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Report:	<b>Electromagnetic Compatibility</b>	Report no:	<b>16-EL-0019.E12</b>
Test item description:	<b>NetModule Router NB3800</b>	Date of test:	<b>September 16 to 21, 2016</b> <b>April 28, 2017</b>
Applicant:	<b>NetModule AG</b> <b>Meriedweg 11</b> <b>3172 Niederwangen bei Bern, SWITZERLAND</b>	Model/Type reference:	<b>NB3800-4L2WacDe-G</b> <b>and NB3800-3LWacCGePbDe</b>
Manufacturer:	<b>NetModule AG</b>	Serial no:	<b>00112BFFDD94 and 00112BFFDD8B</b>

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 V2.2.1	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
Regelung Nr. EMV06	Technische Regeln zur Elektromagnetischen Verträglichkeit – Nachweis der Funkverträglichkeit von Schienenfahrzeugen mit Bahnfunkdiensten	Pass

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(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

NetModule's railway router series are designed for mobile railway communications. These routers comply with the industry standard EN 50155 which is mandatory for most railway appliances.

Supporting the latest WAN/LAN technologies (including GSM, UMTS, LTE, 2.4 GHz WLAN, 5 GHz WLAN) and GNSS they are offering highly-available connectivity with seamlessly handover between the broadband links using to the Mobile IP protocol.

In this test report the versions:

- NB3800-4L2WacDe-G (24-60 VDC), also referred to as EUT1
- NB3800-3LWacCGePbDe (72-110 VDC), also referred to as EUT2

have been tested.

16-EL-0019.E12 replaces 16-EL-0019.E02 completely. The test report has been updated with conducted emission measurement on the antenna ports.

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

§	Test Type	Result
<b>13</b>	<b>Emission</b>	<b>EN 50121-3-2</b>
13.1	Interference voltage EN 55016-2-1 CISPR 16-2-1	<b>PASS</b>
13.4	Radiated electromagnetic field EN 55016-2-3 CISPR 16-2-3	<b>PASS</b>
<b>14</b>	<b>Immunity</b>	<b>EN 50121-3-2</b>
14.1	Electrostatic discharges EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
14.2	Electromagnetic fields EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
14.3	Fast electric transients (Burst) EN 61000-4-4 IEC 61000-4-4	<b>PASS</b> <sup>1</sup>
14.4	Surges EN 61000-4-5 IEC 61000-4-5	<b>PASS</b>
14.5	Radio frequency common mode EN 61000-4-6 IEC 61000-4-6	<b>PASS</b> <sup>1</sup>

1. USB port not tested, service port

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

§	Test Type	Result
<b>13</b>	<b>Emission</b>	<b>EN 50155</b>
13.1	Interference voltage EN 55016-2-1 CISPR 16-2-1	<b>PASS</b>
13.4	Radiated electromagnetic field EN 55016-2-3 CISPR 16-2-3	<b>PASS</b>
<b>14</b>	<b>Immunity</b>	<b>EN 50155</b>
--	Visual inspection EN 50155 §12.2.1	<b>PASS</b>
14.6	Performance test EN 50155 §12.2.2	<b>PASS</b>
14.6	Supply overvoltages EN 50155 §12.2.6	<b>PASS</b>
14.4	Surges, electrostatic discharge and transient burst susceptibility tests EN 50155 §12.2.7	<b>PASS</b>
14.5	Radio interference test EN 50155 §12.2.8	<b>PASS</b> <sup>2</sup>
14.7	Insulation test EN 50155 §12.2.9	<b>PASS</b>

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
<b>13</b>	<b>Emission</b>	<b>EN 55022</b>
13.1	Interference voltage EN 55022 / 55032 CISPR 22 / 32	<b>Not applicable <sup>1</sup></b>
13.2	Common mode at telecom. ports EN 55022 / 55032 CISPR 22 / 32	<b>PASS</b>
13.4	Radiated electromagnetic field EN 55022 / 55032 CISPR 22 / 32	<b>PASS</b>
--	Harmonics EN 61000-3-2 IEC 61000-3-2	<b>Not applicable <sup>1</sup></b>
--	Voltage fluctuations (flicker) EN 61000-3-3 IEC 61000-3-3	<b>Not applicable <sup>1</sup></b>

1. No AC Mains port

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

§	Test Type	Result
<b>13</b>	<b>Emission</b>	<b>EN 61000-6-3</b>
13.1	Interference voltage DC port EN 55016-2-1 CISPR 16-2-1	<b>PASS</b>
13.2	Common mode at telecom. ports EN 55022 / 55032 CISPR 22 / 32	<b>PASS</b>
13.4	Radiated electromagnetic field EN 55016-2-3 CISPR 16-2-3	<b>PASS</b>
--	Harmonics EN 61000-3-2 IEC 61000-3-2	<b>Not applicable</b> <sup>1</sup>
--	Voltage fluctuations (flicker) EN 61000-3-3 IEC 61000-3-3	<b>Not applicable</b> <sup>1</sup>

2. No AC Mains port

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

§	Test Type	Result
<b>14</b>	<b>Immunity</b>	<b>EN 61000-6-2</b>
14.1	Electrostatic discharges EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
14.2	Electromagnetic fields EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
14.3	Fast electric transients (Burst) EN 61000-4-4 IEC 61000-4-4	<b>PASS</b> <sup>1</sup>
14.4	Surges EN 61000-4-5 IEC 61000-4-5	<b>PASS</b>
14.5	Radio frequency common mode EN 61000-4-6 IEC 61000-4-6	<b>PASS</b> <sup>1</sup>
--	Magnetic fields (industrial frequencies) EN 61000-4-8 IEC 61000-4-8	<b>Not applicable</b> <sup>2</sup>
--	Voltage dips and interruptions EN 61000-4-11 IEC 61000-4-11	<b>Not applicable</b> <sup>3</sup>

1. USB port not tested, service port
2. No magnetic field sensitive device
3. No AC Mains port

## 6. 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
<b>13</b>	<b>Emission</b>	<b>EN 301 489-x mobile equipment</b>
13.1	Interference voltage EN 55022 CISPR 22	<b>PASS</b>
13.2	Common mode at telecom. ports EN 55022 CISPR 22	<b>PASS</b>
13.4	Radiated electromagnetic field EN 55022 CISPR 22	<b>PASS</b>
--	Harmonics EN 61000-3-2 IEC 61000-3-2	<b>Not applicable <sup>1</sup></b>
--	Voltage fluctuations (flicker) EN 61000-3-3 IEC 61000-3-3	<b>Not applicable <sup>1</sup></b>
<b>14</b>	<b>Immunity</b>	<b>EN 301 489-x mobile equipment</b>
14.1	Electrostatic discharges EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
14.2	Electromagnetic fields EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
14.3	Fast electric transients (Burst) EN 61000-4-4 IEC 61000-4-4	<b>PASS <sup>2</sup></b>
14.4	Surges EN 61000-4-5 IEC 61000-4-5	<b>PASS</b>
14.5	Radio frequency common mode EN 61000-4-6 IEC 61000-4-6	<b>PASS <sup>2</sup></b>
--	Voltage dips and interruptions EN 61000-4-11 IEC 61000-4-11	<b>Not applicable <sup>1</sup></b>

1. No AC Mains port

2. USB port not tested, service port

## 7. Summary of Test Results (FCC)

§	Test Type	Result
<b>13</b>	<b>Emission</b>	<b>CFR 47</b>
--	Conducted emission CFR 47 § 15.107 (Class B)	<b>Not applicable <sup>1</sup></b>
13.6	Radiated emission – EM-field CFR 47 § 15.109 (Class B)	<b>PASS</b>

1. No AC Mains port



## 8. 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 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
CFR 47 Part 15 Subpart B : 2014	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"
Regelung Nr. EMV06	Technische Regeln zur Elektromagnetischen Verträglichkeit – Nachweis der Funkverträglichkeit von Schienenfahrzeugen mit Bahnfunkdiensten

## 9. 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
dBi	Gain in decibels relative to an isotropic antenna
DC	Direct current
DL	Downlink
dmax	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>

## 10. Applicant

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## 11. Equipment Under Test

### 11.1 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 <b>Router NB3800</b>
<i>Product description</i>	Railway Router with Mobile, WLAN and GNSS
<i>Model/type reference</i>	EUT1: NB3800-4L2WacDe-G EUT2: NB3800-3LWacCGePbDe
<i>Serial number</i>	EUT1: 00112BFFDD94 EUT2: 00112BFFDD8B
<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 = 1.0 A / P = 25 W U = 24 – 48 VDC according to EN 50155 EUT2: U = 72 – 110 VDC / I = 0.4 A / P = 20 W U = 72 - 110 VDC according to EN 50155
<i>Dimension</i>	~ 190 mm x 107 mm x 121 cm (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.

## 11.2 Product Family

Tested Equipment	Covered Variants	Explanation <sup>1)</sup>
NB3800-4L2WacDe-G  And:  NB3800-3LWacCGePbDe	NB3800-H <sub>1</sub> ...H <sub>n</sub> -S <sub>1</sub> ...S <sub>n</sub>	<p>All covered NB3800 variants contain the same CPU Modules, MC Boards, and PSE Boards, have the same case and the same form factor.</p> <p>They can host up to six communication or interface modules and a data storage. There can be up to 11 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>'H<sub>1</sub>...H<sub>n</sub>' is a sequence of the following letters that identify the options 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>L: 4G = 3G+ + LTE</li> <li>La: LTE 450MHz</li> <li>Lb: LTE US</li> <li>Lc: LTE Asia Cat 6</li> <li>Ld: LTE Europe Cat 6</li> <li>Ca: CDMA450</li> <li>Gr: GSM-R</li> <li>Ge: GNSS</li> <li>W: WLAN a/b/g/n Client &amp; Access Point</li> <li>Wac : WLAN a/b/g/n/ac 2.4 / 5 GHz</li> <li>A: Audio in/out</li> <li>C: CAN-bus</li> <li>Sa: RS-485 (on the same module as CAN)</li> <li>I: IBIS-bus</li> <li>Sb: RS-232 (on the same module as IBIS)</li> <li>Pb: Power Supply 72 , 96, 110 VDC</li> <li>Da: Data Storage 32 GB</li> <li>Db: Data Storage 64 GB</li> <li>Dc: Data Storage 128 GB</li> <li>Dd: Data Storage 256 GB</li> <li>De: Data Storage 512 GB</li> <li>Df: Data Storage 1 TB</li> <li>... (more to follow)</li> </ul> <p>'S<sub>1</sub>...S<sub>n</sub>' indicate the software options activated:</p> <ul style="list-style-type: none"> <li>G: GPS</li> <li>V: Voice gateway</li> <li>M: Mobile IP (Client)</li> <li>S: Server</li> </ul> <p>The following NB3800 variants are currently available or planned:</p> <ul style="list-style-type: none"> <li>NB3800-R</li> <li>NB3800-Wac</li> <li>NB3800-2Wac</li> <li>NB3800-UWacA-GV</li> <li>NB3800-LWac-G</li> <li>NB3800-LWac-GV</li> <li>NB3800-LWacA-GV</li> <li>NB3800-LWacC-G</li> <li>NB3800-LWacI-G</li> <li>NB3800-LGrGeDa</li> <li>NB3800-L2Wac</li> <li>NB3800-L2Wac-G</li> </ul>

		NB3800-2L NB3800-2L-G NB3800-2LWac NB3800-2LWac-G NB3800-2LWacPb-G NB3800-2LWacGe NB3800-2LWacDf-G NB3800-2L2Wac-G NB3800-2L2WacPb-G NB3800-2L2WacDf-G NB3800-3L-G NB3800-3LWac-G NB3800-4L-G NB3800-3L2Wac-G NB3800-4L2Wac-G NB3800-4L2WacDf-G-
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1) according to information of the customer and not verified by electrosuisse

### 11.3 Pictures of the EUT



*Top-front view*



*Rear view*



## 11.4 Marking Plate of the EUT



EUT1



EUT2



## 11.5 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).

## 11.6 Ports

### EUT1 (24-60 VDC)

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	FastEthernet
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
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
WLAN 1 & 2	< 30 m	TNC (Coax)	Yes	Connected to multiband-antenna
Mob 1, 2, 3, 4 (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 (72-110 VDC)

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	FastEthernet
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	--	--	--

## 12. Test Conditions

### 12.1 Climatic conditions, location and date

Location	Date	Temp	Pressure [QFE]	Rel. humidity
Electrosuisse Albislab Albisriederstrasse 199 8047 Zürich SWITZERLAND	September 16 to 21, 2016	23 ± 3 °C	969 ± 30 hPa	50 ± 5 %
	April 28, 2017	24 ± 3 °C	980 ± 30 hPa	35 ± 5 %

