FCC/IC TEST REPORT

Test report No.:	EMC- FCC- R0155
FCC ID:	TQ8-AT240A9AN
IC:	5074A-AT240A9AN
Type of equipment:	DIGITAL CAR AVN SYSTEM
Basic Model Name:	AT240A9AN
Applicant:	Hyundai Mobis Co., Ltd.
Max.RF Output Power:	18.56 dBm
FCC Rule Part(s):	FCC Part 15 Subpart C 15.247
IC Rule:	RSS-210, RSS-GEN
Frequency Range:	2 412 MHz ~ 2 462 MHz
Test result:	Complied

The above equipment was tested by EMC compliance Testing Laboratory for compliance with the requirements of FCC Rules and Regulations.
The results of testing in this report apply to the product/system which was tested only.
Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Date of test: 2014. 02. 10 ~ 14

Issued date: 2014. 02. 19

Tested by: AHN, BYUNG WOO

Approved by: YU, SANG HOON

65, Sinwon-ro, Yeongtong-gu, Suwon- si, Gyeonggi-do, 443-390, Korea
82-31-336-9919 (Main) 82-505-299-8311 (Fax)

[Contents]

1. Client information

Applicant:	Hyundai Mobis Co., Ltd.
Address:	203, Teheran-ro, Gangnam-gu, Seoul, Korea (135-977)
Telephone number:	+82-31-260-0098
Facsimile number:	+82-31-899-1788
Contact person:	Seung-Hoon Choe / csh@mobis.co.kr

Manufacturer:	Hyundai Mobis Co., Ltd.
Address:	95, Sayang 2-Gil, Munbaek-Myeon, Jincheon-Gun, Chungcheongbuk-Do 365-862 Korea

2. Laboratory information

Address

EMC compliance Ltd.
65, Sinwon-ro, Yeongtong-gu, Suwon- si, Gyeonggi-do, 443-390, Korea
Telephone Number: 82-31-336-9919 Facsimile Number: 82-505-299-8311

Certificate

KOLAS No.: 231
FCC Site Registration No.: 687132
VCCI Site Registration No.: R-3327, G-198, C-3706, T-1849
IC Site Registration No.:8035A-2

SITE MAP

3. Description of E.U.T.

3.1 Basic description

Applicant:	Hyundai Mobis Co., Ltd.
Address of Applicant	203, Teheran-ro, Gangnam-gu, Seoul, Korea (135-977)
Manufacturer	Hyundai Mobis Co., Ltd.
Address of Manufacturer	95, Sayang 2-Gil, Munbaek-Myeon, Jincheon-Gun, Chungcheongbuk-Do 365-862 Korea
Type of equipment	DIGITAL CAR AVN SYSTEM
Basic Model	AT240A9AN
Serial number	Proto Type

3.2 General description

Frequency Range	2 412 ~ 2 462 MHz(802.11b/g/n_HT20)
Communication	IEEE 802.11b/g/n_HT20
Type of Modulation	CCK, OFDM
Number of Channels	11 ch
Type of Antenna	Monopole type
Antenna Gain	3.08 dBi
Transmit Power	18.56 dBm
Power supply	DC 14.4 V

3.3 Test frequency

For all teset items, the low, middle and high channels of the modes were tested with above worst case data rate.

	Frequency
Low frequency	2 412 MHz
Middle frequency	2 437 MHz
High frequency	2 462 MHz

3.4 Test Voltage

mode	Voltage
Norminal voltage	DC 14.4 V

4. Summary of test results

4.1 Standards & results

FCC Rule Reference	IC Rule Reference	Parameter	Report Section	Test Result
15.203, 15.247(b)(4)	RSS-GEN, 7.1.2	Antenna Requirement	5.1	C
15.247(b)(3)	RSS-210, A8.4(2)	Maximum Peak Output Power	5.2	C
15.247(e)	-	Peak Power Spectral Density	5.3	C
15.247(a)(2)	RSS-GEN,4.6.2	6 dB Channel Bandwidth	5.4	C
-	RSS-210, A1.1	Occupied Bandwidth	5.4	C
15.247(d), 15.205(a), 15.209(a)	RSS-210, A8.5 RSS-210, A2.9 RSS-GEN, 7.2.3	Spurious Emission, Band Edge, and Restricted bands	5.5	C
15.207(a)	RSS-GEN, 7.2.4	Conducted Emissions	-	N/A
15.247(i), 1.1307(b)(1)	-	RF Exposure	5.6	C

Note: C = complies
NC = Not complies
NT = Not tested
NA = Not Applicable

4.2 Uncertainty

Measurement Item	Combined Standard Uncertainty Uc	Expanded Uncertainty U = KUc (K = 2)
Conducted RF power	± 0.29 dB	± 0.58 dB
Radiated disturbance	30 ㎒ ~ 300 ㎒ : + 2.43 dB, - 2.44 dB 300 ㎒~1 000 ㎒ : + 2.49dB, - 2.50 dB 1 ㎓ ~ 6 ㎓ : + 3.10 dB, - 3.10 dB 6 ㎓ ~ 18 ㎓ : + 3.21 dB, - 3.27 dB	30 ㎒ ~ 300 ㎒ : + 4.86 dB, - 4.88 dB 300 ㎒ ~ 1 000 ㎒ + 4.98dB, - 4.99 dB 1 ㎓ ~ 6 ㎓ : + 6.19 dB, - 6.20 dB 6 ㎓ ~ 18 ㎓ : + 6.41 dB, - 6.53 dB

5. Test results

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

- Complied

The transmitter has an monopole type of antenna. The directional peak gain of the antenna is 3.08 dBi.

5.2 Maximum Peak Output Power

5.2.1 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.

5.2.2 Measurement Procedure

These test measurement settings are specified in section 9.0 of 558074 D01 DTS Meas Guidance.

5.2.2.1 Integrated band power method

This procedure may be used when the maximum available RBW of the measurement instrument is less than the DTS bandwidth.

a) Set the RBW = 1 MHz.
b) Set the VBW ≥ 3 x RBW
c) Set the span ≥ 1.5 x DTS bandwidth.
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select peak detector). If the instrument does not have a band power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS bandwidth.

5.2.3 Test Result

- Complied

*** 802.11b**

Channel	Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
Low	2412	16.73	30.00	13.27
Middle	2437	16.59	30.00	13.41
High	2462	15.95	30.00	14.05

*** 802.11g**

Channel	Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
Low	2412	18.50	30.00	11.50
Middle	2437	18.56	30.00	11.44
High	2462	18.36	30.00	11.64

*** 802.11n HT20**

Channel	Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
Low	2412	18.34	30.00	11.66
Middle	2437	18.45	30.00	11.55
High	2462	18.08	30.00	11.92

-NOTE:

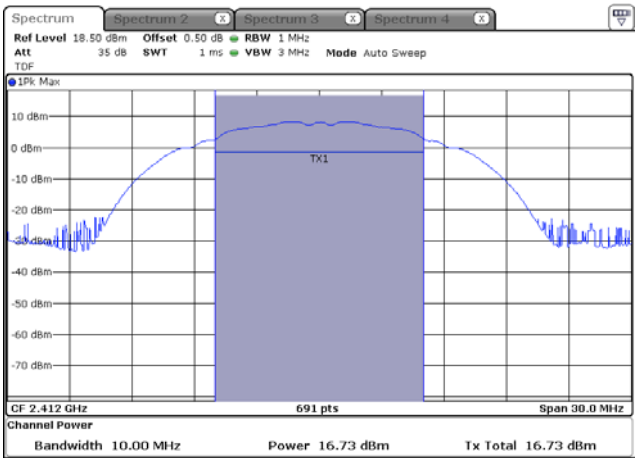
1. Since the directional gain of the integral antenna declared by the manufacturer (G_{ANT} = 3.08 dBi), does not exceed 6.0 dBi, there was no need to reduce the output power.
2. We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.2.4 Test Plot

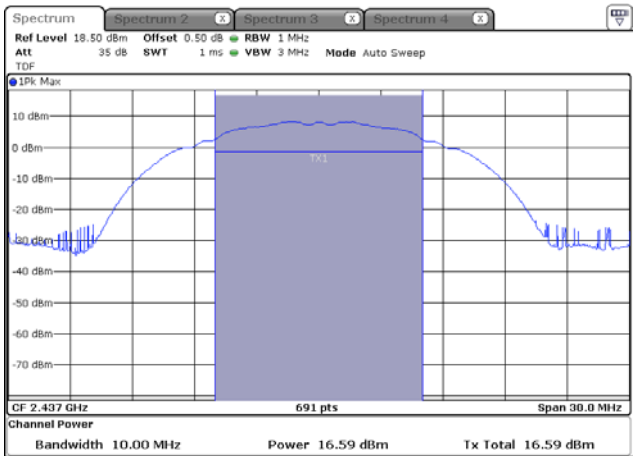
Figure 1. Plot of the Maximum Peak Output Power (Conducted)

*** 802.11b**

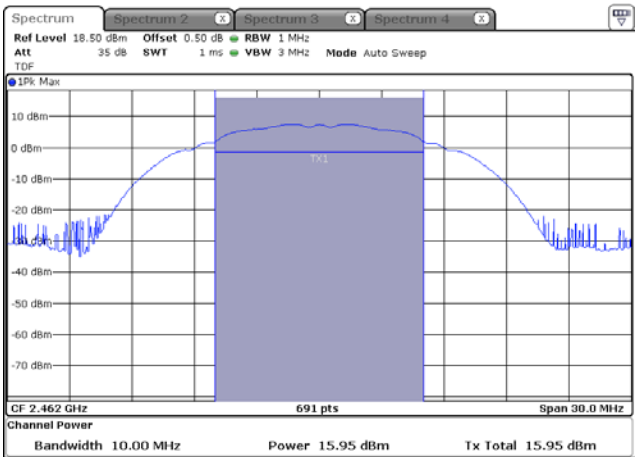
Lowest Channel
(2 412 MHz)



Middle Channel
(2 437 MHz)

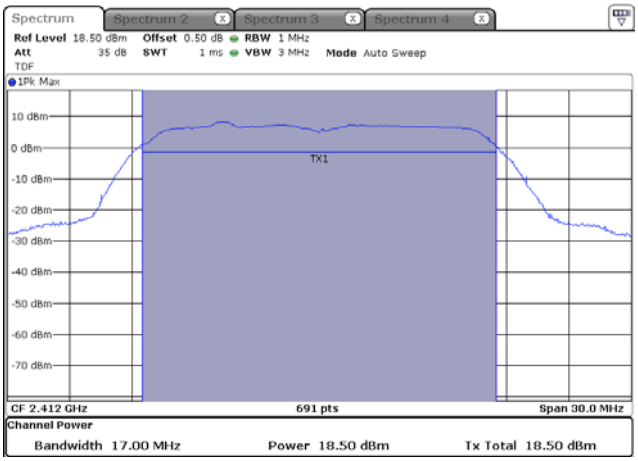


Highest Channel
(2 462 MHz)

