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Test Report

Report Number:

F170475E1

Equipment under Test (EUT):

Flue Gas Analyzer
A 450

Applicant:

Wöhler Technik GmbH

Manufacturer:

Wöhler Technik GmbH

ilac-MRA
DAkkS Deutsche Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

[1] **ANSI C63.10-2013**, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

[2] **FCC CFR 47 Part 15**, Radio Frequency Devices

[3] **RSS-247 Issue 2 (February 2017)**, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

[4] **RSS-Gen Issue 4 (November 2014)**, General Requirements for Compliance of Radio Apparatus

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.
The complete test results are presented in the following.

Test engineer:	Paul NEUFELD		05.04.2018
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		05.04.2018
	Name	Signature	Date

This test report is only valid in its original form.

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1 Identification

1.1 Applicant

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Country:	Germany
Name for contact purposes:	Mr. Christian LEIFELS
Phone:	+49 (0) 2953-73-100
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eMail Address:	c.leifels@woehler.de
Applicant represented during the test by the following person:	Partly: Mr. Nikolai DERING and Mr. Christian LEIFELS

1.2 Manufacturer

Name:	Wöhler Technik GmbH
Address:	Wöhler-Platz 1 33181 Bad Wünnenberg
Country:	Germany
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eMail Address:	c.leifels@woehler.de
Applicant represented during the test by the following person:	Partly: Mr. Nikolai DERING and Mr. Christian LEIFELS

1.3 Test Laboratory

The tests were carried out by:

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Germany

accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-02, FCC Test Firm Accreditation with the registration number 469623, designation number DE0004 and Industry Canada Test site registration SITE# IC3469A-1.

1.4 EUT (Equipment Under Test)

Test object: *	Flue Gas Analyzer
Type / PMN: *	A 450; A 450 L
FCC ID: *	2ANWR-A450
IC: *	23256-A450
Serial number: *	1556
PCB identifier: *	A 450 MB_2
HVIN (Hardware Version Identification Number): *	A 450
FVIN (Firmware Version Identification Number): *	A 450 US
Hardware version: *	2.00
Software version: *	1.00

WLAN radio channels:

Channel 1	RX:	2412 MHz	TX:	2412 MHz
Channel 6	RX:	2437 MHz	TX:	2437 MHz
Channel 11	RX:	2462 MHz	TX:	2462 MHz

1.5 Technical Data of Equipment

Fulfills specifications: *	IEEE, 802.11b, 802.11g, 802.11n HT20					
Antenna type: *	Ceramic chip antenna					
Antenna name: *	Taiyo Yuden AH316M245001-T					
Antenna gain: *	1.9 dBi					
Antenna connector: *	none					
Supply voltage Base Unit: *	U_{nom}=	3.6 V DC	U_{min}=	3.3 V DC	U_{max}=	4.2 V DC
Supply voltage WLAN chip: *	U_{nom}=	3.3 V DC	U_{min}=	3.2 V DC	U_{max}=	3.4 V DC
Type of modulation: *	802.11b: DSSS 802.11g: OFDM 802.11n: OFDM					
Operating frequency range:*	2412 – 2462 MHz					
Number of channels: *	11					
Temperature range: *	5 °C to 40 °C					
Lowest / highest Internal clock frequency: *	32768 Hz / 2462 MHz					

* Declared by the applicant

Ancillary devices:

Test Laptop	Toshiba SATTELITE PRO NB10t-A-108 (provided by the applicant) SN:YD385065S
AC power adapter	"STONTRONICS" type "DSA-5PFU1-05 FCA 050100" (provided by the applicant)

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
USB cable for power supply and data transmission :*	USB Micro Plug	Test Laptop – USB Plug	3 m *

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	11.07.2017
Start of test:	11.07.2017
End of test:	11.09.2017

2 Operational States

The EUT is a Flue Gas Analyzer with WLAN interface. The EUT can operate as a WLAN Access point or a WLAN client to transmit measurement results to an ancillary laptop.

For the test software from TI called "CC3100/3200 Radio Tool v1.2.5942.19689" was used to set the test modes. The test modes were set using an USB interface at the EUT.

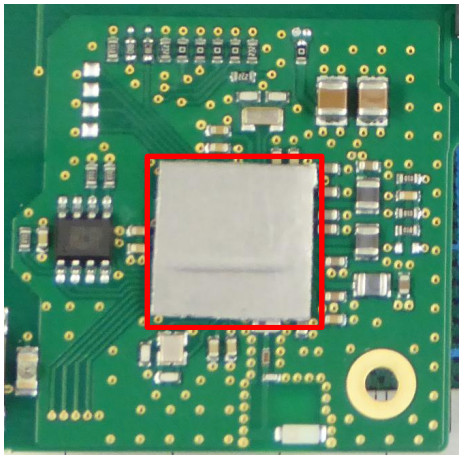
Maximum power Settings for all measurements:

Modulation	Power setting ch. 1 - 11
802.11 b/g/n	Maximum power in radio test tool reduced by 6 dB

Operation mode	Description of the operation mode	mode	channel	Modulation	Data rate / Mbps
1	Continuous transmitting on 2412 MHz	802.11b	1	DSSS	11 Mbps
2	Continuous transmitting on 2437 MHz	802.11b	6	DSSS	11 Mbps
3	Continuous transmitting on 2462 MHz	802.11b	11	DSSS	11 Mbps
4	Continuous transmitting on 2412 MHz	802.11g	1	OFDM	9 Mbps
5	Continuous transmitting on 2437 MHz	802.11g	6	OFDM	9 Mbps
6	Continuous transmitting on 2462 MHz	802.11g	11	OFDM	9 Mbps
7	Continuous transmitting on 2412 MHz	802.11n	1	OFDM	19.5 Mbps
8	Continuous transmitting on 2437 MHz	802.11n	6	OFDM	19.5 Mbps
9	Continuous transmitting on 2462 MHz	802.11n	11	OFDM	19.5 Mbps

3 Additional Information

As depicted below, the manufacturer has applied a RF absorbing material called “Würth Elektronik / WE-FAS EMI”on the radio chip, to pass the spurious emissions. The applied material is indicated by a red square.



4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [3] or RSS-Gen, Issue 4 [4]	Status	Refer page
Maximum Peak Output Power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	11 et seq
Maximum Output Power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	13 et seq
DTS Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [3]	Passed	13 et seq
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [3]	Passed	18 et seq
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	20 et seq.
Radiated emissions (transmitter)	0.009 – 26,500	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	24 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	44 et seq.

5 Results

5.1 Duty cycle

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.7.1.

The method described in chapter 11.6 b) of document [1] was used to perform the following test.

The following measurement technique was used:

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between two bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

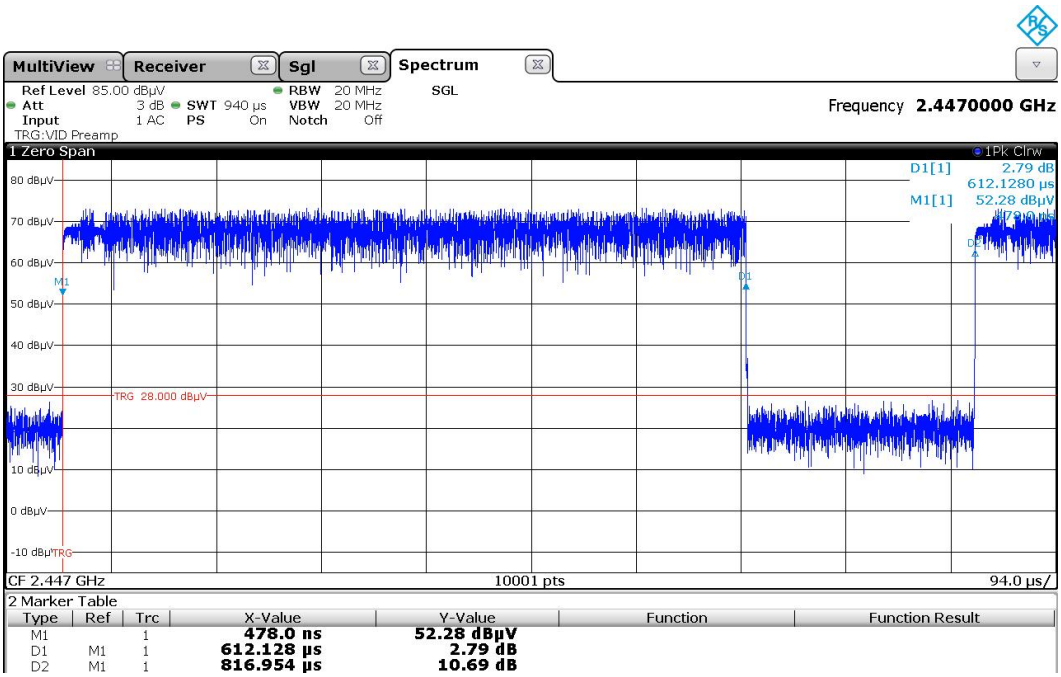
- Set the center frequency of the instrument to the center frequency of the transmission.
- Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.
- Set VBW ≥ RBW.
- Set detector = peak or average.
- The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

5.1.1 Test results

Ambient temperature	22 °C	Relative humidity	40 %

Only the worst case duty cycle plot is submitted below.

DutyCycle MCS2 ch8.PNG: Duty cycle measurement on channel 8 (operation mode 10):



The full calculation is only performed for the worst case, namely the 802.11n mode with MCS2 modulation. For all other modulations, only the results are submitted below.

(1)

$$T_{TX\_On} = 612.128ms \quad , \; T_{TX\_Period} = 816.954ms$$

$$\frac{50}{T_{TX\_On}} = \frac{50}{612.128ms} = 81.682kHz \geq RBW \geq VBW$$

(2)

Measurement Points 10001 for 940 ms à 612.128 ms = 6512 measurement points à Signal has 6512 measurement points (and fulfils the requirement of at least 100 Points resolution for the signal)

If power averaging (RMS) mode was used in step f), then the applicable correction factor is 10 log(1/x), where x is the duty cycle.

$$x = \frac{612.128ms}{816.954ms} = 0.7493 = 74.93\% \quad (3)$$

Correction factor: $10 \times \log\left(\frac{1}{x}\right) = 10 \times \log\left(\frac{1}{0.7493}\right) = 1.25dB$ (4)

Therefore, for average measurements a correction factor of 2.01 dB is used for tests in 802.11n20 mode.

802.11b mode: 1.01 dB correction factor $T_{TX\_On} = 1.2104ms$, $T_{TX\_Period} = 1.5269ms$

802.11g mode: 0.73 dB correction factor $T_{TX\_On} = 1.2682ms$, $T_{TX\_Period} = 1.5002ms$

802.11n20 mode: 1.25 dB correction factor $T_{TX\_On} = 612.128\mu s$, $T_{TX\_Period} = 816.954ms$

TEST EQUIPMENT USED FOR THE TEST:

8 – 14, 17, 18

5.2 Maximum peak conducted output power

5.2.1 Method of measurement

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.7.1.

Acceptable measurement configurations

Procedure 11.9.1.1 in [1] was used for the following test.

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

The measured Electric field strength was corrected with the following correction factor:

Antenna Factor [dB] + Cable Attenuation [dB] - Amplifier Gain[dB] = correction factor [dB]

The formula in 11.12.2.2 e) in [1] was used to calculate the EIRP power:

$E = EIRP - 20\log(d) + 104.8$
$EIRP = E - 95.3$

$MPOP = EIRP - G$

E is the electric field strength in dBµV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m
G is the antenna gain in dBi
MPOP is the maximum peak output power – measured antenna port conducted – in dBm

5.2.2 Test results

Ambient temperature	22 °C	Relative humidity	62 %

The plot below shows the worst case result. All other results are submitted in the table below

MPOP_ch0.PNG: Maximum peak output power measured on channel 0 (operation mode 1):

The antenna gain is below 6 dBi, therefore no conducted output limit reduction is necessary.

Operation mode		Frequency [MHz]	Reading [dBµV]	Corr. Fact. [dB]	Corr. Reading [dBµV]	EIRP [dBm]	MPOP [dBm]	Limit [dBm]
1	b	2412	73.2	33.6	106.8	11.5	9.6	30
2	b	2437	72.1	33.7	105.8	10.5	8.6	30
3	b	2462	69.2	33.8	103.0	7.7	5.8	30
4	g	2412	75.1	33.6	108.7	13.4	11.5	30
5	g	2437	74.5	33.7	108.2	12.9	11.0	30
6	g	2462	72.6	33.8	106.4	11.1	9.2	30
7	n	2412	76.4	33.6	110.0	14.7	12.8	30
8	n	2437	74.2	33.7	107.9	12.6	10.7	30
9	n	2462	73.0	33.8	106.8	11.5	9.6	30

Antenna gain of 1.9dBi respected

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

8 – 14, 17, 18

5.3 Maximum conducted output power

5.3.1 Method of measurement

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.7.1.

Acceptable measurement configurations

Procedure 11.9.2.2.4 in [1] was used for the following test.

Method AVGSA-2 uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction. The procedure for this method is as follows:

a) Measure the duty cycle D of the transmitter output signal as described in 11.6.
b) Set span to at least 1.5 times the OBW.
c) Set RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
d) Set VBW ≥ [3 × RBW].
e) Number of points in sweep ≥ [2 × span / RBW]. (This gives bin-to-bin spacing ≤ RBW / 2, so that narrowband signals are not lost between frequency bins.)
f) Sweep time = auto.
g) Detector = RMS (i.e., power averaging), if available. Otherwise, use the sample detector mode.
h) Do not use sweep triggering. Allow the sweep to "free run."
i) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the ON and OFF periods of the transmitter.
j) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
k) Add [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times (because the measurement represents an average over both the ON and OFF times of the transmission). For example, add [10 log (1/0.25)] = 6 dB if the duty cycle is 25%.

The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

The reading in the table below is already corrected with the duty cycle correction factor documented in 5.1.1.

The measured Electric field strength was corrected with the following correction factor:

Antenna Factor [dB] + Cable Attenuation [dB] - Amplifier Gain[dB] = correction factor [dB]

The formula in 11.12.2.2 e) in [1] was used to calculate the EIRP power:

$E = EIRP - 20\log(d) + 104.8$
$EIRP = E - 95.3$

$MOP = EIRP - G$

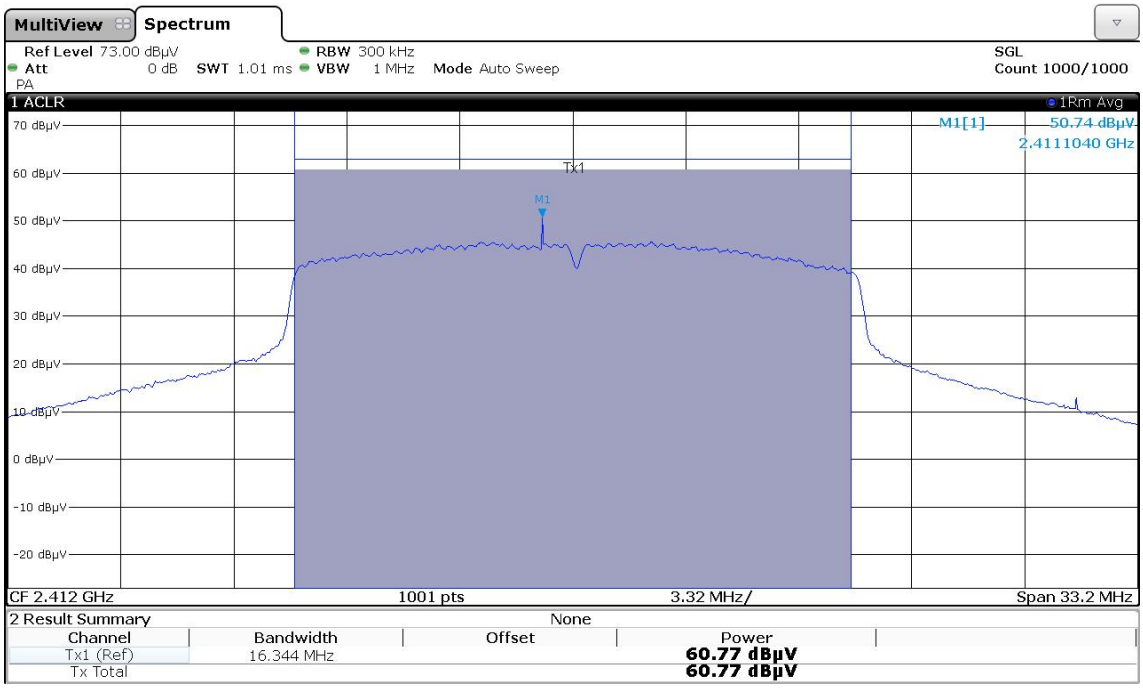
E is the electric field strength in dBµV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m
G is the antenna gain in dBi
MOP is the maximum output power – measured antenna port conducted – in dBm

5.3.2 Test results

Ambient temperature	22 °C	Relative humidity	62 %

The plot below shows the worst case result. All other results are submitted in the table below

g_ch1_AVGSA-2.PNG: Maximum output power measured on channel 0 (operation mode 4):



The antenna gain is below 6 dBi, therefore no conducted output limit reduction is necessary.

Operation mode		Frequency [MHz]	Reading [dBmV]	Corr. Fact. [dB]	Corr. Reading [dBmV]	EIRP [dBm]	MOP [dBm]	Limit [dBm]
1	b	2412	57.5	33.6	91.1	-4.2	-6.1	30
2	b	2437	56.1	33.7	89.8	-5.5	-7.4	30
3	b	2462	54.1	33.8	87.9	-7.4	-9.3	30
4	g	2412	61.5	33.6	95.1	-0.2	-2.1	30
5	g	2437	61.2	33.7	94.9	-0.4	-2.3	30
6	g	2462	57.5	33.8	91.3	-4.0	-5.9	30
7	n	2412	54.8	33.6	88.4	-7.0	-8.9	30
8	n	2437	54.8	33.7	88.5	-6.8	-8.7	30
9	n	2462	52.3	33.8	86.1	-9.3	-11.2	30

Antenna gain of 1.9dBi respected

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

8 – 14, 17, 18

5.4 DTS Bandwidth / 99% Bandwidth

5.4.1 Method of measurement

For the following bandwidth measurements, the EUT was measured radiated in the anechoic chamber using the procedures described in 5.7.1.

Acceptable measurement configurations

The measurement for the DTS bandwidth procedure refers to part 11.8.1 of document [1].

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) ≥ 3 x RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- 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.

The following procedure was used for measuring the 99 % bandwidth:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
- Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labelled. Tabular data maybe reported in addition to the plot(s).

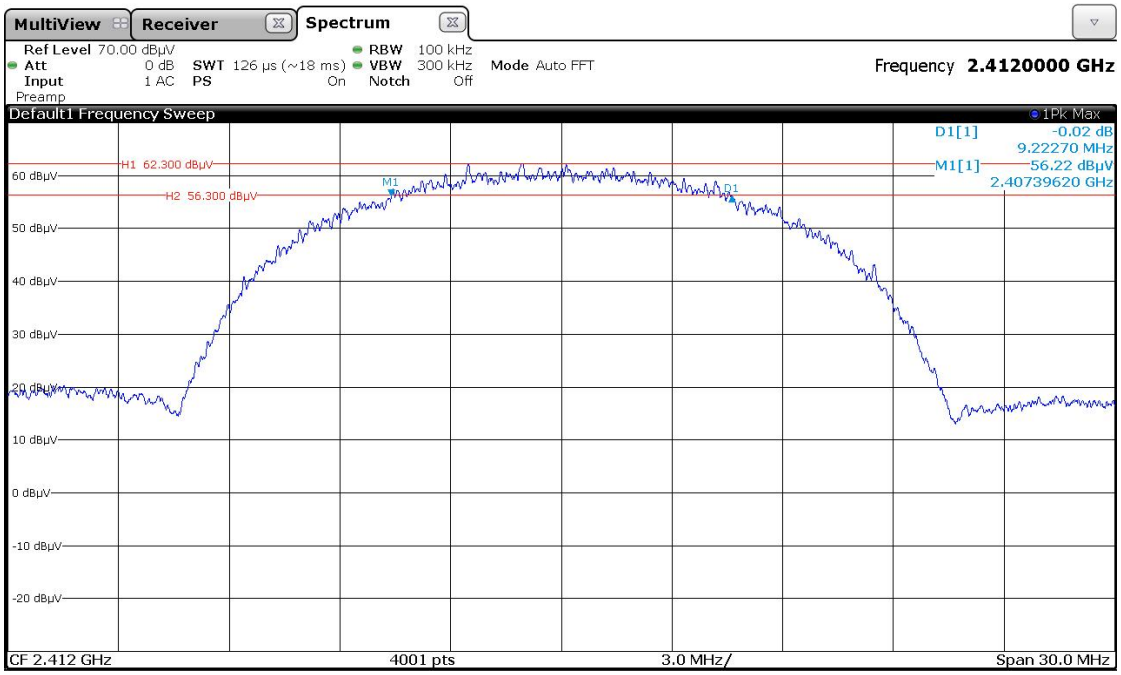
Since this is only a relative measurement, no measurement level correction was performed.

5.4.2 Test result

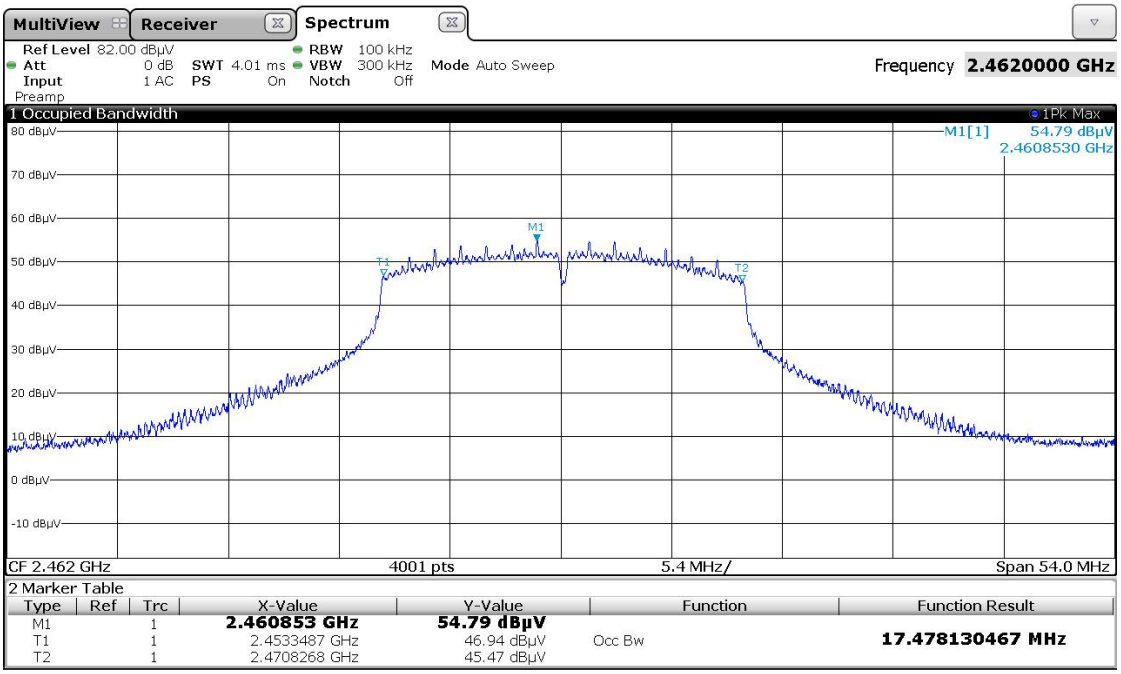
Ambient temperature	22 °C	Relative humidity	59 %

The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

OBW_ch1_11M.wmf: 6-dB Bandwidth (operation mode 1):



99%BW_ch11_MCS2.png: 99% Bandwidth (operation mode 9):



Operation Mode		Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	99 % Bandwidth [MHz]	Result
1	b	2412	0.5	9.223	14.374	Passed
2	b	2437	0.5	9.253	14.360	Passed
3	b	2462	0.5	9.238	14.396	Passed
4	g	2412	0.5	15.431	16.344	Passed
5	g	2437	0.5	15.079	16.425	Passed
6	g	2462	0.5	15.079	16.331	Passed
7	n	2412	0.5	15.379	17.424	Passed
8	n	2437	0.5	15.409	17.472	Passed
9	n	2462	0.5	15.086	17.478	Passed

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

8 – 14, 17, 18

5.5 Peak Power Spectral Density

5.5.1 Method of measurement

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.7.1.

Acceptable measurement configurations

The measurement procedure refers to part 11.10.2 of document [1].

- Set analyser center frequency to DTS channel center frequency
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
- Set the VBW ≥ 3 x RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (not less than 3 kHz) and repeat.

The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

The measured Electric field strength was corrected with the following correction factor:

Antenna Factor [dB] + Cable Attenuation [dB] – Amplifier Gain[dB] = correction factor [dB]

The formula in 11.12.2.2 e) in [1] was used to calculate the EIRP power:

$E = EIRP - 20\log(d) + 104.8$
$EIRP = E - 95.3$

$MPOP = EIRP - G$

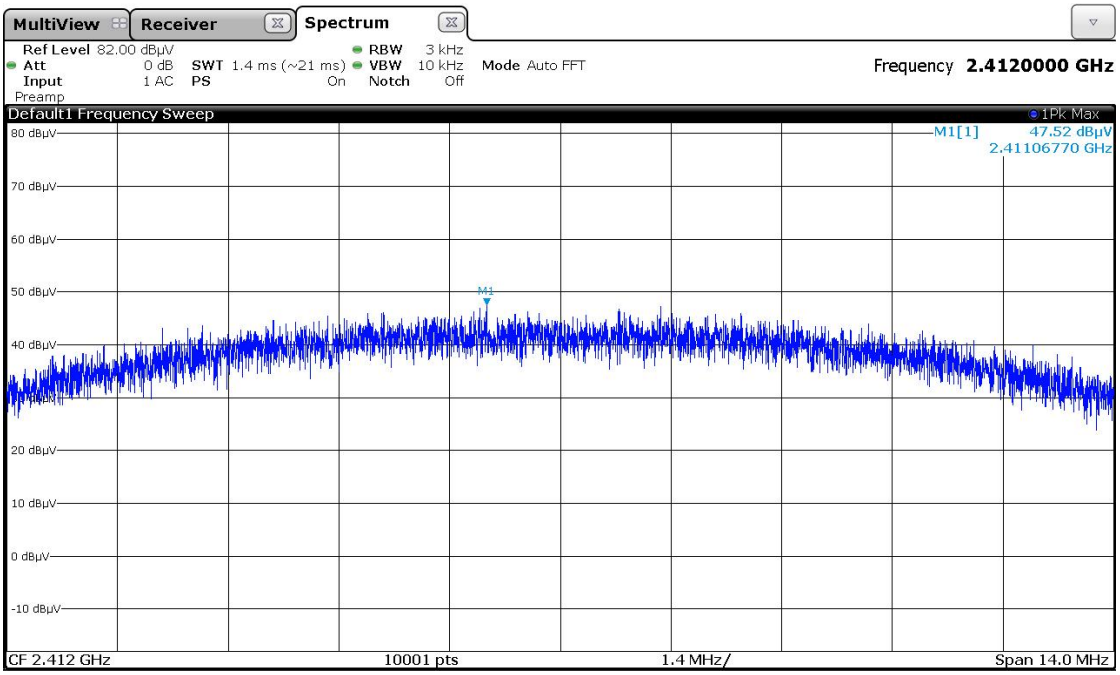
E is the electric field strength in dBµV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m
G is the antenna gain in dBi
MPOP is the maximum peak output power – measured antenna port conducted – in dBm

5.5.2 Test result

Ambient temperature	22 °C	Relative humidity	59 %

The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

PPSD_ch1_11M.png: Peak Power Spectral Density (operation mode 1):



Operation Mode		Peak Frequency [MHz]	PPSD Reading [dBmV/3 kHz]	Corr. Fact. [dB]	Corr. Reading [dBmV/3 kHz]	EIR PPSD [dBm/3 kHz]	PPSD [dBm/3 kHz]	PPSD Limit [dBm/3kHz]
1	b	2411.068	47.5	33.6	81.1	-14.2	-16.1	8
2	b	2436.069	46.4	33.7	80.1	-15.2	-17.1	8
3	b	2462.740	41.6	33.8	75.4	-19.9	-21.8	8
4	g	2409.624	44.2	33.6	77.8	-17.5	-19.4	8
5	g	2437.740	44.5	33.7	78.2	-17.1	-19.0	8
6	g	2461.069	43.8	33.8	77.6	-17.7	-19.6	8
7	n	2408.678	41.9	33.6	75.5	-19.8	-21.7	8
8	n	2437.734	43.8	33.7	77.5	-17.8	-19.7	8
9	n	2460.871	40.8	33.8	74.6	-20.7	-22.6	8

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

8 – 14, 17, 18

5.6 Band-edge compliance

5.6.1 Method of measurement (band edges next to unrestricted bands (radiated))

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.7.1.

Acceptable measurement configurations

The measurement procedure refers to part 11.11.2 and 11.11.3 of document [1].

Measurement Procedure Reference – Reference Level:

- RBW = 100 kHz.
- VBW ≥ 300 kHz.
- Set the span to ≥ 1.5 times the DTS Bandwidth.
- Detector = Peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilise.
- Use the peak marker function to determine the the maximum PSD level.

Measurement Procedure – Unwanted Emissions

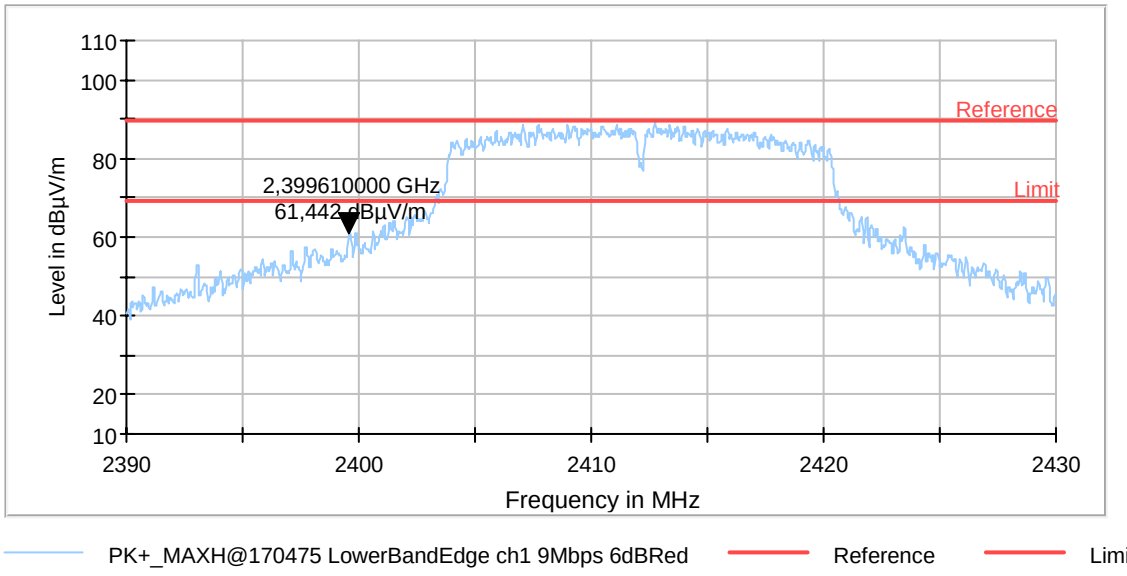
- Set the center frequency and span to encompass the frequency range to be measured.
- RBW = 100 kHz.
- VBW ≥ 300 kHz.
- Detector = Peak.
- Ensure that the number of measurement points ≥ span/RBW.
- Sweep time = auto couple.
- Trace Mode = max hold.
- Allow the trace to stabilise.
- Use the peak marker function to determine the maximum amplitude level.

The measurement procedure at the band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were be encompassed by the span. After trace stabilization, the maximum peak was be determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20 dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

The measurements were performed at the lower end of the 2.4 GHz band.

5.6.2 Test result (band edges next to unrestricted bands (radiated))

170475 LowerBandEdge ch1 9Mbps 6dBRed: radiated band-edge compliance at an unrestricted band-edge (operation mode 4):



Operation Mode		Tx Frequency [MHz]	Emission Frequency [MHz]	Reference Level [dBµV/m]	Limit [dBµV/m]	Emisson Level [dBµV/m]	Margin [dB]	Result
1	b	2412	2398.950	94.3	74.3	54.1	20.0	Passed
4	g	2412	2399.610	89.4	69.4	61.4	8.0	Passed
7	n	2412	2400.000	91.3	71.3	58.9	12.4	Passed

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

8 – 14, 17, 18

5.6.3 Method of measurement (band edges next to restricted bands (radiated))

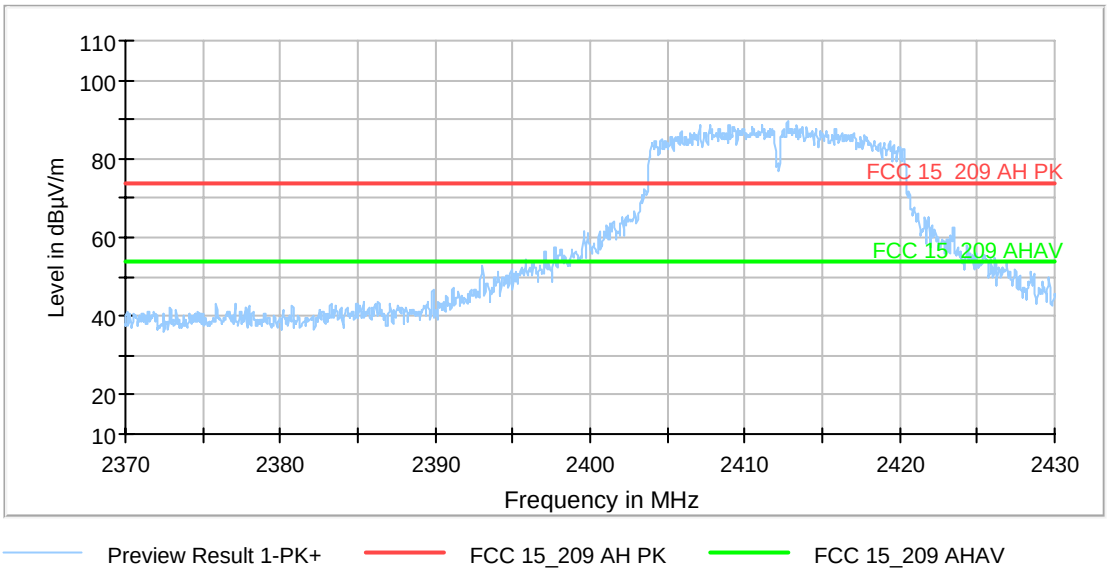
The EUT was measured radiated in the anechoic chamber using the procedures described in 5.7.1.

Acceptable measurement configurations

The same measurement configurations as decribed in 5.7.1. were used for the preview and final measurement.

5.6.4 Test result (band edges next to restricted bands (radiated))

170475 LowerBandEdge ch1 9Mbps 6dBRed: radiated band-edge compliance at an restricted band-edge (operation mode 4):



No emissions were found during the preliminary measurement, therefore no final measurement was performed.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1 b-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2390.000000	---	42.11	54.00	11.89	H	84.0	29.0	33.6
2390.000000	53.99	---	74.00	20.01	H	84.0	29.0	33.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 3 g-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2484.800000	---	40.14	54.00	13.86	H	54.0	29.0	33.7
2484.800000	50.97	---	74.00	23.03	H	54.0	29.0	33.7
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the lower end of the assigned frequency band (operation mode 4 g-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2389.860000	---	43.05	54.00	10.95	H	90.0	29.0	33.6
2389.860000	60.74	---	74.00	13.26	H	90.0	29.0	33.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 6 g-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2484.900000	---	38.83	54.00	15.17	H	31.0	29.0	33.7
2484.900000	53.78	---	74.00	20.22	H	31.0	29.0	33.7
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the lower end of the assigned frequency band (operation mode 7 n-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2389.890000	---	41.12	54.00	12.88	H	81.0	29.0	33.6
2389.890000	57.10	---	74.00	16.90	H	81.0	29.0	33.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 9 n-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2488.825000	---	38.41	54.00	15.59	H	287.0	120.0	33.6
2488.825000	50.33	---	74.00	23.67	H	287.0	120.0	33.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

8 – 14, 17, 18

5.7 Maximum unwanted emissions

5.7.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 1 GHz.
- A final measurement carried out on an outdoor test side without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A final measurement carried out on an open area test side with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a variable antenna distance and height in the frequency range above 1 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range above 1 GHz.

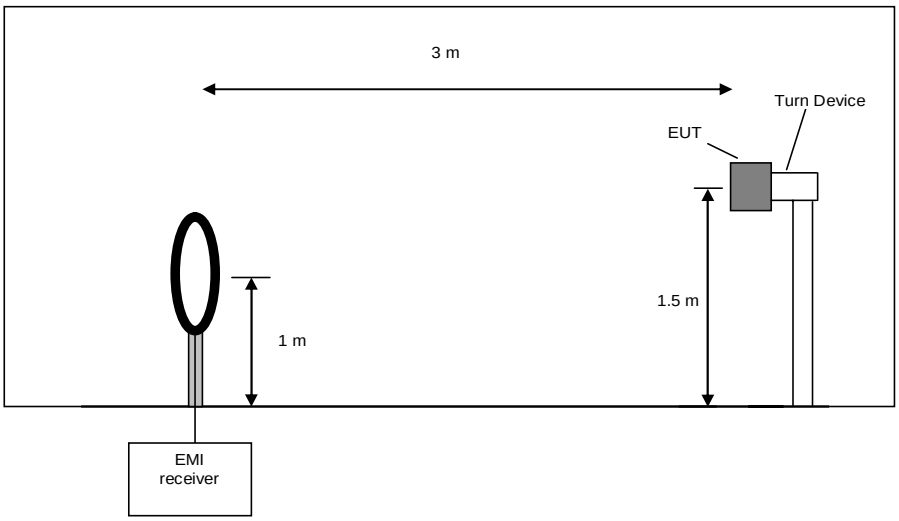
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Table top devices will set up on a non-conducting turn device on the height of 1.5m. Floor-standing devices will be placed directly on the turntable/ground plane. The set-up of the Equipment under test will be in accordance to [1].

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to found the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.
The following procedure will be used:

1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarisation of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. Repeat 1) to 5) with the EUT raised by an angle of 0° (45°, 90°) according to 6.6.5.4 in [1].
7. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

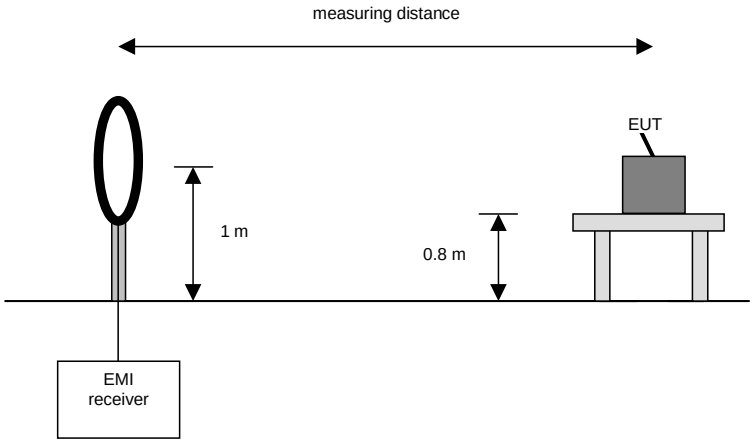
Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the frequencies, which were detected during the preliminary measurements, the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Final measurement procedure:

The following procedure will be used:

1) Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
2) Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
3) Rotate the measuring antenna to find the maximum and note the value.
4) Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
5) Repeat steps 1) to 4) with the other orthogonal axes of the EUT (if the EUT is a module and might be used in a handheld equipment application).

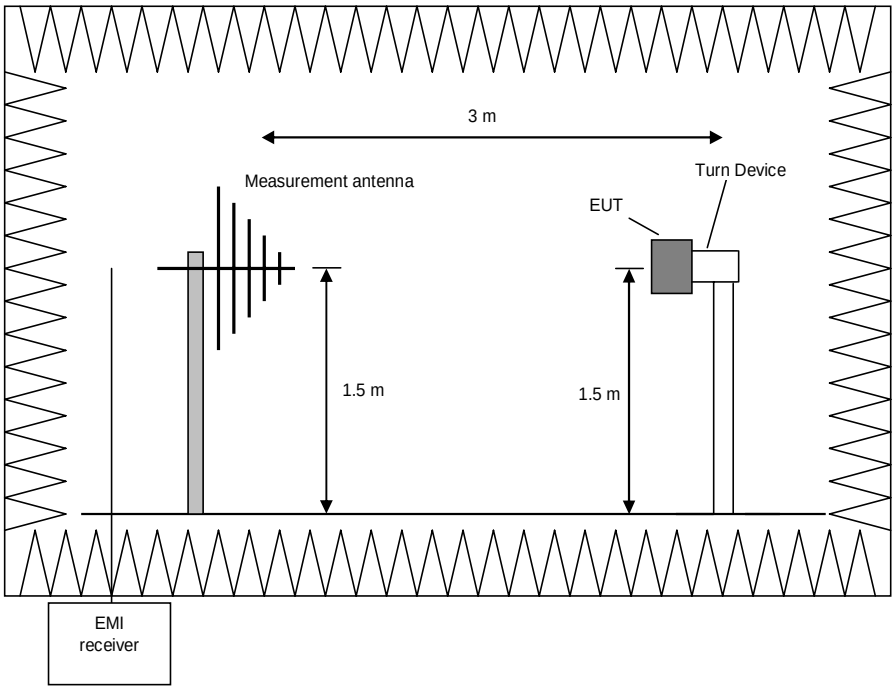
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Table top devices will set up on a non-conducting turn device on the height of 1.5m. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 230 MHz	100 kHz
230 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.
The following procedure will be used:

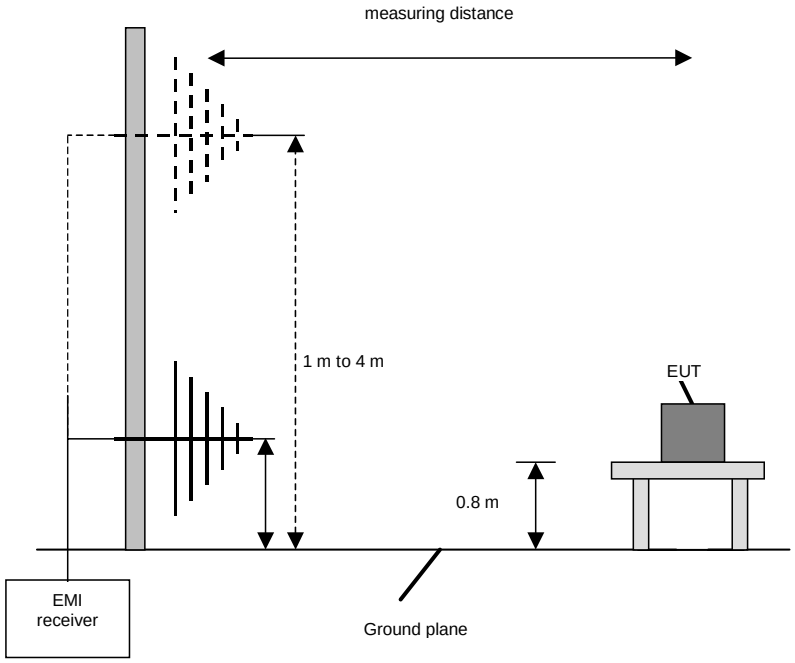
8. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
9. Manipulate the system cables within the range to produce the maximum level of emission.
10. Rotate the EUT by 360 ° to maximize the detected signals.
11. Repeat 1) to 3) with the vertical polarisation of the measuring antenna.
12. Make a hardcopy of the spectrum.
13. Repeat 1) to 5) with the EUT raised by an angle of 0° (45°, 90°) according to 6.6.5.4 in [1].
14. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

Final measurement (30 MHz to 1 GHz)

A final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of
0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarisation and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

1) Measure on the selected frequencies at an antenna height of 1 m and a EUT azimuth of 23 °.
2) Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
3) Rotate the EUT by 45 ° and repeat 2) until an azimuth of 337 ° is reached.
4) Repeat 1) to 3) for the other orthogonal antenna polarization.
5) Move the antenna and the turntable to the position where the maximum value is detected.
6) Measure while moving the antenna slowly +/- 1 m.
7) Set the antenna to the position where the maximum value is found.
8) Measure while moving the turntable +/- 45 °.
9) Set the turntable to the azimuth where the maximum value is found.
10) Measure with Final detector (QP and AV) and note the value.
11) Repeat 5) to 10) for each frequency.
12) Repeat 1) to 11) for each orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).

Preliminary and final measurement (1 GHz to 40 GHz)

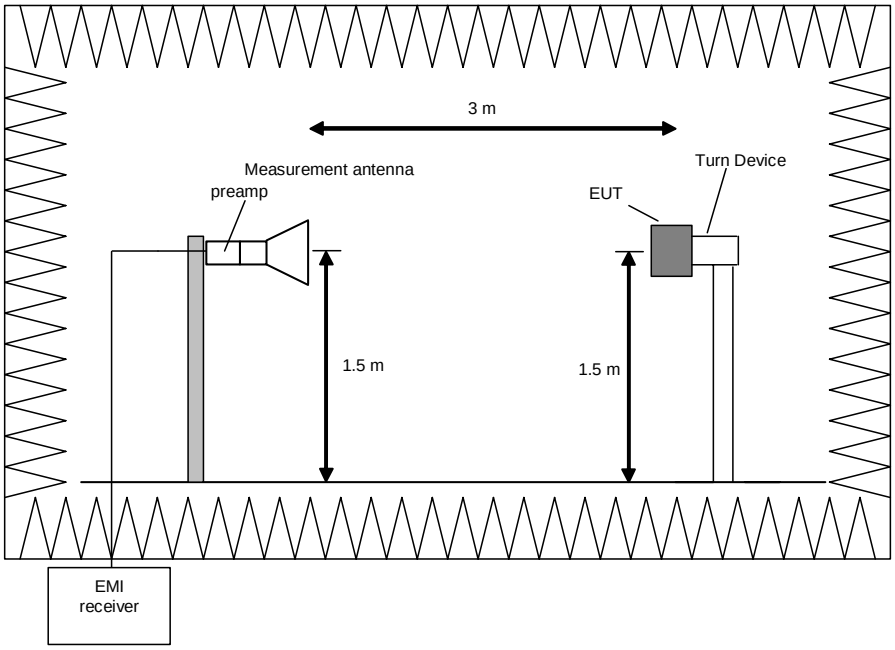
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	100 kHz
4 GHz to 12 GHz	100 kHz
12 GHz to 18 GHz	100 kHz
18 GHz to 25 / 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 40 GHz.
The following procedure will be used:

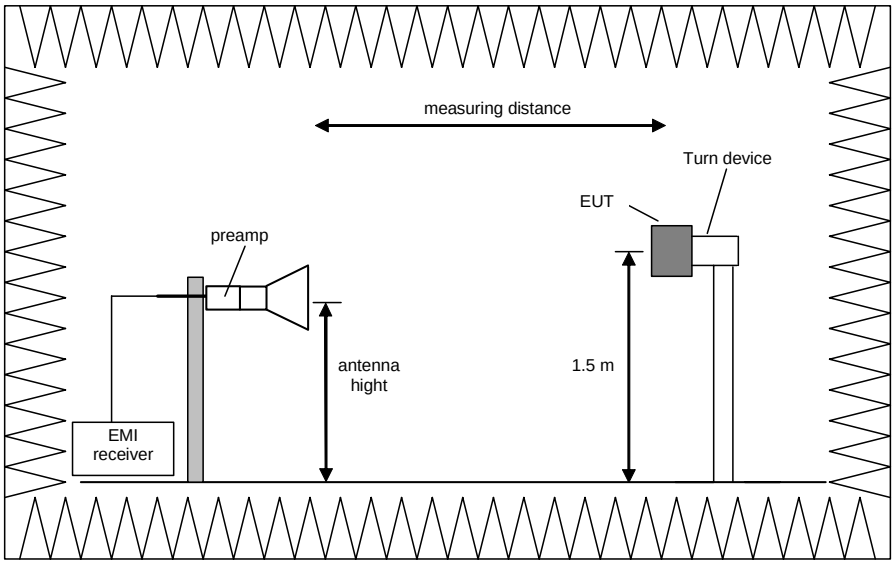
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.
The following procedure will be used:

1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
2) Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
3) Set the spectrum analyser to EMI mode with peak and average detector activated.
4) Rotate the turntable from 0° to 360° to find the TT Pos. that produces the highest emissions.
5) Note the highest displayed peak and average values
6) Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

5.7.2 Test results (radiated emissions) – Emissions with internal antenna from 30 MHz – 25 GHz

5.7.2.1 Preliminary radiated emission measurement 9 kHz – 25 GHz

Ambient temperature	22 °C	Relative humidity	59 %

Position of EUT: The EUT was set-up on an EUT turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m.

For the final test on the open area test site the EUT was placed on a table with the height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Only the plot of the worst case emission is submitted below.

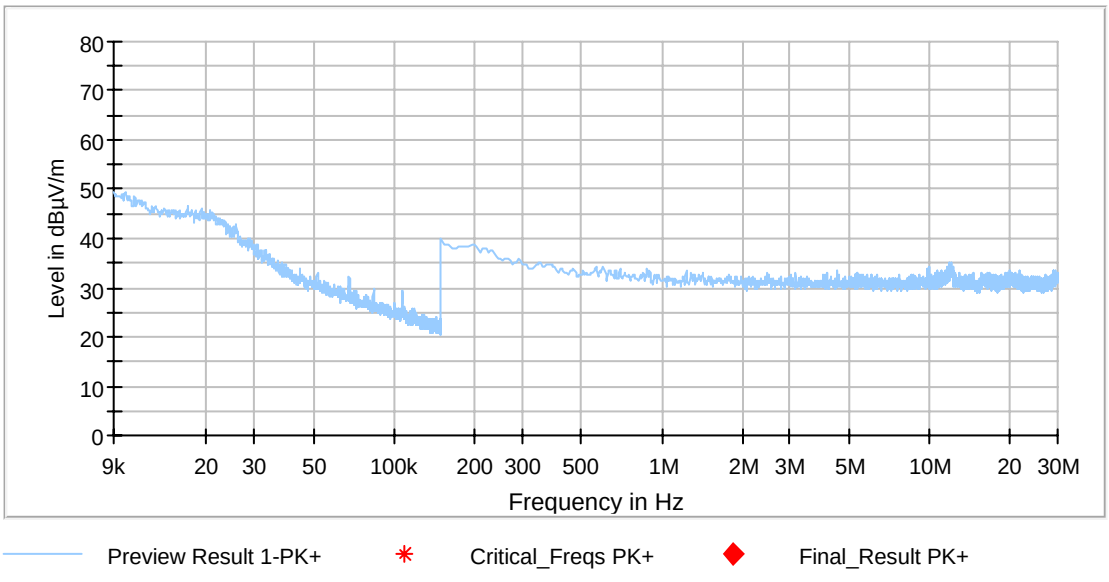
Supply voltage: During all measurements the host of the EUT was powered with 5 V. For the test a power supply type “DSA-5PFU1-05 FCA 050100” by “STONTRONICS” was used. The power supply was provided by the applicant.

Remark: Since there were no differences in the spectrum for f < 1 GHz, only one representative plot is submitted below.

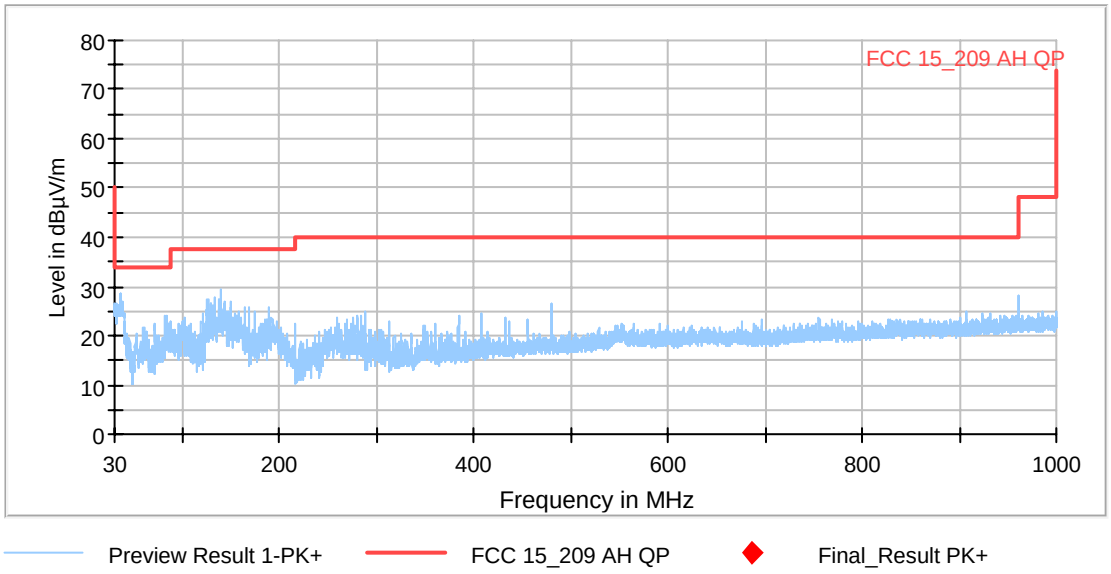
No emissions were found in the frequency range from 9 kHz to 30 MHz, therefore no final test was performed.

Plots of the worst case transmitter spurious emissions

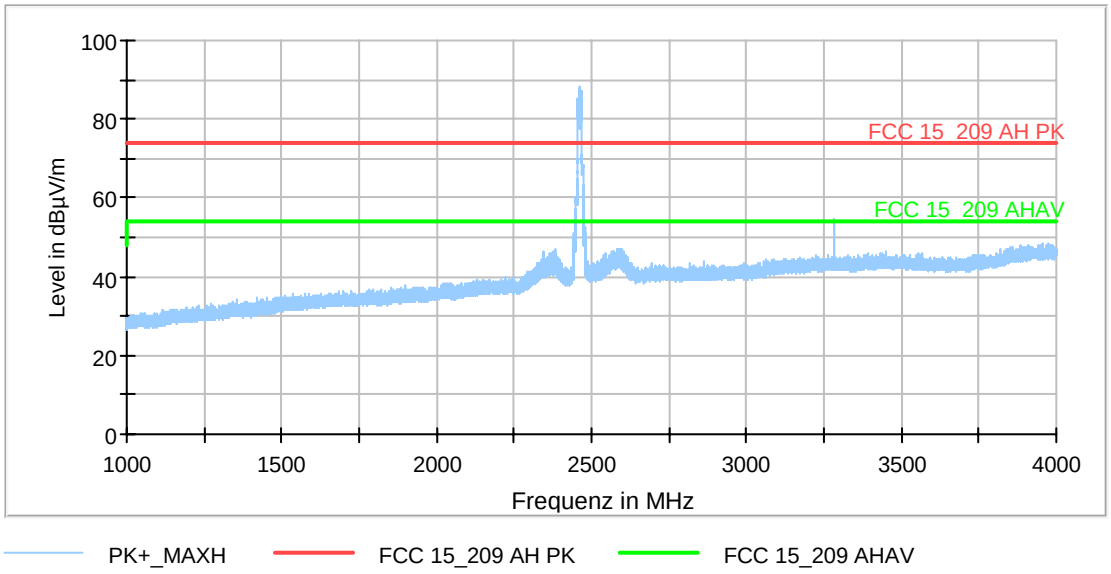
170475 9k-30M ch11 9Mbps 6dBRed: Spurious emissions from 9 kHz to 30 MHz (operation mode 6):



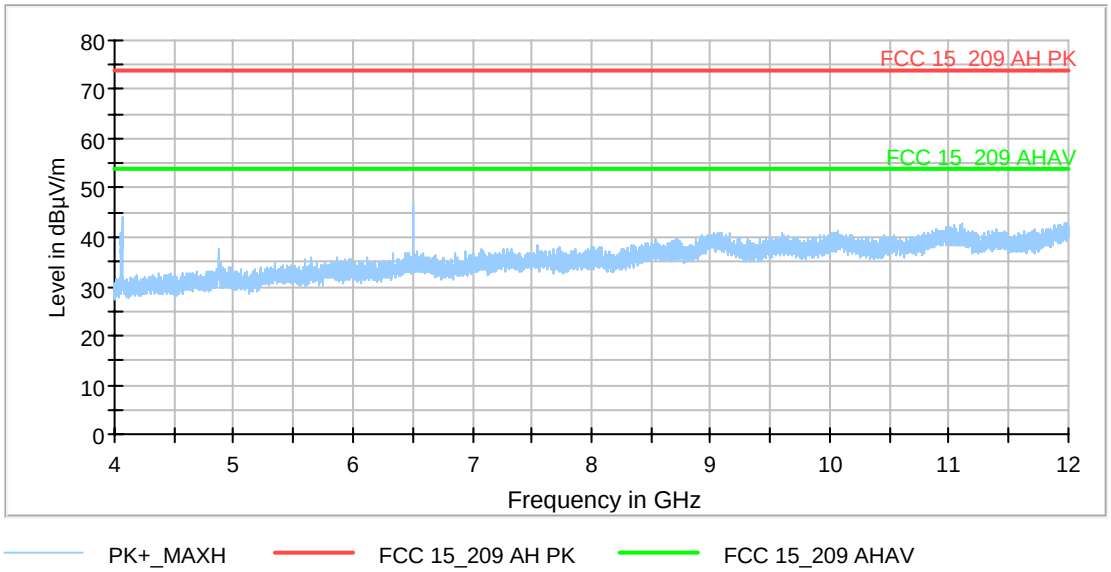
170475 30M-1G ch6 11Mbps 6dBRed: Spurious emissions from 30 MHz to 1 GHz (operation mode 3):



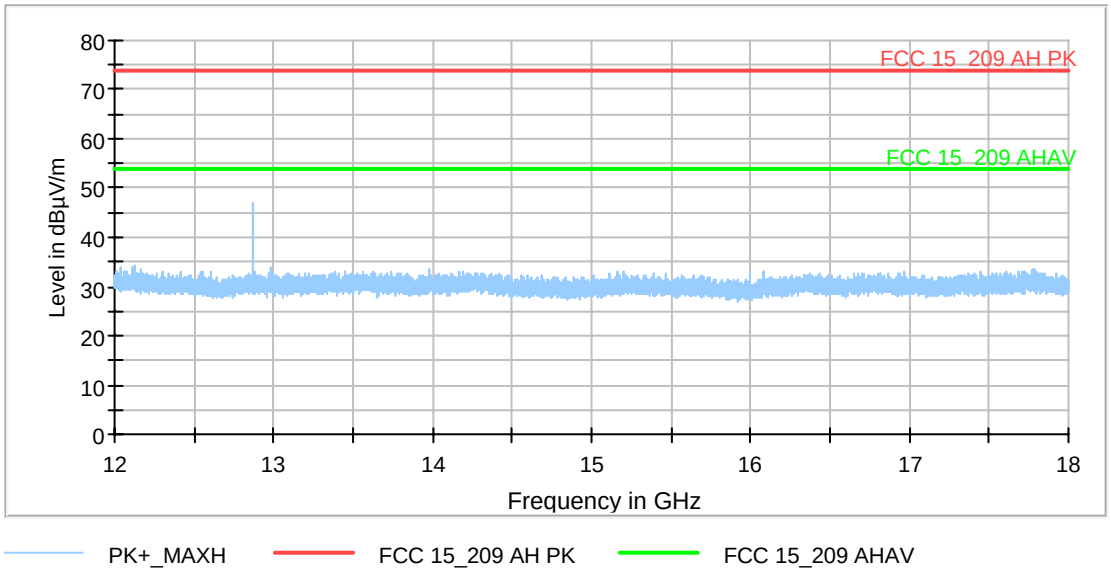
170475 1-4G ch11 9Mbps 6dBRed: Spurious emissions from 1 GHz to 4 GHz (operation mode 6):



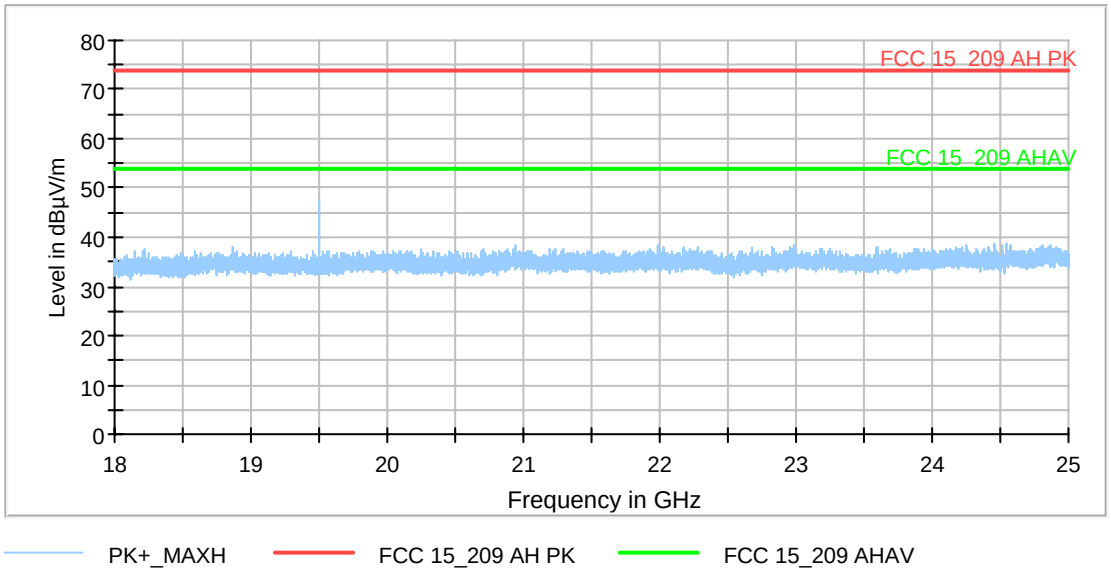
170475 4-12G ch6 9Mbps 6dBRed: Spurious emissions from 4 GHz to 12 GHz (operation mode 5):



170475 12-18G ch1 9Mbps 6dBRed: Spurious emissions from 12 GHz to 18 GHz (operation mode 4):



170475 18-26,5G ch6 9Mbps 6dBRed: Spurious emissions from 18 GHz to 25 GHz (operation mode 5):



5.7.2.2 Final radiated measurements

All TX modes (no difference detected when comparing channel / modulation)

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB]
35.965500	26.32	40.00	13.68	1000.0	120.000	112.0	V	22.0	23.9
36.547500	26.14	40.00	13.86	1000.0	120.000	104.0	V	130.0	23.6
125.981500	26.62	43.50	16.88	1000.0	120.000	102.0	V	58.0	20.3
133.838500	17.86	43.50	25.64	1000.0	120.000	250.0	H	153.0	20.5
138.931000	19.78	43.50	23.72	1000.0	120.000	105.0	V	226.0	20.4
149.795000	18.23	43.50	25.27	1000.0	120.000	106.0	V	178.0	20.2
Measurement uncertainty					+2.2 dB / -3.6 dB				

Transmitter operates at the lower end of the assigned frequency band (operation mode 1, b-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2338.480000	---	38.65	54.00	15.35	H	75.0	60.0	33.3
2338.480000	52.08	---	74.00	21.92	H	75.0	60.0	33.3
2407.120000	---	84.49	Fund.	-	H	77.0	30.0	33.6
2407.120000	97.69	---	Fund.	-	H	77.0	30.0	33.6
2564.860000	---	43.49	54.00	10.51	H	57.0	30.0	33.9
2564.860000	55.84	---	74.00	18.16	H	57.0	30.0	33.9
3216.160000	---	52.20	54.00	1.80	H	59.0	60.0	36.8
3216.160000	58.51	---	74.00	15.49	H	59.0	60.0	36.8
4020.050000	---	44.39	54.00	9.61	H	251.0	90.0	-4.3
4020.050000	54.99	---	74.00	19.01	H	251.0	90.0	-4.3
4824.200000	---	33.57	54.00	20.43	H	213.0	120.0	-1.5
4824.200000	46.35	---	74.00	27.65	H	213.0	120.0	-1.5
6432.250000	---	45.82	54.00	8.18	H	170.0	60.0	2.5
6432.250000	51.15	---	74.00	22.85	H	170.0	60.0	2.5
12864.600000	---	45.36	54.00	8.64	H	35.0	90.0	11.8
12864.600000	50.25	---	74.00	23.75	H	35.0	90.0	11.8
19296.900000	---	43.23	54.00	10.77	H	278.0	120.0	6.7
19296.900000	50.11	---	74.00	23.89	H	278.0	120.0	6.7
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the middle of the assigned frequency band (operation mode 2, b-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2340.220000	---	43.44	54.00	10.56	H	86.0	60.0	33.3
2340.220000	55.57	---	74.00	18.43	H	86.0	60.0	33.3
2434.420000	---	89.92	Fund.	-	H	86.0	60.0	33.7
2434.420000	99.47	---	Fund.	-	H	86.0	60.0	33.7
2577.400000	---	46.67	54.00	7.33	H	322.0	150.0	34.0
2577.400000	58.75	---	74.00	15.25	H	322.0	150.0	34.0
3249.460000	---	50.91	54.00	3.09	H	50.0	29.0	37.1
3249.460000	59.62	---	74.00	14.38	H	50.0	29.0	37.1
4060.150000	---	43.58	54.00	10.42	H	246.0	90.0	-4.1
4060.150000	54.15	---	74.00	19.85	H	246.0	90.0	-4.1
4062.100000	---	43.46	54.00	10.54	H	246.0	90.0	-4.1
4062.100000	53.80	---	74.00	20.20	H	246.0	90.0	-4.1
4874.200000	---	35.29	54.00	18.71	H	166.0	60.0	-1.4
4874.200000	48.80	---	74.00	25.20	H	166.0	60.0	-1.4
6498.950000	---	45.22	54.00	8.78	H	172.0	60.0	3.0
6498.950000	51.62	---	74.00	22.38	H	172.0	60.0	3.0
12997.900000	---	43.22	54.00	10.78	H	35.0	90.0	11.7
12997.900000	48.62	---	74.00	25.38	H	35.0	90.0	11.7
16247.400000	---	33.20	54.00	20.80	H	335.0	90.0	10.6
16247.400000	43.00	---	74.00	31.00	H	335.0	90.0	10.6
19496.900000	---	43.02	54.00	10.98	H	235.0	120.0	6.6
19496.900000	50.18	---	74.00	23.82	H	235.0	120.0	6.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 3, b-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2370.760000	---	43.63	54.00	10.37	H	88.0	30.0	33.4
2370.760000	56.59	---	74.00	17.41	H	88.0	30.0	33.4
2461.960000	---	87.32	Fund.	-	H	79.0	30.0	33.8
2461.960000	97.43	---	Fund.	-	H	79.0	30.0	33.8
2590.720000	---	45.20	54.00	8.80	H	335.0	150.0	34.1
2590.720000	57.35	---	74.00	16.65	H	335.0	150.0	34.1
3282.820000	---	52.36	54.00	1.64	H	335.0	150.0	36.8
3282.820000	59.94	---	74.00	14.06	H	335.0	150.0	36.8
3987.280000	---	38.89	54.00	15.11	H	115.0	30.0	38.5
3987.280000	51.02	---	74.00	22.98	H	115.0	30.0	38.5
4103.750000	---	42.53	54.00	11.47	H	146.0	90.0	-4.5
4103.750000	53.23	---	74.00	20.77	H	146.0	90.0	-4.5
4104.500000	---	43.32	54.00	10.68	V	301.0	150.0	-4.5
4104.500000	53.52	---	74.00	20.48	V	301.0	150.0	-4.5
4924.200000	---	33.13	54.00	20.87	H	154.0	120.0	-1.6
4924.200000	46.65	---	74.00	27.35	H	154.0	120.0	-1.6
6565.600000	---	43.57	54.00	10.43	V	148.0	150.0	3.3
6565.600000	50.24	---	74.00	23.76	V	148.0	150.0	3.3
13131.250000	---	44.18	54.00	9.83	V	81.0	29.0	11.8
13131.250000	49.23	---	74.00	24.77	V	81.0	29.0	11.8
19696.900000	---	44.23	54.00	9.77	H	272.0	120.0	6.6
19696.900000	50.50	---	74.00	23.50	H	272.0	120.0	6.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the lower end of the assigned frequency band (operation mode 4, g-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2326.300000	---	39.98	54.00	14.02	H	93.0	60.0	33.2
2326.300000	52.66	---	74.00	21.34	H	93.0	60.0	33.2
2408.320000	---	86.29	Fund.	-	H	36.0	0.0	33.6
2408.320000	96.82	---	Fund.	-	H	36.0	0.0	33.6
2535.460000	---	39.90	54.00	14.10	H	28.0	30.0	33.7
2535.460000	52.37	---	74.00	21.63	H	28.0	30.0	33.7
3216.160000	---	52.73	54.00	1.27	H	59.0	60.0	36.8
3216.160000	58.60	---	74.00	15.40	H	59.0	60.0	36.8
4017.650000	---	39.17	54.00	14.83	H	162.0	90.0	-4.3
4017.650000	49.63	---	74.00	24.37	H	162.0	90.0	-4.3
4025.150000	---	39.42	54.00	14.58	H	131.0	90.0	-4.3
4025.150000	49.76	---	74.00	24.24	H	131.0	90.0	-4.3
4826.300000	---	32.81	54.00	21.19	H	155.0	60.0	-1.5
4826.300000	45.53	---	74.00	28.47	H	155.0	60.0	-1.5
6432.250000	---	45.72	54.00	8.28	H	170.0	60.0	2.5
6432.250000	51.60	---	74.00	22.40	H	170.0	60.0	2.5
12864.600000	---	45.52	54.00	8.48	H	40.0	90.0	11.8
12864.600000	49.78	---	74.00	24.22	H	40.0	90.0	11.8
19296.900000	---	43.84	54.00	10.16	H	277.0	120.0	6.7
19296.900000	50.22	---	74.00	23.78	H	277.0	120.0	6.7
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the middle of the assigned frequency band (operation mode 5, g-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2362.540000	---	43.94	54.00	10.06	H	79.0	29.0	33.5
2362.540000	56.67	---	74.00	17.33	H	79.0	29.0	33.5
2435.200000	---	88.04	Fund.	-	H	335.0	150.0	33.7
2435.200000	98.79	---	Fund.	-	H	335.0	150.0	33.7
2581.900000	---	46.68	54.00	7.32	H	327.0	150.0	34.1
2581.900000	58.70	---	74.00	15.30	H	327.0	150.0	34.1
3249.460000	---	51.76	54.00	2.24	H	60.0	60.0	37.1
3249.460000	58.65	---	74.00	15.35	H	60.0	60.0	37.1
4060.550000	---	41.02	54.00	12.98	H	243.0	90.0	-4.1
4060.550000	51.38	---	74.00	22.62	H	243.0	90.0	-4.1
4064.350000	---	41.64	54.00	12.36	H	249.0	90.0	-4.1
4064.350000	51.92	---	74.00	22.08	H	249.0	90.0	-4.1
4877.550000	---	34.82	54.00	19.18	H	166.0	60.0	-1.4
4877.550000	48.66	---	74.00	25.34	H	166.0	60.0	-1.4
6498.950000	---	45.89	54.00	8.11	H	171.0	60.0	3.0
6498.950000	51.39	---	74.00	22.61	H	171.0	60.0	3.0
12997.900000	---	44.57	54.00	9.43	H	38.0	90.0	11.7
12997.900000	49.01	---	74.00	24.99	H	38.0	90.0	11.7
19496.900000	---	44.60	54.00	9.40	H	278.0	120.0	6.6
19496.900000	50.51	---	74.00	23.49	H	278.0	120.0	6.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 6, g-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2383.480000	---	42.74	54.00	11.26	H	86.0	60.0	33.5
2383.480000	56.23	---	74.00	17.77	H	86.0	60.0	33.5
2460.880000	---	85.06	Fund.	-	H	311.0	150.0	33.8
2460.880000	95.00	---	Fund.	-	H	311.0	150.0	33.8
2588.260000	---	43.82	54.00	10.18	H	49.0	30.0	34.1
2588.260000	56.14	---	74.00	17.86	H	49.0	30.0	34.1
3282.820000	---	53.38	54.00	0.62	H	56.0	60.0	36.8
3282.820000	59.50	---	74.00	14.50	H	56.0	60.0	36.8
4098.500000	---	38.77	54.00	15.23	H	138.0	90.0	-4.4
4098.500000	49.49	---	74.00	24.51	H	138.0	90.0	-4.4
4925.450000	---	31.32	54.00	22.68	H	156.0	120.0	-1.6
4925.450000	44.67	---	74.00	29.33	H	156.0	120.0	-1.6
6565.600000	---	41.59	54.00	12.41	V	154.0	90.0	3.3
6565.600000	49.59	---	74.00	24.41	V	154.0	90.0	3.3
13131.250000	---	44.31	54.00	9.69	V	77.0	29.0	11.8
13131.250000	48.87	---	74.00	25.13	V	77.0	29.0	11.8
19696.900000	---	43.75	54.00	10.25	H	229.0	120.0	6.6
19696.900000	50.27	---	74.00	23.73	H	229.0	120.0	6.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the lower end of the assigned frequency band (operation mode 7, n20-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2341.660000	---	36.97	54.00	17.03	H	108.0	60.0	33.3
2341.660000	50.31	---	74.00	23.69	H	108.0	60.0	33.3
2410.840000	---	84.26	Fund.	-	H	144.0	29.0	33.6
2410.840000	96.83	---	Fund.	-	H	144.0	29.0	33.6
2555.920000	---	42.63	54.00	11.37	H	66.0	0.0	33.9
2555.920000	54.95	---	74.00	19.05	H	66.0	0.0	33.9
3216.160000	---	52.30	54.00	1.70	H	53.0	60.0	36.8
3216.160000	58.58	---	74.00	15.42	H	53.0	60.0	36.8
3985.000000	---	38.81	54.00	15.19	H	18.0	30.0	38.5
3985.000000	52.01	---	74.00	21.99	H	18.0	30.0	38.5
4016.400000	---	39.07	54.00	14.93	H	248.0	90.0	-4.3
4016.400000	50.96	---	74.00	23.04	H	248.0	90.0	-4.3
4022.650000	---	37.56	54.00	16.44	H	259.0	90.0	-4.3
4022.650000	48.74	---	74.00	25.26	H	259.0	90.0	-4.3
6432.250000	---	43.69	54.00	10.31	H	170.0	90.0	2.5
6432.250000	49.87	---	74.00	24.13	H	170.0	90.0	2.5
12864.600000	---	44.63	54.00	9.37	H	40.0	90.0	11.8
12864.600000	50.14	---	74.00	23.86	H	40.0	90.0	11.8
19296.900000	---	43.11	54.00	10.89	H	277.0	120.0	6.7
19296.900000	50.66	---	74.00	23.34	H	277.0	120.0	6.7
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the middle of the assigned frequency band (operation mode 8, n20-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2356.300000	---	42.75	54.00	11.25	H	78.0	60.0	33.5
2356.300000	56.19	---	74.00	17.81	H	78.0	60.0	33.5
2438.380000	---	85.68	Fund.	-	H	338.0	150.0	33.8
2438.380000	97.81	---	Fund.	-	H	338.0	150.0	33.8
2571.280000	---	44.17	54.00	9.83	H	293.0	150.0	34.0
2571.280000	56.87	---	74.00	17.13	H	293.0	150.0	34.0
3249.460000	---	51.91	54.00	2.09	H	53.0	60.0	37.1
3249.460000	58.95	---	74.00	15.05	H	53.0	60.0	37.1
4063.100000	---	38.00	54.00	16.00	H	170.0	59.0	-4.1
4063.100000	49.65	---	74.00	24.35	H	170.0	59.0	-4.1
4064.300000	---	39.39	54.00	14.61	H	159.0	90.0	-4.1
4064.300000	51.14	---	74.00	22.86	H	159.0	90.0	-4.1
4066.850000	---	38.46	54.00	15.54	H	240.0	90.0	-4.0
4066.850000	50.59	---	74.00	23.41	H	240.0	90.0	-4.0
4872.950000	---	31.32	54.00	22.68	H	169.0	90.0	-1.4
4872.950000	44.04	---	74.00	29.96	H	169.0	90.0	-1.4
6498.950000	---	43.97	54.00	10.03	H	164.0	60.0	3.0
6498.950000	50.63	---	74.00	23.37	H	164.0	60.0	3.0
12997.900000	---	40.93	54.00	13.07	H	346.0	90.0	11.7
12997.900000	47.11	---	74.00	26.89	H	346.0	90.0	11.7
19496.900000	---	43.92	54.00	10.08	H	283.0	120.0	6.6
19496.900000	50.96	---	74.00	23.04	H	283.0	120.0	6.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 9, n20-mode)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2344.540000	---	39.97	54.00	14.03	H	97.0	60.0	33.4
2344.540000	52.43	---	74.00	21.57	H	97.0	60.0	33.4
2463.340000	---	82.94	Fund.	-	H	322.0	150.0	33.8
2463.340000	95.22	---	Fund.	-	H	322.0	150.0	33.8
2577.400000	---	42.26	54.00	11.74	H	50.0	29.0	34.0
2577.400000	55.32	---	74.00	18.68	H	50.0	29.0	34.0
3282.820000	---	52.40	54.00	1.60	H	338.0	150.0	36.8
3282.820000	58.89	---	74.00	15.11	H	338.0	150.0	36.8
4100.700000	---	39.49	54.00	14.51	V	294.0	150.0	-4.4
4100.700000	51.57	---	74.00	22.43	V	294.0	150.0	-4.4
4109.750000	---	35.95	54.00	18.05	H	135.0	90.0	-4.6
4109.750000	48.57	---	74.00	25.43	H	135.0	90.0	-4.6
6565.650000	---	42.48	54.00	11.52	V	146.0	150.0	3.3
6565.650000	49.72	---	74.00	24.28	V	146.0	150.0	3.3
13131.250000	---	43.49	54.00	10.51	V	77.0	29.0	11.8
13131.250000	48.73	---	74.00	25.27	V	77.0	29.0	11.8
19696.900000	---	44.15	54.00	9.85	H	271.0	120.0	6.6
19696.900000	50.59	---	74.00	23.41	H	271.0	120.0	6.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

TEST EQUIPMENT USED FOR THE TEST:
7 – 27

5.8 Conducted emissions on power supply lines (150 kHz to 30 MHz)

Ambient temperature	20 °C	Relative humidity	52 %

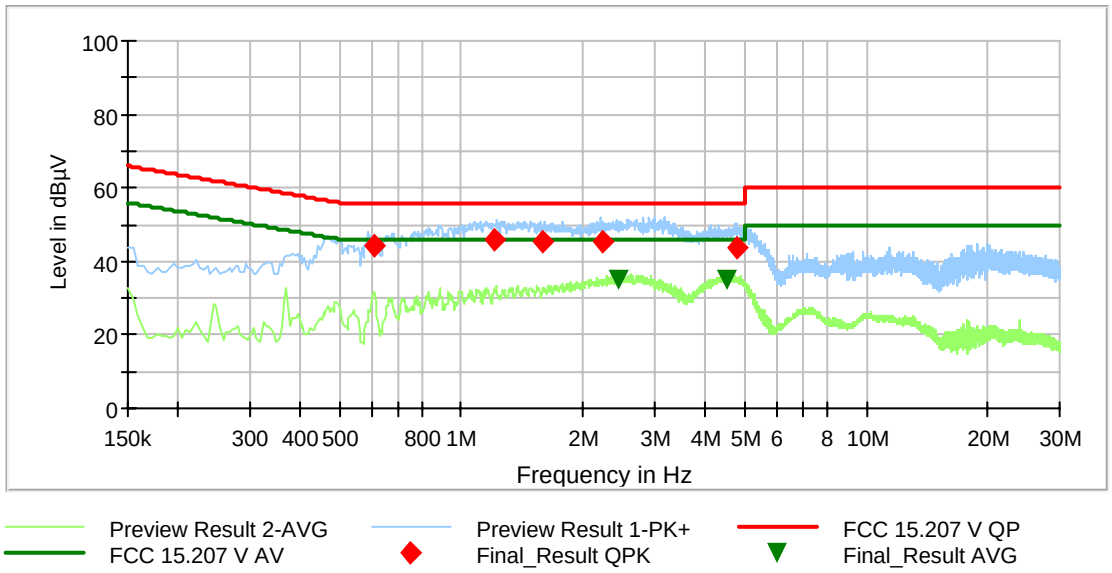
Position of EUT: For this test, the EUT was operated in normal mode. The EUT was active and charging, the WLAN was activated. For the test an fping signal with 1400 Byte was transmitted to the EUT with time delta of 100 ms.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: Measurement performed with US 120V/60Hz. For the test a power supply type "DSA-5PFU1-05 FCA 050100" by "STONTRONICS" was used. The power supply was provided by the applicant.
The power supply was provided by the applicant and supplied the EUT with 5 V DC.

The curves in the diagram only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak measured points are marked by "♦" and the average measured points by "▼".



Data record name: 170475_ACmains_Retest.rtf

Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.606300	44.30	---	56.00	11.70	5000.0	9.000	L1	GND	9.9
1.205700	45.74	---	56.00	10.26	5000.0	9.000	L1	FLO	9.9
1.590000	45.08	---	56.00	10.92	5000.0	9.000	L1	GND	9.9
2.223600	45.39	---	56.00	10.61	5000.0	9.000	N	FLO	10.1
2.445900	---	34.80	46.00	11.20	5000.0	9.000	N	GND	10.2
4.545600	---	34.89	46.00	11.11	5000.0	9.000	L1	GND	10.3
4.800300	43.86	---	56.00	12.14	5000.0	9.000	L1	FLO	10.3

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
1 – 6

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Shielded chamber M47	-	Albatross Projects	B83117-C6439-T262	480662		
2	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	15.02.2016	2.2018
3	LISN	NSLK8128	Schwarzbeck	8128155	480058	16.02.2016	2.2018
4	High pass filter	HR 0.13-5ENN	FSY Microwave Inc.	DC 0109 SN 002	480340	Weekly verification (system cal.)	
5	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	
6	Netzteil AC	AC6803A AC Quelle 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	
7	EMI Software	EMC32	Rohde & Schwarz	100061	481022	-	-
8	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Annual verification (system cal.)	
9	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
10	Signal & Spectrum Analyzer	FSW43	Rohde & Schwarz	100586	481720	24.02.2016	01.02.2018
11	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
12	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
13	Antenna support	AS615P	Deisel	615/310	480187	-	-
14	Antenna (Log.Per.)*	HL050	Rohde & Schwarz	100438	481170	27.08.2014	01.08.2017
						09.10.2017	01.10.2020
15	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
16	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Six month verification (system cal.)	
17	RF-cable No. 3	Sucoflex 106B	Huber&Suhner	0563/6B / Kabel 3	480670	Weekly verification (system cal.)	
18	RF-cable No. 40	Sucoflex 106B	Huber&Suhner	0708/6B / Kabel 40	481330	Weekly verification (system cal.)	
19	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	29.02.2016	29.02.2018
20	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	01.06.2020
21	RF-cable 2 m	KPS-1533-800-KPS	Insulated Wire	-	480302	Six month verification (system cal.)	
22	Kabel 36	Sucoflex 106B	Suhner	500003/6B / Kabel 36	481680	Weekly verification (system cal.)	
23	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	18.02.2016	18.02.2018
24	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	18.02.2016	18.02.2018
25	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	17.02.2016	17.02.2018
26	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	
27	Loop antenna	-	Phoenix Testlab GmbH	-	410085	Calibration not necessary	

* The tests were performed during a time period, during which the antenna was calibrated.

7 Report History

Report Number	Date	Comment
F170475E1	05.04.2018	Initial Test Report

8 List of Annexes

ANNEX A TEST SETUP PHOTOS 8 pages

170475_02.jpg	Test setup – radiated test in anechoic chamber
170475_01.jpg	Test setup – radiated test in anechoic chamber
170475_03.jpg	Test setup – radiated test in anechoic chamber
170475_04.jpg	Test setup – radiated test on open area test site
170475_05.jpg	Test setup – radiated test in anechoic chamber
170475_06.jpg	Test setup – radiated test in anechoic chamber
170475_07.jpg	Test setup – radiated test in anechoic chamber
170475_08.jpg	Test setup – conducted emissions on power supply lines

ANNEX B EXTERNAL PHOTOS 6 pages

170475eut1.jpg	EUT – 3D view 1
170475eut2.jpg	EUT – 3D view 2
170475eut3.jpg	EUT – Top view
170475eut4.jpg	EUT – with opened screen protection
170475eut5.jpg	EUT – label
170475eut5c.jpg	Power supply cable

ANNEX C INTERNAL PHOTOS 9 pages

170475eut6.jpg	EUT – inside view 1
170475eut7.jpg	EUT – inside view 2
170475eut8.jpg	EUT – inside view 3
170475eut9.jpg	Main PCB with display folded away
170475eut10.jpg	Display – top view
170475eut13.jpg	Display – bottom view
170475eut11.jpg	Main PCB – bottom view
170475eut14.jpg	Main PCB – top view (with RF absorption material on RF-chip
170475eut12.jpg	Main PCB – top view (without RF absorption material on RF-chip