Test report

according to ISO/IEC 17025:2017

FCC
(Federal Communications Commission)
Test Firm Registration Number: 768032
Designation Number DE0022

ISED
(Inovation, Science and Economic Development)
CAB identifier: DE0012
ISED#: 6155A

Electromagnetic compatibility

Intentional Radiators

Deutsche
Akkreditierungsstelle
D-PL-17379-01-00
D-PL-17379-01-02
D-PL-17379-01-03

Bundesnetzagentur

BNetzA-CAB-18/21-19

TESTED IN GERMANY

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Test report no.: **18/11-0061a**

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Location of test facility:

STC TESTED IN GERMANY

STC Germany GmbH
Ohmstrasse 1
84160 Frontenhausen
Germany

1. Client information

Name:	Viessmann Elektronik GmbH
Address:	Beetwiese 2; 35108 Allendorf; Germany
Name of contact:	Mr. Michael Weppler
Telephone:	+49 6452 70 2577
Fax:	+49 6452 70 5577
E-mail:	WepM@viessmann.com

2. Equipment under test (EUT)

2.1 Identification of the EUT

Equipment:	RF MODUL
Model:	TCU 200
Brand name:	Viessmann
Serial no.:	#24, #23, #12, #15, #14, #16, #18, #19
Manufacturer:	Viessmann Elektronik GmbH Beetwiese 2, 35108 Allendorf; Germany
Country of origin:	Germany
Power rating:	nominal 24 V ⎓, +/- 10 %
Highest frequency generated or used in the device or on which the device operates or tunes (MHz):	2.48 GHz
Date Sample Received:	29.11.2018
Tests were performed:	08.01.2019 – 14.04.2020

2.2 Additional information about the EUT:

The EUT has an additional RF-function (Zigbee) which is reported in the STC FCC-ISED report No.: 18/11-0061b

To duplicate parts of this test report needs the written confirmation of the test laboratory.

The test results relate only to the above mentioned test sample(s).

3. Description of the Equipment under test and test conditions

FCC-ID:	2AIZ9-RF0119
IC:	21680-RF0119
HVIN:	RF Modul TCU 200
Power:	nominal 24 V ⎓, +/- 10 %
Cables:	USB cable to PC (programming) 13 cm USB to PCB (Ribbon) 18 cm USB cable 100 cm DC cable 135 cm
Approx. Size (l x w x h):	(60 x 90 x 11) mm
Test conditions:	The “RF-module– TCU 200” (= equipment under test – EUT) had been tested, where applicable with test software QA-tool and with maximum RF-output power in the following modes: (1) 802.11b: Tx mode BW 20MHz CCK 1MBps 2412 MHz (2) 802.11b: Tx mode BW 20MHz CCK 1MBps 2437 MHz (3) 802.11b: Tx mode BW 20MHz CCK 1MBps 2462 MHz (4) 802.11g: Tx mode BW 20MHz OFDM 6MBps 2412 MHz (5) 802.11g: Tx mode BW 20MHz OFDM 6MBps 2437 MHz (6) 802.11g: Tx mode BW 20MHz OFDM 6MBps 2462 MHz (7) 802.11n: Tx mode BW 20MHz HT MixMode 6.5MBps 2412 MHz (8) 802.11n: Tx mode BW 20MHz HT MixMode 6.5MBps 2437 MHz (9) 802.11n: Tx mode BW 20MHz HT MixMode 6.5MBps 2462 MHz (10) 802.11n: Tx mode BW 40MHz HT MixMode 6.5MBps 2422 MHz (11) 802.11n: Tx mode BW 40MHz HT MixMode 6.5MBps 2437 MHz (12) 802.11n: Tx mode BW 40MHz HT MixMode 6.5MBps 2452 MHz (13) EUT connected to W-LAN Router in different Modulation types (802.11 b/g/n 20MHz/40MHz) with data transfer (14) EUT continues Tx (802.11b 20MHz) / ZigBee active PING/PONG communication with ZigBee stick The tested configuration represents (based on the product specification) with the tested operation modes the worst case.
Additional information:	Conducted RF Measurements were carried out on a temporary SMA socket
Type of modulation:	802.11b/g/n (20 MHz/40 MHz)
Operating frequencies:	2.412 GHz – 2.462 GHz
Transmission protocol:	W-LAN 802.11 b/g/n: CCK MCS=0; 1 MBps - MCS=11; 11 MBps OFDM MCS=0; 6 MBps - MCS=7; 54 MBps HT MixMode MCS=0; 6.5 MBps - MCS=7; 65 MBps
Channel separation:	5 MHz
Number of channels:	11 - See below
Operating temperature range:	0 °C … +60 °C
Operating voltage range:	24 V ⎓, +/- 10 %
Output power:	radiated: -/- dBm (normal conditions) conducted: 15.61 dBm (normal conditions)
Environmental conditions during tests:	Ambient temperature: 20 °C Relative humitity 40 % Atmospheric pressure 965 mbar
Antenna specification:	Model: Printed PCB Antenna Gain: max. 2dB Type: ☐ External (with accessible antenna socket) ☒ Internal (integrated, PCB antenna 24 mm)
Test standard:	- e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz - RSS-247 issue 02 February 2017 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Channel List

2.4 GHz Band

Frequency Allocation for 802.11b/g/n
20 MHz bandwith systems, use Channel 1 – Channel 11

Frequency Allocation for 802.11n
40 MHz bandwith systems, use Channel 3 – Channel 9

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

4. Performed measurements and results

The complete list of measurements required in e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 is given below.

Standard:	**Standard:**	**Test Method:**		**Test requirements:**			
				applicable:		**fulfilled:**	
				yes	**no**	**yes**	**no**
§ 15.207	RSS-Gen issue 5	ANSI 63.10 Section 6.2	AC Mains Conducted Emissions	☒	☐	☒	☐
§ 15.209	RSS-Gen issue 5	ANSI 63.10 Section 6.3 - 6.6	Radiated Emissions	☒	☐	☒	☐
§15.247	RSS-247 issue 2	ANSI 63.10 Section 11.8.1	6 dB DTS Bandwidth	☒	☐	☒	☐
§15.247	RSS-247 issue 2	ANSI 63.10 Section 11.9.1	Output Power of Fundamental Emissions	☒	☐	☒	☐
§15.247	RSS-247 issue 2	ANSI 63.10 Section 11.10.2	Maximum Power Spectral Density	☒	☐	☒	☐
§15.247	RSS-247 issue 2	ANSI 63.10 Section 11.13.2	Band Edges Measurement	☒	☐	☒	☐
	RSS-Gen issue 5	ANSI 63.10 Section 6.9.3	99% Power Bandwidth	☒	☐	☒	☐

All required / applicable tests according to the following standards were performed under Ref-No. 18/11-0061.

- e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 with test Method according to ANSI C63.10-2013

- RSS-247 issue 02 February 2017 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

- e-CFR data is current as of June 22, 2020

Remark: -/-

5. AC Mains conducted emissions

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.207 Conducted limits
-RSS-Gen issue 05 section 8.8

Test site
Measurements of conducted emission from EUT was made in the shielded chamber (DC - 10GHz) located in the test facility.

Test equipment and test set up
Test equipment used for conducted measurements on Mains as given in clause Test equipment of this report.
Test setup used for conducted measurements on Mains as given in clause Test setups of this report.

Detector function selection and bandwidth
In conducted emissions measurement CISPR quasi-peak- and average-detector were used.
The bandwidth of the detector of instrument is 10 kHz over the frequency range of 150 kHz to 30 MHz.

Frequency range to be scanned
For conducted emission measurements, the spectrum in the range of 150 kHz to 30 MHz was investigated.

Test conditions and configuration of EUT
The EUT was configured and operated under following operation modes:

1. EUT connected to W-LAN Router in different Modulation types (802.11 b/g/n 20MHz/40MHz) with data transfer
2. EUT continues Tx in different Modulation types (802.11 b/g/n 20MHz/40MHz)

All modes are investigated by operating the EUT in a range of typical modes of operation, with typical cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation and for each ac power current-carrying conductor, cable manipulation are performed within the range of likely configurations. The highest values measured are shown in the table below. The corresponding configuration is shown in the “Photo(s) of test setup”.
The EUT was placed on a 80 cm high non metallic table. Measurements were performed on the AC terminals of the Host AC-Adaptor, on neutral (N)- and live (L1)-wire had been performed.

Requirements

Frequency Range [MHz]	Quasi-Peak Limits [dBµV]	Average Limits [dBµV]
0.15 - 0.5	66 to 56 Note 1	56 to 46 Note 1
0.5 - 5.0	56	46
5.0 - 30.0	60	50
Note 1: The level decreases linearly with the logarithm of the frequency		

Measurement

Measruement performened on 08.01.2019

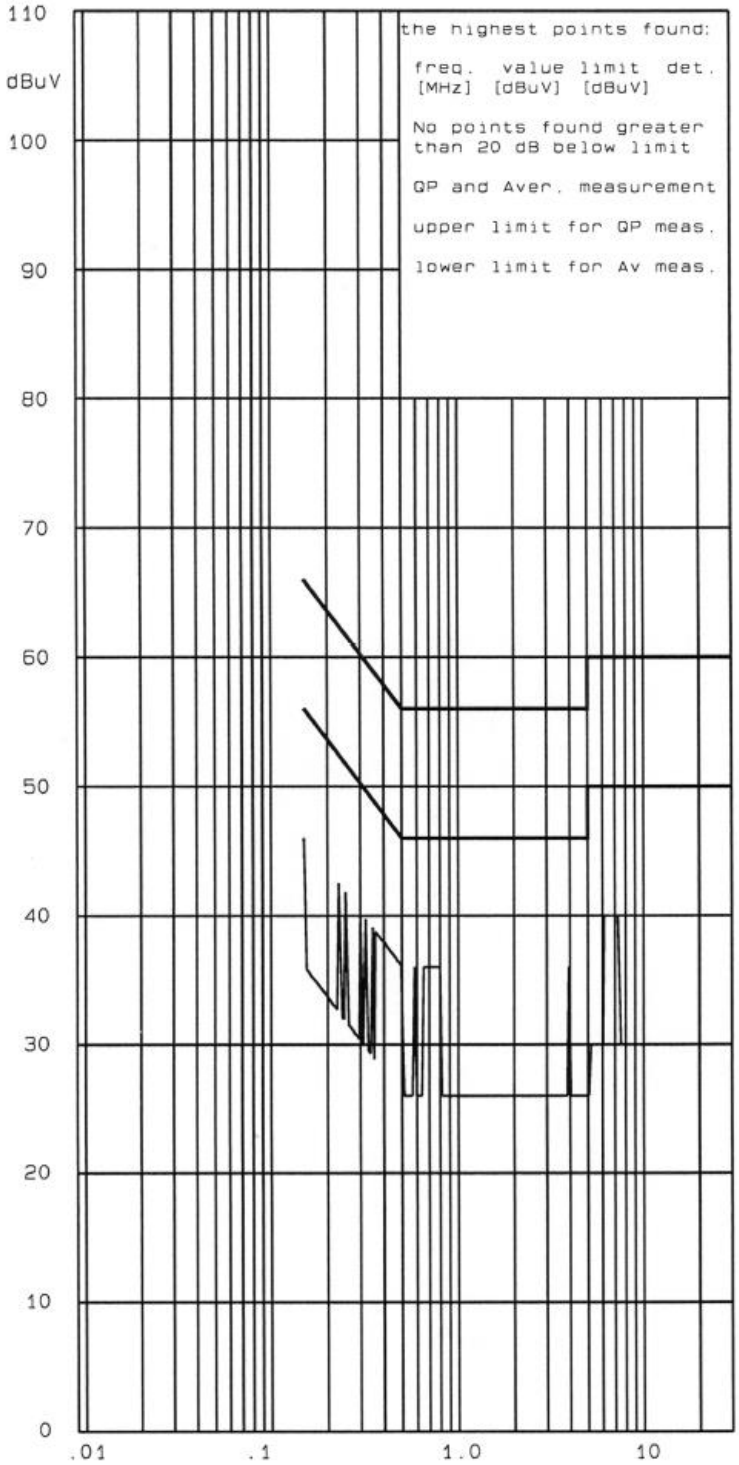
As worst cases the mode No. 1 with 802.11n 20MHz was found and documented in this report.

I T 1 / 2

Interference Voltage 150 KHz - 30 MHz

acc. FCC PART 15.107(a) Class B

ICES-003



Ref.-No.: 18/11-0061

Product: Transm./Receiv.Sys

Sample: 07

Date: 8 Jan 2019

Operator: Gi

Test equipment:

Rohde & Schwarz ESHS 30

Rohde & Schwarz ESH 2-Z5

Connected sets:

Input Voltage 120 V / 60 Hz
AC-Adaptor SUN-1200200

Operating mode:

Wifi Channel 07
802.11n (20 MHz)
Comm. with ping signal FritzB.
Tested on N

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass [X] fail [ ]

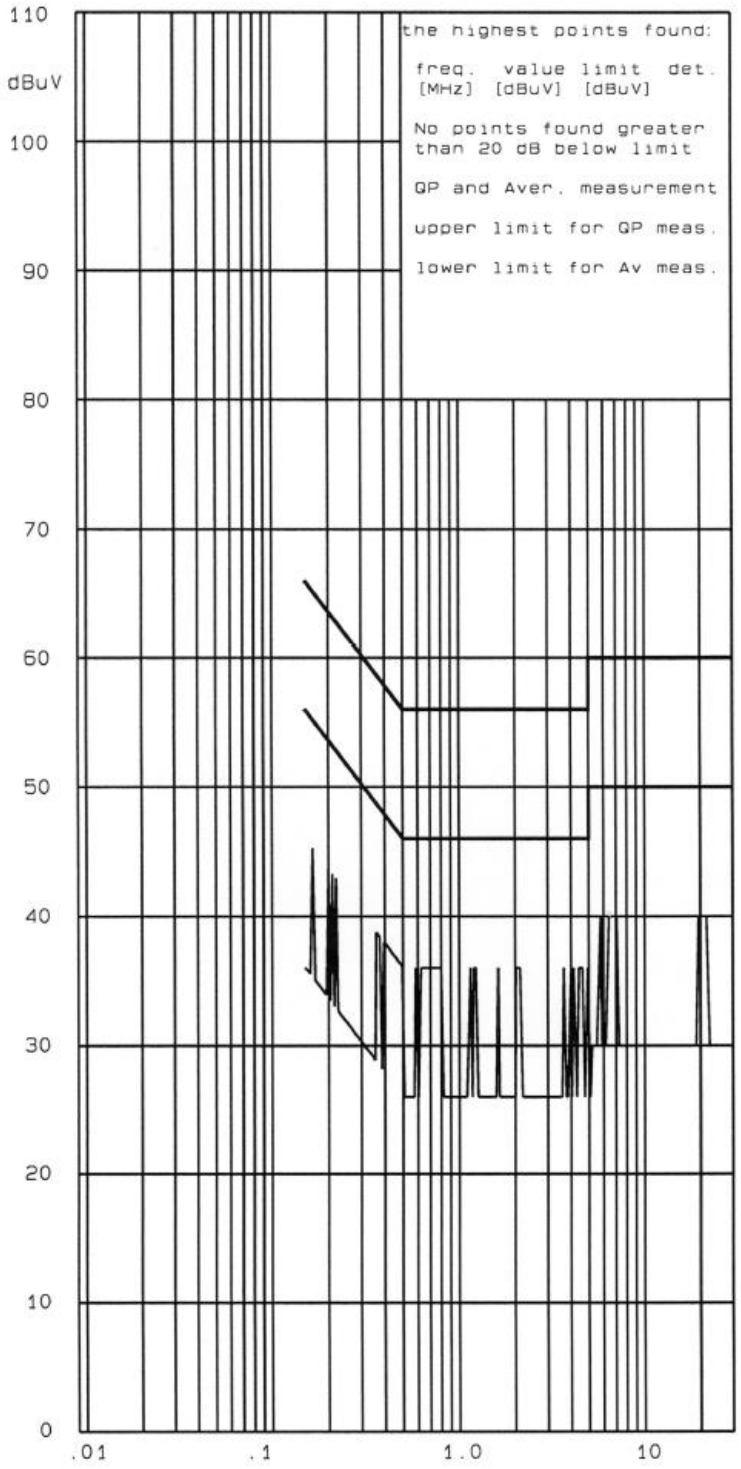
PKM electronic GmbH
Frontenhausen

I T 1 / 2

Interference Voltage 150 KHz - 30 MHz

acc. FCC PART 15.107(a) Class B

ICES-003



Ref.-No.: 18/11-0061

Product: Transm./Receiv.Sys

Sample: 07

Date: 8 Jan 2019

Operator: Gi

Test equipment:

Rohde & Schwarz ESHS 30

Rohde & Schwarz ESH 2-Z5

Connected sets:

Input Voltage 120 V / 60 Hz
AC-Adaptor SUN-1200200

Operating mode:

Wifi Channel 07
802.11n (20 MHz)
Comm. with ping signal FritzB.
Tested on L1

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass [X] fail [ ]

PKM electronic GmbH
Frontenhausen

The six highest emissions for each port (L/N)/detector are as following:

Frequency [MHz] (1)	Reading of test receiver [dBµV] (2)	Detector (3)	Port (4)	loss of cable between LISN and test receiver [dB] (5)	LISN correction [dB] (6)	AC power line conducted emission [dBµV] (7)	Limit [dBµV] (8)	Result (9)
-/-	-/-	QP	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	N	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	QP	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	L1	0.10	0.10	-/-	-/-	Pass
-/-	-/-	AV	L1	0.10	0.10	-/-	-/-	Pass

(1) = test frequency
(2) = Reading of test receiver in dBµV without correction factors
(3) = used detector
(4) = tested port Phase (live, L1) or Neutral (N)
(5) = loss of cable between LISN and test receiver in dB
(6) = correction factor of LISN in dB
(7) = Reading of test receiver [dBµV] (2) + loss of cable between Line impedance stabilisation network (LISN) and test receiver (dB) (5) + LISN correction [dB] (6)
(8) = relevant limit in dBµV
(9) = comparison between Limit [dBµV] (7) / (8) and AC power line conducted emission [dBµV]

Result 0.15 MHz – 30 MHz

All emissions in the frequency range 0.15 MHz – 30 MHz are at least 20 dB below the relevant limit.

