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Test Report

Report Number:

F180803E3

Equipment under Test (EUT):

W-LINK STICK

Applicant:

Mammut Sports Group AG

Manufacturer:

CCS Adaxys AG

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

References

[1] ANSI C63.4:2014 American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

[2] FCC 47 CFR Part 2: General Rules and Regulations

[3] FCC 47 CFR Part 15: Radio Frequency Devices (Subpart B)

[4] ICES-003 Issue 6: (January 2016 Updated April 2017) Information Technology Equipment (Including Digital Apparatus) —Limits and Methods of Measurement

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		11.01.2019
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		11.01.2019
	Name	Signature	Date

This test report is only valid in its original form.

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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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:	16.11.2018
End of test:	28.11.2018

2 Operational states

Description of function of the EUT:

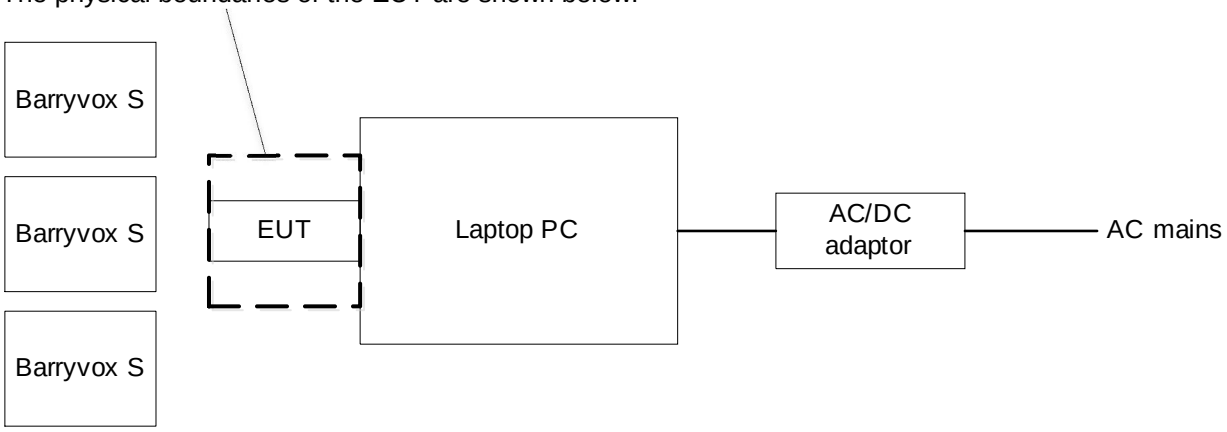
The EUT is a service device for avalanche rescue beacons. All tests were carried out with an unmodified sample.

The following states were defined as the operating conditions:

During all tests 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 send 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 all 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 physical boundaries of the EUT are shown below.



3 Additional information

The intentional radiator parts of the EUT will be certified under other FCC 47 CFR Part 15 sections. The measurement results for these rule sections are documented under PHOENIX TESTLAB GmbH test report reference F180803E1 and F180803E2.

4 Overview

Conducted emissions FCC 47 CFR Part 15 section 15.107 (b) [3] / ICES-003 Issue 6 section 6.1 [4]					
Application	Frequency range	Limits	Reference standard	Remark	Status
AC supply line	0.15 to 0.5 MHz 0.5 to 30 MHz	79 dBµV (QP) 66 dBµV (AV) 73 dBµV (QP) 60 dBµV (AV)	ANSI C63.4	Class A	-
AC supply line	0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56 dBµV (QP)* 56 to 46 dBµV (AV)* 56 dBµV (QP) 46 dBµV (AV) 60 dBµV (QP) 50 dBµV (AV)	ANSI C63.4	Class B	Passed
*: Decreases with the logarithm of the frequency					
Radiated emissions FCC 47 CFR Part 15 section 15.109 (b) [3] / ICES-003 Issue 6 section 6.2 [4]					
Application	Frequency range	Limits	Reference standard	Remark	Status
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	39.0 dBµV /m QP at 10 m 43.5 dBµV /m QP at 10 m 46.5 dBµV /m QP at 10 m 49.5 dBµV /m QP at 10 m 49.5 dBµV /m AV at 10 m and 69.5 dBµV /m PK at 10 m	ANSI C63.4	Class A	-
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	40.0 dBµV/m QP at 3 m 43.5 dBµV/m QP at 3 m 46.0 dBµV/m QP at 3 m 54.0 dBµV/m QP at 3 m 54.0 dBµV/m AV at 3 m and 74.0 dBµV/m PK at 3 m	ANSI C63.4	Class B	Passed

Remark: As declared by the applicant the highest internal clock frequency is < 1 GHz.
Therefore the radiated emission measurement must be carried out up to 5 GHz.

