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Report:	<b><i>Electromagnetic Compatibility</i></b>	Report no:	<b><i>18-EL-0507.E01</i></b>
Test item description:	<b><i>Wireless GPS Tracker</i></b>	Date of test:	<b><i>June 21, 2019</i></b>
Applicant:	<b><i>Nexiot AG Hardstrasse 201 8005 Zürich SWITZERLAND</i></b>	Model/Type reference:	<b><i>Globehopper Crossmodal Ex 2.0</i></b>
Manufacturer:	<b><i>Nexiot AG Hardstrasse 201 8005 Zürich SWITZERLAND</i></b>	Serial no:	<b><i>2019/000039734</i></b>

Standards		Result
<b>EN 50121-3-2:2015 IEC 62236-3-2:2008</b>	Railway applications - EMC - Part 3-2: Rolling stock - Apparatus	<b>Pass</b>
<b>EN 55024:2010 + A1 CISPR 24:2010 CISPR 24:2010/AMD1:2015</b>	Information technology equipment - Immunity characteristics - Limits and methods of measurement	<b>Pass</b>
<b>EN 55035:2017 CISPR 35:2016</b>	Electromagnetic compatibility of multimedia equipment - Immunity requirements	<b>Pass</b>
<b>EN 61000-6-2:2005 IEC 61000-6-2:2016</b>	EMC - Part 6-2: Generic standards - Immunity for industrial environments	<b>Pass</b>
<b>EN 301 489-1 V1.9.2</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 1: Common technical requirements	<b>Pass</b>
<b>DRAFT EN 301 489-1 V2.2.0</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1 (b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU	<b>Pass</b>
<b>EN 301 489-3 V1.6.1</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz	<b>Pass</b>
<b>EN 301 489-7 V1.3.1</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)	<b>Pass</b>
<b>EN 301 489-17 V2.2.1</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment; Part 17: Specific conditions for Broadband Data Transmission Systems	<b>Pass</b>

The EUT fulfils the requirements of the above mentioned standards without any modifications.

Test performed by  
*Mr. Daniel Rufer*  
EMC Test-Engineer



Reviewed by  
*Mr. Andreas Foster*  
EMC Test-Engineer



Zürich, 2019-07-11

(Issue Date)

The present document results from tests on one specimen and does not prejudice to the conformity of all the manufactured products.

## Contents

	Page
1. SUMMARY OF TEST RESULTS (EN 50121-3-2 / IEC 62236-3-2) .....	4
2. SUMMARY OF TEST RESULTS (EN/IEC 61000-6-2/4) .....	4
3. SUMMARY OF TEST RESULTS (EN 55024/CISPR 24 & EN 55035/CISPR 35) .....	5
4. SUMMARY OF TEST RESULTS (EN 301 489-X) .....	6
5. APPLIED STANDARDS .....	7
6. APPLICANT .....	8
7. EQUIPMENT UNDER TEST .....	8
7.1 Identification .....	8
7.2 Pictures of the EUT .....	9
7.3 Classification .....	9
7.4 Ports .....	9
8. TEST CONDITIONS .....	10
8.1 Climatic conditions, location and date .....	10
8.2 Attendant Persons .....	10
8.3 Test Configuration / Operating Conditions .....	11
8.4 Monitoring of the EUT .....	11
8.5 Auxiliary Equipment .....	11
8.6 Performance Criteria .....	11
9. EMISSION TESTS .....	12
9.1 Radiated Electromagnetic Field (30 – 1000 MHz) .....	12
9.2 Radiated Electromagnetic Field (1 – 6 GHz) .....	16
10. IMMUNITY TESTS .....	20
10.1 Immunity to Electrostatic Discharge (ESD) (EN 61000-4-2) .....	20
10.2 Immunity to Electromagnetic Fields (EN 61000-4-3) .....	23
11. MEASUREMENT UNCERTAINTY .....	27

## 1. Summary of Test Results (EN 50121-3-2 / IEC 62236-3-2)

§	Test Type		Result
<b>9</b>	<b>Emission</b>		<b>EN 50121-3-2 IEC 62236-3-2</b>
--	Interference voltage	EN 55011 CISPR 11	<b>Not applicable</b> <sup>1</sup>
9.1	Radiated electromagnetic field	EN 55011 CISPR 11	<b>PASS</b>
<b>10</b>	<b>Immunity</b>		<b>EN 50121-3-2 IEC 62236-3-2</b>
10.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
10.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
--	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	<b>Not applicable</b> <sup>1</sup>
--	Surges	EN 61000-4-5 IEC 61000-4-5	<b>Not applicable</b> <sup>1</sup>
--	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	<b>Not applicable</b> <sup>1</sup>

1. EUT has no ports (cables)

## 2. Summary of Test Results (EN/IEC 61000-6-2/4)

§	Test Type		Result
<b>10</b>	<b>Immunity</b>		<b>EN/IEC 61000-6-2</b>
10.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
10.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
--	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	<b>Not applicable</b> <sup>1</sup>
--	Surges	EN 61000-4-5 IEC 61000-4-5	<b>Not applicable</b> <sup>1</sup>
--	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	<b>Not applicable</b> <sup>1</sup>
--	Magnetic fields (industrial frequencies)	EN 61000-4-8 IEC 61000-4-8	<b>Not applicable</b> <sup>2</sup>
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	<b>Not applicable</b> <sup>1</sup>

1. EUT has no ports (cables)
2. Does not contain any devices susceptible to magnetic fields.

### 3. Summary of Test Results (EN 55024/CISPR 24 & EN 55035/CISPR 35)

§	Test Type		Result
<b>10</b>	<b>Immunity</b>		<b>EN 55024 CISPR 24</b>
10.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
10.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
--	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	<b>Not applicable</b> <sup>1</sup>
--	Surges	EN 61000-4-5 IEC 61000-4-5	<b>Not applicable</b> <sup>1</sup>
--	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	<b>Not applicable</b> <sup>1</sup>
--	Magnetic fields (industrial frequencies)	EN 61000-4-8 IEC 61000-4-8	<b>Not applicable</b> <sup>2</sup>
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	<b>Not applicable</b> <sup>1</sup>
<b>10</b>	<b>Immunity</b>		<b>EN 55035 CISPR 35</b>
10.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
10.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
--	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	<b>Not applicable</b> <sup>1</sup>
--	Surges	EN 61000-4-5 IEC 61000-4-5	<b>Not applicable</b> <sup>1</sup>
--	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	<b>Not applicable</b> <sup>1</sup>
--	Magnetic fields (industrial frequencies)	EN 61000-4-8 IEC 61000-4-8	<b>Not applicable</b> <sup>2</sup>
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	<b>Not applicable</b> <sup>1</sup>

1. EUT has no ports (cables)
2. Does not contain any devices susceptible to magnetic fields.

#### 4. Summary of Test Results (EN 301 489-X)

The EUT contains CE approved radio modules. The modules have been tested by the radio manufacturer and were found to comply with the applicable RADIO ETSI standards 301 489-X.

