L.S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012
262-375-4400 Fax: 262-375-4248

COMPLIANCE TESTING OF:

X12 + Transmitter

PREPARED FOR:

Mortara Instrument, Incorporated
Attn.: Mr. Brian Sueppel
7865 North 86th Street
Milwaukee, WI 53224

TEST REPORT NUMBER:

304274-TCB Rev. 1

TEST DATE(S):

June 21ST - 25TH, 2004

Table of Contents

1. L. S. Compliance In Review

L.S. Compliance - Accreditations and Listing's

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025 : 1999
with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756

Listing of 3 and 10 meter OATS based on Title 47CFR – Part 2.948
FCC Registration Number: 90757

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1
File Number: IC 3088-A

On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1
File Number: IC 3088

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 89/336/EEC, Article 10.2.
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.

Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

2. A2LA Certificate of Accreditation

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

L.S. COMPLIANCE, INC.
Cedarburg, WI

for technical competence in the field of

Electrical Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing. Testing and calibration laboratories that comply with this International Standard also operate in accordance with ISO 9001 or ISO 9002 (1994).

Presented this 26th day of March 2003.

President
For the Accreditation Council
Certificate Number 1255.01
Valid to January 31, 2005

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

3. A2LA Scope of Accreditation

American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

L.S. COMPLIANCE, INC.
W66 N220 Commerce Court
Cedarburg, WI 53012
James Blaha Phone: 262 375 4400

ELECTRICAL (EMC)

Valid to: January 31, 2005 Certificate Number: 1255-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

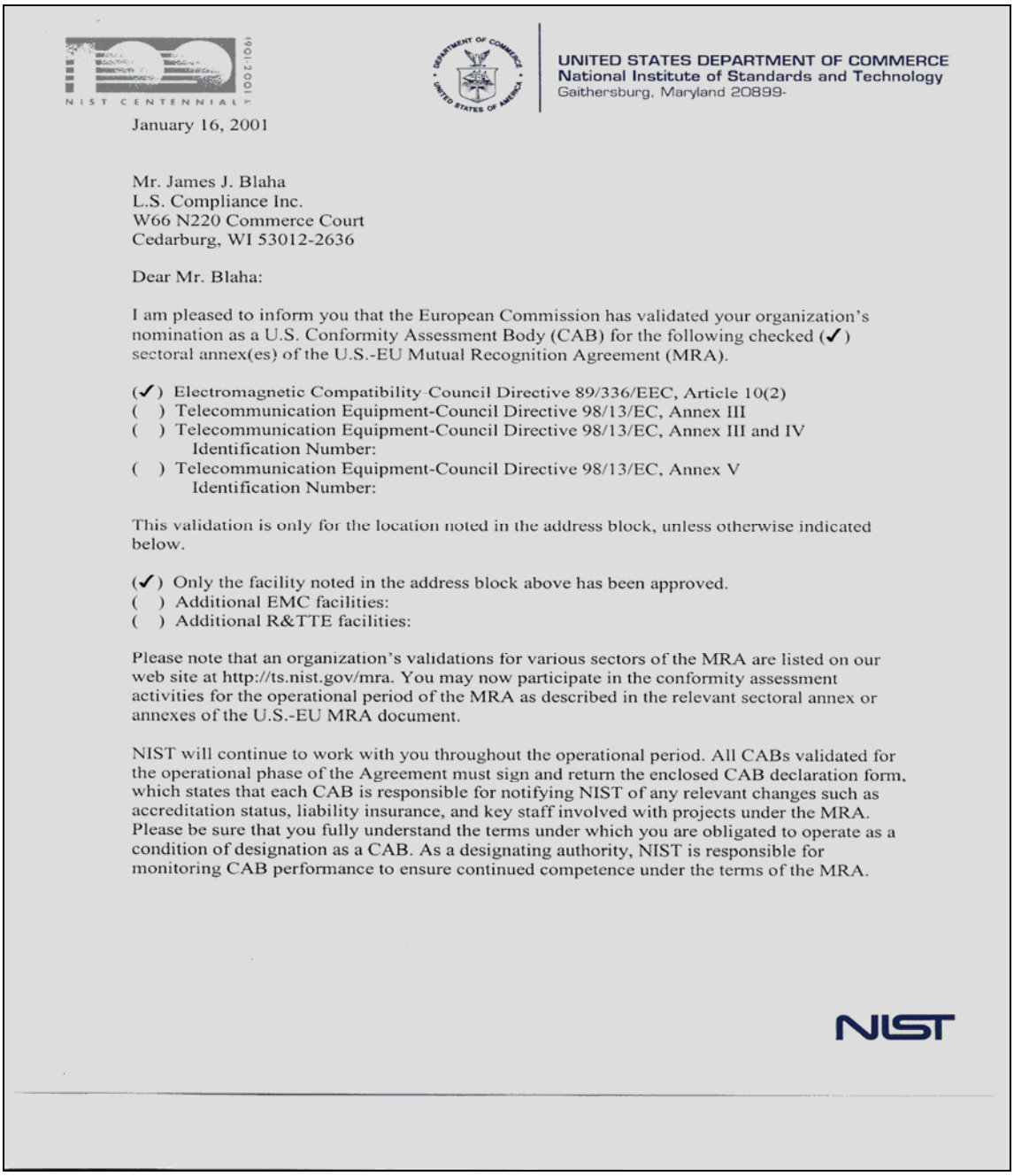
Test	Test Method(s)
Emissions	
Conducted	
Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438
Radiated	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438
Current Harmonics	IEC 61000-3-2; EN 61000-3-2
Voltage Fluctuations & Flicker	IEC 61000-3-3; EN 61000-3-3
Immunity	EN: 50082-1, 50082-2 EN 61000-6-2 CISPR: 14-2, 24
Conducted Immunity	
Fast Transients/Burst	IEC 61000-4-4; EN 61000-4-4
Surge	IEC: 61000-4-5; ENV 50142; EN 61000-4-5
RF Fields	IEC: 61000-4-6; ENV 50141; EN 61000-4-6
Voltage Dips/Interruptions	IEC 61000-4-11; EN 61000-4-11

Roxanne M. Robinson

(A2LA Cert. No. 1255-01) 05/13/03 Page 1 of 2

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-662 2974

4. Validation Letter – U.S. Competent Body for EMC Directive 89/336/EEC



UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

January 16, 2001

Mr. James J. Blaha
L.S. Compliance Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012-2636

Dear Mr. Blaha:

I am pleased to inform you that the European Commission has validated your organization's nomination as a U.S. Conformity Assessment Body (CAB) for the following checked (✓) sectoral annex(es) of the U.S.-EU Mutual Recognition Agreement (MRA).

