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

COMPLIANCE TESTING OF:

PowerFlex Wireless Interface Module
Model series: 2x-WIM-Nxx

Prepared For:

Rockwell Automation
Standard Drives Communication Products
Attention: Mr. Calvin Steinweg
6400 West Enterprise Drive
Mequon, WI 53092 U.S.A.

Test Report Number:

304435-Tx

Test Dates:

November 1ST through 5TH, 2005

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:

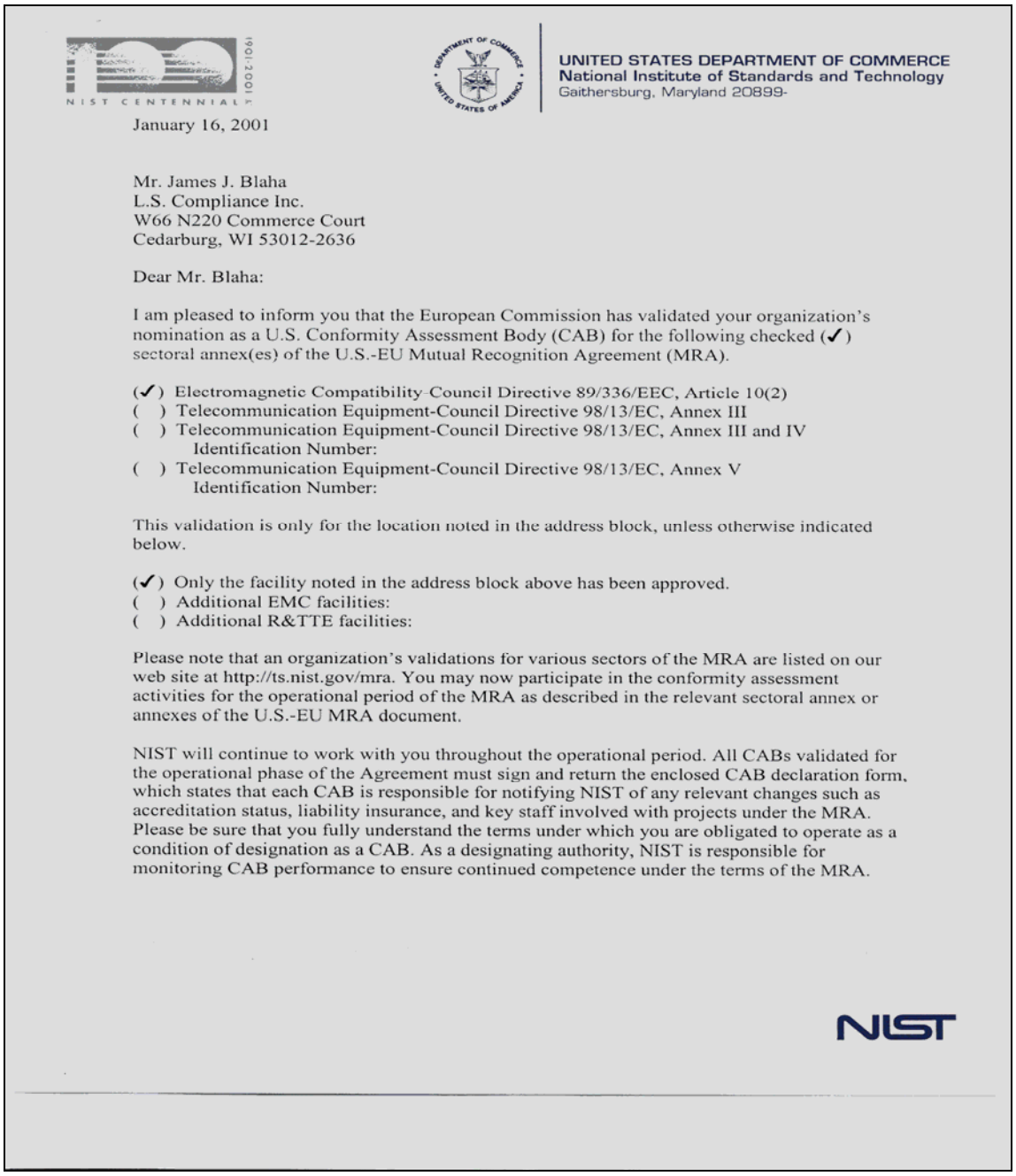
Test	Test Method(s)
Emissions	
Conducted	
Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438
Radiated	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; 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.

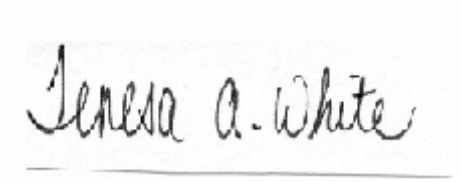
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

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: **January 18, 2005**

Teresa A. White, Document Coordinator **Date**

Tested By: **January 18, 2005**

Abtin Spantman, EMC Engineer **Date**

Approved By: **January 18, 2005**

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:	Rockwell Automation					
Date(s) of Test:	November 1st through 5th , 2005					
Test Engineer(s):		Tom Smith	√	Abtin Spantman		Ken Boston
Model #:	2x-WIM-Nxx					
Serial #:	LSC-DPI and LSC-DSI					
Voltage:	12 VDC at 130 mA provided by host					
Operation Mode:	Normal, continuous transmit, and 'Hopping' mode					

7. Introduction

Between November 1ST and 5TH, 2005, a series of Conducted and Radiated RF Emission tests were performed on two engineering samples of the Rockwell Automation PowerFlex Wireless Interface Modules (WIM), model series: '2x-WIM-Nxx', here forth referred to as the "*Equipment Under Test*" or "*EUT*". The first sample was configured to use the 'Drive Peripheral Interface' (DPI) protocol, here forth referred to as the 'DPI-EUT'. The second sample was configured to use the 'Drive Serial Interface' (DSI) protocol, here forth referred to as the 'DSI-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 15.247 (Industry Canada RSS-210) for a low power transmitter. These tests were performed by Abtin Spantman, EMC Engineer at L.S. Compliance, Inc. and witnessed by Calvin Steinweg of Rockwell Automation, Incorporated.

All Radiated and Conducted RF 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, 15.247 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, 2003.

All tests were performed at L.S. Compliance, Inc., in Cedarburg, Wisconsin, unless otherwise noted.

8. Product Description

Description:

The PowerFlex Wireless Interface Module (WIM) is designed to provide Bluetooth™ compliant wireless interface between Rockwell Automation's PowerFlex Family of AC Drives and Bluetooth™ enabled host computer products. The Wireless Interface Module complies with the Bluetooth™ wireless specifications operating in the unlicensed 2400 MHz band, as a frequency hopping transceiver with 125 mW RF output-power, operating on 79 frequencies, with 1 MHz channel separation and up to 1600 hops per second.

It consists of a single printed wiring board which interfaces to the PowerFlex AC drive through a local peripheral interface which also supplies 12 VDC, 130 mA power needed for the unit. This local peripheral protocol is converted to a serial data stream which is then converted to the Bluetooth radio protocol to interface with a standard PC hosts over a wireless link. The Drive peripheral serial communication data is transferred to the main host processor on the WIM through appropriate physical layer transceiver circuitry. Data transfer between the host processor and the National radio module is UART based serial communication. The LMX9820A Radio Transceiver broadcasts and receives at 2.4GHz through a GigaAnt MICA surface mount antenna. Status information for the WIM is presented to the user through the use of a Tri-color LED visible through the module's packaging.

The WIM printed wiring board can be populated in four different configurations depending on the Drive peripheral network to which it will connect and the physical package desired. The printed wiring board itself and the radio circuitry remain unchanged for all configurations. Only the Drive interface transceiver circuitry and the host processor's firmware flash files vary from assembly to assembly based on the AC Drive family to which it will be connected.

The PowerFlex 4 Family of Drives utilizes a proprietary RS-485 based peripheral interface for its local peripheral network. The PowerFlex 7 Family of Drives utilizes a proprietary CAN (Controller Area Network) based peripheral interface for its local peripheral network. The WIM printed wiring board is designed to interface to either of these proprietary peripheral networks based on the construction configuration and firmware flashed into the host processor.

Configuration 1 (20-WIM-N1) implements a CAN transceiver and a small 26pin PC connector for use with PowerFlex 7 family of Drives in a UL Type 1 (IP:67) packaging.

Configuration 2 (20-WIN-N4S) implements the same CAN transceiver but an 8pin Mini-DIN style connector for use in all UL Type 4X/12 (IP:66) packaging.

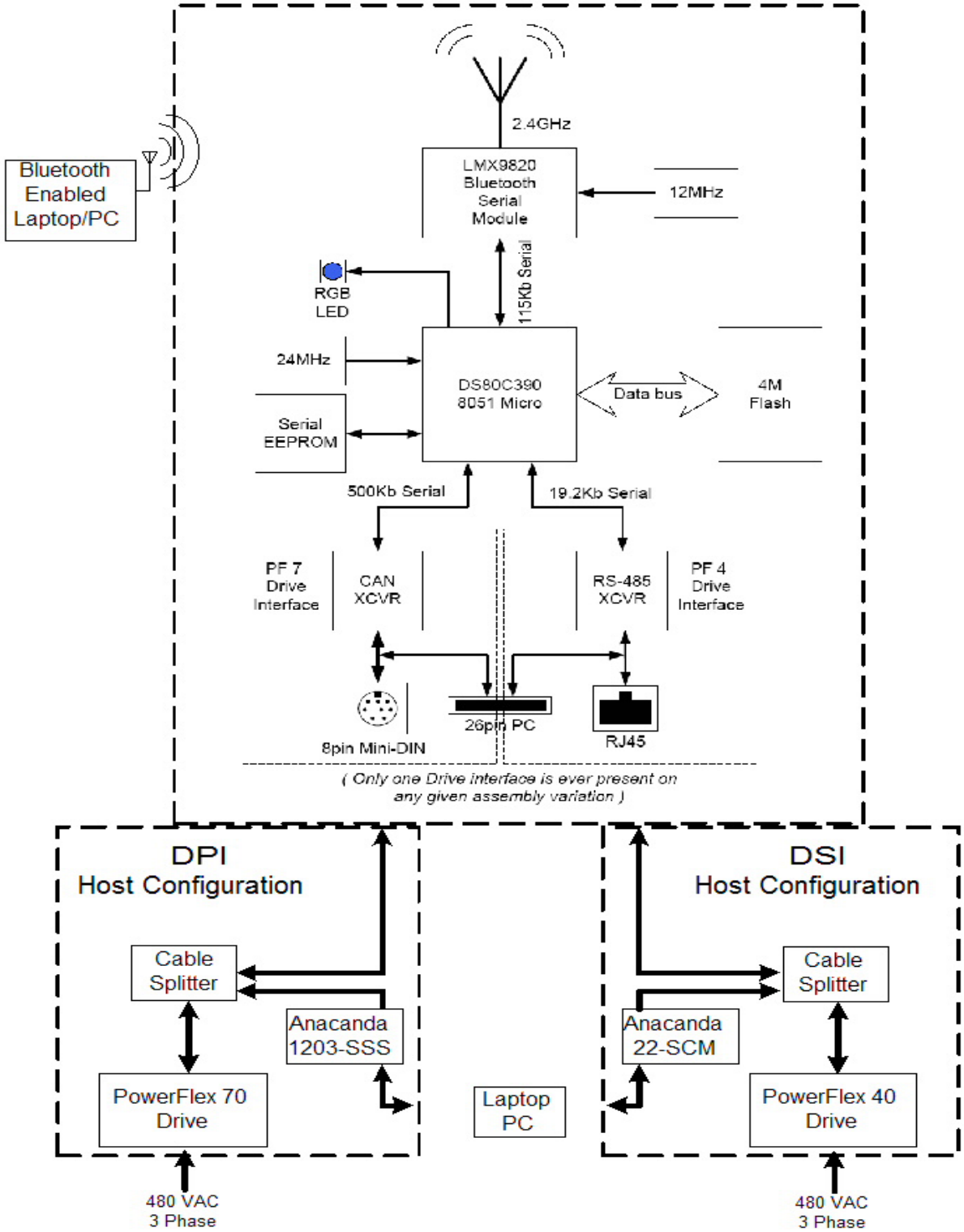
Configuration 3 (22-WIM-N1) implements a RS-485 transceiver and a small 26pin PC connector for use with PowerFlex 4 family of Drives in a UL Type 1 (IP:67) packaging.

Configuration 4 (22-WIM-N4S) implements the same RS-485 transceiver but an 8pin RJ45 style connector for use in all UL Type 4X/12 (IP:66) packaging.

All four configurations utilize the same printed wiring board, host processor, National Semiconductor radio transceiver chip, 12MHz crystal, and antenna. The host processor's FLASH embedded code varies based on the host drive's peripheral protocol. The code executed in the National Semiconductor LMX9820A Bluetooth™. The Serial Module remains constant, and is not changeable by Rockwell Automation or its customers.

