SKT

SK TECH CO., LTD.

Certificate of Compliance

Test Report No.:	**SKTTRT-060126-003**		
NVLAP CODE:	**200220-0**		
Applicant:	**Hitachi Cable, Ltd.**		
Applicant Address:	Takasago Works, 880 Lsagozawa-cho, Hitachi-shi, Ibaraki-ken, 319-1418 Japan		
Manufacturer:	**UniData Communication Systems, Inc.**		
Manufacturer Address:	2F, OhSung-Bldg, 82-15, NonHyun-DongGangNam-Gu, Seoul, 135-010 Korea		
Device Under Test:	**WLAN IP Phone**		
FCC ID: **IC:**	**S99WIRELESSIP5000** **329L-WIP5000**	**Model No.:**	**WirelessIP 5000**
Receipt No.:	SKTEU06-0023	**Date of receipt:**	January 19, 2006
Date of Issue:	January 26, 2006		
Location of Testing:	**SK TECH CO., LTD.** 820-2, Wolmoon-Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea		
Test Specification:	**FCC Part 15 Rules, RSS-210 Issue 6**		
FCC Equipment Class: **IC Equipment Category:**	**DTS - Part 15 Digital Transmission System** **RSS-210 Issue 6: Category I Equipment, Annex 8**		
Test Result:	The above-mentioned device has been tested and passed.		

Tested & Reported by: *Jong-Soo, Yoon*

2006-01-26

Signature *Date*

Approved by: *Jae-Kyung, Bae*

2006-01-26

Signature *Date*

Other Aspects:	
Abbreviations:	**· OK, Pass = passed · Fail = failed · N/A = not applicable**

☞
- **This test report is not permitted to copy partly without our permission.**
- **This test result is dependent on only equipment to be used.**
- **This test result is based on a single evaluation of one sample of the above mentioned.**
- **This test report must not be used to claim product endorsement by NVLAP or any agency of the U.S Government.**
- **We certify that this test report has been based on the measurement standards that is traceable to the national or International standards.**

NVLAP®

NVLAP Lab. Code: 200220-0

>> CONTENTS <<

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, Korea

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.
This laboratory is accredited by NVLAP for NVLAP Lab. Code: 200220-0 and DATech for DAR-Registration No.: TTI-P-G155/97-10

2.2 List of Test and Measurement Instruments

Description	Manufacturer	Model #	Serial #	
Spectrum Analyzer	Agilent	E4405B	US40520856	☒
EMC Spectrum Analyzer	Agilent	E7405A	US40240203	☒
EMI Test Receiver	Rohde&Schwarz	ESIB40	100277	☒
EMI Test Receiver	Rohde&Schwarz	ESVS10	825120/008	
EMI Test Receiver	Rohde&Schwarz	ESVS10	834468/013	
EMI Test Receiver	Rohde&Schwarz	ESHS10	835871/002	
EMI Test Receiver	Rohde&Schwarz	ESHS10	862970/019	☒
Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	836679/018	☒
Pre-amplifier	HP	8447F	3113A05153	☒
Pre-amplifier	MITEQ	AFS44	1116321	☒
Pre-amplifier	MITEQ	AFS44	1116322	
Power Meter	Agilent	E4418B	US39402179	☒
Power Sensor	HP	8485A	3318A13916	☒
Oscilloscope	Agilent	54820A	US40240160	☒
Diode detector	Agilent	8473C	1882A03173	☒
VHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	VHAP	1014 / 1015	
UHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	UHAP	989 / 990	
Loop Antenna	Schwarzbeck	HFH2-Z2	863048/019	
TRILOG Broadband Antenna	Schwarzbeck	VULB9160	3141	☒
Biconical Antenna	Schwarzbeck	VHA9103	2265	☒
Log-Periodic Antenna	Schwarzbeck	UHALP9107	1819	☒
Horn Antenna	AH Systems	SAS-200/571	304	☒
Horn Antenna	EMCO	3115	00040723	☒
Horn Antenna	EMCO	3115	00056768	☒
Vector Signal Generator	Agilent	E4438C	MY42080359	☒
PSG analog signal generator	Agilent	E8257D-520	MY45141255	
DC Power Supply	HP	6634A	2926A-01078	☒
DC Power Supply	HP	6268B	2542A-07856	
Digital Multimeter	HP	HP3458A	2328A14389	☒
PCS Interface	HP	83236B	3711J00881	
CDMA Mobile Test Set	HP	8924C	US35360253	
Hygro/Thermo Graph	SATO	PC-5000TRH-II	-	☒
Temperature/Humidity Chamber	All Three	ATH-50M	20030425	

2.3 Test Date

Date of Application : January 19, 2005

Date of Test : January 20, 2006 ~ January 26, 2006

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

Type / Model No.	WLAN IP Phone / WirelessIP 5000
Labelling (FCC ID & IC)	FCC ID: S99WIRELESSIP5000 IC: 329L-WIP5000 During the tests, the EUT was not labeled with the FCC ID & IC
Power source	DC 3.7V Li-ion Battery
Local Oscillator or X-Tal	X-Tal: 6 MHz, 12.288 MHz, 40 MHz
Transmit Frequency	2412 ~ 2462 MHz (11 channels, 5MHz step)
Antenna Type	Internal antenna (Model: W4I-BP-24, Max. 3.3dBi)
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	16 dBm for DSSS, 12 dBm for OFDM modulation
External Ports **	USB connection to PC for data communication

** The test report for compliance with FCC Part 15B as a Class B digital device should be issued with other test report number.

3.2 Equipment Modifications

None.

3.3 Submitted Documents

Block diagram

Schematic diagram

Antenna Specification

Part List

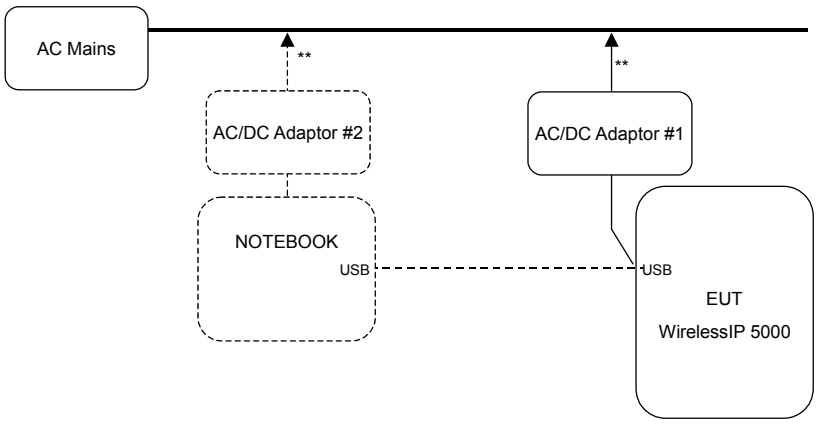
User manual

4. MEASUREMENT CONDITIONS

4.1 Description of test configuration

The measurements were taken in continuous transmitting mode. The operating frequency and modulation types of the EUT could be changed in the test mode on it.

Initial investigations were performed with all modulation types. Final testing was performed while the transmitter continuously operating with the modulation rate of 11 Mbps (CCK) and 6 Mbps (BPSK) as worst case. For radiated emission measurements, the EUT was powered from the fully charged battery.



** For AC power line conducted emission measurements, both tested; The EUT was DIRECTLY powered from the LISN port through the AC/DC Adaptor, and the EUT was INDIRECTLY powered from the LISN port (to which the NOTEBOOK was connected).

4.2 List of Peripherals

Equipment Type	Manufacturer	Model	Cable Description
AC/DC adaptor #1	Wang Huei Company Limited	YFAF22073001	1.5m Unshielded Power Line AC input: 100 ~ 240V, 50~60Hz, 0.15A DC output: 5V / 1A
AC/DC adaptor #2	ASUSTek COMPUTER INC.	ADP-50SB	TO AC mains: unshielded, 1.8 m TO NOTEBOOK: unshielded, 1.5 m
NOTEBOOK	Trigem	Dreambook	USB, unshielded, 1.2 m

4.3 Uncertainty

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

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 (1)	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 (2)	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

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 a permanently attached internal antenna (Model: W4I-BP-24). The directional gain of the antenna is maximum 3.3 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 RBW = 100 kHz, VBW = 100 kHz, Span = 20 MHz, Sweep = AUTO.
3. Set the spectrum analyzer to MAX HOLD mode and then set a reference level on it equal to the highest peak value.
4. Mark the peak frequency and -6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

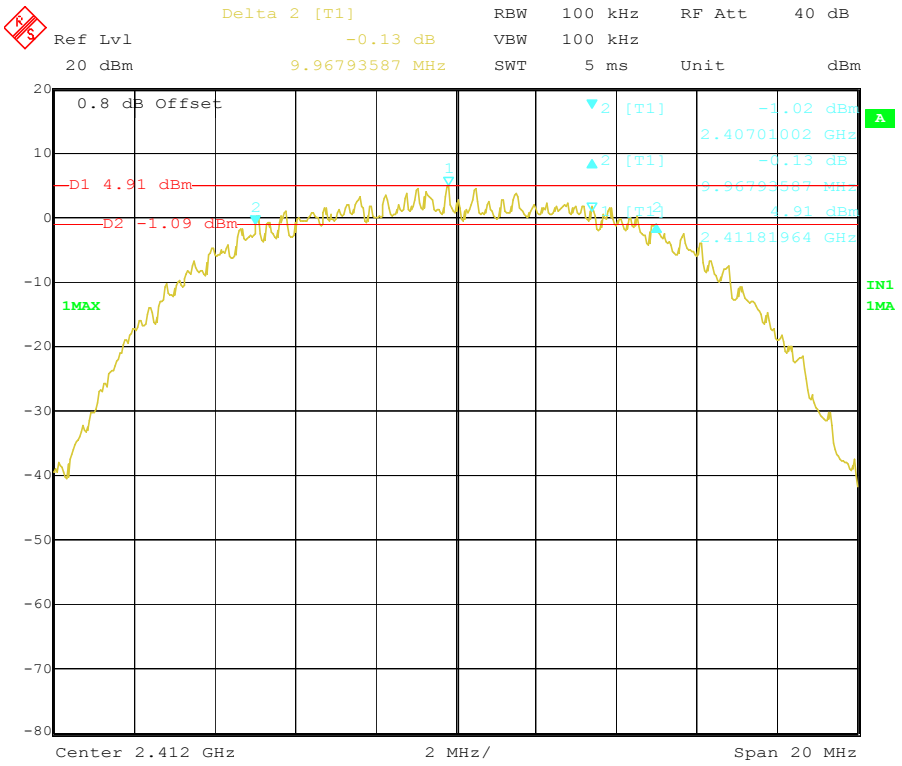
5.2.3 Test Results: PASS

Table 1: Measured values of the 6dB Bandwidth (Conducted)

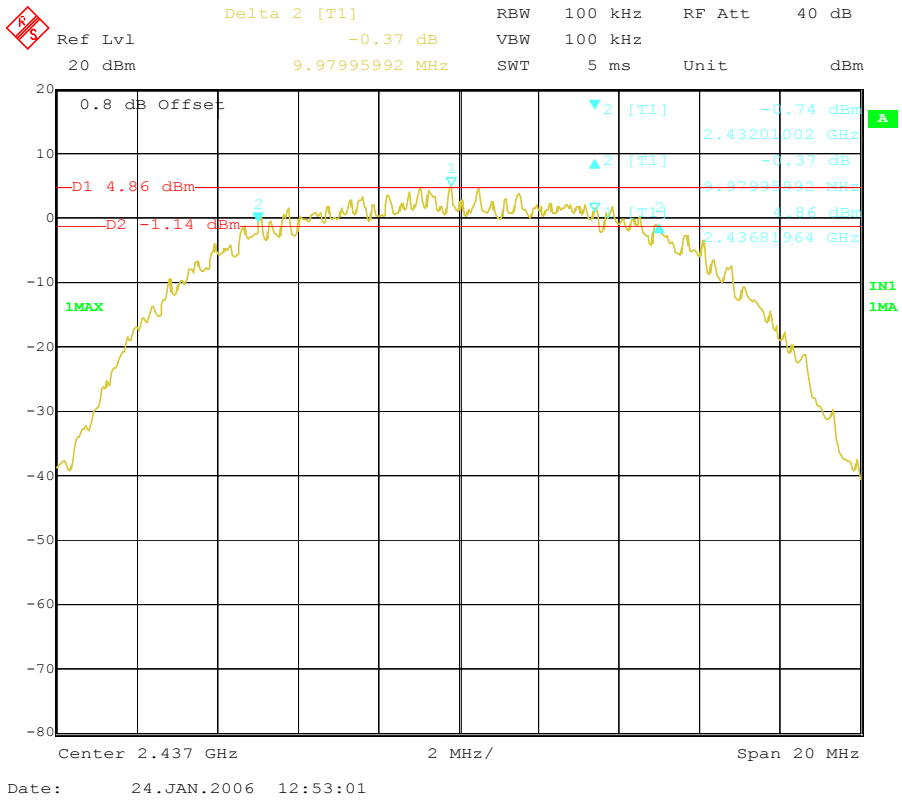
Modulation	Operating frequency	Transfer Rate	6dB Bandwidth	Limit
802.11b	2412 MHz	11 Mbps	9.97 MHz	≥ 500 kHz
	2437 MHz	11 Mbps	9.98 MHz	≥ 500 kHz
	2462 MHz	11 Mbps	9.97 MHz	≥ 500 kHz
802.11g	2412 MHz	6 Mbps	16.51 MHz	≥ 500 kHz
	2437 MHz	6 Mbps	16.53 MHz	≥ 500 kHz
	2462 MHz	6 Mbps	16.53 MHz	≥ 500 kHz

Figure 1. Plot of the 6dB Bandwidth (Conducted)

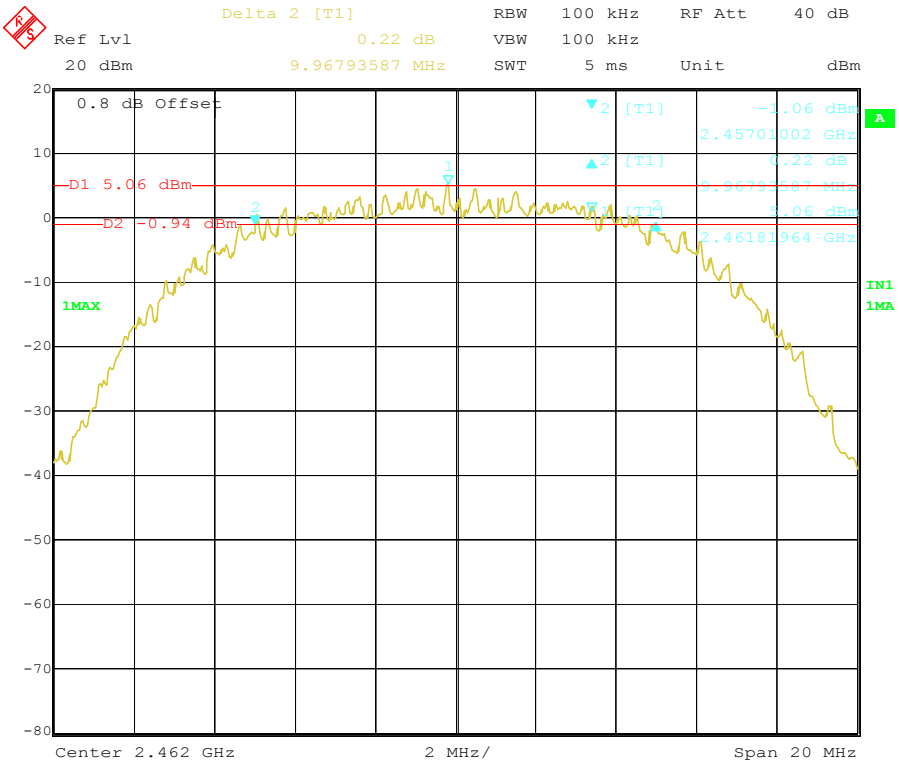
Lowest Channel (operating at 2412 MHz): 802.11b, 11 Mbps



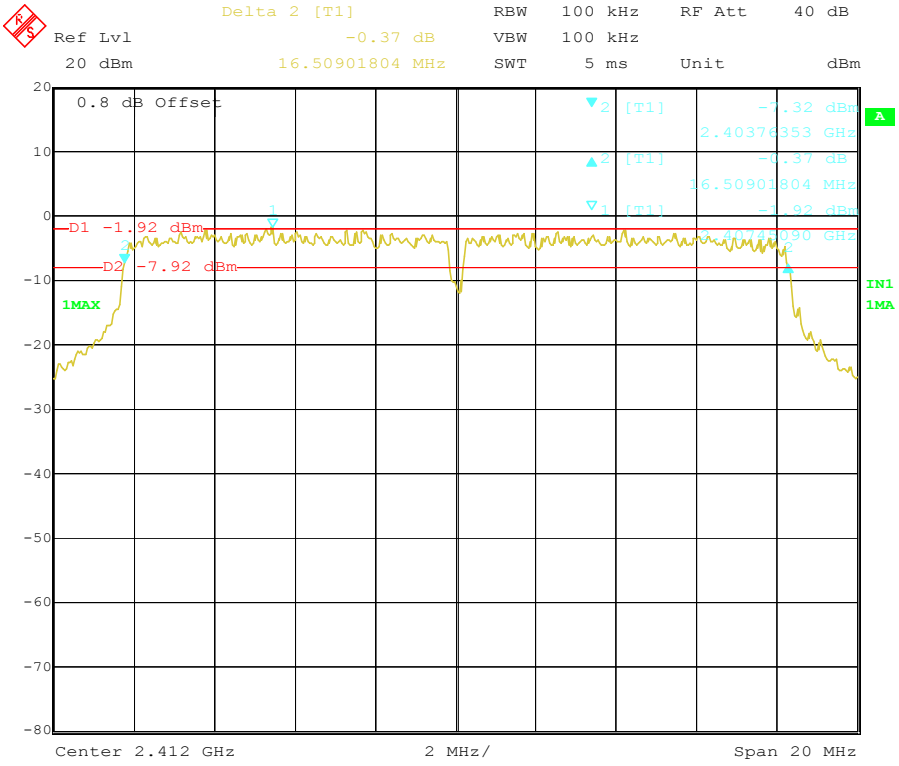
Middle Channel (operating at 2437 MHz): 802.11b, 11 Mbps



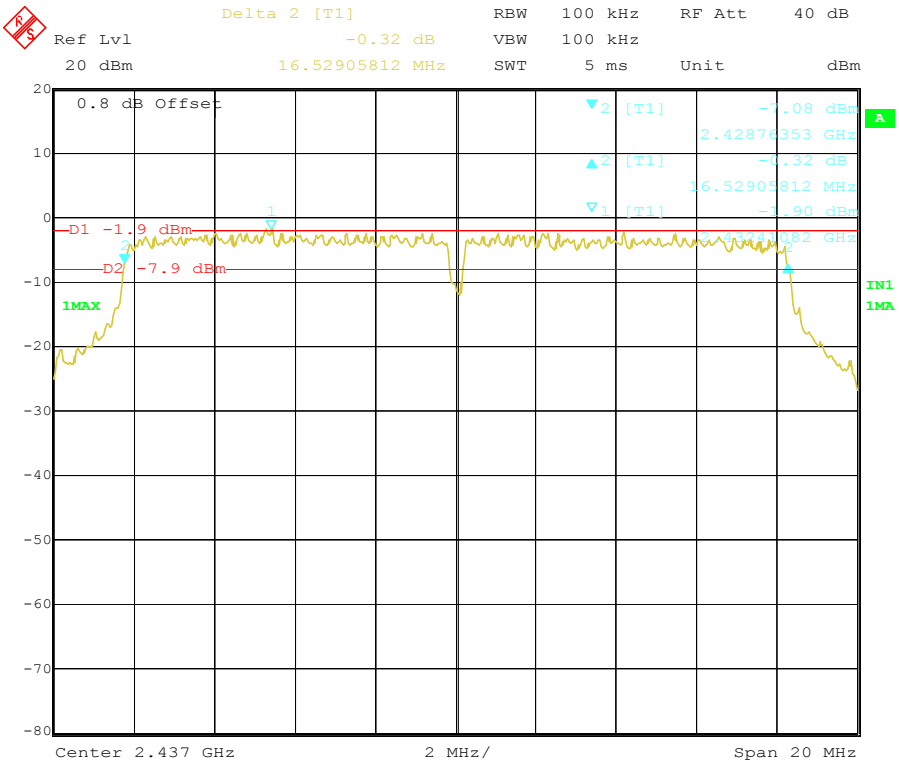
Highest Channel (operating at 2462 MHz): 802.11b, 11 Mbps



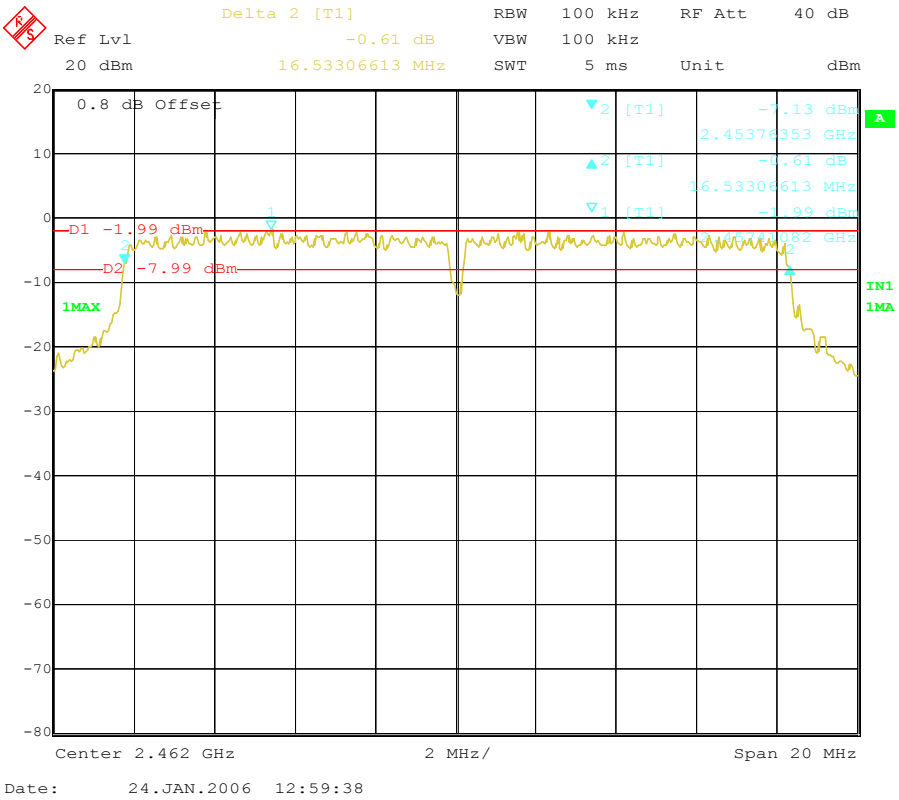
Lowest Channel (operating at 2412 MHz): 802.11g, 6 Mbps



Middle Channel (operating at 2437 MHz): 802.11g, 6 Mbps



Highest Channel (operating at 2462 MHz): 802.11g, 6 Mbps



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

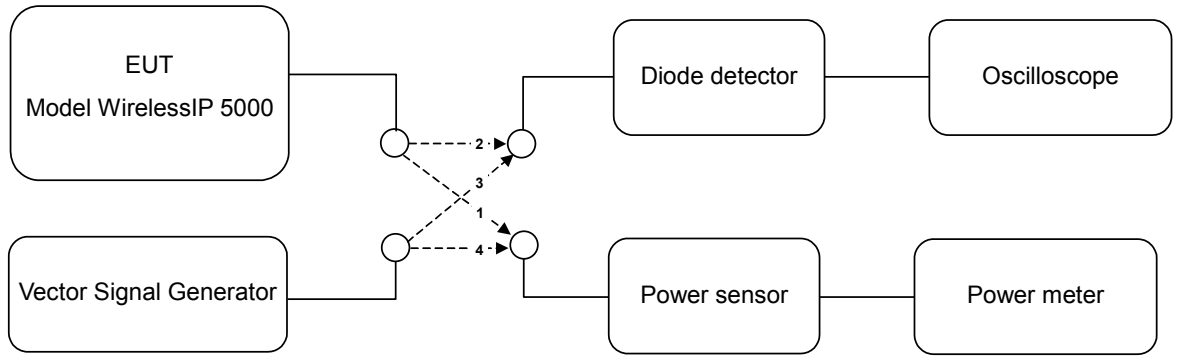
Output power measurements were first taken as EIRP measurements using the Substitution Method during which the EUT transmitted UNMODULATED carrier signals. After the testing was completed, the conducted power measurements were performed using a SMA gender, which can provides the antenna port of the EUT connection to the measuring equipment.

EIRP measurements:

1. The EUT was placed at 1.5m height turnaround table and in a position for normal use.
2. The test antenna was oriented initially for vertical position with 3m away from EUT.
3. The output of the antenna was connected to the spectrum analyzer and the peak detector is used for the measurement with the 1MHz resolution bandwidth.
4. The transmitter was turned on and the spectrum analyzer was tuned to the frequency of EUT.
5. The test antenna was raised and lowered through specified ranged of height until the maximum signal level was detected by the spectrum analyzer.
6. The EUT was rotated through 360° in the horizontal plane until the signal level was detected.
7. The EUT was then replaced by a horn antenna that is a substitution antenna.
8. The substitution antenna was oriented for vertical polarization and then connected to a calibrated signal generator.
9. The test antenna was raised and lowered through specified ranged of height until the maximum signal level was detected.
10. The input signal to the substitution antenna was adjusted to the level to produce a level which was equal to the level noted while the transmitter radiated power was measured, corrected for the change of the input attenuator of the spectrum analyzer.

11. The input level to the substitution antenna was recorded as power level in dBm, corrected for any change of input attenuator of the spectrum analyzer.
12. The measurement was repeated with the test antenna and the substitution antenna oriented for horizontal polarization.
13. The measure of the radiated output power is the larger one of the two level recorded, at the input to the substitution antenna, corrected for grain of the substitution antenna and cable loss.

Conducted Power Measurements:



NOTE: The measurements were taken in continuous transmitting mode; The EUT transmitted continuously with no off intervals.

STEP 1: AVERAGE POWER Measuring

The average output power of the EUT was determined using a wideband, calibrated RF power meter with a thermocouple detector

STEP 2:

1) The output of the EUT was coupled to a diode detector
2) The output of the diode detector was connected to the vertical channel of an oscilloscope
3) Determine, on the oscilloscope, the peak of the envelope of the output signal of the EUT
4) The maximum deviation of the Y-trace of the oscilloscope was recorded as "B"

STEP 3:

1) The EUT was replaced by a signal generator. The output frequency of the signal was made equal to the center of the frequency range occupied by the EUT
2) The signal generator was unmodulated. The output power of the signal generator was raised to a level such that the deviation of the Y-trace of the oscilloscope reaches level B, as indicated in STEP 2

STEP 4: PEAK POWER Measuring

Output power level of the signal generator was determined using a wideband, calibrated RF power meter with a thermocouple detector

STEP 5:

The measurement shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range.

5.3.3 Test Results: PASS

Measured values of the EIRP

Frequency	Resolution Bandwidth	Pol.	EIRP		Limit
		(V/H)	[dBm]	[mW]	
2412 MHz	1 MHz	V	19.09	81.10	36.0 dBm
2437 MHz	1 MHz	V	18.95	78.52	36.0 dBm
2462 MHz	1 MHz	V	18.67	73.62	36.0 dBm

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

Modulation	Operating Frequency	Transfer Rate	AVERAGE POWER		PEAK POWER		Limit
			[dBm]	[mW]	[dBm]	[mW]	
802.11b	2412 MHz	11 Mbps	15.51	35.56	17.31	53.83	1 W
	2437 MHz		15.65	36.73	17.25	53.09	1 W
	2462 MHz		15.05	31.99	17.07	50.93	1 W
802.11g	2412 MHz	6 Mbps	11.41	13.84	18.33	68.08	1 W
	2437 MHz		11.24	13.30	18.14	65.16	1 W
	2462 MHz		11.28	13.43	17.92	61.94	1 W

NOTE: Since the directional gain of the internal antenna declared by manufacturer (G_{ANT} = 3.3 dBi) does not exceed 6.0 dBi, there was no need to reduce the output power.

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 (μV/m @ 3m)	Field strength (dBμV/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 bandedge, as well as any modulation products which fall outside of the authorized band of operation
   RBW ≥ 1% of the span
   VBW ≥ 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 ≥ 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 × 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 from 1000 MHz to 18000 MHz using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 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 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.
7. 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

Table 3: Measured values of the RF antenna port emissions (Conducted)

Frequency [MHz]	Reading [dBm]	Cable Loss [dB]	Actual [dBm]	Limit [dBm]	Margin [dB]
IEEE 802.11b, 11Mbps					
2411.82	4.53	0.8	4.53	-	
2398.80	-39.88	0.8	-39.88	-15.47	24.41
4824.00	---				
2436.80	4.44	0.8	4.44	-	
4874.00	---				
2463.50	3.57	0.8	3.57	-	
2483.50	-51.76	0.8	-51.76	-16.43	35.33
4924.00	---				
IEEE 802.11g, 6Mbps					
2407.50	-2.08	0.8	-2.08	-	
2399.76	-27.62	0.8	-27.62	-22.08	5.54
4824.00	---				
2432.39	-1.32	0.8	-1.32	-	
4874.00	---				
2463.90	-2.20	0.8	-2.20	-	
2483.50	-38.80	0.8	-38.80	-22.20	16.60
4924.00	---				

Actual = Reading

Cable Loss was included in Reading

Remark "---" means the emission level was too low to be measured or in the noise floor.

Table 4: Measured values of the Field strength of spurious emission (Radiated): 802.11b

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Reading [dB(μV)]	Amp Gain [dB]	ATT [dB]	AF / CL [dB(1/m)]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-peak data, emissions below 1000 MHz										
				No Spurious Radiated Emissions Found						
AVERAGE data, emissions above 1000 MHz										
2410.74	1000	H	1.91	99.31	44.0	10.2	28.6/5.2	99.31	-	-
2360.00	1000	H	1.91	43.11	44.0	10.2	28.6/5.2	43.11	54.00	10.89
2373.03	1000	H	1.91	43.69	44.0	10.2	28.6/5.2	43.69	54.00	10.31
2437.39	1000	H	1.07	99.26	44.0	10.2	28.6/5.2	99.26	-	-
2460.44	1000	H	1.00	97.82	44.0	10.2	28.6/5.2	97.82		
2483.50	1000	H	1.00	40.74	44.0	10.2	28.6/5.2	40.74	54.00	13.26
2500.00	1000	H	1.00	40.93	44.0	10.2	28.6/5.2	40.93	54.00	13.07
PEAK data, emissions above 1000 MHz										
2413.39	1000	H	1.91	107.44	44.0	10.2	28.6/5.2	107.44	-	-
2360.00	1000	H	1.91	58.18	44.0	10.2	28.6/5.2	58.18	74.00	15.82
2373.03	1000	H	1.91	58.43	44.0	10.2	28.6/5.2	58.43	74.00	15.57
2438.29	1000	H	1.07	107.49	44.0	10.2	28.6/5.2	107.49	-	-
2463.25	1000	H	1.00	105.93	44.0	10.2	28.6/5.2	105.93	-	-
2483.50	1000	H	1.00	57.41	44.0	10.2	28.6/5.2	57.41	74.00	16.59
2500.00	1000	H	1.00	57.27	44.0	10.2	28.6/5.2	57.27	74.00	16.73

Margin (dB) = Limit – Actual

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

1. H = Horizontal, V = Vertical Polarization
2. ATT = Attenuator (10dB pad), AF/CL = Antenna Factor and Cable Loss

Remark "---" means the emission level was too low to be measured or in the noise floor.

NOTE: The spectrum was scanned from 30 MHz to 18 GHz. All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

Measured values of the Field strength of spurious emission (Radiated): 802.11g

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Reading [dB(μV)]	Amp Gain [dB]	ATT [dB]	AF / CL [dB(1/m)]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-peak data, emissions below 1000 MHz										
				No Spurious Radiated Emissions Found						
AVERAGE data, emissions above 1000 MHz										
2407.21	1000	H	1.91	95.50	44.0	10.2	28.6/5.2	95.50	-	-
2360.00	1000	H	1.91	45.83	44.0	10.2	28.6/5.2	45.83	54.00	8.17
2390.00	1000	H	1.91	51.20	44.0	10.2	28.6/5.2	51.20	54.00	2.80
2430.46	1000	H	1.07	94.92	44.0	10.2	28.6/5.2	94.92	-	-
2455.43	1000	H	1.00	94.04	44.0	10.2	28.6/5.2	94.04		
2483.50	1000	H	1.00	46.79	44.0	10.2	28.6/5.2	46.79	54.00	7.21
2500.00	1000	H	1.00	40.80	44.0	10.2	28.6/5.2	40.80	54.00	13.20
PEAK data, emissions above 1000 MHz										
2406.55	1000	H	1.91	104.91	44.0	10.2	28.6/5.2	104.91	-	-
2360.00	1000	H	1.91	58.61	44.0	10.2	28.6/5.2	58.61	74.00	15.39
2390.00	1000	H	1.91	70.43	44.0	10.2	28.6/5.2	70.43	74.00	3.57
2430.55	1000	H	1.07	104.88	44.0	10.2	28.6/5.2	104.88	-	-
2455.63	1000	H	1.00	103.68	44.0	10.2	28.6/5.2	103.68	-	-
2483.50	1000	H	1.00	66.95	44.0	10.2	28.6/5.2	66.95	74.00	7.05
2500.00	1000	H	1.00	56.28	44.0	10.2	28.6/5.2	56.28	74.00	17.72

Margin (dB) = Limit – Actual

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

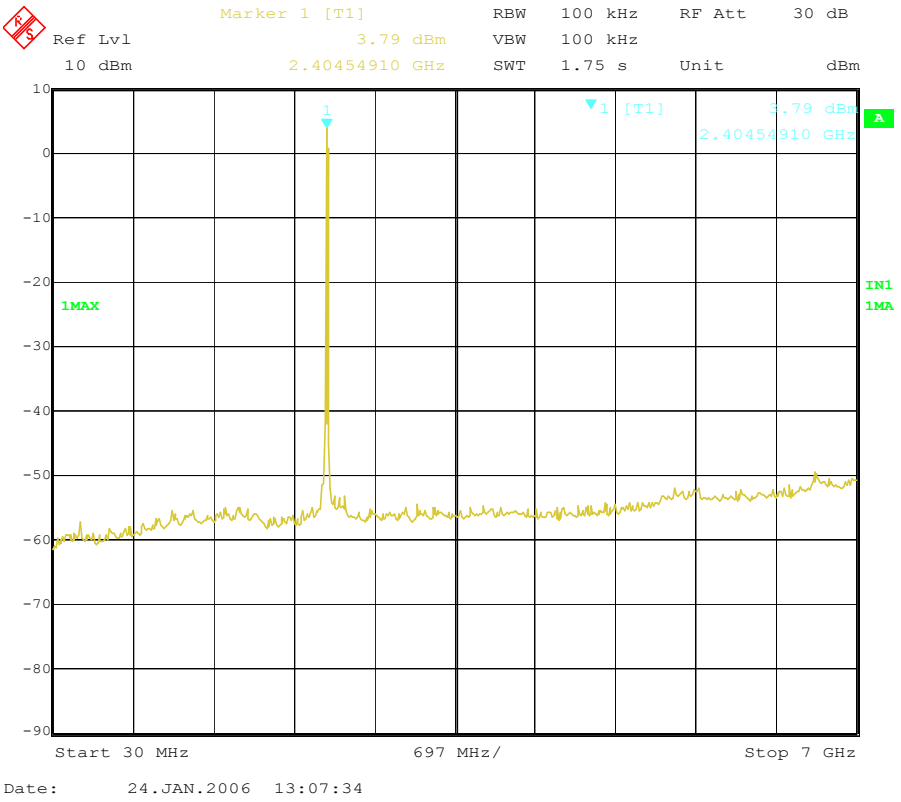
1. H = Horizontal, V = Vertical Polarization
2. ATT = Attenuator (10dB pad), AF/CL = Antenna Factor and Cable Loss

Remark "---" means the emission level was too low to be measured or in the noise floor.

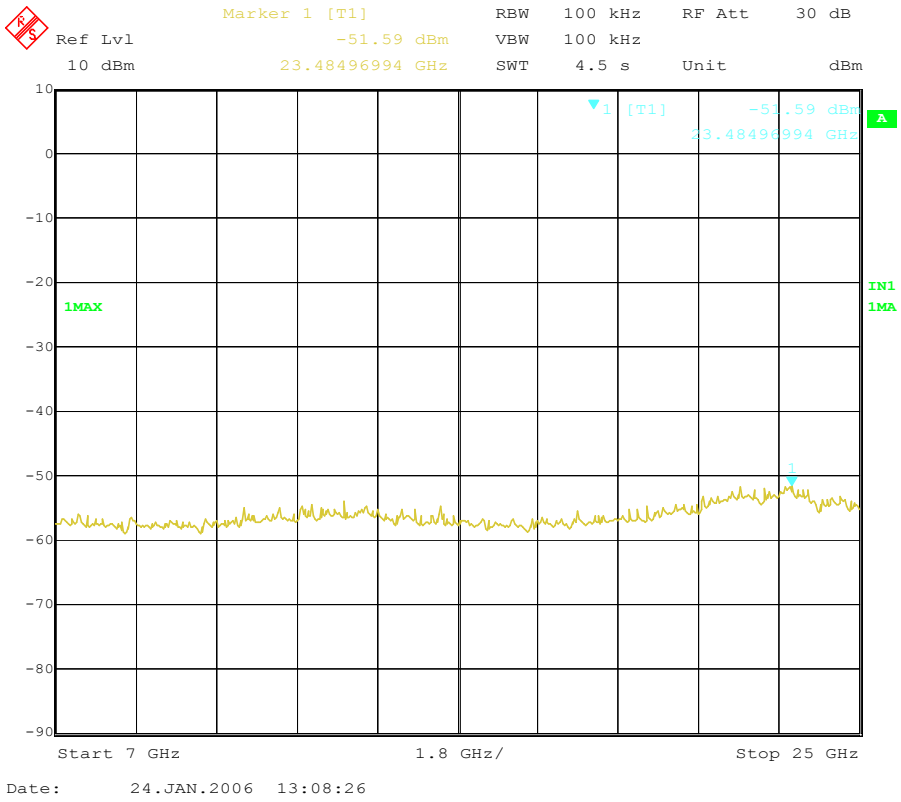
NOTE: The spectrum was scanned from 30 MHz to 18 GHz. All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

Figure 2. Plot of the RF antenna port emissions (Conducted)

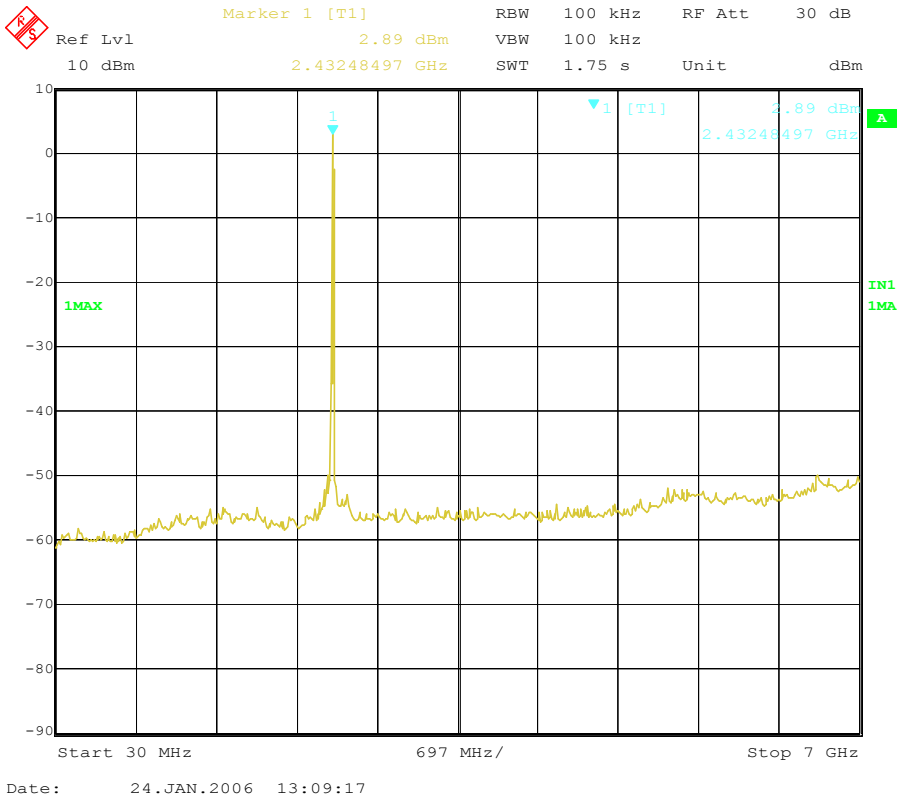
Lowest Channel (operating at 2412 MHz): 30 MHz ~ 7 GHz (802.11b, 11Mbps)



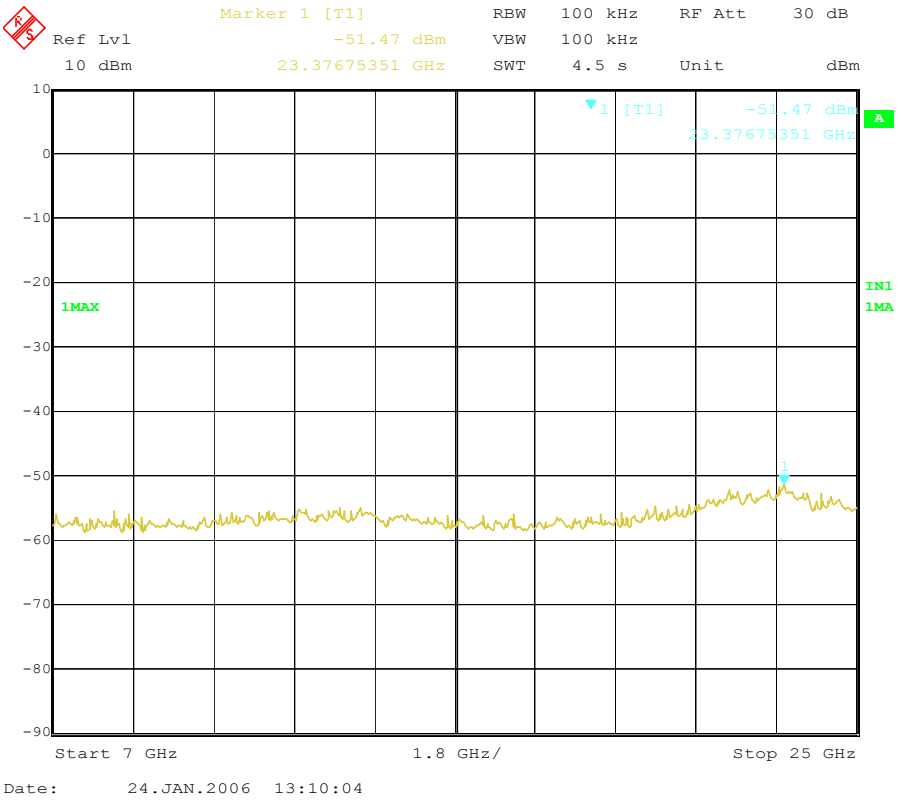
Lowest Channel (operating at 2412 MHz): 7 GHz ~ 25 GHz (802.11b, 11Mbps)



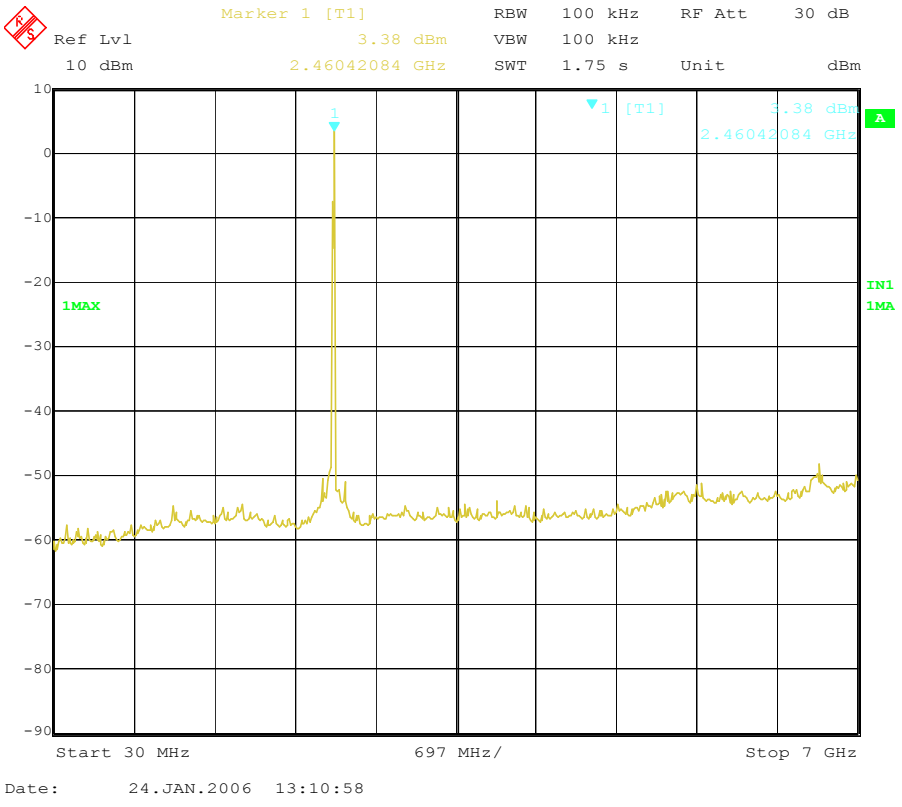
Middle Channel (operating at 2437 MHz): 30 MHz ~ 7 GHz (802.11b, 11Mbps)



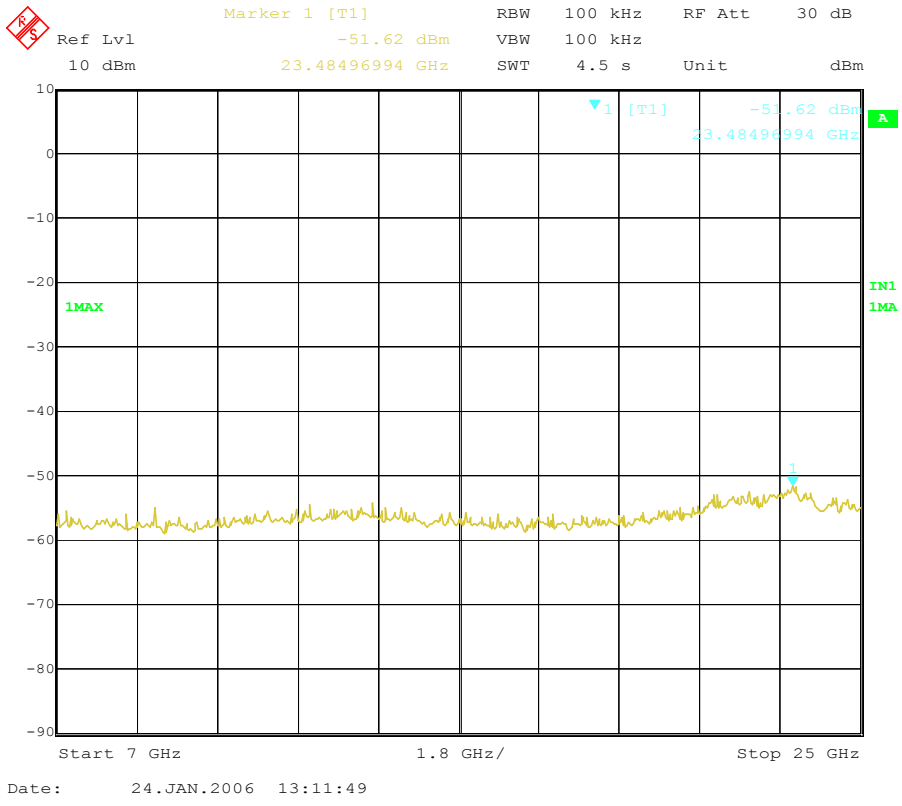
Middle Channel (operating at 2437 MHz): 7 GHz ~ 25 GHz (802.11b, 11Mbps)



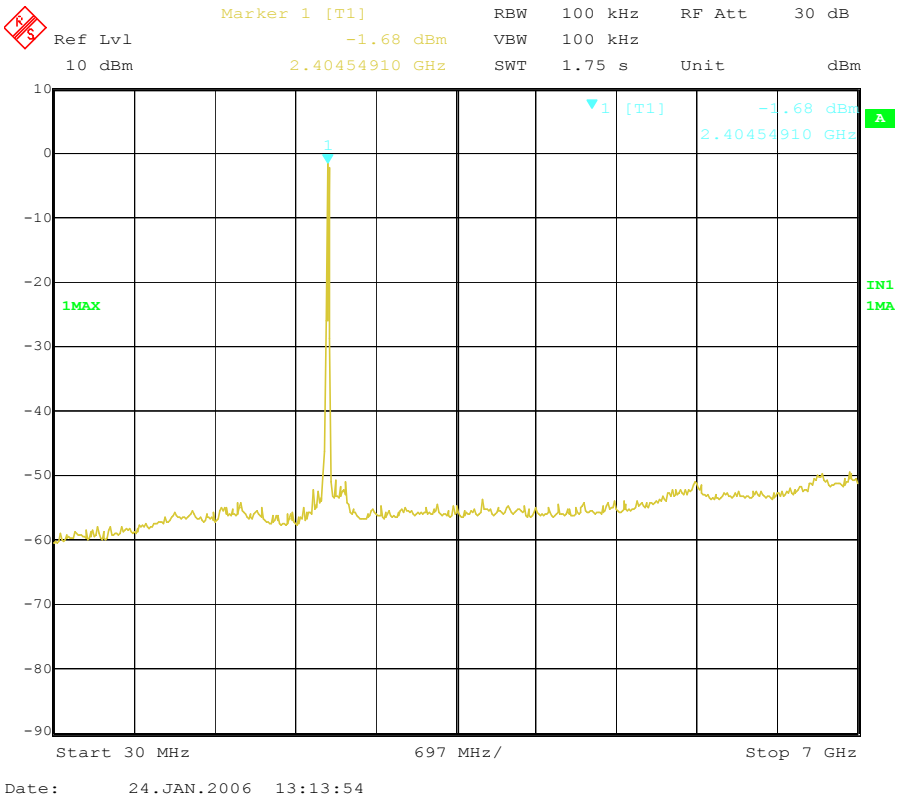
Highest Channel (operating at 2462 MHz): 30 MHz ~ 7 GHz (802.11b, 11Mbps)



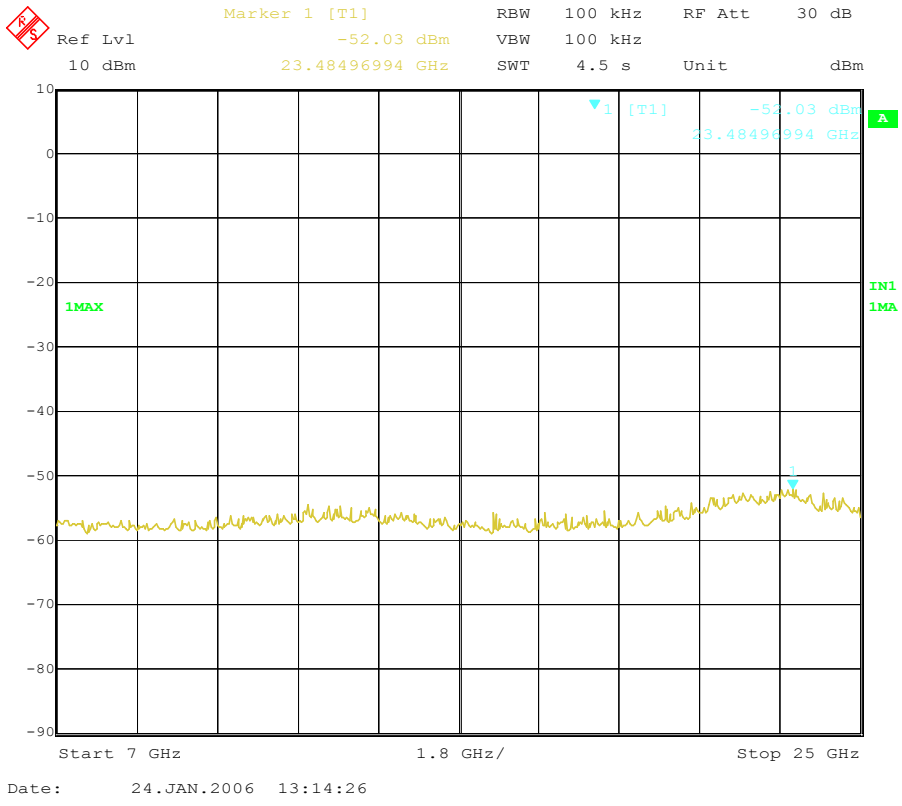
Highest Channel (operating at 2462 MHz): 7 GHz ~ 25 GHz (802.11b, 11Mbps)



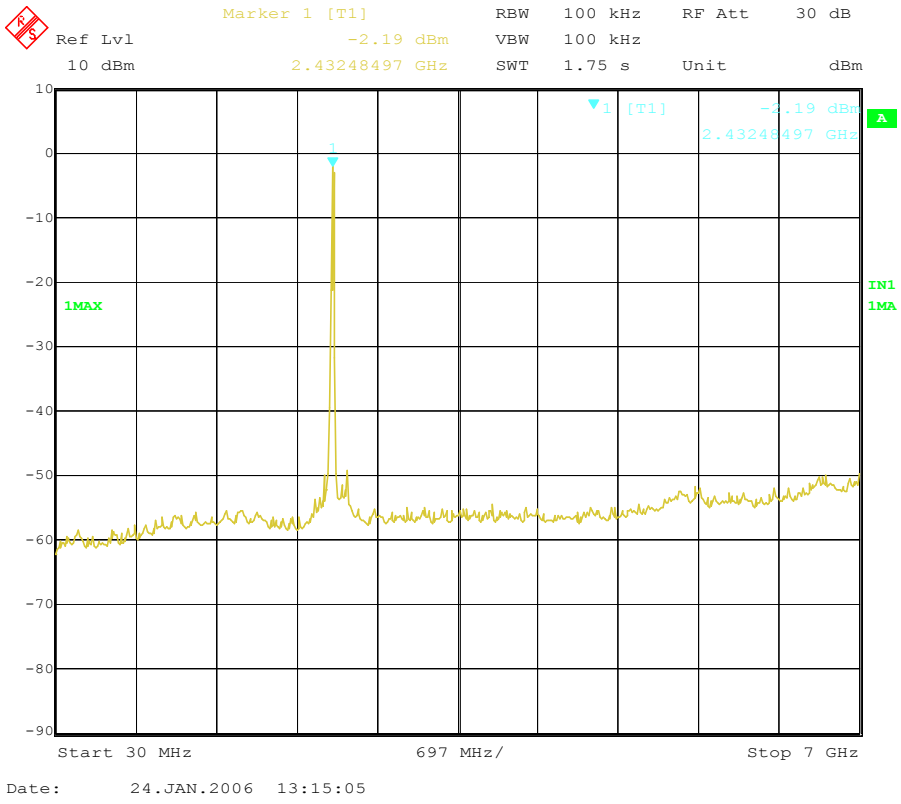
Lowest Channel (operating at 2412 MHz): 30 MHz ~ 7 GHz (802.11g, 6Mbps)



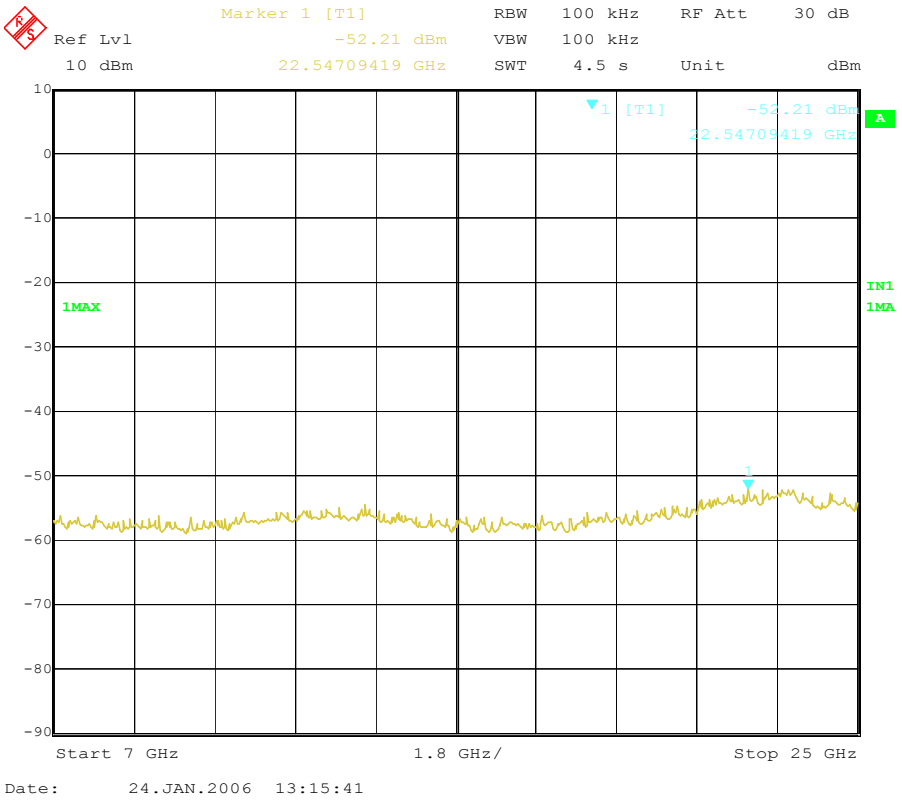
Lowest Channel (operating at 2412 MHz): 7 GHz ~ 25 GHz (802.11g, 6Mbps)



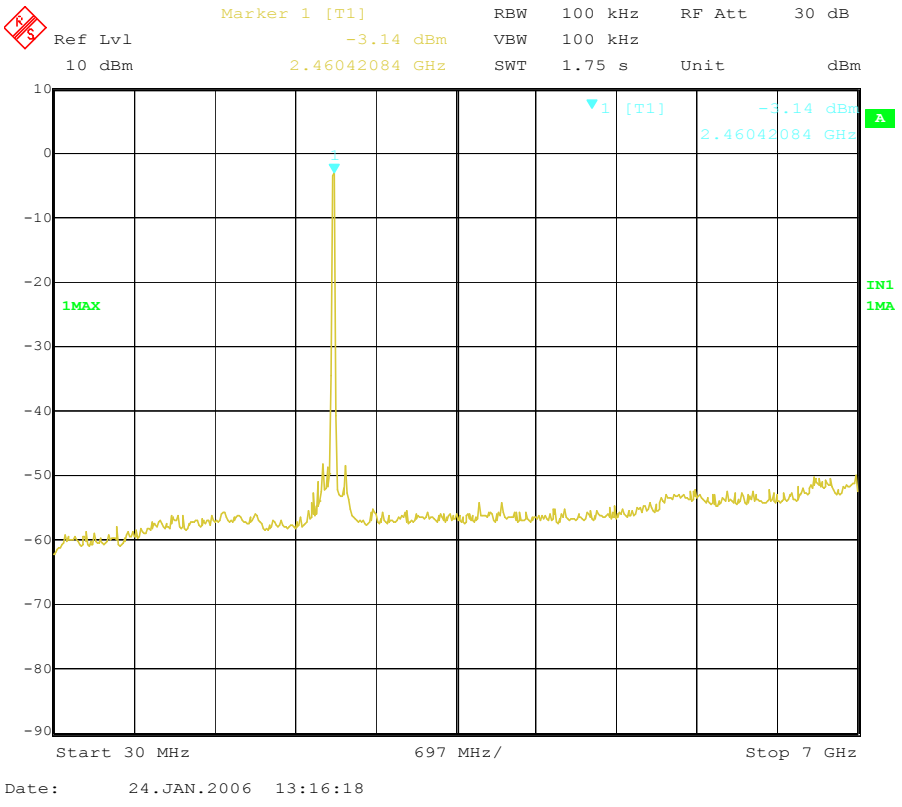
Middle Channel (operating at 2437 MHz): 30 MHz ~ 7 GHz (802.11g, 6Mbps)



Middle Channel (operating at 2437 MHz): 7 GHz ~ 25 GHz (802.11g, 6Mbps)

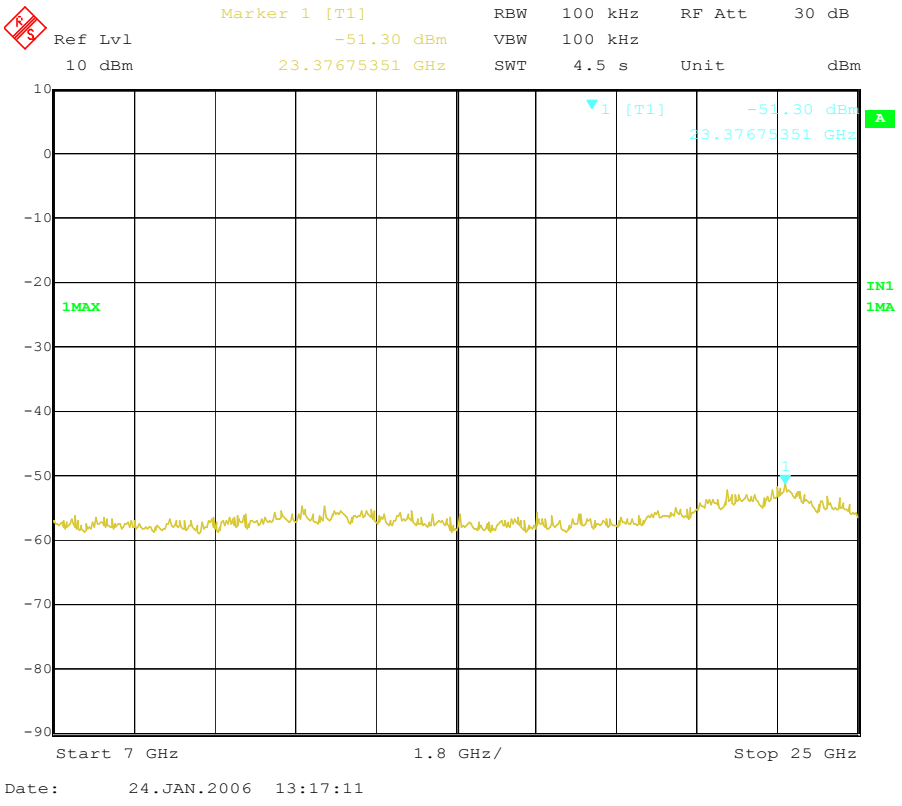


Highest Channel (operating at 2462 MHz): 30 MHz ~ 7 GHz (802.11g, 6Mbps)



Date: 24.JAN.2006 13:16:18

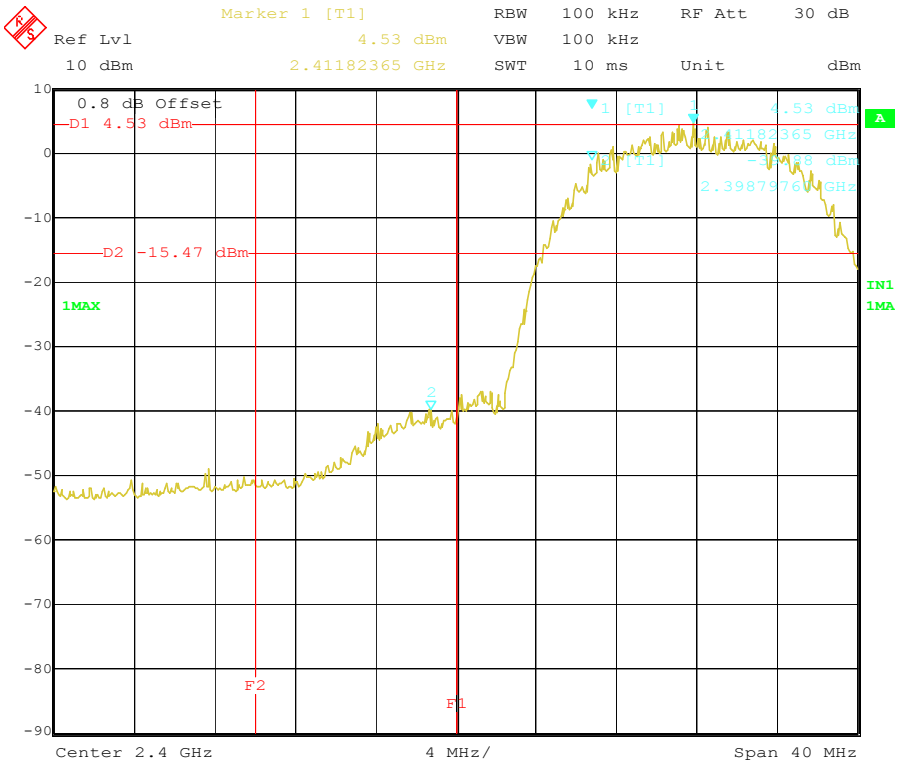
Highest Channel (operating at 2462 MHz): 7 GHz ~ 25 GHz (802.11g, 6Mbps)



Date: 24.JAN.2006 13:17:11

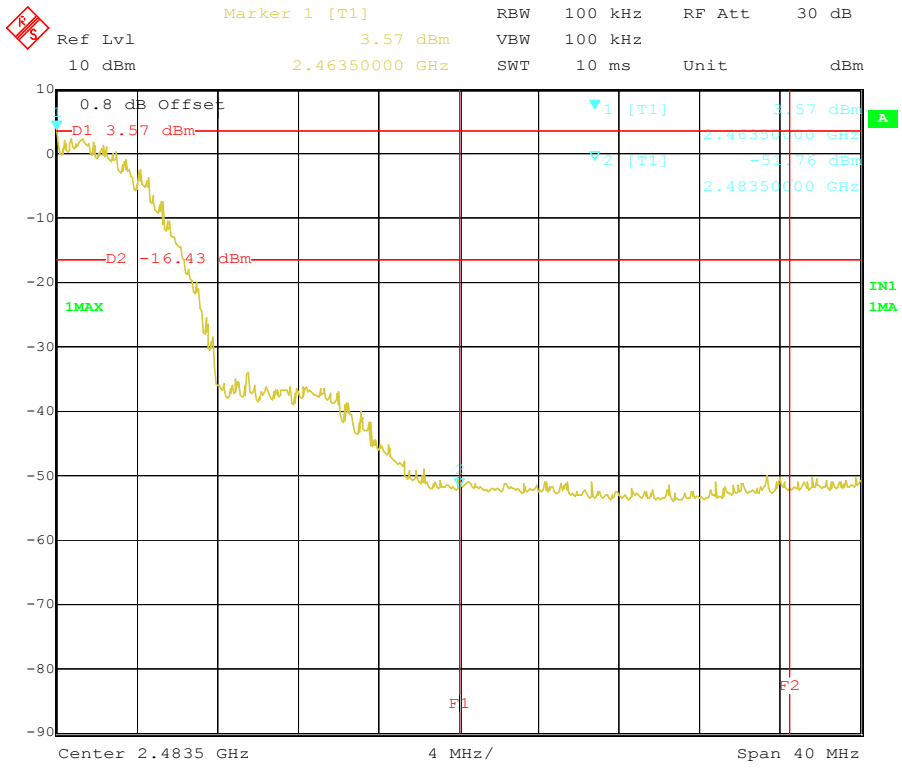
Figure 3. Plot of the Band Edge (Conducted)

Lowest Channel (operating at 2412 MHz): 802.11b, 11Mbps



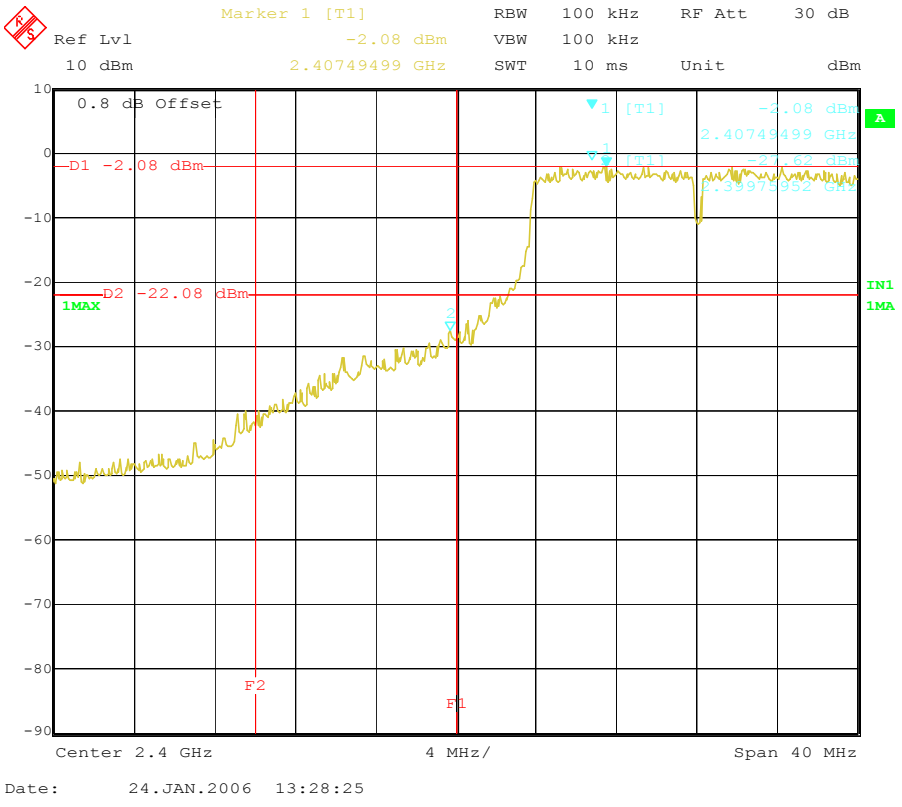
Date: 24.JAN.2006 13:20:28

Highest Channel (operating at 2462 MHz): 802.11b, 11Mbps



Date: 24.JAN.2006 13:23:57

Lowest Channel (operating at 2412 MHz): 802.11g, 6Mbps



Highest Channel (operating at 2462 MHz): 802.11g, 6Mbps

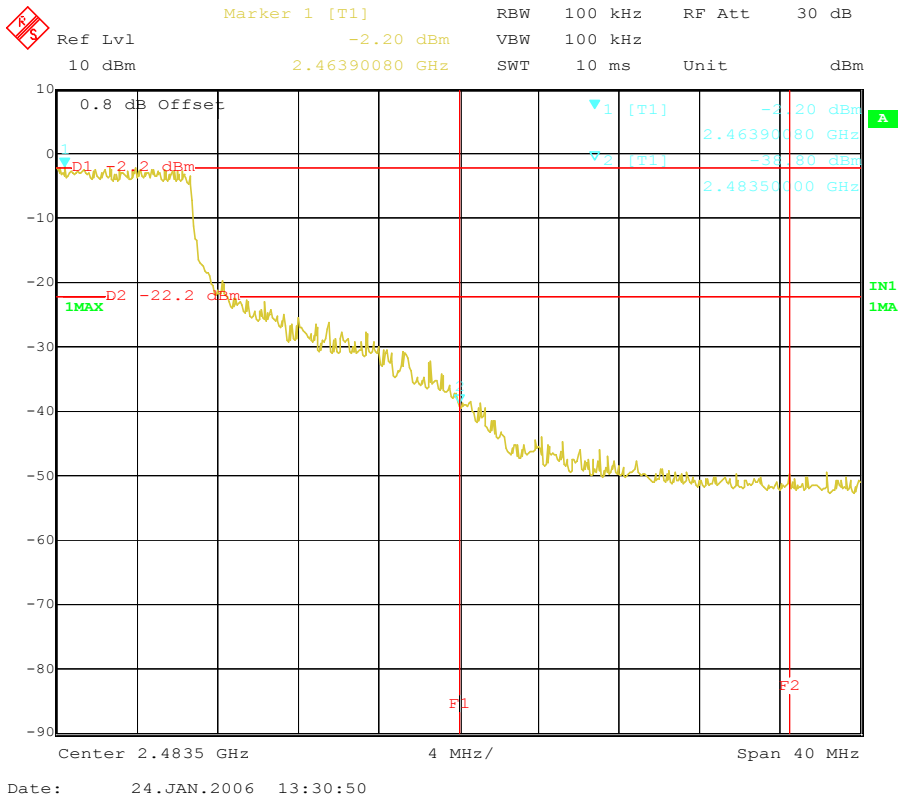
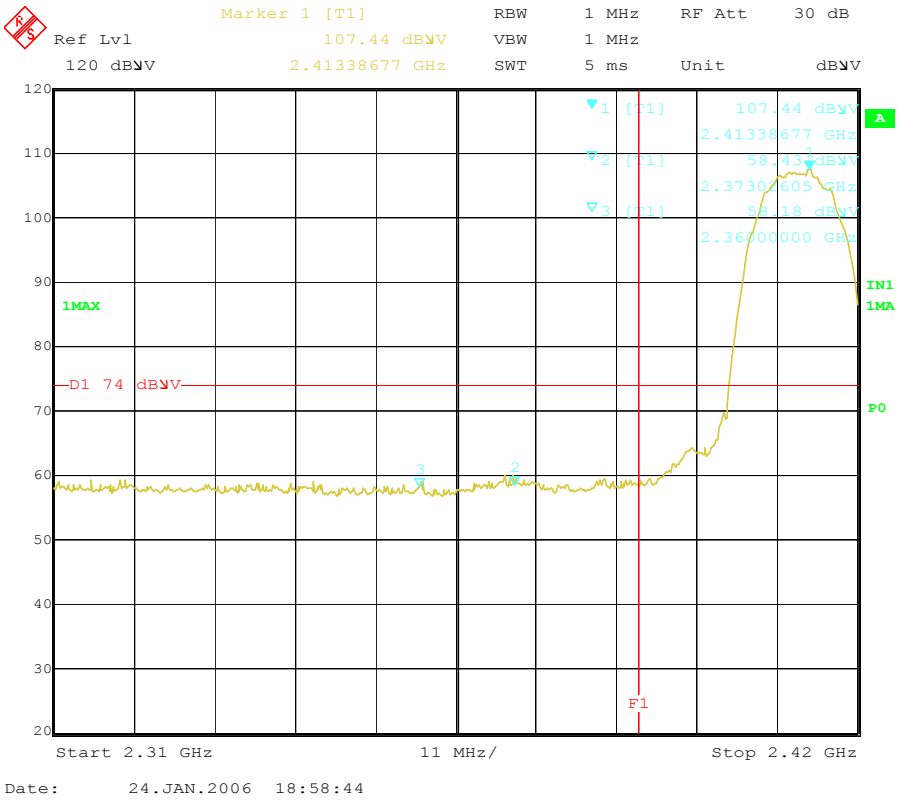
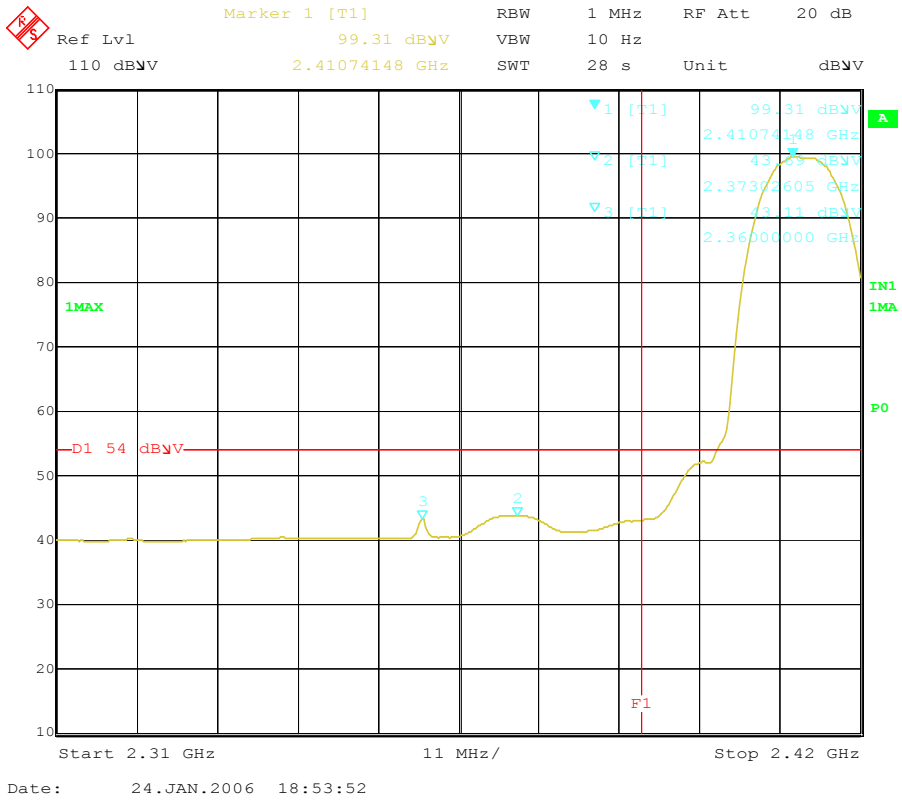


Figure 4. Plot of the Band Edge (Radiated)

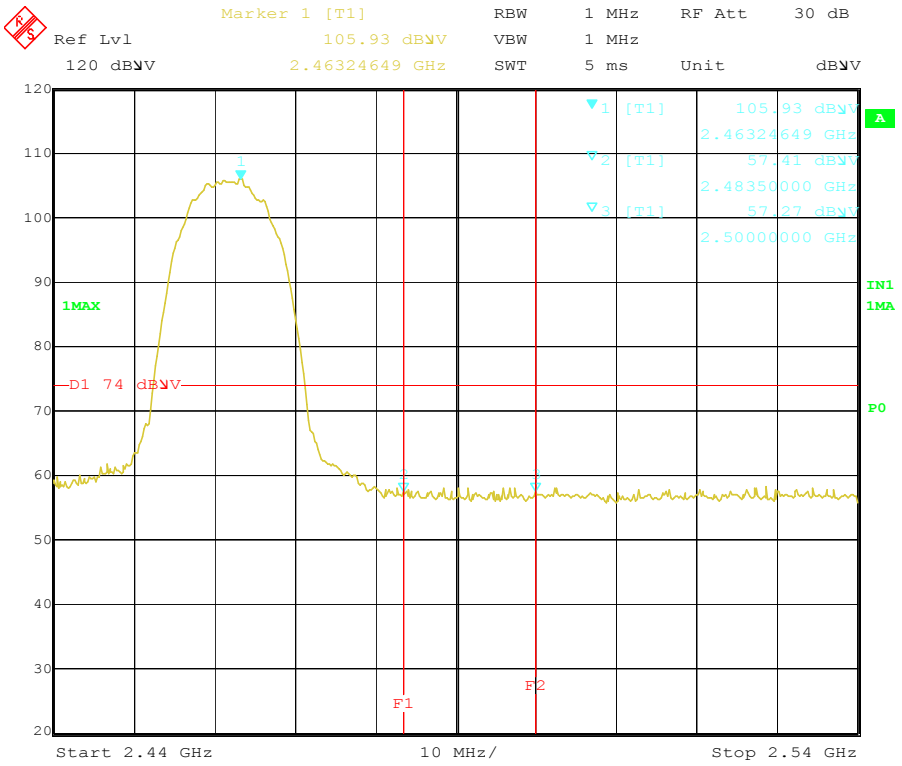
Lowest Channel (operating at 2412 MHz): PEAK (802.11b, 11Mbps)



Lowest Channel (operating at 2412 MHz): AVERAGE (802.11b, 11Mbps)

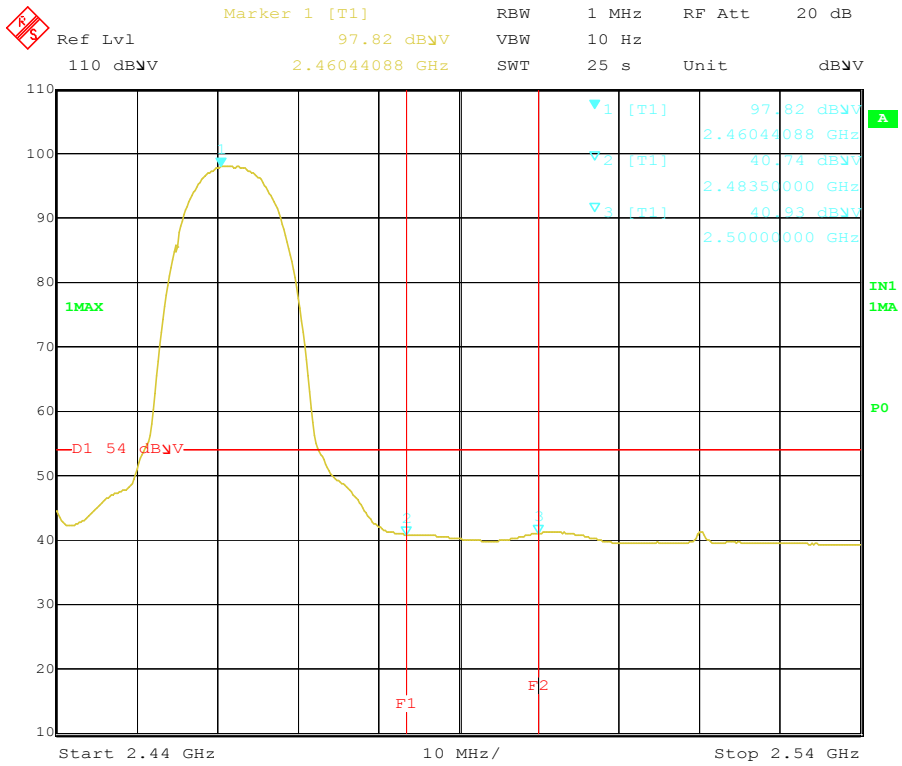


Highest Channel (operating at 2462 MHz): PEAK (802.11b, 11Mbps)



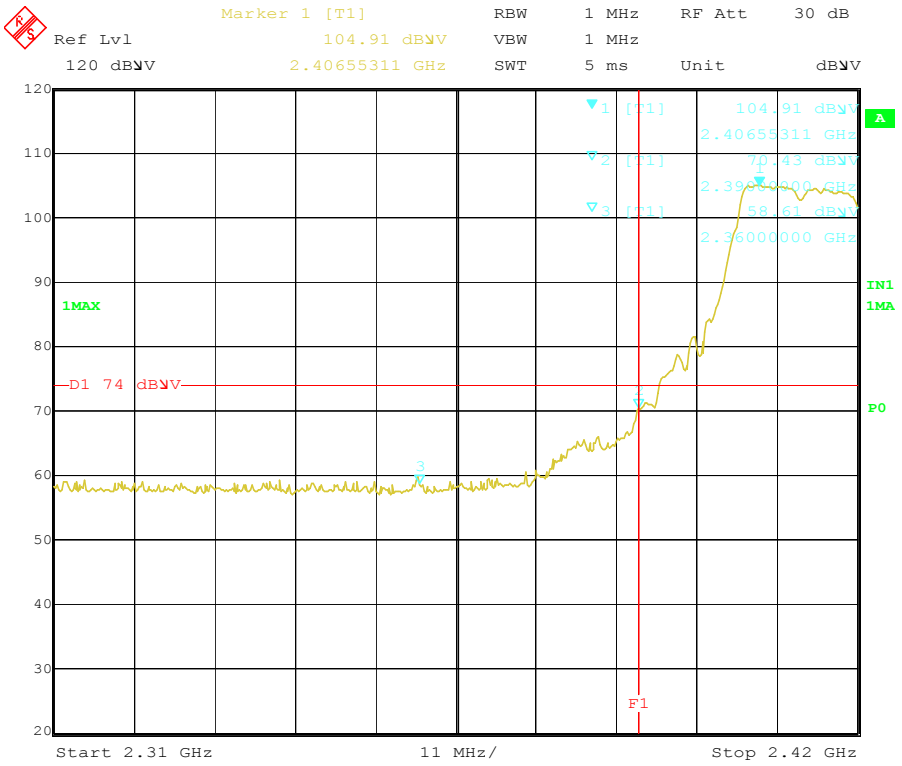
Date: 24.JAN.2006 19:13:05

Highest Channel (operating at 2462 MHz): AVERAGE (802.11b, 11Mbps)

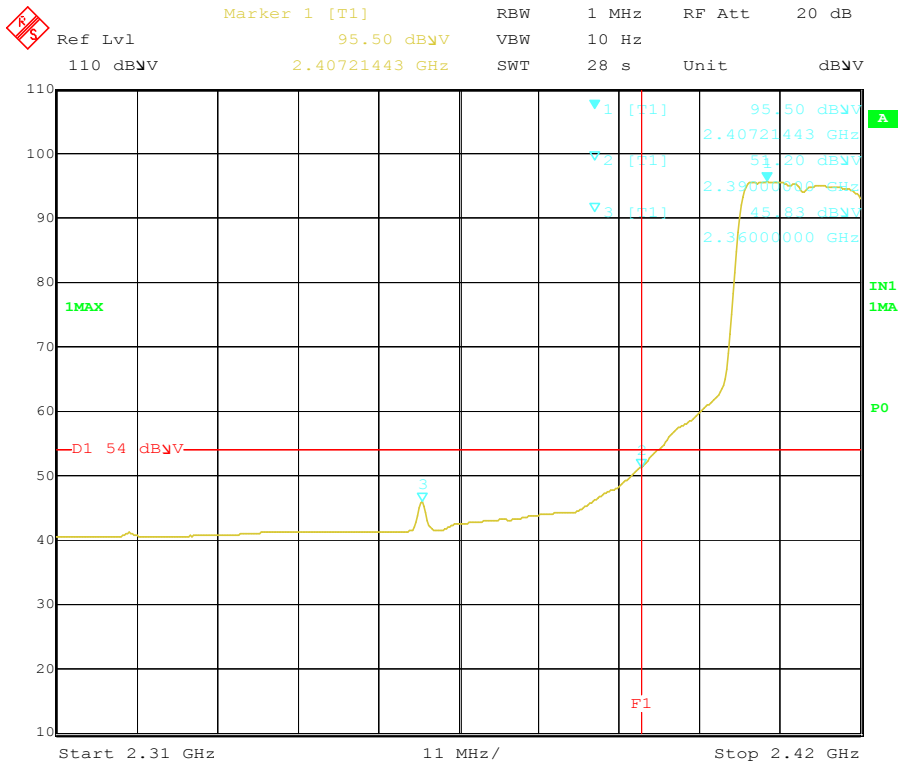


Date: 24.JAN.2006 19:10:51

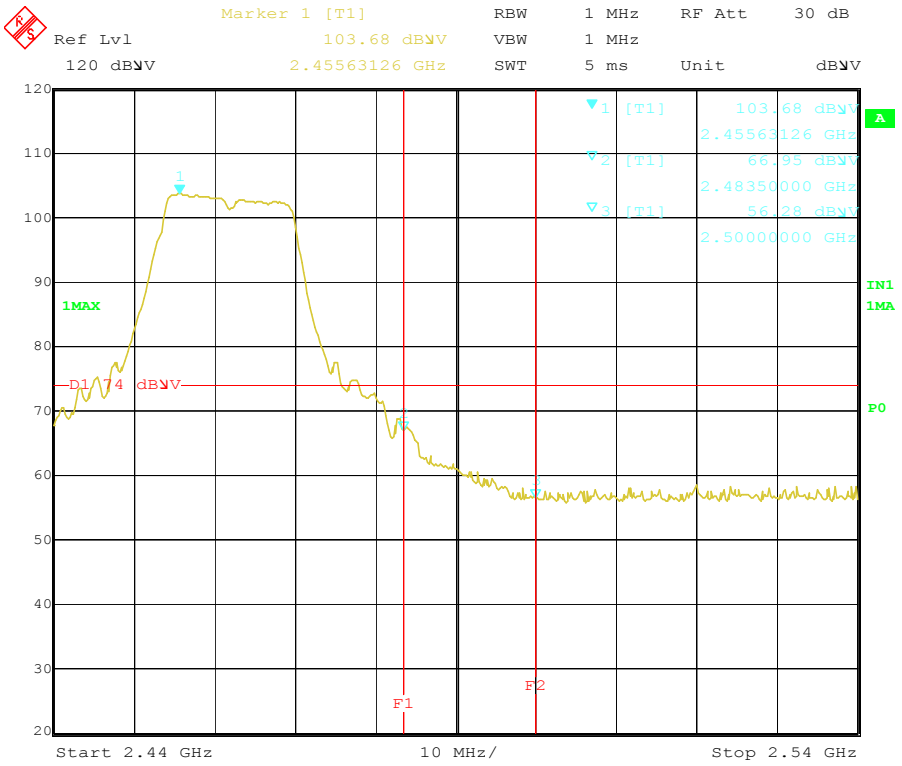
Lowest Channel (operating at 2412 MHz): PEAK (802.11g, 6Mbps)



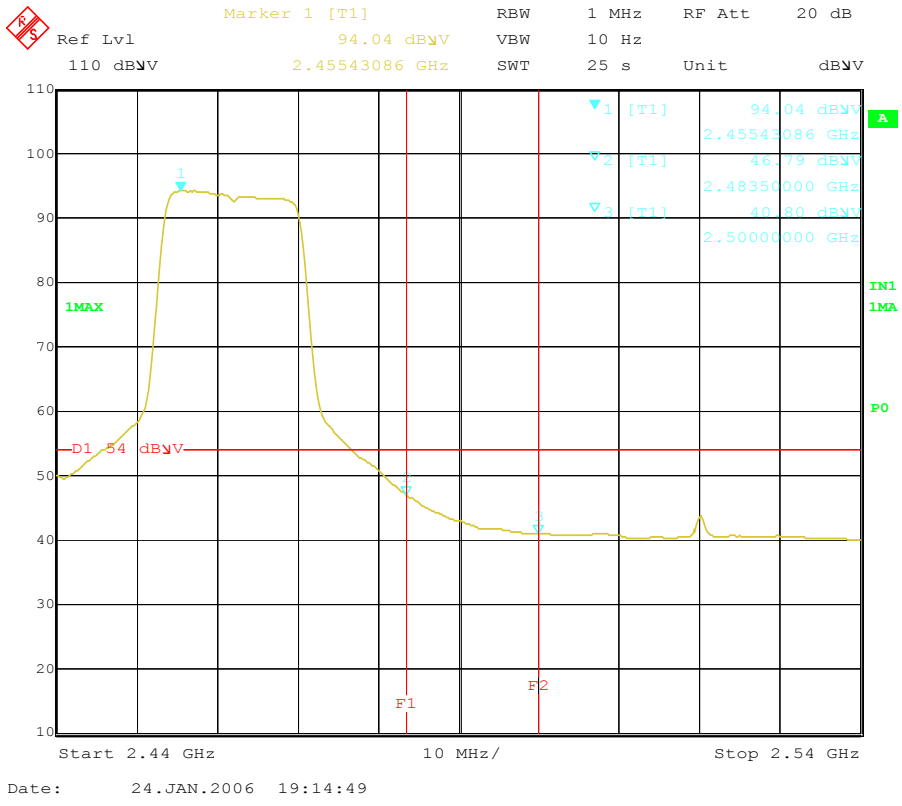
Lowest Channel (operating at 2412 MHz): AVERAGE (802.11g, 6Mbps)



Highest Channel (operating at 2462 MHz): PEAK (802.11g, 6Mbps)



Highest Channel (operating at 2462 MHz): AVERAGE (802.11g, 6Mbps)



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. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
2. Locate and zoom in on emission peak(s) within the passband.
3. Set RBW = 3kHz, VBW = 10kHz, Span = 1.5MHz, and Sweep = 500 seconds.
4. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
5. Repeat above procedures until all frequencies measured were complete.

5.5.3 Test Results: PASS

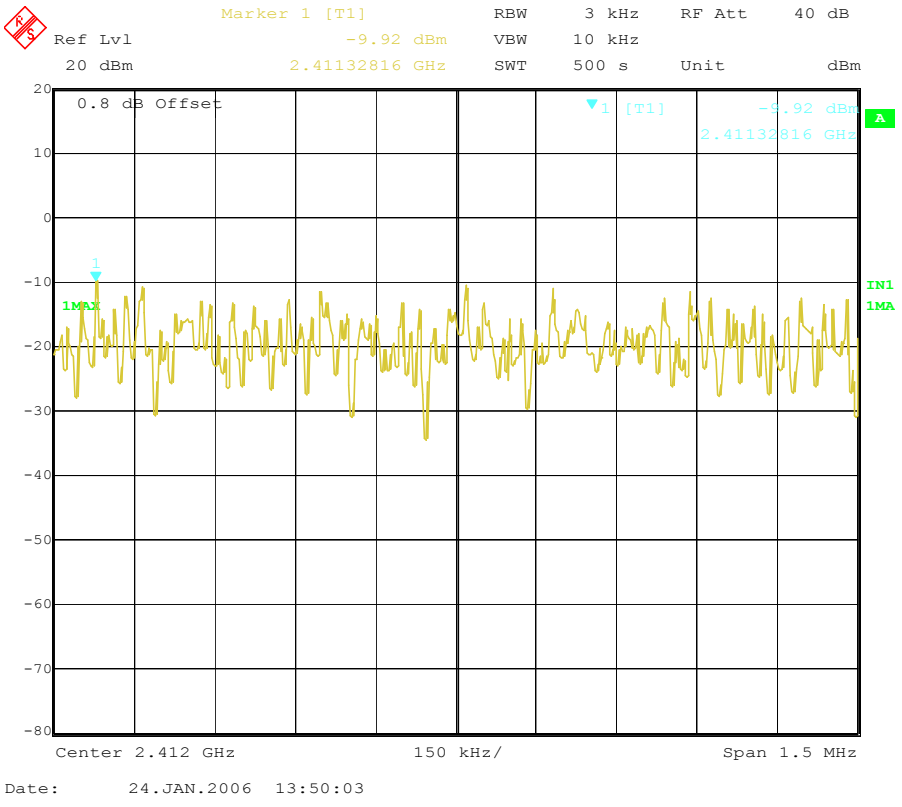
Table 5: Measured values of the Peak Power Spectral Density (Conducted)

Modulation	Operating frequency	Transfer Rate	Cable Loss	Reading (PPSD)	Limit
802.11b	2412 MHz	11Mbps	0.8	-9.92 dBm	8.0 dBm
	2437 MHz	11Mbps	0.8	-9.93 dBm	8.0 dBm
	2462 MHz	11Mbps	0.8	-9.94 dBm	8.0 dBm
802.11g	2412 MHz	6Mbps	0.8	-17.35 dBm	8.0 dBm
	2437 MHz	6Mbps	0.8	-17.76 dBm	8.0 dBm
	2462 MHz	6Mbps	0.8	-17.72 dBm	8.0 dBm

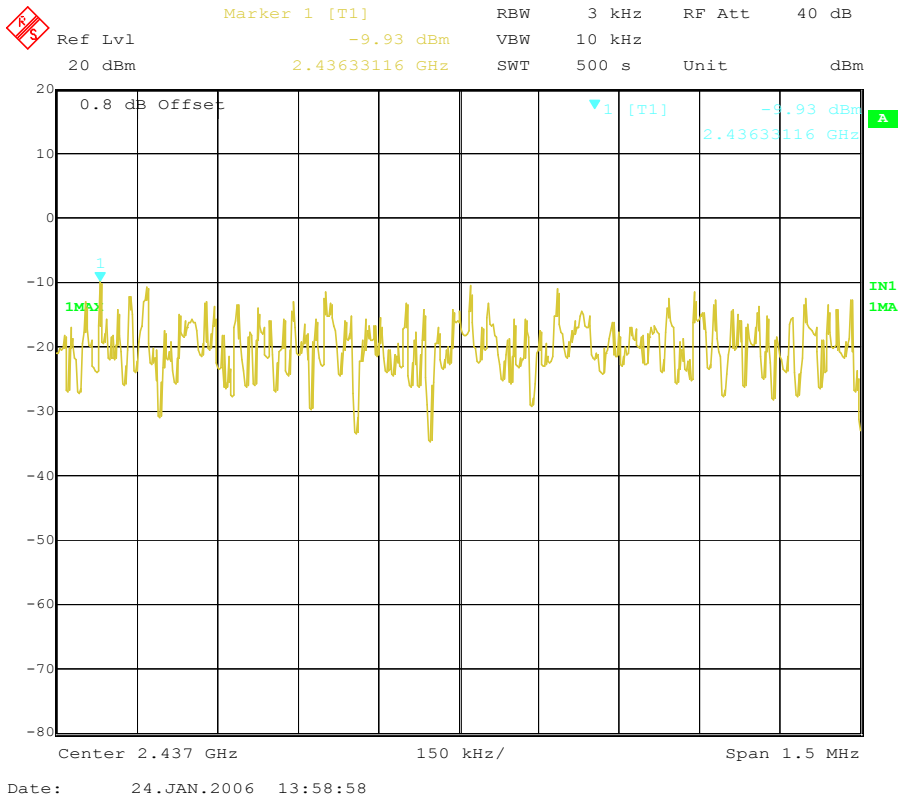
Cable Loss was included in Reading as Offset

Figure 5. Plot of the Peak Power Spectral Density (Conducted)

