

7.3. Power Spectral Density

Applied standards

- e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 (e)
- RSS-247 issue 2 Section 5.2 (b)

Limit

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.

Test equipment and test set up

Test equipment used for conducted measurements as given in clause Test equipment of this report.
Test setup used for conducted measurements as given in clause Test setups of this report.

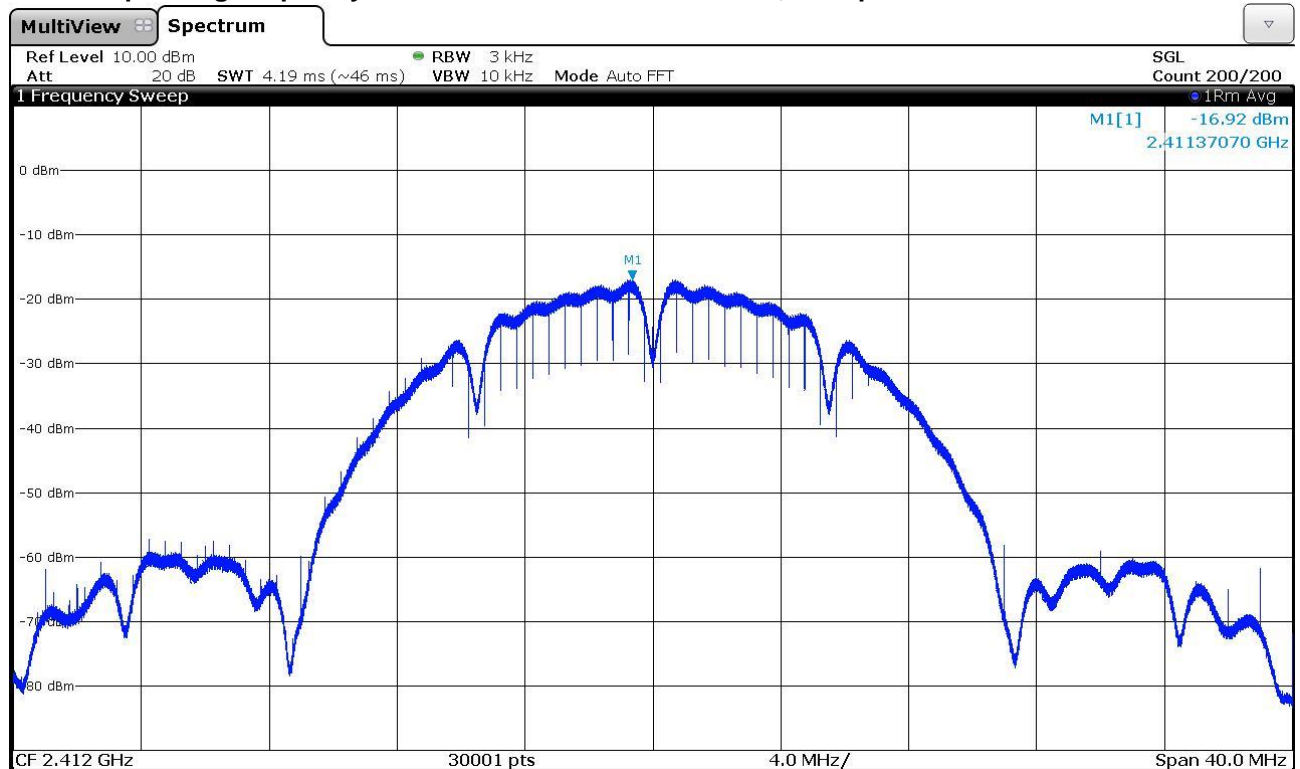
Description

The maximum average conducted output power was used to determine compliance to the fundamental output power limit. So the maximum average conducted PSD level is measured with a power averaging (rms) detector.

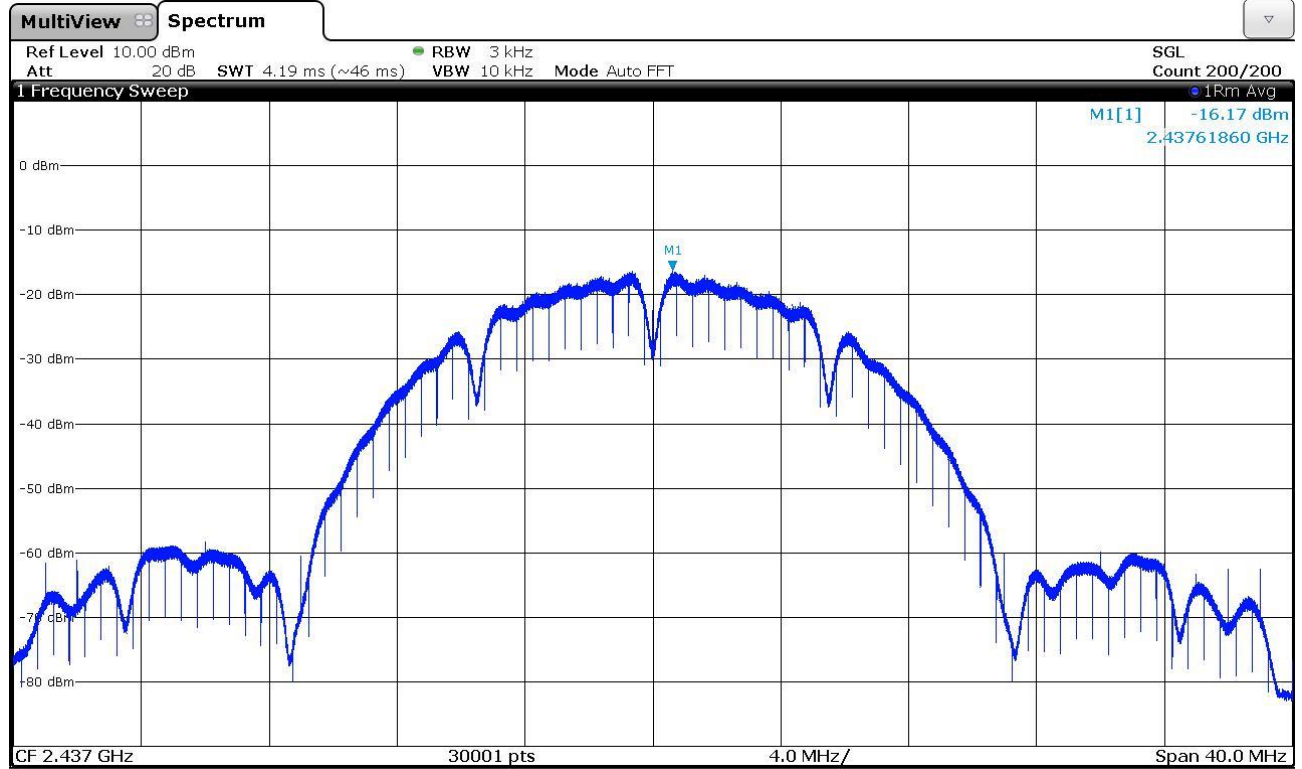
Measurement

The Measurement was performed on: 03.02.2020 and 14.04.2020

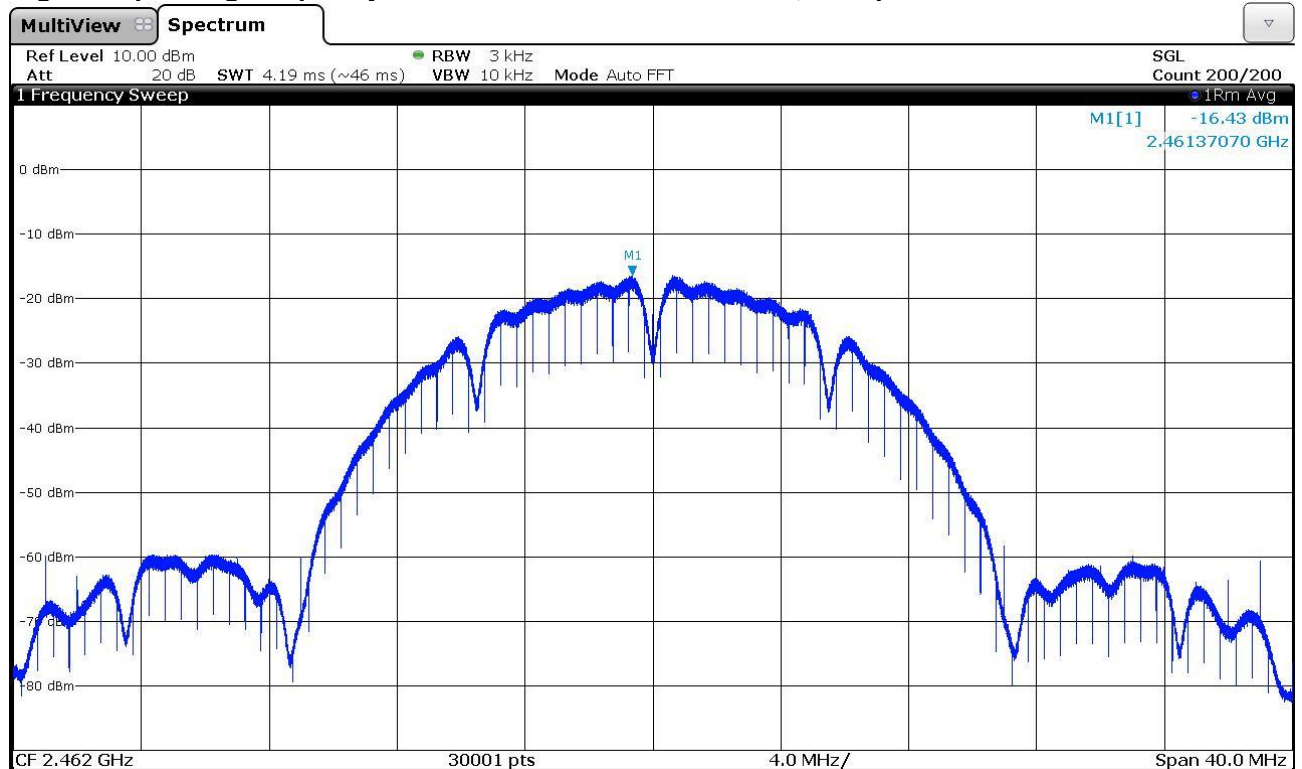
Lowest operating frequency - 802.11b 20MHz / CCK – MCS=0; 1 MBps