Configuration 2 is, expected by the manufacturer to be, the most common configuration. Configuration 2 and Configuration 4 were tested, as covered in this report, as representative samples of the configurations. Three channels were selected for testing, channel 00 (2402 MHz), channel 40 (2442 MHz), and channel 78 (2480 MHz).

Two Host Configurations are shown below.
Only the EUT shown in the center block was placed in the test chamber during testing.



DPI Configuration:
PowerFlex 70 Drive
Cat #: 20AD2P1A3AYNNNNN
S/N: 1JAT6TE7

DSI Configuration:
PowerFlex 40 Drive
Cat #: 22B-D010N104
S/N: BD010N0T2340007

9. Test Requirements

The above mentioned tests were performed in order to determine the compliance of the Rockwell Automation PowerFlex 'Wireless Interface Module' with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.207	15.247b	15.247g
15.205	15.247c	15.209
15.247a	15.247d	

10. Summary of Test Report

DECLARATION OF CONFORMITY

The Rockwell Automation PowerFlex 'Wireless Interface Module' was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Part 15.247, and Industry Canada RSS-210, Section 6.2.2(0) for a Frequency Hopping Spread Spectrum Transmitter.

Some emissions are seen to be within 3 dB of their respective limits. As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

The enclosed test results pertain to the sample(s) of the test item listed, and only for the tests performed on 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.

11. Conducted Emissions Test, Occupied Bandwidth

The 20 dB bandwidth requirement found in FCC Part 15.247(a)(1)(i) states a maximum general allowed occupied bandwidth of 500 kHz for devices operating in the 902-928 MHz band, and a maximum of 1 MHz for devices operating in the 5725-5850 MHz band. For devices operating in the 2400 MHz band, there are no stated maximum occupied bandwidth limits.

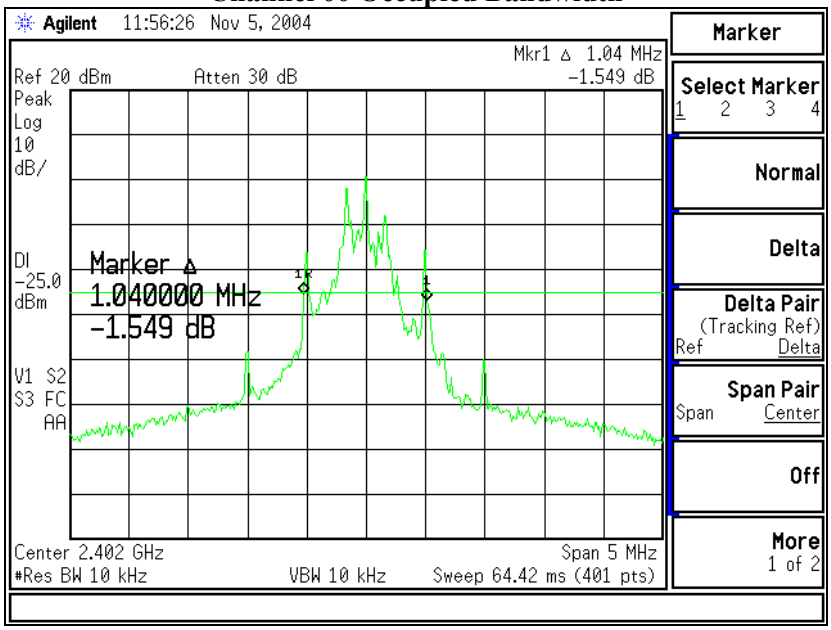
For this portion of the tests, the surface-mount chip antenna was de-soldered and replaced with a 50Ω RF connector. A direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the HP E4407B spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct readings of the measurements made without the need for any further corrections. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 10 kHz for this portion of the tests. The EUT was configured to run in a continuous transmit mode, while being supplied with 1010 binary data patterns as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the occupied bandwidth of Channel 40 is the highest at 1050 kHz.

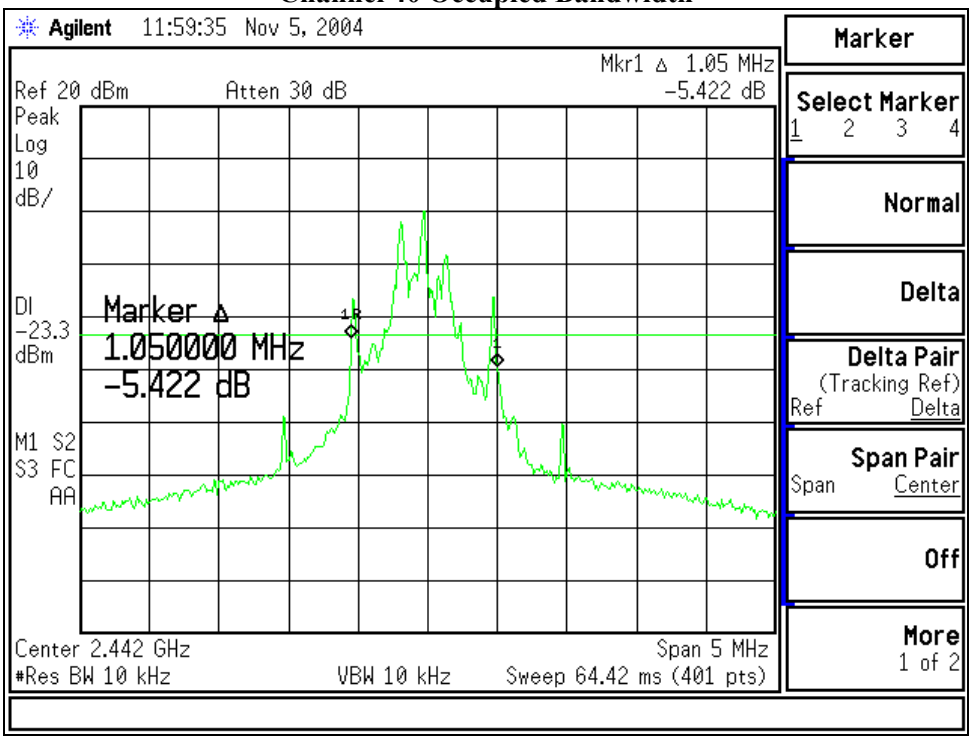
Channel	Center Frequency (MHz)	Measured -20 dB BW (kHz)
00	2402	1040
40	2442	1050
78	2480	1040

Plots of Occupied Bandwidth

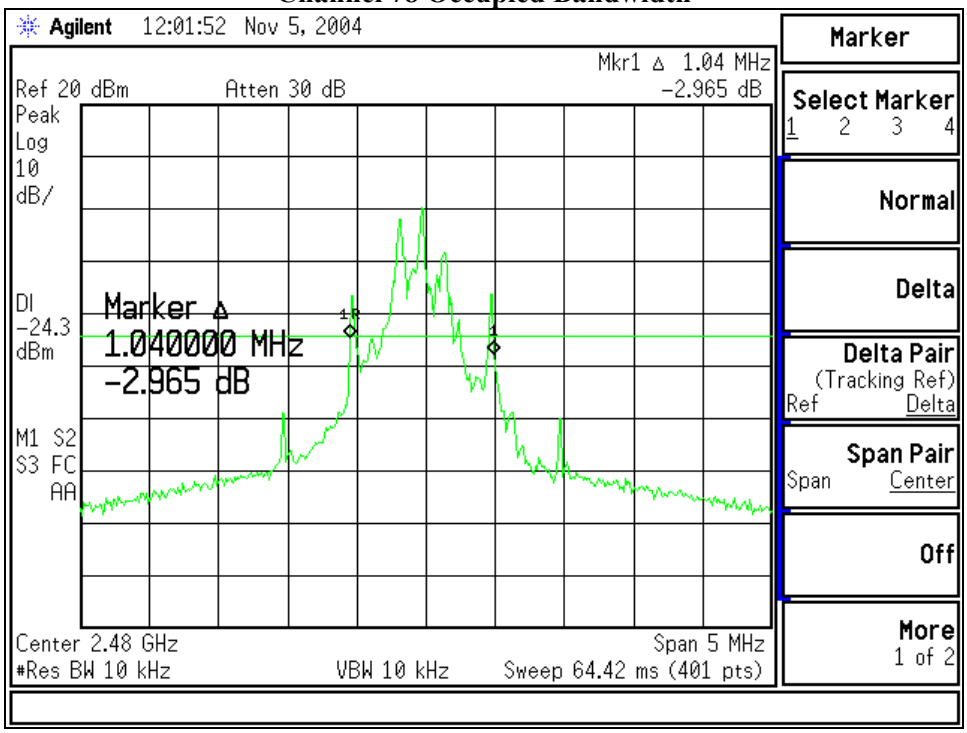
Channel 00 Occupied Bandwidth



Channel 40 Occupied Bandwidth



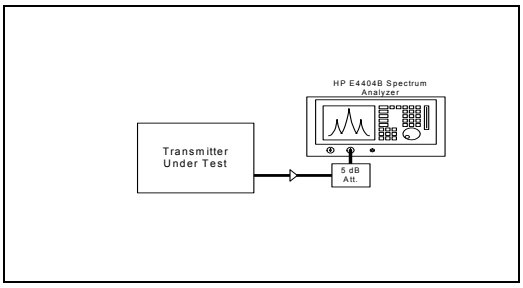
Channel 78 Occupied Bandwidth



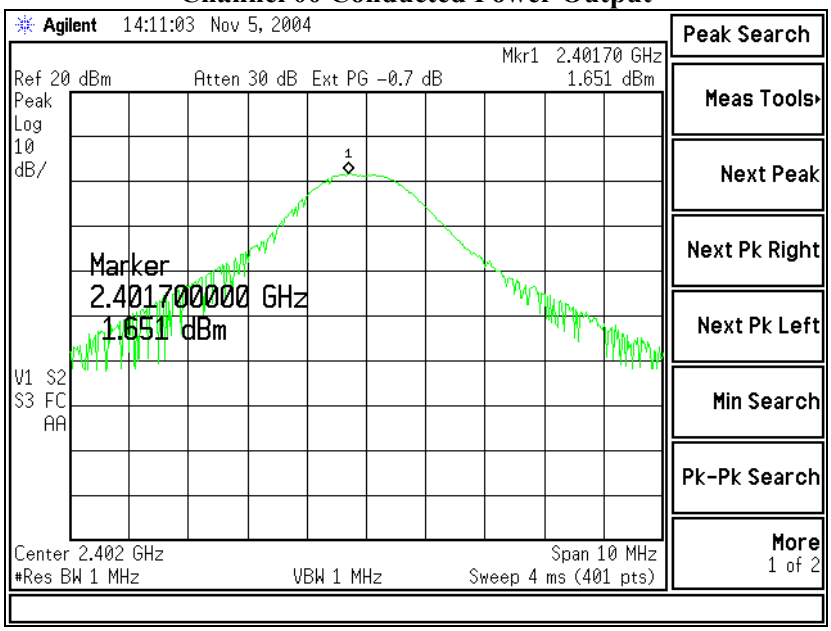
12. Conducted Emissions Test, Power Output 15.247(b)

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable to the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct readings of the measurements made without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical 1010 pattern binary data as a modulation source. The spectrum analyzer was used with resolution and video bandwidths set to 1 MHz, and a span of 10 MHz, with measurements from a peak detector presented in the chart below. The power output limit for this device, from 15.247(a)(i) is 125mW, or 20.9dBm. RF Power output was also monitored while varying the voltage.