§	Test Type	Result
<b>9</b>	<b>Emission</b>	<b>EN 301 489-x</b>
--	Interference voltage EN 55032 CISPR 32	Not applicable <sup>1</sup>
--	Common mode at telecom. ports EN 55032 CISPR 32	Not applicable <sup>1</sup>
9.1	Radiated electromagnetic field EN 55032 CISPR 32	<b>PASS</b>
--	Harmonics EN 61000-3-2 IEC 61000-3-2	Not applicable <sup>1</sup>
--	Voltage fluctuations (flicker) EN 61000-3-3 IEC 61000-3-3	Not applicable <sup>1</sup>
<b>10</b>	<b>Immunity</b>	<b>EN 301 489-x</b>
10.1	Electrostatic discharges EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
10.2	Electromagnetic fields EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
--	Fast electric transients (Burst) EN 61000-4-4 IEC 61000-4-4	Not applicable <sup>1</sup>
--	Surges EN 61000-4-5 IEC 61000-4-5	Not applicable <sup>1</sup>
--	Radio frequency common mode EN 61000-4-6 IEC 61000-4-6	Not applicable <sup>1</sup>
--	Voltage dips and interruptions EN 61000-4-11 IEC 61000-4-11	Not applicable <sup>1</sup>
--	Automotive pulses ISO 7637-1 ISO 7637-2	Not applicable <sup>2</sup>

1. EUT has no ports (cables)
2. Not provided for vehicular use.

## 5. Applied Standards

EN 50121-3-2:2016 IEC 62236-3-2:2018	Railway applications – Electromagnetic compatibility Part 3-2: Rolling stock – Apparatus
EN 55011:2016 CISPR 11:2015	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement
EN 55022:2010 CISPR 22:2008	Information technology equipment Radio disturbance characteristics – Limits and methods of measurement
EN 55032:2015 CISPR 32:2015	Electromagnetic compatibility of multimedia equipment - Emission requirements
EN 55024:2010 + A1: 2015 CISPR 24:2010 CISPR 24:2010/AMD1:2015	Information technology equipment Immunity characteristics – Limits and methods of measurement
EN 55035:2017 CISPR 35:2016	Electromagnetic compatibility of multimedia equipment - Immunity requirements
EN 55016-2-1:2014 CISPR 16-2-1:2014	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements
EN 55016-2-3:2010 CISPR 16-2-3:2010	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements
EN 61000-4-2:2009 IEC 61000-4-2:2008	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
EN 61000-4-3:2006 + A1: 2008 + A2: 2010 IEC 61000-4-3:2006 IEC 61000-4-3:2006/AMD2:2010	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4:2012 IEC 61000-4-4:2012	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
EN 61000-4-5:2014 IEC 61000-4-5:2014	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
EN 61000-4-6:2014 IEC 61000-4-6:2013	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-6-2:2005 IEC 61000-6-2:2016	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 301 489-1 V1.9.2:2011	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 1: Common technical requirements
DRAFT EN 301 489-1 V2.2.0	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1 (b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU
EN 301 489-7 V1.3.1:2005	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
EN 301 489-17 V2.2.1:2012	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment; Part 17: Specific conditions for Broadband Data Transmission Systems

## 6. Applicant

<i>Client name and address</i>	Nexiot AG Hardstrasse 201 8005 Zürich SWITZERLAND
<i>Contact Person</i>	Mr. Samuel Brügger
<i>Telephone</i>	+41 44 275 51 51
<i>E-mail</i>	samuel.bruegger@nexiot.ch

## 7. Equipment Under Test

### 7.1 Identification

<i>Manufacturer name and address</i>	Nexiot AG Hardstrasse 201 8005 Zürich
<i>Production country</i>	SWITZERLAND
<i>Test item description</i>	Wireless GPS Tracker
<i>Model/type reference</i>	Globehopper Crossmodal Ex 2.0
<i>Serial number</i>	2019/000039734
<i>Hardware identification</i>	AX.2A
<i>Software version</i>	EMC_test
<i>Highest frequency</i>	20 MHz
<i>Supply</i>	Li-Ion secondary battery (3.7 V, 26.8 Ah) and solar panel (1.8 W max.)
<i>Dimension</i>	364 mm x 108 mm x 48 mm (l x w x h)
<i>Weight</i>	1.5 kg
<i>Technical documentation</i>	None. The equipment is completely identified by the above-mentioned information. Nexiot AG assures the traceability of the documentation and is responsible for the product identification.



### 7.2 Pictures of the EUT



### 7.3 Classification

EN 50121-3-2 IEC 62236-3-2	<input checked="" type="checkbox"/> Mounted in the passenger compartments, drivers cab or external to the rolling stock (roof, underframe) <input type="checkbox"/> Accessible to passengers and operational staff (not maintenance) <input type="checkbox"/> If the highest internal frequency of the EUT is less than 108 MHz, the measurement shall only be made up to 1 GHz. <input checked="" type="checkbox"/> If the highest internal frequency of the EUT is 800 MHz, the measurement shall be made up to 6 GHz.
EN 301 489	<input type="checkbox"/> Radio and ancillary equipment for fixed use (e.g. base station equipment) <input checked="" type="checkbox"/> Radio and ancillary equipment for vehicular use (e.g. mobile equipment) <input type="checkbox"/> Radio and ancillary equipment for portable use (portable equipment) <input type="checkbox"/> Ancillary equipment

### 7.4 Ports

Port No.	Name	Type*	Cable length	Cable Shielded	Comments
0	Enclosure	N/E	--	--	Plastic enclosure
EUT has no ports					

\*Note: AC = AC Power Port DC = DC Power Port N/E = Non-Electrical  
 I/O = Signal Input or Output Port (Involved in Process Control)  
 TP = Telecommunication Ports

## 8. Test Conditions

### 8.1 Climatic conditions, location and date

Location	Date	Temp	Pressure [QFE]	Rel. humidity
Eurofins Electrosuisse Product Testing AG, Albisriederstrasse 199 8047 Zürich SWITZERLAND	June 21, 2019	25 ± 3 °C	980 ± 30 hPa	40 ± 5 %

### 8.2 Attendant Persons

#### Test Engineer(s):

Mr. Daniel Rufer
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#### Other(s):

Name	Company
Mr. Samuel Brügger	Nexiot AG

### 8.3 Test Configuration / Operating Conditions

The EUT has no cables, it is powered via internal battery.

A connection to the EUT has been established with the communication tester CMU 200. The CMU 200 has been placed outside the chamber. To establish the connection a LogPer Antenna (H9719) was used.

Emission has been measured with battery mode and charging mode. To charge the internal battery a halogen lamp has been used, which has been put in front of the EUT.

### 8.4 Monitoring of the EUT

The performance of the EUT during the test has been monitored with the CMU 200 Communication Tester.

### 8.5 Auxiliary Equipment

The following pieces of equipment are used for the monitoring of the EUT or are necessary for the EUT but they are not part of the EUT.

Product	Brand	Model No.	ID	Remarks
Radio Communication Tester	Rohde & Schwarz	CMU 200	SN: 839005/023	Eurofins
LogPer Antenna	Schwarzbeck	USLP9142	H9719	Eurofins
Coaxial Cables	Huber + Suhner	Enviroflex	H9722, H9723	Eurofins
Halogen Lamp 500 W	--	GT2Q-L500	--	Eurofins

### 8.6 Performance Criteria

General requirements:	Requirements according to the EUT:
<b>Criterion A:</b>	
The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed.	Continuous communication with the AE. No interruption of established connection allowed.
<b>Criterion B:</b>	
The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed.	After the test the EUT shall work as described in criterion A
<b>Criterion C:</b>	
Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.	Not applicable

## 9. Emission Tests

### 9.1 Radiated Electromagnetic Field (30 – 1000 MHz)

*Test site:* semi-anechoic chamber (hybrid)

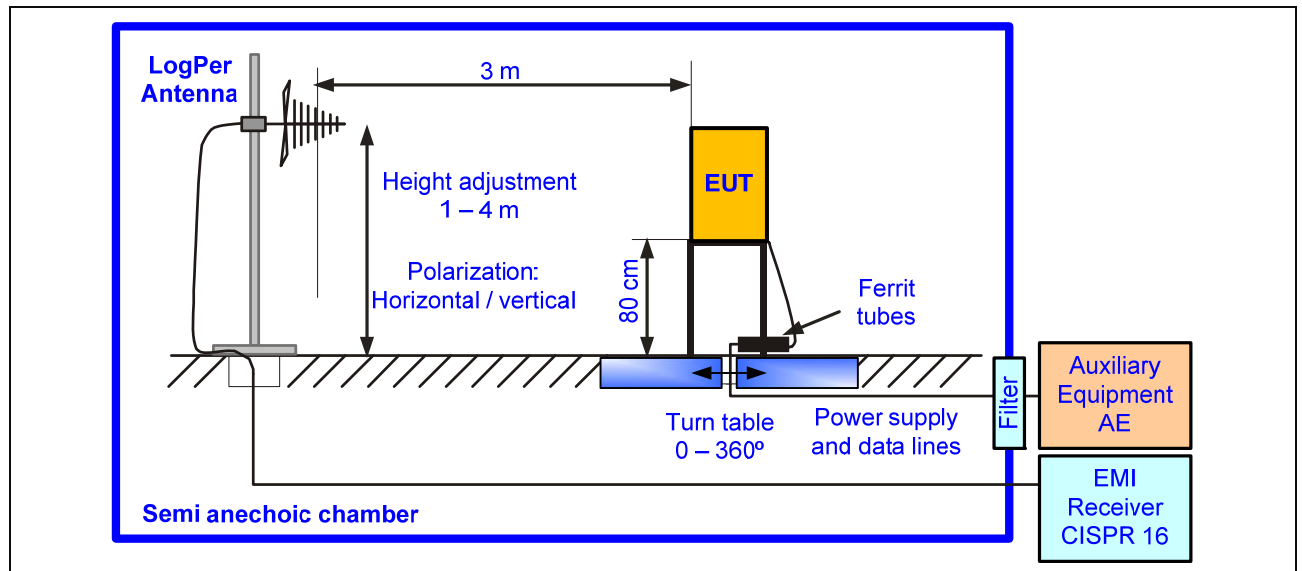
*Distance:* 3 m

*Meas. uncertainty:* see chapter 11

*Measuring method:* The electromagnetic disturbance radiated by the equipment is measured using a EMI receiver and a wide band antenna. The turning table is operated through 360° during the measurements with steps of 30°. The antenna is moved from 1 to 4 m in height with steps of 1 m. The measurements are performed with horizontal and vertical polarizations. The recordings are carried out taking into account the maximum value of all the disturbances appearing while the apparatus is under test. The peak values are recorded continuously. The values exceeding a limit shall be re-measured with the quasi peak detector of the receiver.

*Modifications:* none

#### Test Setup



#### Test Equipment

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESW26	17.6632.05
Antenna LogPer	Chase	CBL 6112A	H8675
Coaxial Cable	Huber & Suhner	Sucoflex 106	17.6632.03, 17.6632.04, 18.6632.02

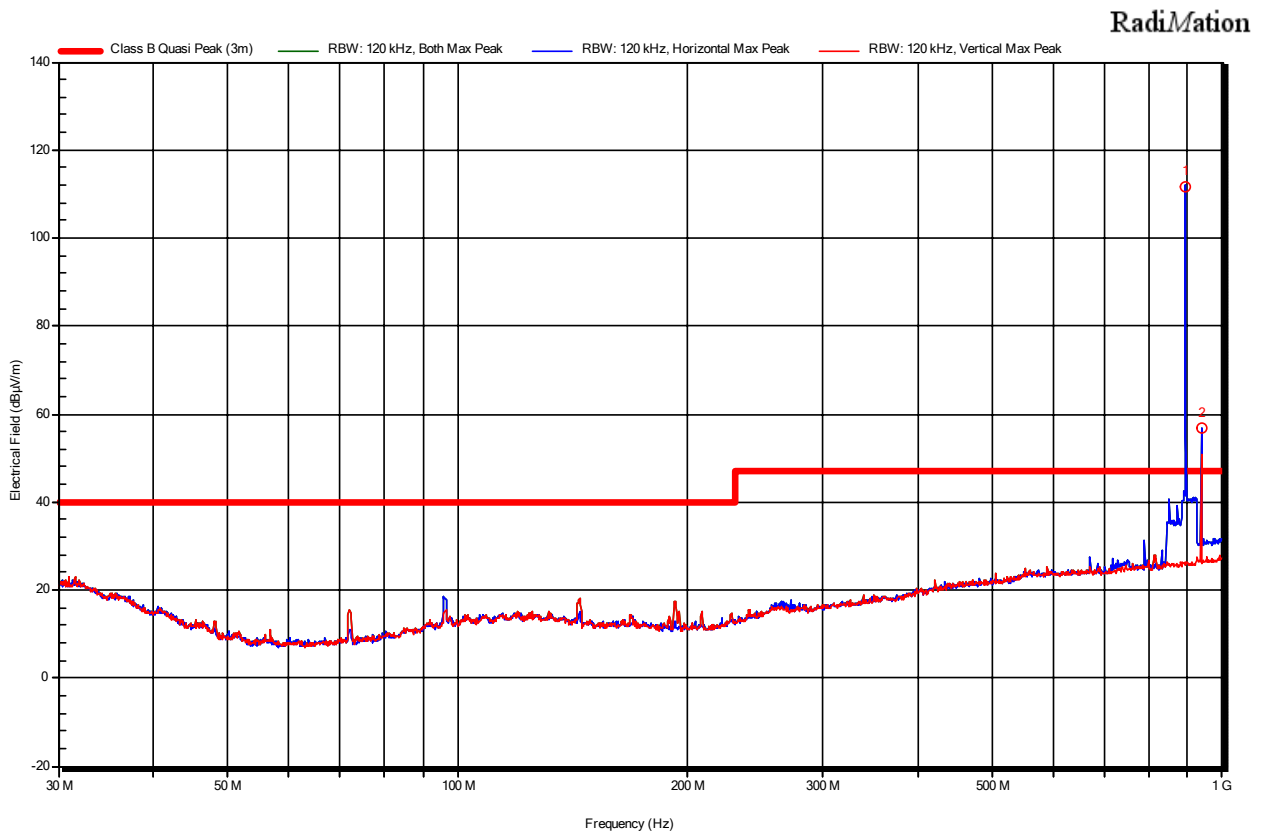
Photos of the Setup



**Measurement Results**

**Diagram 1**

<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode</b>	Connection with CMU Battery-mode		
<b>Test date, time</b>	21.06.2019 13:21:44		
<b>Antenna height</b>	1 m - 2 m with 2 steps	<b>Antenna polarization</b>	Horizontal/Vertical
<b>EUT position</b>	0 degrees to 360 degrees	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2019.1.5, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 20 ms		



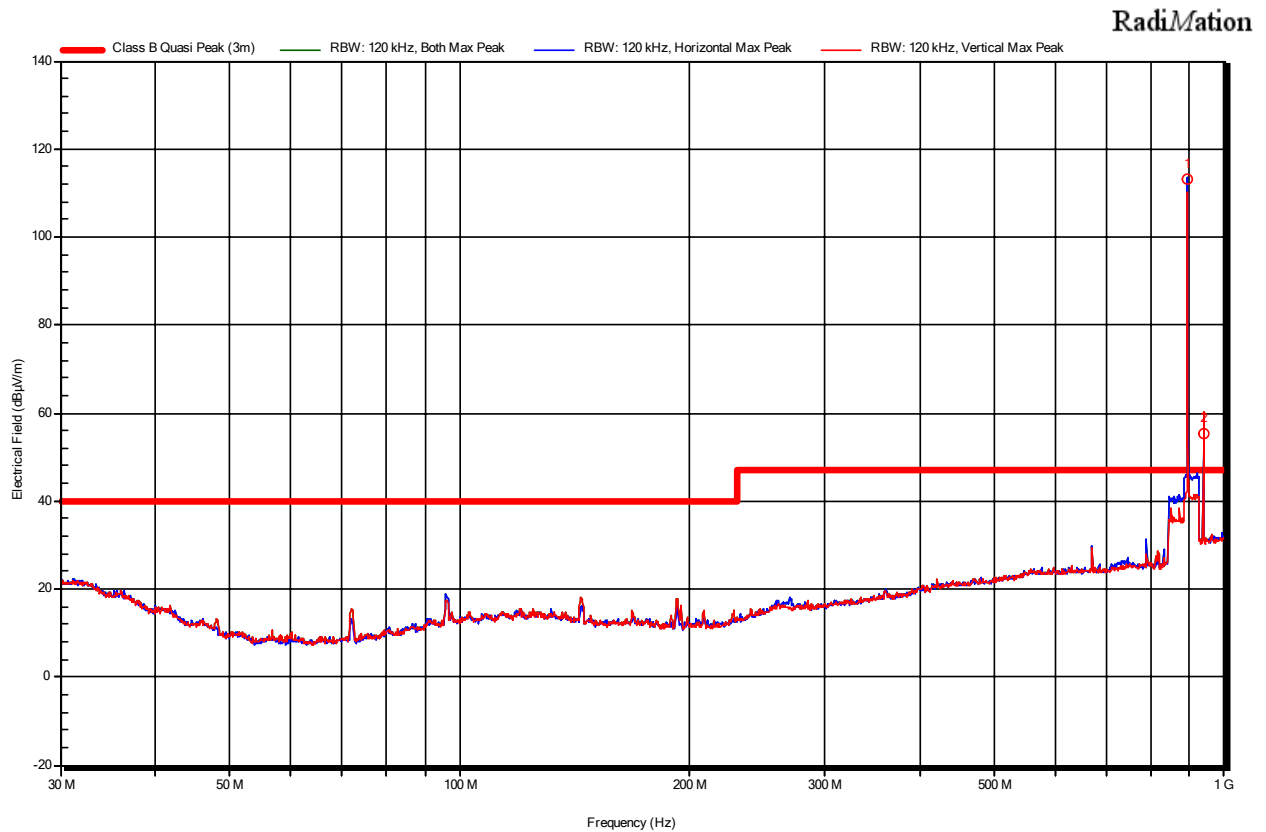
**Detected peaks**

Peak Number	Frequency	Peak	Angle	Height	Polarization
1	894 MHz	111.8 dBµV/m	30 degrees	1 m	Horizontal
2	938.01 MHz	56.7 dBµV/m	330 degrees	1 m	Horizontal

Note: Peak 1 & 2: Exclusion band according ETSI EN 301 489-7 applies

Diagram 2

<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode</b>	Connection with CMU charging (Halogen lamp on table)		
<b>Test date, time</b>	21.06.2019 13:42:03		
<b>Antenna height</b>	1 m - 4 m with 4 steps	<b>Antenna polarization</b>	Horizontal/Vertical
<b>EUT position</b>	0 degrees to 360 degrees	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2019.1.5, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 20 ms		



