MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587-3201 ● PHONE (510) 489-6300 ● FAX (510) 489-6372

Electromagnetic Compatibility Criteria
Test Report

For the

SOMA Networks
NPM-1000-7110 (WCS)
Radio BaseStation for Voice & Data Broadband

Tested under

FCC Certification Rules
Title 47 of the CFR, Part 27 C & D and Part 15 Subpart B for a Class A

MET Report: EMCS17858A-FCC27

November 10, 2005

Prepared For:

SOMA Networks
185 Berry Street, Suite 4600
San Francisco, California 94107

Prepared By:
MET Laboratories, Inc.
33439 Western Ave.
Union City, California 94587

Electromagnetic Compatibility Criteria
Test Report

For the

SOMA Networks
NPM-1000-7110 (WCS)
Radio BaseStation for Voice & Data Broadband

Tested Under

FCC Certification Rules
Title 47 of the CFR, Part 27 C & D and Part 15 Subpart B for a Class A

Shawn McMillen, Project Engineer
Electromagnetic Compatibility Lab

Cheryl Anicete
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 27 C & D and Part 15 Subpart B of the FCC Rules under normal use and maintenance.

Tony Permsombut, Manager
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	November 10, 2005	Initial Issue.

Table of Contents

List of Tables

List of Figures

List of Photographs

List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
d	Measurement Distance
dB	Decibels
dBµV	dB micro Volts
dBµV/m	dB micro Volt per meter
DC	Direct Current
DCF	Distance Correction Factor
E	Electric Field
EUT	Equipment Under Test
EIRP	Effective Isotropic Radiated Power
f	Frequency
FCC	Federal Communications Commission
GHz	Giga Hertz
Hz	Hertz
IEC	International Electro-technical Commission
kHz	kilohertz
kV	kilo Volt
LISN	Line Impedance Stabilization Network
MHz	Mega Hertz
RF	Radio Frequency
RMS	Root-Mean-Square
SNF	Spectrum Analyzer Noise Floor
V/m	Volts per meter

1.0 Testing Summary

Name of Test	FCC Rule Part/Section	Results
RF Power Output	2.1046; 27.50(a)(1)	Compliant
Modulation Characteristics	2.1047(a)	N/A - EUT is non-analog voice.
Occupied Bandwidth	2.1049	Compliant
Spurious Emissions at Antenna Terminals	2.1051; 27.53(a)(1) and (3)	Compliant
Radiated Spurious Emissions	2.1051; 27.53(a)(1) and (3)	Compliant
Frequency Stability over Temperature Variations	2.1055 (a)(1); 27.54	Compliant
Conducted Emission, Class A	15.107 (a)	N/A - EUT is DC powered.
Radiated Emission Class A	15.109 (a)	Compliant

Table 1. Summary of Test Results

Model(s) Tested:	NPM-1000-7110 (WCS)
Model(s) Covered:	NPM-1000-7110 (WCS)
EUT Specifications:	Primary Power: -39 VDC to -57 VDC
	Secondary Power: Not Applicable
	Channel Spacing: 5 MHz
	Equipment Emissions Class: Class A Equipment for use as Other Than Telecom Centre Device
Analysis:	The results obtained relate only to the item(s) tested.
Evaluated by:	Shawn McMillen

2.0 Equipment Configuration

2.1 Overview

MET Laboratories, Inc. was contracted by SOMA Networks to perform testing on the NPM-1000-7110 (WCS) (Soma Port Subscriber Terminal), under SOMA Networks purchase order number 405048.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the SOMA Networks, NPM-1000-7110 (WCS)

In accordance with §2.955(a) (3), the following data is presented in support of the verification of the SOMA Networks, NPM-1000-7110 (WCS).

SOMA Networks should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the NPM-1000-7110 (WCS) has been **permanently** discontinued, as per §2.955(b).

The results obtained relate only to the item(s) tested.

Rule Part:	Certification / Part 27 Subpart C and D
EUT:	NPM-1000-7110 (WCS)
FCC ID:	POZNPMWCS005777A
Equipment Code:	TNB
Emissions Designator:	4M13D7D
RF Power Output:	Output Power at antenna port: Upper Block A: 43 dBm (19.95 W) Upper Block B: 43 dBm (19.95 W)
Frequency Range (MHz):	Upper Block A: 2350 – 2355 MHz Upper Block B: 2355 – 2360 MHz
Frequency Stability:	stays within the authorized bands of operation

2.2 Test Site

All testing was performed at MET Laboratories, Inc., 4855 Patrick Henry Drive, Building 6, Santa Clara, California 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a semi-anechoic chamber. In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories. In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program (Lab Code: 100273-0).

2.3 Description of Test Sample

The NPM-1000-7110 (WCS) Equipment Under Test (EUT), is a radio base station for voice and data broadband.

2.4 Equipment Configuration

The EUT was set up as outlined in Figure 1 and Figure 2. All equipment incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
Radio Rack						
A	Radio Tower		N/A	003338C	N/A	01
A1	Chassis (PDP)		N/A	004714A	SL0310003Y	02
A1 Front	Circuit Breakers Panel		N/A	N/A	N/A	N/A
A2	Upper Cooling Unit		N/A	004746B	SL020446103	01
A3	USC Utility Chassis		N/A	005107A	N/A	01
	Mid-plane		N/A	003948B	041271	01
A3 Front	0	Power Supply	N/A	004733A	0305238	N/A
	1	Power Supply	N/A	004733A	0305243	N/A
	2	Power Supply	N/A	004733A	0305215	N/A
	3	CP946	N/A	005567	321484007	01
	4	Hard Drive Card	N/A	001267-001	502330115	A
	5	AP Host Card	5541A	002558	118MGC	03
	6	PP310	N/A	005353	P16463/191	01
	7	AP Host Card	5541A	002558	0303923957	03
	8	Alarm Card	N/A	004726A	0404260004	04
	9	Alarm Card	N/A	004726A	0404260001	04
	10	PP310	N/A	005353	P16470/062	01
	11	Hard Drive Card	N/A	001267-01	502330107	A
	13	CP946	N/A	005567	321484008	01
A4	RSC Radio Chassis		N/A	005106A	N/A	02
	Mid-plane		N/A	003787B	042927	01
A4 Front	0	Power Supply	N/A	004733A	0203008	01
	9	Modem Card	N/A	0002490B	010303017E	02
	10	IF / RF Card (WCS)	N/A	003257C (260-201 / 003236B)	0102470024 / 0103040198	02
	11	PP310	N/A	005353	P16463/193	01
A5	Lower Cooling Unit		N/A	004745B	02020500	01
A1 Back	Signal & Power Outlets		N/A	N/A	N/A	N/A
A3 Back	1	Rear Power Input Panel	N/A	005250A	020516000	01
	2	Ethernet Switch Panel	N/A	005568	N/A	B
	4	RTM Card	N/A	004685	M8116/074	A
	6	Alarm Wiring Card	N/A	002486C	0102480042	01
	7	RTM Card	N/A	004685	M8116/075	A
A4 Back	1	Rear Power Input Panel	N/A	005250A	064136	01
	5	OCXO BD Card	N/A	005683C	005683C	01
	7	RTM Card	N/A	004685	M8116/072	A
RFSS Rack						
B	RF Tower		N/A	003349C	N/A	01
B1	Chassis (PDP)		N/A	004715A	SL03100021	03

B1 Front	Circuit breakers Panel		N/A	N/A	N/A	N/A
B2	Upper Cooling Unit		N/A	004746B	SL0247000L	01
B3	Chassis		N/A	003330A	N/A	02
B3 Front	2	Power Amplifier (WCS)	N/A	005646A	0203060013	01
	3	Power Amplifier (WCS)	N/A	005646A	0203240003	01
B4	Lower Cooling Unit		N/A	004745B	SL0247000H	01
B1 Back	Signal & Power Outlets		N/A	N/A	N/A	N/A

Table 2. Equipment Configuration

2.5 Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
C	50ohms RF Terminator	N/A	N/A	N/A
D	RF Attenuator	N/A	N/A	N/A
E	RF Attenuator	N/A	N/A	N/A
F	Wireless Router	Soma	CPE 300	N/A
G	Laptop	Dell	N/A	N/A
H	Ethernet Router	NetGear	DS104	N/A

Table 3. Support Equipment

2.6 Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded (Yes/No)	Termination Box ID & Port ID
Emission						
1	A3 back-6, Upper cooling RF	DB9	1	2	Yes	B2 back, Signal
2	A3 back-6, Upper Cooling Radio	DB9	1	2	Yes	A2 back, Signal
3	A3 back-6, Lower cooling, RF	DB9	1	2	Yes	B4 back, Signal
4	A3 back-6, Lower cooling, Radio	DB9	1	2	Yes	A5 back, Signal
5	A3 back-6, PDP RF	DB15	1	2	Yes	B1 back, Signal
6	A3 back-6, PDP, Radio	DB15	1	2	Yes	A1 back, Signal
7	A3 back-2, 2X	10/100 Ethernet	1	0.5	Yes	A3 back-7, link
8	A3 back-2, 4X	10/100 Ethernet	1	0.5	Yes	A3 back-4, link
9	A3 back-2, 6X	10/100 Ethernet	1	0.5	Yes	A4 back-7, link
10	A1 back, power outlets	12AWG	5	2	No	A2 back, power; A3 back-1, PS0, PS1; A4 back-1, PS0; A5 back, power;
11	B1 back, power outlets	12AWG	4	2	No	B2 back, power; B3 back, power 0,1; B4 back, power;
12	A4 front-10, RX Main	Coax	1	1	Yes	B3 front-0,RX
13	A4 front-10, RX Div	Coax	1	1	Yes	B3 front-1, RX
14	A4 front-10, TX Main	Coax	1	1	Yes	B3 front-0, TX
15	A4 front-10, TX Div	Coax	1	1	Yes	B3 front-1, TX
16	A4 front-10, Signal Main	DB9	1	1	No	B3 front-0, Signal
17	A4 front-10, Signal Div	DB9	1	1	No	B3 front-1, Signal
18	DC power Supply	10 AWG	4	3	No	A1back, B1 back
Immunity						
1	A3 back-6, Upper cooling RF	DB9	1	2	Yes	B2 back, Signal
2	A3 back-6, Upper Cooling Radio	DB9	1	2	Yes	A2 back, Signal
3	A3 back-6, Lower cooling, RF	DB9	1	2	Yes	B4 back, Signal
4	A3 back-6, Lower cooling, Radio	DB9	1	2	Yes	A5 back, Signal
5	A3 back-6, PDP RF	DB15	1	2	Yes	B1 back, Signal
6	A3 back-6, PDP, Radio	DB15	1	2	Yes	A1 back, Signal
7	A3 back-2, 2X	10/100 Ethernet	1	0.5	Yes	A3 back-7, link
8	A3 back-2, 4X	10/100 Ethernet	1	0.5	Yes	A3 back-4, link
9	A3 back-2, 6X	10/100 Ethernet	1	0.5	Yes	A4 back-7, link
10	A1 back, power outlets	12AWG	5	2	No	A2 back, power; A3 back-1, PS0, PS1; A4 back-1, PS0; A5 back, power;
11	B1 back, power outlets	12AWG	4	2	No	B2 back, power; B3 back, power 0,1;

