


SK TECH CO., LTD.

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Certificate of Compliance

Test Report No.:	SKTTTRT-080118-001		
Applicant:	SAMSUNG ELECTRONICS CO., LTD.		
Applicant Address:	#416, Meatan-3dong, Yeongtong-gu, Suwon-si, Gyeonggi-do, South Korea		
Manufacturer:	Samsung Electro-Mechanics Co., LTD.		
Manufacturer Address:	#314, Maetan3-Dong, Yeongtong-Gu, Suwon City, Gyunggi-Do, South Korea		
Device Under Test:	WLAN Module		
FCC ID:	A3LSWL-2900U	Model Name:	SWL-2900U
Brand/Trade Name:	SAMSUNG		
Receipt No.:	SKTEU07-1304	Date of receipt:	December 24, 2007
Date of Issue:	January 18, 2008		
Location of Testing:	SK TECH CO., LTD. #820-2, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, 472-905 South Korea		
Test Procedure:	ANSI C63.4:2003		
Test Specification:	47CFR, Part 15 Rules, RSS-210 Issue 7		
FCC Equipment Class: IC Equipment Category:	DTS - Part 15 Digital Transmission System RSS-210 Issue 7 – Category I Equipment, Annex 8		
Test Result:	The above-mentioned device has been tested and passed.		
Tested & Reported by: : Seong-Baek, Ko		Tested & Reported by: Jong-Soo, Yoon	
 Jan. 18. 2008		 Jan. 18. 2008	
Signature Date		Signature Date	
Other Aspects:	-		
Abbreviations:	· OK, Pass = passed · Fail = failed · N/A = not applicable		



- This test report is not permitted to copy partly and entirely without our permission.
- This test result is dependent on only equipment to be used.
- This test result is based on a single evaluation of submitted samples of the above mentioned.



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1. GENERAL

These tests were performed using the test procedure outlined in ANSI C63.4, 2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.247 for Digital Transmission System. The EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards.

We attest to the accuracy of data. All measurements reported herein were performed by SK TECH Co., Ltd. and were made under Chief Engineer's supervision.

We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

2. TEST SITE

SK TECH Co., Ltd.

2.1 Location

820-2, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, 472-905 South Korea

(FCC Registered Test Site Number: 90752)

(OPEN AREA TEST SITE INDUSTRY CANADA NUMBER: IC 5429)

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.

This laboratory is recognized as a Conformity Assessment Body (CAB) for CAB's Designation Number:

KR0007 by FCC, is accredited by NVLAP for NVLAP Lab. Code: **200220-0.**



2.2 List of Test and Measurement Instruments

No.	Description	Manufacturer	Model #	Serial #	Calibrated until	Used
1	Spectrum Analyzer	Agilent	E4405B	US40520856	2008.07.23	☐
2	EMC Spectrum Analyzer	Agilent	E7405A	US40240203	2008.02.02	☒
3	EMI Test Receiver	Rohde&Schwarz	ESIB40	100277	2008.07.23	☒
4	EMI Test Receiver	Rohde&Schwarz	ESVS10	825120/008	2008.07.24	☐
5	EMI Test Receiver	Rohde&Schwarz	ESHS10	862970/019	2008.07.24	☒
6	Artificial Mains Network	Rohde&Schwarz	ESH2-Z5	834549/011	2008.07.25	☒
7	Pre-amplifier	HP	8447F	3113A05153	2008.02.23	☒
8	Pre-amplifier	MITEQ	AFS44	1116321	2008.03.07	☒
9	Pre-amplifier	MITEQ	AFS44	1116322	2008.02.06	☐
10	Power Meter	Agilent	E4417A	MY45100426	2008.07.24	☒
11	Power Sensor	Agilent	E9327A	MY44420696	2008.07.24	☒
12	Attenuator (10dB)	HP	8491B	38067	2008.07.25	☒
13	Oscilloscope	Agilent	54820A	US40240160	2008.03.06	☐
14	Diode detector	Agilent	8473C	1882A03173	2008.02.06	☐
15	High Pass Filter	Wainwright	WHKX3.0/18G	8	2008.07.25	☒
16	VHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	VHAP	1014 / 1015	2008.11.27	☐
17	UHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	UHAP	989 / 990	2008.11.27	☐
18	Loop Antenna	Schwarzbeck	HFH2-Z2	863048/019	2008.12.01	☐
19	TRILOG Broadband Antenna	Schwarzbeck	VULB9160	3141	2008.05.29	☒
20	Horn Antenna	AH Systems	SAS-200/571	304	N/A	☐
21	Horn Antenna	EMCO	3115	00040723	2008.03.15	☐
22	Horn Antenna	EMCO	3115	00056768	2008.07.24	☒
23	Vector Signal Generator	Agilent	E4438C	MY42080359	2008.07.25	☐
24	PSG analog signal generator	Agilent	E8257D-520	MY45141255	2008.07.25	☐
25	DC Power Supply	HP	6622A	3448A03950	2008.07.23	☐
26	DC Power Supply	HP	6268B	2542A-07856	2008.07.23	☐
27	Digital Multimeter	HP	HP3458A	2328A14389	2008.03.07	☐
28	PCS Interface	HP	83236B	3711J00881	2008.03.09	☐
29	CDMA Mobile Test Set	HP	8924C	US35360253	2008.03.09	☐
30	Hygro/Thermo Graph	SATO	PC-5000TRH-II	-	2008.04.09	☒
31	Temperature/Humidity Chamber	All Three	ATM-50M	20030425	2008.03.06	☐
32	Temperature/Humidity Chamber	DAEJIN	DJ-THC02	06071	2008.03.07	☐

2.3 Test Date

Date of Test: January 10, 2008 ~ January 18, 2008

2.4 Test Environment

See each test item's description.



3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

The product specification described herein was obtained from the product data sheet or user's manual.

3.1 Rating and Physical Characteristics

Power source	DC 5.0 V (USB interface)
Local Oscillator or X-Tal	X-Tal: 30 MHz
Transmit Frequency	2412 ~ 2462 MHz (11 channels, 5MHz step)
Antenna Type	Integral (Fractal antenna on PCB(×2), Gain: 2.57 dBi)
Type of Modulation	IEEE 802.11b: DSSS (DBPSK - 1Mbps, DQPSK - 2Mbps, CCK - 5.5/11 Mbps) IEEE 802.11g: OFDM (BPSK - 6/9Mbps, QPSK - 12/18Mbps, 16QAM - 24/36Mbps, 64QAM - 48/54Mbps)
RF Output power	17 dBm for DSSS, 13 dBm for OFDM modulation
External Ports **	USB connection to PC for data communication

** The device into which the WLAN modular transmitter is incorporated should be tested and comply with the requirements as a digital device.

3.2 Equipment Modifications

None

3.3 Submitted Documents

Block diagram

Schematic diagram

Antenna Specification

Part List

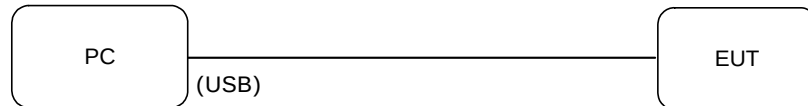
User manual



4. MEASUREMENT CONDITIONS

4.1 Description of test configuration

The measurements were taken in continuous transmitting mode using the TEST MODE. For controlling the EUT as TEST MODE, the test program was provided by the applicant.



[System Block Diagram of Test Configuration]

If not otherwise stated, the transmitter continuously operating with the modulation rate of 11 Mbps (CCK) and 54 Mbps (QAM) as the worst case.

4.2 List of Peripherals

Equipment Type	Manufacturer	Model	S/N
PC *	SAMSUNG	DB-P73	AG4497APA00009X
Monitor*	Erae	ELM-728	2925CJA021461
Keyboard*	HP	SK-1688	C0509036394
Mouse*	Logitech	M-BJ58	HCA54718469
Notebook PC*	DELL	PP19L	CN0MG532-70166-6BT-004G
Adaptor* (for Notebook PC)	DELL	LA65NS0-00	CN-0DF263-71615-6BT-81A8

* For control of the RF module via USB interface in the EUT.

** For the measurements of the field strength of radiated emissions, the PC system with peripherals were used below 1 GHz, and the Notebook PC was used above 1 GHz.

4.3 Type of Used Cables

#	START		END		CABLE	
	NAME	I/O PORT	NAME	I/O PORT	LENGTH(m)	SHIELDED
1	EUT	CON1	Notebook PC	USB	0.3	NO
2	Notebook PC	DC Input	Adaptor	DC Output	2.0	NO
3	Adaptor	AC Input	AC mains	-	0.8	NO

4.4 Uncertainty

Measurement Item	Combined Standard Uncertainty U _c	Expanded Uncertainty U = KU _c (K = 2)
Conducted RF power	± 1.49 dB	± 2.98dB
Radiated disturbance	± 2.30 dB	± 4.60 dB
Conducted disturbance	± 1.96 dB	± 3.92 dB



5. TEST AND MEASUREMENTS

Summary of Test Results

Requirement	CFR 47 Section	RSS Standards	Report Section	Test Result
Antenna Requirement	15.203, 15.247(b)(4)	RSS-Gen, 7.1.4	5.1	PASS
6dB Bandwidth	15.247(a)(2)	RSS-210, A8.2(a)	5.2	PASS
Maximum Peak Output Power	15.247(b)(3), (4)	RSS-210, A8.4(4)	5.3	PASS
Spurious Emission, Band Edge, and Restricted bands	15.247(d), 15.205(a), 15.209(a)	RSS-210, A8.5 Table 1, 2, and 3	5.4	PASS
Peak Power Spectral Density	15.247(e)	RSS-210, A8.2(b)	5.5	PASS
Conducted Emissions	15.207(a)	RSS-Gen, 7.2.2	5.6	PASS
Receiver Spurious emissions	-	RSS-Gen, 7.2.3	5.7	PASS
RF Exposure	15.247(i), 1.1307(b)(1)	RSS-Gen, 5.5 RSS-102, 2.5	5.8	PASS

5.1 ANTENNA REQUIREMENT

5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §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.

5.1.2 Result:

PASS

The transmitter has two integral fractal antennas on the PCB. The directional gain of the antenna is 2.57 dBi.



