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FCC Registration No.: **761065**

Report:	Electromagnetic Compatibility	Report no:	16-EL-0019.E04
Test item description:	NetModule Router NB3000 Line IP65 / IP67	Date of test:	June 19 to 20, 2017 March 12-13, 2018
Applicant:	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern SWITZERLAND	Model/Type reference:	NB3711-2LcWacHd-G NB3800-3LdWacCdHd-G NB3711-2LcWacPbHd-G
Manufacturer:	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern SWITZERLAND	Serial no:	00112B01890D 00112B01880A 00112B01D475
Trade mark:	NETMODULE		

Standards		Result
EN 50121-3-2: 2015 IEC 62236-3-2: 2008	Railway applications - EMC - Part 3-2: Rolling stock - Apparatus	Pass
EN 50155: 2007 IEC 60571: 2006	Railway applications – Electronic equipment used on rolling stock	See § 2
EN 55022: 2010 CISPR 22: 2008	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement - Class B	Pass
EN 55032: 2015 CISPR 32: 2015	Electromagnetic compatibility of multimedia equipment – Emission requirements	Pass
EN 61000-6-3 : 2007 + A1 IEC 61000-6-3 : 2006 + A1	EMC - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments	Pass
EN 61000-6-2: 2005 IEC 61000-6-2: 2016	EMC - Part 6-2: Generic standards - Immunity for industrial environments	Pass
EN 301 489-1 V1.9.2	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 1: Common technical requirements	Pass
EN 301 489-7 V1.3.1	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)	Pass
EN 301 489-17 V3.1.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment; Part 17: Specific conditions for Broadband Data Transmission Systems	Pass
EN 301 489-24 V1.5.1	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	Pass
CFR 47 Part 15 - B: 2014	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"	Pass

Test performed by



Mr. Daniel Rufer
EMC Test-Engineer

Reviewed by



Mr. Pascal Treichler
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Zurich, 2018-03-16

(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

In this test report the versions:

- NB3711-2LcWacHd-G, also referred to as EUT1
- NB3800-3LdWacCDfHd-G, also referred to as EUT2
- NB3711-2LcWacPbHd-G, also referred to as EUT3

have been tested.

This test report completes the 15-EL-0061.E02 (NB37x0)
and 16-EL-0019.E02 (NB3800) test reports.

Due to the new IP 67 enclosure from the types NB3711 and NB3800 the following tests were done:

- Radiated emission
- Conducted emission
- Radiated Immunity
- Burst
- ESD

Reference reports:

EUT1: NB3711, 15-EL-0061.E02

EUT2: NB3800, 16-EL-0019.E02

EUT3 has been tested because of a new power supply implemented. The following tests were done:

- Radiated emission
- Conducted emission
- Radiated Immunity
- Burst
- Surge
- Conducted Immunity

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

§	Test Type		Result
14	Emission		EN 50121-3-2
14.1	Interference voltage	EN 55016-2-1 CISPR 16-2-1	PASS
14.4	Radiated electromagnetic field	EN 55016-2-3 CISPR 16-2-3	PASS
15	Immunity		EN 50121-3-2
15.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	PASS
15.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	PASS
15.3	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	PASS ¹
15.4	Surges	EN 61000-4-5 IEC 61000-4-5	PASS
15.5	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	PASS ¹

1. USB port not tested, service port

2. Summary of Test Results (EN 50155 / IEC 60571)

§	Test Type		Result
14	Emission		EN 50155
14.1	Interference voltage	EN 55016-2-1 CISPR 16-2-1	PASS
14.4	Radiated electromagnetic field	EN 55016-2-3 CISPR 16-2-3	PASS
15	Immunity		EN 50155
--	Visual inspection	EN 50155 §12.2.1	PASS
15.6	Performance test	EN 50155 §12.2.2	PASS
15.6	Supply overvoltages	EN 50155 §12.2.6	PASS
15.4	Surges, electrostatic discharge and transient burst susceptibility tests	EN 50155 §12.2.7	PASS
15.5	Radio interference test	EN 50155 §12.2.8	PASS ²
15.7	Insulation test	EN 50155 §12.2.9	PASS

1. Only EMC part of EN 50155 tested

2. USB port not tested, service port

3. Summary of Test Results (EN 55022 / EN 55032)

§	Test Type		Result
14	Emission		EN 55022
14.1	Interference voltage	EN 55022 / 55032 CISPR 22 / 32	Not applicable ¹
14.2	Common mode at telecom. ports	EN 55022 / 55032 CISPR 22 / 32	PASS
14.4	Radiated electromagnetic field	EN 55022 / 55032 CISPR 22 / 32	PASS
--	Harmonics	EN 61000-3-2 IEC 61000-3-2	Not applicable ¹
--	Voltage fluctuations (flicker)	EN 61000-3-3 IEC 61000-3-3	Not applicable ¹

1. No AC Mains port

4. Summary of Test Results (EN 61000-6-3)

§	Test Type		Result
14	Emission		EN 61000-6-3
14.1	Interference voltage DC port	EN 55016-2-1 CISPR 16-2-1	PASS
14.2	Common mode at telecom. ports	EN 55022 / 55032 CISPR 22 / 32	PASS
14.4	Radiated electromagnetic field	EN 55016-2-3 CISPR 16-2-3	PASS
--	Harmonics	EN 61000-3-2 IEC 61000-3-2	Not applicable ¹
--	Voltage fluctuations (flicker)	EN 61000-3-3 IEC 61000-3-3	Not applicable ¹

2. No AC Mains port

5. Summary of Test Results (FCC)

§	Test Type		Result
14	Emission		CFR 47
14.1	Conducted emission	CFR 47 § 15.107 (Class B)	Not applicable ¹
14.6	Radiated emission – EM-field	CFR 47 § 15.109 (Class B)	PASS

1. Not applicable on DC port (EUT contains no AC power)

6. Summary of Test Results (EN 61000-6-2)

§	Test Type		Result
15	Immunity		EN 61000-6-2
15.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	PASS
15.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	PASS
15.3	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	PASS ¹
15.4	Surges	EN 61000-4-5 IEC 61000-4-5	PASS
15.5	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	PASS ¹
--	Magnetic fields (industrial frequencies)	EN 61000-4-8 IEC 61000-4-8	Not applicable ²
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	Not applicable ³

1. USB port not tested, service port

2. No magnetic field sensitive device

3. No AC Mains port

7. 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. However, during the EMC immunity tests the exclusion bands were considered, see results in the next pages.

§	Test Type		Result
14	Emission		EN 301 489-x mobile equipment
14.1	Interference voltage	EN 55022 CISPR 22	PASS
14.2	Common mode at telecom. ports	EN 55022 CISPR 22	PASS
14.4	Radiated electromagnetic field	EN 55022 CISPR 22	PASS
--	Harmonics	EN 61000-3-2 IEC 61000-3-2	Not applicable ¹
--	Voltage fluctuations (flicker)	EN 61000-3-3 IEC 61000-3-3	Not applicable ¹
15	Immunity		EN 301 489-x mobile equipment
15.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	PASS
15.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	PASS
15.3	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	PASS ²
15.4	Surges	EN 61000-4-5 IEC 61000-4-5	PASS
15.5	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	PASS ²
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	Not applicable ¹

1. No AC Mains port

2. USB port not tested, service port

8. Summary of Test Results (FCC)

§	Test Type		Result
14	Emission		CFR 47
--	Conducted emission	CFR 47 § 15.107 (Class B)	Not applicable ¹
14.6	Radiated emission – EM-field	CFR 47 § 15.109 (Class B)	PASS

1. No AC Mains port

9. Applied Standards

EN 50121-3-2 : 2015 IEC 62236-3-2 : 2008	Railway applications – Electromagnetic compatibility Part 3-2: Rolling stock – Apparatus
EN 550155 : 2007 IEC 60571:2012	Railway applications - Electronic equipment used on rolling stock
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 55022 : 2010 CISPR 22 : 2008	Information technology equipment Radio disturbance characteristics – Limits and methods of measurement
EN 55032 : 2015 CISPR 32 : 2015	Electromagnetic compatibility of multimedia equipment – Emission requirements
EN 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 + A2 IEC 61000-4-3 : 2006 + A1 + A2	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 : 2006 IEC 61000-4-5 : 2005	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 61000-4-29 : 2000 IEC 61000-4-29 : 2000	Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests
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 + A1:2010	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
EN 301 489-7 V1.3.1 : 2005	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
EN 301 489-17 V1.1.1 : 2017	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
CFR 47 Part 15 Subpart B : 2014	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"

10. Abbreviations

Electromagnetic compatibility and radio spectrum matters:

AC	Alternating current
AFA	Adaptive Frequency Agility
AM	Amplitude Modulation
AV	Average
BW	Bandwidth
CDN	Coupling Decoupling Network
CW	Continuous Wave
d(t)	Relative voltage change characteristic
DAA	Detect And Avoid spectrum access technique
dB	Decibel
dB _i	Gain in decibels relative to an isotropic antenna
DC	Direct current
DL	Downlink
d _{max}	Maximum relative voltage change
DSSS	Direct Sequence Spread Spectrum
e.i.r.p.	equivalent isotropic radiated power
EMC	ElectroMagnetic Compatibility
ERC	European Radiocommunication Committee
ESD	Electro Static Discharge
EUT	Equipment under Test
FHSS	Frequency Hopping Spread Spectrum
GBSAR	Ground Based Synthetic Aperture Radar
GRP	Ground reference plane
GTEM	Gigahertz Transverse ElectroMagnetic cell
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ISM	Industrial Scientific Medical (frequency band)
ITU-R	International Telecommunications Union, Radio Sector
ITU-T	International Telecommunications Union, Telecommunications Sector
L1,L2,L3	Phase
LBT	Listen Before Talk
LISN	Line impedance stabilization network
MDS	Absorbing measuring clamp
MU	Master Unit
N	Neutral
NRI	National Radio Interfaces
PE	Protective earth
PK	Peak
Plt	Long-term flicker indicator
PM	Pulse Modulation
Pst	Short-term flicker Indicator
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RFID	Radio Frequency Identification
RU	Remote Unit
SCU	System Control Unit
SF-CW	Step Frequency Continuous Wave (spread spectrum)
SND/ND	Signal + Noise + Distortion divided by Noise + Distortion
SRD	Short Range Device
TEM	Transverse ElectroMagnetic cell
TETRA	Terrestrial Trunked Radio
Tx	Transmitter
UL	Uplink
UWB	Ultra Wide Band
VSWR	Voltage Standing Wave Ratio

General vocabulary: <http://www.electropedia.org>

11. Applicant

<i>Client name and address</i>	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern SWITZERLAND
<i>Contact Person</i>	Mr. Raffael Rohrer
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12. Equipment Under Test

12.1 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>	NetModule Router NB3000 Line IP65 / IP67
<i>Product description</i>	Railway Router with Mobile, WLAN and GNSS
<i>Model/type reference</i>	EUT1: NB3711-2LcWacHd-G EUT2: NB3000-3LdWacCDfHd-G EUT3: NB3711-2LcWacPbHd-G
<i>Serial number</i>	EUT1: 00112B01890D EUT2: 00112B01880A EUT3: 00112B01D475
<i>Highest frequency</i>	CPU Clock: 1.33 GHz PCI Express: 2.5 GHz SATA 3.0 6 Gbits/s: 6 GHz DDR3L SDRAM: 800 MHz USB 2.0: 480 MHz DC/DC Converter (Main): < 1 MHz
<i>Supply</i>	EUT1: U = 24 – 60 VDC / I = 0.7 A / P = 15 W U = 24 – 48 VDC according to EN 50155 EUT2: U = 24 – 60 VDC / I = 1.0 A / P = 25 W U = 24 – 48 VDC according to EN 50155 EUT3: U = 72 – 110 VDC / I = 0.3 A / P = 15 W
<i>Dimension</i>	~ 190 mm x 133 mm x 121 mm (w x d x h)
<i>Weight</i>	~ 2.0 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.

12.2 Product Family

Tested Equipment	Covered Variants	Explanation ¹⁾
NB3711-2LcWacHd-G NB3711-2LcWacPbHd-G And: NB3800-3LdWacCDfHd-G	NB3800-H ₁ ...H _n -S ₁ ...S _n NB3711-H ₁ ...H _n -S ₁ ...S _n NB3701-H ₁ ...H _n -S ₁ ...S _n	<p>All covered NB3000 line IP65 / 67 variants contain the same CPU Modules, have the same case and the same form factor.</p> <p>The NB3700 Series has 5 Fast Ethernet ports. The NB3800 Series 3 Fast Ethernet and 2 Gbit Ethernet ports.</p> <p>They can host up to six communication or interface modules and a data storage. There can be up to 9 antenna connectors.</p> <p>All wireless communication modules applied have been CE and FCC certified in an independent way of the tested equipment.</p> <p>'H₁...H_n' is a sequence of the following letters that identify the options included:</p> <p>R: none, router only Ed: EDGE (EDGE/GPRS/GSM) U: UMTS (UMTS/HSPA/HSPA+ for Europe) L: LTE (for Europe) La: LTE-450 (LTE 450MHz) Lb: LTE-US (LTE North America) Lc: LTE-Adv. Asia (LTE Advanced for Asia) Ld: LTE-Adv. (LTE Advanced for Europe) Ca: CDMA-450 (CDMA 450MHz) Gr: GSM-R (GSM for Railway) Ge: GNSS-Adv. (GPS, GLONASS, Dead Reckoning) W: WLAN (802.11 a/b/g/n for 2.4/5GHz) Wac : WLAN-ac (802.11 a/b/g/n/ac for 2.4/5GHz) Wt : BT/BLE (Bluetooth + BLE) A: Audio (Audio with Line in / Line out) C: CAN (CAN-Bus) Sa: RS-485 (galv. isolated interface) I: IBIS (IBIS-Bus) Sb: RS-232 (galv. isolated interface) Pb: 72-110V PS (72, 96, 110VDC Input Voltage) Da: 32GB Storage (External Flash Storage 32GB) Db: 64GB Storage (External Flash Storage 64GB) Dc: 128GB Storage (External SSD Storage 128GB) Dd: 256GB Storage (External SSD Storage 256GB) De: 512GB Storage (External SSD Storage 512GB) Df: 1TB Storage (External SSD Storage 1TB) Hd IP67 (IP65/7 Housing) ... (more to follow)</p> <p>'S₁...S_n' indicate the software options activated:</p> <p>G: GPS V: Voice gateway M: Mobile IP (Client) S: Server Vi: Virt. (LXC Virtualization)</p> <p>The following NB3000 IP65/7 variants are currently available or planned:</p> <p>NB3701-LHd-S1..Sn1 NB3701-LDaHd-S1..Sn1 NB3701-LHd-S1..Sn1 NB3701-LWacHd-S1..Sn1 NB3701-LWWtHd-S1..Sn1</p>

		NB3701-LWacPbHd-S1..Sn1 NB3701-LWacHd-S1..Sn1 NB3701-LdWacHd-S1..Sn1 NB3711-3LWacHd-S1..Sn1 NB3711-2LcWacHd-G-S1..Sn1 NB3711-2LcWacHdPb-G-S1..Sn1 NB3711-2LdWacHd-G-S1..Sn1 NB3711-2LdWacPbHd-G-S1..Sn1 NB3800-LWacHd-S1..Sn1 NB3800-LWacPbHd-S1..Sn1 NB3800-LWacHd-S1..Sn1 NB3800-LWacAHd-S1..Sn1 NB3800-LWacCHd-S1..Sn1 NB3800-LWacIHd-S1..Sn1 NB3800-LWacDaHd-S1..Sn1 NB3800-LGrGeDaHd-S1..Sn1 NB3800-L2WacHd-S1..Sn1 NB3800-Ld2WacHd-S1..Sn1 NB3800-2LHd-S1..Sn1 NB3800-2LWacHd-S1..Sn1 NB3800-2LWacPbHd-S1..Sn1 NB3800-2LWacGeHd-S1..Sn1 NB3800-2LWacDfHd-S1..Sn1 NB3800-2L2WacHd-S1..Sn1 NB3800-2Ld2WacHd-S1..Sn1 NB3800-2LcWacHd-S1..Sn1 NB3800-2LcWacHdPb-S1..Sn1 NB3800-2L2WacPbHd-S1..Sn1 NB3800-2L2WacDfHd-S1..Sn1 NB3800-2Ld2WacDfHd-S1..Sn1 NB3800-3LHd-S1..Sn1 NB3800-3LWacHd-S1..Sn1 NB3800-3LWWtHd-S1..Sn1 NB3800-3LdWacCDfHd-S1..Sn1 NB3800-4LHd-S1..Sn1 NB3800-4LbHd-S1..Sn1 NB3800-4LdDfHd-S1..Sn1 NB3800-4LdPbDfHd-S1..Sn1
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1) according to information of the customer and not verified by Eurofins

12.3 Pictures of the EUT



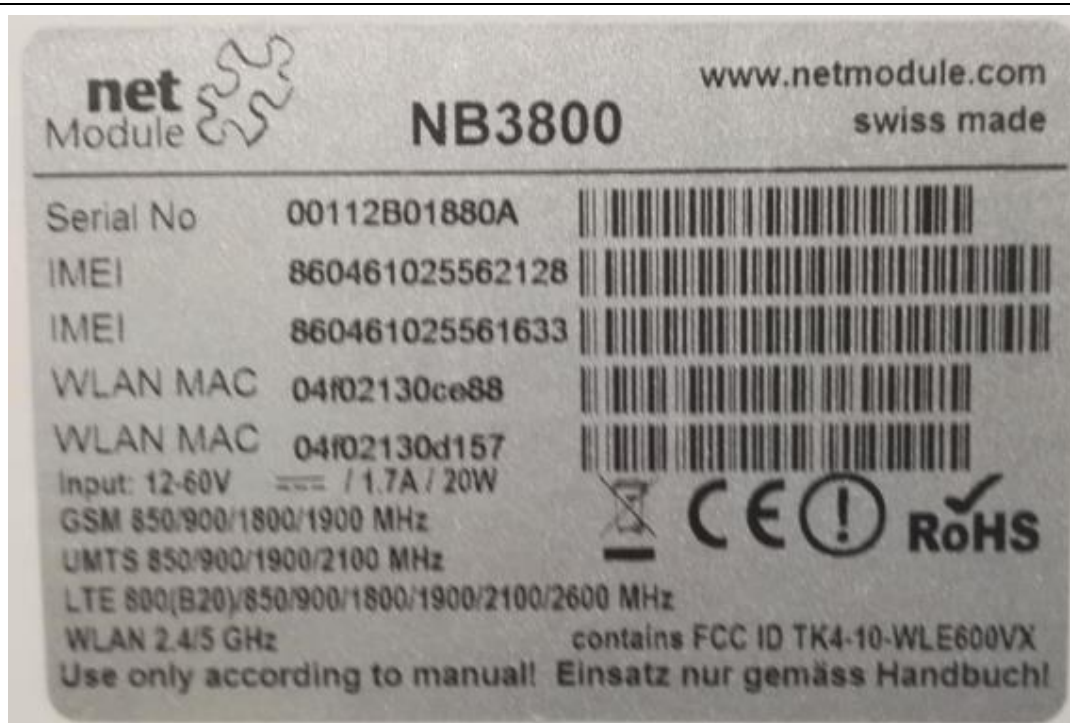
Top-front view



Rear view

*Top-front view**Rear view*

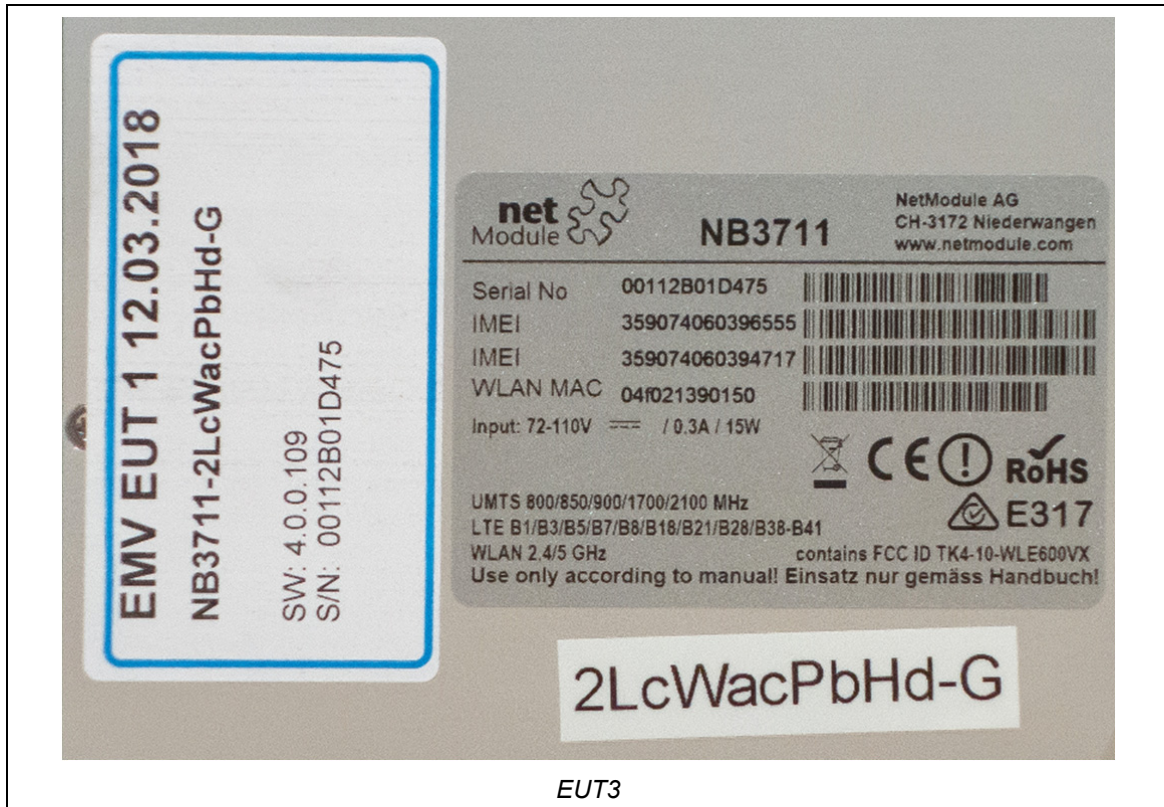
12.4 Marking Plate of the EUT



EUT2



EUT1



12.5 Classification

EN 50121-3-2	<input checked="" type="checkbox"/> Mounted in the passenger compartments, drivers cab or external to the rolling stock (roof, underframe) <input type="checkbox"/> Accessible to passengers and operational staff (not maintenance)
EN 50155	<input type="checkbox"/> Class S1: no interruptions of voltage supply <input checked="" type="checkbox"/> Class S2: 10 ms interruptions of voltage supply <input checked="" type="checkbox"/> Class C1: Supply change over at 0.6 U _n during 100 ms (without interruptions) <input type="checkbox"/> Class C2: Supply break of 30 ms
EN 55022 CISPR 22 EN 55032 CISPR 32 EN 61000-6-3 IEC 61000-6-3	<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 301 489	<input type="checkbox"/> Radio and ancillary equipment for fixed use (e.g. base station equipment) <input checked="" type="checkbox"/> Radio and ancillary equipment for vehicular use (e.g. mobile equipment) <input type="checkbox"/> Radio and ancillary equipment for portable use (portable equipment) <input type="checkbox"/> Ancillary equipment
CFR 47 Part 15	<input checked="" 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). <input type="checkbox"/> Intentional radiator (Subpart C) <input type="checkbox"/> The highest fundamental frequency of the EUT is less than 10 GHz (measurement shall be made up to the tenth harmonic or 40 GHz, whichever is lower). <input type="checkbox"/> The highest fundamental frequency of the EUT is between 10 GHz and 30 GHz (measurement shall be made up to the fifth harmonic or 100 GHz, whichever is lower). <input type="checkbox"/> The highest fundamental frequency of the EUT is above 30 GHz (measurement shall be made up to the fifth harmonic or 200 GHz, whichever is lower).

12.6 Ports

EUT1 & EUT3

Port	Cable			Remark
	Max. length	Type	Screen	
DC Power Supply	Not defined	2 wires	No	If not stated otherwise, powered with Lab Supply
Ethernet 1	< 100m	M12	Yes	Fast Ethernet
Ethernet 2	< 100m	M12	Yes	no cable connected
Ethernet 3	< 100m	M12	Yes	no cable connected
Ethernet 4	< 100m	M12	Yes	no cable connected
Ethernet 5	< 100m	M12	Yes	Fast Ethernet
RS-232	< 10 m	3 wire	Yes	Connected to Test-PC
USB Type A connector (Service Port)	< 3m	USB	Yes	2m cable + USB stick connected (EUT1 only)
WLAN 1	< 30 m	TNC (Coax)	Yes	Connected to multiband-antenna
Mob 1, 2 (GSM, UMTS, LTE)	< 30 m	TNC (Coax)	Yes	Connected to multiband-antenna
GNSS	< 30 m	TNC (Coax)	Yes	Connected to multiband-antenna
Earth	Not defined	--	--	--

EUT2

Port	Cable			Remark
	Max. length	Type	Screen	
DC Power Supply	Not defined	2 wires	No	If not stated otherwise, powered with Lab Supply
Ethernet 1	< 100m	M12	Yes	Fast Ethernet
Ethernet 2	< 100m	M12	Yes	no cable connected
Ethernet 3	< 100m	M12	Yes	no cable connected
Ethernet 4	< 100m	M12	Yes	no cable connected
Ethernet 5	< 100m	M12	Yes	GBit Ethernet
CAN	< 1000 m	3 wire	Yes	Connected to Test-PC
USB Type A connector (Service Port)	< 3m	USB	Yes	2m cable + USB stick connected
WLAN 1	< 30 m	TNC (Coax)	Yes	Connected to multiband-antenna
Mob 1, 2, 3 (GSM, UMTS, LTE)	< 30 m	TNC (Coax)	Yes	Connected to multiband-antenna
GNSS	< 30 m	TNC (Coax)	Yes	Connected to multiband-antenna
Earth	Not defined	--	--	--

13. Test Conditions

13.1 Climatic conditions, location and date

Location	Date	Temp	Pressure [QFE]	Rel. humidity
Eurofins Electrosuisse Product Testing AG, Albisriederstrasse 199 8047 Zürich SWITZERLAND	June 19 to 20, 2017	$23 \pm 3 \text{ }^{\circ}\text{C}$	$969 \pm 30 \text{ hPa}$	$50 \pm 5 \%$
	March 12 to 13, 2018	$22 \pm 3 \text{ }^{\circ}\text{C}$	$975 \pm 30 \text{ hPa}$	$45 \pm 5 \%$

13.2 Test facility and methodology

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

13.3 Attendant Persons

Test Engineer(s):

Mr. Peter Stillhard
Mr. Daniel Rufer

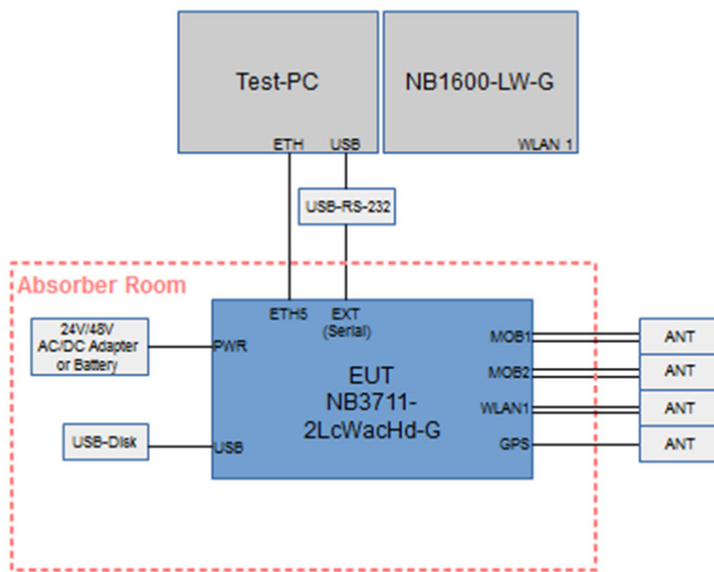
Other(s):

Name	Company
Mr. Raffael Rohrer	NetModule AG

13.4 Test Configuration

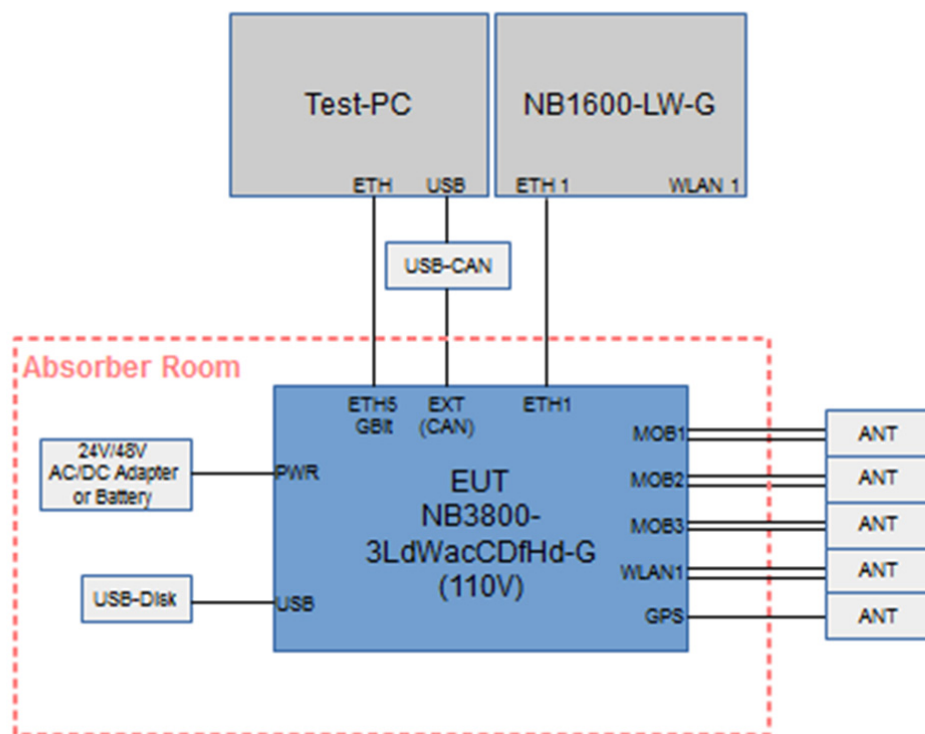
EUT1: & EUT3

- DC Supply
- 1 Ethernet-connection to Test-PC
- 1 RS232-connection to Test PC
- 2 GSM/UMTS/LTE antennas (4 cables)
- 1 WLAN antennas (2 cables)
- 1 GNSS antenna (1 cable)
- 2 SIM cards
- 1 USB stick (EUT1 only)



EUT2:

- DC Supply
- 1 Ethernet-connection to Test-PC (Gbit)
- 1 Ethernet-connection to NB1600
- 1 CAN-connection to Test PC
- 3 GSM/UMTS/LTE antennas (6 cables)
- 1 WLAN antenna (2 cables)
- 1 GNSS antenna (1 cable)
- 3 SIM cards
- 1 USB stick



13.5 Operating Conditions

EUT1:

Normal mode:

- Ping over WLAN 1
- Ping over WWAN 1, 2 (GSM/UMTS/LTE)
- Ping over Ethernet 5 cable
- Access with RS-232
- Access to USB stick

powered with 24 VDC unless otherwise specified

EUT2:

Normal mode:

- Ping over WLAN 1
- Ping over WWAN 1, 2 & 3 (GSM/UMTS/LTE)
- Ping over Ethernet 1 & 5 cable
- CAN loop
- Access to SSD disc

powered with 24 VDC unless otherwise specified

EUT3:

Normal mode:

- Ping over WLAN 1
- Ping over WWAN 1, 2 (GSM/UMTS/LTE)
- Ping over Ethernet 5 cable
- Access with RS-232

powered with 110 VDC unless otherwise specified

13.6 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

13.7 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.

EUT1:

Product	Brand	Model No.	SN
Test-PC / Notebook	Dell	E5540	1PF9N12
USB-to-RS232 Adapter	MOXA	USB UPORT 1150I	--
Router	NetModule	NB1600 LW-G	00112B012C99
WWAN Antenna	n/a	Antenna-Roof-2L DL-9	A140812300036
GPS Antenna	REEL	C70ZAR 0300 00 03 03 PWN1	02 1501
WLAN Antenna	--	Antenna-Roof-2W	--
SMA – TNC Adapter	--	--	--
USB stick	Silica		
Power Supply 160 VDC	Elektro Automatik (EA)	PS 8160-04	1179370008

EUT2:

Product	Brand	Model No.	SN
Test-PC / Notebook	Dell	E5540	1PF9N12
USB-to-CAN Adapter	IXXAT	USB-to CAN Compact	HW24342B
Router	NetModule	NB1600 LW-G	00112B012C99
WWAN Antenna	n/a	Antenna-Roof-2L DL-9	A140812300036
GPS Antenna	REEL	C70ZAR 0300 00 03 03 PWN1	02 1501
WLAN Antenna	--	Antenna-Roof-2W	--
SMA – TNC Adapter	--	--	--
USB stick	Silica	--	--
Power Supply 160 VDC	Elektro Automatik (EA)	PS 8160-04	1179370008

EUT3:

Product	Brand	Model No.	SN
Test-PC / Notebook	Dell	E5540	1PF9N12
USB-to-RS232 Adapter	MOXA	USB UPORT 1150I	--
Router	NetModule	NB2800 2Wac	00112B015CC7
WWAN Antenna	n/a	Antenna-Roof-2L DL-9	A140812300036
GPS Antenna	REEL	C70ZAR 0300 00 03 03 PWN1	02 1501
WLAN Antenna	--	Antenna-Roof-2W	--
SMA – TNC Adapter	--	--	--
Power Supply 160 VDC	Elektro Automatik (EA)	PS 8160-04	1179370008

13.8 Performance Criteria

General requirements:	Requirements according to the EUT:
<p align="center">Criterion A:</p>	
The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed.	<p><u>EUT1:</u> <i>No transmission loss LAN (FE), WWAN (GSM/UMTS/LTE), WLAN, USB and RS-232</i></p> <p><u>EUT2:</u> <i>No transmission loss LAN (GBit and FE), WWAN (GSM/UMTS/LTE), WLAN, USB, SSD and CAN</i></p> <p><u>EUT3:</u> <i>No transmission loss LAN (FE), WWAN (GSM/UMTS/LTE), WLAN and RS-232</i></p>
<p align="center">Criterion B:</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><i>During the test:</i></p> <ul style="list-style-type: none"> - <i>short interruptions of the communication allowed</i> - <i>LED's may flicker</i> <p><i>After the test the EUT shall operate as in normal mode</i></p>
<p align="center">Criterion C:</p>	
Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.	<i>No specific requirements</i>

14. Emission Tests

14.1 Interference Voltage (V-LISN)

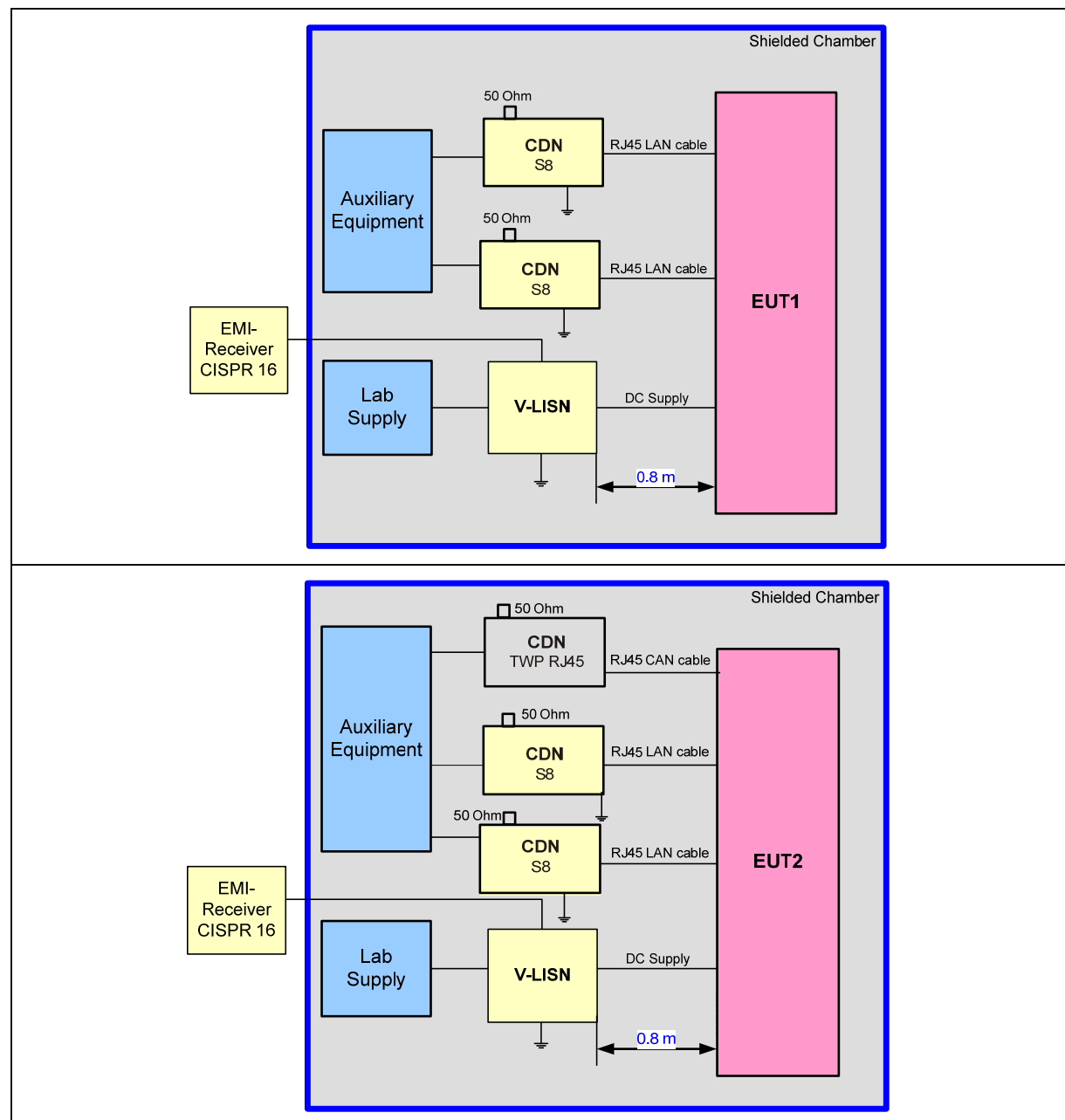
Test site: shielded room

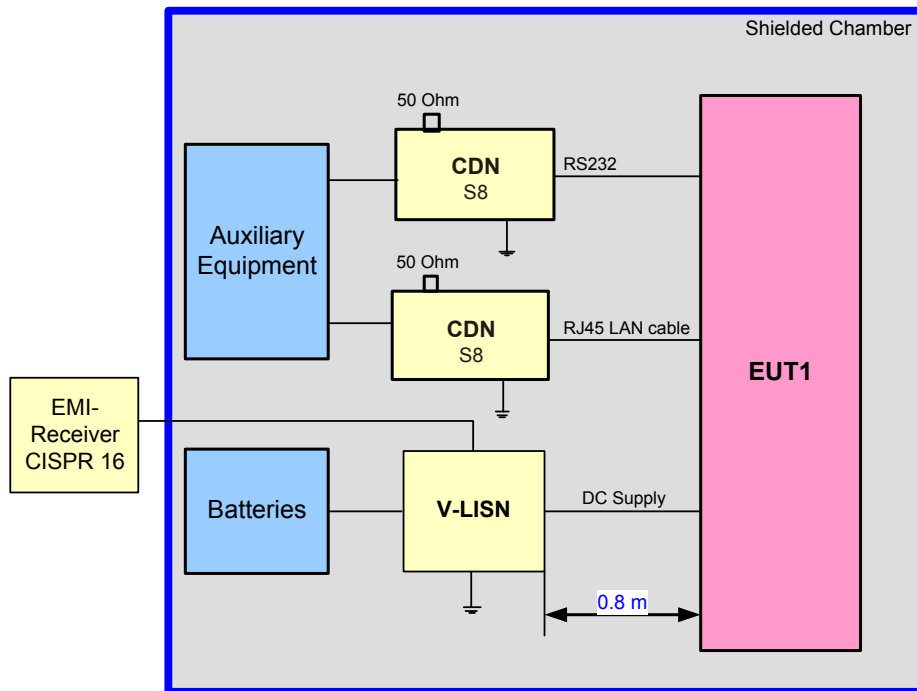
Meas. uncertainty: see chapter 16

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 peak values are recorded continuously. Values that exceed the average limit shall be re-measured with the average and quasi peak detector of the receiver.

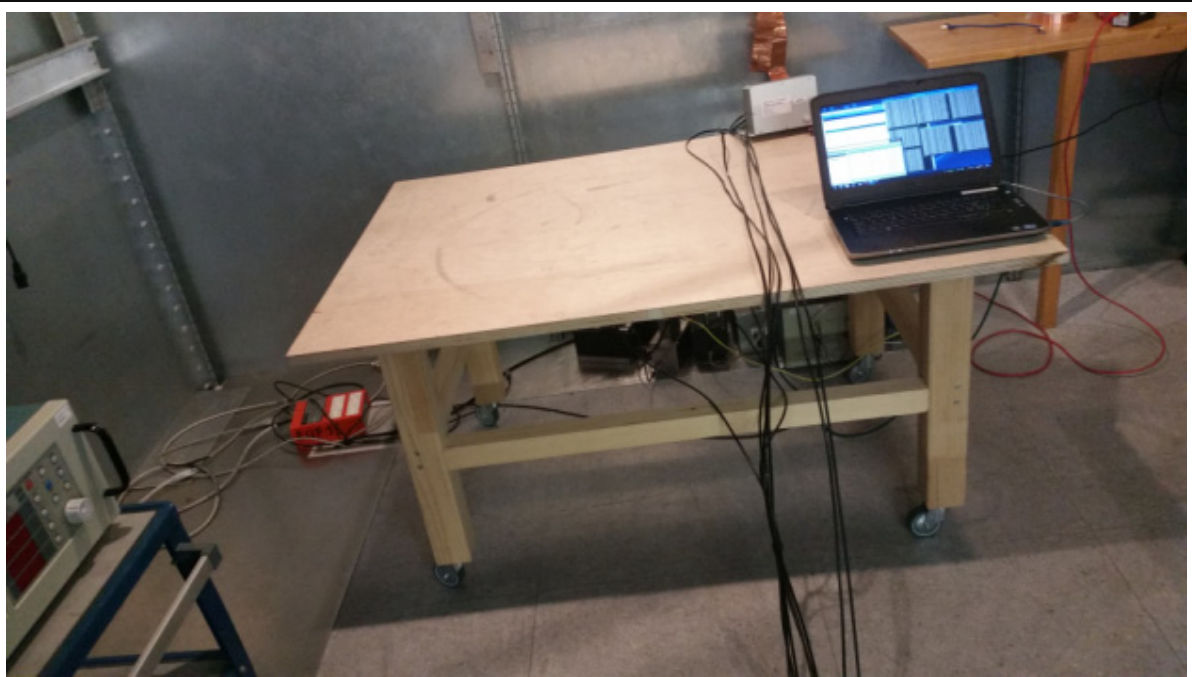
Modifications: none

Test Setup

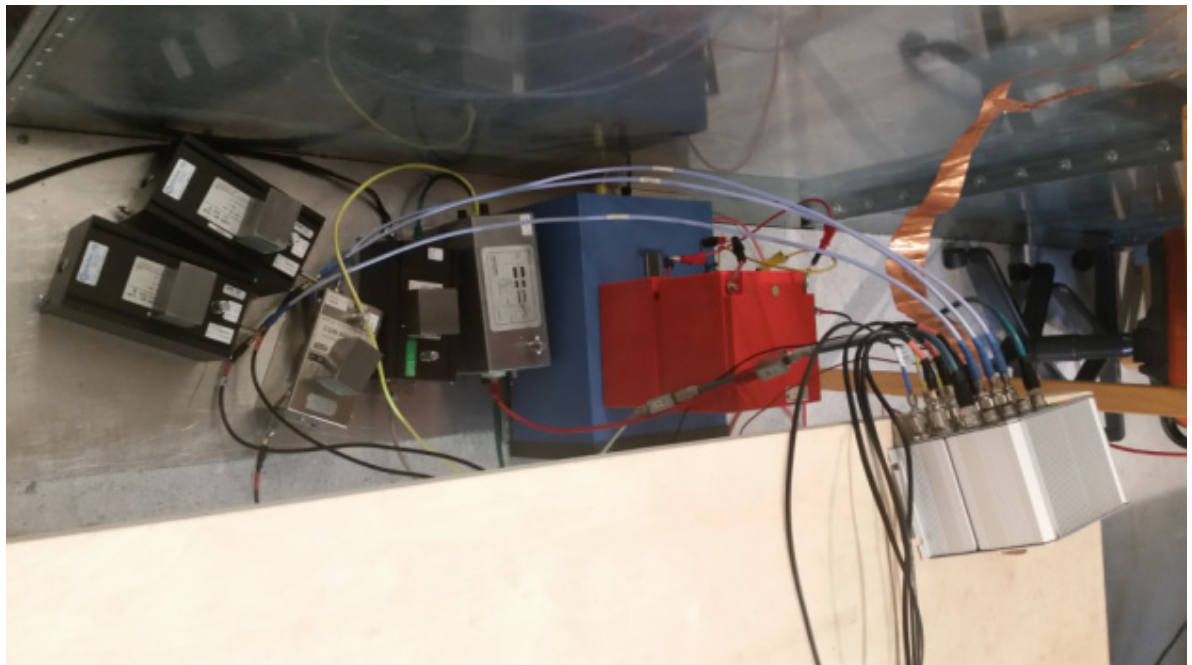


Test Setup EUT3:

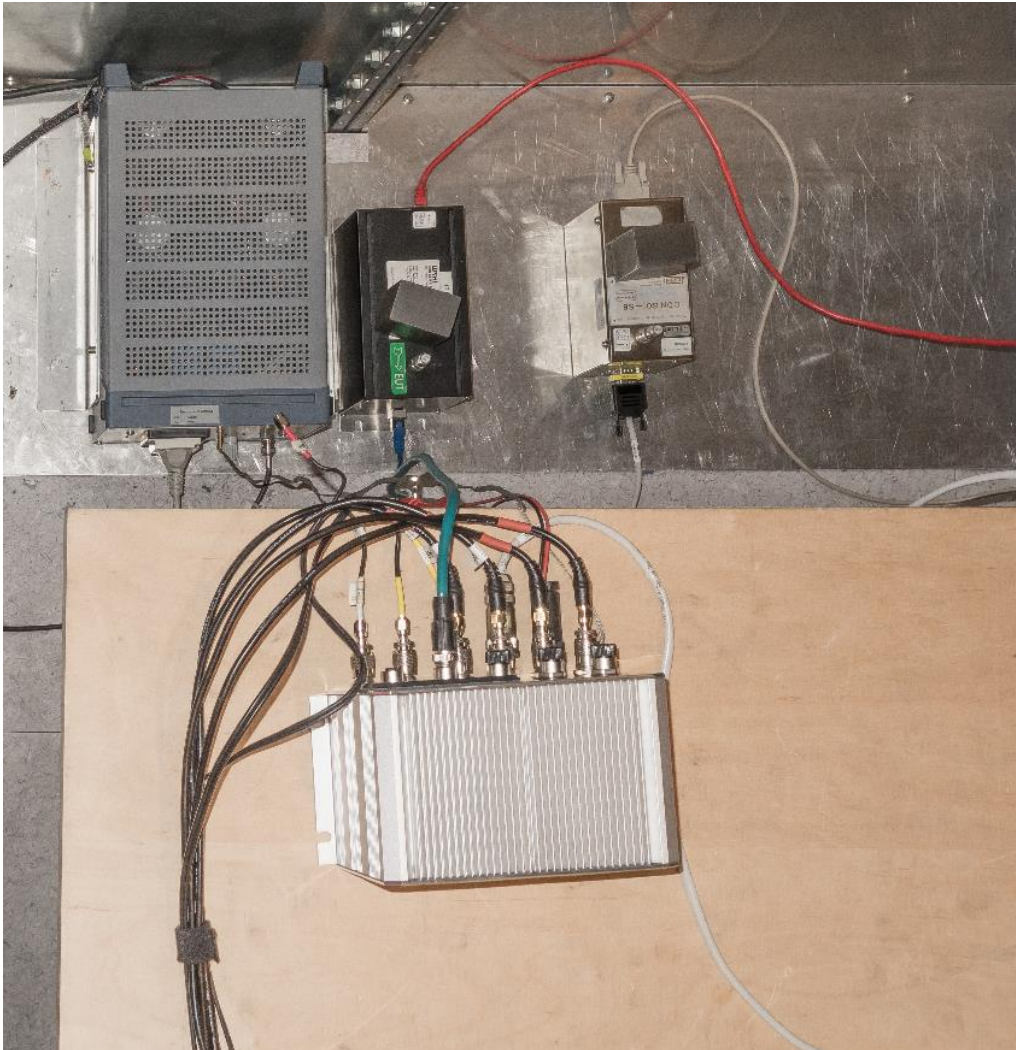
Photos of the Setup



EUT1



EUT2



EUT3

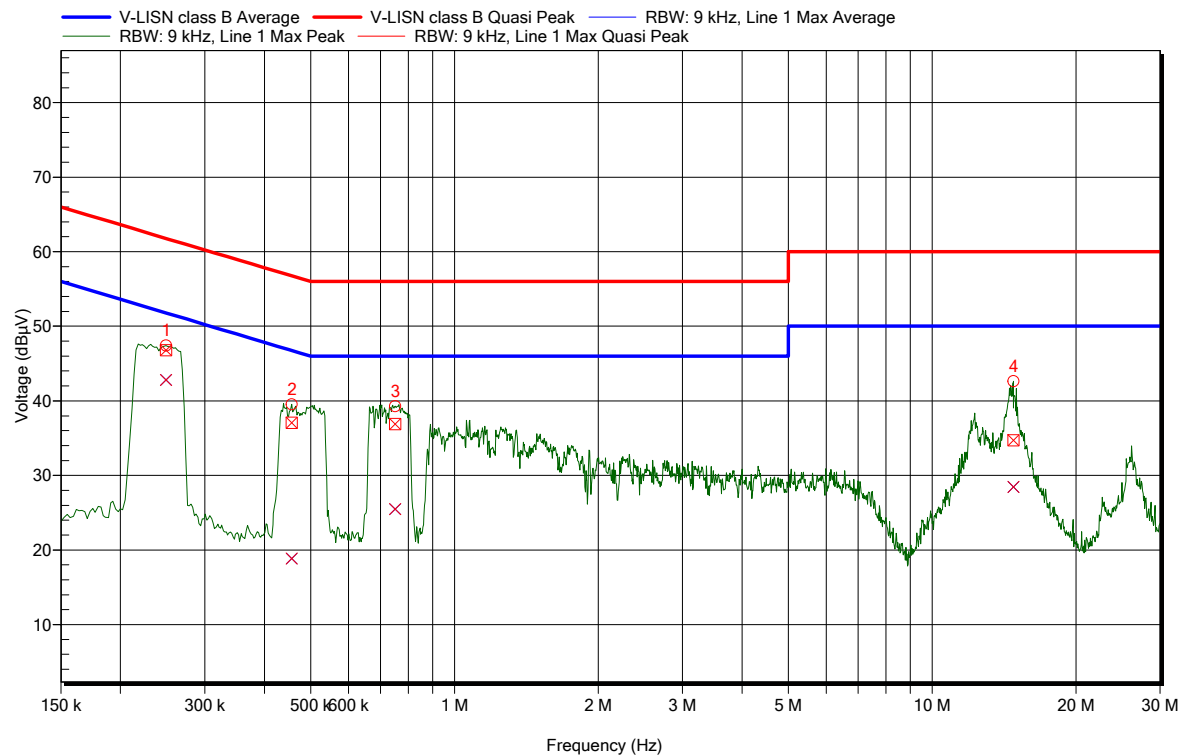
Test Equipment

Device Type	Brand	Type	ID
Spectrum analyser	Rohde & Schwarz	ESU 8 Input 2 Time Domain (LAN)	OA 10193
V-Network	Rohde & Schwarz	ESH3-Z5	PE7627
CDN	EM Test	CDN S8 RJ45	13.6632.07
CDN	EM Test	CDN S8 RJ45	13.6632.08
Coaxial Cable	Huber & Suhner	RG223/U	H8002+13.6632.02

Measurement Results

Measurement 1 :

EUT	EUT1 (NB3711-2LcWacHd-G)
Verdict, Test	PASS, CISPR 22 / 32 Class B
Power supply voltage	24 VDC
Cables, Notes	--
Mode of operation	Normal operation
Test date, time	20.06.2017 10:13:43
Interface / Line under test	Neutral (0 VDC)
Transducer	H4536 V-LISN 2Ph 25A EMCO 3825/2
Measurement settings	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: 100 ms

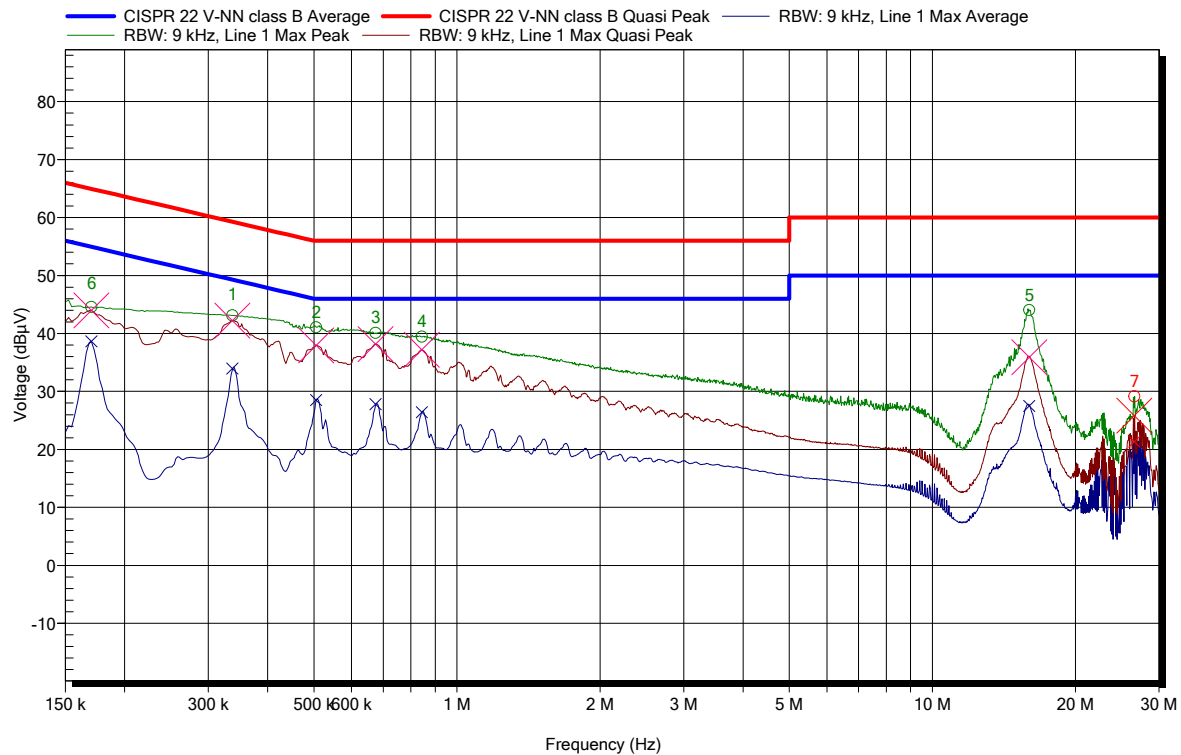


Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	249 kHz	47.42 dBμV	42.82 dBμV	-8.97 dB	46.8 dBμV	-14.99 dB	Pass
2	456 kHz	39.53 dBμV	18.84 dBμV	-27.92 dB	37.06 dBμV	-19.7 dB	Pass
3	750.75 kHz	39.29 dBμV	25.49 dBμV	-20.51 dB	36.9 dBμV	-19.1 dB	Pass
4	14.78 MHz	42.65 dBμV	28.47 dBμV	-21.53 dB	34.69 dBμV	-25.31 dB	Pass

Measurement 2:

EUT	EUT1 (NB3711-2LcWachd-G)
Verdict, Test	PASS, CISPR 22 / 32 Class B
Power supply voltage	24 VDC
Cables, Notes	--
Mode of operation	Normal operation
Test date, time	20.06.2017 10:19:24
Interface / Line under test	Line (+24 VDC)
Transducer	H4536 V-LISN 2Ph 25A EMCO 3825/2
Measurement settings	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: 100 ms,

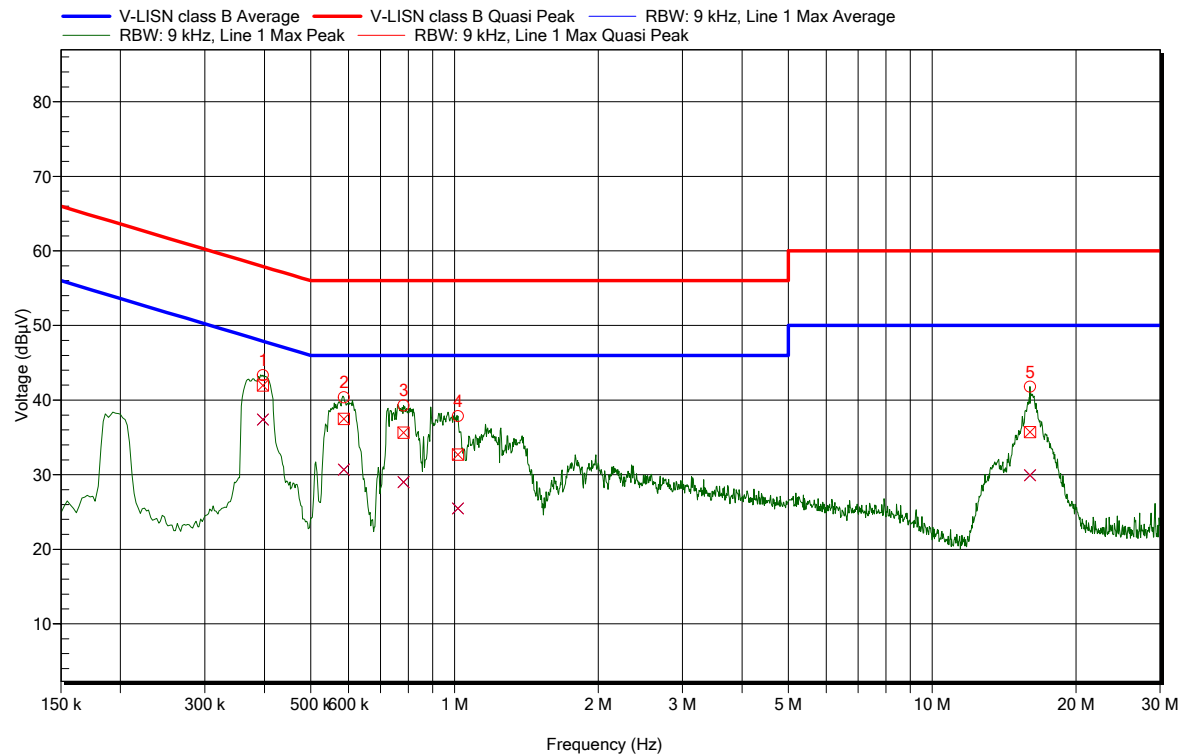


Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	336.75 kHz	43.12 dBμV	33.94 dBμV	-15.34 dB	42.23 dBμV	-17.05 dB	Pass
2	505.5 kHz	41.06 dBμV	28.51 dBμV	-17.49 dB	37.94 dBμV	-18.06 dB	Pass
3	674.25 kHz	40.08 dBμV	27.79 dBμV	-18.21 dB	38.17 dBμV	-17.83 dB	Pass
4	843 kHz	39.44 dBμV	26.43 dBμV	-19.57 dB	37.2 dBμV	-18.8 dB	Pass
5	15.981 MHz	44.03 dBμV	27.47 dBμV	-22.53 dB	35.88 dBμV	-24.12 dB	Pass
6	170.25 kHz	44.56 dBμV	38.65 dBμV	-16.3 dB	43.97 dBμV	-20.98 dB	Pass
7	26.608 MHz	29.16 dBμV	21.36 dBμV	-28.64 dB	25.8 dBμV	-34.2 dB	Pass

Measurement 3:

EUT	EUT2 (NB3800-3LdWacCDfHd-G)
Verdict, Test	PASS, CISPR 22 / 32 Class B
Power supply voltage	24 VDC
Cables, Notes	--
Mode of operation	Normal operation
Test date, time	20.06.2017 11:11:14
Interface / Line under test	Line (+24 VDC)
Transducer	H4536 V-LISN 2Ph 25A EMCO 3825/2
Measurement settings	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: 100 ms,

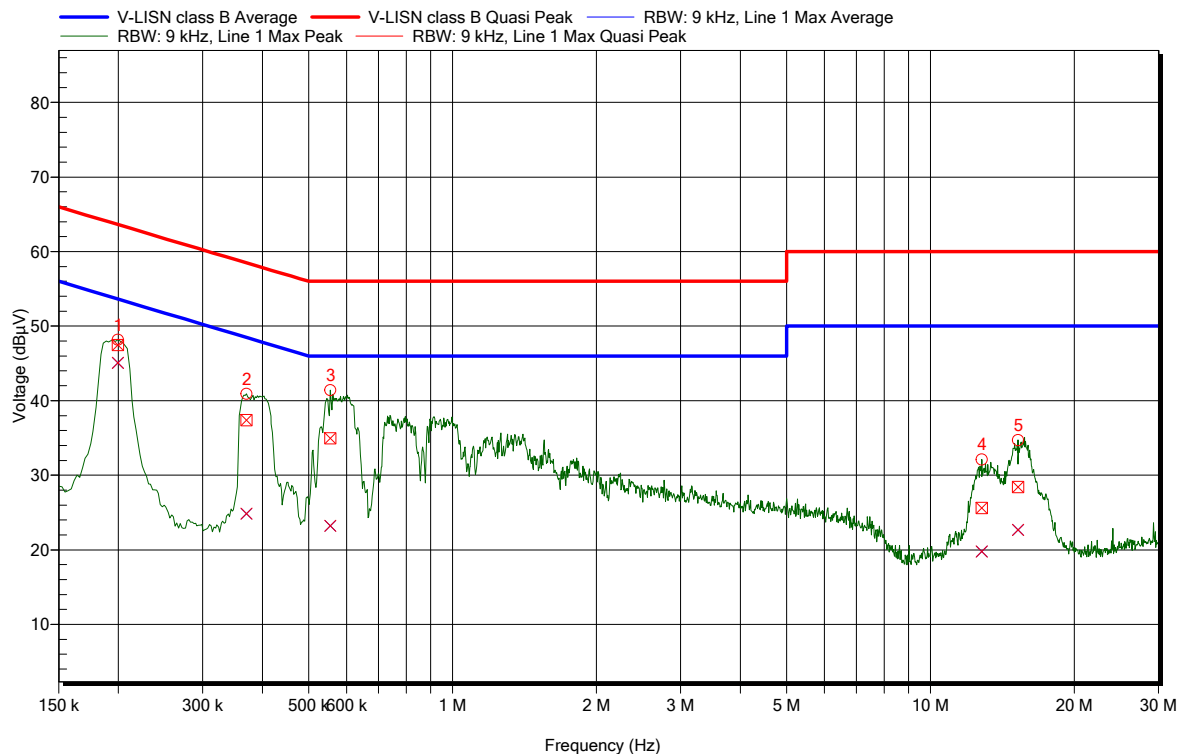


Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	397.5 kHz	43.37 dBμV	37.39 dBμV	-10.52 dB	41.95 dBμV	-15.95 dB	Pass
2	586.5 kHz	40.37 dBμV	30.68 dBμV	-15.32 dB	37.49 dBμV	-18.51 dB	Pass
3	782.25 kHz	39.29 dBμV	29.02 dBμV	-16.98 dB	35.62 dBμV	-20.38 dB	Pass
4	1.016 MHz	37.84 dBμV	25.48 dBμV	-20.52 dB	32.7 dBμV	-23.3 dB	Pass
5	16.028 MHz	41.81 dBμV	29.94 dBμV	-20.06 dB	35.72 dBμV	-24.28 dB	Pass

Measurement 4:

EUT	EUT2 (NB3800-3LdWacCDfHd-G)
Verdict, Test	PASS, CISPR 22 / 32 Class B
Power supply voltage	24 VDC
Cables, Notes	--
Mode of operation	Normal operation
Test date, time	20.06.2017 11:02:53
Interface / Line under test	Neutral (0 VDC)
Transducer	H4536 V-LISN 2Ph 25A EMCO 3825/2
Measurement settings	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: 100 ms,



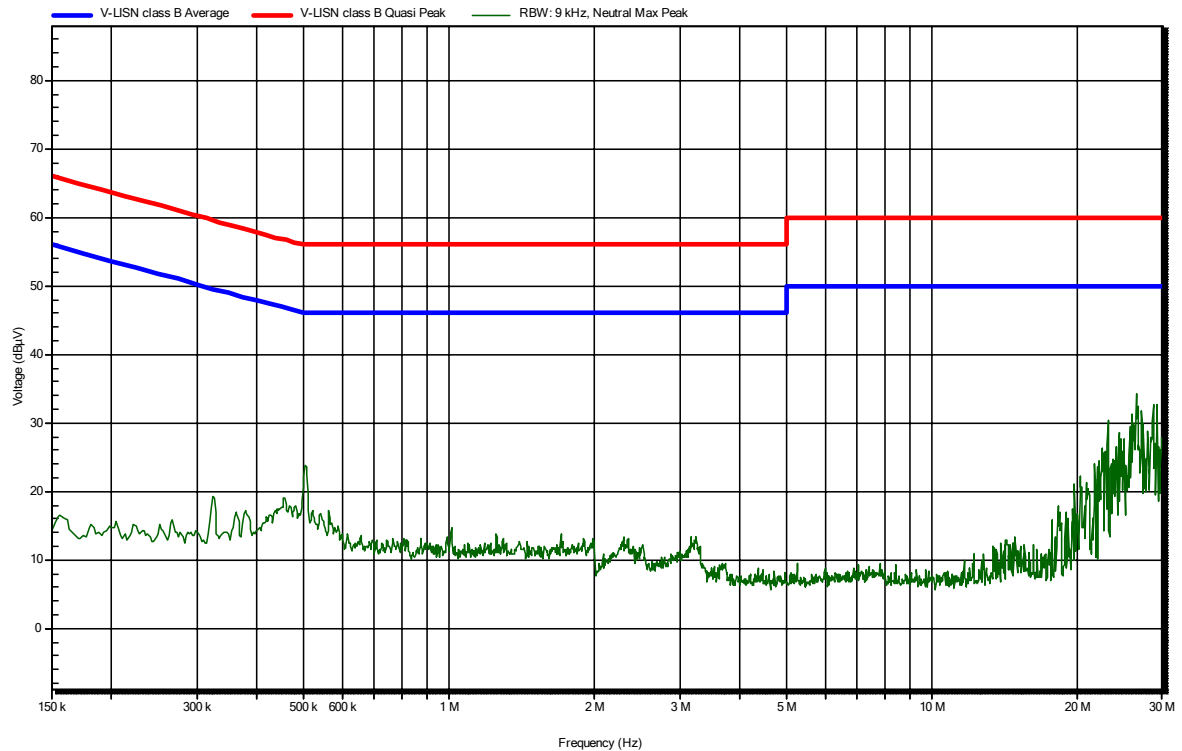
Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	199.5 kHz	48.16 dBμV	45.08 dBμV	-8.55 dB	47.45 dBμV	-16.18 dB	Pass
2	370.5 kHz	40.92 dBμV	24.87 dBμV	-23.62 dB	37.38 dBμV	-21.11 dB	Pass
3	555 kHz	41.44 dBμV	23.21 dBμV	-22.79 dB	34.94 dBμV	-21.06 dB	Pass
4	12.802 MHz	32.12 dBμV	19.79 dBμV	-30.21 dB	25.61 dBμV	-34.39 dB	Pass
5	15.243 MHz	34.72 dBμV	22.69 dBμV	-27.31 dB	28.42 dBμV	-31.58 dB	Pass

Measurement 5:

EUT	EUT3 (NB3711-2LcWacPbHd-G)
Verdict	PASS, CISPR 22 / 32 Class B
Mode of operation	Normal mode, 60 VDC (5x Batteries 12 V)
Test date, time	13.03.2018 09:28:14
Line under test	Power Supply, Positive Port
Transducer	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
Measurement settings	Radimation Version: 2017.2.5, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10 dB], Internal preamp: 0 dB, Measure time: 100 ms

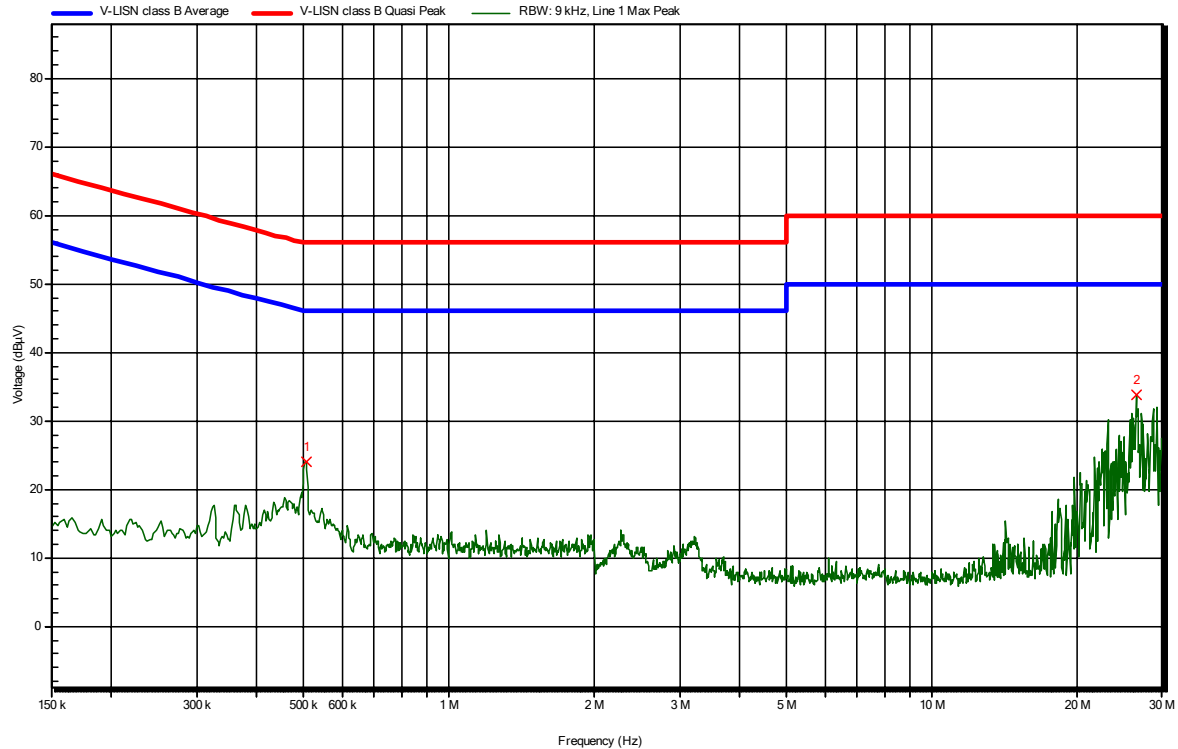
Radimation



Measurement 6:

EUT	EUT3 (NB3711-2LcWacPbHd-G)
Verdict	PASS, CISPR 22 / 32 Class B
Mode of operation	Normal mode, 60 VDC (5x Batteries 12 V)
Test date, time	13.03.2018 09:29:48
Line under test	Power Supply, Negative Port
Transducer	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
Measurement settings	Radimation Version: 2017.2.5, RBW: 9 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10 dB], Internal preamp: 0 dB, Measure time: 100 ms

RadiMation



Detected peaks

Peak Number	Frequency	Peak	LISN
1	505.5 kHz	24.13 dBμV	Line 1
2	26.486 MHz	33.75 dBμV	Line 1

14.2 Interference Voltage (Telecommunications cables: LAN+CAN)

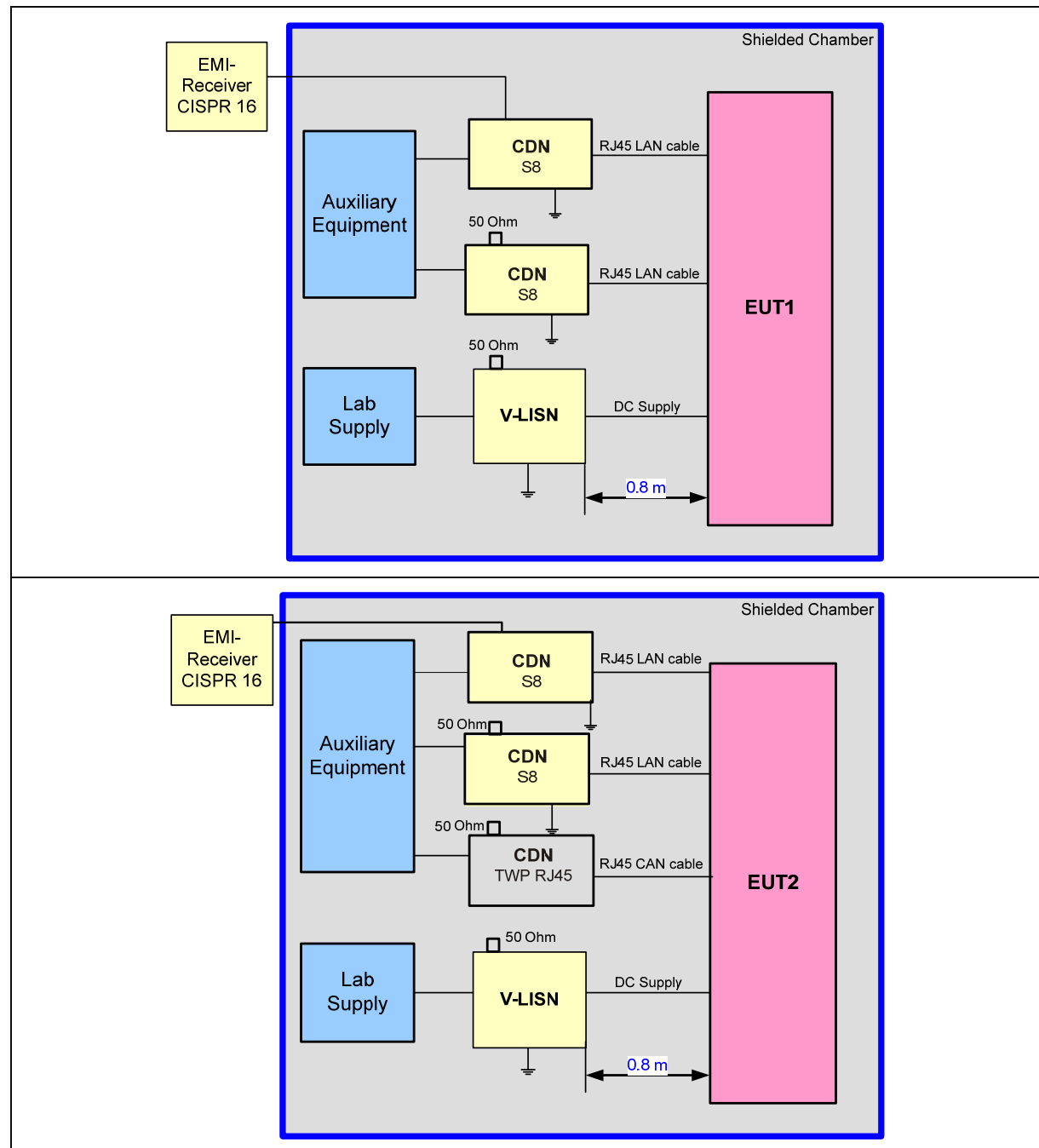
Test site: shielded room

Meas. uncertainty: see chapter 16

Measuring method: The conducted disturbance is measured using a EMI receiver and a line coupling device network (CDN-S8). The measurement of the voltage on the shield of the cable against the earth is carried out successively. The peak values are recorded continuously. Values that exceed the average limit shall be re-measured with the average and quasi peak detector of the receiver.

Modifications: none

Test Setup



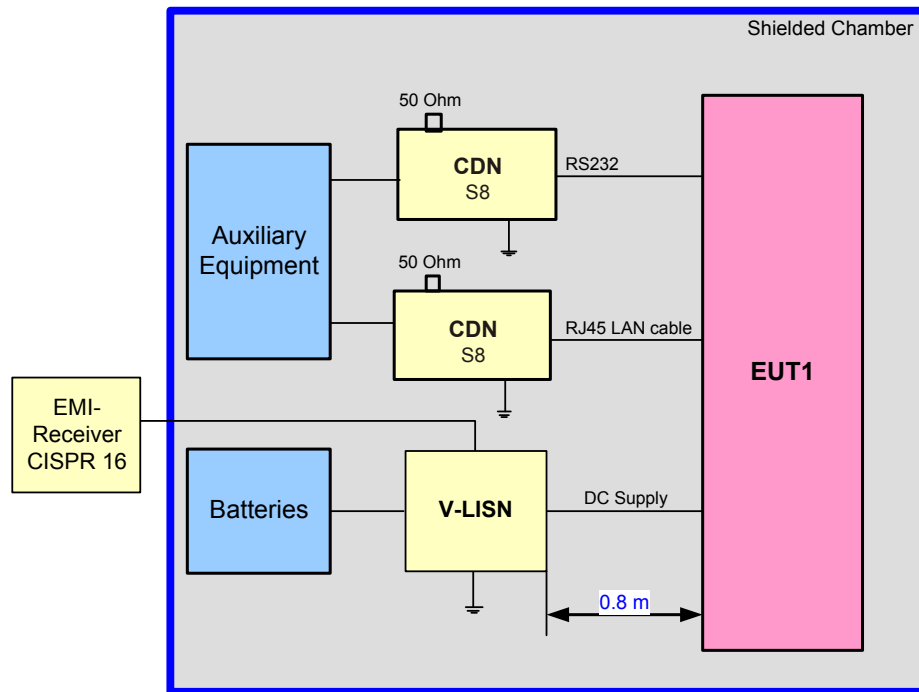
Test Setup EUT3:

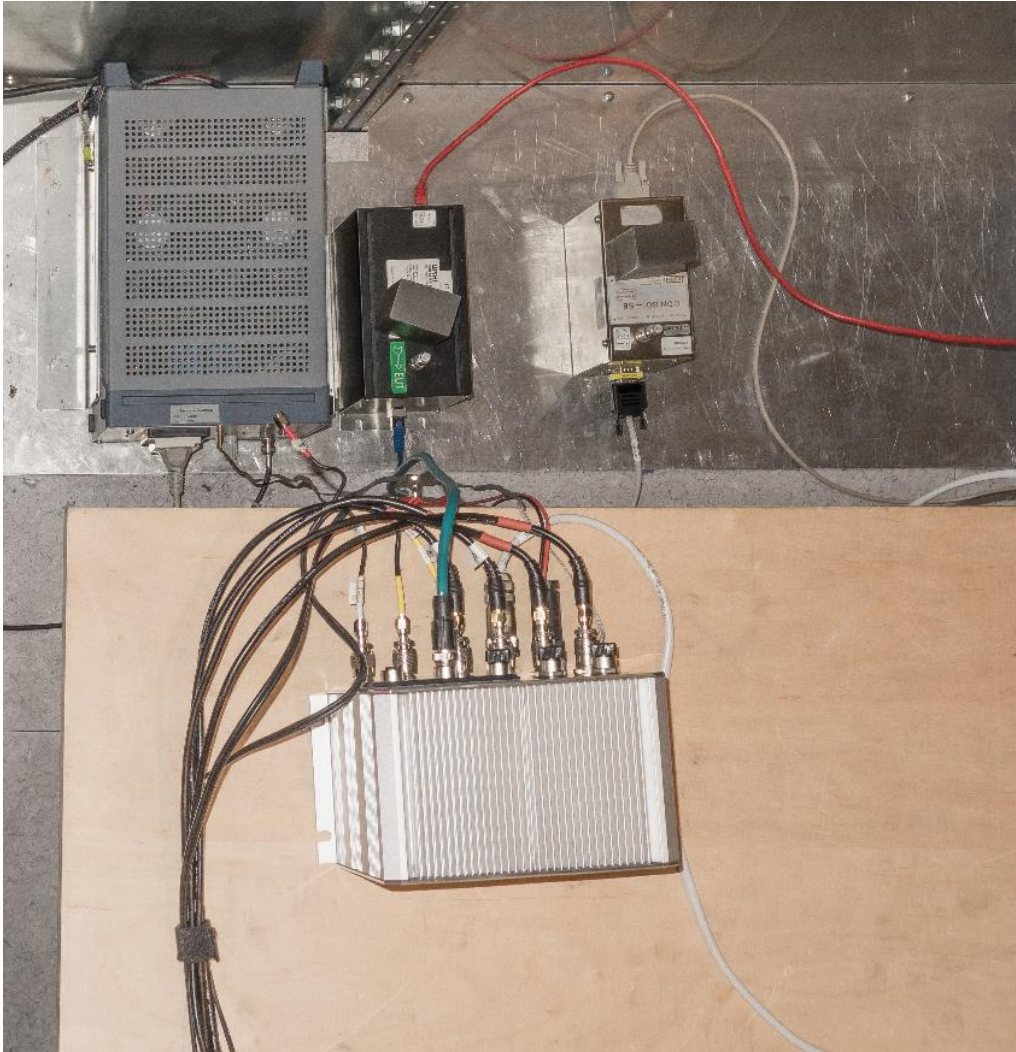
Photo of the Setup



EUT1



EUT2



EUT3

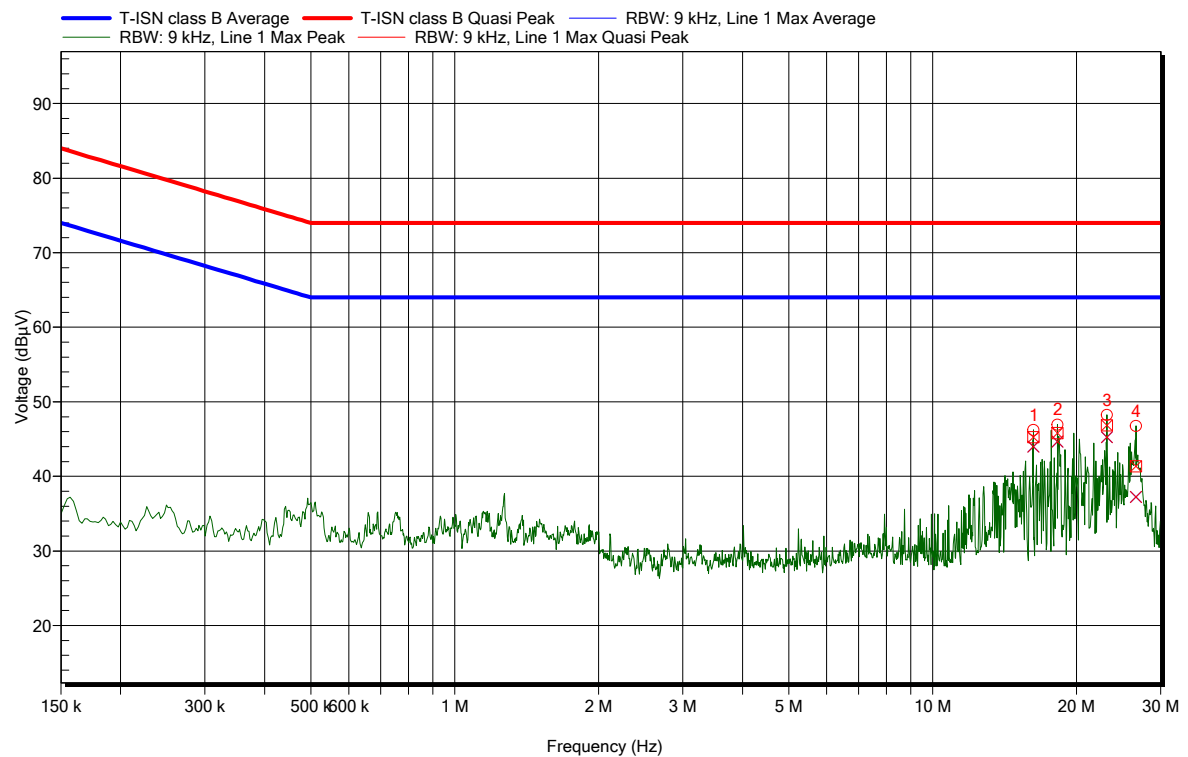
Test Equipment

Device Type	Brand	Type	ID
Spectrum analyser	Rohde & Schwarz	ESU 8 Input 2 Time Domain (LAN)	OA 10193
V-Network	Rohde & Schwarz	ESH3-Z5	PE7627
CDN	EM Test	CDN S8 RJ45	13.6632.07
CDN	EM Test	CDN S8 RJ45	13.6632.08
Coaxial Cable	Huber & Suhner	RG223/U	H8002+13.6632.02

Measurement Results

Measurement 7:

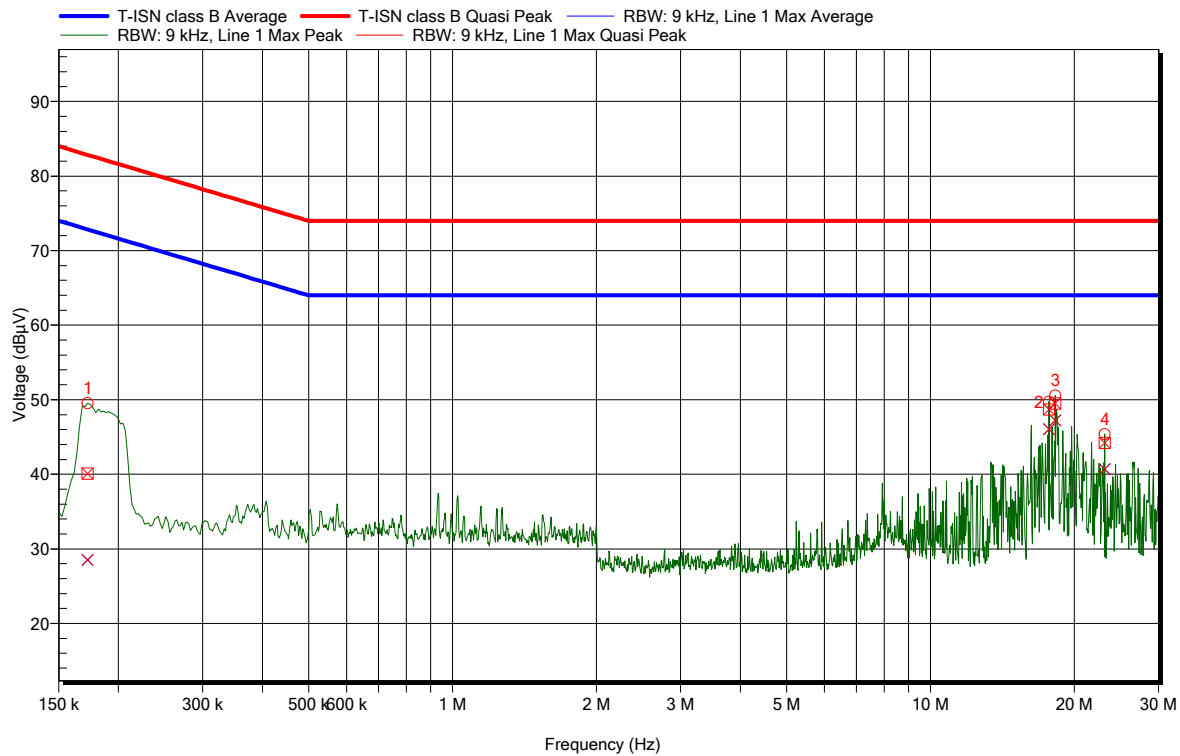
EUT	EUT1 (NB3711-2LcWacHd-G)
Verdict, Test	PASS, CISPR 22 / 32 Class B
Mode of operation	Normal mode, 24 VDC
Test date, time	20.06.2017 10:28:37
Interface / Line under test	LAN
Transducer	CDN S8 RJ45
Measurement settings	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: 100 ms,

**Detected peaks**

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	16.229 MHz	46.2 dBμV	44 dBμV	-20 dB	45.24 dBμV	-28.76 dB	Pass
2	18.242 MHz	46.92 dBμV	44.65 dBμV	-19.35 dB	45.82 dBμV	-28.18 dB	Pass
3	23.129 MHz	48.23 dBμV	45.26 dBμV	-18.74 dB	46.86 dBμV	-27.14 dB	Pass
4	26.61 MHz	46.78 dBμV	37.24 dBμV	-26.76 dB	41.36 dBμV	-32.64 dB	Pass

Measurement 8:

EUT	EUT2 (NB3800-3LdWacCDfHd-G)
Verdict, Test	PASS, CISPR 22 / 32 Class B
Mode of operation	Normal mode
Test date, time	20.06.2017 11:16:02
Interface / Line under test	LAN1 fast Ethernet
Transducer	CDN S8 RJ45
Measurement settings	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: 100 ms,

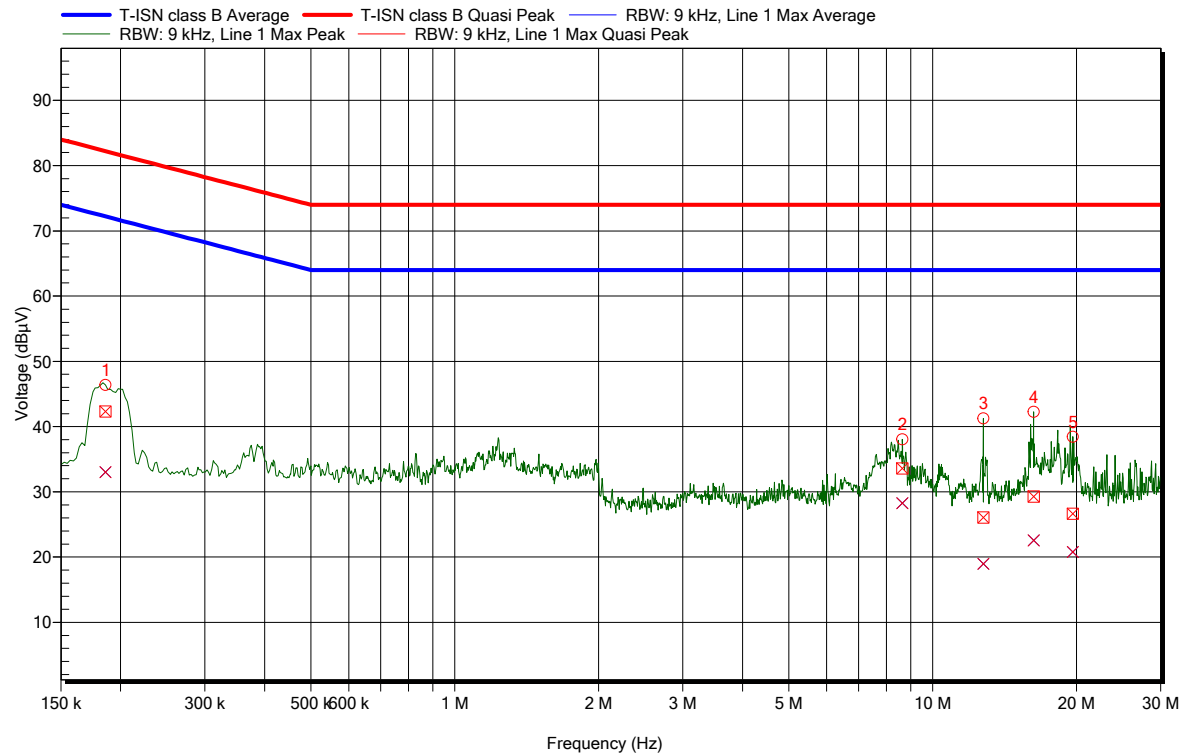


Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	172.5 kHz	49.55 dBμV	28.51 dBμV	-44.33 dB	40.11 dBμV	-42.73 dB	Pass
2	17.693 MHz	49.73 dBμV	46.04 dBμV	-17.96 dB	48.68 dBμV	-25.32 dB	Pass
3	18.242 MHz	50.57 dBμV	47.21 dBμV	-16.79 dB	49.5 dBμV	-24.5 dB	Pass
4	23.129 MHz	45.39 dBμV	40.69 dBμV	-23.31 dB	44.2 dBμV	-29.8 dB	Pass

Measurement 9:

EUT	EUT2 (NB3800-3LdWacCDfHd-G)
Verdict, Test	PASS, CISPR 22 / 32 Class B
Mode of operation	Normal mode
Test date, time	20.09.2016 09:57:20
Interface / Line under test	LAN 5 Gigabit Ethernet
Transducer	CDN S8 RJ45
Measurement settings	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: 100 ms,



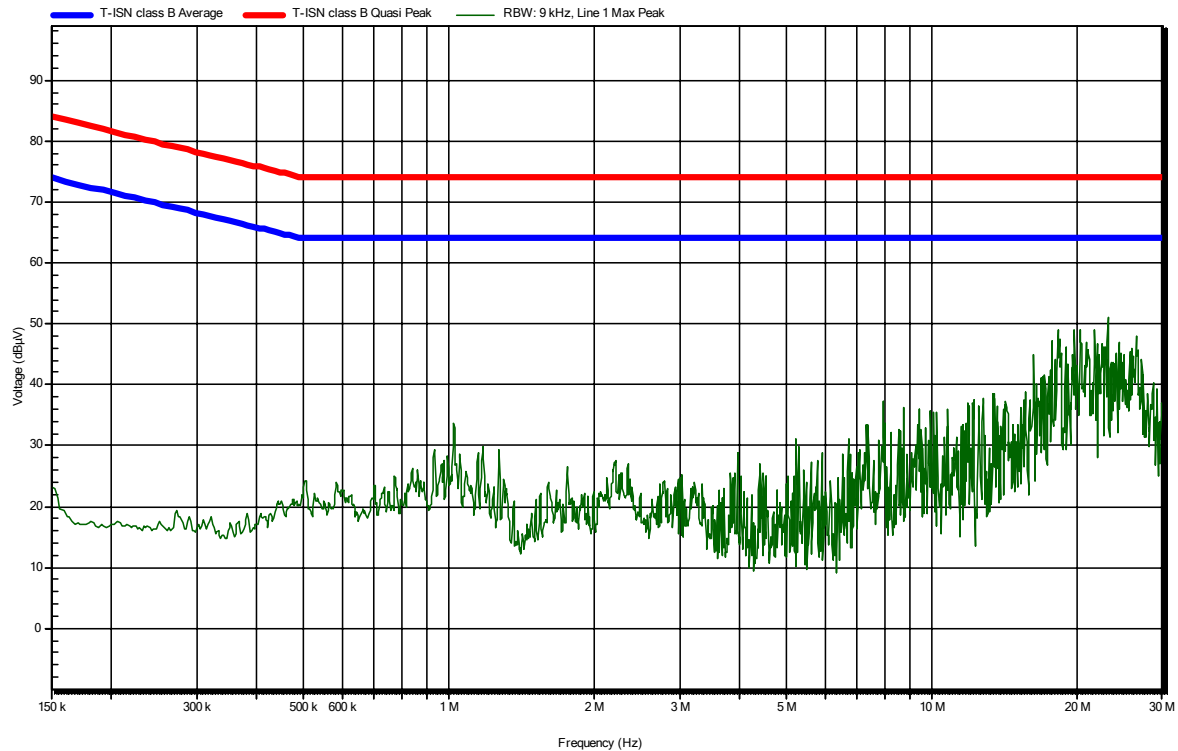
Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	186 kHz	46.38 dBμV	33 dBμV	-39.21 dB	42.31 dBμV	-39.91 dB	Pass
2	8.644 MHz	38.06 dBμV	28.29 dBμV	-35.71 dB	33.6 dBμV	-40.4 dB	Pass
3	12.75 MHz	41.27 dBμV	18.96 dBμV	-45.04 dB	26.07 dBμV	-47.93 dB	Pass
4	16.251 MHz	42.29 dBμV	22.55 dBμV	-41.45 dB	29.28 dBμV	-44.72 dB	Pass
5	19.626 MHz	38.43 dBμV	20.8 dBμV	-43.2 dB	26.65 dBμV	-47.35 dB	Pass

Measurement 10:

EUT	EUT3 (NB3711-2LcWacPbHd-G)
Verdict	PASS, CISPR 22 / 32 Class B
Mode of operation	Normal mode, 60 VDC (5x Batteries 12 V)
Test date, time	13.03.2018 09:34:38
Line under test	Ethernet 4
Transducer	LAN LISN 13.6632.07
Measurement settings	Radimation Version: 2017.2.5, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: Auto [10 dB], Internal preamp: 0 dB, Measure time: 100 ms,

RadiMation



14.3 Interference Voltage (Antenna Ports)

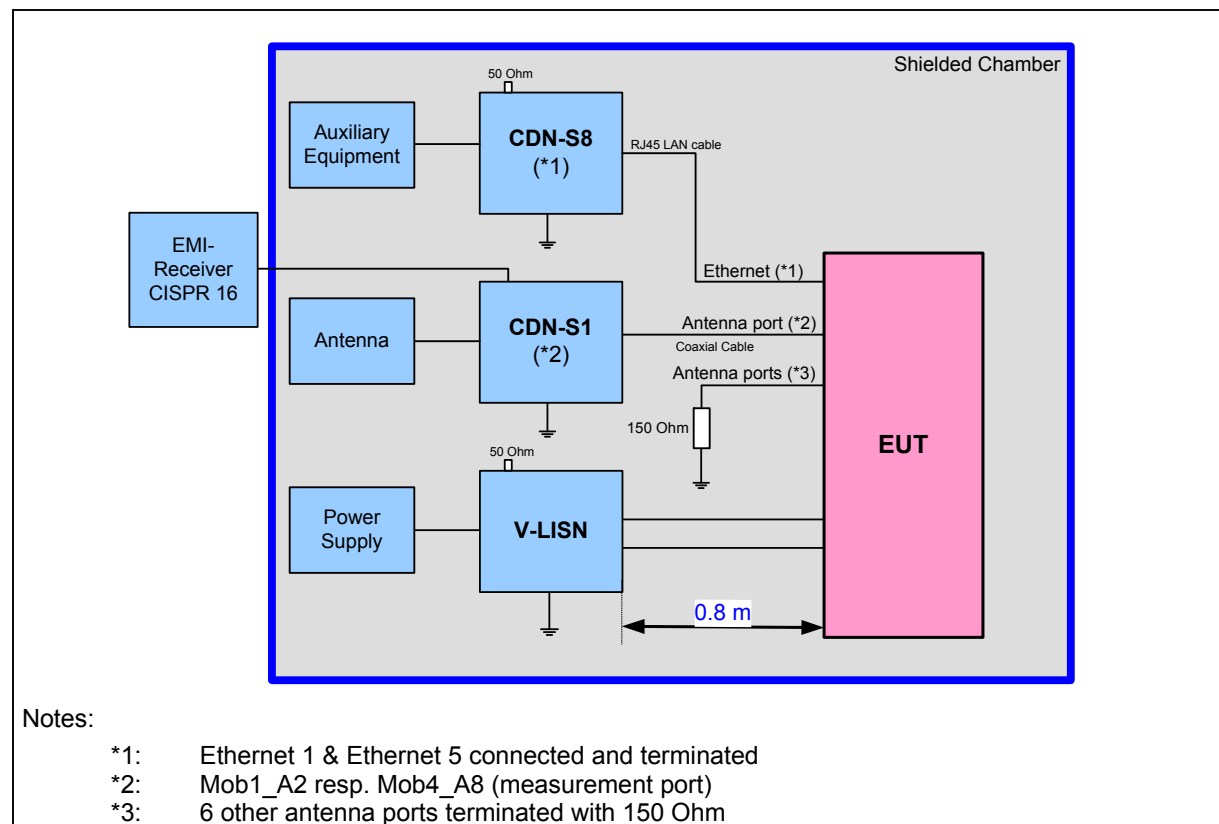
Test site: shielded room

Meas. uncertainty: see chapter 16

Measuring method: The conducted disturbance is measured using a EMI receiver and a line coupling device network (CDN-S1). The measurement of the voltage on the shield of the cable against the earth is carried out successively. The peak values are recorded continuously. Values that exceed the average limit shall be re-measured with the average and quasi peak detector of the receiver.

Modifications: none

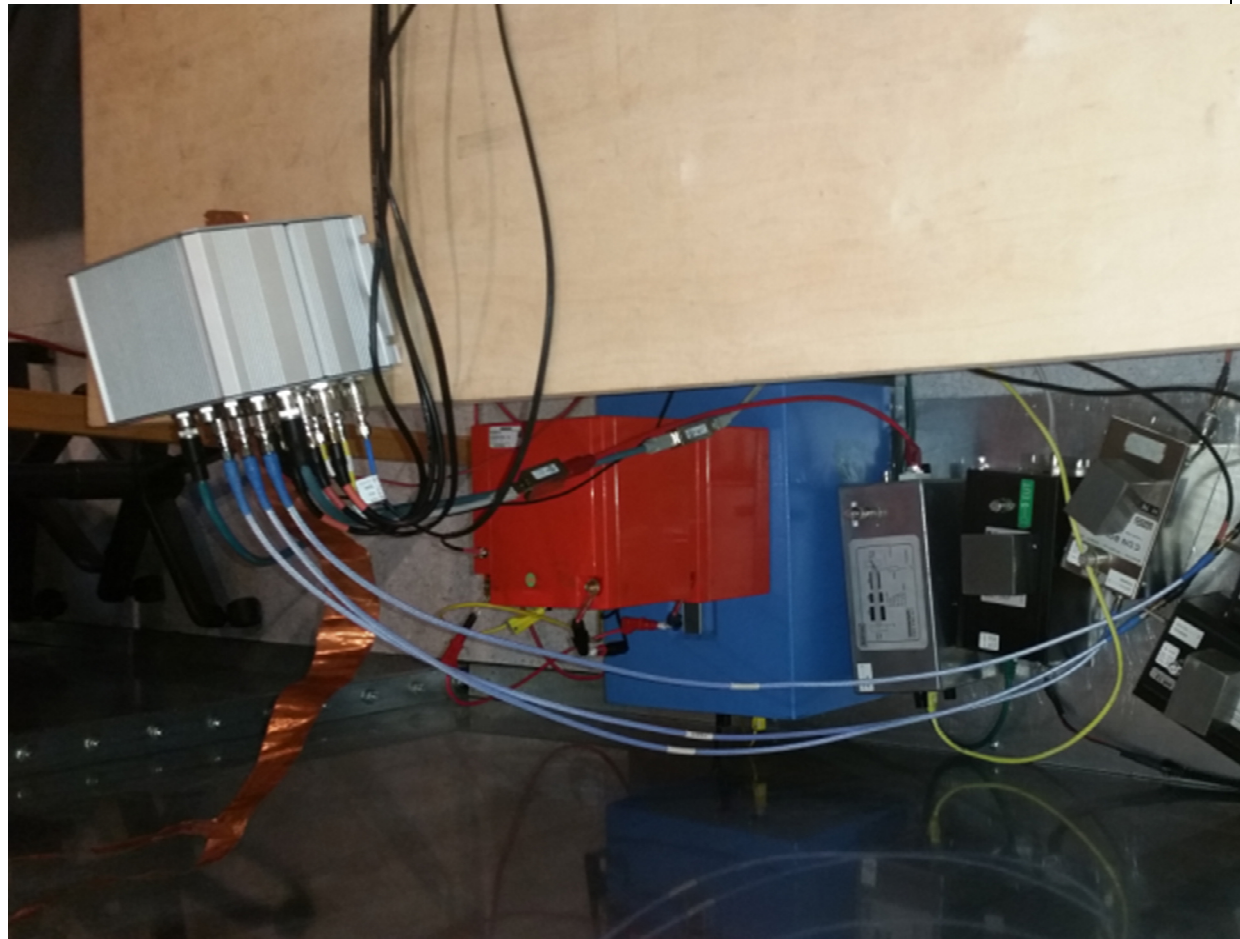
Test Setup



Test Equipment

Device Type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU 8	OA10193
CDN (measurement port)	EM Test	CDN S1	H7679
V-Network (decoupling)	Rohde & Schwarz	ESH3-Z5	PE7627
CDN (decoupling)	EM Test	CDN S8 RJ45	13.6632.07
CDN (decoupling)	EM Test	CDN S8 RJ45	13.6632.08
Coaxial Cable	Huber & Suhner	RG223/U	H8002+13.6632.02

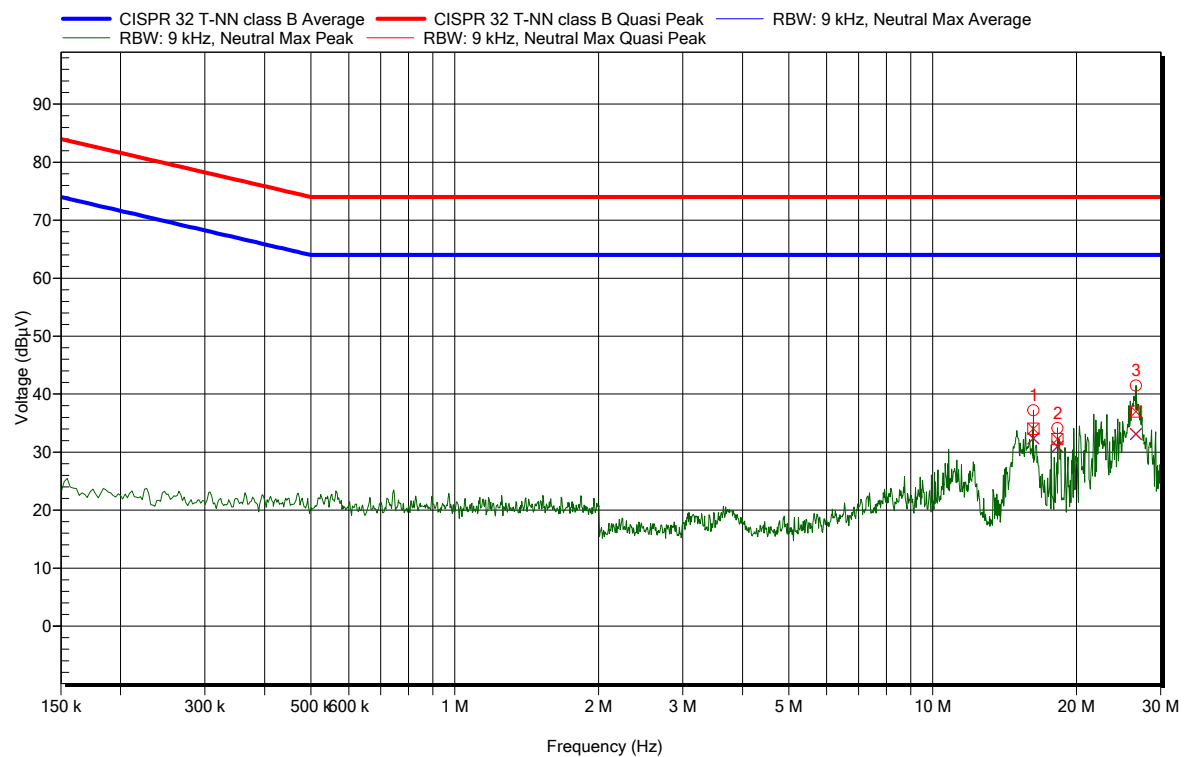
Photos of the Setup



Measurement Results

Measurement 11:

EUT	EUT1 (NB3711-2LcWacHd-G)
Verdict, Test	PASS, CISPR 22 / 32 Class B
Mode of operation	Normal mode, 24 VDC
Test date, time	20.06.2017 10:32:49
Interface / Line under test	Antenna A1
Transducer	CDN S8 RJ45
Measurement settings	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: 100 ms,



Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	16.229 MHz	37.21 dBμV	32.37 dBμV	-31.63 dB	34.01 dBμV	-39.99 dB	Pass
2	18.242 MHz	34.15 dBμV	30.97 dBμV	-33.03 dB	32.25 dBμV	-41.75 dB	Pass
3	26.608 MHz	41.46 dBμV	33.09 dBμV	-30.91 dB	37 dBμV	-37 dB	Pass

14.4 Radiated Electromagnetic Field (30 – 1000 MHz)

Test site: semi-anechoic chamber (hybrid)

Distance: 3 m

Meas. uncertainty: see chapter 16

Measuring method: CISPR 16-2-3

The electromagnetic disturbance radiated by the equipment is measured using a EMI reveicer 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

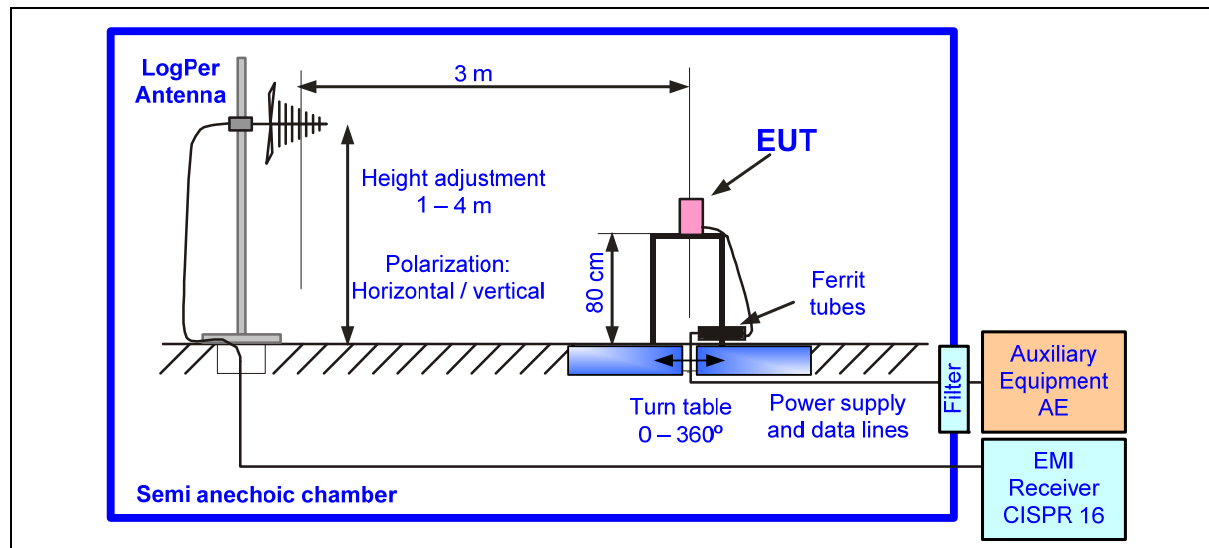


Photo of the Setup



EUT2

*EUT3***Test Equipment (EUT1 & EUT2)**

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU8	OA 10193
Antenna LogPer	Chase	CBL 6112B	H9695
Coaxial Cable	Huber & Suhner	Sucoflex 106	H10010, H10011, H10016, H10145
Power Supply	Elektro Automatik	PS 8160-04	Q10152

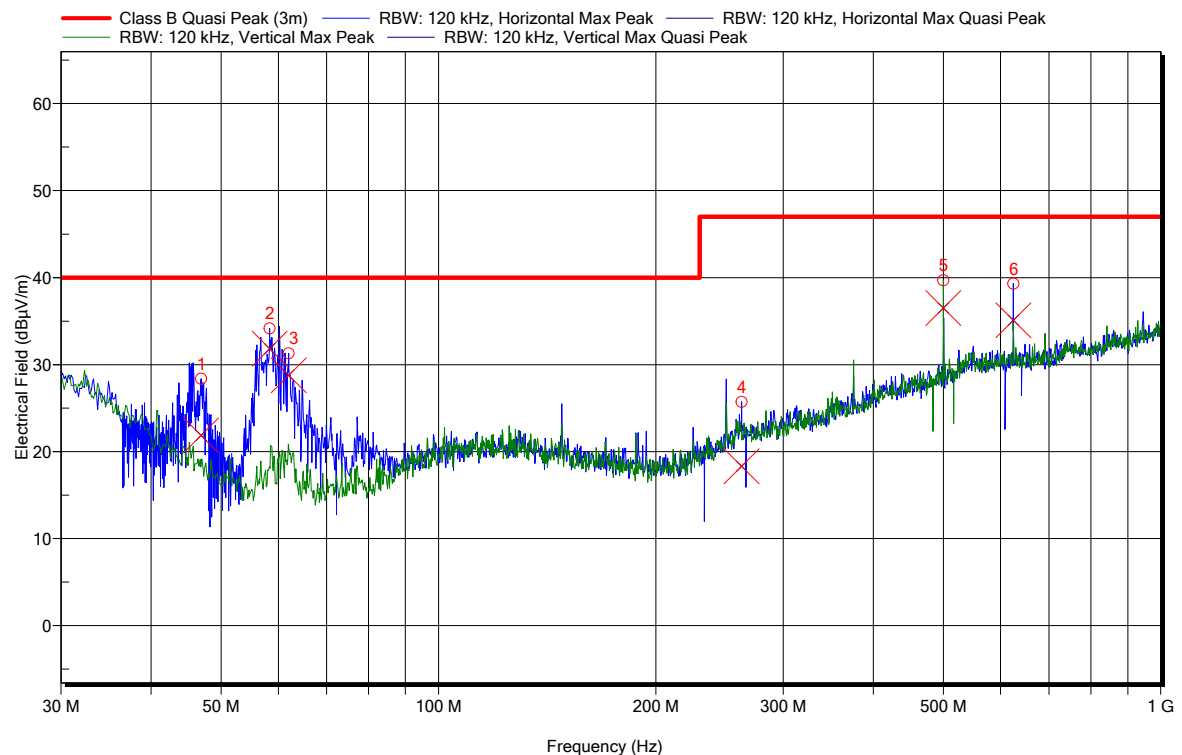
Test Equipment (EUT3)

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESW26	17.6632.05
Antenna LogPer	Chase	CBL 6112B	H9695
Coaxial Cable	Huber & Suhner	Sucoflex 106	17.6632.03, 17.6632.04, 18.6632.2
Power Supply 160 VDC	Elektro Automatik (EA)	PS 8160-04	1179370008

Measurement Results

Measurement 1:

EUT	EUT1 (NB3711-2LcWacHd-G)		
Verdict, Test	PASS, CISPR 22 / 32 Class B		
Mode of operation	normal mode 24 VDC; all cables connected		
Test date, time	19.06.2017 14:48:54		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2016.2.8, RBW: 120 kHz, VBW: 1 MHz, Sweep time: Auto [13.5 ms], Step freq: Fixed step count: 6801 steps per Band, Attenuator: Auto [10 dB], Internal preamp: 20 dB, Measure time: Auto [0 ms]		



Detected peaks

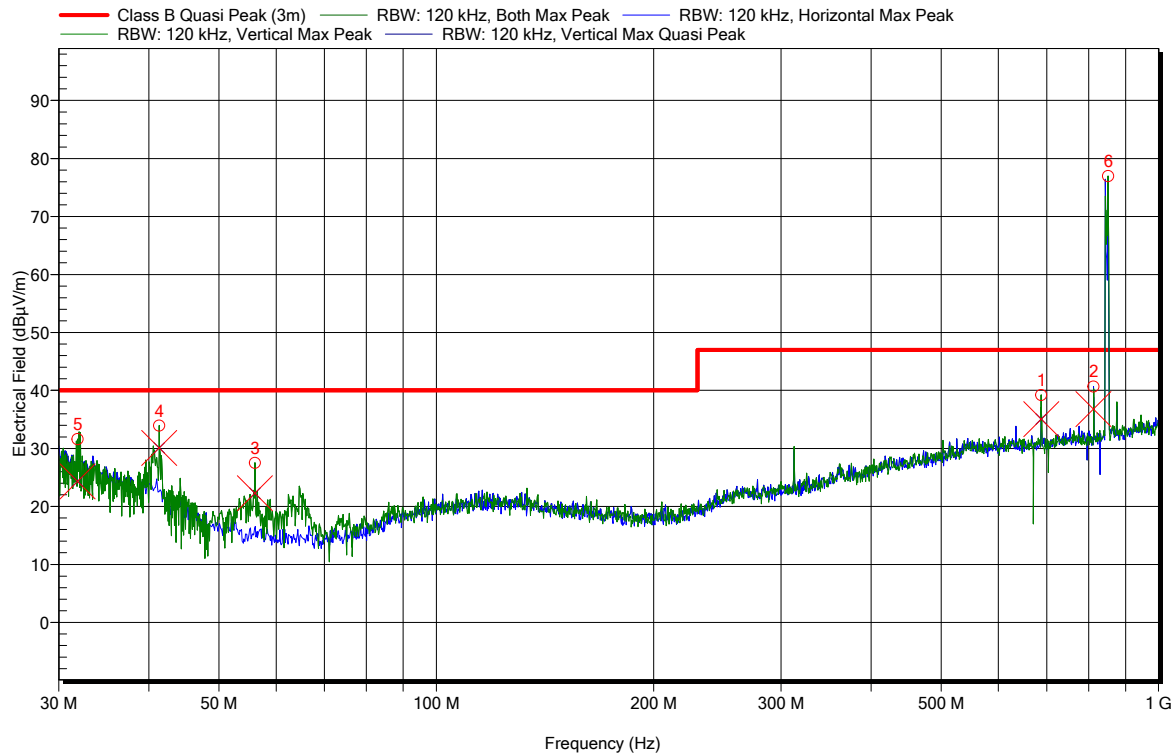
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	46.917 MHz	28.35 dBμV/m	21.85 dBμV/m	-18.15 dB	Pass	330 Degree	2 m	Horizontal
2	58.386 MHz	34.16 dBμV/m	31.83 dBμV/m	-8.17 dB	Pass	210 Degree	2 m	Horizontal
3	62.018 MHz	31.27 dBμV/m	28.78 dBμV/m	-11.22 dB	Pass	330 Degree	2 m	Horizontal
4	262.727 MHz	25.73 dBμV/m	18.29 dBμV/m	-28.71 dB	Pass	90 Degree	1 m	Horizontal
5	499.991 MHz	39.69 dBμV/m	36.49 dBμV/m	-10.51 dB	Pass	240 Degree	2 m	Vertical
6	624.998 MHz	39.3 dBμV/m	35.08 dBμV/m	-11.92 dB	Pass	180 Degree	1 m	Horizontal

Note:

- 1) Exclusion bands according to ETSI EN 301 489-7 / -24 apply

Measurement 2:

EUT	EUT2 (NB3800-3LdWacCDfHd-G)		
Verdict, Test	PASS, CISPR 22 / 32 Class B		
Mode of operation	normal mode 24 VDC; all cables connected		
Test date, time	19.06.2017 09:42:29		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2016.2.8, RBW: 120 kHz, VBW: 1 MHz, Sweep time: Auto [13.5 ms], Step freq: Fixed step count: 6801 steps per Band, Attenuator: Auto [10 dB], Internal preamp: 20 dB, Measure time: Auto [0 ms]		



Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	687.492 MHz	39.24 dBμV/m	35.08 dBμV/m	-11.92 dB	Pass	210 Degree	1 m	Vertical
2	812.487 MHz	40.69 dBμV/m	36.77 dBμV/m	-10.23 dB	Pass	300 Degree	2 m	Horizontal
3	56.066 MHz	27.52 dBμV/m	22.26 dBμV/m	-17.74 dB	Pass	330 Degree	2 m	Vertical
4	41.352 MHz	33.93 dBμV/m	30.09 dBμV/m	-9.91 dB	Pass	270 Degree	3 m	Vertical
5	31.881 MHz	31.6 dBμV/m	24.31 dBμV/m	-15.69 dB	Pass	240 Degree	1 m	Vertical
6	851.219 MHz	76.98 dBμV/m			Pass, see note	30 Degree	1 m	Vertical

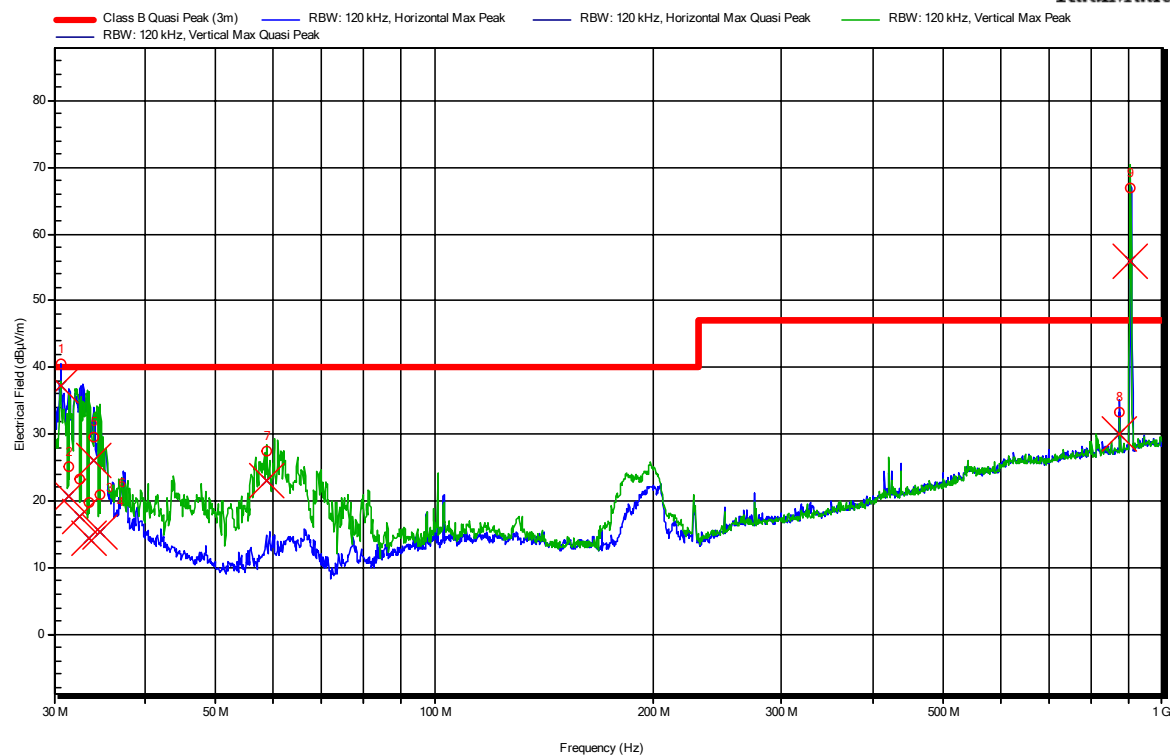
Notes:

- 1) Exclusion bands according to ETSI EN 301 489-7 / -24 apply

Measurement 3:

EUT	EUT3 (NB3711-2LcWacPbHd-G)		
Verdict	PASS, CISPR 22 / 32 Class B		
Mode of operation	normal mode, 110 VDC		
Test date, time	12.03.2018 10:31:37		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	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		

RadiMation



Detected peaks

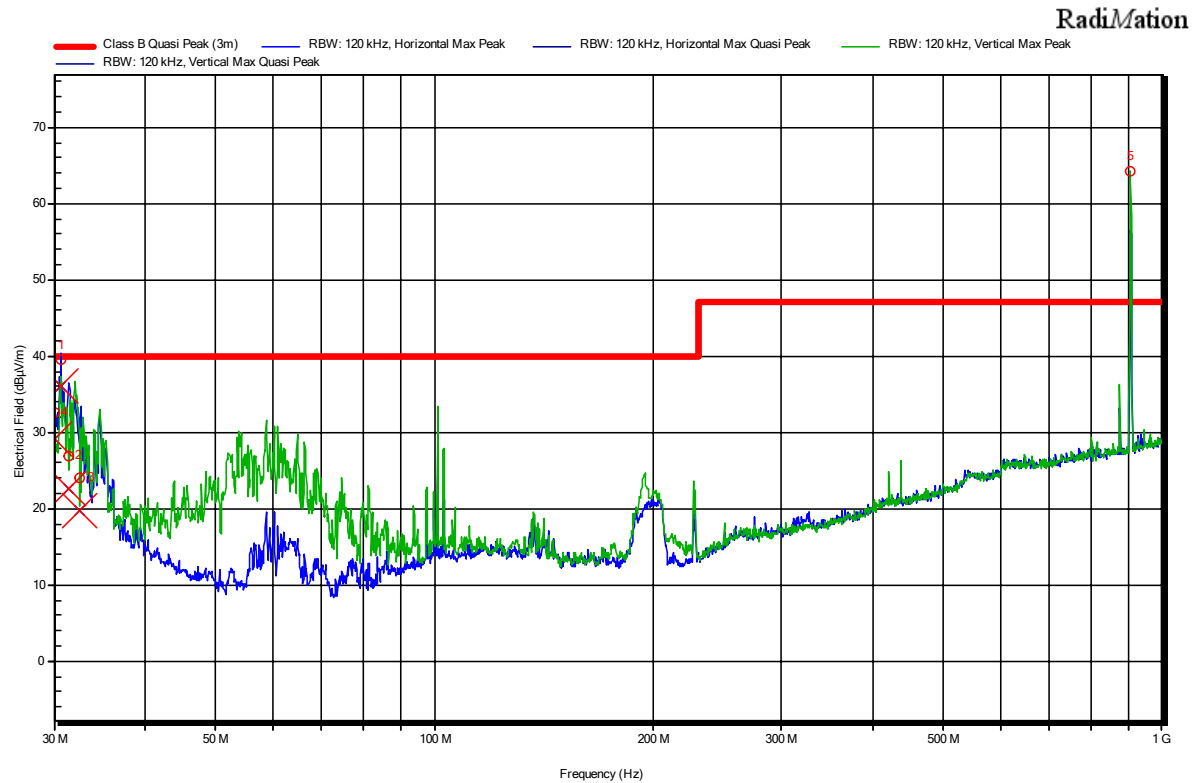
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	30.63 MHz	40.5 dBμV/m	37.2 dBμV/m	-2.8 dB	Pass	240 Degree	3 m	Horizontal
2	31.41 MHz	25.1 dBμV/m	20.7 dBμV/m	-19.3 dB	Pass	270 Degree	4 m	Vertical
3	32.58 MHz	23.3 dBμV/m	17.7 dBμV/m	-22.3 dB	Pass	270 Degree	4 m	Vertical
4	33.45 MHz	19.9 dBμV/m	14.3 dBμV/m	-25.7 dB	Pass	270 Degree	4 m	Vertical
5	34.08 MHz	29.5 dBμV/m	26.1 dBμV/m	-13.9 dB	Pass	330 Degree	3 m	Horizontal
6	34.62 MHz	21 dBμV/m	15.4 dBμV/m	-24.6 dB	Pass	270 Degree	4 m	Vertical
7	58.71 MHz	27.5 dBμV/m	23.1 dBμV/m	-16.9 dB	Pass	270 Degree	2 m	Vertical
8	874.98 MHz	33.3 dBμV/m	30.1 dBμV/m	-16.9 dB	Pass	180 Degree	4 m	Horizontal
9	904.32 MHz	66.9 dBμV/m	55.9 dBμV/m	8.9 dB	Note	300 Degree	2 m	Vertical

Note:

- 1) Exclusion bands according to ETSI EN 301 489-7 apply

Measurement 4:

EUT	EUT3 (NB3711-2LcWacPbHd-G)		
Verdict	PASS, CISPR 22 / 32 Class B		
Mode of operation	normal mode, 72 VDC		
Test date, time	12.03.2018 11:12:34		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	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
4	30 MHz	32.7 dBV/m	29.1 dBV/m	-10.9 dB	Pass	60 Degree	4 m	Horizontal
1	30.63 MHz	39.5 dBV/m	36.1 dBV/m	-3.9 dB	Pass	0 Degree	3 m	Horizontal
2	31.44 MHz	26.9 dBV/m	22.6 dBV/m	-17.4 dB	Pass	300 Degree	3 m	Vertical
3	32.58 MHz	24 dBV/m	19.8 dBV/m	-20.2 dB	Pass	300 Degree	3 m	Vertical
5	904.11 MHz	64.2 dBV/m	--	--	Note	60 Degree	1 m	Vertical

Note:

- 1) Exclusion bands according to ETSI EN 301 489-7 apply

14.5 Radiated Electromagnetic Field (1 – 6 GHz)

Test site: semi-anechoic chamber (hybrid)

Distance: 3 m

Meas. uncertainty: see chapter 16

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 peak and average detectors of the receiver.

Modifications: none

Test Setup

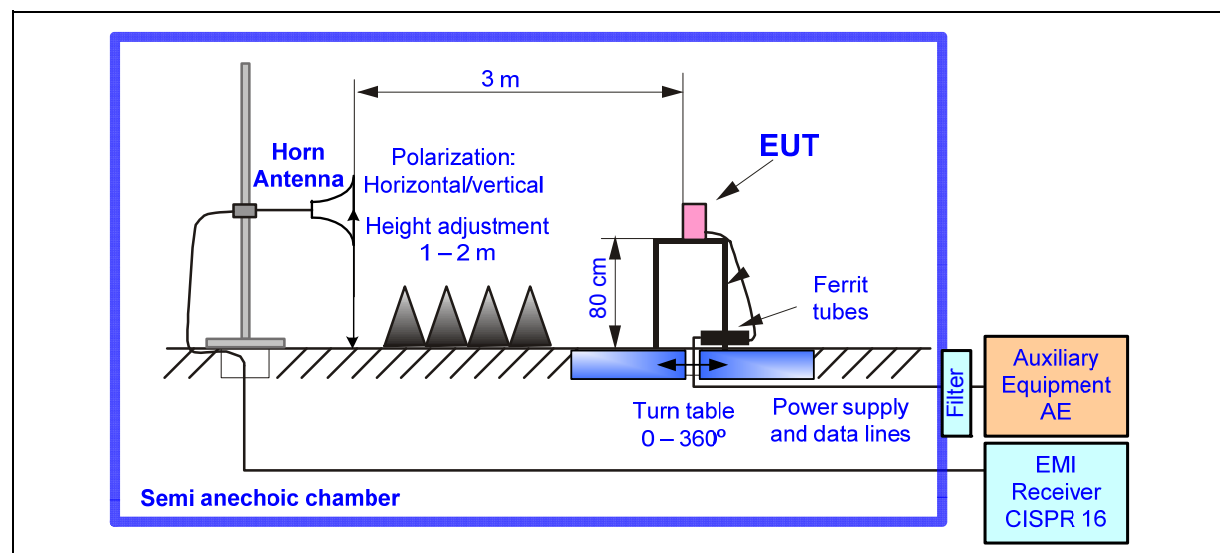
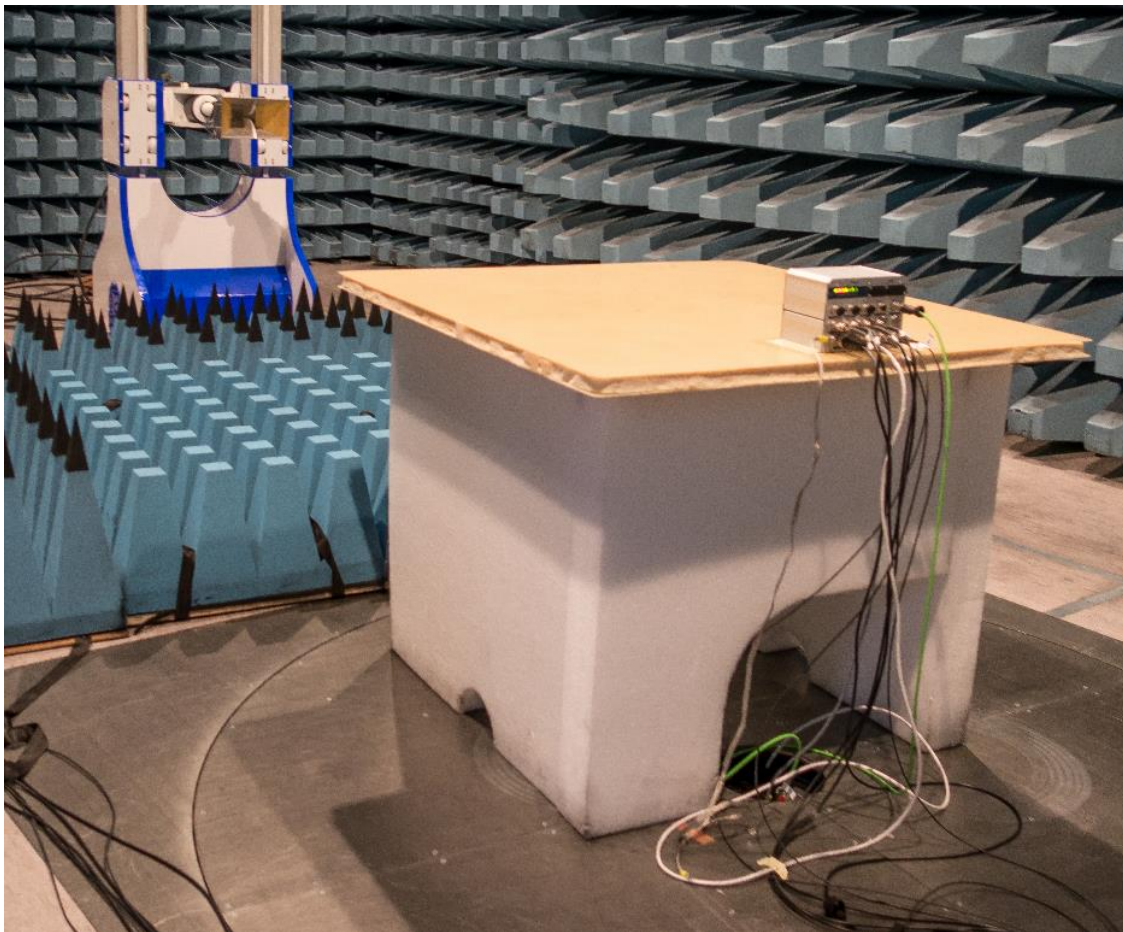


Photo of the Setup*EUT1**EUT2*



EUT3

Test Equipment (EUT1 & EUT2)

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU8	OA 10193
Horn Antenna	EMCO	3115	H9353
Coaxial Cable	Huber & Suhner	Sucoflex 106	H10010, H10011, H10016, H10145
Power Supply	Elektro Automatik	PS 8160-04	Q10152

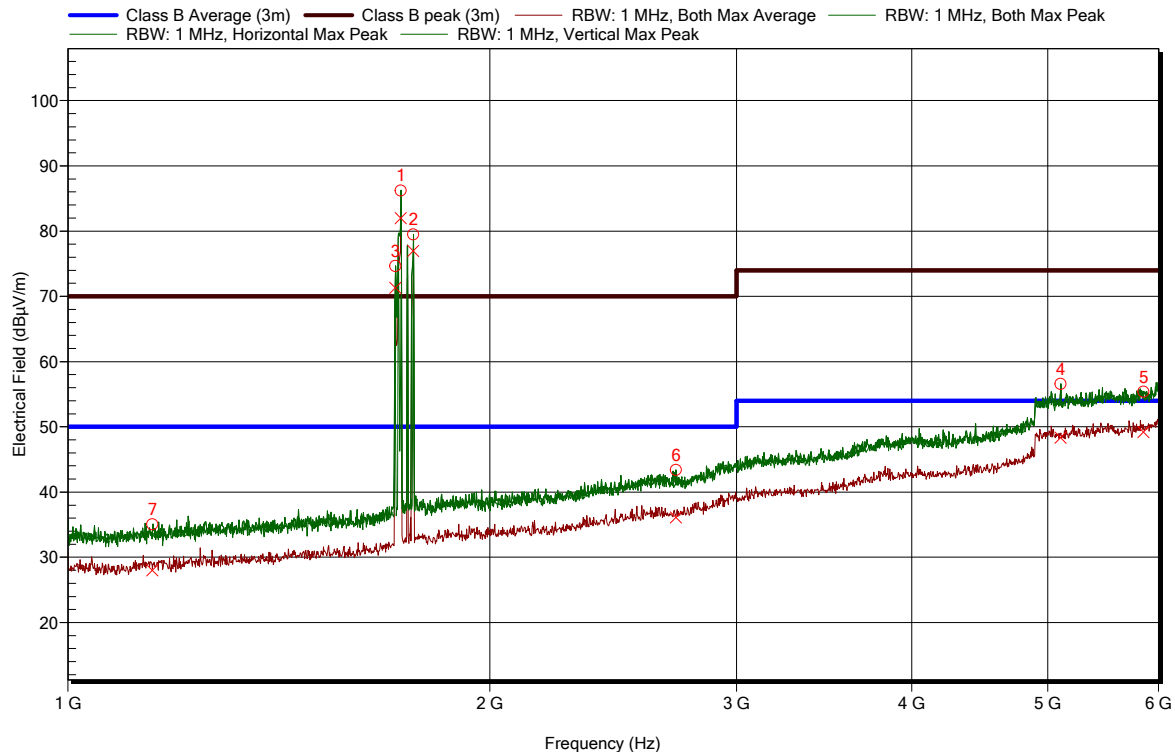
Test Equipment (EUT3)

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESW26	17.6632.05
Horn Antenna	EMCO	3115	H9353
Coaxial Cable	Huber & Suhner	Sucoflex 106	17.6632.03, 17.6632.04, 18.6632.2
Power Supply 160 VDC	Elektro Automatik (EA)	PS 8160-04	1179370008

Measurement Results

Measurement 5:

EUT	EUT1 (NB3711-2LcWacHd-G)		
Verdict, Test	PASS, CISPR 22 / 32 Class B		
Mode of operation	Normal mode, 24 VDC		
Test date, time	19.06.2017 14:15:28		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2016.2.8, RBW: 1 MHz, VBW: 300 kHz, Sweep time: Auto [47.2 ms], Step freq: Fixed step count: 6801 steps per Band, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: Auto [120 ms]		



Detected peaks

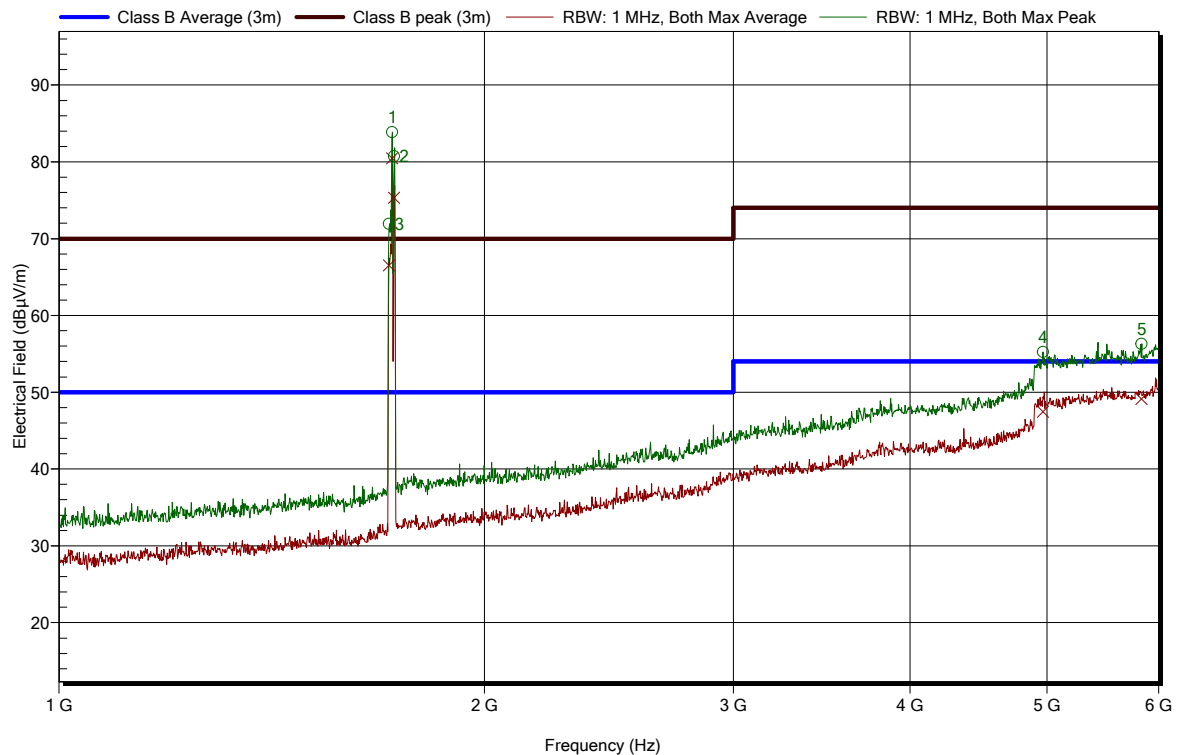
Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Polarization
1	1.728 GHz	86.23 dBμV/m	16.23 dB	81.99 dBμV/m	31.99 dB	Pass, see note	120 Degree	Horizontal
2	1.764 GHz	79.5 dBμV/m	9.5 dB	76.95 dBμV/m	26.95 dB	Pass, see note	120 Degree	Vertical
3	1.713 GHz	74.65 dBμV/m	4.65 dB	71.3 dBμV/m	21.3 dB	Pass, see note	150 Degree	Horizontal
4	5.109 GHz	56.57 dBμV/m	-17.43 dB	48.32 dBμV/m	-5.68 dB	Pass	180 Degree	Horizontal
5	5.852 GHz	55.4 dBμV/m	-18.6 dB	49.2 dBμV/m	-4.8 dB	Pass	30 Degree	Horizontal
6	2.715 GHz	43.37 dBμV/m	-26.63 dB	36.08 dBμV/m	-13.92 dB	Pass	150 Degree	Vertical
7	1.149 GHz	35.07 dBμV/m	-34.93 dB	28 dBμV/m	-22 dB	Pass	120 Degree	Vertical

Notes:

- 1) Exclusion band according to ETSI EN 301 489-24 applies
- 2) Exclusion band according to ETSI EN 301 489-17 applies

Measurement 6:

EUT	EUT2 (NB3800-3LdWacCDfHd-G)		
Verdict, Test	PASS, CISPR 22 / 32 Class B		
Mode of operation	Normal mode, 24 VDC		
Test date, time	19.06.2017 09:56:27		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2016.2.8, RBW: 1 MHz, VBW: 300 kHz, Sweep time: Auto [47.2 ms], Step freq: Fixed step count: 6801 steps per Band, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: Auto [120 ms]		



Detected peaks

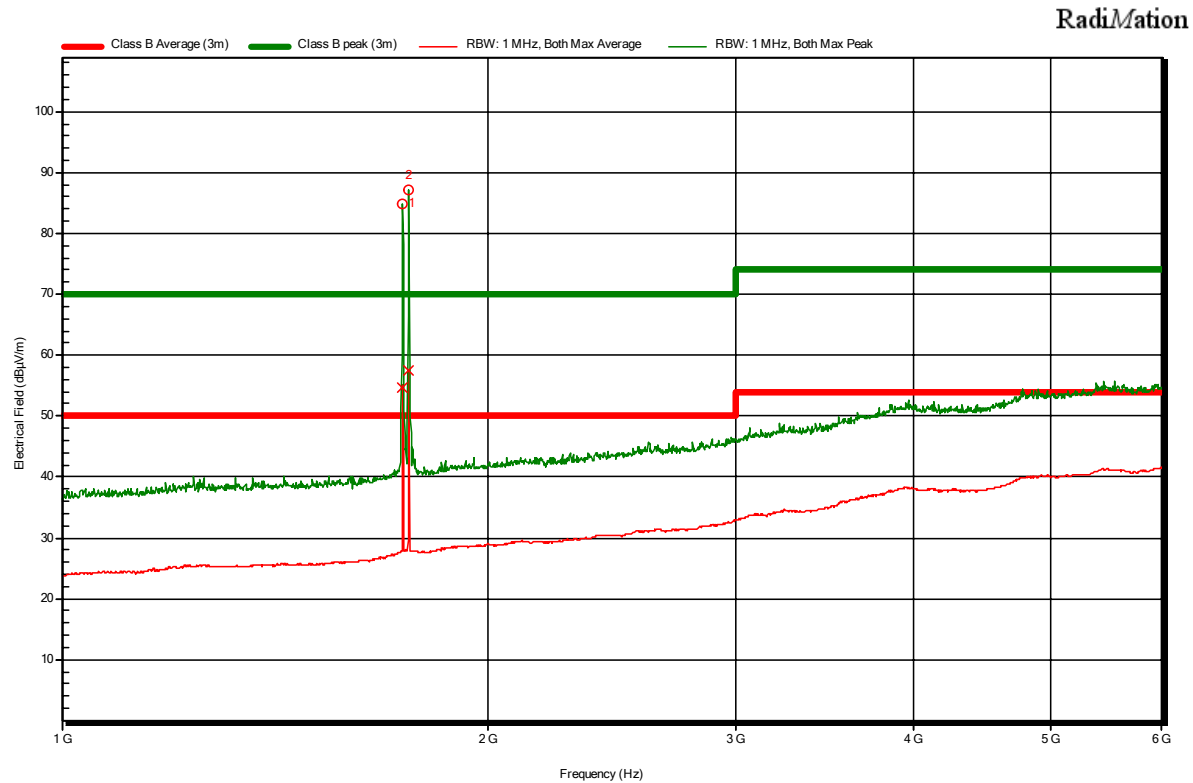
Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Polarization
1	1.721 GHz	83.86 dBµV/m	13.86 dB	80.46 dBµV/m	30.46 dB	Pass, see note	240 Degree	Vertical
2	1.726 GHz	80.74 dBµV/m	10.74 dB	75.3 dBµV/m	25.3 dB	Pass, see note	0 Degree	Vertical
3	1.713 GHz	71.92 dBµV/m	1.92 dB	66.53 dBµV/m	16.53 dB	Pass, see note	90 Degree	Vertical
4	4.968 GHz	55.24 dBµV/m	-18.76 dB	47.46 dBµV/m	-6.54 dB	Pass	0 Degree	Horizontal
5	5.832 GHz	56.31 dBµV/m	-17.69 dB	49.15 dBµV/m	-4.85 dB	Pass	150 Degree	Vertical

Notes:

- 1) Exclusion band according to ETSI EN 301 489-24 applies

Measurement 7:

EUT	EUT3 (NB3711-2LcWacPbHd-G)		
Verdict	PASS, CISPR 22 / 32 Class B		
Mode of operation	normal mode, 72 VDC		
Test date, time	12.03.2018 12:33:43		
Antenna height	1 m - 2 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	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: 20 ms		



Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Polarization
1	1.742 GHz	84.8 dBµV/m	14.8 dB	54.6 dBµV/m	4.6 dB	Note	240 Degree	Vertical
2	1.759 GHz	87 dBµV/m	17.0 dB	57.4 dBµV/m	7.4 dB	Note	270 Degree	Vertical

Note:

- 1) Exclusion band according to ETSI EN 301 489-24 applies

14.6 Radiated Emission - Electromagnetic Field - FCC

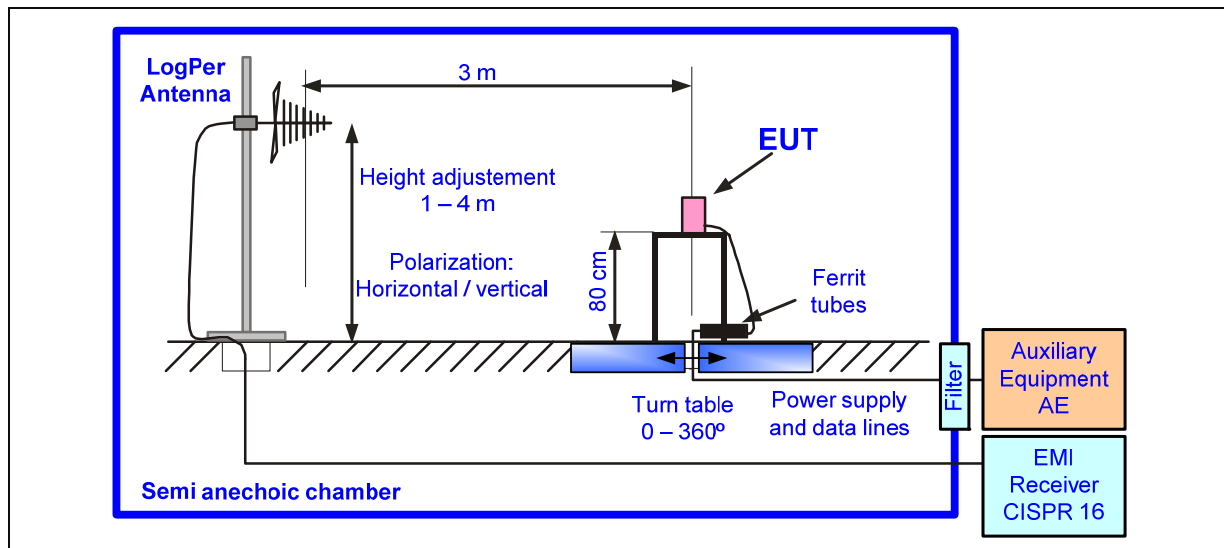
Test site: semi-anechoic chamber (hybrid)

Distance: 3 m

Meas. uncertainty: see chapter 16

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.

Test Setup



Test Equipment

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU8	OA 10193
Antenna LogPer	Chase	CBL 6112B	H9695

Not tested see test reports the 15-EL-0061.E01 and 15-EL-0061.E02 (NB3711) and 16-EL-0019.E01 and 16-EL-0019.E02 (NB3800).

15. Immunity Tests

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

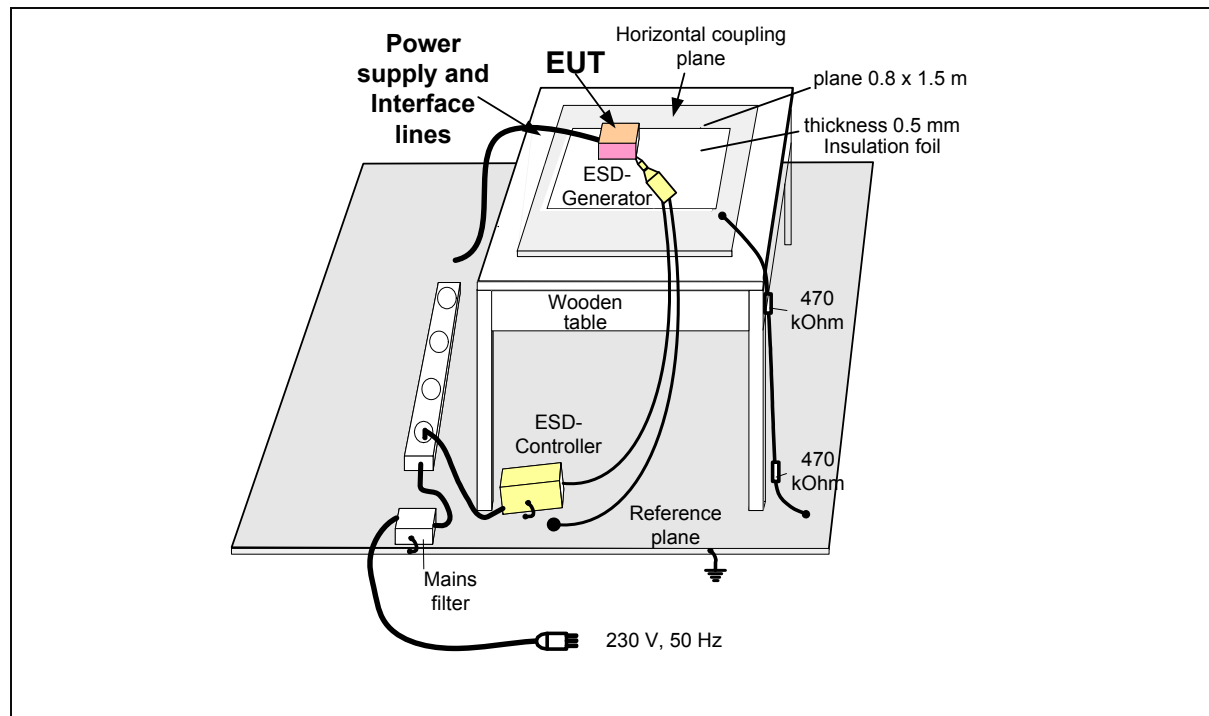
Introduction: The aim of this test is to determine the reaction of the material to electrostatic discharges (ESD) produced for example by walking on a carpet made of synthetic fiber. The humidity of the air has an influence on the discharge time and therefore on the severity of the discharge that could appear.

Coupling: 150 pF / 330 Ohm

Meas. uncertainty: see chapter 16

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.

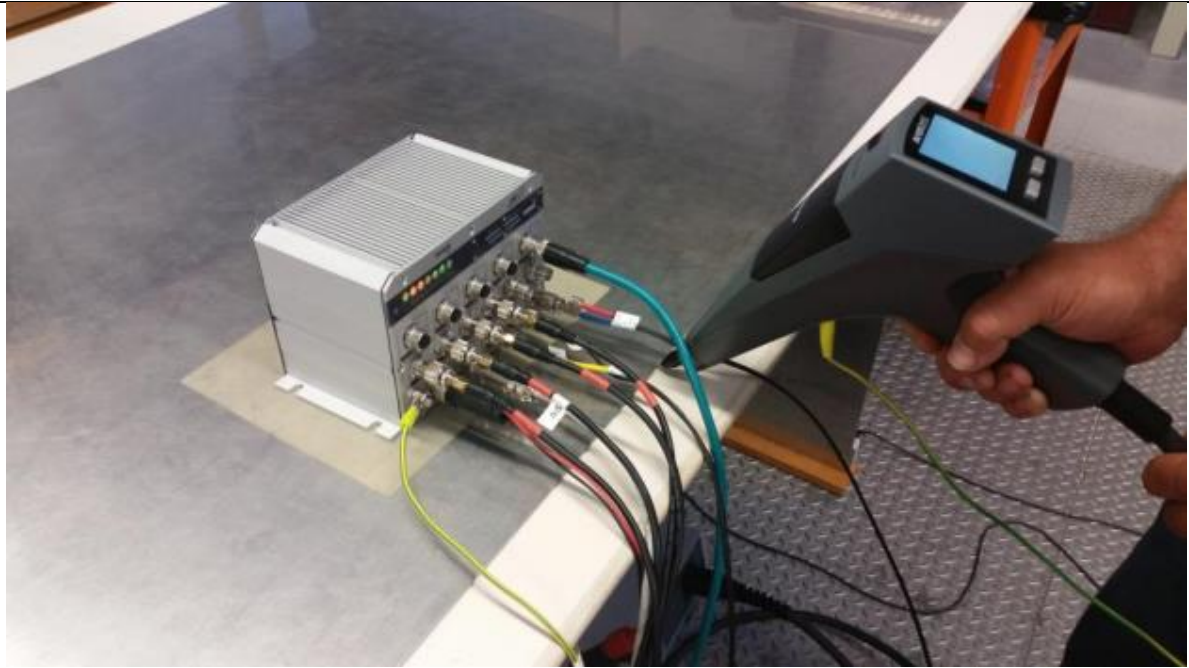
Test Setup



Test Equipment

Device Type	Brand	Type	ID
ESD Generator	EM-Test	ESD 30	PE5039
Power Supply	Hameg	HM8143	Q10153

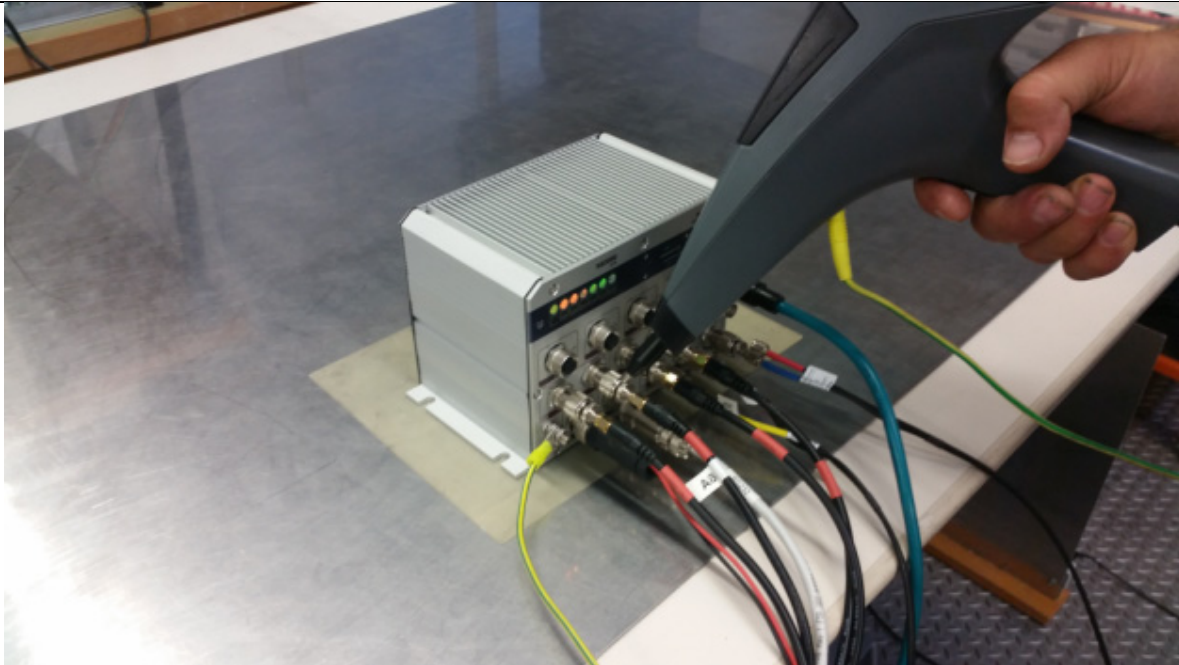
Photos of the Setup



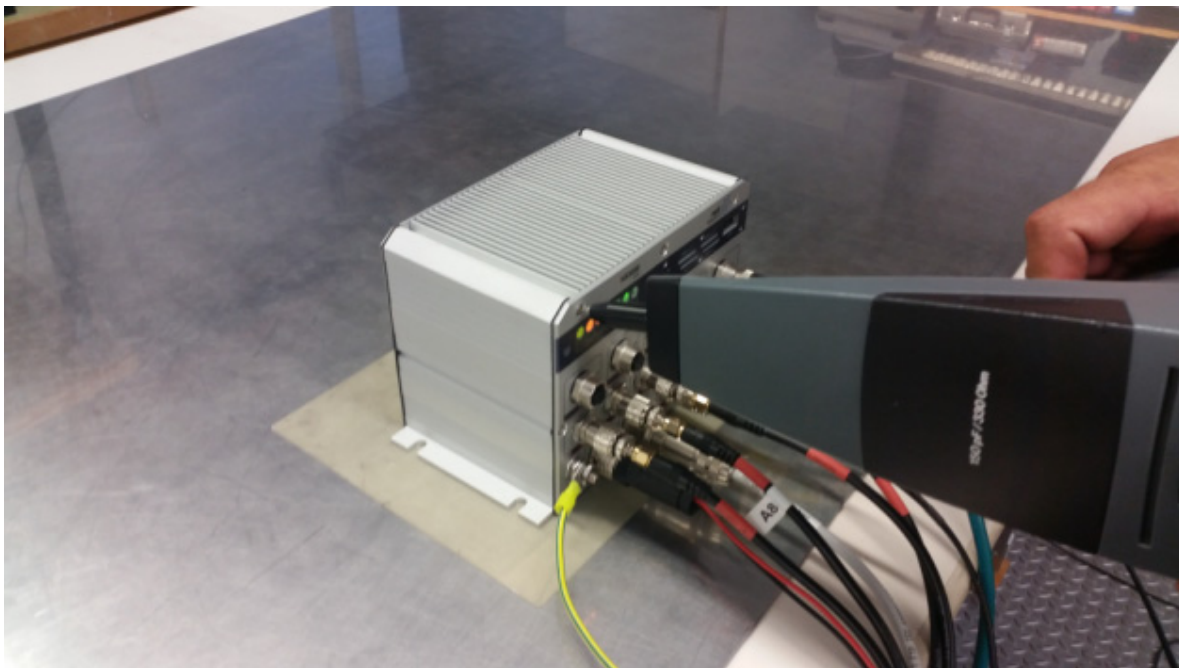
Horizontal Coupling Plane (HCP)



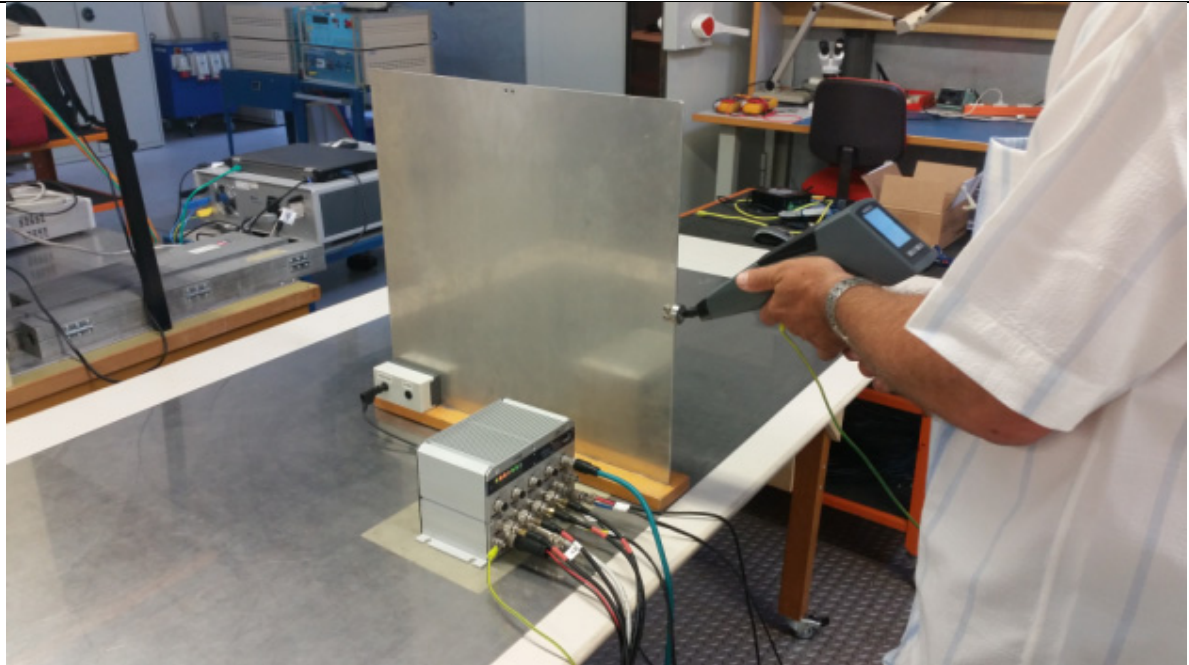
Direct Discharge



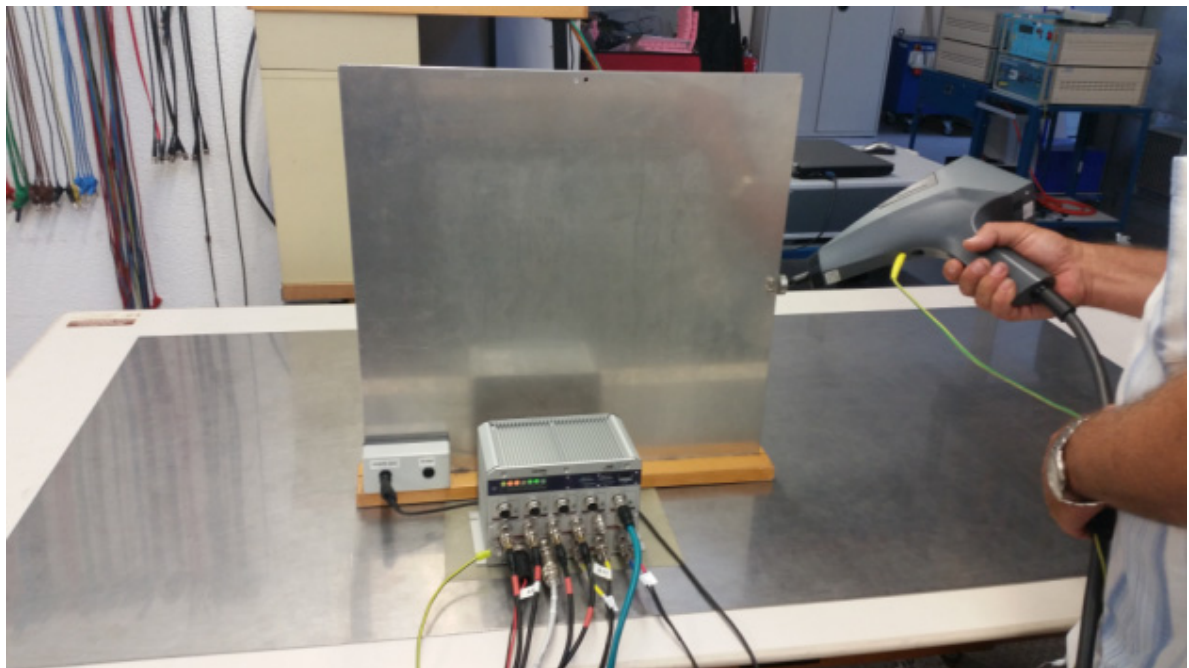
Direct Discharge



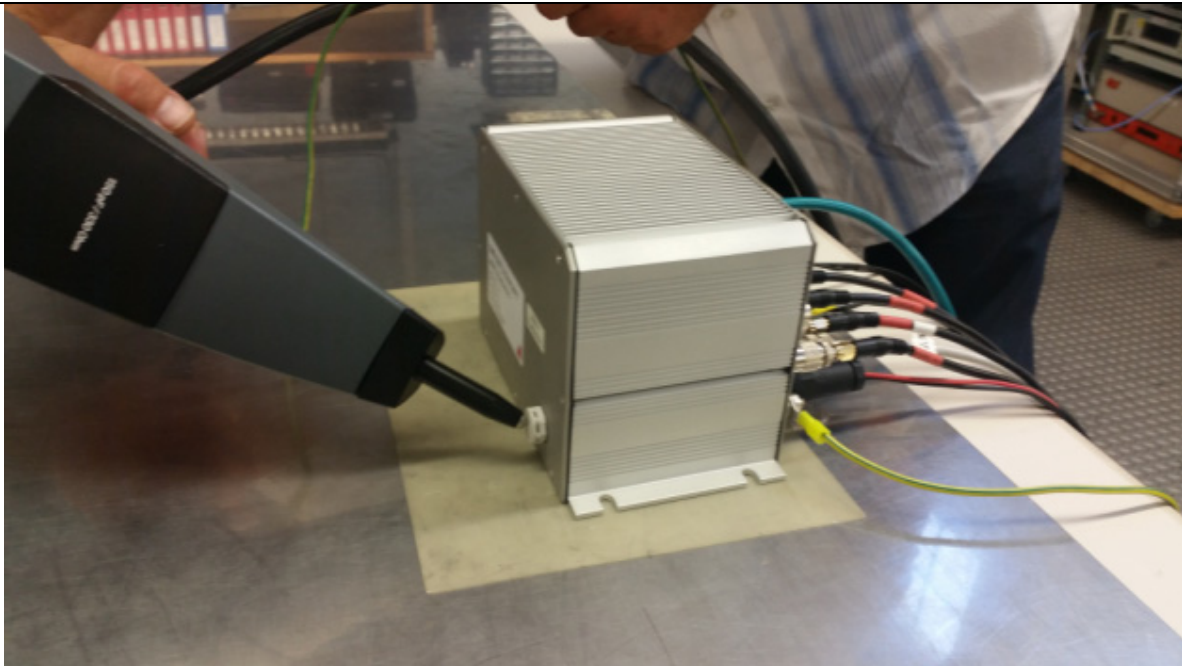
Direct Discharge



Vertical Coupling Plane (VCP)



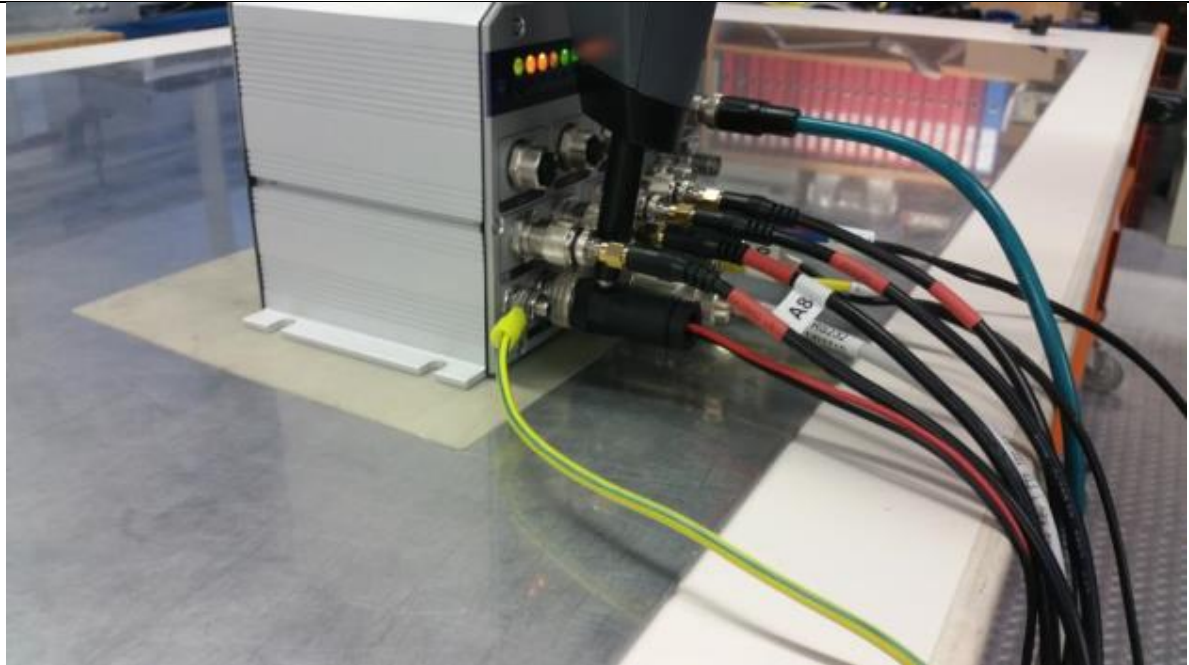
Vertical Coupling Plane (VCP)



