



PHOENIX  
**TESTLAB**

Königswinkel 10  
32825 Blomberg, Germany  
Phone: +49 (0) 52 35 / 95 00-0  
Fax: +49 (0) 52 35 / 95 00-10  
office@phoenix-testlab.de  
www.phoenix-testlab.de

# Test Report

Report Number:

**F180803E2**

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

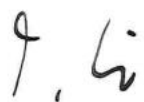

## References

- [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-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
- [5] **558074 D01** Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules

## 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:	Thomas KÜHN <small>Name</small>	 <small>Signature</small>	10.01.2019 <small>Date</small>
Authorized reviewer:	Bernd STEINER <small>Name</small>	 <small>Signature</small>	10.01.2019 <small>Date</small>

**This test report is only valid in its original form.**

Any reproduction of its contents in extracts without written permission of the accredited test laboratory PHOENIX TESTLAB GmbH is prohibited.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

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

<b>Contents</b>	<b>Page</b>
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 .....	7
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 Maximum peak conducted output power .....	11
5.2.1 Method of measurement (maximum peak conducted output power) .....	11
5.2.2 Test results (maximum peak conducted output power).....	11
5.3 Power spectral density .....	12
5.3.1 Method of measurement (power spectral density) .....	12
5.3.2 Test results (power spectral density, radiated).....	12
5.4 Maximum unwanted emissions .....	13
5.4.1 Method of measurement (radiated emissions) .....	13
5.4.2 Test results (radiated emissions) 150 kHz – 10 GHz.....	20
5.4.2.1 Preliminary radiated emission measurement 150 kHz – 10 GHz .....	20
5.4.2.2 Final radiated measurements .....	22
5.4.2.3 Final radiated emission measurement (150 kHz to 30 MHz).....	22
5.4.2.4 Final radiated emission measurement (30 MHz to 1 GHz).....	22
5.4.2.5 Final radiated emission measurement (1 GHz to 10 GHz).....	23
5.5 Conducted emissions on power supply lines .....	24
5.5.1 Method of measurement (conducted emissions on power supply lines).....	24
5.5.2 Test result .....	25
6 Test equipment and ancillaries used for tests .....	26
7 Report history .....	27
8 List of annexes.....	27

# 1 Identification

## 1.1 Applicant

Name:	Mammut Sports Group AG
Address:	Birren 5 5703 Seon
Country:	Switzerland
Name for contact purposes:	Mr. Ilari DAMMERT
Phone:	Tel. +41 62 769 83 16
eMail Address:	ilari.dammert@mammut.ch
Applicant represented during the test by the following person:	None

## 1.2 Manufacturer

Name:	CCS Adaxys AG
Address:	Alpenblickstraße 26 8853 Lachen
Country:	Switzerland
Name for contact purposes:	Mr. Kurt MÜLLER
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	
-	-	-	-
-	No lines are connectable to the EUT		-
-	-	-	-

\*: 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.

The following test mode was used:

Operation mode	Description of the operation mode	Channel
1	Transmits continuously on the upgrade channel (911.800 MHz)	51 (upgrade)
2	Firmware update of three avalanche rescue beacons	51

### 3 Additional information

This report just contains the results of the EUT in SW-update mode (transmitting on 911.800 MHz). The results of the EUT in normal mode (hopping) are documented under PHOENIX TESTLAB GmbH test report reference F180803E1.

### 4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [3] or RSS-Gen [4]	Status	Refer page
Maximum Peak Output Power	902 MHz to 928 MHz	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	11 et seq.
DTS Bandwidth	902 MHz to 928 MHz	15.247 (a) (2)	5.2 (a) [3]	Passed	8 et seq.
Peak Power Spectral Density	902 MHz to 928 MHz	15.247 (e)	5.2 (b) [3]	Passed	12
Radiated emissions (transmitter)	0.150 MHz to 10,000 MHz	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	13 et seq.
Conducted emissions	150 kHz to 30 MHz	15.207	8.8 [4]	Passed	24 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.

##### 6 dB bandwidth:

The following spectrum analyser settings according to [5] shall be used:

- Span: App. 2 to 5 times the OBW, centred on the actual channel.
- Resolution bandwidth: 100 kHz.
- 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 6 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.

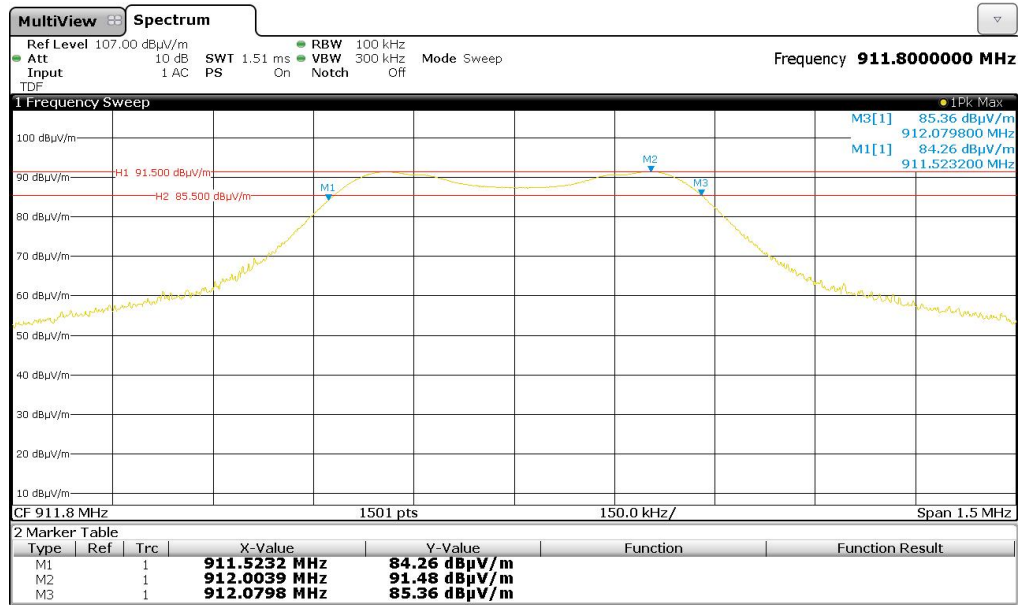


### 5.1.2 Test result

Ambient temperature	22 °C
---------------------	-------

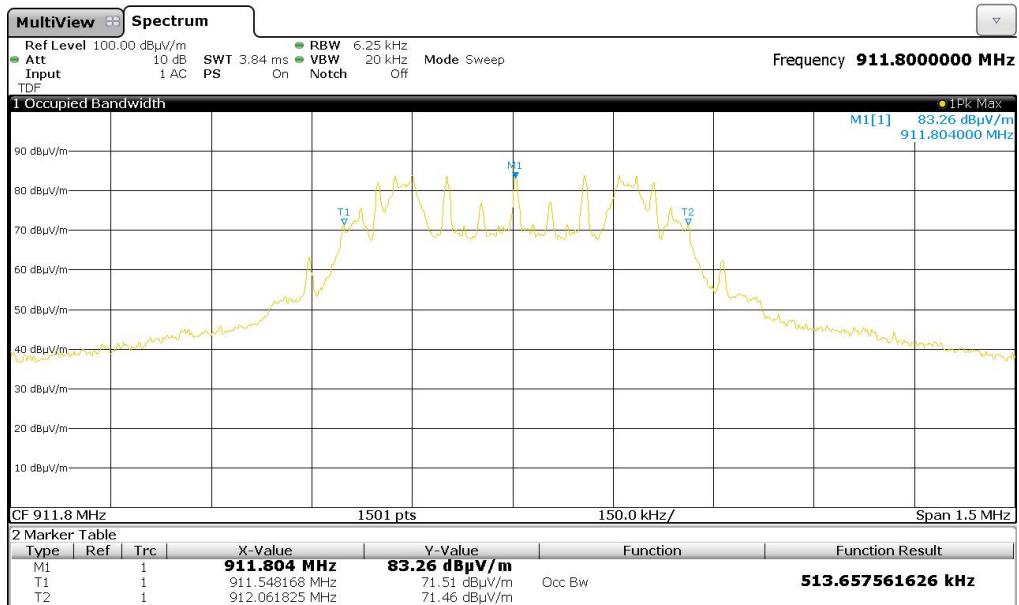
Relative humidity	45 %
-------------------	------

180803\_51\_10.png: 6 dB Bandwidth:



Center Frequency	F <sub>L</sub>	F <sub>U</sub>	6 dB Bandwidth	Result
911.800 MHz	911.523200 MHz	912.079800 MHz	556.5 kHz	Passed
Measurement uncertainty			<1*10 <sup>-7</sup>	

180803\_51\_11.png: 99% Bandwidth:



Center Frequency	F <sub>L</sub>	F <sub>U</sub>	99 % Bandwidth	Result
911.800 MHz	911.548168 MHz	912.061825 MHz	513.658 kHz	Passed
Measurement uncertainty		<1*10 <sup>-7</sup>		

Test equipment used (refer clause 6):

2 - 7, 13, 14

## 5.2 Maximum peak conducted output power

### 5.2.1 Method of measurement (maximum peak conducted output power)

Because the EUT has no antenna connector, which presents the power delivered to the antenna, the peak value of the field strength was measured. The method of measurement is described under clause 5.4.1 (final measurement (30 MHz to 1 GHz)) of this test report with the exception that a peak detector was used. According to [1] with this the field strength value the radiated peak power of the EUT was calculated. With the antenna gain of the EUTs antenna the conducted peak power was calculated.

### 5.2.2 Test results (maximum peak conducted output power)

Ambient temperature	21 °C
---------------------	-------

Relative humidity	55 %
-------------------	------

Result measured with the peak detector:

Transmitter operates on the lower end of the assigned frequency band (operation mode 1)										
Frequency (MHz)	Peak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Restr. Band
911.800	99.6	Carrier	-	1000.0	120.000	103.0	Hor.	213.0	34.6	-
Measurement uncertainty						+2.2 dB / -3.6 dB				

The peak radiated output power was calculated with the following formula:

Calculated peak radiated output power [W] = (field strength [V/m] \* measuring distance [m])<sup>2</sup> / 49.2

The maximum peak output power was calculated with the following formula:

Maximum peak output power [dBm] = Calculated peak radiated output power [dBm] – antenna gain [dB]

Frequency (MHz)	Field strength		Peak radiated power		Antenna gain (dB)	Maximum peak conducted output power	
	(dB $\mu$ V/m)	(V/m)	(W)	(dBm)		(dBm)	(W)
911.800	99.6	0.095	0.0017	2.2	-3.0	5.2	0.0033

Test: Passed

Test equipment used (see chapter 6):

1, 18 - 24
------------

### 5.3 Power spectral density

#### 5.3.1 Method of measurement (power spectral density)

For the PSD measurement, the EUT was measured radiated in the anechoic chamber using the procedures described in 5.4.1.

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

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- Set the VBW  $\geq [3 \times \text{RBW}]$ .
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

#### 5.3.2 Test results (power spectral density, radiated)

Ambient temperature	21 °C
---------------------	-------

Relative humidity	55 %
-------------------	------

Peak Frequency [MHz]	Reading [dBmV]	Corr. Fact. [dB/m]	Field strength @3m [dBmV/m]	PSD radiated (ERP) [dBm / 100 kHz]	PSD conducted [dBm / 100 kHz]	PSD Limit [dBm / 3 kHz]
911.800	65.0	34.6	99.6	2.2	5.2	8
Measurement uncertainty				+2.2 dB / -3.6 dB		

Test equipment used (see chapter 6):

1, 18 - 24
------------

## 5.4 Maximum unwanted emissions

### 5.4.1 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 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.

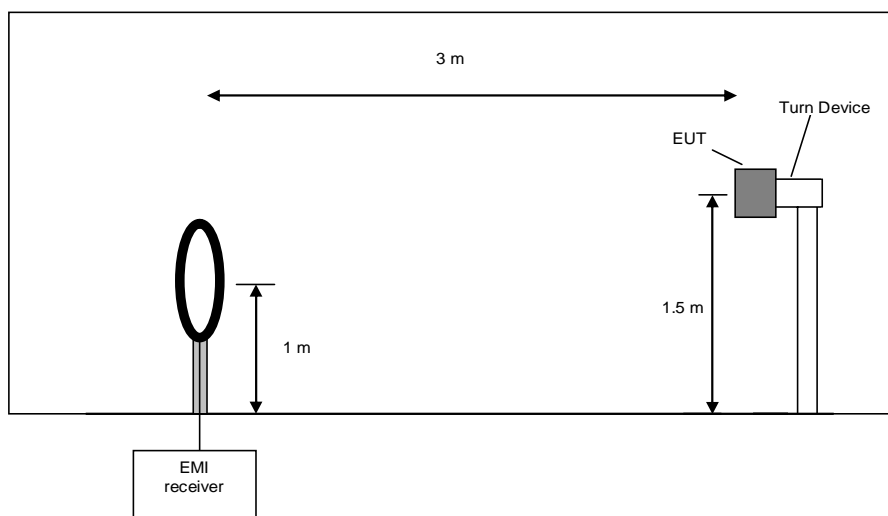
#### **Preliminary measurement (9 kHz to 30 MHz):**

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.

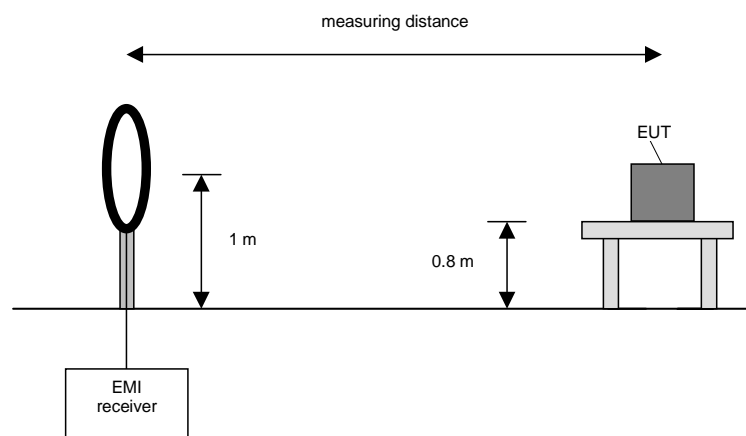
**Final measurement (9 kHz to 30 MHz):**

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).

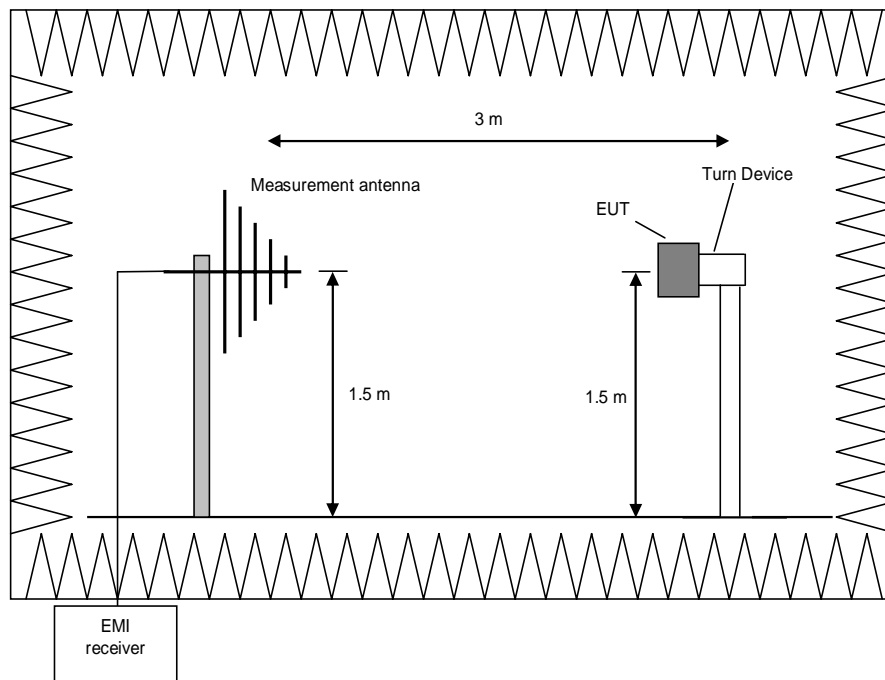
**Preliminary measurement (30 MHz to 1 GHz)**

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:

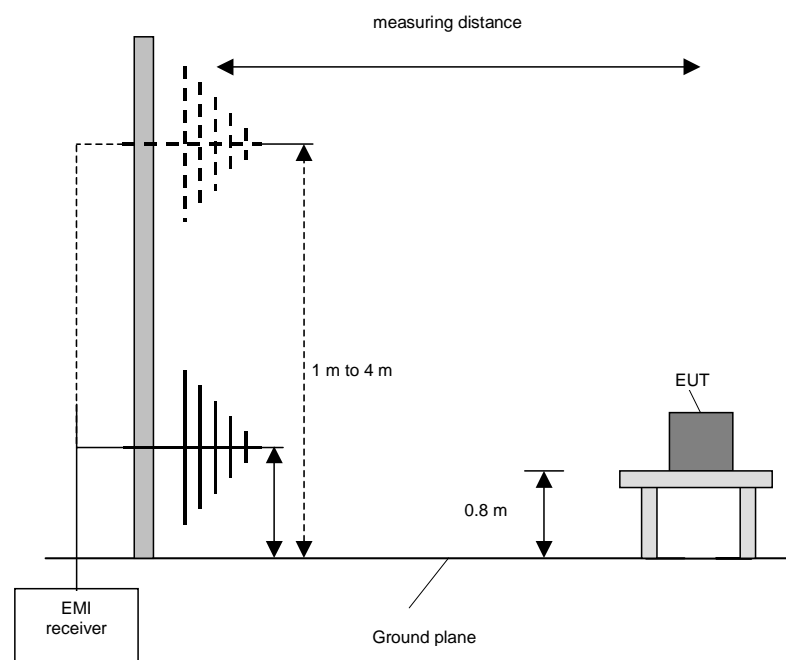
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarisation of the measuring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

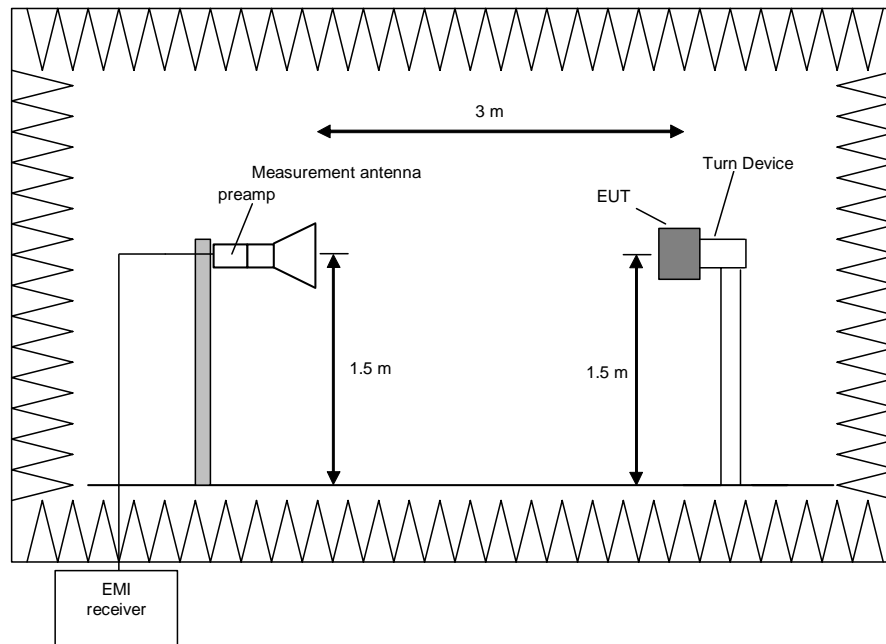
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

**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:

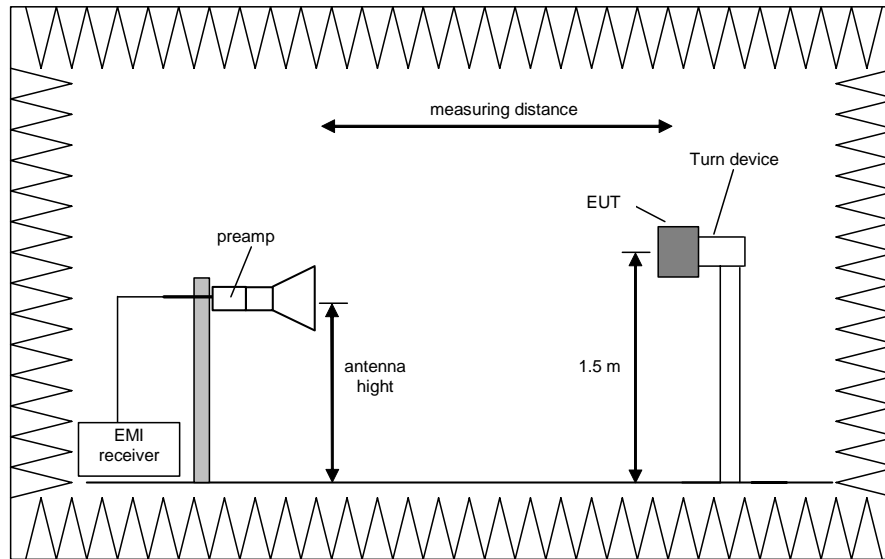
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an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

## 5.4.2 Test results (radiated emissions) 150 kHz – 10 GHz

### 5.4.2.1 Preliminary radiated emission measurement 150 kHz – 10 GHz

Ambient temperature	23 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

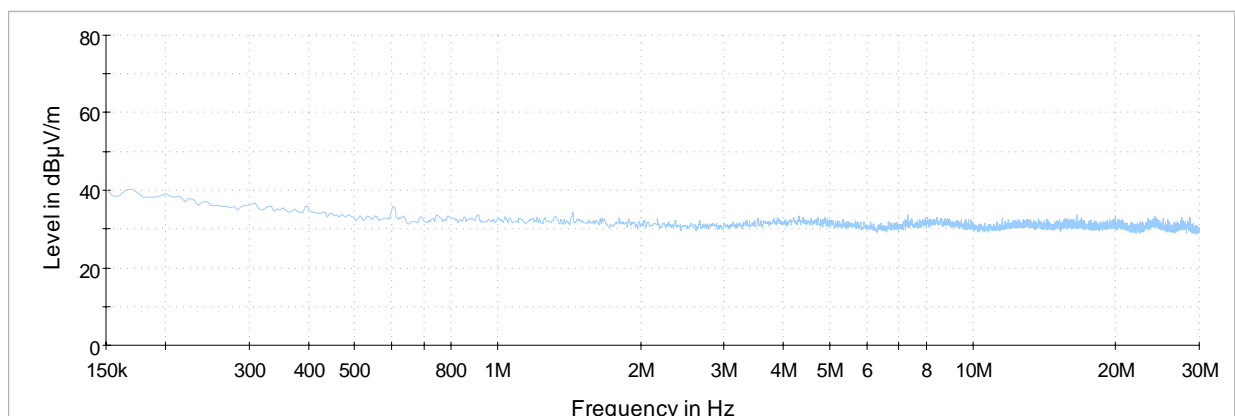
Position of EUT: The EUT was set-up on a turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m.

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 with 5.0 V<sub>DC</sub> via USB to fibre optic converter.

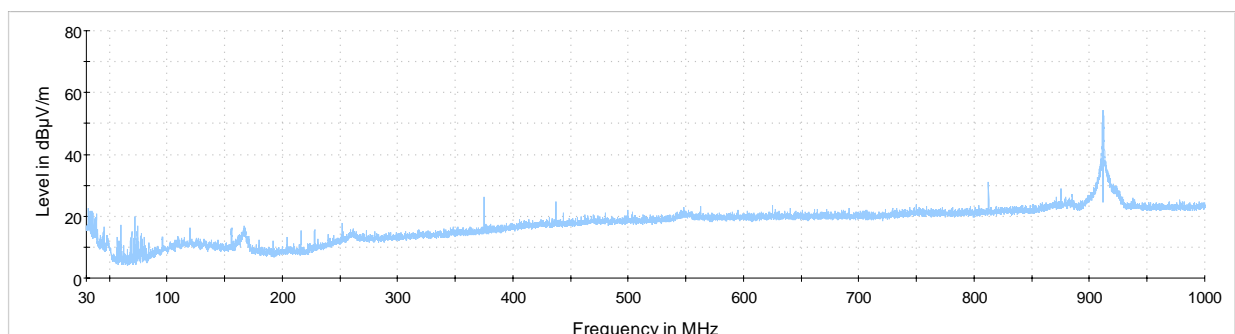
#### Spurious emissions from 150 kHz to 30 MHz:



Preview Result 1-PK+

No significant emissions above 40.2 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 (carrier notched):



Preview Result 1-PK+

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

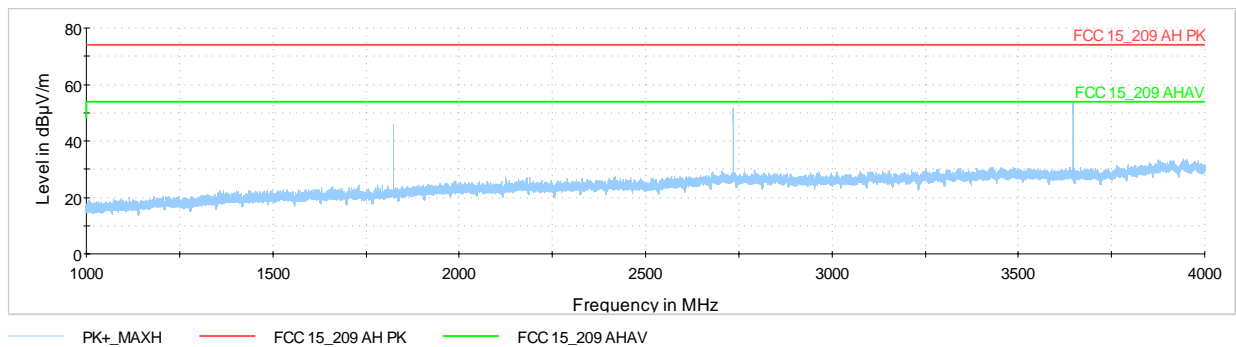
- 31.7945 MHz, 34.5105 MHz, 38.5845 MHz, 59.876 MHz, 72.001 MHz, 374.9805 MHz, 437.4485 MHz, 812.4505 MHz, 874.967 MHz and 911.800 MHz.

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

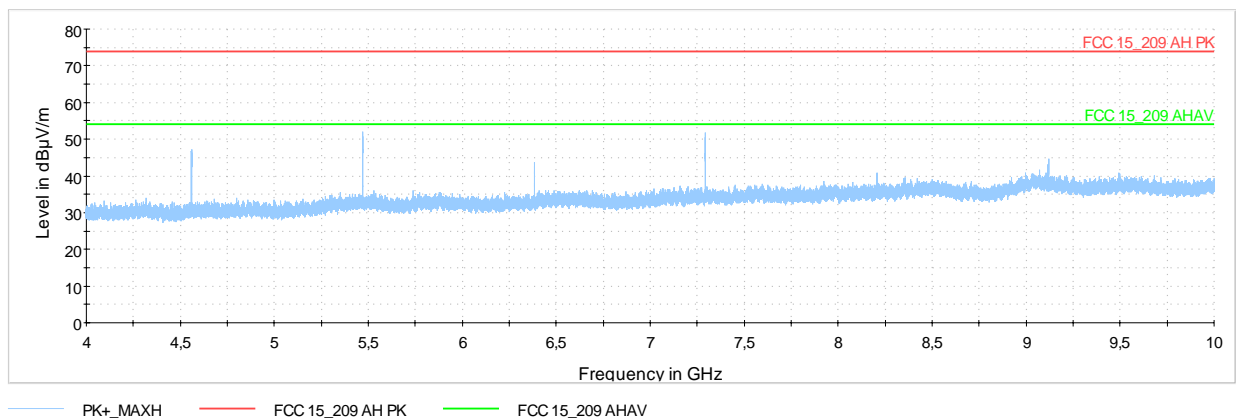
- 251.9845 MHz

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:



#### Spurious emissions from 4 GHz to 10 GHz:



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

- 1823.600 MHz, 5470.800 MHz and 6382.600 MHz.

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

- 2735.400 MHz, 3647.200 MHz, 4559.000 MHz, 7294.400 MHz, 8206.200 MHz and 9118.000 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

#### 5.4.2.2 Final radiated measurements

#### 5.4.2.3 Final radiated emission measurement (150 kHz to 30 MHz)

No significant emissions above 40.2 dB $\mu$ 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.

#### 5.4.2.4 Final radiated emission measurement (30 MHz to 1 GHz)

Ambient temperature	21 °C	Relative humidity	55 %
---------------------	-------	-------------------	------

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 optics converter with 5.0 V<sub>DC</sub>.

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:

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Restr. Band	Pos.
31.794500	34.2	78.8	44.6	1000	120	105	Vert.	25	26.5	No	1
34.515000	27.8	78.8	51.0	1000	120	150	Vert.	62	25.3	No	3
38.584500	28.1	78.8	50.7	1000	120	100	Vert.	5	23.5	No	1
59.876000	24.2	78.8	54.6	1000	120	260	Vert.	346	12.7	No	2
72.001000	24.1	78.8	54.7	1000	120	160	Vert.	126	13.9	No	2
251.98450	20.3	46.0	25.7	1000	120	100	Hor.	0	21.2	Yes	2
374.98050	29.8	78.8	49.0	1000	120	100	Hor.	126	24.0	No	3
437.44850	26.4	78.8	52.4	1000	120	233	Hor.	112	26.2	No	3
812.45050	35.1	78.8	43.7	1000	120	176	Vert.	167	32.9	No	3
874.96700	34.1	78.8	44.7	1000	120	104	Hor.	141	33.8	No	1
911.80000	98.8	Carrier		1000	120	103	Hor.	213	34.6	No	1
Measurement uncertainty				+2.2 dB / -3.6 dB							

Test: Passed

Test equipment used (refer clause 6):

1, 18 - 24
------------

#### 5.4.2.5 Final radiated emission measurement (1 GHz to 10 GHz)

Ambient temperature	23 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

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 with 5.0 V<sub>DC</sub> via USB to fibre optic converter.

Frequency [MHz]	MaxPeak [dB $\mu$ V/m]	Average [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Restr. Band
1823.6000	---	45.1	78.8	33.7	Hor.	235	0	-12.8	No
	47.1	---	78.8	31.7	Hor.	235	0	-12.8	No
2735.4000	---	50.3	54.0	3.7	Hor.	293	90	-8.2	Yes
	52.6	---	74.0	21.4	Hor.	293	90	-8.2	Yes
3647.2000	---	52.3	54.0	1.7	Hor.	30	90	-6.4	Yes
	54.9	---	74.0	19.1	Hor.	30	90	-6.4	Yes
4559.0000	---	45.5	54.0	8.5	Hor.	18	60	-2.6	Yes
	50.5	---	74.0	23.5	Hor.	18	60	-2.6	Yes
5470.8000	---	49.5	78.8	29.3	Hor.	308	90	0.2	No
	54.5	---	78.8	24.3	Hor.	308	90	0.2	No
6382.6000	---	41.9	78.8	36.9	Vert.	179	90	1.8	No
	49.7	---	78.8	29.1	Vert.	179	90	1.8	No
7294.4000	---	48.2	54.0	5.8	Hor.	114	90	4.8	Yes
	55.1	---	74.0	18.9	Hor.	114	90	4.8	Yes
8206.2000	---	38.0	54.0	16.0	Vert.	346	120	6.1	Yes
	49.3	---	74.0	24.7	Vert.	346	120	6.1	Yes
9118.0000	---	40.1	54.0	13.9	Hor.	2	59	7.9	Yes
	51.5	---	74.0	22.5	Hor.	2	59	7.9	Yes
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

Test equipment used (refer clause 6):

1 - 8, 10, 11, 15 - 17

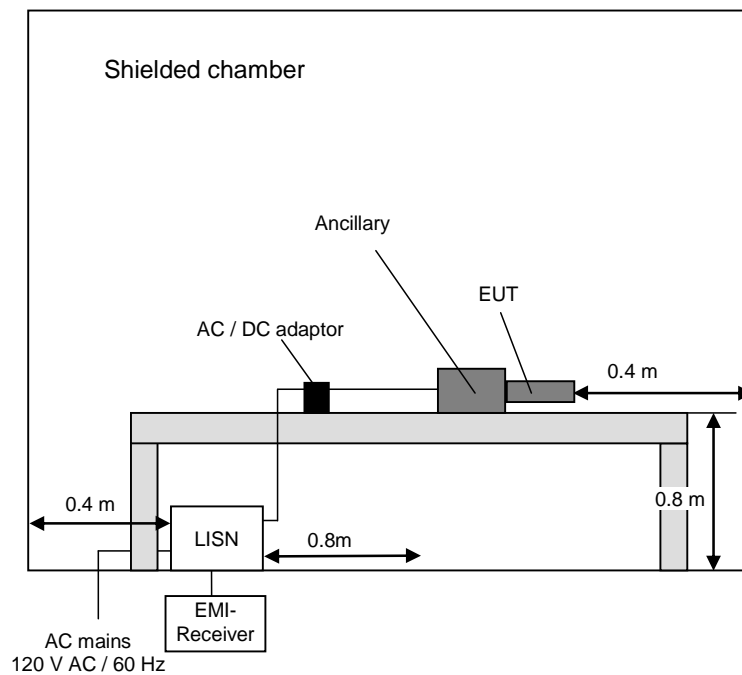
## 5.5 Conducted emissions on power supply lines

### 5.5.1 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 appropriate 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



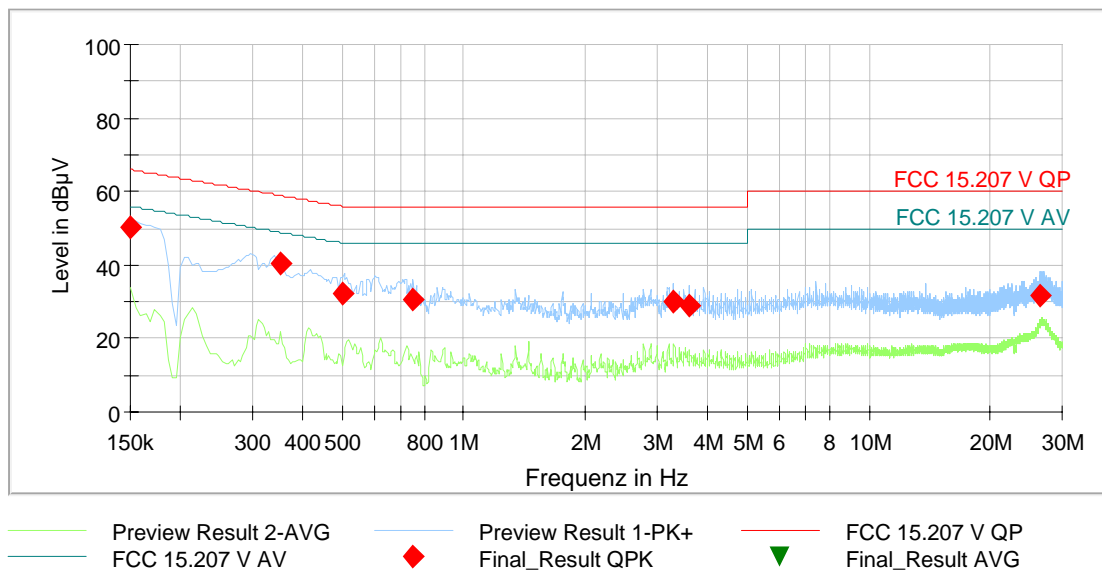


### 5.5.2 Test result

Ambient temperature	22 °C	Relative humidity	29 %
---------------------	-------	-------------------	------

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):

25 - 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 Elektrotest 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

