

Appendix B: Test results. 802.11 bgn20 1x1.

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TEST CONDITIONS

POWER SUPPLY (V):

V nominal: 12 Vdc

Type of Power Supply: External power supply (Battery).

Type of Antenna: External antenna.

Declared Gain for antenna RF port 1 (maximum): +2.2 dBi. (Antenna gain plus antenna cable loss).

Declared Gain for antenna RF port 2 (maximum): +2.2 dBi. (Antenna gain plus antenna cable loss).

Declared Gain for antenna RF port 4 (maximum): +1.6 dBi. (Antenna gain plus antenna cable loss).

TEST FREQUENCIES:

For WiFi 802.11b/g/n20:

Low Channel: 2412 MHz

Middle Channel: 2437 MHz

High Channel: 2462 MHz

The sample was used to configure the EUT to continuously transmit at a specified output power in all channels with different modes and modulation schemes.

It was necessary to change between CORE 0 with antenna 1, CORE 0 with antenna 2 and CORE 1 with antenna 4.

The field strength at the band edges was evaluated for each mode for the channel under test.

During transmitter test the EUT was being controlled by the SW tool to operate in a continuous transmit mode on the test channel as required and in each of the different modulation modes.

The data rates of 1Mb/s for 802.11b, 6.5Mb/s for 802.11g, MSC0 for 802.11n20 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and band edge levels at restricted bands.

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer.



RADIATED MEASUREMENTS

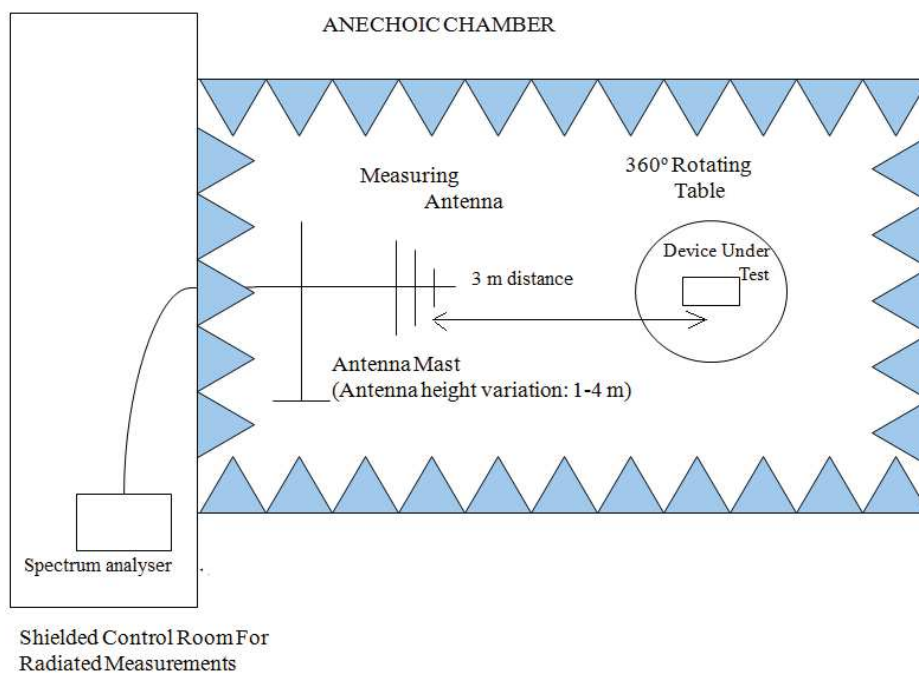
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1 m for the frequency range 1 GHz-25 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-25 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

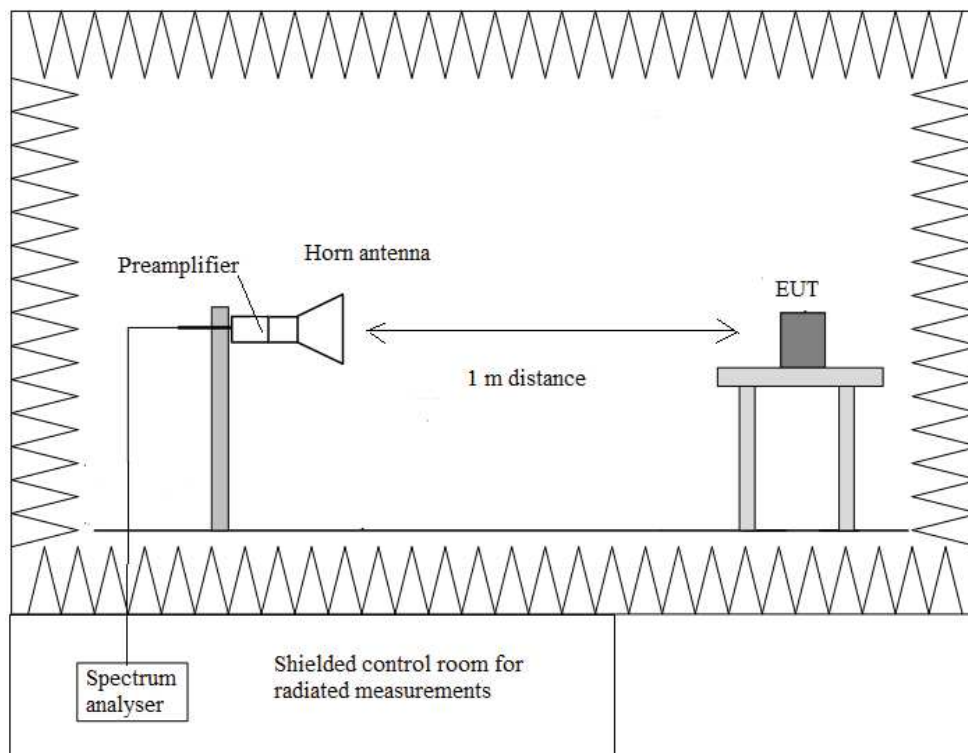
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

Radiated measurements setup $f < 1$ GHz



Radiated measurements setup $f > 1$ GHz:



Occupied Bandwidth

RESULTS:

(see next plots).

- **CORE 0 – Antenna RF External port 2**

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	11.16	11.10	10.92
Measurement uncertainty (kHz)	<± 23.08		

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	16.85	16.85	16.85
Measurement uncertainty (kHz)	<± 23.08		

- **Mode 802.11 N20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	18.10	18.05	18.05
Measurement uncertainty (kHz)	<± 23.08		

- **CORE 1 – Antenna RF External port 4**

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	11.03	11.02	10.93
Measurement uncertainty (kHz)	<± 28.03		

- **Mode 802.11 g**

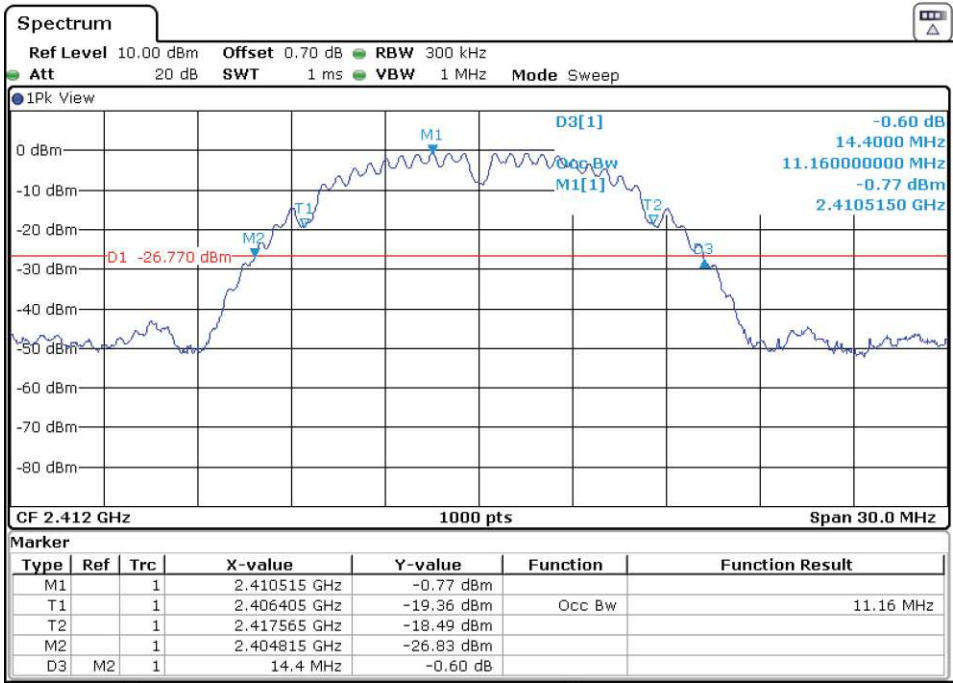
	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	16.85	16.85	16.87
Measurement uncertainty (kHz)	<± 28.03		

- **Mode 802.11 N20**

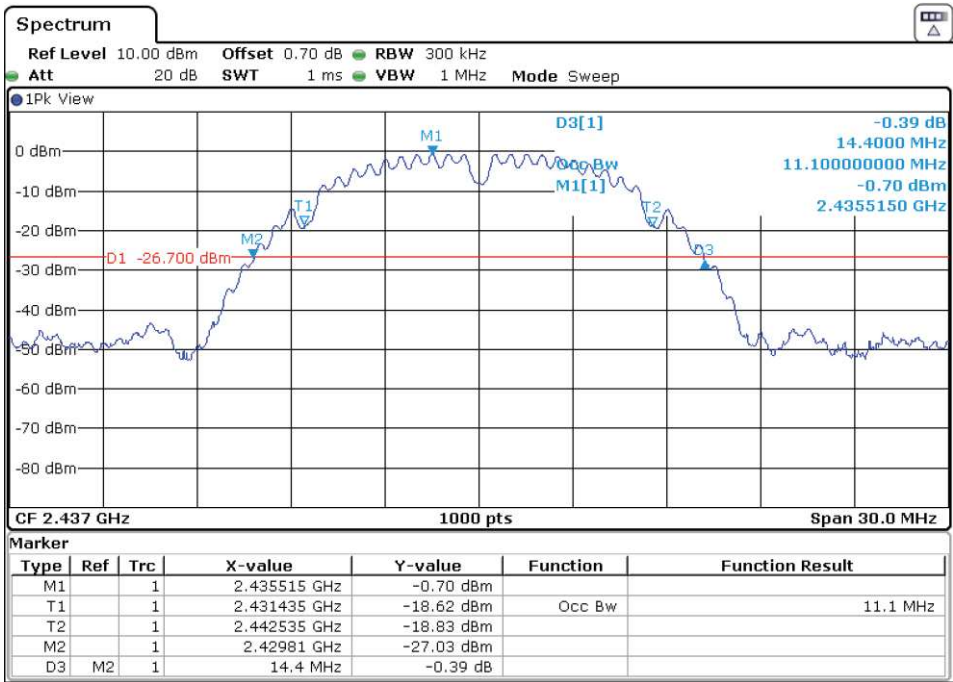
	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
99% bandwidth (MHz)	18.00	17.99	18.03
Measurement uncertainty (kHz)	<± 28.03		

- CORE 0 – Antenna RF External port 2
 - Mode 802.11 b – Occupied Bandwidth

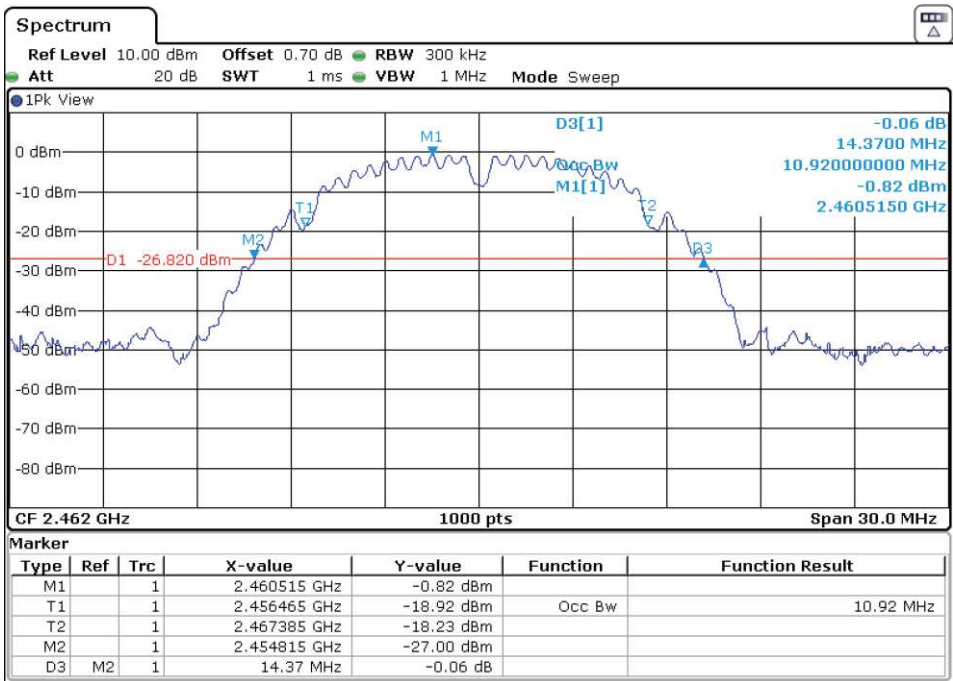
- Low Channel:



- Middle Channel:

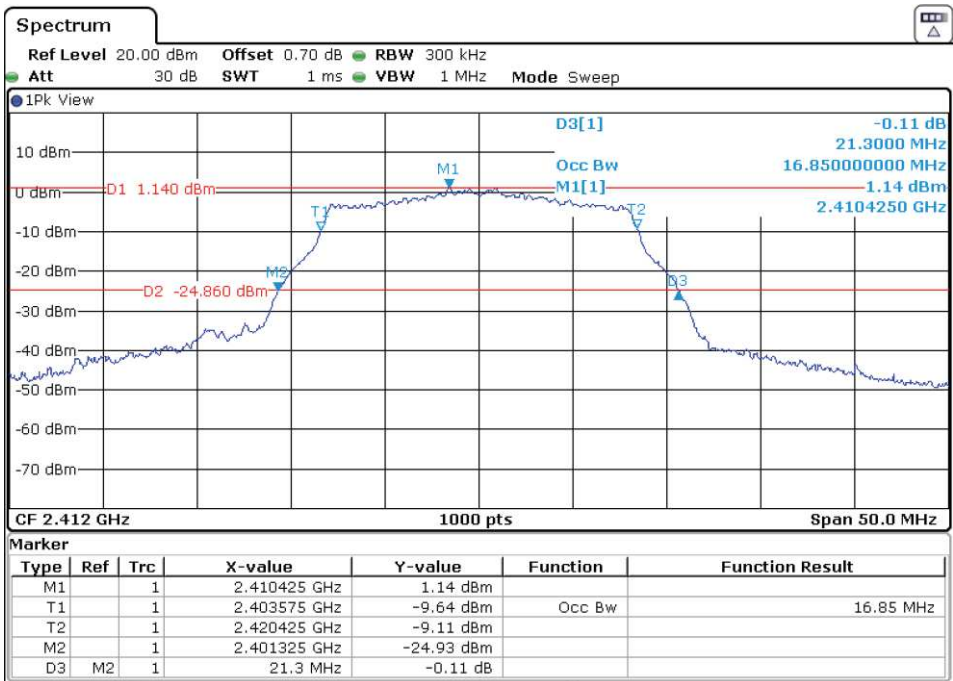


- High Channel:

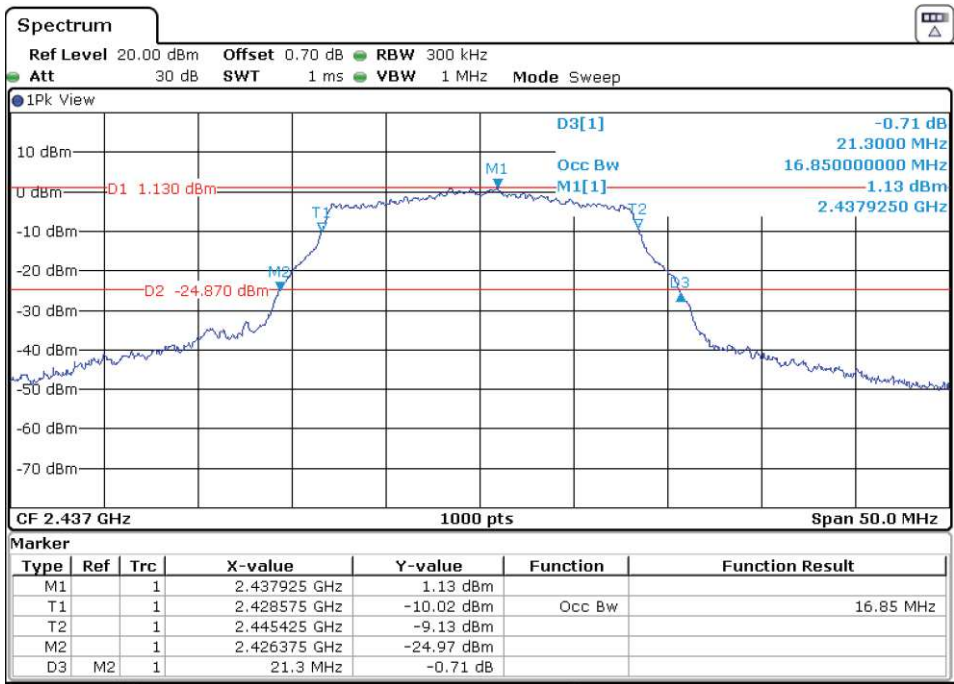


○ Mode 802.11 g – Occupied Bandwidth

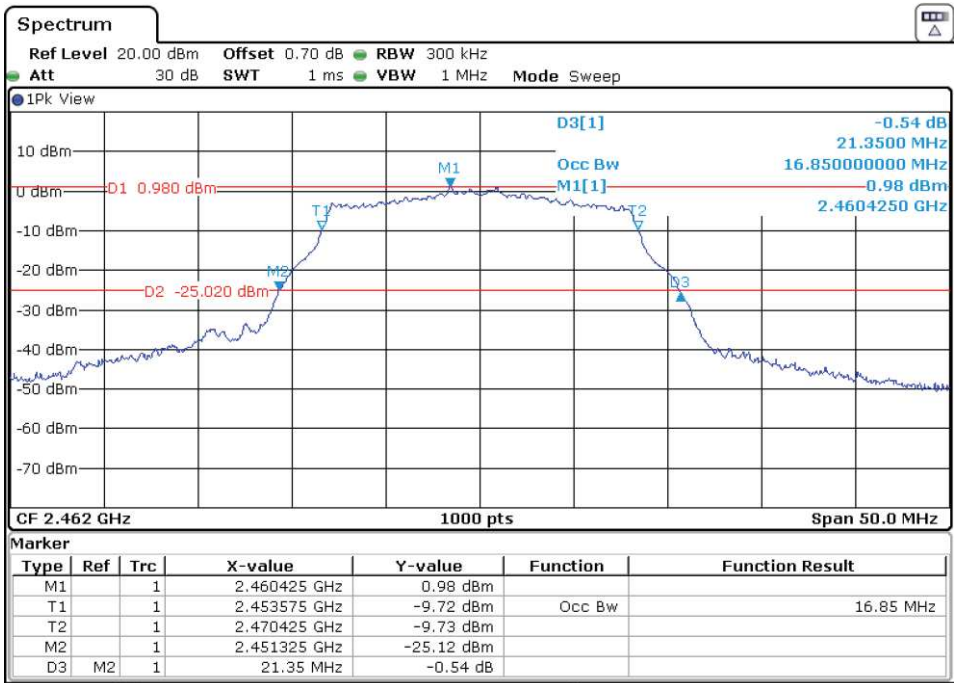
- Low Channel:



- Middle Channel:

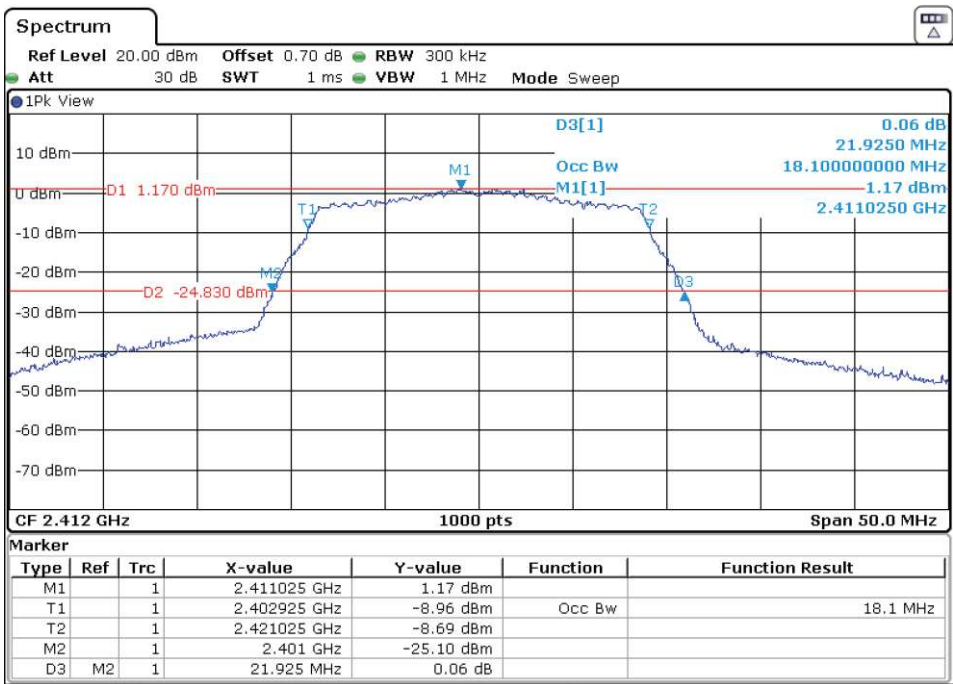


- High Channel:

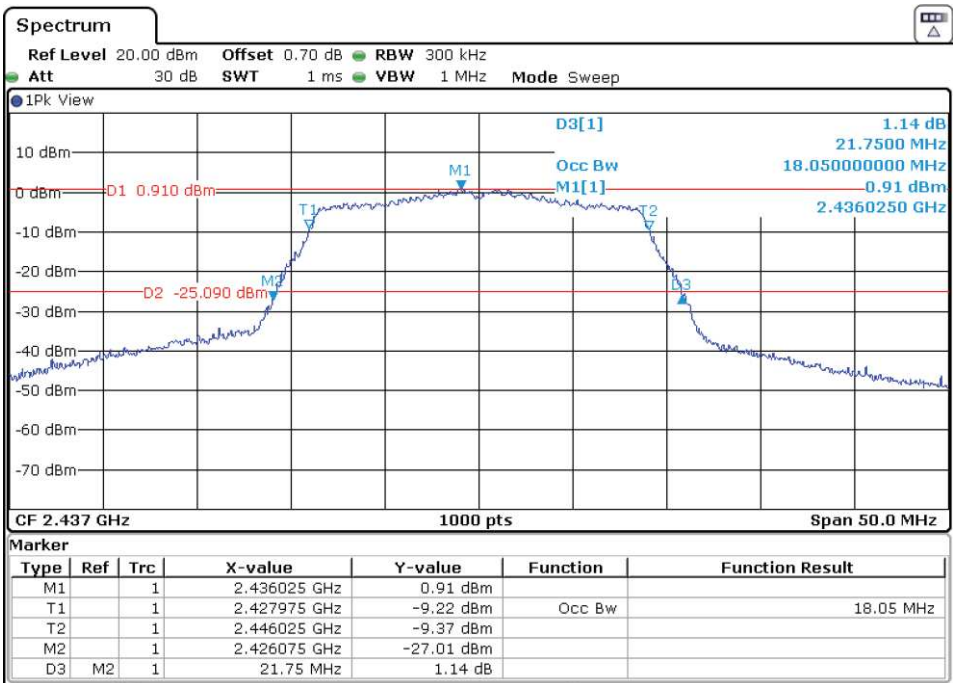


○ Mode 802.11 N20 – Occupied Bandwidth

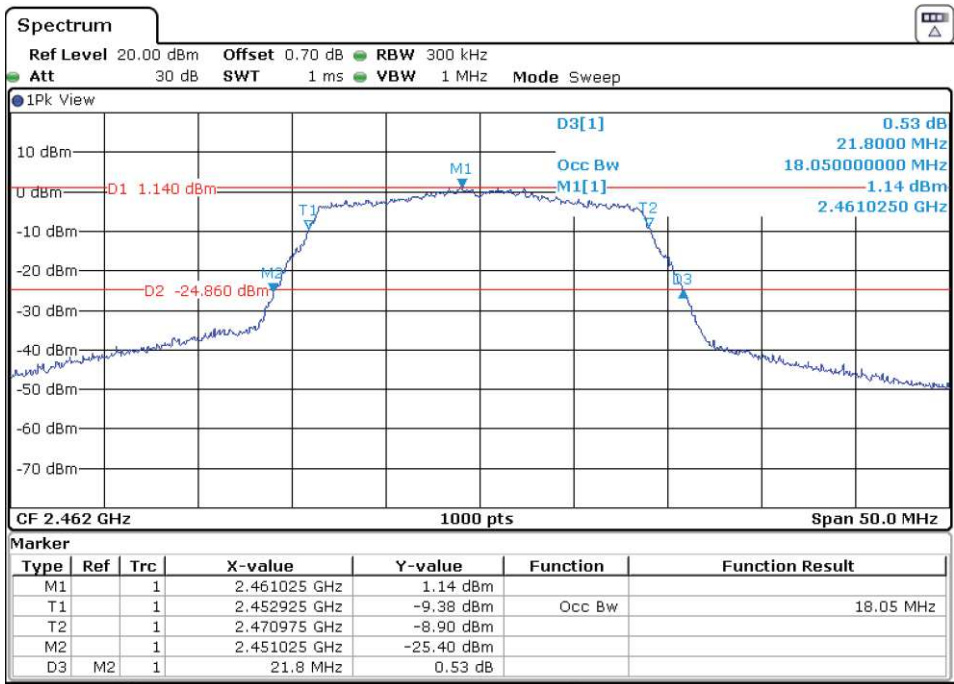
- Low Channel:



- Middle Channel:

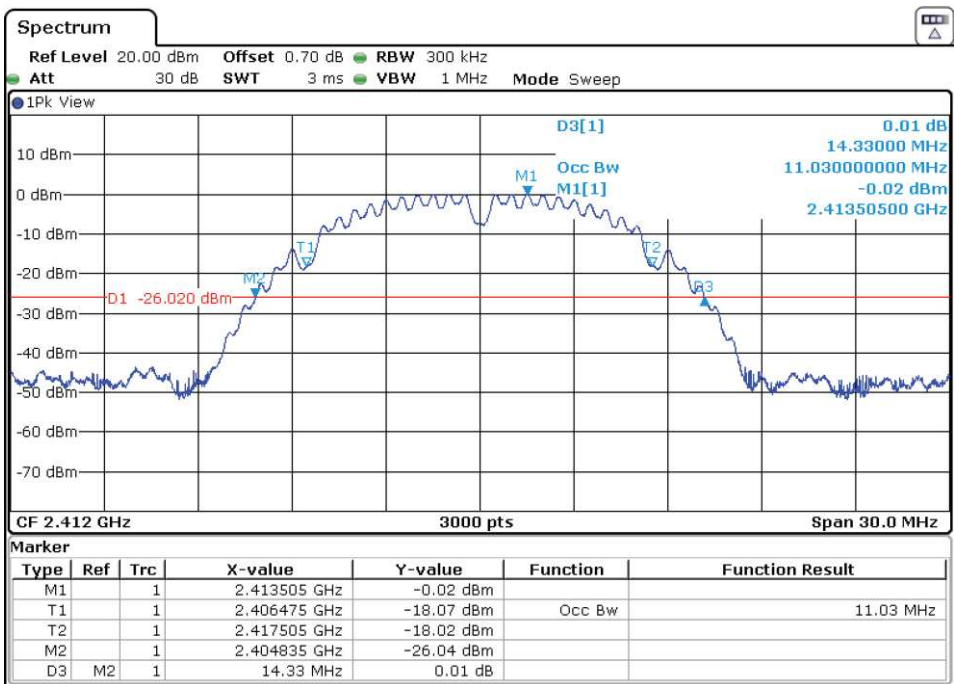


- High Channel:

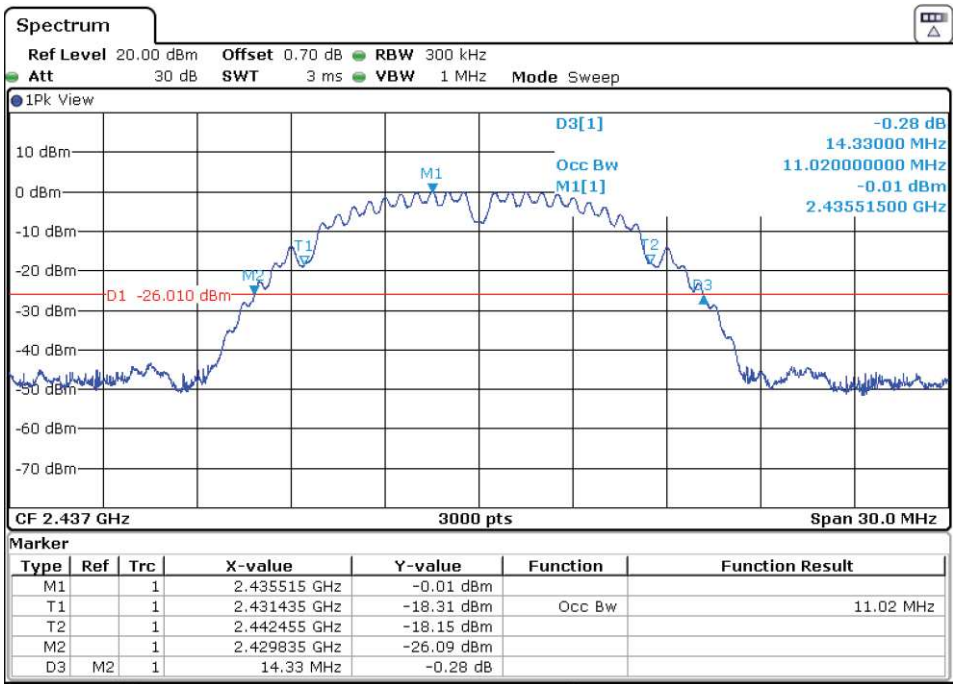


- CORE 1 – Antenna RF External port 4
 - Mode 802.11 b – Occupied Bandwidth

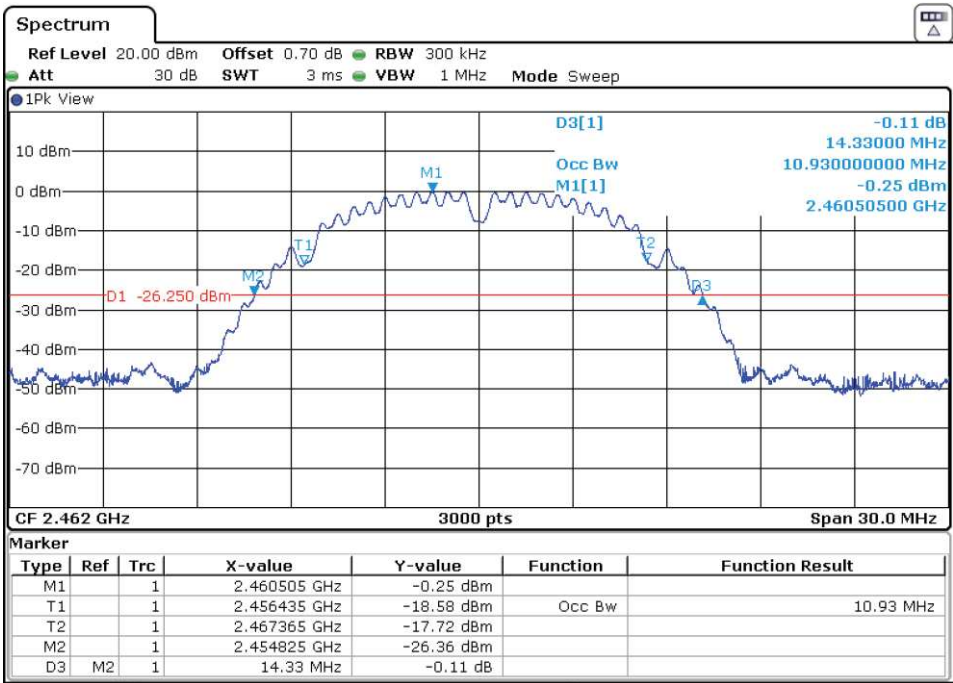
- Low Channel:



- Middle Channel:

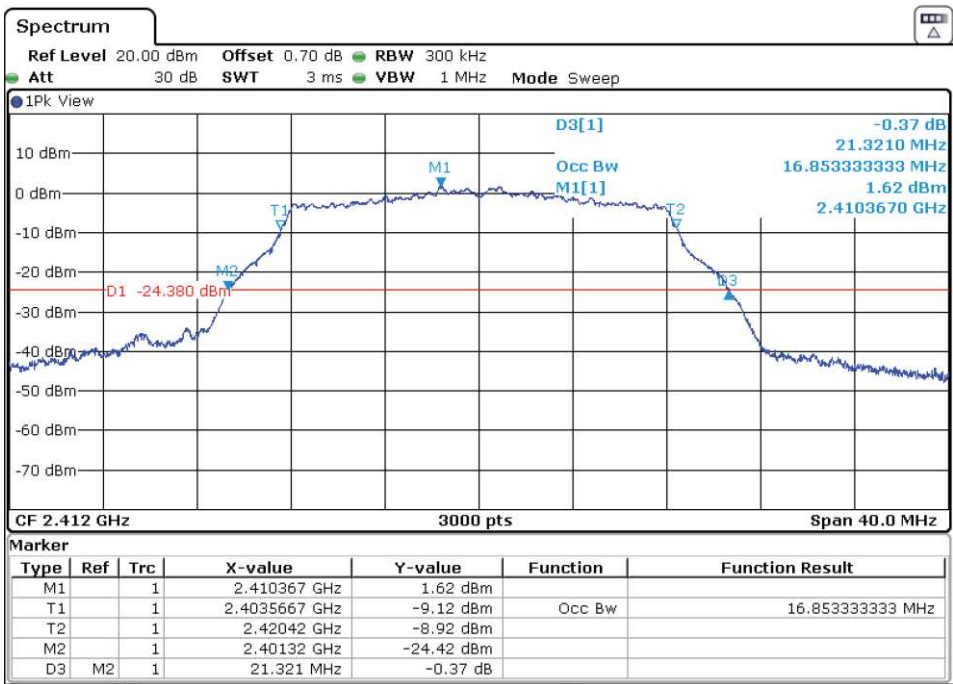


- High Channel:

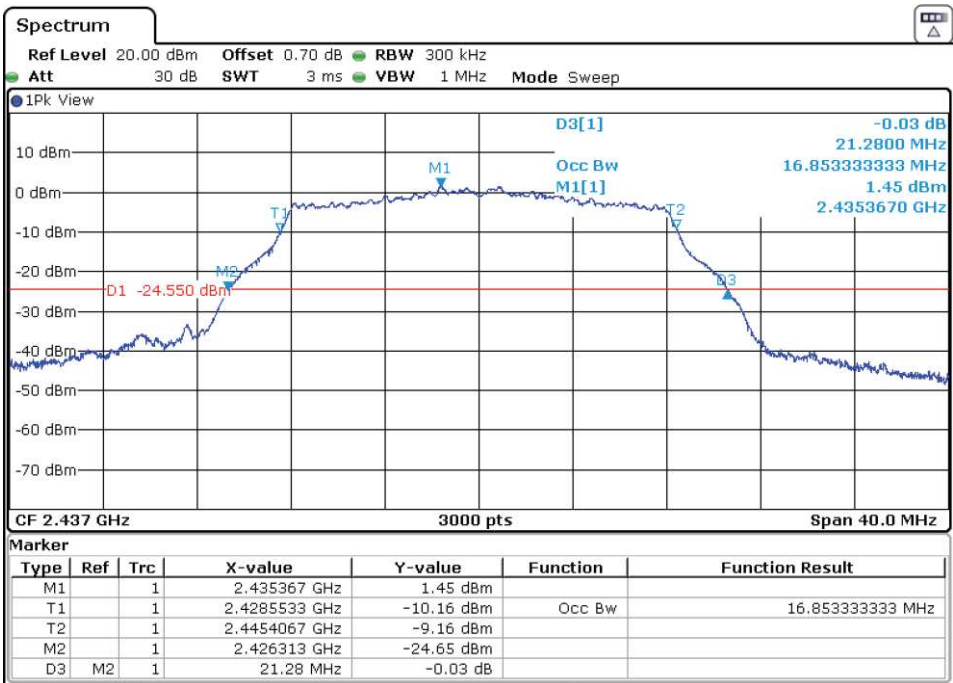


○ Mode 802.11 g – Occupied Bandwidth

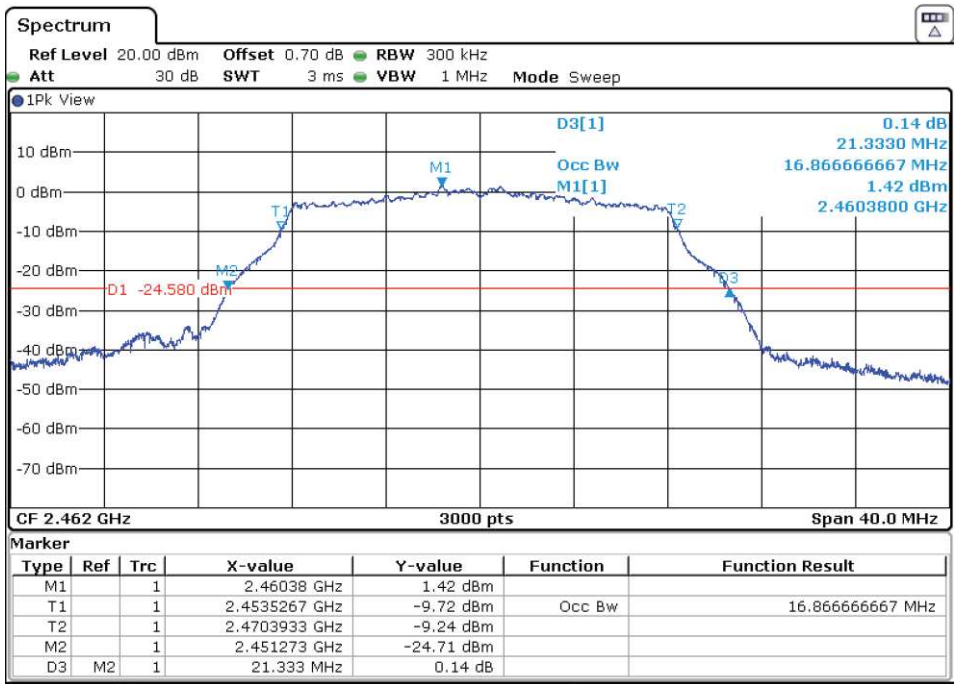
- Low Channel:



- Middle Channel:

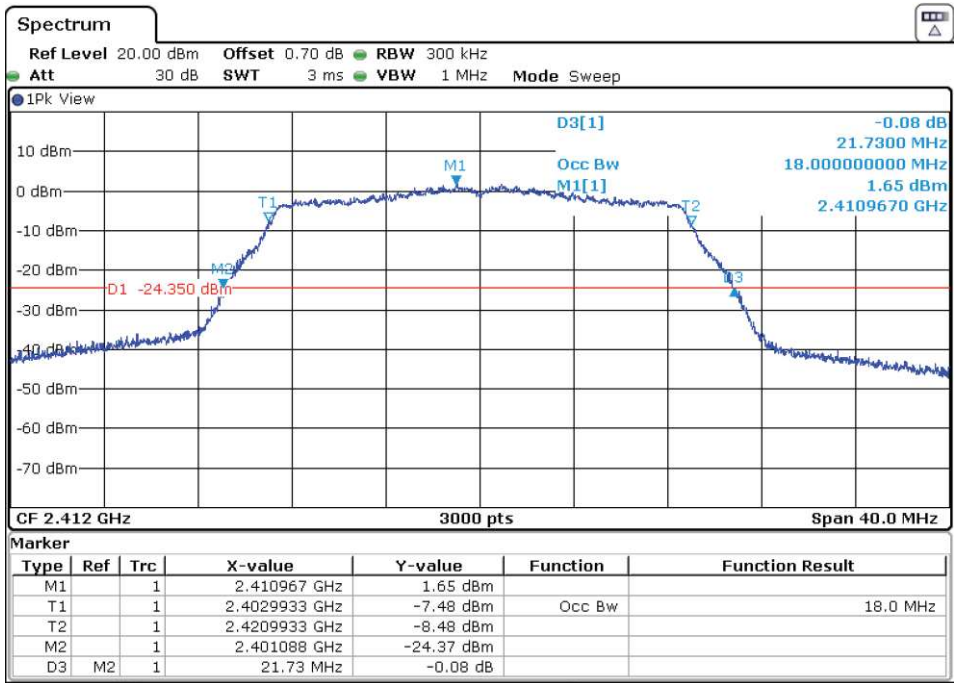


- High Channel:

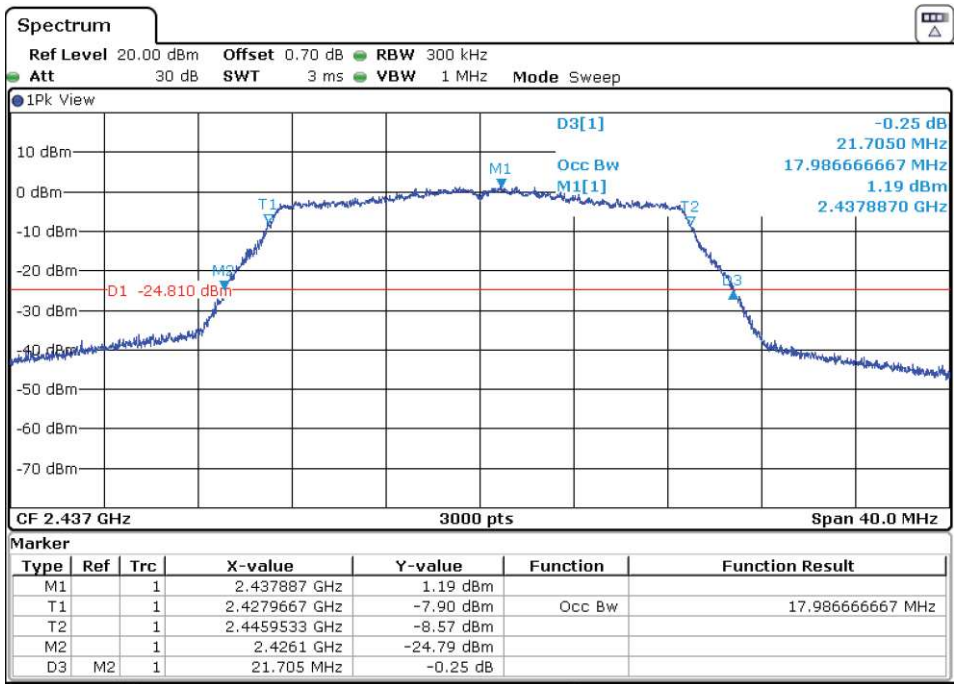


○ Mode 802.11 N20 – Occupied Bandwidth

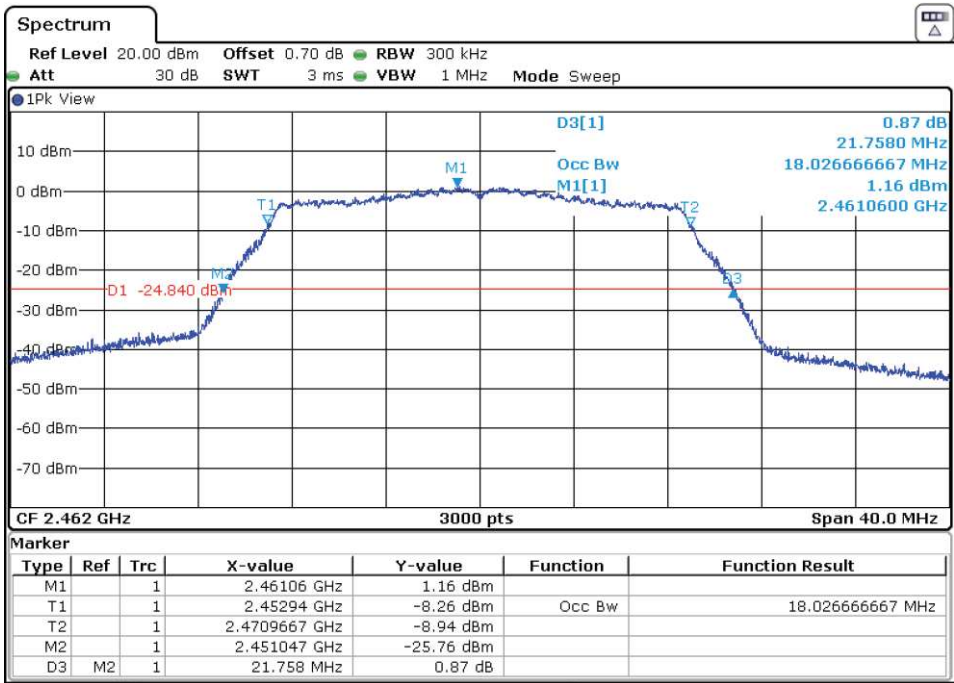
- Low Channel:



- Middle Channel:



- High Channel:



FCC Section 15.247 Subclause (a) (2) / RSS-247 Clause 5.2 (a) 6 dB Bandwidth.

SPECIFICATION:

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

6 dB Bandwidth (see next plots).

- **CORE 0 – Antenna RF External port 2**

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum bandwidth (MHz)	9.06	9.06	9.06
Measurement uncertainty (kHz)	<±1.80		

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum bandwidth (MHz)	16.32	16.32	16.30
Measurement uncertainty (kHz)	<±1.80		

- **Mode 802.11 N20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum bandwidth (MHz)	17.56	17.58	17.34
Measurement uncertainty (kHz)	<±1.80		

- **CORE 1 – Antenna RF External port 4**

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum bandwidth (MHz)	8.11	8.12	8.55
Measurement uncertainty (kHz)	<±1.80		

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum bandwidth (MHz)	16.06	16.31	16.31
Measurement uncertainty (kHz)	<±1.80		

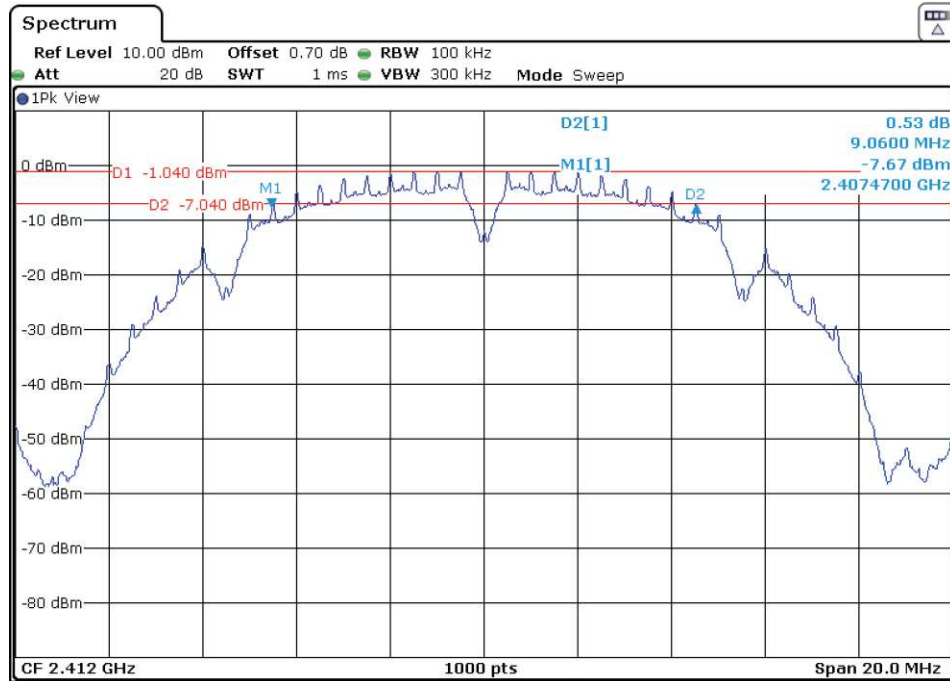
- **Mode 802.11 N20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
6 dB Spectrum bandwidth (MHz)	17.30	17.56	17.16
Measurement uncertainty (kHz)	<±1.80		

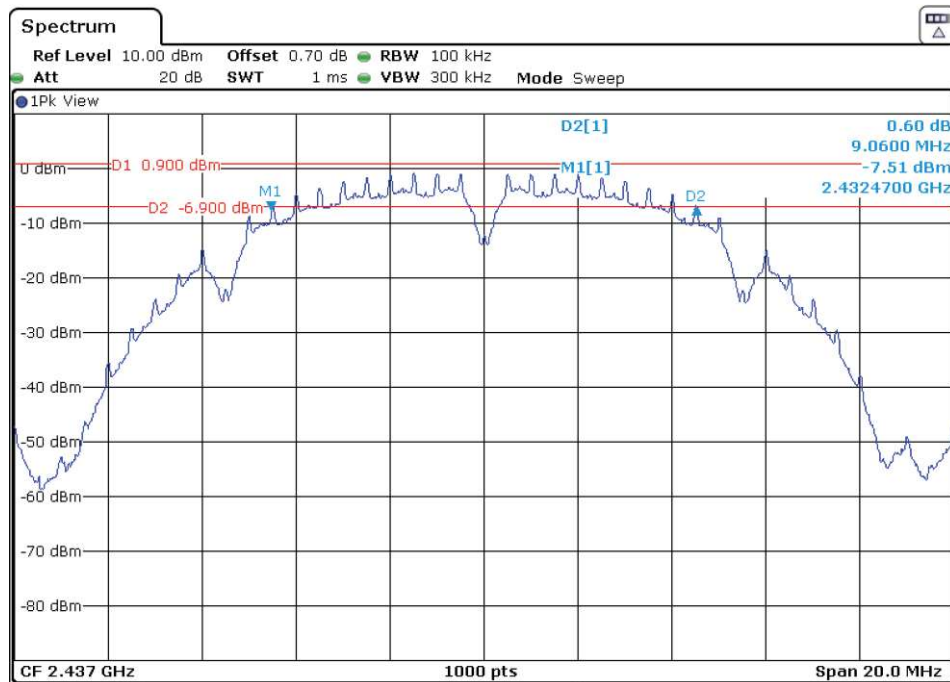
Verdict: PASS

- **CORE 0 – Antenna RF External port 2**
 - **Mode 802.11 b – DTS Bandwidth**

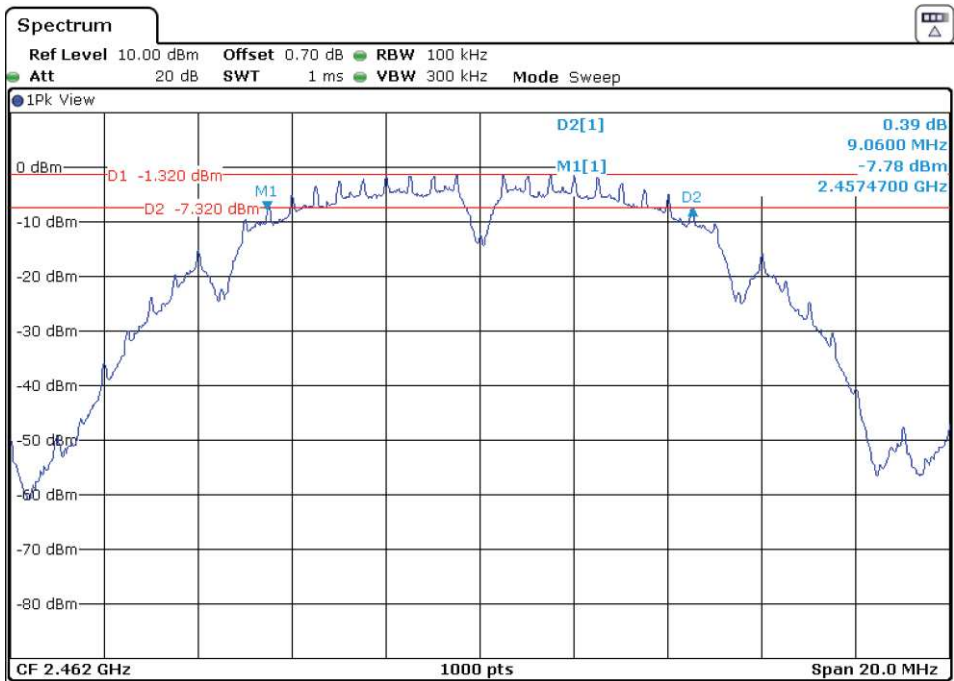
- Low Channel:



- Middle Channel:

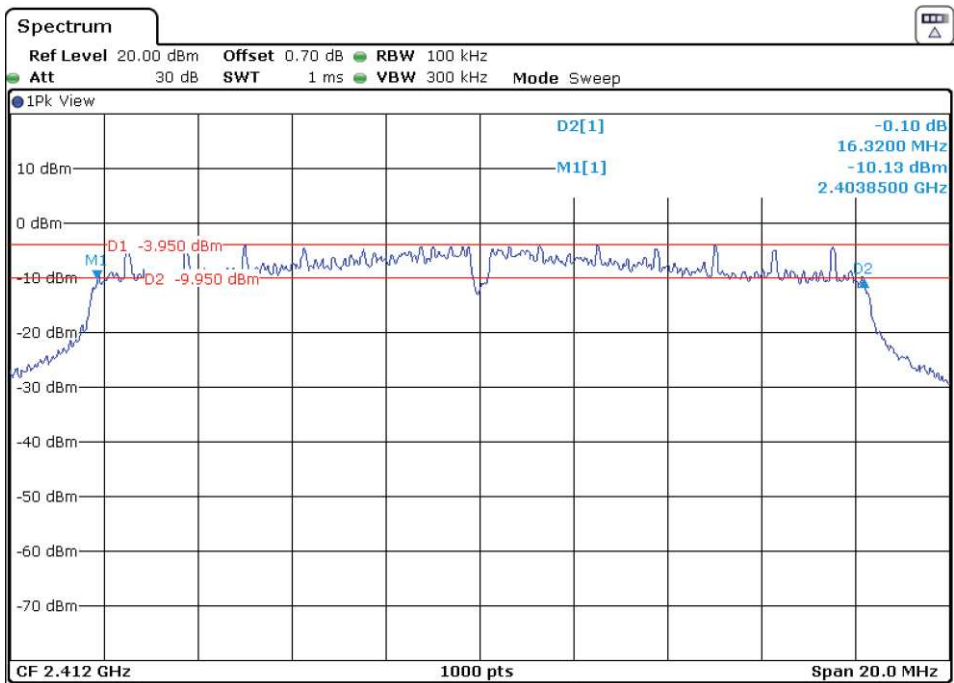


- High Channel:

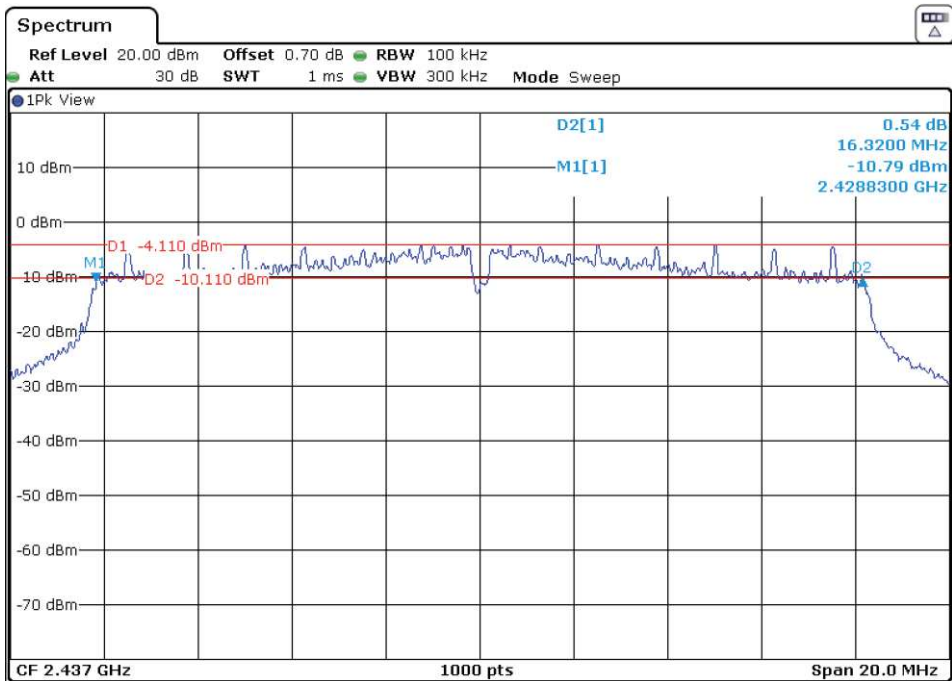


○ Mode 802.11 g – DTS Bandwidth

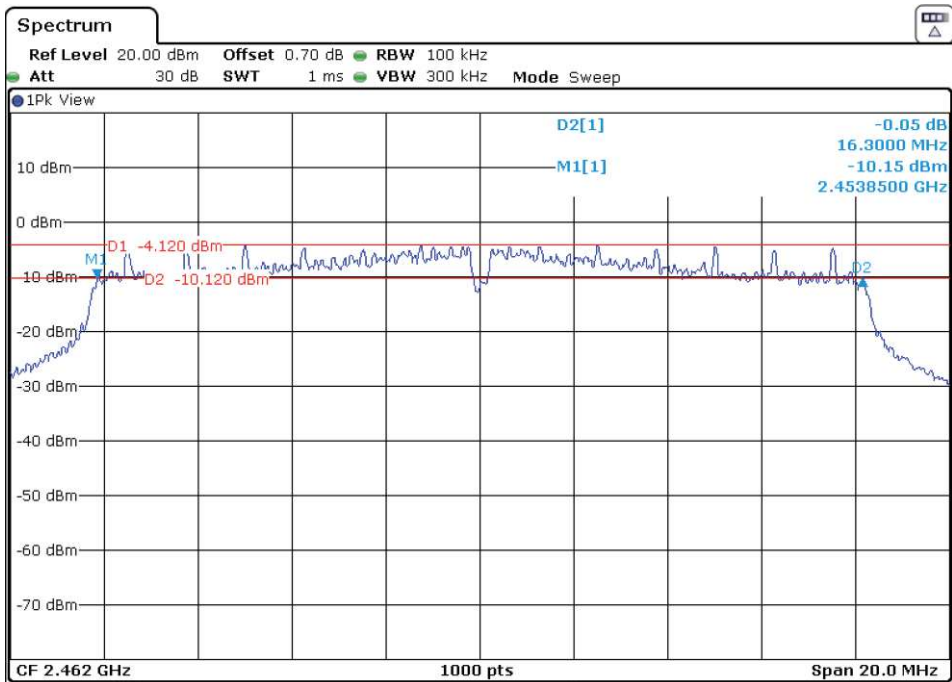
- Low Channel:



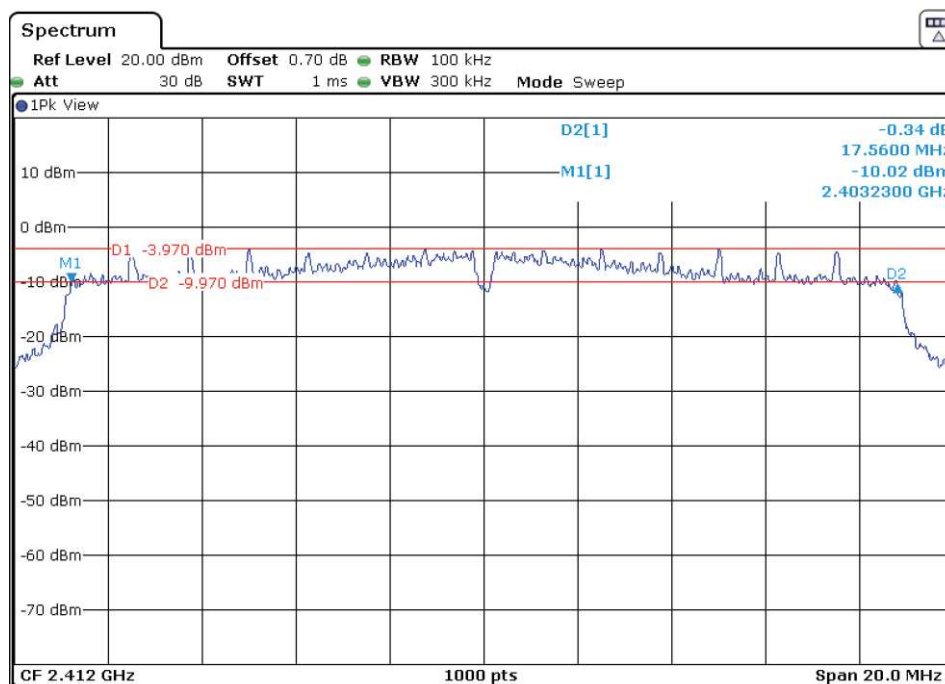
- Middle Channel:



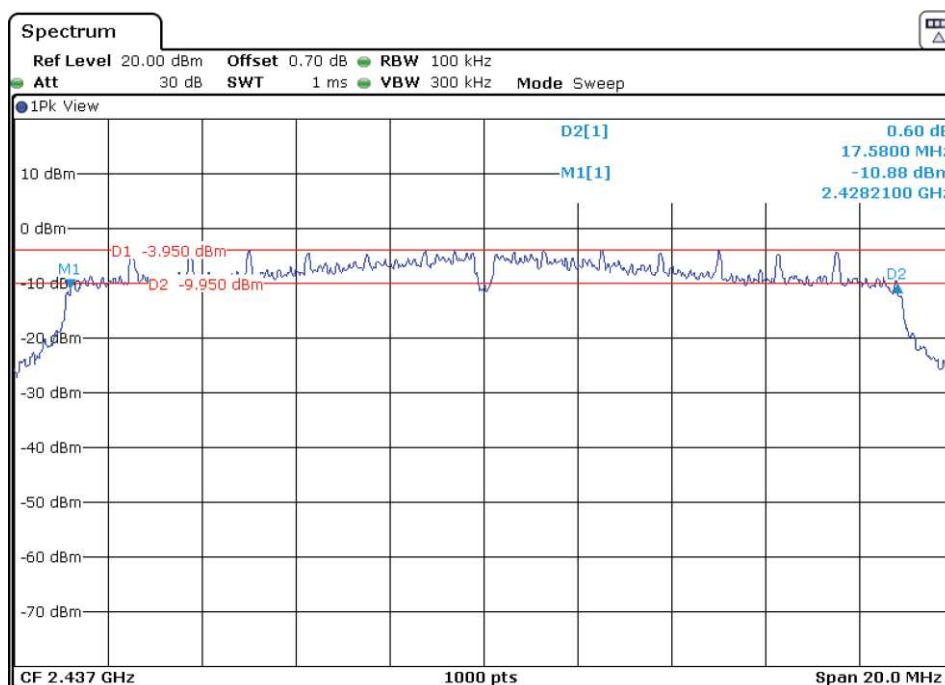
- High Channel:



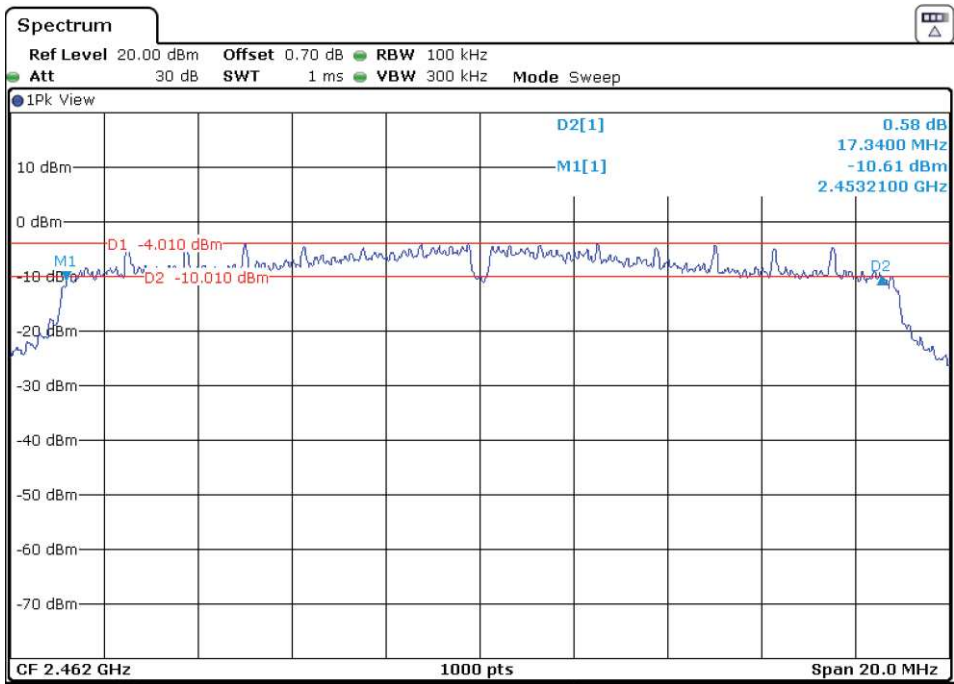
- Low Channel:



- Middle Channel:

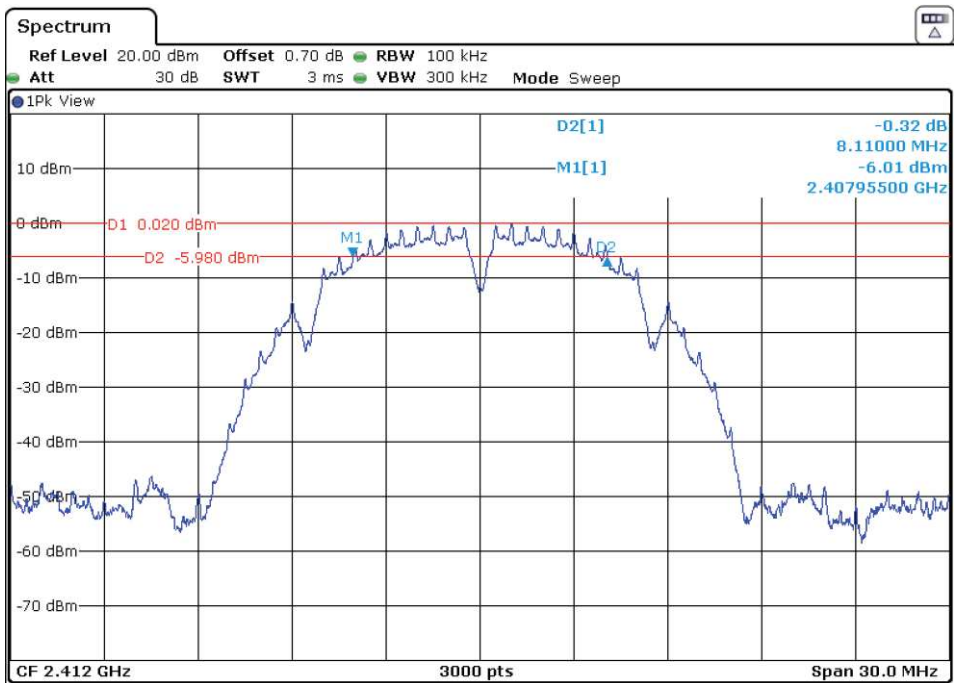


- High Channel:



- CORE 1 – Antenna RF External port 4
 - Mode 802.11 b – DTS Bandwidth

- Low Channel:



Spectrum

Ref Level 20.00 dBm Offset 0.70 dB RBW 100 kHz
Att 30 dB SWT 3 ms VBW 300 kHz Mode Sweep

1Pk View

0.03 dBm
8.12000 MHz
-6.70 dBm
2.43294500 GHz

D2[1]
M1[1]

D1 -0.340 dBm
D2 -6.340 dBm

M1 M2

CF 2.437 GHz 3000 pts Span 30.0 MHz

Spectrum

Ref Level 20.00 dBm Offset 0.70 dB RBW 100 kHz
 Att 30 dB SWT 3 ms VBW 300 kHz Mode Sweep

1Pk View

10 dBm
 0 dBm
 -10 dBm
 -20 dBm
 -30 dBm
 -40 dBm
 -50 dBm
 -60 dBm
 -70 dBm

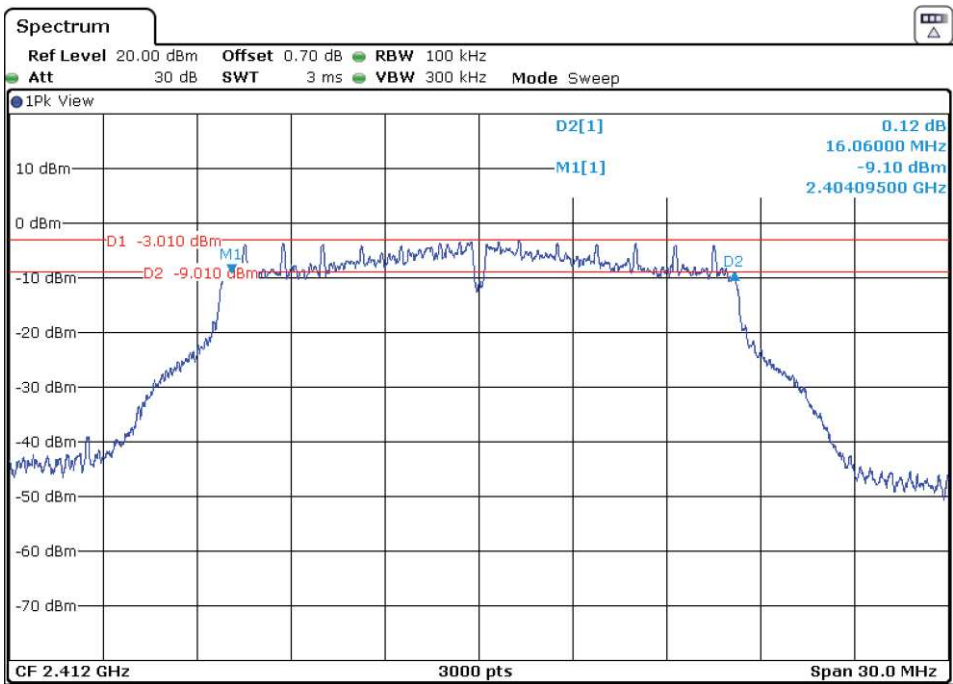
D2[1] -0.35 dBm
 M1[1] -6.35 dBm
 8.55000 MHz
 2.45749500 GHz

D1 -0.300 dBm
 D2 -6.300 dBm
 M1
 D2

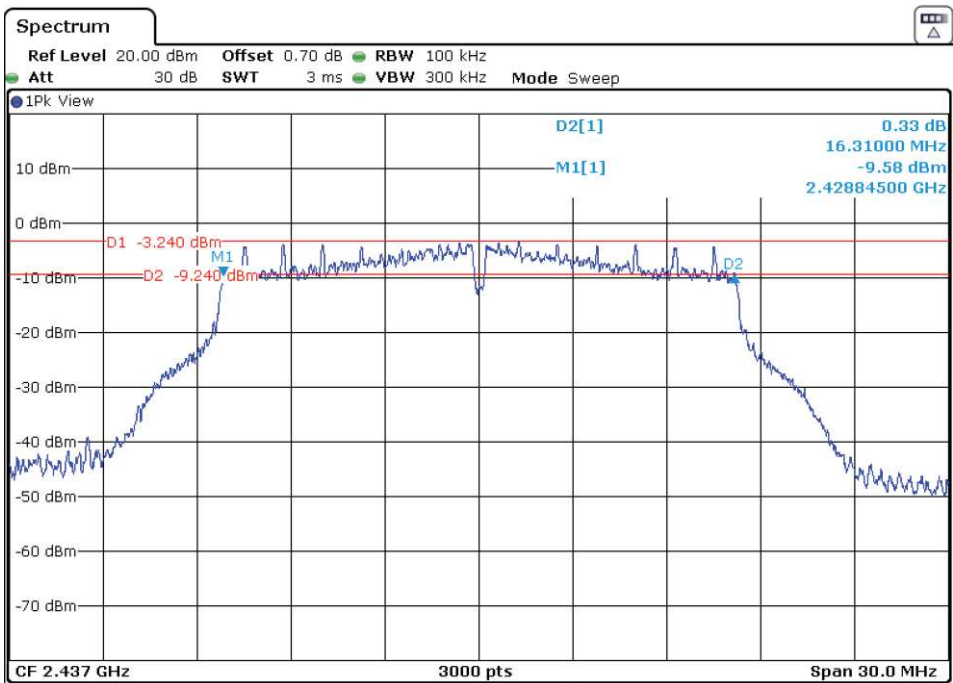
CF 2.462 GHz 3000 pts Span 30.0 MHz

○ Mode 802.11 g – DTS Bandwidth

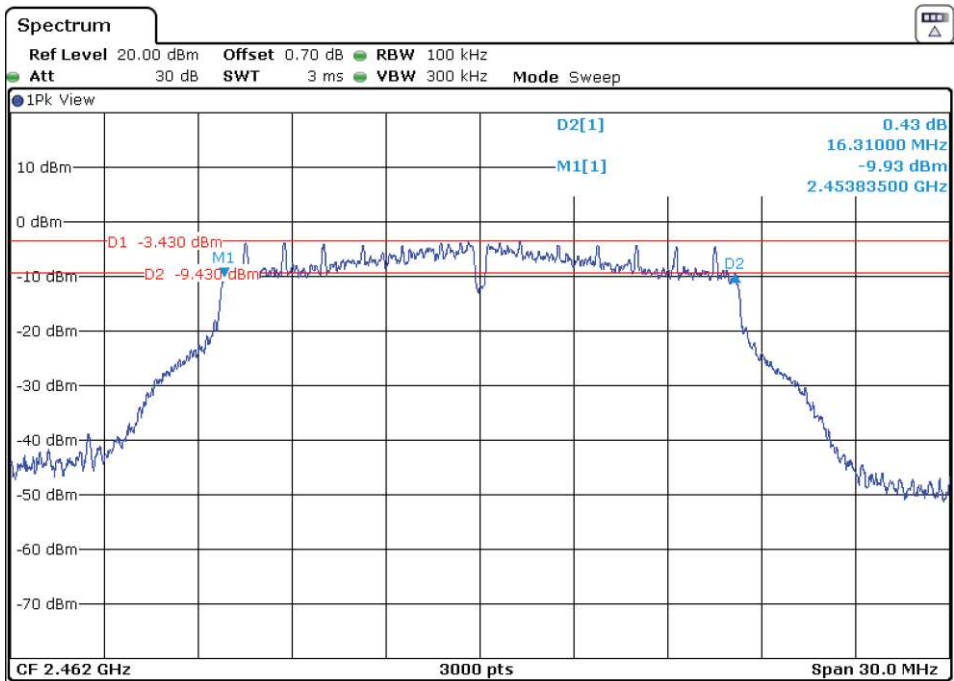
- Low Channel:



- Middle Channel:

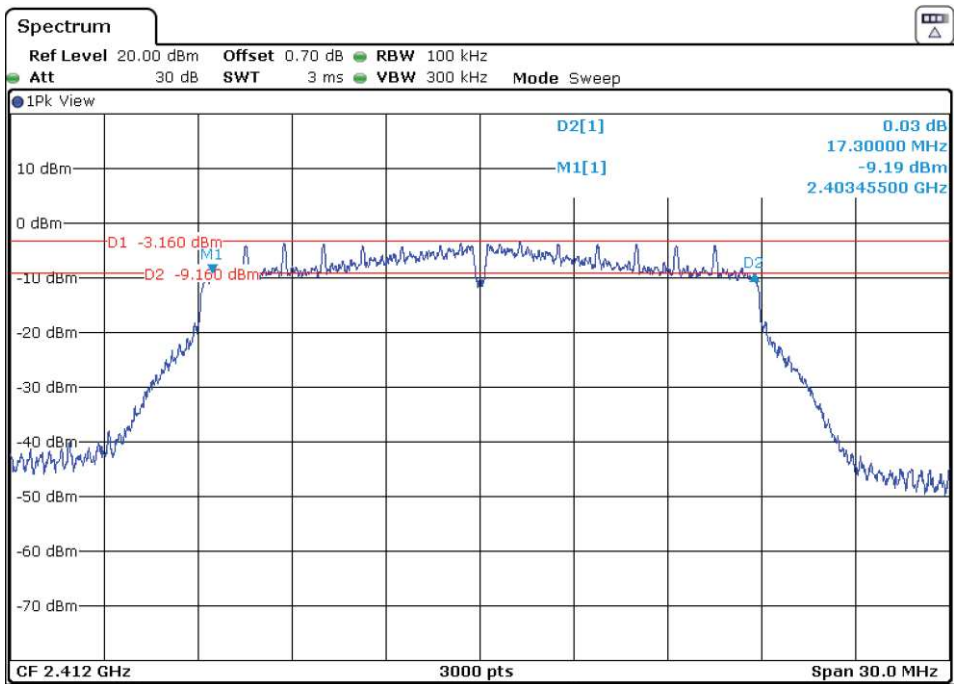


- High Channel:

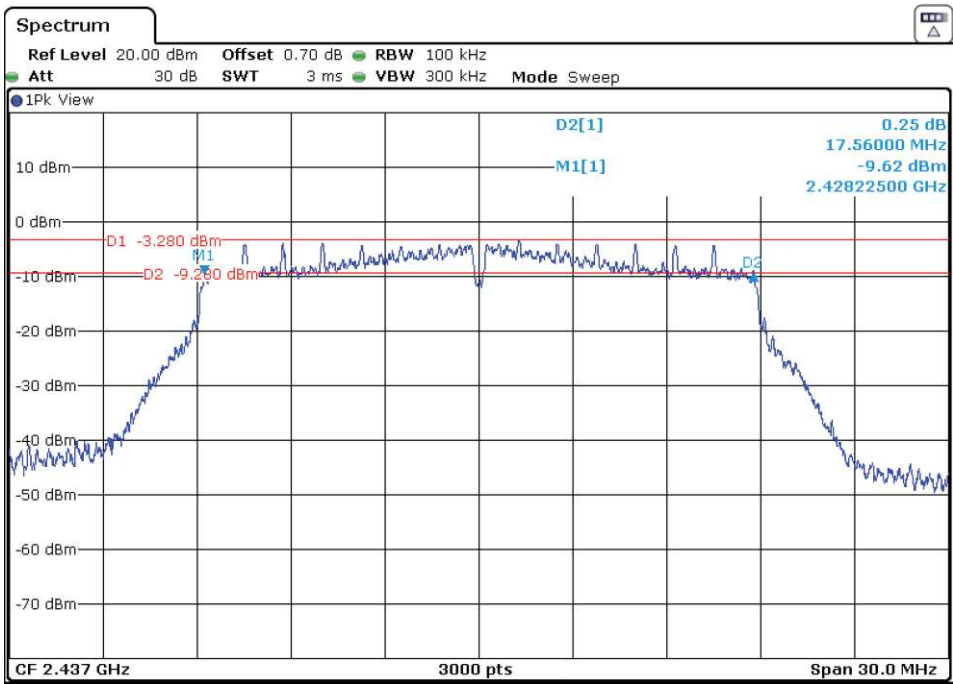


○ Mode 802.11 N20 – DTS Bandwidth

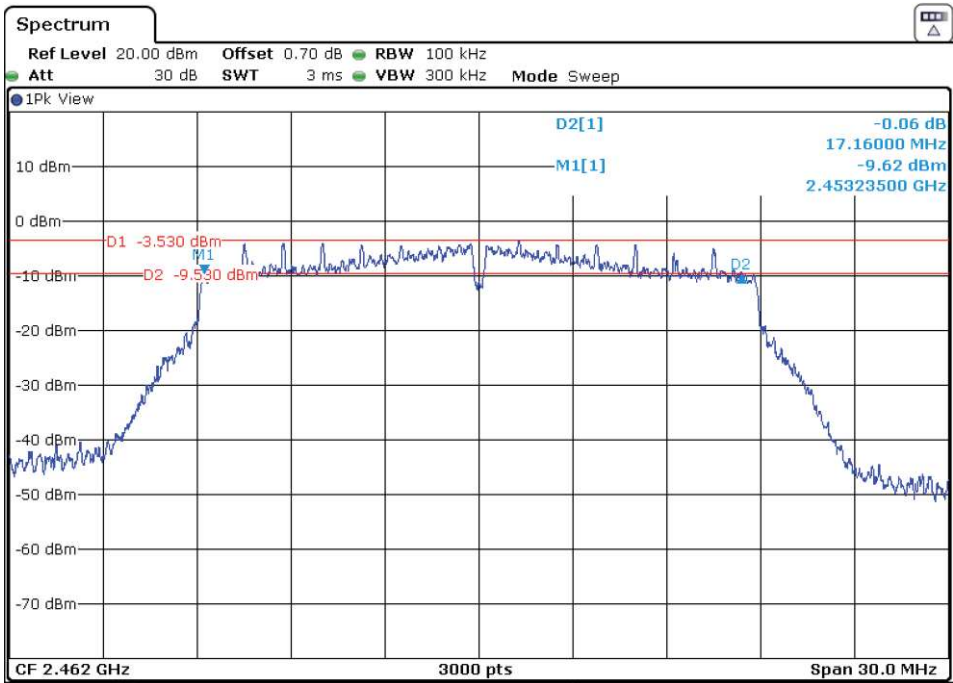
- Low Channel:



- Middle Channel:



- High Channel:



Transmitter Duty Cycle

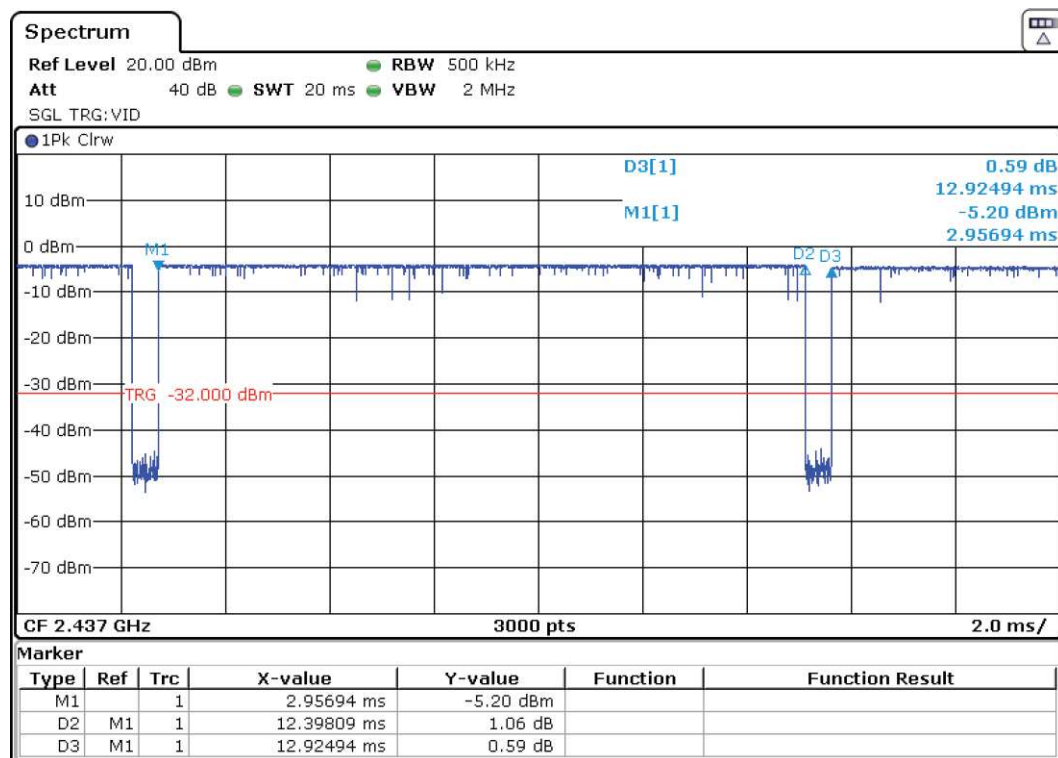
RESULTS:

The transmitter duty cycle is measured using a spectrum analyser in time domain and calculated:

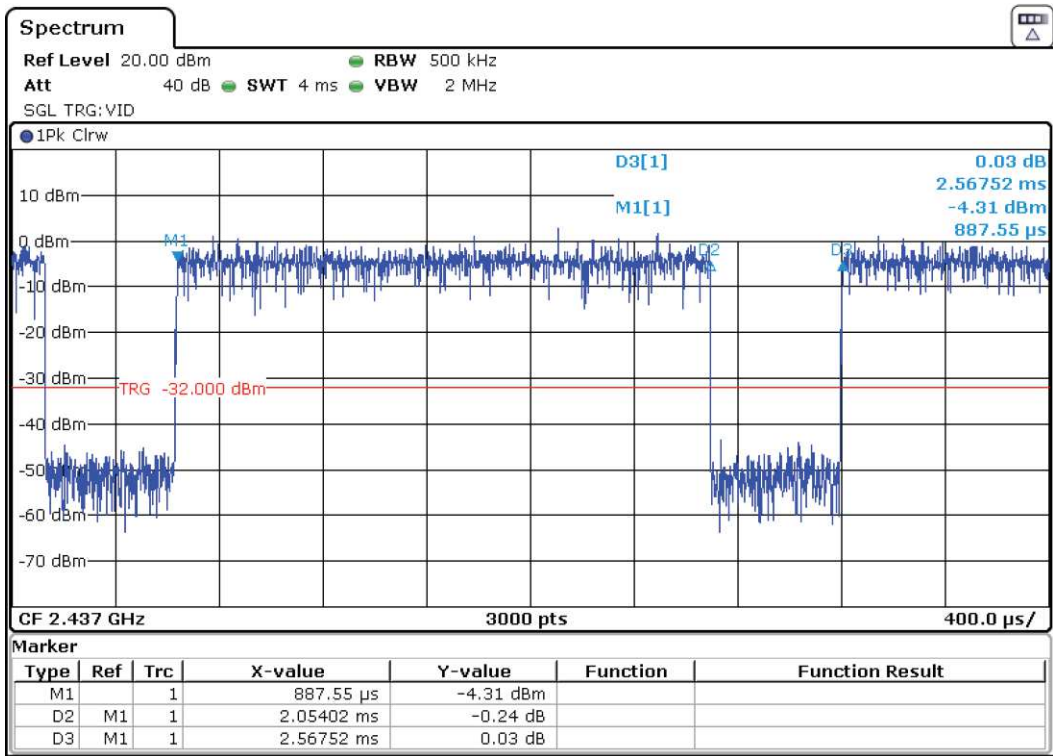
Duty cycle correction: $10 \log (1 / (\text{Pulse duration} / \text{Period}))$

Mode	Pulse duration (ms)	Period (ms)	Duty Cycle correction (dB)
B	12.398	12.925	0.181
G	2.054	2.568	0.970
N20	1.910	2.423	1.033

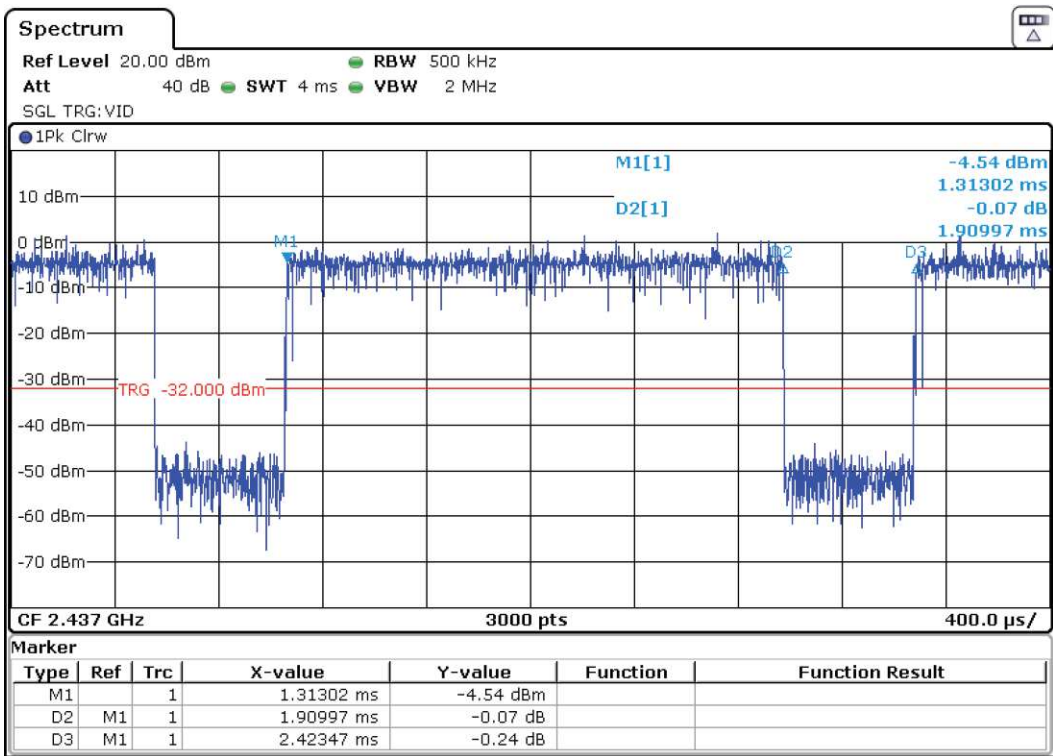
- Mode 802.11 b



• Mode 802.11 g



• Mode 802.11 n20



FCC Section 15.247 Subclause (b) / RSS-247 Clause 5.4 (d) Maximum output power and antenna gain

SPECIFICATION:

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).
The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).

RESULTS:

For all modes, the maximum conducted (average) output power was measured using the method according to point 8.3.1 of Guidance for Performing Compliance Measurements on Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v05r02 dated 04/02/2019.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

Declared Gain for antenna RF port 2 (maximum): +2.2 dBi. (Antenna gain plus antenna cable loss).

Declared Gain for antenna RF port 4 (maximum): +1.6 dBi. (Antenna gain plus antenna cable loss).

- **CORE 0 – Antenna RF External port 2**

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Conducted Power (dBm)	7.32	7.35	7.21
Duty Cycle Correction Factor (dB)	0.181	0.181	0.181
Max. Conducted Power corrected (dBm)	7.501	7.531	7.391
Maximum EIRP Power (dBm)	9.701	9.731	9.591
Measurement uncertainty (dB)	<±0.33		

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Conducted Power (dBm)	6.78	6.62	6.88
Duty Cycle Correction Factor (dB)	0.97	0.97	0.97
Max. Conducted Power corrected (dBm)	7.75	7.59	7.85
Maximum EIRP Power (dBm)	9.95	9.79	10.05
Measurement uncertainty (dB)	<±0.33		

- **Mode 802.11 N20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Conducted Power (dBm)	6.86	6.77	6.91
Duty Cycle Correction Factor (dB)	1.033	1.033	1.033
Max. Conducted Power corrected (dBm)	7.893	7.803	7.943
Maximum EIRP Power (dBm)	10.093	10.003	10.143
Measurement uncertainty (dB)	<±0.33		

- **CORE 1 – Antenna RF External port 4**

- **Mode 802.11 b**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Conducted Power (dBm)	8.18	7.92	7.82
Duty Cycle Correction Factor (dB)	0.181	0.181	0.181
Max. Conducted Power corrected (dBm)	8.361	8.101	8.001
Maximum EIRP Power (dBm)	9.961	9.701	8.601
Measurement uncertainty (dB)	<±0.33		

- **Mode 802.11 g**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Conducted Power (dBm)	7.62	7.52	7.28
Duty Cycle Correction Factor (dB)	0.97	0.97	0.97
Max. Conducted Power corrected (dBm)	8.59	8.49	8.25
Maximum EIRP Power (dBm)	10.19	10.09	9.85
Measurement uncertainty (dB)	<±0.33		

- **Mode 802.11 N20**

	Low Channel 2412 MHz	Middle Channel 2437 MHz	High Channel 2462 MHz
Maximum Conducted Power (dBm)	7.49	7.32	7.12
Duty Cycle Correction Factor (dB)	1.033	1.033	1.033
Max. Conducted Power corrected (dBm)	8.523	8.353	8.153
Maximum EIRP Power (dBm)	10.123	9.953	9.753
Measurement uncertainty (dB)	<±0.33		

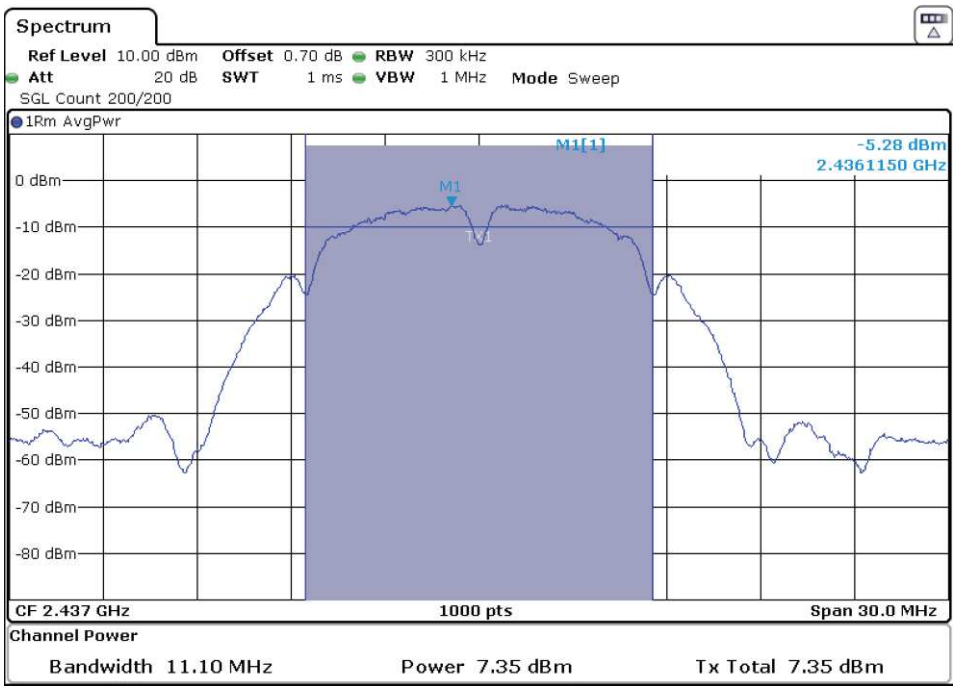
Verdict: PASS

- CORE 0 – Antenna RF External port 2
 - Mode 802.11 b – Average Conducted Output Power

- Low Channel:



- Middle Channel:

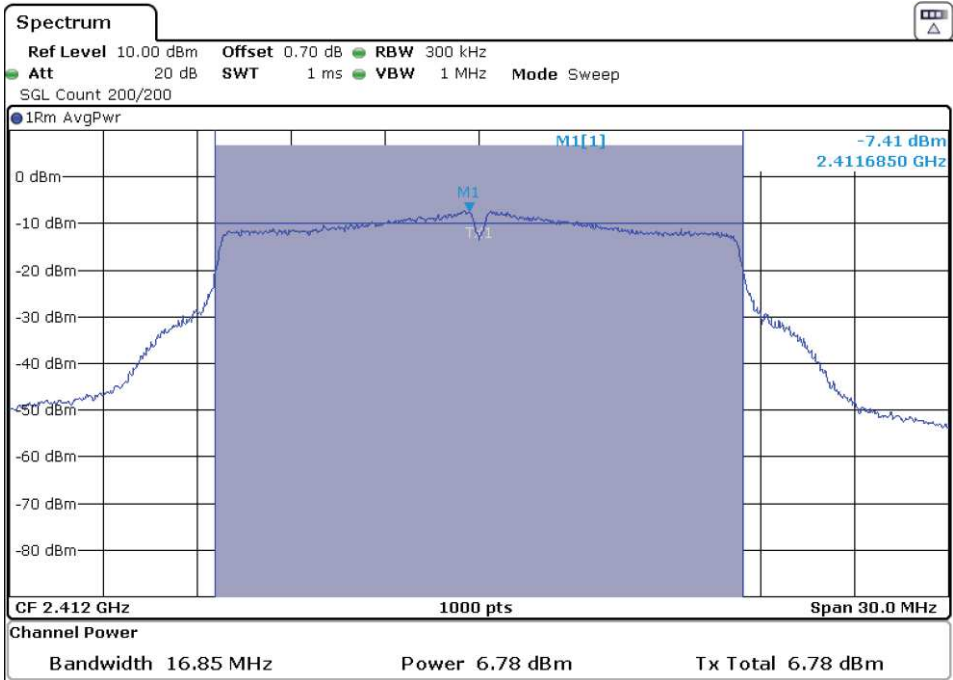


- High Channel:

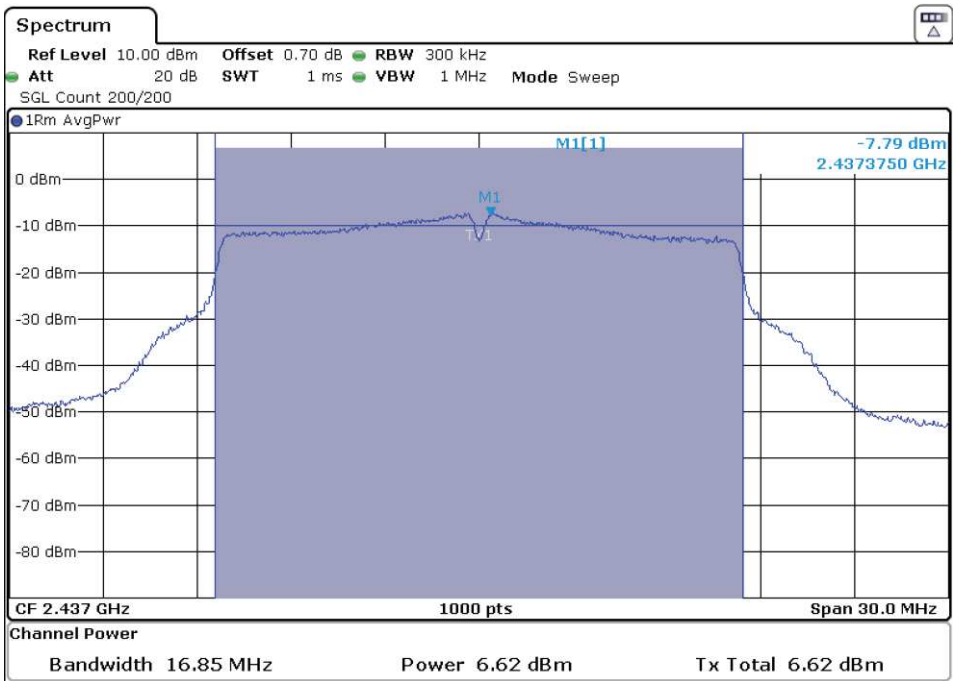


○ Mode 802.11 g – Average Conducted Output Power

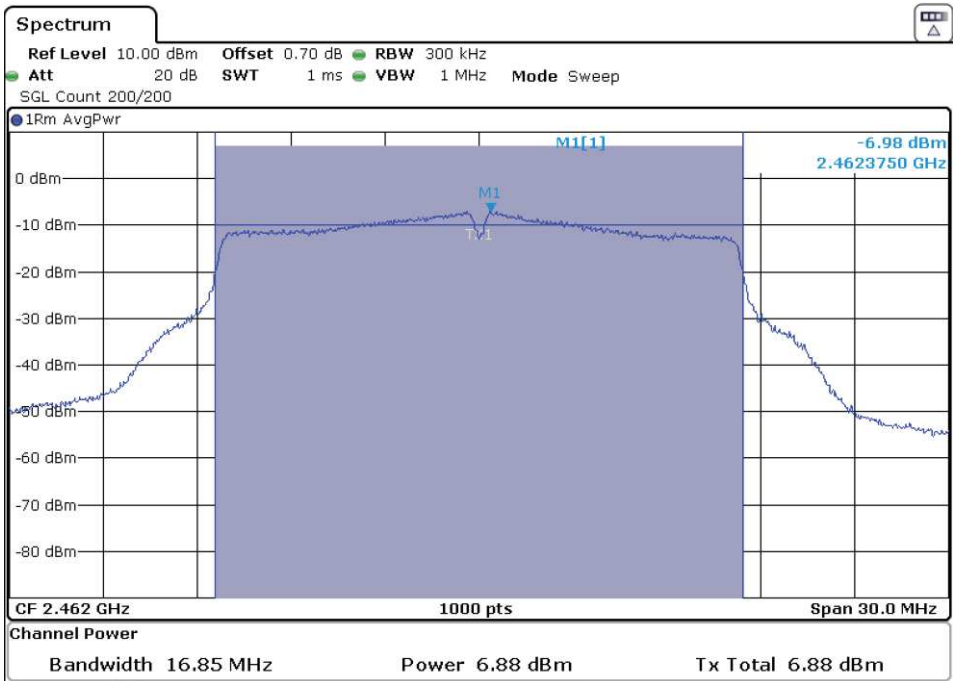
- Low Channel:



- Middle Channel:

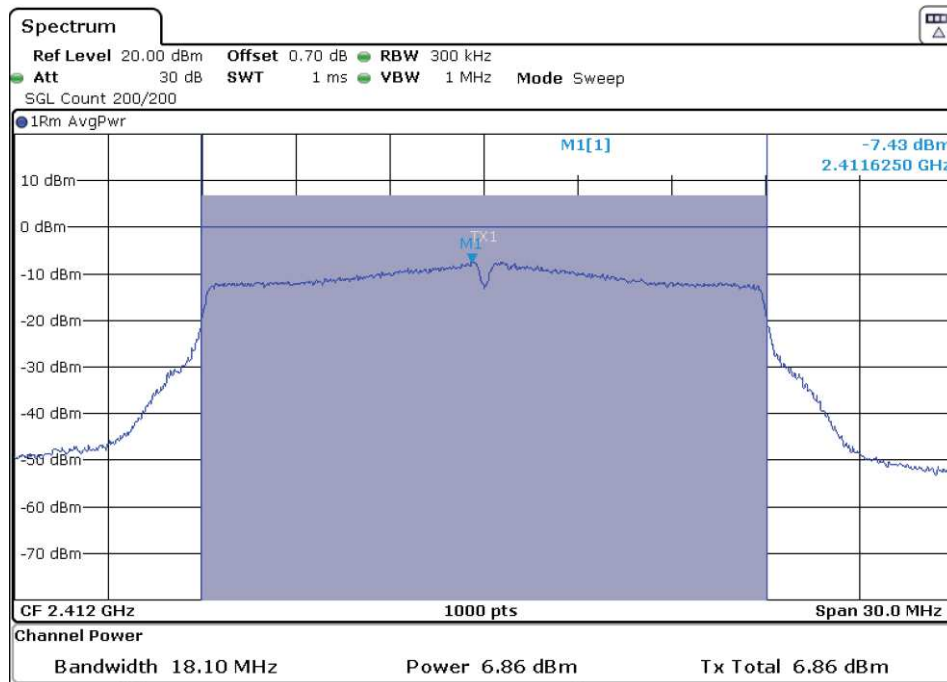


- High Channel:

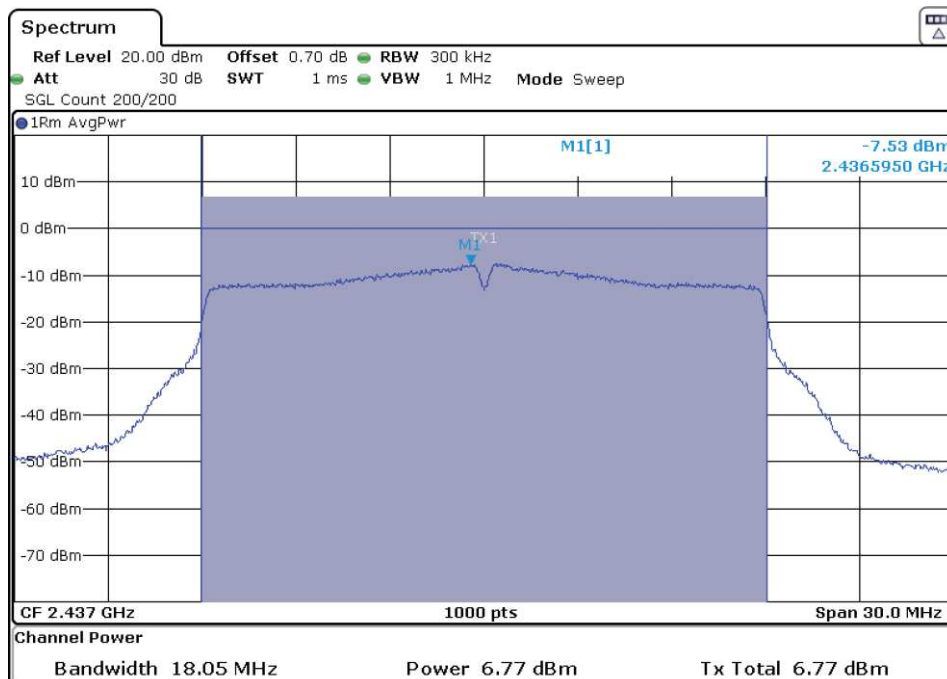


○ **Mode 802.11 N20 – Average Conducted Output Power**

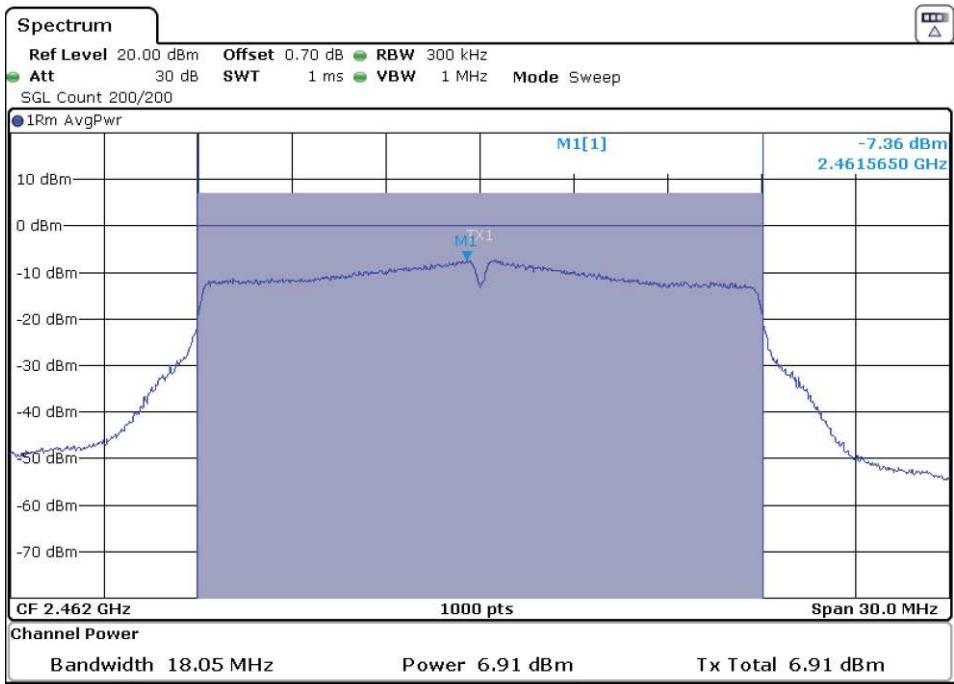
- Low Channel:



- Middle Channel:



- High Channel:



- CORE 1 – Antenna RF External port 4
 - Mode 802.11 b – Average Conducted Output Power

- Low Channel:



- Middle Channel:

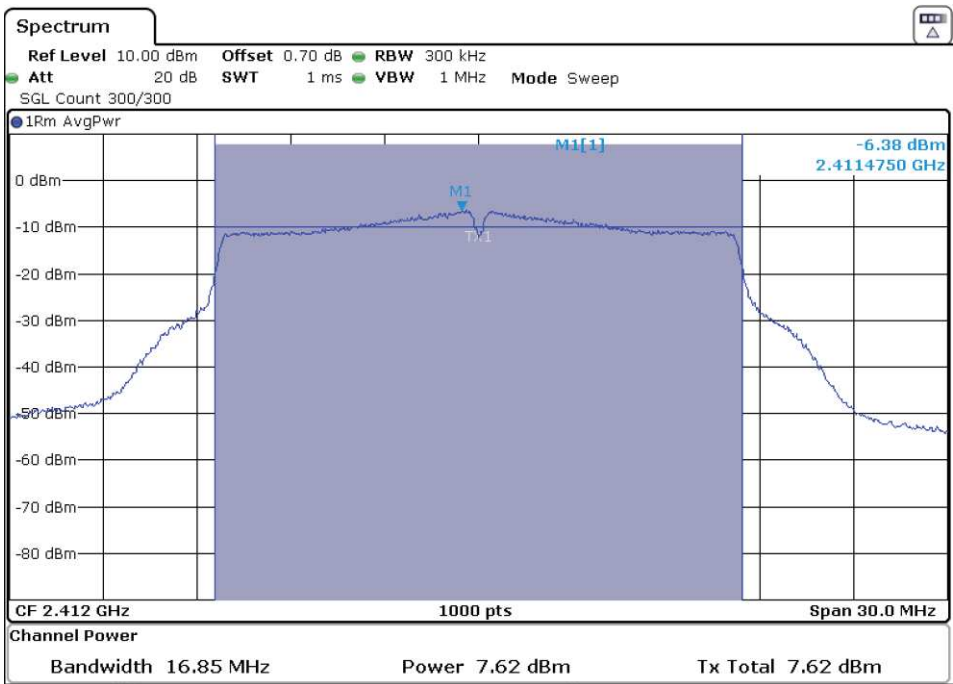


- High Channel:

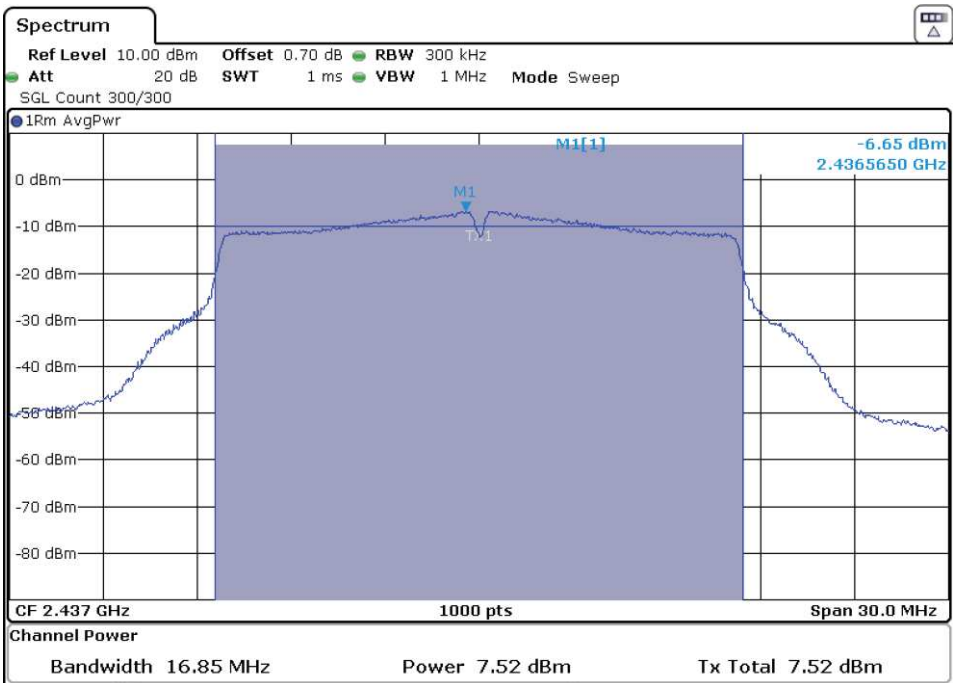


○ Mode 802.11 g – Average Conducted Output Power

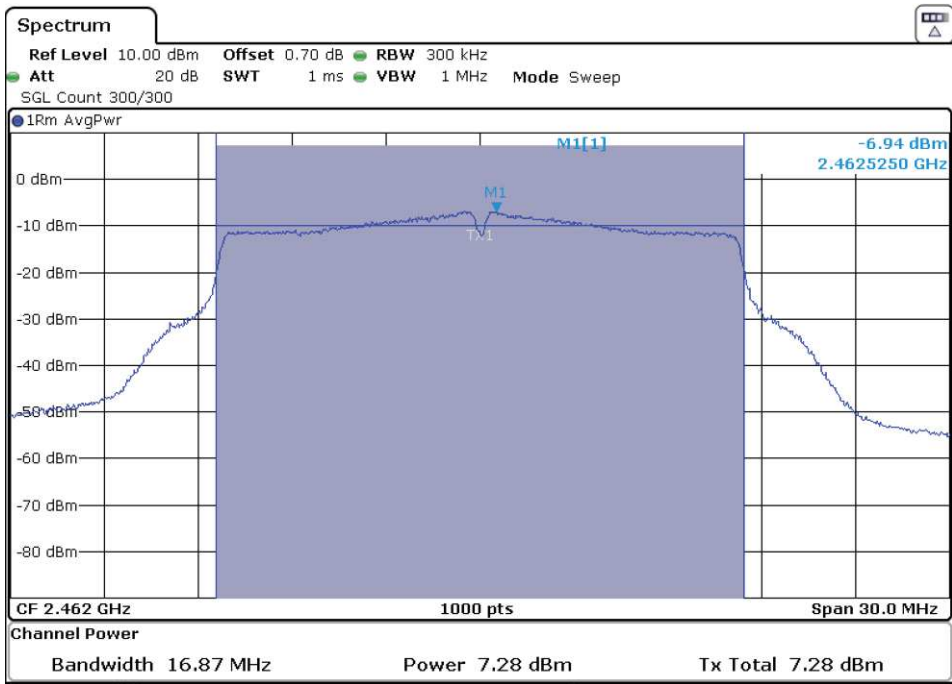
- Low Channel:



- Middle Channel:

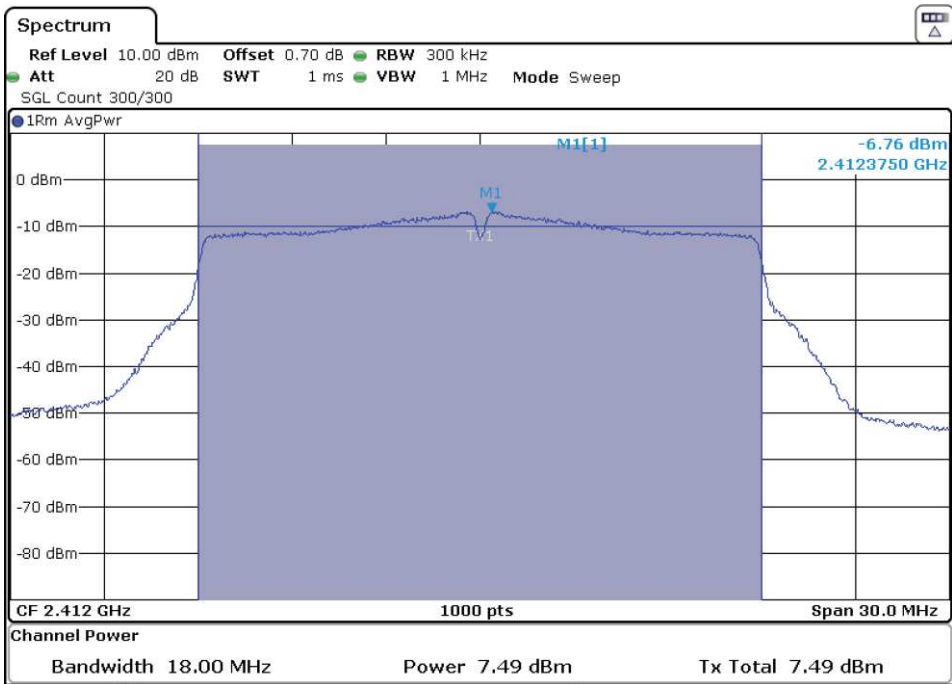


- High Channel:

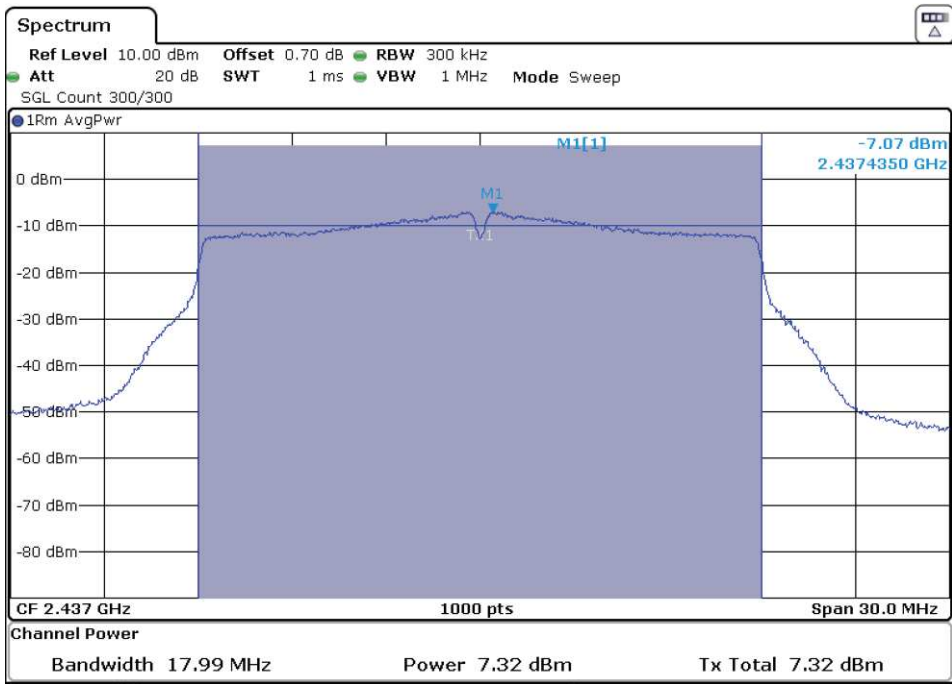


○ Mode 802.11 N20 – Average Conducted Output Power

- Low Channel:



- Middle Channel:



- High Channel:

