



Test Report

FCC Part 15, Subpart E Industry Canada RSS-210, Issue 7

Report Number: 2023288-15E

Model: TPMC-3X

FCC ID: ERO2023288
IC: 5683C-2023288

Date: November 2, 2009 (Revised November 11, 2009)

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1. General Description

1.1 Product Description

The equipment under test (EUT) is a Crestron Isys i/O[®] 2.8” handheld WiFi touchpanel, model: TPMC-3X.

The EUT contains one WLAN module. The WLAN module employs IEEE 802.11 a/b/g technology. Its specifications are listed in the following table:

Technology	IEEE 802.11 b	IEEE 802.11 g	IEEE 802.11 a	
Modulation	DSSS	DSSS, OFDM	OFDM	
Data Rate (Mbps)	1, 2, 5.5, 11	1, 2, 5.5, 11, 6, 9, 12, 18, 24, 36, 48, 54	6, 9, 12, 18, 24, 36, 48, 54	
Frequency Band (GHz)	2.4 – 2.4835	2.4 – 2.4835	5.15 – 5.25	5.725 – 5.850
Number of Channels	11	11	4	5
Channel Numbers	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	36, 40, 44, 48	149, 153, 157, 161, 165
Channel Frequency (GHz)	2.412, 2.417, 2.422, 2.427, 2.432, 2.437, 2.442, 2.447, 2.452, 2.457, 2.462	2.412, 2.417, 2.422, 2.427, 2.432, 2.437, 2.442, 2.447, 2.452, 2.457, 2.462	5.18, 5.20, 5.22, 5.24	5.745, 5.765, 5.785, 5.895, 5.825

1.2 Test Methodology

Measurements were performed according to the following procedures and standards:

- 1) ANSI C63.4: 2003
- 2) FCC Public Notice DA 02-2138, “Measurement Procedure Updated for Peak Transmit Power in the Unlicensed National Information Infrastructure (U-NII) Bands”, August 30, 2002
- 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. Each channel was tested at the worst case data rate.

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	Oct. 7, 2009
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
ETS-Lindgren Standard Gain Horn Antenna	3160-10	00109155	26.5 – 40 GHz	Oct. 19, 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

*Mechanical inspection

1.5 Evaluation Summary

Rule Section		Description/Parameters	Results
FCC	IC		
§15.203	N/A	Antenna Requirement	Complies
§15.407(a)(2)	§A9.2(1) of RSS-210	26 dB Bandwidth (B)	(for reporting only)
N/A	§4.6.1 of RSS-Gen	99% Occupied Bandwidth	(for reporting only)
§15.407(a)(1)	§A9.2(1) of RSS-210	Conducted Output Power, 50 mW or 4 dBm + 10 log B	Complies
§15.407(a)(1)	§A9.2(1) of RSS-210	Peak Power Spectral Density (PPSD), 4 dBm in any 1 MHz band.	Complies
§15.407(a)(6)	N/A	Peak Excursion, 13 dB across any 1 MHz bandwidth	Complies
§15.407(b)(1)	§A9.3(1) of RSS-210	Conducted Spurious Emissions, EIRP of -27 dBm/MHz	Complies
§15.407(f)	§5.5 of RSS-Gen	Maximum Permissible Exposure	Complies
§15.407(b)(6), §15.107, §15.207	Table 2 of RSS-Gen	AC Power Line Conducted Emissions	Complies
§15.407(b)(6), §15.205, §15.209	Table 2 of RSS-210	Radiated Emissions and Radiated Spurious Emissions	Complies
§15.109	§4.8 of RSS-Gen	Receiver Spurious Emission	Complies

Note: The channels selected for test were 36, 44, and 48.

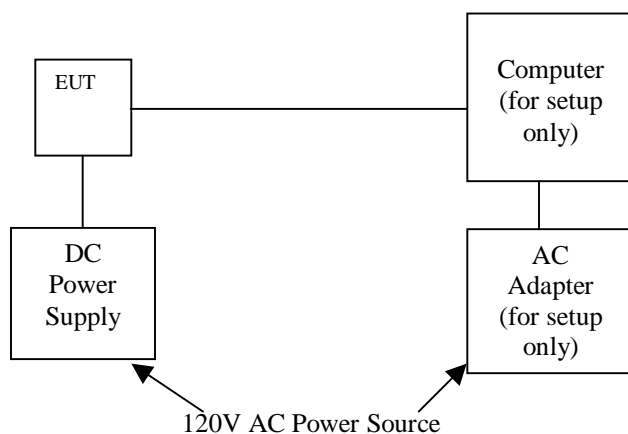
2. System Test Configuration

2.1 Justification

The EUT was tested standalone. A DC power supply supplied power to the EUT. A computer supplied test commands during setup.

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. The following table lists the channels tested. There are two test reports covering test data. One test report covers the frequency band of 5.15 – 5.25 GHz. This test report covers the rest of frequency bands.

Technology	IEEE 802.11 b	IEEE 802.11 g	IEEE 802.11 a	
Frequency Band (GHz)	2.4 – 2.4835	2.4 – 2.4835	5.15 – 5.25	5.725 – 5.850
Channels Tested	1, 6, 11	1, 6, 11	36, 44, 48	149, 157, 165

2.4 Cables

Qty	Description	Length (m)	From - To	Shielded/ Unshielded
1	Power Cord	1.5	Power Source – Computer	Unshielded
1	USB	11.5 or 2	Computer – EUT	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	PP02X	11109700981
2	AC Adapter	DELL	LA90PS0-00	CN-0DF266-71615-68A-2AB1
3	Power Supply	CUI	3A-161WP12	Not Labeled
4	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*

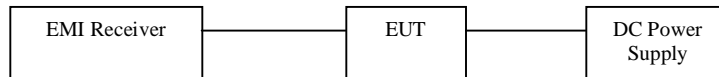
The EUT is equipped with two antennas: Pulse W3006 and Antenova A10194. Both antennas are in SMD package. Antennas' specifications are included in separate files.

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



3.2 26 dB Bandwidth

Test Details: The procedure described in Public Notice DA 02-2138 was used. Refers to the following block diagram, data table, and receiver screen captures. The EUT was tested in a continuous transmit mode.



Channel No.	Frequency (MHz)	Port No.	Technology	26dB BW (MHz)
36	5180	1	802.11a	19.71
44	5220	1		19.79
48	5240	1		19.95
36	5180	2		19.23
44	5220	2		19.71
48	5240	2		19.71