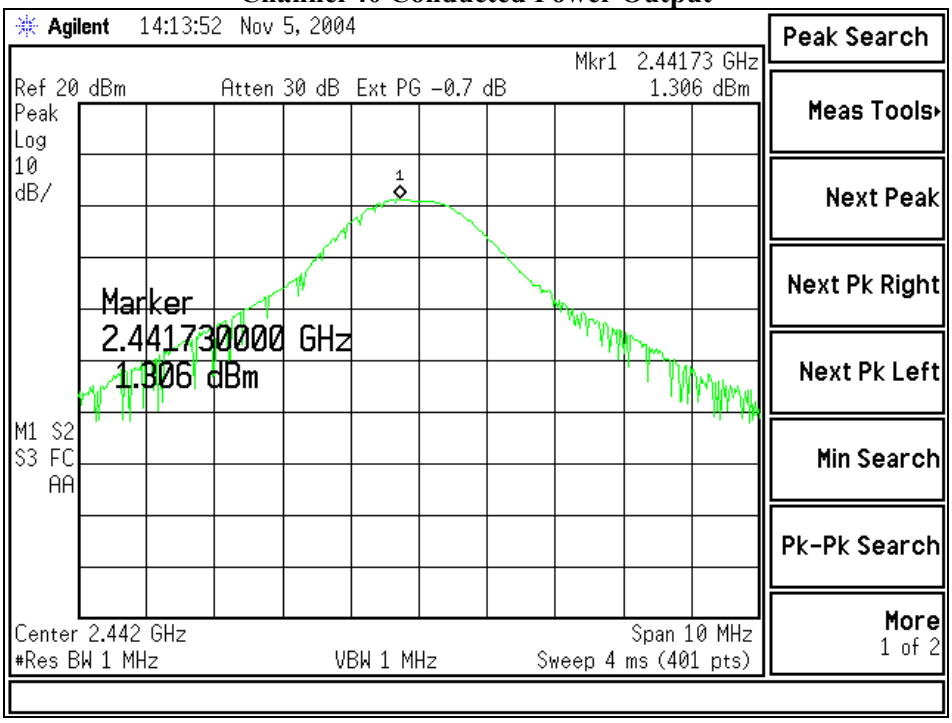
CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
00	2402	20.9 dBm	1.6	19.3
40	2442	20.9 dBm	1.3	19.6
78	2480	20.9 dBm	1.4	19.5



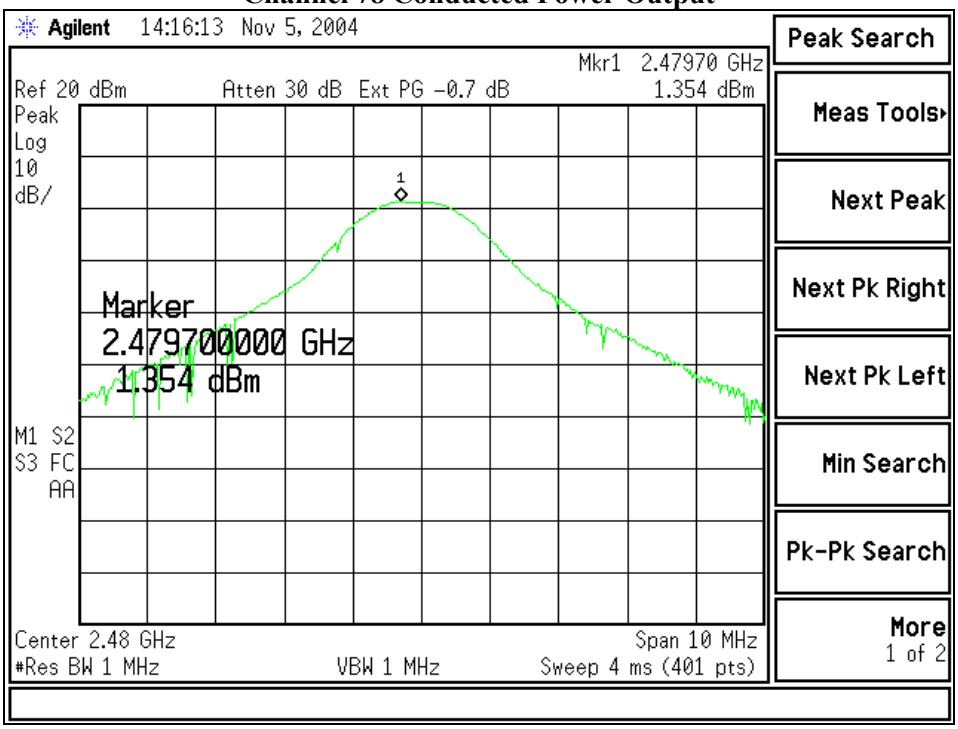
Channel 00 Conducted Power Output



Channel 40 Conducted Power Output



Channel 78 Conducted Power Output



13. Frequency and Power Stability over Voltage and Temperature Variations

For measurements of the frequency and voltage stability, the transmitter was placed inside a temperature controlled environmental chamber (Thermotron S-8C). A Spectrum Analyzer was used to measure the frequency at the appropriate frequency markers. 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 the 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 with a receiver resolution bandwidth of 300 Hz, and video bandwidth of 300 Hz.

Center Freq	2402	MHz

		DC Voltage Source		
		102.00	120.00	138.00
Temperature °C	+50	2401.8050	2401.8050	2401.8050
	+25	2401.8127	2401.8127	2401.8127
	0	2401.8161	2401.8161	2401.8161
	-20	2401.8118	2401.8118	2401.8118

Max Freq	2401.8161	MHz
Min Freq	2401.8050	MHz
Total Freq Excursion	0.0111	MHz
Limit	0.2402	MHz
	Pass	

Center Freq	2442	MHz

		DC Voltage Source		
		102.00	120.00	138.00
Temperature °C	+50	2441.8036	2441.8036	2441.8036
	+25	2441.8112	2441.8112	2441.8112
	0	2441.8140	2441.8140	2441.8140
	-20	2441.8103	2441.8103	2441.8103

Max Freq	2441.8140	MHz
Min Freq	2441.8036	MHz
Total Freq Excursion	0.0104	MHz
Limit	0.2442	MHz
	Pass	

Center Freq	2480	MHz

		DC Voltage Source		
		102.00	120.00	138.00
Temperature °C	+50	2479.8041	2479.8041	2479.8041
	+25	2479.8119	2479.8119	2479.8119
	0	2479.8145	2479.8145	2479.8145
	-20	2479.8109	2479.8109	2479.8109

Max Freq	2479.8145	MHz
Min Freq	2479.8041	MHz
Total Freq Excursion	0.0104	MHz
Limit	0.2480	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 standby state after power up, as required by the manufacturer.

At the extreme temperature settings, a wide frequency sweep was also investigated, with minimum and maximum input voltages, to ensure that no unexpected anomalies have occurred.

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

14. Conducted Emissions Test, Spurious Emissions 15.247(d)

FCC Part 15.247(d) requires a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable to the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct readings of the measurements made without the need for any further corrections. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical 1010 pattern binary data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

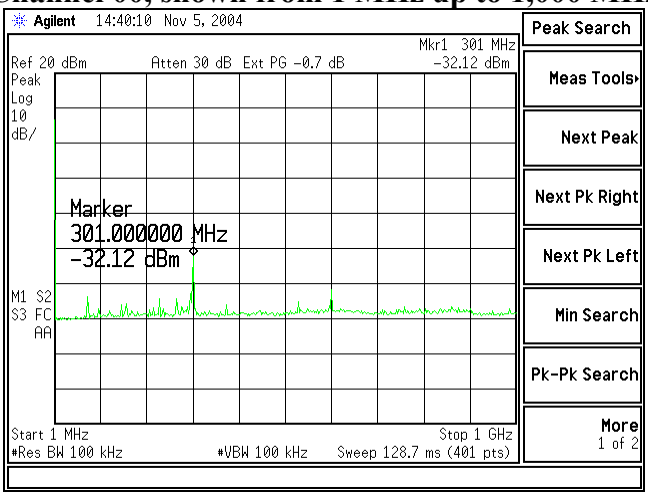
No significant emissions could be noted within -30 dBc of the fundamental level for this product.

	Channel 00	Channel 40	Channel 78
301-313 MHz	- 32.1 (dBm)	- 32.4 (dBm)	- 33.0 (dBm)
Fundamental	+ 1.23 (dBm)	+ 0.89 (dBm)	+ 1.03 (dBm)
2nd Harmonic	- 36.9 (dBm)	- 37.9 (dBm)	- 38.8 (dBm)
3rd Harmonic	- 42.4 (dBm)	- 48.1 (dBm)	- 43.1 (dBm)
4th Harmonic	Note (1)	Note (1)	Note (1)
5th Harmonic	Note (1)	Note (1)	Note (1)
6th Harmonic	Note (1)	Note (1)	Note (1)
7th Harmonic	Note (1)	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)

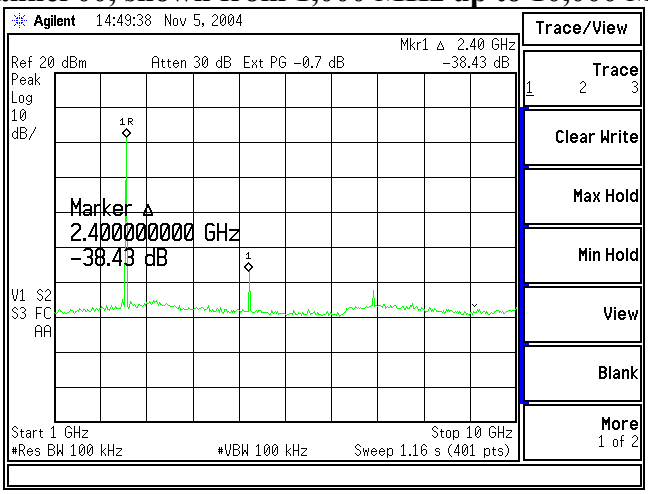
Notes:
(1) Measurement at system noise floor.

Plots of Conducted Spurious and Fundamental Levels

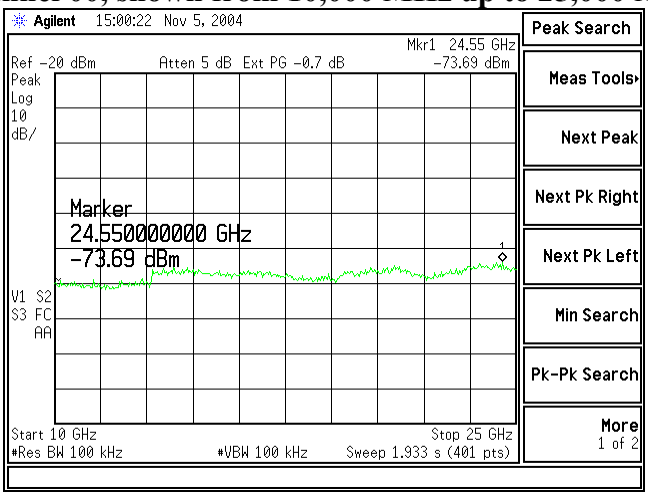
Channel 00, shown from 1 MHz up to 1,000 MHz



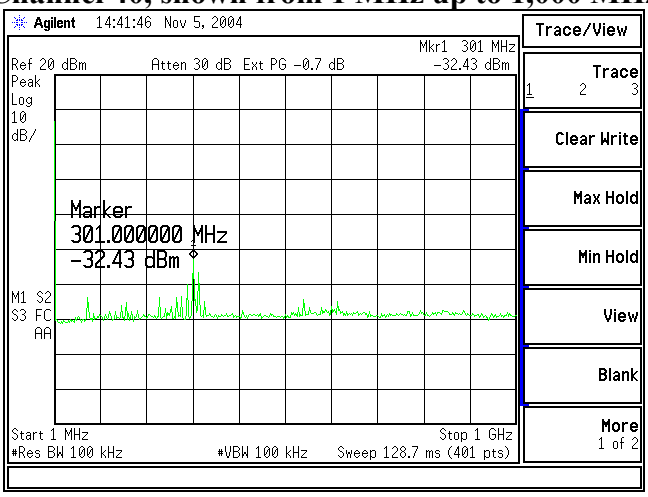
Channel 00, shown from 1,000 MHz up to 10,000 MHz



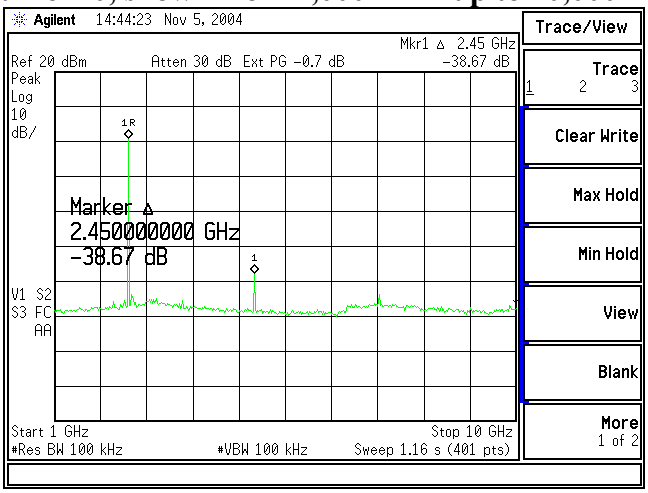
Channel 00, shown from 10,000 MHz up to 25,000 MHz



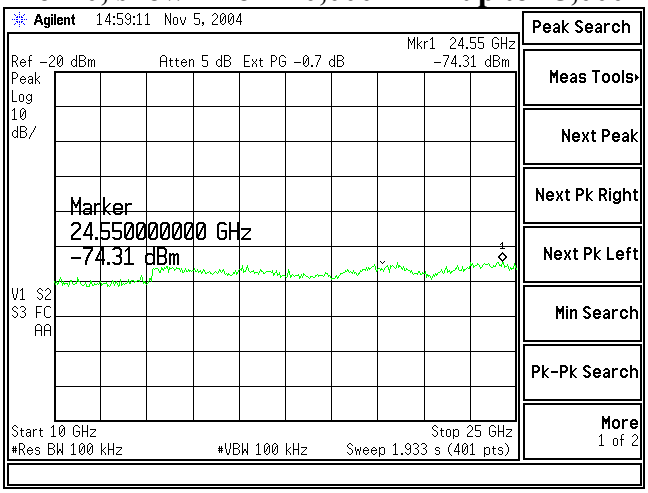
Channel 40, shown from 1 MHz up to 1,000 MHz



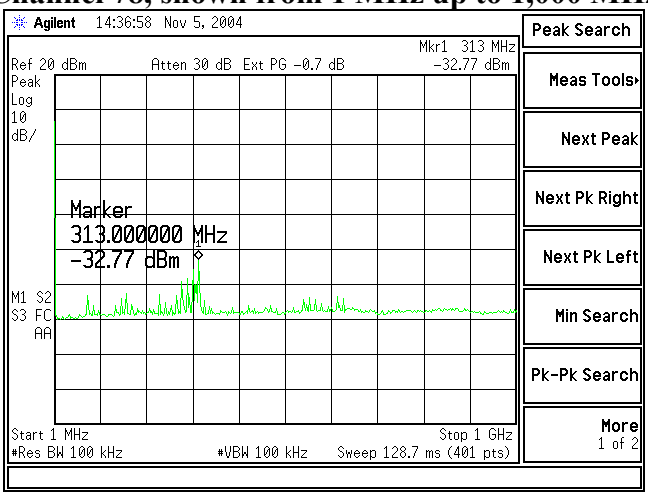
Channel 40, shown from 1,000 MHz up to 10,000 MHz



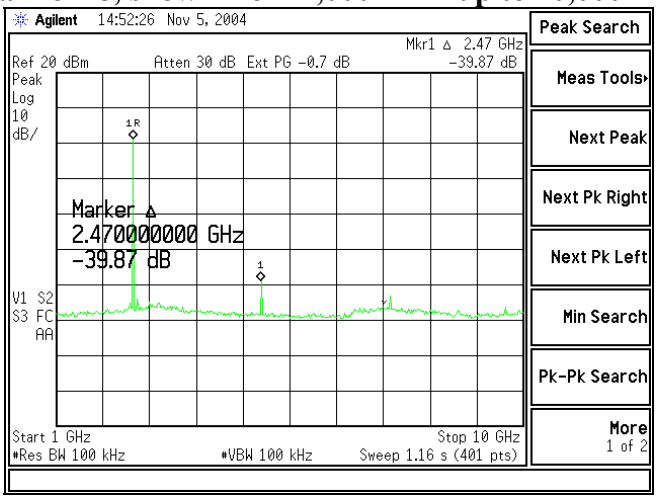
Channel 40, shown from 10,000 MHz up to 25,000 MHz



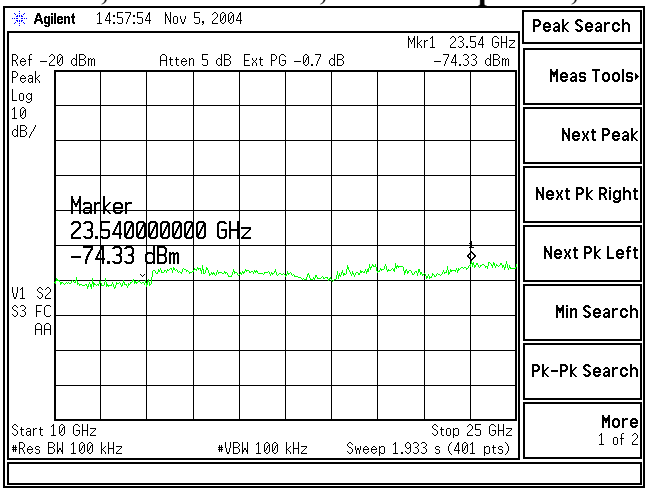
Channel 78, shown from 1 MHz up to 1,000 MHz



Channel 78, shown from 1,000 MHz up to 10,000 MHz



Channel 78, shown from 10,000 MHz up to 25,000 MHz



15. Conducted Emissions Test, Minimum Channel Separation

Part 15.247(a)(1) requires a minimum channel separation of 25 kHz or the equivalent of the 20 dB occupied bandwidth of the fundamental transmission, whichever is greater. Alternatively[Note 1], for systems operating in the 2400 MHz band, the hopping channel carrier frequencies may be separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, which ever is greater. An HP E4407B spectrum analyzer was used with a resolution bandwidth of 30 kHz to measure the channel separation of the EUT.

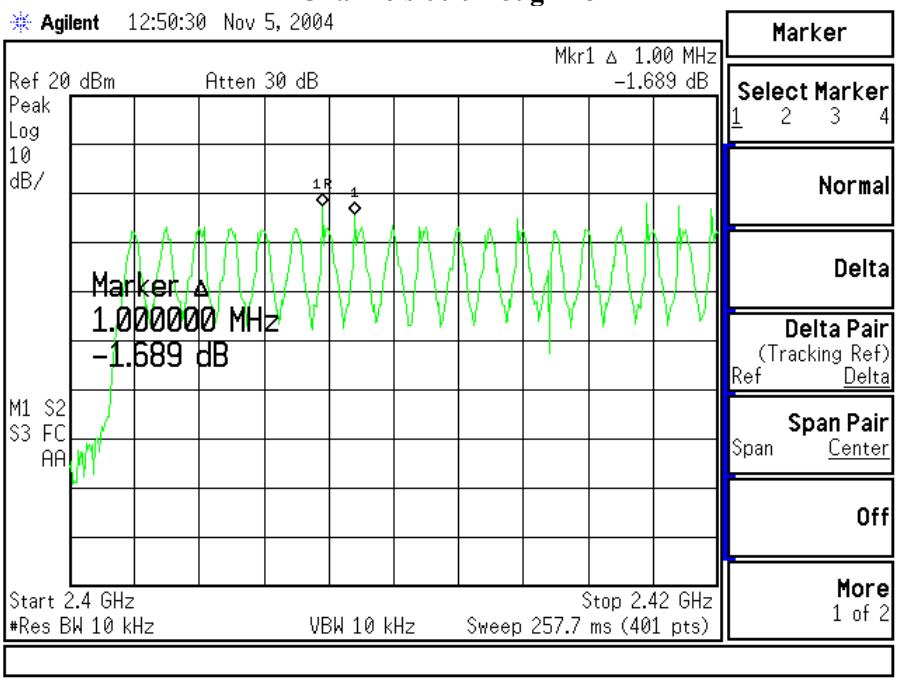
The channel-separations measured for this device is 1MHz. The maximum occupied bandwidth of the device, as reported in the previous section is 1050 kHz. The minimum channel separation for the EUT exceeds both the 25 kHz criteria and the two-thirds of 20 dB occupied bandwidth criteria, and hence meets the requirements. The following plots describe this spacing, and also establish the number of hop channels, which is a total of 79 channels.

Frequency Span (MHz)	Number of Channels	Minimum Separation (MHz)
2400-2420	19	1.0
2420-2440	20	1.0
2440-2460	20	1.0
2460-2480	20	1.0
2480-2500	0	-

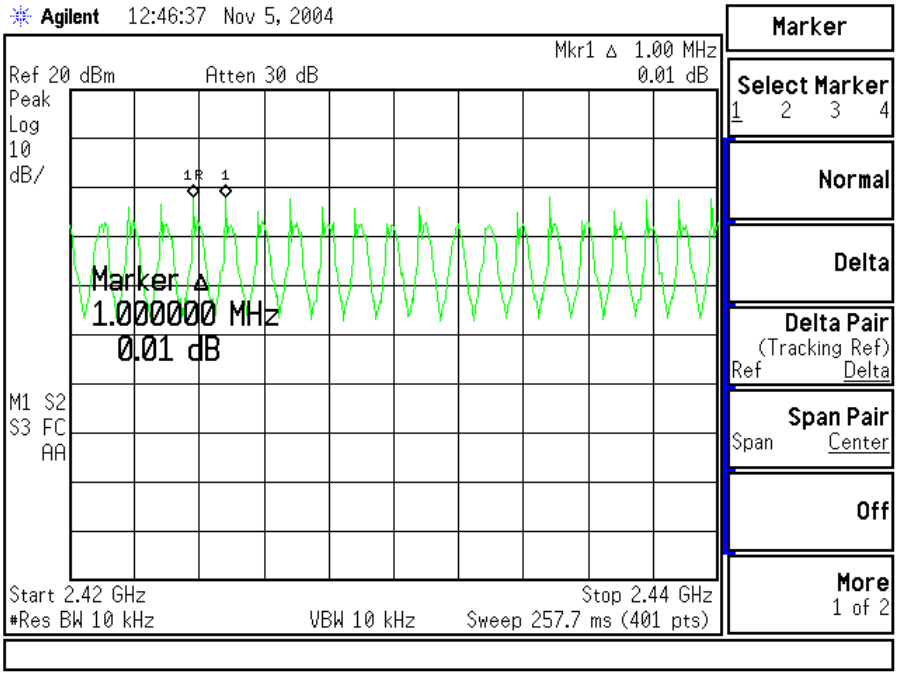
Notes:
1) Allowance valid for systems operating with an output power no greater than 125 mW, conducted at the antenna port.

