



Test Report

FCC Part 15, Subpart C, Section 15.247 Industry Canada RSS-210, Issue 8

Report Number: MP-FS-RX2-Cert

Model: MP-FS-RX2

FCC ID: EROMP-FS-RX2
IC: 5683C-MPFSRX2

Date: May 25, 2011 (Revised June 8, 2011)

Prepared by: Grace Lin
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Date: May 25, 2011

Reviewed by: Wayne Owens
Wayne Owens, Director of Program Management

Date: May 25, 2011



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1. General Description

1.1 Product Description

The equipment under test (EUT) is a Crestron FreeSpeech™ Dual-Channel Wireless Mic Receiver, model: MP-FS-RX2.

1.2 Test Methodology

Measurements were performed according to the following procedures and standards:

- 1) ANSI C63.4-2003
- 2) ANSI C63.10-2009
- 3) Industry Canada RSS-Gen Issue 3
- 4) Industry Canada RSS-210 Issue 8
- 5) Industry Canada ICES-003 Issue 4

All measurements were performed in a 3-meter semi-anechoic chamber and the control room.

1.3 Test Facility

The 3-meter semi-anechoic chamber used to collect conducted and radiated emission data is located at 22 Link Drive, Rockleigh, New Jersey. This test facility has been placed on file with the FCC, Registration Number: 412871, and Industry Canada, Site Number: 5683C-1.



1.4 Test Equipment

Description	Model	Serial No.	Frequency Range	Calibration Date
R&S EMI Receiver	ESU40	100076	20 Hz – 40 GHz	Dec. 10, 2010
Teseq Bilog Antenna	CBL 6112D	25231	30 MHz – 2 GHz	Dec. 8, 2010
ETS-Lindgren Double Ridge Horn Antenna	3117	00047560	1 GHz – 18 GHz	Feb. 4, 2011
R&S Preamplifier	TS-PR18	100044	30 MHz – 18 GHz	Dec. 2, 2010
ETS-Lindgren Standard Gain Horn Antenna	3160-09	00078911	18 GHz – 26.5 GHz	Dec. 3, 2010
R&S Preamplifier	TS-PR26	100030	18 GHz – 26.5 GHz	Dec. 6, 2010
Solar Electronics LISN	9252-50-R-24-N	068545	10 kHz – 50 MHz	Feb. 15, 2011

1.5 Evaluation Summary

Rule Section		Description/Parameters	Results
FCC	IC		
§15.203	N/A	Antenna Requirement	Complies
§15.247(a)(1)	§A8.1(a) of RSS-210	Carrier Frequency Separation, 25kHz or 20 dB BW	Complies
§15.247(a)(1)(iii)	§A8.1(d) of RSS-210	Number of Hopping Frequencies	Complies
§15.247(a)(1)(iii)	§A8.1(d) of RSS-210	Time of Occupancy (Dwell Time)	Complies
§15.247(a)(1)(iii)	§A8.1(a) of RSS-210	20 dB Bandwidth	Complies
N/A	§4.6.1 of RSS-Gen	99% Occupied Bandwidth	(for reporting purpose)
§15.247(b)(1)	§A8.4(2) of RSS-210	Peak Output Power, conducted, 1 Watt (30dBm)	Complies
§15.247(c)	§2.1, §A8.5 of RSS-210	Band Edge	Complies
§15.247(d)(1)	§A8.5 of RSS-210	Spurious Conducted Emissions, 20 dBc	Complies
§15.247(c)	§2.2, §2.7, §A8.5 of RSS-210	Spurious Radiated Emissions	Complies
§15.107	§7.2.2 of RSS-Gen	Transmitter AC Power Line Conducted Emissions	Complies
§15.101(b)	§6 of RSS-Gen	Receiver Radiated Emissions	Complies
§15.107	§7.2.2 of RSS-Gen	Receiver AC Power Line Conducted Emissions	Complies



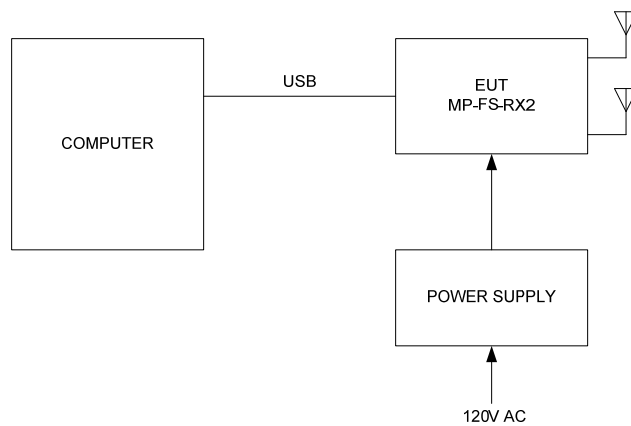
2. System Test Configuration

2.1 Justification

A power supply supplied power to the EUT. A computer supplied test commands to the EUT through the USB port.

2.2 Block Diagram

Block diagram is shown below.



2.3 EUT Exercise Software and Mode(s) of Operation

The EUT was configured to transmit continuously. Channel frequencies 2402 MHz, 2441 MHz, and 2480 MHz were selected for test.

2.4 Cables

Qty	Description	Length (ft)	From - To	Shielded/ Unshielded
1	USB	6	EUT – Computer	Shielded



2.5 *Special Accessories*

There are no special accessories for compliance of this EUT.

2.6 *Support equipment*

No	Description	Manufacturer	Model No	Serial No
1	Computer	DELL	PP15L	16774629877
2	Power Supply	DELL	PA-1900-000	CN-09T215-71615-53C-1692

2.7 *Equipment Modifications*

There were no modifications installed during compliance measurements.



3. Evaluation

3.1 *Antenna Requirements*

The EUT is validated with dipole antennas. Antenna gain of the dipole antenna is 5dBi. Detail antenna information is included in Theory of Operation.

The reverse polarity SMA (RP-SMA) connector of the dipole antenna is unique in the sense of complying with FCC §15.203, §15.204(b), and §15.204(c).

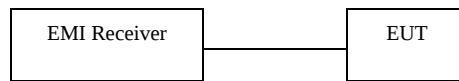


3.2 Carrier Frequency Separation

Performance Criterion: 25 kHz or 20 dB bandwidth of the hopping channel, whichever is greater

Test Results: Complies

Test Details: Refers to the following block diagram and receiver screen captures. The EUT was tested in a continuous transmit mode with maximum power level.



Date: 24.MAY.2011 10:34:26

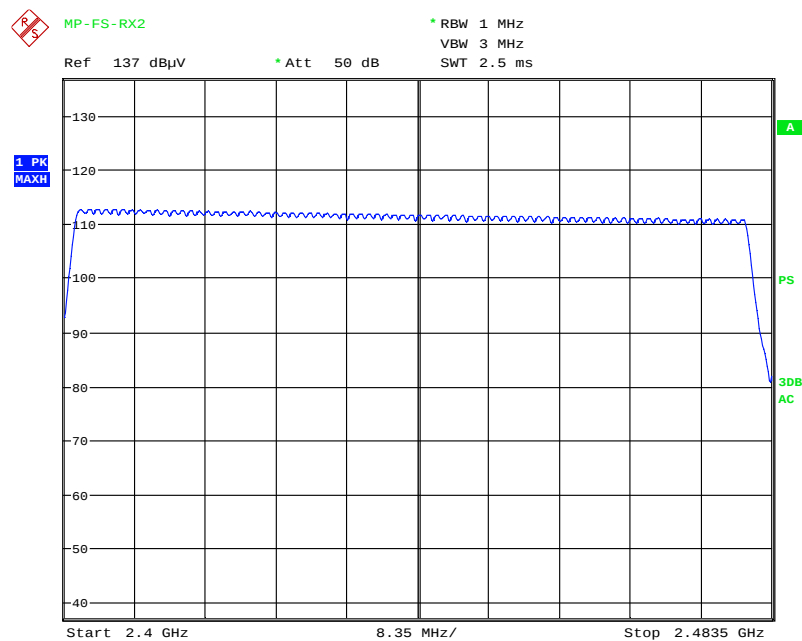
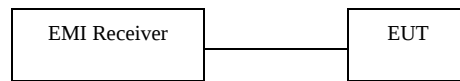


3.3 Number of Hopping Frequencies

Performance Criterion: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels

Test Results: Complies

Test Details: Refers to the following block diagram and receiver screen captures. The EUT was tested in a continuous transmit mode with maximum power level.