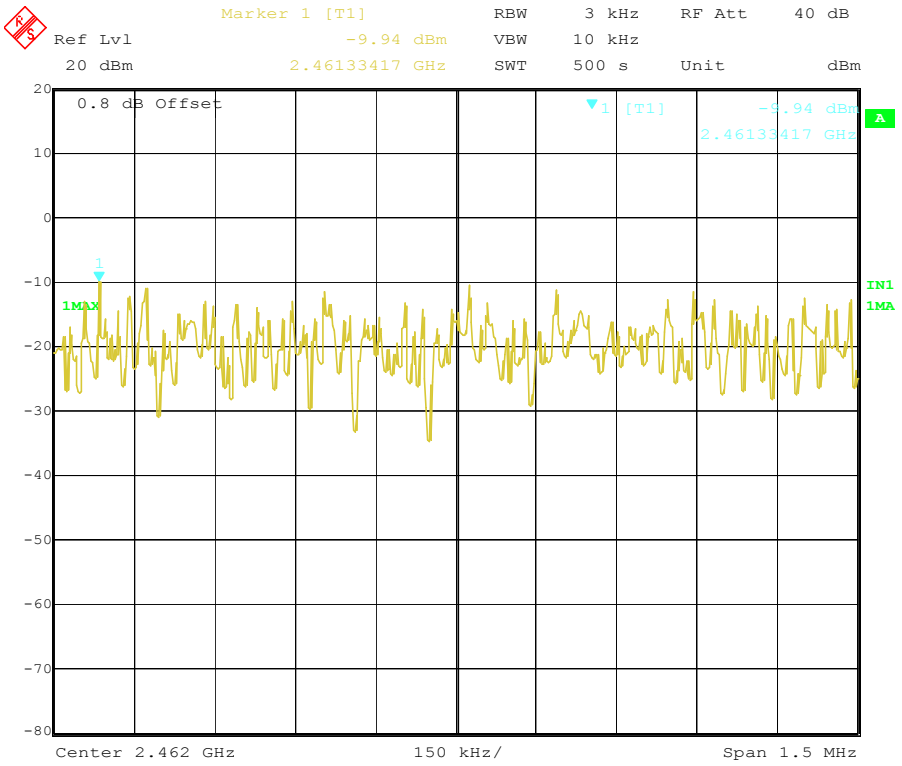
Lowest Channel (operating at 2412 MHz): 802.11b, 11Mbps



Middle Channel (operating at 2437 MHz): 802.11b, 11Mbps

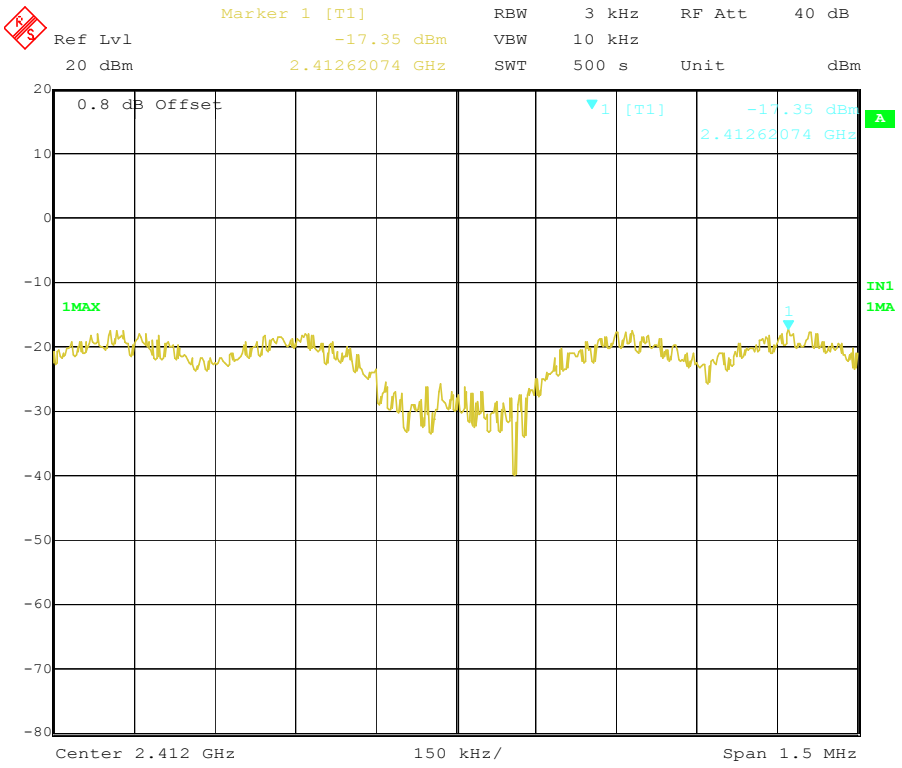


Highest Channel (operating at 2462 MHz): 802.11b, 11Mbps



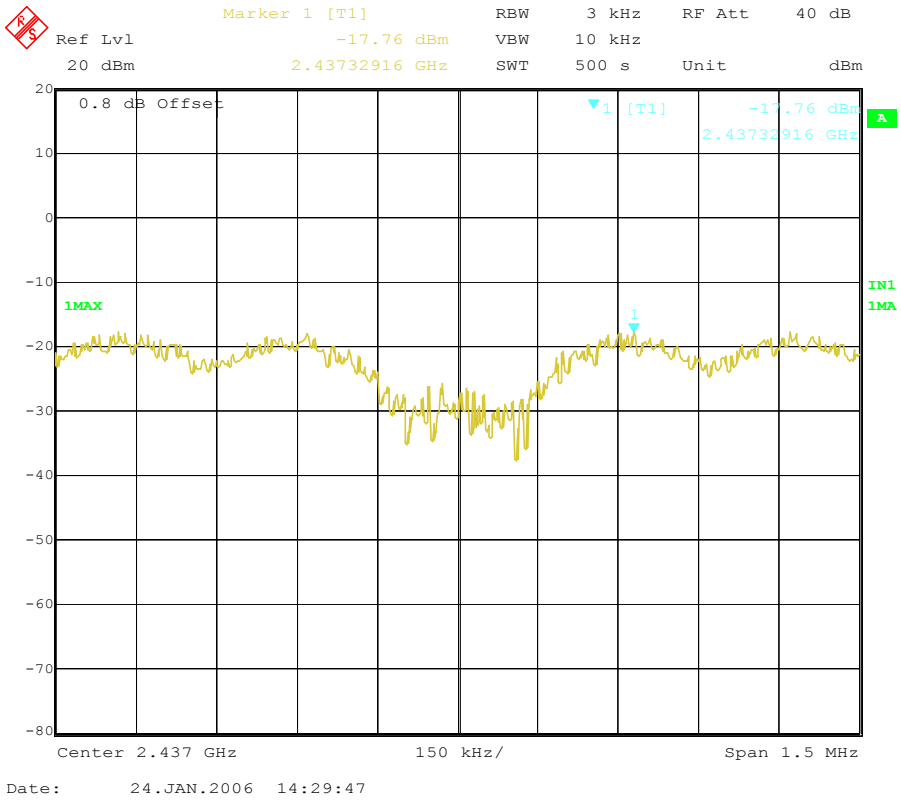
Date: 24.JAN.2006 14:07:38

Lowest Channel (operating at 2412 MHz): 802.11g, 6Mbps

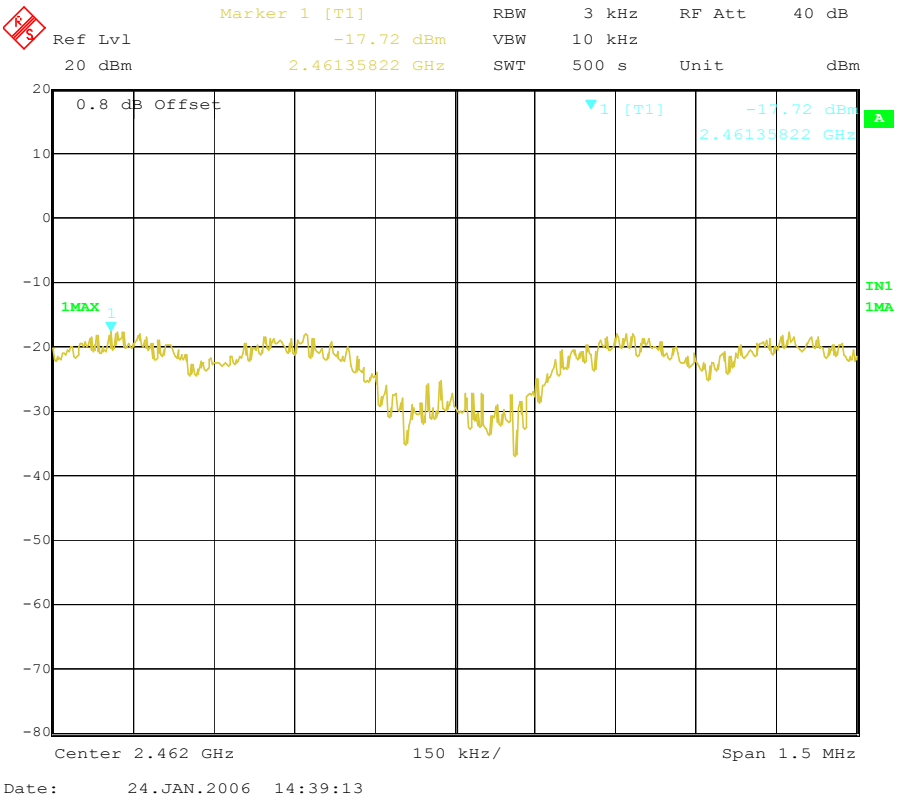


Date: 24.JAN.2006 14:20:06

Middle Channel (operating at 2437 MHz): 802.11g, 6Mbps



Highest Channel (operating at 2462 MHz): 802.11g, 6Mbps



5.6 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 50μH/50Ω 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 (dBμV)	
	Qausi-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 50Ω/50μH 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 6: Measured values of the Conducted Emissions

- DIRECTLY powered: **Transmitting at 2437 MHz**

Frequency [MHz]	Reading [dBµV]		CF/CL [dB]	Actual [dBµV]		Limit [dBµV]		Margin [dB]	
	Qp	Avg		Qp	Avg	Qp	Avg	Qp	Avg
LINE – PE									
0.530	46.33	28.78	0.14/0.05	46.52	28.97	56.00	46.00	9.48	17.03
0.600	46.83	26.65	0.14/0.05	47.02	26.84	56.00	46.00	8.98	19.16
0.665	48.28	28.78	0.14/0.05	48.48	28.98	56.00	46.00	7.52	17.02
0.710	45.87	28.70	0.14/0.06	46.07	28.90	56.00	46.00	9.93	17.10
0.735	47.46	24.75	0.14/0.06	47.66	24.95	56.00	46.00	8.34	21.05
0.775	46.47	31.54	0.14/0.06	46.67	31.74	56.00	46.00	9.33	14.26
0.800	49.00	28.87	0.15/0.06	49.21	29.08	56.00	46.00	6.79	16.92
0.840	46.01	28.61	0.15/0.07	46.23	28.83	56.00	46.00	9.77	17.17
0.865	47.56	25.22	0.15/0.07	47.78	25.44	56.00	46.00	8.22	20.56
1.200	45.10	27.29	0.18/0.11	45.39	27.58	56.00	46.00	10.61	18.42
NEUTRAL – PE									
0.200	38.35	21.97	0.12/0.05	38.52	22.14	63.61	53.61	25.09	31.47
0.500	38.45	18.77	0.12/0.05	38.62	18.94	56.00	46.00	17.38	27.06
0.570	40.73	21.34	0.12/0.05	40.90	21.51	56.00	46.00	15.10	24.49
0.640	41.47	22.42	0.13/0.06	41.66	22.61	56.00	46.00	14.34	23.39
0.715	38.29	20.22	0.13/0.06	38.48	20.41	56.00	46.00	17.52	25.59
0.785	40.55	21.63	0.13/0.06	40.74	21.82	56.00	46.00	15.26	24.18
0.830	38.43	21.97	0.14/0.07	38.64	22.18	56.00	46.00	17.36	23.82
0.855	40.61	22.61	0.14/0.07	40.82	22.82	56.00	46.00	15.18	23.18
0.925	36.06	16.95	0.14/0.07	36.27	17.16	56.00	46.00	19.73	28.84
1.210	36.54	19.50	0.15/0.11	36.80	19.76	56.00	46.00	19.20	26.24

Margin (dB) = Limit – Actual
[Actual = Reading + CF + CL]

1. Remark "---" means the level is undetectable or the Qausi-peak value is lower than the limit of Average.
2. CF/CL = Correction Factor and Cable Loss
3. Qp = Quasi-peak, Avg = Average value

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.

Measured values of the Conducted Emissions

- INDIRECTLY powered: **Transmitting at 2437 MHz**

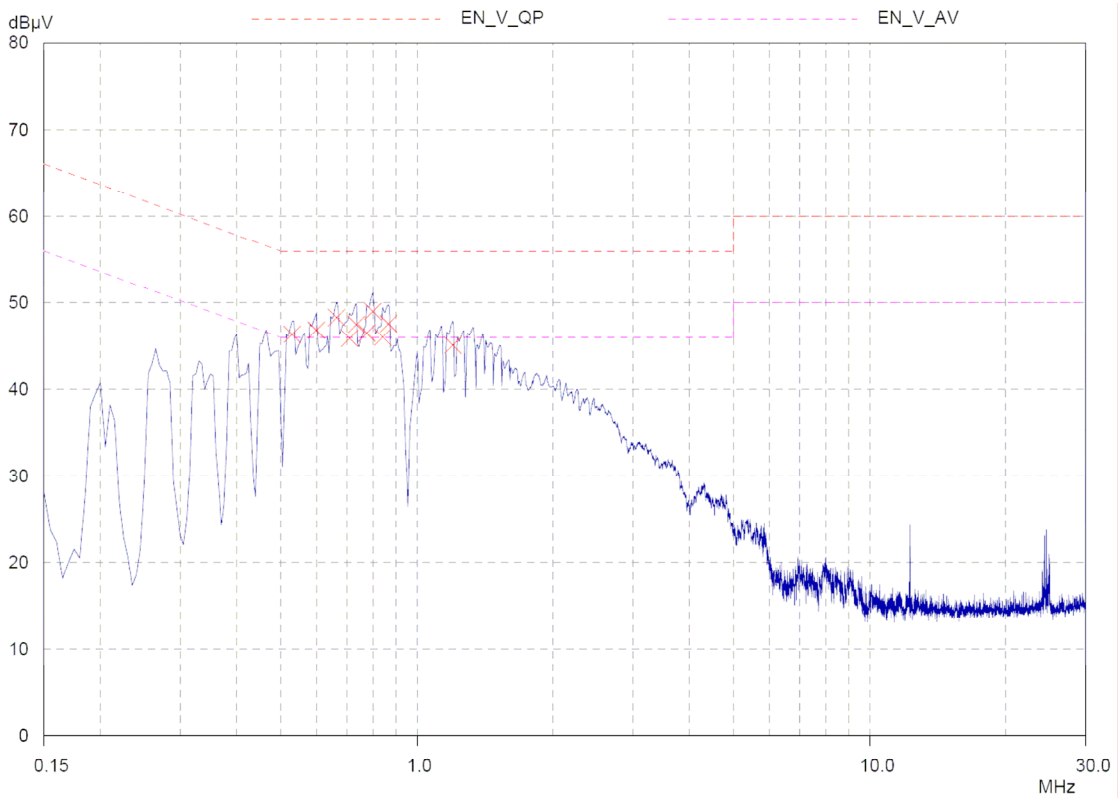
Frequency [MHz]	Reading [dBµV]		CF/CL [dB]	Actual [dBµV]		Limit [dBµV]		Margin [dB]	
	Qp	Avg		Qp	Avg	Qp	Avg	Qp	Avg
LINE – PE									
0.150	45.12	---	0.13/0.01	45.26	---	66.00	56.00	20.74	---
0.195	41.05	---	0.13/0.02	41.20	---	63.82	53.82	22.62	---
0.265	34.44	---	0.13/0.04	34.61	---	61.27	51.27	26.66	---
0.330	33.05	---	0.13/0.04	33.22	---	59.45	49.45	26.23	---
0.395	27.87	---	0.13/0.04	28.04	---	57.96	47.96	29.92	---
0.465	28.98	---	0.14/0.05	29.14	---	56.60	46.60	27.43	---
0.530	26.57	---	0.14/0.05	26.76	---	56.00	46.00	29.24	---
0.995	25.81	---	0.15/0.07	26.03	---	56.00	46.00	29.97	---
1.195	26.90	---	0.18/0.11	27.19	---	56.00	46.00	28.81	---
1.395	27.87	---	0.18/0.11	28.16	---	56.00	46.00	27.84	---
NEUTRAL – PE									
0.150	45.28	---	0.12/0.01	45.41	---	66.00	56.00	20.59	---
0.195	40.26	---	0.12/0.02	40.40	---	63.82	53.82	23.42	---
0.265	33.25	---	0.12/0.04	33.41	---	61.27	51.27	27.86	---
0.330	31.83	---	0.12/0.04	31.99	---	59.45	49.45	27.46	---
0.395	25.48	---	0.12/0.04	25.64	---	57.96	47.96	32.32	---
0.465	28.32	---	0.12/0.05	28.49	---	56.60	46.60	28.11	---
1.060	25.83	---	0.15/0.11	26.09	---	56.00	46.00	29.91	---
1.260	27.42	---	0.15/0.11	27.68	---	56.00	46.00	28.32	---
1.460	26.92	---	0.15/0.11	27.18	---	56.00	46.00	28.82	---
23.645	16.35	---	0.89/0.41	17.65	---	60.00	46.00	42.35	---