Plots of Channel Separations

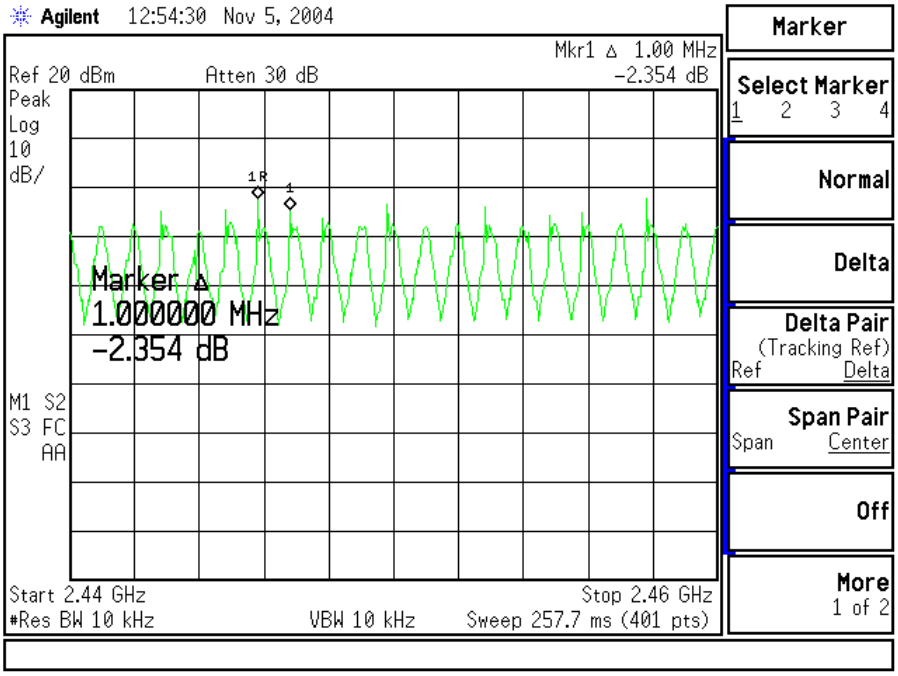
Channels 00 through 18



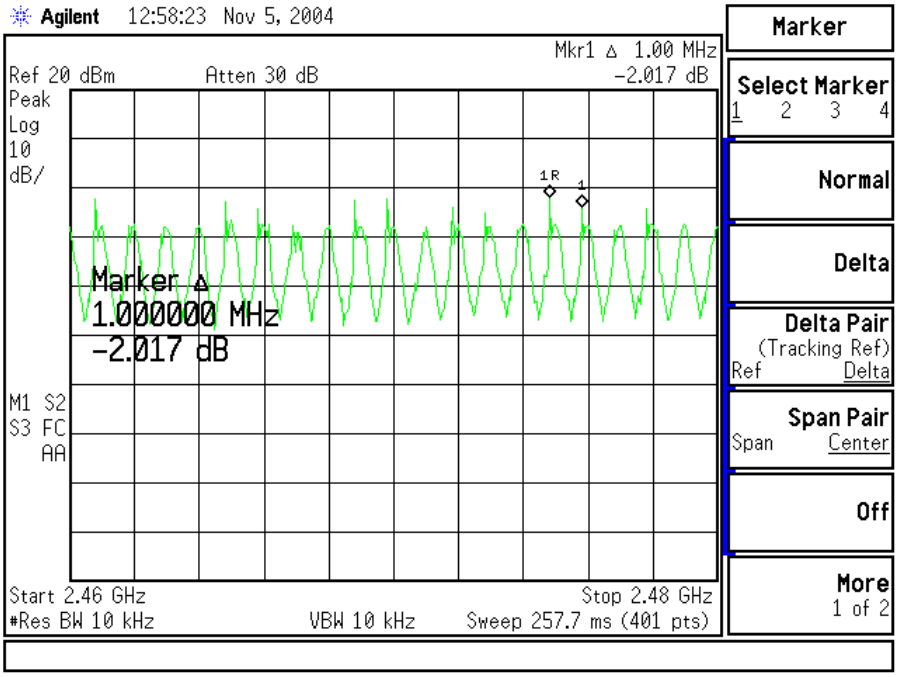
Channels 19 through 38



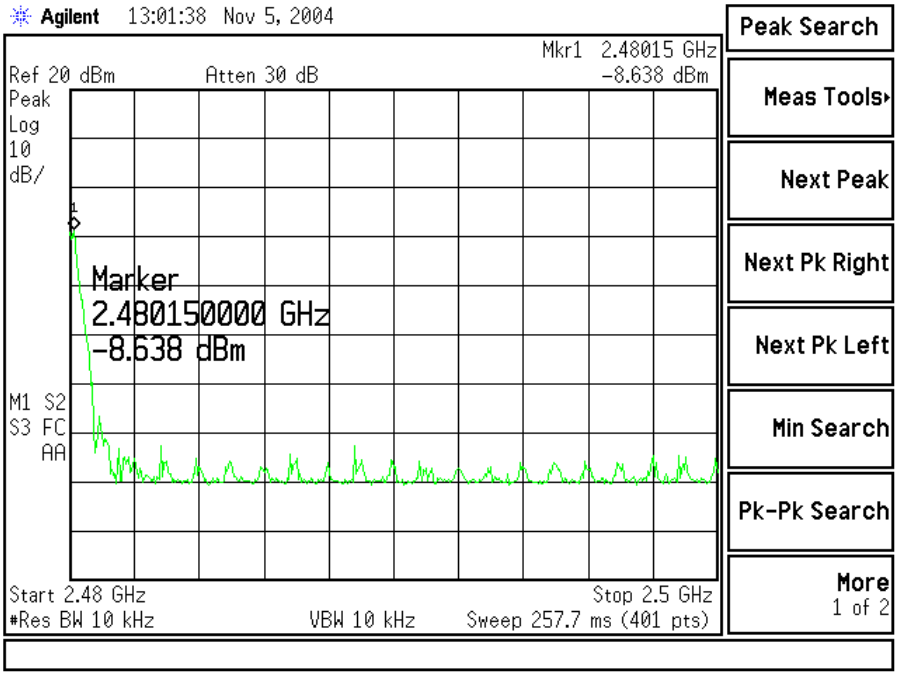
Channels 39 through 58



Channels 59 through 78



Channel 78


Agilent 13:01:38 Nov 5, 2004
Mkr1 2.48015 GHz
-8.638 dBm
Ref 20 dBm
Atten 30 dB
Peak
Log
10
dB/
Marker
2.480150000 GHz
-8.638 dBm
M1 S2
S3 FC
AA
Start 2.48 GHz
#Res BW 10 kHz
VBW 10 kHz
Stop 2.5 GHz
Sweep 257.7 ms (401 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

16. Conducted Emissions Test, Channel Occupancy

Part 15.247(a)(1)(iii) requires the use of a minimum of 15 channels, and a channel occupancy, of no more than 0.4 seconds in a any 0.4 seconds multiplied by the number of hopping channels employed. The channel occupancy for this EUT was measured using an HP E4407B spectrum analyzer, set to zero-span at the frequency of interest. With the analyzer in peak-hold mode, the transmission lengths can be measured by adjusting the sweep rate of the analyzer. A suitable sweep rate was used to measure the channel occupancy at the low, mid and high channels.

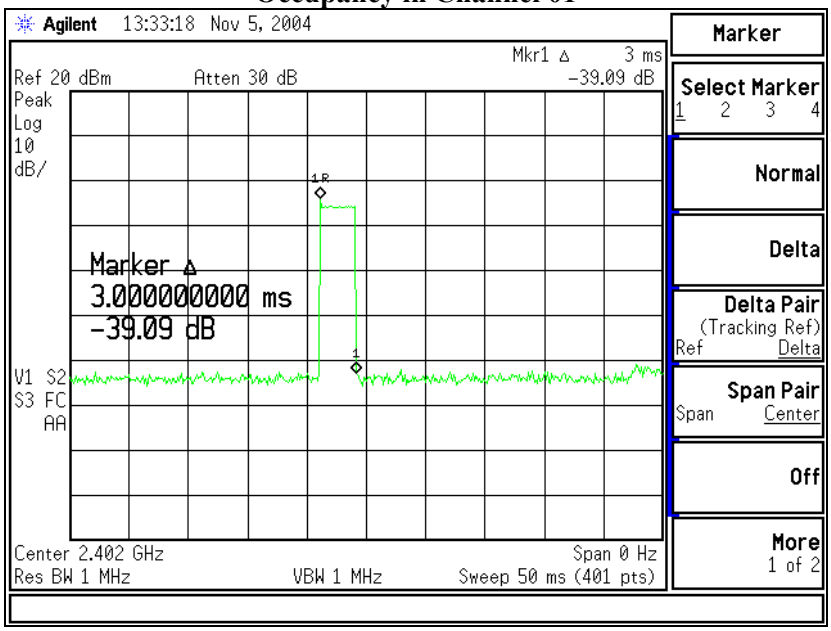
Window of assessment: 0.4 seconds x 79 channels = 31.6 seconds.

The longest time any transmission will occur on a single channel is 3 ms. With a total of 79 channels used, each occupying a 3 ms slot, it will take 0.237 seconds for the sequence to repeat. In a 31.6 second window, each channel would have 133.3 transmission cycles. The maximum occupancy in a 31.6 second window is calculated by multiplying the 133.3 transmission cycles by 3 ms transmission duration per cycle, to arrive at 400 ms total occupancy.

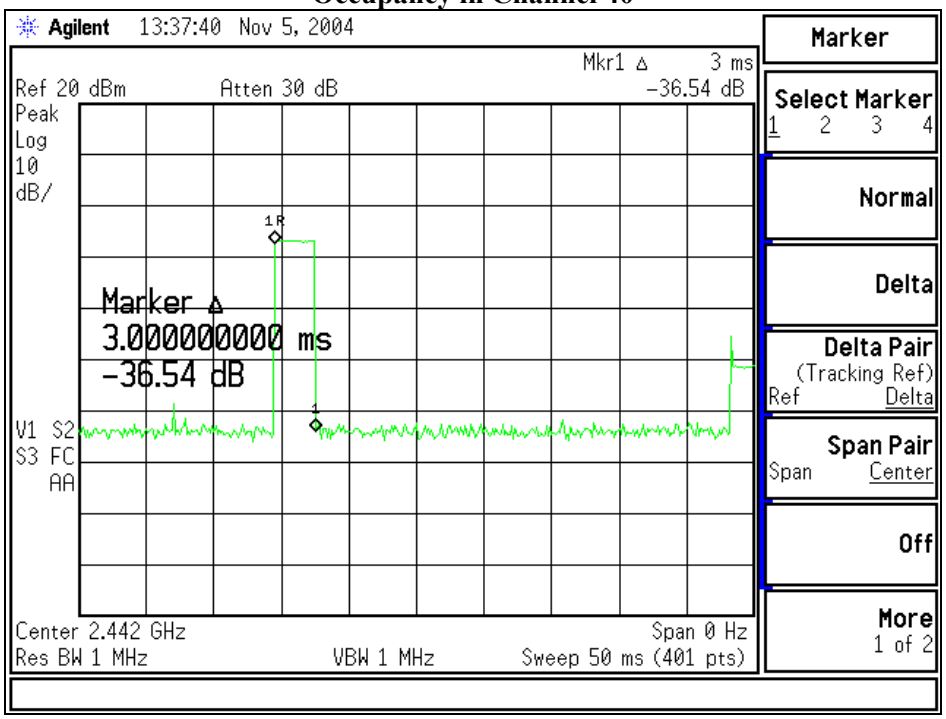
Channel	Frequency (MHz)	Occupancy Per transmission (ms)	Occupancy in window [(0.4 ms) x (# ch)] (ms)
00	2402	3.0	400
40	2442	3.0	400
78	2480	3.0	400

Plots of Channel Occupancy

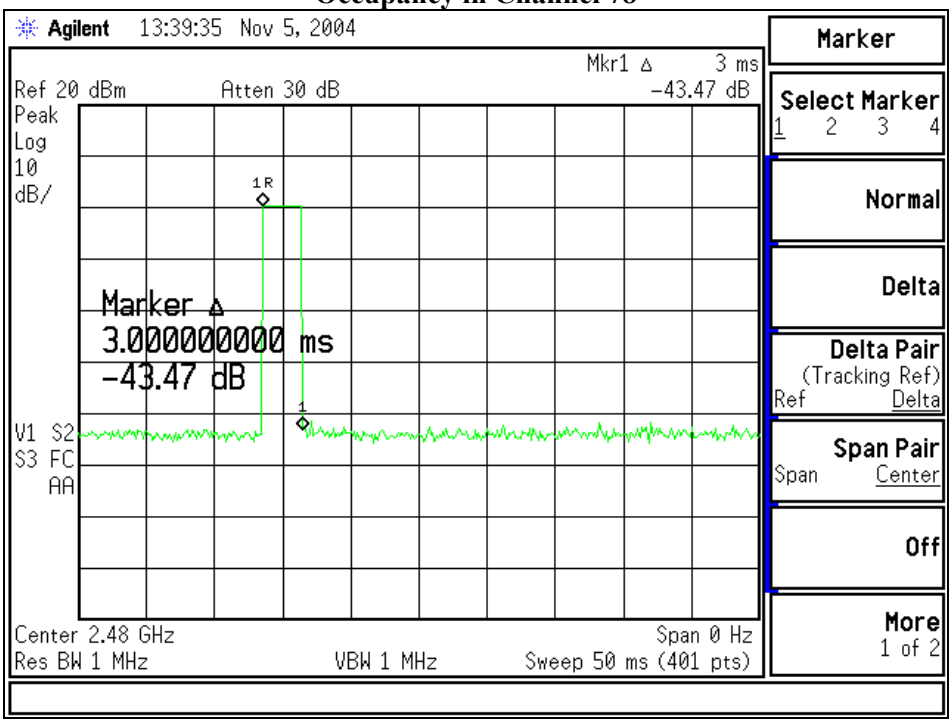
Occupancy in Channel 01



Occupancy in Channel 40



Occupancy in Channel 78



The information on this page is provided by the manufacturer.

17. Equal Channel Usage

(TBD)

18. Pseudorandom Hopping Pattern

(TBD)

19. Radiated Emissions Test

Test Setup

The test setup was assembled in accordance with Title 47, CFR 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 a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous transmit mode, using power as provided by the host drive controller setup. The unit has the capability to operate on 79 channels, controllable via a laptop PC during these tests. Both the DPI-EUT and the DSI-EUT host modes were tested, and the worst case RF emissions results from both are presented in this report, in the spurious emissions section. The radio performance, however, was very similar and only the data from the DPI-EUT is published.

The applicable limits apply at a 3 meter distance. Measurements above 5 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (2402 MHz), middle (2442 MHz) and high (2480 MHz) to comply with FCC Part 15.35. The channels and operating modes were changed using a Laptop PC.

Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. 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 a 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 24 GHz, the EUT was measured at a 0.3 meter separation, using a standard gain Horn Antenna and pre-amplifier.

The EUT was rotated along three orthogonal axis during the investigations to find the highest emission levels.

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, and preamp were used.

Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for a FHSS transmitter [Canada RSS-210, Clause 6.2.2(0)]. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

CALCULATION OF RADIATED EMISSIONS LIMITS

The system under test, as covered in this report utilizes bandwidths greater than 500 kHz, and hence is limited to a maximum power output of 125 Mw, or 116.19 dB μV/m when measured at 3 meters.

The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d), shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c).

The following table depicts the Class B limits for an unintentional radiator. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24,000	500	54.0	63.5

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

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

= 40 dBμV/m (from 30-88 MHz)

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

960 MHz to 10,000 MHz

500μV/m or 54.0 dB/μV/m at 3 meters

54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

For measurements made at 0.3 meter, a 20 dB correction has been invoked.