5.2 6dB BANDWIDTH

5.2.1 Regulation

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

5.2.2 Test Procedure

1. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
2. Set the spectrum analyzer as follows:
 RBW = 100 kHz, VBW $\geq$ RBW
 Span $\gg$ RBW
 Sweep = auto
 Detector function = peak
 Trace = max hold
3. Mark the peak frequency and -6dB (upper and lower) frequency.
4. Set the RBW to as close to 1% of the selected span as is possible without being below 1%.
5. Set the DETECTOR to sample where practical. [REMARK: the function of the PEAK HOLD was used]
6. Measure the 99% occupied bandwidth.
7. Repeat until all the rest channels are investigated.

5.2.3 Test Results:

PASS

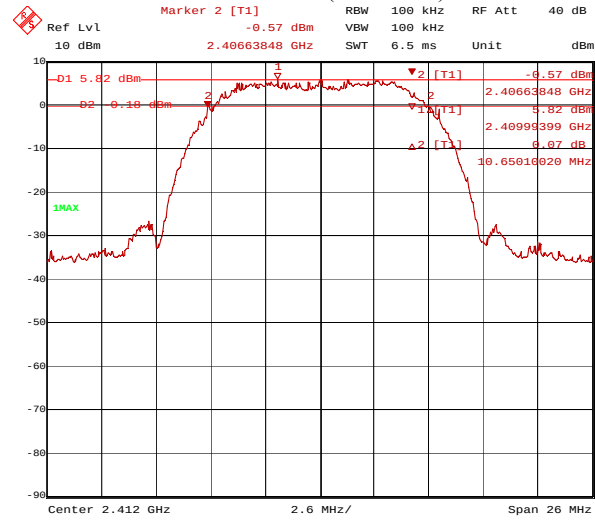
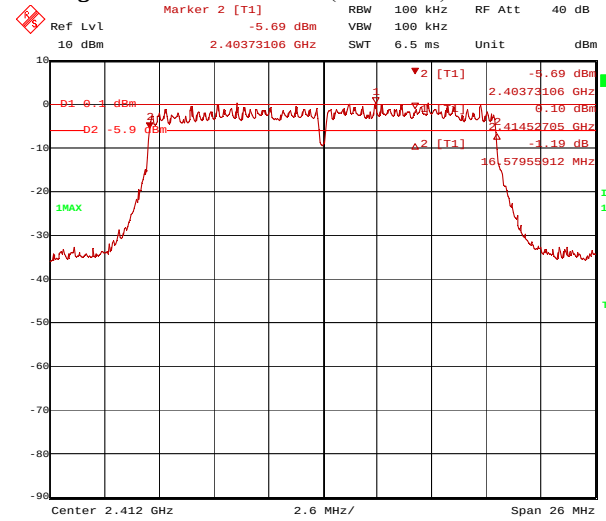
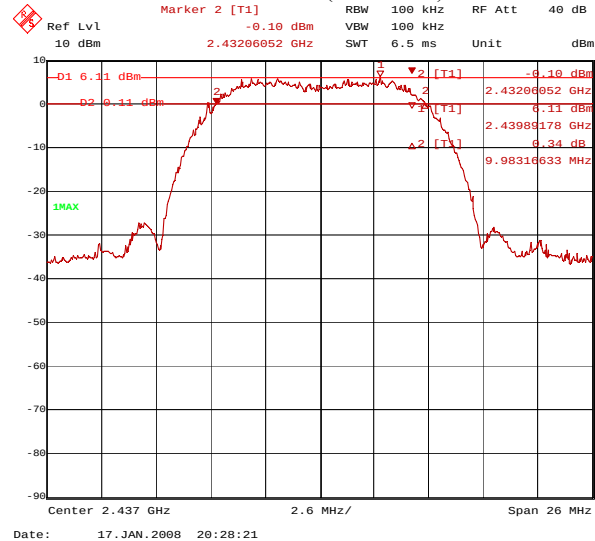
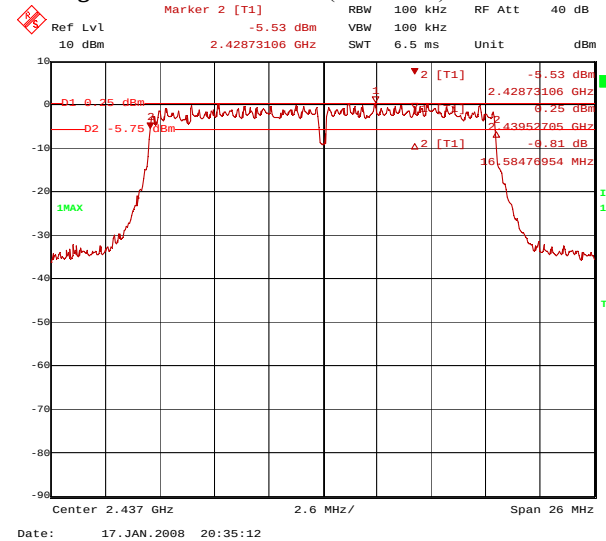
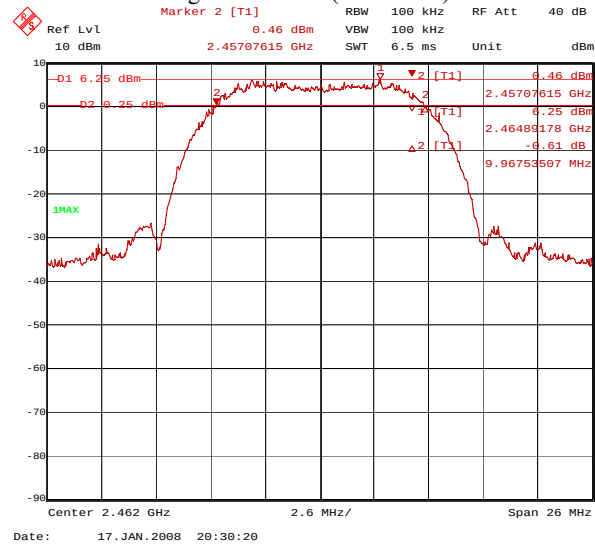
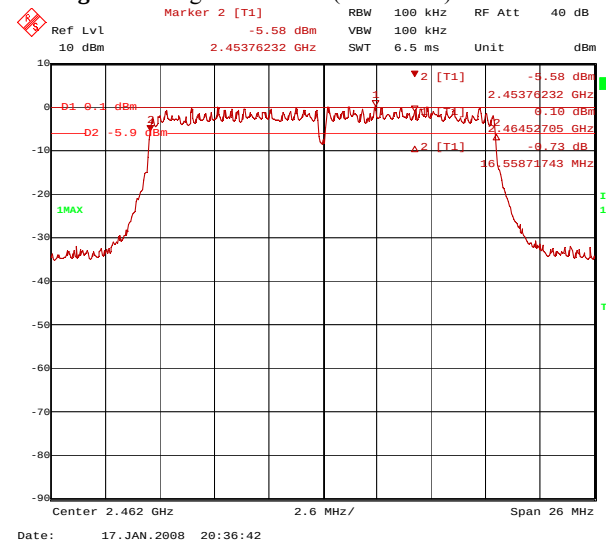
Table 1: Measured values of the 6dB Bandwidth

Modulation	Operating frequency	Transfer Rate	Occupied Bandwidth (99%)	6dB Bandwidth	Limit
802.11b	2412 MHz	11 Mbps	11.84 MHz	10.65 MHz	≥ 500 kHz
	2437 MHz	11 Mbps	11.84 MHz	9.98 MHz	≥ 500 kHz
	2462 MHz	11 Mbps	11.84 MHz	9.97 MHz	≥ 500 kHz
802.11g	2412 MHz	54 Mbps	16.59 MHz	16.58 MHz	≥ 500 kHz
	2437 MHz	54 Mbps	16.59 MHz	16.58 MHz	≥ 500 kHz
	2462 MHz	54 Mbps	16.59 MHz	16.56 MHz	≥ 500 kHz



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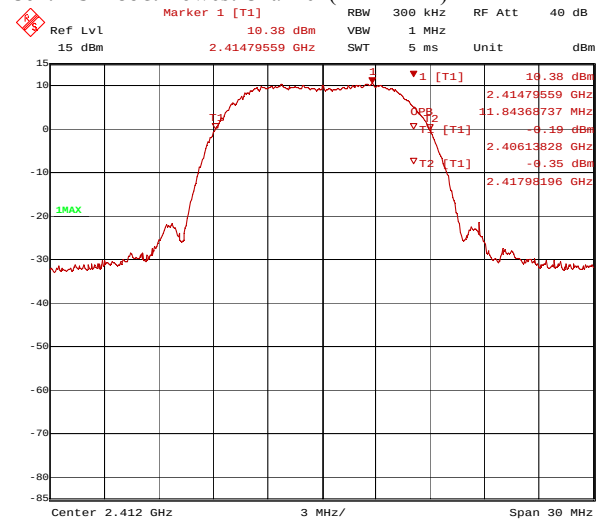
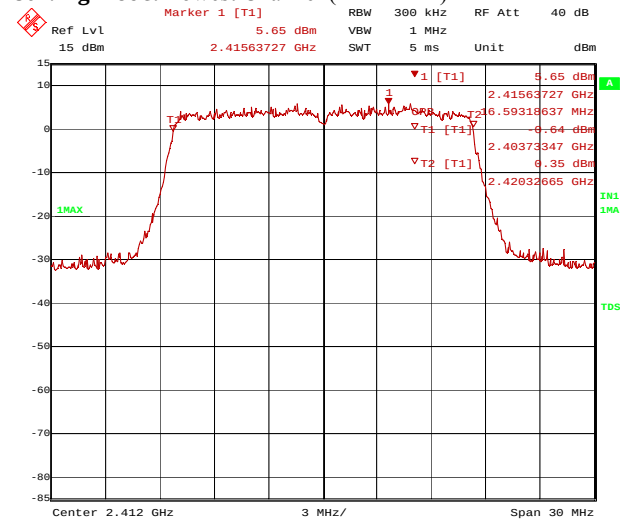
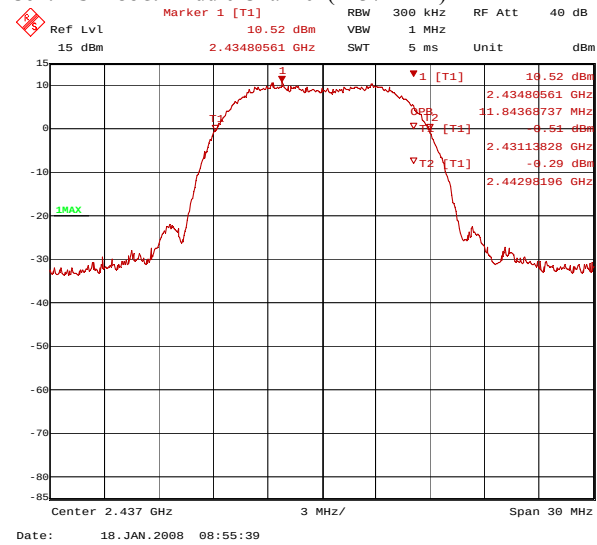
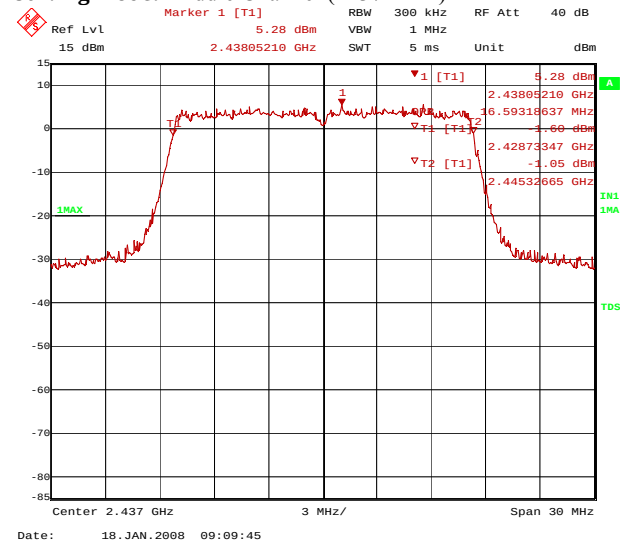
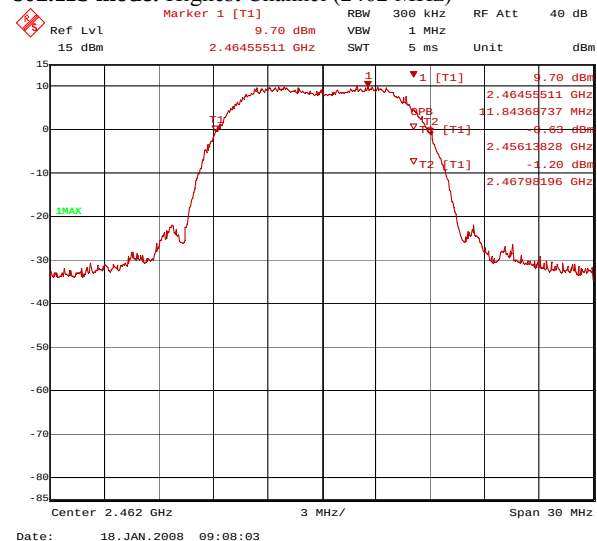
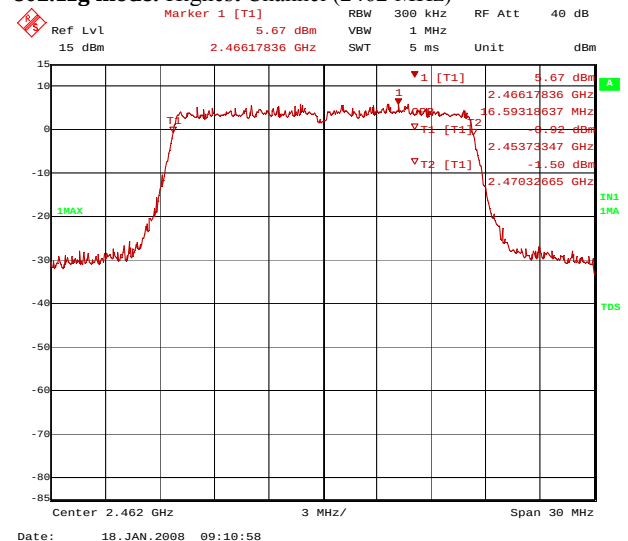
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Figure 1. Plot of the 6dB Bandwidth**802.11b mode: Lowest Channel (2412 MHz)****802.11g mode: Lowest Channel (2412 MHz)****802.11b mode: Middle Channel (2437 MHz)****802.11g mode: Middle Channel (2437 MHz)****802.11b mode: Highest Channel (2462 MHz)****802.11g mode: Highest Channel (2462 MHz)**



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Figure 2. Plot of the Occupied Bandwidth (99%)**802.11b mode: Lowest Channel (2412 MHz)****802.11g mode: Lowest Channel (2412 MHz)****802.11b mode: Middle Channel (2437 MHz)****802.11g mode: Middle Channel (2437 MHz)****802.11b mode: Highest Channel (2462 MHz)****802.11g mode: Highest Channel (2462 MHz)**



5.3 MAXIMUM PEAK OUTPUT POWER

5.3.1 Regulation

According to §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.

According to §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.

5.3.2 Test Procedure

Conducted output power measurements were directly made by using Peak-Average power meter with peak power sensor.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on peak power meter via a low loss cable and attenuator.
3. Measure the peak output power.

5.3.3 Test Results:

PASS

Table 2: Measured values of the Maximum Peak Conducted Output Power

Modulation	Operating Frequency	Transfer Rate	AVERAGE POWER		PEAK POWER		Limit
			[dBm]	[W]	[dBm]	[W]	
802.11b	2412 MHz	11 Mbps	16.29	0.043	18.19	0.066	1 W
	2437 MHz		16.48	0.044	18.23	0.067	1 W
	2462 MHz		16.34	0.043	18.13	0.065	1 W
802.11g	2412 MHz	54 Mbps	13.18	0.021	18.72	0.074	1 W
	2437 MHz		13.03	0.020	18.88	0.077	1 W
	2462 MHz		13.08	0.020	18.53	0.071	1 W



5.4 SPURIOUS EMISSIONS, BAND EDGE, AND RESTRICTED BANDS

5.4.1 Regulation

According to §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)).

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength ($\mu\text{V/m}$ @ 3m)	Field strength ($\text{dB}\mu\text{V/m}$ @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.



5.4.2 Test Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation

RBW $\geq$ 1% of the span

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 $\times$ 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1000 MHz using the TRILOG broadband antenna, and above 1000 MHz using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 $\times$ 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.



6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative "marker-delta" method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function as the above Spurious Radiated Emissions test procedure.
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.
3. Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two "standard" bandwidths must be measured as the above Spurious Radiated Emissions test procedure.



5.4.3 Test Results:

PASS

Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 3 and 4.
Spurious RF conducted emissions were shown in the Figure 5.

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

**Table 3: Measured values of the Field strength of spurious emission (Radiated)
Operating 802.11b mode**

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Turn Table [degree]	Reading [dB(μV)]	Amp Gain [dB]	ATT [dB]	AF [dB(1/m)]	CL [dB]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-peak data, emissions below 1000 MHz												
336.01*	120	H	1.0	81	41.9	27.1	0	12.9	1.7	29.5	46.0	16.5
721.74*	120	H	1.0	0	42.4	28.5	0	20.5	3.1	37.5	46.0	8.5
960.00	120	H	1.0	187	37.1	27.9	0	24.1	3.1	36.5	46.0	9.5
AVERAGE data, emissions above 1000 MHz												
2412.0	1000	H	2.01	71	96.65	43.7	10.1	28.3	4.9	96.3	-	-
4824.0	1000	V	1.84	129	41.12	44.6	0.8	32.6	7.2	37.1	54.0	16.9
2437.0	1000	H	1.93	66	98.34	43.7	10.1	28.3	4.9	97.9	-	-
4874.0	1000	V	1.79	99	40.46	44.6	0.8	32.5	7.3	36.5	54.0	17.5
2462.0	1000	H	2.00	67	99.06	43.8	10.1	28.6	5.0	99.0	-	-
4924.0	1000	V	1.63	352	41.03	44.6	0.8	32.5	7.3	37.0	54.0	17.0
PEAK data, emissions above 1000 MHz												
2412.0	1000	H	2.01	71	107.01	43.7	10.1	28.3	4.9	106.6	-	-
4824.0	1000	V	1.84	129	54.54	44.6	0.8	32.6	7.2	50.5	74.0	23.5
2437.0	1000	H	1.93	66	108.83	43.7	10.1	28.3	4.9	108.4	-	-
4874.0	1000	V	1.79	99	54.41	44.6	0.8	32.5	7.3	50.4	74.0	23.6
2462.0	1000	H	2.00	67	109.52	43.8	10.1	28.6	5.0	109.4	-	-
4924.0	1000	V	1.63	352	55.94	44.6	0.8	32.5	7.3	51.9	74.0	22.1

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



**Table 3: Measured values of the Field strength of spurious emission (Radiated) (cont.)
Operating 802.11g mode**

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Turn Table [degree]	Reading [dB(μV)]	Amp Gain [dB]	ATT [dB]	AF [dB(1/m)]	CL [dB]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-peak data, emissions below 1000 MHz												
336.01*	120	H	1.0	84	41.7	27.1	0	12.9	1.7	29.2	46.0	16.8
721.74*	120	H	1.0	0	42.0	28.5	0	20.5	3.1	37.1	46.0	8.9
960.00	120	H	1.0	189	36.7	27.9	0	24.1	3.1	36.0	46.0	10.0
AVERAGE data, emissions above 1000 MHz												
2412.0	1000	H	2.08	72	87.23	43.7	10.1	28.3	4.9	86.8	-	-
4824.0	1000	V	1.82	125	35.98	44.6	0.8	32.6	7.2	32.0	54.0	22.0
2437.0	1000	H	1.98	66	88.42	43.7	10.1	28.3	4.9	88.0	-	-
4874.0	1000	V	1.76	97	35.31	44.6	0.8	32.5	7.3	31.3	54.0	22.7
2462.0	1000	H	2.01	65	88.78	43.8	10.1	28.6	5.0	88.7	-	-
4924.0	1000	V	1.62	352	35.40	44.6	0.8	32.5	7.3	31.4	54.0	22.6
PEAK data, emissions above 1000 MHz												
2412.0	1000	H	2.08	72	103.93	43.7	10.1	28.3	4.9	103.5	-	-
4824.0	1000	V	1.82	125	49.26	44.6	0.8	32.6	7.2	45.3	74.0	28.7
2437.0	1000	H	1.98	66	104.71	43.7	10.1	28.3	4.9	104.3	-	-
4874.0	1000	V	1.76	97	47.58	44.6	0.8	32.5	7.3	43.6	74.0	30.4
2462.0	1000	H	2.01	65	105.21	43.8	10.1	28.6	5.0	105.1	-	-
4924.0	1000	V	1.62	352	48.53	44.6	0.8	32.5	7.3	44.5	74.0	29.5