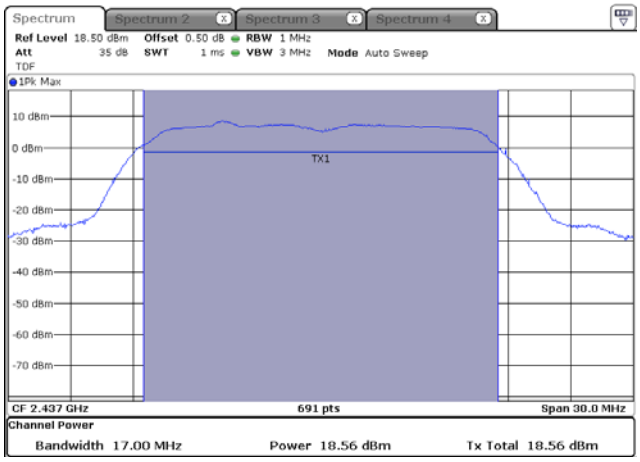


***802.11g**

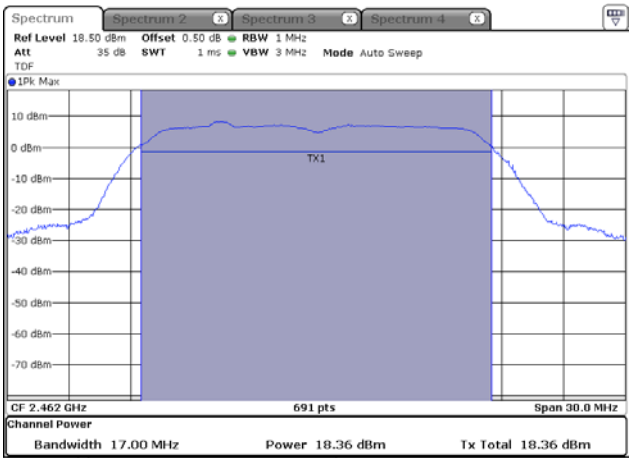
Lowest Channel
(2 412 MHz)



Middle Channel
(2 437 MHz)

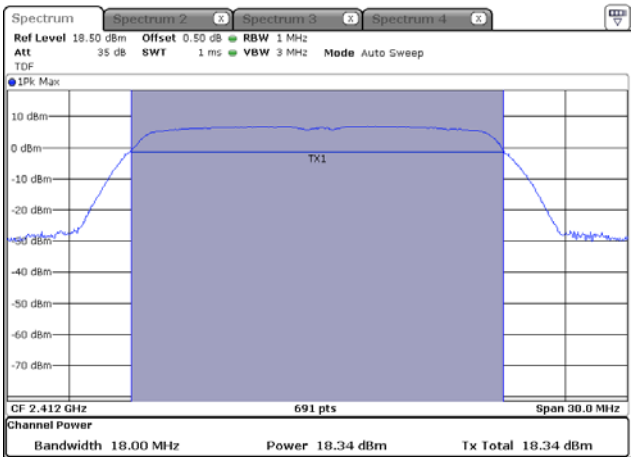


Highest Channel
(2 462 MHz)

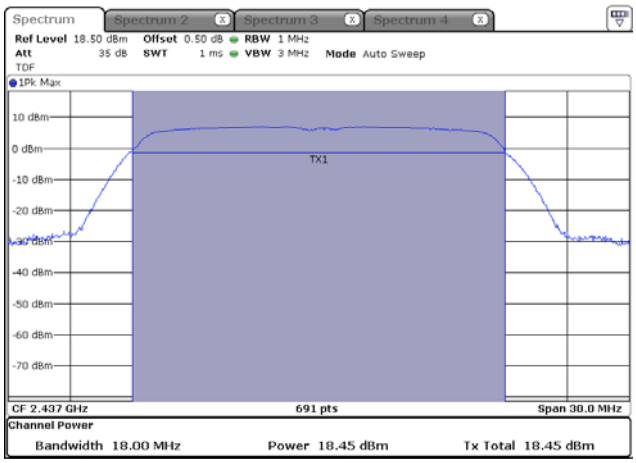


*** 802.11n HT20**

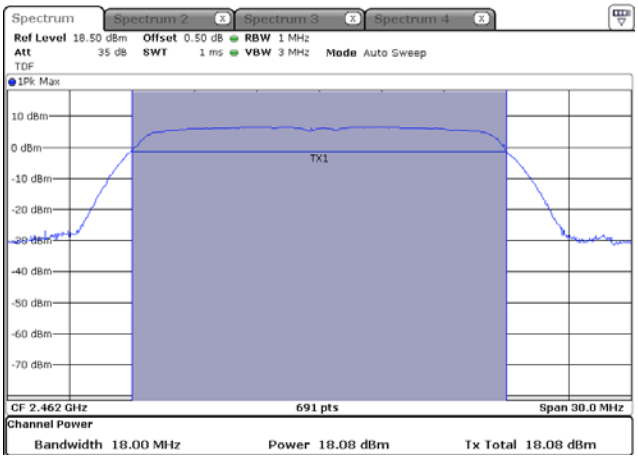
Lowest Channel
(2 412 MHz)



Middle Channel
(2 437 MHz)



Highest Channel
(2 462 MHz)



5.3 Peak Power Spectral Density

5.3.1 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.

5.3.2 Measurement Procedure

These test measurement settings are specified in section 10.0 of 558074 D01 DTS Meas Guidance.

5.3.2.1 Method PKPSD (peak PSD)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

1) Set analyzer center frequency to DTS channel center frequency.

2) Set the span to 1.5 times the DTS bandwidth.

3) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.

4) Set the VBW ≥ 3 x RBW.

5) Detector = peak.

6) Sweep time = auto couple.

7) Trace mode = max hold.

8) Allow trace to fully stabilize.

9) Use the peak marker function to determine the maximum amplitude level within the RBW.

10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3.3 Test Result

- Complied

*** 802.11b**

Channel	Result [dBm]	Limit [dBm]	Margin [dBm]
Low	5.32	8.00	2.68
Middle	5.58	8.00	2.42
High	5.38	8.00	2.62

*** 802.11g**

Channel	Result [dBm]	Limit [dBm]	Margin [dBm]
Low	-0.12	8.00	8.12
Middle	-0.20	8.00	8.20
High	-0.31	8.00	8.31

*** 802.11n HT20**

Channel	Result [dBm]	Limit [dBm]	Margin [dBm]
Low	-0.22	8.00	8.22
Middle	-0.13	8.00	8.13
High	-0.60	8.00	8.60

-NOTE:

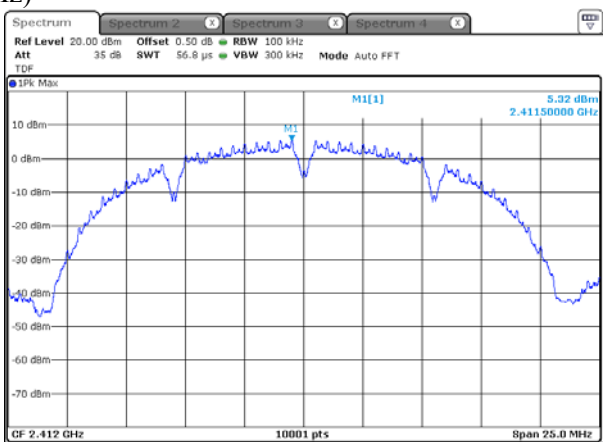
1. Since the directional gain of the integral antenna declared by the manufacturer (G_{ANT} = 3.08 dBi), does not exceed 6.0 dBi, there was no need to reduce the output power.
2. We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.3.4 Test Plot

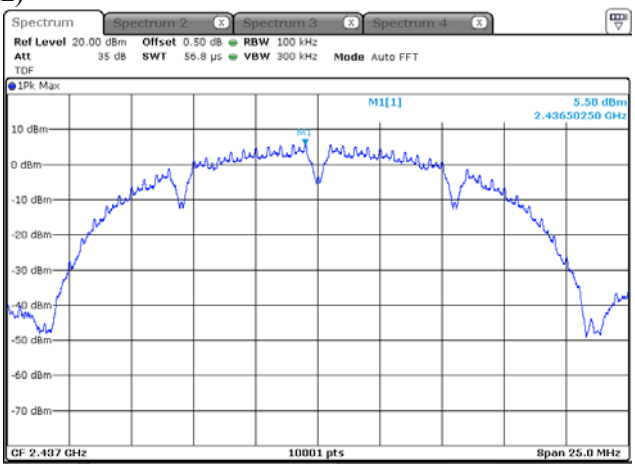
Figure 3. Plot of the Power Density (Conducted)

*** 802.11b**

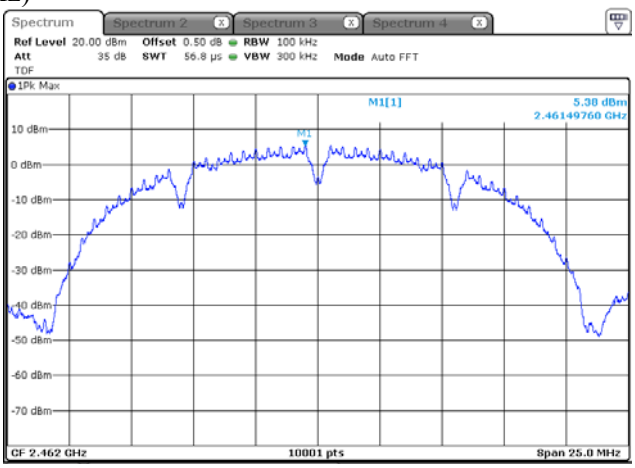
Lowest Channel(2 412 MHz)



Middle Chnnel (2 437 MHz)

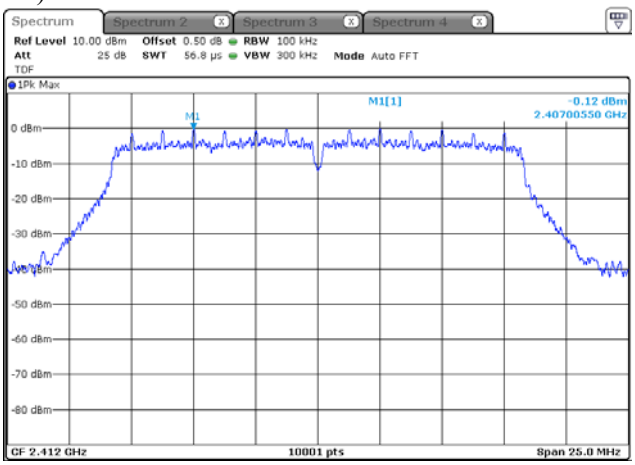


Highest Chnnel (2 462 MHz)