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Conducted Emission**.

6. Radiated emission measurements

Test site
Measurement of radiated emissions from EUT was made in the semi-anechoic chamber SAC3 (DC to 40 GHz) located in the test facility.

Test equipment and test set up
Test equipment used for radiated measurements as given in clause Test equipment of this report.
Test setup used for radiated measurements as given in clause Test setups of this report.

Detector function selection and bandwidth
In radiated emissions measurement, an EMI test receiver that have CISPR detectors was used.

Frequency range	Resolution Bandwidth
9KHz – 150kHz (Quasi Peak & Average* Detector)	200Hz
150KHz – 30MHz (Quasi Peak & Average* Detector)	9kHz
30MHz – 1GHz (Quasi Peak Detector)	120kHz
Above 1GHz (Peak & Average Detector)	1MHz

*Average Detector only in specify frequency range.

Antennas
Measurements were made using a calibrated loop antenna in the range 9 kHz – 30 MHz, as well as a calibrated bilog antenna in the range of 30 to 1000 MHz to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization.
The horizontal distance between the receiving antenna and the EUT was 3 meters.
In the range of 1 GHz to 26 GHz measurements were made using a calibrated horn antenna to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization. The horizontal distance between the receiving antenna and the EUT was 3 meters.

Frequency range to be scanned
For radiated emissions measurements, the spectrum in the range of 9kHz MHz to 26 GHz was investigated as the highest frequency generated in the EUT is 2.462 GHz.

Test conditions and configuration of EUT

The EUT was configured and operated under following operation modes:

1. EUT connected to W-LAN Router in different Modulation types (802.11 b/g/n 20MHz/40MHz) with data transfer
2. EUT continues Tx in different Modulation types (802.11 b/g/n 20MHz/40MHz)
3. EUT continues Tx (802.11b 20MHz) / ZigBee active communication with PING/PONG

During test the EUT was operated as specified in the user manual of the EUT. For frequencies below 1000 MHz the EUT was placed on a 80 cm and for frequencies above 1000 MHz the RF Transmitter modul was placed on a 150 cm high non metallic table placed on the turntable. The EUT was rotated and the antenna height was varied between 1 m to 4 m to find the maximum RF energy generated from EUT. The procedure according to ANSI C63.10:2013 is used and all modes are investigated by operating the EUT in a range of typical modes of operation, with typical cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation, cable manipulation are performed within the range of likely configurations. The highest values measured are shown in the table below.

As worst cases the mode No. 2 with 802.11n 20MHz and the mode No. 3 with continues Tx (802.11b 20MHz) / ZigBee active communication with PING/PONG were found and documented in this report.

Remarks:
-Correction factor included antenna factor and cable attenuation.
-In the frequency range 1 GHz – 7 GHz the Band Reject Filter 2,4 GHz (ID11243) was used to attenuate the fundamental emission.

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits
-RSS-Gen issue 05 section 8.9

Requirements

acc. e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits

Frequency MHz	Limits [µV/m] Quasi-peak	Limits [dBµV/m] Quasi-peak	Limits [µV/m] Average	Limits [dBµV/m] Average	Test distance [m]
0.009 – 0.090	-/-	-/-	2400/F (kHz)	48.5 – 28.5	300
0.090 - 0.110	2400/F (kHz)	28.5 – 26.8	-/-	-/-	300
0.110 – 0.490	-/-	-/-	2400/F (kHz)	26.8 – 13.8	300
0.490 - 1.705	24000/F (kHz)	33.8 – 23.0	-/-	-/-	30
1.705 - 30.0	30	29.5	-/-	-/-	30

acc. RSS-Gen issue 05 section 8.9

Frequency MHz	Limits [µA/m] Quasi-peak	Limits [dBµA/m] Quasi-peak	Limits [µA/m] Average	Limits [dBµA/m] Average	Test distance [m]
0.009 – 0.090	-/-	-/-	6.37/F (kHz)	-3 – -23.0	300
0.090 - 0.110	6.37/F (kHz)	-23.0 – -24.7	-/-	-/-	300
0.110 – 0.490	-/-	-/-	6.37/F (kHz)	-24.7 – -37.7	300
0.490 - 1.705	63.7/F (kHz)	-17.7 – -28.5	-/-	-/-	30
1.705 - 30.0	0.08	-22	-/-	-/-	30

acc. e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits and RSS-Gen issue 05 section 8.9

Frequency MHz	Limits [µV/m] Quasi-peak	Limits [dBµV/m] Quasi-peak	Limits [µV/m] Average	Limits [dBµV/m] Average	Test distance [m]
30 - 88	100	40	-/-	-/-	3
88 - 216	150	43.5	-/-	-/-	3
216 - 960	200	46	-/-	-/-	3
960 - 1000	500	54	-/-	-/-	3
Above 1000	-/-	-/-	500	54	3

Measurement

The Measurement was performed on: 10.01.2019; 30.01.2020 and 01.04.2020

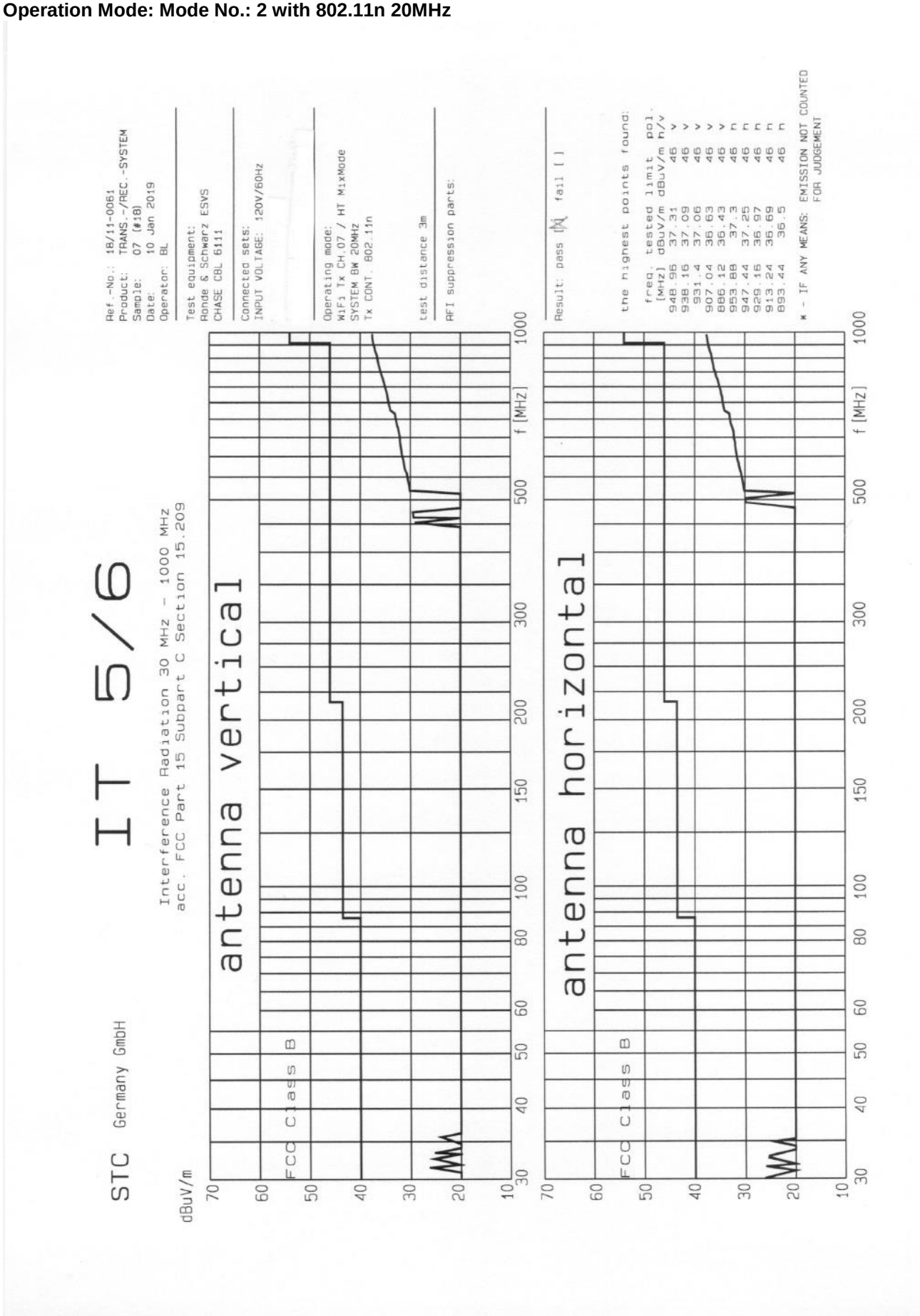
Result 9 kHz – 30 MHz

In the frequency range 9 kHz – 30 MHz the EUT had been scanned in a distance of 3 m and the limit was corrected to the test distance of 3 m using a factor of 40 dB/decade acc. to § 15.31 (f)(2).

All emissions in the frequency range 9 kHz – 30 MHz are at least 20 dB below the relevant limit.

Result 30 MHz – 1000 MHz

Operation Mode: Mode No.: 2 with 802.11n 20MHz

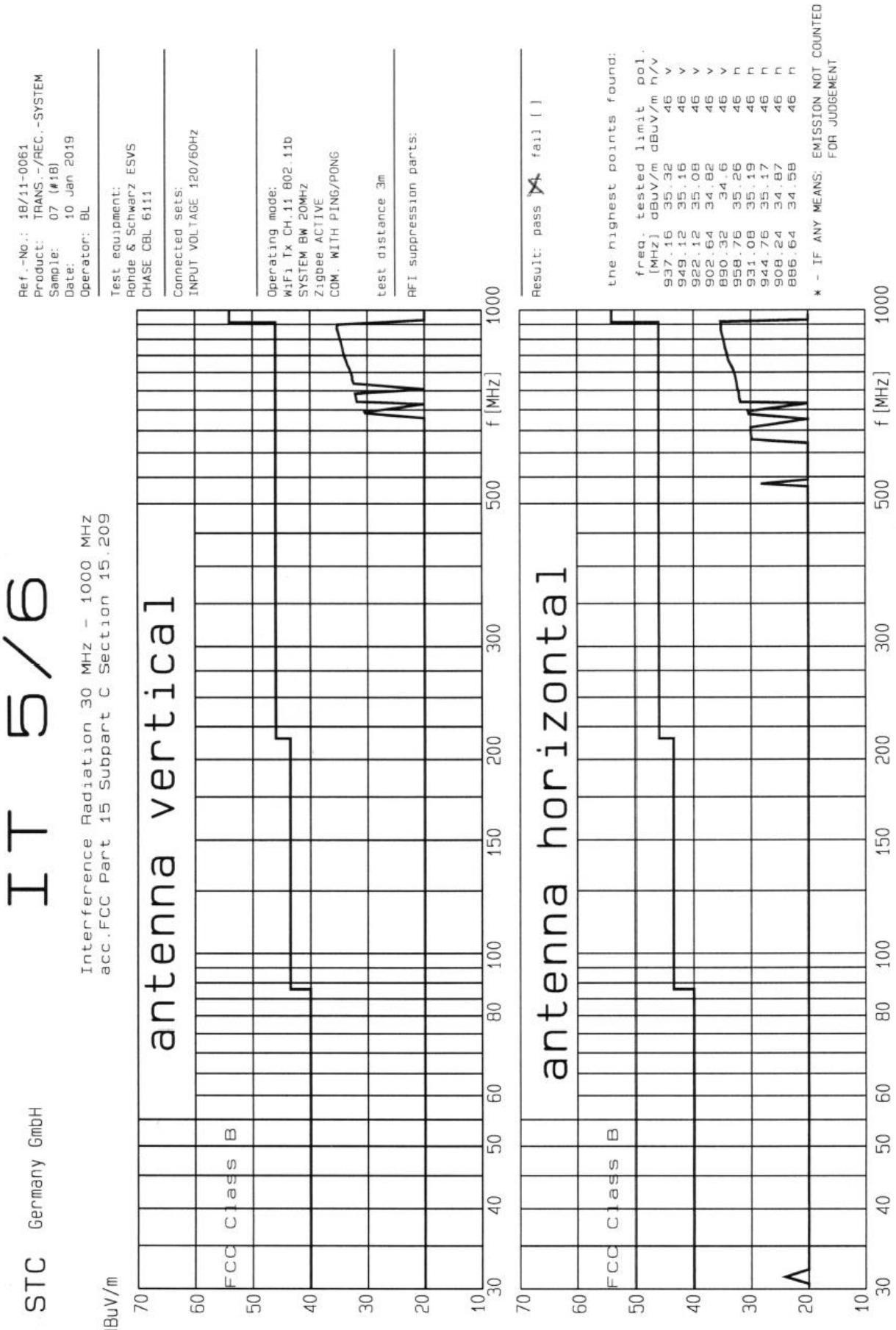


The six highest emissions for each polarization (H/V) in the frequency range 30 MHz – 1000 MHz are as following:

Frequency [MHz] (1)	Detector (2)	Antenna polarization (3)	Radiated emission [dBµV/m] (4)	Radiated emission [µV/m] (5)	Limit [dBµV/m] (3 m) (6)	Limit [µV/m] (3 m) (7)	Result (8)
948.96	QP	V	37.31	73.37	46.00	200	Pass
938.16	QP	V	37.09	71.53	46.00	200	Pass
931.40	QP	V	37.06	71.29	46.00	200	Pass
907.04	QP	V	36.63	67.84	46.00	200	Pass
886.12	QP	V	36.43	66.30	46.00	200	Pass
-/-	QP	V	-/-	-/-	-/-	-/-	-/-
953.88	QP	H	37.30	73.28	46.00	200	Pass
947.44	QP	H	37.25	72.86	46.00	200	Pass
929.16	QP	H	36.97	70.55	46.00	200	Pass
913.24	QP	H	36.69	68.31	46.00	200	Pass
893.44	QP	H	36.50	66.83	46.00	200	Pass
-/-	QP	H	-/-	-/-	-/-	-/-	-/-

(1) = test frequency
(2) = used detector - quasi peak (QP), peak, average (AV)
(3) = polarization of the test antenna (Horizontal/Vertical)
(4) = Reading of test receiver [dBµV] + correction factor
(5) = 10 ^ ((Radiated emission [dBµV/m] (5))/20)
(6) = relevant limit in dBµV/m
(7) = relevant limit in µV/m
(8) = comparison between Limit [dBµV/m] (6) and Radiated emission [dBµV/m] (4)

Operation Mode: Mode No.: 3 with 802.11b 20MHz / ZigBee active communication with PING/PONG