Date: 24.MAY.2011 10:36:16

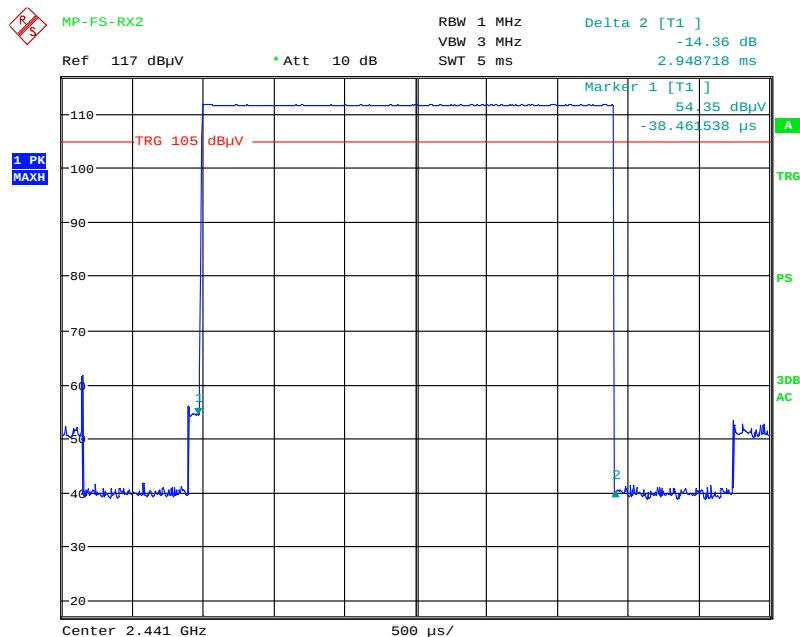
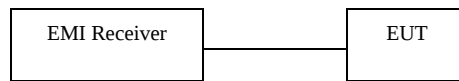


3.4 Time of Occupancy (Dwell Time)

Performance Criterion: The average time of occupancy on any channel shall not be greater than 0.4 seconds multiplied by the number of hopping channels employed.

Test Results: Complies

Test Details: Refers to the following block diagram and receiver screen captures. The EUT was tested in a continuous transmit mode with maximum power level.



Date: 24.MAY.2011 10:39:39

Calculation:

0.4 sec x 79 hopping channels = 31.6 sec

2.948718 ms x 79 hopping channels = 232.9487 ms (total duration of all channels)

31.6 sec / 232.9487 ms = 135.6522 (no. of time that one channel transmits within a 31.6 sec time frame)

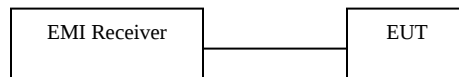
135.6522 x 2.948718 ms = 400 ms (total duration of time that one channel transmits within a 31.6 sec time frame)



3.5 20 dB Bandwidth

Performance Criterion: The maximum permissible 20dB bandwidth is 1 MHz, unless more than 15 non-overlapping channels are employed.

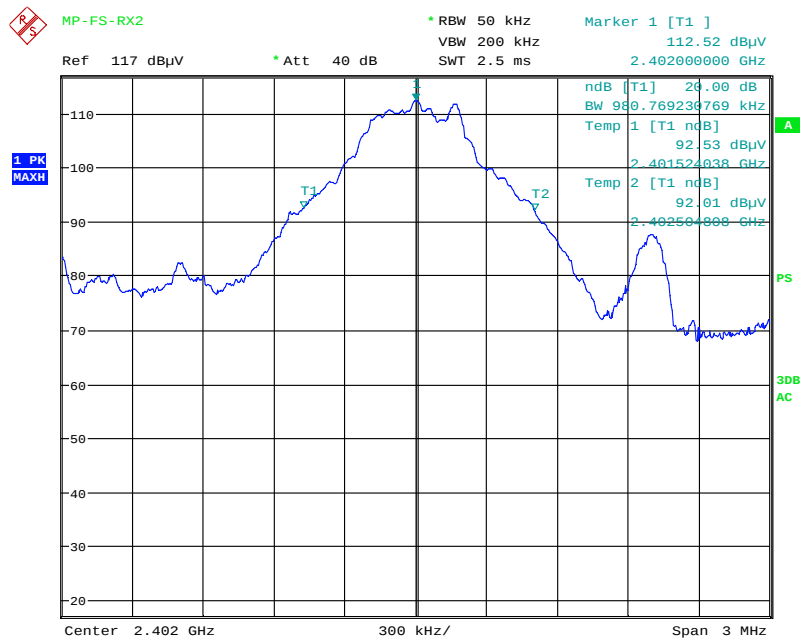
Test Details: Refers to the following block diagram, data table, and receiver screen captures. The EUT was tested in a continuous transmit mode with maximum power level.



Channel Frequency (MHz)	20 dB Bandwidth (kHz)
2402	980.77
2441	990.38
2480	985.58

Note: The RF level in the plots is relative and is not the indication of RF output power.

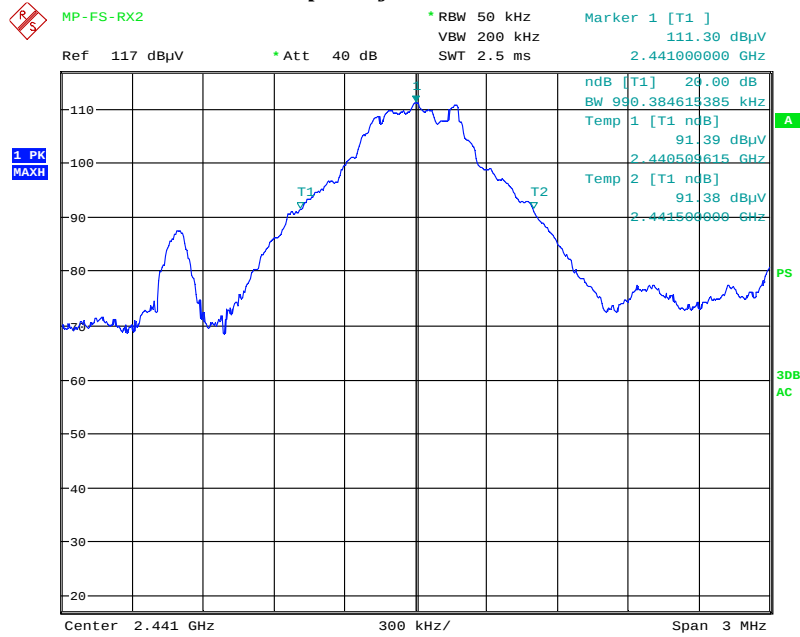
20 dB Bandwidth, Channel Frequency 2402MHz:



Date: 24.MAY.2011 10:43:50

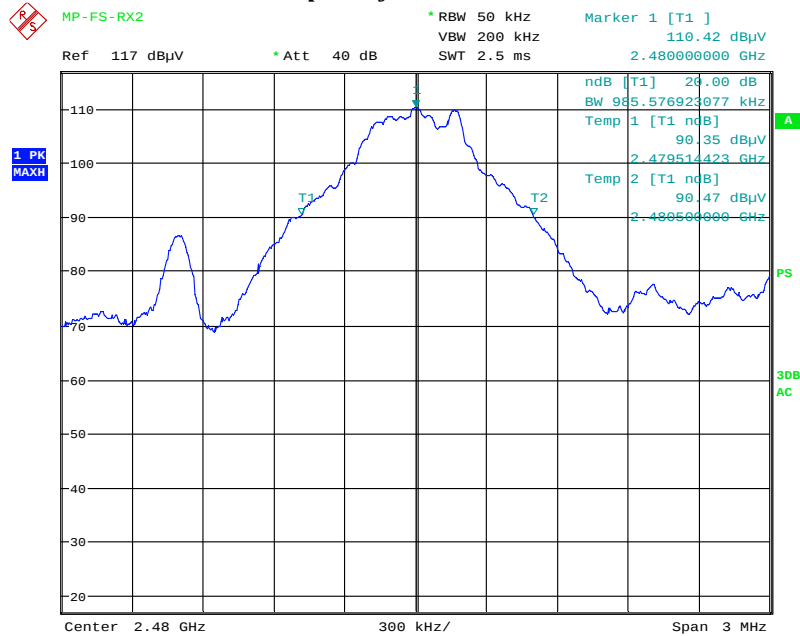


20 dB Bandwidth, Channel Frequency 2441 MHz:



Date: 24.MAY.2011 10:45:19

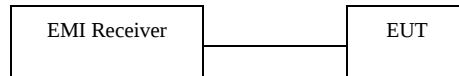
20 dB Bandwidth, Channel Frequency 2480 MHz:



Date: 24.MAY.2011 10:46:56

3.6 99% Bandwidth

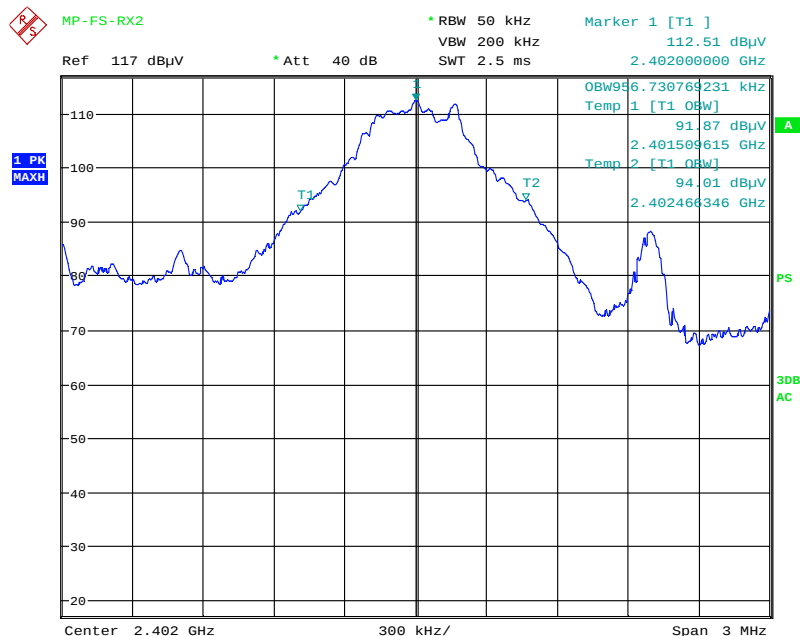
Test Details: Refers to the following block diagram, data table, and receiver screen captures. The EUT was tested in a continuous transmit mode with maximum power level.



Channel Frequency (MHz)	99% Bandwidth (kHz)
2402	956.73
2441	966.35
2480	932.69

Note: The RF level in the plots is relative and is not the indication of RF output power.

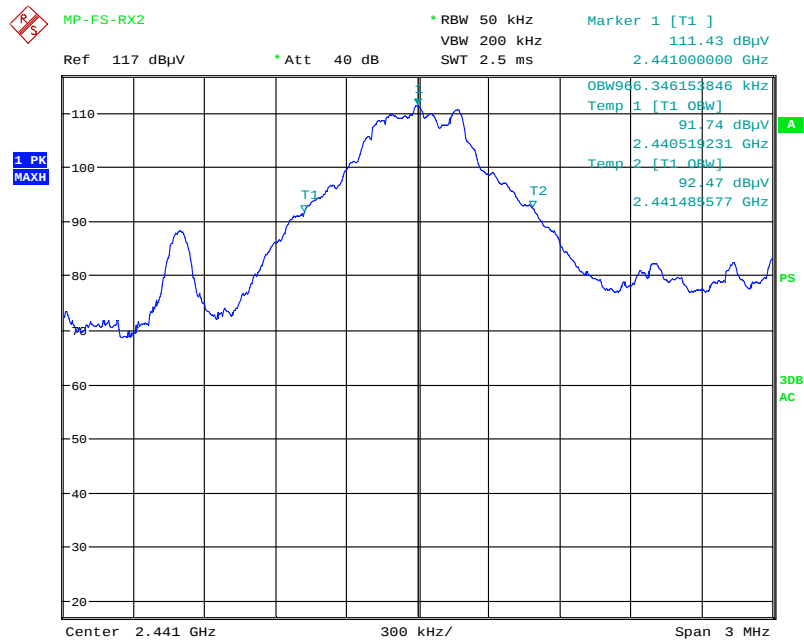
99% Bandwidth, Channel Frequency 2402 MHz:



Date: 24.MAY.2011 10:51:45

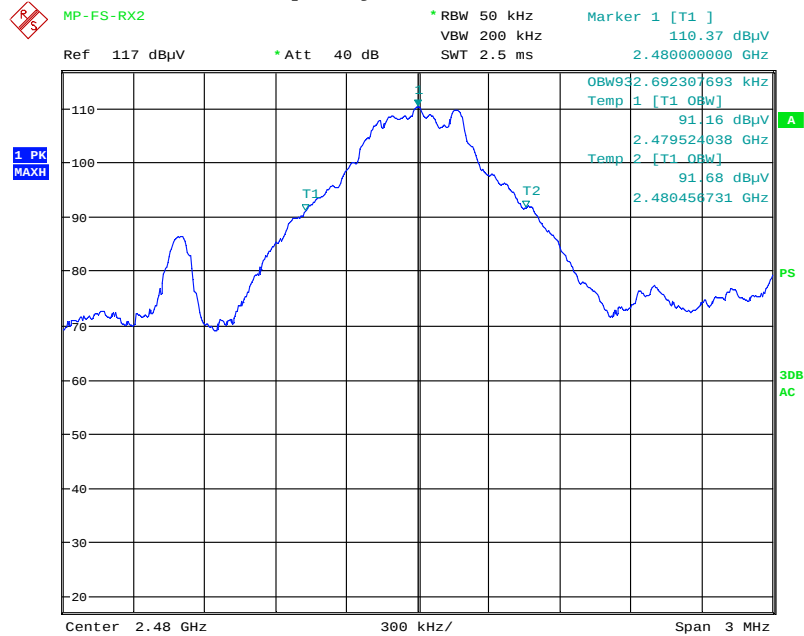


99% Bandwidth, Channel Frequency 2441 MHz:



Date: 24.MAY.2011 10:50:33

99% Bandwidth, Channel Frequency 2480 MHz:



Date: 24.MAY.2011 10:49:02

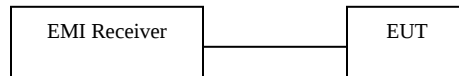


3.7 Peak Output Power

Performance Criterion: For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, the maximum peak conducted output power shall not exceed 1 Watt.

Test Results: Complies

Test Details: The EUT was tested in a continuous transmit mode with maximum power level. Refers to the following block diagram, data table, and receiver screen captures.

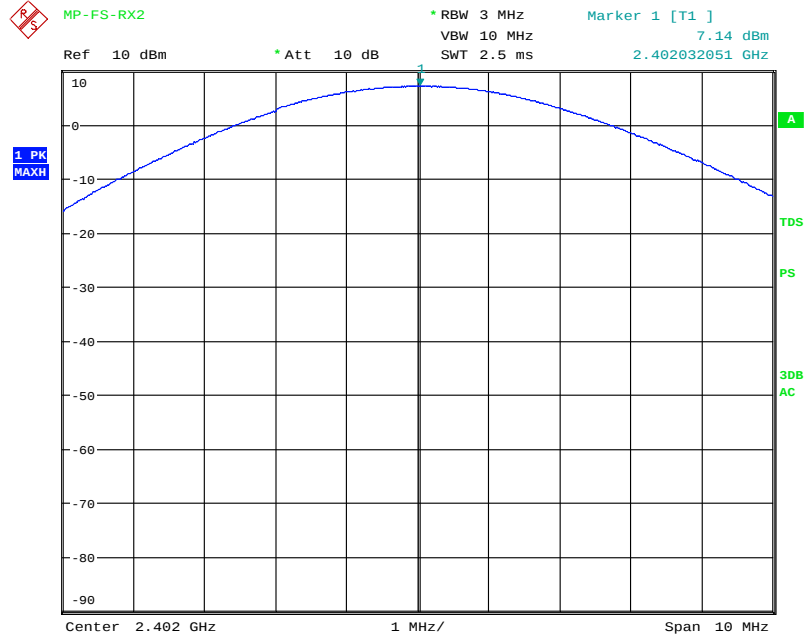


Channel Frequency (MHz)	Power Level	Power	
		dBm	mW
2402	12	7.14	5.1761
2441	12	5.77	3.7757
2480	12	4.97	3.1405

Note: The insertion loss was compensated for in the receiver.