### 12.2 Test facility and methodology

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

### 12.3 Attendant Persons

#### Test Engineer(s):

Mr. Stéphane Egot-Lemaire

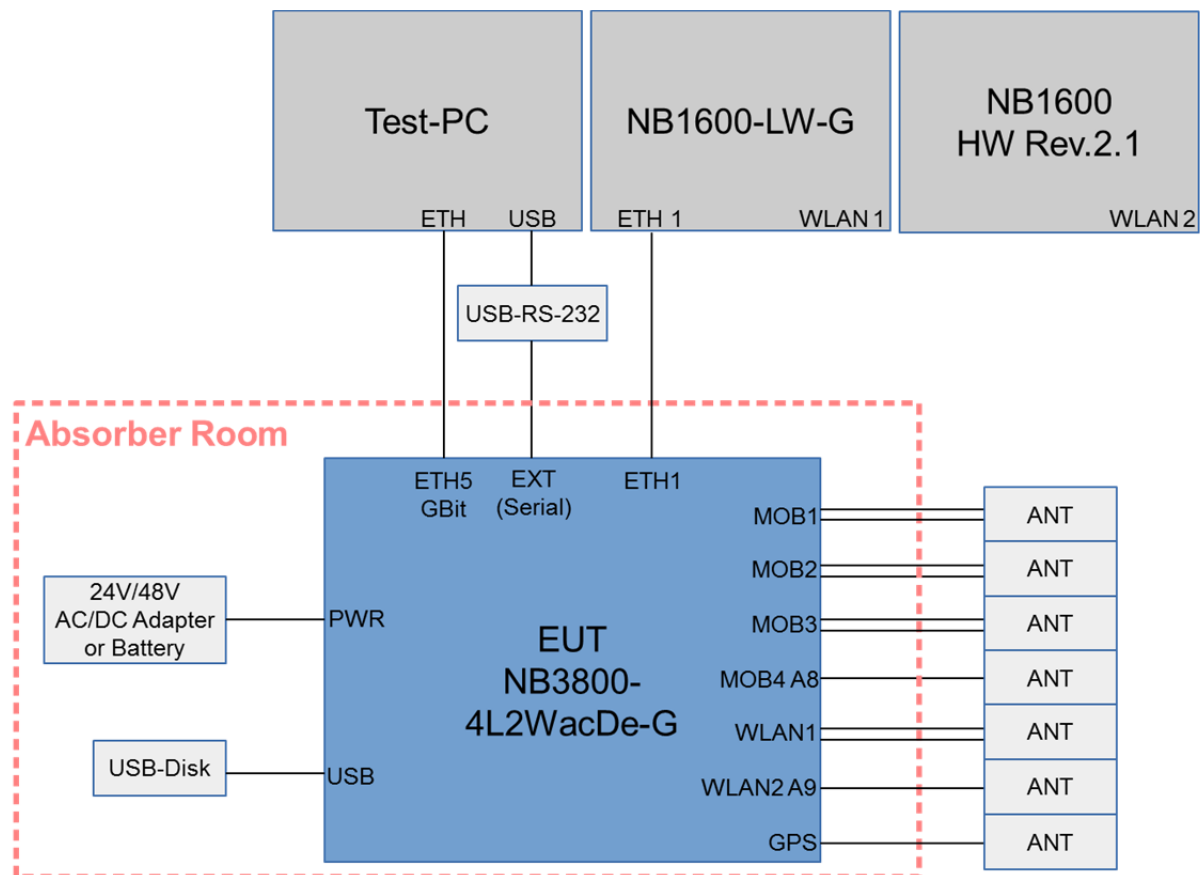
#### Other(s):

Name	Company
Mr. Simon Maurer	NetModule AG
Mr. Alexander Ott	NetModule AG
Mr. Raffael Rohrer	NetModule AG

## 12.4 Test Configuration

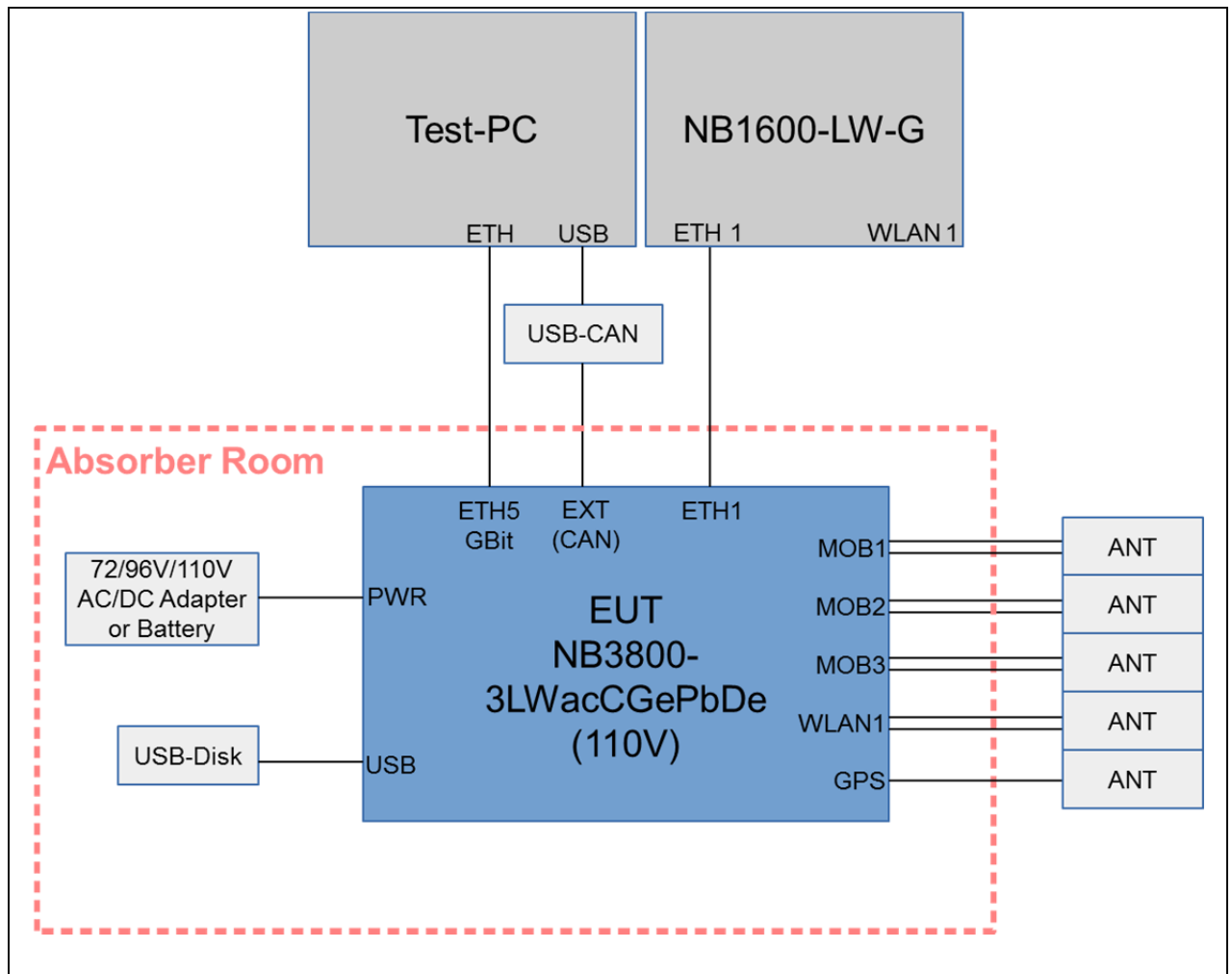
### EUT1 (24-60 VDC):

- DC Supply
- 1 Ethernet-connection to Test-PC
- 1 Ethernet-connection to NB1600
- 1 RS232-connection to Test PC
- 4 GSM/UMTS/LTE antennas (7 cables)
- 2 WLAN antennas (3 cables)
- 1 GNSS antenna (1 cable)
- 4 SIM cards
- 1 USB stick



### EUT2 (72-110 VDC):

- DC Supply
- 1 Ethernet-connection to Test-PC
- 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



## 12.5 Operating Conditions

### EUT1 (24-60 VDC):

#### *Normal mode:*

- Ping over WLAN 1 & 2
- Ping over WWAN 1, 2, 3, 4 (GSM/UMTS/LTE)
- Ping over Ethernet 1 & 5 cable
- Access with RS-232
- Access to SSD disc
- Access to USB stick

*powered with 24 VDC unless otherwise specified*

### EUT2 (72-110 VDC):

#### *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
- Access to USB stick

*powered with 110 VDC unless otherwise specified*

## 12.6 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*

## 12.7 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 (24-60 VDC):

Product	Brand	Model No.	SN
<i>Test-PC / Notebook</i>	<i>Dell</i>	<i>E5540</i>	<i>1PF9N12</i>
<i>USB-to-RS232 Adapter</i>	<i>MOXA</i>	<i>USB UPORT 1150I</i>	<i>--</i>
<i>Router</i>	<i>NetModul</i>	<i>NB1600 LW-G</i>	<i>00112B012C99</i>
<i>Router</i>	<i>NetModul</i>	<i>NB1600 HW Rev. 2.1</i>	<i>00112B0020BB</i>
<i>WWAN Antenna</i>	<i>n/a</i>	<i>Antenna-Roof-2L DL-9</i>	<i>A140812300036</i>
<i>GPS Antenna</i>	<i>REEL</i>	<i>C70ZAR 0300 00 03 03 PWN1</i>	<i>02 1501</i>
<i>WLAN Antenna</i>	<i>--</i>	<i>Antenna-Roof-2W</i>	<i>--</i>
<i>SMA – BNC Adapter</i>	<i>--</i>	<i>--</i>	<i>--</i>
<i>USB stick</i>	<i>Silica</i>		
<i>Power Supply 160 VDC</i>	<i>Elektro Automatik (EA)</i>	<i>PS 8160-04</i>	<i>1179370008</i>

### EUT2 (72-110 VDC):

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

## 12.8 Performance Criteria

General requirements:	Requirements according to the EUT:
<b>Criterion A:</b>	
The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed.	<p><b><u>EUT1 (24-60 VDC):</u></b>  <i>No transmission loss LAN (GBit and FE), WWAN (GSM/UMTS/LTE), WLAN, USB, SSD and RS-232</i></p> <p><b><u>EUT2 (72-110 VDC):</u></b>  <i>No transmission loss LAN (GBit and FE), WWAN (GSM/UMTS/LTE), WLAN, USB, SSD and CAN</i></p>
<b>Criterion B:</b>	
The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed.	<p><i>During the test:</i></p> <ul style="list-style-type: none"> <li>- <i>short interruptions of the communication allowed</i></li> <li>- <i>LED's may flicker</i></li> </ul> <p><i>After the test the EUT shall operate as in normal mode</i></p>
<b>Criterion C:</b>	
Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.	<i>No specific requirements</i>

