EMC Engineering Test Report
Ingenium Project Number:JCEAQ1201

EMC Testing of:
Dickson Company "WiZARD2 - 2.4 GHz Transceiver"

Prepared for:
Dickson Company
Attention: Mr. Fred Kirsch
930 South Westwood Avenue
Addison, IL 60101-4917
United States of America

Test Date(s):
August 31ST through September 10TH, 2010

In accordance with:
United States Code of Federal Regulations, Title 47, Part 15:
Subpart B, Section 107, Section 109.
Subpart C, Section 207, Section 249,Operation within the band 2400-2483.5 MHz.
Industry Canada:
ICES-003
RSS-Gen
RSS-210

This page was intentionally left blank

TABLE OF CONTENTS

INTRODUCTION 7

1.1 SCOPE 7

1.2 PRODUCT DESCRIPTION 8

1.2.1 General Product Description 8
1.2.2 Detailed Product Description 8
1.2.3 Modes of operation 9
1.2.4 Equipment Under Test (EUT) Information 11
1.2.5 EUT's Technical Specifications 11
1.2.6 Associated Antenna Description 12
1.2.7 RF Technical Information 12

1.3 APPLICABLE NORMATIVE DOCUMENTS 13

1.4 DEFINED PERFORMANCE CRITERION 14

1.5 APPLICABLE TEST MATRIX AND TEST RESULTS 15

1.6 NOTES AND EXCEPTIONS TO REPORT 18

1.7 DECLARATION OF CONFORMITY 19

1.8 SIGNATORIES 20

1.9 TEST FACILITY AND ACCREDITATIONS 21

1.9.1 Ingenium Testing, LLC Accreditation 21
1.9.2 Location of Test Facility 21

TEST DETAILS 22

2.1 ELECTROMAGNETIC EMISSION TESTS 22

2.1.1 Radiated RF Emissions Measurements 22
2.1.2 Conducted RF Emission onto AC Mains Measurements 49
2.1.3 Radiated RF Performance Parameters – Occupied Bandwidth Measurements 66
2.1.4 Radiated RF Performance Parameters – Carrier Frequency and RF Power Stability Measurements (Voltage and Temperature Variation) 69
2.1.5 Time Average Use of the Spectrum – Relaxation Factor Calculations 73
2.1.6 Radiated RF Performance Parameters – MPE Calculations 75

3.1 ELECTROMAGNETIC SUSCEPTIBILITY TESTS 76

APPENDIX A 78

A INGENIUM TESTING, LLC APPLICABLE ACCREDITATIONS. 78

TABLE OF FIGURES

FIGURE 1: THE DICKSON 'WIZARD2' TELEMETRY SYSTEM, AS TESTED: FRONT VIEW, RIGHT SIDE VIEW, AND REAR VIEW.....8
FIGURE 2: THE TRANSCEIVER SECTION SHOWN WITH THE CONNECTOR, IN THE LEFT PHOTO IN THE PHOTO SET.....8
FIGURE 3: POWER SOURCE OPTIONS OF BATTERY, USB, AND WALL-TYPE STEP-DOWN TRANSFORMER MAY BE USED WITH THE WIZARD2. 9
FIGURE 4: VIE OF THE RF MODULE AND EXTENSION HARNESS USED FOR LIMITED MODULAR QUALIFICATION TESTS. 10
FIGURE 5: EUT ON TEST PEDESTAL AS VIEWED FROM THE SENSE ANTENNA; EMISSION TESTING BELOW 1 GHZ, AT 3M SEPARATION DISTANCE. 25
FIGURE 6: EUT ON TEST PEDESTAL; EMISSION TESTING ABOVE 1 GHZ, AT 3M SEPARATION DISTANCE.....25
FIGURE 7: THE LAP-TOP COMPUTER PROVIDING THE POWER THROUGH USB PORT WAS PLACED BENEATH THE TURN-TABLE DURING TESTING. .26
FIGURE 8: THE WALL-TYPE STEP-DOWN TRANSFORMER WAS PLACED ON A NON-CONDUCTIVE PEDESTAL 40 CM ABOVE GROUND PLANE. 26
FIGURE 9: VERTICAL ORIENTATION REFERENCE POINT - TESTS FOR HOST QUALIFICATION.....27
FIGURE 10: HORIZONTAL ORIENTATION REFERENCE POINT- TESTS FOR HOST QUALIFICATION.....27
FIGURE 11: SIDE ORIENTATION REFERENCE POINT- TESTS FOR HOST QUALIFICATION. 27
FIGURE 12: VERTICAL ORIENTATION REFERENCE POINT – TESTS FOR (LMA) QUALIFICATIONS. 28
FIGURE 13: HORIZONTAL ORIENTATION REFERENCE POINT– TESTS FOR (LMA) QUALIFICATIONS. 28
FIGURE 14: SIDE ORIENTATION REFERENCE POINT– TESTS FOR (LMA) QUALIFICATIONS.....28
FIGURE 15: TX HOST MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA VERTICALLY POLARIZED, 30-1000MHZ, AT 3 M. 35
FIGURE 16: TX HOST MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, 30-1000MHZ, AT 3 M.....35
FIGURE 17: TX HOST MODE RF EMISSION SIGNATURE, USB POWER, EUT ON LEFT SIDE, ANTENNA VERTICALLY POLARIZED, 30-1000MHZ, AT 3 M. 36
FIGURE 18: TX HOST MODE RF EMISSION SIGNATURE, USB POWER, EUT ON LEFT SIDE, ANTENNA HORIZONTALLY POLARIZED, 30-1000MHZ, AT 3 M.....36
FIGURE 19: TX HOST MODE RF EMISSION SIGNATURE, USB POWER, EUT VERTICAL, ANTENNA VERTICALLY POLARIZED, 30-1000MHZ, AT 3 M.....37
FIGURE 20: TX HOST MODE RF EMISSION SIGNATURE, USB POWER, EUT VERTICAL, ANTENNA HORIZONTALLY POLARIZED, 30-1000MHZ, AT 3 M. 37
FIGURE 21: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA VERTICALLY POLARIZED, 30-1000MHZ, AT 3 M. 38
FIGURE 22: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, 30-1000MHZ, AT 3 M.....38
FIGURE 23: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT ON LEFT SIDE, ANTENNA VERTICALLY POLARIZED, 30-1000MHZ, AT 3 M. 39
FIGURE 24: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT ON LEFT SIDE, ANTENNA HORIZONTALLY POLARIZED, 30-1000MHZ, AT 3 M.....39
FIGURE 25: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT VERTICAL, ANTENNA VERTICALLY POLARIZED, 30-1000MHZ, AT 3 M. 40
FIGURE 26: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT VERTICAL, ANTENNA HORIZONTALLY POLARIZED, 30-1000MHZ, AT 3 M. 40
FIGURE 27: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, 1-2.4GHZ, AT 3 M. 41
FIGURE 28: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, 2.4-2.483 GHZ, AT 3 M.....41
FIGURE 29: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, 2.483-18 GHZ, AT 3 M.....42
FIGURE 30: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, DETAIL OF SPURIOUS EMISSIONS AT 10.53 GHZ, AT 3 M. 42
FIGURE 31: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, FUNDAMENTAL FREQUENCY AT 2.477 GHZ, AT 3 M. 43
FIGURE 32: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, SECOND HARMONIC AT 4.954 GHZ, AT 3 M. 43

FIGURE 33: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT VERTICAL, ANTENNA HORIZONTALLY POLARIZED, THIRD HARMONIC AT 7.431 GHZ, AT 3 M. 44
FIGURE 34: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA VERTICALLY POLARIZED, FOURTH HARMONIC AT 9.908 GHZ, AT 3 M. 44
FIGURE 35: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT VERTICAL, ANTENNA HORIZONTALLY POLARIZED, FIFTH HARMONIC AT 12.385 GHZ, AT 3 M. 45
FIGURE 36: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, SIXTH HARMONIC AT 14.862 GHZ, AT 3 M – SHOWING MEASUREMENT AT SYSTEM NOISE FLOOR 45
FIGURE 37: TX (LMA) MODE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, 18-25 GHZ, AT 3 M – SHOWING MEASUREMENT AT SYSTEM NOISE FLOOR 46
FIGURE 38: RECEIVE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA VERTICALLY POLARIZED, 30-1000MHZ, AT 3 M. 47
FIGURE 39: RECEIVE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, 30-1000MHZ, AT 3 M. 47
FIGURE 40: RECEIVE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA VERTICALLY POLARIZED, 1-18 GHZ, AT 3 M. RBW IS REDUCED FOR ENHANCED RESOLUTION DURING INVESTIGATIONS. 48
FIGURE 41: RECEIVE RF EMISSION SIGNATURE, USB POWER, EUT HORIZONTAL, ANTENNA HORIZONTALLY POLARIZED, 1-18 GHZ, AT 3 M. RBW IS REDUCED FOR ENHANCED RESOLUTION DURING INVESTIGATIONS. 48
FIGURE 42: EQUIPMENT SETUP DURING CONDUCTED RF EMISSIONS TESTS – SHOWING TEST INSTRUMENTS RELATIVE TO EUT 51
FIGURE 43: EQUIPMENT SETUP DURING CONDUCTED RF EMISSIONS TESTS – REPRESENTATIVE TEST SHOWING EUT POWERED THROUGH USB PORT OF A LAP-TOP COMPUTER. 52
FIGURE 44: EQUIPMENT SETUP DURING CONDUCTED RF EMISSIONS TESTS – REPRESENTATIVE TEST SHOWING EUT (TX-LMA MODE) POWERED BY A WALL-TYPE STEP-DOWN TRANSFORMER. 52
FIGURE 45: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM USB, 102 VAC, 60 HZ, LINE L1 59
FIGURE 46: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM USB, 102 VAC, 60 HZ, LINE L2 59
FIGURE 47: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM USB, 120 VAC, 60 HZ, LINE L1 60
FIGURE 48: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM USB, 120 VAC, 60 HZ, LINE L2 60
FIGURE 49: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM USB, 138 VAC, 60 HZ, LINE L1 61
FIGURE 50: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM USB, 138 VAC, 60 HZ, LINE L2 61
FIGURE 51: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM TRANSFORMER, 102 VAC, 60 HZ, LINE L1 62
FIGURE 52: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM TRANSFORMER, 102 VAC, 60 HZ, LINE L2 62
FIGURE 53: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM TRANSFORMER, 120 VAC, 60 HZ, LINE L1 63
FIGURE 54: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM TRANSFORMER, 120 VAC, 60 HZ, LINE L2 63
FIGURE 55: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM TRANSFORMER, 138 VAC, 60 HZ, LINE L1 64
FIGURE 56: CONDUCTED RF EMISSIONS, TX (LMA) MODE, POWER FROM TRANSFORMER, 138 VAC, 60 HZ, LINE L2 64
FIGURE 57: CONDUCTED RF EMISSIONS, RX MODE, POWER FROM USB, 120 VAC, 60 HZ, LINE L1 65
FIGURE 58: CONDUCTED RF EMISSIONS, RX MODE, POWER FROM USB, 120 VAC, 60 HZ, LINE L2 65
FIGURE 59: EUT ON TEST PEDESTAL DURING OCCUPIED BANDWIDTH TESTING. 67
FIGURE 60: TRANSMIT OCCUPIED BANDWIDTH (-6DBC LEVEL). 68
FIGURE 61: TRANSMIT OCCUPIED BANDWIDTH (-20DBC LEVEL). 68
FIGURE 62: TRANSMIT RADIATED PEAK RF OUTPUT POWER. 72
FIGURE 63: TRANSMIT PACKET ENVELOPE 73
FIGURE 64: FASTEST TRANSMIT REPETITION RATE IS AT ONE TRANSMISSION PER SECOND. 73

TABLE OF REVISION HISTORY

Revision and Revision Date:	V1_0 ; 2010-09-15
Total number of pages	78/Electronic
Reason for change: Affected Section or Area: Authorizing Agent:	Original Document Creation Entire Document Abtin Spantman
Reason for change: Affected Section or Area: Authorizing Agent:	
Reason for change: Affected Section or Area: Authorizing Agent:	

Introduction

1.1 Scope

Between August 31ST and September 10TH, 2010, a series of radiated RF Emissions (EMC) tests were performed on two production samples of the Dickson Company, model "WiZARD2" 2.4 GHz transceiver, tagged as serial number "ITS-ES1 and ITS-ES2", here forth collectively referred to as the "*Equipment Under Test*" or "*EUT*". The radio-frequency electromagnetic emissions characteristics of the EUT were tested in transmit mode (ITS-ES1) and receive mode (ITS-ES2). The EUT was tested in receive mode, in transmit mode, and with the RF section extended out for 'Limited Modular' testing. The EUTs were tested with batteries, with a step-down wall transformer, and with a USB connection to a lap-top computer as three different sources for power.
The results are presented in this report.

The radio frequency (RF) electromagnetic emission tests were performed are in accordance with Title 47 CFR, Part 15, issue (2008-10), Subpart C, for an *Intentional Radiator* product, qualifying under section 15.249 with 'Limited Modular Approval' (LMA)for the transmitter, as well as Subpart B, for an *Un-Intentional Radiator* product, qualifying under section 15.109 and 15.107, using the emission standards test procedures outlined in ANSI C63.4 (2003), with test instruments adhering to CISPR 16-2 guidelines. The tests were performed according to a test plan matrix with the consensus of Dickson Company (client), and Ingenium Testing, LLC (Third Party Test Facility), with the EUT in pre-set operating modes prepared in advance by Dickson Company. This test plan matrix is here forth referred to as the *"Dickson Test Plan"*.

The tests were performed to allow verification, in part, of the product's EMI compliance in accordance with the EMC standards in the United States of America and abroad. The test results presented in this report will also be used as supporting evidence to demonstrate compliance with other regulations such as RSS-210 (issue 7) from Industry Canada. The tests were performed by Abtin Spantman, EMC Engineer at Ingenium Testing.

1.2 Product Description

1.2.1 General Product Description

The Dickson WiZARD2 remote data acquisition system is a multi-point intelligent data acquisition and recording system. The WiZARD2 uses transceiver modules designed for specific functions, such as measurement of temperature and humidity, and transmits the information to a central location, such as a personal computer system for monitoring, assessing and archiving. These transceivers may be powered by batteries (4xAA type), or by a wall-type step-down transformer, or even powered through the USB connection when connected to a computer.

Figure 1: The Dickson 'Wizard2' telemetry system, as tested: Front view, right side view, and rear view.

1.2.2 Detailed Product Description

The WiZARD2 system uses the same circuitry for the different device configurations, and may be configured as a (Data) Loggers, Receivers, Repeaters, or Signal Sensors by simply programming the unit for that function, at the time of manufacture (not end-user programmable). The circuitry is further designed to have a connector that interfaces with another circuit board that contains only the RF section. This RF section is tested in normal configuration and as a modular transmitter (Limited Modular Application).

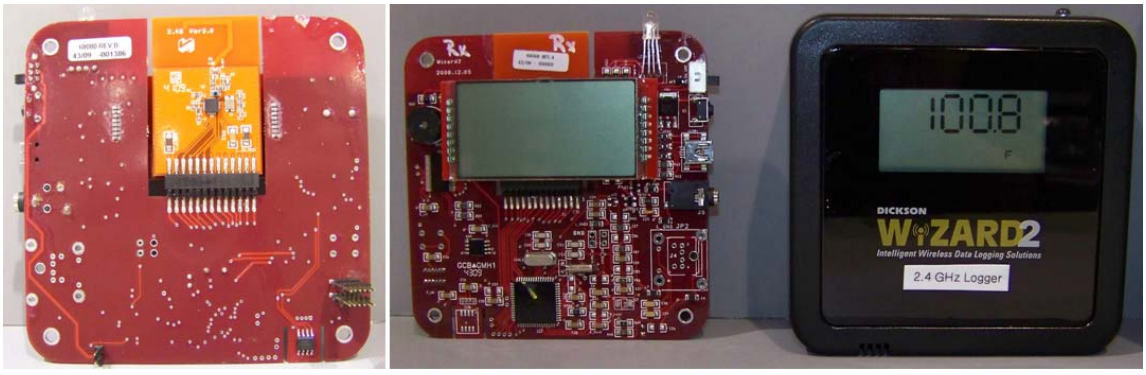

Figure 2: The transceiver section shown with the connector, in the left photo in the photo set.

The WiZARD2 system, during this series of tests, is outfitted with a transceiver module with a fundamental carrier frequency of 2477 MHz, with an effective radiated power (ERP) of approximately 2 mW. The transmitter uses binary data (250 kbps to 2000 kbps) with GFSK modulation with approximately 450 kHz of occupied bandwidth. These characteristics are strictly a function of the RF sub-module, transceiver model 'nRF24L01+' produced by Nordic Semiconductor, and are not controlled by the end user. The transceiver chip is buffered, and controls the data rate based on the RF channel availability. The transceiver chip also has an on-board voltage regulator. Control of the module is thru IO pins for such functions as interrupt, power down, and data thru an SPI buss.

Figure 3: Power source options of Battery, USB, and Wall-type Step-Down transformer may be used with the WiZARD2.

The WiZARD2 system has an integrated internal PC-Board trace monopole antenna, and does not have any facilities for using any other types of antennas. The antenna is approximately 3cm in length.

1.2.3 Modes of operation

After commissioning, the WiZARD2 has 4 modes of operation:

- Logger: Each logger takes a reading every sample interval which can range from 10 seconds up to 1 hour. After taking five samples or after five minutes, the logger will send a thirty two byte packet upstream to its target unit. If the logger receives an acknowledgement for the packet, that is the end of it. If the logger does not receive an acknowledgement, it will store the readings and try again after another sample interval or five minutes whichever comes first. Since it is a logger, it can store up to 32,000 samples during a period of non communication to avoid data loss.
- Repeater: Each repeater looks for packets addressed to its id. When it receives a packet addressed to it, it sends an acknowledgement and then transmits the packet upstream to its target unit. If it receives an acknowledgement it returns to listening downstream for more packets. If it does not receive an acknowledgement, it will retry at random intervals (to avoid collisions) until it receives an acknowledgement.
- Receiver: There is one and only one receiver per system. It is the final upstream targeted address. When it receives a packet addressed to it, it sends an acknowledgement and stores the packet in a buffer for retrieval by

a program running in the base PC. The receiver is connected to the base PC at all times via USB. If the buffers in the receiver become full or the PC is disconnected, the receiver will no longer acknowledge packets. WiZARD software runs on the Base PC and continuously polls the receiver via USB. The software maintains a database of readings from the loggers and allows the user to via this data in a wide variety of methods. The software can also send commands to the receiver which will be embedded in the acknowledgements that are sent when a packet is received

- Signal Strength Monitor: The Signal Strength Monitor function is a diagnostic tool and is used during initial installations or troubleshooting activities. In the Signal Strength Monitor mode, the unit behaves as a receiver, and reports the strength of the signal from each logger within the intended network.

1.2.3.1 Mode of operation during RF Emission testing

Two samples of the EUT were provided for testing. One sample, designated "Engineering Sample 1" or "ITS-ES1" was programmed to provide modes needed for transmitter testing. The second sample, designated "Engineering Sample 2" or "ITS-ES2" was programmed for normal operation and to provide modes needed for receiver and non-intentional radiator type testing.

During radiated and conducted RF emission testing, both samples were tested.
For transmitter tests, the "ITS-ES1" unit should was tested for peak power measurements, channel bandwidth and occupancy, and any other transmit-timing functions that may be applicable. The "ITS-ES1" unit is programmed to switch between CW and normal Logger operation (transmitter) with maximum transmit cycles as would be available to the end user.

The "ITS-ES2" unit should be used in receive and normal operating modes, to verify spurious emissions.

These three test modes cover all of the different RF functions of the WiZARD2.

A lap-top personal computer, will be provided with software to use with the EUT in receive mode.
A standard wall-type step-down transformer will be provided with the EUT for testing.
USB power will also be provided using the lap-top computer.

A 30 cm extension harness is also used during testing of the transmitter characteristics, qualifying for the 'Limited Modular Approval' (LMA).

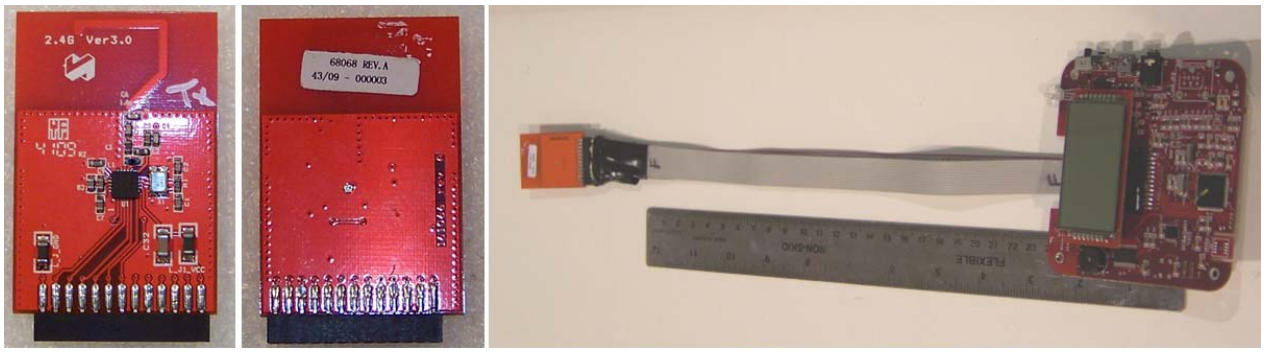

Figure 4: Vie of the RF Module and Extension Harness used for Limited Modular qualification tests.

1.2.4 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Table 1: Equipment Under Test (EUT) Product Information

Product Name:	WiZARD2 2.4 GHz
Model Number:	WiZARD2 2.4 GHz
Serial Number:	Production units, re-programmed for test modes: "ITS- ES1" and "ITS-ES2"

Table 2: Support Equipment Product Information

Product Name:	Hewlett Packard Presario
Model Number:	C700
Serial Number:	CND8050TQZ

Product Name:	Dickson AC Adapter ; Vin=120VAC,60Hz,16W Vout=9VDC, 1A
Model Number:	21349
Serial Number:	N/A

1.2.5 EUT's Technical Specifications

Additional Information:

Table 3: Equipment Under Test (EUT) Technical Specifications

Frequency Range (in MHz)	2477 MHz
RF Power in Watts	1.77 mW
Field Strength (and at what distance)	97.7 dBµV/m at 3m
Occupied Bandwidth (99% BW)	450 kHz
Type of Modulation	GFSK
Emission Designator	450k-F1D
Transmitter Spurious (worst case)	18.1 dBµV/m at 10m
Frequency Tolerance %, Hz, ppm	50 ppm (123.85 kHz)
Operating Temperature Range	-10ºC (14F) to +50ºC (122F)
Microprocessor Model # (if applicable)	nRF24L01+
EUT will be operated under FCC Rule Part(s)	47 CFR 15.249
Modular Filing	☒ Yes ☐ No ***(Limited Modular)***
Design Engineer (optional)	N/A
Cabinet Size	10.5cm x 10.5cm x 4.5cm
Cabinet Weight	0.5 Pounds
Power Requirements	Four 1.2V AA 1200mAh Battery, or 9VDC, 1Ah Step-Down Wall Transformer, or USB power (5VDC, 500mA)
Environmental Operating conditions	Residential and Light Industrial
Communication Ports	USB and RF channel
Alarm Output	On board sounder available

1.2.6 Associated Antenna Description

The only antenna on the system is an integrated internal PC-Board trace 'folded-monopole' antenna, approximately 3 cm in length.
There are no contingencies for any other types of antennas.
The antenna is not accessible to the end user.
The antenna is not adjustable.

1.2.7 RF Technical Information

Type of Evaluation (check one)		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	X	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100%
- Standard used for evaluation: 47 CFR 2.1091
- Measurement Distance: 3 m
- RF Value: (97.7 dBµV/m) =1.562e-5 ☒ W/m^2 ☐ A/m ☐ V/m
  ☒ Measured ☐ Computed ☐ Calculated

1.3 Applicable Normative Documents

The following documents are referenced in the construction of this test portfolio.

Table 4: Regulatory documents

Publication	Year	Title
47 CFR, Parts 0-15 (FCC)	Release Date 2008-07-10	United States of America Code of Federal Regulations Title 47 - Telecommunications
ANSI C63.4	2003	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.
ICES-003	Issue 4 (2004-02)	Industry Canada Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard Digital Apparatus
RSS-Gen	Issue 2 (2007-06)	Industry Canada Spectrum Management and Telecommunications Radio Standard Specification. General Requirements and Information for the Certification of Radiocommunication Equipment
RSS-210	Issue 7 (2007-06)	Industry Canada Spectrum Management and Telecommunications Radio Standard Specification. Low-power License-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
CISPR 16-1-1	Edition 3.0 (2010-01)	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-1-2	Edition 1.2 (2006-08)	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Ancillary equipment – conducted disturbances..
CISPR 16-2-1	Edition 1.1 (2005-09)	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement.
CISPR 16-2-2	Edition 2 (2010-07)	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-2: Measurement of disturbance power.
CISPR 16-2-3	Second Edition (2006-07)	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-3: Methods of Measurement of disturbance and immunity – Radiated disturbance measurements

Table 5: Non-Regulatory controlled documents from Dickson or Ingenium Testing.

Document	Owner	Title
Wizard2.4 Operational Description.doc	Dickson Company	Wizard2.4 Receiver/Repeater/Logger Operational Description
JCEAQ1201	Ingenium Testing, LLC	Statement of Work

1.4 Defined Performance Criterion

Manufacturer and Device-Specific Operational Definitions and Performance Criterion:
During all susceptibility testing, the EUT shall be in normal operating mode, as defined below:
In normal operational mode, the "ITS-ES1" unit shall operate in "Logger" mode, per manufacturer specifications, transmitting as fast as possible. The "ITS-ES2" unit shall operate in "Receiver" mode, per manufacturer specifications, receiving and transferring data to a Lap-top personal computer.

Performance Criterion A:
The EUT system continues to sample the environment, collect data locally, transmit data through the air to the receiver, and the system shall collect the data with no degradation in performance.

Performance Criterion B:
The EUT system continues to sample the environment, collect data locally, transmit data through the air to the receiver, and the system shall collect the data. Degradation in performance is considered acceptable, under criterion B operation, with no loss of data. Automatic re-initializations, re-transmissions and lowered data-rates are considered acceptable performance under Criterion B.

Performance Criterion C:
The EUT system continues to sample the environment, collect data locally, transmit data through the air to the receiver, and the system shall collect the data. Degradation in performance or loss of data is considered acceptable, under criterion C operation. Degradation of data is considered acceptable only during the test, while administering the RF threat. Previously logged data should not be contaminated or lost. Manual or automatic re-initializations are considered acceptable, as are re-transmissions and lowered data-rates, under Criterion C performance. User intervention is considered acceptable under Criterion C.

