

# **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



DAkkS

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

BNetzA-CAB-18/21-19



**STC Germany GmbH** Ohmstrasse 1 84160 Frontenhausen, Germany Tel.: + 49 (0) 8732 6381 Fax: + 49 (0) 8732 2345 E-mail: grstc@stc.group

Test report no .:

18/11-0061a

Page 1 of 79 pages



# Table of contents

1.	Client information	3
2.	Equipment under test (EUT)	3
3.	Description of the Equipment under test and test conditions	4
4.	Performed measurements and results	6
5.	AC Mains conducted emissions	7
6.	Radiated emission measurements	11
7.	Operation within the band 902-928 MHz, 2400-2483,5 MHz and 5725-5850 MHz	21
8.	Test equipment	70
9.	Test Setups	72
10.	Measurement uncertainty	76
11.	Photos setup	77
12.	Conclusions	78
13.	Photos of tested sample	79

# Location of test facility:



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).

	Test report no.:	Bage 4 of 70 pages
ESTC IN GERMANY	18/11-0061a	Page 4 of 79 pages

# 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 (I x w x h):	(60 x 90 x 11) mm			
Test conditions:	<ul> <li>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:</li> <li>(1) 802.11b: Tx mode BW 20MHz CCK 1MBps 2412 MHz</li> <li>(2) 802.11b: Tx mode BW 20MHz CCK 1MBps 2437 MHz</li> <li>(3) 802.11b: Tx mode BW 20MHz CCK 1MBps 2462 MHz</li> <li>(4) 802.11g: Tx mode BW 20MHz OFDM 6MBps 2412 MHz</li> <li>(5) 802.11g: Tx mode BW 20MHz OFDM 6MBps 2437 MHz</li> <li>(6) 802.11g: Tx mode BW 20MHz OFDM 6MBps 2462 MHz</li> <li>(7) 802.11n: Tx mode BW 20MHz OFDM 6MBps 2462 MHz</li> <li>(8) 802.11n: Tx mode BW 20MHz HT MixMode 6.5MBps 2412 MHz</li> <li>(9) 802.11n: Tx mode BW 20MHz HT MixMode 6.5MBps 2437 MHz</li> <li>(10) 802.11n: Tx mode BW 20MHz HT MixMode 6.5MBps 2424 MHz</li> <li>(11) 802.11n: Tx mode BW 20MHz HT MixMode 6.5MBps 2437 MHz</li> <li>(12) 802.11n: Tx mode BW 40MHz HT MixMode 6.5MBps 2422 MHz</li> <li>(13) EUT connected to W-LAN Router in different Modulation types (802.11 b/g/n 20MHz/40MHz) with data transfer</li> <li>(14) EUT continues Tx (802.11b 20MHz) /</li> </ul>			
Additional information	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         CCK         MCS=0; 1 MBps - MCS=11; 11 MBps           802.11 b/g/n         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	Ambient temperature: 20 °C			
tests:	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:	<ul> <li>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</li> </ul>			
	<ul> <li>RSS-247 issue 02 February 2017</li> <li>Digital Transmission Systems (DTSs), Frequency Hopping</li> <li>Systems (FHSs) and Licence-Exempt Local Area Network</li> <li>(LE-LAN) Devices</li> </ul>			

	Test report no.:	
ESTC IN GERMANY	18/11-0061a	

#### **Channel List**

Frequency Allocation 20 MHz bandwith sys	i for 802.11b/g/n tems, use Channel 1 – Chanr	nel 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				
	2422	9	2452				
3	2722						
3 4	2427	10	2457				
		10 11	2457 2462				

### 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:		Tes	st requi	remen	ts:
				applic	cable:	fulfil	led:
				yes	no	yes	no
§ 15.207	RSS-Gen issue 5	ANSI 63.10 Section 6.2	AC Mains Conducted Emissions	$\boxtimes$		$\boxtimes$	
§ 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	$\boxtimes$		$\boxtimes$	
§15.247	RSS-247 issue 2	ANSI 63.10 Section 11.9.1	Output Power of Fundamental Emissions	$\boxtimes$			
§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			$\boxtimes$	

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.

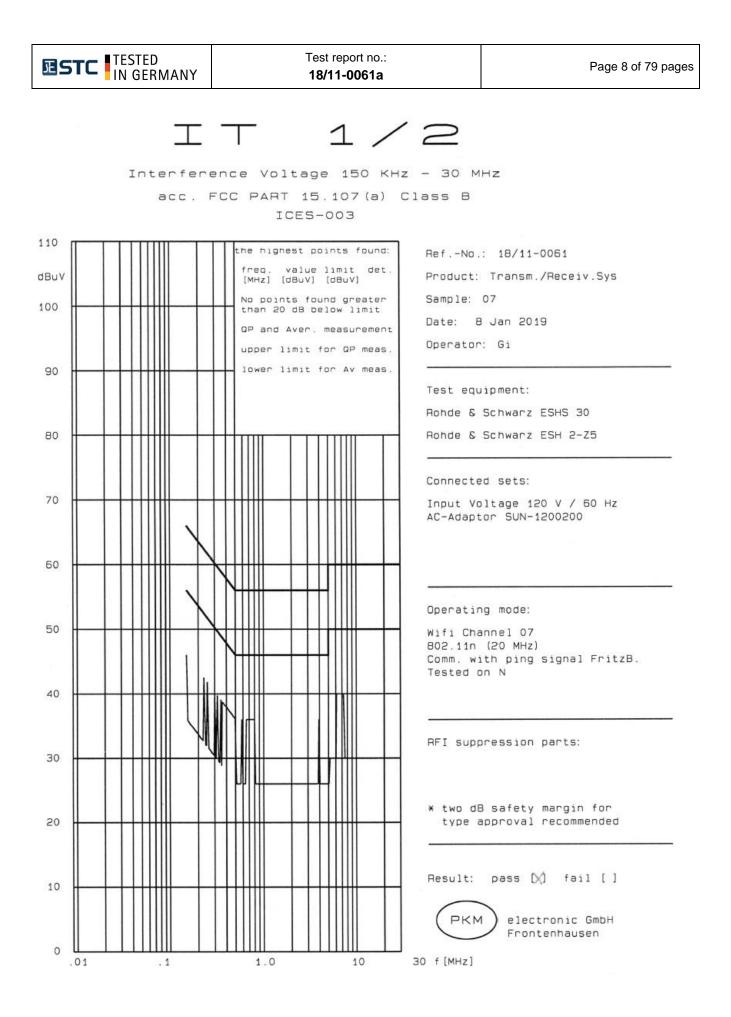
#### Requirements

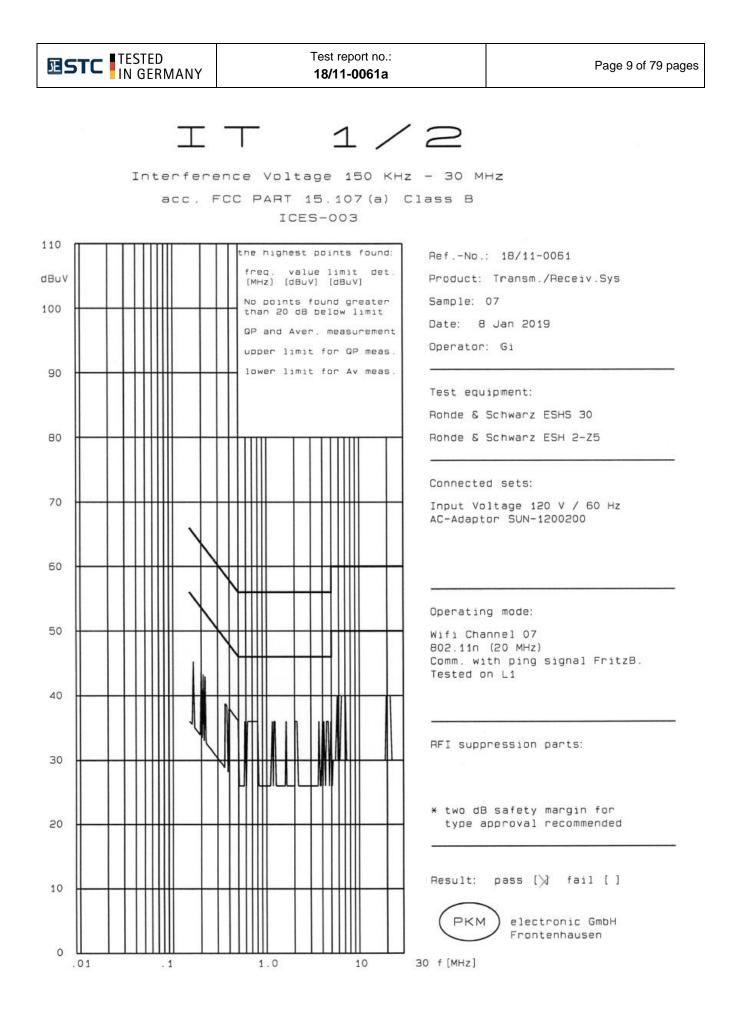
Frequency Range	Quasi-Peak Limits	Average Limits				
[MHz]	[dBµV]	[dBµV]				
0.15 - 0.5	66 to 56 Note 1	56 to 46 Note 1				
0.5 - 5.0	56	46				
5.0 - 30.0 60 50						
Note 1: The level decreases linearly with the logarithm of the frequency						

#### 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.





ESTC IN GERMANY	Test report no.:	Page 10 of 79 pages
🛤 🗩 📕 IN GERMANY	18/11-0061a	Fage 10 0179 pages

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

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

(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.

ESTC TESTED IN GERMANY	Test report no.:	Page 12 of 79 pages
ESIC IN GERMANY	18/11-0061a	Fage 12 01 79 pages

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

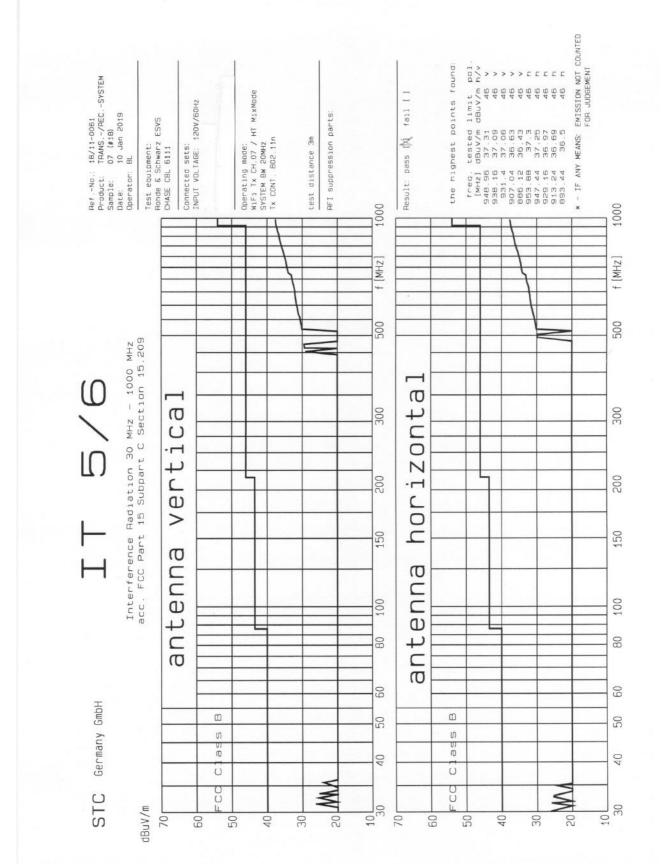
In the frequency range 9 kHz – 30 MHz the EUT had been scanned in a distance of 3 m and the limit was corrected to the test distance of 3 m using a factor of 40 dB/decade acc. to § 15.31 (f)(2).

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

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

#### Result 30 MHz – 1000 MHz

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



	Test report no.:	Baga 14 of 70 pagas
<b>ESTC</b> IN GERMANY	18/11-0061a	Page 14 of 79 pages

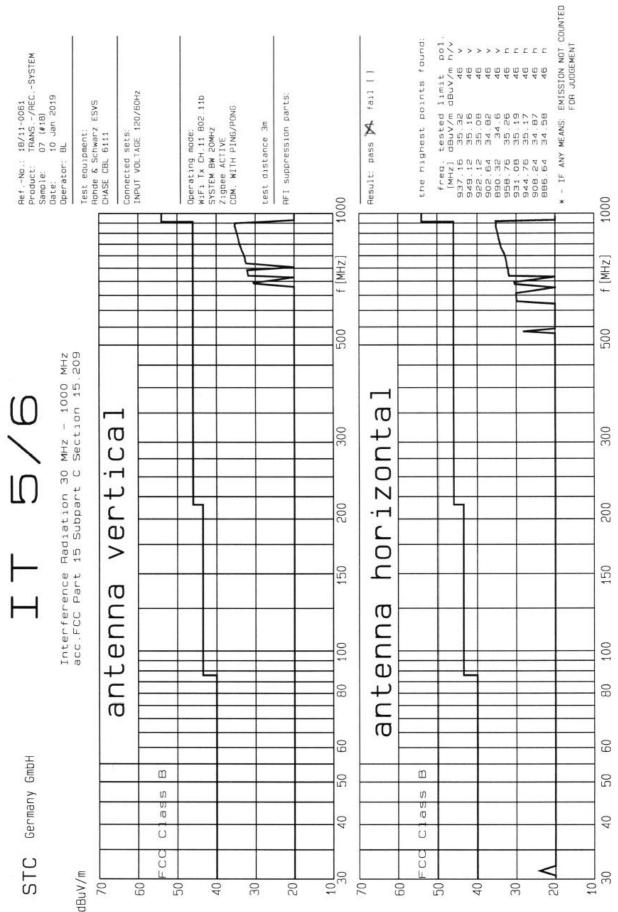
Frequency [MHz]	Detector	Antenna polarization	Radiated emission [dBµV/m]	Radiated emission [µV/m]	Limit [dBµV/m] (3 m)	Limit [µV/m] (3 m)	Result
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
948.96	QP	V	37.31	73.37	46.00	200	Pass
938.16	QP	V	37.09	71.53	46.00	200	Pass
931.40	QP	V	37.06	71.29	46.00	200	Pass
907.04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

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

- (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  $dB\mu V/m$
- (7) = relevant limit in  $\mu$ V/m
- (8) = comparison between Limit  $[dB\mu V/m]$  (6) and Radiated emission  $[dB\mu V/m]$  (4)

BCTC	TESTED		
EDIC	TESTED		

Page 15 of 79 pages



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

	Test report no.:	Dage 16 of 70 pages
ESTC IN GERMANY	18/11-0061a	Page 16 of 79 pages

Frequency [MHz]	Detector	Antenna polarization	Radiated emission [dBµV/m]	Radiated emission [µV/m]	Limit [dBµV/m] (3 m)	Limit [µV/m] (3 m)	Result
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(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	Н	35.26	57.94	46.00	200	Pass
931.08	QP	Н	35.19	57.48	46.00	200	Pass
944.76	QP	Н	35.17	57.35	46.00	200	Pass
908.24	QP	Н	34.87	55.40	46.00	200	Pass
886.64	QP	Н	34.58	53.58	46.00	200	Pass
-/-	QP	Н	-/-	-/-	-/-	-/-	-/-

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

- (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  $[dB\mu V]$  + correction factor
- $(5) = 10^{(Radiated emission [dBµV/m] (5))/20)}$
- (6) = relevant limit in  $dB\mu V/m$
- (7) = relevant limit in  $\mu$ V/m
- (8) = comparison between Limit  $[dB\mu V/m]$  (6) and Radiated emission  $[dB\mu V/m]$  (4)

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

Result 1 GHz – 7 GHz

Mode No.: 2 with 802.11n 20MHz

TESTED	IANY	IT 5/ Interference r according to FCC §1	adiation	ES	ГС
RefNo.:	18/11-0061				
Product:	Transmitting/	Receiving System			
Sample:	01				
Date:	30.01.2020				
Operator:	BI			pass	fail
Remarks:	All cables cor	nected; Input Voltage \$	System 24V/DC	Result: 🔀	
Operation mo		(802.11b 20MHz/CH11	-	_	ed
	_	x x	,,	, , , ,	
Receiver					
	BW (EMI) 1 MHz		IT56-1-6GHz.TDF		
Input 1 AC A Scan 🔵 1Av M		Preamp OFF Step TD S	ican		
Limit Che		PASS			-
		C-Class B PASS			
		GG-GLAS PASS			
80 dBµV/m					
oo aspyin					
IT56-1-7GHZ-PE	AK-FCC-CLASS B				
70 аврулі					
60 dBµV/m					
IT56-1-7GHZ-AV	-FCC-Class B			+	-
				mare to the own Warrow I want	1.00
40 dBuV/m			manufarment		
Montheman	A. Me Marco	mban hur hand and hand		the second	statuto
	hours and an	Mu	human	- market the second second	
30 dBµV/m		- marken how	man		
man	marken				
20 dBµV/m					
10 dBµV/m					1
			TF		
Start 1.0 GHz				Stop	7.0 GHz

	Polarisation: V									
Detector Average					Detector Peak					
<b>Frequ</b> . [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

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



#### Ref.-No.: 18/11-0061

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

Receiver	
RBW (EMI) 1 MHz MT 1 s	IT56-1-6GHz.TDF
Input 1 AC Att 0 dB Preamp OFF Step TD Scan	
Scan 🕒 1Av Maxo2Pk Max	
Limit Check PASS	
Line IT56-1-7GHZ-AV-FCC-Class B PASS	
90 dBjtV/mT56-1-7CHZ-PEAK-FGG-GLA8_PA88	
80 dBµV/m	
IT56-1-7GHZ-PEAK-FCC-CLASS B	
60 dBµV/m	
IT56-1-7GHZ-AV-FCC-Class B	
	the and
40 dBus/m	umphant
A0 dBuV/m	+ more when
Vary Comme commence	and the second s
30 dBµV/m	and with
a marine when and a second when the	
20 dBµV/m	
10 dBµV/m	
Start 1.0 GHz	Stop 7.0 GHz
	atup 7.0 GHz

	Polarisation: H									
Detector Average					Detector Peak					
<b>Frequ</b> . [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						

ESTC TESTED IN GERMANY	Test report no.: <b>18/11-0061a</b>	Page 19 of 79 pages
---------------------------	--	---------------------

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	BSTC

Ref.-No.: 18/11-0061

Product:	Transmitting/Receiving System			
Sample:	07 (#18)			
Date:	01.04.2020			
Operator:	BI		pass	fail
Remarks:	All cables connected; Input Voltage System 24V/DC	Result:	$\boxtimes$	
Operation m	de: Tx Wife (902 14b 20MUz/CU11 - 2462MUz): Zighee (Comm	aunication	with nir	

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

Spectrum Receiver 🗷
RBW (EMI) 1 MHz MT 1 s IT56-1-6GHz.TDF
Input 1 AC Att 0 dB Preamp OFF Step TD Scan
Scan 🕒 1Av Max 🗠 2Pk Max
Limit Check PASS
Line IT56-1-7GHZ-AV-FCC-Class B PASS
90 dBjrv/mT56-1-7CHZ-PEAK-FCC-CLA8 PASE
80 dBµV/m
IT56-1-7GHZ-PEAK-FCC-Class B.LIN
70 uBµv/m
60 dBµV/m
IT56-1-7GHZ-AV-FCC-Class B.LIN
and the second se
advise them the the second and the s
the
Very musical film to manufacture
30 dBµV/m
and the manufacture of the second s
20 dBµV/m-
10 dBµV/m
10 dbh/ill
Start 1.0 GHz Stop 7.0 GHz

	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

# IT 5/6



Interference radiation according to FCC §15.209 RSS-Gen

#### 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

Spectrum Receiver 🗵
RBW (EMI) 1 MHz MT 1 s IT56-1-6GHz.TDF
Input 1 AC Att 0 dB Preamp OFF Step TD Scan
Scan 🕤 1Av Maxo2Pk Max
Limit Check PASS
Line IT56-1-7GHZ-AV-FCC-Class B PASS
90 dBjtv/mT56-1-7CHZ-PEAK-FCC-CLA8 PA88
80 dBµV/m
IT56.1.7GH7-DEAK-ECC-Class B LIN
IT56-1-7GHZ-PEAK-FCC-Class B.LIN
60 dBµV/m
IT56-1-7GHZ-AV-FCC-Class B.LIN
DU UBHV/III
My My manufacture and the second seco
Asver and the second
Wardhamera hale more the
30 dBµV/m
30 dBµV/m
market how man have the second s
20 dBµV/m
10 dBµV/m
Start 1.0 GHz Stop 7.0 GHz

	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.

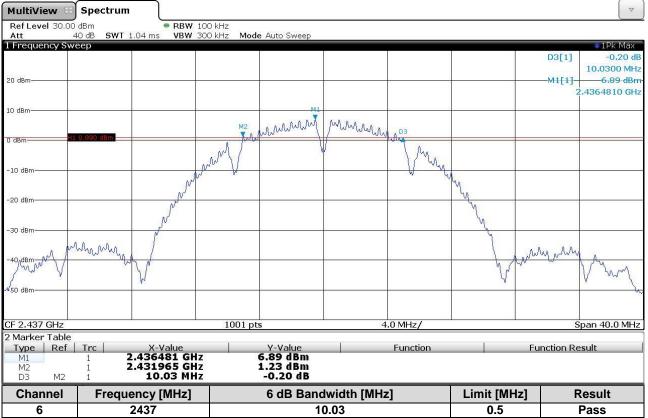
#### Measurement

The Measurement was performed on: 03.02.2020 and 14.04.2020

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

20 dbm         D3[1]         -0.2           20 dbm         M1[1]         6.72           10 dbm         MMMMM         MMMMM           -20 dbm         M1[1]         6.72           -20 dbm         MMMMM         MMMMM           -20 dbm         Finction Result         Span 40.0           Z Marker Table         Trc         X-41248 GHz         S.72 dBm <t< th=""><th><u> </u></th><th>Spectrum</th><th>ן <b>ר</b></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>	<u> </u>	Spectrum	ן <b>ר</b>							
Att         40 db         SWT 1.04 ms         VBW 300 kHz         Mode Auto Sweep           IFrequency Sweep         03[1]         -0.2         10.0300           20 dbm         03[1]         -0.2         10.0300           10 dbm         41         2.4124800         2.4124800           10 dbm         10 dbm         41         2.4124800           10 dbm         10 dbm         41         10.0300           -10 dbm         10 dbm         10 dbm         41         10.01           -10 dbm         10 dbm         10 dbm         10 dbm         41         10 dbm           -20 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm           -20 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm           -20 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm           -20 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm           -20 dbm         10 dbm         10 dbm         10 dbm         10 dbm         10 dbm           -20 dbm         10 dbm         10 dbm         10 dbm	Ref Level 30.00	dBm	BBW 1	00 kHz						
20 dBm         D3[1]         -0.2           10 dBm         1003000         1003000         1003000           10 dBm         100400         100400         100400         100400           10 dBm         100400         100400         100400         100400         100400           10 dBm         100400         100400         100400         100400         100400         100400           -10 dBm         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         1004000         10040000         10040000         10040000<	Att 4	10 dB SWT 1.04 m			e Auto Sweep					
20 dsm.	1 Frequency Swe	eep								1Pk Max
20 dBm         M1[1]         -6.72           10 dBm         M2         MMMM         M3           -10 dBm         M2         MMMM         M3           -10 dBm         M2         MMMM         M3           -20 dBm         M2         M4         M4           -20 dBm         M2         M4         M4           -20 dBm         M4         M4         M4           -20 dBm         1         Chanel         Function Result           -21 dBm         -0.22 dB									D3[1]	-0.22 dB
10 dBm										10.0300 MHz
10 dBm	20 dBm									6.72 dBm
U dbm         Horzoddm         MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM									2	.4124800 GHz
U dam         Itom 201000         MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM	10 dBm					50.1				
-10 dBm -20 dBm -20 dBm -30 dBm -40	TO UBM					Y				
-10 dBm				M2	MANNAW	In www.hall	. D3			
-20 dBm -20 dBm -30 dBm -40	U dBm	0.720 dBm			he fo		W			
-20 dBm -20 dBm -30 dBm -30 dBm -40				M/	V	1	1 Au			
-20 dBm -20 dBm -30 dBm -30 dBm -40	10 d0m			NW VI		1	17 When			
-30 dBm	-10 UBM-		.N	ν. γ			w W			
-30 dBm			.M					M		
-40 dBm	-20 dBm		, N					N.		
-40 dBm			N					M		
-40 dBm			N					N		
-40 dBm with with with with with with with with	-30 dBm-		N					ý		
-40 dBm with with with with with with with with	M	Was rolar							A. A A. A.	
W         V         V         V         V         V         V         V         W         V         W         V         W         V         W         V         W         V         W         V         W         V         W	-40 dBm	m www. w			1	×	8 8	h d	Mr. M.	A
CF 2.412 GHz         1001 pts         4.0 MHz/         Span 40.0 I           2 Marker Table         Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.41248 GHz         6.72 dBm         Function         Function Result           M2         1         2.406965 GHz         1.04 dBm         -0.22 dB         Function         Function Result           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result	Man 11	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						<i>ل</i> ر )*	v	1/ Mama
CF 2.412 GHz         1001 pts         4.0 MHz/         Span 40.0 I           2 Marker Table         Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.41248 GHz         6.72 dBm         Function         Function Result           M2         1         2.406965 GHz         1.04 dBm         -0.22 dB         Function         Function Result           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result		V						V		W W
2 Marker Table           Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.41248 GHz         6.72 dBm         6.72 dBm         Function Result         Function Result           M2         1         2.406965 GHz         1.04 dBm         -0.22 dB         Function Result         Function Result           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result	v50 dBm-									1/m
2 Marker Table           Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.41248 GHz         6.72 dBm         6.72 dBm         Function Result         Function Result           M2         1         2.406965 GHz         1.04 dBm         -0.22 dB         Function Result         Function Result           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result										
2 Marker Table           Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.41248 GHz         6.72 dBm         6.72 dBm         Function Result         Function Result           M2         1         2.406965 GHz         1.04 dBm         -0.22 dB         Function Result         Function Result           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result	CE 0 410 CU-			1001 pt		4				non 40 0 Mila
Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.41248 GHz         6.72 dBm         1.04 dBm				1001 pt	5	4			2	pan 40.0 Minz
M1         1         2.41248 GHz         6.72 dBm           M2         1         2.406965 GHz         1.04 dBm           D3         M2         1         10.03 MHz         -0.22 dB           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result		Tro	/ Valua	T	V Value	r.	Eurotion	ľ.	Eurotion Br	soult.
M2 D3         1 M2         1 1         2.406965 GHz 10.03 MHz         1.04 dBm -0.22 dB           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result		1 2.4	1248 GHz				rancion		Function Re	suit
Channel Frequency [MHz] 6 dB Bandwidth [MHz] Limit [MHz] Result		1 2.40	6965 GHz		1.04 dBm					
		1 1	0.03 MHz	<u> </u>	-0.22 dB					
	Channel	Frequency	/[MHz]		6 dB Banc	lwidth [MHz	:]	Limit [MH	z] F	Result
1 2412 10.03 0.5 Pass	1	2412	2		1	0.03		0.5		Pass

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



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

MultiView 8	Spectrum	, ,				•			
Ref Level 30.00 d		• RBW							
	db SWT 1.04	1 ms VBW	300 kHz Mode	e Auto Sweep					
1 Frequency Swee	ер								1Pk Max
								M2[1]	0.67 dBm
1000000.000									2.4569480 GHz
20 dBm						10			
									2.4614810 GHz
10 dBm				MI					
			1000	0.0.0	0.0 0 1 1				
			M2	www.ww	Mininhow	A D3			
0 dBm H1 0	1.490 dBm				1				
			www	V	,	M.			
-10 dBm			ww 11			15 WW			
10 0011			N W			W W			
		.N					Y		
-20 dBm		-VL				8	- V.		1
		r					M		
-30 dBm		N					N		
-30 dBm		r -					6		
anta	mm	1							
-40 dBm	Mr. WL	1				-		mann	M A
Anger 11	Wh	N					٩Z	M.	15 The ANA
/ ~ ~	6	1					V		V var y
\ <sub>2</sub> ∕50 dBm						6			-W-
25.2.112.211			1001				3		
CF 2.462 GHz			1001 pt	\$	4	.0 MHz/			Span 40.0 MHz
2 Marker Table	<b>-</b> [	V U-L	T	V V-1	T	<b>E</b>	Ē.	E	
Type Ref	Trc   2.4	X-Value 61481 GH	7	Y-Value 5.49 dBm		Function		Function R	esult
M2		56948 GH	7	0.67 dBm					
D3 M2	1	10.07 MH	Z	-0.70 dB					
Channel	Frequen	cy [MHz]		6 dB Band	width [MHz	<u>·]</u>	Limit [MH	lz]	Result
11	24				<u>-</u>	-	0.5	_	Pass
• •		~=					0.0		

⊡STC	TESTED	Test report no.:
	IN GERMANY	18/11-0061a

Page 23 of 79 pages

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

MultiView 😣	Spectrum							
Ref Level 30.00	dBm	· RBW	' 100 kHz					
		1.04 ms VBW	300 kHz Mo	de Auto Sweep				
1 Frequency Swe	еер							1Pk Max
								M2[1] -1.05 dBm
								2.4044080 GHz
20 dBm		-		-				
								2.4107210 GHz
10 dBm				M1				
			MO 0 0	0 8. 0.0	montrahand	1		
0 dBm H1	-0.150 dBm		W WWW WWWW	million many music	Mar who breadly	from months the		
			A MY MANA		V	and the	n l	
-10 dBm		t f					1	
		J.					h	
-20 dBm		N					2	
20 0011					52		30	
	1	M					V.	
-30 dBm	1 a Ma M	Inv					Montha	N. <sup>10</sup>
-30 dBm	MAN M	X					• <b>•</b> • • • • • • • • • • • • • • • • •	manyahan
Mary Mary	1							a ma manan
-40 dBm								1 Wahan
<b>V 1</b>								0.6.2
-50 dBm-								
00 4011								
CF 2.412 GHz		-	1001	ots	4	L LO MHz/		Span 40.0 MHz
2 Marker Table								
Type   Ref	Trc	X-Value		Y-Value		Function	E	unction Result
M1		2.410721 G		5.85 dBm				
M2	1 2	2.404408 G		-1.05 dBm				
D3 M2	1	15.145 M	HZ	1.23 dB				
Channel	Freque	ency [MHz]		6 dB Ban	dwidth [MHz	z]	Limit [MHz]	Result
1		2412		1	5.145		0.5	Pass

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

MultiView 88	Spectrum								
Ref Level 30.00		• RBW 10		- proprietario de contrato					
Att 4 1 Frequency Swe	0 dB <b>SWT</b> 1.04 m	is VBW 30	00 kHz <b>Mode</b>	Auto Sweep					1Pk Max
I Trequency office								D3[1]	0.86 dB
								00[1]	15.1450 MHz
20 dBm								M1[1]-	5.87 dBm
									.4357210 GHz
10 dBm				MI					
		MC	5 6 A	A An Ano	monterational	A			
0 dBm H1	-0.130 dBm		wan would and	Anorthanthing	min who brand	assol www. Marian	42.1		
		Mary		l	1		1		
-10 dBm-									
		5					7		
		N					Ly .		
-20 dBm-		p				8 6	10		
		M					V)		
-30 dBm	an An Anna	/			(		month	A	
1-1-5	WWW						N N	warmen.	A.
-40 ABM						s		<u>1</u> V	Marin
N.M.									W May Man
1000 0000									
-50 dBm-									
CF 2.437 GHz			1001 pts		4	.0 MHz/		S	pan 40.0 MHz
2 Marker Table									
Type Ref	Trc X	-Value		Y-Value	1	Function		Function Re	esult
M1 M2		5721 GHz 9408 GHz		5.87 dBm 0.80 dBm					
D3 M2		145 MHz		0.86 dB					
	_					- 1			· ··
Channel	Frequency	' [MHz]		6 dB Band	lwidth [MHz	Z]	Limit [MH:	ZJ   F	Result

⊡STC	TESTED IN GERMANY

Page 24 of 79 pages

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

MultiView 😣	Spectrum									
Ref Level 30.00			<b>BW</b> 100 k							
		1.04 ms V	BW 300 k	Hz Mode	e Auto Sweep					
1 Frequency Swe	еер									1Pk Max
									D3[1]	1.03 dB
										15.1450 MHz
20 dBm			-			1.				5.80 dBm-
										2.4607210 GHz
10 dBm					M1					
			M2	A Mart	Anon Joan John	manhand	A. A 93			
O dBm H1	-0.200 dBm	-	MM	M Pro And Martin	N YO FT		halmonternam			-
			{			Y				
-10 dBm			1							
10 0011			1					7		
		1	4					Ny		
-20 dBm		N				2	0	the second		
		ma						Ч		
00.10	J	1.nd						Marshel .	o. A .	
-30 dBm	no alla mar	A0 4.						1	MM a	and the second
MARY									V Wr	mar .
- #0 dBm										1 MM
Cont. 4										WW
63900 - 155005										
-50 dBm		-				<				7
CF 2.462 GHz				1001 pts		1	.0 MHz/			Span 40.0 MHz
2 Marker Table				1001 pts	,	4				
Type Ref	Trc	X-Value	2	1	Y-Value	ſ	Function	Ē.	Function R	ecult
M1		2.460721			5.80 dBm		randaon		TUNCTOTIK	Court
M2	ī	2.454408	GHz	-	0.76 dBm					
D3 M2	1	15.145	MHz		1.03 dB					
Channel	Frequ	ency [MH	lz]		6 dB Ban	dwidth [MHz	z]	Limit [MH:	z]	Result
11		2462			15	5.145		0.5		Pass

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

MultiView 8	Spectrum			-	
Ref Level 30.00		00 kHz			
	0 dB <b>SWT</b> 1.04 ms <b>VBW</b> 30	00 kHz Mode Auto Sweep			
1 Frequency Swe	eep				∎1Pk Max
					M2[1] -2.04 dBm
1000000					2.4044080 GHz
20 dBm					
					2.4132390 GHz
10 dBm					
68.660X			M1		
			Å Å Å		
0 dBm	- 1, 380, dBm	- mater trading	perlambar but hat		
	MM	Public Public and a line	and the second second	www	
-10 dBm					
	ſ				
-20 dBm	J				
	1			<u>\</u>	
-17	5			1	
-30 dBm	MMMMM	· · · · · · · · · · · · · · · · · · ·		3.0	mmmmmmm
	NANNANAN			WWWWW	
-40 dBm - A AMW	1 M/A			. v M.	mmmala
AND				1	www.And
					6. MA
-50 dBm					
CF 2.412 GHz		1001 pts	4.0 MHz/		Span 40.0 MHz
2 Marker Table					
	Trc X-Value	Y-Value	Function	Fu	nction Result
M1	1 2.413239 GHz				
M2	1 2.404408 GHz				
D3 M2	1 15.145 MHz	1.01 dB			
Channel	Frequency [MHz]	6 dB Banc	lwidth [MHz]	Limit [MHz]	Result
	2412				

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

-10 dBm -20 dBm -20 dBm -30 dBm -50	MultiView 😁	Spectrum						•		▽
IFrequency Sweep         IPR Max         0.90 df           20 dbm         D3[1]         0.90 df           20 dbm         M1         M1[1]         5.04 dbm           10 dbm         M1         2.4357210 GHz         2.4357210 GHz           10 dbm         M2         M1         M2         M1           10 dbm         M2         M1         M2         M1           10 dbm         M2         M1         M2         M1           -10 dbm         M2         M1         M2         M1         M2           -20 dbm         M2         M1         M2         M1         M2           -30 dbm         M2         M1         M2         M1         M2           -30 dbm         M2         M1         M2         M1         M2           -30 dbm         M2         M2         M2         M2         M2           -30 dbm         M2         1001 pts         4.0 MHz/         Span 40.0 MHz           -50 dbm         Span 40.0 MHz         Span 40.0 MHz         Span 40.0 MHz           2 Marker Table         Y-Value         Function         Function Result           M2         1         2.425448 GHz         0.45 dBm										
20 dBm         03[1]         0.90 dt           20 dBm         15.0650 Mtz         5.04 dBm           0 dBm         24357210 GHz         2.4357210 GHz           0 dBm         10 dBm         10 dBm         2.4357210 GHz           0 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -10 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -20 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -30 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -20 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -20 dBm         10 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -20 dBm         10 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -20 dBm         10 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -20 dBm         10 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -50 dBm         10 dBm         10 dBm         10 dBm         10 dBm         10 dBm         10 dBm           -50 dBm         10 dBm         10 dBm			VBW 300 k	KHZ Mode Au	uto Sweep					
20 dBm         15.0650 MHz           10 dBm         2.4357210 GHz           10 dBm         10 dBm           -10 dBm         10 dBm           -20 dBm         10 dBm     <	1 Frequency Swo	eep							D9[1]	
20 dBm         M1         5.04 dBm           10 dBm         M2         M1         0         2.4357210 GHz           10 dBm         M2         M1         0         0         0           -10 dBm         M2         M1         0         0         0         0           -20 dBm         M2         M4         M4         M4         0         0         0           -30 dBm         -30 dBm         -40									DS[1]	
10 dBm       10 dBm       10 dBm       10 dBm       10 dBm       03       <	20 dBm								M1[1]	the second s
10 dBm       M2       M1       03       03       03       03         -10 dBm       M2       M1       03       03       03       03       03         -10 dBm       M2       M1       03       03       03       03       03       03         -10 dBm       M2       M1       03	Lo dom									
O dBm         M2         M4										
D dBm         D dBm <th< td=""><td>10 dBm</td><td></td><td></td><td></td><td>M1</td><td></td><td></td><td></td><td></td><td></td></th<>	10 dBm				M1					
-10 dBm -20 dBm -20 dBm -30 dBm -50				A A A	Λ	ΛΛο	n D3			
-10 dBm -20 dBm -20 dBm -30 dBm -50	0 dBm H1	0,890 dBm	l. al	Monatoria	and for the first for	and way proved for	matrantest			
-20 dBm -30 dBm -50			Month		V		in a side of Pro	M		
-20 dBm -30 dBm -50	-10 dBm									
-30 dBm -30 dBm -30 dBm -30 dBm -30 dBm -30 dBm -30 dBm -50			N							
-30 dBm -30 dBm -30 dBm -30 dBm -30 dBm -30 dBm -30 dBm -50	Shi a tha setta ann		N					h		
-50 dBm       Image: Second Barder Constraints       Image: Second Barder Con	-20 dBm	N	N .				8	h		
-50 dBm       Image: Second Barder Constraints       Image: Second Barder Con		لمح ا						1		
-50 dBm       Image: Second Barder Constraints       Image: Second Barder Con	-30 dBm	1000						hall		
-50 dBm       Image: Second Barder Constraints       Image: Second Barder Con	٨	MARAMMAN						as prof	Maddage	
-50 dBm       Image: Second Barder Constraints       Image: Second Barder Con	-401 dBm AMM	1.1.1.1							IL IN VORM	Margan
-50 dBm       Image: Second Barder Constraints       Image: Second Barder Con	Mar. and									non man
CF 2.437 GHz         1001 pts         4.0 MHz/         Span 40.0 MHz           2 Marker Table         7 Marker Table         5.04 dBm         Function Result           M1         1         2.435721 GHz         5.04 dBm           M2         1         2.429448 GHz         0.45 dBm           D3         M2         1         15.065 MHz         0.90 dB           Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result	(1902 - 160205									
2 Marker Table           Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.435721 GHz         5.04 dBm         Function         Function Result           M2         1         2.429448 GHz         0.45 dBm         O.45 dBm         Function         Function Result           D3         M2         1         15.065 MHz         0.90 dB         Function Result         Function Result           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result	-50 dBm-								2	
2 Marker Table           Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.435721 GHz         5.04 dBm         Function         Function Result           M2         1         2.429448 GHz         0.45 dBm         O.45 dBm         Function         Function Result           D3         M2         1         15.065 MHz         0.90 dB         Function Result         Function Result           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result										
2 Marker Table           Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         2.435721 GHz         5.04 dBm         Function         Function Result           M2         1         2.429448 GHz         0.45 dBm         O.45 dBm         O.90 dB           D3         M2         1         15.065 MHz         O.90 dB         Emit [MHz]         Result	CF 2.437 GHz			1001 pts		4	.0 MHz/	3		pan 40.0 MHz
M1         1         2.435721 GHz         5.04 dBm           M2         1         2.429448 GHz         0.45 dBm           D3         M2         1         15.065 MHz         0.90 dB           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result	2 Marker Table									•
M2         1         2.429448 GHz         0.45 dBm           D3         M2         1         15.065 MHz         0.90 dB           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result		Trc X-Va	lue				Function		Function Re	esult
D3         M2         1         15.065 MHz         0.90 dB           Channel         Frequency [MHz]         6 dB Bandwidth [MHz]         Limit [MHz]         Result				5.0	14 dBm					
				0.4	.90 dB					
	Channel	Frequency [M	/Hz]	6	dB Band	width [MHz	2]	Limit [MH	z] F	Result
	6	2437	-				-	0.5	-	Pass

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

<u> </u>	Spectrum		······································		
Ref Level 30.00					
Att 4 1 Frequency Swe	0 dB SWT 1.04 ms VBW 300	KHz Mode Auto Sweep			1Pk Max
I Trequency Swe					M2[1] -1.80 dBm
					2.4544080 GHz
20 dBm					-M1[1] 4.90 dBm
					2.4607210 GHz
10 dBm		M1			
			Munhudpaloutant		
0 dBm-	-1.100 dBm	almohran han long for	When have A B3		
	months	W.	in manufally	My	
-10 dBm					
	A				
a contactor	ľ			1	
-20 dBm	1		-8	2	
	1			2	
-30 dBm	Mumhum			3.0	mmuhammuh
	and amplitudes			WWWW	Man 18.
-49 dBm AAVW	V Y VV *				WWWWWWWWWWWWWWW
WARA					A WAY
unop duras					
-50 dBm-					
CF 2.462 GHz		1001 pts	4.0 MHz/		Span 40.0 MHz
2 Marker Table					
Type Ref	Trc X-Value	Y-Value	Function	Fu	nction Result
M1 M2	2.460721 GHz 2.454408 GHz	4.90 dBm -1.80 dBm			
D3 M2	1 15.145 MHz	0.93 dB			
Channel	Frequency [MHz]	6 dB Bandv	vidth [MHz]	Limit [MHz]	Result
11	2462	15.	145	0.5	Pass

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

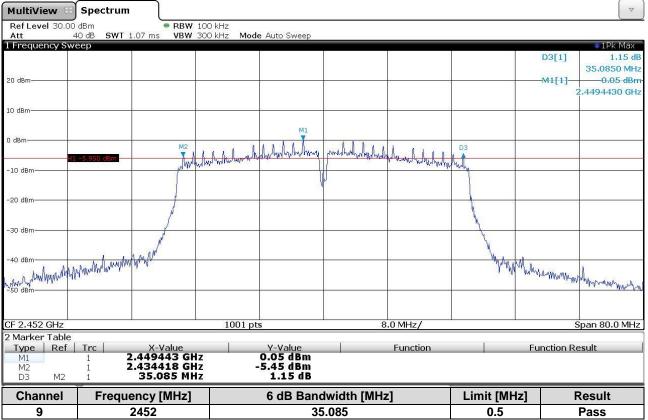
MultiView 😁	Spectrum								
Ref Level 30.00			100 kHz						10.200 - 520
Att 2 1 Frequency Swi	40 dB SWT 1	.07 ms VBW	300 kHz Mode	e Auto Sweep					1Pk Max
I Frequency Sw	eeh							M1[1]	0.62 dBm
									2.4194430 GHz
00 40									-5.31 dBm
20 dBm							1		
									2.4044080 GHz
10 dBm		-				a			
10.010									
				M1					
0 dBm		M2	C	1111		Muschhalterthe	D2		
	-5.380 dBm	<b>T</b>	utwitrostrations	flyllwhill will	pantal and man public	March 1	1.1		
-10 dBm-	1	NUM	tr 1 Mar Mar administra		1	and wanter water	min		
-10 0511-						-			
		ſ							
-20 dBm			8		2	2			
		1					A		
-30 dBm -40 dBm -40 villen Anno Anno Anno Anno Anno Anno Anno An	Ĩ	AMAN					and the second	1	
-40 dBm	Augustan Mary	Munh ,					"The second	M Mar 11	
a Am Lawampy	What							m manyment	mandaludama
SO dBm								11 4	in which may when
CF 2.422 GHz			1001 pts	3	8	.0 MHz/			Span 80.0 MHz
2 Marker Table			p	-					
Type   Ref	Trc	X-Value		Y-Value	1	Function		Function R	esult
M1	1 2	.419443 GH	z	0.62 dBm					
M2	1 2	.404408 GH		5.31 dBm					
D3 M2	1	35.125 MH	Z	1.18 dB					
Channel	Freque	ency [MHz]		6 dB Band	width [MHz	2]	Limit [MH:	z]	Result
3		2422		35	5.125		0.5		Pass

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

MultiView 😁	Spectrum								
Ref Level 30.00		• RBW 1							
Att 2 1 Frequency Sw		1.07 ms VBW 3	00 kHz <b>Mode</b>	e Auto Sweep					1Pk Max
I frequency of	eep							D3[1]	0.94 dB
								00[1]	35.0450 MHz
20 dBm								M1[1]	0.61 dBm
									4344430 GHz
10 dBm		-							
				M1					
0 dBm-				· · · · · · · · · · · · · · · · · · ·					
		M2	1 a A h	And what when the	muchal haber had	when al which which when	D3		
	1 -5,390 dBm	Junity	Jaw My Har Jawy Morris	and we a	1 we had by the	many which when	Aut		
-10 dBm				li					
				Y					
-20 dBm							3		
20 dbm		5					1		
		1					X		
-30 dBm		ſ		1			1		-
		1					1		
-40 dBm	A suc Asu	a physical				a	What we are		Annalymmen
h 1 . Mar	My May May May May May May May May May M	Mr. J					A.A.A.	M. My Mars and	1
Man Mary Man 19							(-3)	1 May May May	White and many
-50 dBm									a the second
CF 2.437 GHz			1001 pts	6	8	.0 MHz/		S	pan 80.0 MHz
2 Marker Table	1	2				×.			
Type Ref	Trc	X-Value 434443 GH2		Y-Value 0.61 dBm		Function		Function Re	esult
M1 M2		.419433 GHz		5.02 dBm					
D3 M2	1	35.045 MHz		0.94 dB					
Channel	Freque	ency [MHz]		6 dB Band	width [MHz	z]	Limit [MHz	z] F	Result
6		2437			<u>.</u> .045	_	0.5	-	Pass

ESTC TESTED	Test report no.: <b>18/11-0061a</b>	Page 27 of 79 pages
-------------	--	---------------------

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



#### 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.

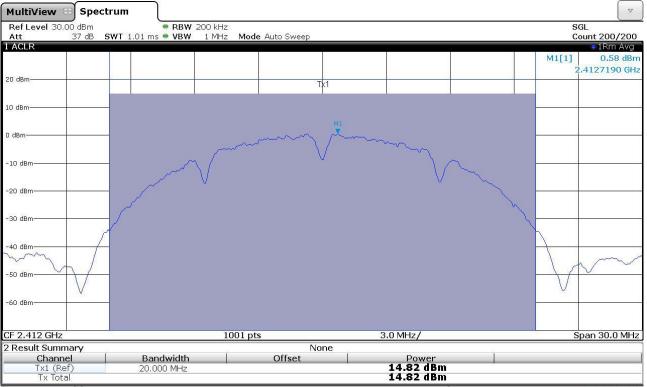
#### Description

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.

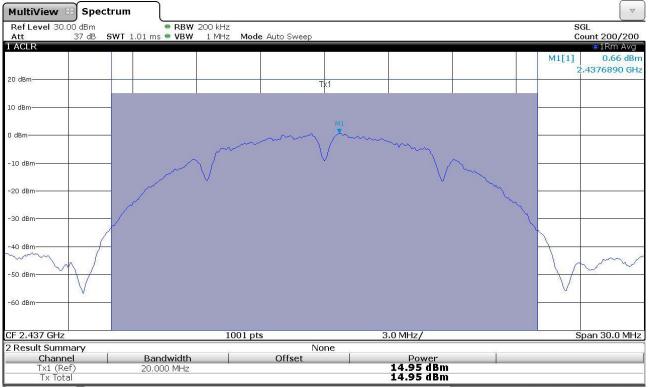
#### Measurement

The Measurement was performed on: 03.02.2020 and 14.04.2020

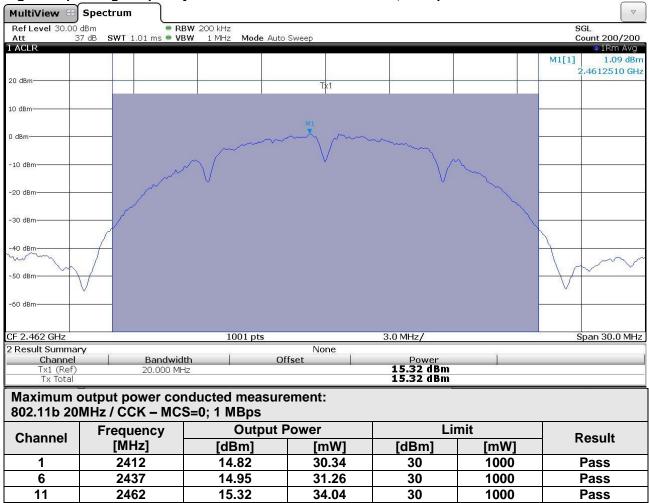
#### Lowest operating frequency - 802.11b 20MHz / CCK – MCS=0; 1 MBps



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

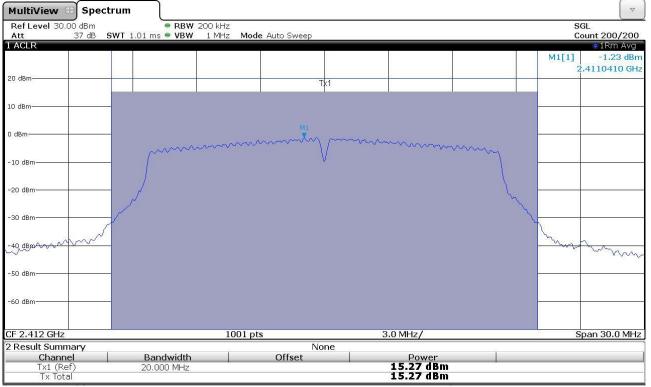


#### Highest Operating Frequency - 802.11b 20MHz / CCK - MCS=0; 1 MBps

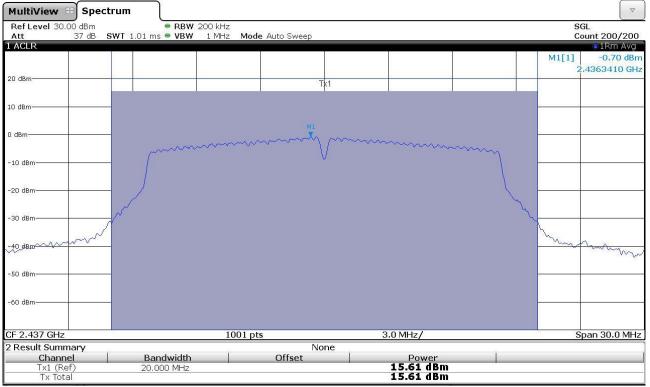


ESTC TESTED	Test report no.:	Page 30 of 79 pages
🖬 🗩 🖡 IN GERMANY	18/11-0061a	Fage 50 0179 pages

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



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



	Test report no.:	Bogo 21 of 70 pages
ESTC IN GERMANY	18/11-0061a	Page 31 of 79 pages

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

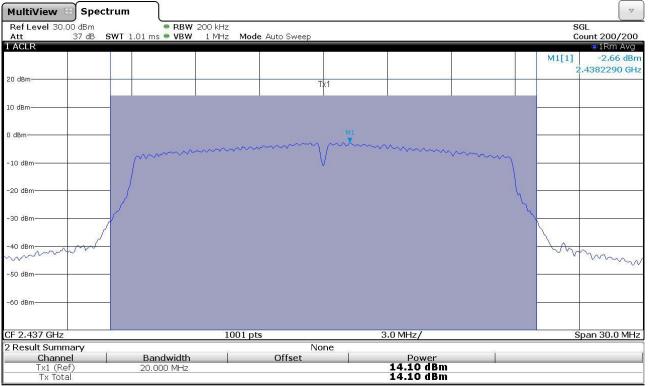
Ref Level 30.00 Att 3	Spectrum         RE           dBm	W 200 kHz W 1 MHz Mode Auto	Sweep			SGL Count 200/200
ACLR			1			●1Rm Avg
						M1[1] -1.14 dBn
20 dBm	a a a a a a a a a a a a a a a a a a a		e			2.4632290 GH
.o ubin			Tx1			
LO dBm						
) dBm			M1			
en calantenne.		······	mund have		mm	
10 dBm			V		A.	
404204-0000394038						
20 dBm	/				h	
	and a second sec				h.	
30 dBm	/				h	
	and a second					
-40 dBm	~~~					Mary Mary
-50 dBm						
-60 dBm						
F 2.462 GHz		1001 pts		3.0 MHz/		Span 30.0 MHz
Result Summar		80	None			
	Bandwidt		ffset	Power		
Channel		7		1546 dBm		
	20.000 MH	Z		15.46 dBm 15.46 dBm		
Channel Tx1 (Ref) Tx Total	20.000 MH		ement:			
Channel Tx1 (Ref) Tx Total	20.000 MH	ducted measure	ement:			
Channel Tx1 (Ref) Tx Total Maximum ( 802.11g 20	20.000 MH output power cor MHz / OFDM – M	ducted measure			nit	Beerk
Channel Tx1 (Ref) Tx Total	Dutput power cor MHz / OFDM – M Frequency	ducted measurd CS=0; 6 MBps Output F	Power	15.46 dBm Lir		Result
Channel Tx1 (Ref) Tx Total Maximum ( 802.11g 20	output power cor MHz / OFDM – M Frequency [MHz]	ducted measurd CS=0; 6 MBps Output F [dBm]	Power [mW]	15.46 dBm Lir [dBm]	[mW]	
Channel Tx1 (Ref) Tx Total Maximum o 802.11g 20 Channel 1	20.000 MH output power cor MHz / OFDM – M Frequency [MHz] 2412	ducted measure CS=0; 6 MBps Output F [dBm] 15.27	Power [mW] 33.65	15.46 dBm Lir [dBm] 30	[mW] 1000	Pass
Channel Tx1 (Ref) Tx Total Maximum ( 802.11g 20 Channel	output power cor MHz / OFDM – M Frequency [MHz]	ducted measurd CS=0; 6 MBps Output F [dBm]	Power [mW]	15.46 dBm Lir [dBm]	[mW]	

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

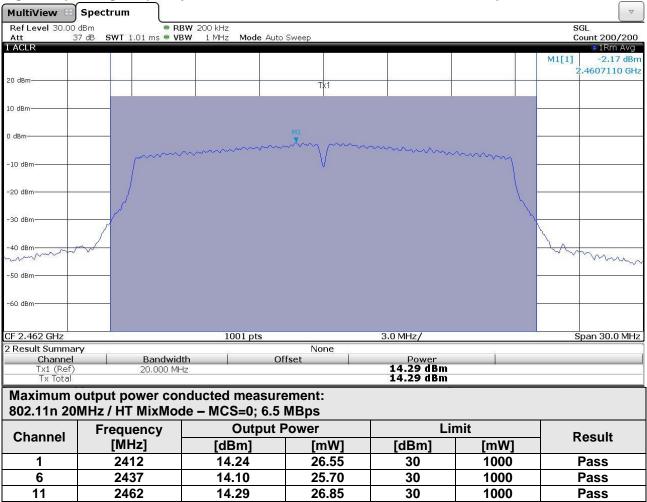
	rum			$\nabla$
Ref Level 30.00 dBm	• RBW 200 kHz WT 1.01 ms • VBW 1 MHz			SGL Count 200/200
Att 37 dB S	YVIII.UIMS ♥ VBVV IM⊓z	widde Auto Sweep		● 1Rm Avg
TACEN				
				M1[1] -2.54 dBm 2.4123600 GHz
20 dBm				2,4123600 GHz
20 0011		T¥1		
	I	I	I	
10 dBm				
0 dBm		× • • • •		
		ment for the second second	man man man	
-10 dBm-	munit	V	······	my
10 dbm				
-20 dBm				
1000 March 1				
10.00 60.07	1 -			
-30 dBm				
10 d0m				
-40 dBm				home
				- mm
-50 dBm-				
-60 dBm				
CF 2.412 GHz	<u> </u>	1001 pts	3.0 MHz/	Span 30.0 MHz
2 Result Summary		None		
	Bandwidth	Offset	Power	
Unannel				
Channel Tx1 (Ref)	20.000 MHz		Power 14.24 dBm	

	Test report no.:	Page 22 of 70 pages
ESTC IN GERMANY	18/11-0061a	Page 32 of 79 pages

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

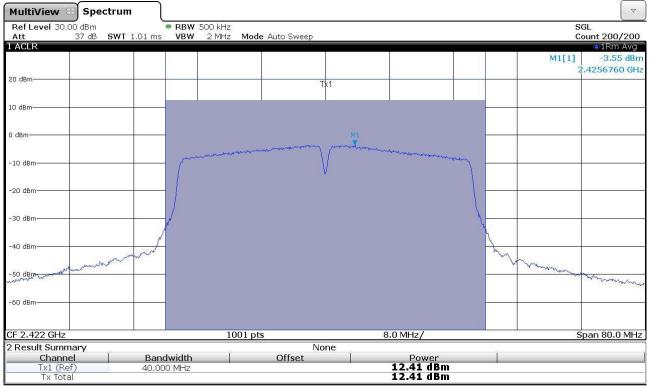


#### Highest Operating Frequency - 802.11n 20MHz / HT MixMode - MCS=0; 6.5 MBps

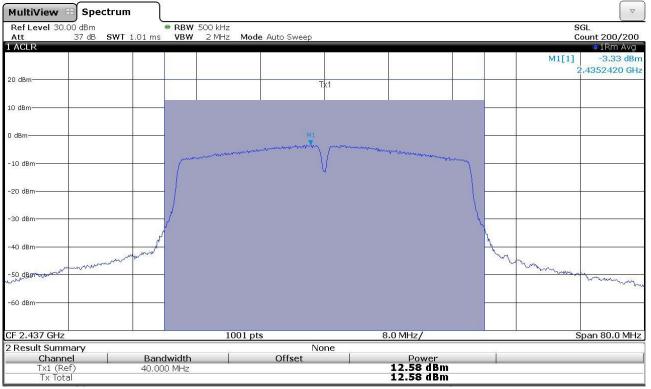


	Test report no.:	Dage 22 of 70 pages
ESTC IN GERMANY	18/11-0061a	Page 33 of 79 pages

#### 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



ESTC TESTED	Test report no.:	Page 34 of 79 pages
IN GERMANY	18/11-0061a	r age 54 0179 pages

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

MultiView 8	Spectrum			<b>,</b>	•	
Ref Level 30.00 Att 3		<b>3W</b> 500 kHz <b>3W</b> 2 MHz <b>Mode</b> Auto	Sweep			SGL Count 200/200
ACLR						1Rm Avg
						M1[1] -3.79 dBm
						2.4504820 GHz
20 dBm	2 2		Tx1			
.0 dBm						
) dBm						
, abiii			M1			
		ment and the second second	man / man	and and more thank the		
-10 dBm			$\langle \mathbf{V} \rangle$			
-20 dBm						
-30 dBm	{				4	7
					A.	
-40 dBm	1				2	
-+0 uBm-	when when				ha	
	monore				" Vm m	and the same
-50 dBm						million and the second and
						- marked
-60 dBm						
F 2.452 GHz		1001 pts		8.0 MHz/		Span 80.0 MHz
Result Summar	2/	1001 pts	None	0.0 141127		3part 60.0 Minz
Channel	Bandwid	th O	ffset	Power		
Tx1 (Ref)	40.000 MF		i i i i i i i i i i i i i i i i i i i	12.04 dBm		
Tx Total				12.04 dBm		
Maximum	output power cor	nducted measur	ement:	· · · · · · · · · · · · · · · · · · ·		
	MHz / HT MixMod					
Channel	Frequency	Output	Power	Lir	nit	Result
Channel	[MHz]	[dBm]	[mW]	[dBm]	[mW]	Result
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**.