ENGINEERING TEST REPORT

Vivolink Control Unit
Model No.: V50

FCC ID: TVZ-V50

Applicant: **Vivosonic Inc.**
56 Aberfoyle Crescent, Suite 620
Toronto, Ontario
Canada, M8X 2W4

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C, SEC. 15.247
Digital Modulation (Bluetooth) Transmitters operating in the frequency band 2402-2480 MHz

UltraTech's File No.: VIVO-003FCC15C

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: Jan. 16, 2006	
Report Prepared by: Dharmajit Solanki Issued Date: Jan. 16, 2006	Tested by: Hung Trinh, RFI Technologist Test Dates: Jan. 04-Jan. 12, 2006

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Docket No.: 99-231:2002 (Amendment to FCC Part 15 of the Commission's Rules Regarding to Spread Spectrum Devices), Part 15, Subpart C, Section 15.247
Title	Telecommunication - Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Digital Modulation (Bluetooth) Transmitters operating in the Frequency Band 2402-2480 MHz .
Test Procedures	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - 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.
Environmental Classification:	• Residential • Light-industry, Commercial • Industry

1.2. RELATED SUBMITAL(S)/GRANT(S)

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC 47CFR Parts 0-19	2005	Code of Federal Regulations – Telecommunication
ANSI C63.4	2004	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
CISPR 22 +A1 EN 55022	2003-04-10 2004-10-14 2003	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement
CISPR 16-2-3	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-3: Radiated disturbance measurement
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
FCC Procedures	…	FCC Guidance for Measurements for Direct Sequence Spread Spectrum Systems

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT:	
Name:	Vivosonic Inc.
Address:	56 Aberfoyle Crescent, Suite 620 Toronto, Ontario Canada, M8X 2W4
Contact Person:	Mr. Amjad Rana Phone #: 416-231-9997 Fax #: 416-231-2289 Email Address: rana@vivosonic.com

MANUFACTURER:	
Name:	Vivosonic Inc.
Address:	56 Aberfoyle Crescent, Suite 620 Toronto, Ontario Canada, M8X 2W4
Contact Person:	Mr. Amjad Rana Phone #: 416-231-9997 Fax #: 416-231-2289 Email Address: rana@vivosonic.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name	Vivosonic Inc.
Product Name	Vivolink Control Unit
Model Name or Number	V50
Serial Number	VP016
Type of Equipment	Digital Modulation (Bluetooth) Transmitters
Input Power Supply Type	4 x 1.5V AA NiMH Batteries
Primary User Functions of EUT:	Provide data communication link through air

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Portable
Intended Operating Environment:	▪ Residential ▪ Medical , commercial & light industry
Power Supply Requirement:	4 x 1.5V AA Batteries (NiMH/Alkaline)
RF Output Power Rating:	+1.0 dBm
Operating Frequency Range:	2402-2480 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	1 MHz
Duty Cycle:	64.48%
20 dB Bandwidth: **6 dB Bandwidth:**	0.7936 MHz 0.5691 MHz
Modulation Type:	Bluetooth
Spectral Density	1.02 mW/MHz (Power output at the antenna / bandwidth of the RF output spectrum)
Antenna Connector Type:	Integral (the antenna component is soldered onto the radio printed circuit board and located inside the enclosure)
Antenna Details:	(a) Type : Multilayer Ceramic (b) Manufacturer and model number : Yageo 4311-111-00245 (c) Gain : 1.2 dBi

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Amplitrode	1	Mini-DIN 8 Pin	Shielded
2	OAE	1	Mini-DIN 9 pin	Shielded
3	ER-3A	1	Switchcraft TB4 locking connector	Shielded
4	B-71	1	¼" audio phone jack	Non-shielded

2.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Amplitrode
Brand name:	Vivosonic Inc.
Model Name or Number:	A50
FCC ID:	N/A (Passive device)
Serial Number:	AP035
Connected to EUT's Port:	Mini-DIN 8 Pin

Ancillary Equipment # 2	
Description:	OAE Probe
Brand name:	Vivosonic Inc.
Model Name or Number:	P40
FCC ID:	N/A (Passive device)
Connected to EUT's Port:	Mini-DIN 9 Pin

Ancillary Equipment # 3	
Description:	Insert Earphone
Brand name:	Vivosonic Inc.
Model Name or Number:	ER3-A-ABR
FCC ID:	N/A (Passive device)
Serial Number:	41176 & 41177
Connected to EUT's Port:	Switchcraft TB4 locking connector

Ancillary Equipment # 4	
Description:	Bone Conductor
Brand name:	Vivosonic Inc.
Model Name or Number:	B-71-10
FCC ID:	N/A (Passive device)
Serial Number:	27078
Connected to EUT's Port:	¼" audio phone jack

2.6. TEST SETUP BLOCK DIAGRAM

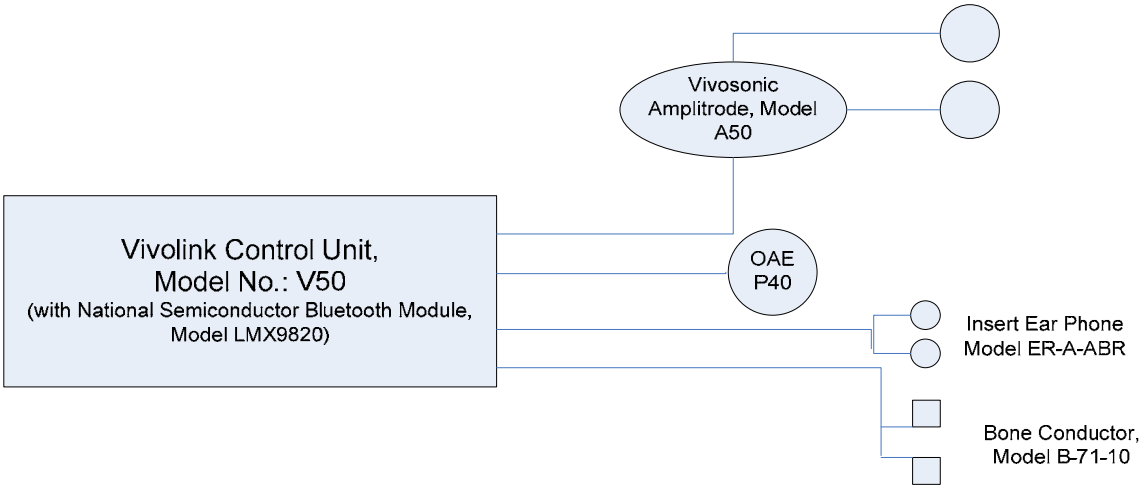


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	4 x 1.5V AA Batteries (NiMH/Alkaline)

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements. ▪ The EUT operates in Frequency Hopping Mode and Direct Sequence mode.
Special Test Software:	▪ Special software is provided by the Applicant to select and operate the EUT at each channel frequency continuously and mode of operation such as frequency hopping or direct sequence for testing purpose.
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as an integral antenna equipment.

Transmitter Test Signals:	
Frequencies: ▪ 2402-2480 MHz band:	Lowest, middle and highest channel frequencies tested: 2402, 2441 & 2480 MHz.
Transmitter Wanted Output Test Signals: ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation ▪ Modulating Signal Source:	 ▪ 1.02 mW EIRP ▪ Bluetooth ▪ Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049-1). Last Date of Site Calibration: June. 20, 2005.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
15.107(a) & 207	AC Power Conducted Emissions	N/A for battery operated device
15.247(a)(1)&(2)	20dB & 6 dB Bandwidths of a Digital Modulation (Bluetooth) System	Yes
15.247(b)(1) & (3)	Maximum Peak EIRP (Substitution Methods)	Yes
15.247(b)(5), 15.247(e)(i) & 1.1307(b)(1)	RF Exposure Limit	N/A (Note 1)
15.247(f)	Average Time of Occupancy on any Channel shall not be greater than 0.4 seconds	Yes
15.247(e)&(f)	Transmitted Power Density of a Hybrid System (Bluetooth) in acquisition mode	Yes
15.247(d), 15.209 & 15.205	Transmitter Radiated Emissions	Yes
FCC Part 15, Sub. B, Sec. 15.109	Class B Radiated Emissions	Yes (Note 2)

Notes:

(1) The SAR tests and RF Exposure requirements is exempted the radio transmitter with the Average EIRP = 0.1 dBm – 3.81 dB = -3.71 dBm or 0.43 mWatts
(2) A separate engineering test report for compliance with FCC Part 15, Subpart B - Class B Unintentional Radiators will be provided upon request.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in ANSI C63.4, ULTR-P001-2004, ULTR-P002-2004 and ULTR-P003-2004.

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document LAB 34 with a confidence level of 95%. Please refer to Exhibit 6 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1.

5.4. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: • The application (or intended use) of the EUT • The installation requirements of the EUT • The method by which the EUT will be marketed	**The integral antenna is permanently mounted on the printed circuit board and located inside the enclosure**
15.204	Provided the information for every antenna proposed for use with the EUT: (c) type (e.g. Yagi, patch, grid, dish, etc…), (d) manufacturer and model number (e) gain with reference to an isotropic radiator	 - **Multilayer Ceramic Antenna** - **Yageo 4311-111-00245** - **1.2 dBi**

5.5. 6 DB & 20 DB BANDWIDTH @ FCC 15.247(A)(1)&(2)

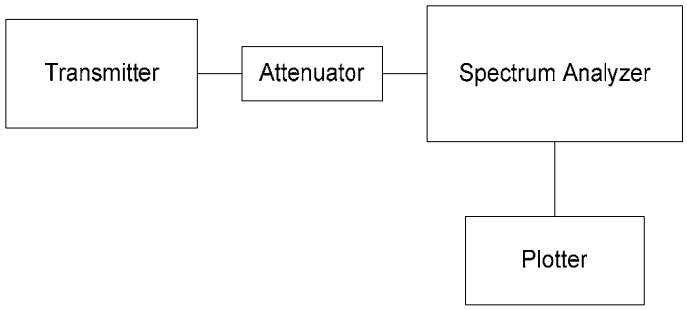
5.5.1. Limits

- For Frequency Hopping System, The 20 dB bandwidth shall not exceed 1 MHz.
- For a Digital Modulation System, the 6 dB bandwidth shall be at least 500 KHz.