Air discharge



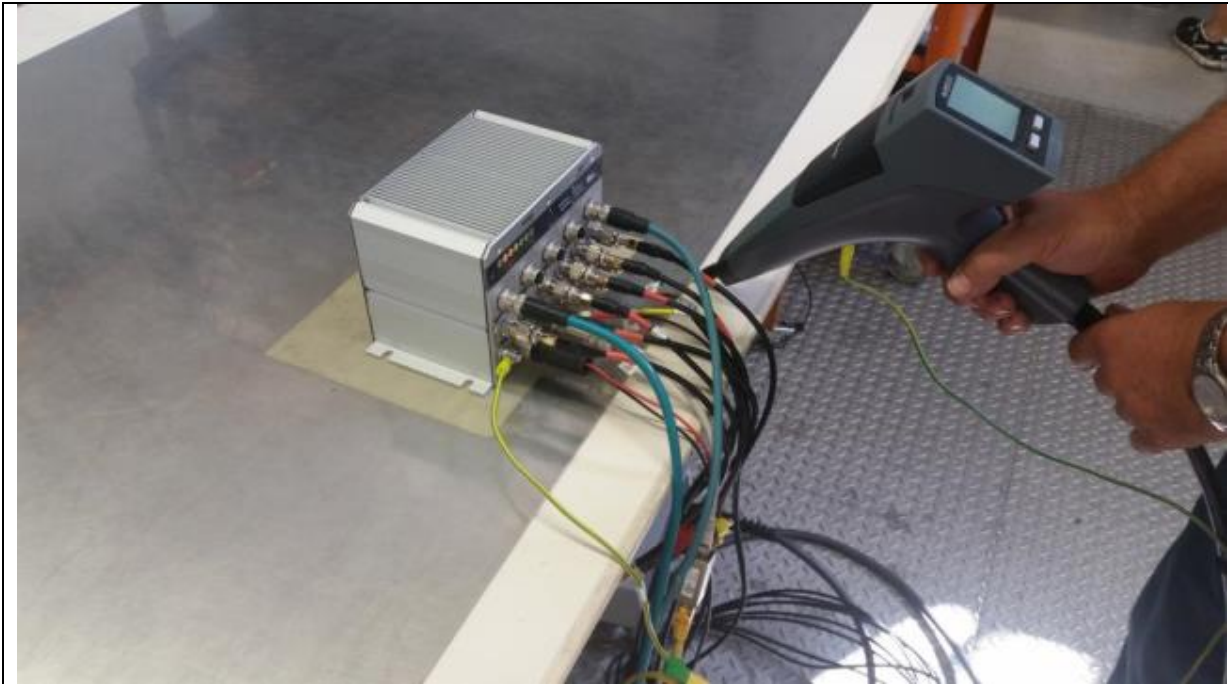
Air discharge



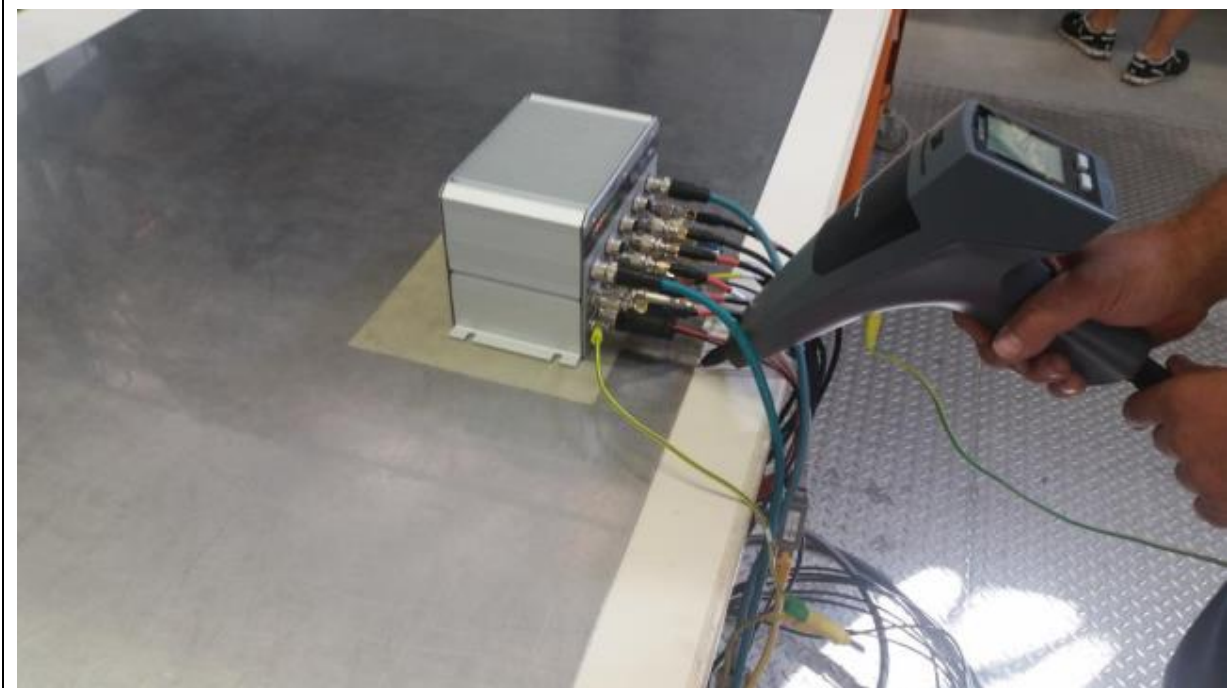
Air discharge



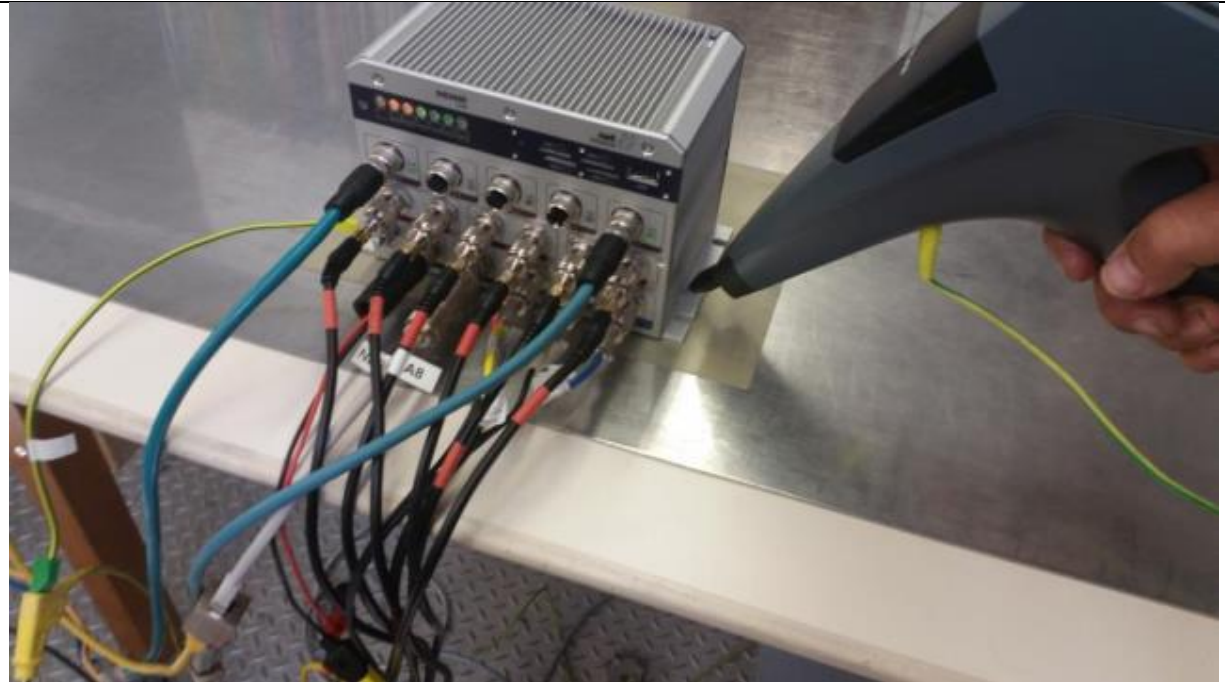
Air discharge



Air discharge



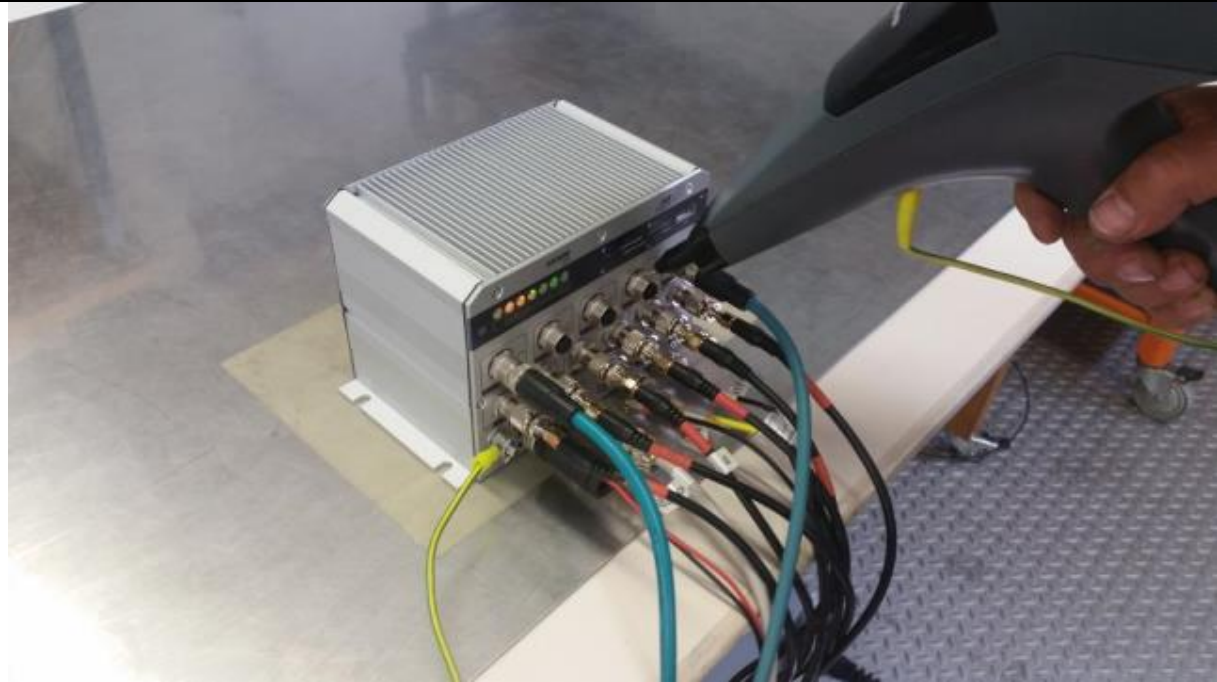
Horizontal Coupling Plane (HCP)



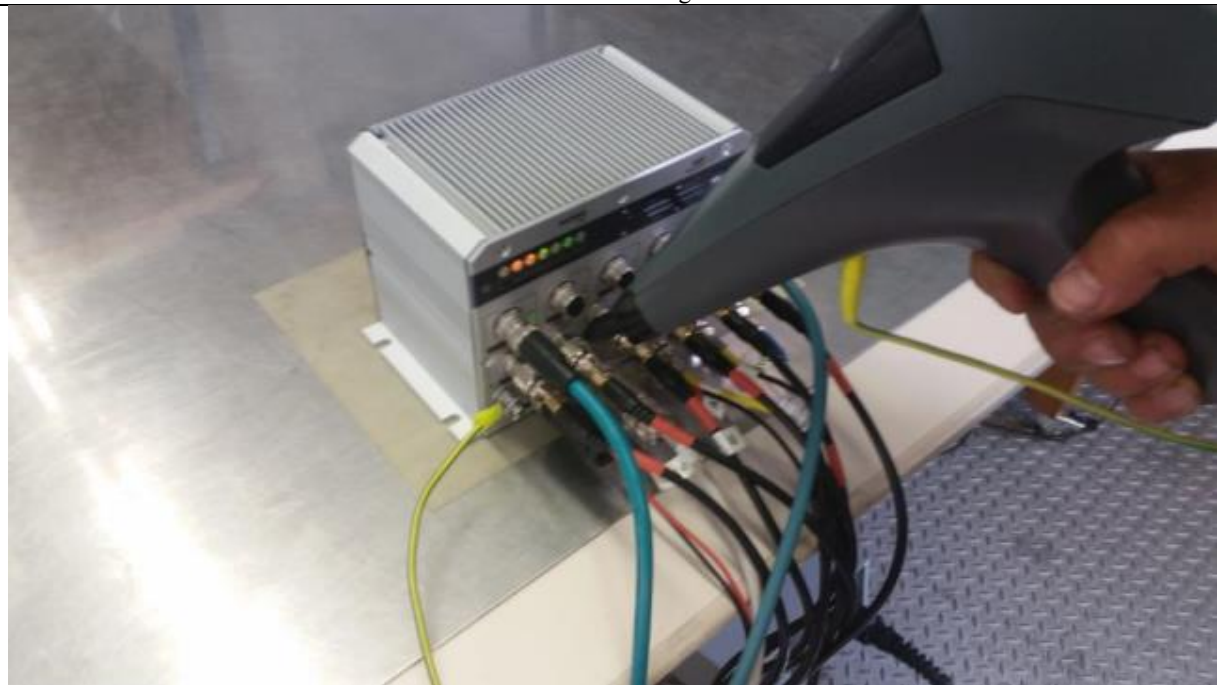
Contact discharge



Contact discharge



Contact discharge



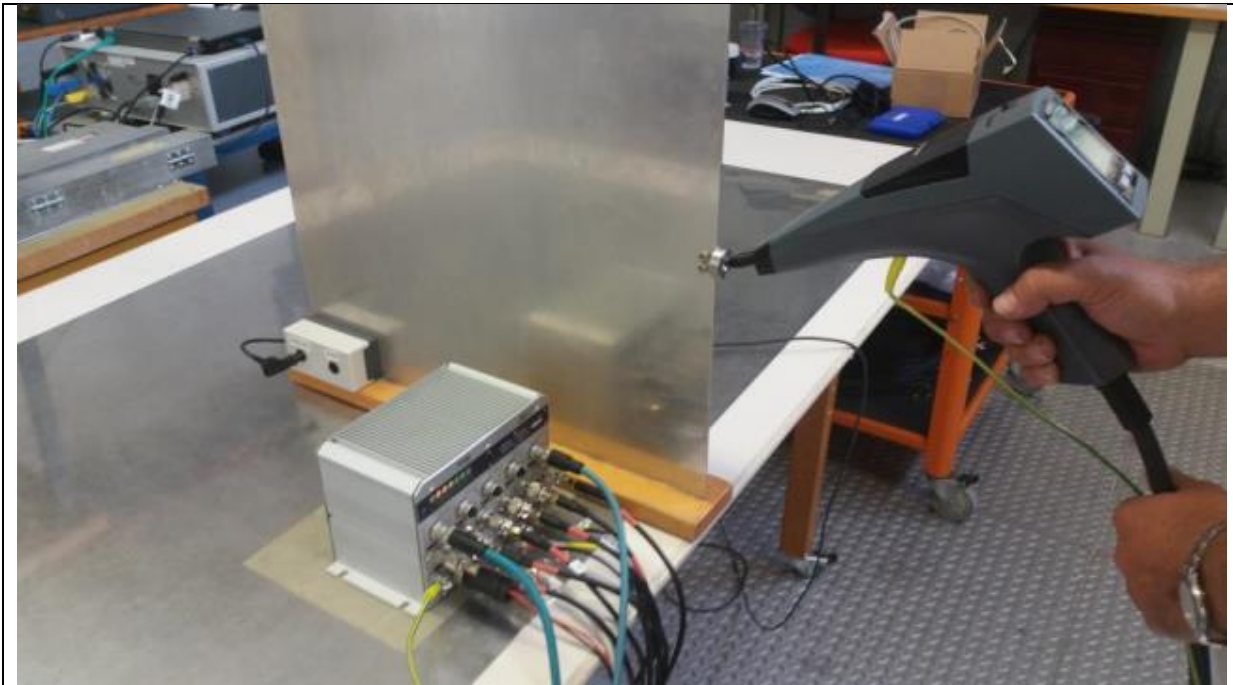
Contact discharge



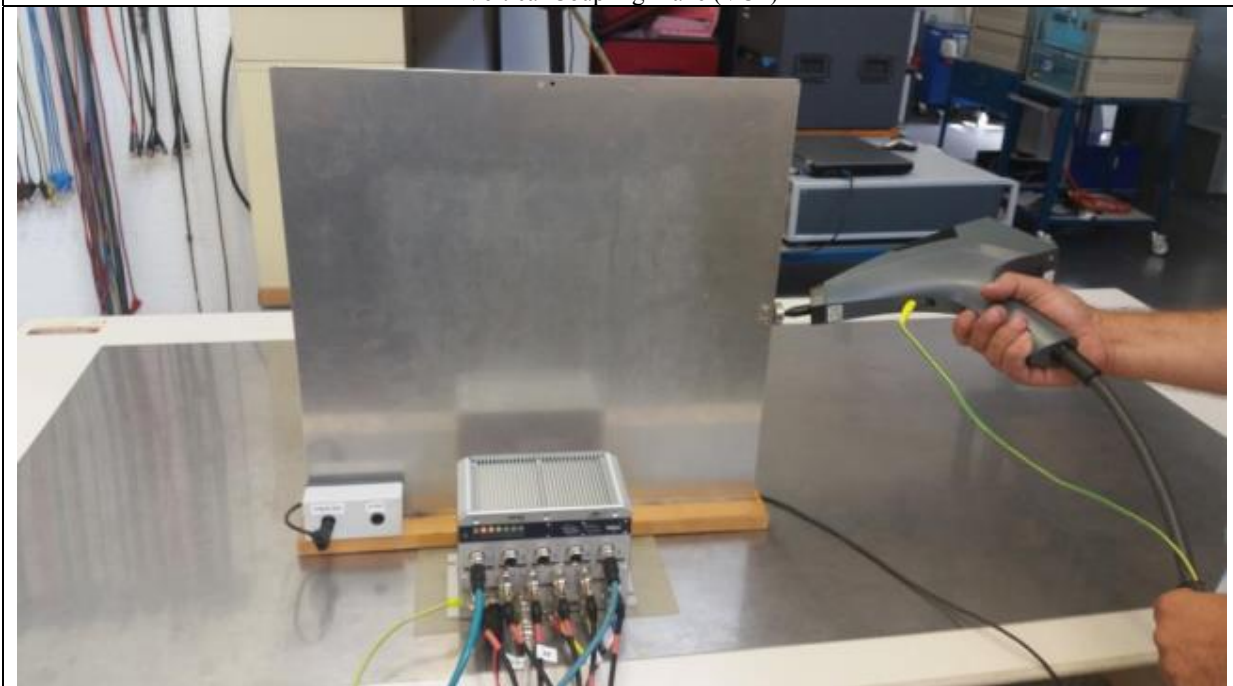
Air discharge



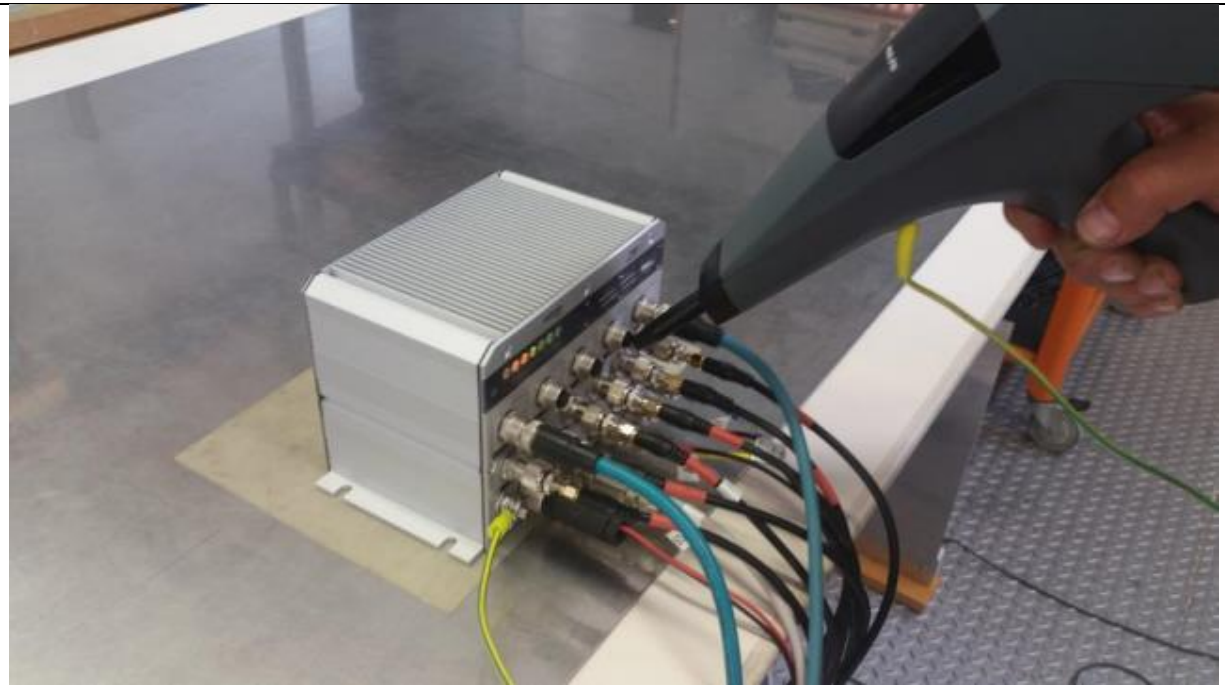
Contact discharge



Vertical Coupling Plane (VCP)



Vertical Coupling Plane (VCP)



Discharge on connectors



Discharge on connectors

Test Results

Equipment: EUT1 (NB3711-2LcWacHd-G)
 EUT2 (NB3800-3LdWacCDfHd-G)
Cables connected: See chapter 13.4
Operating mode: Normal operation, see chapter 13.5
Observation of EUT: See chapter 13.6
Modifications: none
Test site: laboratory

Requirements

Standard	Required Level Air Discharge	Required Level Contact Discharge	Impulses per Point, Level and Polarity	Performance Criterion
EN 50121-3-2	±8 kV	±6 kV	10	B
EN 50155	±8 kV	±6 kV	10	B
EN 61000-6-2	±8 kV	±4 kV	10	B
EN 301 489-1	±8 kV	±4 kV	10	B

Protocol of the Test

EUT1 (NB3711-2LcWacHd-G):

Indirect Discharges:

Level [kV]	No of discharges (for each level)	Discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
± 4; ± 6	10	HCP	No errors observed	A	Pass
± 4; ± 6	10	VCP	No errors observed	A	Pass

Direct Discharges:

Level [kV]	No of discharges (for each level)	Discharge		Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
		Air	Contact			
± 4; ± 6	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Tested: all metallic parts, screws, connectors No errors observed	A	Pass
± 2; ± 4; ± 8	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Tested: LEDs, USB connector, SIM slots, cables. No errors observed	A	Pass

EUT2 (NB3800-3LdWacCDfHd-G):

Indirect Discharges:

Level [kV]	No of discharges (for each level)	Discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
± 4; ± 6	10	HCP	No errors observed	A	Pass
± 4; ± 6	10	VCP	No errors observed	A	Pass

Direct Discharges:

Level [kV]	No of discharges (for each level)	Discharge		Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
		Air	Contact			
± 4; ± 6	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Tested: all metallic parts, screws, connectors No errors observed	A	Pass
± 2; ± 4; ± 8	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Tested: LEDs, USB connector, SIM slots, cables. No errors observed	A	Pass

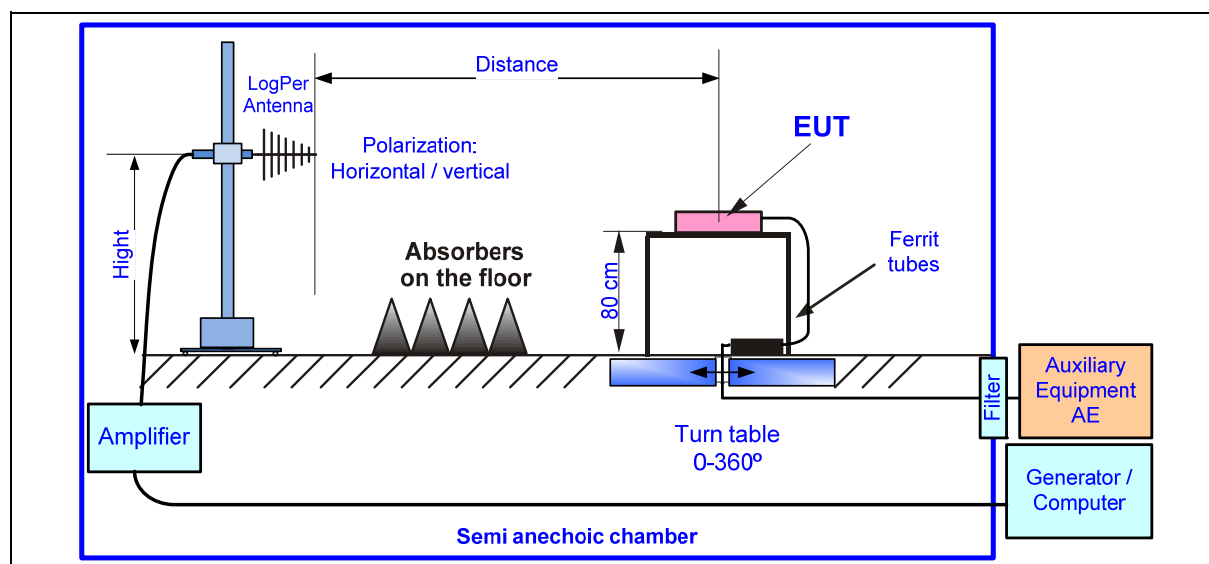
15.2 Immunity to Electromagnetic Fields (EN 61000-4-3)

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 16

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

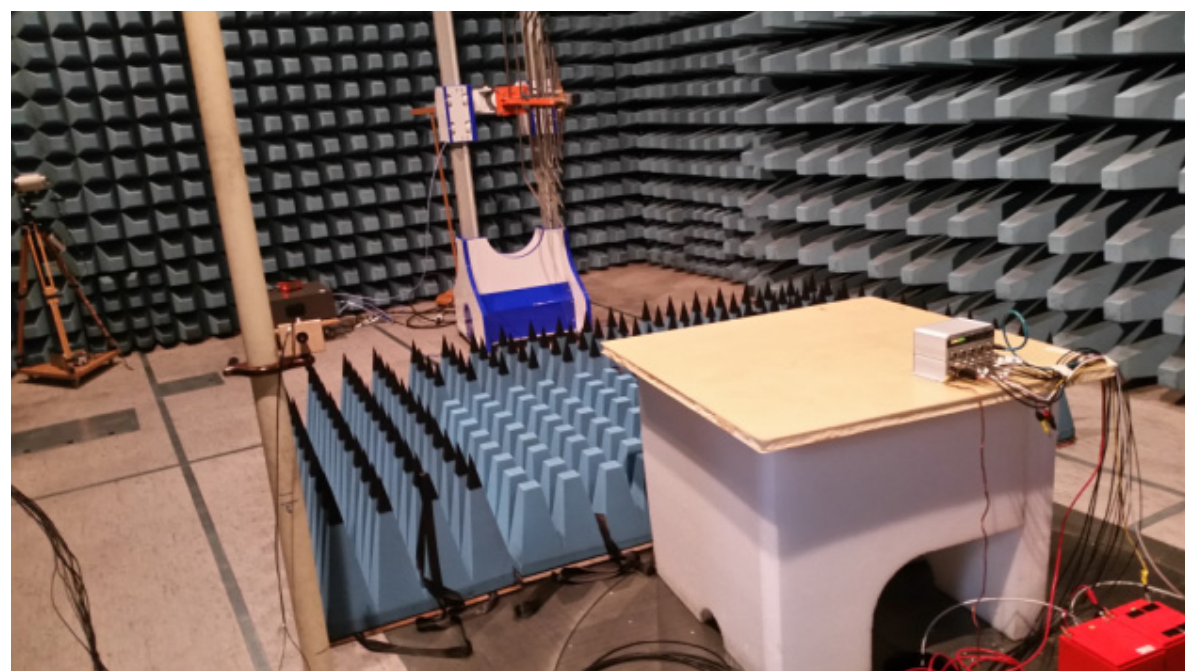


Test Equipment

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
Power Supply	Hameg	HM8143	Q10153
Power Supply 160 VDC (EUT3)	Elektro Automatik (EA)	PS 8160-04	1179370008

Photo of the Setup

EUT1



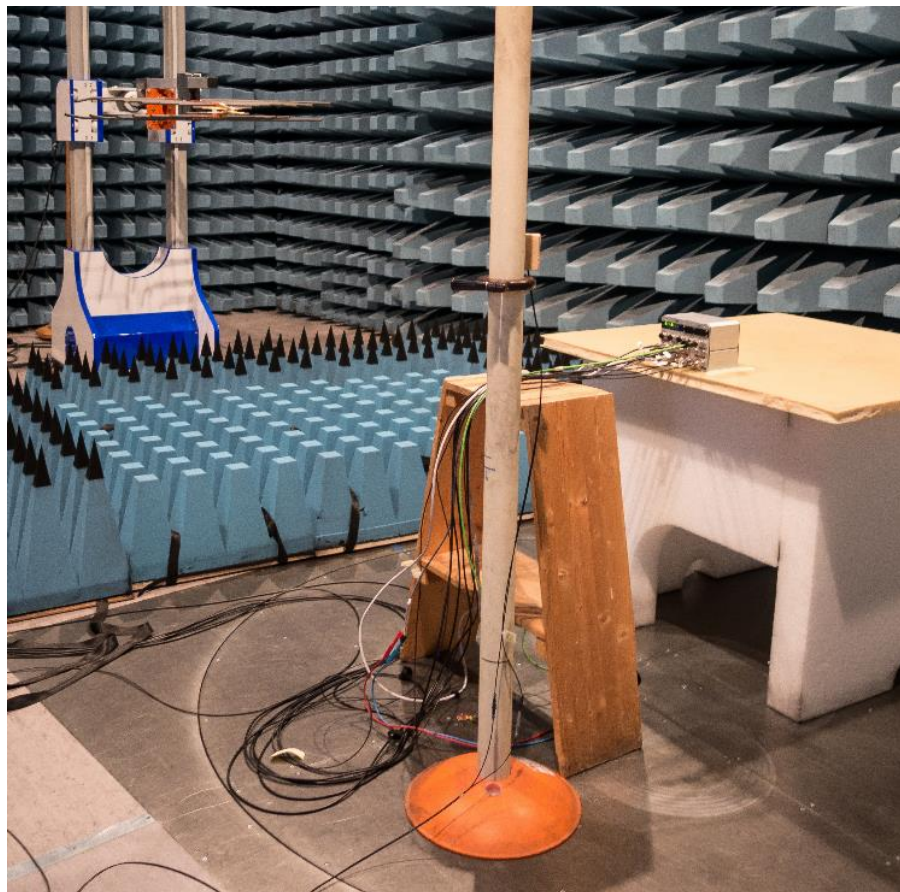
EUT1



EUT2



EUT2



EUT3

Test Results

Equipment: EUT1 (NB3711-2LcWacHd-G)
 EUT2 (NB3800-3LdWacCDfHd-G)
 EUT3 (NB3711-2LcWacPbHd-G)

Cables connected: See chapter 13.4

Operating mode: Normal operation, see chapter 13.5

Observation of EUT: See chapter 13.6

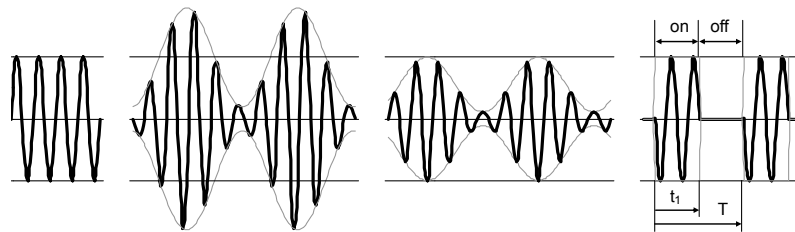
Modifications: none

Test site: semi-anechoic chamber (hybrid)

Requirements

Standard	Frequency Range	Required Level	Modulation	Freq. step	Dwell time	Performance Criterion
EN 50121-3-2	80 – 1000 MHz	20 V/m	AM, 1 kHz, 80%	1 %	1 s	A
	1400 – 2000 MHz	10 V/m	AM, 1 kHz, 80 %	1 %		A
	2000 – 2700 MHz	5 V/m	AM, 1 kHz, 80 %	1 %		A
	5100 – 6000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %		A
EN 50155	80 – 1000 MHz	20 V/m	AM, 1 kHz, 80%	1 %	1 s	A
	1400 – 2000 MHz	10 V/m	AM, 1 kHz, 80 %	1 %		A
	2000 – 2700 MHz	5 V/m	AM, 1 kHz, 80 %	1 %		A
	5100 – 6000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %		A
EN 61000-6-2	80 – 1000 MHz	10 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1400 – 2000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %		A
	2000 – 2700 MHz	1 V/m	AM, 1 kHz, 80 %	1 %		A
EN 301 489-1	80 – 1000 MHz	3 V/m	AM, 1 kHz, 80 %	1 %	1 s	A
	1400 – 2700 MHz	3 V/m	AM, 1 kHz, 80 %	1%		A

Modulation:

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


Protocol of the Test

EUT1 (NB3711-2LcWacHd-G) and EUT2 (NB3800-3LdWacCDfHd-G):

Partly tested, see also test reports 15-EL-0061.E01 and 15-EL-0061.E02 (NB3711) and 16-EL-0019.E01 and 16-EL-0019.E02 (NB3800).

Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	20	horizontal	0°, 90°	No errors observed	A	Pass
	20	vertical	0°, 90°	No errors observed	A	Pass
1000 - 6000	10	horizontal	0°, 90°	No errors observed	A	Pass
	10	vertical	0°, 90°	No errors observed	A	Pass

EUT3 (NB3711-2LcWacPbHd-G):

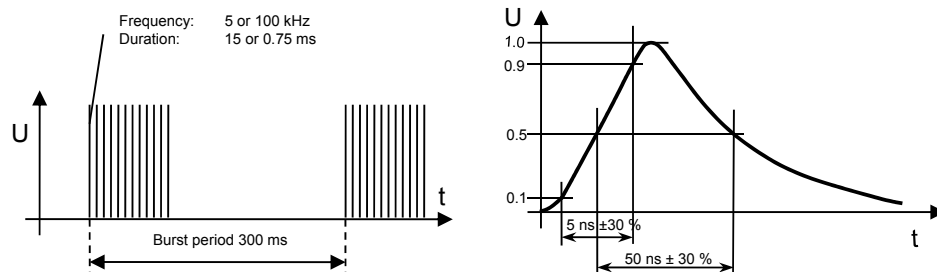
Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	20	horizontal	90°	No errors observed	A	Pass
	20	vertical	90°	No errors observed	A	Pass
1000 - 6000	10	horizontal	90°	No errors observed	A	Pass
	10	vertical	90°	No errors observed	A	Pass

15.3 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:



Open-circuit voltage

Voltage in a 50 Ω -Load

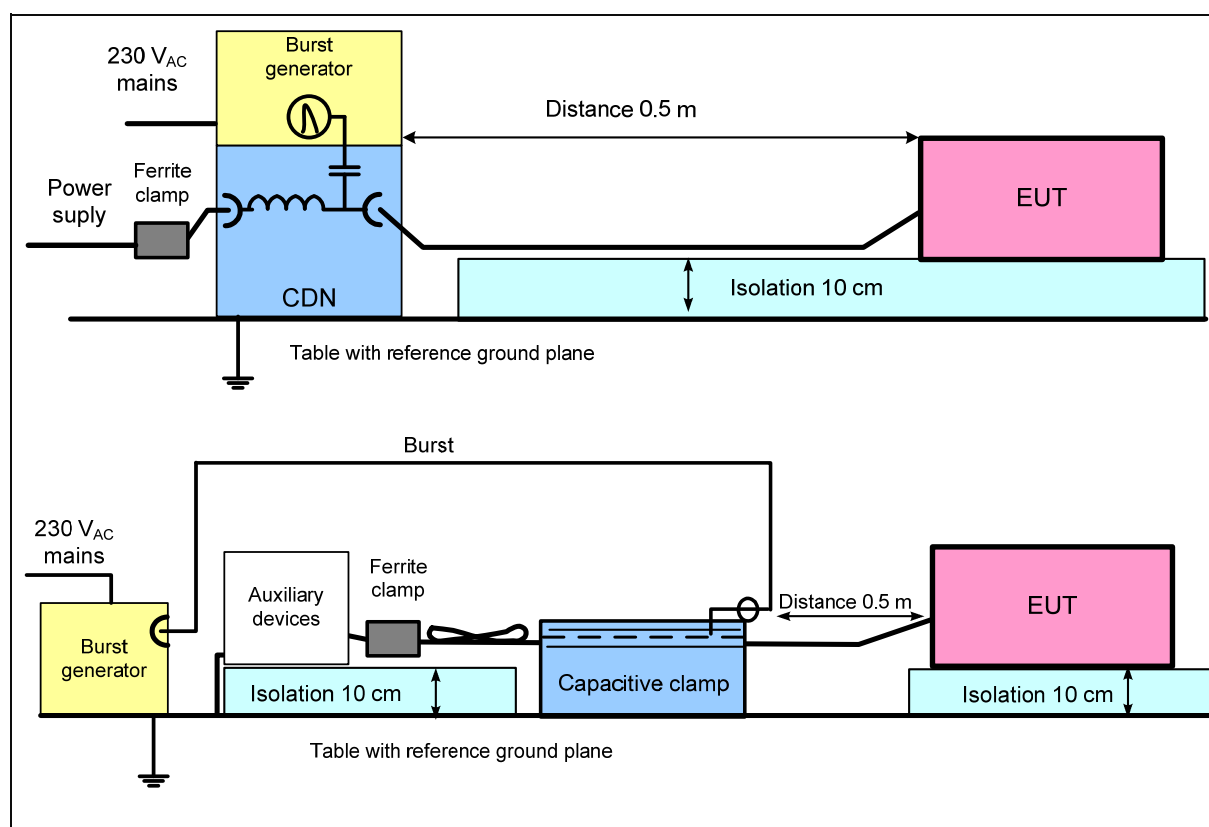
Meas. uncertainty:

see chapter 16

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

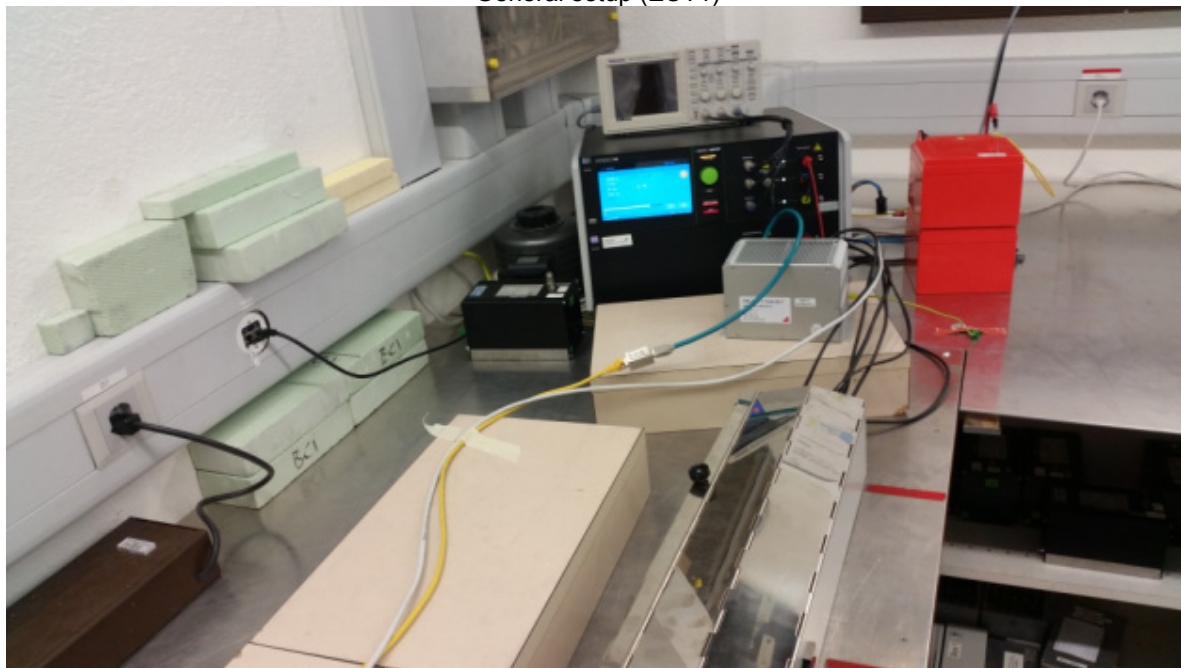


Test Equipment

Device Type	Brand	Type	ID
Burst Generator	EM-Test	EFT500M4S1	PE10105
Capacitive Coupling Clamp	EM-Test	EM-Test HFK	H9360
Power Supply	Hameg	HM8143	Q10153
Power Supply 160 VDC (EUT3)	Elektro Automatik (EA)	PS 8160-04	1179370008

Photos of the Setup

General setup (EUT1)



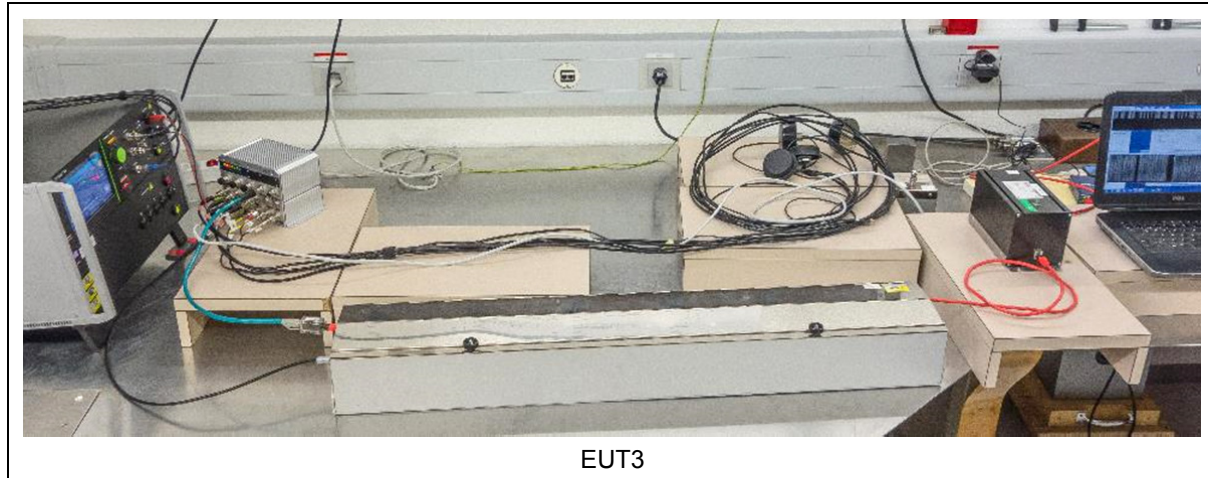
General setup (EUT1)



General setup (EUT2)



General setup (EUT2)



Test Results

Equipment: EUT1 (NB3711-2LcWacHd-G)
 EUT2 (NB3800-3LdWacCDfHd-G)
 EUT3 (NB3711-2LcWacPbHd-G)
Cables connected: See chapter 13.4
Operating mode: Normal operation, see chapter 13.5
Observation of EUT: See chapter 13.6
Modifications: none
Test site: laboratory

Requirements

Standard	Required Level AC Supply:	Required Level DC Supply	Required Level Signal	Protection. Earth	Burst Frequency	Performance Criterion
EN 50121-3-2	±2.0 kV	.....	±2.0 kV	.....	5 kHz	A
EN 50155	±2.0 kV	.....	±2.0 kV	.....	5 kHz	A
EN 61000-6-2	±2.0 kV	±2.0 kV	±1.0 kV	.....	5 kHz	B
EN 301 489-1	±1.0 kV	±0.5 kV	±0.5 kV	.....	5 kHz	B

Protocol of the TestEUT1 (NB3711-2LcWacHd-G):

Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Port	2.0 kV	60 s	5 kHz	direct	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	direct	No errors observed	A	Pass
Ethernet 1	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Ethernet 5	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass

All the other ports already tested before (see Electrosuisse test report no. 16-EL-0019.E01)

EUT2 (NB3800-3LdWacCDfHd-G):

Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Port	2.0 kV	60 s	5 kHz	direct	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	direct	No errors observed	A	Pass
Ethernet 1	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Ethernet 5	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
CAN	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Antenna cables (Note)	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass

Note : All antenna cables tested together

EUT3 (NB3711-2LcWacPbHd-G):

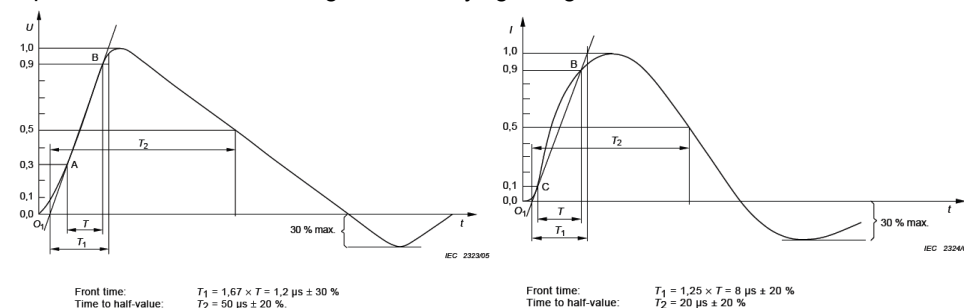
Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Port	2.0 kV	60 s	5 kHz	direct	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	direct	No errors observed	A	Pass
Ethernet 4	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass

15.4 Immunity to Surge (EN 61000-4-5 : 1.2/50 μ 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

see chapter 16

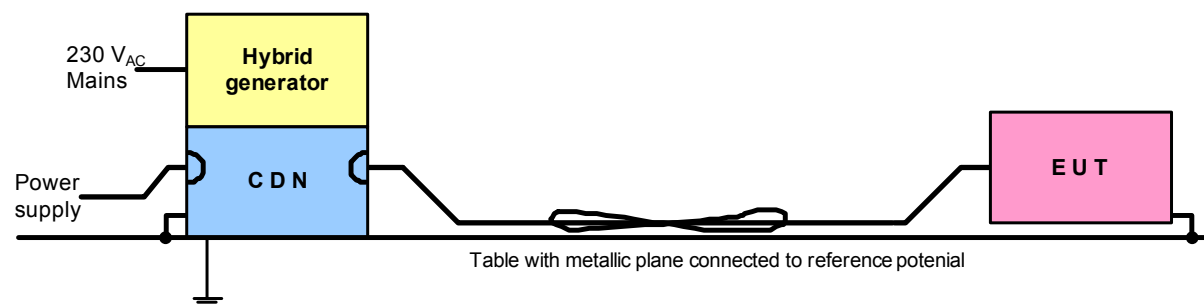
Short-circuit current

Meas. uncertainty:

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.

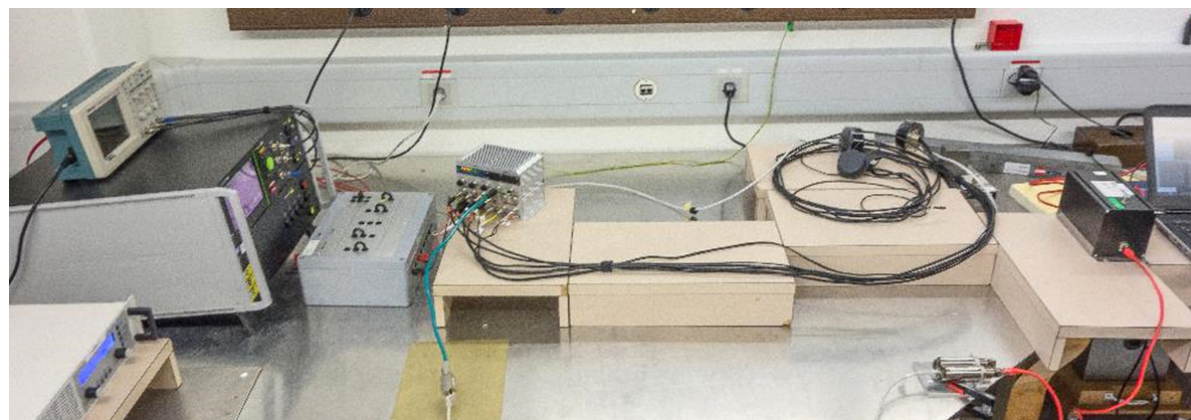
Test Setup



Test Equipment

Device Type	Brand	Type	ID
Surge Generator	EM Test	VCS 500	PE 7239
Coupling/Decoupling Network	EM Test	CNV 504N	15.6632.13
Power Supply	Hameg	HM8143	Q10153
Power Supply 160 VDC (EUT3)	Elektro Automatik (EA)	PS 8160-04	1179370008

Photos of the Setup



Test Results

Equipment: EUT1 (NB3711-2LcWacHd-G)
 EUT2 (NB3800-3LdWacCDfHd-G)
 EUT3 (NB3711-2LcWacPbHd-G)
Cables connected: See chapter 13.4
Operating mode: Normal operation, see chapter 13.5
Observation of EUT: See chapter 13.6
Modifications: none
Test site: laboratory

Requirements

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

Notes:

- 1) Telecom ports: Indoor cables >10m and in telecom centers: ± 0.5 kV Outdoor cables: ± 1 kV

Standard	Required Level Battery referenced ports, auxiliary AC power input ports		Required Level Signal and communication, process measurement and control ports		Performance Criterion
	L1 – L2 42 Ω +0.5 μ F	L1, L2 – PE 42 Ω +0.5 μ F	L1 – L2 42 Ω +0.5 μ F	L1, L2 – PE 42 Ω +0.5 μ F	
EN 50121-3-2	± 1.0 kV	± 2.0 kV	--	--	B
EN 50155	± 1.0 kV	± 2.0 kV	--	--	B

Protocol of the Test

EUT1 & EUT2

PASS, see test reports 15-EL-0061.E01 and 15-EL-0061.E02 (NB3711)
and 16-EL-0019.E01 and 16-EL-0019.E02 (NB3800).

EUT3:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses*	Result, Observation, Behavior of EUT	Fulfilled Criterion	Verdict
DC Power Supply	±0.5; ±1.0	L1 – L2	42 Ω + 0.5 μ F	5	no errors occurred	A	Pass
	±0.5; ±1.0; ±2.0	L1 – PE L2 – PE	42 Ω + 0.5 μ F	5	no errors occurred	A	Pass
Ethernet 4	±0.5; ±1.0	L1 – PE	2 Ω + 0.5 μ F	5	no errors occurred	A	Pass

* Number of pulses for each voltage level and each polarity

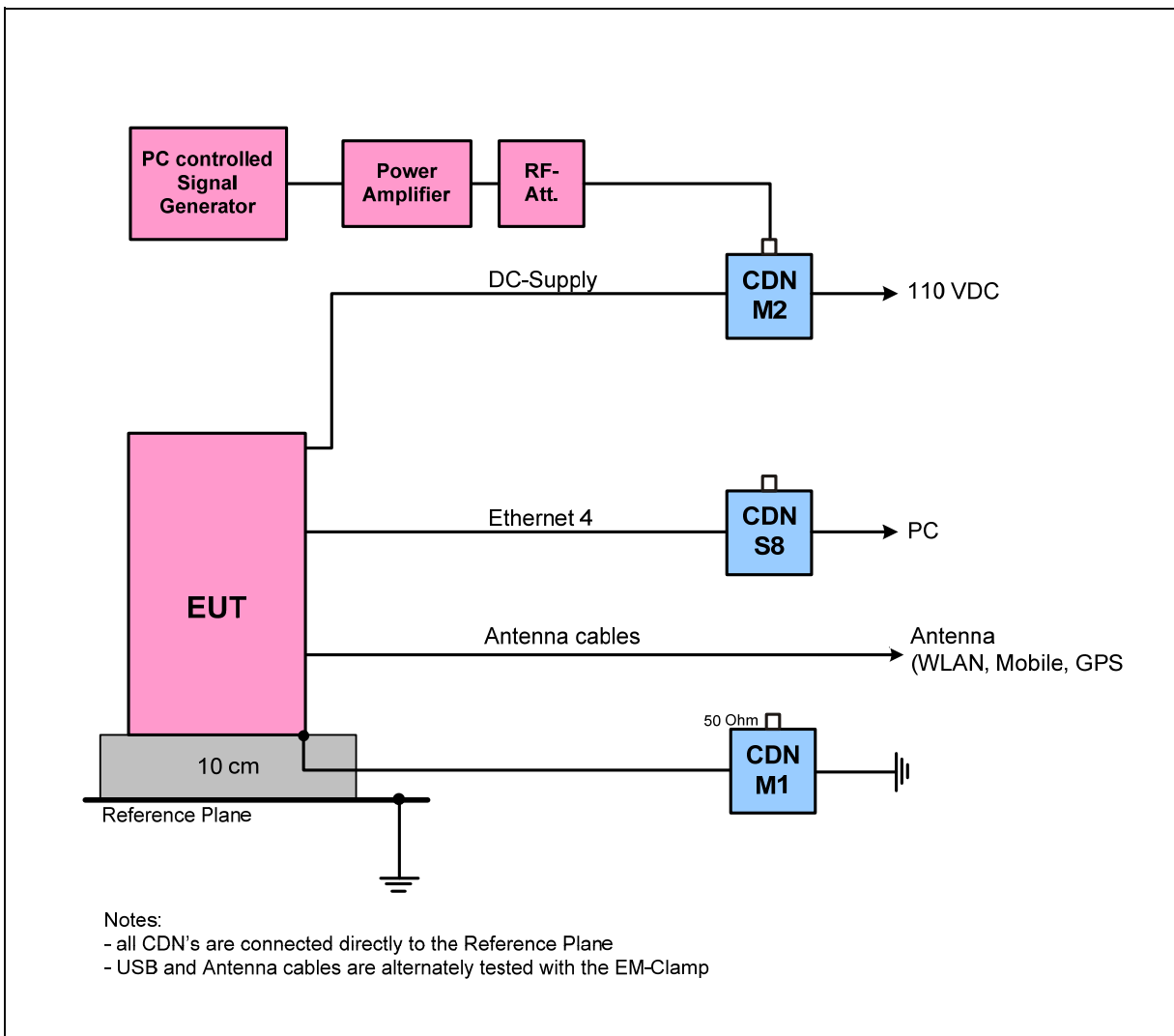
15.5 Immunity to Conducted Disturbances Induced by RF Fields (EN 61000-4-6)

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 16

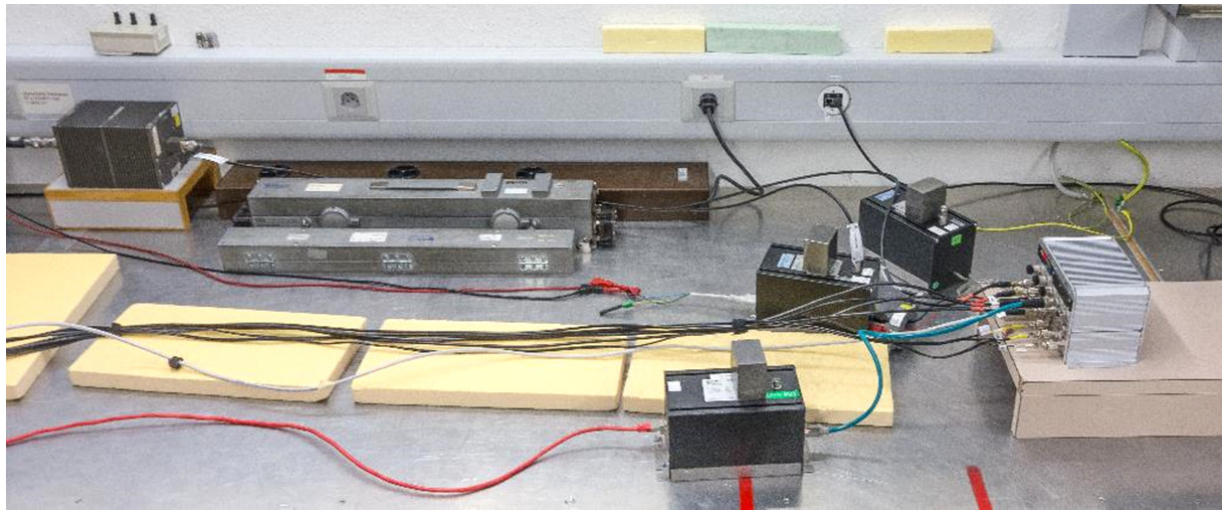
Measuring method: The HF voltage is injected on the cables using different coupling/decoupling networks. All connected cables shall be provided with the appropriate coupling and decoupling devices. The voltage is calibrated without the equipment under test. The Dwell time is depending on the reaction 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	Gigatronik	8541	IV9490
Injection device	EM-Test	CDN M2	H10166
Injection device	EM-Test	CDN M1 32 A	H10164
Injection device	Lüthi	CDS S8 (RJ45)	13.6632.07
Power Supply 160 VDC (EUT3)	Elektro Automatik (EA)	PS 8160-04	1179370008

Photos of the Setup

Test Results

Equipment: EUT1 (NB3711-2LcWacHd-G)
 EUT2 (NB3800-3LdWacCDfHd-G)
 EUT3 (NB3711-2LcWacPbHd-G)
Cables connected: See chapter 13.4
Operating mode: Normal operation, see chapter 13.5
Observation of EUT: See chapter 13.6
Modifications: none
Test site: laboratory

Requirements

Standard	Frequency range	Required level	Modulation	Freq. step	Dwell time	Performance crit.
EN 50121-3-2	0.15 – 80 MHz	10 V _{EMF}	AM, 1 kHz, 80 %	1 %	1 s	A
EN 50155	0.15 – 80 MHz	10 V _{EMF}	AM, 1 kHz, 80 %	1 %	1 s	A
EN 61000-6-2	0.15 – 80 MHz	10 V _{EMF}	AM, 1 kHz, 80 %	1 %	1 s	A
EN 301 489-1	0.15 – 80 MHz	3 V _{EMF}	AM, 1 kHz, 80 %	1 %	1 s	A

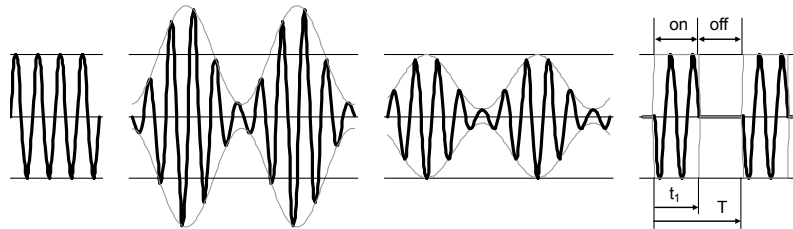
Signal modulation:

☐ CW

☒ AM

☐ AM

☐ PM



Protocol of the Test

EUT1 & EUT2:

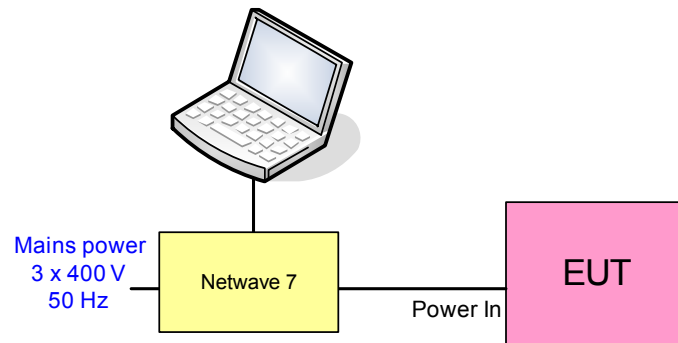
PASS, see test reports 15-EL-0061.E01 and 15-EL-0061.E02 (NB3711) and 16-EL-0019.E01 and 16-EL-0019.E02 (NB3800).

EUT3:

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

15.6 Performance Test & Supply Overvoltages (EN 50155 §12.2 & EN 61000-4-29)

Test Setup



Test Equipment

Device Type	Brand	Type	ID
Power Source & Power Fail Generator	EM Test	NetWave 7	Q10381

Photos of the Setup



Test Results

Equipment: EUT1 (NB3711-2LcWacHd-G)
 EUT2 (NB3800-3LdWacCDfHd-G)
 EUT3 (NB3711-2LcWacPbHd-G)

Cables connected: see chapter 13.4

Operating mode: see chapter 13.5

Observation of EUT: See chapter 13.6

Modifications: none

Test site: Laboratory

Protocol of the Test**EUT1 & EUT2:**

PASS, see test reports 15-EL-0061.E01 and 15-EL-0061.E02 (NB3711) and 16-EL-0019.E01 and 16-EL-0019.E02 (NB3800).

EUT3:

Test at 72 V:

Standard	Chapter	Voltage		Duration	Requirements	Remarks	Verdict
EN 50155	5.1.1.1	43.2 V	0.6 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	100.8 V	1.4 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	90 V	1.25 U_N	1 s	Criterion C	No errors observed	Pass
	5.1.1.1	100.8 V	1.4 U_N	1 s	Criterion C	No errors observed	Pass
	5.1.1.2	0 V (Note 1)	0 U_N	10 ms	Criterion A	No errors observed	Pass
	5.1.2	64.8 V	0.9 U_N	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	79.2 V	1.1 U_N	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	43.2 V	0.6 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	100.8 V	1.4 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	50.4 V	0.7 U_N	1 s	Criterion A	No errors observed	Pass
	5.1.2	90 V	1.25 U_N	1 s	Criterion A	No errors observed	Pass
	5.1.3	43.2 V	0.6 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.3	0 V (Note 1)	0 U_N	30 ms	Criterion A	No errors observed	Pass
	12.2.6	100.8 V	1.4 U_N	1 s	Criterion A	rise & fall time 0.1 s No errors observed	Pass

Test at 110 V:

Standard	Chapter	Voltage		Duration	Requirements	Remarks	Verdict
EN 50155	5.1.1.1	66 V	0.6 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	154 V	1.4 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	137.5 V	1.25 U_N	1 s	Criterion C	No errors observed	Pass
	5.1.1.1	154 V	1.4 U_N	1 s	Criterion C	No errors observed	Pass
	5.1.1.2	0 V (Note 1)	0 U_N	10 ms	Criterion A	No errors observed	Pass
	5.1.2	99 V	0.9 U_N	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	121 V	1.1 U_N	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	66 V	0.6 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	154 V	1.4 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	77 V	0.7 U_N	1 s	Criterion A	No errors observed	Pass
	5.1.2	137.5 V	1.25 U_N	1 s	Criterion A	No errors observed	Pass
	5.1.3	66 V	0.6 U_N	0.1 s	Criterion A	No errors observed	Pass
	5.1.3	0 V (Note 1)	0 U_N	30 ms	Criterion A	No errors observed	Pass
	12.2.6	154 V	1.4 U_N	1 s	Criterion A	rise & fall time 0.1 s No errors observed	Pass

Note 1: tested with low impedance (according EN 61000-4-29)

15.7 Insulation Test (EN 50155 §12.2.9)

Test Equipment

Device Type	Brand	Type	ID
Insulation Tester	Elabo	SIS 05	PE 9829
HV Tester	ETL Prüftechnik	ATS 400	14.6632.03

Test Results

Equipment: EUT1 (NB3711-2LcWacHd-G)
EUT2 (NB3800-3LdWacCDfHd-G)

Cables connected: See chapter 13.4

Operating mode: See chapter 13.5

Observation of EUT: See chapter 13.6

Modifications: none

Test site: Safety Laboratory

Protocol of the Test

PASS, see test reports 15-EL-0061.E01 and 15-EL-0061.E02 (NB3711) and 16-EL-0019.E01 and 16-EL-0019.E02 (NB3800).

16. 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 φ_o :(rectangular distribution)		± 2.8 %
Voltage fluctuation	Output voltage U_o : (normal distribution)		± 9 %