1.5 Applicable Test Matrix and Test Results

The following matrix defines the scope of testing as covered by this report, and agreed to between Dickson Company (Client) and Ingenium Testing, LLC.

This series of testing is performed to verify that the electromagnetic performance of the "WiZARD2 2.4 GHz" adheres to the expected performance stated in the aforementioned standards. These tests verified that the transmitter characteristics meet the specific limits dictated by 47CFR 15.249, and that the receiver characteristics meet the specific limits dictated by 47CFR 15.109. The following matrix describes the test regiment.

Table 6: Test Matrix and Test Results

Port Definition	Terminal Name	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
Enclosure	N/A	Logger Enclosure containing digital circuitry ***Transmit Mode USB Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Logger Enclosure containing digital circuitry ***Transmit Mode Wall XFMR Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Logger Enclosure containing digital circuitry ***Transmit Mode Battery Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
Enclosure	N/A	Transceiver Module with Logger as host. ***Transmit Mode Limited Modular USB Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module with Logger as host. ***Transmit Mode Limited Modular Wall XFMR Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module with Logger as host.	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified	Pass

		Transmit Mode Limited Modular Battery Power		Limits	
Enclosure	N/A	Transceiver Module in Receiver Mode ***Receive Mode USB Power***	Radiated RF Emissions 47 CFR 15.109 RSS-Gen, Sec. 6	30 MHz-18.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module in Receiver Mode ***Receive Mode Wall XFMR Power***	Radiated RF Emissions 47 CFR 15.109 RSS-Gen, Sec. 6	30 MHz-18.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module in Receiver Mode ***Receive Mode Battery Power***	Radiated RF Emissions 47 CFR 15.109 RSS-Gen, Sec. 6	30 MHz-18.0 GHz Measured RF Emission should be Below specified Limits	Pass
AC Mains input terminals	120 (H) 120 (N) GND	Logger Enclosure containing digital circuitry ***Transmit Mode USB Power***	Conducted RF Emissions 47 CFR 15.207	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
		Logger Enclosure containing digital circuitry ***Transmit Mode Wall XFMR Power***	Conducted RF Emissions 47 CFR 15.207	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
AC Mains input terminals	120 (H) 120 (N) GND	Transceiver Module with Logger as host. ***Transmit Mode Limited Modular USB Power***	Conducted RF Emissions 47 CFR 15.207	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module with Logger as host. ***Transmit Mode Limited Modular Wall XFMR Power***	Conducted RF Emissions 47 CFR 15.207	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
AC Mains input terminals	120 (H) 120 (N) GND	Transceiver Module in Receiver Mode	Conducted RF Emissions 47 CFR 15.107	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass

		Receive Mode USB Power			
		Transceiver Module in Receiver Mode ***Receive Mode Wall XFMR Power***	Conducted RF Emissions 47 CFR 15.107	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
Enclosure	N/A	Transceiver Module with Logger as host. ***Transmit Mode Limited Modular Wall XFMR Power***	Occupied Bandwidth -20dBc -6dBc RSS-GEN, 4.6.1 RSS-GEN, 4.6.2	Emissions must be contained within the authorized band of operation.	Pass
Enclosure	N/A	Transceiver Module with Logger as host. ***Transmit Mode Limited Modular Wall XFMR Power***	Carrier Frequency and RF Power Stability RSS-Gen Section 4.7 Section 4.8	No Limits Specified. (Note 1) Emissions must be contained within the authorized band of operation.	Pass

Notes:

1) Some additional testing was performed, and the results incorporated in this report, in anticipation of future needs in documentation and regulatory filing requirements.

1.6 Notes and Exceptions to Report

None.

1.7 Declaration of Conformity

DECLARATION OF CONFORMITY

The Dickson Company "WiZARD2" wireless telemetry units, with designated serial numbers "ITS-ES1 and ITS-ES2" were found to ***MEET*** *the RF emission and performance requirements as described within the specifications of Title 47, Part 15, of the Code of Federal Regulations for the United States of America.*

The Dickson Company "WiZARD2" wireless telemetry units meet the requirements of 47 CFR Part 15, in subpart C, for an intentional radiator product under 15.249 and 15.207, while operating in transmit mode, and in subpart B for an un-intentional radiator operating under 15.107 and 15.109, while operating in receive mode.

If 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.

Ingenium Testing, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

1.8 Signatories

The test matrix presented in section 1.5 of this report was generated, in agreement, by the cognizant parties representing the client as the manufacturer of the equipment, and by the cognizant parties at Ingenium Testing. The performance of the tests and reporting of the results are accurate to the best of our collective knowledge as presented within the body of this report.

The testing of this product was approved by the cognizant parties representing the manufacturer:

Mr. Dean A. Tjaden, Jr. **Senior Electrical Engineer, Dickson Company**	**Date**

Manufacturer Name:	**Dickson Company**
Address:	930 S. Westwood Ave. Addison, IL 601101-4917 United States of America
Contact Person:	Mr. Dean A. Tjaden, Jr. Dickson Company 930 S. Westwood Ave. Addison, IL 60101-4917 United States of America PH: +1 630-563-4254 EM: DTjaden@Dicksondata.com

This Test Report is issued under the Authority of:

Mr. Phil Cox **VP of Engineering, Ingenium Testing, LLC**	**Date**

The testing was performed by:

Abtin Spantman **RF/EMC Engineer, Ingenium Testing, LLC**	**Date**

1.9 Test Facility and Accreditations

1.9.1 Ingenium Testing, LLC Accreditation

Ingenium Testing, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

Ingenium Testing, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. A copy of the accreditation may be accessed on our web site: www.IngeniumTesting.com. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.9.2 Location of Test Facility

All testing was performed at Ingenium Testing, LLC, 3761 South Central Avenue, Rockford, Illinois, 61102-4292, United States of America, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at Ingenium Testing, LLC:

- 10-meter Semi-Anechoic Chamber, designated Chamber number 6.
- 3-meter Semi-Anechoic Chamber, designated Chamber number 10.
- RF Shielded room, designated Chamber 11.

Test Details

2.1 Electromagnetic Emission Tests

2.1.1 Radiated RF Emissions Measurements

2.1.1.1 Test Criterion

The test matrix in section 1.5 was used as a guide for test points and conditions.

Port Definition	Terminal Name	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
Enclosure	N/A	Logger Enclosure containing digital circuitry ***Transmit Mode USB Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Logger Enclosure containing digital circuitry ***Transmit Mode Wall XFMR Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Logger Enclosure containing digital circuitry ***Transmit Mode Battery Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
Enclosure	N/A	Transceiver Module with Logger as host. ***Transmit Mode Limited Modular USB Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module with Logger as host. ***Transmit Mode Limited Modular Wall XFMR Power***	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module with Logger as host.	Radiated RF Emissions 47 CFR 15.249 RSS-210, A2.9	30 MHz-25.0 GHz Measured RF Emission should be Below specified	Pass

		Transmit Mode Limited Modular Battery Power		Limits	
Enclosure	N/A	Transceiver Module in Receiver Mode ***Receive Mode USB Power***	Radiated RF Emissions 47 CFR 15.109 RSS-Gen, Sec. 6	30 MHz-18.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module in Receiver Mode ***Receive Mode Wall XFMR Power***	Radiated RF Emissions 47 CFR 15.109 RSS-Gen, Sec. 6	30 MHz-18.0 GHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module in Receiver Mode ***Receive Mode Battery Power***	Radiated RF Emissions 47 CFR 15.109 RSS-Gen, Sec. 6	30 MHz-18.0 GHz Measured RF Emission should be Below specified Limits	Pass

The following tables present the limits for intentional radiated RF emissions, at the fundamental frequency, and harmonic frequencies as specified in Title 47 CFR, Part 15.249, section (a). These limits were also applied to any signals found in the restricted frequency bands as defined in 47 CFR, Part 15.205.

Table 7: Field Strength Limit for Intentional Radiators under 47CFR 15.249.

Emission	Field Strength Limit at 3m (mV/m)	Field Strength Limit at 3m (µV/m)	Field Strength Limit at 3m (dBµV/m)	Field Strength Limit at 10m (dBµV/m)
Fundamental: 2400-2483.5 MHz	50.0	50,000.0	93.9	83.5
Harmonic: 2nd through 10th	-	500.0	53.9	43.5
Spurious:	-	500.0	53.9	43.5

The following table presents the limits for unintentional radiated RF emissions as specified in Title 47 CFR, Part 15.109, section (a), for products qualifying as Class B Digital Devices. These limits were also applied to any signals found in the restricted frequency bands as defined in 47 CFR, Part 15.205.

Table 8: Field Strength Limits for Un-intentional Radiators under 47CFR 15.109, Class B Digital Devices.

Frequency (MHz)	Field Strength Limit at 3m (µV/m)	Field Strength Limit at 3m (dBµV/m)	Field Strength Limit at 10m (dBµV/m)
30 – 88	100.0	40.0	29.5
88 - 216	150.0	43.5	33.0
216 – 960	200.0	46.0	35.5
Above 960	500.0	54.0	43.5

Notes:
In the calculations for margin below the limit, the limits are rounded to one digit past the decimal.

2.1.1.2 Test Equipment

All equipment is calibrated according to governing standards, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset Number	Description	Last Cal data	Cal due date
Agilent	E4440A	1207	PSA Spec. Analyzer	01 Dec 2010	01 Dec 2011
Agilent	N9039A	1206	Pre-Selector	01 Dec 2010	01 Dec 2011
Agilent	N5182	1208	RF Generator	01 Dec 2010	01 Dec 2011
Hewlett Packard	8447D	RP-0055	Preamplifier	28 Mar 2010	28 Sep 2010
Hewlett Packard	8449B	RP-0056	Preamplifier	12 Jul 2010	12 Jan 2011
ETS	3142C	1360	Hybrid Antenna	19 Nov 2009	19 Nov 2010
ETS	3117	1352	Horn Antenna	18 Nov 2009	18 Nov 2010
ETS	3116	1316	Horn Antenna	07 Dec 2009	07 Dec 2010

The data presented 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 measurement result.

2.1.1.3 Test Setup

The EUT was tested as a "table-top device" type product, as described in ANSI C63.4, and as a "mobile device" as described in 47 CFR Part 2.1091. The EUT was placed on a non-conductive pedestal, centered on a flush-mounted 3 meter-diameter turntable in the 10 Meter FCC Listed Semi-Anechoic Chamber located at Ingenium Testing. The test setup complies with the necessary procedures as described in the ANSI standard. The EUT was tested in two configurations: the first configuration is with the EUT in final manufactured form, and the second configuration is with the RF module extended out with a 30 cm extension cable to accommodate the 'Limited Modular Application' test requirements.

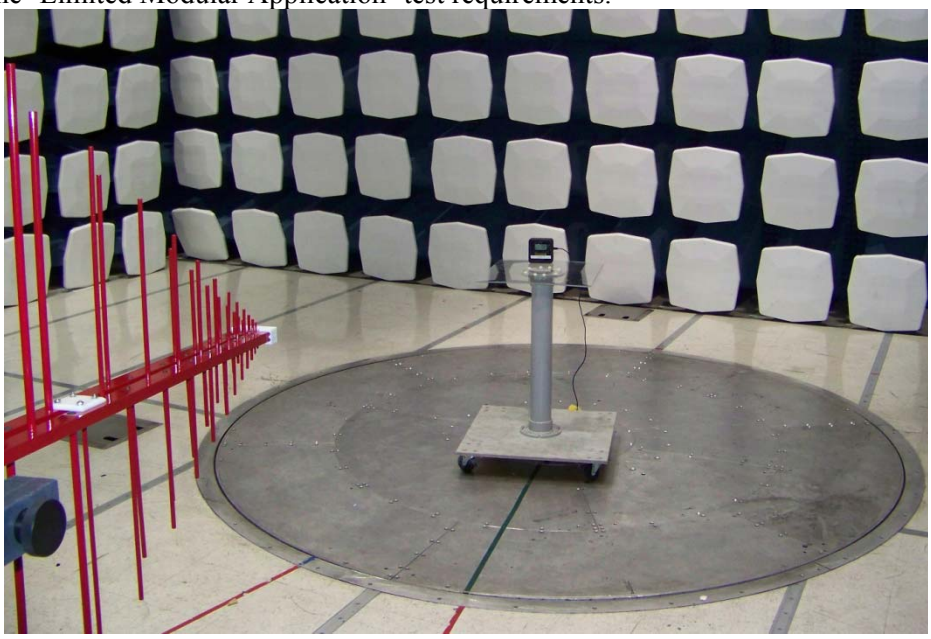

Figure 5: EUT on Test Pedestal as viewed from the sense antenna; emission testing below 1 GHz, at 3m separation distance.

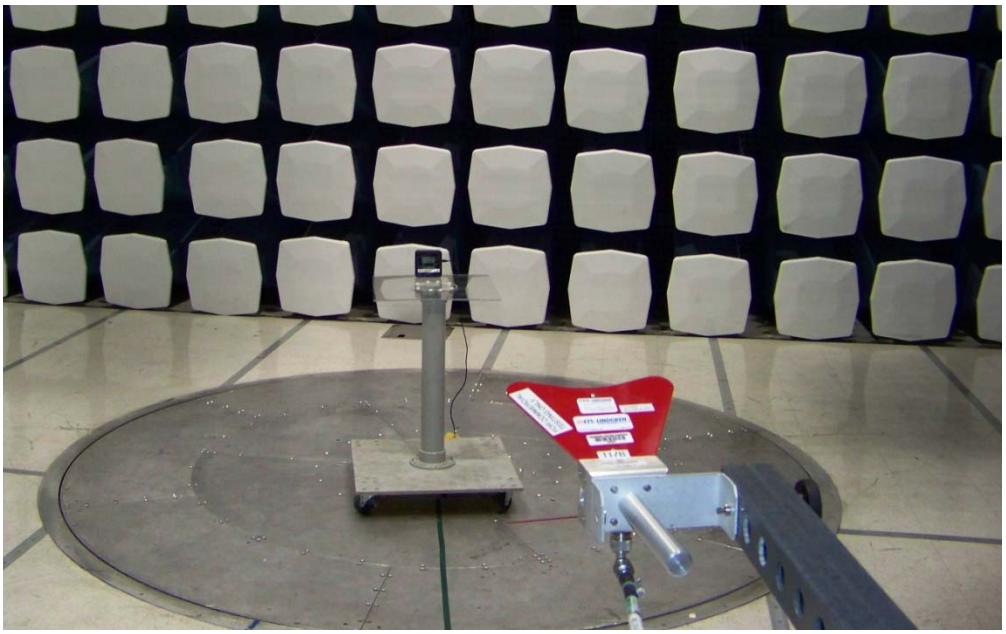

Figure 6: EUT on Test Pedestal; emission testing above 1 GHz, at 3m separation distance.

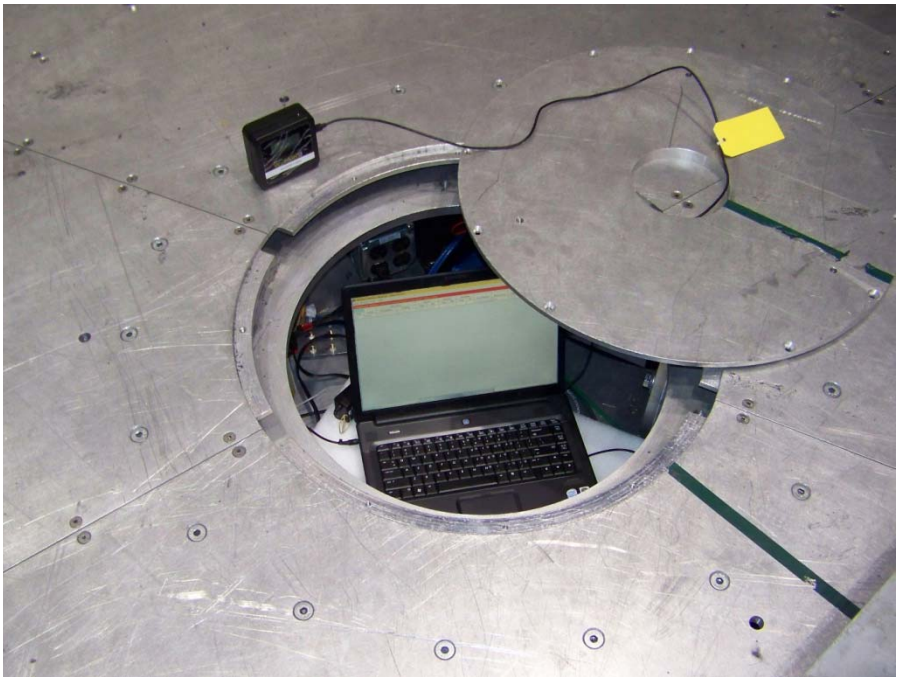

Figure 7: The Lap-top computer providing the power through USB port was placed beneath the turn-table during testing.

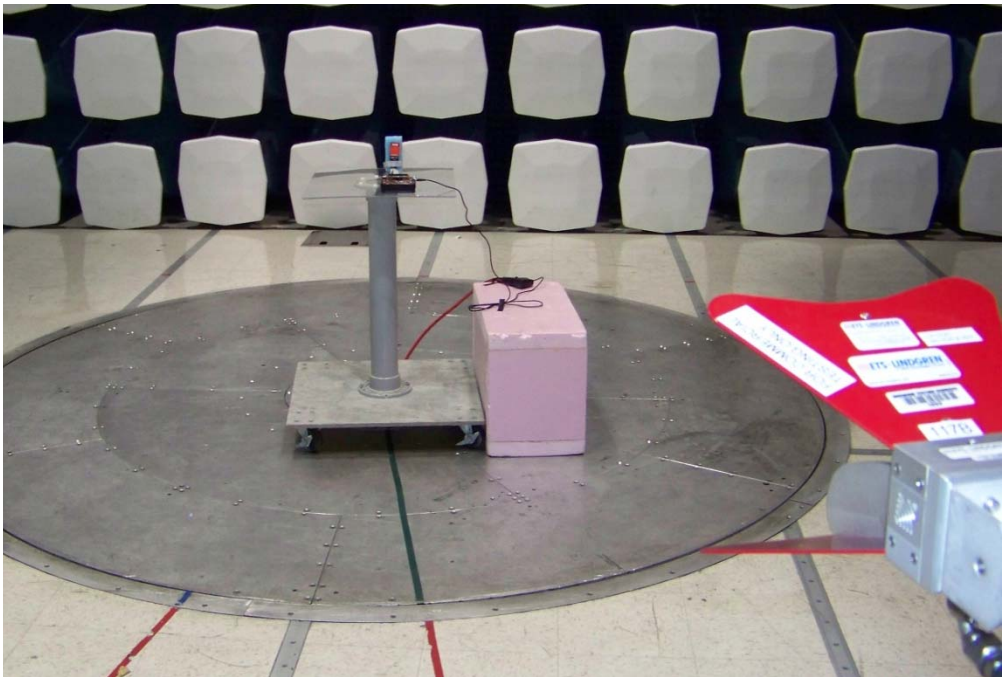

Figure 8: The Wall-type step-down transformer was placed on a non-conductive pedestal 40 cm above ground plane.

Test Setup Photos: Orientations and views during investigation in three orthogonal axis in host mode:

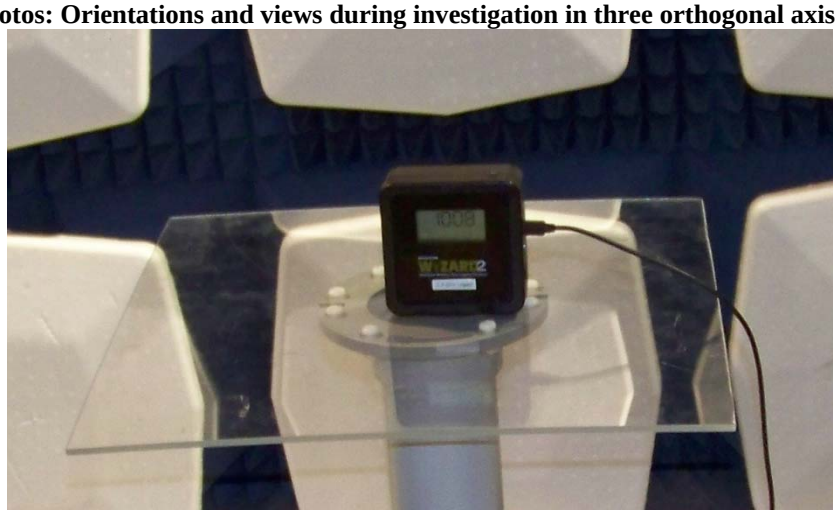

Figure 9: Vertical orientation reference point - tests for host qualification.

Figure 10: Horizontal orientation reference point- tests for host qualification.

Figure 11: Side orientation reference point- tests for host qualification.

Test Setup Photos: Orientations and views during investigation in three orthogonal axis in (LMA) mode:

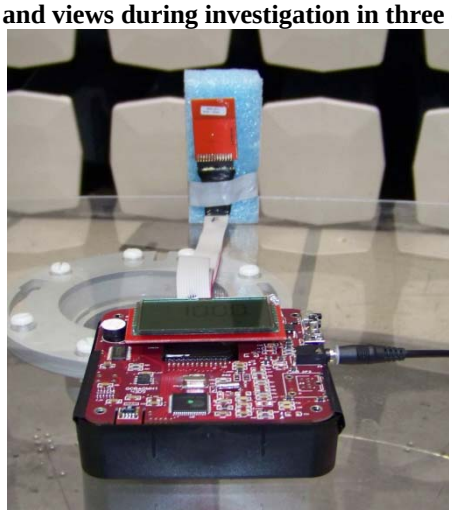

Figure 12: Vertical orientation reference point – tests for (LMA) qualifications.

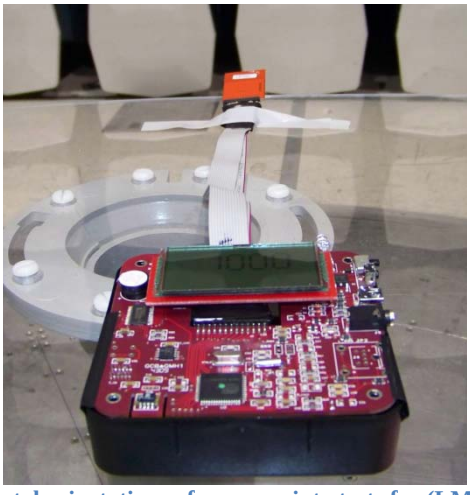

Figure 13: Horizontal orientation reference point– tests for (LMA) qualifications.

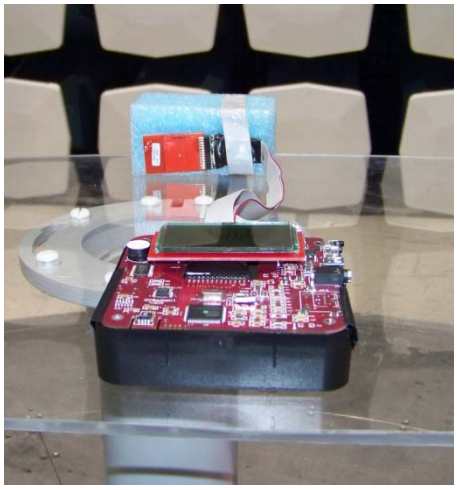

Figure 14: Side orientation reference point– tests for (LMA) qualifications.

2.1.1.4 Test Procedure

The EUT was measured for Radiated RF Emissions in the 10 Meter FCC Listed Semi-Anechoic Chamber located at Ingenium Testing. The frequency range from 30 MHz to 10 GHz was investigated for RF emissions, and emission levels were noted along with the fixed degree settings of azimuth on the turntable and sense antenna height. The EUT was placed on a non-conductive pedestal, centered on a turn-table with a conductive rotating surface, flush and in contact with the conductive ground plane. The antenna mast was placed such that the antenna was separated by 3 meters from the test object for testing below 18 GHz, and separated by 1 meter for testing above 18 GHz. A Hybrid Bicon-Log Antenna was used to measure emissions from 30 MHz to 1000 MHz. A Double-Ridged Wave-Guide Horn Antenna was used to measure emissions from 1 GHz to 18 GHz, and a smaller Double-Ridged Wave-Guide Horn Antenna was used to measure emissions from 18 GHz to 25 GHz. The maximum radiated emissions were found by raising and lowering the antenna between 1 and 4 meters in height, while utilizing the turn-table to rotate the product. The process was repeated using both horizontal and vertical antenna polarizations. The maximum emission levels were then recorded along with the attitude of the product.

The receiver was operated with the IF resolution bandwidth (RBW) of 120 kHz for measurements between 30 MHz and 1 GHz (video bandwidth of 300 kHz), and a resolution bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz or higher up to 8MHz –instrument default states were used).

The EUT was set-up in advance, by the client cognizant engineer, in the proper mode. The mode tested was in continuous-transmit CW, for the intentional radiator testing, and in receive mode for the un-intentional radiator testing. The maximum emission level tests for transmit characteristics were performed with the transmitter in a continuous transmit (CW) mode, and the reported measurements using a Peak and Average detector functions are approximately the same. The transmit packet envelope is approximately 1.6 ms, which would permit up to 20 dB of relaxation based on time averaging calculations per 47CFR 15.35c. The 20 dB allowed relaxation based on time averaging is invoked for these tests. Calculations and support evidence for the time-averaging are presented in later sections of this report.

The applicable limits as noted in 47 CFR 15.249 were applied for the intentional radiator tests.
The applicable limits as noted in 47 CFR 15.109 for a Class B type product were applied for the un-intentional radiator tests.

2.1.1.5 Test Results

The EUT was found to **MEET** the requirements as described within the specifications of the FCC, Title 47 CFR, Part 15.249 for radiated emissions from an intentional radiator.
The EUT was found to **MEET** the requirements as described within the specifications of the FCC, Title 47 CFR, Part 15.109 for radiated emissions from a Class B product, as well as the Industry Canada requirements specified within ICES-003 for a Class B digital device. Supporting evidence of significant measured RF emissions, are tabulated and presented below.

CLIMATE TEST CONDITIONS

Temperature:	73.1 °F (22.8 °C)
Humidity:	57 % RH

Uncertainty Calculations – All Factors Combined Includes a comparison between CISPR 16-4-2 and Ingenium Testing			
Measurement		U_{CISPR}	Ingenium Testing
Radiated Disturbance	30 MHz – 300 MHz	7.4 dB	5.4 dB
Radiated Disturbance	300 MHz – 1 GHz	6.5 dB	5.1 dB

Notes: Date of Estimation: November 02, 2007.

Table 9: Level of significant spurious radiated RF emissions measured in transmit mode, LMA configuration.