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

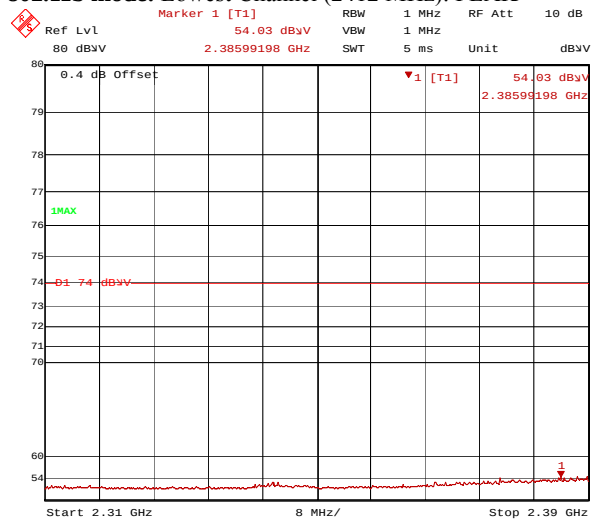
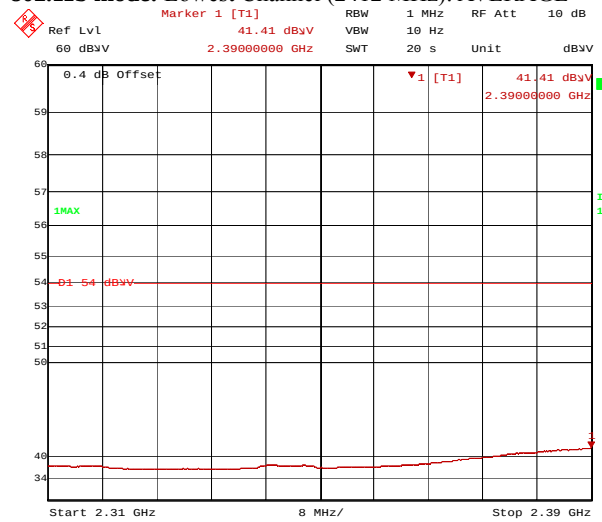
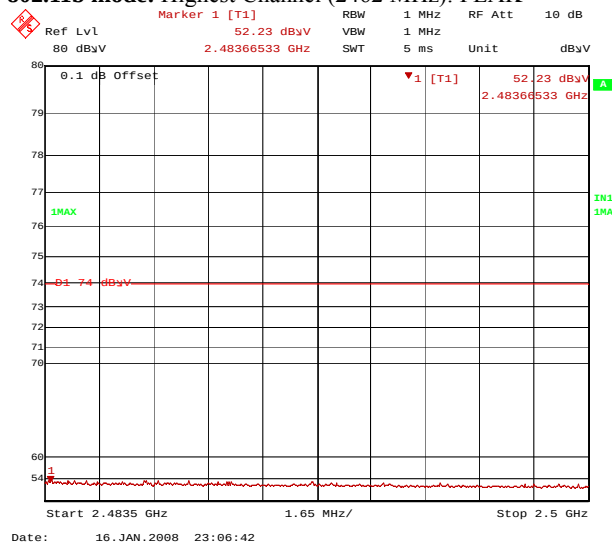
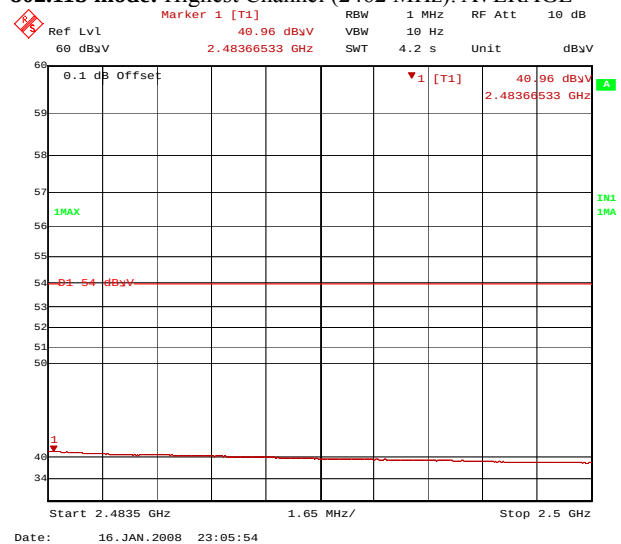
* The spurious emission at the frequency does not fall in the restricted bands.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

Date: 17.JAN.2008 22:56:44

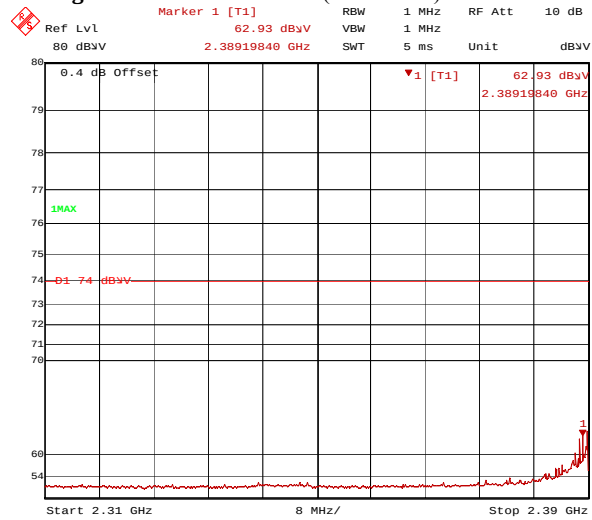
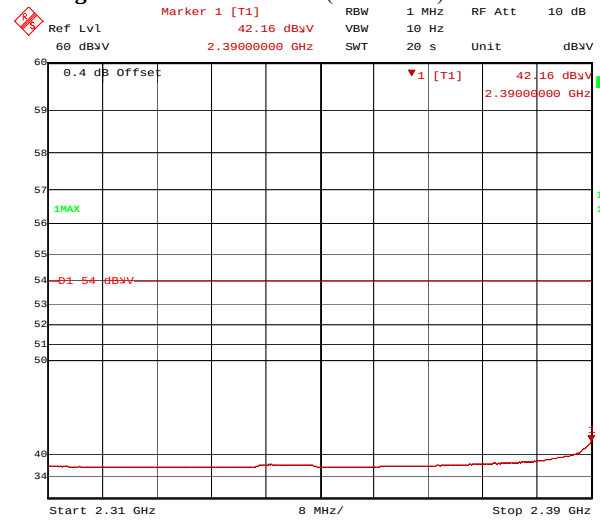
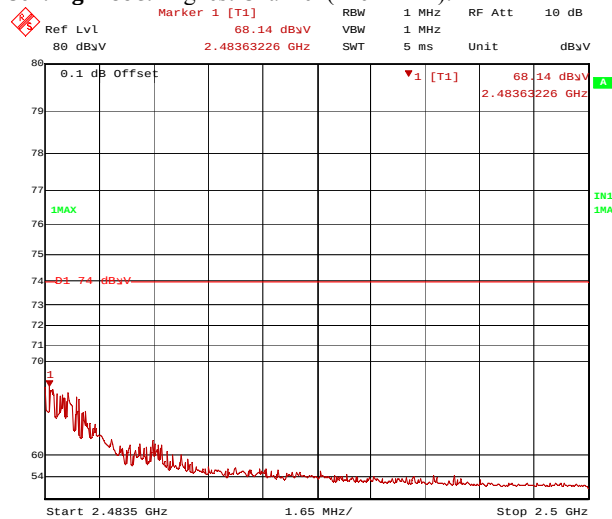
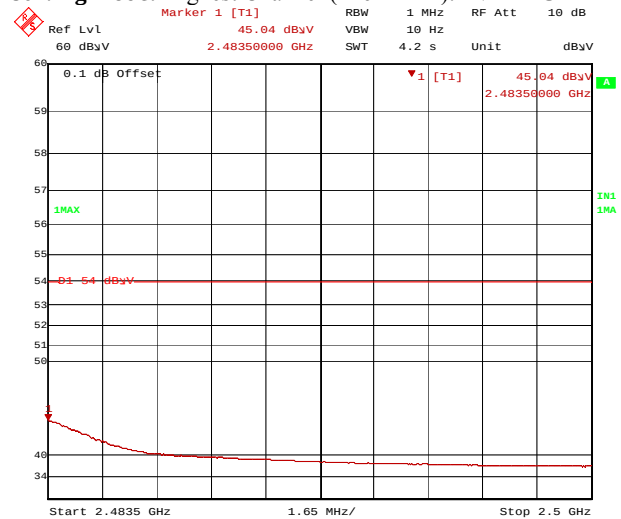
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Figure 4. Plot of the Band Edge (Radiated)**802.11b mode: Lowest Channel (2412 MHz): PEAK****802.11b mode: Lowest Channel (2412 MHz): AVERAGE****802.11b mode: Highest Channel (2462 MHz): PEAK****802.11b mode: Highest Channel (2462 MHz): AVERAGE**

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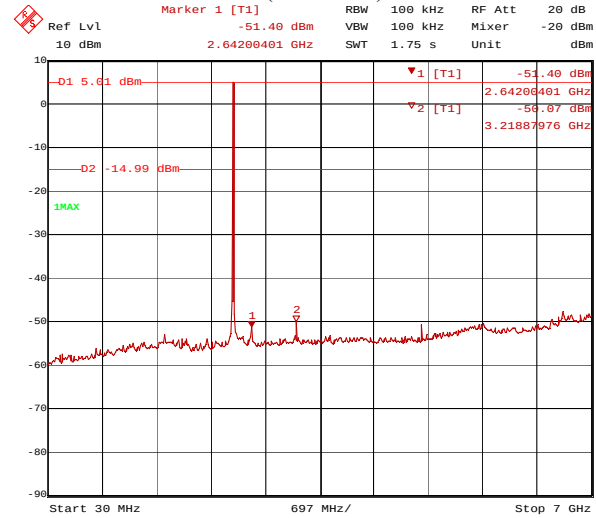
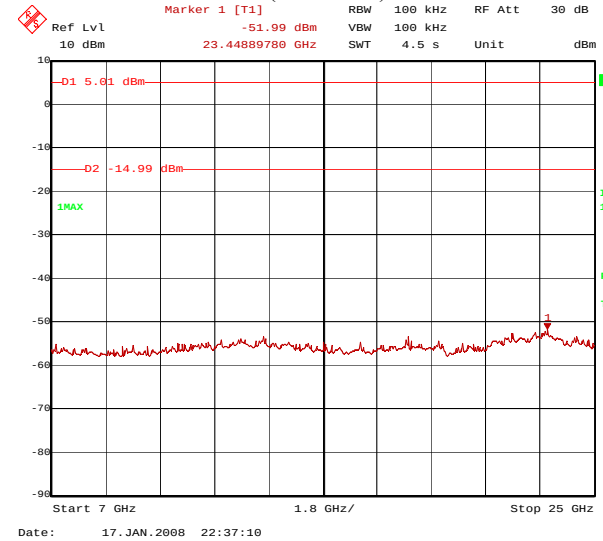
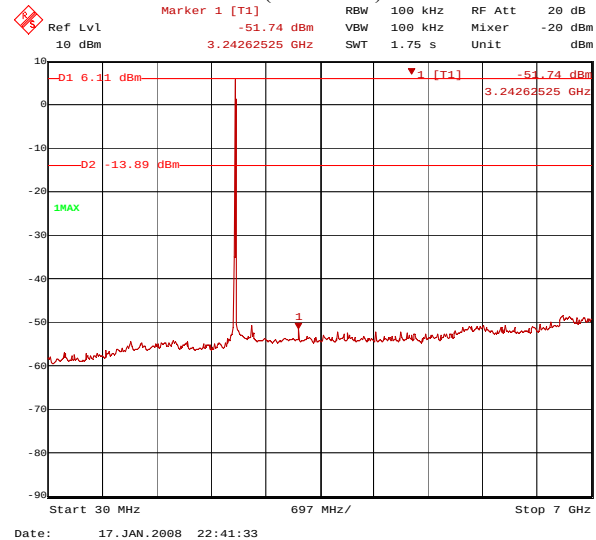
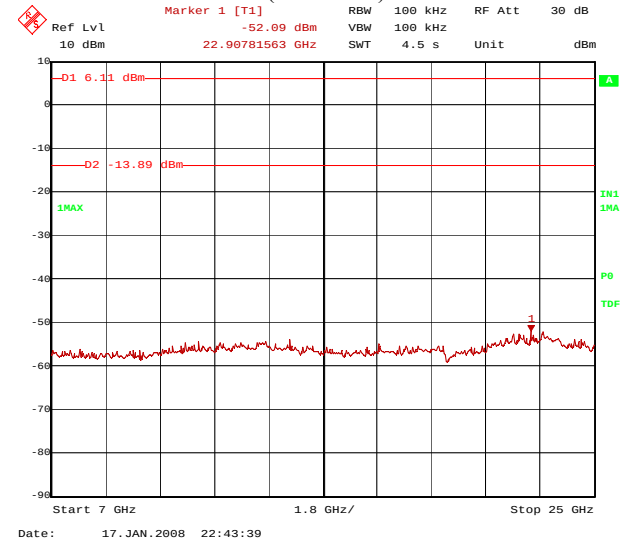
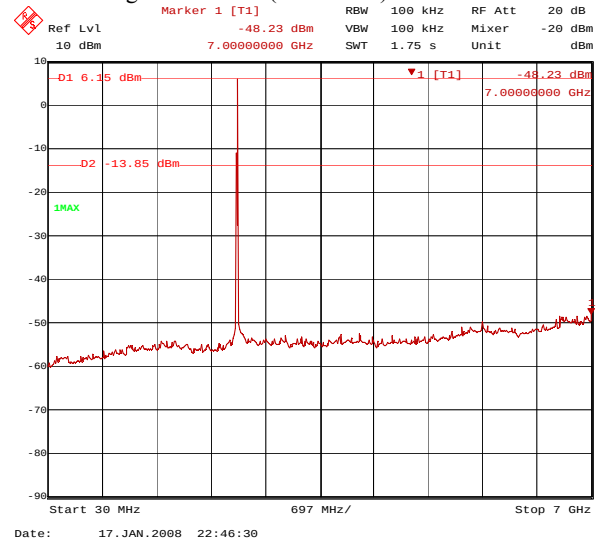
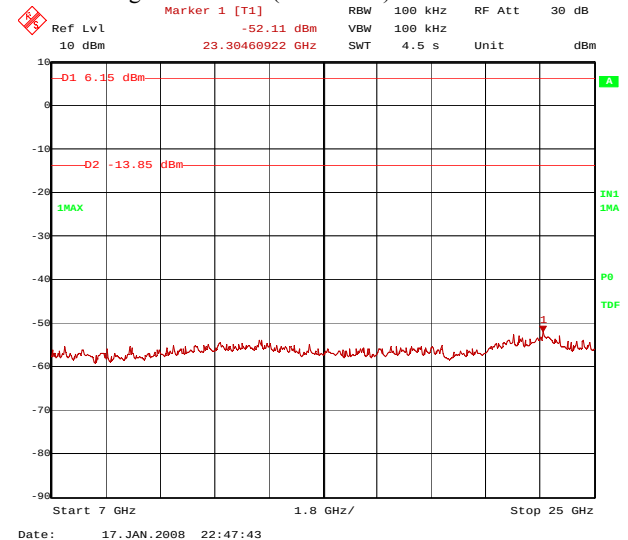
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Figure 4. Plot of the Band Edge (Radiated) (cont.)**802.11g mode: Lowest Channel (2412 MHz): PEAK****802.11g mode: Lowest Channel (2412 MHz): AVERAGE****802.11g mode: Highest Channel (2462 MHz): PEAK****802.11g mode: Highest Channel (2462 MHz): AVERAGE**



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Figure 5. Spurious RF conducted emissions**802.11b: Lowest Channel (2412 MHz): 30 MHz ~ 7 GHz****802.11b: Lowest Channel (2412 MHz): 7 GHz ~ 25 GHz****802.11b: Middle Channel (2437 MHz): 30 MHz ~ 7 GHz****802.11b: Middle Channel (2437 MHz): 7 GHz ~ 25 GHz****802.11b: Highest Channel (2462 MHz): 30 MHz ~ 7 GHz****802.11b: Highest Channel (2462 MHz): 7 GHz ~ 25 GHz**

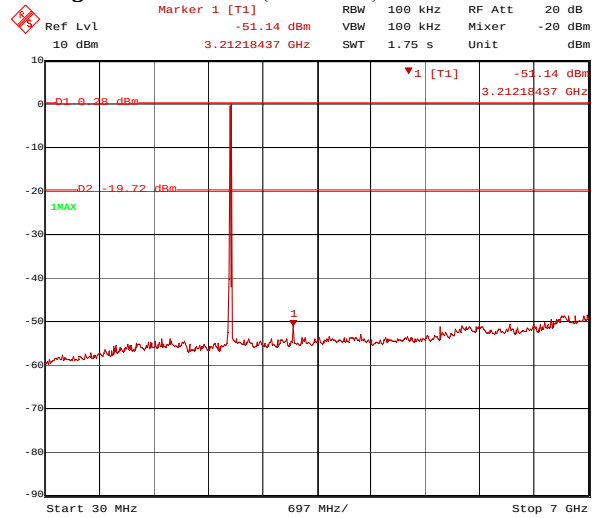


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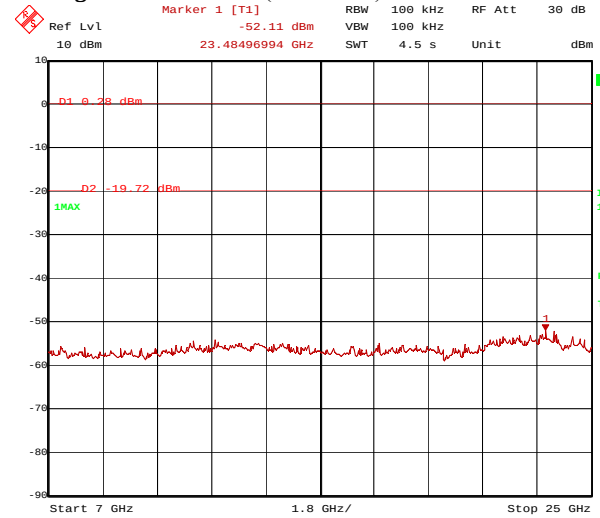
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Figure 5. Spurious RF conducted emissions (cont.)

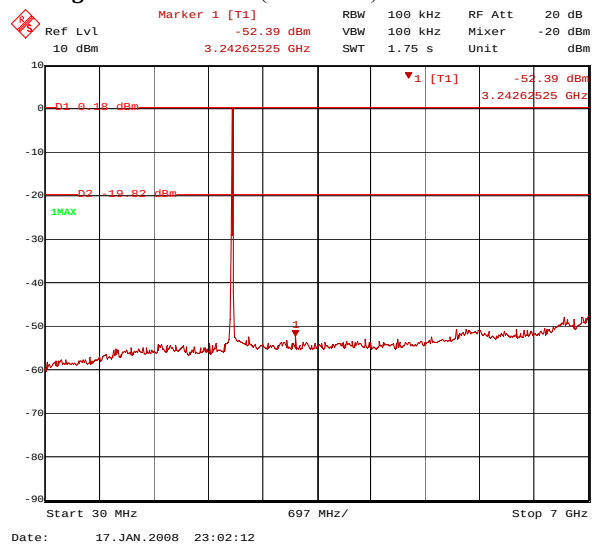
802.11g: Lowest Channel (2412 MHz): 30 MHz ~ 7 GHz



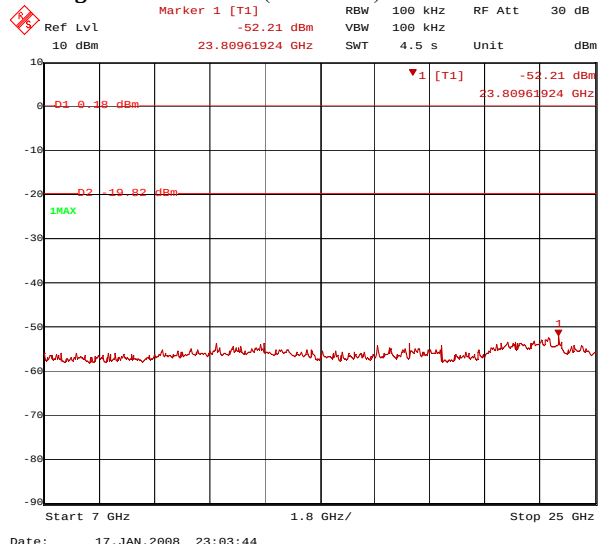
802.11g: Lowest Channel (2412 MHz): 7 GHz ~ 25 GHz



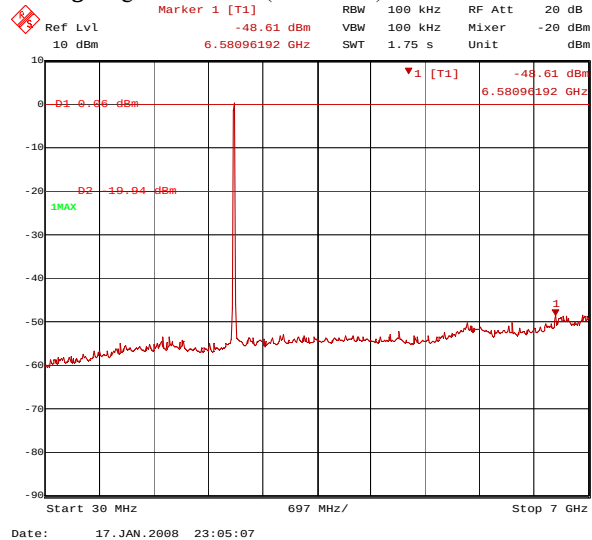
802.11g: Middle Channel (2437 MHz): 30 MHz ~ 7 GHz



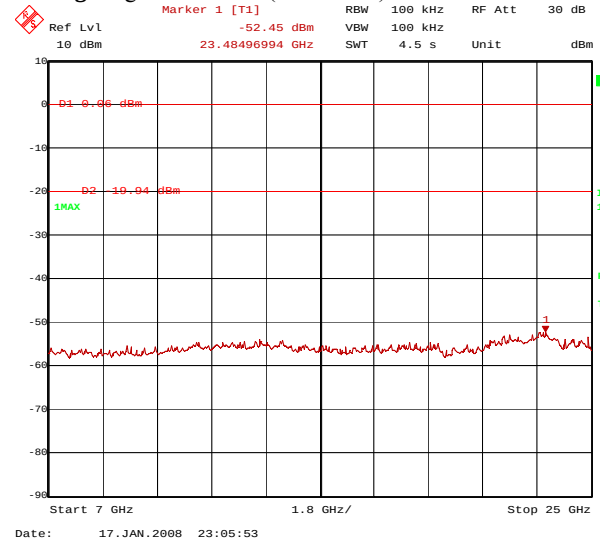
802.11g: Middle Channel (2437 MHz): 7 GHz ~ 25 GHz



802.11g: Highest Channel (2462 MHz): 30 MHz ~ 7 GHz



802.11g: Highest Channel (2462 MHz): 7 GHz ~ 25 GHz





5.5 PEAK POWER SPECTRAL DENSITY

5.5.1 Regulation

According to §15.247(e), 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.5.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
3. Turn on the EUT and locate and zoom in on emission peak(s) within the passband.
4. Set the spectrum analyzer as follows:
 RBW = 3 kHz, VBW $\geq$ RBW
 Span = 1.5 MHz
 Sweep = 500 seconds
 Detector function = peak
 Trace = max hold
5. Measure the highest amplitude appearing on spectral display and record the level to calculate results.

5.5.3 Test Results:

PASS

Table 4: Measured values of the Peak Power Spectral Density (Conducted)

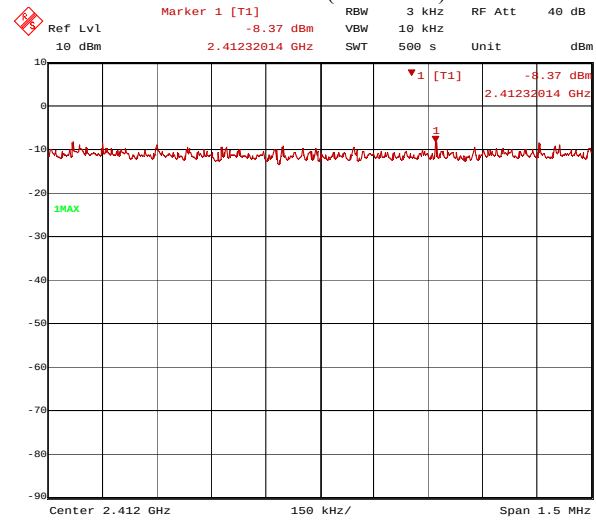
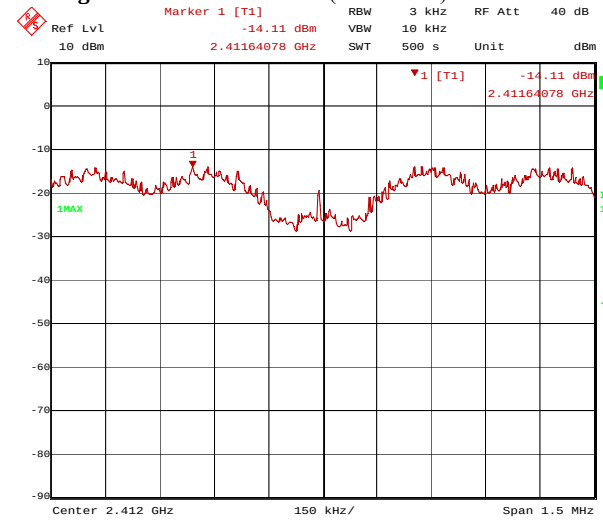
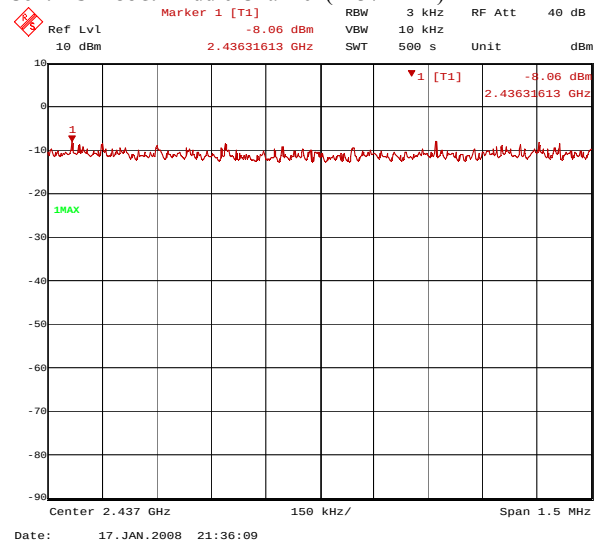
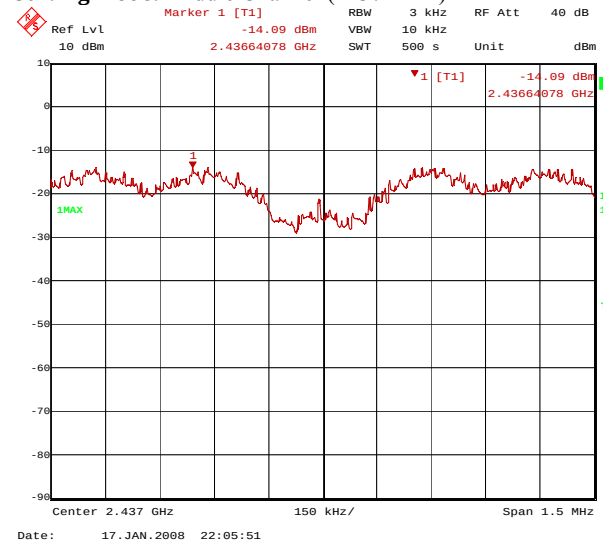
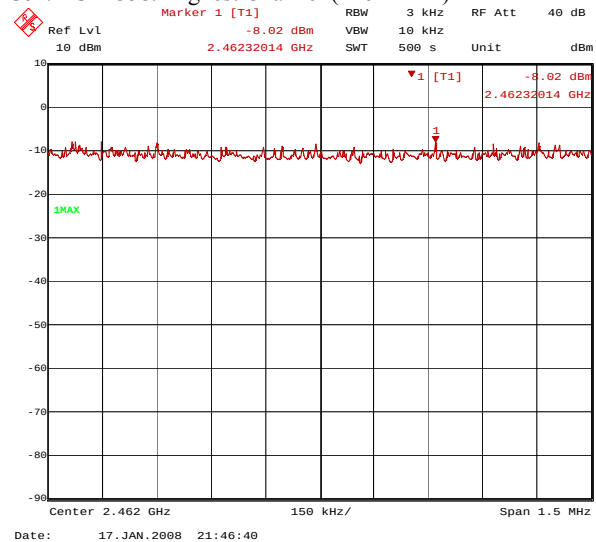
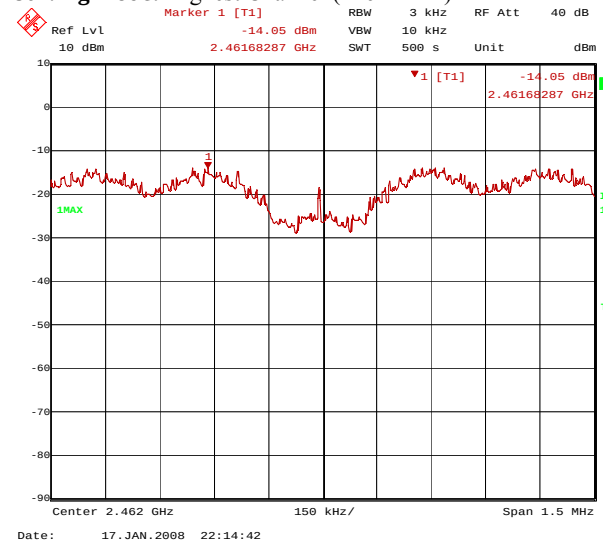
Modulation	Operating frequency	Transfer Rate	Reading (PPSD)	Limit
802.11b	2412 MHz	11 Mbps	-8.37 dBm	8.0 dBm
	2437 MHz	11 Mbps	-8.06 dBm	8.0 dBm
	2462 MHz	11 Mbps	-8.02 dBm	8.0 dBm
802.11g	2412 MHz	54 Mbps	-14.11 dBm	8.0 dBm
	2437 MHz	54 Mbps	-14.09 dBm	8.0 dBm
	2462 MHz	54 Mbps	-14.05 dBm	8.0 dBm

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.



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Figure 6. Plot of the Peak Power Spectral Density (Conducted)**802.11b mode: Lowest Channel (2412 MHz)****802.11g mode: Lowest Channel (2412 MHz)****802.11b mode: Middle Channel (2437 MHz)****802.11g mode: Middle Channel (2437 MHz)****802.11b mode: Highest Channel (2462 MHz)****802.11g mode: Highest Channel (2462 MHz)**



5.6 AC POWER LINE CONDUCTED EMISSIONS

5.6.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.6.2 Test Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω /50 μ H LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.



5.6.3 Test Results:

PASS

**Table 5: Measured values of the AC Power Line Conducted Emissions
Operating 802.11b mode**

Frequency [MHz]	Reading [dBμV]	L / N	CF [dB]	CL [dB]	Actual [dBμV]	Limit [dBμV]	Margin [dB]
QUASI-PEAK DATA							
0.150	53.66	N	0.05	0.15	53.86	66.00	12.14
0.175	51.45	N	0.05	0.15	51.65	64.72	13.07
0.235	45.54	N	0.14	0.18	45.86	62.27	16.41
0.290	41.03	L	0.12	0.18	41.33	60.52	19.19
1.700	35.09	N	0.14	0.36	35.59	56.00	20.41
1.755	35.50	N	0.14	0.36	36.00	56.00	20.00
1.815	35.15	N	0.14	0.36	35.65	56.00	20.35
1.875	35.11	N	0.14	0.36	35.61	56.00	20.39
1.930	36.74	N	0.14	0.36	37.24	56.00	18.76
1.990	35.17	N	0.14	0.36	35.67	56.00	20.33
3.805	36.96	N	0.15	0.42	37.53	56.00	18.47
AVERAGE DATA							
0.290	32.21	L	0.12	0.18	32.51	50.52	18.01
1.285	26.61	L	0.14	0.36	27.11	46.00	18.89
1.400	27.82	L	0.14	0.36	28.32	46.00	17.68
1.460	27.18	L	0.14	0.36	27.68	46.00	18.32
1.635	27.64	L	0.14	0.36	28.14	46.00	17.86
1.700	30.04	N	0.14	0.36	30.54	46.00	15.46
1.755	30.91	N	0.14	0.36	31.41	46.00	14.59
1.815	30.33	N	0.14	0.36	30.83	46.00	15.17
1.875	30.27	N	0.14	0.36	30.77	46.00	15.23
1.930	31.45	N	0.14	0.36	31.95	46.00	14.05
1.990	30.86	N	0.14	0.36	31.36	46.00	14.64

Margin (dB) = Limit – Actual

[Actual = Reading + CF + CL]

L/N = LINE / NEUTRAL

CF/CL = Correction Factor and Cable Loss

NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.



**Table 5: Measured values of the AC Power Line Conducted Emissions (cont.)
Operating 802.11g mode**

Frequency [MHz]	Reading [dBμV]	L / N	CF [dB]	CL [dB]	Actual [dBμV]	Limit [dBμV]	Margin [dB]
QUASI-PEAK DATA							
0.150	44.34	L	0.06	0.15	44.55	66.00	21.45
0.175	48.86	L	0.06	0.15	49.07	64.72	15.65
0.230	40.24	N	0.14	0.18	40.56	62.45	21.89
0.290	40.97	L	0.12	0.18	41.27	60.52	19.25
1.455	32.51	N	0.14	0.36	33.01	56.00	22.99
1.515	33.05	N	0.14	0.36	33.55	56.00	22.45
1.690	34.63	N	0.14	0.36	35.13	56.00	20.87
1.805	35.56	N	0.14	0.36	36.06	56.00	19.94
1.920	34.02	N	0.14	0.36	34.52	56.00	21.48
1.980	35.19	N	0.14	0.36	35.69	56.00	20.31
2.095	33.34	N	0.15	0.42	33.91	56.00	22.09
AVERAGE DATA							
0.175	38.93	L	0.06	0.15	39.14	54.72	15.58
0.290	32.21	L	0.12	0.18	32.51	50.52	18.01
0.580	27.54	L	0.13	0.24	27.91	46.00	18.09
0.755	27.05	L	0.14	0.31	27.50	46.00	18.50
1.455	29.13	N	0.14	0.36	29.63	46.00	16.37
1.515	29.60	N	0.14	0.36	30.10	46.00	15.90
1.690	31.45	N	0.14	0.36	31.95	46.00	14.05
1.805	31.69	N	0.14	0.36	32.19	46.00	13.81
1.920	30.86	N	0.14	0.36	31.36	46.00	14.64
1.980	31.16	N	0.14	0.36	31.66	46.00	14.34
2.095	30.10	N	0.15	0.42	30.67	46.00	15.33

Margin (dB) = Limit – Actual

[Actual = Reading + CF + CL]

L/N = LINE / NEUTRAL

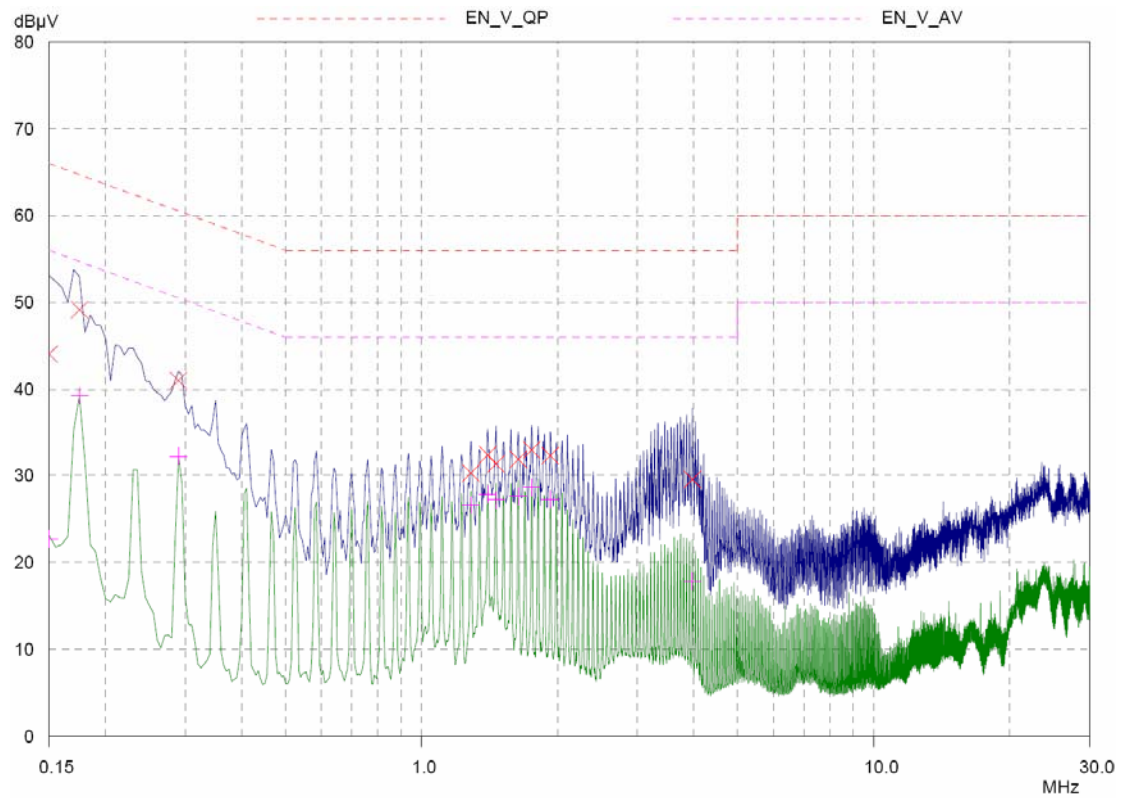
CF/CL = Correction Factor and Cable Loss

NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.



Figure 7. Plot of the AC Power Line Conducted Emissions
Operating 802.11b mode

Line – PE(Peak and Average detector used)



Neutral – PE(Peak and Average detector used)

