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Project No.: 12CA41629
File No.: MC17075
Report No.: 12CA41629-FCC-1
Date: July 23, 2012
Model No.: SWB-A52H
FCC ID.: E2XSWB-A52H

FCC Test Report

in accordance with
FCC Part 15 Subpart C §15.247

for

WiFi Module

Samsung Electro-Mechanics Co., Ltd.

150 Maeyoungro, Yeongtong-gu, Suwon, Gyeonggi-do, Korea

Summary of Test Results:

The following tests were performed on a sample submitted for evaluation of compliance with FCC Part 15 C Section 15.247

No	Reference Clause No.	FCC Part15 Subpart C Conformance Requirements	Verdict	Remark
1	15.205(a) 15.209(a) 15.247(d)	Transmitter radiated spurious emissions and Conducted spurious emission	Complied	
2	15.247(a)(2)	6 dB Bandwidth	Complied	
3	15.247(b)(3)	Maximum peak output power	Complied	
4	15.247(e)	Power spectral density	Complied	
5	15.207	Transmitter AC power line conducted emission	Complied	

Conclusion:

The tests listed in the Summary of Testing section of this report have been performed and the results recorded by UL Korea Ltd. in accordance with the procedures stated in each test requirement and specification. The test list was determined by the Applicant as being applicable to the Equipment Under Test. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.

Tested by
Kyung Duk Ko, WiSE Project Engineer
UL Verification Services- 3014ASEO
UL Korea Ltd.
July 23, 2012

Tested by
Jeawoon, Choi, WiSE Engineering Leader
UL Verification Services- 3014ASEO
UL Korea Ltd.
July 23, 2012

Test Report Details

Tests Performed By:	UL Korea Ltd. 33rd FL. GFC Center, 737 Yeoksam-dong, Gangnam-gu, Seoul, 135-984, Korea
Test Site:	ESTECH CO., LTD. 97-1, Hoeok-Ri, Majang-Myun, Icheon-City, Kyunggi-Do, 467-811, Korea
Applicant:	Samsung Electro-Mechanics Co., Ltd. 150 Maeyoungro, Yeongtong-gu, Suwon, Gyeonggi-do, Korea
Applicant Contact:	Seung Pil Jung
Title:	Senior Engineer
Phone:	+82-31-210-5748
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E-mail:	seungpil.jung@samsung.com
Product Type:	WiFi Module
Model Number:	SWB-A52H
Trademark	SEMCO
Sample Serial Number:	N/A
Test standards:	FCC Part 15 C Section 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz
Sample Serial Number:	N / A
Sample Receive Date:	2012-07-02
Testing Date:	2012-07-02 ~ 2012-07-20
Overall Results:	**Pass**

UL Korea Ltd. reports apply only to the specific test samples and test results submitted for UL's review. All samples tested were in good operating condition throughout the entire test program. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. UL Korea Ltd. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from UL Korea Ltd. issued reports. This report shall not be used to claim, constitute or imply product certification, approval, or any agency of the National Authorities. This report may contain test results that are not covered by the NVLAP or KOLAS accreditation.

Report Directory

1. General Product Information

1.1. Equipment Description

SWB-A52H is the module that integrates Wireless LAN (WLAN). This embedded module is optimized for WLAN enabled handheld mobile device.

1.2. Details of Test Equipment (EUT)

- Equipment Type : WiFi Module
- Model No. : SWB-A52H
- Trade name : SEMCO
- Type of test Equipment : module type
- Operating characteristic : Short range wireless device operating in the 2400 – 2483.5 ISM frequency band
- Manufacturer : Samsung Electro-Mechanics Co., Ltd.
  Samsung Electro-Mechanics(Thailand), Ltd/93 Moo 5 T.Bangsmak, A.Bangpakong, Chachoengsao 24180, Thailand

1.3. Equipment Configuration

The EUT is consisted of the following component provided by the manufacturer.

Use*	Product Type	Manufacturer	Model	Comments
EUT	Module	Samsung Electrical-Mechanics	SWB-A52H	-
EUT	Antenna	SEMCO	MSA-4008-25GC1-A1-500002	-
Note: Use = EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment. SIM - Simulator (Not Subjected to Test)				

1.4. Technical Data

Item	Type of WiFi module
Frequency Ranges	2400 – 2483.5 MHz 5150 – 5350 MHz, 5470 – 5725 MHz, 5725 – 5850 MHz,
Output power	2.4 G : Max. 22.11 dBm 5 G : Max. 15.58 dBm
Kind of modulation (s)	CCK, OFDM, BPSK, QPSK, 16QAM, 64QAM
Emission Designator	G1D, D2D
Channel	2.4 G : 13 channel(11b/g/n_HT20) 5 G : 5 channel (11a/n_HT20 – DTS), 2 channel (11n_HT40 – DTS) 4 channel(11a/n_HT20 – Non DFS), 2 channel(11a/n_HT40 – Non DFS) 15 channel (11a/n_HT20_DFS), 7 channel (11a/n_HT40_DFS)
Antenna Gain	2.4 G : Max. 3.51 dBi, 5 G : Max. 4.07 dBi
Antenna information	Integral antenna (Metal Stamping Antenna Assembly)
Working temperature	-20 ~ 70 ℃
Supply Voltage	DC 3.3 V

Note ;
1. All the technical data described above were provided by the manufacturer.

1.5. Antenna Information

Antenna Model Name : MSA-4008-25GC1-A1-500002
Antenna Type : Metal Stamping Antenna Assembly
Manufacturer : MAG. LAYERS SCUENTIFIC-TECHNICS CO., LTD.
Transmit Gain dBi : 2.4 G : Max. 3.51 dBi, 5 G : Max. 4.07 dBi
Azimuth Beam Pattern : Linear vertical

1.6. Equipment Type :

☒ Radio and ancillary equipment for fixed or semi-fixed use
☐ Radio and ancillary equipment for vehicular mounted use
☐ Radio and ancillary equipment for portable or handheld use

☒ Stand alone ☐ Host connected ☐ Host connected

☐ Self contained single unit ☒ Module with associated connection or interface

1.7. Technical descriptions and documents

The following documents was provided by the manufacturer.

No.	Document Title and Description
1	User Manual
2	MAG. LAYERS SCUENTIFIC-TECHNICS CO., LTD., APPROVAL SHEET (RoHS) / MSA-4008-25GC1-A1-500002

1.8. Description of additional model name

Model name	Model name Designation	Description of design
SWB-A52H	Basic model	-

1.9. Maximum Output Power

Mode	Rate		Peak Power(dBm)		
			2412 MHz	2437 MHz	2462 MHz
802.11b	1	Mbps	18.10	18.06	17.10
	2	Mbps	18.37	18.24	17.34
	5.5	Mbps	18.38	19.24	18.43
	11	Mbps	**20.67**	**20.46**	**19.89**
802.11g	6	Mbps	20.38	21.54	20.37
	9	Mbps	20.44	21.42	20.26
	12	Mbps	20.21	21.47	20.11
	18	Mbps	20.27	21.74	20.23
	24	Mbps	20.71	21.84	20.28
	36	Mbps	20.78	21.92	20.46
	48	Mbps	20.48	21.44	20.53
	54	Mbps	**20.96**	**21.94**	**20.56**
802.11n (HT20)	MCS	0	19.35	21.62	19.46
	MCS	1	18.87	21.58	19.28
	MCS	2	19.15	21.48	19.29
	MCS	3	19.39	22.05	19.07
	MCS	4	19.37	21.86	19.60
	MCS	5	19.41	21.80	19.61
	MCS	6	19.50	21.81	19.66
	MCS	7	**19.77**	**22.11**	**19.78**

Mode	Rate		Peak Power(dBm)		
			5745 MHz	5785 MHz	5825 MHz
802.11a	6	Mbps	17.37	16.97	17.09
	9	Mbps	17.12	17.14	17.12
	12	Mbps	17.10	17.13	17.13
	18	Mbps	17.25	16.93	17.15
	24	Mbps	17.41	16.95	17.33
	36	Mbps	17.54	16.87	17.38
	48	Mbps	17.50	16.92	17.42
	54	Mbps	**17.64**	**17.16**	**17.72**
802.11n (HT20)	MCS	0	17.43	17.31	17.26
	MCS	1	17.48	17.45	17.35
	MCS	2	17.62	17.62	17.38
	MCS	3	17.71	17.66	17.32
	MCS	4	17.83	17.59	17.39
	MCS	5	17.86	17.63	17.42
	MCS	6	17.91	17.70	17.40
	MCS	7	**18.08**	**17.77**	**17.53**

Mode	Rate		Peak Power(dBm)	
			5755 MHz	5795 MHz
802.11n (HT40)	MCS	0	17.66	17.57
	MCS	1	18.21	17.59
	MCS	2	18.32	17.62
	MCS	3	18.21	17.66
	MCS	4	18.16	17.84
	MCS	5	18.23	17.88
	MCS	6	18.29	18.02
	MCS	7	**18.49**	**18.07**

2. Test Specification

The following test specifications and standards have been applied and used for testing.

1) FCC Part 15 C Section 15.247 : Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz
2) ANSI C63.4:2009 : American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
3) ANSI C63.10:2009 : American National Standard for Testing Unlicensed Wireless Devices
4) KDB 558074 : Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

3. Test Conditions

3.1. Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
EUT	WiFi module	Samsung Electro-Mechanics	SWB-A52H	-
AE	Note PC	Dell	X61	-
Note: Use = EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment. SIM - Simulator (Not Subjected to Test)				

3.2. Input/Output Ports

No	Port Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
1	Power Input	DC	N	N	Connected to DC Power supply
2	Radio Antenna	I/O	N	Y	-
Note: *AC = AC Power Port DC = DC Power Port N/E = Non-Electrical I/O = Signal Input or Output Port (Not Involved in Process Control) TP = Telecommunication Ports					

3.3. Power Interface

Mode #	**Voltage (V)**	**Current (A)**	**Power (W)**	**Frequency (DC/AC-Hz)**	**Phases (#)**	**Comments**
Rated	3.3 V	-	-	DC	-	Normal operating voltage
1	2.97 V	-	-	DC	-	V_{MIN}
2	3.63 V	-	-	DC	-	V_{MAX}

3.4. Operating Frequencies

Mode #	Frequency tested
1	2 412 ㎒ ~ 2 462 ㎒ : 802.11b/g/n_HT20 - Low : 2412 MHz / CH = 1 - Mid : 2437 MHz / CH = 6 - Top : 2462 MHz / CH= 11
2	2 422 ㎒ ~ 2 452 ㎒ : 802.11n_HT40 - Low : 2422 MHz / CH = 3 - Mid : 2437 MHz / CH = 6 - Top : 2452 MHz / CH= 9
3	5 745 ㎒ ~ 5 825 ㎒ : 802.11b/g/n_HT20 - Low : 5745 MHz / CH = 149 - Mid : 5785 MHz / CH = 157 - Top : 5825 MHz / CH= 165
4	5 755 ㎒ ~ 5 795 ㎒ : 802.11n_HT40 - Low : 5755 MHz / CH = 149 - Top : 5795 MHz / CH= 157

3.5. Operation Modes

Mode #	Description
1	Carrier on mode: Signal from the RF module was generated continuously for the representative channels (Low, Mid, High) by the test program incorporated
2	Carrier off (Idle) mode: RF carrier was not activated by the RF module

Note :

1. The measurements of the spurious emissions for transmitter on stand-by mode were performed as the receiver spurious emissions.
2. The worst-case condition is determined by the baseline measurement of rf output power out of various modulations and data rates. The worst-case channel was determined as the channel with highest output power. The worst-case data rates in below were used for final measurement.

2412 ~ 2462 MHz

- 802.11b mode: 11 Mbps
- 802.11g mode: 54 Mbps
- 802.11n_HT20 mode: MCS 7

5745 ~ 5825 MHz

- 802.11a mode: 54 Mbps
- 802.11n_HT20 mode: MCS7
- 802.11n_HT40 mode: MCS7

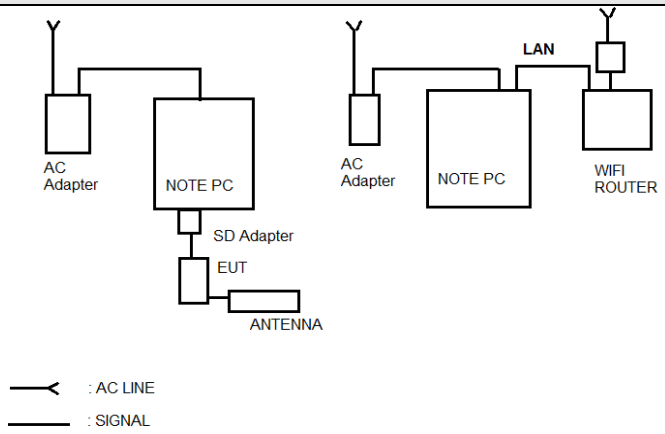
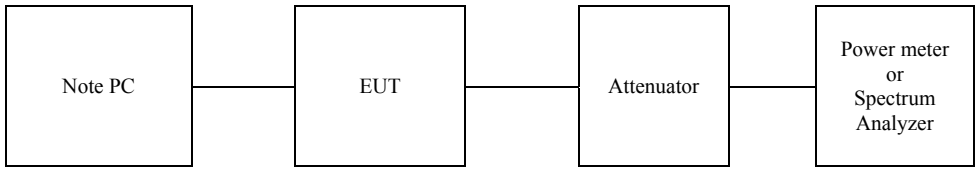
3.6. Environment Conditions

Parameters	Normal condition	Extreme condition
Temperature	+ 15℃ ~ +35℃	-20℃ / +55℃
Humidity	20% ~ 75%	No excessive condensation occur
Supply voltage	3.3 Vdc (Rated nominal voltage)	2.97 Vdc / 3.63 Vdc

Note ;

- The extreme condition is applied to the boundary limits of the declared operational environmental condition by the manufacturer.
- The operating condition for humidity requirement has not been declared in the manufacturer's specification.
- Test has been carried out for three frequencies specified above under the normal condition and for the extreme condition, minimum and maximum frequencies has been tested.

3.7. Test Configurations

Mode #	Description
1	
2	

3.8. List of Test Equipment

No	Description	Manufacturer	Model	Identifier	Cal. Due
1	Spectrum Analyzer	Agilent	E4407B	US42041281	2012/9/8
2	Signal Analyzer	ROHDE&SCHWARZ	FSV	100939	2013/1/26
3	Attenuator	HP	8491A	54297	2012/12/29
4	Attenuator	HP	8498A	1801A04999	2013/2/23
5	Attenuator	Bird Electronic Corp.	100-SA-MFN-30	0138	2013/6/5
6	Attenuator	SRT	F04-K1830-01	11060801	2013/6/5
7	LISN	Rohde & Schwarz	ESH3-Z5	836679/025	2012/09/27
8	TEST Receiver	Rohde & Schwarz	ESHS 30	828765/002	2012/12/16
9	Pulse Limiter	Rohde & Schwarz	ESH3Z2	NONE	2013/01/25
10	Logbicon Antenna	SCHWARZBECK	VULB 9168	237	2013/01/20
11	TEST Receiver	Rohde & Schwarz	ESCI7	1166.5950.07	2013/03/28
12	Horn Antenna	SCHWARZBECK	BBHA9120D	469	2012/09/06
13	SPECTRUM ANALYZER	ADVANTEST	R3273	110600592	2013/01/26
14	Amplifier	Agilent	8449B	3008A00581	2013/01/27
15	Pyramidal Horn Antenna	ETS-LINDGREN	3160-09	00102642	2012/09/07

4. Overview of Technical requirements

The following essential requirements and test specifications are relevant to the presumption of conformity FCC Part 15 C Section 15.247			Reported
Reference Clause No.	Essential technical requirements	Test method	
15.247(a)(2)	6 dB Bandwidth	ANSI C63.10-2009 KDB 558074	[X]
15.247(b)(3)	Maximum peak output power	ANSI C63.10-2009 KDB 558074	[X]
15.247(e)	Power spectral density	ANSI C63.10-2009 KDB 558074	[X]
15.205(a) 15.209(a) 15.247(d)	Transmitter radiated spurious emissions and Conducted spurious emission	ANSI C63.4-2009 KDB 558074	[X]
15.207	Transmitter AC power line conducted emission	ANSI C63.4-2009	[X]

5. Test Results

5.1. 6 dB Bandwidth

TEST: 6 dB Bandwidth		
Method	The transmitter output is connected to the Spectrum analyzer. 6 dB Bandwidth from the EUT was measured under the below setting condition. 1. Set resolution bandwidth (RBW) = 1-5 % of the emission bandwidth (EBW). 2. Set the video bandwidth (VBW) ≥ 3 x RBW. 3. Detector = Peak. 4. Trace mode = max hold. 5. Sweep = auto couple. 7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1-5 %.	
Reference Clause	Part15 C Section 15.247 (a)(2)	
Parameters recorded during the test	Laboratory Ambient Temperature	22 °C
	Relative Humidity	36 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2412 MHz - 2462 MHz 5745 MHz - 5825 MHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
Rated	1	2
Supplementary information: None		

Limits

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 ~928 MHz, 2400 ~ 2483.5 MHz, and 5725 ~ 5825 MHz bands. The minimum of 6 dB Bandwidth shall be at least 500 kHz.

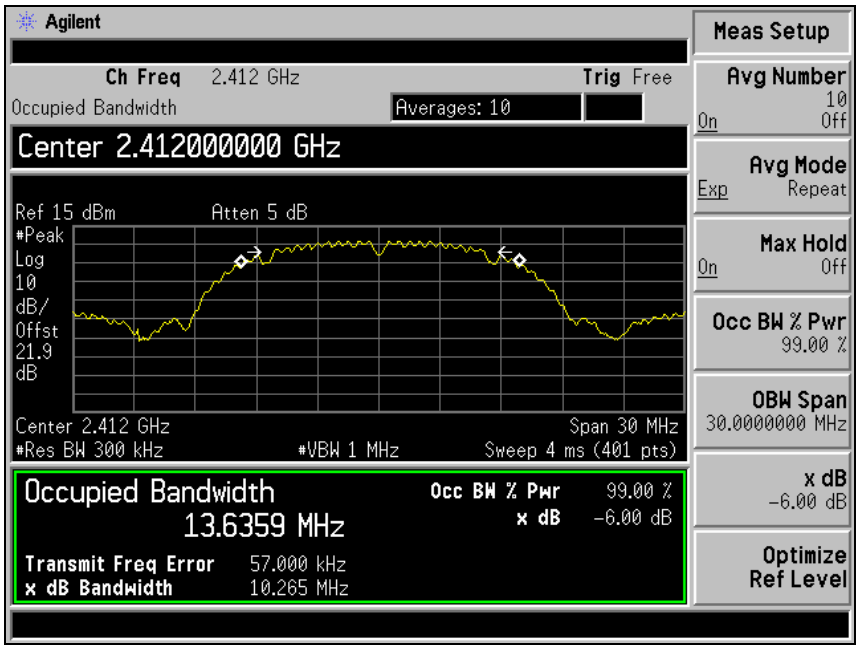
5.1.1. Measurement Results

Table 1. Data Table of 6 dB Bandwidth

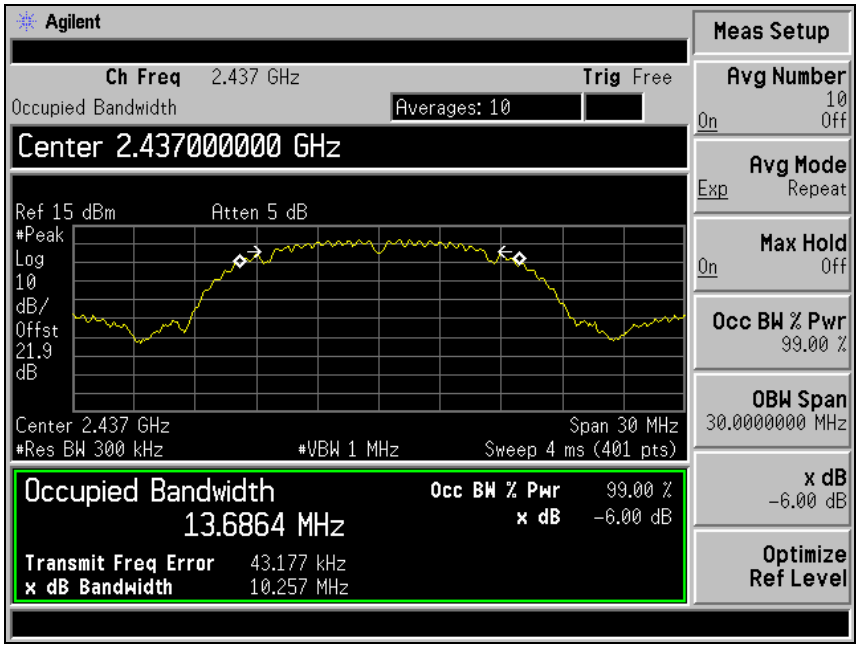
Operating Mode	Data Rate (Mbps)	Channel	Channel Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
2.4GHz Band 802.11b	1	Low	2412	10.27	> 0.5
		Middle	2437	10.26	
		High	2462	10.27	
2.4GHz Band 802.11g	6	Low	2412	16.43	
		Middle	2437	16.55	
		High	2462	16.46	
2.4GHz Band 802.11n-HT20	MCS0	Low	2412	17.65	
		Middle	2437	17.67	
		High	2462	17.61	
5.8GHz Band 802.11a	6	Low	5745	16.36	
		Middle	5785	16.37	
		High	5825	16.25	
5.8GHz Band 802.11n-HT20	MCS0	Low	5745	17.48	
		Middle	5785	17.47	
		High	5825	17.27	
5.8GHz Band 802.11n-HT40	MCS0	Low	5755	36.31	
		High	5795	36.05	