5.5.2. Method of Measurements

Refer to Ultratech Test Procedures, Files # ULTR P002-2004 & ULTR P003-2004 and ANSI C63.4 for measurement methods

5.5.3. Test Arrangement



5.5.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer

5.5.5. Test Data

5.5.6. For Frequency Hopping Spread Spectrum Mode @ FCC 15.247(a)(1)

CHANNEL FREQUENCY (MHz)	20 dB Bandwidth (MHz)	MAXIMUM LIMIT (MHz)	PASS/FAIL
2402	0.7936	1.00	PASS
2441	0.7936	1.00	PASS
2480	0.7936	1.00	PASS

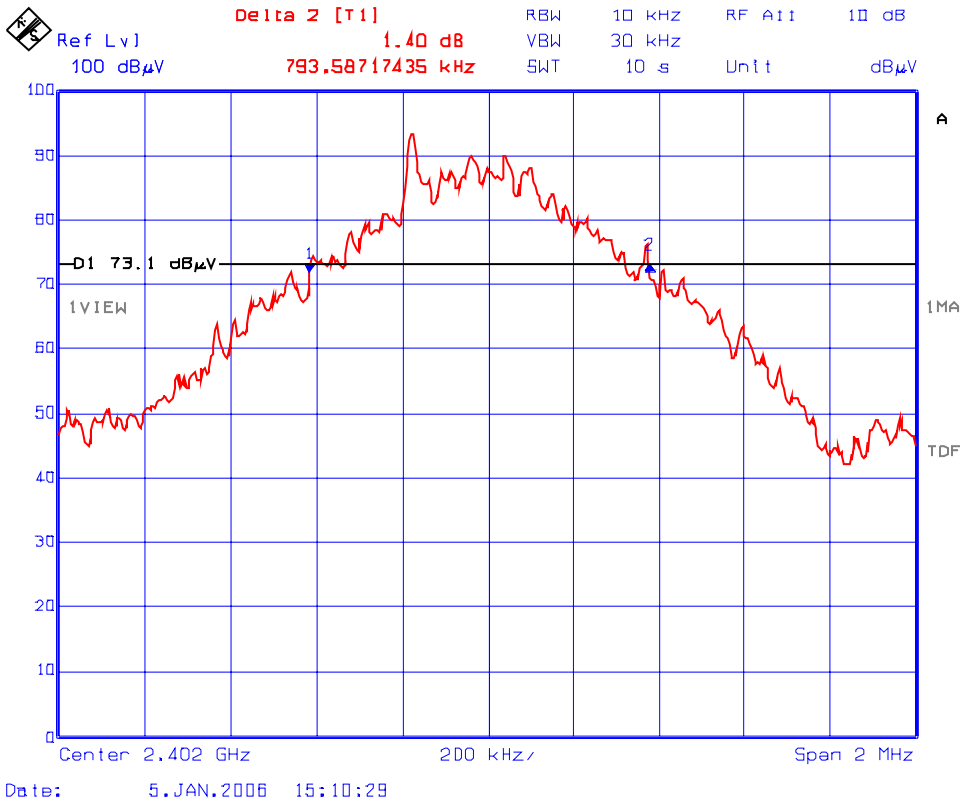
* Refer to Plots 1, 2 & 3 for detailed measurements

5.5.7. For Direct Sequence Frequency Spread Spectrum Mode @ FCC 15.247(a)(2)

CHANNEL FREQUENCY (MHz)	6 dB Bandwidth (MHz)	MINIMUM LIMIT (MHz)	PASS/FAIL
2402	0.569	0.500	PASS
2441	0.529	0.500	PASS
2480	0.561	0.500	PASS

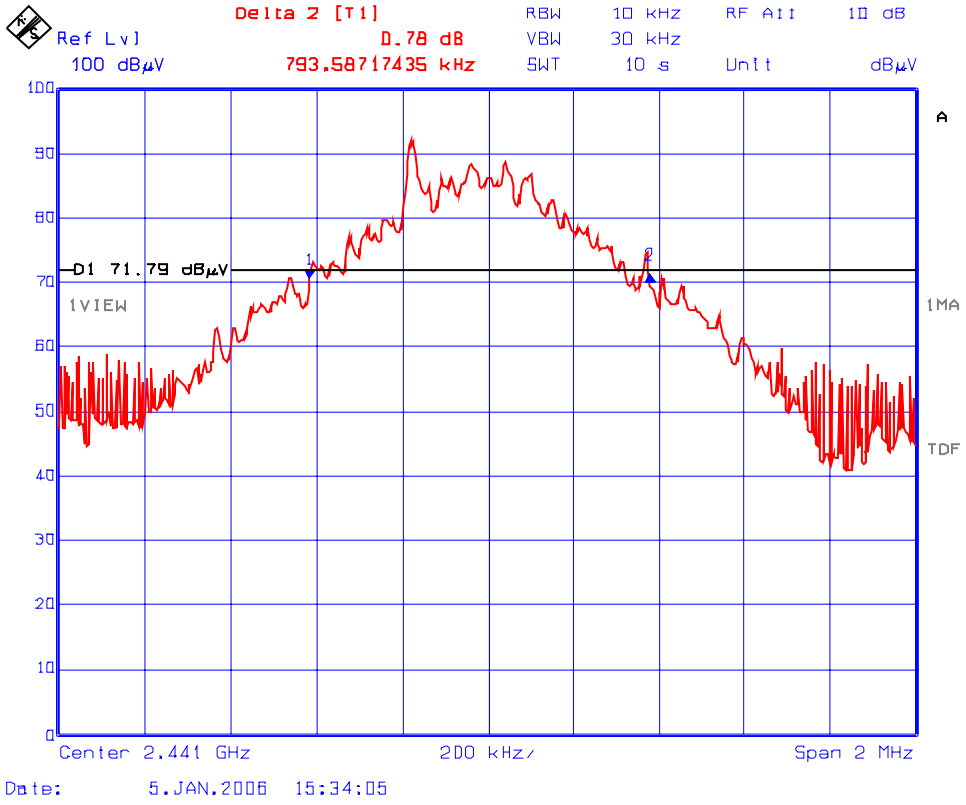
* Refer to Plots 4, 5 & 6 for detailed measurements

Plot #1: 20 dB Bandwidth of 2042 MHz Hopping Channel Frequency

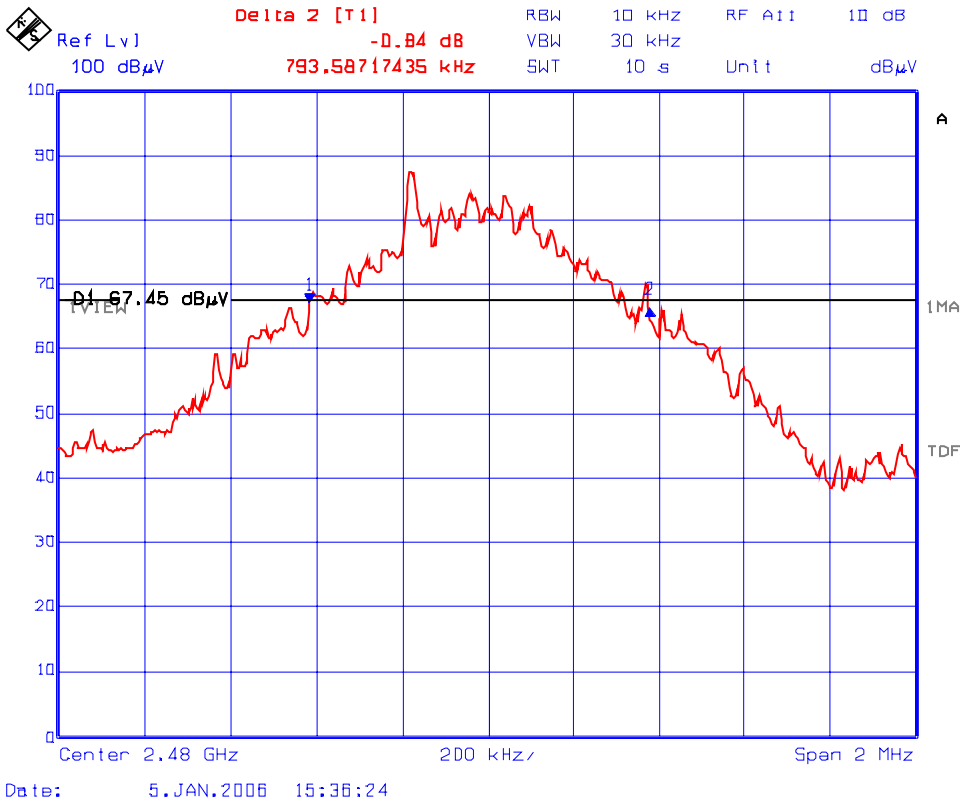


- ***All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)***

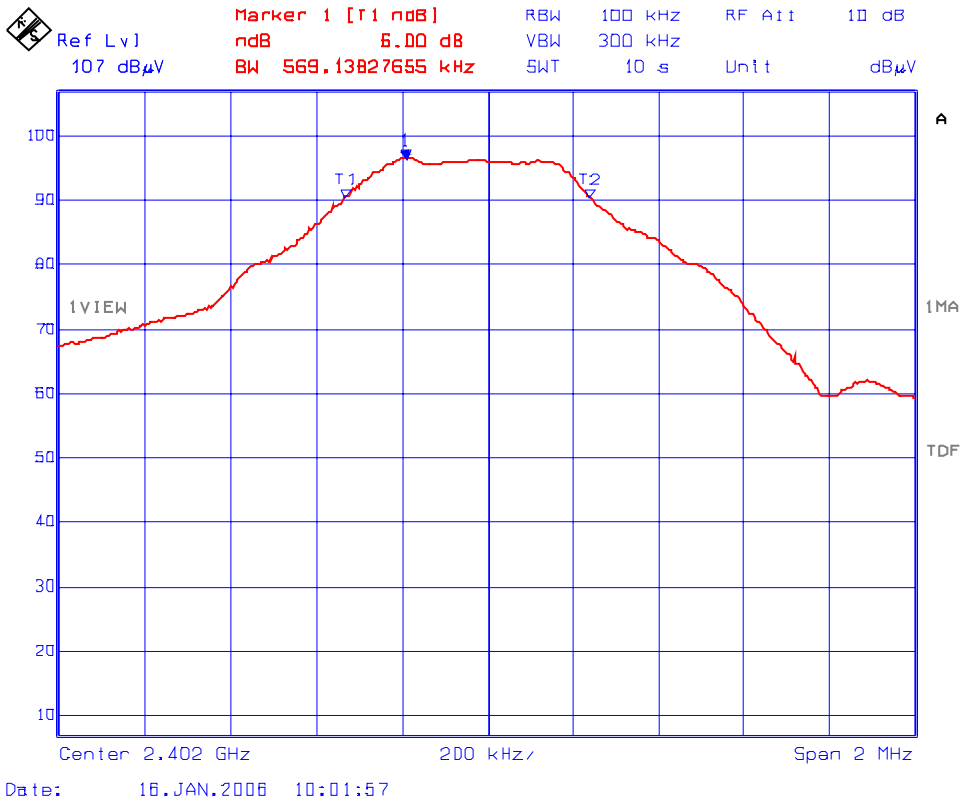
Plot #2: 20 dB Bandwidth of 2441 MHz Hopping Channel Frequency



Plot #3: 20 dB Bandwidth of 2480 MHz Hopping Channel Frequency

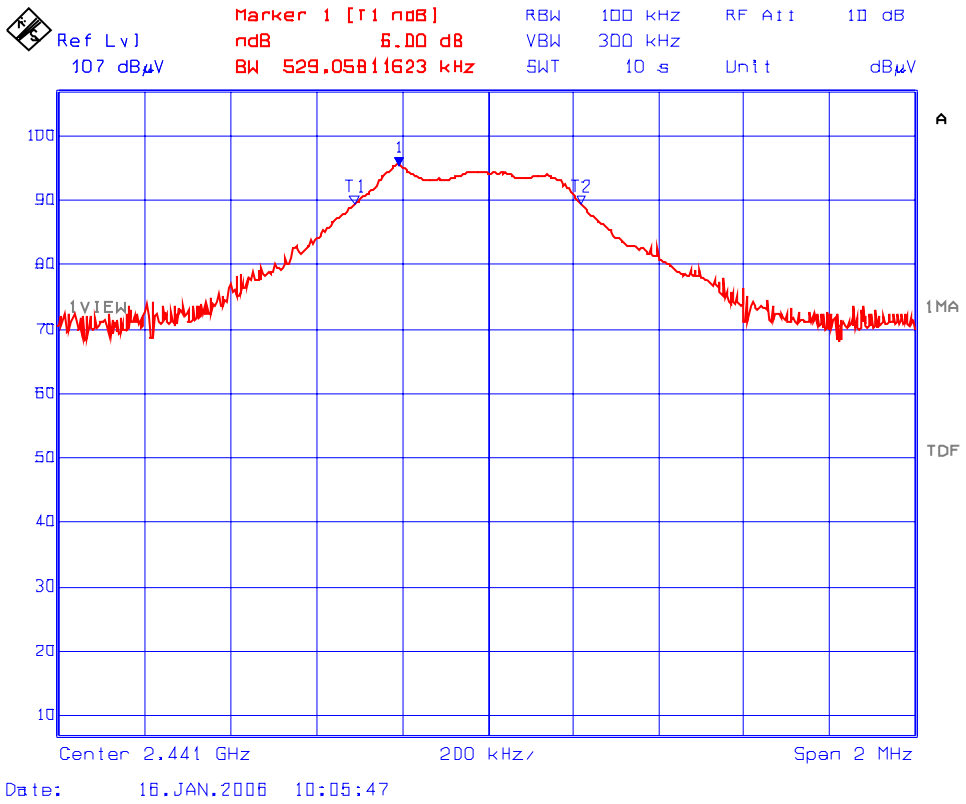


Plot #4: 6 dB Bandwidth of 2402 MHz DSSS Channel Frequency

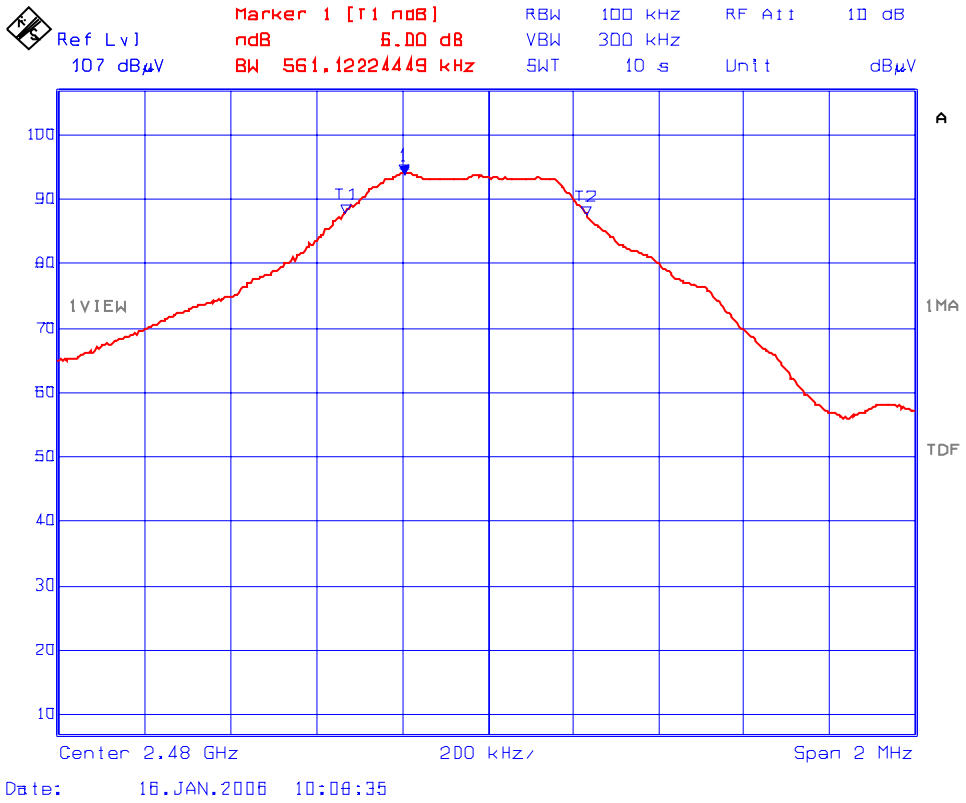


- ***All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)***

Plot #5: 6 dB Bandwidth of 2441 MHz DSSS Channel Frequency



Plot #6: 6 dB Bandwidth of 2480 MHz DSSS Channel Frequency



5.6. PEAK CONDUCTED OUTPUT POWER & EIRP @ FCC 15.247(B)(1)&(3)

5.6.1. Limits

- **FCC 15.247(b)(1):** Maximum peak output power of the transmitter shall not exceed 1 Watt.
- **FCC 15.247(b)(3)(i):** If the device is not for fixed point to point radio, the antenna of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.6.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P002-2004, FCC DA-00-705 and ANSI C63.4 for measurement methods

The EIRP was measured using substitution method for integral antenna which can not be easily replaced by a RF connector.

5.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

5.6.4. Test Data

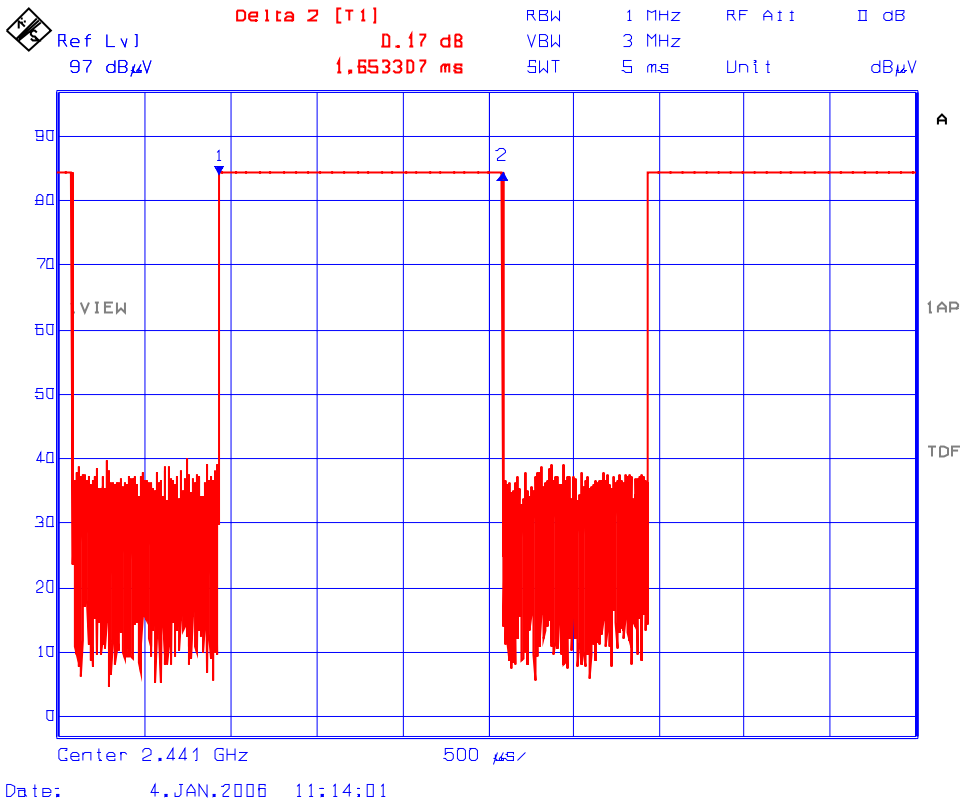
Frequency (MHz)	Peak E-Field in 1 MHz@3m (dBuV/m)	Antenna Polarization (V/H)	Power from Signal Gen. (dBm)	Subs. Ant. Horn Gain (dBi)	Measured Peak EIRP in 1MHz (dBm)	EIRP Limit (dBm)	Margin (dB)
2402	98.30	V	-7.80	7.9	0.10	30	-29.90
2402	97.12	H	-9.39	7.9	-1.49	30	-31.49
2441	96.86	V	-9.97	8.3	-1.67	30	-31.67
2441	95.39	H	-11.77	8.3	-3.47	30	-33.47
2480	96.86	V	-10.90	8.4	-2.50	30	-32.50
2480	95.78	H	-11.50	8.4	-3.10	30	-33.10

5.7. DUTY CYCLE MEASUREMENT

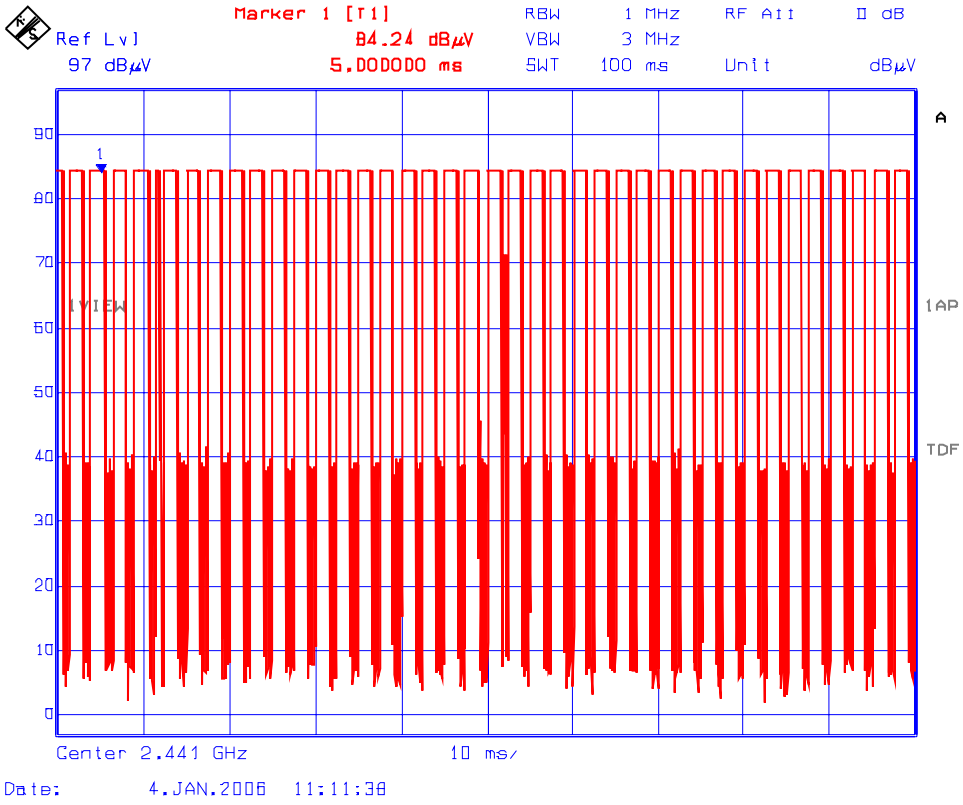
Duty Cylce Measurements: Refer to Plot # 7 & 8 for detailed measurements and the calculation is as below:

Duty cycle in 100 mS = 39 x 1.653307 ms = 64.478973 ms
Duty Cycle X = 20*log(0.64478973) = **-3.81 dB.**

Plot #7: Pulse Width (1.653307 mS)



Plot #8: Pulse Train (39 pulses) in 100 mS Interval



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

5.8. RF EXPOSURE REQUIRMENTS @ FCC 15.247(B)(5), 15.247(E)(I) & 1.1307(B)(1)

The device is exempted as calculated Average EIRP = Max EIRP – Duty Cycle factor
= 0.1 dBm – 3.81 dB
= -3.71 dBm or 0.43 mWatts

5.9. TRANSMITTER BAND-EDGE & SPURIOUS EMISSIONS (CONDUCTED), FCC CFR 47, PARA. 15.247(D)

5.9.1. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

5.9.2. Test Data

Tests can not be performed because the antenna is integral.

Refer to Section 4.3 of the enclosed test reports for RF Conducted Emissions test results from the Bluetooth Transceiver LMX9820A, performed by InterLab for National Semiconductor.

5.10. TRANSMITTER BAND-EDGE & SPURIOUS EMISSIONS (RADIATED @ 3 METERS), FCC CFR 47, PARA. 15.247(C), 15.209 & 15.205

5.10.1. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- **@ FCC CFR 47, Para. 15.237(c)** - The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in **@15.35** for limiting peak emissions apply.

