

Test Report

Report Number:

F180803E1

Equipment under Test (EUT):

W-LINK STICK

Applicant:

Mammut Sports Group AG

Manufacturer:

CCS Adaxys AG



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-210 Issue 9 (August 2016)**, Licence-Exempt Radio Apparatus: Category I Equipment
- [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:	<u>Thomas KÜHN</u>	<u></u>	<u>09.01.2019</u>
	Name	Signature	Date
Authorized reviewer:	<u>Bernd STEINER</u>	<u></u>	<u>09.01.2019</u>
	Name	Signature	Date

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This test report is valid in hardcopy form as well as in electronic form.

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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:	Switzerland
Name for contact purposes:	Mr. Kurt MUELLER
Phone:	+41 55 451 78 78
eMail Address:	Kurt.Mueller@ccsedms.com
Manufacturer 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: *	Service device for avalanche rescue beacons
Type / PMN: *	W-LINK STICK
FCC ID: *	ARN-WLINK
IC: *	8038A-WLINK
Serial number: *	1811802378
PCB identifier: *	211.8112B
HVIN (Hardware Version Identification Number): *	7600.0049
FVIN (Firmware Version Identification Number): *	1.3

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical data of equipment

Antenna type: *	Integrated PCB antenna				
Antenna connector: *	None				
Antenna gain: *	-3 dBi				
Power supply – EUT: *	U _{nom} =	5.0 V DC	U _{min} =	4.75 V DC	U _{max} = 5.25 V DC
Type of modulation: *	GFSK (SW-upgrade mode) FHSS / GFSK (normal mode)				
Data rate: *	50 kbps				
Operating frequency range:*	911.800 MHz (SW-upgrade mode) 915.9131 MHz to 925.9894 MHz (normal mode)				
Number of channels: *	1 (SW-upgrade mode) and 50 (normal mode)				
Temperature range: *	+10 °C to 45 °C				
Lowest / highest Internal clock frequency: *	12.0 MHz / 27.0 MHz				
Ancillaries used for testing:	Fujitsu Lifebook E-Series (laptop PC) Model E780 with its dedicated AC/DC adaptor and BarryvoxMonitor software, three Barryvox S (7600.0032).				

* Declared by the applicant

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
USB	-	-	3 m
-	-	-	-
-	-	-	-

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	25.07.2018
Start of test:	10.09.2018
End of test:	28.11.2018

2 Operational states

The EUT is a service device for avalanche rescue beacons. All tests were carried out with an unmodified sample.

During all RF-tests the EUT was supplied with 5.0 V DC by a USB to fibre optics converter.

Because the EUT is a USB Stick and not normal position could be defined, the measurements inside the fully anechoic chamber were carried out with the EUT mounted on a 3-D positioner; the final measurements on the open area test site were carried out in three orthogonal directions. These were defined as follows:

- Pos. 1: EUT lying on the table, broadside shows upwards.
- Pos. 2: EUT lying on the table standing, narrow side shows upwards.
- Pos. 3: EUT showing upwards.

For details of these positions refer also the photographs in annex A of this test report.

With the help of a test-software (BarryvoxMonitor Rev. 3505, supplied by the applicant) installed on a laptop PC it was possible to set a test mode, where the UHF operating mode could be selected.

For the AC power line conducted measurement the following operation mode was measured:

The EUT was connected via USB to the laptop PC, which was powered by its dedicated AC/DC adaptor, solely powered by an AC mains network with 120 V AC / 60 Hz. A software (BarryvoxMonitor Rev. 3505, supplied by the applicant) was installed on a laptop PC and running. A connection to three avalanche rescue beacons type Barryvox was established and the firmware of the beacons was updated continuously. For this data was sent from the PC via USB to the W-LINK STICK and transmitted wireless to the beacon. The reception of the beacon was transmitted wireless to the EUT and via USB to the software on the laptop PC.

With this four operation modes of the EUT were tested:

- Receiving data via USB.
- Transmitting data wireless in SW-upgrade mode.
- Receiving data wireless.
- Transmitting data via USB.

This operation mode was used because of higher power consumption as in normal hopping mode.

The following test modes were used:

Operation mode	Description of the operation mode	Channel
1	Transmits continuously with modulation on 915.9131 MHz	0 (lowest)
2	Transmits continuously with modulation on 920.8485 MHz	24 (middle)
3	Transmits continuously with modulation on 925.9894 MHz	49 (highest)
4	Firmware update of three avalanche rescue beacons	51

3 Additional information

This report just contains the results of the EUT in normal mode (hopping). The results of the SW-upgrade mode (transmitting on 911.800 MHz) are documented under PHOENIX TESTLAB GmbH test report reference F180803E2.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-210 [3] or RSS-Gen [4]	Status	Refer page
Bandwidth	902 MHz to 928 MHz	15.215 (c)	6.7 [4]	Passed	8 et seq.
Radiated emissions (transmitter)	0.150 MHz to 10,000 MHz	15.249 (a), 15.249 (d), 15.205 (a), 15.209 (a).	B.10 [3], 8.9 [4]	Passed	11 et seq.
Conducted emissions	150 kHz to 30 MHz	15.207	8.8 [4]	Passed	28 et seq.
Antenna requirement	-	15.203	6.8 [4]	Passed *	-

*: The EUT has an internal antenna only and no antenna connector, so this requirement is regarded as fulfilled.

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 according to [1] shall be used:

- Span: App. 2 to 5 times the 20 dB bandwidth, centred on the actual hopping channel.
- Resolution bandwidth: 1 % to 5 % of the 20 dB bandwidth.
- Video bandwidth: three times the resolution bandwidth.
- Set the reference level of the instrument either above the measured peak conducted output power level or 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.
- 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.

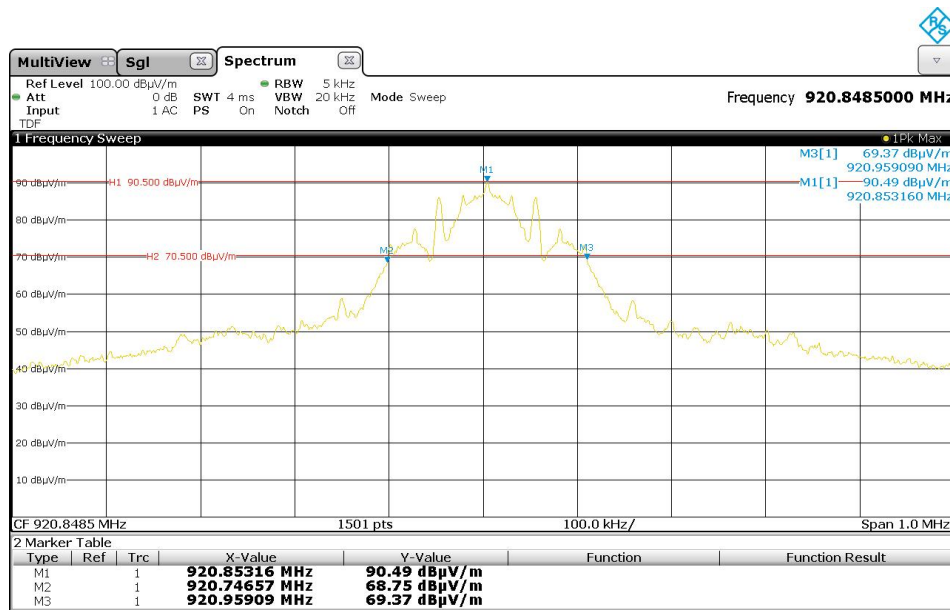
After trace stabilisation the marker shall be set on the signal peak. Use the 99 % bandwidth functionality of the spectrum analyser to integrate the requested bandwidth.

5.1.2 Test result

Ambient temperature	22 °C	Relative humidity	45 %
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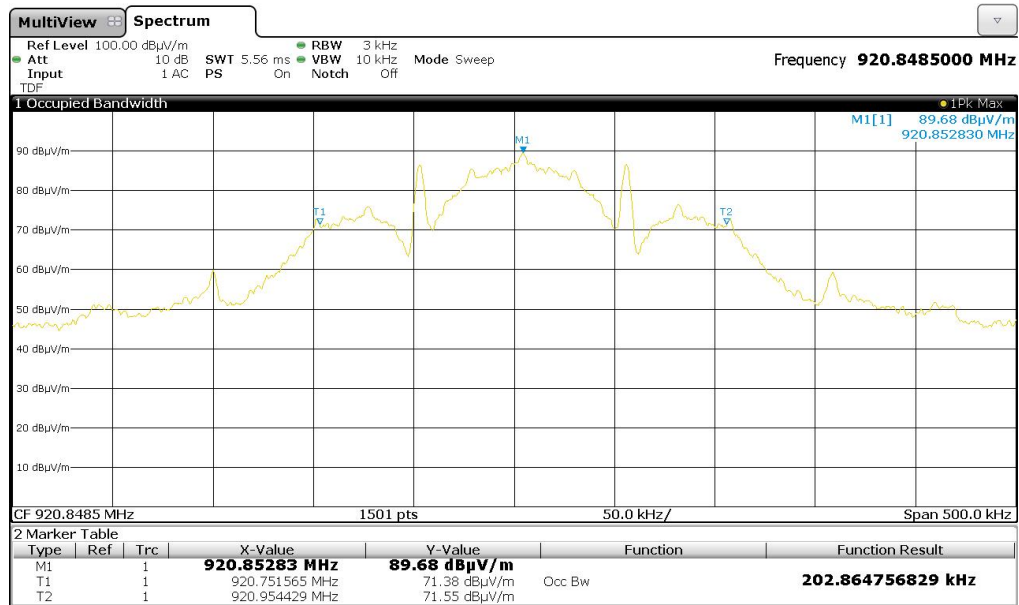
The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following table.

180803_24_10.png: 20 dB bandwidth at the middle of the assigned frequency band (operation mode 2):



Operation Mode	Center Frequency	F_L	F_U	20 dB Bandwidth	Result
1	915.9131 MHz	915.81089 MHz	916.02369 MHz	212.800 kHz	Passed
2	920.8485 MHz	920.74657 MHz	920.95909 MHz	213.330 kHz	Passed
3	925.9894 MHz	925.88719 MHz	926.10032 MHz	213.130 kHz	Passed
Measurement uncertainty			$<1 \cdot 10^{-7}$		

180803_24_11.PNG: 99% Bandwidth (operation mode 2):



Operation Mode	Center Frequency	F _L	F _U	99 % Bandwidth	Result
1	915.9131 MHz	915.817164 MHz	916.010929 MHz	201.865 kHz	Passed
2	920.8485 MHz	920.751565 MHz	920.954429 MHz	202.865 kHz	Passed
3	925.9894 MHz	925.892465 MHz	926.095329 MHz	202.865 kHz	Passed
Measurement uncertainty			<1*10 ⁻⁷		

Test equipment used (refer clause 6):

2 - 7, 13, 14

5.2 Maximum unwanted emissions

5.2.1 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 heights in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with fixed 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.

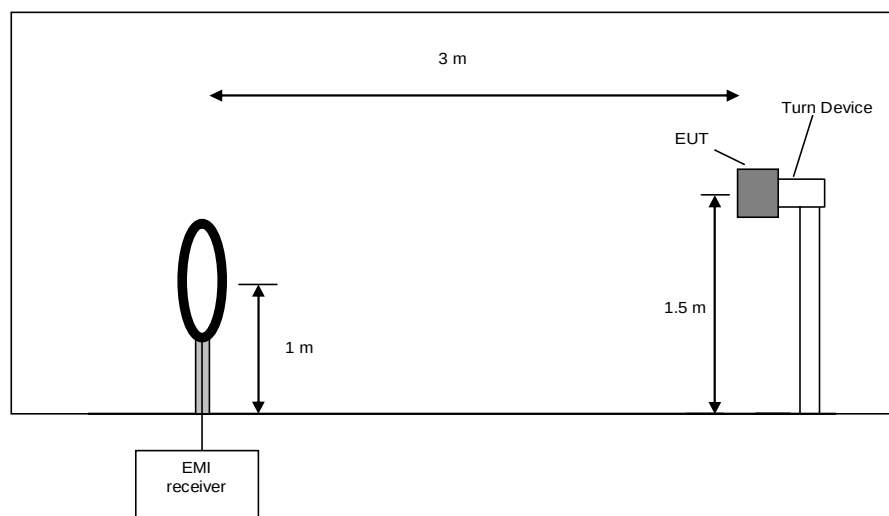
Preliminary measurement (9 kHz to 30 MHz):

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.

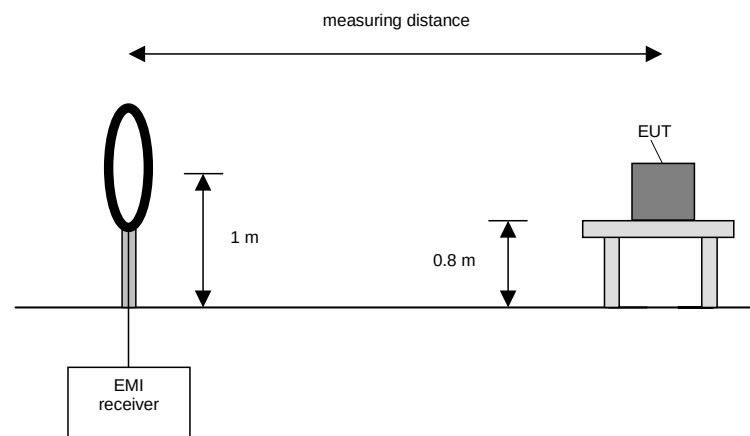
Final measurement (9 kHz to 30 MHz):

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).

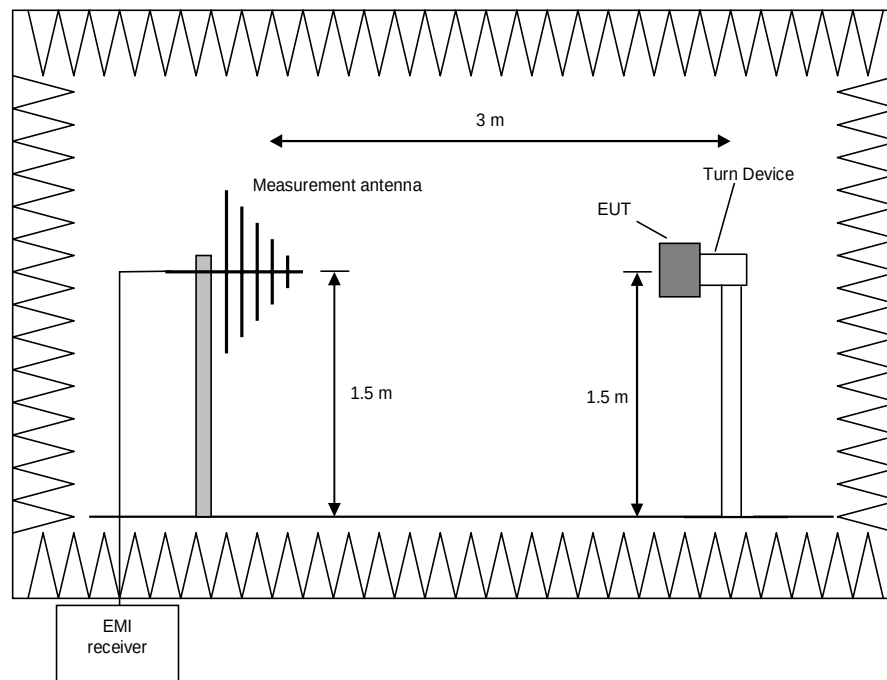
Preliminary measurement (30 MHz to 1 GHz)

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:

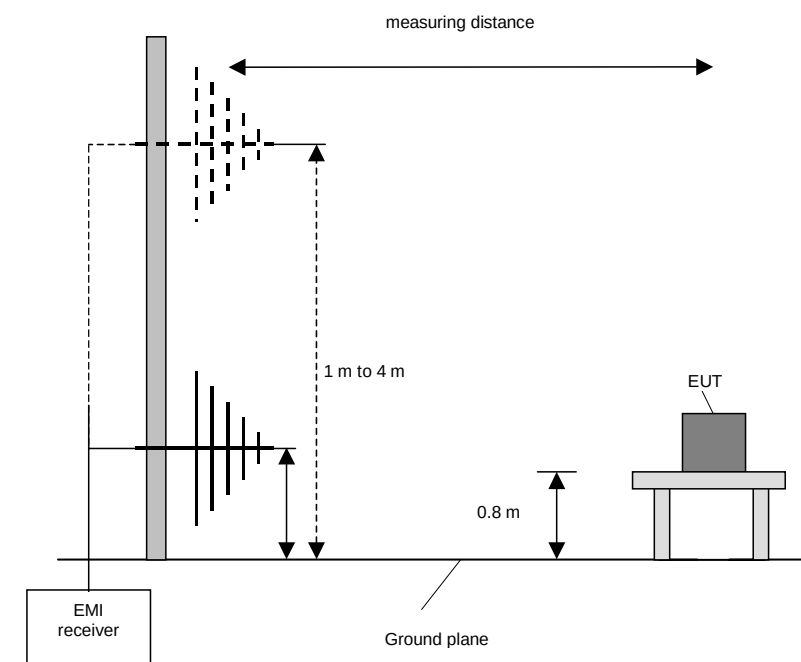
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarisation of the measuring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

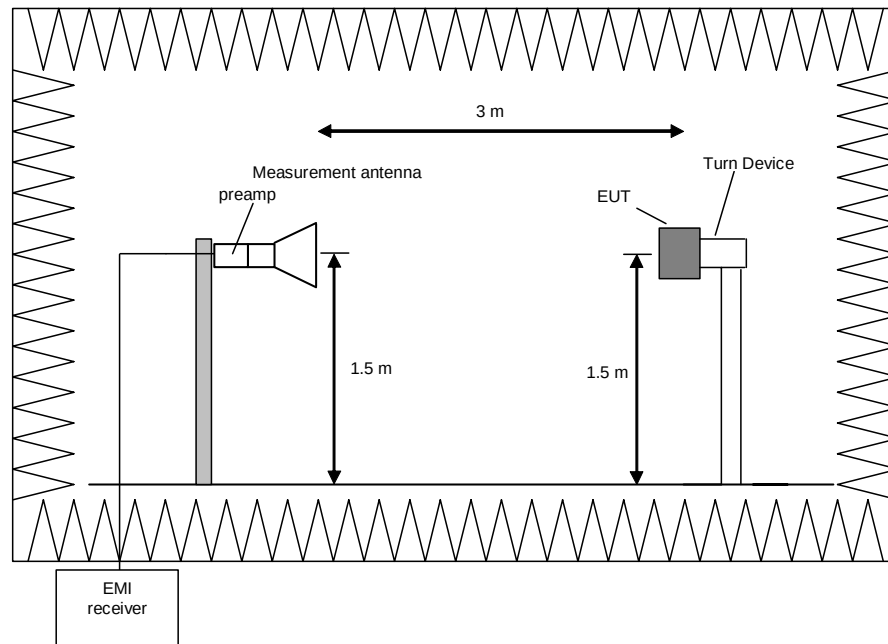
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

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:

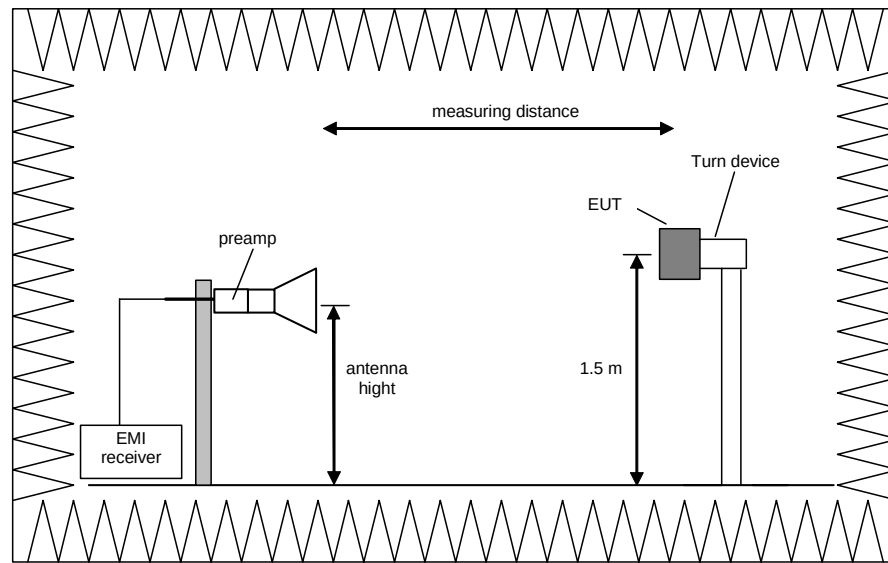
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle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

5.2.2 Test results (radiated emissions) 150 kHz – 10 GHz

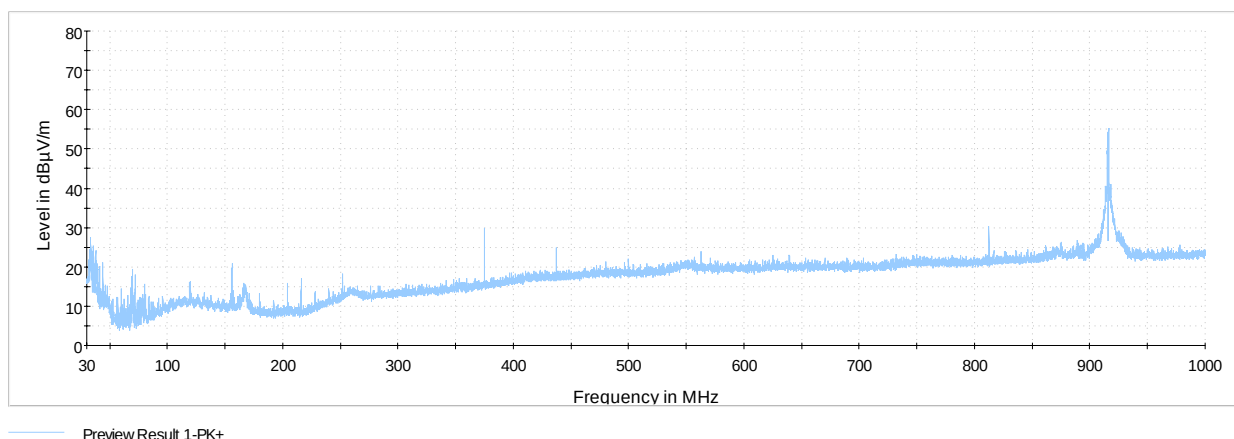
5.2.2.1 Preliminary radiated emission measurement 150 kHz – 10 GHz

Ambient temperature	23 °C	Relative humidity	52 %
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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 this test the EUT was powered by the USB to fibre optic converter with 5.0 V _{DC} .
Remark:	Since there were no differences in the spectrum for $f < 30$ MHz, only one representative plot is submitted below.

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

Spurious emissions from 30 MHz to 1 GHz (operation mode 1, carrier notched):



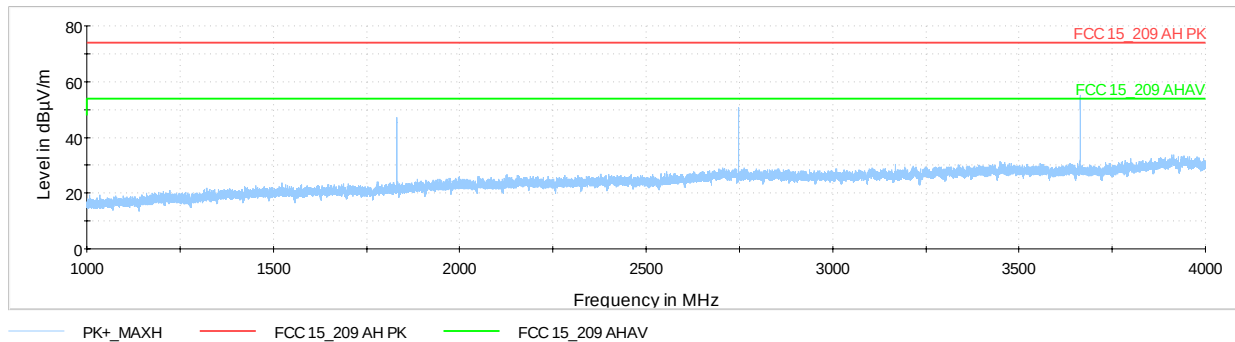
The following frequencies were found outside restricted bands during the preliminary radiated emission test:

- 33.298 MHz, 35.9655 MHz, 69.6245 MHz, 156.003 MHz, 374.9805 MHz, 437.9805 MHz, 812.499 MHz and 915.9131 MHz.

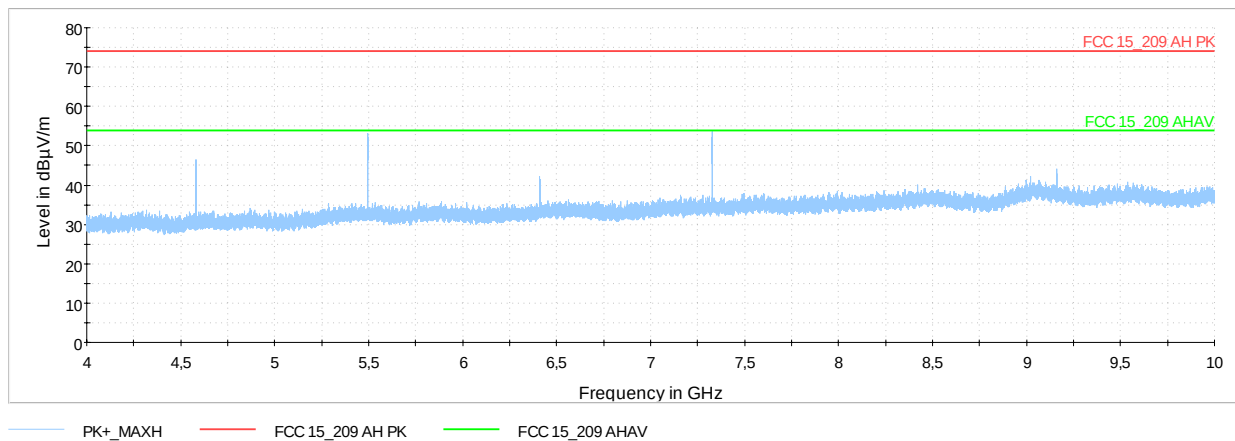
No frequencies were found inside the restricted bands during the preliminary radiated emission test.

These frequencies have to be measured on the open area test site. The results were presented in the following.

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



Spurious emissions from 4 GHz to 10 GHz (operation mode 1):



The following frequencies were found outside restricted bands during the preliminary radiated emission test:

- 1831.8262 MHz, 5495.4786 MHz and 6411.3917 MHz.

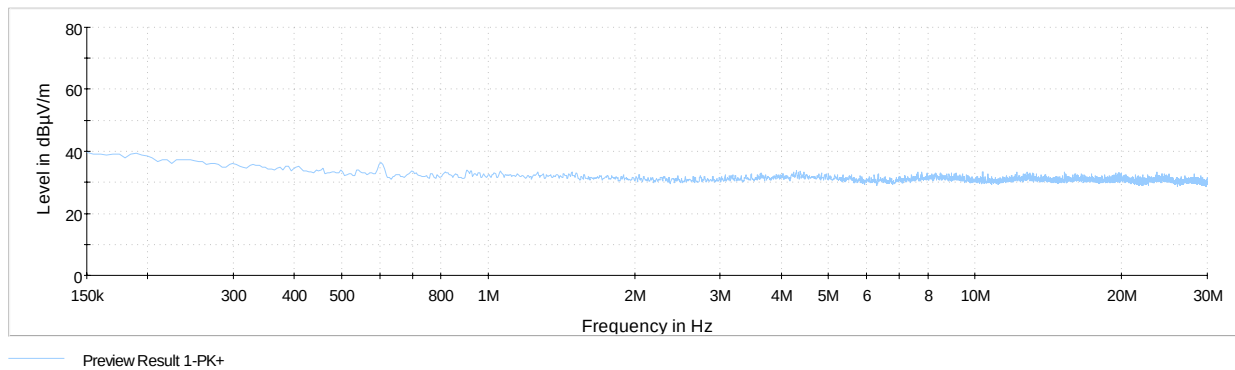
The following frequencies were found inside the restricted bands during the preliminary radiated emission test.

- 2747.7393 MHz, 3663.6524 MHz, 4579.5655 MHz, 7327.3048 MHz and 9159.1310 MHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

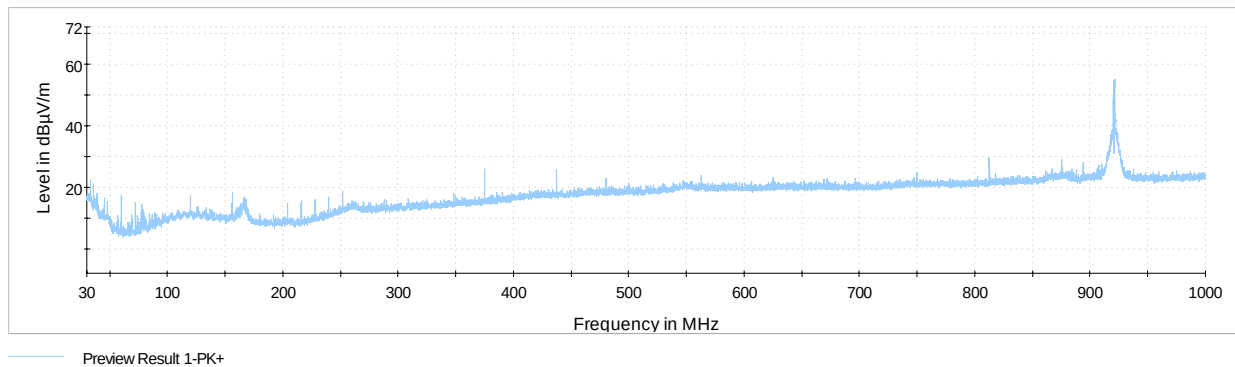
Transmitter operates at the middle of the assigned frequency band (operation mode 2)

Spurious emissions from 150 kHz to 30 MHz (operation mode 2):



No significant emissions above 39.5 dBµV/m (measured with peak-detector) at 3 m measuring distance were found during the preliminary measurement, so no final measurements on the outdoor test site will be carried out in this frequency range.

Spurious emissions from 30 MHz to 1 GHz (operation mode 2, carrier notched):



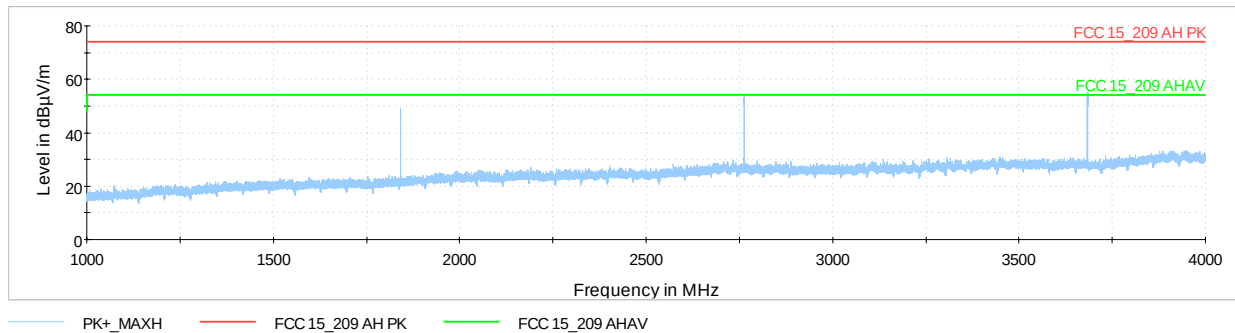
The following frequencies were found outside restricted bands during the preliminary radiated emission test:

- 33.3465 MHz, 36.014 MHz, 59.9245 MHz, 374.9805 MHz, 437.4485 MHz, 812.499 MHz, 874.967 MHz and 920.8485 MHz.

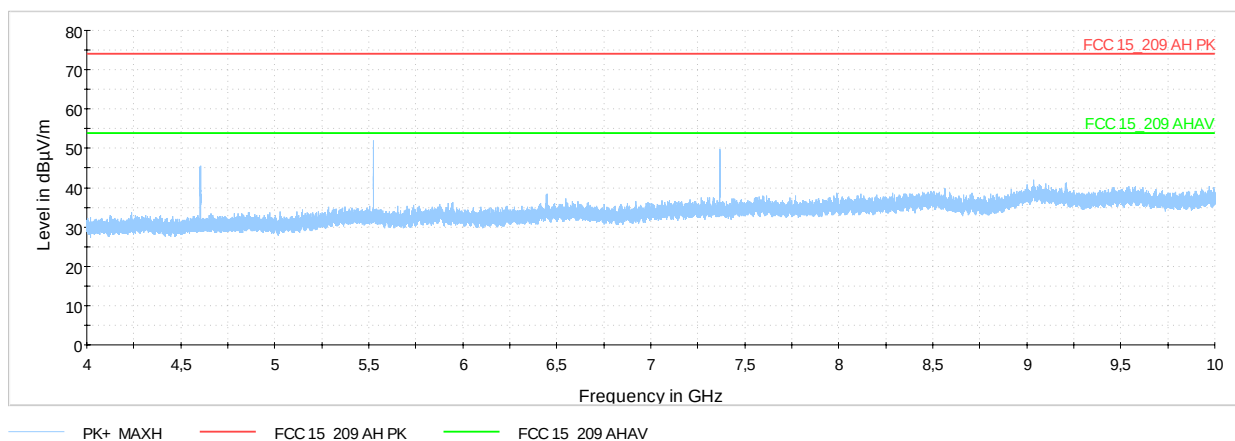
No frequencies were found inside the restricted bands during the preliminary radiated emission test.

These frequencies have to be measured on the open area test site. The results were presented in the following.

Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



Spurious emissions from 4 GHz to 10 GHz (operation mode 2):



The following frequencies were found outside restricted bands during the preliminary radiated emission test:

- 1841.6970 MHz, 5525.0910 MHz and 6445.9395 MHz.

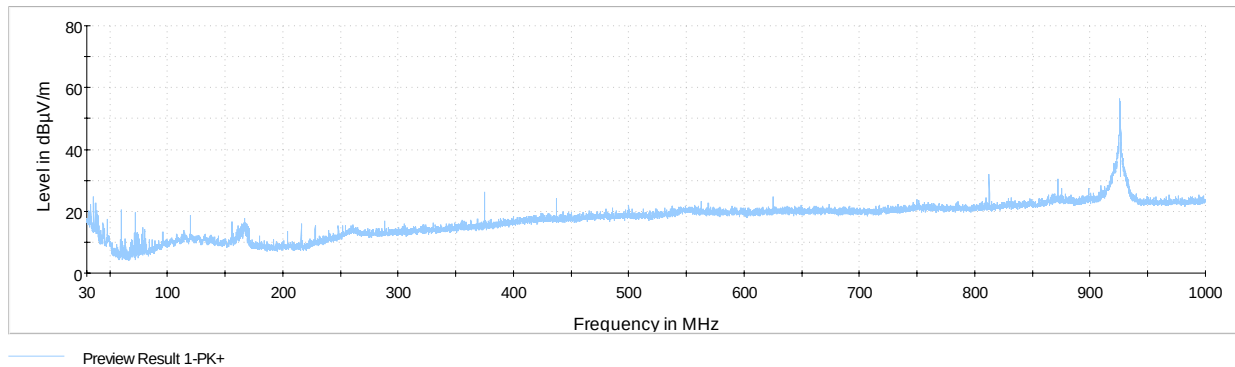
The following frequencies were found inside the restricted bands during the preliminary radiated emission test.

- 2762.5455 MHz, 3683.3940 MHz, 4604.2425 MHz and 7366.7880 MHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

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

Spurious emissions from 30 MHz to 1 GHz (operation mode 3, carrier notched):



The following frequencies were found outside restricted bands during the preliminary radiated emission test:

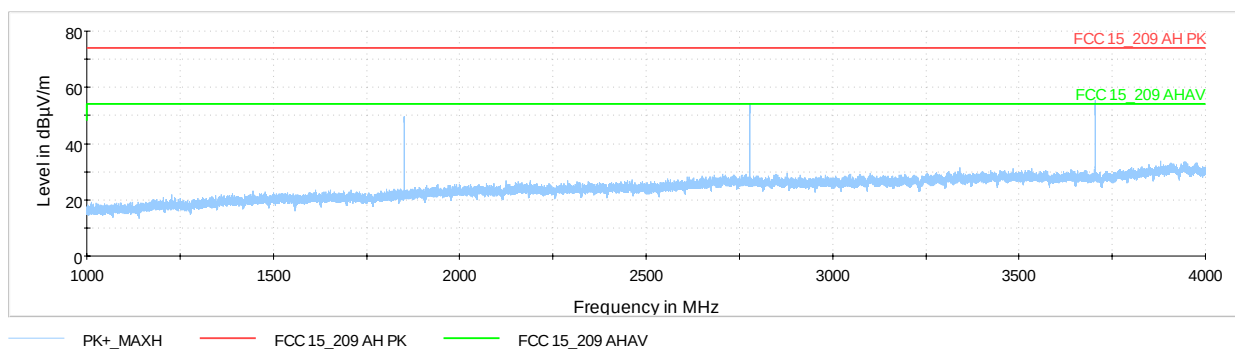
- 35.9655 MHz, 37.7115 MHz, 59.973 MHz, 71.9525 MHz, 374.9805 MHz, 624.998 MHz, 812.499 MHz, 872.0085 MHz and 925.9894 MHz

The following frequency was found inside restricted bands during the preliminary radiated emission test:

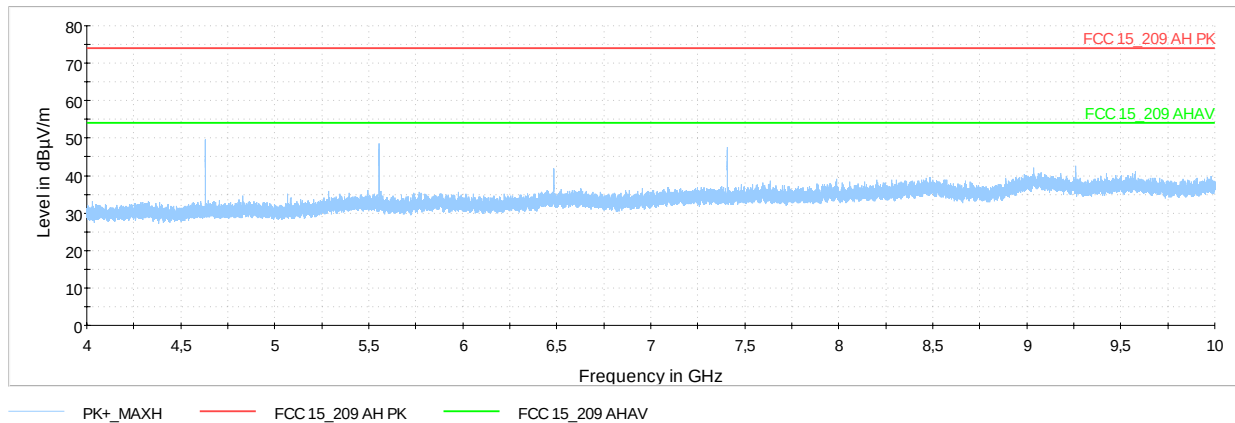
- 119.9675 MHz

These frequencies have to be measured on the open area test site. The results were presented in the following.

Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



Spurious emissions from 4 GHz to 10 GHz (operation mode 3):



The following frequencies were found outside restricted bands during the preliminary radiated emission test:

- 1851.9788 MHz, 5555.9364 MHz and 6481.9258 MHz.

The following frequencies were found inside the restricted bands during the preliminary radiated emission test.

- 2777.9682 MHz, 3703.9576 MHz, 4629.9470 MHz, 7407.9152 MHz and 9259.8940 MHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

Test equipment used (refer clause 6):

1 - 8, 10 - 17

5.2.2.2 Final radiated measurements

5.2.2.3 Final radiated emission measurement (150 kHz to 30 MHz)

No significant emissions above 39.5 dB μ V/m (measured with peak-detector) at 3 m measuring distance were found during the preliminary measurement, so no final measurements on the outdoor test site will be carried out in this frequency range.

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

Ambient temperature	21 °C	Relative humidity	35 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m in three orthogonal directions. The distance between EUT and antenna was 3 m.

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

Test record: The maximum results are shown in the following.

Supply voltage: During this test the EUT was powered by the USB to fibre optic converter with 5.0 V_{DC}.

Test results: The test results were calculated with the following formula:

$$\text{Result [dB}\mu\text{V/m]} = \text{reading [dB}\mu\text{V]} + \text{cable loss [dB]} + \text{antenna factor [dB/m]}.$$

The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

The measurement time with the quasi-peak measuring detector is 1 second.

Result measured with the quasi-peak detector:

Transmitter operates on the lower end of the assigned frequency band (operation mode 1)											
Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Restr. Band	Pos.
33.298000	35.2	73.9	38.7	1000	120	137	V	242	25.9	No	3
35.965500	36.7	73.9	37.2	1000	120	100	V	242	24.7	No	3
69.624500	26.1	73.9	47.8	1000	120	123	V	233	13.5	No	2
156.00300	19.9	73.9	54.0	1000	120	105	V	279	18.9	No	3
374.98050	34.2	73.9	39.7	1000	120	105	H	290	24.0	No	1
437.98050	24.5	73.9	49.4	1000	120	105	V	42	26.2	No	3
812.49900	34.9	73.9	39.0	1000	120	150	V	146	32.9	No	3
915.91310	93.9	94.0	0.1	1000	120	100	H	223	34.8	No	1
Transmitter operates on the middle of the assigned frequency band (operation mode 2)											
Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Restr. Band	Pos.
33.346500	33.6	73.5	39.9	1000	120	186	V	0	25.8	No	2
36.014000	36.0	73.5	37.5	1000	120	103	V	328	24.7	No	2
59.924500	24.8	73.5	48.7	1000	120	192	V	68	12.7	No	3
374.98050	29.8	73.5	43.7	1000	120	100	H	125	24.0	No	3
437.44850	26.4	73.5	47.1	1000	120	236	H	126	26.2	No	3
812.49900	35.0	73.5	38.5	1000	120	289	V	156	32.9	No	2
874.96700	34.1	73.5	39.4	1000	120	100	H	213	33.8	No	1
920.84850	93.5	94.0	0.5	1000	120	103	H	214	35.0	No	1
Transmitter operates on the upper end of the assigned frequency band (operation mode 3)											
Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Restr. Band	Pos.
35.965500	30.2	72.0	41.8	1000	120	109	V	37	24.6	No	1
37.711500	29.8	72.0	42.2	1000	120	146	V	226	23.8	No	2
59.973000	23.4	72.0	48.6	1000	120	134	V	38	12.5	No	2
71.952500	33.8	72.0	38.2	1000	120	162	V	94	13.7	No	2
119.96750	18.8	72.0	53.2	1000	120	159	V	71	18.9	No	2
374.98050	26.2	72.0	45.8	1000	120	103	H	124	23.6	No	1
624.99800	25.0	72.0	47.0	1000	120	165	V	177	30.2	No	2
812.49900	34.8	72.0	37.2	1000	120	169	V	250	32.4	No	2
872.00850	30.5	72.0	41.5	1000	120	104	H	331	33.2	No	1
925.98940	92.0	94.0	2.0	1000	120	102	H	215	34.7	No	1
Measurement uncertainty				+2.2 dB / -3.6 dB							

Test: Passed

Test equipment used (refer clause 6):

1, 18 - 24

5.2.2.5 Final radiated emission measurement (1 GHz to 10 GHz)

Ambient temperature	23 °C	Relative humidity	52 %
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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.

Supply voltage: During this test the EUT was powered by the USB to fibre optic converter with 5.0 V_{DC}.

Transmitter operates on the lower end of the assigned frequency band (operation mode 1)									
Frequency (MHz)	MaxPeak [dBμV/m]	Average [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1831.8262	---	46.9	73.9	27.0	Hor.	234	0	-12.9	No
	48.5	---	73.9	25.4	Hor.	234	0	-12.9	No
2747.7393	---	49.9	54.0	4.1	Hor.	352	90	-8.3	Yes
	52.1	---	74.0	21.9	Hor.	352	90	-8.3	Yes
3663.6524	---	53.8	54.0	0.2	Hor.	55	120	-6.3	Yes
	56.1	---	74.0	17.9	Hor.	55	120	-6.3	Yes
4579.5655	---	45.0	54.0	9.0	Hor.	323	120	-2.7	Yes
	49.9	---	74.0	24.1	Hor.	323	120	-2.7	Yes
5495.4786	---	49.8	73.9	24.1	Hor.	304	120	0.2	No
	54.9	---	73.9	19.0	Hor.	304	120	0.2	No
6411.3917	---	41.5	73.9	32.4	Vert.	178	90	2.0	No
	49.3	---	73.9	24.6	Vert.	178	90	2.0	No
7327.3048	---	49.1	54.0	4.9	Hor.	116	90	4.9	Yes
	55.8	---	74.0	18.2	Hor.	116	90	4.9	Yes
9159.1310	---	39.2	54.0	14.8	Hor.	214	90	7.5	Yes
	50.2	---	74.0	23.8	Hor.	214	90	7.5	Yes
Transmitter operates on the middle of the assigned frequency band (operation mode 2)									
Frequency (MHz)	MaxPeak [dBμV/m]	Average [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1841.6970	---	48.7	73.5	24.8	Hor.	236	30	-12.9	No
	50.2	---	73.5	23.3	Hor.	236	30	-12.9	No
2762.5455	---	53.2	54.0	0.8	Hor.	9	90	-8.4	Yes
	54.9	---	74.0	19.1	Hor.	9	90	-8.4	Yes
3683.3940	---	53.9	54.0	0.1	Hor.	55	120	-6.2	Yes
	56.4	---	74.0	17.6	Hor.	55	120	-6.2	Yes
4604.2425	---	39.6	54.0	14.4	Hor.	31	90	-2.7	Yes
	49.4	---	74.0	24.6	Hor.	31	90	-2.7	Yes
5525.0910	---	44.8	73.5	28.7	Hor.	310	120	0.4	No
	54.6	---	73.5	18.9	Hor.	310	120	0.4	No
6445.9395	---	33.4	73.5	40.1	Hor.	36	120	2.2	No
	45.1	---	73.5	28.4	Hor.	36	120	2.2	No
7366.7880	---	43.8	54.0	10.2	Hor.	108	90	4.9	Yes
	54.7	---	74.0	19.3	Hor.	108	90	4.9	Yes

Transmitter operates on the upper end of the assigned frequency band (operation mode 3)									
Frequency [MHz]	MaxPeak [dBμV/m]	Average [dBμV/m]	Limit [dBμV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1851.9788	---	50.0	72.0	22.0	Hor.	235	30	-12.9	No
	51.1	---	74.0	22.9	Hor.	235	30	-12.9	No
2777.9682	---	53.9	54.0	0.1	Hor.	175	90	-8.5	Yes
	55.5	---	74.0	18.5	Hor.	175	90	-8.5	Yes
3703.9576	---	53.8	54.0	0.2	Hor.	50	90	-6.3	Yes
	55.6	---	74.0	18.4	Hor.	50	90	-6.3	Yes
4629.9470	---	46.1	54.0	7.9	Hor.	313	90	-2.7	Yes
	51.1	---	74.0	22.9	Hor.	313	90	-2.7	Yes
5555.9364	---	46.5	72.0	25.5	Hor.	309	60	0.5	No
	52.1	---	74.0	21.9	Hor.	309	60	0.5	No
6481.9258	---	38.9	72.0	33.1	Vert.	185	90	2.3	No
	49.1	---	74.0	24.9	Vert.	185	90	2.3	No
7407.9152	---	43.0	54.0	11.0	Hor.	287	90	4.8	Yes
	51.4	---	74.0	22.6	Hor.	287	90	4.8	Yes
9259.8940	---	39.9	54.0	14.1	Hor.	43	90	6.4	Yes
	50.8	---	74.0	23.2	Hor.	43	90	6.4	Yes
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

Test equipment used (refer clause 6):

1 - 8, 10, 11, 15 - 17

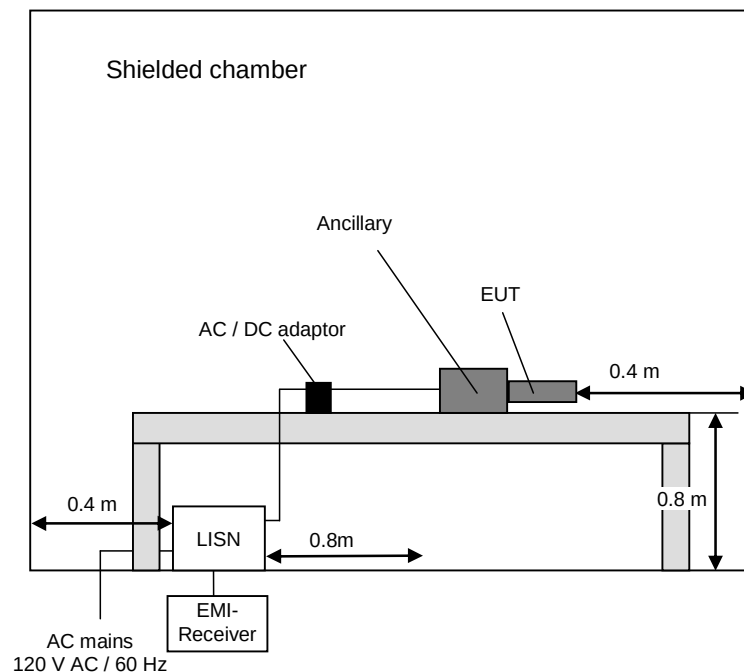
5.3 Conducted emissions on power supply lines

5.3.1 Method of measurement (conducted emissions on power supply lines)

This test will be carried out in a shielded chamber. Table top devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm above the ground plane. Floor-standing devices will be placed directly on the ground plane. The setup of the Equipment under test will be in accordance to [1].

The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below the appropriable limit, this emission will be measured with the average and quasi-peak detector on all lines.

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz

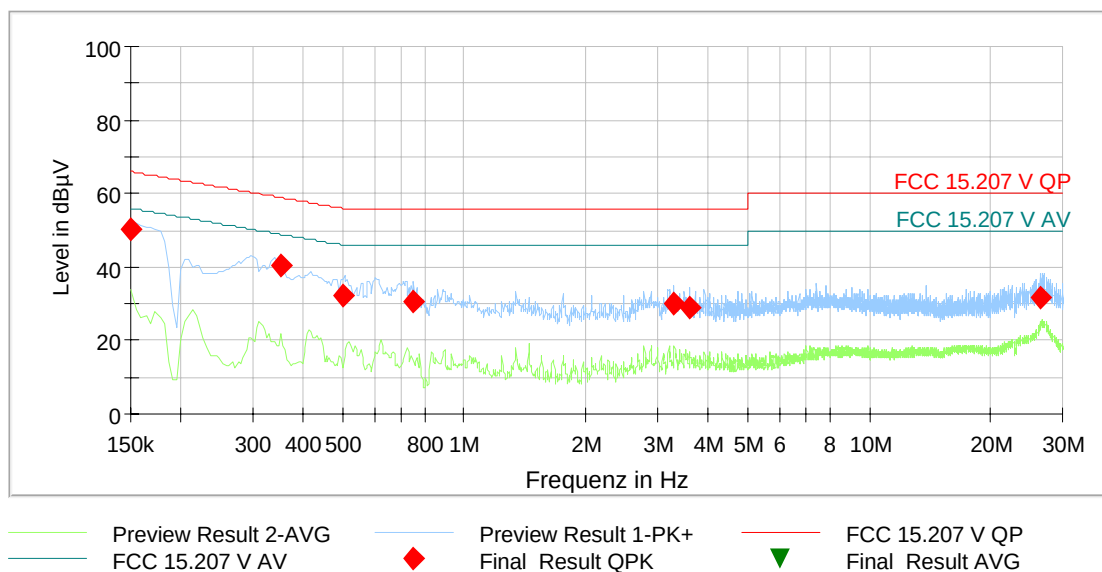


5.3.2 Test result

Ambient temperature	22 °C	Relative humidity	29 %
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Test description: Radiated emission measurement
 EUT: W-LINK STICK
 Manufacturer: CCS Adaxys AG
 Operating conditions: Upgrading of three Barryvox
 Test site: Phoenix TESTLAB GmbH, anechoic chamber M20
 Operator: Th. KÜHN
 Power supply: Via USB to the laptop PC, which was powered by its dedicated AC/DC adaptor, solely powered by an AC mains network with 120 V AC / 60 Hz
 Date of test: 28.11.2018

The curves in the diagrams below 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 ▼.



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Transducer (dB)
0.150000	50.04	---	66.00	15.96	5000.0	9.000	N	GND	9.8
0.350700	40.17	---	58.95	18.77	5000.0	9.000	L1	FLO	9.9
0.504600	32.07	---	56.00	23.93	5000.0	9.000	L1	GND	9.9
0.746700	30.55	---	56.00	25.45	5000.0	9.000	L1	FLO	9.9
3.300000	30.12	---	56.00	25.88	5000.0	9.000	L1	FLO	10.2
3.614100	28.70	---	56.00	27.30	5000.0	9.000	L1	GND	10.3
26.614500	31.46	---	60.00	28.54	5000.0	9.000	L1	GND	11.1
Measurement uncertainty				+2.76 dB / -2.76 dB					

Test result Passed

Test equipment used (refer clause 6):

26 - 30

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
2	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Calibration not necessary	
3	Signal & Spectrum Analyzer	ESW44	Rohde & Schwarz	101635	482467	22.06.017	06.2019
4	Controller	MCU	Maturo	MCU/043/971107	480832	Calibration not necessary	
5	Turn device	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
6	Turntable	DS420HE	Deisel	420/620/80	480315	Calibration not necessary	
7	Antenna support	AS615P	Deisel	615/310	480187	Calibration not necessary	
8	Antenna (log.-per)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
9	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Calibration not necessary	
10	RF-cable No. 3	Sucoflex106B	Huber&Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
11	RF-cable No. 40	Sucoflex106B	Huber&Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
12	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	21.02.2018	02.2020
13	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	06.2020
14	Kabel 36	Sucoflex 106B	Suhner	500003/6B / Kabel 36	481680	Calibration not necessary	
15	Preamplifier	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	10.07.2018	07.2020
16	1 GHz High Pass Filter	WHJS1000C11/60 EF	Wainwright	1	480413	Calibration not necessary	
17	4 GHz High Pass Filter	WHKX4.0/18G-8SS	Wainwright	1	480587	Calibration not necessary	
18	Open area test site M6	Freifeld M6	Phoenix Contact	-	480085	Calibration not necessary	
19	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
20	Controller	HD100	Deisel	100/670	480139	Calibration not necessary	
21	Turntable	DS420HE	Deisel	420/620/80	480087	Calibration not necessary	
22	Antenna support	AS615P	Deisel	615/310	480086	Calibration not necessary	
23	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
24	Antenna (Bilog)	CBL6111D	Schaffner Elektrottest GmbH / Teseq GmbH	25761	480894	19.10.2017	10.2020
25	Tuneable notch filter	WRCA800/960-0.2/40-6EEK	Wainwright	15	480414	Calibration not necessary	
26	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.03.2018	03.2020
27	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
28	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
29	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
30	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	14.03.2018	03.2020

7 Report history

Report Number	Date	Comment
F180803E1	09.01.2019	Initial Test Report
-	-	-
-	-	-
-	-	-

8 List of annexes

Annex A Test setup photographs 7 pages

180803_1.JPG: W-LINK STICK, test setup fully anechoic chamber
 180803_3.JPG: W-LINK STICK, test setup fully anechoic chamber
 180803_4.JPG: W-LINK STICK, test setup fully anechoic chamber
 180803_5.JPG: W-LINK STICK, test setup fully anechoic chamber
 180803_6.JPG: W-LINK STICK, test setup open area test site (pos. 1)
 180803_7.JPG: W-LINK STICK, test setup open area test site (pos. 2)
 180803_8.JPG: W-LINK STICK, test setup open area test site (pos. 3)

Annex B External photographs 2 pages

180803_a.JPG: W-LINK STICK, 3-D-view 1
 180803_b.JPG: W-LINK STICK, 3-D-view 2

Annex C Internal photographs 3 pages

180803_e.JPG: W-LINK STICK, internal view
 180803_f.JPG: W-LINK STICK, PCB, top view
 180803_g.JPG: W-LINK STICK, PCB, bottom view