Figure 1. Plots of 6 dB Bandwidth

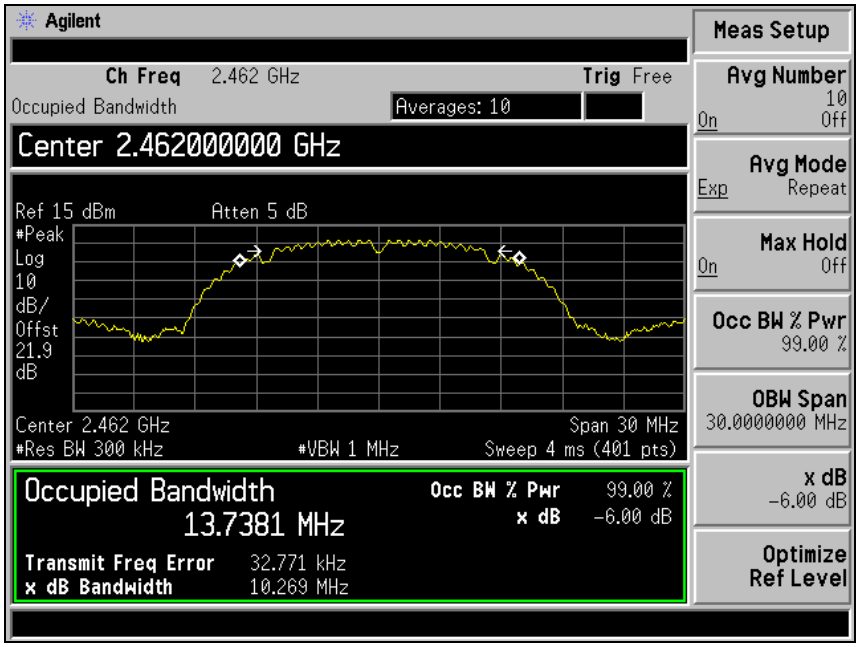
802.11b : Low



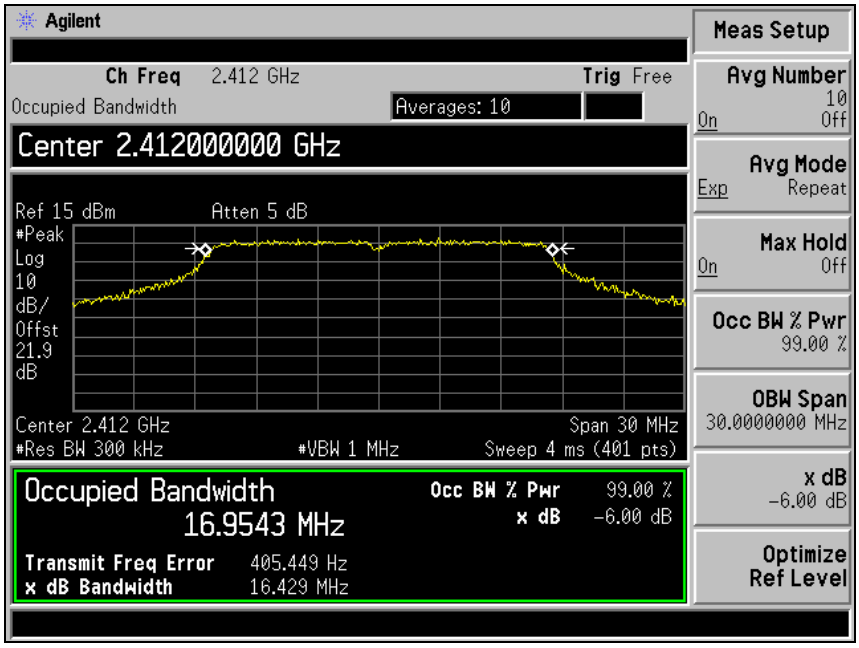
802.11b : Middle



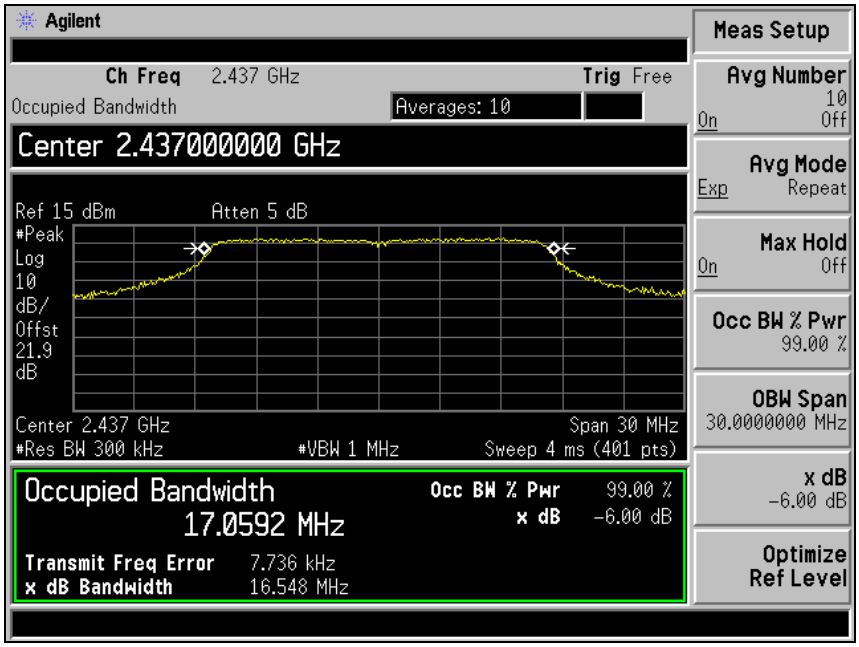
802.11b : High



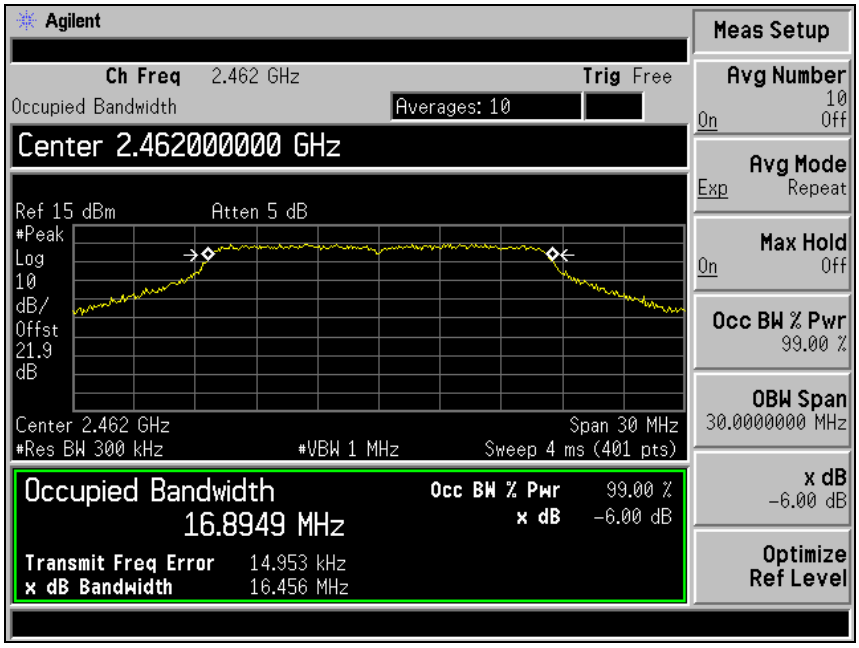
802.11g : Low



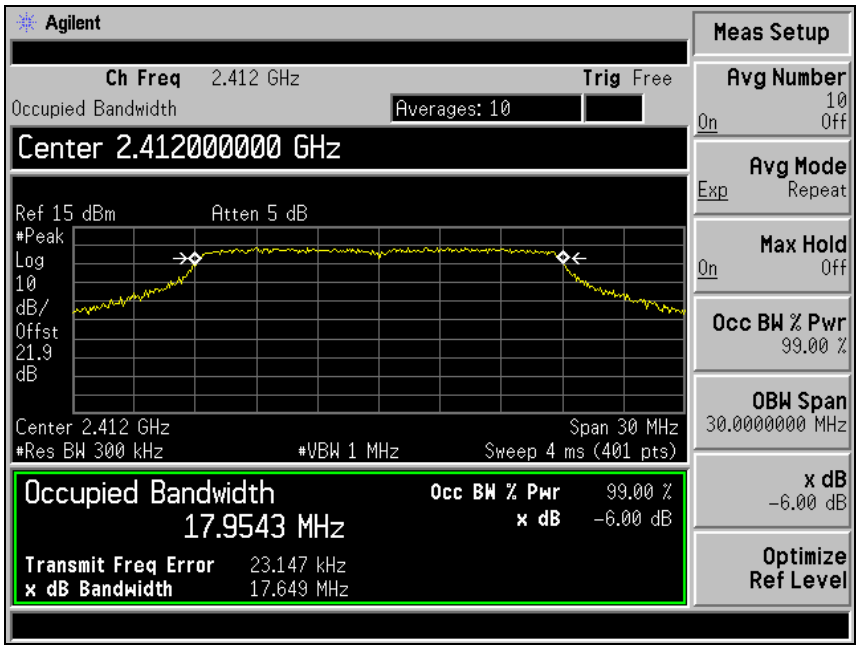
802.11g Middle



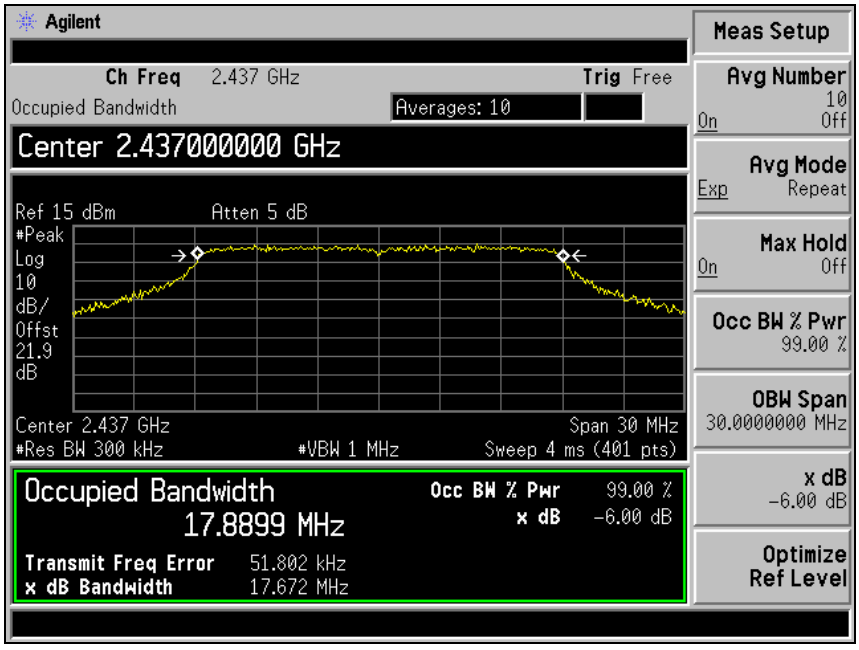
802.11g High



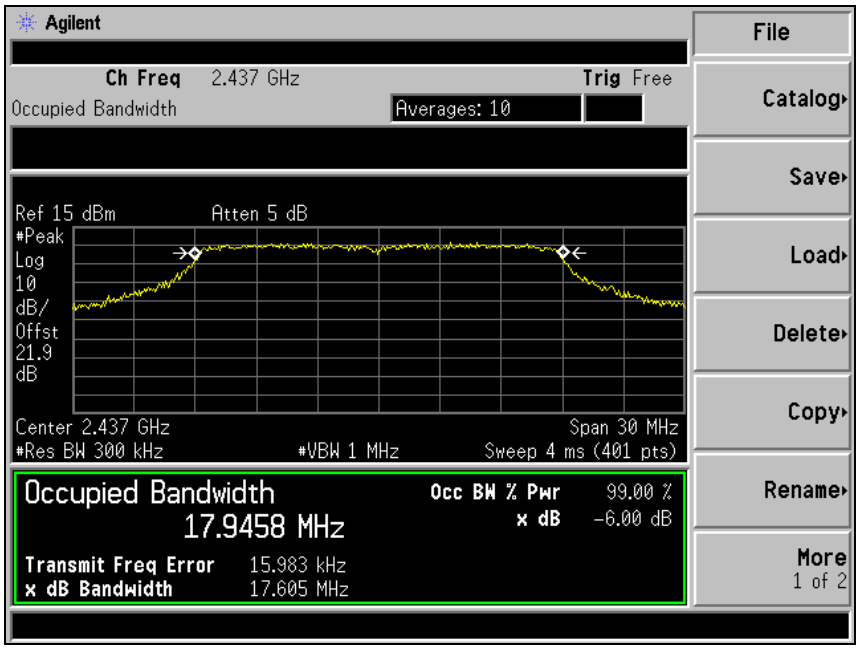
2.4 GHz 802.11n-HT20 : Low



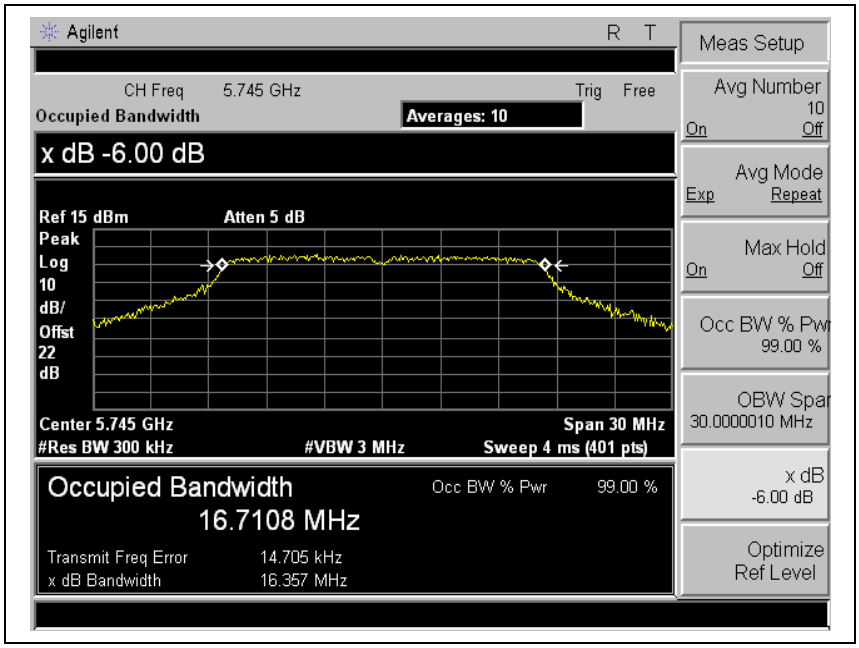
2.4 GHz 802.11n-HT20 : Middle



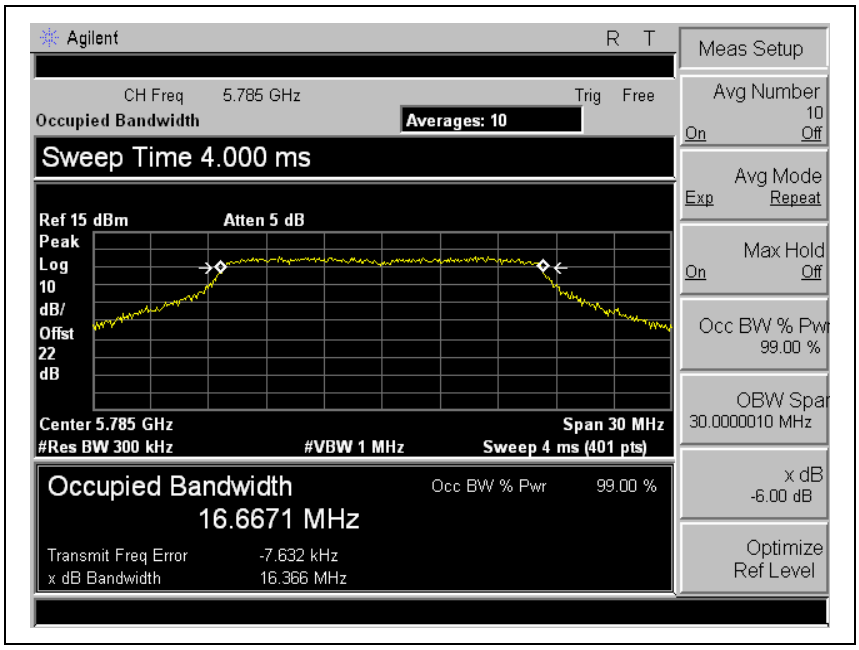
2.4 GHz 802.11n-HT20 : High



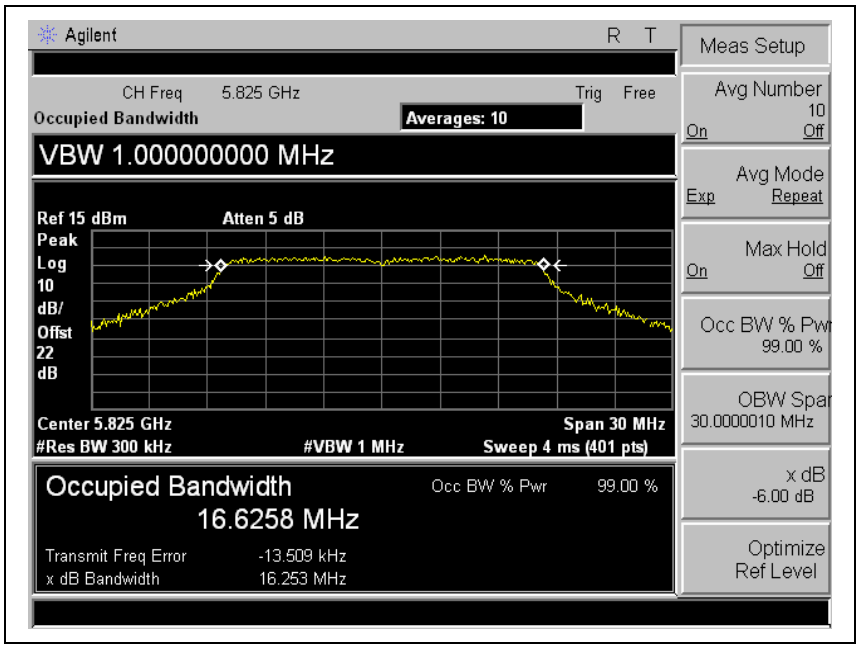
5.8 GHz 802.11a : Low



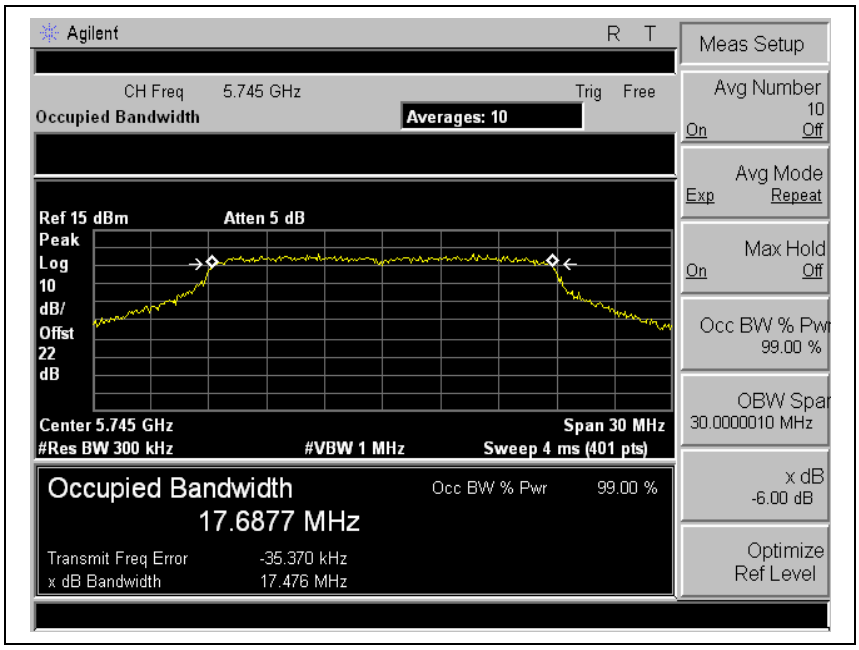
5.8 GHz 802.11a : Middle



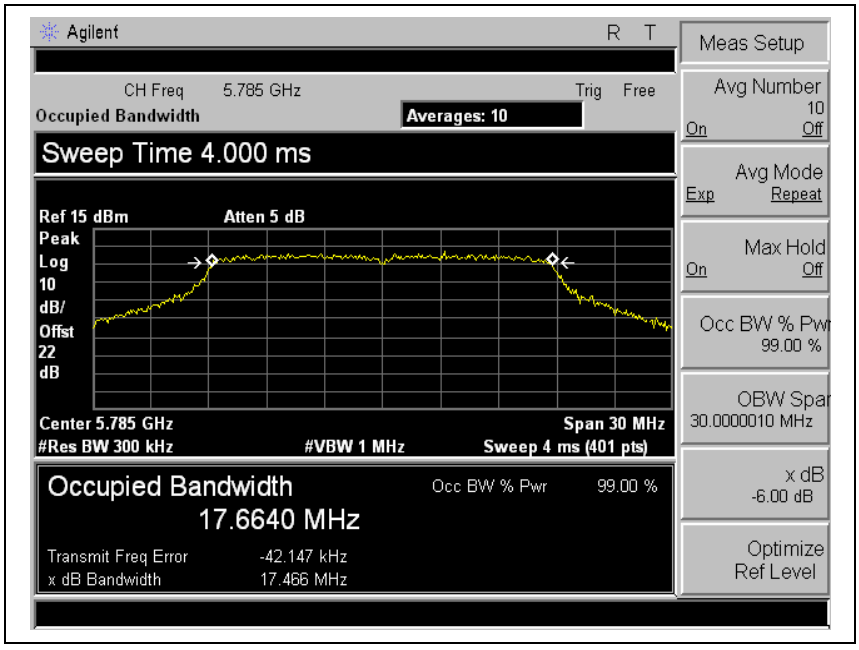
5.8 GHz 802.11a : High



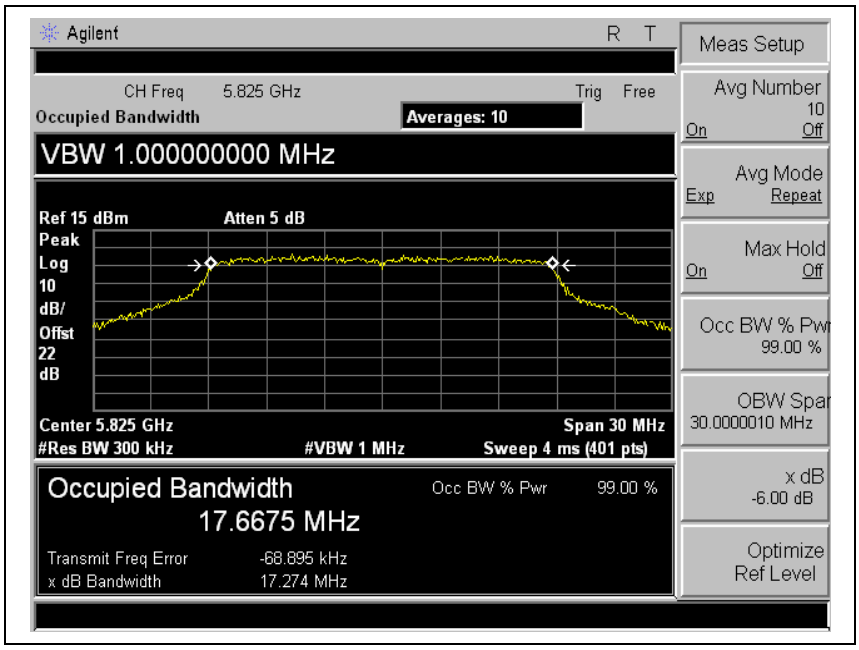
5.8 GHz 802.11n-HT20 : Low



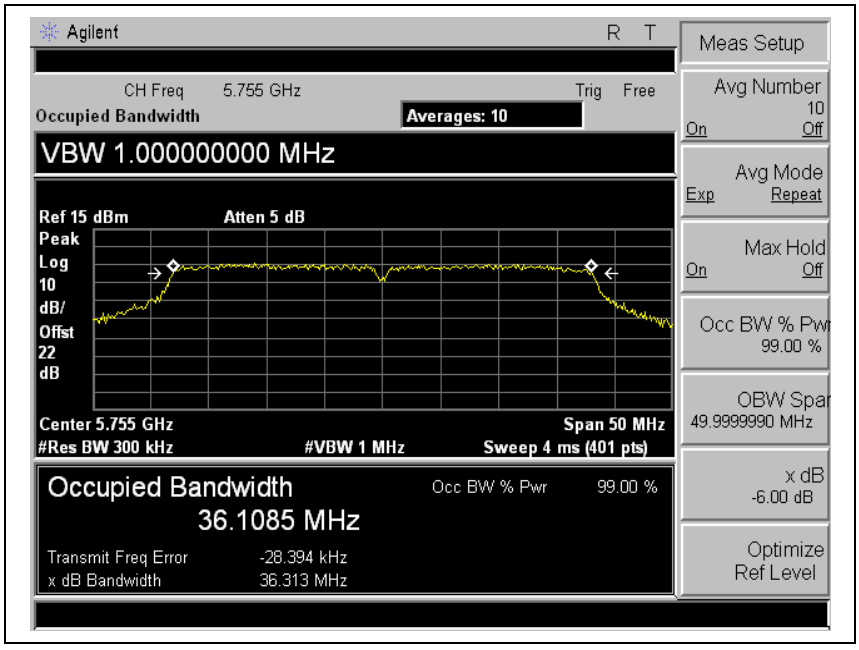
5.8 GHz 802.11n-HT20 : Middle



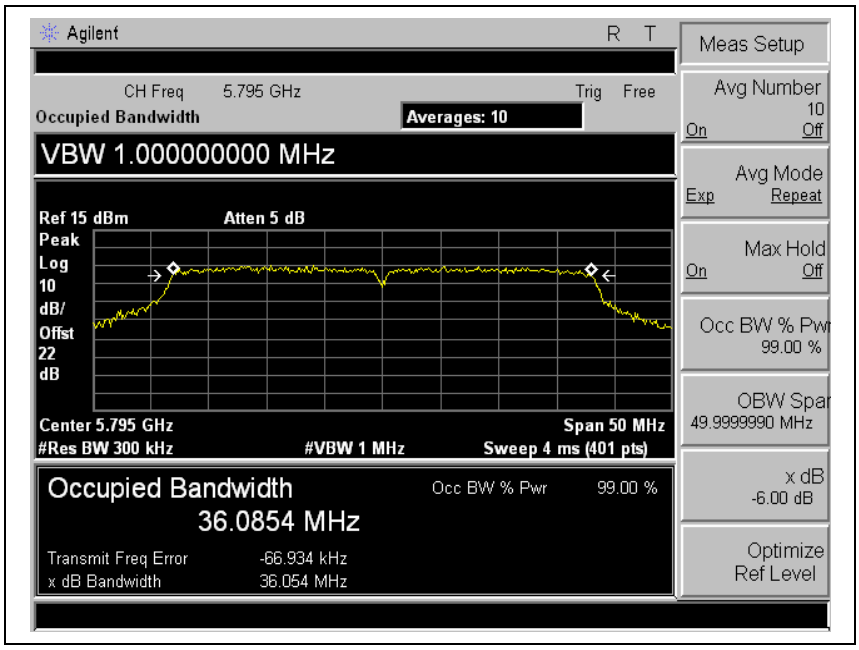
5.8 GHz 802.11n-HT20 : High



5.8 GHz 802.11n-HT40 : Low



5.8 GHz 802.11n-HT40 : High



5.2. Maximum Peak Output Power

TEST: Maximum Peak Output Power			
Method	Maximum Peak Output Power from the EUT were measured according to the dictates PK2 measurement procedure in section 5.2 of KDB 558074 1. This procedure provides an integrated measurement alternative when the maximum available RBW < EBW. 2. Set the RBW = 1 MHz. 3. Set the VBW = 3 MHz. 4. Set the span to a value that is 5-30 % greater than the EBW. 5. Detector = peak. 6. Sweep time = auto couple. 7. Trace mode = max hold. 8. Allow trace to fully stabilize. 9. Use the spectrum analyzer's integrated band power measurement function with band limits set equal to the EBW band edges (for some analyzers, this may require a manual override to ensure use of peak detector). If the spectrum analyzer does not have a band power function, sum the spectrum levels (in linear power units) at 1 MHz intervals extending across the EBW of the spectrum.		
Reference Clause	Part15 C Section 15.247 (b)(3)		
Parameters recorded during the test	Laboratory Ambient Temperature	22 °C	
	Relative Humidity	36 %	
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	2412 MHz - 2462 MHz 5745 MHz - 5825 MHz	Antenna port	

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
Rated	1	2
Supplementary information: None		

Limits

According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 MHz, 2400 ~2483.5 MHz, and 5725 ~ 5850 MHz band: 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 antenna elements. The average must not include any 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 antenna with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, if transmitting antenna 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 paragraph (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.