Mode (Tx / Rx)	Frequency (MHz)	Polarization Ant. / EUT	Height (cm)	Azimuth (0° - 360°)	Measured EFI PK-Detector (dBµV/m @3m)	Measured EFI QP-Detector (dBµV/m @3m)	15.109 Limit (dBµV/m @3m)	Margin (dB)
Tx-LMA mode, USB Power								
Tx-(LMA)	31.09	Ant=H, EUT=V	101	74	41.6	35.1	40.0	4.9
Tx-(LMA)	33.61	Ant=H, EUT=V	101	334	45.5	39.2	40.0	0.8
Tx-(LMA)	35.91	Ant=H, EUT=V	101	355	48.5	34.8	40.0	5.2
Tx-(LMA)	44.34	Ant=H, EUT=V	101	234	35.6	28.3	40.0	11.7
Tx-(LMA)	89.50	Ant=H, EUT=V	101	126	38.1	37.3	43.5	6.2
Tx-(LMA)	97.48	Ant=H, EUT=V	101	213	46.7	41.0	43.5	2.5
Tx-(LMA)	120.00	Ant=H, EUT=V	101	164	37.8	36.1	43.5	7.4
Tx-(LMA)	287.66	Ant=H, EUT=V	101	95	42.9	38.7	46.0	7.3
Tx-(LMA)	431.55	Ant=H, EUT=V	101	60	40.8	32.9	46.0	13.1
Tx-(LMA)	482.29	Ant=H, EUT=V	101	77	58.1	44.1	46.0	1.9
Tx-(LMA)	643.10	Ant=H, EUT=V	101	344	44.2	38.6	46.0	7.4
Tx-(LMA)	10528.0	Ant=H, EUT=V	100	0	52.1	37.6	54.0	16.4
Tx-(LMA)	30.67	Ant=V, EUT=V	101	160	41.8	36.9	40.0	3.1
Tx-(LMA)	32.00	Ant=V, EUT=V	101	5	41.5	35.2	40.0	4.8
Tx-(LMA)	33.55	Ant=V, EUT=V	101	291	45.4	35.9	40.0	4.1
Tx-(LMA)	36.12	Ant=V, EUT=V	101	117	51.3	38.6	40.0	1.4
Tx-(LMA)	89.50	Ant=V, EUT=V	101	318	37.7	35.8	43.5	7.7
Tx-(LMA)	97.45	Ant=V, EUT=V	101	5	45.8	41.9	43.5	1.6
Tx-(LMA)	120.00	Ant=V, EUT=V	101	60	41.9	40.0	43.5	3.5
Tx-(LMA)	144.01	Ant=V, EUT=V	101	194	40.8	38.7	43.5	4.8
Tx-(LMA)	482.29	Ant=V, EUT=V	101	260	56.8	42.8	46.0	3.2
Tx-(LMA)	590.02	Ant=V, EUT=V	101	247	43.7	31.8	46.0	14.2
Tx-(LMA)	643.40	Ant=V, EUT=V	101	157	43.2	37.7	46.0	8.3
Tx-(LMA)	888.97	Ant=V, EUT=V	101	87	45.2	38.4	46.0	7.6
Tx-(LMA)	35.97	Ant=H, EUT=S	101	355	39.9	26.4	40.0	13.6
Tx-(LMA)	287.63	Ant=H, EUT=S	101	289	40.0	34.2	46.0	11.8
Tx-(LMA)	35.94	Ant=V, EUT=S	101	222	49.2	35.0	40.0	5.0
Tx-(LMA)	36.28	Ant=V, EUT=S	101	103	49.4	35.3	40.0	4.7
Tx-(LMA)	120.00	Ant=V, EUT=S	101	272	39.7	37.9	43.5	5.6
Tx-(LMA)	143.98	Ant=V, EUT=S	101	114	40.1	37.9	43.5	5.6
Tx-(LMA)	191.99	Ant=V, EUT=S	101	300	36.4	32.0	43.5	11.5
Tx-(LMA)	215.73	Ant=V, EUT=S	101	333	42.5	36.6	43.5	6.9
Tx-(LMA)	288.69	Ant=V, EUT=S	101	170	43.7	39.6	46.0	6.4
Tx-(LMA)	216.00	Ant=H, EUT=H	101	102	36.3	31.6	43.5	11.9
Tx-(LMA)	287.69	Ant=H, EUT=H	101	70	43.4	38.0	46.0	8.0
Tx-(LMA)	914.91	Ant=H, EUT=H	101	355	43.1	37.0	46.0	9.0
Tx-(LMA)	10528.0	Ant=H, EUT=H	100	0	56.1	37.9	54.0	16.1
Tx-(LMA)	36.28	Ant=V, EUT=H	101	84	48.8	34.7	40.0	5.3
Tx-(LMA)	120.03	Ant=V, EUT=H	101	229	37.0	34.7	43.5	8.8
Tx-(LMA)	288.69	Ant=V, EUT=H	101	33	43.0	38.0	46.0	8.0

Table 10: Level of significant spurious radiated RF emissions measured in transmit mode, Host (normal) configuration.

Mode (Tx / Rx)	Frequency (MHz)	Polarization Ant. / EUT	Height (cm)	Azimuth (0° - 360°)	Measured EFI PK-Detector (dBμV/m @3m)	Measured EFI QP-Detector (dBμV/m @3m)	15.109 Limit (dBμV/m @3m)	Margin (dB)
Tx-Host mode, USB Power								
Tx-Host	97.54	Ant=H, EUT=V	100	5	34.8	31.6	43.5	11.9
Tx-Host	143.98	Ant=H, EUT=V	100	147	31.9	29.4	43.5	14.1
Tx-Host	287.63	Ant=H, EUT=V	100	27	39.5	33.7	46.0	12.3
Tx-Host	482.35	Ant=H, EUT=V	100	287	44.4	40.8	46.0	5.2
Tx-Host	888.33	Ant=H, EUT=V	100	163	47.5	40.9	46.0	5.1
Tx-Host	482.29	Ant=V, EUT=V	100	191	44.4	41.2	46.0	4.8
Tx-Host	888.94	Ant=V, EUT=V	100	111	51.2	42.7	46.0	3.3
Tx-Host	144.01	Ant=H, EUT=S	100	148	34.2	32.1	43.5	11.4
Tx-Host	36.03	Ant=V, EUT=S	100	55	43.3	29.0	40.0	11.0
Tx-Host	44.34	Ant=V, EUT=S	100	176	41.9	29.8	40.0	10.2
Tx-Host	119.97	Ant=V, EUT=S	100	279	42.3	39.9	43.5	3.6
Tx-Host	143.98	Ant=V, EUT=S	100	141	42.8	41.2	43.5	2.3
Tx-Host	215.97	Ant=V, EUT=S	100	305	38.8	33.6	43.5	9.9
Tx-Host	287.66	Ant=V, EUT=S	100	80	41.9	37.0	46.0	9.0
Tx-Host	395.51	Ant=V, EUT=S	100	130	41.4	36.1	46.0	9.9
Tx-Host	899.42	Ant=V, EUT=S	100	316	44.4	37.5	46.0	8.5
Tx-Host	216.00	Ant=H, EUT=H	101	102	36.3	31.6	43.5	11.9
Tx-Host	287.69	Ant=H, EUT=H	101	70	43.4	38.0	46.0	8.0
Tx-Host	914.91	Ant=H, EUT=H	101	355	43.1	37.0	46.0	9.0
Tx-Host	36.28	Ant=V, EUT=H	101	84	48.8	34.7	40.0	5.3
Tx-Host	120.02	Ant=V, EUT=H	101	229	37.0	34.7	43.5	8.8
Tx-Host	216.00	Ant=V, EUT=H	101	221	40.1	33.1	43.5	10.4
Tx-Host	288.68	Ant=V, EUT=H	101	33	43.0	38.0	46.0	8.0
Tx-Host	359.74	Ant=V, EUT=H	101	5	42.6	34.5	46.0	11.5

Table 11: Level of significant spurious radiated RF emissions measured in receive mode (normal) configuration.

Mode (Tx / Rx)	Frequency (MHz)	Polarization Ant. / EUT	Height (cm)	Azimuth (0° - 360°)	Measured EFI PK-Detector (dBµV/m @3m)	Measured EFI QP-Detector (dBµV/m @3m)	15.109 Limit (dBµV/m @3m)	Margin (dB)
Rx mode, USB Power								
Rx - USB	120.00	Ant=H, EUT=H	100	123	31.9	29.3	43.5	14.2
Rx - USB	288.69	Ant=H, EUT=H	100	293	40.5	35.7	46.0	10.3
Rx - USB	395.54	Ant=H, EUT=H	100	306	41.6	36.4	46.0	9.6
Rx - USB	600.24	Ant=H, EUT=H	100	200	39.1	32.4	46.0	13.6
Rx - USB	31.70	Ant=V, EUT=H	100	141	32.9	26.5	40.0	13.5
Rx - USB	47.10	Ant=V, EUT=H	100	194	43.1	28.2	40.0	11.8
Rx - USB	47.70	Ant=V, EUT=H	100	201	44.4	30.2	40.0	9.8
Rx - USB	47.89	Ant=V, EUT=H	100	27	50.3	35.7	40.0	4.3
Rx - USB	120.00	Ant=V, EUT=H	100	265	40.0	37.7	43.5	5.8
Rx - USB	144.01	Ant=V, EUT=H	100	78	40.3	39.1	43.5	4.4
Rx - USB	215.73	Ant=V, EUT=H	100	170	41.2	35.4	43.5	8.1
Rx - USB	288.69	Ant=V, EUT=H	100	150	38.0	33.5	46.0	12.5
Rx - USB	395.51	Ant=V, EUT=H	100	209	39.1	33.6	46.0	12.4
Rx - USB								
Rx mode, Battery Power								
Rx - Batt	97.54	Ant=H, EUT=H	101	321	35.1	33.1	43.5	10.4
Rx - Batt	486.90	Ant=H, EUT=H	101	157	46.5	41.1	46.0	4.9
Rx - Batt	89.53	Ant=V, EUT=H	101	325	30.9	28.3	43.5	15.2
Rx - Batt	97.54	Ant=V, EUT=H	101	335	34.9	33.3	43.5	10.2
Rx - Batt	486.78	Ant=V, EUT=H	101	156	46.6	40.7	46.0	5.3
Rx - Batt	632.31	Ant=V, EUT=H	101	23	42.7	37.1	46.0	8.9
Rx - Batt	888.33	Ant=V, EUT=H	101	145	45.4	39.2	46.0	6.8

Table 12: Level of significant radiated RF emissions measured in transmit fundamental and harmonic frequencies.

Frequency (MHz)	Antenna Polarization	Height (cm)	Azimuth (0° - 360°)	Measured EFI Peak Detector (dBμV/m@10m)	Measured EFI AVG-Detector (dBμV/m@10m)	15.249 Limit AVG-Detector (dBμV/m)	Margin (dB)
Tx – (LMA) mode, EUT = Horizontal Orientation, Power through Laptop USB port.							
2477	H	154	345	97.7	97.7	93.9	- 3.8 (Note 4)
4954	H	100	319	65.3	64.3	54.0	- 10.3 (Note 4)
7431	V	100	301	53.6	47.5	54.0	6.5
9908	V	100	271	52.2	41.2	54.0	12.8
12385	H	125	17	51.6	39.5	54.0	14.5
14862	H	100	0	52.5	40.2(Note 3)	54.0	13.8
17339	H	100	0	51.3	39.4(Note 3)	54.0	14.6
19816					(Note 3)	54.0	
22293					(Note 3)	54.0	
24770					(Note 3)	54.0	
Tx – (LMA) mode, EUT = Vertical Orientation, Power through Laptop USB port.							
2477	V	198	6	97.4	97.3	93.9	- 3.4 (Note 4)
4954	H	142	206	62.6	61.5	54.0	- 7.5 (Note 4)
7431	H	100	185	54.1	49.9	54.0	4.1
9908	H	114	225	51.1	40.9	54.0	13.1
12385	H	100	138	51.5	40.9	54.0	13.1
14862	H	100	0	52.6	40.4(Note 3)	54.0	13.6
17339	H	100	0	52.5	39.4(Note 3)	54.0	14.6
19816					(Note 3)	54.0	
22293					(Note 3)	54.0	
24770					(Note 3)	54.0	
Tx – (LMA) mode, EUT = Side Orientation, Power through Laptop USB port.							
2477	H	110	329	97.3	97.3	93.9	- 3.4 (Note 4)
4954	H	113	24	63.5	62.4	54.0	- 8.4 (Note 4)
7431	V	100	238	52.9	48.4	54.0	5.6
9908	H	132	130	50.5	37.8	54.0	16.2
12385	H	100	0	47.1	34.8	54.0	19.2
14862	H	100	0	52.8	40.4(Note 3)	54.0	13.6
17339	H	100	0	52.1	39.4(Note 3)	54.0	14.6
19816					(Note 3)	54.0	
22293					(Note 3)	54.0	
24770					(Note 3)	54.0	

Notes:

1) 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. Measurements using the Average detector are published in the tables above for frequencies above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
2) Measurements above 18 GHz were made at 1 meters of separation from the EUT.
3) Measurement at receiver system noise floor, and better than 20 dB below limits.
4) Up to 20 dB of relaxation is invoked based on time averaging of the signal. The transmit packet is 1.6ms in duration.

SCREEN CAPTURES – RADIATED RF EMISSIONS TESTING

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured with the sense antenna both in vertical and horizontal polarity.

Transmit Host Mode – Lap-top USB Power, EUT Horizontal

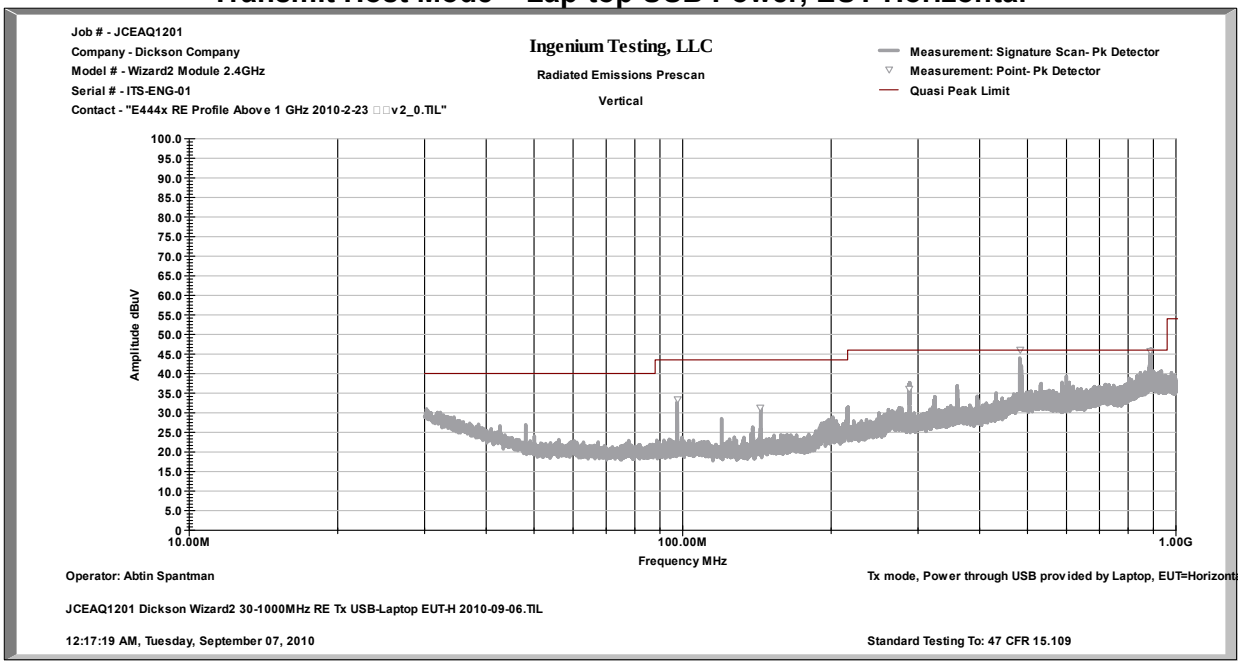

Figure 15: Tx Host Mode RF Emission Signature, USB Power, EUT horizontal, Antenna Vertically Polarized, 30-1000MHz, at 3 m.

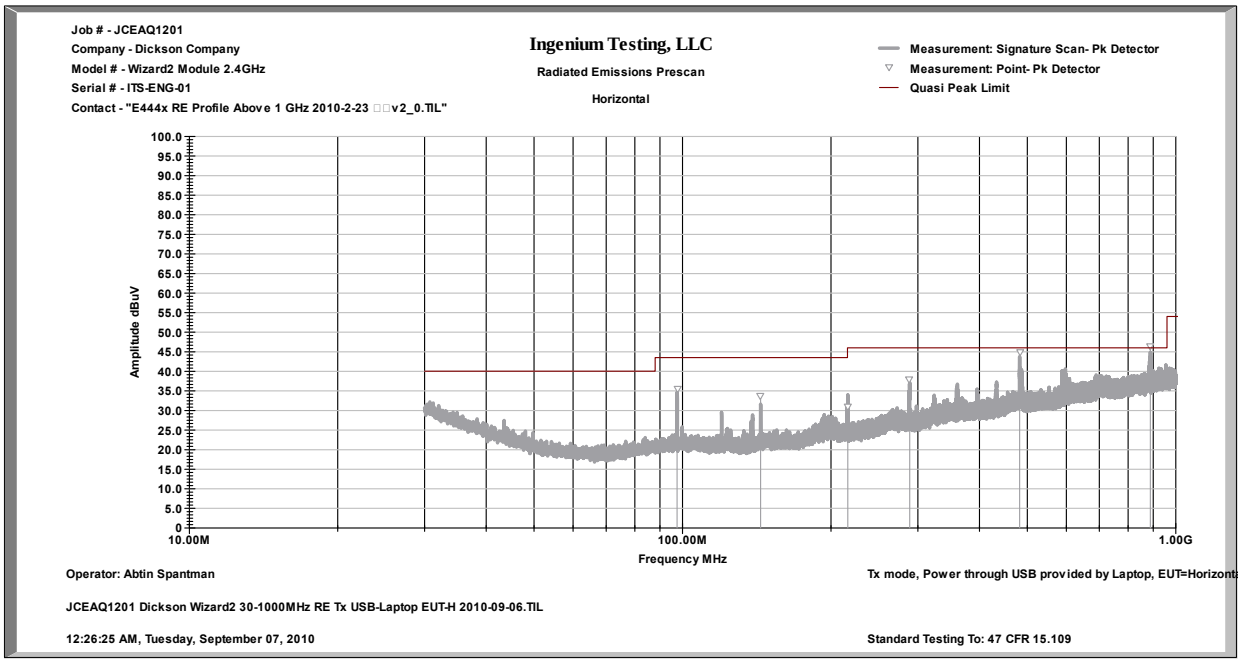

Figure 16: Tx Host Mode RF Emission Signature, USB Power, EUT horizontal, Antenna Horizontally Polarized, 30-1000MHz, at 3 m.

Transmit Host Mode – Lap-top USB Power, EUT on left Side

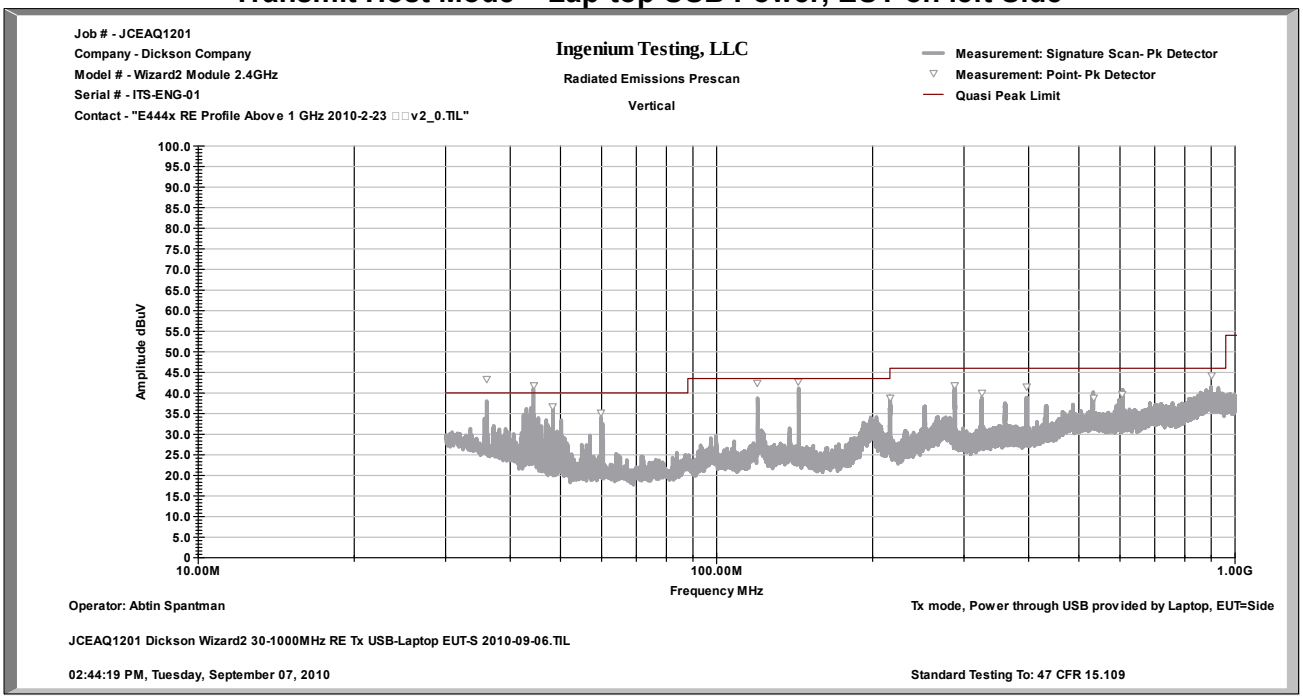

Figure 17: Tx Host Mode RF Emission Signature, USB Power, EUT on left side, Antenna Vertically Polarized, 30-1000MHz, at 3 m.

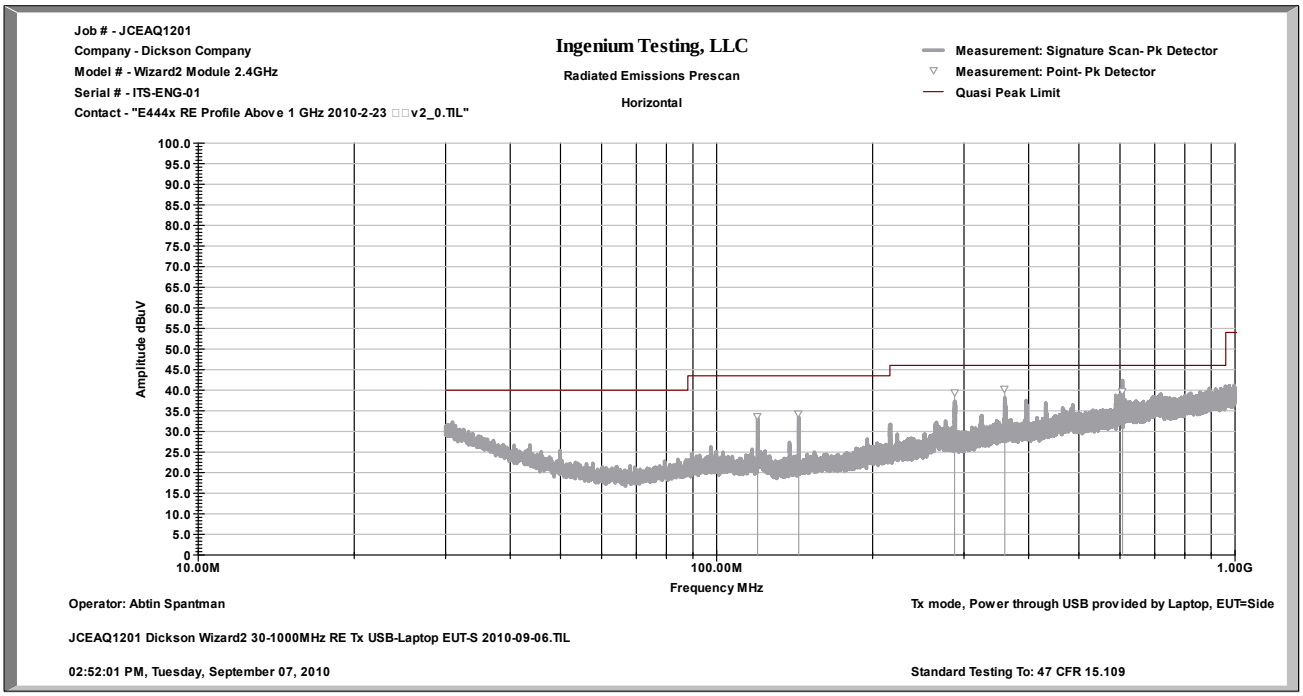

Figure 18: Tx Host Mode RF Emission Signature, USB Power, EUT on left side, Antenna Horizontally Polarized, 30-1000MHz, at 3 m.

Transmit Host Mode – Lap-top USB Power, EUT Vertical

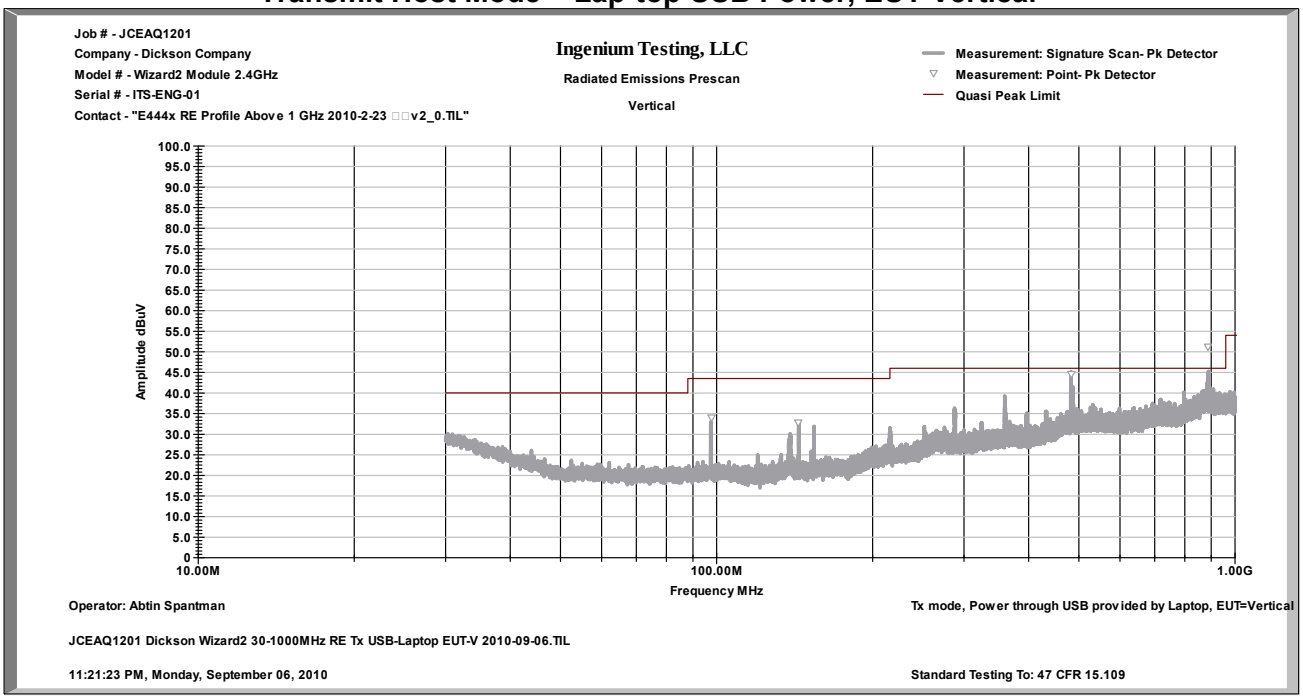

Figure 19: Tx Host Mode RF Emission Signature, USB Power, EUT Vertical, Antenna Vertically Polarized, 30-1000MHz, at 3 m.