The six highest emissions for each polarization (H/V) in the frequency range 30 MHz – 1000 MHz are as following:

Frequency [MHz] (1)	Detector (2)	Antenna polarization (3)	Radiated emission [dBµV/m] (4)	Radiated emission [µV/m] (5)	Limit [dBµV/m] (3 m) (6)	Limit [µV/m] (3 m) (7)	Result (8)
937.16	**QP**	**V**	**35.32**	**58.34**	**46.00**	**200**	**Pass**
949.12	**QP**	**V**	**35.16**	**57.28**	**46.00**	**200**	**Pass**
922.12	**QP**	**V**	**35.08**	**56.75**	**46.00**	**200**	**Pass**
902.64	**QP**	**V**	**34.82**	**55.08**	**46.00**	**200**	**Pass**
890.32	**QP**	**V**	**34.60**	**53.70**	**46.00**	**200**	**Pass**
-/-	**QP**	**V**	**-/-**	**-/-**	**-/-**	**-/-**	**-/-**
958.76	**QP**	**H**	**35.26**	**57.94**	**46.00**	**200**	**Pass**
931.08	**QP**	**H**	**35.19**	**57.48**	**46.00**	**200**	**Pass**
944.76	**QP**	**H**	**35.17**	**57.35**	**46.00**	**200**	**Pass**
908.24	**QP**	**H**	**34.87**	**55.40**	**46.00**	**200**	**Pass**
886.64	**QP**	**H**	**34.58**	**53.58**	**46.00**	**200**	**Pass**
-/-	**QP**	**H**	**-/-**	**-/-**	**-/-**	**-/-**	**-/-**

(1) = test frequency
(2) = used detector - quasi peak (QP), peak, average (AV)
(3) = polarization of the test antenna (Horizontal/Vertical)
(4) = Reading of test receiver [dBµV] + correction factor
(5) = 10 ^ ((Radiated emission [dBµV/m] (5))/20)
(6) = relevant limit in dBµV/m
(7) = relevant limit in µV/m
(8) = comparison between Limit [dBµV/m] (6) and Radiated emission [dBµV/m] (4)

Result 1 GHz – 7 GHz

Mode No.: 2 with 802.11n 20MHz

TESTED IN GERMANY

IT 5/6
Interference radiation
according to FCC §15.209 RSS-Gen

STC

Ref.-No.: 18/11-0061

Product: Transmitting/Receiving System

Sample: 01

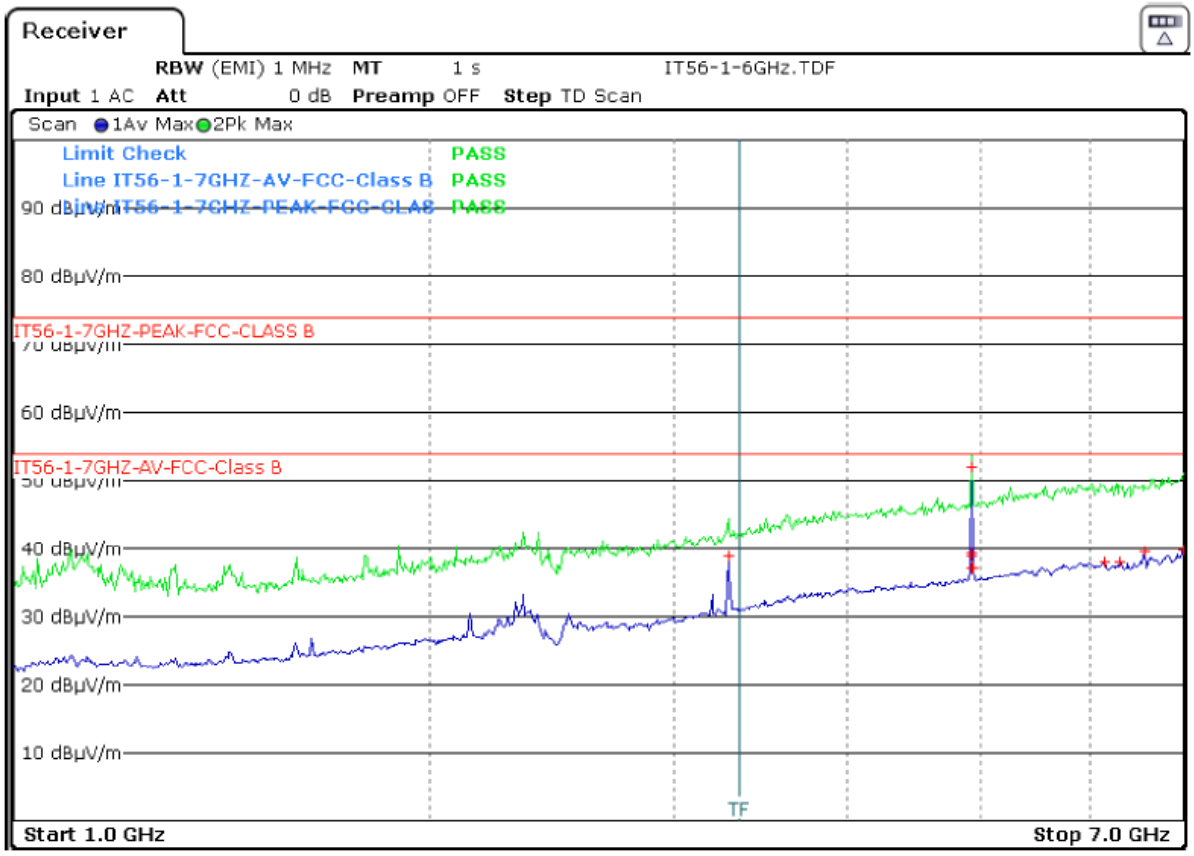
Date: 30.01.2020

Operator: BI

Remarks: All cables connected; Input Voltage System 24V/DC

pass ☒ fail ☐ Result:

Operation mode: Tx 2.4GHz (802.11b 20MHz/CH11 – 2462MHz); BPF 2,4GHz (ID11243) used



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
4,9240	51,88	-2,12	54,00	pass	1 - 7	--/--	>20	74	pass
6,9998	39,74	-14,26	54,00	pass					
6,5653	39,61	-14,39	54,00	pass					
4,9270	39,29	-14,71	54,00	pass					
4,9210	39,00	-15,00	54,00	pass					
3,2828	38,81	-15,19	54,00	pass					

TESTED IN GERMANY

IT 5/6

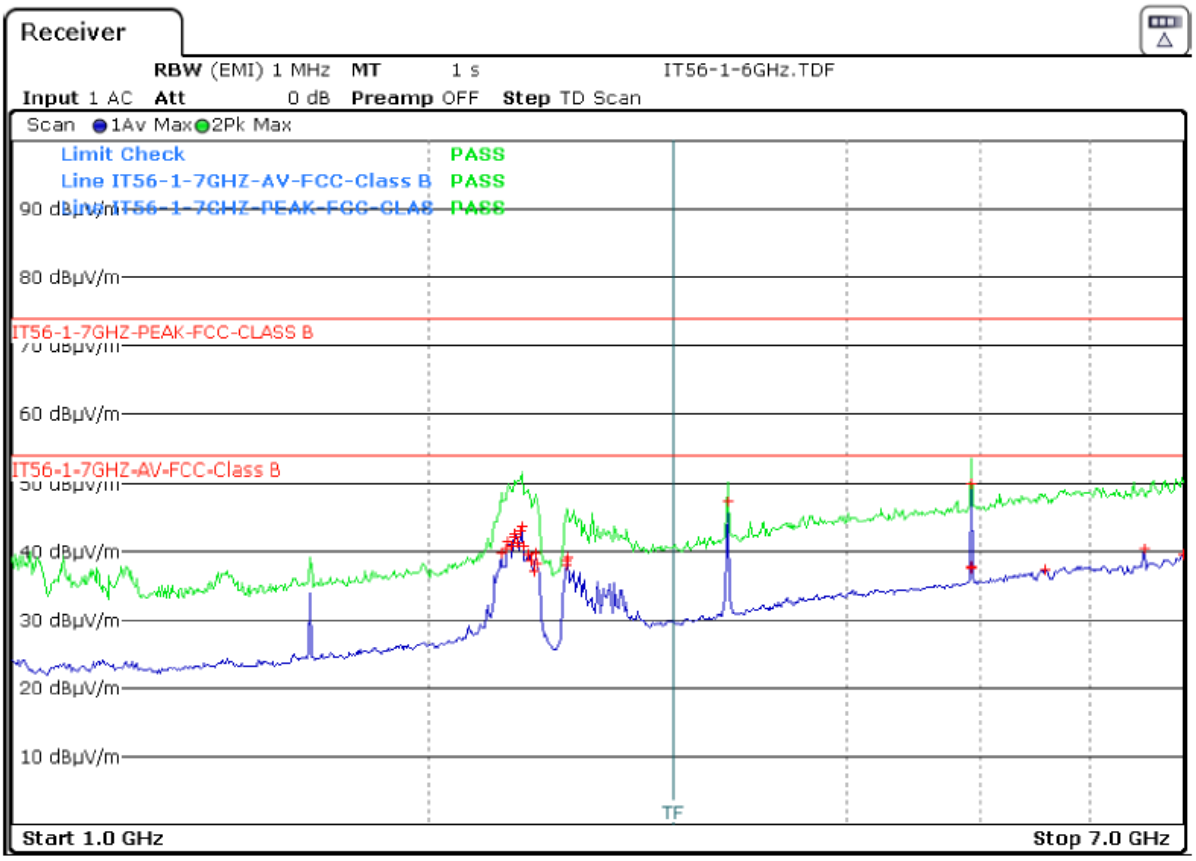
Interference radiation

according to FCC §15.209 RSS-Gen

STC

Ref.-No.: 18/11-0061

Operation mode: Tx 2.4GHz (802.11b 20MHz/CH11 – 2462MHz); BPF 2,4GHz (ID11243) used



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
4,9240	49,95	-4,05	54,00	pass	1 - 7	--/--	>20	74	pass
3,2828	47,45	-6,55	54,00	pass					
2,3340	43,64	-10,36	54,00	pass					
2,3305	43,07	-10,93	54,00	pass					
2,3075	42,53	-11,47	54,00	pass					
2,3050	42,19	-11,81	54,00	pass					

Mode No.: 3 with 802.11b 20MHz / ZigBee active communication with PING/PONG

TESTED IN GERMANY

IT 5/6
Interference radiation
according to FCC §15.209 RSS-Gen

STC

Ref.-No.: 18/11-0061

Product: Transmitting/Receiving System

Sample: 07 (#18)

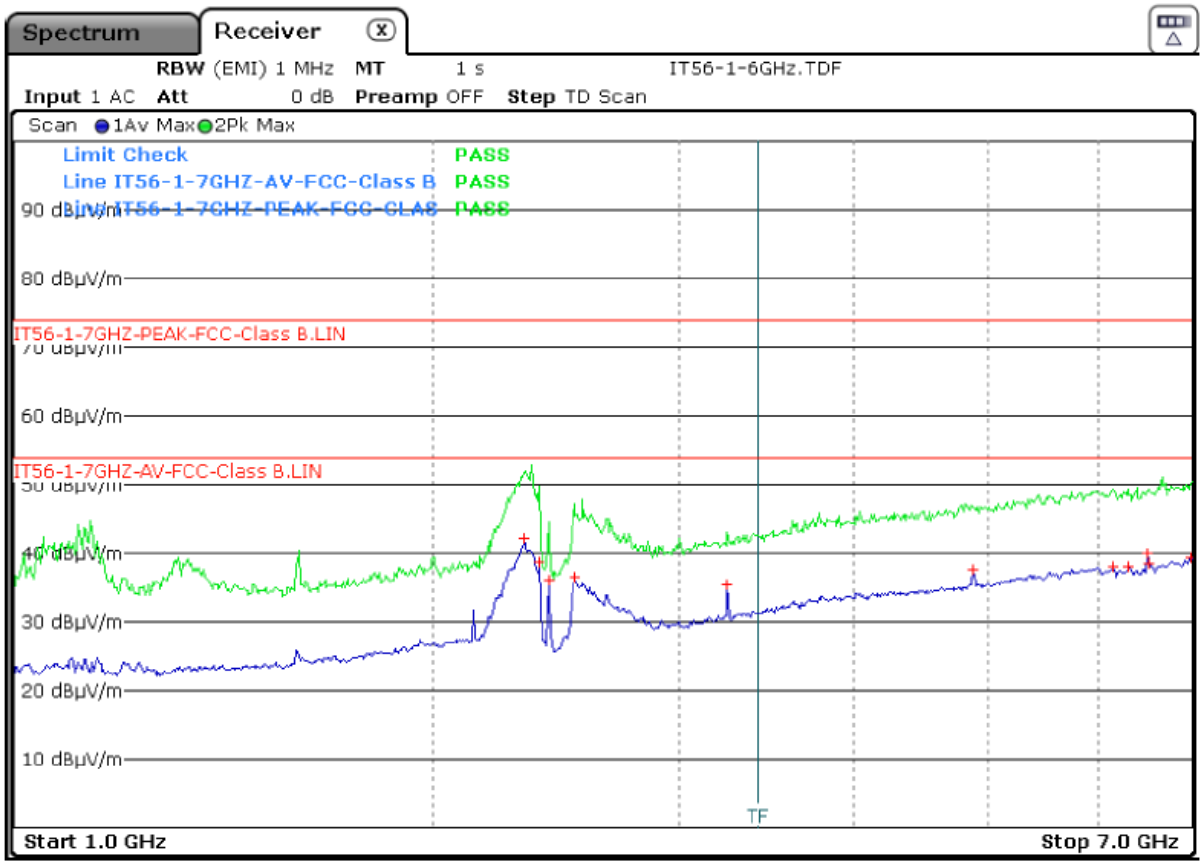
Date: 01.04.2020

Operator: BI

Remarks: All cables connected; Input Voltage System 24V/DC

pass ☒ fail ☐ Result:

Operation mode: Tx Wifi (802.11b 20MHz/CH11 – 2462MHz); Zigbee (Communication with ping/pong)
Band Stop Filter 2,4GHz (ID11243) used



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
2,3213	42,09	-11,91	54,00	pass	1 - 7	--/--	>20	74,00	pass
6,4988	39,91	-14,09	54,00	pass					
6,9883	39,28	-14,72	54,00	pass					
2,3828	38,74	-15,26	54,00	pass					
6,5118	38,57	-15,43	54,00	pass					
6,1453	37,98	-16,02	54,00	pass					

TESTED IN GERMANY

IT 5/6

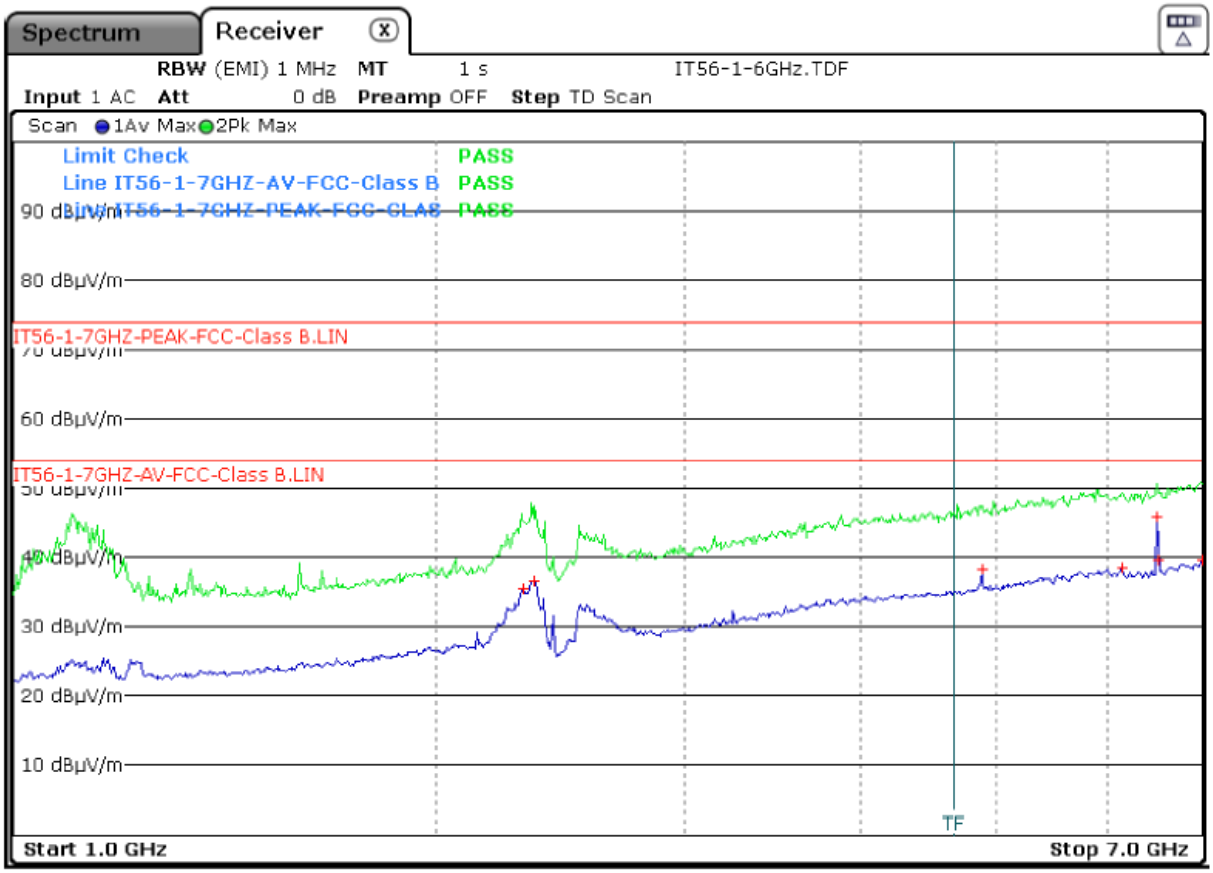
Interference radiation

according to FCC §15.209 RSS-Gen

STC

Ref.-No.: 18/11-0061

Operation mode: Tx Wifi (802.11b 20MHz/CH11 – 2462MHz); Zigbee (Communication with ping/pong)
Band Stop Filter 2,4GHz (ID11243) used



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
6,4988	45,84	-8,16	54,00	pass	1 - 7	--/--	>20	74,00	pass
6,9928	39,57	-14,43	54,00	pass					
6,5120	39,51	-14,49	54,00	pass					
6,1458	38,38	-15,62	54,00	pass					
4,8808	38,36	-15,64	54,00	pass					
2,3463	36,54	-17,46	54,00	pass					

Result 7GHz – 26GHz

All emissions in the frequency range 7 GHz – 26 GHz are at least 20 dB below the relevant limit

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Radiated Emissions**.