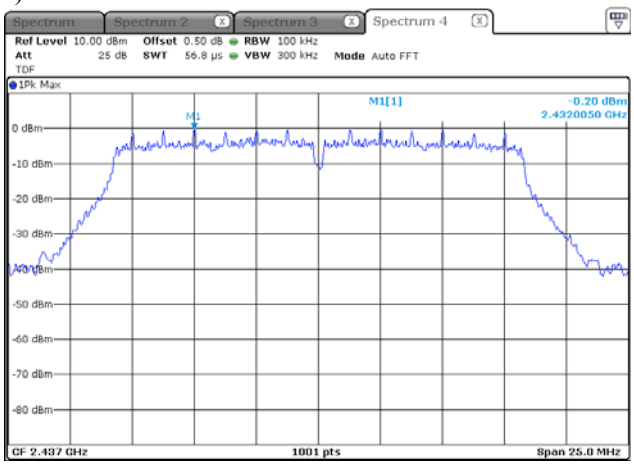


*** 802.11g**

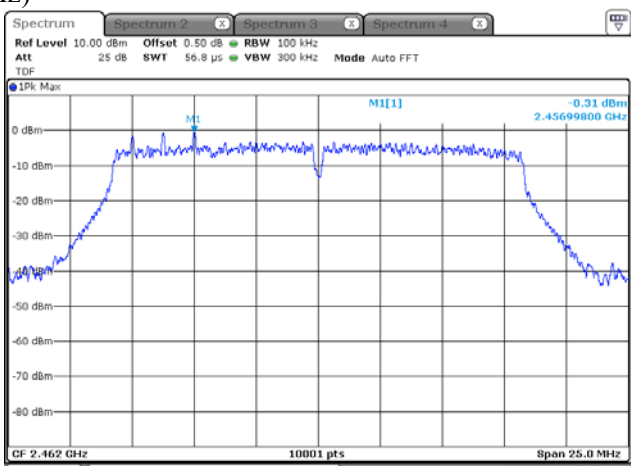
Lowest Channel(2 412 MHz)



Middle Chnnel (2 437 MHz)

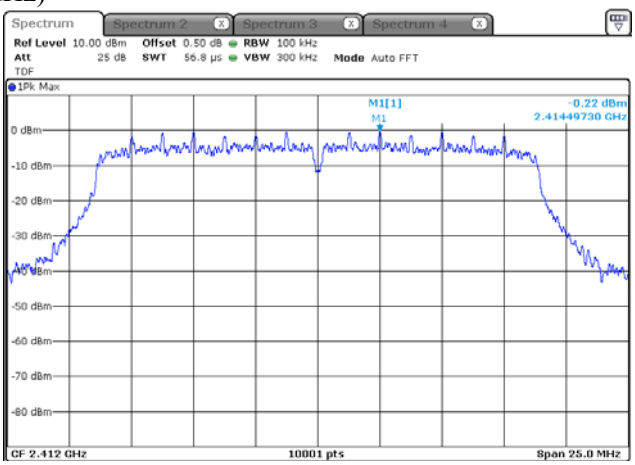


Highest Chnnel (2 462 MHz)

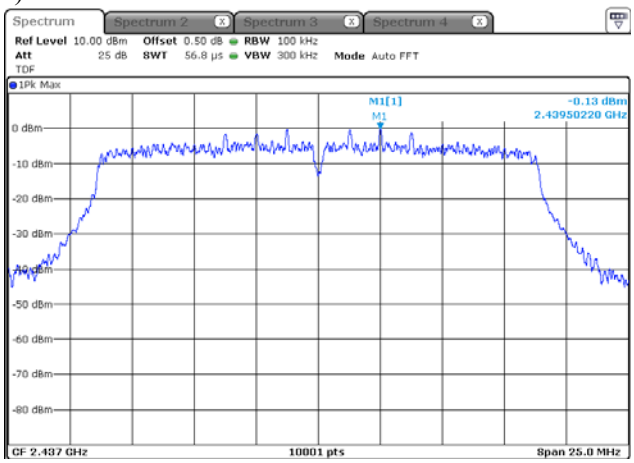


*** 802.11n HT20**

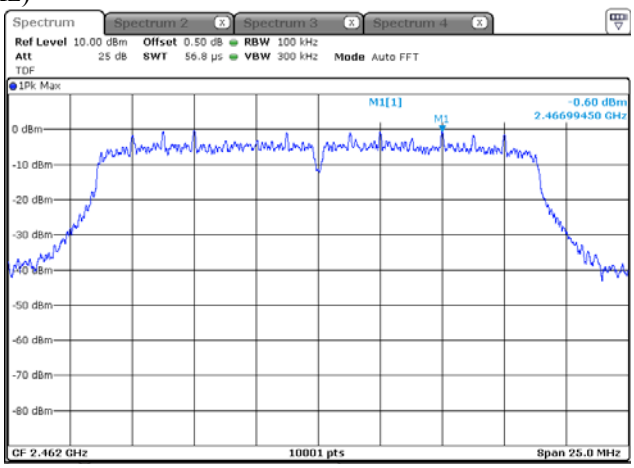
Lowest Channel(2 412 MHz)



Middle Chnnel (2 437 MHz)



Highest Chnnel (2 462 MHz)



5.4 6 dB Bandwidth(DTS Channel Bandwidth)

5.4.1 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 6 dB bandwidth shall be at least 500 kHz.

5.4.2 Measurement Procedure

These test measurement settings are specified in section 8.0 of 558074 D01 DTS Meas Guidance.

5.4.2.1 DTS Channel Bandwidth-Option 1

1) Set RBW = 100 kHz.
2) Set the video bandwidth (VBW) ≥ 3 x RBW.
3) Detector = Peak.
4) Trace mode = max hold.
5) Sweep = auto couple.
6) Allow the trace to stabilize.
7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.4.2.2 DTS Channel Bandwidth Measurement Procedure-Option 2

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 x RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

5.4.3 Test Result

- Complied

*** 802.11b**

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Min. Limit (kHz)	Occupied Bandwidth (99% BW)(MHz)
Low	2 412	10.1	500kHz	15.3
Middle	2 437	10.0	500kHz	15.3
High	2 462	10.1	500kHz	15.3

*** 802.11g**

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Min. Limit (kHz)	Occupied Bandwidth (99% BW)(MHz)
Low	2 412	16.4	500kHz	16.8
Middle	2 437	16.3	500kHz	16.8
High	2 462	16.4	500kHz	16.7

*** 802.11n HT20**

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Min. Limit (kHz)	Occupied Bandwidth (99% BW)(MHz)
Low	2 412	17.4	500kHz	17.6
Middle	2 437	17.0	500kHz	17.7
High	2 462	16.9	500kHz	17.6

-NOTE:

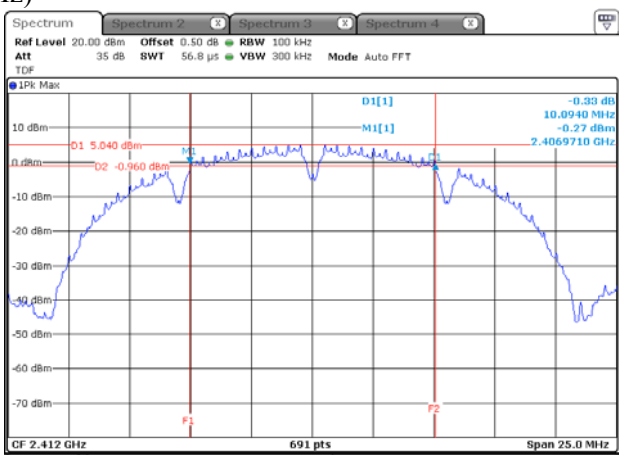
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.4.4 Test Plot

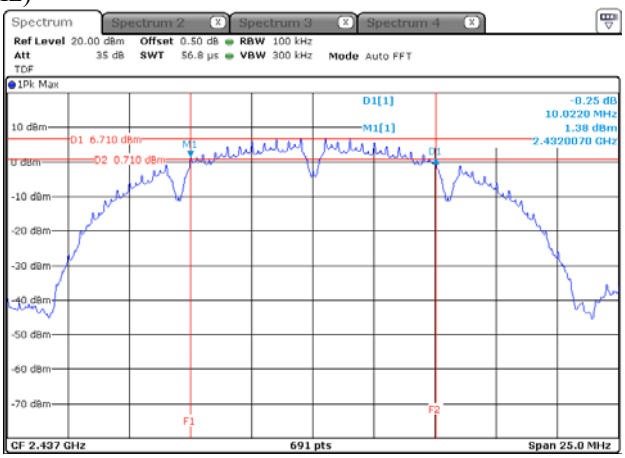
Figure 4. Plot of the 6dB Bandwidth & Occupied Bandwidth (Conducted)

*** 802.11b (6dB Bandwidth)**

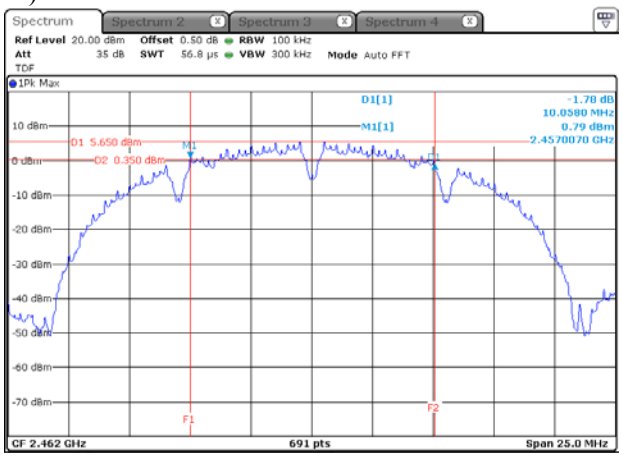
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

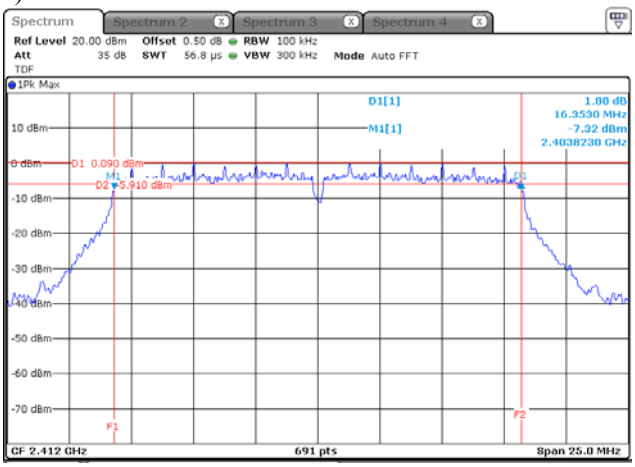


Highest Channel (2 462 MHz)

