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Test Report

Report Number:

F180488E2

Equipment under Test (EUT):

Video inspection camera
VIS 700

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 5 (April 2018)**, 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 Name	 Signature	24.08.2018 Date
Authorized reviewer:	Wolfgang KASALOWSKY Name	 Signature	24.08.2018 Date

This test report is only valid in its original form.

Contents

Page

1 Identification

1.1 Applicant

Name:	Wöhler Technik GmbH
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Country:	Germany
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eMail Address:	n.dering@woehler.de
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Wöhler Technik GmbH
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Country:	Germany
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Applicant represented during the test by the following person:	-

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: *	Inspection camera for exhaust (et al.) pipes with transmitter @ 512 Hz / 8.9 kHz
Type / PMN: *	VIS 700
FCC ID: *	2ANWR-VIS700
IC: *	23256-VIS700
Serial number: *	1022
PCB identifier: *	VIS700-MB
HVIN (Hardware Version Identification Number): *	VIS 700
FVIN (Firmware Version Identification Number): *	VIS 700
Hardware version: *	V3.0
Software version: *	V1.1.8

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: *	A2450M000000S007					
Antenna gain: *	1.5 dBi max.					
Antenna connector: *	none					
Supply voltage Base Unit: *	U_{nom}=	3.7 V DC	U_{min}=	3.0 V DC	U_{max}=	4.2 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: *	0 °C to 40 °C					
Lowest / highest Internal clock frequency: *	512 Hz / 2462 MHz					

* Declared by the applicant

Ancillary devices:

Test Laptop	Fujitsu S760
AC power adapter: *	Switching Adapter Input: 100 – 240 V AC 1.2 A, 50/60 Hz; Output:5.0 V DC 3 A Model: ASSA73w_05091520300 Manufacturer: Aqil Star Pecision Industrial (Shenzen) CO.,LTD.
WLAN Router: *	ASUS RT-AC87U

* Provided by the applicant

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
USB cable for power supply:*	USB 3.1 type C	USB 3.1 type C @ AC power adaptor	3 m *
Ethernet cable:*	USB interface via USB to Ethernet adaptor	WLAN router type ASUS RT-AC87U	3 m *

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	08.02.2018
Start of test:	20.06.2018
End of test:	13.07.2018

2 Operational States

The EUT is an inspection camera for exhaust (et al.) pipes with transmitter @ 512 Hz / 8.9 kHz and with a WLAN interface. The EUT can operate as a WLAN Access point or a WLAN client to transmit measurement results to an ancillary laptop, smartphone or tablet.

For the test, a script in the directory /home/pi named ./wlan_radio.sh was executed to start the WLAN test modes.

Maximum power Settings for all measurements:

Modulation	Power setting ch. 1 - 11
802.11 b/g/n	12

Operation mode	Description of the operation mode	mode	channel	Modulation	Data rate / Mbps
1	Continuous transmitting on 2412 MHz	802.11b	1	DSSS	5.5 Mbps
2	Continuous transmitting on 2437 MHz	802.11b	6	DSSS	5.5 Mbps
3	Continuous transmitting on 2462 MHz	802.11b	11	DSSS	5.5 Mbps
4	Continuous transmitting on 2412 MHz	802.11g	1	OFDM	54 Mbps
5	Continuous transmitting on 2437 MHz	802.11g	6	OFDM	54 Mbps
6	Continuous transmitting on 2462 MHz	802.11g	11	OFDM	54 Mbps
7	Continuous transmitting on 2412 MHz	802.11n	1	OFDM	MCS5
8	Continuous transmitting on 2437 MHz	802.11n	6	OFDM	MCS5
9	Continuous transmitting on 2462 MHz	802.11n	11	OFDM	MCS5

3 Additional Information

All tests were performed using an unmodified sample.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [3] or RSS-Gen, Issue 5 [4]	Status	Refer page
Maximum Peak Output Power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	10 et seq
Maximum Output Power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	11 et seq
DTS Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [3]	Passed	11 et seq
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [3]	Passed	16 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	18 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	23 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	39 et seq.

5 Results

5.1 Duty cycle

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1.

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.)

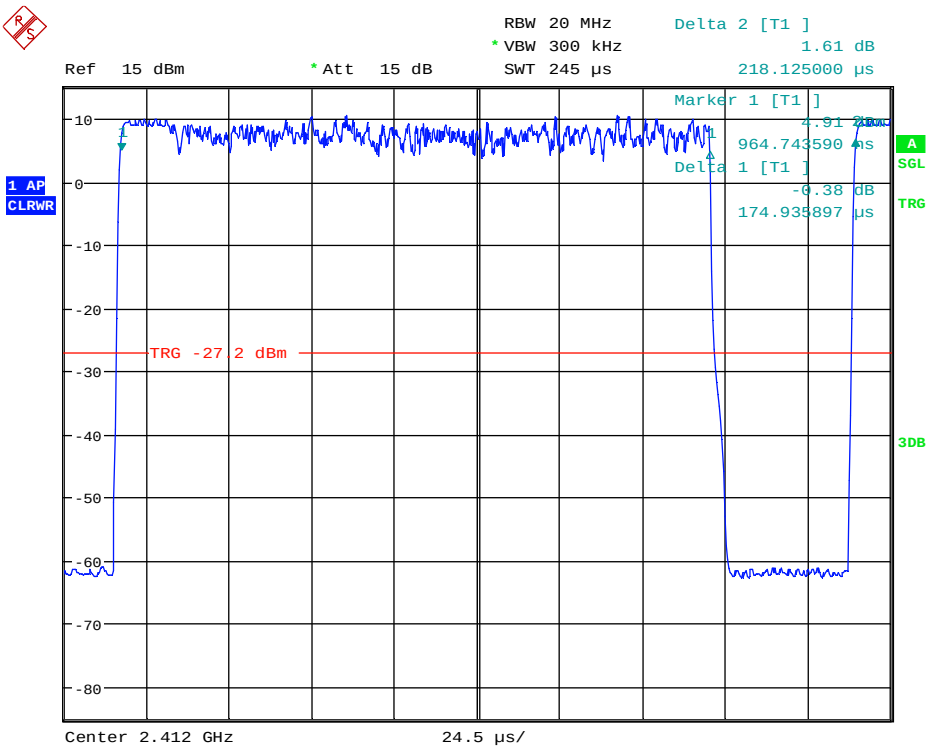
5.1.1 Test results

Ambient temperature	22 °C

Relative humidity	40 %

Only the worst case duty cycle plot is submitted below.

DutyCycle_54Mbps_ch1.WMF: Duty cycle measurement on channel 1 (operation mode 4):



The full calculation is only performed for the worst case, namely the 802.11g mode with 54 Mbps modulation. For all other modulations, only the results are submitted below.

$$T_{TX\_On} = 174.9\mu s;\ T_{TX\_Period} = 218.1\mu s$$

$$\frac{50}{T_{TX\_On}} = \frac{50}{174.9\mu s} = 285.9kHz \ll RBW \leq VBW$$

Measurement Points 10001 for 245 ms à 174.9 ms = 7139 measurement points à Signal has 7139 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.

$$x = \frac{174.9\mu s}{218.1\mu s} = 0.802 = 80.2\%$$

$$Correction\ factor: 10 \cdot \log\left(\frac{1}{x}\right) = 10 \cdot \log\left(\frac{1}{0.802}\right) = 1.0dB$$

Therefore, for average measurements a correction factor of 1.0 dB is used for tests in 802.11g mode.

802.11b mode: 0.1 dB correction factor T_{TX_On} = 1587μs; T_{TX_Period} = 1631μs

802.11g mode: 1.0 dB correction factor T_{TX_On} = 174.9μs; T_{TX_Period} = 218.1μs

802.11n20 mode: 0.9 dB correction factor T_{TX_On} = 195.2μs; T_{TX_Period} = 237.4μs

TEST EQUIPMENT USED FOR THE TEST:

37, 38

5.2 Maximum conducted output power

5.2.1 Method of measurement

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1.

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 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

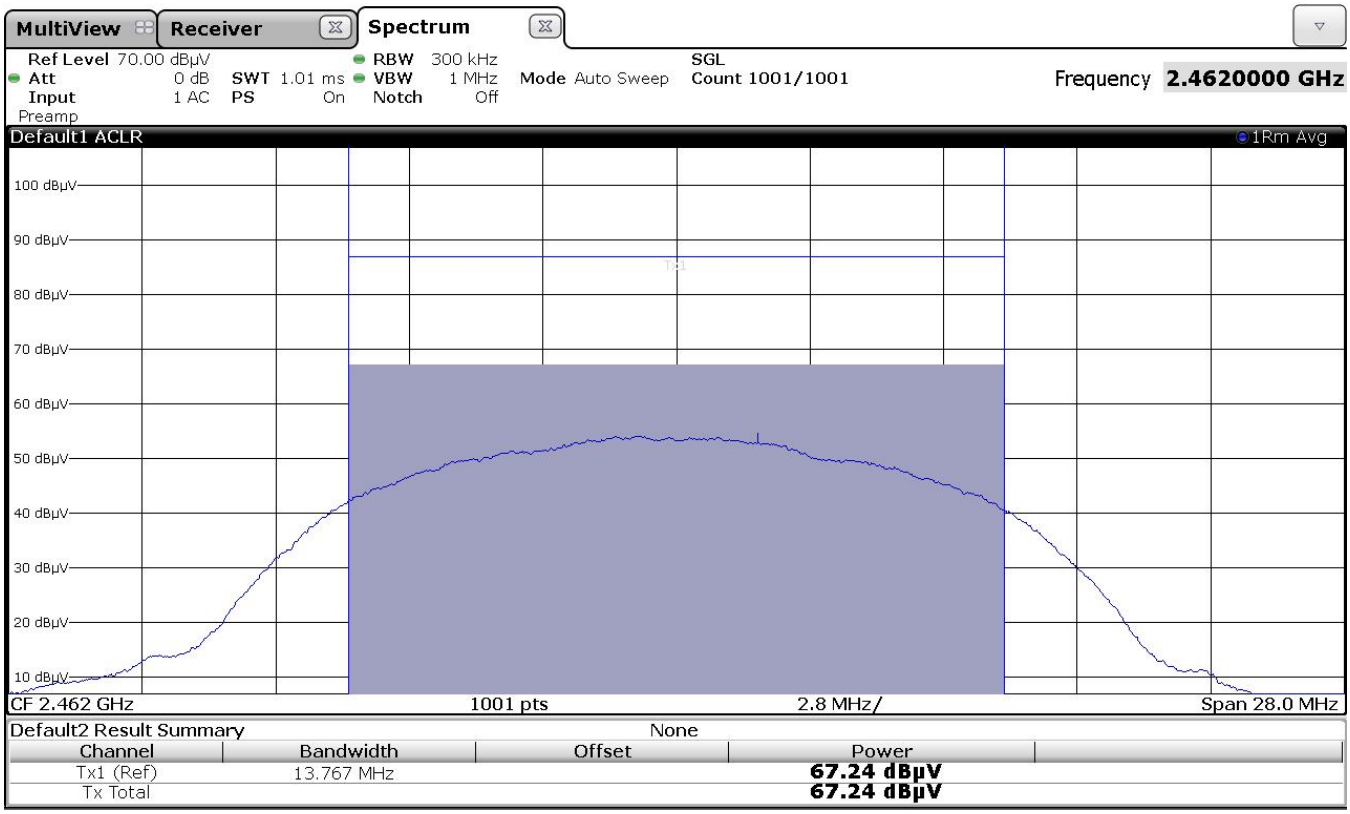
5.2.2 Test results

Ambient temperature	22 °C

Relative humidity	62 %

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

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]	Duty Cycle corr. [dB]	Corr. Fact. [dB]	Corr. Reading [dBmV]	EIRP* [dBm]	MOP [dBm]	Limit [dBm]
1	b	2412	65.7	0.1	33.6	99.4	4.1	2.6	30
2	b	2437	66.7	0.1	33.7	100.5	5.2	3.7	30
3	b	2462	67.2	0.1	33.8	101.1	5.8	4.3	30
4	g	2412	58.4	1.0	33.6	93.0	-2.3	-3.8	30
5	g	2437	59.5	1.0	33.7	94.2	-1.1	-2.6	30
6	g	2462	59.3	1.0	33.8	94.1	-1.2	-2.7	30
7	n	2412	59.2	0.9	33.6	93.7	-1.6	-3.1	30
8	n	2437	60.4	0.9	33.7	95.0	-0.3	-1.8	30
9	n	2462	60.0	0.9	33.8	94.7	-0.6	-2.1	30

*The EIRP values are measured radiated and therefor include the antenna gain.

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

9 – 14, 17, 18

5.3 DTS Bandwidth / 99% Bandwidth

5.3.1 Method of measurement

For the following bandwidth measurements, the EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1.

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).

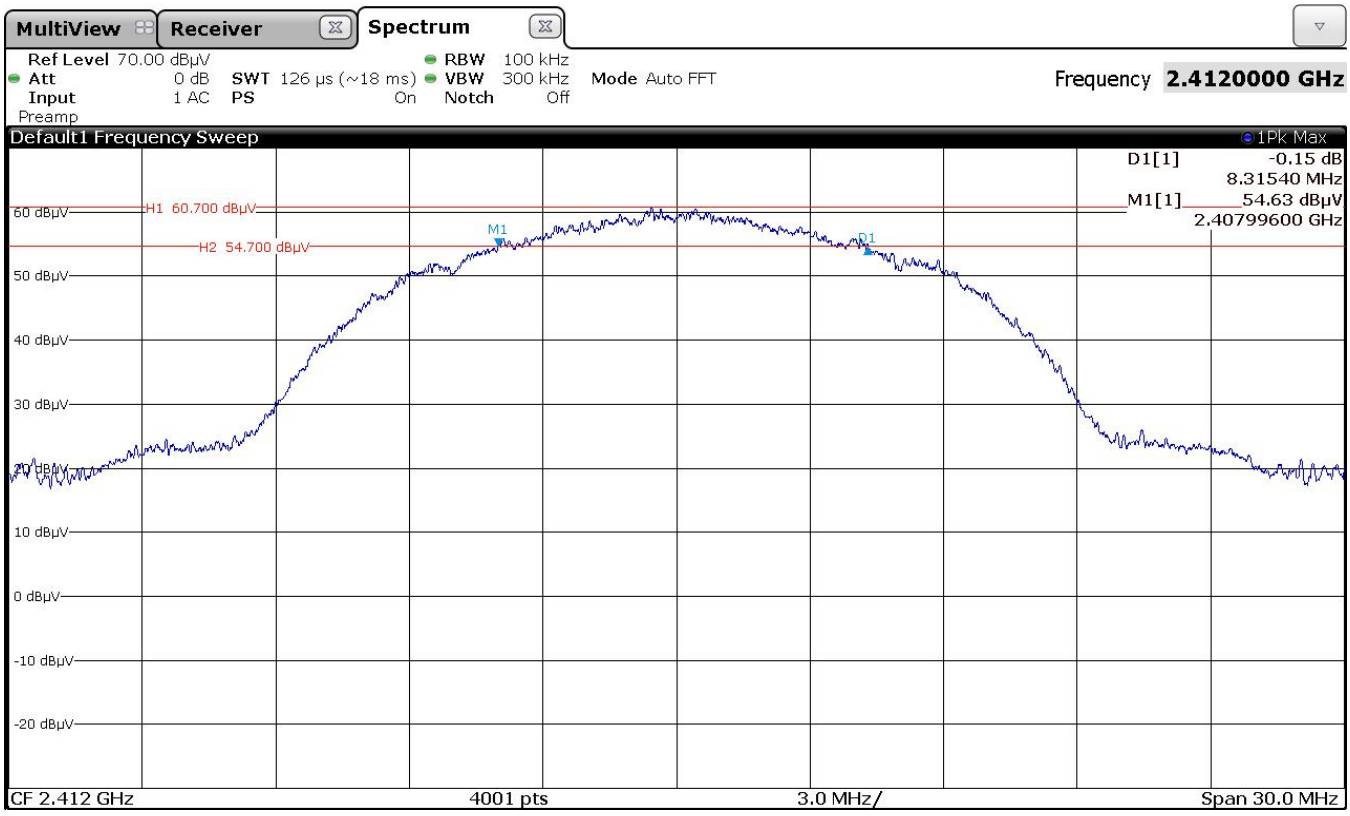
Since this is only a relative measurement, no measurement level correction was performed.

5.3.2 Test result

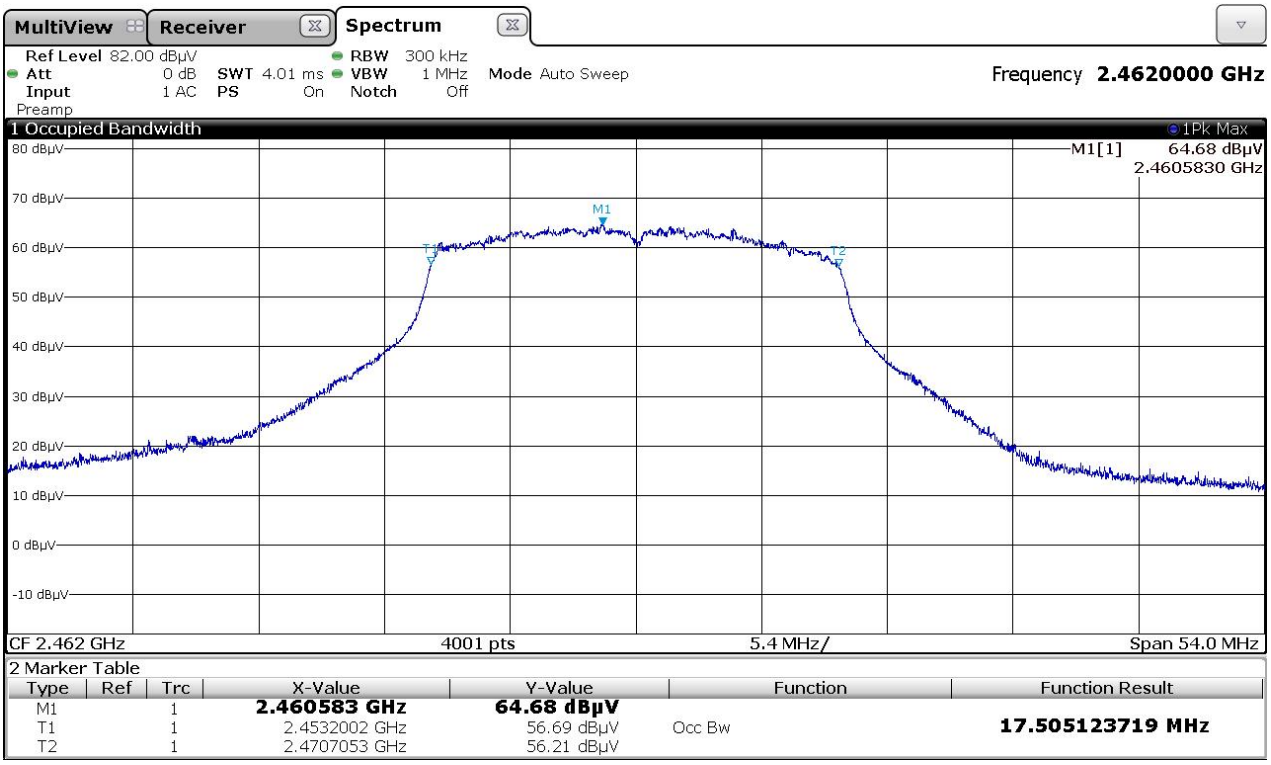
Ambient temperature	22 °C	Relative humidity	59 %

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

6-dB-BW_ch1.PNG: 6-dB Bandwidth (operation mode 1):



99%-BW_ch11.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	8.315	13.861	Passed
2	b	2437	0.5	8.465	13.807	Passed
3	b	2462	0.5	8.630	13.767	Passed
4	g	2412	0.5	16.353	16.952	Passed
5	g	2437	0.5	16.046	16.466	Passed
6	g	2462	0.5	16.021	16.466	Passed
7	n	2412	0.5	16.638	17.964	Passed
8	n	2437	0.5	16.323	17.546	Passed
9	n	2462	0.5	16.335	17.505	Passed

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

9 – 14, 17, 18

5.4 Average Power Spectral Density

5.4.1 Method of measurement

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1.

Acceptable measurement configurations

The measurement procedure refers to part 11.10.5 of document [1].

a) Measure the duty cycle (D) of the transmitter output signal as described in 11.6.
b) Set instrument center frequency to DTS channel center frequency.
c) Set span to at least 1.5 times the OBW.
d) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
e) Set VBW ≥ [3 × RBW].
f) Detector = power averaging (rms) or sample detector (when rms not available).
g) Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
h) Sweep time = auto couple.
i) Do not use sweep triggering; allow sweep to “free run.”
j) Employ trace averaging (rms) mode over a minimum of 100 traces.
k) Use the peak marker function to determine the maximum amplitude level.Add [10 log (1 / D)], where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time.
l) Add [10 log (1 / D)], where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time.
m) If measured value exceeds requirement specified by regulatory agency, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

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:

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

$PSD = EIRP - G$

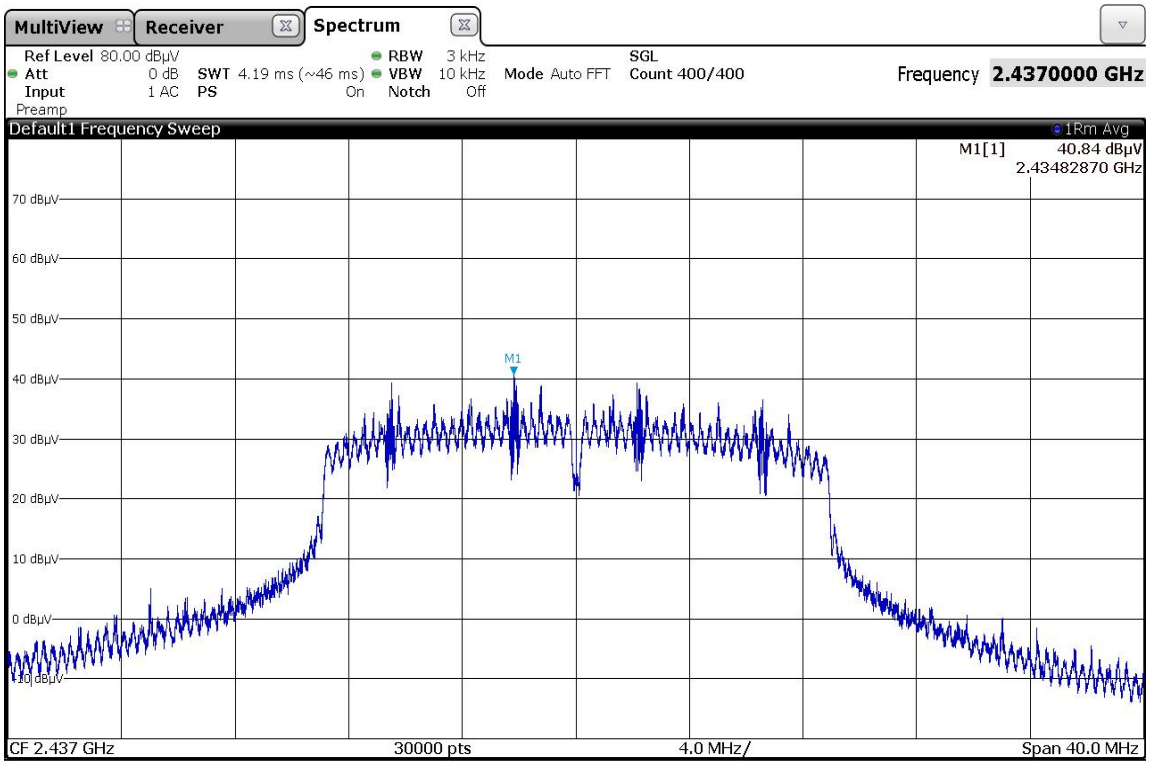
E	is the electric field strength in dBµV/m
EIRP_PSD	is the equivalent isotropically radiated power spectral density in dBm
d	is the specified measurement distance in m
G	is the antenna gain in dBi
AVPSD	is the average power density – measured antenna port conducted – in dBm

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.

AVGPSD-2_ch6.png: Peak Power Spectral Density (operation mode 8):



Operation Mode		Peak Frequency [MHz]	PPSD Reading [dBmV/3 kHz]	Duty Cycle corr. [dB]	Corr. Fact. [dB]	Corr. Reading [dBmV/3 kHz]	EIRP PPSD [dBm/3 kHz]	PPSD [dBm/3 kHz]	PPSD Limit [dBm/3kHz]
1	b	2412.725	34.6	0.1	33.6	68.3	-27.0	-28.5	8.0
2	b	2436.165	36.5	0.1	33.7	70.3	-25.0	-26.5	8.0
3	b	2461.277	36.1	0.1	33.8	70.0	-25.3	-26.8	8.0
4	g	2409.853	37.9	1.0	33.6	72.5	-22.8	-24.3	8.0
5	g	2434.858	39.4	1.0	33.7	74.1	-21.2	-22.7	8.0
6	g	2459.839	39.3	1.0	33.8	74.1	-21.2	-22.7	8.0
7	n	2409.825	38.4	0.9	33.6	72.9	-22.4	-23.9	8.0
8	n	2434.829	40.8	0.9	33.7	75.4	-19.9	-21.4	8.0
9	n	2459.830	40.2	0.9	33.8	74.9	-20.4	-21.9	8.0

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

9 – 14, 17, 18

5.5 Band-edge compliance

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

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1.

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

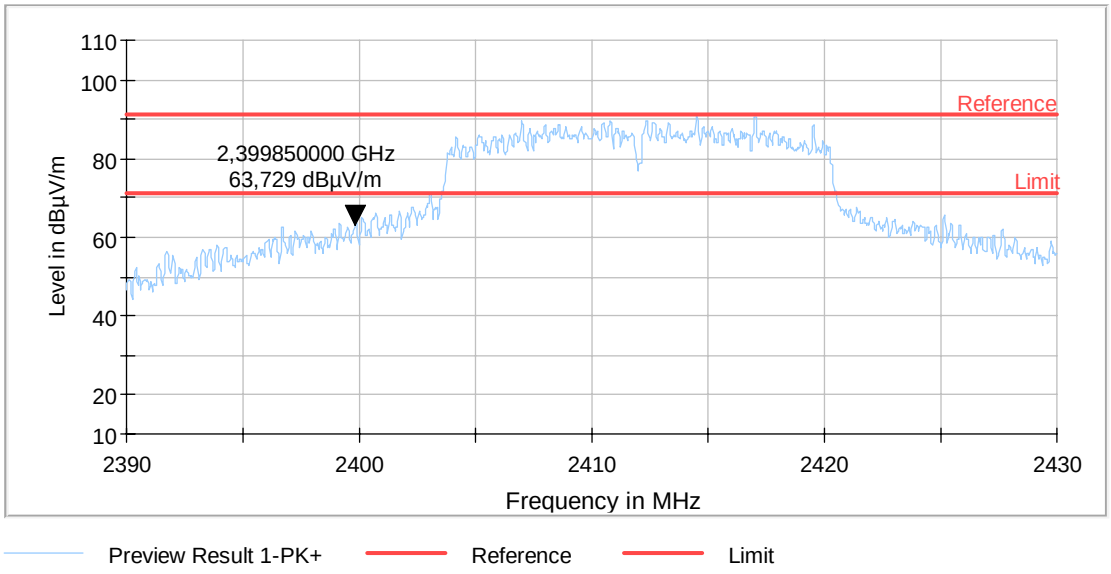
- Set the center frequency and span to encompass the frequency range to be measured.
- RBW = 100 kHz.
- VBW ≥ 300 kHz.
- Detector = Peak.
- Ensure that the number of measurement points ≥ span/RBW.
- Sweep time = auto couple.
- Trace Mode = max hold.
- Allow the trace to stabilise.
- Use the peak marker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

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

180488_g_ch1_12dBm_LowerBandEdge_Unr: 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	2398.620	91.0	71.0	52.5	18.5	Passed
4	g	2412	2399.850	91.0	71.0	63.7	7.3	Passed
7	n	2412	2399.610	91.5	71.5	64.0	7.5	Passed

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

9 – 14, 17, 18

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

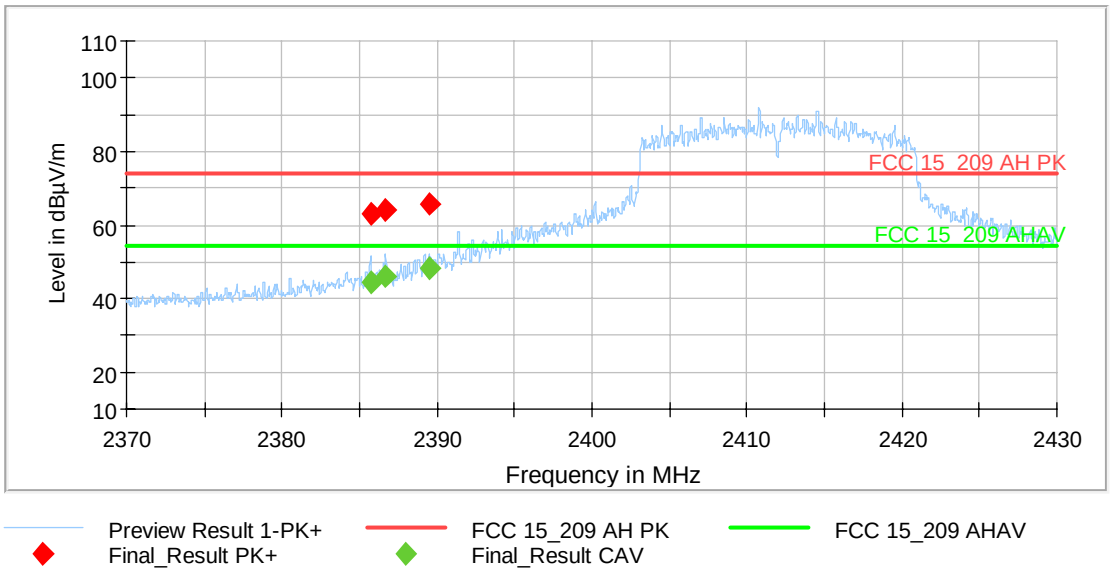
The EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1.

Acceptable measurement configurations

The same measurement configurations as decribed in 5.6.1. were used for the preview and final measurement.

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

180488_n20_ch1_12dBm_LowerBandEdge: radiated band-edge compliance at an restricted band-edge (operation mode 7):



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)
2386.500000	---	34.67	54.00	19.33	V	99.0	0.0	33.3
2386.500000	47.15	---	74.00	26.85	V	99.0	0.0	33.3
2386.890000	---	34.50	54.00	19.50	V	111.0	0.0	33.3
2386.890000	46.14	---	74.00	27.86	V	111.0	0.0	33.3
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)
2485.350000	---	32.56	54.00	21.44	V	317.0	0.0	33.6
2485.350000	44.50	---	74.00	29.50	V	317.0	0.0	33.6
2487.525000	---	33.17	54.00	20.83	V	358.0	0.0	33.5
2487.525000	45.82	---	74.00	28.18	V	358.0	0.0	33.5
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)
2386.980000	---	44.73	54.00	9.27	V	108.0	0.0	33.3
2386.980000	62.88	---	74.00	11.12	V	108.0	0.0	33.3
2388.240000	---	46.40	54.00	7.60	V	116.0	0.0	33.3
2388.240000	64.45	---	74.00	9.55	V	116.0	0.0	33.3
2389.500000	---	45.01	54.00	8.99	V	90.0	0.0	33.3
2389.500000	63.15	---	74.00	10.85	V	90.0	0.0	33.3
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)
2483.900000	---	37.47	54.00	16.53	V	89.0	0.0	33.5
2483.900000	51.78	---	74.00	22.22	V	89.0	0.0	33.5
2485.775000	---	38.56	54.00	15.44	V	104.0	0.0	33.6
2485.775000	52.68	---	74.00	21.32	V	104.0	0.0	33.6
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)
2385.750000	---	44.66	54.00	9.34	V	116.0	0.0	33.3
2385.750000	62.80	---	74.00	11.20	V	116.0	0.0	33.3
2386.710000	---	45.98	54.00	8.02	V	99.0	0.0	33.3
2386.710000	64.26	---	74.00	9.74	V	99.0	0.0	33.3
2389.500000	---	48.30	54.00	5.70	V	116.0	0.0	33.3
2389.500000	65.63	---	74.00	8.37	V	116.0	0.0	33.3
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)
2485.200000	---	37.53	54.00	16.47	V	110.0	0.0	33.6
2485.200000	51.24	---	74.00	22.76	V	110.0	0.0	33.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

9 – 14, 17, 18

5.6 Maximum unwanted emissions

5.6.1 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.

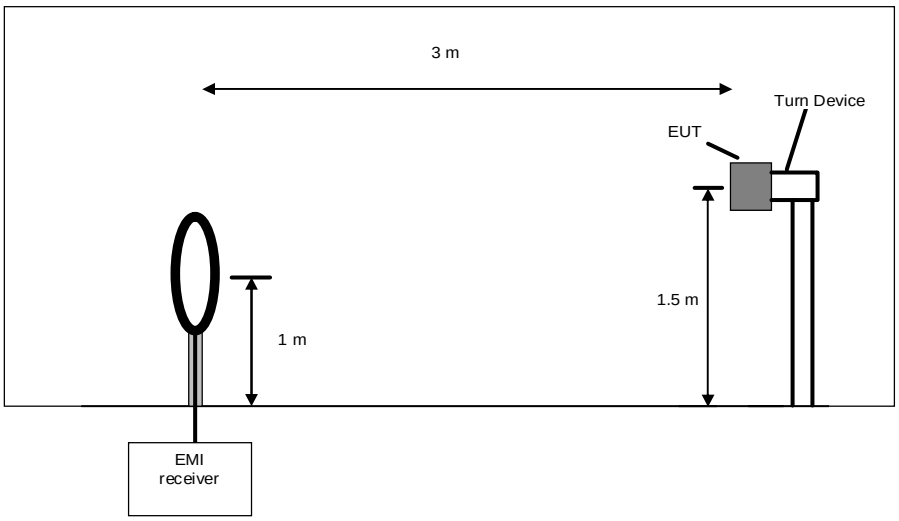
Preliminary measurement (9 kHz to 30 MHz):

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.

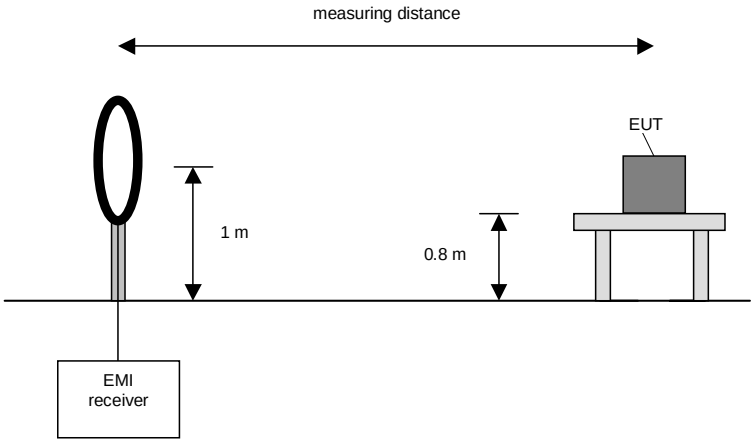
Final measurement (9 kHz to 30 MHz):

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).

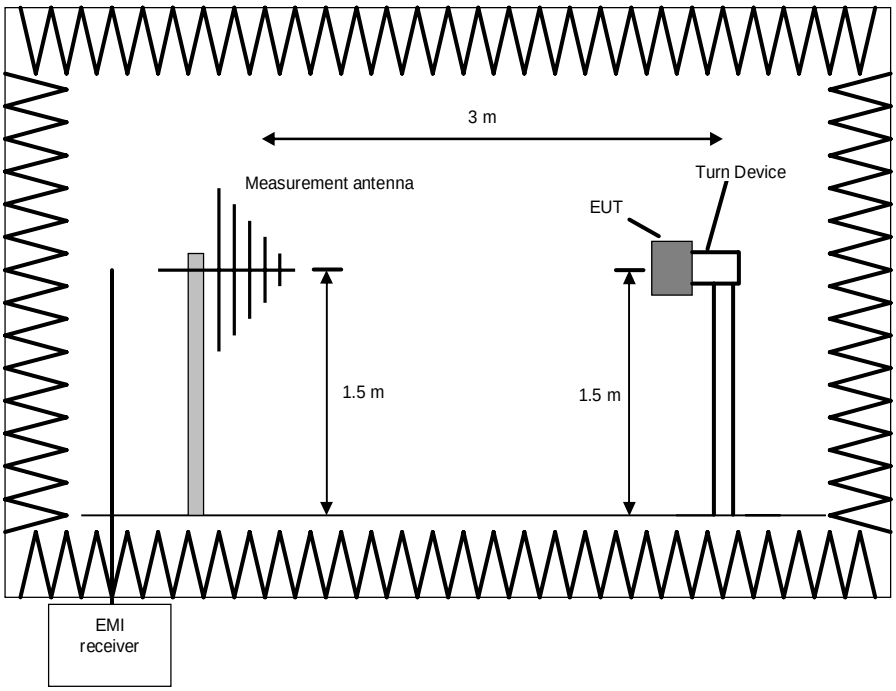
Preliminary measurement (30 MHz to 1 GHz)

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:

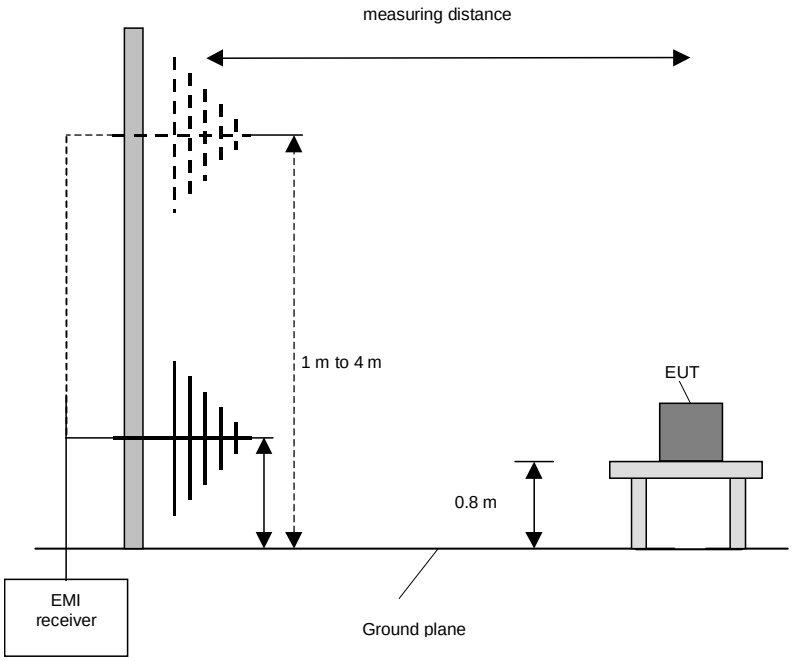
8. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
9. Manipulate the system cables within the range to produce the maximum level of emission.
10. Rotate the EUT by 360 ° to maximize the detected signals.
11. Repeat 1) to 3) with the vertical polarisation of the measuring 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)

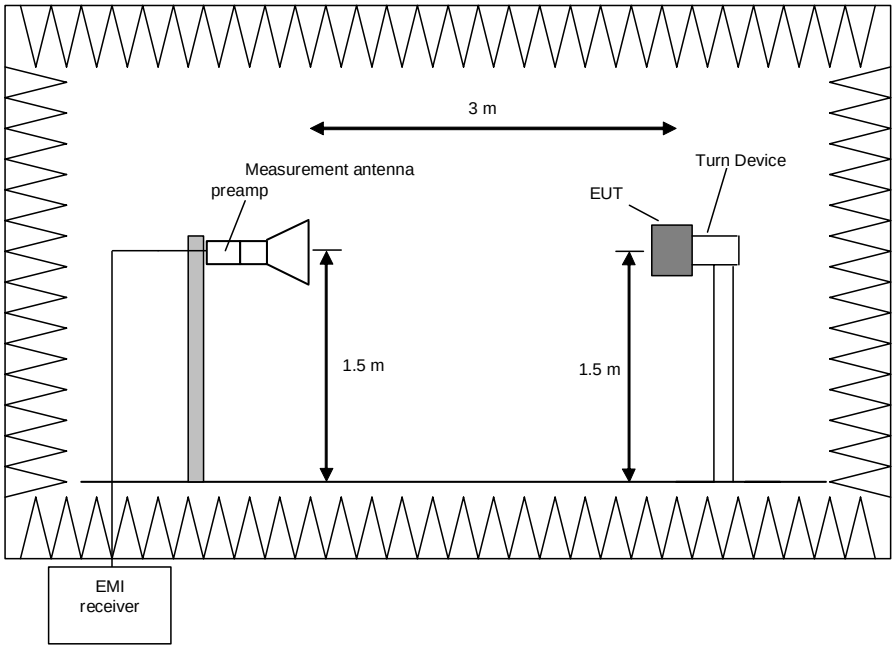
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

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:

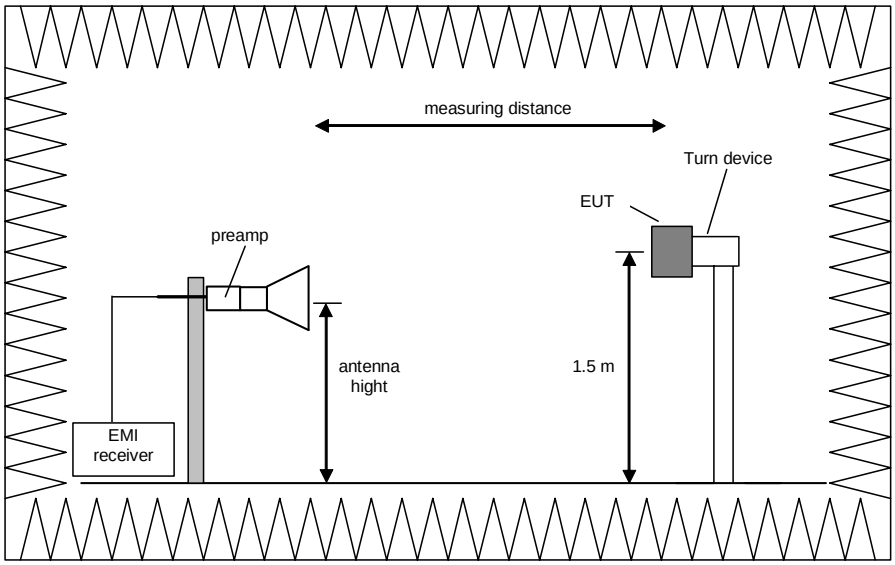
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an 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.

5.6.2 Test results radiated emissions with internal antenna from 30 MHz – 25 GHz

5.6.2.1 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.

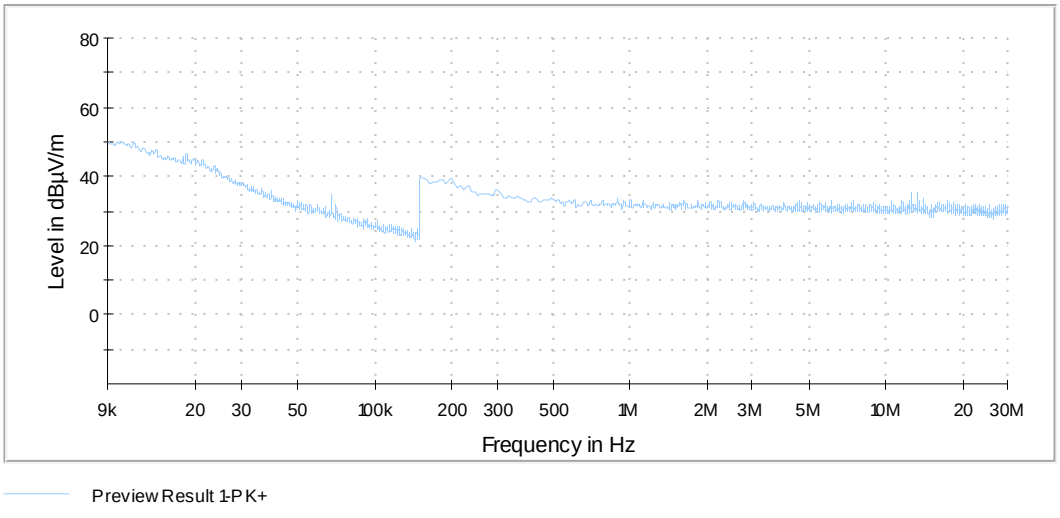
Supply voltage: During all measurements > 1 GHz the host of the EUT was powered with 5 V. For the test a power supply type “ASSA73w_05091520300” by “Aqil Star Pecision Industrial (Shenzen) CO.,LTD.” was used. The power supply was provided by the applicant. For emissions < 1 GHz no power supply was connected and the EUT was powered by the internal battery.

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

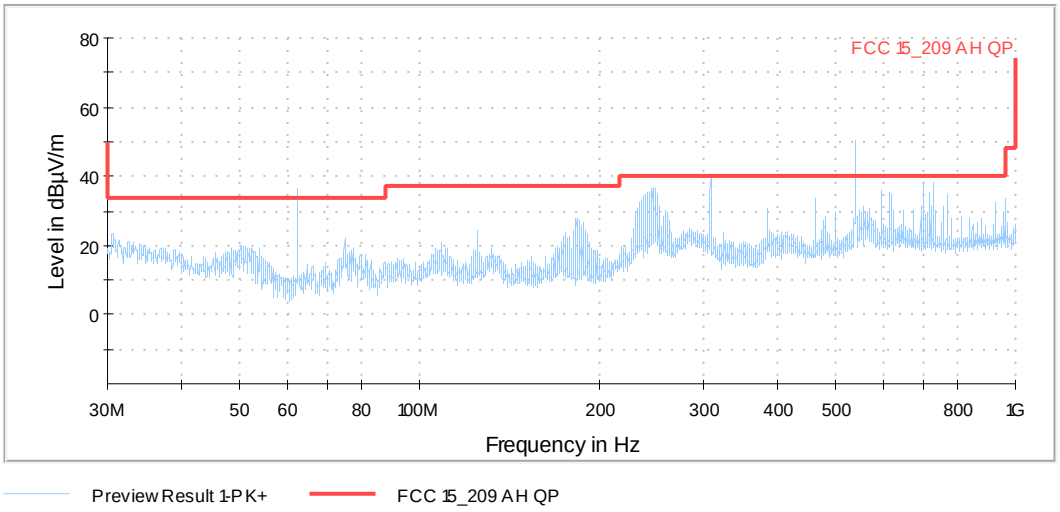
No emissions were found in the frequency range from 9 kHz to 30 MHz, therefore no final test was performed.

Plots of the worst case transmitter spurious emissions

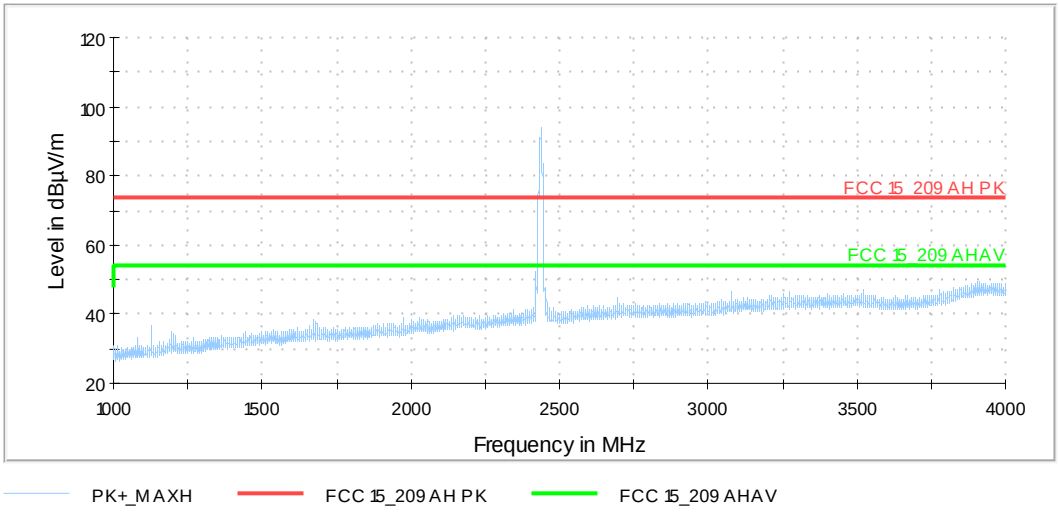
180488_b_ch11_12dBm_9k-30M: Spurious emissions from 9 kHz to 30 MHz (no diff. with op. modes):



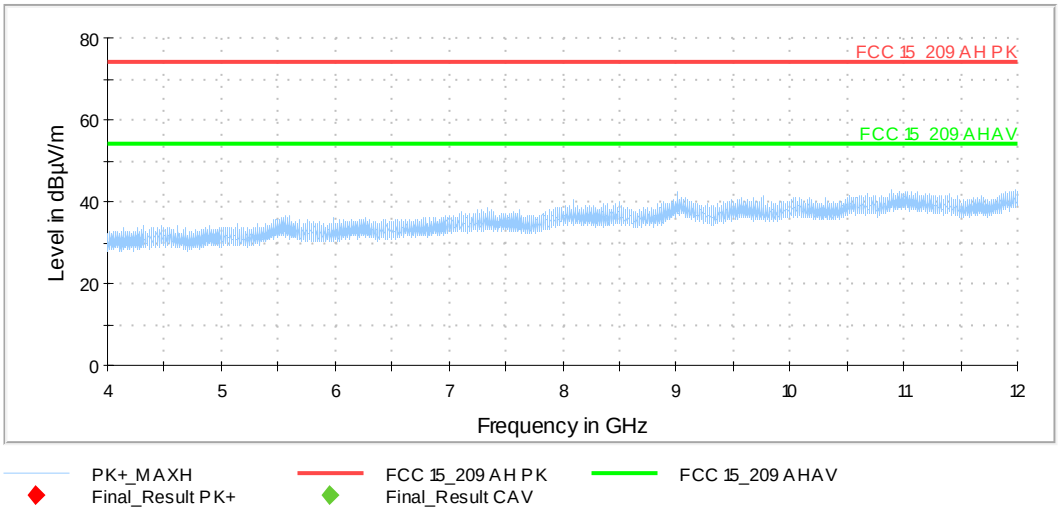
180488_b_ch11_12dBm_30M-1G: Spurious emissions from 30 MHz to 1 GHz (no diff. with op. modes):



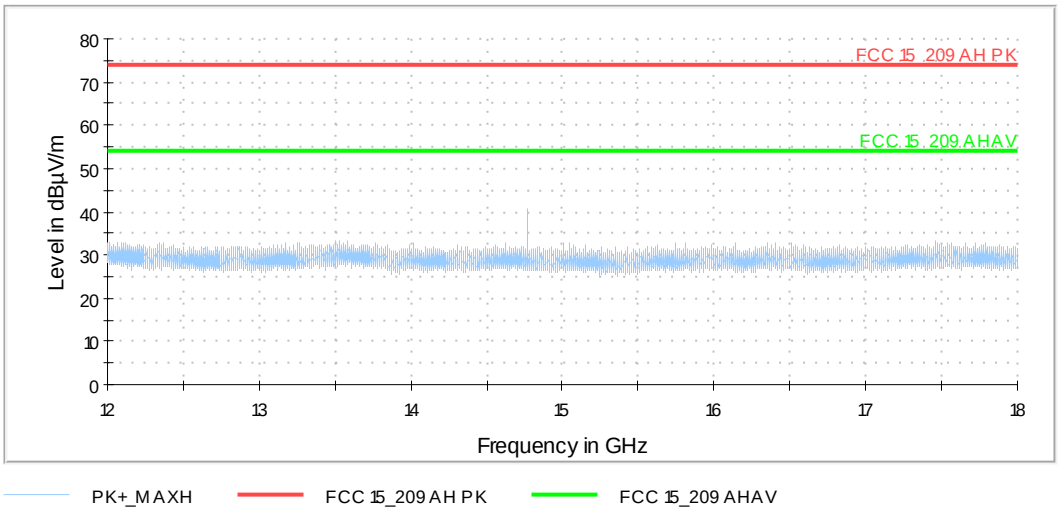
180488_b_ch6_12dBm_1-4G: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



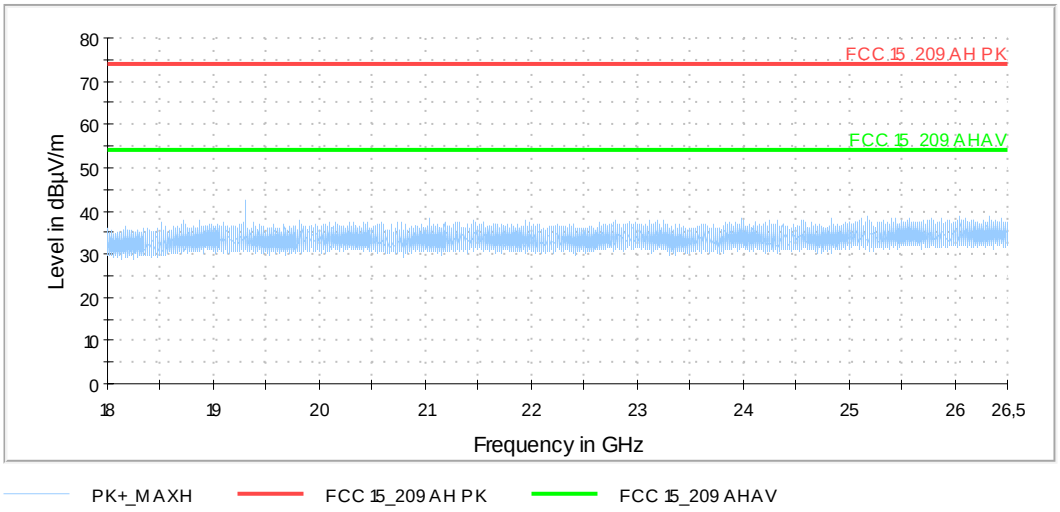
180488_b_ch6_12dBm_4-12G: Spurious emissions from 4 GHz to 12 GHz (operation mode 2):



180488_g_ch11_12dBm_12-18G: Spurious emissions from 12 GHz to 18 GHz (operation mode 6):



180488_g_ch1_12dBm_18-26,5G: Spurious emissions from 18 GHz to 25 GHz (operation mode 4):



5.6.2.2 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]
62.495000	23.63	40.00	16.37	1000.0	120.000	218.0	V	142.0	12.6
246.202222	36.19	46.00	9.81	1000.0	120.000	122.0	H	61.0	20.3
308.012778	43.96	46.00	2.04	1000.0	120.000	100.0	H	0.0	22.2
594.001111	37.69	46.00	8.31	1000.0	120.000	100.0	V	295.0	29.7
615.987778	38.98	46.00	7.02	1000.0	120.000	110.0	V	288.0	30.2
701.994444	37.72	46.00	8.28	1000.0	120.000	100.0	V	288.0	31.1
728.992778	39.71	46.00	6.29	1000.0	120.000	100.0	V	288.0	32.3
Measurement uncertainty					+2.2 dB / -3.6 dB				

All average emissions > 1 GHz are corrected with the according duty cycle correction factor.

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)
1077.950000	---	29.21	54	24.79	H	91	90	25.1
1077.950000	39.53	---	74	34.47	H	91	90	25.1
1124.950000	---	33.2	54	20.80	H	104	59	25.1
1124.950000	39.47	---	74	34.53	H	104	59	25.1
1154.950000	---	25.03	54	28.97	H	100	59	25.5
1154.950000	38.41	---	74	35.59	H	100	59	25.5
1199.100000	---	30.27	54	23.73	H	135	30	26.3
1199.100000	39.14	---	74	34.86	H	135	30	26.3
1681.850000	---	33.35	54	20.65	H	135	60	29.5
1681.850000	42.64	---	74	31.36	H	135	60	29.5
2411.100000	---	91.37	Fund.	-	V	114.0	0.0	33.5
2411.100000	97.55	---	Fund.	-	V	114.0	0.0	33.5
14472.060000	---	41.26	54	12.74	V	138	29	11.5
14472.060000	46.64	---	74	27.36	V	138	29	11.5
19296.150000	---	40.62	54	13.38	H	49	120	6.7
19296.150000	48.63	---	74	25.37	H	49	120	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)
1077.950000	---	28.93	54	25.07	V	123	119	25.1
1077.950000	38.68	---	74	35.32	V	123	119	25.1
1124.950000	---	33.93	54	20.07	H	96	90	25.1
1124.950000	40.29	---	74	33.71	H	96	90	25.1
2436.250000	---	91.74	Fund.	-	V	132.0	29.0	33.6
2436.250000	98.58	---	Fund.	-	V	132.0	29.0	33.6
3080.000000	---	44.96	54	9.04	H	113	90	36.3
3080.000000	57.16	---	74	16.84	H	113	90	36.3
14622.120000	---	40.24	54	13.76	V	135	30	11.5
14622.120000	46.83	---	74	27.17	V	135	30	11.5
19496.150000	---	38.86	54	15.14	V	96	90	6.6
19496.150000	48.14	---	74	25.86	V	96	90	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)
1077.950000	---	29.13	54	24.87	V	94	60	25.1
1077.950000	38.68	---	74	35.32	V	94	60	25.1
1125.000000	---	30.64	54	23.36	V	77	60	25.1
1125.000000	38.21	---	74	35.79	V	77	60	25.1
1197.350000	---	30.44	54	23.56	H	132	30	26.3
1197.350000	39.19	---	74	34.81	H	132	30	26.3
1681.850000	---	34.06	54	19.94	H	128	30	29.5
1681.850000	42.94	---	74	31.06	H	128	30	29.5
2462.200000	---	93.38	Fund.	-	V	146.0	30.0	33.6
2462.200000	100.04	---	Fund.	-	V	146.0	30.0	33.6
14772.120000	---	42.24	54	11.76	V	57	150	11.3
14772.120000	46.99	---	74	27.01	V	57	150	11.3
19696.150000	---	39.45	54	14.55	V	73	90	6.6
19696.150000	48.44	---	74	25.56	V	73	90	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)
1077.950000	38.97	---	74	35.03	H	134	90	25.1
1077.950000	---	29.57	54	24.43	H	134	90	25.1
1124.950000	38.14	---	74	35.86	H	90	30	25.1
1124.950000	---	31.67	54	22.33	H	90	30	25.1
1200.950000	---	30.78	54	23.22	H	130	90	26.3
1200.950000	38.81	---	74	35.19	H	130	90	26.3
1674.800000	41.86	---	74	32.14	H	123	30	29.6
1674.800000	---	32.63	54	21.37	H	123	30	29.6
1682.750000	42.98	---	74	31.02	H	130	30	29.5
1682.750000	---	34.41	54	19.59	H	130	30	29.5
2408.250000	---	87.51	Fund.	-	V	113.0	0.0	33.4
2408.250000	99.29	---	Fund.	-	V	113.0	0.0	33.4
14472.060000	---	39.8	54	14.2	V	134	29	11.5
14472.060000	45.49	---	74	28.51	V	134	29	11.5
19296.150000	---	42.6	54	11.4	H	54	120	6.7
19296.150000	49.19	---	74	24.81	H	54	120	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)
1124.950000	---	33.83	54.00	20.17	H	112.0	90.0	25.1
1124.950000	39.21	---	74.00	34.79	H	112.0	90.0	25.1
1198.200000	---	30.10	54.00	23.90	H	138.0	29.0	26.3
1198.200000	39.25	---	74.00	34.75	H	138.0	29.0	26.3
1680.050000	---	33.90	54.00	20.10	H	126.0	120.0	29.5
1680.050000	44.48	---	74.00	29.52	H	126.0	120.0	29.5
2438.250000	---	89.09	Fund.	-	V	101.0	0.0	33.6
2438.250000	101.28	---	Fund.	-	V	101.0	0.0	33.6
14622.120000	---	42.02	54.00	11.98	V	136.0	30.0	11.5
14622.120000	47.32	---	74.00	26.68	V	136.0	30.0	11.5
19496.100000	---	40.55	54.00	13.45	V	71.0	90.0	6.6
19496.100000	48.57	---	74.00	25.43	V	71.0	90.0	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)
1077.950000	---	28.89	54	25.11	H	96	59	25.1
1077.950000	38.6	---	74	35.4	H	96	59	25.1
1124.950000	---	34.94	54	19.06	H	107	89	25.1
1124.950000	39.63	---	74	34.37	H	107	89	25.1
1194.750000	---	31.21	54	22.79	H	135	60	26.3
1194.750000	40.7	---	74	33.3	H	135	60	26.3
1680.100000	---	32.49	54	21.51	V	144	60	29.5
1680.100000	43.23	---	74	30.77	V	144	60	29.5
2460.750000	---	89.51	Fund.	-	V	141.0	29.0	33.6
2460.750000	102.24	---	Fund.	-	V	141.0	29.0	33.6
14772.120000	---	42.38	54	11.62	V	55	150	11.3
14772.120000	46.95	---	74	27.05	V	55	150	11.3
19696.150000	---	40.62	54	13.38	V	81	90	6.6
19696.150000	48.36	---	74	25.64	V	81	90	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)
1077.950000	---	29.23	54	24.77	V	85	90	25.1
1077.950000	38.1	---	74	35.9	V	85	90	25.1
1124.950000	---	34.87	54	19.13	H	101	90	25.1
1124.950000	39.67	---	74	34.33	H	101	90	25.1
1154.950000	---	25.2	54	28.8	H	64	60	25.5
1154.950000	38.01	---	74	35.99	H	64	60	25.5
1200.950000	---	31.35	54	22.65	H	132	30	26.3
1200.950000	39.73	---	74	34.27	H	132	30	26.3
1680.950000	---	34.25	54	19.75	H	126	60	29.5
1680.950000	43.77	---	74	30.23	H	126	60	29.5
2410.750000	---	87.98	Fund.	-	V	126.0	0.0	33.4
2410.750000	99.31	---	Fund.	-	V	126.0	0.0	33.4
14472.060000	---	41.77	54	12.23	V	138	29	11.5
14472.060000	46.64	---	74	27.36	V	138	29	11.5
19296.100000	---	42.02	54	11.98	H	51	120	6.7
19296.100000	48.77	---	74	25.23	H	51	120	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)
1077.950000	---	29.69	54	24.31	V	252	29	25.1
1077.950000	38.92	---	74	35.08	V	252	29	25.1
1124.950000	---	34.66	54	19.34	H	113	90	25.1
1124.950000	40.23	---	74	33.77	H	113	90	25.1
1200.050000	---	31.17	54	22.83	H	138	90	26.3
1200.050000	39.51	---	74	34.49	H	138	90	26.3
2439.500000	---	86.60	Fund.	-	H	24.0	90.0	33.6
2439.500000	97.91	---	Fund.	-	H	24.0	90.0	33.6
2618.000000	---	43.43	54	10.57	V	68	30	34.5
2618.000000	54.67	---	74	19.33	V	68	30	34.5
14622.120000	---	41.48	54	12.52	V	124	30	11.5
14622.120000	46.4	---	74	27.6	V	124	30	11.5
19496.150000	---	40.33	54	13.67	V	40	90	6.6
19496.150000	48.33	---	74	25.67	V	40	90	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)
1077.950000	---	27.31	54	26.69	H	113	59	25.1
1077.950000	37.13	---	74	36.87	H	113	59	25.1
1124.950000	---	34.1	54	19.9	H	107	59	25.1
1124.950000	39.01	---	74	34.99	H	107	59	25.1
1154.950000	---	25.64	54	28.36	H	110	59	25.5
1154.950000	38.39	---	74	35.61	H	110	59	25.5
1677.450000	---	33.91	54	20.09	H	124	90	29.5
1677.450000	42.06	---	74	31.94	H	124	90	29.5
2457.000000	---	88.29	Fund.	-	V	141.0	29.0	33.7
2457.000000	100.01	---	Fund.	-	V	141.0	29.0	33.7
14772.120000	---	43.25	54	10.75	V	57	150	11.3
14772.120000	47.82	---	74	26.18	V	57	150	11.3
19696.150000	---	37.85	54	16.15	V	68	90	6.6
19696.150000	47.26	---	74	26.74	V	68	90	6.6
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
1 – 29, 37

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

Ambient temperature	20 °C	Relative humidity	52 %

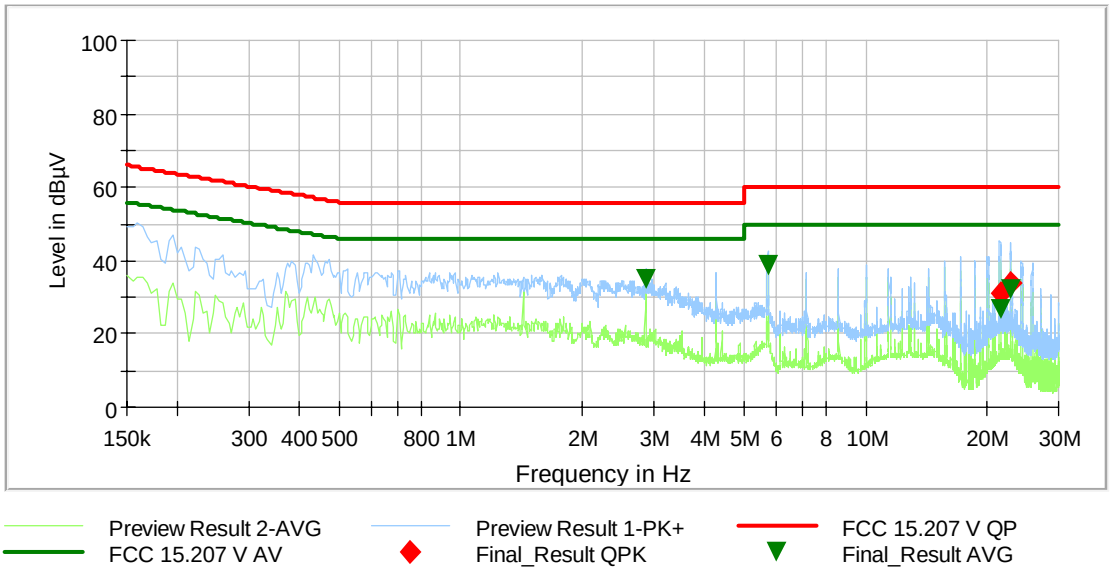
Position of EUT: For this test the EUT was placed on a table with the height of 0.8 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report and the operational states in chapter 2.

Test record: All results are shown in the following.

Supply voltage: Measurement performed with US 120V/60Hz. For the test a power supply type "ASSA73w_05091520300" by "Aqil Star Pecision Industrial (Shenzen) CO.,LTD." 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 "▼".



Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth (kHz)	Line	PE	Corr. (dB)
2.859000	---	35.01	46.00	10.99	5000.0	9.000	N	GND	10.2
5.721000	---	38.82	50.00	11.18	5000.0	9.000	N	GND	10.4
21.448500	---	26.94	50.00	23.06	5000.0	9.000	N	FLO	11.0
21.448500	31.22	---	60.00	28.78	5000.0	9.000	N	GND	11.0
22.877700	---	32.34	50.00	17.66	5000.0	9.000	N	GND	11.0
22.884900	33.69	---	60.00	26.31	5000.0	9.000	N	GND	11.0

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30 - 36

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Open area test site M6	Freifeld M6	Phoenix Contact	-	480085	Calibration not necessary	
2	Antenna mast	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	Calibration not necessary	
3	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
4	Relay Switch Unit	RSU	Rohde & Schwarz	375344/005	480077	Calibration not necessary	
5	Controller	MCU	Maturo	041/971107	482113	Calibration not necessary	
6	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
7	EMI Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
8	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Calibration not necessary	
9	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Calibration not necessary	
10	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	22.06.2017	06.2019
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	09.10.2017	01.10.2020
15	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Calibration not necessary	
16	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Calibration not necessary	
17	RF-cable No. 3	Sucoflex 106B	Huber&Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
18	RF-cable No. 40	Sucoflex 106B	Huber&Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
19	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	21.02.2018	02.2020
20	Antenna (Bilog)	CBL6112B	Schaffner	2688	480328	19.06.2017	06.2020
21	RF-cable 2 m	KPS-1533-800-KPS	Insulated Wire	-	480302	Calibration not necessary	
22	Kabel 36	Sucoflex 106B	Suhner	500003/6B / Kabel 36	481680	Calibration not necessary	
23	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	23.11.2016	11.2018
24	Preamplifier 12 GHz - 18 GHz	JS3-12001800-16-5A	MITEQ Hauppauge N.Y.	571667	480343	14.03.2018	03.2020
25	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ.	658697	480342	14.03.2018	03.2020
26	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright	1	480587	Calibration not necessary	
27	Loop antenna	-	Phoenix Testlab GmbH	-	410085	Calibration not necessary	
28	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	28.02.2018	02.2020
29	Antenna (Bilog)	CBL6111D	Schaffner	25761	480894	19.10.2017	10.2020
30	Shielded chamber M4	-	Siemens	B83117S1-X158	480088	Calibration not necessary	

31	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	28.02.2018	2.2020
32	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.03.2018	3.2020
33	High pass filter	HR 0.13-5ENN	FSY Microwave Inc.	DC 0109 SN 002	480340	Calibration not necessary	
34	EMI Software	ES-K1	Rohde & Schwarz	-	480111	Calibration not necessary	
35	Netzteil AC	AC6803A AC Quelle 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	
36	EMI Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
37	Spectrum Analyzer	FSU46	Rohde & Schwarz	200125	480956	01.03.2018	03.2020
38	Test fixture	-	Phoenix Testlab	-	410160	Calibration not necessary	

7 Report History

Report Number	Date	Comment
F180488E1	24.08.2018	Initial Test Report

8 List of Annexes

ANNEX A TEST SETUP PHOTOS 8 pages

180488_radio_01.JPG:	Test setup – radiated test in anechoic chamber
180488_radio_02.JPG:	Test setup – radiated test in anechoic chamber
180488_radio_03.JPG:	Test setup – radiated test in anechoic chamber
180488_radio_04.JPG:	Test setup – radiated test on open area test site
180488_radio_05.JPG:	Test setup – radiated test in anechoic chamber
180488_radio_06.JPG:	Test setup – radiated test in anechoic chamber
180488_radio_08.JPG:	Test setup – conducted emissions on power supply lines

ANNEX B EXTERNAL PHOTOS 5 pages

180488_radio_14.jpg:	EUT – Top view
180488_radio_10.jpg	EUT – 3D view 1
180488_radio_11.jpg	EUT – 3D view 2
180488_radio_11a.jpg:	EUT – rear view
180488_radio_11b.jpg:	EUT – bottom view
180488_radio_11c.jpg:	EUT with connected camera
180488_radio_12.jpg	EUT – type label
180488_radio_13.jpg	AC/DC power adapter
180488_radio_15.jpg	AC/DC power adapter type label
180488eutTX1.jpg:	Camera view 1
180488eutTX2.jpg:	Camera view 1

ANNEX C INTERNAL PHOTOS 10 pages

180488_radio_14.jpg	EUT – inside view 1
180488_radio_15.jpg	EUT – inside view with radio PCB
180488_radio_16.jpg	EUT – inside view without radio PCB
180488_radio_17.jpg	EUT – inside view all PCBs removed
180488_radio_18.jpg	Radio PCB top view
180488_radio_19.jpg	Radio PCB bottom view
180488_radio_20.jpg	Main PCB – top view
180488_radio_21.jpg	Main PCB – bottom view
180488_radio_22.jpg	“Joystick” PCB top view
180488_radio_23.jpg	“Joystick” PCB bottom view