7. Operation within the band 902-928 MHz, 2400-2483,5 MHz and 5725-5850 MHz

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247
-RSS-247 issue 2

7.1. 6 dB DTS Bandwidth Measurement

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

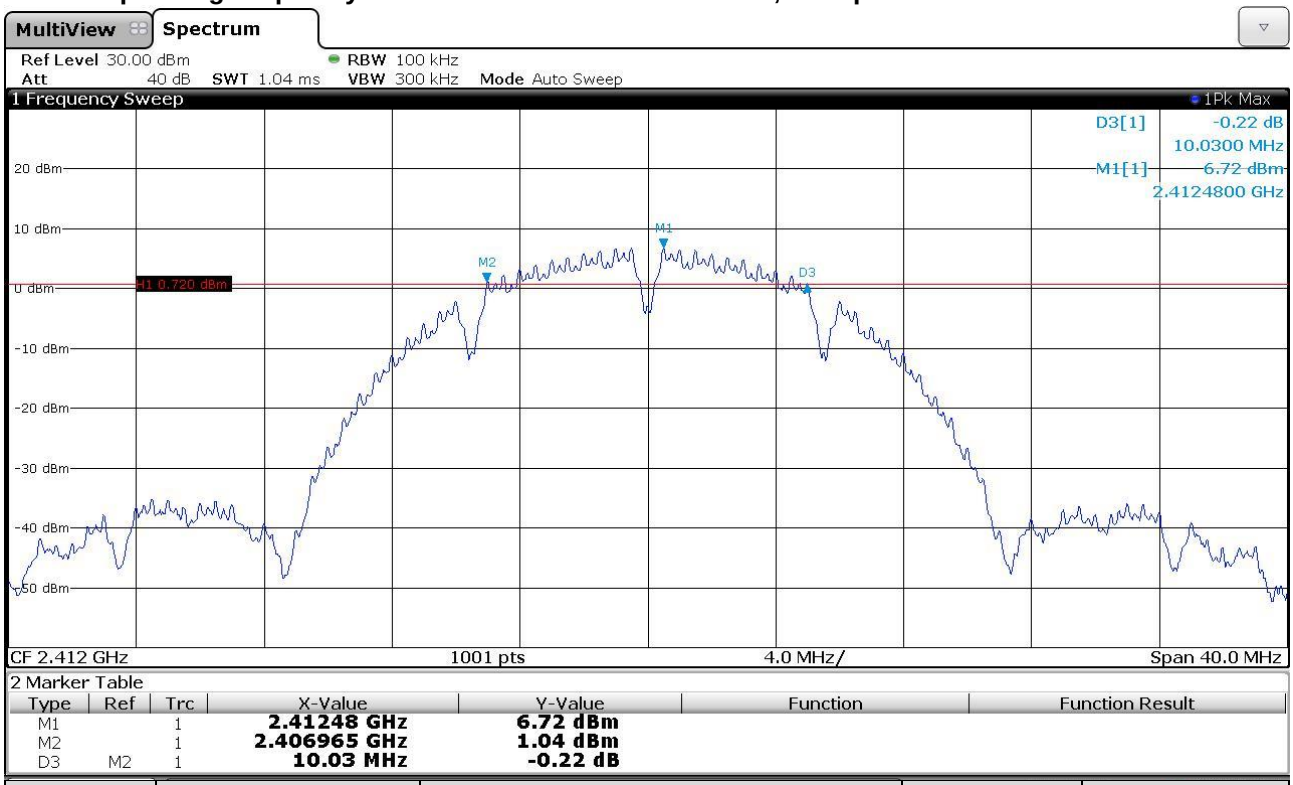
Limit
The minimum 6 dB bandwidth shall be at least 500 kHz.

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
Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

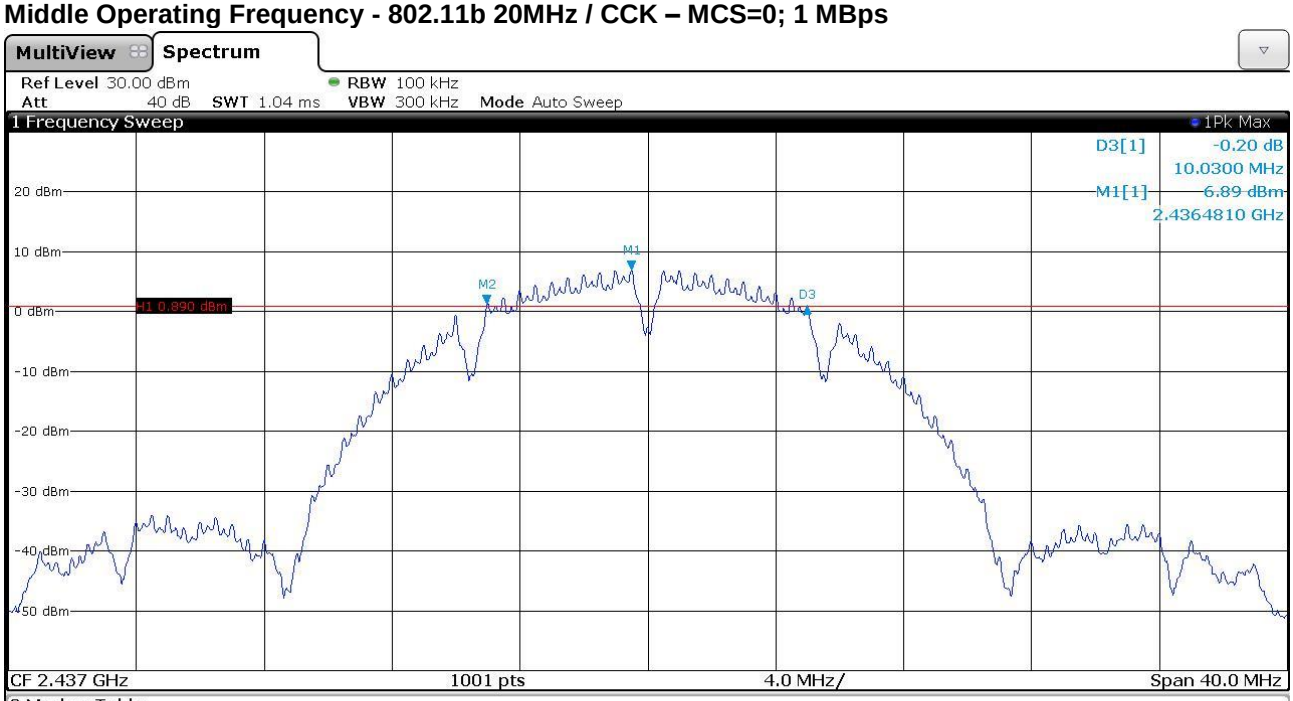
Measurement
The Measurement was performed on: 03.02.2020 and 14.04.2020

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



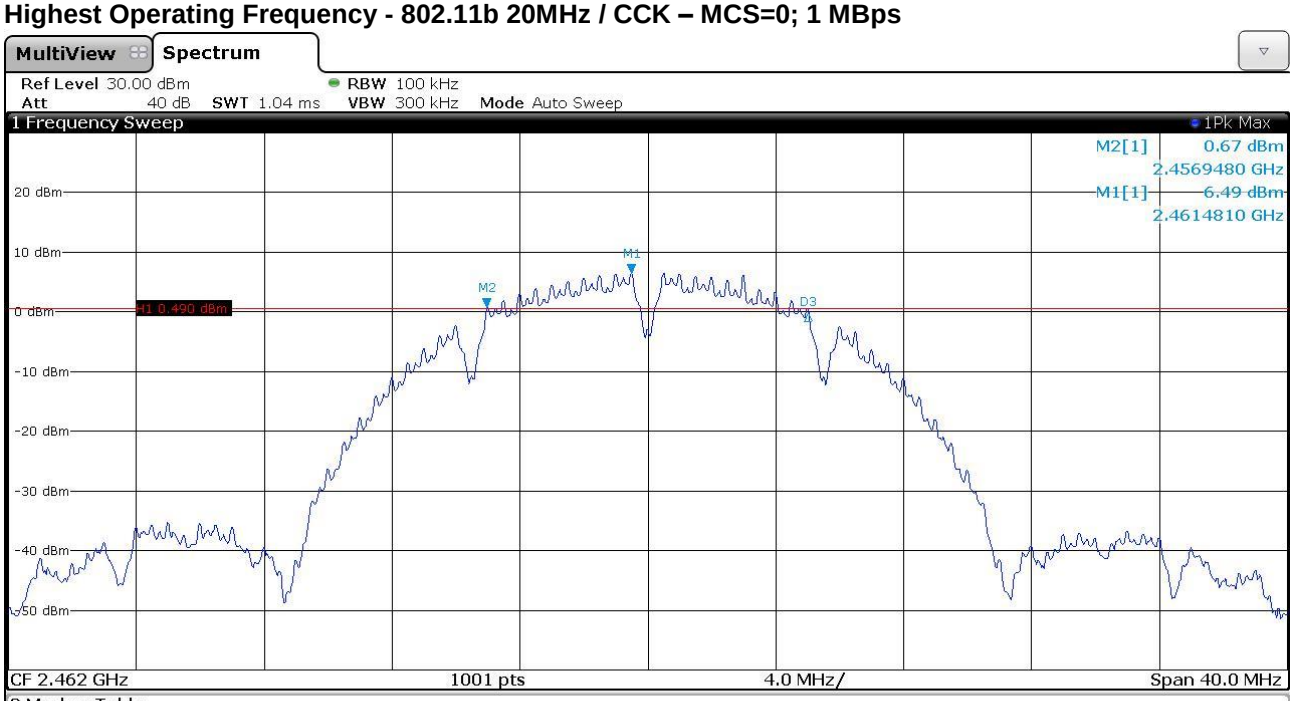
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
1	2412	10.03	0.5	Pass

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



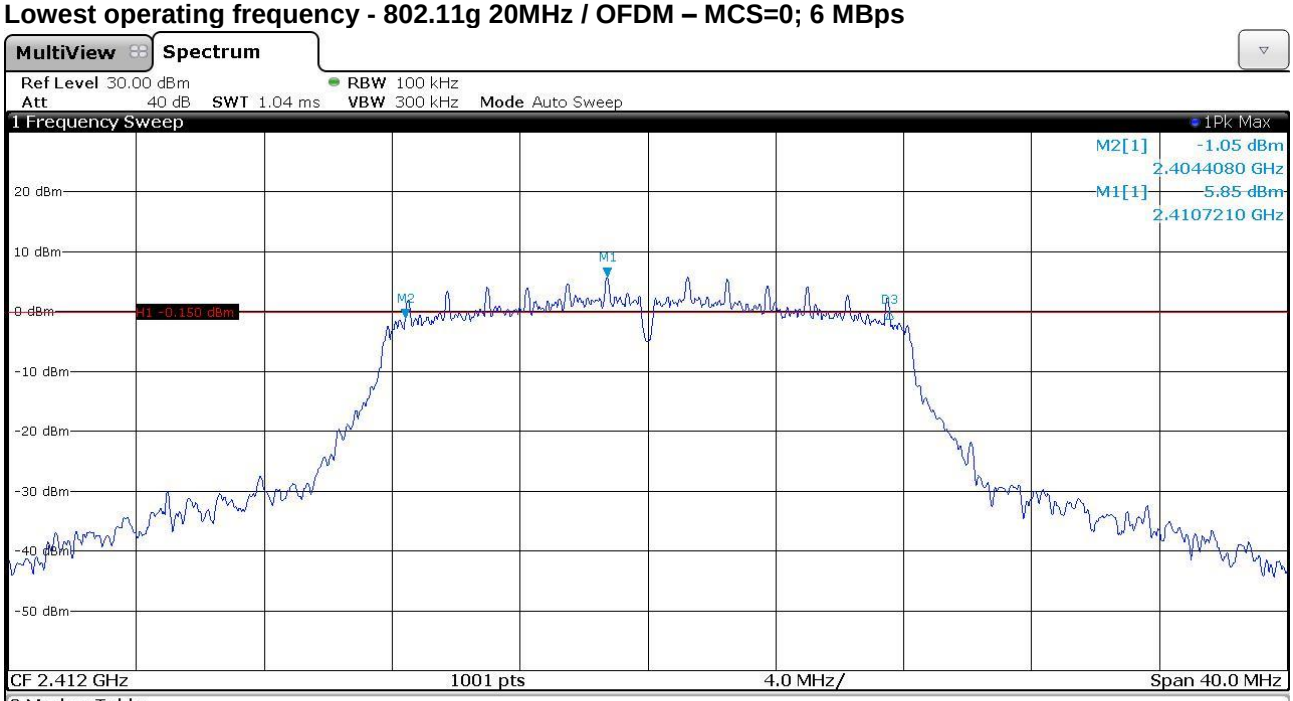
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
6	2437	10.03	0.5	Pass

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



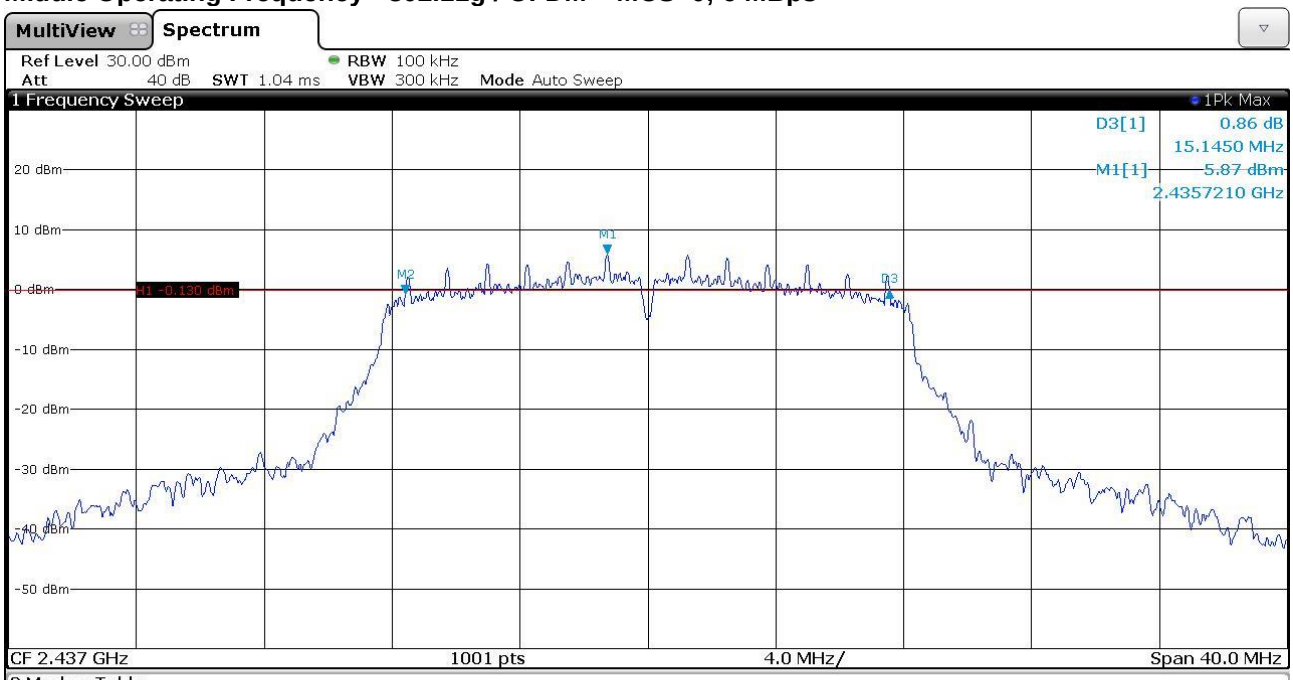
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
11	2462	10.07	0.5	Pass

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



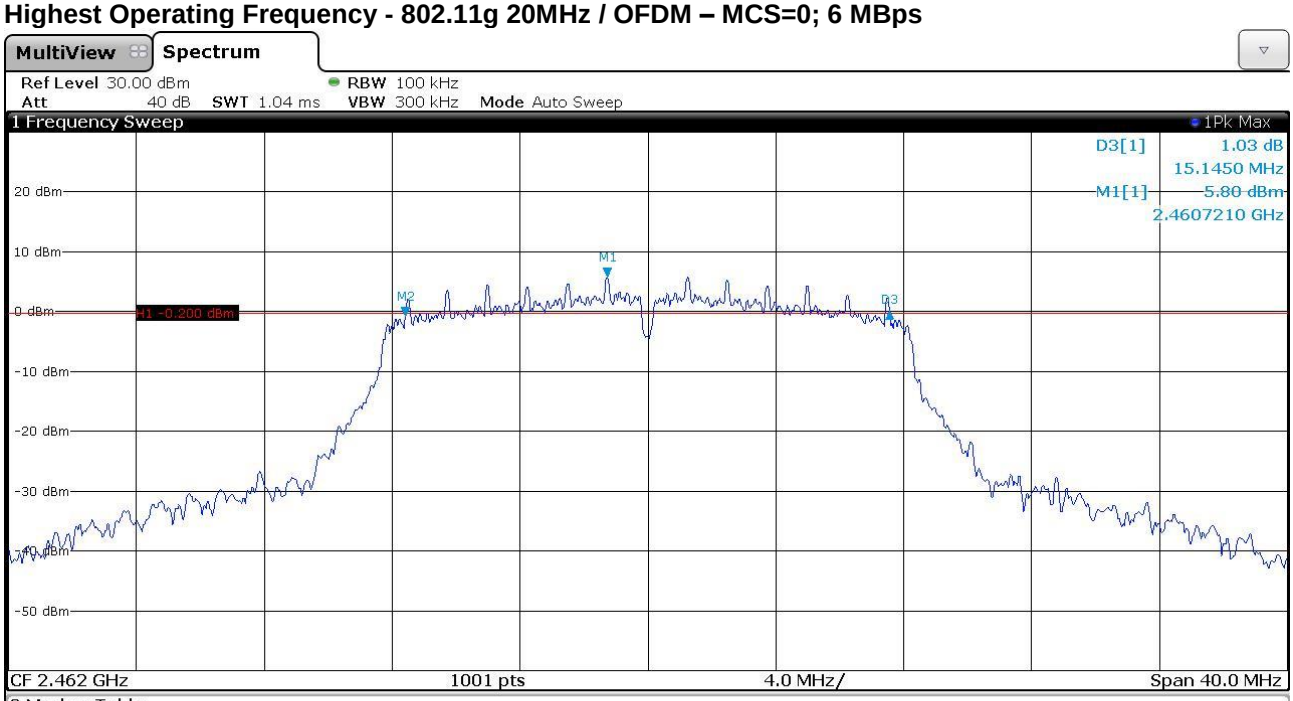
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
1	2412	15.145	0.5	Pass

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



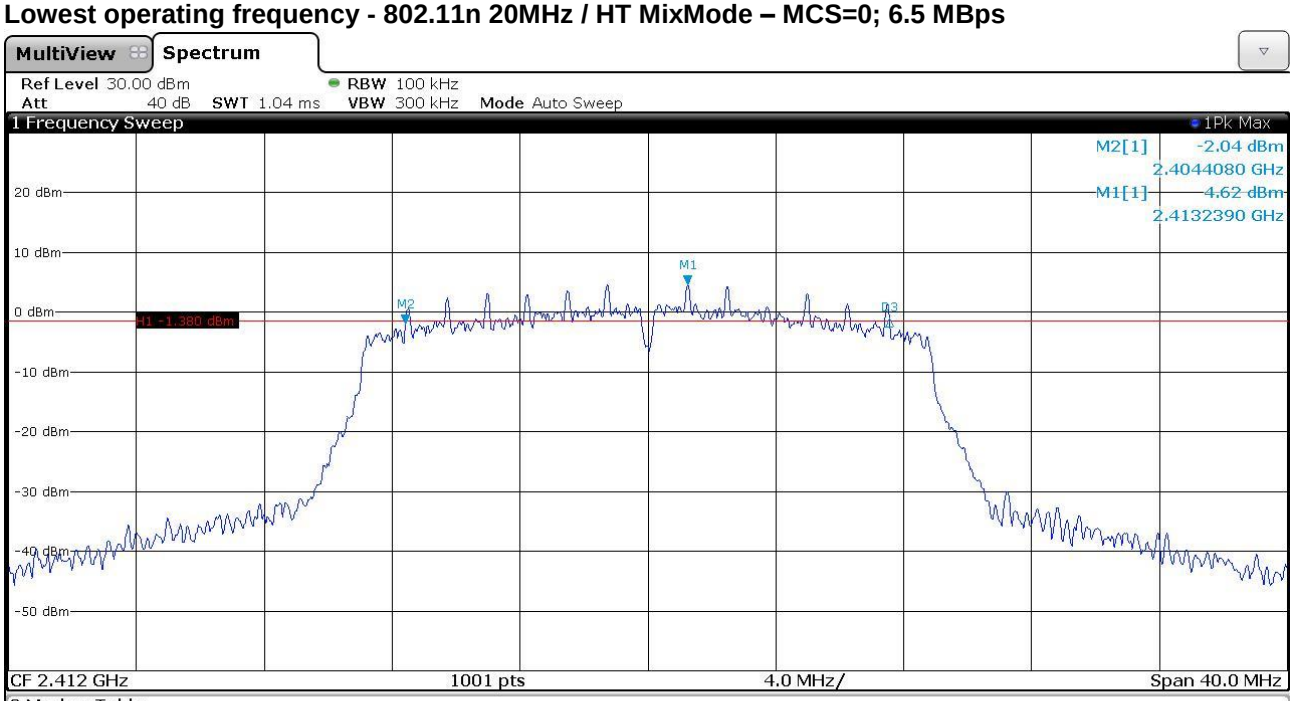
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
6	2437	15.145	0.5	Pass

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



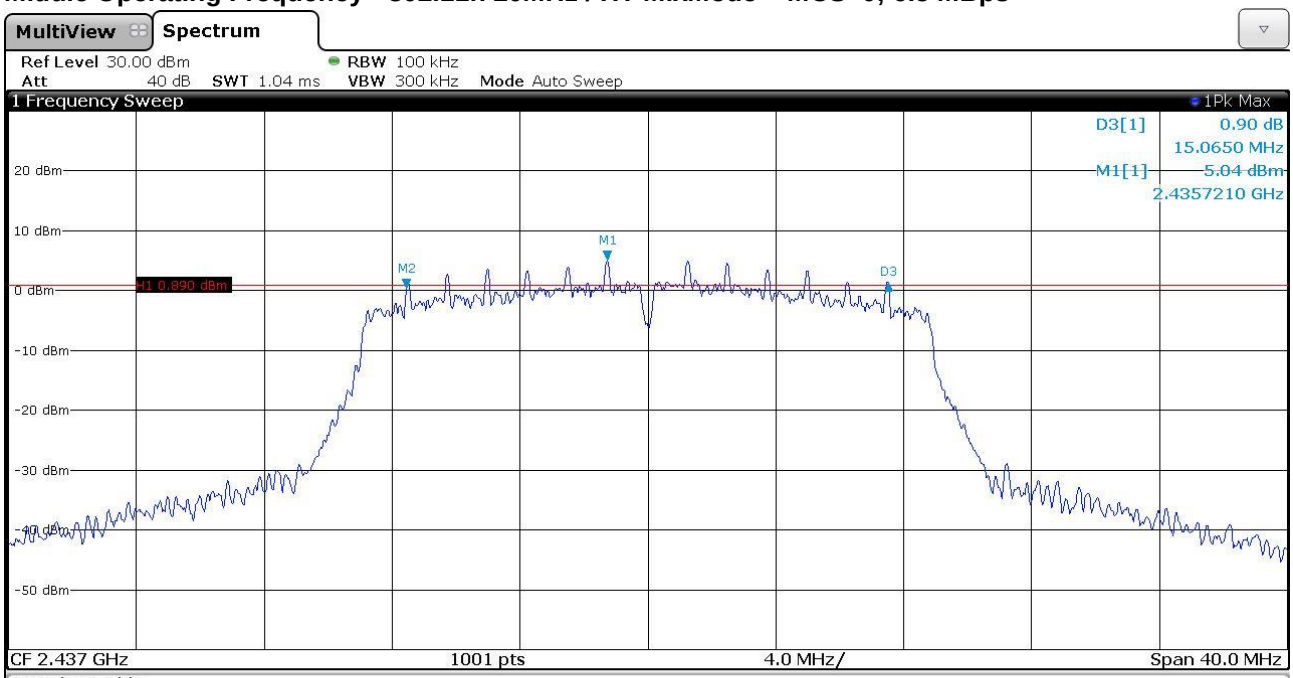
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
11	2462	15.145	0.5	Pass

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



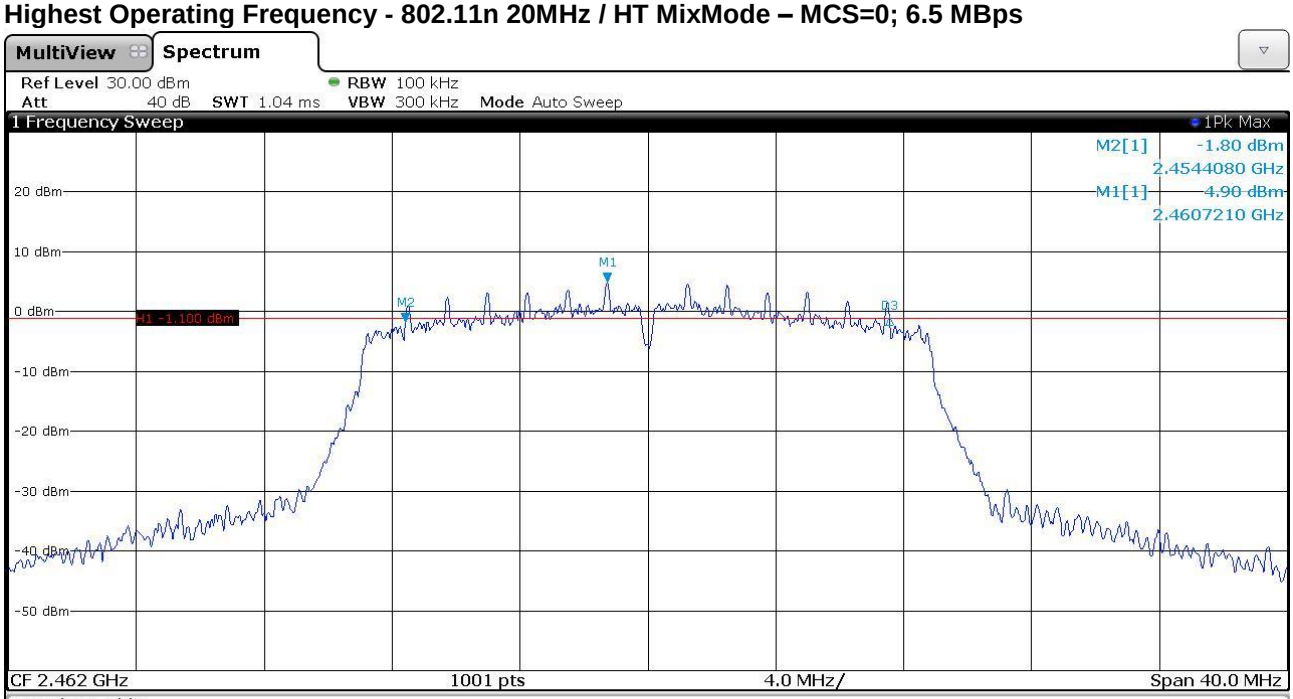
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
1	2412	15.145	0.5	Pass

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



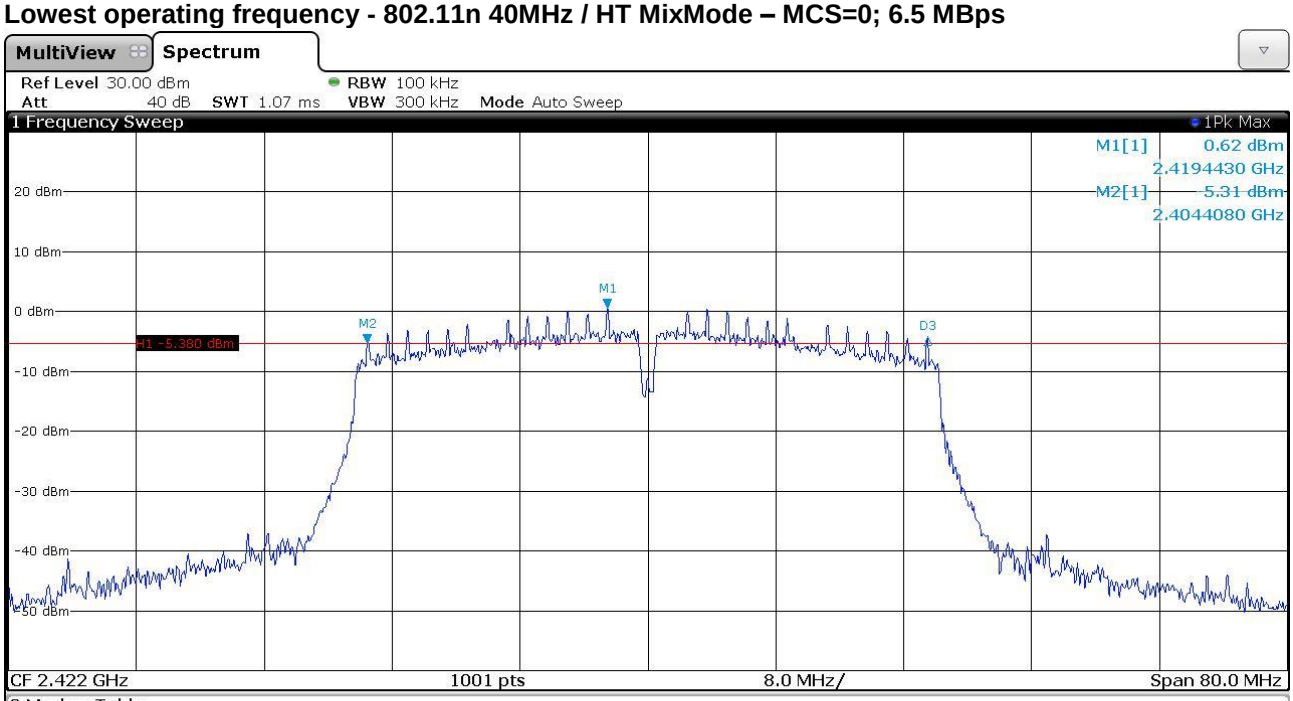
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
6	2437	15.065	0.5	Pass

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



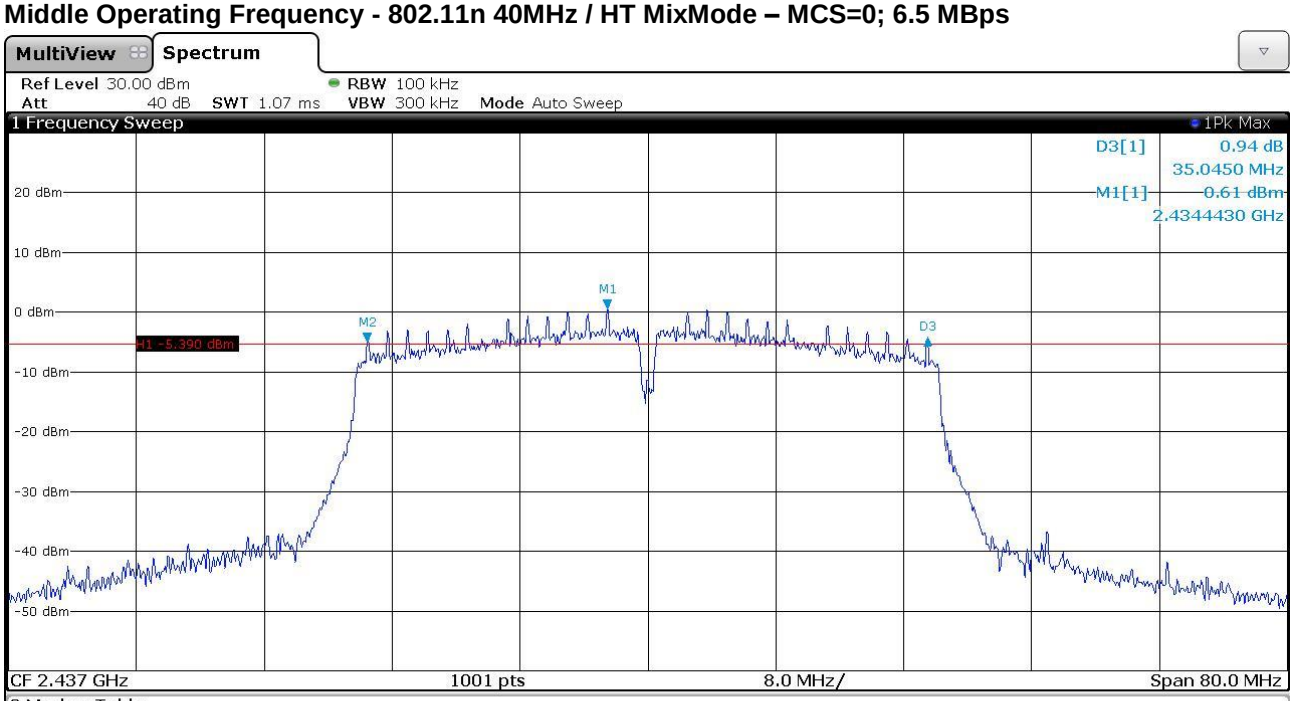
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
11	2462	15.145	0.5	Pass

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



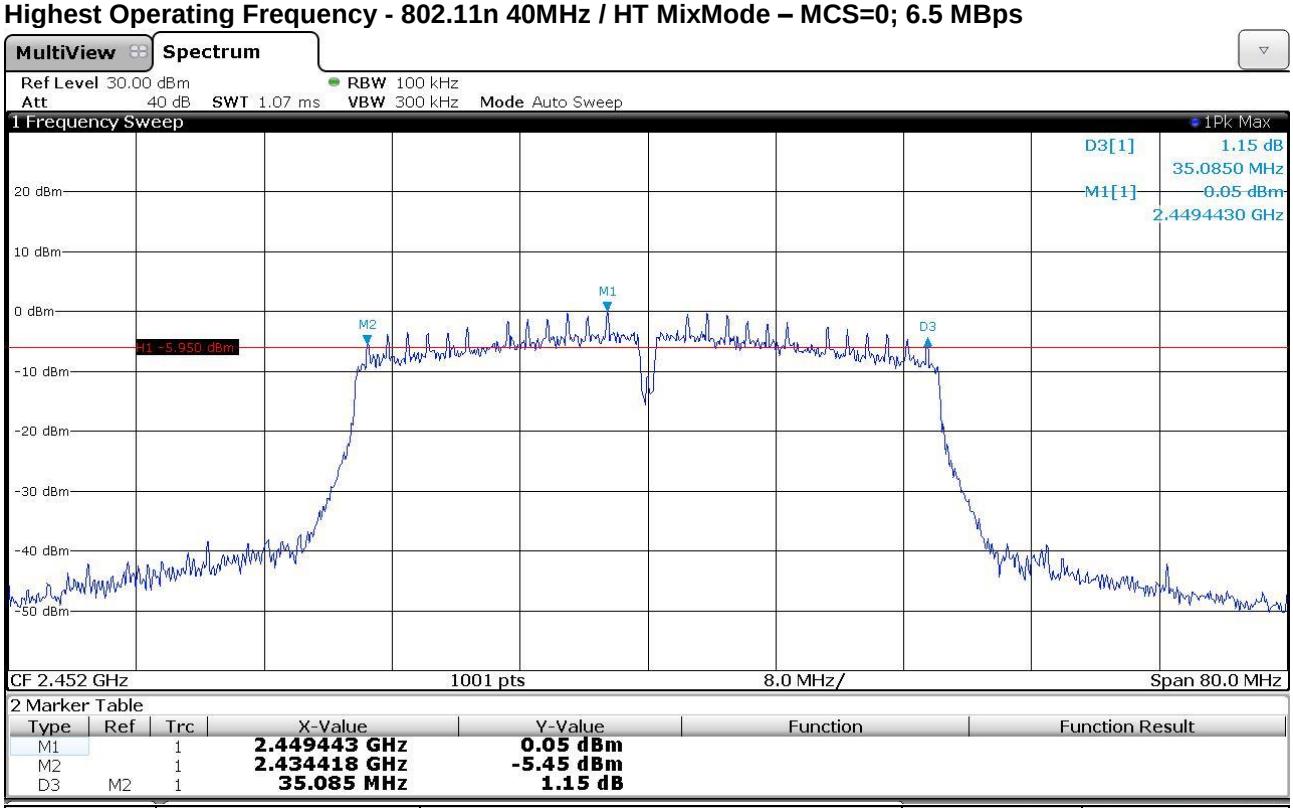
Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
3	2422	35.125	0.5	Pass

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



Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
6	2437	35.045	0.5	Pass

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



Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Result
9	2452	35.085	0.5	Pass

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **6 dB Bandwidth**.

7.2. Output Power of Fundamental Emissions
Maximum Conducted Output Power

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C §15.247 (b) (3)
-RSS-247 Issue 2 section 5.4 (d)

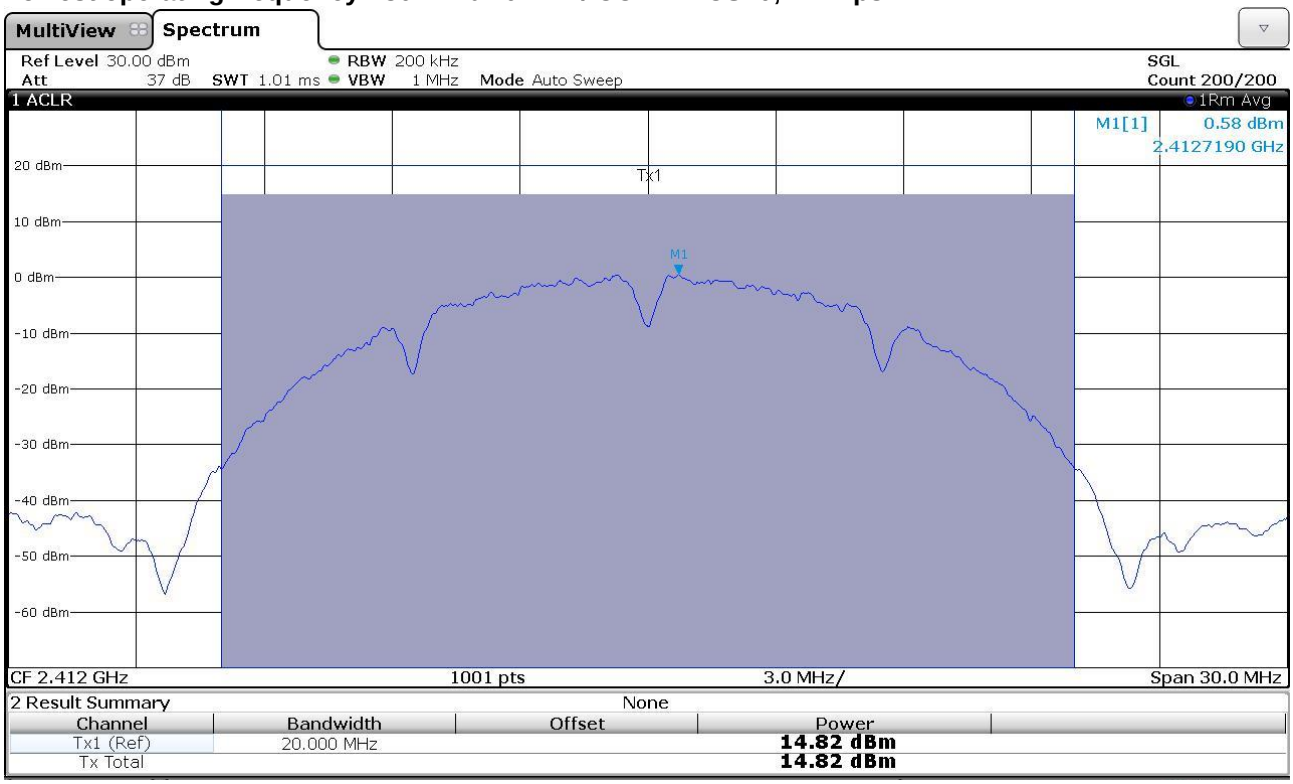
Limits for Peak Output Power of Fundamental (EIRP)
The maximum peak conducted output power of the intentional radiator shall not exceeded: 1 Watt
As an alternative to the maximum peak conducted output power the average output power is measured to show compliance to the limit.

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.

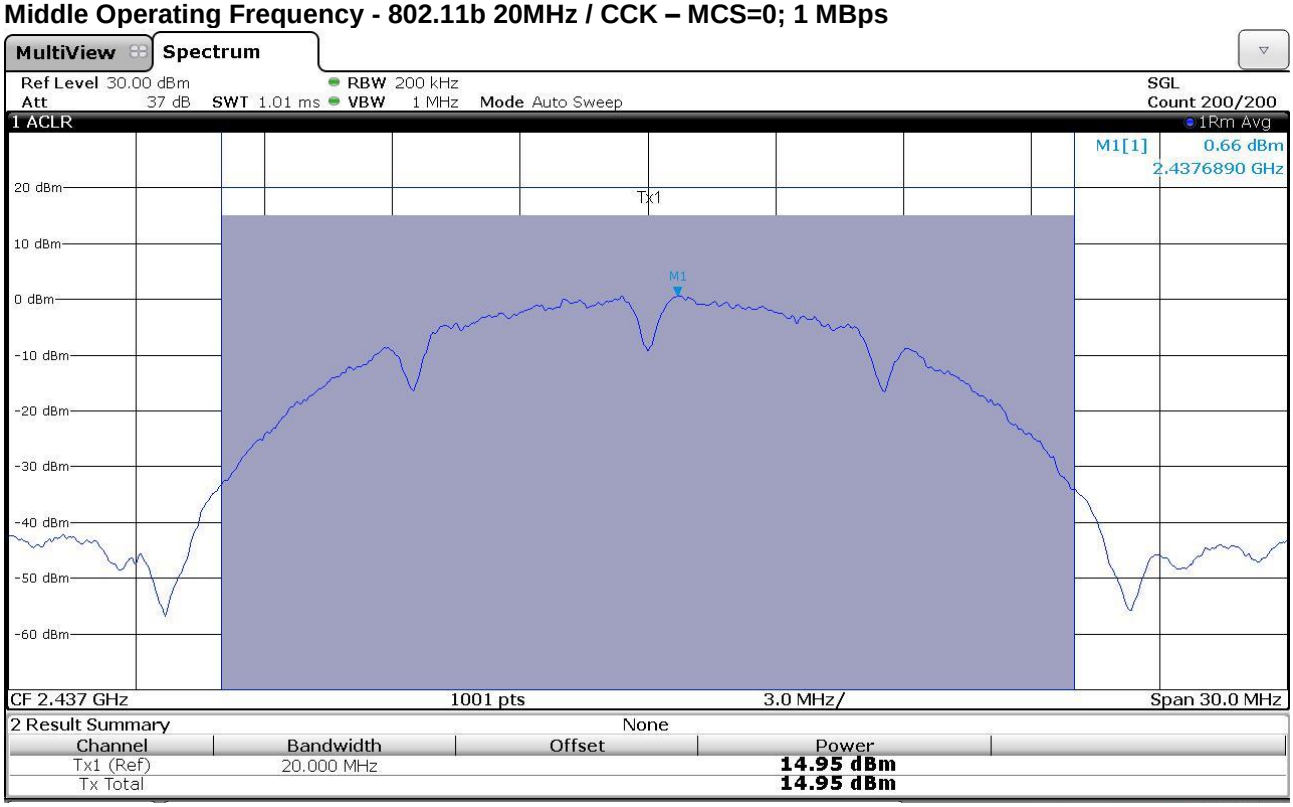
Description
For the conducted measurement, the RF output of the EUT was connected to the Analyzer. All the attenuation or cable loss will be added to the measured maximum output power.
The results are recorded in Watt.

Measurement
The Measurement was performed on: 03.02.2020 and 14.04.2020

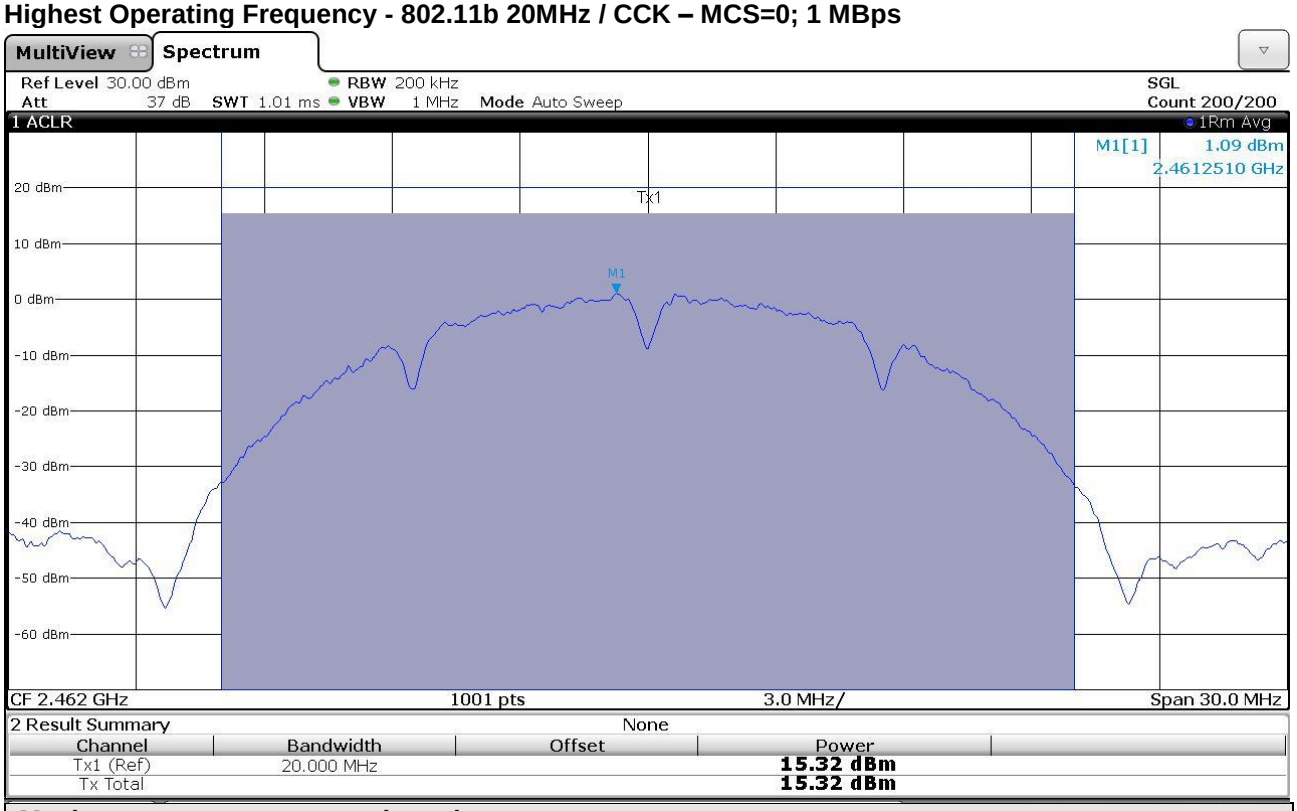
Lowest operating frequency - 802.11b 20MHz / CCK – MCS=0; 1 MBps



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



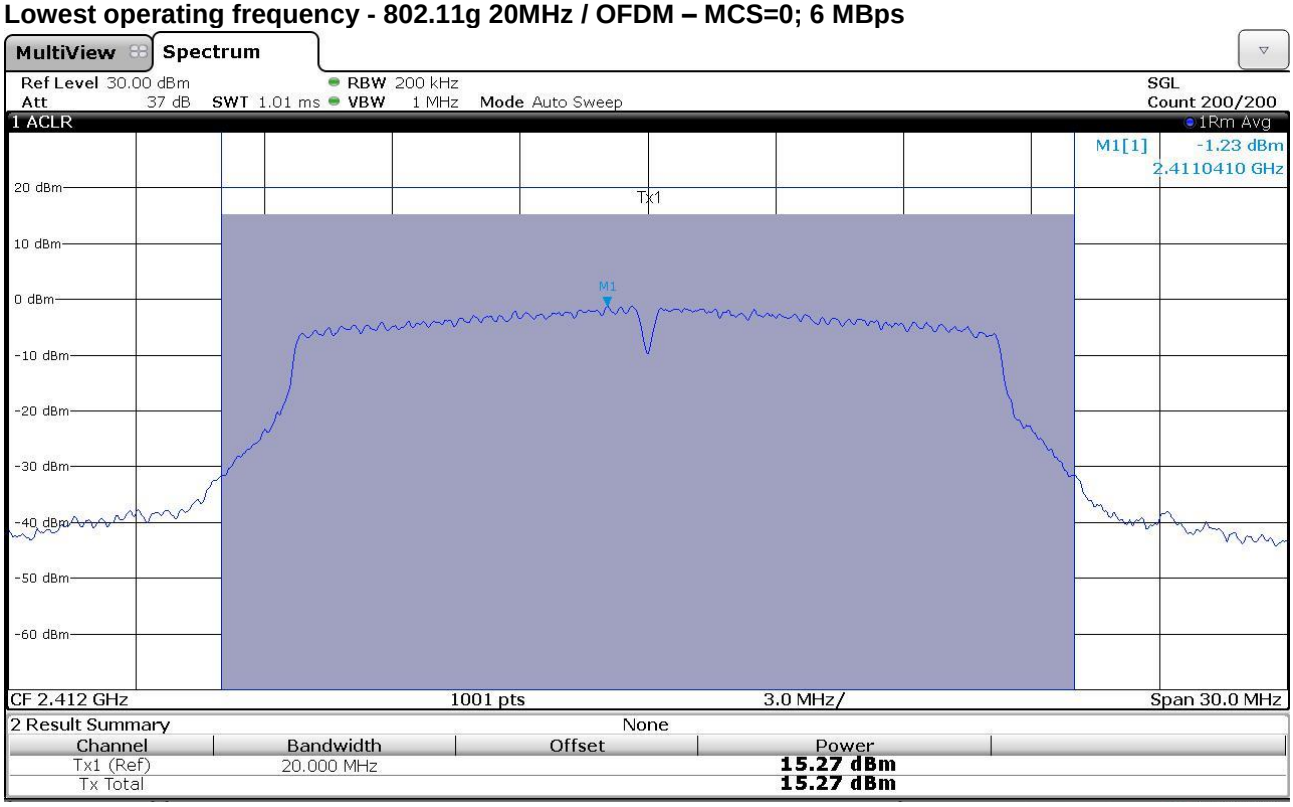
Highest Operating Frequency - 802.11b 20MHz / CCK – MCS=0; 1 MBps



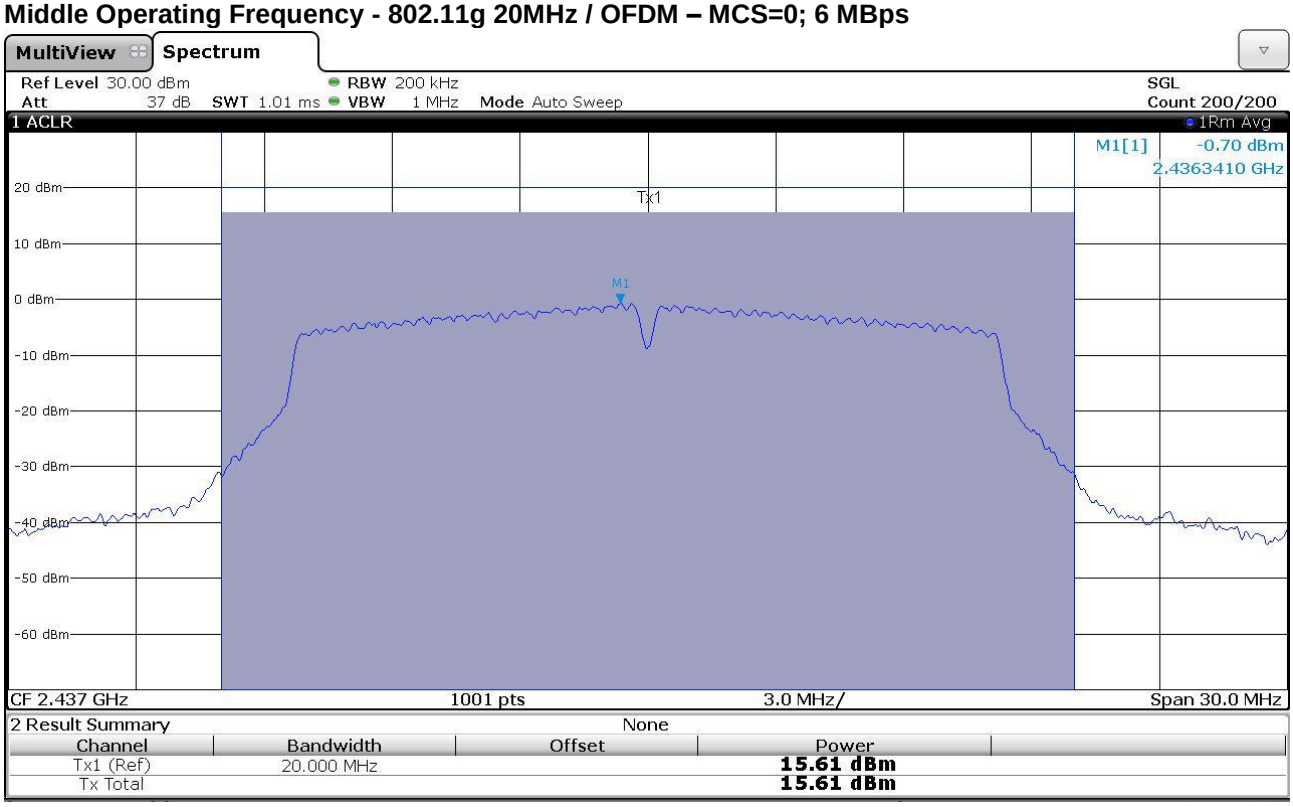
Maximum output power conducted measurement:
802.11b 20MHz / CCK – MCS=0; 1 MBps

Channel	Frequency [MHz]	Output Power		Limit		Result
		[dBm]	[mW]	[dBm]	[mW]	
1	2412	14.82	30.34	30	1000	Pass
6	2437	14.95	31.26	30	1000	Pass
11	2462	15.32	34.04	30	1000	Pass

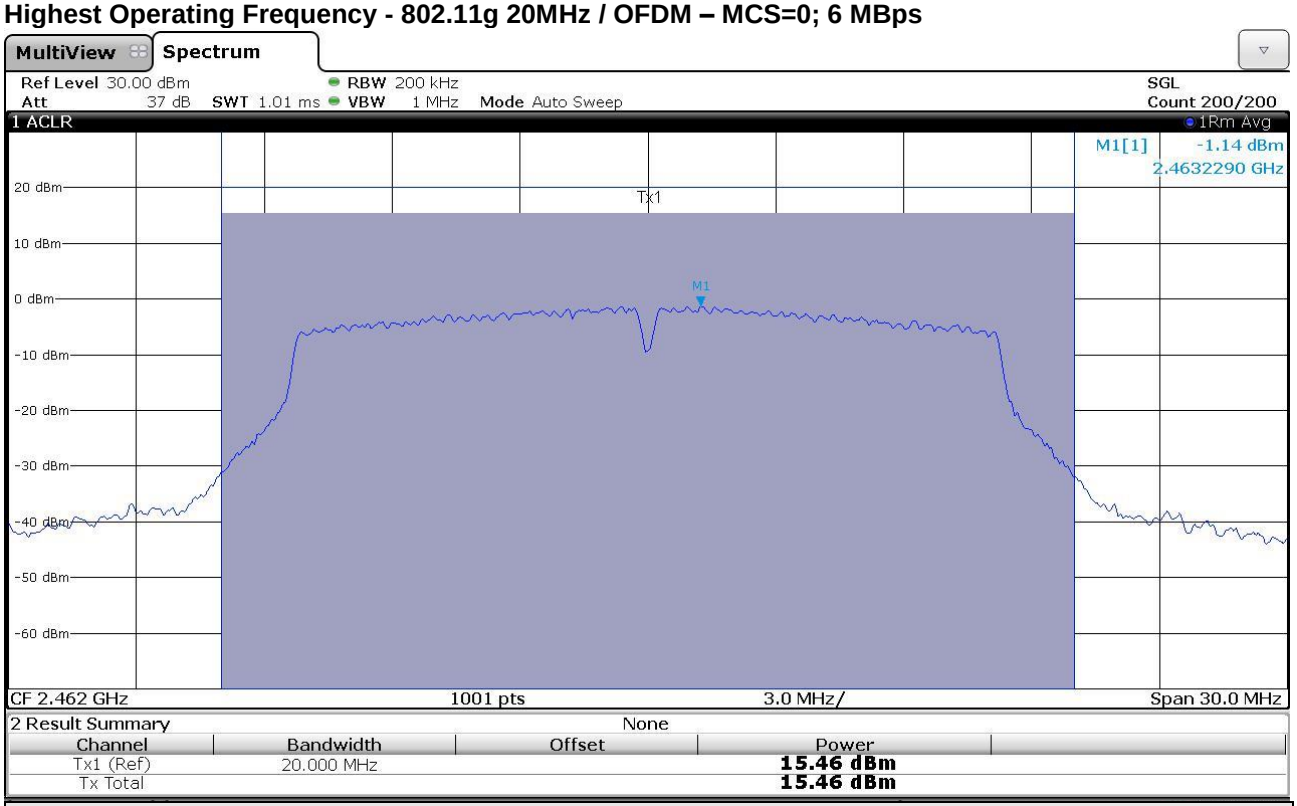
Lowest operating frequency - 802.11g 20MHz / OFDM – MCS=0; 6 MBps



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



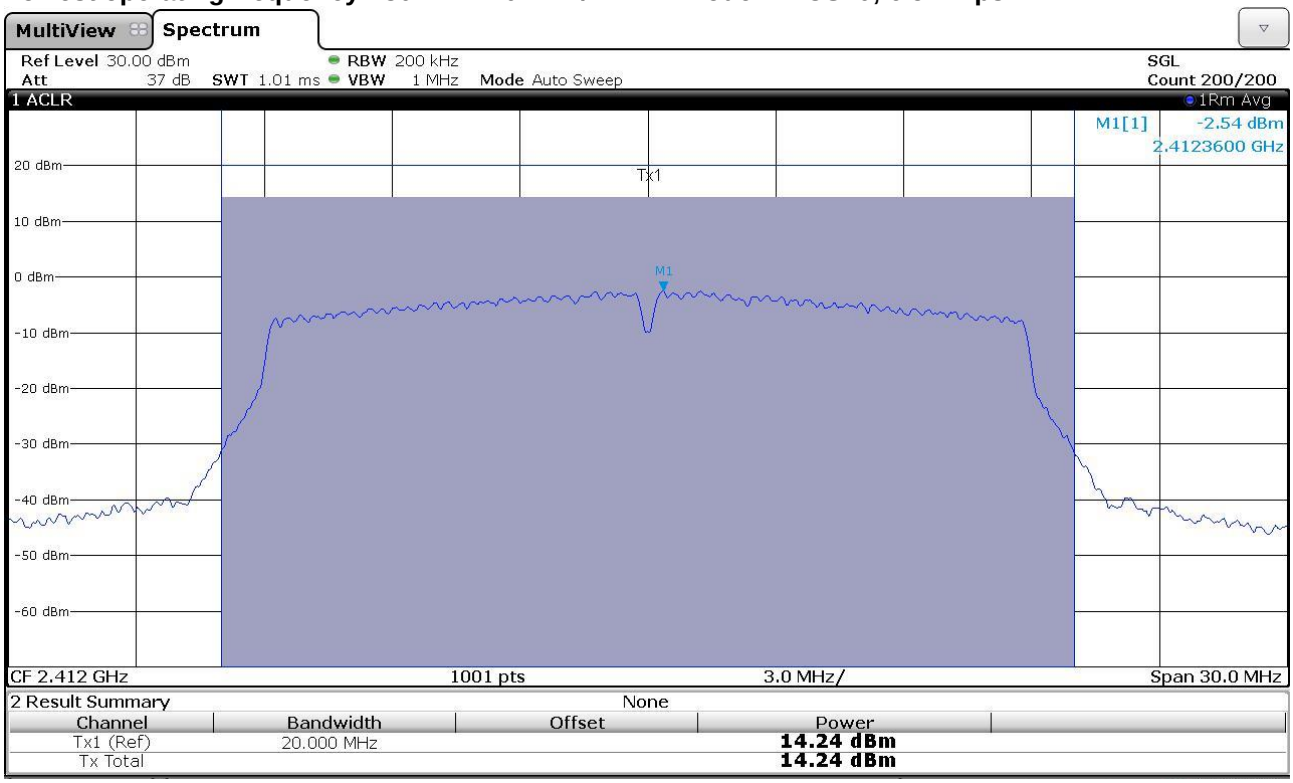
Highest Operating Frequency - 802.11g 20MHz / OFDM – MCS=0; 6 MBps