FCC CFR 47, Part 15, Subpart C, Para. 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 – 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 – 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 – 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 – 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 – 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 – 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 – 156.9	2200 - 2300	9000 - 9200	

FCC CFR 47, Part 15, Subpart C, Para. 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	DISTANCE (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.10.2. Method of Measurements

Refer to Ultratech Test Procedures, Files # ULTR P002-2004 or ULTR P003-2004 and ANSI C63.4 for measurement methods

5.10.3. Test Arrangement

Refer to Sec.3.6 of this test report for test setup.

5.10.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3160-09	..	18 GHz – 26.5 GHz
Horn Antenna	EMCO	3160-10	..	26.5 GHz – 40 GHz
Mixer	Tektronix	118-0098-00	..	18 GHz – 26.5 GHz
Mixer	Tektronix	119-0098-00	..	26.5 GHz – 40 GHz

5.10.5. Photographs of Test Setup

Refer to the Photographs # 1 & 2 in Annex 1 for setup and arrangement of equipment under tests and its ancillary equipment.

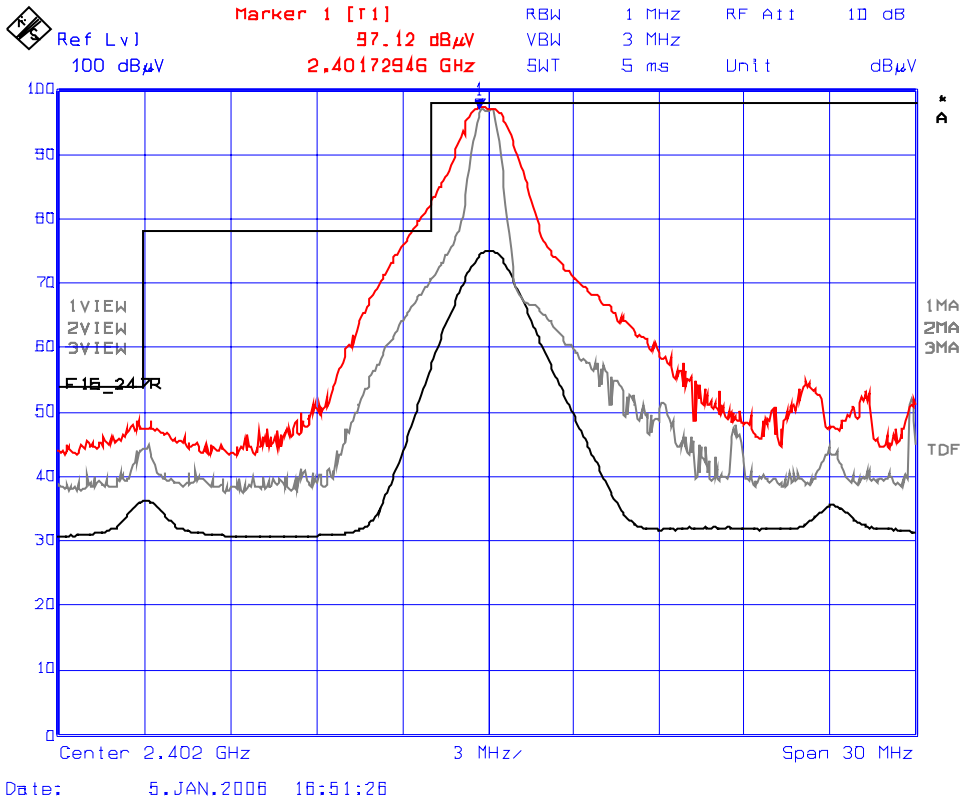
5.10.6. Test Data

5.10.6.1. Transmitter Radiated Band-edge Spurious Emissions

Please refer to Plots # 9 to 20 for detailed measurements of band-edge conducted emissions.

Plot #9: Lower Band-Edge Radiated Emissions, Continuous Mode, Horizontal Polarization Frequency: 2402 MHz

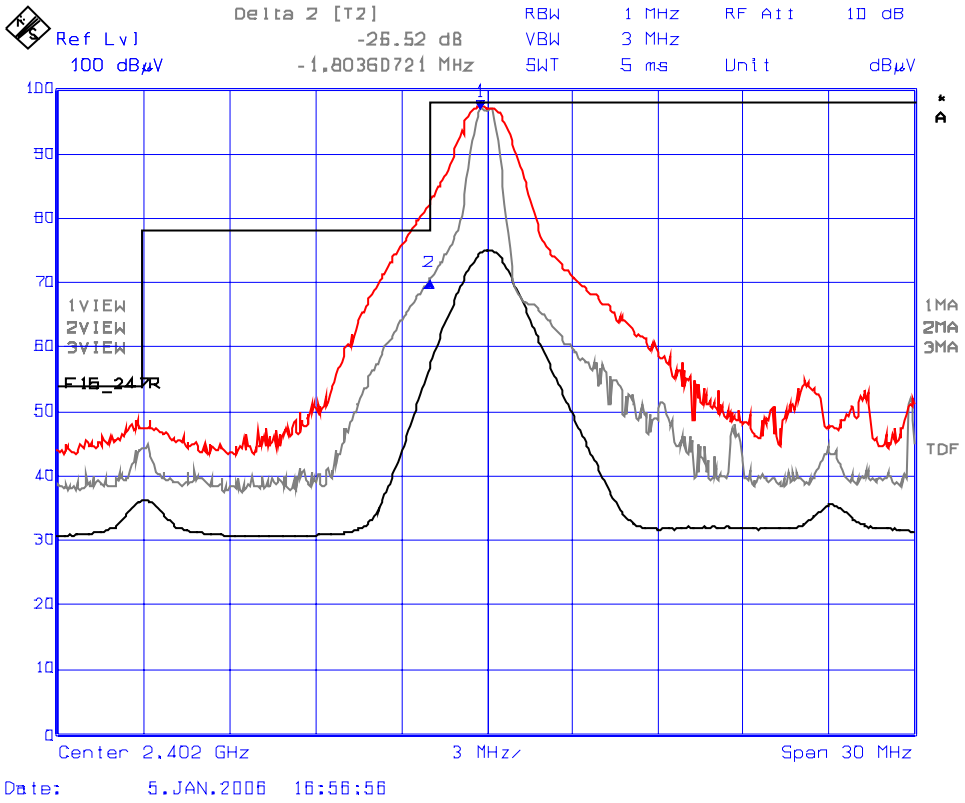
Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz
Trace 3: RBW= 1 MHz, VBW= 10 Hz



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

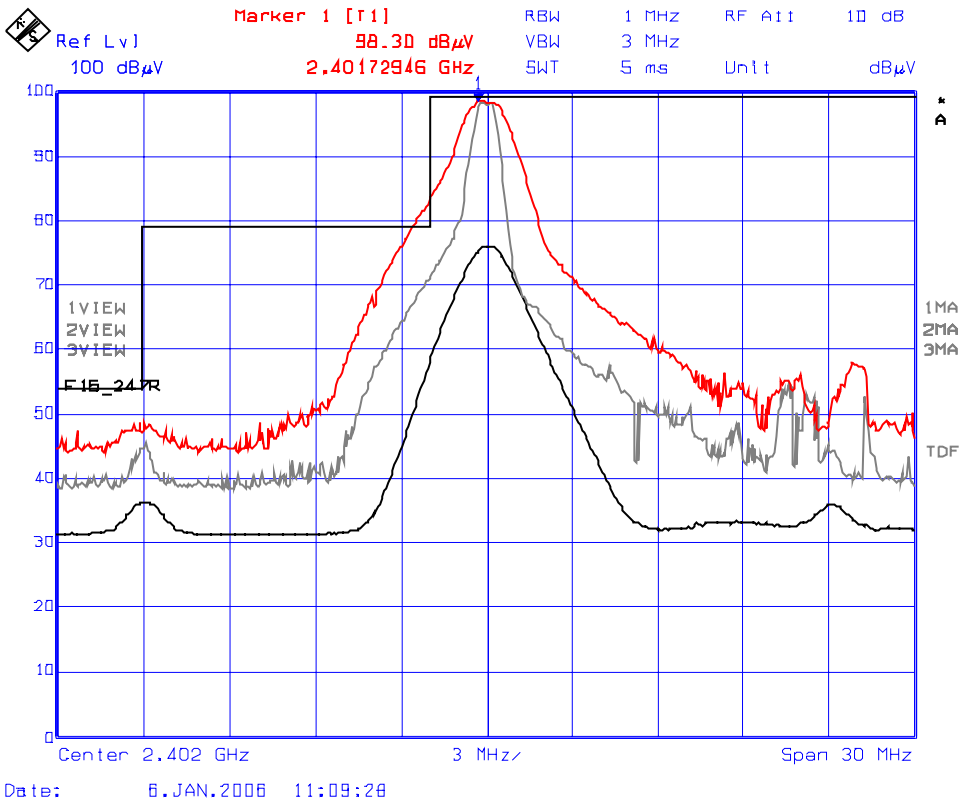
Plot #10: **Lower Band-Edge Radiated Emissions, Continuous Mode, Horizontal Polarization**
Frequency: 2402 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz, Delta (Peak to Band-Edge): 26.52 dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Band-Edge Level at 2400 MHz: 97.12 dBuV/m – 26.52 dB= 70.60 dBuV/m



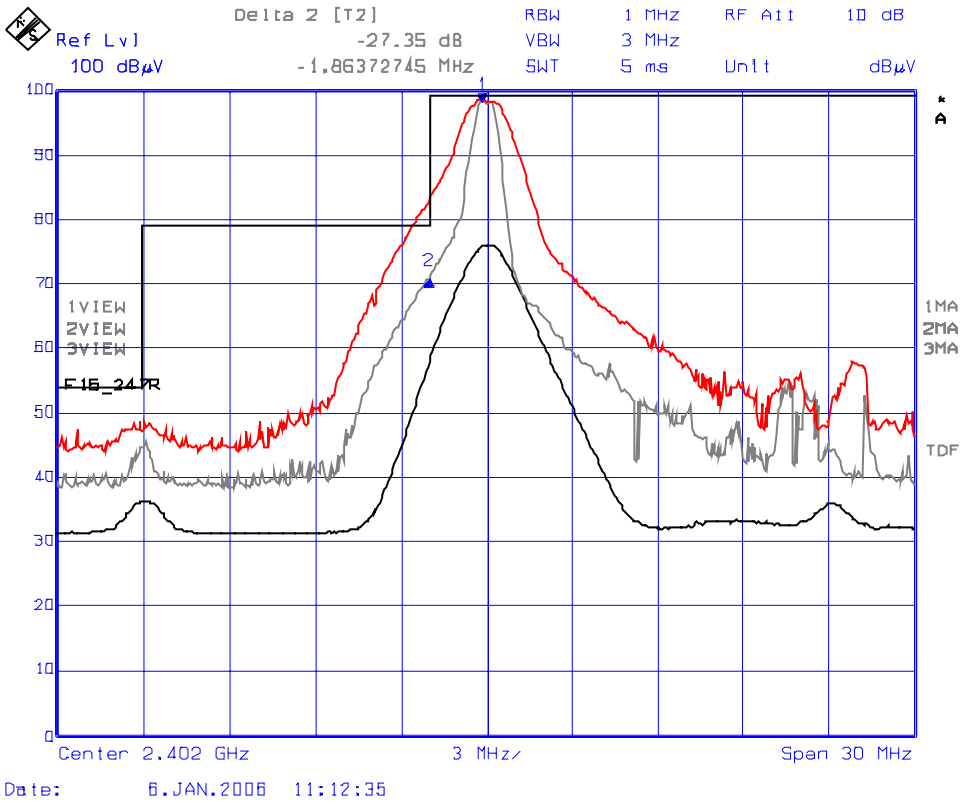
Plot #11: **Lower Band-Edge Radiated Emissions, Continuous Mode, Vertical Polarization**
Frequency: 2402 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz
Trace 3: RBW= 1 MHz, VBW= 10 Hz