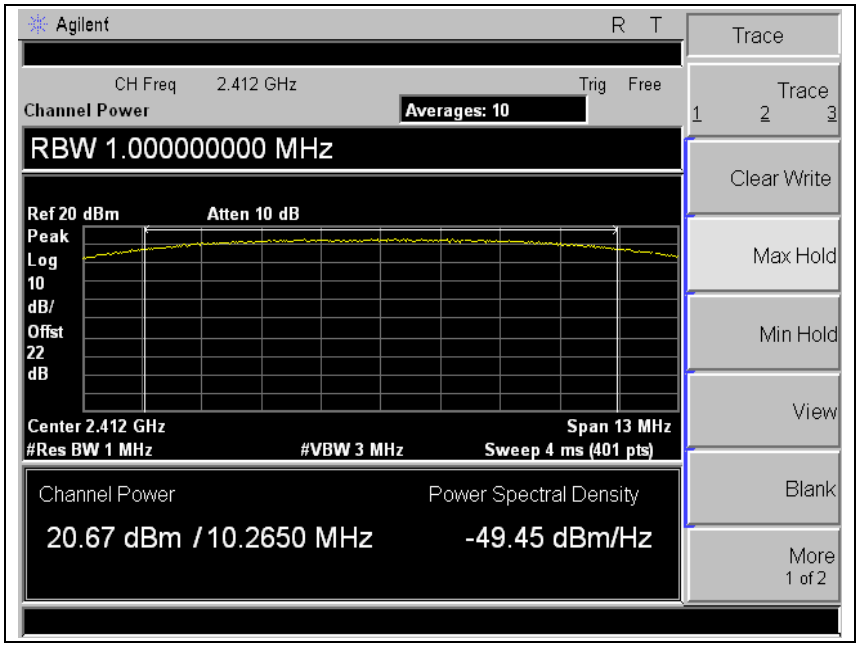
Measurement Results

Table 2. Data Table of Maximum Peak Output Power

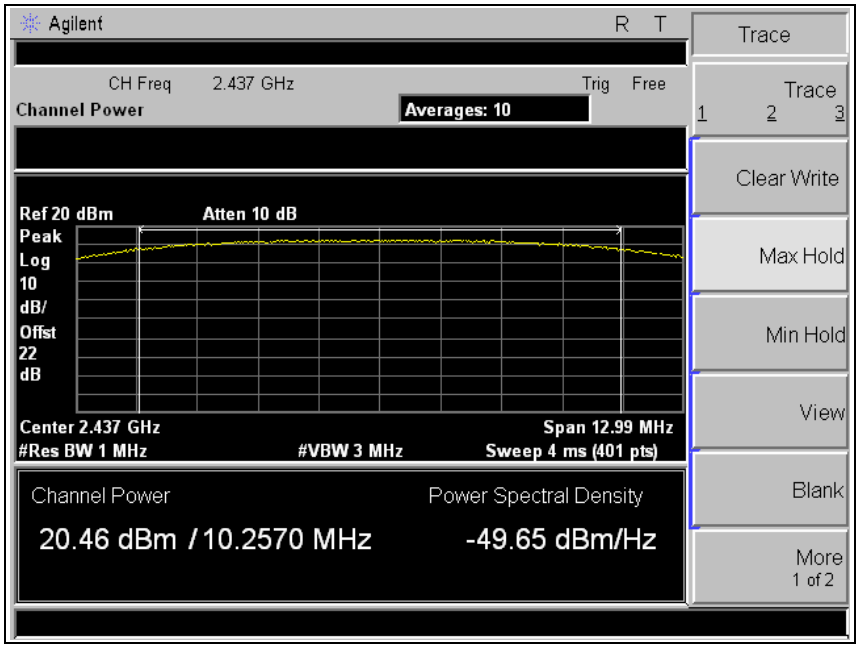
Operating Mode	Data Rate (Mbps)	Channel	Channel Frequency (MHz)	Peak Power Result (dBm)	Limit (dBm)
2.4GHz Band 802.11b	11	Low	2412	20.67	< 30
		Middle	2437	20.46	
		High	2462	19.89	
2.4GHz Band 802.11g	54	Low	2412	20.96	
		Middle	2437	21.94	
		High	2462	20.56	
2.4GHz Band 802.11n-HT20	MCS7	Low	2412	19.77	
		Middle	2437	22.11	
		High	2462	19.78	
5.8GHz Band 802.11a	54	Low	5745	17.64	
		Middle	5785	17.16	
		High	5825	17.72	
5.8GHz Band 802.11n-HT20	MCS7	Low	5745	18.08	
		Middle	5785	17.77	
		High	5825	17.53	
5.8GHz Band 802.11n-HT40	MCS7	Low	5755	18.49	
		High	5795	18.07	