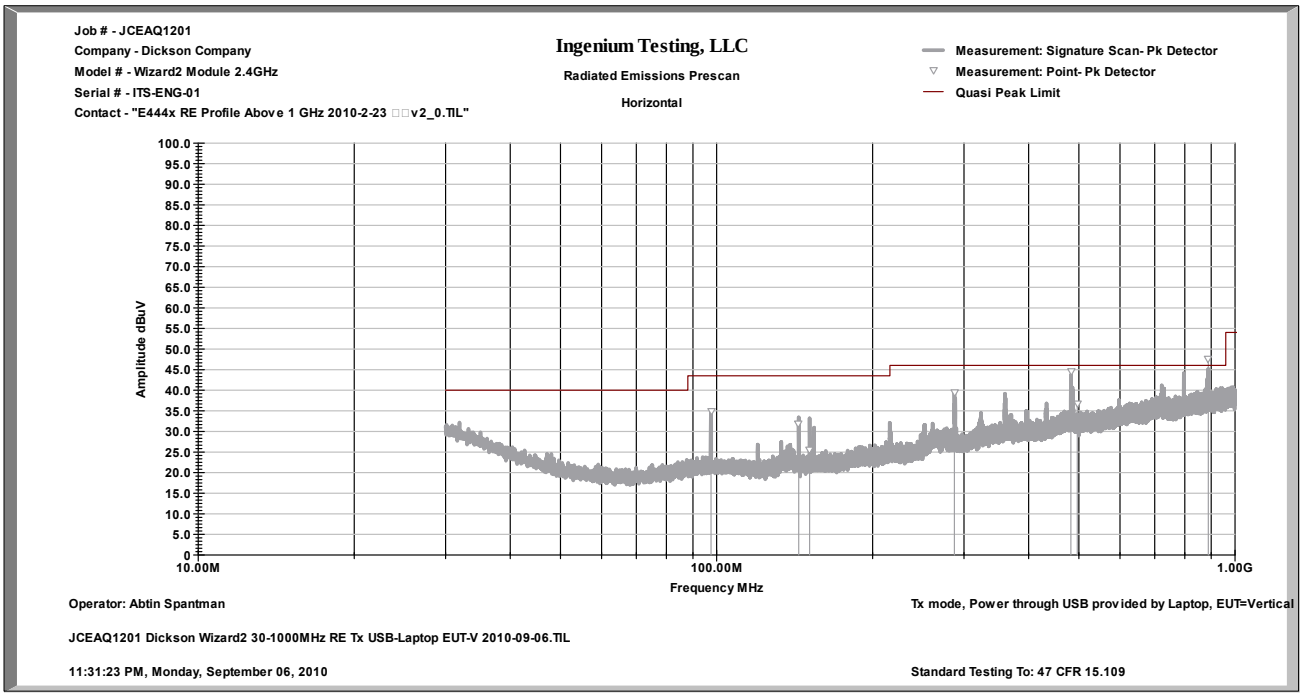

Figure 20: Tx Host Mode RF Emission Signature, USB Power, EUT Vertical, Antenna Horizontally Polarized, 30-1000MHz, at 3 m.

Transmit (LMA) Mode – Lap-top USB Power, EUT Horizontal

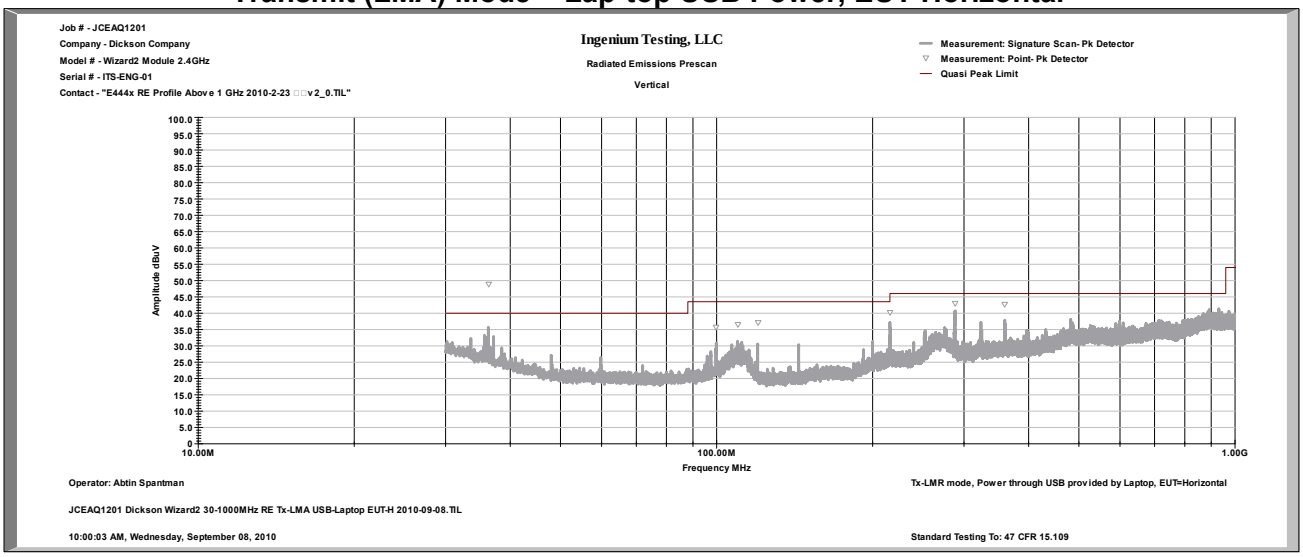

Figure 21: Tx (LMA) Mode RF Emission Signature, USB Power, EUT horizontal, Antenna Vertically Polarized, 30-1000MHz, at 3 m.

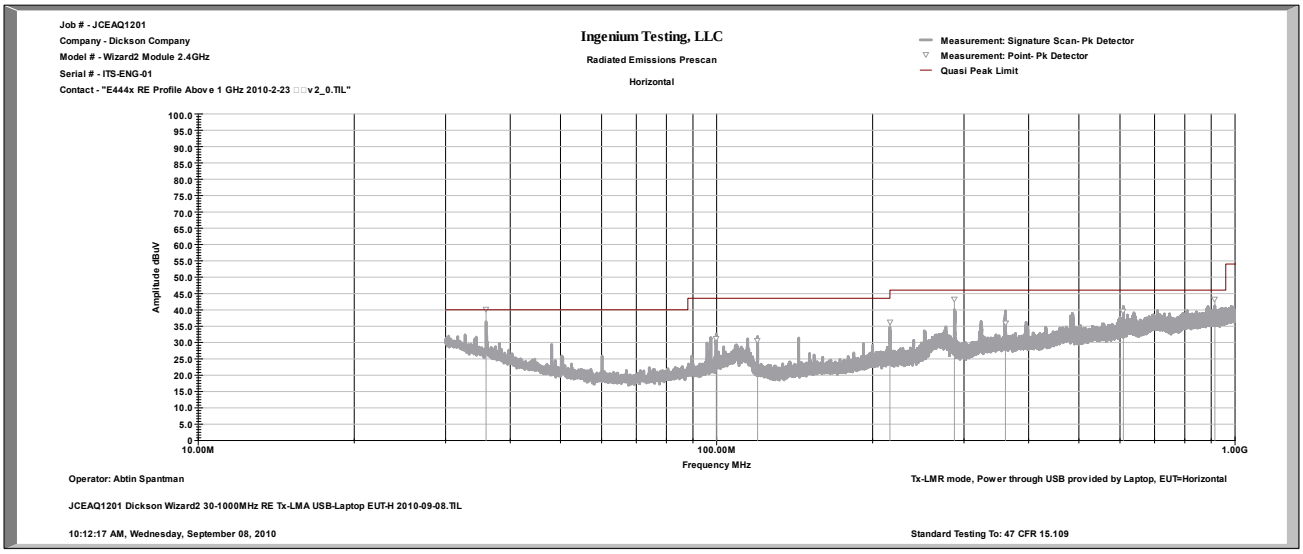

Figure 22: Tx (LMA) Mode RF Emission Signature, USB Power, EUT horizontal, Antenna Horizontally Polarized, 30-1000MHz, at 3 m.

Transmit (LMA) Mode – Lap-top USB Power, EUT on left Side

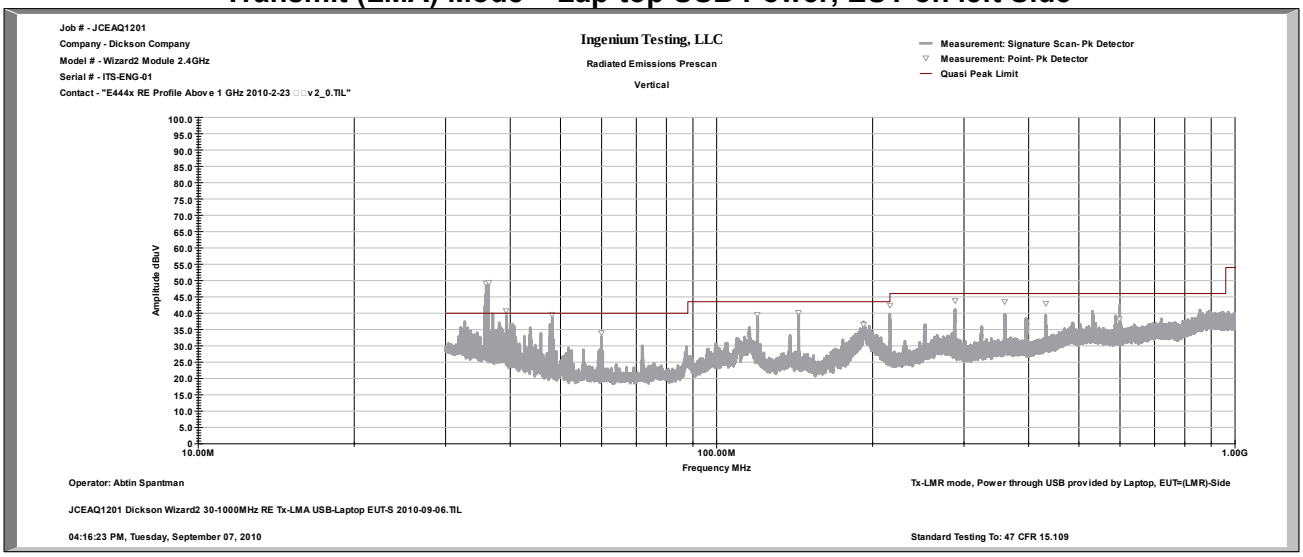

Figure 23: Tx (LMA) Mode RF Emission Signature, USB Power, EUT on left side, Antenna Vertically Polarized, 30-1000MHz, at 3 m.

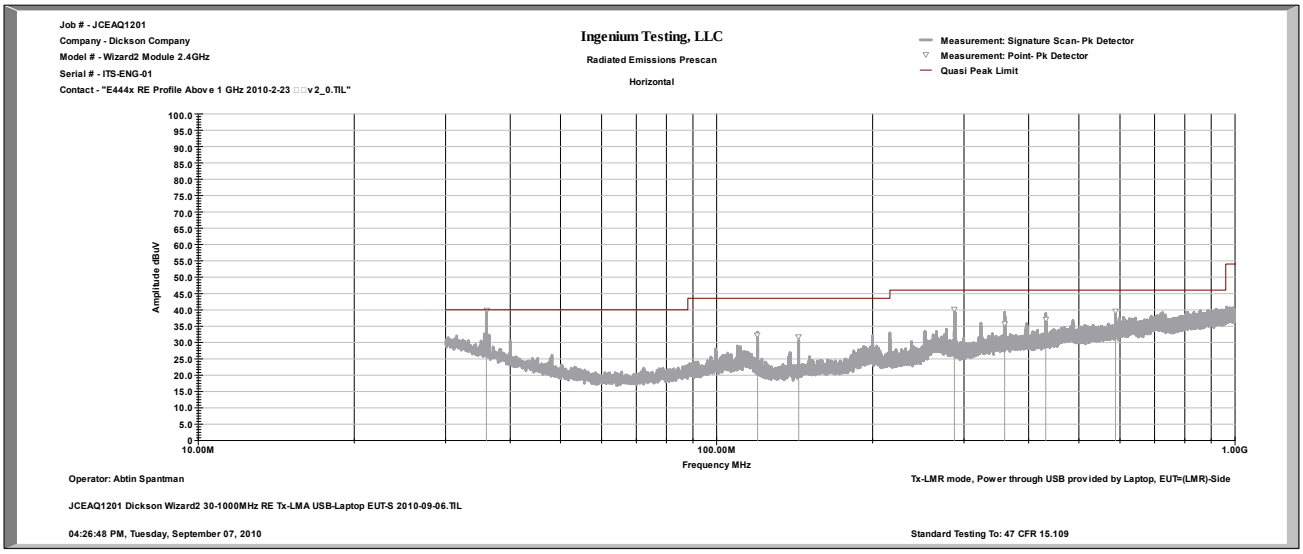

Figure 24: Tx (LMA) Mode RF Emission Signature, USB Power, EUT on left side, Antenna Horizontally Polarized, 30-1000MHz, at 3 m.

Transmit (LMA) Mode – Lap-top USB Power, EUT Vertical

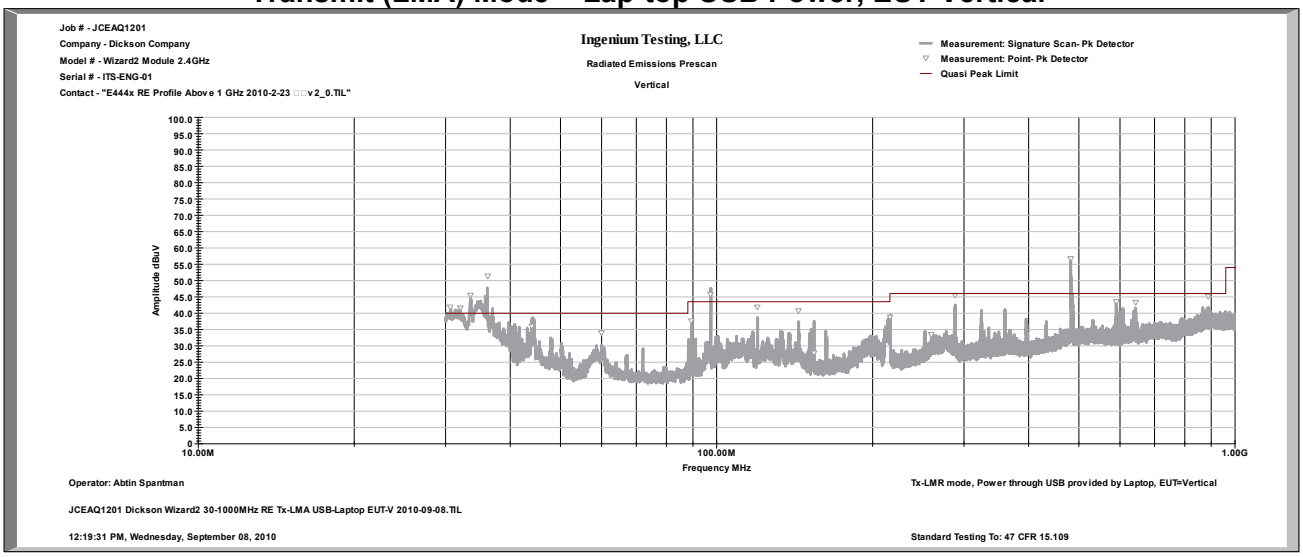

Figure 25: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Vertical, Antenna Vertically Polarized, 30-1000MHz, at 3 m.

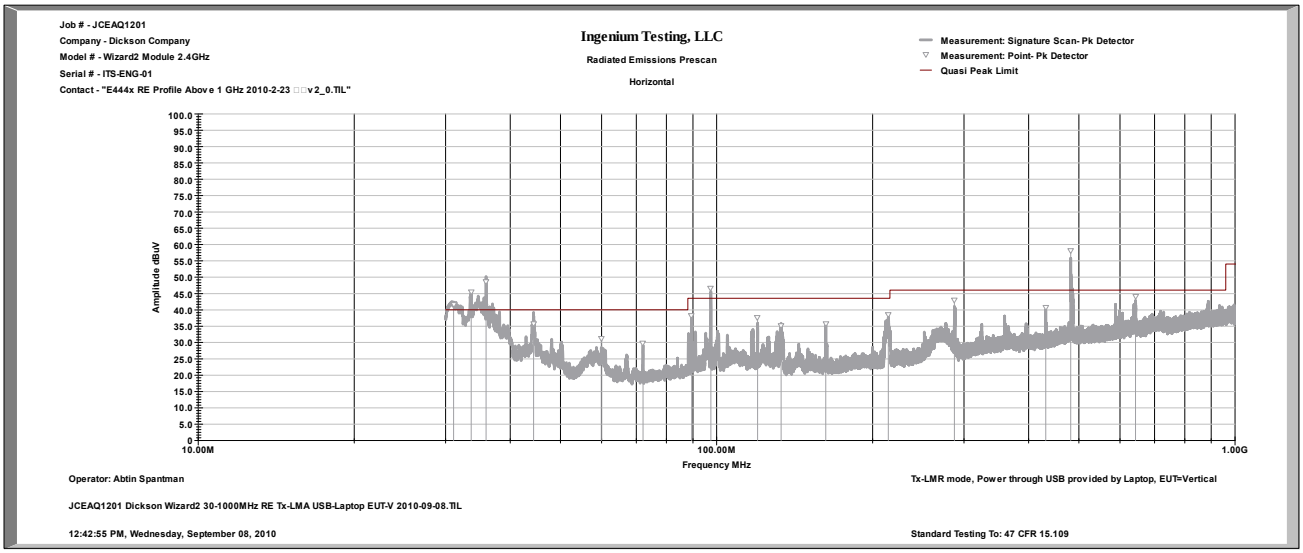

Figure 26: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Vertical, Antenna Horizontally Polarized, 30-1000MHz, at 3 m.

Transmit (LMA) Mode – Lap-top USB Power, EUT Horizontal

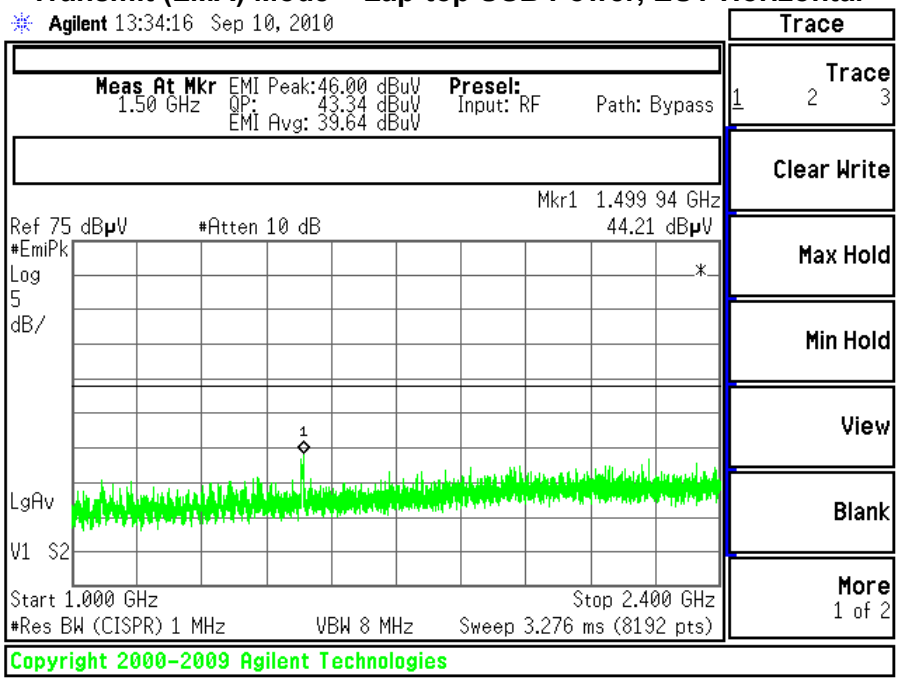

Figure 27: Tx (LMA) Mode RF Emission Signature, USB Power, EUT horizontal, Antenna Horizontally Polarized, 1-2.4GHz, at 3 m.

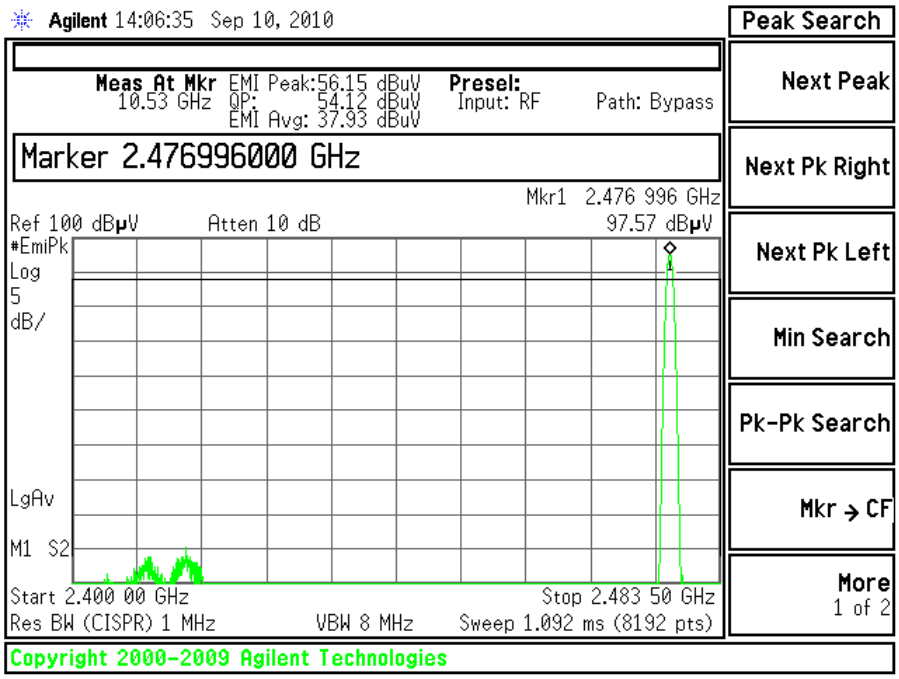

Figure 28: Tx (LMA) Mode RF Emission Signature, USB Power, EUT horizontal, Antenna Horizontally Polarized, 2.4-2.483 GHz, at 3 m.

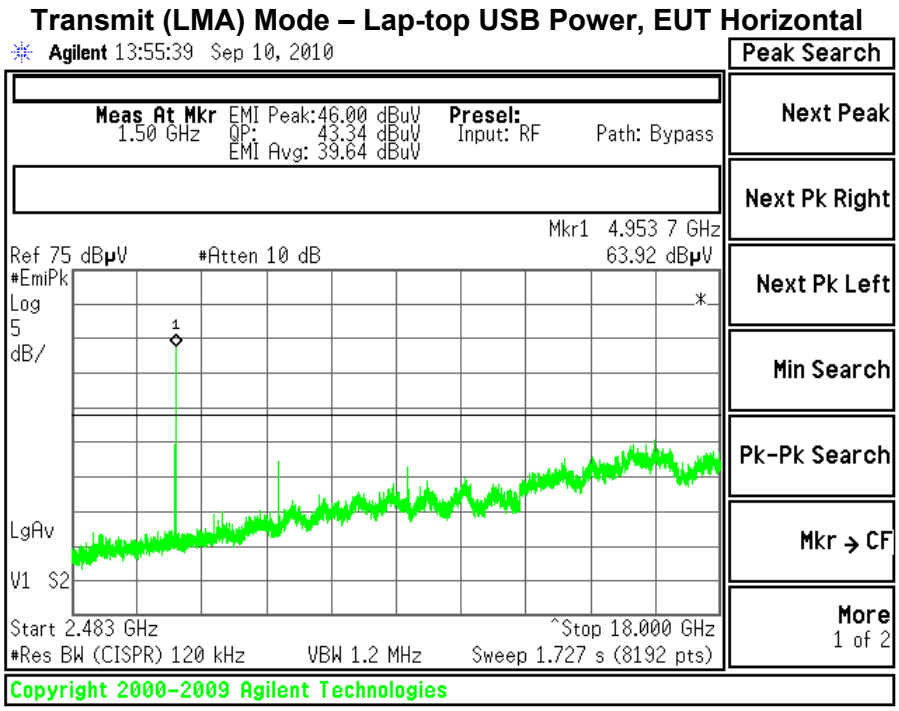

Figure 29: Tx (LMA) Mode RF Emission Signature, USB Power, EUT horizontal, Antenna Horizontally Polarized, 2.483-18 GHz, at 3 m.

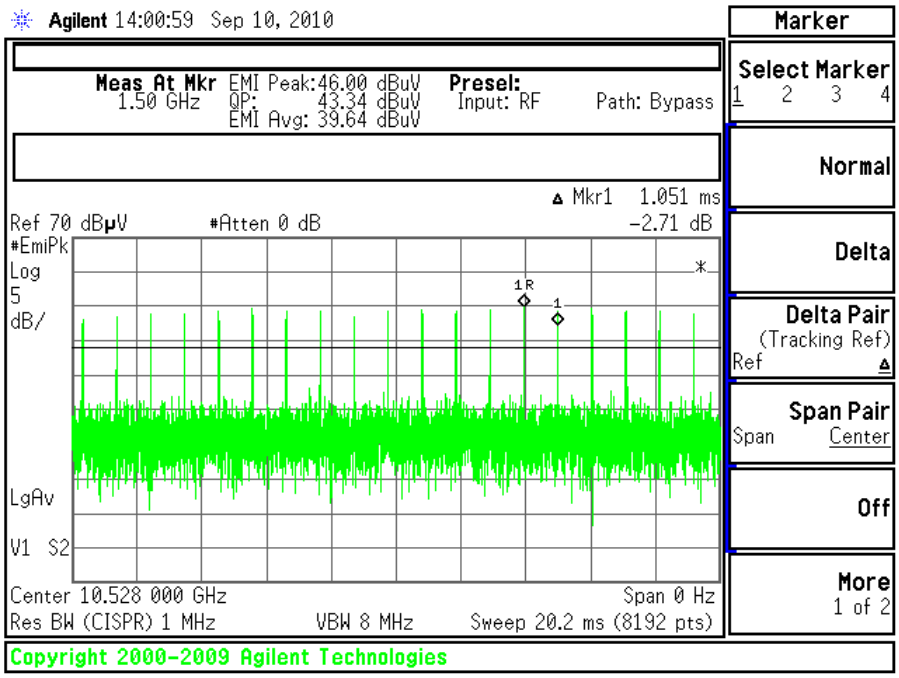

Figure 30: Tx (LMA) Mode RF Emission Signature, USB Power, EUT horizontal, Antenna Horizontally Polarized, Detail of spurious emissions at 10.53 GHz, at 3 m.

Transmit (LMA) Mode – Lap-top USB Power, highest measured peaks

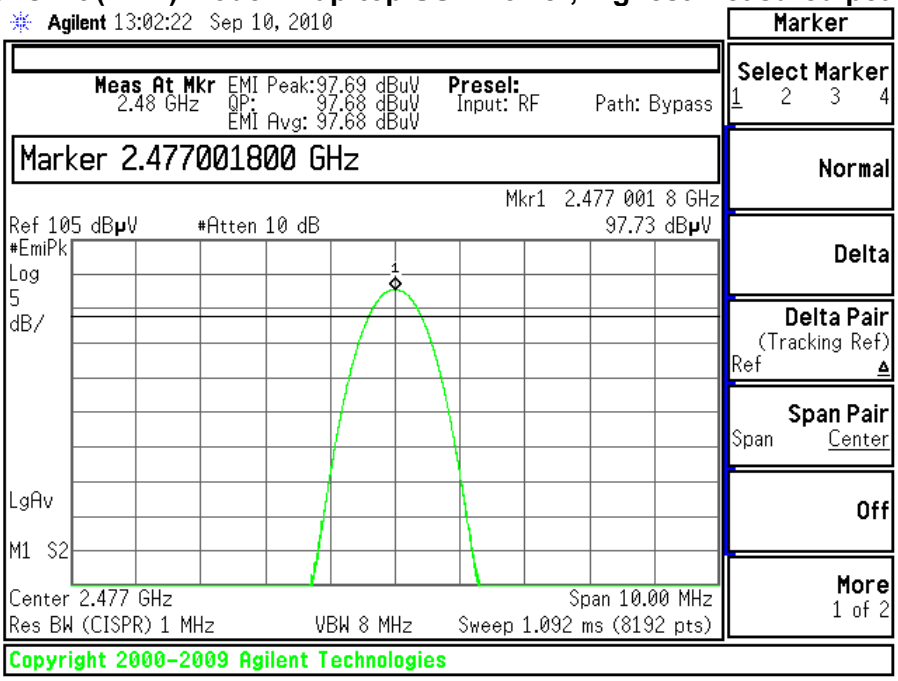

Figure 31: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Horizontal, Antenna Horizontally Polarized, Fundamental frequency at 2.477 GHz, at 3 m.

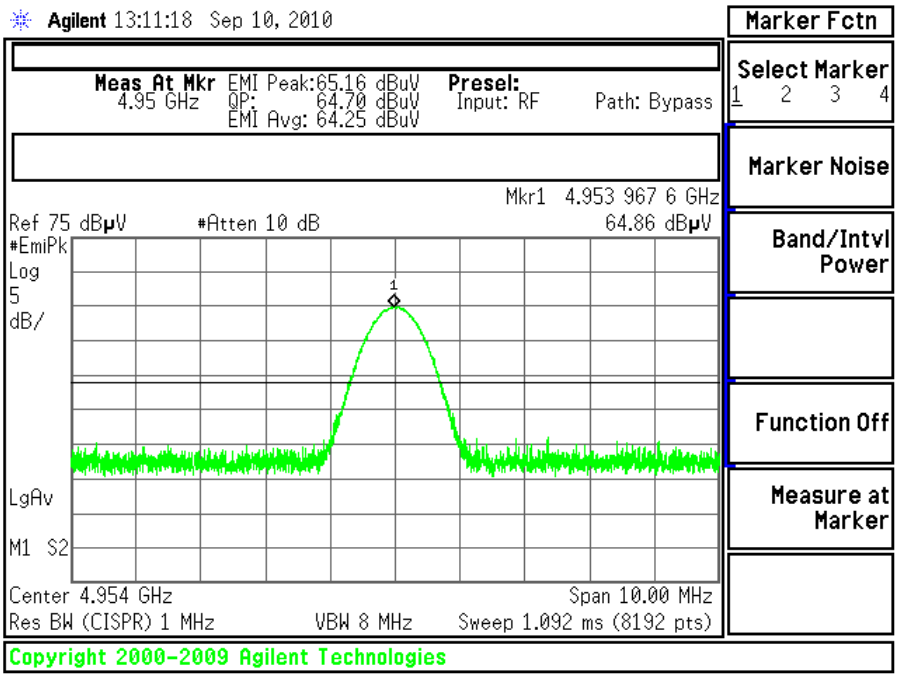

Figure 32: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Horizontal, Antenna Horizontally Polarized, Second Harmonic at 4.954 GHz, at 3 m.

Transmit (LMA) Mode – Lap-top USB Power, highest measured peaks

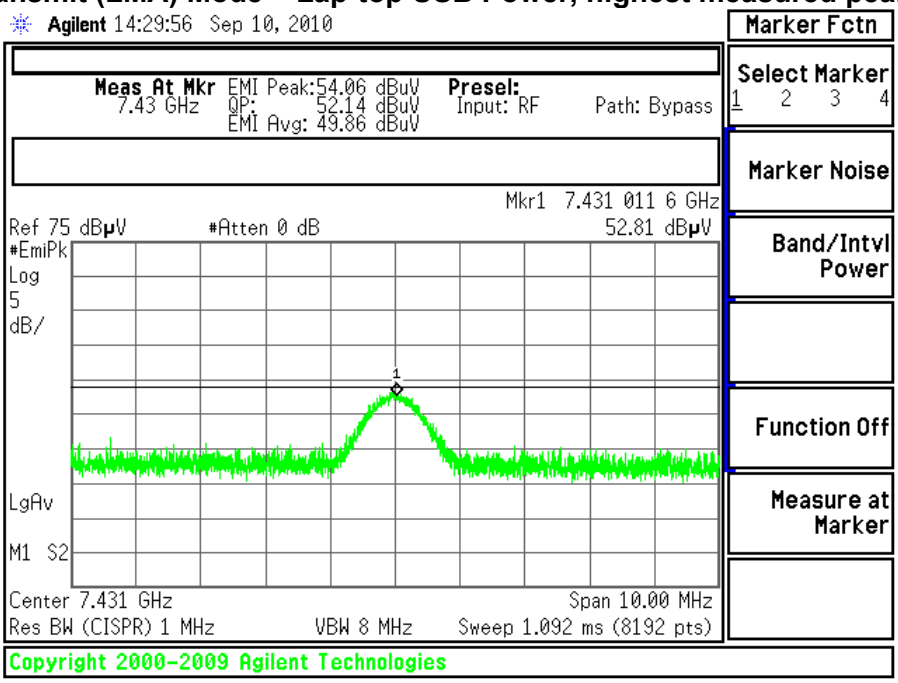

Figure 33: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Vertical, Antenna Horizontally Polarized, Third Harmonic at 7.431 GHz, at 3 m.

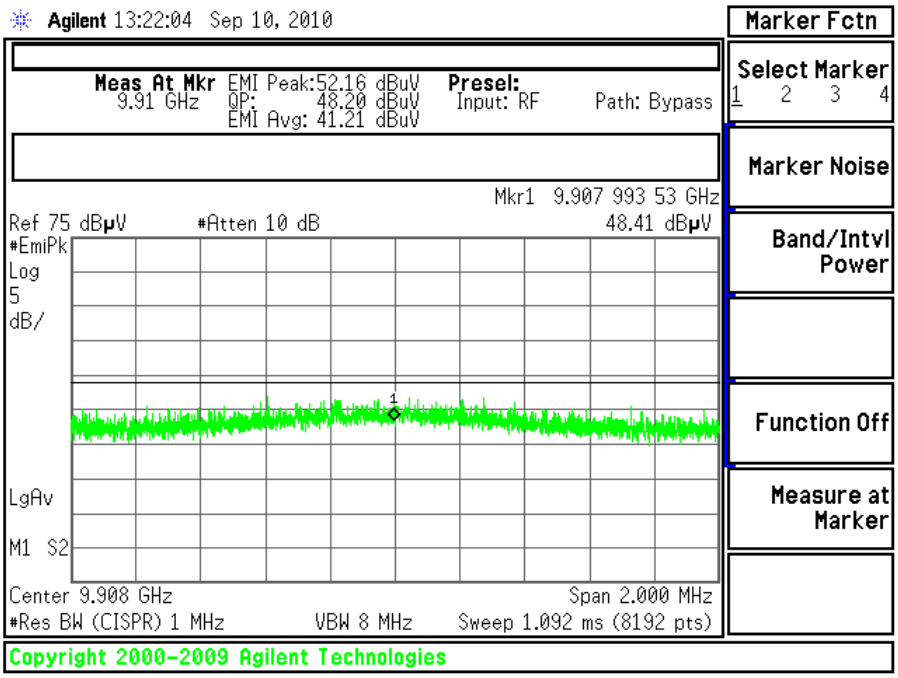

Figure 34: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Horizontal, Antenna Vertically Polarized, Fourth Harmonic at 9.908 GHz, at 3 m.

Transmit (LMA) Mode – Lap-top USB Power, highest measured peaks

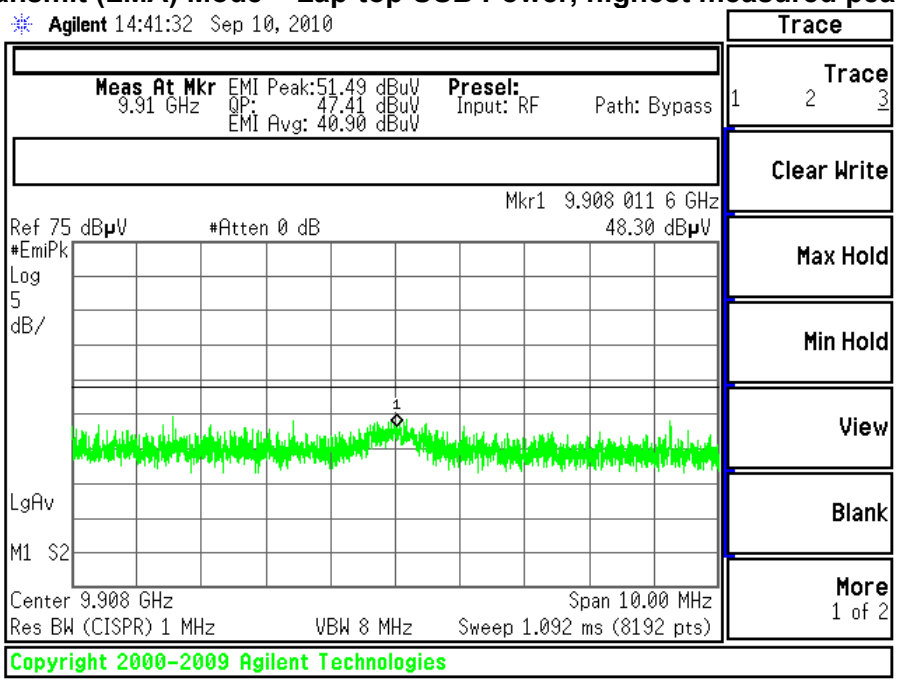

Figure 35: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Vertical, Antenna Horizontally Polarized, Fifth Harmonic at 12.385 GHz, at 3 m.

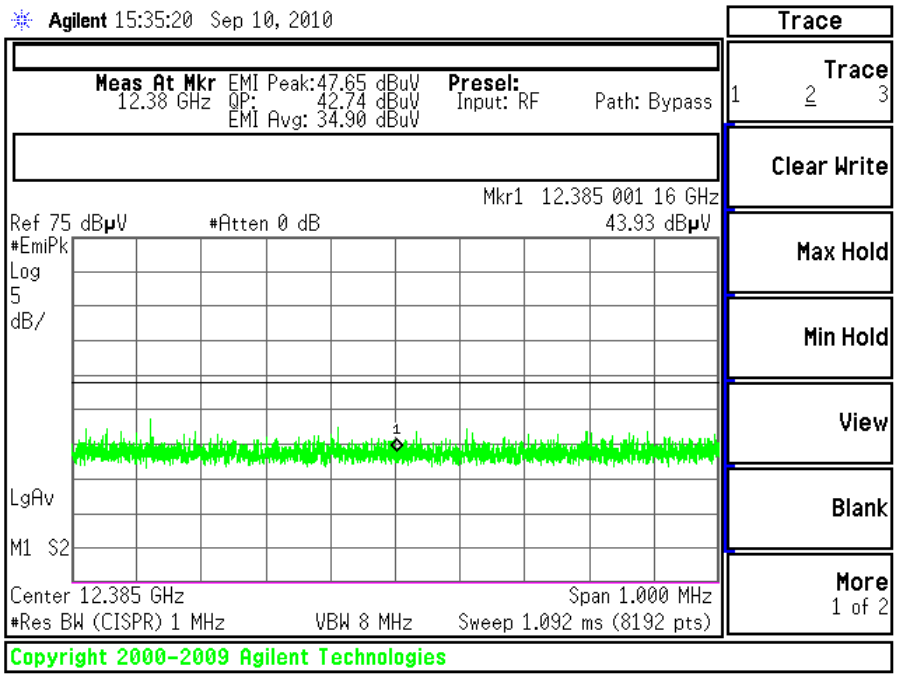

Figure 36: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Horizontal, Antenna Horizontally Polarized, Sixth Harmonic at 14.862 GHz, at 3 m – showing measurement at system noise floor

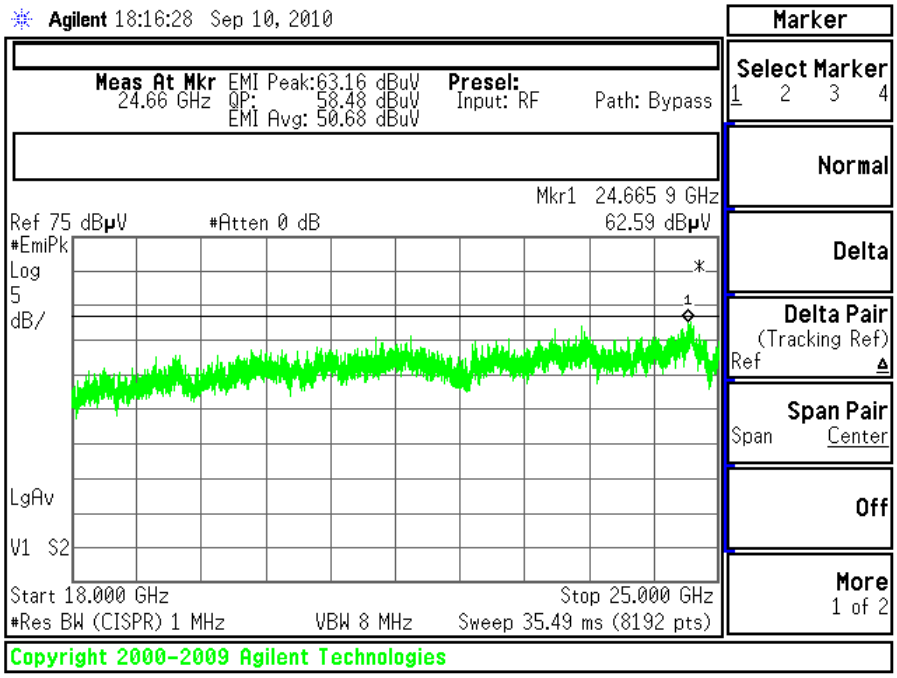

Figure 37: Tx (LMA) Mode RF Emission Signature, USB Power, EUT Horizontal, Antenna Horizontally Polarized, 18-25 GHz, at 3 m – showing measurement at system noise floor

Receive Mode

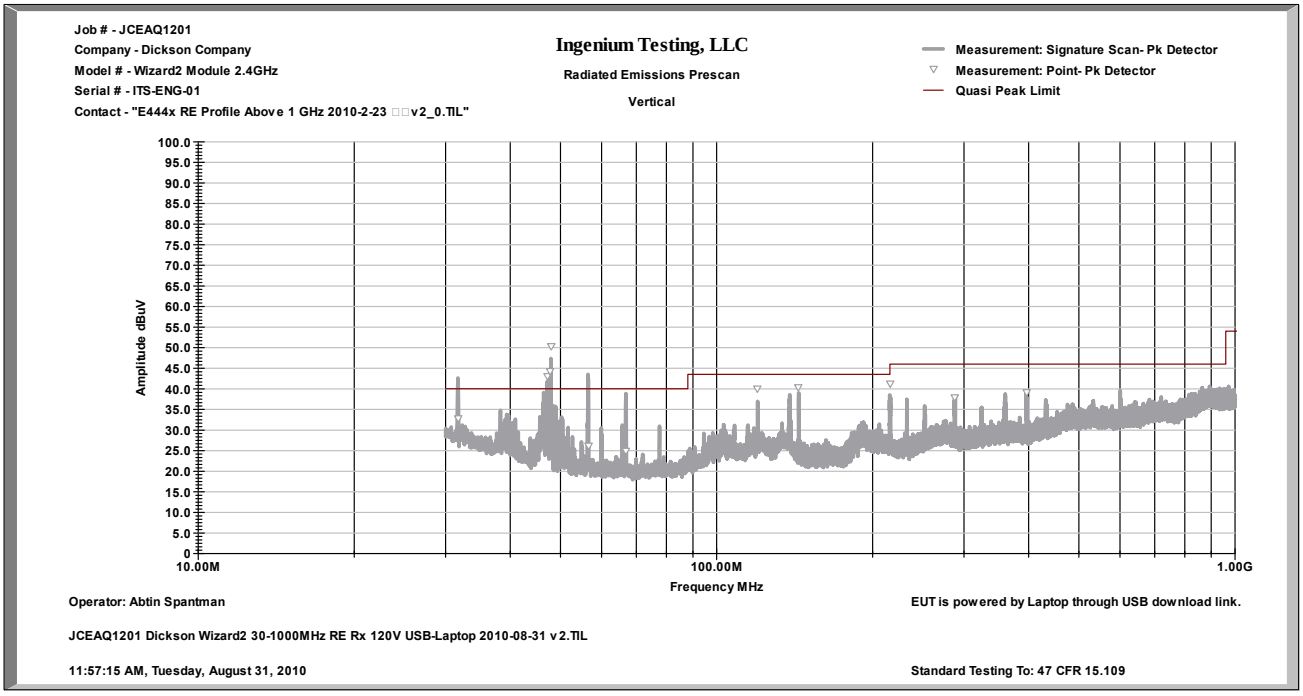

Figure 38: Receive RF Emission Signature, USB Power, EUT Horizontal, Antenna Vertically Polarized, 30-1000MHz, at 3 m.

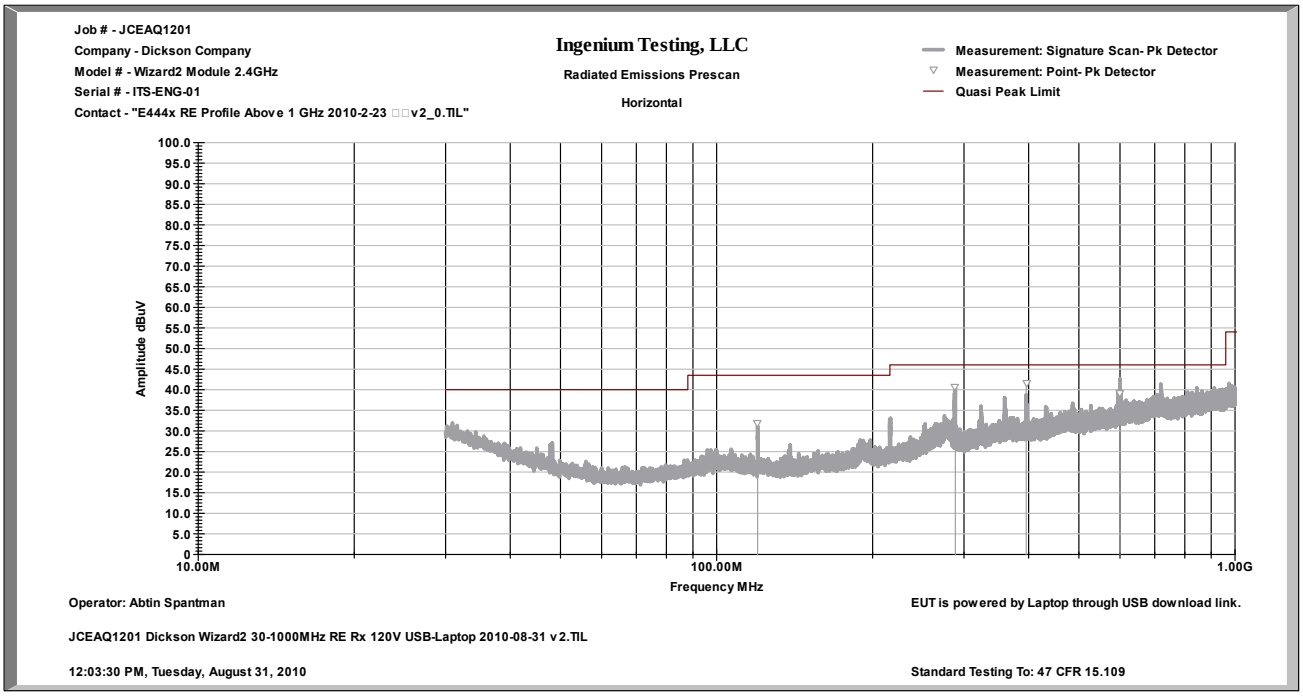

Figure 39: Receive RF Emission Signature, USB Power, EUT Horizontal, Antenna Horizontally Polarized, 30-1000MHz, at 3 m.

Receive Mode

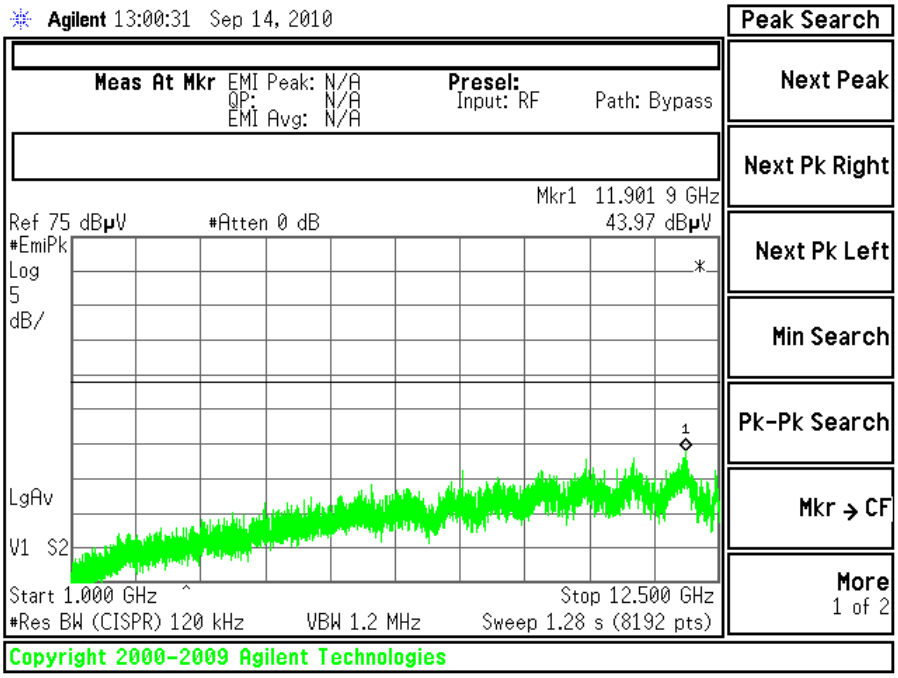

Figure 40: Receive RF Emission Signature, USB Power, EUT Horizontal, Antenna Vertically Polarized, 1-18 GHz, at 3 m. RBW is reduced for enhanced resolution during investigations.

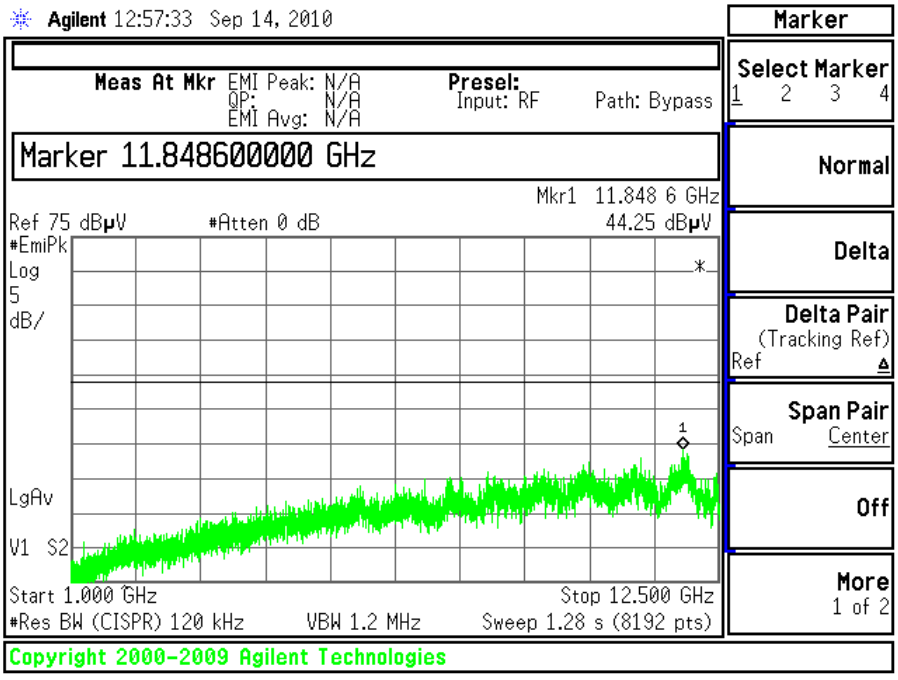

Figure 41: Receive RF Emission Signature, USB Power, EUT Horizontal, Antenna Horizontally Polarized, 1-18 GHz, at 3 m. RBW is reduced for enhanced resolution during investigations.

2.1.2 Conducted RF Emission onto AC Mains Measurements

2.1.2.1 Test Criterion

The test matrix in section 1.5 was used as a guide for test points and conditions.

Port Definition	Terminal Name	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
AC Mains input terminals	120 (H) 120 (N) GND	Logger Enclosure containing digital circuitry ***Transmit Mode USB Power***	Conducted RF Emissions 47 CFR 15.207	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
		Logger Enclosure containing digital circuitry ***Transmit Mode Wall XFMR Power***	Conducted RF Emissions 47 CFR 15.207	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
AC Mains input terminals	120 (H) 120 (N) GND	Transceiver Module with Logger as host. ***Transmit Mode Limited Modular USB Power***	Conducted RF Emissions 47 CFR 15.207	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module with Logger as host. ***Transmit Mode Limited Modular Wall XFMR Power***	Conducted RF Emissions 47 CFR 15.207	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
AC Mains input terminals	120 (H) 120 (N) GND	Transceiver Module in Receiver Mode ***Receive Mode USB Power***	Conducted RF Emissions 47 CFR 15.107	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass
		Transceiver Module in Receiver Mode ***Receive Mode Wall XFMR Power***	Conducted RF Emissions 47 CFR 15.107	150 kHz-30 MHz Measured RF Emission should be Below specified Limits	Pass

The following table presents the limits for unintentional RF emissions conducted onto AC Mains, as specified in the FCC Title 47 CFR, Part 15.107(a), for unintentional radiators and products qualifying as Class B Digital Devices, and also for intentional radiators as specified under Part 15.207.

Table 13: Limits for RF conducted onto AC Mains, per 47CFR 15.107(a) – for Non-Intentional Radiators under Class B, and per 47CFR 15.207 for Intentional Radiators.

Frequency (MHz)	Conducted RF Voltage Quasi-peak Limit (dBµV)	Conducted RF Voltage Average Limit (dBµV)
0.15 – 0.50	66.0 Decreasing linearly with logarithm of frequency to 56.0	56.0 Decreasing linearly with logarithm of frequency to 46.0
0.50 – 5.0	56.0	46.0
5.0 – 30.0	60.0	50.0

Notes: In the calculations for margin below the limit, the limits are rounded to one digit past the decimal.

2.1.2.2 Test Equipment

All equipment is calibrated according to governing standards, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset Number	Description	Last Cal data	Cal due date
Hewlett Packard	8546A	1133	EMI analyzer	18 Dec 2009	18 Dec 2010
ETS	3816/2NM	1365	Dual LISN	15 Mar 2010	15 Mar 2011
Agilent	11947A	1314	Transient Limiter	13 Jan 2010	13 Jan 2011
Storm Products	PR90-195	1858	RF Cable	8 Mar 2010	8 Mar 2011
EM Test	ACS 500	1348	Prog. AC Source	NCR	NCR
Fluke	87V	1935	RMS Multi-meter	8 Feb 2010	8 Feb 2011
Vaisala	HM34F	1948	Temp/Hum Probe	17 Nov 2009	17 Nov 2010

Correction factors and cable loss factors were entered into the appropriate test equipment or automated testing programs. As a result, the data taken 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 measurement result.

2.1.2.3 Test Setup

The EUT was tested as a "Table-Top" type product, as described in ANSI C63.4. The EUT was placed on a non-conductive pedestal, 80 cm above the reference ground plane and approximately 40 cm from the vertical ground plane, inside an RF shielded room located at Ingenium Testing. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 µH Line Impedance Stabilization Network (LISN). The AC power supply (120V, 60 Hz nominal) was provided to the LISN via appropriate broadband EMI Filters. The LISN used has the ability to terminate the unused RF sampling port connection with an internal 50Ω (ohm) load, when switched to either L1 (line) or L2 (neutral). A transient limiter was installed in the RF path to protect the detection equipment. The EUT was exercised under standard operating conditions per the modes defined in section 1.5. An adjustable power source was used to vary the input voltage as needed at the LISN (POR).

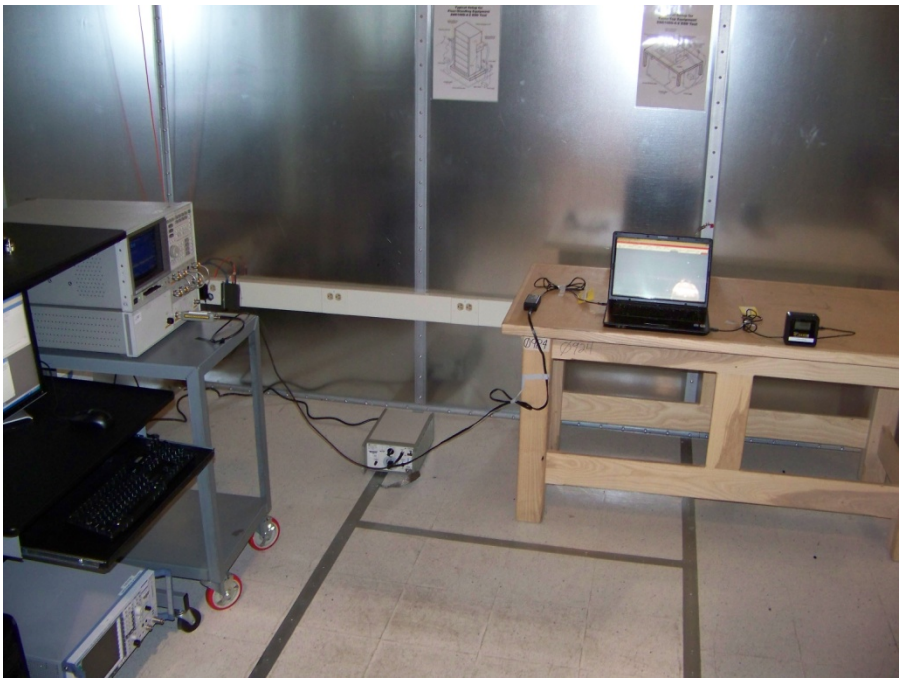

Figure 42: Equipment setup during Conducted RF Emissions tests – showing test instruments relative to EUT

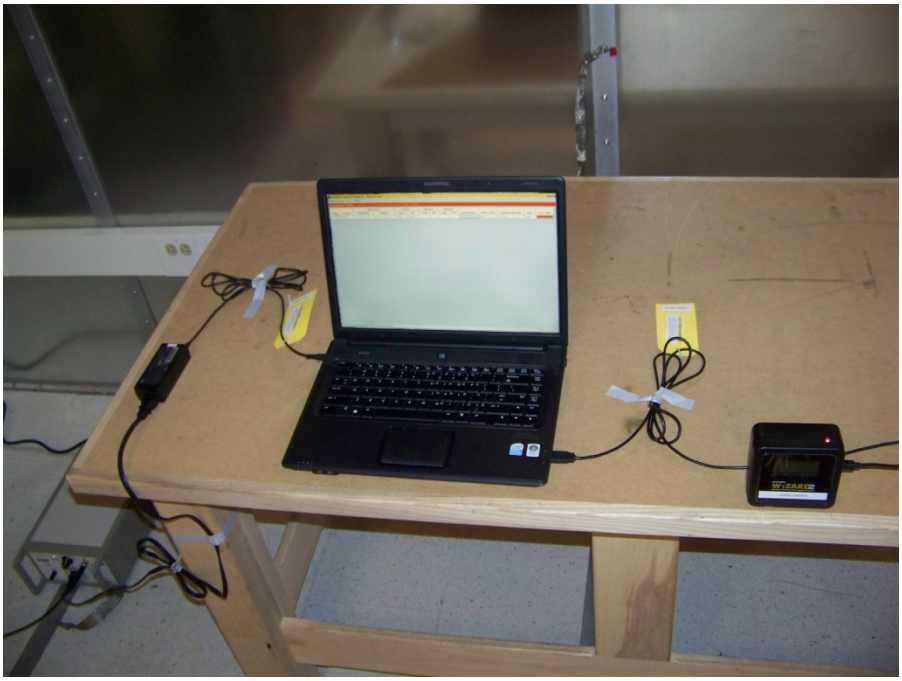

Figure 43: Equipment setup during Conducted RF Emissions tests – representative test showing EUT powered through USB port of a lap-top computer.

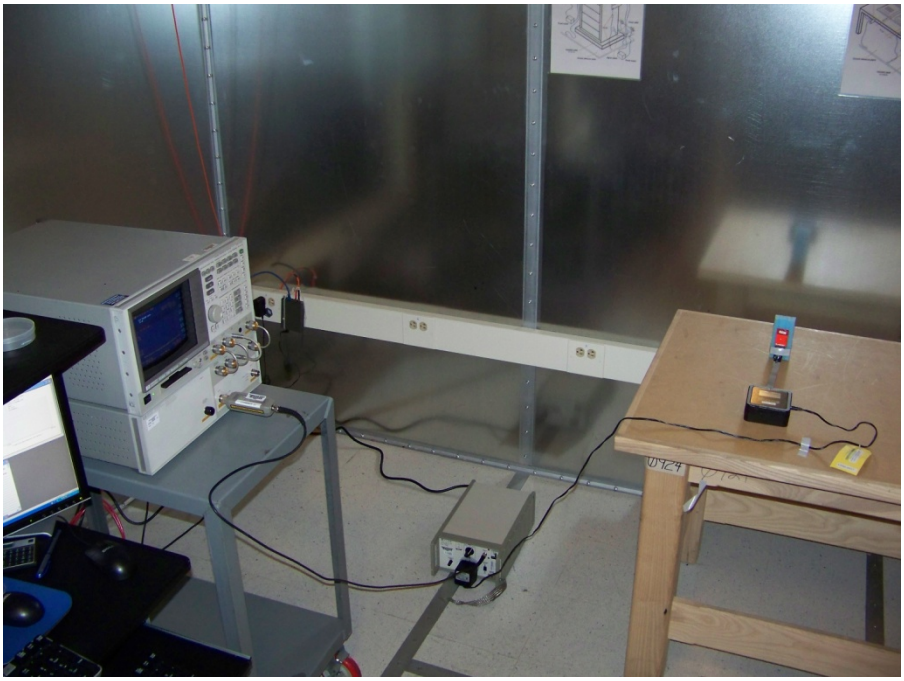

Figure 44: Equipment setup during Conducted RF Emissions tests – representative test showing EUT (Tx-LMA mode) powered by a wall-type step-down transformer.

2.1.2.4 Test Procedure

The EUT was measured for RF Emissions conducted onto AC Mains lines, in an RF-shielded room located at Ingenium Testing. Frequency range from 150 kHz to 30 MHz was investigated for RF emissions. Measurements were made via a LISN, equipped with a 50 Ω RF sampling port.
The measurements were made using the "Quasi-Peak" and "Average" detector functions as defined in CISPR 16-1-1, and available on the test equipment selected for this test.

The EUT was set-up and operated, by the client cognizant engineer, in the proper mode. The modes tested were per the test matrix in section 1.5 of this report. The EUT was investigated in three modes for this portion of the testing:

- Tx-LMA mode was tested with the transmitter operating in CW mode.
- Tx-host mode was tested with the EUT in normal configuration and operating in logger mode, and transmitting as fast as possible, approximately one every second.
- Rx-host mode was tested with the EUT in normal configuration and operating receive mode.

The receiver was operated with the IF resolution bandwidth (RBW) of 9 kHz for measurements between the frequencies of 150 kHz and 30 MHz (video bandwidth of 30 kHz).
The applicable Class B limits, as noted in 47 CFR 15.107 for a Class B type product were applied.
The tests were then repeated with the input voltage source varied to ±15 % per 47CFR15.31e.

2.1.2.5 Test Results

The EUT was found to **MEET** the requirements as described within the specifications of the FCC, Title 47 CFR, Part 15.107 for conducted emissions from a Class B product, onto AC Mains, as well as Part 15.207 and the Industry Canada requirements specified within ICES-003 for a Class B digital device. Supporting evidence of significant measured RF emissions, are tabulated and presented below.

CLIMATE TEST CONDITIONS

Temperature:	73 ^{o}F (22.8 ^{o}C)
Humidity:	48 % RH

Table 14: Results table – RF emissions conducted onto AC Mains: Tx-LMA mode, Power from USB, (102VAC,60Hz).

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line/ Test Mode	QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.214	L1	47.5	63.0	15.5	43.3	53.0	9.8
0.289	L1	46.0	60.5	14.6	41.9	50.5	8.7
0.433	L1	23.7	57.2	33.5	16.9	47.2	30.3
0.697	L1	27.4	56.0	28.6	26.6	46.0	19.4
3.598	L1	15.4	56.0	40.7	6.9	46.0	39.1
5.561	L1	23.6	60.0	36.4	11.1	50.0	38.9
16.191	L1	28.2	60.0	31.8	19.8	50.0	30.2
0.217	L2	45.6	62.9	17.3	42.5	52.9	10.5
0.257	L2	31.8	61.5	29.7	13.6	51.5	37.9
0.289	L2	46.0	60.5	14.5	44.1	50.5	6.4
0.436	L2	24.4	57.1	32.7	19.4	47.1	27.8
0.696	L2	28.5	56.0	27.5	27.6	46.0	18.4
3.764	L2	13.8	56.0	42.2	5.9	46.0	40.1
5.385	L2	24.5	60.0	35.5	12.2	50.0	37.8
16.276	L2	27.2	60.0	32.8	19.0	50.0	31.0

Table 15: Results table – RF emissions conducted onto AC Mains: Tx-LMA mode, Power from USB, (120VAC,60Hz).

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line/ Test Mode	QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.212	L1	48.8	63.1	14.3	46.3	53.1	6.8
0.279	L1	44.4	60.8	16.5	40.5	50.8	10.3
0.353	L1	29.6	58.9	29.3	25.2	48.9	23.6
0.426	L1	24.9	57.3	32.4	21.6	47.3	25.7
0.642	L1	17.7	56.0	38.3	14.9	46.0	31.1
0.697	L1	27.3	56.0	28.7	26.4	46.0	19.6
3.818	L1	22.1	56.0	33.9	7.0	46.0	39.0
5.086	L1	19.5	60.0	40.5	8.4	50.0	41.6
5.506	L1	26.1	60.0	33.9	11.4	50.0	38.6
16.187	L1	27.4	60.0	32.6	19.5	50.0	30.5
0.171	L2	38.5	64.9	26.4	8.7	54.9	46.2
0.210	L2	48.3	63.2	14.8	45.2	53.2	8.0
0.280	L2	44.8	60.8	16.0	42.0	50.8	8.8
0.351	L2	29.4	58.9	29.5	25.6	48.9	23.3
0.694	L2	33.0	56.0	23.0	32.7	46.0	13.3
4.102	L2	25.3	56.0	30.7	7.0	46.0	39.0
5.490	L2	28.5	60.0	31.5	14.9	50.0	35.1
5.856	L2	27.9	60.0	32.1	17.8	50.0	32.2
16.241	L2	27.3	60.0	32.7	17.6	50.0	32.4

Table 16: Results table – RF emissions conducted onto AC Mains: Tx-LMA mode, Power from USB, (138VAC,60Hz).

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	**Line/ Test Mode**	**QP Measurement (dBµV)**	**QP Limit (dBµV)**	**QP Margin (dB)**	**Average Measurement (dBµV)**	**Average Limit (dBµV)**	**Average Margin (dB)**
0.152	L1	51.7	65.9	14.2	44.3	55.9	11.6
0.160	L1	44.9	65.5	20.6	24.8	55.5	30.7
0.200	L1	38.0	63.6	25.6	11.0	53.6	42.6
0.222	L1	50.1	62.7	12.7	46.3	52.7	6.5
0.272	L1	31.7	61.1	29.4	17.8	51.1	33.2
0.294	L1	41.0	60.4	19.4	31.9	50.4	18.6
0.368	L1	33.7	58.5	24.8	29.1	48.5	19.5
1.463	L1	21.3	56.0	34.7	14.2	46.0	31.8
4.182	L1	14.9	56.0	41.1	5.2	46.0	40.9
5.792	L1	16.2	60.0	43.8	13.2	50.0	36.8
15.083	L1	34.3	60.0	25.7	21.4	50.0	28.6
0.208	L2	48.8	63.3	14.5	46.6	53.3	6.7
0.277	L2	50.1	60.9	10.8	47.4	50.9	3.5
0.421	L2	28.6	57.4	28.8	23.0	47.4	24.4
0.694	L2	32.8	56.0	23.2	32.4	46.0	13.6
3.984	L2	22.3	56.0	33.7	9.1	46.0	36.9
5.274	L2	19.8	60.0	40.2	8.5	50.0	41.5
5.912	L2	23.7	60.0	36.3	13.9	50.0	36.1
15.648	L2	26.3	60.0	33.7	16.4	50.0	33.6
16.595	L2	26.3	60.0	33.7	19.2	50.0	30.8

Table 17: Results table – RF emissions conducted onto AC Mains: Tx-LMA mode, Power from XFMR, (102VAC,60Hz).

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line/ Test Mode	QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.153	L1	9.6	65.8	56.3	5.8	55.8	50.0
0.500	L1	9.5	56.0	46.5	5.8	46.0	40.2
1.500	L1	9.5	56.0	46.5	5.7	46.0	40.3
4.500	L1	9.6	56.0	46.4	5.7	46.0	40.3
8.500	L1	9.3	60.0	50.7	5.6	50.0	44.4
12.500	L1	9.1	60.0	50.9	5.4	50.0	44.6
29.000	L1	9.0	60.0	51.0	5.4	50.0	44.6
0.152	L2	9.5	65.9	56.4	5.8	55.9	50.1
0.501	L2	9.5	56.0	46.5	5.9	46.0	40.1
1.501	L2	9.5	56.0	46.5	5.6	46.0	40.4
4.499	L2	9.6	56.0	46.4	5.7	46.0	40.3
8.499	L2	9.2	60.0	50.8	5.7	50.0	44.3
12.501	L2	9.0	60.0	51.0	5.3	50.0	44.7
29.000	L2	9.2	60.0	50.8	5.3	50.0	44.7

Table 18: Results table – RF emissions conducted onto AC Mains: Tx-LMA mode, Power from XFMR, (120VAC,60Hz).

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line/ Test Mode	QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.152	L1	9.6	65.9	56.3	5.8	55.9	50.1
0.500	L1	10.2	56.0	45.8	6.1	46.0	39.9
1.045	L1	18.9	56.0	37.1	13.0	46.0	33.0
1.501	L1	17.1	56.0	38.9	11.2	46.0	34.8
4.500	L1	18.0	56.0	38.0	12.1	46.0	33.9
8.499	L1	16.4	60.0	43.6	10.7	50.0	39.3
12.499	L1	14.5	60.0	45.5	9.1	50.0	40.9
29.001	L1	10.1	60.0	49.9	6.1	50.0	43.9
0.152	L2	9.7	65.9	56.2	5.8	55.9	50.1
0.501	L2	10.1	56.0	45.9	6.1	46.0	40.0
1.046	L2	17.2	56.0	38.8	11.6	46.0	34.4
1.500	L2	15.4	56.0	40.6	9.8	46.0	36.2
4.499	L2	16.4	56.0	39.6	10.7	46.0	35.3
8.499	L2	14.7	60.0	45.3	9.4	50.0	40.6
12.501	L2	13.2	60.0	46.8	8.0	50.0	42.0
29.001	L2	11.3	60.0	48.7	6.7	50.0	43.3

Table 19: Results table – RF emissions conducted onto AC Mains: Tx-LMA mode, Power from XFMR, (138VAC,60Hz).

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line/ Test Mode	QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.189	L1	9.5	64.1	54.6	5.8	54.1	48.3
0.500	L1	9.5	56.0	46.5	5.7	46.0	40.3
1.500	L1	19.4	56.0	36.6	13.2	46.0	32.8
2.371	L1	29.4	56.0	26.6	23.1	46.0	22.9
4.405	L1	26.9	56.0	29.1	20.6	46.0	25.4
9.070	L1	24.8	60.0	35.2	18.7	50.0	31.3
15.322	L1	22.0	60.0	38.0	15.5	50.0	34.5
0.189	L2	9.5	64.1	54.6	5.7	54.1	48.4
0.500	L2	9.6	56.0	46.4	6.0	46.0	40.0
1.500	L2	17.0	56.0	39.0	11.0	46.0	35.0
2.227	L2	27.3	56.0	28.7	21.1	46.0	24.9
4.406	L2	24.8	56.0	31.2	18.7	46.0	27.3
9.070	L2	22.6	60.0	37.4	16.4	50.0	33.6
15.322	L2	19.6	60.0	40.4	13.5	50.0	36.5

Table 20: Results table – RF emissions conducted onto AC Mains: Receive mode, Power from USB, (120VAC,60Hz).

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line/ Test Mode	QP Measurement (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Average Measurement (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.168	L1	38.6	65.1	26.5	9.7	55.1	45.4
0.212	L1	48.9	63.1	14.3	46.6	53.1	6.5
0.280	L1	43.7	60.8	17.1	32.2	50.8	18.7
0.354	L1	29.4	58.9	29.5	25.4	48.9	23.4
0.696	L1	27.3	56.0	28.7	26.6	46.0	19.4
5.493	L1	22.4	60.0	37.6	14.2	50.0	35.8
15.008	L1	24.1	60.0	35.9	17.5	50.0	32.5
16.620	L1	27.9	60.0	32.1	20.0	50.0	30.0
0.187	L2	35.4	64.1	28.7	7.9	54.1	46.3
0.217	L2	45.7	62.9	17.2	40.0	52.9	12.9
0.221	L2	44.0	62.8	18.8	28.2	52.8	24.6
0.286	L2	42.9	60.6	17.8	40.2	50.6	10.4
0.433	L2	22.0	57.2	35.2	9.6	47.2	37.6
0.696	L2	27.8	56.0	28.2	27.2	46.0	18.8
4.155	L2	26.4	56.0	29.6	11.6	46.0	34.4
5.901	L2	23.0	60.0	37.0	12.1	50.0	37.9
15.423	L2	25.1	60.0	35.0	15.8	50.0	34.2
16.001	L2	29.4	60.0	30.6	23.6	50.0	26.4

Uncertainty Calculations Includes a comparison between CISPR 16-4-2 and Ingenium Testing			
Measurement		U_{CISPR}	Ingenium Testing
Conducted Disturbance	150 kHz – 30 MHz	5.1 dB	4.2 dB

Notes:

Date of Estimation: November 02, 2007.

SCREEN CAPTURES – RADIATED RF EMISSIONS TESTING

These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector and an Average detector function is utilized.

Transmit (LMA) Mode – Lap-top USB Power, Mains at 102VAC.

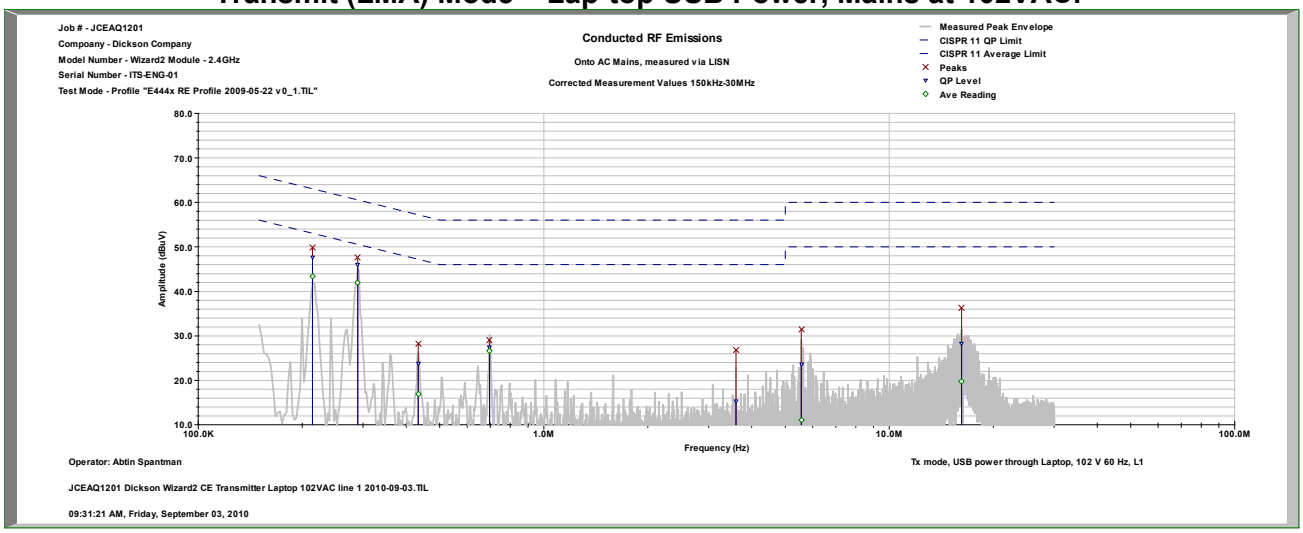

Figure 45: Conducted RF Emissions, Tx (LMA) mode, Power from USB, 102 VAC, 60 Hz, Line L1

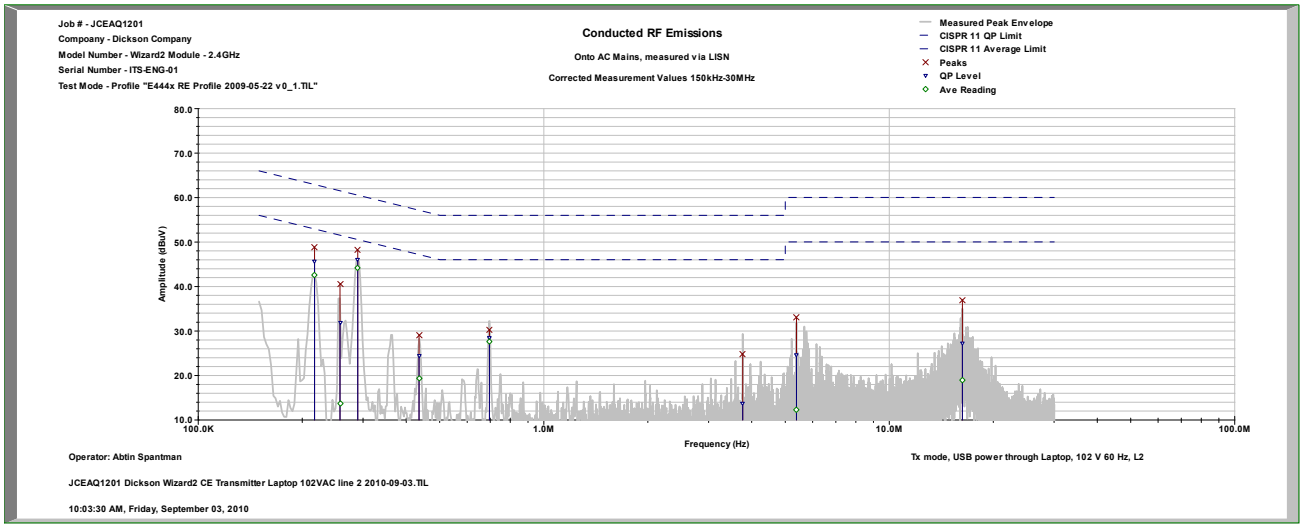

Figure 46: Conducted RF Emissions, Tx (LMA) mode, Power from USB, 102 VAC, 60 Hz, Line L2

Transmit (LMA) Mode – Lap-top USB Power, Mains at 120VAC.

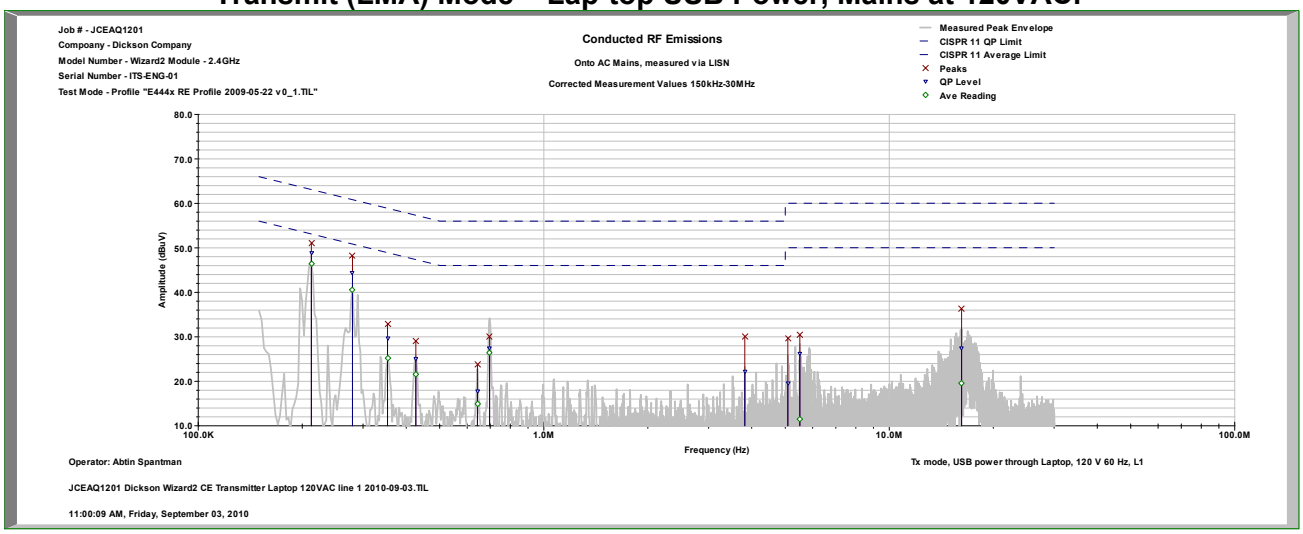

Figure 47: Conducted RF Emissions, Tx (LMA) mode, Power from USB, 120 VAC, 60 Hz, Line L1

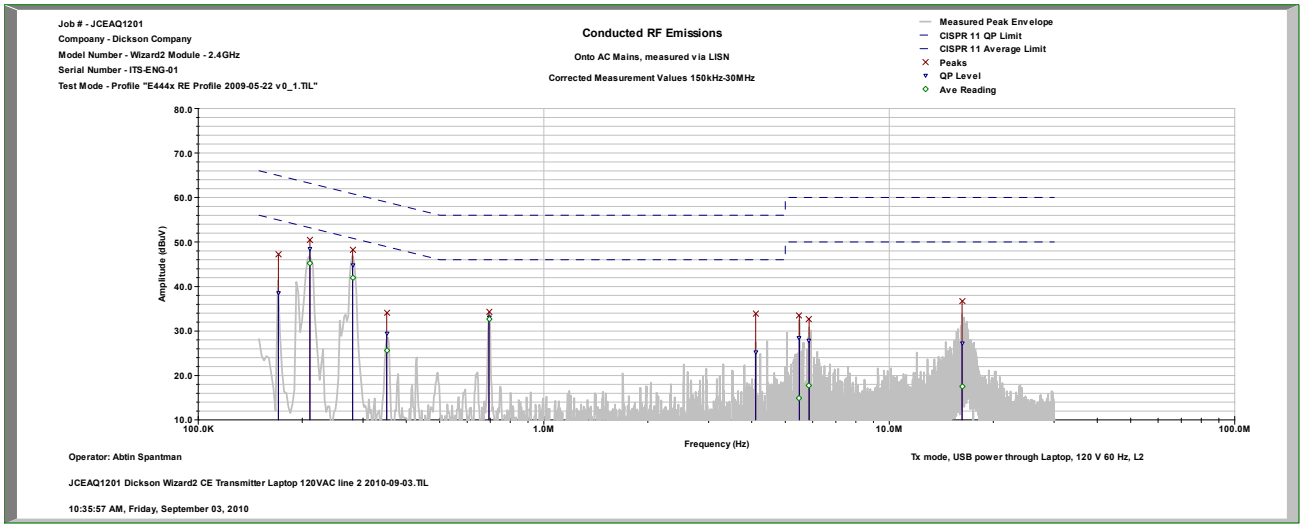

Figure 48: Conducted RF Emissions, Tx (LMA) mode, Power from USB, 120 VAC, 60 Hz, Line L2

Transmit (LMA) Mode – Lap-top USB Power, Mains at 138VAC.

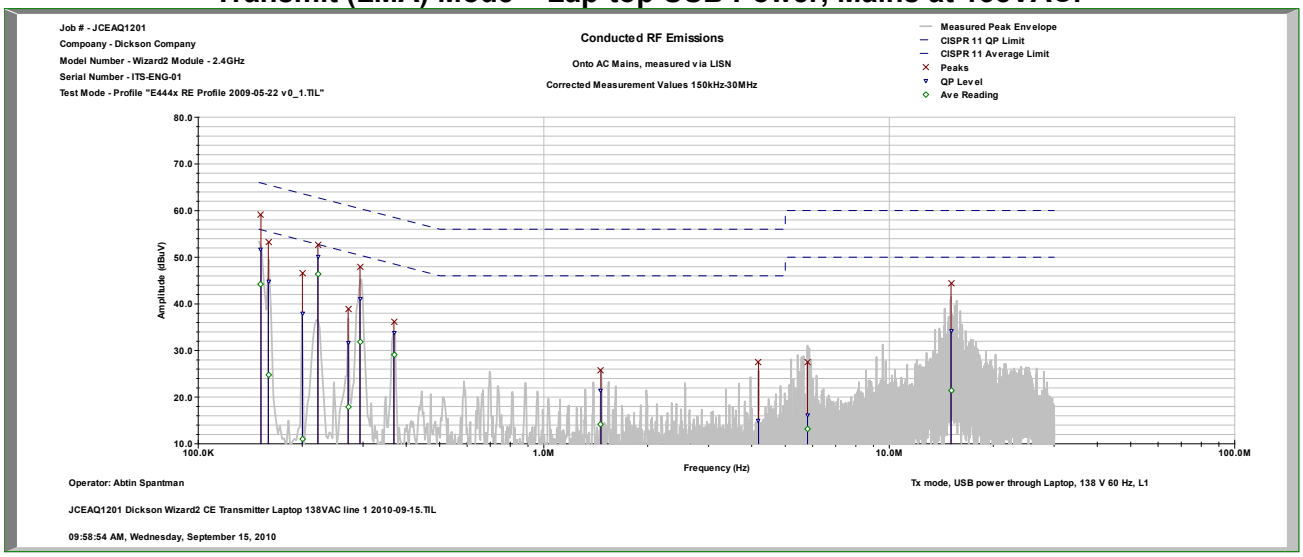

Figure 49: Conducted RF Emissions, Tx (LMA) mode, Power from USB, 138 VAC, 60 Hz, Line L1

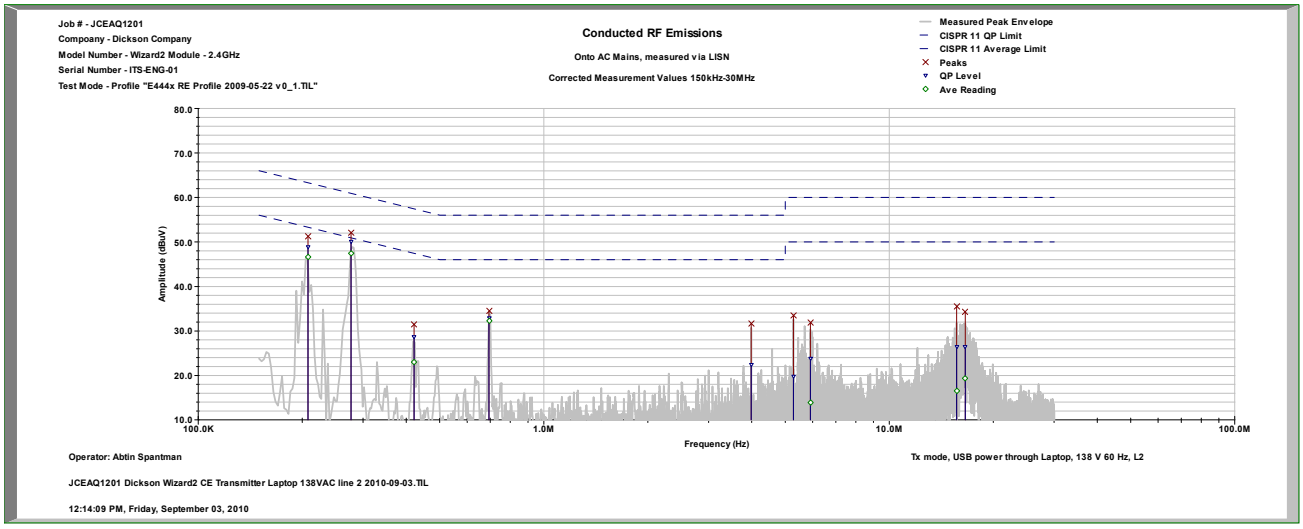

Figure 50: Conducted RF Emissions, Tx (LMA) mode, Power from USB, 138 VAC, 60 Hz, Line L2

Transmit (LMA) Mode – Wall step-down transformer, Mains at 102VAC.

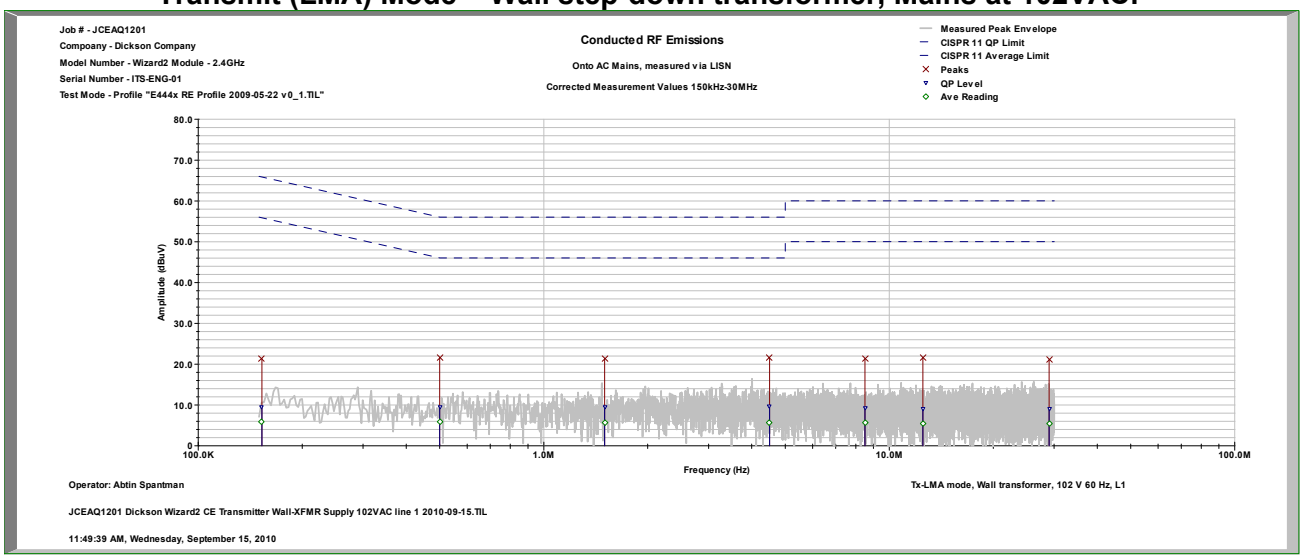

Figure 51: Conducted RF Emissions, Tx (LMA) mode, Power from transformer, 102 VAC, 60 Hz, Line L1

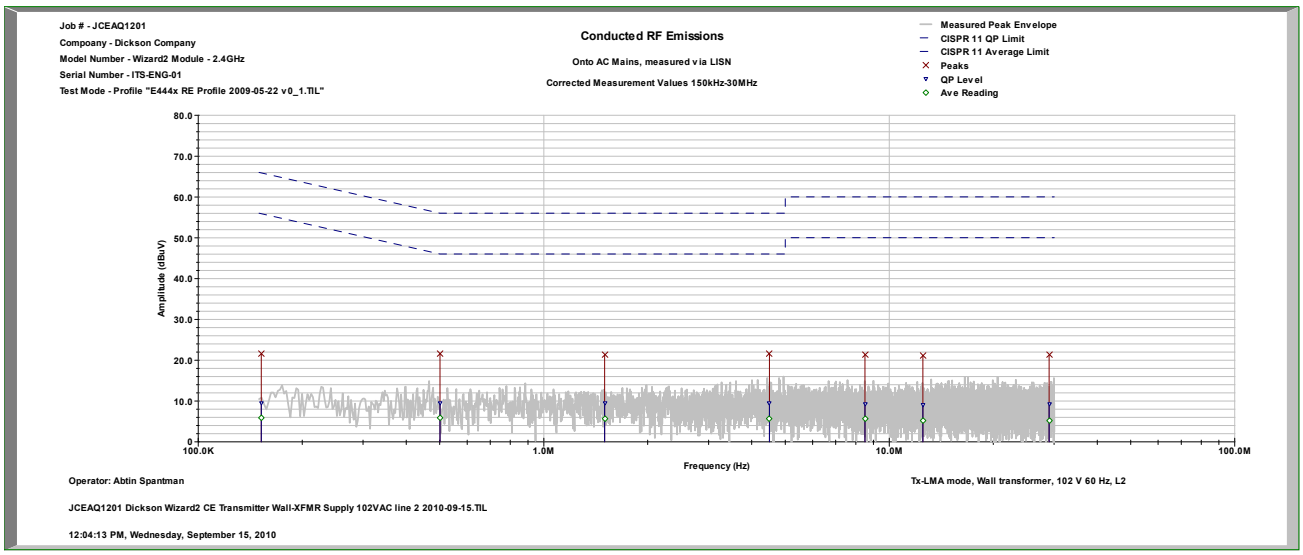

Figure 52: Conducted RF Emissions, Tx (LMA) mode, Power from transformer, 102 VAC, 60 Hz, Line L2

Transmit (LMA) Mode – Wall step-down transformer, Mains at 120VAC.

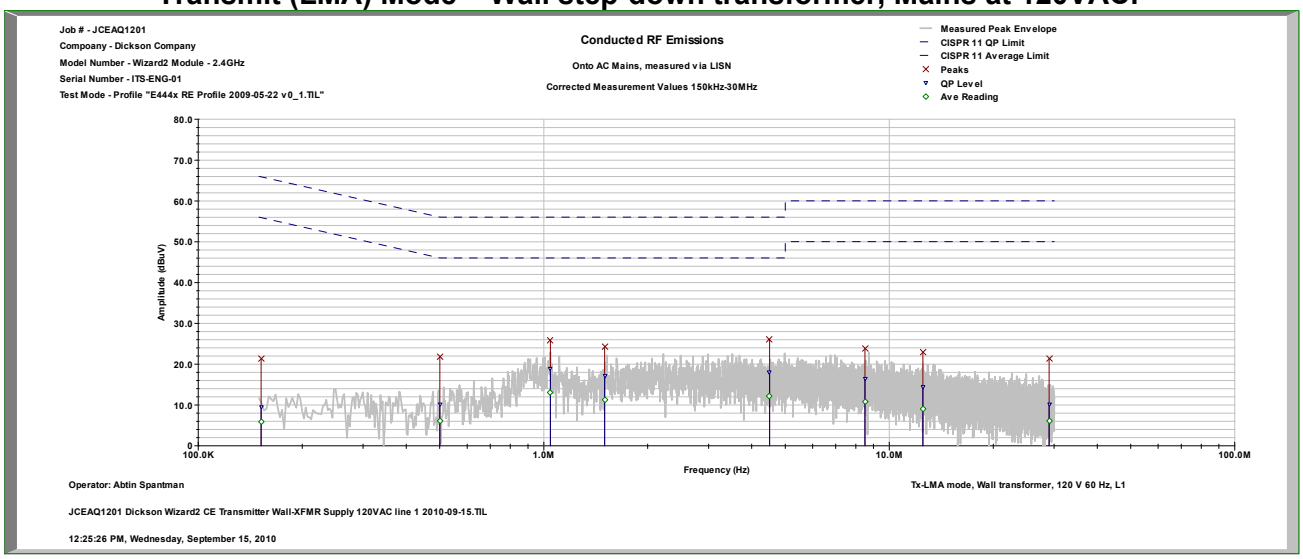

Figure 53: Conducted RF Emissions, Tx (LMA) mode, Power from transformer, 120 VAC, 60 Hz, Line L1

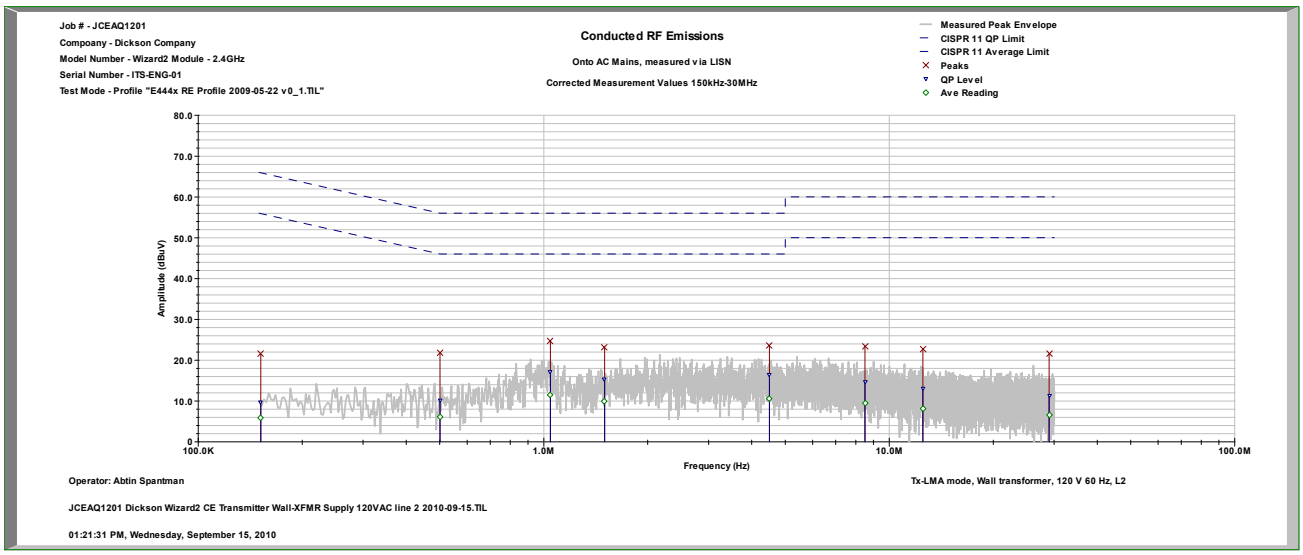

Figure 54: Conducted RF Emissions, Tx (LMA) mode, Power from transformer, 120 VAC, 60 Hz, Line L2

Transmit (LMA) Mode – Wall step-down transformer, Mains at 138VAC.

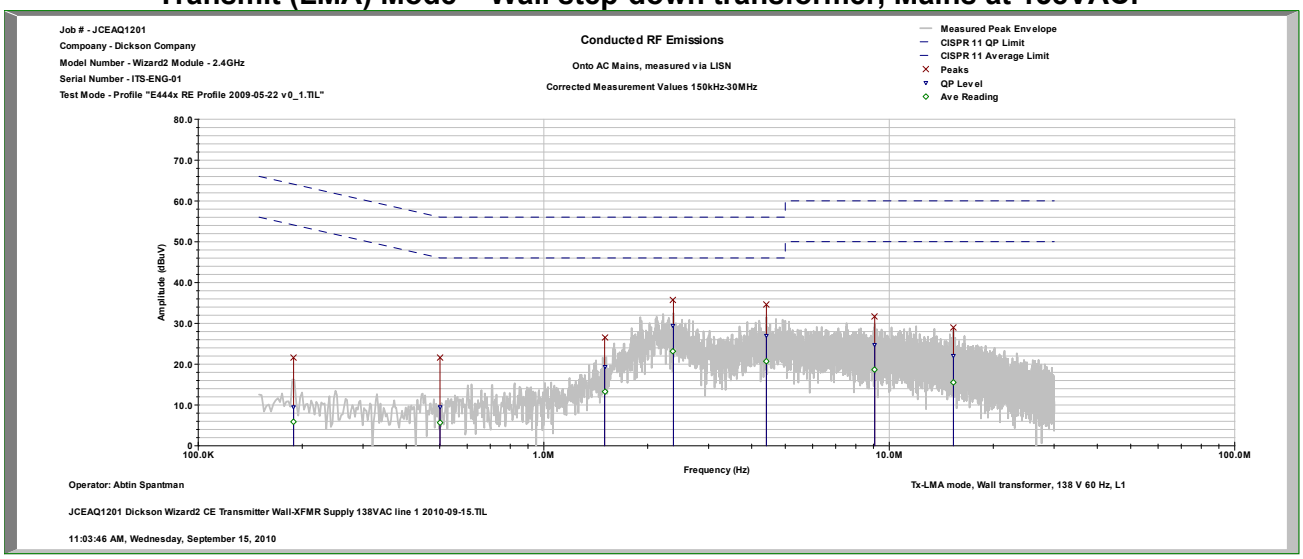

Figure 55: Conducted RF Emissions, Tx (LMA) mode, Power from transformer, 138 VAC, 60 Hz, Line L1

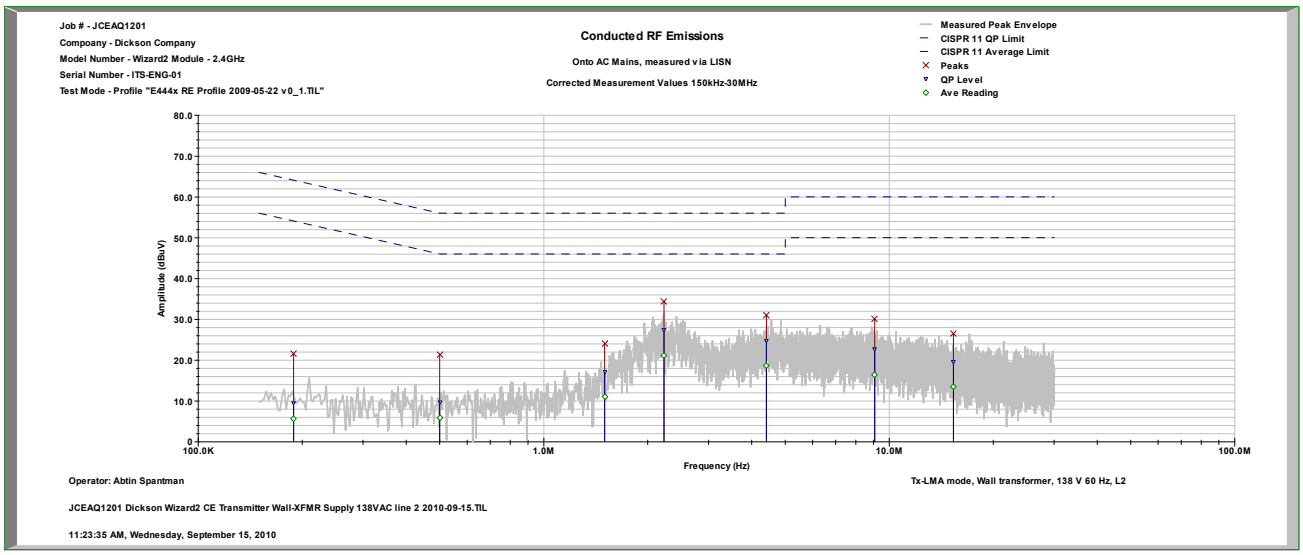

Figure 56: Conducted RF Emissions, Tx (LMA) mode, Power from transformer, 138 VAC, 60 Hz, Line L2

Receiver Mode – Lap-top USB Power, Mains at 120VAC.

