125 Technology Parkway
Norcross, Georgia, US 30092

Direct Sequence Spread Spectrum Transmitter

Testing Performed for: EMS Technologies
Testing Performed by: LXE Inc.

PRISM System
Model: CAL-Node

FCC ID: DNY160995A

Issue Date: February 1, 2000

Table of Contents

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. Testing was performed by LXE Inc., a division of EMS Technologies, Inc.

1.2 Product Description

The equipment under test(EUT) is a single channel, direct sequence spread spectrum transmitter, referred to as the CAL Node or generically as a PDU (Personnel Detection Unit). The CAL Node is a single component of the larger Prison Inmate and Safety Management(PRISM) system. PRISM is a system that uses a series of transmitters and receivers, connected to a main computer for purpose of, among others, the monitoring/tracking of prison inmates and guards inside of a correctional facility. The CAL Node is mounted on a wall or pole and is used to transmit known messages for synchronization and system state of health testing. See Appendix A for detailed photographs of the EUT.

2.0 LOCATION OF TEST FACILITY

The LXE test facility is located at the following address:

LXE, Inc.
An EMS Technologies Company
125 Technology Parkway
Norcross, GA US 30092-2993
Tel: (770) 447-4224
Fax: (770) 447-6928

Radiated emission tests were conducted at the manufacture's test facility at a location specifically prepared for this testing. The radiated emissions test site meets the characteristics of ANSI C63.4:1992, CISPR 16 and EN 55022:1994. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT, 1300F2.

3.0 DESCRIPTION OF OPEN AREA TEST SITE

The open area test site(OATS) is located in the center of the rooftop of the building. The roof is located at a height of approximately 8 meters above the ground. The 3 meters radiated emissions test site is an open, flat area (open area) test site approximately 6.2m x 9.2m in dimension. All reflecting objects including test personnel lie outside the perimeter of the ellipse. The 3 meters test site ground plane is made of a 1/4" metal screen mesh which extends 2 meters past the mast and equipment under test(EUT). Material of the ground plane, comprised of individual 1/4" metal screen mesh rolls, were soldered at the seams with gaps smaller than 1/10 of the wavelength at 1000MHz. The ground plane is connected to the earth ground by ground rods. All wiring is done at floor level around the test site periphery. The radiated emissions test setup is shown in figure 1.

3.1 Radiated Emissions Testing Facility Drawing

All dimensions are in meters(m)

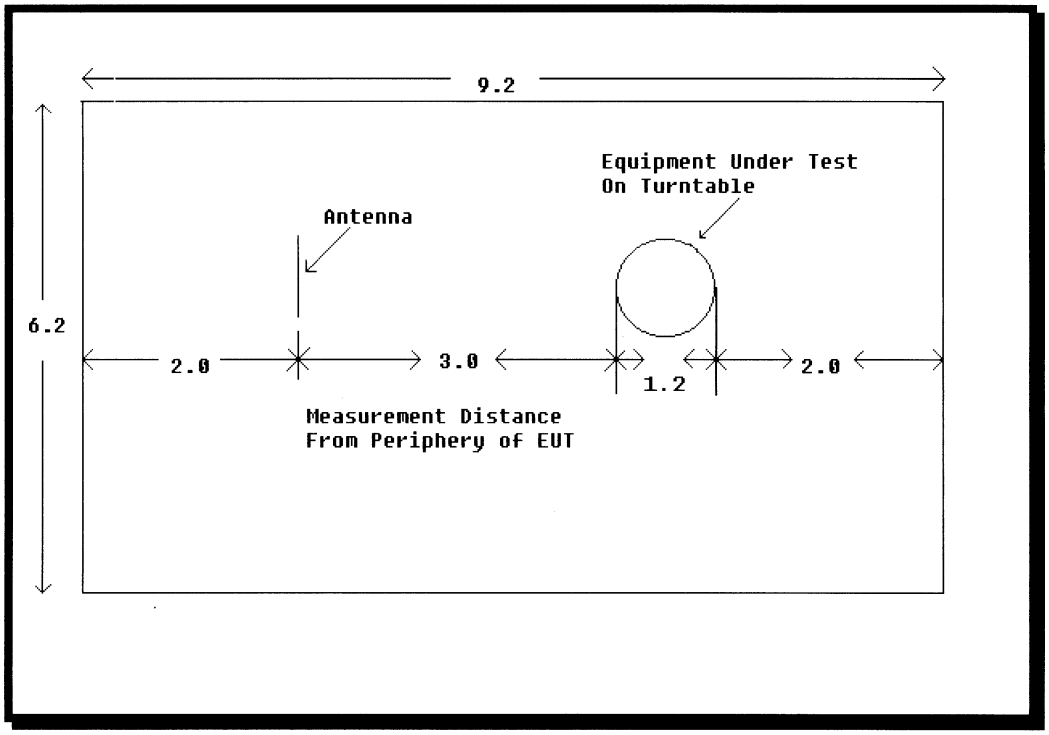

Figure 1: Open Area Test Site(OATS)

4.0 APPLICABLE STANDARD REFERENCES

The following standards were used for this test:

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 (CRF): Title 47, Part 15, Radio Frequency Devices, Subpart C, Intentional Radiators (October 1997)

5.0 LIST OF TEST EQUIPMENT

Table 1: Test and Support Equipment

Description	Manufacturer	Model/Part #	Serial #	Calibration Due Date
Spectrum Analyzer	Hewlett Packard	HP 8563E	3304A00657	05/05/00
Preamplifier	Hewlett Packard	83006A	3116A01317	11/09/99
HI-Pass Filter	MicroWave Circuits	H1G810G1	0001	10/27/00
Biconical Antenna	EMCO	3104C	9012-4360	05/06/00
Log Periodic	EMCO	3146	3011-2946	04/01/00
Horn Antenna	ElectroMetric	RGA-60	6166	04/05/00
Horn Antenna	ElectroMetric	RGA-60	6165	08/28/00
RF Cable			NSN	07/20/00
RF Cable			7015	11/05/00
RF Cable			6986	11/05/00
Antenna Mast	CDI	CDI	N/A	N/A
Turntable	CDI	CDI	N/A	N/A
RF Enclosure	Lindgren Enclosure	14-2/2-0	8147	N/A

6.0 TEST METHODOLOGY

For the radiated emissions tests, measurements were made over the frequency range of 30MHz to 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. A nonconductive remotely controlled turntable approximately 0.91m x 1.2m x 0.8m was used to measure radiated emissions from all sides of the EUT. The turntable has a center opening that allows cabling to be routed directly down to the conducting ground plane.

Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements above 30MHz and below 1000MHz, and 1MHz for measurements above 1000 MHz.

7.0 SUPPORT EQUIPMENT

Table 2: Support Equipment

Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
Tenma	Power Supply	72-2010	None	None

8.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

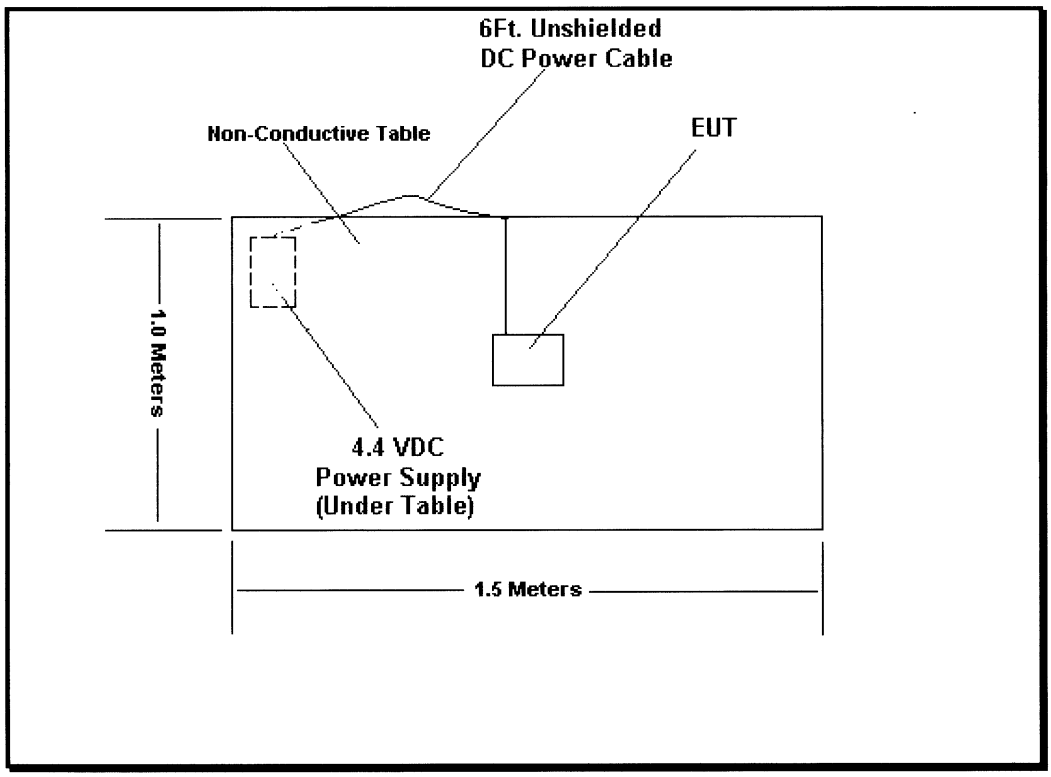

Figure 2

9.0 TEST SETUP PHOTOGRAPHS

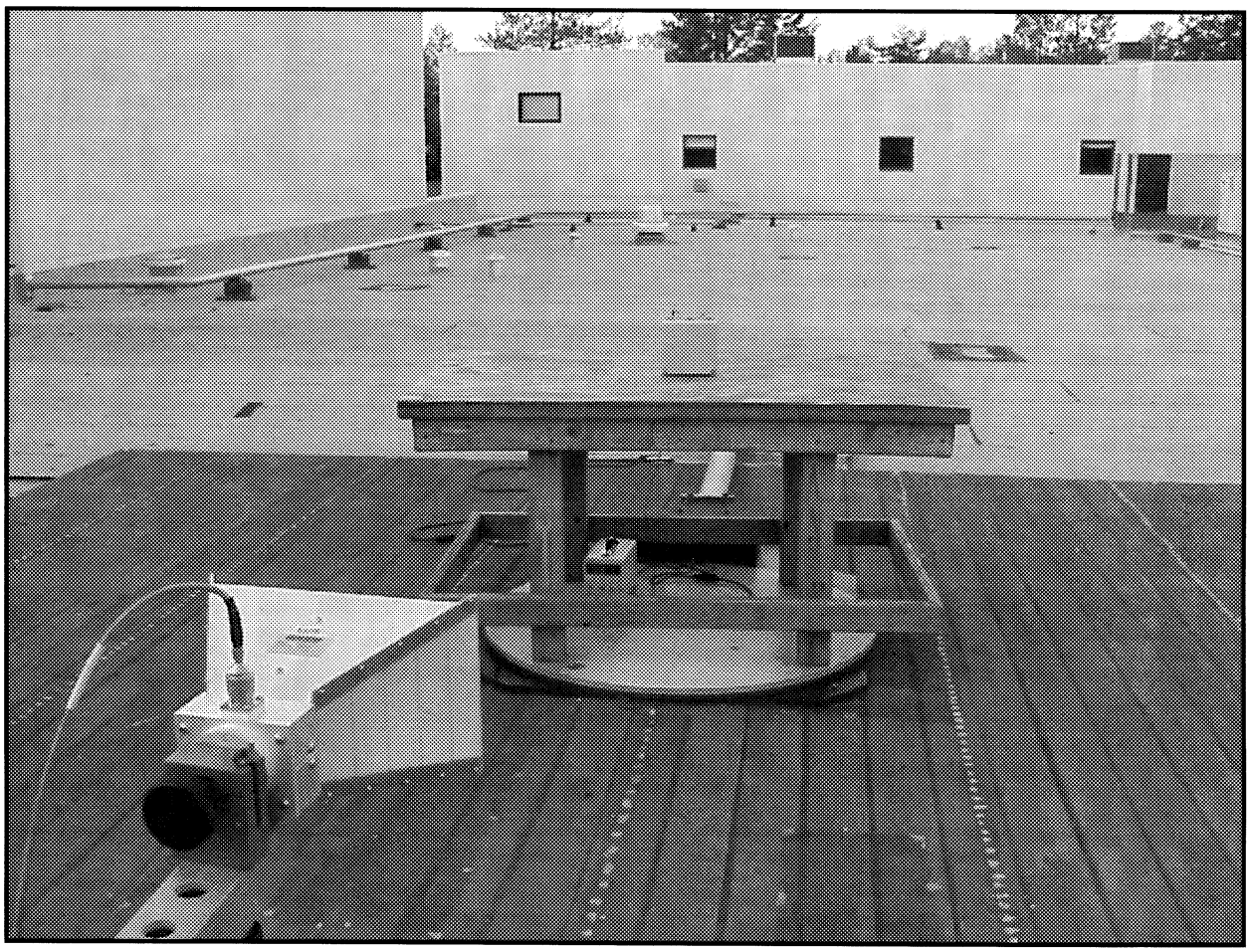

Figure 3: Front View

9.0 TEST SETUP PHOTOGRAPHS(cont.)

Figure 4: Back View

10.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were also taken of all signals deemed important enough to document. The tables below make reference to plot numbers that can be found following each section.

10.1 Antenna Requirement - FCC Section 15.203

The antenna for the CAL-NODE unit is an integrated wire antenna that is sealed within the CAL-NODE housing. Substitution of the antenna cannot be made without electrical modifications.

10.2 Power Line Conducted Emissions - FCC Section 15.207

The EUT is powered by a 3.5VDC battery and has no connection to the AC Mains. Conducted emissions are not required.

Table 3: Conducted Emissions

Frequency (MHz)	Level (dBm)	Correction Factors	Corrected Level(dBm)	Corrected Level(uV/m)	Limit (uV/m)	Margin (uV/m)	Pass/Fail
	Conducted Emissions not Required						

Conversions

uV/m = Antilog((dBm + 107)/20)

Sample Calculations

Margin = Limit - Corrected Level(uV/m)

10.3 Radiated Emissions - FCC Section 15.209

The EUT was investigated for radiated emissions from 30 MHz to 10GHz.

Table 4: Radiated Emissions

Frequency (MHz)	Level (dBm)	Correction Factors	Corrected Level(dBm)	Corrected Level(uV/m)	Limit (uV/m)	Margin (uV/m)	Pass/Fail
	No Emissions detected from 30 MHz to 10 GHz						

Conversions

uV/m = Antilog((dBm + 107)/20)

Sample Calculations

Margin = Limit - Corrected Level(uV/m)

10.4 Bandwidth Requirement - FCC Section 15.247(a)(2)

10.4.1 Band Utilization

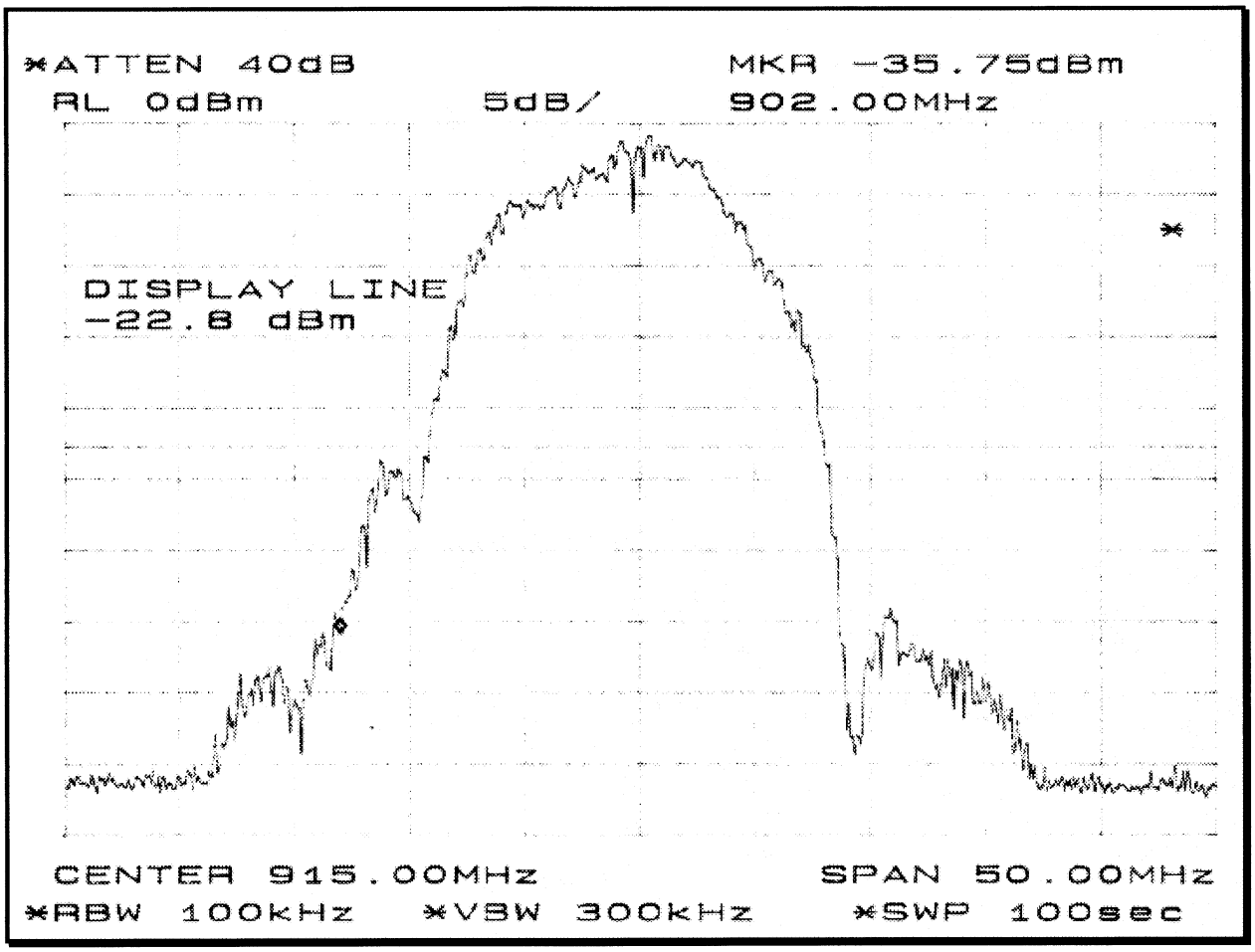

Figure 5: Lower Bandedge

10.4.1 Band Utilization(cont.)

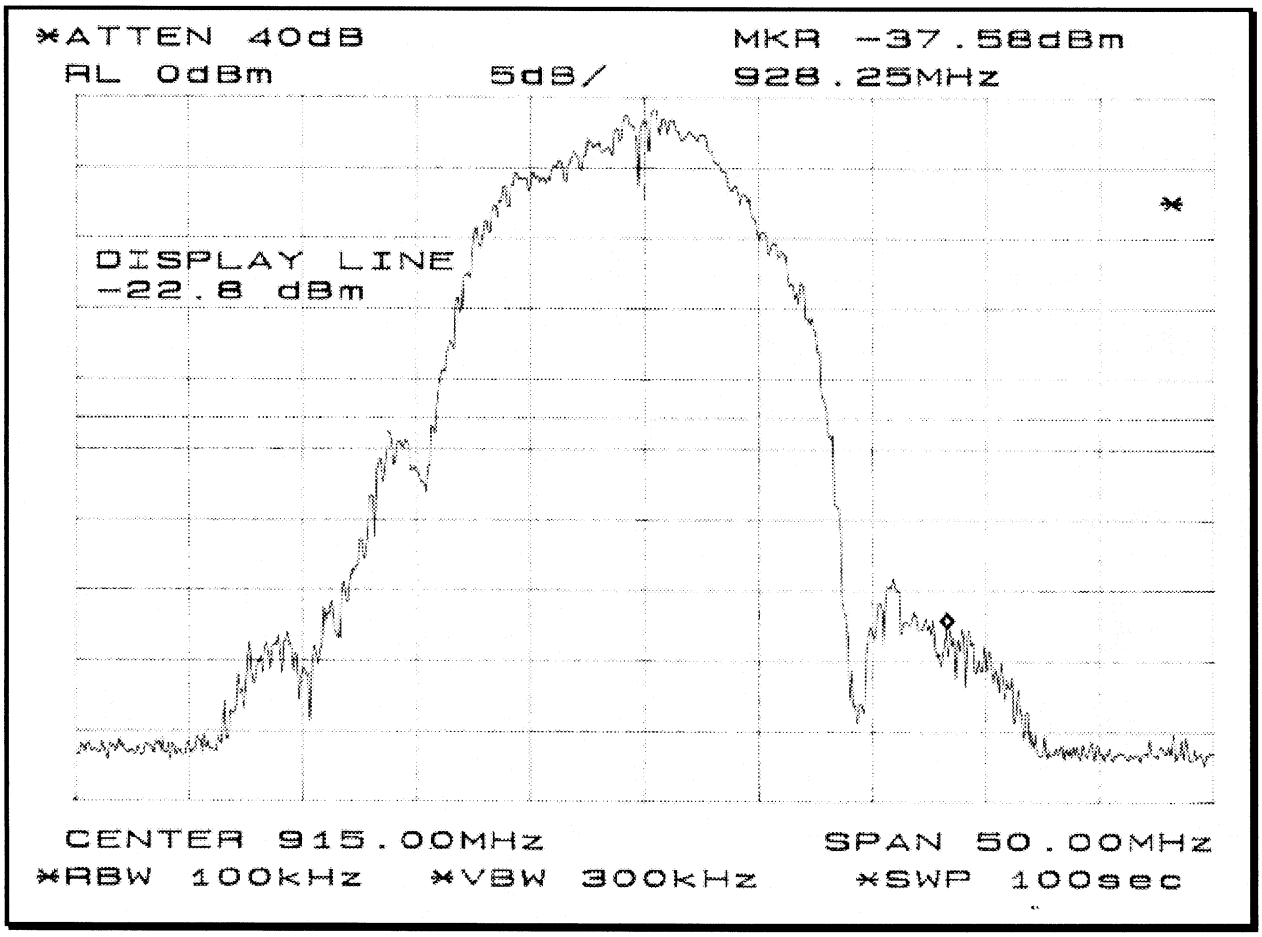

Figure 6: Upper Bandedge

10.4.2 6dB Bandwidth Requirement

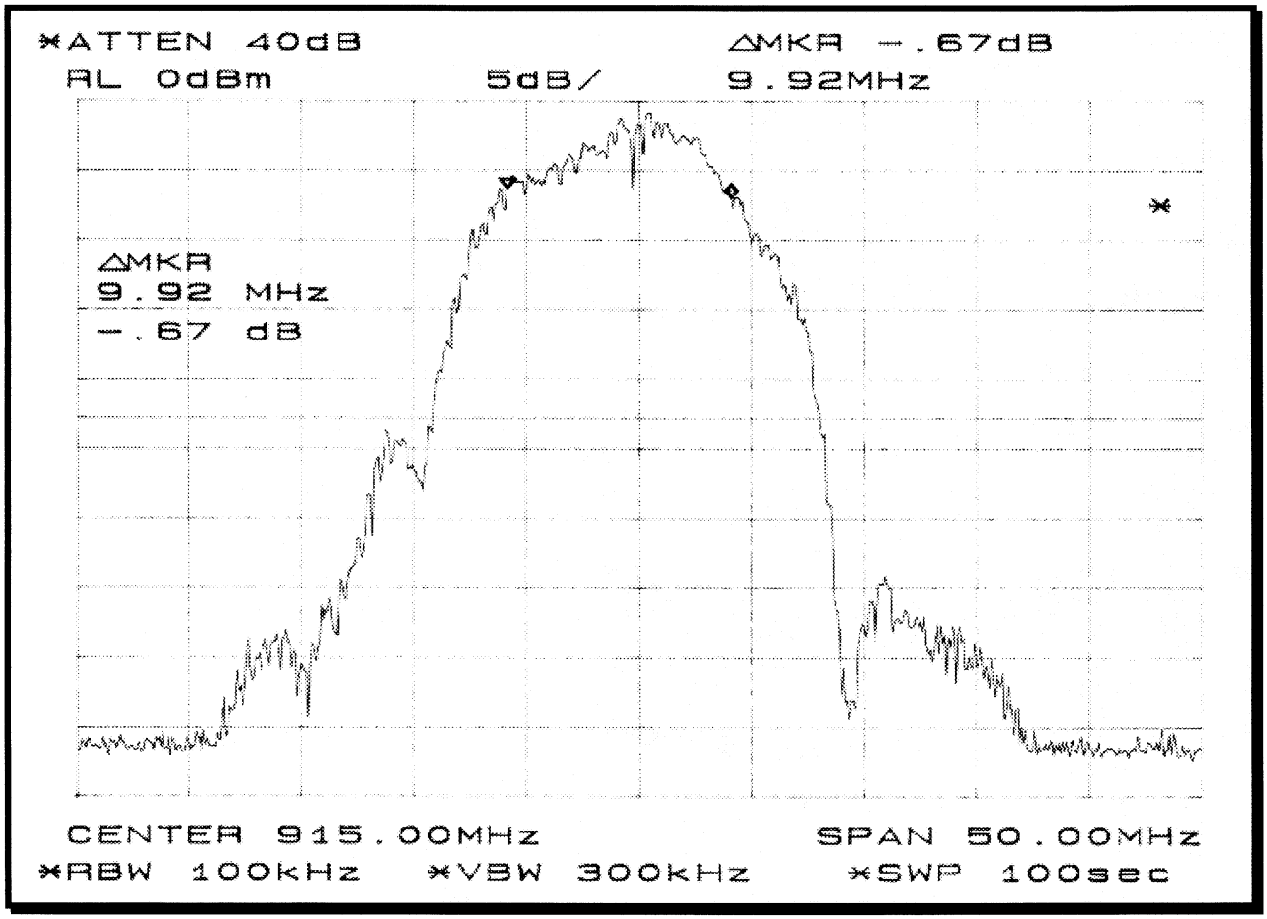

Figure 7: 6dB Bandwidth

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

The peak output power of the equipment under test(EUT) was measured with an HP 436A power meter and is shown in Table 5 below. Normally this measurement is made with a spectrum analyzer, however the spectrum analyzer's RBW and VBW could not be set greater than the 6dB bandwidth of the device.

The EUT has 2 modes of operation, a normal transmit mode that transmits a 176 microsecond pulse every 2 seconds, and a continuous mode that transmits a constant signal used for diagnostic purposes only. The normal mode of operation was not practical to make this measurement as the response time of the measurement equipment was not quick enough to capture the peak power, therefore the continuous mode was used. Both modes were analyzed on an oscilloscope and the amplitudes of each were found to be similar.

Table 5: Peak Output Power Results

Frequency (MHz)	Measurement Method	Uncorrected Level (dBm)	Correction Factors* (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
915	Conducted	13.84	1	14.84	30	15.16

***Correction factors include a Cable Loss of 1dB.**

10.6 Spurious Emissions - FCC Section 15.247(c)

10.6.1 RF Conducted Spurious Emissions

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

The RF conducted spurious emissions found in the band of 300MHz to 10GHz are reported below and the following plots were taken to show compliance.

Table 6: Conducted Spurious Emissions Data

Conducted Spurious Emissions Data Table				
Measured Peak Power(dBm) =		14.84		
Frequency (GHz)	Level (dBm)	dB Below Carrier	Final Result	Plot Figure Number
0.13	-82.00	96.84	PASS	8
0.98	-39.80	54.64	PASS	9
2.75	-36.00	50.84	PASS	10
6.93	-43.33	58.17	PASS	11
8.19	-44.33	59.17	PASS	12

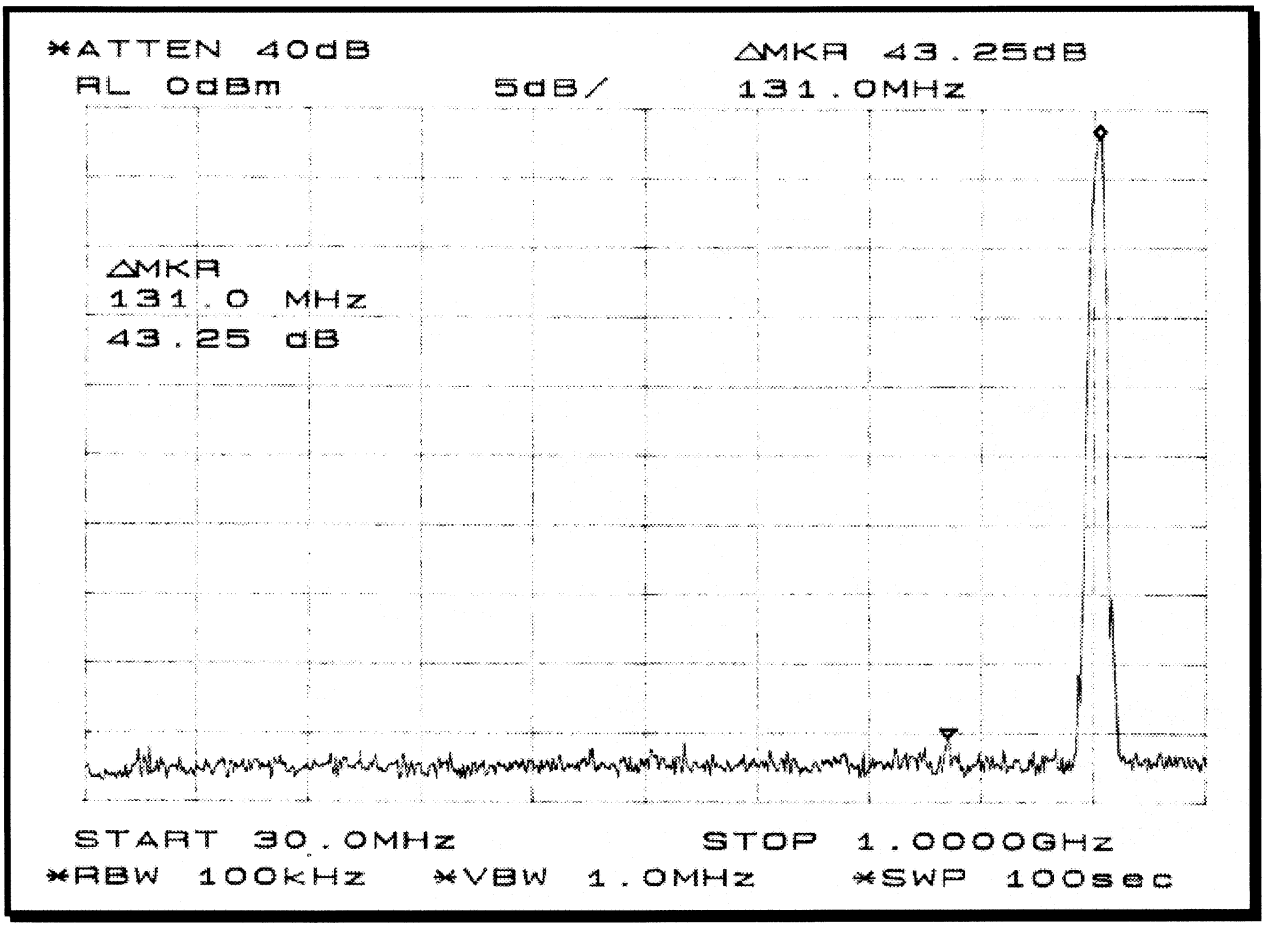

Figure 8: 30 - 1000 MHz

10.6.1 RF Conducted Spurious Emissions(cont.)

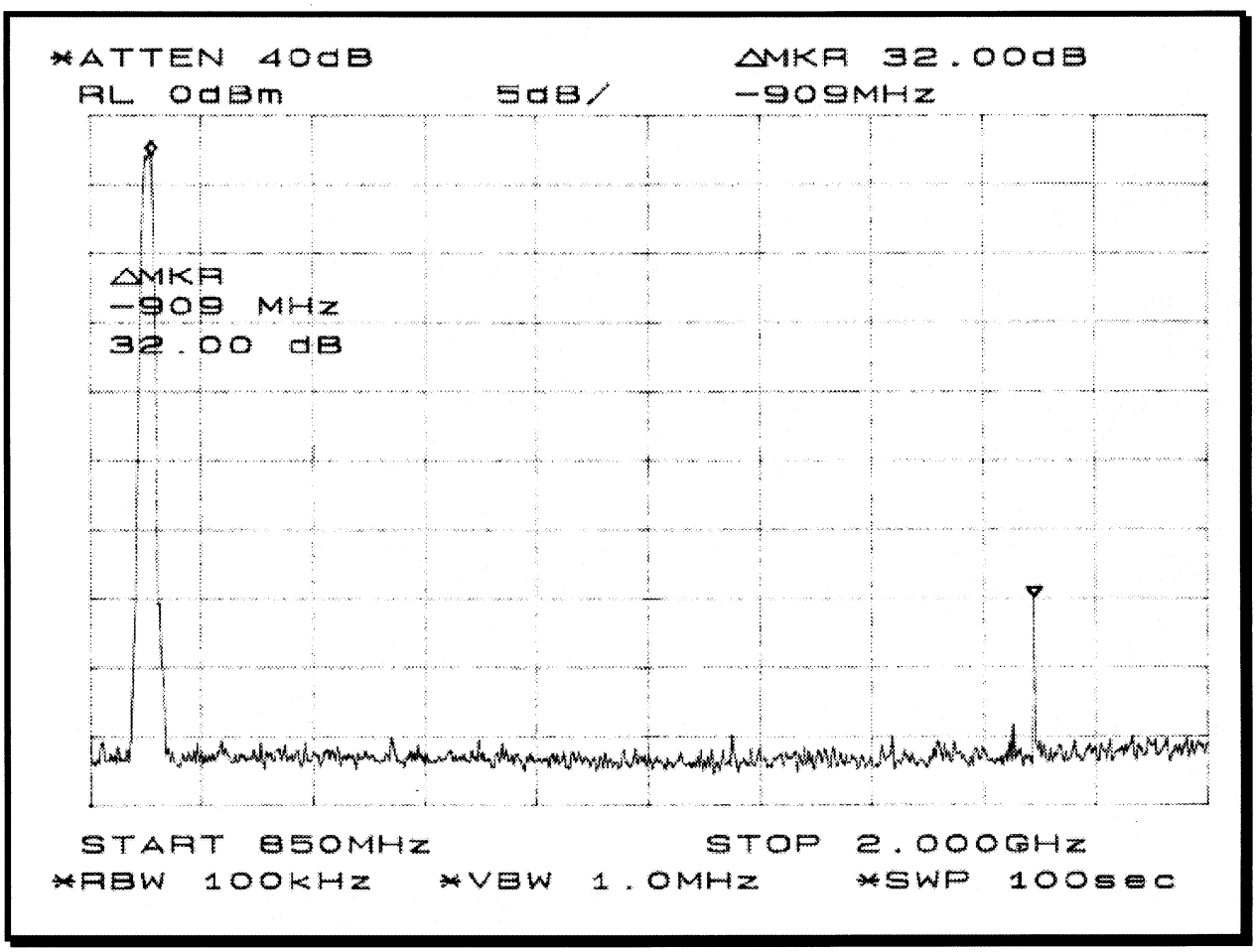

Figure 9: 850 - 2000 MHz

10.6.1 RF Conducted Spurious Emissions(cont.)

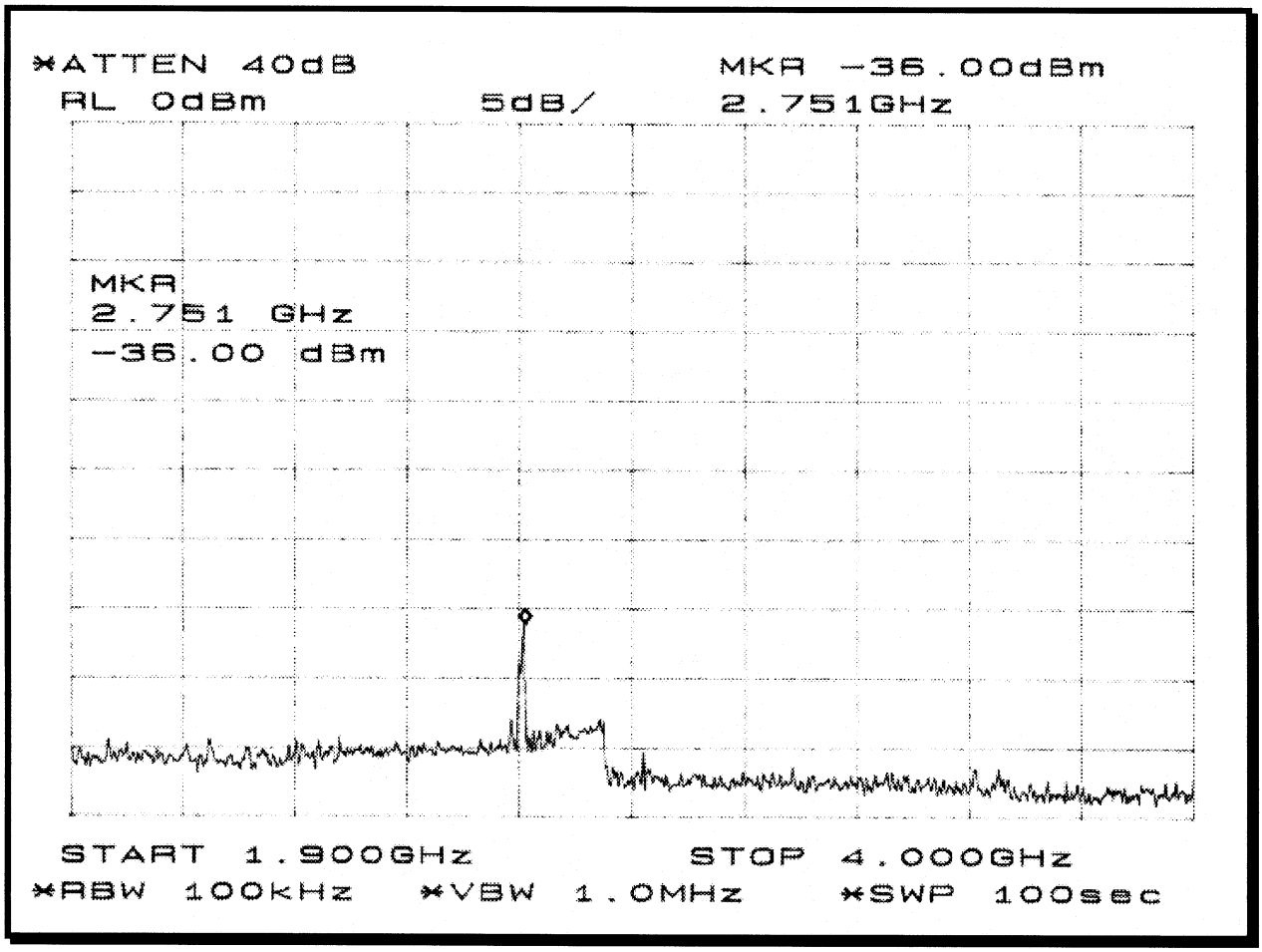

Figure 10: 1.90 - 4.00 GHz

10.6.1 RF Conducted Spurious Emissions(cont.)

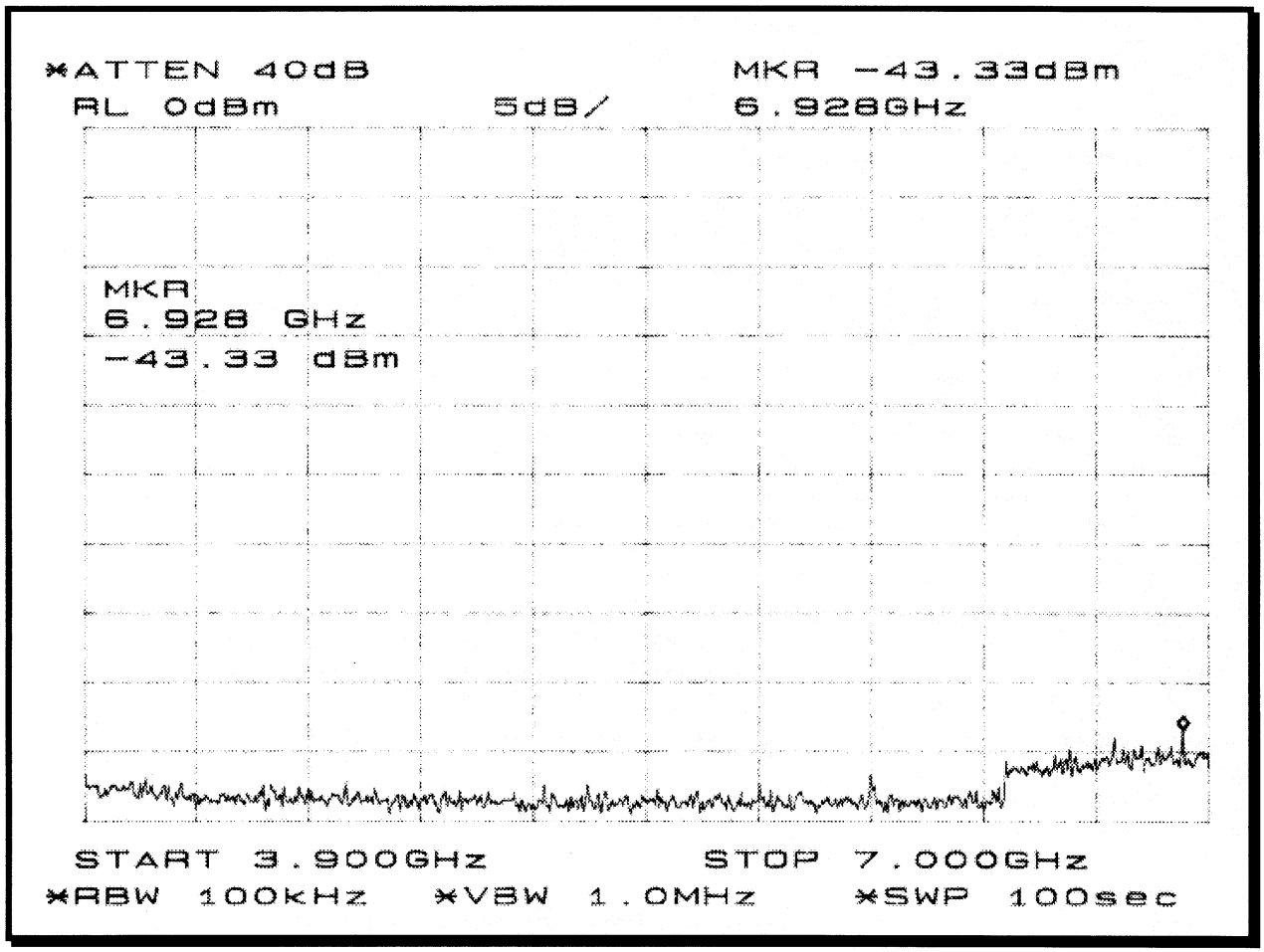

Figure 11: 3.90 - 7.00 GHz

10.6.1 RF Conducted Spurious Emissions(cont.)

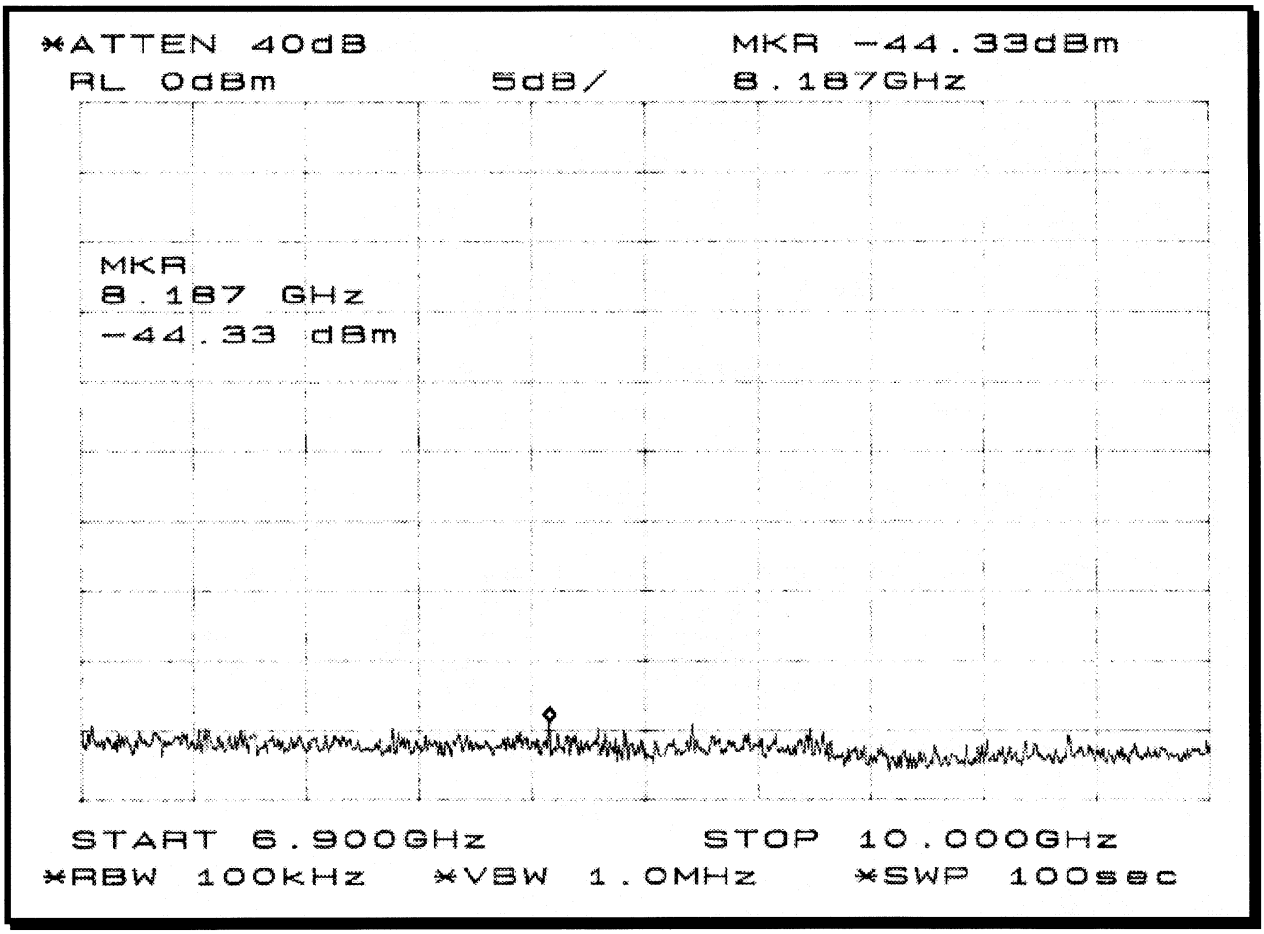

Figure 12: 6.90 - 10.0 GHz

10.6.2 Radiated Spurious Emissions(Restricted Bands)

The peak radiated spurious emissions found in the restricted bands are reported below in table 4. Average measurements are shown in table 5. Plots of this data were also taken and follow these tables. A correction factor of 9.54 was subtracted from the reading as it was necessary to move the antenna up to 1 meter in order to detect the emissions.

The EUT was evaluated on all axis to determine the worst case angle for each reading.

Table 4: Peak Radiated Spurious Emissions in Restricted Bands

Frequency (MHz)	Antenna Distance (m)	Level (dBm)	Detector Function (P/A)	Correction Factors (dB)	Corrected Level (uV/m)	Limit (uV/m)	Margin (uV)	Final Result (Pass/Fail)	Plot Figure Number
2745	1	-59.67	p	2.28	302.18	500	197.82	**PASS**	**13**
3660	1	-70.00	p	4.94	125.10	500	374.90	**PASS**	**14**
4575*	1	-73.15	p	6.66	106.02	500	393.98	**PASS**	**15**
5490*	1	-72.80	p	8.91	143.10	500	356.90	**PASS**	**16**

* Measurement noise floor

Correction Factors

Range Correction = 20Log(D1/D2) Where D1 is the specified distance used and D2 is the distance used to make measurements = [20Log(3/1)] = 9.54 dB

Sample Calculations

Corrected Level(dBm) = Receiver Level + Correction Factors - Range Correction

Conversion from dBm to uV/m = Antilog(dBm + 107)/20)

10.6.2 Radiated Spurious Emissions(Data Plots)

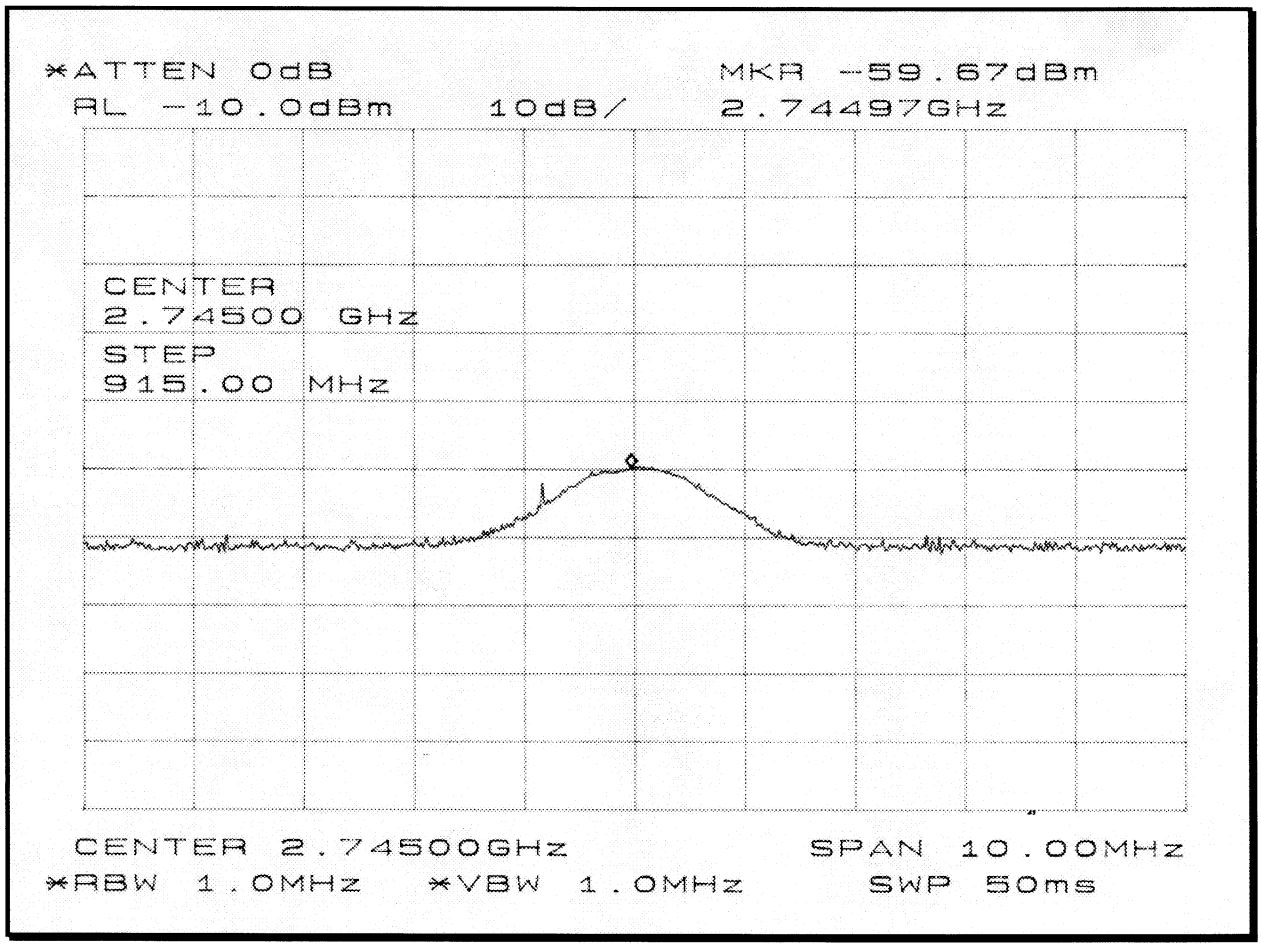

Figure 13: Radiated Spurious Emission at 2.7449GHz

10.6.2 Radiated Spurious Emissions(Data Plots)

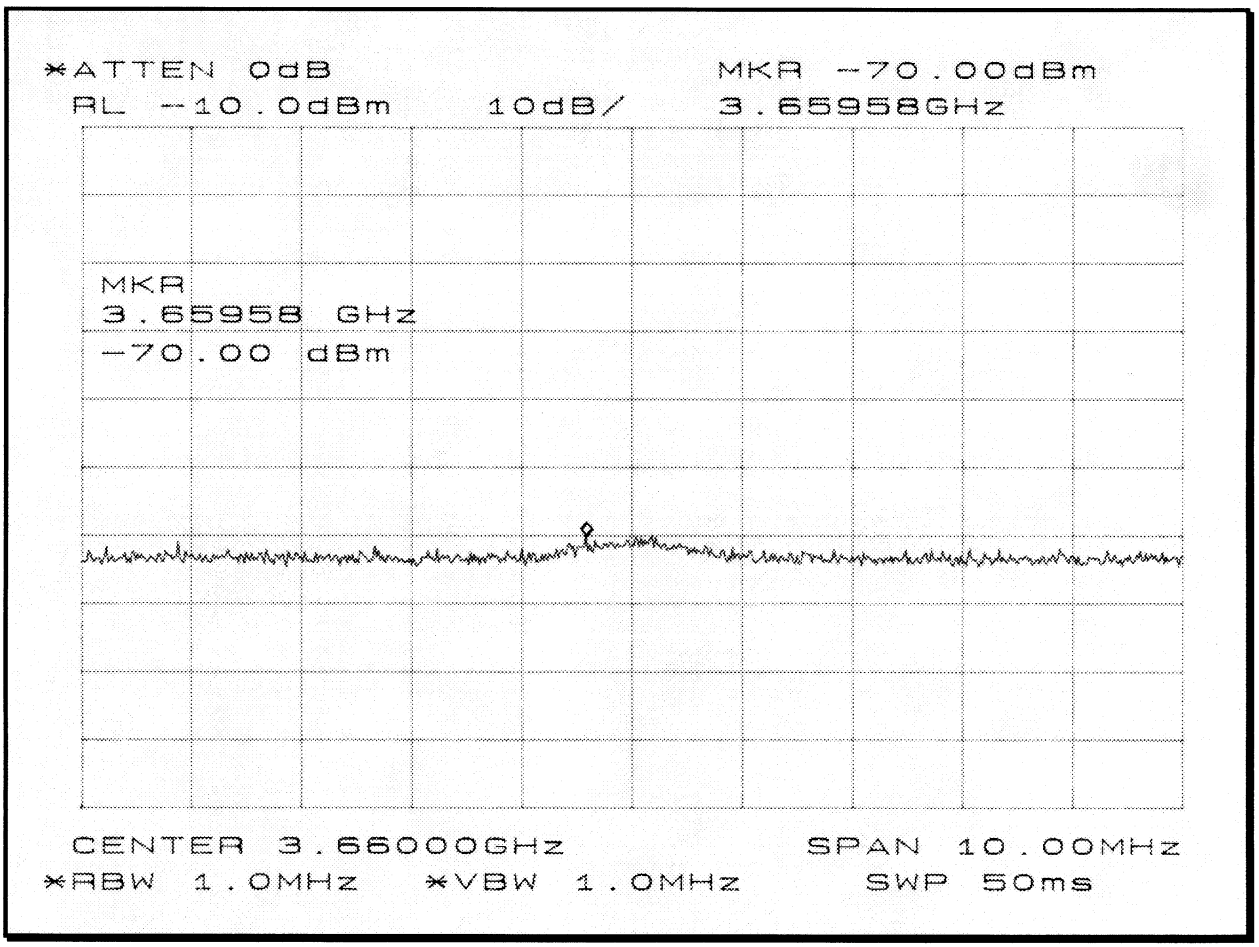

Figure 14: Radiated Spurious Emission at 3.6595GHz

10.6.2 Radiated Spurious Emissions(Data Plots)

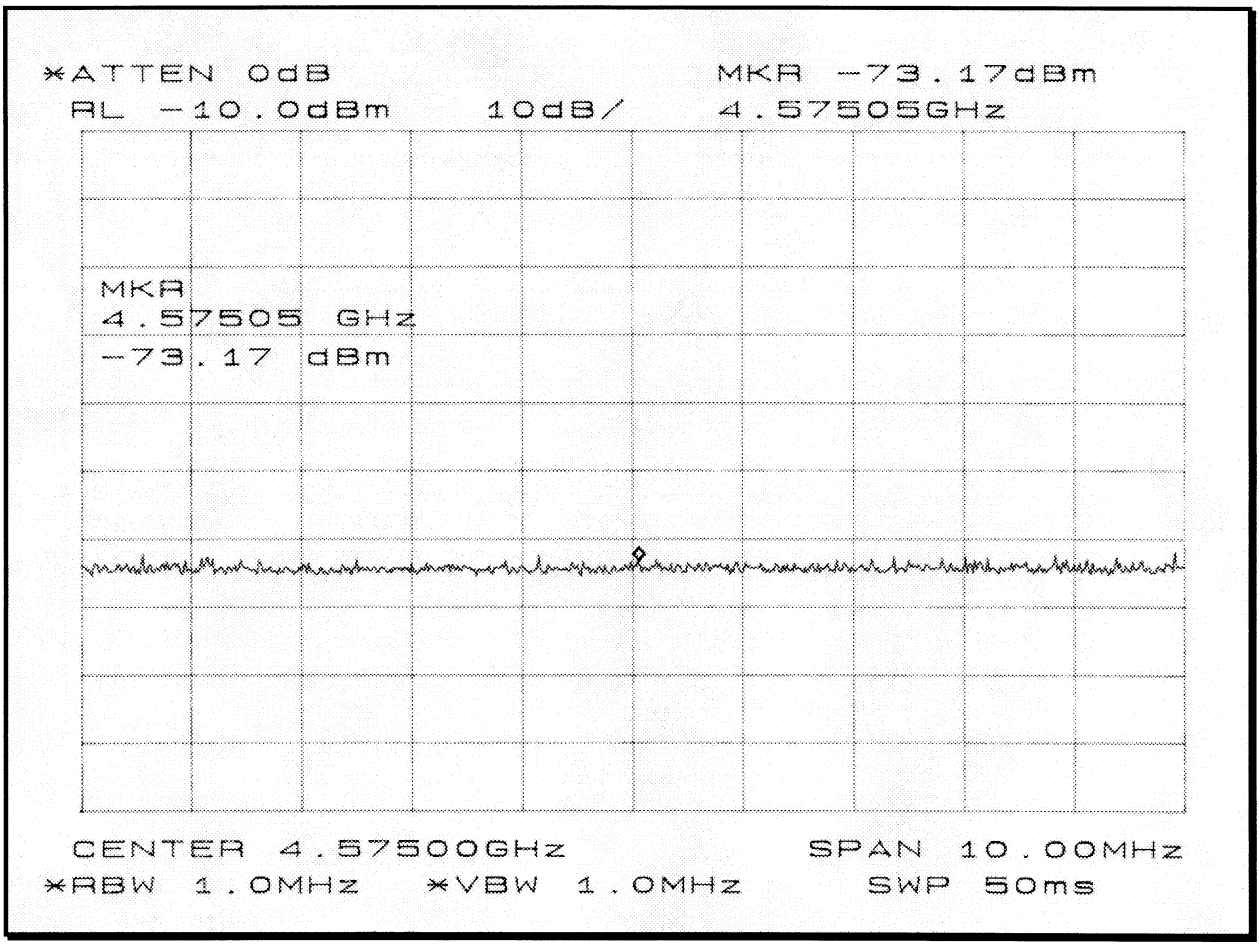

Figure 15: Radiated Spurious Emission at 4.575GHz

10.7 Power Spectral Density - FCC Section 15.247(d)

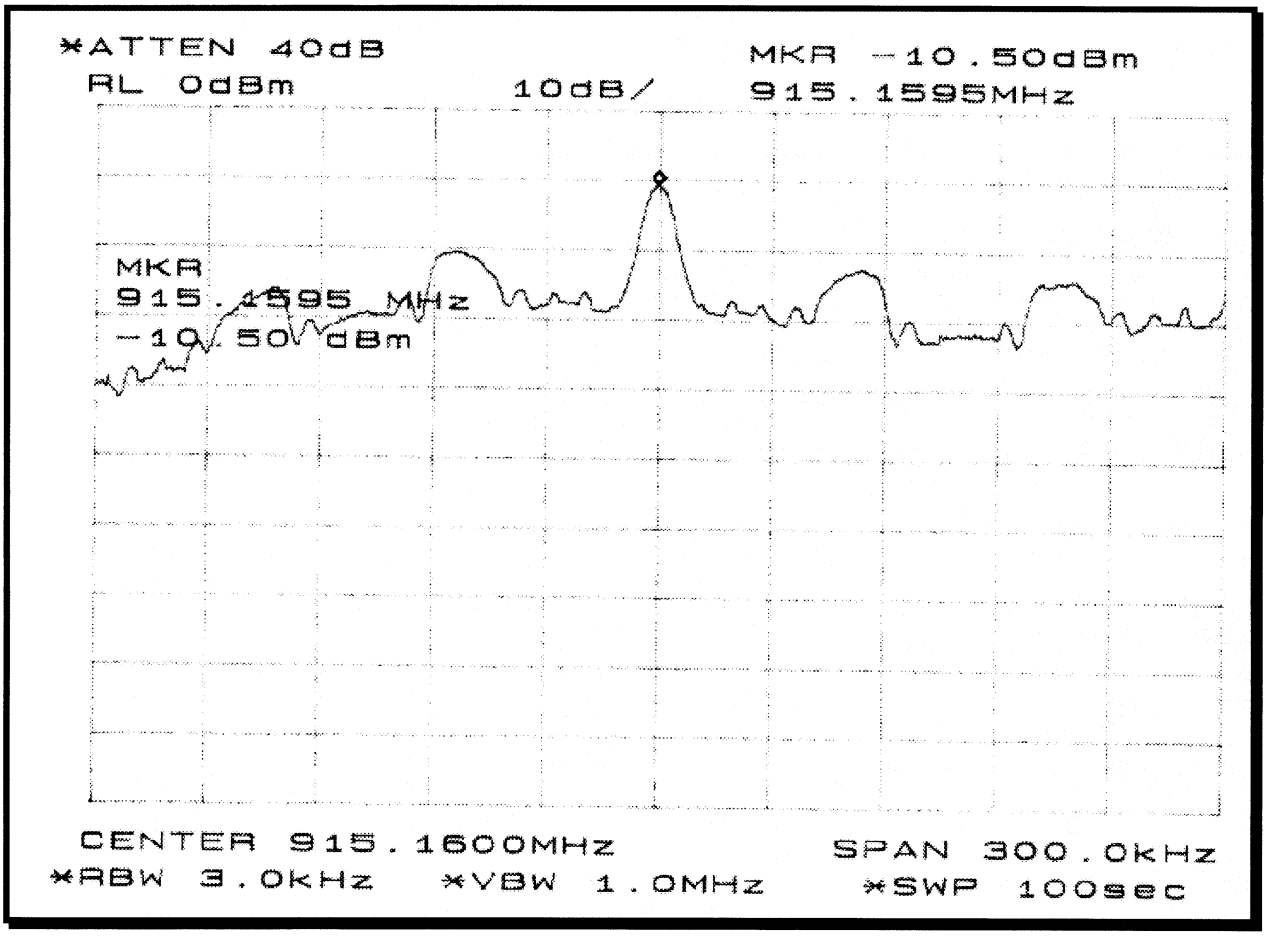

Figure 16: Spectral Density

11.0 RF Safety 15.247(b)(4)

The following text will be added to the installation instructions to inform the installer of the RF Safety requirements for this device:

> **"In accordance with FCC rules concerning RF Safety, this device should be installed to ensure that a distance of 20cm is maintained at all times between the radiating element and the general population."**

12.0 SAMPLE LABEL

The label shown below will be placed on the top of the unit in plain view.

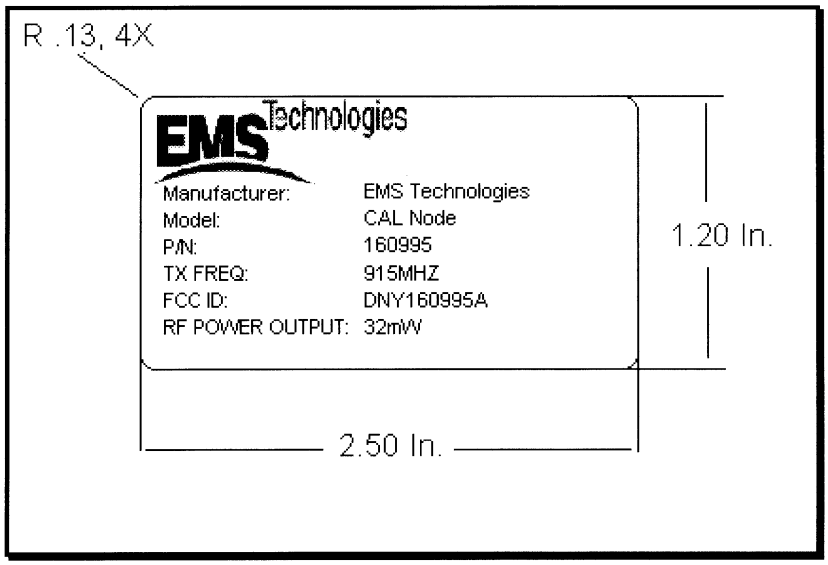

Figure 17: Sample Label

Labels are not to scale, however they will be large enough so that they are legible without the use of magnifying devices.

13.0 CONCLUSION

The product covered by this report has been tested and found to comply with the requirements as described in Part 15, Subpart C, Section 15.247 of the FCC Code of Federal Regulations.

Testing Performed By:_____
Sam Wismer
RF Approvals Engineer

Report Reviewed By:_____
Erik Collins
EMI/EMC Engineer

11.0 RF Safety 15.247(b)(4)

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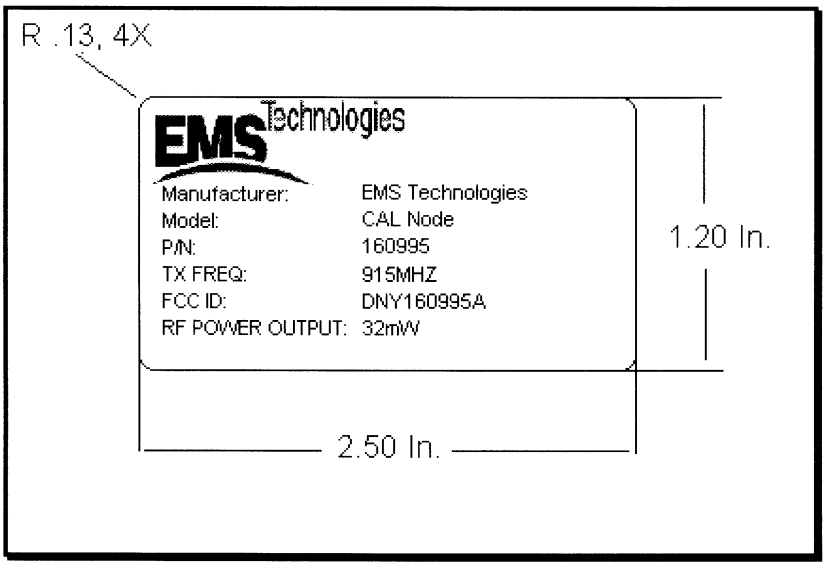

Figure 17: Sample Label

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13.0 CONCLUSION

The product covered by this report has been tested and found to comply with the requirements as described in Part 15, Subpart C, Section 15.247 of the FCC Code of Federal Regulations.

Testing Performed By: R. Smith

Sam Wismer
RF Approvals Engineer