ENGINEERING TEST REPORT

MSR Radio Module
Model No.: MSR-RTWAVE

FCC ID: SU5-MSR-RTWAVE

Applicant:

VideoComm Technologies (1156488 Ontario Inc.)
204-407 Speers Road
Oakville, ON
Canada L6K 3T5

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Digital Modulation Systems (DTS)
Operating in 2412-2462 MHz and 5745-5805 MHz Bands.

UltraTech's File No.: VCT-003F15C247

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: March 14, 2008	
Report Prepared by: Dan Huynh Issued Date: March 14, 2008	Tested by: Mr. Hung Trinh, EMI/RFI Technician Mr. Quan Ngo, EMC Technician Test Dates: January 21-29, 2008 February 7, 2008 March 11 & 13, 2008

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.

UltraTech

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

TABLE OF CONTENTS

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	▪ Power Line 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 ▪ Letter from the Applicant to request for Modular Approval	OK
5	Attestation Statements	--	--
6	ID Label/Location Info	ID Label and Location of Label	OK
7	Block Diagrams	Block Diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	--	--
10	Operational Description	Operation Description	OK
11	RF Exposure Info	MPE Evaluation, see section 6.11 in this Test Report for details.	OK
12	Users Manual	Installation Manual for the MSR Radio Module	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:	Equipment Certification for Digital Modulation Systems (DTS) Transmitter Operating in the Frequency Bands 2400-2483.5 MHz and 5725-5850 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 [ ] Residential environment

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

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2007	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. 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
KDB Publication No. 558074	2005	Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	VideoComm Technologies (1156488 Ontario Inc.).
Address:	204-407 Speers Road Oakville, ON Canada L6K 3T5
Contact Person:	Mr. Jeff Johnson Phone #: 905-339-0366 Fax #: 905-339-1776 Email Address: jeff@VideoTransmitters.com

MANUFACTURER	
Name:	VideoComm Technologies (1156488 Ontario Inc.).
Address:	204-407 Speers Road Oakville, ON Canada L6K 3T5
Contact Person:	Mr. Jeff Johnson Phone #: 905-339-0366 Fax #: 905-339-1776 Email Address: jeff@VideoTransmitters.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:	VideoComm Technologies
Product Name:	MSR Radio Module
Model Name or Number:	MSR-RTWAVE
Serial Number:	Test Sample
Type of Equipment:	Digital Modulation Transmitter
Input Power Supply Type:	External Regulated DC Sources
Primary User Functions of EUT:	Digital radio video link point-to-point
External Amplifier Description:	Manufacturer: VideoComm Technologies Model: MSR-AMP Specification: • 4.9 - 6.0 GHz Frequency Range • 11 dB Nominal Gain @ 8V 480 mA • 34 dBm Nominal P1dB @ 8V 480 mA • Bias Conditions: 7-9 VDC @ 480 mA (Quiescent)

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	• Mobile • Base Station (fixed use)
Intended Operating Environment:	Commercial, industrial or business
Power Supply Requirement:	9 VDC 2 Amp
RF Output Power Rating: ▪ 2412-2462 MHz band: (no amplifier) ▪ 5745-5805 MHz band: (with/without amplifier)	 +24.27 to +26.80 dBm (Software Power Settings: 46-50) +18.92 to +20.88 dBm (Software Power Settings: 33-38) With Amplifier: +27.99 to +29.04 dBm (Software Power Settings: 24-30) Without Amplifier: +26.10 to +26.59 dBm (Software Power Settings: 45)
Operating Frequency Range:	2412-2462 MHz and 5745-5805 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	5 MHz for 802.11 g 20 MHz for 802.11 a
Duty Cycle:	100%
6 dB bandwidth:	802.11g (2412-2462 MHz): 16.59 MHz 802.11a (5745-5805 MHz): 16.67 MHz
99% Occupied Bandwidth:	802.11g (2412-2462 MHz): 16.51 MHz 802.11a (5745-5805 MHz): 16.59 MHz
Modulation Type:	OFDM
Antenna Connector Type:	U_FL (IPEX)

3.4. ASSOCIATED ANTENNA DESCRIPTION

There are three antenna types:

1. Rubber Ducky Antenna
2. Panel Antenna
3. Parabolic 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	Mini PCI Connector	1	Mini PCI	N/A
2	Antenna Port	4	U_FL (IPEX)	6" shielded

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:	Test Jig Boards
Brand name:	VideoComm Technologies
Model Name or Number:	N/A
Serial Number:	N/A
Connected to EUT's Port:	Module pin signals

Ancillary Equipment # 2	
Description:	AC/DC Power Adapter
Brand name:	AQualities
Model Name or Number:	GFP181U-0920-1
Serial Number:	0711-00485RoHS
Connected to EUT's Port:	Test Jig Board

Ancillary Equipment # 3	
Description:	AC/DC Power Adapter
Brand name:	AQualities
Model Name or Number:	GFP181U-0920-1
Serial Number:	0711-00483RoHS
Connected to EUT's Port:	Test Jig Board

Ancillary Equipment # 4	
Description:	AC/DC Power Adapter
Brand name:	HJC Hua Jung Corp. Co. Ltd.
Model Name or Number:	HAPU05F2
Serial Number:	n/a
Connected to EUT's Port:	VideoComm Power Supply Board

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:	9 VDC via external AC/DC adapter

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements.
Special Test Software:	Special software and hardware by the Applicant to operate the EUT at each channel frequency continuously. For example, the transmitter will be operated at each of the lowest, middle and highest frequencies individually continuously during testing.
Special Hardware Used:	The RF Module could be tested outside of the enclosure using VideoComm Technologies Test Jig Board connected to EUT.
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):	2412-2462 MHz and 5745-5805 MHz
Frequency(ies) Tested:	
▪ 802.11g (2412-2462 MHz):	2412, 2417, 2422, 2427, 2432, 2437, 2442, 2447 2452, 2457 and 2462 MHz
▪ 802-11a (5745-5805 MHz):	5745, 5765, 5785 and 5805 MHz

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-3, Expiry Date: May 17, 2009).

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes*
15.207(a)	Power Line Conducted Emissions	Yes
15.247(a)(2)	6 dB Bandwidth	Yes
15.247(b)(3)	Peak Conducted Output Power - DTS	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
15.247(e)	Power Spectral Density	Yes
15.247(b)(5), (e)(i) 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure	Yes
MSR Radio Module, **Model No.: MSR-RTWAVE**, by **VideoComm Technologies (1156488 Ontario Inc.)** has also been tested and found to comply with **FCC Part 15, Subpart B - Class A Digital Devices**. The engineering test report has been documented and kept on file and it is available upon request.		

* Must be professional installed, the installer shall be responsible for ensuring that the proper antenna is employed so that the FCC limits are not exceeded.

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in ANSI C63.4; FCC KDB Publication No. 558074: Guidance on Measurements for Digital Transmission 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

Digital radio video link point-to-point.

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

6.5.1. Limit(s)

The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5 .....……..	66 to 56*	56 to 46*
0.5–5 .....……..	56	46
5-30 ……..	60 ..……..	50

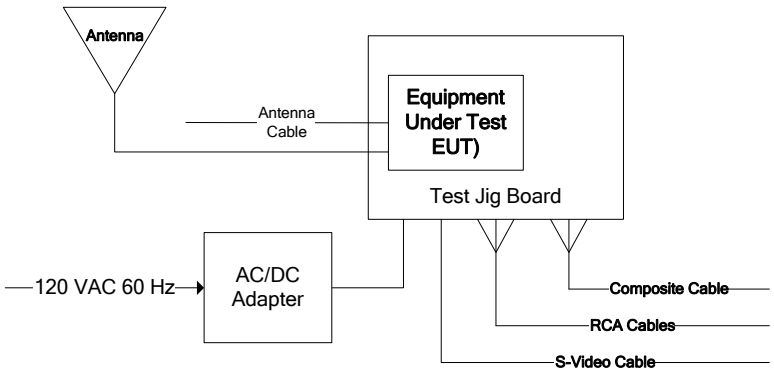
*Decreases linearly with the logarithm of the frequency

6.5.2. Method of Measurements

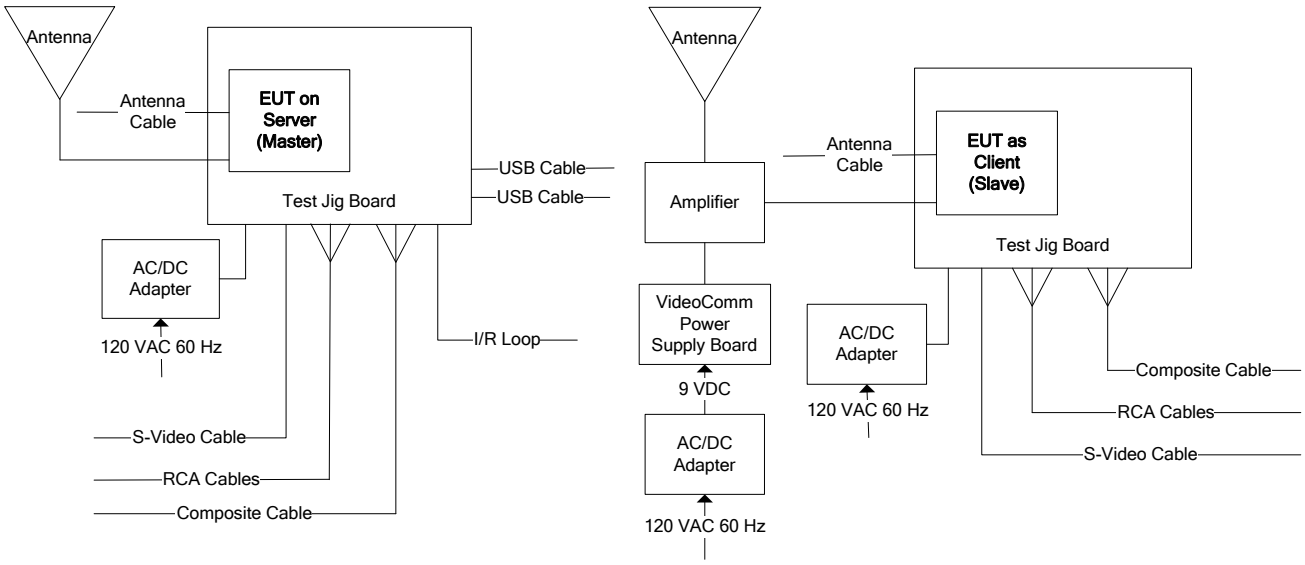
ANSI C63.4

6.5.3. Test Arrangement

Test Configuration 1: EUT with Test Jig Board



Test Configuration 2: EUT on Server (Master) and as Client (Slave) with Amplifier
(Test Conducted on Power Source of the Test Jig Boards and Amplifier)



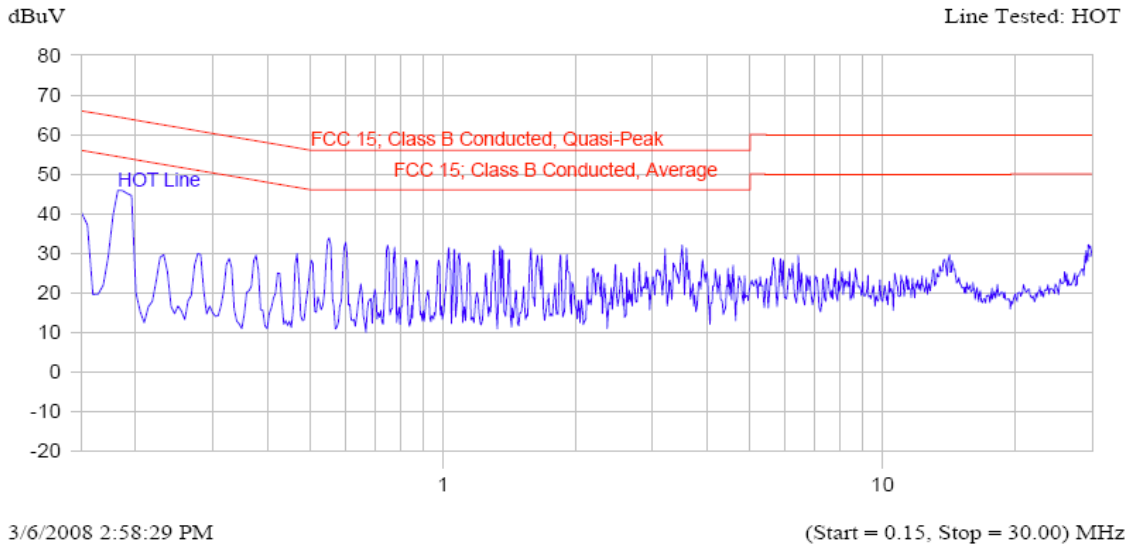
6.5.4. Test Equipment List

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	…	…	…

6.5.5. Test Data

Plot 6.5.5.1(i) Power Line Conducted Emissions
Test Configuration 1: EUT with Test Jig Board
Line Voltage: 120 VAC 60 Hz; Line Tested: Hot

Current Graph

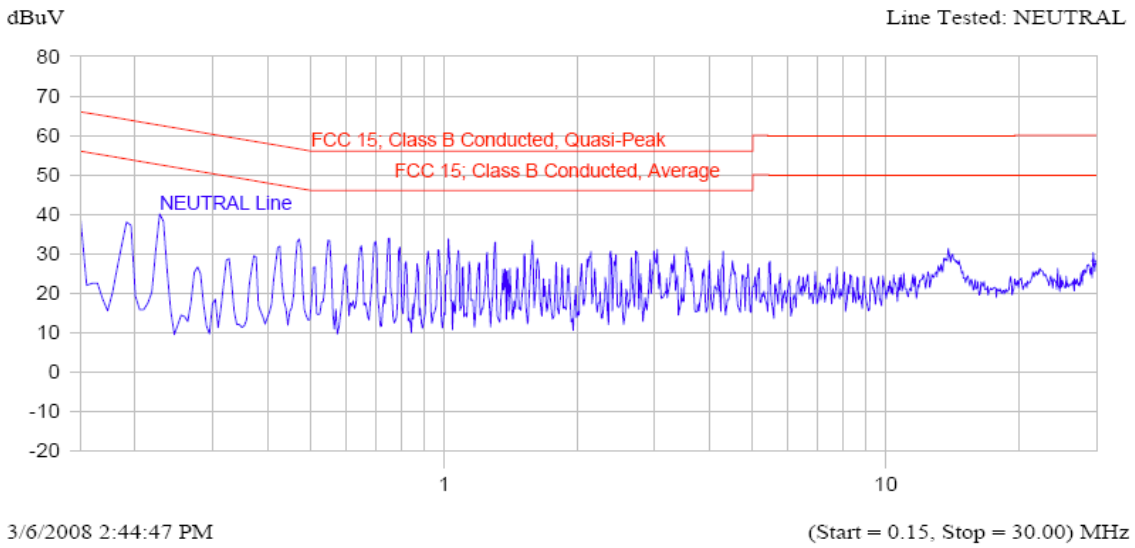


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.182	50.0	44.3	-20.7	35.2	-19.8	HOT Line
0.547	37.6	35.3	-20.7	20.6	-25.4	HOT Line
0.601	36.6	35.0	-21.0	27.2	-18.8	HOT Line
0.737	32.0	30.0	-26.0	22.1	-23.9	HOT Line
1.342	32.3	29.2	-26.8	18.4	-27.6	HOT Line

Plot 6.5.5.1(ii) Power Line Conducted Emissions
Test Configuration 1: EUT with Test Jig Board
Line Voltage: 120 VAC 60 Hz; Line Tested: Neutral

Current Graph

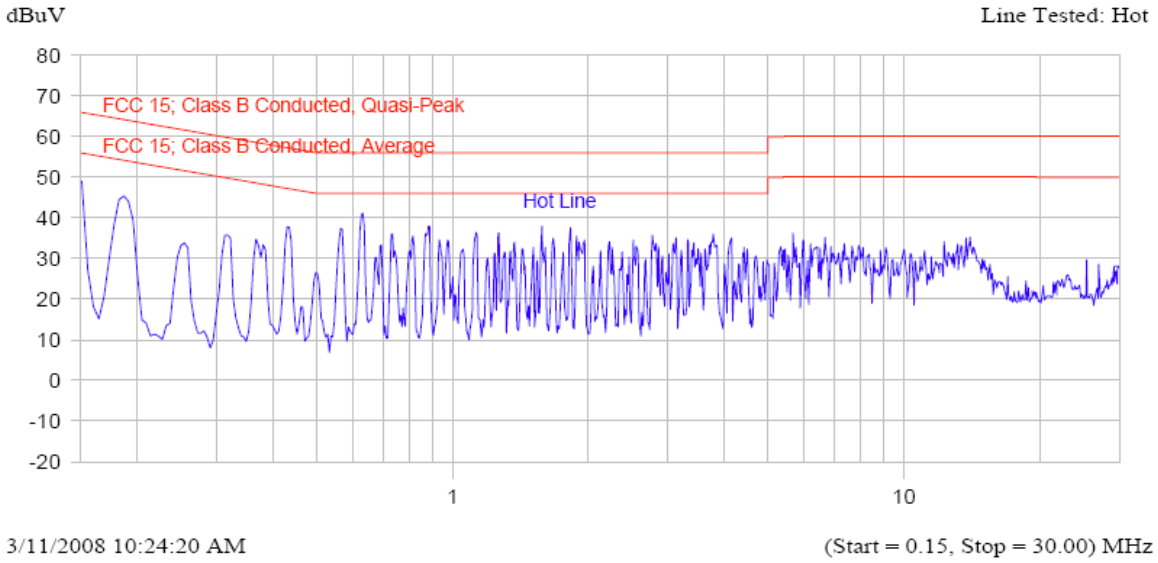


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.183	50.1	45.0	-20.1	34.8	-20.3	NEUTRAL Line
0.223	43.4	35.0	-28.8	20.4	-33.4	NEUTRAL Line
0.453	29.0	31.3	-26.0	16.6	-30.7	NEUTRAL Line
0.745	33.5	32.2	-23.8	22.9	-23.1	NEUTRAL Line
1.013	34.7	31.1	-24.9	23.1	-22.9	NEUTRAL Line

Plot 6.5.5.2(i) Power Line Conducted Emissions
Test Configuration 2: EUT on Server (Master) and as Client (Slave) with Amplifier
(Test Conducted on Power Source of the Test Jig Board with the Master Unit)
Line Voltage: 120 VAC 60 Hz; Line Tested: Hot

Current Graph

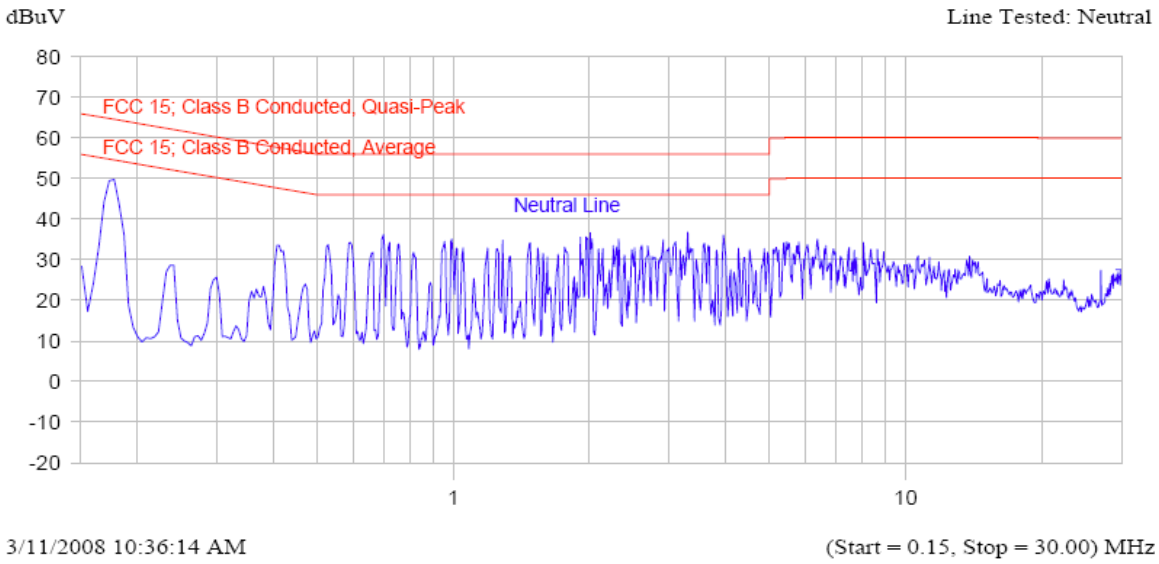


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.185	50.5	49.1	-15.8	43.1	-11.8	Hot Line
0.312	38.0	36.6	-24.7	33.0	-18.3	Hot Line
0.427	38.7	37.5	-20.6	28.3	-19.7	Hot Line
0.627	41.7	40.7	-15.3	32.2	-13.8	Hot Line
1.572	38.5	37.0	-19.0	21.5	-24.5	Hot Line
14.020	36.0	30.9	-29.1	22.6	-27.4	Hot Line

Plot 6.5.5.2(ii) Power Line Conducted Emissions
Test Configuration 2: EUT on Server (Master) and as Client (Slave) with Amplifier
(Test Conducted on Power Source of the Test Jig Board with the Master Unit)
Line Voltage: 120 VAC 60 Hz; Line Tested: Neutral

Current Graph

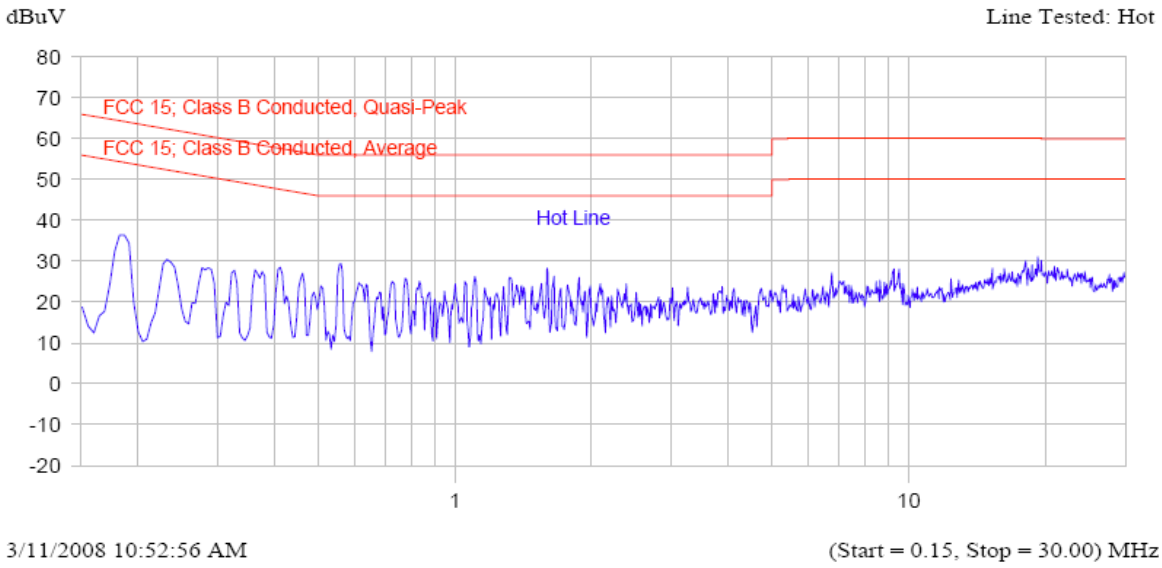


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.172	52.2	48.7	-16.7	39.0	-16.3	Neutral Line
0.407	33.6	31.4	-27.1	24.4	-24.2	Neutral Line
0.697	37.1	35.1	-20.9	26.5	-19.5	Neutral Line
2.006	36.8	33.0	-23.0	19.7	-26.3	Neutral Line
3.291	36.9	31.6	-24.4	19.1	-26.9	Neutral Line

Plot 6.5.5.2(iii) Power Line Conducted Emissions
Test Configuration 2: EUT on Server (Master) and as Client (Slave) with Amplifier
(Test Conducted on Power Source of the Test Jig Board with the Slave Unit)
Line Voltage: 120 VAC 60 Hz; Line Tested: Hot

Current Graph

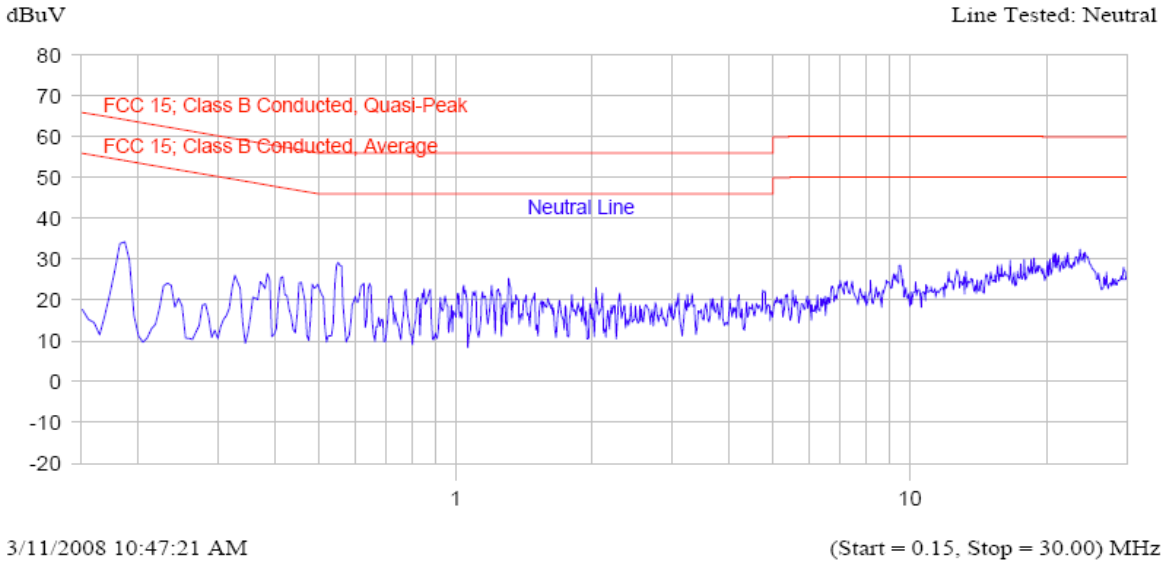


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.181	46.1	43.4	-21.7	33.6	-21.5	Hot Line
0.558	27.6	25.9	-30.1	15.5	-30.5	Hot Line
1.596	26.8	23.2	-32.8	14.4	-31.6	Hot Line
19.250	30.6	24.1	-35.9	17.0	-33.0	Hot Line

