



Test Report

FCC Part 15, Subpart C, Section 15.247 Industry Canada RSS-210, Issue 7

Report Number: CWD6609-Cert

Model: CWD6609

FCC ID: EROCWD6609
IC: 5683C-CWD6609

Date: May 8, 2009 (Revised May 20, 2009)

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Date: May 8, 2009

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

Date: May 8, 2009



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1. General Description

1.1 Product Description

The equipment under test (EUT) is a Crestron 2.4GHz two-way RF transceiver module, model: CWD6609, serial number: CNA6336255.

1.2 Test Methodology

Measurements were performed according to the following procedures and standards:

- 1) ANSI C63.4: 2003
- 2) FCC Procedure, "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005
- 3) Industry Canada RSS-Gen Issue 2
- 4) Industry Canada RSS-210 Issue 7
- 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, File: 46405-5683.



1.4 Test Equipment

Description	Model	Serial No.	Frequency Range	Calibration Date
R&S EMI Receiver	ESU40	100076	20 Hz – 40 GHz	Dec. 12, 2008
Teseq Bilog Antenna	CBL 6112D	25231	30 MHz – 2 GHz	Jan. 12, 2009
ETS-Lindgren Double Ridge Horn Antenna	3117	00092366	1 GHz – 18 GHz	Aug. 14, 2008
R&S Preamplifier	TS-PR18	100044	30 MHz – 18 GHz	Feb. 11, 2009
ETS-Lindgren Standard Gain Horn Antenna	3160-09	00078911	18 GHz – 26.5 GHz	Apr. 3, 2009
R&S Preamplifier	TS-PR26	100030	18 GHz – 26.5 GHz	Jan. 21, 2009
Solar Electronics LISN	9252-50-R-24-N	068545	10 kHz – 50 MHz	Feb. 16, 2009

1.5 Evaluation Summary

Rule Section		Description/Parameters	Results
FCC	IC		
§15.203	N/A	Antenna Requirement	Complies
§15.247(a)(2)	§A8.2(a) of RSS-210	6 dB Bandwidth, 500 kHz	Complies
N/A	§4.6.1 of RSS-Gen	99% Occupied Bandwidth	Complies
§15.247(b)(3)	§A8.4(4) of RSS-210	Power Output, conducted, 1 Watt (30dBm)	Complies
§15.247(d)	§2.1, §A8.5 of RSS-210	Band Edge	Complies
§15.247(d)	§A8.5 of RSS-210	Conducted Spurious Emissions, 20 dBc	Complies
§15.247(e)	§A8.2(b) of RSS-210	Power Spectral Density (PSD), 8 dBm in any 3 kHz band.	Complies
§15.247(i)	§5.5 of RSS-Gen	RF Safety	Complies
§15.207	§7.2.2 of RSS-Gen	AC Power Line Conducted Emissions	Complies
§15.205, §15.209, §15.247(d)	§2.2, §2.7, §A8.5 of RSS-210	Radiated Spurious Emissions	Complies
§15.101(b)	§6 of RSS-Gen	Receiver Radiated Emission	Complies

Note:

The channels selected for test were 11, 18, and 26.

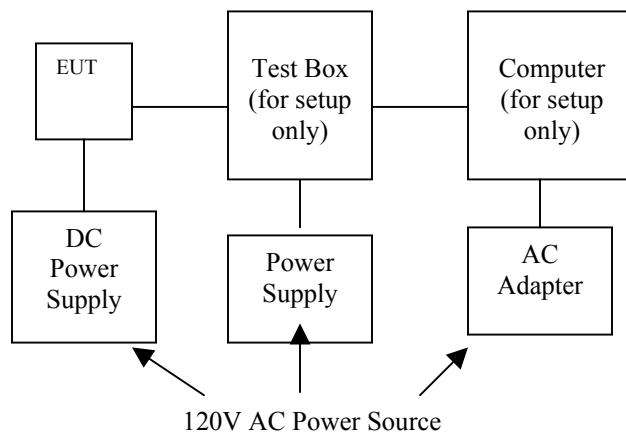
2. System Test Configuration

2.1 Justification

The EUT was connected to a test box. A DC power supply supplied power to the EUT. A computer supplied test commands through the test box.

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. Channels 11 (2405 MHz), 18 (2440 MHz), and 26 (2480 MHz) were selected for test.

2.4 Cables

Qty	Description	Length (m)	From - To	Shielded/ Unshielded
1	Power Cord	1.5	Power Source – Computer	Unshielded
1	Cat 6	2.2	Computer – Test Box	Unshielded
1	10-conductor Flat Cable	0.3	Test Box – EUT	Unshielded



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	PP02X	11109700981
2	AC Adapter	DELL	LA90PS0-00	CN-0DF266-71615-68A-2AB1
3	Test Box	ember	Not Labeled	ember05
4	Power Supply	CUI	3A-161WP12	Not Labeled
5	DC Power Supply	BK Precision	1670	281-2152

2.7 *Equipment Modifications*

There were no modifications installed during compliance measurements.



3. Evaluation

3.1 *Antenna Requirements*

This module is validated with an Antenova Mica 2.4GHz SMD antenna. Antenna's specifications are included in a separate file.

The antennas' connectors are unique in the sense of complying with FCC §15.203, §15.204(b), and §15.204(c).

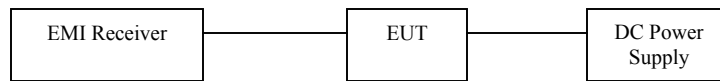


3.2 6 dB Bandwidth

Performance Criterion: The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Results: Complies

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 of 3 at boost mode.

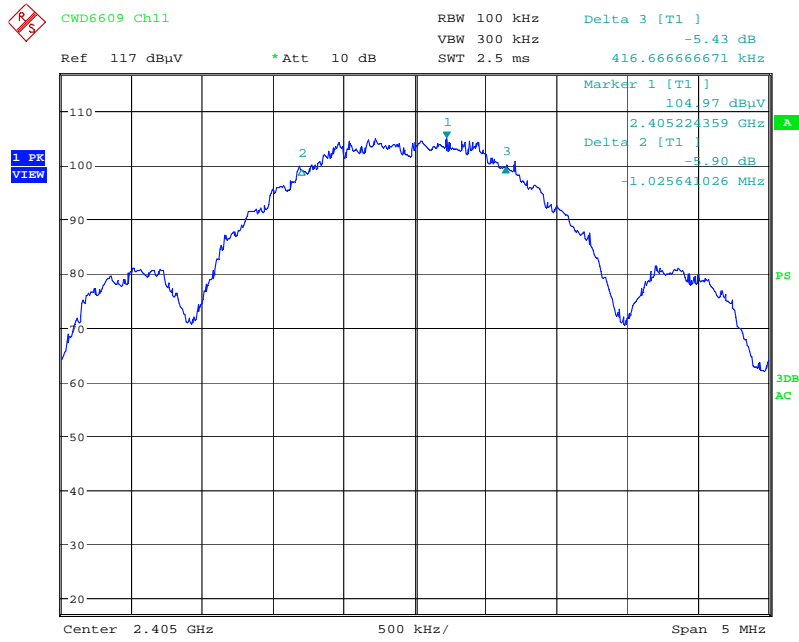


Channel	Frequency (MHz)	6 dB Bandwidth (kHz)
11	2405	1442.3
18	2440	1450.3
26	2480	1434.3

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

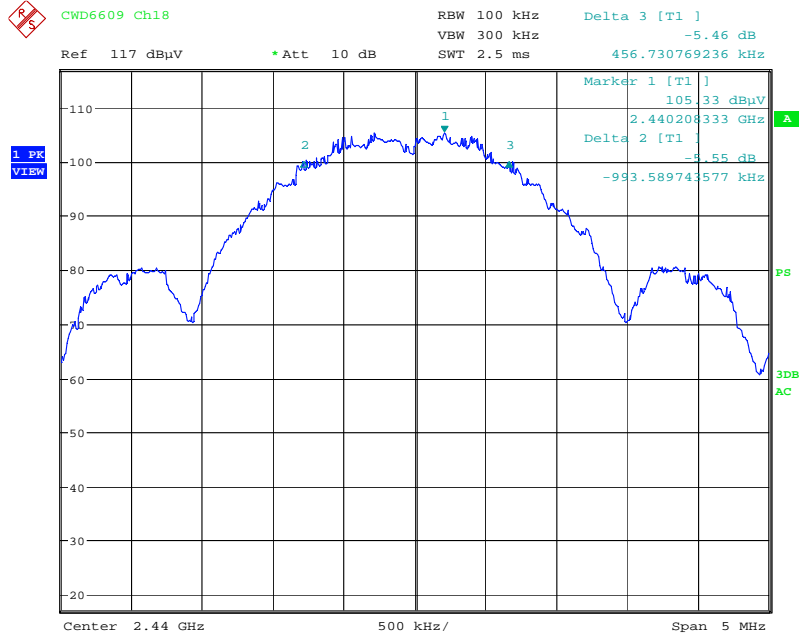


6 dB Bandwidth, Channel 11:



Date: 1.MAY.2009 15:25:27

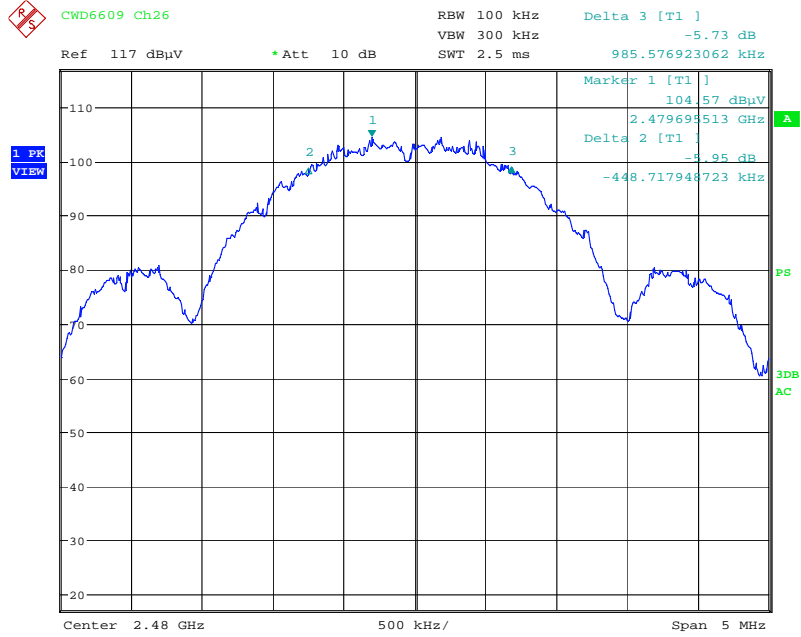
6 dB Bandwidth, Channel 18:



Date: 1.MAY.2009 15:23:30



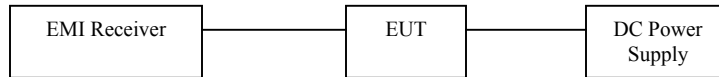
6 dB Bandwidth, Channel 26:



Date: 1.MAY.2009 15:27:42

3.3 99% Bandwidth

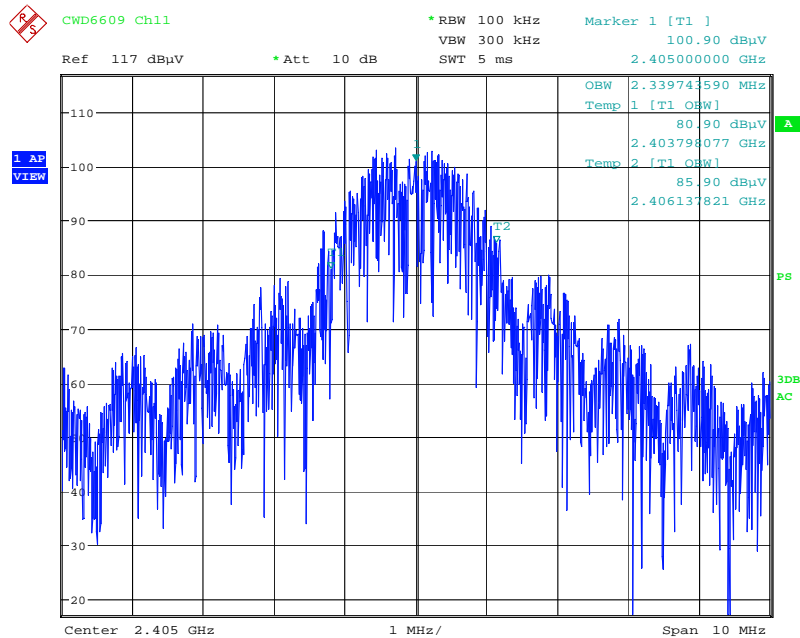
Test Details: Refers to the following block diagram, data table, and receiver screen captures. The EUT was tested in a continuous transmit mode with maximum power level of 3 at boost mode.



Channel	Frequency (MHz)	99% Bandwidth (MHz)
11	2405	2.34
18	2440	2.34
26	2480	2.24

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

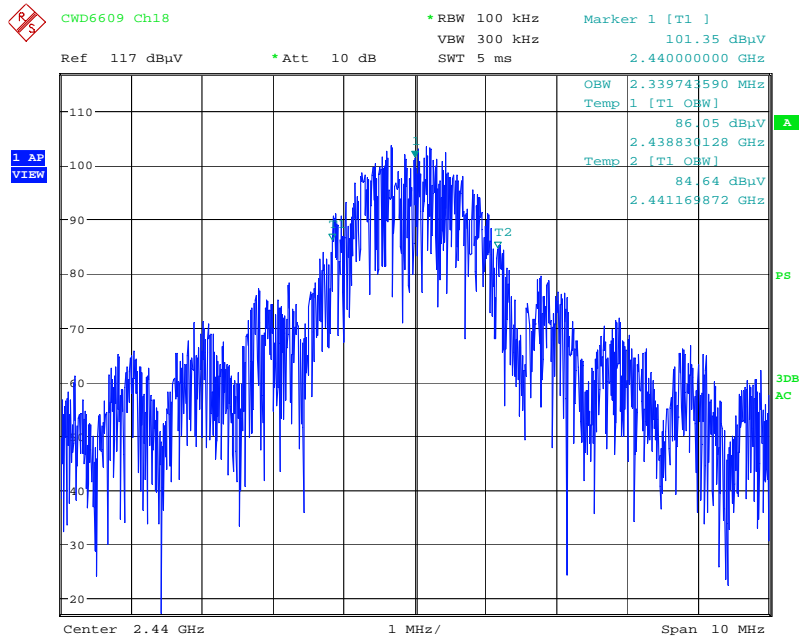
99% Bandwidth, Channel 11:



Date: 1.MAY.2009 15:33:53

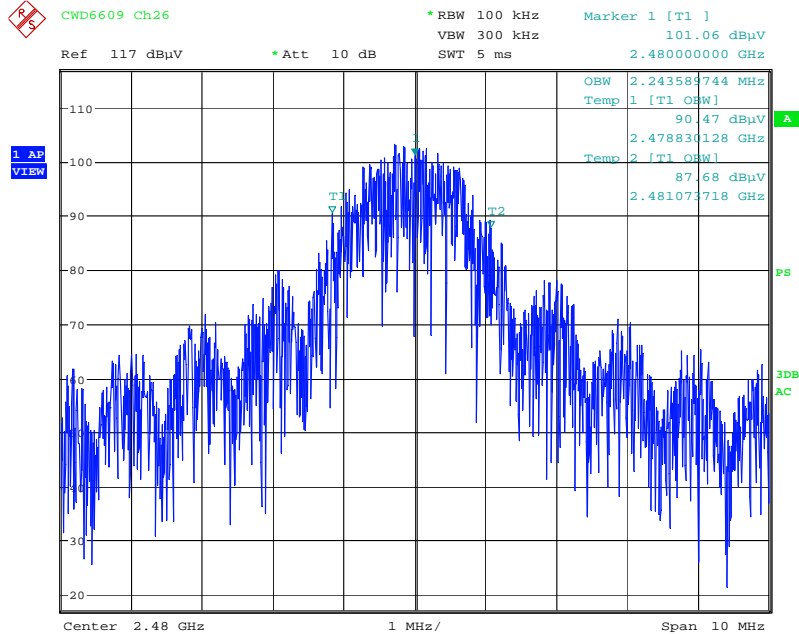


99% Bandwidth, Channel 18:



Date: 1.MAY.2009 15:31:58

99% Bandwidth, Channel 26:



Date: 1.MAY.2009 15:30:13



3.4 Power Output

Performance Criterion: 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 of 3 at boost mode. Refers to the following block diagram, data table, and receiver screen captures.