Middle Operating Frequency - 802.11b 20MHz / CCK – MCS=0; 1 MBps



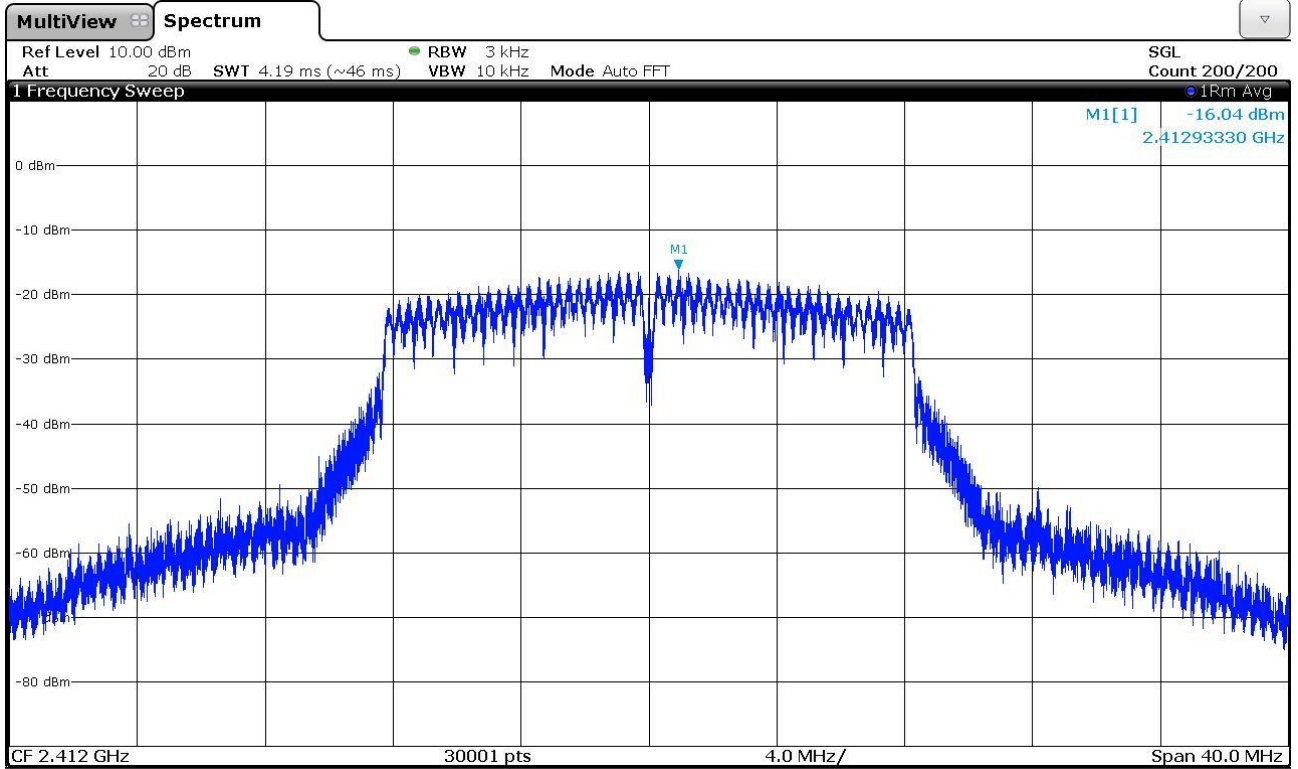
Highest Operating Frequency - 802.11b 20MHz / CCK – MCS=0; 1 MBps



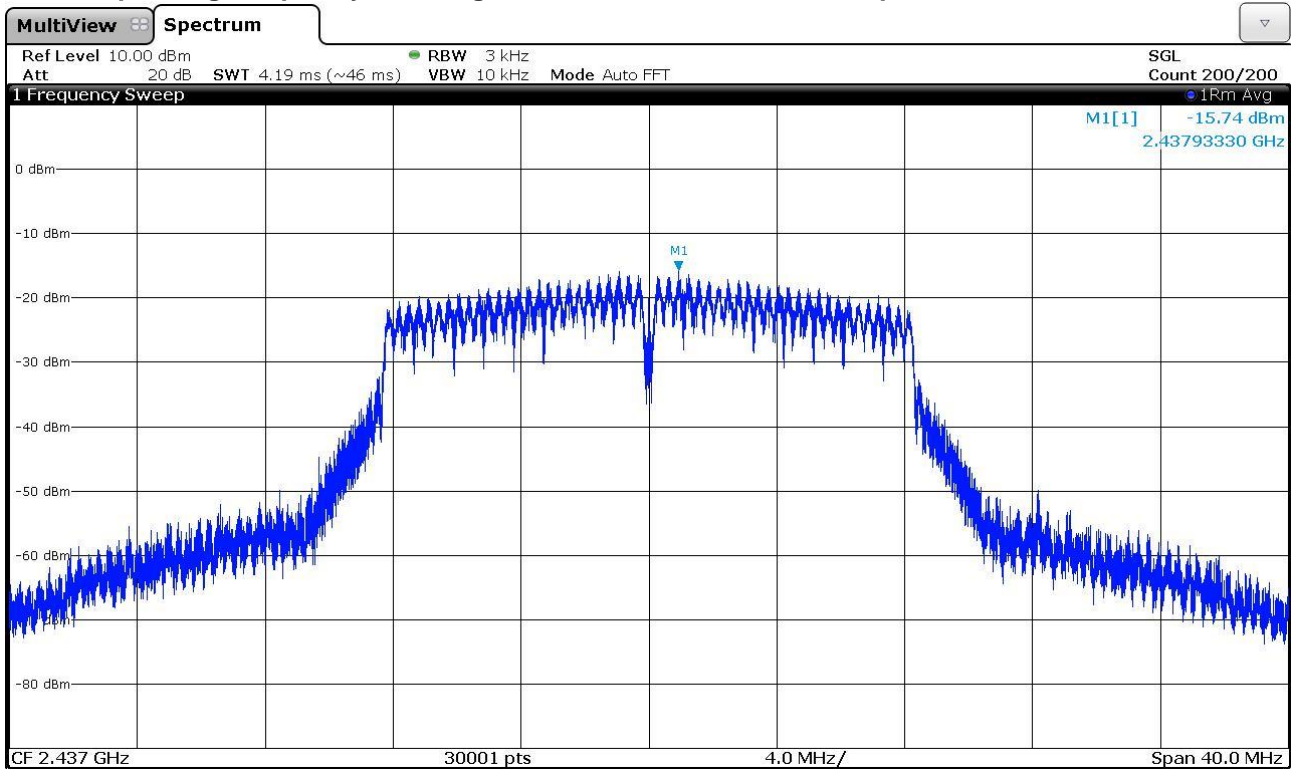
**Maximum power spectral density
802.11b 20MHz / CCK – MCS=0; 1 MBps**

Channel	Frequency [MHz]	Power Spectral Density [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Result
1	2412	-16.92	8	Pass
6	2437	-16.17	8	Pass
11	2462	-16.43	8	Pass

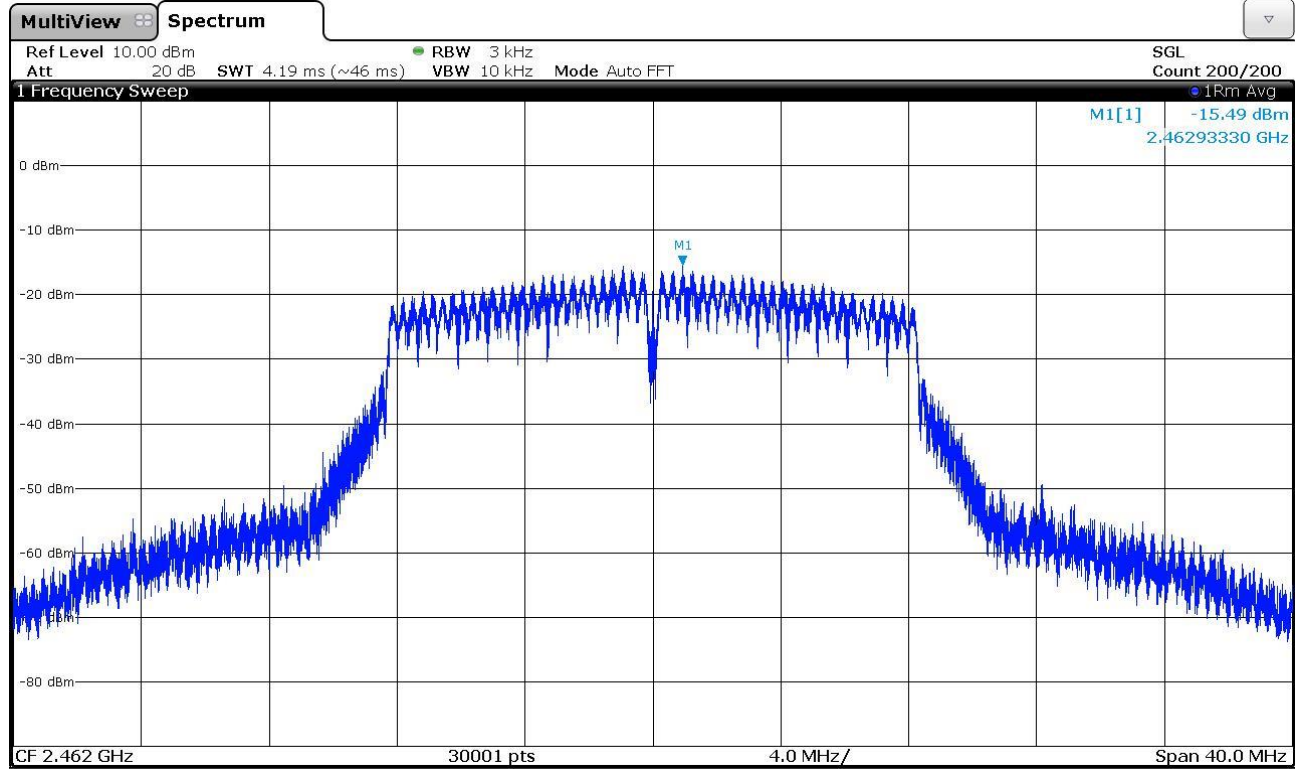
Lowest operating frequency - 802.11g 20MHz / OFDM – MCS=0; 6 MBps



Middle Operating Frequency - 802.11g 20MHz / OFDM – MCS=0; 6 MBps



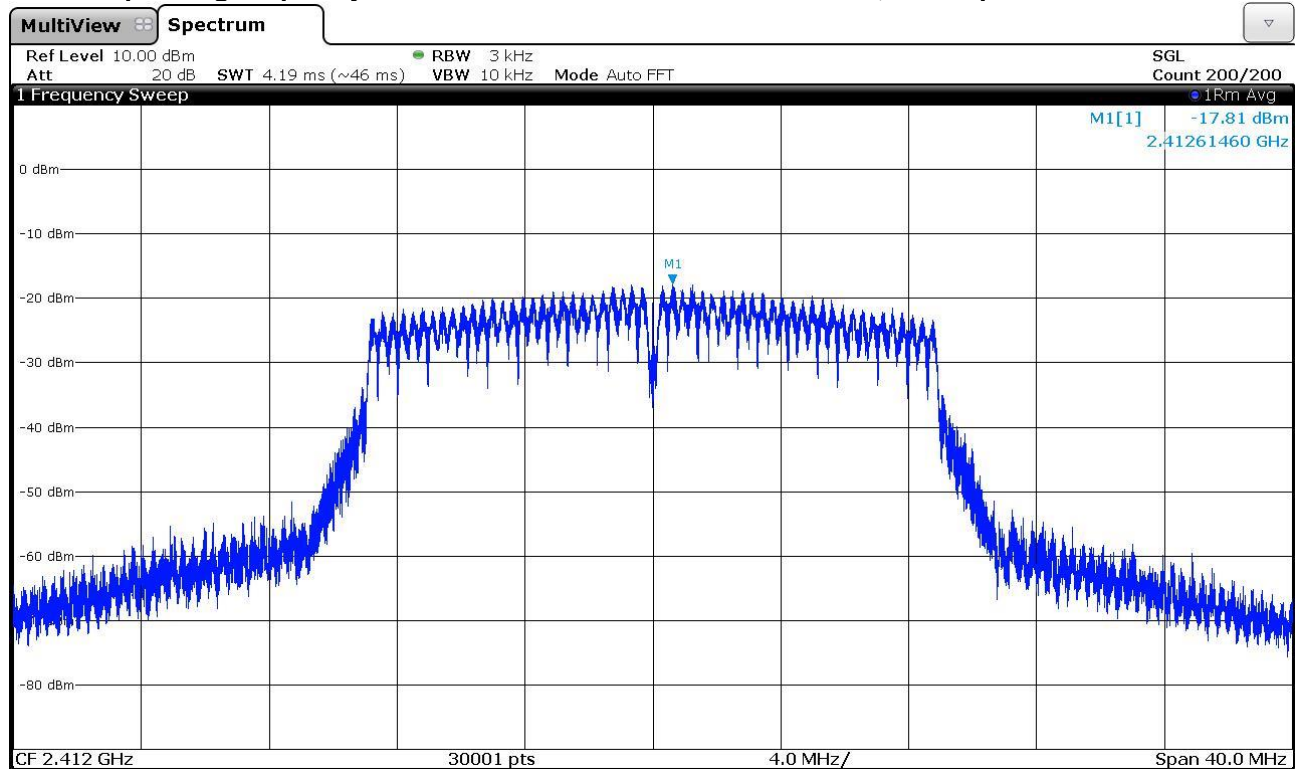
Highest Operating Frequency - 802.11g 20MHz / OFDM – MCS=0; 6 MBps



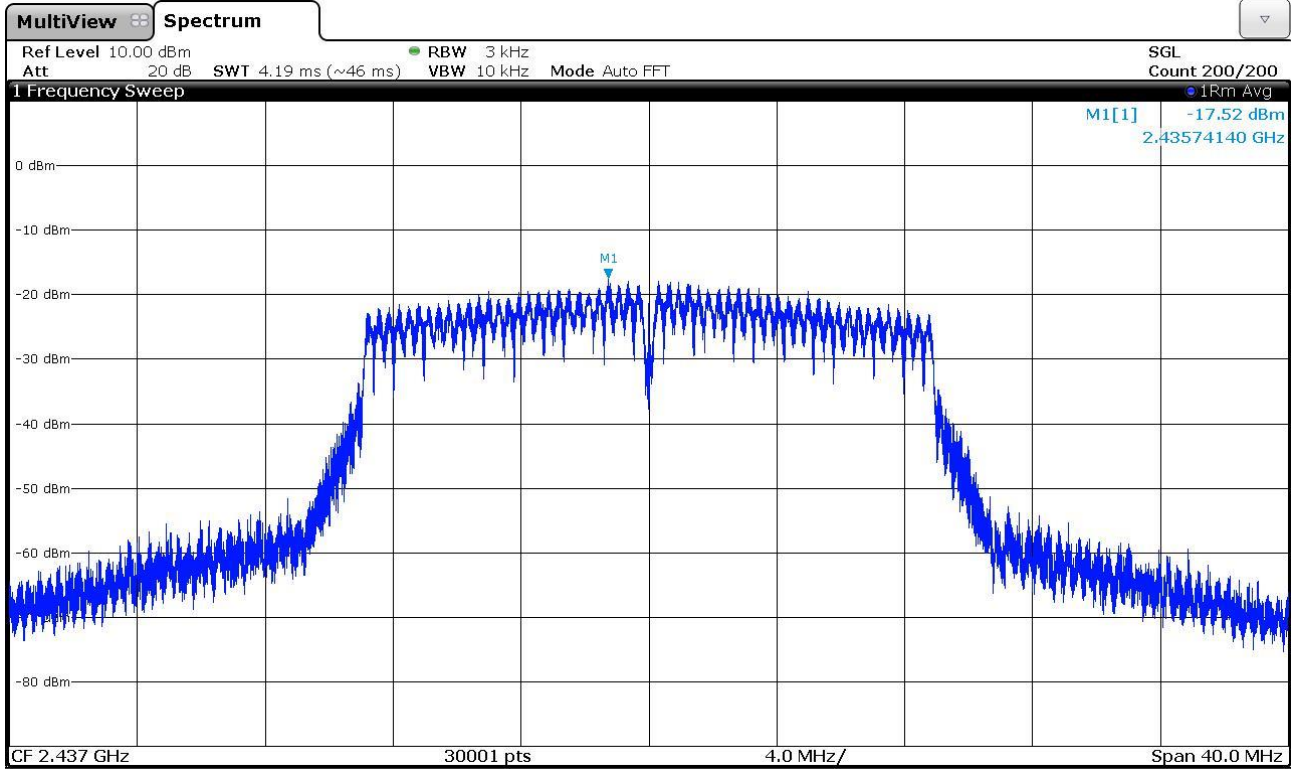
**Maximum power spectral density
802.11g 20MHz / OFDM – MCS=0; 6 MBps**

Channel	Frequency [MHz]	Power Spectral Density [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Result
1	2412	-16.04	8	Pass
6	2437	-15.74	8	Pass
11	2462	-15.49	8	Pass

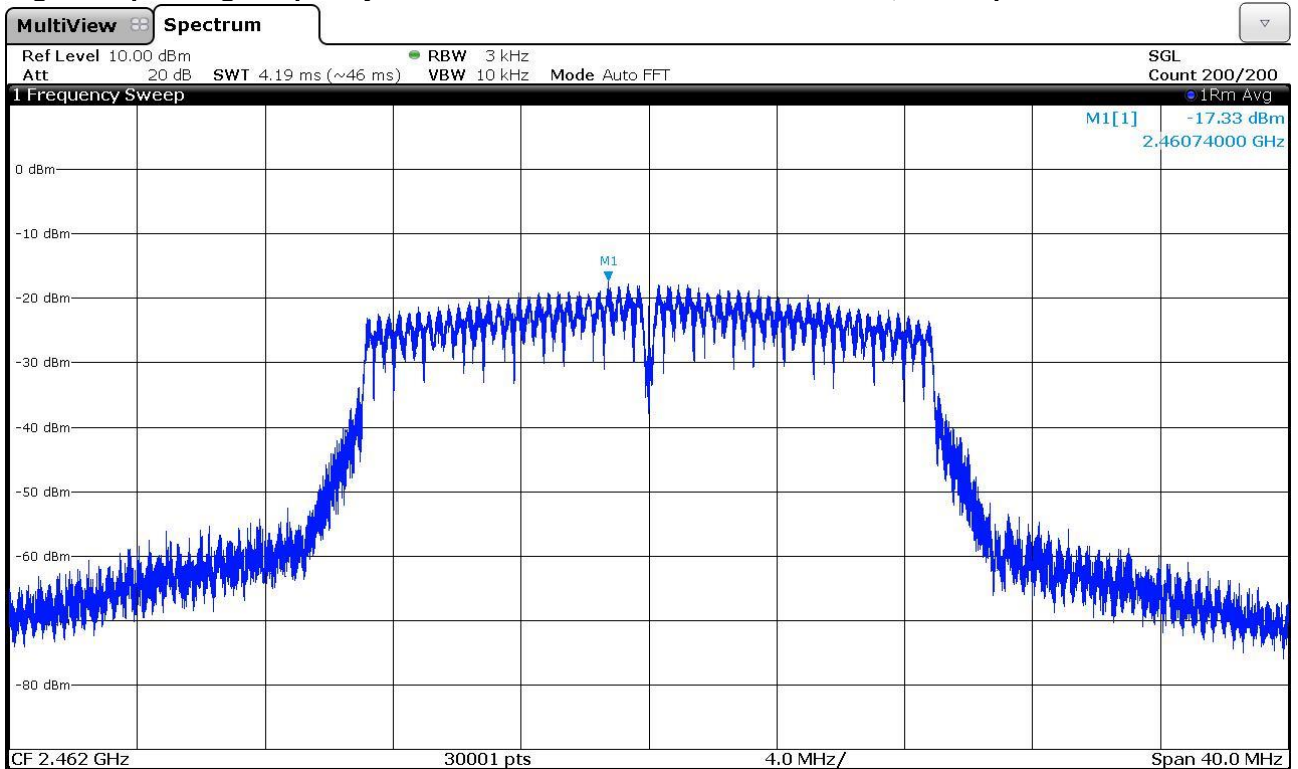
Lowest operating frequency - 802.11n 20MHz / HT MixMode – MCS=0; 6.5 MBps



Middle Operating Frequency - 802.11n 20MHz / HT MixMode – MCS=0; 6.5 MBps



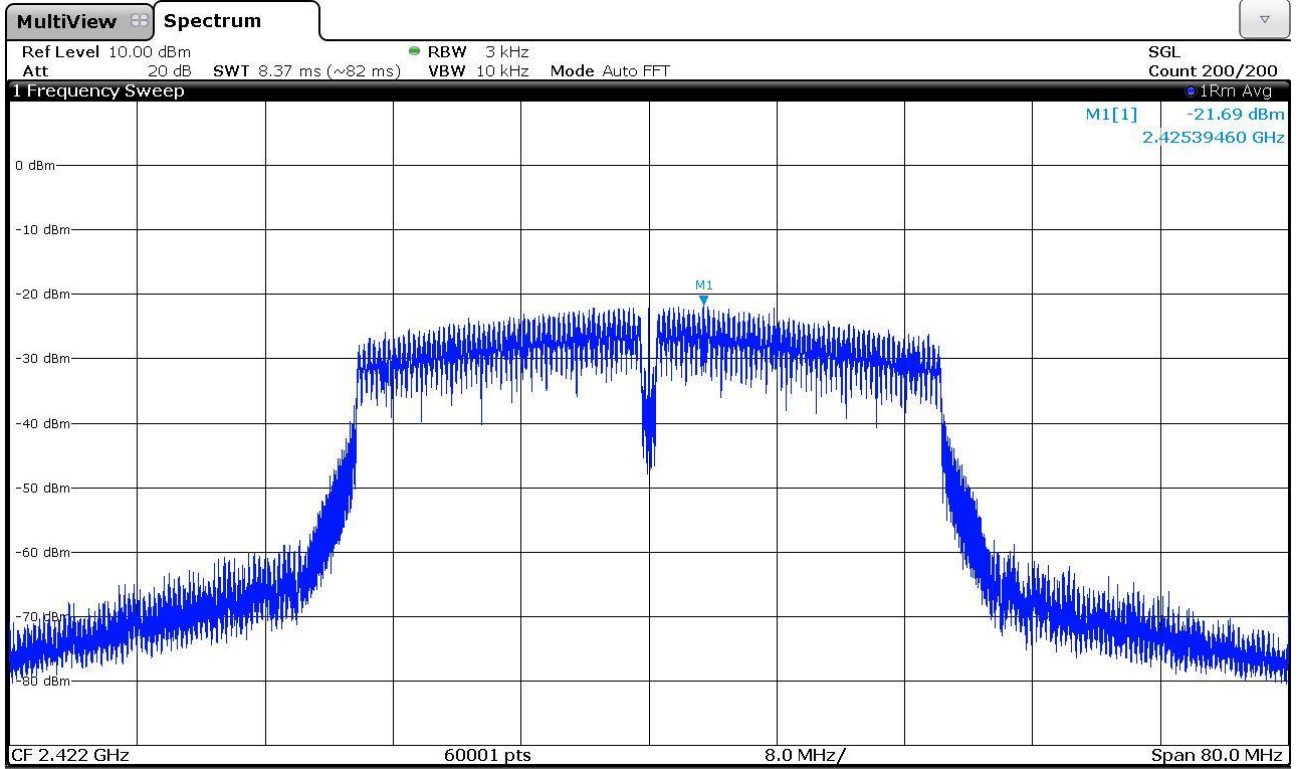
Highest Operating Frequency - 802.11n 20MHz / HT MixMode – MCS=0; 6.5 MBps