Plot 6.5.5.2(iv) Power Line Conducted Emissions
Test Configuration 2: EUT on Server (Master) and as Client (Slave) with Amplifier
(Test Conducted on Power Source of the Test Jig Board with the Slave Unit)
Line Voltage: 120 VAC 60 Hz; Line Tested: Neutral

Current Graph

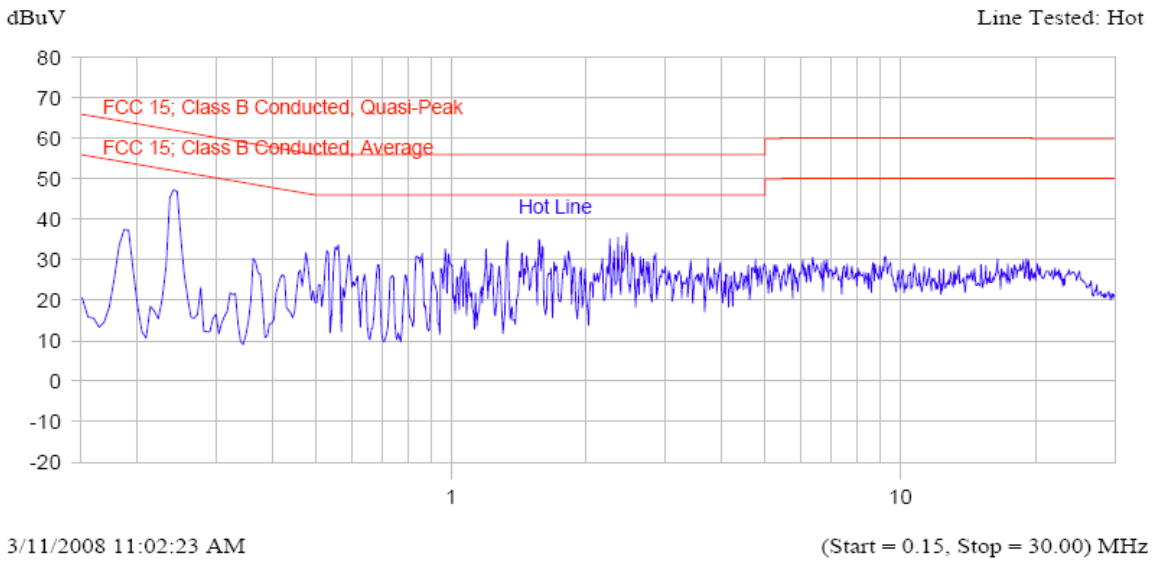


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.179	49.1	43.6	-21.5	29.4	-25.7	Neutral Line
0.554	30.6	28.5	-27.5	19.2	-26.8	Neutral Line
9.448	30.4	23.9	-36.1	15.9	-34.1	Neutral Line
23.692	31.3	26.6	-33.4	20.4	-29.6	Neutral Line

Plot 6.5.5.2(v) Power Line Conducted Emissions
Test Configuration 2: EUT on Server (Master) and as Client (Slave) with Amplifier
(Test Conducted on Power Source of the Amplifier)
Line Voltage: 120 VAC 60 Hz; Line Tested: Hot

Current Graph

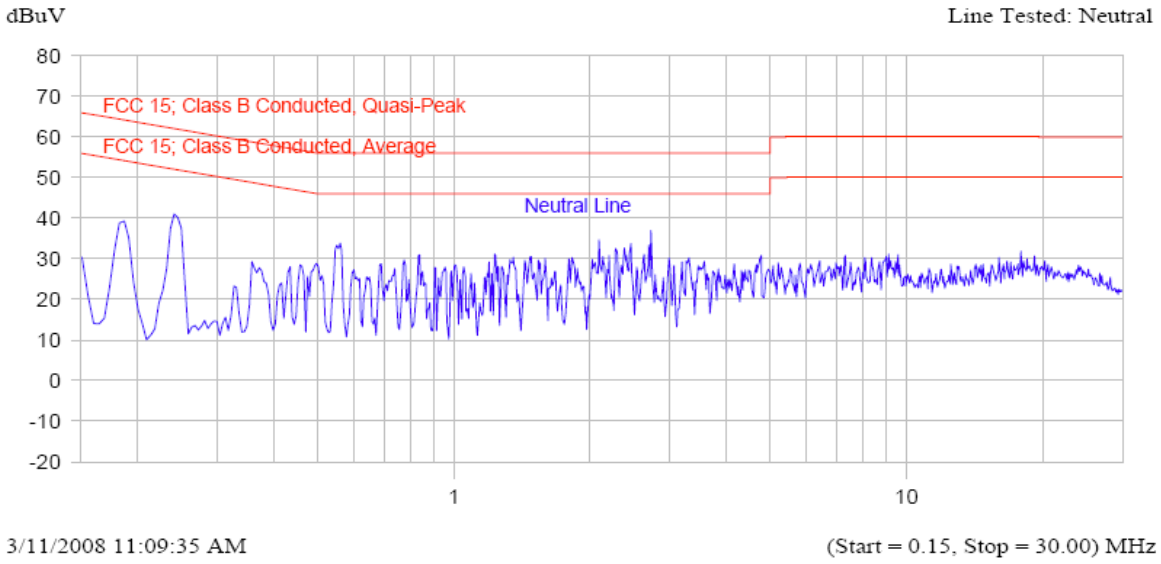


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.181	49.8	40.7	-24.4	32.1	-23.0	Hot Line
0.239	47.2	45.5	-17.9	35.4	-18.1	Hot Line
0.554	34.2	32.3	-23.7	24.9	-21.1	Hot Line
1.569	35.9	31.8	-24.2	20.7	-25.3	Hot Line
2.454	38.4	35.0	-21.0	20.7	-25.3	Hot Line

Plot 6.5.5.2(vi) Power Line Conducted Emissions
Test Configuration 2: EUT on Server (Master) and as Client (Slave) with Amplifier
(Test Conducted on Power Source of the Amplifier)
Line Voltage: 120 VAC 60 Hz; Line Tested: Neutral

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.183	47.8	39.1	-25.9	33.4	-21.6	Neutral Line
0.239	46.6	44.4	-19.0	36.2	-17.2	Neutral Line
0.550	34.9	33.3	-22.7	26.5	-19.5	Neutral Line
2.717	36.7	30.8	-25.2	16.9	-29.1	Neutral Line

6.6. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]

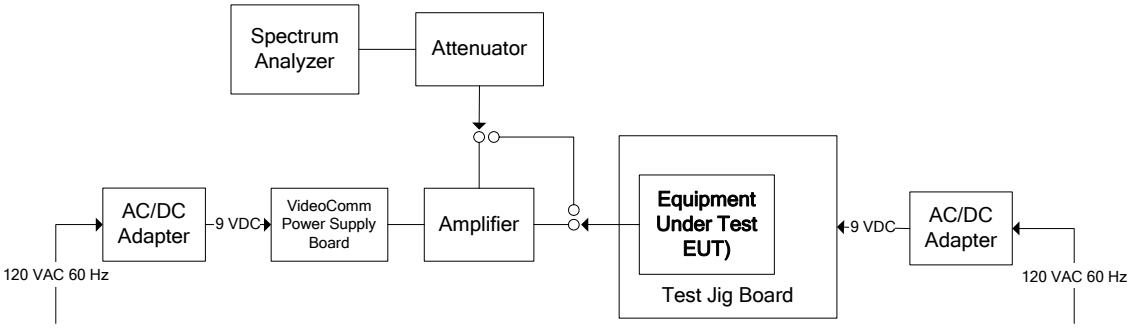
6.6.1. Limit(s)

For a Digital Modulation System, the minimum 6 dB bandwidth shall be at least 500 kHz.

6.6.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.6.3. Test Arrangement



6.6.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
Attenuator	Narda	4768-20	--	DC - 40 GHz

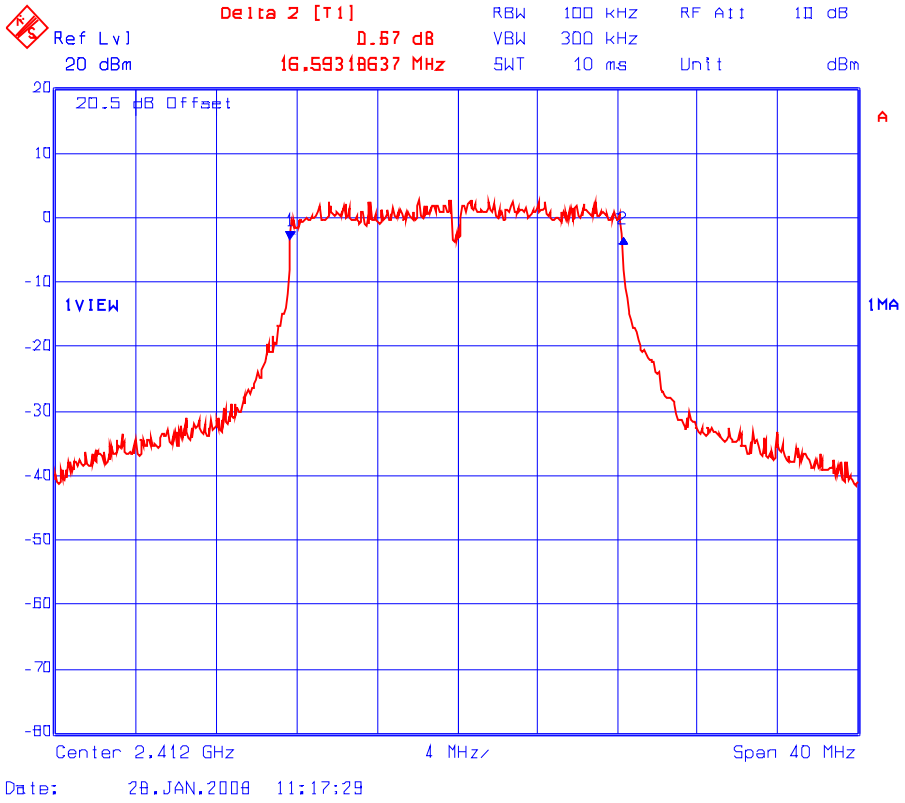
6.6.5. Test Data

Remark(s): For 5745-5805 MHz band, both settings with and without amplifier were pre-scanned, similar results were observed. Therefore, the configuration with amplifier was chosen for final tests, since the output power in this configuration was higher than setting without amplifier.

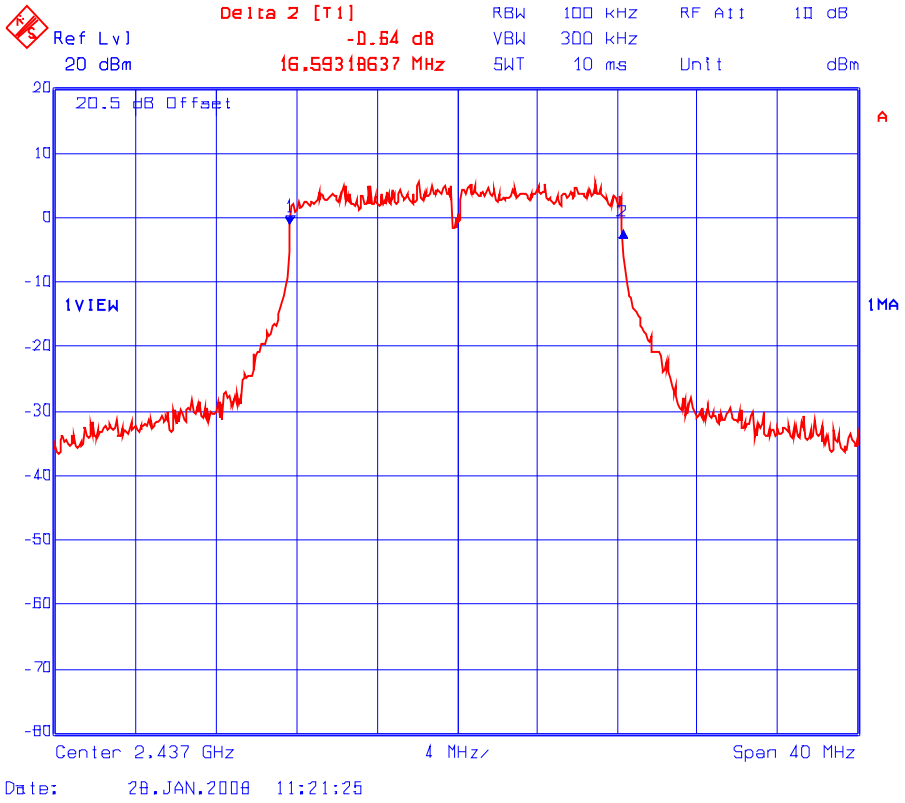
Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2412	16.59	16.51
2437	16.59	16.51
2462	16.59	16.51
5745	16.67	16.51
5785	16.67	16.59
5805	16.67	16.51

See the following plots for detailed measurements.

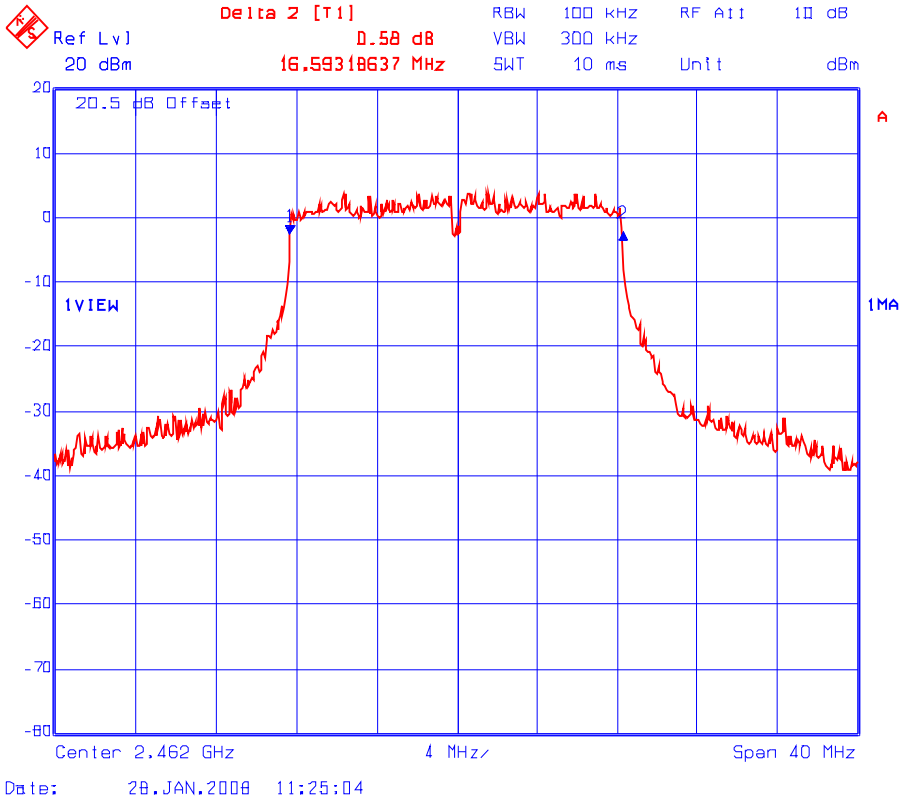
Plot 6.6.5.1 6 dB Bandwidth
Frequency: 2412 MHz; Modulation: 64-QAM at 54 Mbps



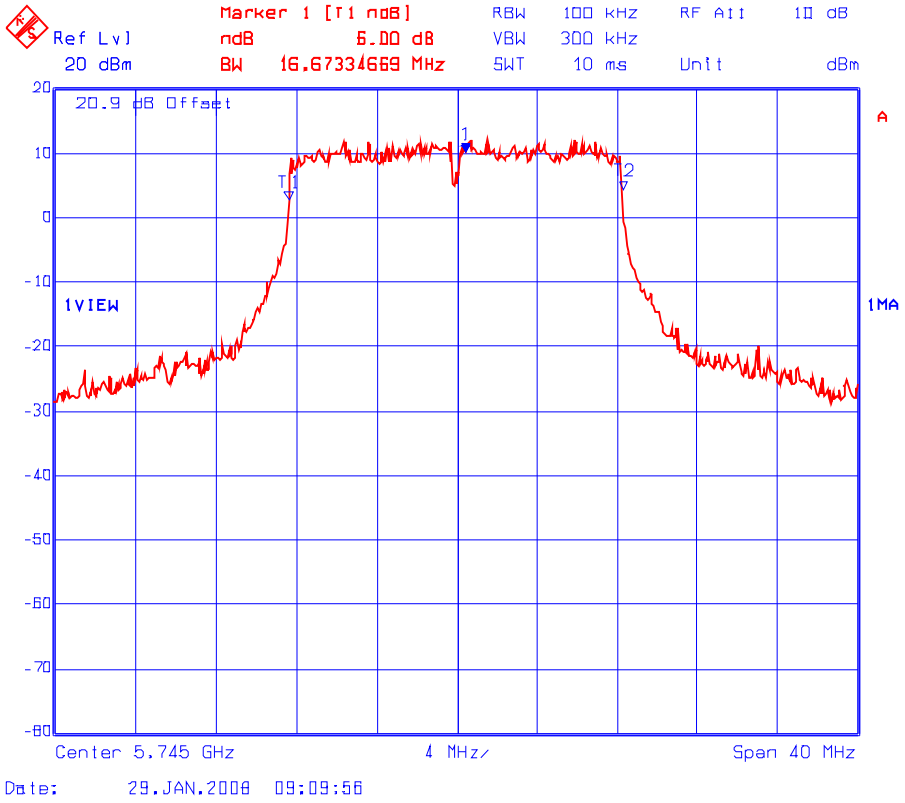
Plot 6.6.5.2 6 dB Bandwidth
Frequency: 2437 MHz; Modulation: 64-QAM at 54 Mbps



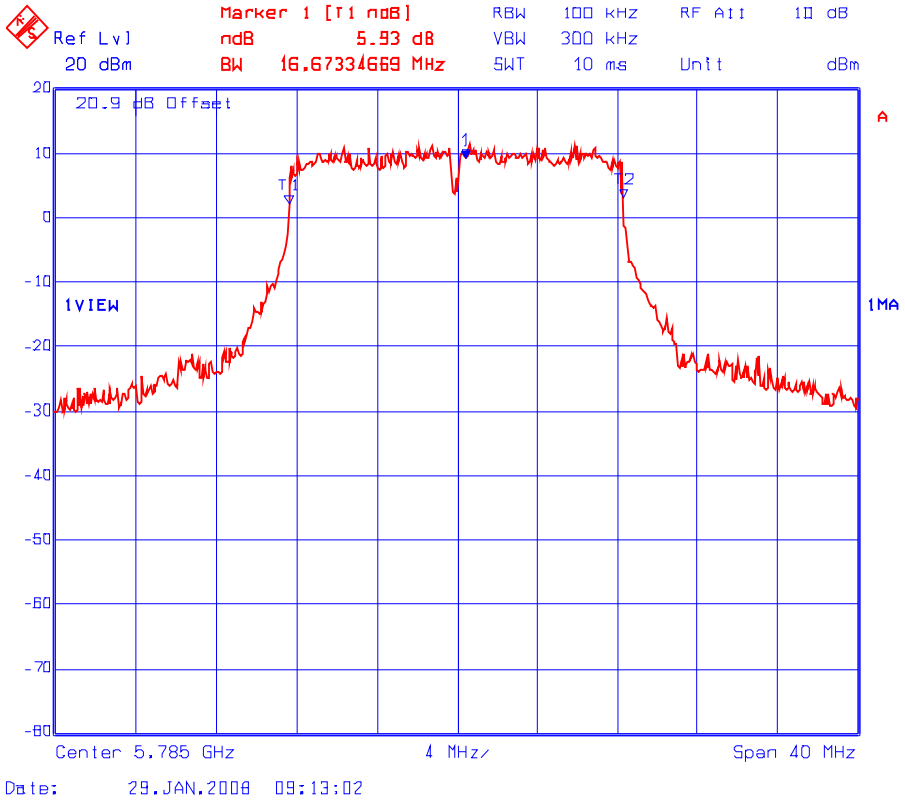
Plot 6.6.5.3 6 dB Bandwidth
Frequency: 2462 MHz; Modulation: 64-QAM at 54 Mbps



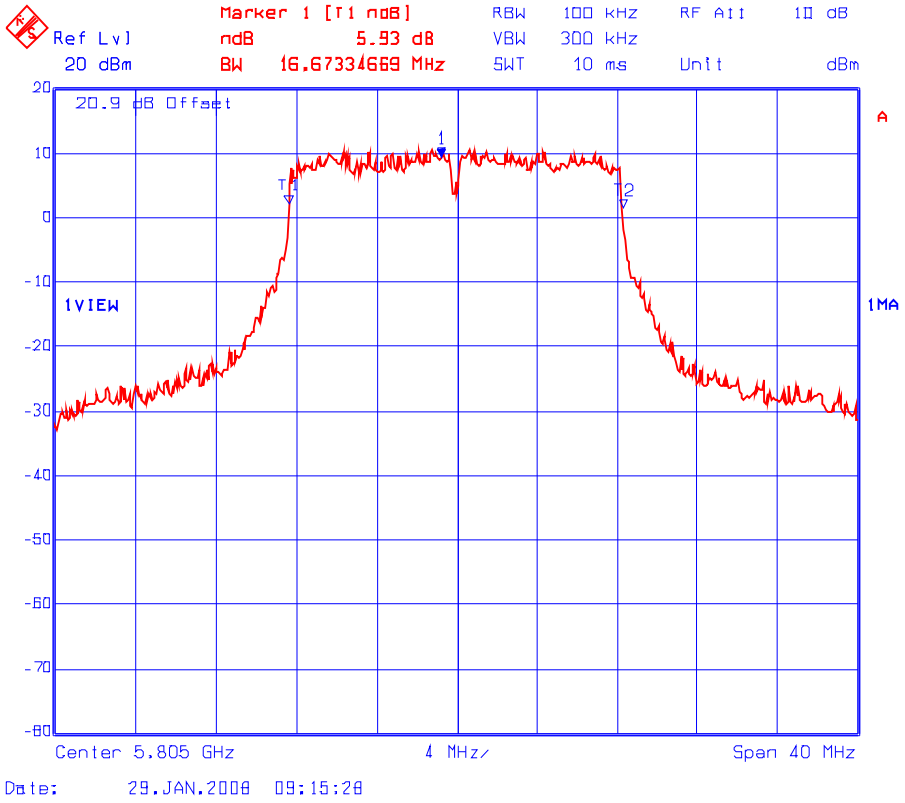
Plot 6.6.5.4 6 dB Bandwidth
Frequency: 5745 MHz; Modulation: 64-QAM at 54 Mbps



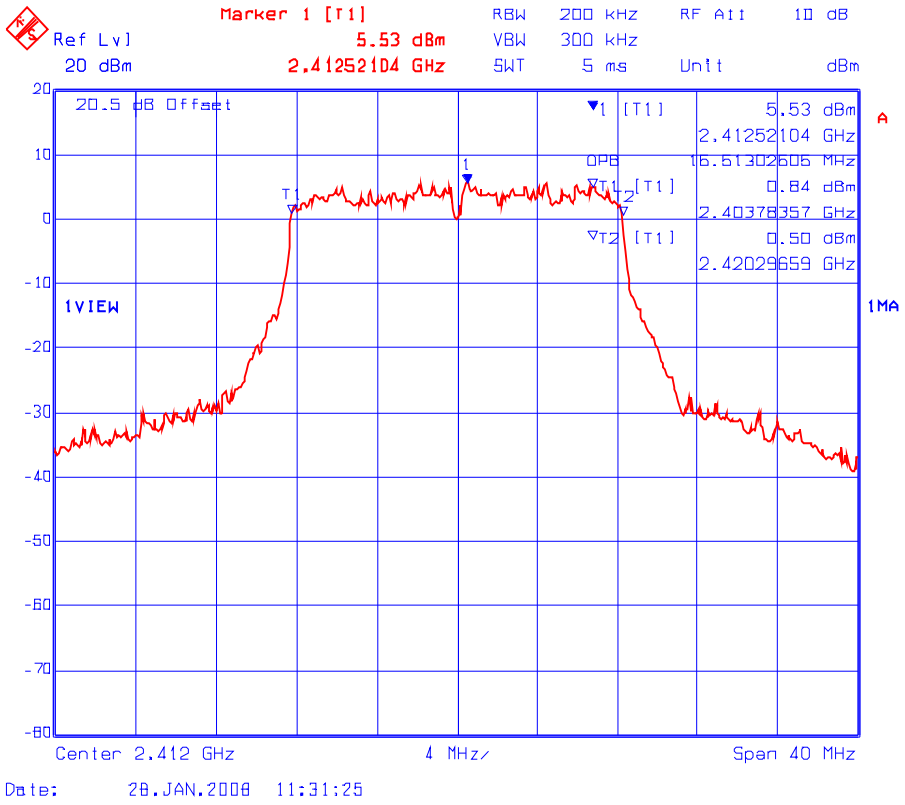
Plot 6.6.5.5 6 dB Bandwidth
Frequency: 5785 MHz; Modulation: 64-QAM at 54 Mbps



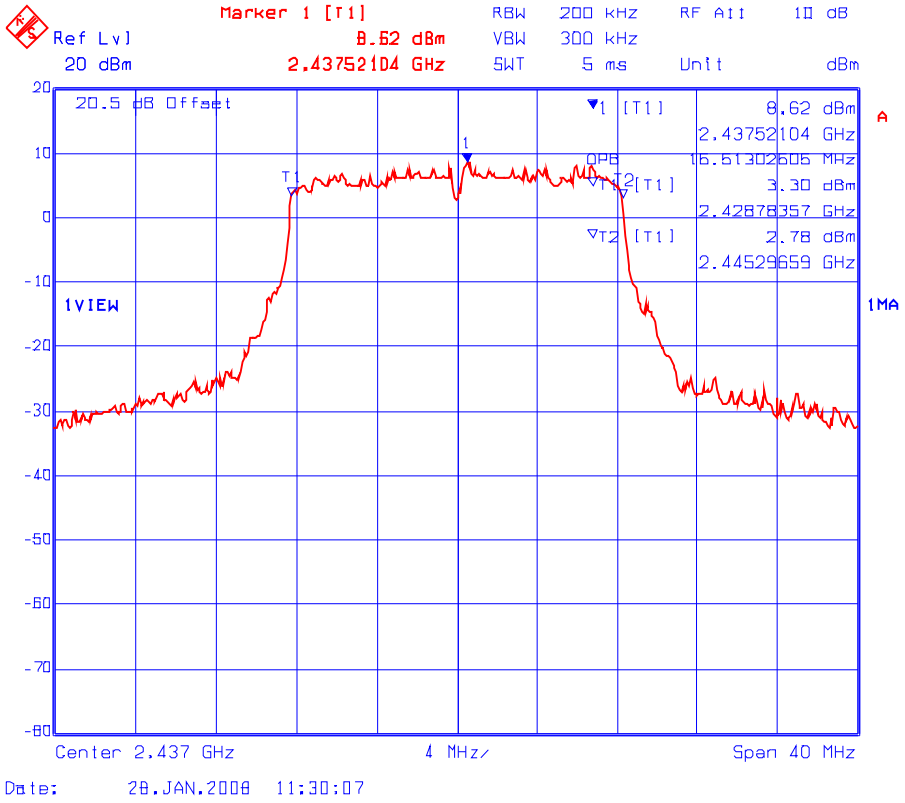
Plot 6.6.5.6 6 dB Bandwidth
Frequency: 5805 MHz; Modulation: 64-QAM at 54 Mbps