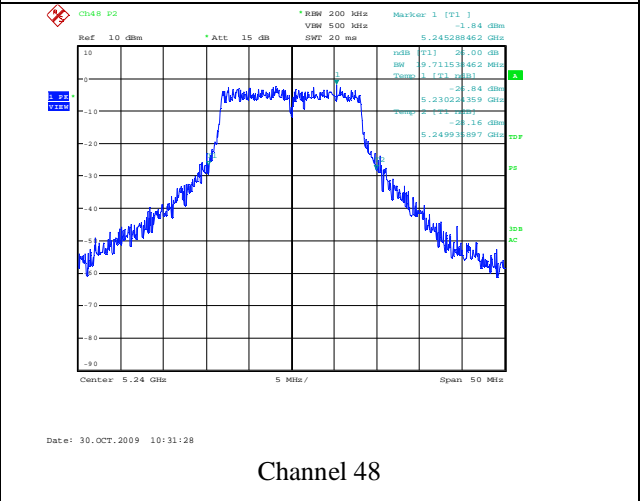
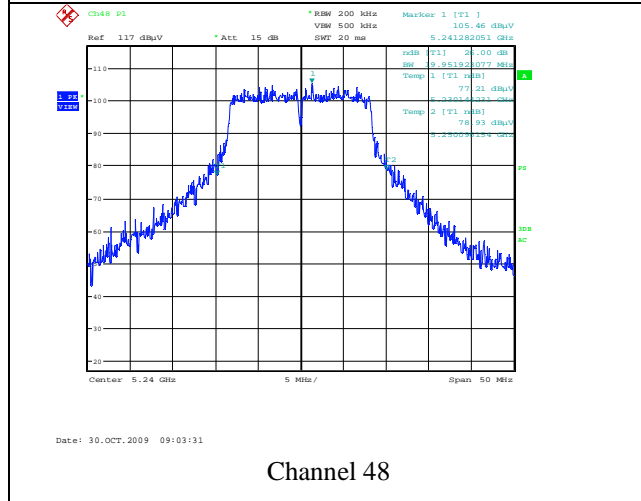
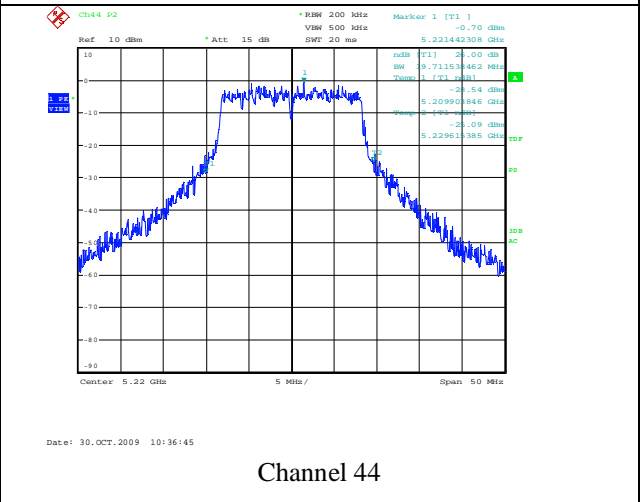
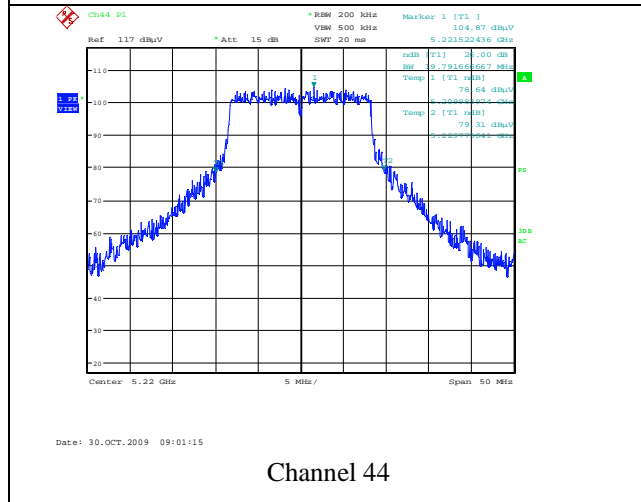
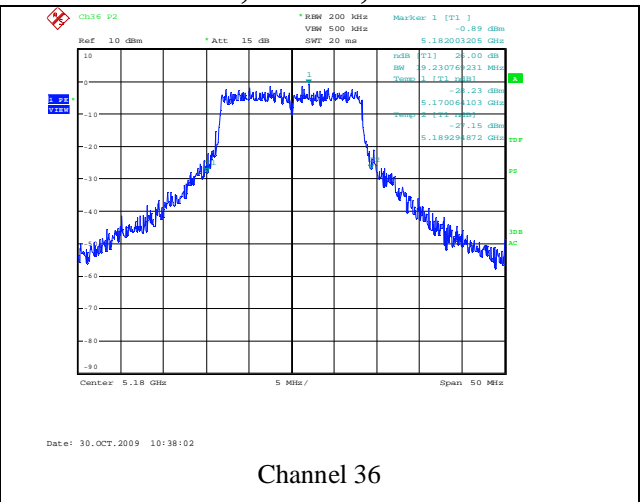
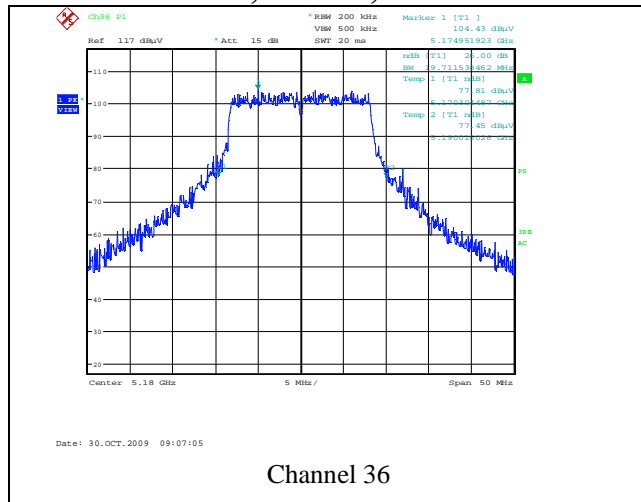
Tested by: Grace Lin

Date of Test: October 30, 2009



26 dB Bandwidth, 802.11a, Port 1:

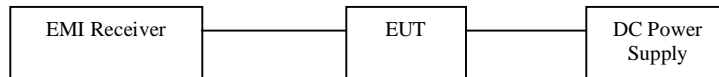
26 dB Bandwidth, 802.11a, Port 2:





3.3 99% Bandwidth

Test Details: The built-in occupied bandwidth function of the EMI receiver, under spectrum analyzer mode, was used. 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.



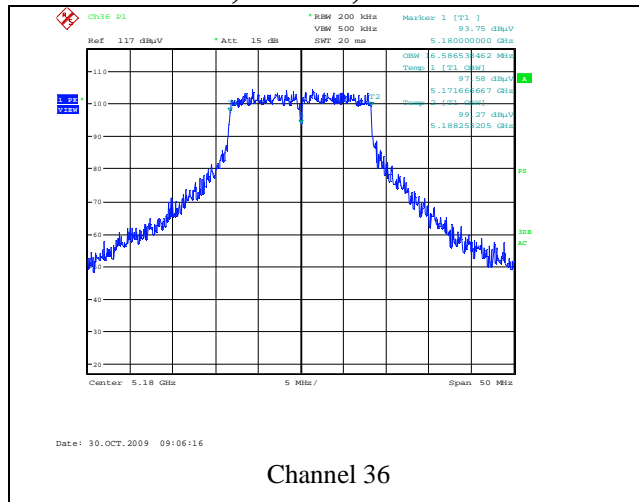
Channel No.	Frequency (MHz)	Port No.	Technology	99% BW (MHz)
36	5180	1	802.11a	16.59
44	5220	1		16.67
48	5240	1		16.59
36	5180	2		16.59
44	5220	2		16.59
48	5240	2		16.59

Tested by: Grace Lin

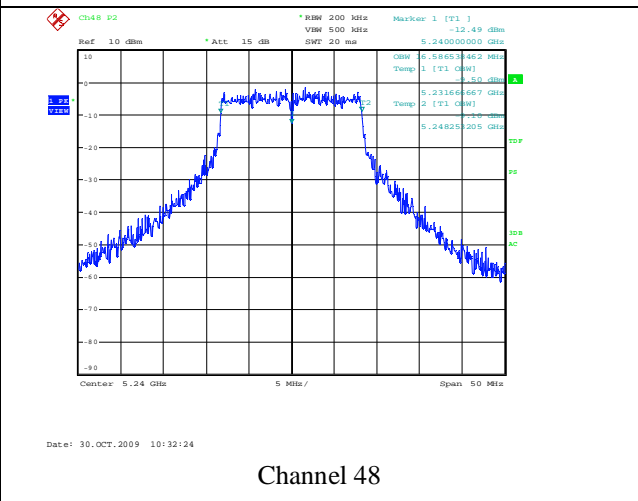
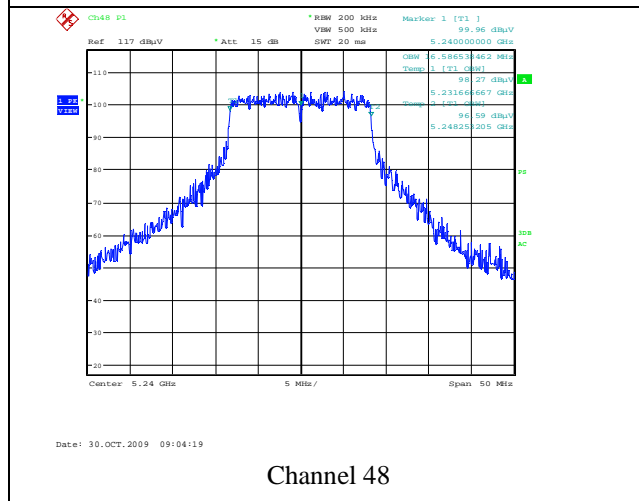
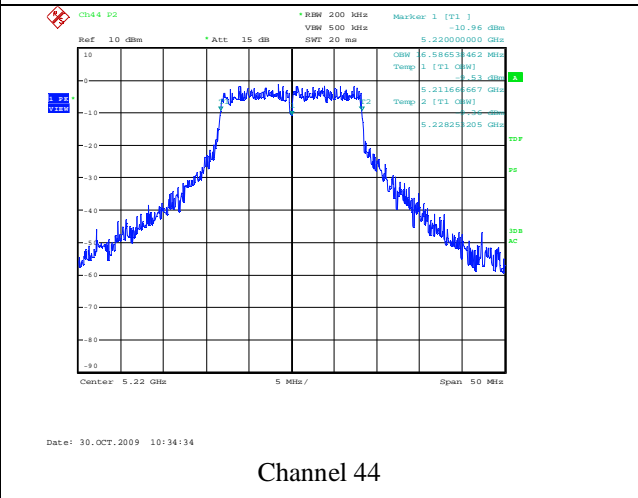
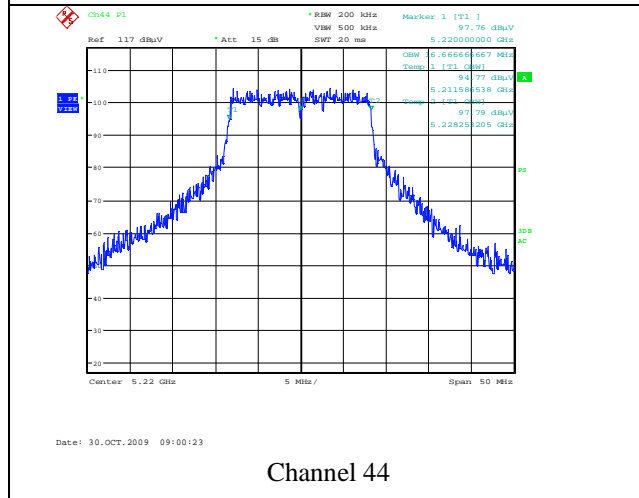
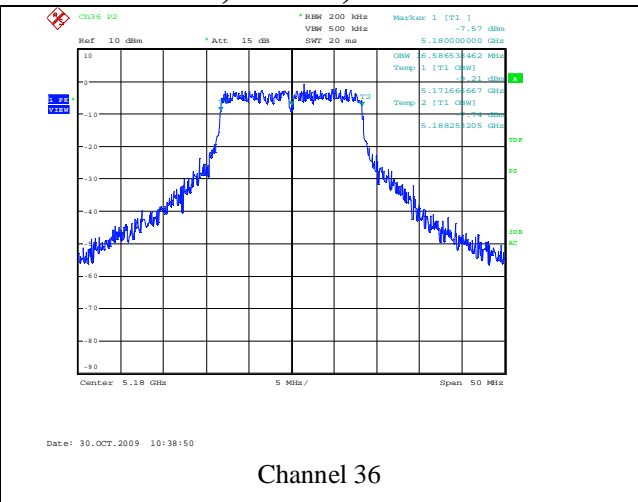
Date of Test: October 30, 2009



99% Bandwidth, 802.11a, Port 1:



99% Bandwidth, 802.11a, Port 2:





3.4 Conducted Output Power

Performance Criterion: For the band 5.12-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or $4 \text{ dBm} + 10 \log B$, where B is the 26-dB emission bandwidth in MHz.

Test Results: Complies

Test Details: Method #1 of Public Notice DA 02-2138 was selected for the measurement. A built-in channel power measurement function with a sample detector and averaging 100 traces in power averaging mode was used. The channel bandwidth was set equal to or greater than 26-dB bandwidth. Transmitter operates continuously with the maximum power level. Refers to the following block diagram, data table, and screen captures.



Channel No.	Frequency (MHz)	Port No.	Maximum Conducted Power (dBm)							
			6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
36	5180	1	7.03	7.51	7.54	6.97	7.52	7.48	7.51	7.47
44	5220	1	6.11	6.11	6.08	6.13	6.62	5.56	6.59	6.56
48	5240	1	5.94	5.95	5.94	5.92	5.95	5.95	5.93	5.91
36	5180	2	6.73	6.75	6.98	7.46	6.91	7.37	7.30	7.28
44	5220	2	6.99	7.00	7.06	7.01	6.97	6.92	6.92	6.92
48	5240	2	6.56	6.55	6.55	6.63	6.51	6.50	6.47	6.48

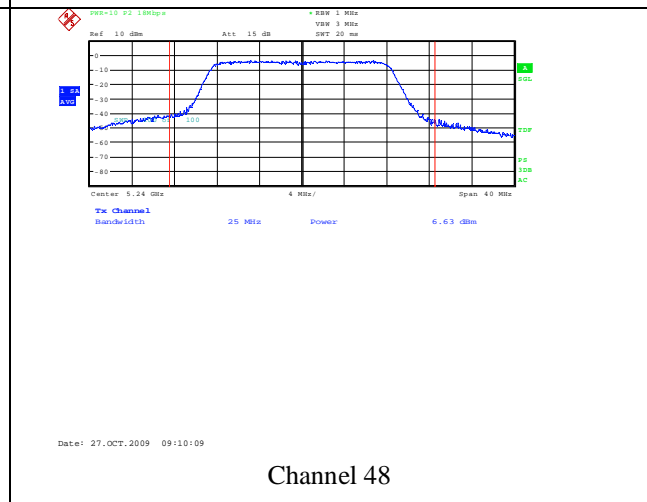
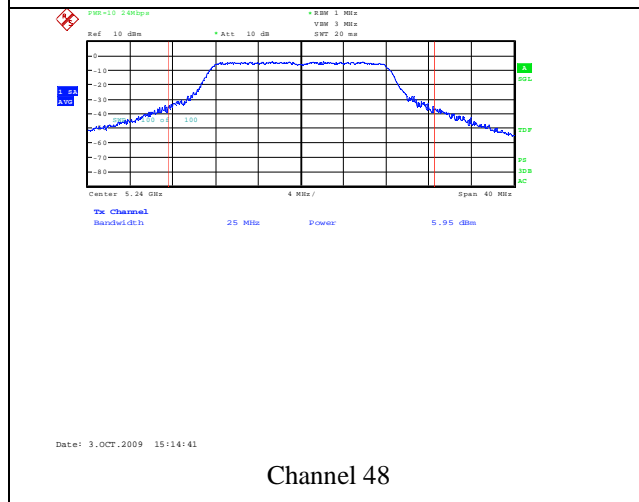
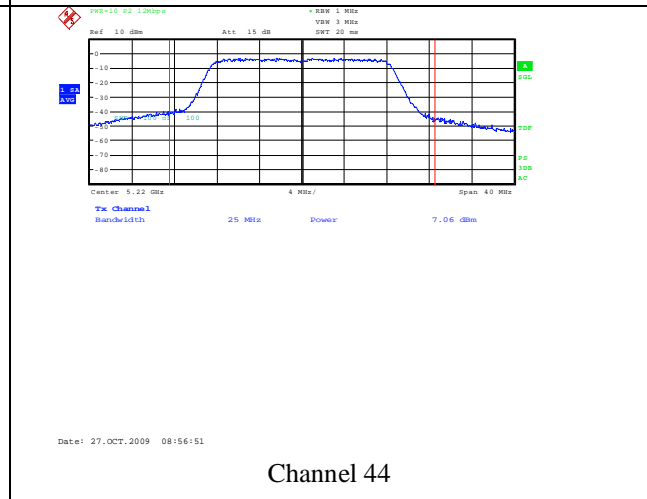
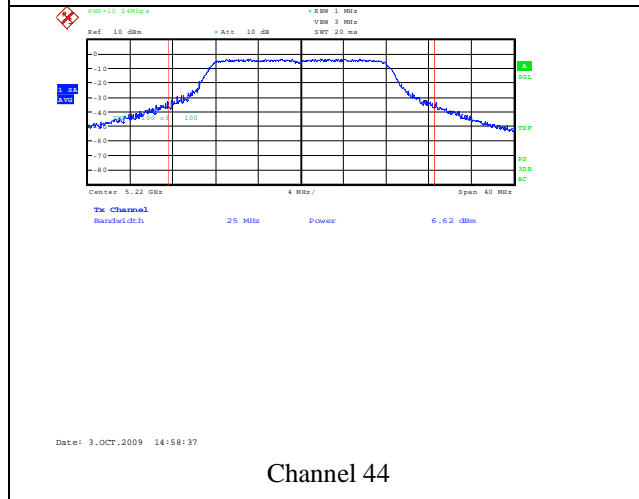
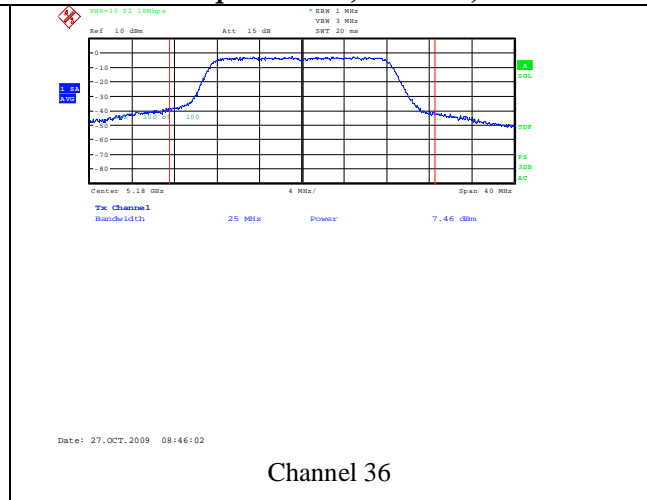
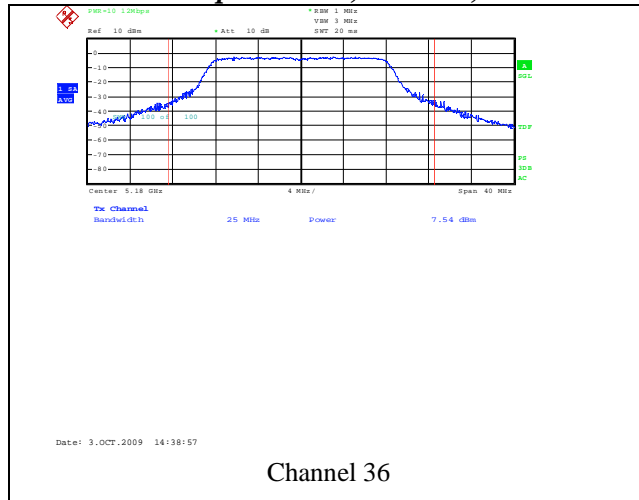
Date of Test: October 3 & 27, 2009

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



Maximum Output Power, 802.11a, Port 1:

Maximum Output Power, 802.11a, Port 2:





3.5 Peak Power Spectral Density

Performance Criterion: For the band 5.15-5.25 GHz, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band.

Test Results: Complies

Test Details: Method 2 (with a sample detector and averaging over 100 traces) of Public Notice DA 02-2138 was selected for the measurement. Resolution bandwidth was set to 1 MHz. The EUT was tested in a continuous transmit mode with maximum power level. Refers to the following table and receiver screen captures. The insertion loss was compensated for in the receiver.



Channel No.	Frequency (MHz)	Port No.	Technology	PPSD (dBm)
36	5180	1	802.11a	-1.44
44	5220	1		-1.74
48	5240	1		-1.98
36	5180	2		-0.82
44	5220	2		-1.17
48	5240	2		-1.22

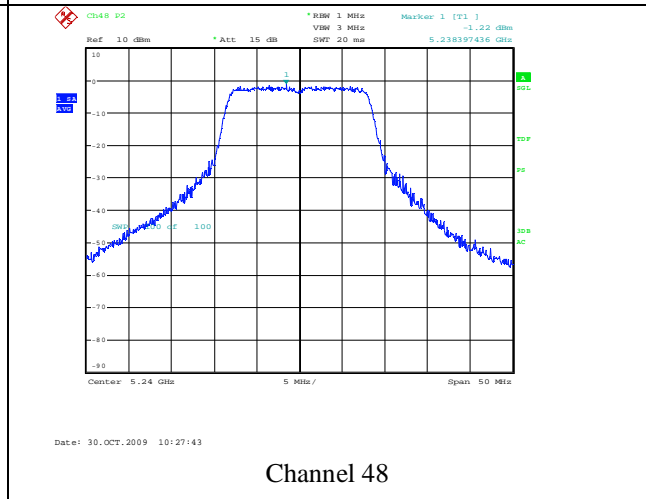
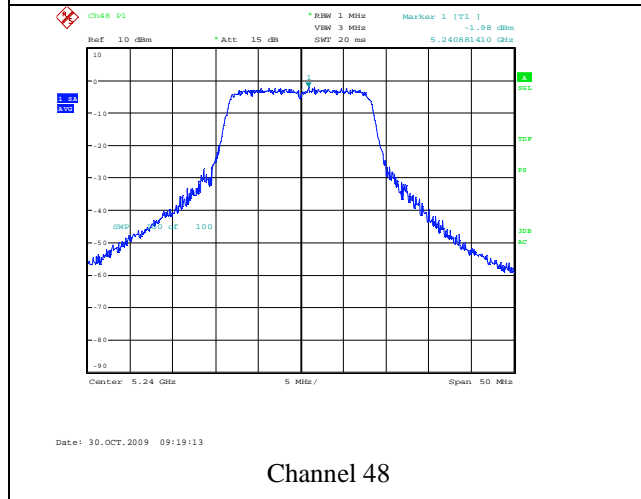
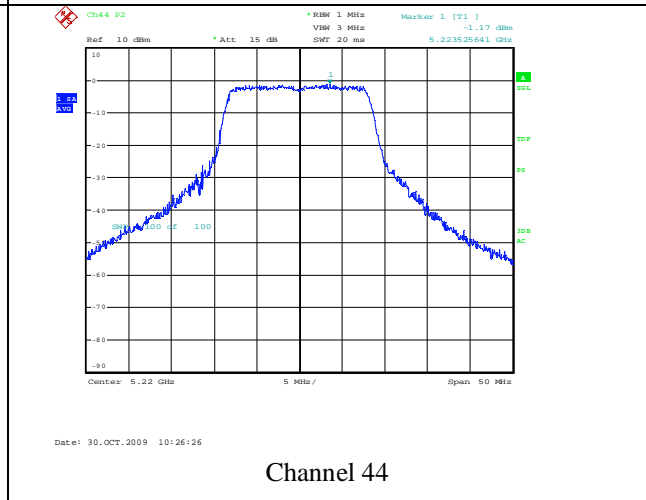
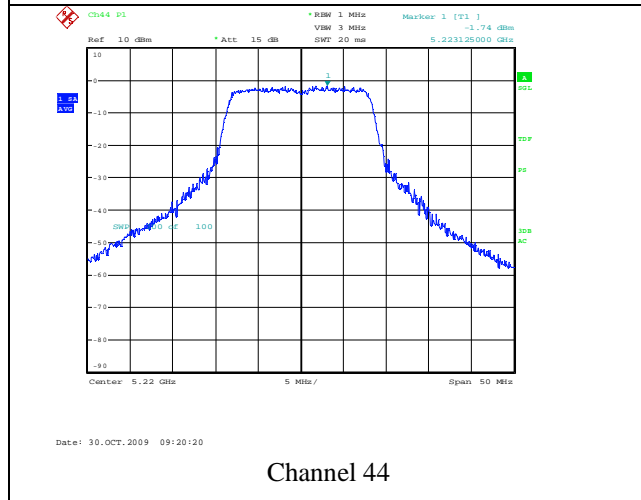
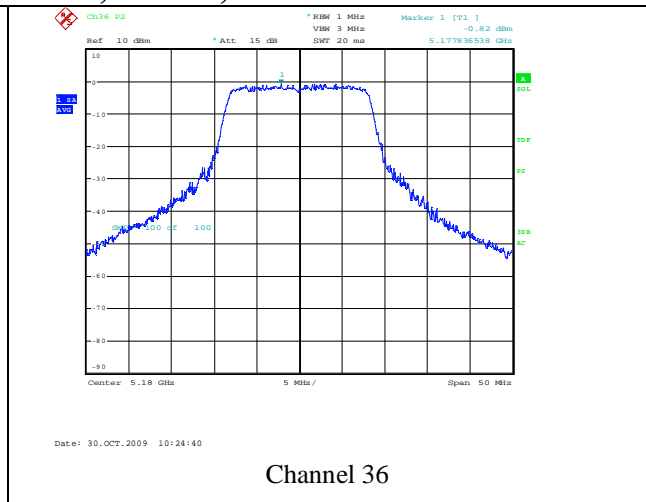
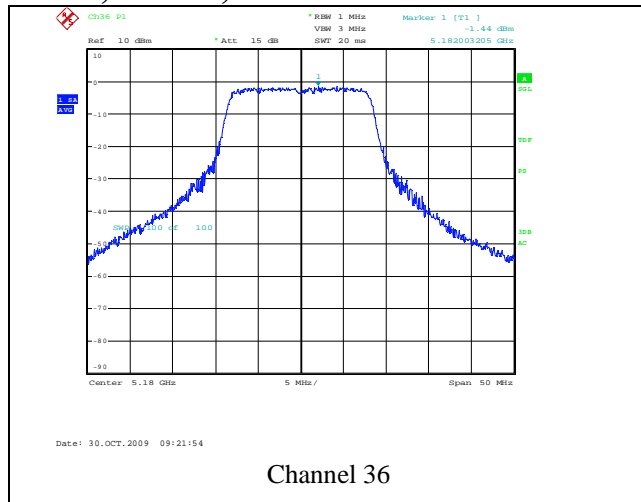
Tested by: Grace Lin

Date of Test: October 30, 2009



PPSD, 802.11a, Port 1:

PPSD, 802.11a, Port 2:





3.6 Peak Excursion

Performance Criterion: The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

Test Results: Complies

Test Details: The procedure described in Public Notice DA 02-2138 was used. 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. The insertion loss was compensated for in the receiver.



Channel No.	Frequency (MHz)	Port No.	Technology	Peak Excursion (dBm)
36	5180	1	802.11a	10.73
44	5220	1		11.29
48	5240	1		11.87
36	5180	2		10.70
44	5220	2		11.86
48	5240	2		11.23

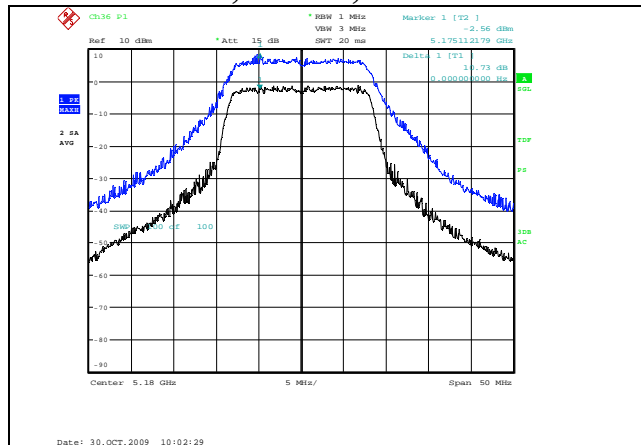
Tested by: Grace Lin

Date of Test: October 30, 2009

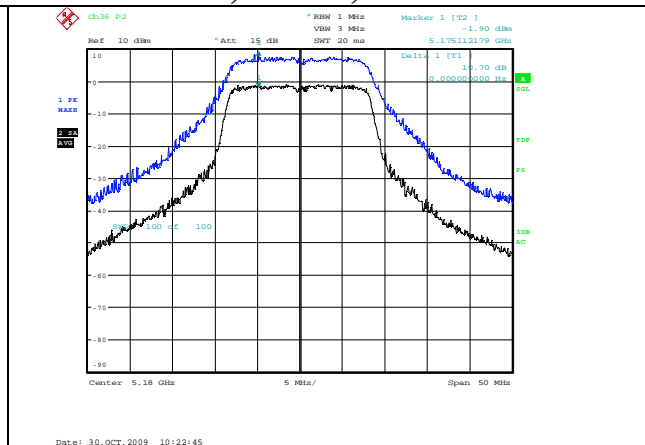


Peak Excursion, 802.11a, Port 1:

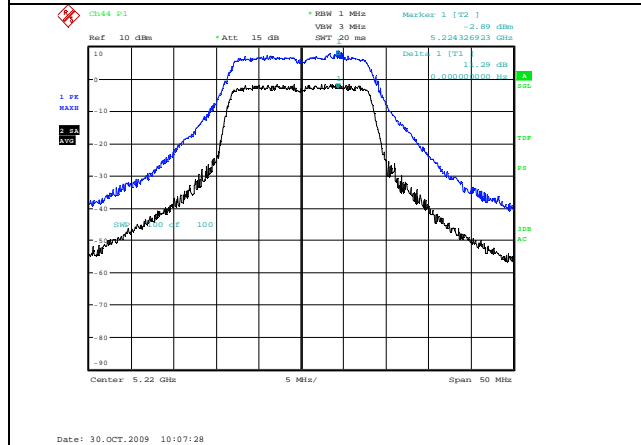
Peak Excursion, 802.11a, Port 2:



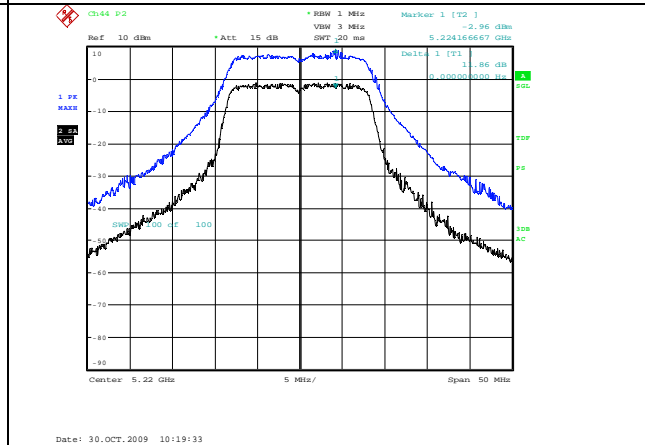
Channel 36



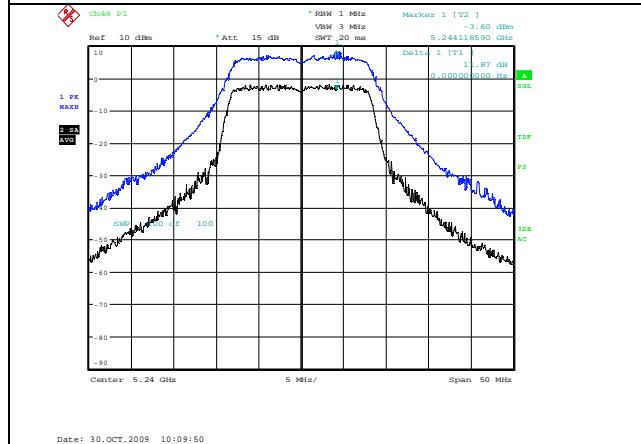
Channel 36



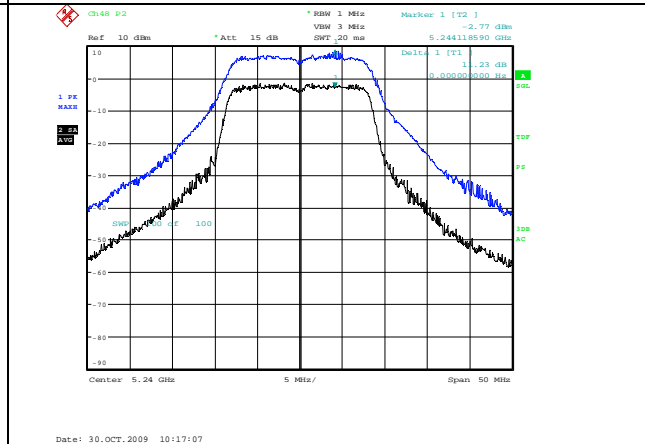
Channel 44



Channel 44



Channel 48



Channel 48



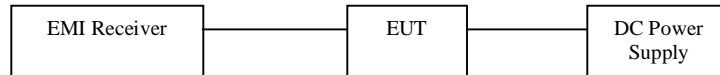
3.7 *Conducted Spurious Emissions*

Performance Criterion: For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.25 GHz band shall not exceed an EIRP of -27 dBm/MHz.

Test Results: Complies

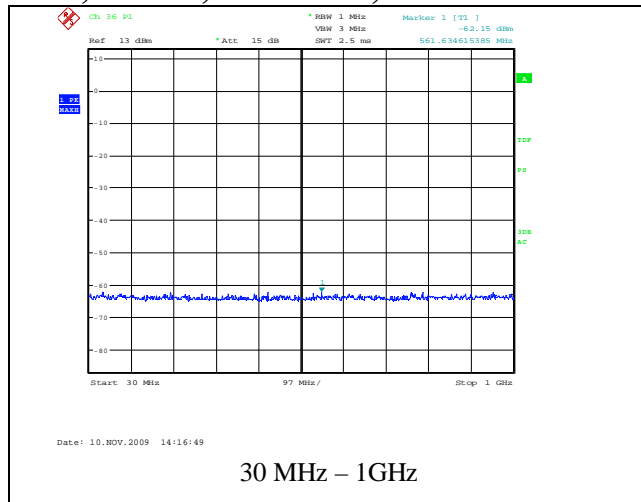
Test Details: Refers to the following block diagram and receiver screen captures. To compare to the EIRP limits, for emissions detected inside the 5 GHz band, the antenna gain of 4.2 dBi must be added to the receiver readings on the screen captures.

Note: The EUT was tested in a continuous transmit mode with maximum power level.

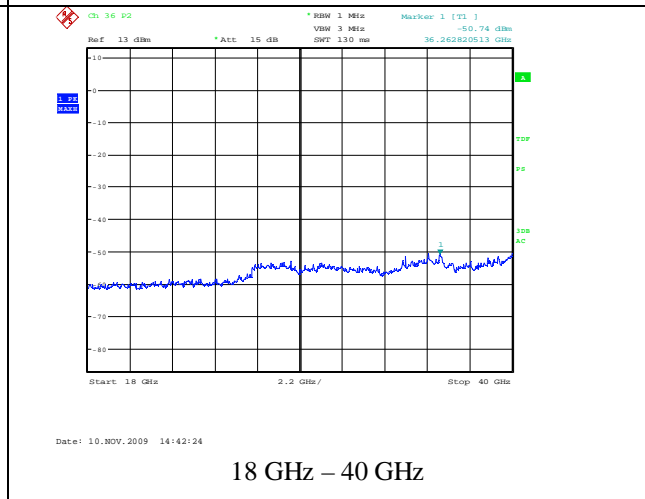
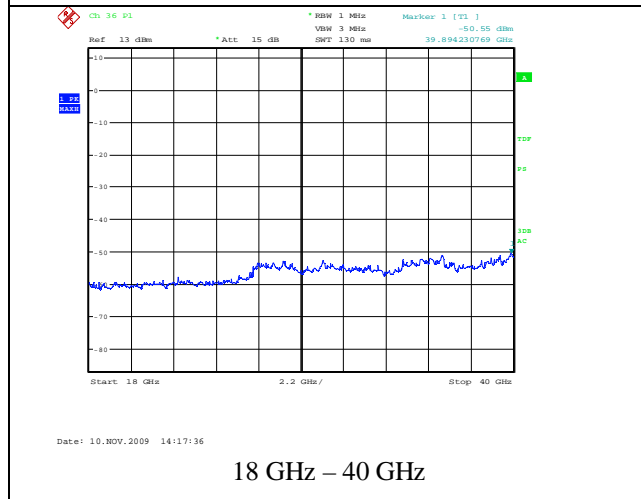
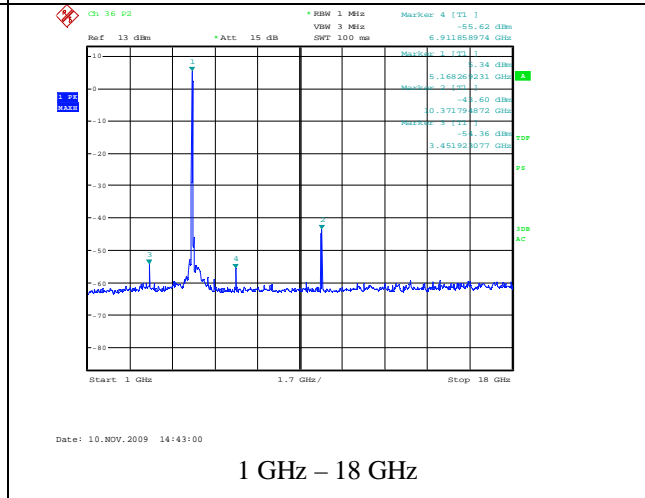
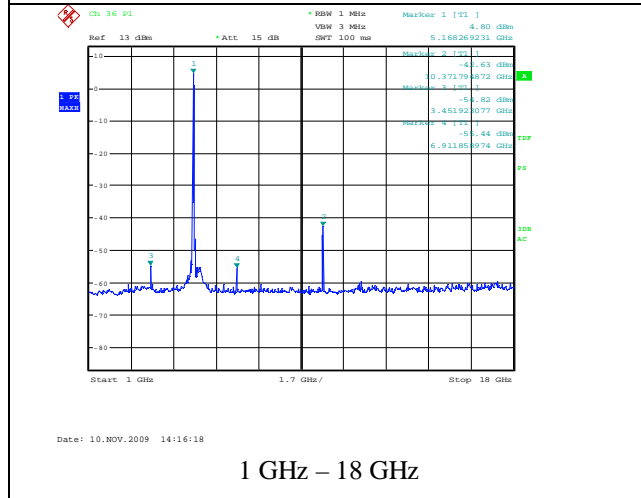
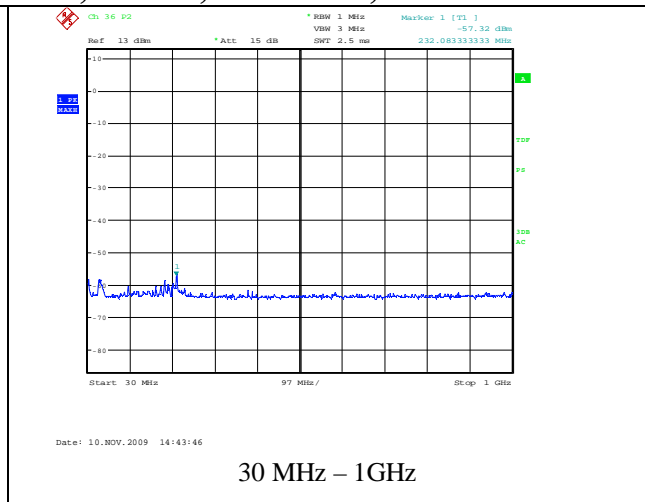




CSE, 802.11a, Channel 36, Port 1:

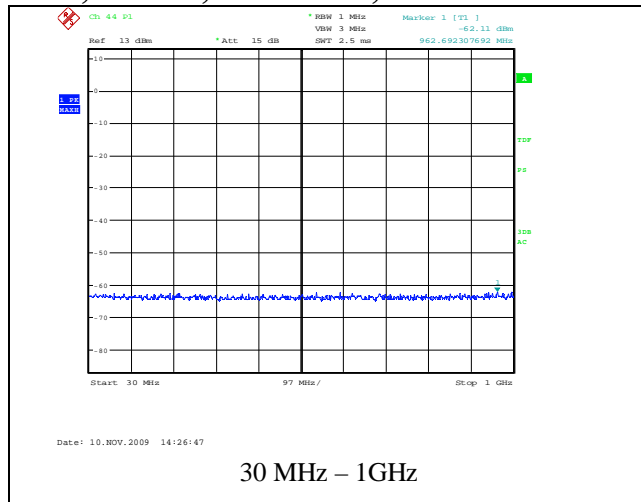


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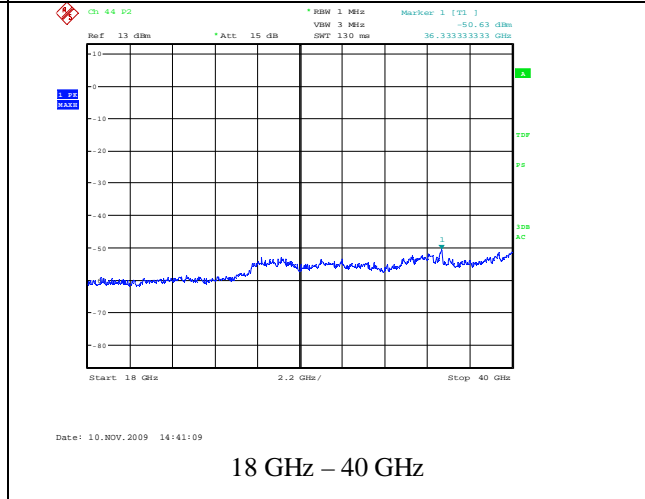
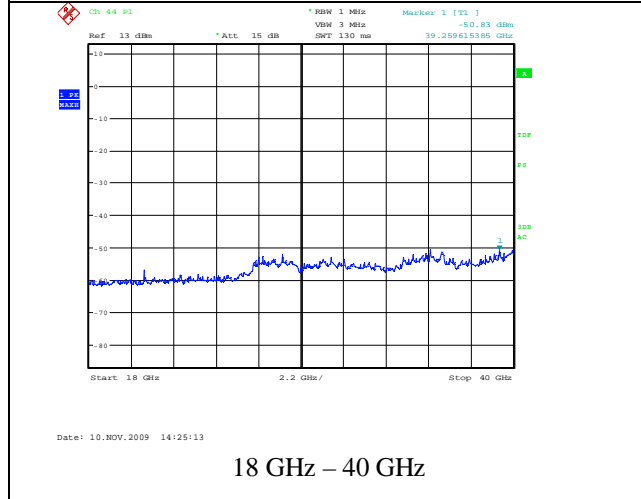
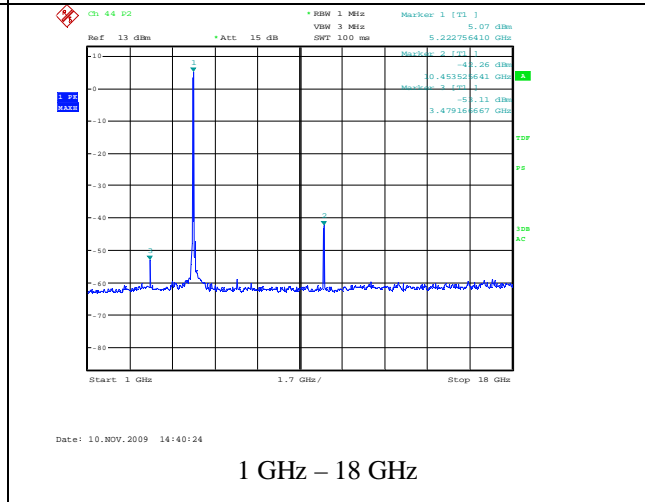
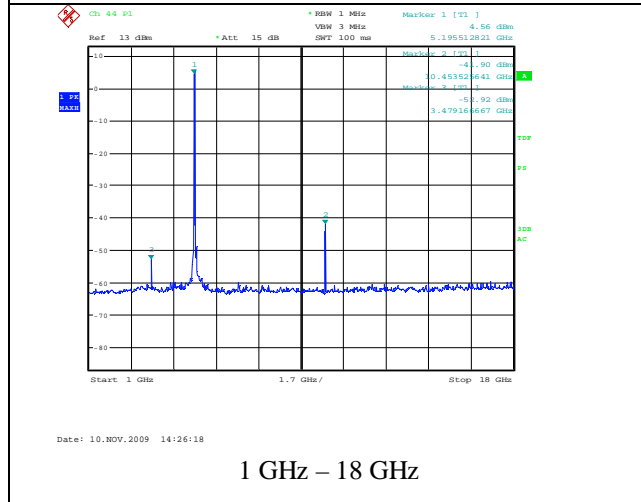
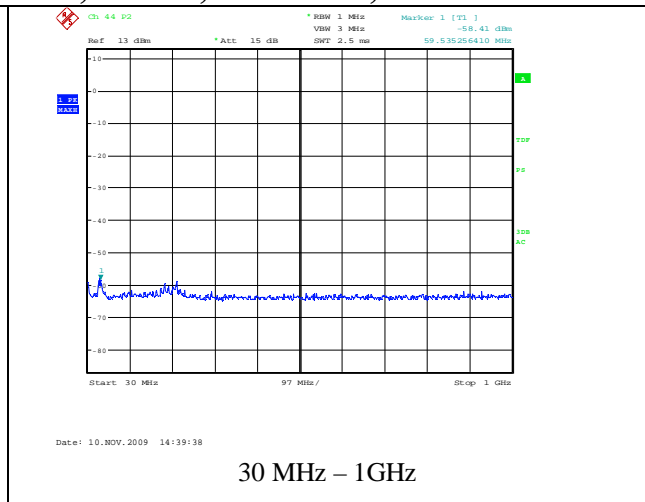




CSE, 802.11a, Channel 44, Port 1:

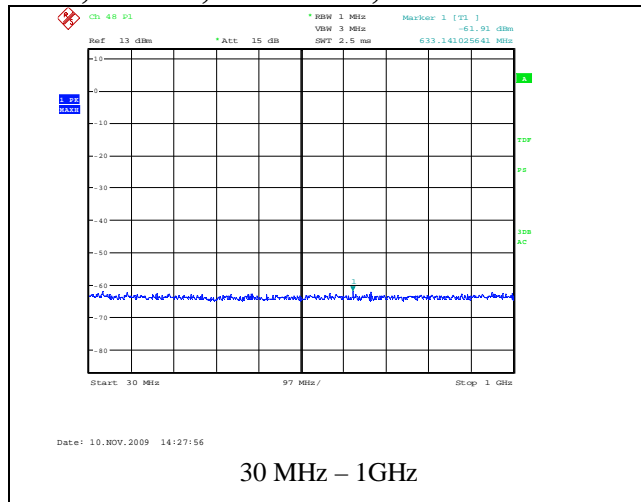


CSE, 802.11a, Channel 44, Port 2:

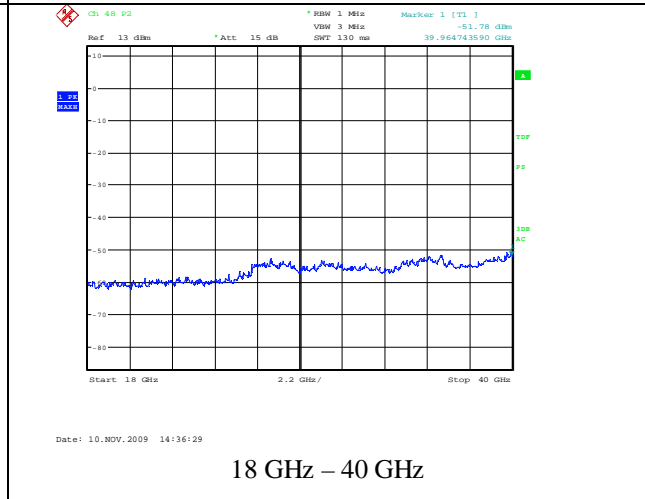
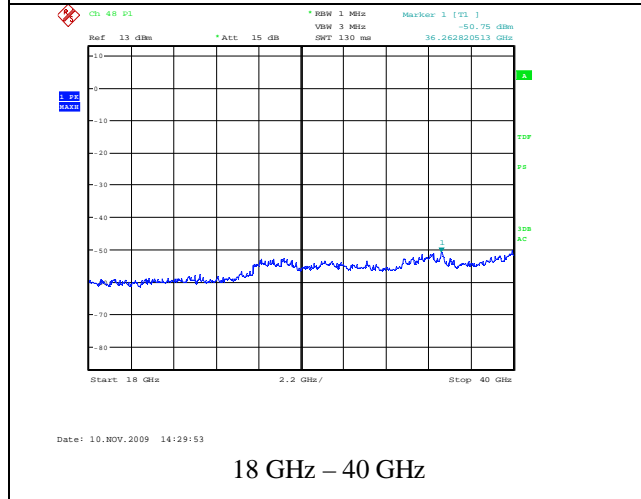
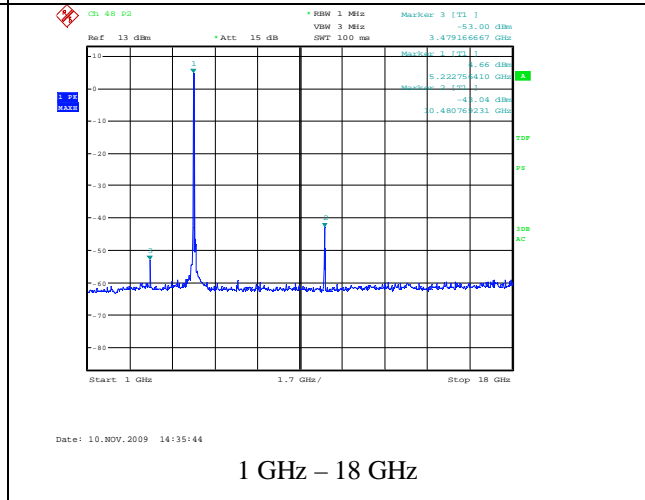
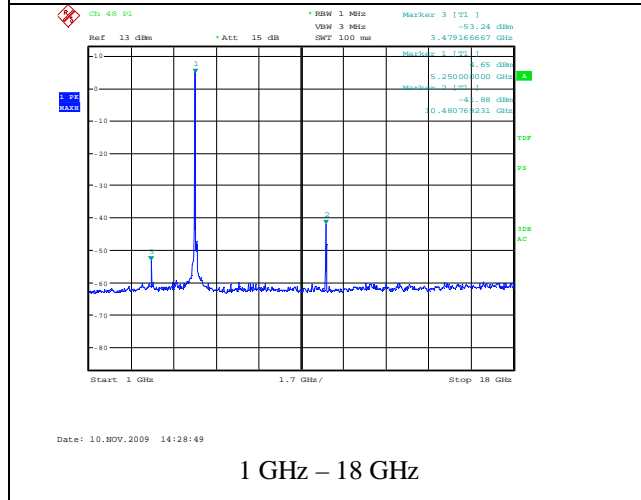
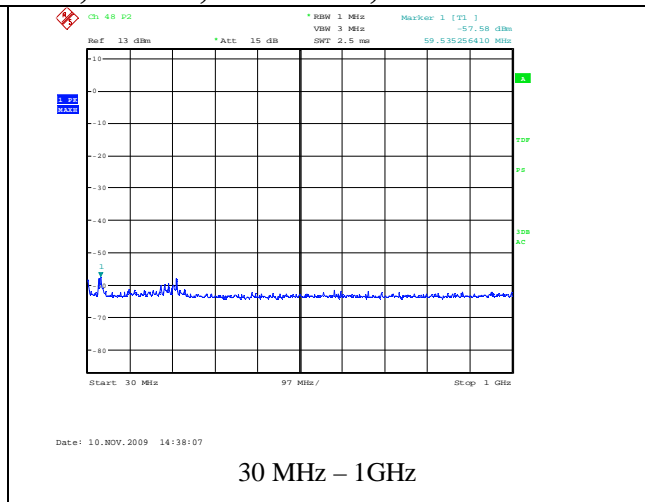




CSE, 802.11a, Channel 48, Port 1:



CSE, 802.11a, Channel 48, Port 2:



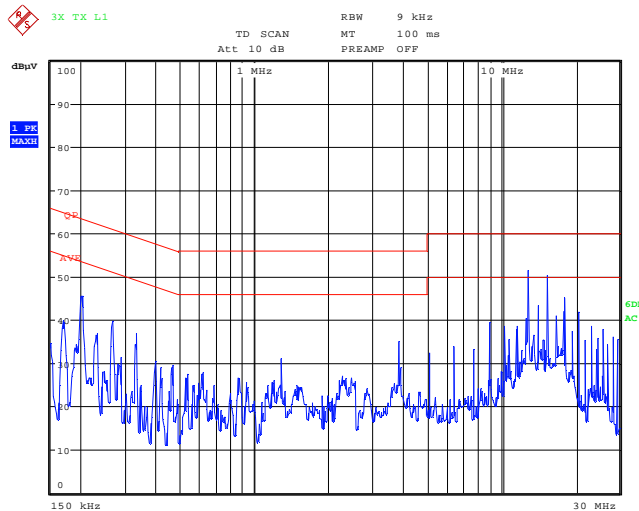
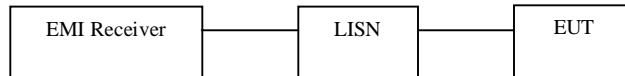


3.8 AC Power Line Conducted Emissions

Performance Criterion: AC power line conducted emissions shall not exceed the limits specified in FCC § 15.207 and Table 2 of 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 transmitting mode. Refers to the following screen captures (using a peak detector), block diagram, and data tables.



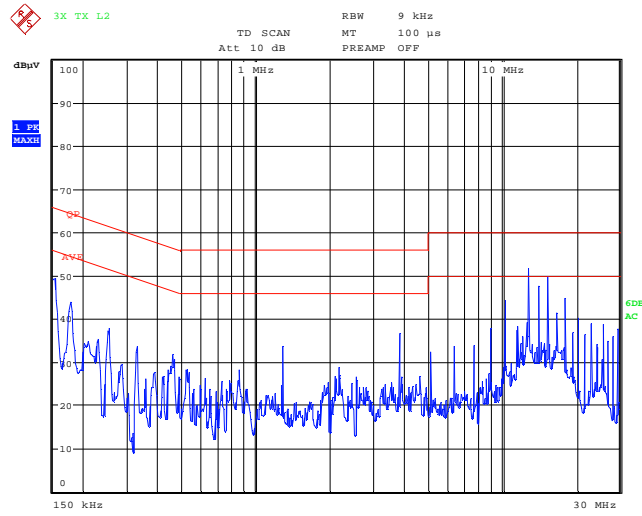
Date: 11.NOV.2009 12:37:22

Line 1:

Frequency (MHz)	Level (dBuV)		Limits (dBuV)		Margin (dB)
	QP	AVE	QP	AVE	
0.200	45.24	30.07	63.61	53.61	18.37
12.824	52.27	47.16	60	50	2.84
14.107	47.13	44.29	60	50	5.71
15.389	50.73	49.04	60	50	0.96
16.672	42.55	40.49	60	50	9.51
17.950	45.45	44.29	60	50	5.71

Tested by: Grace Lin

Date of Test: November 11, 2009



Date: 11.NOV.2009 12:50:54

Line 2:

Frequency (MHz)	Level (dBuV)		Limits (dBuV)		Margin (dB)
	QP	AVE	QP	AVE	
0.152	49.55	36.97	65.89	55.89	16.34
10.257	43.34	38.46	60	50	11.54
12.824	52.42	47.61	60	50	2.39
14.102	43.53	37.72	60	50	12.28
15.387	50.25	47.46	60	50	2.54
17.952	44.51	42.15	60	50	7.85

Tested by: Grace Lin

Date of Test: November 11, 2009

3.9 Radiated Spurious Emission

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 modified for continuous operation using the settings shown above.

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



EUT = XY

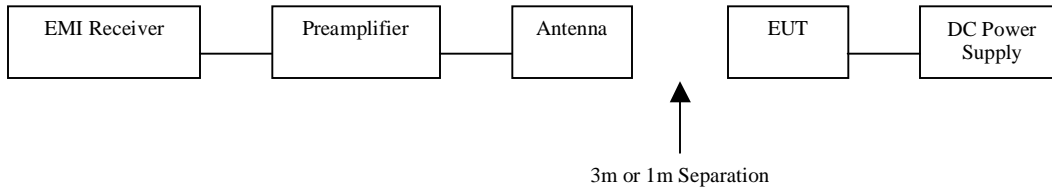


EUT = YZ



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. A factor of 20 dB/decade applies to measurements made at a closer distance than the limit distance before comparing to the limits. For the emissions compared to the limit of 74 dBuV/m, a peak detector was used. For the emissions compared to the limit of 54 dBuV/m, an average detector was used.