960 MHz to 10,000 MHz

500μV/m or 54.0 dB/μV/m at 3 meters

54.0 + 20 = 74 dB/μV/m at 0.3 meters

Radiated Emissions Data Chart

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.205 and 15.247(FHSS)
Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	Rockwell Automation					
Date(s) of Test:	November 1st through 5th , 2005					
Test Engineer(s):		Tom Smith	√	Abtin Spantman		Ken Boston
Model #:	2x-WIM-Nxx					
Serial #:	LSC-DPI and LSC-DSI					
Voltage:	12 VDC at 130 mA provided by host					
Operation Mode:	Normal, continuous transmit, and 'Hopping' mode					
EUT Power:		Single Phase ___VAC	√	3 Phase 480VAC		
		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 93110
Pre-Amp: Advanced Microwave WHA6224
Standard Gain Horn: EMCO 3160-09

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

Frequency (MHz)	Antenna Polarity	Host Mode	Height (meters)	Azimuth (0° - 360°)	Measured ERP (dBμV/m)	15.205 Limit (dBμV/m)	Margin (dB)
120.0	H	DPI	1.60	60	31.3	43.0	11.7

Notes:

1) *A Quasi-Peak Detector was used in measurements below 1 GHz, and an Average Detector was used in measurements above 1 GHz. The Peak detector was also use to ensure that the emission levels do not exceed 20 dB beyond the Average limits.*

2) *No significant spurious emissions observed. All spurious emissions were better than 20 dB below the limits..*

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

Frequency (MHz)	Antenna Polarity	Host Mode	Height (meters)	Azimuth (0° - 360°)	Measured ERP (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
2402	H	DPI	1.25	45	93.8	116.2	22.4
4808	H	DPI	1.00	65	53.4	54.0	0.6
7206	H	DPI	1.00	355	52.4	83.3	30.9
9608	H	DPI	1.05	10	49.7	83.3	33.6
12010	H	DPI	1.00	0	35.8	63.5	27.7
14412	H	DPI	1.00	0	39.8	83.3	43.5
16814	V	DPI	1.00	0	43.8	83.3	39.5
19216	V	DPI	1.00	350	45.1	74.0	28.9
21618	V	DPI	1.00	0	37.7	93.8	56.1
24020	V	DPI	1.00	0	40.3	93.8	53.5

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 40:

Frequency (MHz)	Antenna Polarity	Host Mode	Height (meters)	Azimuth (0° - 360°)	Measured ERP (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
2442	H	DPI	1.25	0	95.2	116.2	21.0
4884	H	DPI	1.00	60	51.8	54.0	2.2
7326	H	DPI	1.00	355	54.5	63.5	9.0
9768	V	DPI	1.00	5	50.3	84.7	34.4
12210	V	DPI	1.00	0	36.0	63.5	27.5
14652	V	DPI	1.00	0	39.6	63.5	23.9
17094	H	DPI	1.00	0	44.4	84.7	40.3
19536	V	DPI	1.00	20	47.5	74.0	26.5
21978	V	DPI	1.00	0	37.0	74.0	37.0
24420	V	DPI	1.00	0	39.8	95.2	55.4

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 78:

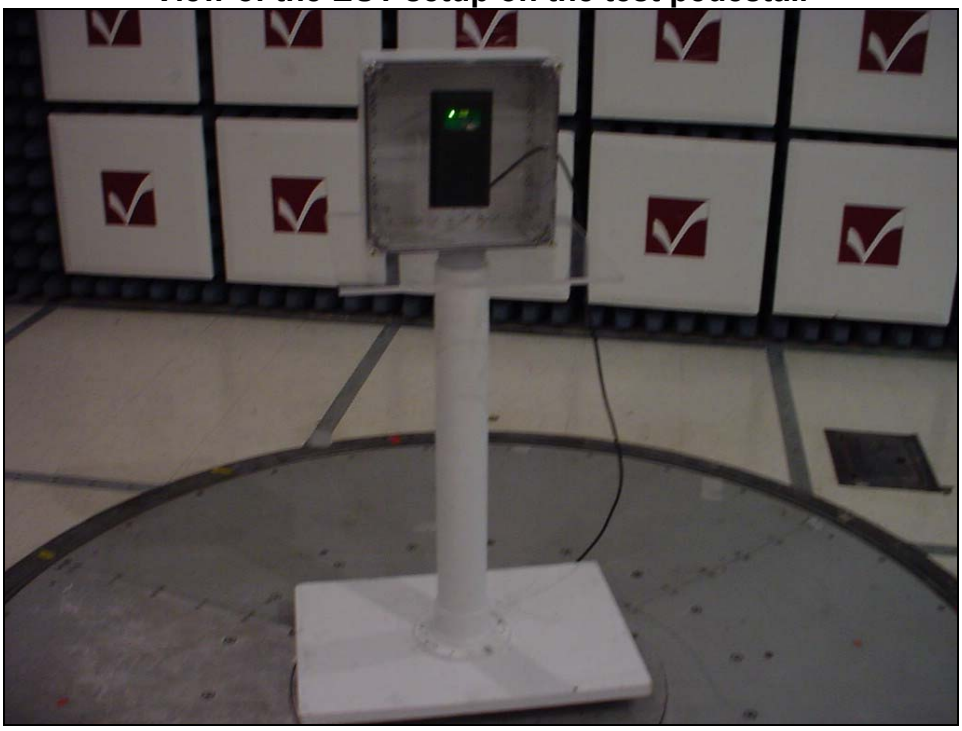
Frequency (MHz)	Antenna Polarity	Host Mode	Height (meters)	Azimuth (0° - 360°)	Measured ERP (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
2480	H	DPI	1.20	0	95.6	116.2	20.6
4960	H	DPI	1.00	300	53.8	54.0	0.2
7440	H	DPI	1.00	350	54.9	63.5	8.6
9920	H	DPI	1.00	10	52.4	85.1	32.7
12400	V	DPI	1.00	0	35.6	63.5	27.9
14880	V	DPI	1.00	0	39.8	85.1	45.3
17360	V	DPI	1.00	0	44.6	85.1	40.5
19840	V	DPI	1.00	350	48.9	74.0	25.1
22320	V	DPI	1.00	0	46.2	74.0	27.8
24800	V	DPI	1.00	0	40.1	95.6	55.5

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

Close-up view of the EUT installation on a fixture box, in vertical orientation.

View of the EUT setup on the test pedestal.



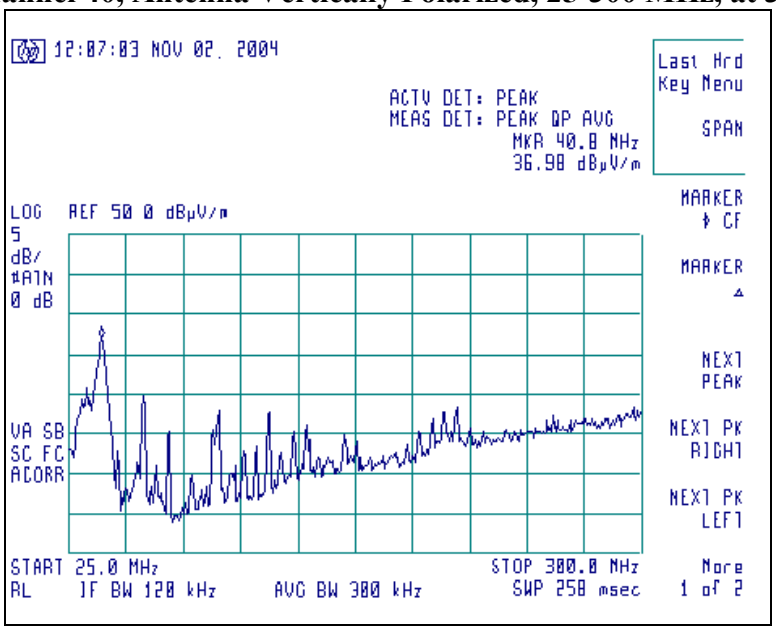
Graphs made during Radiated Emission Testing

Screen Captures of Radiated RF Emissions:

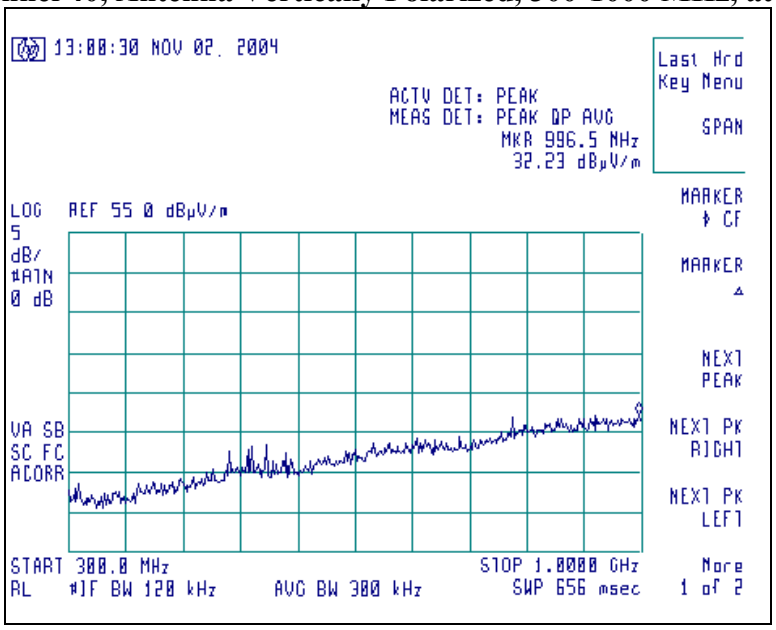
Please note these screen captures represent Peak Emissions. For radiated emission measurements, we utilize a Quasi-Peak detector function when measuring frequencies below 1 GHz, and an Average detector function when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 00, 40, or 78, with the sense and EUT antennas both in vertical polarity for worst case presentations.

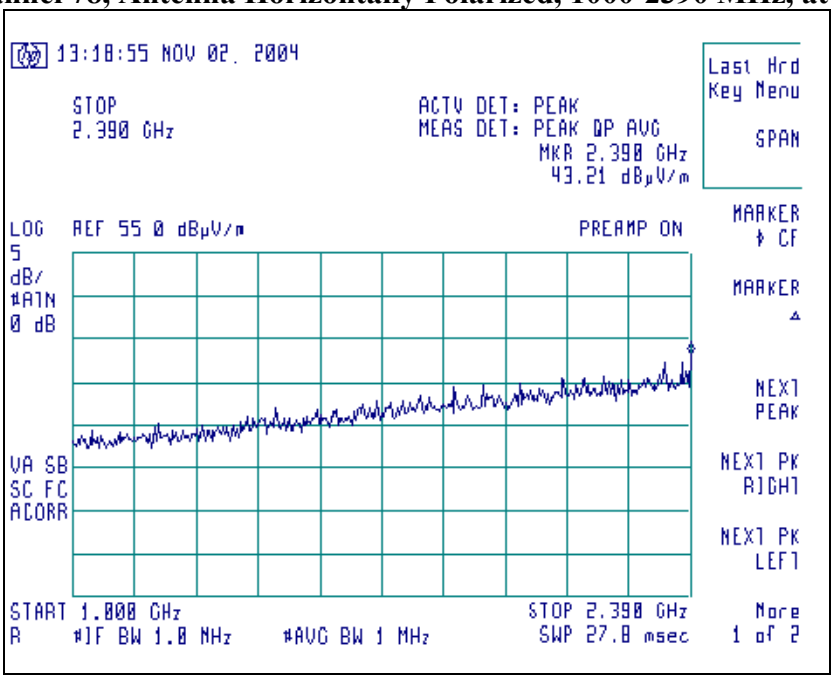
Channel 40, Antenna Vertically Polarized, 25-300 MHz, at 3m.



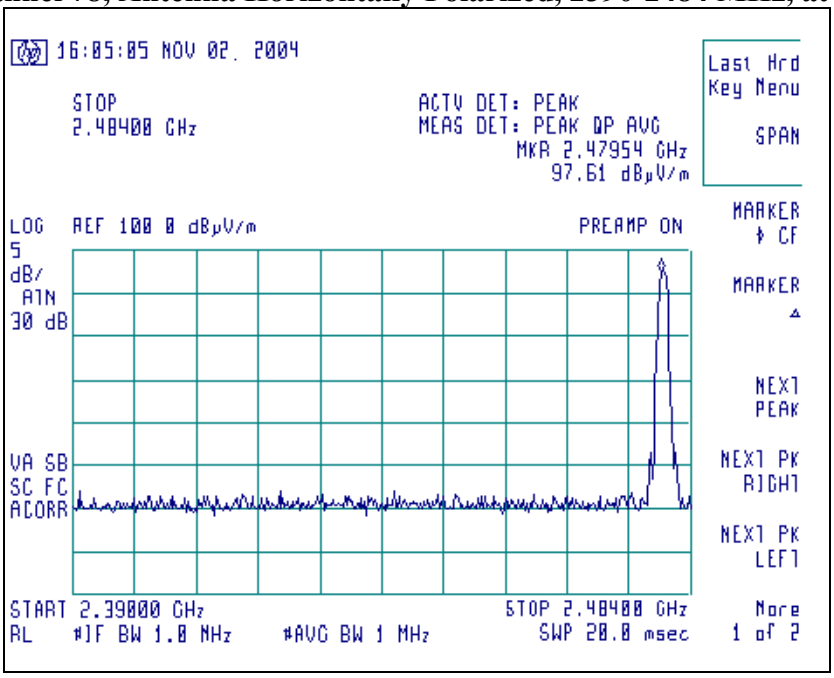
Channel 40, Antenna Vertically Polarized, 300-1000 MHz, at 3m.



