3	26.9	19.9	9.80	36.70	29.70	60.24	50.24	23.5	20.5	FLO
0.36	22.3	19.6	9.81	32.11	29.41	58.73	48.73	26.6	19.3	FLO
0.42	18.7	15.2	9.90	28.60	25.10	57.45	47.45	28.8	22.3	FLO
0.48	17.6	12.7	9.90	27.50	22.60	56.34	46.34	28.8	23.7	FLO
Line 2										
0.18	36.5	25.6	9.82	46.32	35.42	64.49	54.49	18.2	19.1	FLO
0.24	26.7	17.1	9.81	36.51	26.91	62.10	52.10	25.6	25.2	FLO
0.3	20.9	18.3	9.80	30.70	28.10	60.24	50.24	29.5	22.1	FLO
0.36	15.7	12.9	9.81	25.51	22.71	58.73	48.73	33.2	26.0	FLO
2.43	15.9	11.8	9.90	25.80	21.70	56.00	46.00	30.2	24.3	FLO
3.38	15.1	10.7	9.90	25.00	20.60	56.00	46.00	31.0	25.4	FLO

8.0 CONCLUSION

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

End Report