Figure 2. Plots of Maximum Peak Output Power

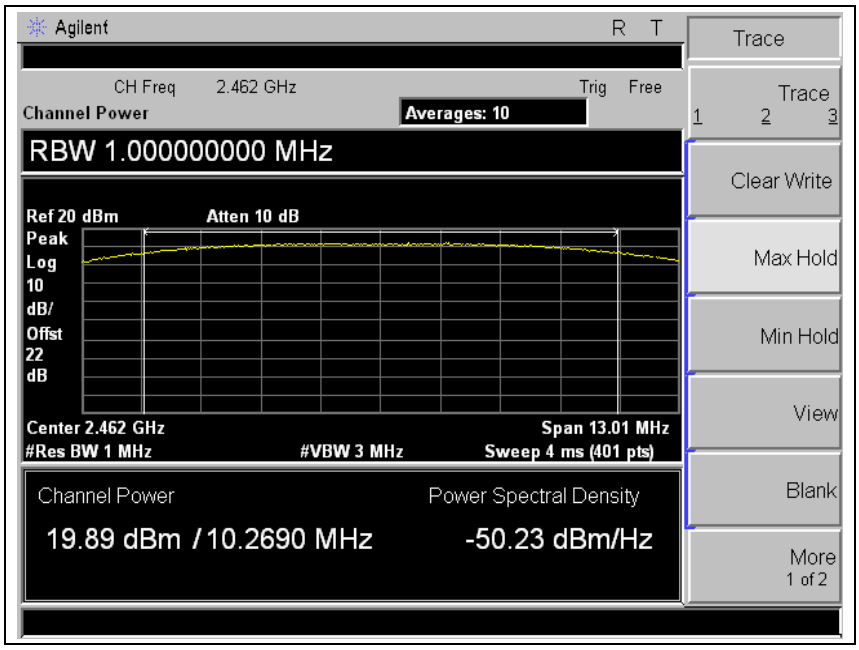
802.11b : Low



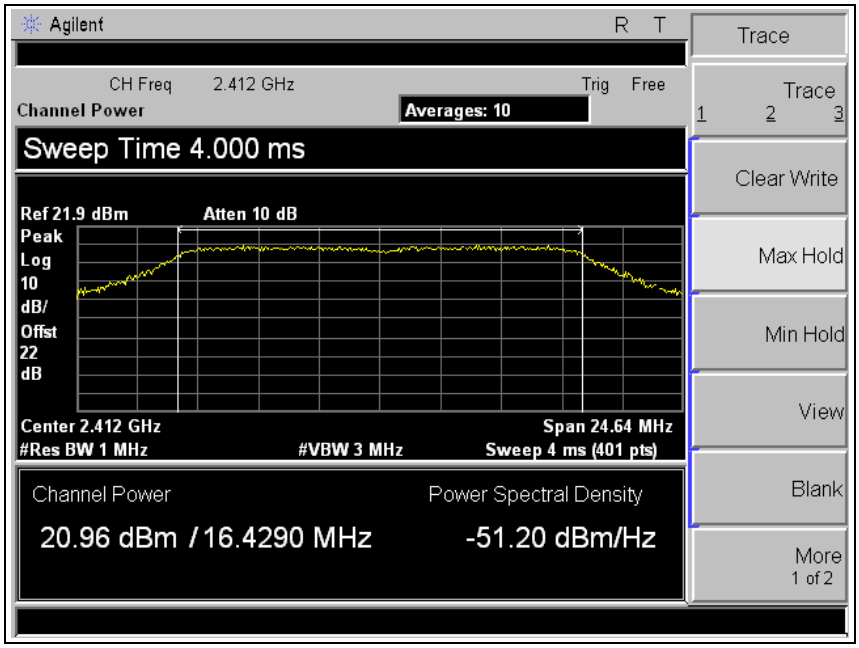
802.11b : Middle



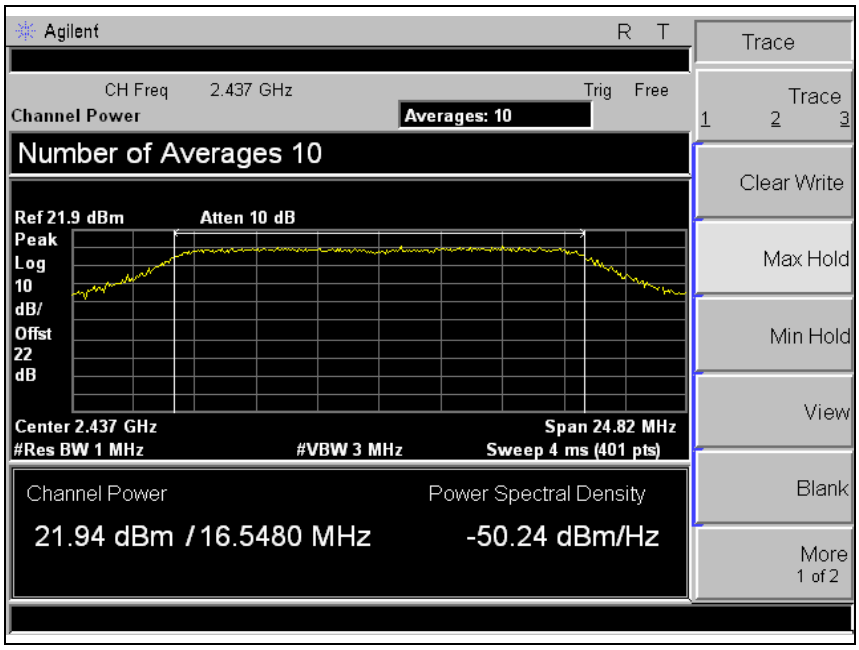
802.11b : High



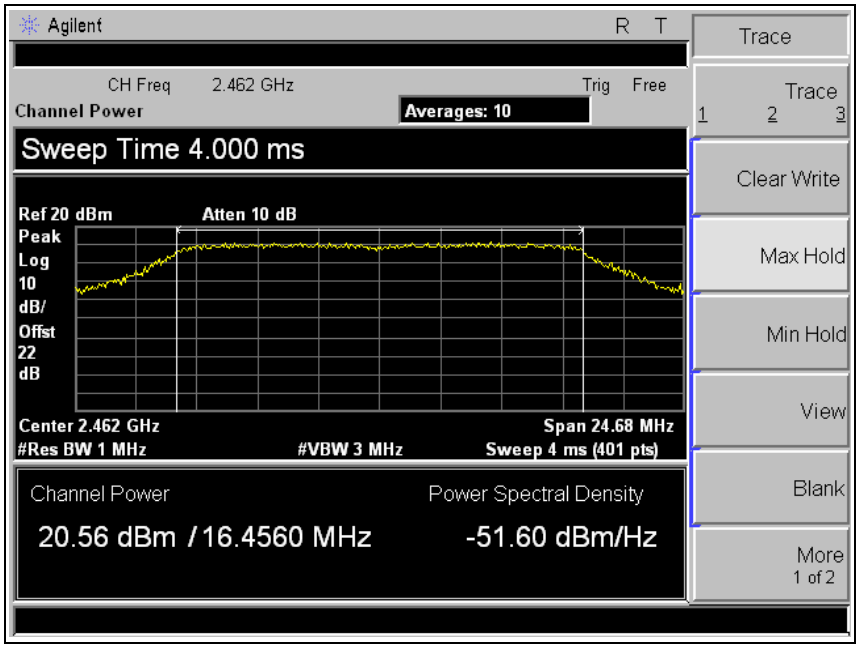
802.11g : Low



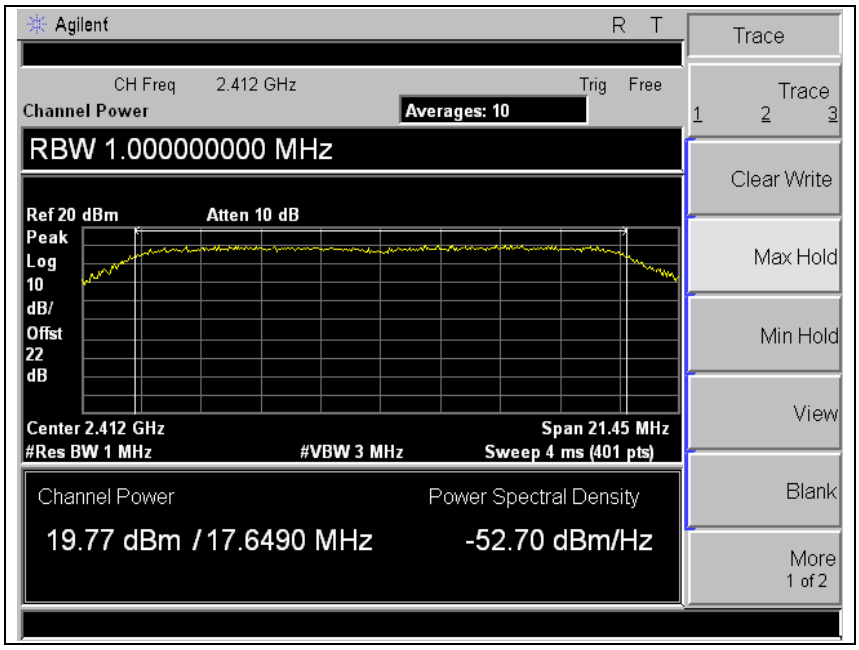
802.11g : Middle



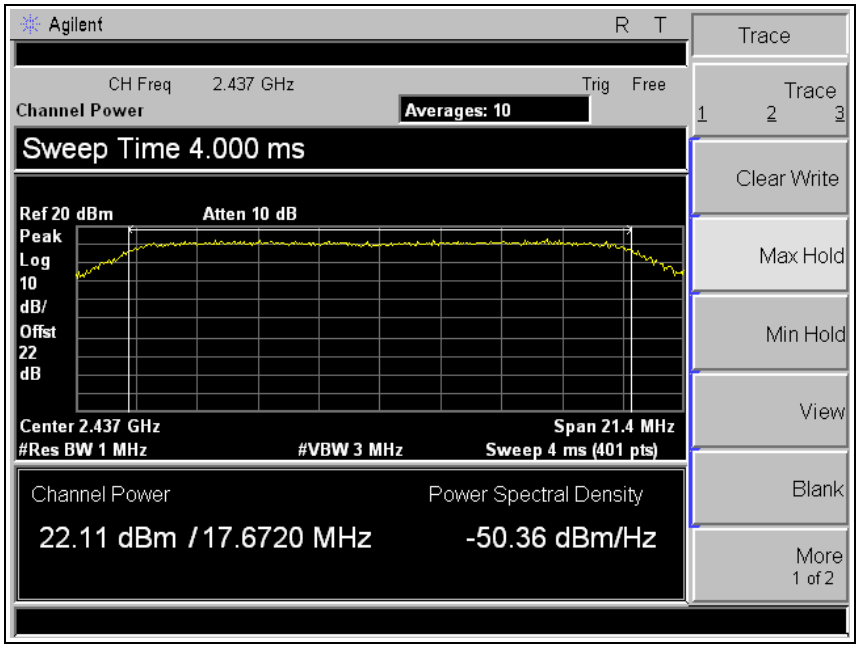
802.11g : High



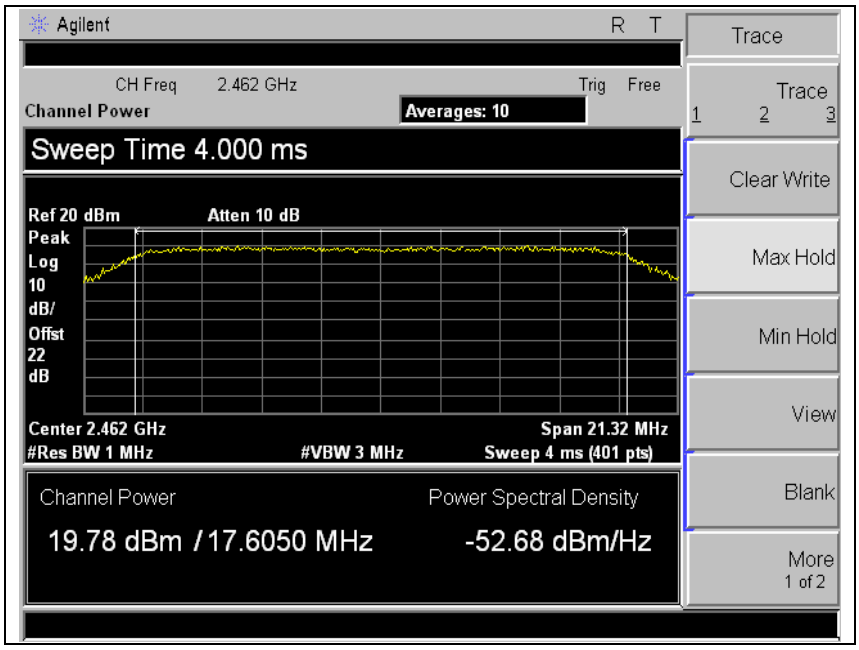
2.4GHz 802.11n-HT20 : Low



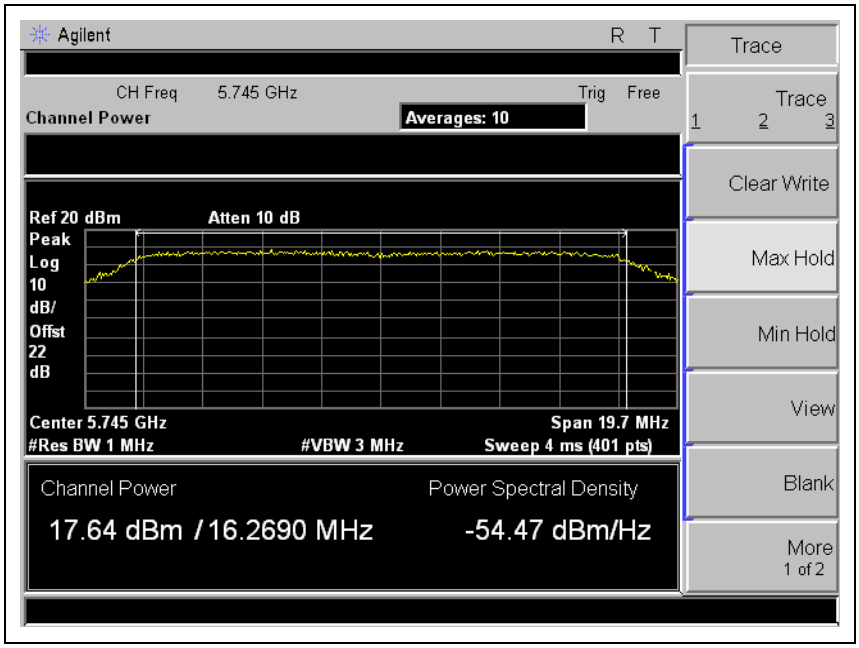
2.4GHz 802.11n-HT20 : Middle



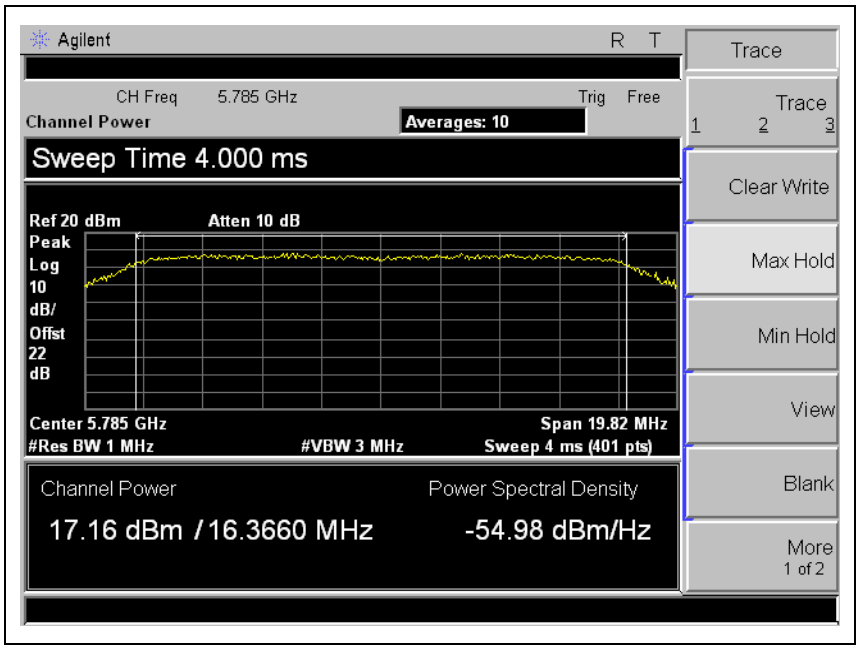
2.4GHz 802.11n-HT20 : High



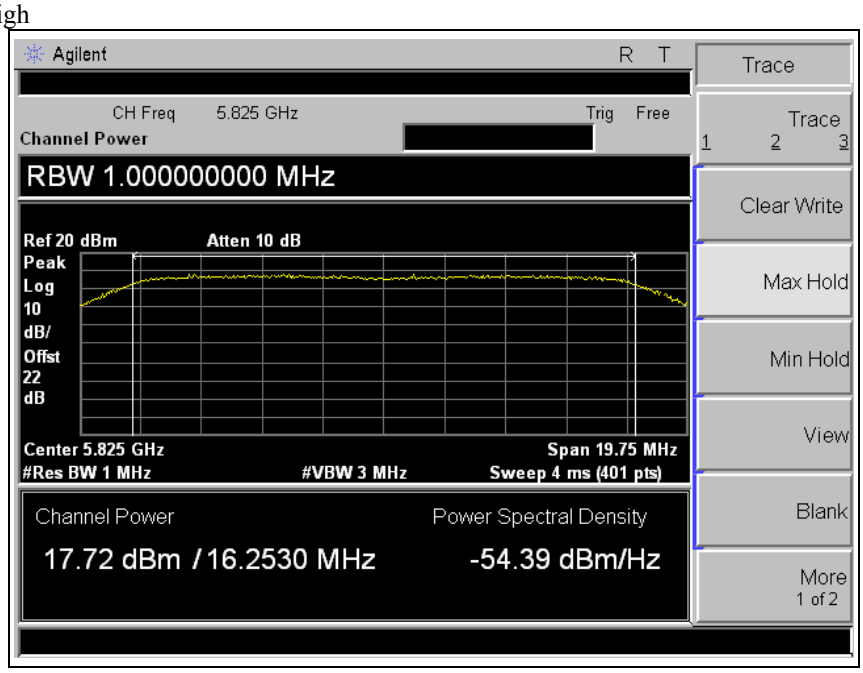
5.8GHz 802.11a : Low



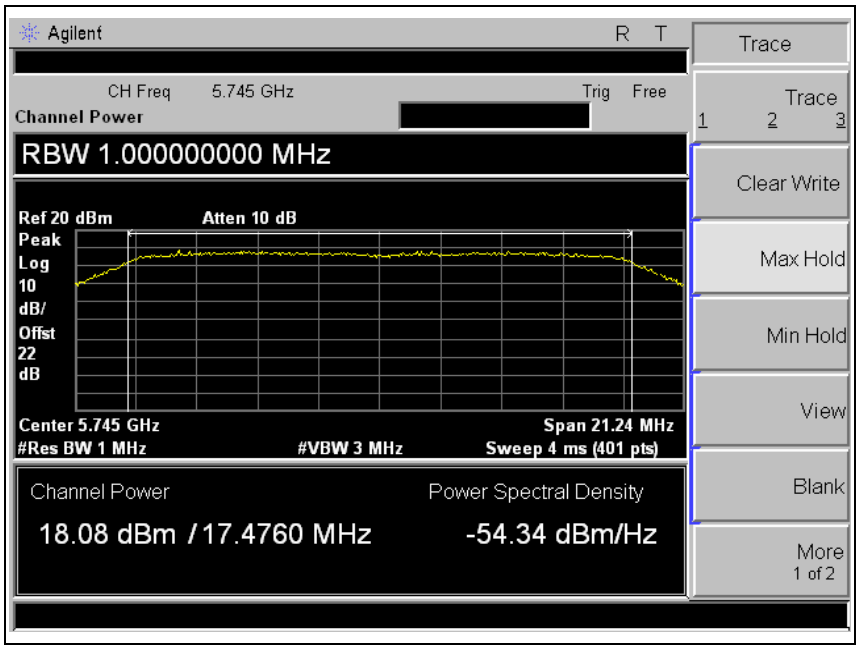
5.8GHz 802.11a : Middle



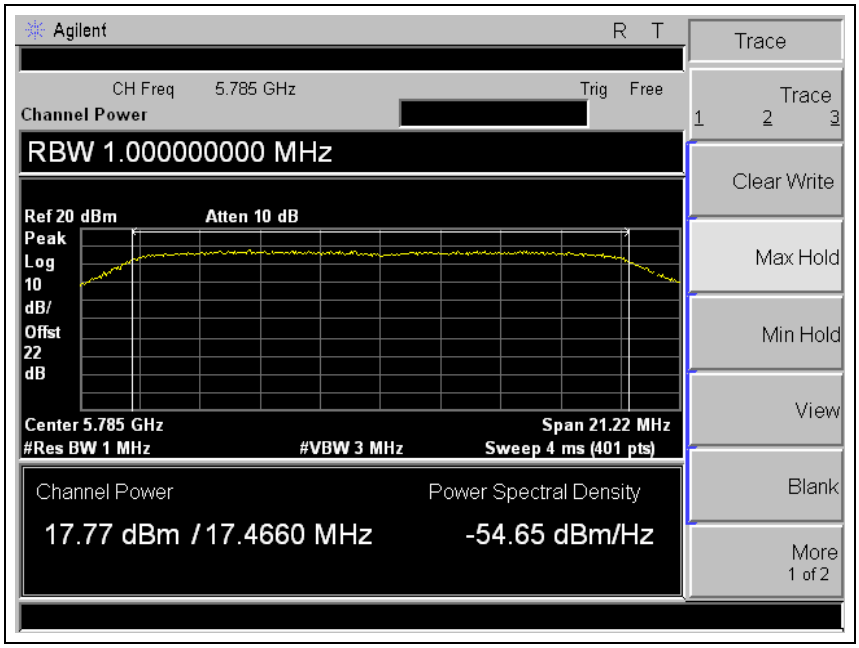
5.8GHz 802.11a : High



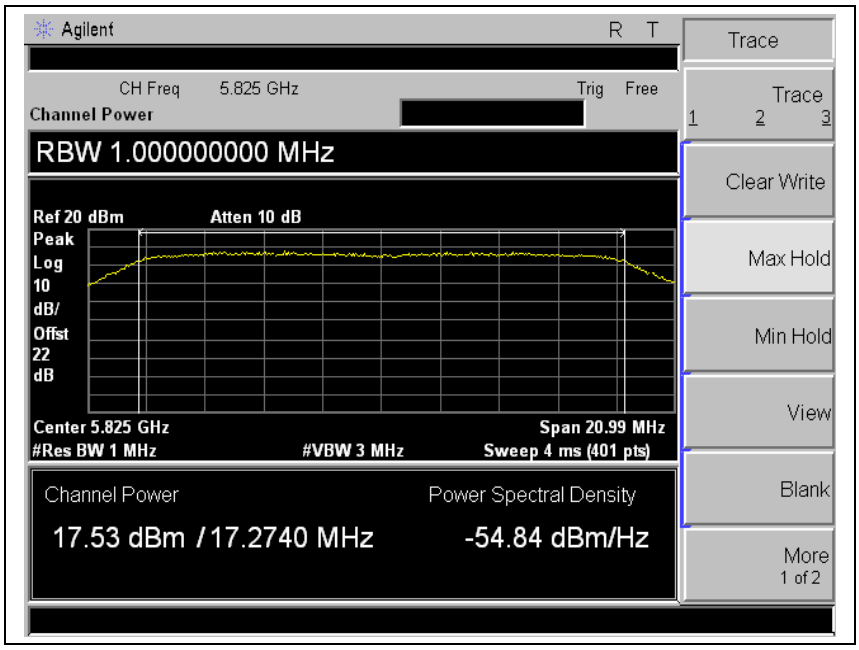
5.8GHz 802.11n-HT20 : Low



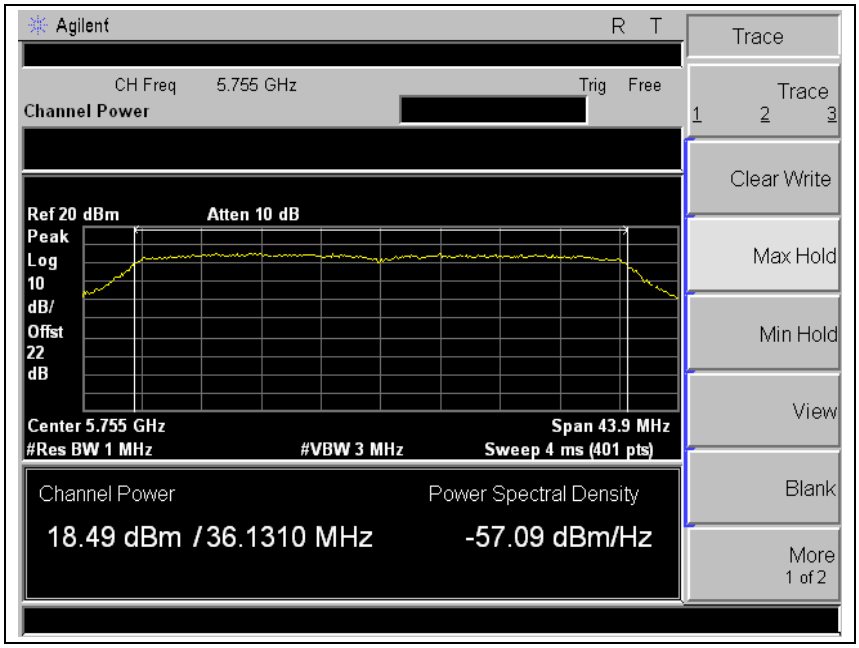
5.8GHz 802.11n-HT20 : Middle



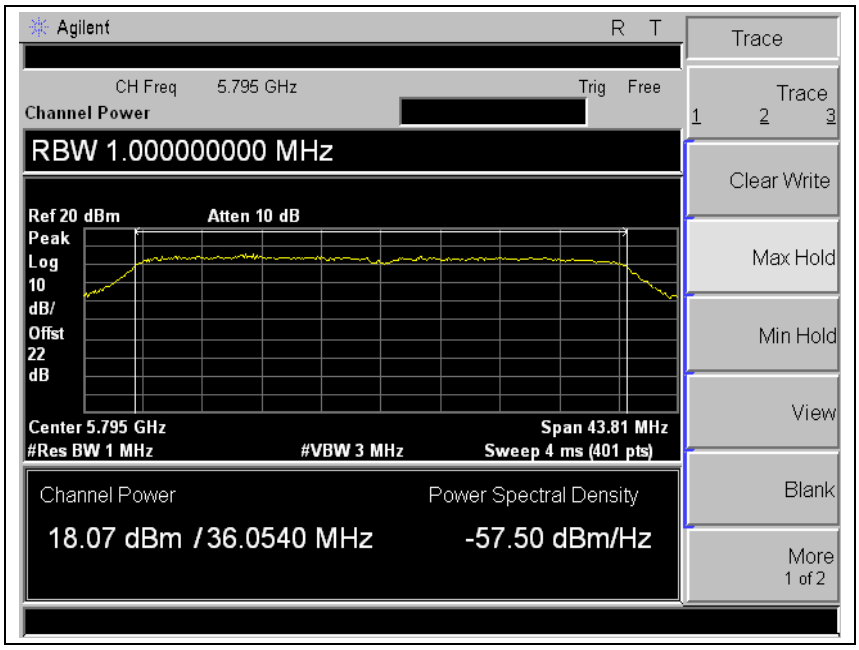
5.8GHz 802.11n-HT20 : High



5.8GHz 802.11n-HT40: Low



5.8GHz 802.11n-HT40: High



5.3. Power Spectral Density

TEST: Power Spectral Density			
Method	Power Spectral Density from the EUT were measured according to the dictates PKPSD measurement procedure in section 5.3 of KDB 558074 1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance. 2. Set the RBW = 100 kHz. 3. Set the VBW ≥ 300 kHz. 4. Set the span to 5-30 % greater than the EBW. 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 power level in any 100 kHz band segment within the fundamental EBW. 10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log (3 kHz/100 kHz = -15.2 dB). 11. The resulting peak PSD level must be ≤ 8 dBm.		
Reference Clause		Part15 C Section 15.247 (e)	
Parameters recorded during the test		Laboratory Ambient Temperature	22 °C
		Relative Humidity	36 %
		Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range		2412 MHz - 2462 MHz 5745 MHz - 5825 MHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
Rated	1	2
Supplementary information: None		

Limits

§15.247(e) For digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dB m in any 3 kHz band 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.

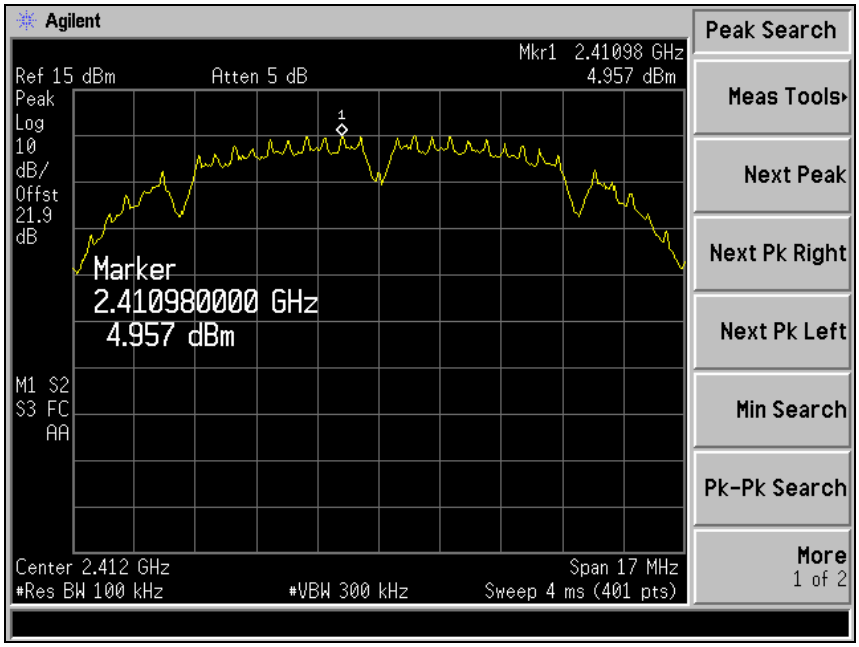
Measurement Result

Table 3. Data Table of Power Spectral Density

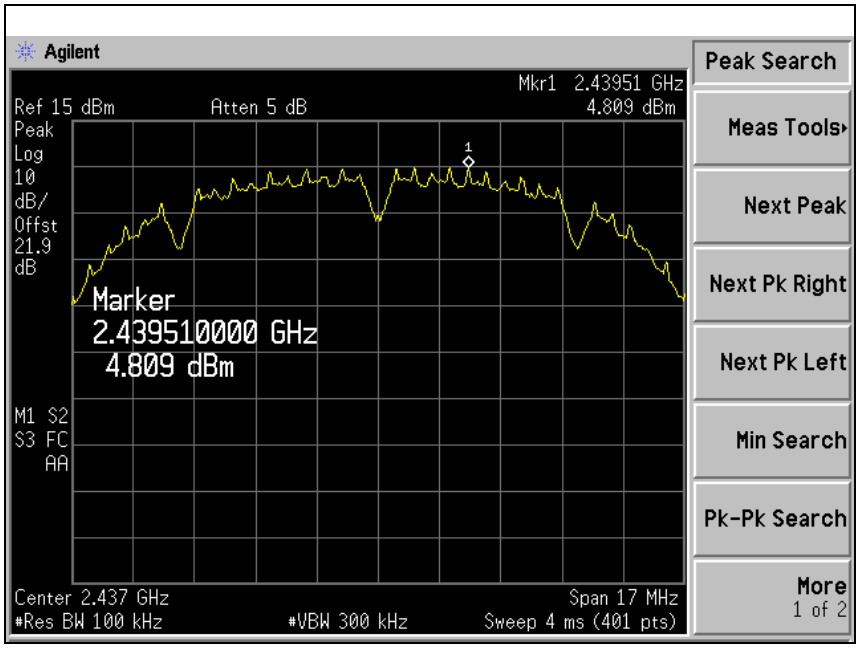
Operating Mode	Data Rate (Mbps)	Channel	Channel Frequency (MHz)	Measured PSD (dBm)	Bandwidth Correction Factor (dB)	Result PSD (dBm)	Limit (dBm)
2.4GHz Band 802.11b	1	Low	2412	4.96	-15.2	-10.24	< 8
		Middle	2437	4.81		-10.39	
		High	2462	4.11		-11.09	
2.4GHz Band 802.11g	6	Low	2412	1.58		-13.62	
		Middle	2437	3.13		-12.07	
		High	2462	1.83		-13.37	
2.4GHz Band 802.11n-HT20	MCS0	Low	2412	0.59		-14.61	
		Middle	2437	3.20		-12.00	
		High	2462	0.72		-14.48	
5.8GHz Band 802.11a	6	Low	5745	-1.41		-16.61	
		Middle	5785	-1.94		-17.14	
		High	5825	-2.07		-17.27	
5.8GHz Band 802.11n-HT20	MCS0	Low	5745	-1.42		-16.62	
		Middle	5785	-1.20		-16.40	
		High	5825	-2.10		-17.30	
5.8GHz Band 802.11n-HT40	MCS0	Low	5755	-3.94		-19.14	
		High	5795	-4.06		-19.26	