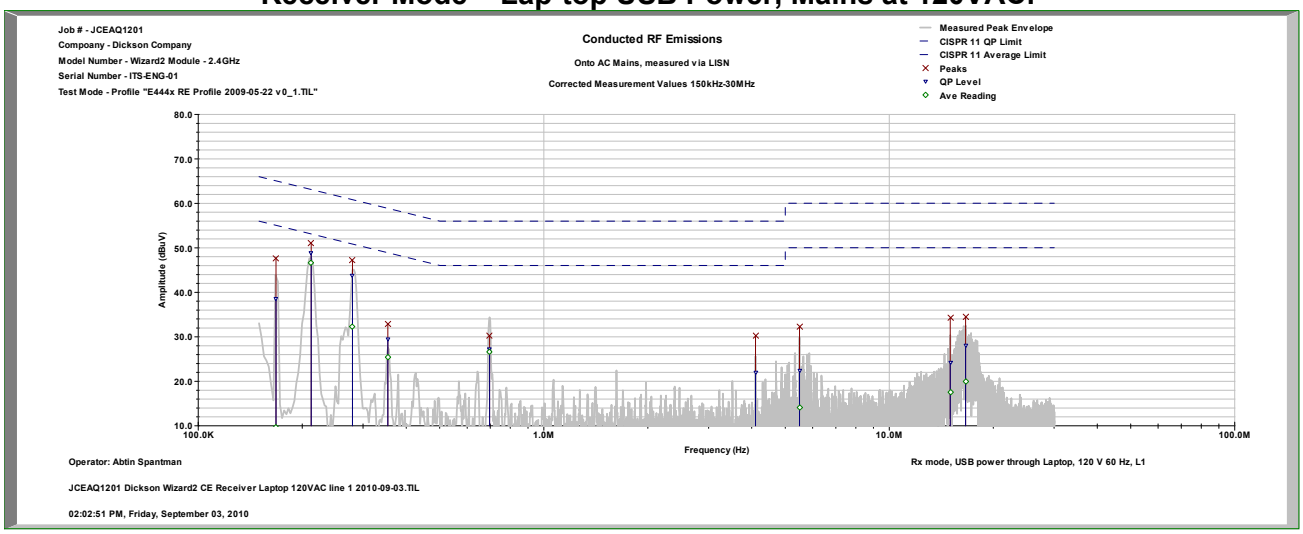

Figure 57: Conducted RF Emissions, Rx mode, Power from USB, 120 VAC, 60 Hz, Line L1

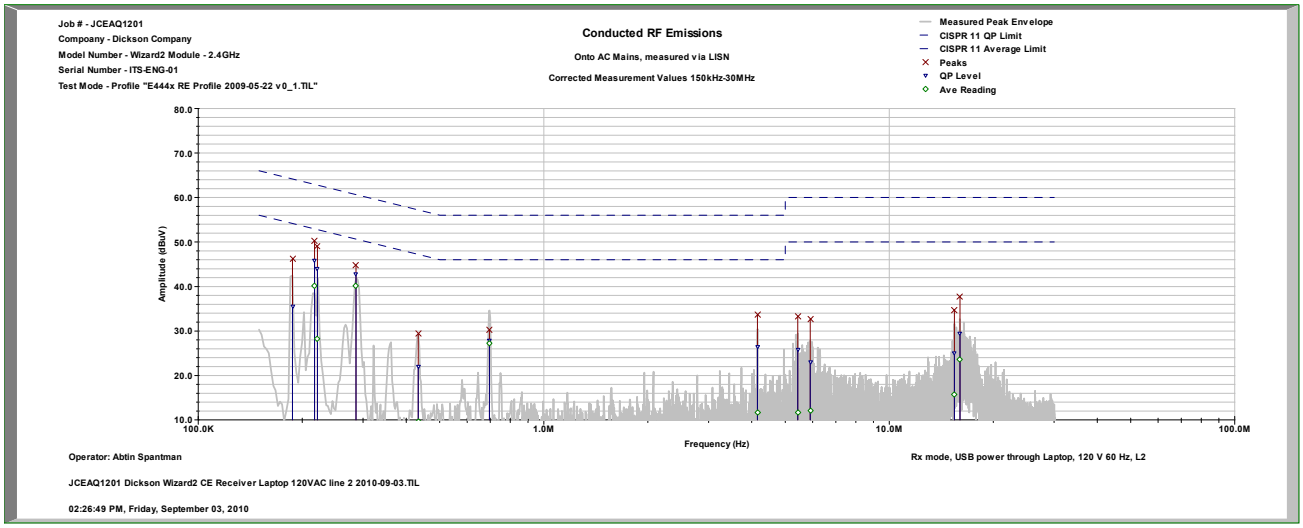

Figure 58: Conducted RF Emissions, Rx mode, Power from USB, 120 VAC, 60 Hz, Line L2

2.1.3 Radiated RF Performance Parameters – Occupied Bandwidth Measurements

2.1.3.1 Test Criterion

Occupied Bandwidth measurements are not required, under part 15.249, for this transmitter, but are needed per RSS-Gen, to ensure the emissions are contained within the authorized frequency band of operation and included here for reporting purpose and regulatory filing information.

Port Definition	Terminal Name	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
Enclosure	N/A	Transceiver Module with Logger as host. ***Transmit Mode Limited Modular Wall XFMR Power***	Occupied Bandwidth -20dBc -6dBc RSS-GEN, 4.6.1 RSS-GEN, 4.6.2	Emissions must be contained within the authorized band of operation.	Pass

2.1.3.2 Test Equipment

All equipment is calibrated according to governing standards, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers.

List of Equipment Used:

Manufacturer	Model	Ingenium Asset Number	Description	Last Cal data	Cal due date
Agilent	E4440A	1207	PSA Spec. Analyzer	01 Dec 2010	01 Dec 2011
Agilent	N9039A	1206	Pre-Selector	01 Dec 2010	01 Dec 2011
Hewlett Packard	8449B	RP-0056	Preamplifier	12 Jul 2010	12 Jan 2011
ETS	3117	1352	Horn Antenna	18 Nov 2009	18 Nov 2010

The data presented 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 measurement result.

2.1.3.3 Test Setup

Since the EUT does not have an available antenna port, the same setup was used as for radiated emissions measurements. The EUT was tested as a "table-top device" type product, as described in ANSI C63.4. The EUT was placed on a non-conductive pedestal, centered on a flush-mounted 3 meter-diameter turntable in the 10 Meter FCC Listed Semi-Anechoic Chamber located at Ingenium Testing.

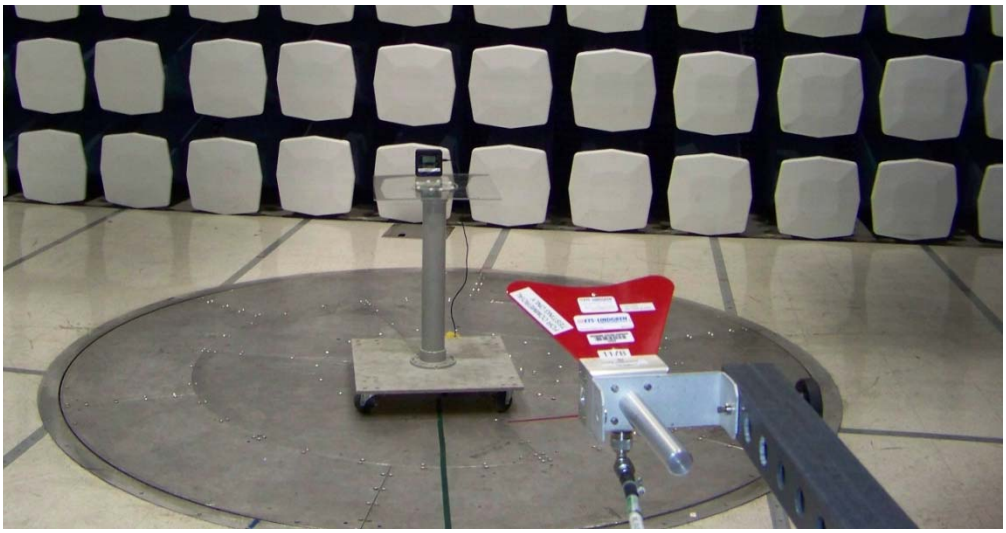

Figure 59: EUT on Test Pedestal during Occupied Bandwidth testing.

2.1.3.4 Test Procedure

The transmitter was placed in normal operating mode, transmitting once per second, as the fastest rate allowable by the firmware.. The transmitter was sending actual data, as would normally be transmitted, as a modulation source. The spectrum analyzer was operated as in emissions measurement, but placed in 'Peak-hold' mode (infinite hysteresis) in order to capture the 1.6ms transmission pulses. A receiver resolution bandwidth (RBW) of 9 kHz was selected for the spectrum analyzer (VBW at 91 kHz), and the span was adjusted to 2 MHz to capture the entire spectrum.

2.1.3.5 Test Results

Center Frequency	Measured Occupied Bandwidth At the -6 dBc level	Measured Occupied Bandwidth At the -20 dBc level
2.477 GHz	330 kHz	450 kHz

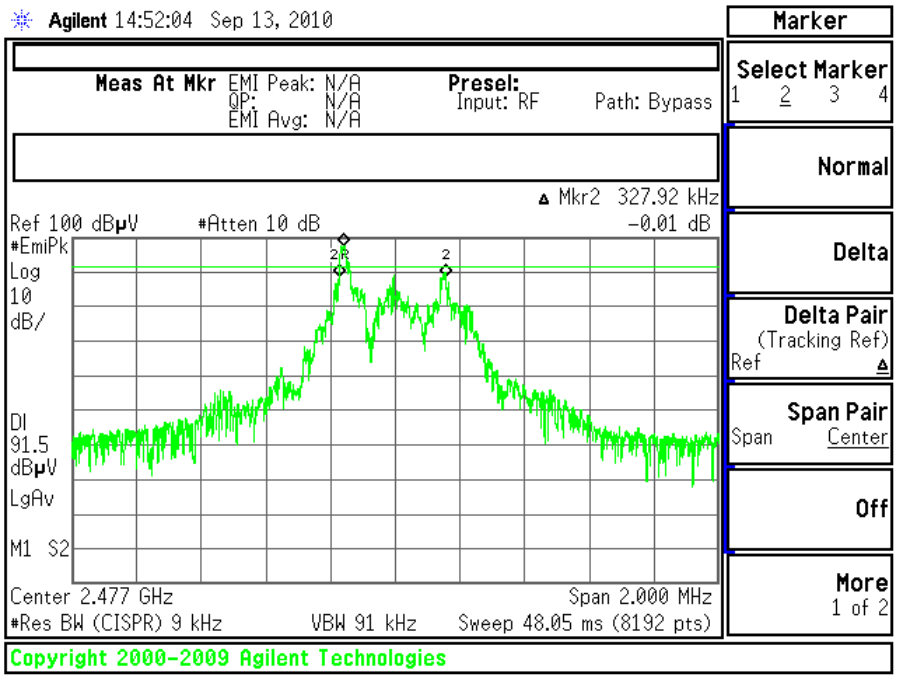

Figure 60: Transmit Occupied Bandwidth (-6dBc level).

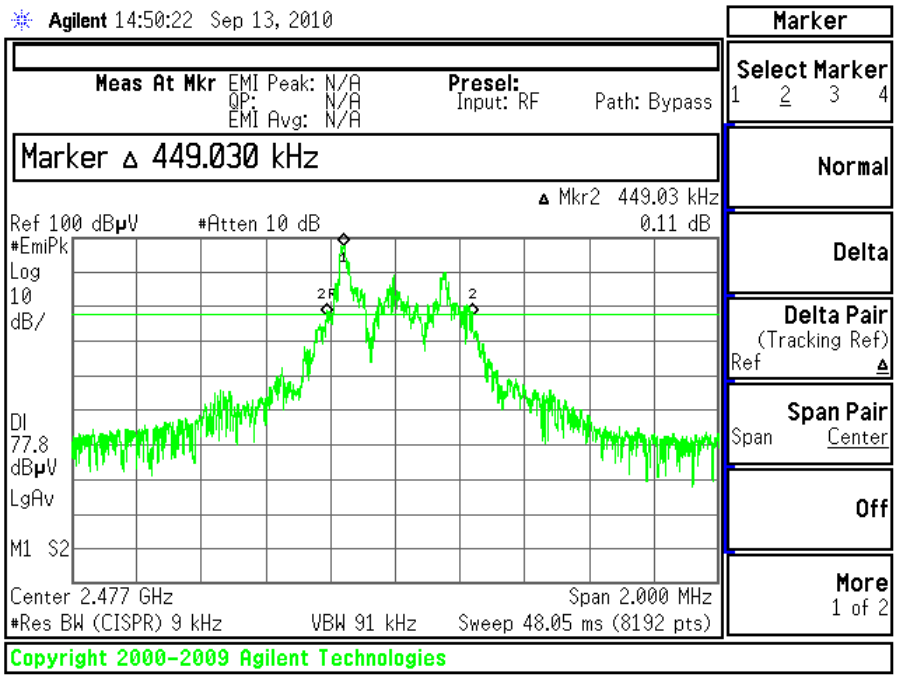

Figure 61: Transmit Occupied Bandwidth (-20dBc level).

2.1.4 Radiated RF Performance Parameters – Carrier Frequency and RF Power Stability Measurements (Voltage and Temperature Variation)

2.1.4.1 Test Criterion

Per 47 CFR Part 15.31(e), all intentional radiators shall be tested with a supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery. RSS-Gen, section 4.7 and 4.8 expect the transmitter characteristics to be maintained in an acceptable fashion with respect to variations in source power voltage and ambient temperatures between (-)30^{o} C and (+)50^{o} C.

Port Definition	Terminal Name	Description/ Detail	Test Standard	Performance Criteria	Pass / Fail
Enclosure	N/A	Transceiver Module with Logger as host. ***Transmit Mode Limited Modular Wall XFMR Power***	Carrier Frequency and RF Power Stability RSS-Gen Section 4.7 Section 4.8	No Limits Specified. (Note 1) Emissions must be contained within the authorized band of operation.	Pass

2.1.4.2 Test Equipment

All equipment is calibrated according to governing standards, and is N.I.S.T. traceable. The equipment is used according to the operation manuals as provided by the manufacturers.

List of Equipment Used for e.i.r.p. Tests :

Manufacturer	Model	Ingenium Asset Number	Description	Last Cal data	Cal due date
Agilent	E4440A	1207	Spectrum Analyzer	01 Dec 2010	01 Dec 2011
Agilent	N9039A	1206	Pre-Selector	01 Dec 2010	01 Dec 2011
Hewlett Packard	8449B	RP-0056	Preamplifier	12 Jul 2010	12 Jan 2011
ETS	3117	1352	Horn Antenna	18 Nov 2009	18 Nov 2010

List of Equipment Used Stability Tests:

Manufacturer	Model	Ingenium Asset Number	Description	Last Cal data	Cal due date
AET	AAD-19915-00	CP99-0112	Temp. Chamber	NCR	NCR
Amprobe/Meterr	AM-160A	CP99-0113	Tru-RMS meter	15 Jul 2010	15 Jul 2011
Rhode&Schwarz	FSP-7	CP99-0114	Spectrum Analyzer	18 Jul 2010	18 Jul 2011
AET	APD-10022-01	CP99-0115	Near-Field Probe	NCR	NCR
Mastech	HY3020D	CP99-0116	Variable Supply	NCR	NCR

The data presented 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 measurement result.

2.1.4.3 Test Setup

The test setup as described in section 2.1.3.3, for conducted RF measurements was used for the RF stability measurements.

For measurements of the frequency and voltage stability, the transmitter was placed inside a temperature controlled environmental chamber. A Spectrum Analyzer was connected to the EUT through a small coaxial cable. For this test, the EUT was place inside a temperature chamber, with the transmitter portion of the EUT placed in continuous transmit CW mode. Power to the EUT was supplied by an external bench-type variable power supply. The frequency of operation was monitored using the spectrum analyzer. The power supply and spectrum analyzer were located outside the temperature chamber. The frequency was measured with a receiver resolution bandwidth of 100 Hz, and video bandwidth of 300 Hz (span=100kHz, sweep=1.2s).

2.1.4.4 Test Procedure

The stability of the device was examined as a function of the input voltage available to the EUT and the ambient temperature. For measurements of the frequency and power stability, the transmitter was placed inside a temperature controlled environmental chamber. A spectrum analyzer was used to measure the frequency at the appropriate frequency markers, as well as the relative power out. For this test, the EUT was place inside a temperature chamber, with the transmitter portion of the EUT placed in CW continuous transmit mode. Power was supplied by an external bench-type variable power supply.. The power supply and spectrum analyzer were located outside the temperature chamber.

This EUT can operate on three types of input power sources. A switch-mode buck power supply (USB through lap-top) should see little change on the output. A linear step-down supply would experience a ratio (20:1) change in output based on the change in the input voltage. The battery at 6V nominal, and a linear step-down would see the same change in output voltage. The battery power was chosen as the power port to test.

The spectrum analyzer was used again, with proper resolution and video bandwidths (RBW = 1 MHz and VBW = 8 MHz), and a span of 5 MHz, to measure the maximum radiated power as may used for e.i.r.p. calculations. This test was performed in anechoic chambers, in the conditions that produced the highest radiated emission levels as measured and presented in the previous sections of this report.

2.1.4.5 Test Results

The frequency drift during the voltage and temperature variation was approximately 11.5 kHz, or 4.5ppm.

	DC Voltage Source		
Temperature (^{o}C)	5.1 VDC	6.0 VDC	6.9 VDC
+50		2.476998560 GHz	
+20	2.476999835 GHz	2.476999880 GHz	2.476999820 GHz
-30		2.477009680 GHz	

The **relative** RF Power Output of the EUT was also monitored, in CW mode, using the Spectrum Analyzer and a near-field probe, with RBW=100 Hz, VBW= 300 Hz setting while the voltage was varied.

	DC Voltage Source		
Temperature (^{o}C)	5.1 VDC	6.0 VDC	6.9 VDC
+50		-46.92 dBm	
+20	-47.38 dBm	-47.38 dBm	-47.38 dBm
-30		-47.88 dBm	

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

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 and temperature variation tests.

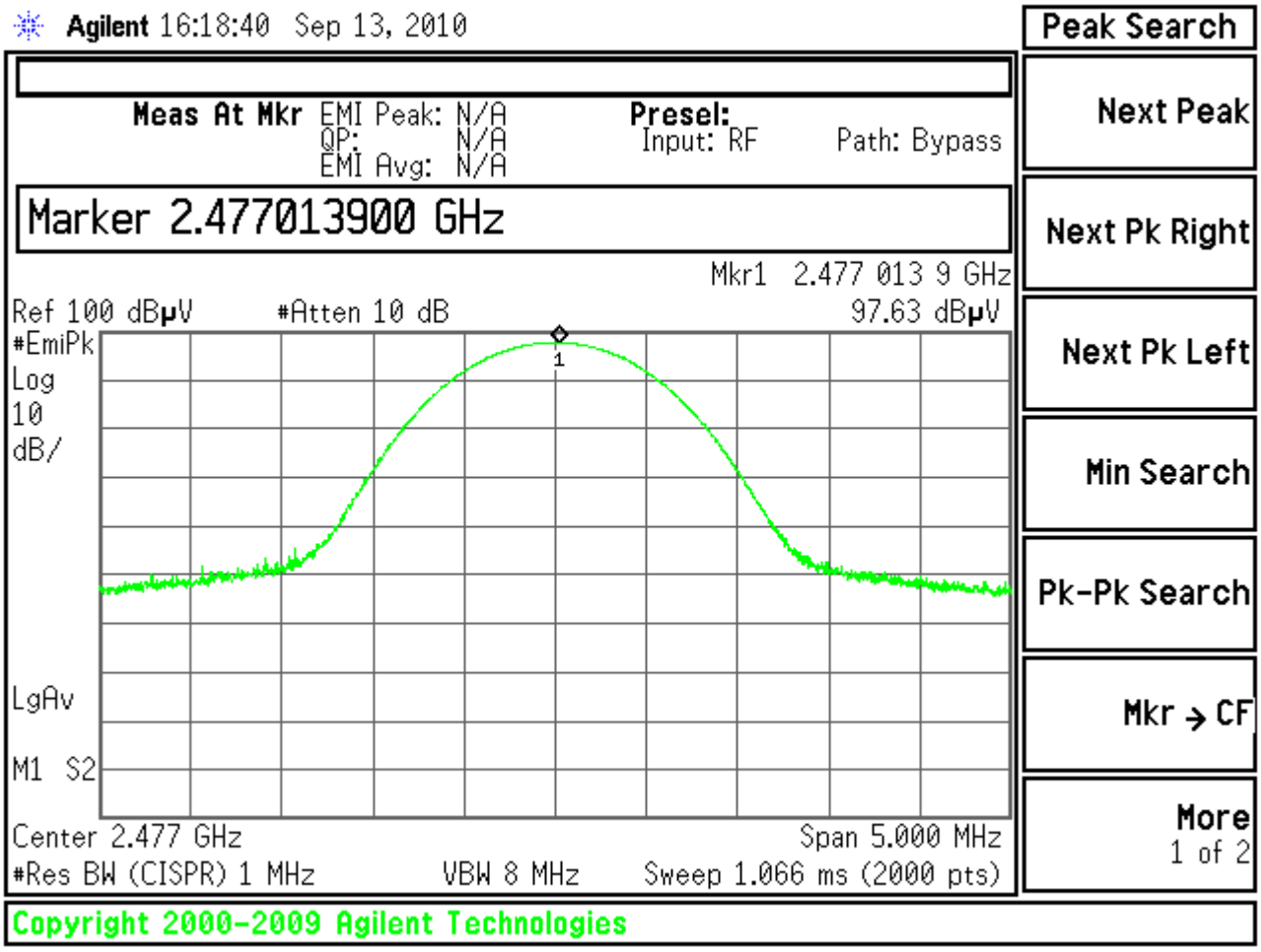

Figure 62: Transmit Radiated Peak RF Output Power.

Fundamental Frequency (GHz)	Measured RF Output Power (dBµV/m @ 3m)	Measured RF Output Power (dBm)
2.477	97.7	+2.47

Rated RF power output (watts): **1.00 mW max. (Typ:0dBm, 4dBm max:RFIC Manuf.)**
Measured RF Power Output (Watts): **1.77 mW**
Declared RF Power Output (Watts): **1.00 mW**

2.1.5 Time Average Use of the Spectrum – Relaxation Factor Calculations

For the purposes of regulatory compliance verifications, this device was tested in CW mode, as documented in this report.
The normal mode of operation for this transceiver unit, is pulsed transmission of binary encoded data using GFSK modulation.
The pulsed transmit packet envelope is approximately 1.6ms in duration.

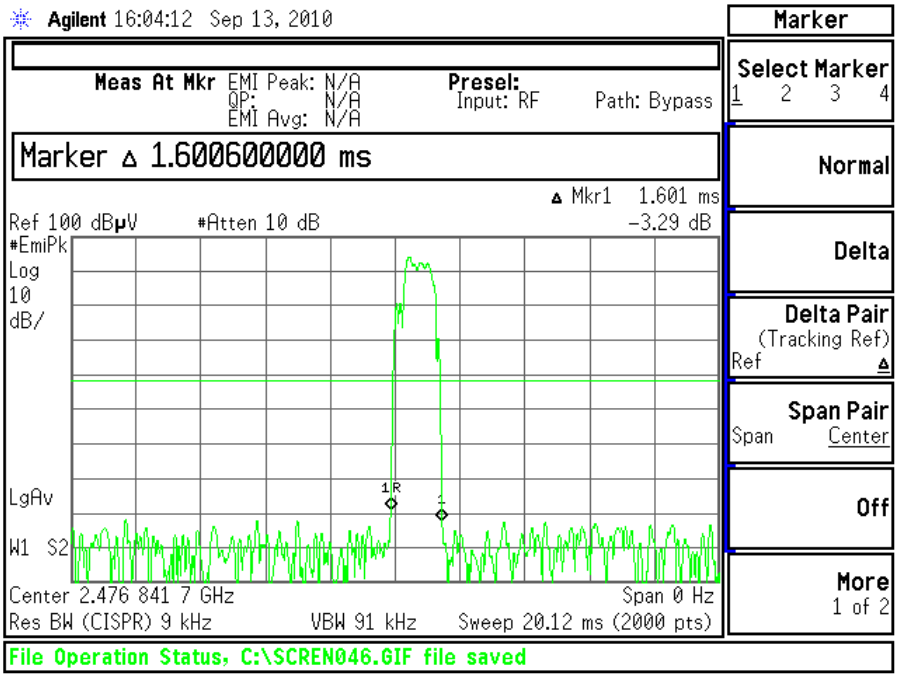

Figure 63: Transmit packet envelope

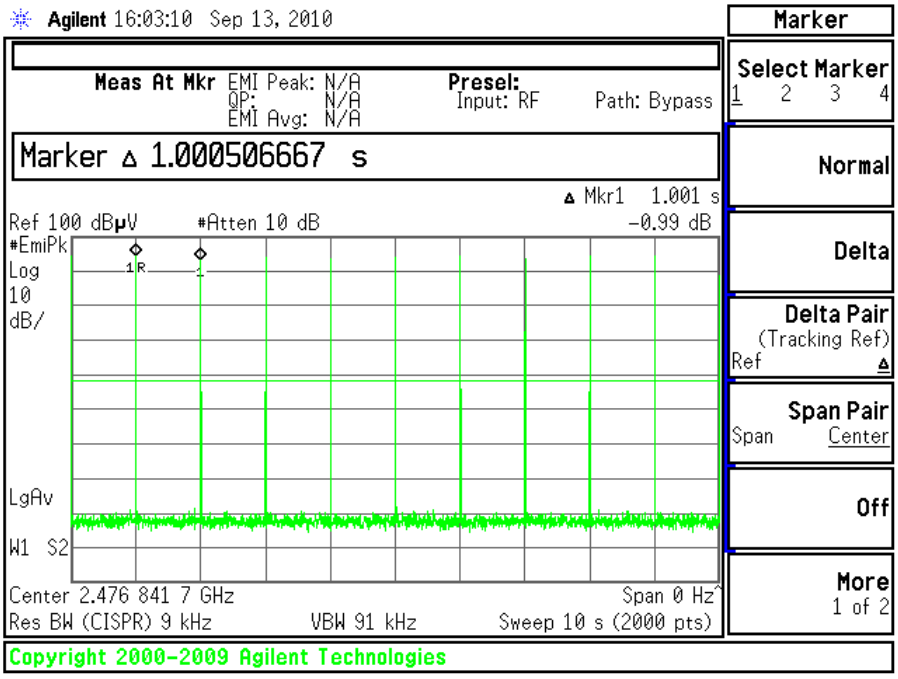

Figure 64: Fastest transmit repetition rate is at one transmission per second.

Based on the fact that the transmit packet envelope is approximately 1.6ms in duration, and no other transmissions occur within the 100 ms window of observation, a time-averaging relaxation may be applied to the measurements of the field strength.

Allowable relaxation, up to a maximum of 20 dB, may be calculated as follows:

$$Relaxation\ factor = \ 20\ \times Log_{10}\left(\frac{1.6\ ms}{100\ ms}\right) = \ -35.9\ dB$$

A maximum allowable relaxation of 20 dB is invoked for this transceiver, for the field strength measurements, based on time-average use of the spectrum, as allowed per 47CFR 15.35(c).

2.1.6 Radiated RF Performance Parameters – MPE Calculations

This device transmits with power less than 2 mW, at distances greater than 20 cm from the body.

3.1 Electromagnetic Susceptibility Tests

There are no susceptibility requirements.
No susceptibility tests were performed on this product.

This page was intentionally left blank

Appendix A

A Ingenium Testing, LLC Applicable Accreditations.

Ingenium Testing, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025:2005, "General Requirements for the Competence of Calibration and Testing Laboratories."

Ingenium Testing's scope of accreditation includes all test methods listed herein, unless otherwise noted. A copy of the accreditation (testing certificate number 2674.01) may be accessed at the Ingenium Testing website (www.ingeniumtesting.com), and the accreditation status may be verified at the A2LA website (www.a2la.net).

TESTING CERTIFICATE NUMBER 2674.01