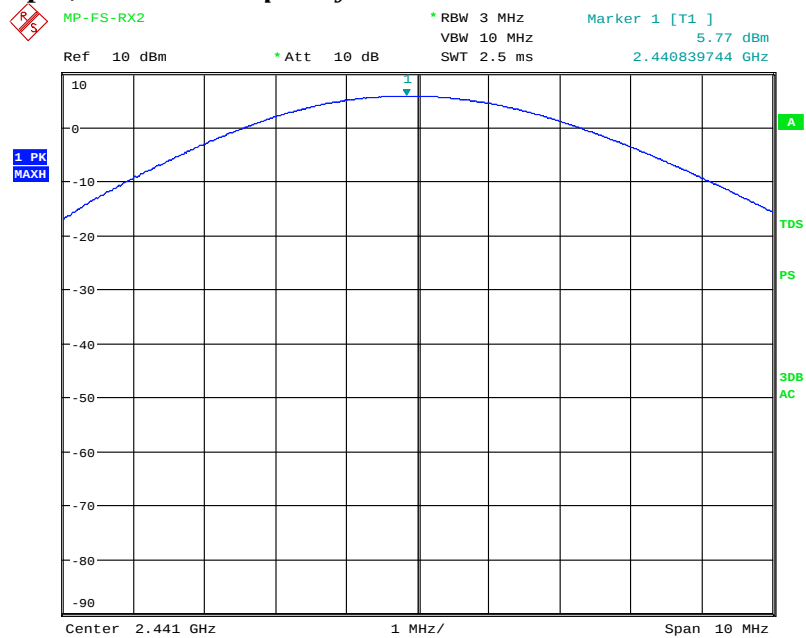


Power Output, Channel Frequency 2402 MHz:



Date: 24.MAY.2011 11:18:32

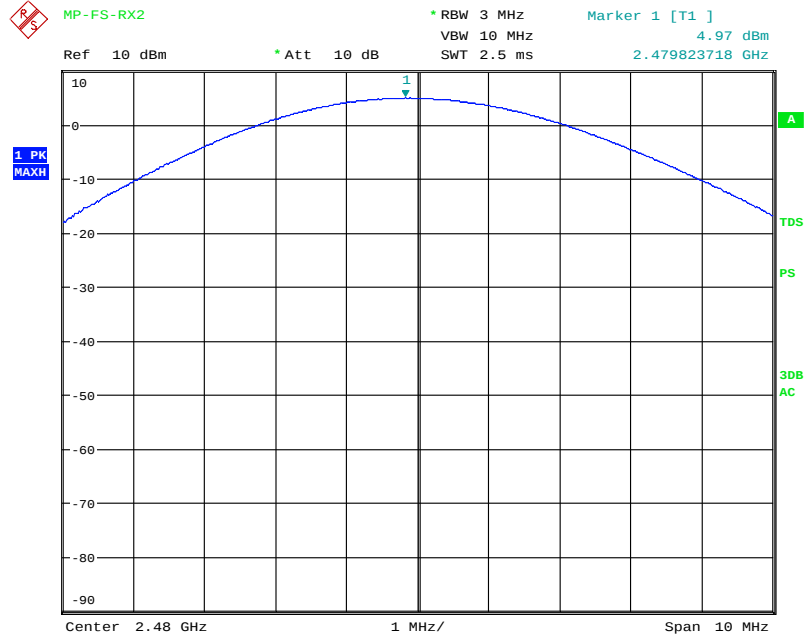
Power Output, Channel Frequency 2441 MHz:



Date: 24.MAY.2011 11:16:13



Power Output, Channel Frequency 2480 MHz:



Date: 24.MAY.2011 11:17:17

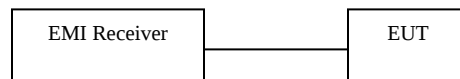


3.8 *Band Edge*

Performance Criterion: In any 100 kHz bandwidth outside the frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

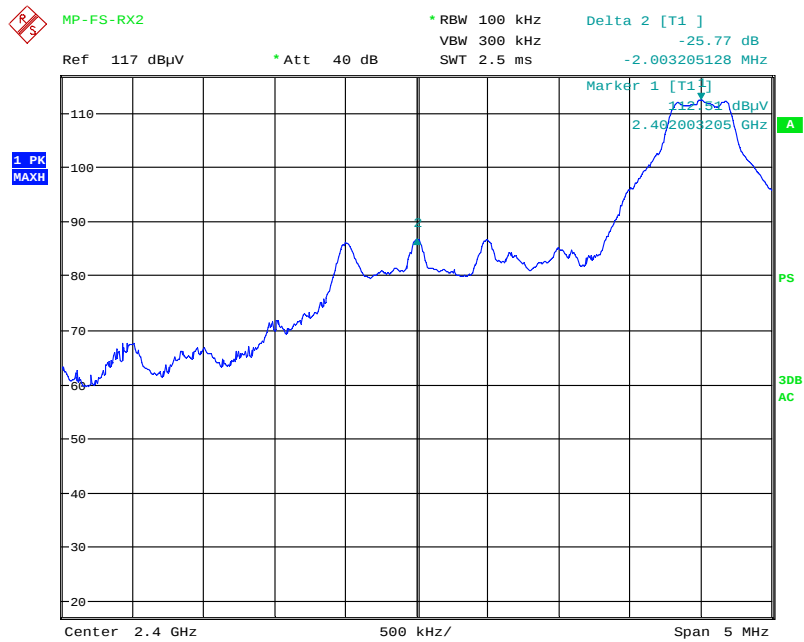
Test Results: Complies

Test Details: Refers to the following block diagram and receiver screen captures

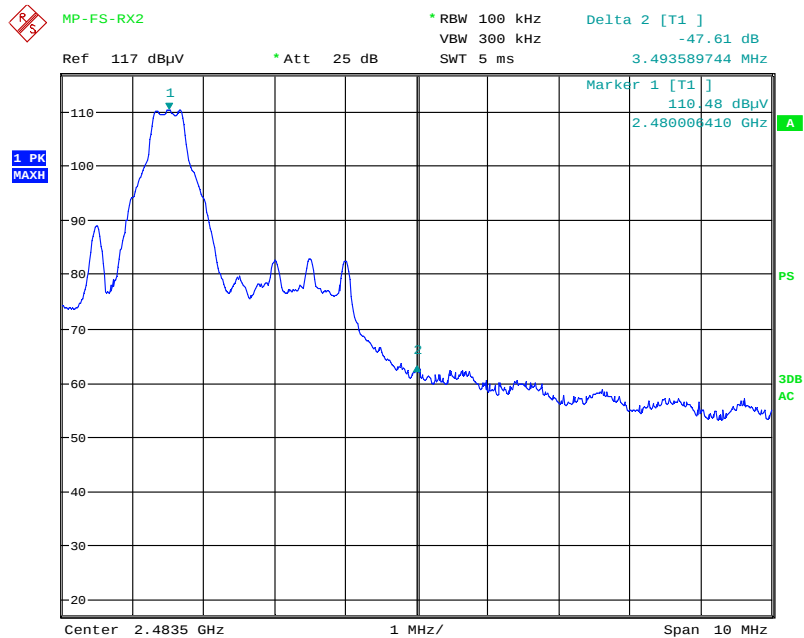




Band Edge:



Date: 24.MAY.2011 10:53:31



Date: 24.MAY.2011 10:56:32



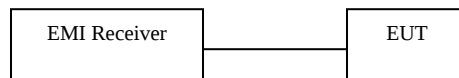
3.9 *Spurious Conducted Emissions*

Performance Criterion: In any 100 kHz bandwidth outside the frequency band, the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band.