Margin (dB) = Limit – Actual
[Actual = Reading + CF + CL]
1. Remark "---" means the level is undetectable or the Qausi-peak value is lower than the limit of Average.
2. CF/CL = Correction Factor and Cable Loss
3. Qp = Quasi-peak, Avg = Average value

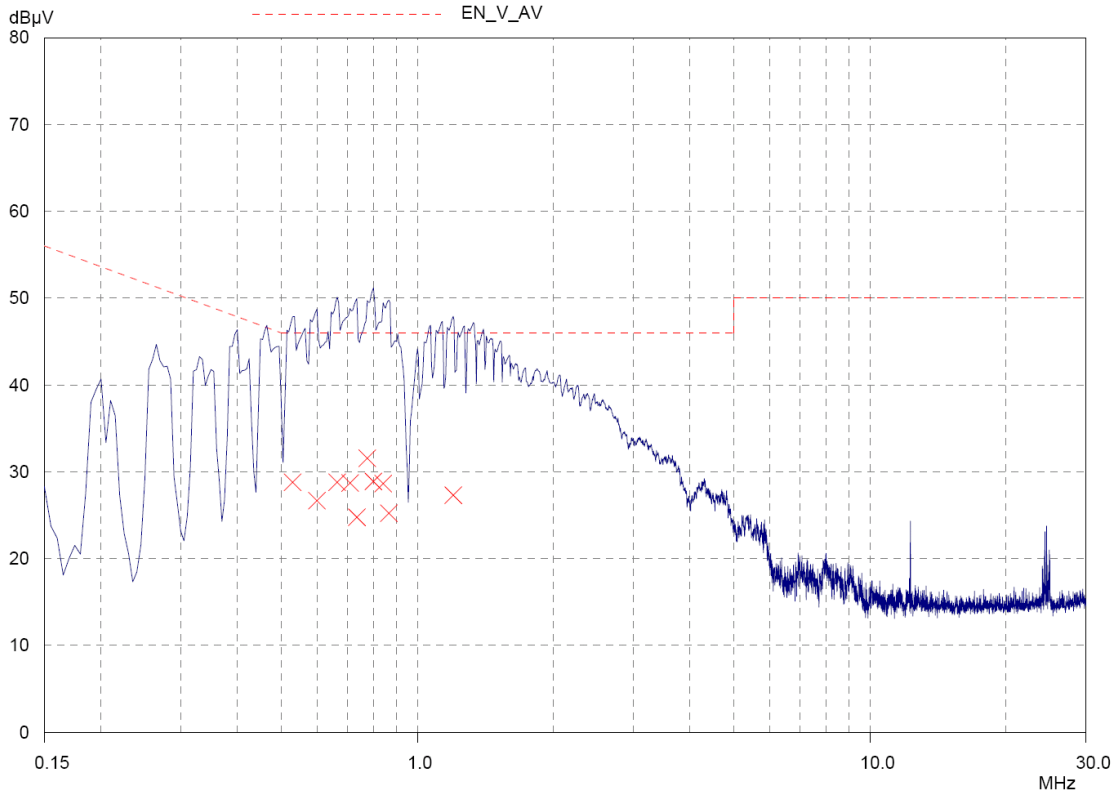
NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.

Figure 6. Plot of the Conducted Emissions

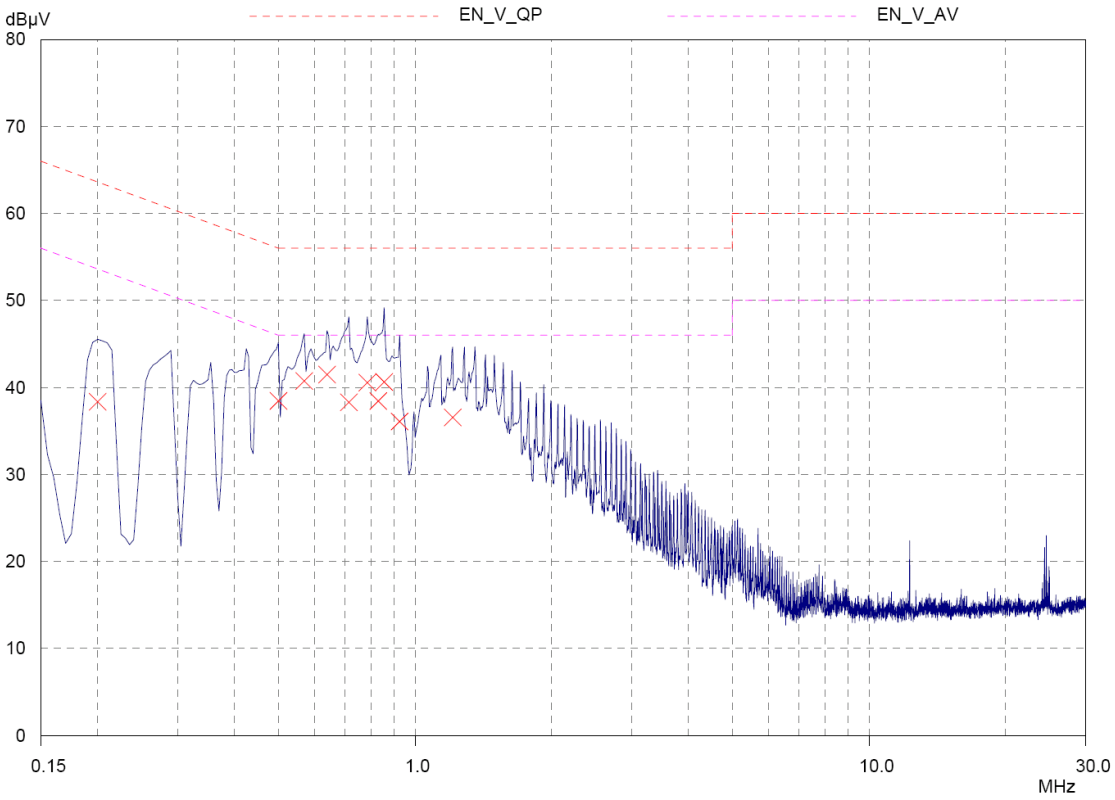
DIRECTLY powered, Transmitting at 2437 MHz: LINE – PE, '×': Quasi-Peak values



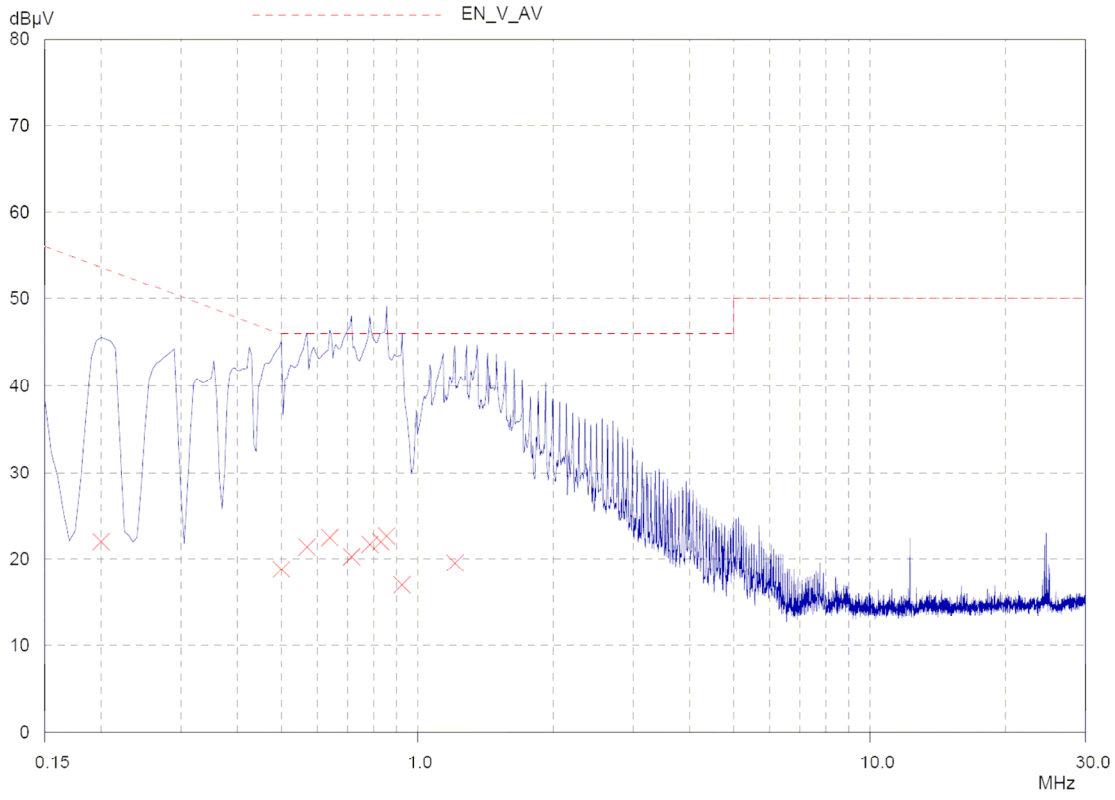
DIRECTLY powered, Transmitting at 2437 MHz: LINE – PE, '×': Average values



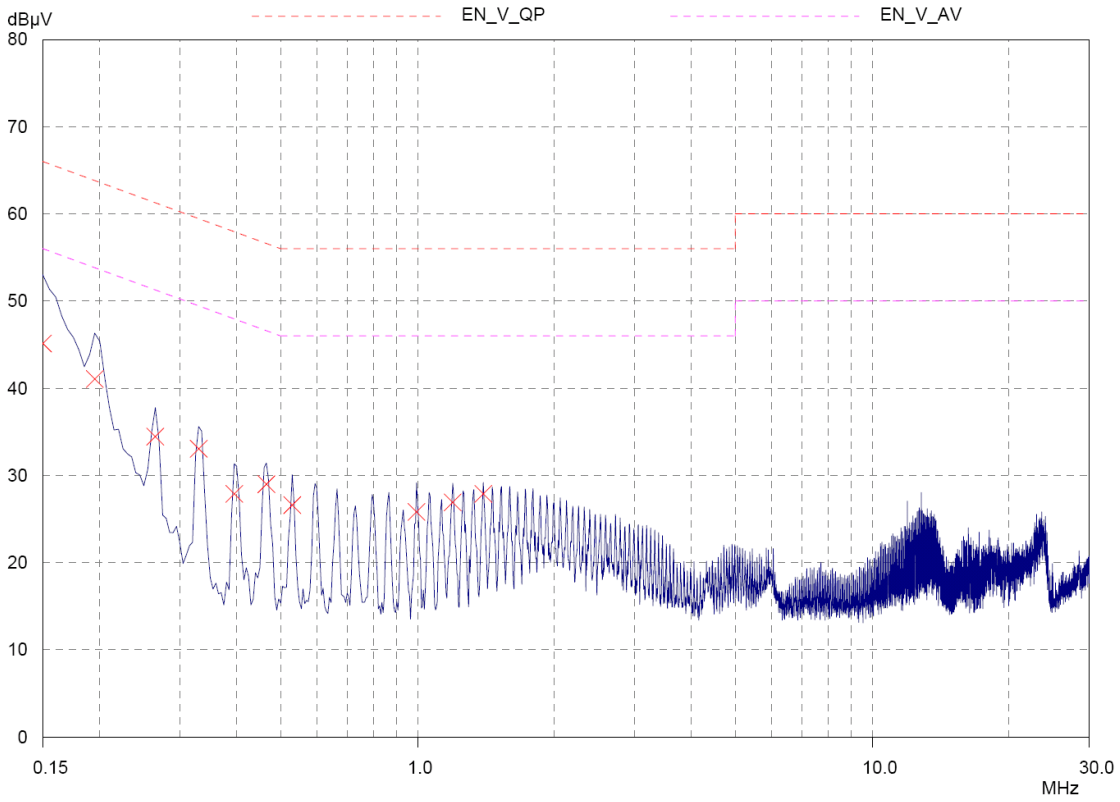
DIRECTLY powered, Transmitting at 2437 MHz: Neutral – PE, '×': Quasi-Peak values



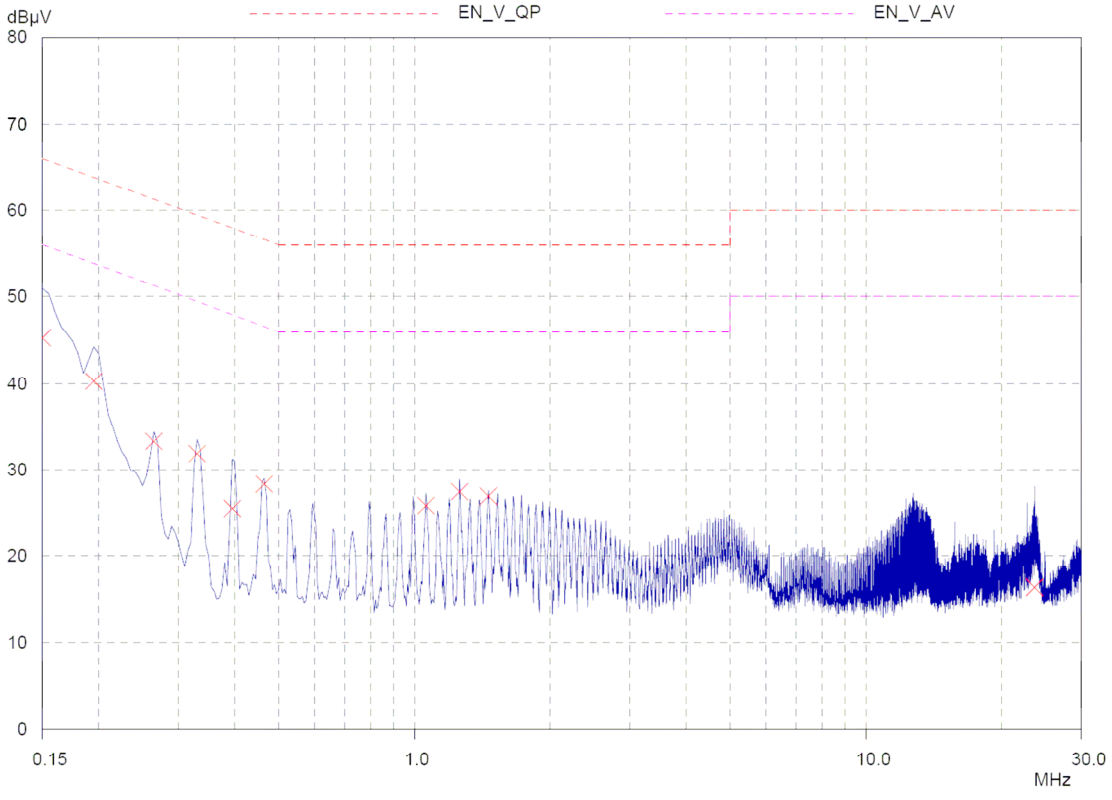
DIRECTLY powered, Transmitting at 2437 MHz: Neutral – PE, '×': Average values



INDIRECTLY powered, Transmitting at 2437 MHz: LINE – PE, '×': Quasi-Peak values



INDIRECTLY powered, Transmitting at 2437 MHz: Neutral – PE, '×': Quasi-Peak values



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 (μV/m @ 3m)	Field strength (dBμV/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 7: Receiver spurious emission (Radiated)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Table Angle [°]	Reading [dB(μV)]	Amp Gain [dB]	AF / CL [dB(1/m)]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Receive mode										
230.4	120	H	1.0	95	33.2	27.1	17.2/1.3	24.6	46.0	21.4
460.8	120	H	1.0	180	35.2	27.8	18.0/1.9	27.3	46.0	18.7

Margin (dB) = Limit – Actual
[Actual = Reading – Amp Gain + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss

NOTE: The spectrum was scanned from 30 MHz to 18 GHz. All emissions not reported were more than 20 dB below the specified limit or in the noise floor. The measured data in the above table include the spurious radiated emissions that do not fall in the restricted bands.