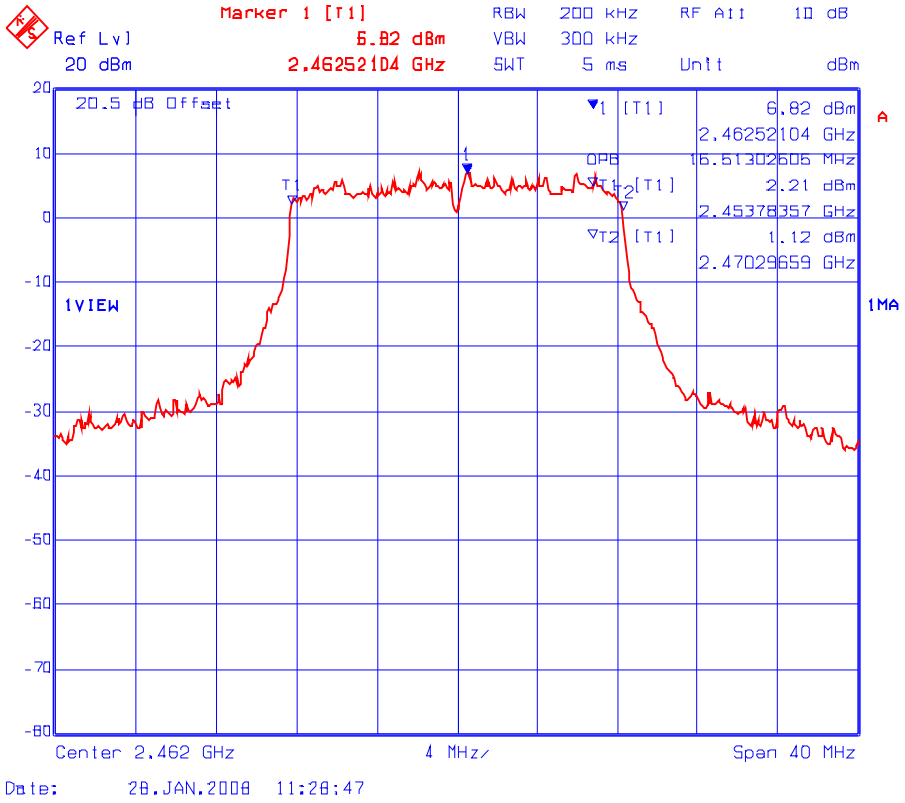
Plot 6.6.5.7 99% Occupied Bandwidth
Frequency: 2412 MHz; Modulation: 64-QAM at 54 Mbps



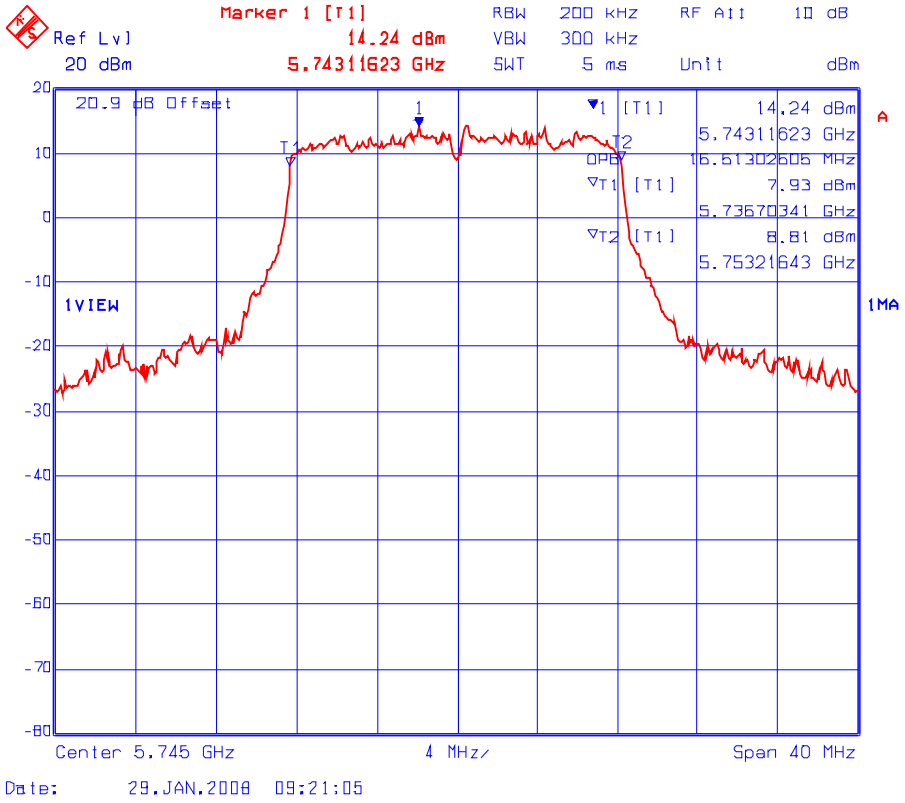
Plot 6.6.5.8 99% Occupied Bandwidth
Frequency: 2437 MHz; Modulation: 64-QAM at 54 Mbps



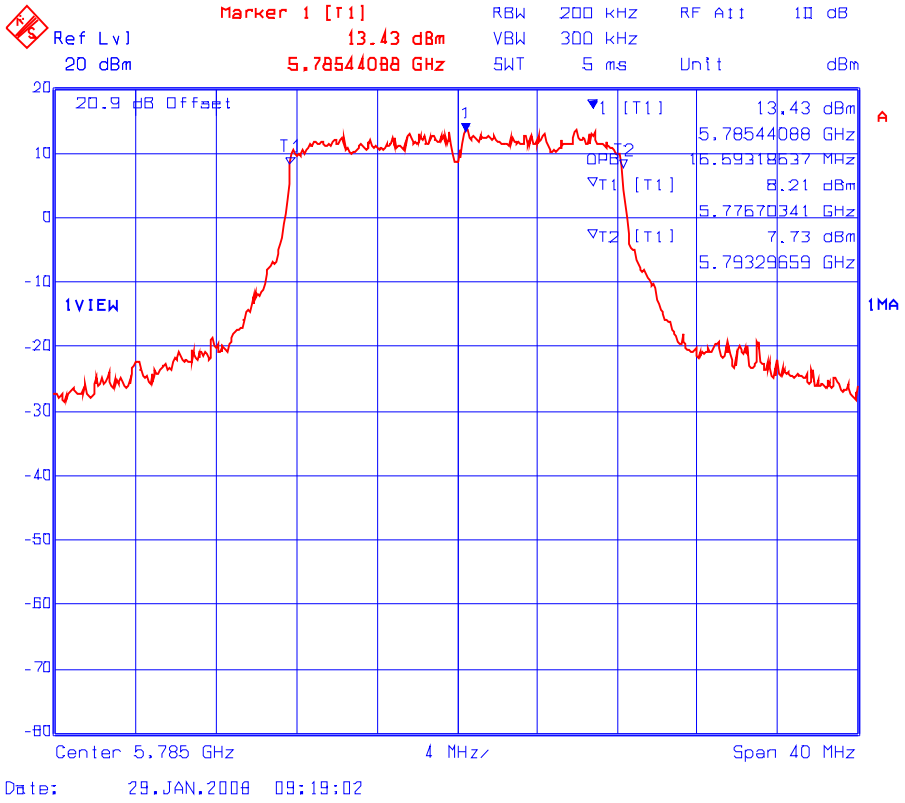
Plot 6.6.5.9 99% Occupied Bandwidth
Frequency: 2462 MHz; Modulation: 64-QAM at 54 Mbps



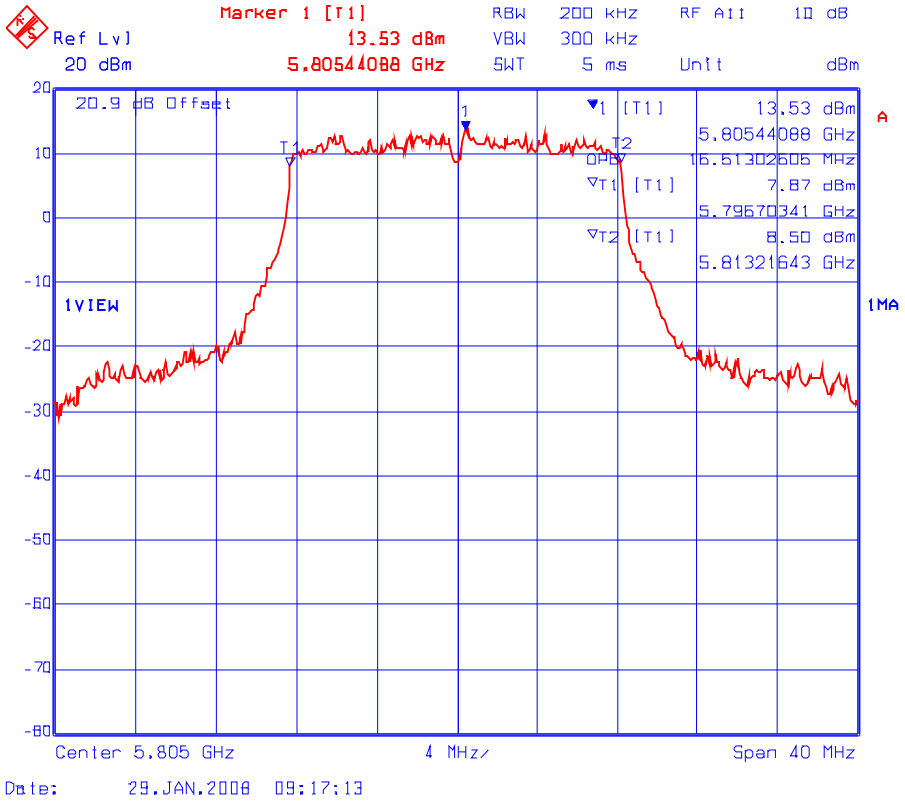
Plot 6.6.5.10 99% Occupied Bandwidth
Frequency: 5745 MHz; Modulation: 64-QAM at 54 Mbps



Plot 6.6.5.11 99% Occupied Bandwidth
Frequency: 5785 MHz; Modulation: 64-QAM at 54 Mbps



Plot 6.6.5.12 99% Occupied Bandwidth
Frequency: 5805 MHz; Modulation: 64-QAM at 54 Mbps



6.7. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

6.7.1. Limit(s)

§ 15.247(b)(3):
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

§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.

(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.

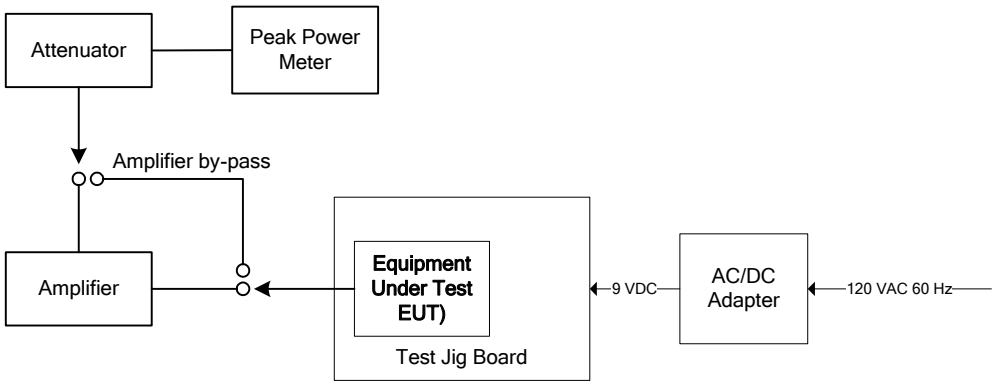
(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

6.7.2. Method of Measurements & Test Arrangement

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.7.3. Test Arrangement



6.7.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
Attenuator	Narda	4768-20	--	DC - 40 GHz
Peak Power Meter	Hewlett Packard	8900D	2131A01044	0.1 - 18 GHz
Power Sensor	Hewlett Packard	84811A	2551A01484	0.1 - 18 GHz

6.7.5. Test Data

Remarks: Test method: Power Output Option 1, peak measurement

6.7.5.1. EUT with 3 dBi Rubber Ducky Antenna (Model RT-L2R2403)

Frequency (MHz)	Data Rate (Mbits/s)	Modulation	Software Power Setting	Peak Power at Antenna Terminals (dBm)	Peak EIRP(Note 1, 2) (dBm)	Peak Conducted Power Limit (dBm)	EIRP Limit (dBm)
2412 (CH 01)	9	BPSK	47	24.62	27.62	30	36
	18	QPSK	47	24.27	27.27	30	36
	36	16-QAM	47	25.09	28.09	30	36
	54	64-QAM	47	24.78	27.78	30	36
2417 (CH 02)	9	BPSK	50	25.78	28.78	30	36
	18	QPSK	50	25.38	28.38	30	36
	36	16-QAM	50	26.15	29.15	30	36
	54	64-QAM	50	25.91	28.91	30	36
2437 (CH 06)	9	BPSK	50	26.38	29.38	30	36
	18	QPSK	50	25.52	28.52	30	36
	36	16-QAM	50	26.15	29.15	30	36
	54	64-QAM	50	26.38	29.38	30	36
2457 (CH 10)	9	BPSK	50	26.80	29.80	30	36
	18	QPSK	50	26.49	29.49	30	36
	36	16-QAM	50	26.49	29.49	30	36
	54	64-QAM	50	26.60	29.60	30	36
2462 (CH 11)	9	BPSK	46	25.38	28.38	30	36
	18	QPSK	46	24.78	27.78	30	36
	36	16-QAM	46	25.78	28.78	30	36
	54	64-QAM	46	25.24	28.24	30	36

Note 1: The Peak EIRP is calculated as the sum of Peak Conducted Power in dBm and maximum antenna gain to be used with the EUT in dBi minus antenna cable loss in dB.
Note 2: The maximum antenna gain to be used for this type of antenna with the EUT is 3 dBi

6.7.5.2. EUT with 15 dBi Panel Antenna (Model RT-WR2L245)

Frequency (MHz)	Data Rate (Mbits/s)	Modulation	Software Power Setting	Peak Power at Antenna Terminals (dBm)	Peak EIRP(Note 1, 2) (dBm)	Peak Conducted Power Limit (dBm)	EIRP Limit (dBm)
2412 (CH 01)	9	BPSK	38	20.47	35.47	30	36
	18	QPSK	38	20.01	35.01	30	36
	36	16-QAM	38	20.47	35.47	30	36
	54	64-QAM	38	20.47	35.47	30	36
2417 (CH 02)	9	BPSK	38	20.47	35.47	30	36
	18	QPSK	38	20.01	35.01	30	36
	36	16-QAM	38	20.88	35.88	30	36
	54	64-QAM	38	20.47	35.47	30	36
2422 (CH 03)	9	BPSK	36	20.01	35.01	30	36
	18	QPSK	36	18.92	33.92	30	36
	36	16-QAM	36	20.01	35.01	30	36
	54	64-QAM	36	20.01	35.01	30	36
2427 (CH 04)	9	BPSK	36	20.01	35.01	30	36
	18	QPSK	36	19.50	34.50	30	36
	36	16-QAM	36	20.01	35.01	30	36
	54	64-QAM	36	20.01	35.01	30	36
2432 (CH 05)	9	BPSK	36	20.01	35.01	30	36
	18	QPSK	36	19.50	34.50	30	36
	36	16-QAM	36	20.01	35.01	30	36
	54	64-QAM	36	20.47	35.47	30	36
2437 (CH 06)	9	BPSK	36	20.47	35.47	30	36
	18	QPSK	36	19.50	34.50	30	36
	36	16-QAM	36	20.47	35.47	30	36
	54	64-QAM	36	20.47	35.47	30	36
2442 (CH 07)	9	BPSK	36	20.47	35.47	30	36
	18	QPSK	36	19.50	34.50	30	36
	36	16-QAM	36	20.47	35.47	30	36
	54	64-QAM	36	20.47	35.47	30	36
2447 (CH 08)	9	BPSK	34	20.01	35.01	30	36
	18	QPSK	34	18.92	33.92	30	36
	36	16-QAM	34	20.01	35.01	30	36
	54	64-QAM	34	20.01	35.01	30	36
2452 (CH 09)	9	BPSK	34	20.01	35.01	30	36
	18	QPSK	34	18.92	33.92	30	36
	36	16-QAM	34	20.01	35.01	30	36
	54	64-QAM	34	20.01	35.01	30	36
2457 (CH 10)	9	BPSK	34	20.47	35.47	30	36
	18	QPSK	34	19.50	34.50	30	36
	36	16-QAM	34	20.47	35.47	30	36
	54	64-QAM	34	20.01	35.01	30	36

Frequency (MHz)	Data Rate (Mbits/s)	Modulation	Software Power Setting	Peak Power at Antenna Terminals (dBm)	Peak EIRP(Note 1, 2) (dBm)	Peak Conducted Power Limit (dBm)	EIRP (dBm)
2462 (CH 11)	9	BPSK	33	20.47	35.47	30	36
	18	QPSK	33	20.01	35.01	30	36
	36	16-QAM	33	20.47	35.47	30	36
	54	64-QAM	33	20.47	35.47	30	36

Note 1: The Peak EIRP is calculated as the sum of Peak Conducted Power in dBm and maximum antenna gain to be used with the EUT in dBi minus antenna cable loss in dB.
Note 2: The maximum antenna gain to be used for this type of antenna with the EUT is 15 dBi.

6.7.5.3. EUT with Amplifier for All 5.8 GHz Antennas (For Fixed, Point-to-Point Operation)

Frequency (MHz)	Data Rate (Mbits/s)	Modulation	Software Power Setting	Peak Power at Antenna Terminals (dBm)	Peak Conducted Power Limit (dBm)
5745 (CH 149)	9	BPSK	30	28.69	30
	18	QPSK	30	28.31	30
	36	16-QAM	30	28.31	30
	54	64-QAM	30	28.54	30
5765 (CH 153)	9	BPSK	29	29.04	30
	18	QPSK	29	28.76	30
	36	16-QAM	29	29.04	30
	54	64-QAM	29	28.76	30
5785 (CH 157)	9	BPSK	26	28.62	30
	18	QPSK	26	28.23	30
	36	16-QAM	26	28.23	30
	54	64-QAM	26	28.47	30
5805 (CH 161)	9	BPSK	24	27.99	30
	18	QPSK	24	28.47	30
	36	16-QAM	24	28.62	30
	54	64-QAM	24	28.31	30

6.7.5.4. EUT without Amplifier for All 5.8 GHz Antennas (For Fixed, Point-to-Point Operation)

Frequency (MHz)	Data Rate (Mbits/s)	Modulation	Software Power Setting	Peak Power at Antenna Terminals (dBm)	Peak Conducted Power Limit (dBm)
5745 (CH 149)	9	BPSK	45	26.47	30
	18	QPSK	45	26.10	30
	36	16-QAM	45	26.22	30
	54	64-QAM	45	26.35	30
5765 (CH 153)	9	BPSK	45	26.59	30
	18	QPSK	45	26.35	30
	36	16-QAM	45	26.35	30
	54	64-QAM	45	26.35	30
5785 (CH 157)	9	BPSK	45	26.59	30
	18	QPSK	45	26.59	30
	36	16-QAM	45	26.35	30
	54	64-QAM	45	26.47	30
5805 (CH 161)	9	BPSK	45	26.59	30
	18	QPSK	45	26.47	30
	36	16-QAM	45	26.35	30
	54	64-QAM	45	26.47	30

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

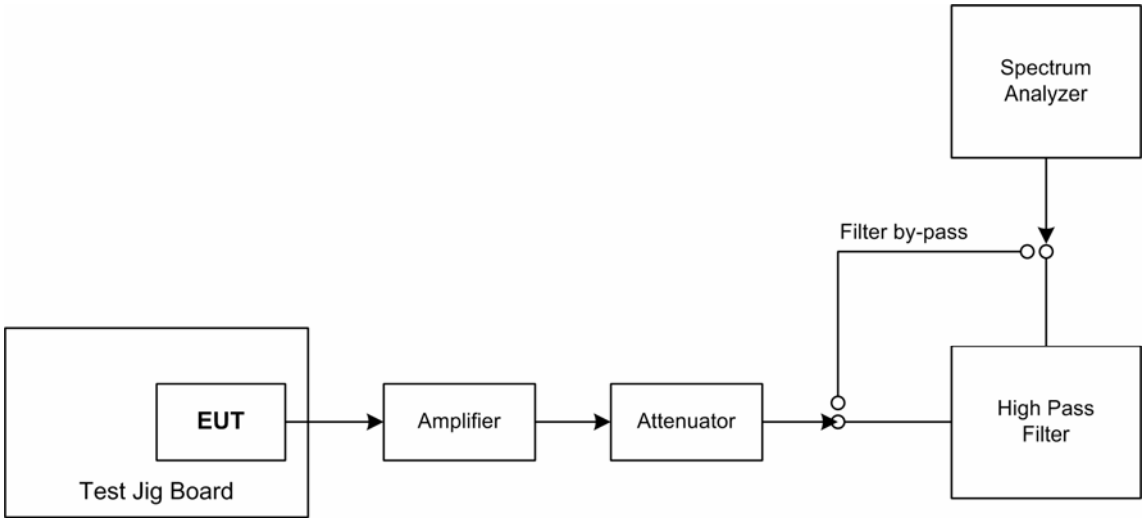
6.8.1. Limit(s)

§ 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.

6.8.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.8.3. Test Arrangement



6.8.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
Attenuator	Narda	4768-20	--	DC - 40 GHz
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 3.4 GHz
High Pass Filter	K & L	11SH10-8000/T18000	3	Cut off 7 GHz

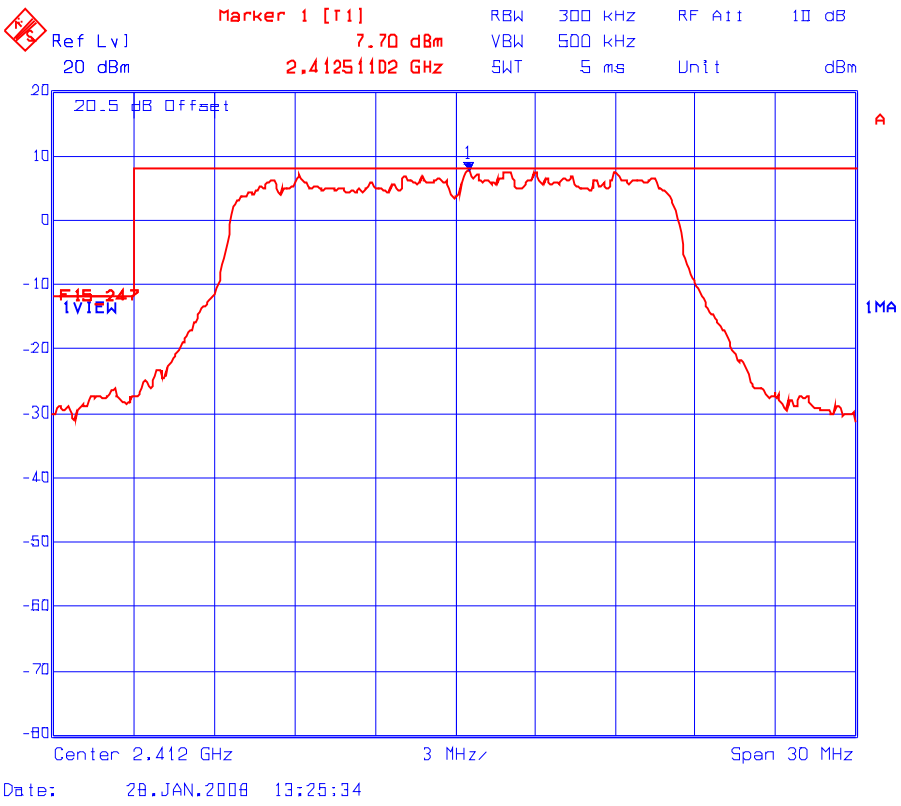
6.8.5. Test Data

Remark(s): For 5745-5805 MHz band, both settings with and without amplifier were pre-scanned, similar results were observed. Therefore, the configuration with amplifier was chosen for final tests, since the output power in this configuration was higher than setting without amplifier.