						B4 back, power;
12	A4 front-10, RX Main	Coax	1	1	Yes	B3 front-0,RX
13	A4 front-10, RX Div	Coax	1	1	Yes	B3 front-1, RX
14	A4 front-10, TX Main	Coax	1	1	Yes	B3 front-0, TX
15	A4 front-10, TX Div	Coax	1	1	Yes	B3 front-1, TX
16	A4 front-10, Signal Main	DB9	1	1	No	B3 front-0, Signal
17	A4 front-10, Signal Div	DB9	1	1	No	B3 front-1, Signal
18	DC power Supply	10 AWG	4	3	No	A1back, B1 back
19	B3 back,	Coax	1	5	Yes	F, Antenna Port
20	A3 back-2, 8X	10/100 Ethernet	1	5	Yes	H, Port 1

Table 4. Ports and Cabling Information

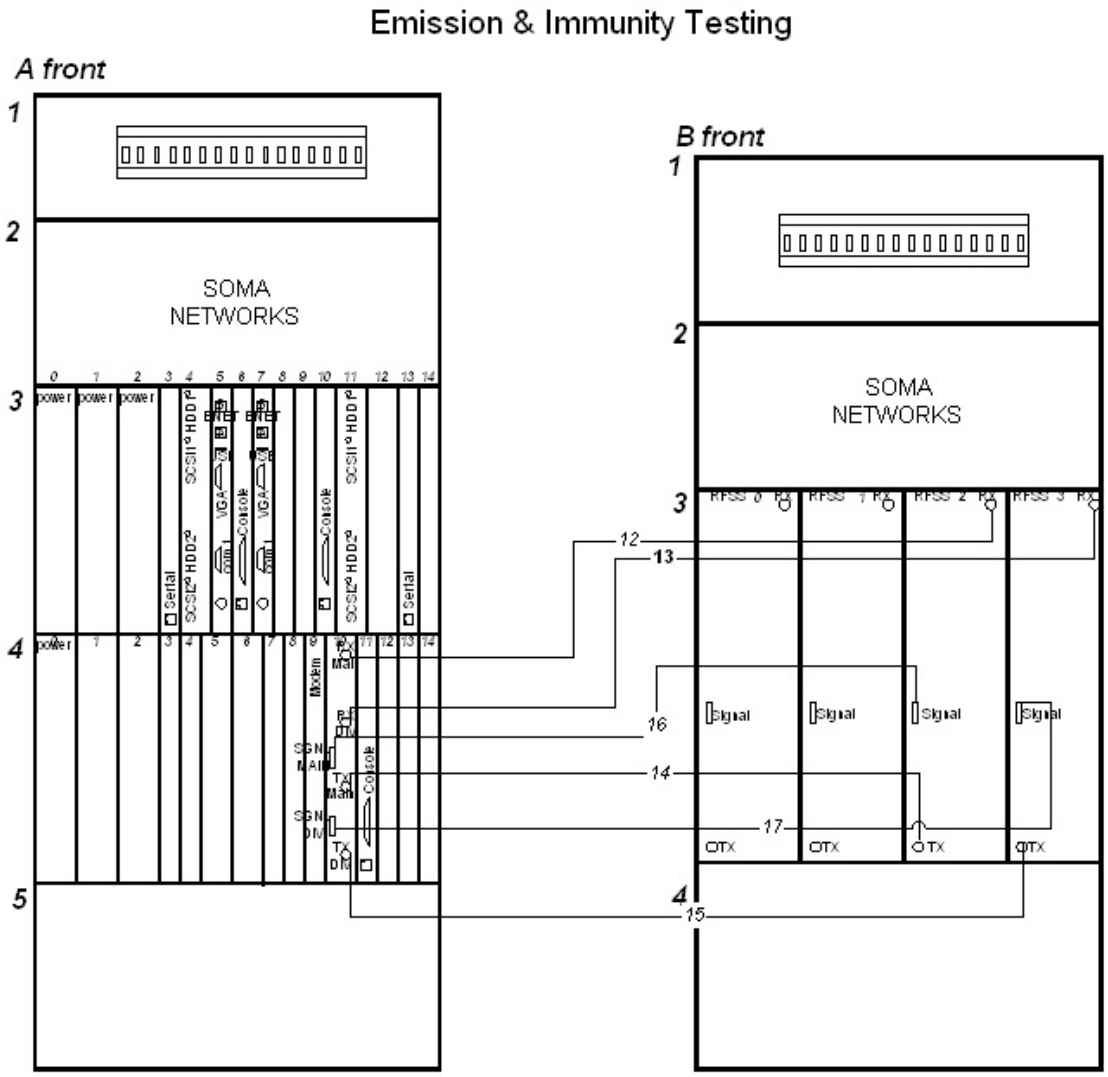


Figure 1: Block Diagram of Emission and Immunity (WCS) Test Configuration

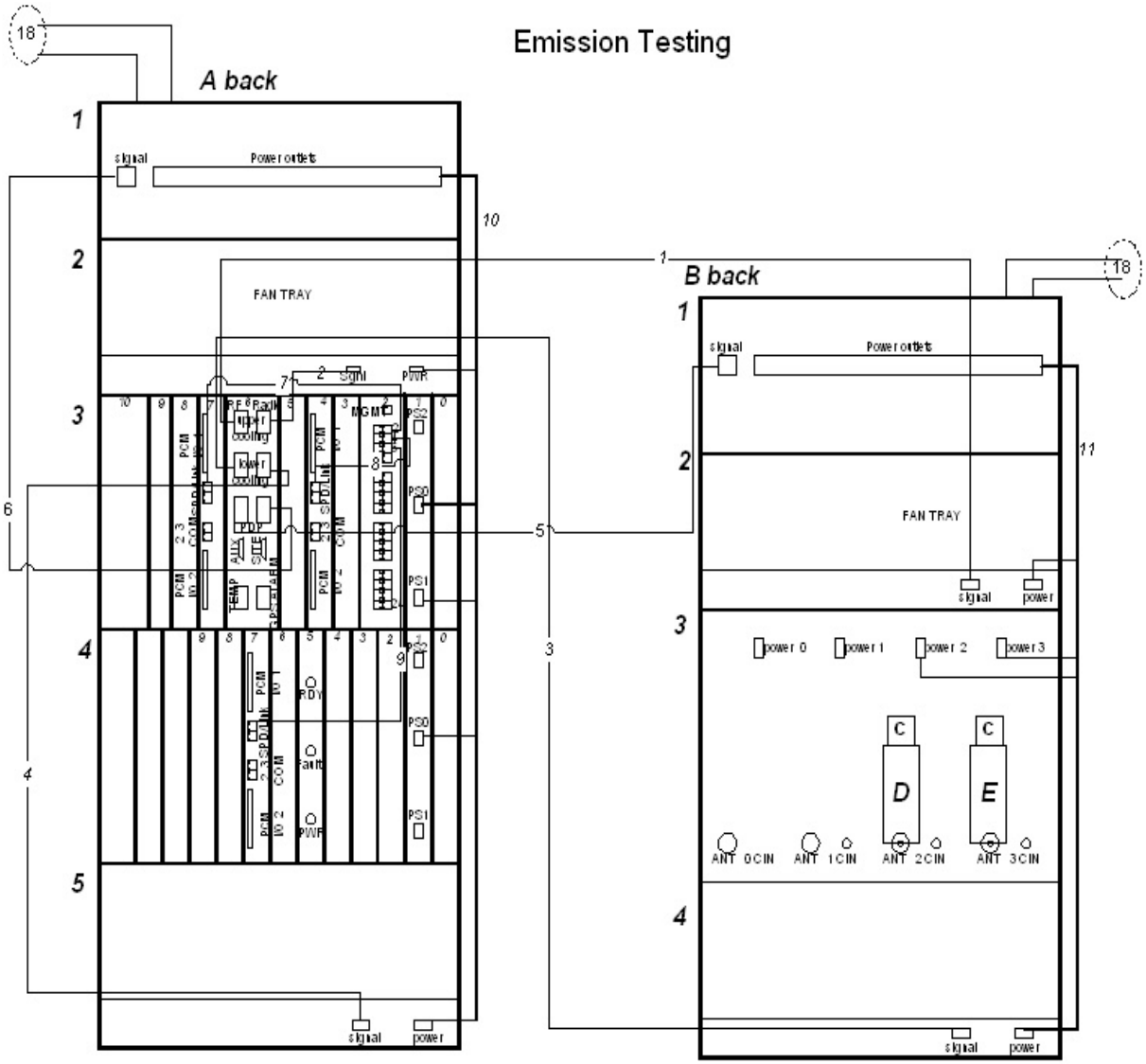


Figure 2: Block Diagram of Emission (WCS) Test Configuration

2.7 Mode of Operation

The EUT was normally placed close to a computer connected via Ethernet or USB.

2.8 Method of Monitoring EUT Operation

SNMP & Proprietary software

2.9 Modifications

2.9.1 Modifications to the EUT

No modifications were made to the EUT.

2.9.2 Modifications to the Test Standard

No modifications were made to the test standard.

2.10 Disposition of EUT

The test sample including all support equipment (if any), submitted to the Electro-Magnetic Compatibility Lab for testing was returned to SOMA Networks upon completion of testing.

3.0 Electromagnetic Compatibility RF Power Output Requirements

3.1 RF Power Output

Test Requirement(s): §2.1046 and §27.50(a)(1)

Test Procedures: As required by 47 CFR 2.1046, *RF power output measurement* was made at the RF output terminal using a Power Meter with a Power Sensor capable of measuring a modulated carrier.

Test Results: Equipment complies with 47CFR 2.1046 and 27.50(a) (1). The NPM-1000-7110 (WCS) does not exceed 2000 Watts peak (EIRP) at the carrier frequency.

All RF Power output measurements were direct connection to RF output Terminal of EUT.

The following page show measurements of RF Power output which is recorded below:

Frequency Range (MHz)	Output Power (dBm)	Output Power (Watts)
2350-2355	43	19.95
2355-2360	43	19.95

Test Engineer(s): Shawn McMillen

Test Date(s): October 12, 2005

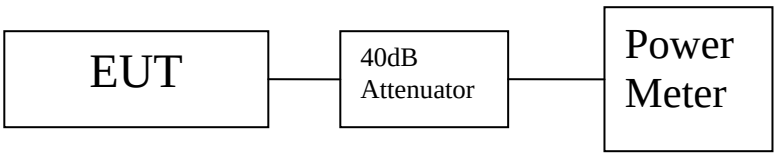


Figure 3. Block Diagram of Maximum Power Output Test setup

4.0 Electromagnetic Compatibility Modulation Characteristics Requirements

4.1 Modulation Characteristics

Test Requirement(s): §2.1047

Test Procedures: As required by 47 CFR 2.1047, Modulation Characteristics measurements were made at the RF output terminals.