(✓) Electromagnetic Compatibility-Council Directive 89/336/EEC, Article 10(2)
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III and IV
Identification Number:
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex V
Identification Number:

This validation is only for the location noted in the address block, unless otherwise indicated below.

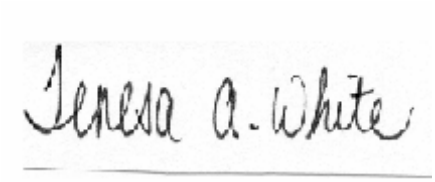
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

Please note that an organization's validations for various sectors of the MRA are listed on our web site at http://ts.nist.gov/mra. You may now participate in the conformity assessment activities for the operational period of the MRA as described in the relevant sectoral annex or annexes of the U.S.-EU MRA document.

NIST will continue to work with you throughout the operational period. All CABs validated for the operational phase of the Agreement must sign and return the enclosed CAB declaration form, which states that each CAB is responsible for notifying NIST of any relevant changes such as accreditation status, liability insurance, and key staff involved with projects under the MRA. Please be sure that you fully understand the terms under which you are obligated to operate as a condition of designation as a CAB. As a designating authority, NIST is responsible for monitoring CAB performance to ensure continued competence under the terms of the MRA.

NIST

5. Signature Page



Prepared By: November 15, 2004

Teresa A. White, Document Coordinator Date

Tested By: November 15, 2004

Abtin Spantman, EMC Engineer Date

Approved By: November 15, 2004

Kenneth L. Boston, EMC Lab Manager Date
PE #31926 Licensed Professional Engineer
Registered in the State of Wisconsin, United States

6. Product and General Information

Manufacturer:	Mortara Instrument, Inc.					
Date(s) of Test:	June 21ST – 25TH , 2004					
Test Engineer(s):		Tom Smith	√	Abtin Spantman		Ken Boston
Model #:	X12 +					
Serial #:	Proto #2					
Voltage:	1.5 VDC					
Operation Mode:	Normal and Continuous Transmit					

7. Introduction

Between June 21ST and 25TH, 2004 a series of Conducted and Radiated Emission tests were performed on one sample of the Mortara Instrument model number X12+ transmitter, serial number "Proto #2", here forth referred to as the "*Equipment Under Test*" or "*EUT*". These tests were performed using the procedures outlined in ANSI C63.4-2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.249 (Industry Canada RSS-210) for a low power transmitter. These tests were performed by Abtin Spantman, EMC Engineer of L.S. Compliance, Incorporated and witnessed by Brian Sueppel of Mortara Instrument, Incorporated.

All Radiated and Conducted Emission tests were performed upon the EUT to measure the emissions in the frequency bands described in Title 47 CFR, FCC Part 15, including 15.35, 15.209, 15.249 and Industry Canada RSS-210 to determine whether these emissions are below the limits expressed within the standards. These tests were performed in accordance with the procedures described in the American National Standard for methods of measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelelectriques (CISPR) Number 16-1, 2002.

8. Product Description

The X12+ (2500) is a patient worn telemetry transmitter used in hospitals and clinics for the transmission of ECG data. The transmitter is made up of an ECG amplifier, microprocessor, and RF transmitter. The ECG amplifier is a 12 lead device with diagnostic quality response and digital conversion. The microprocessor formats the ECG data for transmission, handles user I/O, and sets the RF transmission channel. The RF transmitter operates in the 2.4 GHz ISM band, on 256 channels, and is designed to meet FCC rules Part 15.249. The modulation of the carrier is done with simple Gaussian Frequency Shift Keying (GFSK). The antenna is integrated internally to the X12+ and is not removable or replaceable. The X12+ has a detachable light weight 12 lead patient cable and operates from single AA Alkaline batteries for over 24 Hours. The battery is installed through a removable back panel. The front side has a three button keypad and a 33x18 mm graphic LCD. The overall dimensions are 110x63x25 mm.

9. Test Requirements

The above mentioned tests were performed in order to determine the compliance of the Mortara Instrument X12+ transmitter with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.31	15.205
15.33	15.207
15.35	15.209
15.37	15.249

10. Summary of Test Report

DECLARATION OF CONFORMITY

The Mortara Instrument X12+ transmitter was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Part 15.249, Subpart (a); and Industry Canada RSS-210, Section 6.2 for a *'Non-Momentarily Operated Transmitting Device'*.

11. Radiated Emissions Test

Test Setup

The test setup was assembled in accordance with Title 47, CRF FCC Part 15 and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal centered on a flush mounted 2-meter diameter turntable inside the 3 Meter Semi-Anechoic, FCC listed Chamber located at L. S. Compliance, Inc., Cedarburg, Wisconsin. The EUT was operated in continuous transmit mode with data modulation, as well as normal operation mode, using power as provided by one standard 1.5VDC "AA" type battery. The unit has the capability to operate on 256 channels, controllable via switches on the front of the unit. The applicable limits apply at a 3 meter distance, and are found later in this section. Measurements between 5 GHz to 18 GHz were performed at a 1.0 meter separation distance, and measurements between 18 GHz to 25 GHz were performed at a 0.3 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a list of the test equipment. The test sample was operated on one of three (3) standard channels: low (Ch:00; 2400.96MHz), medium (Ch:80; 2441.92MHz) and high (Ch:FF; 2482.56MHz) to comply with FCC Part 15.35. The channels and operating modes were changed using front panel switches with the special firmware provided to facilitate testing.