The EUT was classified by the applicant as CLASS B equipment.

5 Results

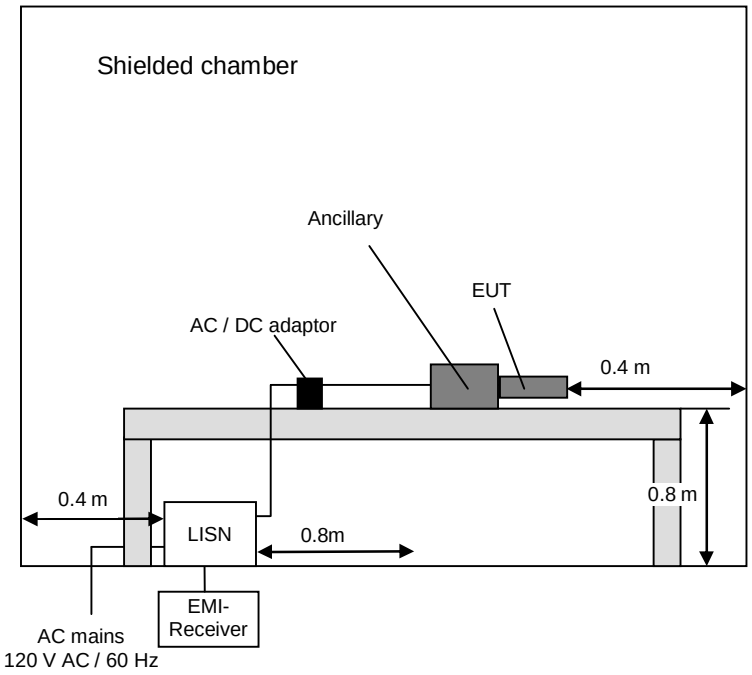
5.1 Conducted emissions on power supply lines

5.1.1 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



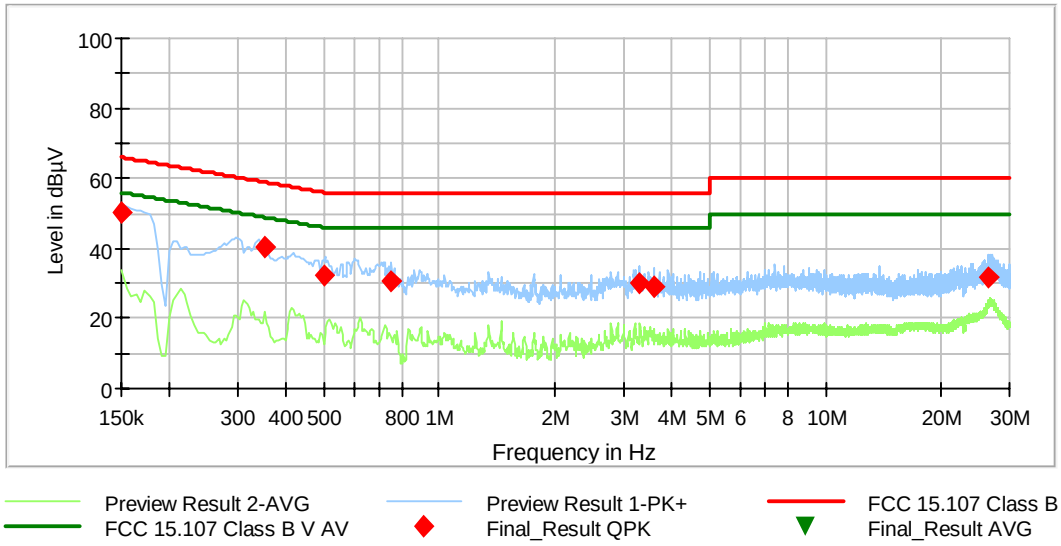
5.1.2 Test result

Ambient temperature	22 °C

Relative humidity	29 %

Test description:	Radiated emission measurement
EUT:	W-LINK STICK
Manufacturer:	CCS Adaxys AG
Operating conditions:	Upgrating 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):

1 - 5

5.2 Radiated emissions

5.2.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 30 MHz to 1 GHz.
- 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 a various antenna height of 100 to 250 cm at a distance of 1.90 m to the EUT position in the frequency range 1 GHz to 40 GHz.
- A final measurement carried out in a fully anechoic chamber and various antenna height of 100 to 250 cm at a distance of 1.90 m to the EUT position in the frequency range 1 GHz to 40 GHz.

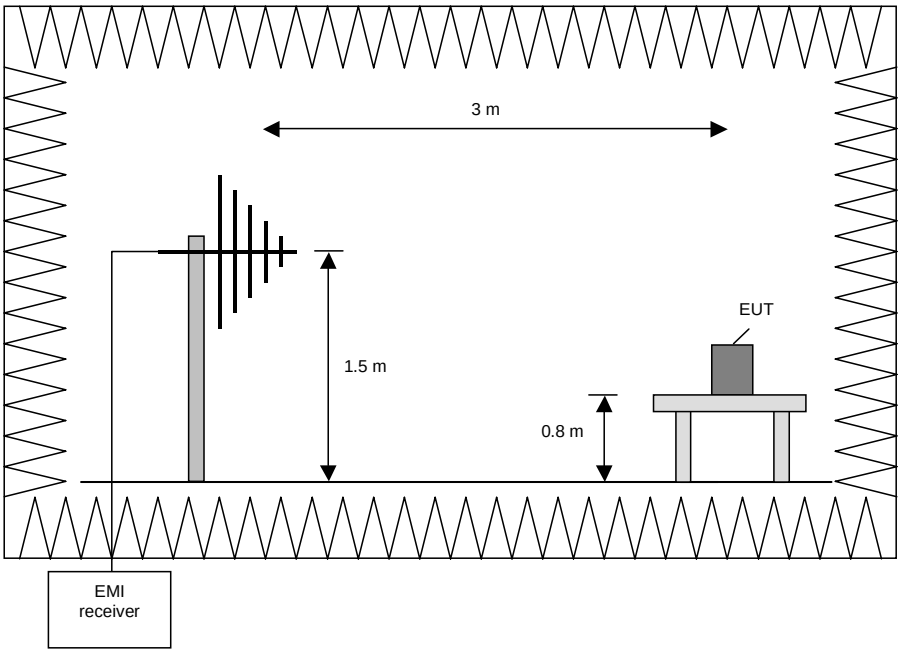
Preliminary measurement (30 MHz to 1 GHz)

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 support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup 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 120 kHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °.

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 preliminary measurement:

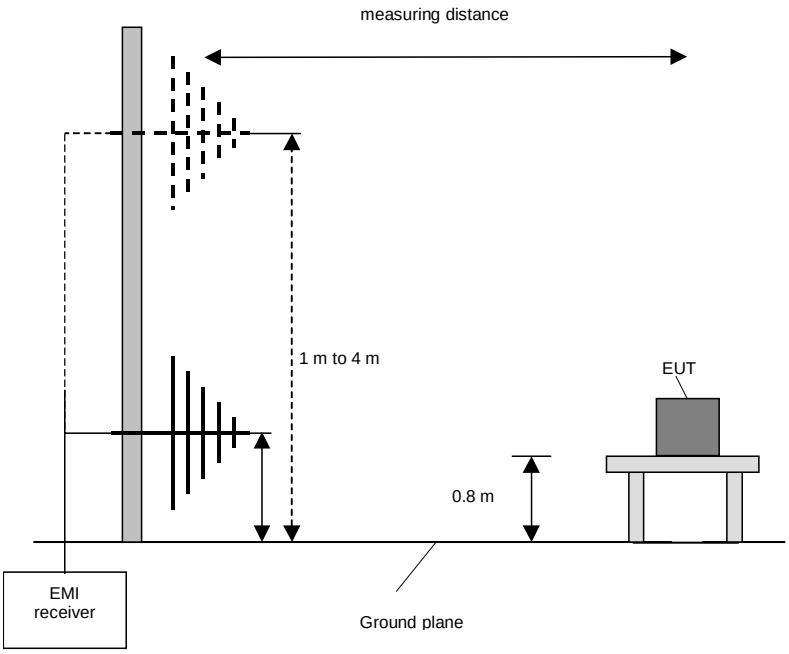
Prescans were performed in the frequency range 30 MHz to 1 GHz.
The following procedure will be used:
Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
Manipulate the system cables within the range to produce the maximum level of emission.
Rotate the EUT by 360 ° to maximize the detected signals.
Make a hardcopy of the spectrum.
Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
Repeat 1) to 4) with the other orthogonal axes of the EUT if handheld equipment.
Repeat 1) to 5) with the vertical polarization of the measuring antenna.