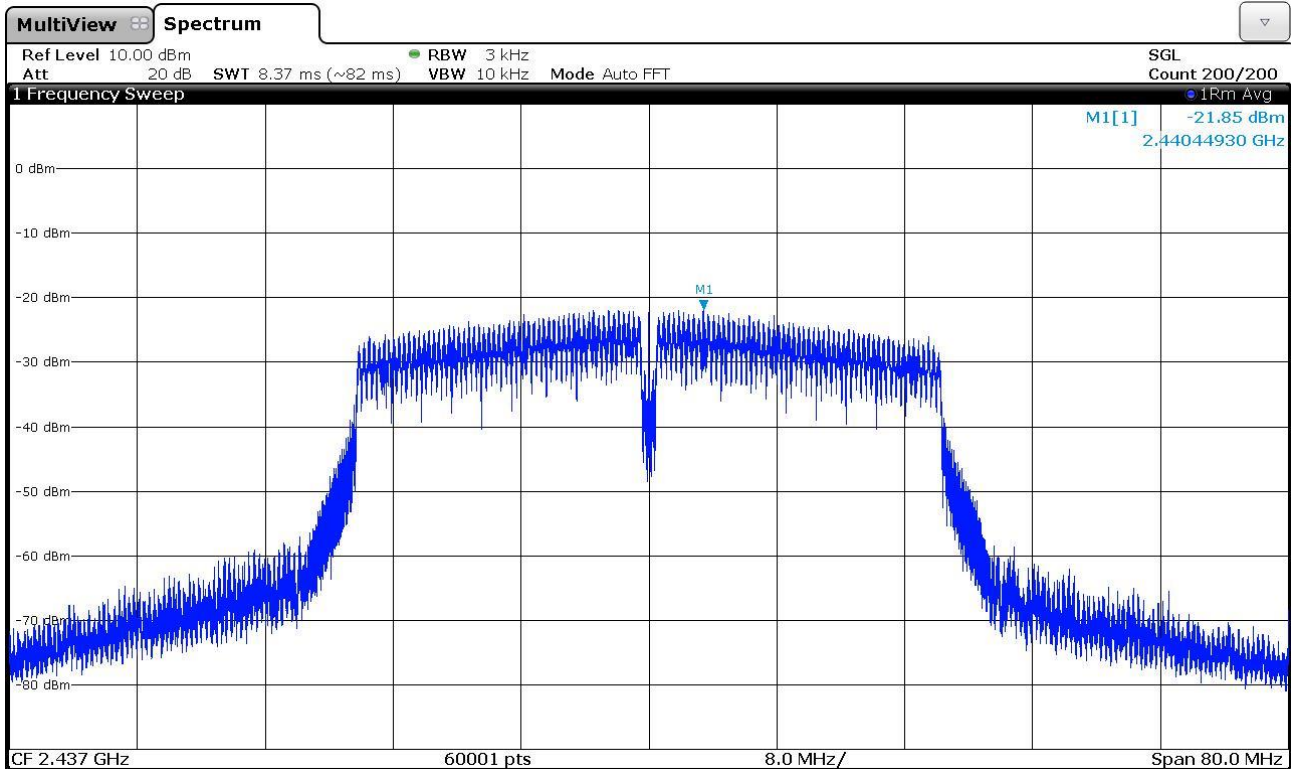
**Maximum power spectral density
802.11n 20MHz / HT MixMode – MCS=0; 6.5 MBps**

Channel	Frequency [MHz]	Power Spectral Density [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Result
1	2412	-17.81	8	Pass
6	2437	-17.52	8	Pass
11	2462	-17.33	8	Pass

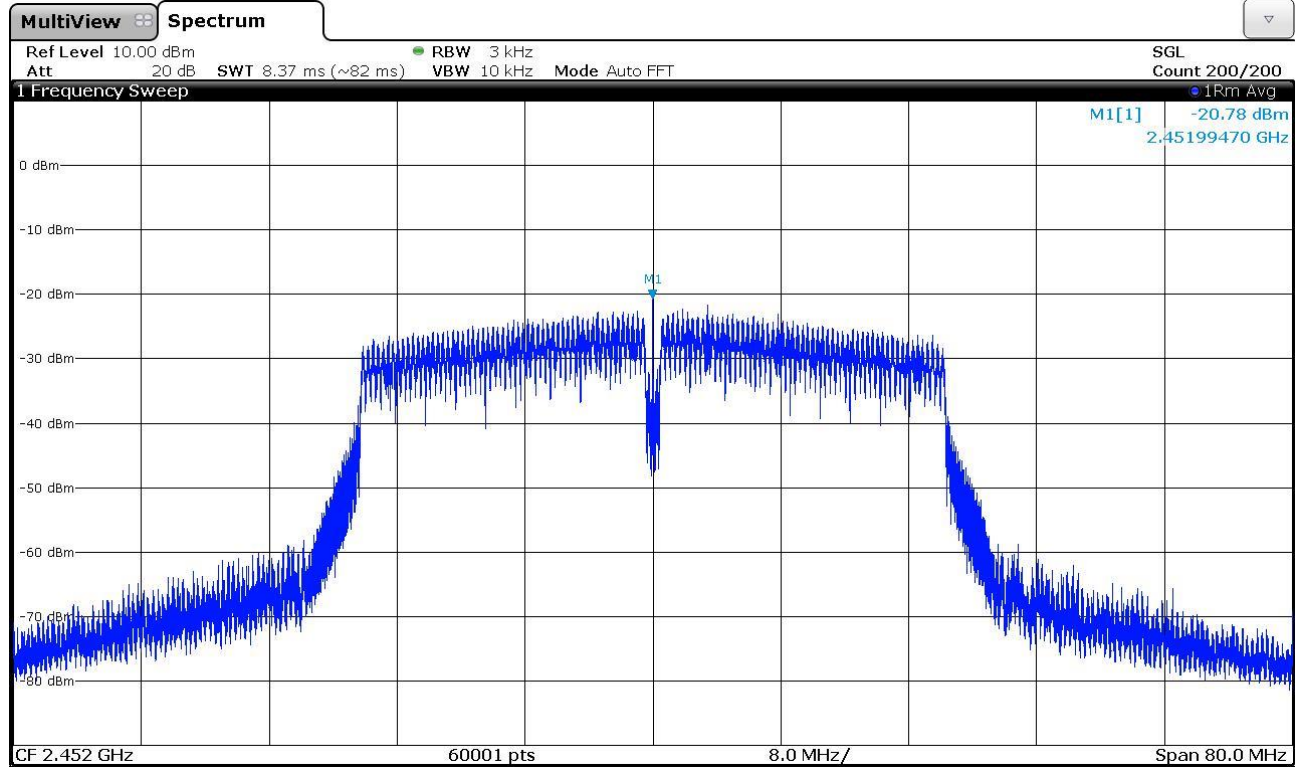
Lowest operating frequency - 802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps



Middle Operating Frequency - 802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps



Highest Operating Frequency - 802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps



**Maximum power spectral density
802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps**

Channel	Frequency [MHz]	Power Spectral Density [dBm / 3 kHz]	Limit [dBm / 3 kHz]	Result
3	2422	-21.69	8	Pass
6	2437	-21.85	8	Pass
9	2452	-20.78	8	Pass

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Power Spectral Density**.

7.4. Band-Edges Measurement

Applied standards

-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 (d)
-RSS-247 issue 2 Section 5.5

Limit

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 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Emissions which fall in the restricted bands, as defined in §15.205 Restricted Bands of operation as well as in restricted bands of the RSS-Gen Issue 5 (see Section 8.10 Restricted Frequency Bands) and must also comply with the radiated emission limits specified in §15.209 Radiated emission limits as well as the limits specified in RSS-Gen Table 5.

Test equipment and test set up

Test equipment used for Band Edge measurements as given in clause Test equipment of this report.
Test setup used for Band Edge measurements as given in clause Test setups of this report.

Description

The band edge is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

Detector function

For the measurement, an EMI test receiver that have CISPR peak and average detector was used.