Test Results: EUT is not required for this test since it has no analog voice.

5.0 Electromagnetic Compatibility Occupied Bandwidth Requirements

5.1 Occupied Bandwidth

Test Requirement(s): §2.1049

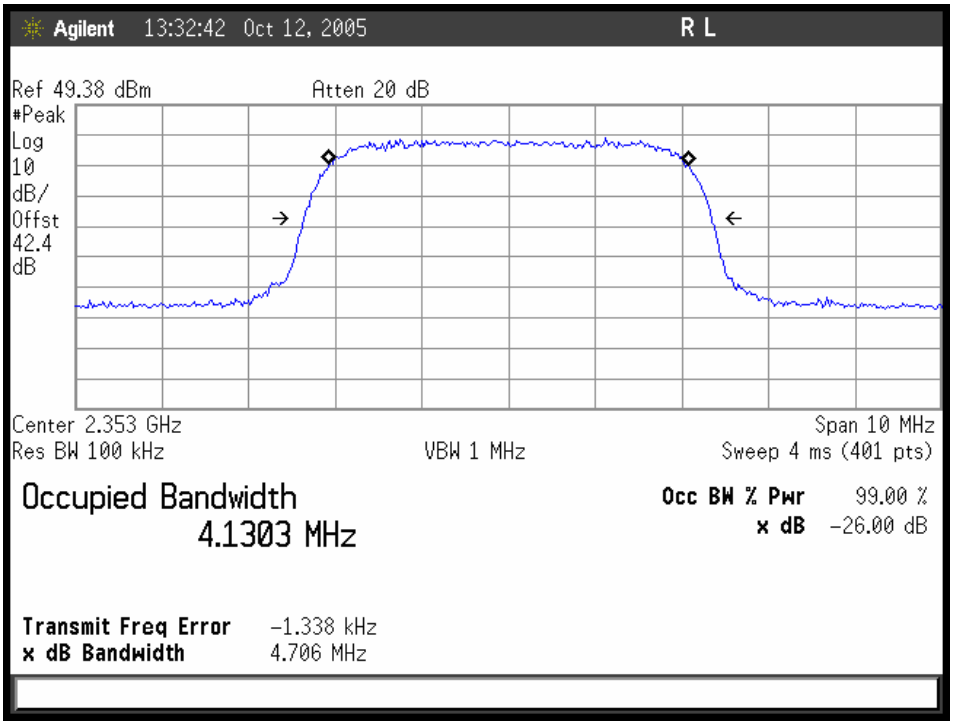
Test Procedures: As required by 47 CFR 2.1049, the occupied bandwidth measurements were made at the RF output terminals using a Spectrum Analyzer.

Test Results: Equipment complies with Section 2.1049. The following pages show measurements of 99% Occupied Bandwidth plots:

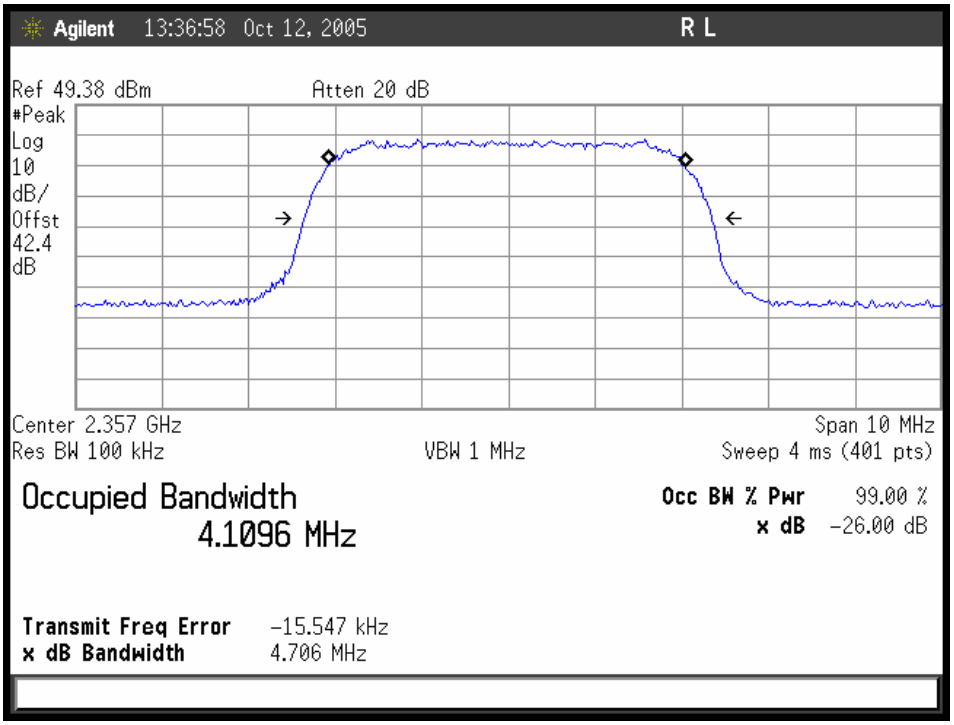
WCS Block A and B	
Plot #	**Comment**
1	Upper Block A: 99% Occupied Bandwidth at center frequency of 2352.5 MHz
2	Upper Block B: 99% Occupied Bandwidth at center frequency of 2357.5 MHz

Test Engineer(s): Shawn McMillen

Test Date(s): October 12, 2005



Plot 1. Upper Block A 99% Occupied BW



Plot 2. Upper Block B 99% Occupied BW

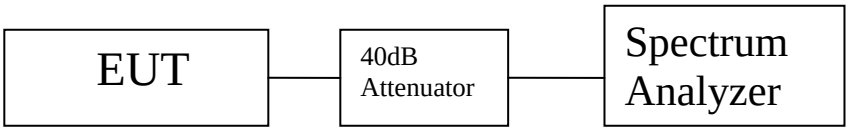


Figure 4. Block Diagram of Occupied Bandwidth Test Setup

6.0 Electromagnetic Compatibility Emissions Requirements

6.1 Spurious Emissions at Antenna Terminals

Test Requirement(s): §2.1051 and §27.53(a) (1) and (3)

Test Procedures: As required by 47 CFR 2.1051, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a Spectrum Analyzer.

The Spectrum Analyzer was set to RBW = VBW = 1MHz. The EUT was set to transmit in the operating frequency range. Frequencies were swept from 30 MHz to the 10th harmonic of the fundamental. Measurements were carried out for both Upper A and B blocks. Only emissions <20dBc needed to be reported.

Measured maximum Output Power of the EUT at antenna port: 43 dBm or 19.95W

Emission Limit between the frequencies of 2320 - 2345 MHz: 80 + 10 log (P) dB
Po - (80 + 10log 19.95) = 43dBm - (93.0 dB) = -50 dBm

> **Note: The spurious emissions in the restricted band 2320 – 2435MHz could not be measured directly due to limitations of the spectrum analyzer. Below is an alternative method of determining compliance.

Emission Limit below 2300 MHz and above 2370 MHz: 70 + 10 log (P) dB
Po - (70 + 10log 19.95) = 43dBm - (83.0 dB) = -40 dBm

Emission Limit between 2300 - 2320 MHz and 2345 - 2370 MHz: 43 + 10 log (P) dB
Po - (43 + 10log 19.95) = 43 dBm - (56.0 dB) = -13 dBm

Test Results: Equipment complies with Section 2.1051 and 27.53(a) (1) and (3). The following pages show measurements of Spurious Emission plots

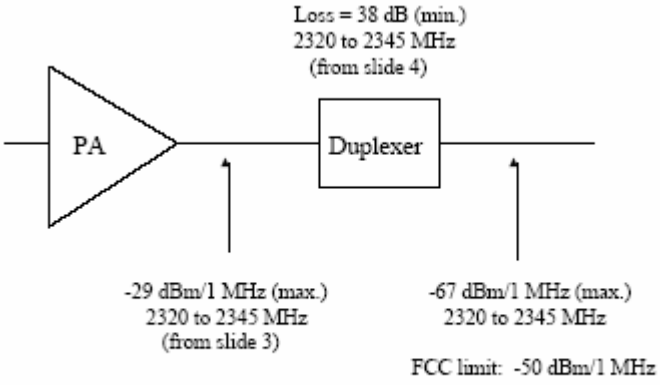
The following analysis and plots are included below to illustrate compliance with the required rule parts.

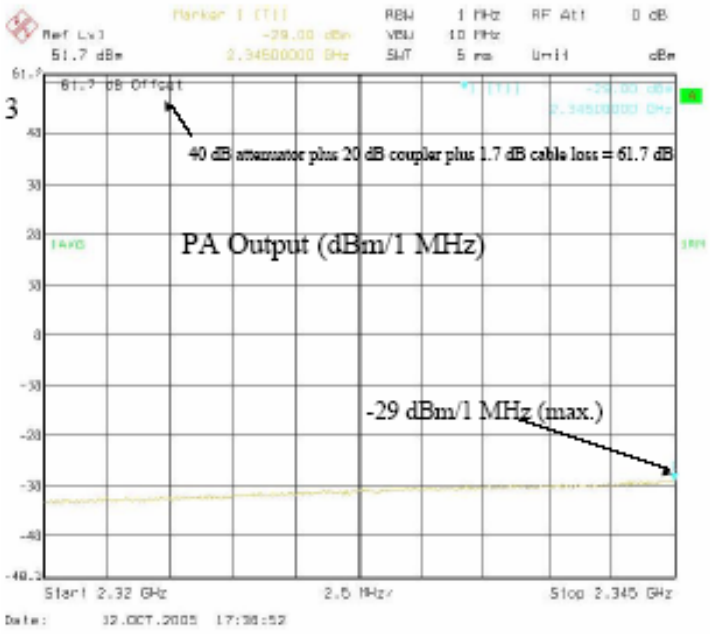
Test Engineer(s): Shawn McMillen

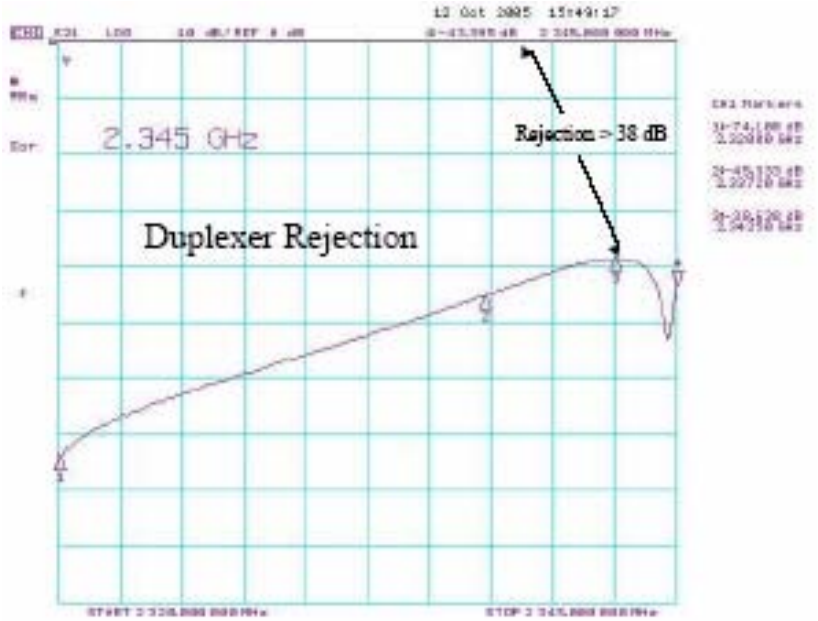
Test Date(s): October 12, 2005

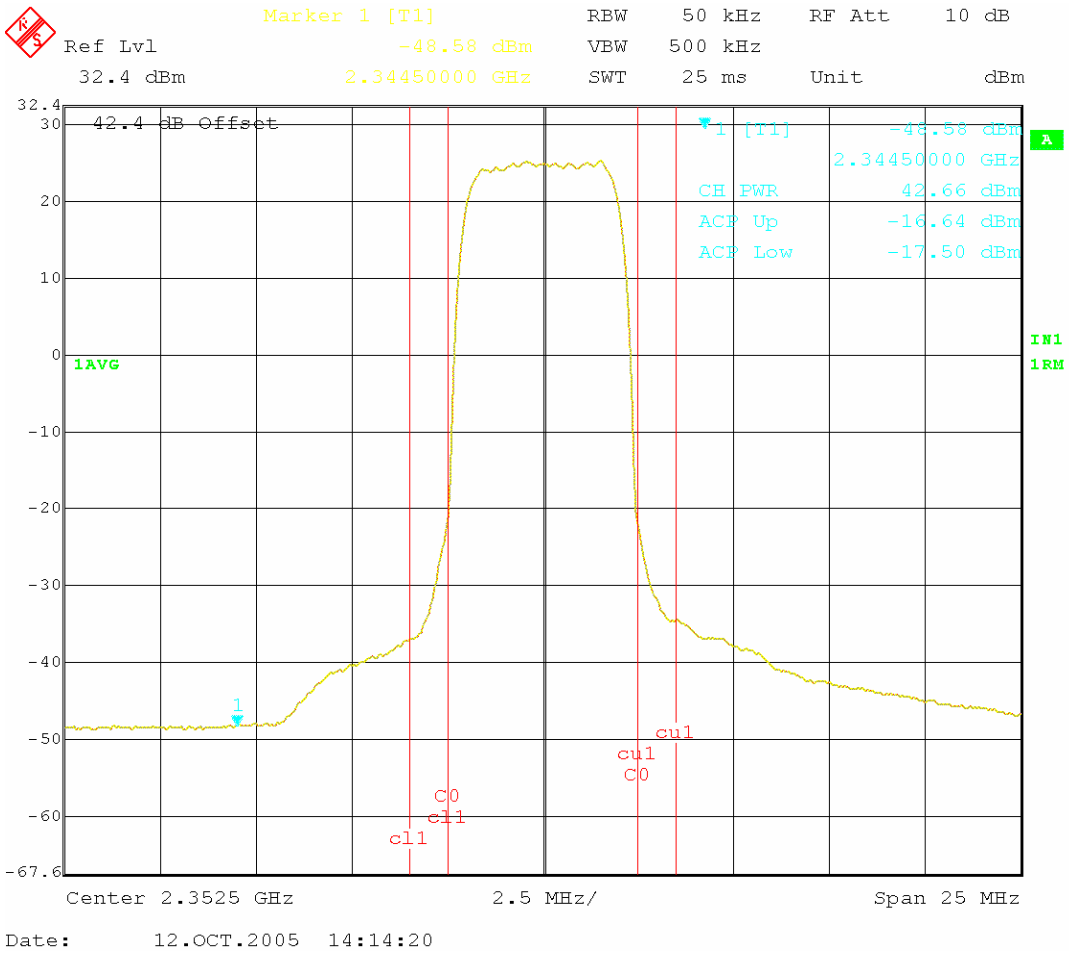
The following measurements were taken to demonstrate compliance with the requirements for -50dBm (max) per 1 MHz bandwidth spurious emissions in the SDARS band (2320 to 2435 MHz). The test equipment used was a Rhode and Schwarz FSIQ 7 spectrum analyzer and an Agilent 8753ES Network Analyzer. The accuracy of the test equipment was verified by substitution of a signal generator.

As can be see, the NPM transmitter exhibits a maximum spurious output of -67 dBm per 1 MHz bandwidth from 2320 – 2345 MHz, as calculated from the individual measurements of the transmitter chain through the power amplifier (PA), and the duplexer.

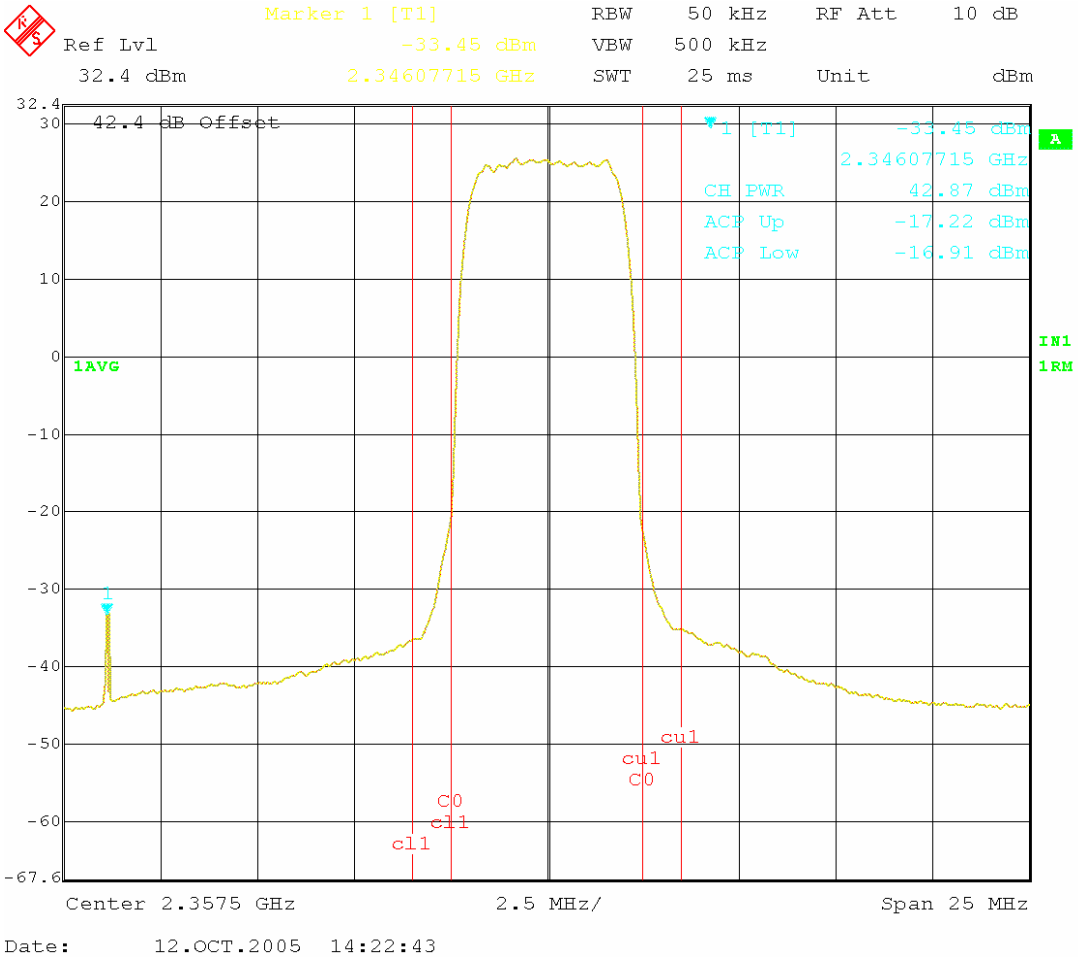




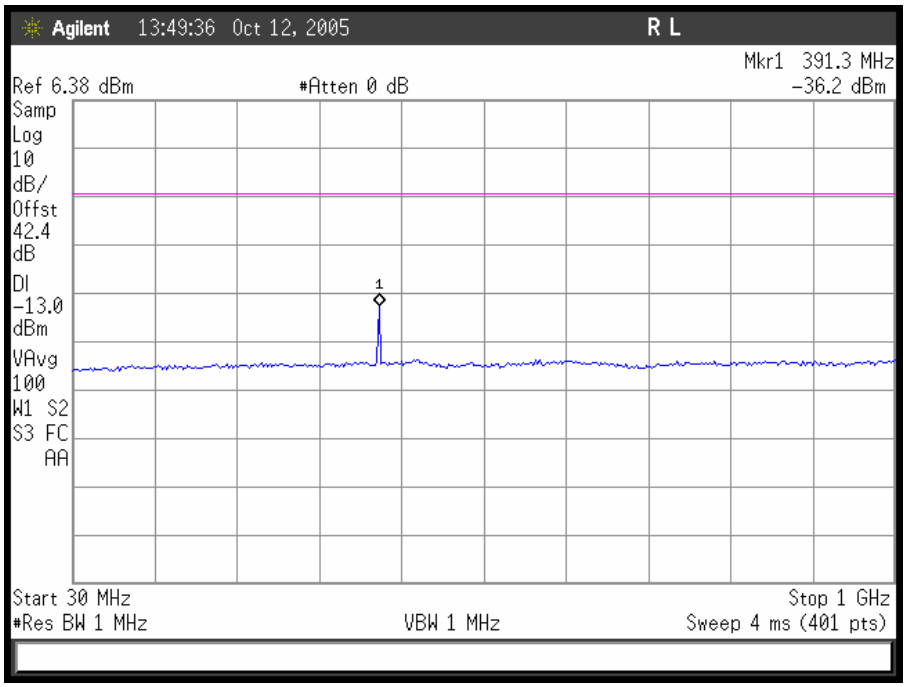




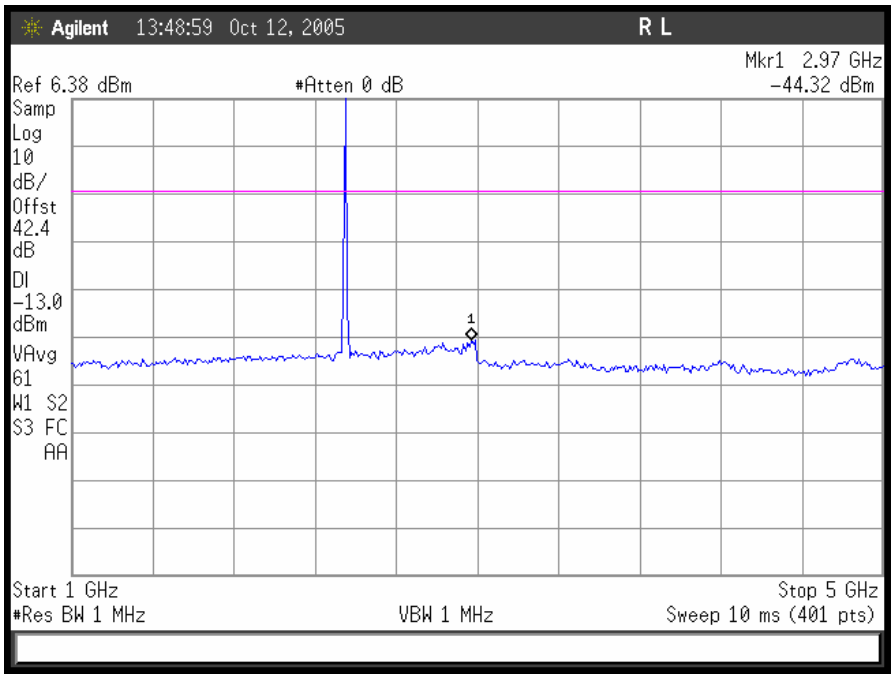
Plot 3: Upper Block A Band Edge and in-band emissions



