

Test Report

Report Number:

F170813E2 2nd version

Equipment under Test (EUT):

**RF 2.4 GHz to UART converter
Transceiver PV**

Applicant:

Hunter Douglas GmbH

Manufacturer:

Hunter Douglas Europe B.V.



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 (June 2017)**, Radio Frequency Devices
- [3] **RSS-210 Issue 9 (August 2016)**, Licence-Exempt Radio Apparatus: Category I Equipment
- [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:	<u>Thomas KÜHN</u>	<u></u>	<u>05/24/2018</u>
	Name	Signature	Date
Authorized reviewer:	<u>Bernd STEINER</u>	<u></u>	<u>05/24/2018</u>
	Name	Signature	Date

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Contents

Page

1	Identification.....	4
1.1	Applicant.....	4
1.2	Manufacturer.....	4
1.3	Test laboratory	4
1.4	EUT (Equipment Under Test)	5
1.5	Technical data of equipment.....	5
1.6	Dates	6
2	Operational states.....	6
3	Additional information	6
4	Overview.....	7
5	Results.....	8
5.1	Bandwidth.....	8
5.1.1	Method of measurement (bandwidth)	8
5.1.2	Test result	9
5.2	Band-edge compliance.....	11
5.2.1	Method of measurement (band edges next to unrestricted bands (radiated))	11
5.2.2	Test result (band edges next to unrestricted bands (radiated)).....	12
5.2.3	Method of measurement (band edges next to restricted bands (radiated))	13
5.2.4	Test result (band edges next to restricted bands (radiated))	13
5.3	Maximum unwanted emissions.....	14
5.3.1	Method of measurement (radiated emissions)	14
5.3.2	Test results (radiated emissions) – 9 kHz – 25 GHz	21
5.3.2.1	Preliminary radiated emission measurement 9 kHz – 25 GHz	21
5.3.2.2	Final radiated measurements.....	29
5.3.2.3	Final radiated emission measurement (9 kHz to 30 MHz).....	29
5.3.2.4	Final radiated emission measurement (30 MHz to 1 GHz).....	29
5.3.2.5	Final radiated emission measurement (1 GHz to 25 GHz).....	30
5.4	Conducted emissions on power supply lines (150 kHz to 30 MHz).....	33
6	Test equipment and ancillaries used for tests	34
7	Report history	35
8	List of annexes.....	35

1 Identification

1.1 Applicant

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Applicant represented during the test by the following person:	None

1.2 Manufacturer

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Country:	The Netherlands
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Applicant represented during the test by the following person:	None

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: *	RF 2.4GHz to UART converter with integrated protocol translator
Type / PMN: *	PV Transceiver CT
FCC ID: *	UXUCT1
IC: *	7316A-CT1
Serial number: *	EMV-023
PCB identifier: *	LP9646-FS ILA REV 1.0
HVIN (Hardware Version Identification Number): *	PV Transceiver CT
FVIN (Firmware Version Identification Number): *	REV 0.11
Hardware version: *	REV 1.0
Software version: *	NA

1.5 Technical data of equipment

Antenna type: *	PCB antenna					
Antenna gain: *	1.0 dBi					
Antenna connector: *	None					
Power supply – EUT: *	U _{nom} =	5.0 V DC	U _{min} =	4.0 V DC	U _{max} =	6.0 V DC
Power supply – RF part: *	U _{nom} =	3.3 V DC	U _{min} =	1.8 V DC	U _{max} =	3.6 V DC
Type of modulation: *	GFSK					
Data rate: *	1Mbps					
Operating frequency range:*	2407 - 2480 MHz					
Number of channels: *	3 (2407 MHz, 2440 MHz and 2480 MHz)					
Temperature range: *	0 °C to 60 °C					
Lowest / highest Internal clock frequency: *	32 kHz / 16 MHz					
Ancillaries used for testing:	Forest shuttle FS2S, AC/DC adapter type ZF120A-2403000 (used for conducted emissions on power supply line only)					

* Declared by the applicant

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
DC Power and data*	RJ11	RJ45	0.15 m *
-	-	-	-

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	05/22/2017
Start of test:	07/25/2017
End of test:	07/28/2017

2 Operational states

The EUT is a remote control transceiver intended to be used in combination with a roller blind motor.

The test modes were set via a modified EUT by pressing the push button.

During all RF-tests the EUT was supplied with 6 V DC by a four AA battery pack with new batteries.

During the emission test on the power supply line the EUT was mounted on a roller blind motor type Forest shuttle FS2S, which was connected to the 120 V / 60 Hz AC mains via an AC/DC adapter type ZF120A-2403000 from ShenZenShi ZhenHuan Electronic.

The following test modes were adjustable by pressing the push button of the EUT:

Operation mode	Description of the operation mode	channel	Modulation	Data rate / Mbps
1	Transmits continuously without modulation on 2407 MHz	Lowest	None	-
2	Transmits continuously without modulation on 2440 MHz	Middle	None	-
3	Transmits continuously without modulation on 2480 MHz	Highest	None	-
4	Transmits continuously with modulation on 2407 MHz	Lowest	GFSK	1 Mbps
5	Transmits continuously with modulation on 2440 MHz	Middle	GFSK	1 Mbps
6	Transmits continuously with modulation on 2480 MHz	Highest	GFSK	1 Mbps
7	Receives continuously on 2407 MHz	Lowest	-	-
8	Receives continuously on 2440 MHz	Middle	-	-
9	Receives continuously on 2480 MHz	Highest	-	-

3 Additional information

The EUT which was used for the radio tests was equipped with a firmware that allows the adjustment of the test modes listed above.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-210 [3] or RSS-Gen, Issue 4 [4]	Status	Refer page
Bandwidth	2400 MHz to 2480 MHz	15.215 (c)	6.6 [4]	Passed	8 et seq.
Band edge compliance	2400 MHz to 2480 MHz	15.215 (c)	-	Passed	11 et seq.
Radiated emissions (transmitter)	0.009 – 25,000	15.249 (a), 15.249 (d), 15.205 (a), 15.209 (a).	B.10 [3], [4]	Passed	14 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	33 et seq.

5 Results

5.1 Bandwidth

5.1.1 Method of measurement (bandwidth)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed or a test fixture shall be used. The EUT has to be switched on, the transmitter shall work with its maximum data rate.

20 dB bandwidth:

The following spectrum analyser settings shall be used:

- Span: App. 2 to 5 times the OBW, centred on the actual channel.
- Resolution bandwidth: 1 to 5 % of the OBW.
- Video bandwidth: App. three times the RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency lines shall be set on the intersection points between the second display line and the measured curve.

99 % bandwidth:

The following spectrum analyser settings shall be used:

- Span: wide enough to capture all emission scirts.
- Resolution bandwidth: 1 to 5 % of the OBW.
- Video bandwidth: App. three times the RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

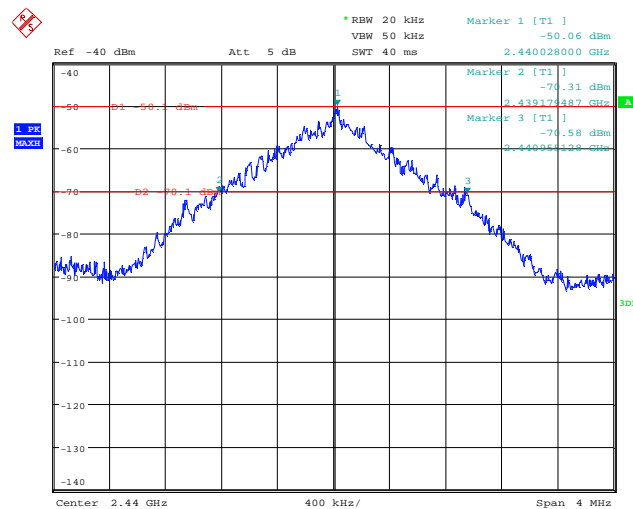
After trace stabilisation the marker shall be set on the signal peak. Use the 99 % bandwidth functionality of the spectrum analyser to integrate the requested bandwidth.

5.1.2 Test result

Ambient temperature	23 °C	Relative humidity	47 %
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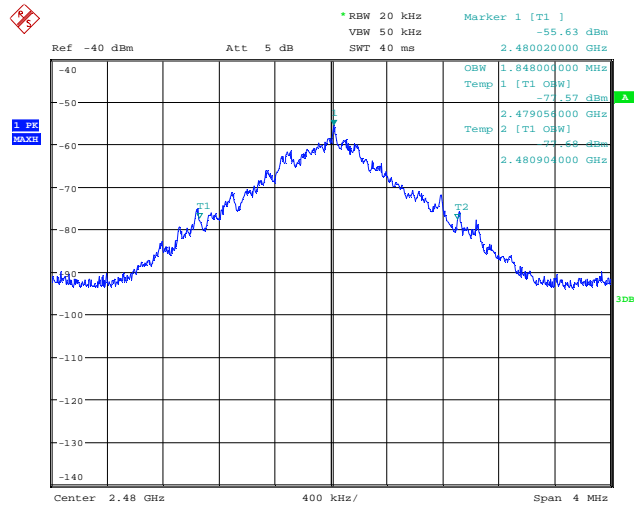
The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

170813_002.wmf: 20 dB Bandwidth (operation mode 5):



Operation Mode	Center Frequency	F_L	F_U	20 dB Bandwidth	Result
4	2407 MHz	2406.203487 MHz	2407.857333 MHz	1.654 MHz	Passed
5	2440 MHz	2439.179487 MHz	2440.955128 MHz	1.776 MHz	Passed
6	2480 MHz	2479.217949 MHz	2480.801282 MHz	1.583 MHz	Passed

170813_006.wmf: 99% Bandwidth (operation mode 6):



Operation Mode	Center Frequency	F_L	F_U	99 % Bandwidth	Result
4	2407 MHz	2406.148000 MHz	2407.868000 MHz	1.720 MHz	Passed
5	2440 MHz	2439.108000 MHz	2440.848000 MHz	1.740 MHz	Passed
6	2480 MHz	2479.056000 MHz	2480.904000 MHz	1.848 MHz	Passed

Test: Passed

Test equipment used (refer clause 6):

6, 26

5.2 Band-edge compliance

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

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.3.1.

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 \geq 300 kHz.
- Set the span to \geq 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 maximum amplitude level.

Measurement Procedure – Unwanted Emissions

- Set the center frequency and span to encompass the frequency range to be measured.
- RBW = 100 kHz.
- VBW \geq 300 kHz.
- Detector = Peak.
- Ensure that the number of measurement points \geq 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.

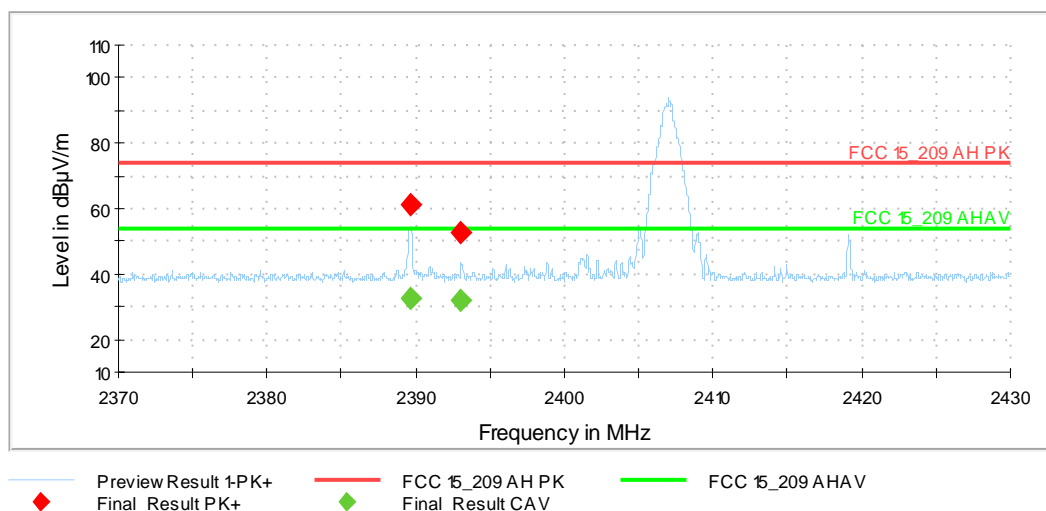
The measurement procedure at the band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were encompassed by the span. After trace stabilization, the maximum peak was determined by a peak detector and the value was marked by an appropriate 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.

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

Ambient temperature	22 °C	Relative humidity	58 %
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Radiated band-edge compliance at an unrestricted band-edge (operation mode 4):



Results measured with peak detector

Operation Mode	Tx Frequency [MHz]	Emission Frequency [MHz]	Emission Level [dBµV/m]	Restricted band	Limit [dBµV/m]	Margin [dB]	Result
4	2407	2389.650	61.4	Yes	74.0	12.6	Passed
		2393.040	52.4	No	74.0	21.6	Passed

Results measured with average detector

Operation Mode	Tx Frequency [MHz]	Emission Frequency [MHz]	Emission Level [dBµV/m]	Restricted band	Limit [dBµV/m]	Margin [dB]	Result
4	2407	2389.650	32.6	Yes	54.0	21.4	Passed
		2393.040	31.8	No	54.0	22.4	Passed

Test: Passed

Test equipment used (refer clause 6):

5, 8, 9 – 13, 16, 17

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

Ambient temperature	22 °C	Relative humidity	58 %
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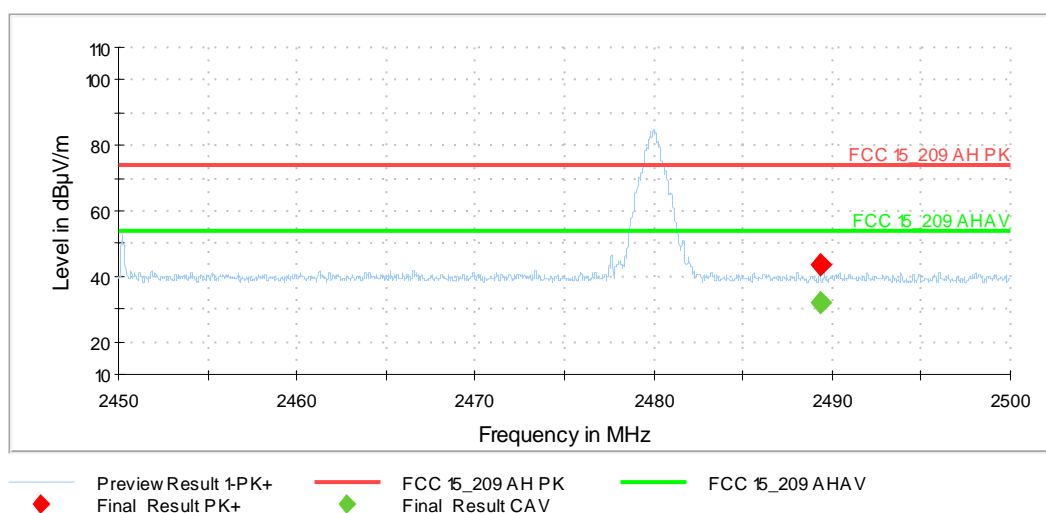
The EUT was measured radiated in the anechoic chamber using the procedures described in 5.3.1.

Acceptable measurement configurations

The same measurement configurations as described in 5.3.1 were used for the preview and final measurement.

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

Radiated band-edge compliance at an restricted band-edge (operation mode 6):



Results measured with peak detector

Operation Mode	Tx Frequency [MHz]	Emission Frequency [MHz]	Emission Level [dBµV/m]	Restricted band	Limit [dBµV/m]	Margin [dB]	Result
6	2480	2489.325	43.8	Yes	74.0	30.2	Passed

Results measured with average detector

Operation Mode	Tx Frequency [MHz]	Emission Frequency [MHz]	Emission Level [dBµV/m]	Restricted band	Limit [dBµV/m]	Margin [dB]	Result
6	2480	2489.325	31.7	Yes	54.0	22.3	Passed

Test: Passed

Test equipment used (refer clause 6):

5, 8, 9 – 13, 16, 17

5.3 Maximum unwanted emissions

5.3.1 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.

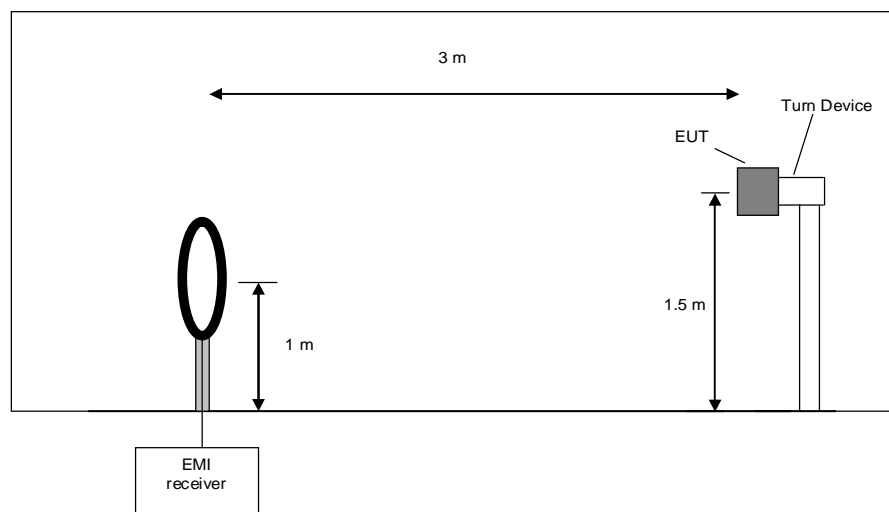
Preliminary measurement (9 kHz to 30 MHz):

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.

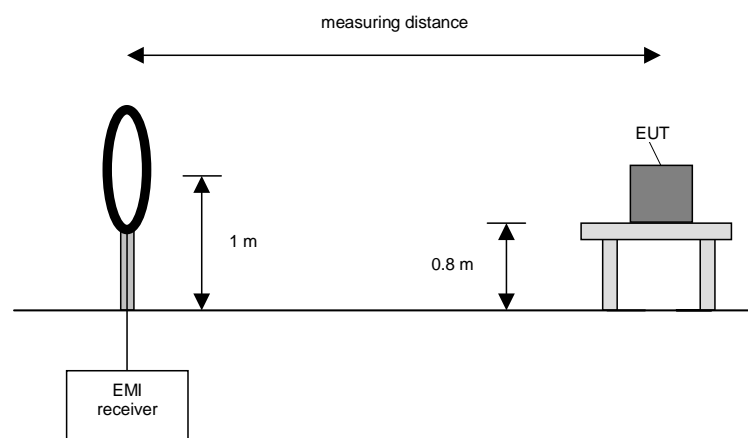
Final measurement (9 kHz to 30 MHz):

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).

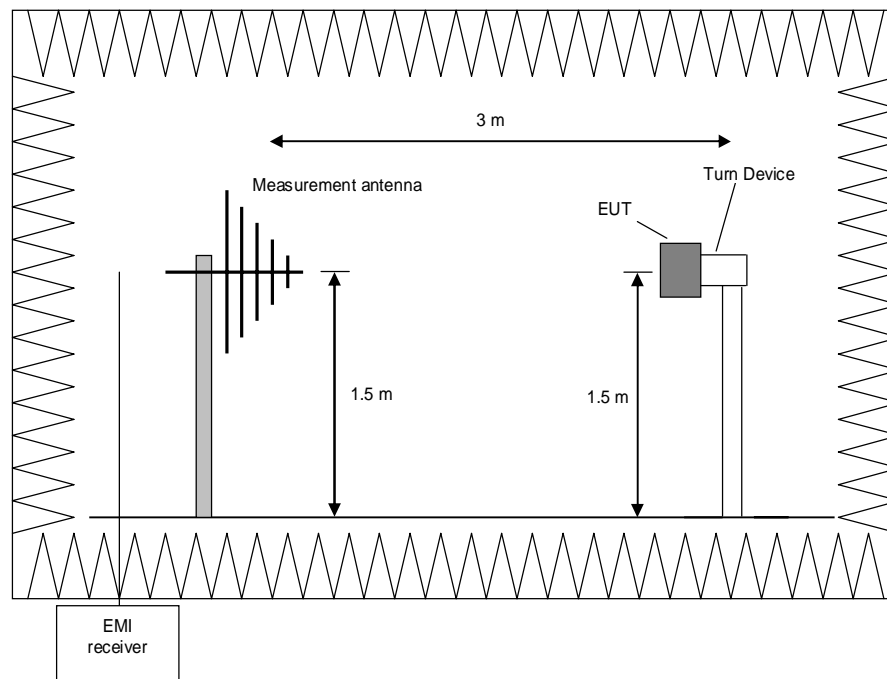
Preliminary measurement (30 MHz to 1 GHz)

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:

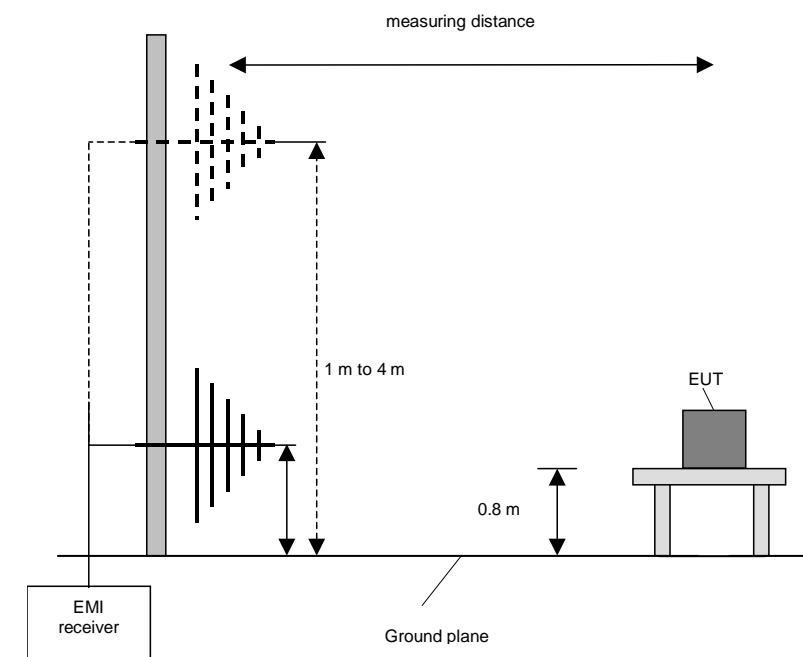
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarisation of the measuring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

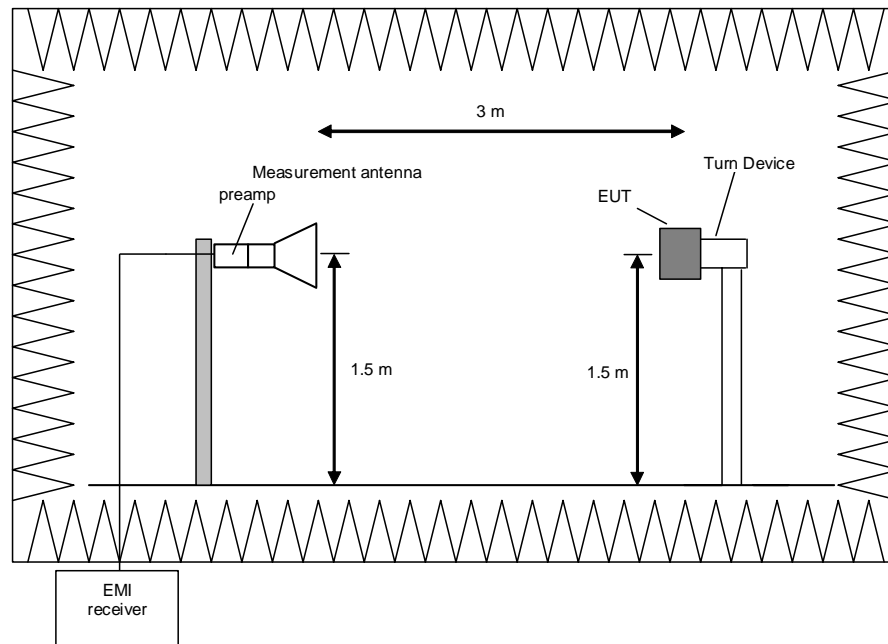
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