Test Results: Complies

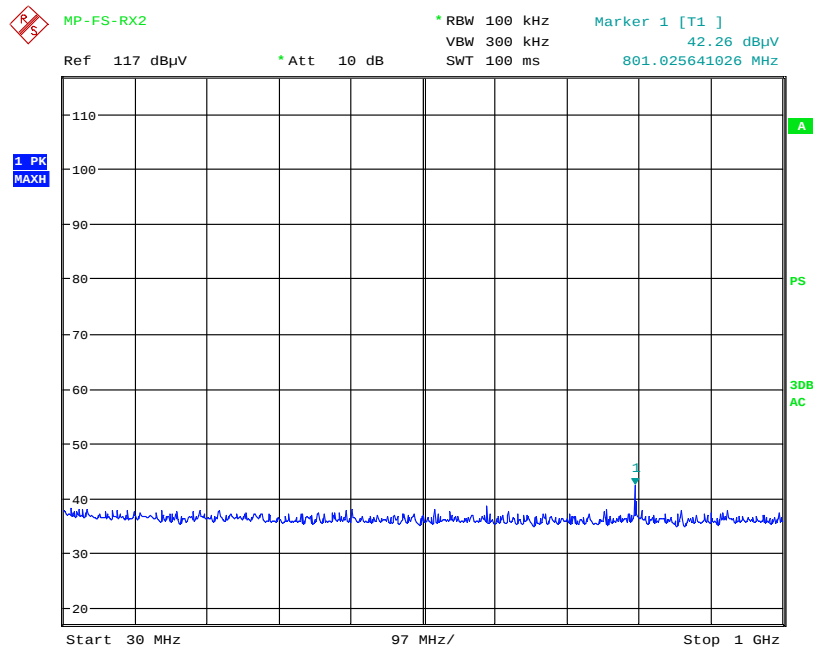
Test Details: Refers to the following block diagram and receiver screen captures

Note: The EUT was tested in a continuous transmit mode with maximum power level. The RF level in the screen captures is relative and is not the indication of RF output power.

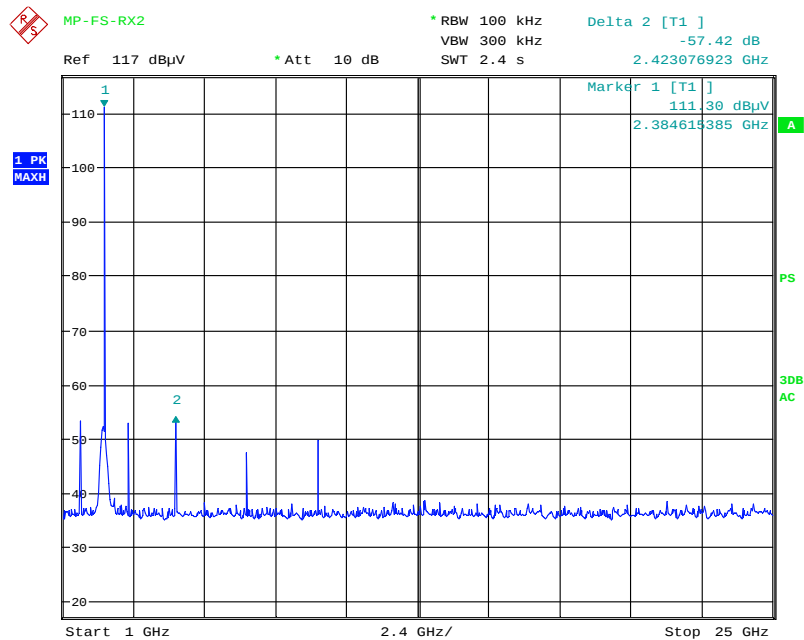




Conducted Spurious Emission – Channel Frequency 2402 MHz



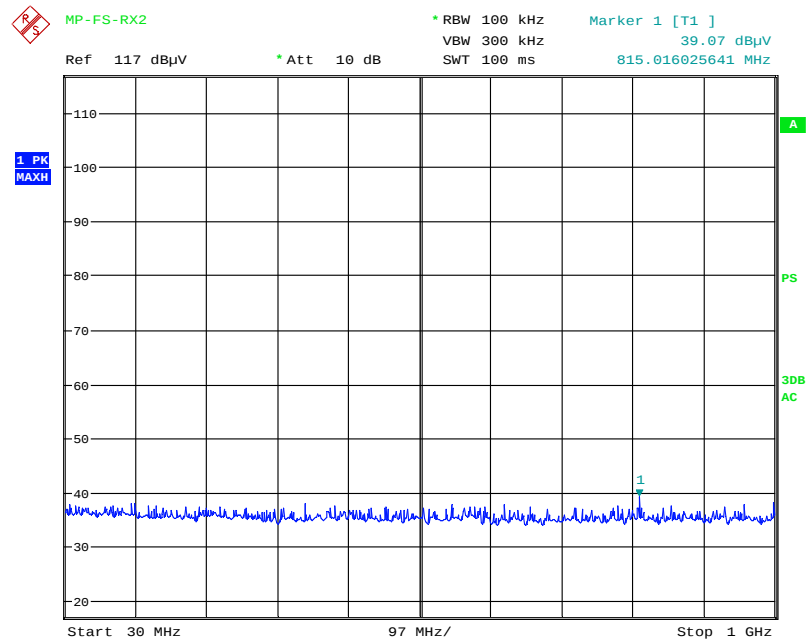
Date: 24.MAY.2011 11:01:38



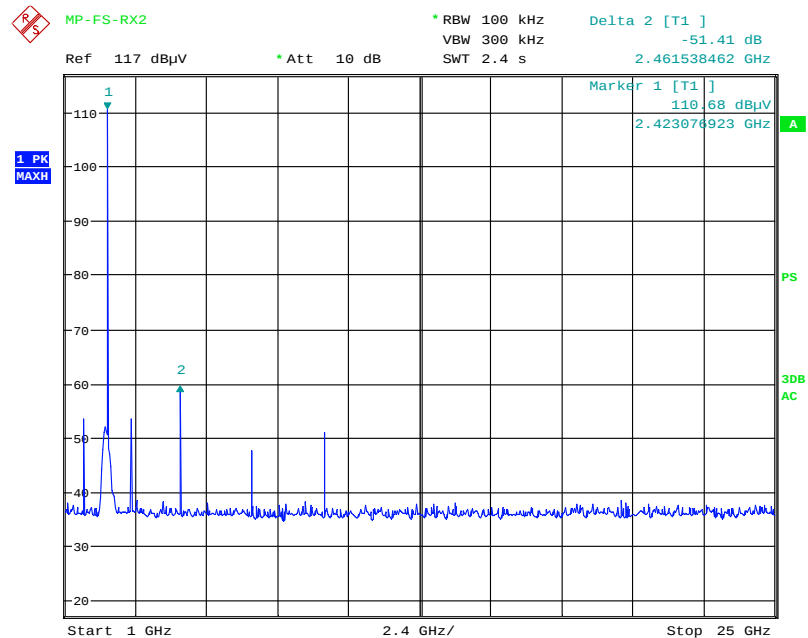
Date: 24.MAY.2011 11:02:23



Conducted Spurious Emission – Channel Frequency 2441 MHz



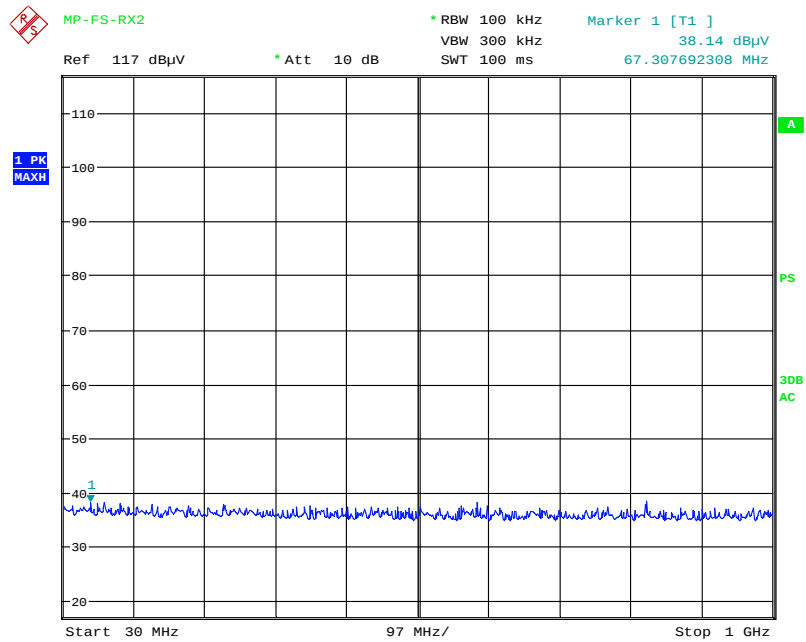
Date: 24.MAY.2011 11:00:20



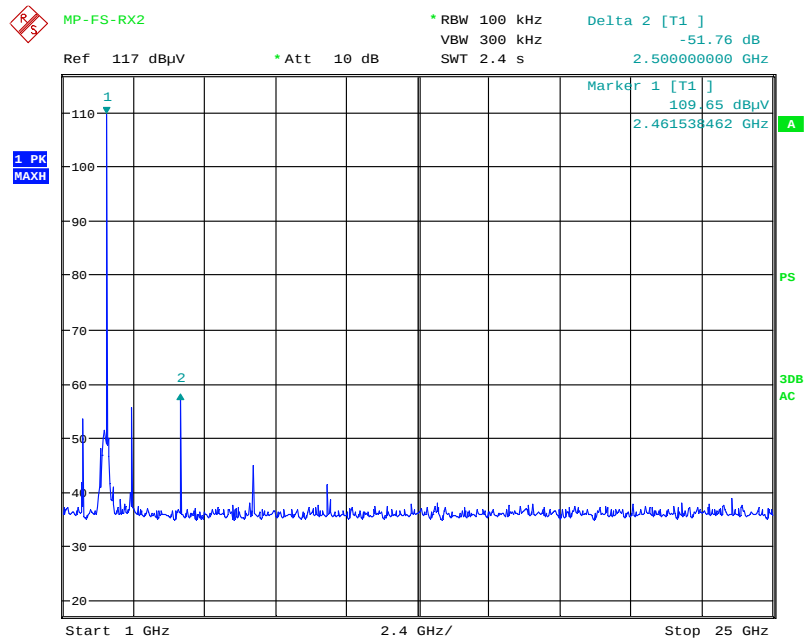
Date: 24.MAY.2011 10:59:50



Conducted Spurious Emission – Channel Frequency 2480 MHz



Date: 24.MAY.2011 10:58:07



Date: 24.MAY.2011 10:58:46

3.10 *Spurious Radiated Emissions*

Performance Criterion: Radiated spurious emissions which fall in the restricted bands must comply with the radiated emission limits specified in FCC § 15.209(a) and Table 2 of IC RSS-210.

Test Results: Complies

Test Details: Radiated spurious emission was performed from 30 MHz to the tenth harmonics of the carrier. For each scan of radiated emission measurement, the procedures for maximizing emissions were followed. The EUT was rotated and antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. All radiated emission measurements, up to 18 GHz, were performed at 3-meter distance between an antenna and the EUT. All radiated emission measurements, above 18 GHz, were performed at 1-meter distance between an antenna and the EUT.

The peak level of radiated emissions above 1 GHz was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 3 MHz.

For harmonics/spurs that fall in the restricted band, the radiated spurious emissions above 1 GHz were measured with RBW of 1 MHz, VBW of 10 Hz, and Sweep of Auto. The unit was configured for continuous operation.

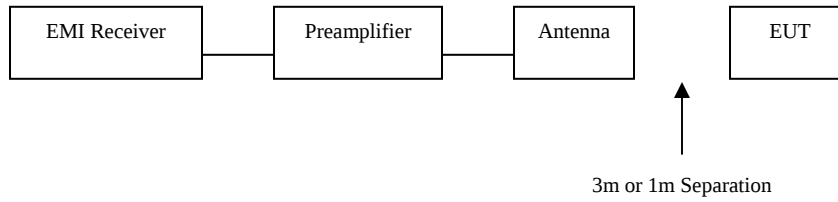
EUT was tested with antenna at 45° and vertical orientation.



Antenna Orientation

Refers to the following block diagram and data table for test data. Antenna factor, cable loss, and preamplifier gain were compensated for in the receiver. A factor of 20 dB/decade applies to measurements made at a closer distance than the limit distance before comparing to the limits.

Duty cycle calculation and screen shots are included in Theory of Operation.



MP-FS-RX2, Radiated Spurious Emissions

Antenna Polarization	Frequency (MHz)	Channel No.	Power Setting (Level)	EUT Ant Orientation	Measured Data (dBuV/m)	Duty Cycle Correction Factor (dB)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turntable Degree	Detector
V	2402	2402	12	V, V	102.63	-	-	-	-	106.3	89.5	AVE
V	2402	2402	12	V, V	107.90	-	-	-	-	106.3	89.5	PK
V	2390	2402	12	V, V	41.48	30	11.48	54	42.52	106.3	89.5	AVE
V	2390	2402	12	V, V	63.99	0	63.99	74	10.01	106.3	89.5	PK
V	4804	2402	12	V, V	47.14	30	17.14	54	36.86	133.9	71.2	AVE
V	4804	2402	12	V, V	57.55	0	57.55	74	16.45	133.9	71.2	PK
V	12010 (NF)	2402	12	V, V	46.59	30	16.59	54	37.41	-	-	AVE
V	12010 (NF)	2402	12	V, V	58.59	0	58.59	74	15.41	-	-	PK
V	19216 (NF)*	2402	12	V, V	39.24	30	9.24	54	44.76	-	-	AVE
V	19216 (NF)*	2402	12	V, V	51.87	0	51.87	74	22.13	-	-	PK
V	2441	2441	12	V, V	100.67	-	-	-	-	129.6	283.5	AVE
V	2441	2441	12	V, V	105.88	-	-	-	-	129.6	283.5	PK
V	4882	2441	12	V, V	46.62	30	16.62	54	37.38	115.3	288.7	AVE
V	4882	2441	12	V, V	57.83	0	57.83	74	16.17	115.3	288.7	PK
V	7323 (NF)	2441	12	V, V	40.88	30	10.88	54	43.12	-	-	AVE
V	7323 (NF)	2441	12	V, V	53.19	0	53.19	74	20.81	-	-	PK
V	12205 (NF)	2441	12	V, V	47.05	30	17.05	54	36.95	-	-	AVE
V	12205 (NF)	2441	12	V, V	57.42	0	57.42	74	16.58	-	-	PK
V	19528 (NF)*	2441	12	V, V	39.31	30	9.31	54	44.69	-	-	AVE
V	19528 (NF)*	2441	12	V, V	52.46	0	52.46	74	21.54	-	-	PK
V	2480	2480	12	V, V	100.07	-	-	-	-	125.3	133.5	AVE
V	2480	2480	12	V, V	108.29	-	-	-	-	125.3	133.5	PK
V	2483.5	2480	12	V, V	49.97	30	19.97	54	34.03	125.3	133.5	AVE**
V	2483.5	2480	12	V, V	58.19	0	58.19	74	15.81	125.3	133.5	PK**
V	4960	2480	12	V, V	49.06	30	19.06	54	34.94	158.9	279.9	AVE
V	4960	2480	12	V, V	59.05	0	59.05	74	14.95	158.9	279.9	PK
V	7440 (NF)	2480	12	V, V	41.01	30	11.01	54	42.99	-	-	AVE
V	7440 (NF)	2480	12	V, V	51.99	0	51.99	74	22.01	-	-	PK
V	12400 (NF)	2480	12	V, V	47.10	30	17.10	54	36.90	-	-	AVE
V	12400 (NF)	2480	12	V, V	58.85	0	58.85	74	15.15	-	-	PK
V	19840 (NF)*	2480	12	V, V	39.02	30	9.02	54	44.98	-	-	AVE
V	19840 (NF)*	2480	12	V, V	51.84	0	51.84	74	22.16	-	-	PK
V	22320 (NF)*	2480	12	V, V	39.78	30	9.78	54	44.22	-	-	AVE
V	22320 (NF)*	2480	12	V, V	52.06	0	52.06	74	21.94	-	-	PK

NF: Noise Floor

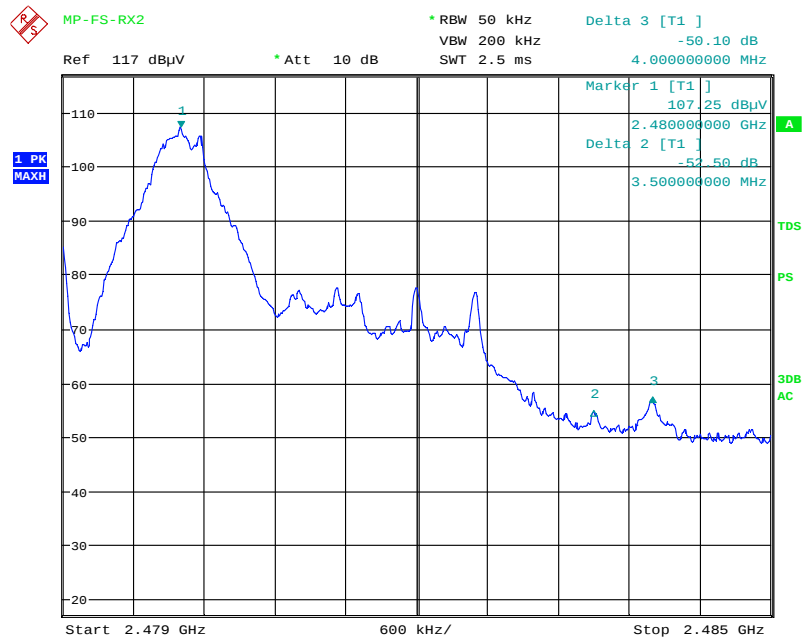
*: Tested at 1m **: Marker-Delta Method

Tested: May 23, 2011

Tested by: Grace Lin



Marker-Delta Screen Capture:



Date: 23.MAY.2011 10:34:30

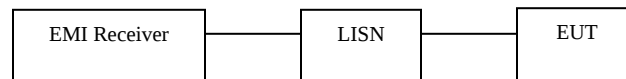


3.11 Transmitter AC Power Line Conducted Emissions

Performance Criterion: AC power line conducted emissions shall not exceed the limits specified in FCC § 15.107 and Table 2 of IC RSS-Gen.