Measurement

The Measurement was performed on: 06.04.2020

Higher Band Edge - 802.11g 20MHz / OFDM – MCS=0; 6 MBps - radiated



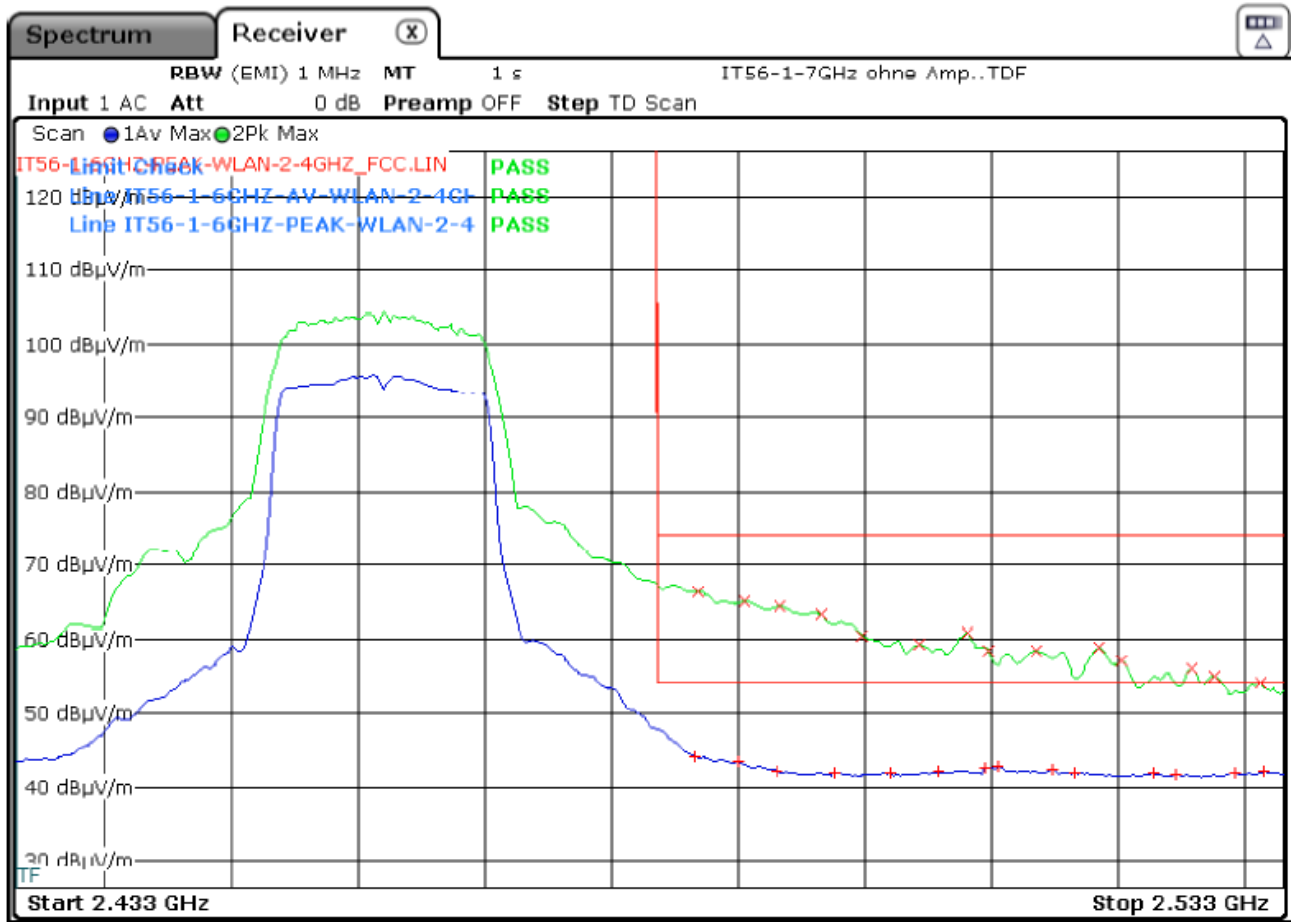
FCC 3
Band edge emission
according to



FCC §15.247, RSS-247, FCC §15.209 RSS-Gen

Ref.-No.: 18/11-0061

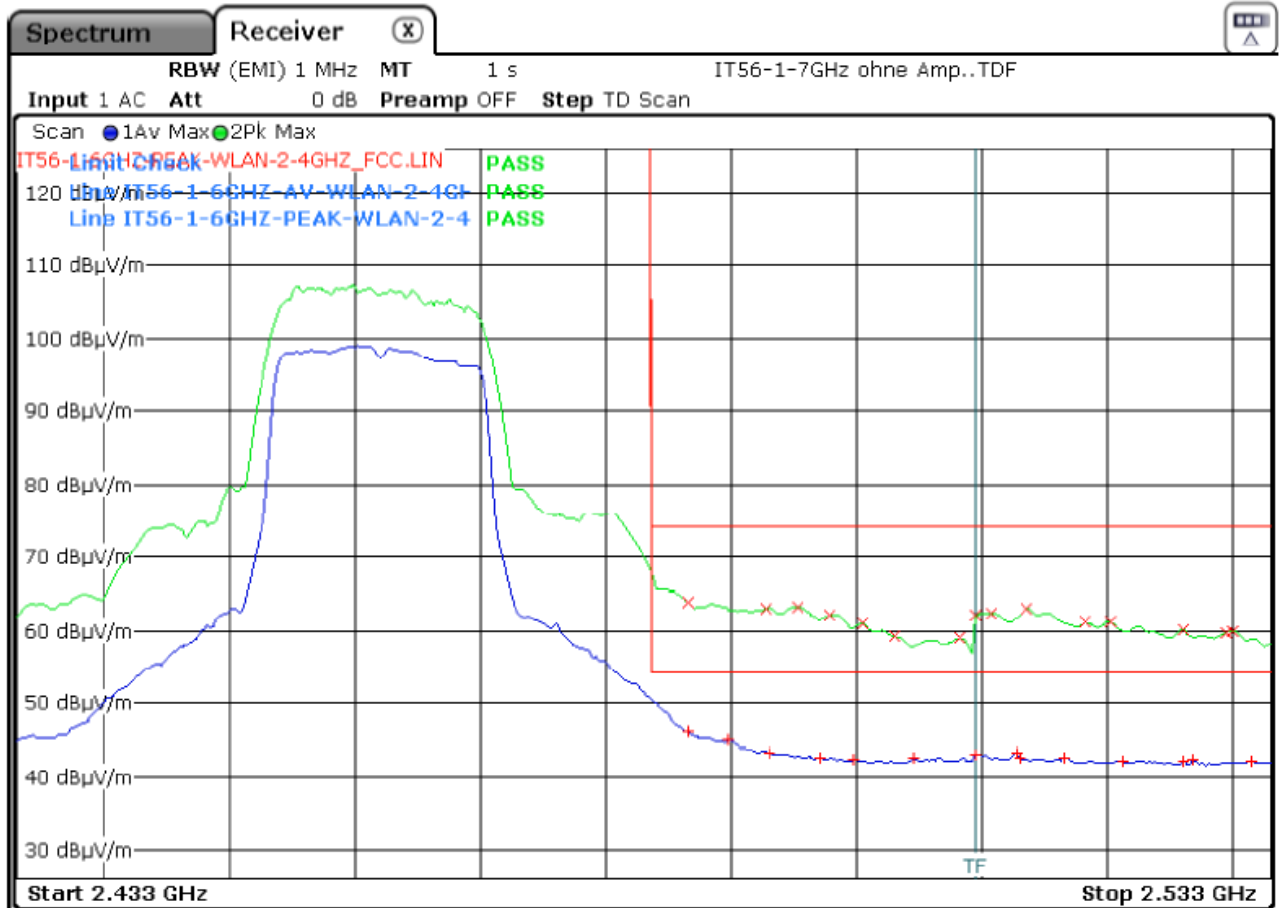
Operation mode: WLAN CH.11; BW = 20MHz; OFDM; 802.11g; Power level 1D; High edge



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,4865	44,08	-9,92	54,00	pass	2,4868	66,25	-7,75	74,00	pass
2,4900	43,29	-10,71	54,00	pass	2,4905	64,98	-9,02	74,00	pass
2,5105	42,74	-11,26	54,00	pass	2,4933	64,24	-9,76	74,00	pass
2,5095	42,54	-11,46	54,00	pass	2,4965	63,11	-10,89	74,00	pass
2,5148	42,39	-11,61	54,00	pass	2,5080	60,83	-13,17	74,00	pass
2,4930	42,18	-11,82	54,00	pass	2,4998	60,45	-13,55	74,00	pass

Ref.-No.: 18/11-0061

Operation mode: WLAN CH.11; BW = 20MHz; OFDM; 802.11g; Power level 1D; High edge



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,4865	45,96	-8,04	54,00	pass	2,4865	63,74	-10,26	74,00	pass
2,4898	44,84	-9,16	54,00	pass	2,4953	63,22	-10,78	74,00	pass
2,4930	43,13	-10,87	54,00	pass	2,4928	63,01	-10,99	74,00	pass
2,5128	43,08	-10,92	54,00	pass	2,5135	62,93	-11,07	74,00	pass
2,5095	42,87	-11,13	54,00	pass	2,5108	62,40	-11,60	74,00	pass
2,5130	42,55	-11,45	54,00	pass	2,5095	62,11	-11,89	74,00	pass

Higher Band Edge - 802.11n 20MHz / HT MixMode – MCS=0; 6.5 MBps - radiated



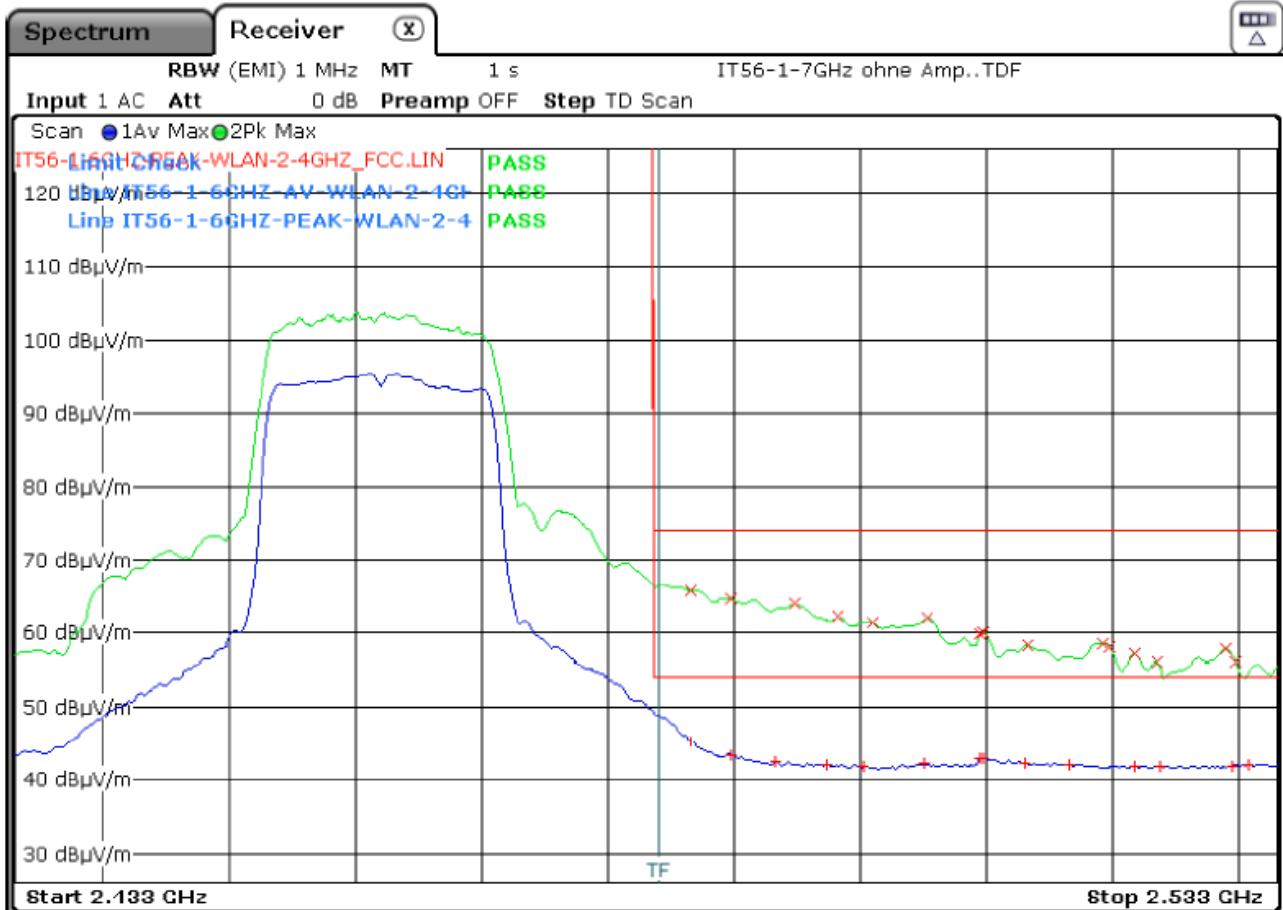
FCC 3
Band edge emission
according to



FCC §15.247, RSS-247, FCC §15.209 RSS-Gen

Ref.-No.: 18/11-0061

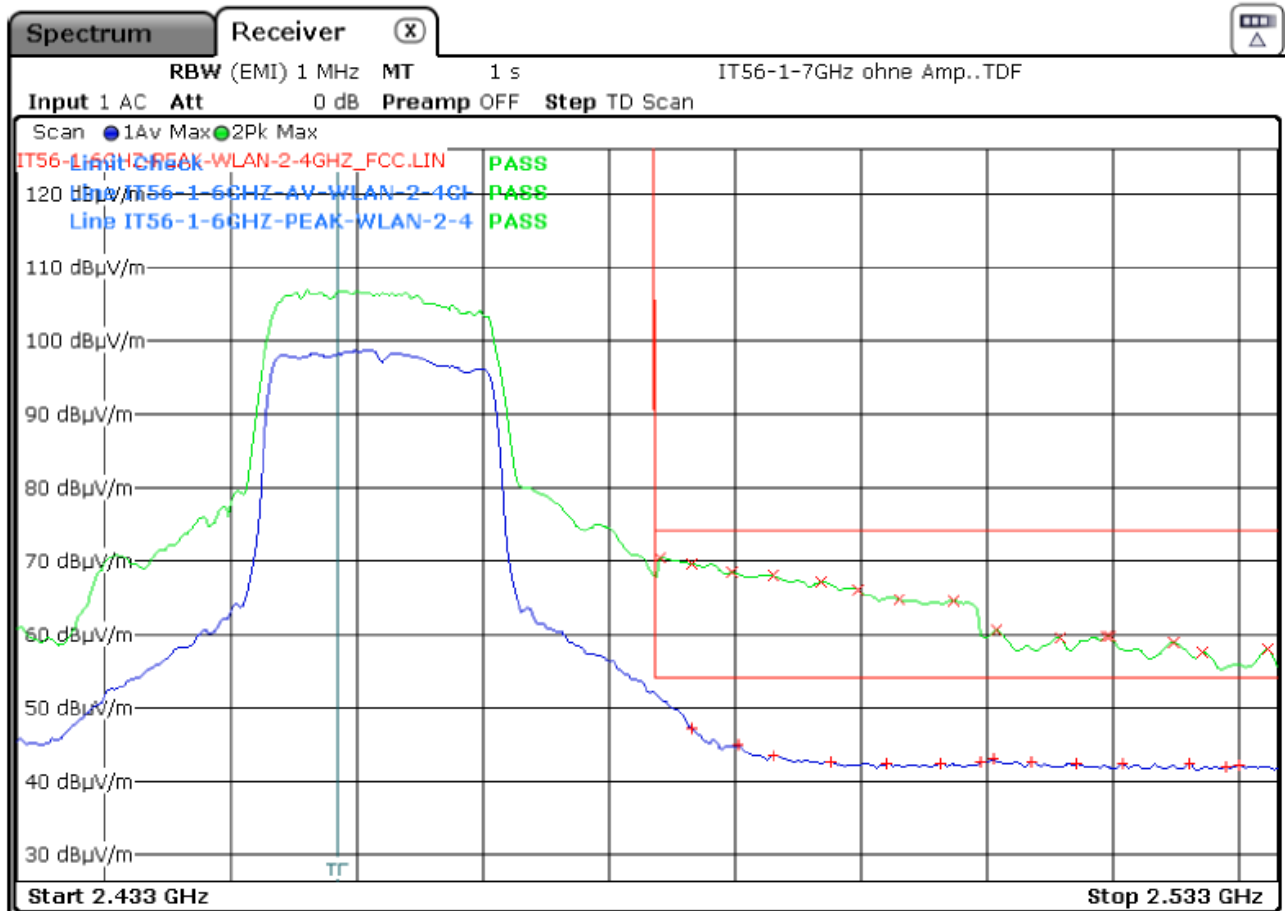
Operation mode: WLAN CH.11; BW = 20MHz; HT Mix Mode; 802.11n; Power level 1D; High edge