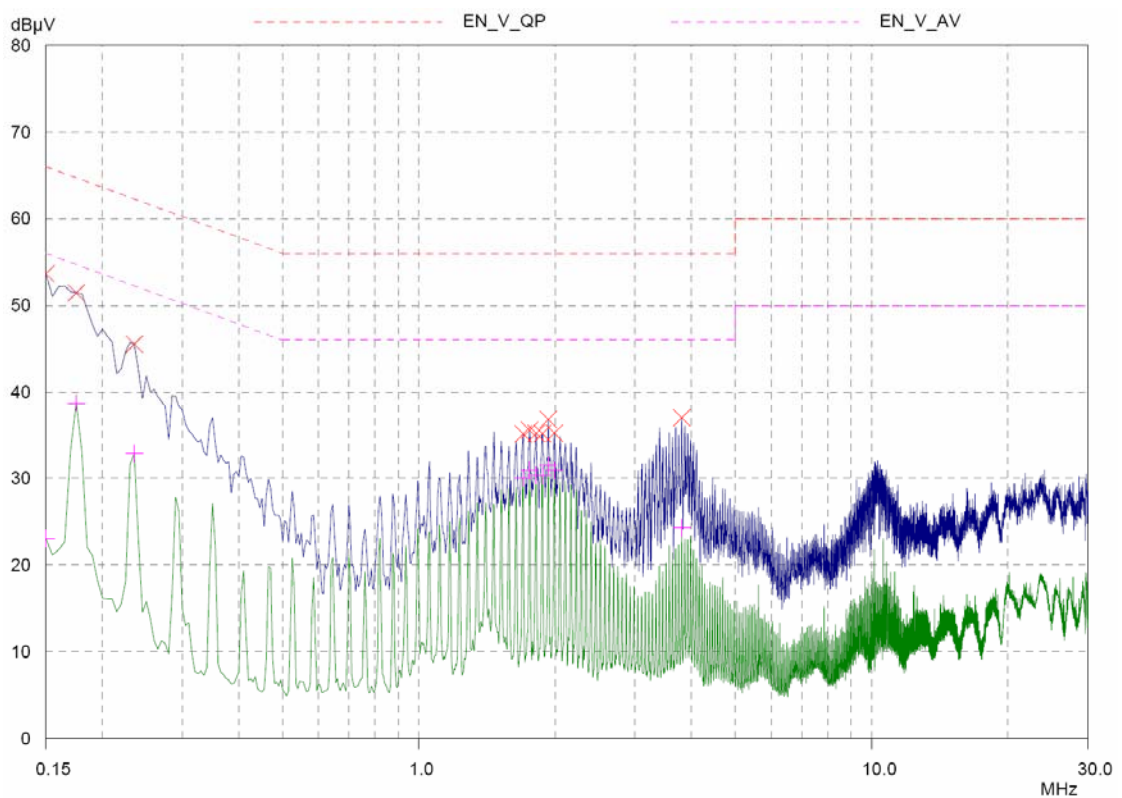
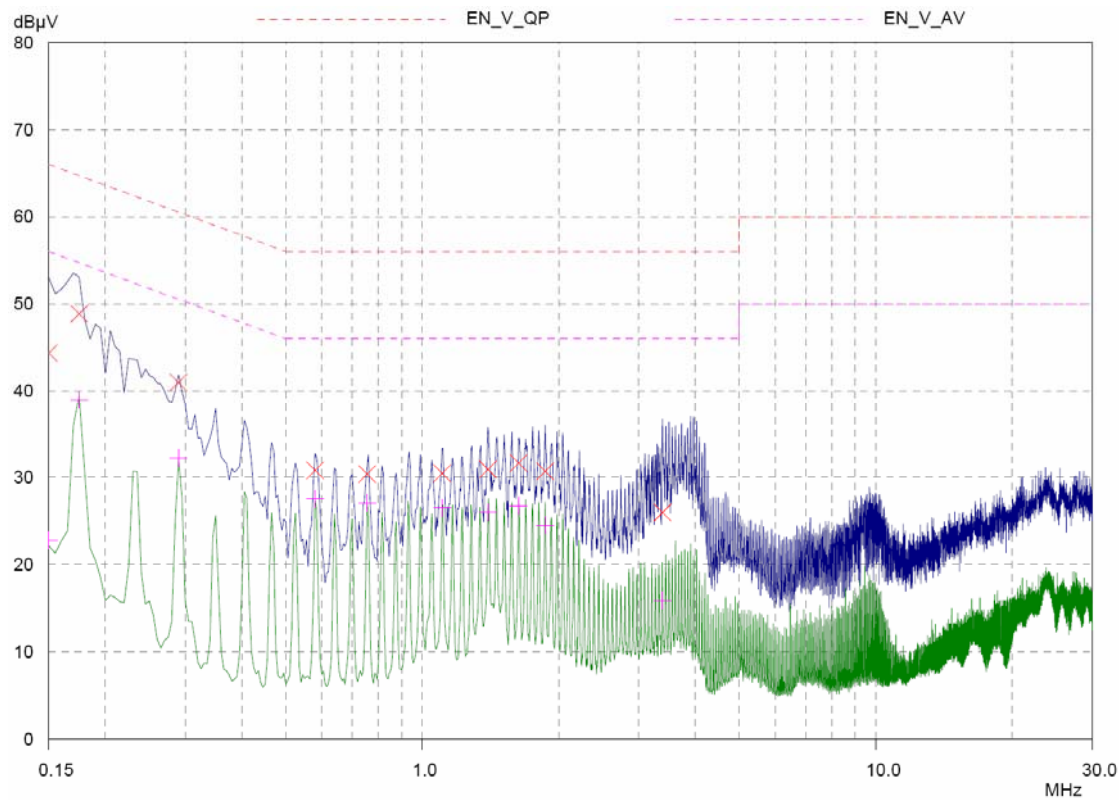


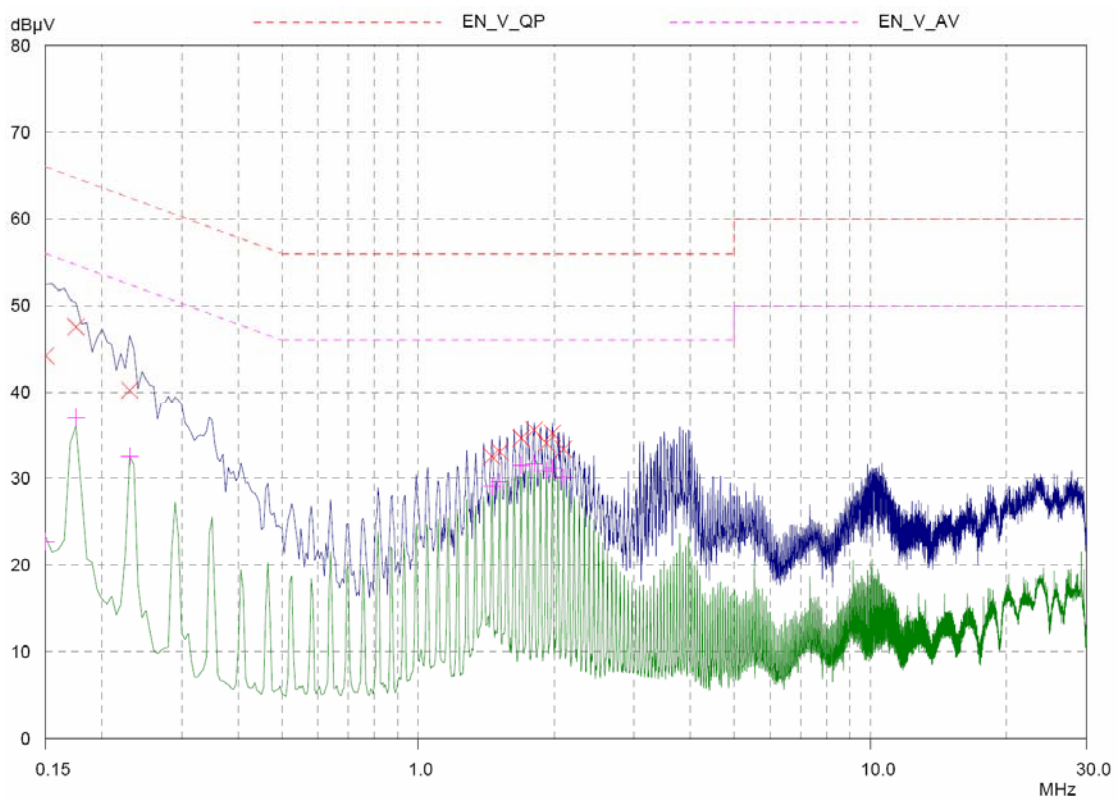


Figure 7. Plot of the AC Power Line Conducted Emissions (cont.)
Operating 802.11g mode

Line – PE(Peak and Average detector used)



Neutral – PE(Peak and Average detector used)





5.7 Receiver Spurious Emissions

5.7.1 Regulation

According to RSS-Gen 7.2.3, the following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1. The resolution bandwidth of the spectrum analyzer shall be 100 kHz for spurious emission measurements below 1.0 GHz, and 1.0 MHz for measurements above 1.0 GHz.

Table 1. Spurious Emission Limit for Receivers

Frequency (MHz)	Field strength ($\mu\text{V/m}$ @ 3m)	Field strength ($\text{dB}\mu\text{V/m}$ @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

* Use quasi-peak below 1000 MHz and averaging meter above 1000 MHz.

5.7.2 Test Results:

PASS

**Table 6: Receiver spurious emission (Radiated)
Operating 802.11b mode**

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Turn Table [degree]	Reading [dB(μV)]	Amp Gain [dB]	ATT [dB]	AF [dB(1/m)]	CL [dB]	Actual [dB($\mu\text{V/m}$)]	Limit [dB($\mu\text{V/m}$)]	Margin [dB]
Quasi-peak data, emissions below 1000 MHz												
960.00	120	V	1.0	269	35.14	27.9	0.0	24.1	3.1	34.5	46.0	11.5
AVERAGE data, emissions above 1000 MHz												
3282.67	1000	H	1.94	83	35.47	44.2	1.4	30.8	5.8	29.3	54.0	24.7
PEAK data, emissions above 1000 MHz												
3282.67	1000	H	1.94	83	49.22	44.2	1.4	30.8	5.8	43.0	74.0	31.0

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



Table 6: Receiver spurious emission (Radiated)(cont.)
Operating 802.11g mode

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Turn Table [degree]	Reading [dB(μV)]	Amp Gain [dB]	ATT [dB]	AF [dB(1/m)]	CL [dB]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-peak data, emissions below 1000 MHz												
960.00	120	V	1.0	269	35.00	27.9	0.0	24.1	3.1	34.3	46.0	11.7
AVERAGE data, emissions above 1000 MHz												
3282.67	1000	H	1.92	87	35.07	44.2	1.4	30.8	5.8	28.9	54.0	25.1
PEAK data, emissions above 1000 MHz												
3282.67	1000	H	1.92	87	48.83	44.2	1.4	30.8	5.8	42.6	74.0	31.4

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



5.8 RF Exposure

5.8.1 Regulation

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

Limits for Maximum Permissible Exposure: RF exposure is calculated.

Frequency Range	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [mW/cm ²]	Averaging Time [minute]
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 ~ 15000	/	/	<u>1.0</u>	<u>30</u>

f = frequency in MHz,

* = Plane-wave equivalent power density

MPE (Maximum Permissible Exposure) Prediction

Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

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

S = power density [mW/cm²]

P = power input to antenna [mW]

$$\left(\Rightarrow R = \sqrt{PG/4\pi S}\right)$$

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 [cm]

EUT: Maximum peak output power = 77.3 [mW](= 18.88 dBm) & Antenna gain = 1.81 (= 2.57 [dBi])	
100 mW, at 20 cm from an antenna 6 [dBi]	$S = PG/4\pi R^2 = 100 \times 3.98 / (4 \times \pi \times 400) = 0.0792 \text{ [mW/cm}^2\text{]} < 1.0 \text{ [mW/cm}^2\text{]}$
77.3 mW, at 20 cm from the antenna 2.57 [dBi]	$S = PG/4\pi R^2 = 0.0278 \text{ [mW/cm}^2\text{]} < 1.0 \text{ [mW/cm}^2\text{]}$
77.3 mW, at 2.5 cm from the antenna 2.57 [dBi]	$S = PG/4\pi R^2 = 1.7814 \text{ [mW/cm}^2\text{]}$

5.8.2 RF Exposure Compliance Issue

July 02 TCB Exclusion List: for portable transmitters,

Low threshold [(60/f_{GHZ} ≈ 25) mW, d < 2.5 cm, (120/f_{GHZ} ≈ 50) mW, d ≥ 2.5 cm], and

High threshold [(900/f_{GHZ} ≈ 370) mW, d < 20 cm], where f_{GHZ}: 2.44, d: distance to a person's body

The users manual for end users must include the following information in a prominent location "IMPORTANT

NOTE: To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter."