FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

EMI – TEST REPORT

- FCC Part 15.407 and RSS210 -

Test Report No. : T36325-00-04HS	25 March 2014 Date of issue

Type / Model Name : SCALANCE W700 / ELN

Product Description : Industrial WLAN access point

Applicant : Siemens AG, Industrial Automation Division

Address : Gleiwitzer Strasse 555

90475 NUERNBERG, GERMANY

Manufacturer : Siemens AG, Automation & Drives

Address : Oestliche Rheinbrueckenstrasse 50

76187 KARLSRUHE, GERMANY

Licence holder : Siemens AG, Automation & Drives

Address : Oestliche Rheinbrueckenstrasse 50

76187 KARLSRUHE, GERMANY

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

Deutsche Akkreditierungsstelle D-PL-12030-01-00

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2013)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2013)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements

FCC Rules and Regulations Part 15, Subpart E – Unlicensed National Information Infrastructure Devices (September, 2013)

Part 15, Subpart E, Section 15.407	Operation within the bands 5.15 - 5.25 GHz, 5.25 - 5.35 GHz, 5.47 - 5.725 GHz and 5.725 - 5.825 GHz

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable device
OET Bulletin 65, 65A, 65B, 65C Edition 97-01, August 1997	– Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
ET Docket No. 03-122, FCC 06-96	Released June 30, 2006, Memorandum Opinion and Order concerning DFS
ANSI C63.4: 2009	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C95.1: 2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment
KDB 789033 D01 v01r03	Guidelines for compliance testing of UNII-Devices – Part 15, Subpart E, April 8, 2013.

2 SUMMARY

2.1 Test result summary

Operating in the 5150 MHz - 5250 MHz:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 7.2.4.	AC power line conducted emissions	passed
15.407(a)		EBW 26 dB	passed
15.407(a)	RSS210, A9.2	Conducted output power and PSD	passed
15.407(a)(6)		Peak excursion	passed
15.407(b)	RSS210, A9.2	Undesirable emissions	passed
15.205(a)	RSS-Gen, 7.2.2	Emissions in restricted bands	passed
15.407(g)	RSS-Gen, 7.2.6	Frequency stability	passed
15.407(f)	RSS102, 2.5.2	Maximum permissible exposure (MPE)	passed
15.407(h)(1)	RSS210, A9.2	TPC	not applicable
15.407(a)	RSS210, A9.2	Antenna requirement	passed
OET Bulletin 65	RSS102, 3.2	Co-location, Co-transmission	passed
	RSS210, A9.2	OBW 99 %	passed

The mentioned RSS Rule Parts in the above table are related to:
RSS Gen, Issue 3, December 2010
RSS 210, Issue 8, December 2010
RSS 102, Issue 4, March 2010

2.2 General remarks

The EUT is a 1-Port WLAN-access point. The firmware does not support ad-hoc modes. The possibility to choose the channel for data transmission or power setting in relation to the used antenna with antenna cable makes a professional installation necessary. The AP is compatible with 802.11a, n Standard. It supports the 5 GHz frequency band and provides no beam forming.

Variants of the EUT

Variant	Device-Name	WLAN-Interfaces	LAN connector	Antenna Ports	Order numbers
V01	ELN-W1-RJ-E1	1	RJ45	1	6GK5721-1FC00-xxxx 6GK5722-1FC00-xxxx 6GK5761-1FC00-xxxx

Operation frequency and channel plan

The operation frequency range is 5150 – 5250 MHz.

Channel plan:
802.11a, n, HT20:

Channel	Frequency
36	5180
40	5200
44	5220
48	5240

802.11n, HT40:

Channel	Frequency
36up	5190
44up	5230

Transmit operating modes

The module use OFDM modulation and is capable to provide following data rates:
- 802.11a 54, 48, 36, 24, 18, 12, 9, 6 Mbps
- 802.11n HT20, MCS 0 – 15
- 802.11n HT40, MCS 0 – 15

HT20

MCS Index	Modulation	R	$N_{BPSCS}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI (see NOTE)
0	BPSK	1/2	1	52	4	52	26	6.5	7.2
1	QPSK	1/2	2	52	4	104	52	13.0	14.4
2	QPSK	3/4	2	52	4	104	78	19.5	21.7
3	16-QAM	1/2	4	52	4	208	104	26.0	28.9
4	16-QAM	3/4	4	52	4	208	156	39.0	43.3
5	64-QAM	2/3	6	52	4	312	208	52.0	57.8
6	64-QAM	3/4	6	52	4	312	234	58.5	65.0
7	64-QAM	5/6	6	52	4	312	260	65.0	72.2
NOTE—Support of 400 ns GI is optional on transmit and receive.									

MCS Index	Modulation	R	$N_{BPSCS}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
8	BPSK	1/2	1	108	6	216	108	27.0	30.0
9	QPSK	1/2	2	108	6	432	216	54.0	60.0
10	QPSK	3/4	2	108	6	432	324	81.0	90.0
11	16-QAM	1/2	4	108	6	864	432	108.0	120.0
12	16-QAM	3/4	4	108	6	864	648	162.0	180.0
13	64-QAM	2/3	6	108	6	1296	864	216.0	240.0
14	64-QAM	3/4	6	108	6	1296	972	243.0	270.0
15	64-QAM	5/6	6	108	6	1296	1080	270.0	300.0

HT40

MCS Index	Modulation	R	$N_{BPSCS}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
0	BPSK	1/2	1	108	6	108	54	13.5	15.0
1	QPSK	1/2	2	108	6	216	108	27.0	30.0
2	QPSK	3/4	2	108	6	216	162	40.5	45.0
3	16-QAM	1/2	4	108	6	432	216	54.0	60.0
4	16-QAM	3/4	4	108	6	432	324	81.0	90.0
5	64-QAM	2/3	6	108	6	648	432	108.0	120.0
6	64-QAM	3/4	6	108	6	648	486	121.5	135.0
7	64-QAM	5/6	6	108	6	648	540	135.0	150.0

MCS Index	Modulation	R	$N_{BPSCS}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
8	BPSK	1/2	1	108	6	216	108	27.0	30.0
9	QPSK	1/2	2	108	6	432	216	54.0	60.0
10	QPSK	3/4	2	108	6	432	324	81.0	90.0
11	16-QAM	1/2	4	108	6	864	432	108.0	120.0
12	16-QAM	3/4	4	108	6	864	648	162.0	180.0
13	64-QAM	2/3	6	108	6	1296	864	216.0	240.0
14	64-QAM	3/4	6	108	6	1296	972	243.0	270.0
15	64-QAM	5/6	6	108	6	1296	1080	270.0	300.0

Symbol	Explanation
N_{SS}	Number of spatial streams
R	Coding rate
N_{BPSC}	Number of coded bits per single carrier (total across spatial streams)
$N_{BPSCS}(i_{SS})$	Number of coded bits per single carrier for each spatial stream, $i_{SS} = 1,...,N_{SS}$
N_{SD}	Number of complex data numbers per spatial stream per OFDM symbol
N_{SP}	Number of pilot values per OFDM symbol
N_{CBPS}	Number of coded bits per OFDM symbol
N_{DBPS}	Number of data bits per OFDM symbol
N_{ES}	Number of BCC encoders for the DATA field
N_{TBPS}	Total bits per subcarrier

Antennas

Antennas intended for use are classified into 2 gain groups:

- Antenna gain group 1: Antennas 0 to 6 dBi
- Antenna gain group 2: Antennas 6 to 9 dBi

The following antennas shall be used with the EUT:

Number	Manufacturer Number	Characteristic	Model number	Connector	Frequency (GHz)	Gain 5GHz (dBi)	Cable loss (dB)	effective gain 5 GHz (dBi)	Group
1	6GK5795-6DC00-0AA0	Wide angle	**ANT 795-6DC**	N-female	2.4 + 5 GHz	9	0	9	6-9 dBi
2	6GK5793-6DG00-0AA0	Wide angle	**ANT793-6DG**	2x N-female	5 GHz	9	0	9	6-9 dBi
3	6GK5795-6MN10-0AA6	Omni	**ANT 795-6MN**	N-female	2.4 + 5 GHz	8	0	8	6-9 dBi
4	6GK5 793-4MN00-0AA6	Omni	**ANT 793-4MN**	N-female	5 GHz	6	0	6	0-6 dBi
5	6GK5795-4MD00-0AA3	Omni	**ANT795-4MD**	N-male	2.4 + 5 GHz	5	0	5	0-6 dBi
6	6GK5795-4MC00-0AA3	Omni	**ANT795-4MC**	N-male	2.4 + 5 GHz	5	0	5	0-6 dBi
7	6GK5795-4MA00-0AA3	Omni	**ANT 795-4MA**	R-SMA male	2.4 + 5 GHz	5	0	5	0-6 dBi
8	6GK5793-6MN00-0AA6	Omni	**ANT 793-6MN**	N-female	5 GHz	5	0	5	0-6 dBi
9	6XV1875-2D	Omni	**IWLAN Rcoax 1/2"**	N-female	5 GHz	0	0	0	0-6 dBi

2.3 Final assessment

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 7 October 2013

Testing concluded on : 30 October 2013

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this documents
2014.03.25 11:41:05 +01'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Hermann Smetana
I am the author of this document
2014.03.25 11:33:23 +01'00'

Hermann Smetana
Radio Team

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see attachment A

3.2 Power supply system utilised

Power supply voltage : 100 - 120 VAC
V_{nom}= 110 V
V_{min}= 100 V
V_{max}= 120 V

3.3 Short description of the equipment under test (EUT)

The EUT is a 1-Port WLAN-access point for cap rail applications. The EUT provides a menu to choose the channel for data transmission, the connected antenna and the length of the antenna cable. The AP is compatible with 802.11a, b, g, n Standard. It supports the 2.4 GHz and 5 GHz frequency band.

Number of tested samples: 1
Serial number: D3548822
Firmware ID: P03.00.00.00.130101

EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- TX continuous mode, 801.11a

- TX continuous mode, 801.11n, HT20

- TX continuous mode, 801.11n, HT40

EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

- LAN cable, 3m Model : CAT5
- Power supply cable, 1m Model : Self-made
- Model :

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 °C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.1 Measurement protocol for FCC and IC

4.1.1 General information

4.1.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A

In compliance with RSS 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.1.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left without termination. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.1.1.3 Details of test procedures

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.2 Determination of worst case measurement conditions

Measurements have been made in all three orthogonal axes and the settings of the EUT were changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set on cap rail test rack.
The tests are carried out in the following frequency bands:

5.15 - 5.25 GHz

Preliminary tests were performed to find the worst case mode from all possible combinations between available modulations, data rates and small antenna system is determined through pre-scans. The maximum output power depends on used data rate. As worse case the HT20 mode (BW = 20 MHz), 1 TX chain and HT40 mode (BW = 40 MHz) is used.
The EUT is controlled for several tests with special test software used for testing only where continuous signals are needed. For the tests a maximum duty cycle (x) is set.

Following channels and test modes were selected for the final test as listed below:

Technology	Available channels	Tested channels	Modulation	Modulation type	Data rate
802.11a	36 - 48	36, 40, 48	OFDM	BPSK	6 Mbps (BW=20 MHz)
802.11n, HT20	36 - 48	36, 40, 48	OFDM	BPSK	MCS=0 (BW=20 MHz)
802.11n, HT40	36up – 44up	36up, 44up	OFDM	BPSK	MCS=8 (BW=40 MHz)

5 TEST CONDITIONS AND RESULTS

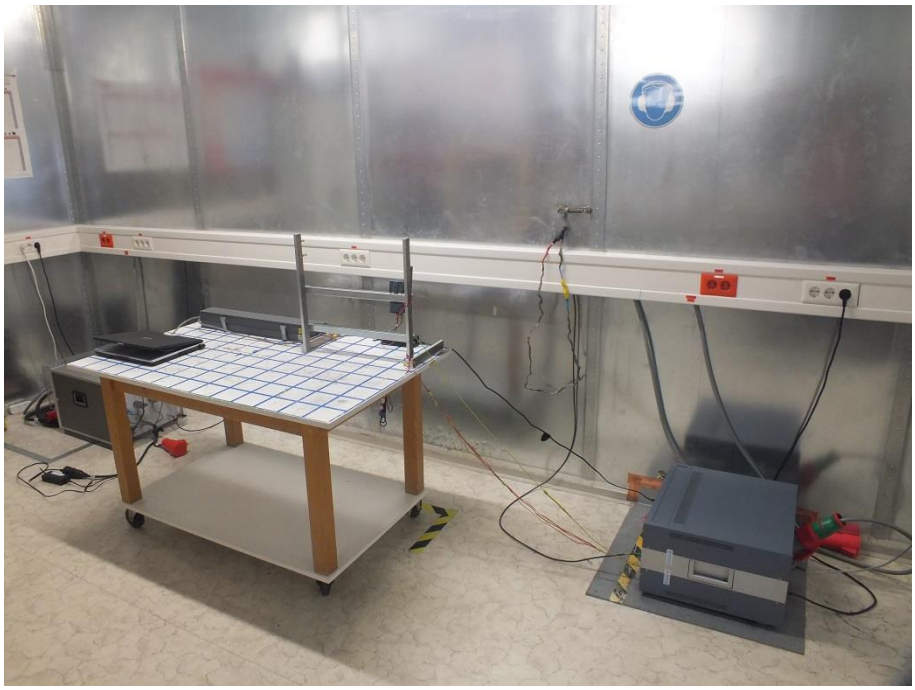
5.1 Conducted emissions

For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up



5.1.3 Applicable standard

According to FCC Part 15C, Section 15.107(a) and Section 15.207(a):
Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

5.1.4 Description of Measurement

The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a line impedance stabilization network (LISN) with 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded.

To convert between dBμV and μV, the following conversions apply:

dBμV = 20 log μV

μV = 10^(dBμV/20)

5.1.5 Test result

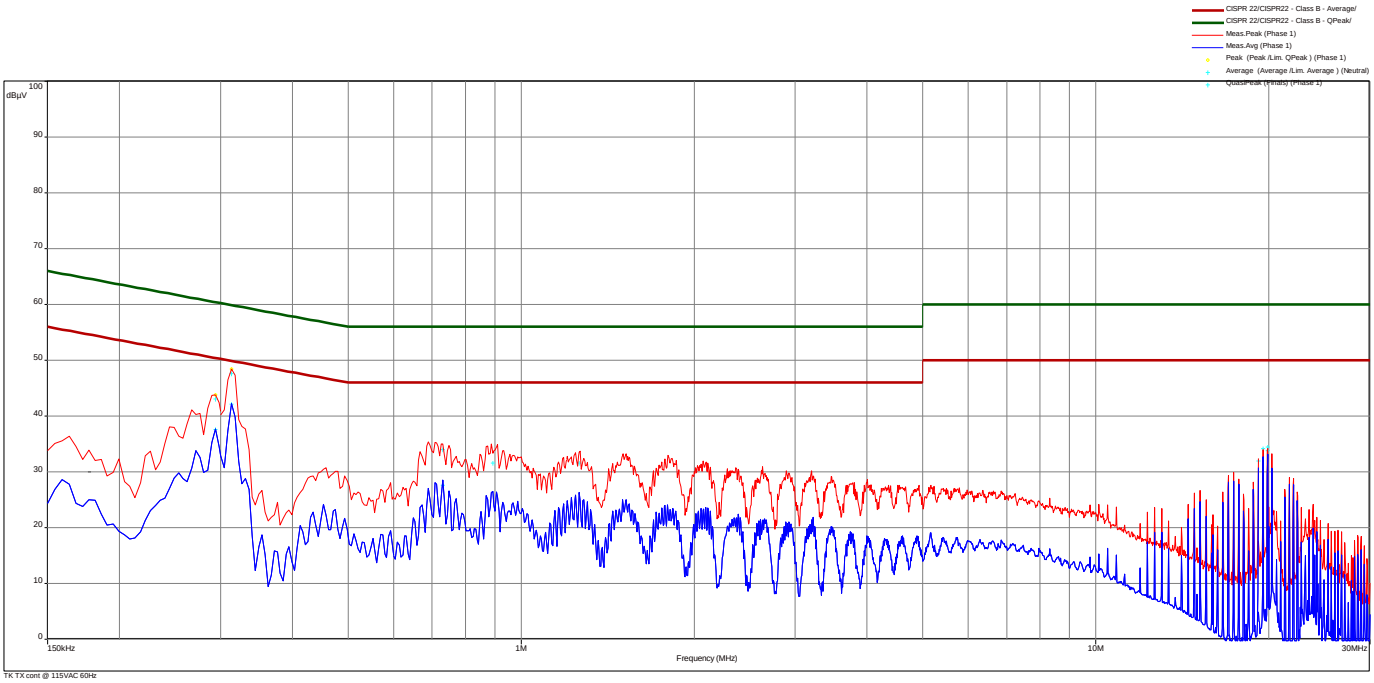
Frequency range:	0.15 MHz - 30 MHz
Min. limit margin	7.6 dB at 0.314 MHz

The requirements are **FULFILLED.**

Remarks: For detailed test result please see following test protocols.

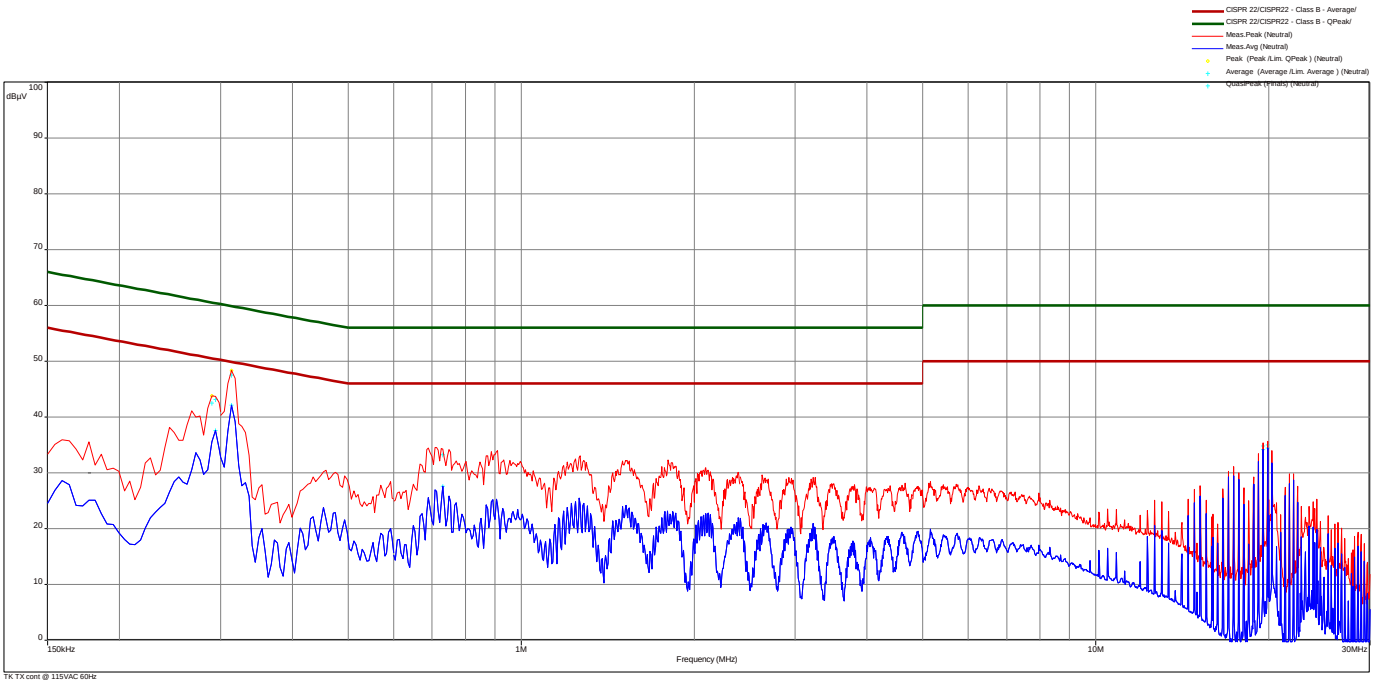
5.1.6 Test protocol

Test point L1 Result: passed
Operation mode: **TX continuous mode, 801.11a**
Remarks:



freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB	
0.294	9	43.1	17.3	60.4	37.7	12.8	50.4	Phase 1
0.314	10	47.6	12.3	59.9	42.3	7.6	49.9	Phase 1
0.731	11	34.0	22.1	56.0	28.5	17.5	46.0	Phase 1
0.893	11	31.6	24.4	56.0	26.5	19.5	46.0	Phase 1
1.263	12	31.6	24.4	56.0	26.2	19.8	46.0	Phase 1
19.172	15	32.0	28.0	60.0	31.0	19.0	50.0	Phase 1
19.898	16	33.8	26.2	60.0	33.2	16.8	50.0	Phase 1

Test point N Result: passed
Operation mode: TX continuous mode, 801.11a
Remarks:



freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB	
0.290	1	42.5	18.0	60.5	35.5	15.1	50.5	Neutral
0.294	1	43.1	17.3	60.4	37.6	12.8	50.4	Neutral
0.314	2	47.5	12.4	59.9	42.1	7.7	49.9	Neutral
0.731	3	33.3	22.7	56.0	27.7	18.3	46.0	Neutral
19.541	7	34.8	25.2	60.0	34.1	15.9	50.0	Neutral
19.899	8	35.0	25.0	60.0	34.3	15.8	50.0	Neutral

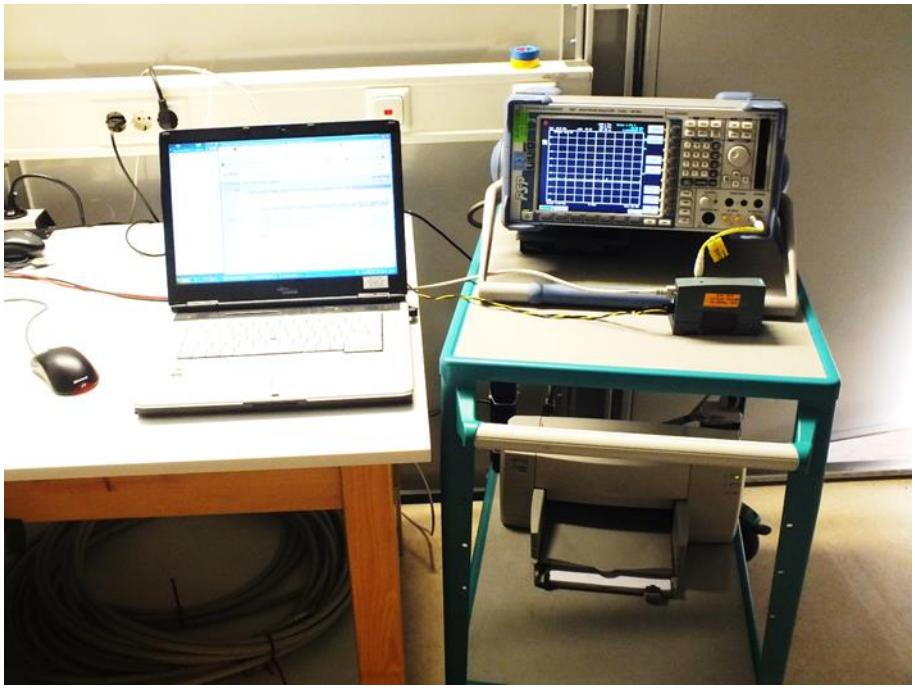
5.2 EBW and OBW

For test instruments and accessories used see section 6 Part **MB**.

5.2.1 Description of the test location

Test location: AREA 4

5.2.2 Photo documentation of the test set-up



5.2.3 Applicable standard

According to FCC Part 15E, Section 15.407(i):
The emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier centre frequency and one above the carrier centre frequency, that are 26 dB down relative to the maximum of the modulated carrier.

5.2.4 Description of Measurement

The bandwidth is measured conducted using a spectrum analyser and following the procedures according the OET 789033, item C. The spectrum analyser function “n-dB-down” is used to determine the 26 dB EBW. For the OBW the analyser function “OBW” is used to determine the bandwidth. The procedures according the OET 789033, item D are followed in this case. The measurement is done at the highest power setting P20.

5.2.5 Test result

802.11a, Mbps 6, Port1:
Spectrum analyser settings: RBW: 300 kHz VBW: 1 MHz Detector: Peak

Channel	Centre frequency	26 dB bandwidth	99% OBW
	(MHz)	(MHz)	(MHz)
36	5180	34.92	17.31
40	5200	35.04	17.57
48	5240	34.92	17.24

802.11n, HT20, MCS0, Port1:
Spectrum analyser settings: RBW: 300 kHz VBW: 1 MHz Detector: Peak

Channel	Centre frequency	26 dB bandwidth	99% OBW
	(MHz)	(MHz)	(MHz)
36	5180	34.92	18.27
40	5200	36.60	18.63
48	5240	34.44	18.23

802.11n, HT40, MCS0, Port1:
Spectrum analyser settings: RBW: 1 MHz VBW: 3 MHz Detector: Peak

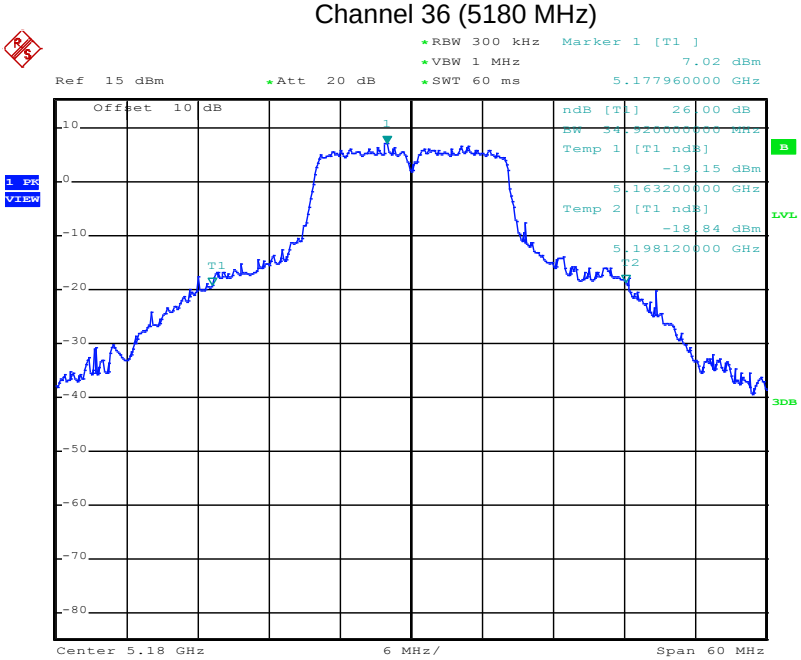
Channel	Centre frequency	26 dB bandwidth	99% OBW
	(MHz)	(MHz)	(MHz)
36up	5190	82.40	38.07
44up	5230	84.20	37.92

Remarks: For detailed test results please see the following test protocols. For the bandwidth is no limit under FCC Rules or IC Rules.

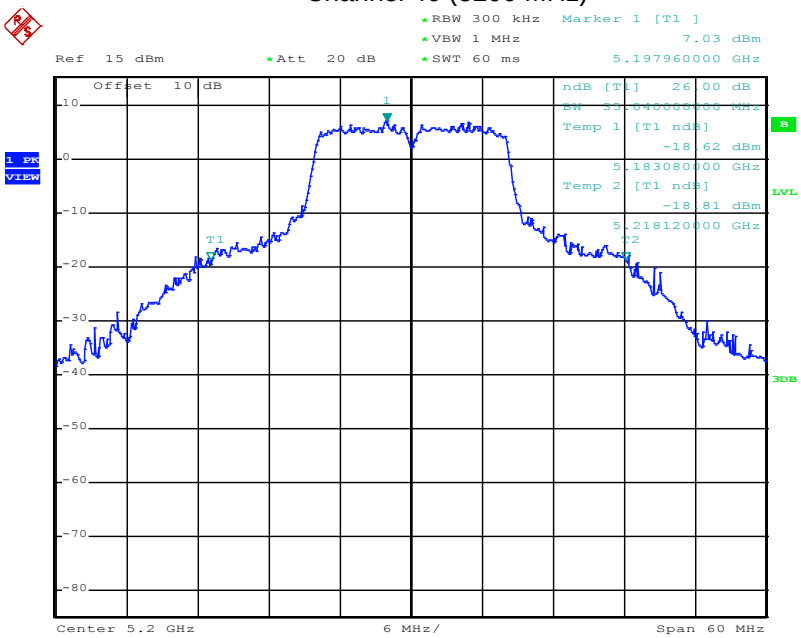
5.2.6 Test protocol

5.2.6.1 26dB bandwidth beasurement plots, 802.11a, Mbps 6, Port1:

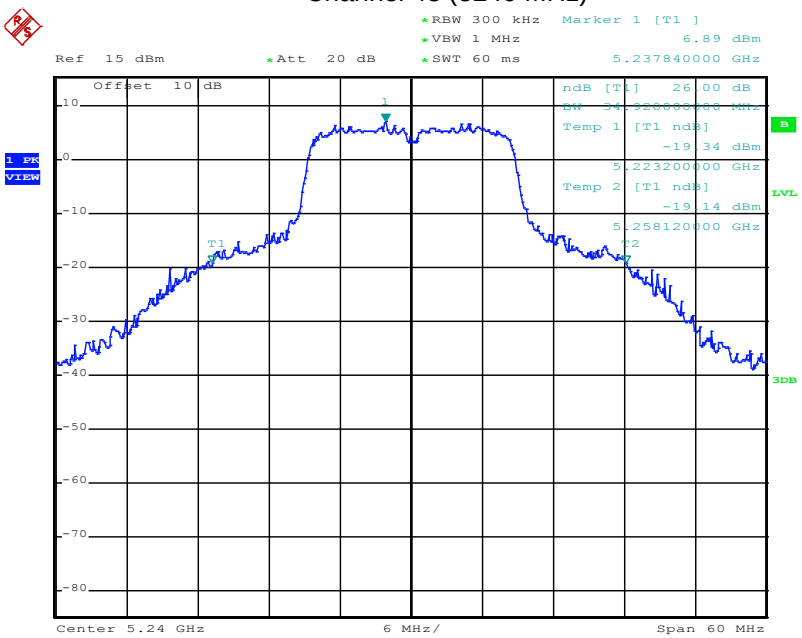
Channel 36 (5180 MHz)



Channel 40 (5200 MHz)

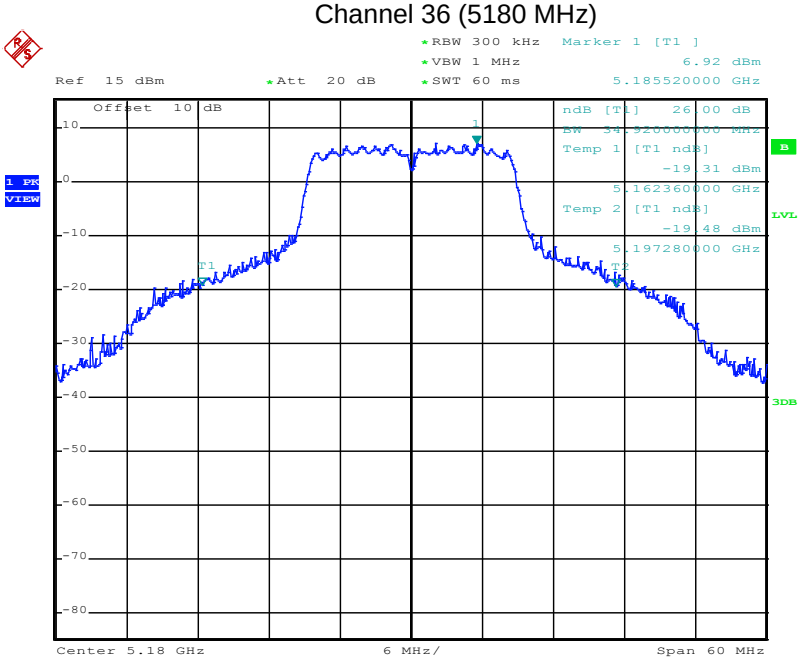


Channel 48 (5240 MHz)



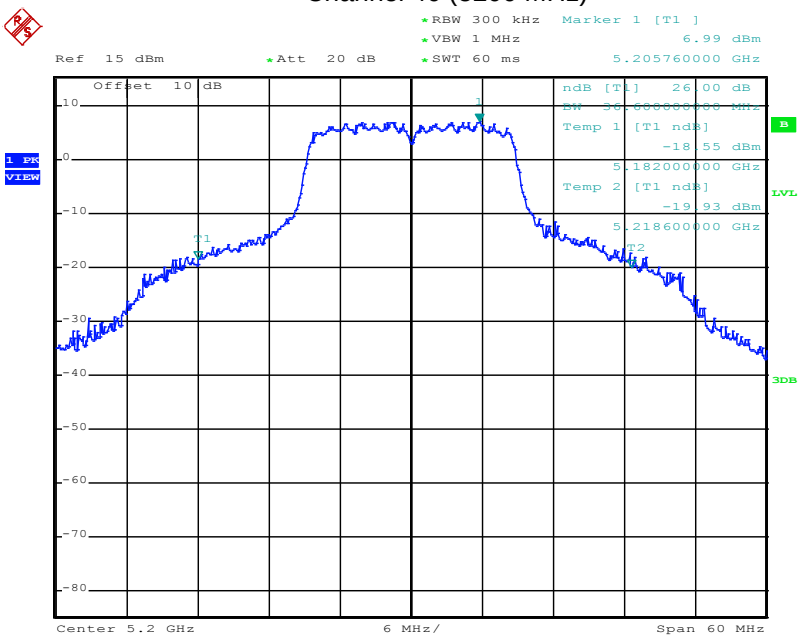
5.2.6.2 26dB Bandwidth Measurement plots, 802.11n, HT20, MCS0, Port1:

Channel 36 (5180 MHz)

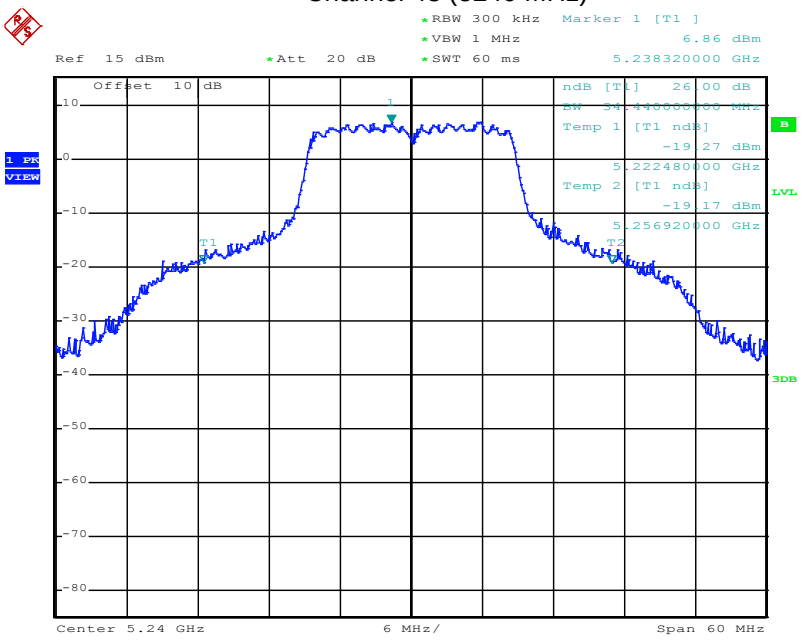


FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

Channel 40 (5200 MHz)

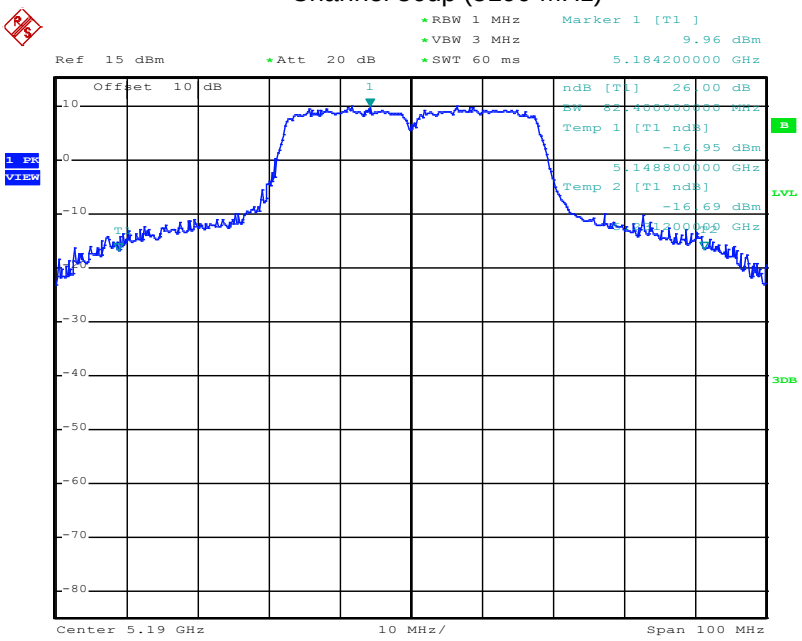


Channel 48 (5240 MHz)

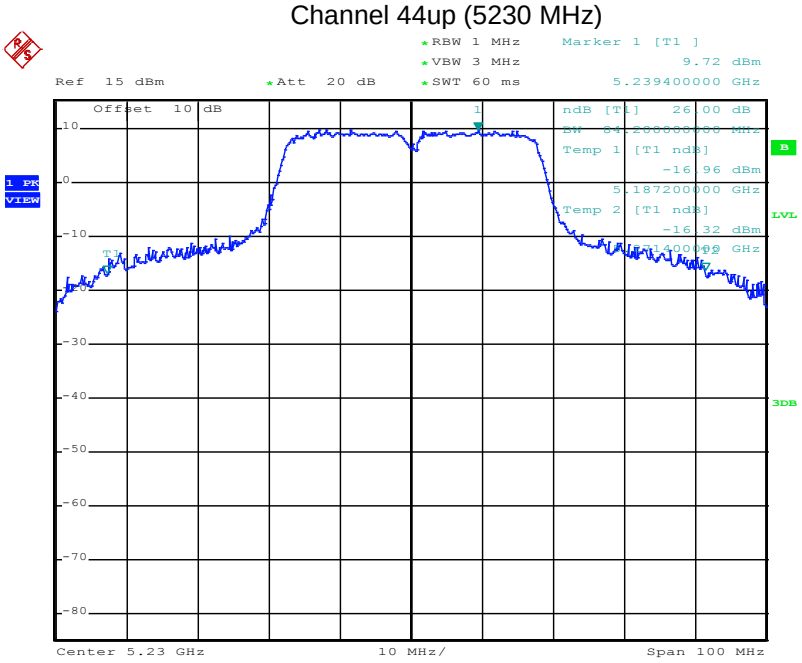


5.2.6.3 26dB Bandwidth Measurement plots, 802.11n, HT40, MCS0, Port1:

Channel 36up (5190 MHz)

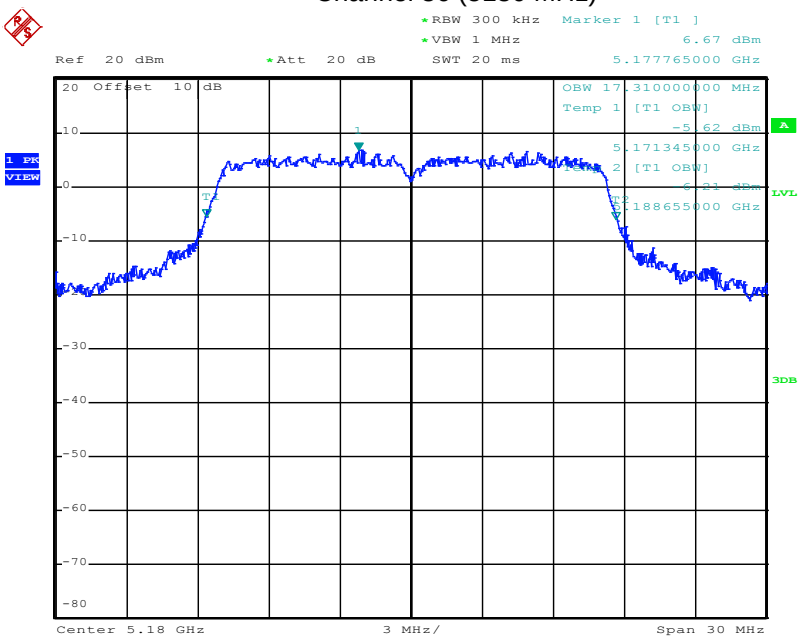


Channel 44up (5230 MHz)

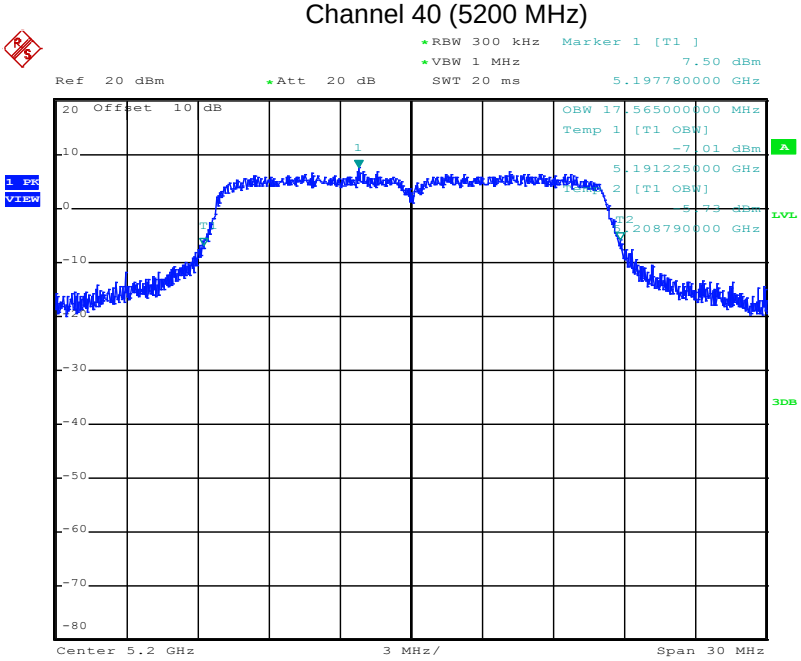


5.2.6.4 OBW 99, 802.11a, Mbps 6, Port1:

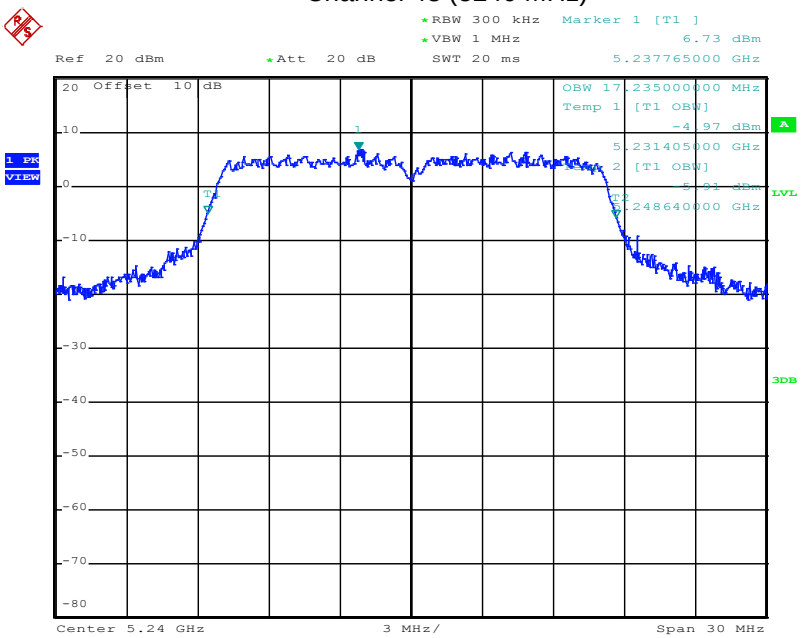
Channel 36 (5180 MHz)



Channel 40 (5200 MHz)

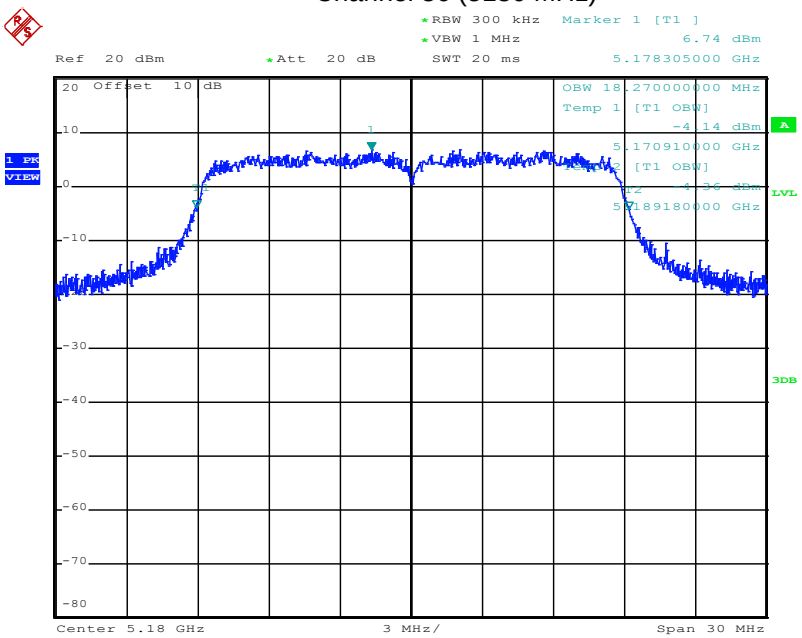


Channel 48 (5240 MHz)



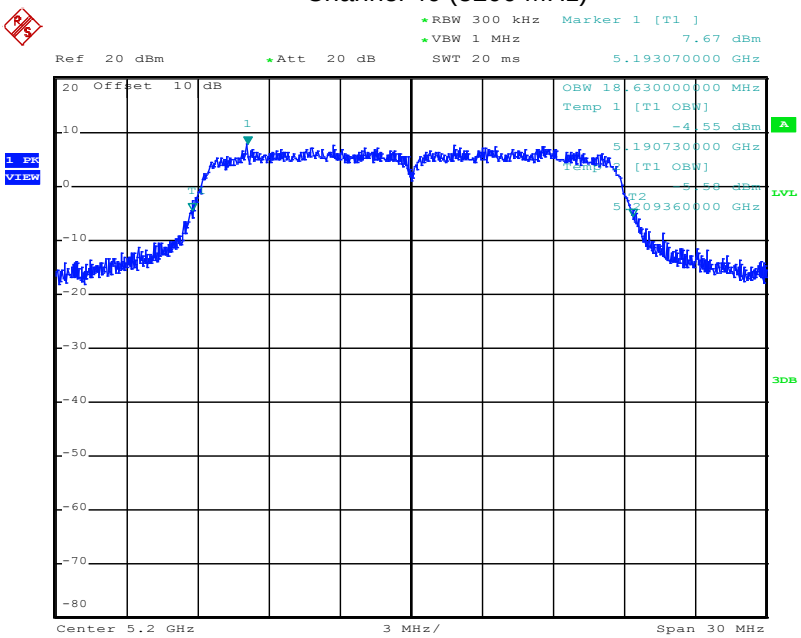
5.2.6.5 OBW 99, 802.11n, HT20, MCS0, Port1:

Channel 36 (5180 MHz)

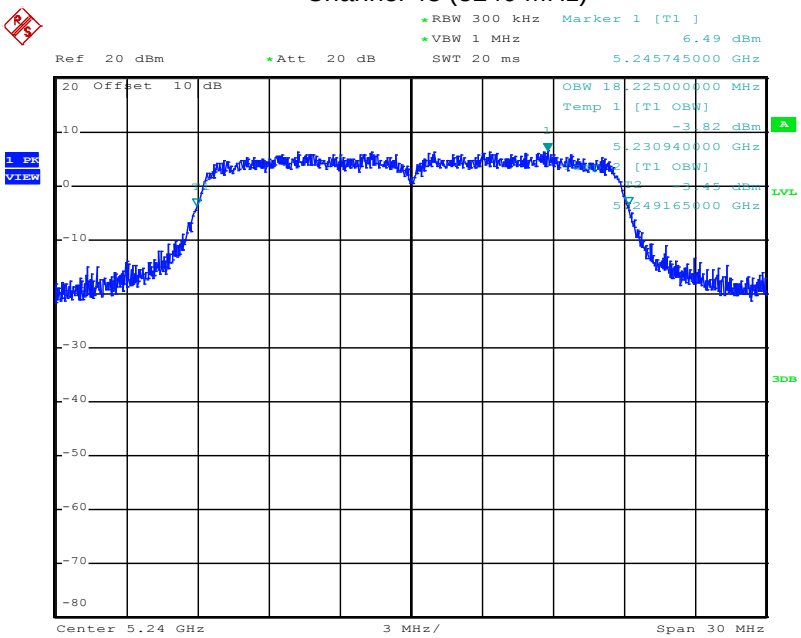


FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

Channel 40 (5200 MHz)

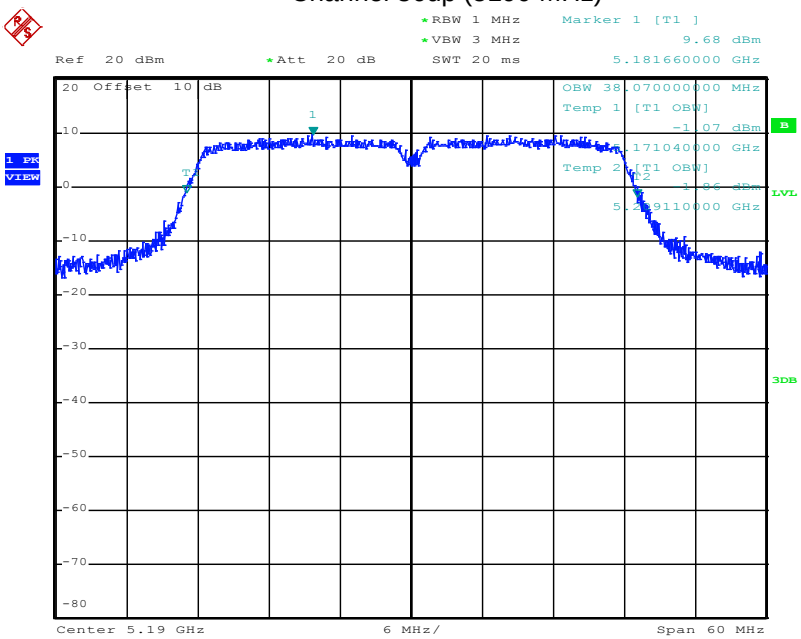


Channel 48 (5240 MHz)

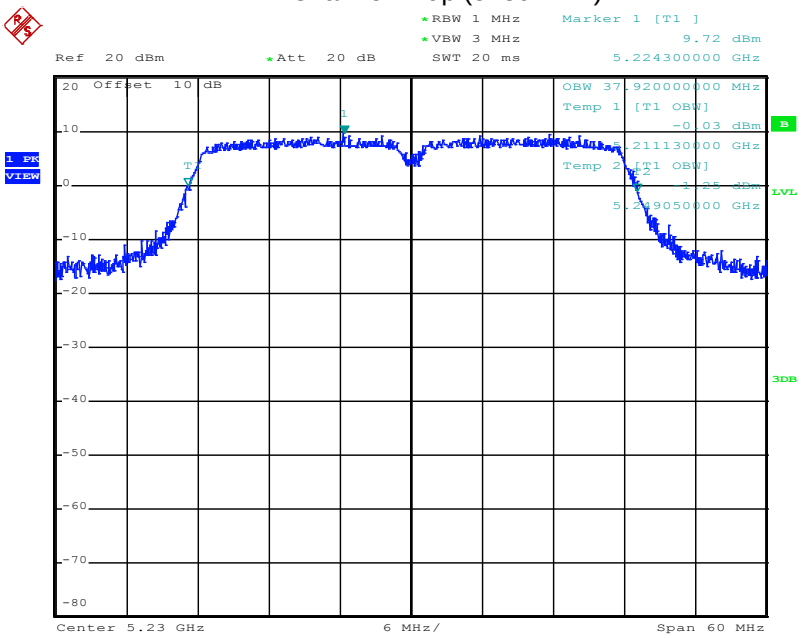


5.2.6.6 OBW 99, 802.11n, HT40, MCS0, Port1:

Channel 36up (5190 MHz)



Channel 44up (5230 MHz)



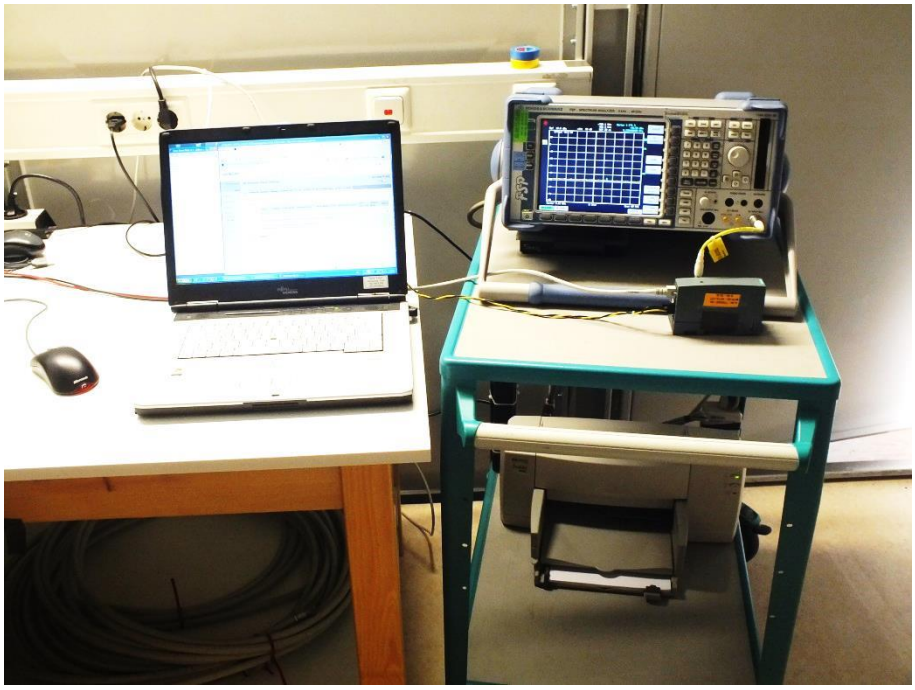
5.3 Maximum conducted output power

For test instruments and accessories used see section 6 Part **CPC 3**.

5.3.1 Description of the test location

Test location: AREA 4

5.3.2 Photo documentation of the test set-up



5.3.3 Applicable standard

According to FCC Part 15E, Section 15.407(a):
The maximum conducted output power over the frequency band of operation shall not exceed the effective values. If transmitting antennas of directional gain are greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.4 Description of Measurement

The output power is measured conducted using a spectrum analyser. The EUT has no constant duty cycle and may be smaller than 98% therefore the procedure according the OET 789033; item E g) Method SA-3 Alternative is followed. The EUT is set while measuring in TX continuous mode with a maximum duty cycle. The insertion loss of the measurement cable is taken into account with amplitude offset while measuring. The output power is integrated across the OBW 99 alternatively.

Determination of the min VBW for AV-Measurement:

Transmission duration			
Standard	min puls in TX continuous mode	1/T	min VBW
	(ms)	(Hz)	
801.11a	2.000	500	1 kHz
801.11n, HT20	1.850	541	1 kHz
801.11n, HT40	0.455	2198	3 kHz

Spectrum analyser settings:
Channel power measurement function, TX channel bandwidth equal to OBW;
RBW: 1 MHz, VBW: 1 kHz, Sweep time: auto, Detector: PK, Trace: max hold;

5.3.5 Test result

Test conditions:			
801.11a, Mbps 6:		Test results	
	A [P11]	A [P17]	A [P20]
Chain1	(dBm)	(dBm)	(dBm)
CH36	6.9	12.6	12.9
CH40	7.1	12.9	12.5
CH48	7.3	12.9	12.9

Calculating of the conducted power and EIRP:

CH36a	Test results							
	P set	Ant gain	A	Limit	Margin	EIRP	Limit	Margin
		(dBi)	(dBm)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Ant_group1	P20	6.0	12.9	17.0	-4.1	18.9	23.0	-4.1
Ant_group2	P17	9.0	12.6	17.0	-4.4	21.6	23.0	-1.4

CH40a	Test results							
	P set	Ant gain	A	Limit	Margin	EIRP	Limit	Margin
		(dBi)	(dBm)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Ant_group1	P20	6.0	12.5	17.0	-4.5	18.5	23.0	-4.5
Ant_group2	P17	9.0	12.9	17.0	-4.1	21.9	23.0	-1.1

CH48a	Test results							
	P set	Ant gain	A	Limit	Margin	EIRP	Limit	Margin
		(dBi)	(dBm)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Ant_group1	P20	6.0	12.9	17.0	-4.1	18.9	23.0	-4.1
Ant_group2	P17	9.0	12.9	17.0	-4.1	21.9	23.0	-1.1

Test conditions:			
801.11n, HT20, MCS0:		Test results	
	A [P11]	A [P17]	A [P20]
Chain1	(dBm)	(dBm)	(dBm)
CH36	7.0	12.6	12.7
CH40	7.1	12.6	12.7
CH48	7.4	12.7	12.8

Calculating of the conducted power and EIRP:

CH36, HT20	Test results							
	P set	Ant gain	A	Limit	Margin	EIRP	Limit	Margin
		(dBi)	(dBm)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Ant_group1	P20	6.0	12.7	17.0	-4.3	18.7	23.0	-4.3
Ant_group2	P17	9.0	12.6	17.0	-4.4	21.6	23.0	-1.4

CH40, HT20	Test results							
	P set	Ant gain	A	Limit	Margin	EIRP	Limit	Margin
		(dBi)	(dBm)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Ant_group1	P20	6.0	12.7	17.0	-4.3	18.7	23.0	-4.3
Ant_group2	P17	9.0	12.6	17.0	-4.4	21.6	23.0	-1.4

CH48, HT20	Test results							
	P set	Ant gain	A	Limit	Margin	EIRP	Limit	Margin
		(dBi)	(dBm)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Ant_group1	P20	6.0	12.8	17.0	-4.2	18.8	23.0	-4.2
Ant_group2	P17	9.0	12.7	17.0	-4.3	21.7	23.0	-1.3

Test conditions:			
801.11n, HT40, MCS8:		Test results	
	A [P11]	A [P17]	A [P20]
Chain1	(dBm)	(dBm)	(dBm)
CH36up	6.4	11.8	11.8
CH44up	6.6	11.8	11.8

Calculating of the conducted power and EIRP:

CH36up	Test results							
	P set	Ant gain	A	Limit	Margin	EIRP	Limit	Margin
		(dBi)	(dBm)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Ant_group1	P20	6.0	11.8	17.0	-5.2	17.8	23.0	-5.2
Ant_group2	P17	9.0	11.8	17.0	-5.2	20.8	23.0	-2.2

CH44up	Test results							
	P set	Ant gain	A	Limit	Margin	EIRP	Limit	Margin
		(dBi)	(dBm)	(dBm)	(dB)	(dBm)	(dBm)	(dB)
Ant_group1	P20	6.0	11.8	17.0	-5.2	17.8	23.0	-5.2
Ant_group2	P17	9.0	11.8	17.0	-5.2	20.8	23.0	-2.2

Peak power limit according to FCC Part 15E, Section 15.407(a):

Frequency	Conducted power limit		
(GHz)		(dBm)	(dBm)
5.150 - 5.250	Legacy, 4 + 10 log B =	19.4	17.0
	HT20, 4 + 10 log B =	19.6	17.0
	HT40, 4 + 10 log B =	23.3	17.0

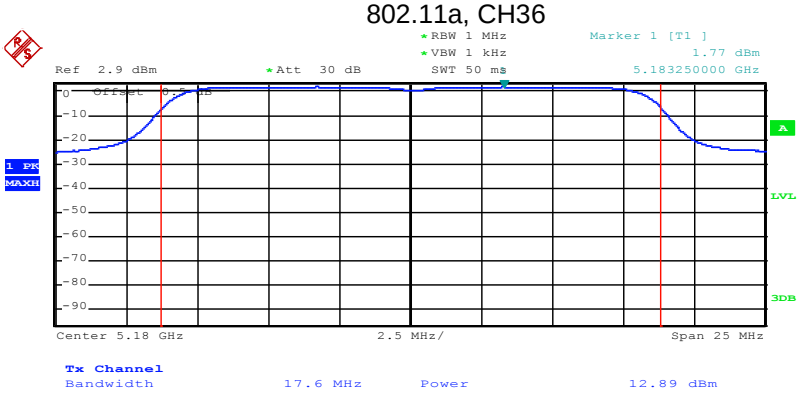
Note: The lower limit applies!

The requirements are **FULFILLED.**

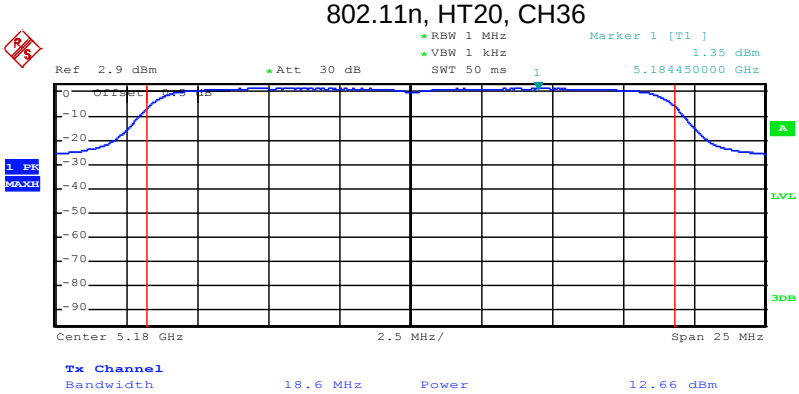
Remarks: For detailed test results please see the following test protocols. CH36 is listed as representative.

5.3.6 Test protocol output power

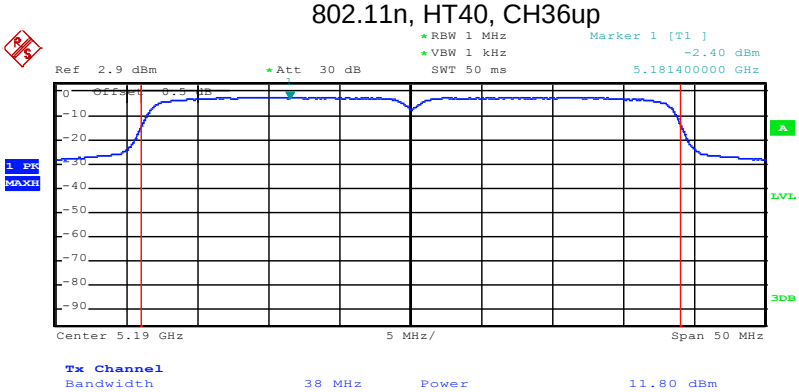
802.11a, CH36



802.11n, HT20, CH36



802.11n, HT40, CH36up



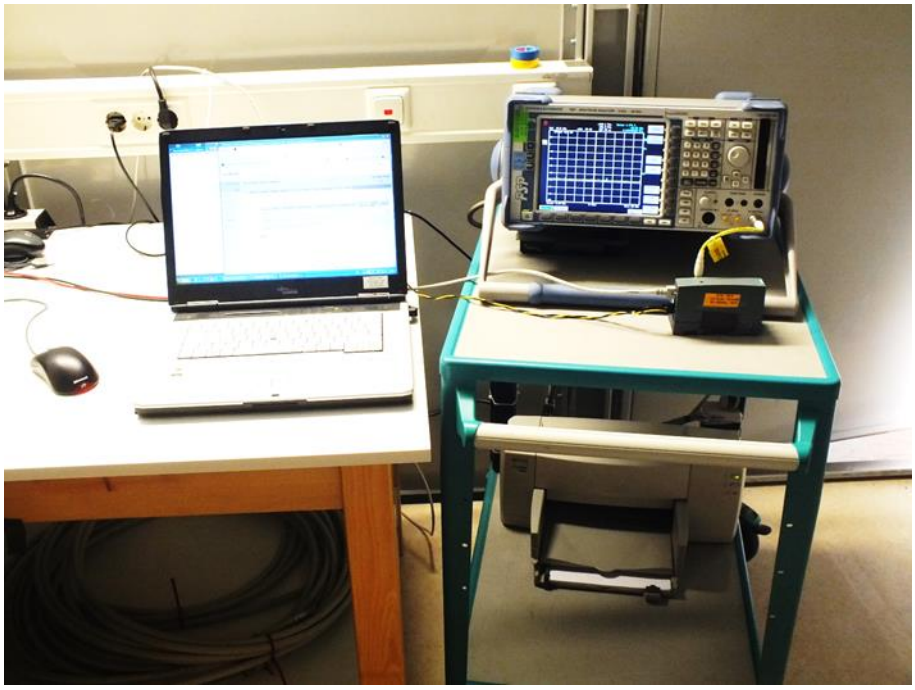
5.4 Peak power spectral density

For test instruments and accessories used see section 6 Part **CPC 3**.

5.4.1 Description of the test location

Test location: AREA 4

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

According to FCC Part 15E, Section 15.407(a):
For the defined operating bands the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than the appropriate limit in any 1 MHz band during any time interval of continuous transmission.

5.4.4 Description of Measurement

The bandwidth is measured conducted using a spectrum analyser and following the procedures according the OET 789033, item F. Since the method SA-3 alternative was used for channel power the spectrum analyser settings are the same as under item F)g). The marker function “Marker to max” is used to set at peak power spectral density.

Spectrum analyser settings:
Channel power measurement function, TX channel bandwidth equal to OBW;
RBW: 1 MHz, VBW: 1 kHz, Sweep time: auto, Detector: PK, Trace: max hold;

5.4.5 Test result

Test conditions: 801.11a, Mbps 6, conducted				
	Test results			
Channel	Power setting	D	PPSD limit	Margin
		(dBm/MHz)	(dBm/MHz)	(dB)
CH36	P11	-4.3	4	-8.3
	P17	1.4	4	-2.6
	P20	1.8	4	-2.2
CH40	P11	-4.1	4	-8.1
	P17	1.8	4	-2.2
	P20	1.2	4	-2.8
CH48	P11	-3.9	4	-7.9
	P17	2.0	4	-2.0
	P20	1.8	4	-2.2

Test conditions: HT20, MCS0, conducted				
	Test results			
Channel	Power setting	D	PPSD limit	Margin
		(dBm/MHz)	(dBm/MHz)	(dB)
CH36	P11	-4.2	4	-8.2
	P17	1.3	4	-2.7
	P20	1.4	4	-2.6
CH40	P11	-4.1	4	-8.1
	P17	1.5	4	-2.5
	P20	1.4	4	-2.6
CH48	P11	-4.0	4	-8.0
	P17	1.4	4	-2.6
	P20	1.5	4	-2.5

Test conditions: HT40, MCS8, conducted				
	Test results			
Channel	Power setting	D	PPSD limit	Margin
		(dBm/MHz)	(dBm/MHz)	(dB)
CH36up	P11	-7.9	4	-11.9
	P17	-2.4	4	-6.4
	P20	-2.4	4	-6.4
CH44up	P11	-7.6	4	-11.6
	P17	-2.4	4	-6.4
	P20	-2.4	4	-6.4

Peak power limit according to FCC Part 15E, Section 15.407(a):

Frequency	Peak power spectral density limit
(GHz)	(dBm/MHz)
5.150 - 5.250	4

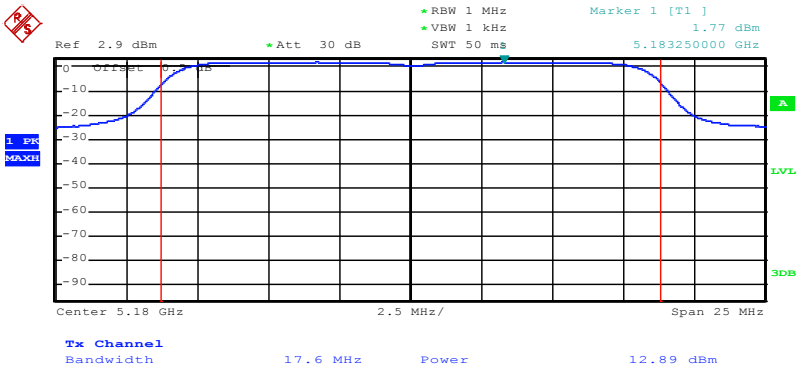
The requirements are **FULFILLED.**

Remarks: For detailed test results please refer to following test protocols.

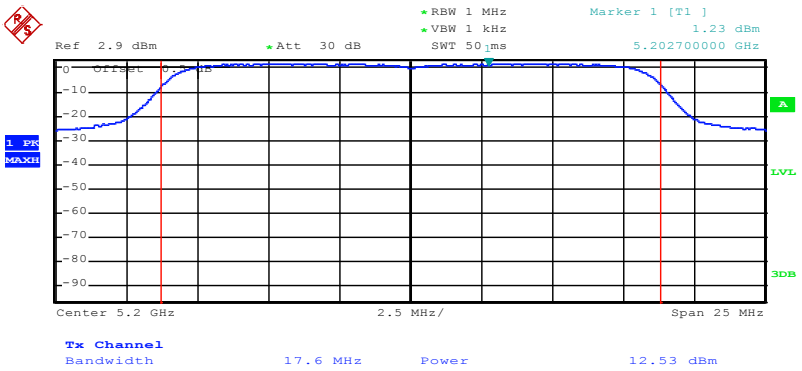
5.4.6 Peak Power spectral density plots, P20:

802.11a:

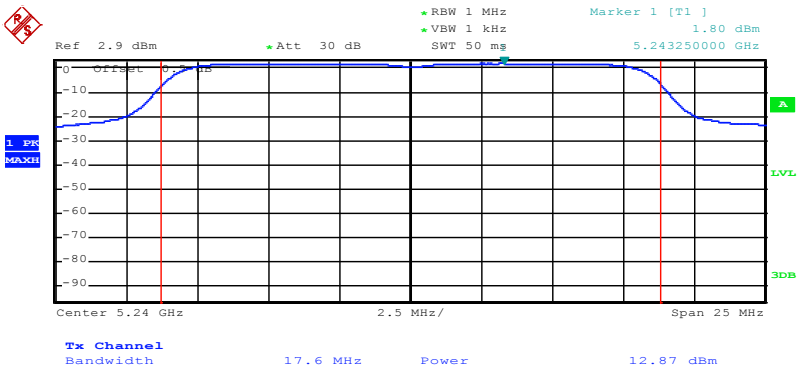
Channel 36 (5180 MHz)



Channel 40 (5200 MHz)

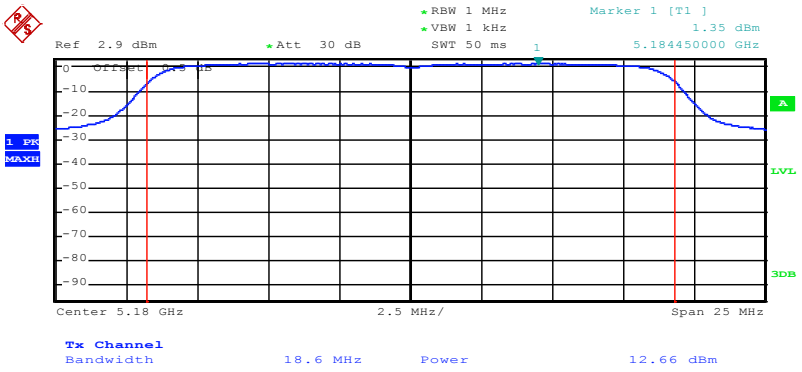


Channel 48 (5240 MHz)

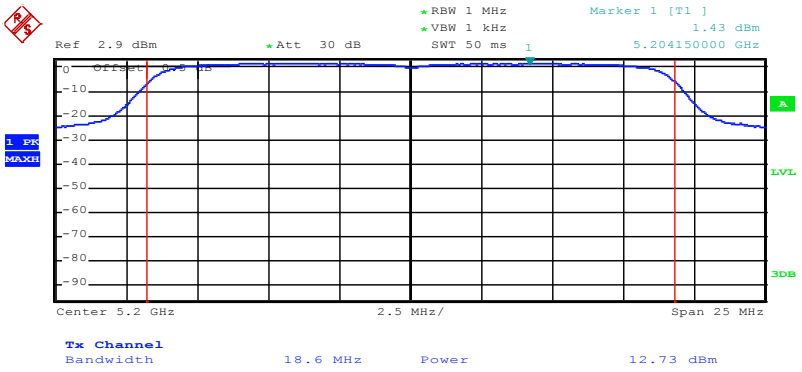


HT20:

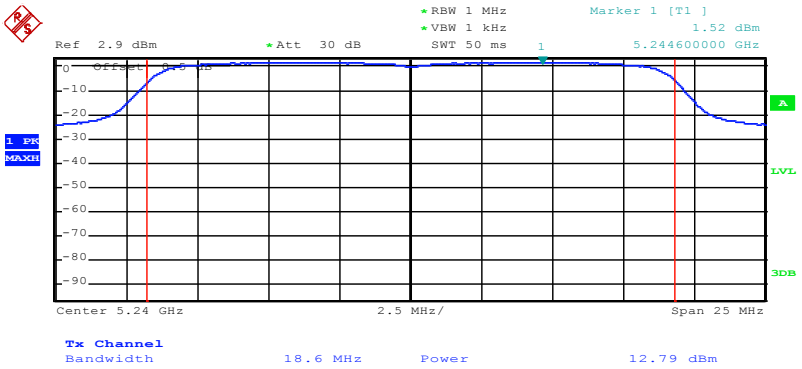
Channel 36 (5180 MHz)



Channel 40 (5200 MHz)

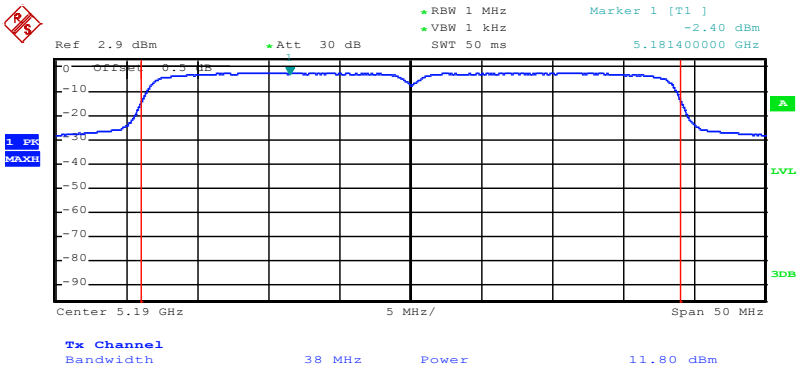


Channel 48 (5240 MHz)

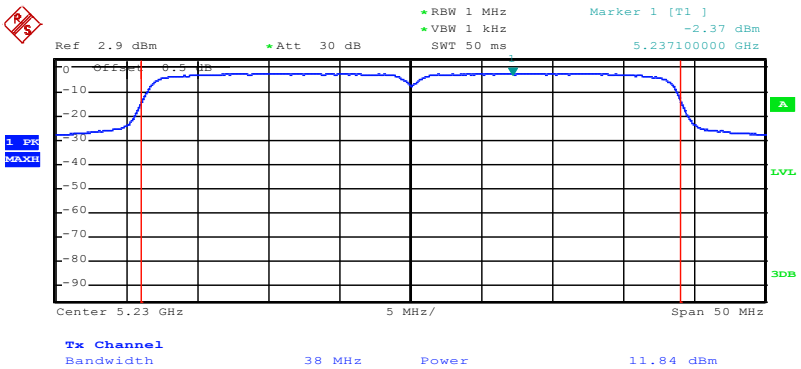


HT40:

Channel 36up (5190 MHz)



Channel 44up (5230 MHz)



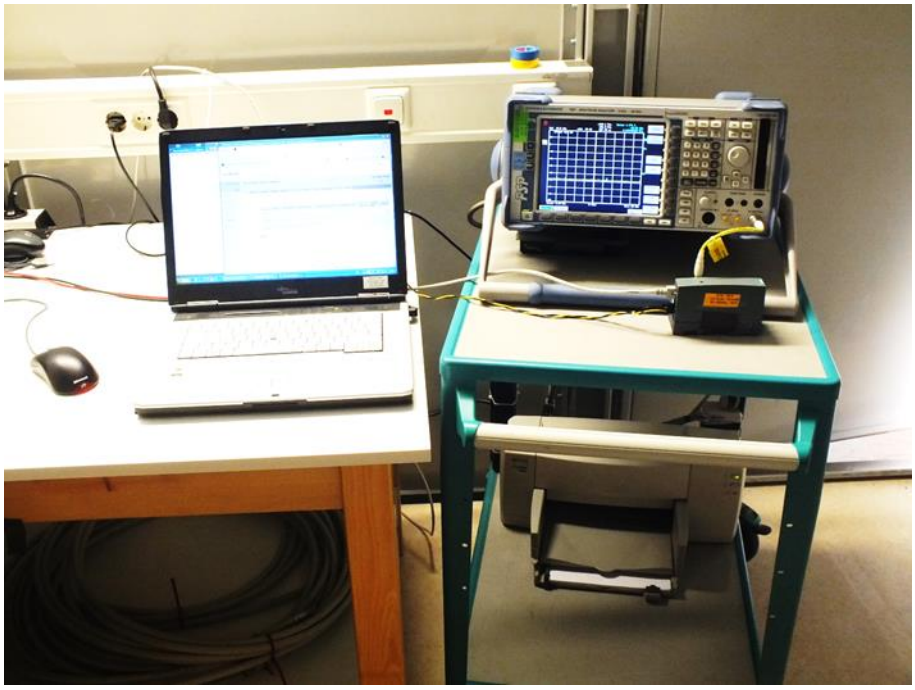
5.5 Peak excursion

For test instruments and accessories used see section 6 Part **MB**.

5.5.1 Description of the test location

Test location: AREA 4

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

According to FCC Part 15E, Section 15.407(a)(6):
The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured like before) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

5.5.4 Description of Measurement

Peak excursion is measured using a spectrum analyser and following the procedures according the OET 789033, item G. The peak max spectrum is determined with the analyser setting mentioned below. The ratio between peak-max-hold spectrum and average spectrum is calculated and listed as PEX in the tables below.

Spectrum analyser settings:
RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto, Detector: PK, Trace: max hold;

5.5.5 Test result

Test conditions: 801.11a, Mbps 6, conducted						
	Test results					
Chain1	Power setting	PPSD	Level VBW=3 MHz	PEX	PEX limit	Margin
		(dBm)	(dBm)	(dB)	(dB)	(dB)
CH36	P20	1.8	10.8	9.0	13	-4.0
CH40	P20	1.2	11.2	10.0	13	-3.0
CH48	P20	1.8	11.1	9.3	13	-3.7

Test conditions: HT20, MCS0, conducted						
	Test results					
Chain1	Power setting	PPSD	Level VBW=3 MHz	PEX	PEX limit	Margin
		(dBm)	(dBm)	(dB)	(dB)	(dB)
CH36	P20	1.4	11.8	10.4	13	-2.6
CH40	P20	1.4	11.8	10.4	13	-2.6
CH48	P20	1.5	11.8	10.3	13	-2.7

Test conditions: HT40, MCS0, conducted						
	Test results					
Chain1	Power setting	PPSD	Level VBW=3 MHz	PEX	PEX limit	Margin
		(dBm)	(dBm)	(dB)	(dB)	(dB)
CH36up	P20	-2.4	8.9	11.3	13	-1.7
CH44up	P20	-2.4	9.2	11.6	13	-1.4

Limit according to FCC Part 15E, Section 15.407(a)(6):

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured like before) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

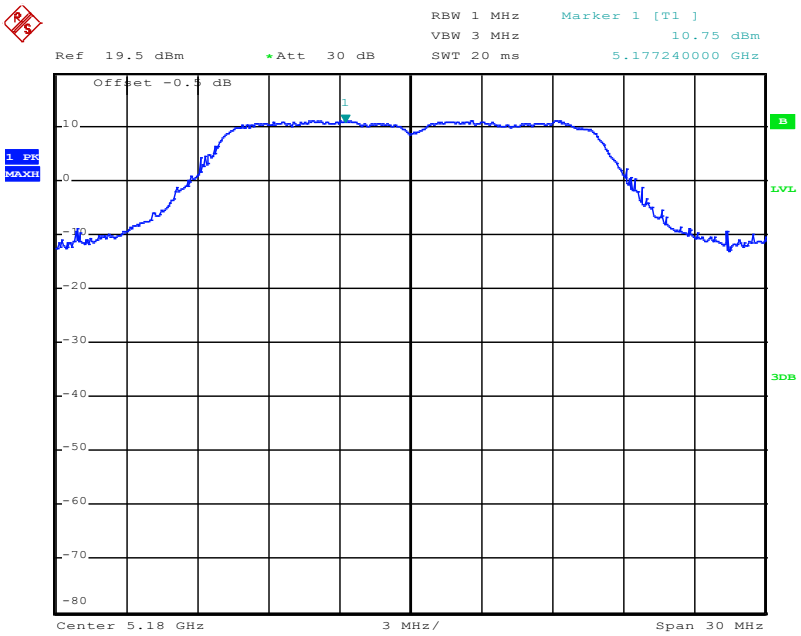
The requirements are **FULFILLED.**

Remarks: For detailed test results please see the following test protocols. Only the worst case of the plots are listed.

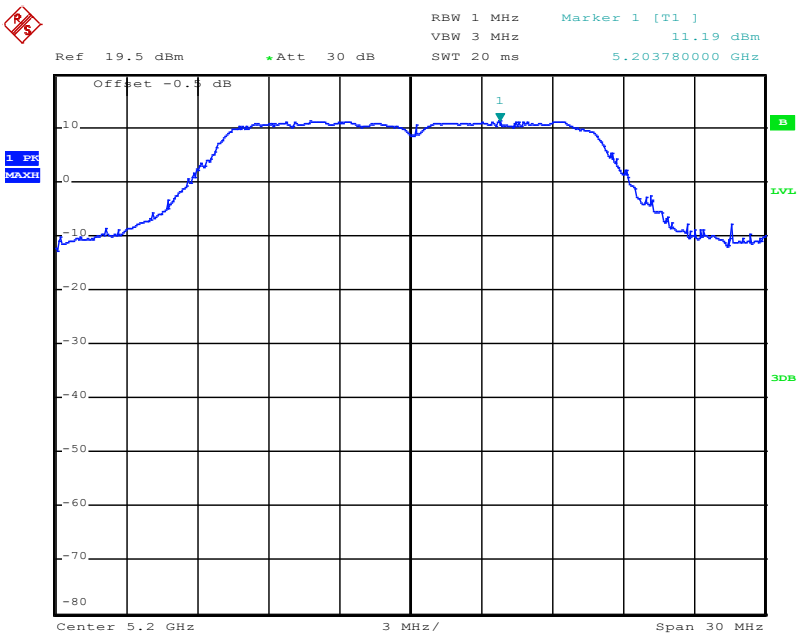
5.5.6 Peak excursion plots

802.11a:

Channel 36 (5180 MHz)

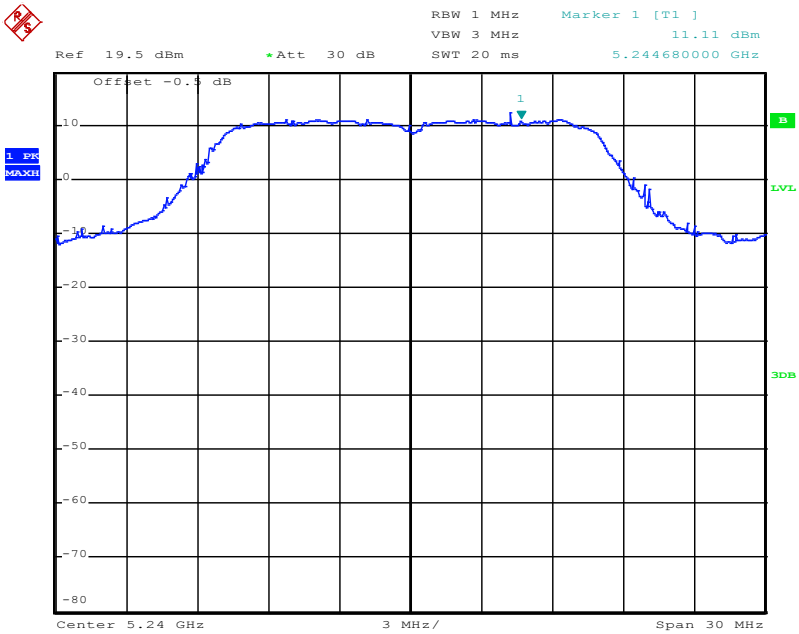


Channel 40 (5200 MHz)



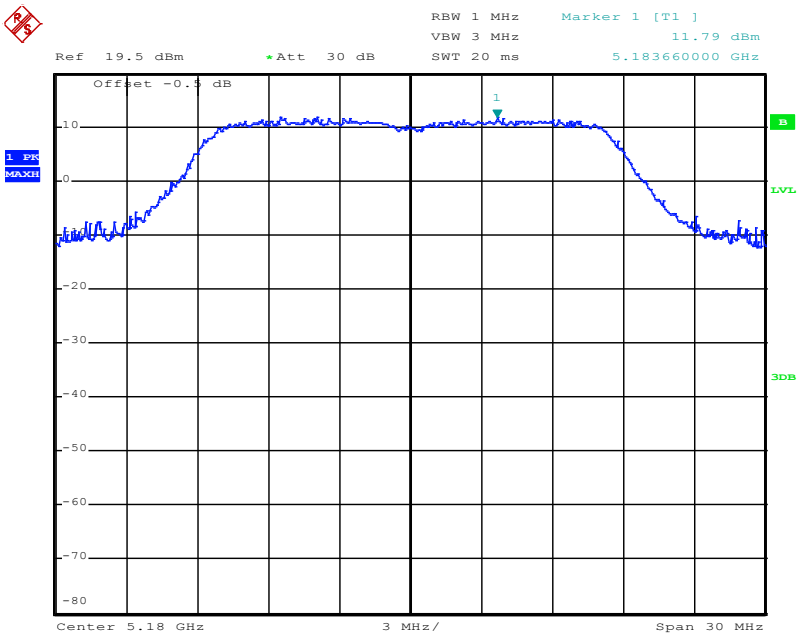
FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

Channel 48 (5240 MHz)



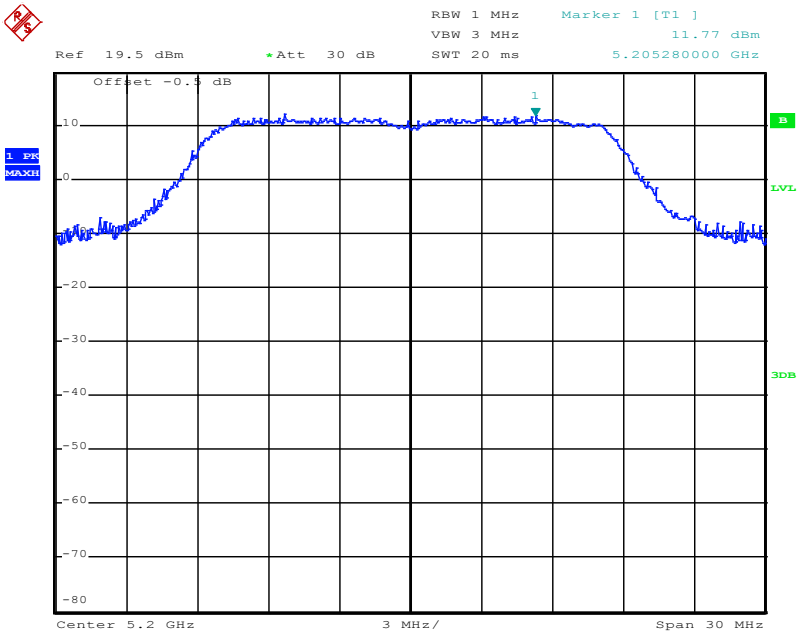
802.11n, HT20:

Channel 36 (5180 MHz)

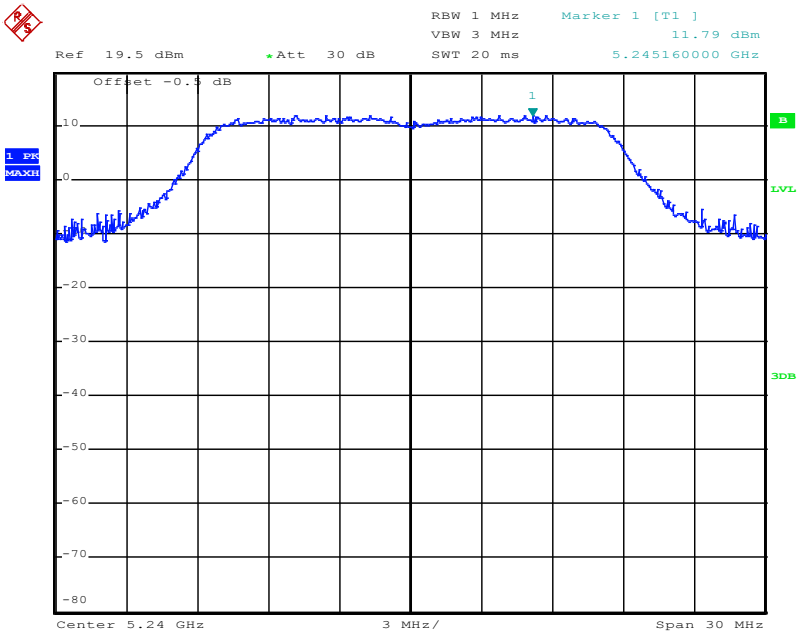


FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

Channel 40 (5200 MHz)

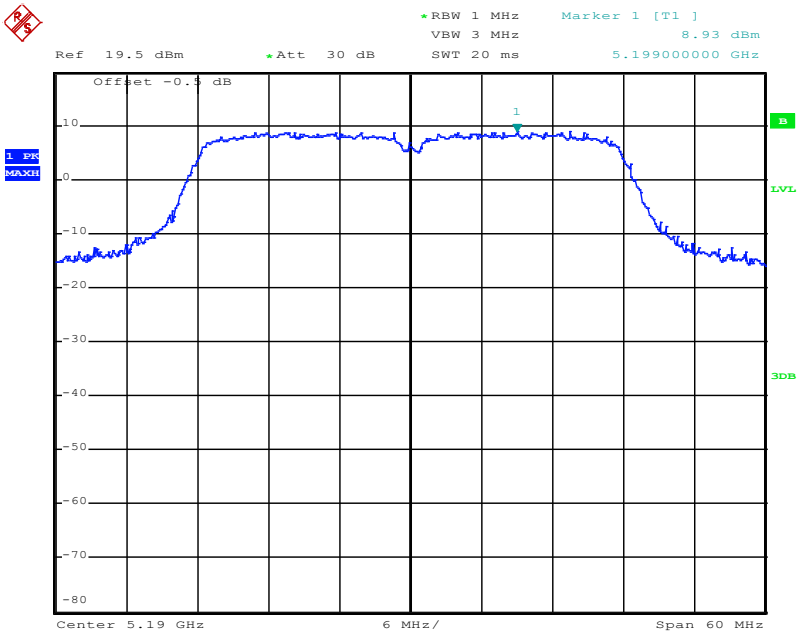


Channel 48 (5240 MHz)

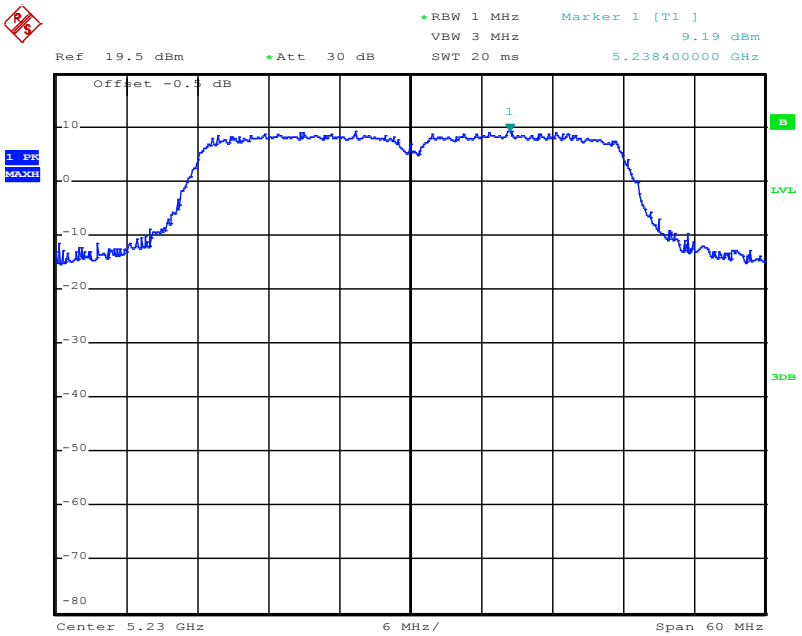


802.11n, HT40:

Channel 36up (5190 MHz)



Channel 44up (5230 MHz)



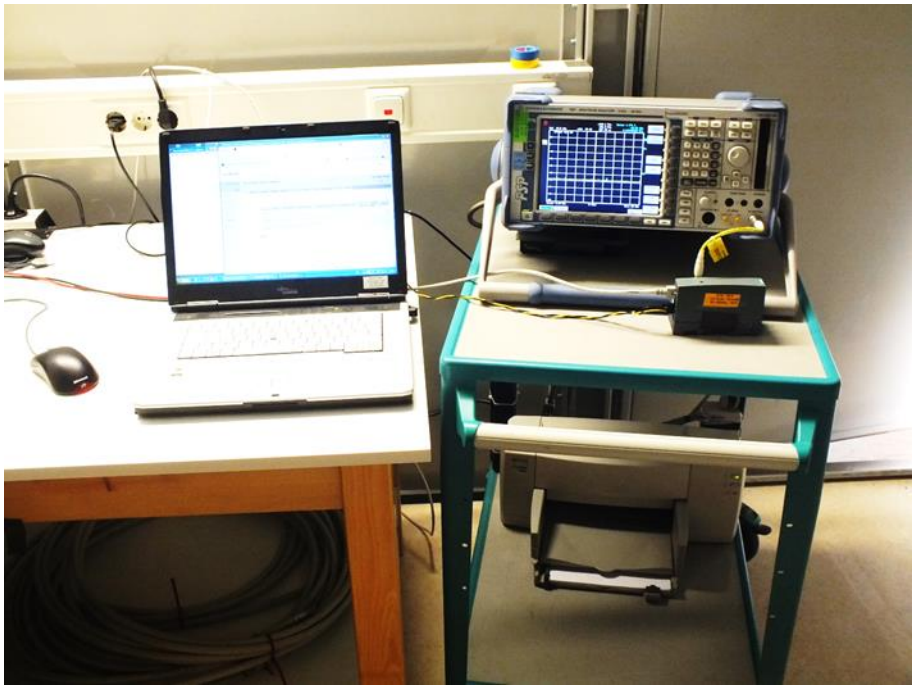
5.6 Undesirable emissions conducted

For test instruments and accessories used see section 6 Part **SEC 1, SEC 2 and SEC 3**.

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up



5.6.3 Applicable standard

According to FCC Part 15E, Section 15.407(b):
For transmitters operating in the defined bands shall not exceed the appropriate emission limit outside of the operating bands.
In addition, radiated emissions which fall in the restricted bands, as defined in Section15.205(a), must also comply with the radiated emission limit specified in Section15.209(a) (see Section15.205(c)).

5.6.4 Description of Measurement

Undesirable emissions are measured using a spectrum analyser and following the procedures according the OET 789033, item H. If the emission level of the EUT in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. Up from 8 GHz a HP filter is used.
Spectrum analyser settings:
Peak-measurement:

9 - 150 kHz:	RBW: 300 Hz,	VBW: 1 kHz,	Detector: Max peak,	Trace Mode: Max hold;
0.15 - 30 MHz:	RBW: 10 kHz,	VBW: 30 kHz,	Detector: Max peak,	Trace Mode: Max hold;
30 – 1000 MHz:	RBW: 100 kHz,	VBW: 300 kHz,	Detector: Max peak,	Trace Mode: Max hold;
1 – 40 GHz:	RBW: 1 MHz,	VBW: 3 MHz,	Detector: Max peak,	Trace Mode: Max hold;

AV-measurement according KDB 789033, Item H)6)d) Method VB:
RBW: 1 MHz, VBW: ≥ 1/T, Detector: Max peak, Trace Mode: Max hold, Sweep time: auto;
For 801.11a, n HT20: VBW = 1 kHz, for 802.11 n, HT40: VBW = 3 kHz;

5.6.5 Test result conducted emissions outside of the operation frequency bands

5.6.5.1 Gain group 1

Due to the antenna gain the limit is 6 dB reduced!

802.11a	PK-measurement					
Lowest frequency: CH36						
Test conditions: 1 TX , P14, 6 Mbps, 6 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	2.710	-79.0	-33.0	-46.0
30	1000	100	372.7	-72.6	-33.0	-39.6
1000	5150	1000	5096.1	-45.1	-33.0	-12.1
5250	12000	1000	5628.0	-51.3	-33.0	-18.3
12000	20000	1000	15540.0	-66.9	-33.0	-33.9
20000	40000	1000	39993.8	-56.3	-33.0	-23.3
Measurement uncertainty				±3 dB		

802.11a	PK-measurement					
Middle frequency: CH40						
Test conditions: 1 TX , P14, 6 Mbps						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	2.710	-79.0	-33.0	-46.0
30	1000	100	372.7	-72.6	-33.0	-39.6
1000	5150	1000	5096.1	-45.1	-33.0	-12.1
5250	12000	1000	5628.0	-51.3	-33.0	-18.3
12000	20000	1000	15540.0	-66.9	-33.0	-33.9
20000	40000	1000	39977.5	-56.8	-33.0	-23.8
Measurement uncertainty				±3 dB		

802.11a	PK-measurement					
Highest frequency: CH48						
Test conditions: 1 TX , P14, 6 Mbps						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	100	1.866	-78.5	-33.0	-45.5
30	1000	100	368.5	-72.0	-33.0	-39.0
1000	5150	1000	4760.4	-48.9	-33.0	-15.9
5250	12000	1000	5657.7	-52.0	-33.0	-19.0
12000	20000	1000	17916.0	-66.4	-33.0	-33.4
20000	40000	1000	39998.8	-56.4	-33.0	-23.4
Measurement uncertainty				±3 dB		

802.11n, HT20			PK-measurement			
Lowest frequency: CH36						
Test conditions: 1 TX , P14, MCS0						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	30.000	-72.1	-33.0	-39.1
30	1000	100	370.7	-72.2	-33.0	-39.2
1000	5150	1000	5150.0	-41.8	-33.0	-8.8
5250	12000	1000	5251.8	-48.7	-33.0	-15.7
12000	20000	1000	15541.8	-64.7	-33.0	-31.7
20000	40000	1000	39738.8	-55.6	-33.0	-22.6
Measurement uncertainty				±3 dB		

802.11n, HT20			PK-measurement			
Middle frequency: CH40						
Test conditions: 1 TX , P14, MCS0						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	1.829	-77.8	-33.0	-44.8
30	1000	100	368.8	-72.5	-33.0	-39.5
1000	5150	1000	5117.3	-45.0	-33.0	-12.0
5250	12000	1000	5652.2	-51.6	-33.0	-18.6
12000	20000	1000	17692.6	-67.4	-33.0	-34.4
20000	40000	1000	39945.0	-55.1	-33.0	-22.1
Measurement uncertainty				±3 dB		

802.11n, HT20			PK-measurement			
Highest frequency: CH48						
Test conditions: 1 TX , P14, MCS0						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	1.725	-78.9	-33.0	-45.9
30	1000	100	367.0	-72.1	-33.0	-39.1
1000	5150	1000	4760.4	-49.5	-33.0	-16.5
5250	12000	1000	5600.9	-51.5	-33.0	-18.5
12000	20000	1000	17855.6	-66.0	-33.0	-33.0
20000	40000	1000	39993.8	-55.3	-33.0	-22.3
Measurement uncertainty				±3 dB		

802.11n, HT40			PK-measurement			
Lowest frequency: CH36up						
Test conditions: 1 TX , P11, MCS8						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	2.001	-77.6	-33.0	-44.6
30	1000	100	30.1	-74.0	-33.0	-41.0
1000	5150	1000	5147.4	-35.6	-33.0	-2.6
5250	12000	1000	5639.0	-53.0	-33.0	-20.0
12000	20000	1000	17813.3	-66.6	-33.0	-33.6
20000	40000	1000	39945.0	-56.3	-33.0	-23.3
Measurement uncertainty				±3 dB		

Note: The output power setting for this channel is reduced to P11!

802.11n, HT40			PK-measurement			
Highest frequency: CH44up						
Test conditions: 1 TX , P14, MCS8						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	2.075	-78.7	-33.0	-45.7
30	1000	100	30.2	-72.2	-33.0	-39.2
1000	5150	1000	5143.8	-46.3	-33.0	-13.3
5250	12000	1000	5615.5	-53.5	-33.0	-20.5
12000	20000	1000	14942.1	-66.6	-33.0	-33.6
20000	40000	1000	39971.3	-56.1	-33.0	-23.1
Measurement uncertainty				±3 dB		

5.6.5.2 Gain group 2

Due to the antenna gain the limit is 9 dB reduced!

802.11a	PK-measurement					
Lowest frequency: CH36						
Test conditions: 1 TX , P11, 6 Mbps, 9 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	1.762	-79.1	-36.0	-43.1
30	1000	100	34.6	-73.3	-36.0	-37.3
1000	5150	1000	5096.1	-48.0	-36.0	-12.0
5250	12000	1000	5639.3	-53.3	-36.0	-17.3
12000	20000	1000	17370.3	-66.6	-36.0	-30.6
20000	40000	1000	39995.0	-56.3	-36.0	-20.3
Measurement uncertainty				±3 dB		

802.11a	PK-measurement					
Middle frequency: CH40						
Test conditions: 1 TX , P11, 6 Mbps, 9 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	30.000	-72.2	-36.0	-36.2
30	1000	100	34.5	-74.2	-36.0	-38.2
1000	5150	1000	5116.8	-47.6	-36.0	-11.6
5250	12000	1000	5622.9	-54.1	-36.0	-18.1
12000	20000	1000	19362.7	-66.6	-36.0	-30.6
20000	40000	1000	39958.8	-57.0	-36.0	-21.0
Measurement uncertainty				±3 dB		

802.11a	PK-measurement					
Highest frequency: CH48						
Test conditions: 1 TX , P11, 6 Mbps, 9 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	100	1.986	-78.9	-36.0	-42.9
30	1000	100	36.1	-73.8	-36.0	-37.8
1000	5150	100	4759.9	-49.8	-36.0	-13.8
5250	12000	100	5719.9	-53.1	-36.0	-17.1
12000	20000	100	18879.3	-66.4	-36.0	-30.4
20000	40000	100	39988.8	-57.0	-36.0	-21.0
Measurement uncertainty				±3 dB		

802.11n, HT20			PK-measurement			
Lowest frequency: CH36						
Test conditions: 1 TX , P11, MCS0, 9 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	2.142	-78.4	-36.0	-42.4
30	1000	100	37.2	-73.9	-36.0	-37.9
1000	5150	1000	5102.3	-46.6	-36.0	-10.6
10000	12000	1000	10362.1	-67.6	-36.0	-31.6
12000	20000	1000	17910.5	-65.9	-36.0	-29.9
20000	40000	1000	39995.0	-56.7	-36.0	-20.7
Measurement uncertainty				±3 dB		

802.11n, HT20			PK-measurement			
Middle frequency: CH40						
Test conditions: 1 TX , P11, MCS0, 9 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	2.628	-78.6	-36.0	-42.6
30	1000	100	366.3	-74.9	-36.0	-38.9
1000	5150	1000	5123.0	-47.4	-36.0	-11.4
5250	12000	1000	5644.8	-53.8	-36.0	-17.8
12000	20000	1000	15024.5	-66.6	-36.0	-30.6
20000	40000	1000	39988.8	-57.0	-36.0	-21.0
Measurement uncertainty				±3 dB		

802.11n, HT20			PK-measurement			
Highest frequency: CH48						
Test conditions: 1 TX , P11, MCS0, 9 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	2.113	-78.2	-36.0	-42.2
30	1000	100	30.5	-72.8	-36.0	-36.8
1000	5150	1000	4760.4	-49.6	-36.0	-13.6
5250	12000	1000	5599.1	-53.3	-36.0	-17.3
12000	20000	1000	19236.4	-67.1	-36.0	-31.1
20000	40000	1000	39978.8	-57.2	-36.0	-21.2
Measurement uncertainty				±3 dB		

802.11n, HT40			PK-measurement			
Lowest frequency: CH36up						
Test conditions: 1 TX , P11, MCS8, 9 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	1.934	-78.6	-36.0	-42.6
30	1000	100	30.1	-71.6	-36.0	-35.6
1000	5150	1000	5145.3	-43.6	-36.0	-7.6
5250	12000	1000	5679.6	-53.8	-36.0	-17.8
12000	20000	1000	19216.2	-66.9	-36.0	-30.9
20000	40000	1000	39996.3	-56.0	-36.0	-20.0
Measurement uncertainty				±3 dB		

802.11n, HT40			PK-measurement			
Highest frequency: CH44up						
Test conditions: 1 TX , P11, MCS8, 9 dBi gain						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm/MHz)	(dBm/MHz)	(dB)
0.009	30	10	1.896	-78.2	-36.0	-42.2
30	1000	100	30.4	-73.2	-36.0	-37.2
1000	5150	1000	4759.9	-49.1	-36.0	-13.1
5250	12000	1000	5624.7	-54.2	-36.0	-18.2
12000	20000	1000	13669.4	-66.8	-36.0	-30.8
20000	40000	1000	39987.5	-56.8	-36.0	-20.8
Measurement uncertainty				±3 dB		

Limit according to FCC Part 15E, Section 15.407(b) for undesirable emissions:

Operating frequency range	Undesirable emission limit, EIRP
(MHz)	(dBm/MHz)
5150 - 5250	-27.0

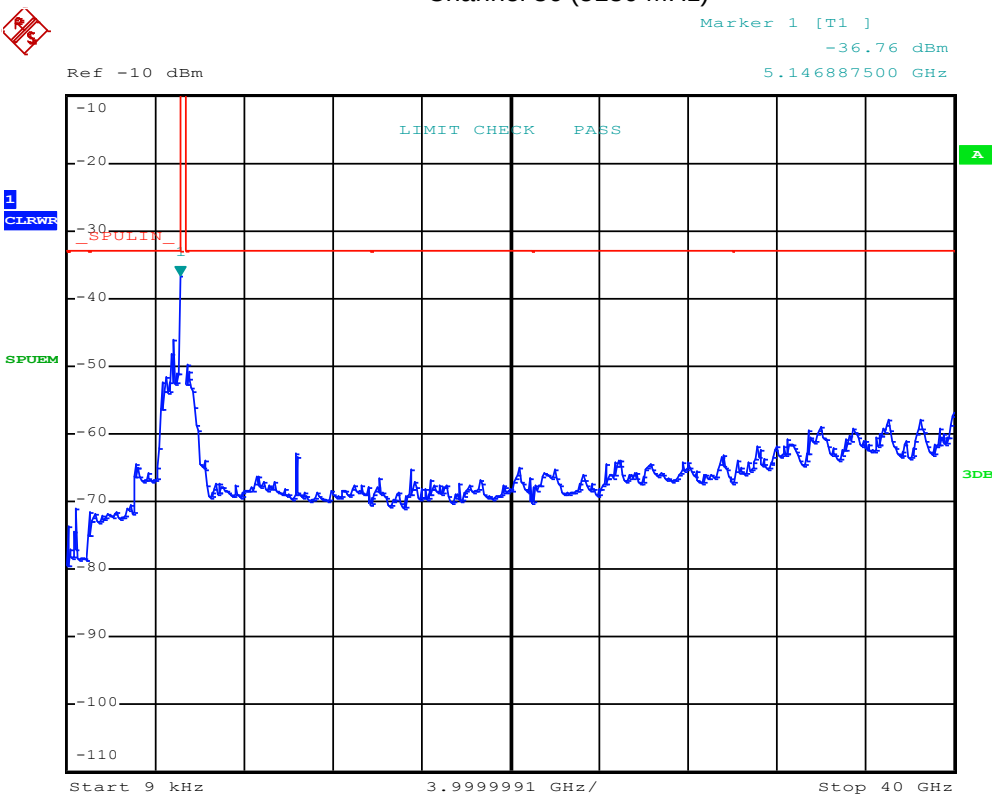
The requirements are **FULFILLED.**

Remarks: The measurement is performed from 9 kHz up to 40 GHz. For detailed test results please see the following test protocols. The CH36, HT20 is listed as representative.

5.6.6 Test protocols undesirable emission conducted

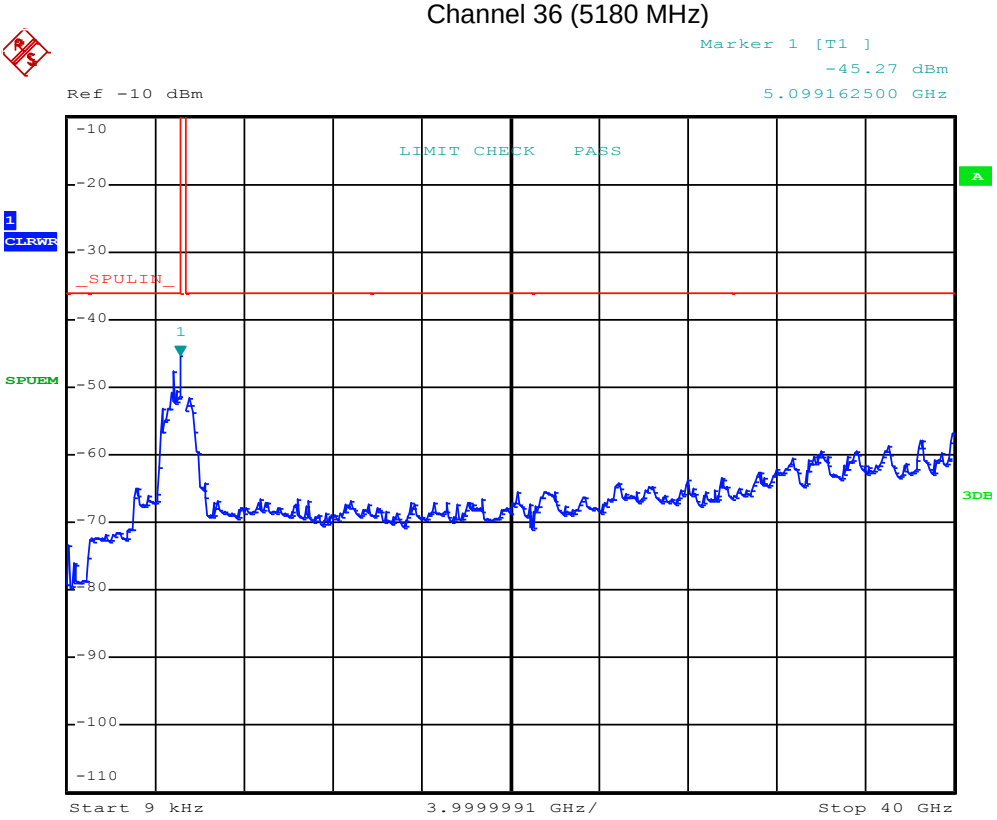
Gain group 1, HT20:

Channel 36 (5180 MHz)



Gain group 2, HT20:

Channel 36 (5180 MHz)



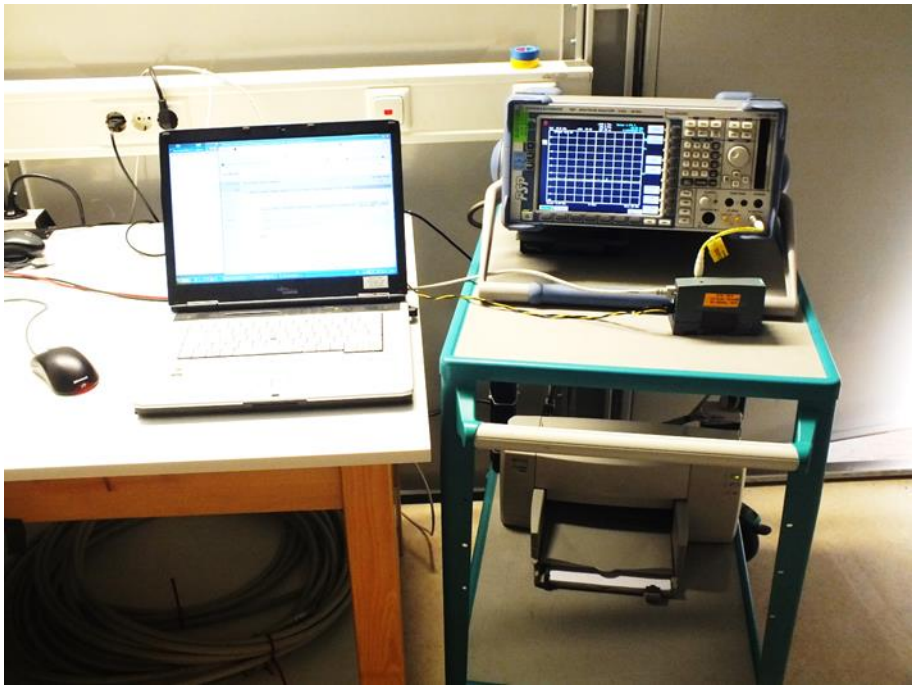
5.7 Undesirable emissions in restricted bands, conducted

For test instruments and accessories used see section 6 Part **SEC 1, SEC 2 and SEC 3**.

5.7.1 Description of the test location

Test location: AREA4

5.7.2 Photo documentation of the test set-up



5.7.3 Applicable standard

According to FCC Part 15E, Section 15.407(b):
For transmitters operating in the defined bands shall not exceed the appropriate emission limit outside of the operating bands.
In addition, radiated emissions which fall in the restricted bands, as defined in Section15.205(a), must also comply with the radiated emission limit specified in Section15.209(a) (see Section15.205(c)).

5.7.4 Description of Measurement

Undesirable emissions are measured using a spectrum analyser and following the procedures according the OET 789033, item H. If the emission level of the EUT in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. Up from 8 GHz a HP filter is used.
Spectrum analyser setting:
Peak-measurement:

9 - 150 kHz:	RBW: 300 Hz,	VBW: 1 kHz,	Detector: Max peak,	Trace Mode: Max hold;
0.15 - 30 MHz:	RBW: 10 kHz,	VBW: 30 kHz,	Detector: Max peak,	Trace Mode: Max hold;
30 – 1000 MHz:	RBW: 100 kHz,	VBW: 300 kHz,	Detector: Max peak,	Trace Mode: Max hold;
1 – 40 GHz:	RBW: 1 MHz,	VBW: 3 MHz,	Detector: Max peak,	Trace Mode: Max hold;

AV-measurement according KDB 789033, Item H)6)d) Method VB:
RBW: 1 MHz, VBW: ≥ 1/T, Detector: Max peak, Trace Mode: Max hold, Sweep time: auto;
For 801.11b: VBW = 100 Hz, for 801.11g, n HT20: VBW = 1 kHz, for 801.11g, n HT40: VBW = 3 kHz;

5.7.5 Test result emissions in restricted bands, conducted

5.7.5.1 Gain group 1

802.11a	PK-measurement						
Lowest frequency: CH36							
Test conditions: 1 TX, P14, 6 Mbps			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4399.8	45.9	6.0	74.0	-22.1
4500	5150	1000	5143.5	62.8	6.0	74.0	-5.2
5350	5460	1000	5360.4	46.5	6.0	74.0	-21.5
7250	7750	1000	7697.9	38.4	6.0	74.0	-29.6
Measurement uncertainty				±3 dB			

Note: The marked frequency/margin has exceeded the AV-Limit and has to be re-measured.

AV-measurement						
Lowest frequency: CH36						
Test conditions: 1 TX, P14, 6 Mbps				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
5150	46.5	1000	6.0	52.5	54.0	-1.5
Measurement uncertainty				±3 dB		

802.11a	PK-measurement						
Middle frequency: CH40							
Test conditions: 1 TX, P14, 6 Mbps			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4400.0	45.5	6.0	74.0	-22.5
4500	5150	1000	5141.6	50.2	6.0	74.0	-17.8
5350	5460	1000	5382.1	44.4	6.0	74.0	-23.6
7250	7750	1000	7400.9	38.5	6.0	74.0	-29.5
Measurement uncertainty				±3 dB			

AV-measurement						
Middle frequency: CH40						
Test conditions: 1 TX, P14, 6 Mbps				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
5125	44.4	1000	6.0	50.4	54.0	-3.6
Measurement uncertainty				±3 dB		

FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

802.11a	PK-measurement						
Highest frequency: CH48							
Test conditions: 1 TX, P14, 6 Mbps			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4400.0	46.0	6.0	74.0	-22.0
4500	5150	1000	4906.2	48.1	6.0	74.0	-19.9
5350	5460	1000	5370.0	46.7	6.0	74.0	-21.3
7250	7750	1000	7464.6	38.5	6.0	74.0	-29.5
Measurement uncertainty				±3 dB			

AV-measurement						
Highest frequency: CH48						
Test conditions: 1 TX, P14, 6 Mbps				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4720	46.7	1000	6.0	52.7	54.0	-1.3
Measurement uncertainty				±3 dB		

802.11n, HT20	PK-measurement						
Lowest frequency: CH36							
Test conditions: 1 TX, P14, MCS0			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4399.8	46.3	6.0	74.0	-21.7
4500	5150	1000	5148.1	63.2	6.0	74.0	-4.8
5350	5460	1000	5358.2	46.8	6.0	74.0	-21.2
7250	7750	1000	7280.7	38.8	6.0	74.0	-29.2
Measurement uncertainty				±3 dB			

Note: The marked frequency/margin has exceeded the AV-Limit and has to be re-measured.

AV-measurement						
Lowest frequency: CH36						
Test conditions: 1 TX, P14, MCS0				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
5150	46.8	1000	6.0	52.8	54.0	-1.2
Measurement uncertainty				±3 dB		

802.11n, HT20	PK-measurement						
Middle frequency: CH40							
Test conditions: 1 TX, P14, MCS0			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4399.8	45.7	6.0	74.0	-22.3
4500	5150	1000	5125.7	54.2	6.0	74.0	-13.8
5350	5460	1000	5354.2	46.9	6.0	74.0	-21.1
7250	7750	1000	7266.6	38.3	6.0	74.0	-29.7
Measurement uncertainty				±3 dB			

AV-measurement						
Middle frequency: CH40						
Test conditions: 1 TX, P14, MCS0				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
5125	46.9	1000	6.0	52.9	54.0	-1.1
Measurement uncertainty				±3 dB		

802.11n, HT20	PK-measurement						
Highest frequency: CH48							
Test conditions: 1 TX, P14, MCS0			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4399.8	46	6.0	74.0	-21.8
4500	5150	1000	4897.8	48	6.0	74.0	-19.9
5350	5460	1000	5364.0	47	6.0	74.0	-21.0
7250	7750	1000	7316.5	39	6.0	74.0	-29.4
Measurement uncertainty				±3 dB			

AV-measurement						
Highest frequency: CH48						
Test conditions: 1 TX, P14, MCS0				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4720	38.1	1000	6.0	44.1	54.0	-9.9
Measurement uncertainty				±3 dB		

802.11n, HT40	PK-measurement						
Lowest frequency: CH36up							
Test conditions: 1 TX, P11, MCS8			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4359.9	39.4	6.0	74.0	-28.6
4500	5150	1000	5147.4	59.7	6.0	74.0	-8.3
5350	5460	1000	5403.0	40.8	6.0	74.0	-27.2
7250	7750	1000	7423.8	17.8	6.0	74.0	-50.2
Measurement uncertainty				±3 dB			

Note: The output power setting for this channel is reduced to P11! The marked frequency/margin has exceeded the AV-Limit and has to be re-measured.

AV-measurement						
Lowest frequency: CH36up						
Test conditions: 1 TX, P11, MCS8				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBµV/m)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4800	46.3	1000	6.0	52.3	54.0	-1.7
Measurement uncertainty				±3 dB		

802.11n, HT40	PK-measurement						
Highest frequency: CH44up							
Test conditions: 1 TX, P14, MCS0			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4359.9	44.4	6.0	74.0	-23.6
4500	5150	1000	5148.8	57.2	6.0	74.0	-10.8
5350	5460	1000	5366.0	46.6	6.0	74.0	-21.4
7250	7750	1000	7629.8	38.9	6.0	74.0	-29.1
Measurement uncertainty				±3 dB			

AV-measurement						
Lowest frequency: CH44up						
Test conditions: 1 TX, P14, MCS0				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
5148	41.5	1000	6.0	47.5	54.0	-6.5
Measurement uncertainty				±3 dB		

5.7.5.2 Gain group 2

802.11a	PK-measurement						
Lowest frequency: CH36							
Test conditions: 1 TX, P11, 6 Mbps			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4400.0	46.0	9.0	74.0	-19.0
4500	5150	1000	5148.1	56.4	9.0	74.0	-8.6
5350	5460	1000	5399.9	45.7	9.0	74.0	-19.3
7250	7750	1000	7474.2	38.4	9.0	74.0	-26.6
Measurement uncertainty				±3 dB			

Note: The marked frequency/margin has exceeded the AV-Limit and has to be re-measured.

AV-measurement						
Lowest frequency: CH36						
Test conditions: 1 TX, P11, 6 Mbps				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4360	42.1	1000	9.0	51.1	54.0	-2.9
4680	40.9	1000	9.0	49.9	54.0	-4.1
5440	33.4	1000	9.0	42.4	54.0	-11.6
Measurement uncertainty				±3 dB		

802.11a	PK-measurement						
Middle frequency: CH40							
Test conditions: 1 TX, P11, 6 Mbps			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4400.0	45.5	9.0	74.0	-19.5
4500	5150	1000	5141.6	50.2	9.0	74.0	-14.8
5350	5460	1000	5382.1	44.4	9.0	74.0	-20.6
7250	7750	1000	7400.9	38.5	9.0	74.0	-26.5
Measurement uncertainty				±3 dB			

AV-measurement						
Middle frequency: CH40						
Test conditions: 1 TX, P11, 6 Mbps				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4360	42.3	1000	9.0	51.3	54.0	-2.7
4680	41.8	1000	9.0	50.8	54.0	-3.2
Measurement uncertainty				±3 dB		

FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

802.11a	PK-measurement						
Highest frequency: CH48							
Test conditions: 1 TX, P11, 6 Mbps			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4359.9	45.0	9.0	74.0	-20.0
4500	5150	1000	5065.3	46.2	9.0	74.0	-18.8
5350	5460	1000	5413.9	44.5	9.0	74.0	-20.5
7250	7750	1000	7251.8	38.3	9.0	74.0	-26.7
Measurement uncertainty				±3 dB			

AV-measurement						
Highest frequency: CH48						
Test conditions: 1 TX, P11, 6 Mbps				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4360	40.4	1000	9.0	49.4	54.0	-4.6
4720	40.9	1000	9.0	49.9	54.0	-4.1
Measurement uncertainty				±3 dB		

802.11n, HT20	PK-measurement						
Lowest frequency: CH36							
Test conditions: 1 TX, P11, MCS0			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4359.9	44.9	9.0	74.0	-20.1
4500	5150	1000	5149.4	58.4	9.0	74.0	-6.6
5350	5460	1000	5416.7	45.2	9.0	74.0	-19.8
7250	7750	1000	7350.4	38.2	9.0	74.0	-26.8
Measurement uncertainty				±3 dB			

Note: The marked frequency/margin has exceeded the AV-Limit and has to be re-measured.

AV-measurement						
Lowest frequency: CH36						
Test conditions: 1 TX, P11, MCS0				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4680	41.6	1000	9.0	50.6	54.0	-3.4
5440	34.2	1000	9.0	43.2	54.0	-10.8
Measurement uncertainty				±3 dB		

FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

802.11n, HT20	PK-measurement						
Middle frequency: CH40							
Test conditions: 1 TX, P11, MCS0			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4360.1	45.1	9.0	74.0	-19.9
4500	5150	1000	5114.1	51.9	9.0	74.0	-13.1
5350	5460	1000	5396.7	44.6	9.0	74.0	-20.4
7250	7750	1000	7474.0	38.6	9.0	74.0	-26.4
Measurement uncertainty				±3 dB			

AV-measurement						
Middle frequency: CH40						
Test conditions: 1 TX, P11, MCS0				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4360	41.9	1000	9.0	50.9	54.0	-3.1
4680	40.4	1000	9.0	49.4	54.0	-4.6
Measurement uncertainty				±3 dB		

802.11n, HT20	PK-measurement						
Highest frequency: CH48							
Test conditions: 1 TX, P11, MCS0			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4359.7	45.6	9.0	74.0	-19.4
4500	5150	1000	5097.0	45.9	9.0	74.0	-19.1
5350	5460	1000	5392.7	44.6	9.0	74.0	-20.4
7250	7750	1000	7469.2	38.7	9.0	74.0	-26.3
Measurement uncertainty				±3 dB			

AV-measurement						
Highest frequency: CH48						
Test conditions: 1 TX, P11, MCS0				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBm)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4400	41.3	1000	9.0	50.3	54.0	-3.7
4720	40.9	1000	9.0	49.9	54.0	-4.1
Measurement uncertainty				±3 dB		

FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

802.11n, HT40			PK-measurement				
Lowest frequency: CH36up							
Test conditions: 1 TX, P11, MCS8			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4280.1	40.9	9.0	74.0	-24.1
4500	5150	1000	5145.3	51.7	9.0	74.0	-13.3
5350	5460	1000	5432.4	40.7	9.0	74.0	-24.3
7250	7750	1000	7547.5	18.3	9.0	74.0	-46.7
Measurement uncertainty				±3 dB			

Lowest frequency: CH36up						
Test conditions: 1 TX, P11, MCS8				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBµV/m)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
5150	42.3	1000	9.0	51.3	54.0	-2.7
Measurement uncertainty				±3 dB		

802.11n, HT40			PK-measurement				
Highest frequency: CH44up							
Test conditions: 1 TX, P11, MCS8			Test results				
Start *f*	Stop *f*	RBW	Maximum emission		G	Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBi)	(dBµV/m)	(dB)
3600	4400	1000	4280.1	40.1	9.0	74.0	-24.9
4500	5150	1000	4759.9	46.2	9.0	74.0	-18.8
5350	5460	1000	5436.1	40.4	9.0	74.0	-24.6
7250	7750	1000	7466.9	18.1	9.0	74.0	-46.9
Measurement uncertainty				±3 dB			

Note: The marked frequency/margin has exceeded the AV-Limit and has to be re-measured.

AV-measurement						
Lowest frequency: CH44up						
Test conditions: 1 TX, P11, MCS8				Test results		
f	A	RBW	G	E	AV Limit	Margin
(MHz)	(dBµV/m)	(kHz)	(dBi)	(dBµV/m)	(dBµV/m)	(dB)
4680	41.0	1000	9.0	50.0	54.0	-4.0
Measurement uncertainty				±3 dB		

FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

Radiated limits according to FCC Part 15C, Section 15.209(a):

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
0.009 - 0.490	2400/F(kHz)		300
0.490 - 1.705	24000/F(kHz)		30
1.705 - 30	30	29.5	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

FCC Part 15C, Section 15.205, restricted bands of operation:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

The requirements are **FULFILLED.**

Remarks: _____

_____

5.9 Undesirable emissions, cabinet radiation

For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

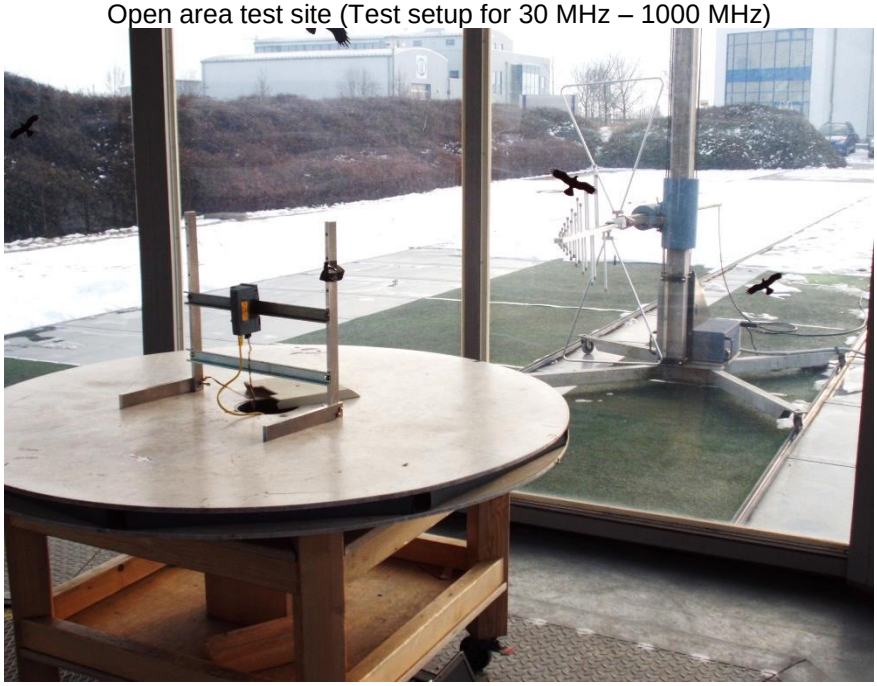
5.9.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 2

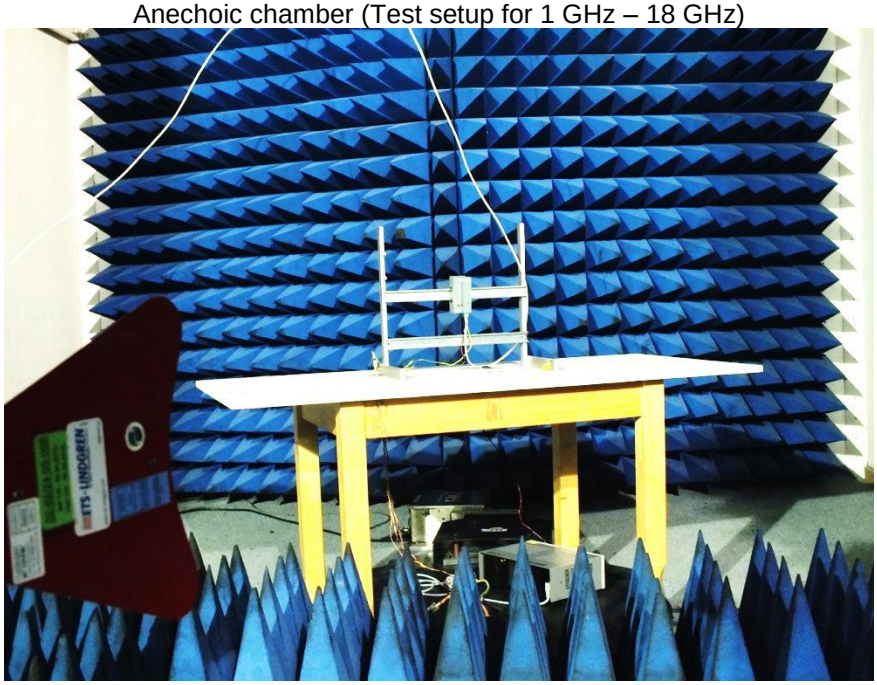
Test distance: 3 m

5.9.2 Photo documentation of the test set-up

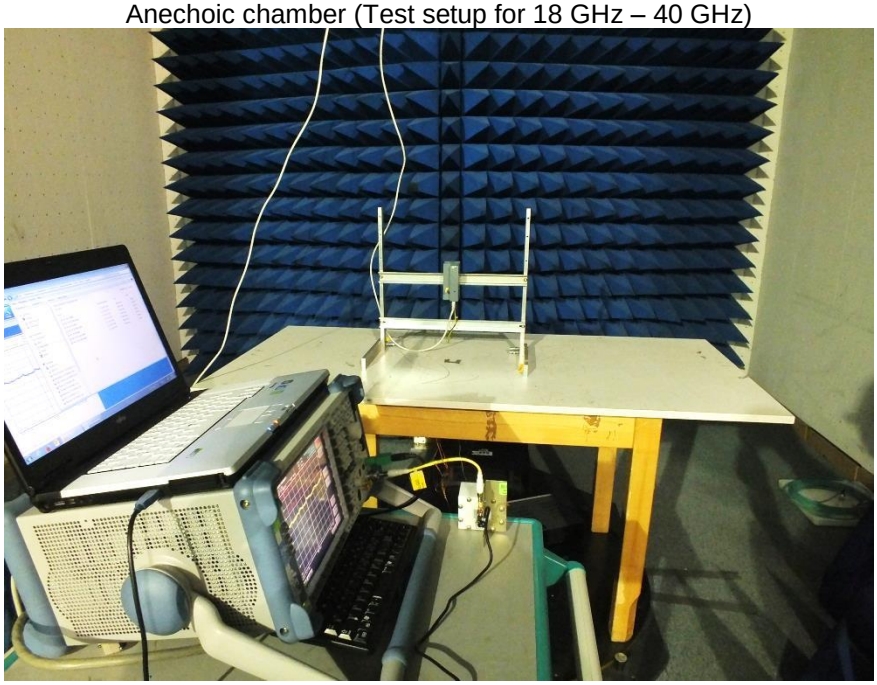
Open area test site (Test setup for 30 MHz – 1000 MHz)



Anechoic chamber (Test setup for 1 GHz – 18 GHz)



Anechoic chamber (Test setup for 18 GHz – 40 GHz)



5.9.3 Applicable standard

According to FCC Part 15E, Section 15.407(b):
For transmitters operating in the defined bands shall not exceed the appropriate emission limit outside of the operating bands.
In addition, radiated emissions which fall in the restricted bands, as defined in Section15.205(a), must also comply with the radiated emission limit specified in Section15.209(a) (see Section15.205(c)).

5.9.4 Description of Measurement

Radiated spurious emissions are measured with the setup set out in ANSI C63.4. If the emission level of the EUT in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. Up from 8 GHz a HP filter is used. A conversion EIRP to Field strength is done with the formula FS = EIRP + 95.2 , FS (dBµV/m), EIRP (dBm).

Spectrum analyser settings for peak values:
RBW: 1 MHz VBW: 3 MHz Sweep: Auto

5.9.5 Test result

In the frequency range 30 MHz. to 1000 MHz no emission could be detected.

802.11a:

Lowest frequency: **5180 MHz**						
Highest power setting : P20						
			Test results			
Start frequ.	Stop frequ.	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
1000	4000	1000	3792	42.4	74.0	-31.6
4000	5150	1000	4800	45.6	74.0	-28.4
5350	12000	1000	11974	53.7	74.0	-20.3
12000	18000	1000	16680	54.0	74.0	-20.0
18000	40000	1000	-	< 50	74.0	< -24
Measurement uncertainty			±6 dB			

HT20

Lowest frequency: **5180 MHz**						
Highest power setting : P20						
			Test results			
Start frequ.	Stop frequ.	RBW	Maximum emission		Limit	Margin
1000	4000	1000	1873	42.4	74.0	-31.6
4000	5150	1000	4635	45.3	74.0	-28.7
5350	12000	1000	11936	51.3	74.0	-22.7
12000	18000	1000	17580	47.9	74.0	-26.1
18000	40000	1000	-	< 50	74.0	< -24
Measurement uncertainty			±6 dB			

HT40:

Lowest frequency: **5190 MHz**						
Highest power setting : P20						
			Test results			
Start frequ.	Stop frequ.	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
1000	4000	1000	1828	41.9	74.0	-32.1
4000	5150	1000	5150	52.3	74.0	-21.7
5350	12000	1000	11858	52.1	74.0	-21.9
12000	18000	1000	16812	53.5	74.0	-20.5
18000	40000	1000	-	< 50	74.0	< -24
Measurement uncertainty			±6 dB			

FCC ID: LYHELN1V1 IC: 267AA-ELN1V1

Radiated limits according to FCC Part 15C, Section 15.209(a):

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
0.009 - 0.490	2400/F(kHz)		300
0.490 - 1.705	24000/F(kHz)		30
1.705 - 30	30	29.5	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

The requirements are **FULFILLED.**

Remarks: The measurement was performed from 30 MHz up to 40 GHz.

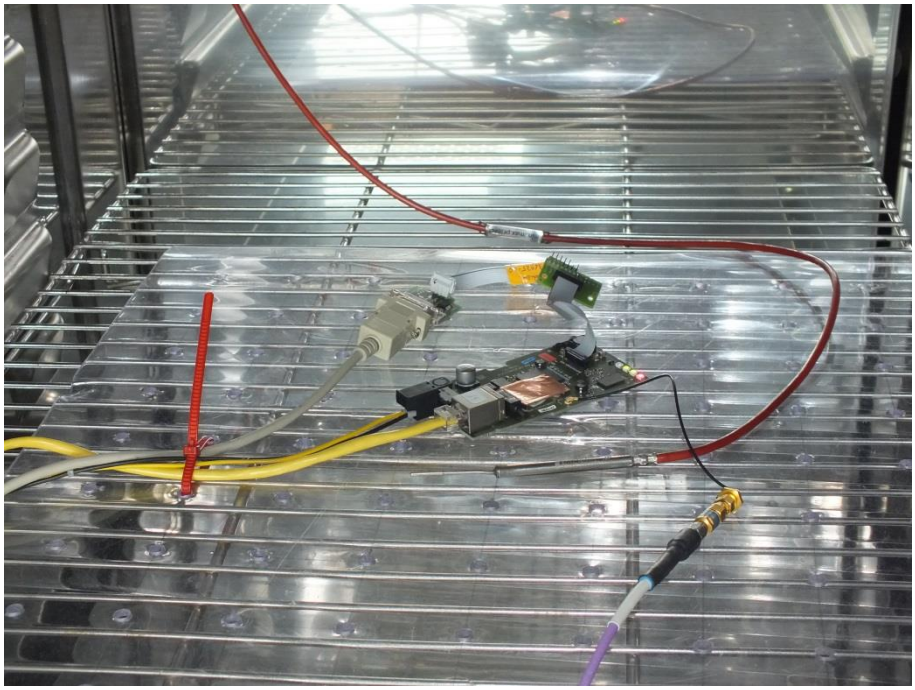
5.10 Frequency stability

For test instruments and accessories used see section 6 Part **MB**.

5.10.1 Description of the test location

Test location: AREA4

5.10.2 Photo documentation of the test setup



5.10.3 Applicable standard

According to FCC Part 15, Subpart E, Section 15.407 (g):
Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

5.10.4 Description of Measurement

This test has been performed over variations in temperature and voltage. The lowest and the highest channel in the operating frequency bands are measured at the 20 dB bandwidth under following conditions:

1. Supply voltage from 100 VAC to 120 VAC at normal temperature
2. Extreme temperature from 0 ˚C to 40 ˚C at nominal voltage.

5.10.5 Test result

Frequency band 5150 – 5250 MHz:
802.11a:

Test conditions		Test result			
		Frequency (MHz)			
T (0°C)	V_{nom}	f_l	5171.724	f_h	5248.410
T(10°C)	V_{nom}	f_l	5171.690	f_h	5248.420
T_{nom}(20°C)	V_{max}	f_l	5171.680	f_h	5248.420
	V_{min}	f_l	5171.680	f_h	5248.420
T (30°C)	V_{nom}	f_l	5171.700	f_h	5248.445
T (40°C)	V_{nom}	f_l	5171.730	f_h	5248.473
T (50°C)	V_{nom}	f_l	5171.750	f_h	5248.490
T (60°C)	V_{nom}	f_l	5171.778	f_h	5248.501
Measurement uncertainty		±1500 Hz			

Occupied spectrum envelope:

Measured frequency nearest at the lowest band edge: f_l = 5171.680

Measured frequency nearest at the highest band edge: f_h = 5248.501

802.11n, HT20:

Test conditions		Test result			
		Frequency (MHz)			
T (0°C)	V_{nom}	f_l	5171.127	f_h	5249.039
T(10°C)	V_{nom}	f_l	5171.122	f_h	5249.025
T_{nom}(20°C)	V_{max}	f_l	5171.120	f_h	5249.020
	V_{min}	f_l	5171.120	f_h	5249.020
T (30°C)	V_{nom}	f_l	5171.145	f_h	5249.042
T (40°C)	V_{nom}	f_l	5171.163	f_h	5249.066
T (50°C)	V_{nom}	f_l	5171.186	f_h	5249.088
T (60°C)	V_{nom}	f_l	5171.202	f_h	5249.108
Measurement uncertainty		±1500 Hz			

Occupied spectrum envelope:

Measured frequency nearest at the lowest band edge: f_l = 5171.120

Measured frequency nearest at the highest band edge: f_h = 5249.108

802.11n, HT40:

Test conditions		Test result			
		Frequency (MHz)			
T (0°C)	V_{nom}	f_l	5171.898	f_h	5248.712
T(10°C)	V_{nom}	f_l	5171.891	f_h	5248.706
T_{nom}(20°C)	V_{max}	f_l	5171.880	f_h	5248.700
	V_{min}	f_l	5171.880	f_h	5248.700
T (30°C)	V_{nom}	f_l	5171.899	f_h	5248.709
T (40°C)	V_{nom}	f_l	5171.923	f_h	5248.733
T (50°C)	V_{nom}	f_l	5171.937	f_h	5248.751
T (60°C)	V_{nom}	f_l	5171.968	f_h	5248.772
Measurement uncertainty		±1500 Hz			

Occupied spectrum envelope:

Measured frequency nearest at the lowest band edge: f_l = 5171.880

Measured frequency nearest at the highest band edge: f_h = 5248.772

According to FCC Part 15, Subpart E, Section 15.407 (g):
Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

Operating frequency range limit	
(MHz)	(MHz)
5150	5250

The requirements are **FULFILLED.**

Remarks: _____

_____

5.11 Maximum permissible exposure (MPE)

For test instruments and accessories used see section 6 Part **CPC 3**.

5.11.1 Description of the test location

Test location: AREA4

5.11.2 Applicable standard

According to FCC Part 15, Section 15.407(f):
U-NII devices are subject to the radio frequency radiation exposure requirements specified in Section 1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. All equipment shall considered to operate in a "general population/uncontrolled" environment. The test methods used comply with ANSI/IEEE C95.1-2005, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".

5.11.3 Description of Measurement

The maximum total power input to the antenna has been measured conducted as described in clause 5.3 of this document. Through the Friis transmission formula, which is a far field assumption and the known maximum gain of the antenna, the maximum MPE at a defined distance away from the product, can be calculated.

Friis transmission formula:

$$P_d = \frac{P_{out} * G}{4 * \Pi * r^2}$$

where

P_d =power density in mW/cm^2
P_{out} = output power to antenna in mW
G = gain of antenna (linear scale)
r = distance between antenna and observation point (cm)

5.11.4 Test result

For fixed equipment the distance r = 20 cm

5.11.4.1 Gain group 1

WLAN Standard 802.11a, Legacy, 1 TX chain, highest power level

Channel No.	Power setting	A (dBm)	Antgain (dBi)	A (mW)	G linear	P (W)	S (mW/cm^2)	Limit S_{eq} (mW/cm^2)
36	P20	12.9	6.0	19.50	3.98	0.0776	0.0154	1.0
40	P20	12.5	6.0	17.78	3.98	0.0708	0.0141	1.0
48	P20	12.9	6.0	19.50	3.98	0.0776	0.0154	1.0

WLAN Standard 802.11n, HT20, 1 TX chain, highest power level

Channel No.	Power setting	A (dBm)	Antgain (dBi)	A (mW)	G linear	P (W)	S (mW/cm^2)	Limit S_{eq} (mW/cm^2)
36	P20	12.7	6.0	18.62	3.98	0.0741	0.0147	1.0
40	P20	12.7	6.0	18.62	3.98	0.0741	0.0147	1.0
48	P20	12.8	6.0	19.05	3.98	0.0759	0.0151	1.0

WLAN Standard 802.11n, HT40, 1 TX chain, highest power level

Channel No.	Power setting	A (dBm)	Antgain (dBi)	A (mW)	G linear	P (W)	S (mW/cm^2)	Limit S_{eq} (mW/cm^2)
36up	P20	11.8	6.0	15.14	3.98	0.0603	0.0120	1.0
44up	P20	11.8	6.0	15.14	3.98	0.0603	0.0120	1.0

5.11.4.2 Gain group 2

WLAN Standard 802.11a, Legacy, 1 TX chain, highest power level

Channel No.	Power setting	A (dBm)	Antgain (dBi)	A (mW)	G linear	P (W)	S (mW/cm^2)	Limit S_{eq} (mW/cm^2)
36	P17	12.6	9.0	18.20	7.94	0.1445	0.0288	1.0
40	P17	12.9	9.0	19.50	7.94	0.1549	0.0308	1.0
48	P17	12.9	9.0	19.50	7.94	0.1549	0.0308	1.0

WLAN Standard 802.11n, HT20, 1 TX chain, highest power level

Channel No.	Power setting	A (dBm)	Antgain (dBi)	A (mW)	G linear	P (W)	S (mW/cm^2)	Limit S_{eq} (mW/cm^2)
36	P17	12.6	9.0	18.20	7.94	0.1445	0.0288	1.0
40	P17	12.6	9.0	18.20	7.94	0.1445	0.0288	1.0
48	P17	12.7	9.0	18.62	7.94	0.1479	0.0294	1.0

WLAN Standard 802.11n, HT40, 1 TX chain, highest power level

Channel No.	Power setting	A (dBm)	Antgain (dBi)	A (mW)	G linear	P (W)	S (mW/cm^2)	Limit S_{eq} (mW/cm^2)
36up	P17	11.8	9.0	15.14	7.94	0.1202	0.0239	1.0
44up	P17	11.8	9.0	15.14	7.94	0.1202	0.0239	1.0

Limits for maximum permissible exposure (MPE):

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(B) Limits for General Population / Uncontrolled Exposure				
0.3 – 3.0	614	1.63	100	30
3.0 – 30	824/f	2.19/f	180/ f^2	30
30 - 300	27.5	0.073	0.2	30
300-1500	---	---	f/1500	30
1500-100000	**---**	**---**	**1.0**	**30**

f = Frequency (MHz)

The requirements are **FULFILLED.**

Remarks: This test report shows the compliance with the limits for maximum permissible exposure (MPE) specified in FCC 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in FCC 1.1307(b).

5.12 Co-location and Co-transmission

Applicable standard:
OET Bulletin 65, Edition 97-01, Section 2: Multiple-transmitter sites and complex environments

The MPE limits of FCC vary with frequency. Therefore, in mixed or broadband RF fields where several sources and frequencies are involved, the fraction of the recommended limit (in terms of power density or square of the electric or magnetic field strength) incurred within each frequency interval should be determined, and the sum of all fractional contributions should not exceed 1.0, or 100 % in terms of percentage.

There is no co-location issue the EUT provides 1 TX port only.

The requirements are **FULFILLED.**

Remarks: For detailed test results please refer to following test protocols.

5.13 Antenna application

5.13.1 Applicable standard

According to FCC Part 15C, Section 15.203:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT use the listed antennas.

5.13.2 Antenna requirements

According to FCC Part 15E, Section 15.407(a):
The conducted output power limit specified in paragraph (a) of 15.407 is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (a)(1), (a)(2) and (a)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds the effective value.

5.13.3 Defacto EIRP-Limit:

For the output power reduction of the used antennas see the following table. The limit is calculated as using following formula, Pout = 30 – (Gx – 6);

Ant. group 2 antennas with max 6 to 9 dBi gain:

Antenna	Gx	Cond. limit	max. G	A [P17]	Limit P_{out}	Reduction	P set
	(dBi)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)	5 GHz
ANT793-6DT	9.0	23.0	6.0	11.8	20.0	-8.2	P17
ANT793-6DG	9.0	23.0	6.0	11.8	20.0	-8.2	P17
ANT795-6DC	9.0	23.0	6.0	11.8	20.0	-8.2	P17
ANT795-6MN	8.0	23.0	6.0	11.8	21.0	-9.2	P17
ANT795-6MT	7.0	23.0	6.0	11.8	22.0	-10.2	P17

Ant. group 1 antennas with max 0 to 6 dBi gain:

Antenna	Gx	Cond. limit	max. G	A [P20]	Limit P_{out}	Reduction	P set
	(dBi)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)	5 GHz
ANT793-4MN	6.0	23.0	6.0	11.8	23.0	-11.2	P20
ANT793-6MN	5.0	23.0	6.0	11.8	24.0	-12.2	P20
ANT795-4MC	5.0	23.0	6.0	11.8	24.0	-12.2	P20
ANT795-4MD	5.0	23.0	6.0	11.8	24.0	-12.2	P20
ANT795-4MA	5.0	23.0	6.0	11.8	24.0	-12.2	P20
A5E002280427-06	5.0	23.0	6.0	11.8	24.0	-12.2	P20
Rcoax 5G	0.0	23.0	6.0	11.8	29.0	-17.2	P20

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	ESHS 30	02-02/03-05-002	16/07/2014	16/07/2013		
	ESH 2 - Z 5	02-02/20-05-004	18/10/2014	18/10/2013		
	KEMA 801	02-02/22-05-016				
	EMV D 30000/PAS	02-02/30-05-006				
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155			10/04/2014	10/10/2013
CPC 3	FSP 40	02-02/11-11-001	30/09/2014	30/09/2013		
	HM8143	02-02/50-10-016				
	KMS102-0,2 m	02-02/50-11-016				
MB	FSP 40	02-02/11-11-001	30/09/2014	30/09/2013		
	WK-340/40	02-02/45-05-001	31/05/2014	31/05/2011		
	HM8143	02-02/50-10-016				
	KMS102-0,2 m	02-02/50-11-016				
SEC 1-3	FSP 40	02-02/11-11-001	30/09/2014	30/09/2013		
	HM8143	02-02/50-10-016				
	KMS102-0,2 m	02-02/50-11-016				
SER 2	ESVS 30	02-02/03-05-006	28/06/2014	28/06/2013		
	VULB 9168	02-02/24-05-005	11/04/2014	11/04/2013		
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
SER 3	FSP 40	02-02/11-11-001	30/09/2014	30/09/2013		
	JS4-18004000-30-5A	02-02/17-05-017				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009			04/04/2014	04/04/2013
	BBHA 9170	02-02/24-05-014				
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	KMS102-0,2 m	02-02/50-11-020				
	SF104/11N/11N/1500MM	02-02/50-13-015				