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,4865	45,19	-8,81	54,00	pass	2,4865	65,56	-8,44	74,00	pass
2,4898	43,15	-10,85	54,00	pass	2,4898	64,43	-9,57	74,00	pass
2,5095	42,69	-11,31	54,00	pass	2,4948	63,73	-10,27	74,00	pass
2,5098	42,67	-11,33	54,00	pass	2,4983	62,03	-11,97	74,00	pass
2,4933	42,23	-11,77	54,00	pass	2,5053	61,77	-12,23	74,00	pass
2,5130	42,10	-11,90	54,00	pass	2,5010	61,21	-12,79	74,00	pass

Ref.-No.: 18/11-0061

Operation mode: WLAN CH.11; BW = 20MHz; HT Mix Mode; 802.11n; Power level 1D; High edge



Polarisation: H									
Frequ. [GHz]	Level [dBµV/m]	Detector Average			Detector Peak				
		Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,4865	47,12	-6,88	54,00	pass	2,4840	70,32	-3,68	74,00	pass
2,4903	44,81	-9,19	54,00	pass	2,4865	69,53	-4,47	74,00	pass
2,4930	43,50	-10,50	54,00	pass	2,4898	68,35	-5,65	74,00	pass
2,5105	42,90	-11,10	54,00	pass	2,4930	67,91	-6,09	74,00	pass
2,4975	42,60	-11,40	54,00	pass	2,4968	67,09	-6,91	74,00	pass
2,5095	42,55	-11,45	54,00	pass	2,4998	65,91	-8,09	74,00	pass

Higher Band Edge - 802.11n 40MHz / HT MixMode – MCS=0; 6.5 Mbps - radiated



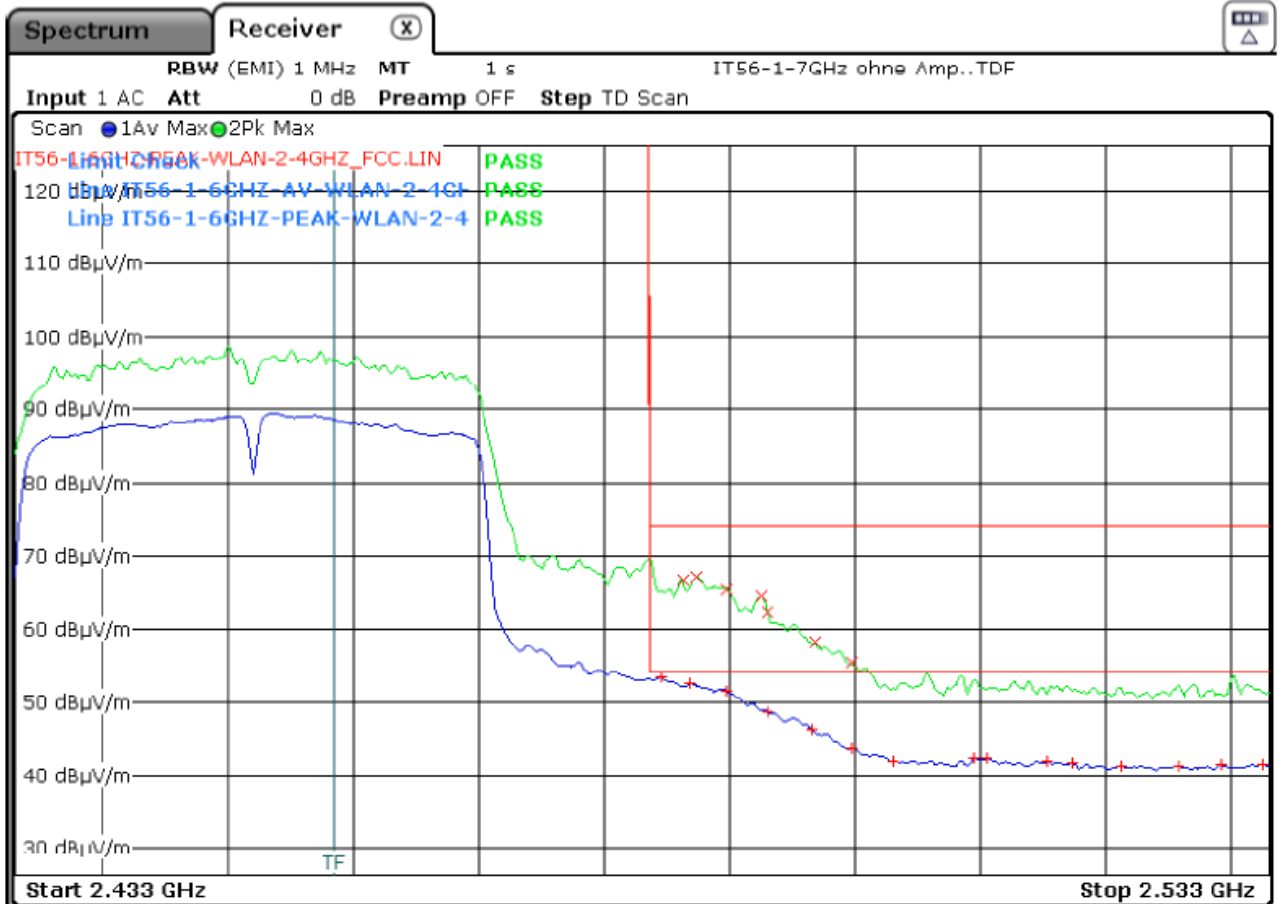
FCC 3
Band edge emission
according to



FCC §15.247, RSS-247, FCC §15.209 RSS-Gen

Ref.-No.: 18/11-0061

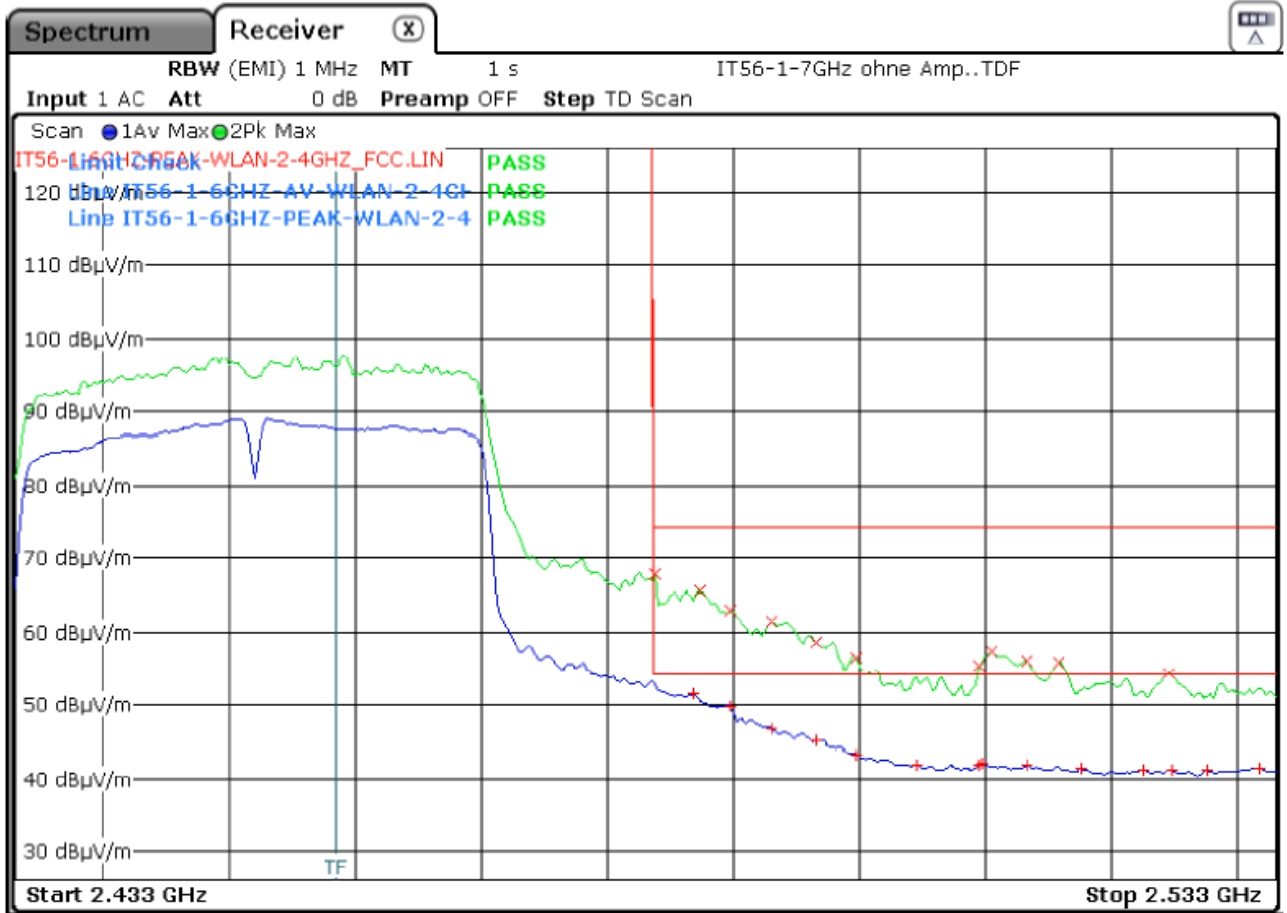
Operation mode: WLAN CH.09; BW = 40MHz; HT Mix Mode; 802.11n40; Power level 1E; High edge



Polarisation: V									
Frequ. [GHz]	Detector Average				Result	Detector Peak			
	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result		Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]
2,4845	53,43	-0,57	54,00	pass	2,4873	67,04	-6,96	74,00	pass
2,4868	52,44	-1,56	54,00	pass	2,4863	66,63	-7,37	74,00	pass
2,4898	51,35	-2,65	54,00	pass	2,4898	65,30	-8,70	74,00	pass
2,4930	48,54	-5,46	54,00	pass	2,4925	64,46	-9,54	74,00	pass
2,4965	46,22	-7,78	54,00	pass	2,4930	62,41	-11,59	74,00	pass
2,4998	43,60	-10,40	54,00	pass	2,4968	58,23	-15,77	74,00	pass

