

Test Report

Report Number:

F171626E6

Equipment under Test (EUT):

Barryvox

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


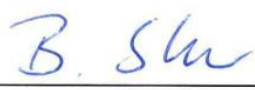
References

- [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 4 (November 2014)**, General Requirements for Compliance of Radio Apparatus

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.

The complete test results are presented in the following.

Test engineer:	Thomas KÜHN		11/13/2017
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		11/13/2017
	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

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: *	Avalanche rescue beacon
Type / PMN: *	Barryvox
FCC ID: *	ARN-BARRYVOX
IC: *	8038A-BARRYVOX
Serial number: *	1649800961
PCB identifier: *	BNG_Barryvox
HVIN (Hardware Version Identification Number): *	7600.0035
FVIN (Firmware Version Identification Number): *	2.0

1.5 Technical data of equipment

Antenna type: *	Integrated wire antenna (UHF transceiver) and three integrated ferrite coil antennas (457 kHz transceiver)					
Antenna connector: *	None					
Power supply – EUT: *	U _{nom} =	4.5 V DC	U _{min} =	4.0 V DC	U _{max} =	6.0 V DC
Type of modulation: *	FHSS / GFSK (UHF transceiver), AM with carrier keying (457 kHz transceiver)					
Data rate: *	50 kbps (UHF transceiver) and no data (457 kHz transceiver)					
Operating frequency range: *	915.9131 to 925.9894 MHz (UHF transceiver) and 457 kHz					
Number of channels: *	50 (UHF transceiver) and 1 (457 kHz transceiver)					
Temperature range: *	-20 °C to 45 °C					
Lowest / highest Internal clock frequency: *	11.882 MHz / 27.0 MHz					
Ancillaries used for testing:	None					

* 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:	10/09/2017
Start of test:	10/12/2017
End of test:	10/27/2017

2 Operational states

The EUT is an avalanche rescue beacon. All tests were carried out with an unmodified sample.

During all RF-tests the EUT was supplied with 4.5 V DC by three new AAA batteries.

Because the EUT is a handheld device, the preliminary radiated measurements were carried out with the EUT mounted on a 3-D positioner; the final measurements on the outdoor test site were carried out in three orthogonal directions. These were defined as follows:

- Pos. 1: EUT lying on the table, display shows upwards.
- Pos. 2: EUT standing on the bottom side, display shows to the measuring antenna.
- Pos. 3: EUT lying on the long side display shows to the measuring antenna.

With the help of a test-software (Monitor Rev. 2385, supplied by the applicant) installed on a laptop PC and a UHF modem (WLink Adapter 462001-70000 C, supplied by the applicant) it was possible to adjust a test mode, where the UHF operating mode could be adjusted. After adjusting the test mode, the connection to the UHF modem was terminated.

The EUT was set to transmit on UHF channel 24 (920.8485 MHz) and the 457 kHz transmitter was active during all tests. So both transmitters were operational during all tests.

3 Additional information

The EUT contains also a UHF transceiver, which is will be certified under another FCC 47 CFR Part 15 section. The measurement results for this rule section are documented under PHOENIX TESTLAB GmbH test report reference F17626E5.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-210 [3] or RSS-Gen, Issue 4 [4]	Status	Refer page
Bandwidth	457 kHz	15.215 (c)	6.6 [4]	Passed	7 et seq.
Radiated emissions (transmitter)	0.150 MHz to 1,000 MHz	15.205 (a), 15.209 (a).	3 and 4.1 [3], 8.9 [4]	Passed	10 et seq.
Antenna requirement	-	15.203	8.3 [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 shall be used:

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

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

99 % bandwidth:

The following spectrum analyser settings shall be used:

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

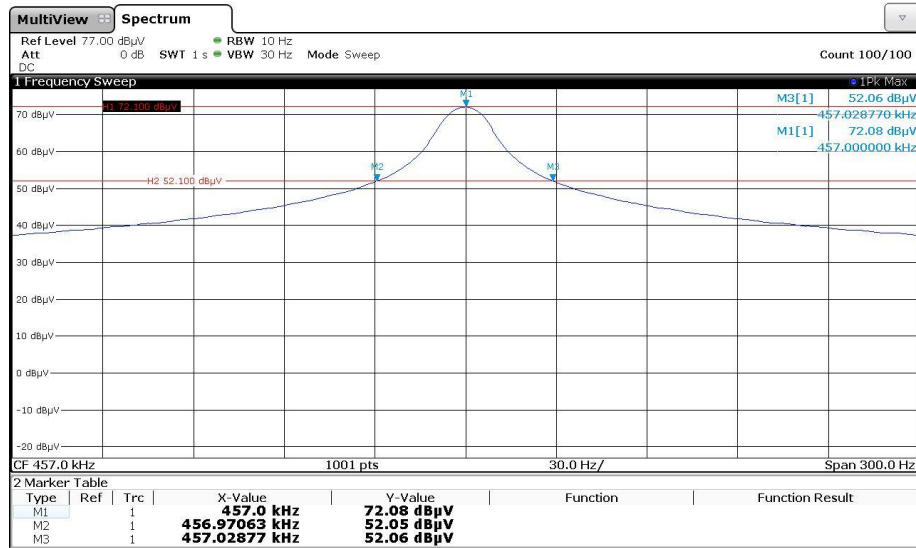
After trace stabilisation the marker shall be set on the signal peak. Use the 99 % bandwidth functionality of the spectrum analyser to integrate the requested bandwidth.

5.1.2 Test result

Ambient temperature	22 °C
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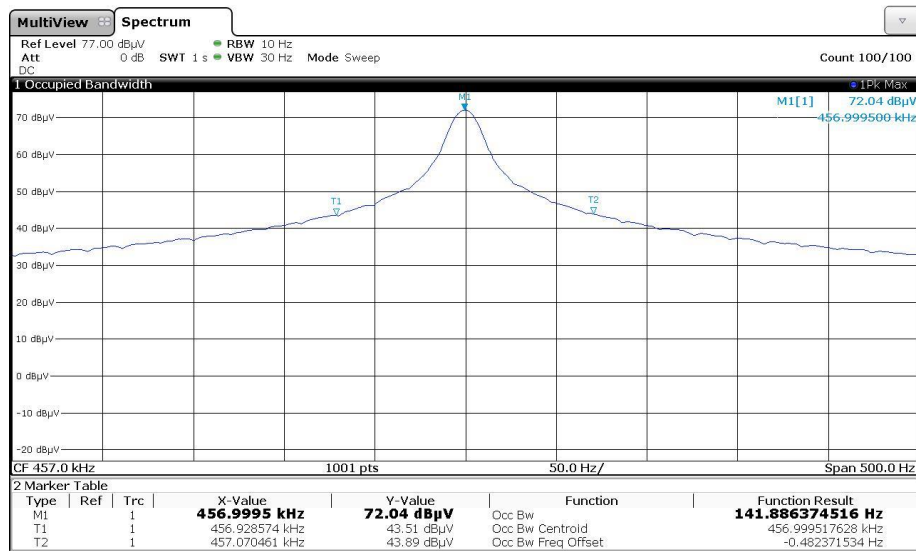
Relative humidity	35 %
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171626_f10.PNG: 20 dB Bandwidth:



Operation Mode	Center Frequency	F_L	F_U	20 dB Bandwidth	Result
4	457 kHz	456.971 kHz	457.029 kHz	58 Hz	Passed

171626_f9.PNG: 99% Bandwidth:



Operation Mode	Center Frequency	F _L	F _U	99 % Bandwidth	Result
4	457 kHz	456.928	457.070	142 Hz	Passed

Test equipment used (refer clause 6):

2 - 9, 11

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 height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a variable antenna distance and height in the frequency range above 1 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range above 1 GHz.