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:

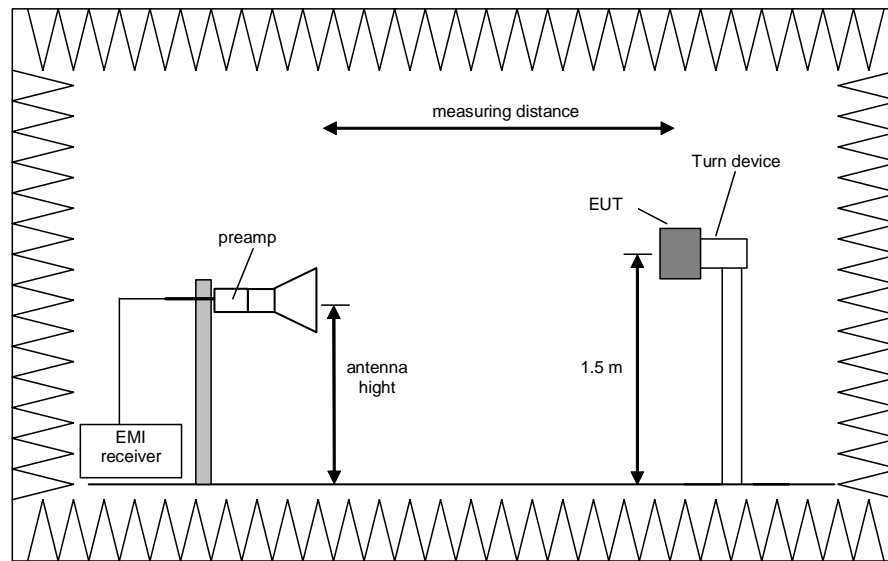
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle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

5.3.2 Test results (radiated emissions) – 9 kHz – 25 GHz

5.3.2.1 Preliminary radiated emission measurement 9 kHz – 25 GHz

Ambient temperature	22 °C	Relative humidity	59 %
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Position of EUT: The EUT was set-up on a turn device of a height of 1.5 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.

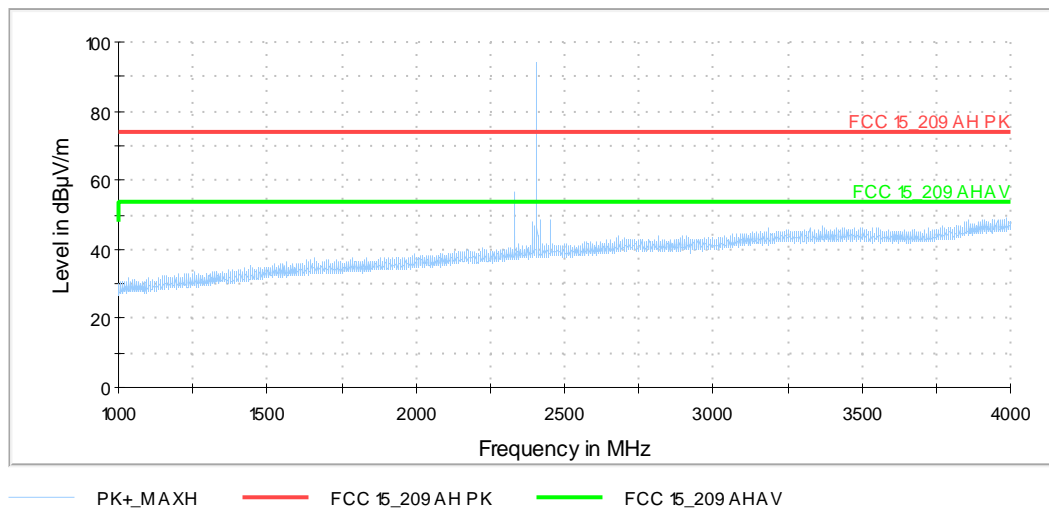
Test record: Only the plot of the worst case emission is submitted below.

Supply voltage: During all measurements the EUT was powered with 6.0 V DC by an external battery.

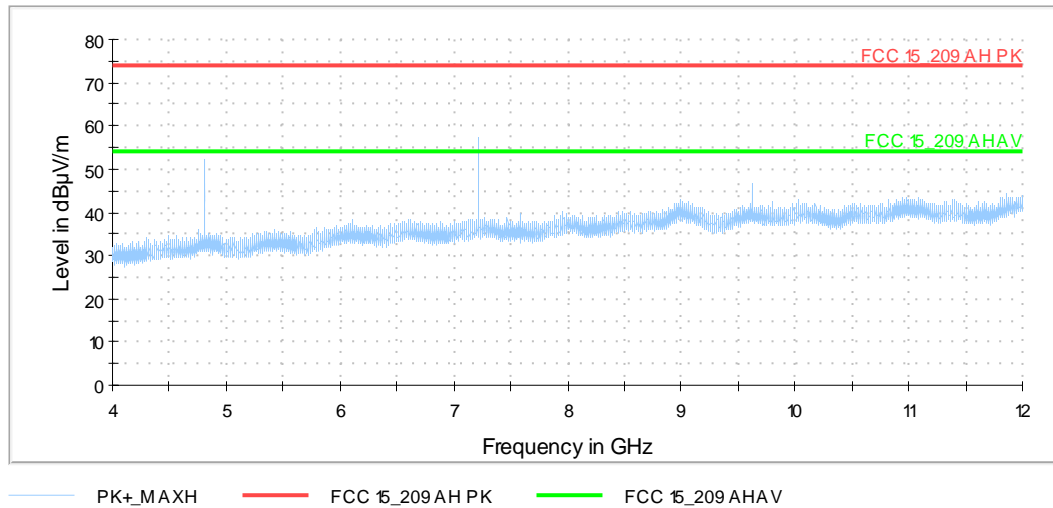
Remark: Since there were no differences in the spectrum for $f < 1$ GHz, only one representative plot is submitted below.

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

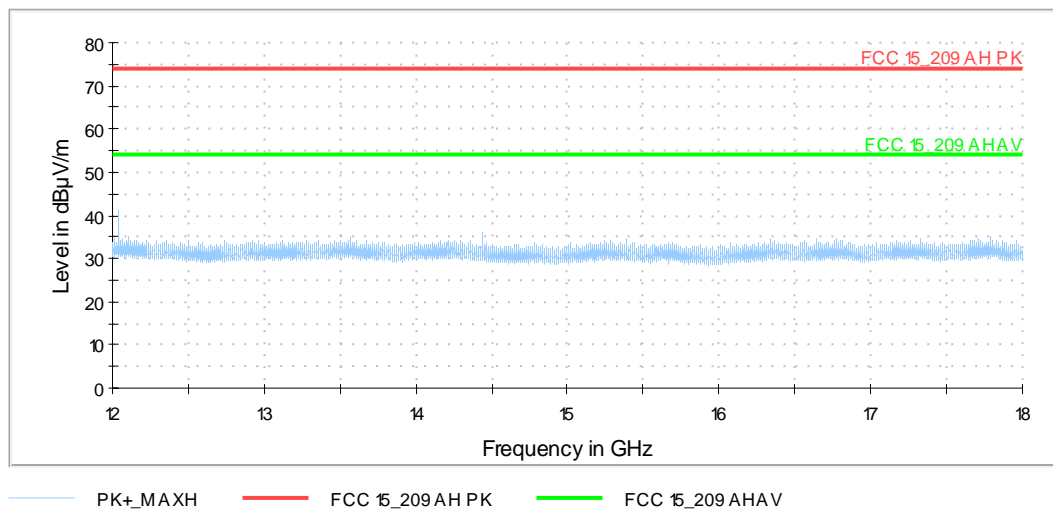
Spurious emissions from 1 GHz to 4 GHz (operation mode 4):



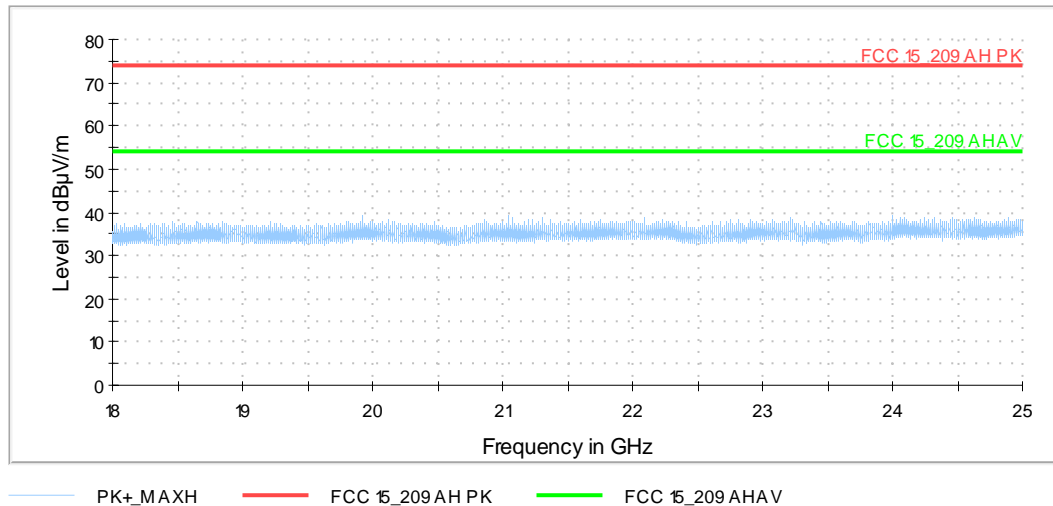
Spurious emissions from 4 GHz to 12 GHz (operation mode 4):



Spurious emissions from 12 GHz to 18 GHz (operation mode 4):



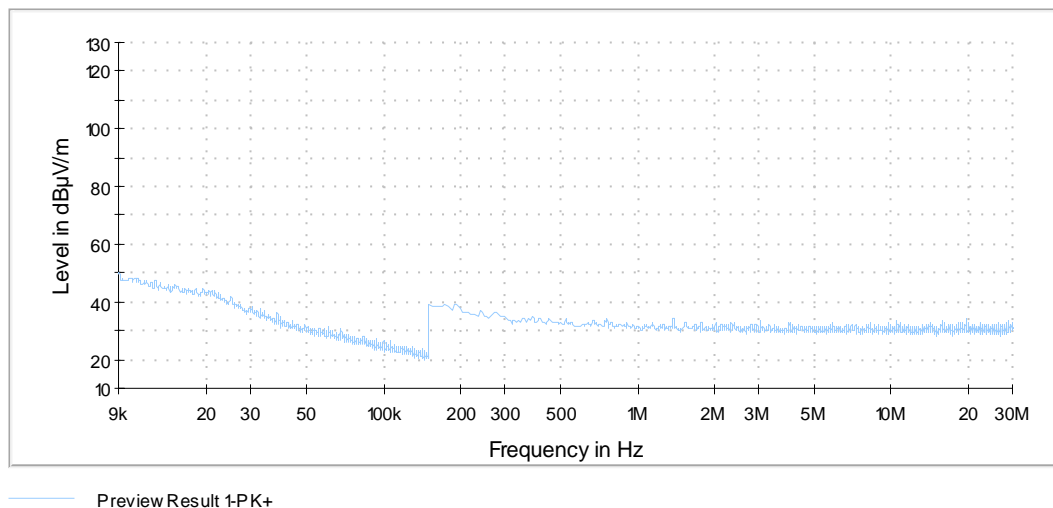
Spurious emissions from 18 GHz to 25 GHz (operation mode 4):



No emissions above the noise floor of the measurement system (max. 38 dBµV/m (measured with peak detector)) found during the preliminary measurement. So no final measurements were carried out in this frequency range.

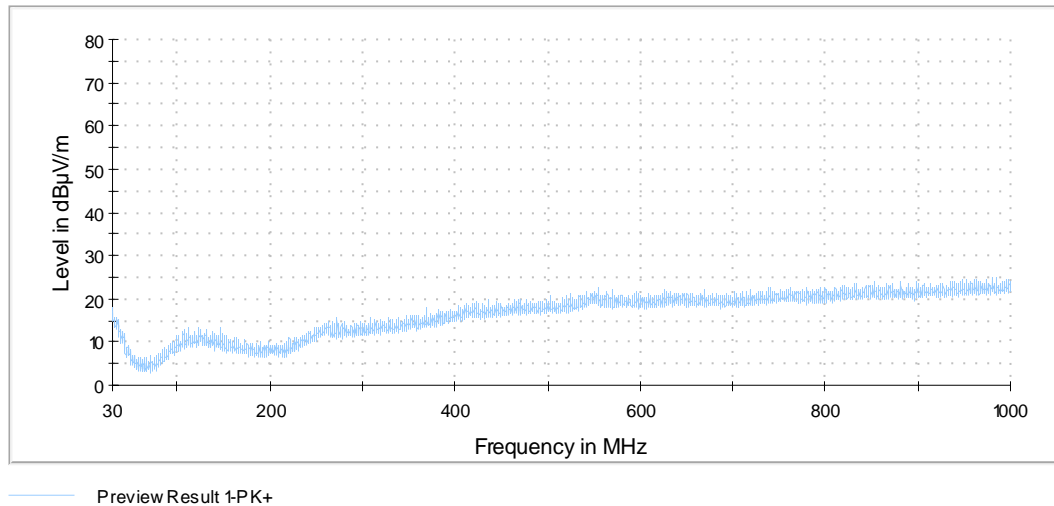
Transmitter operates at the middle of the assigned frequency band (operation mode 5)

Spurious emissions from 9 kHz to 30 MHz (operation mode 5):



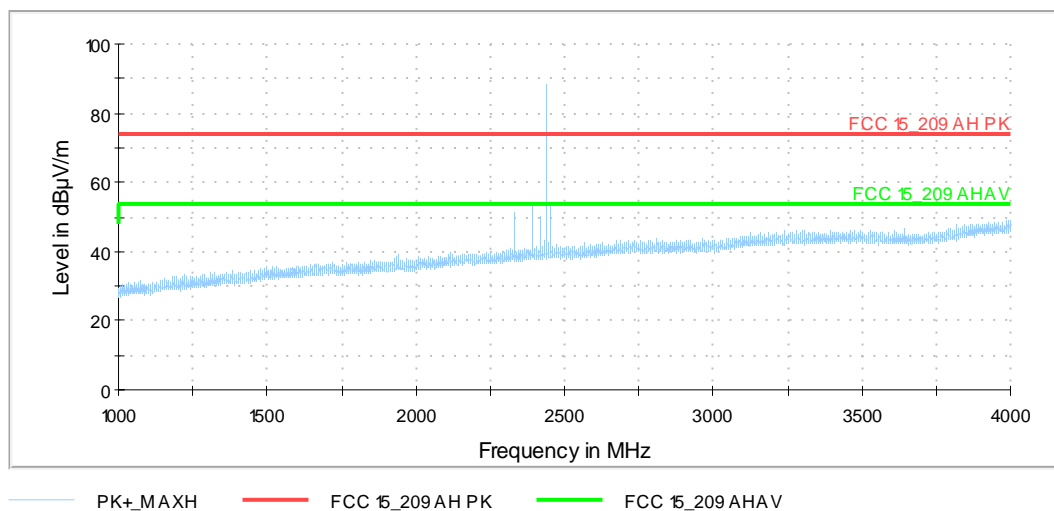
No emissions above the noise floor of the measurement system (max. 49 dBµV/m in the frequency range 9 kHz to 490 kHz, max. 34 dBµV/m in the frequency range 490 kHz to 1.705 MHz and max. 32 dBµV/m in the frequency range 1.705 MHz to 30 MHz (all levels measured with peak detector)) found during the preliminary measurement. So no final measurements on the outdoor test site were carried out.

Spurious emissions from 30 MHz to 1 GHz (operation mode 5):

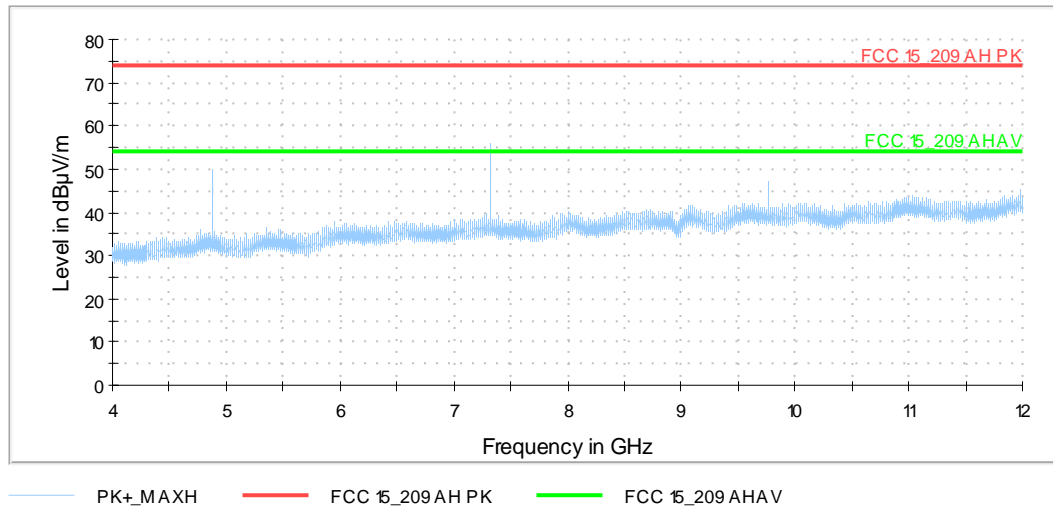


No emissions above the noise floor of the measurement system (max. 24 dBµV/m (measured with peak detector)) found during the preliminary measurement. So no final measurements on the open area test site were carried out.

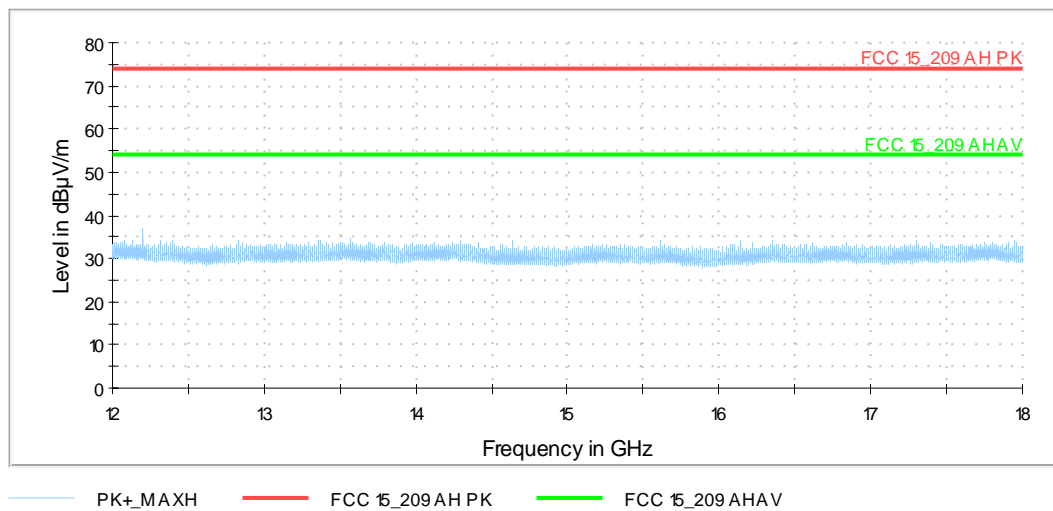
Spurious emissions from 1 GHz to 4 GHz (operation mode 5):



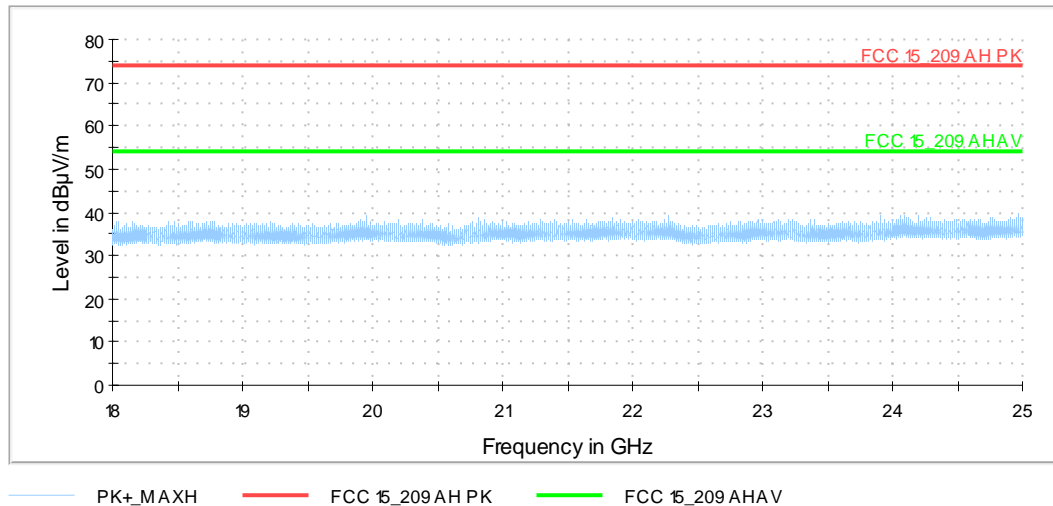
Spurious emissions from 4 GHz to 12 GHz (operation mode 5):



Spurious emissions from 12 GHz to 18 GHz (operation mode 5):



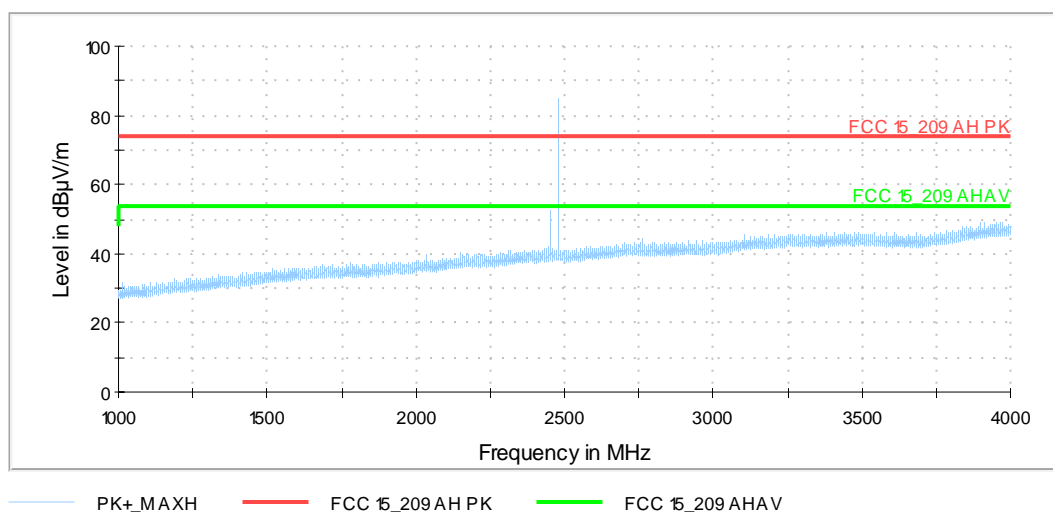
Spurious emissions from 18 GHz to 25 GHz (operation mode 5):



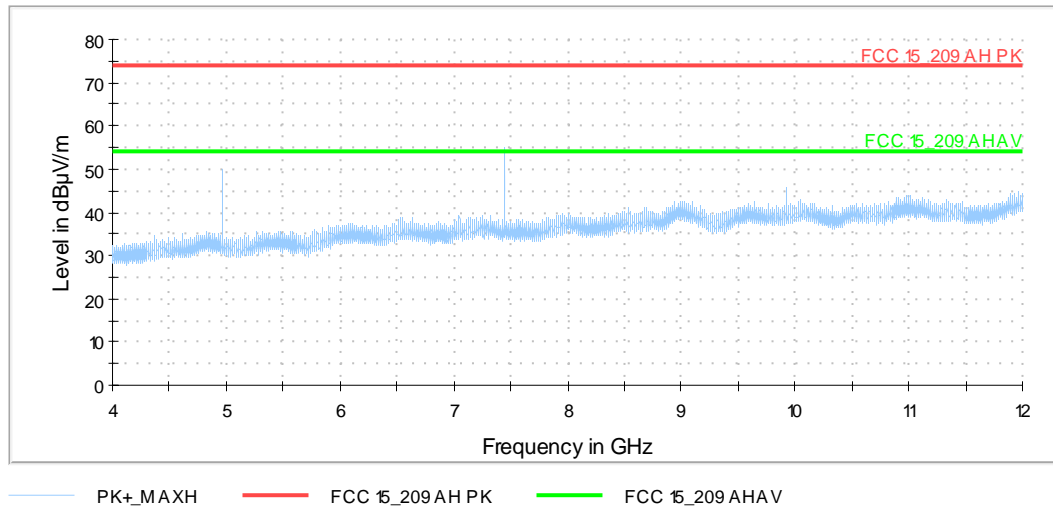
No emissions above the noise floor of the measurement system (max. 38 dBµV/m (measured with peak detector)) found during the preliminary measurement. So no final measurements were carried out in this frequency range.

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

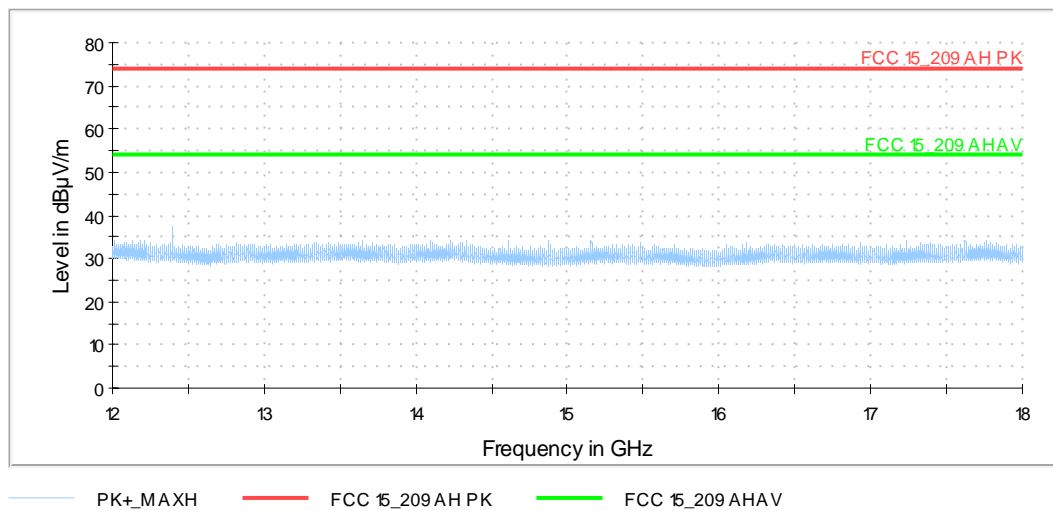
Spurious emissions from 1 GHz to 4 GHz (operation mode 6):



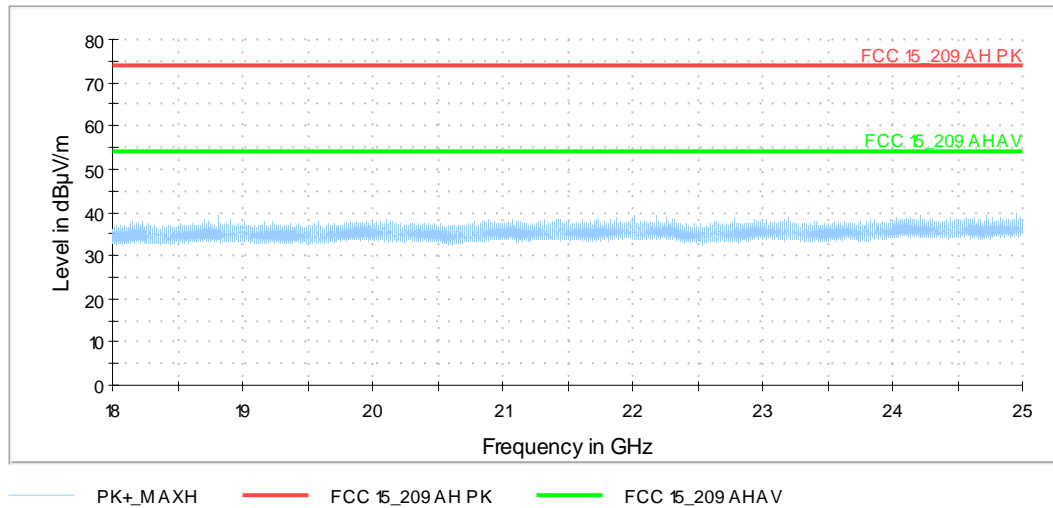
Spurious emissions from 4 GHz to 12 GHz (operation mode 6):



Spurious emissions from 12 GHz to 18 GHz (operation mode 6):



Spurious emissions from 18 GHz to 25 GHz (operation mode 6):



No emissions above the noise floor of the measurement system (max. 38 dBμV/m (measured with peak detector)) found during the preliminary measurement. So no final measurements were carried out in this frequency range.

Test equipment used (refer clause 6):

5, 8 - 25

5.3.2.2 Final radiated measurements

5.3.2.3 Final radiated emission measurement (9 kHz to 30 MHz)

No emissions above the noise floor of the measurement system (max. 49 dB μ V/m in the frequency range 9 kHz to 490 kHz, max. 34 dB μ V/m in the frequency range 490 kHz to 1.705 MHz and max. 32 dB μ V/m in the frequency range 1.705 MHz to 30 MHz (all levels measured with peak detector)) found during the preliminary measurement. So no final measurements on the outdoor test site were carried out.

5.3.2.4 Final radiated emission measurement (30 MHz to 1 GHz)

No emissions above the noise floor of the measurement system (max. 24 dB μ V/m (measured with peak detector)) found during the preliminary measurement. So no final measurements on the open area test site were carried out.

5.3.2.5 Final radiated emission measurement (1 GHz to 25 GHz)

Ambient temperature	22 °C	Relative humidity	59 %
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Transmitter operates at the lower end of the assigned frequency band (operation mode 4)

Frequency [MHz]	MaxPeak [dBμV/m]	Coverage [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2333.320	-	31.9	54.0	22.1	V	152.0	60.0	33.7
2333.320	62.7	-	74.0	11.3	V	152.0	60.0	33.7
2389.600	-	31.9	54.0	22.1	V	59.0	120.0	34.0
2389.600	56.0	-	74.0	18.0	V	59.0	120.0	34.0
2402.260	-	32.4	54.0	21.6	V	209.0	0.0	34.0
2402.260	55.0	-	74.0	19.0	V	209.0	0.0	34.0
2407.000	-	93.4	94.0	0.6	V	257.0	150.0	34.0
2407.000	95.0	-	114.0	19.0	V	257.0	150.0	34.0
2419.180	-	36.9	54.0	17.1	V	276.0	150.0	34.1
2419.180	55.9	-	74.0	18.1	V	276.0	150.0	34.1
2450.140	-	32.6	54.0	21.4	V	30.0	150.0	34.3
2450.140	55.9	-	74.0	18.1	V	30.0	150.0	34.3
4814.000	-	46.9	54.0	7.06	V	129.0	150.0	-1.1
4814.000	53.8	-	74.0	20.2	V	129.0	150.0	-1.1
7221.000	-	49.2	54.0	4.8	H	106.0	90.0	5.3
7221.000	58.3	-	74.0	15.7	H	106.0	90.0	5.3
9628.000	-	39.8	54.0	14.2	V	34.0	0.0	8.6
9628.000	51.9	-	74.0	22.1	V	34.0	0.0	8.6
12035.000	-	31.3	54.0	22.7	H	57.0	90.0	12.1
12035.000	45.4	-	74.0	28.6	H	57.0	90.0	12.1
14442.000	-	29.7	54.0	24.3	V	128.0	60.0	11.5
14442.000	43.0	-	74.0	31.0	V	128.0	60.0	11.5
Measurement uncertainty				+2.2 dB / -3.6 dB				

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

Frequency [MHz]	MaxPeak [dBμV/m]	Coverage [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2333.380	-	31.5	54.0	22.5	H	136.0	120.0	33.7
2333.380	58.7	-	74.0	15.3	H	136.0	120.0	33.7
2389.780	-	32.1	54.0	21.9	V	119.0	0.0	34.0
2389.780	59.9	-	74.0	14.1	V	119.0	0.0	34.0
2419.180	-	32.2	54.0	21.8	V	157.0	0.0	34.1
2419.180	58.5	-	74.0	15.5	V	157.0	0.0	34.1
2440.000	-	88.7	94.0	5.3	V	260.0	150.0	34.2
2440.000	90.5	-	114.0	23.5	V	260.0	150.0	34.2
2450.260	-	32.8	54.0	21.2	V	119.0	29.0	34.3
2450.260	54.9	-	74.0	19.1	V	119.0	29.0	34.3
4880.000	-	44.8	54.0	9.2	V	158.0	150.0	-0.8
4880.000	52.2	-	74.0	21.8	V	158.0	150.0	-0.8
7320.000	-	48.2	54.0	5.8	H	134.0	90.0	5.8
7320.000	58.5	-	74.0	15.5	H	134.0	90.0	5.8
9760.000	-	40.1	54.0	13.9	H	319.0	150.0	7.6
9760.000	52.7	-	74.0	21.3	H	319.0	150.0	7.6
12200.000	-	30.5	54.0	23.5	H	53.0	120.0	11.9
12200.000	43.6	-	74.0	30.4	H	53.0	120.0	11.9
14640.000	-	28.8	54.0	25.2	V	277.0	150.0	11.4
14640.000	41.5	-	74.0	32.5	V	277.0	150.0	11.4
Measurement uncertainty				+2.2 dB / -3.6 dB				

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

Frequency [MHz]	MaxPeak [dBμV/m]	Coverage [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2450.200	-	32.7	54.0	21.3	V	323.0	0.0	34.3
2450.200	56.3	-	74.0	17.7	V	323.0	0.0	34.3
2480.000	-	84.0	94.0	10.0	V	218.0	150.0	34.1
2480.000	85.8	-	114.0	28.2	V	218.0	150.0	34.1
4960.000	-	45.6	54.0	8.4	V	85.0	90.0	-0.9
4960.000	52.7	-	74.0	21.3	V	85.0	90.0	-0.9
7440.000	-	45.8	54.0	8.2	V	136.0	30.0	5.9
7440.000	55.9	-	74.0	18.1	V	136.0	30.0	5.9
9920.000	-	38.9	54.0	15.1	V	36.0	0.0	7.6
9920.000	51.2	-	74.0	22.8	V	36.0	0.0	7.6
12400.000	-	36.0	54.0	18.0	H	113.0	90.0	12.1
12400.000	45.7	---	74.0	28.3	H	113.0	90.0	12.1
14613.650	-	28.3	54.0	25.7	H	135.0	60.0	11.5
14613.650	40.1	-	74.0	33.9	H	135.0	60.0	11.5
14880.000	-	30.0	54.0	24.0	V	115.0	90.0	11.2
14880.000	42.4	-	74.0	31.6	V	115.0	90.0	11.2
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test equipment used (refer clause 6):

5, 8 – 17, 20, 22 - 25

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

Ambient temperature	21 °C	Relative humidity	60 %
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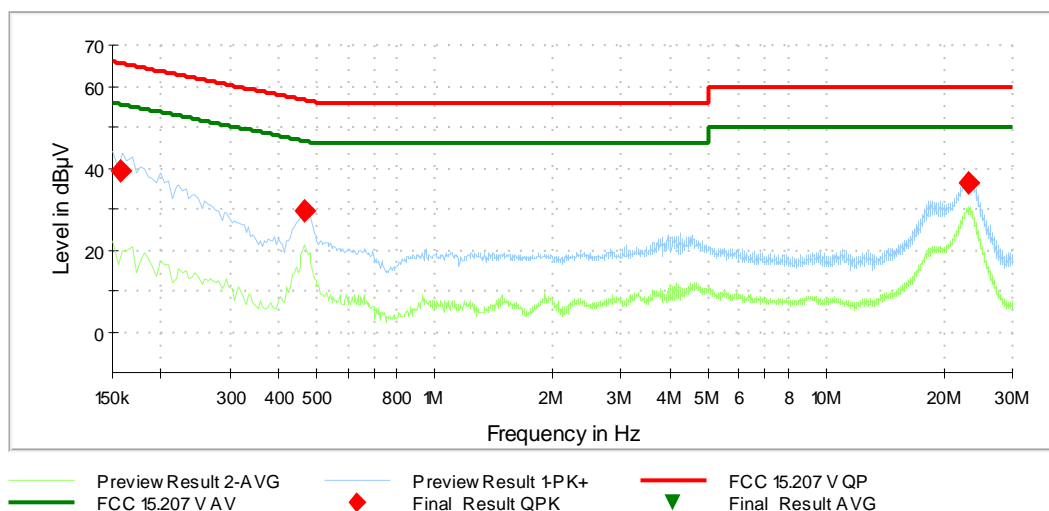
Position of EUT: For this test, the EUT was set to transmit on lowest channel.

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: The EUT was mounted on a roller blind motor type Forest shuttle FS2S, which was connected to the 120 V / 60 Hz AC mains via an AC/DC adapter type ZF120A-2403000 from ShenZenShi ZhenHuan Electronic.

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)
0.157200	39.1	-	65.6	26.5	5000.0	9.000	L1	FLO	9.8
0.466800	29.5	-	56.6	27.1	5000.0	9.000	N	GND	9.9
23.229600	36.2	-	60.0	23.8	5000.0	9.000	L1	GND	10.9
23.229600	36.2	-	60.0	23.8	5000.0	9.000	L1	GND	10.9

Test: Passed

Test equipment used (refer clause 6):

1 - 5

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
2	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	02/15/2016	02.2018
3	LISN	NSLK8128	Schwarzbeck	8128155	480058	02/16/2016	02/2018
4	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	02/18/2016	02.2018
5	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
6	Spectrum analyser	FSU46	Rohde & Schwarz	200125	480956	03/17/2017	03/2018
7	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Annual verification (system cal.)	
8	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
9	Signal & Spectrum Analyzer	ESW44	Rohde & Schwarz		482467	06/22/2017	06/2019
10	Controller	MCU	Maturo	MCU/043/971107	480832	Calibration not necessary	
11	Turntable	DS420HE	Deisel	420/620/80	480315	Calibration not necessary	
12	Antenna support	AS615P	Deisel	615/310	480187	Calibration not necessary	
13	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	08/27/2014	08/2017
14	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
15	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Six month verification (system cal.)	
16	RF-cable No. 3	Sucoflex 106B	Huber&Suhner	0563/6B / Kabel 3	480670	Weekly verification (system cal.)	
17	RF-cable No. 40	Sucoflex 106B	Huber&Suhner	0708/6B / Kabel 40	481330	Weekly verification (system cal.)	
18	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/29/2016	02/2018
19	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	06/19/2017	06/2020
20	RF-cable 2 m	KPS-1533-800-KPS	Insulated Wire	-	480302	Six month verification (system cal.)	
21	Kabel 36	Sucoflex 106B	Suhner	500003/6B / Kabel 36	481680	Weekly verification (system cal.)	
22	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	02/18/2016	02/2018
23	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	02/18/2016	02/2018
24	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	02/17/2016	02/2018
25	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	
26	Test fixture	-	Phoenix Test-Lab	-	410160	Calibration not necessary	