Ref.-No.: 18/11-0061

Operation mode: WLAN CH.09; BW = 40MHz; HT Mix Mode; 802.11n40; Power level 1E; High edge



Polarisation: H

Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,4868	51,38	-2,62	54,00	pass	2,4838	67,66	-6,34	74,00	pass
2,4898	49,64	-4,36	54,00	pass	2,4873	65,59	-8,41	74,00	pass
2,4930	46,75	-7,25	54,00	pass	2,4898	62,85	-11,15	74,00	pass
2,4965	45,12	-8,88	54,00	pass	2,4930	61,39	-12,61	74,00	pass
2,4998	43,15	-10,85	54,00	pass	2,4965	58,68	-15,32	74,00	pass
2,5098	42,06	-11,94	54,00	pass	2,5105	57,21	-16,79	74,00	pass

Lower Band Edge - 802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps - radiated



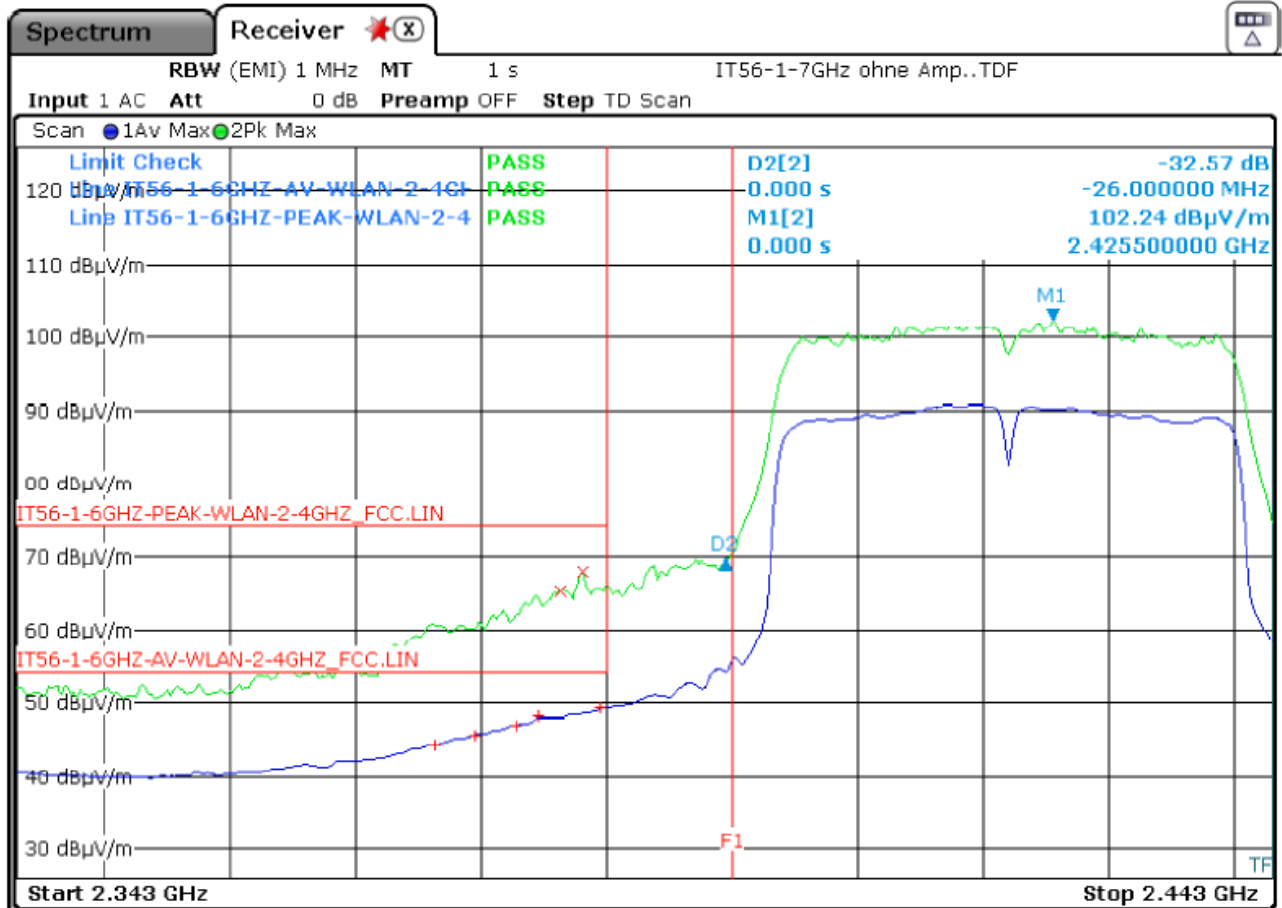
FCC 3
Band edge emission
according to



FCC §15.247, RSS-247, FCC §15.209 RSS-Gen

Ref.-No.: 18/11-0061

Operation mode: WLAN CH.03; BW = 40MHz; HT Mix Mode; 802.11n40; Power level 1E; Low edge



Polarisation: V

Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,3895	49,16	-4,84	54,00	pass	2,3880	68,00	-6,00	74,00	pass
2,3845	48,08	-5,92	54,00	pass	2,3863	65,24	-8,76	74,00	pass
2,3828	46,89	-7,11	54,00	pass					
2,3795	45,61	-8,39	54,00	pass					
2,3763	44,23	-9,77	54,00	pass					

Higher Band Edge - 802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps / ZigBee CH 26 - radiated



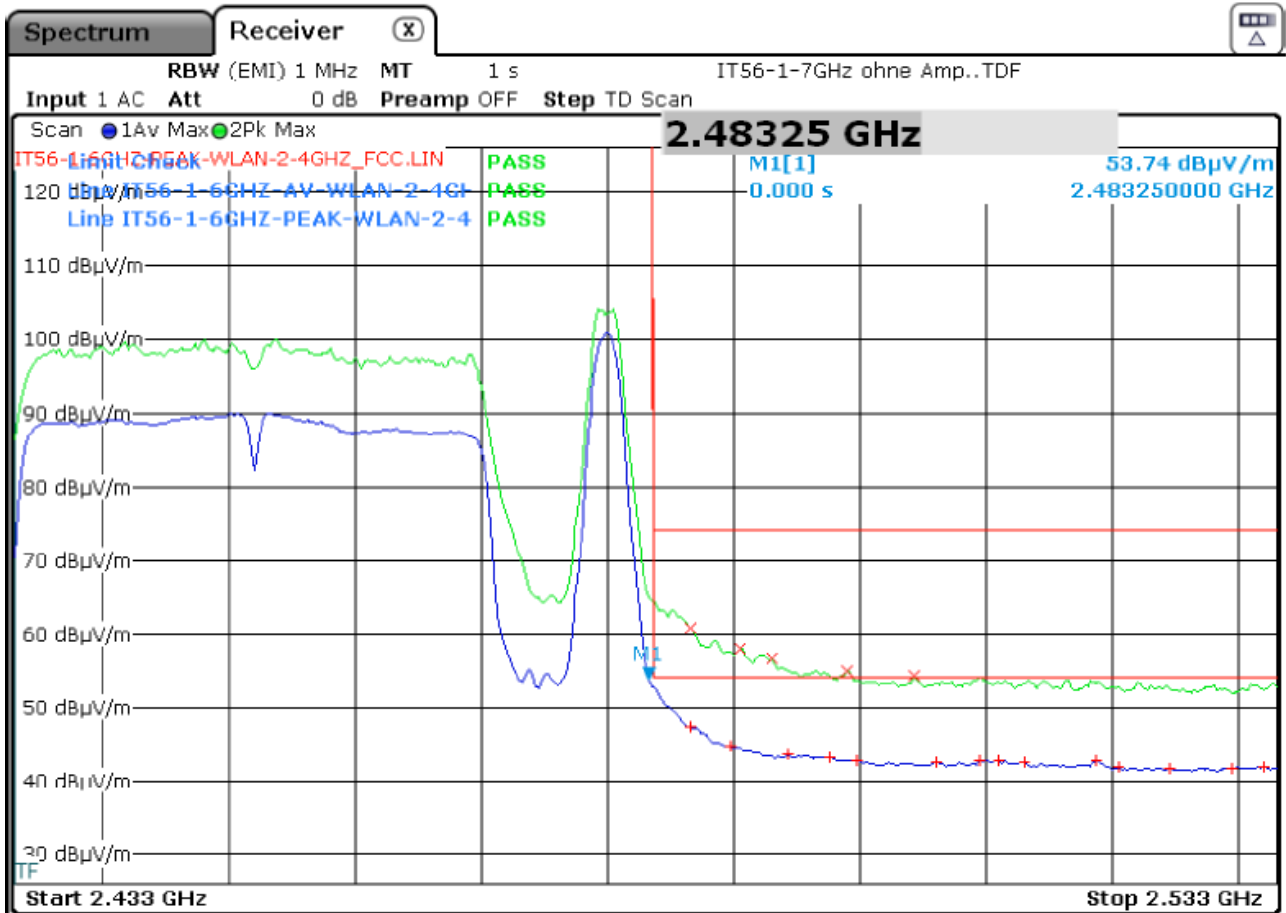
FCC 3
Band edge emission
according to



FCC §15.247, RSS-247, FCC §15.209 RSS-Gen

Ref.-No.: 18/11-0061

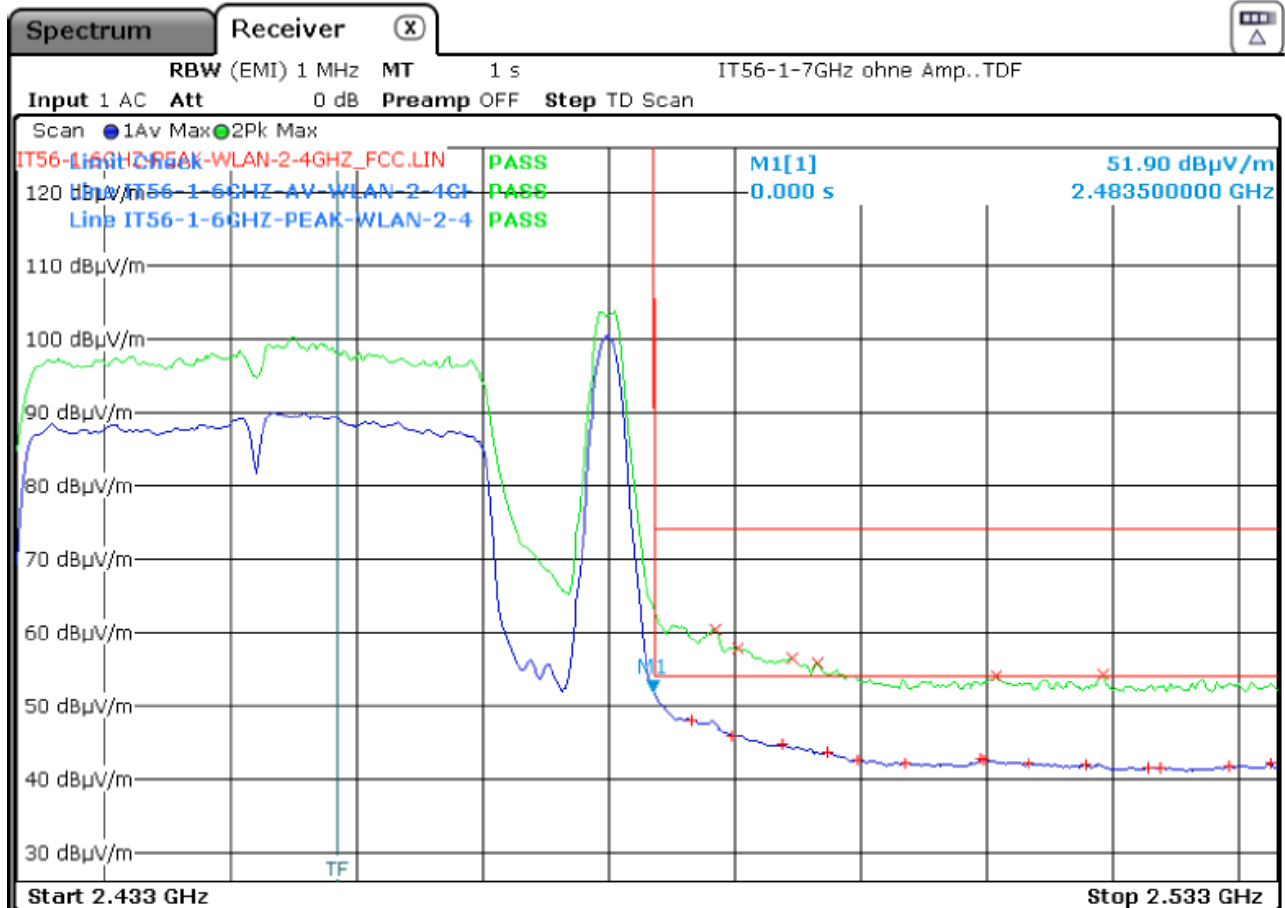
Operation mode: WLAN CH.09; BW = 40MHz; HT Mix Mode; 802.11n40; Power level 1E;
Zigbee CH.26; High edge



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,4835	53,74	-0,26	54,00	pass	2,4865	60,81	-13,19	74,00	pass
2,4865	47,25	-6,75	54,00	pass	2,4905	58,00	-16,00	74,00	pass
2,4898	44,64	-9,36	54,00	pass	2,4930	56,56	-17,44	74,00	pass
2,4943	43,59	-10,41	54,00	pass	2,4990	54,94	-19,06	74,00	pass
2,4975	43,22	-10,78	54,00	pass	2,5043	54,16	-19,84	74,00	pass
2,5110	42,70	-11,30	54,00	pass					

Ref.-No.: 18/11-0061

Operation mode: WLAN CH.09; BW = 40MHz; HT Mix Mode; 802.11n40; Power level 1E;
Zigbee CH.26; High edge



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,4835	51,90	-2,10	54,00	pass	2,4885	60,38	-13,62	74,00	pass
2,4865	48,02	-5,98	54,00	pass	2,4903	57,78	-16,22	74,00	pass
2,4898	45,85	-8,15	54,00	pass	2,4945	56,41	-17,59	74,00	pass
2,4938	44,65	-9,35	54,00	pass	2,4965	55,71	-18,29	74,00	pass
2,4973	43,69	-10,31	54,00	pass	2,5193	54,16	-19,84	74,00	pass
2,5095	42,64	-11,36	54,00	pass	2,5108	54,07	-19,93	74,00	pass

Lower Band Edge - 802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps / ZigBee CH 11 - radiated



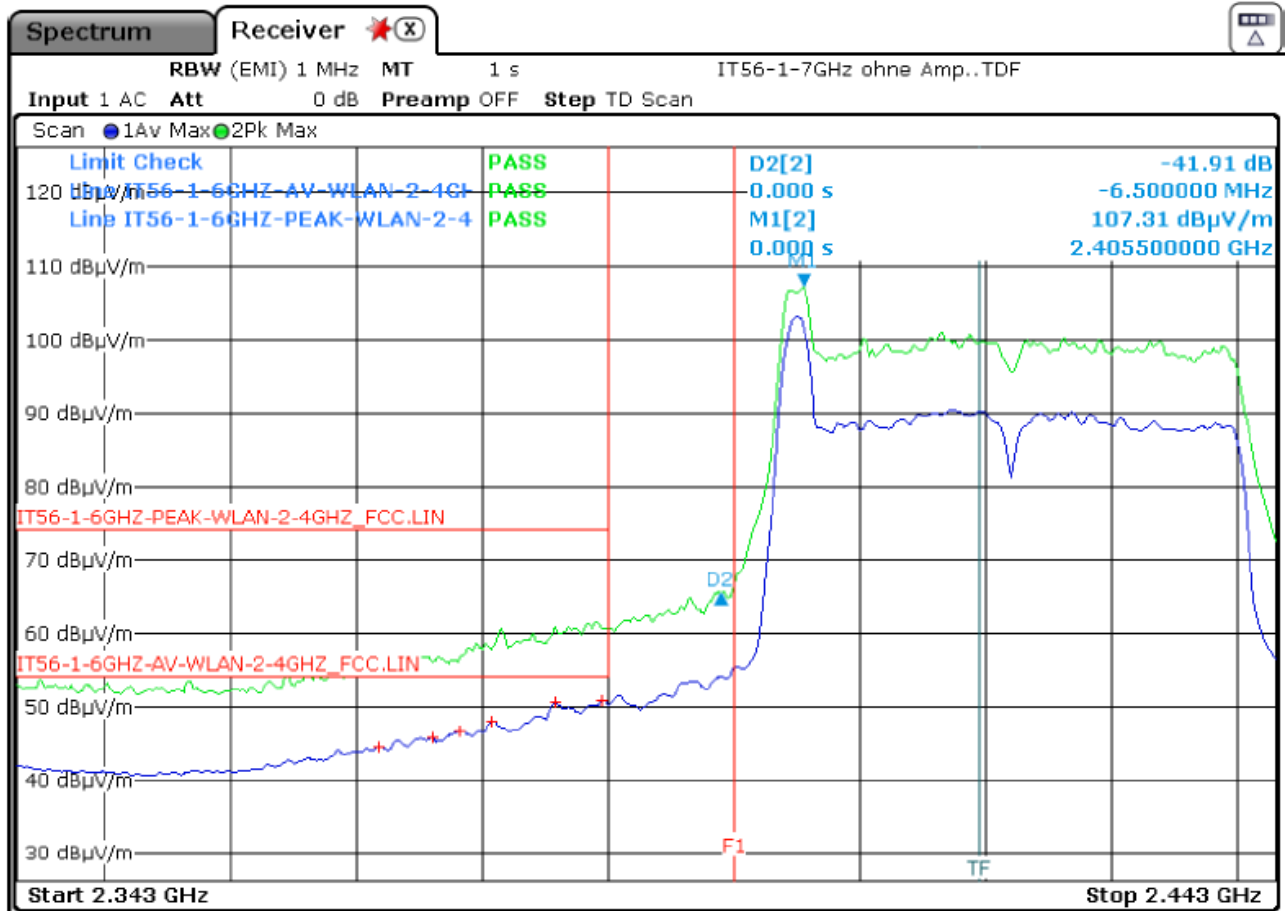
FCC 3
Band edge emission
according to



FCC §15.247, RSS-247, FCC §15.209 RSS-Gen

Ref.-No.: 18/11-0061

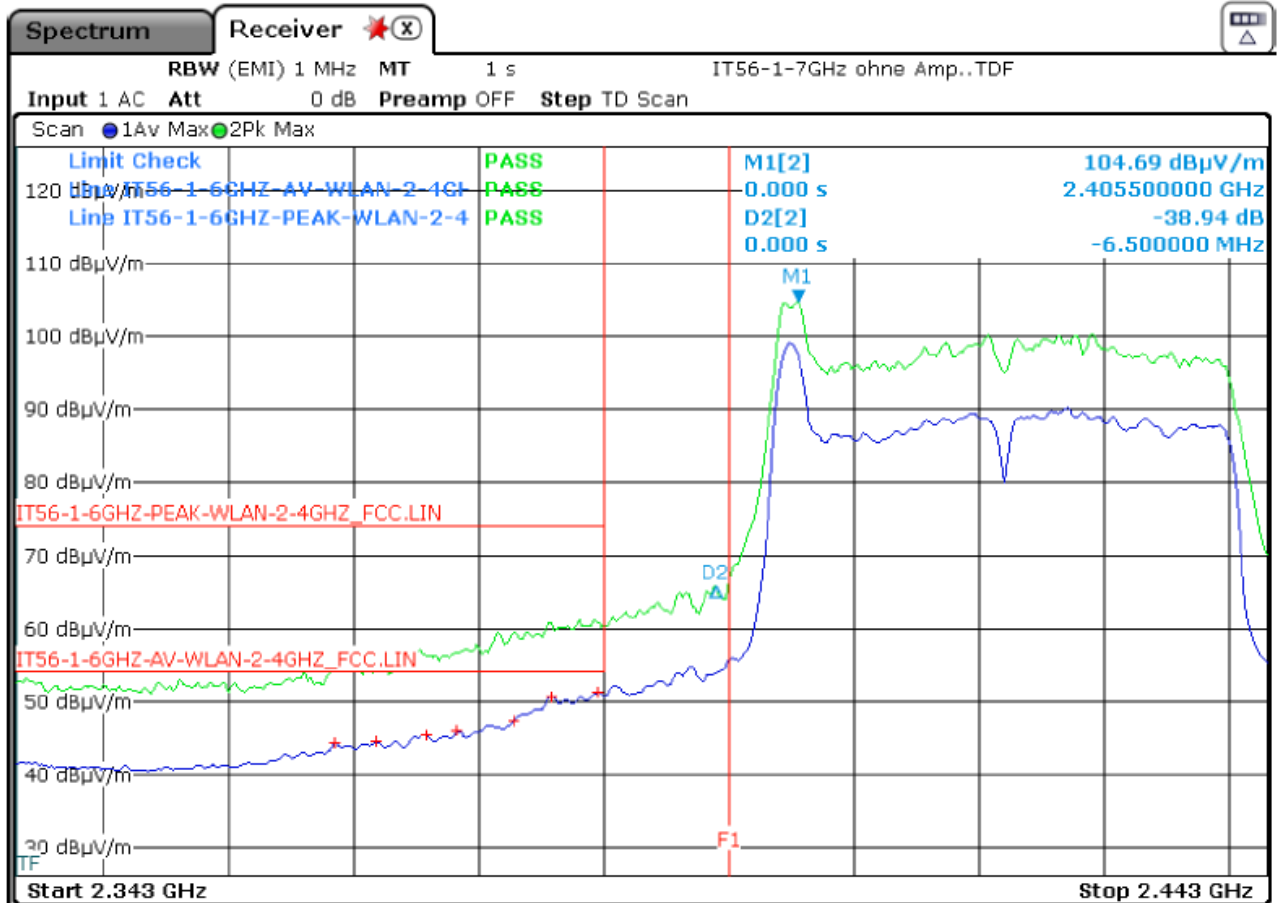
Operation mode: WLAN CH.03; BW = 40MHz; HT Mix Mode; 802.11n40; Power level 1E;
Zigbee CH.11; Low edge



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,3895	50,70	-3,30	54,00	pass	all emissions are 10dB below limit				pass
2,3858	50,54	-3,46	54,00	pass					
2,3808	47,92	-6,08	54,00	pass					
2,3783	46,75	-7,25	54,00	pass					
2,3760	45,77	-8,23	54,00	pass					
2,3718	44,44	-9,56	54,00	pass					

Ref.-No.: 18/11-0061

Operation mode: WLAN CH.03; BW = 40MHz; HT Mix Mode; 802.11n40; Power level 1E;
Zigbee CH.11; Low edge



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
2,3895	51,13	-2,87	54,00	pass	all emissions are 10dB below limit				pass
2,3858	50,67	-3,33	54,00	pass					
2,3828	47,23	-6,77	54,00	pass					
2,3783	45,93	-8,07	54,00	pass					
2,3758	45,29	-8,71	54,00	pass					
2,3718	44,38	-9,62	54,00	pass					

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Band Edges / Out of Band Emission**.