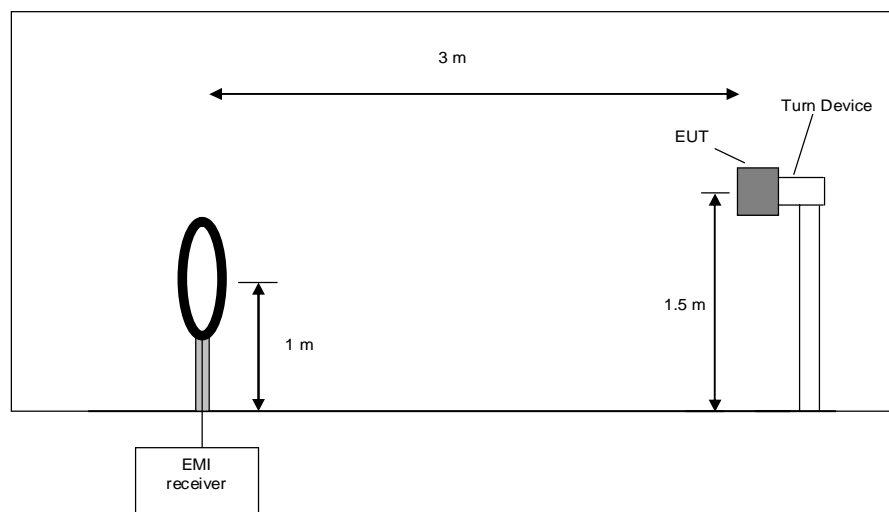
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Table top devices will set up on a non-conducting turn device on the height of 1.5m. Floor-standing devices will be placed directly on the turntable/ground plane. The set-up of the Equipment under test will be in accordance to [1].

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to found the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.

The following procedure will be used:

1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarisation of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. Repeat 1) to 5) with the EUT raised by an angle of 0° (45°, 90°) according to 6.6.5.4 in [1].
7. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

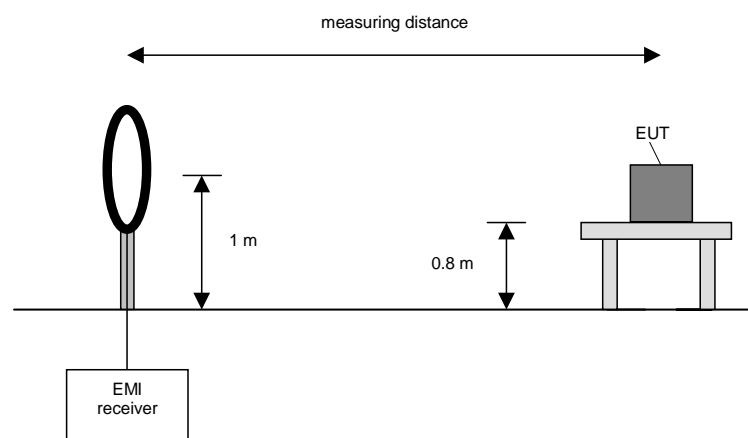
Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the frequencies, which were detected during the preliminary measurements, the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0° to 360° around their vertical axis until the maximum value is found.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Final measurement procedure:

The following procedure will be used:

1. Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
2. Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
3. Rotate the measuring antenna to find the maximum and note the value.
4. Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
5. Repeat steps 1) to 4) with the other orthogonal axes of the EUT (if the EUT is a module and might be used in a handheld equipment application).