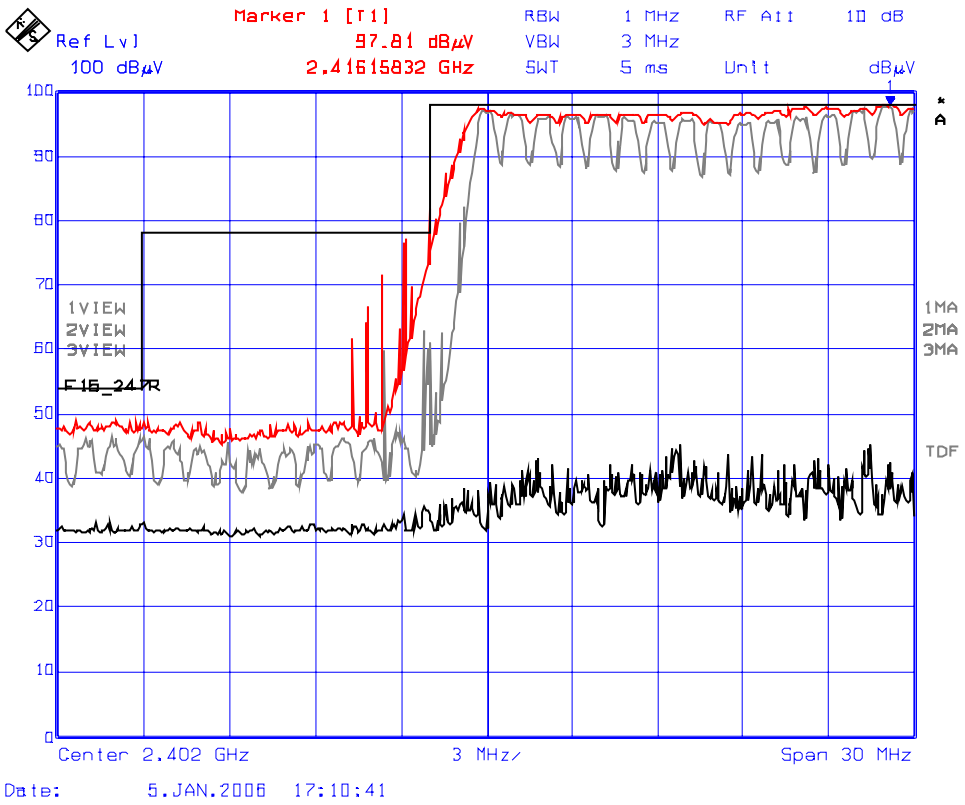
Plot #12: **Lower Band-Edge Radiated Emissions, Continuous Mode, Vertical Polarization**
Frequency: 2402 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz, Delta (Peak to Band-Edge): 27.35 dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Band-Edge Level at 2400 MHz: 98.30 dBuV/m –27.35 dB= 70.95 dBuV/m



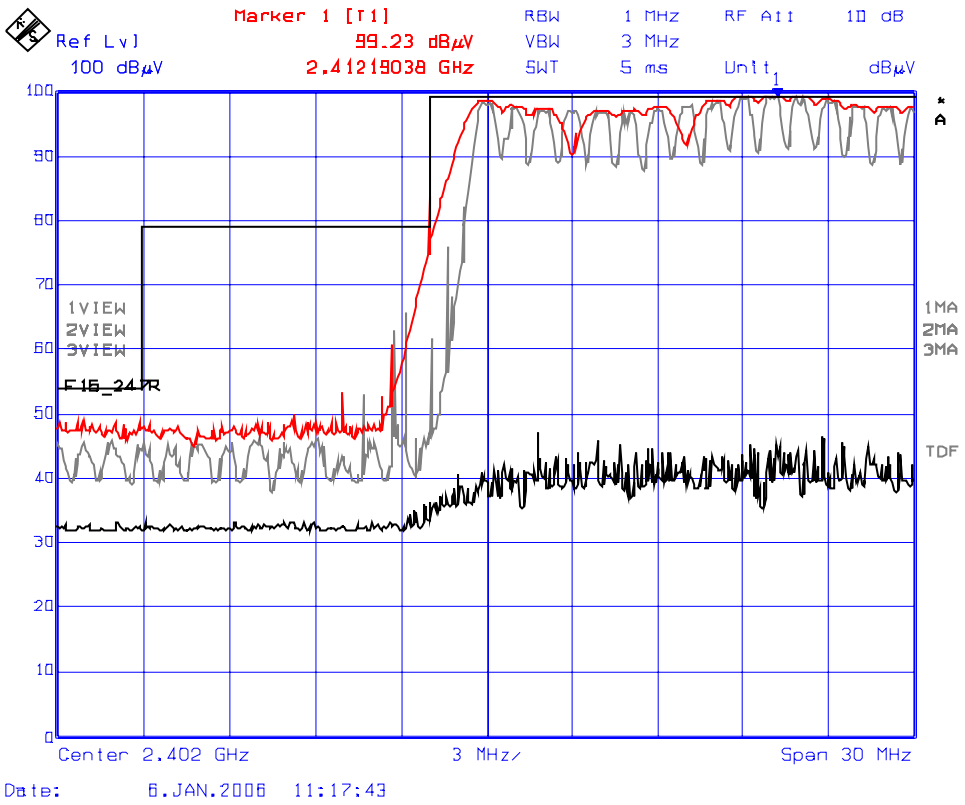
Plot #13: **Lower Band-Edge Radiated Emissions, Hopping Mode, Horizontal Polarization**
Frequency: 2402 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz
Trace 3: RBW= 1 MHz, VBW= 10 Hz



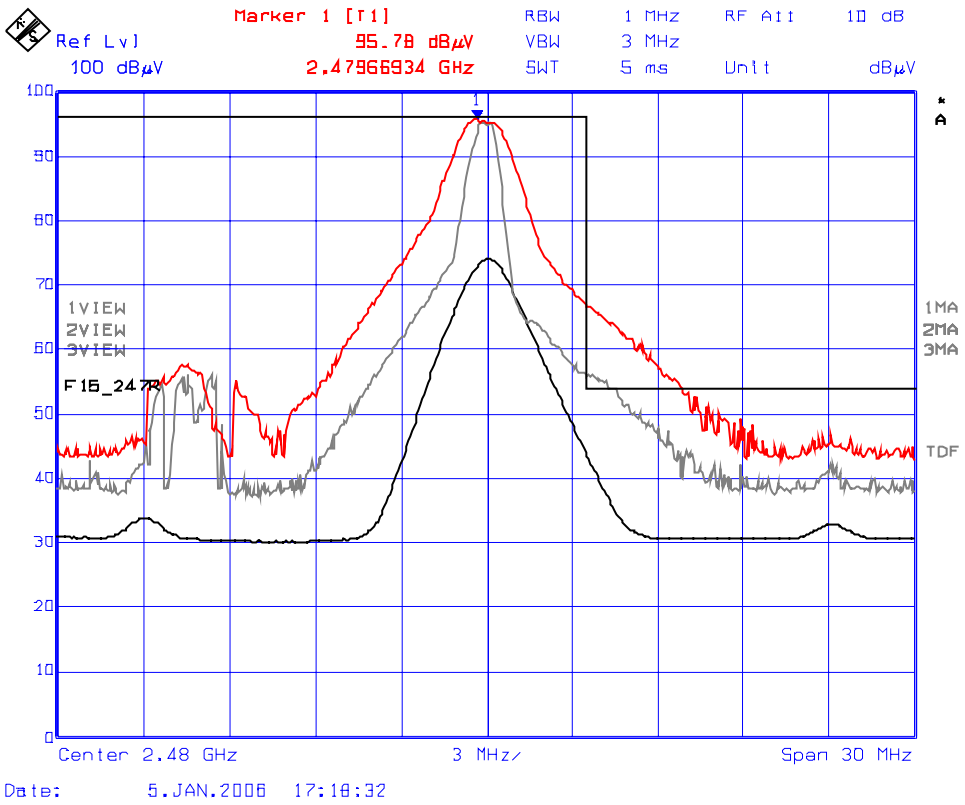
Plot #14: **Lower Band-Edge Radiated Emissions, Hopping Mode, Vertical Polarization**
Frequency: 2402 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz
Trace 3: RBW= 1 MHz, VBW= 10 Hz



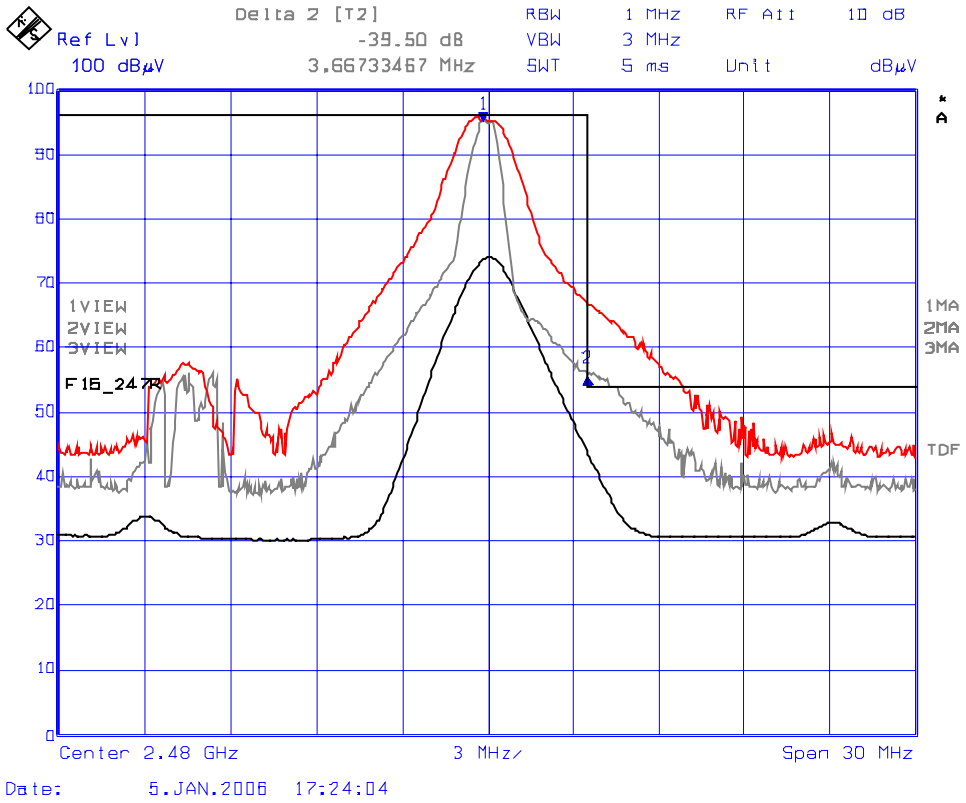
Plot #15: **Upper Band-Edge Radiated Emissions, Continuous Mode, Horizontal Polarization**
Frequency: 2480 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz
Trace 3: RBW= 1 MHz, VBW= 10 Hz