Detected peaks

Peak Number	Frequency	Peak	Angle	Height	Polarization
1	894 MHz	113.3 dBµV/m	210 degrees	2 m	Horizontal
2	939 MHz	55.2 dBµV/m	150 degrees	4 m	Horizontal

Note: Peak 1 & 2: Exclusion band according ETSI EN 301 489-7 applies

## 9.2 Radiated Electromagnetic Field (1 – 6 GHz)

*Test site:* semi-anechoic chamber (hybrid)

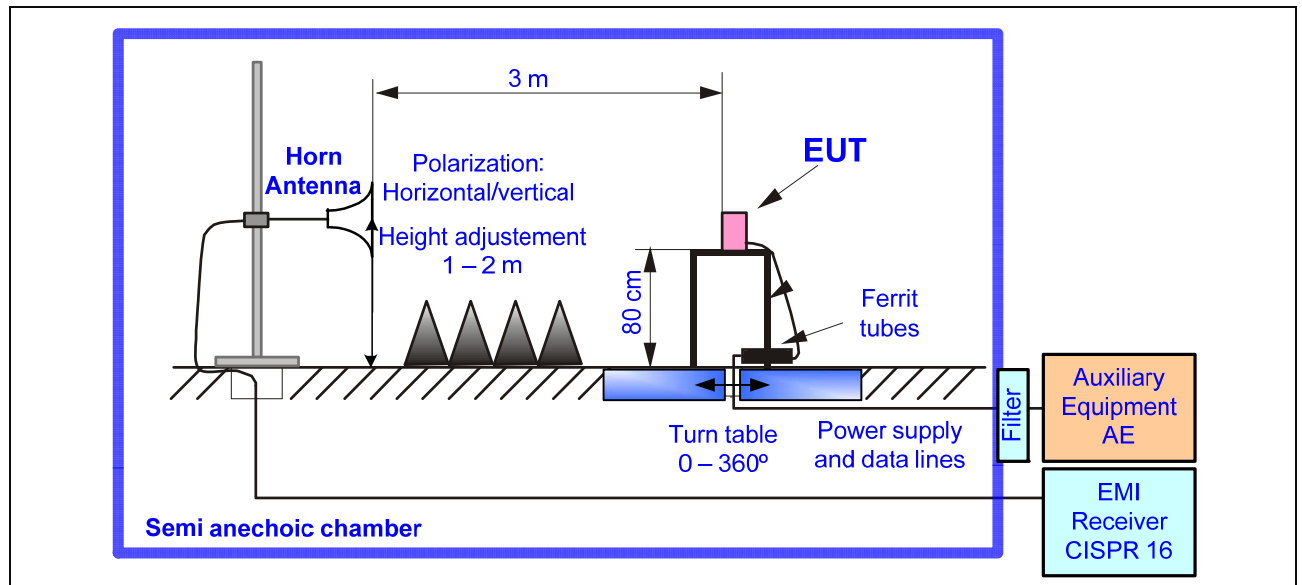
*Distance:* 3 m

*Meas. uncertainty:* see chapter 11

*Measuring method:* The electromagnetic disturbance radiated by the equipment is measured using a EMI receiver and a wide band antenna. The turning table is operated through 360° during the measurements with steps of 30°. The measurements are performed with horizontal and vertical polarizations.

*Modifications:* none

### Test Setup



### Test Equipment

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESW26	17.6632.05
Horn Antenna	EMCO	3115	H9353
Coaxial Cable	Huber & Suhner	Sucoflex 106	17.6632.03, 17.6632.04, 18.6632.02



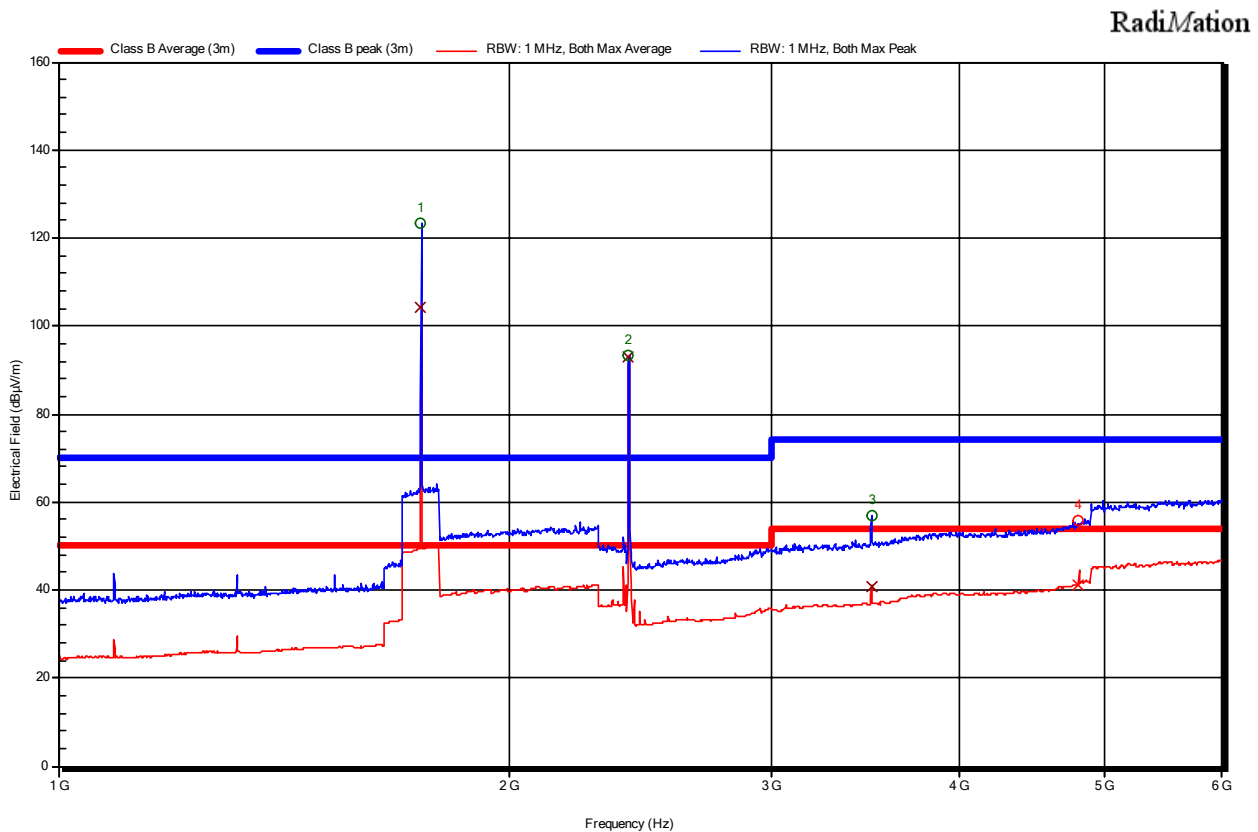
Photos of the Setup



Measurement Results

Diagram 3

<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode</b>	Connection with CMU Battery-mode		
<b>Test date, time</b>	21.06.2019 12:43:45		
<b>Antenna height</b>	1 m	<b>Antenna polarization</b>	Horizontal/Vertical
<b>EUT position</b>	0 degrees to 360 degrees	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2019.1.5, RBW: 1 MHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 250 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 20 ms		



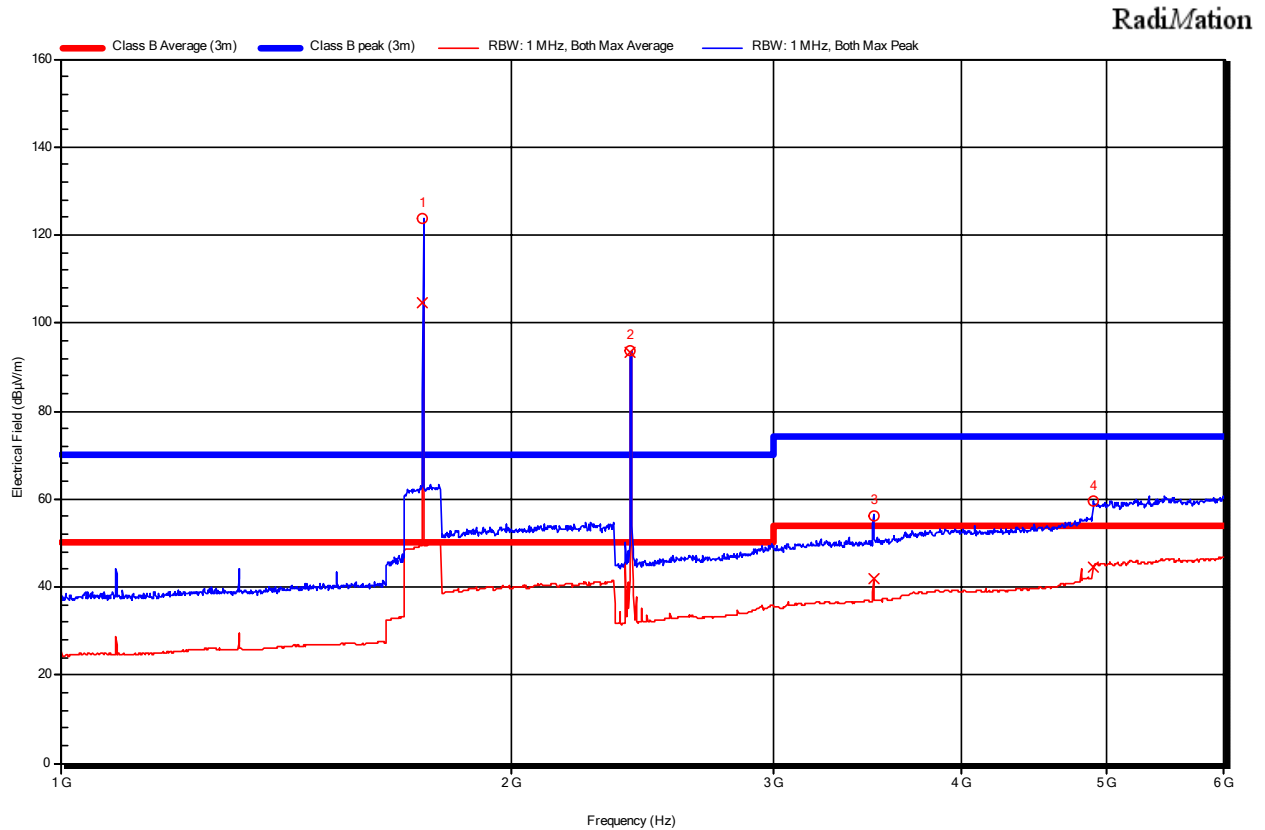
Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Polarization
1	1.748 GHz	123.5 dBµV/m	53.5 dB	104.1 dBµV/m	54.1 dB	Note	240 degrees	Vertical
2	2.406 GHz	93.3 dBµV/m	23.3 dB	93 dBµV/m	43.0 dB	Note	270 degrees	Vertical
3	3.495 GHz	56.8 dBµV/m	-17.2 dB	40.8 dBµV/m	-13.2 dB	Pass	60 degrees	Horizontal
4	4.811 GHz	55.7 dBµV/m	-18.3 dB	41.1 dBµV/m	-12.9 dB	Pass	90 degrees	Vertical

Note: Peak 1 & 2: Exclusion band according ETSI EN 301 489-7 applies

Diagram 4

<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode</b>	Connection with CMU charging (Halogen lamp on table)		
<b>Test date, time</b>	21.06.2019 12:38:15		
<b>Antenna height</b>	1 m	<b>Antenna polarization</b>	Horizontal/Vertical
<b>EUT position</b>	0 degrees to 360 degrees	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2019.1.5, RBW: 1 MHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 250 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 20 ms		



Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Polarization
1	1.748 GHz	123.9 dBµV/m	53.9 dB	104.5 dBµV/m	54.5 dB	Note	240 degrees	Vertical
2	2.406 GHz	93.6 dBµV/m	23.6 dB	93.2 dBµV/m	43.2 dB	Note	270 degrees	Vertical
3	3.495 GHz	56.3 dBµV/m	-17.7 dB	41.8 dBµV/m	-12.2 dB	Pass	60 degrees	Horizontal
4	4.903 GHz	59.4 dBµV/m	-14.6 dB	44.7 dBµV/m	-9.3 dB	Pass	330 degrees	Horizontal

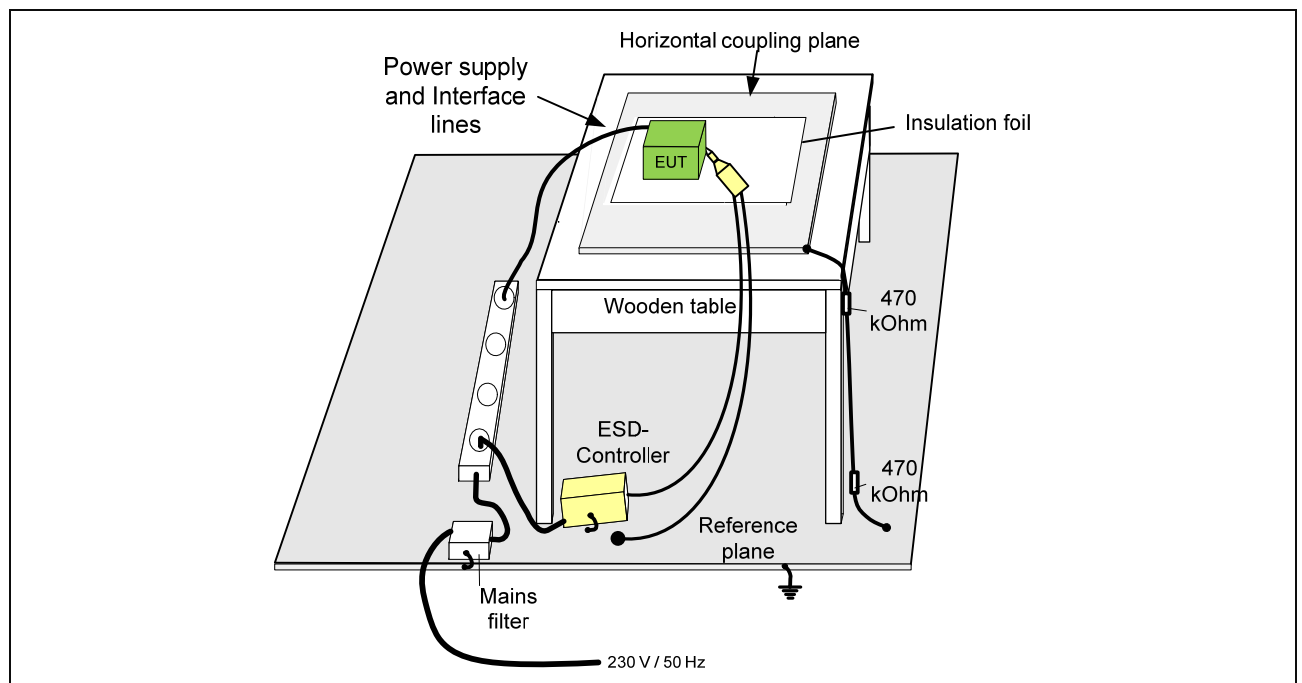
Note: Peak 1 & 2: Exclusion band according ETSI EN 301 489-7/-17 applies

## 10. Immunity Tests

### 10.1 Immunity to Electrostatic Discharge (ESD) (EN 61000-4-2)

- Introduction:** The aim of this test is to determine the reaction of the material to electrostatic discharges (ESD) produced for example by walking on a carpet made of synthetic fiber. The humidity of the air has an influence on the discharge time and therefore on the severity of the discharge that could appear.
- Coupling:** 150 pF / 330 Ohm
- Meas. uncertainty:** see chapter 11
- Test method:** All the points accessible to the operator are tested successively. Contact discharges are carried out on conducting surfaces as well as indirect discharges on a vertical or horizontal coupling plane. Air discharges are carried out on insulated surfaces. A minimum of 10 discharges for each voltage level and polarity are applied to each test point.

#### Test Setup



#### Test Equipment

Device Type	Brand	Type	ID
ESD Generator	EM-Test	ESD N30	PE10238

Photos of the Setup



**Test Results**

*Operating mode:* see chapter 8.3  
*Observation of EUT:* see chapter 8.4  
*Modifications:* none  
*Test site:* laboratory

**Requirements**

Standard	Required Level Air Discharge	Required Level Contact Discharge	Impulses per Point, Level and Polarity	Performance Criterion
EN 50121-3-2 IEC 62236-3-2	±8 kV	±6 kV	10	B
EN 61000-6-2 IEC 61000-6-2	±8 kV	±4 kV	10	B
EN 55024 CISPR 24	±8 kV	±4 kV	25	B
EN 55035 CISPR 35	±8 kV	±4 kV	10	B
EN 301 489-1	±8 kV	±4 kV	10	B

**Protocol of the Test**

Level [kV]	No of discharges (for each level)	Discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
± 6	25	HCP	No errors occurred	A	Pass
± 6	25	Contact	No errors occurred	A	Pass
± 2; ± 4; ± 8	25	Air	No errors occurred	A	Pass
HCP: Horizontal coupling plane, EUT tested on front and backside Tested points: Enclosure, Solar panel, mounting holes					

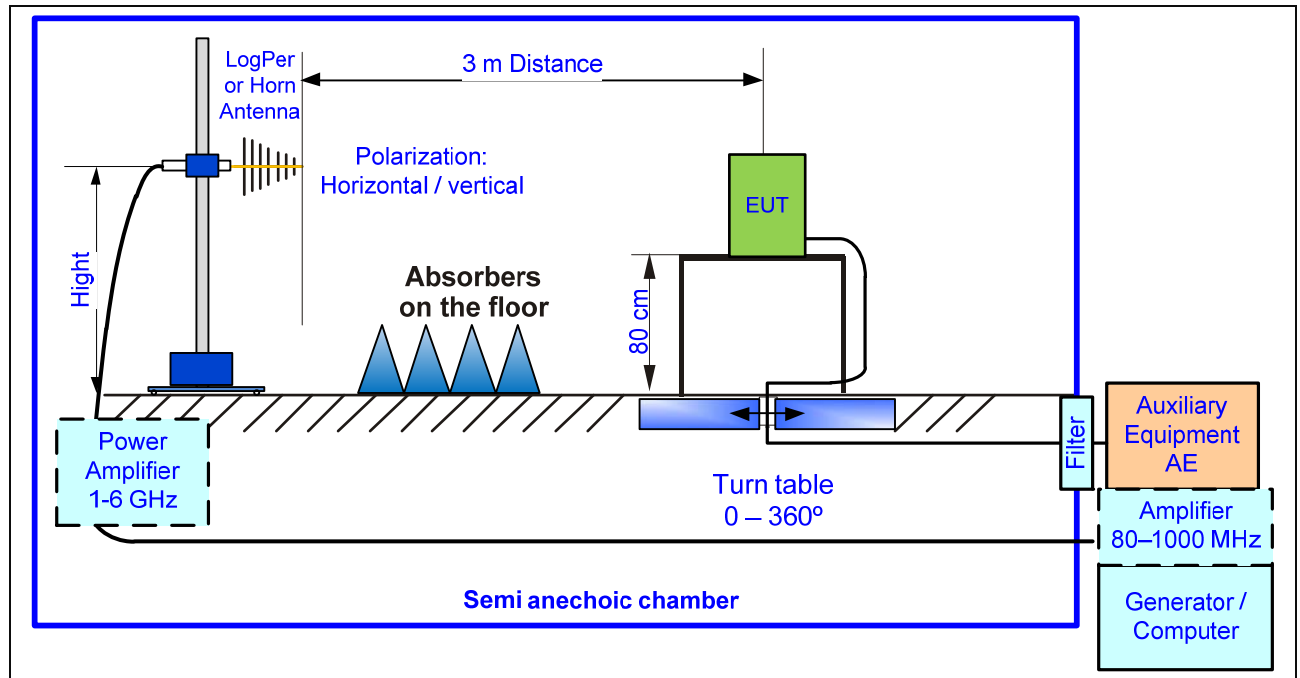
## 10.2 Immunity to Electromagnetic Fields (EN 61000-4-3)

**Introduction:** The aim of this test is to evaluate the performance of the equipment when in the presence of electromagnetic fields created by the transmission of radio or television, by cellular phones or by any other system producing electromagnetic radiation in continuous waves

**Meas. Uncertainty:** see chapter 11

**Test method:** The field is emitted from one or different antennas placed successively in vertical and then in horizontal polarization. The field is calibrated without the EUT using an isotropic probe.

### Test Setup



### Test Equipment

Device Type	Brand	Type	ID
Signal Generator	AnaPico	APSin 6010	13.6632.14
Amplifier 80 – 1000 MHz	Amplifier Research	750W1000	14.6632.04
Amplifier 1 – 6 GHz	Amplifier Research	50S1G6	14.6632.01
Antenna	Amplifier Research	AT 6080	H10192
Field Sensor	Narda S.T.S	EP 601	14.6632.02



Photos of the Setup





**Test Results**

Operating mode: see chapter 8.3  
 Observation of EUT: see chapter 8.4  
 Modifications: none  
 Test site: semi-anechoic chamber (hybrid)

**Requirements**

Standard	Frequency Range	Required Level	Modulation	Freq. step	Dwell time	Performance Criterion
EN 50121-3-2	80 – 1000 MHz	20 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1400 – 2000 MHz	10 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	2000 – 2700 MHz	5 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	5100 – 6000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
IEC 62236-3-2	80 – 1000 MHz	20 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1400 – 2100 MHz	10 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	2100 – 2500 MHz	5 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
EN 55024 CISPR 24	80 – 1000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
EN 55035 CISPR 35	80 – 1000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1800 MHz ± 1%	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	2600 MHz ± 1%					
	3500 MHz ± 1% 5000 MHz ± 1%					
EN 61000-6-2	80 – 1000 MHz	10 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1400 – 2000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	2000 – 2700 MHz	1 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
IEC 61000-6-2	80 – 1000 MHz	10 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1400 – 6000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A

Modulation:

CW     
  AM (normal)     
  AM (const. peak)     
  PM

**Protocol of the Test**

Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	10	horizontal	x-axis	No errors occurred	A	Pass
	10	vertical	x-axis	No errors occurred	A	Pass
	10	horizontal	y-axis	No errors occurred	A	Pass
	10	vertical	y-axis	No errors occurred	A	Pass
	10	horizontal	z-axis	No errors occurred	A	Pass
	10	vertical	z-axis	No errors occurred	A	Pass
1000 – 6000	10	horizontal	x-axis	No errors occurred	A	Pass
	10	vertical	x-axis	No errors occurred	A	Pass
	10	horizontal	y-axis	No errors occurred	A	Pass
	10	vertical	y-axis	No errors occurred	A	Pass
	10	horizontal	z-axis	No errors occurred	A	Pass
	10	vertical	z-axis	No errors occurred	A	Pass

## 11. Measurement Uncertainty

Conducted emission	Estimated uncertainty of the measurement results: (normal distribution, k=2)	MAINS/ DC 150 kHz – 30 MHz	± 3.3 dB
	Maximum uncertainty defined by the standard:		± 3.4 dB
	Estimated uncertainty of the measurement results: (normal distribution, k=2)	Current Clamp 150 kHz – 30 MHz	± 2.7 dB
	Maximum uncertainty defined by the standard:		± 2.9 dB
	Estimated uncertainty of the measurement results: (normal distribution, k=2)	Wire Network ports 150 k – 30 MHz	± 4.9 dB
	Maximum uncertainty defined by the standard:		± 5.0 dB
Radiated emission	Estimated uncertainty of the measurement results for 30 – 200 MHz: (normal distribution, k=2)		± 4.5 dB
	Maximum uncertainty defined by the standard for 200 – 1000 MHz:		± 6.3 dB
	Estimated uncertainty of the measurement results for 200 – 1000 MHz:(normal distribution, k=2)		± 2.7 dB
	Maximum uncertainty defined by the standard for 30 – 200 MHz:		± 6.3 dB
	Estimated uncertainty of the measurement results for 1 – 6 GHz:(normal distribution, k=2)		± 5.1 dB
	Maximum uncertainty defined by the standard for 1 – 6 GHz:		± 5.2 dB
Electrostatic discharge	The measurement uncertainties are within the requirements of EN 61000-4-2 with a confidence level of 95 %.		/
Radiated immunity	The Uncertainty of measurement instrumentation is: (normal distribution, k=2)		± 2.4 dB
Fast transients	The measurement uncertainties are within the requirements of EN 61000-4-4 with a confidence level of 95 %.		/
Conducted radio frequency	The Uncertainty of measurement instrumentation is: (normal distribution, k=2)	CDN	± 1.51 dB
		EM clamp and direct injection	± 3.3 dB
		Current clamp	± 3.4 dB
Slow transients surge	The measurement uncertainties are within the requirements of EN 61000-4-5 with a confidence level of 95 %.		/
Power frequency magnetic field	The uncertainty of the measurement is: (normal distribution)		± 16 %
Voltage dips and interruptions	Output voltage $U_o$ : (normal distribution)		± 9.0 %
	Duration of the voltage interruption $t_e$ : (rectangular distribution)		± 5.0 %
	Phase $\phi_o$ :(rectangular distribution)		± 2.8 %
Voltage fluctuation	Output voltage $U_o$ : (normal distribution)		± 9 %
	Duration of the voltage fluctuation $t_o$ : (rectangular distribution)		± 20 %