Figure 3. Plots of Power Spectral Density

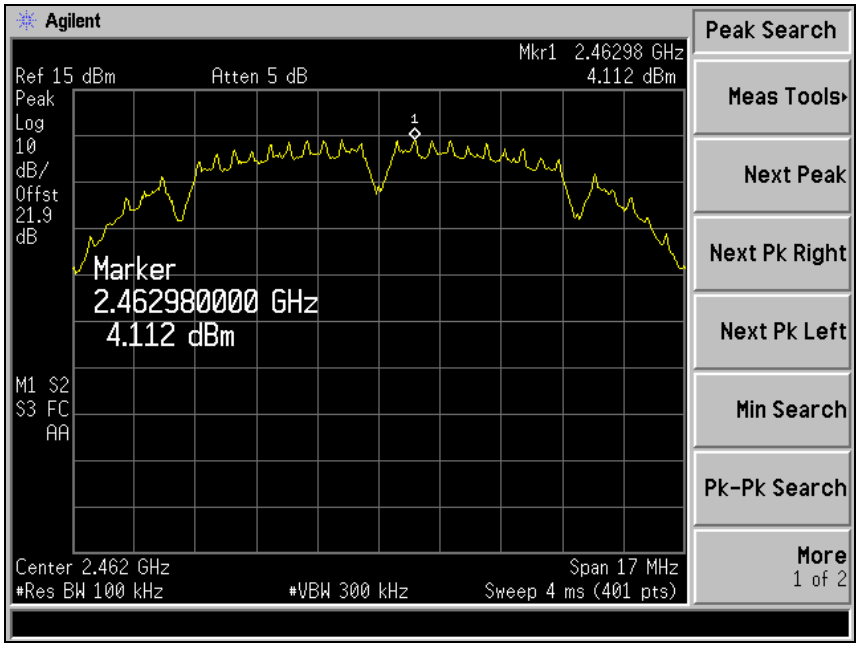
802.11b : Low



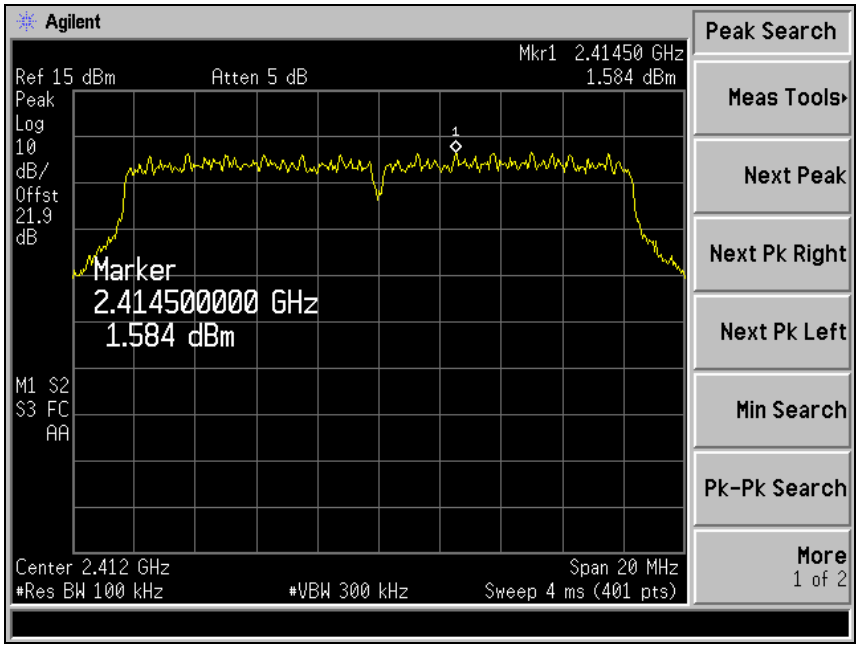
802.11b : Middle



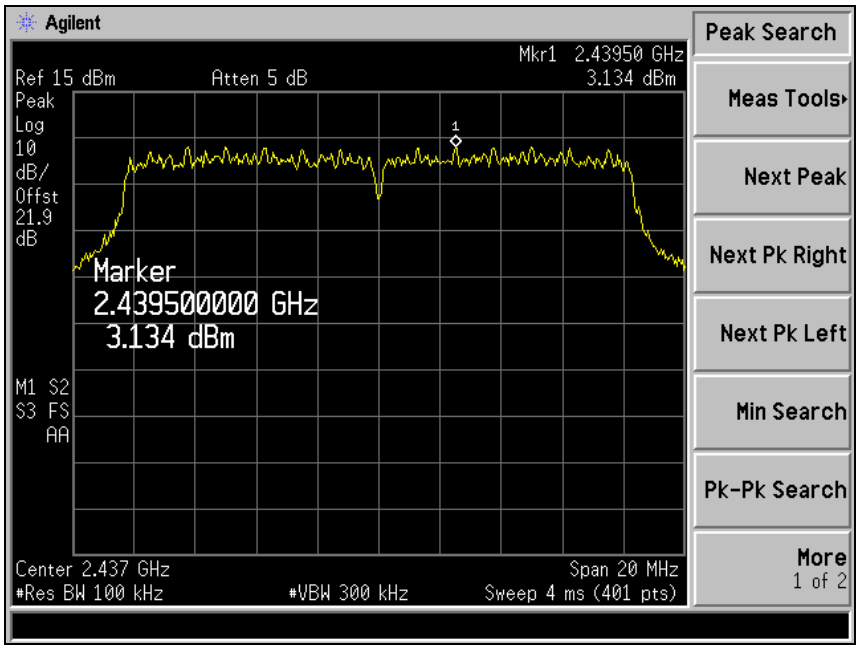
802.11b : High



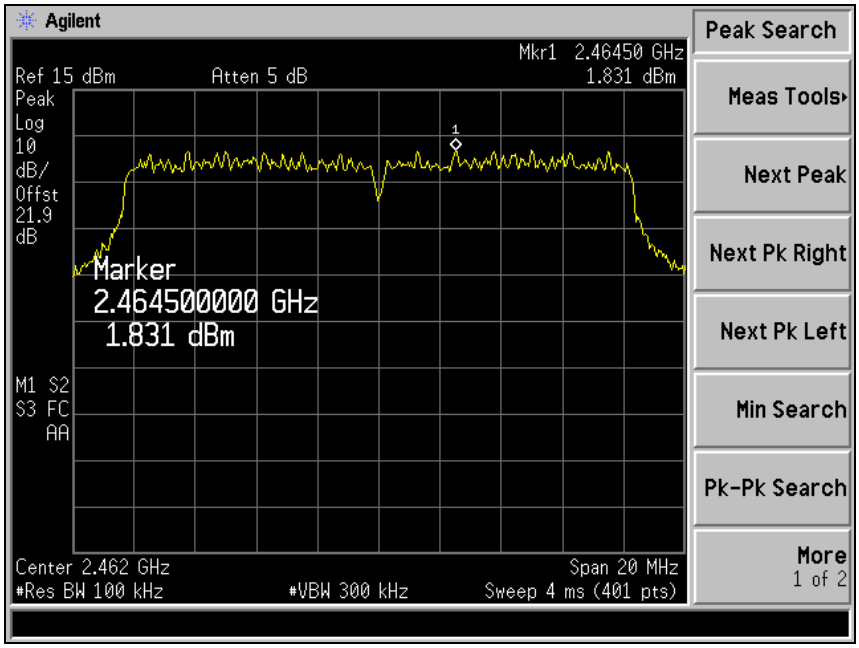
802.11g : Low



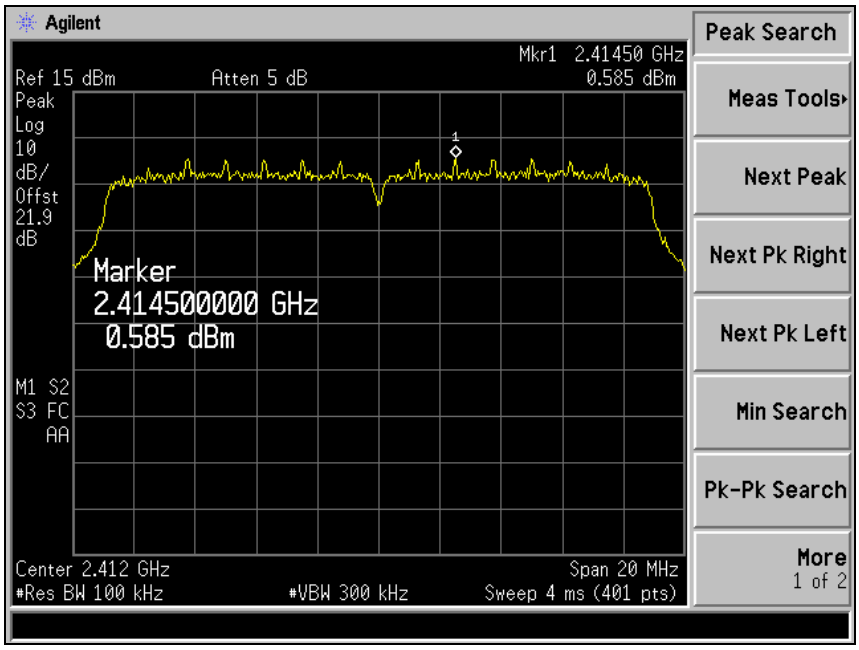
802.11g : Middle



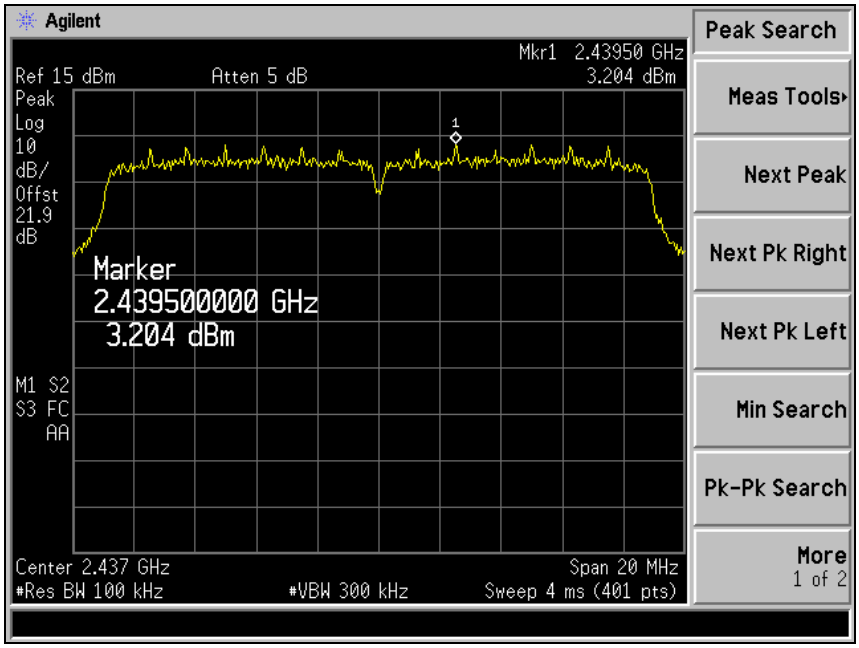
802.11g : High



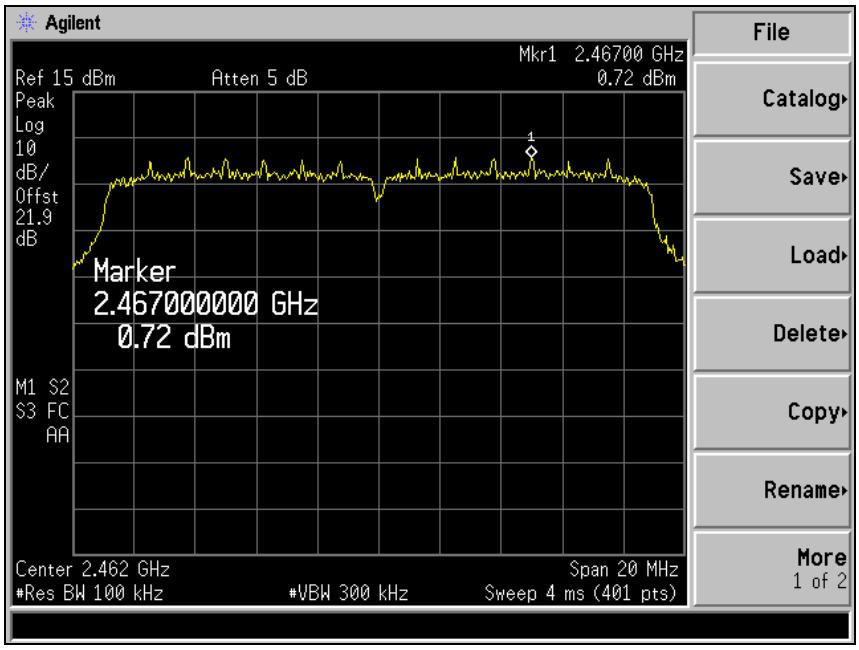
2.4GHz 802.11n-HT20 : Low



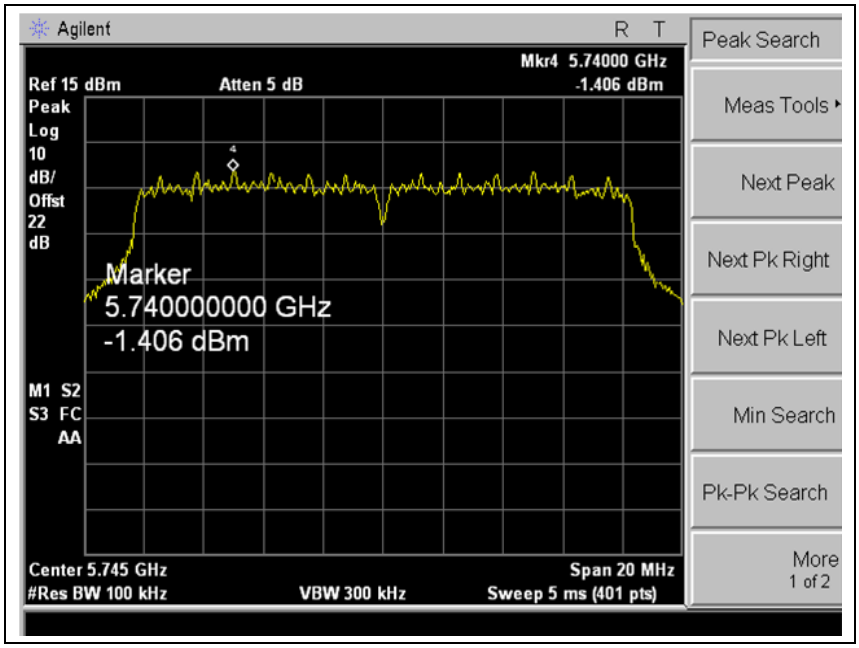
2.4GHz 802.11n-HT20 : Middle



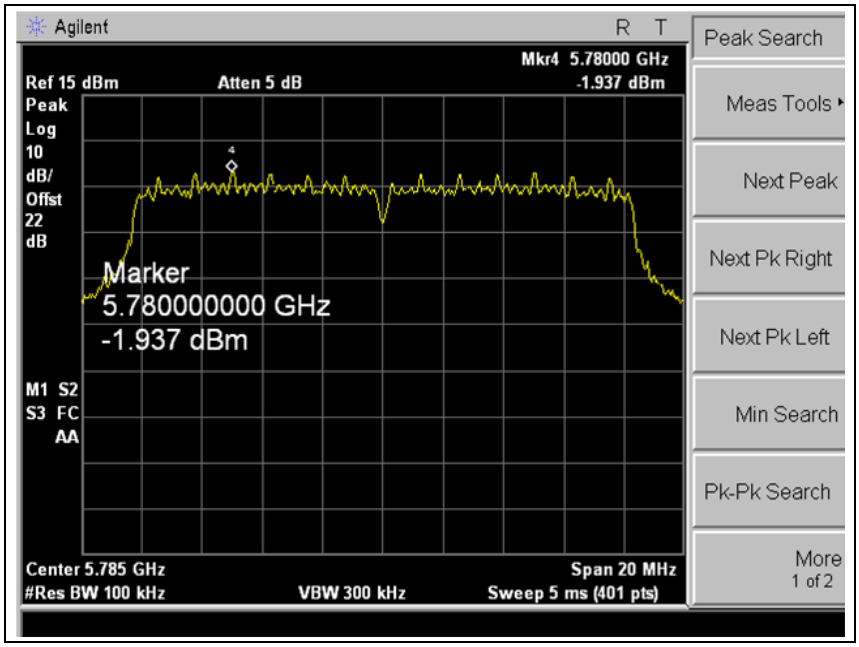
2.4GHz 802.11n-HT20 : High



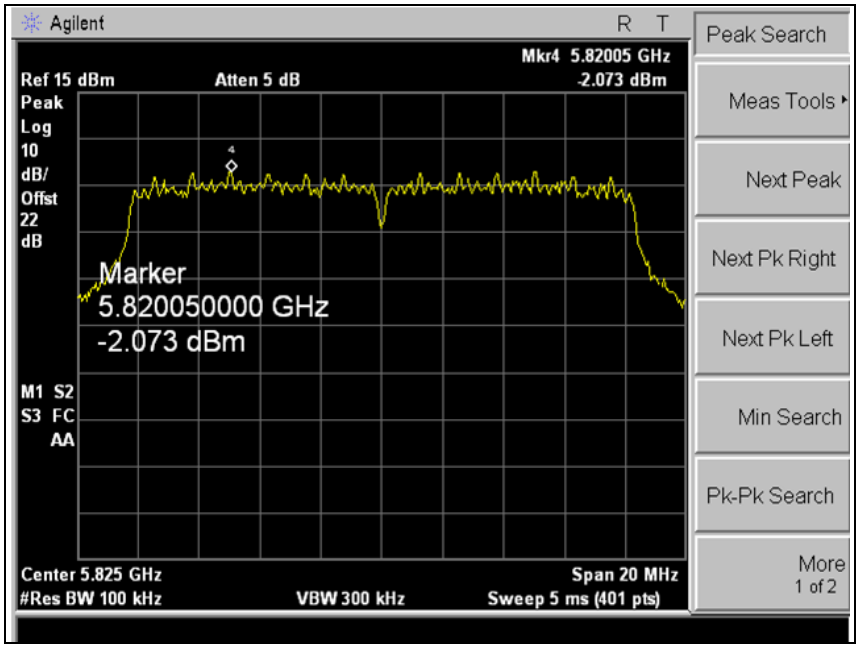
5.8GHz 802.11a : Low



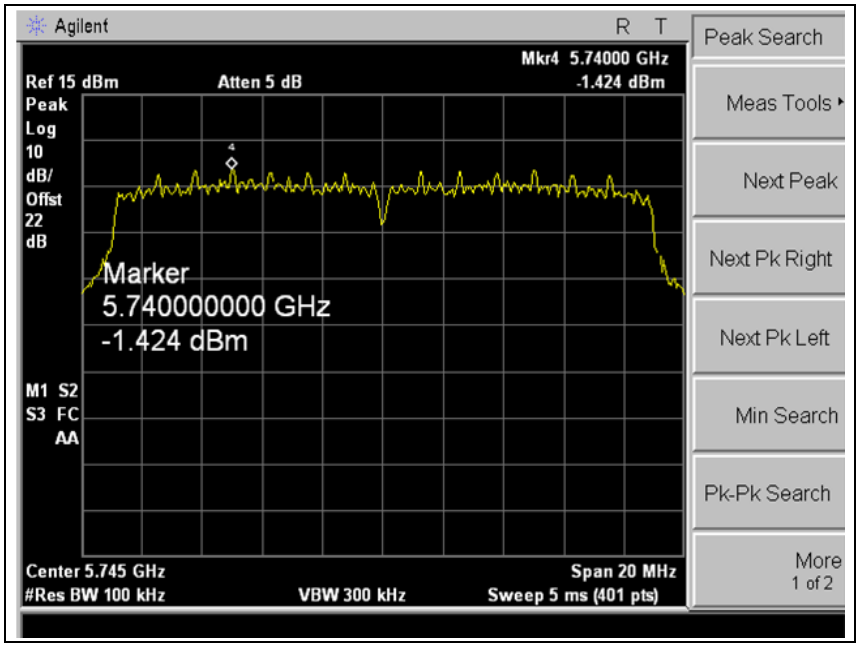
5.8GHz 802.11a : Middle



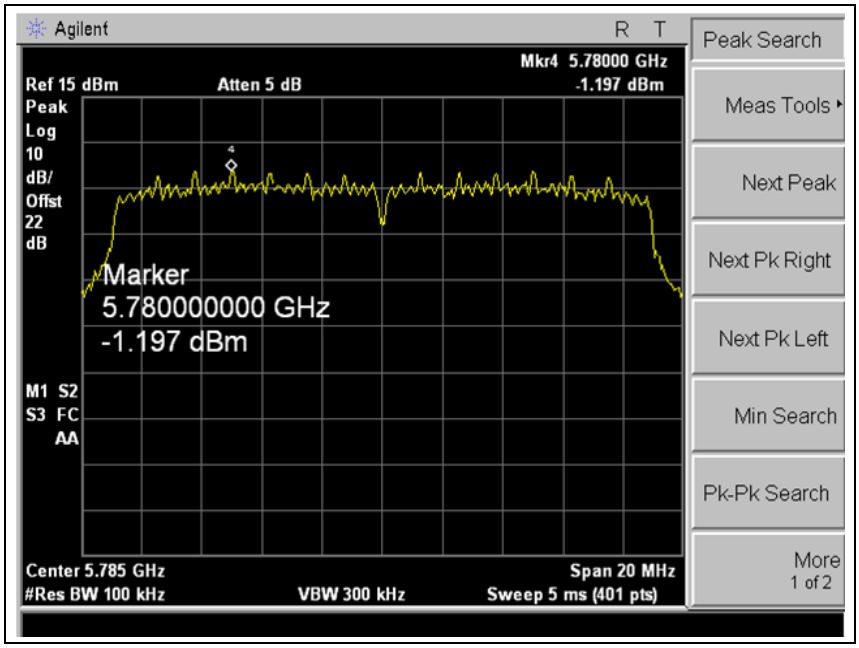
5.8GHz 802.11a : High



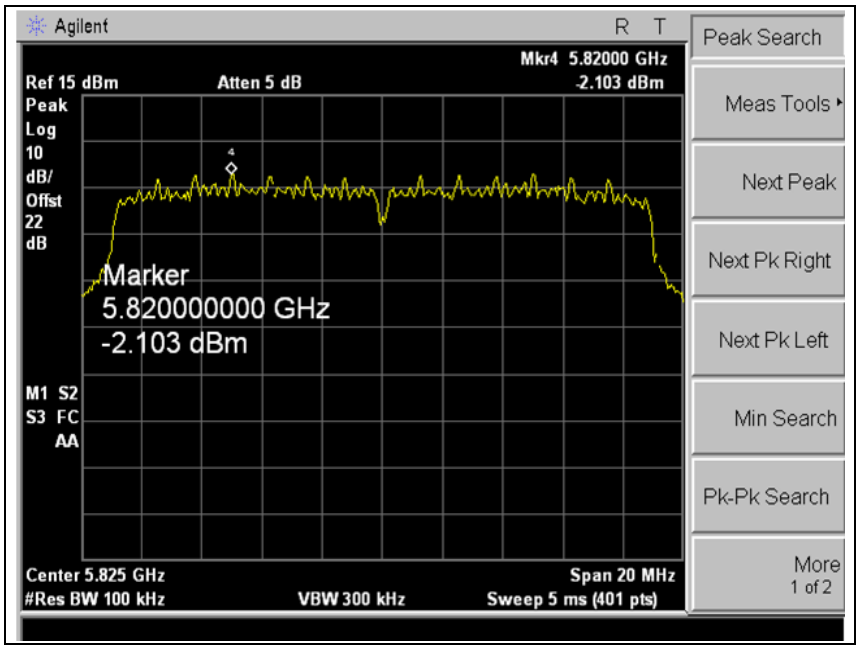
5.8GHz 802.11n-HT20 : Low



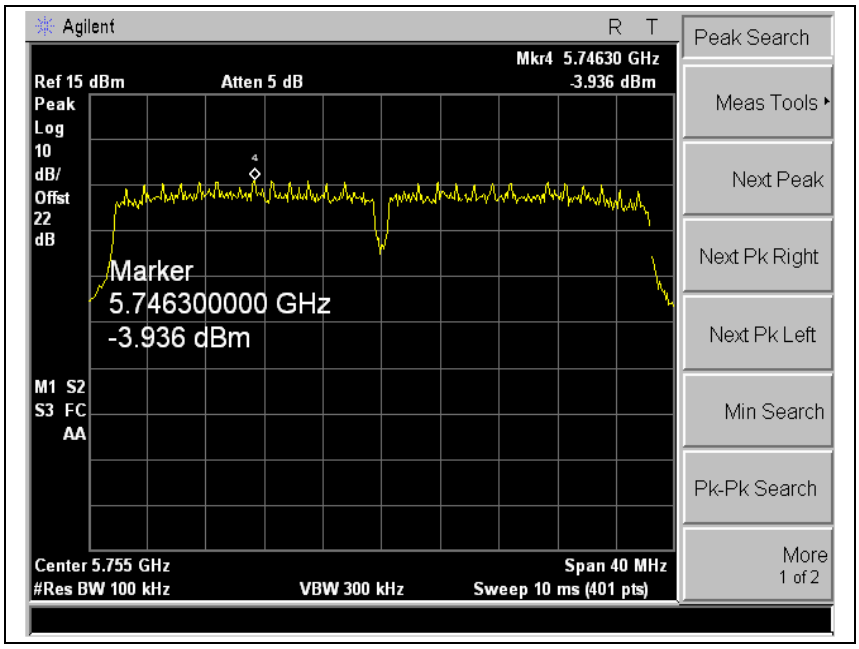
5.8GHz 802.11n-HT20 : Middle



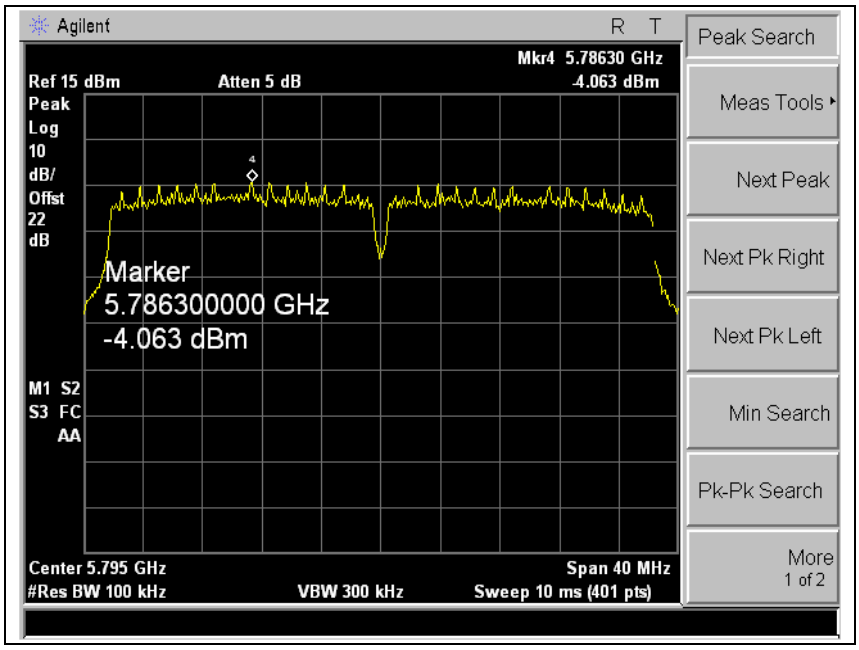
5.8GHz 802.11n-HT20 : High



5.8GHz 802.11n-HT40 : Low



5.8GHz 802.11n-HT40 : High



5.4. Conducted spurious emission Measurement

TEST: Transmitter Conducted spurious emission Measurement			
Method	Transmitter output is connected to a spectrum analyzer and emissions from the EUT were measured according to the dictates in section 5.4 of KDB 558074. The peak output power procedure is used to measure the fundamental emission power and unwanted emissions. Measurement Procedure – Reference Level 1. Set the RBW = 100 kHz., VBW ≥ 300 kHz. 2. Set the span to 5-30 % greater than the EBW. 4. Detector = peak. 5. Sweep time = auto couple. 6. Trace mode = max hold. 8. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW. Measurement Procedure - Unwanted Emissions 1. Set RBW, VBW, detector as same with above 2. Set span to encompass the spectrum to be examined.		
Reference Clause	Part15 C Section 15.247 (d)		
Parameters recorded during the test	Laboratory Ambient Temperature	22 °C	
	Relative Humidity	36 %	
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	30 MHz – 40 GHz	Antenna port	

Configuration Settings

Test Item	Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
Conducted Spurious emission	Rated	1	2
Supplementary information: None			

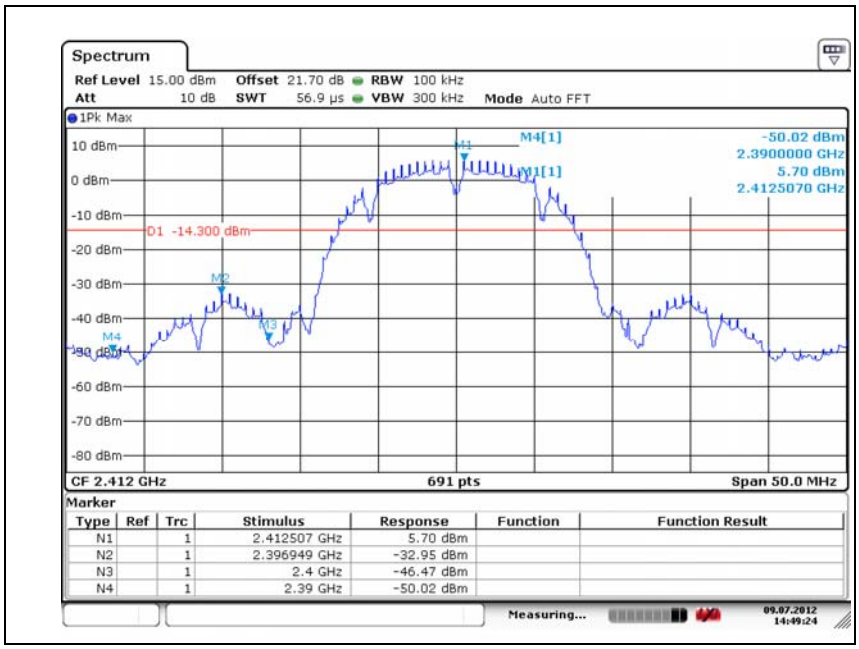
Limits

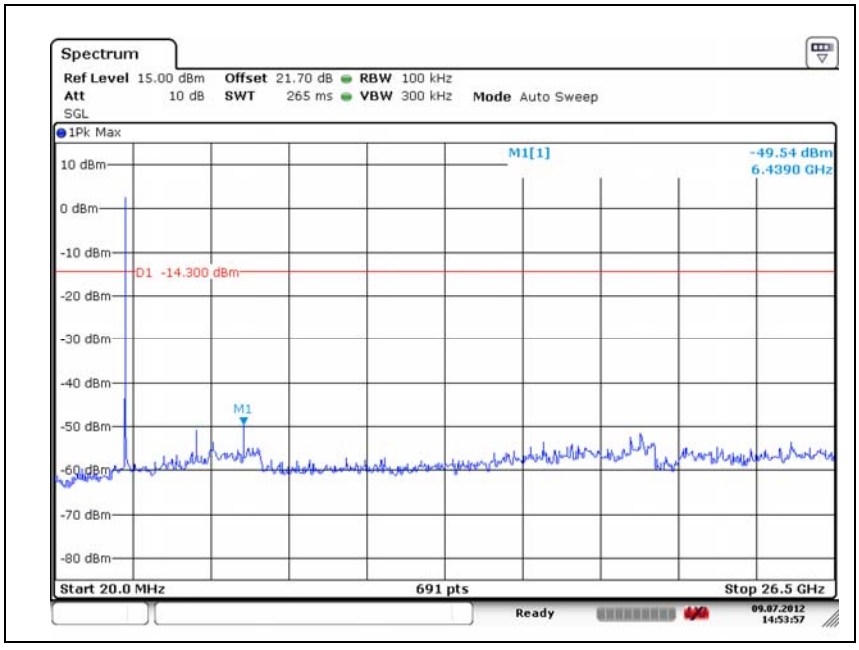
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within 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. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

Measurement Results

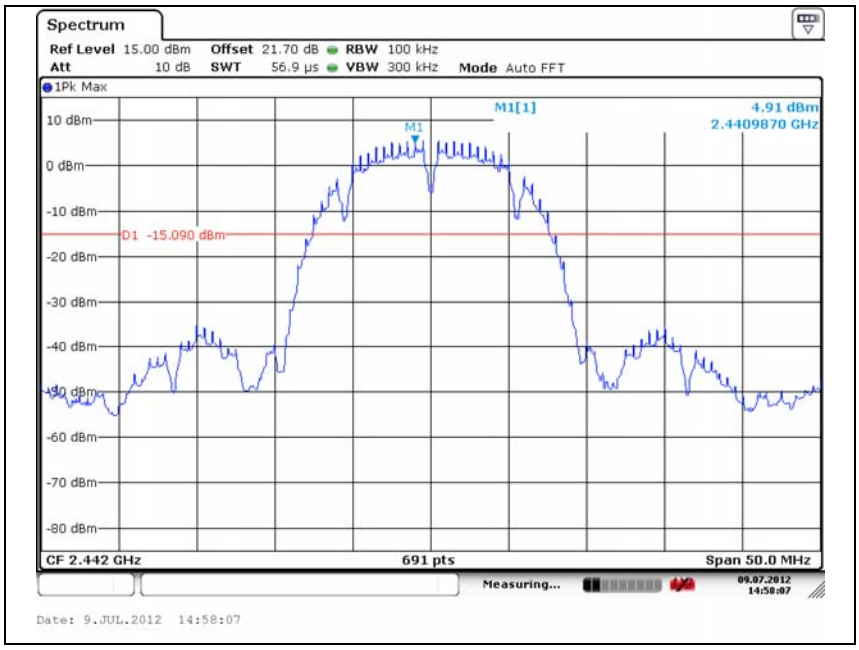
Figure 4. Plots of Band-Edge and Restricted / Non-Restricted frequency bands

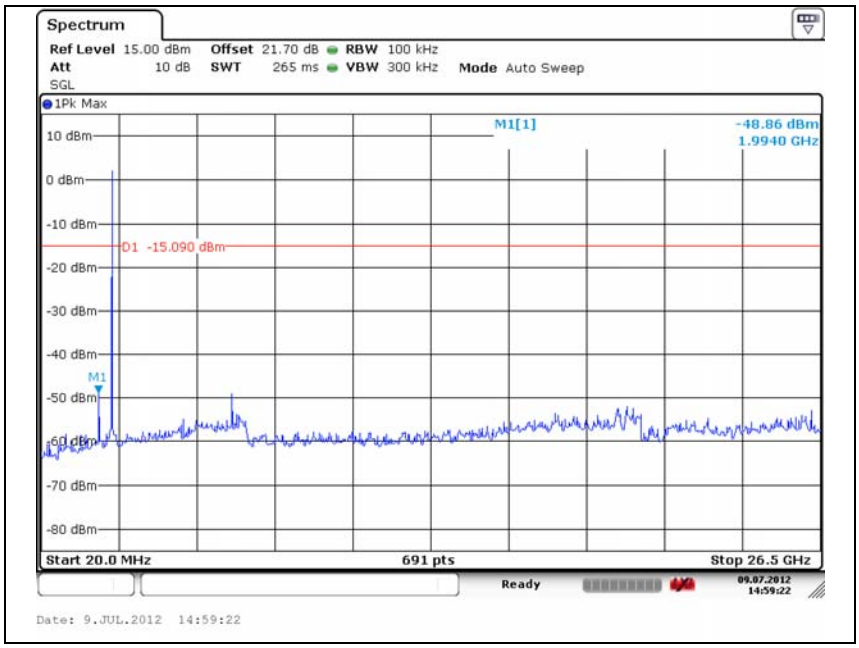
802.11b : Low



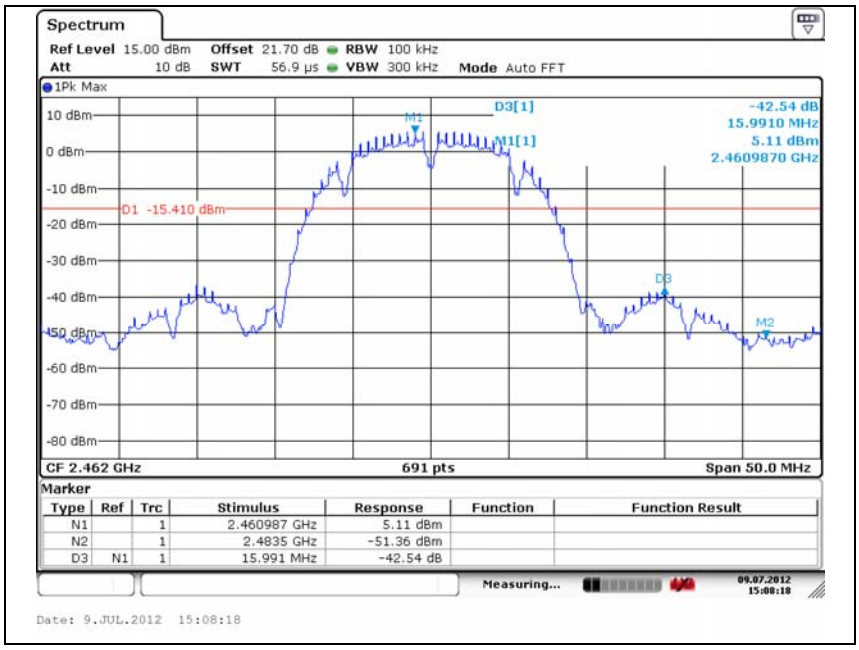


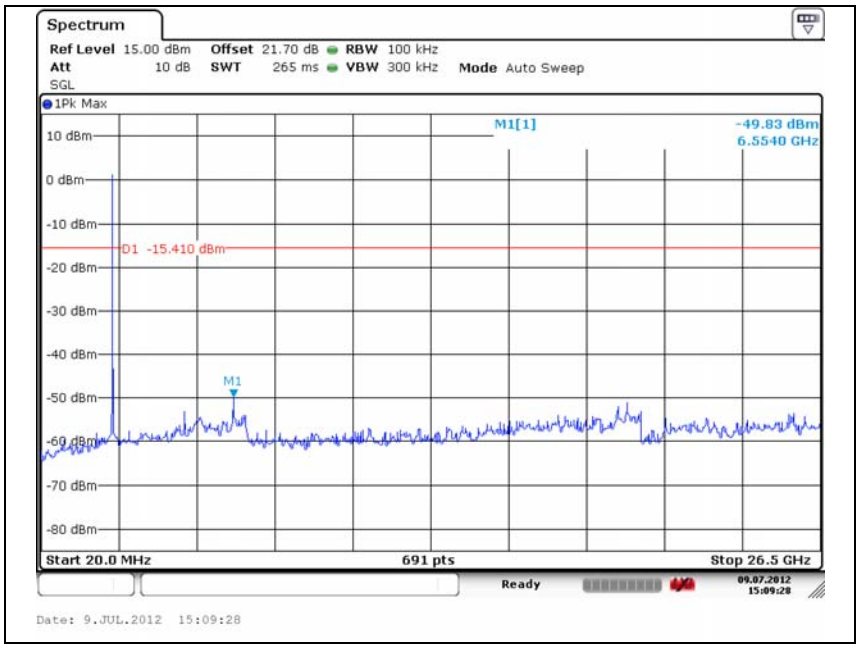
802.11b : Middle



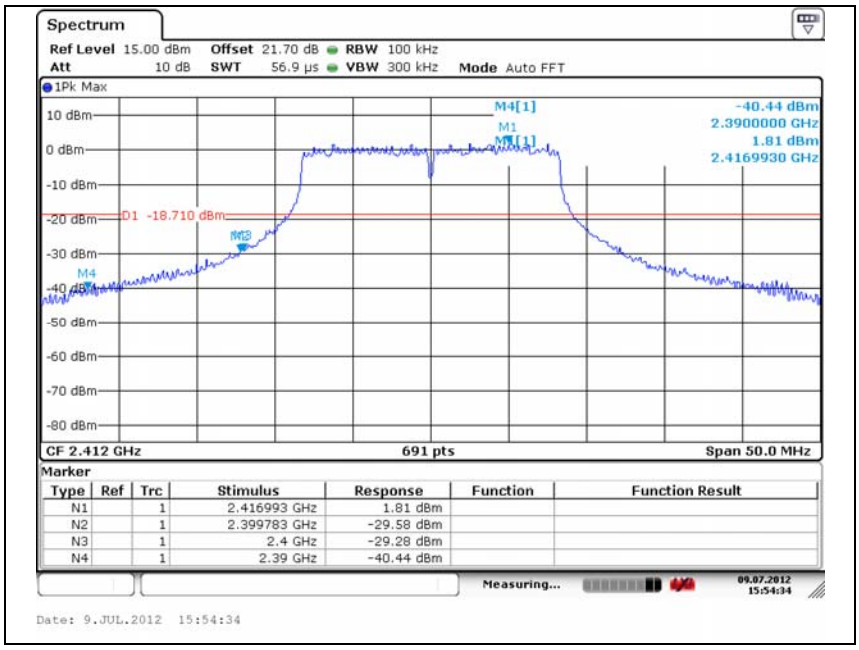


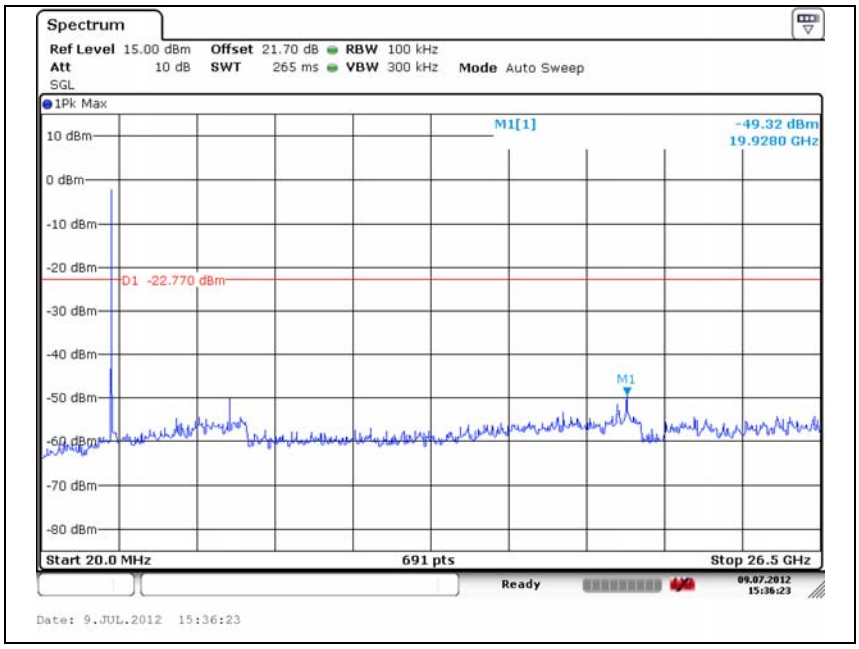
802.11b : High



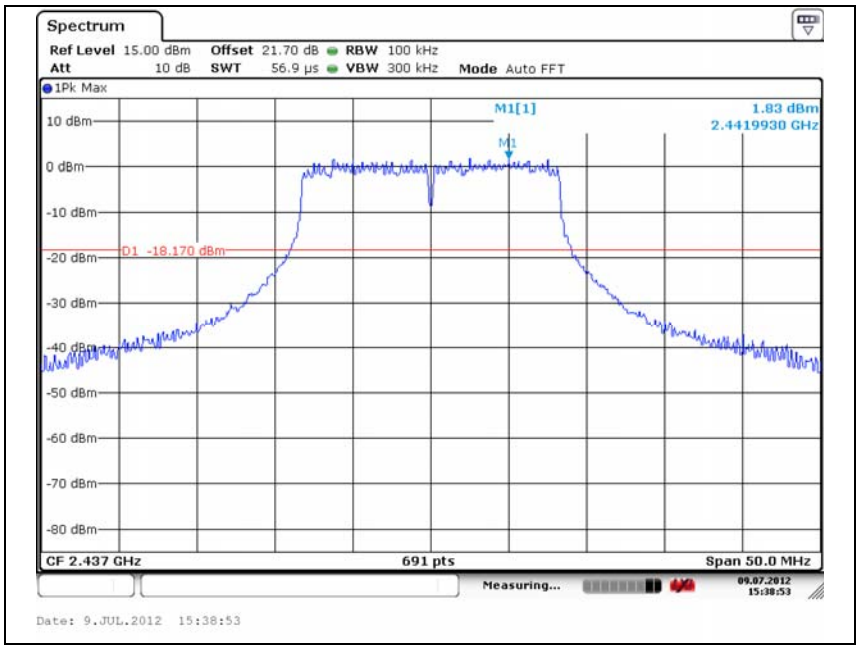


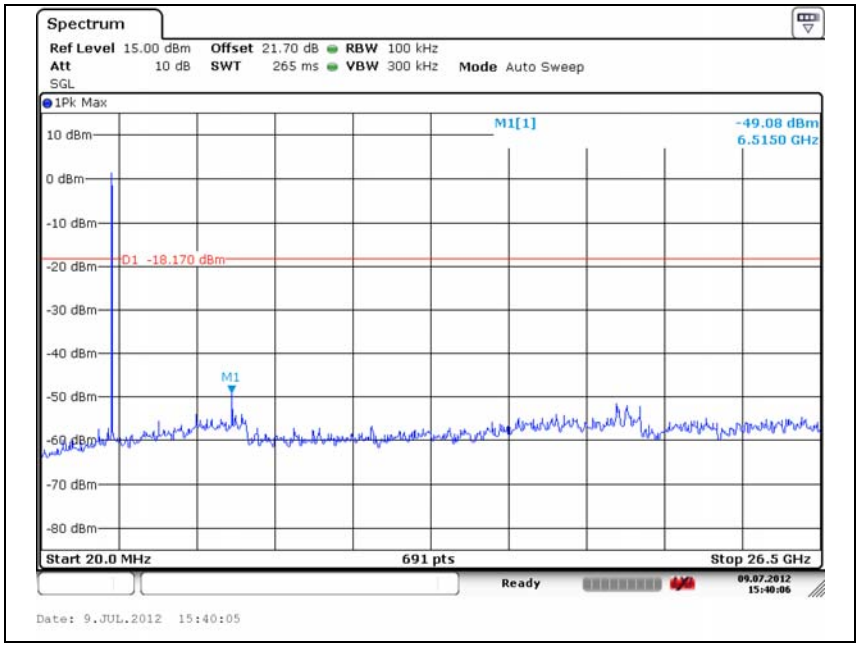
802.11g : Low



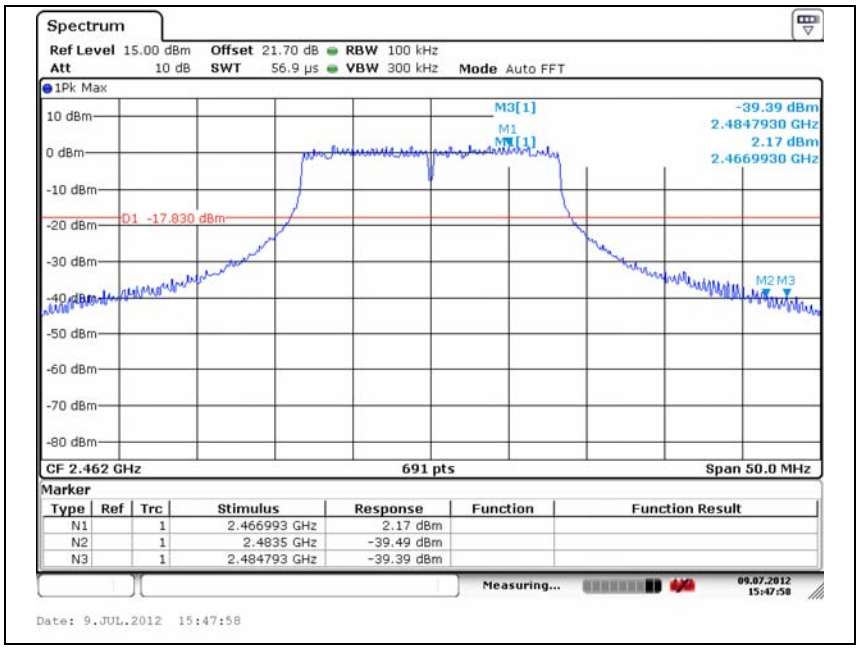


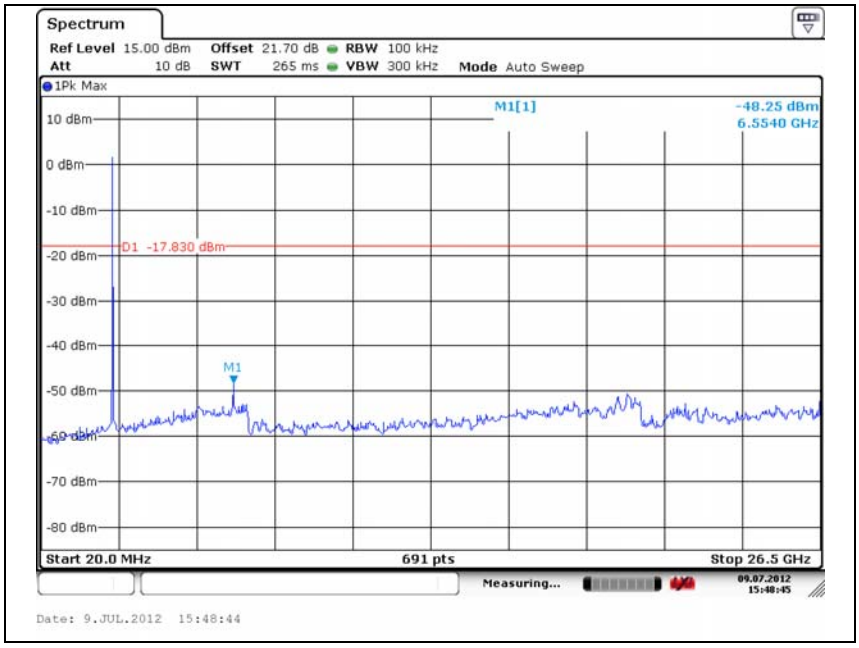
802.11g : Middle



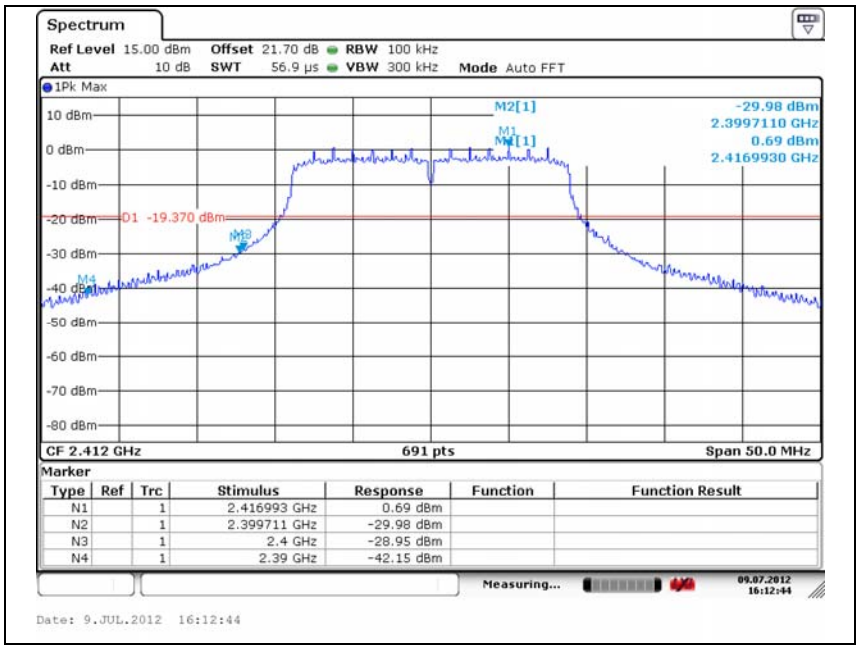


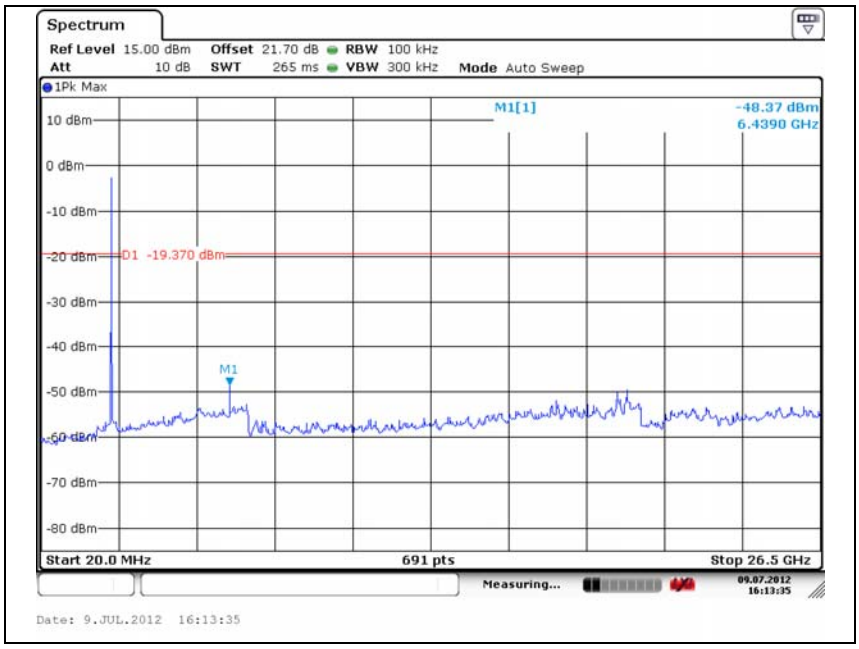
802.11g : High



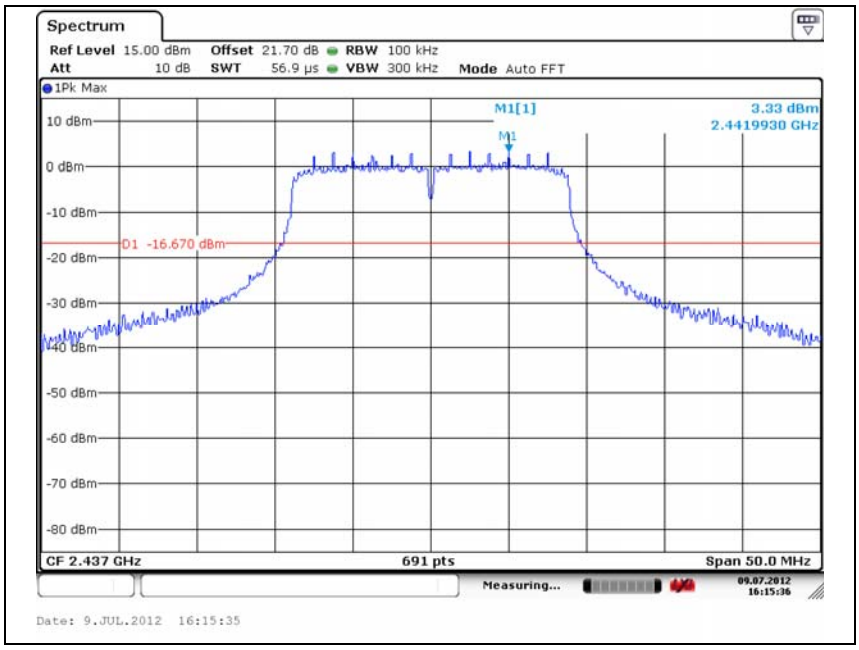


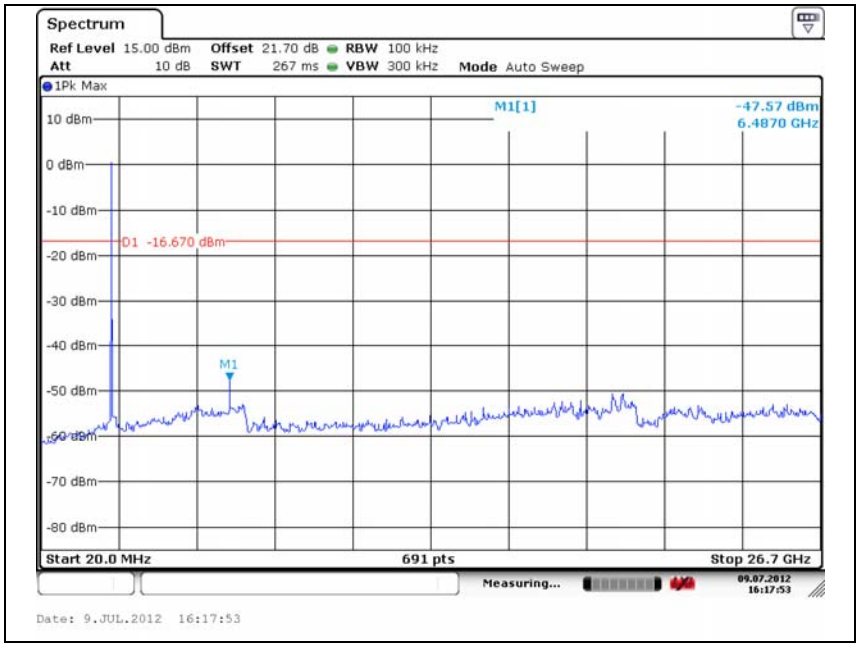
2.4GHz 802.11n : Low



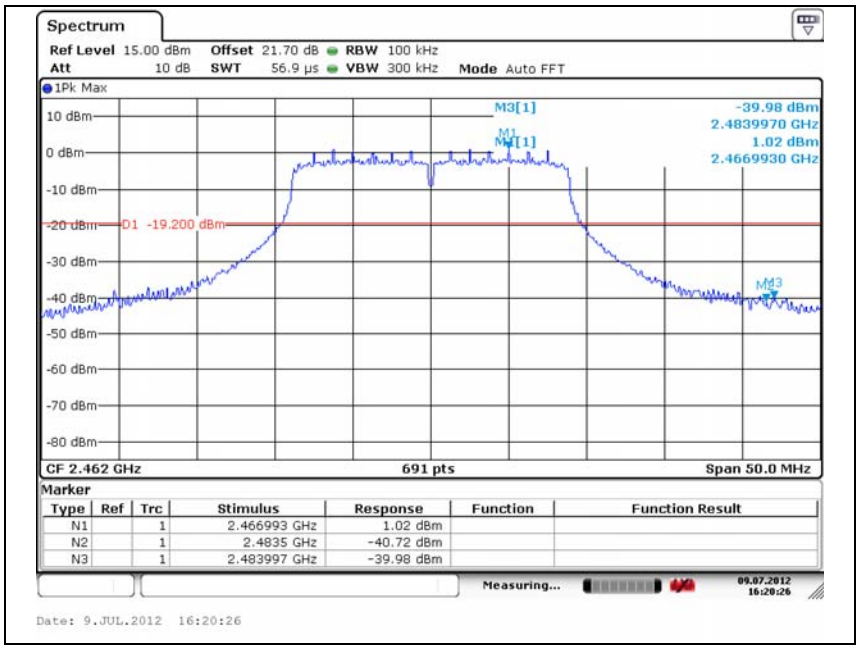


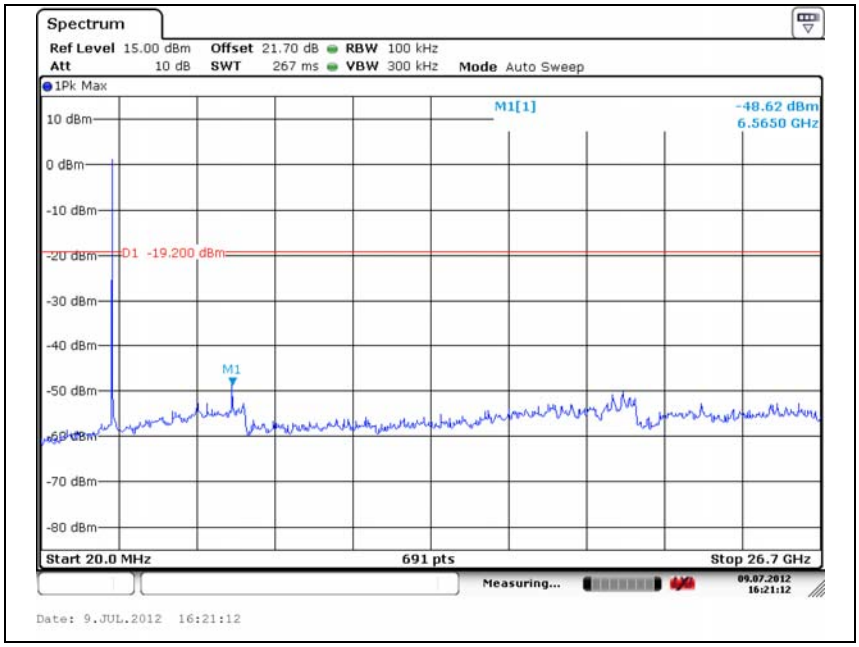
2.4GHz 802.11n : Middle



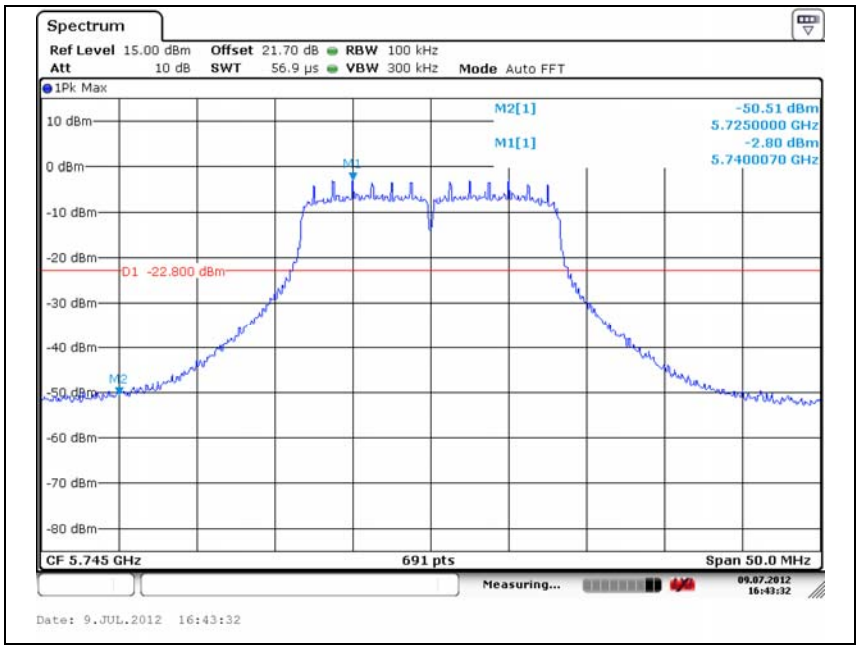


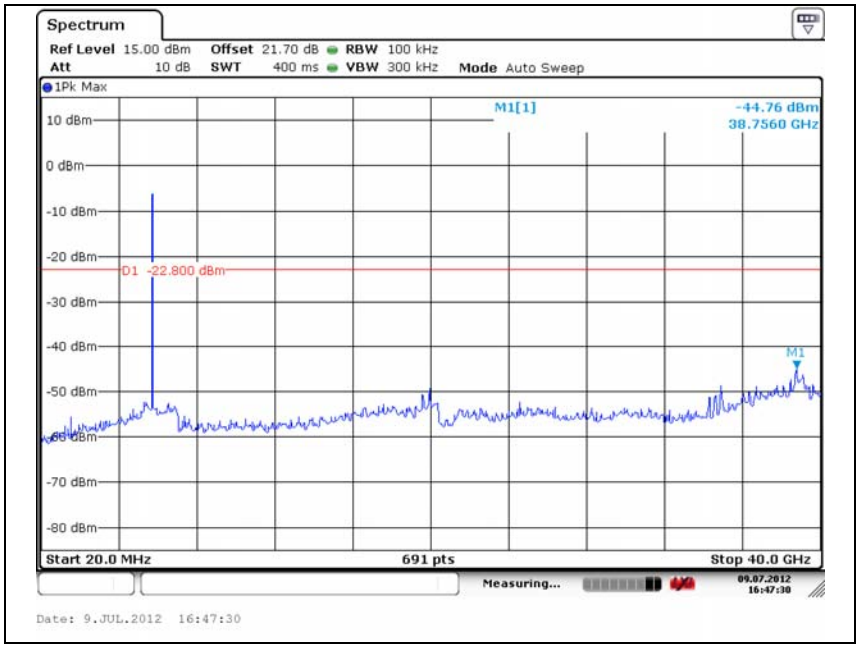
2.4GHz 802.11n : High



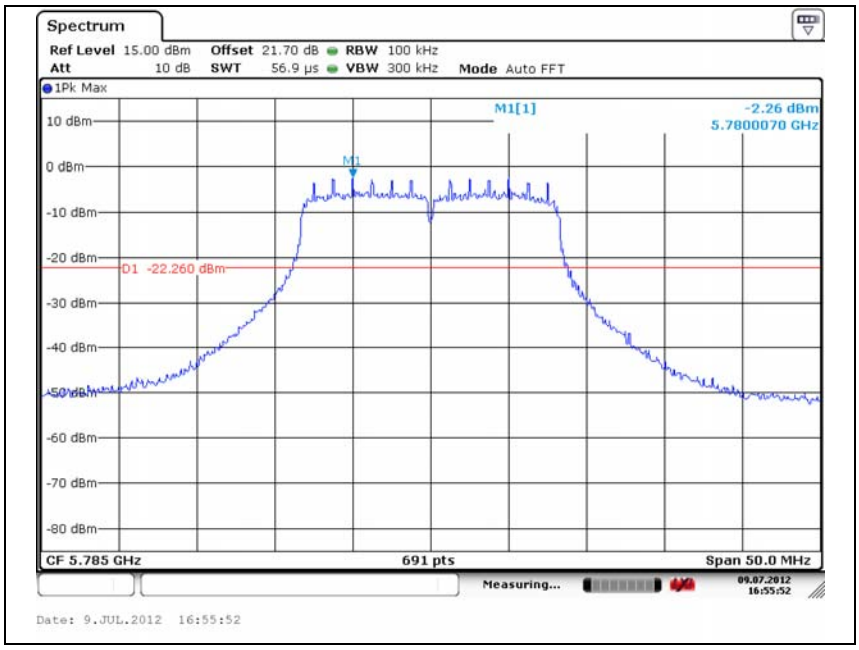


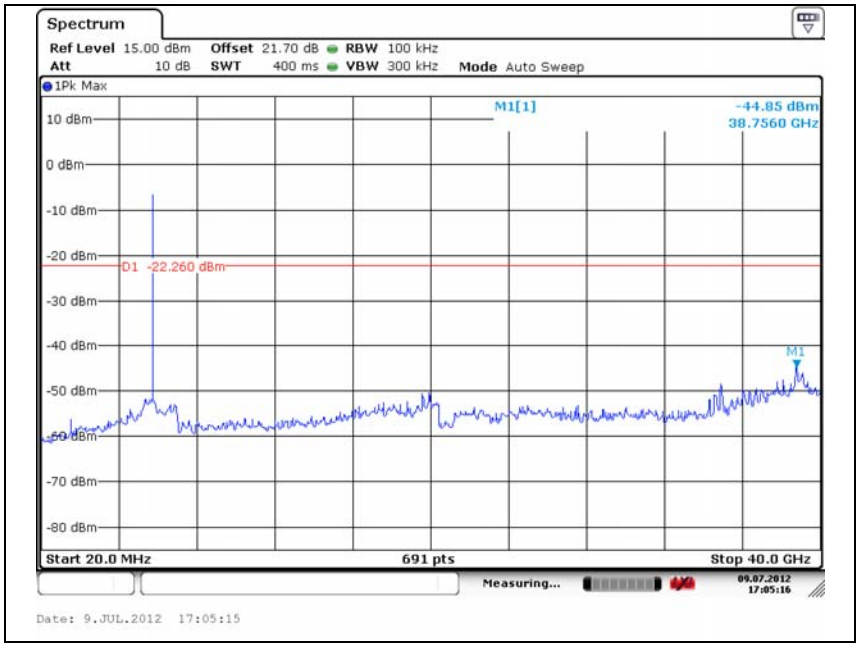
802.11a : Low



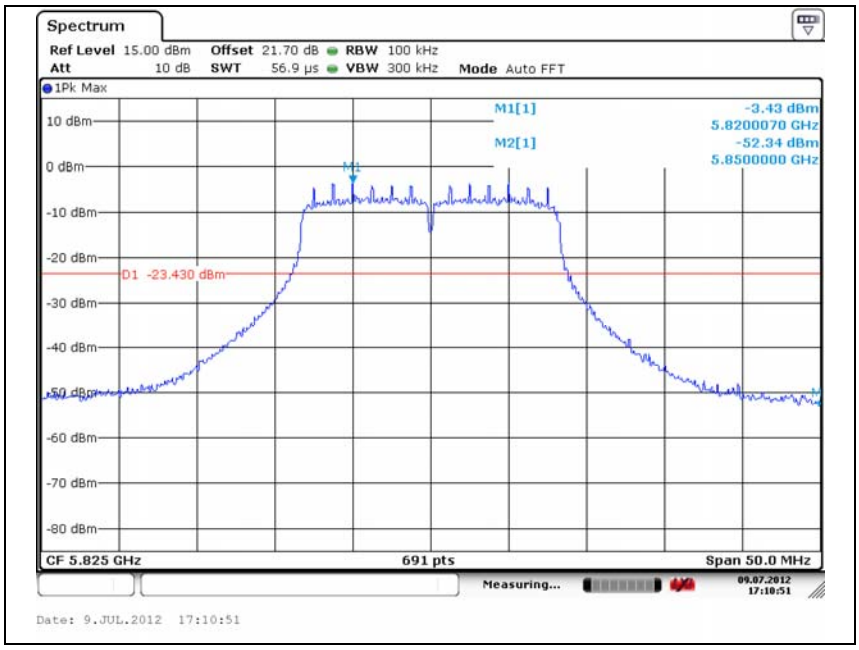


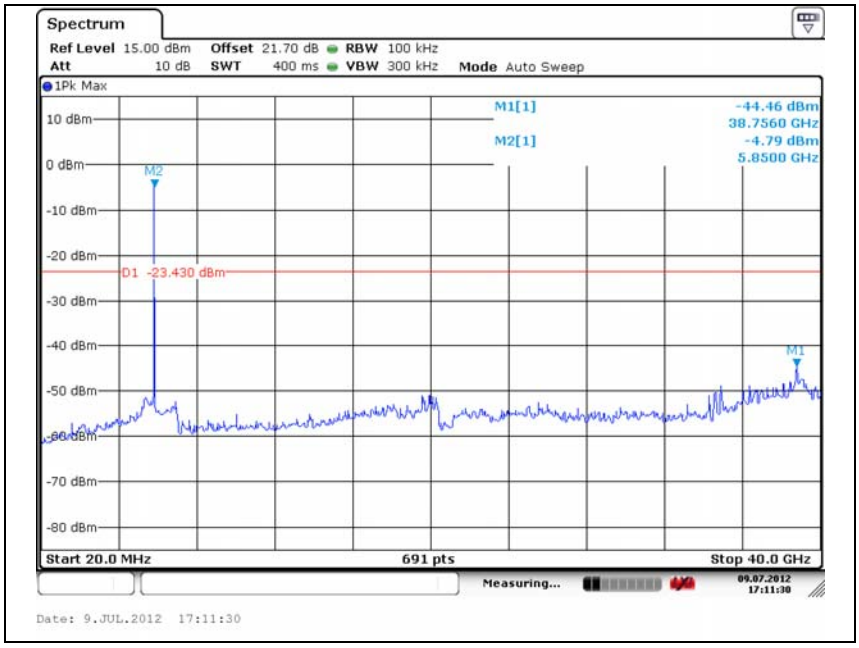
802.11a : Middle



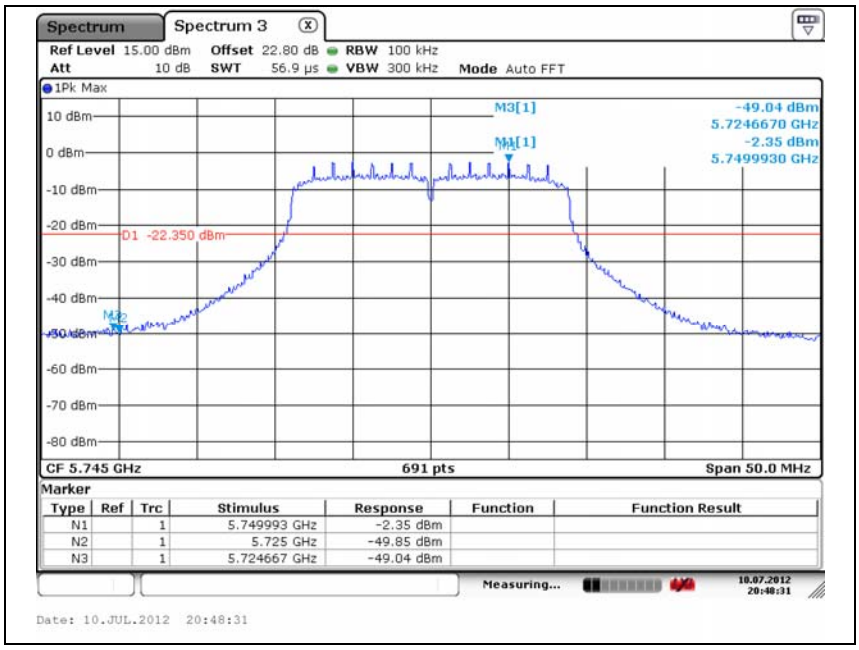


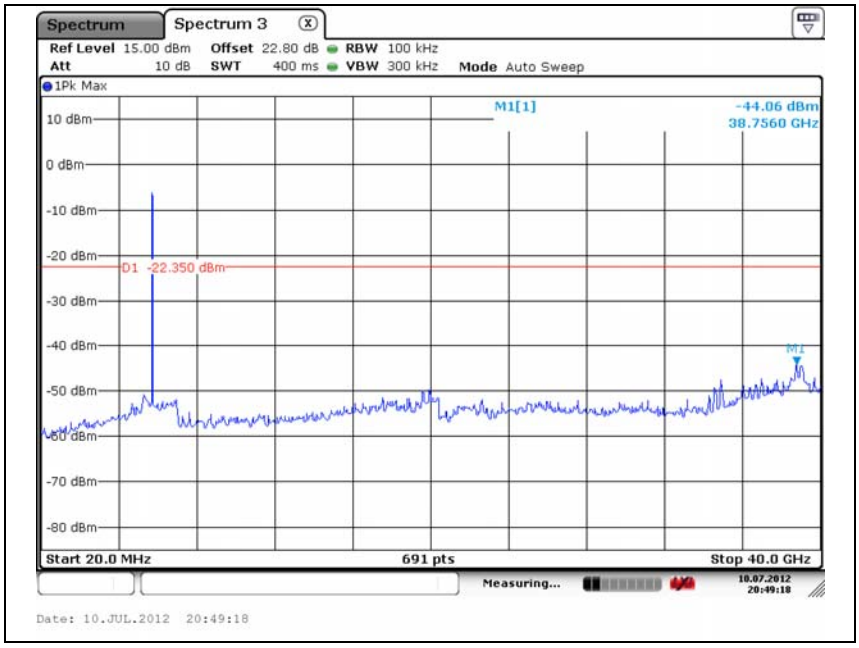
802.11a : High



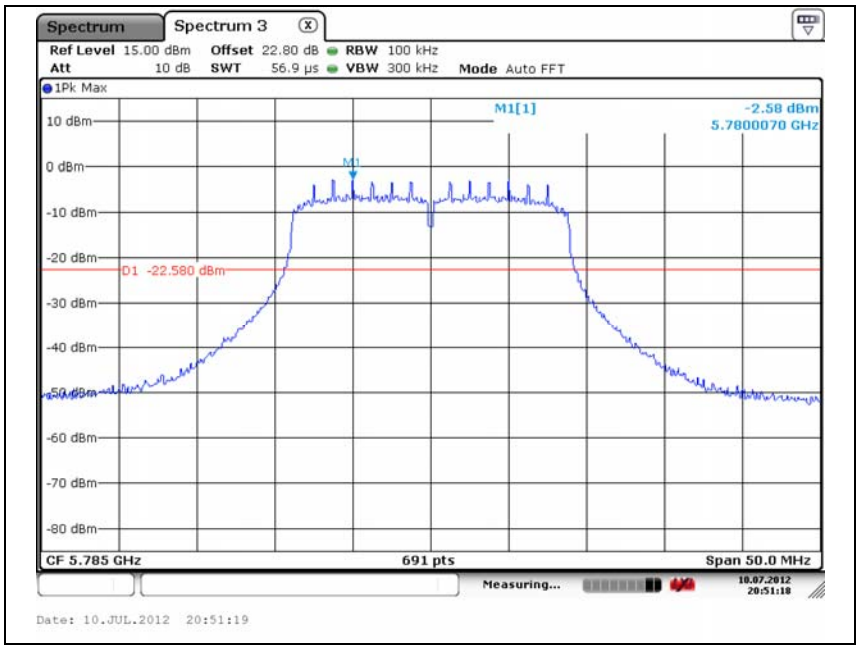


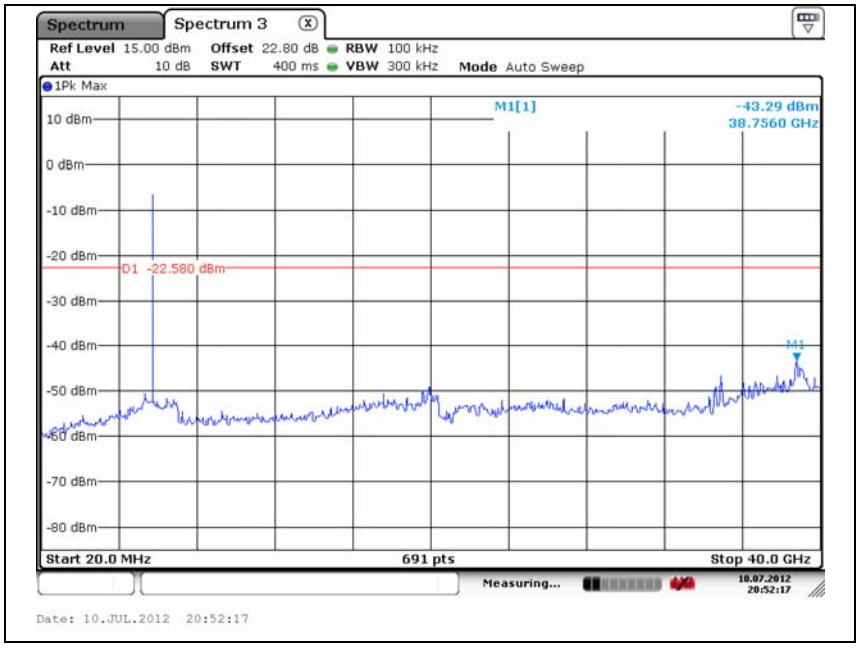
5GHz 802.11n-HT20 : Low



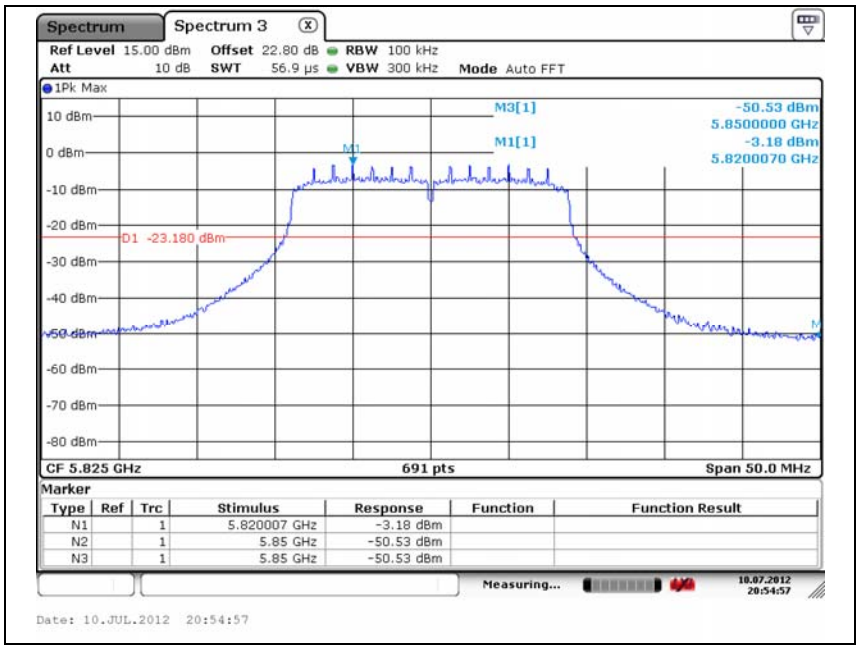


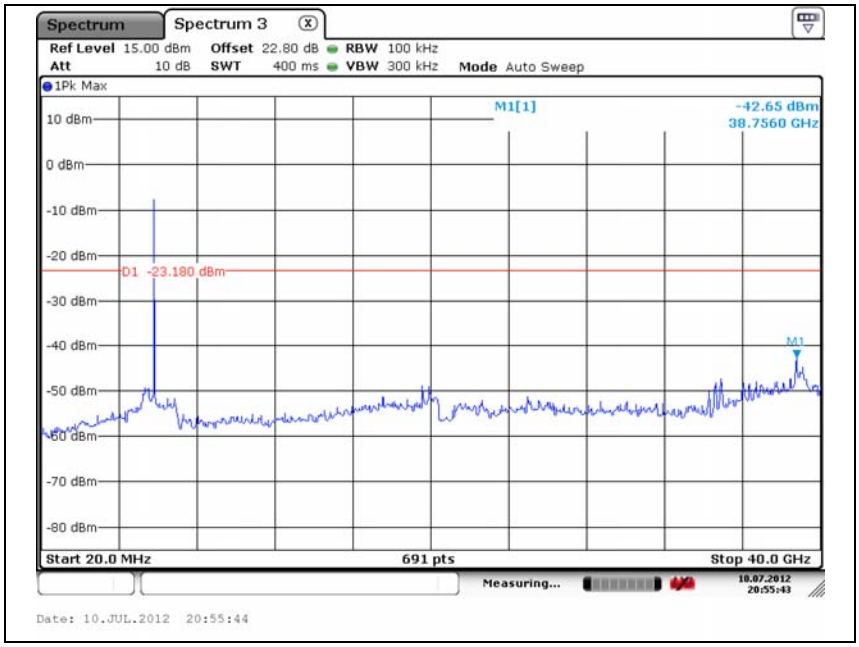
5GHz 802.11n-HT20 : Middle



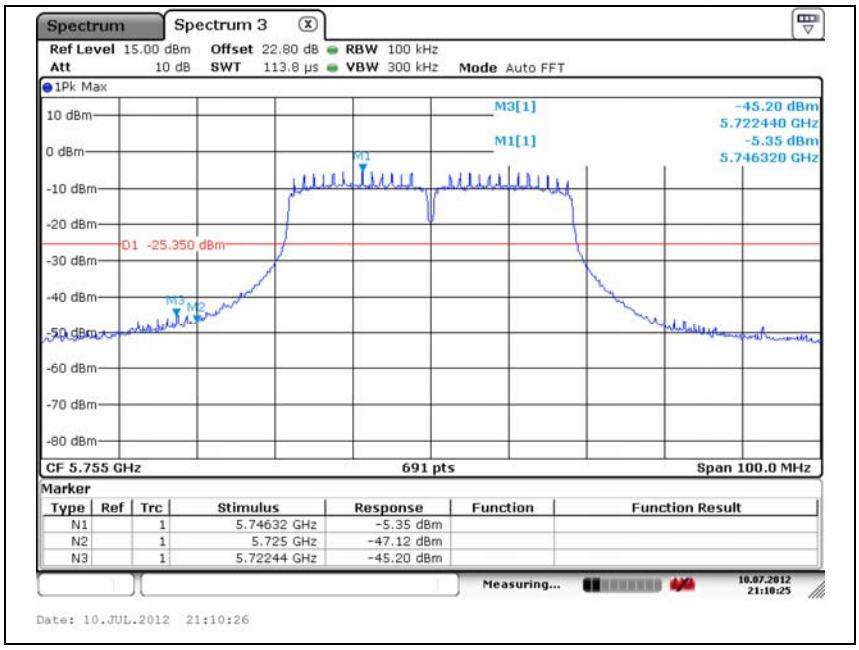


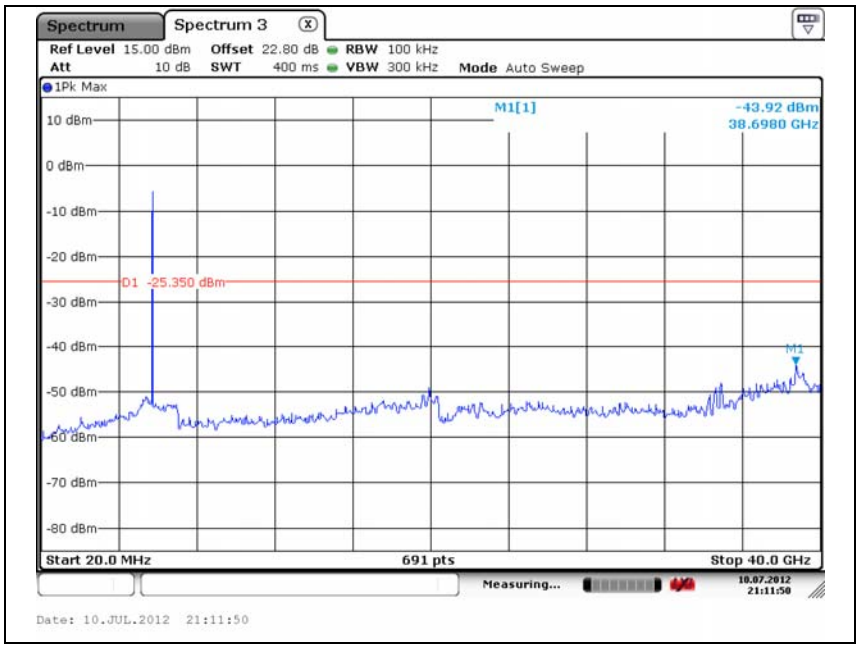
5GHz 802.11n-HT20 : High



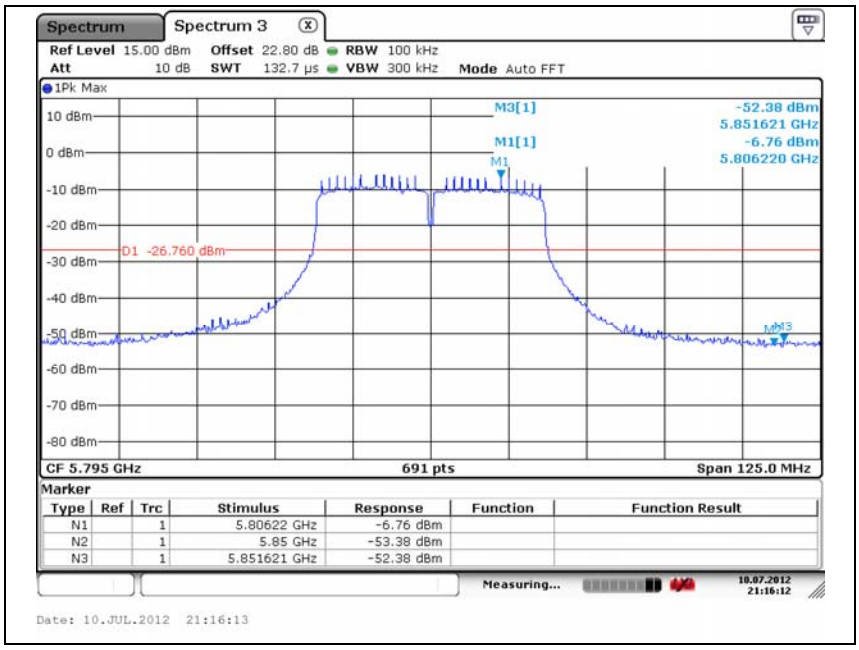


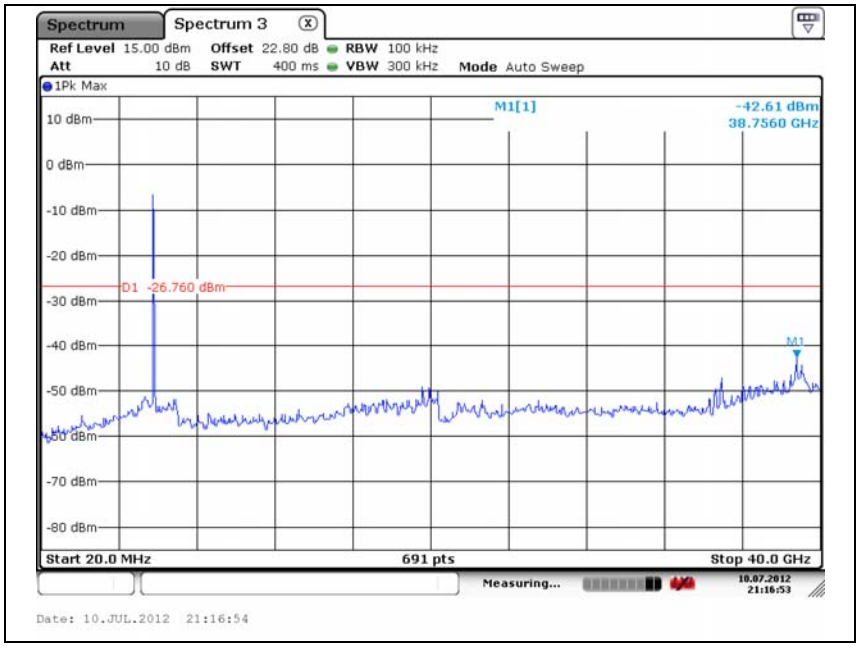
5GHz 802.11n-HT40 : Low





5GHz 802.11n-HT40 : High





5.5. Radiated spurious emissions Measurement

TEST: Transmitter radiated spurious emissions measurement		
Method	Radiated emissions from the EUT were measured according to ANSI C63.4 procedure. 1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation. The antenna is is varied from 1 to 4 meters above the ground to find the maximum field strength. Measurement are made with both horizontal and vertical polarizations For dundamental investigation, the EUT was positioned for 3 orthogonal orientations. 2. For measurement below 1GHz, the resolution bandwidth is set to 100 kHz for peak detection or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak. 3. For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement. 4. For 2.4GHz transmitter measurement, the spectrum from 30 MHz to 26GHz is investigated for Low, Mid and High channels. 5. For 5 GHz transmitter measurement, the spectrum from 30 MHz to 40GHz is investigated for Low, Mid and High channels.	
Reference Clause	Part15 C Section 15.247 (d)	
Parameters recorded during the test	Laboratory Ambient Temperature	22 °C
	Relative Humidity	36 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30 MHz – 40 GHz	3 meter chamber

Configuration Settings

Test Item	Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
Radiated Spurious emission	Rated	1	1
Supplementary information: None			

Limits

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. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Distance (meters)	Field Strength (dBuV/m)	Field Strength (uV/m)
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

5.5.1. Radiated Spurious Emissions Below 1 GHz

Measurement method : ☒ Radiated ☐ Conducted
Mode of operation : Continuous Wave
Power setting : Max. Power condition declared by the manufacturer
Worst case configuration :

Table 4. Test data for Radiated emission Below 1 GHz

Radiated emissions			Ant	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
48.00	3.24	Peak	V	N/A	12.65	1.06	16.95	40.00	23.05
72.00	9.04	Peak	V	N/A	10.67	1.24	20.95	40.00	19.05
74.10	10.27	Peak	V	N/A	10.28	1.28	21.84	40.00	18.16
101.90	9.77	Peak	V	N/A	8.27	1.60	19.64	43.50	23.86
117.30	23.57	Peak	V	N/A	9.65	1.67	34.89	43.50	8.61
119.80	23.10	Peak	V	N/A	9.87	1.70	34.67	43.50	8.83
123.10	23.79	Peak	V	N/A	10.21	1.70	35.70	43.50	7.80
184.30	7.74	Peak	V	N/A	10.63	2.04	20.41	43.50	23.09
245.50	10.01	Peak	H	N/A	11.00	2.36	23.37	46.00	22.63
282.90	7.48	Peak	H	N/A	12.49	2.53	22.50	46.00	23.50
562.50	5.74	Peak	V	N/A	19.01	3.64	28.39	46.00	17.61
662.80	5.12	Peak	H	N/A	20.31	4.00	29.43	46.00	16.57

Supplementary information:

- The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels of 30 dB below than the limit is not reported.
- The worst case is x-axis and reported.
- Actual = Reading + AF + CL (AF : Antenna factor, CL : Cable loss)
- Distance factor = 20log(Measurement distance / The measured distance)
- Margin = Limit (dBuV/m) - Actual (dBuV/m)
- The measurements for above 1 GHz, Average measurements are recorded using the RBAVG1 measurement procedure of KDB 558074. Peak measurements are recorded using RBW = 1 MHz, VBW = 3 MHz

5.5.2. Radiated Spurious Emissions Above 1 GHz – 2.4 GHz band

Measurement method : ☒ Radiated ☐ Conducted
Mode of operation : 2.4 GHz band Continuous Wave
Power setting : Max. Power condition declared by the manufacturer

Table 5. 802.11b Low Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
*2390.0	53.14	Peak	H	N/A	27.11	-28.37	74.00	51.88	22.12
*2390.0	52.14	Peak	V	N/A	27.11	-28.37	74.00	50.88	23.12
2412.0	78.06	Peak	H	N/A	27.16	5.45	-	110.66	OB
2412.0	72.08	Peak	V	N/A	27.16	5.45	-	104.68	OB
4824.0	46.62	Peak	H	N/A	31.52	-22.74	74.00	55.40	18.60
4824.0	45.01	Peak	V	N/A	31.52	-22.74	74.00	53.79	20.21
6412.0	47.32	Peak	H	N/A	33.84	-20.63	74.00	60.53	13.47
6412.0	46.67	Peak	V	N/A	33.84	-20.63	74.00	59.88	14.12
*2390.0	35.62	Average	H	N/A	27.11	-28.37	54.00	34.36	19.64
*2390.0	34.62	Average	V	N/A	27.11	-28.37	54.00	33.36	20.64
2412.0	66.62	Average	H	N/A	27.16	5.45	-	99.22	OB
2412.0	61.08	Average	V	N/A	27.16	5.45	-	93.68	OB
4824.0	33.90	Average	H	N/A	31.52	-22.74	54.00	42.68	11.32
4824.0	32.11	Average	V	N/A	31.52	-22.74	54.00	40.89	13.11
6412.0	34.72	Average	H	N/A	33.84	-20.63	54.00	47.93	6.07
6412.0	34.48	Average	V	N/A	33.84	-20.63	54.00	47.69	6.31

Table 6. 802.11b Mid Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
2437.0	78.45	Peak	H	N/A	27.21	5.49	-	111.15	OB
2437.0	72.38	Peak	V	N/A	27.21	5.49	-	105.08	OB
4874.0	44.46	Peak	H	N/A	31.61	-22.55	74.00	53.52	20.48
4874.0	44.96	Peak	V	N/A	31.61	-22.55	74.00	54.02	19.98
6486.0	46.96	Peak	H	N/A	34.03	-20.53	74.00	60.46	13.54
6486.0	46.57	Peak	V	N/A	34.03	-20.53	74.00	60.07	13.93
2437.0	68.45	Average	H	N/A	27.21	5.49	-	101.15	OB
2437.0	62.69	Average	V	N/A	27.21	5.49	-	95.39	OB
4874.0	32.87	Average	H	N/A	31.61	-22.55	54.00	41.93	12.07
4874.0	31.91	Average	V	N/A	31.61	-22.55	54.00	40.97	13.03
6486.0	33.46	Average	H	N/A	34.03	-20.53	54.00	46.96	7.04
6486.0	33.96	Average	V	N/A	34.03	-20.53	54.00	47.46	6.54

Table 7. 802.11b High Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
*2483.5	51.11	Peak	H	N/A	27.31	-28.16	74.00	50.26	23.74
*2483.5	50.38	Peak	V	N/A	27.31	-28.16	74.00	49.53	24.47
2462.0	79.15	Peak	H	N/A	27.26	5.52	-	111.94	OB
2462.0	71.38	Peak	V	N/A	27.26	5.52	-	104.17	OB
4924.0	44.56	Peak	H	N/A	31.70	-22.37	74.00	53.89	20.11
4924.0	44.70	Peak	V	N/A	31.70	-22.37	74.00	54.03	19.97
6565.0	46.07	Peak	H	N/A	34.24	-20.43	74.00	59.88	14.12
6565.0	46.71	Peak	V	N/A	34.24	-20.43	74.00	60.52	13.48
*2483.5	34.91	Average	H	N/A	27.31	-28.16	54.00	34.06	19.94
*2483.5	34.62	Average	V	N/A	27.31	-28.16	54.00	33.77	20.23
2462.0	68.82	Average	H	N/A	27.26	5.52	-	101.61	OB
2462.0	60.70	Average	V	N/A	27.26	5.52	-	93.49	OB
4924.0	33.01	Average	H	N/A	31.70	-22.37	54.00	42.34	11.66
4924.0	32.07	Average	V	N/A	31.70	-22.37	54.00	41.40	12.60
6565.0	34.12	Average	H	N/A	34.24	-20.43	54.00	47.93	6.07
6565.0	34.27	Average	V	N/A	34.24	-20.43	54.00	48.08	5.92

Table 8. 802.11g Low Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
*2390.0	62.71	Peak	H	N/A	27.11	-28.37	74.00	61.45	12.55
*2390.0	60.14	Peak	V	N/A	27.11	-28.37	74.00	58.88	15.12
2412.0	74.23	Peak	H	N/A	27.16	5.45	-	106.83	OB
2412.0	70.12	Peak	V	N/A	27.16	5.45	-	102.72	OB
4824.0	46.71	Peak	H	N/A	31.52	-22.74	74.00	55.49	18.51
4824.0	45.87	Peak	V	N/A	31.52	-22.74	74.00	54.65	19.35
6412.0	47.27	Peak	H	N/A	33.84	-20.63	74.00	60.48	13.52
6412.0	44.72	Peak	V	N/A	33.84	-20.63	74.00	57.93	16.07
*2390.0	42.23	Average	H	N/A	27.11	-28.37	54.00	40.97	13.03
*2390.0	40.47	Average	V	N/A	27.11	-28.37	54.00	39.21	14.79
2412.0	56.43	Average	H	N/A	27.16	5.45	-	89.03	OB
2412.0	53.05	Average	V	N/A	27.16	5.45	-	85.65	OB
4824.0	33.72	Average	H	N/A	31.52	-22.74	54.00	42.50	11.50
4824.0	32.21	Average	V	N/A	31.52	-22.74	54.00	40.99	13.01
6412.0	34.51	Average	H	N/A	33.84	-20.63	54.00	47.72	6.28
6412.0	32.03	Average	V	N/A	33.84	-20.63	54.00	45.24	8.76

Table 9. 802.11g Middle Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
2437.0	74.17	Peak	H	N/A	27.21	5.49	-	106.87	OB
2437.0	70.07	Peak	V	N/A	27.21	5.49	-	102.77	OB
4874.0	44.46	Peak	H	N/A	31.61	-22.55	74.00	53.52	20.48
4874.0	44.87	Peak	V	N/A	31.61	-22.55	74.00	53.93	20.07
6486.0	46.17	Peak	H	N/A	34.03	-20.53	74.00	59.67	14.33
6486.0	44.62	Peak	V	N/A	34.03	-20.53	74.00	58.12	15.88
2437.0	56.17	Average	H	N/A	27.21	5.49	-	88.87	OB
2437.0	52.91	Average	V	N/A	27.21	5.49	-	85.61	OB
4874.0	32.87	Average	H	N/A	31.61	-22.55	54.00	41.93	12.07
4874.0	32.22	Average	V	N/A	31.61	-22.55	54.00	41.28	12.72
6486.0	33.71	Average	H	N/A	34.03	-20.53	54.00	47.21	6.79
6486.0	32.01	Average	V	N/A	34.03	-20.53	54.00	45.51	8.49

Table 10. 802.11g High Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
*2483.5	60.17	Peak	H	N/A	27.31	-28.16	74.00	59.32	14.68
*2483.5	59.14	Peak	V	N/A	27.31	-28.16	74.00	58.29	15.71
2462.0	74.15	Peak	H	N/A	27.26	5.52	-	106.94	OB
2462.0	70.08	Peak	V	N/A	27.26	5.52	-	102.87	OB
4924.0	44.41	Peak	H	N/A	31.70	-15.08	74.00	61.03	12.97
4924.0	44.52	Peak	V	N/A	31.70	-15.08	74.00	61.14	12.86
6565.0	46.10	Peak	H	N/A	34.24	-20.43	74.00	59.91	14.09
6565.0	44.62	Peak	V	N/A	34.24	-20.43	74.00	58.43	15.57
*2483.5	39.80	Average	H	N/A	27.31	-28.16	54.00	38.95	15.05
*2483.5	39.50	Average	V	N/A	27.31	-28.16	54.00	38.65	15.35
2462.0	58.08	Average	H	N/A	27.26	5.52	-	90.87	OB
2462.0	52.89	Average	V	N/A	27.26	5.52	-	85.68	OB
4924.0	32.62	Average	H	N/A	31.70	-15.08	54.00	49.24	4.76
4924.0	34.02	Average	V	N/A	31.70	-15.08	54.00	50.64	3.36
6565.0	32.04	Average	H	N/A	34.24	-20.43	54.00	45.85	8.15
6565.0	32.01	Average	V	N/A	34.24	-20.43	54.00	45.82	8.18

Table 11. 802.11n-HT20 Low Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
*2390.0	59.48	Peak	H	N/A	27.11	-28.37	74.00	58.22	15.78
*2390.0	59.21	Peak	V	N/A	27.11	-28.37	74.00	57.95	16.05
2412.0	77.87	Peak	H	N/A	27.16	5.45	-	110.47	OB
2412.0	70.07	Peak	V	N/A	27.16	5.45	-	102.67	OB
4824.0	43.72	Peak	H	N/A	31.52	-22.74	74.00	52.50	21.50
4824.0	44.01	Peak	V	N/A	31.52	-22.74	74.00	52.79	21.21
6412.0	44.72	Peak	H	N/A	33.84	-20.63	74.00	57.93	16.07
6412.0	44.62	Peak	V	N/A	33.84	-20.63	74.00	57.83	16.17
*2390.0	39.50	Average	H	N/A	27.11	-28.37	54.00	38.24	15.76
*2390.0	39.21	Average	V	N/A	27.11	-28.37	54.00	37.95	16.05
2412.0	63.72	Average	H	N/A	27.16	5.45	-	96.32	OB
2412.0	53.01	Average	V	N/A	27.16	5.45	-	85.61	OB
4824.0	31.20	Average	H	N/A	31.52	-22.74	54.00	39.98	14.02
4824.0	30.90	Average	V	N/A	31.52	-22.74	54.00	39.68	14.32
6412.0	30.90	Average	H	N/A	33.84	-20.63	54.00	44.11	9.89
6412.0	31.10	Average	V	N/A	33.84	-20.63	54.00	44.31	9.69

Table 12. 802.11n-HT20 Middle Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
2437.0	78.41	Peak	H	N/A	27.21	5.49	-	111.11	OB
2437.0	69.27	Peak	V	N/A	27.21	5.49	-	101.97	OB
4874.0	43.77	Peak	H	N/A	31.61	-22.55	74.00	52.83	21.17
4874.0	44.22	Peak	V	N/A	31.61	-22.55	74.00	53.28	20.72
6486.0	44.71	Peak	H	N/A	34.03	-20.53	74.00	58.21	15.79
6486.0	43.72	Peak	V	N/A	34.03	-20.53	74.00	57.22	16.78
2437.0	64.72	Average	H	N/A	27.21	5.49	-	97.42	OB
2437.0	52.72	Average	V	N/A	27.21	5.49	-	85.42	OB
4874.0	31.20	Average	H	N/A	31.61	-22.55	54.00	40.26	13.74
4874.0	30.70	Average	V	N/A	31.61	-22.55	54.00	39.76	14.24
6486.0	31.10	Average	H	N/A	34.03	-20.53	54.00	44.60	9.40
6486.0	31.20	Average	V	N/A	34.03	-20.53	54.00	44.70	9.30

Table 13. 802.11n-HT20 High Channel

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
*2483.5	60.11	Peak	H	N/A	27.31	-28.16	74.00	59.26	14.74
*2483.5	59.11	Peak	V	N/A	27.31	-28.16	74.00	58.26	15.74
2462.0	78.81	Peak	H	N/A	27.26	5.52	-	111.60	OB
2462.0	69.72	Peak	V	N/A	27.26	5.52	-	102.51	OB
4924.0	44.01	Peak	H	N/A	31.70	-15.08	74.00	60.63	13.37
4924.0	43.72	Peak	V	N/A	31.70	-15.08	74.00	60.34	13.66
6565.0	44.73	Peak	H	N/A	34.24	-20.43	74.00	58.54	15.46
6565.0	43.94	Peak	V	N/A	34.24	-20.43	74.00	57.75	16.256
*2483.5	39.91	Average	H	N/A	27.31	-28.16	54.00	39.06	14.94
*2483.5	39.84	Average	V	N/A	27.31	-28.16	54.00	38.99	15.01
2462.0	63.61	Average	H	N/A	27.26	5.52	-	96.40	OB
2462.0	52.20	Average	V	N/A	27.26	5.52	-	84.99	OB
4924.0	30.72	Average	H	N/A	31.70	-15.08	54.00	47.34	6.66
4924.0	30.21	Average	V	N/A	31.70	-15.08	54.00	46.83	7.17
6565.0	31.10	Average	H	N/A	34.24	-20.43	54.00	44.91	9.09
6565.0	31.24	Average	V	N/A	34.24	-20.43	54.00	45.05	8.95

Supplementary information:

- The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels of 30 dB below than the limit is not reported.
- The worst case is x-axis and reported.
- Actual = Reading + AF + CL (AF : Antenna factor, CL : Cable loss)
- Distance factor = 20log(Measurement distance / The measured distance)
- Margin = Limit (dBuV/m) - Actual (dBuV/m)
- The measurements for above 1 GHz, Average measurements are recorded using the RBAVG1 measurement procedure of KDB 558074. Peak measurements are recorded using RBW = 1 MHz, VBW = 3 MHz

5.5.3. Radiated Spurious Emissions Above 1 GHz – 5 GHz band

Measurement method : ☒ Radiated ☐ Conducted
Mode of operation : 5 GHz band Continuous Wave
Power setting : Max. Power condition declared by the manufacturer

Table 14. 802.11a Low Channel (5745 MHz)

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
5745.0	67.11	Peak	H	N/A	32.54	8.89	-	108.54	OB
5745.0	57.09	Peak	V	N/A	32.54	8.89	-	98.52	OB
11490.0	43.01	Peak	H	N/A	39.30	-14.80	74.00	67.51	6.49
11490.0	43.36	Peak	V	N/A	39.30	-14.80	74.00	67.86	6.14
5745.0	53.44	Average	H	N/A	32.54	8.89	-	94.87	OB
5745.0	44.03	Average	V	N/A	32.54	8.89	-	85.46	OB
11490.0	24.42	Average	H	N/A	39.30	-14.80	54.00	48.92	5.08
11490.0	24.72	Average	V	N/A	39.30	-14.80	54.00	49.22	4.78

Table 15. 802.11a Middle Channel (5785 MHz)

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
5785.0	66.36	Peak	H	N/A	32.58	8.91	-	107.84	OB
5785.0	56.82	Peak	V	N/A	32.58	8.91	-	98.30	OB
11570.0	43.09	Peak	H	N/A	39.06	-14.74	74.00	67.41	6.59
11570.0	42.36	Peak	V	N/A	39.06	-14.74	74.00	66.68	7.32
5785.0	54.03	Average	H	N/A	32.58	8.91	-	95.51	OB
5785.0	43.87	Average	V	N/A	32.58	8.91	-	85.35	OB
11570.0	24.43	Average	H	N/A	39.06	-14.74	54.00	48.75	5.25
11570.0	24.27	Average	V	N/A	39.06	-14.74	54.00	48.59	5.41

Table 16. 802.11a High Channel (5825 MHz)

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
5825.0	67.20	Peak	H	N/A	32.61	8.95	-	108.76	OB
5825.0	58.72	Peak	V	N/A	32.61	8.95	-	100.28	OB
11650.0	43.81	Peak	H	N/A	38.82	-14.69	74.00	67.94	6.06
11650.0	42.34	Peak	V	N/A	38.82	-14.69	74.00	66.47	7.53
5825.0	51.96	Average	H	N/A	32.61	8.95	-	93.52	OB
5825.0	44.96	Average	V	N/A	32.61	8.95	-	86.52	OB
11650.0	24.22	Average	H	N/A	38.82	-14.69	54.00	48.35	5.65
11650.0	24.18	Average	V	N/A	38.82	-14.69	54.00	48.31	5.69

Supplementary information:

- The frequency spectrum from 1 GHz to 40 GHz was investigated. Emission levels of 30 dB below than the limit is not reported.
- "*" means the restricted band. "OB" means Operating band.
- The worst case is x-axis and reported.
- Actual = Reading + AF + CL (AF : Antenna factor, CL : Cable loss)
- Distance factor = 20log(Measurement distance / The measured distance)
- Margin = Limit (dBuV/m) - Actual (dBuV/m)
- The measurements for above 1 GHz, Average measurements are recorded using the RBAVG1 measurement procedure of KDB 558074. Peak measurements are recorded using RBW = 1 MHz, VBW = 3 MHz

Table 17. 5 GHz 802.11n-HT20 Low Channel (5745 MHz)

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
5745.0	67.54	Peak	H	N/A	32.54	8.89	-	108.97	OB
5745.0	57.64	Peak	V	N/A	32.54	8.89	-	99.07	OB
11490.0	43.38	Peak	H	N/A	39.30	-14.80	74.00	67.88	6.12
11490.0	43.19	Peak	V	N/A	39.30	-14.80	74.00	67.69	6.31
5745.0	54.24	Average	H	N/A	32.54	8.89	-	95.67	OB
5745.0	43.61	Average	V	N/A	32.54	8.89	-	85.04	OB
11490.0	24.11	Average	H	N/A	39.30	-14.80	54.00	48.61	5.39
11490.0	24.16	Average	V	N/A	39.30	-14.80	54.00	48.66	5.34

Table 18. 5 GHz 802.11n-HT20 Middle Channel (5785 MHz)

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
5785.0	66.94	Peak	H	N/A	32.58	8.91	-	108.42	OB
5785.0	56.11	Peak	V	N/A	32.58	8.91	-	97.59	OB
11570.0	44.11	Peak	H	N/A	39.06	-14.74	74.00	68.43	5.57
11570.0	42.53	Peak	V	N/A	39.06	-14.74	74.00	66.85	7.15
5785.0	53.61	Average	H	N/A	32.58	8.91	-	95.09	OB
5785.0	43.21	Average	V	N/A	32.58	8.91	-	84.69	OB
11570.0	24.24	Average	H	N/A	39.06	-14.74	54.00	48.56	5.44
11570.0	24.21	Average	V	N/A	39.06	-14.74	54.00	48.53	5.47

Table 19. 5 GHz 802.11n-HT20 High Channel (5825 MHz)

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
5825.0	67.24	Peak	H	N/A	32.61	8.95	-	108.80	OB
5825.0	57.21	Peak	V	N/A	32.61	8.95	-	98.77	OB
11650.0	43.81	Peak	H	N/A	38.82	-14.69	74.00	67.94	6.06
11650.0	43.01	Peak	V	N/A	38.82	-14.69	74.00	67.14	6.86
5825.0	53.84	Average	H	N/A	32.61	8.95	-	95.40	OB
5825.0	43.55	Average	V	N/A	32.61	8.95	-	85.11	OB
11650.0	24.36	Average	H	N/A	38.82	-14.69	54.00	48.49	5.51
11650.0	24.40	Average	V	N/A	38.82	-14.69	54.00	48.53	5.47

Supplementary information:

- The frequency spectrum from 1 GHz to 40 GHz was investigated. Emission levels of 30 dB below than the limit is not reported.
- "*" means the restricted band. "OB" means Operating band.
- The worst case is x-axis and reported.
- Actual = Reading + AF + CL (AF : Antenna factor, CL : Cable loss)
- Distance factor = 20log(Measurement distance / The measured distance)
- Margin = Limit (dBuV/m) - Actual (dBuV/m)
- The measurements for above 1 GHz, Average measurements are recorded using the RBAVG1 measurement procedure of KDB 558074. Peak measurements are recorded using RBW = 1 MHz, VBW = 3 MHz

Table 20. 5 GHz 802.11n-HT40 Low Channel (5755 MHz)

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
5755.0	59.87	Peak	H	N/A	32.55	8.90	-	101.31	OB
5755.0	53.84	Peak	V	N/A	32.55	8.90	-	95.28	OB
11510.0	43.21	Peak	H	N/A	39.24	-14.78	74.00	67.67	6.33
11510.0	43.21	Peak	V	N/A	39.24	-14.78	74.00	67.67	6.33
5755.0	42.69	Average	H	N/A	32.55	8.90	-	84.13	OB
5755.0	36.24	Average	V	N/A	32.55	8.90	-	77.68	OB
11510.0	24.10	Average	H	N/A	39.24	-14.78	54.00	48.56	5.44
11510.0	24.22	Average	V	N/A	39.24	-14.78	54.00	48.68	5.32

Table 21. 5 GHz 802.11n-HT20 High Channel (5795 MHz)

Radiated emissions			Ant	Correction factors			Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	Distance (dB)	AF (dB/m)	Amp gain+CL (dB)		Actual (dBuV/m)	Margin (dB)
5795.0	60.15	Peak	H	N/A	32.59	8.91	-	101.64	OB
5795.0	54.66	Peak	V	N/A	32.59	8.91	-	96.15	OB
11590.0	43.19	Peak	H	N/A	39.00	-14.73	74.00	67.46	6.54
11590.0	43.68	Peak	V	N/A	39.00	-14.73	74.00	67.95	6.05
5795.0	42.54	Average	H	N/A	32.59	8.91	-	84.03	OB
5795.0	37.22	Average	V	N/A	32.59	8.91	-	78.71	OB
11590.0	24.94	Average	H	N/A	39.00	-14.73	54.00	49.21	4.79
11590.0	25.01	Average	V	N/A	39.00	-14.73	54.00	49.28	4.72

Supplementary information:

- The frequency spectrum from 1 GHz to 40 GHz was investigated. Emission levels of 30 dB below than the limit is not reported.
- "*" means the restricted band. "OB" means Operating band.
-
- The worst case is x-axis and reported.
- Actual = Reading + AF + CL (AF : Antenna factor, CL : Cable loss)
- Distance factor = 20log(Measurement distance / The measured distance)
- Margin = Limit (dBuV/m) - Actual (dBuV/m)
- The measurements for above 1 GHz, Average measurements are recorded using the RBAVG1 measurement procedure of KDB 558074. Peak measurements are recorded using RBW = 1 MHz, VBW = 3 MHz

5.6. Transmitter AC Power Line Conducted Emission

TEST: Transmitter AC Power Line Conducted Emission		
Method	AC line conducted emissions from the EUT were measured according to the dictates of ANSI C63.4-2003. 1. The test procedure is performed in a 5.05m × 4.0m× 3.0m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m(W)× 1.5 m(L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. 2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. 3. The excess power cable between the EUT and the LISN was bundled. All connecting cables of EUT were moved to find the maximum emission.	
Basic Standard	FCC Part 15.207(a)	
Parameters recorded during the test	Laboratory Ambient Temperature	22°C
	Relative Humidity	46%
-	Frequency range on each side of line	Measurement Point
Fully configured sample scanned over the following frequency range	150 kHz to 30 MHz	A.C. Input port of A.C. to D.C. adapter.

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
Rated	1	1
Supplementary information: None		

Limits

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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency of Emission (㎒)	Conducted limit (㏈ μV)	
	Quasi-peak	Average
0.15 – 0.5	66 - 56*	56 - 46*
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

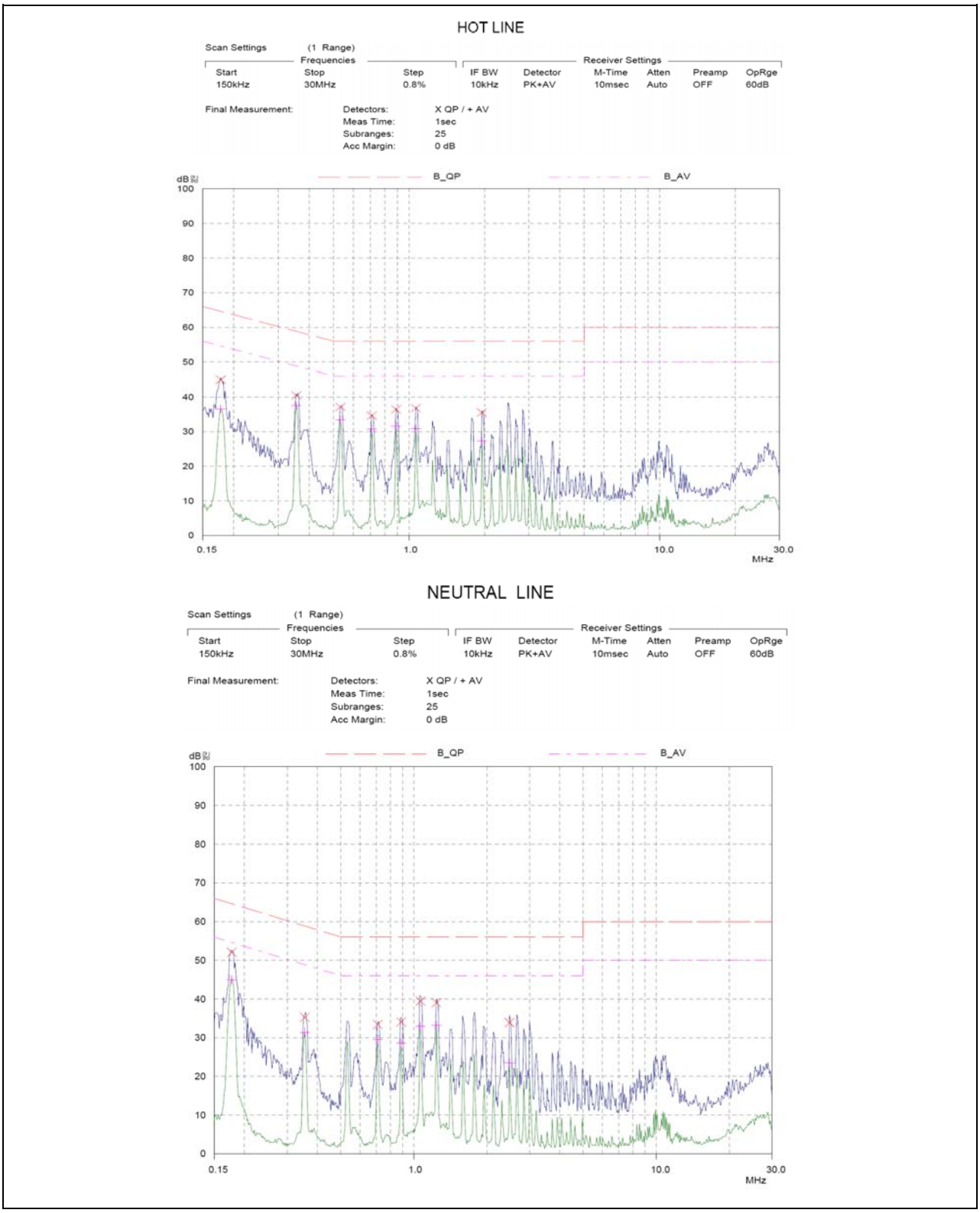
5.6.1. Transmitter AC Power Line Conducted Emission

Measurement method : ☐ Radiated ☒ Conducted
Mode of operation : Continuous Wave
Power setting : Max. Power condition declared by the manufacturer

Table 22. Test data for conducted emission

Frequency (MHz)	Correction Factor (dB)		Line (H/N)	Quasi-peak Value (dBuV)			Average Value (dBuV)		
	LISN	Cable etc.		Limit	Reading	Result	Limit	Reading	Result
0.17	0.15	0.35	H	65.0	52.07	52.57	54.96	45.00	45.50
0.35	0.13	0.36	N	59.0	40.44	40.94	49.0		
0.53	0.16	0.37	H	56.0	37.17	37.70	46.0		
0.88	0.16	0.41	N	56.0	36.45	37.02	46.0		
1.06	0.18	0.47	H	56.0	39.47	40.12	46.0		
1.23	0.18	0.46	N	56.0	38.99	39.64	46.0		
Remark	H : Hot Line, N : Neutral Line Correction factor=LISN factor + Cable loss								

Figure 5. Graphical representation of Conducted Emission



5.7. Antenna Requirement

5.7.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §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. And according to FCC 47 CFR Section § 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in Db that the gain of the antenna exceeds 6 dBi.

5.7.2. Antenna Connected Construction

The antenna used of this product is Metal Stamping Antenna Assembly and peak max gain of each antennas as below . :

Band	2412 – 2462 MHz	5745 – 5825 MHz 5180 – 5320 MHz 5500 – 5700 MHz
Antenna Gain (dBi)	3.51	4.07

APPENDIX A. Accreditations and Authorizations

ESTECH CO., LTD. has been accredited / filed / authorized by the agencies listed in the following table;

Certificate	Nation	Agency	Code	Mark
Accreditation	Korea	KOLAS	KT141	ISO/IEC 17025
Site Filing	USA	FCC	659627	Test Facility list & NSA Data
Certification	Korea	KC	KR0019	Test Facility list & NSA Data

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the "General requirements for the competent of calibration and testing laboratory".