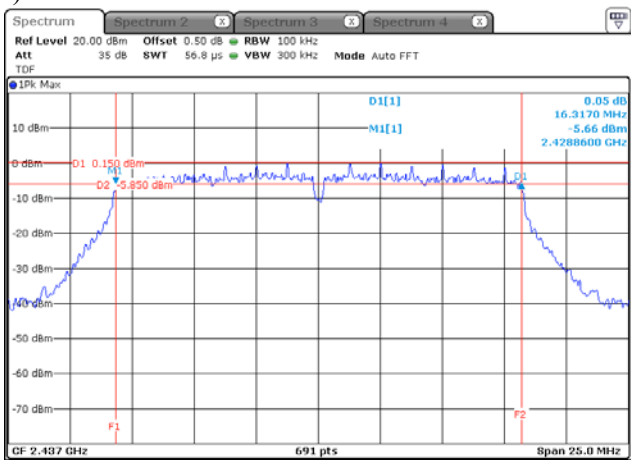


*** 802.11g (6dB Bandwidth)**

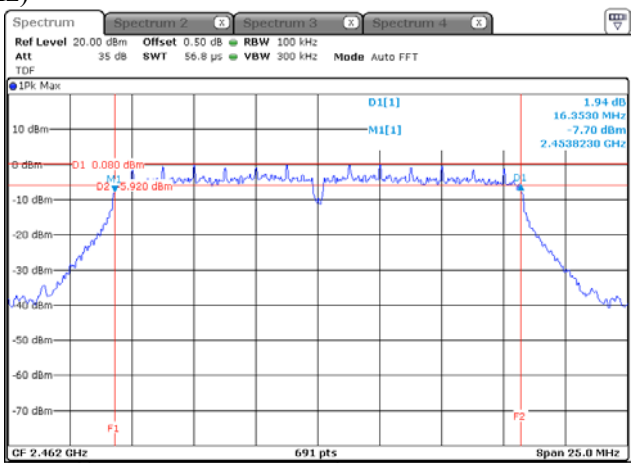
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

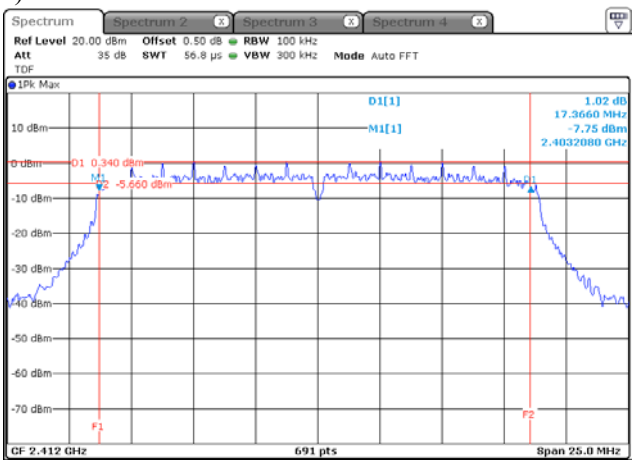


Highest Channel (2 462 MHz)

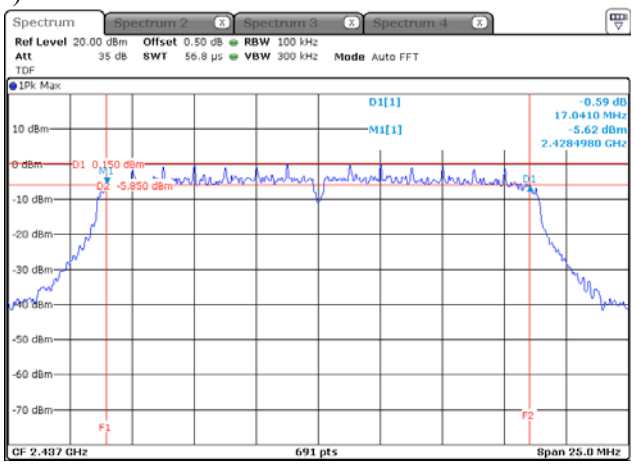


*** 802.11n HT20 (6dB Bandwidth)**

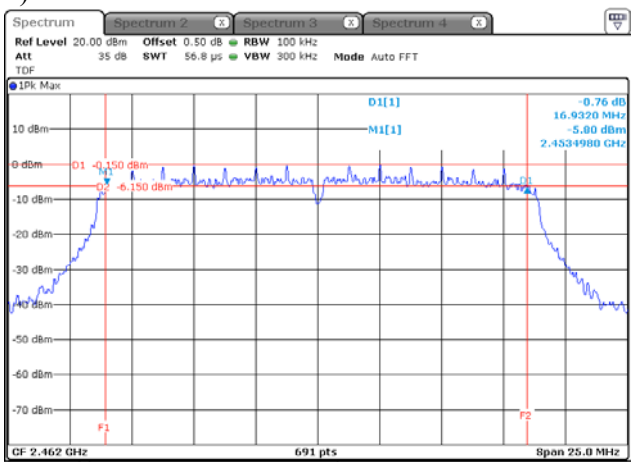
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

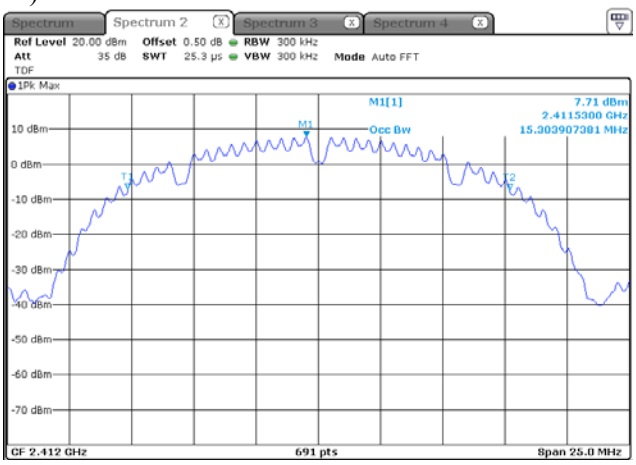


Highest Channel (2 462 MHz)

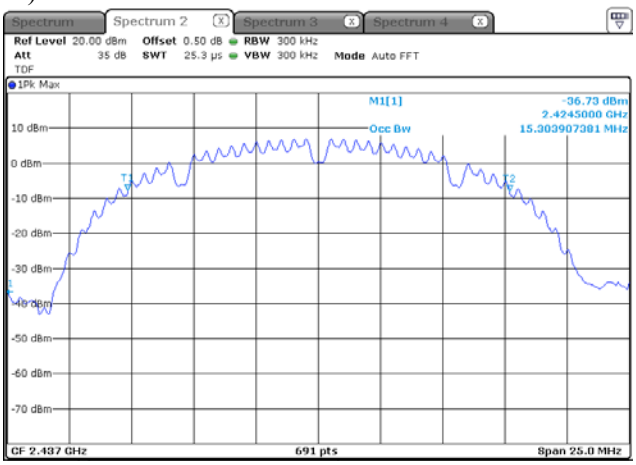


*** 802.11b (Occupied Bandwidth)**

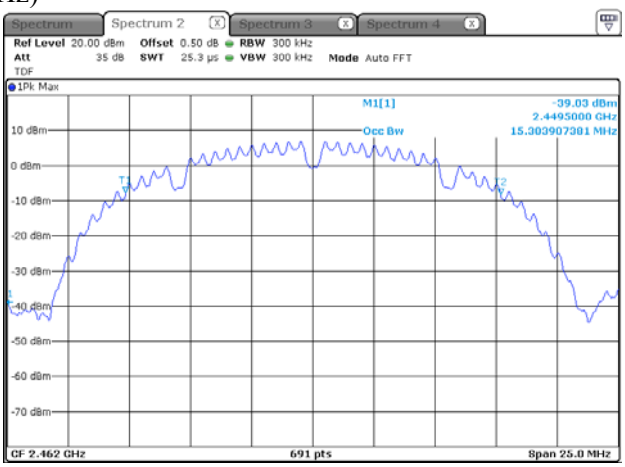
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

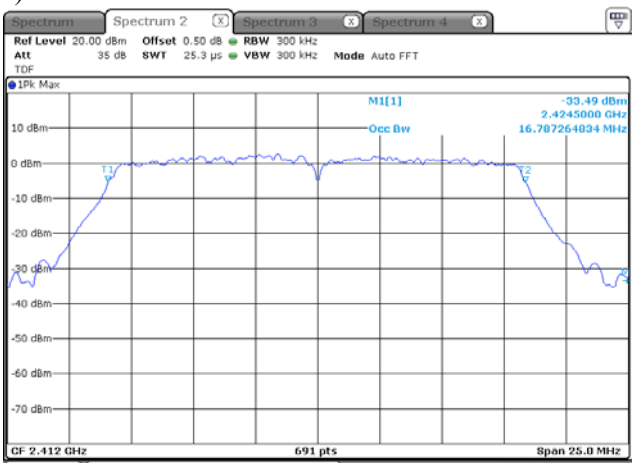


Highest Channel (2 462 MHz)

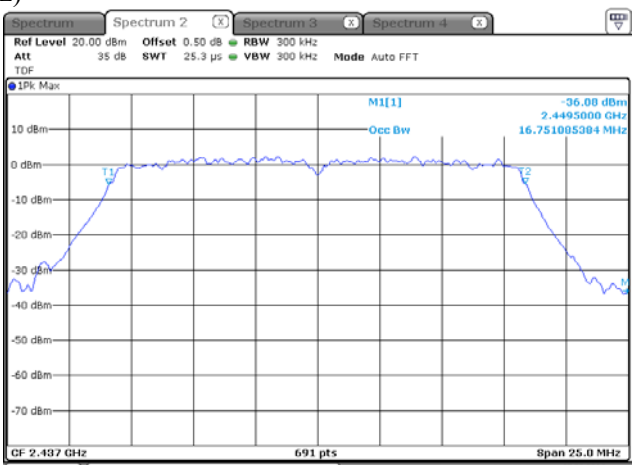


*** 802.11g (Occupied Bandwidth)**

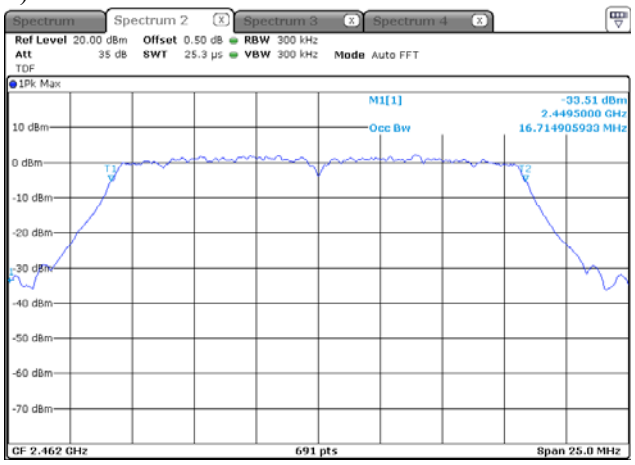
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

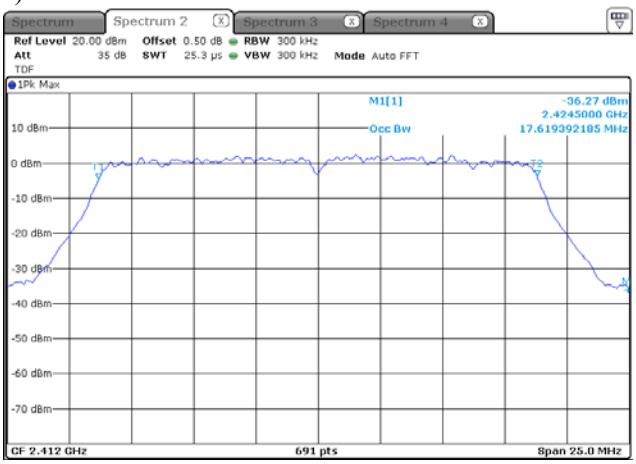


Highest Channel (2 462 MHz)

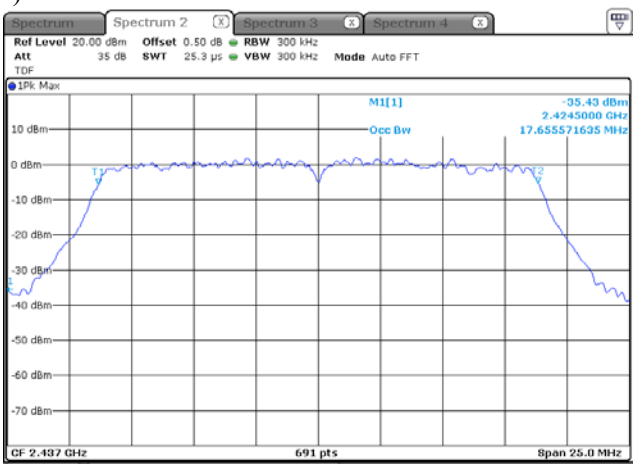


*** 802.11n HT20 (Occupied Bandwidth)**

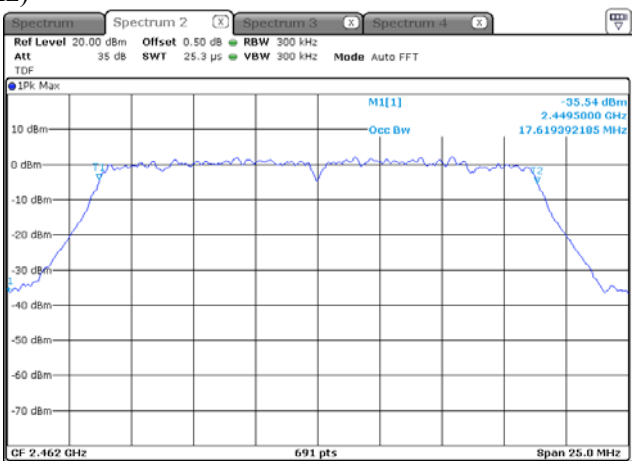
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)



Highest Channel (2 462 MHz)



5.5 Spurious Emission, Band Edge, and Restricted bands

5.5.1 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), Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall notexceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (μV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permItted under other sections of this part, e.g., §§15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	Above 38.6
13.36 - 13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

5.5.2 Measurement Procedure

5.5.2.1 Band-edge Compliance of RF Conducted Emissions

5.5.2.1.1 Reference Level Measurement

Establish a reference level by using the following procedure:

1) Set instrument center frequency to DTS channel center frequency.
2) Set the span to ≥ 1.5 times the DTS bandwidth.
3) Set the RBW = 100 kHz.
4) Set the VBW ≥ 3 x RBW.
5) Detector = peak.
6) Sweep time = auto couple.
7) Trace mode = max hold.
8) Allow trace to fully stabilize.
9) Use the peak marker function to determine the maximum PSD level.

5.5.2.1.2 Emissions Level Measurement

1) Set the center frequency and span to encompass frequency range to be measured.
2) Set the RBW = 100 kHz.
3) Set the VBW ≥ 3 x RBW.
4) Detector = peak.
5) Ensure that the number of measurement points ≥ span/RBW
6) Sweep time = auto couple.
7) Trace mode = max hold.
8) Allow trace to fully stabilize.
9) Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

5.5.2.2 Conducted Spurious Emissions

Set the spectrum analyzer as follows:

1) 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.
2) RBW = 100 kHz
3) VBW ≥ RBW
4) Sweep = auto
5) Detector function = peak
6) Trace = max hold
7) Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
8) 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.

5.5.2.3 Radiated Spurious Emissions

1) The preliminary and final rdiated measurements were performed to determine the frequency producing the maximum emissions in at a 10m anechoic chamber. The EUT was tested at a distance 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 9 kHz to 30 MHz using the loop antenna, and from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1 000 MHz to 26 500 MHz using the horn antenna.
4) 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.

- Sample calculation

The field strength is calculated adding the antenna Factor, cable loss and, Antenna pad adding, subtracting the amplifier gain from the measured reading.

** The sample calculation is as follow:

Result = M.R + C.F(A.F + C.L +3 dB Att – A.G)
M.R = Meter Reading
C.F = Correction Factor
A.F = Antenna Factor
C.L = Cable Loss
A.G = Amplifier Gain
3 dB Att = 3 dB Attenuator

5.5.3 Test Result

- Complied

1. Conducted Spurious Emissions was shown in figure 5.
   Note: We took the insertion loss of the cable into consideration within the measuring instrument.
2. Band edge compliance of Radiated Emissions(Restricted Bands) was shown in figure 6.
3. Measured value of the Field strength of spurious Emissions (Radiated)

*** Below 1 GHz data (worst-case: 802.11b)**

Middle channel (2 437 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 MHz (3m Distance)							
Below 30.00	Not Detected	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1 GHz							
131.00	120	V	34.3	-18.5	15.8	43.5	27.7
Above 200.00	Not Detected	-	-	-	-	-	-

*** Above 1 GHz data**

802.11b_Low channel (2 412 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 337.75	1 000	V	56.3	-0.5	55.8	74.0	18.2
2 496.00	1 000	V	55.6	-1.1	54.5	74.0	19.5
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 337.75	1 000	V	30.2	-0.5	29.7	54.0	24.3
2 496.00	1 000	V	30.2	-1.1	29.1	54.0	24.9
Above 3 000.00	Not Detected	-	-	-	-	-	-

802.11b_ Middle channel (2 437 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 334.00	1 000	V	61.1	-8.6	52.5	74.0	21.5
2 513.25	1 000	V	61.6	-8.5	53.1	74.0	20.9
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 334.00	1 000	V	48.9	-8.6	40.3	54.0	13.7
2 513.25	1 000	V	50.1	-8.5	41.6	54.0	12.4
Above 3 000.00	Not Detected	-	-	-	-	-	-

802.11b_High channel (2 462 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 333.50	1 000	V	61.3	-0.5	60.8	74.0	13.2
2 521.00	1 000	V	59.7	-1.1	58.6	74.0	15.4
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 333.50	1 000	V	38.9	-0.5	38.4	54.0	15.6
2 521.00	1 000	V	37.3	-1.1	36.2	54.0	17.8
Above 3 000.00	Not Detected	-	-	-	-	-	-

802.11g_Low channel (2 412 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 341.50	1 000	V	59.9	-0.5	59.4	74.0	14.6
2 490.75	1 000	V	58.9	-1.0	57.9	74.0	16.1
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 341.50	1 000	V	41.2	-0.5	40.7	54.0	13.3
2 490.75	1 000	V	40.1	-1.0	39.1	54.0	14.9
Above 3 000.00	Not Detected	-	-	-	-	-	-

802.11g_ Middle channel (2 437 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 346.00	1 000	V	61.9	-0.5	61.4	74.0	12.6
2 512.50	1 000	V	60.7	-1.1	59.6	74.0	14.4
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 346.00	1 000	V	43.0	-0.5	42.5	54.0	11.5
2 512.50	1 000	V	42.5	-1.1	41.4	54.0	12.6
Above 3 000.00	Not Detected	-	-	-	-	-	-

802.11g_High channel (2 462 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 330.00	1 000	V	61.7	-0.5	61.2	74.0	12.8
2 535.00	1 000	V	58.5	-1.2	57.3	74.0	16.7
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 330.00	1 000	V	45.2	-0.5	44.7	54.0	9.3
2 535.00	1 000	V	40.0	-1.2	38.8	54.0	15.2
Above 3 000.00	Not Detected	-	-	-	-	-	-

802.11n HT20_Low channel (2 412 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 338.00	1 000	V	60.8	-8.6	52.2	74.0	21.8
2 512.25	1 000	V	59.5	-8.5	51.0	74.0	23.0
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 338.00	1 000	V	46.9	-8.6	38.3	54.0	15.7
2 512.25	1 000	V	47.2	-8.5	38.7	54.0	15.3
Above 3 000.00	Not Detected	-	-	-	-	-	-

802.11n HT20_ Middle channel (2 437MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 352.25	1 000	V	61.8	-8.6	53.2	74.0	20.8
2 515.00	1 000	V	60.7	-8.5	52.2	74.0	21.8
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 352.25	1 000	V	48.0	-8.6	39.4	54.0	14.6
2 515.00	1 000	V	47.4	-8.5	38.9	54.0	15.1
Above 3 000.00	Not Detected	-	-	-	-	-	-

802.11n HT20_ High channel (2 462 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Peak DATA. Emissions above 1 GHz							
2 347.00	1 000	V	62.1	-8.6	53.5	74.0	20.5
2 494.25	1 000	V	60.7	-8.5	52.2	74.0	21.8
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 GHz							
2 347.00	1 000	V	47.4	-8.6	38.8	54.0	15.2
2 494.25	1 000	V	47.8	-8.5	39.3	54.0	14.7
Above 3 000.00	Not Detected	-	-	-	-	-	-

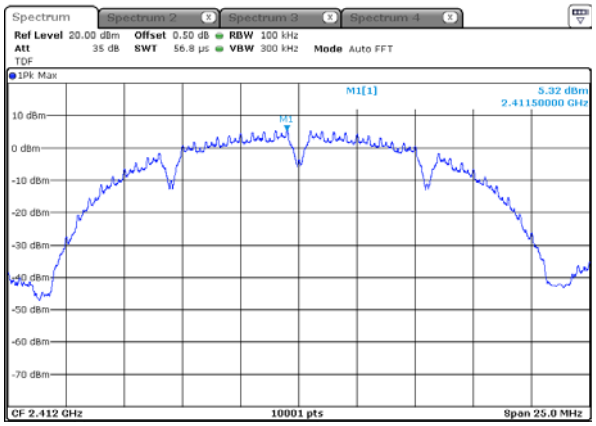
5.5.4 Test Plot

Figure 5. Plot of the Band-edge & Conducted Spurious Emissions

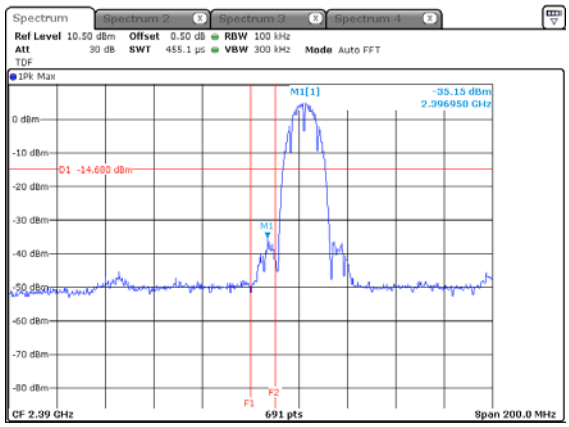
*** 802.11b**

Lowest Channel (2 412 MHz)

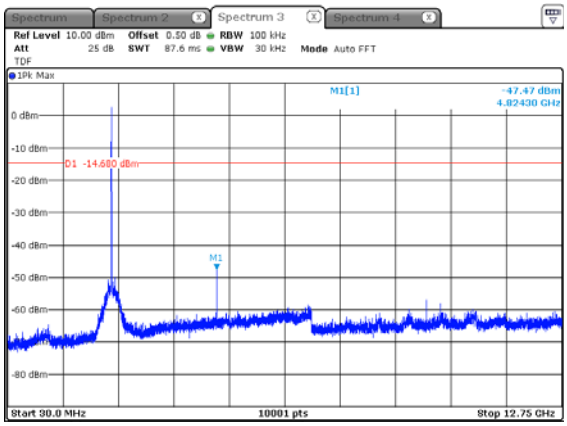
Reference



Band-edge

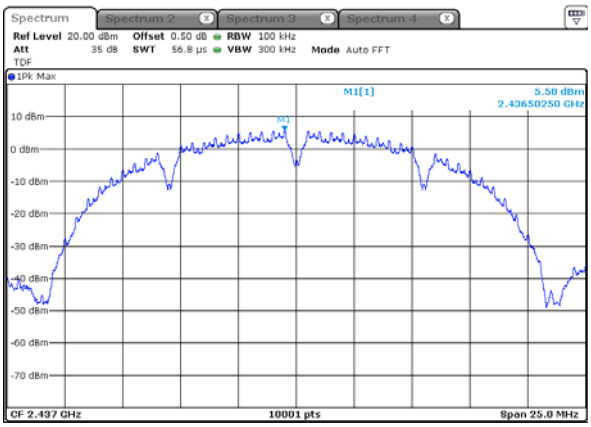


Conducted Spurious Emissions

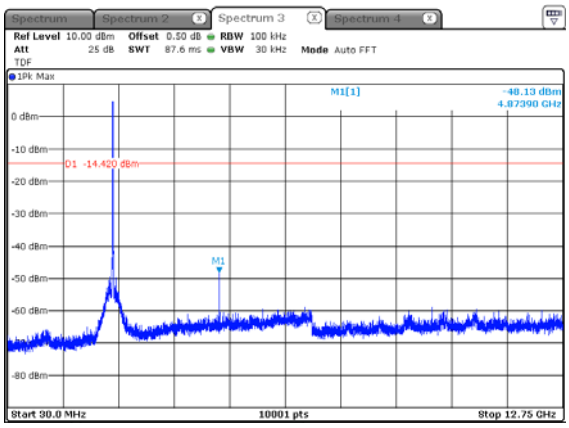


Middle Channel (2 437 MHz)

Reference

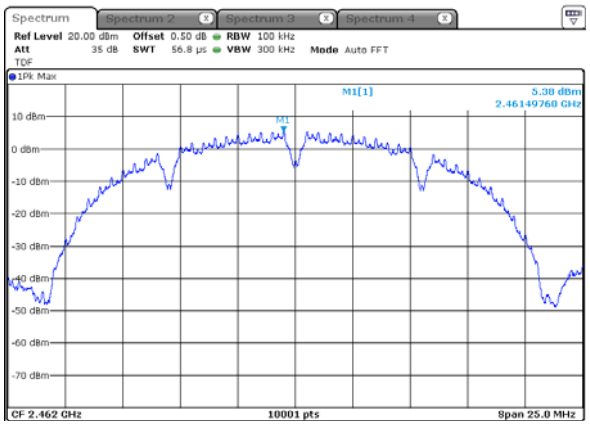


Conducted Spurious Emissions

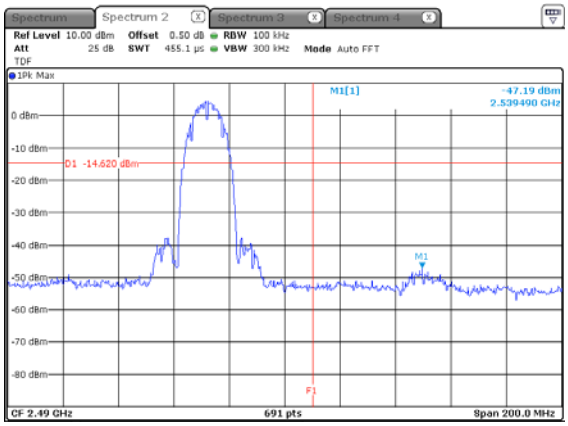


Highest Channel (2 462 MHz)

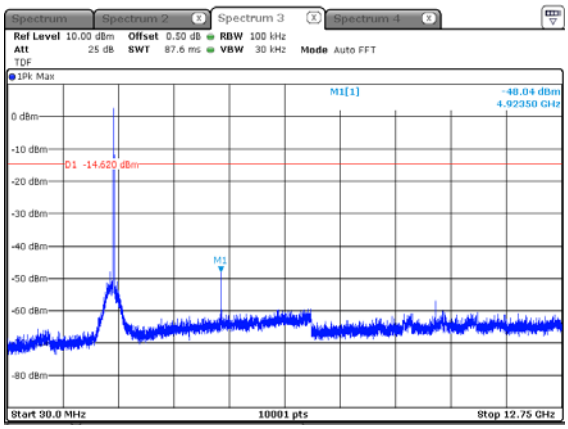
Reference



Band-edge



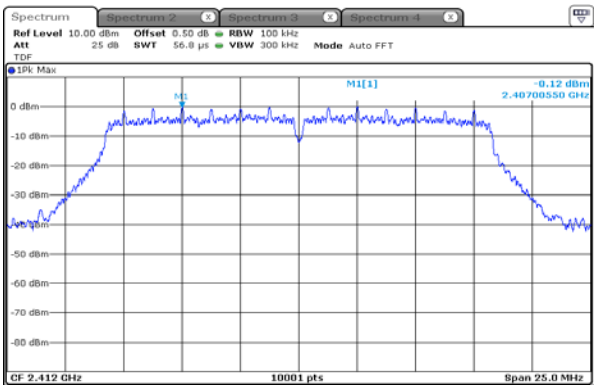
Conducted Spurious Emissions



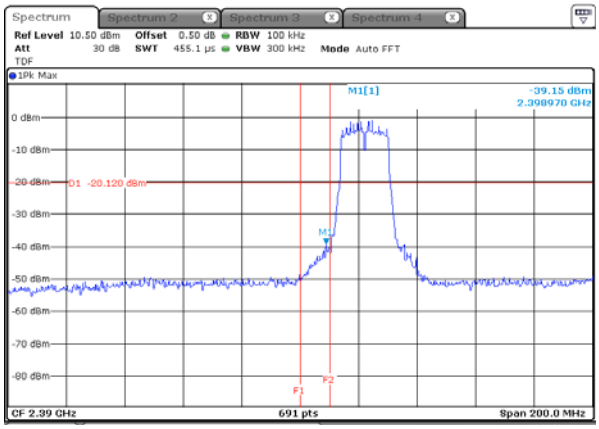
*** 802.11g**

Lowest Channel (2 412 MHz)

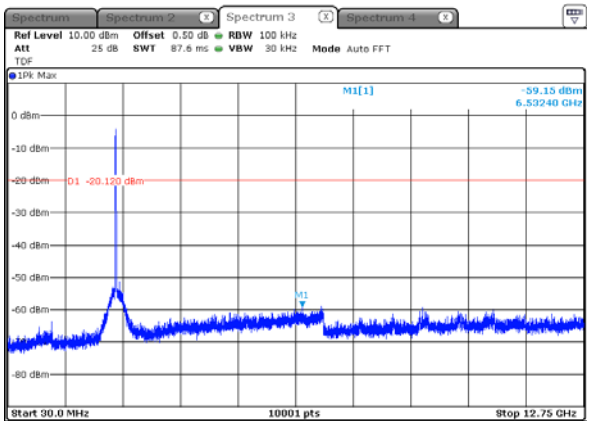
Reference



Band-edge

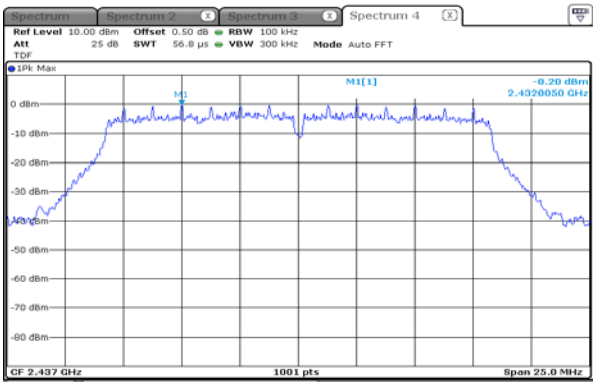


Conducted Spurious Emissions

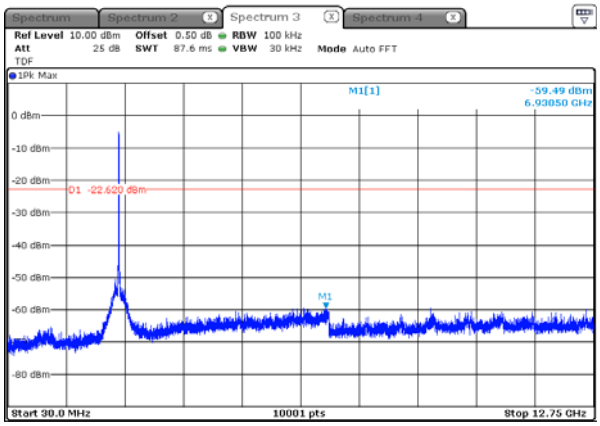


Middle Channel (2 437 MHz)

Reference

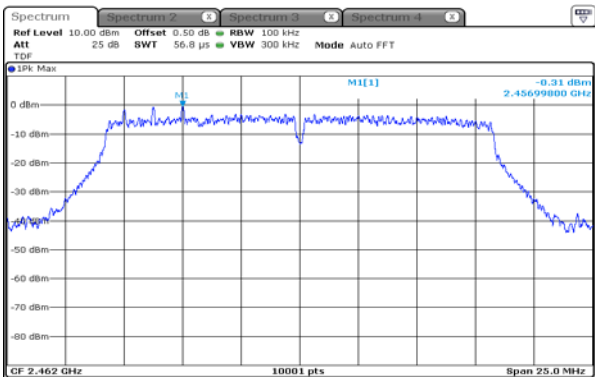


Conducted Spurious Emissions

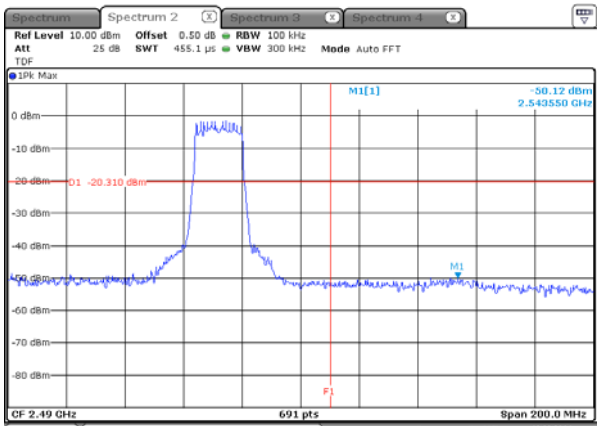


Highest Channel (2 462 MHz)

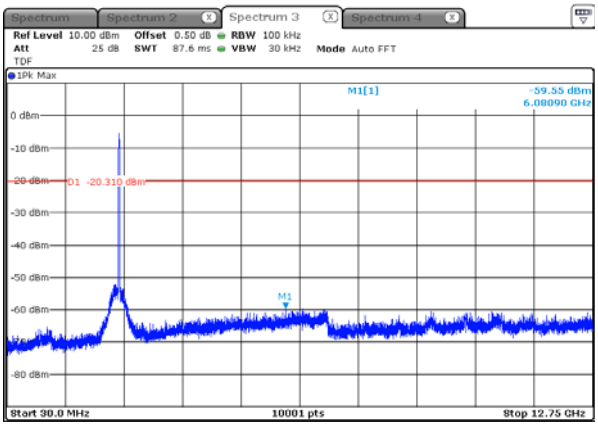
Reference



Band-edge



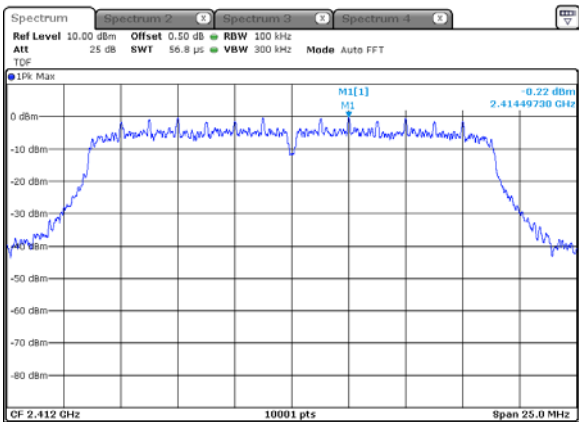
Conducted Spurious Emissions



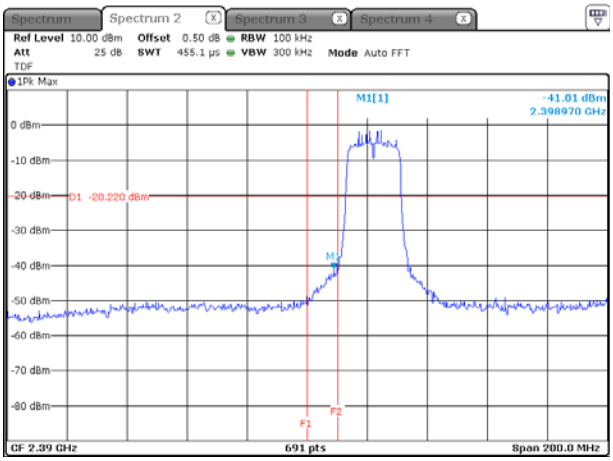
*** 802.11n HT20**

Lowest Channel (2 412 MHz)

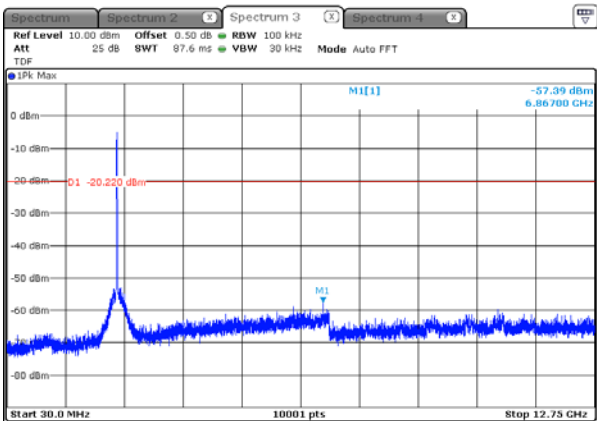
Reference



Band-edge

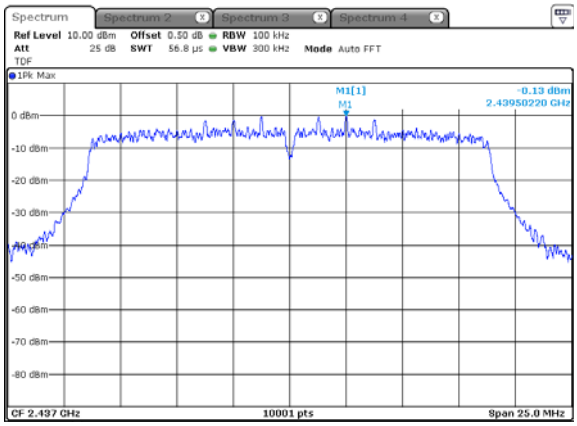


Conducted Spurious Emissions

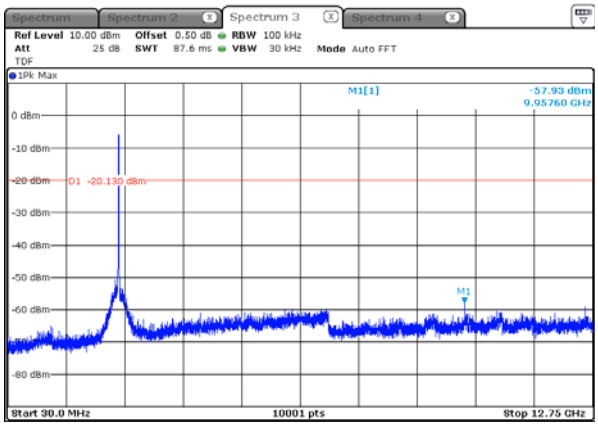


Middle Channel (2 437 MHz)

Reference

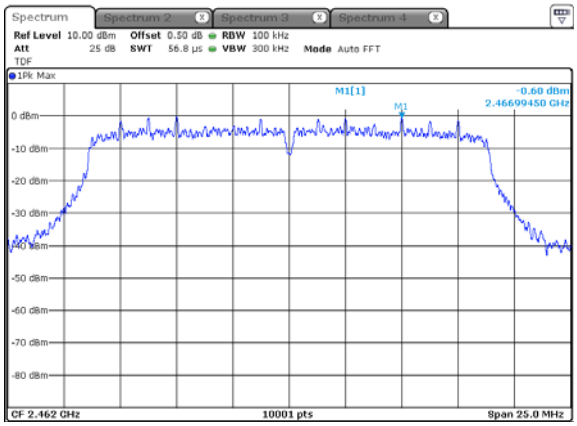


Conducted Spurious Emissions

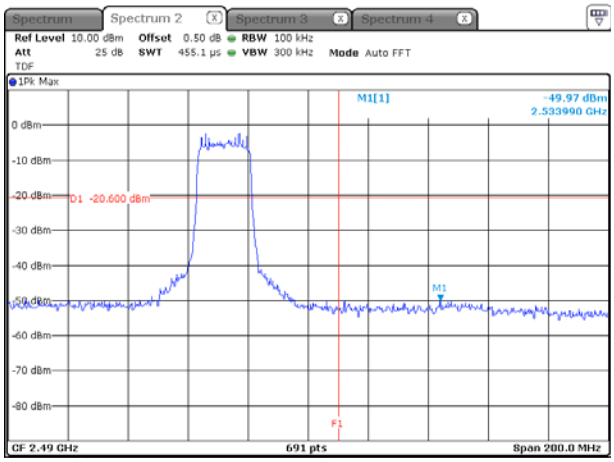


Highest Channel (2 462 MHz)

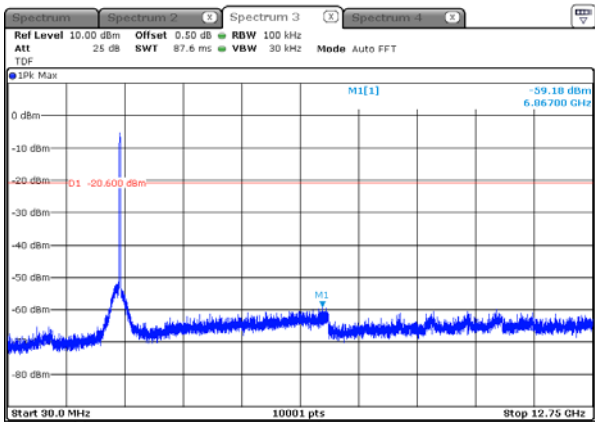
Reference



Band-edge



Conducted Spurious Emissions

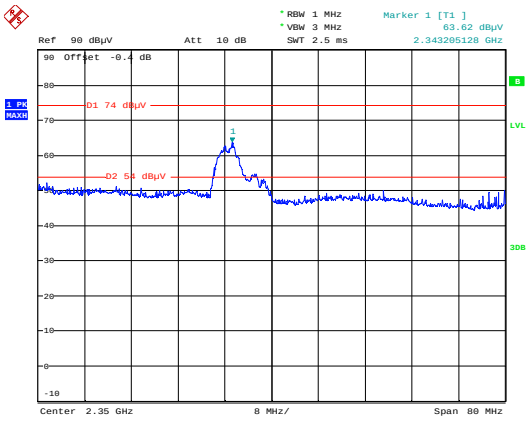


5.5.4 Test Plot (Continue)

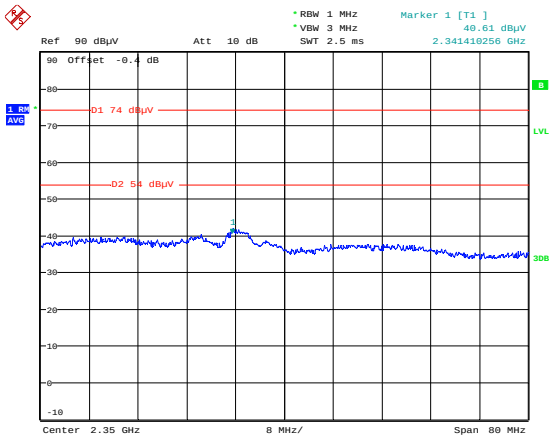
Figure 6. Plot of the Band Edge (Radiated Restricted Bands)