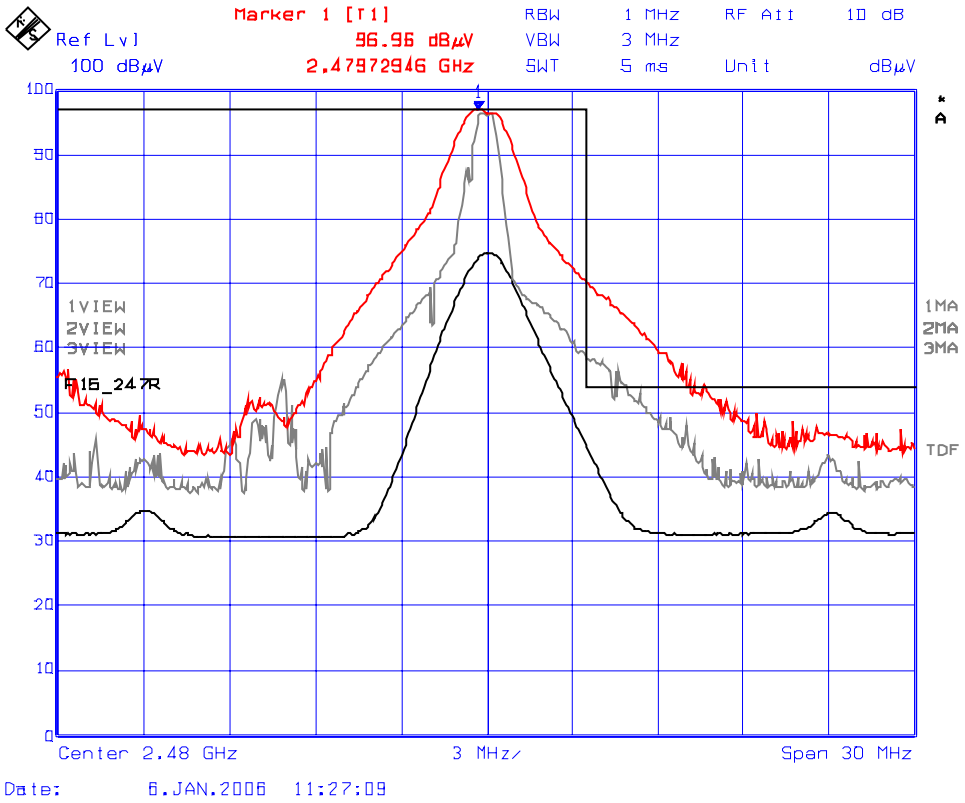
Plot #16: **Upper Band-Edge Radiated Emissions, Continuous Mode, Horizontal Polarization**
Frequency: 2480 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz, , Delta (Peak to Band-Edge): 39.50 dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Band-Edge Level at 2483.5 MHz: 95.78 dBuV/m – 39.50 dB= 56.28 dBuV/m



Plot #17: **Upper Band-Edge Radiated Emissions, Continuous Mode, Vertical Polarization**
Frequency: 2480 MHz

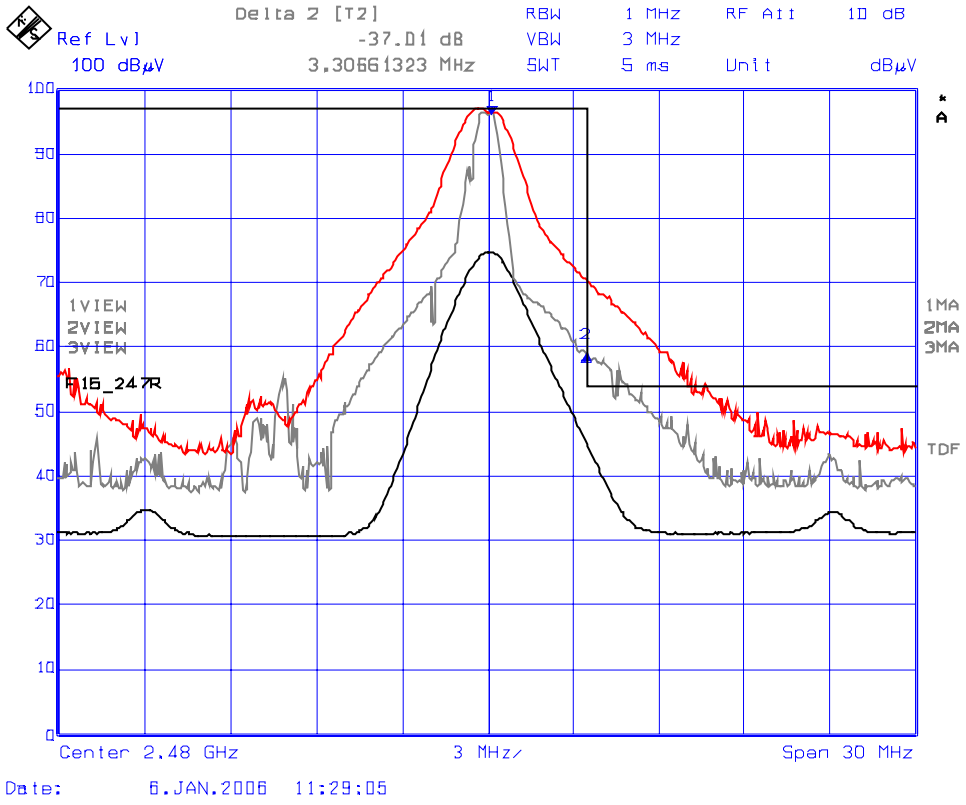
Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz
Trace 3: RBW= 1 MHz, VBW= 10 Hz



- ***All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)***

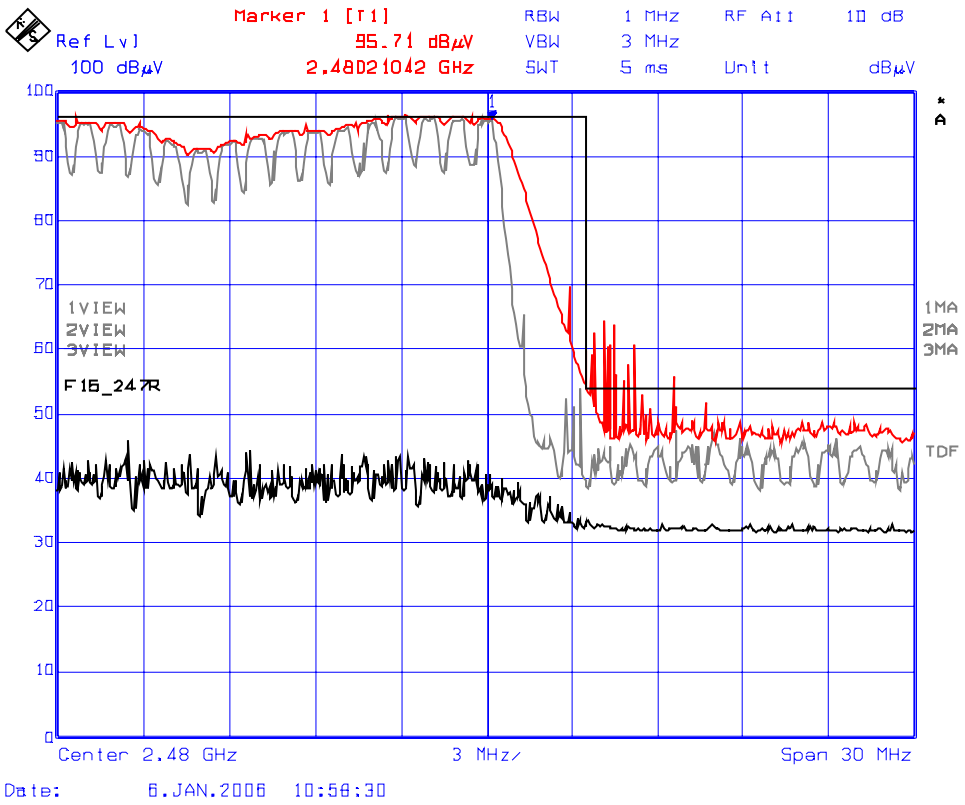
Plot #18: **Upper Band-Edge Radiated Emissions, Continuous Mode, Vertical Polarization**
Frequency: 2480 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz, Delta (Peak to Band-Edge): 37.01 dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Band-Edge Level at 2483.5 MHz: 96.96 dBuV/m – 37.01 dB= 59.95 dBuV/m



Plot #19: **Upper Band-Edge Radiated Emissions, Hopping Mode, Horizontal Polarization**
Frequency: 2480 MHz

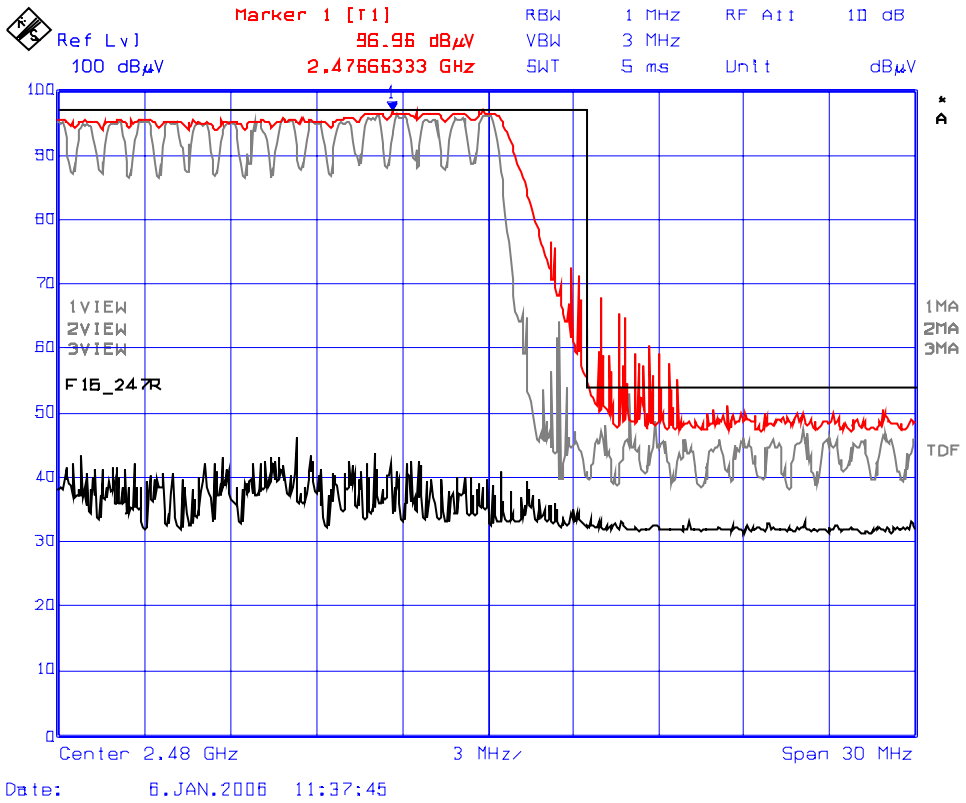
Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz
Trace 3: RBW= 1 MHz, VBW= 10 Hz



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot #20: **Upper Band-Edge Radiated Emissions, Hopping Mode, Vertical Polarization**
Frequency: 2480 MHz

Trace 1: RBW= 1 MHz, VBW= 3 MHz
Trace 2: RBW= 300 kHz, VBW= 1 MHz
Trace 3: RBW= 1 MHz, VBW= 10 Hz



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

5.10.6.2. Transmitter Radiated Spurious Emissions

5.10.6.2.1. Lowest Frequency (2402 MHz)

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m After Duty cycle factor (-3.81dB) (dBµV/m)	Antenna Plane (H/V)	Average Field Strength Limit of Fundamental/ Harmonic (dBµV/m)	Field Strength Limit for emission in Restricted band § 15.205(a) (dBµV/m)	Margin (dB)
2402	98.30	--	V	--	--	--
2402	97.12	--	H	--	--	--
4804	69.68	49.93	V	--	54.0	-4.1
4804	70.93	51.64	H	--	54.0	-2.4
7206	73.13	52.12	V	78.30	--	-26.2
7206	75.31	53.94	H	77.12	--	-23.2
9608	58.13	40.36	V	78.30	--	-37.9
9608	58.17	41.23	H	77.12	--	-35.9
The emissions were scanned from 30 MHz to 25 GHz and all emissions within 40 dB below the limits were recorded.						