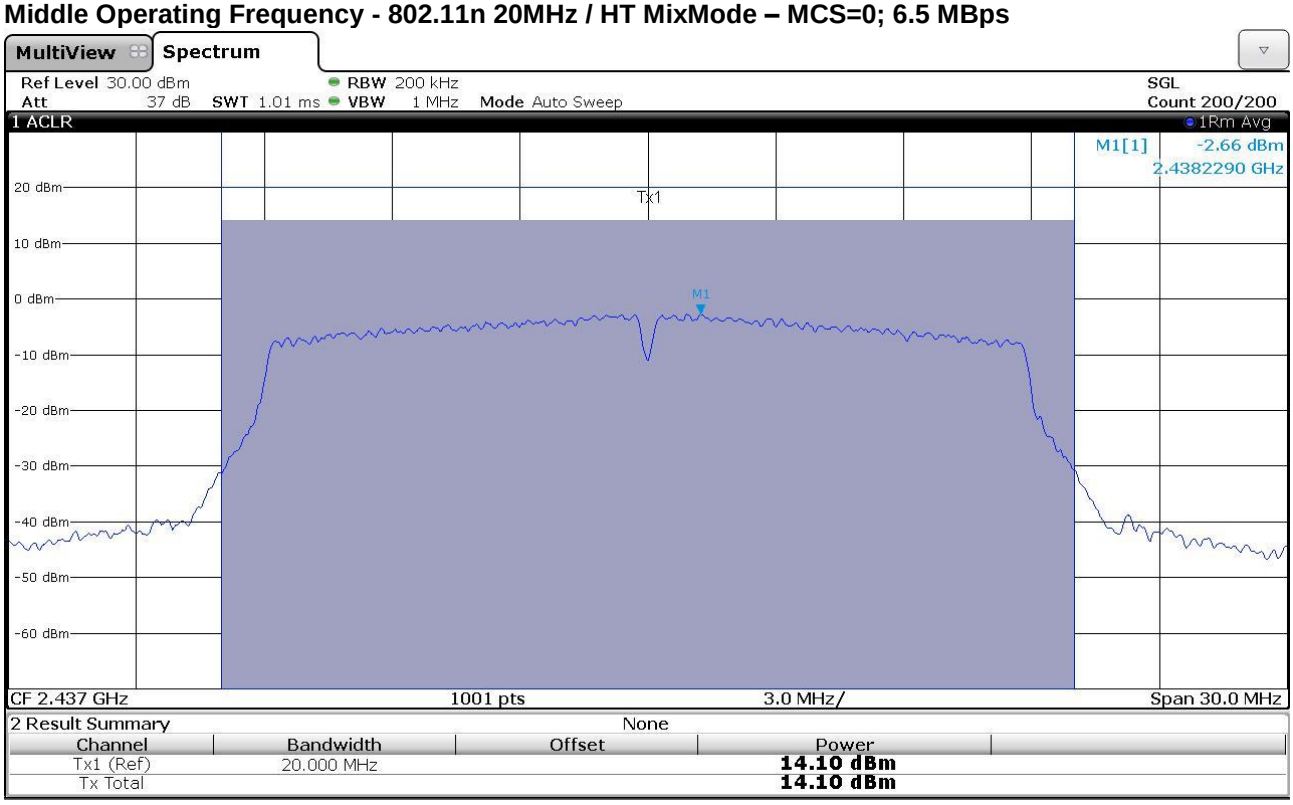
Maximum output power conducted measurement:
802.11g 20MHz / OFDM – MCS=0; 6 MBps

Channel	Frequency [MHz]	Output Power		Limit		Result
		[dBm]	[mW]	[dBm]	[mW]	
1	2412	15.27	33.65	30	1000	Pass
6	2437	15.61	36.39	30	1000	Pass
11	2462	15.46	35.16	30	1000	Pass

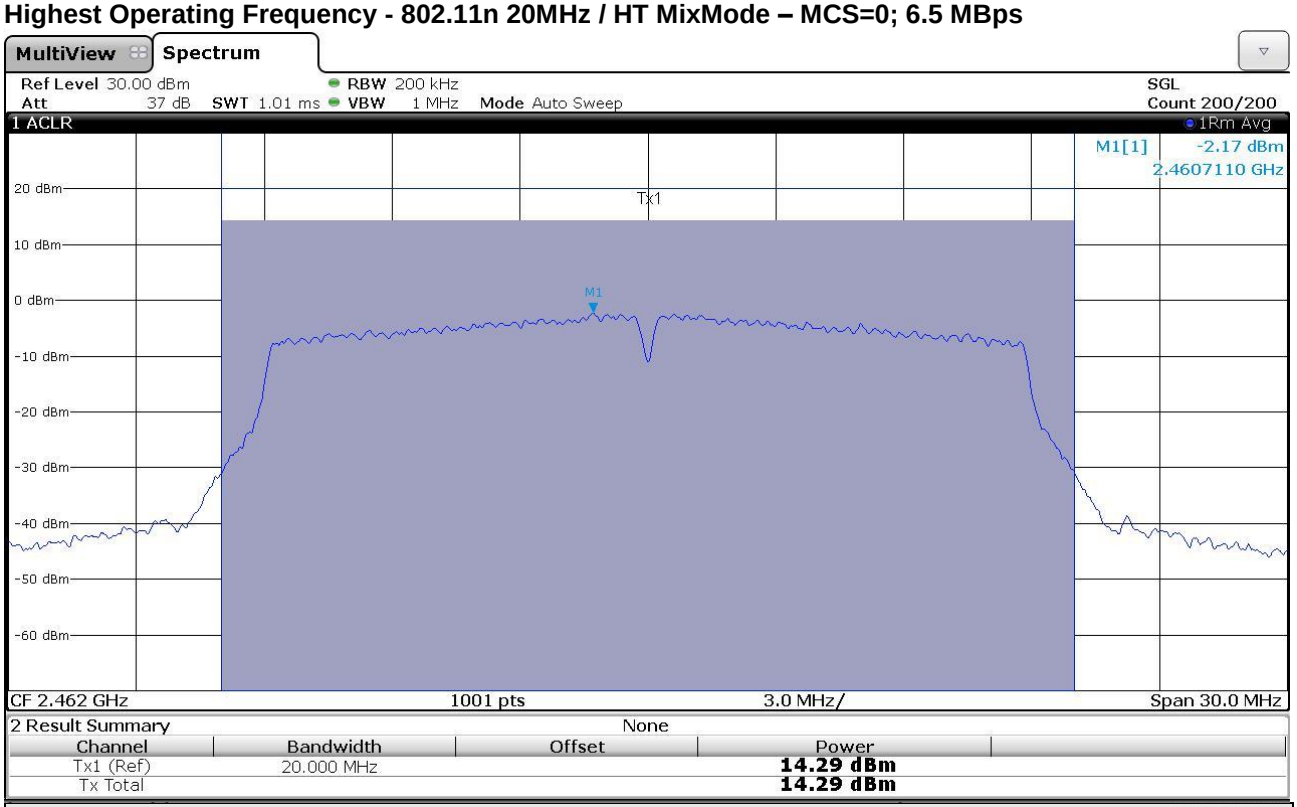
Lowest operating frequency - 802.11n 20MHz / HT MixMode – MCS=0; 6.5 MBps



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



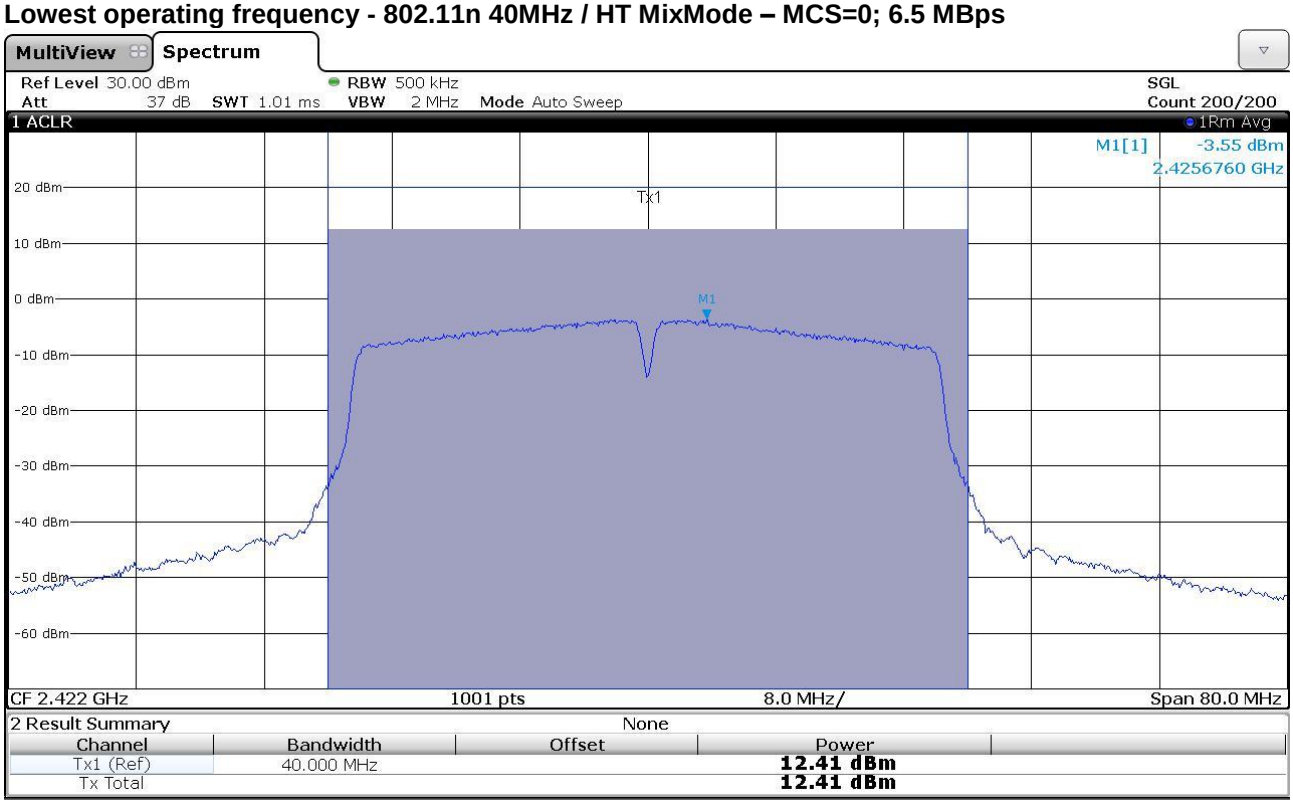
Highest Operating Frequency - 802.11n 20MHz / HT MixMode – MCS=0; 6.5 MBps



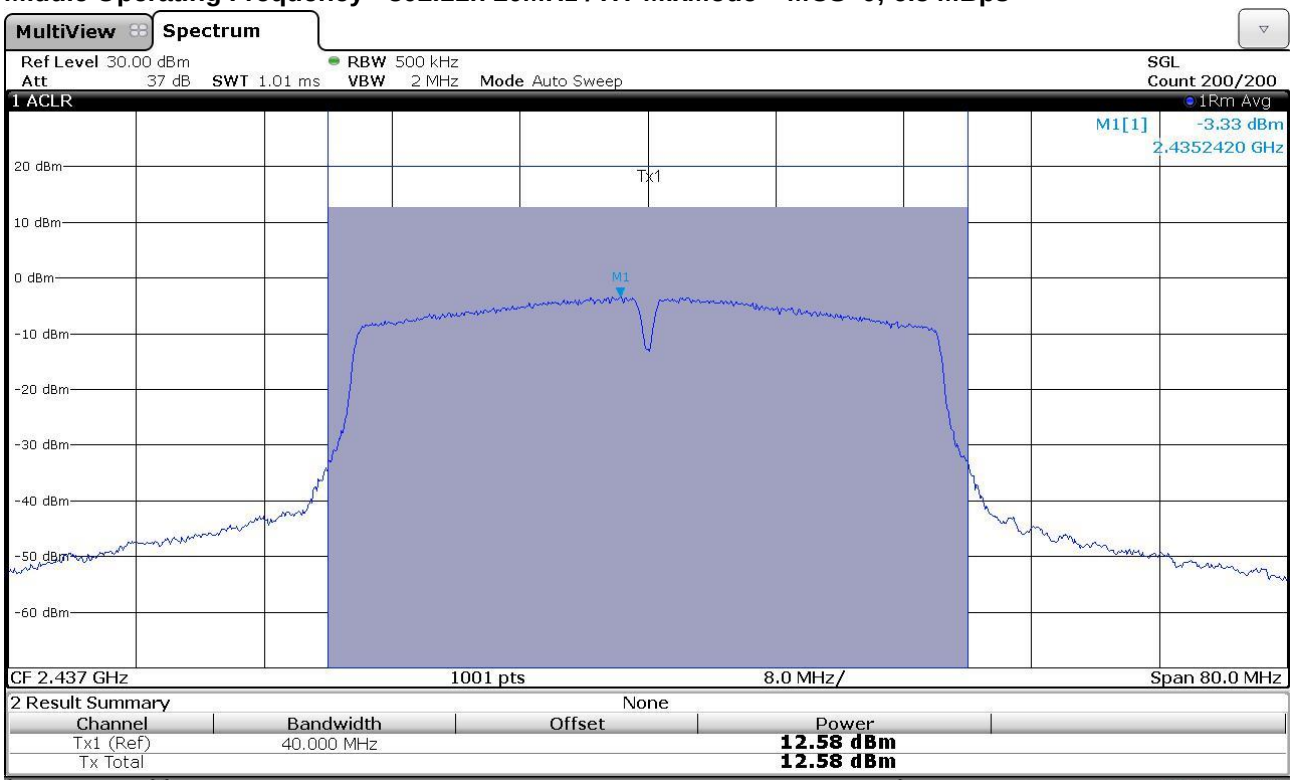
Maximum output power conducted measurement:
802.11n 20MHz / HT MixMode – MCS=0; 6.5 MBps

Channel	Frequency [MHz]	Output Power		Limit		Result
		[dBm]	[mW]	[dBm]	[mW]	
1	2412	14.24	26.55	30	1000	Pass
6	2437	14.10	25.70	30	1000	Pass
11	2462	14.29	26.85	30	1000	Pass

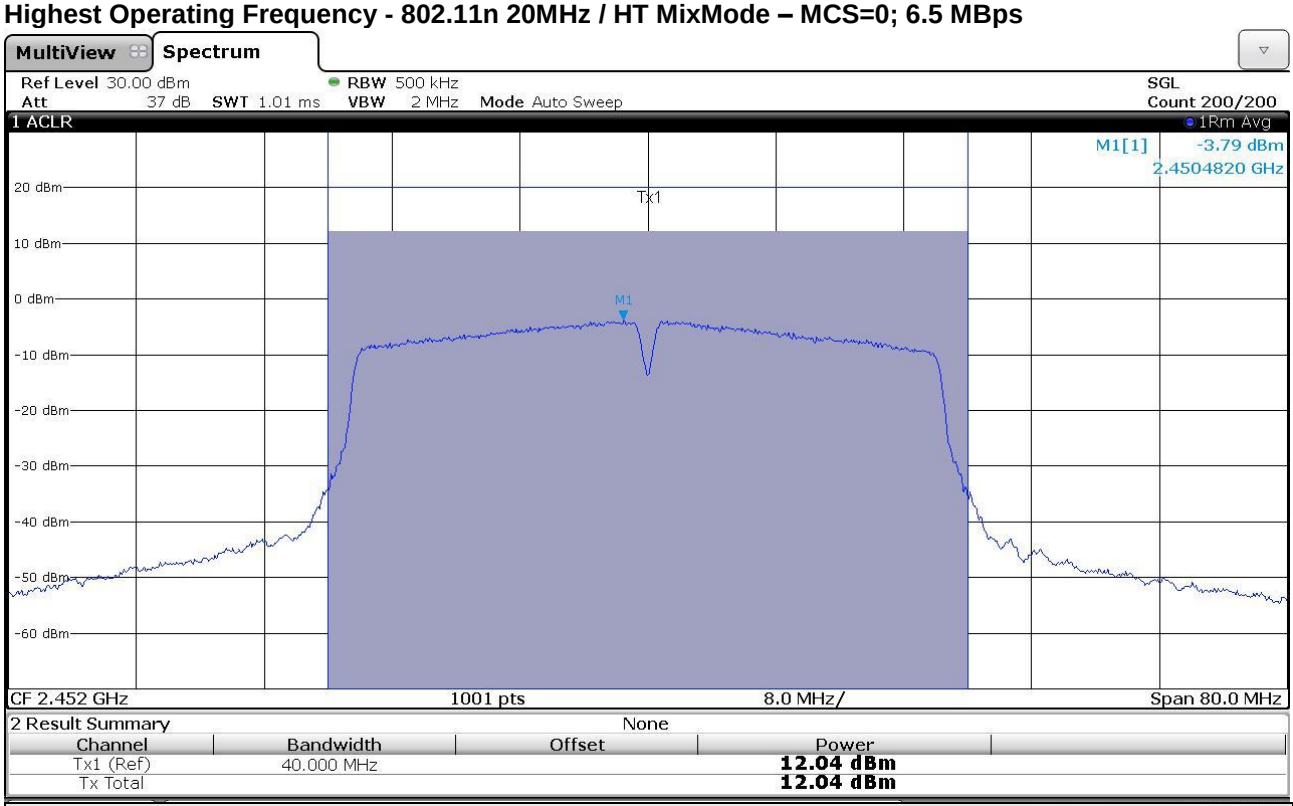
Lowest operating frequency - 802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps



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 output power conducted measurement:
802.11n 40MHz / HT MixMode – MCS=0; 6.5 MBps

Channel	Frequency [MHz]	Output Power		Limit		Result
		[dBm]	[mW]	[dBm]	[mW]	
3	2422	12.41	17.42	30	1000	Pass
6	2437	12.58	18.11	30	1000	Pass
9	2452	12.04	16.00	30	1000	Pass

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements of **Output Power of Fundamental Emissions**.