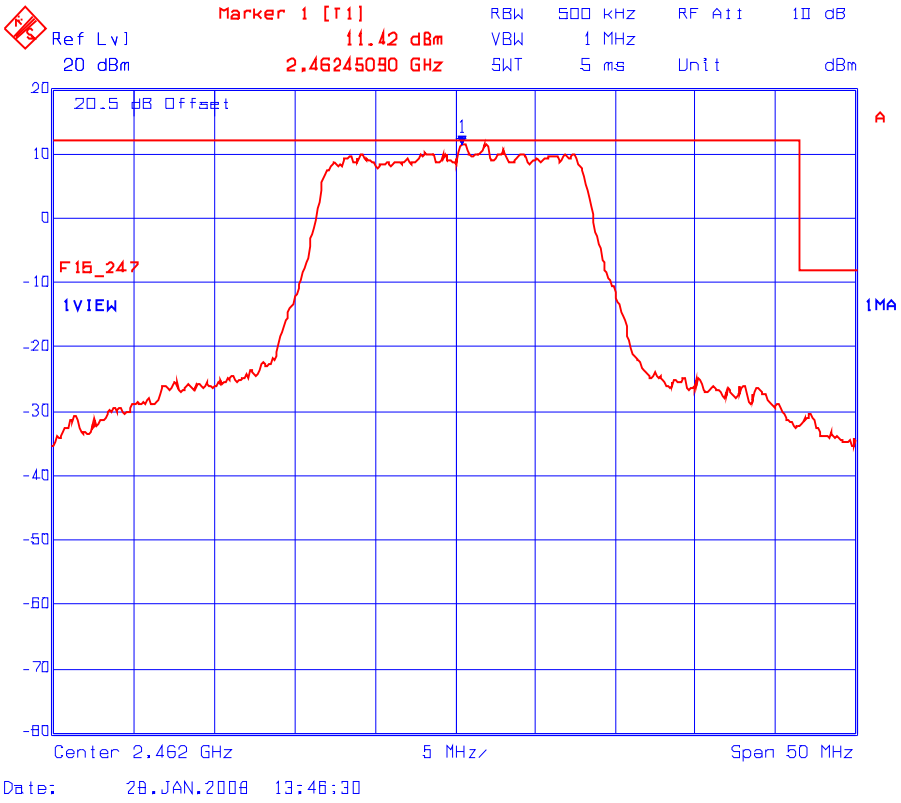
The following tests are the worst-case test configuration, with the EUT set at maximum data rate (64-QAM at 54 Mbps)

6.8.5.1. Band-Edge RF Conducted Emissions

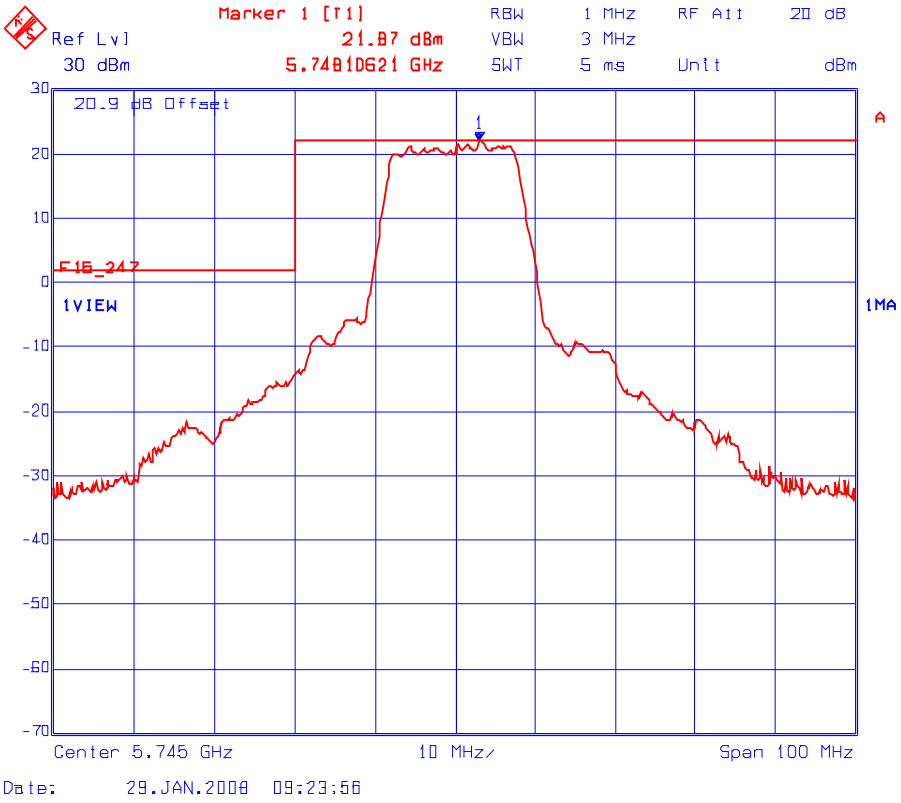
Plot 6.8.5.1.1 Band-Edge RF Conducted Emissions
Low End of Frequency Band 2412 -2462 MHz



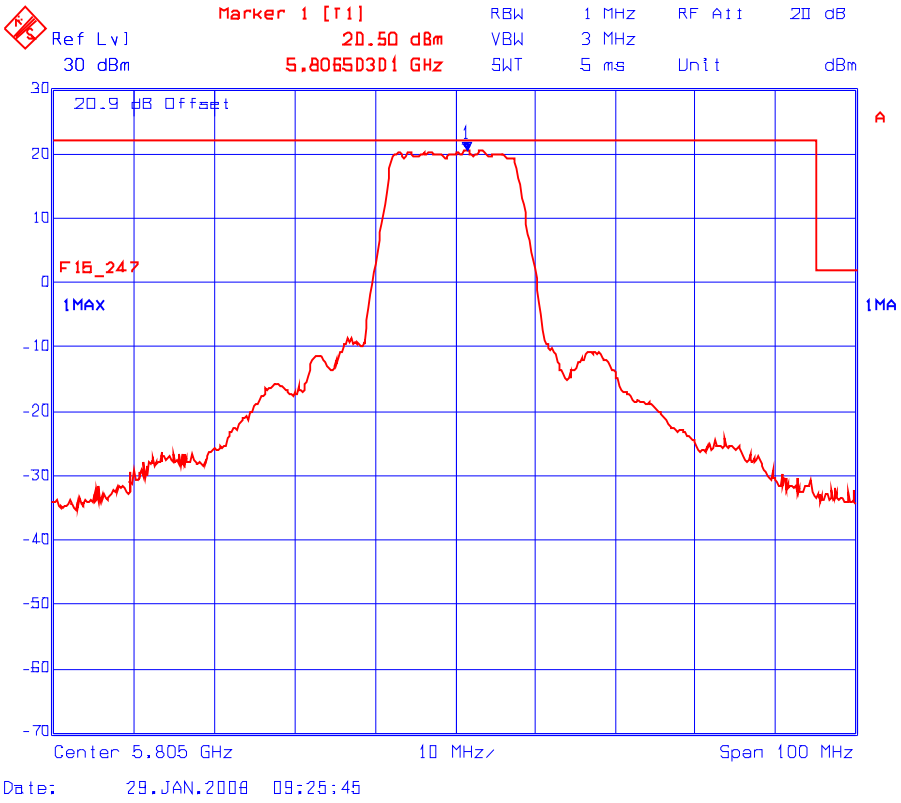
Plot 6.8.5.1.2 Band-Edge RF Conducted Emissions
High End of Frequency Band 2412 -2462 MHz



Plot 6.8.5.1.3 Band-Edge RF Conducted Emissions
Low End of Frequency Band 5745-5805 MHz

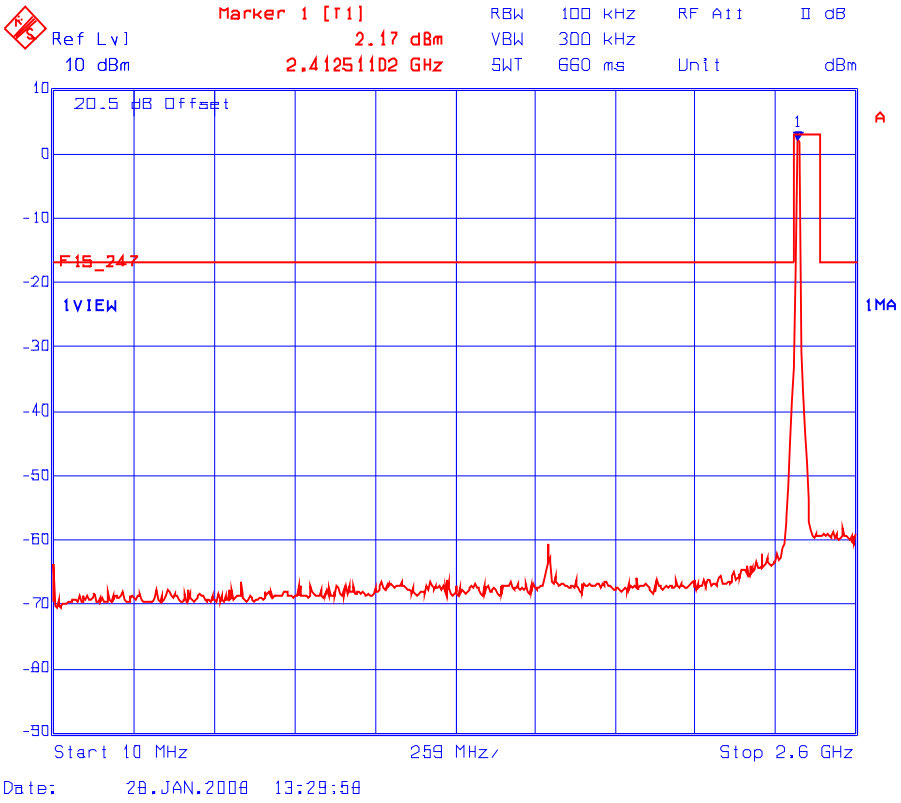


Plot 6.8.5.1.4 Band-Edge RF Conducted Emissions
High End of Frequency Band 5745-5805 MHz

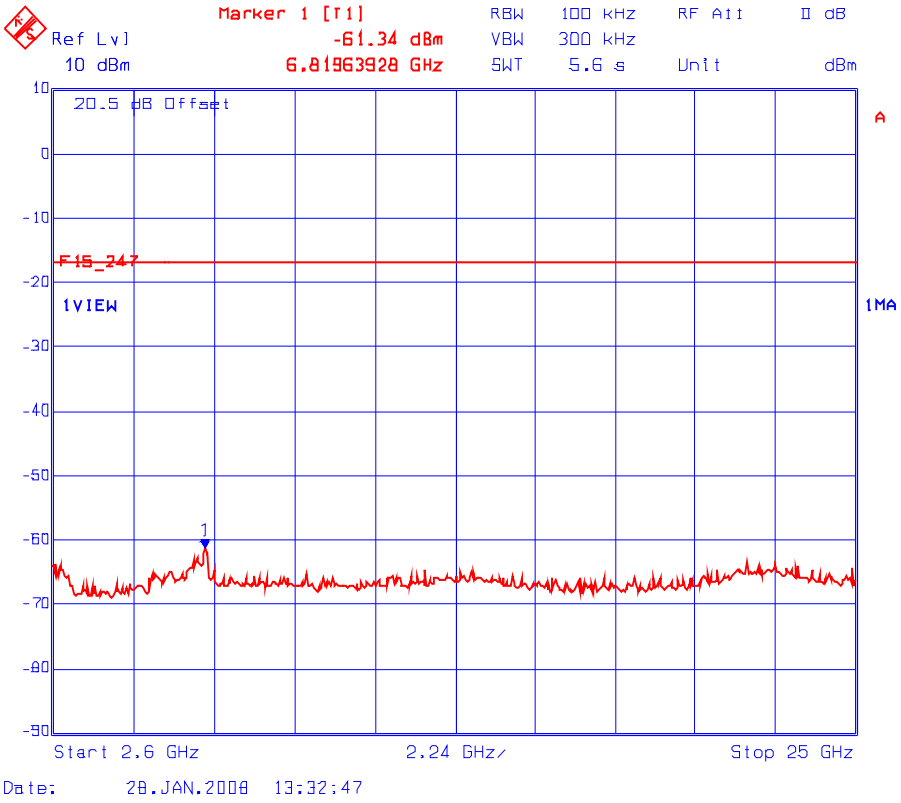


6.8.5.2. Spurious RF Conducted Emissions

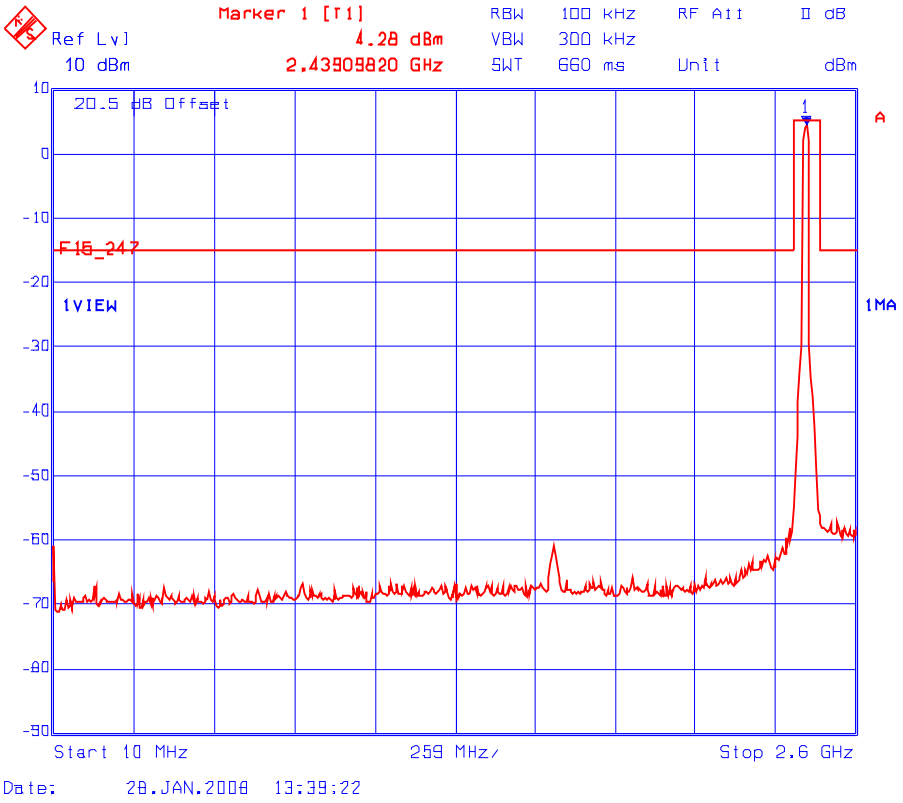
Plot 6.8.5.2.1(i) Spurious RF Conducted Emissions
Transmitter Frequency: 2412 MHz



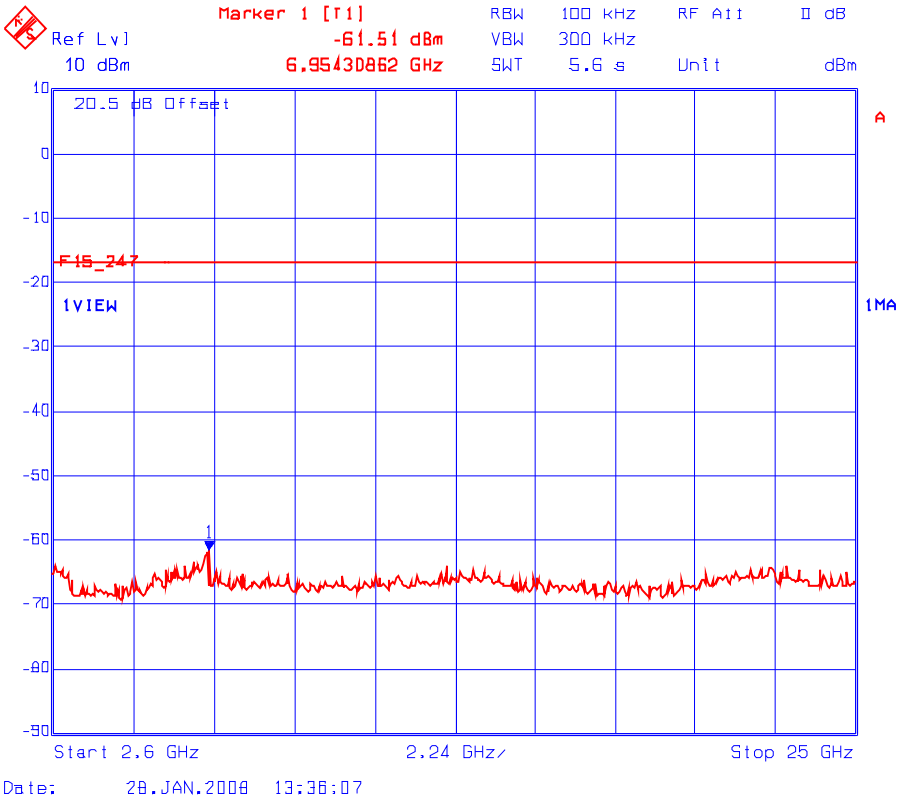
Plot 6.8.5.2.1(ii) Spurious RF Conducted Emissions
Transmitter Frequency: 2412 MHz



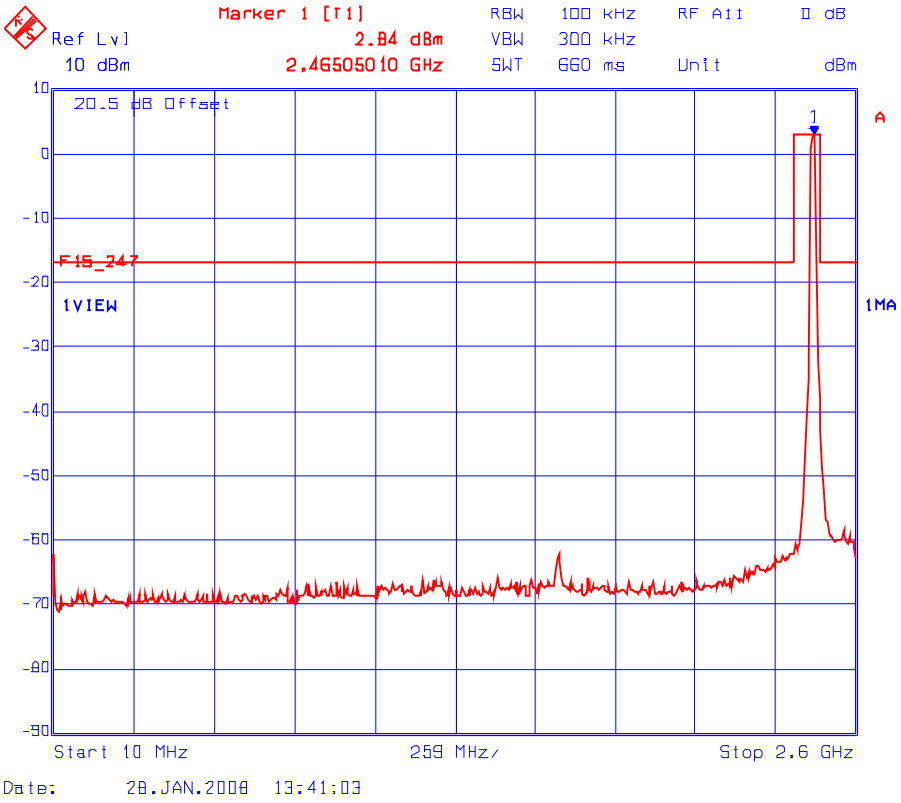
Plot 6.8.5.2.2(i) Spurious RF Conducted Emissions
Transmitter Frequency: 2437 MHz



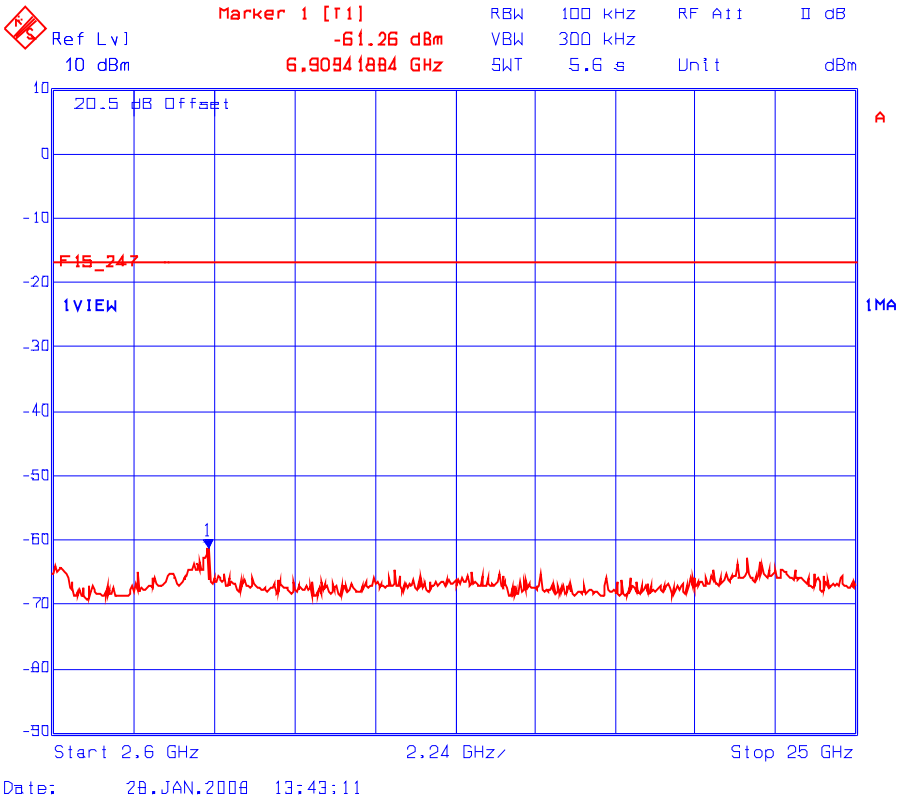
Plot 6.8.5.2.2(ii) Spurious RF Conducted Emissions
Transmitter Frequency: 2437 MHz



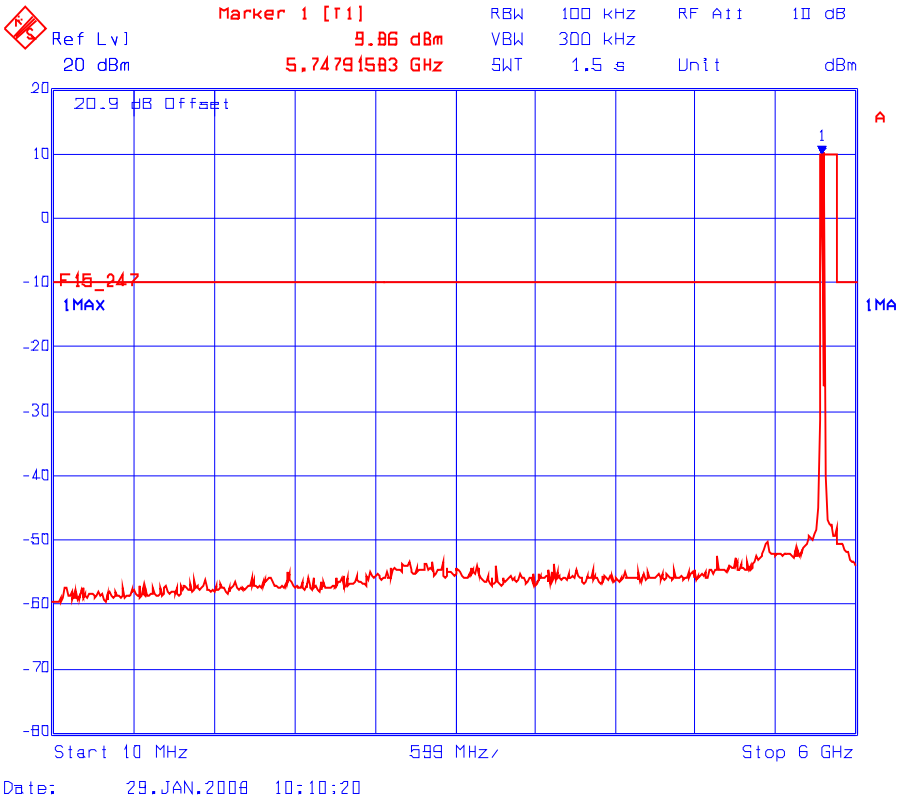
Plot 6.8.5.2.3(i) Spurious RF Conducted Emissions
Transmitter Frequency: 2462 MHz



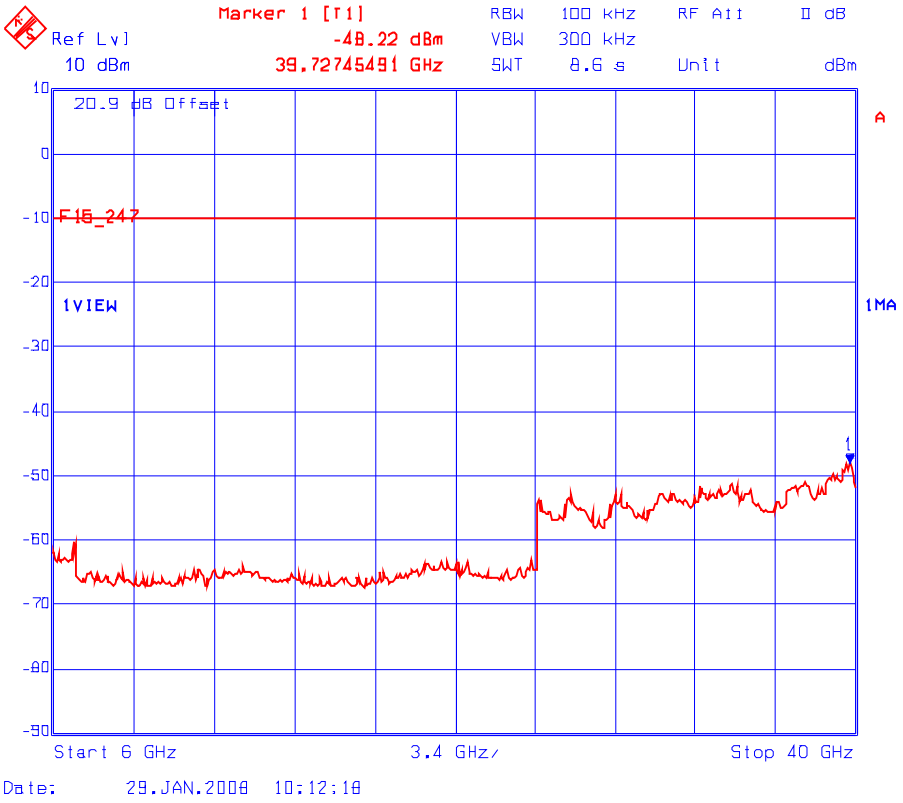
Plot 6.8.5.2.3(ii) Spurious RF Conducted Emissions
Transmitter Frequency: 2462 MHz



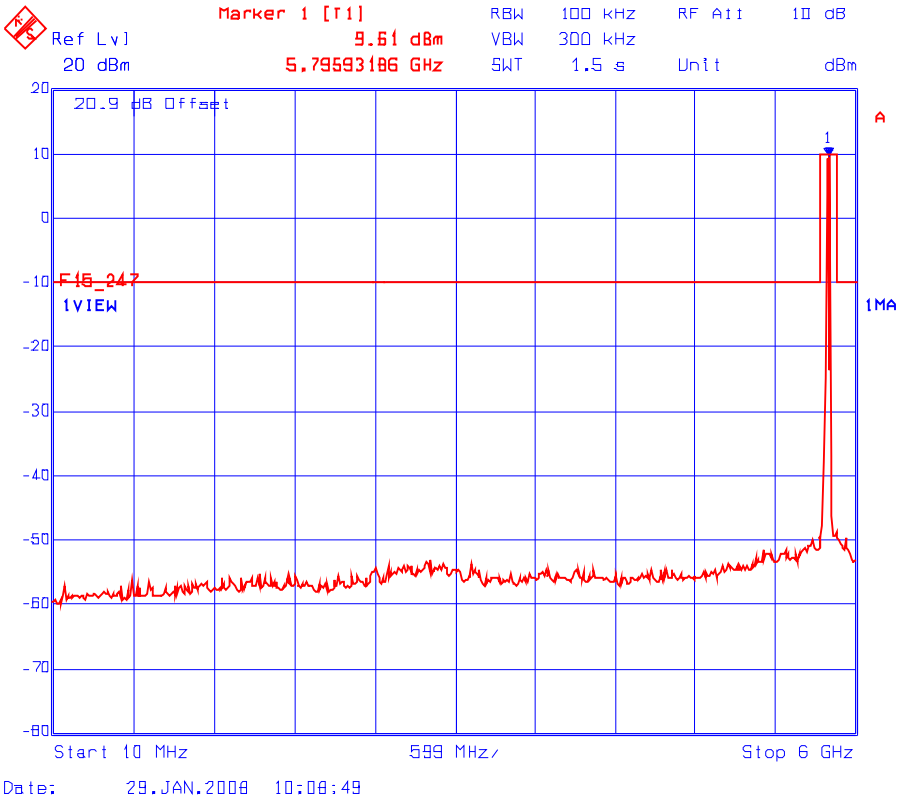
Plot 6.8.5.2.4(i) Spurious RF Conducted Emissions
Transmitter Frequency: 5745 MHz



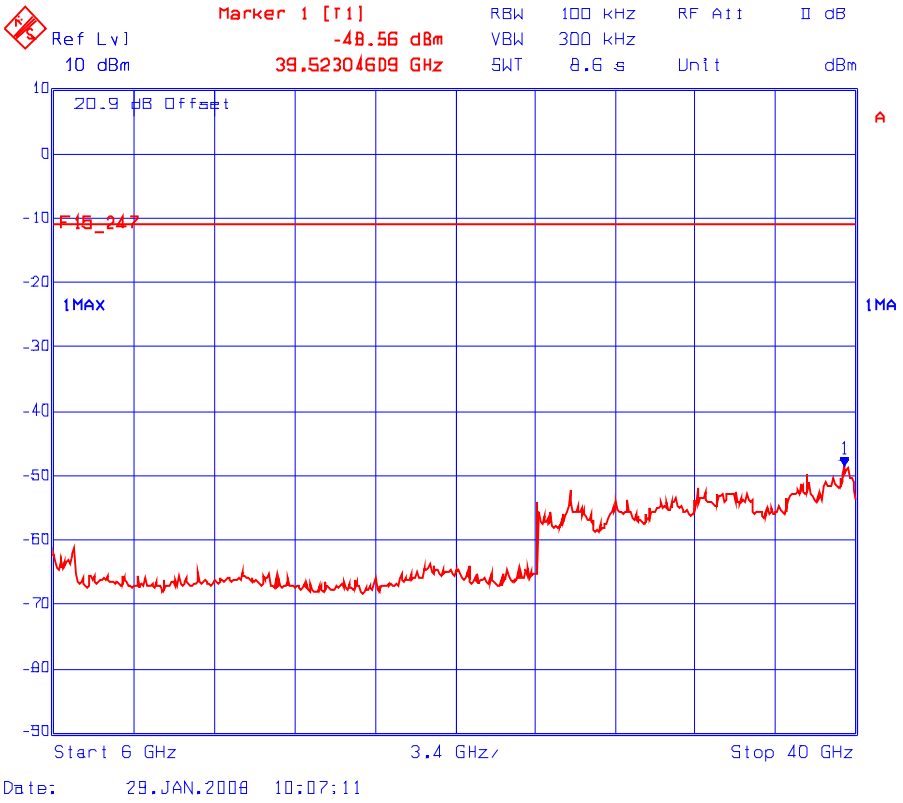
Plot 6.8.5.2.4(ii) Spurious RF Conducted Emissions
Transmitter Frequency: 5745 MHz



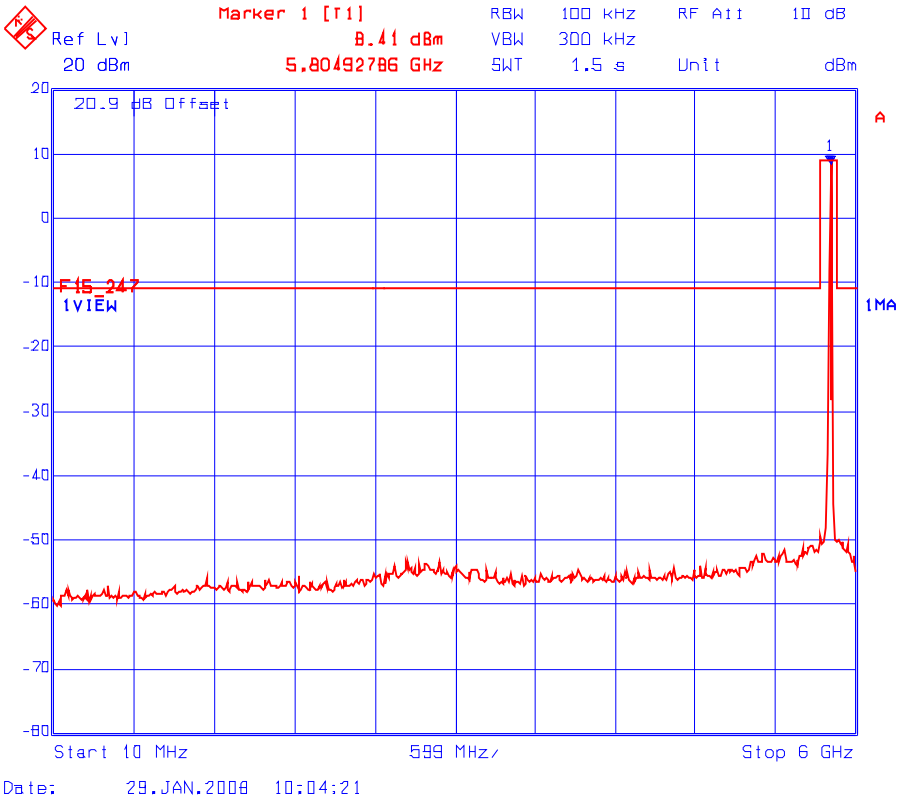
Plot 6.8.5.2.5(i) Spurious RF Conducted Emissions
Transmitter Frequency: 5785 MHz



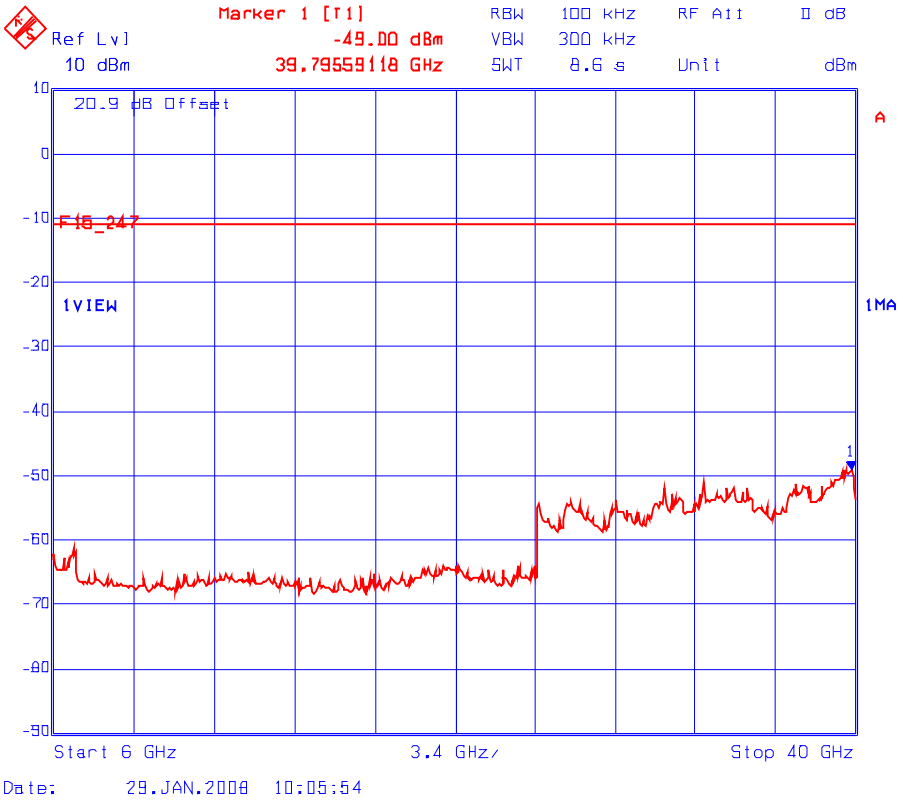
Plot 6.8.5.2.5(ii) Spurious RF Conducted Emissions
Transmitter Frequency: 5785 MHz



Plot 6.8.5.2.6(i) Spurious RF Conducted Emissions
Transmitter Frequency: 5805 MHz



Plot 6.8.5.2.6(ii) Spurious RF Conducted Emissions
Transmitter Frequency: 5805 MHz



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

6.9.1. Limit(s)

§ 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 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

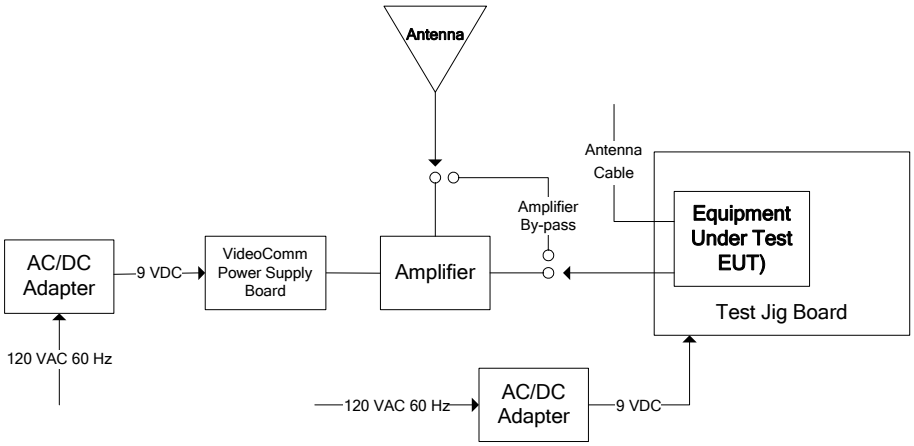
Section 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

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

6.9.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.9.3. Test Arrangement



6.9.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
RF Amplifier	Hewlett Packard	8447F	2944A04098	0.1 - 1300 MHz
RF Amplifier	Hewlett Packard	8449B	3008A00769	1 – 26.5 GHz
Biconilog antenna	EMCO	3142C	34792	26 - 3000 MHz
Horn Antenna	EMCO	3155	6570	1 – 18 GHz
Horn Antenna	EMCO	3160-09	1007	18 – 26.5 GHz
Horn Antenna	EMCO	3160-10	1001	26.5 – 40 GHz

6.9.5. Test Data

Remarks:

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT is tested in three orthogonal positions.
- For 5745-5805 MHz band, both settings with and without amplifier were pre-scanned, similar results were observed. Therefore, the configuration with amplifier was chosen for final tests, since the output power in this configuration was higher than setting without amplifier.
- The following tests are the worst-case test configuration, with the EUT set at maximum data rate (64-QAM at 54 Mbps)

6.9.5.1. EUT with 3 dBi Rubber Ducky Antenna (Model RT-L2R2403)

Fundamental Frequency:	2412 MHz
Software Power Setting:	47
Test Frequency 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
2412	111.07	--	V	--	--	--	--
2412	113.24	--	H	--	--	--	--
4824	52.56	39.05	V	54.0	93.2	-15.0	Pass*
4824	55.37	43.17	H	54.0	93.2	-10.8	Pass*

* Emission within the restricted frequency bands.

Fundamental Frequency:	2437 MHz
Software Power Setting:	50
Test Frequency 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
2437	114.16	--	V	--	--	--	--
2437	113.74	--	H	--	--	--	--
4874	59.21	46.77	V	54.0	94.2	-7.2	Pass*
4874	54.97	41.52	H	54.0	94.2	-12.5	Pass*
7311	49.75	37.07	V	54.0	94.2	-16.9	Pass*

* Emission within the restricted frequency bands.

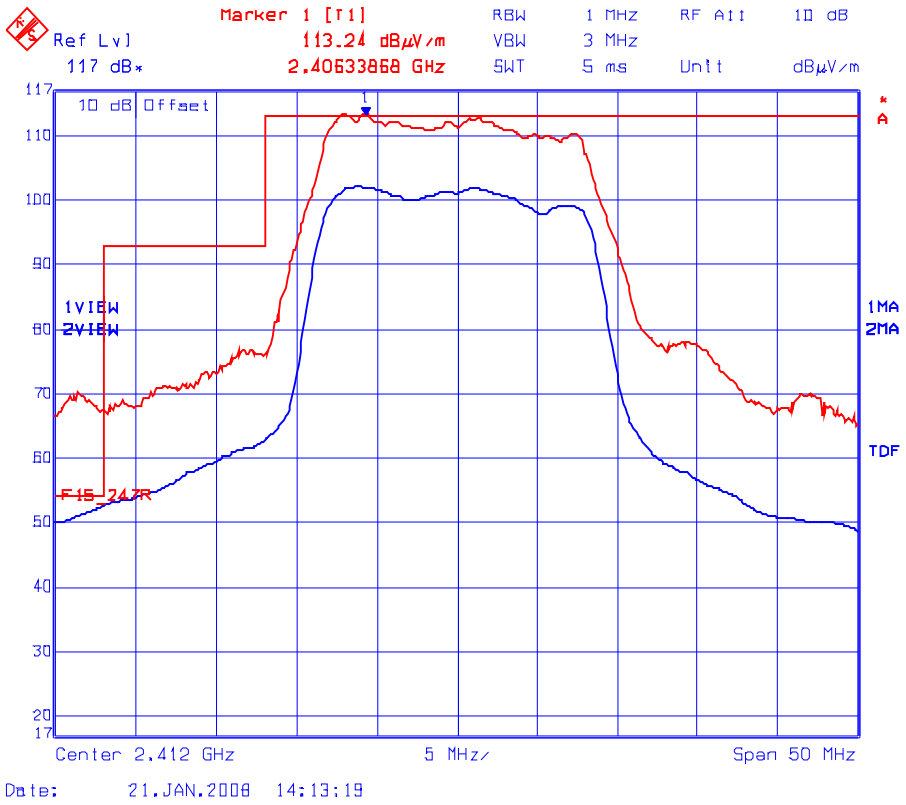
Fundamental Frequency:	2462 MHz
Software Power Setting:	46
Test Frequency Range:	30 MHz – 25 GHz

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
2462	113.53	--	V	--	--	--	--
2462	112.68	--	H	--	--	--	--
4924	56.06	42.59	V	54.0	93.5	-11.4	Pass*
4924	57.52	43.88	H	54.0	93.5	-10.1	Pass*
7386	55.00	40.79	V	54.0	93.5	-13.2	Pass*
7386	53.35	39.85	H	54.0	93.5	-14.2	Pass*

* Emission within the restricted frequency bands.

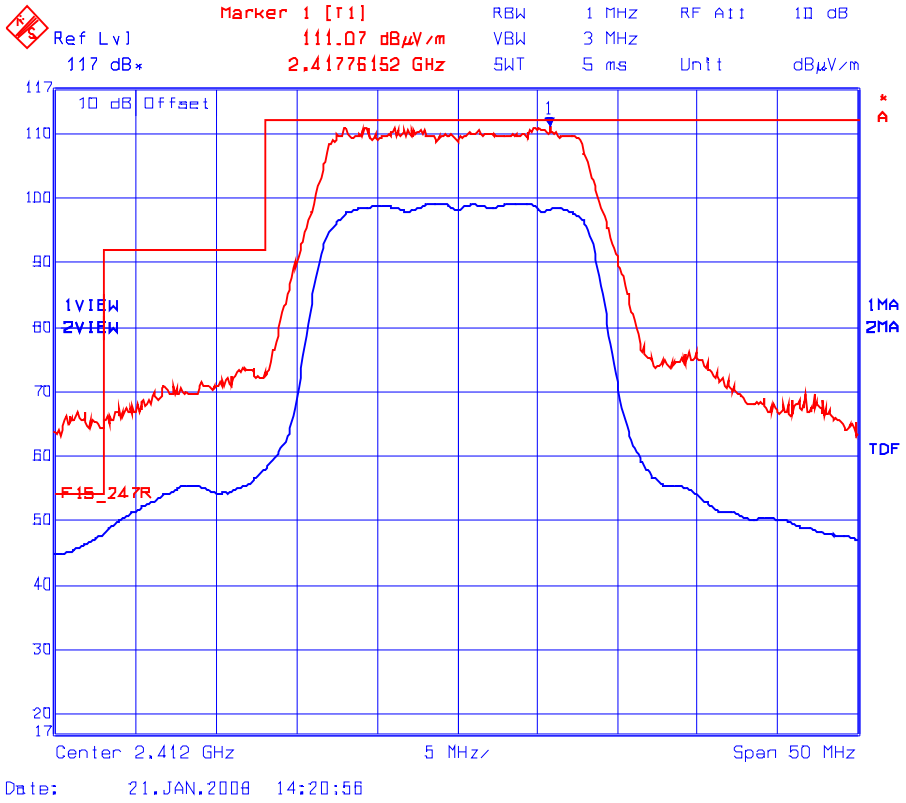
See the following test data plots for band-edge emissions.

Plot 6.9.5.1.1 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2412 MHz; Software Power Setting: 47
Rx Antenna Orientation: Horizontal



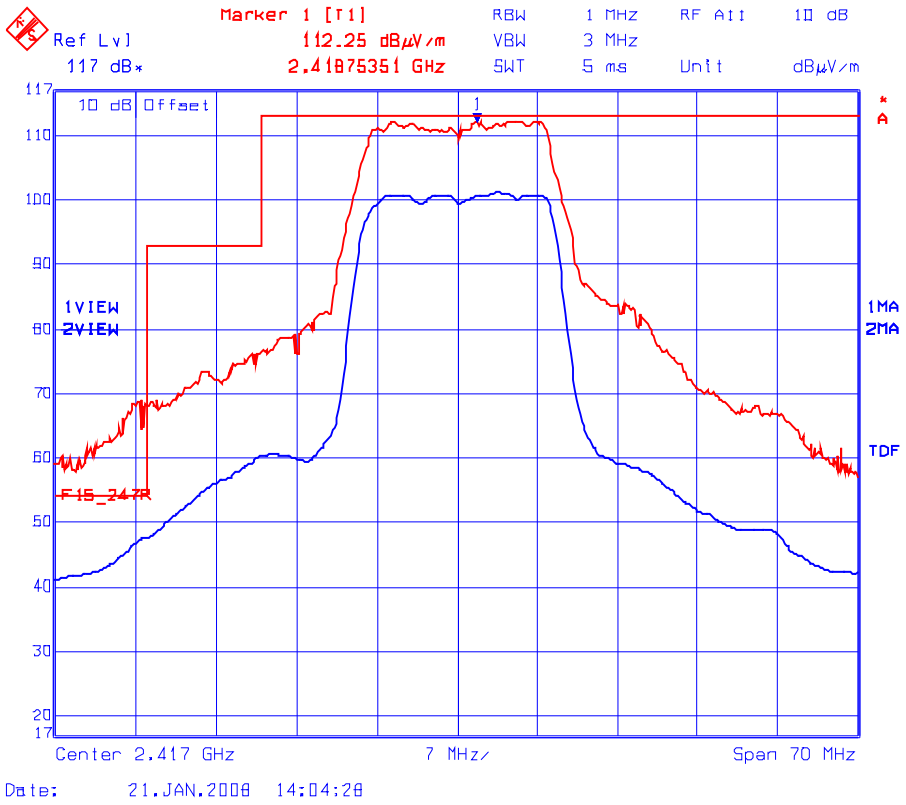
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.1.2 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2412 MHz; Software Power Setting: 47
Rx Antenna Orientation: Vertical



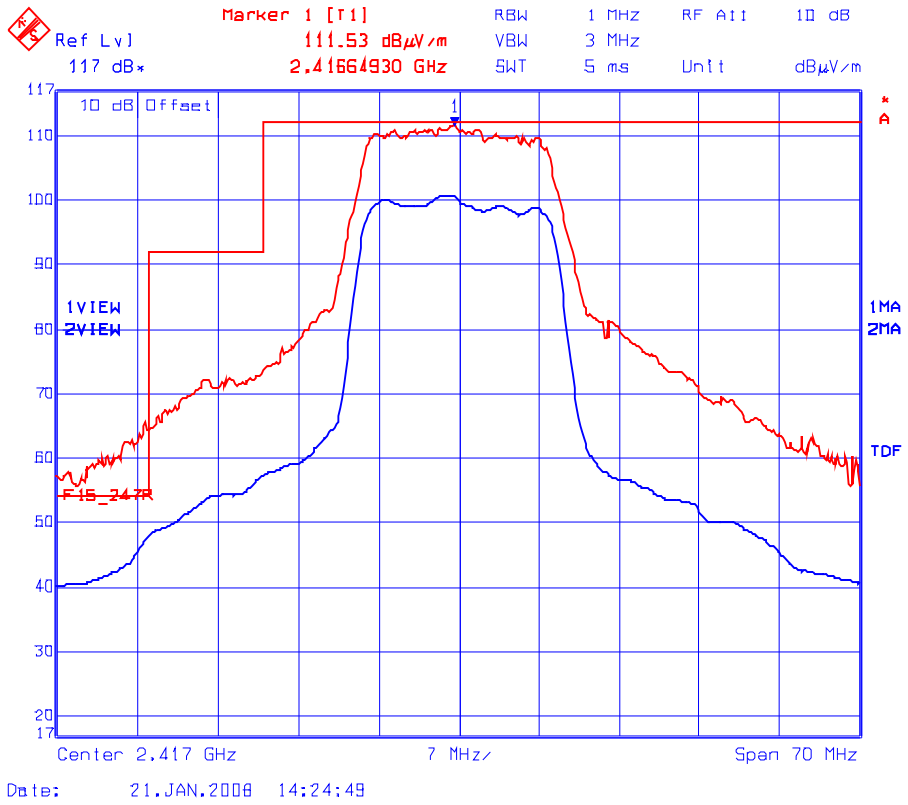
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.1.3 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2417 MHz: Software Power Setting: 50
Rx Antenna Orientation: Horizontal



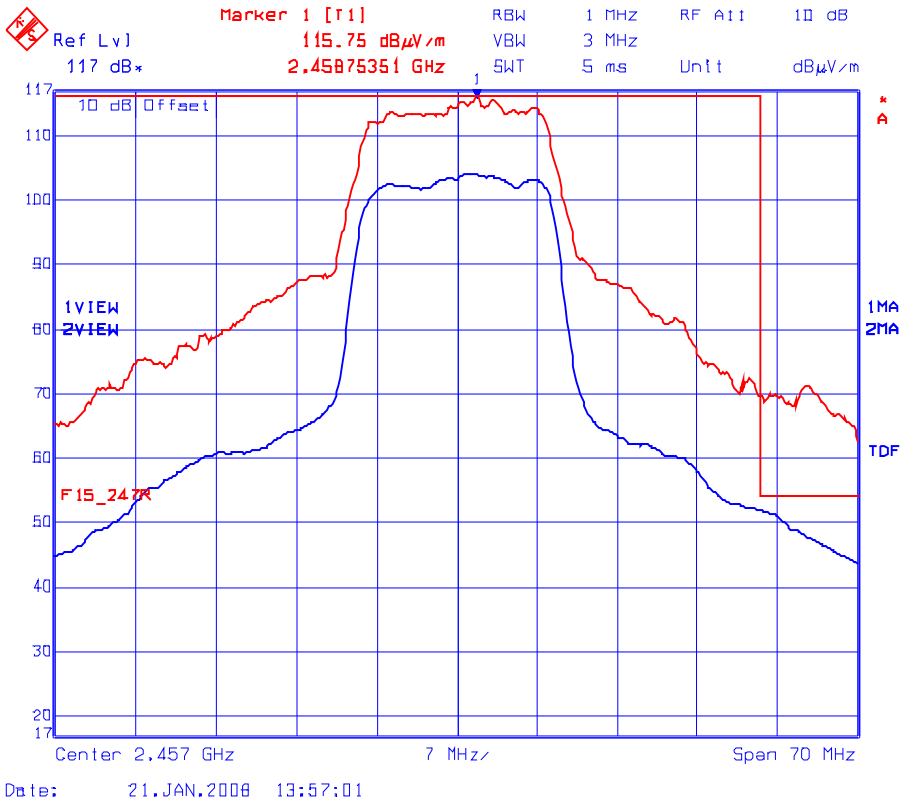
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.1.4 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2417 MHz; Software Power Setting: 50
Rx Antenna Orientation: Vertical



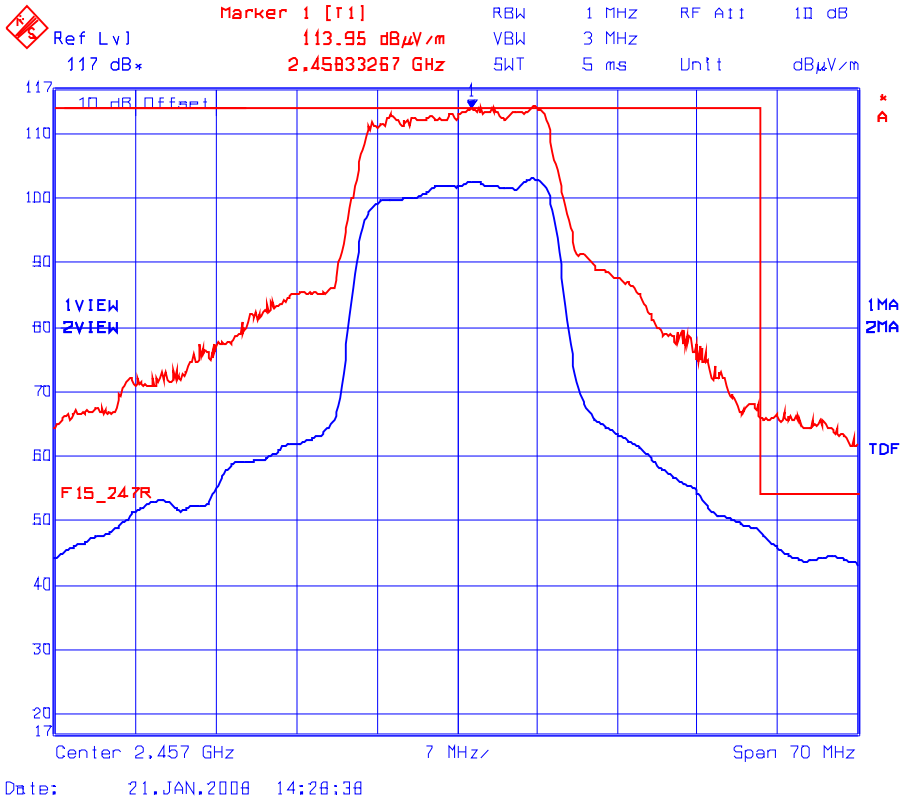
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.1.5 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2457 MHz, Software Power Setting: 50
Rx Antenna Orientation: Horizontal