Antenna Polarization	Frequency (MHz)	Channel No.	Antenna Port	Data Rate	EUT Orientation	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turntable Degree
H	15540 (NF)	36	2	18	XY	53.92	74	20.08	-	-
H	15540 (NF)	36	2	18	XY	40.84	54	13.16	-	-
H	20720*	36	2	18	XY	44.17	74	29.83	100.0	0.0
H	20720*	36	2	18	XY	30.94	54	23.06	100.0	0.0
H	15660 (NF)	44	2	18	XY	53.57	74	20.43	-	-
H	15660 (NF)	44	2	18	XY	40.85	54	13.15	-	-
H	20880*	44	2	18	XY	43.99	74	30.01	100.0	0.0
H	20880*	44	2	18	XY	32.00	54	22.00	100.0	0.0
H	31320 (NF)**	44	2	18	XY	42.81	74	31.19	-	-
H	31320 (NF)**	44	2	18	XY	28.63	54	25.37	-	-
H	15720 (NF)	48	2	18	XY	53.76	74	20.24	-	-
H	15720 (NF)	48	2	18	XY	40.95	54	13.05	-	-
H	20960*	48	2	18	XY	44.37	74	29.63	100.0	0.0
H	20960*	48	2	18	XY	31.94	54	22.06	100.0	0.0
H	31440 (NF)**	48	2	18	XY	43.22	74	30.78	-	-
H	31440 (NF)**	48	2	18	XY	28.63	54	25.37	-	-

NF: Noise floor

Date of Test: October 16-19, 2009

*: Measured at 1m

** : Measured at 0.03m

3.10 Receiver Radiated Emissions

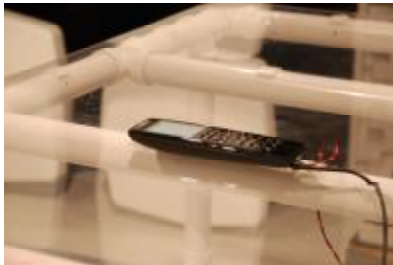
Performance Criterion: Receiver radiated emissions must meet the requirements of Table 1 of IC RSS-Gen. Receivers operating above 960 MHz or below 30 MHz are exempt from complying with the technical provisions of FCC Part 15 Subpart B.

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. All radiated emission measurements, above 18 GHz, were performed at 1-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

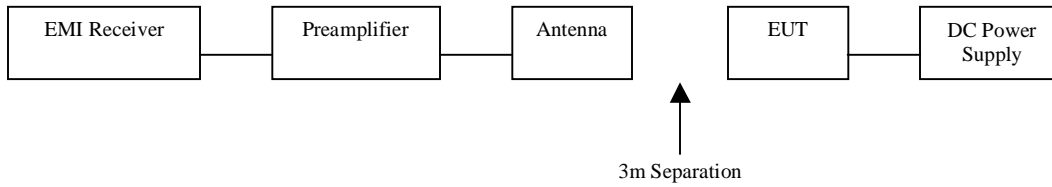


EUT = YZ



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. For the emissions compared to the limit of 74 dBuV/m, a peak detector was used. For the emissions compared to the limit of 54 dBuV/m, an average detector was used.



Antenna Polarization	Frequency (MHz)	Channel No.	EUT Orientation	Antenna Port	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Turntable Degree
H	180.36	36	ZX	1	39.80	43.5	3.70	114.7	117.2
V	480.00	36	YZ	2	42.07	46	3.93	100.0	303.5
V	540.00	36	YZ	1	38.88	46	7.12	100.0	286.5
V	624.00	36	YZ	2	38.68	46	7.32	100.0	266.2
V	660.00	36	YZ	2	41.43	46	4.57	100.0	277.9
H	960.00	36	YZ	2	34.92	46	11.08	100.0	148.0
H	6906.59	36	ZX	1	50.06	74	23.94	147.3	175.8
H	6906.59	36	ZX	1	46.27	54	7.73	147.3	175.8
H	180.36	44	ZX	1	39.85	43.5	3.65	114.7	118.9
V	480.00	44	YZ	2	42.12	46	3.88	100.0	304.0
V	540.00	44	YZ	1	38.03	46	7.97	100.0	279.1
V	624.00	44	YZ	2	38.52	46	7.48	100.0	274.7
V	660.00	44	YZ	2	41.52	46	4.48	100.0	275.4
H	960.00	44	YZ	2	35.03	46	10.97	100.0	42.0
H	6959.91	44	ZX	1	49.83	74	24.17	142.4	172.8
H	6959.91	44	ZX	1	46.39	54	7.61	142.4	172.8
H	180.36	48	ZX	1	39.76	43.5	3.74	115.5	113.0
V	480.00	48	YZ	2	41.62	46	4.38	100.0	306.0
V	540.00	48	YZ	1	38.86	46	7.14	100.0	286.3
V	624.00	48	YZ	2	39.05	46	6.95	100.0	266.0
V	660.00	48	YZ	2	41.60	46	4.40	100.0	267.7
H	960.00	48	YZ	2	34.67	46	11.33	100.0	47.3
H	6986.59	48	ZX	1	50.64	74	23.36	133.5	175.5
H	6986.59	48	ZX	1	45.95	54	8.05	133.5	175.5

Tested by: Grace Lin

Date of Test: October 22-23, 2009

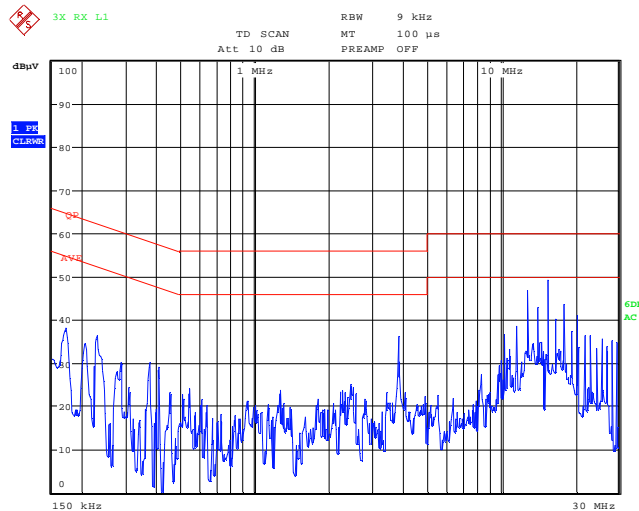
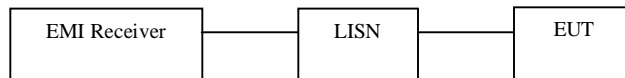


3.11 Receiver AC Power Line Conducted Emissions

Performance Criterion: AC power line conducted emissions shall not exceed the limits specified in FCC § 15.207 and Table 2 of 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 screen captures (using a peak detector), block diagram, and data tables.



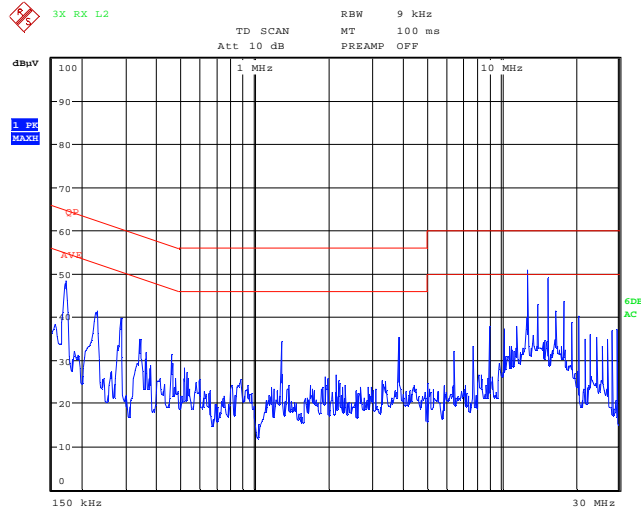
Date: 11.NOV.2009 11:59:09

Line 1:

Frequency (MHz)	Level (dBuV)		Limits (dBuV)		Margin (dB)
	QP	AVE	QP	AVE	
0.173	47.07	35.01	64.82	54.82	17.75
12.849	49.08	43.15	60	50	6.85
14.134	43.97	43.70	60	50	6.30
15.421	47.19	42.46	60	50	7.54
16.708	40.86	35.35	60	50	14.65
17.993	42.84	37.63	60	50	12.37

Tested by: Grace Lin

Date of Test: November 11, 2009



Date: 11.NOV.2009 12:22:00

Line 2:

Frequency (MHz)	Level (dBuV)		Limits (dBuV)		Margin (dB)
	QP	AVE	QP	AVE	
0.170	47.87	36.93	64.96	54.96	17.09
12.854	49.49	42.34	60	50	7.66
14.141	44.97	41.54	60	50	8.46
15.423	46.86	43.97	60	50	6.03
16.708	38.53	36.17	60	50	13.83
17.997	42.62	39.54	60	50	10.46

Tested by: Grace Lin

Date of Test: November 11, 2009