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Registration number: **STS 0001**

Schweizerischer Prüfstellendienst  
Service suisse d'essai  
Swiss testing service



FCC Registration No.: **761065**

Report:	<b>Electromagnetic Compatibility</b>	Report no:	<b>17-EL-0434.E02</b>
Test item description:	<b>Router NB1800</b>	Date of test:	<b>April 4 – 6, 2018 August 9, 2018</b>
Applicant:	<b>NetModule AG Meriedweg 11 3172 Niederwangen bei Bern SWITZERLAND</b>	Model/Type reference:	<b>NB1810-LWac4Ep NB1800-LWac</b>
Manufacturer:	<b>NetModule AG Meriedweg 11 3172 Niederwangen bei Bern SWITZERLAND</b>	Serial no:	<b>--</b>
Trade mark:	<b>NETMODULE</b>		

Standards		Result
<b>EN 55032:2015 CISPR 32:2015</b>	Electromagnetic compatibility of multimedia equipment - Emission requirements	<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 61000-6-3:2007 + A1 IEC 61000-6-3:2006 IEC 61000-6-3:2006/AMD1:2010</b>	EMC - Part 6-3: Generic standards - Emission standard for residential, commercial and light-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 301 489-7 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>

<b>EN 301 489-24 V1.5.1</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA and E-UTRA) for Mobile and portable (UE) radio and ancillary equipment	<b>Pass</b>
<b>ETSI EN 301 489-52 V1.1.0 Draft</b>	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication Mobile and portable (UE) radio and ancillary equipment; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU	<b>Pass</b>
<b>CFR 47 Part 15 - B:2016</b>	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"	<b>Pass</b>
<b>ICES-003:2016</b>	Information Technology Equipment (Including Digital Apparatus) - Limits and Methods of Measurement	<b>Pass</b>

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

Result of this test is achieved: with ☒ without ☐ modification of EUT (see modifications of EUT documented § 12 of this report).

Test performed by

*Mr. Daniel Rufer*  
EMC Test-Engineer



Reviewed by

*Mr. Pascal Treichler*  
Head Lab Zürich



Zürich, 2018-08-31

(Issue Date)

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

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## Foreword

This test report has been updated to edition E02 because of some changes in the hardware. The input circuit and 5V regulator has been optimized according to EMC problems.

As the modification only affect the power supply, only the tests related to the supply have been repeated.

## 1. Summary of Test Results (EN/IEC 61000-6-2/3)

§	Test Type		Result
<b>9</b>	<b>Emission</b>		<b>EN/IEC 61000-6-3</b>
9.1	Interference voltage	EN 55016-2-1 CISPR 16-2-1	PASS
9.2	Common mode at telecommunication ports	EN 55022 CISPR 22	PASS
9.3	Radiated electromagnetic field	EN 55016-2-3 CISPR 16-2-3	PASS
--	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/IEC 61000-6-2</b>
10.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	PASS
10.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	PASS
10.3	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	PASS
10.4	Surges	EN 61000-4-5 IEC 61000-4-5	PASS
10.5	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	PASS
--	Magnetic fields (industrial frequencies)	EN 61000-4-8 IEC 61000-4-8	Not applicable <sup>2</sup>
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	Not applicable <sup>1</sup>

1. Powered with 24 VDC, no AC Mains Port

2. Does not contain any devices susceptible to magnetic fields.

## 2. Summary of Test Results (EN 55032 / CISPR 32)

§	Test Type		Result
<b>9</b>	<b>Emission</b>		<b>EN 55032 CISPR 32</b>
--	Conducted Emission from AC Mains Power Ports	EN 55032 CISPR 32	Not applicable <sup>1</sup>
9.2	Conducted Emission from Wired Network Ports	EN 55032 CISPR 32	PASS
9.2	Conducted Emission from Antenna Ports	EN 55032 CISPR 32	PASS
--	Conducted Emission from Opticle Fibre Ports (with metallic shield or tension members)	EN 55032 CISPR 32	Not applicable <sup>1</sup>
9.3	Radiated electromagnetic field	EN 55032 CISPR 32	PASS
--	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 55035 CISPR 35</b>
10.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	PASS
10.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	PASS
10.3	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	PASS
10.4	Surges	EN 61000-4-5 IEC 61000-4-5	PASS
10.5	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	PASS
--	Magnetic fields (industrial frequencies)	EN 61000-4-8 IEC 61000-4-8	Not applicable <sup>2</sup>
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	Not applicable <sup>1</sup>

1. Powered with 24 VDC, no AC Mains Port

2. Does not contain any devices susceptible to magnetic fields.

### 3. Summary of Test Results (FCC / Canada)

§	Test Type		Result
9	Emission		CFR 47 (FCC) ICES-003 (Industry Canada)
9.1	Conducted emission	CFR 47 § 15.107 (Class B) ICES-003 §5.3 (Class B)	PASS
9.5	Radiated emission – EM-field	CFR 47 § 15.109 (Class B) ICES-003 §5.5 (Class B)	PASS

#### 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.

However, during the EMC immunity tests the exclusion bands were considered, see results in the next pages. The Emission tests were carried out in the intended operation mode of the EUT.

§	Test Type		Result
<b>9</b>	<b>Emission</b>		<b>EN 301 489-x</b>
9.1	Interference voltage	EN 55032 CISPR 32	PASS
9.2	Common mode at telecom. ports	EN 55032 CISPR 32	PASS
9.3	Radiated electromagnetic field	EN 55032 CISPR 32	PASS
--	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	PASS
10.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	PASS
10.3	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	PASS
10.4	Surges	EN 61000-4-5 IEC 61000-4-5	PASS
10.5	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	PASS
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	Not applicable <sup>1</sup>

1. Powered with 24 VDC, no AC Mains Port

2. Does not contain any devices susceptible to magnetic fields.

## 5. Applied Standards

EN 55032:2015 CISPR 32:2015	Electromagnetic compatibility of multimedia equipment - Emission requirements
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 61000-6-3:2007 + A1: 2011 IEC 61000-6-3:2006 IEC 61000-6-3:2006/AMD1:2010	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-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 301 489-9 V1.4.1:2007	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 9: Specific conditions for wireless microphones, similar Radio Frequency (RF) audio link equipment, cordless audio and in-ear monitoring devices
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
EN 301 489-24 V1.5.1:2010	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
ETSI EN 301 489-52 V1.1.0 Draft	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication Mobile and portable (UE) radio and ancillary equipment; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
CFR 47 Part 15 Subpart B:2016	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"
ICES-003:2016	Information Technology Equipment (Including Digital Apparatus) - Limits and Methods of Measurement

## 6. Applicant



<i>Client name and address</i>	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern SWITZERLAND
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## 7. Equipment Under Test

### 7.1 Identification

<i>Manufacturer name and address</i>	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern
<i>Production country</i>	SWITZERLAND
<i>Trade mark</i>	NETMODULE
<i>Test item description</i>	Router NB1800
<i>Product description</i>	The EUT is a versatile router for a multiplicity of communication interfaces (wired and radio interfaces)
<i>Model/type reference</i>	EUT 1, EUT 3: NB1810-LWac4Ep EUT 2, EUT 4: NB1800-LWac
<i>Serial number</i>	EUT 1: 00112B01E99A EUT 2: 00112B01E9A3 EUT 3: 00112B020A84 EUT 4: 00112B0230A84
<i>Hardware identification</i>	EUT 1: Mainboard Rev. 2.2 4xETH_PoE Board Rev.2.0 Patch1 EUT 2: Mainboard Rev. 2.2 EUT 3: Mainboard #5 Rev. 2.4 4xETH_PoE Board Rev.2.0 Patch1-3 EUT 4: Mainboard #6 Rev. 2.4
<i>Software version</i>	EUT 1: 0.0.0.0 release date: 2018-03-23 EUT 2: 0.0.0.0 release date: 2018-03-23 EUT 3: 0.0.0.0 release date: 2018-07-24 EUT 4: 0.0.0.0 release date: 2018-07-24
<i>Highest frequency</i>	CPU Clock: 1.33 GHz PCI Express: 2.5 GHz DDR3L SDRAM: 800 MHz USB 2.0: 480 MHz DC/DC Converter (Main): 500 kHz DC/DC converter (Internal): 1.2 MHz
<i>Supply</i>	EUT 1 & 3: 48 VDC / 1.8 A / 87 W EUT 2 & 4: 12 – 48 VDC / 1.7 A / 20 W
<i>Dimension</i>	EUT 1 & 3: 94 x 126 (140 incl. antennas) x 125 (w x h x d) EUT 2 & 4: 61 x 126 (140 incl. antennas) x 125
<i>Weight</i>	EUT 1 & 3: 1.1 kg EUT 2 & 4: 0.75 kg
<i>Technical documentation</i>	None. The equipment is completely identified by the above-mentioned information. NetModule AG assures the traceability of the documentation and is responsible for the product identification.

## 7.2 Product Family

Tested Equipment	Covered Variants	Explanation <sup>1)</sup>
<b>NB1810-LWac4Ep</b> (fully tested)	NB1810-H <sub>1</sub> ...H <sub>n</sub> -S <sub>1</sub> ...S <sub>n</sub>	All covered NB1800 Series variants contain the same Mainboard. They can host up to three communication and other interface extension boards. These extension boards can include a GNSS module. There can be up to 7 antenna connectors. The wireless communication modules applied have been CE and FCC certified in an independent way of the tested equipment.
NB1800-Lwac (partly tested)	NB1800-H <sub>1</sub> ...H <sub>n</sub> -S <sub>1</sub> ...S <sub>n</sub>	<p>Mechanically there are two housing types available. One wide, with order code <b>NB1810-...</b> and one small with order code <b>NB1800-...</b></p> <p>Basically, the difference between NB1810 and NB1800 is, that NB1810 can host a more complex extension board (e.g. '4Ep': 4x Gigabit Ethernet Switch with PoE, ETH 3...ETH 6 in below picture). Both NB1810 and NB1800 can host two simple 'low end' extension boards in slots 'EXT 1' and 'EXT 2' (e.g. digital Ios, various serial interface etc.).</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p><b>NB1810-...</b></p>  </div> <div style="text-align: center;"> <p><b>NB1800-...</b></p>  </div> </div> <p>'H1...Hn' is a sequence of the following letters that identify the communication modules included:</p> <ul style="list-style-type: none"> <li>R: none, router only</li> <li>Ed: 2G = GPRS/EDGE</li> <li>U: 3G+ = 2G+UMTS/HSPA/HSPA+</li> <li>Ub: UMTS / CDMA US</li> <li>L: 4G = 3G+ + LTE</li> <li>La : LTE 450MHz</li> <li>Lb : LTE US</li> <li>Lc: LTE Advanced Asia</li> <li>Ld: LTE Advanced Europe</li> <li>Le: LTE Advanced South America</li> <li>Lf: LTE South America</li> <li>Ca: CDMA450</li> <li>Gr: GSM-R</li> </ul>

		<p>Ga: GNSS Advanced Gd: GNSS Untethered Dead Reckoning W: WLAN a/b/g/n Wac : WiFi a/b/g/n/ac Wt: Bluetooth + BLE Wz: Zigbee Eg: Gigabit Ethernet Ep: Gigabit Ethernet with PoE D: Digital Inputs &amp; Outputs A: Audio in/out C: CAN-bus Sa: RS-485 (on the same module as CAN) I: IBIS-bus Sb: RS-232 (on the same module as IBIS) Da: Data Storage 32 GB Db: Data Storage 64 GB Dc: Data Storage 128 GB Dd: Data Storage 256 GB De: Data Storage 512 GB Df: Data Storage 1 TB ... (more to follow)</p> <p>'S<sub>1</sub>...S<sub>n</sub>' indicate software options activated:</p> <table><tr><td>G</td><td>GPS</td></tr><tr><td>S</td><td>VPN Server</td></tr><tr><td>V</td><td>VoIP Gateway</td></tr><tr><td>Y</td><td>Plain Linux</td></tr><tr><td>Vi</td><td>Virtualisation, LXC</td></tr></table> <p>'O' indicates OEM options, typ. customer brand labeling e.g.:</p> <table><tr><td>TAG</td><td>Tagfinder</td></tr><tr><td>OEMa</td><td>Customer A</td></tr><tr><td>OEMb</td><td>Customer B</td></tr></table> <p><b>The following NB1800 Series variants are currently available or planned. In below order codes, 'NB1810' can be replaced with 'NB1800' as long as all extensions fit into the smaller housing. NB1800 is always a less complex sub-set of NB1810.</b></p> <p><u>Radio Interface Options:</u></p> <table><tr><td>NB1810-L...</td><td>LTE for Europe/Asia</td><td>mPCIe card</td></tr><tr><td>NB1810-2L...</td><td>2x LTE</td><td>2x mPCIe card</td></tr><tr><td>Nb1810-Lwac...</td><td>LTE + WLAN-ac</td><td>2x mPCIe card</td></tr><tr><td>NB1810-Wac...</td><td>WLAN-ac</td><td>1x mPCIe card</td></tr><tr><td>NB1810-2Wac...</td><td>2x WLAN</td><td>2x mPCIe card</td></tr></table> <p>Examples to assembled 2<sup>nd</sup> mPCIe card slot if only one mPCIe slot is used by a radio module:</p> <table><tr><td>NB1810-Lga</td><td>LTE + GNSS Adv.</td></tr><tr><td>NB1810-WacGa</td><td>WLAN-ac +GNSS Adv.</td></tr></table> <p>2<sup>nd</sup> mPCIe slot can be assembled with any other mPCIe card e.g. storage 'Dx' or GNSS Udr 'Gd'.</p> <p>'L' (LTE modem for Europe) above can be replaced with below listed modems:</p> <table><tr><td>NB1810-...Lb...</td><td>LTE modem for North America</td></tr></table>	G	GPS	S	VPN Server	V	VoIP Gateway	Y	Plain Linux	Vi	Virtualisation, LXC	TAG	Tagfinder	OEMa	Customer A	OEMb	Customer B	NB1810-L...	LTE for Europe/Asia	mPCIe card	NB1810-2L...	2x LTE	2x mPCIe card	Nb1810-Lwac...	LTE + WLAN-ac	2x mPCIe card	NB1810-Wac...	WLAN-ac	1x mPCIe card	NB1810-2Wac...	2x WLAN	2x mPCIe card	NB1810-Lga	LTE + GNSS Adv.	NB1810-WacGa	WLAN-ac +GNSS Adv.	NB1810-...Lb...	LTE modem for North America
G	GPS																																						
S	VPN Server																																						
V	VoIP Gateway																																						
Y	Plain Linux																																						
Vi	Virtualisation, LXC																																						
TAG	Tagfinder																																						
OEMa	Customer A																																						
OEMb	Customer B																																						
NB1810-L...	LTE for Europe/Asia	mPCIe card																																					
NB1810-2L...	2x LTE	2x mPCIe card																																					
Nb1810-Lwac...	LTE + WLAN-ac	2x mPCIe card																																					
NB1810-Wac...	WLAN-ac	1x mPCIe card																																					
NB1810-2Wac...	2x WLAN	2x mPCIe card																																					
NB1810-Lga	LTE + GNSS Adv.																																						
NB1810-WacGa	WLAN-ac +GNSS Adv.																																						
NB1810-...Lb...	LTE modem for North America																																						

		<p>NB1810-...Lf...      LTE modem for South America</p> <p>NB1810-...Lc...      LTE Advanced modem for Asia</p> <p>NB1810-...Ld...      LTE Advanced modem for Europe</p> <p>NB1810-...Le...      LTE Advanced modem for South America</p> <p>NB1810-...La...      LTE450MHz</p> <p>NB1810-...Gr...      GSM-R</p> <p>NB1810-...Ca...      CDMA</p> <p><i>'Wac' (WLAN 802.11ac) above can be replaced with below listed Standards:</i></p> <p>NB1810-...W...      WLAN a/b/g/n</p> <p>NB1810-...WWt...      802.11abgn +Bluetooth +BLE</p> <p><u>Storage Options:</u></p> <p>Any order code combination      mPCIe card or SSD</p> <p>NB1810-...Da...      +32 GB Storage</p> <p>NB1810-...Db...      +64 GB Storage</p> <p>NB1810-...Dc...      +128 GB Storage</p> <p>NB1810-...Dd...      +256 GB Storage</p> <p>NB1810-...De...      +512 GB Storage</p> <p>NB1810-...Df...      +1 TB Storage</p> <p><u>GNSS Options:</u></p> <p>Any order code combination      +GNSS (e.g. mPCIe card)</p> <p>NB1810-...Ga...      +GNSS-Adv.</p> <p>NB1810-...Gd...      +GNSS-Udr</p> <p><u>Other Interface Options:</u></p> <p>Any order code combination      Slots 'EXT 1' and 'EXT 2'</p> <p>NB1810-...C...      +CAN</p> <p>NB1810-...2C...      +2xCAN</p> <p>NB1810-...D...      +Digital Inputs &amp; Outputs</p> <p>NB1810-...I...      +IBIS bus</p> <p>NB1810-...S...      +Serial, non-isolated</p> <p>NB1810-...Sa...      +Serial RS485, isolated</p> <p>NB1810-...Sb...      +Serial RS232, isolated</p> <p>NB1810-...Sc...      +RS232/485 combo +I/O</p> <p>...(more to follow)      e.g. 4-wire Serial, multiple or combo interfaces</p> <p><u>Ethernet Switch Options:</u></p> <p><b>NB1810-4Ep</b>      Extension Board with PCIe conn. to Mainboard <b>4x GbE Switch with PoE</b></p> <p>NB1810-Wac4Ep      +WLAN-ac</p> <p>NB1810-2Wac4Ep      +2x WLAN</p> <p>NB1810-L4Ep      +LTE</p> <p>NB1810-2L4Ep      +2x LTE</p> <p><b>NB1810-Lwac4Ep</b>      <b>LTE +WLAN-ac + 4x GbE Switch with PoE</b></p> <p>NB1810-Lda4Ep      +LTE +32GB Storage</p> <p>NB1810-LDb4Ep      +LTE +64GB Storage</p> <p>NB1810-Lga4Ep      +LTE +GNSS-Adv.</p> <p>NB1810-LGd4Ep      +LTE +GNSS-Udr.</p> <p><i>'Ep' above can be replaced with 'E' (Ethernet without PoE), e.g.:</i></p>
--	--	---

		<p>NB1810-...4E...                      4xGbE Switch</p> <p><u>Base-Devices (without radio interfaces)</u></p> <p>NB1810-R                      Wireline</p> <p>NB1810-Ga                      +GNSS-Adv. (uses one of two mPCIe slots)</p> <p>NB1810-Gd                      +GNSS-Udr. (uses one of two mPCIe slots)</p> <p><u>SW Options:</u></p> <p>Add suffix for any SW option, e.g. -Y for plain Linux, -Vi for LX Container</p> <p>Examples:</p> <p>NB1810-Lwac-<b>Y</b></p> <p>NB1810-Lwac-<b>Vi</b></p> <p>NB1810-Lwac-<b>Y</b></p> <p>NB1810-Lwac-<b>Vi</b></p> <p><u>OEM Options:</u></p> <p>Add suffix -TAG, -OEM1, -OEM2 for OEM branding options (logo print), e.g.</p> <p>NB1810-Lwac-<b>TAG</b></p>
--	--	--

1) according to information of the customer and not verified by eurofins

### 7.3 Pictures of the EUT



## 7.4 Classification

EN 55032 CISPR 32	<input type="checkbox"/> Class A (suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes) Such equipment should not be restricted in its sale but the following warning shall be included in the instructions for use: <i>Warning: This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.</i> <input checked="" type="checkbox"/> Class B (suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes) <input type="checkbox"/> The highest frequency of the internal sources of the EUT is less than 108 MHz (measurement shall be made up to 1 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz (measurement shall be made up to 2 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz (measurement shall be made up to 5 GHz). <input checked="" type="checkbox"/> The highest frequency of the internal sources of the EUT is above 1 GHz (measurement shall be made up to 5 times the highest frequency or 6 GHz, whichever is less).
EN 61000-6-3 IEC 61000-6-3	<input type="checkbox"/> The highest frequency of the internal sources of the EUT is less than 108 MHz (measurement shall be made up to 1 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz (measurement shall be made up to 2 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz (measurement shall be made up to 5 GHz). <input checked="" type="checkbox"/> The highest frequency of the internal sources of the EUT is above 1 GHz (measurement shall be made up to 5 times the highest frequency or 6 GHz, whichever is less).
EN 301 489	<input checked="" type="checkbox"/> Radio and ancillary equipment for fixed use (e.g. base station equipment) <input 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
CFR 47 Part 15	<input type="checkbox"/> Unintentional radiator (Subpart B) <input type="checkbox"/> Class A digital device <input checked="" type="checkbox"/> Class B digital device <input type="checkbox"/> The highest frequency of the internal sources of the EUT is less than 108 MHz (measurement shall be made up to 1 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz (measurement shall be made up to 2 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz (measurement shall be made up to 5 GHz). <input checked="" type="checkbox"/> The highest frequency of the internal sources of the EUT is above 1 GHz (measurement shall be made up to 5 times the highest frequency or 40 GHz, whichever is lower).

## 7.5 Ports

Port	Cable length	Cable Shielded	Remarks
Enclosure	--	--	Enclosure can be connected to earth
DC Supply	30 m	No	--
USB	< 3 m	Yes	--
Ethernet 1	< 100 m	Yes	Ethernet ports, can be used for LAN/WAN
Ethernet 3 – 6 (EUT 1 & 3 only)	< 100 m	Yes	Ethernet ports, can be used for LAN/WAN and PoE+ devices (Max. 60 W)
Mobile1	< 30 m	Coaxial	SMA jacks for MIMO LTE antenna
Mobile2	< 30 m	Coaxial	SMA jacks for MIMO LTE antenna
WLAN1	< 30 m	Coaxial	SMA jacks for MIMO WLAN antenna
WLAN2	< 30 m	Coaxial	SMA jacks for MIMO WLAN antenna
RS-232	< 10 m	No	Non-isolated serial RS-232 interface, which can be used for console administration, serial device server or other serial based communication applications.
SFP	--	--	Optical communication

## 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	April 4 to 6, 2018	23 ± 3 °C	980 ± 30 hPa	38 ± 5 %
	August 9, 2018	27 ± 3 °C	980 ± 30 hPa	42 ± 5 %

### 8.2 Test facility and methodology

Conducted and radiated measurements are performed according to the ANSI C63.4 (2014) procedure.

### 8.3 Attendant Persons

#### Test Engineer(s):

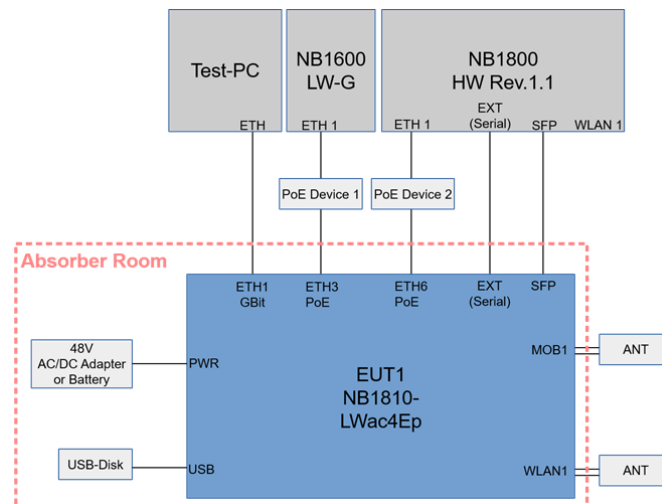
Mr. Daniel Rufer

#### Other(s):

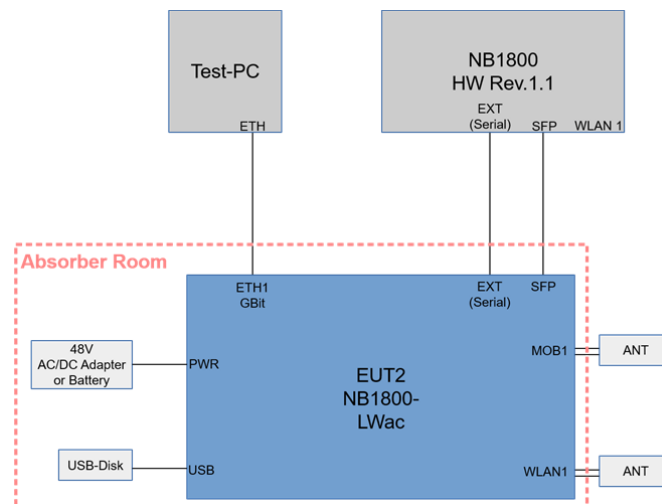
Name	Company
Mr. Alexander Ott	Netmodule AG
Mr. Raffael Rohrer	Netmodule AG

## 8.4 Test Configuration

EUT 1:



EUT 2:



## 8.5 Operating Conditions

Normal mode EUT 1:

- Ping over ETH 1
- Ping over ETH3
- Ping over ETH6
- Ping over WWAN (LTE)
- Ping over WLAN1 (5GHz)
- Ping over SFP
- Ping over serial connection
- Write ping to USB-flash drive
- Added two PoE+ Device (Each 25W)
- Tested at 48 VDC

Normal mode EUT 2:

Same as EUT1 but without PoE+ Devices and without Ping over ETH3 and ETH6

Normal mode EUT 3 & 4:

additional write ping to SD-Card

## 8.6 Monitoring of the EUT

The performance of the EUT during the test is monitored as following:

Monitor of all Ping-Outputs on the Test-PC

## 8.7 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
Batteries (4x 12 VDC)	Panasonic	LC-CA1215P1	Eurofins	Note 1
Test-PC (Notebook)	Dell	--	--	--
WWAN Antenna	--	Antenna-Roof-2L DL-9	--	--
WLAN Antenna	--	Antenna-Roof-2W	--	--
SIM	Swisscom	--	--	--
USB flash drive	Transcend	--	--	16 GB
SFP Module	TP-LINK	TL-SM321BSFP Module	--	--
SFP Module	TP-LINK	TL-SM321B	--	--
Router	NetModule	NB1600	--	LW-G
Router	NetModule	NB1600	--	LWacE (HW V1.1)
PoE+ Device 1	TI	TPS2378EVM-105	--	--
PoE+ Device 1	Linear	DC2093A-B	--	--
SD Card	SanDisk	16 GB	--	--

Notes:

1) Batteries used as power supply unless otherwise described in the appropriate test chapter

## 8.8 Performance Criteria

General requirements:	Requirements according to the EUT:
<p style="text-align: center;"><b>Criterion A:</b></p> <p>The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed.</p>	
<p style="text-align: center;"><b>Criterion B:</b></p> <p>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.</p>	
<p style="text-align: center;"><b>Criterion C:</b></p> <p>Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.</p>	

## 9. Emission Tests

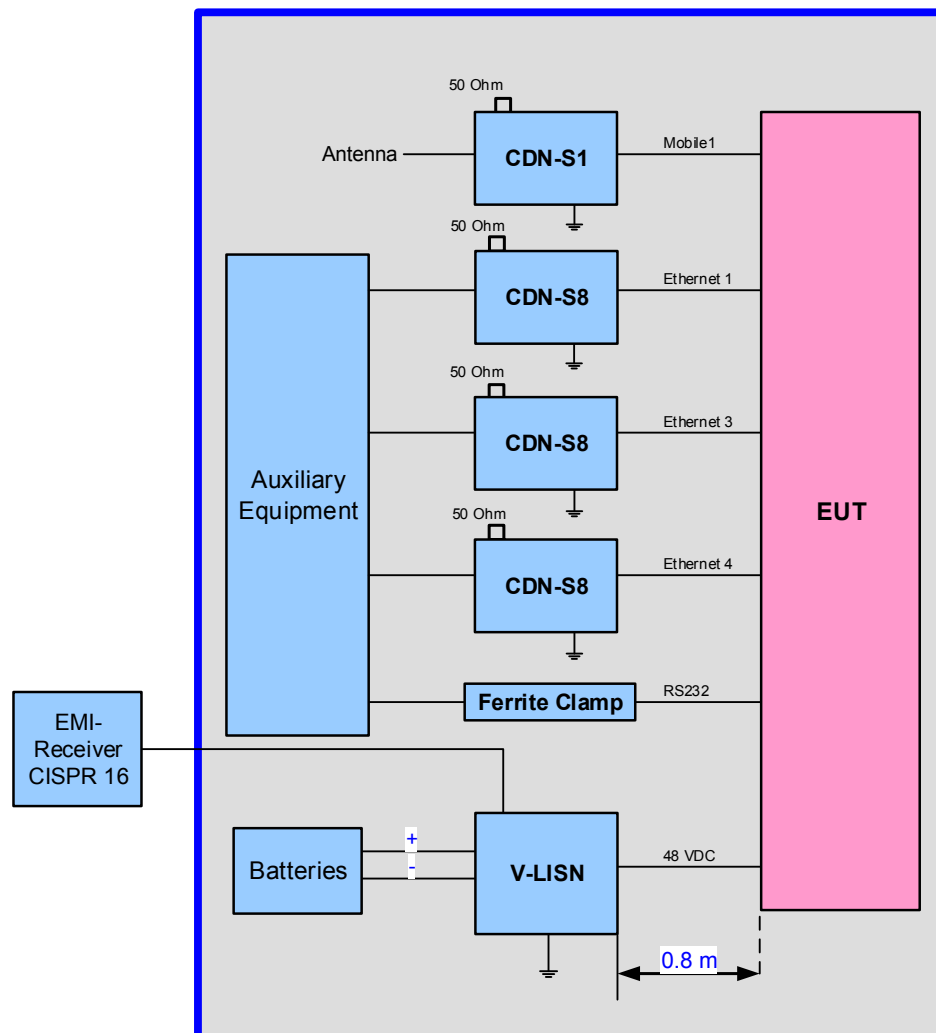
### 9.1 Interference Voltage (V-LISN)

*Test site:* shielded room

*Meas. uncertainty:* see chapter 11

*Measuring method:* The conducted disturbance is measured using a EMI receiver and a line impedance substitution network (LISN). The measurement of the voltage against the earth is carried out successively. The average and quasi peak values are recorded continuously using the EMI receiver in time domain mode.

#### Test Setup

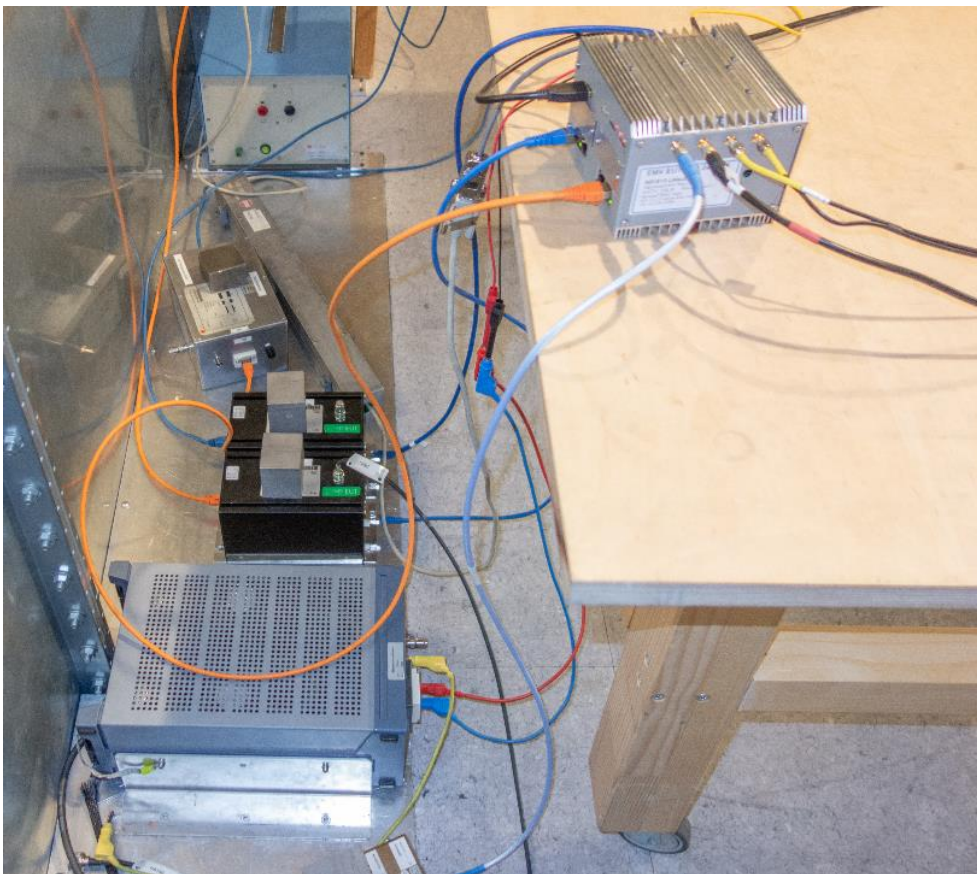


**Test Equipment**

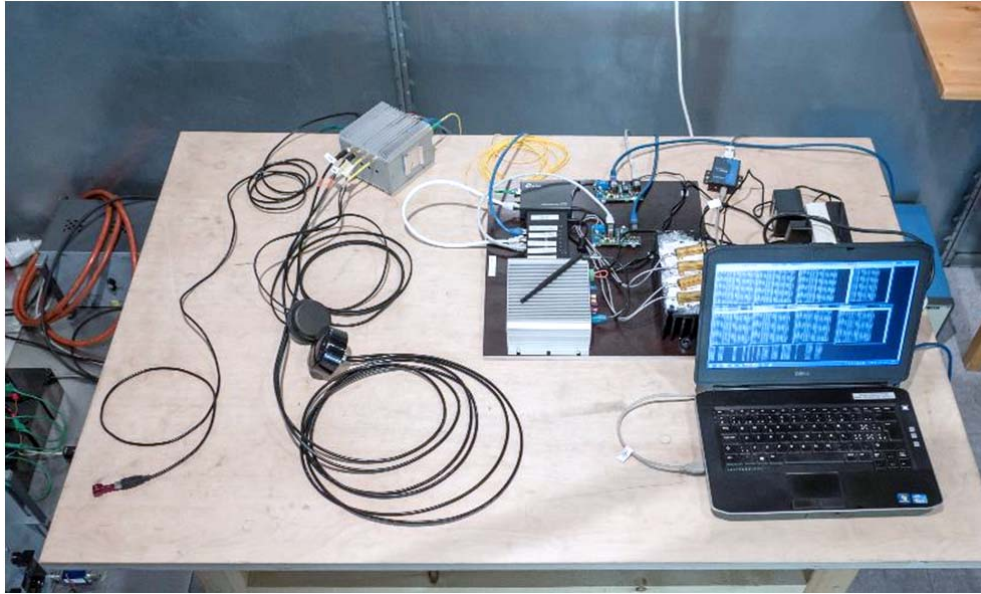
Device Type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU 8	OA10193
V-Network	Rohde & Schwarz	ESH3-Z5	PE7627
CDN	Lüthi	CDN S8 (RJ45)	13.6632.07 13.6632.08
CDN	Lüthi	CDN S1 (coaxial)	H7679
Decoupling device	Marti	TWP 4x2	H10420
Decoupling Clamp	Lüthi	FGZ40X15 E	--
Coaxial Cable	Huber & Suhner	RG223/U	H8002+13.6632.02

**Photos of the Setup**

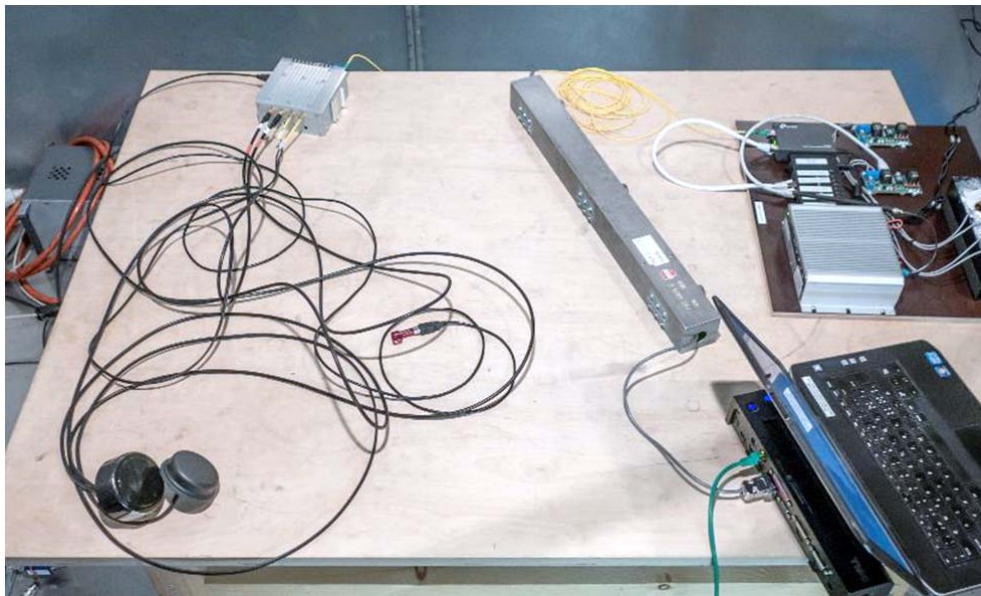
EUT 1:



EUT 3:



EUT 4:

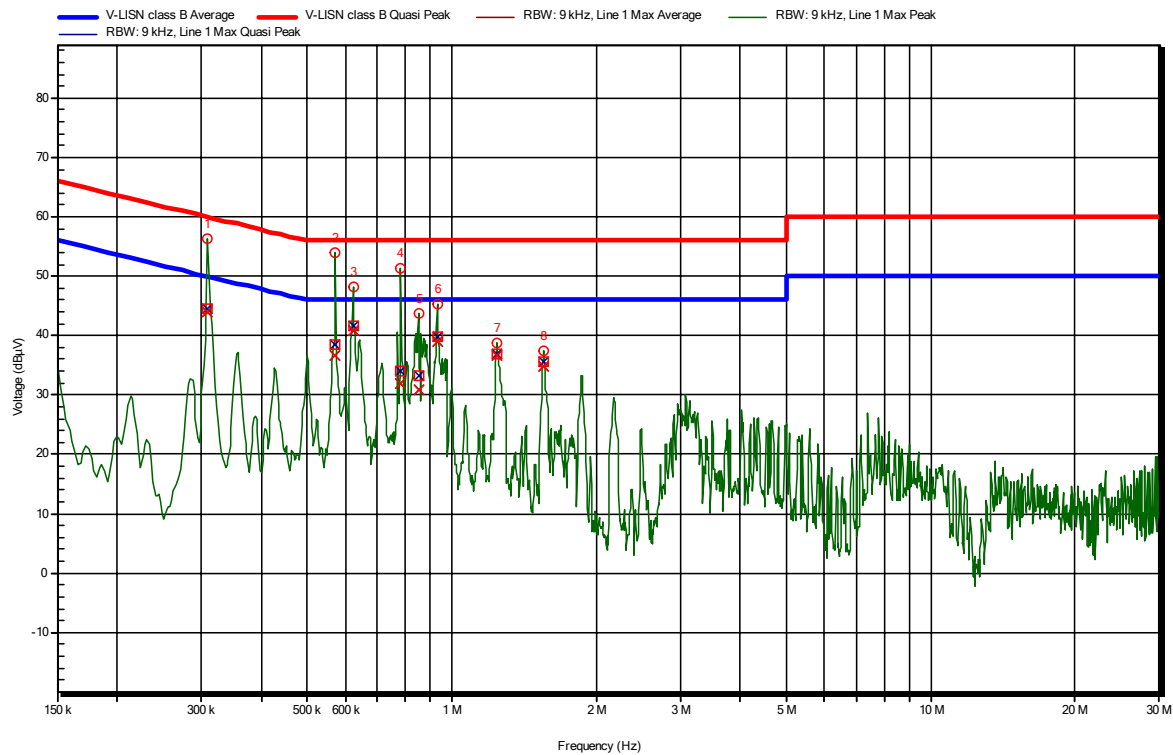


## Measurement Results

### Diagram 1

<b>EUT</b>	EUT 1
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see §12
<b>Test date, time</b>	06.04.2018 09:38:31
<b>Line under test</b>	Minus-Port, DC Supply (without Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radiation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 5 ms

RadiMation



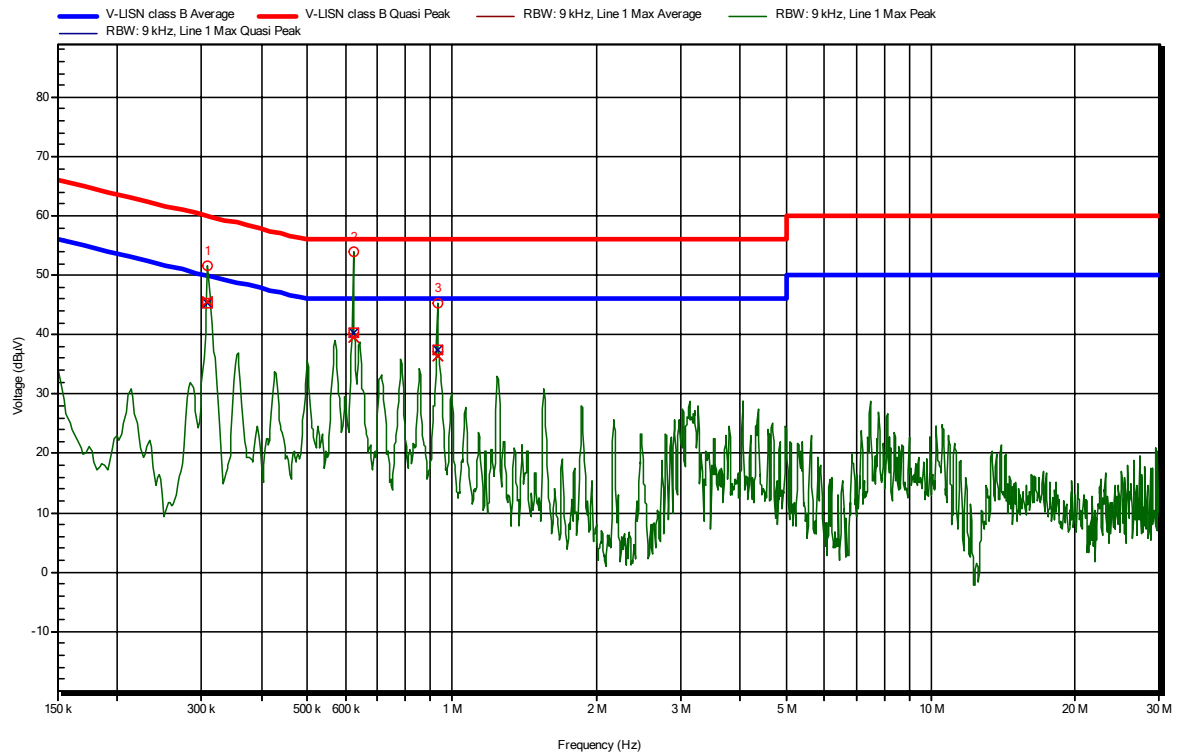
### Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	309.75 kHz	56.2 dBµV	44 dBµV	-6.0 dB	44.5 dBµV	-15.5 dB	Pass
2	570.75 kHz	54 dBµV	36.7 dBµV	-9.3 dB	38.4 dBµV	-17.6 dB	Pass
3	622.5 kHz	48.2 dBµV	40.8 dBµV	-5.2 dB	41.6 dBµV	-14.4 dB	Pass
4	782.25 kHz	51.3 dBµV	31.9 dBµV	-14.1 dB	34 dBµV	-22.0 dB	Pass
5	852 kHz	43.8 dBµV	30.8 dBµV	-15.2 dB	33.2 dBµV	-22.8 dB	Pass
6	933 kHz	45.4 dBµV	38.9 dBµV	-7.1 dB	39.7 dBµV	-16.3 dB	Pass
7	1.243 MHz	38.8 dBµV	36.5 dBµV	-9.5 dB	37 dBµV	-19.0 dB	Pass
8	1.554 MHz	37.5 dBµV	34.9 dBµV	-11.1 dB	35.5 dBµV	-20.5 dB	Pass

Diagram 2

<b>EUT</b>	EUT 1
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see §12
<b>Test date, time</b>	06.04.2018 09:42:15
<b>Line under test</b>	Plus-Port, DC Supply (without Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 5 ms

RadiMation



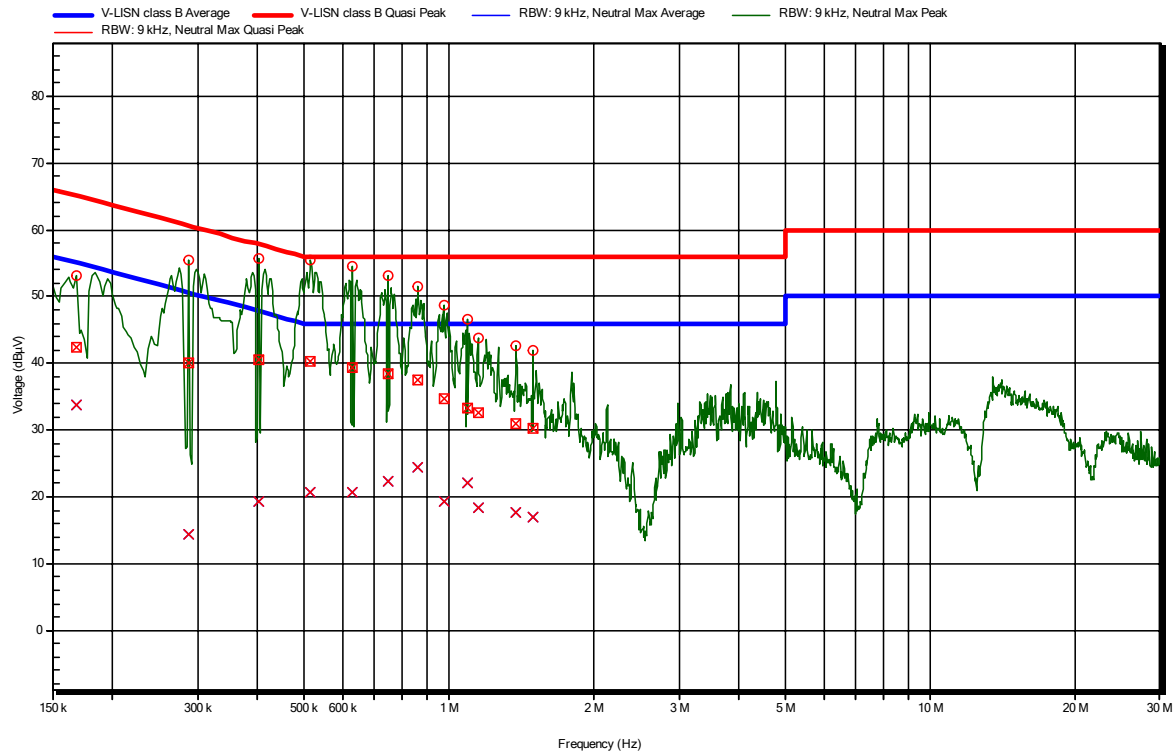
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	309.75 kHz	51.6 dBμV	45.5 dBμV	-4.5 dB	45.2 dBμV	-14.8 dB	Pass
2	622.5 kHz	53.9 dBμV	39.5 dBμV	-6.5 dB	40.3 dBμV	-15.7 dB	Pass
3	933 kHz	45.4 dBμV	36.5 dBμV	-9.5 dB	37.5 dBμV	-18.5 dB	Pass

Diagram 3

<b>EUT</b>	EUT 3
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see § 12
<b>Test date, time</b>	09.08.2018 09:26:24
<b>Line under test</b>	Minus-Port, DC Supply 48 V (without Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 100 ms

RadiMation



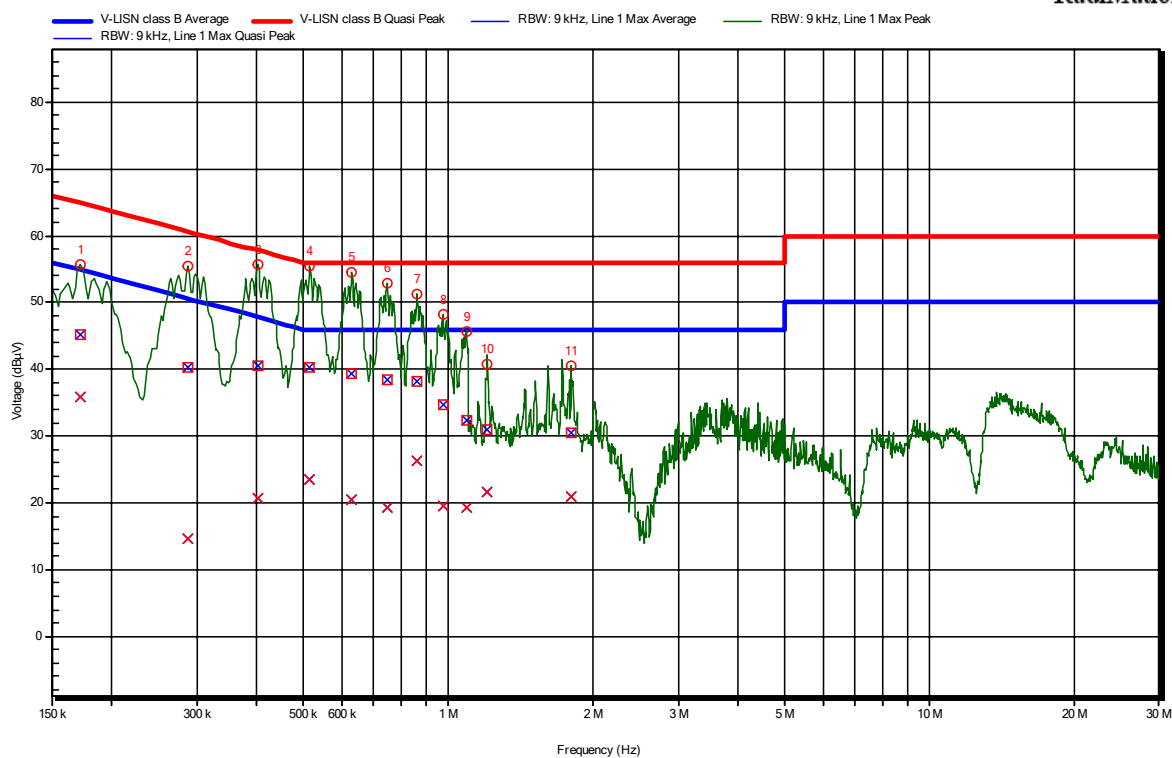
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	168 kHz	53.1 dBμV	33.7 dBμV	-21.3 dB	42.4 dBμV	-22.7 dB	Pass
2	287.25 kHz	55.5 dBμV	14.5 dBμV	-36.1 dB	40.1 dBμV	-20.5 dB	Pass
3	402 kHz	55.8 dBμV	19.2 dBμV	-28.6 dB	40.4 dBμV	-17.4 dB	Pass
4	516.75 kHz	55.4 dBμV	20.8 dBμV	-25.2 dB	40.3 dBμV	-15.7 dB	Pass
5	631.5 kHz	54.5 dBμV	20.6 dBμV	-25.4 dB	39.5 dBμV	-16.5 dB	Pass
6	746.25 kHz	53.1 dBμV	22.4 dBμV	-23.6 dB	38.4 dBμV	-17.6 dB	Pass
7	861 kHz	51.4 dBμV	24.3 dBμV	-21.7 dB	37.5 dBμV	-18.5 dB	Pass
8	975.75 kHz	48.6 dBμV	19.4 dBμV	-26.6 dB	34.6 dBμV	-21.4 dB	Pass
9	1.09 MHz	46.7 dBμV	22 dBμV	-24.0 dB	33.3 dBμV	-22.7 dB	Pass
10	1.149 MHz	43.9 dBμV	18.4 dBμV	-27.6 dB	32.5 dBμV	-23.5 dB	Pass
11	1.379 MHz	42.7 dBμV	17.7 dBμV	-28.3 dB	30.9 dBμV	-25.1 dB	Pass
12	1.493 MHz	41.9 dBμV	17.1 dBμV	-28.9 dB	30.3 dBμV	-25.7 dB	Pass

Diagram 4

<b>EUT</b>	EUT 3
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see § 12
<b>Test date, time</b>	09.08.2018 09:36:40
<b>Line under test</b>	Plus-Port, DC Supply 48 V (without Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 100 ms

RadiMation



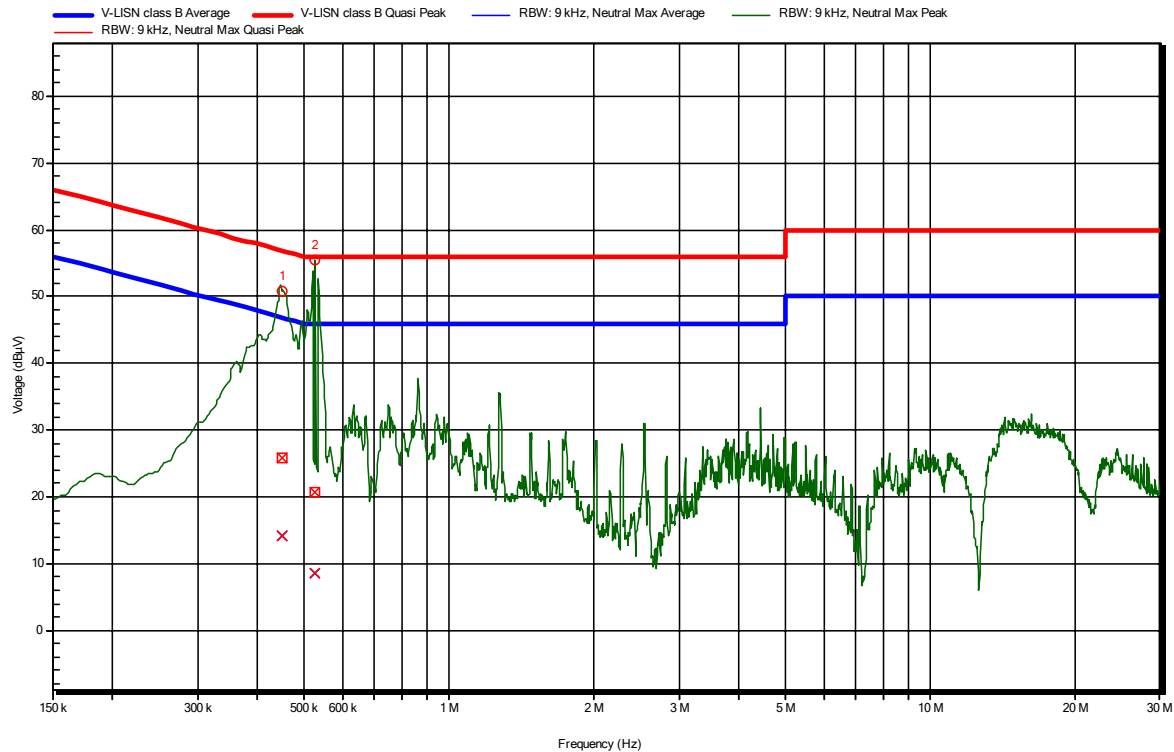
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	172.5 kHz	55.6 dBμV	35.9 dBμV	-18.9 dB	45.1 dBμV	-19.7 dB	Pass
2	287.25 kHz	55.5 dBμV	14.6 dBμV	-36.0 dB	40.3 dBμV	-20.3 dB	Pass
3	402 kHz	55.8 dBμV	20.6 dBμV	-27.2 dB	40.5 dBμV	-17.4 dB	Pass
4	516.75 kHz	55.4 dBμV	23.5 dBμV	-22.5 dB	40.4 dBμV	-15.6 dB	Pass
5	631.5 kHz	54.6 dBμV	20.4 dBμV	-25.6 dB	39.3 dBμV	-16.7 dB	Pass
6	746.25 kHz	52.9 dBμV	19.3 dBμV	-26.7 dB	38.5 dBμV	-17.5 dB	Pass
7	861 kHz	51.3 dBμV	26.2 dBμV	-19.8 dB	38.1 dBμV	-17.9 dB	Pass
8	975.75 kHz	48.3 dBμV	19.5 dBμV	-26.5 dB	34.8 dBμV	-21.2 dB	Pass
9	1.09 MHz	45.8 dBμV	19.3 dBμV	-26.7 dB	32.3 dBμV	-23.7 dB	Pass
10	1.203 MHz	40.7 dBμV	21.6 dBμV	-24.4 dB	31.1 dBμV	-24.9 dB	Pass
11	1.799 MHz	40.6 dBμV	21 dBμV	-25.0 dB	30.4 dBμV	-25.6 dB	Pass

Diagram 5

<b>EUT</b>	EUT 3
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see § 12
<b>Test date, time</b>	09.08.2018 09:44:34
<b>Line under test</b>	Minus-Port, DC Supply 48 V (with Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 100 ms

RadiMation



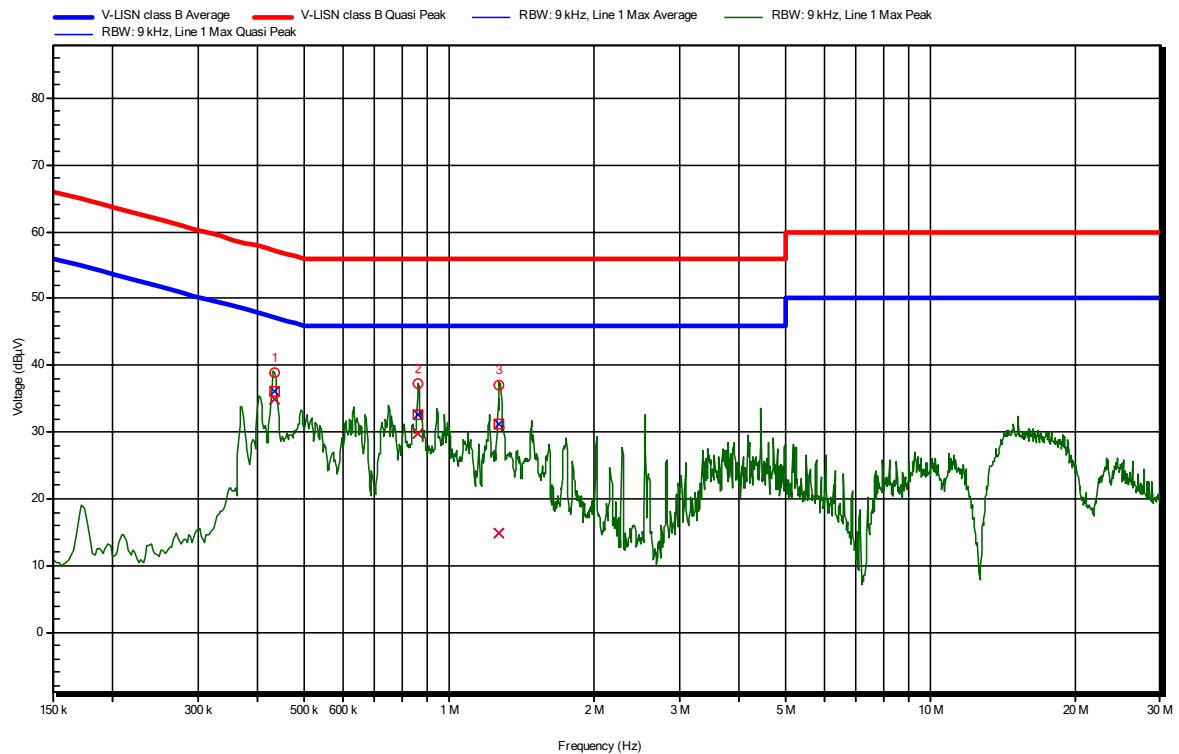
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	449.25 kHz	50.9 dBμV	14.1 dBμV	-32.8 dB	25.8 dBμV	-31.0 dB	Pass
2	528 kHz	55.5 dBμV	8.6 dBμV	-37.4 dB	20.7 dBμV	-35.3 dB	Pass

Diagram 6

<b>EUT</b>	EUT 3
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see § 12
<b>Test date, time</b>	09.08.2018 09:53:30
<b>Line under test</b>	Plus-Port, DC Supply 48 V (with Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radiation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 100 ms

RadiMation



## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	433.5 kHz	38.8 dBμV	35 dBμV	-12.2 dB	36.1 dBμV	-21.1 dB	Pass
2	861 kHz	37.3 dBμV	29.7 dBμV	-16.3 dB	32.5 dBμV	-23.5 dB	Pass
3	1.273 MHz	37 dBμV	14.8 dBμV	-31.2 dB	31.3 dBμV	-24.7 dB	Pass

Diagram 7

<b>EUT</b>	EUT 4
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see § 12
<b>Test date, time</b>	09.08.2018 17:27:50
<b>Line under test</b>	Minus-Port, DC Supply 12 V (without Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 10 ms

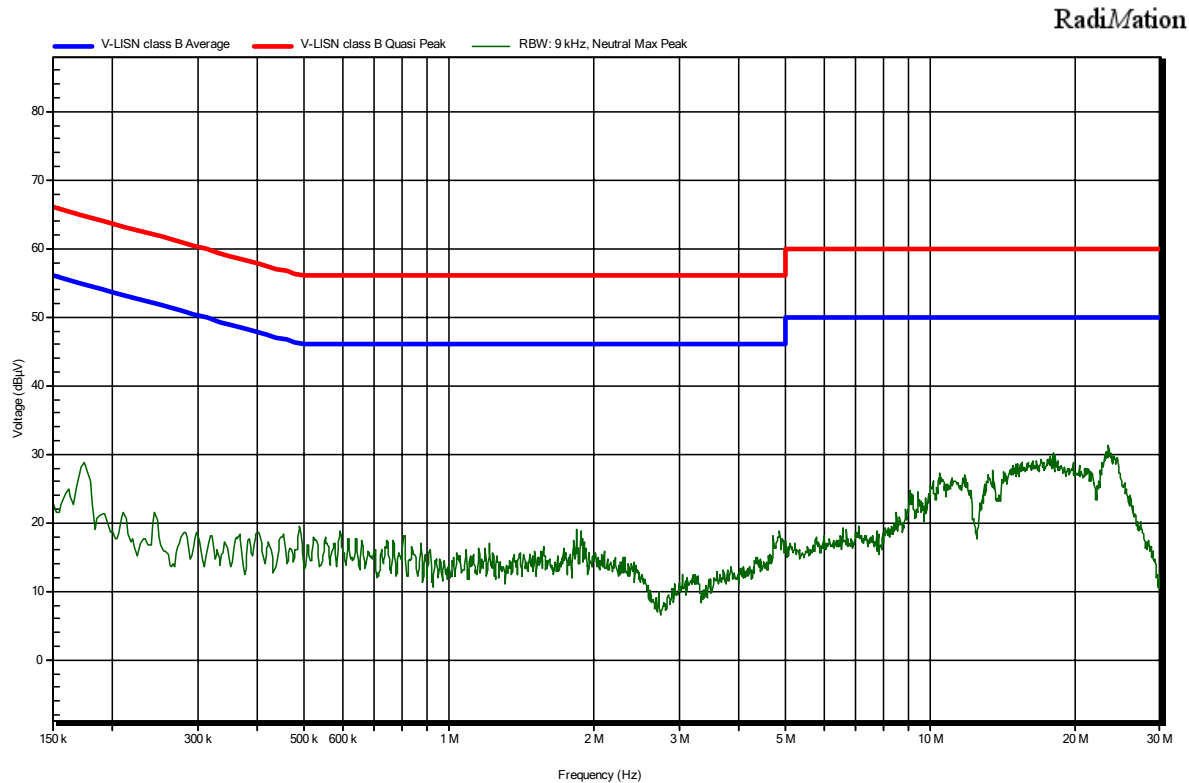


Diagram 8

<b>EUT</b>	EUT 4
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see § 12
<b>Test date, time</b>	09.08.2018 17:28:30
<b>Line under test</b>	Plus-Port, DC Supply 12 V (without Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 10 ms

RadiMation

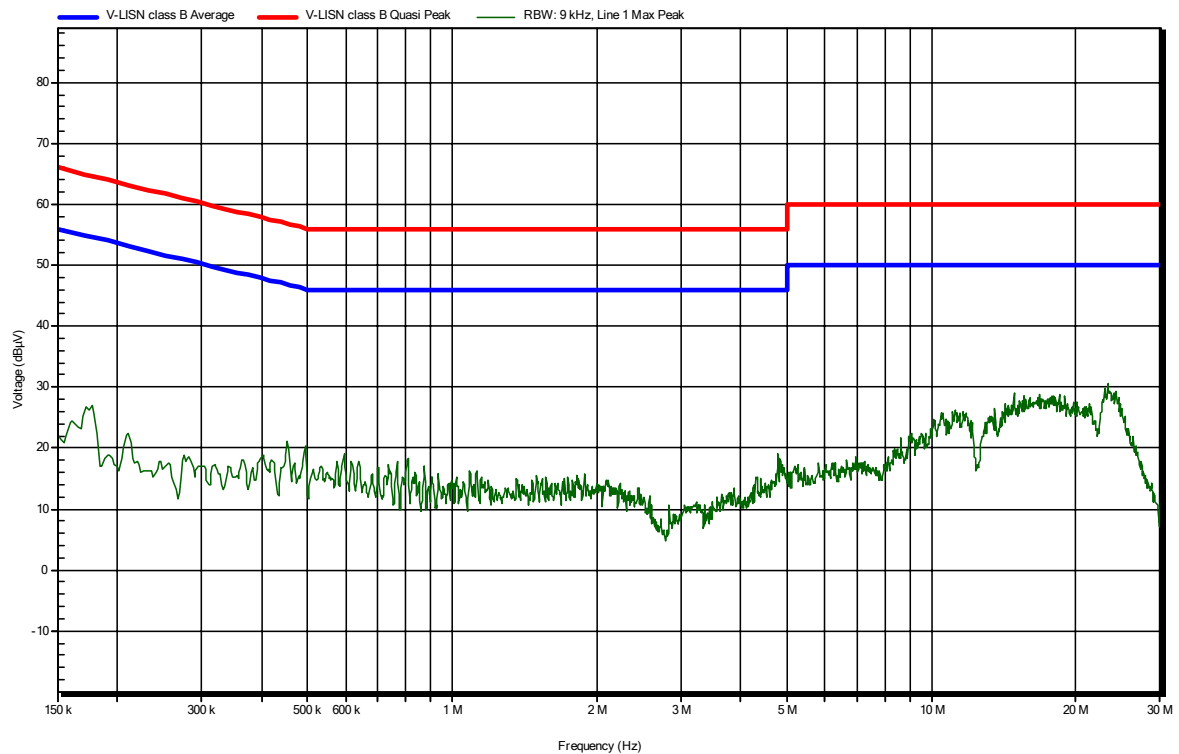


Diagram 9

<b>EUT</b>	EUT 4
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see § 12
<b>Test date, time</b>	09.08.2018 17:30:00
<b>Line under test</b>	Minus-Port, DC Supply 12 V (with Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 10 ms

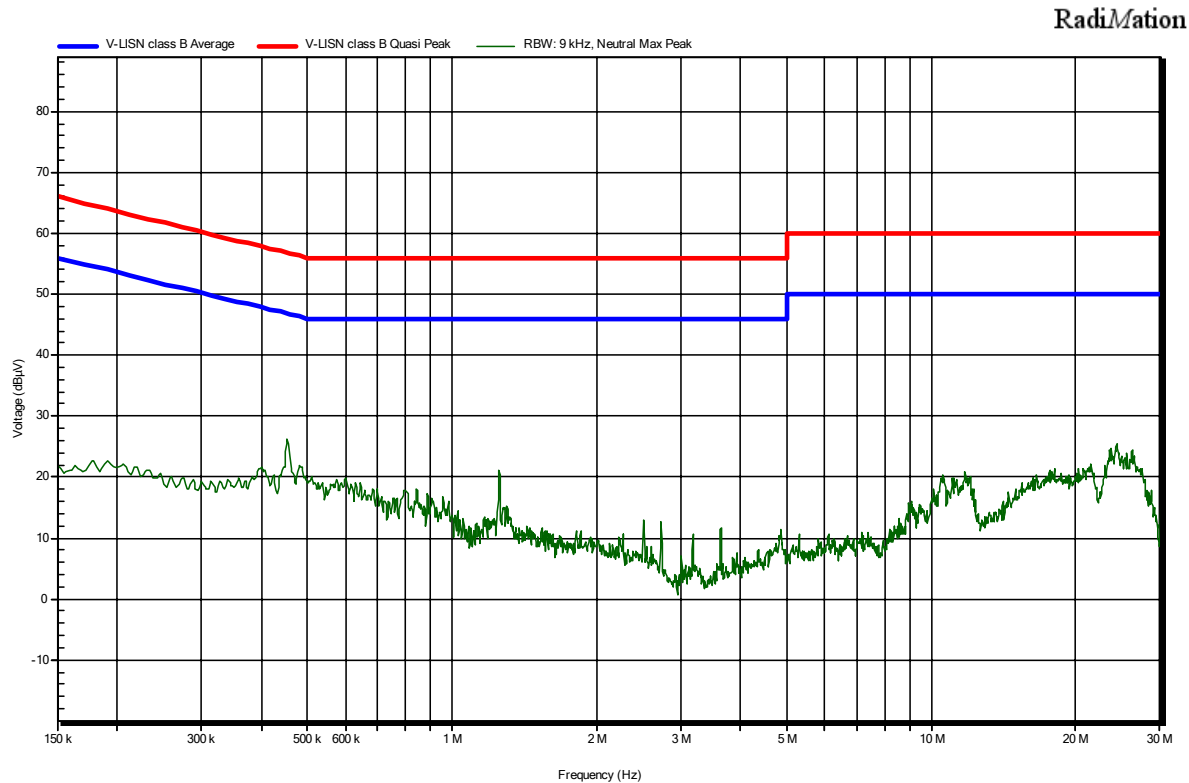
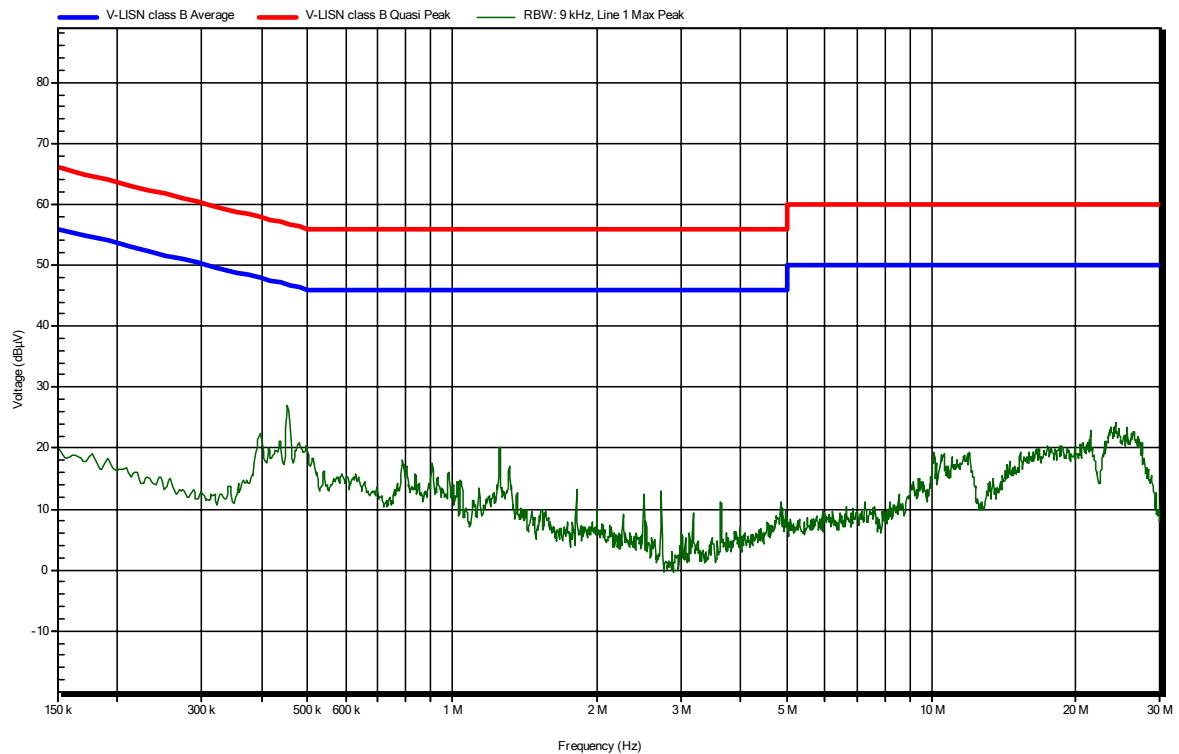


Diagram 10

<b>EUT</b>	EUT 4
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see § 12
<b>Test date, time</b>	09.08.2018 17:30:41
<b>Line under test</b>	Plus-Port, DC Supply 12 V (with Ground connection)
<b>Transducer</b>	V-LISN Rohde & Schwarz ESH3-Z5 - PE7627
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 10 ms

RadiMation



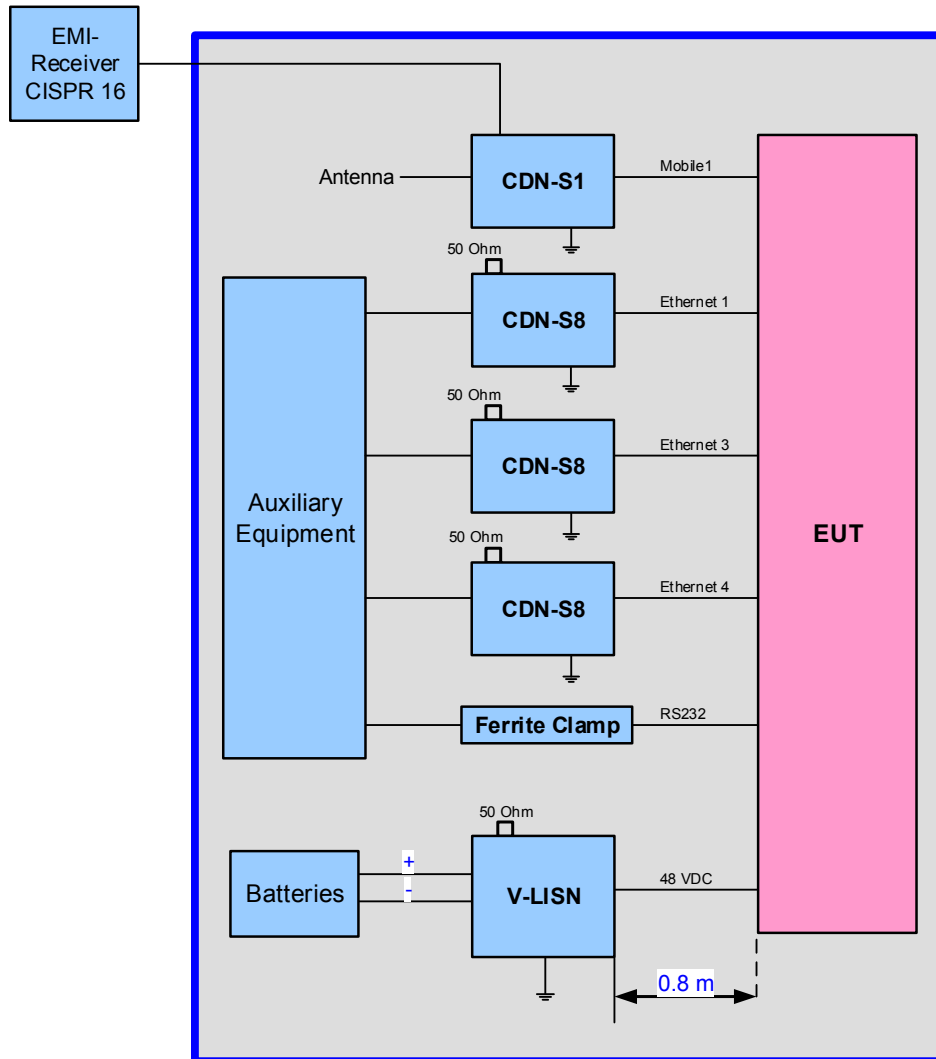
## 9.2 Interference Voltage (LAN-Cable & Antenna Ports)

*Test site:* shielded room

*Meas. uncertainty:* see chapter 11

*Measuring method:* The conducted disturbance is measured using a EMI receiver and a line coupling device network (CDN-Sx) for shielded Cables The measurement of the voltage on the shield of the cable (CDN-Sx) against the earth is carried out successively. The average and quasi peak values are recorded continuously using the EMI receiver in time domain mode.

### Test Setup



**Test Equipment**

Device Type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU 8	OA10193
V-Network	Rohde & Schwarz	ESH3-Z5	PE7627
CDN	Lüthi	CDN S8 (RJ45)	13.6632.07 13.6632.08
CDN	Lüthi	CDN S1 (coaxial)	H7679
Decoupling device	Marti	TWP 4x2	H10420
Decoupling Clamp	Lüthi	FGZ40X15 E	--
Coaxial Cable	Huber & Suhner	RG223/U	H8002+13.6632.02

**Photos of the Setup**

see §9.1

## Measurement Results

Diagram 11

<b>EUT</b>	EUT 1
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see §12
<b>Test date, time</b>	06.04.2018 12:56:31
<b>Line under test</b>	Ethernet 3 (without Ground connection)
<b>Transducer</b>	CDN-S8
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 10 ms

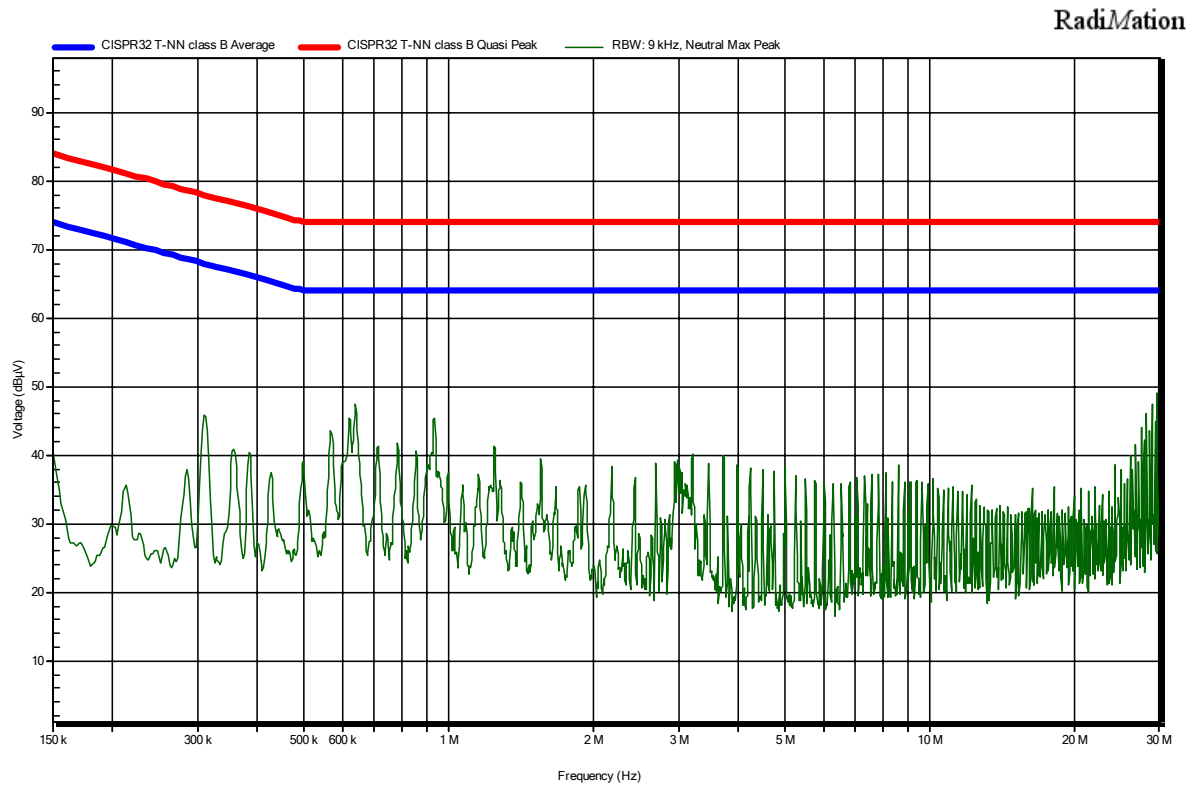


Diagram 12

<b>EUT</b>	EUT 1
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see §12
<b>Test date, time</b>	06.04.2018 12:58:26
<b>Line under test</b>	Ethernet 1 (without Ground connection)
<b>Transducer</b>	CDN-S8
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 10 ms

RadiMation

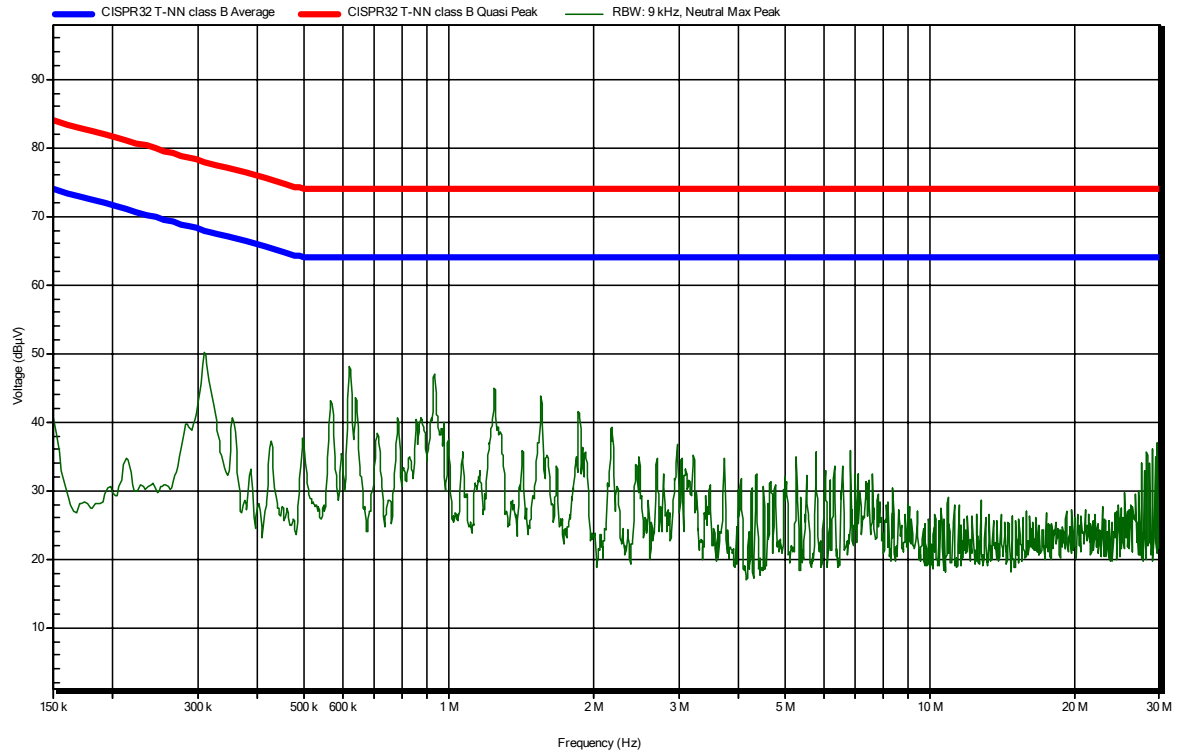


Diagram 13

<b>EUT</b>	EUT 1
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see §12
<b>Test date, time</b>	06.04.2018 13:01:43
<b>Line under test</b>	Antenna Mobile 1 (without Ground connection)
<b>Transducer</b>	CDN-S1
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 10 ms

RadiMation

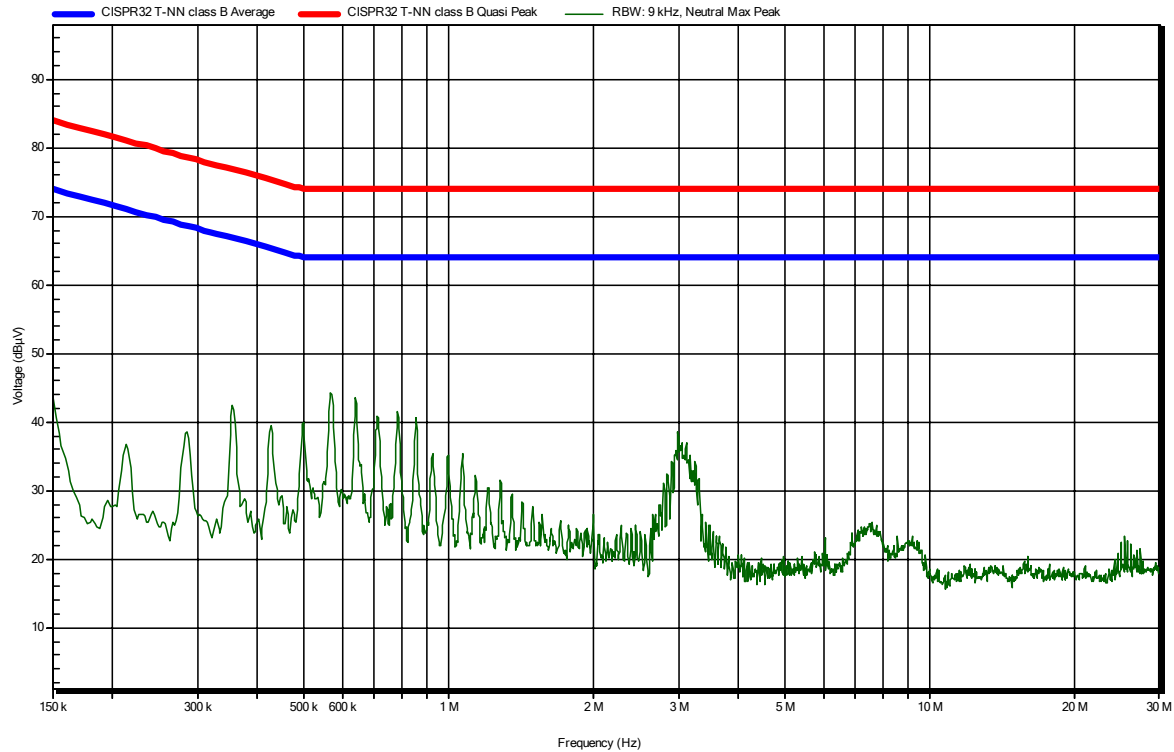


Diagram 14

<b>EUT</b>	EUT 3
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see §12
<b>Test date, time</b>	09.08.2018 09:57:36
<b>Line under test</b>	Ethernet 1 (with Ground connection)
<b>Transducer</b>	CDN-S8
<b>Measurement settings</b>	Radiation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 100 ms

RadiMation

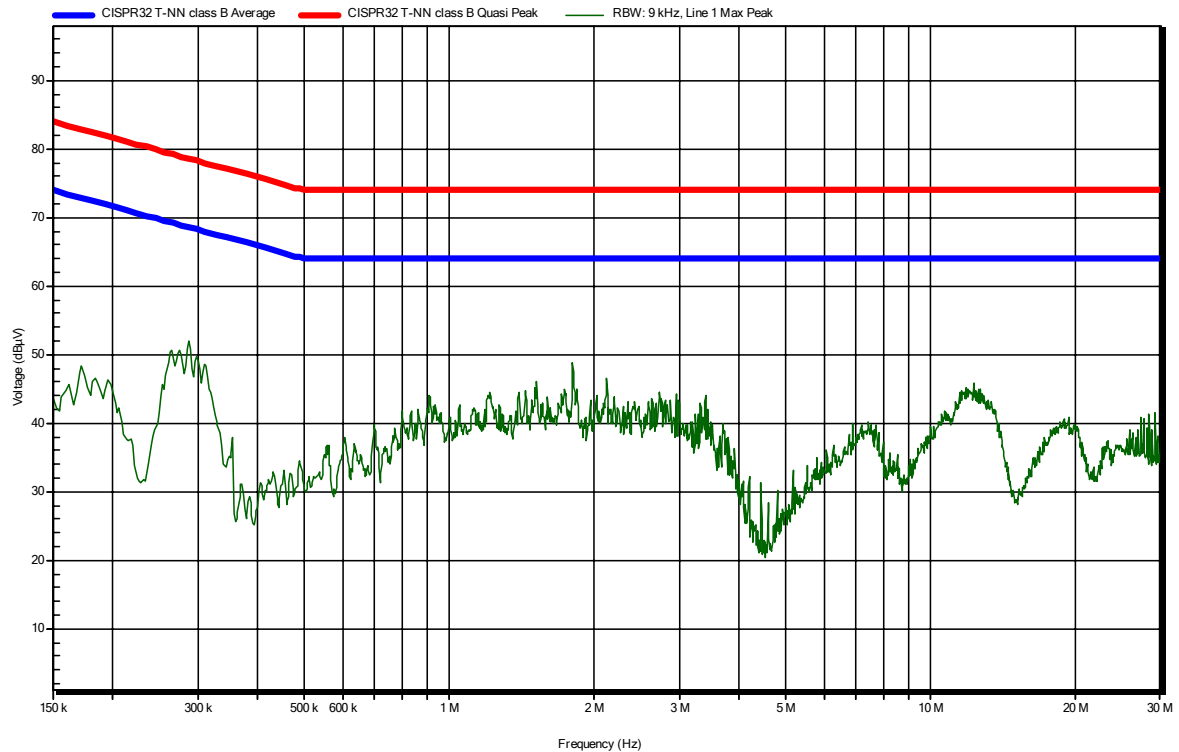
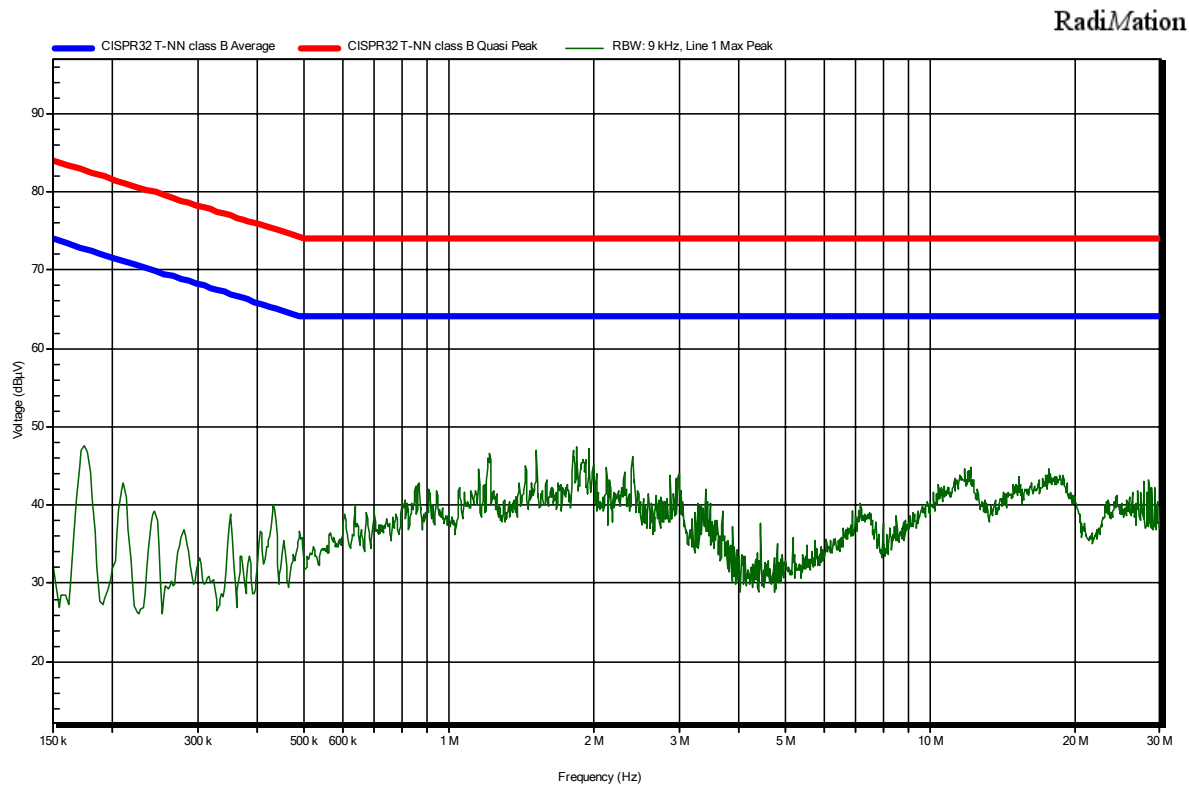


Diagram 15

<b>EUT</b>	EUT 3
<b>Verdict</b>	Pass according CISPR 32, Class B & FCC Class B
<b>Modification</b>	see §12
<b>Test date, time</b>	09.08.2018 09:59:52
<b>Line under test</b>	Ethernet 1 (without Ground connection)
<b>Transducer</b>	CDN-S8
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 0 dB, Measure time: 100 ms



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

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

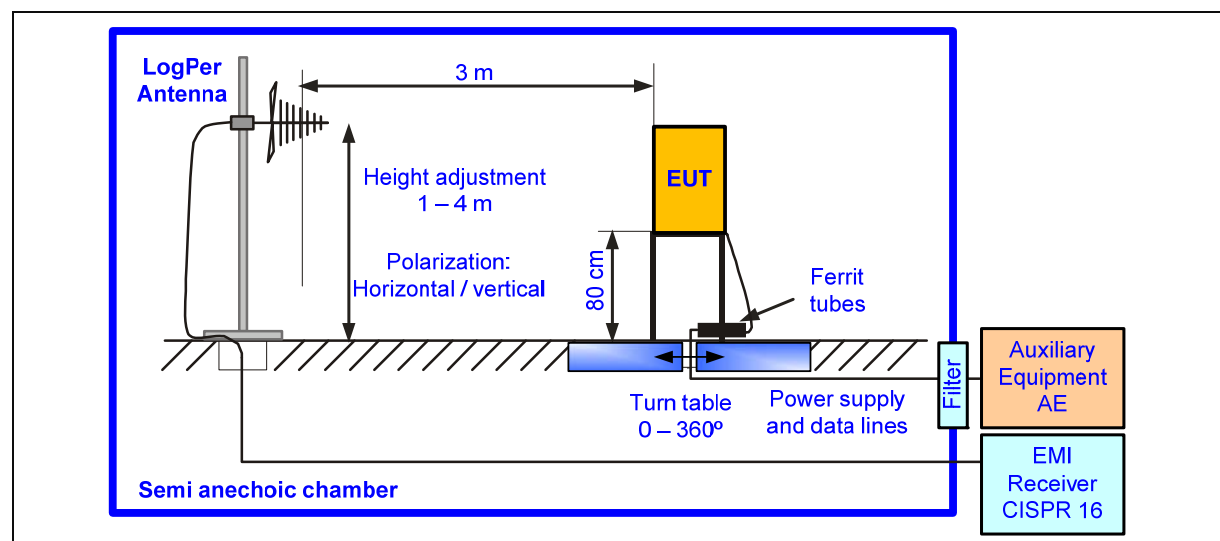
**Distance:** 3 m

**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

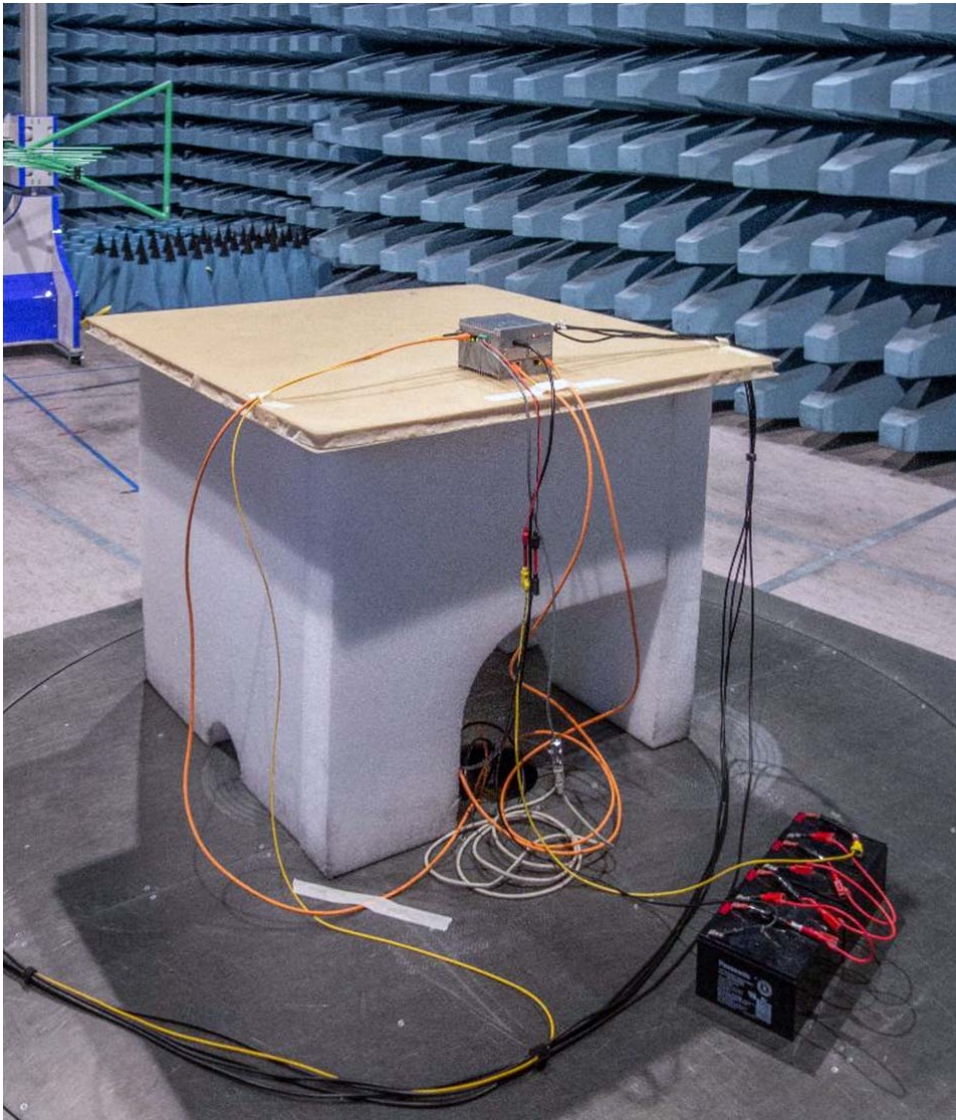


#### Test Equipment

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU 8	OA10193
Antenna LogPer	Chase	CBL 6112B	H9728
Coaxial Cable	Huber & Suhner	Sucoflex 106	17.6632.03, 17.6632.04, 18.6632.02

## Photos of the Setup

EUT 1:



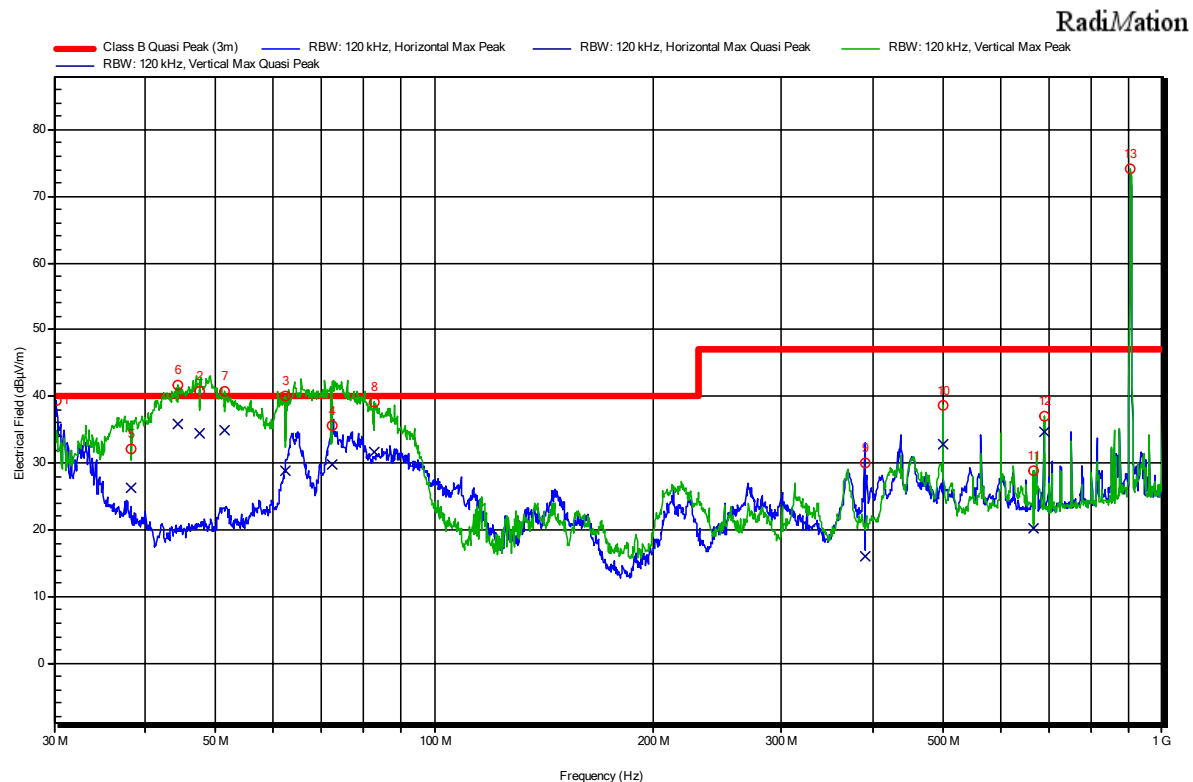
EUT 3:



## Measurement Results

Diagram 16

<b>EUT</b>	EUT 1		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Modification</b>	see §12		
<b>Mode of operation</b>	without Ground connection		
<b>Test date, time</b>	04.04.2018 10:09:49		
<b>Antenna height</b>	1 m - 4 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 10 ms		



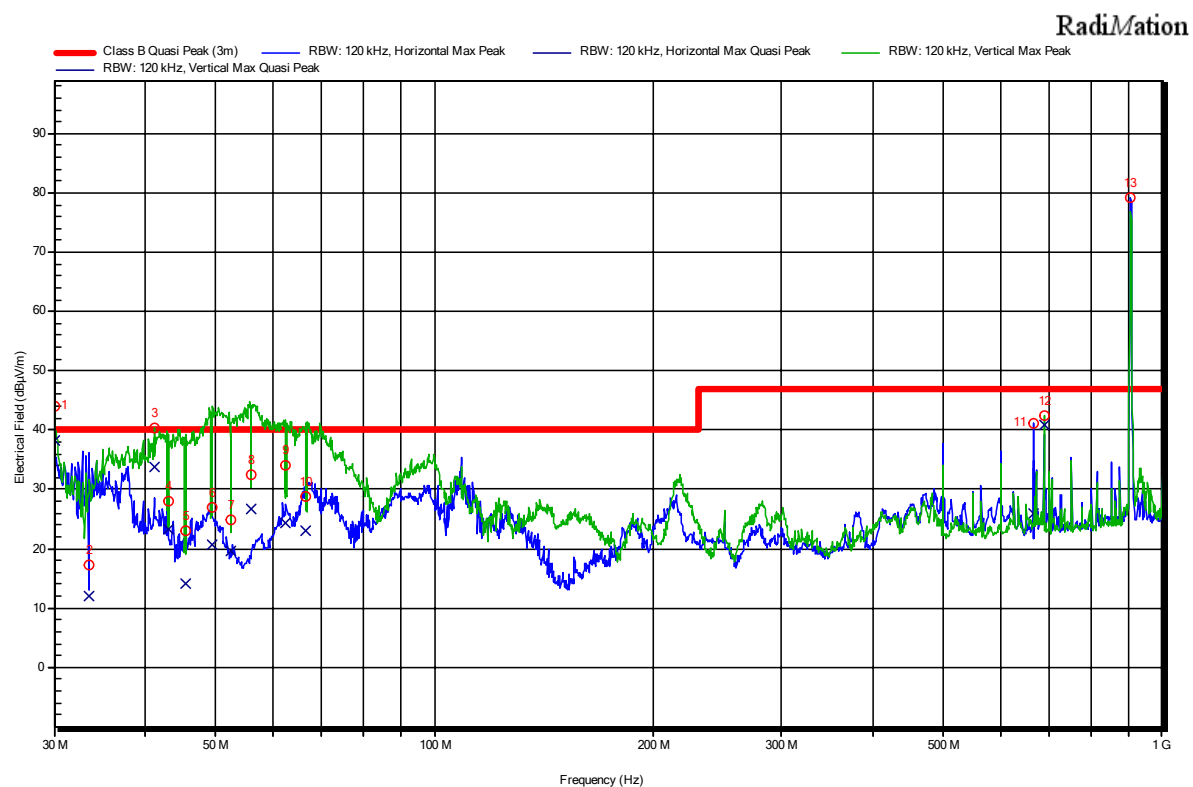
## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	30.21 MHz	39.4 dBµV/m	34.8 dBµV/m	-5.2 dB	Pass	0 Degree	4 m	Horizontal
5	38.31 MHz	32 dBµV/m	26.3 dBµV/m	-13.7 dB	Pass	30 Degree	1 m	Vertical
6	44.34 MHz	41.7 dBµV/m	35.9 dBµV/m	-4.1 dB	Pass	30 Degree	1 m	Vertical
2	47.55 MHz	40.7 dBµV/m	34.4 dBµV/m	-5.6 dB	Pass	30 Degree	1 m	Vertical
7	51.48 MHz	40.7 dBµV/m	34.9 dBµV/m	-5.1 dB	Pass	30 Degree	1 m	Vertical
3	62.49 MHz	40 dBµV/m	28.8 dBµV/m	-11.2 dB	Pass	30 Degree	1 m	Vertical
4	72.21 MHz	35.6 dBµV/m	29.8 dBµV/m	-10.2 dB	Pass	30 Degree	1 m	Vertical
8	82.5 MHz	39.1 dBµV/m	31.7 dBµV/m	-8.3 dB	Pass	30 Degree	1 m	Vertical
9	390.03 MHz	30 dBµV/m	16 dBµV/m	-31.0 dB	Pass	90 Degree	1 m	Horizontal
10	500.01 MHz	38.8 dBµV/m	32.8 dBµV/m	-14.2 dB	Pass	330 Degree	4 m	Vertical
11	666.66 MHz	29 dBµV/m	20.2 dBµV/m	-26.8 dB	Pass	180 Degree	2 m	Vertical
12	687.51 MHz	37.1 dBµV/m	34.6 dBµV/m	-12.4 dB	Pass	300 Degree	4 m	Vertical
13	905.67 MHz	74.2 dBµV/m	--	--	Note	--	--	--

Note: UMTS, exclusion band according ETSI EN 301 489-24 applies

Diagram 17

<b>EUT</b>	EUT 1		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Modification</b>	see §12		
<b>Mode of operation</b>	with Ground connection		
<b>Test date, time</b>	04.04.2018 17:17:19		
<b>Antenna height</b>	1 m - 2 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 10 ms		



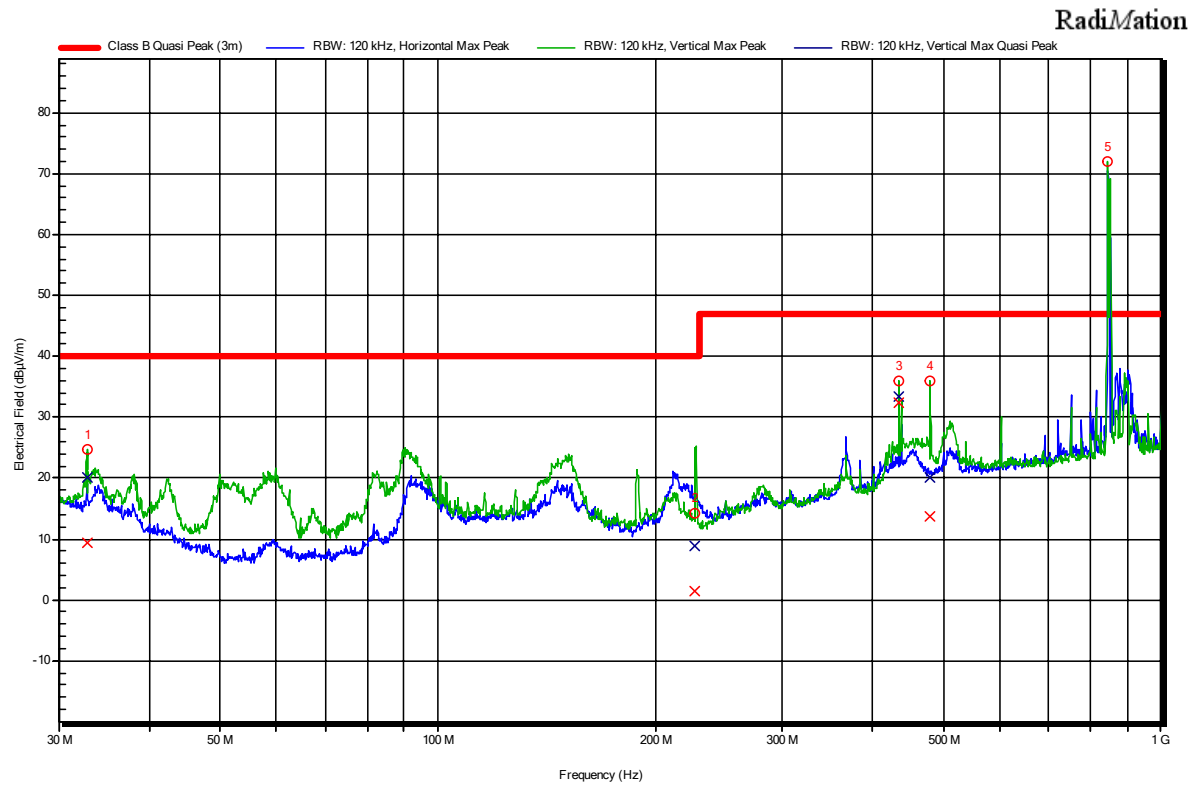
## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	30 MHz	44 dBµV/m	36.5 dBµV/m	-3.5 dB	Pass	120 Degree	1 m	Vertical
2	33.51 MHz	17.2 dBµV/m	12.1 dBµV/m	-27.9 dB	Pass	270 Degree	2 m	Horizontal
3	41.16 MHz	40.3 dBµV/m	33.9 dBµV/m	-6.1 dB	Pass	330 Degree	2 m	Vertical
4	43.02 MHz	27.9 dBµV/m	23.4 dBµV/m	-16.6 dB	Pass	90 Degree	2 m	Vertical
5	45.42 MHz	22.9 dBµV/m	14 dBµV/m	-26.0 dB	Pass	90 Degree	2 m	Vertical
6	49.41 MHz	27.1 dBµV/m	20.6 dBµV/m	-19.4 dB	Pass	90 Degree	2 m	Vertical
7	52.44 MHz	24.9 dBµV/m	19.6 dBµV/m	-20.4 dB	Pass	90 Degree	2 m	Vertical
8	56.01 MHz	32.5 dBµV/m	26.7 dBµV/m	-13.3 dB	Pass	90 Degree	2 m	Vertical
9	62.52 MHz	34 dBµV/m	24.5 dBµV/m	-15.5 dB	Pass	90 Degree	2 m	Vertical
10	66.69 MHz	28.7 dBµV/m	23 dBµV/m	-17.0 dB	Pass	90 Degree	2 m	Vertical
11	666.66 MHz	41 dBµV/m	25.9 dBµV/m	-21.1 dB	Pass	60 Degree	2 m	Horizontal
12	687.51 MHz	42.4 dBµV/m	40.9 dBµV/m	-6.1 dB	Pass	30 Degree	1 m	Vertical
13	905.73 MHz	79.1 dBµV/m	--	--	Note	--	--	--

Note: UMTS, exclusion band according ETSI EN 301 489-24 applies

Diagram 18

<b>EUT</b>	EUT 2		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode of operation</b>	with Ground connection		
<b>Test date, time</b>	13.04.2018 14:54:30		
<b>Antenna height</b>	1 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 20 ms		

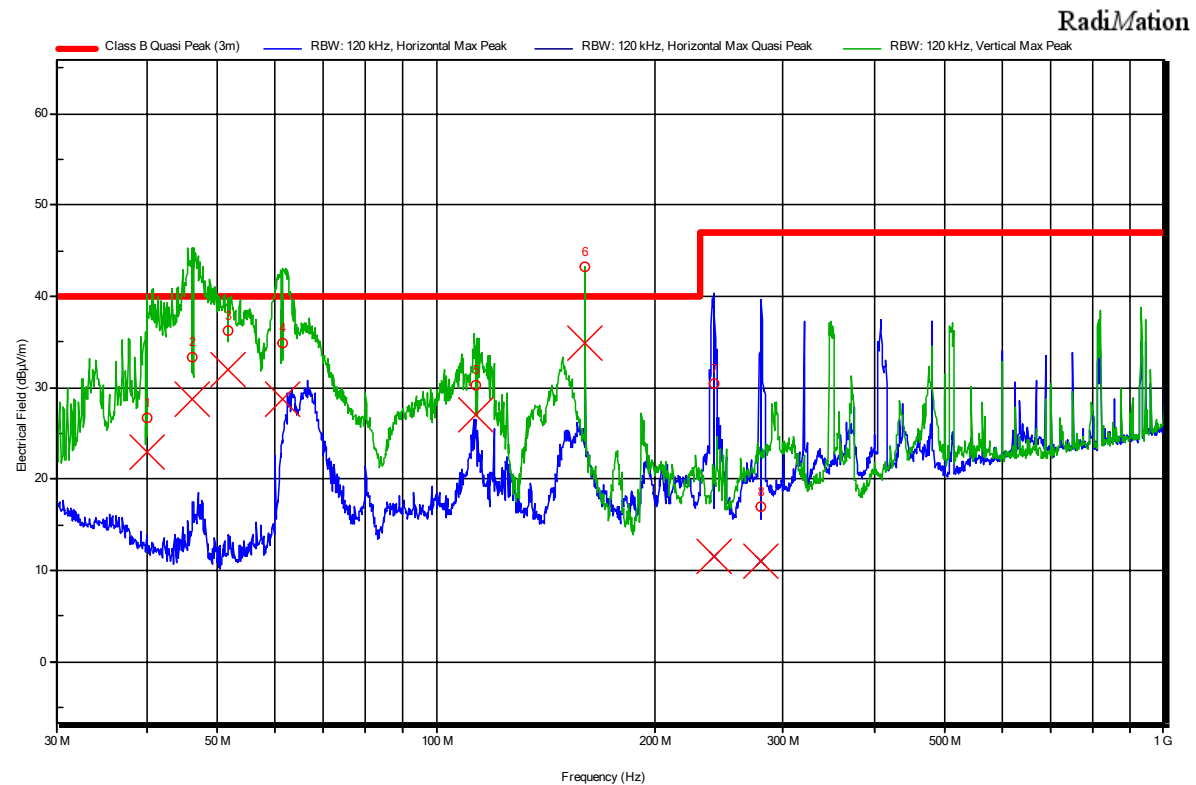
**Detected peaks**

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	32.82 MHz	24.8 dBµV/m	20 dBµV/m	-20.0 dB	Pass	90 Degree	1 m	Vertical
2	227.19 MHz	14.3 dBµV/m	8.9 dBµV/m	-31.1 dB	Pass	210 Degree	1 m	Vertical
3	433.32 MHz	35.9 dBµV/m	33.4 dBµV/m	-13.6 dB	Pass	270 Degree	1 m	Vertical
4	480 MHz	35.9 dBµV/m	20.2 dBµV/m	-26.8 dB	Pass	120 Degree	1 m	Vertical
5	843.21 MHz	72.1 dBµV/m	--	--	Note	210 Degree	1 m	Vertical

Note: UMTS, exclusion band according ETSI EN 301 489-24 applies

Diagram 19

<b>EUT</b>	EUT 3		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode of operation</b>	48 VDC, without Ground connection		
<b>Test date, time</b>	09.08.2018 14:23:18		
<b>Antenna height</b>	1 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 20 ms		

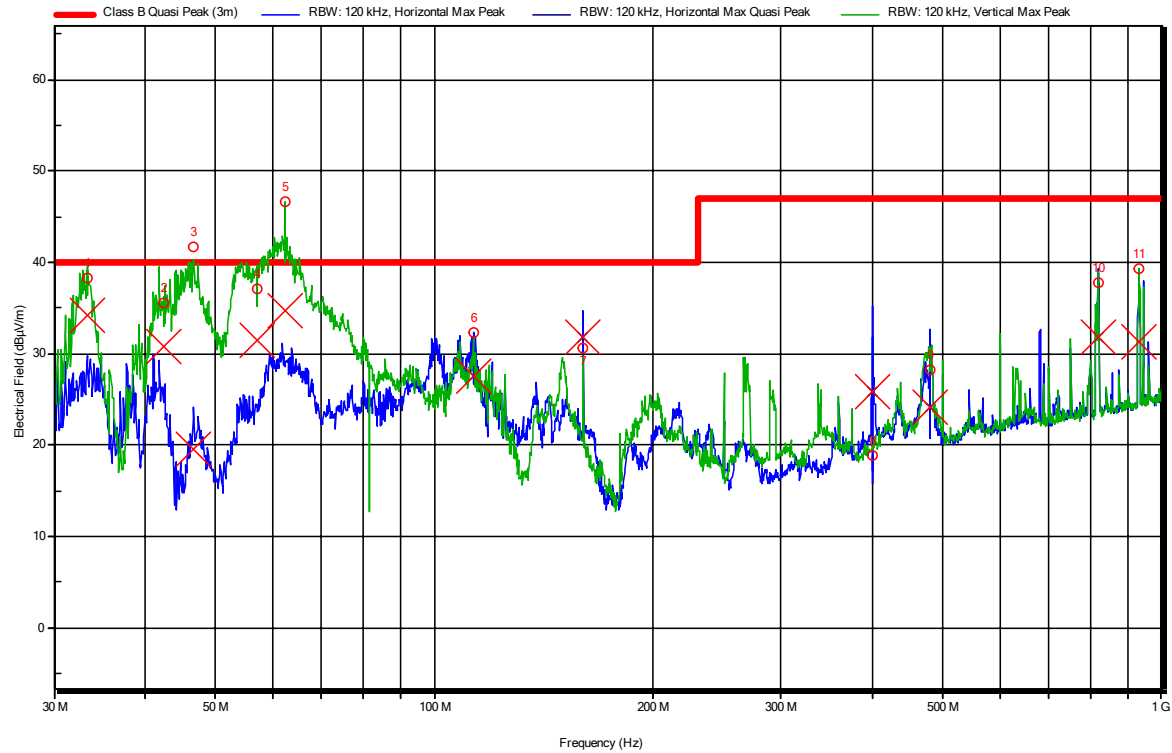
**Detected peaks**

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	39.96 MHz	26.7 dBµV/m	23 dBµV/m	-17.0 dB	Pass	210 Degree	1 m	Vertical
2	46.26 MHz	33.4 dBµV/m	28.8 dBµV/m	-11.2 dB	Pass	180 Degree	1 m	Vertical
3	51.732 MHz	36.2 dBµV/m	32 dBµV/m	-8.0 dB	Pass	150 Degree	1 m	Vertical
4	61.35 MHz	35 dBµV/m	28.8 dBµV/m	-11.2 dB	Pass	90 Degree	1 m	Vertical
5	113.61 MHz	30.4 dBµV/m	27 dBµV/m	-13.0 dB	Pass	150 Degree	1 m	Vertical
6	159.99 MHz	43.2 dBµV/m	34.8 dBµV/m	-5.2 dB	Pass	30 Degree	1 m	Vertical
7	240.69 MHz	30.4 dBµV/m	11.6 dBµV/m	-35.4 dB	Pass	210 Degree	1 m	Horizontal
8	280.02 MHz	17 dBµV/m	11.1 dBµV/m	-35.9 dB	Pass	180 Degree	1 m	Horizontal

Diagram 20

<b>EUT</b>	EUT 3		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode of operation</b>	48 VDC, without Ground connection		
<b>Test date, time</b>	09.08.2018 15:04:51		
<b>Antenna height</b>	2 m - 4 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 1 s		

RadiMation

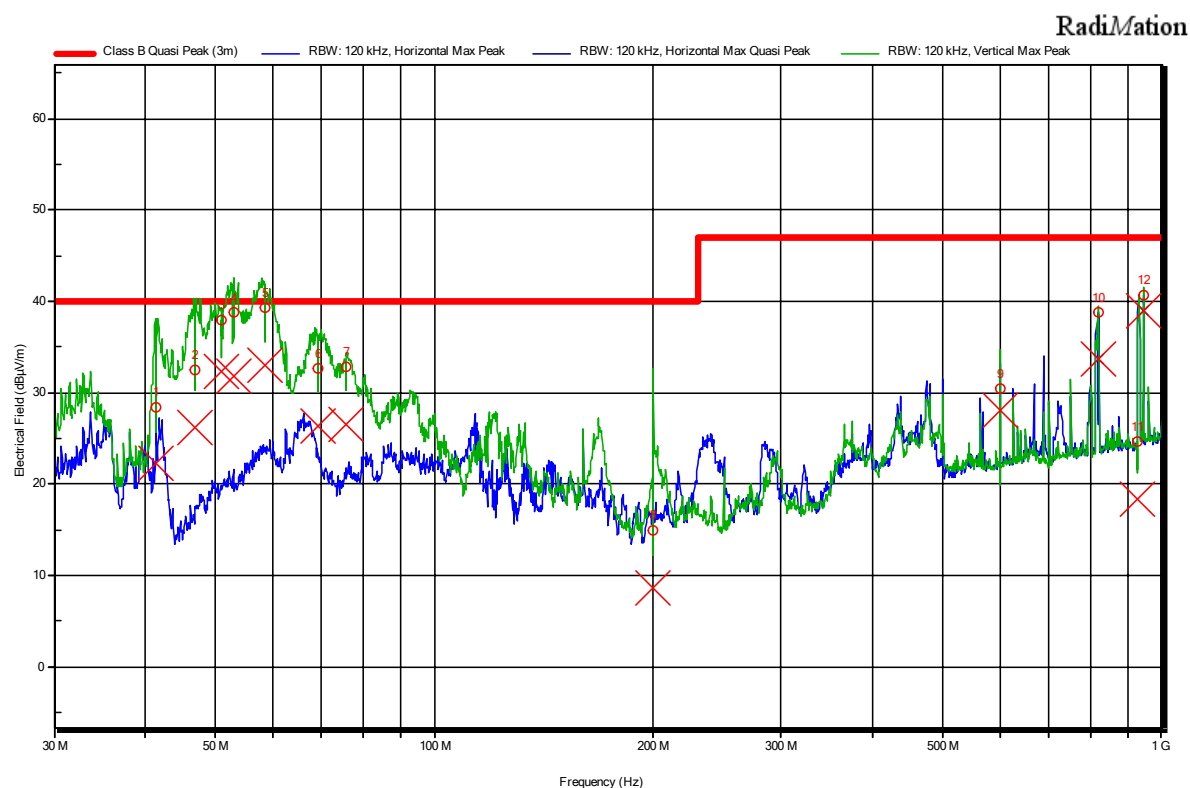


## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	33.3 MHz	38.3 dBµV/m	34.2 dBµV/m	-5.8 dB	Pass	180 Degree	3 m	Vertical
2	42.54 MHz	35.5 dBµV/m	30.8 dBµV/m	-9.2 dB	Pass	315 Degree	2 m	Vertical
3	46.62 MHz	41.8 dBµV/m	19.5 dBµV/m	-20.5 dB	Pass	315 Degree	3 m	Vertical
4	57.06 MHz	37.1 dBµV/m	31.4 dBµV/m	-8.6 dB	Pass	315 Degree	2 m	Vertical
5	62.49 MHz	46.7 dBµV/m	34.8 dBµV/m	-5.2 dB	Pass	225 Degree	2 m	Vertical
6	113.22 MHz	32.3 dBµV/m	27.6 dBµV/m	-12.4 dB	Pass	180 Degree	3 m	Horizontal
7	159.99 MHz	30.7 dBµV/m	31.9 dBµV/m	-8.1 dB	Pass	225 Degree	2 m	Horizontal
8	399.99 MHz	18.9 dBµV/m	25.9 dBµV/m	-21.1 dB	Pass	225 Degree	4 m	Horizontal
9	480 MHz	28.3 dBµV/m	24.1 dBµV/m	-22.9 dB	Pass	315 Degree	4 m	Horizontal
10	819.63 MHz	37.8 dBµV/m	31.8 dBµV/m	-15.2 dB	Pass	45 Degree	4 m	Horizontal
11	931.29 MHz	39.3 dBµV/m	31.3 dBµV/m	-15.7 dB	Pass	180 Degree	2 m	Vertical

Diagram 21

<b>EUT</b>	EUT 3		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode of operation</b>	48 VDC, with Ground connection		
<b>Test date, time</b>	09.08.2018 15:47:25		
<b>Antenna height</b>	1 m - 4 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 10 ms		



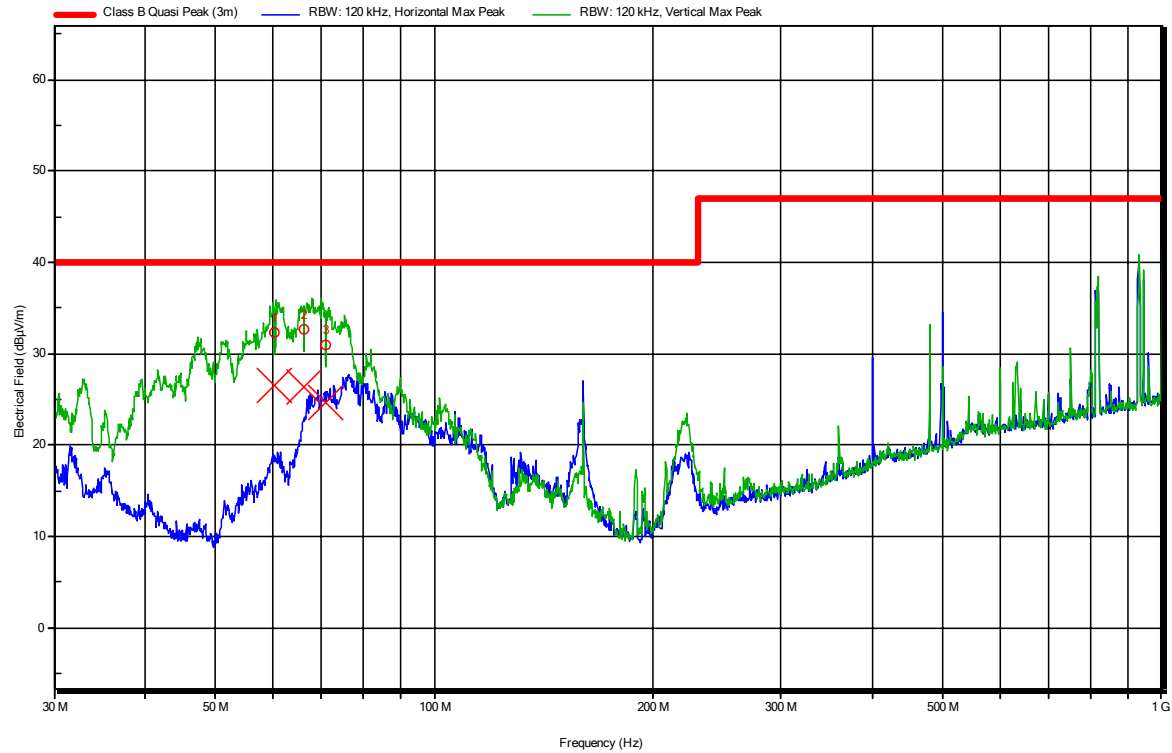
## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	41.43 MHz	28.3 dBµV/m	22.3 dBµV/m	-17.7 dB	Pass	0 Degree	1 m	Vertical
2	46.83 MHz	32.5 dBµV/m	26.2 dBµV/m	-13.8 dB	Pass	0 Degree	1 m	Vertical
3	51.06 MHz	37.9 dBµV/m	32.3 dBµV/m	-7.7 dB	Pass	0 Degree	1 m	Vertical
4	52.95 MHz	38.8 dBµV/m	31.9 dBµV/m	-8.1 dB	Pass	0 Degree	1 m	Vertical
5	58.5 MHz	39.3 dBµV/m	33.1 dBµV/m	-6.9 dB	Pass	0 Degree	1 m	Vertical
6	69.24 MHz	32.7 dBµV/m	26.3 dBµV/m	-13.7 dB	Pass	0 Degree	1 m	Vertical
7	75.6 MHz	32.8 dBµV/m	26.5 dBµV/m	-13.5 dB	Pass	180 Degree	2 m	Vertical
8	200.01 MHz	15 dBµV/m	8.6 dBµV/m	-31.4 dB	Pass	180 Degree	1 m	Vertical
9	599.97 MHz	30.5 dBµV/m	28 dBµV/m	-19.0 dB	Pass	45 Degree	3 m	Vertical
10	820.38 MHz	38.8 dBµV/m	33.7 dBµV/m	-13.3 dB	Pass	270 Degree	3 m	Horizontal
11	925.434 MHz	24.7 dBµV/m	18.4 dBµV/m	-28.6 dB	Pass	90 Degree	2 m	Vertical
12	943.8 MHz	40.7 dBµV/m	39 dBµV/m	-8.0 dB	Pass	0 Degree	1 m	Horizontal

Diagram 22

<b>EUT</b>	EUT 4		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode of operation</b>	12 VDC, without Ground connection		
<b>Test date, time</b>	09.08.2018 16:25:51		
<b>Antenna height</b>	1 m - 4 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 10 ms		

RadiMation



## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	60.39 MHz	32.4 dBμV/m	26.6 dBμV/m	-13.4 dB	Pass	135 Degree	2 m	Vertical
2	66.18 MHz	32.7 dBμV/m	26.3 dBμV/m	-13.7 dB	Pass	135 Degree	2 m	Vertical
3	70.89 MHz	31 dBμV/m	24.8 dBμV/m	-15.2 dB	Pass	135 Degree	2 m	Vertical

9.4 Radiated Electromagnetic Field (1 – 6 GHz)

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

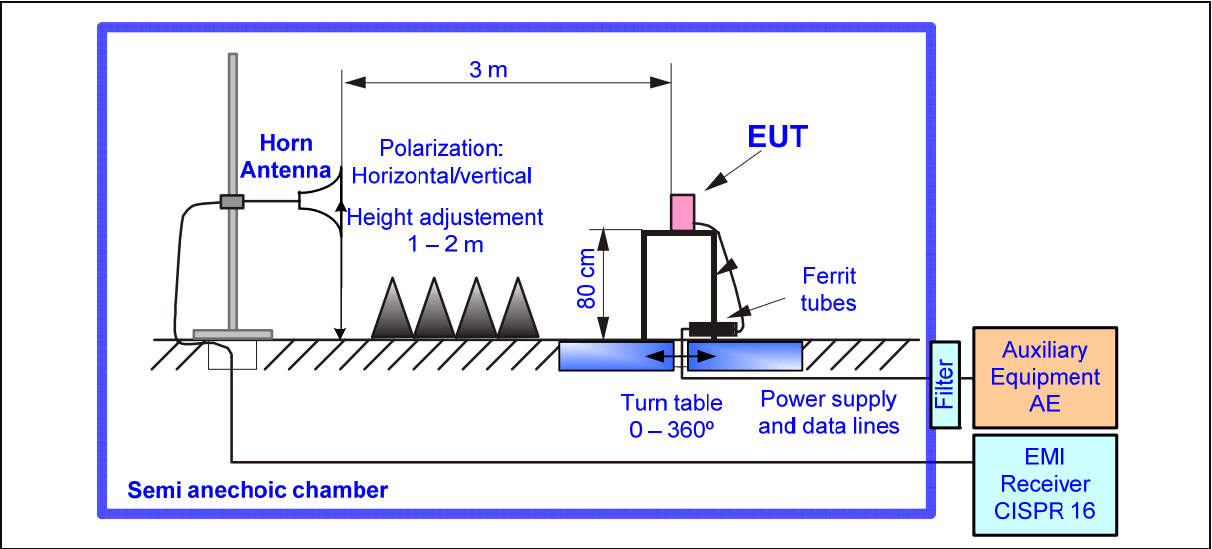
*Distance:* 3 m

*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 antenna is moved from 1 to 2 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	ESU 8	OA10193
Horn Antenna	EMCO	3115	H9353
Coaxial Cable	Huber & Suhner	Sucoflex 106	17.6632.03, 17.6632.04, 18.6632.02

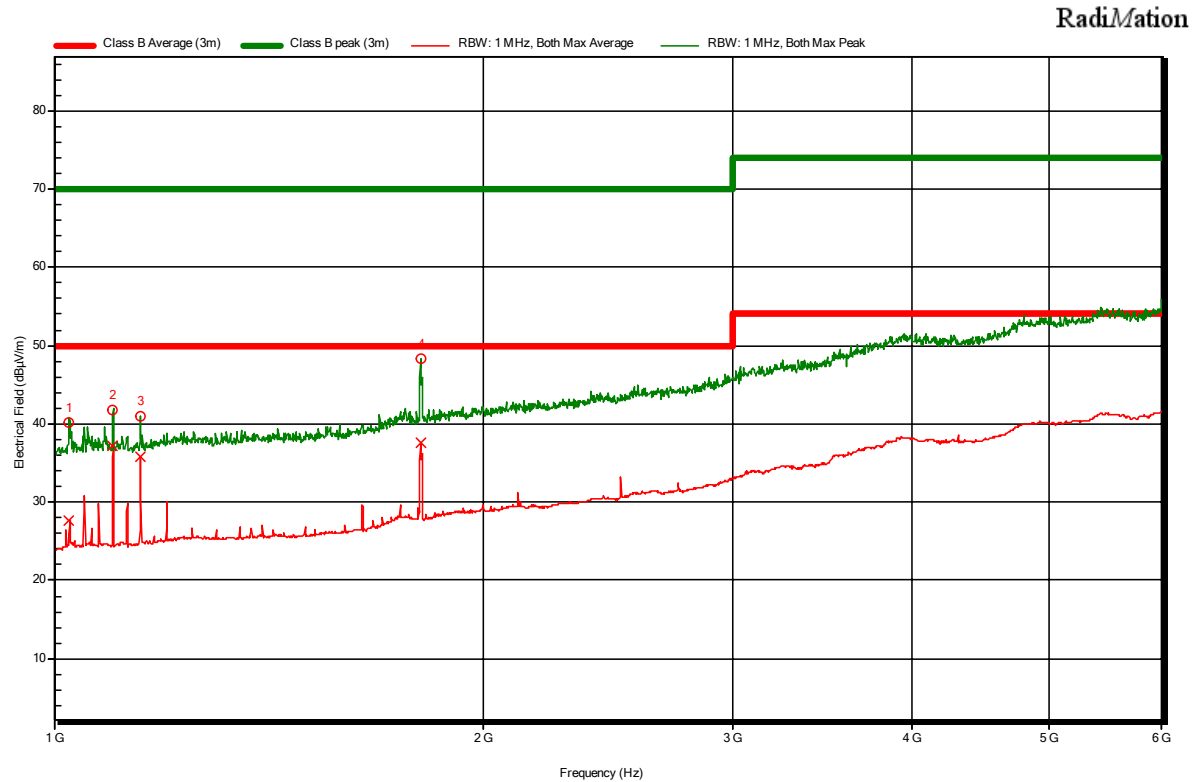
Photos of the Setup

see §9.3

## Measurement Results

Diagram 23

<b>EUT</b>	EUT 1		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Modification</b>	see §12		
<b>Test date, time</b>	04.04.2018 10:44:10		
<b>Antenna height</b>	1 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, 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: 5 ms		



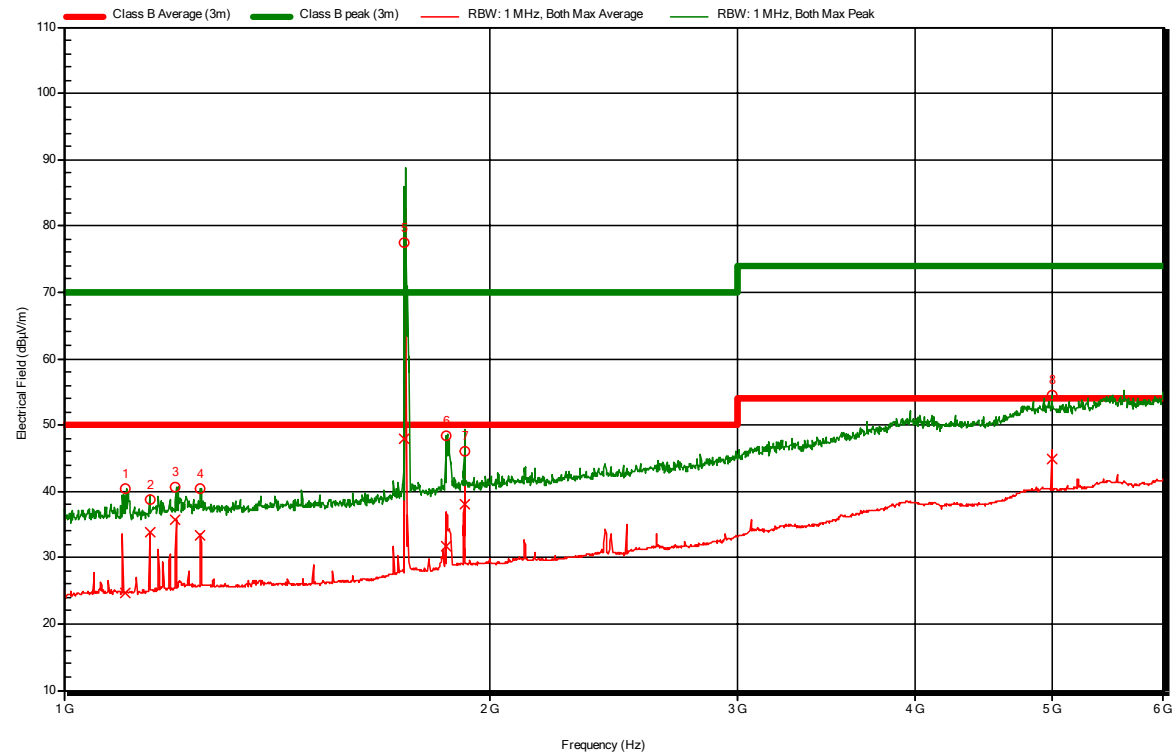
## Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.025 GHz	40.3 dBµV/m	-29.7 dB	27.6 dBµV/m	-22.4 dB	Pass	300 Degree	1 m	Vertical
2	1.1 GHz	41.9 dBµV/m	-28.1 dB	37.2 dBµV/m	-12.8 dB	Pass	300 Degree	1 m	Vertical
3	1.15 GHz	41.1 dBµV/m	-28.9 dB	35.7 dBµV/m	-14.3 dB	Pass	0 Degree	1 m	Vertical
4	1.808 GHz	48.3 dBµV/m	-21.7 dB	37.5 dBµV/m	-12.5 dB	Pass	150 Degree	1 m	Horizontal

Diagram 24

<b>EUT</b>	EUT 3		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Mode of operation</b>	48 VDC, with Ground connection		
<b>Test date, time</b>	09.08.2018 13:18:37		
<b>Antenna height</b>	1 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, 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: 1 ms		

RadiMation



## Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Polarization
1	1.107 GHz	40.5 dBµV/m	-29.5 dB	24.7 dBµV/m	-25.3 dB	Pass	0 Degree	Horizontal
2	1.15 GHz	38.8 dBµV/m	-31.2 dB	33.9 dBµV/m	-16.1 dB	Pass	300 Degree	Vertical
3	1.2 GHz	40.7 dBµV/m	-29.3 dB	35.7 dBµV/m	-14.3 dB	Pass	0 Degree	Horizontal
4	1.25 GHz	40.4 dBµV/m	-29.6 dB	33.3 dBµV/m	-16.7 dB	Pass	210 Degree	Horizontal
5	1.743 GHz	77.4 dBµV/m	7.4 dB	47.9 dBµV/m	-2.1 dB	Note	60 Degree	Vertical
6	1.866 GHz	48.4 dBµV/m	-21.6 dB	31.8 dBµV/m	-18.2 dB	Pass	0 Degree	Horizontal
7	1.92 GHz	46.1 dBµV/m	-23.9 dB	38 dBµV/m	-12.0 dB	Pass	30 Degree	Vertical
8	5 GHz	54.5 dBµV/m	-19.5 dB	44.9 dBµV/m	-9.1 dB	Pass	120 Degree	Horizontal

Note: LTE, exclusion band according ETSI EN 301 489-24 applies

## 9.5 Radiated Emission – Electromagnetic Field – FCC

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

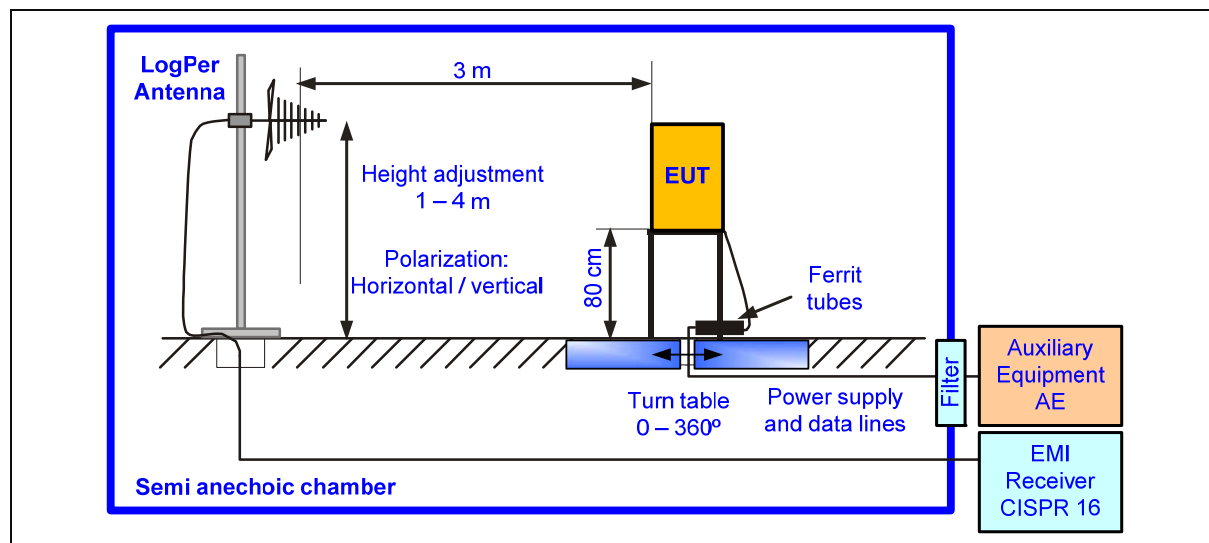
**Distance:** 3 m

**Meas. uncertainty:** see chapter 11

**Measuring method:** The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is moved from 1 to 4 m in height successively with horizontal and vertical polarizations. The turning table is operated through 360° during the measurements. 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 on the graph. The values exceeding a limit shall be re-measured manually using a receiver.

None

### Test Setup



### Test Equipment

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU 8	OA10193
Antenna LogPer	Chase	CBL 6112B	H9728
Coaxial Cable	Huber & Suhner	Sucoflex 106	17.6632.03, 17.6632.04, 18.6632.02

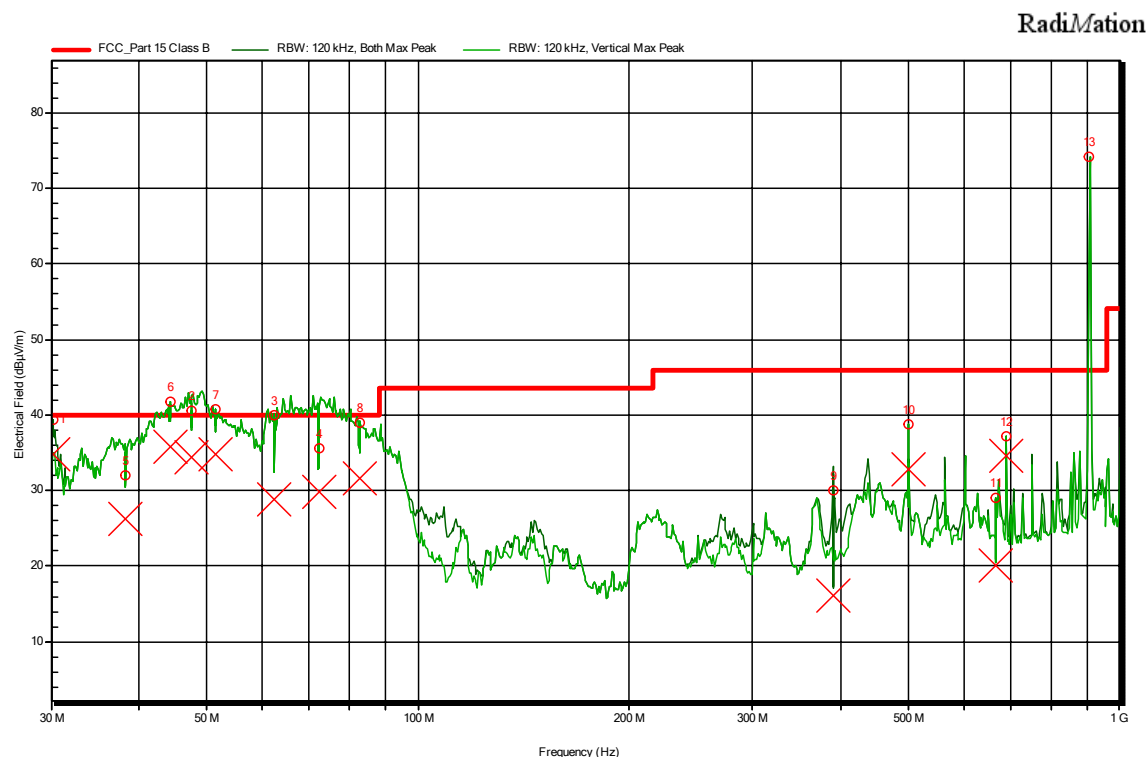
### Photos of the Setup

see §9.3

## Measurement Results

Diagram 25

<b>EUT</b>	EUT 1		
<b>Verdict</b>	Pass according FCC, Class B		
<b>Modification</b>	see §12		
<b>Mode of operation</b>	without Ground connection		
<b>Test date, time</b>	04.04.2018 10:09:49		
<b>Antenna height</b>	1 m - 4 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 10 ms		



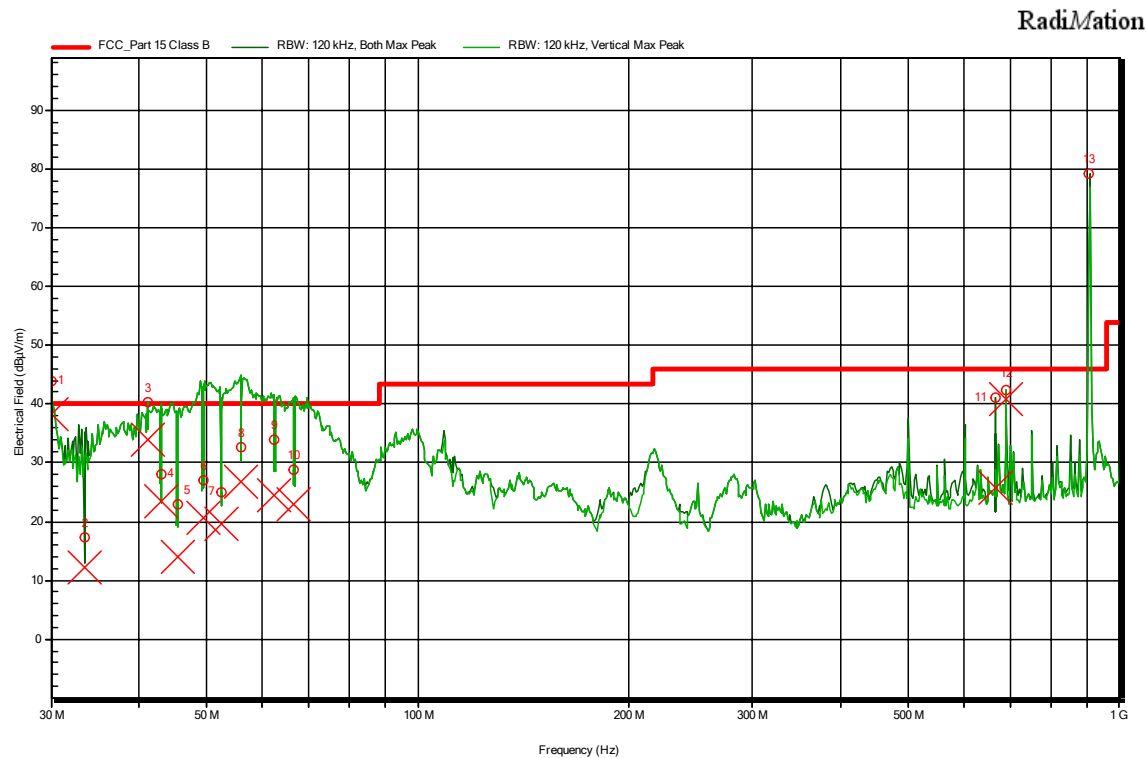
## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	30.21 MHz	39.4 dBµV/m	34.8 dBµV/m	-5.2 dB	Pass	0 Degree	4 m	Horizontal
5	38.31 MHz	32 dBµV/m	26.3 dBµV/m	-13.7 dB	Pass	30 Degree	1 m	Vertical
6	44.34 MHz	41.7 dBµV/m	35.9 dBµV/m	-4.1 dB	Pass	30 Degree	1 m	Vertical
2	47.55 MHz	40.7 dBµV/m	34.4 dBµV/m	-5.6 dB	Pass	30 Degree	1 m	Vertical
7	51.48 MHz	40.7 dBµV/m	34.9 dBµV/m	-5.1 dB	Pass	30 Degree	1 m	Vertical
3	62.49 MHz	40 dBµV/m	28.8 dBµV/m	-11.2 dB	Pass	30 Degree	1 m	Vertical
4	72.21 MHz	35.6 dBµV/m	29.8 dBµV/m	-10.2 dB	Pass	30 Degree	1 m	Vertical
8	82.5 MHz	39.1 dBµV/m	31.7 dBµV/m	-8.3 dB	Pass	30 Degree	1 m	Vertical
9	390.03 MHz	30 dBµV/m	16 dBµV/m	-31.0 dB	Pass	90 Degree	1 m	Horizontal
10	500.01 MHz	38.8 dBµV/m	32.8 dBµV/m	-14.2 dB	Pass	330 Degree	4 m	Vertical
11	666.66 MHz	29 dBµV/m	20.2 dBµV/m	-26.8 dB	Pass	180 Degree	2 m	Vertical
12	687.51 MHz	37.1 dBµV/m	34.6 dBµV/m	-12.4 dB	Pass	300 Degree	4 m	Vertical
13	905.67 MHz	74.2 dBµV/m	--	--	Note	--	--	--

Note: UMTS, exclusion band according ETSI EN 301 489-24 applies

Diagram 26

<b>EUT</b>	EUT 1		
<b>Verdict</b>	Pass according CISPR 32, Class B		
<b>Modification</b>	see §12		
<b>Mode of operation</b>	with Ground connection		
<b>Test date, time</b>	04.04.2018 17:17:19		
<b>Antenna height</b>	1 m - 2 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 120 kHz, VBW: 300 kHz, Sweep time: 50 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 10 ms		



## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	30 MHz	44 dBµV/m	36.5 dBµV/m	-3.5 dB	Pass	120 Degree	1 m	Vertical
2	33.51 MHz	17.2 dBµV/m	12.1 dBµV/m	-27.9 dB	Pass	270 Degree	2 m	Horizontal
3	41.16 MHz	40.3 dBµV/m	33.9 dBµV/m	-6.1 dB	Pass	330 Degree	2 m	Vertical
4	43.02 MHz	27.9 dBµV/m	23.4 dBµV/m	-16.6 dB	Pass	90 Degree	2 m	Vertical
5	45.42 MHz	22.9 dBµV/m	14 dBµV/m	-26.0 dB	Pass	90 Degree	2 m	Vertical
6	49.41 MHz	27.1 dBµV/m	20.6 dBµV/m	-19.4 dB	Pass	90 Degree	2 m	Vertical
7	52.44 MHz	24.9 dBµV/m	19.6 dBµV/m	-20.4 dB	Pass	90 Degree	2 m	Vertical
8	56.01 MHz	32.5 dBµV/m	26.7 dBµV/m	-13.3 dB	Pass	90 Degree	2 m	Vertical
9	62.52 MHz	34 dBµV/m	24.5 dBµV/m	-15.5 dB	Pass	90 Degree	2 m	Vertical
10	66.69 MHz	28.7 dBµV/m	23 dBµV/m	-17.0 dB	Pass	90 Degree	2 m	Vertical
11	666.66 MHz	41 dBµV/m	25.9 dBµV/m	-21.1 dB	Pass	60 Degree	2 m	Horizontal
12	687.51 MHz	42.4 dBµV/m	40.9 dBµV/m	-6.1 dB	Pass	30 Degree	1 m	Vertical
13	905.73 MHz	79.1 dBµV/m	--	--	Note	--	--	--

Note: UMTS, exclusion band according ETSI EN 301 489-24 applies

## 9.6 Radiated Electromagnetic Field – FCC (1 – 13 GHz)

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

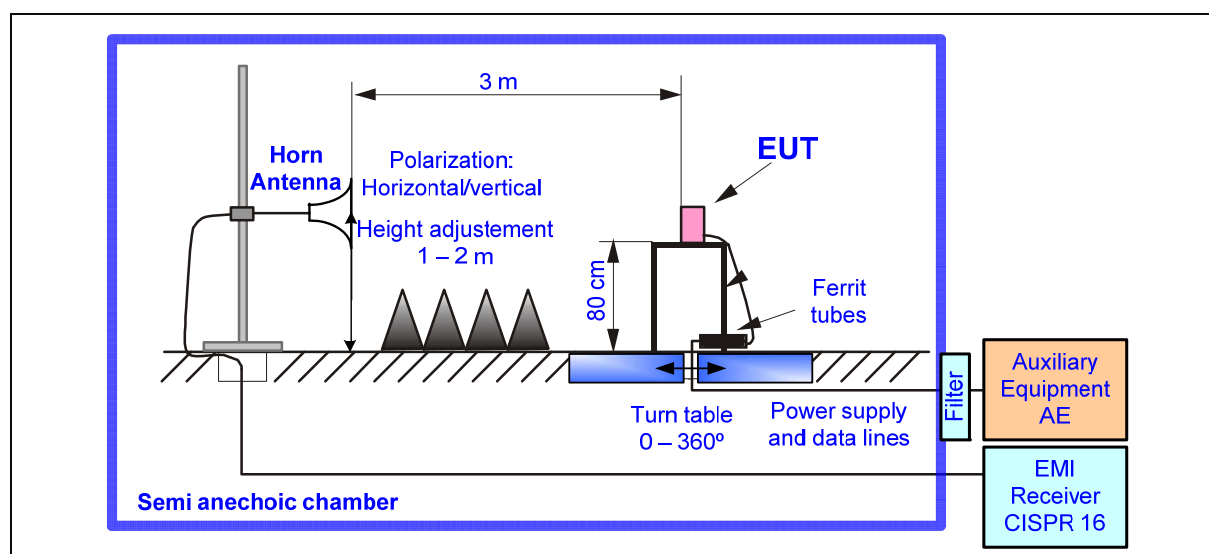
**Distance:** 3 m

**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 antenna is moved from 1 to 2 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
Spectrum Analyzer	Rohde & Schwarz	FSV13	SN: 100849
Pre Amplifier	Mini circuits	ZVA-183A	99.6632.10
Horn Antenna	EMCO	3115	H9353
Coaxial Cable	Huber & Suhner	Sucoflex 106	13.6632.03
Coaxial Cable	Huber & Suhner	Sucoflex 126	18.6632.03

### Photos of the Setup

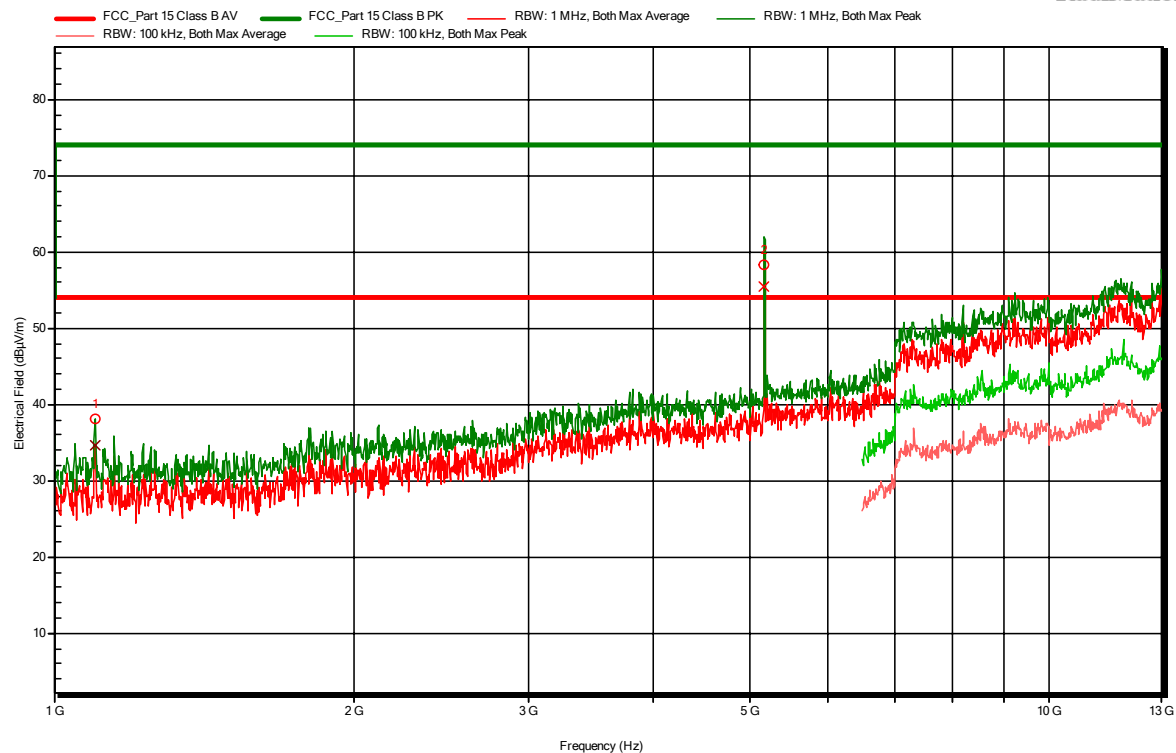
see §9.3

## Measurement Results

Diagram 27

<b>EUT</b>	EUT 1		
<b>Verdict</b>	Pass according FCC Class B		
<b>Modifications</b>	see §12		
<b>Test date, time</b>	04.04.2018 16:32:48		
<b>Antenna height</b>	1 m	<b>Antenna polarization</b>	Vertical/Horizontal
<b>EUT position</b>	0 Degree to 360 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2017.1.6, RBW: 1 MHz, VBW: 3 MHz, Sweep time: 5 ms, Step freq: Fixed step count: 7001 steps per Band, Attenuator: Auto [10.0 dB], Internal preamp: 20 dB, Measure time: 20 ms		

RadiMation



## Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Polarization
1	1.099 GHz	38.2 dBμV/m	-35.8 dB	34.7 dBμV/m	-19.3 dB	Pass	60 Degree	Vertical
2	5.174 GHz	58.3 dBμV/m	--	55.4 dBμV/m	--	Note	--	--

## Notes:

- 1) WLAN, exclusion band according ETSI EN 301 489-24 applies
- 2) Remeasurement from 6.5 – 13 GHz with a RBW of 100 kHz to reduce measurement noise. No peaks in this range could be observed

## 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

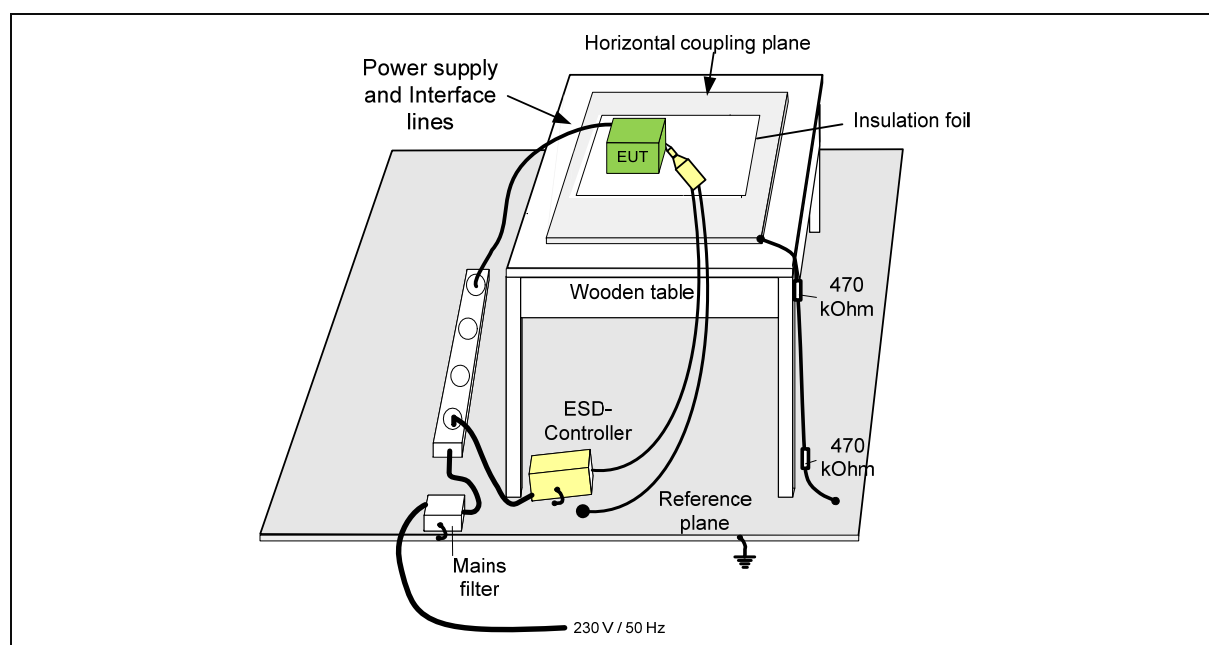
**Meas. uncertainty:**

see chapter 11

**Test method:**

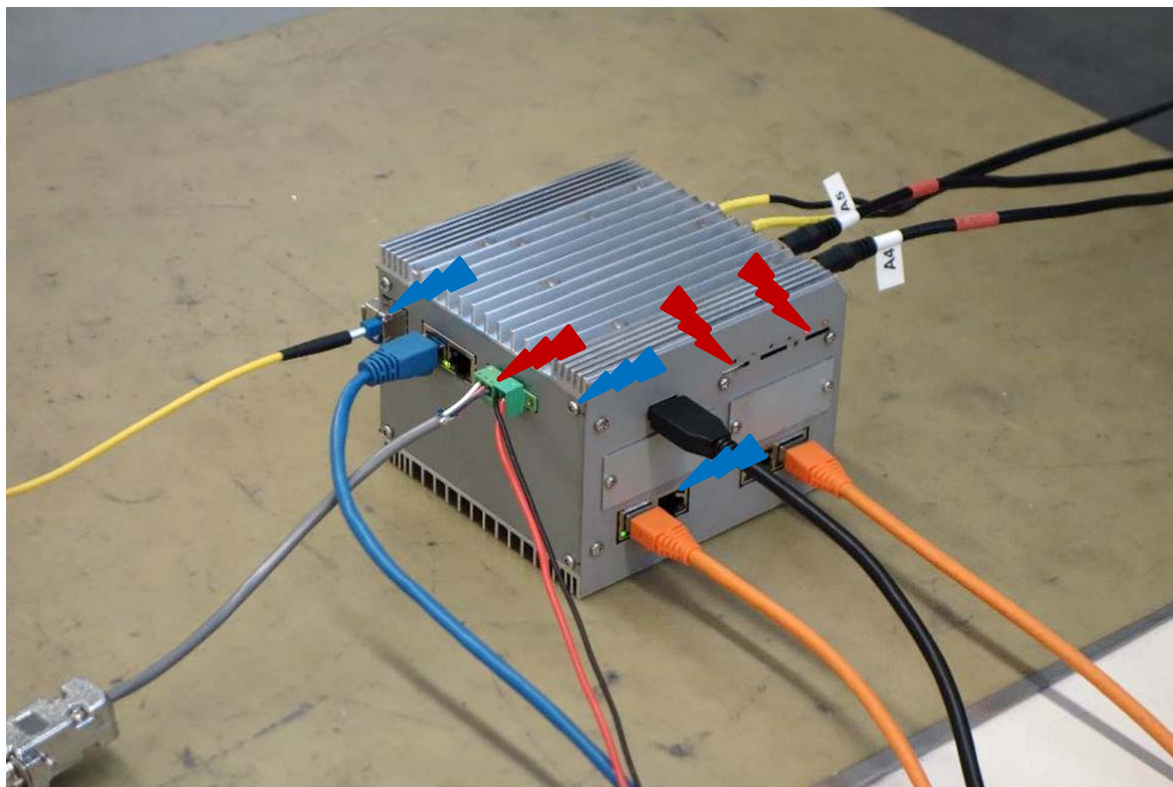
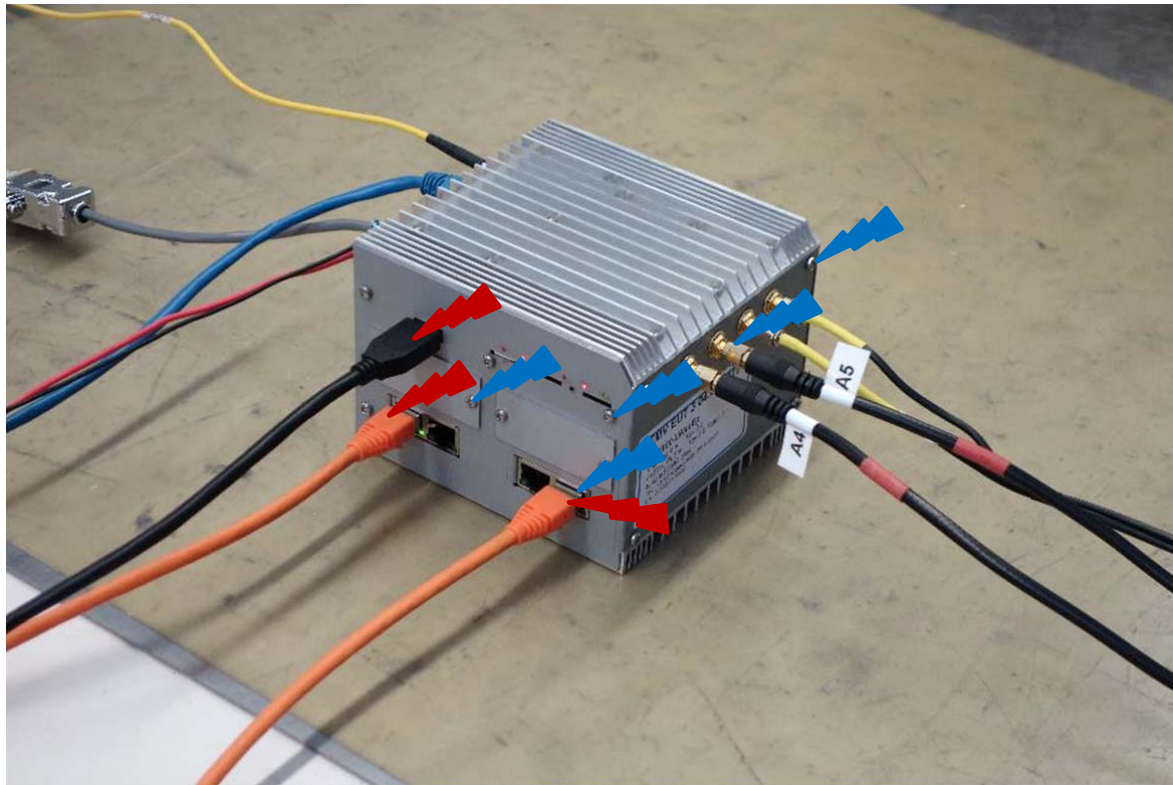
All the points accessible to the operator are tested successively. Contact discharges are carried out on conducting surfaces as well as indirect discharges on a vertical or horizontal coupling plate. Air discharges are carried out on insulated surfaces. A minimum of 10 discharges for each voltage level 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**

**Equipment:** EUT 1  
**Cables connected:** All, see chapter 8.4  
**Operating mode:** Active, see chapter 8.5  
**Observation of EUT:** Visually, see chapter 8.6  
**Modifications:** see §12  
**Test site:** laboratory

**Requirements**

Standard	Required Level Air Discharge	Required Level Contact Discharge	Impulses per Point, Level and Polarity	Performance Criterion
EN 61000-6-2 IEC 61000-6-2	±8 kV	±4 kV	10	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 - Indirect Discharges**

Level [kV]	No of discharges (for each level)	Discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
± 2; ± 4	10	HCP	No errors occurred	A	Pass

Note:

- 1) on all sides of the EUT

**Protocol of the Test - Direct Discharges**

Level [kV]	No of discharges (for each level)	Discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
± 2; ± 4	10	Contact	No errors occurred	A	Pass
± 2; ± 4; ± 8	10	Air	No errors occurred	A	Pass

Tested points: Screws, Connectors, LED's, Slots

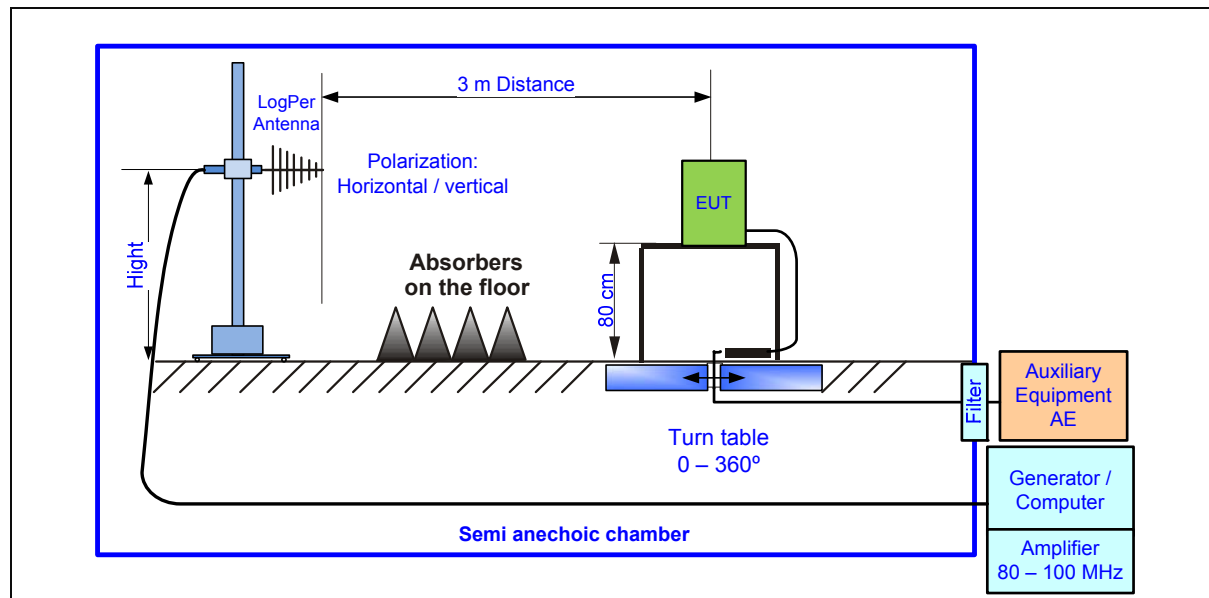
## 10.2 Immunity to Electromagnetic Fields (EN 61000-4-3)

**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



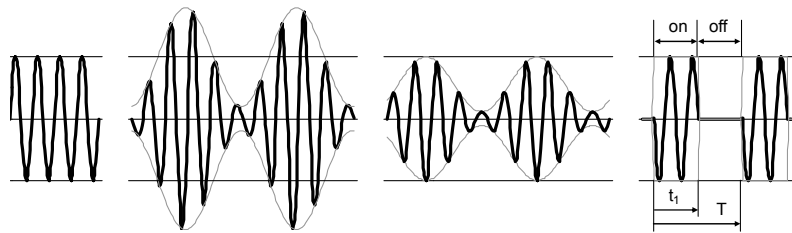
**Test Results**

**Equipment:** EUT 1  
**Cables connected:** All, see chapter 8.4  
**Operating mode:** Active, see chapter 8.5  
**Observation of EUT:** Visually, see chapter 8.6  
**Modifications:** see §12  
**Test site:** semi-anechoic chamber (hybrid)

**Requirements**

Standard	Frequency Range	Required Level	Modulation	Freq. step	Dwell time	Performance Criterion
EN 55035 CISPR 35	80 – 1000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1800 MHz $\pm$ 1% 2600 MHz $\pm$ 1% 3500 MHz $\pm$ 1% 5000 MHz $\pm$ 1%	3 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
EN 301 489-1	80 – 1000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1000 – 6000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A

Modulation:

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


Dwell time:

1 s

**Protocol of the Test**

EUT 1:

Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	10	horizontal	Rear, 0°	No errors occurred	A	Pass
	10	vertical	Rear, 0°	No errors occurred	A	Pass
	10	horizontal	Side, 90°	No errors occurred	A	Pass
	10	vertical	Side, 90°	No errors occurred	A	Pass
	10	horizontal	Front, 180°	No errors occurred	A	Pass
	10	vertical	Front, 180°	No errors occurred	A	Pass
	10	horizontal	Side, 270°	No errors occurred	A	Pass
	10	vertical	Side, 270°	No errors occurred	A	Pass
1000 – 6000	10	horizontal	Rear, 0°	No errors occurred	A	Pass
	10	vertical	Rear, 0°	No errors occurred	A	Pass
	10	horizontal	Side, 90°	No errors occurred	A	Pass
	10	vertical	Side, 90°	No errors occurred	A	Pass
	10	horizontal	Front, 180°	No errors occurred	A	Pass
	10	vertical	Front, 180°	No errors occurred	A	Pass
	10	horizontal	Side, 270°	No errors occurred	A	Pass
	10	vertical	Side, 270°	No errors occurred	A	Pass

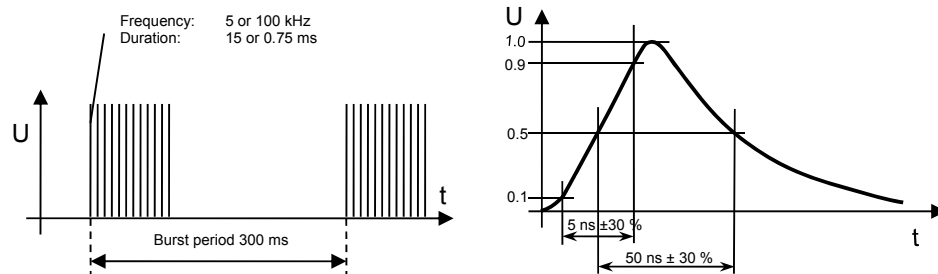
EUT 2:

Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	10	horizontal	Front, 180°	No errors occurred	A	Pass
	10	vertical	Front, 180°	No errors occurred	A	Pass
1000 – 6000	10	horizontal	Front, 180°	No errors occurred	A	Pass
	10	vertical	Front, 180°	No errors occurred	A	Pass

### 10.3 Immunity to Fast Electric Transients (EN 61000-4-4)

**Introduction:** The test is intended to demonstrate the immunity when subjected to types of transient disturbances such as those originating from switching transients (interruption of inductive loads, relay contact bounce, etc.). This test is also known as “burst”.

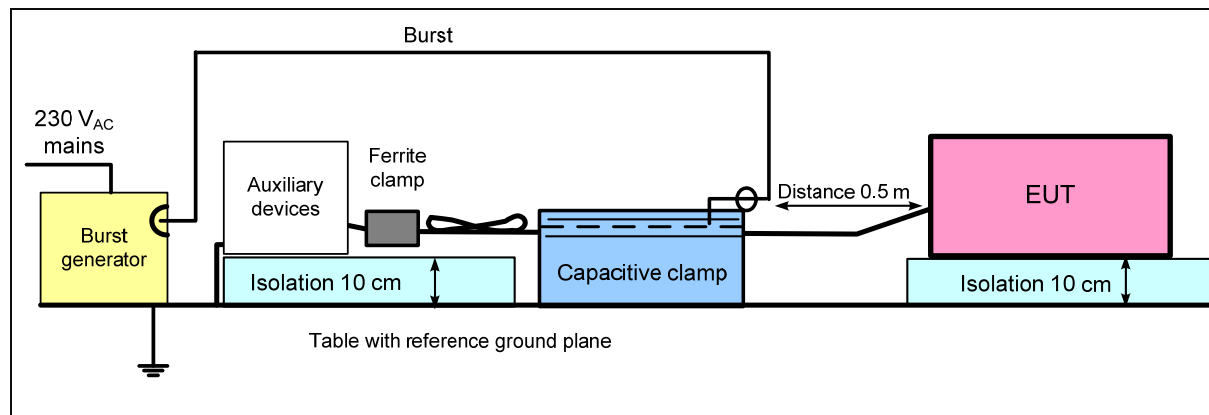
**Pulse:**



**Meas. uncertainty:** see chapter 11

**Test method:** The transient coupling is carried out using a coupling network for the supply cables and a capacitive coupling clamp for the other cables. The two voltage polarities and all the intermediate levels are tested.

#### Test Setup

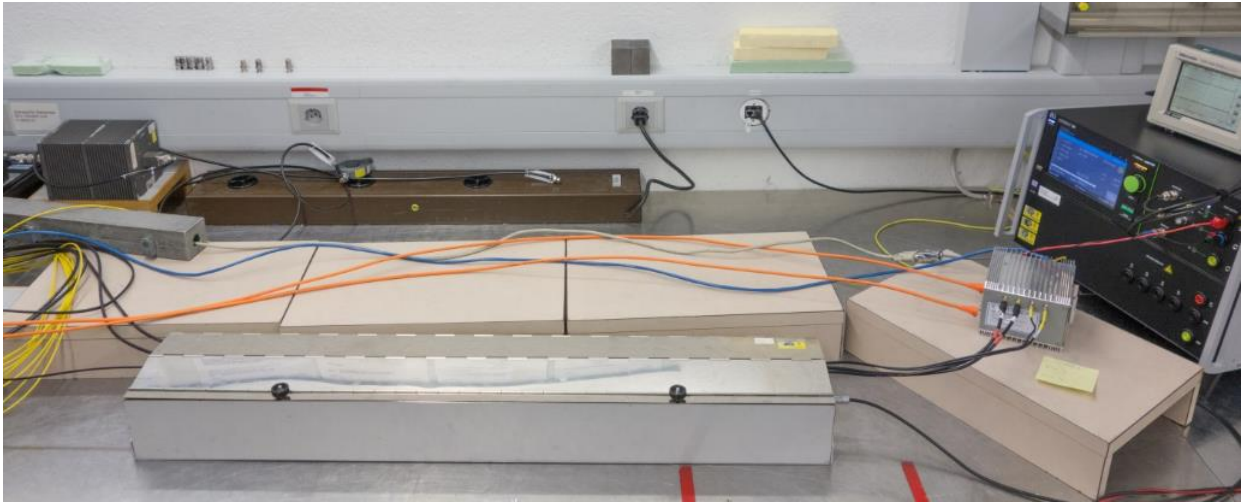


#### Test Equipment

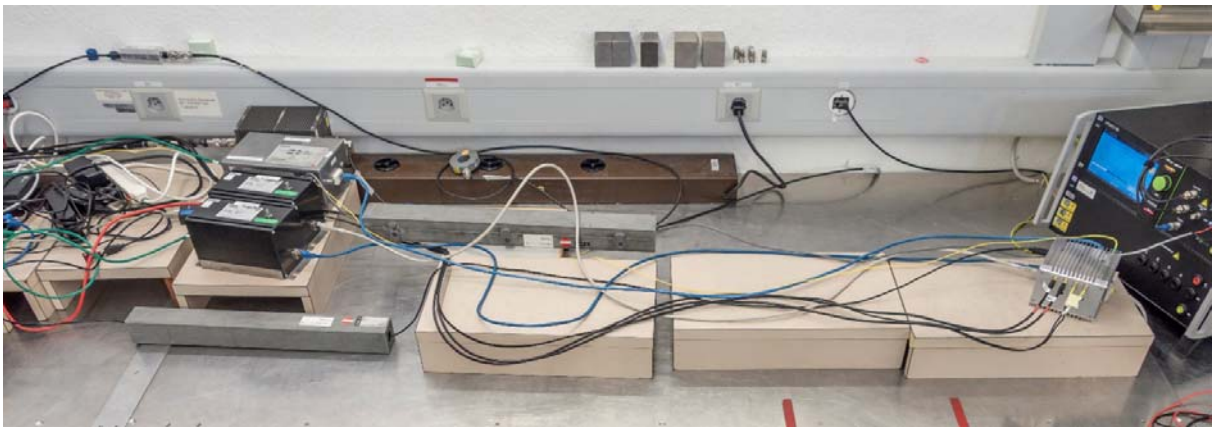
Device Type	Brand	Type	ID
Burst Generator	EM-Test	Compact NX5	17.6632.01
Capacitive Coupling Clamp	EM-Test	EM-Test HFK	H9360
Decoupling device	Lüthi	CDS S8 (RJ45)	13.6632.07 13.6632.08
Decoupling device	Marti	TWP 4x2	H10420
Decoupling clamp	Lüthi	FGZ40X15 E	--
Power Supply	Wayne Kerr	AP7030A	Q8186

## Photos of the Setup

EUT 1:



EUT 3:



**Test Results**

**Equipment:** EUT 1, EUT 3  
**Cables connected:** All, see chapter 8.4  
**Operating mode:** Active, see chapter 8.5  
**Observation of EUT:** Visually, see chapter 8.6  
**Modifications:** see §12  
**Test site:** laboratory

**Requirements**

Standard	Required Level AC Supply	Required Level DC Supply	Required Level Signal	Protection. Earth	Burst Frequency	Performance Criterion
EN 55035 CISPR 35	±1.0 kV	±0.5 kV	±0.5 kV	--	5 kHz	B
EN 61000-6-2 IEC 61000-6-2	±2.0 kV	±1.0 kV	±1.0 kV	--	5 kHz	B
EN 301 489-1	±1.0 kV	±0.5 kV	±0.5 kV	--	5 kHz	B

**Overview Ports**

Port	Cable length	Applicable	Remarks
Enclosure	--	--	Tested with <u>and</u> without earth connection
DC Supply	30 m	Yes	--
USB	< 3 m	No	Service port
Ethernet 1	< 100 m	Yes	--
Ethernet 3 - 6	< 100 m	Yes	Identical ports, tested only on Ethernet 3
Mobile1	< 30 m	Yes	All Antenna cables tested together
Mobile2	< 30 m	Yes	
WLAN1	< 30 m	Yes	
WLAN2	< 30 m	Yes	
RS-232	< 10 m	Yes	--
SFP	--	No	Optical communication

**Protocol of the Test**

EUT 1 with Ground connection:

Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply	1.0 kV	60 s	5 kHz	direct	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	direct	no errors occurred	A	Pass
Antenna Ports	1.0 kV	60 s	5 kHz	clamp	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	clamp	no errors occurred	A	Pass
Ethernet 1	1.0 kV	60 s	5 kHz	clamp	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	clamp	no errors occurred	A	Pass
Ethernet 3	1.0 kV	60 s	5 kHz	clamp	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	clamp	no errors occurred	A	Pass
RS-232	1.0 kV	60 s	5 kHz	clamp	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	clamp	no errors occurred	A	Pass

EUT 1 without Ground connection:

Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply	1.0 kV	60 s	5 kHz	direct	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	direct	no errors occurred	A	Pass
Antenna Ports	1.0 kV	60 s	5 kHz	clamp	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	clamp	no errors occurred	A	Pass
Ethernet 1	1.0 kV	60 s	5 kHz	clamp	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	clamp	no errors occurred	A	Pass
Ethernet 3	1.0 kV	60 s	5 kHz	clamp	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	clamp	no errors occurred	A	Pass
RS-232	1.0 kV	60 s	5 kHz	clamp	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	clamp	no errors occurred	A	Pass

EUT 3 with Ground connection:

Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply	1.0 kV	60 s	5 kHz	direct	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	direct	no errors occurred	A	Pass

EUT 3 without Ground connection:

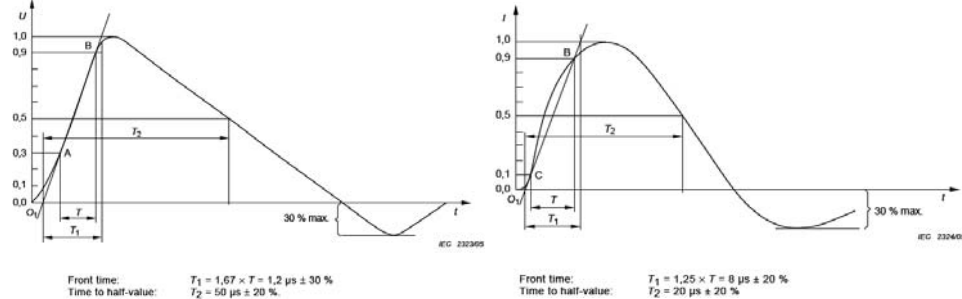
Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply	1.0 kV	60 s	5 kHz	direct	no errors occurred	A	Pass
	1.0 kV	60 s	100 kHz	direct	no errors occurred	A	Pass

## 10.4 Immunity to Surge (EN 61000-4-5 : 1.2/50 $\mu$ s)

### Introduction:

The aim of the test is to determine the immunity of the material submitted to non-repetitive transient overvoltage created by lightning.

### Impulses:



Open-circuit voltage

Short-circuit current

### Meas. uncertainty:

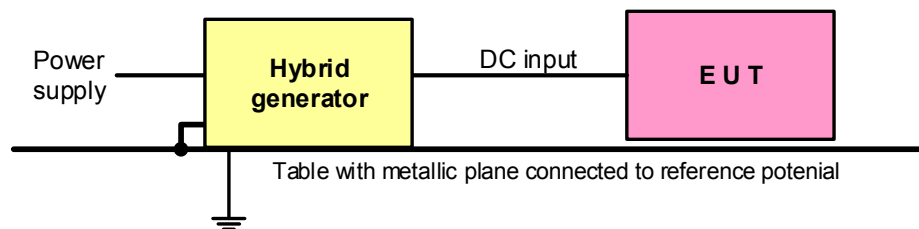
see chapter 11

### Measuring method:

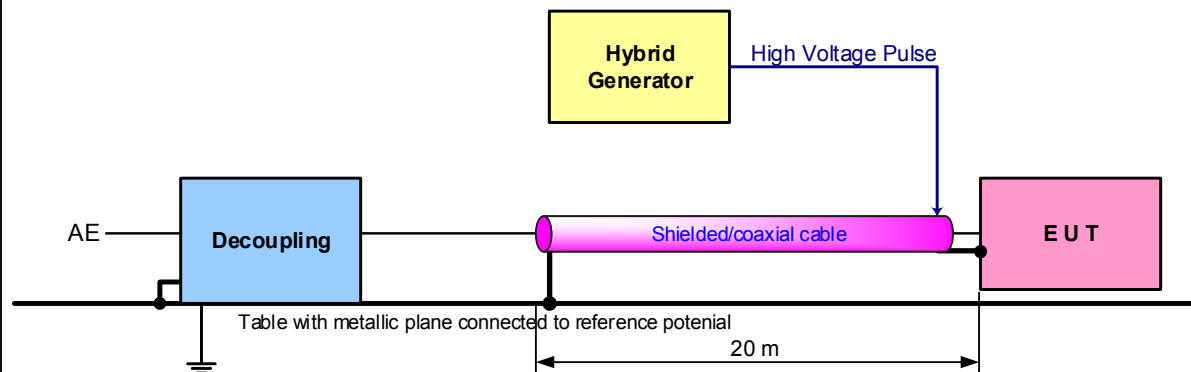
The impulses are coupled using the coupling network where the supply lines and unshielded cables are concerned. The shielded cables are coupled directly. The two polarities and different phase angles are tested for all the test levels up until the specified level.

## Test Setup

### Tests on Power Ports:



### Test on LAN ports with shielded cable:



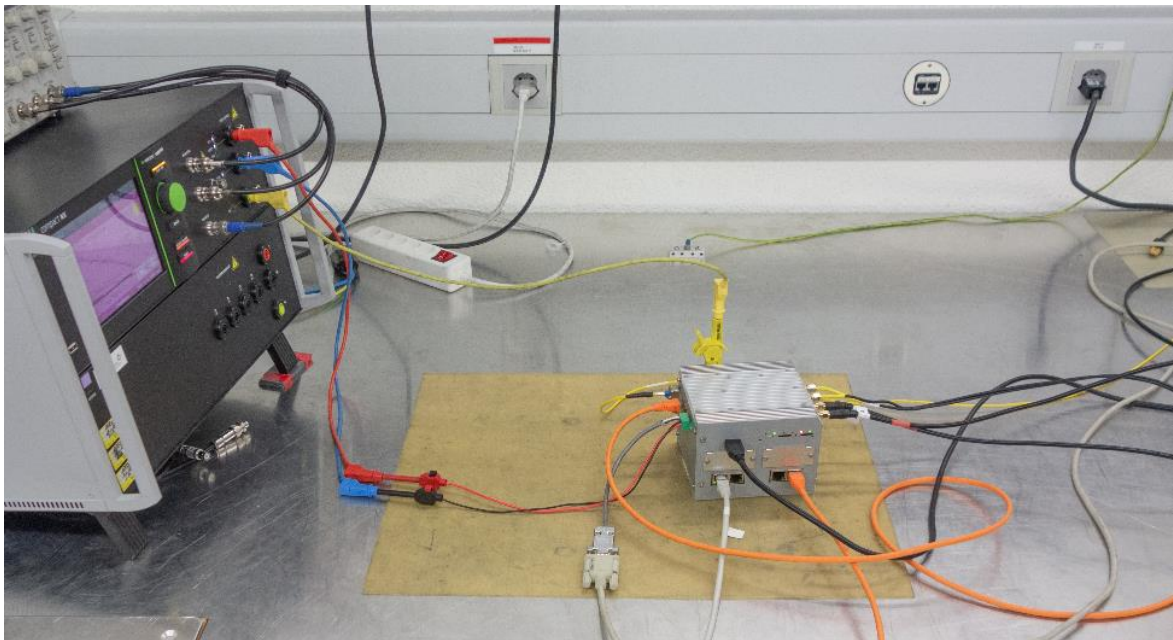
**Test Equipment**

Device Type	Brand	Type	ID
Surge Generator	EM-Test	Compact NX5	17.6632.01
Decoupling Network	EM Test	CNI 508N2	17.6632.02
Power Supply	Wayne Kerr	AP7030A	Q8186

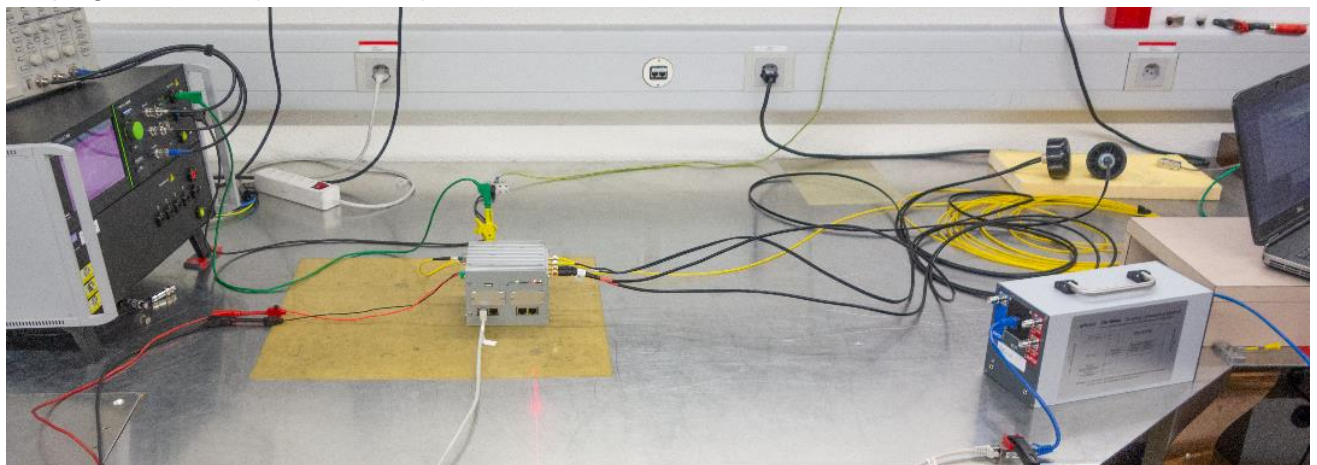
**Photos of the Setup**

EUT 1:

Coupling to DC Supply:



Coupling to Enclosure(Ethernet Ports):



EUT 3: see §10.3

## Test Results

**Equipment:** EUT 1, EUT 3  
**Cables connected:** All, see chapter 8.4  
**Operating mode:** Active, see chapter 8.5  
**Observation of EUT:** Visually, see chapter 8.6  
**Modifications:** see §12  
**Test site:** laboratory

## Requirements

Standard	Required Level AC-Supply		Required Level DC-Supply		Required Level Signal		Performance Criterion
	L – N 2 Ω+18 μF	L, N – PE 12 Ω+9 μF	L1 – L2 2 Ω+18 μF	L1, L2 – PE 12 Ω+9 μF	L1 – L2 42 Ω+0.5 μF	L1, L2 – PE 42 Ω+0.5 μF	
EN 61000-6-2	±1.0 kV	±2.0 kV	±0.5 kV	±0.5 kV	---	±1.0 kV	B
IEC 61000-6-2	±1.0 kV	±2.0 kV	±0.5 kV	±1.0 kV	---	±1.0 kV	B
EN 55035 CISPR 35	±1.0 kV	±2.0 kV	---	±0.5 kV	--	±1.0 kV	B
EN 301 489-1	±1.0 kV	±2.0 kV	---	---	±0.5 kV	±1.0 kV	B

## Overview Ports

Port	Cable length	Applicable	Remarks
Enclosure	--	--	Tested with <u>and</u> without earth connection
DC Supply	30 m	Yes	--
USB	< 3 m	No	Service port
Ethernet 1	< 100 m	Yes	--
Ethernet 3 - 6	< 100 m	Yes	Identical ports, tested only on Ethernet 3
Mobile1	< 30 m	No	--
Mobile2	< 30 m	No	--
WLAN1	< 30 m	No	--
WLAN2	< 30 m	No	--
RS-232	< 10 m	No	--
SFP	--	No	Optical communication

**Protocol of the Test – Tests on Power Ports**

EUT 1 without Ground connection:

Tested port	Level [kV]	Coupling	Number of pulses*	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply L+ – L-	±0.5	2 $\Omega$ + 18 $\mu$ F	5	no errors occurred	A	Pass

\* Number of pulses for each voltage level and each polarity

EUT 1 with Ground connection:

Tested port	Level [kV]	Coupling	Number of pulses*	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply L+ – L-	±0.5	2 $\Omega$ + 18 $\mu$ F	5	no errors occurred	A	Pass
DC Supply L+ – PE	±0.5; ±1.0	12 $\Omega$ + 9 $\mu$ F	5	no errors occurred	A	Pass
DC Supply L- – PE	±0.5; ±1.0	12 $\Omega$ + 9 $\mu$ F	5	no errors occurred	A	Pass

\* Number of pulses for each voltage level and each polarity

**Protocol of the Test – Test on LAN ports with shielded cable**

EUT 1

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses*	Result, Observation, Behavior of EUT	Fulfilled Criterion	Verdict
Ethernet 1	±0.5; ±1.0	Screen – PE	2 $\Omega$ + 18 $\mu$ F	5	no errors occurred	A	Pass
Ethernet 3	±0.5; ±1.0	Screen – PE	2 $\Omega$ + 18 $\mu$ F	5	no errors occurred	A	Pass

\* Number of pulses for each voltage level and each polarity

Notes:

- Tested with and without Ground connection

EUT 3 without Ground connection:

Tested port	Level [kV]	Coupling	Number of pulses*	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply L+ – L-	±0.5	2 $\Omega$ + 18 $\mu$ F	5	no errors occurred	A	Pass

\* Number of pulses for each voltage level and each polarity

EUT 3 with Ground connection:

Tested port	Level [kV]	Coupling	Number of pulses*	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply L+ – L-	±0.5	2 $\Omega$ + 18 $\mu$ F	5	no errors occurred	A	Pass
DC Supply L+ – PE	±0.5; ±1.0	12 $\Omega$ + 9 $\mu$ F	5	no errors occurred	A	Pass
DC Supply L- – PE	±0.5; ±1.0	12 $\Omega$ + 9 $\mu$ F	5	no errors occurred	A	Pass

\* Number of pulses for each voltage level and each polarity

## 10.5 Immunity to Conducted Disturbances Induced by RF Fields (EN 61000-4-6)

### Introduction:

The object of this test is to determine the immunity of equipment when subjected to conducted disturbances coming from intended radiofrequency transmitters. These disturbances can be found as common mode currents on the conductors and the screens of the cables.

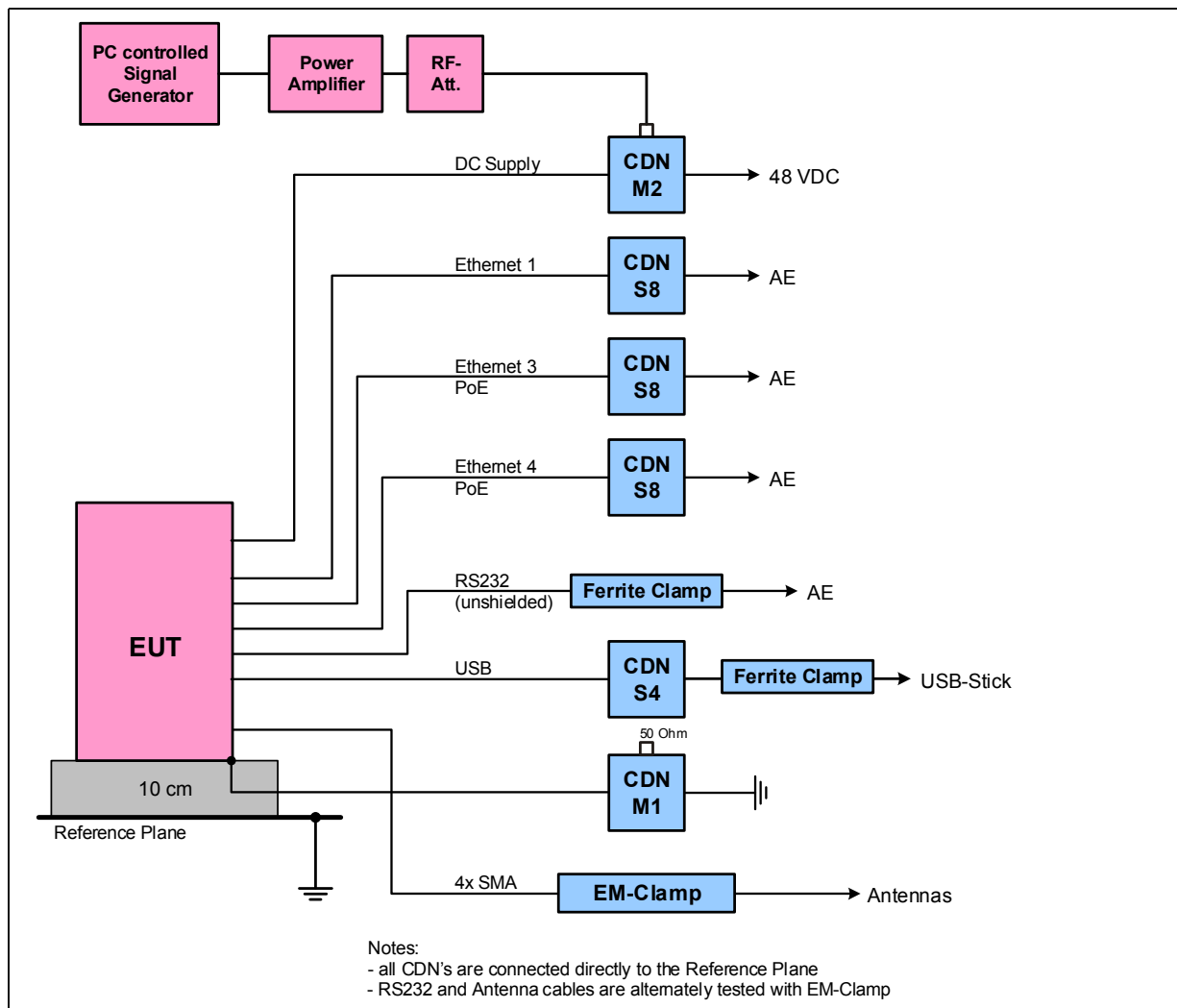
### Meas. uncertainty:

see chapter 11

### Measuring method:

The HF voltage is injected on the cables using different coupling/decoupling networks. All connected cables shall be provided with the appropriate coupling and decoupling devices. The voltage is calibrated without the equipment under test. The Dwell time is depending on the reaction time of the tested equipment.

### Test Setup

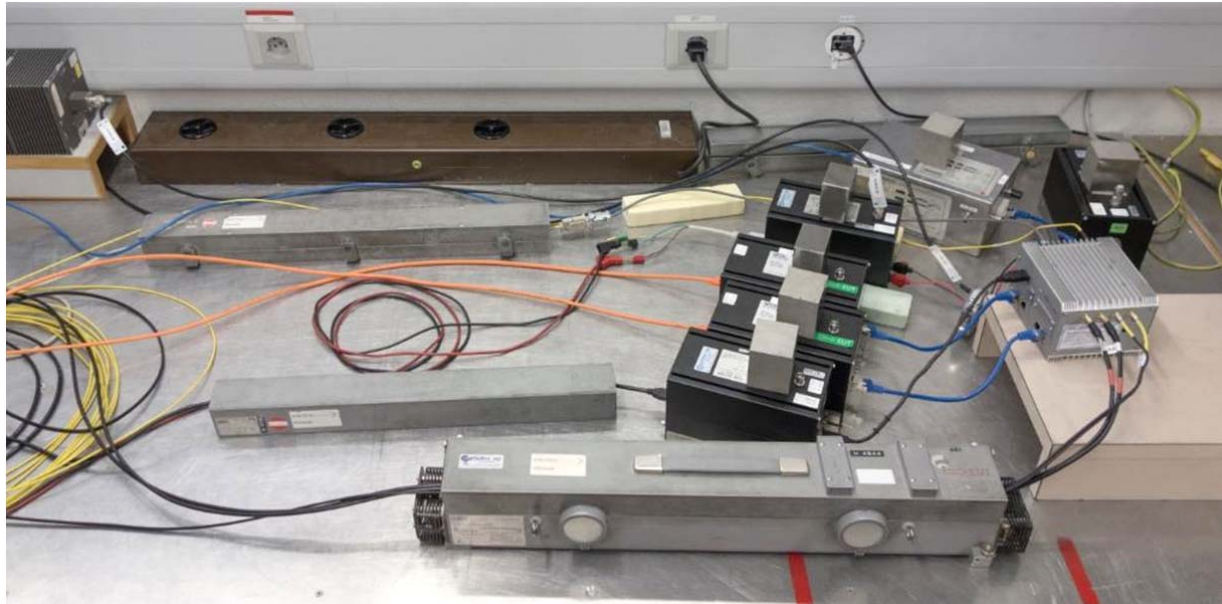


### Test Equipment

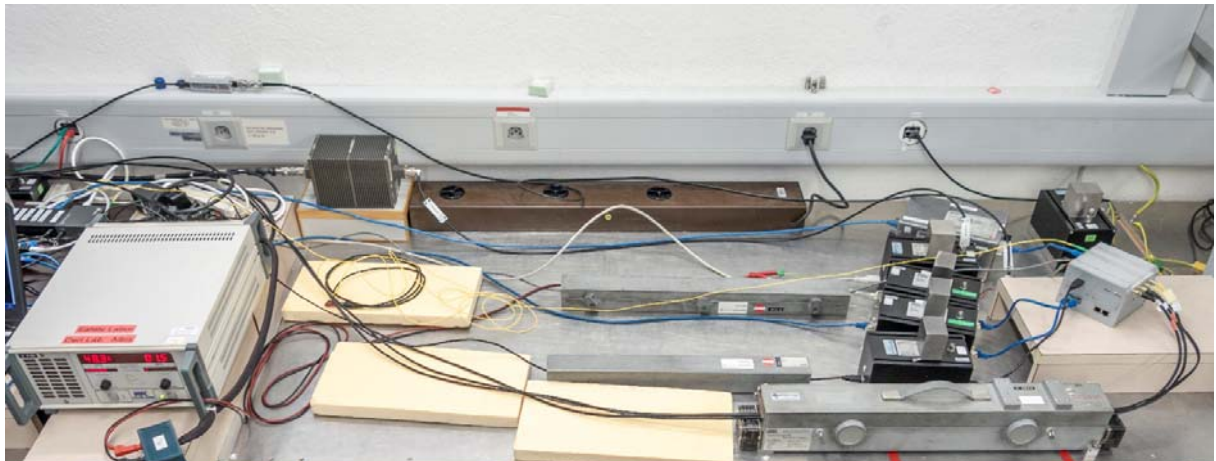
Device Type	Brand	Type	ID
Signal Generator	Marconi	2024	GF7839
Amplifier	Amplifier Research	150A250	V10108
Current sensor	Fischer	F-55	H10123
Sensor power meter	Gigatronic	8541	IV9490
Injection device	EM-Test	CDN M2/3	H10167
Injection device	EM-Test	CDN M1 32 A	H10165
Injection device	EM-Test	CDN S4 (USB)	H10173
Injection device	Lüthi	CDS S8 (RJ45)	13.6632.07 13.6632.08
Injection device	EM-Test	EM 100 FTC101	H4844 H6979
Decoupling device	Marti	TWP 4x2	H10420
Decoupling clamp	Lüthi	FGZ40X15 E FG40X15	-- --
Power Supply	Wayne Kerr	AP7030A	Q8186

### Photos of the Setup

EUT 1:



EUT 3:



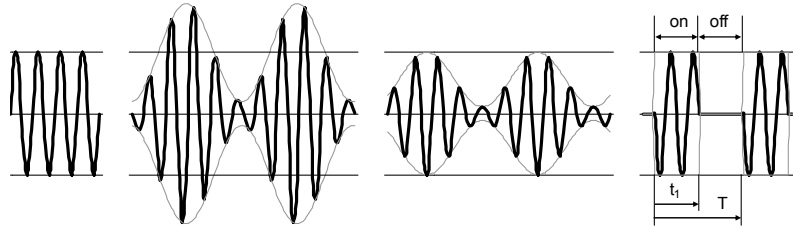
## Test Results

**Equipment:** EUT 1, EUT 3  
**Cables connected:** All, see chapter 8.4  
**Operating mode:** Active, see chapter 8.5  
**Observation of EUT:** Visually, see chapter 8.6  
**Modifications:** see §12  
**Test site:** laboratory

## Requirements

Standard	Frequency range	Required level	Modulation	Freq. step	Dwell time	Performance crit.
EN 55035 CISPR 35	0.15 – 10 MHz 10 – 30 MHz 30 – 80 MHz	3 V <sub>EMF</sub> 3 – 1 V <sub>EMF</sub> 1 V <sub>EMF</sub>	AM, 1 kHz, 80 %	1 %	1 s	A
EN 61000-6-2 IEC 61000-6-2	0.15 – 80 MHz	10 V <sub>EMF</sub>	AM, 1 kHz, 80 %	1 %	1 s	A
EN 301 489-1	0.15 – 80 MHz	3 V <sub>EMF</sub>	AM, 1 kHz, 80 % ev. AM, 400 Hz, 80%	1 %	1 s	A

Signal modulation: ☐ CW ☒ AM (normal) ☐ AM (const. peak) ☐ PM



Dwell time: 1 s

## Overview Ports

Port	Cable length	Applicable	Remarks
Enclosure	--	--	Tested with <u>and</u> without earth connection, as described below
DC Supply	30 m	Yes	--
USB	< 3 m	No	Service port
Ethernet 1	< 100 m	Yes	--
Ethernet 3 - 6	< 100 m	Yes	--
Mobile1	< 30 m	Yes	All Antenna cables tested together
Mobile2	< 30 m	Yes	
WLAN1	< 30 m	Yes	
WLAN2	< 30 m	Yes	
RS-232	< 10 m	Yes	--
SFP	--	No	Optical communication

**Protocol of the Test**

EUT 1:

Coupling	CDN	Terminated(50 $\Omega$ )	Freq. [MHz]	Level [V]	Remarks	Fulfilled criterion	Verdict
DC Supply	M2	Enclosure, M1	0.15 – 80	12	no errors occurred	A	Pass
DC Supply	M2	Ethernet 4, S8	0.15 – 80	12	no errors occurred	A	Pass
Ethernet 1	S8	Enclosure, M1	0.15 – 80	12	no errors occurred	A	Pass
Ethernet 3	S8	Enclosure, M1	0.15 – 80	12	no errors occurred	A	Pass
Ethernet 4	S8	Ethernet 1, S8	0.15 – 80	12	no errors occurred	A	Pass
Antenna Ports	EM100	DC Supply, M2	0.15 – 80	12	no errors occurred	A	Pass
RS232	EM100	Ethernet 4, S8	0.15 – 80	12	no errors occurred	A	Pass

EUT 3:

Coupling	CDN	Terminated(50 $\Omega$ )	Freq. [MHz]	Level [V]	Remarks	Fulfilled criterion	Verdict
DC Supply	M2	Enclosure, M1	0.15 – 80	12	no errors occurred	A	Pass

# 11. Measurement Uncertainty

Conducted emission	Estimated uncertainty of the measurement results: (normal distribution, k=2)		± 2.8 dB
	Maximum uncertainty defined by the standard:		± 3.6 dB
Radiated emission	Estimated uncertainty of the measurement results for 30 – 230 MHz: (normal distribution, k=2)		± 3.4 dB
	Estimated uncertainty of the measurement results for 230 – 1000 MHz:(normal distribution, k=2)		± 2.2 dB
	Maximum uncertainty defined by the standard for 30 – 230 MHz:		± 5.2 dB
	Maximum uncertainty defined by the standard for 230 – 1000 MHz:		± 5.2 dB
	Estimated uncertainty of the measurement results for 1 – 6 GHz:(normal distribution, k=2)		± 4.8 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 %

## 12. Modifications on the EUT

EUT 1 & 2:

All EMC flaps of the enclosure were isolated. Therefore, they will be removed on housing redesign.

To pass the conducted emission test following modifications have been done:

- Changed R2513 to 75kOhm