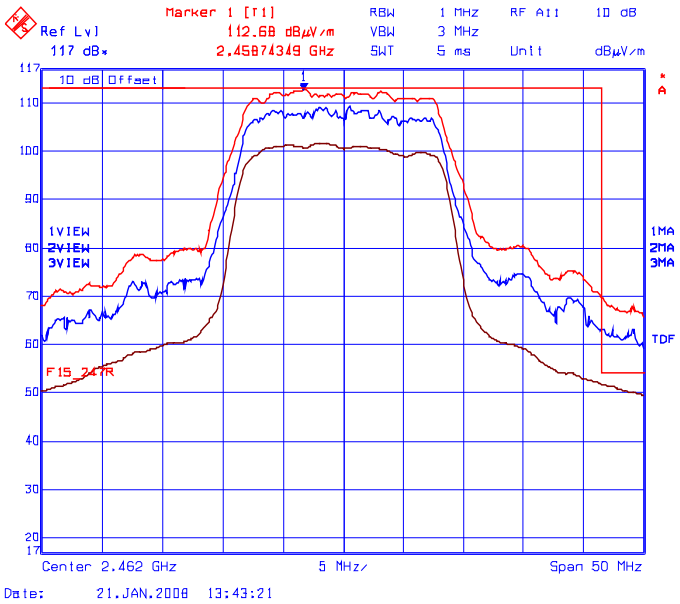
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.1.6 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2457 MHz; Software Power Setting: 50
Rx Antenna Orientation: Vertical

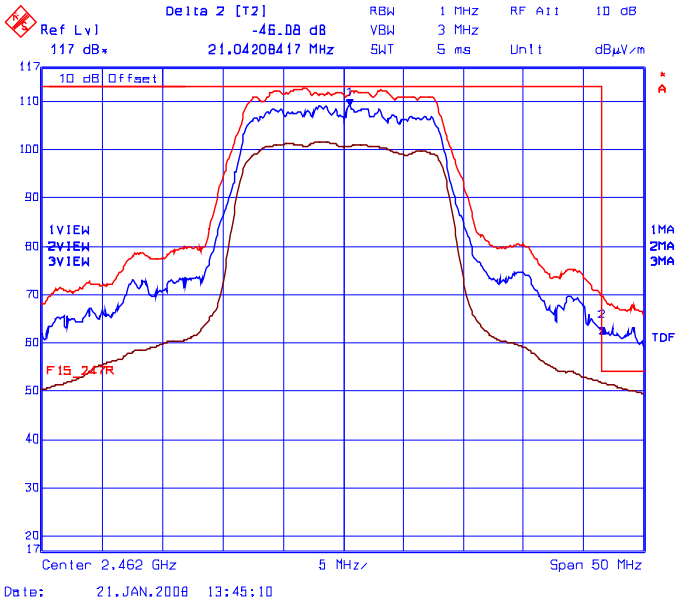


Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.1.7(i) Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz; Software Power Setting: 46
Rx Antenna Orientation: Horizontal

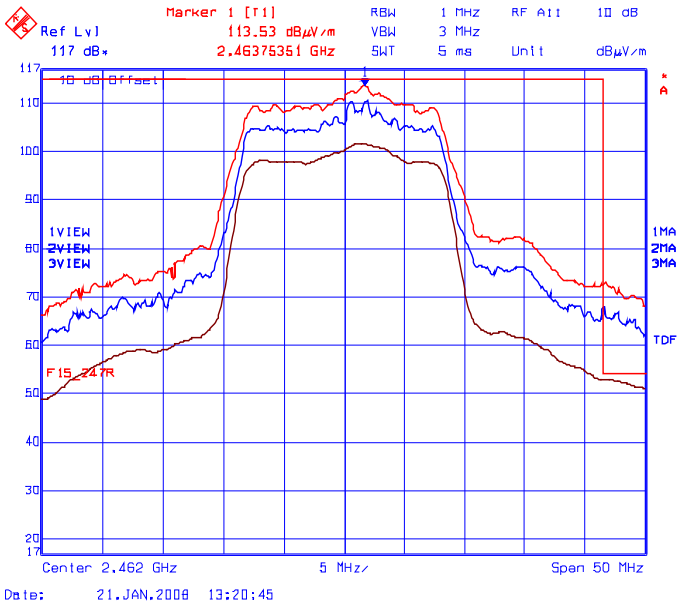


Plot 6.9.5.1.7(ii) Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz; Software Power Setting: 46
Rx Antenna Orientation: Horizontal

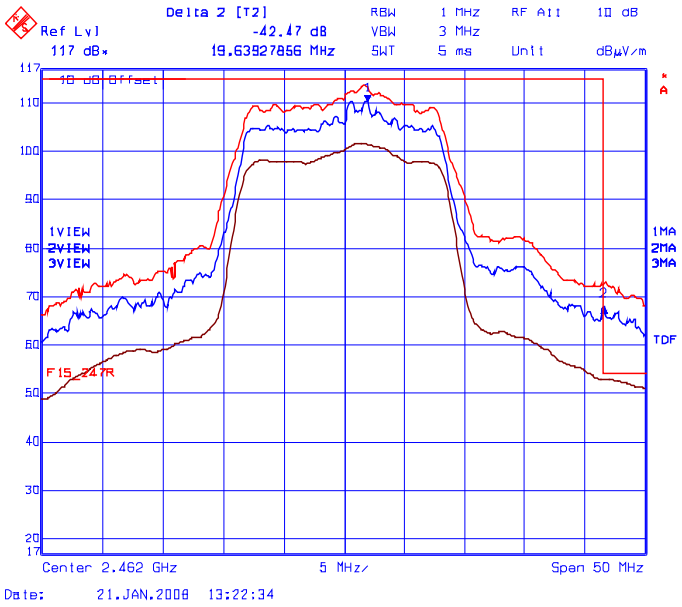


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 500 kHz, VBW = 1 MHz, Delta (Peak to Band-Edge): 46.08 dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 112.68dBuV/m – 46.08dB = 66.60 dBµV/m (limit 74dBµV/m)

Plot 6.9.5.1.8(i) Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz; Software Power Setting: 46
Rx Antenna Orientation: Vertical



Plot 6.9.5.1.8(ii) Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz; Software Power Setting: 46
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): 42.47dB
Trace 3: RBW = 1 MHz, VBW = 10 Hz
Peak Band-Edge at 2483.5 MHz: Peak = 113.53 dBµV/m – 42.47dB = 71.06 dBµV/m (limit 74 dBµV/m)

6.9.5.2. EUT with 15 dBi Panel Antenna (Model RT-WR2L245)

Fundamental Frequency:	2412 MHz
Software Power Setting:	38
Test Frequency 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
2412	114.80	--	V	--	--	--	--
2412	113.73	--	H	--	--	--	--

All spurious emissions are more than 20 dB below the specified limit

Fundamental Frequency:	2437 MHz
Software Power Setting:	36
Test Frequency 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
2437	118.34	--	V	--	--	--	--
2437	118.89	--	H	--	--	--	--

All spurious emissions are more than 20 dB below the specified limit

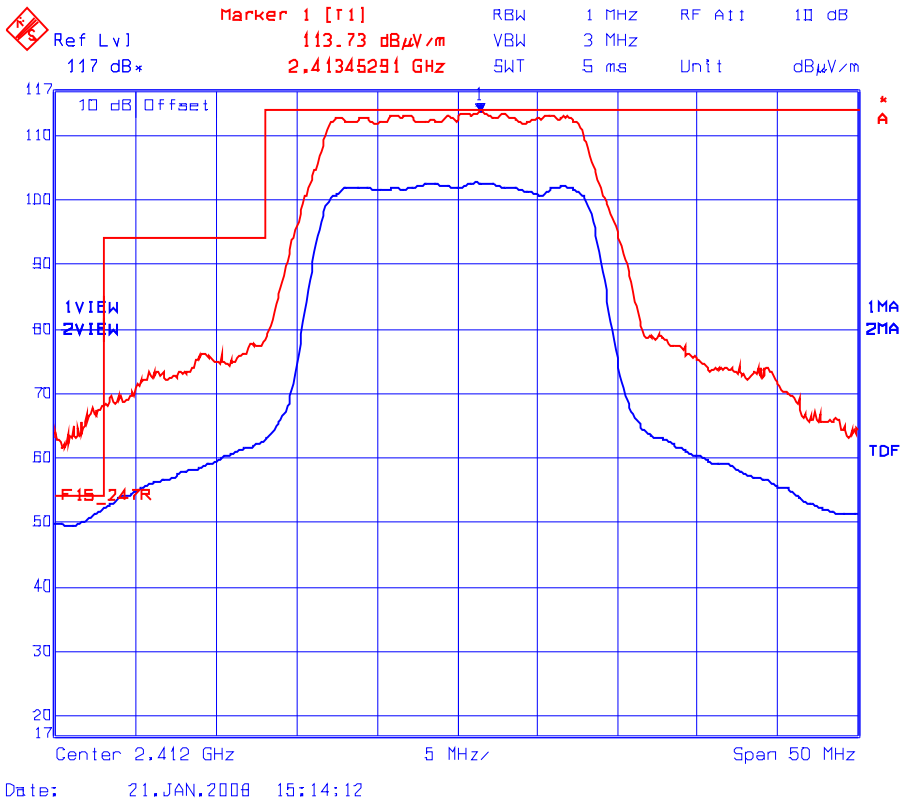
Fundamental Frequency:	2462 MHz
Software Power Setting:	33
Test Frequency Range:	30 MHz – 25 GHz

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
2462	114.22	--	V	--	--	--	--
2462	115.27	--	H	--	--	--	--

All spurious emissions are more than 20 dB below the specified limit

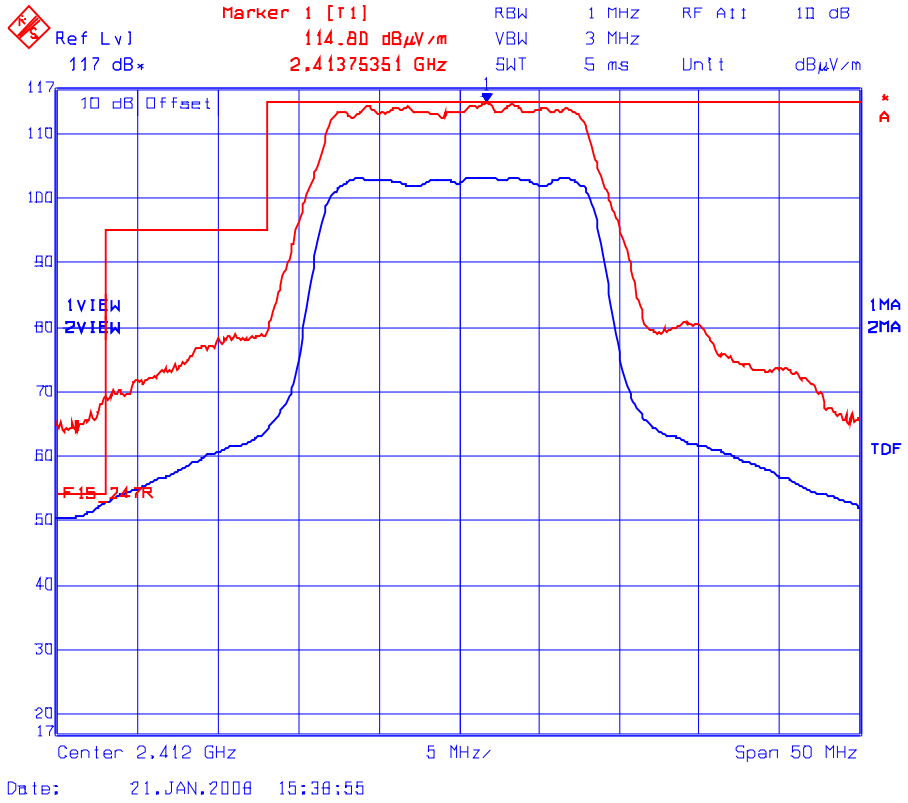
See the following test data plots for band-edge emissions.

Plot 6.9.5.2.1 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band, Test Frequency: 2412 MHz; Software Power Setting: 38
Rx Antenna Orientation: Horizontal



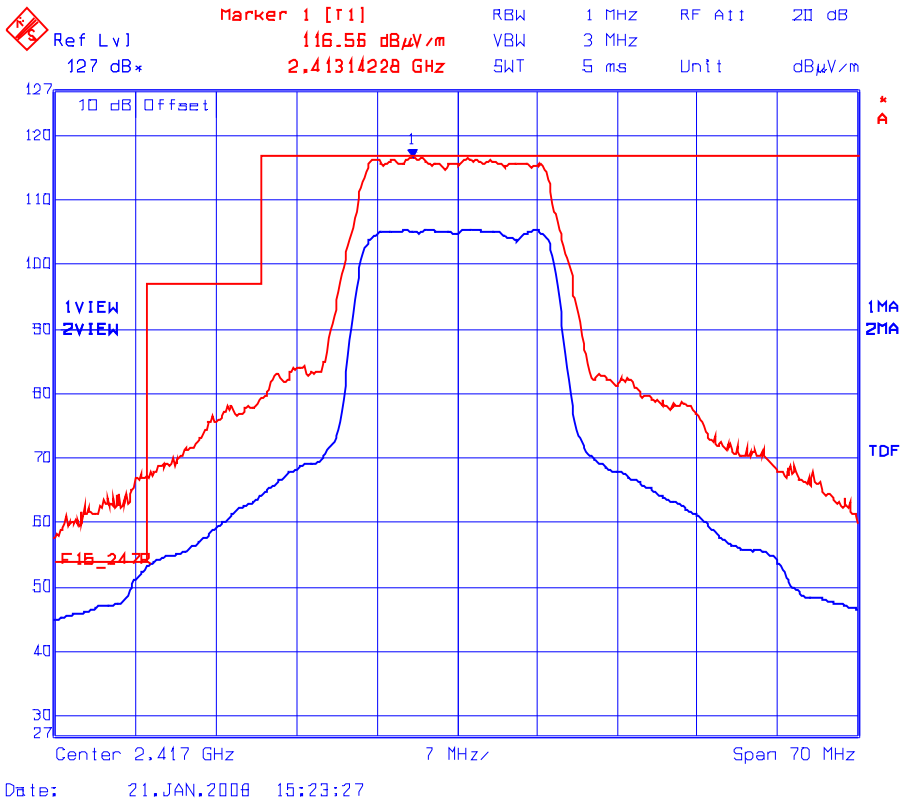
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.2.2 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band, Test Frequency: 2412 MHz; Software Power Setting: 38
Rx Antenna Orientation: Vertical



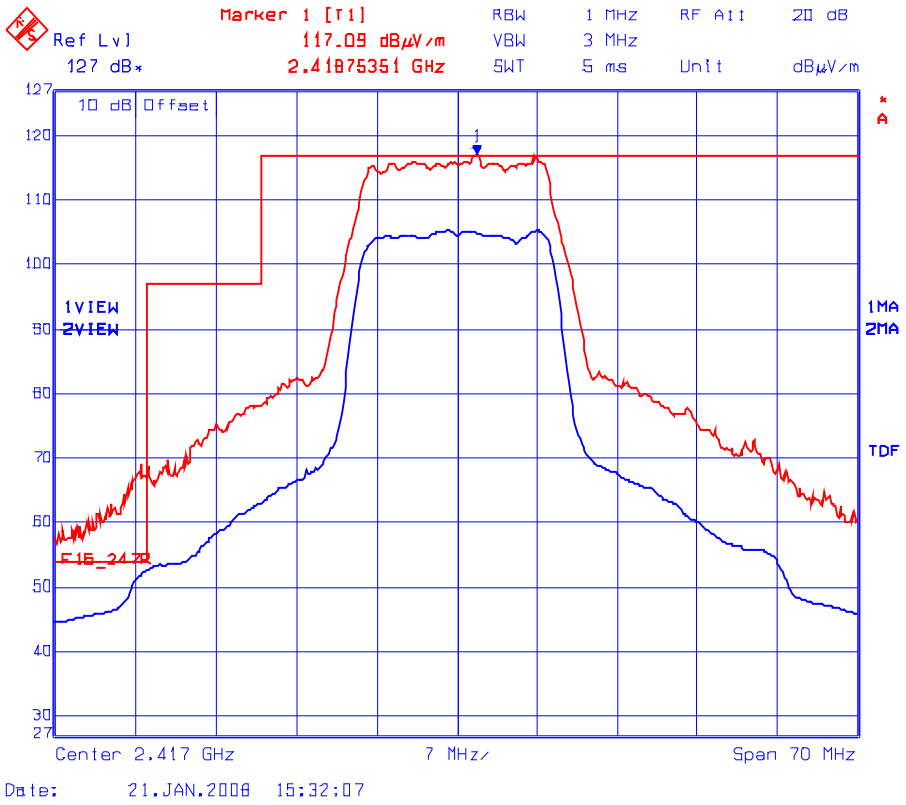
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.2.3 Band-Edge RF Radiated Emissions @ 3
Low End of Frequency Band; Test Frequency: 2417; Software Power Setting: 38
Rx Antenna Orientation: Horizontal



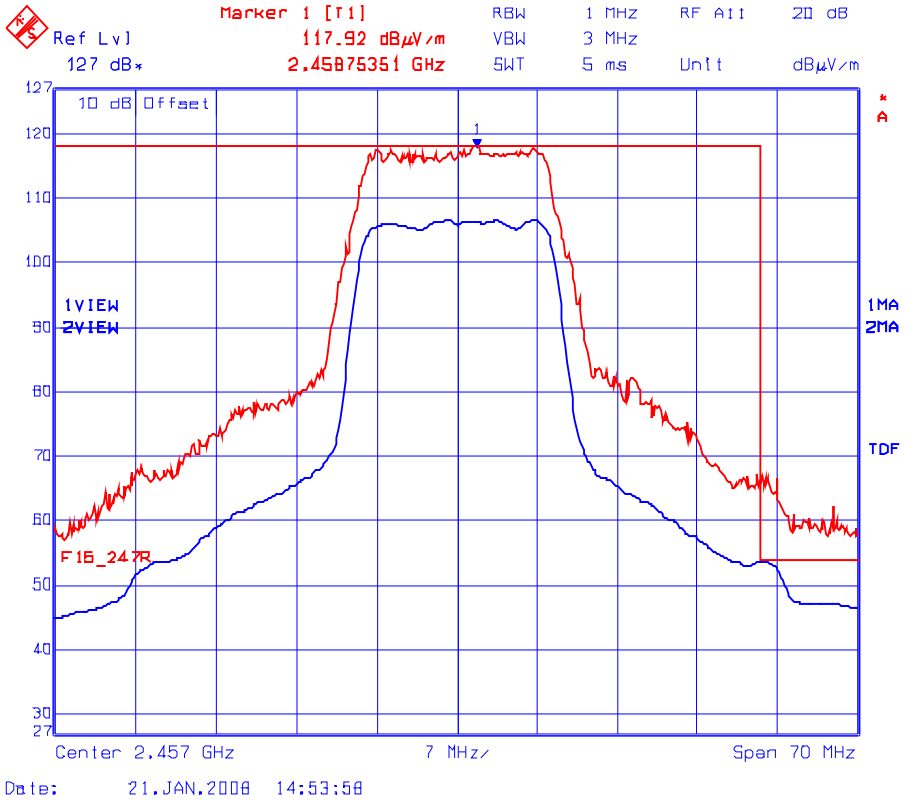
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.2.4 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2417; Software Power Setting: 38
Rx Antenna Orientation: Vertical



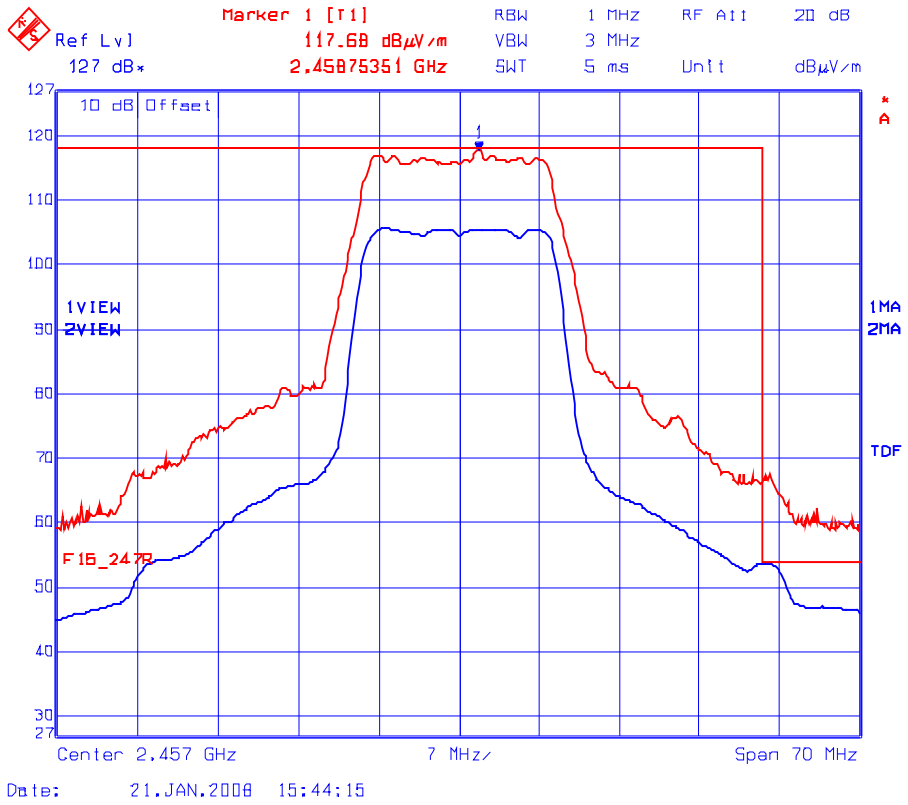
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.2.5 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2457 MHz; Software Power Setting: 34
Rx Antenna Orientation: Horizontal



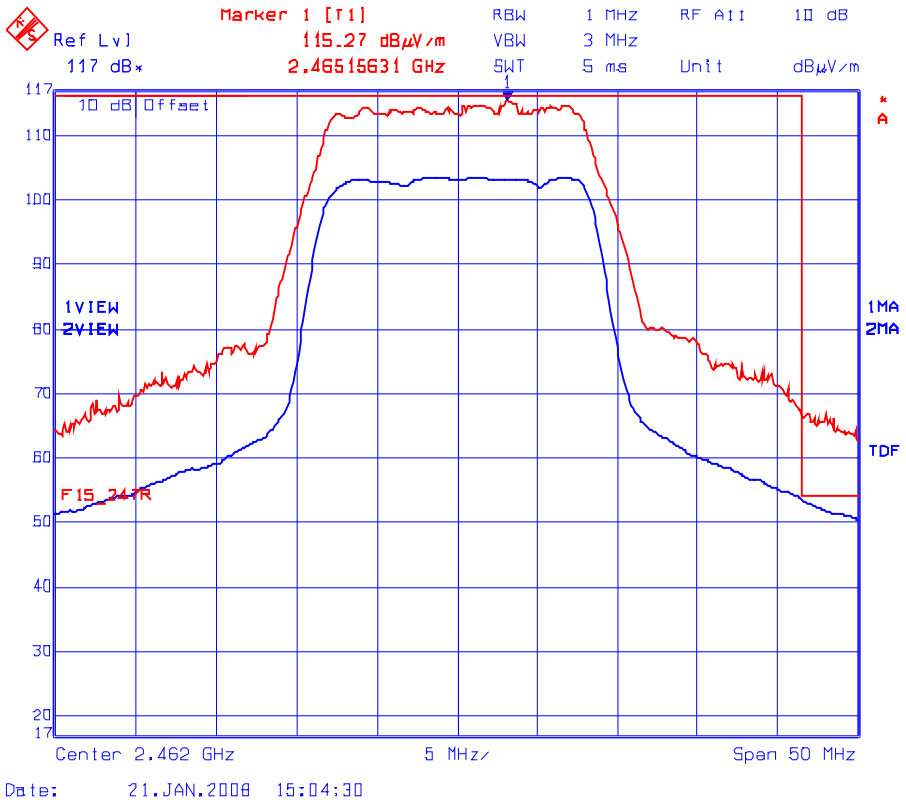
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.2.6 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2457 MHz; Software Power Setting: 34
Rx Antenna Orientation: Vertical



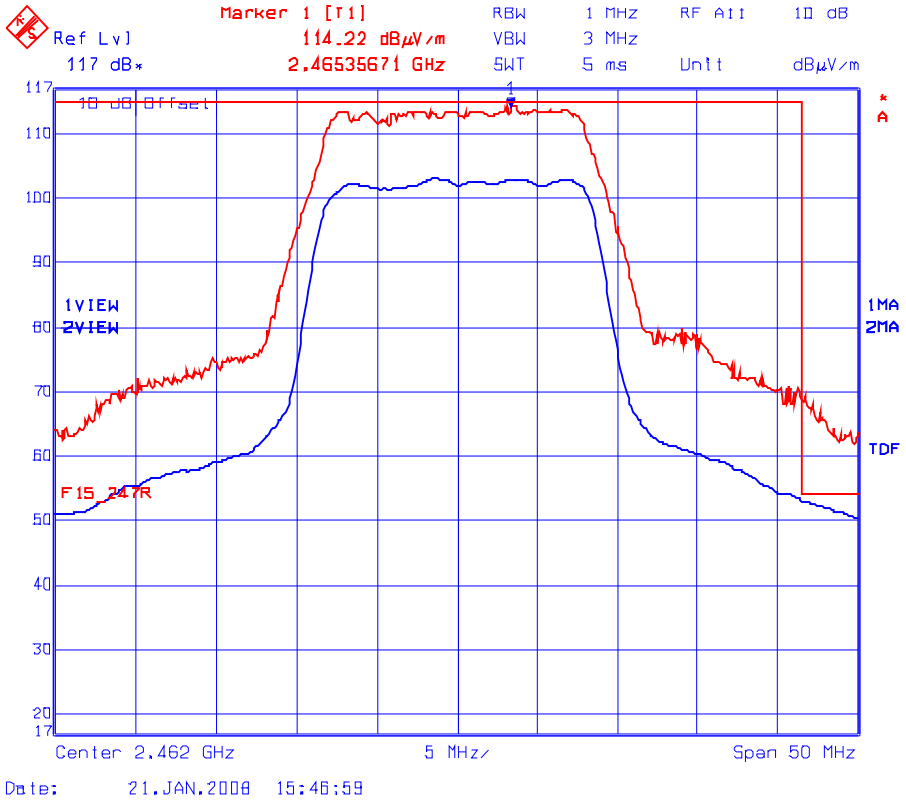
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 6.9.5.2.7 Band-Edge RF Radiated Emissions @ 3
High End of Frequency Band; Test Frequency: 2462 MHz; Software Power Setting: 33
Rx Antenna Orientation: Horizontal



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

Plot 6.9.5.2.8 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz; Software Power Setting: 33
Rx Antenna Orientation: Vertical



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

6.9.5.3. EUT with Amplifier and 3 dBi Rubber Ducky Antenna (Model RT-X1R5803)

Fundamental Frequency:	5745 MHz
Software Power Setting:	30
Test Frequency Range:	30 MHz – 40 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
5745	119.55	--	V	--	--	--	--
5745	120.10	--	H	--	--	--	--
11490	67.37	49.81	V	54.0	100.1	-4.2	Pass*
11490	65.31	46.51	H	54.0	100.1	-7.5	Pass*

* Emission within the restricted frequency bands.

Fundamental Frequency:	5765 MHz
Software Power Setting:	29
Test Frequency Range:	30 MHz – 40 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
5765	120.79	--	V	--	--	--	--
5765	118.53	--	H	--	--	--	--
11530	69.28	48.15	V	54.0	100.8	-5.9	Pass*
11530	68.77	47.58	H	54.0	100.8	-6.4	Pass*

* Emission within the restricted frequency bands.

Fundamental Frequency:	5785 MHz
Software Power Setting:	26
Test Frequency Range:	30 MHz – 40 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
5785	119.57	--	V	--	--	--	--
5785	119.25	--	H	--	--	--	--
11570	70.21	48.66	V	54.0	99.6	-5.3	Pass*
11570	68.88	48.14	H	54.0	99.6	-5.9	Pass*

* Emission within the restricted frequency bands.

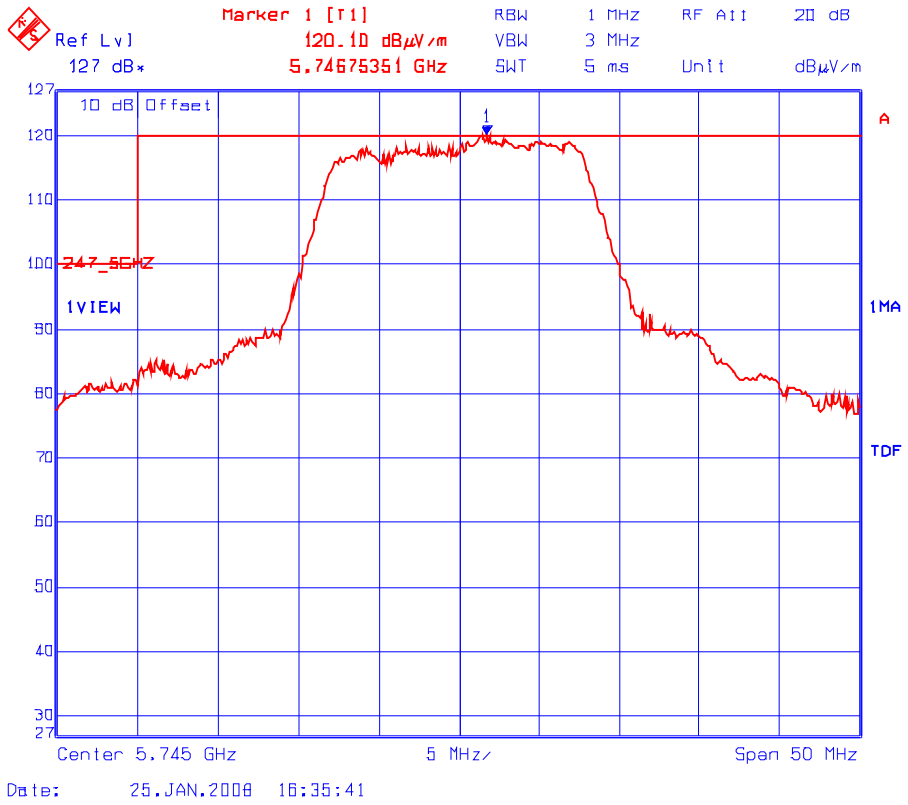
Fundamental Frequency:	5805 MHz
Software Power Setting:	24
Test Frequency Range:	30 MHz – 40 GHz

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
5805	120.07	--	V	--	--	--	--
5805	121.08	--	H	--	--	--	--
11610	68.99	47.80	V	54.0	101.1	-6.2	Pass*
11610	67.84	47.61	H	54.0	101.1	-6.4	Pass*

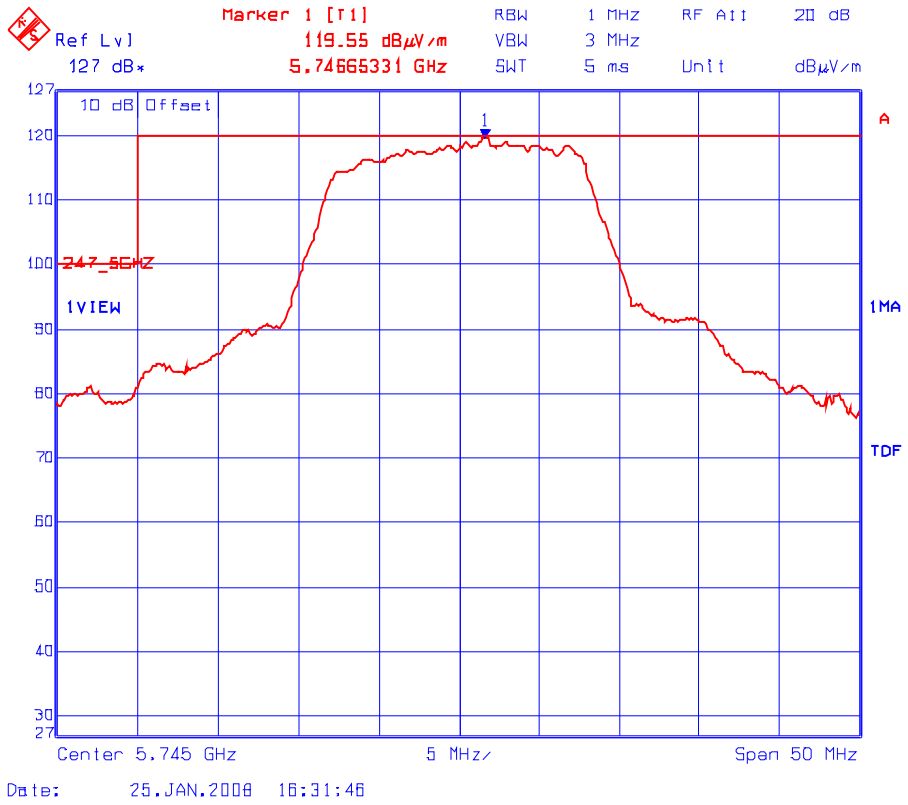
* Emission within the restricted frequency bands.

See the following test data plots for band-edge emissions.

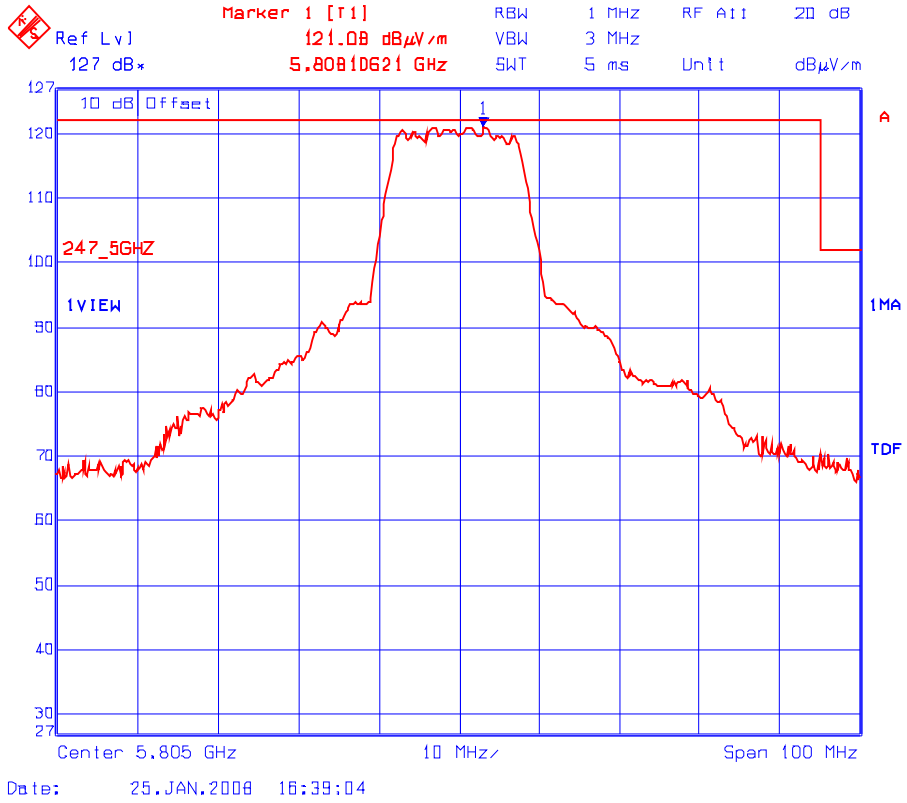
Plot 6.9.5.3.1 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band, Test Frequency: 5745 MHz; Software Power Setting: 30
Rx Antenna Orientation: Horizontal



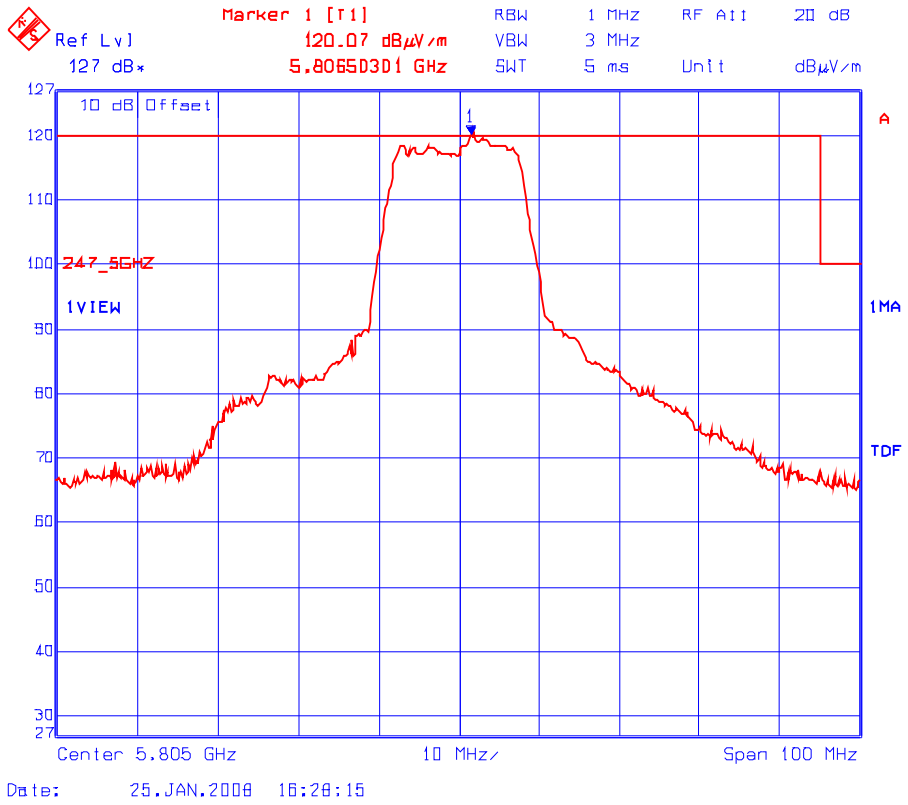
Plot 6.9.5.3.2 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band, Test Frequency: 5745 MHz; Software Power Setting: 30
Rx Antenna Orientation: Vertical



Plot 6.9.5.3.3 Band-Edge RF Radiated Emissions @ 3
High End of Frequency Band; Test Frequency: 5805 MHz; Software Power Setting: 24
Rx Antenna Orientation: Horizontal



Plot 6.9.5.3.4 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 5805 MHz; Software Power Setting: 24
Rx Antenna Orientation: Vertical



6.9.5.4. EUT with Amplifier and 21 dBi Panel Antenna (Model RT-X1R5821)

Fundamental Frequency:	5745 MHz
Software Power Setting:	30
Test Frequency Range:	30 MHz – 40 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
5745	135.07	--	V	--	--	--	--
5745	134.66	--	H	--	--	--	--
11490	56.10	44.21	V	54.0	115.1	-9.8	Pass*
11490	55.12	43.12	H	54.0	115.1	-10.9	Pass*

* Emission within the restricted frequency bands.

Fundamental Frequency:	5765 MHz
Software Power Setting:	29
Test Frequency Range:	30 MHz – 40 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
5765	134.79	--	V	--	--	--	--
5765	134.68	--	H	--	--	--	--
11530	60.94	48.06	V	54.0	114.8	-5.9	Pass*
11530	58.85	46.12	H	54.0	114.8	-7.9	Pass*

* Emission within the restricted frequency bands.

Fundamental Frequency:	5785 MHz
Software Power Setting:	26
Test Frequency Range:	30 MHz – 40 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
5785	134.98	--	V	--	--	--	--
5785	134.71	--	H	--	--	--	--
11570	59.55	47.56	V	54.0	115.0	-6.4	Pass*
11570	57.35	44.29	H	54.0	115.0	-9.7	Pass*

* Emission within the restricted frequency bands.

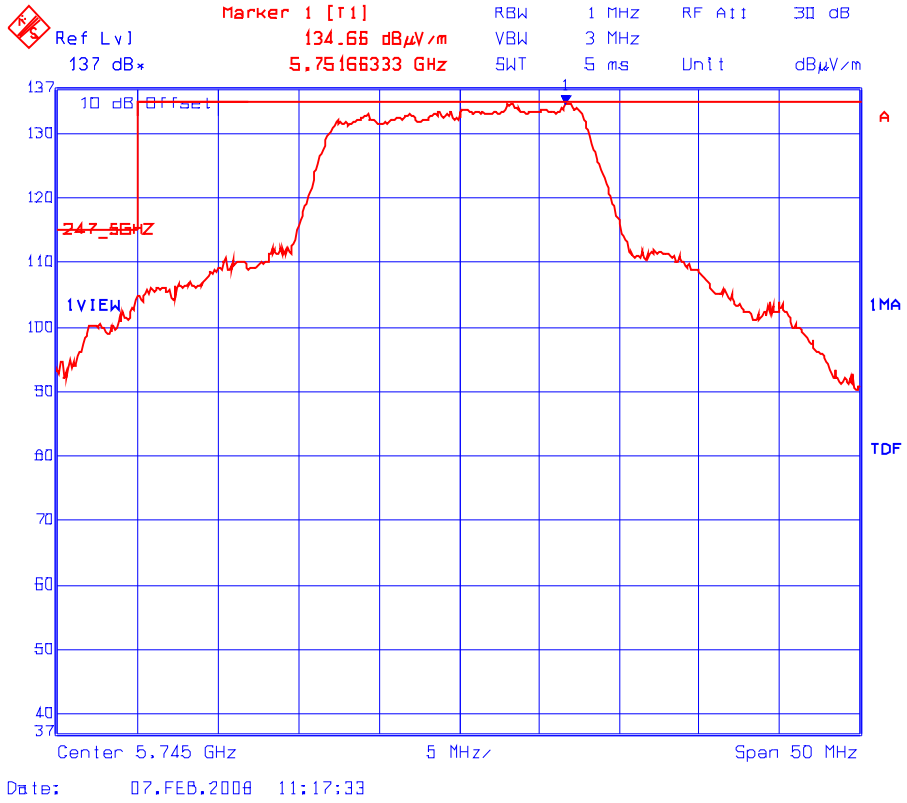
Fundamental Frequency:	5805 MHz
Software Power Setting:	24
Test Frequency Range:	30 MHz – 40 GHz

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
5805	134.67	--	V	--	--	--	--
5805	134.14	--	H	--	--	--	--
11610	60.86	46.98	V	54.0	114.7	-7.0	Pass*
11610	55.94	42.50	H	54.0	114.7	-11.5	Pass*

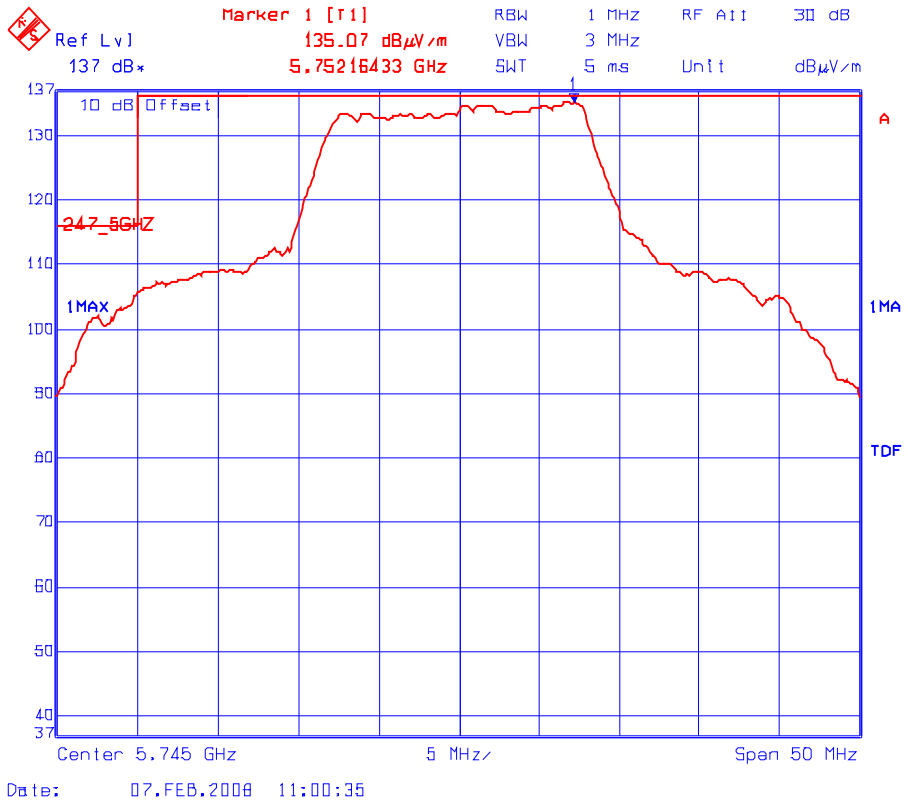
* Emission within the restricted frequency bands.

See the following test data plots for band-edge emissions.

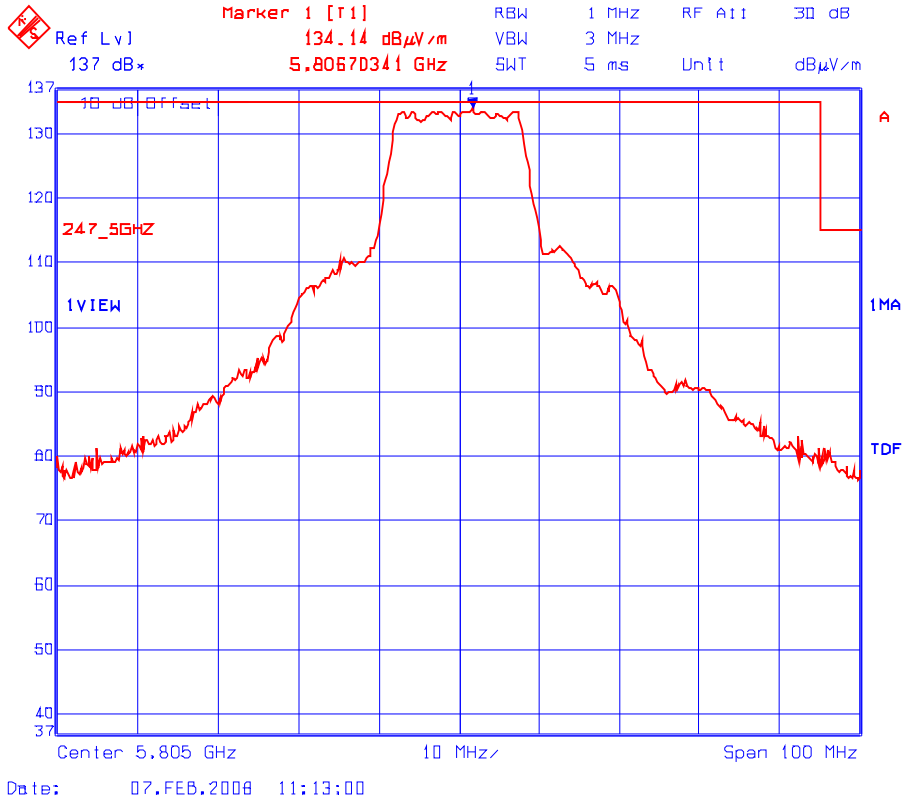
Plot 6.9.5.4.1 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band, Test Frequency: 5745 MHz; Software Power Setting: 30
Rx Antenna Orientation: Horizontal



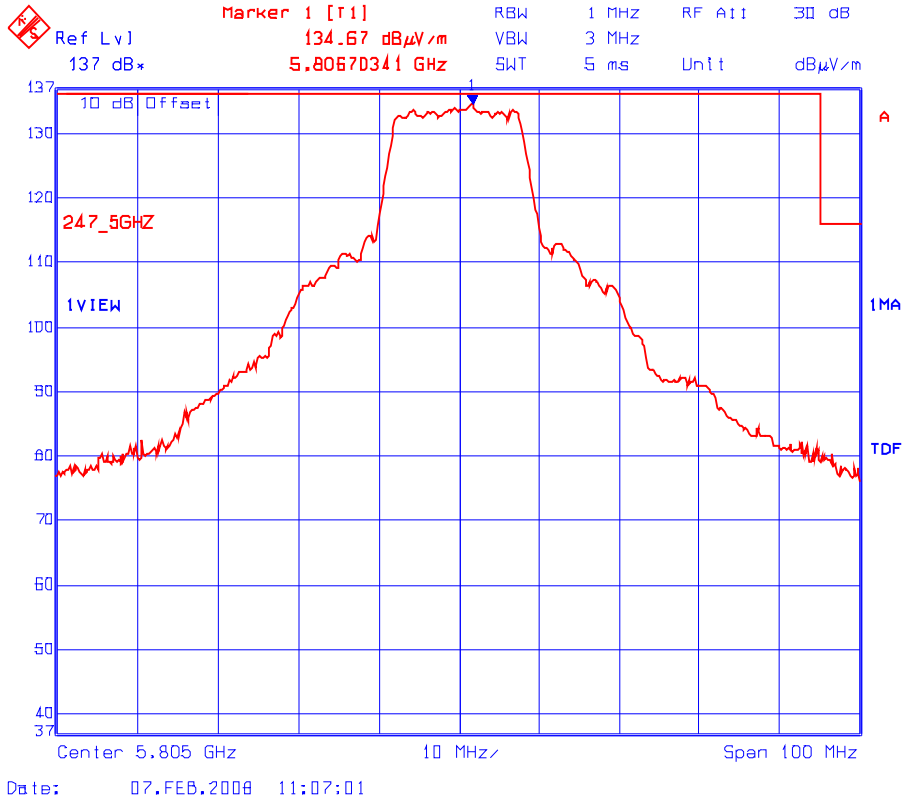
Plot 6.9.5.4.2 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band, Test Frequency: 5745 MHz; Software Power Setting: 30
Rx Antenna Orientation: Vertical



Plot 6.9.5.4.3 Band-Edge RF Radiated Emissions @ 3
High End of Frequency Band; Test Frequency: 5805 MHz; Software Power Setting: 24
Rx Antenna Orientation: Horizontal



Plot 6.9.5.4.4 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 5805 MHz; Software Power Setting: 24
Rx Antenna Orientation: Vertical



6.9.5.5. EUT with Amplifier and 32 dBi Parabolic Antenna (Model RT-X1R5832)

Fundamental Frequency:	5745 MHz
Software Power Setting:	30
Test Frequency Range:	30 MHz – 40 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
5745	137.59	--	V	--	--	--	--
5745	137.38	--	H	--	--	--	--
11490	68.34	47.44	V	54.0	117.6	-6.6	Pass*
11490	67.27	46.57	H	54.0	117.6	-7.4	Pass*

* Emission within the restricted frequency bands.

Fundamental Frequency:	5765 MHz
Software Power Setting:	29
Test Frequency Range:	30 MHz – 40 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
5765	137.40	--	V	--	--	--	--
5765	137.12	--	H	--	--	--	--
11530	70.85	51.94	V	54.0	117.4	-2.1	Pass*
11530	68.24	51.31	H	54.0	117.4	-2.7	Pass*

* Emission within the restricted frequency bands.

Fundamental Frequency:	5785 MHz
Software Power Setting:	26
Test Frequency Range:	30 MHz – 40 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
5785	137.20	--	V	--	--	--	--
5785	137.19	--	H	--	--	--	--
11570	72.07	48.61	V	54.0	117.2	-5.4	Pass*
11570	71.44	48.94	H	54.0	117.2	-5.1	Pass*

* Emission within the restricted frequency bands.

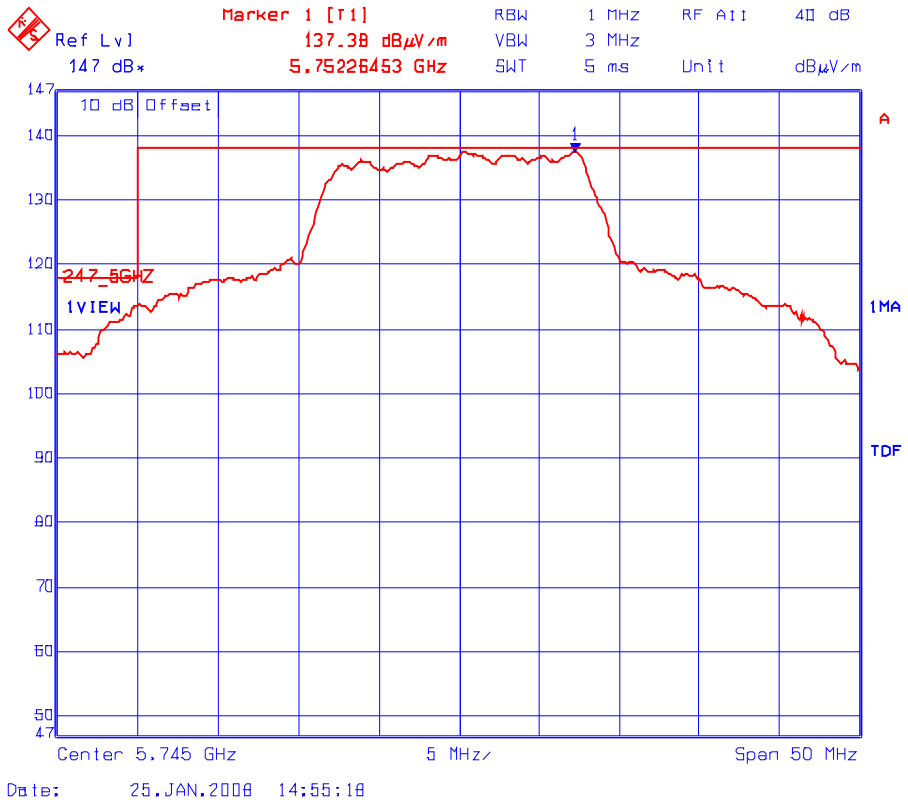
Fundamental Frequency:	5805 MHz
Software Power Setting:	24
Test Frequency Range:	30 MHz – 40 GHz

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
5805	136.93	--	V	--	--	--	--
5805	136.76	--	H	--	--	--	--
11610	69.52	47.57	V	54.0	116.9	-6.4	Pass*
11610	69.68	48.95	H	54.0	116.9	-5.1	Pass*

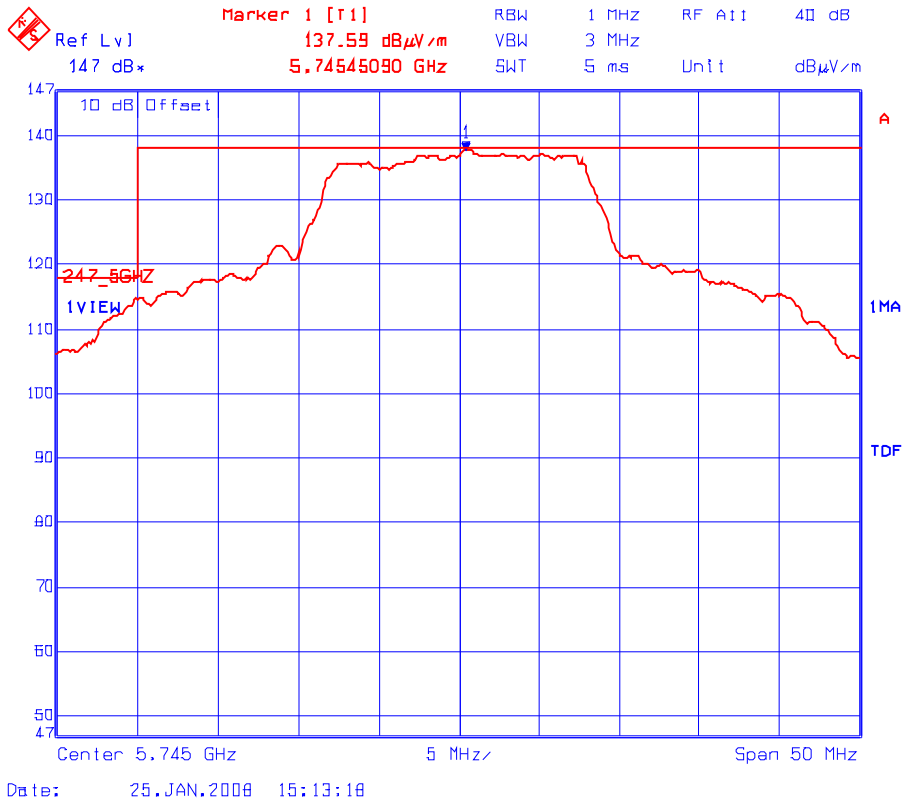
* Emission within the restricted frequency bands.

See the following test data plots for band-edge emissions.

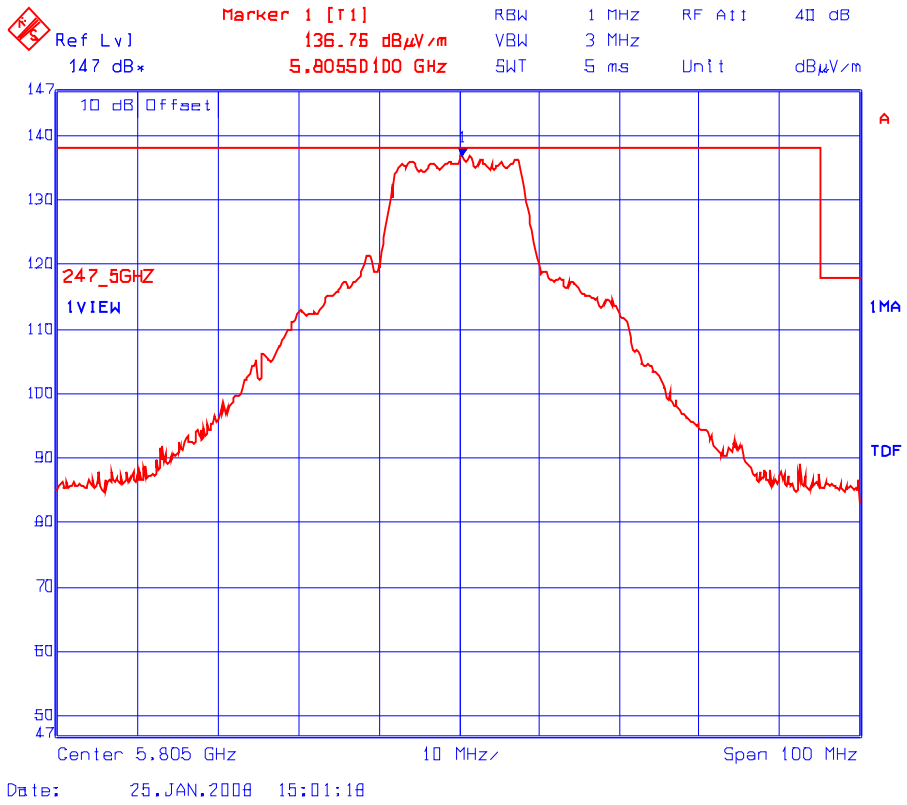
Plot 6.9.5.5.1 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band, Test Frequency: 5745 MHz; Software Power Setting: 30
Rx Antenna Orientation: Horizontal



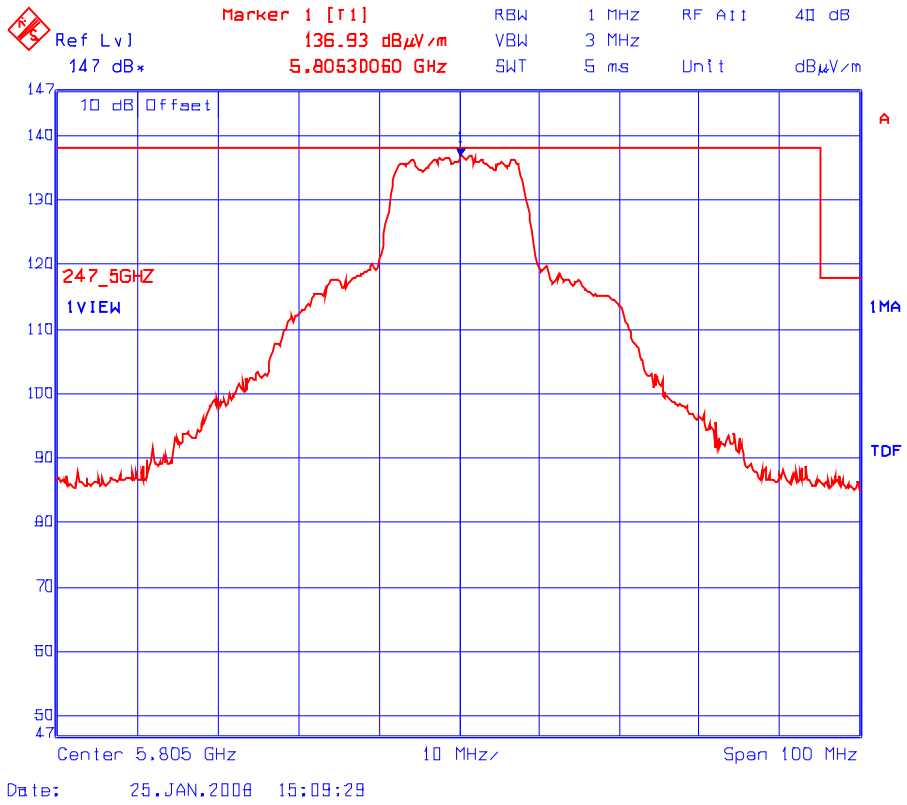
Plot 6.9.5.5.2 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band, Test Frequency: 5745 MHz; Software Power Setting: 30
Rx Antenna Orientation: Vertical



Plot 6.9.5.5.3 Band-Edge RF Radiated Emissions @ 3
High End of Frequency Band; Test Frequency: 5805 MHz; Software Power Setting: 24
Rx Antenna Orientation: Horizontal



Plot 6.9.5.5.4 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 5805 MHz; Software Power Setting: 24



Rx Antenna Orientation: Vertical

6.10. POWER SPECTRAL DENSITY [§ 15.247(e)]

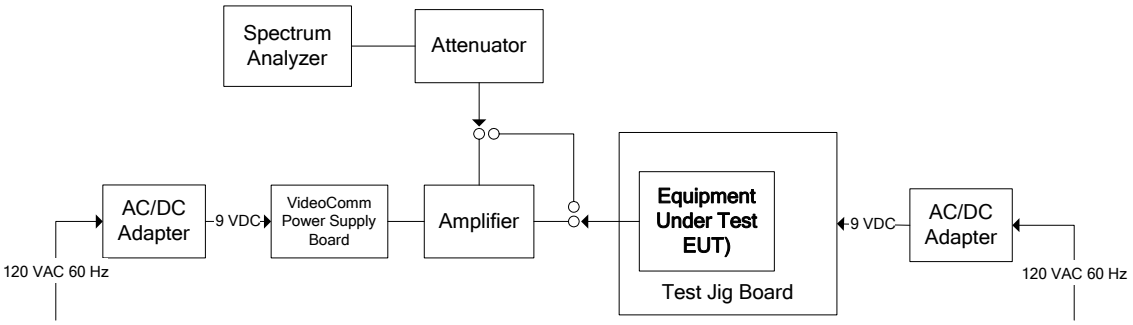
6.10.1. Limit(s)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

6.10.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), PSD Option 1 method.

6.10.3. Test Arrangement



6.10.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
Attenuator	Narda	4768-20	--	DC - 40 GHz

6.10.5. Test Data

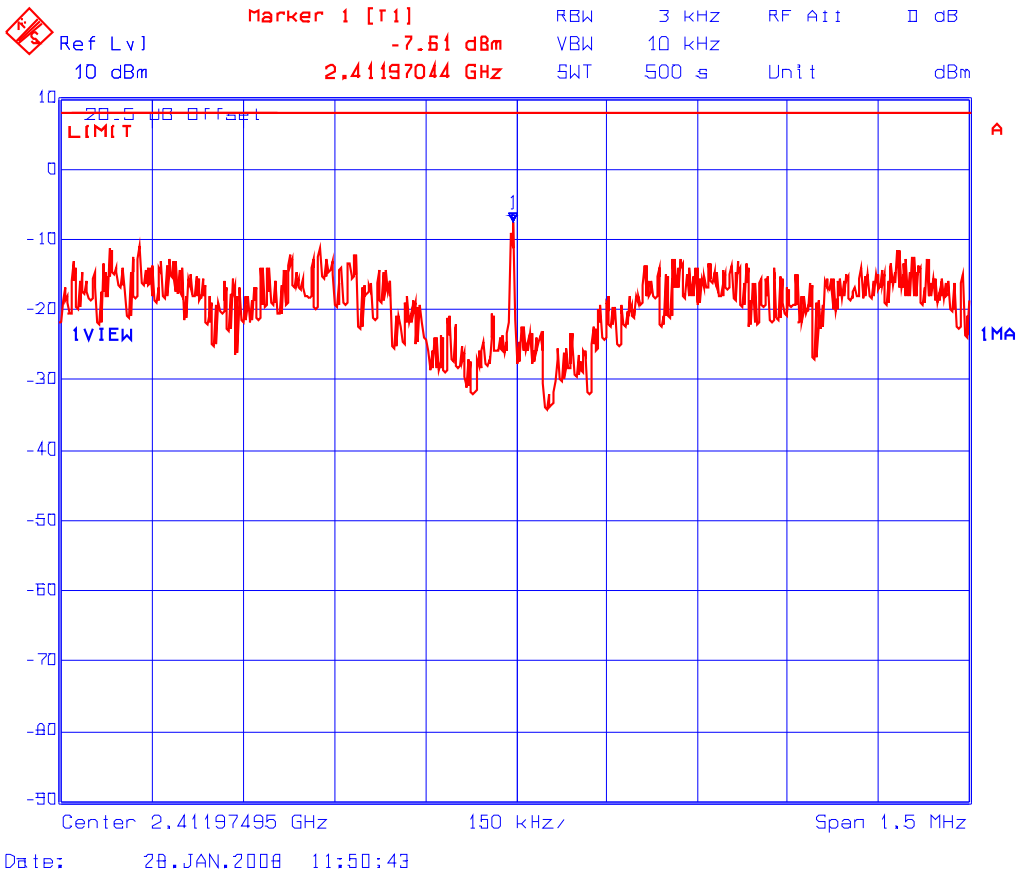
Remarks:

- Measurement method: Power spectral density (PSD) Option 1.
- For 5745-5805 MHz band, both settings with and without amplifier were pre-scanned, worst-case results were observed with the amplifier. Therefore, the configuration with amplifier was chosen for final tests.
- The following tests are the worst-case test configuration, with the EUT set at maximum data rate (64-QAM at 54 Mbps)

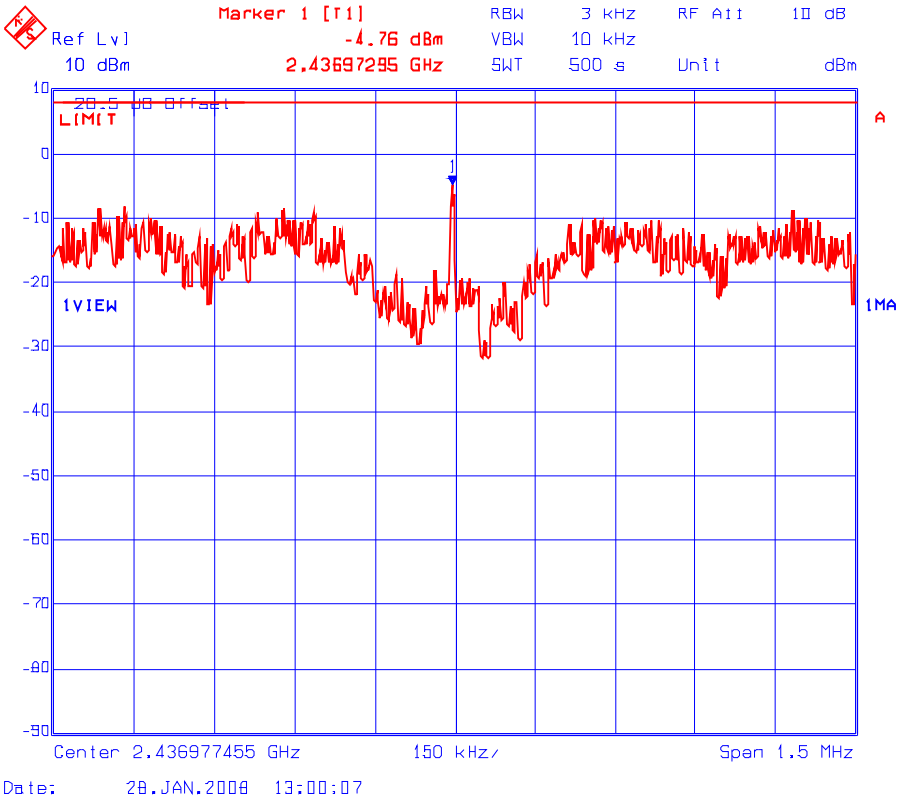
Frequency (MHz)	*PSD in 3 kHz BW dBm)	Limit (dBm)	Margin (dB)	Comments (Pass/Fail)
2412	-7.61	8	-15.61	Pass
2437	-4.76	8	-12.76	Pass
2462	-6.64	8	-14.64	Pass
5745	0.40	8	-7.60	Pass
5785	0	8	-8.00	Pass
5805	-0.56	8	-8.56	Pass

*See the following plots for measurement details.

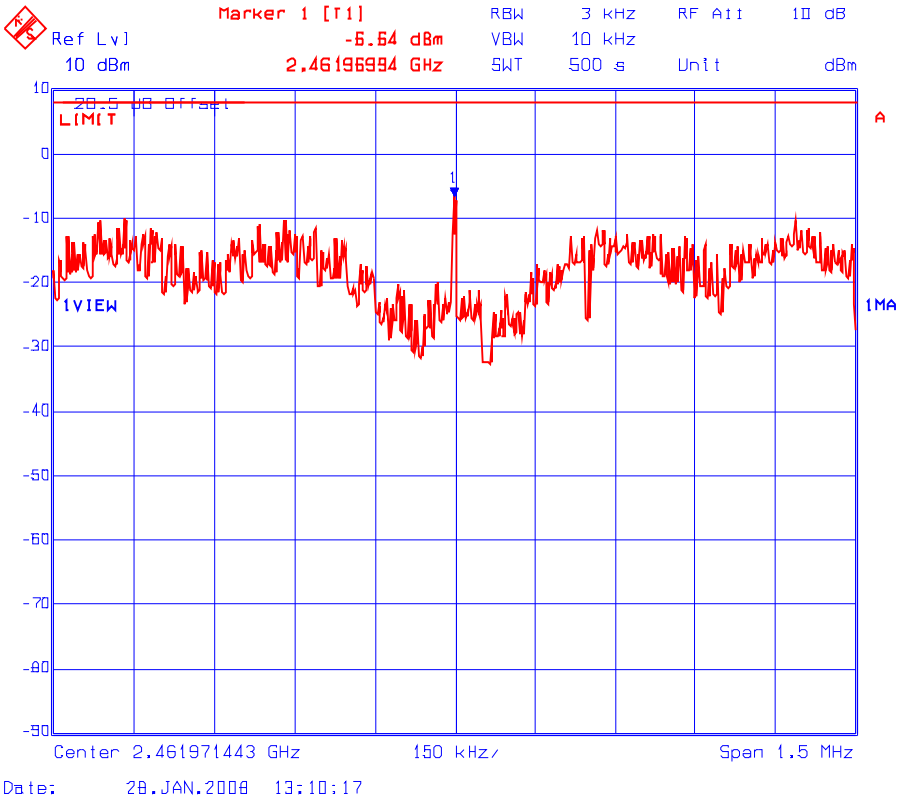
Plot 6.10.5.1 Power Spectral Density
Frequency: 2412 MHz



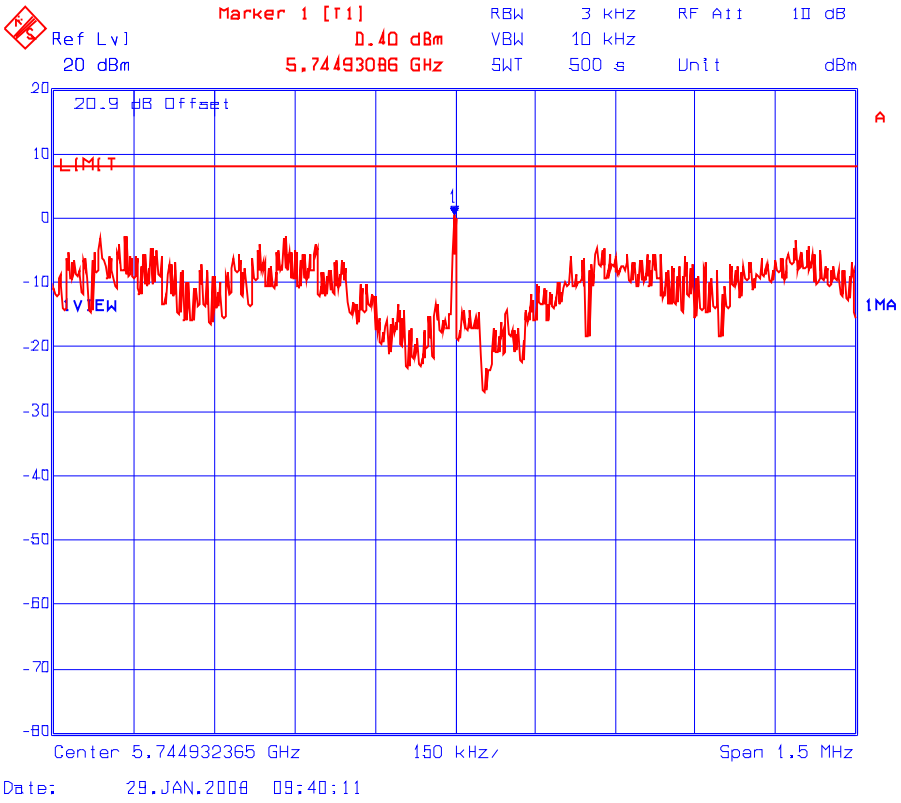
Plot 6.10.5.2 Power Spectral Density
Frequency: 2437 MHz



Plot 6.10.5.3 Power Spectral Density
Frequency: 2462 MHz

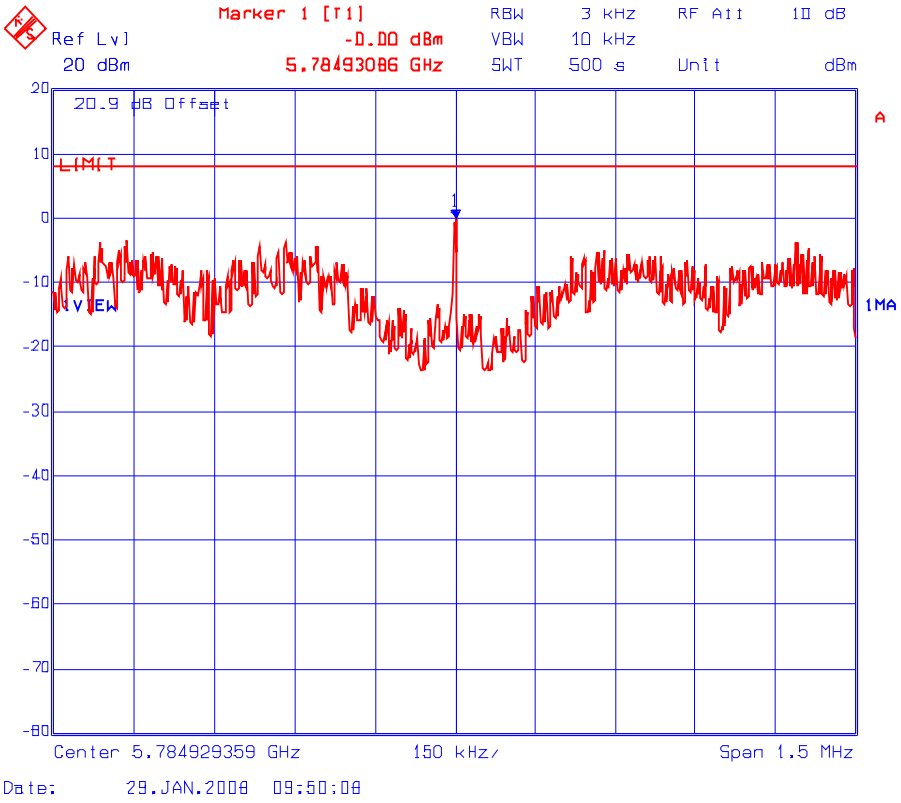


Plot 6.10.5.4 Power Spectral Density
Frequency: 5745 MHz

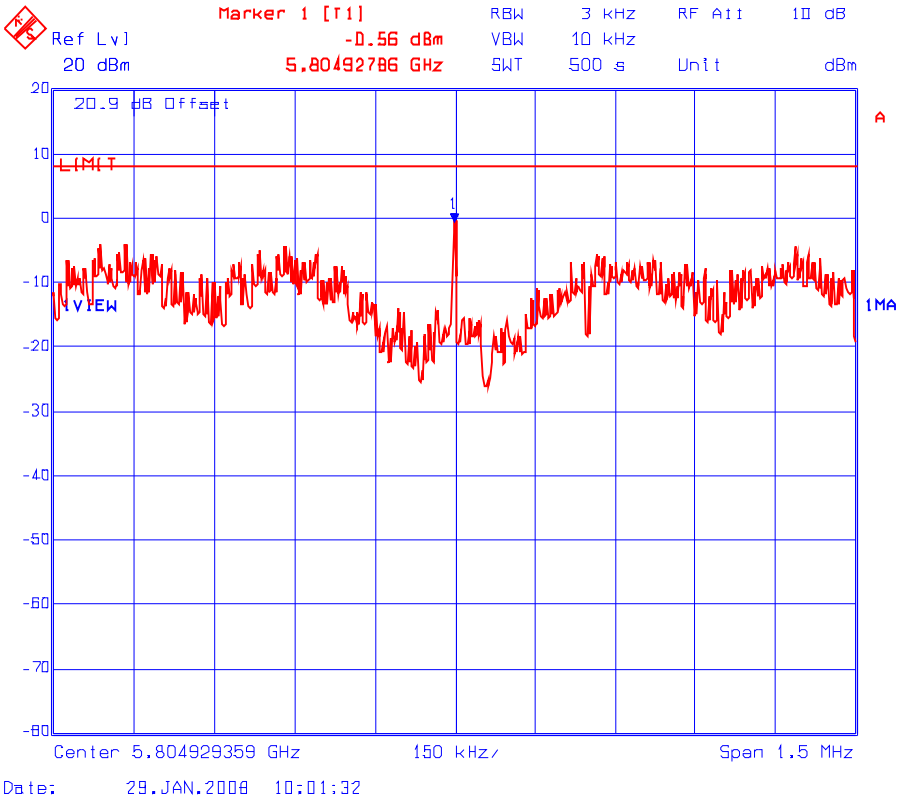


All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 6.10.5.5 Power Spectral Density
Frequency: 5785 MHz



Plot 6.10.5.6 Power Spectral Density
Frequency: 5805 MHz



6.11. RF EXPOSURE REQUIRMENTS [§§ 15.247(e)(i), 1.1310 & 2.1091]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

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.

6.11.1. Method of Measurements

Refer to Sections 1.1310, 2.1091

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:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot r^2} = \frac{EIRP}{4 \cdot \pi \cdot r^2}$$

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

6.11.2. RF Evaluation

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: For mobile applications: *15.15 cm For fixed applications: See user manual for details	Manufacturer' instruction for separation distance between antenna and persons required: For mobile applications: 20 cm For fixed applications: See user manual for details
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

$$r = \sqrt{\frac{P \cdot G}{4 \cdot \pi \cdot S}} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}}$$

S = 1.0 mW/cm^2
EIRP = 34.60 dBm = $10^{34.60/10}$ mW = 2884 mW (Worst Case)

(Minimum Safe Distance, r) = $\sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{2884}{4 \cdot \pi \cdot (1.0)}} \approx 15.15cm$

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