Test Procedure

Radiated RF measurements were performed on the EUT in the 3 Meter Semi-Anechoic, FCC listed Chamber, located at L. S. Compliance, Inc. in Cedarburg, Wisconsin. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on the non-conductive pedestal in the 3 Meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. From 18 GHz to 25 GHz, the EUT was measured at a 0.3 meter separation, using a standard gain Horn antenna and pre-amplifier. The battery voltage was checked frequently, and the batteries were replaced as necessary.

Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz). From 5 GHz to 18 GHz, an HP E4407 Spectrum Analyzer and an EMCO Horn Antenna were used. From 18 GHz to 24 GHz, the HP E4407 with a standard gain horn antenna, and preamp were used.

Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.249 for a transmitter (Canada RSS-210). The frequencies with significant signals were recorded and plotted as shown in the Data Charts and Graphs.

CALCULATION OF RADIATED EMISSIONS LIMITS:

Field Strength of Fundamental Frequencies:

The fundamental emissions for an intentional radiator in the 2400-2483.5 MHz band, operating under FCC part 15.249 limits, must have electric field strength of no greater than 50 mV/m, for the fundamental frequency, when measured at 3 meters, and harmonic field strength of no greater than 500 μV/m, when measured at 3 meters. Spurious emissions outside the 2400-2483.5 MHz band shall be attenuated by at least 50 dB below the level of the fundamental, or meet the limits expressed in FCC part 15.209 under general emission limits.

Field Strength of Fundamental Frequencies is Limited to 50,000 μV/m, or 94 dBμV/m.

Field Strength of Harmonic and Spurious Frequencies is Limited by FCC 15.249(d)

The harmonic limit of –50 dBc with respect to the fundamental limit would be:

94 dBμV/m – 50 dB = 44 dBμV/m,

with the exception of where FCC 15.209 allows for a higher limit to be used.

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)
30-88 ; 88-216	159	44.0
216 - 960	500	46.0*
960 - 2400	500	54.0*
2400 - 2483.5	50,000	94.0
2483.5 - 40000	500	54.0*

The following table depicts the general radiated emission limits obtained from Title 47 CFR, part 15.209a, for radiated emissions measurements, including restricted band limits as expressed in 47 CFR, part 15.205.

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-40,000	500	54.0

Sample conversion from field strength μV/m to dBμV/m:

$dB\mu V/m = 20 \log_{10}$ (3m limit)

from 30 - 88 MHz for example: $dB\mu V/m = 20 \log_{10}$ (100)

40.0 $dB\mu V/m = 20 \log_{10}$ (100)

For measurements made at 1 meter, a 9.5 dB correction may be been invoked.

960 MHz to 40,000 MHz

500 μV/m or 54.0 dBμV/m at 3 meters

54.0 + 9.5 = 63.5 dBμV/m at 1 meter

54.0 + 20.0 = 74.0 dBμV/m at 0.3 meters

Note: Limits are conservatively rounded to the nearest tenth of a whole number.

Summary of Results and Conclusions

Based on the procedures outlined in this report, and the test results, it can be determined that the EUT does MEET the emission requirements of Title 47 CFR, FCC Part 15.249, for a frequency modulated transmitter.

The enclosed test results pertain to the samples of the test item listed, and only for the tests performed per the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.

Radiated Emissions Data Chart

3 Meter Measurements of Electromagnetic Radiated Emissions

Test Standard: Title 47 CFR 15.249

Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	Mortara Instrument, Inc.						
Date(s) of Test:	June 21ST – 25TH , 2004						
Test Engineer(s):		Tom Smith	√	Abtin Spantman		Ken Boston	
Model #:	X12 +						
Serial #:	Proto #2						
Voltage:	1.5 VDC						
Operation Mode:	Normal and Continuous Transmit						
EUT Power:		Single Phase ___VAC		3 Phase ___VAC			
	√	Battery		Other:			
EUT Placement:		80cm non-conductive table		10cm Spacers			
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS			
Measurements:		Pre-Compliance		Preliminary	√	Final	
Detectors Used:	√	Peak	√	Quasi-Peak	√	Average	

Environmental Conditions in the Lab:
Temperature: 20 – 25°C
Relative Humidity: 30 – 60 %

Test Equipment Used:
EMI Measurement Instrument: HP8546A and Agilent E4407B
Log Periodic Antenna: EMCO #93146
Horn Antenna: EMCO #3115
Biconical Antenna: EMCO 3110
Pre-Amp: Advanced Microwave WHA6224
Standard Gain Horn: EMCO 3160-09

The following table depicts the level of significant spurious radiated emissions found:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	15.249 Limit (dBμV/m)	Margin (dB)
184.3	H	00	1.15	250	35.4	43.5	8.1
194.6	H	80	1.75	255	33.3	43.5	10.2
363.5	H	80	1.00	280	36	46	10.0
373.8	H	80	1.00	280	36.7	46	9.3
394.2	H	80	1.00	280	34.3	46	11.7
583.7	V	80	1.00	275	39.9	46	6.1
588.8	V	80	1.00	275	40.2	46	5.8
593.9	V	80	1.00	275	39.5	46	6.5
599.0	V	80	1.00	275	42.6	46	3.4
609.3	V	80	1.00	275	44.1	46	1.9
619.3	V	80	1.00	275	44.5	46	1.5
629.8	V	80	1.00	275	42.6	46	3.4
640.0	H	80	1.55	305	40.1	46	5.9

Notes: A Quasi-Peak Detector was used in measurements below 1 GHz, and an Average Detector was used in measurements above 1 GHz

.