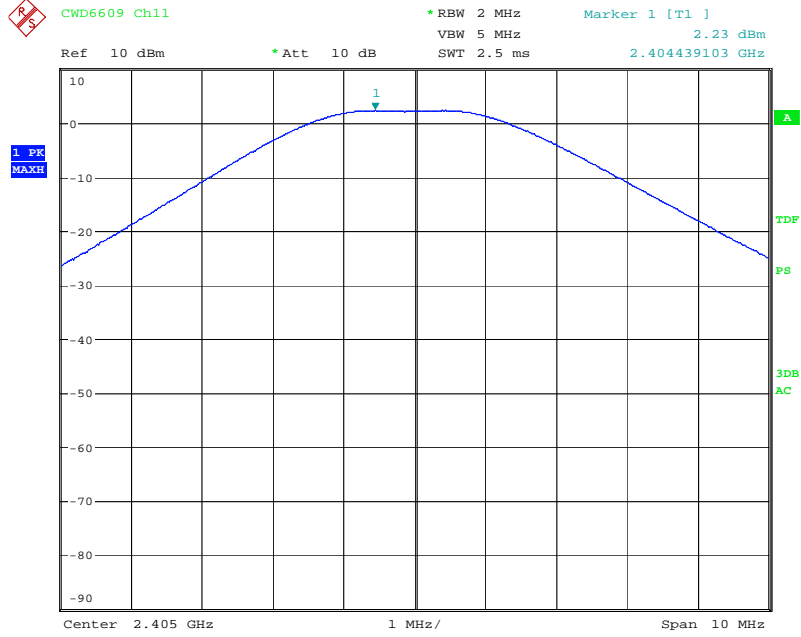


Channel	Frequency (MHz)	Power Level	Power	
			dBm	mW
11	2405	3	2.23	1.67
18	2440	3	2.22	1.66
26	2480	3	1.58	1.44

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

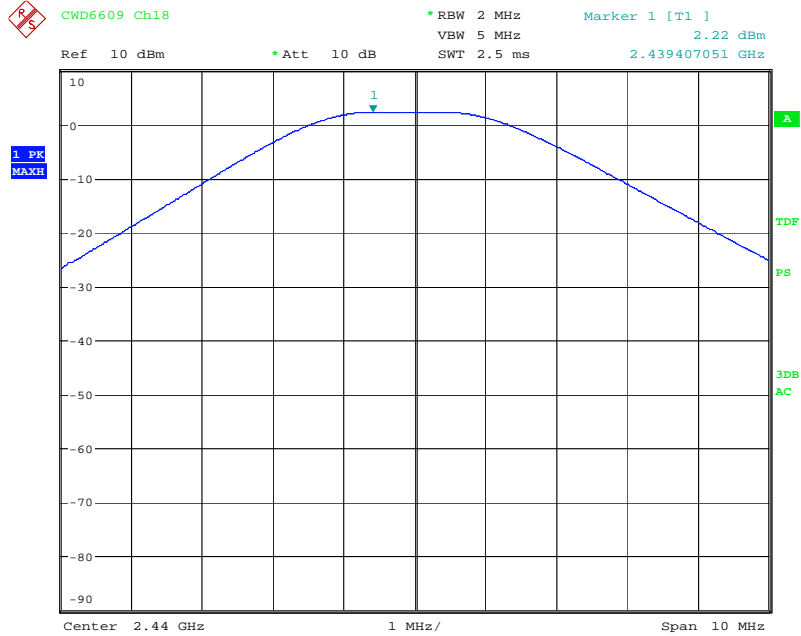


Power Output, Channel 11:



Date: 1.MAY.2009 15:39:12

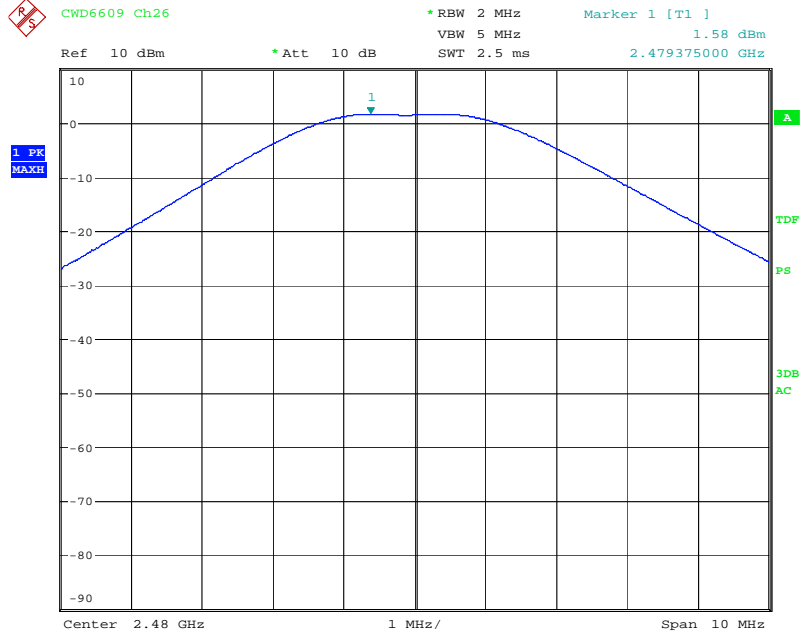
Power Output, Channel 18:



Date: 1.MAY.2009 15:40:25



Power Output, Channel 26:



Date: 1.MAY.2009 15:41:48



3.5 *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.

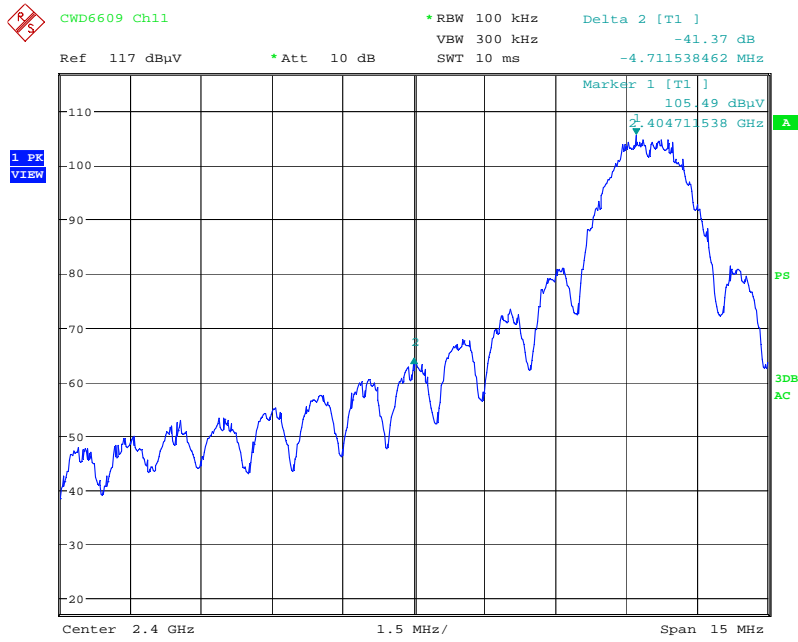
Test Results: Complies

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

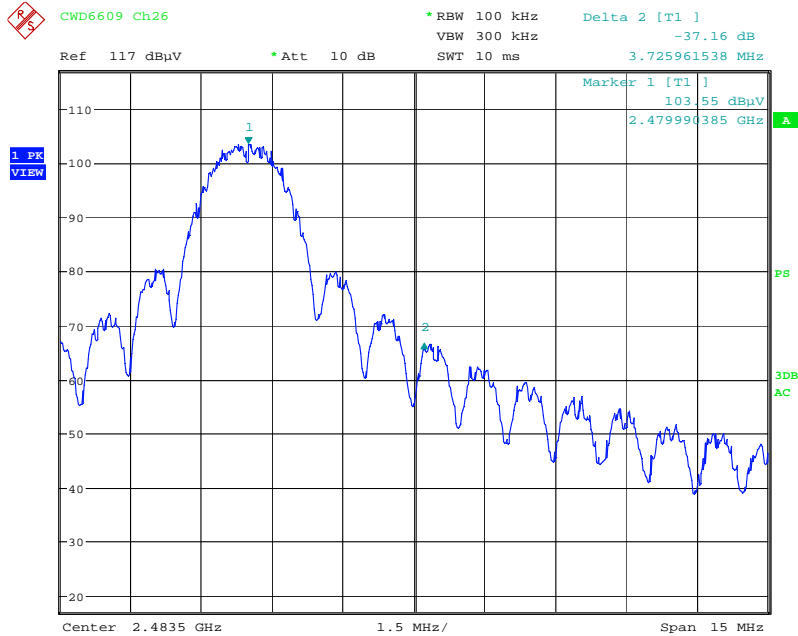




Band Edge:



Date: 5.MAY.2009 14:15:39



Date: 5.MAY.2009 14:17:19



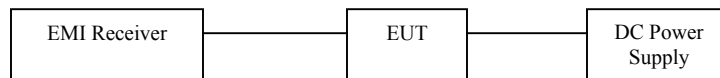
3.6 *Conducted Spurious Emissions*

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

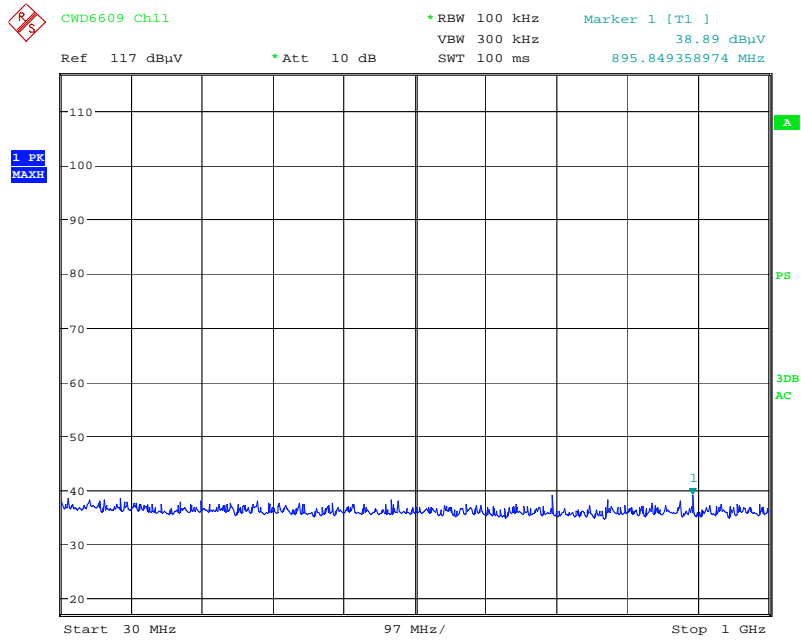
Test Details: Refers to the following block diagram and receiver screen captures

Note: The EUT was tested in a continuous transmit mode with maximum power level of 3 at boost mode. The RF level in the screen captures is relative and is not the indication of RF output power.

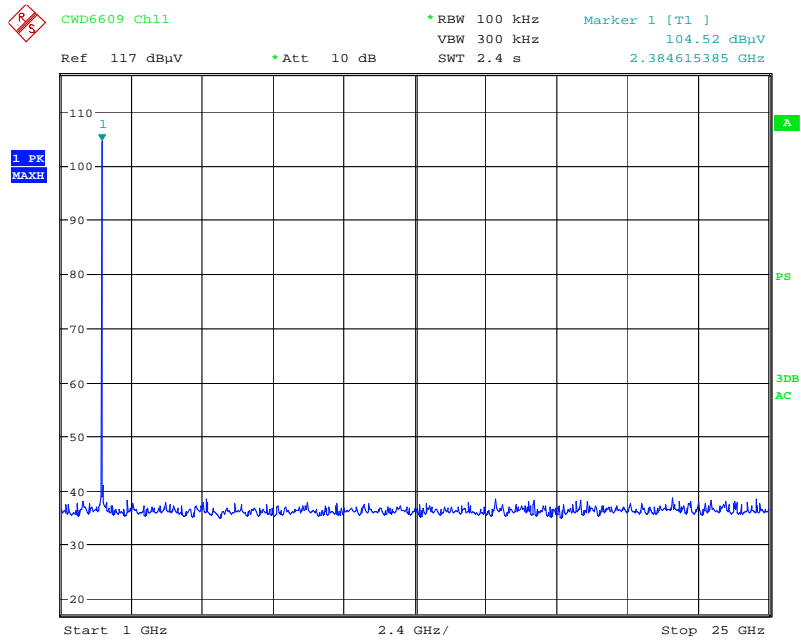




Conducted Spurious Emission – Channel 11



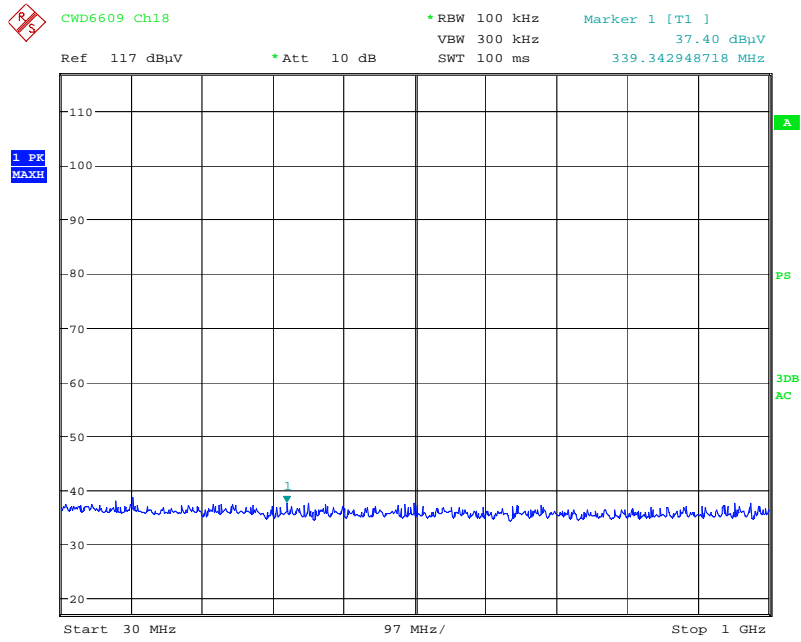
Date: 5.MAY.2009 14:28:03



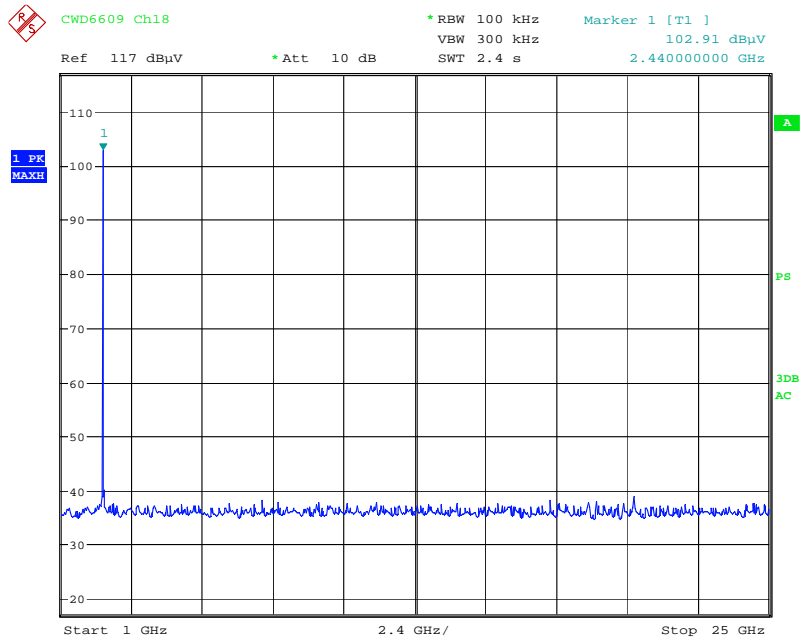
Date: 5.MAY.2009 14:27:20



Conducted Spurious Emission – Channel 18



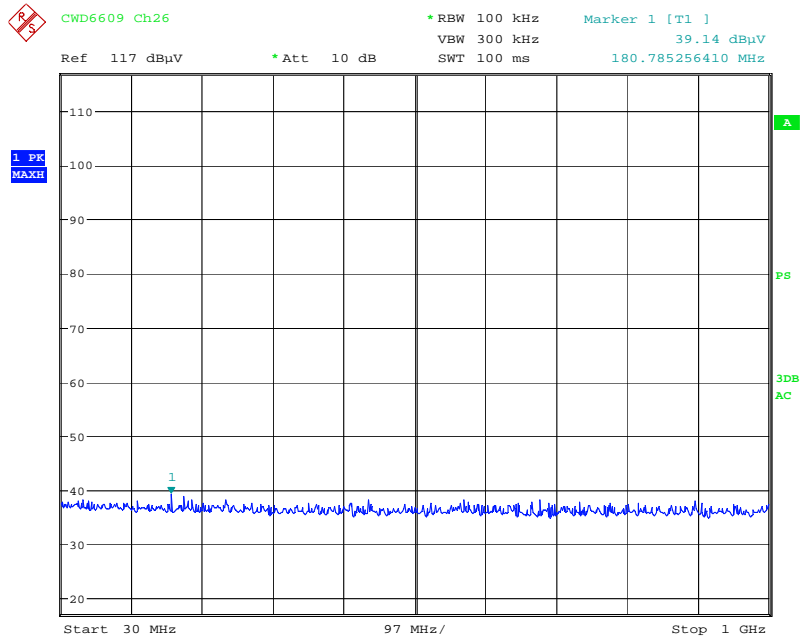
Date: 5.MAY.2009 14:23:51



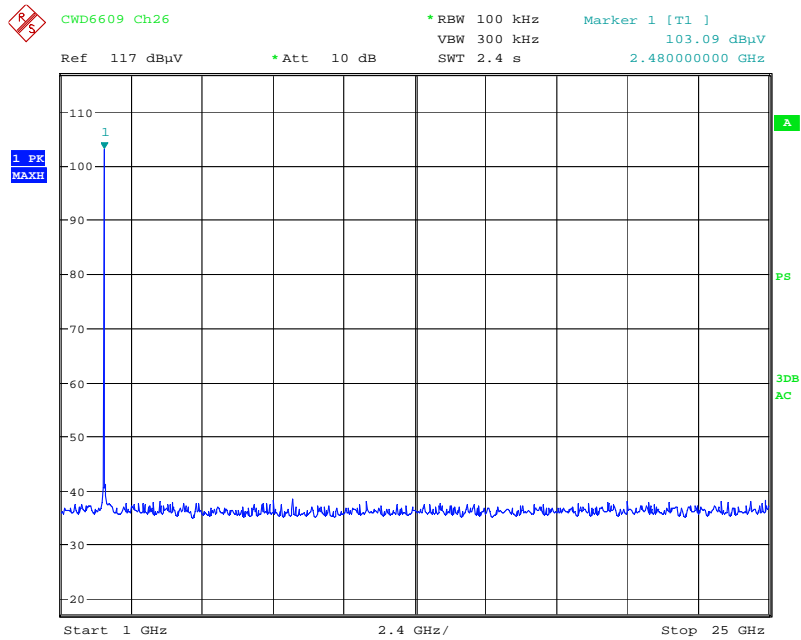
Date: 5.MAY.2009 14:24:22



Conducted Spurious Emission – Channel 26



Date: 5.MAY.2009 14:20:37



Date: 5.MAY.2009 14:21:15



3.7 Power Spectral Density

Performance Criterion: The power spectral density shall not be greater than 8 dBm in any 3 kHz band.

Test Results: Complies

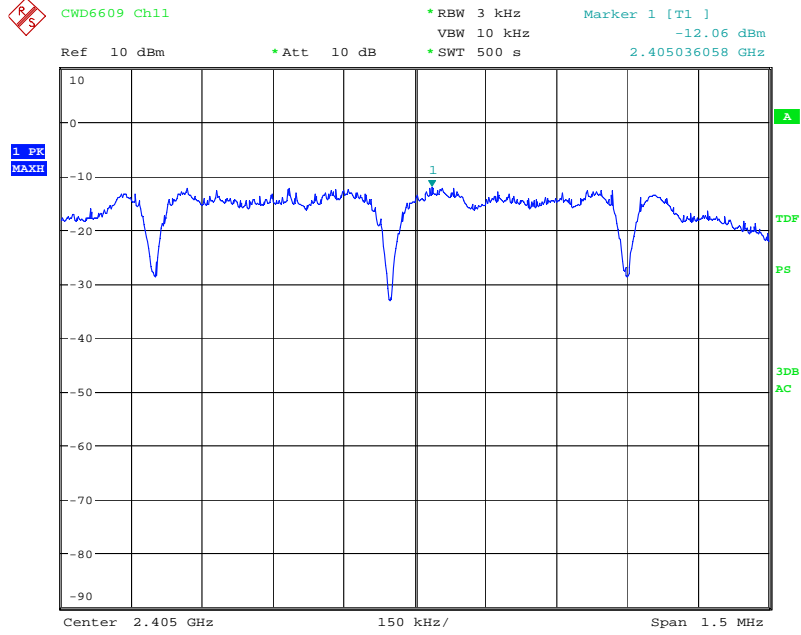
Test Details: The EUT was tested in a continuous transmit mode with maximum power level of 3. Refers to the following table and receiver screen captures. The insertion loss was compensated for in the receiver.



Channel	Frequency (MHz)	Power Spectral Density (dBm)
11	2405	-12.06
18	2440	-11.74
26	2480	-12.79

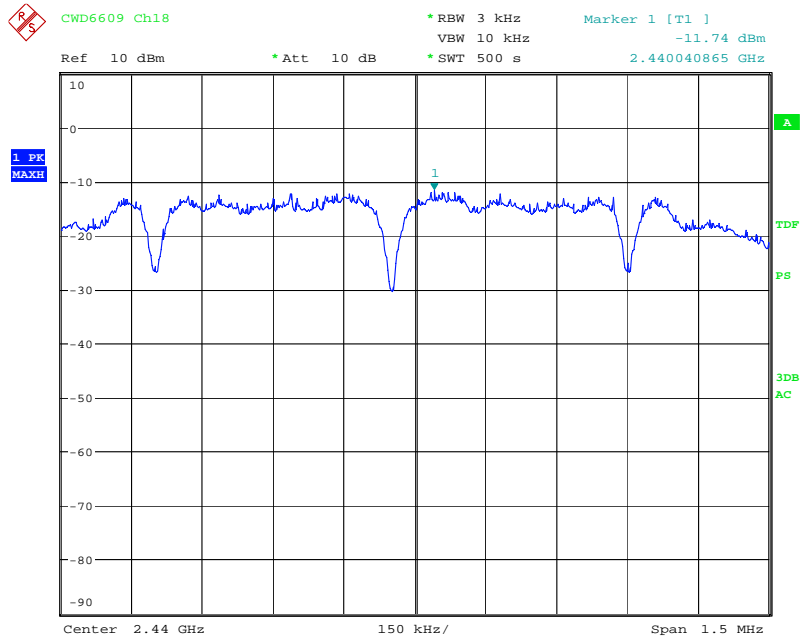


Power Spectral Density, Channel 11:



Date: 5.MAY.2009 15:12:01

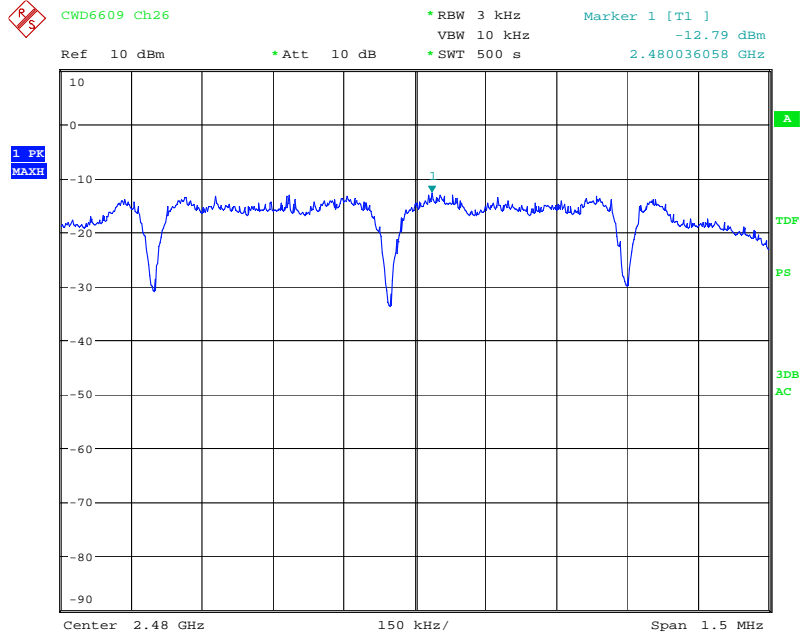
Power Spectral Density, Channel 18:



Date: 5.MAY.2009 14:50:49



Power Spectral Density, Channel 26:



Date: 5.MAY.2009 15:00:06



3.8 RF Safety

Performance Criterion: The human RF exposure limit is 1 mW/cm².

Test Results: Complies

Details: The maximum permissible exposure (MPE) is predicted by using Equation (3) of Section 2 of FCC OET Bulletin 65, Edition 97-01:

$$S = PG/4\pi R^2$$

where: S = power density (in appropriate units, e.g. mW/cm²)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

P = 1.67 mW (2.23 dBm), G = 1.5136 (1.8 dBi), R = 20 cm

$$S = 0.005 \text{ mW/cm}^2 = 0.005 \text{ W/m}^2$$

MPE limit for uncontrolled exposure at prediction frequency: 1 mW/cm²

Maximum allowable antenna gain: 34.7855dBi

Margin of Compliance at 20 cm = **32.9 dB**

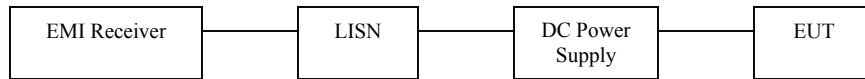


3.9 AC Power Line Conducted Emissions

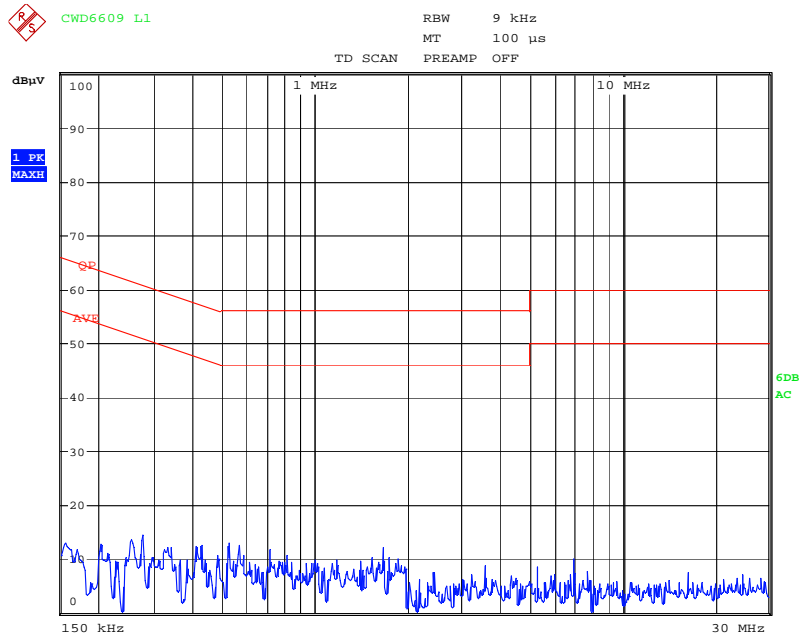
Performance Criterion: AC power line conducted emissions shall not exceed the limits specified in FCC § 15.207 and Table 2 of § 7.2.2 of IC RSS-Gen.

Test Results: Complies.

Test Details: Refers to the following block diagram and receiver screen captures. The screen captures represent Peak emissions.



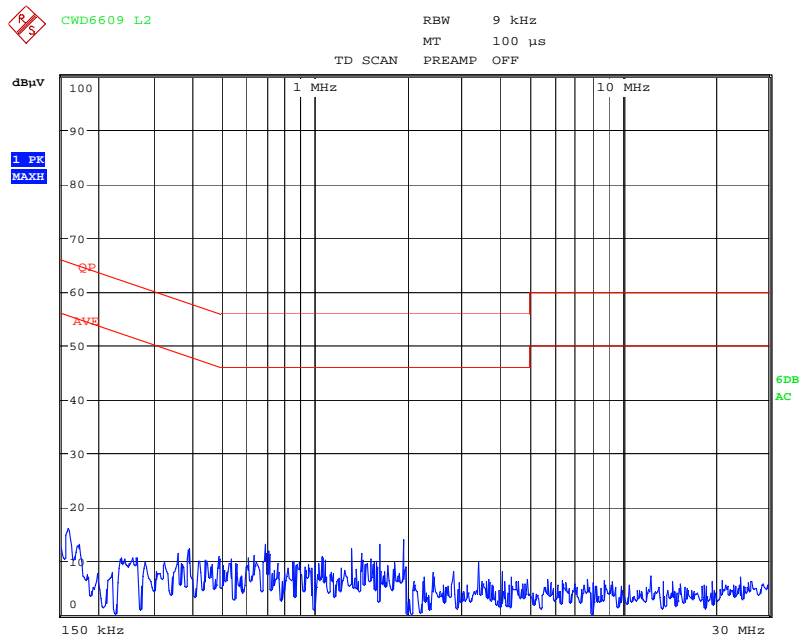
AC Power Line Conducted Emissions, Line 1:



Date: 7.MAY.2009 11:19:14



AC Power Line Conducted Emissions, Line 2:



Date: 7.MAY.2009 11:20:27

3.10 Radiated Spurious 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.

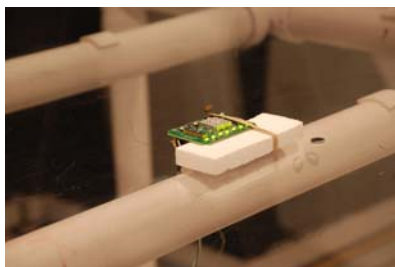
Test Results: Complies

Test Details: For each scan of radiated spurious 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 and radiated spurious emission measurements, up to 18 GHz, were performed at 3-meter distance between an antenna and the EUT. Above 18 GHz, radiated spurious emission measurement was performed at 1-meter distance.

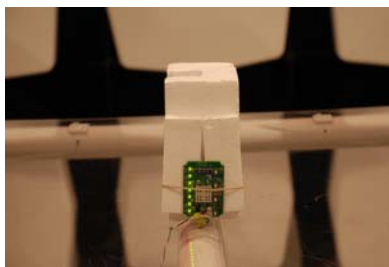
The peak level of radiated emissions above 1 GHz was measured with a resolution bandwidth (RBW) of 1 MHz and a video bandwidth (VBW) of 1 MHz.

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 modified for continuous operation using the settings shown above. Then the reading was corrected by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.

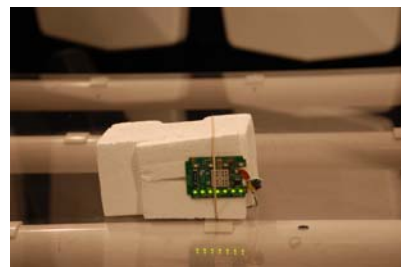
EUT was tested in three orthogonal orientations (XY, YZ, and ZX planes).



EUT = XY

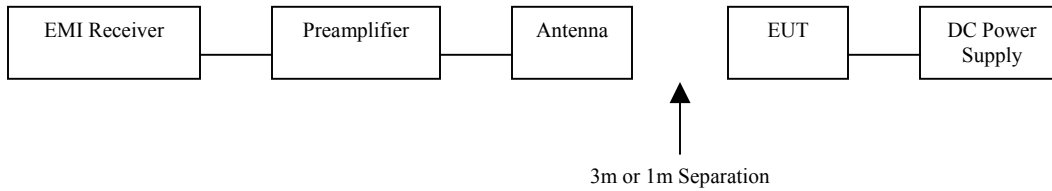


EUT = YZ



EUT = ZX

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. Calculation of duty cycle correction factor is included in a separate file.



CWD6609 Radiated Spurious Emissions, Boost Mode

Tested by: Grace Lin

Antenna Polarization	Frequency (MHz)	Channel No.	Power Setting (Level)	EUT Orientation	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turttable Degree
V	2390	11	3	ZX	41.55	74	32.45	100	104.7
V	4810	11	3	ZX	52.11	74	21.89	135.8	96.4
V	4880	18	3	ZX	50.57	74	23.43	134.6	100
V	7320	18	3	ZX	51.27	74	22.73	148.8	274.6
V	4960	26	3	ZX	49.23	74	24.77	100	81.6
V	7440	26	3	ZX	52.65	74	21.35	146.8	99.2

Tested May 6, 2009

CWD6609 Radiated Spurious Emissions, Boost Mode

Tested by: Grace Lin

Antenna Polarization	Frequency (MHz)	Channel No.	Power Setting (Level)	EUT Orientation	Measured Data (dBuV/m)	Duty Cycle Correction Factor (dB)	Corrected Data	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turttable Degree
V	2390	11	3	ZX	33.08	7.5	25.58	54	28.42	100	104.7
V	4810	11	3	ZX	42.3	7.5	34.8	54	19.2	135.8	96.4
V	12025 (NF)	11	3	ZX	36.51	7.5	29.01	54	24.99	-	-
V	19240 (NF)	11	3	ZX	33.75	7.5	26.25	54	27.75	-	-
V	4880	18	3	ZX	40.79	7.5	33.29	54	20.71	134.6	100
V	7320	18	3	ZX	39.63	7.5	32.13	54	21.87	148.8	274.6
V	12200 (NF)	18	3	ZX	36.72	7.5	29.22	54	24.78	-	-
V	19520 (NF)	18	3	ZX	33.82	7.5	26.32	54	27.68	-	-
V	4960	26	3	ZX	37.61	7.5	30.11	54	23.89	100	81.6
V	7440	26	3	ZX	40.56	7.5	33.06	54	20.94	146.8	99.2
V	12400 (NF)	26	3	ZX	39.79	7.5	32.29	54	21.71	-	-
V	19840 (NF)	26	3	ZX	33.91	7.5	26.41	54	27.59	-	-
V	22320 (NF)	26	3	ZX	34.29	7.5	26.79	54	27.21	-	-

NF: Noise Floor

Tested: May 6 & 8, 2009

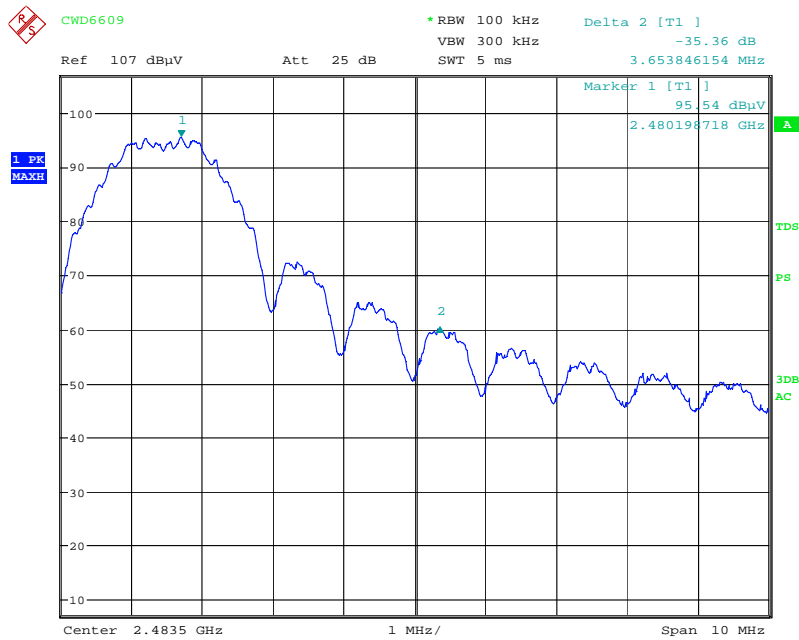


CWD6609 Radiated Spurious Emissions at 2483.5MHz, Channel 26, Power Level of 3 at Boost Mode Tested by: Grace Lin

Antenna Polarization	Frequency (MHz)	Measured Data (dBuV/m)	Duty Cycle Correction Factor (dB)	Reference Data (dBuV/m)	Amplitude Delta (dB)	Evaluation Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turttable Degree	Level
V	2480	98.83	-	98.83	-	-	-	-	100	91.5	Peak*
V	2480	96.52	7.5	89.02	-	-	-	-	100	91.5	Ave**
V	2483.5	-	-	98.83	35.36	63.47	74	10.53	100	91.5	Peak*
V	2483.5	-	-	89.02	35.36	53.66	54	0.34	100	91.5	Ave**

*: RBW=VBW=1MHz **: RBW=1MHz, VBW=10Hz

Tested May 19, 2009

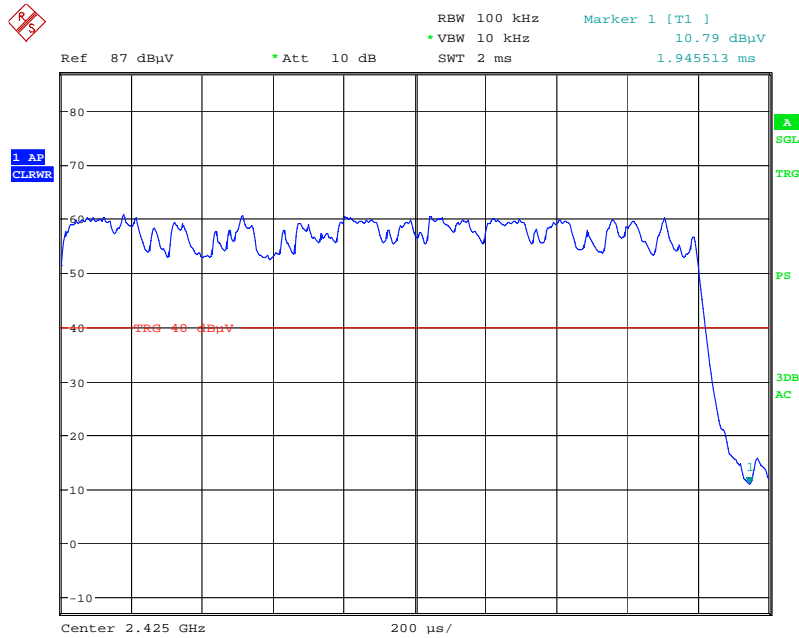


Date: 19.MAY.2009 11:11:12



Duty Cycle Calculation

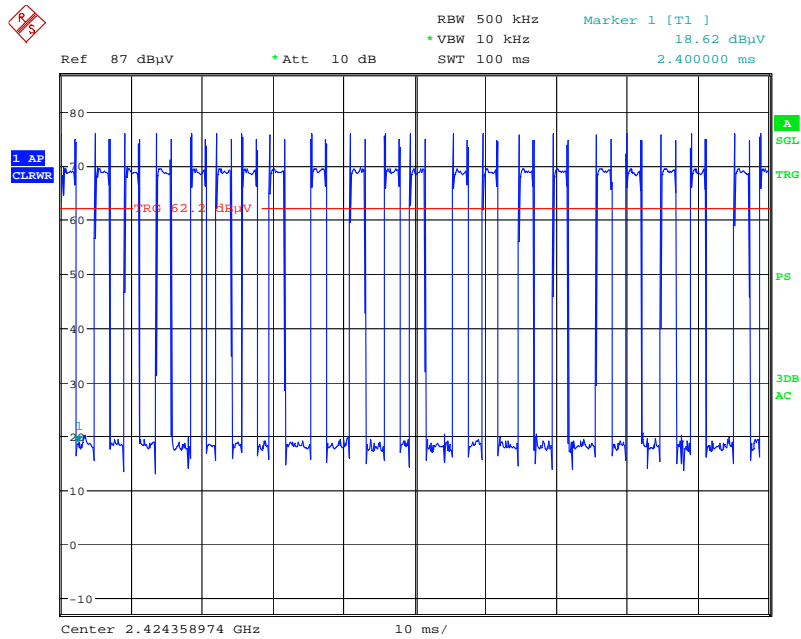
Worst-case pulse width: 1.95 ms
Worst-case number of pulses per 100ms: 21.5
Duty Cycle Correction Factor: $20 \log (21.5 \times 1.95 / 100) = -7.55$



Date: 18.MAY.2009 12:30:16



Duty Cycle Calculation (Continued)



Date: 13.MAY.2009 11:02:04

3.11 Receiver Radiated Emissions

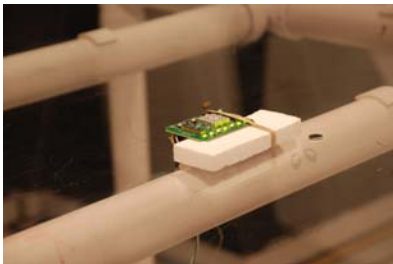
Performance Criterion: Receiver radiated emissions must meet the requirements of Table 1 of IC RSS-Gen. Receivers operating above 960 MHz or below 30 MHz are exempt from complying with the technical provisions of FCC Part 15 Subpart B.

Test Results: Complies

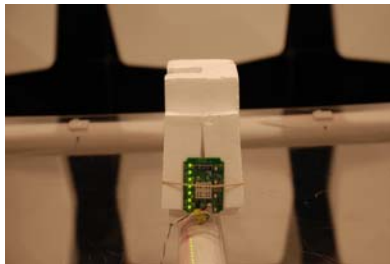
Test Details: For each scan of radiated emission measurement, the procedures for maximizing emissions were followed. The EUT was rotated and antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data 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.

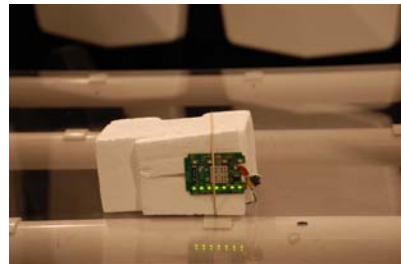
EUT was tested in three orthogonal orientations (XY, YZ, and ZX planes).



EUT = XY

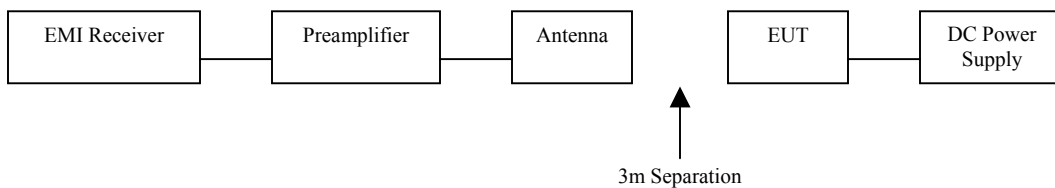


EUT = YZ



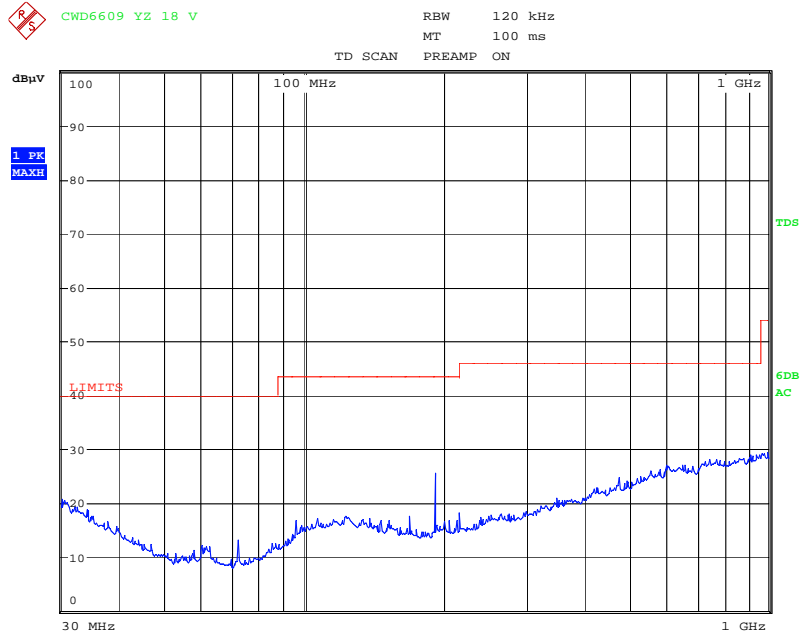
EUT = ZX

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.





Receiver Radiated Emission, 30MHz-1GHz:



Date: 7.MAY.2009 10:27:12

CWD6609 Radiated Emissions, Boost Mode

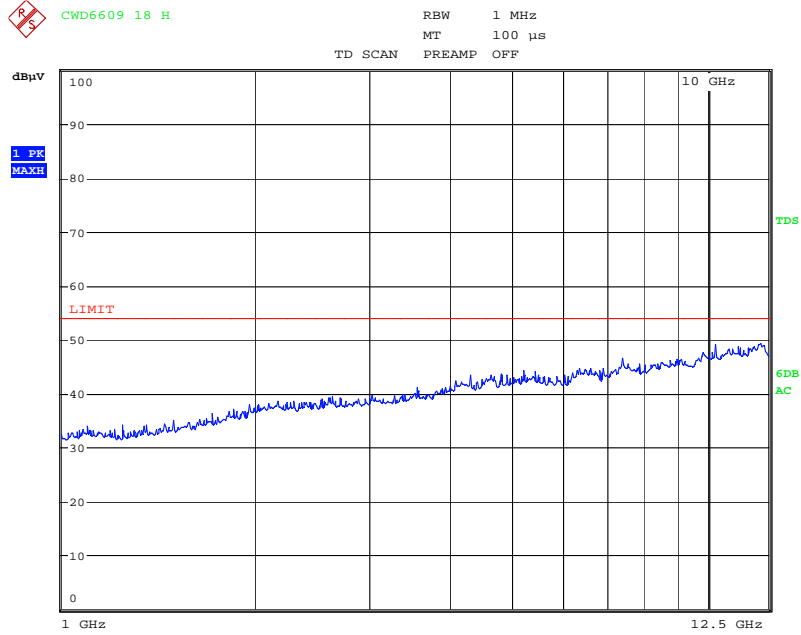
Tested by: Grace Lin

Antenna Polarization	Frequency (MHz)	Channel No.	Power Setting (Level)	EUT Orientation	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Tunable Degree
V	192	18	3	YZ	25.7	43.5	17.8	100	85.5

Tested May 7, 2009

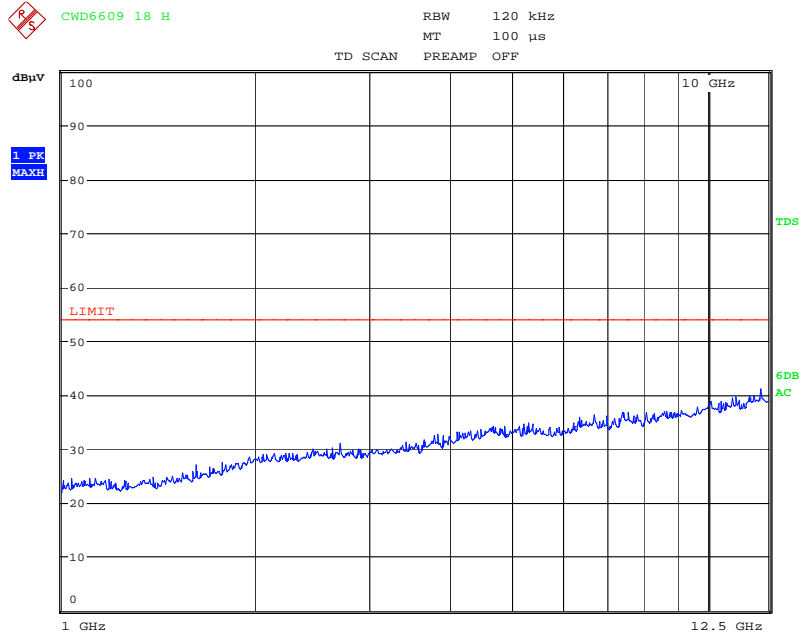


Receiver Radiated Emission, 1-12.5GHz, RBW=1MHz:



Date: 7.MAY.2009 09:14:32

Receiver Radiated Emission, 1-12.5GHz, RBW=120kHz:

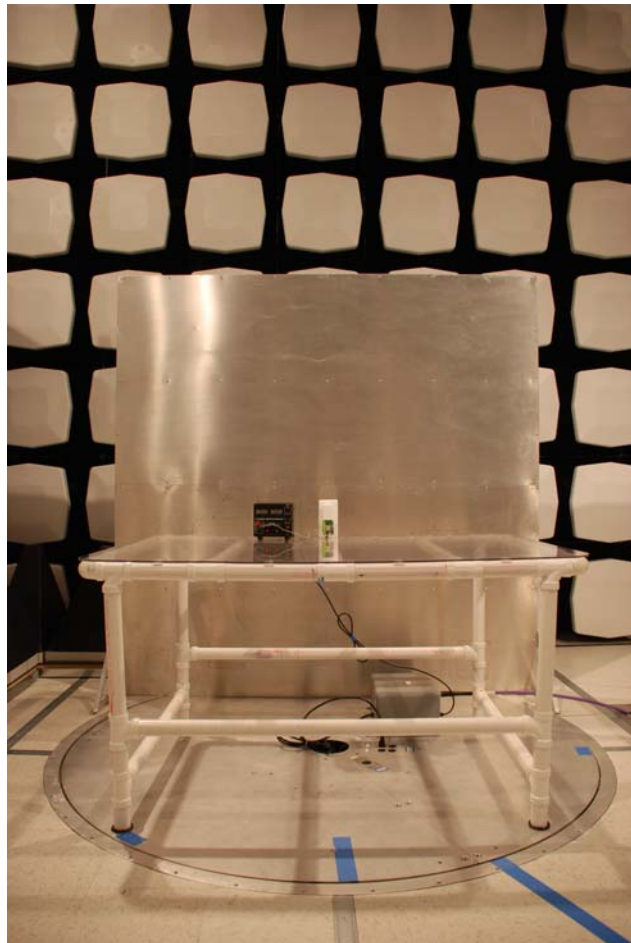


Date: 7.MAY.2009 09:13:04

4. Test Setup Photos

Conducted Emission Configuration Photographs

Worst-case conducted emission, front view



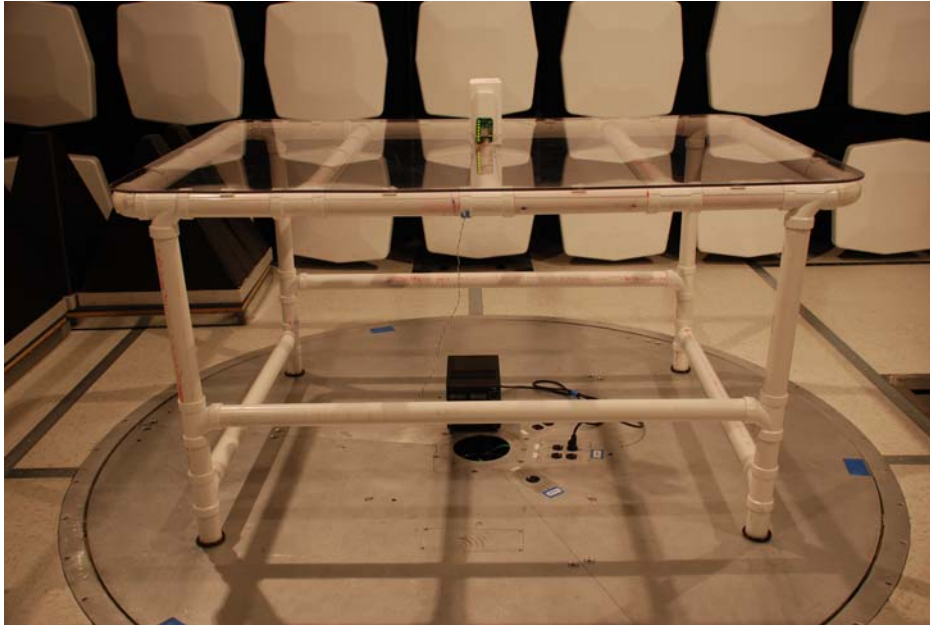
Conducted Emission Configuration Photographs

Worst-case conducted emission, side view



Radiated Emission Configuration Photographs

Worst-case radiated emission, front view



Worst-case radiated emission, side view