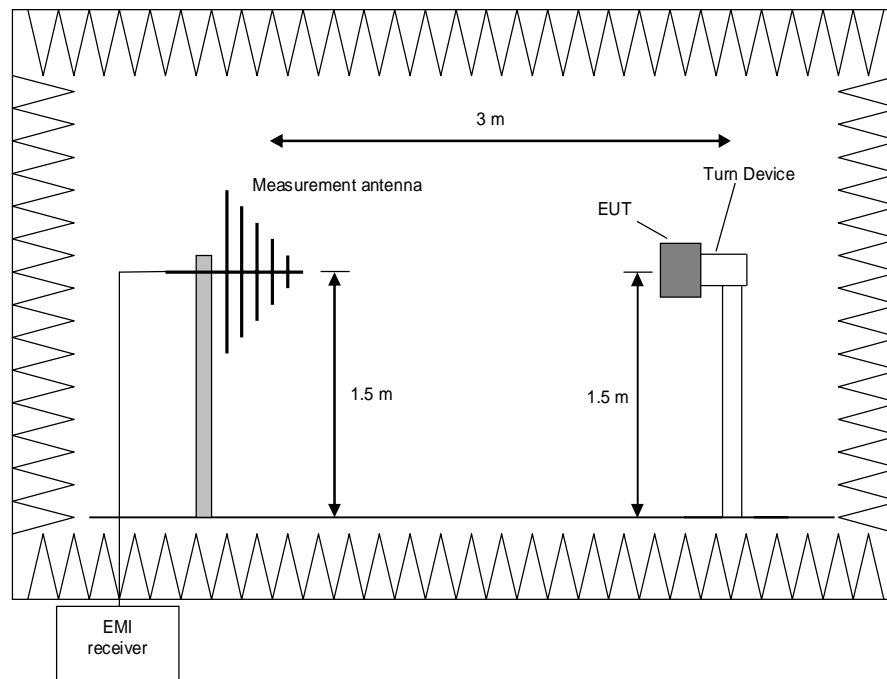
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Table top devices will set up on a non-conducting turn device on the height of 1.5m. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 230 MHz	100 kHz
230 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.

The following procedure will be used:

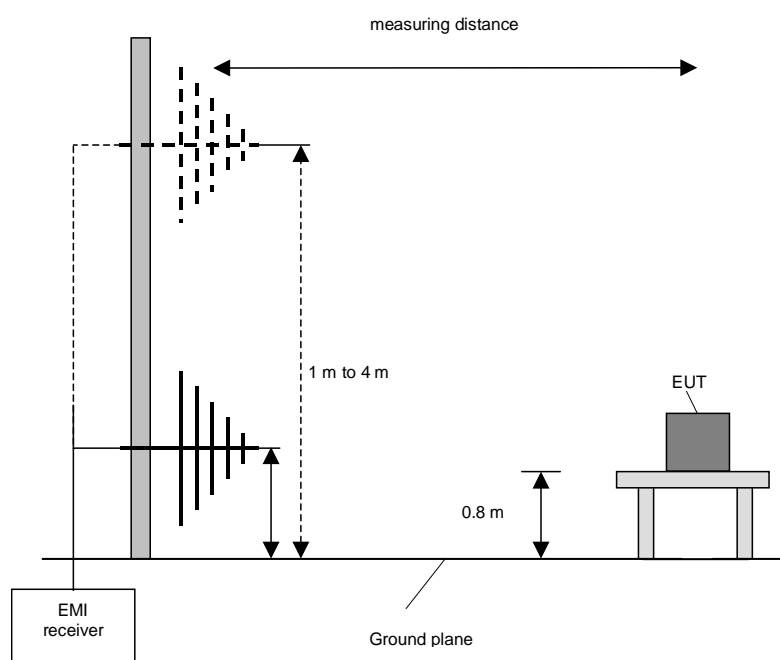
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarisation of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. Repeat 1) to 5) with the EUT raised by an angle of 0° (45°, 90°) according to 6.6.5.4 in [1].
7. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

Final measurement (30 MHz to 1 GHz)

A final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of 0° to 360°, the measuring antenna will be set to horizontal and vertical polarisation and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

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

Preliminary and final measurement (1 GHz to 40 GHz)

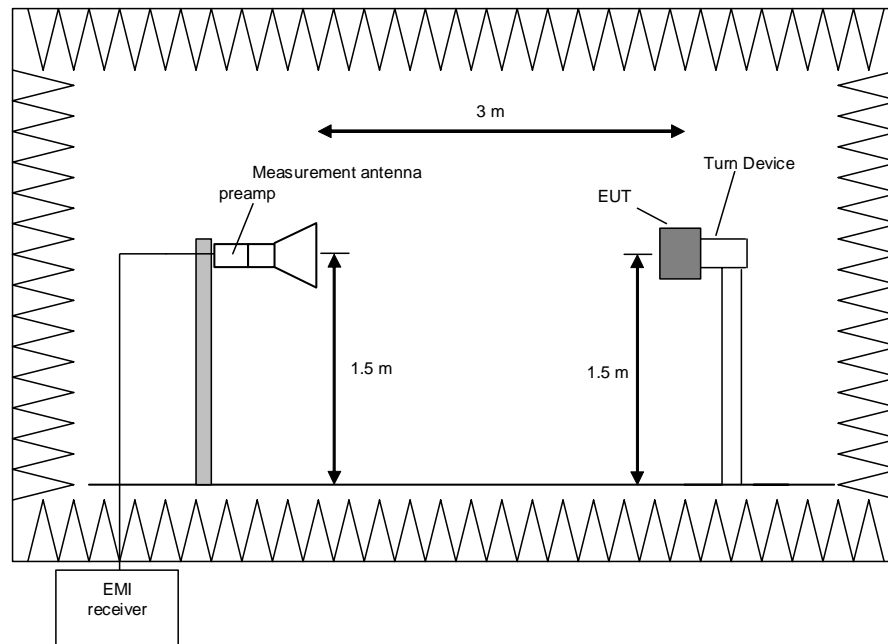
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	100 kHz
4 GHz to 12 GHz	100 kHz
12 GHz to 18 GHz	100 kHz
18 GHz to 25 / 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 40 GHz.

The following procedure will be used:

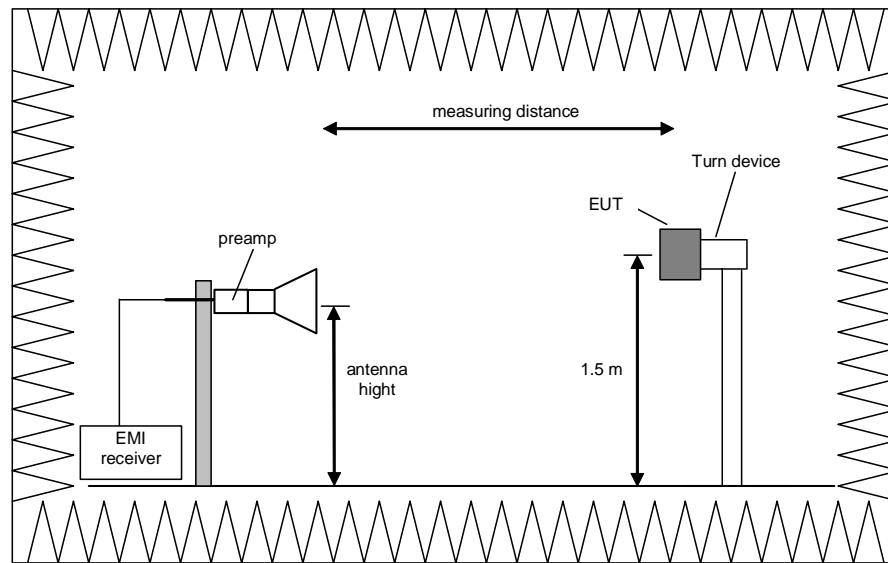
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0°.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.

The following procedure will be used:

1. Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
2. Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
3. Set the spectrum analyser to EMI mode with peak and average detector activated.
4. Rotate the turntable from 0° to 360° to find the TT Pos. that produces the highest emissions.
5. Note the highest displayed peak and average values
6. Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

5.2.2 Test results (radiated emissions) 150 kHz – 1 GHz

5.2.2.1 Preliminary radiated emission measurement 150 kHz – 1 GHz

Ambient temperature	22 °C	Relative humidity	42 %
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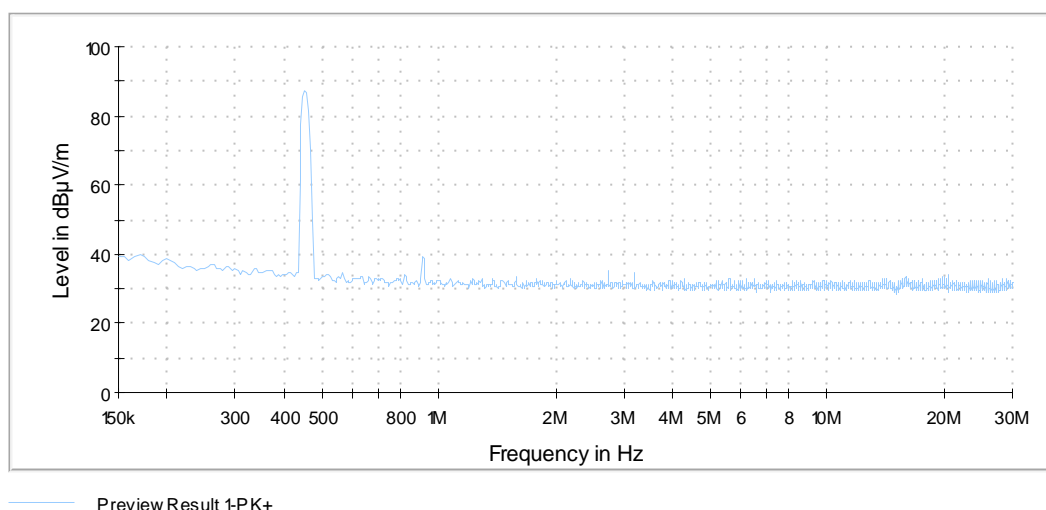
Position of EUT: The EUT was set-up on a turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m.

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 fresh batteries with 4.5 V_{DC}.

Spurious emissions from 150 kHz to 30 MHz:



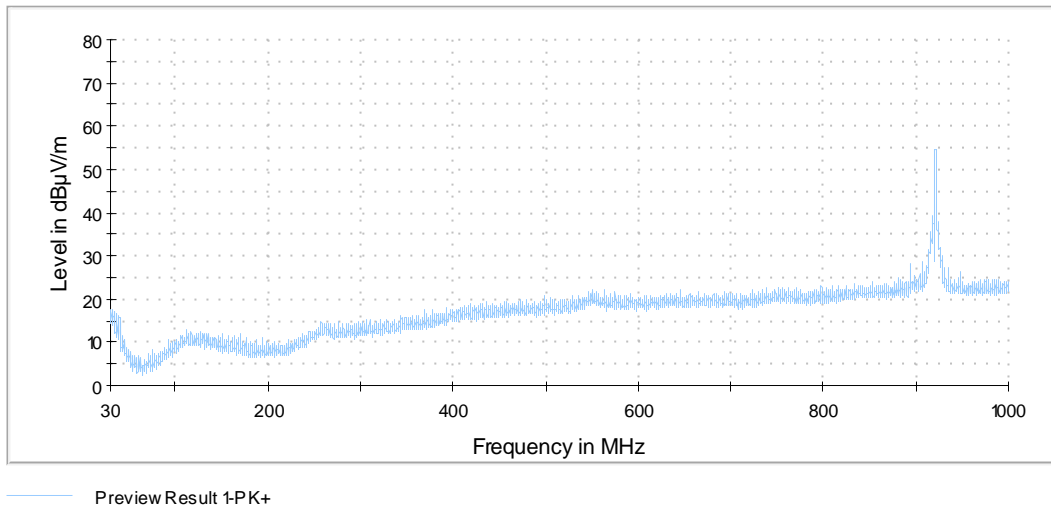
The following frequencies were found outside restricted bands during the preliminary radiated emission test:

- 457.0 kHz, 914.0 kHz and 2.742 MHz.

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

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

Spurious emissions from 30 MHz to 1 GHz (UHF carrier notched):



The emissions found in this frequency range are caused by the UHF transceiver of the EUT, which is will be certified under an other FCC 47 CFR Part 15 section. The measurement results for this rule section are documented under PHOENIX TESTLAB GmbH test report reference F17626E1.