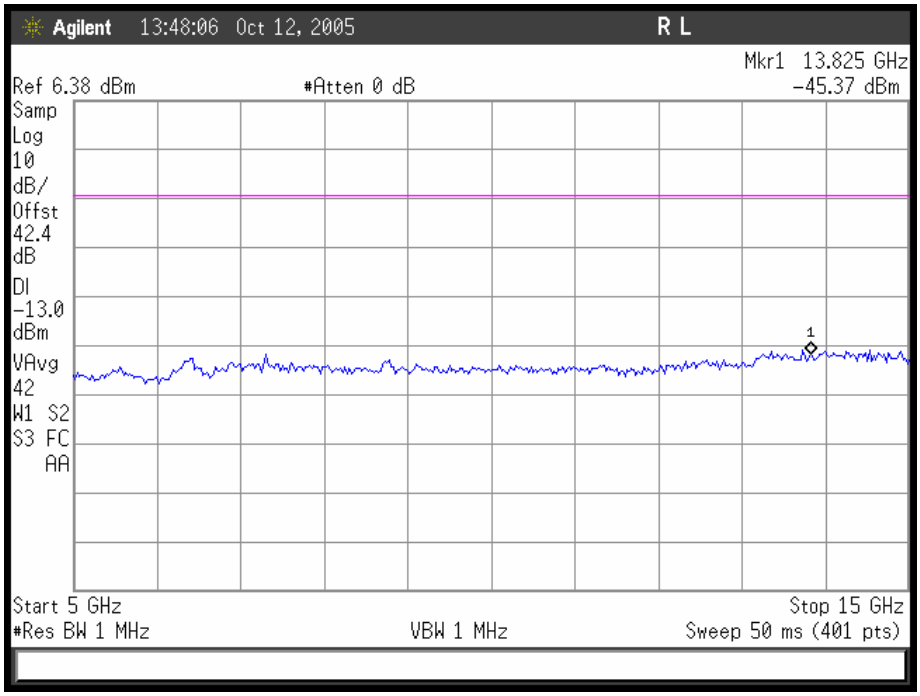
Plot 4: Upper Block B Band Edge and in-band Emissions



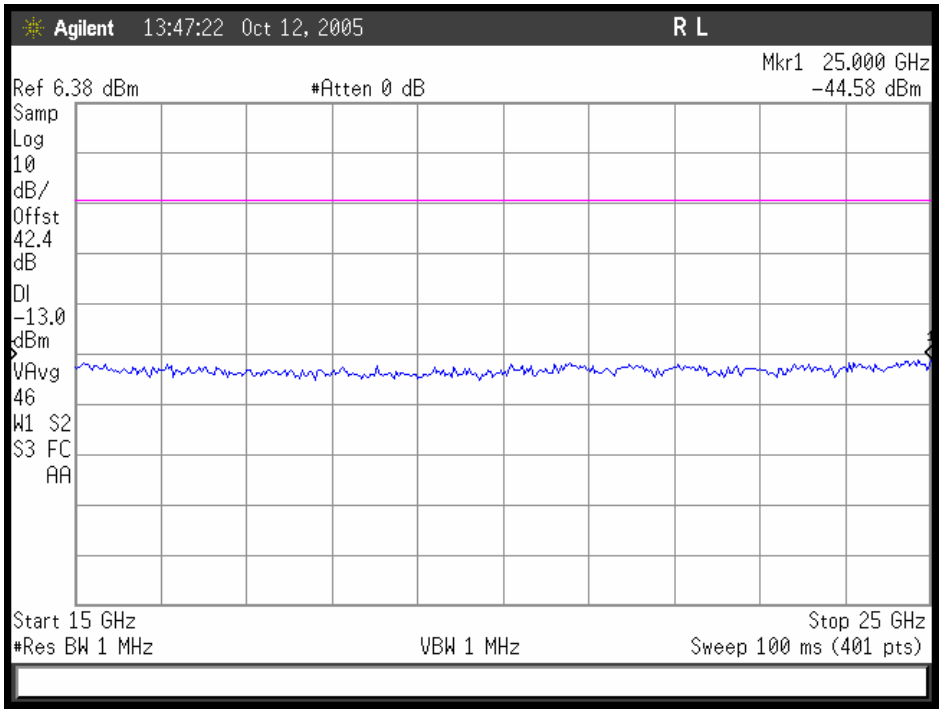
Plot 5: Upper Block A Spurious Emission 30MHz – 1 GHz



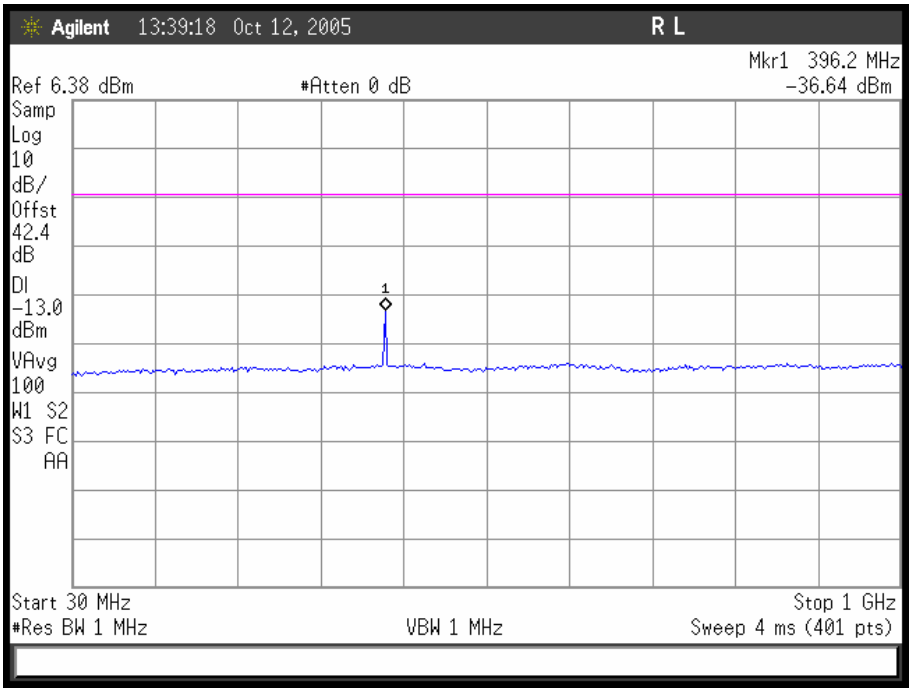
Plot 6: Upper Block A Spurious Emission 1 – 5GHz



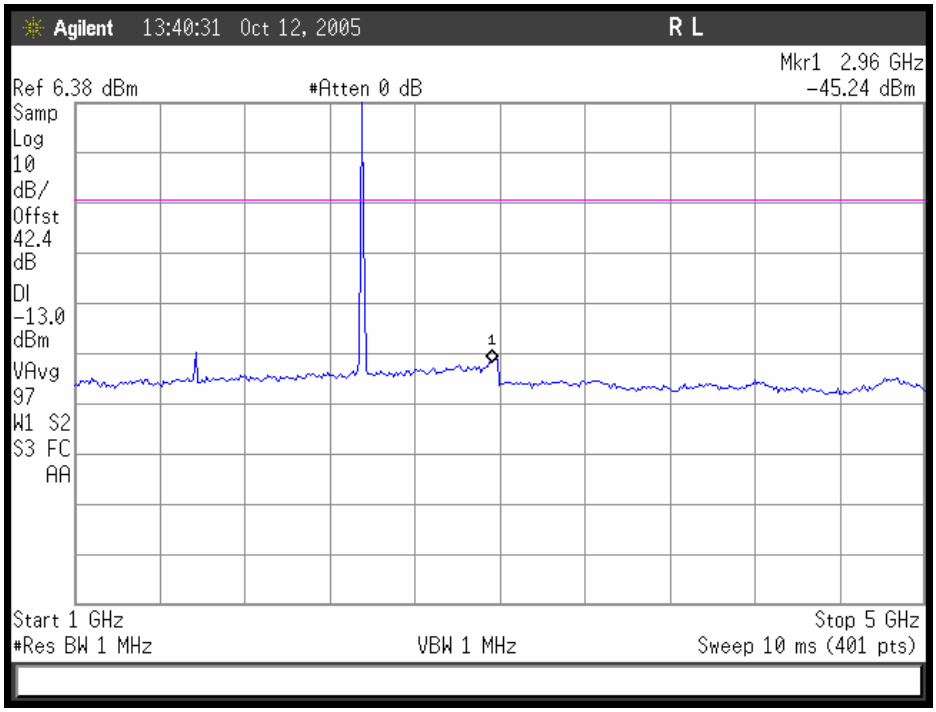
Plot 7: Upper Block A Spurious Emission 5 - 15GHz



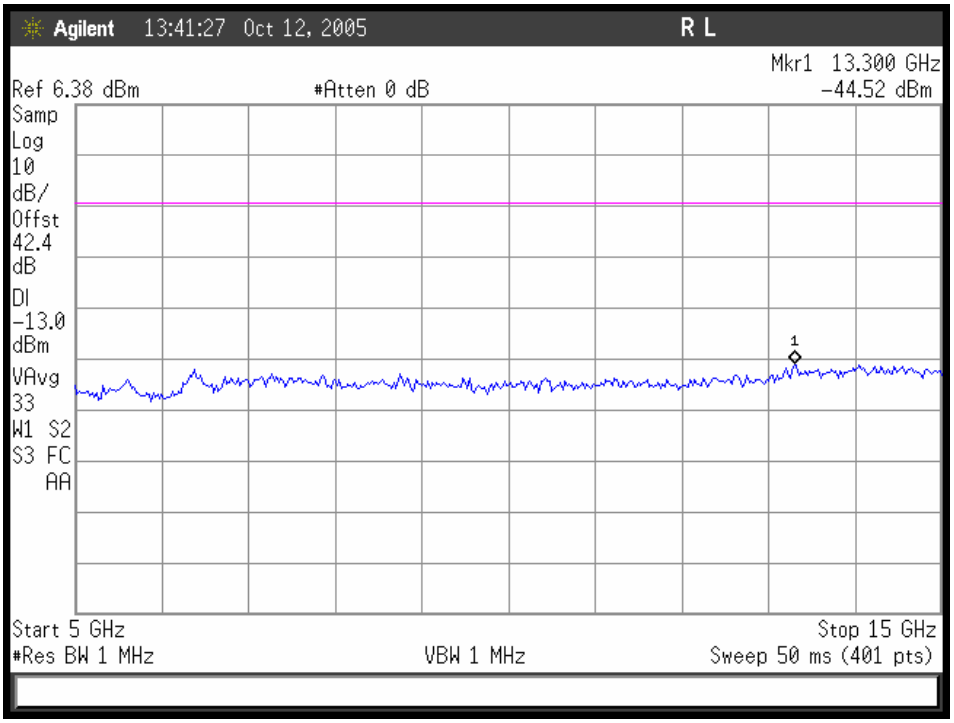
Plot 8: Upper Block A Spurious Emission 15 - 25GHz



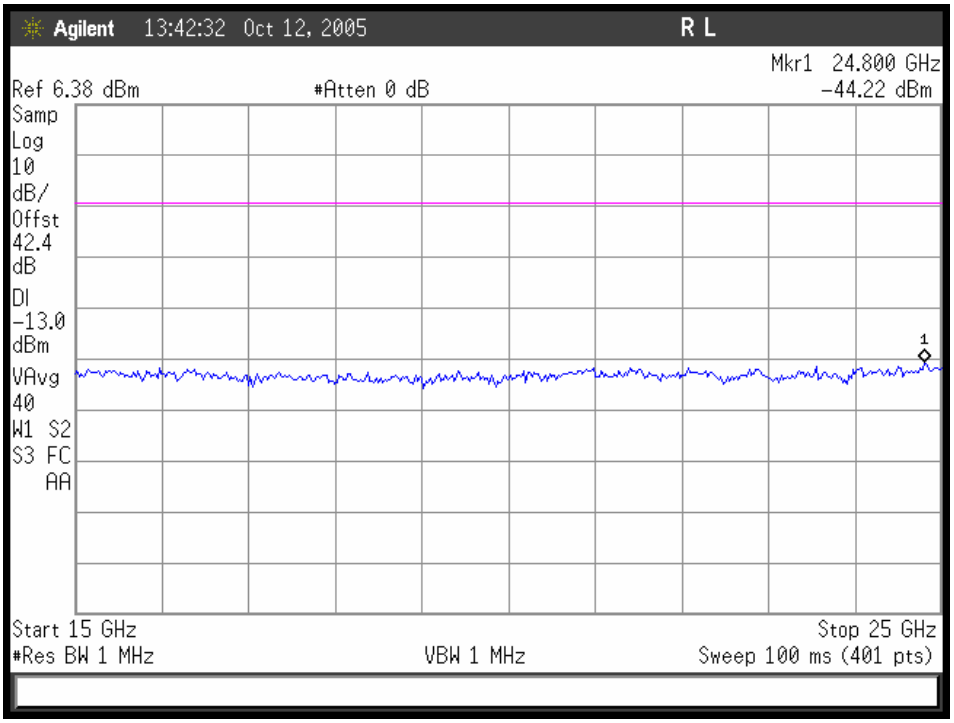
Plot 9: Upper Block B Spurious Emission 30 MHz – 1 GHz



Plot 10: Upper Block B Spurious Emission 1 -5GHz



Plot 11: Upper Block B Spurious Emission 5 -15GHz



Plot 12: Upper Block B Spurious Emission 15-25GHz

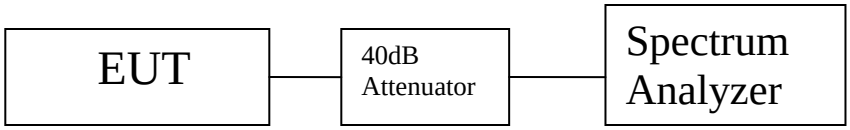


Figure 5. Block Diagram of Spurious Emissions at Antenna Terminals Test Setup

6.2 Radiated Emissions (Substitution Method)

Test Requirement(s): §2.1053 and §27.53(a)(3)

Test Procedures: As required by 47 CFR 2.1053, the *field strengths of radiated spurious emissions* were made in accordance with the procedures of TIA/EIA-603-A-2001 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). The distance between the EUT and the test antenna was 3 meter. The EUTs RF port was connected to a dummy load. The EUT was set to transmit at its designated operating frequency range and at its maximum output power level. The intensities of the radiated emissions were maximized by rotating the turntable 360 degrees and varying the receive antenna from 1 to 4m. Measurements were made with the receive antenna in both horizontal and vertical polarizations.

In order to determine the magnitude of the radiated emissions, a calibrated antenna source was positioned in place of the EUT and fed with a modulated carrier equal to that of the EUT. The effective isotropic radiated power of each emission was determined by adding the forward power to the substitution antenna at the previously recorded amplitude, and adding the gain of the antenna at the given frequency.

The Radiated Spurious Emissions *Limit* is obtained by the following:

Emission Limit below 2300 MHz and above 2370 MHz: 70 + 10 log (P) dB
Po - (70 + 10log 5) = 37dBm - (77 dB) = -40 dBm

Test Results: Equipment complies with Section 2.1053 and 27.53(a) (3). All harmonics found were at the noise floor of the spectrum analyzer. The following pages show measurements of emissions data sheet which are recorded below.

Frequency	Polarization	Spectrum Analyzer	Signal Generator Pwr	Tx Ant. Gain	EIRP	Limit	Margin
(MHz)	V/H	(dB/m) AVG	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
4705.0	V	SNF	-	9.7	-	-40	-
7057.5	V	SNF	-	10.4	-	-40	-
9410	V	SNF	-	11.2	-	-40	-
11762.5	V	SNF	-	10.8	-	-40	-
14115	V	SNF	-	10.9	-	-40	-
16467.5	V	SNF	-	14.3	-	-40	-
18820	V	SNF	-	-	-	-40	-
21172.5	V	SNF	-	-	-	-40	-
23525	V	SNF	-	-	-	-40	-

Table 5: Upper Block A Vertical Polarization

Frequency	Polarization	Spectrum Analyzer	Signal Generator	Tx Ant. Gain	EIRP	Limit	Margin
(MHz)	V/H	(dB/m) AVG	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
4705.0	H	SNF	-	9.7	-	-40	-
7057.5	H	SNF	-	10.4	-	-40	-
9410.0	H	SNF	-	11.2	-	-40	-
11762.5	H	SNF	-	10.8	-	-40	-
14115.0	H	SNF	-	10.9	-	-40	-
16467.5	H	SNF	-	14.3	-	-40	-
18820.0	H	SNF	-	-	-	-40	-
21172.5	H	SNF	-	-	-	-40	-
23525.0	H	SNF	-	-	-	-40	-

Table 6: Upper Block A Horizontal Polarization

Note: V = vertical, H = horizontal, and SNF = Spectrum Analyzer noise floor
All harmonic emissions measured were at the noise floor of the spectrum analyzer which was >-65dBm with a VBW and RBW = 1MHz

Frequency	Polarization	Spectrum Analyzer	Signal Generator	Tx Ant. Gain	EIRP	Limit	Margin
(MHz)	V/H	(dB/m) AVG	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
4715.0	V	SNF	-	9.7	-	-40	-
7072.5	V	SNF	-	10.4	-	-40	-
9430.0	V	SNF	-	11.2	-	-40	-
11787.5	V	SNF	-	10.8	-	-40	-
14145.0	V	SNF	-	10.9	-	-40	-
16502.5	V	SNF	-	14.3	-	-40	-
18860.0	V	SNF	-	-	-	-40	-
21217.5	V	SNF	-	-	-	-40	-
23575.0	V	SNF	-	-	-	-40	-

Table 7: Upper Block B Vertical Polarization

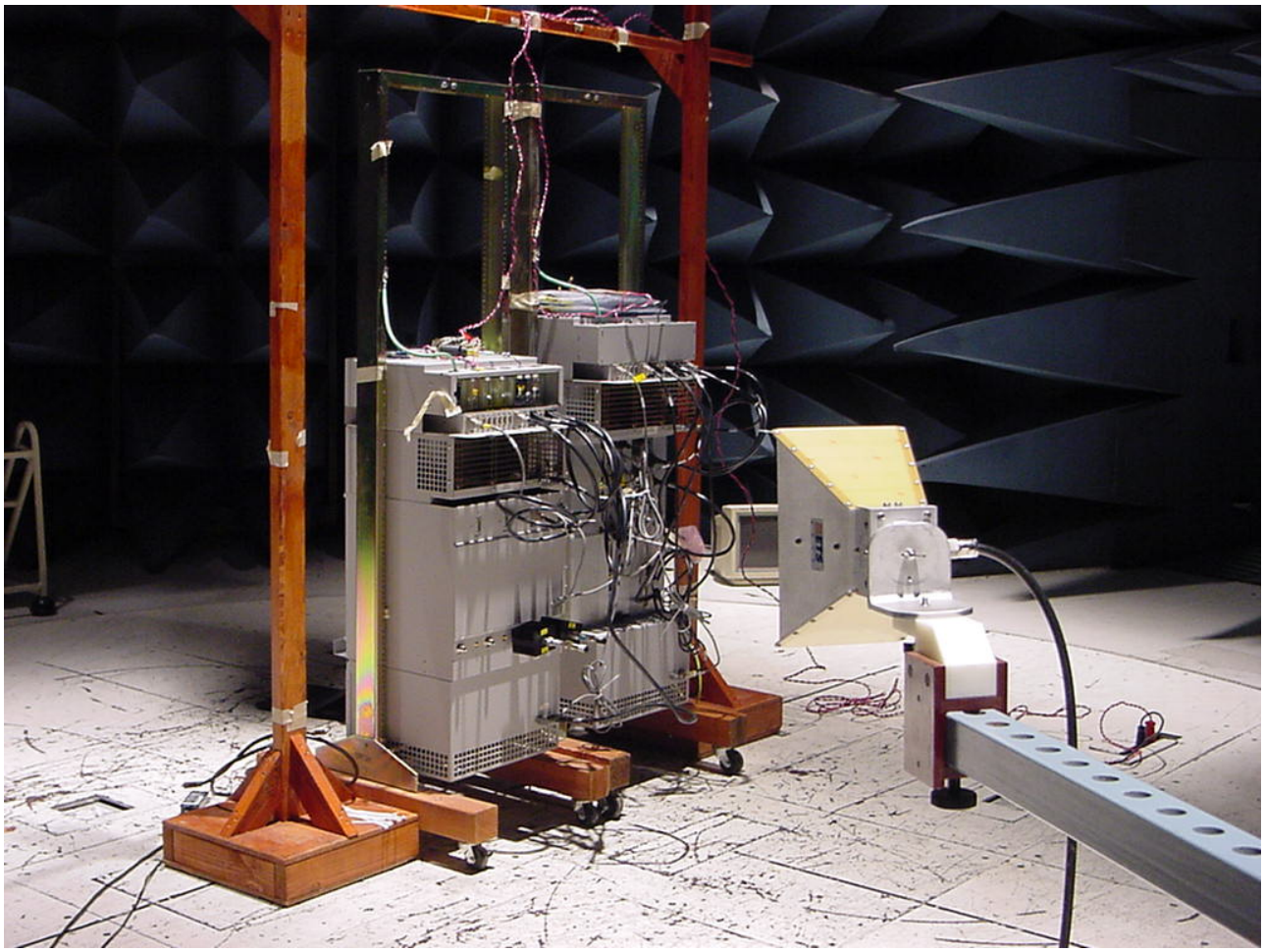
Frequency	Polarization	Spectrum Analyzer	Signal Generator	Tx Ant. Gain	EIRP	Limit	Margin
(MHz)	V/H	(dB/m) AVG	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
4715.0	H	SNF	-	9.7	-	-40	-
7072.5	H	SNF	-	10.4	-	-40	-
9430.0	H	SNF	-	11.2	-	-40	-
11787.5	H	SNF	-	10.8	-	-40	-
14145.0	H	SNF	-	10.9	-	-40	-
16502.5	H	SNF	-	14.3	-	-40	-
18860.0	H	SNF	-	-	-	-40	-
21217.5	H	SNF	-	-	-	-40	-
23575.0	H	SNF	-	-	-	-40	-

Table 8: Upper Block B Horizontal Polarization

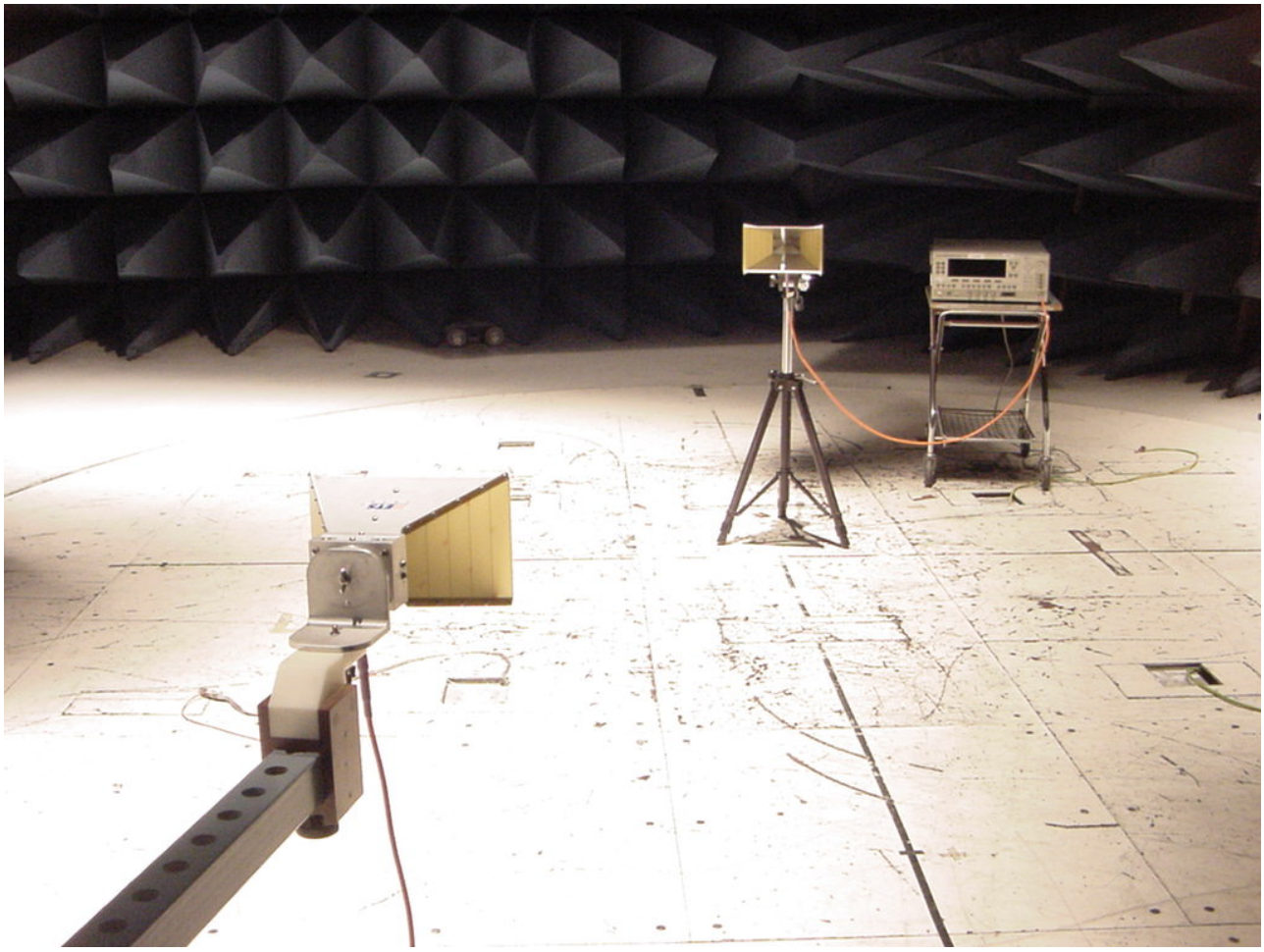
Note: V = vertical, H = horizontal, and SNF = Spectrum Analyzer noise floor
All harmonic emissions measured were at the noise floor of the spectrum analyzer which was >-65dBm with a VBW and RBW = 1MHz

Test Engineer(s): Shawn McMillen

Test Date(s): October 20, 2005



Photograph 1. Radiated Emissions Test Setup Photo



Photograph 2 . Radiated Emissions Test Setup Photo (Signal Substitution Method)

6.3 Radiated Emissions Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 9.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 9.

Frequency (MHz)	Field Strength (dBµV/m)	
	§15.109 (b), Class A Limit (dBµV) @ 10m	§15.109 (a),Class B Limit (dBµV) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

Table 9. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures: The EUT was installed in a standard Telco rack inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 10 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

Test Results: The EUT was found compliant with the Class A requirement(s) of this section. Measured emissions below applicable limits.

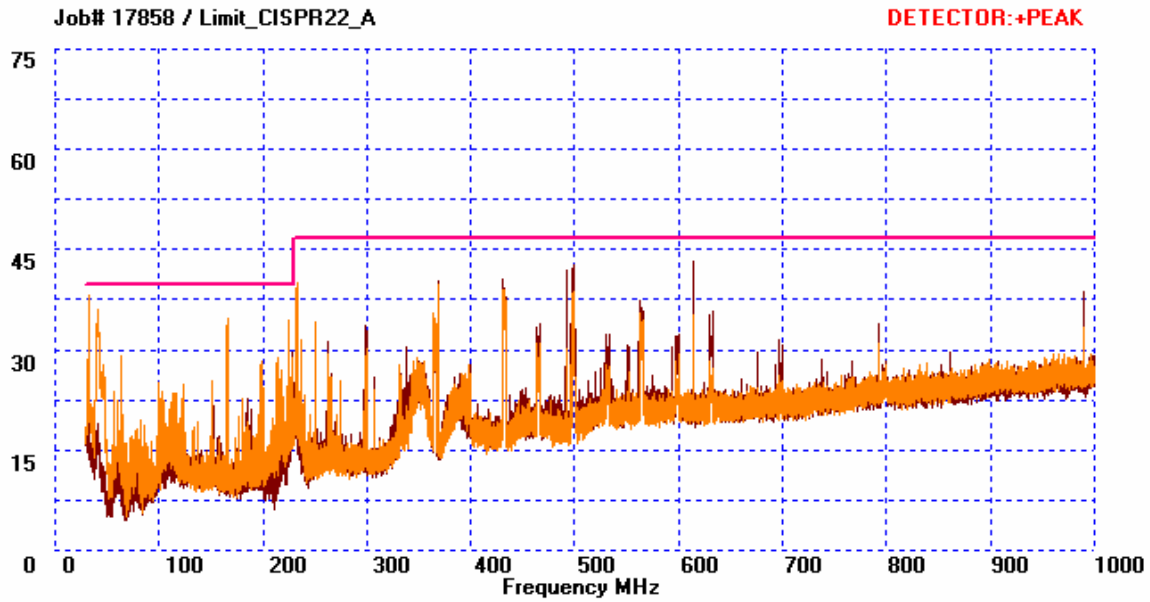
Test Engineer(s): Tony Permsombut

Test Date(s): October 14, 2005 and November 5, 2005

Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity (H/V)	EUT Azimuth (Degrees)	Antenna Height (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB/m) (+)	Pre Amp Gain (dB) (-)	Cable Loss (dB) (+)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.4	V	206	1	9.30	17.30	0.00	0.93	27.54	40.00	-12.46
41.2	V	97	1	23.10	11.52	0.00	1.04	35.65	40.00	-4.35
165.72	V	157	1	22.15	9.72	0.00	2.33	34.20	40.00	-5.80
430.8	H	174	1.7	22.05	16.70	0.00	3.65	42.41	47.00	-4.60
499.68	H	219	1.86	18.91	17.40	0.00	4.03	40.34	47.00	-6.66
614.4	H	65	1.96	19.85	18.61	0.00	4.65	43.12	47.00	-3.88