Test Results: Complies.

Test Details: AC power line conducted emissions were performed from 150 kHz to 30 MHz and measured with a resolution bandwidth of 9 kHz. EUT was set in the receiving mode. Refers to the following block diagram, data, and screen captures (using a peak detector).



MP-FS-RX2 Conducted Emissions:

Line 1, TX

Frequency (MHz)	Measured Level (dBuV)		Limit (dBuV)		Margin (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	
0.176	37.5	34.2	64.7	54.7	20.5
0.2347	34.8	31.8	62.3	52.3	20.5
0.352	36.1	34.1	58.9	48.9	14.8
0.4107	32.5	29.3	57.6	47.6	18.3
0.4694	29.9	27.5	56.5	46.5	19.1
0.528	25.8	22.1	56.0	46.0	23.9

Date of Test: May 13, 2011

MP-FS-RX2 Conducted Emissions:

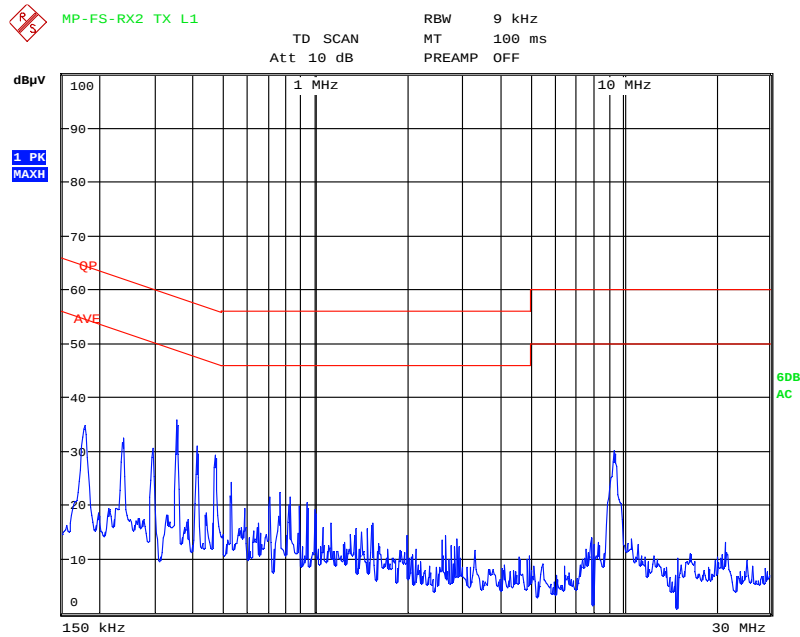
Line 2, TX

Frequency (MHz)	Measured Level (dBuV)		Limit (dBuV)		Margin (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	
0.176	44.2	36.8	64.7	54.7	20.5
0.2347	39.5	34.3	62.3	52.3	22.8
0.352	38.8	36.8	58.9	48.9	20.1
0.4107	34.7	31.4	57.6	47.6	23.0
0.4694	31.8	29.7	56.5	46.5	24.8
0.528	27.5	24.6	56.0	46.0	21.4

Date of Test: May 13, 2011

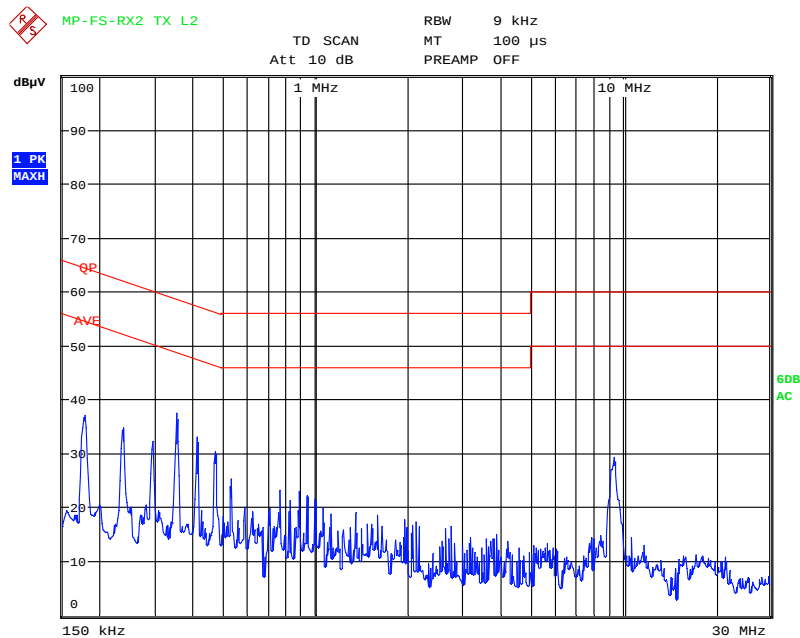


Line 1:



Date: 13.MAY.2011 14:05:26

Line 2:



Date: 13.MAY.2011 11:46:17



3.12 Receiver Radiated Emissions

Performance Criterion: Receiver radiated emissions must meet the requirements of Table 1 of IC RSS-Gen. Receivers operating above 960 MHz or below 30 MHz are exempt from complying with the technical provisions of FCC Part 15 Subpart B.

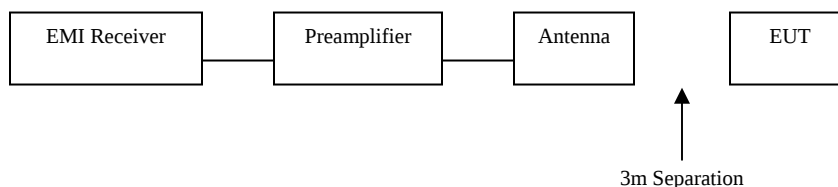
Test Results: Complies

Test Details: Radiated emission was performed from 30 MHz to the fifth harmonics of the carrier. For each scan of radiated emission measurement, the procedures for maximizing emissions were followed. The EUT was rotated and antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. All radiated emission measurements, up to 18 GHz, were performed at 3-meter distance between an antenna and the EUT.

For the measurement of radiated emission at the frequency range 30-1000MHz, measurement was made by using a quasi-peak detector with a 120 kHz bandwidth. For the frequency range above 1 GHz, measurement was made using an average detector with a 1 MHz bandwidth.

EUT was tested with antenna at vertical orientation.

Refers to the following block diagram, data table, and receiver screen captures for test data. Antenna factor, cable loss, and preamplifier gain were compensated for in the receiver.



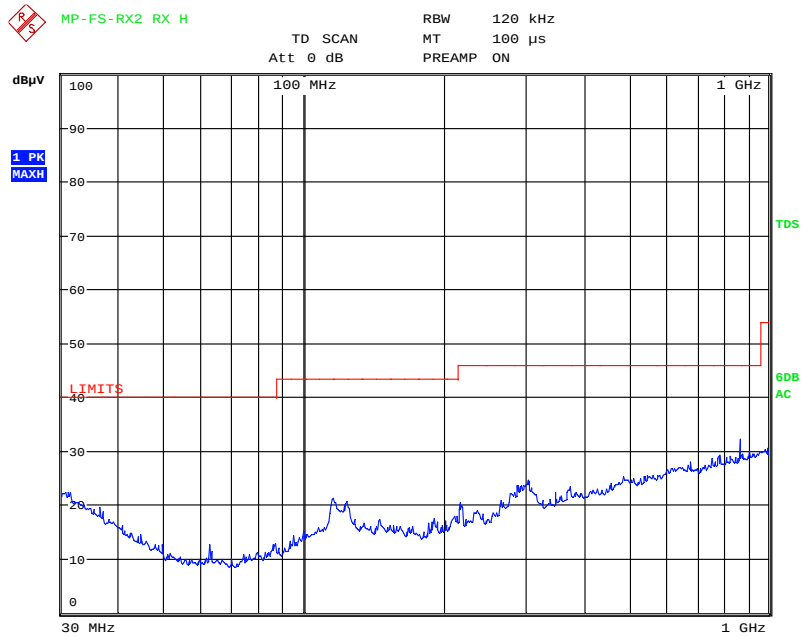
Radiated Emissions, MP-FS-RX2, Receiver

Antenna Polarization	Frequency (MHz)	Measured Data (dBuV/m)	FCC Class B Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turntable Degree	Turntable Degree
V	120.45	20.9	43.5	22.6	100.0	123.8	123.8
H	869.81	31.4	46	14.6	146.8	107.6	107.6
V	1628.25	43.0	54	11.0	117.3	205.5	205.5
V	1628.25	48.2	74	25.8	117.3	205.5	205.5

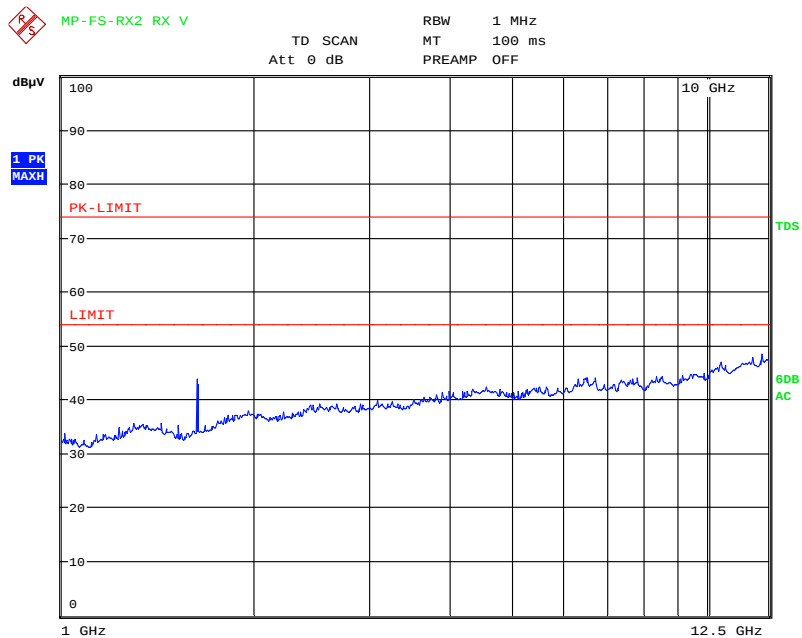
*All other emissions were at least 20 dB below the limits

Tested by: Grace Lin

Date of Test: May 13-16, 2011



Date: 13.MAY.2011 14:55:13



Date: 16.MAY.2011 10:50:39

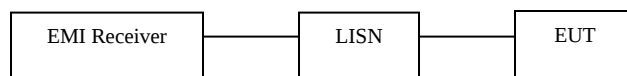


3.13 Receiver AC Power Line Conducted Emissions

Performance Criterion: AC power line conducted emissions shall not exceed the limits specified in FCC § 15.107 and Table 2 of IC RSS-Gen.

Test Results: Complies.

Test Details: AC power line conducted emissions were performed from 150 kHz to 30 MHz and measured with a resolution bandwidth of 9 kHz. EUT was set in the receiving mode. Refers to the following block diagram, data, and screen captures (using a peak detector).



MP-FS-RX2 Conducted Emissions:

Line 1, Receiver

Frequency (MHz)	Measured Level (dBuV)		Limit (dBuV)		Margin (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	
0.176	38.4	34.8	64.7	54.7	19.8
0.2347	35.8	32.9	62.3	52.3	19.4
0.352	35.9	34.0	58.9	48.9	14.9
0.4107	34.9	32.6	57.6	47.6	15.0
0.4694	29.9	27.7	56.5	46.5	18.9
0.528	26.9	23.6	56.0	46.0	22.4

Date of Test: May 13, 2011

MP-FS-RX2 Conducted Emissions:

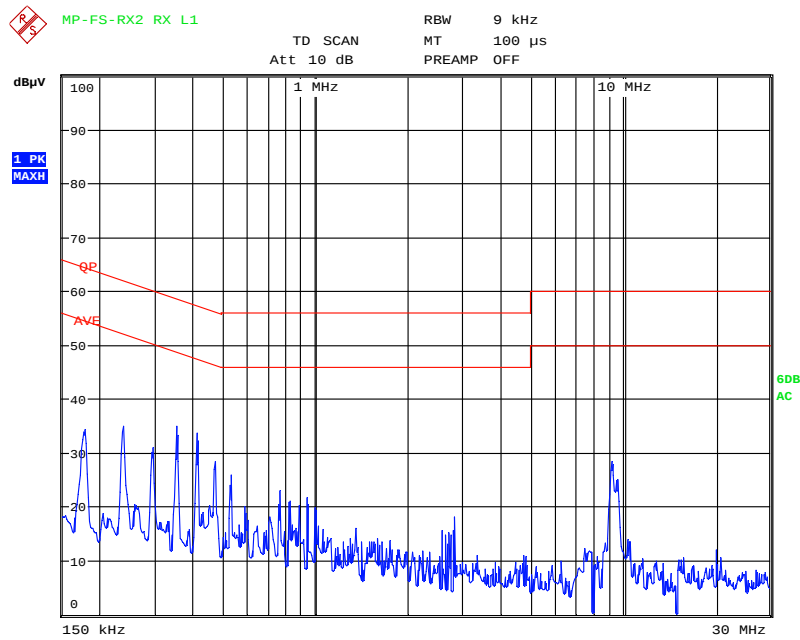
Line 2, Receiver

Frequency (MHz)	Measured Level (dBuV)		Limit (dBuV)		Margin (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	
0.176	44.0	36.6	64.7	54.7	20.7
0.2347	39.6	34.5	62.3	52.3	22.7
0.352	37.9	36.0	58.9	48.9	21.0
0.4107	36.1	34.0	57.6	47.6	21.6
0.4694	31.5	29.4	56.5	46.5	25.0
0.528	28.1	25.6	56.0	46.0	20.4

Date of Test: May 13, 2011

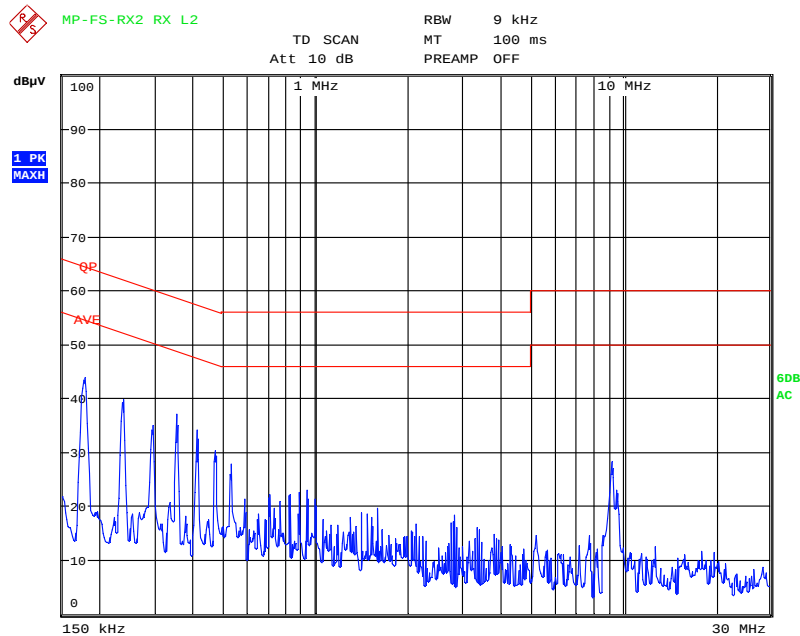


Line 1:



Date: 13.MAY.2011 11:29:55

Line 2:



Date: 13.MAY.2011 11:41:41