Test equipment used (refer clause 6):

2 - 12

5.2.2.2 Final radiated measurements

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

Ambient temperature	15 °C	Relative humidity	56 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m and 10 m.

Cable guide: No cables are connectable to the EUT. For detail information of test set-up refer to the pictures in annex A of this test report.

Test record: All results are shown in the following. The measuring time was 5 s.

Supply voltage: During this test the EUT was powered by fresh batteries with 4.5 V_{DC}.

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

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

Results with measuring distance of 3 m							
Frequency (kHz)	Result (dBµV/m)	Limit ²⁾ (dBµV/m)	Margin (dB)	Detector	Readings (dBµV)	Antenna factor ¹⁾ (dB/m)	Pos.
457.0	65.2	94.4	29.2	AV	45.2	20.0	1
914.0	39.9	66.3	26.4	QP	61.1	20.0	1
2742.0	10.3	70.0	59.7	QP	-9.7	20.0	1
Results with measuring distance of 10 m							
Frequency (kHz)	Result (dBµV/m)	Limit ²⁾ (dBµV/m)	Margin (dB)	Detector	Readings (dBµV)	Antenna factor ¹⁾ (dB/m)	Pos.
457.0	48.7	74.4	25.7	AV	28.7	20.0	1
914.0	The signal was below the noise floor of the measuring system at 10 m distance						
2742.0	The signal was below the noise floor of the measuring system at 10 m distance						
Measurement uncertainty: +2.2 dB / -3.6 dB							

¹⁾: Cable loss included

²⁾: Limits according to [2] and [3] extrapolated with a factor of 40 dB/decade according to [2]

Test: Passed

Test equipment used (refer clause 6):

1, 9

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

The emissions found in this frequency range are caused by the UHF transceiver of the EUT, which is will be certified under an other FCC 47 CFR Part 15 section. The measurement results for this rule section are documented under PHOENIX TESTLAB GmbH test report reference F17626E5.

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	EMI Receiver / Spectrum Analyser	ESI40	Rohde & Schwarz	100064/040	480355	02/15/2017	02/2018
2	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
3	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
4	Signal & Spectrum Analyzer	ESW44	Rohde & Schwarz	101635	482467	06/22/2017	06/2019
5	Controller	MCU	Maturo	MCU/043/971107	480832	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	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Weekly verification (system cal.)	
9	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/29/2016	02/2018
10	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	06/19/2017	06/2020
11	Positioner	TDF 1.5-10Kg	Maturo	15920215	482034	Calibration not necessary	
12	Tuneable notch filter	WRCA800/96 0-0.2/40-6EEK	Wainwright	15	480414	Annual verification (system cal.)	

7 Report history

Report Number	Date	Comment
F171626E6	11/13/2017	Initial Test Report
-	-	-
-	-	-
-	-	-

8 List of annexes

Annex A Test setup photographs 4 pages

171626_p.JPG: Barryvox, test setup fully anechoic chamber
 171626_r.JPG: Barryvox, test setup fully anechoic chamber
 171626_q.JPG: Barryvox, test setup fully anechoic chamber
 171626_h.JPG: Barryvox, test setup outdoor test site

Annex B External photographs 5 pages

171626_12.JPG: Barryvox, 3-D-view 1
 171626_13.JPG: Barryvox, 3-D-view 2
 171626_14.JPG: Barryvox, rear view
 171626_15.JPG: Barryvox, rear view, battery cover removed
 171626_16.JPG: Barryvox, rear view, batteries removed

Annex C Internal photographs 6 pages

171626_18.JPG: Barryvox, internal view 1
 171626_19.JPG: Barryvox, internal view 2 (housing removed)
 171626_21.JPG: Barryvox, internal view 3 (display removed)
 171626_22.JPG: Barryvox, PCB, top view
 171626_23.JPG: Barryvox, PCB, top view, shielding removed
 171626_24.JPG: Barryvox, PCB, bottom view