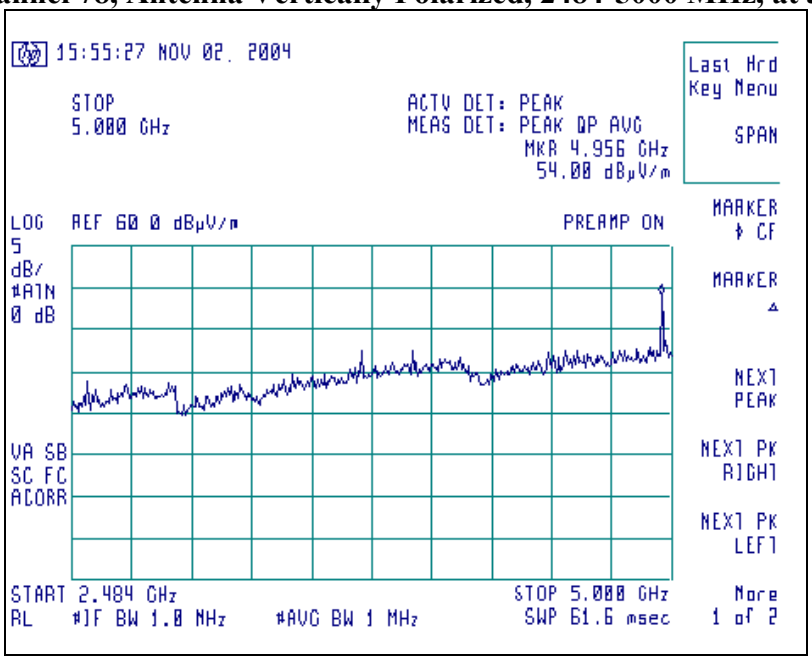
Channel 78, Antenna Horizontally Polarized, 1000-2390 MHz, at 3m.



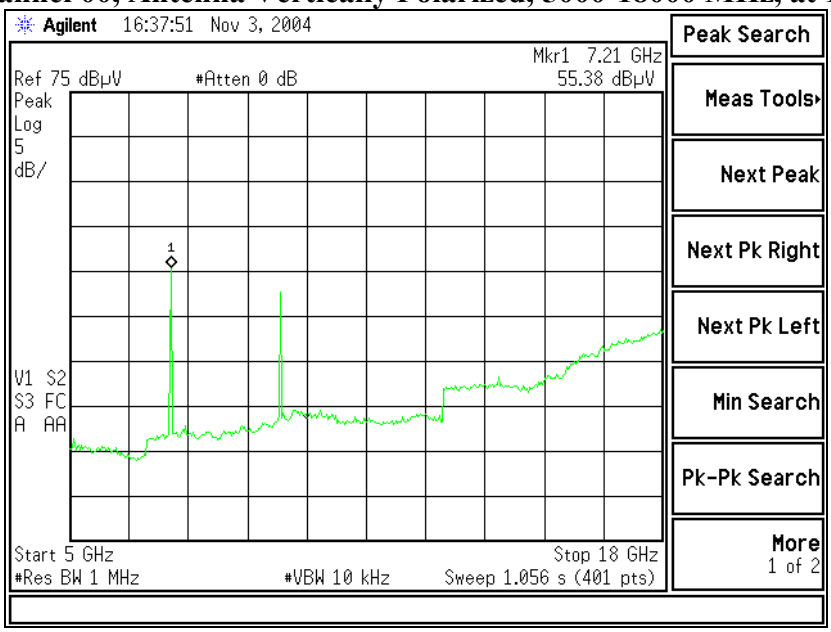
Channel 78, Antenna Horizontally Polarized, 2390-2484 MHz, at 3m.



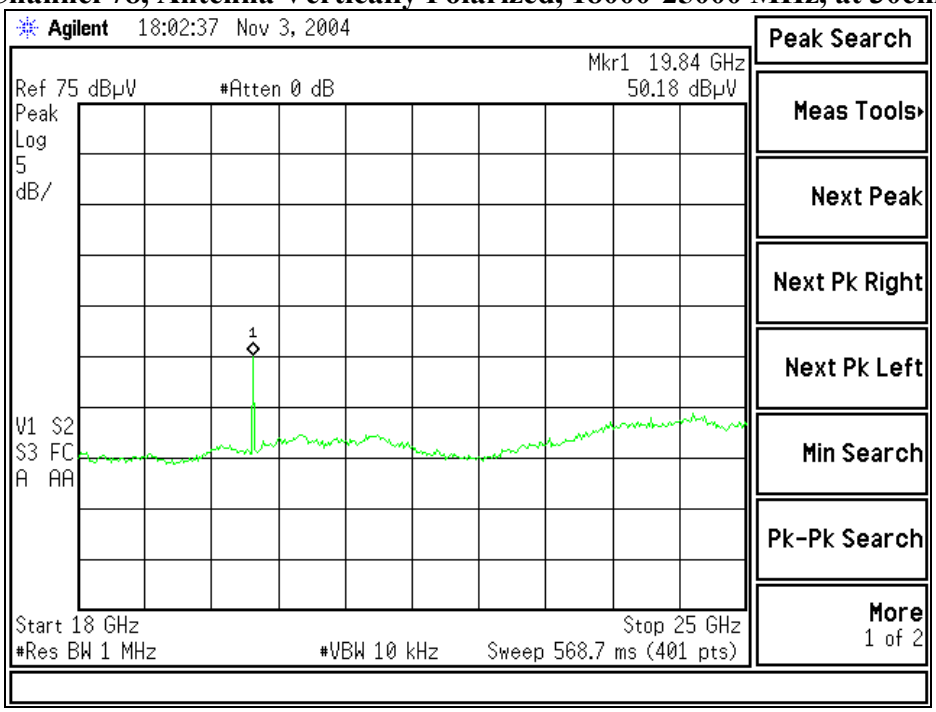
Channel 78, Antenna Vertically Polarized, 2484-5000 MHz, at 3m.



Channel 00, Antenna Vertically Polarized, 5000-18000 MHz, at 1m.



Channel 78, Antenna Vertically Polarized, 18000-25000 MHz, at 30cm.

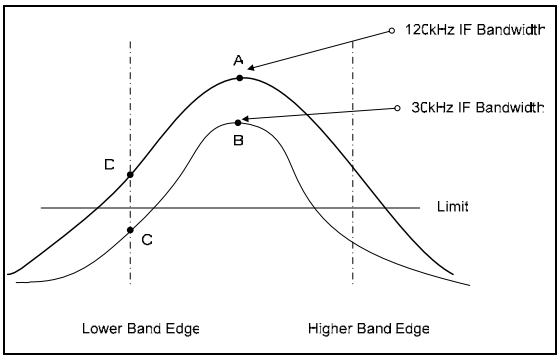


20. Band-Edge Measurements

FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the band-edges where the intentional radiator operates. The following measurements demonstrate compliance of the intentional radiator at the 2400-2483.5 MHz band-edges. Furthermore, the 24 GHz band happens to be bracketed by restricted bands, necessitating compliance with 15.209 limits in these restricted bands.

The EUT was operated at the lowest channel 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 30kHz IF Bandwidth at the Center Frequency.
Measurement C is taken using a 30kHz 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:

$A - B = \Delta$; $95.7 dB\mu V/m - 93.7 dB\mu V/m = 2.0 dB$

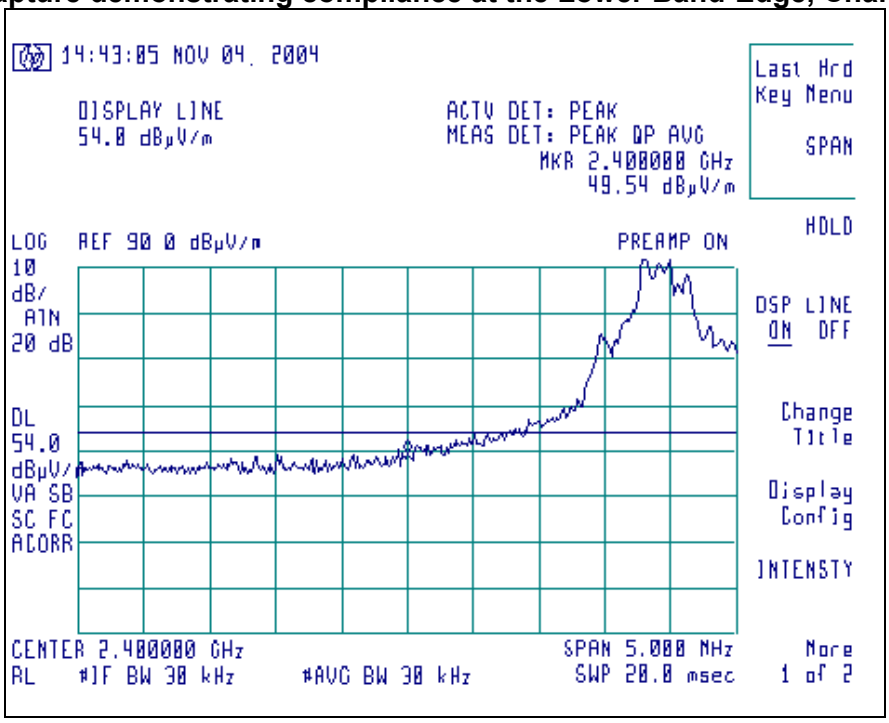
$\Delta + C = D$; $2.0 dB + 51.1 dB\mu V/m = 53.1 dB$ Showing compliance at Lower Band-Edge

At the Upper Band-edge:

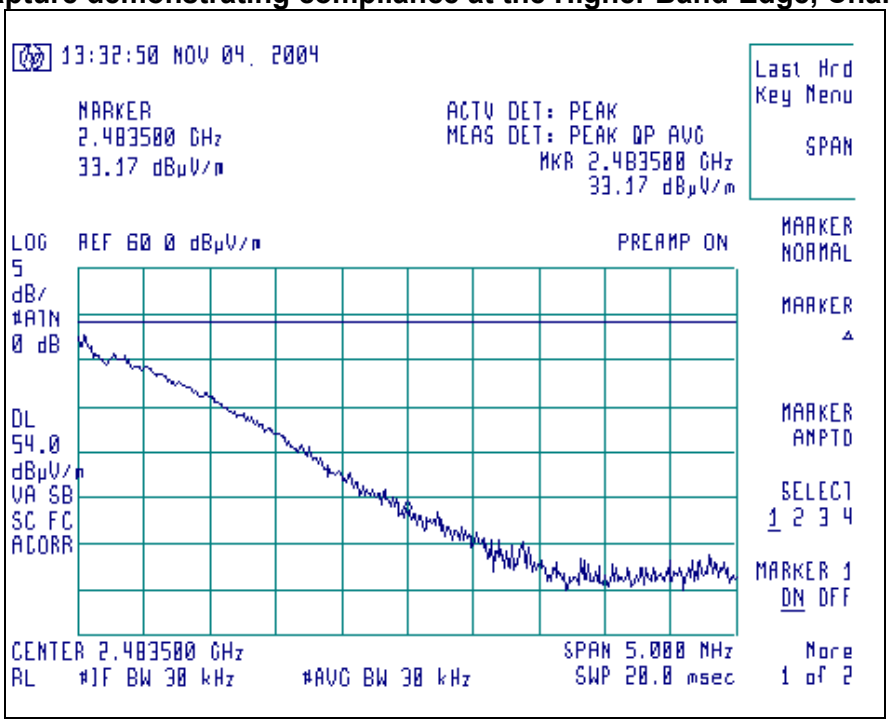
$A - B = \Delta$; $98.2 dB\mu V/m - 96.4 dB\mu V/m = 1.8 dB$

$\Delta + C = D$; $1.8 dB + 39.0 dB\mu V/m = 40.8 dB$ Showing compliance at Upper Band-Edge

Screen Capture demonstrating compliance at the Lower Band-Edge, Channel 00 TX



Screen Capture demonstrating compliance at the Higher Band-Edge, Channel 79 TX



21. Conducted RF Emissions Test on AC Power Line

Test Setup

The Conducted Emissions test was performed at L.S. Compliance, Inc. in Cedarburg, Wisconsin. The test area and setup are in accordance with ANSI C63.4-2003 and with Title 47 CFR, FCC Part 15 (Industry Canada RSS-210). The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 480V, 60 Hz, 3 phase was provided inside the Shielded Room via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the HP 8546A EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either phase.

Test Procedure

The EUT was investigated in continuous transmit mode, with modulation from 1010 pattern binary data, for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1 (2003), Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30MHz. Final readings were then taken and recorded.

Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided 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. Calibrations of the LISN and Limiter are traceable to N.I.S.T. All cables are calibrated and checked periodically for conformance. The emissions are measured on the HP 8546A EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15.207 Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

Calculation of Conducted Emissions Limits

The following table describes the Class **B** limits for an unintentional radiator. These limits are obtained from Title 47 CFR, Part 15.107 (a) for Conducted Emissions.

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)
0.15 – 0.5	66 – 56 *	56 - 46
0.5 – 5.0	56	46
5.0 – 30.0	60	50

* Decreases with the logarithm of the frequency.