Table 10. Radiated Emissions Limits Test Results



Radiated Emissions Limits Test Results, 1 GHz to 5 GHz, Class A

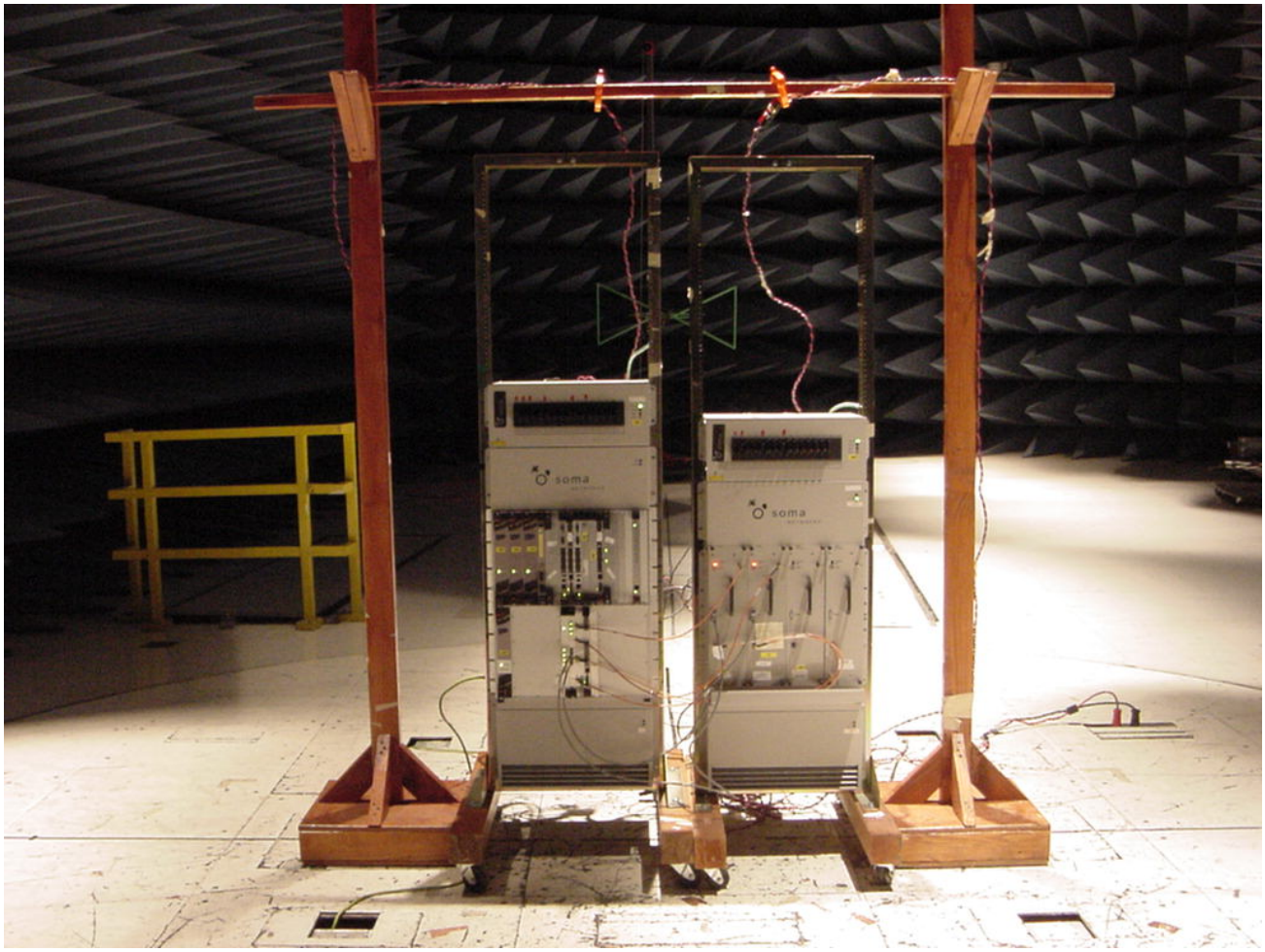
Freq.	Azimuth	Antenna Polarity	Height	Raw Amp. @ 3m	P.Amp	Ant. Cor. Factor	Cable Loss	Dist. Cor. Factor	EUT Field Strength Final Amp.	Limit per FCC pt 15 @ 3m	Delta
(GHz)	(Degrees)	(H/V)	(m)	(Avg)	(dB)	(dB/m)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
1.095	190	H	1	39.76	35.77	24.33	2.20	10.46	20.05	49.5	-29.45
1.1	160	V	1	43.15	35.76	24.23	2.20	10.46	23.36	49.5	-26.14
1.193	200	H	1	40.07	35.52	24.50	2.26	10.46	20.86	49.5	-28.64
1.194	170	V	1	40.21	35.51	24.41	2.26	10.46	20.91	49.5	-28.59
1.998	60	H	1.05	36.25	34.72	27.44	3.25	10.46	21.76	49.5	-27.74
2	200	V	1.17	35.46	34.72	27.34	3.25	10.46	20.87	49.5	-28.63
2.39	0	V	1.09	35.7	34.65	28.11	3.59	10.46	22.29	49.5	-27.21
2.99	0	H	1.08	43.07	34.92	30.14	4.04	10.46	31.88	49.5	-17.62
2.99	315	V	1	44.53	34.92	29.98	4.04	10.46	33.17	49.5	-16.33
4.626	315	H	1	52.82	34.61	32.95	5.11	10.46	45.81	49.5	-3.69
***4.626**	**0**	**V**	**1**	**54.44**	**34.61**	**32.75**	**5.11**	**10.46**	**47.22**	**49.5**	**-2.28**
5	0	H	1	31.47	34.55	33.88	5.34	10.46	25.68	49.5	-23.82
5	0	V	1	32.06	34.55	33.73	5.34	10.46	26.11	49.5	-23.39

Table 11. Radiated Emissions Limits Test Results, 1 GHz to 5 GHz

Note 1: * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

Note 2: The EUT was tested at 1 m. The data has been corrected for comparison with the 3 m limit using the formula: 20log (3 m/1 m) as expressed in the 'Distance Correction' column.

Radiated Emission Limits Test Setup



Photograph 3. Radiated Emission Limits Test Setup

7.0 Electromagnetic Compatibility Frequency Stability Requirements

7.1 Frequency Stability

Test Requirement(s): §2.1055 and §27.54

Test Procedures: The frequency stability was measured at the EUTs antenna terminal using a spectrum analyzer. The EUT was placed into a CW mode and the frequency was counted using the frequency counter option of the spectrum analyzer. The frequency was first measured at room temperature in order to establish a base from which the deviations would be measured against. The EUTs supply voltage, 121 VAC, was also set to 85 and 115% of its nominal valued and the resulting frequencies were measured. The EUT was then placed into a temperature chamber and the temperature was varied from 0 – 50 ^{0}C in 10 ^{0}C increments. The resulting frequency was measured at each interval once the EUT was given enough time to stabilize at each temperature setting.

Test Results: Equipment complies with Section 2.1055 and 27.54. The following table shows the measured frequencies in accordance with the applicable rule parts.

Temperature ^{0}C	Voltage %	Frequency (GHz)	Deviation (ppm)
+20	100	2.307740200	0.004
+20	85	2.307740191	0.001
+20	115	2.307740197	0.174
0	100	2.307740601	0.203
+10	100	2.307740669	0.001
+30	100	2.307740203	0.105
+40	100	2.307739958	0.166
+50	100	2.307739817	0.004

Test Engineer(s): Shawn McMillen

Test Date(s): November 1, 2005

8.0 Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

Test Name: RF Power Output, PPSD & Emission Masks					**Test Date(s): 10/12/2005**
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2430	Power Meter	Anritsu Company	ML2488A	01/12/2005	01/12/2006
1S2432	Power Sensor	Anritsu Company	MA2491A	01/12/2005	01/12/2006
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2006
1S2001	DC Power Supply	Hewlett Packard	6236B	See Note	
N/A	10 dB Attenuator	Weinschel Corporation	33-10-34	See Note	
1S2034	Coupler, Directional 1-20 GHz	KRYTAR	101020020	See Note	
Test Name: Spurious Emissions at Antenna Terminals					**Test Date(s): 10/12/2005**
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2430	Power Meter	Anritsu Company	ML2488A	01/12/2005	01/12/2006
1S2432	Power Sensor	Anritsu Company	MA2491A	01/12/2005	01/12/2006
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2006
N/A	10 dB Attenuator	Weinschel Corporation	33-10-34	See Note	
1S2041	Coupler, Bi Directional Coaxial	NARDA	N/A	See Note	
1S2034	Coupler, Directional 1-20 GHz	KRYTAR	101020020	See Note	
1S2001	DC Power Supply	Hewlett Packard	6236B	See Note	
Test Name: Frequency Stability					**Test Date(s): 11/01/2005**
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2430	Power Meter	Anritsu Company	ML2488A	01/12/2005	01/12/2006
1S2432	Power Sensor	Anritsu Company	MA2491A	01/12/2005	01/12/2006
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2006
N/A	10 dB Attenuator	Weinschel Corporation	33-10-34	See Note	
1S2034	Coupler, Directional 1-20 GHz	KRYTAR	101020020	See Note	
1S2001	DC Power Supply	Hewlett Packard	6236B	See Note	
1S2100	Digital Multi Meter	Fluke	77 Series II	09/29/2005	09/29/2006
1S2229	Chamber, Temperature	Tenny Engineering	T63C	11/04/2005	11/04/2006

Test Name: Radiated Emissions (Substitution Method)					Test Date(s): 10/20/2005
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2263	Chamber, 10 Meter	Rantec	N2-14	07/25/2005	07/25/2006
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2006
1S2278	Generator, Swept Signal	Hewlett Packard	83650B	06/11/2005	06/11/2006
1U7	Antenna, Horn	EMCO	3115	02/23/2005	02/23/2006
1S2198	Antenna, Horn	EMCO	3115	07/14/2005	07/14/2006
1S2129	Mixer, Harmonic	Hewlett Packard	11970K	03/10/2003	03/10/2006
1S2128	Mixer, Harmonic	Hewlett Packard	11970A	03/10/2003	03/10/2006
1S2121	Pre-Amplifier	Hewlett Packard	8449B	10/27/2005	10/27/2006
N/A	7 GHz High Pass Filter	Micro-Tronics	HPM13147	See Note	
Test Name: Radiated Emissions					**Test Date(s): 10/14/2005 & 11/05/2005**
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2184	Antenna, Bilog	Chase	CBL6112A	01/12/2005	1/12/2006
1S2263	Chamber, 10 Meter	Rantec	N2-14	07/25/2005	07/25/2006
1S2413	Hygrometer/Thermometer, Digital	Fischer Scientific	11-661-13	05/25/2005	05/25/2007
1S2421	EMI Test Receiver	Rhode & Schwarz	ESIB 7	02/09/2005	02/09/2006
1S2121	Pre-Amplifier	Hewlett Packard	8449B	10/27/2005	10/27/2006
1S2198	Antenna, Horn	EMCO	3115	07/14/2005	07/14/2006
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2006

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

9.0 Certification Label & User's Manual Information

9.1 Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is

to be operated.[1] In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, or the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant, whichever is applicable.

§ 2.907 Certification.

a. Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart C (of Part 15), which deals with intentional radiators.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but

9.2 Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(ii Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(ii A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(ii All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

8.0 Appendix A (Customer Supplied Documentation)