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 polarization 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:

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

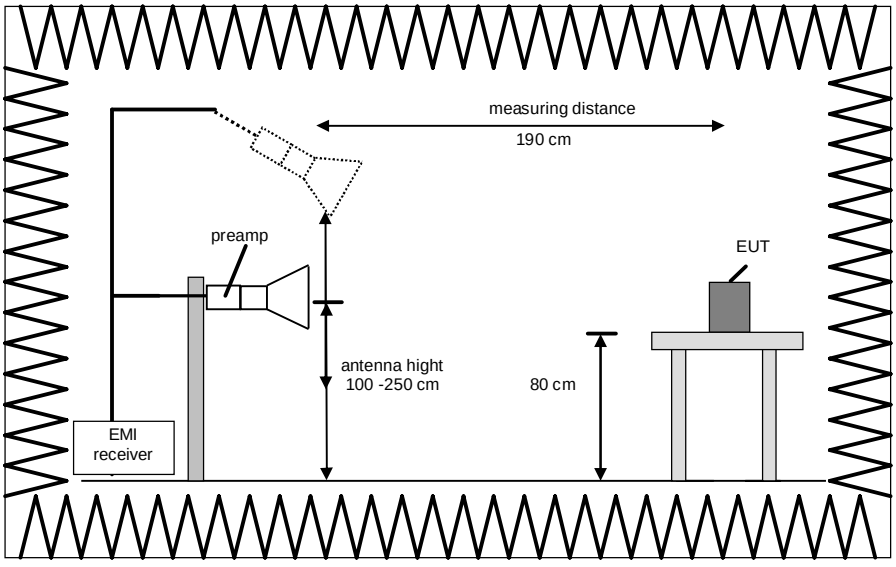
Preliminary and final measurement (1 GHz to 40 GHz)

This measurement will be performed in a fully anechoic chamber. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance to ANSI C63.4 [1].
The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth (preliminary)	Resolution bandwidth (final)
1 GHz to 40 GHz	1 MHz	1 MHz

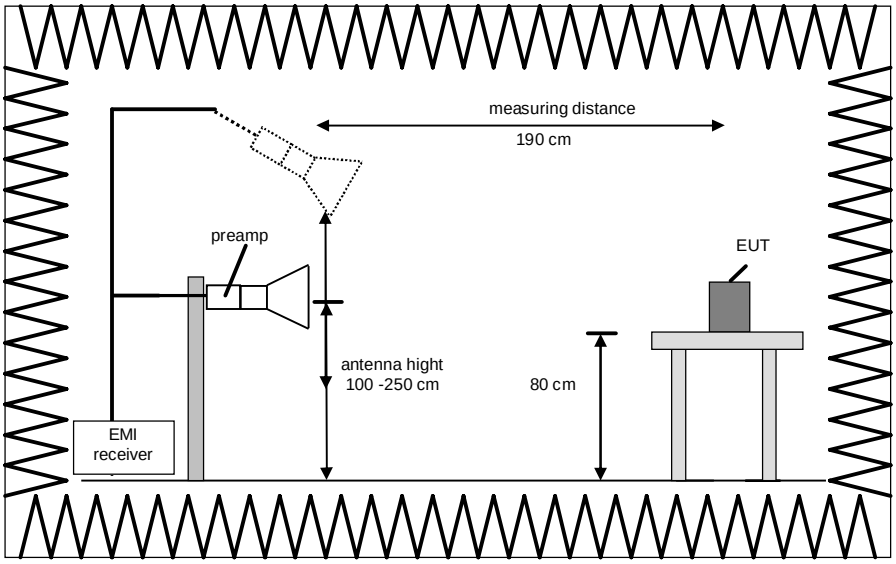
Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna in a measuring distance of 1.9 m.
The antenna high was varied from 100 cm up to 250 cm.
The EUT was turned around 360 ° at each antenna high and polarisation and the maximum values were stored by the EMC 32 software.
After storing the maximum plot the antenna was set to the position where the maximum value for each emission was found 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 antenna. The antenna high was varied from 100 cm up to 250 cm depending where the maximum was found during the preliminary measurement in a measuring distance of 1.9 m.
The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. 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 ° in order to have the antenna inside the cone of radiation.



Procedure of measurement:

The measurements were performed in the frequency range 1 to 40 GHz.
The following procedure will be used by software EMC32 assisted:

1. Monitor the frequency range at horizontal and vertical polarisation and turn the EUT 360°.
2. Change the antenna high and repeat 1) with 100, 125, 150, 175, 200, 225 and 250 cm high and an elevation pointing towards the EUT.
3. The EUT was turned around 360 ° at each antenna high and polarisation and the maximum values were stored by the EMC 32 software.
4. After storing the maximum plot the antenna was set to the position where the maximum value for each emission was found for the final measurement.
5. Start the single measurement mode in the EMC 32 software and do the final measurement at each frequency with the antenna polarisation and azimuth and the peak and average detector, which causes the maximum emission. Take the scan table for the final measurement with the correct resolution bandwidth, measure time, detector and save the maximum values manually in the EMC 32.
6. Repeat steps 1) to 5) for the next antenna spot if the EUT is larger than the antenna beam width.

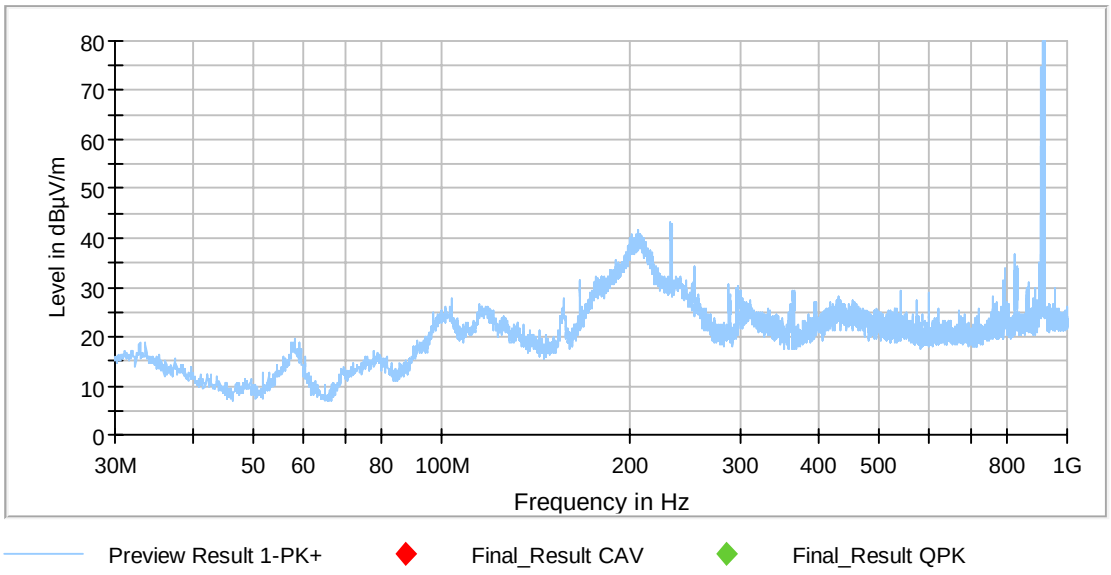
Step 1) to 4) are defined as preliminary measurement.

5.2.2 Preliminary radiated emission measurement 30 MHz – 5 GHz

Ambient temperature	22 °C	Relative humidity	34 %

Test description:	Radiated emission measurement
EUT:	W-LINK STICK
Manufacturer:	CCS Adaxys AG
Operating conditions:	Upgrating 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:	16.11.2018

The curves in the diagram only represent the maximum measured peak value for each frequency point of all preliminary measurements, which were carried out with the EUT in various positions.

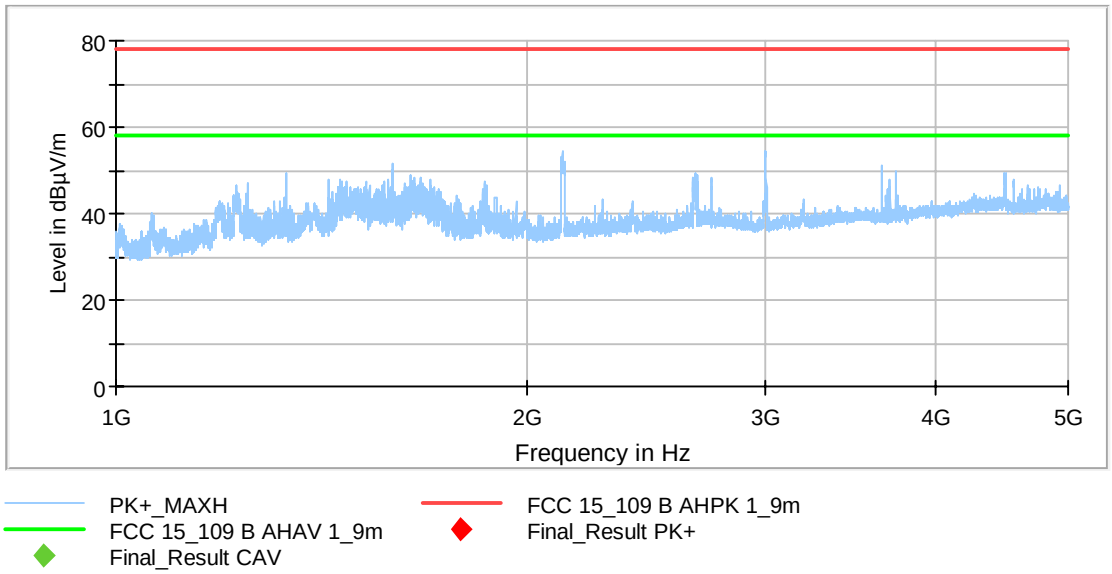


Except the wanted signal on 911.800 MHz, which is tested and documented under another rule part, the following frequencies were found during the preliminary radiated emission test:

156.772 MHz, 166.084 MHz, 206.634 MHz, 232.273 MHz, 253.488 MHz, 287.127 MHz, 825.994 MHz and 959.985 MHz.

These frequencies have to be measured with in a final measurement.

The curves in the diagram only represent the maximum measured peak value for each frequency point of all preliminary measurements, which were carried out with the EUT in various positions. The results of the standard subsequent measurement above 1 GHz in an anechoic chamber are indicated 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 1.9 m measuring distance.



Remark*: The measurement was carried out at a distance from 1.9 m instead of 3 m. Therefore 4 dB were added to the 3 m limit according FCC part 15.109 Class B devices. Limits extrapolated from 3 m distance to 1.9 m distance by 20 dB /decade

Because the measured peak values were lower than the required average limit, no final measurement was carried out in this frequency range. The highest peak value of 54.2 dBµV/m was caused by the intentional radiator part of the EUT, which is tested and documented under another rule part.

Test equipment used (refer clause 6):

6 - 21

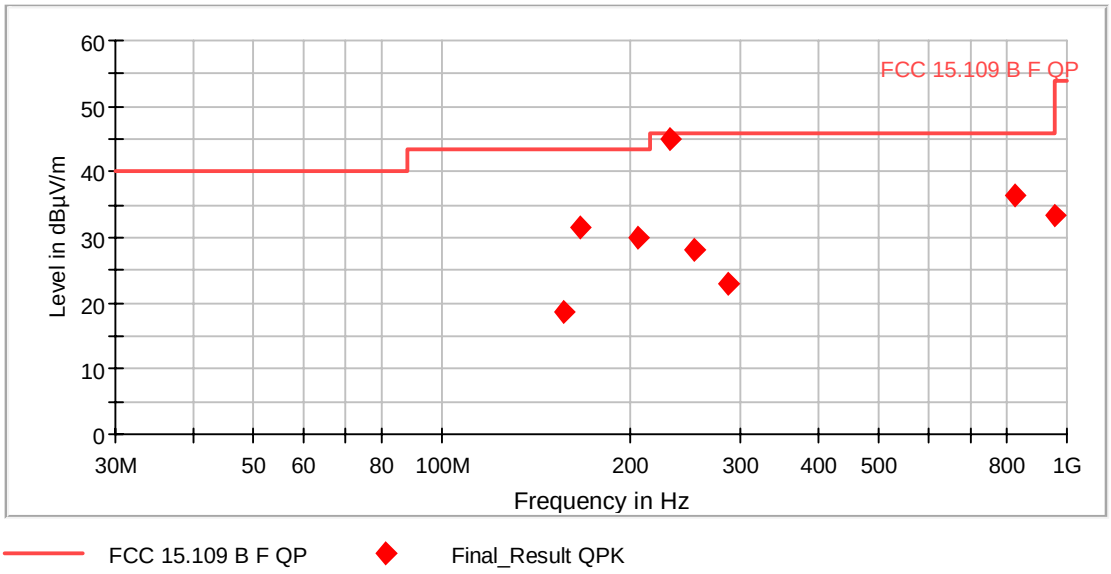
5.2.3 Final radiated measurements

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

Ambient temperature	22 °C	Relative humidity	29 %

Test description:	Radiated emission measurement
EUT:	W-LINK STICK
Manufacturer:	CCS Adaxys AG
Operating conditions:	Upgrating 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:	16.11.2018

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above mentioned standard. The measured points marked with "◆" are the measured results of the standard subsequent measurement on the open area test site.



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.

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
156.772000	18.70	43.50	24.80	1000.0	120.000	101.0	H	69.0	18.7
166.084000	31.51	43.50	11.99	1000.0	120.000	102.0	H	345.0	18.0
206.634000	30.08	43.50	13.42	1000.0	120.000	145.0	V	4.0	17.0
232.273000	44.89	46.00	1.11	1000.0	120.000	130.0	V	270.0	18.5
253.488000	28.28	46.00	17.72	1000.0	120.000	104.0	V	22.0	21.2
287.127000	23.10	46.00	22.90	1000.0	120.000	150.0	H	201.0	21.3
825.994000	36.56	46.00	9.44	1000.0	120.000	105.0	V	303.0	33.0
959.985000	33.40	46.00	12.60	1000.0	120.000	246.0	V	146.0	35.6
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

The correction factor was calculated as follows.

Corr. (dB) = cable attenuation (dB) + antenna factor (dB)

Therefore the reading can be calculated as follows:

Reading (dBµV/m) = result QuasiPeak (dBµV/m) - Corr. (dB)

Test equipment used (refer clause 6):

2, 4, 22 - 27

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.03.2018	03.2020
2	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
3	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
4	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
5	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	14.03.2018	03.2020
6	Antenna mast	AS615P	Deisel	615/310	480187	Calibration not necessary	
7	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	13.02.2018	02.2019
8	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
9	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	06.2020
10	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
11	Software	WMS32	Rohde & Schwarz		481800	Calibration not necessary	
12	RF-cable No.36	Sucoflex 106B	Suhner	0587/6B / Kabel 36	480865	Calibration not necessary	
13	HF-Cable	Sucoflex 104	Huber+Suhner	517402	482392	Calibration not necessary	
14	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	22.06.2017	06.2019
15	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
16	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	10.07.2018	07.2020
17	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
18	RF-cable No.38	Sucoflex 106B	Suhner	0709/6B / Kabel 38	481328	Calibration not necessary	
19	RF-Cable No. 40	Sucoflex 106B	Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
20	Highpass Filter	WHJS1000C11/60EF	Wainwright Instruments GmbH	1	480413	Calibration not necessary	
21	Tunable Notch Filter	WRCA800/960-0.2/40-6EEK	Wainwright Instruments GmbH	15	480414	Calibration not necessary	
22	Open area test site M6	Freifeld M6	Phoenix Contact	-	480085	Calibration not necessary	
23	Antenna mast	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	Calibration not necessary	
24	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
25	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
26	Antenna (Bilog)	CBL6111D	Schaffner Elektrotest GmbH / Teseq GmbH	25761	480894	19.10.2017	10.2020
27	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	

7 Report history

Report Number	Date	Comment
F180803E3	11.01.2019	Initial Test Report
-	-	-
-	-	-
-	-	-

8 List of annexes

Annex A Test setup photographs 5 pages

180803_13.JPG: W-LINK STICK, test setup fully anechoic chamber
180803_14.JPG: W-LINK STICK, test setup fully anechoic chamber
180803_15.JPG: W-LINK STICK, test setup fully anechoic chamber
180803_17.JPG: W-LINK STICK, test setup open area test site
180803_18.JPG: W-LINK STICK, test setup shielded chamber

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