Sample calculation for the limits in the 0.15 to 0.5 MHz:

$$\text{Limit} = -19.12 \left(\text{Log}_{10} \left(F[\text{MHz}] / 0.15\ [\text{MHz}] \right) \right) + 66.0\ \text{dB}\mu\text{V}$$

For a frequency of 200 kHz for example:

$$\text{Quasi-Peak Limit (F = 200kHz)} = -19.12 \left(\text{Log}_{10} \left(0.2[\text{MHz}] / 0.15\ [\text{MHz}] \right) \right) + 66.0\ \text{dB}\mu\text{V}$$

$$\text{Quasi-Peak Limit (F = 200kHz)} = 63.6\ \text{dB}\mu\text{V}$$

$$\text{Average Limit (F=200kHz)} = -19.12 \left(\text{Log}_{10}(0.2[\text{MHz}]/0.15[\text{MHz}]) \right) + 56.0\ \text{dB}\mu\text{V}$$

$$\text{Average Limit (F = 200 kHz)} = 53.6\ \text{dB}\mu\text{V}$$

Measurement of Electromagnetic Conducted Emission

Frequency Range inspected: 150 KHz to 30 MHz

Test Standard: FCC 15.207 (a)

Manufacturer:	Rockwell Automation					
Date(s) of Test:	November 1st through 5th , 2005					
Test Engineer:		Tom Smith	√	Abtin Spantman		Ken Boston
Model #:	2x-WIM-Nxx					
Serial #:	LSC-DPI and LSC-DSI					
Voltage:	12 VDC at 130 mA provided by host; host using 480 VAC 3 phase					
Operation Mode:	Normal, continuous transmit, and 'Hopping' mode					
Test Location:	√	Shielded Room				Chamber
EUT Placed On:	√	40cm from Vertical Ground Plane				10cm Spacers
	√	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	√	Final
Detectors Used:		Peak	√	Quasi-Peak	√	Average

Environmental Conditions in the Lab:
Temperature: 20 – 25° C
Atmospheric Pressure: 86 kPa – 106 kPa
Relative Humidity: 30 – 60%

Test Equipment Utilized:
EMI Receiver: HP 8546A
LISN: EMCO 3816/2NM
Transient Limiter: HP 119474A

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line	Q-Peak Reading (dBµV/m)	Q-Peak Limit (dBµ V/m)	Quasi-Peak Margin (dB)	Average Reading (dBµV/m)	Average Limit (dBµ V/m)	Average Margin (dB)
0.22	L1	44.6	62.8	18.2	37.4	52.8	15.4
0.99	L1	43.5	56.0	12.5	41.8	46.0	4.2
1.85	L1	41.9	56.0	14.1	39.7	46.0	6.3
12.51	L1	46.5	60.0	13.5	39.5	50.0	10.5
29.04	L1	42.4	60.0	17.6	36.7	50.0	13.3
0.22	L2	42.1	62.8	20.7	35.2	52.8	17.6
0.99	L2	43.9	56.0	12.1	42.1	46.0	3.9
1.85	L2	43.9	56.0	12.1	41.7	46.0	4.3
8.16	L2	44.3	60.0	15.7	39.8	50.0	10.2
12.62	L2	44.6	60.0	15.4	37.8	50.0	12.2
28.74	L2	42.8	60.0	17.2	34.9	50.0	15.1
0.22	L3	41.6	62.8	21.2	35.5	52.8	17.3
0.96	L3	46.4	56.0	9.6	44.2	46.0	1.8
1.88	L3	46.2	56.0	9.8	44.8	46.0	1.2
7.86	L3	39.0	60.0	21.0	33.8	50.0	16.2
12.62	L3	37.6	60.0	22.4	31.7	50.0	18.3
28.97	L3	39.5	60.0	20.5	34.5	50.0	15.5

Notes:

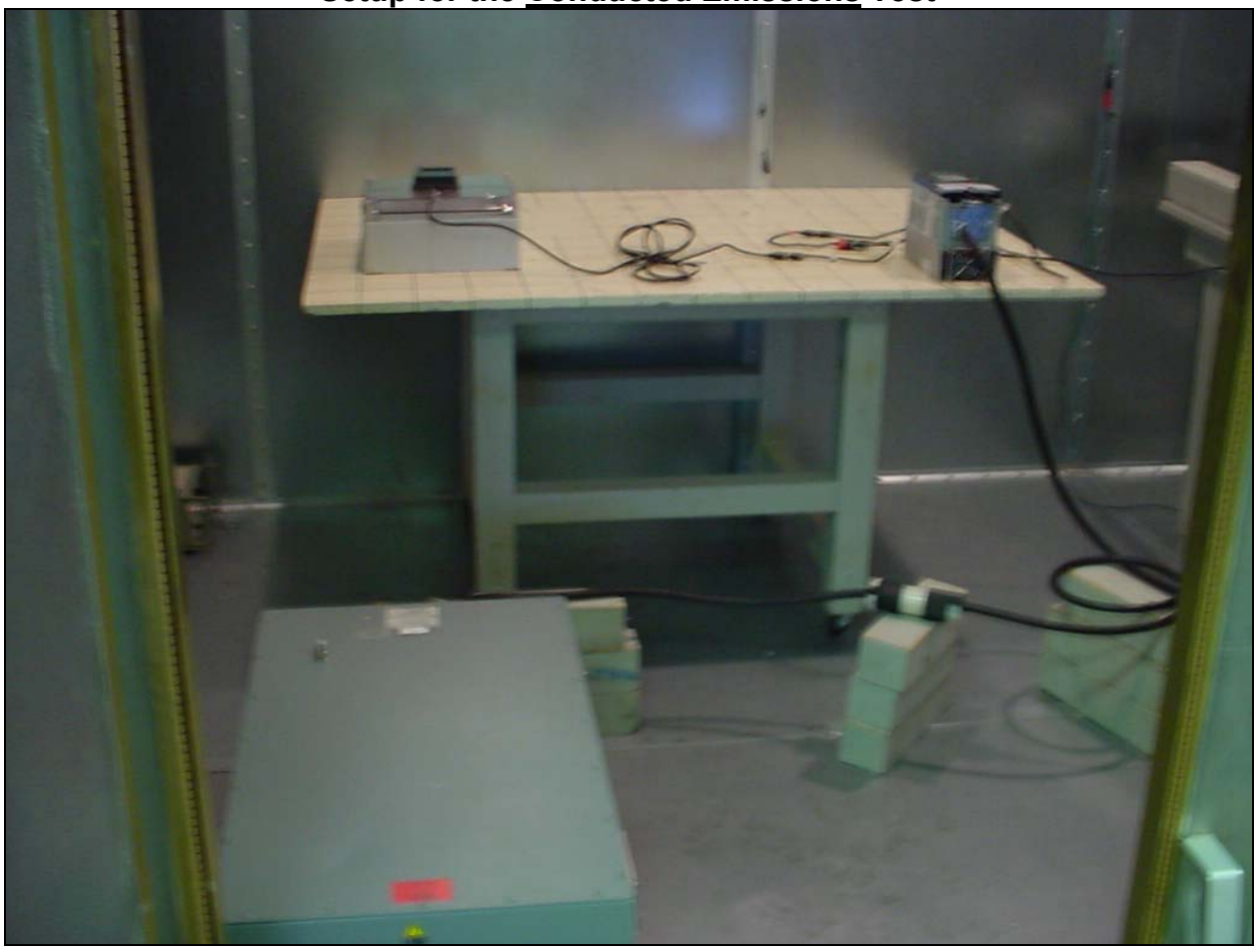
1) The emissions listed are characteristic of the host system, and were not affected by the EUT.

2) All other emissions were better than 20 dB below the limits.

3) The EUT exhibited similar emissions in transmit and receive modes, and across the Low, Middle and High channels tested.

Photo(s) Taken During Conducted Emission Testing

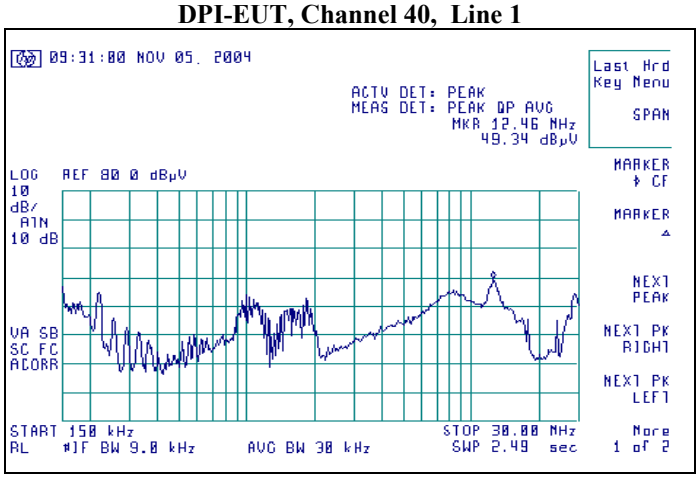
Setup for the Conducted Emissions Test



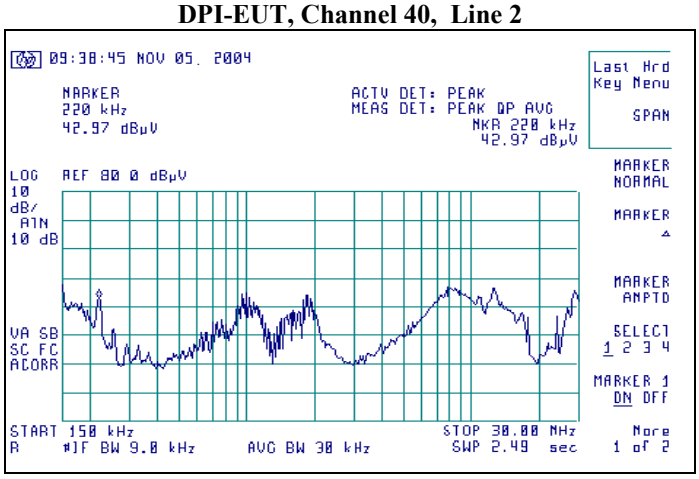
Screen Captures of Conducted AC Mains Emissions:

Please note these screen captures represent Peak Emissions. For conducted emission measurements, we utilize both a Quasi-Peak detector function as well as the Average detector function for measurements. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.209.
The signature scans shown here are from channel 40, chosen as being a good representative of channels.

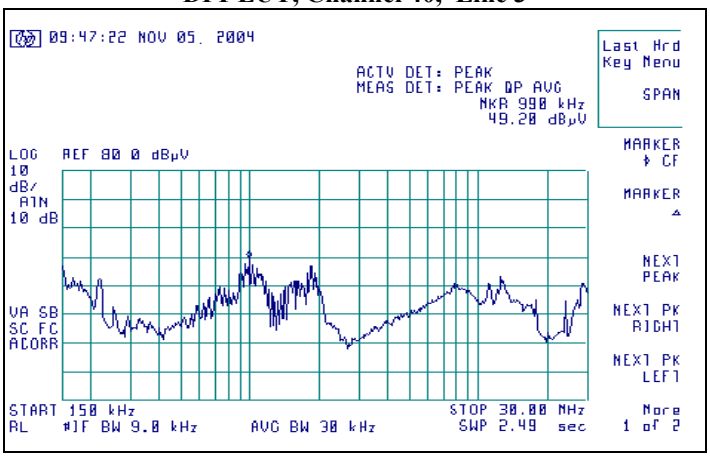
DPI-EUT, Channel 40, Line 1



DPI-EUT, Channel 40, Line 2



DPI-EUT, Channel 40, Line 3



22. Receiver Synchronization

(TBD)

23. Receiver Input Bandwidth

(TBD)

24. MPE Calculations

Base Station Transceiver
MPE Calcluation

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	1.60	(dBm)
Maximum peak output power at antenna input terminal:	1.445	(mW)
Antenna gain(typical):	2.7	(dBi)
Maximum antenna gain:	1.862	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2440	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.000535	(mW/cm^2)
Maximum allowable antenna gain:	35.4	(dBi)
Margin of Compliance at 20 cm =	32.7	dB

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.

Uncertainty Statement

This uncertainty represents an expanded uncertainty
expressed at approximately the 95% confidence level using a coverage factor of k=2.

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

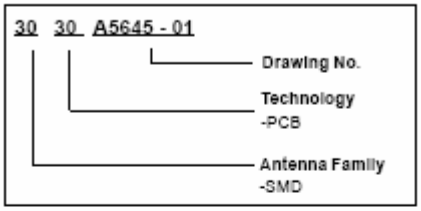
Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	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

Appendix B

Antenna Specification

gigaAnt — Mica 2.4 GHz SMD Antenna

4.MODEL NAME



5. GENERAL DATA

Product Name	Mica 2.4 GHz
Article No.	3030A5645-01
Frequency	2.4-2.5 GHz
Polarization	Linear
Operating temperature	-40 to + 85 degC
Impedance	50 Ohm
Weight	0.4 gram
Antenna type	SMD

6. ELECTRICAL CHARACTERISTICS

	Characteristics			Conditions*
	Min	Typ	Max	
Peak Gain	2.1 dBi	2.4 dBi	2.7 dBi	Frequency 2.4-2.5 GHz, Measured in 3D chamber (near field)
Efficiency	70%	75%	79%	
VSWR	1.0:1	1.5:1	1.9:1	Frequency 2.4-2.5 GHz, Measured in Network Analyzer
*Note all data provided in this table are based on the gigaAnt reference board				

Appendix C

Firmware and Setup Instructions

Proprietary test software was provided by Rockwell Automation for the specific purpose of testing. This test software was used in conjunction with a Laptop PC to control the EUT, by connection to communication lines between the drive controller and the EUT.