5.10.6.2.2. Middle Frequency (2441 MHz)

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m After Duty cycle factor (-3.81dB) (dBµV/m)	Antenna Plane (H/V)	Average Field Strength Limit of Fundamental/ Harmonic (dBµV/m)	Field Strength Limit for emission in Restricted band § 15.205(a) (dBµV/m)	Margin (dB)
2441	96.86	--	V	--	--	--
2441	95.39	--	H	--	--	--
4882	65.78	50.90	V	--	54.0	-3.1
4882	66.16	51.66	H	--	54.0	-2.3
7323	63.01	43.19	V	--	54.0	-10.8
7323	65.42	44.82	H	--	54.0	-9.2
9764	56.14	38.70	V	76.86	--	-38.2
9764	57.20	39.23	H	75.39	--	-36.2
12205	58.06	40.57	V	--	54.0	-13.4
12205	60.65	41.77	H	--	54.0	-12.2
The emissions were scanned from 30 MHz to 25 GHz and all emissions within 40 dB below the limits were recorded.						

5.10.6.2.3. Highest Frequency (2480 MHz)

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m After Duty cycle factor (-3.81dB) (dBµV/m)	Antenna Plane (H/V)	Average Field Strength Limit of Fundamental/ Harmonic (dBµV/m)	Field Strength Limit for emission in Restricted band § 15.205(a) (dBµV/m)	Margin (dB)
2480	96.96	--	V	--	--	--
2480	95.78	--	H	--	--	--
4960	65.72	51.49	V	--	54.0	-2.5
4960	66.27	51.99	H	--	54.0	-2.0
7440	63.15	41.68	V	--	54.0	-12.3
7440	66.59	43.46	H	--	54.0	-10.5
9920	57.97	40.68	V	76.96	--	-36.3
9920	55.99	38.50	H	75.78	--	-37.3
The emissions were scanned from 30 MHz to 25 GHz and all emissions within 40 dB below the limits were recorded.						

5.11. TRANSMITTED POWER SPECTRAL DENSITY OF A DIGITALLY MODULATED SYSTEM IN THE ACQUISITION MODE, FCC CFR 47, PARA. 15.247(E)

5.11.1. Limits

For a digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be grater than 8 dBm in any 3 KHz bandwidth within this band during any time interval of continuous transmission.

5.11.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P003-2004, FCC DA-00-705 and ANSI C63.4 for measurement methods.

The power spectral density shall be determined as the same method as conducted output power measurement.

5.11.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

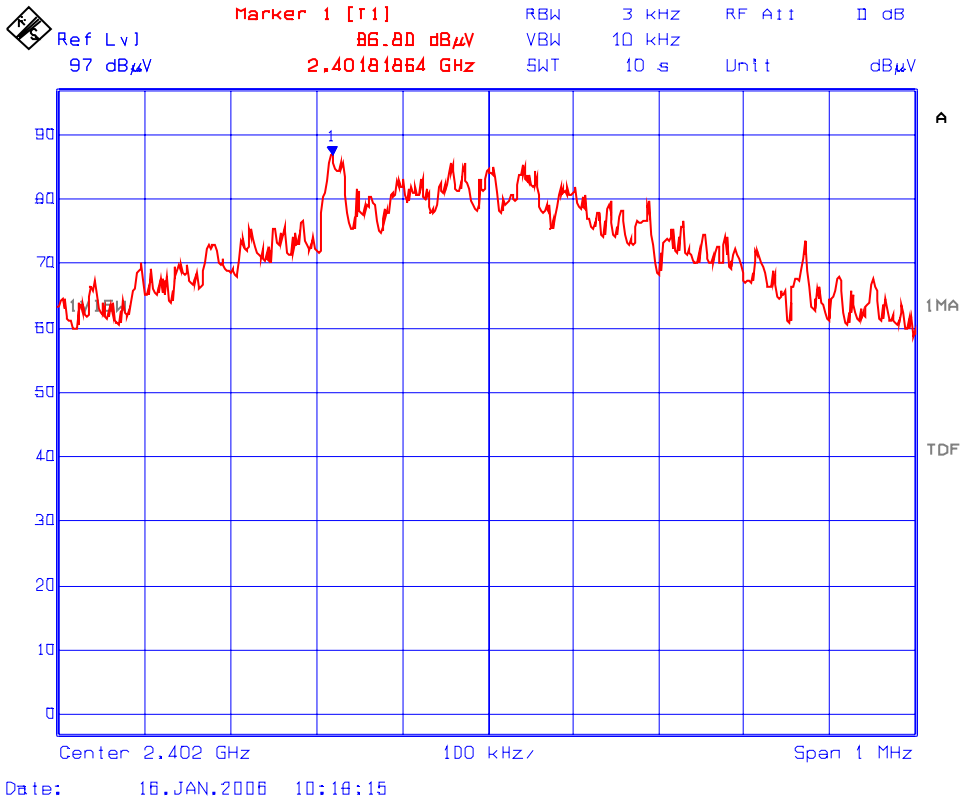
5.11.4. Test Data

Frequency (MHz)	Peak E-Field in 3 kHz@3m (dBuV/m)	Power from Signal Gen. (dBm)	Subs. Ant. Horn Gain (dBi)	Measured Peak EIRP of SPD in 3 kHz (dBm)	EIRP Limit (dBm)	Margin (dB)
2402	86.80	-19.3	7.9	-11.4	8.0	-19.4
2441	83.07	-23.8	8.3	-15.5	8.0	-23.5
2480	84.76	-23.0	8.4	-14.6	8.0	-22.6

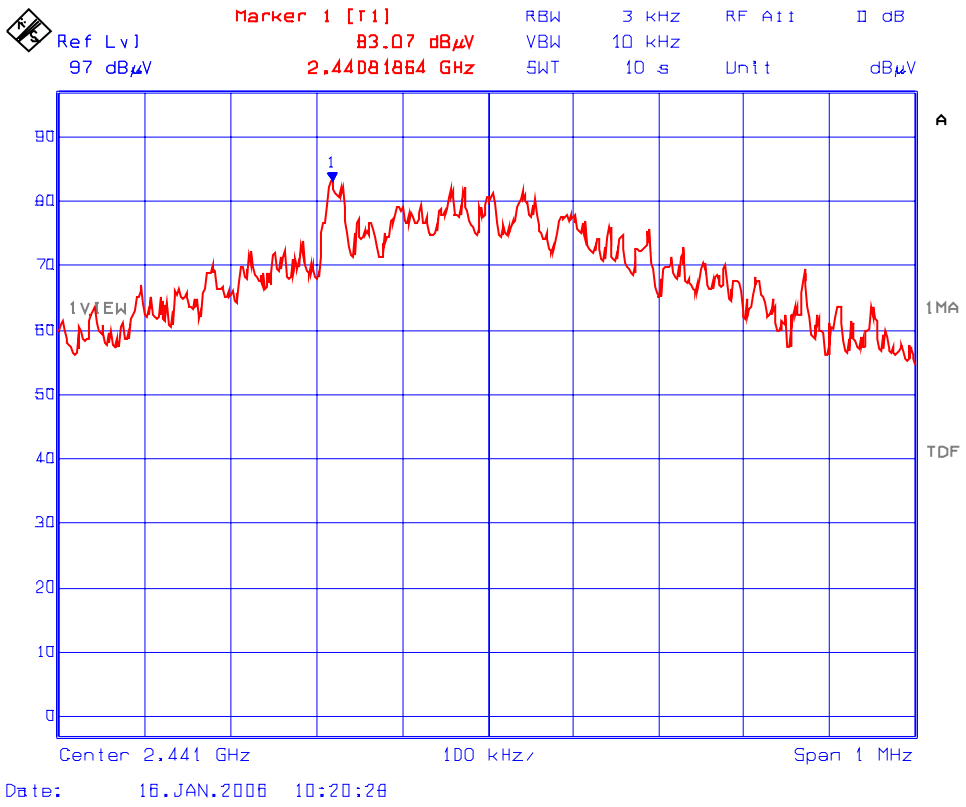
5.11.5. Plots

Please refer to Plot # 21 to 23 for measurement details.

Plot #21: Power Spectral Density in 3 KHz, Frequency: 2402 MHz

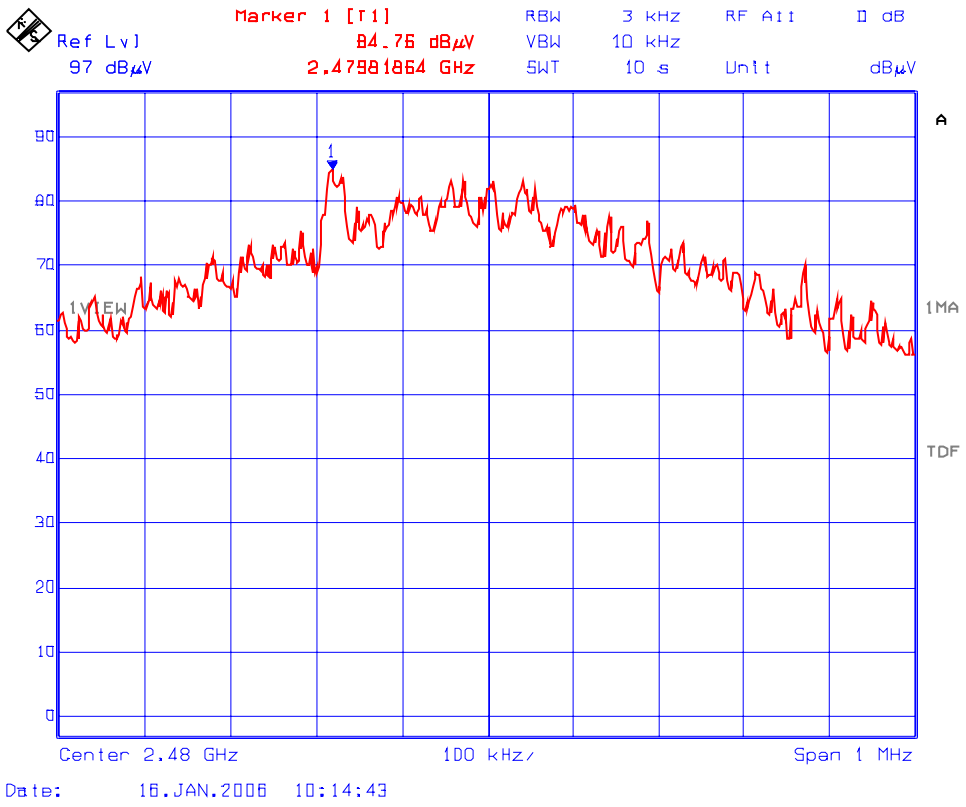


Plot #22: Power Spectral Density in 3 KHz, Frequency: 2441 MHz



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot #23: Power Spectral Density in 3 KHz, Frequency: 2480 MHz



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

5.12. AVERAGE TIME OF OCCUPANCY ON ANY CHANNEL, FCC CFR 47, PARA. 15.247(F)

5.12.1. Limits

The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned off shall have an average time of occupancy on any frequency not to exceed 0.4 seconds with in a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4.

5.12.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P003-2004, FCC DA-00-705 and ANSI C63.4 for measurement methods.

The power spectral density shall be determined as the same method as conducted output power measurement.

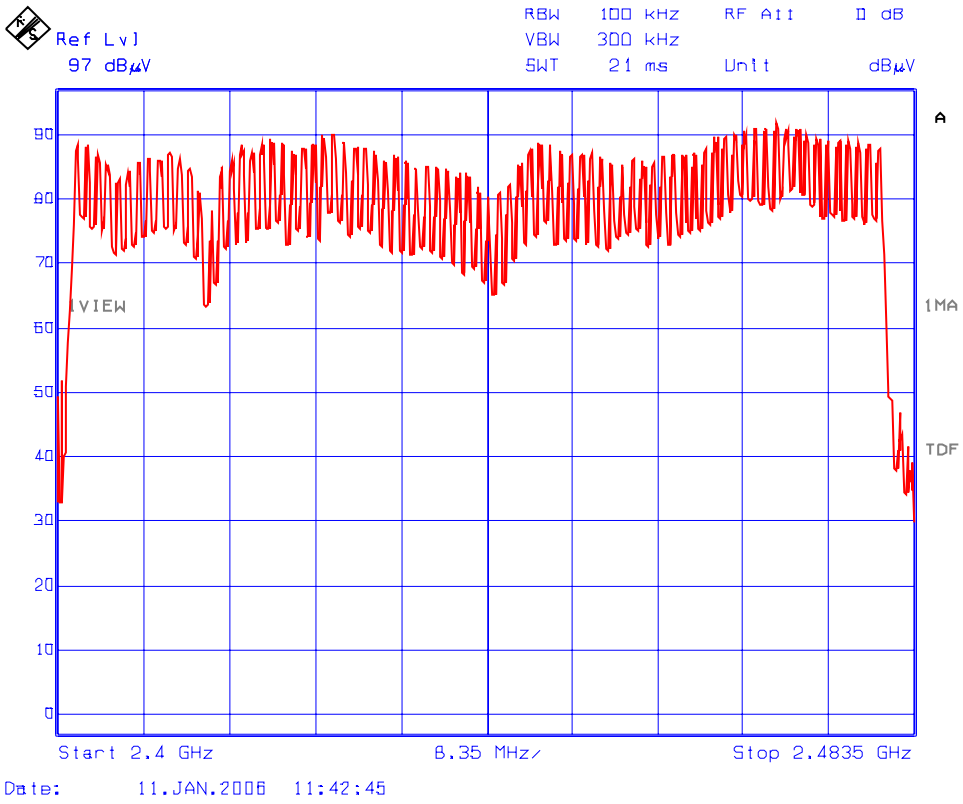
5.12.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

5.12.4. Test Data

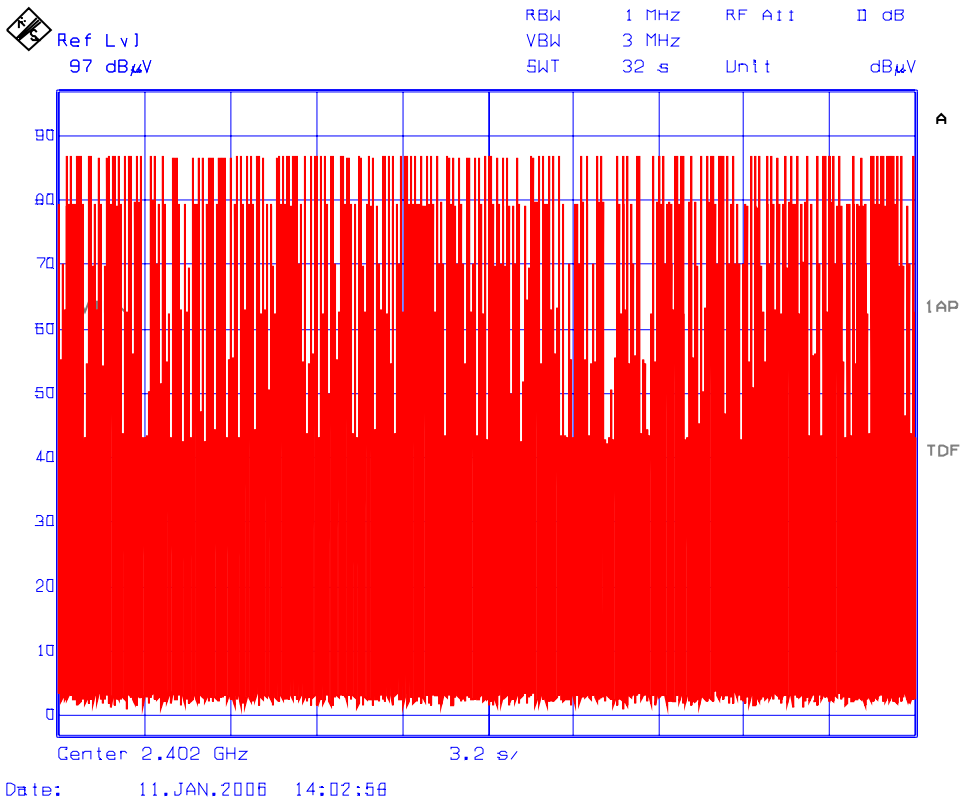
Please refer to Plot # 24 to 27 for measurement details..

Plot #24: Number of Hopping Frequencies 79 channels

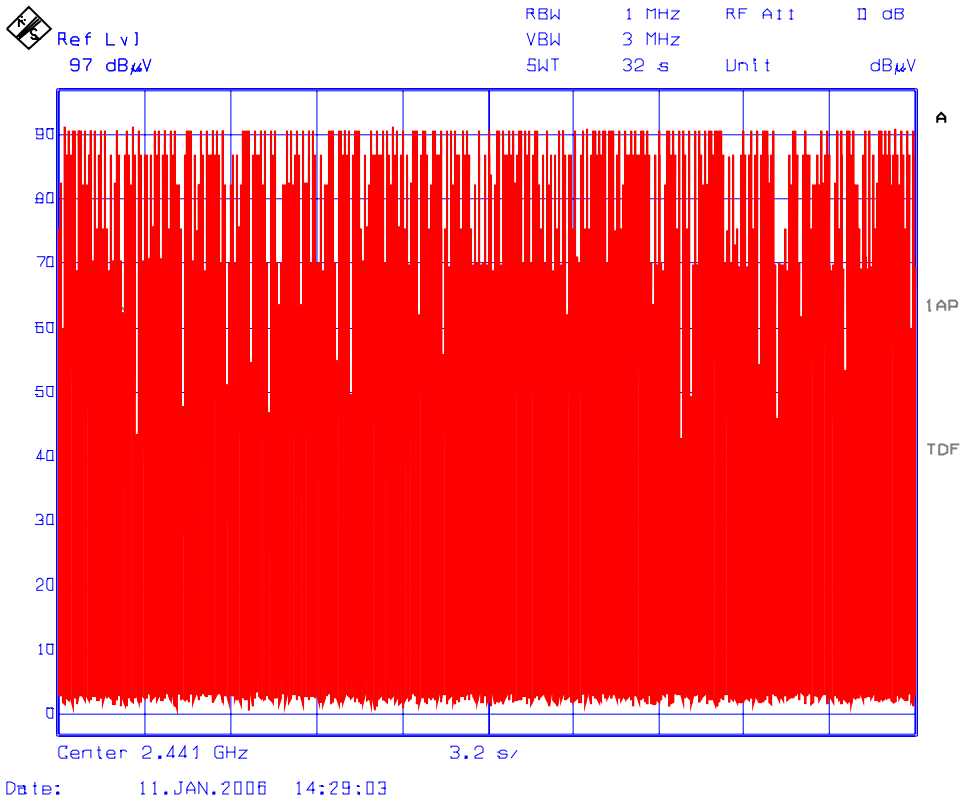


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot #25: **Time of Occupancy in 0.4 Seconds, Frequency: 2402 MHz**
Total Time: 152 x 1.653307 ms = 251.30 ms < 400 ms in 31.6 seconds



Plot #26: **Time of Occupancy in 0.4 Seconds, Frequency: 2441 MHz**
Total Time: 152 x 1.653307 ms = 251.30 ms < 400 ms in 31.6 seconds



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot #27: **Time of Occupancy in 0.4 Seconds, Frequency: 2480 MHz**
Total Time: 152 x 1.653307 ms = 251.30 ms < 400 ms in 31.6 seconds

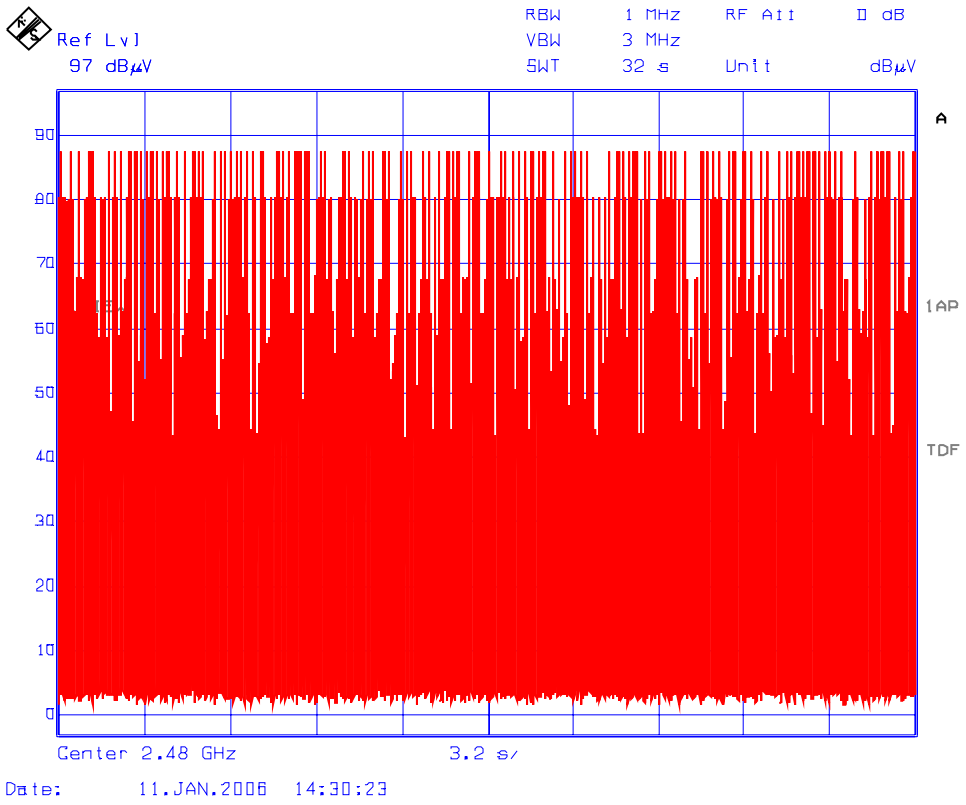


EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

6.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	±1.5	±1.5
LISN coupling specification	Rectangular	±1.5	±1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	±0.3	±0.5
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8$(9 kHz) 0.2 (30 MHz) Uncertainty limits $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	U-Shaped	±0.2	±0.3
System repeatability	Std. deviation	±0.2	±0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	±1.25	±1.30
Expanded uncertainty U	Normal (k=2)	±2.50	±2.60

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30$ dB

$U = 2u_c(y) = \pm 2.6$ dB

6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivity	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp) Uncertainty limits $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB