ENGINEERING TEST REPORT

2400 MHz OEM Frequency Hopping Module
Model No.: MHX2420

FCC ID: NS907P22

Applicant:

Microhard Systems Inc.
#17, 2135 - 32nd Avenue N.E.
Calgary, Alberta
Canada T2E 6Z3

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Frequency Hopping Spread Spectrum (FHSS)
Operating in 2400– 2483.5 MHz Band

UltraTech's File No.: MCRS-014F15C247

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: August 21, 2007	
Report Prepared by: Dan Huynh Issued Date: August 21, 2007	Tested by: Mr. Hung Trinh, EMI/RFI Technician Test Dates: August 1, 9, 10, 16, 17 & 21, 2007

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. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	▪ Exhibit 1: Submittal check lists ▪ Exhibit 2: Introduction ▪ Exhibit 3: Performance Assessment ▪ Exhibit 4: EUT Operation and Configuration during Tests ▪ Exhibit 5: Summary of test Results ▪ Exhibit 6: Measurement Data ▪ Exhibit 7: Measurement Uncertainty	OK
1	Test Setup Photos	▪ AC Conducted Emissions Setup Photos ▪ Radiated Emissions Setup Photos	OK
2	External EUT Photos	External EUT Photos	OK
3	Internal EUT Photos	Internal EUT Photos	OK
4	Cover Letters	▪ Letter from Ultratech for Certification Request ▪ Letter from the Applicant to appoint Ultratech to act as an agent ▪ Letter from the Applicant to request for Confidentiality Filing ▪ Microhard Systems Inc. Modular Request	OK
5	Attestation Statements	--	--
6	ID Label/Location Info	▪ ID Label ▪ Location of ID Label	OK
7	Block Diagrams	Block Diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	Parts List	OK
10	Operational Description	Operation Description	OK
11	RF Exposure Info	MPE Evaluation, see section 6.9 in this Test Report for details.	OK
12	Users Manual	MHX2420, 2400 MHz Spread Spectrum OEM Transceiver Operating Manual	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	To gain FCC Equipment Authorization for Frequency Hopping Spread Spectrum Transceiver Operating in the Frequency Band 2400– 2483.5 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:	[x] Commercial, industrial or business environment [x] Residential environment

2.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2006	Code of Federal Regulations – Telecommunication
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
CISPR 22 & EN 55022	2006 2006	Information Technology Equipment - Radio Disturbance Characteristics – Limits and Methods of Measurement
CISPR 16-1-1	2003	Specification for Radio Disturbance and Immunity measuring apparatus and methods
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding to Spread Spectrum Devices

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Microhard Systems Inc.
Address:	#17, 2135 - 32nd Avenue N.E. Calgary, Alberta Canada T2E 6Z3
Contact Person:	Mr. Hany Shenouda Phone #: 403 248-0028 Fax #: 403 248 2762 Email Address: shenouda@microhardcorp.com

MANUFACTURER	
Name:	Microhard Systems Inc.
Address:	#17, 2135 - 32nd Avenue N.E. Calgary, Alberta Canada T2E 6Z3
Contact Person:	Mr. Hany Shenouda Phone #: 403 248-0028 Fax #: 403 248-2762 Email Address: shenouda@microhardcorp.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

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

Brand Name:	Microhard Systems Inc.
Product Name:	2400 MHz OEM Frequency Hopping Module
Model Name or Number:	MHX2420
Serial Number:	Test Sample
Type of Equipment:	Spread Spectrum Transmitter
Input Power Supply Type:	External Regulated DC Sources
Primary User Functions of EUT:	Spread Spectrum OEM Transceiver.

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Mobile ▪ Base Station (fixed use)
Intended Operating Environment:	▪ Commercial, industrial or business environment ▪ Residential environment
Power Supply Requirement:	4 to 5.5VDC
RF Output Power Rating:	0.001 to 1 W
Operating Frequency Range:	2401.6 – 2477.6 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	50kHz / 280kHz / 400 kHz
Duty Cycle:	Continuous
Modulation Type:	FHSS
Antenna Connector Type:	The MHX2420 Module is tested with MCX and Reverse Polarity SMA

3.4. ASSOCIATED ANTENNA DESCRIPTIONS

There are five antenna types:

1. Rubber Ducky Antenna
2. Transit Antenna
3. Patch Antenna
4. Yagi Antenna
5. Omni Directional Antenna

The highest gain antenna from each of the above antenna types were selected for testing to represents the worst-case. Refer to antennas list exhibit for detailed specifications.

3.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RF IN/OUT Port	1	Reversed SMA or MCX for external antenna	Shielded coaxial cable with unique coupling connectors
2	DC Supply & I/O Port	1	Pin Header	No cable, direct connection

3.6. 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:	Laptop
Brand name:	Toshiba
Model Name or Number:	1605CDS/4.3
FCC Certification	FCC DoC
Serial Number:	1027387CU
Connected to EUT's Port:	Test Jig of the EUT

Ancillary Equipment # 2	
Description:	Test Jig
Brand name:	Microhard Systems Inc.
Connected to EUT's Port:	I/O Port

Ancillary Equipment # 3	
Description:	AC Adaptor
Brand name:	Maxim
Model Name or Number:	MD4812112
Connected to EUT's Port:	Test jig of the EUT

EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. 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 to 5.5VDC

4.2. 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 normal Frequency Hopping mode for occupancy duration, and frequency separation.
Special Test Software & Hardware:	Special software provided by the Applicant was installed to allow the EUT to operate in hopping mode or at each channel frequency continuously. For example, the transmitter will be operated at each of lowest, middle and highest frequencies individually continuously during testing.
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as non-integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	2401.6 – 2477.6 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	2401.6, 2439.6 and 2477.6 MHz
RF Power Output: (measured maximum output power at antenna terminals)	1 Watt (conducted) and 36 dBm EIRP maximum
Normal Test Modulation:	See test data
Modulating Signal Source:	Internal

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. 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.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- 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 Site No.: 2049A-2, Expiry Date: July 4, 2008).

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Requirements	Compliance (Yes/No)
15.207(a)	Power Line Conducted Emissions Measurements	Yes
15.247(a)(1)	Provisions for Frequency Hopping Systems	Yes
15.247(b)	Peak Output Power	Yes
15.247(b) (5), 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.247(d)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices. The engineering test report is available upon request.		

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

ANSI C63.4 and FCC Public Notice @ DA 00-705 (March 30, 2000) – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED

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

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

6.5. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	Manufacturer's Clarification
15.31	The hoping function must be disabled for tests, which should be performed with the EUT transmitting on the number of frequencies specified in this Section. The measurements made at the upper and lower ends of the band of operation should be made with the EUT tuned to the highest and lowest available channels.	See Operational Description
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 antenna employs unique antenna connectors: MCX and Reverse Polarity SMA
15.204	Provided the information for every antenna proposed for use with the EUT: type (e.g. Yagi, patch, grid, dish, etc…), manufacturer and model number gain with reference to an isotropic radiator	See proposed antenna list.
15.247(a)	Description of how the EUT meets the definition of a frequency hopping spread spectrum, found in Section 2.1. Based on the technical description.	See Operational Description
15.247(a)	Pseudo Frequency Hopping Sequence: Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirements specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1	See Operational Description

FCC Section	FCC Rules	Manufacturer's Clarification
15.247(a)	Equal Hopping Frequency Use: Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g. that each new transmission event begins on the next channel in the hopping sequence after final channel used in the previous transmission events).	See Operational Description
15.247(g)	Describe how the EUT complies with the requirement that it be designed to be capable of operating as a true frequency hopping system	See Operational Description
15.247(h)	Describe how the EUT complies with the requirement that it not have the ability to coordinated with other FHSS is an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters	See Operational Description
Public Notice DA 00-705	System Receiver Input Bandwidth: Describe how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.	See Operational Description
Public Notice DA 00-705	System Receiver Hopping Capability: Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals	See Operational Description

6.6. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

6.6.1. Limit

The equipment shall meet the limits of the following table:

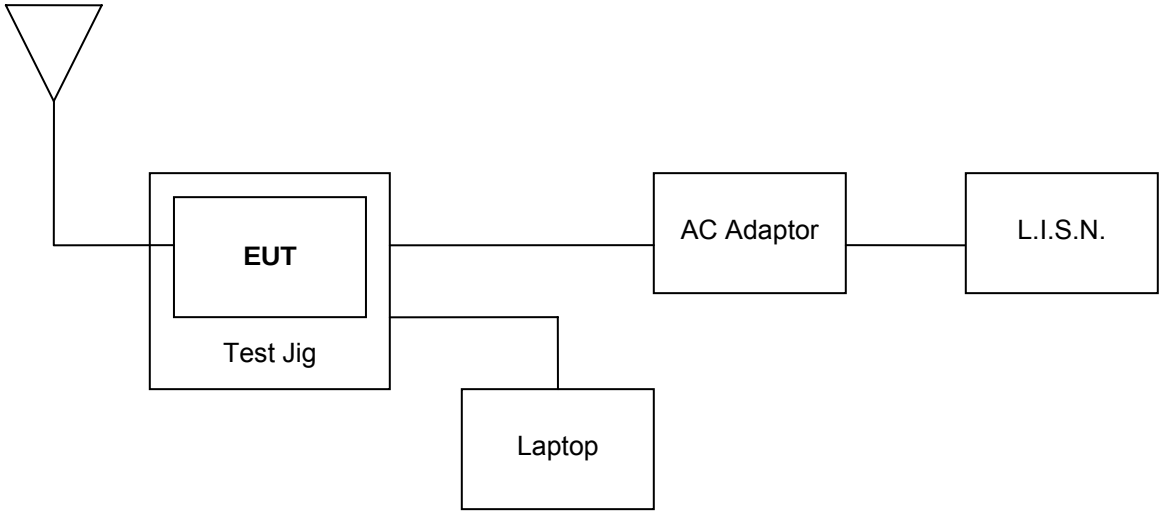
Frequency of emission (MHz)	Class B Conducted Limits (dBμV)		Measuring Bandwidth
	Quasi-peak	Average	
0.15–0.5 .....……..	66 to 56*	56 to 46*	RBW = 9 kHz
0.5–5 .....……..	56	46	VBW ≥ 9 kHz for QP
5-30 ……..	60 ..……..	50	VBW = 1 Hz for Average

*Decreases linearly with the logarithm of the frequency

6.6.2. Method of Measurements

ANSI C63.4

6.6.3. Test Arrangement



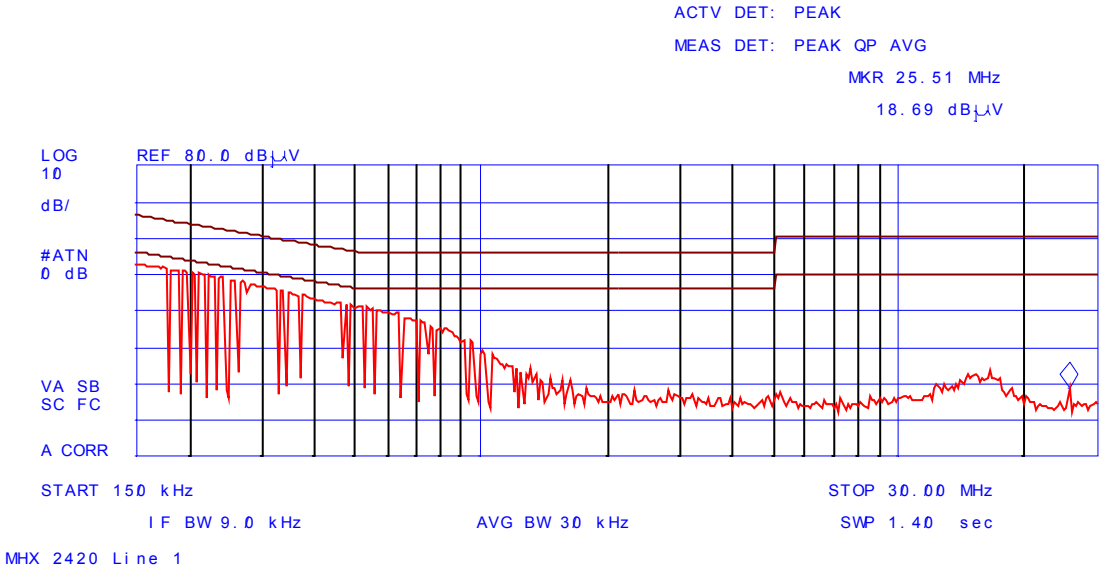
6.6.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 μH
24'(L) x 16'(W) x 8'(H) RF Shielded Chamber	Braden Shielding	…	…	…

6.6.5. Test Data

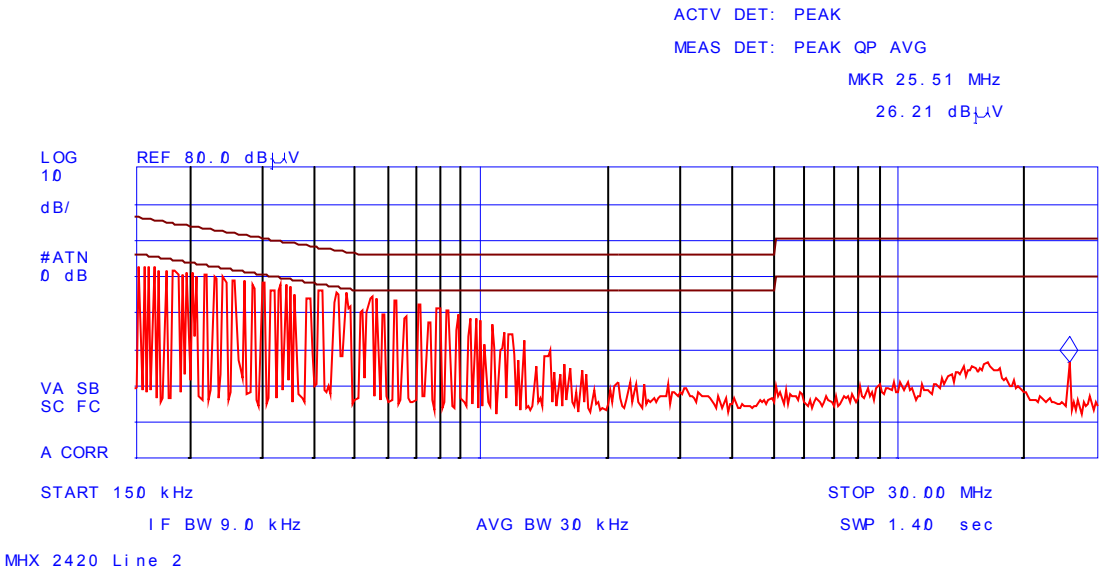
Plot 6.6.5.1 Power Line Conducted Emissions
Line Voltage: 120VAC 60Hz
Line Tested: L1
Transmitter and Receiver Combined mode

Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	QP△L1
1	0.153725	52.9	46.9	13.3	-18.9
2	15.626750	24.4	21.4	18.2	-38.6
3	25.638500	20.4	18.2	15.9	-41.8



Plot 6.6.5.2 Power Line Conducted Emissions
Line Voltage: 120VAC 60Hz
Line Tested: L2
Transmitter and Receiver Combined mode

Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	QP△L1
1	0.152113	52.5	46.6	13.1	-19.3
2	15.966213	26.1	21.5	16.0	-38.5
3	25.640275	26.7	24.9	23.4	-35.2



6.7. PROVISIONS FOR FREQUENCY HOPPING SYSTEMS [§ 15.247(a)(1)]

6.7.1. Limit

§ 15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

§ 15.247(a)(1)(iii): Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

6.7.2. Method of Measurements

FCC Public Notice DA 00-705

Carrier Frequency Separation:

The hopping function of the EUT is enabled. Use the spectrum analyzer setting as follows:

- Span = wide enough to capture the peaks of two adjacent channels
- RBW = 1% of the span
- VBW ≥ RBW
- Sweep = Auto
- Detector = peak
- Trace = max hold

Number of hopping frequency:

The hopping function of the EUT is enabled. Use the spectrum analyzer setting as follows:

- Span = the frequency band of operation
- RBW = 1% of the span
- VBW ≥ RBW
- Sweep = Auto
- Detector = peak
- Trace = max hold

Time of Occupancy (Dwell Time):

The hopping function of the EUT is enabled. Use the spectrum analyzer setting as follows:

- Span = 0 Hz centered on a hopping channel
- RBW = 1 MHz
- VBW ≥ RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector = peak
- Trace = max hold

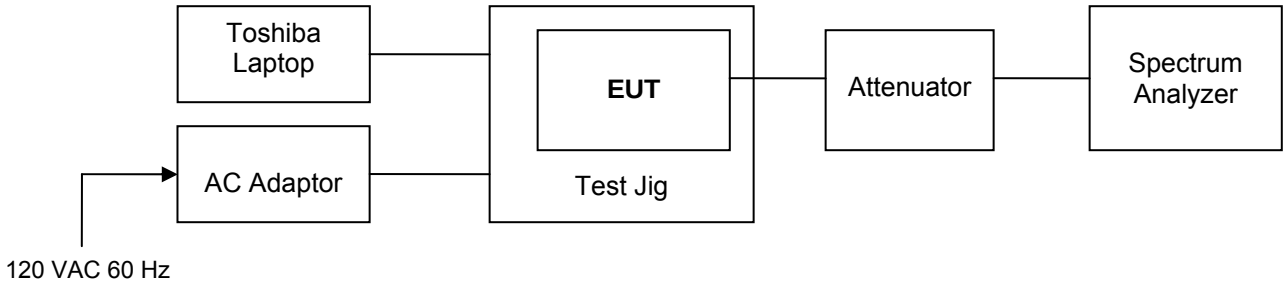
If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g. date rate modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

20 dB Bandwidth:

Use the spectrum analyzer setting as follows:

- Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- RBW = 1% of the 20 dB bandwidth
- VBW ≥ RBW
- Sweep = auto
- Detector = peak
- Trace = max hold
- The transmitter shall be transmitting at its maximum data rate.
- Allow the trace to stabilize.
- Use the marker-to-peak function to set the marker to the peak of the emission.
- Use the marker-delta function to measure 20 dB down on both sides of the emission.
- The 20 dB BW is the delta reading in frequency between two markers.

6.7.3. Test Arrangement



6.7.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK20/B4/B21	834157/005	9kHz - 40GHz
Attenuator	Narda	4768-10	0702	DC -40GHz

6.7.5. Test Data

Test Description	FCC Specification	Measured Values	Comments
Receiver Input Bandwidth and Hopping Capability	The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.	--	See Note 1
20 dB BW of the hopping channel	--	At very low data rate: 44.19 kHz At middle data rate: 263.33 kHz At high data rate: 366.73 kHz	See Note 2
Channel Hopping Frequency Separation	Minimum of 25 kHz or 20dB BW whichever is greater or 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW	At very low data rate: 49.90 kHz At middle data rate: 278.56 kHz At high data rate: 398.80 kHz	See Note 2
Number of hopping frequencies	Shall use at least 15 channels	76 hopping frequencies	See Note 2 and 3
Average Time of Occupancy	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed	At very low data rate:87 ms At middle data rate: 337 ms At high data rate: 230 ms	See Note 2

Note 1: See operational description exhibit for details.

Note 2: See the following plots for details.

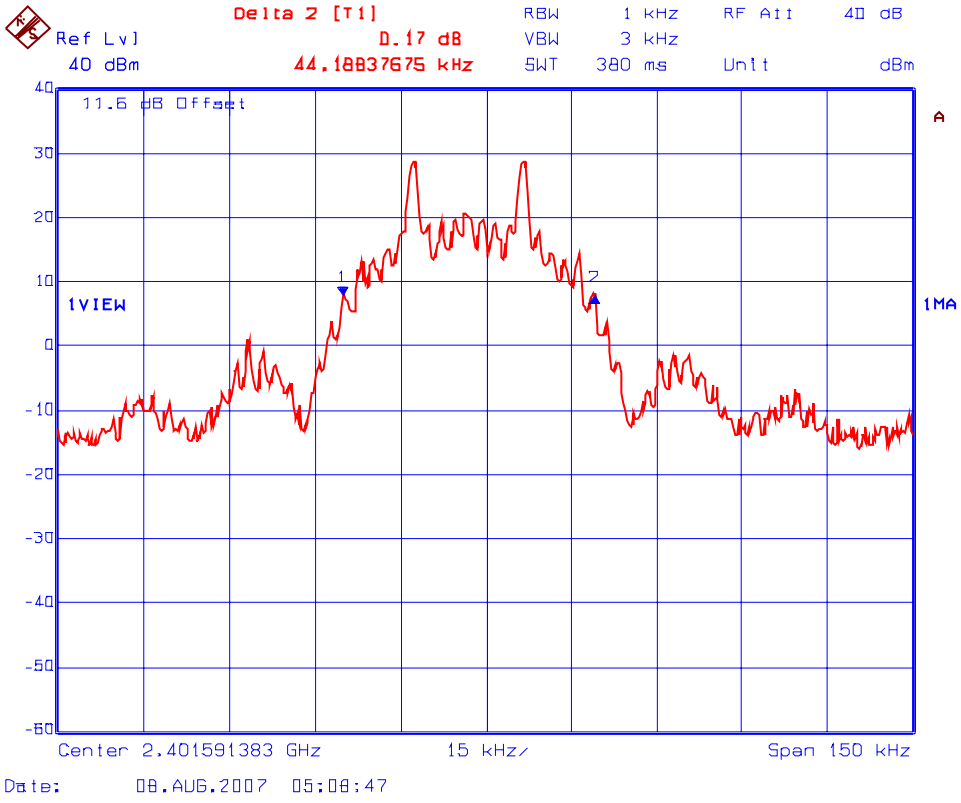
Note 3: Below is the list of pseudorandomly generated frequency in kHz for each rate. These are only a representative sample and the frequencies are generated may be different depend on the pseudorandom seed.

Rate 0 Slow Mode (channel space 50 kHz)
const unsigned int fcc_pattern0[76] = {
2401600, 2401650, 2401700, 2401750, 2401800, 2407200, 2408000, 2409600, 2410400, 2412000,
2413600, 2415200, 2416000, 2417600, 2418400, 2420000, 2420800, 2422400, 2423200, 2424800,
2426400, 2427600, 2428400, 2429600, 2430400, 2431600, 2432000, 2433200, 2434000, 2435200,
2438400, 2439550, 2439600, 2439650, 2439700, 2439750, 2446400, 2449200, 2450000, 2450400,
2452400, 2452800, 2454000, 2454800, 2455200, 2456000, 2456400, 2457600, 2458400, 2459600,
2460000, 2460800, 2462000, 2462400, 2463200, 2463600, 2464400, 2464800, 2465600, 2466000,
2466800, 2468400, 2469200, 2469600, 2470400, 2470800, 2472000, 2472800, 2473200, 2474000,
2474400, 2477400, 2477450, 2477500, 2477550, 2477600};

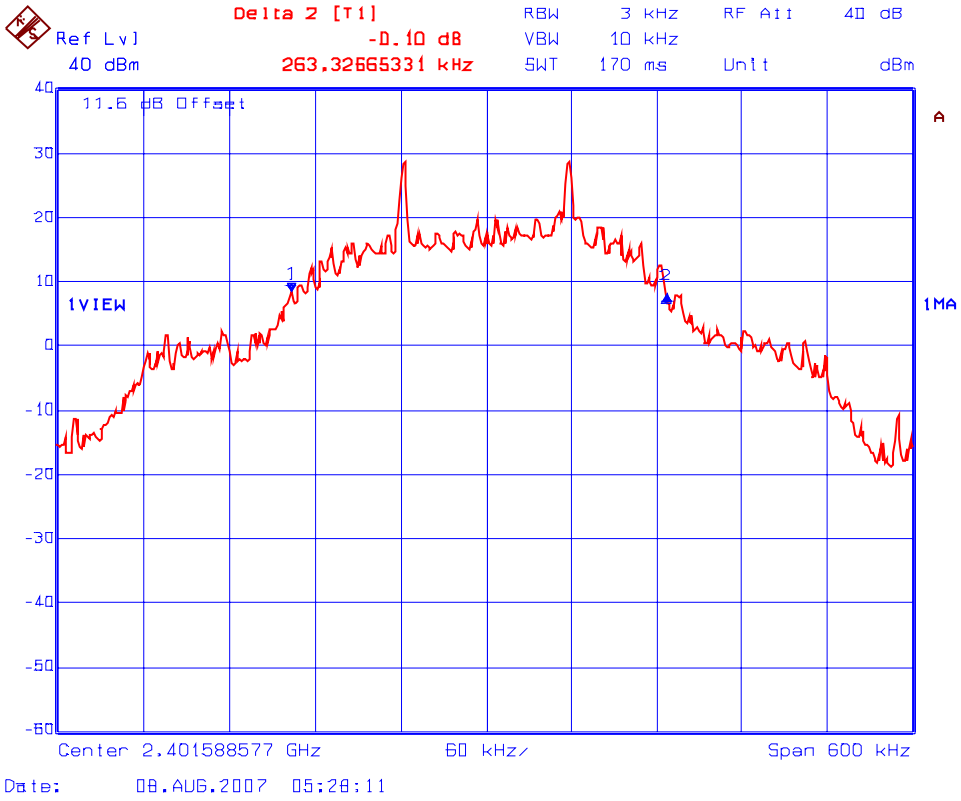
Rate 0,1,2,3 (channel space 280 kHz)
const unsigned int fcc_pattern1[76] = {
2401600, 2401880, 2402160, 2402440, 2402720, 2405800, 2406640, 2407480, 2408320, 2409160,
2410000, 2410280, 2411120, 2411960, 2412800, 2413640, 2414480, 2414760, 2415600, 2416440,
2417280, 2418120, 2418960, 2419800, 2420640, 2421480, 2422320, 2423160, 2424000, 2424840,
2425680, 2426520, 2427360, 2428200, 2429040, 2429880, 2430720, 2431560, 2432400, 2433240,
2434080, 2434920, 2435760, 2436600, 2437440, 2438280, 2439400, 2439680, 2439960, 2440240,
2440520, 2440800, 2445840, 2447520, 2448360, 2449200, 2450880, 2451720, 2452560, 2453400,
2456760, 2457600, 2460120, 2461800, 2463480, 2465160, 2466840, 2468520, 2469360, 2470200,
2471040, 2476360, 2476640, 2476920, 2477200, 2477480};

Rate 0,1,2,3,4,5 // High link rate (channel space 400 kHz)
const unsigned int fcc_pattern3[76] = {
2401600, 2402100, 2402600, 2403100, 2403600, 2407200, 2408000, 2409600, 2410400, 2412000,
2413600, 2415200, 2416000, 2417600, 2418400, 2420000, 2420800, 2422400, 2423200, 2424800,
2426400, 2427600, 2428400, 2429600, 2430400, 2431600, 2432000, 2433200, 2434000, 2435200,
2438400, 2439200, 2439600, 2440000, 2440400, 2440800, 2441200, 2442000, 2445200, 2446400,
2450000, 2452400, 2452800, 2454000, 2455200, 2456000, 2456400, 2457600, 2458400, 2459600,
2460000, 2460800, 2462000, 2462400, 2463200, 2463600, 2464400, 2464800, 2465600, 2466000,
2466800, 2468400, 2469200, 2469600, 2470400, 2470800, 2472000, 2472800, 2473200, 2474000,
2474400, 2475600, 2476100, 2476600, 2477100, 2477600}

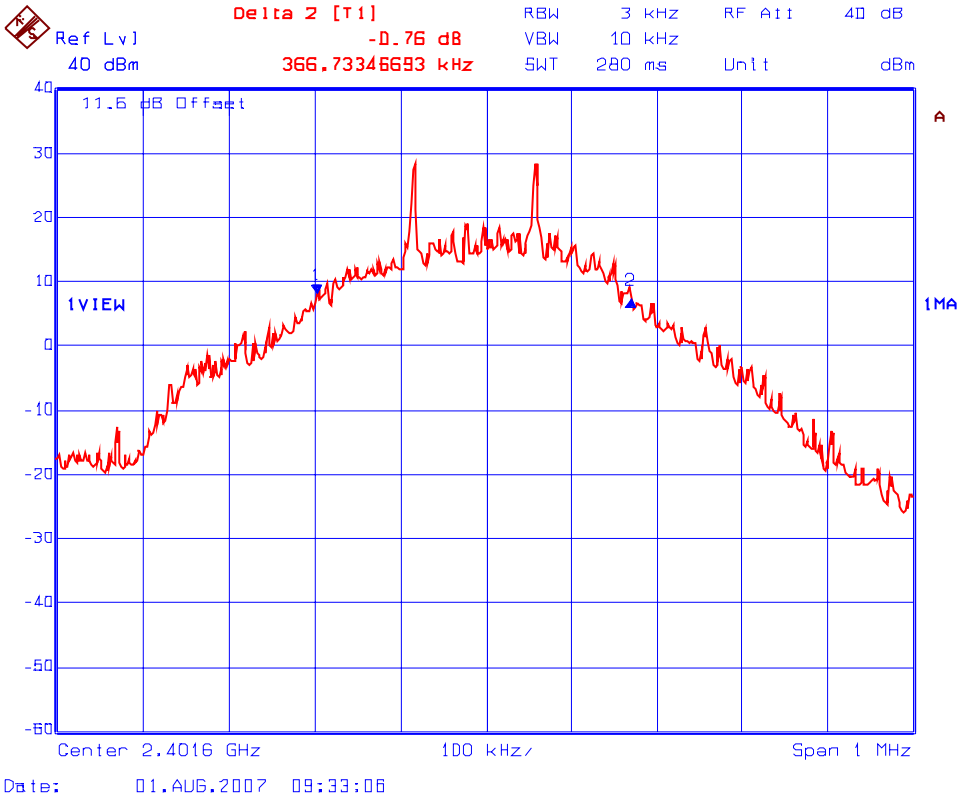
Plot 6.7.5.1 20 dB Bandwidth
Test Frequency: 2401.6 MHz, Data Rate Setting: 0 (at very low data rate)



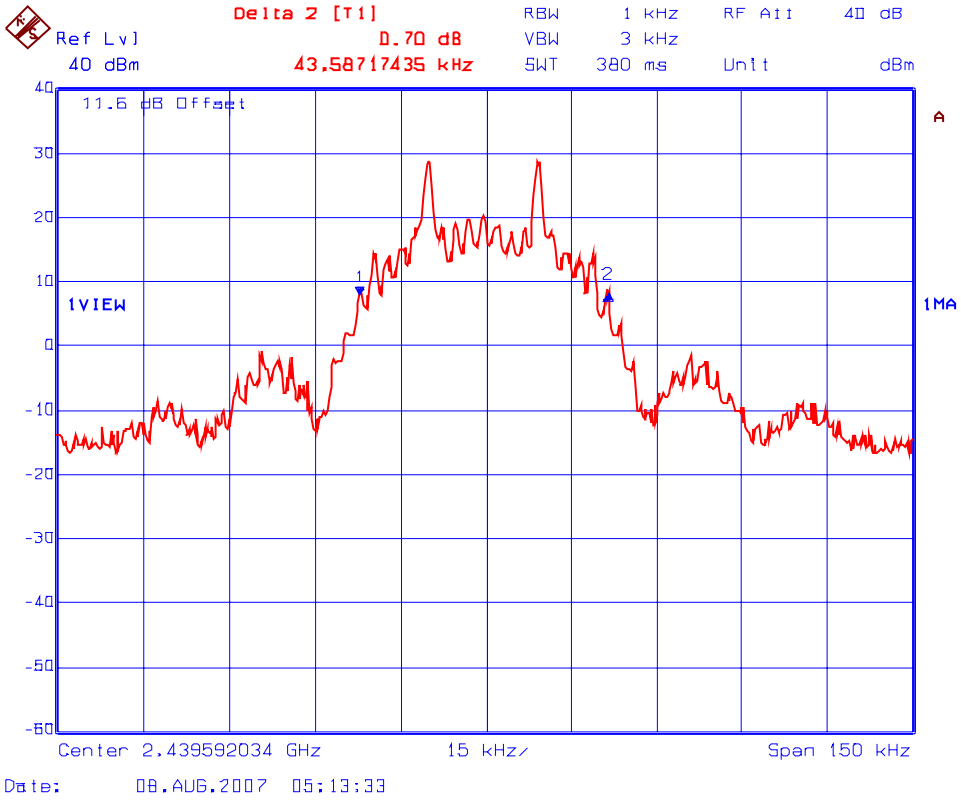
Plot 6.7.5.2 20 dB Bandwidth
Test Frequency: 2401.6 MHz, Data Rate Setting: 3 (at middle data rate)



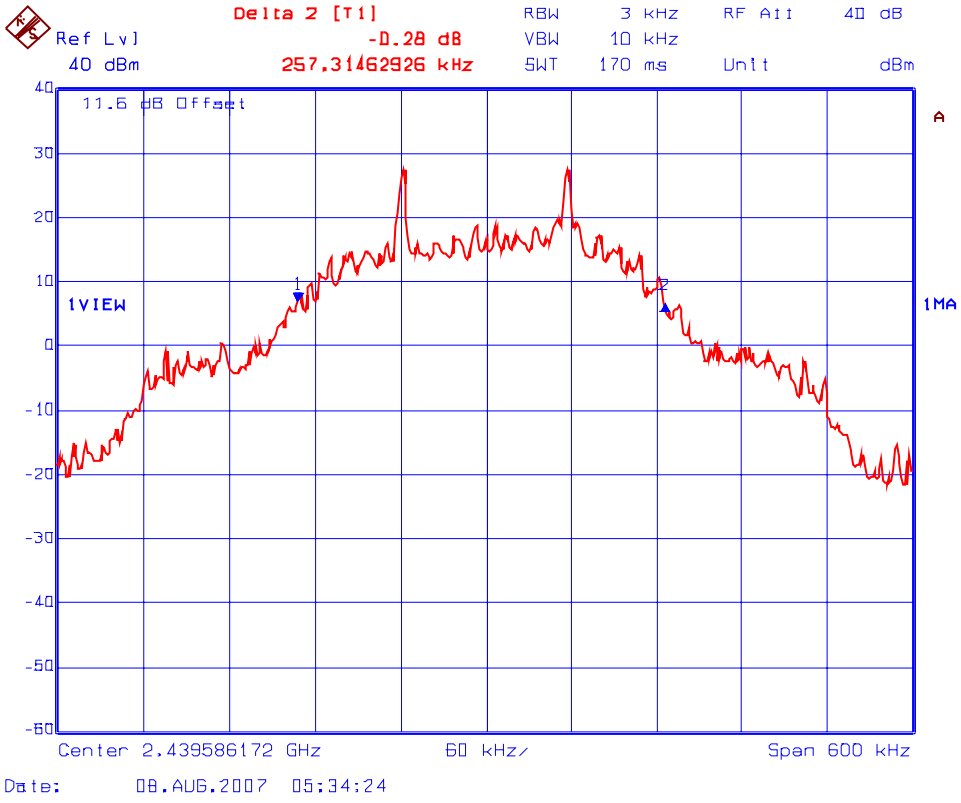
Plot 6.7.5.3 20 dB Bandwidth
Test Frequency: 2401.6 MHz, Data Rate Setting: 5 (at high data rate)



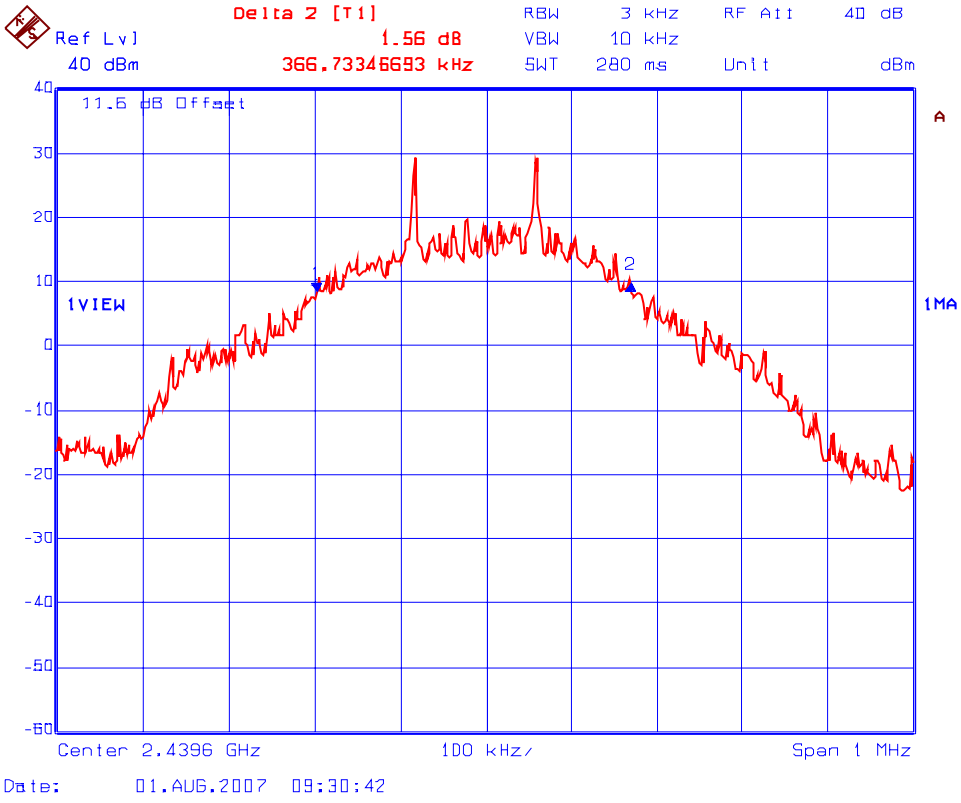
Plot 6.7.5.4 20 dB Bandwidth
Test Frequency: 2439.6 MHz, Data Rate Setting: 0 (at very low data rate)



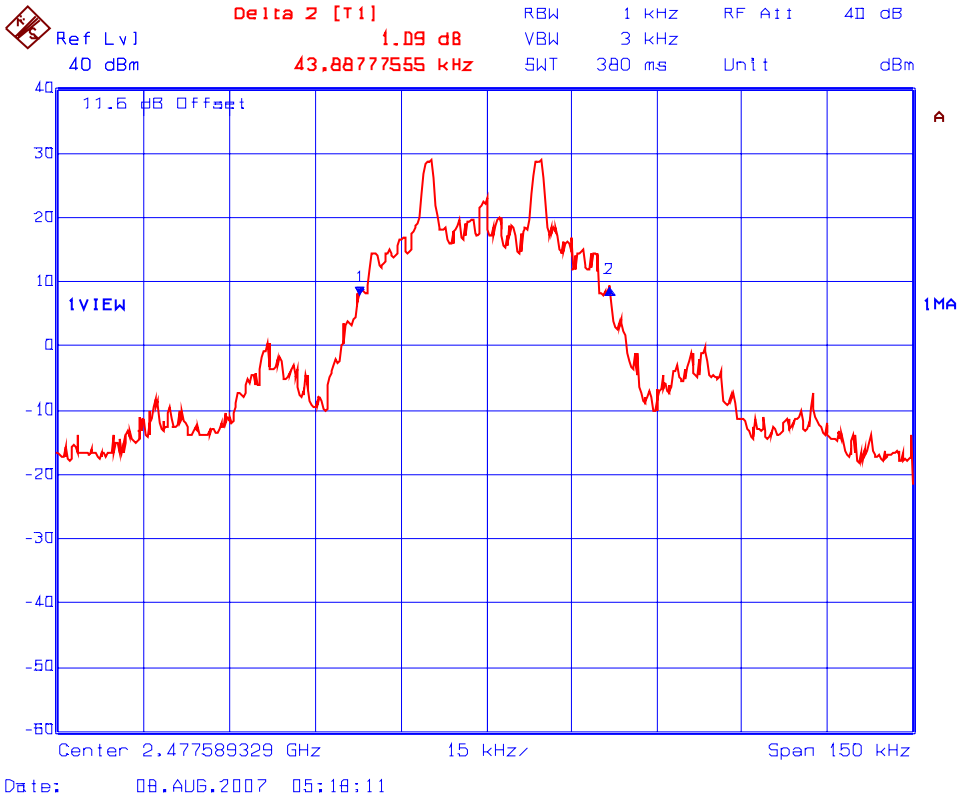
Plot 6.7.5.5 20 dB Bandwidth
Test Frequency: 2439.6 MHz, Data Rate Setting: 3 (at middle data rate)



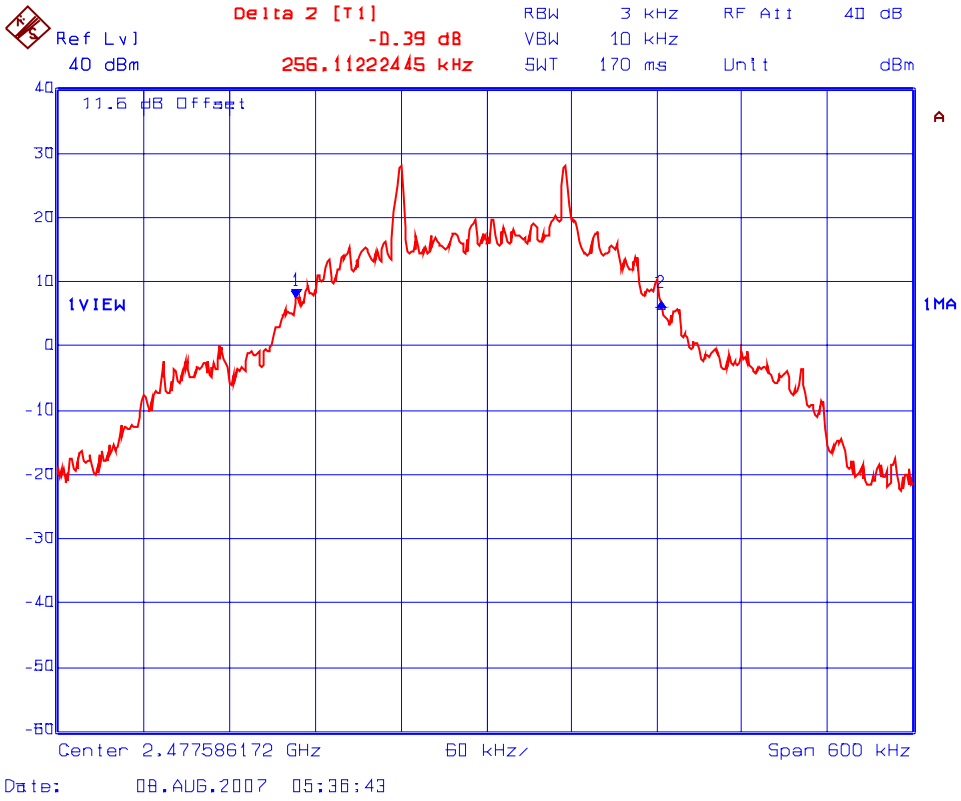
Plot 6.7.5.6 20 dB Bandwidth
Test Frequency: 2439.6 MHz, Data Rate Setting: 5 (at high data rate)



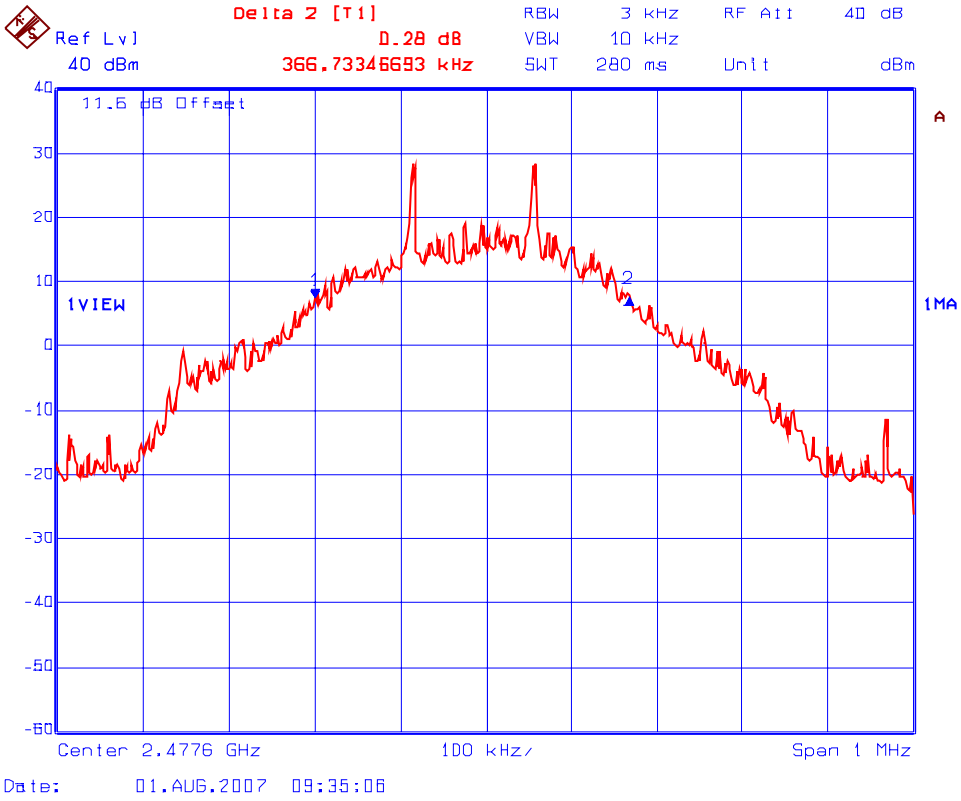
Plot 6.7.5.7 20 dB Bandwidth
Test Frequency: 2477.6 MHz, Data Rate Setting: 0 (at very low data rate)



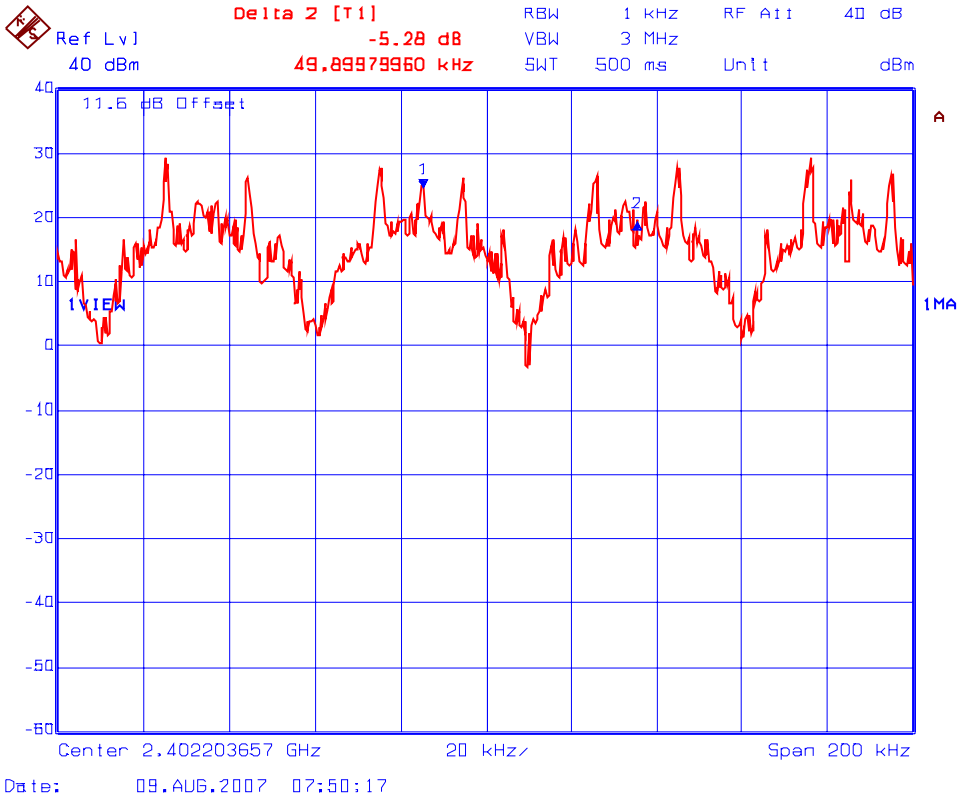
Plot 6.7.5.8 20 dB Bandwidth
Test Frequency: 2477.6 MHz, Data Rate Setting: 3 (at middle data rate)



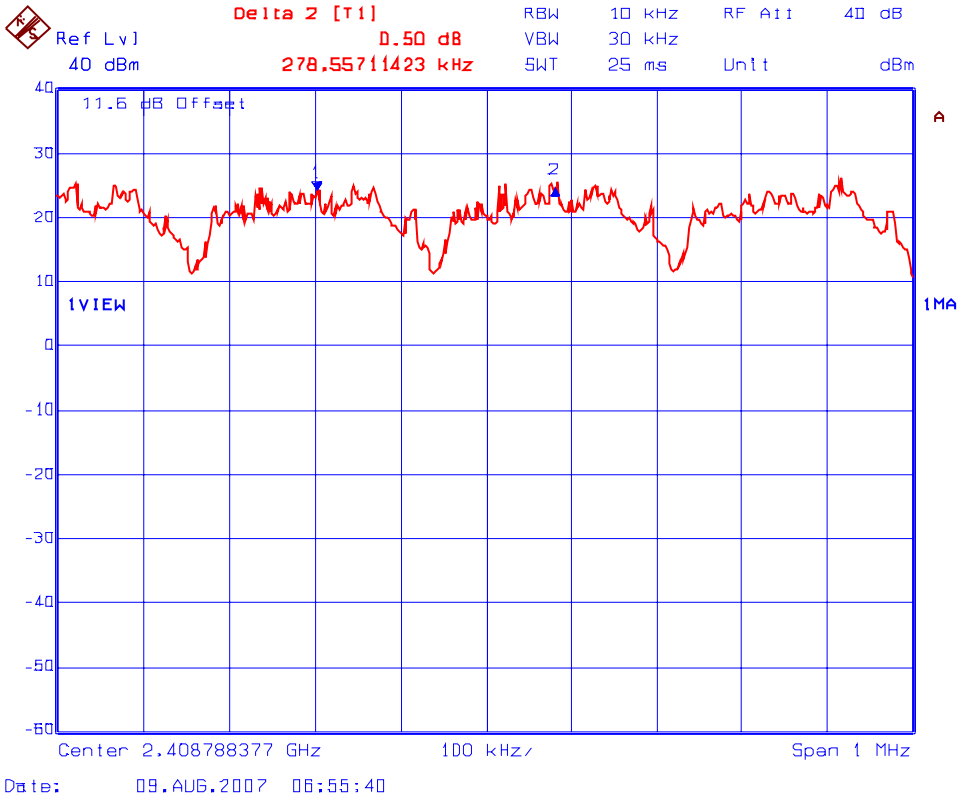
Plot 6.7.5.9 20 dB Bandwidth
Test Frequency: 2477.6 MHz, Data Rate Setting: 5 (at high data rate)



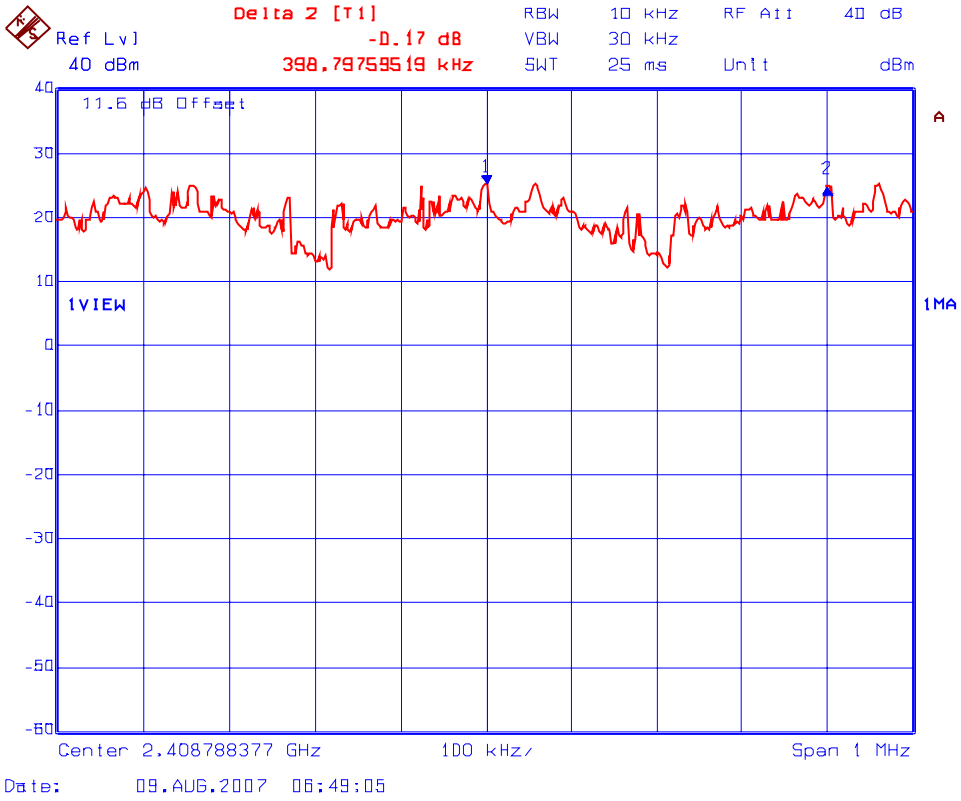
Plot 6.7.5.10 Carrier Frequency Separation
Data Rate Setting: 0 (at very low data rate)



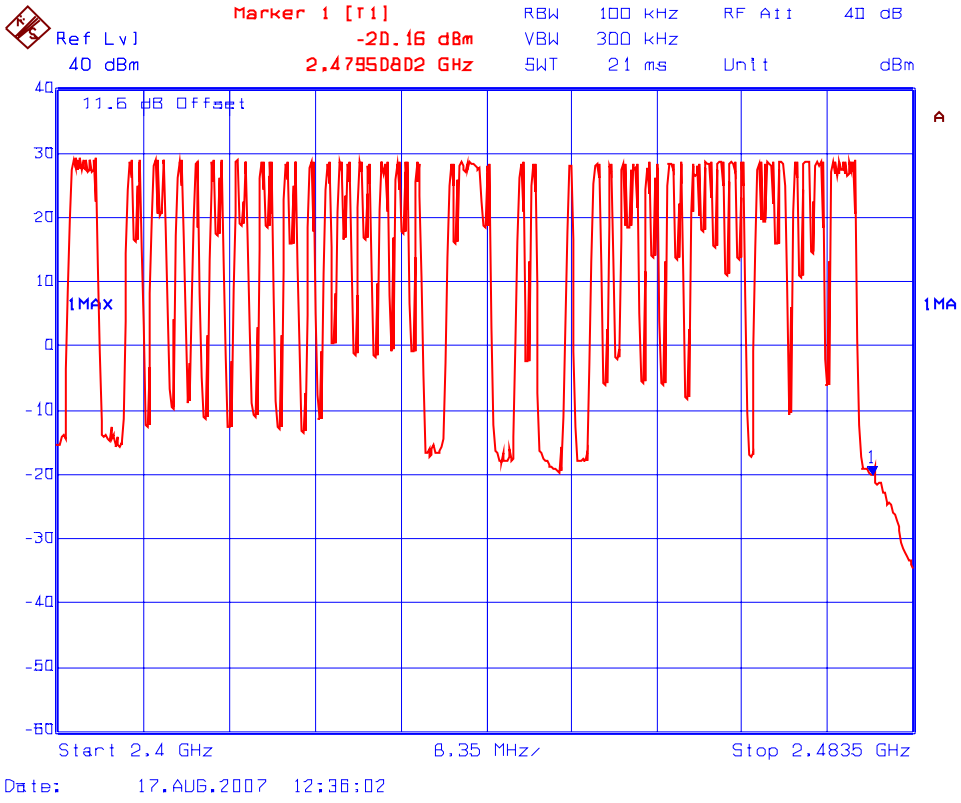
Plot 6.7.5.11 Carrier Frequency Separation
Data Rate Setting: 3 (at middle data rate)



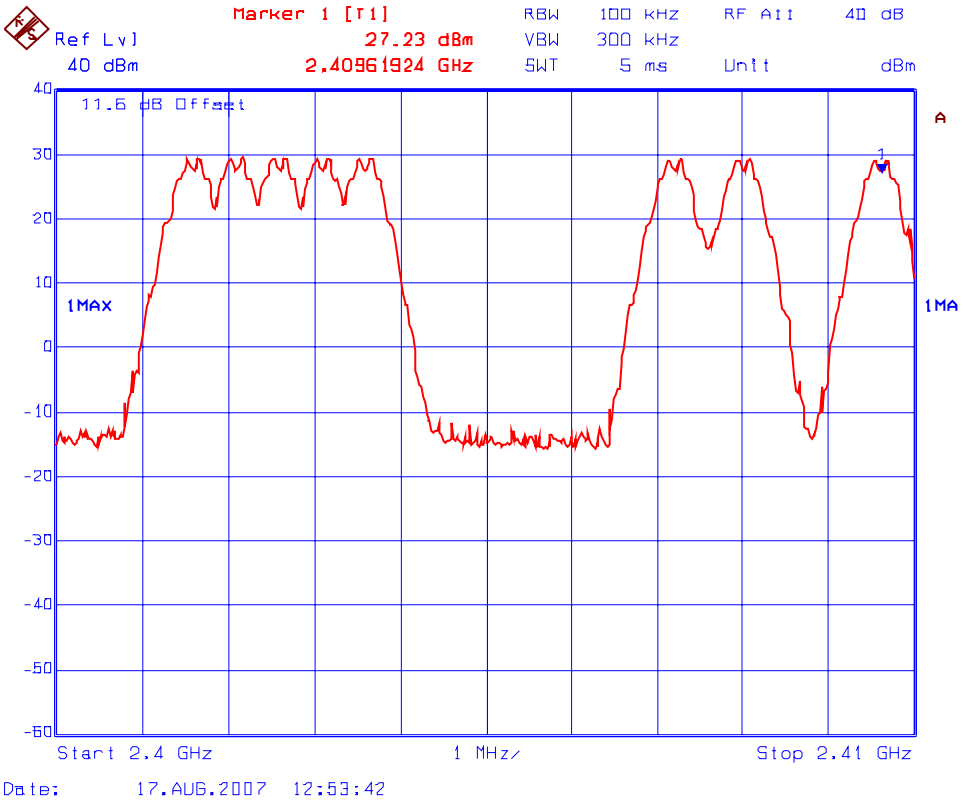
Plot 6.7.5.12 Carrier Frequency Separation
Data Rate Setting: 5 (at high data rate)



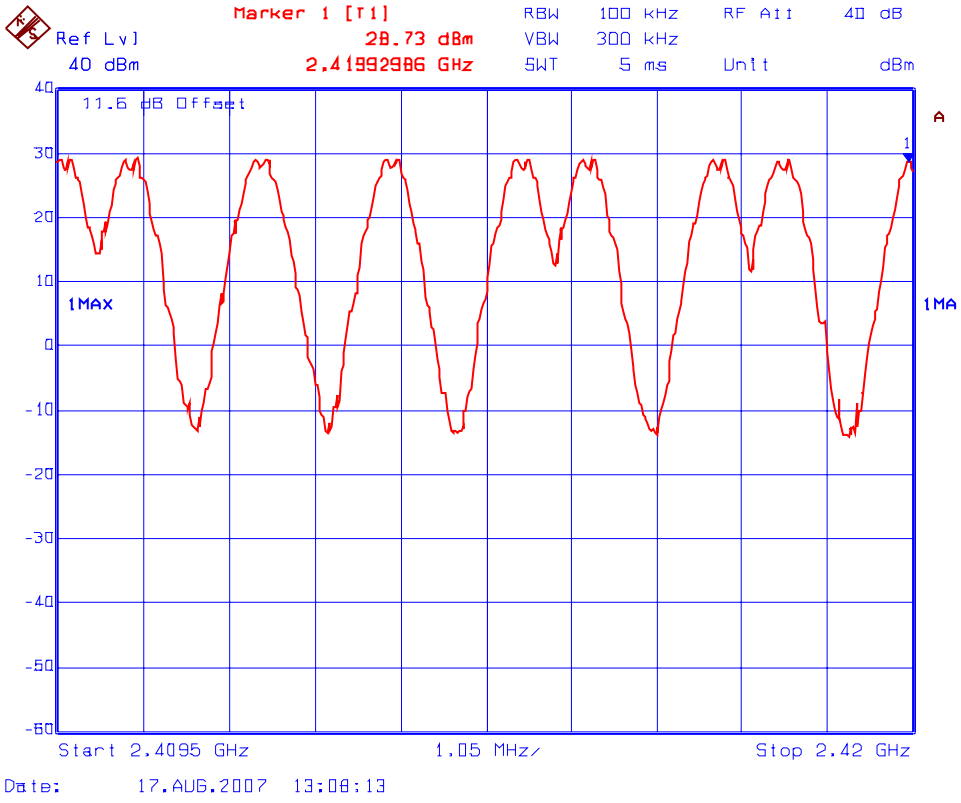
Plot 6.7.5.13 Number of Hopping Frequencies
76 Hopping Channels from 2400-2483.5 MHz



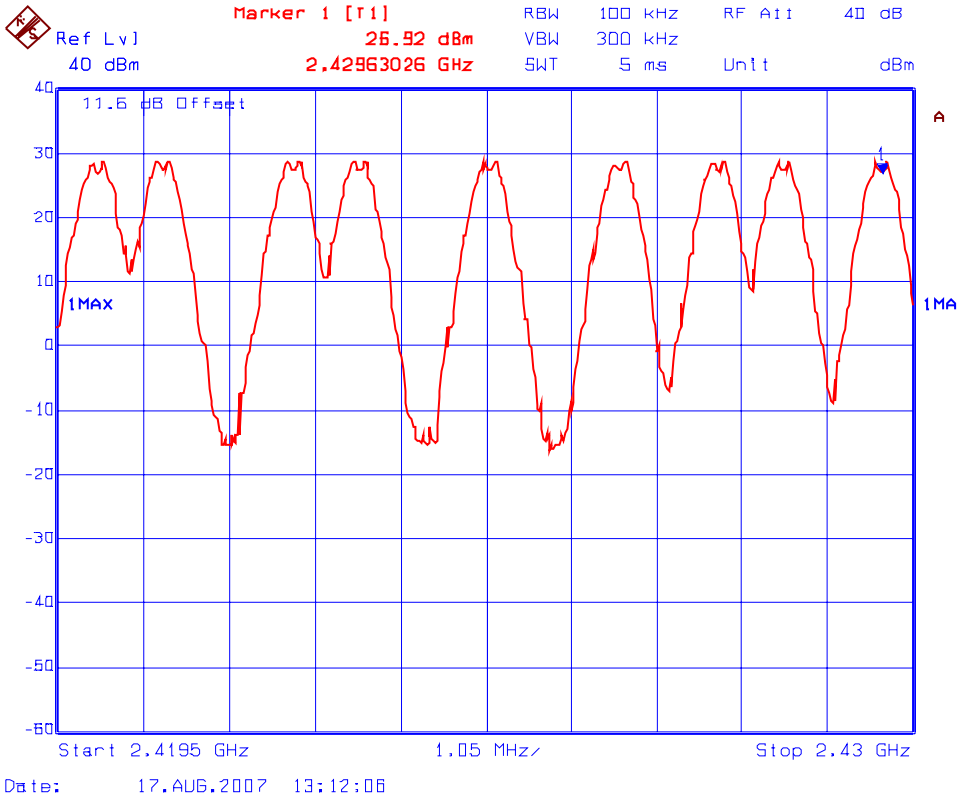
Plot 6.7.5.14 Number of Hopping Frequencies
8 Hopping Channels from 2400 - 2410 MHz



Plot 6.7.5.15 Number of Hopping Frequencies
8 Hopping Channels from 2409.5 - 2420 MHz

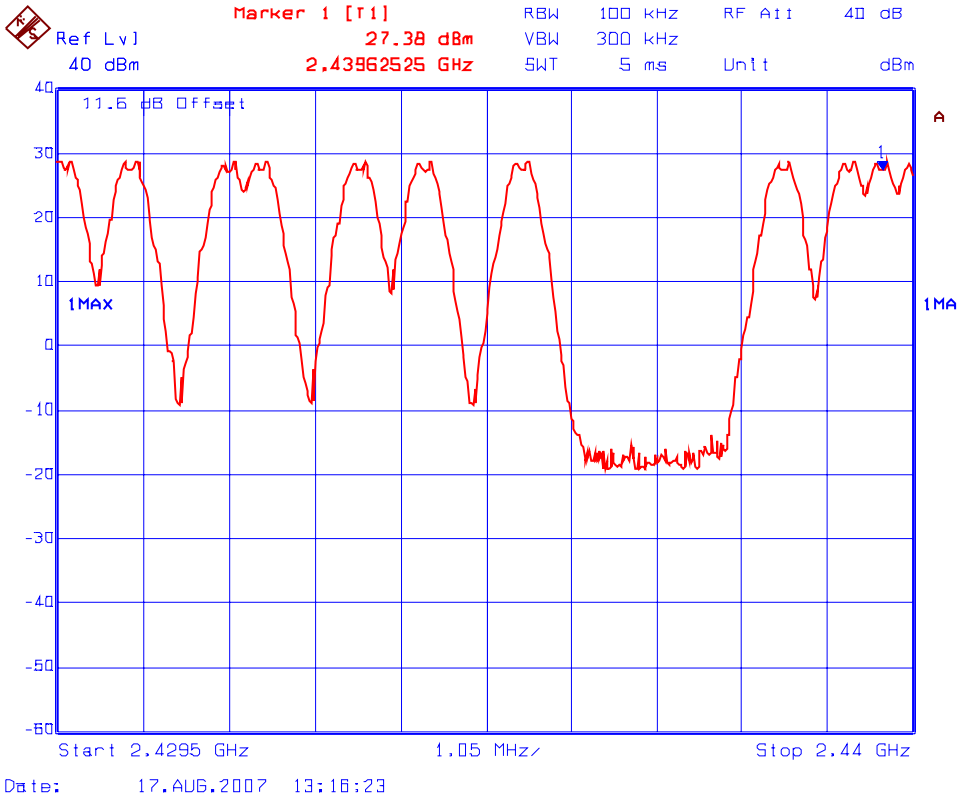


Plot 6.7.5.16 Number of Hopping Frequencies
8 Hopping Channels from 2419.5 - 2430 MHz

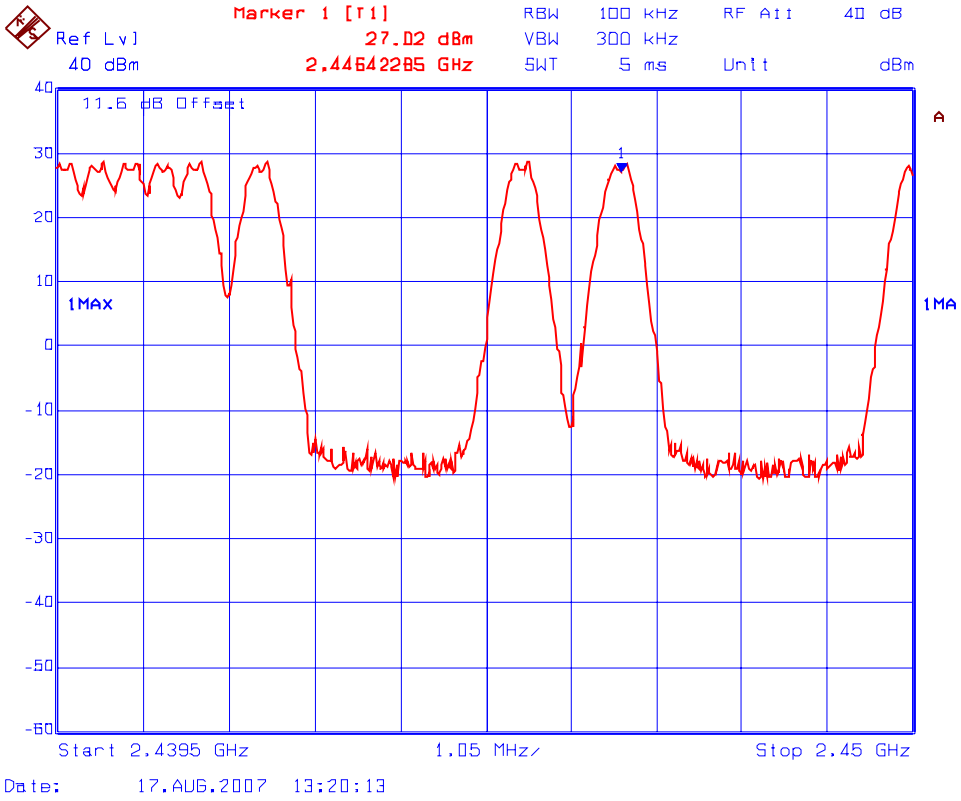


All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 6.7.5.17 Number of Hopping Frequencies
9 Hopping Channels from 2429.5 - 2440 MHz

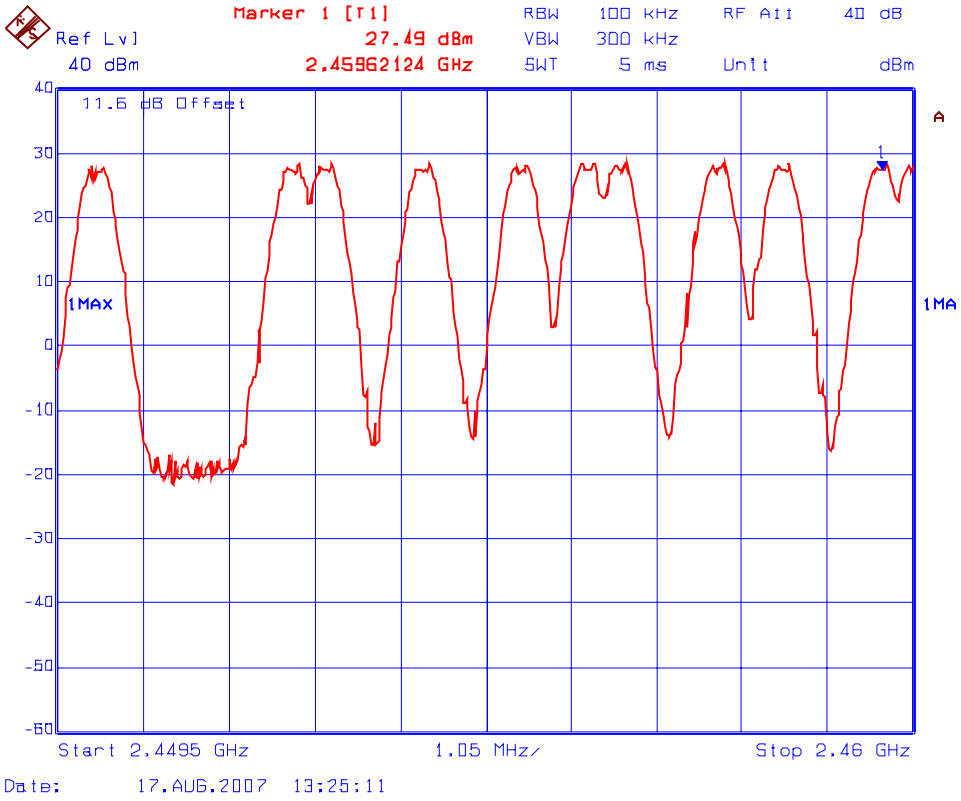


Plot 6.7.5.18 Number of Hopping Frequencies
7 Hopping Channels from 2439.5 - 2450 MHz

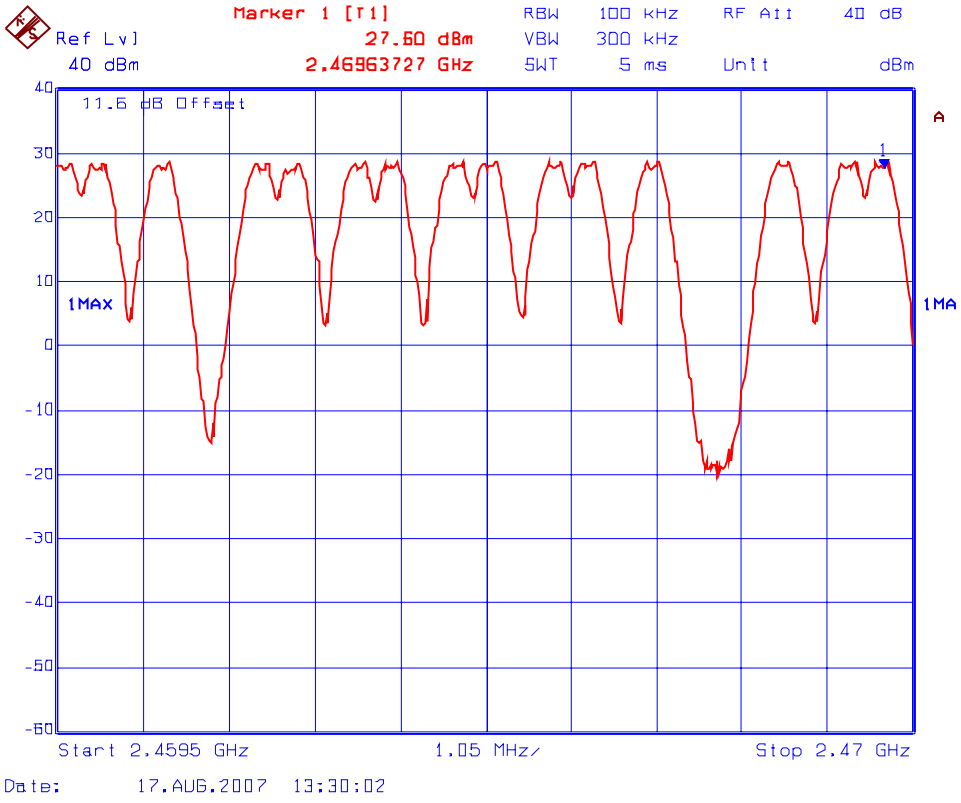


All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

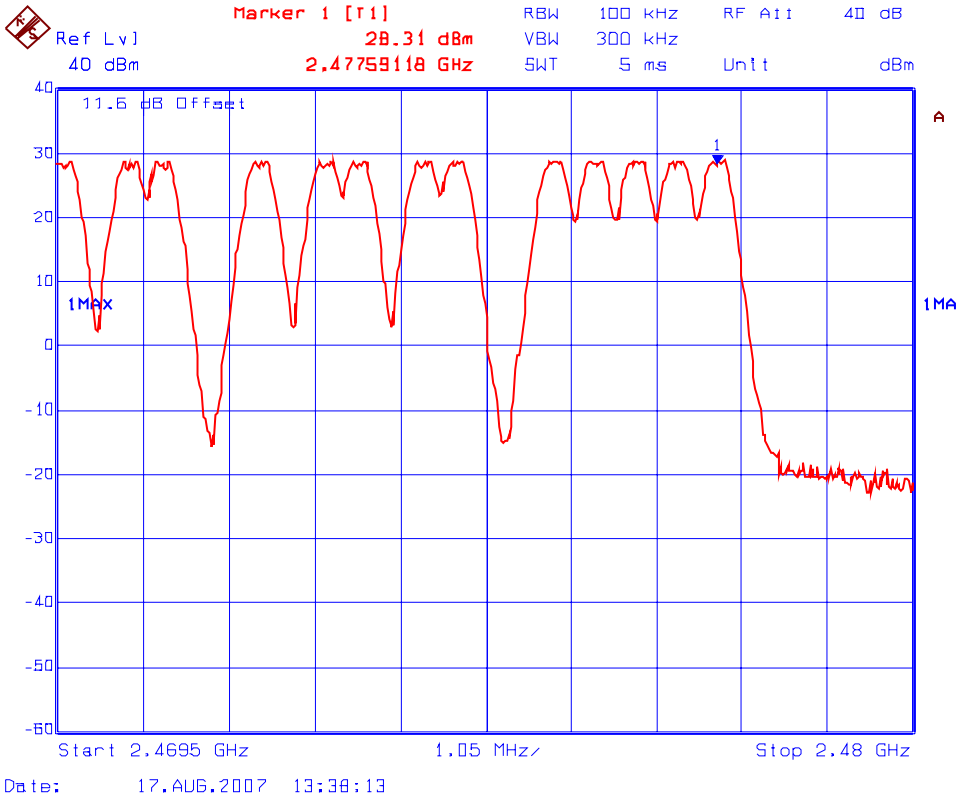
Plot 6.7.5.19 Number of Hopping Frequencies
10 Hopping Channels from 2449.5 - 2460 MHz



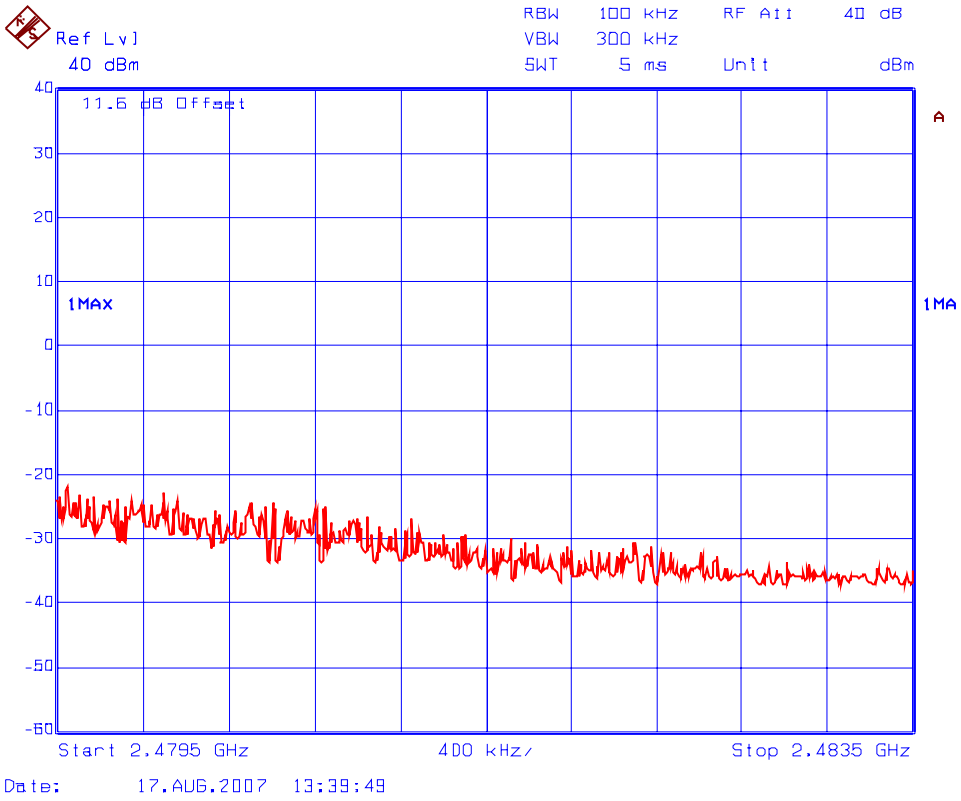
Plot 6.7.5.20 Number of Hopping Frequencies
14 Hopping Channels from 2459.5 - 2470 MHz



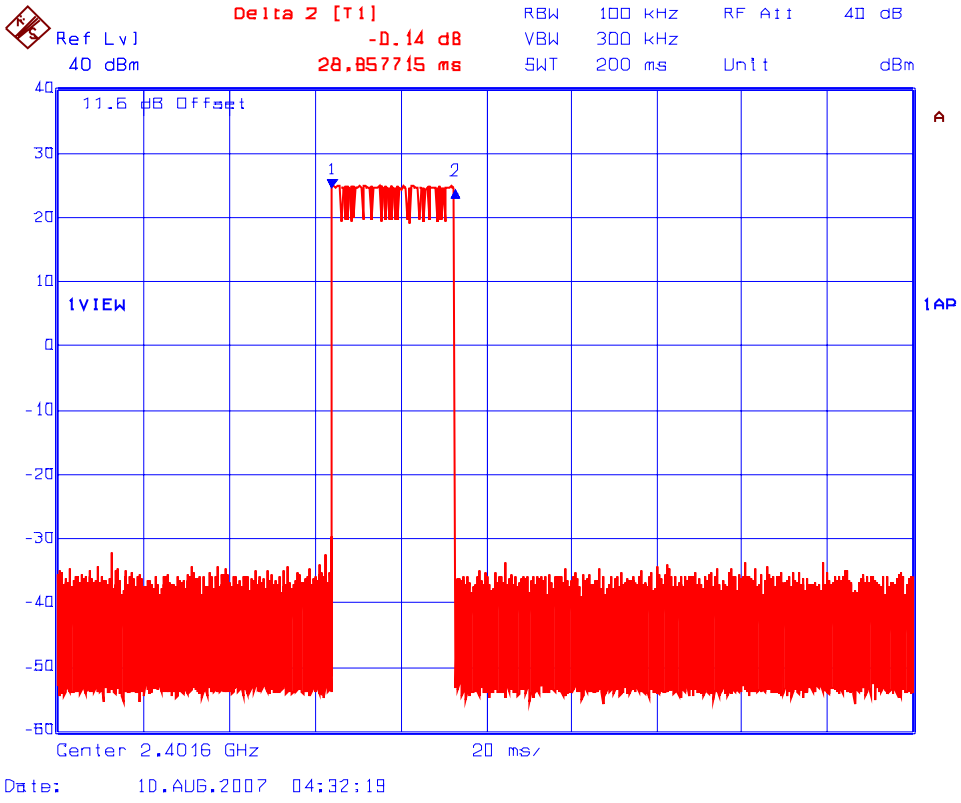
Plot 6.7.5.21 Number of Hopping Frequencies
12 Hopping Channels from 2469.5 - 2480 MHz



Plot 6.7.5.22 Number of Hopping Frequencies
0 Hopping Channels from 2479.5 – 2483.5 MHz

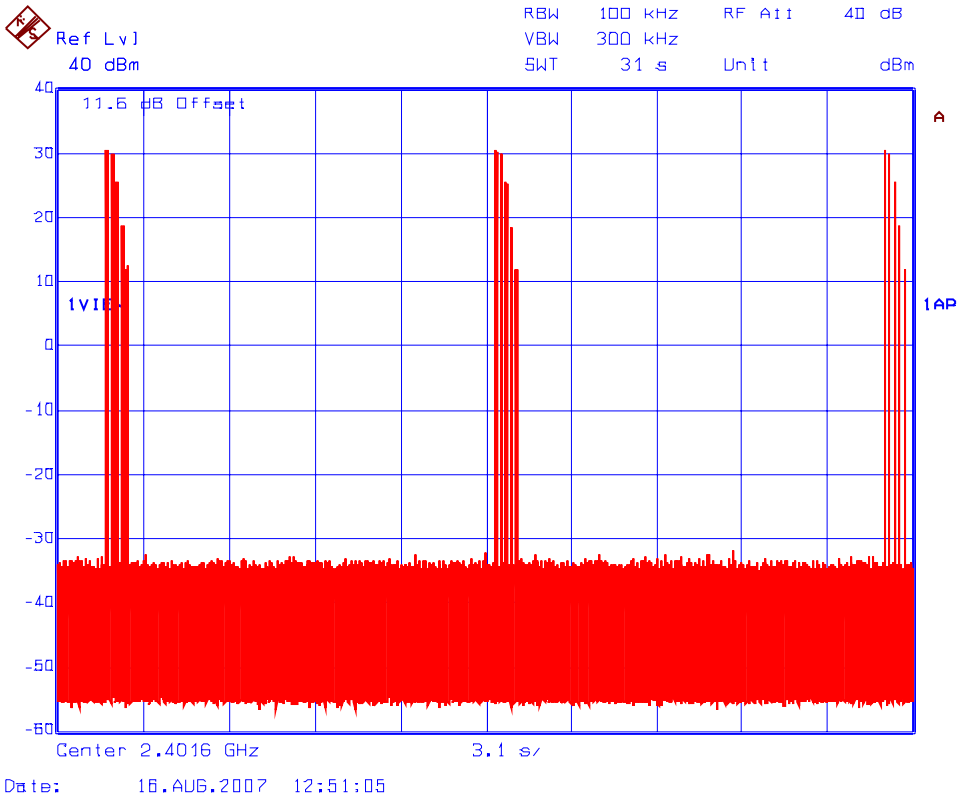


Plot 6.7.5.23 Time of Occupancy
Test Frequency: 2401.6 MHz MHz, Data Rate Setting: 0 (at very low data rate)



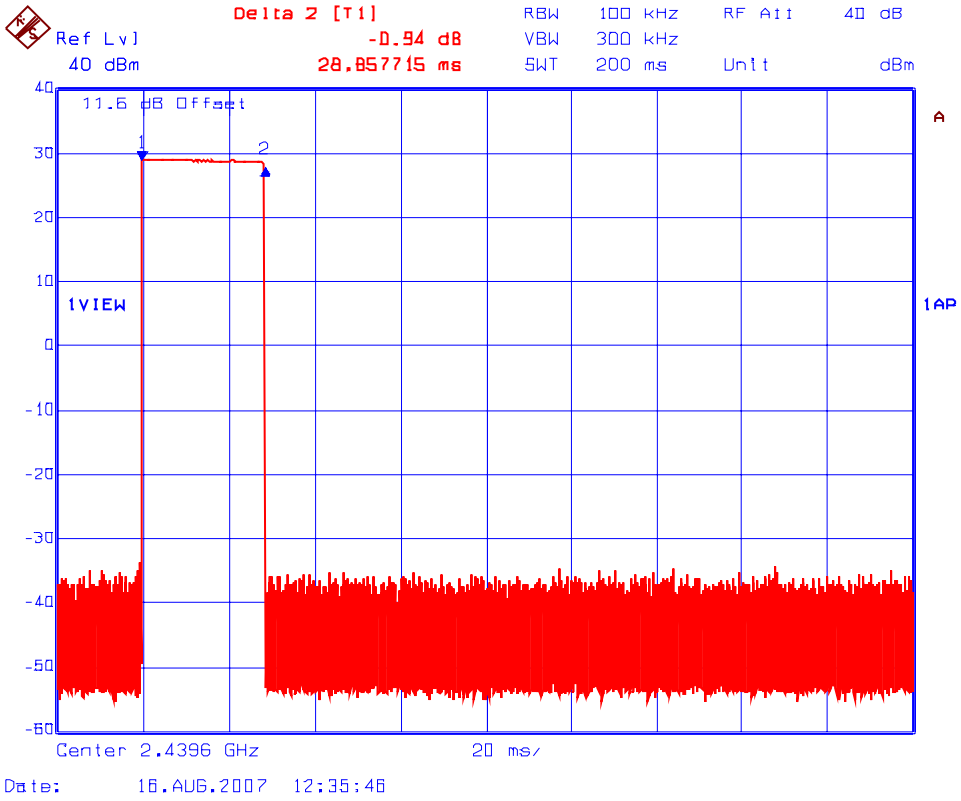
Dwell Time @ 2401.6 MHz = 28.857715 ms

Plot 6.7.5.24 Time of Occupancy
Test Frequency: 2401.6 MHz, Data Rate Setting: 0 (at very low data rate)



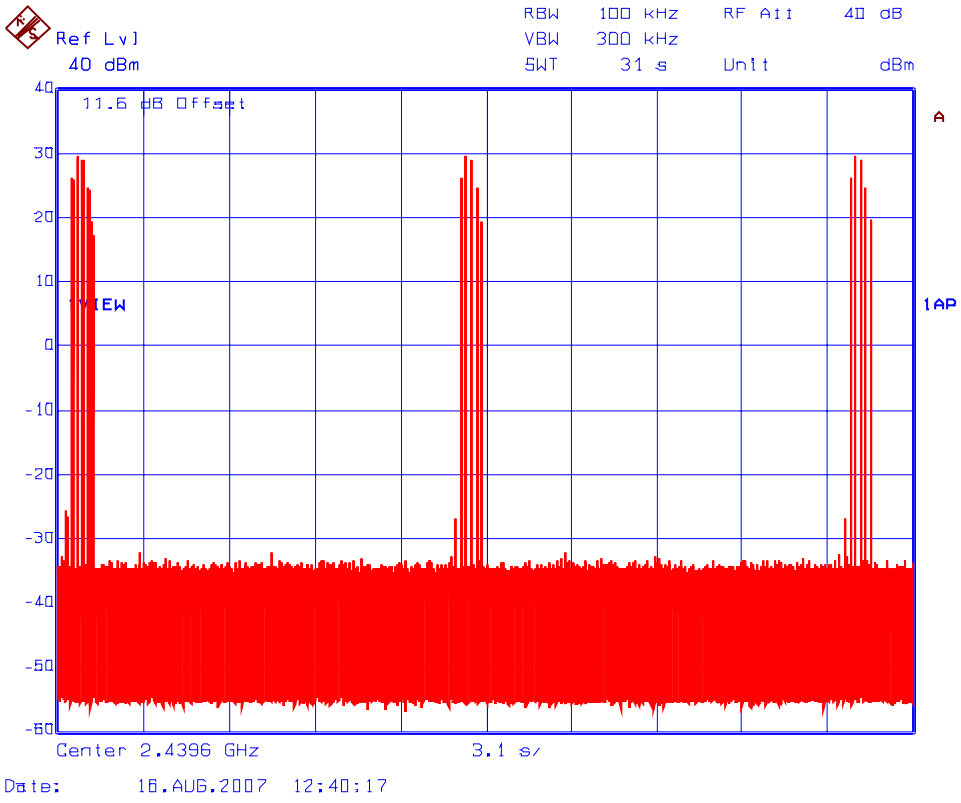
Average time of occupancy = (Dwell Time @ 2401.6 MHz) x (number of hops within a period)
= 28.857715 ms x 3
= 87 ms

Plot 6.7.5.25 Time of Occupancy
Test Frequency: 2439.6 MHz, Data Rate Setting: 0 (at very low data rate)



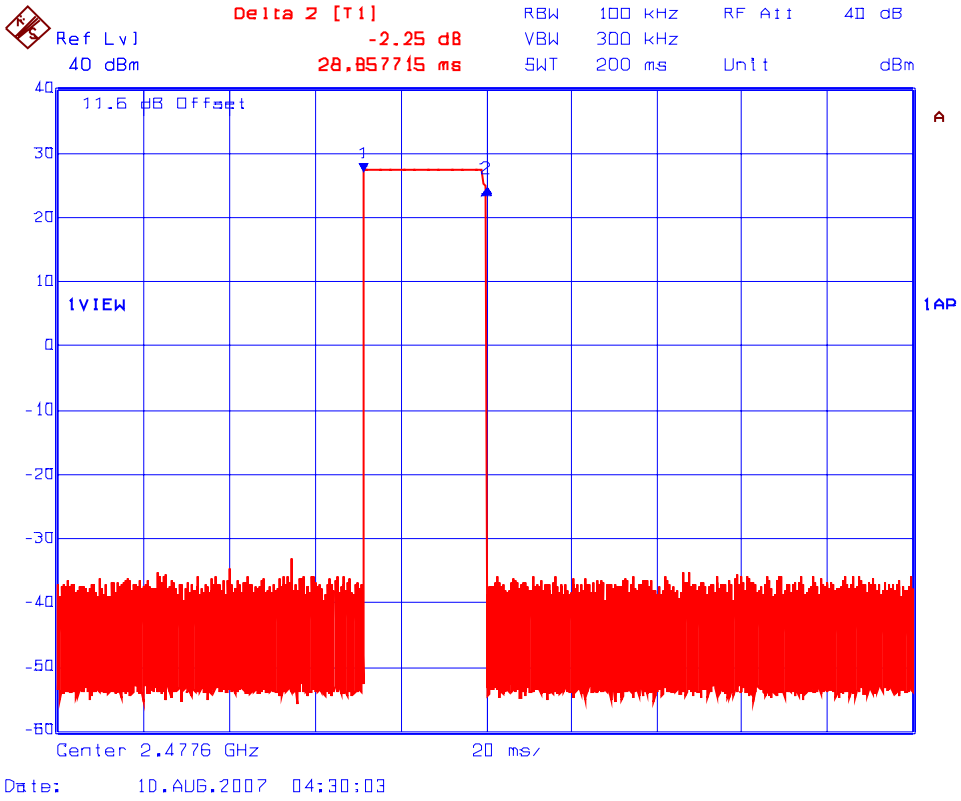
Dwell Time @ 2439.6 MHz = 28.857715 ms

Plot 6.7.5.26 Time of Occupancy
Test Frequency: 2439.6 MHz, Data Rate Setting: 0 (at very low data rate)



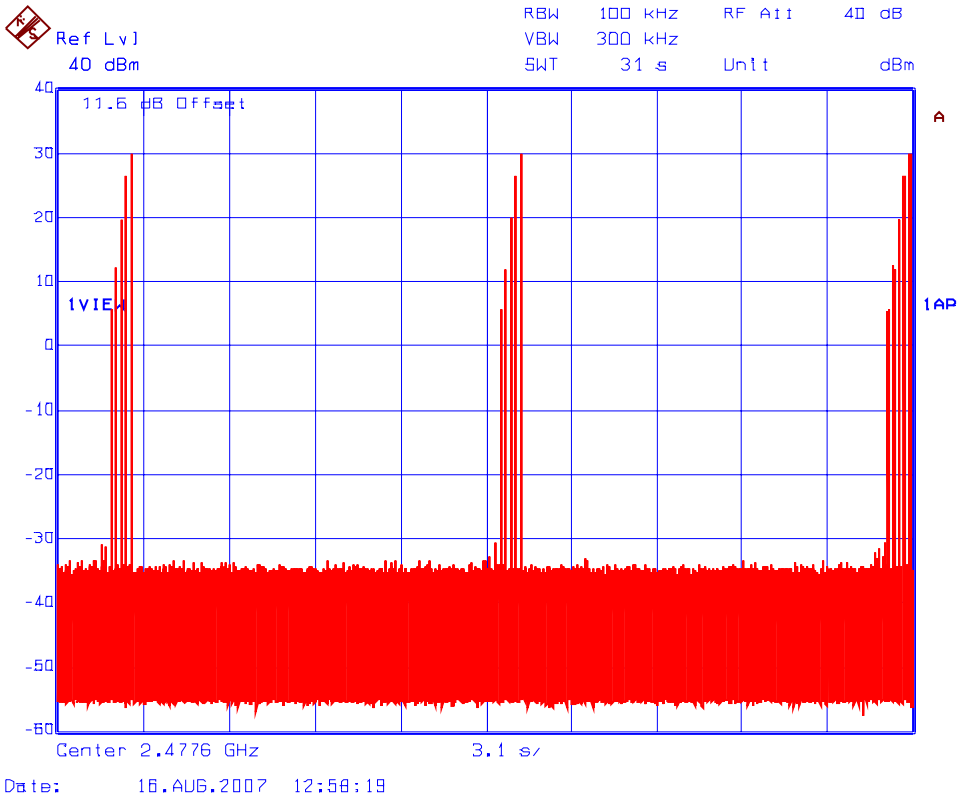
Average time of occupancy = (Dwell Time @ 2439.6 MHz) x (number of hops within a period)
= 28.857715 ms x 3
= 87 ms

Plot 6.7.5.27 Time of Occupancy
Test Frequency: 2477.6 MHz, Data Rate Setting: 0 (at very low data rate)



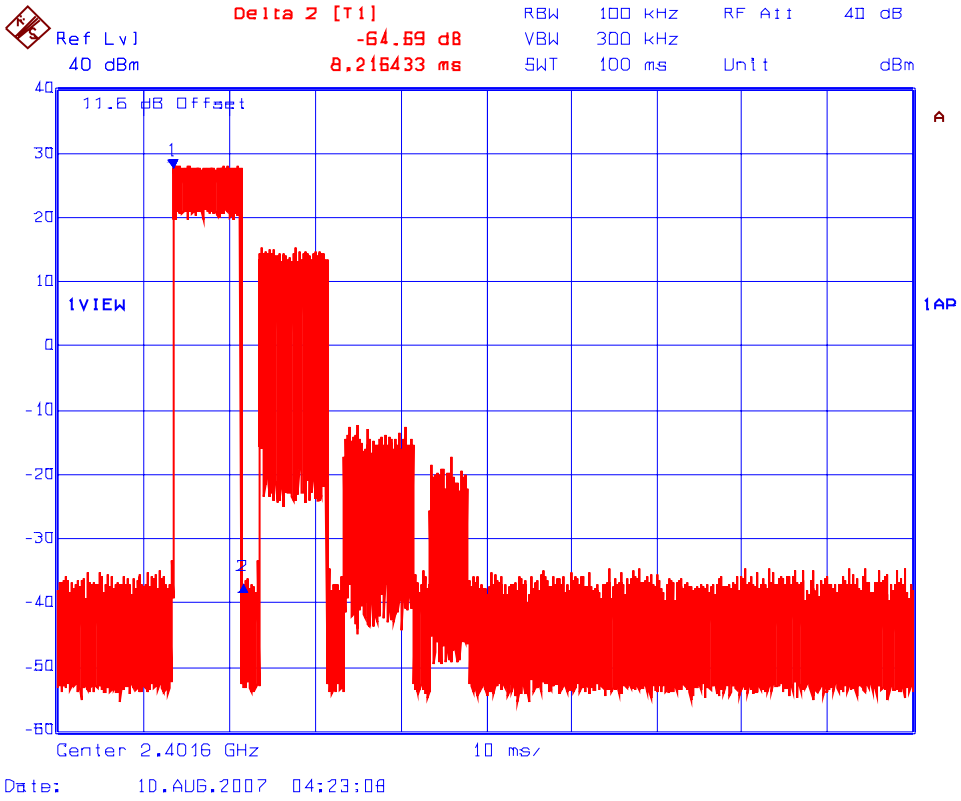
Dwell Time @ 2477.6 MHz = 28.857715 ms

Plot 6.7.5.28 Time of Occupancy
Test Frequency: 2477.6 MHz, Data Rate Setting: 0 (at very low data rate)



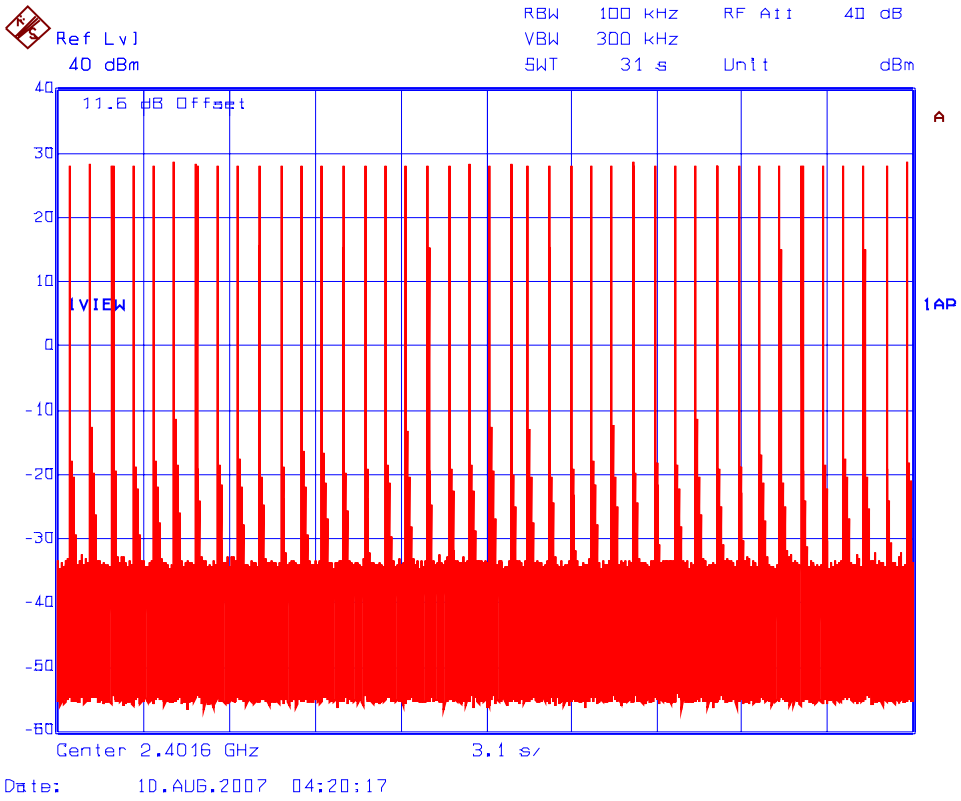
Average time of occupancy = (Dwell Time @ 2477.6 MHz) x (number of hops within a period)
= 28.857715 ms x 3
= 87 ms

Plot 6.7.5.29 Time of Occupancy
Test Frequency: 2401.6 MHz, Data Rate Setting: 3 (at middle data rate)



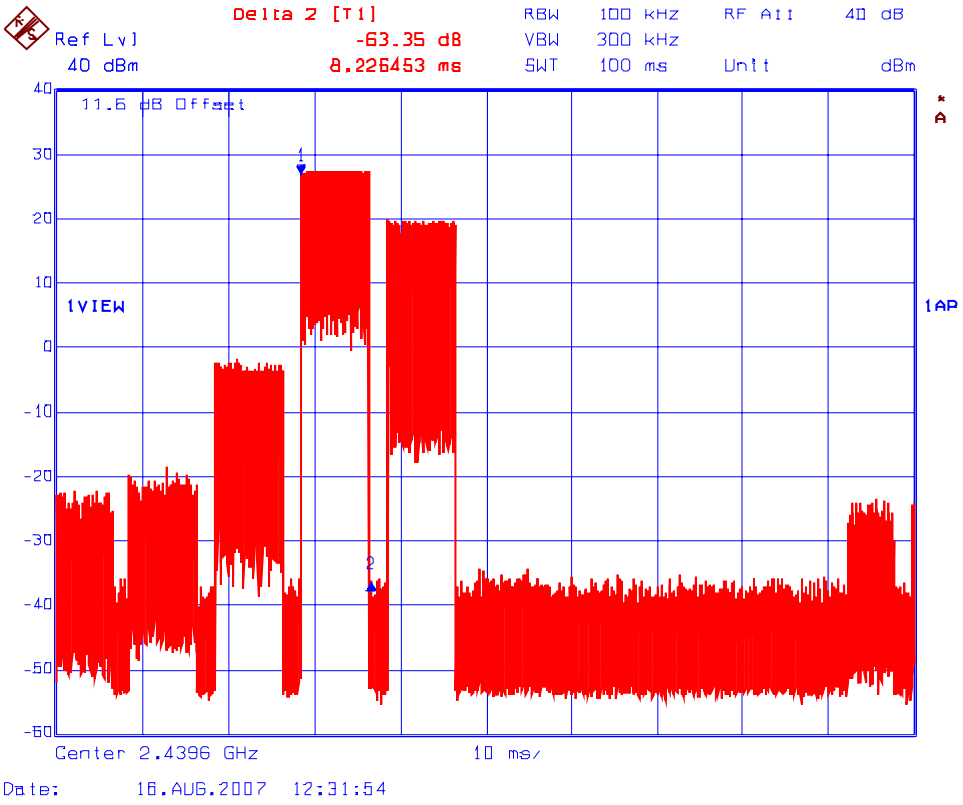
Dwell Time @ 2401.6 MHz = 8.216433 ms

Plot 6.7.5.30 Time of Occupancy
Test Frequency: 2401.6 MHz, Data Rate Setting: 3 (at middle data rate)



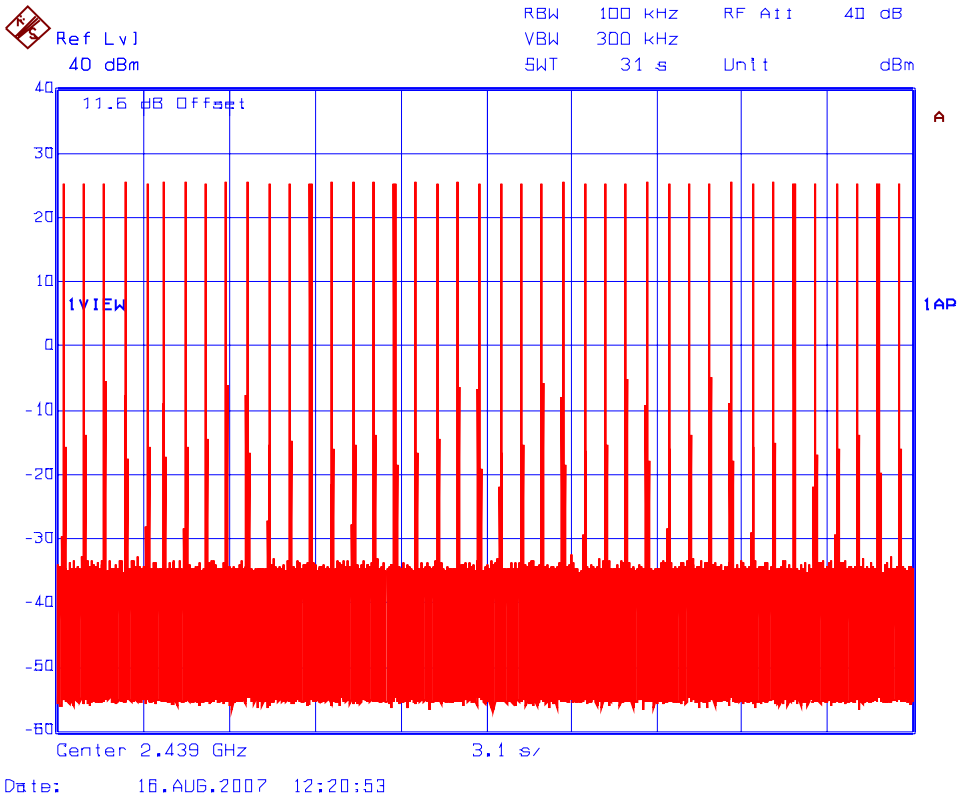
Average time of occupancy = (Dwell Time @ 2401.6 MHz) x (number of hops within a period)
= 8.216433 ms x 41
= 337 ms

Plot 6.7.5.31 Time of Occupancy
Test Frequency: 2439.6 MHz Data Rate Setting: 3 (at middle data rate)



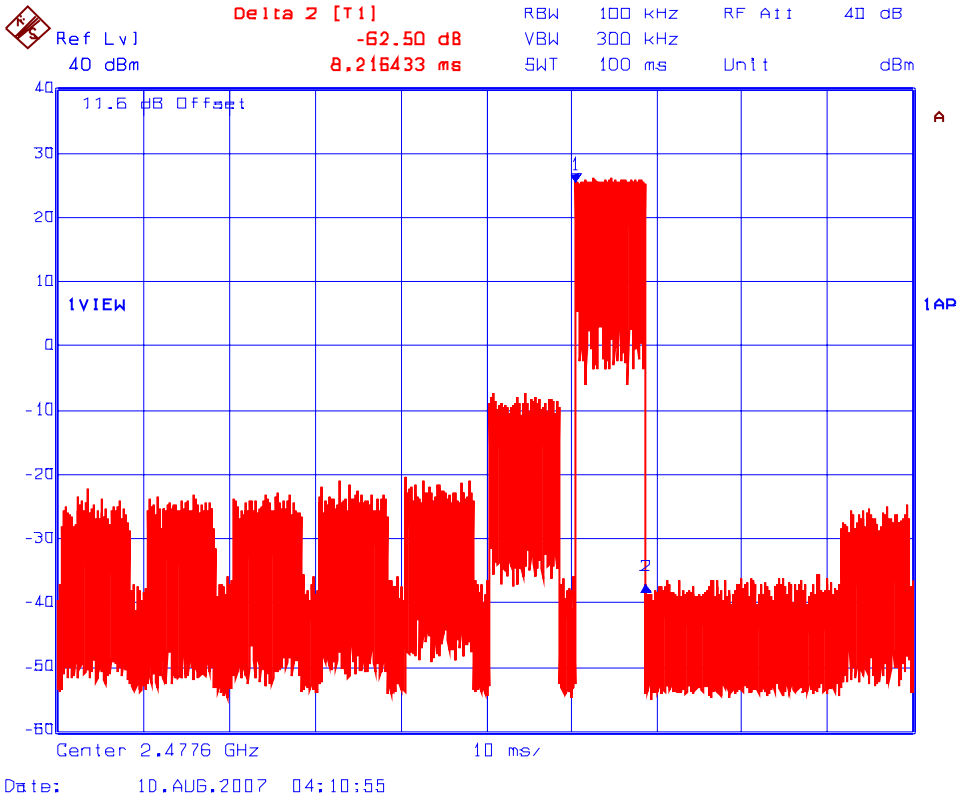
Dwell Time @ 2439.6 MHz = 8.226453 ms

Plot 6.7.5.32 Time of Occupancy
Test Frequency: 2439.6 MHz, Data Rate Setting: 3 (at middle data rate)



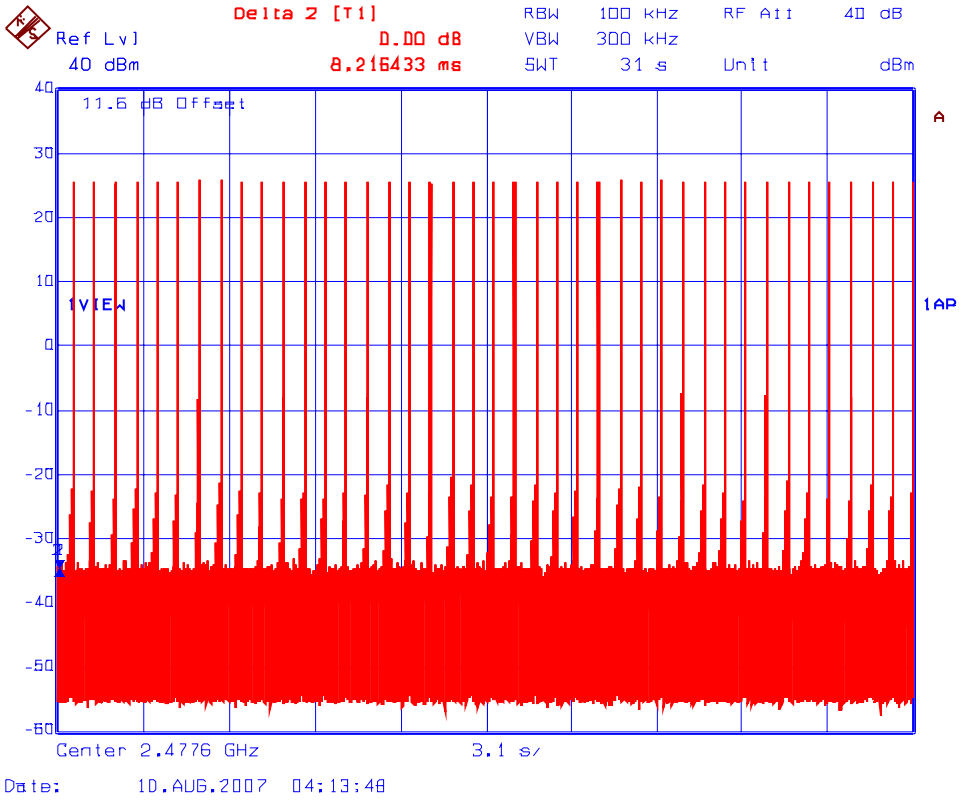
Average time of occupancy = (Dwell Time @ 2439.6 MHz) x (number of hops within a period)
= 8.226453 ms x 41
= 337 ms

Plot 6.7.5.33 Time of Occupancy
Test Frequency: 2477.6 MHz, Data Setting: 3 (at middle data rate)



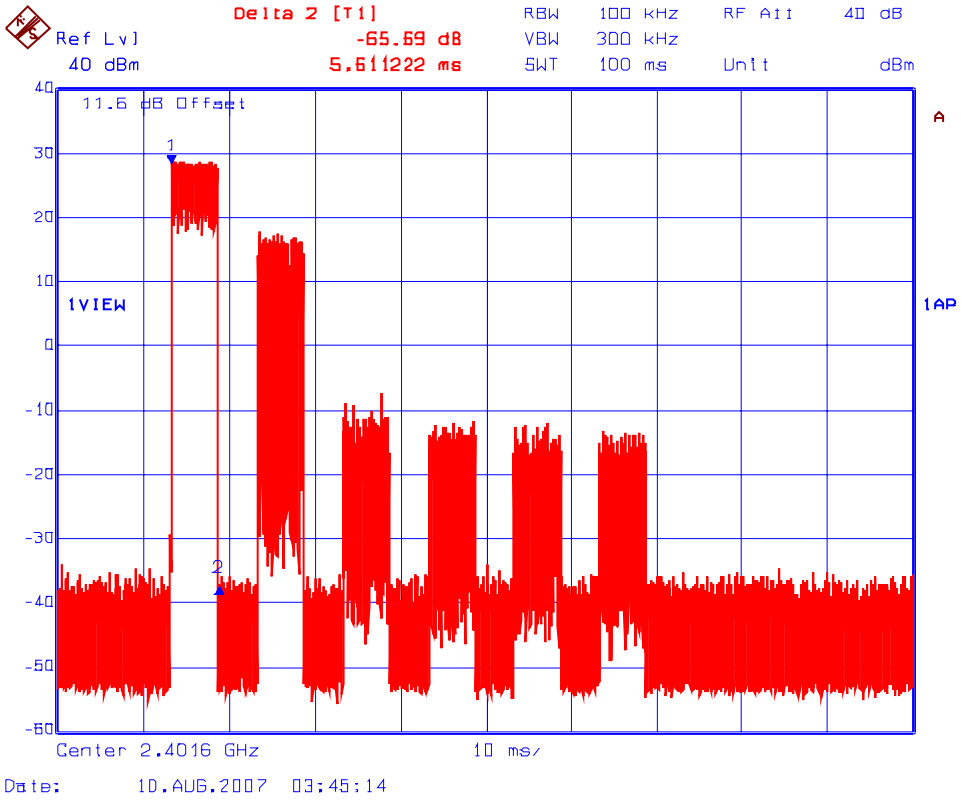
Dwell Time @ 2477.6 MHz = 8.216433 ms

Plot 6.7.5.34 Time of Occupancy
Test Frequency: 2477.6 MHz, Data Rate Setting: 3 (at middle data rate)



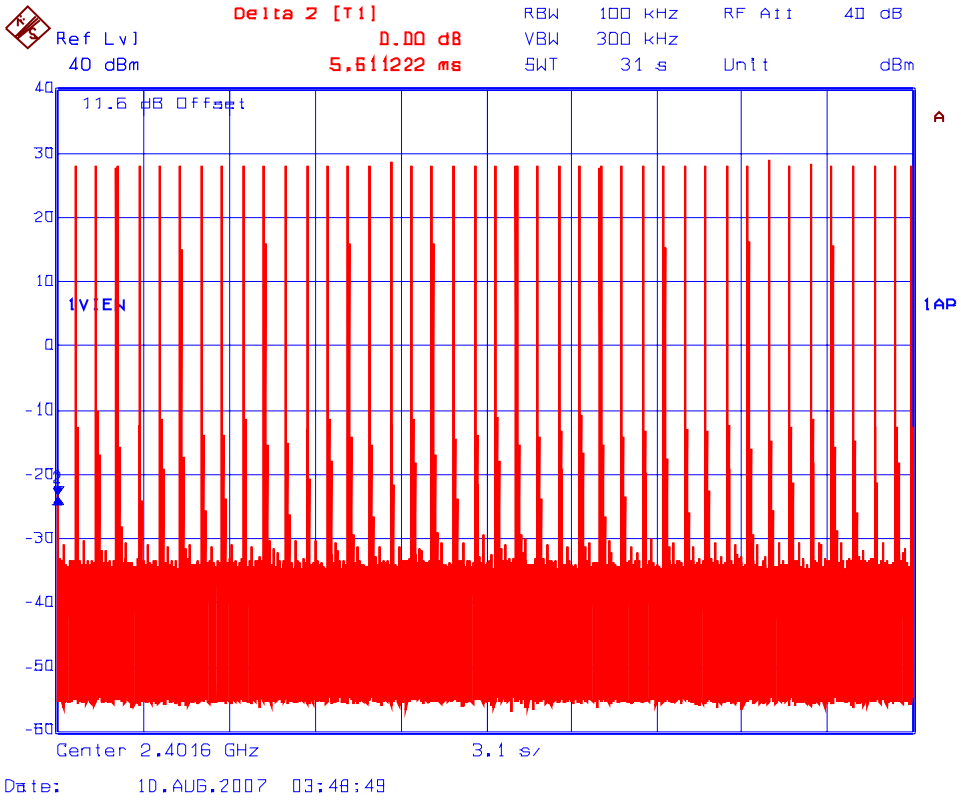
Average time of occupancy = (Dwell Time @ 2477.6 MHz) x (number of hops within a period)
= 8.216433 ms x 41
= 337 ms

Plot 6.7.5.35 Time of Occupancy
Test Frequency: 2401.6 MHz, Data Rate Setting: 5 (at high data rate)



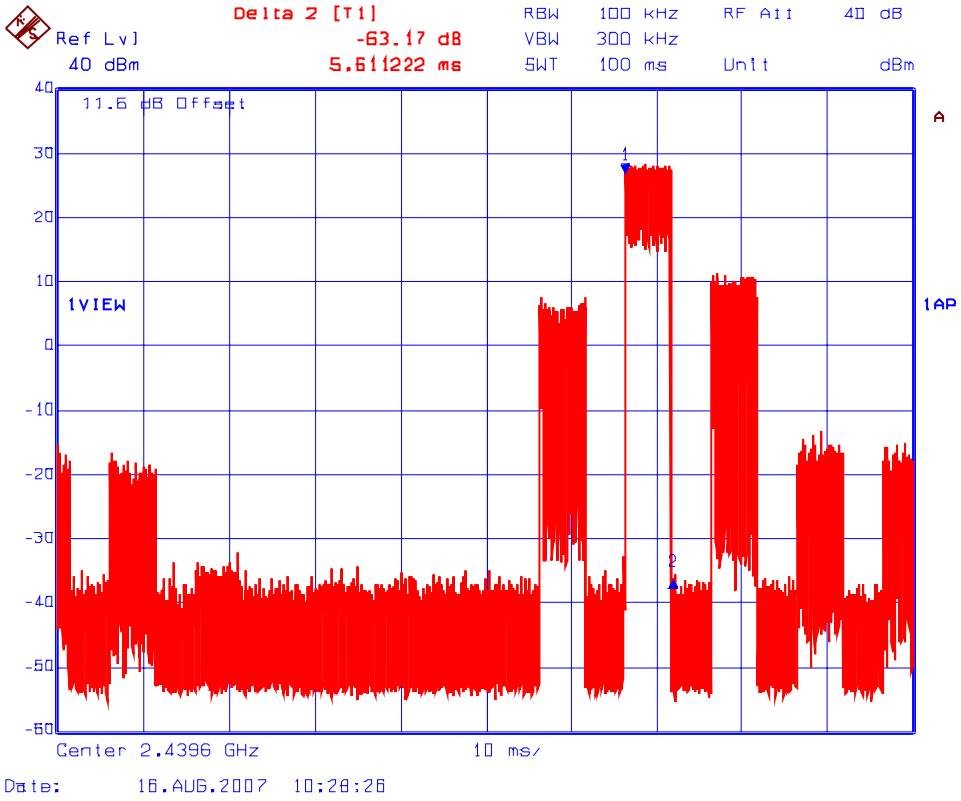
Dwell Time @ 2401.6 MHz = 5.611222 ms

Plot 6.7.5.36 Time of Occupancy
Test Frequency: 2401.6 MHz, Data Rate Setting: 5 (at high data rate)



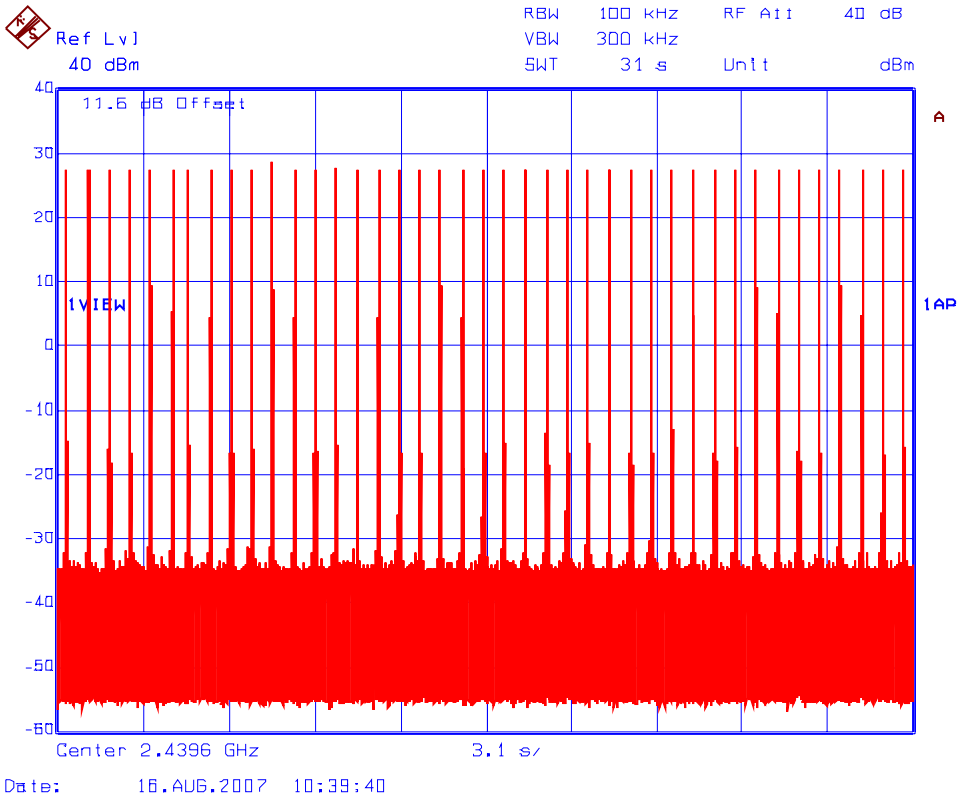
Average time of occupancy = (Dwell Time @ 2401.6 MHz) x (number of hops within a period)
= 5.611222 ms x 41
= 230 ms

Plot 6.7.5.37 Time of Occupancy
Test Frequency: 2439.6 MHz, Data Rate Setting: 5 (at high data rate)



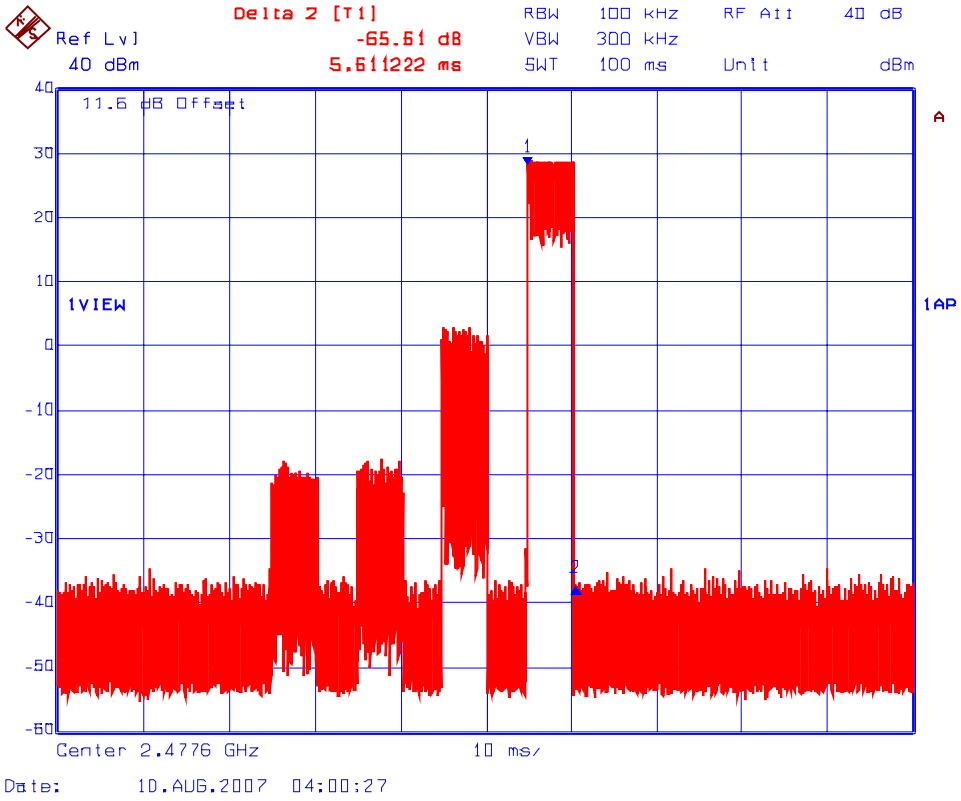
Dwell Time @ 2439.6 MHz = 5.611222 ms

Plot 6.7.5.38 Time of Occupancy
Test Frequency: 2439.6 MHz, Data Rate Setting: 5 (at high data rate)



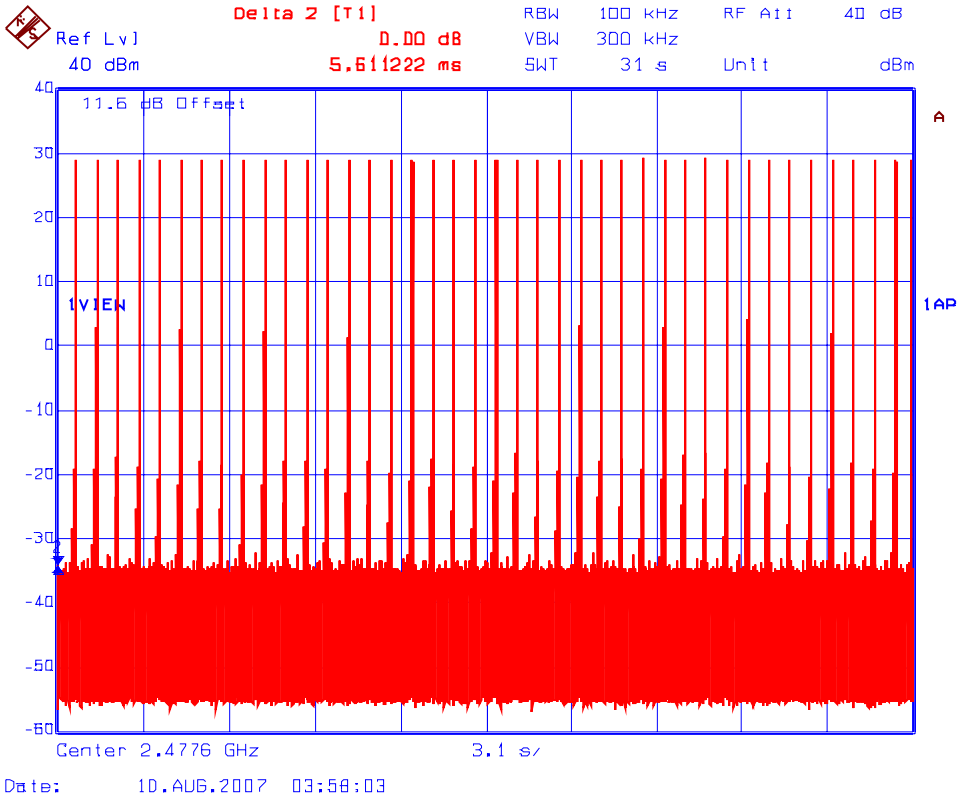
Average time of occupancy = (Dwell Time @ 2439.6 MHz) x (number of hops within a period)
= 5.611222 ms x 41
= 230 ms

Plot 6.7.5.39 Time of Occupancy
Test Frequency: 2477.6 MHz, Data Rate Setting: 5 (at high data rate)



Dwell Time @ 2477.6 MHz = 5.611222 ms

Plot 6.7.5.40 Time of Occupancy
Test Frequency: 2477.6 MHz, Data Rate Setting: 5 (at high data rate)



Average time of occupancy = (Dwell Time @ 2477.6 MHz) x (number of hops within a period)
= 5.611222 ms x 41
= 230 ms

6.8. PEAK OUTPUT POWER & EQUIVALENT ISOTROPIC RADIATED POWER (EIRP) [§ 15.247(b)]

6.8.1. Limit

§15.247(b)(1): For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

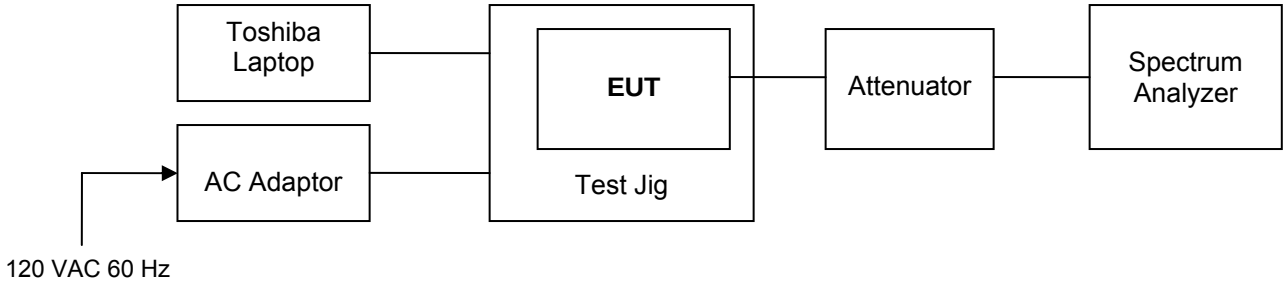
§15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.247(b)(4)(i): Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

6.8.2. Method of Measurements

FCC Public Notice DA 00-705 and ANSI C63.4.

6.8.3. Test Arrangement



6.8.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK20/B4/B21	834157/005	9kHz - 40GHz
Attenuator	Narda	4768-10	0702	DC -40GHz

6.8.5. Test Data

Transmitter Channel	Frequency (MHz)	Peak Output Power at Antenna Terminal (dBm)	Calculated EIRP (dBm)	Peak Output Power Limit (dBm)	EIRP Limit (dBm)
Power Setting: 30 dBm (1W)					
Lowest	2401.6	29.72	See Notes below	30.0	36.0
Middle	2439.6	29.43	See Notes below	30.0	36.0
Highest	2477.6	29.55	See Notes below	30.0	36.0
Power Setting: 0 dBm (1 mW)					
Lowest	2401.6	-0.45	See Notes below	30.0	36.0
Middle	2439.6	0.00	See Notes below	30.0	36.0
Highest	2477.6	-0.34	See Notes below	30.0	36.0

Notes:

1. The EIRP shall be calculated based on the transmitter antenna gain (G_{dBi}), cable loss (CL_{dB}) and peak output power at antenna terminal (P_{dBm}). Calculated EIRP = $P_{dBm} + G_{dBi} - CL_{dB}$

2. EIRP shall not exceed 36 dBm limit (Power Setting = 36 dBm - $G_{dBi} + CL_{dB}$). See page 2 of the Operating Manual for instruction of power setting.

6.9. RF EXPOSURE REQUIRMENTS [§§ 15.247(b)(5), 1.1310 & 2.1091]

6.9.1. Limit

§ 15.247(b)(5): Systems operating under provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1).

§ 1.1310:- The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

6.9.2. Method of Measurements

Refer to Sections 1.1310, 2.1091 and Public Notice DA 00-705 (March 30, 2000)

Spread spectrum transmitters operating under section 15.247 are categorically from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance (As indicated in Section 15.247(b)(4), these transmitters are required to operate in a manner that ensures that exposure to public users and nearby persons) does not exceed the Commission's RF exposure guidelines (see Section 1.1307 and 2.1093). Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

$r = \sqrt{EIRP/4\Pi S}$

For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones, SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d)

6.9.3. Test Data

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: ***18 cm**	Manufacturer' instruction for separation distance between antenna and persons required: **23 cm.**
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Antenna installation and device operating instructions shall be provided to installers to maintain and ensure compliance with RF exposure requirements.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Refer to User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

*The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

RF EXPOSURE DISTANCE LIMITS: $r = (PG/4\Pi S)^{1/2} = (EIRP/4\Pi S)^{1/2}$

$S = 1\ mW/cm^2$
$EIRP = 36.0\ dBm = 10^{36/10}$ mW max. (Worst Case)

$r = (EIRP/4\Pi S)^{1/2} = (10^{36/10}/4\Pi(1))^{1/2} = 18\ cm$

6.10. TRANSMITTER BAND-EDGE & SPURIOUS CONDUCTED EMISSIONS [§ 15.247(d)]

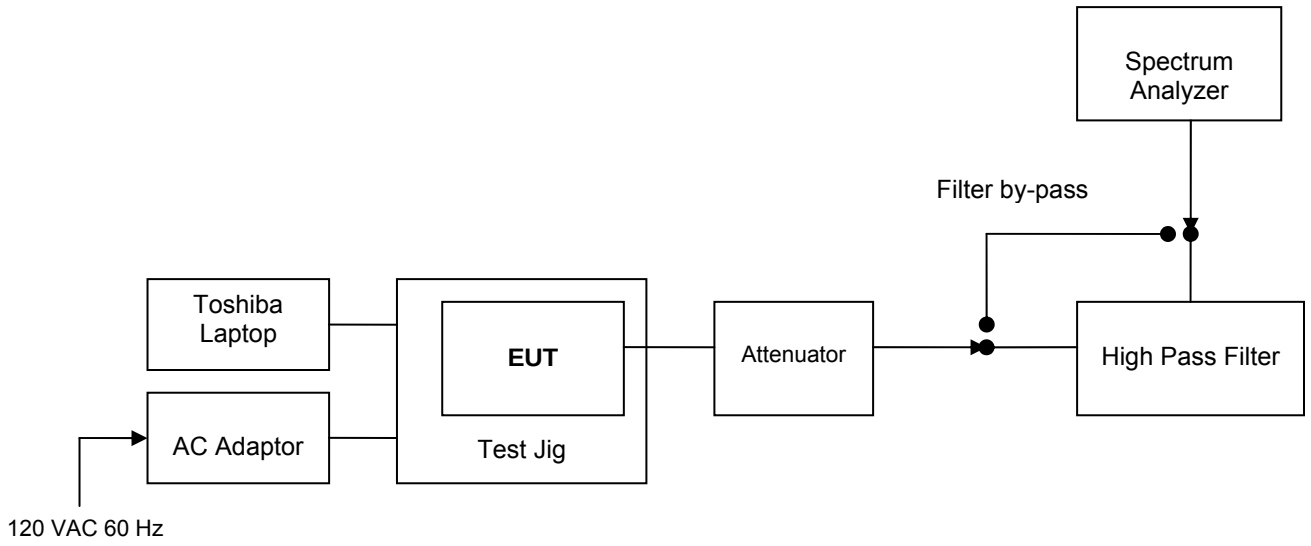
6.10.1. Limit

§ 15.247 (d): 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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)).

6.10.2. Method of Measurements

FCC Public Notice DA 00-705.

6.10.3. Test Arrangement



6.10.4. Test Equipment List

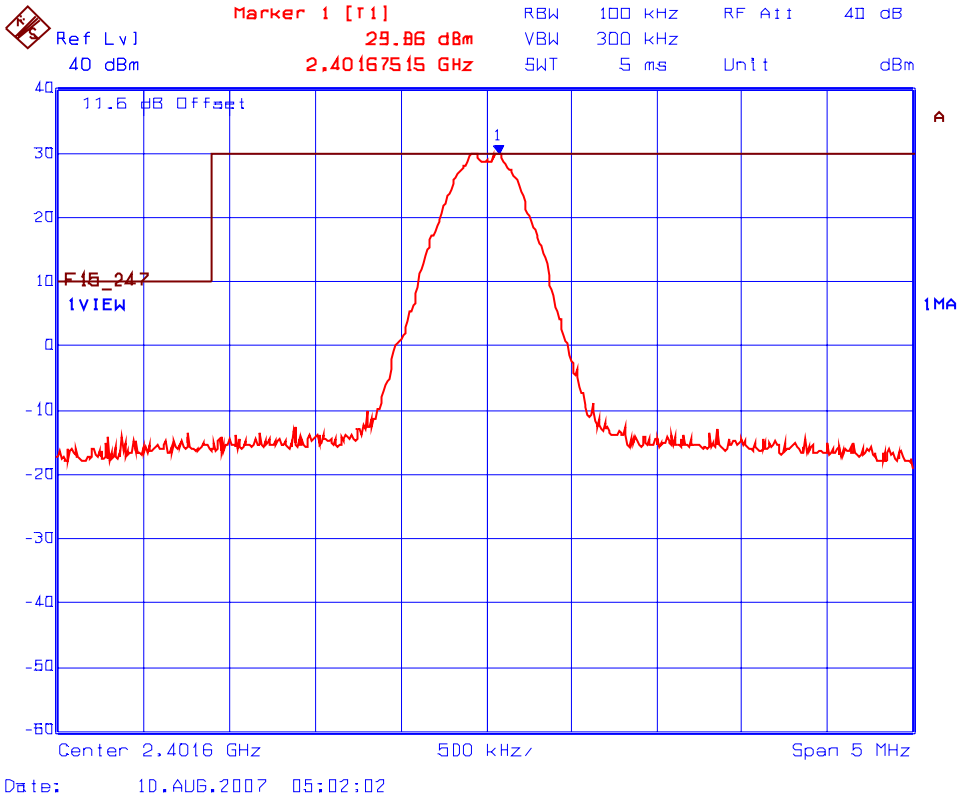
Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK20/B4/B21	834157/005	9kHz - 40GHz
High Pass Filter	K & L	11SH10-4000/T12000	4	1 - 26 GHz
Attenuator	Narda	4768-10	0702	DC -40GHz

6.10.5. Test Data

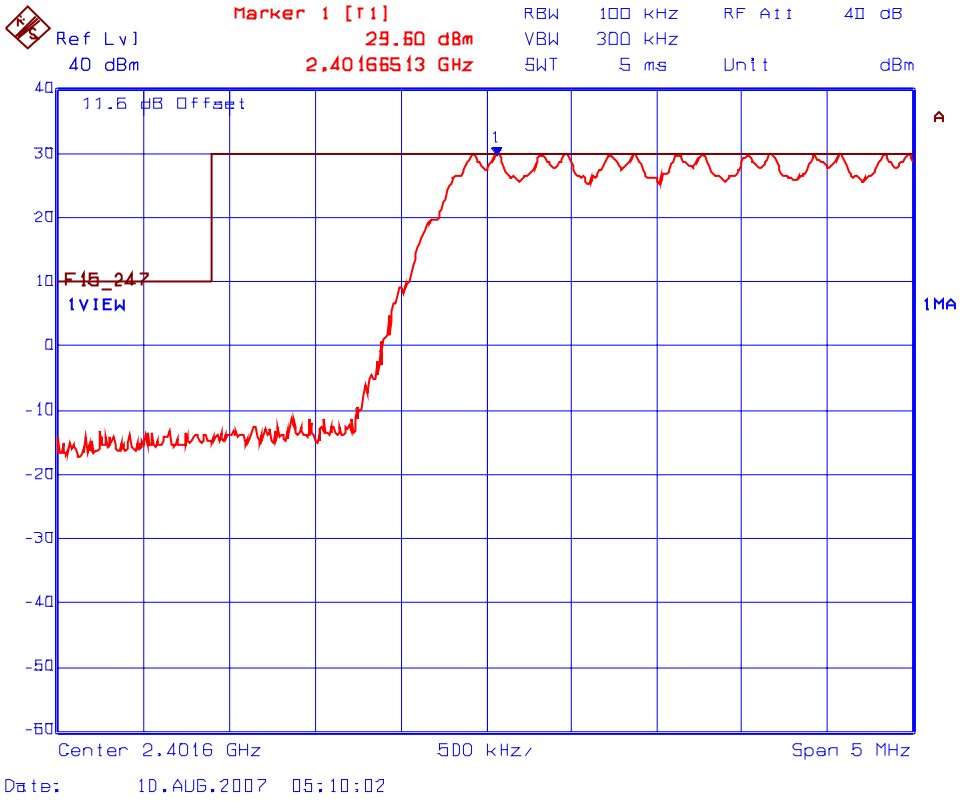
6.10.5.1. Band-Edge RF Conducted Emissions

See the following test data plots for measurement results:

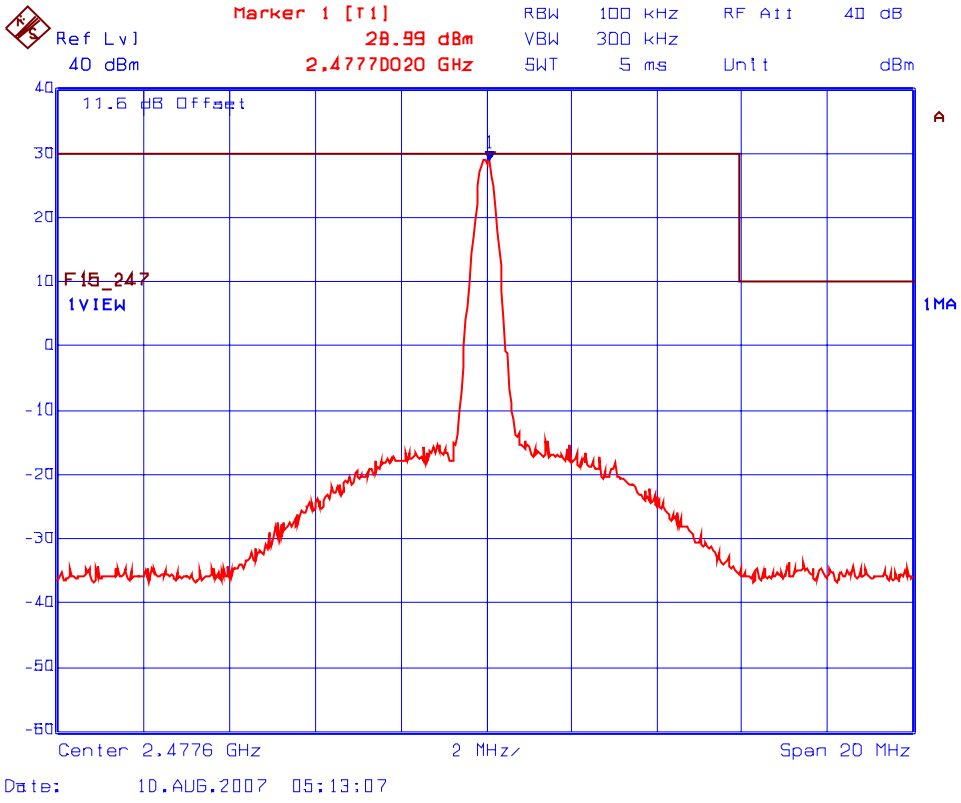
Plot 6.10.5.1.1 Band-Edge RF Conducted Emissions
Low End of Frequency Band
Single Frequency Mode (at high data rate)



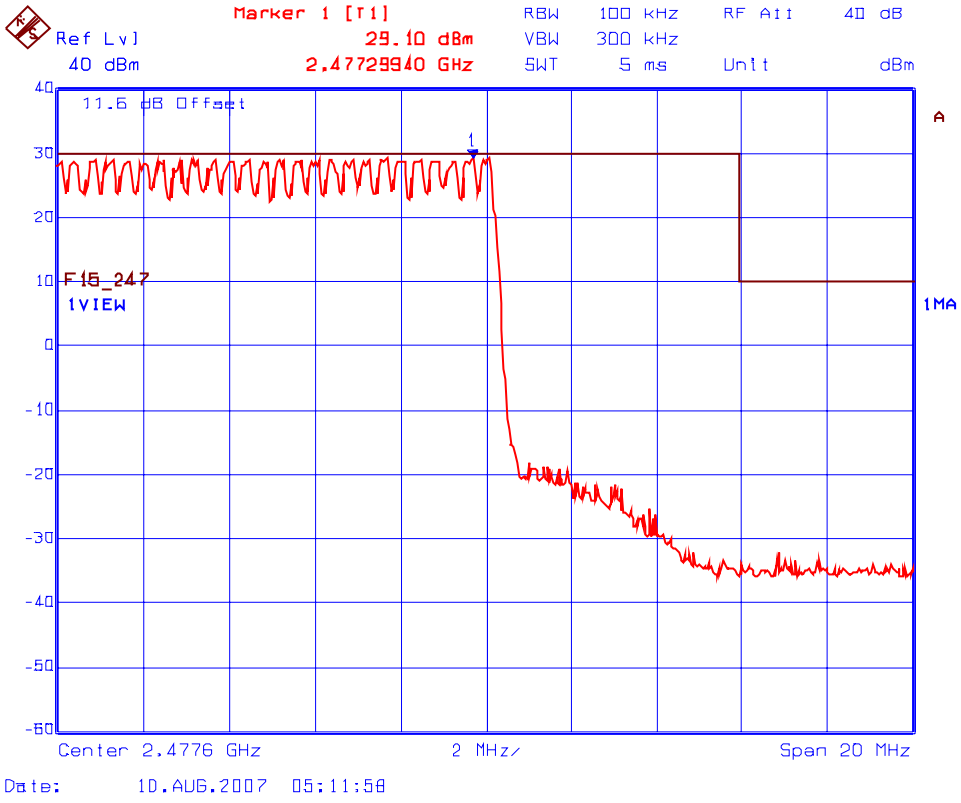
Plot 6.10.5.1.2 and-Edge RF Conducted Emissions
Low End of Frequency Band
Pseudorandom Channel Hopping Mode (at high data rate)



Plot 6.10.5.1.3 Band-Edge RF Conducted Emissions
High End of Frequency Band
Single Frequency Mode (at high data rate)



Plot 6.10.5.1.4 Band-Edge RF Conducted Emissions
High End of Frequency Band
Pseudorandom Channel Hopping Mode (at high data rate)

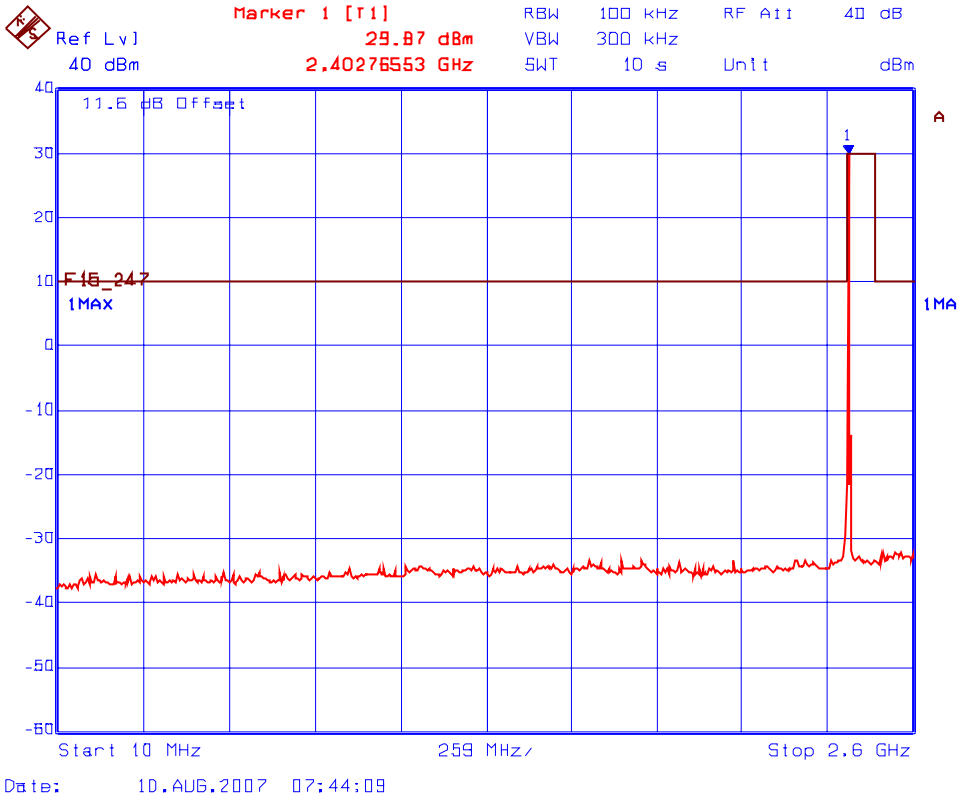


6.10.5.2. Spurious RF Conducted Emissions

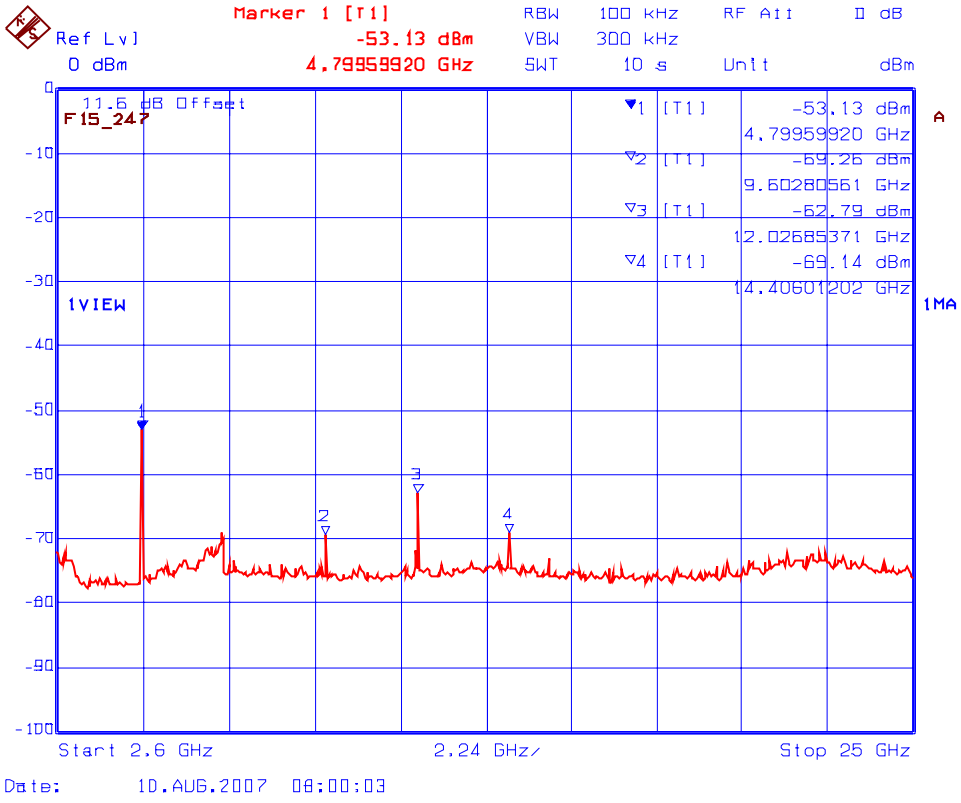
The emissions were scanned from 10 MHz to 25 GHz; see the following test data plots for measurement results.

Plot 6.10.5.2.1 Spurious RF Conducted Emissions
Transmitter Frequency: 2401.6 MHz at 1W Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate

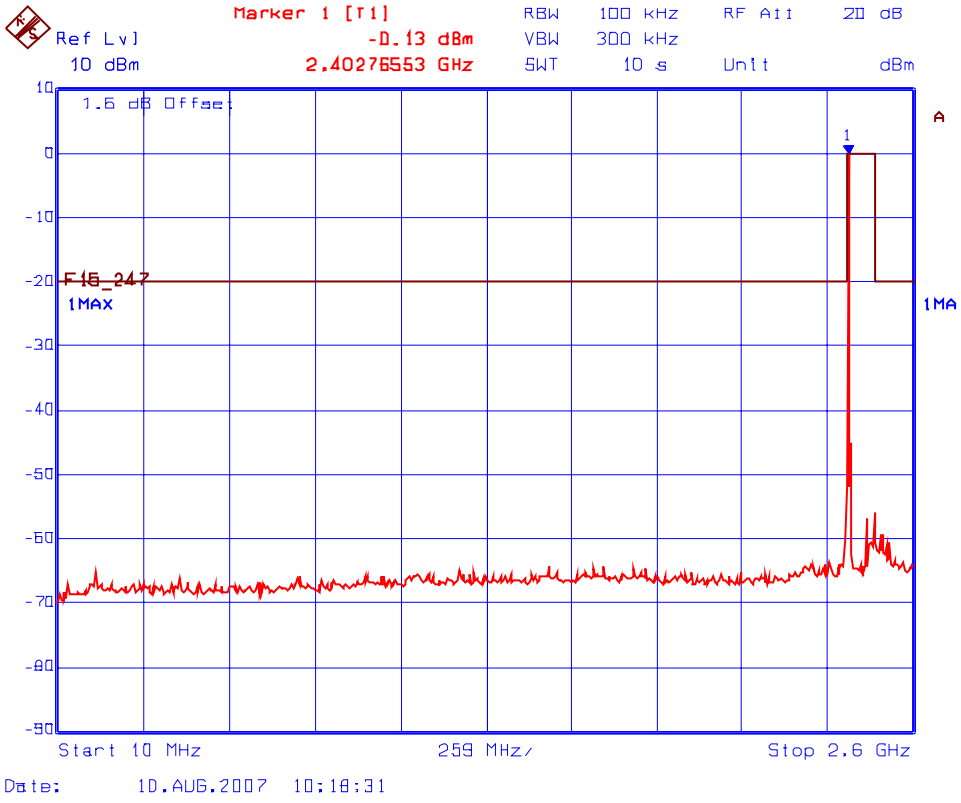
.



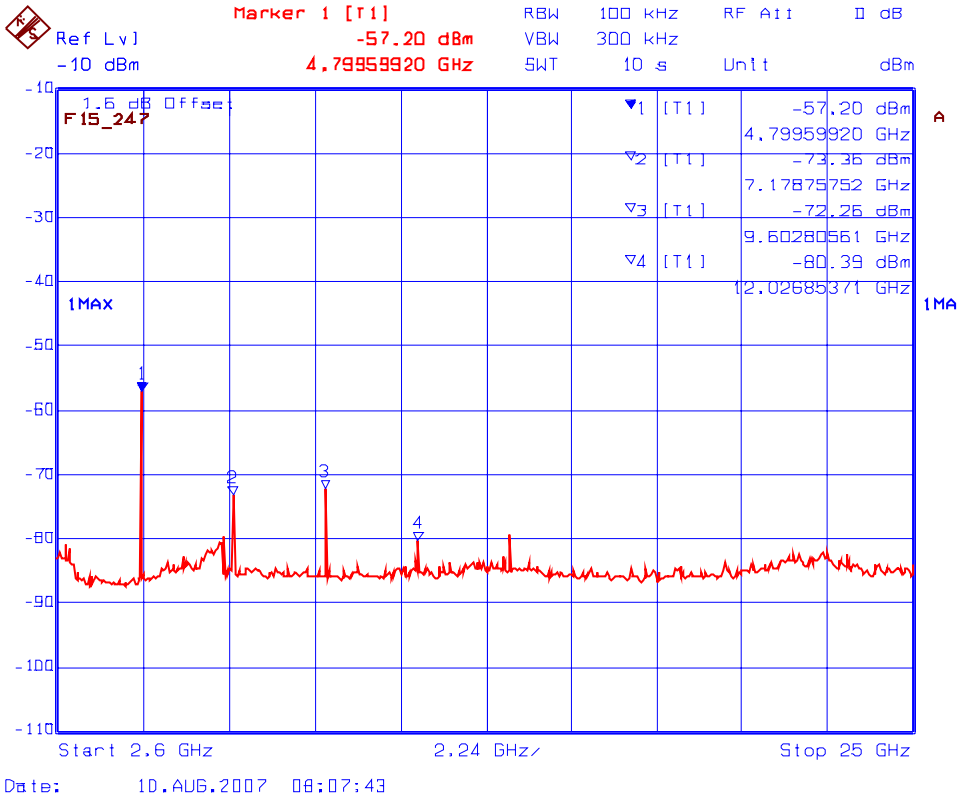
Plot 6.10.5.2.2 Spurious RF Conducted Emissions
Transmitter Frequency: 2401.6 MHz at 1W Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



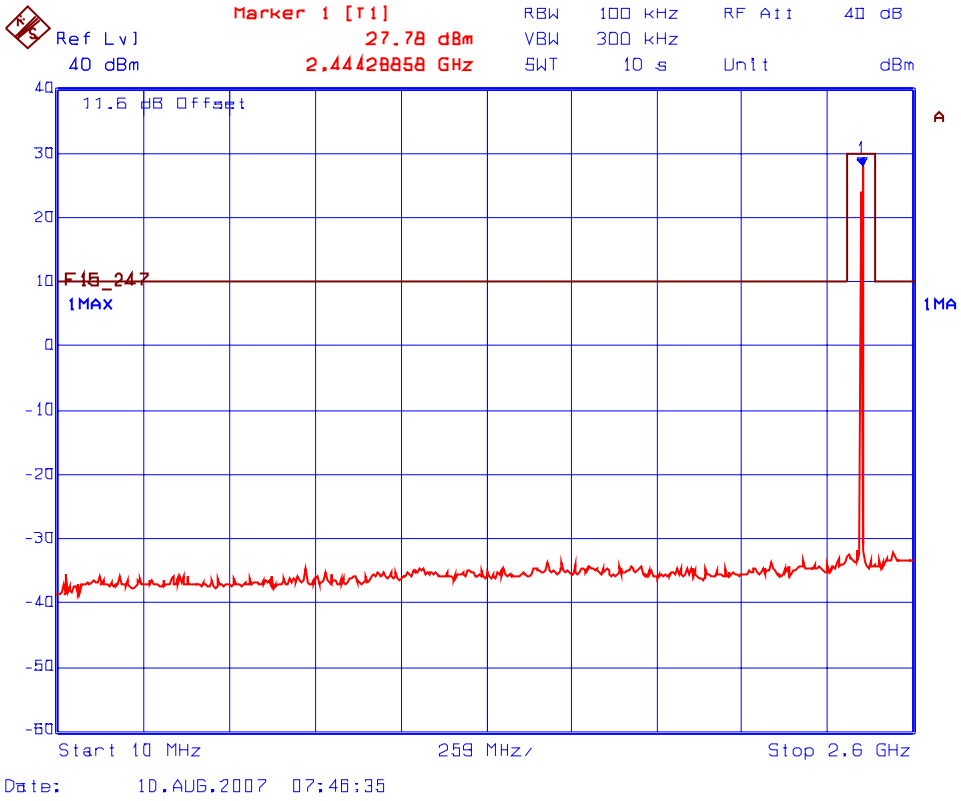
Plot 6.10.5.2.3 Spurious RF Conducted Emissions
Transmitter Frequency: 2401.6 MHz at 1mW Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



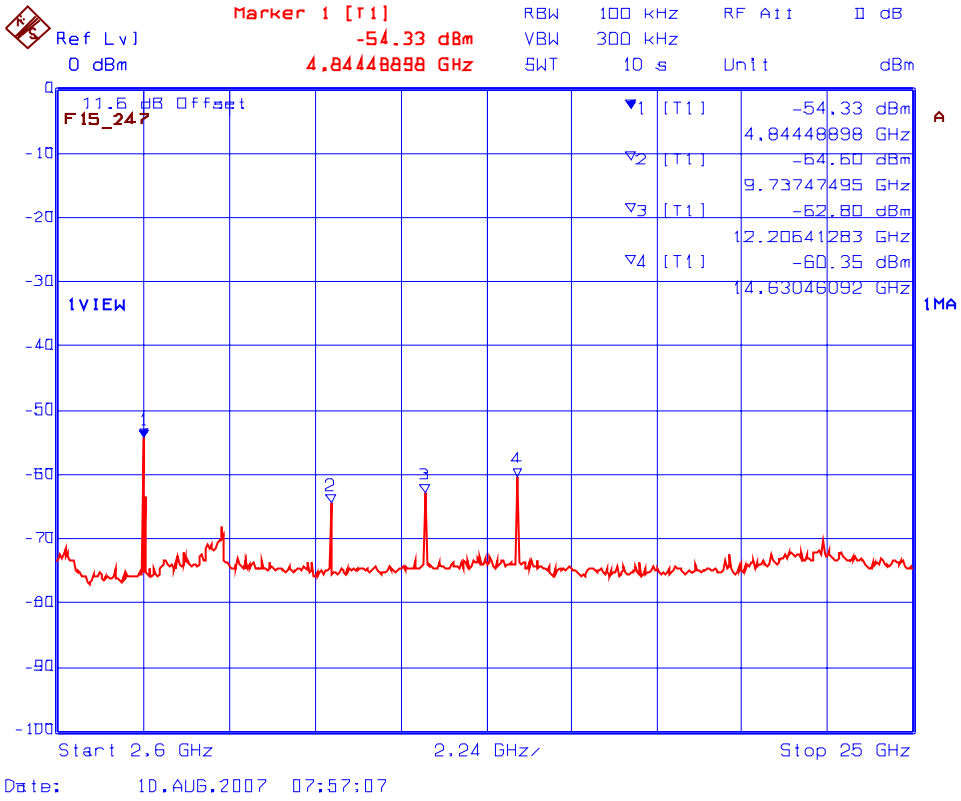
Plot 6.10.5.2.4 Spurious RF Conducted Emissions
Transmitter Frequency: 2401.6 MHz at 1mW Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



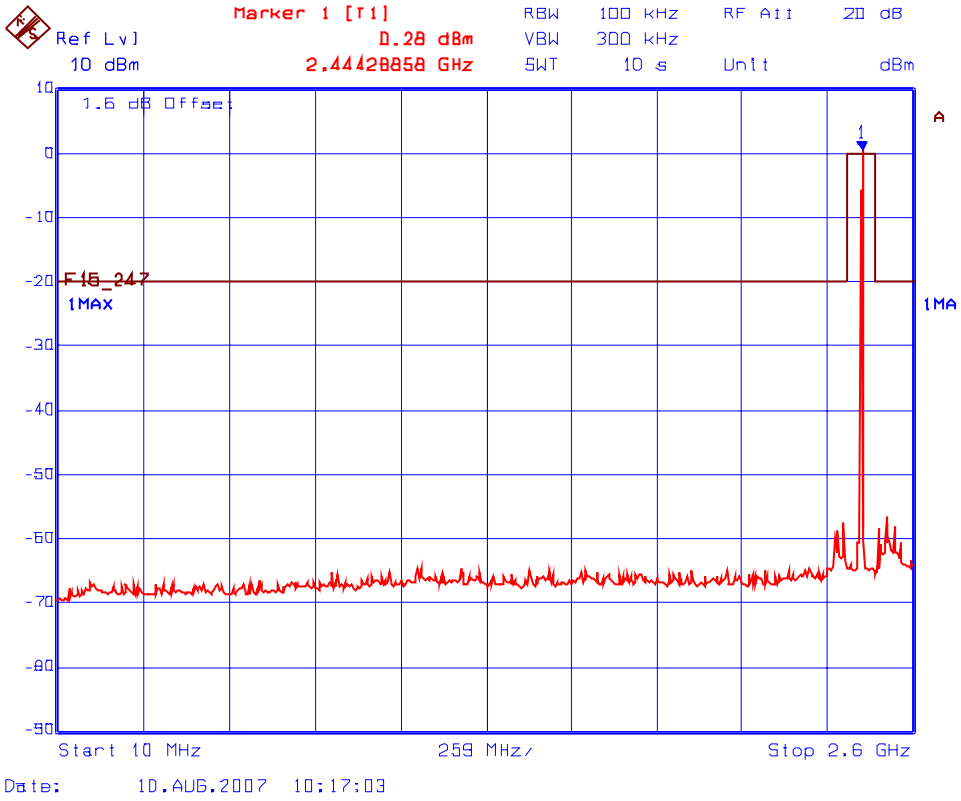
Plot 6.10.5.2.5 Spurious RF Conducted Emissions
Transmitter Frequency: 2439.6 MHz at 1W Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



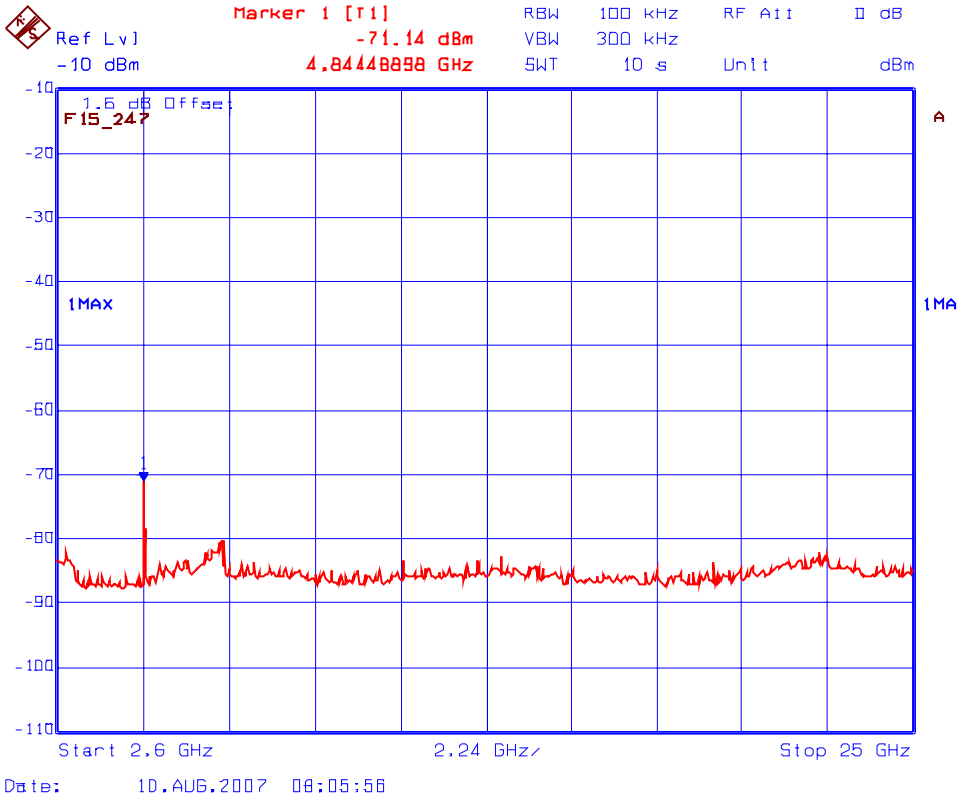
Plot 6.10.5.2.6 Spurious RF Conducted Emissions
Transmitter Frequency: 2439.6 MHz at 1W Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



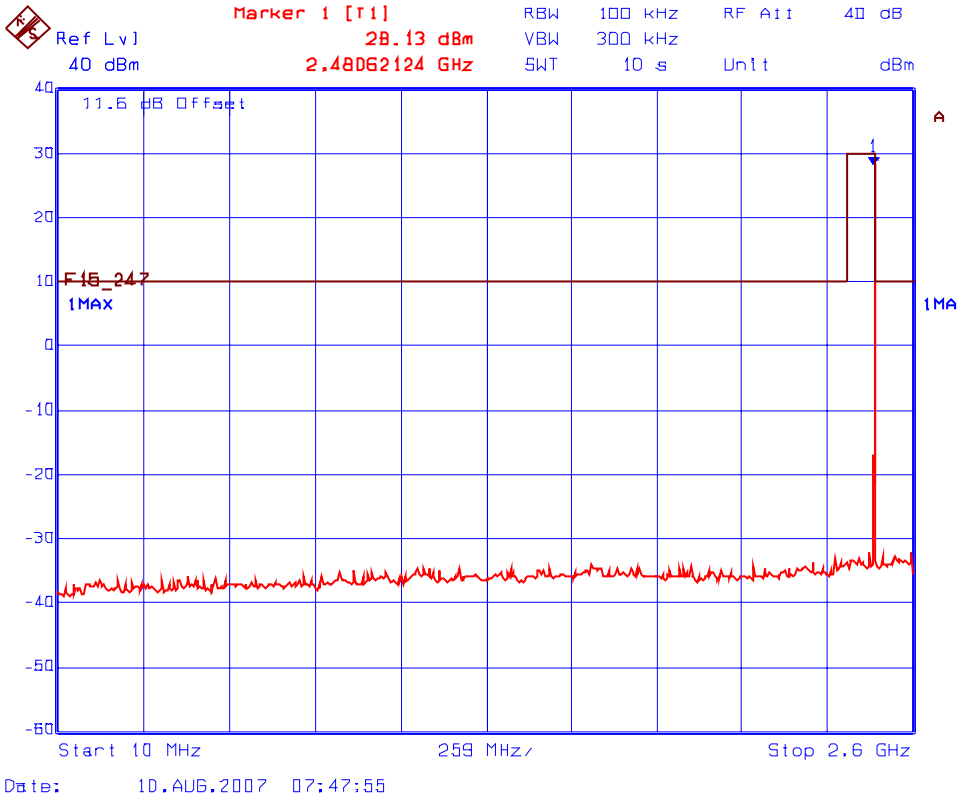
Plot 6.10.5.2.7 Spurious RF Conducted Emissions
Transmitter Frequency: 2439.6 MHz at 1mW Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



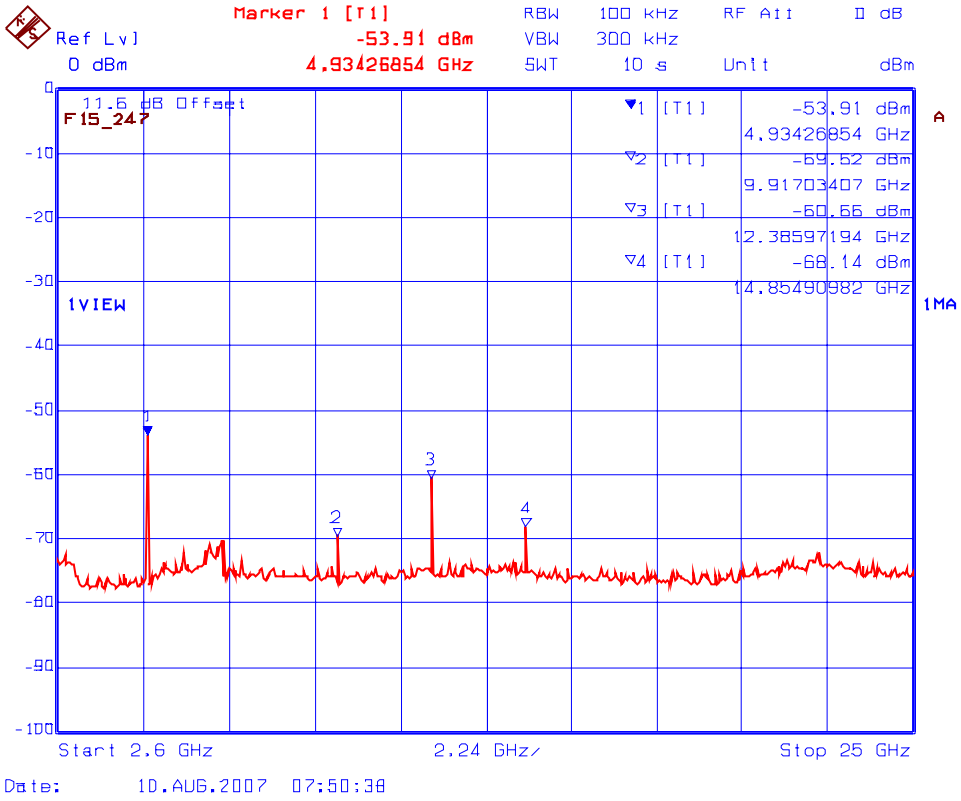
Plot 6.10.5.2.8 Spurious RF Conducted Emissions
Transmitter Frequency: 2439.6 MHz at 1mW Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



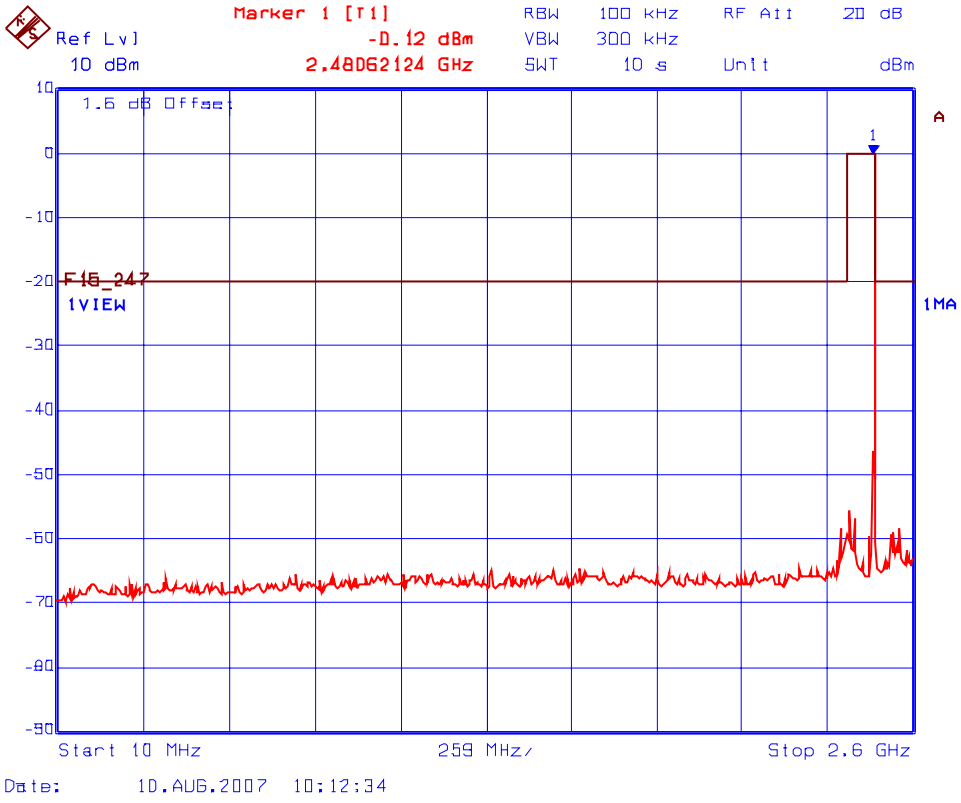
Plot 6.10.5.2.9 Spurious RF Conducted Emissions
Transmitter Frequency: 2477.6 MHz at 1W Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



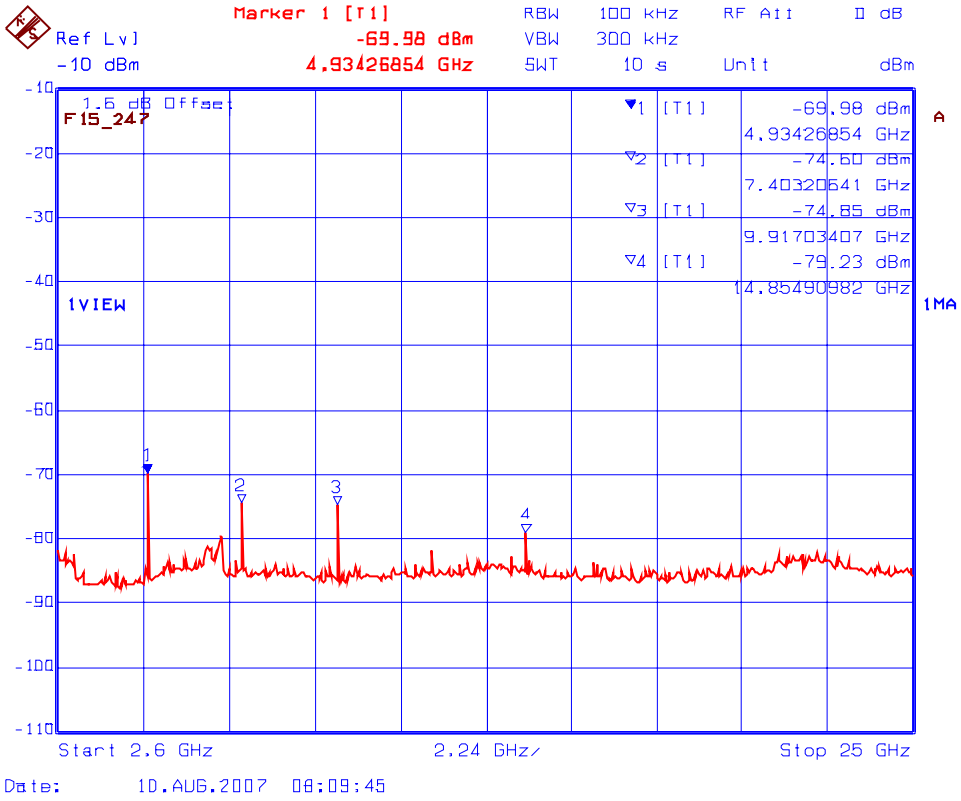
Plot 6.10.5.2.10 Spurious RF Conducted Emissions
Transmitter Frequency: 2477.6 MHz at 1W Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



Plot 6.10.5.2.11 Spurious RF Conducted Emissions
Transmitter Frequency: 2477.6 MHz at 1mW Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



Plot 6.10.5.2.12 Spurious RF Conducted Emissions
Transmitter Frequency: 2477.6 MHz at 1mW Output Power Setting
Detector at Max Hold with EUT Operating at High Data Rate



6.11. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

6.11.1. Limit

§ 15.247 (d): 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	([2])
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

Section 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement 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

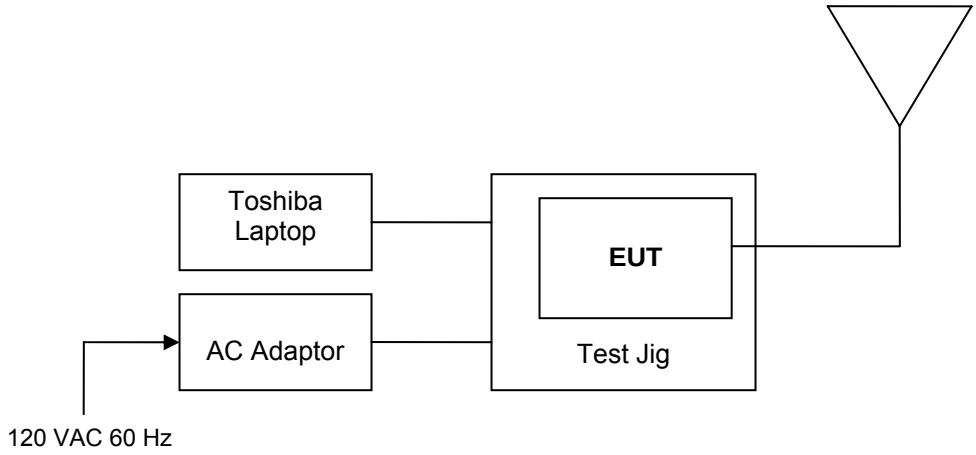
6.11.2. Method of Measurements

ANSI C63.4.

The following measurement procedures were also applied:

- Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.
- For measurement below 1 GHz, set RBW = 100 KHz, VBW $\geq$ 100 KHz, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz (Peak) & VBW = 10 Hz (Average), SWEEP=AUTO.
- If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

6.11.3. Test Arrangement



6.11.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK20/B4/B21	834157/005	9kHz – 40GHz
Microwave Amplifier	Hewlett Packard	8449B	3008A00769	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	3160-9	1007	18 GHz – 26.5 GHz

6.11.5. Test Data

The following test results are the worst-case measurements.

6.11.5.1. EUT with 2 dBi Rubber Ducky Antenna and 1.01 dB Assembly Cable Loss

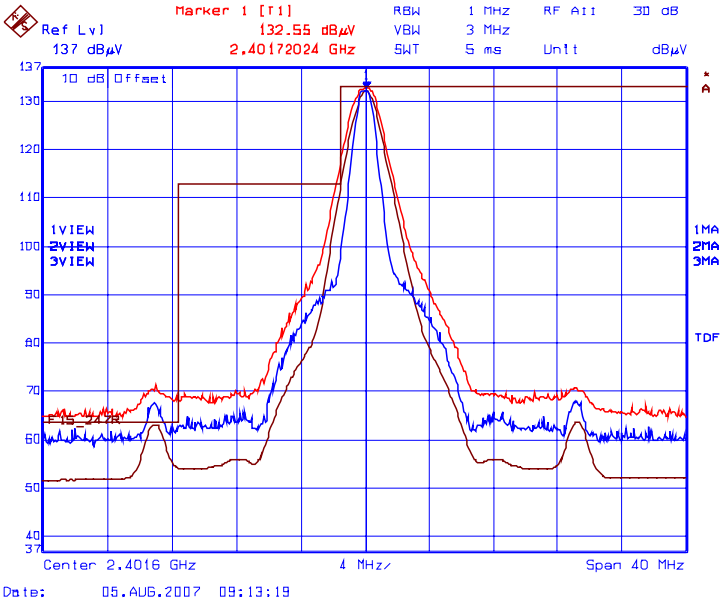
Fundamental Frequency:	2401.6 MHz
Software Power Setting:	255
Measured Conducted Power:	29.72 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2401.6	131.76	--	V	--	--	--	--
2401.6	132.62	--	H	--	--	--	--
4803.2	50.51	41.60	V	54.0	112.6	-12.4	Pass*
4803.2	47.46	36.04	H	54.0	112.6	-18.0	Pass*
12008.0	56.07	43.57	V	54.0	112.6	-10.4	Pass*
12008.0	56.45	43.94	H	54.0	112.6	-10.1	Pass*

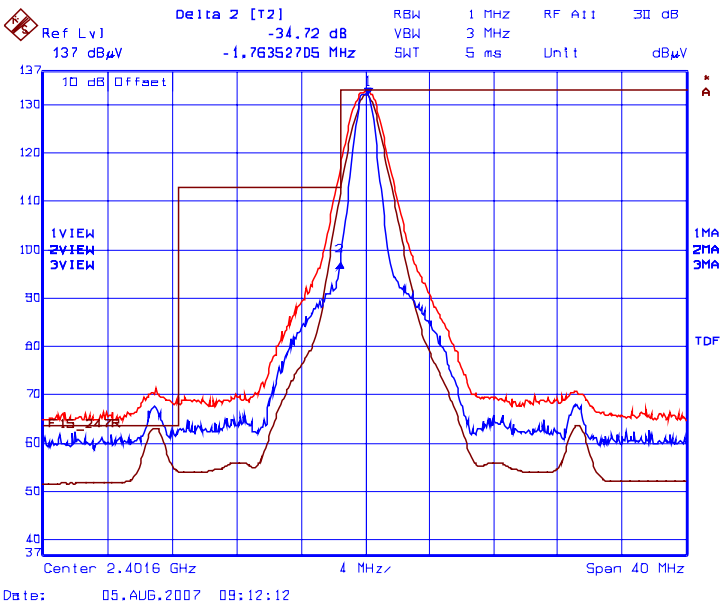
All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

* Emission within the restricted frequency bands.

Plot 6.11.5.1.1(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

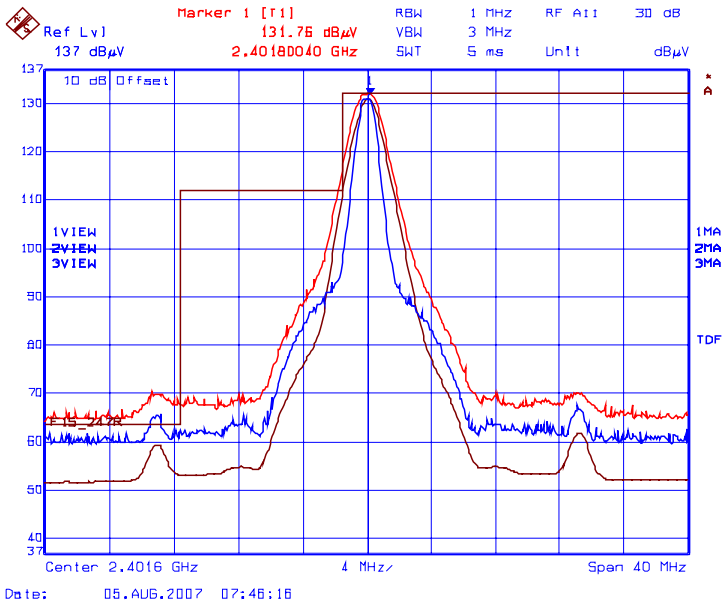


Plot 6.11.5.1.1(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

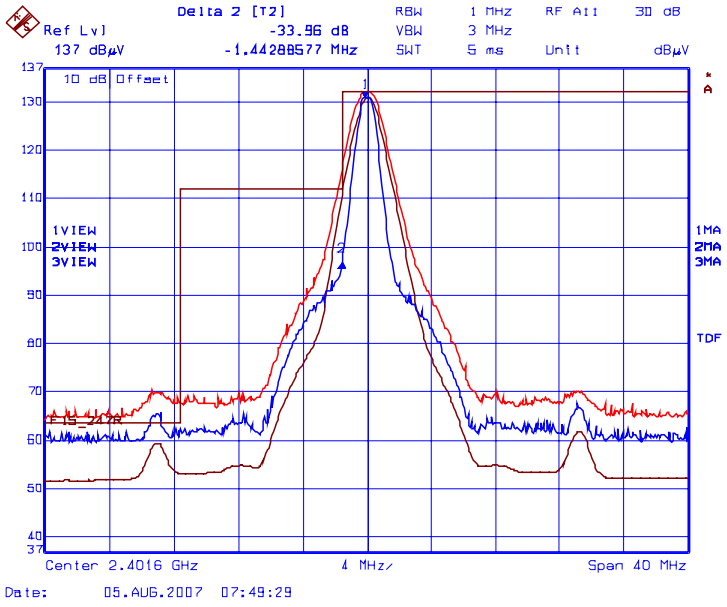


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 34.72 dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Band-Edge Level at 2400 MHz: Peak = 132.55 dBµV/m – 34.72 dB = 97.83 dBµV/m (limit 112.55 dBµV/m)

Plot 6.11.5.1.2(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Plot 6.11.5.1.2(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 33.96 dB
Trace 3: RBW= 1 MHz, VBW= 10 Hz
Band-Edge Level at 2400 MHz: Peak = 131.76 dBµV/m – 33.96 dB = 97.8 dBµV/m (limit 111.76 dBµV/m)

Fundamental Frequency:	2439.6 MHz
Software Power Setting:	255
Measured Conducted Power:	29.43 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2439.6	131.24	--	V	--	--	--	--
2439.6	132.08	--	H	--	--	--	--
4879.2	51.57	37.15	V	54.0	112.1	-16.9	Pass*
4879.2	48.98	36.95	H	54.0	112.1	-17.1	Pass*
7318.8	49.10	37.55	V	54.0	112.1	-16.5	Pass*
7318.8	49.87	37.95	H	54.0	112.1	-16.1	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

* Emission within the restricted frequency bands.

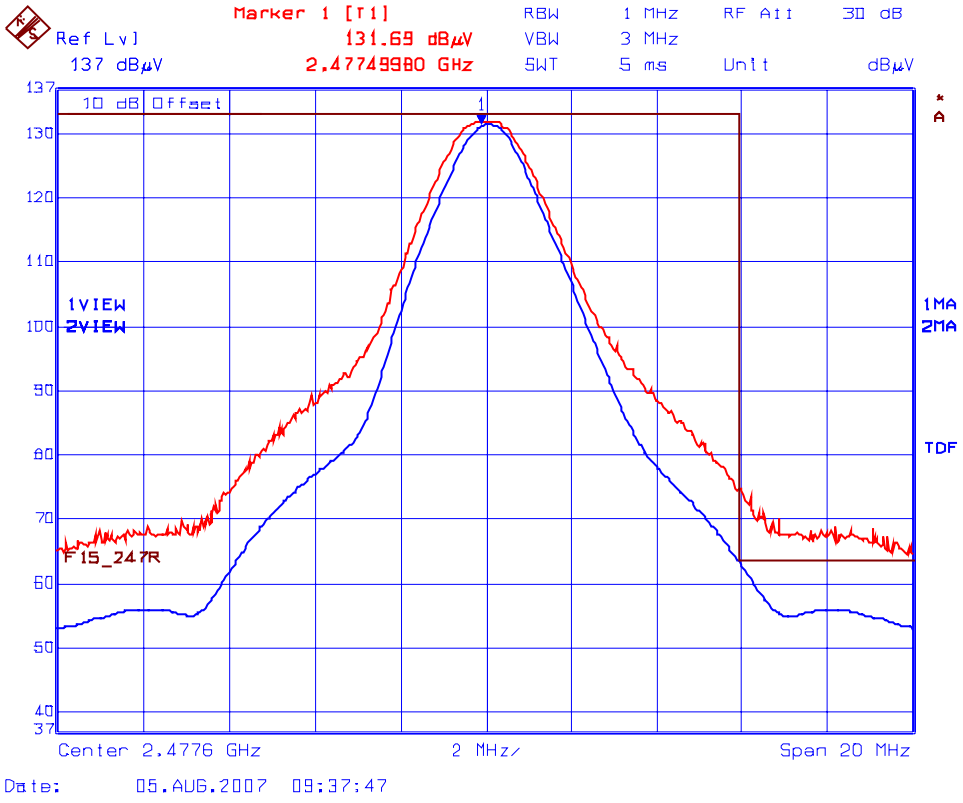
Fundamental Frequency:	2477.6 MHz
Software Power Setting:	255
Measured Conducted Power:	29.55 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2477.6	130.99	--	V	--	--	--	--
2477.6	131.89	--	H	--	--	--	--
4955.2	53.93	48.89	V	54.0	111.9	-5.1	Pass*
4955.2	50.14	40.25	H	54.0	111.9	-13.8	Pass*
7432.8	53.21	44.08	V	54.0	111.9	-9.9	Pass*
7432.8	51.76	43.22	H	54.0	111.9	-10.8	Pass*
12388.0	57.33	46.02	V	54.0	111.9	-8.0	Pass*
12388.0	57.35	43.44	H	54.0	111.9	-10.6	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

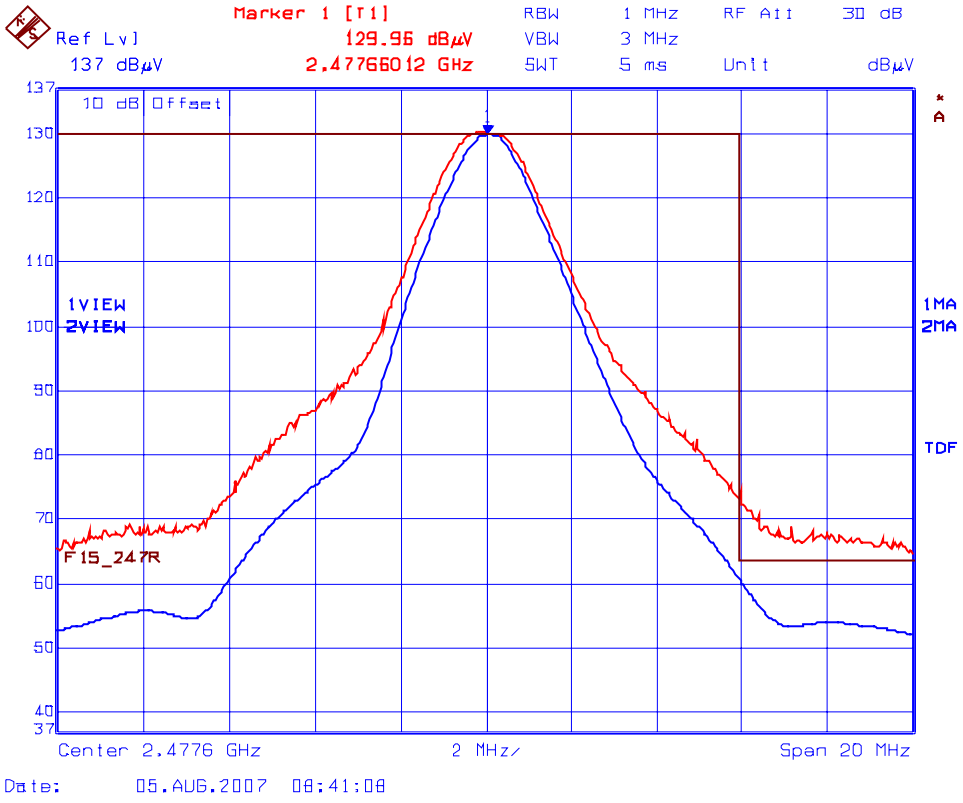
* Emission within the restricted frequency bands.

Plot 6.11.5.1.3 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal



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

Plot 6.11.5.1.4 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



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

6.11.5.2. EUT with 3 dBi Transit Antenna and 1.01 dB Assembly Cable Loss

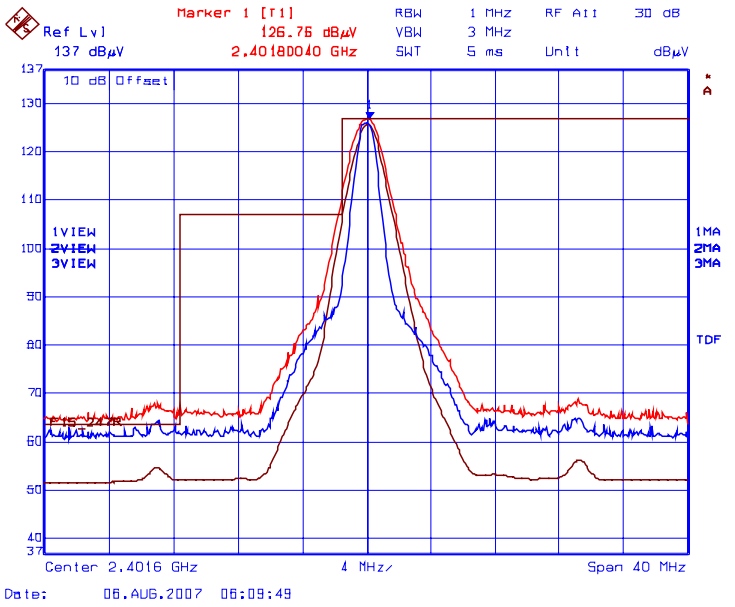
Fundamental Frequency:	2401.6 MHz
Software Power Setting:	255
Measured Conducted Power:	29.72 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2401.6	128.46	--	V	--	--	--	--
2401.6	126.76	--	H	--	--	--	--
4803.2	50.28	39.06	V	54.0	108.5	-14.9	Pass*
4803.2	49.17	42.22	H	54.0	108.5	-11.8	Pass*
12008.0	58.09	49.86	V	54.0	108.5	-4.1	Pass*
12008.0	58.19	49.45	H	54.0	108.5	-4.6	Pass*

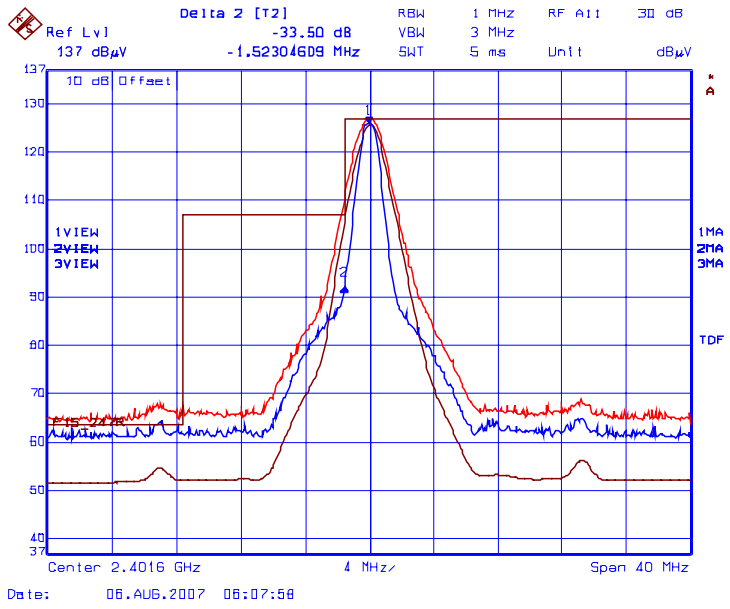
All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

* Emission within the restricted frequency bands.

Plot 6.11.5.2.1(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

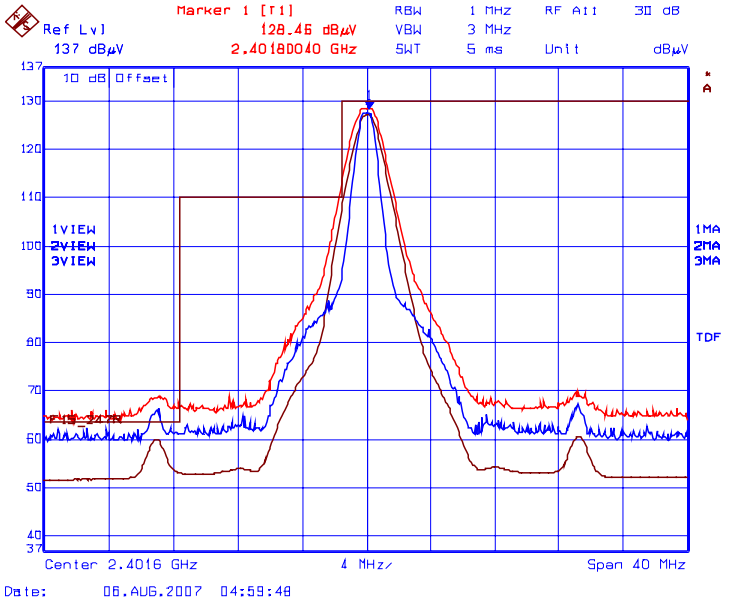


Plot 6.11.5.2.1(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

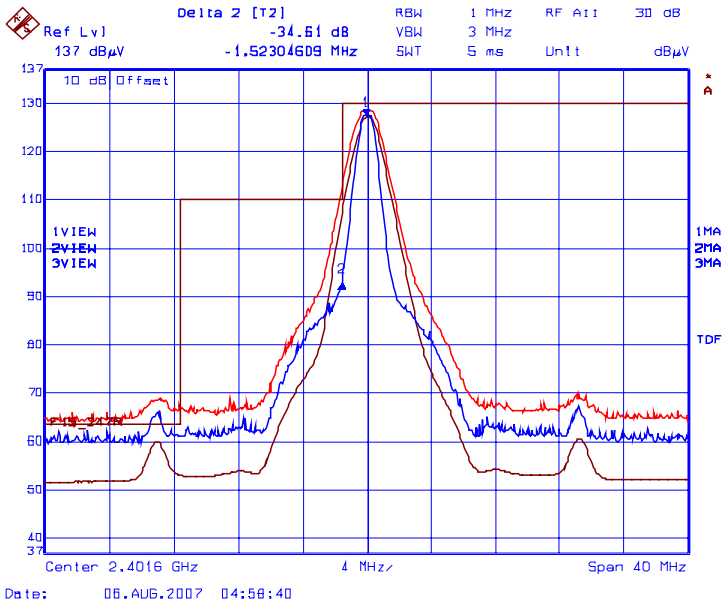


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 33.50 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Band-Edge Level at 2400 MHz: 126.76 dBµV/m – 33.50 dB = 93.26 dBµV/m (limit 106.76 dBµV/m)

Plot 6.11.5.2.2(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Plot 6.11.5.2.2(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 34.61 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Band-Edge Level at 2400 MHz: Peak = 128.46 dBµV/m – 34.61 dB = 93.85 dBµV/m (limit 108.46 dBµV/m)

Fundamental Frequency:	2439.6 MHz
Software Power Setting:	255
Measured Conducted Power:	29.43 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2439.6	128.45	--	V	--	--	--	--
2439.6	126.71	--	H	--	--	--	--
4879.2	49.16	41.30	V	54.0	108.5	-12.7	Pass*
4879.2	47.35	35.23	H	54.0	108.5	-18.8	Pass*
7318.8	49.91	39.07	V	54.0	108.5	-14.9	Pass*
7318.8	50.11	37.97	H	54.0	108.5	-16.0	Pass*
12198.0	57.56	47.21	V	54.0	108.5	-6.8	Pass*
12198.0	58.66	49.91	H	54.0	108.5	-4.1	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

* Emission within the restricted frequency bands.

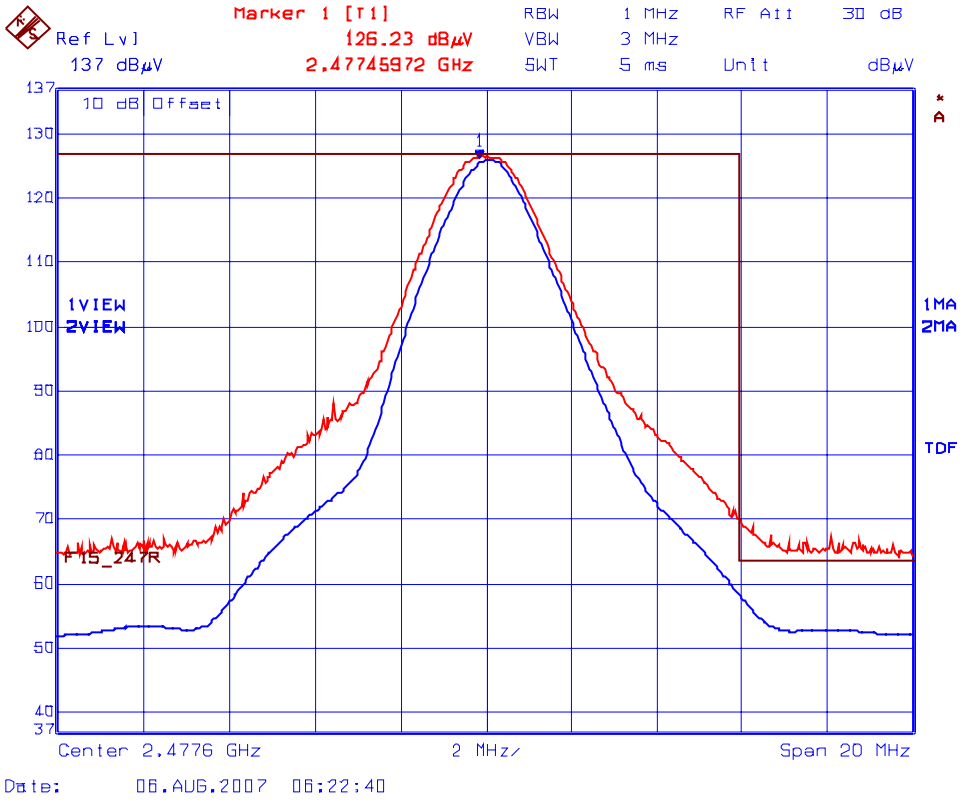
Fundamental Frequency:	2477.6 MHz
Software Power Setting:	255
Measured Conducted Power:	29.55 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2477.6	128.66	--	V	--	--	--	--
2477.6	126.97	--	H	--	--	--	--
4955.2	52.60	47.44	V	54.0	108.7	-6.6	Pass*
4955.2	48.72	40.85	H	54.0	108.7	-13.2	Pass*
7432.8	52.15	45.90	V	54.0	108.7	-8.1	Pass*
7432.8	52.17	45.75	H	54.0	108.7	-8.3	Pass*
12388.0	57.33	46.54	V	54.0	108.7	-7.5	Pass*
12388.0	58.67	50.39	H	54.0	108.7	-3.6	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

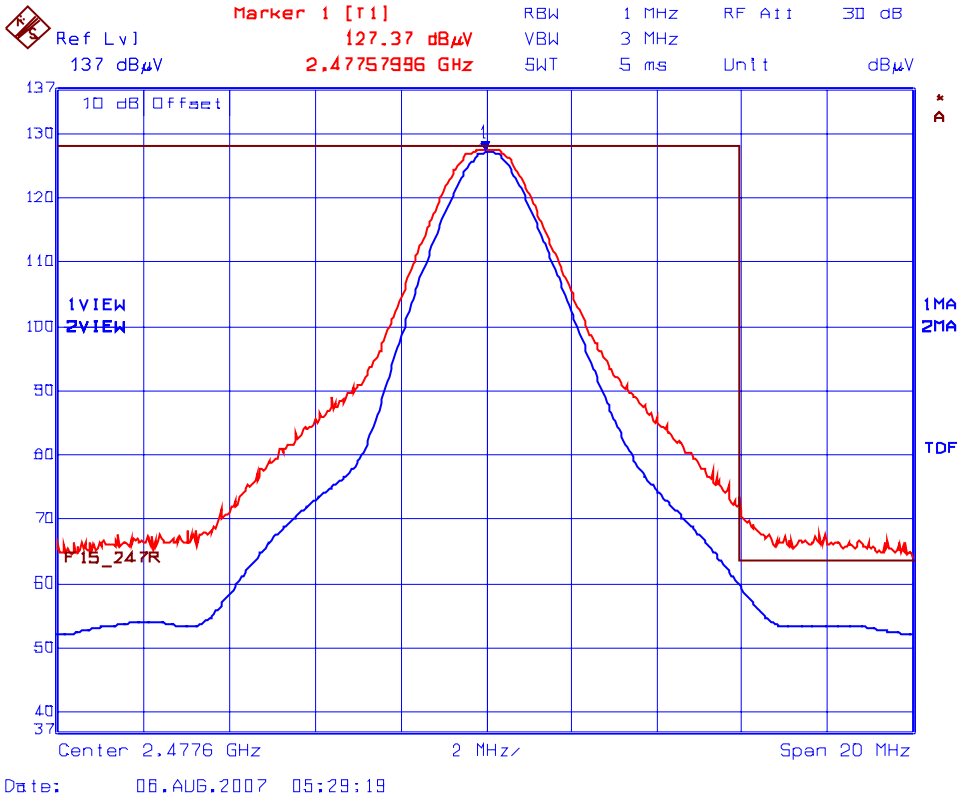
* Emission within the restricted frequency bands.

Plot 6.11.5.2.3 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal



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

Plot 6.11.5.2.4 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



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

6.11.5.3. EUT with 14 dBi Flat Patch Antenna and 2.13 dB Assembly Cable Loss

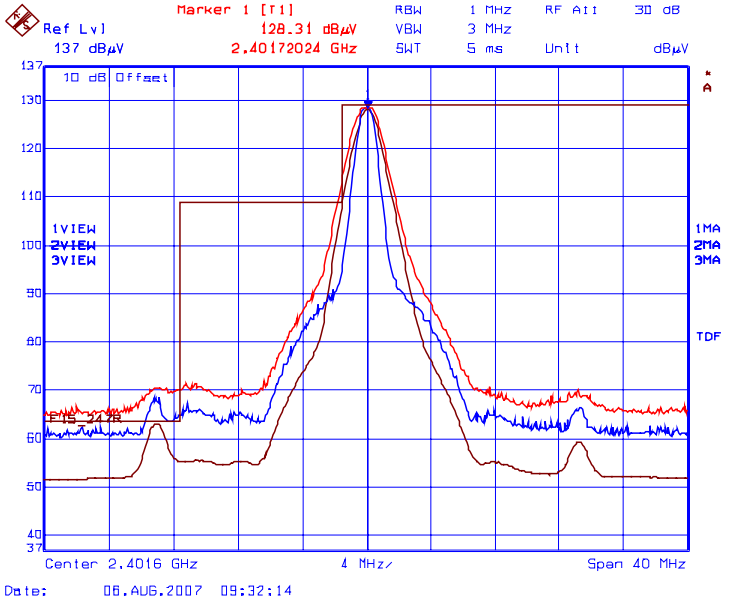
Fundamental Frequency:	2401.6 MHz
Software Power Setting:	90
Measured Conducted Power:	14.86 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2401.6	129.94	--	V	--	--	--	--
2401.6	129.56	--	H	--	--	--	--
4803.2	52.63	47.79	V	54.0	109.9	-6.2	Pass*
4803.2	51.79	46.93	H	54.0	109.9	-7.1	Pass*
12008.0	58.46	49.95	V	54.0	109.9	-4.1	Pass*
12008.0	57.88	48.38	H	54.0	109.9	-5.6	Pass*

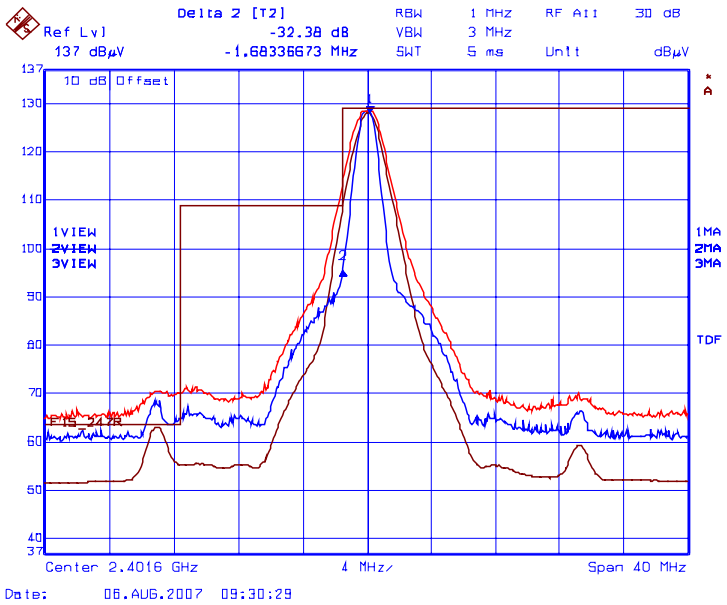
All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

* Emission within the restricted frequency bands.

Plot 6.11.5.3.1(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

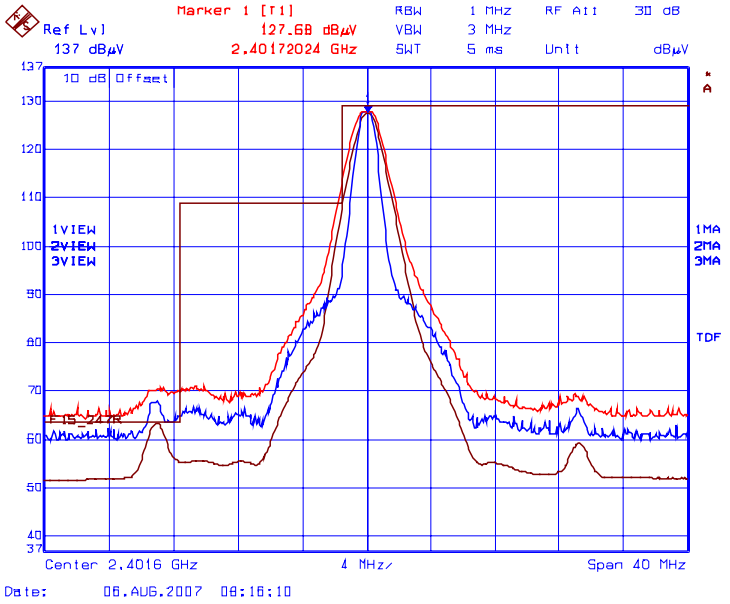


Plot 6.11.5.3.1(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

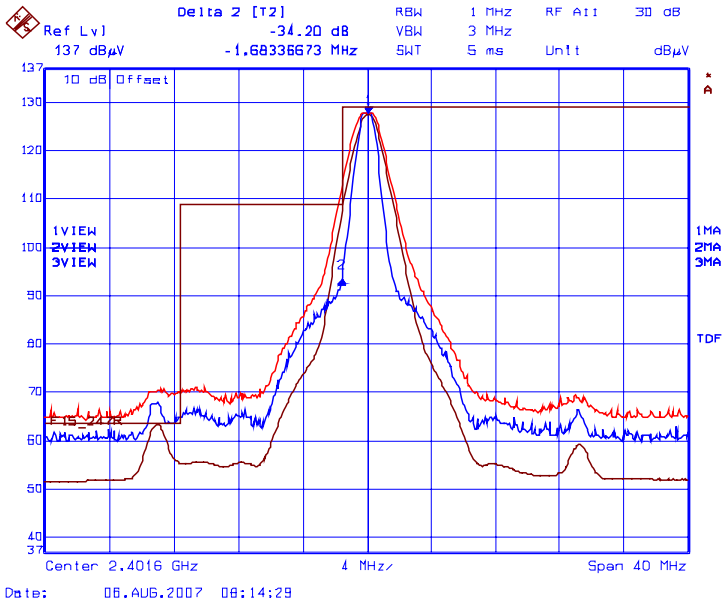


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 32.38 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Band-Edge Level at 2400 MHz: Peak = 128.31 dBµV/m – 32.38 dB = 95.93 dBµV/m (limit 108.31 dBµV/m)

Plot 6.11.5.3.2(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Plot 6.11.5.3.2(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 34.20 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Band-Edge Level at 2400 MHz: Peak = 127.68 dBµV/m – 34.20 dB = 93.48 dBµV/m (limit 107.68 dBµV/m)

Fundamental Frequency:	2439.6 MHz
Software Power Setting:	90
Measured Conducted Power:	16.43 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2439.6	130.56	--	V	--	--	--	--
2439.6	130.12	--	H	--	--	--	--
4879.2	52.09	48.00	V	54.0	110.6	-6.0	Pass*
4879.2	48.75	42.33	H	54.0	110.6	-11.7	Pass*
7318.8	50.76	42.81	V	54.0	110.6	-11.2	Pass*
7318.8	56.57	52.21	H	54.0	110.6	-1.8	Pass*
12198.0	55.41	46.12	V	54.0	110.6	-7.9	Pass*
12198.0	57.78	48.89	H	54.0	110.6	-5.1	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

* Emission within the restricted frequency bands.

Fundamental Frequency:	2477.6 MHz
Software Power Setting:	90
Measured Conducted Power:	17.46 dBm
Frequency Test Range:	30 MHz – 25 GHz

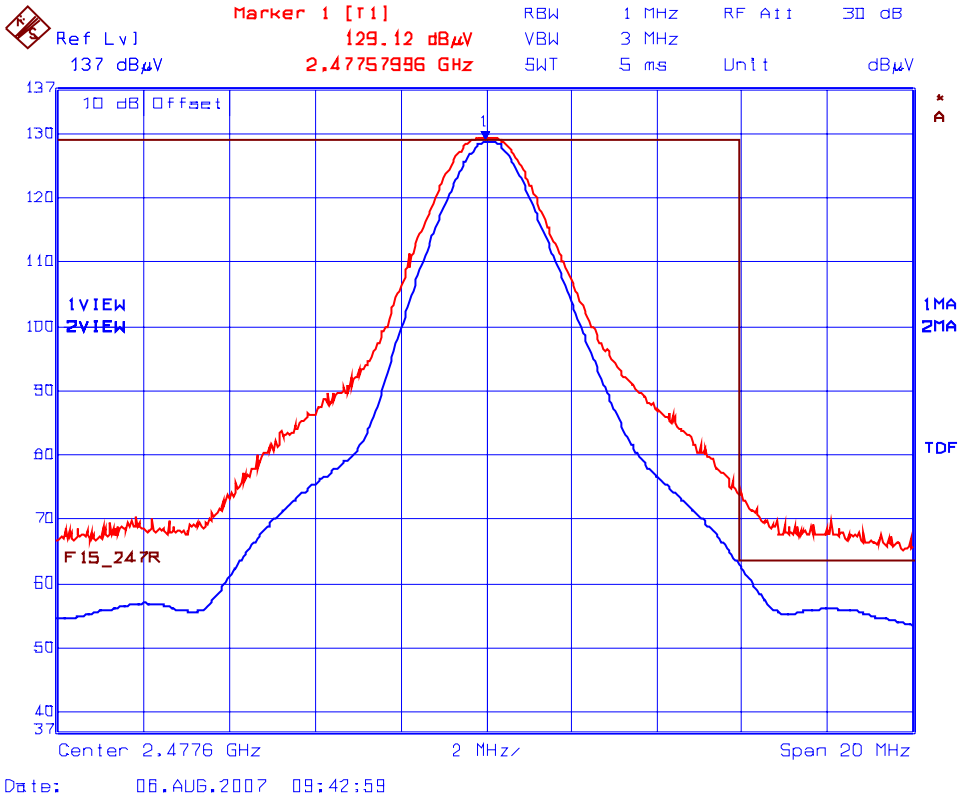
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2477.6	131.12	--	V	--	--	--	--
2477.6	131.15	--	H	--	--	--	--
4955.2	51.26	44.81	V	54.0	111.2	-9.2	Pass*
4955.2	48.92	42.10	H	54.0	111.2	-11.9	Pass*
7432.8	52.68	46.44	V	54.0	111.2	-7.6	Pass*
7432.8	54.29	49.54	H	54.0	111.2	-4.5	Pass*
12388.0	57.18	43.65	V	54.0	111.2	-10.4	Pass*
12388.0	57.14	47.54	H	54.0	111.2	-6.5	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

* Emission within the restricted frequency bands.

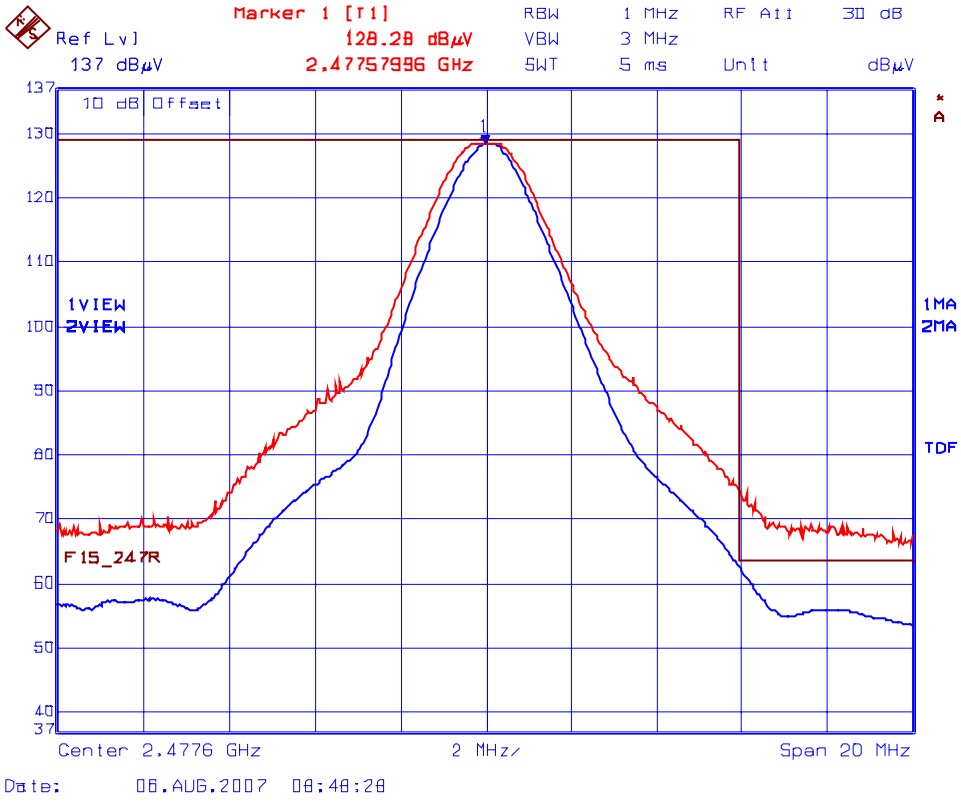
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: http://www.ultratech-labs.com

Plot 6.11.5.3.3 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal



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

Plot 6.11.5.3.4 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



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

6.11.5.4. EUT with 14.5 dBi Yagi Antenna and 2.13 dB Assembly Cable Loss

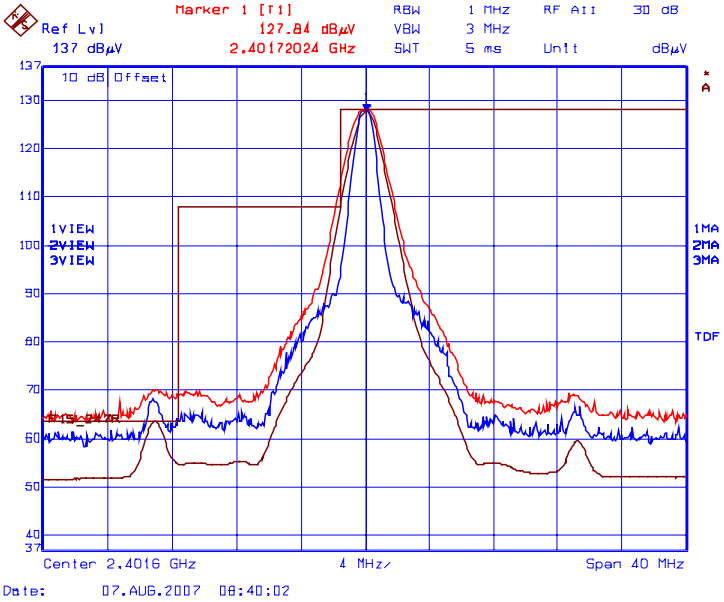
Fundamental Frequency:	2401.6 MHz
Software Power Setting:	94
Measured Conducted Power:	16.55 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2401.6	131.57	--	V	--	--	--	--
2401.6	131.47	--	H	--	--	--	--
4803.2	56.34	51.78	V	54.0	111.6	-2.2	Pass*
4803.2	51.86	47.06	H	54.0	111.6	-6.9	Pass*
12008.0	58.43	50.10	V	54.0	111.6	-3.9	Pass*
12008.0	58.69	50.48	H	54.0	111.6	-3.5	Pass*

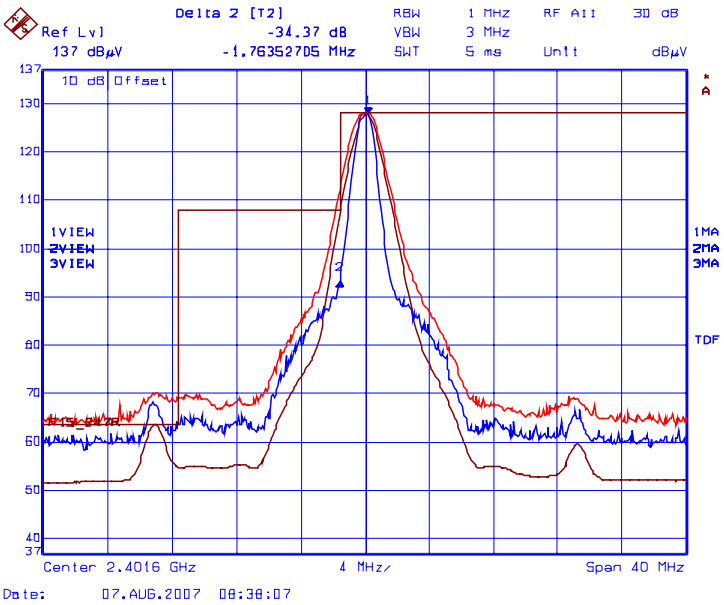
All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

* Emission within the restricted frequency bands.

Plot 6.11.5.4.1(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

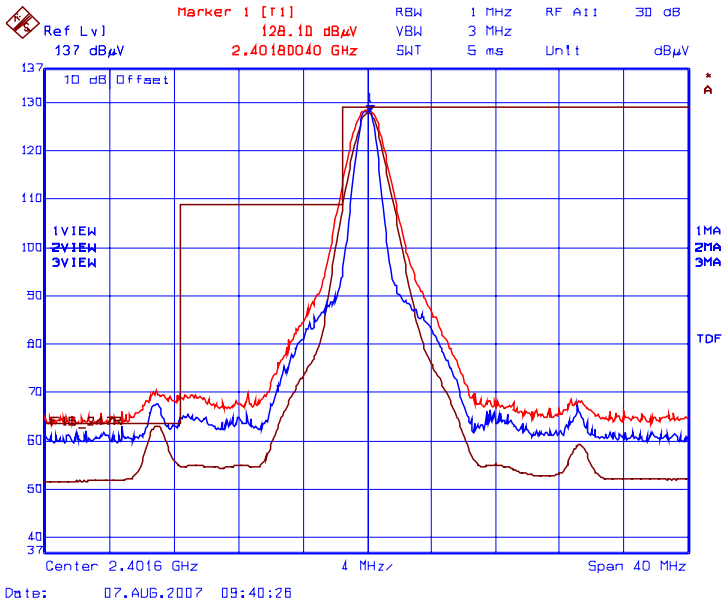


Plot 6.11.5.4.1(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

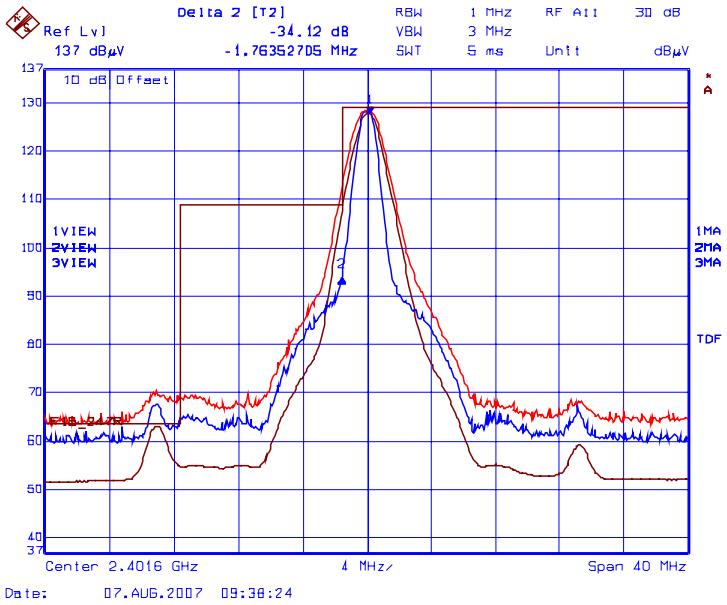


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 34.37 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Band-Edge Level at 2400 MHz: Peak = 127.84 dBµV/m – 34.37 dB = 93.47 dBµV/m (limit 107.84dBuV/m)

Plot 6.11.5.4.2(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Plot 6.11.5.4.2(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 34.12 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Band-Edge Level at 2400 MHz: Peak = 128.10 dBµV/m – 34.12 dB = 93.98 dBµV/m (limit 108.10 dBµV/m)

Fundamental Frequency:	2439.6 MHz
Software Power Setting:	94
Measured Conducted Power:	17.85 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2439.6	131.02	--	V	--	--	--	--
2439.6	131.23	--	H	--	--	--	--
4879.2	52.03	50.25	V	54.0	111.2	-3.8	Pass*
4879.2	48.30	41.29	H	54.0	111.2	-12.7	Pass*
7318.8	50.23	41.61	V	54.0	111.2	-12.4	Pass*
7318.8	53.50	48.69	H	54.0	111.2	-5.3	Pass*
12198.0	58.41	49.44	V	54.0	111.2	-4.6	Pass*
12198.0	57.76	49.04	H	54.0	111.2	-5.0	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

* Emission within the restricted frequency bands.

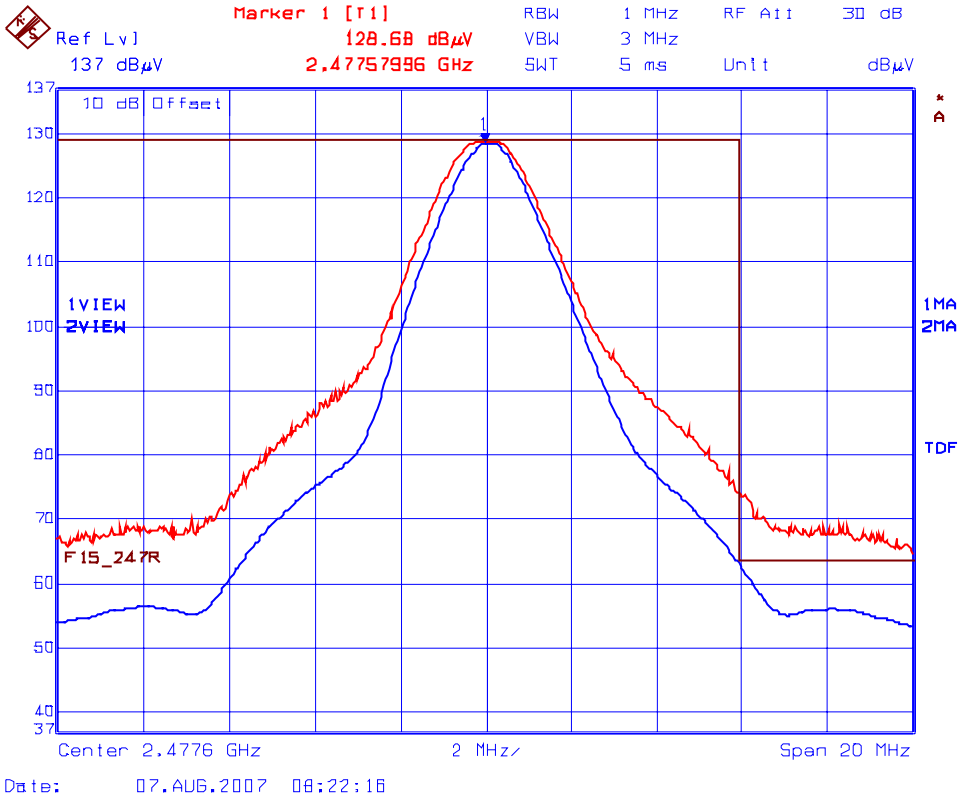
Fundamental Frequency:	2477.6 MHz
Software Power Setting:	94
Measured Conducted Power:	18.67 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2477.6	130.99	--	V	--	--	--	--
2477.6	131.15	--	H	--	--	--	--
4955.2	51.84	47.14	V	54.0	111.2	-6.9	Pass*
4955.2	48.02	38.73	H	54.0	111.2	-15.3	Pass*
7432.8	53.25	47.80	V	54.0	111.2	-6.2	Pass*
7432.8	55.00	50.17	H	54.0	111.2	-3.8	Pass*
12388.0	56.99	44.73	V	54.0	111.2	-9.3	Pass*
12388.0	56.77	45.78	H	54.0	111.2	-8.2	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

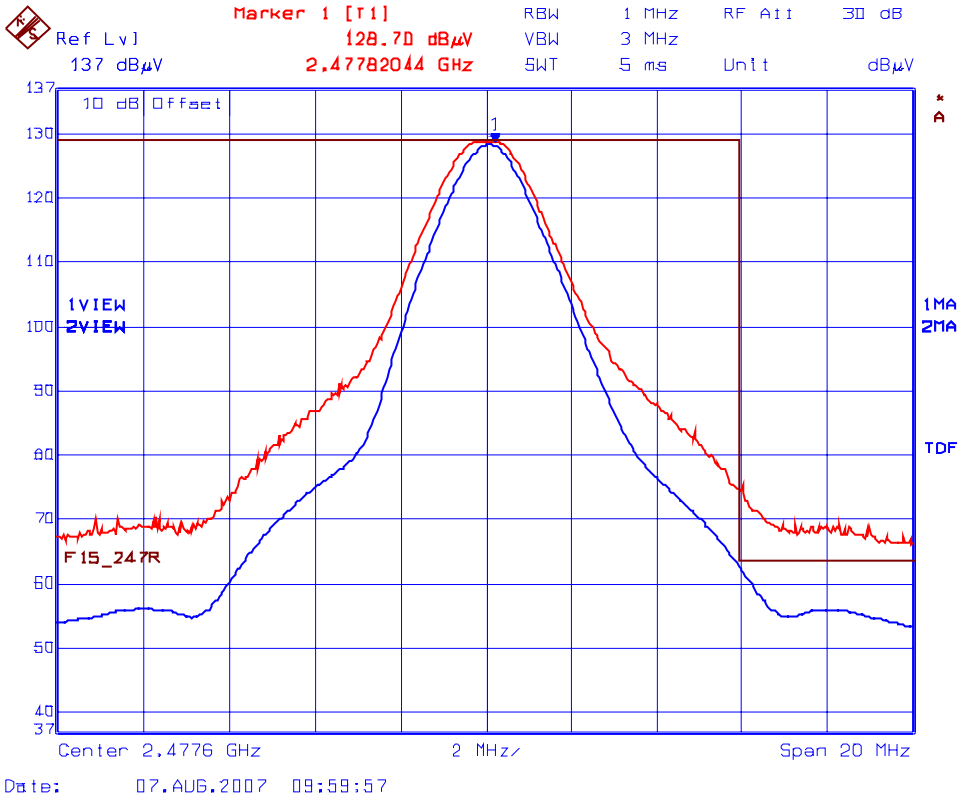
* Emission within the restricted frequency bands.

Plot 6.11.5.4.3 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal



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

Plot 6.11.5.4.4 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



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

6.11.5.5. EUT with 15 dBi Omni Directional Antenna and 2.13 dB Assembly Cable Loss

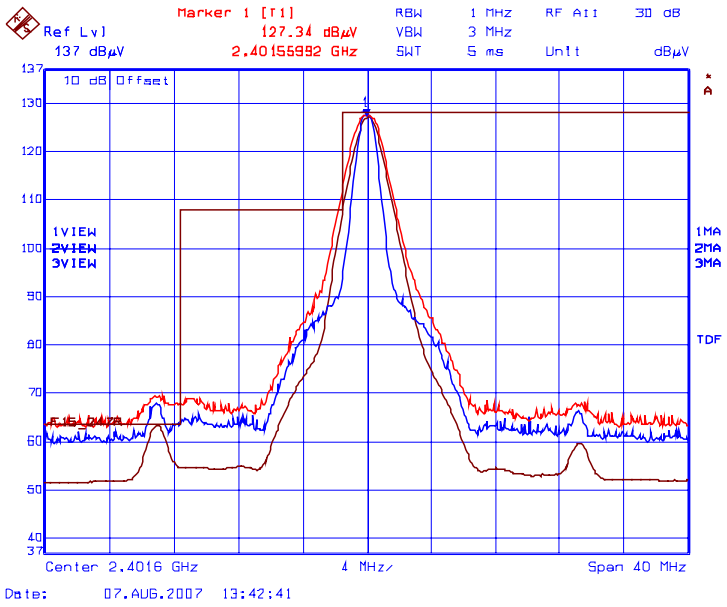
Fundamental Frequency:	2401.6 MHz
Software Power Setting:	115
Measured Conducted Power:	21.75 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2401.6	129.75	--	V	--	--	--	--
2401.6	129.01	--	H	--	--	--	--
4803.2	55.14	52.81	V	54.0	109.8	-1.2	Pass*
4803.2	53.60	49.73	H	54.0	109.8	-4.3	Pass*
12008.0	59.61	50.78	V	54.0	109.8	-3.2	Pass*
12008.0	57.66	49.30	H	54.0	109.8	-4.7	Pass*

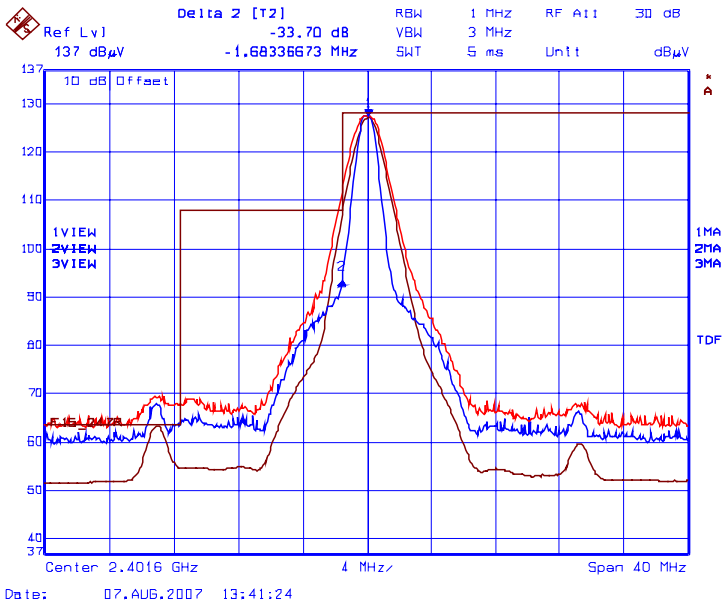
All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

* Emission within the restricted frequency bands.

Plot 6.11.5.5.1(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

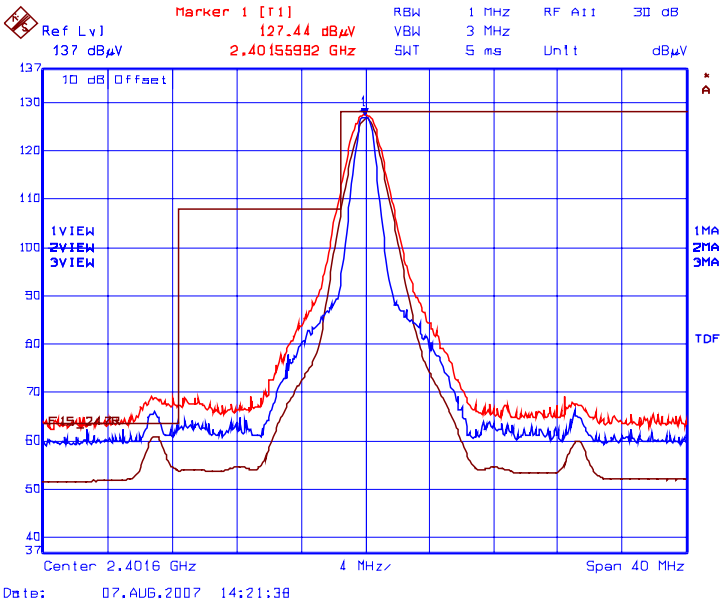


Plot 6.11.5.5.1(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal

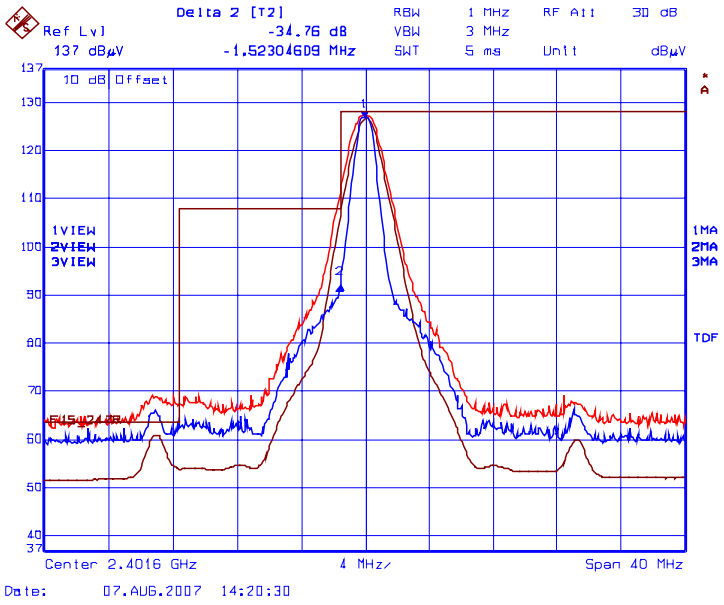


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 33.70 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Band-Edge Level at 2400 MHz: Peak = 127.34 dBµV/m – 33.70 dB = 93.64 dBµV/m (limit 107.34 dBµV/m)

Plot 6.11.5.5.2(a) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Plot 6.11.5.5.2(b) Band-Edge RF Radiated Emissions @ 1 meter
Low End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 34.76 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Band-Edge Level at 2400 MHz: Peak = 127.44 dBµV/m – 34.76 dB = 92.68 dBµV/m (limit 107.44 dBµV/m)

Fundamental Frequency:	2439.6 MHz
Software Power Setting:	115
Measured Conducted Power:	22.88 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2439.6	129.06	--	V	--	--	--	--
2439.6	129.87	--	H	--	--	--	--
4879.2	51.87	47.88	V	54.0	109.9	-6.1	Pass*
4879.2	50.96	45.61	H	54.0	109.9	-8.4	Pass*
7318.8	52.39	47.20	V	54.0	109.9	-6.8	Pass*
7318.8	55.33	51.52	H	54.0	109.9	-2.5	Pass*
12198.0	58.85	50.54	V	54.0	109.9	-3.5	Pass*
12198.0	59.63	52.74	H	54.0	109.9	-1.3	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

* Emission within the restricted frequency bands.

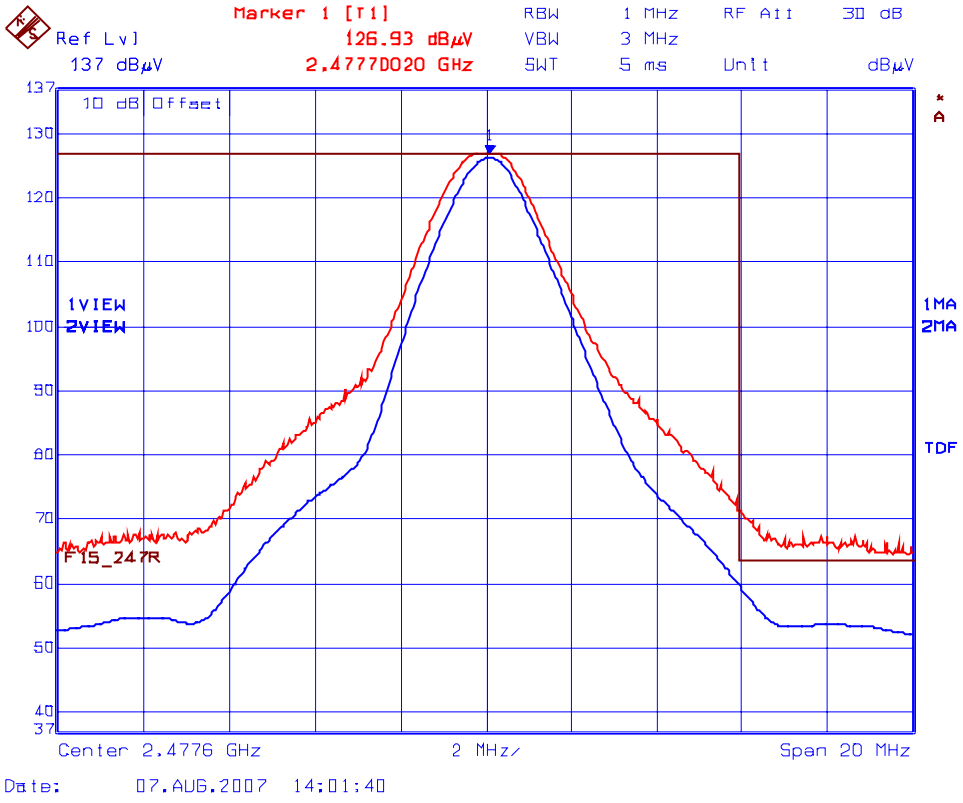
Fundamental Frequency:	2477.6 MHz
Software Power Setting:	115
Measured Conducted Power:	23.28 dBm
Frequency Test Range:	30 MHz – 25 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
2477.6	128.68	--	V	--	--	--	--
2477.6	130.24	--	H	--	--	--	--
4955.2	52.31	48.69	V	54.0	110.2	-5.3	Pass*
4955.2	50.67	43.01	H	54.0	110.2	-11.0	Pass*
7432.8	54.00	49.71	V	54.0	110.2	-4.3	Pass*
7432.8	54.73	49.74	H	54.0	110.2	-4.3	Pass*
12388.0	57.63	47.59	V	54.0	110.2	-6.4	Pass*
12388.0	57.70	49.83	H	54.0	110.2	-4.2	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit. See the following test data plots for band-edge emissions.

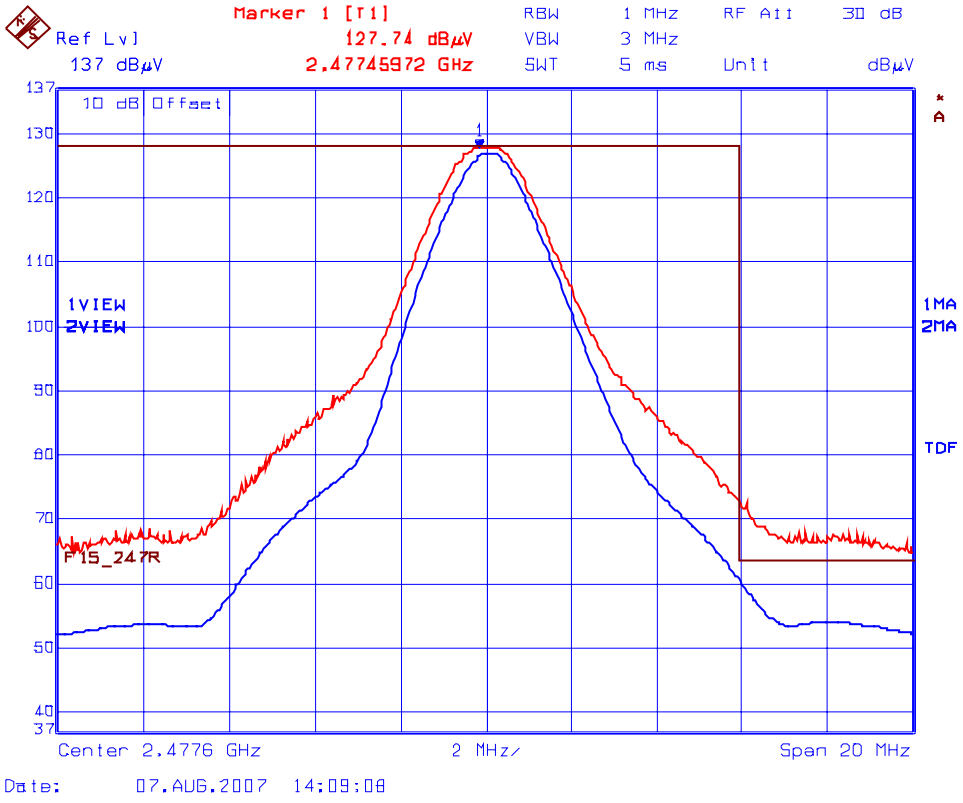
* Emission within the restricted frequency bands.

Plot 6.11.5.5.3 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Horizontal



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

Plot 6.11.5.5.4 Band-Edge RF Radiated Emissions @ 1 meter
High End of Frequency Band (at high power and data rate)
Rx Antenna Orientation: Vertical



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

EXHIBIT 7. MEASUREMENT UNCERTAINTY

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

7.1. 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 Γ_1 = 0.03 LISN VRC Γ_R = 0.8(9 kHz) 0.2 (30 MHz) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	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

7.2. 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 Directivit	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 Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	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