*** 802.11b**

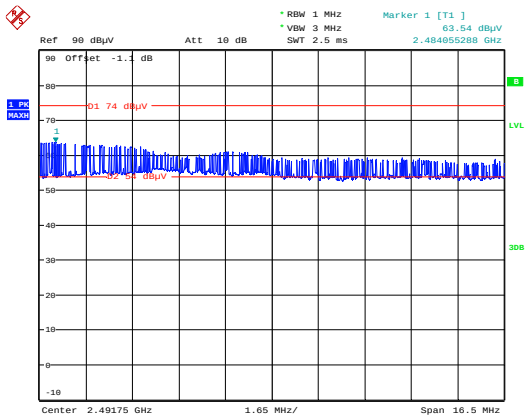
Lowest Channel(2 412 MHz): Peak



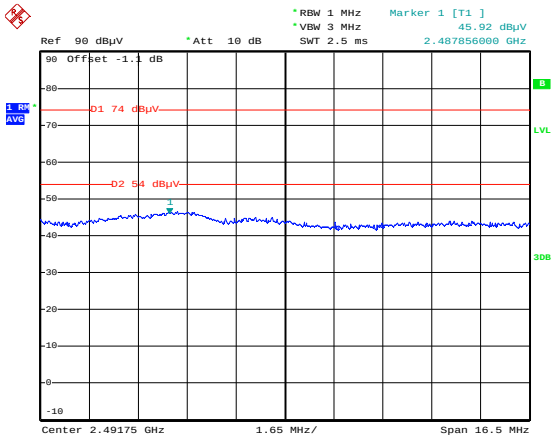
Lowest Channel(2 412 MHz): Average



Highest Channel(2 462 MHz): Peak



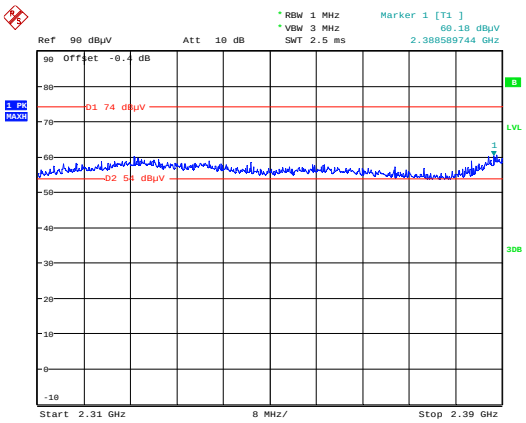
Highest Channel(2 462 MHz): Average



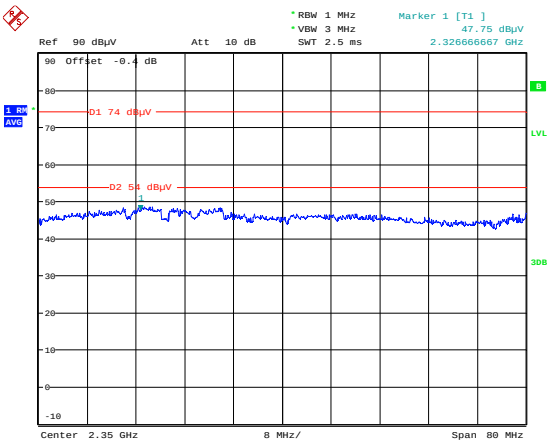
*** offset = Factor (ANT Factor+ Amp Gain + Cable Loss) [dB]**
= -0.4 dB (2 412 MHz)
= -1.1 dB (2 462 MHz)

*** 802.11g**

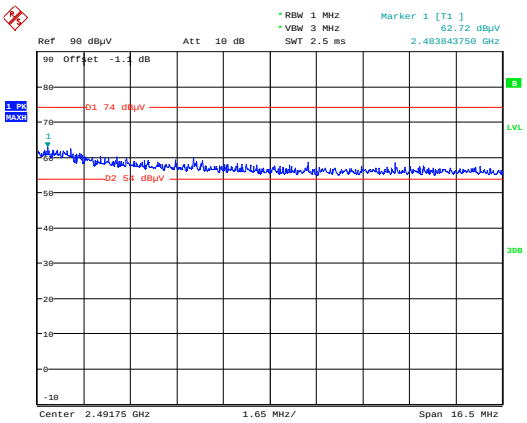
Lowest Channel(2 412 MHz): Peak



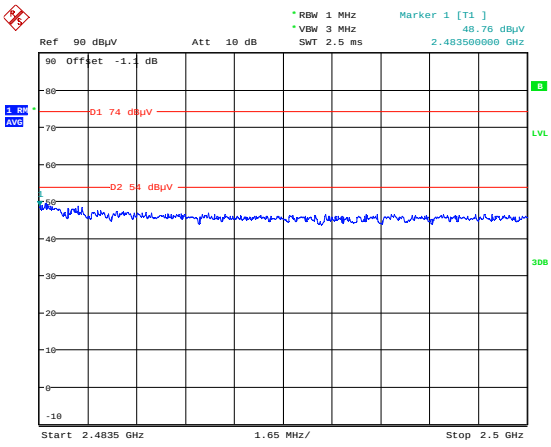
Lowest Channel(2 412 MHz): Average



Highest Channel(2 462 MHz): Peak



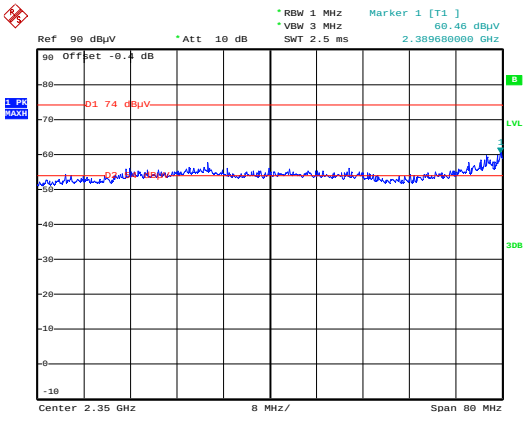
Highest Channel(2 462 MHz): Average



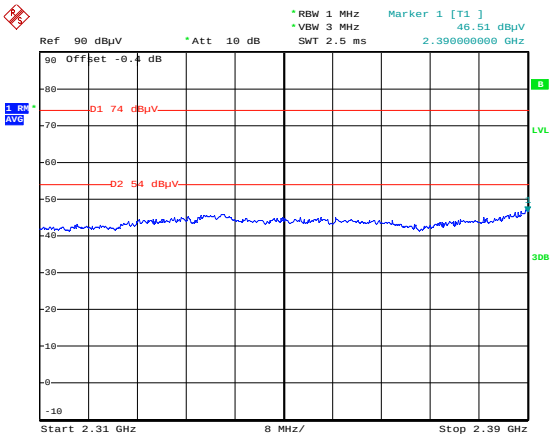
*** offset = Factor (ANT Factor+ Amp Gain + Cable Loss) [dB]**
= -0.4 dB (2 412 MHz)
= -1.1 dB (2 462 MHz)

*** 802.11n HT20**

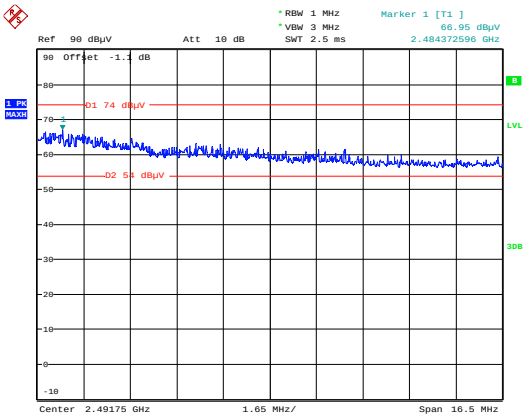
Lowest Channel(2 412 MHz): Peak



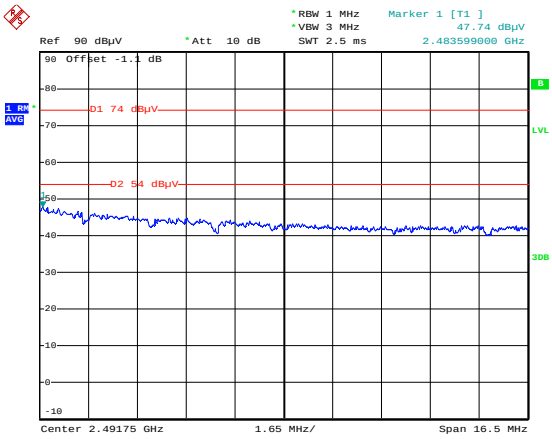
Lowest Channel(2 412 MHz): Average



Highest Channel(2 462 MHz): Peak



Highest Channel(2 462 MHz): Average



*** offset = Factor (ANT Factor+ Amp Gain + Cable Loss) [dB]**
= -0.4 dB (2 412 MHz)
= -1.1 dB (2 462 MHz)

5.6 RF Exposure

5.6.1 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 Permissive 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 ~ 1 500	/	/	f/1 500	30
1 500 ~ 15 000	/	/	1.0	30

*f=frequency in MHz, *= plane-wave equivalent power density*

MPE (Maximum Permissive Exposure) Prediction

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

$S = PG/4\pi R^2 \quad \left(\Rightarrow R = \sqrt{PG/4\pi S}\right)$

S = power density [mW/cm^2]
P = Power input to antenna [mW]
G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna [cm]

EUT: Maximum peak output power = 71.78 [mW] (18.56 dBm) Antenna gain = 2.03 (3.08 [dBi])	
100 mW, at 20 cm from an antenna 6 [dBi]	S = PG/4πR² = 100 × 3.98 / (4 × π × 400) = 0.079 18 [mW/cm^2] < 1.0 [mW/cm^2]
71.78 mW, at 20 cm from an antenna 3.08 [dBi]	S = PG/4πR² = 0.029 02 [mW/cm^2] < 1.0 [mW/cm^2]

5.6.2 RF Exposure Compliance Issue

The information should be included in the user's manual:
This appliance and its antenna must not be co-located or operation in conjunction with any other antenna or transmitter. A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

5.6.3 Calculation Result of RF Exposure

*** 802.11b**

Channel	Frequency [MHz]	Ant Gain [mW]	power [dBm]	power [mW]	Power Density at 20 cm [mW/cm^2]
Lowest	2 412	2.03	16.73	47.10	0.019 04
Middle	2 437	2.03	16.59	45.60	0.018 44
Highest	2 462	2.03	15.95	39.36	0.015 91

*** 802.11g**

Channel	Frequency [MHz]	Ant Gain [mW]	power [dBm]	power [mW]	Power Density at 20 cm [mW/cm^2]
Lowest	2 412	2.03	18.50	70.79	0.028 62
Middle	2 437	2.03	18.56	71.78	0.029 02
Highest	2 462	2.03	18.36	68.55	0.027 72

*** 802.11n HT20**

Channel	Frequency [MHz]	Ant Gain [mW]	power [dBm]	power [mW]	Power Density at 20 cm [mW/cm^2]
Lowest	2 412	2.03	18.34	68.23	0.027 59
Middle	2 437	2.03	18.45	69.98	0.028 30
Highest	2 462	2.03	18.08	64.27	0.025 99

6. Test equipment used for test

	Description	Manufacture	Model No.	Serial No.	Next Cal Date.
■	DC Power Supply	Agilent	E3632A	MY51220373	14.12.24
■	Signal Generator	R&S	SMR40	100007	14.06.11
■	Spectrum Analyzer	R&S	FSP40	100988	15.01.29
■	Loop Antenna	R&S	HFH2-Z2	100355	15.06.19
■	Bi-Log Antenna	Schwarzbeck	VULB9163	552	14.07.18
■	Horn Antenna	ETS-Lindgren	3115	86706	14.08.20
■	Horn Antenna	ETS-Lindgren	3116	86632	15.11.15
■	Amplifier	Sonoma	310N	186280	15.01.27
■	Amplifier	Schwarzbeck	BBV9718	233	14.05.03
■	Amplifier	Schwarzbeck	BBV9721	2	14.05.09
■	Attenuator	HP	8491A	16861	14.07.08
■	Antenna Mast	Innco Systems	MA4000-EP	303	-
■	Turn Table	Innco Systems	DT2000S-1t	79	-