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 00:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	15.249 Limit (dBμV/m)	Margin (dB)
2401	V	00	1.10	150	88.0	94.0	6.0
4802	H	00	1.15	190	47.8	53.9	6.1
7203	V	00	1.00	270	47.2	63.2	16.0
9604	V	00	1.00	210	55.5	63.2	7.7
12005	H	00	1.00	275	53.5	63.2	9.7
14406	H	00	1.00	120	47.1	63.2	16.1
16807	H	00	1.00	165	50.1	63.2	13.1
19208	H	00	1.00	0	47.4	73.9	26.5
21609	H	00	1.00	0	41.6	73.9	32.3
24000	H	00	1.00	0	43.1	73.9	30.8

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 80:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	15.249 Limit (dBμV/m)	Margin (dB)
2442	V	80	1.10	150	85.8	94.0	8.2
4884	H	80	1.40	190	49.7	53.9	4.2
7326	V	80	1.00	270	56.2	63.2	7.0
9767	V	80	1.00	190	56.7	63.2	6.5
12210	H	80	1.00	270	56.6	63.2	6.6
14651	H	80	1.00	120	50.2	63.2	13.0
17093	H	80	1.00	175	48.7	63.2	14.5
19535	H	80	1.00	0	48.0	74.0	26.0
21977	H	80	1.00	0	41.1	74.0	32.9
24419	H	80	1.00	0	40.8	74.0	33.2

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel FF:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	15.249 Limit (dBμV/m)	Margin (dB)
2483	V	FF	1.10	150	84.0	94.0	10.0
4965	H	FF	1.35	190	51.3	53.9	2.6
7448	V	FF	1.00	270	53.1	63.2	10.1
9930	V	FF	1.00	195	54.1	63.2	9.1
12413	H	FF	1.00	280	57.6	63.2	5.6
14895	H	FF	1.00	240	47.3	63.2	15.9
17378	H	FF	1.00	130	45.1	63.2	18.1
19860	H	FF	1.00	0	47.0	74.0	27.0
22343	H	FF	1.00	0	43.0	74.0	31.0
24826	H	FF	1.00	0	43.0	74.0	31.0

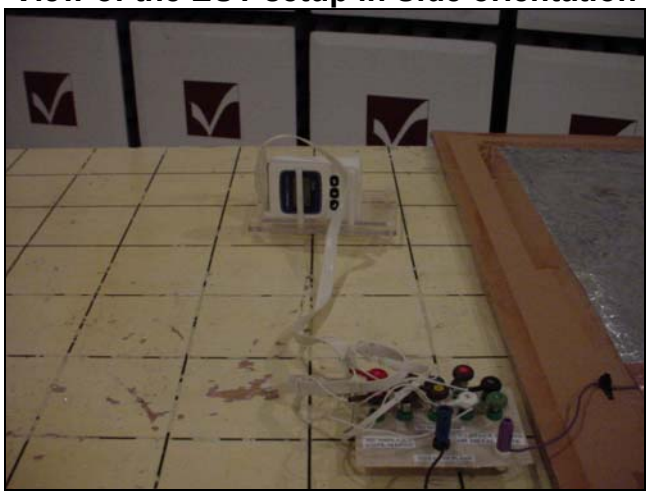
Notes: A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. Only the results from the Average detector are published in the table above. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits. Measurements above 5 GHz were made at 1 meters of separation from the EUT, and at 0.3 m separation at 18 – 26 GHz.

Photos Taken During Radiated Emission Testing

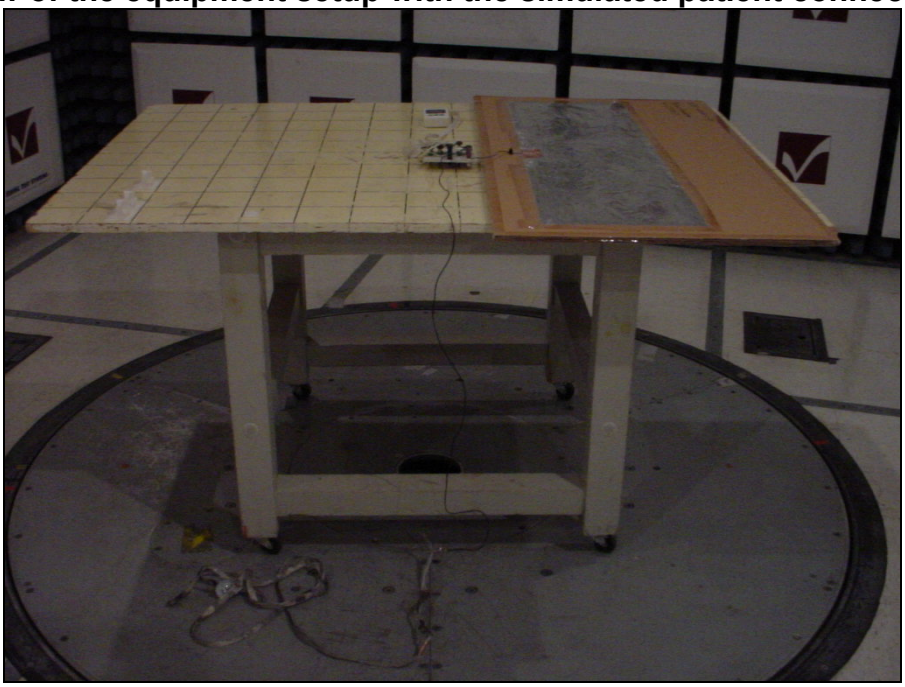
View of the EUT setup in vertical orientation

View of the EUT setup in Horizontal orientation

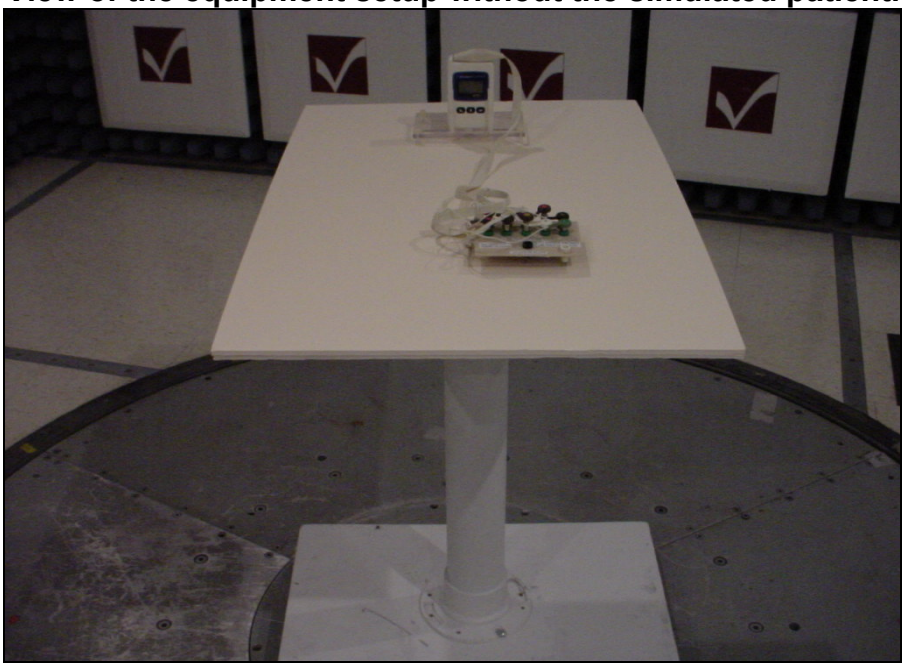
View of the EUT setup in Side orientation



View of the equipment setup with the simulated patient connected.



View of the equipment setup without the simulated patient.



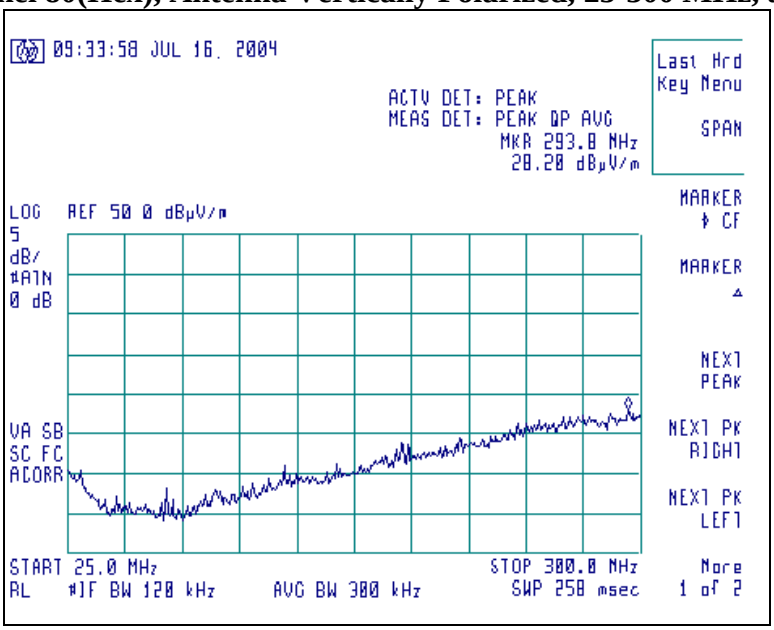
Graphs made during Radiated Emission Testing

Screen Captures of Radiated RF Emissions:

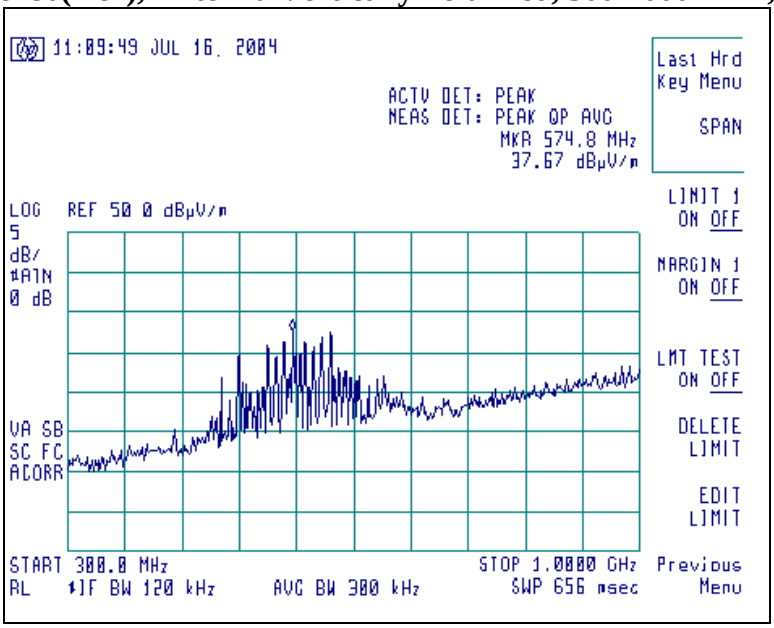
Please note these screen captures represent Peak Emissions. For radiated emission measurements, we utilize a Quasi-Peak detector function when measuring frequencies below 1 GHz, and an Average detector function when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 01, 80, or FF (hex), with the sense and EUT antennas both in vertical polarity for worst case presentations.

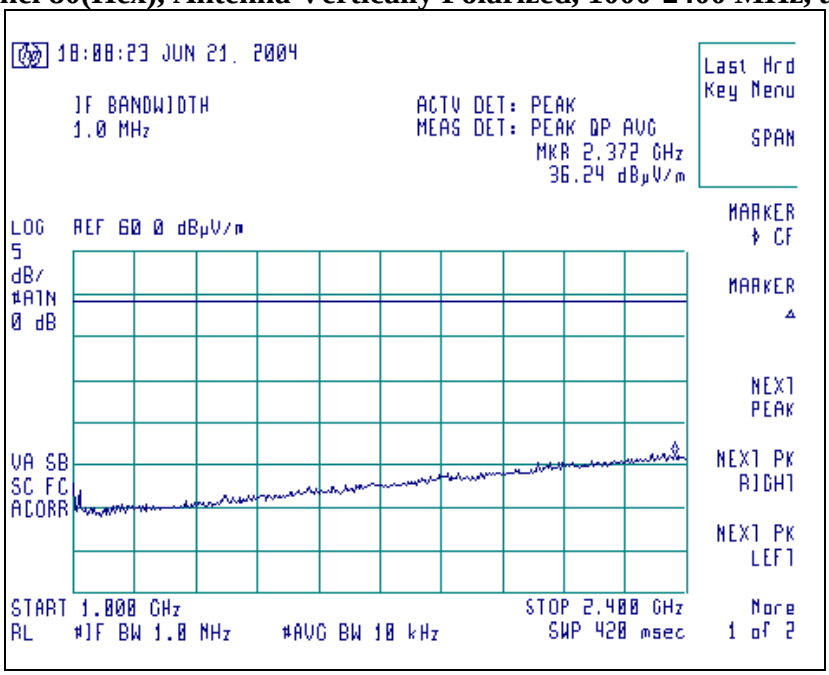
Channel 80(Hex), Antenna Vertically Polarized, 25-300 MHz, at 3m.



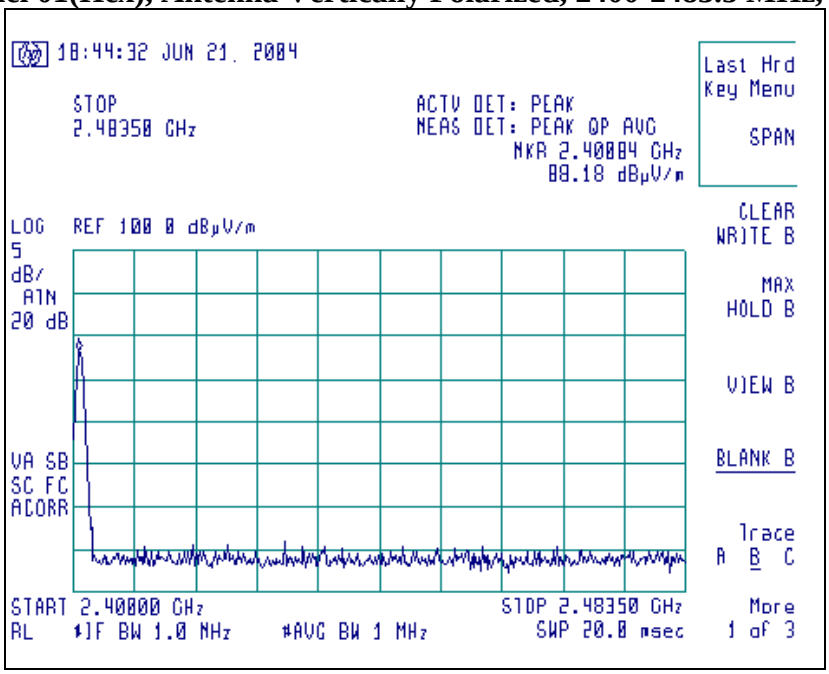
Channel 80(Hex), Antenna Vertically Polarized, 300-1000 MHz, at 3m.



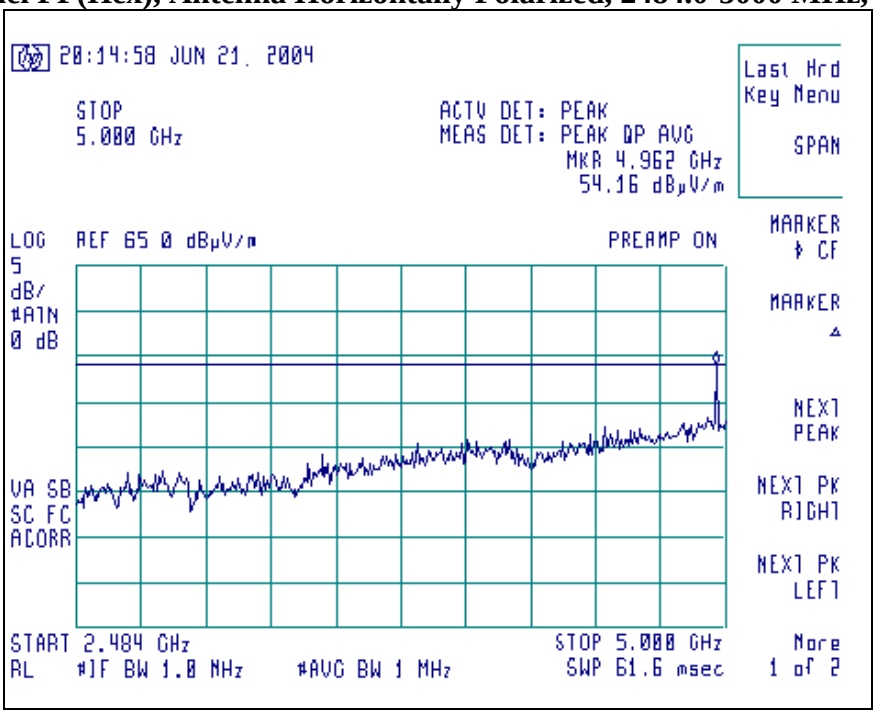
Channel 80(Hex), Antenna Vertically Polarized, 1000-2400 MHz, at 3m.



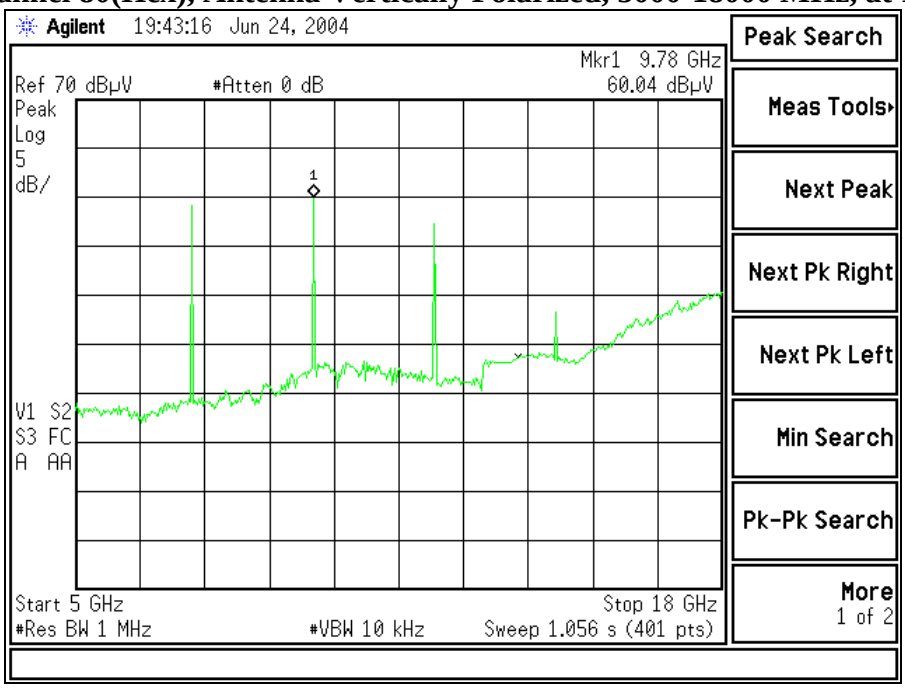
Channel 01(Hex), Antenna Vertically Polarized, 2400-2483.5 MHz, at 3m.



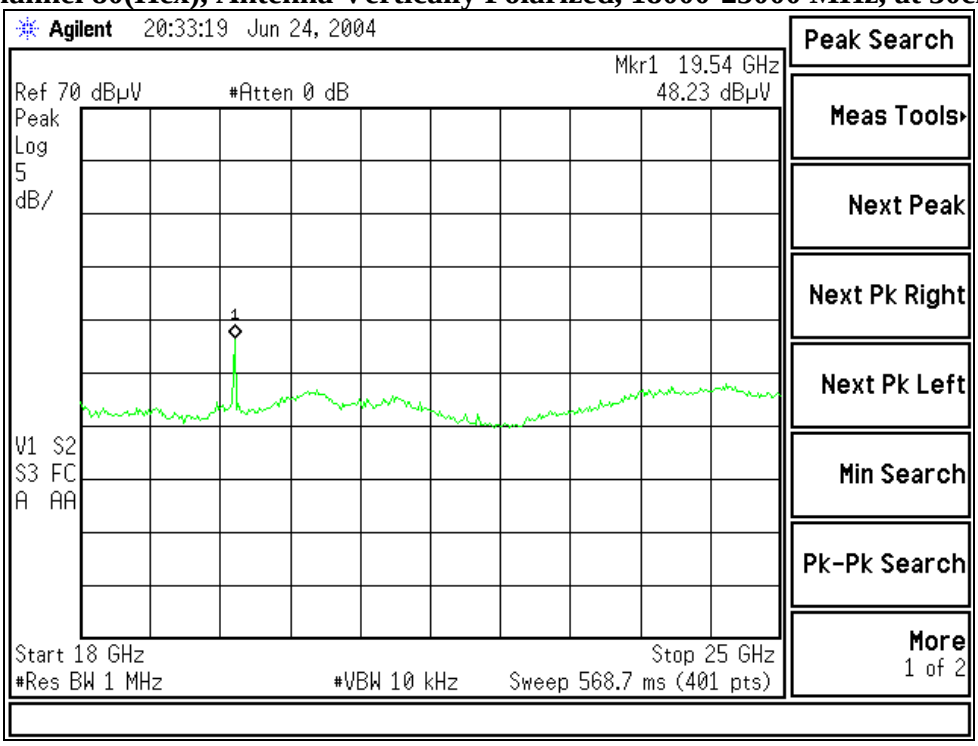
Channel FF(Hex), Antenna Horizontally Polarized, 2484.0-5000 MHz, at 3m.



Channel 80(Hex), Antenna Vertically Polarized, 5000-18000 MHz, at 1m.



Channel 80(Hex), Antenna Vertically Polarized, 18000-25000 MHz, at 30cm.



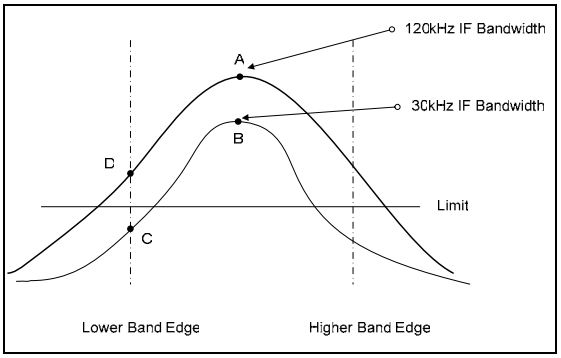
12. Conducted Emissions Test, AC Power Line

This device operates on a single 1.5 VDC type "AA" battery, and does not have any facilities for connection to AC mains. There were no conducted RF tests administered.

13. Band-Edge Measurements

FCC 15.209(b) and 15.249(d) require a measurement of spurious emission levels, in particular at the band-edges where the intentional radiator operates. The following screen captures demonstrate compliance of the intentional radiator at the 2400-2483.5 MHz band-edges. The EUT was operated at the lowest channel, with continuous modulation, with internally generated data as the modulating source, for the investigation of the lower band-edge, and at the highest channel for the investigation of the higher band-edge.

The bandwidth of the modulated signal is measured using a marker delta method, to ensure that the modulated signal does not exceed the emission limits outside of the operational band. The EUT was placed in continuous transmit mode with internal typical data as the source of modulation. The emissions were then measured at the operational band edges to ensure compliance. The following diagram and formula illustrates how the band edge measurements were taken.



Measurement A is taken using a 1 MHz IF Bandwidth at the Center Frequency.
Measurement B is taken using a 100kHz IF Bandwidth at the Center Frequency.
Measurement C is taken using a 100kHz IF Bandwidth at the lower Band Edge Frequency

To Calculate the Value for lower Band Edge Frequency at Point D:

$$A - B = \Delta$$
$$\Delta + C = D$$

The Band Edge limit, in this case, would be D = 54.0 dBµV/m.
The measurements and calculations are as follows:

At the Lower Band-edge:

$A - B = \Delta$; $82.35 dB\mu V/m - 82.10 dB\mu V/m = 0.25 dB$

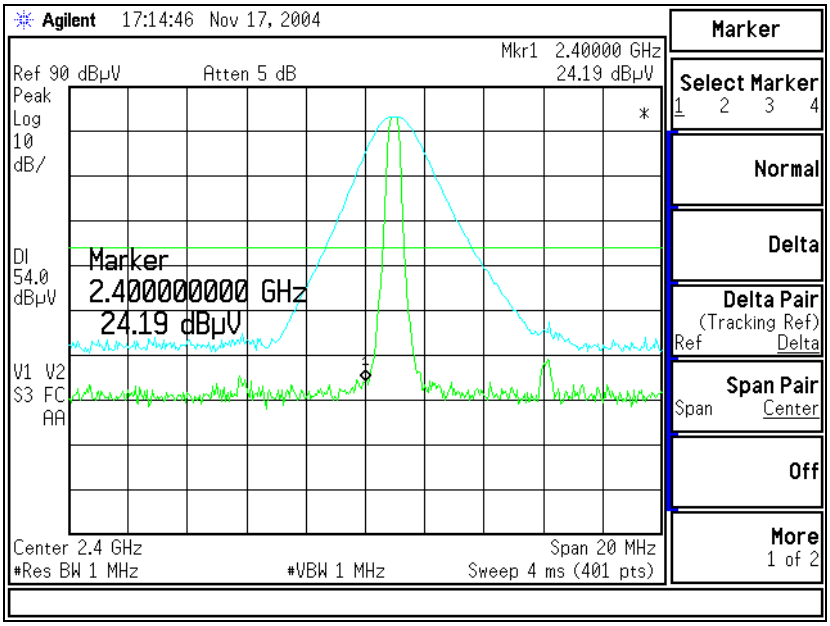
$\Delta + C = D$; $0.25 dB + 22.87 dB\mu V/m = 23.12 dB$ Showing compliance at Lower Band-Edge

At the Upper Band-edge:

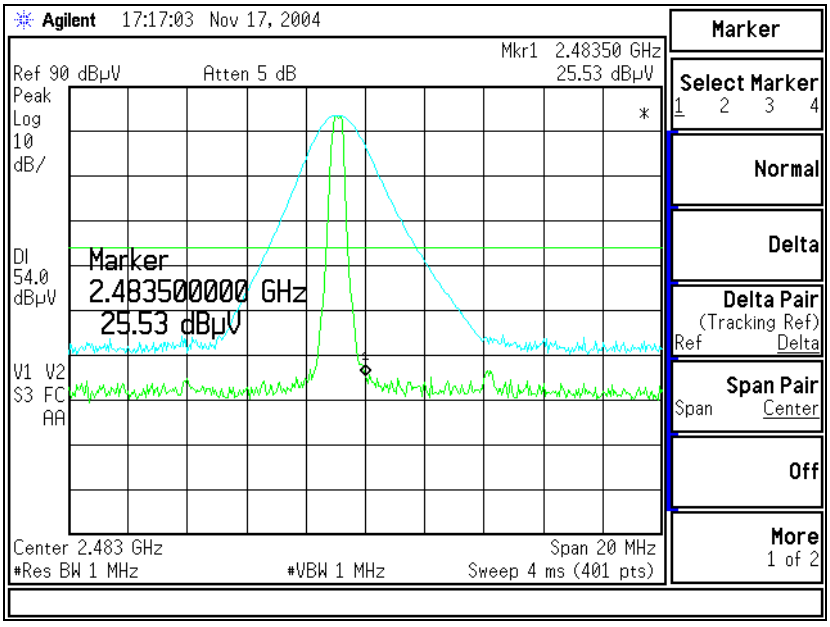
$A - B = \Delta$; $75.42 dB\mu V/m - 75.17 dB\mu V/m = 0.25 dB$

$\Delta + C = D$; $0.25 dB + 23.32 dB\mu V/m = 23.57 dB$ Showing compliance at Upper Band-Edge

Screen Capture demonstrating compliance at the Lower Band-Edge
Top trace shows spectral signature using RBW=1 MHz,
while lower trace uses RBW=100 kHz



Screen Capture demonstrating compliance at the Higher Band-Edge
Top trace shows spectral signature using RBW=1 MHz,
while lower trace uses RBW=100 kHz



14. Frequency and Power Stability across input voltage

The fundamental emission of the transmitter needs to be stable with varying voltage. According to the FCC Part 15.31 (e) the supply voltage should be varied between 85 % and 115 % from the nominal specified voltage.

For this test, the EUT was place inside a temperature chamber, with the transmitter portion of the EUT placed in modulated continuous transmit mode. Power was supplied by an external bench-type variable power supply, and the frequency of operation was monitored using a spectrum analyzer, with the antenna placed inside the chamber. The power supply and spectrum analyzer were located outside the temperature chamber. The frequency was measured at the right ear of the FSK type spectrum, with a receiver resolution bandwidth of 10 Hz, and video bandwidth of 10 Hz. The data presented below is from channel 00 (Hex) which produced the widest frequency variation during the tests.

		DC Voltage Source		
		1.28	1.50	1.73
Temperat	+50	2401.0630	2401.0600	2401.0630
	+25	2401.0430	2401.0430	2401.0400
	0	2401.0180	2401.0200	2401.0180
	-20	2400.9680	2400.9700	2400.9700
		Max Freq	2401.063	MHz
		Min Freq	2400.968	MHz
		Total Freq Excursion	0.095	MHz
		Limit	0.240096	MHz
			Pass	

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle.

No anomalies were noted, in the measured transmit power, varying less than 1 dB, during the voltage variation tests.

Appendix A

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	9/15/04	9/15/05
AA960031	HP	119474A	3107A01708	Transient Limiter	Note 1	Note 1
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	9/16/04	9/16/05
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/16/04	9/16/05
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	11/14/03	11/14/04
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	11/04/03	11/04/04
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/16/04	9/16/05
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/16/04	9/16/05
N/A	LSC	Cable	0011	3 Meter ½" Armored Cable	Note 1	Note 1
N/A	LSC	Cable	0038	1 Meter RG 214 Cable	Note 1	Note 1
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	Note 1	Note 1
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	Note 1	Note 1

Note 1 - Equipment calibrated within a traceable system.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V