## 13. Emission Tests

### 13.1 Interference Voltage (V-LISN)

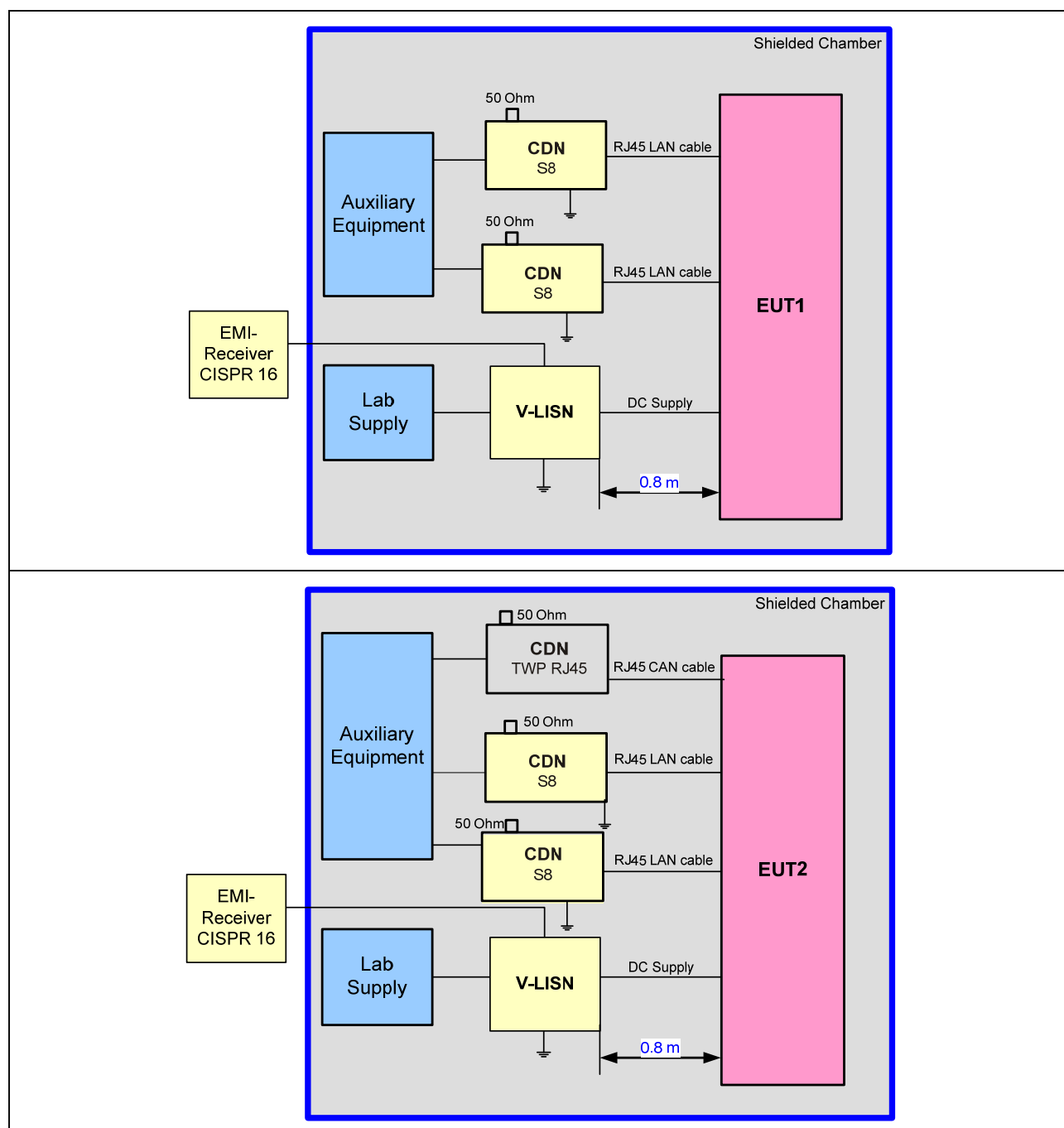
**Test site:** shielded room

**Meas. uncertainty:** see chapter 15

**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.

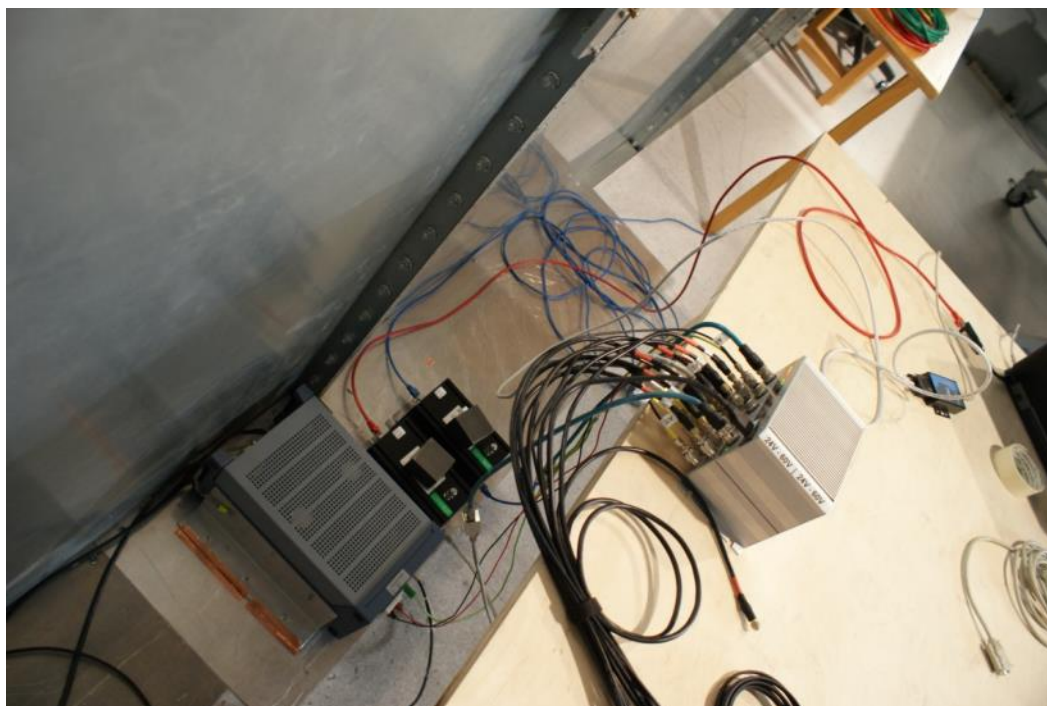
**Modifications:** none

#### Test Setup

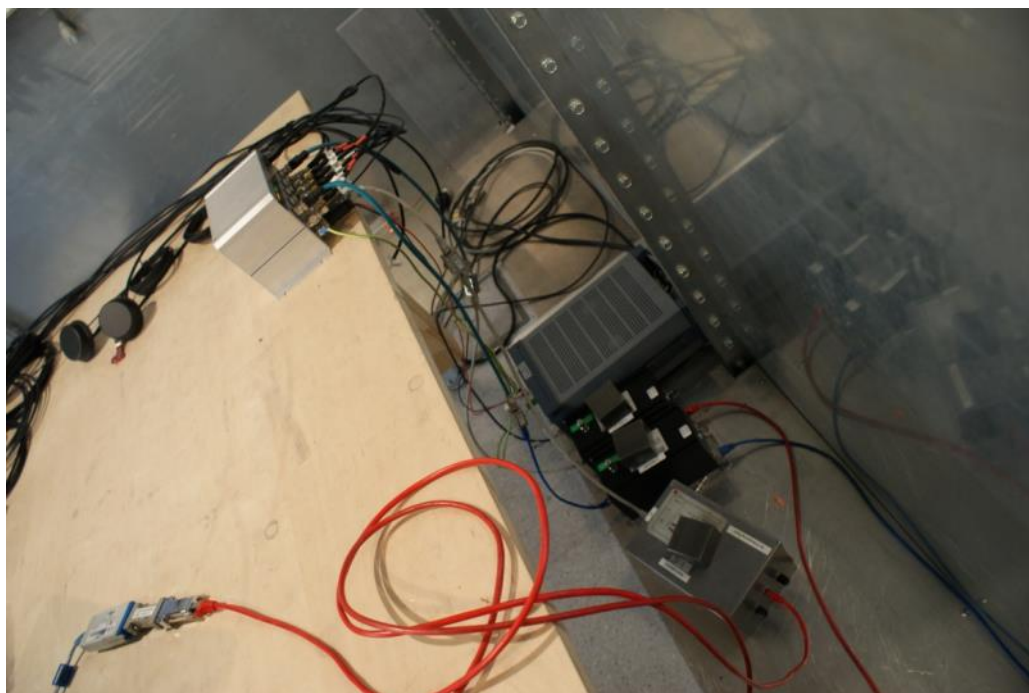




## Photos of the Setup



*EUT1 (24-60 VDC)*



*EUT2 (72-110 VDC)*

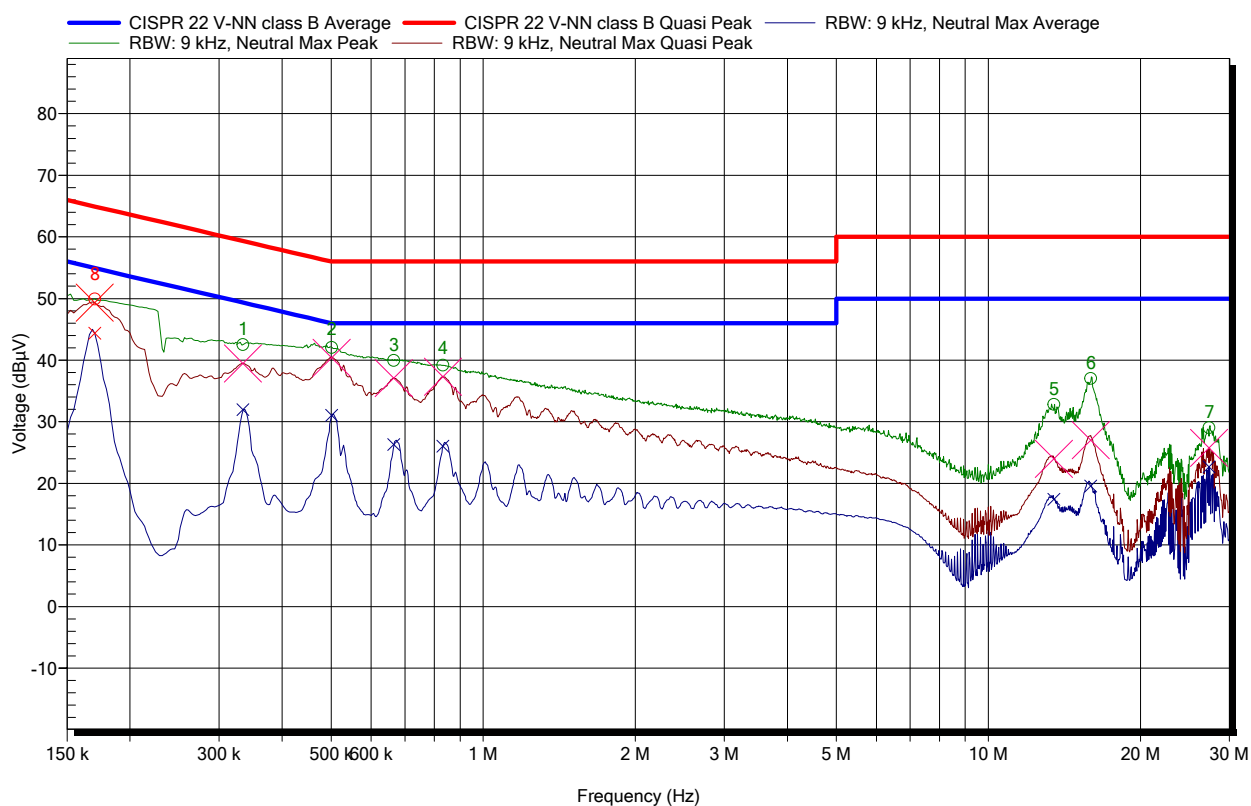
## Test Equipment

Device Type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESR 7	15.6637.06
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
Power Supply	Elektro Automatik	PS 8160-04	Q10152

## Measurement Results

### Measurement 1:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Power supply voltage</b>	24 VDC
<b>Cables, Notes</b>	--
<b>Mode of operation</b>	Normal operation
<b>Test date, time</b>	20.09.2016 08:48:23
<b>Interface / Line under test</b>	Neutral (0 VDC)
<b>Transducer</b>	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 1 s,

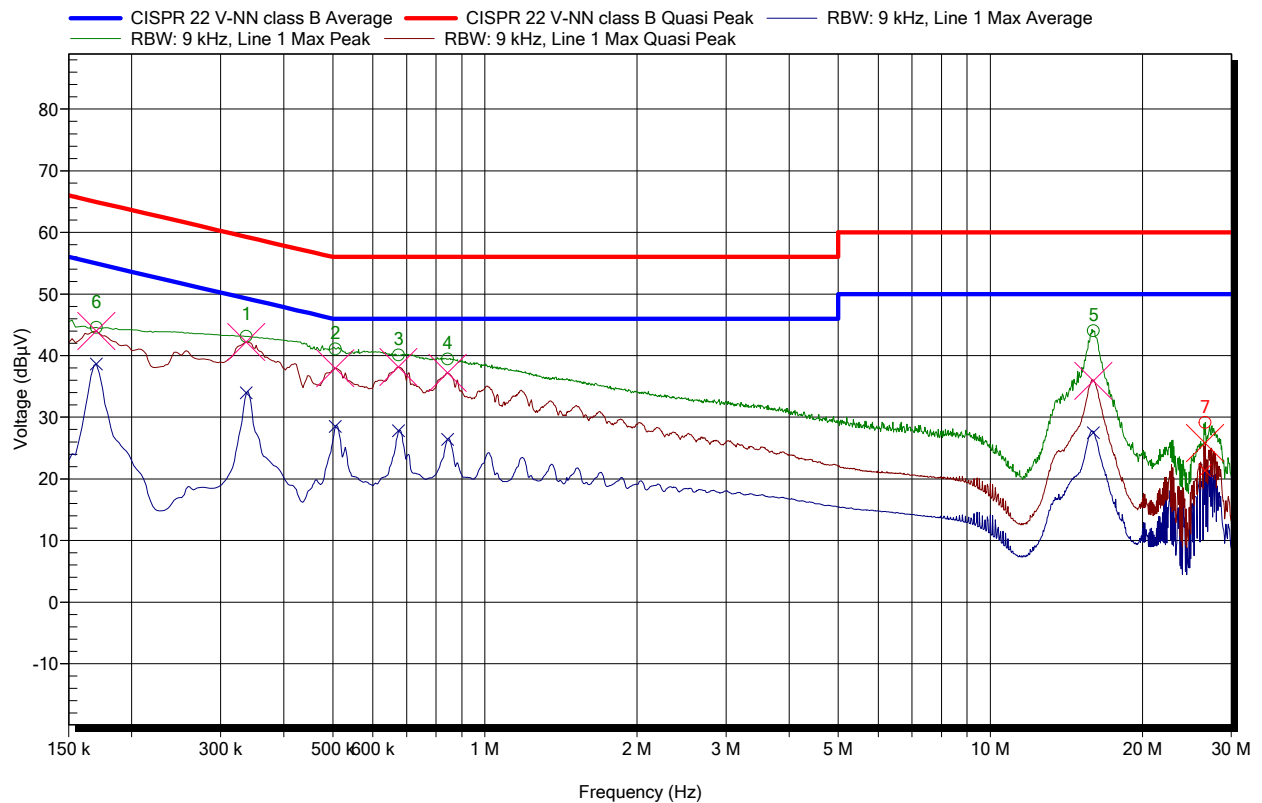


### Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	334.5 kHz	42.56 dBμV	31.95 dBμV	-17.39 dB	39.46 dBμV	-19.88 dB	Pass
2	501 kHz	42.03 dBμV	31.04 dBμV	-14.96 dB	40.39 dBμV	-15.61 dB	Pass
3	665.25 kHz	39.92 dBμV	26.31 dBμV	-19.69 dB	37.07 dBμV	-18.93 dB	Pass
4	831.75 kHz	39.2 dBμV	26.04 dBμV	-19.96 dB	37.29 dBμV	-18.71 dB	Pass
5	13.477 MHz	32.81 dBμV	17.4 dBμV	-32.6 dB	23.99 dBμV	-36.01 dB	Pass
6	15.947 MHz	37.04 dBμV	19.57 dBμV	-30.43 dB	26.99 dBμV	-33.01 dB	Pass
7	27.319 MHz	29.06 dBμV	22.66 dBμV	-27.34 dB	25.76 dBμV	-34.24 dB	Pass
8	170.25 kHz	49.9 dBμV	44.37 dBμV	-10.58 dB	49.31 dBμV	-15.64 dB	Pass

## Measurement 2:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Power supply voltage</b>	24 VDC
<b>Cables, Notes</b>	--
<b>Mode of operation</b>	Normal operation
<b>Test date, time</b>	20.09.2016 08:50:00
<b>Interface / Line under test</b>	Line (+24 VDC)
<b>Transducer</b>	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 1 s,



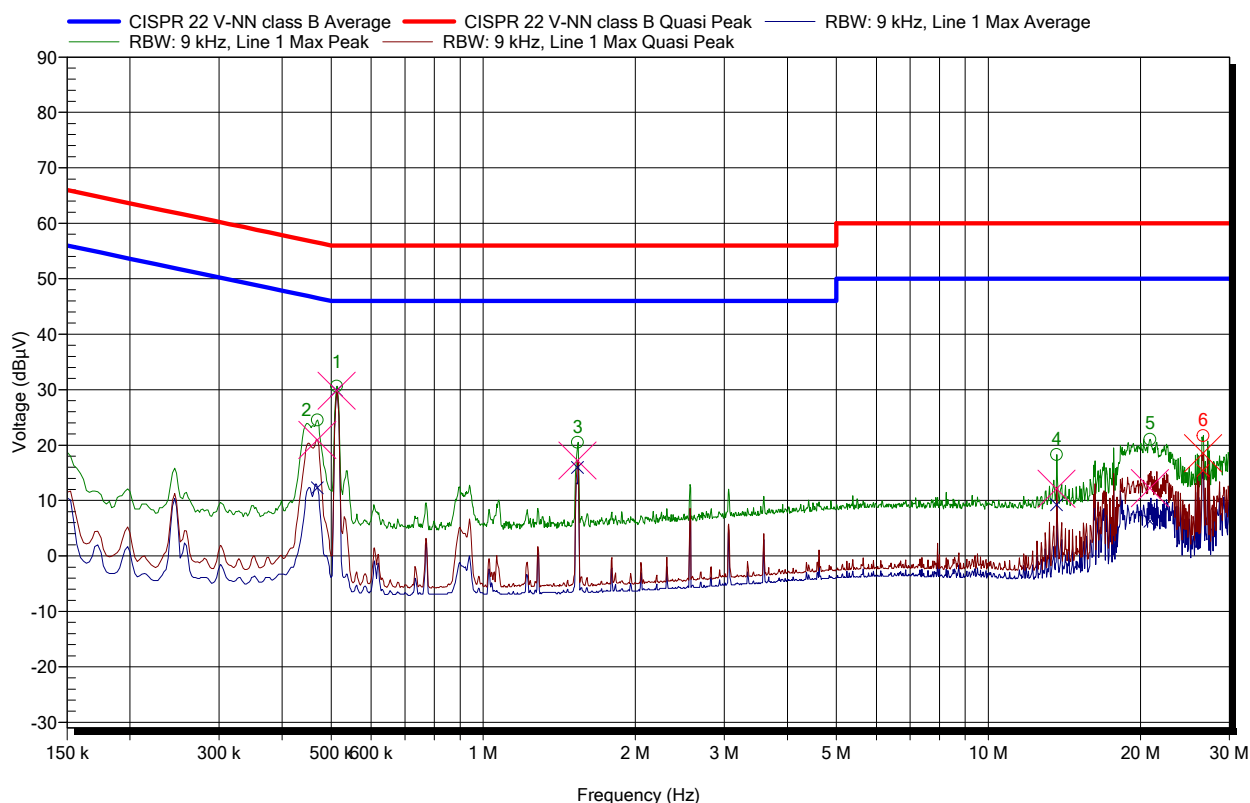
## Detected peaks

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

**Note:** Measurements at other specified voltages (36 VDC, 48 VDC, 60 VDC) for EUT1 were already carried out and reported in Electrosuisse test report no. 16-EL-0019.E01.

## Measurement 3:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Power supply voltage</b>	72 VDC
<b>Cables, Notes</b>	--
<b>Mode of operation</b>	Normal operation
<b>Test date, time</b>	20.09.2016 09:33:14
<b>Interface / Line under test</b>	Line (+72 VDC)
<b>Transducer</b>	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 1 s,

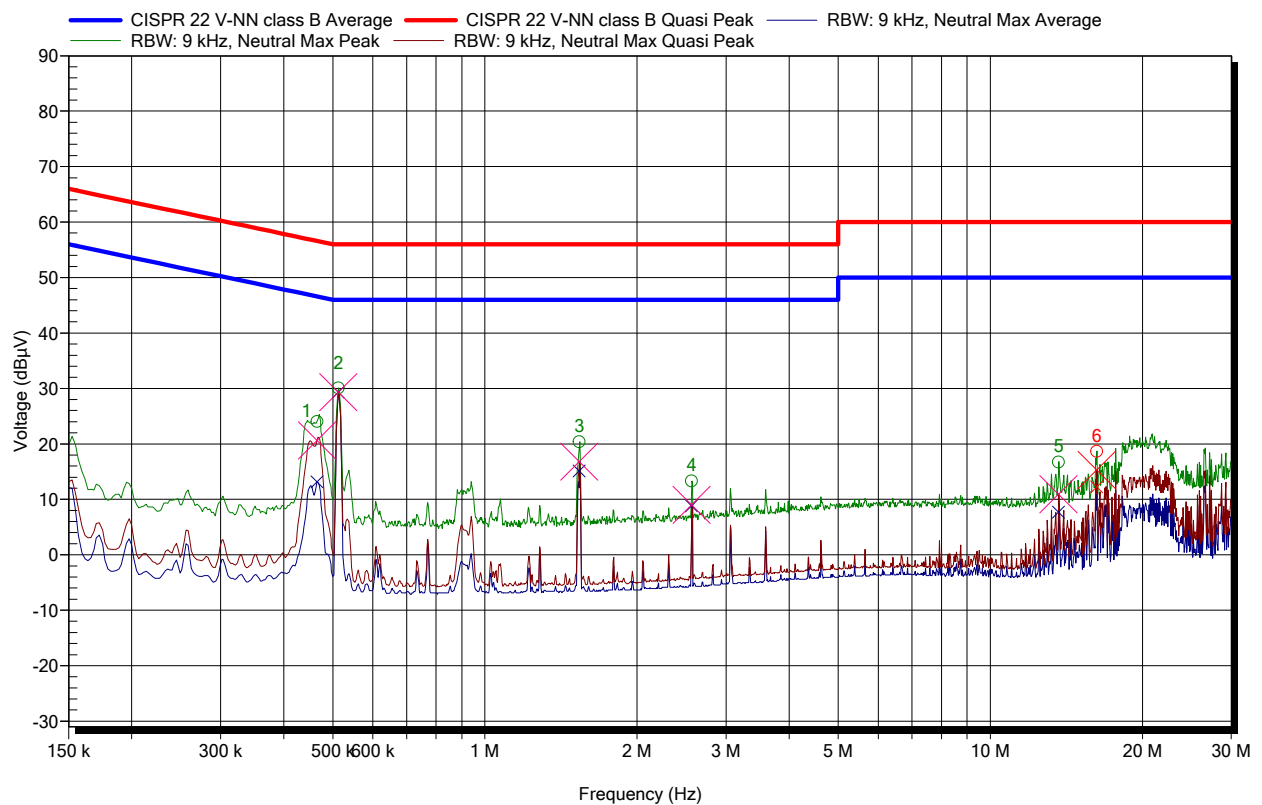


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	512.25 kHz	30.61 dBμV	29.85 dBμV	-16.15 dB	29.82 dBμV	-26.18 dB	Pass
2	469.5 kHz	24.55 dBμV	12.3 dBμV	-34.22 dB	20.91 dBμV	-35.61 dB	Pass
3	1.536 MHz	20.53 dBμV	15.94 dBμV	-30.06 dB	17.23 dBμV	-38.77 dB	Pass
4	13.637 MHz	18.31 dBμV	9.21 dBμV	-40.79 dB	12.13 dBμV	-47.87 dB	Pass
5	20.873 MHz	21.04 dBμV	6.27 dBμV	-43.73 dB	12.21 dBμV	-47.79 dB	Pass
6	26.61 MHz	21.73 dBμV	15.39 dBμV	-34.61 dB	18.55 dBμV	-41.45 dB	Pass

## Measurement 4:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Power supply voltage</b>	72 VDC
<b>Cables, Notes</b>	--
<b>Mode of operation</b>	Normal operation
<b>Test date, time</b>	20.09.2016 09:34:48
<b>Interface / Line under test</b>	Neutral (0 VDC)
<b>Transducer</b>	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
<b>Measurement settings</b>	Radiation Version: 2015.1.11, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 1 s,

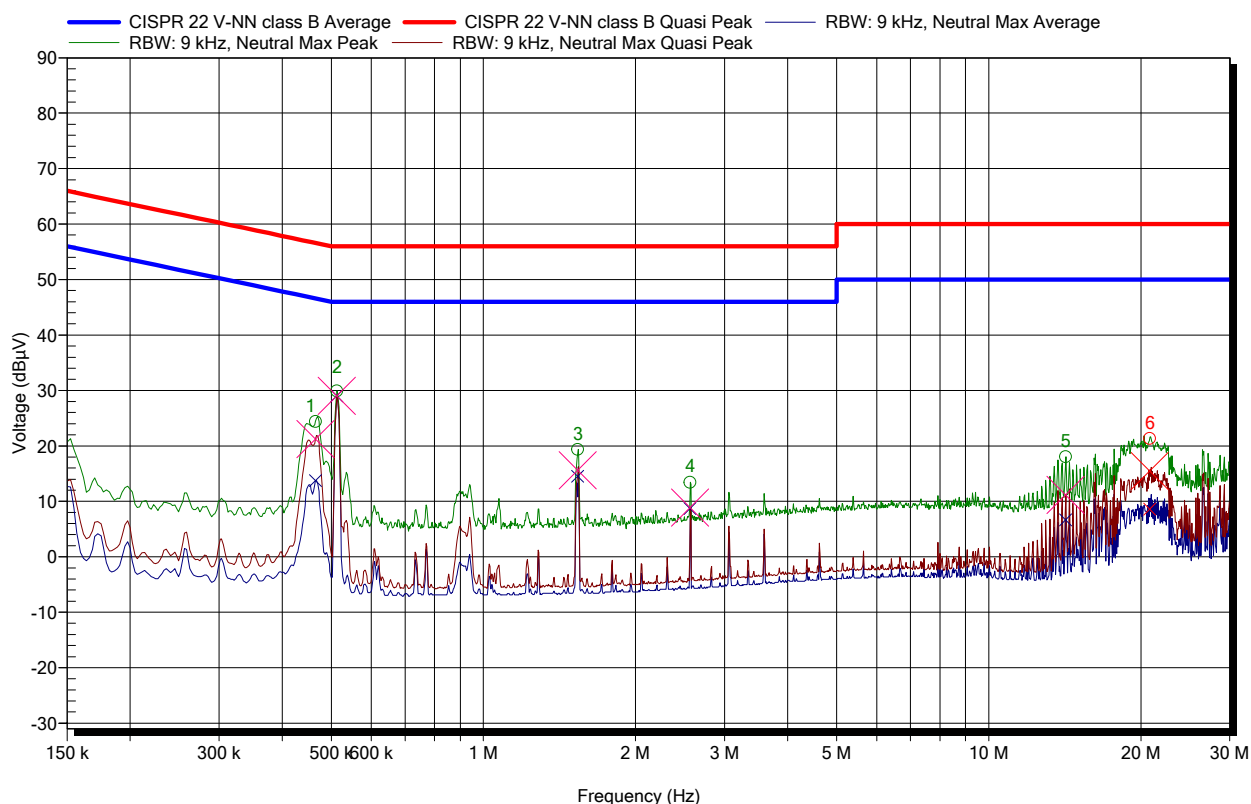


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	465 kHz	24.04 dBμV	13.13 dBμV	-33.47 dB	20.61 dBμV	-35.99 dB	Pass
2	512.25 kHz	30.12 dBμV	29.34 dBμV	-16.66 dB	29.3 dBμV	-26.7 dB	Pass
3	1.536 MHz	20.39 dBμV	15.14 dBμV	-30.86 dB	16.82 dBμV	-39.18 dB	Pass
4	2.564 MHz	13.35 dBμV	8.82 dBμV	-37.18 dB	9.03 dBμV	-46.97 dB	Pass
5	13.637 MHz	16.71 dBμV	7.69 dBμV	-42.31 dB	10.92 dBμV	-49.08 dB	Pass
6	16.229 MHz	18.68 dBμV	12.24 dBμV	-37.76 dB	15.28 dBμV	-44.72 dB	Pass

## Measurement 5:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Power supply voltage</b>	96 VDC
<b>Cables, Notes</b>	--
<b>Mode of operation</b>	Normal operation
<b>Test date, time</b>	20.09.2016 09:36:31
<b>Interface / Line under test</b>	Neutral (0 VDC)
<b>Transducer</b>	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 1 s,



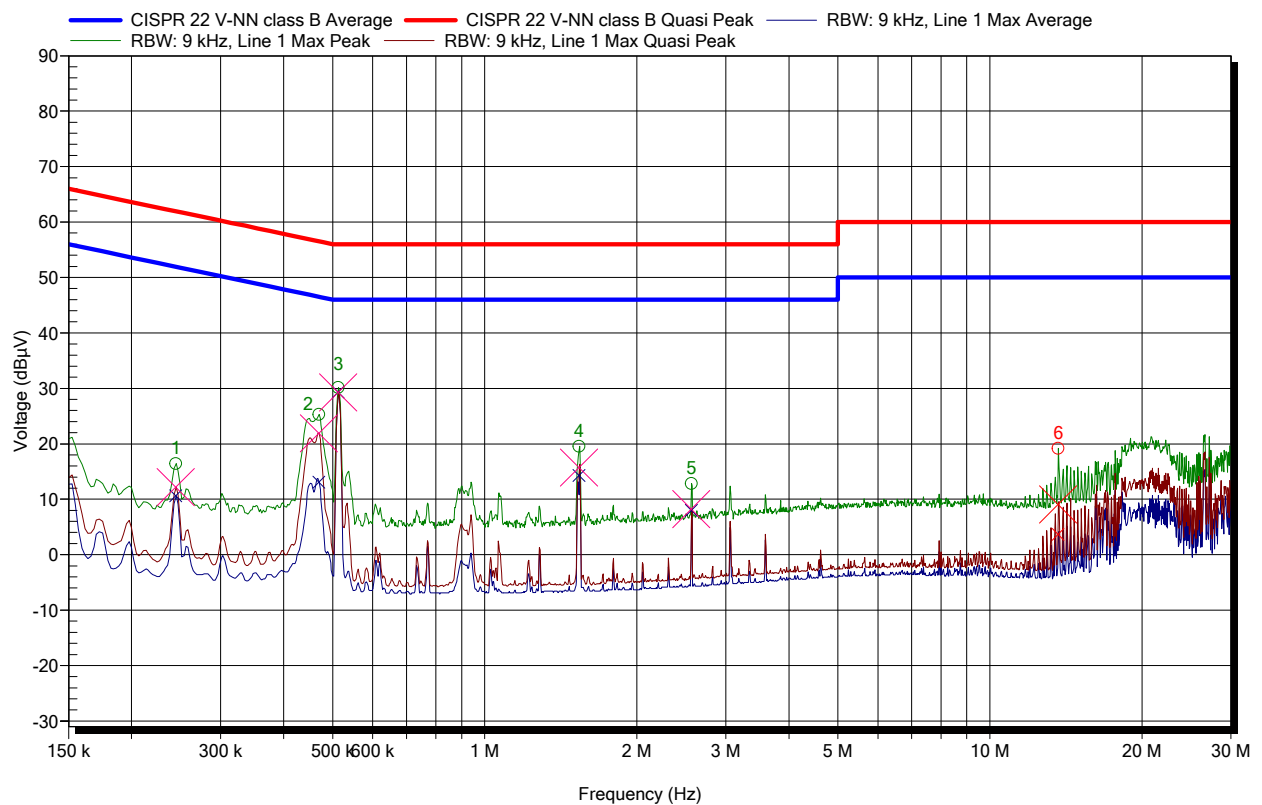
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	465 kHz	24.4 dBμV	13.76 dBμV	-32.84 dB	21.25 dBμV	-35.35 dB	Pass
2	512.25 kHz	29.9 dBμV	29.02 dBμV	-16.98 dB	29 dBμV	-27 dB	Pass
3	1.536 MHz	19.4 dBμV	14.53 dBμV	-31.47 dB	15.58 dBμV	-40.42 dB	Pass
4	2.564 MHz	13.42 dBμV	8.71 dBμV	-37.29 dB	8.9 dBμV	-47.1 dB	Pass
5	14.181 MHz	18.05 dBμV	6.69 dBμV	-43.31 dB	11.14 dBμV	-48.86 dB	Pass
6	20.825 MHz	21.33 dBμV	8.57 dBμV	-41.43 dB	15.48 dBμV	-44.52 dB	Pass



## Measurement 6:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Power supply voltage</b>	96 VDC
<b>Cables, Notes</b>	--
<b>Mode of operation</b>	Normal operation
<b>Test date, time</b>	20.09.2016 09:38:00
<b>Interface / Line under test</b>	Line (+96 VDC)
<b>Transducer</b>	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
<b>Measurement settings</b>	Radiation Version: 2015.1.11, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 1 s,

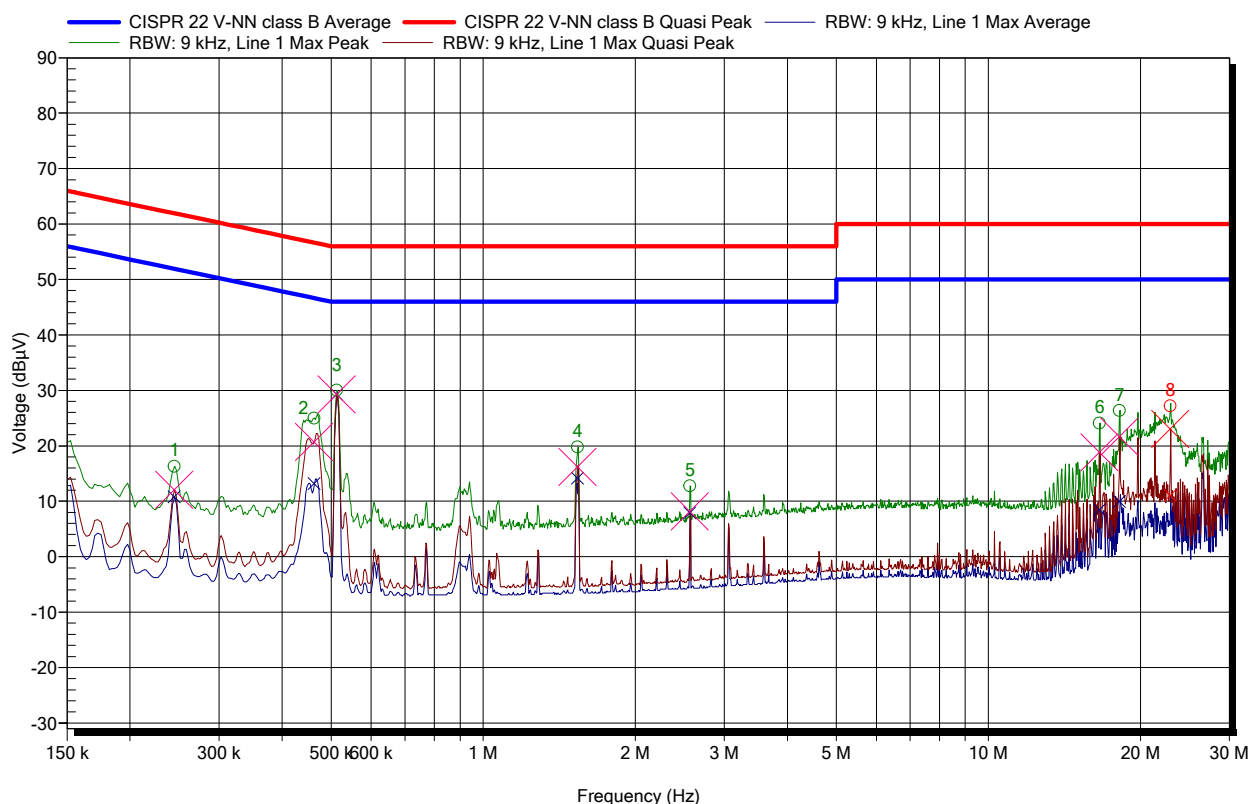


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	244.5 kHz	16.43 dBμV	10.62 dBμV	-41.33 dB	12.19 dBμV	-49.76 dB	Pass
2	469.5 kHz	25.28 dBμV	13.11 dBμV	-33.41 dB	21.88 dBμV	-34.64 dB	Pass
3	512.25 kHz	30.13 dBμV	29.31 dBμV	-16.69 dB	29.28 dBμV	-26.72 dB	Pass
4	1.536 MHz	19.56 dBμV	14.31 dBμV	-31.69 dB	15.75 dBμV	-40.25 dB	Pass
5	2.564 MHz	12.84 dBμV	7.98 dBμV	-38.02 dB	8.23 dBμV	-47.77 dB	Pass
6	13.634 MHz	19.19 dBμV	3.64 dBμV	-46.36 dB	9.06 dBμV	-50.94 dB	Pass

## Measurement 7:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Power supply voltage</b>	110 VDC
<b>Cables, Notes</b>	--
<b>Mode of operation</b>	Normal operation
<b>Test date, time</b>	20.09.2016 09:39:47
<b>Interface / Line under test</b>	Line (+110 VDC)
<b>Transducer</b>	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 1 s,



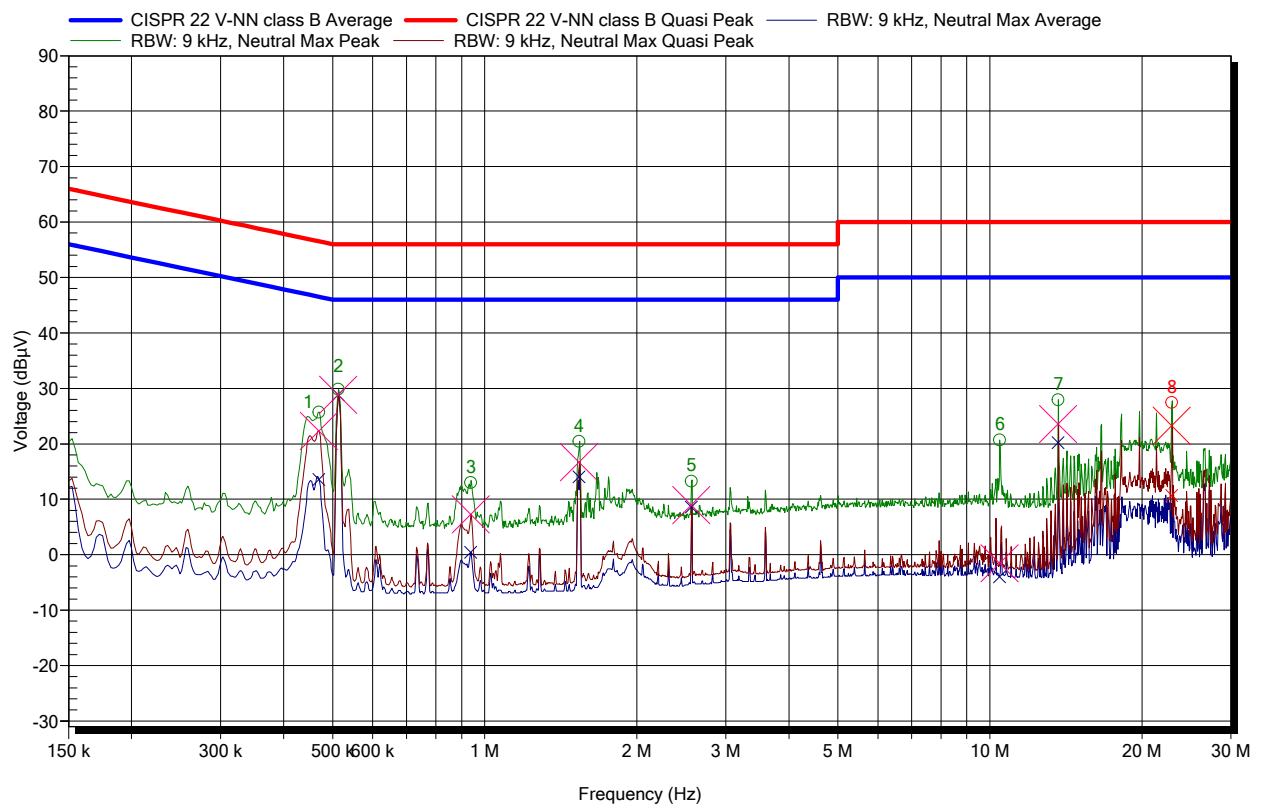
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	244.5 kHz	16.32 dBμV	10.83 dBμV	-41.12 dB	12.06 dBμV	-49.89 dB	Pass
2	462.75 kHz	24.98 dBμV	13.22 dBμV	-33.42 dB	20.71 dBμV	-35.93 dB	Pass
3	512.25 kHz	30.04 dBμV	29.23 dBμV	-16.77 dB	29.23 dBμV	-26.77 dB	Pass
4	1.536 MHz	19.78 dBμV	14.15 dBμV	-31.85 dB	16.19 dBμV	-39.81 dB	Pass
5	2.564 MHz	12.77 dBμV	7.9 dBμV	-38.1 dB	8.17 dBμV	-47.83 dB	Pass
6	16.584 MHz	24.1 dBμV	8.46 dBμV	-41.54 dB	18.85 dBμV	-41.15 dB	Pass
7	18.164 MHz	26.4 dBμV	9.93 dBμV	-40.07 dB	21.66 dBμV	-38.34 dB	Pass
8	22.904 MHz	27.24 dBμV	11.04 dBμV	-38.96 dB	23.04 dBμV	-36.96 dB	Pass



## Measurement 8:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Power supply voltage</b>	110 VDC
<b>Cables, Notes</b>	--
<b>Mode of operation</b>	Normal operation
<b>Test date, time</b>	20.09.2016 09:41:11
<b>Interface / Line under test</b>	Neutral (0 VDC)
<b>Transducer</b>	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
<b>Measurement settings</b>	Radiation Version: 2015.1.11, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [120 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 1 s,



## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	469.5 kHz	25.75 dBμV	13.55 dBμV	-32.97 dB	22.29 dBμV	-34.23 dB	Pass
2	512.25 kHz	29.84 dBμV	28.83 dBμV	-17.17 dB	28.81 dBμV	-27.19 dB	Pass
3	937.5 kHz	13.03 dBμV	0.41 dBμV	-45.59 dB	7.24 dBμV	-48.76 dB	Pass
4	1.536 MHz	20.43 dBμV	14.07 dBμV	-31.93 dB	16.67 dBμV	-39.33 dB	Pass
5	2.564 MHz	13.28 dBμV	8.59 dBμV	-37.41 dB	8.93 dBμV	-47.07 dB	Pass
6	10.448 MHz	20.68 dBμV	-3.97 dBμV	-53.97 dB	-1.56 dBμV	-61.56 dB	Pass
7	13.634 MHz	27.93 dBμV	20.22 dBμV	-29.78 dB	23.54 dBμV	-36.46 dB	Pass
8	22.9 MHz	27.44 dBμV	10.71 dBμV	-39.29 dB	23.28 dBμV	-36.72 dB	Pass

### 13.2 Interference Voltage (Telecommunications cables: LAN+CAN)

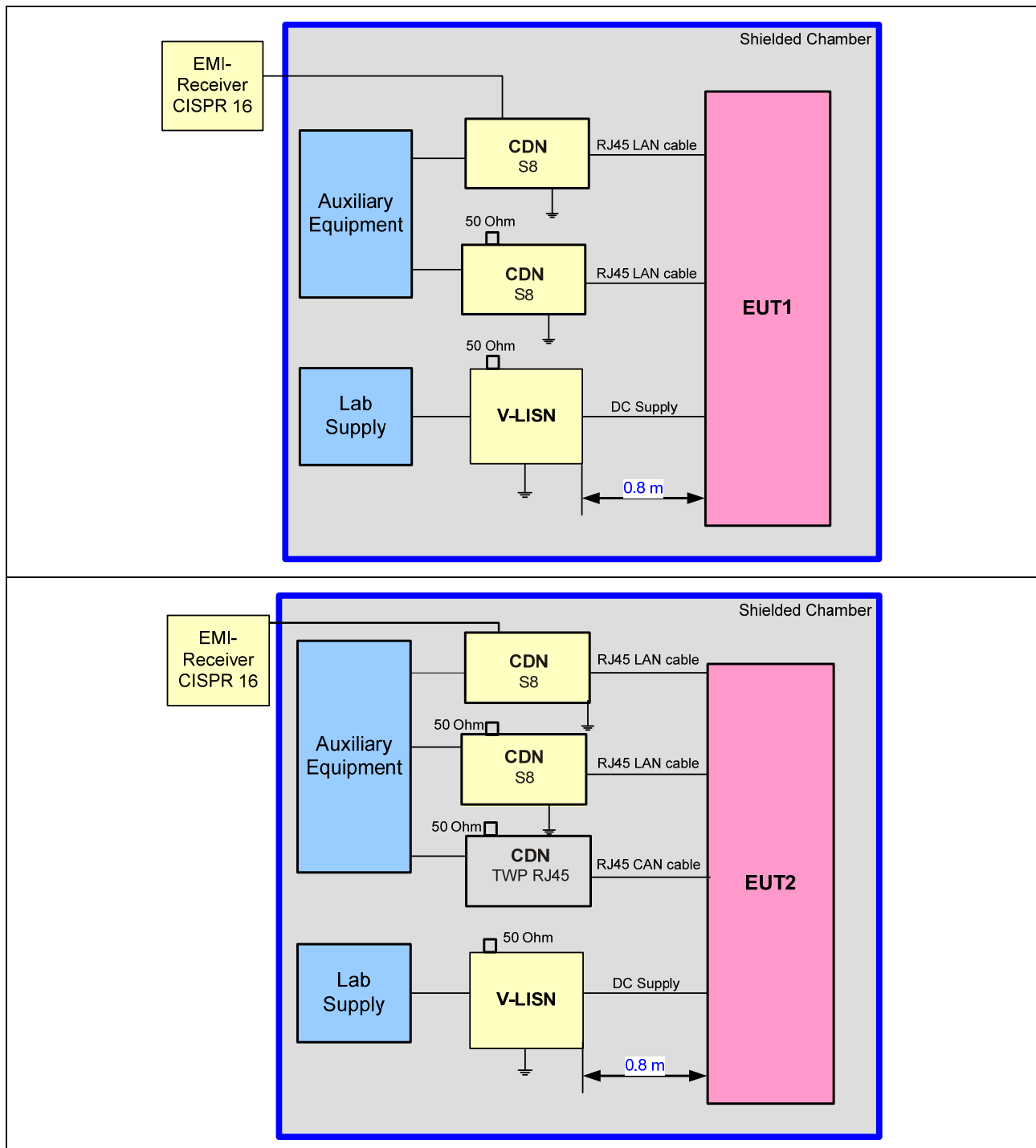
**Test site:** shielded room

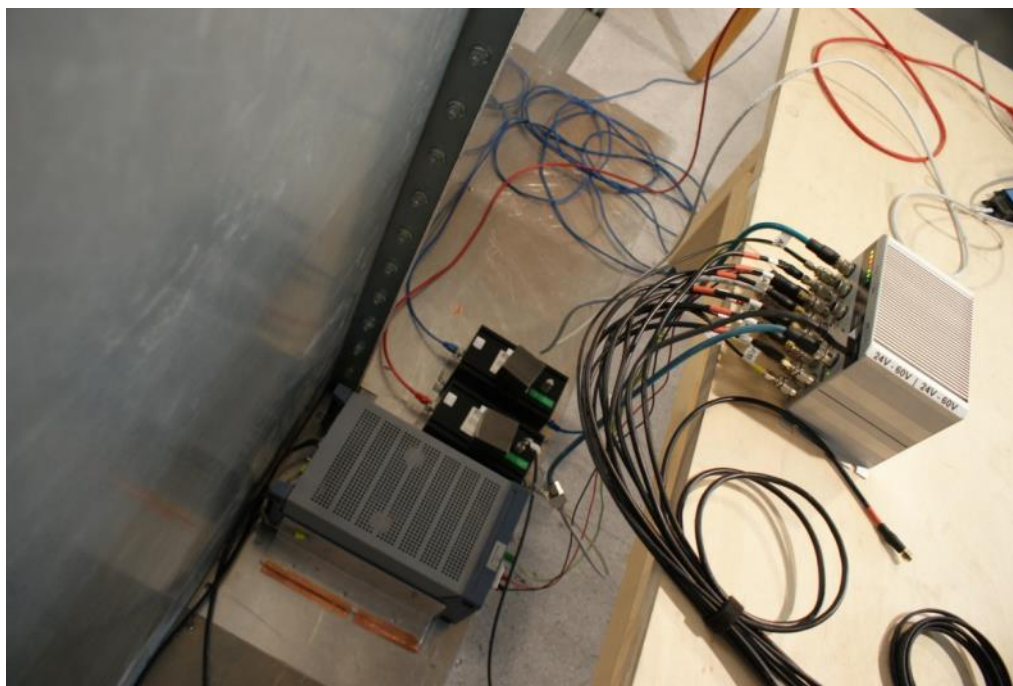
**Meas. uncertainty:** see chapter 15

**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.

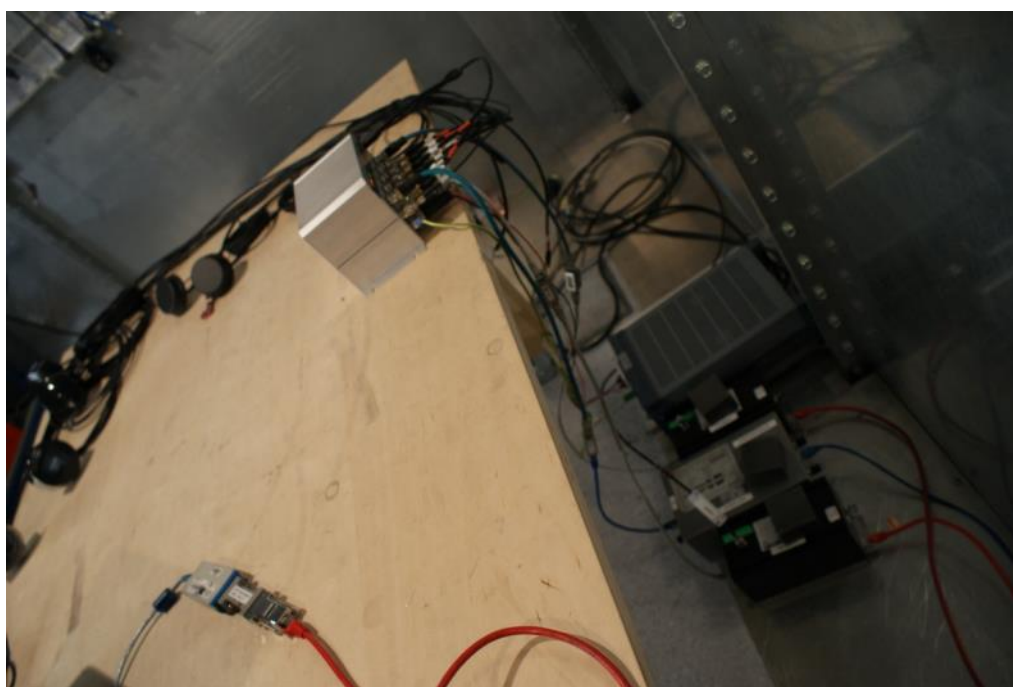
**Modifications:** none

#### Test Setup



**Photo of the Setup**

EUT1 (24-60 VDC)



EUT2 (72-110 VDC)

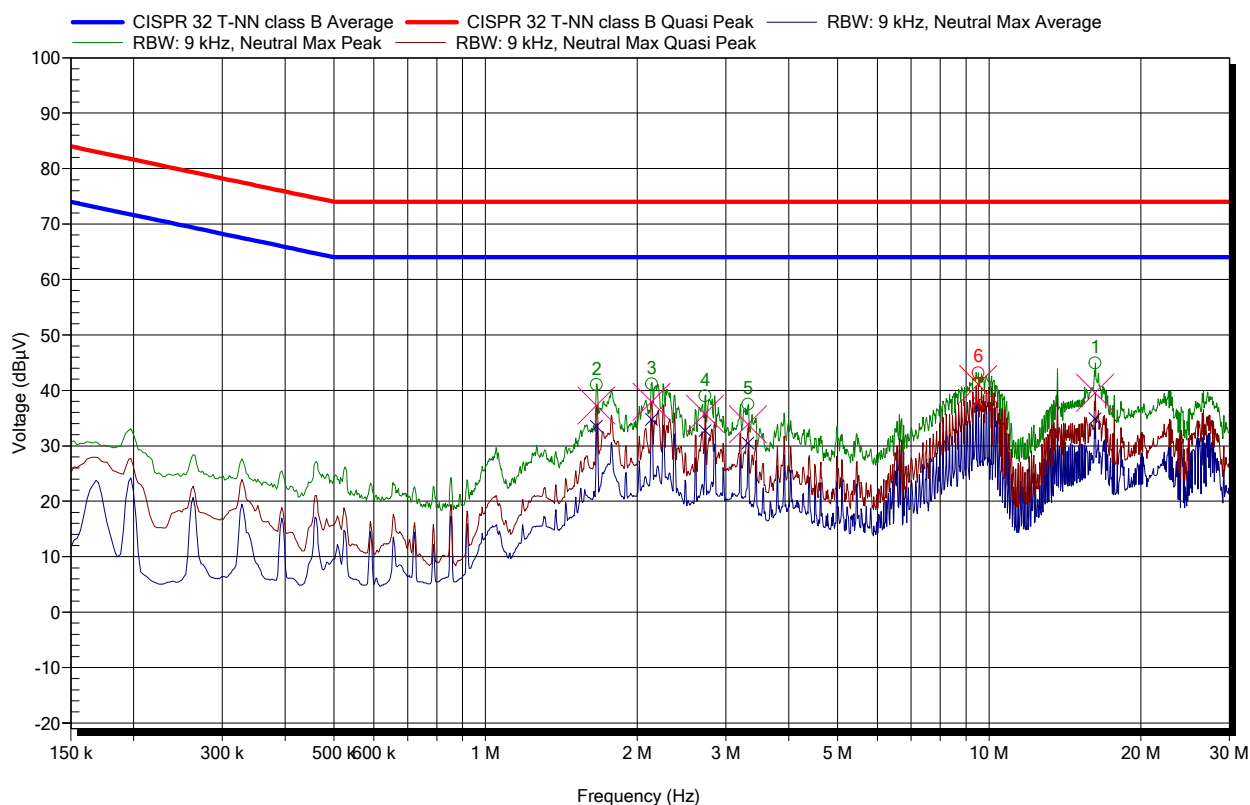
**Test Equipment**

Device Type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESR 7	15.6637.06
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
Power Supply	Elektro Automatik	PS 8160-04	Q10152

## Measurement Results

Measurement 9:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Mode of operation</b>	Normal mode, 24 VDC
<b>Test date, time</b>	20.09.2016 08:59:46
<b>Interface / Line under test</b>	LAN / Ethernet 5, GBit Ethernet
<b>Transducer</b>	CDN S8 RJ45
<b>Measurement settings</b>	Radimation Version: 2015.1.11, 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: 1 s



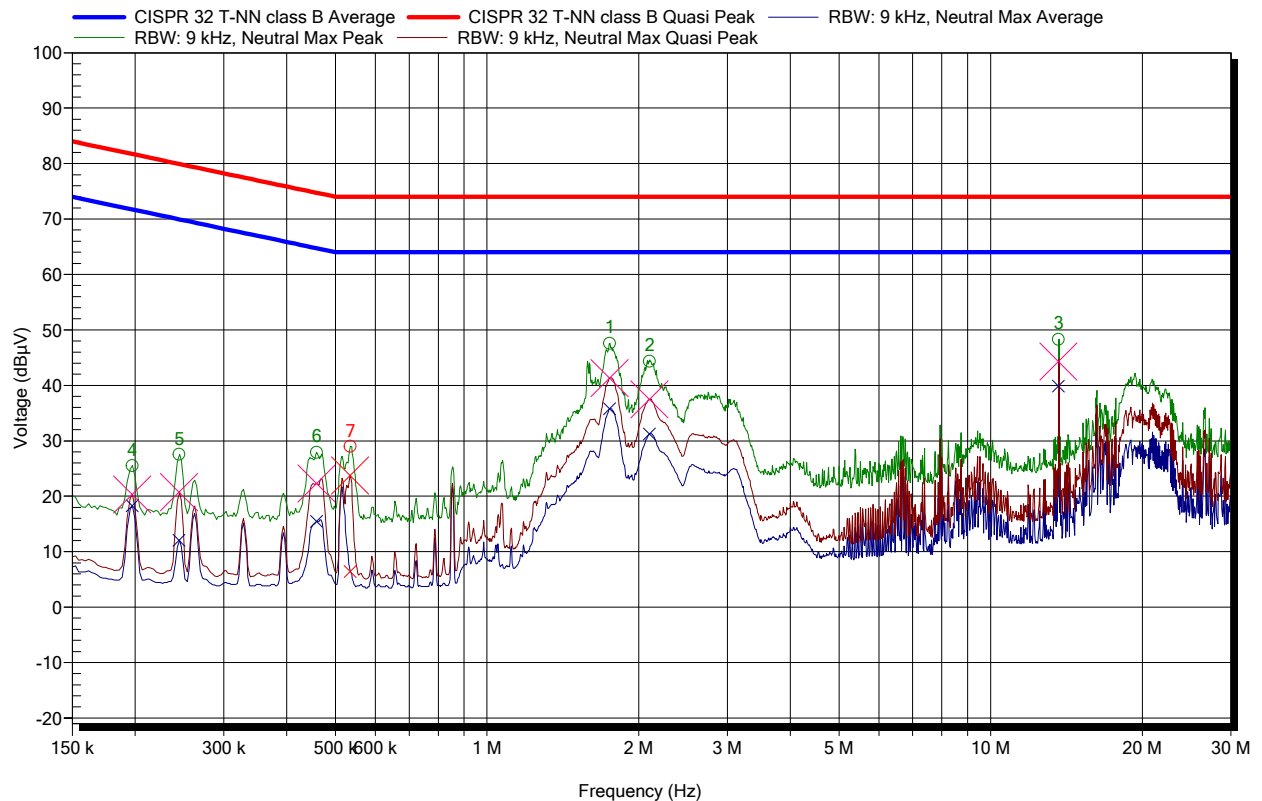
### Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	16.229 MHz	44.95 dBμV	34.89 dBμV	-29.11 dB	39.53 dBμV	-34.47 dB	Pass
2	1.66 MHz	41.04 dBμV	33.51 dBμV	-30.49 dB	37.26 dBμV	-36.74 dB	Pass
3	2.135 MHz	41.21 dBμV	34.78 dBμV	-29.22 dB	37.95 dBμV	-36.05 dB	Pass
4	2.726 MHz	39.05 dBμV	32.71 dBμV	-31.29 dB	35.76 dBμV	-38.24 dB	Pass
5	3.318 MHz	37.51 dBμV	30.5 dBμV	-33.5 dB	33.85 dBμV	-40.15 dB	Pass
6	9.512 MHz	43.18 dBμV	37.93 dBμV	-26.07 dB	41.11 dBμV	-32.89 dB	Pass

**Note:** Measurements at the Ethernet 1 of EUT1 port was already carried out and reported in Electrosuisse test report no. 16-EL-0019.E01.

## Measurement 10:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Mode of operation</b>	Normal mode, 110 VDC
<b>Test date, time</b>	20.09.2016 09:52:59
<b>Interface / Line under test</b>	LAN / Ethernet 5, GBit Ethernet
<b>Transducer</b>	CDN S8 RJ45
<b>Measurement settings</b>	Radimation Version: 2015.1.11, 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: 1 s

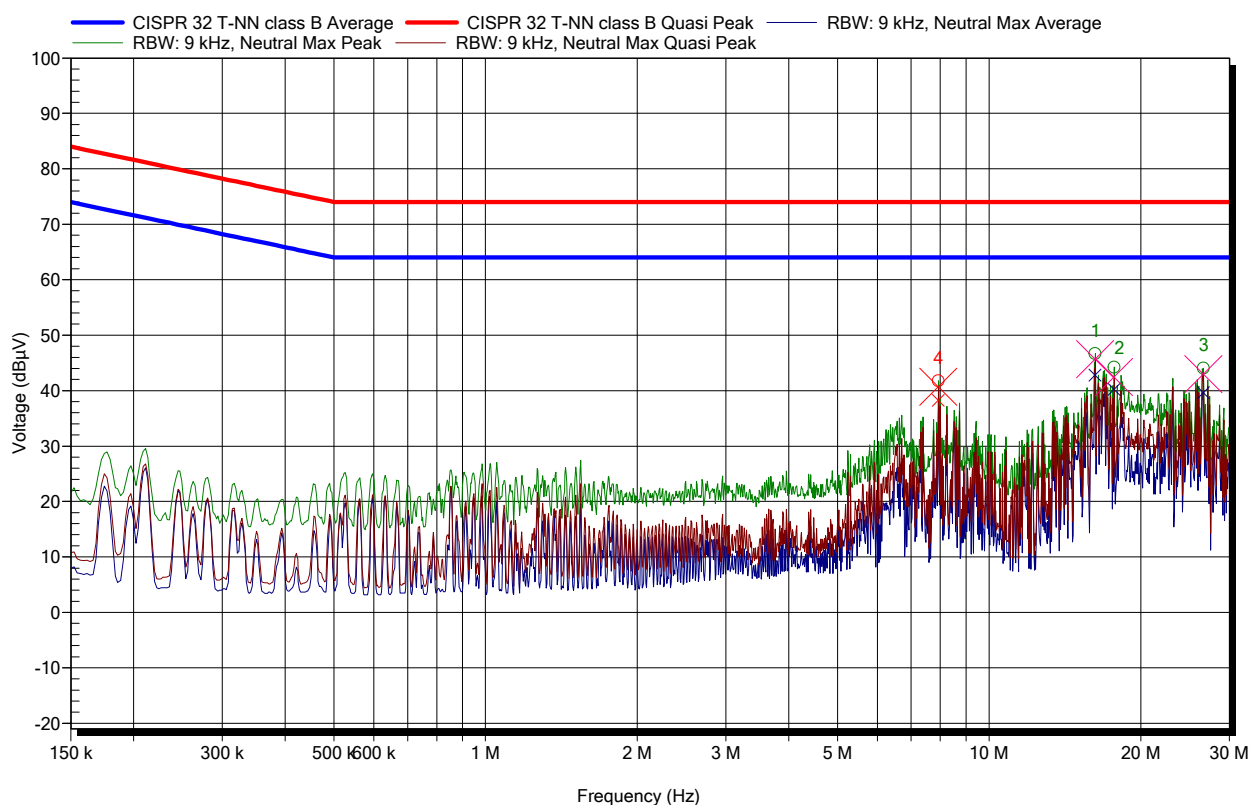


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	1.75 MHz	47.57 dBμV	35.77 dBμV	-28.23 dB	41.33 dBμV	-32.67 dB	Pass
2	2.101 MHz	44.33 dBμV	31.24 dBμV	-32.76 dB	37.45 dBμV	-36.55 dB	Pass
3	13.637 MHz	48.31 dBμV	39.88 dBμV	-24.12 dB	44.32 dBμV	-29.68 dB	Pass
4	197.25 kHz	25.54 dBμV	18.3 dBμV	-53.43 dB	20.31 dBμV	-61.42 dB	Pass
5	244.5 kHz	27.55 dBμV	12.08 dBμV	-57.86 dB	20.72 dBμV	-59.22 dB	Pass
6	458.25 kHz	27.92 dBμV	15.47 dBμV	-49.26 dB	22.29 dBμV	-52.44 dB	Pass
7	534.75 kHz	28.99 dBμV	6.41 dBμV	-57.59 dB	23.74 dBμV	-50.26 dB	Pass

## Measurement 11:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Mode of operation</b>	Normal mode, 110 VDC
<b>Test date, time</b>	20.09.2016 09:57:20
<b>Interface / Line under test</b>	LAN / Ethernet 1
<b>Transducer</b>	CDN S8 RJ45
<b>Measurement settings</b>	Radimation Version: 2015.1.11, 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: 1 s

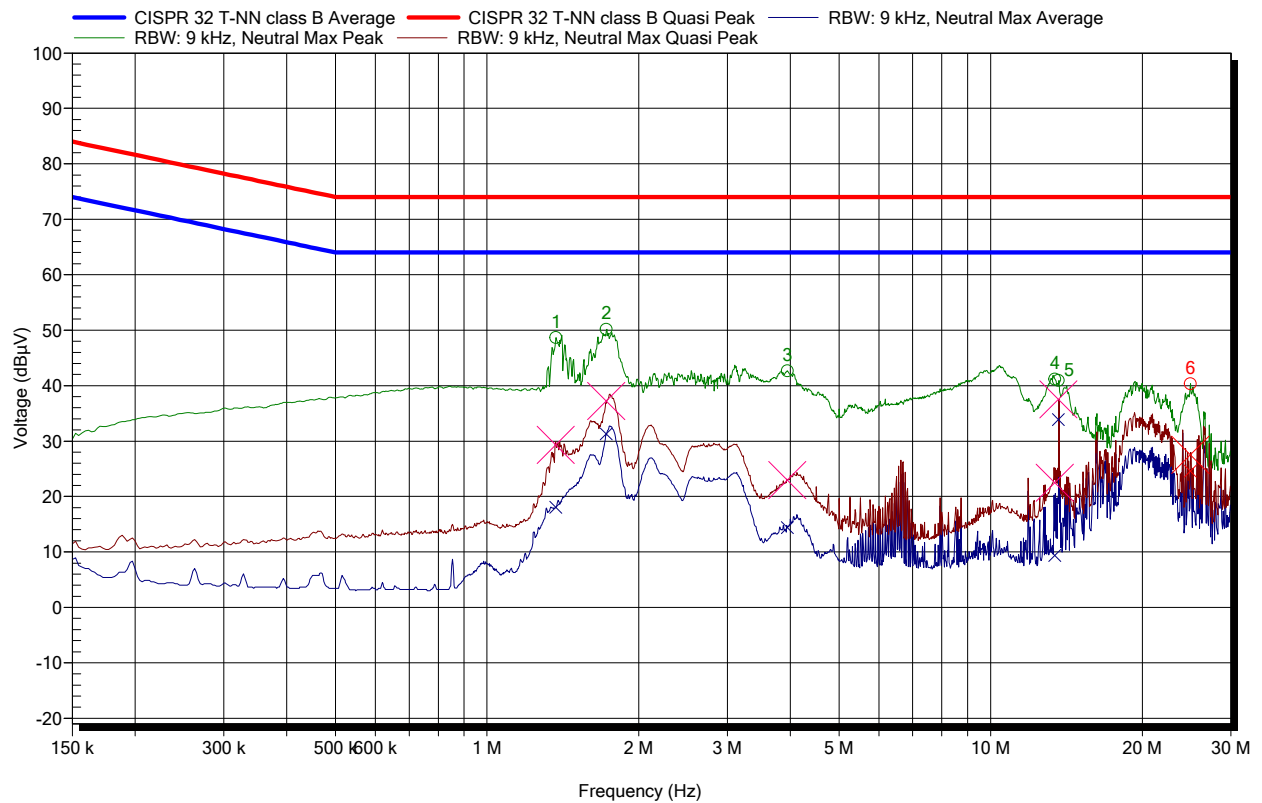


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	16.229 MHz	46.7 dBμV	42.79 dBμV	-21.21 dB	45.67 dBμV	-28.33 dB	Pass
2	17.693 MHz	44.23 dBμV	40.21 dBμV	-23.79 dB	42.44 dBμV	-31.56 dB	Pass
3	26.61 MHz	44.07 dBμV	39.65 dBμV	-24.35 dB	43 dBμV	-31 dB	Pass
4	7.924 MHz	41.75 dBμV	38.21 dBμV	-25.79 dB	40.68 dBμV	-33.32 dB	Pass

## Measurement 12:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B
<b>Mode of operation</b>	Normal mode, 110 VDC
<b>Test date, time</b>	20.09.2016 10:02:50
<b>Interface / Line under test</b>	CAN
<b>Transducer</b>	CDN S8 RJ45
<b>Measurement settings</b>	Radimation Version: 2015.1.11, 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: 1 s



## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	1.37 MHz	48.64 dBμV	18.05 dBμV	-45.95 dB	29.3 dBμV	-44.7 dB	Pass
2	1.725 MHz	50.16 dBμV	31.29 dBμV	-32.71 dB	37.23 dBμV	-36.77 dB	Pass
3	3.944 MHz	42.67 dBμV	14.38 dBμV	-49.62 dB	22.98 dBμV	-51.02 dB	Pass
4	13.398 MHz	41.17 dBμV	9.37 dBμV	-54.63 dB	22.48 dBμV	-51.52 dB	Pass
5	13.634 MHz	40.91 dBμV	33.89 dBμV	-30.11 dB	37.54 dBμV	-36.46 dB	Pass
6	24.898 MHz	40.32 dBμV	24.58 dBμV	-39.42 dB	27.54 dBμV	-46.46 dB	Pass



### 13.3 Interference Voltage (Antenna Ports)

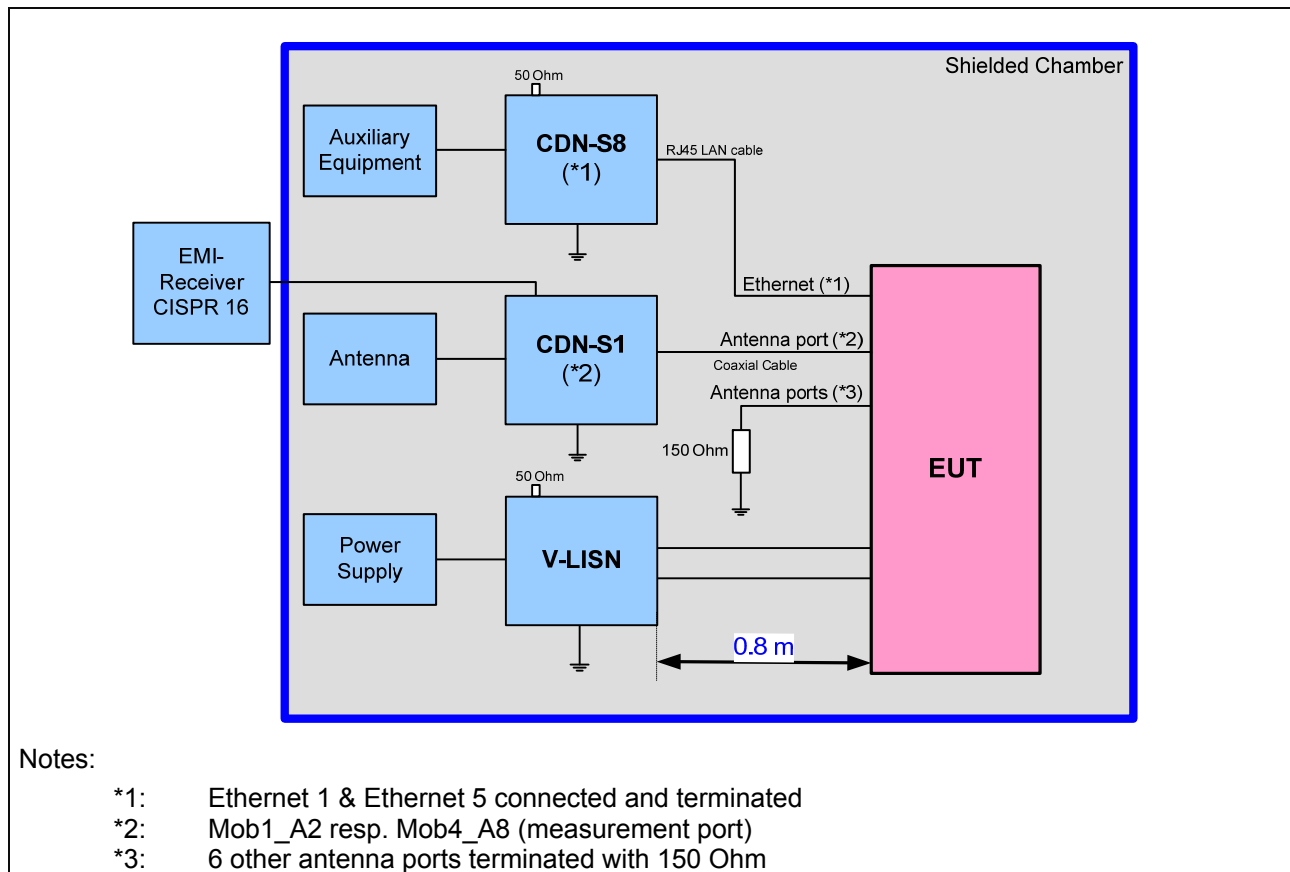
**Test site:** shielded room

**Meas. uncertainty:** see chapter 15

**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

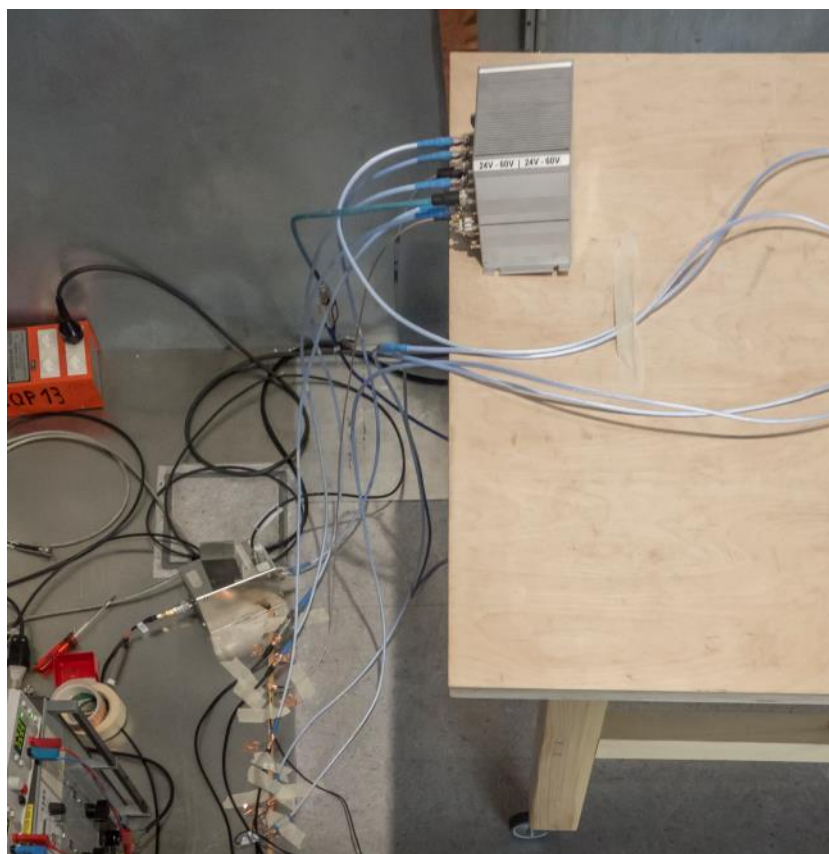


#### Test Equipment

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



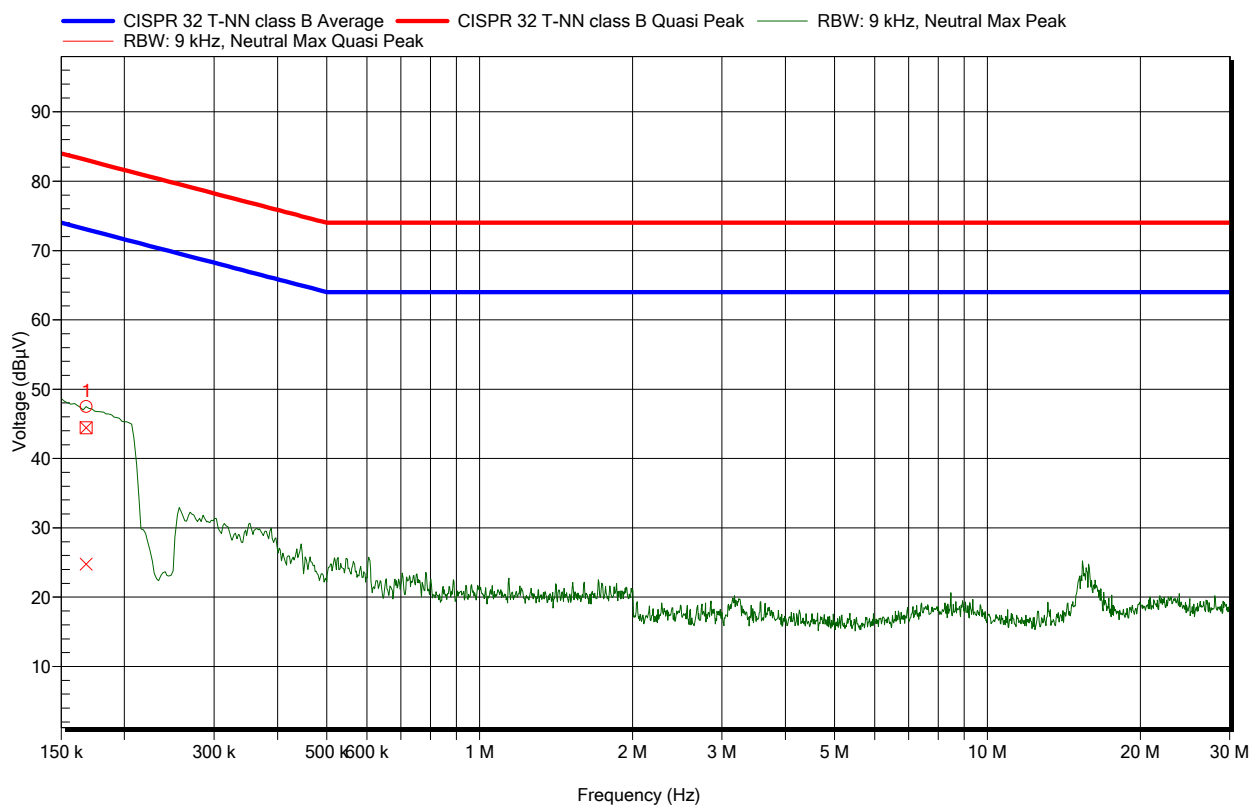
## Photos of the Setup



## Measurement Results

Diagram 1:

<b>EUT</b>	EUT 1
<b>Verdict, Test</b>	Pass, CISPR 32 & EN 55032, Class B
<b>Mode of operation</b>	Normal mode, 24 VDC
<b>Test date, time</b>	28.04.2017 13:42:08
<b>Interface / Line under test</b>	Antenna port Mob1_A2
<b>Transducer</b>	ISN S1
<b>Measurement settings</b>	Radimation Version: 2016.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: 10 ms, Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 10 ms

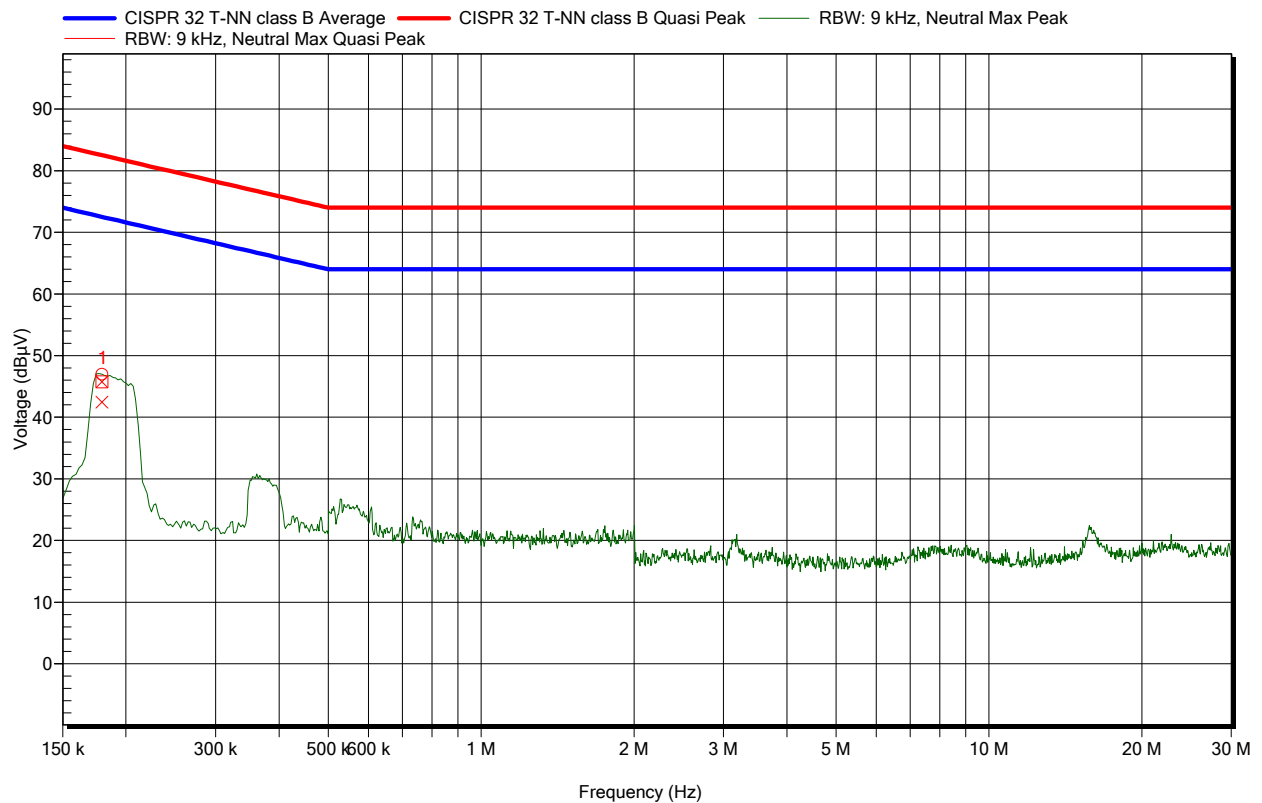


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	168 kHz	47.51 dBμV	24.75 dBμV	-48.31 dB	44.43 dBμV	-38.63 dB	Pass

Diagram 2:

<b>EUT</b>	EUT 1
<b>Verdict, Test</b>	Pass, CISPR 32 & EN 55032, Class B
<b>Mode of operation</b>	Normal mode, 24 VDC
<b>Test date, time</b>	28.04.2017 13:46:43
<b>Interface / Line under test</b>	Antenna port Mob4_A8
<b>Transducer</b>	ISN S1
<b>Measurement settings</b>	Radiation Version: 2016.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: 10 ms, Step freq: Linear: 2.25 kHz steps, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: 10 ms



### Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	179.25 kHz	46.96 dBμV	42.47 dBμV	-30.05 dB	45.74 dBμV	-36.78 dB	Pass

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

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

**Distance:** 3 m

**Meas. uncertainty:** see chapter 15

**Measuring method1:** CISPR 16-2-3

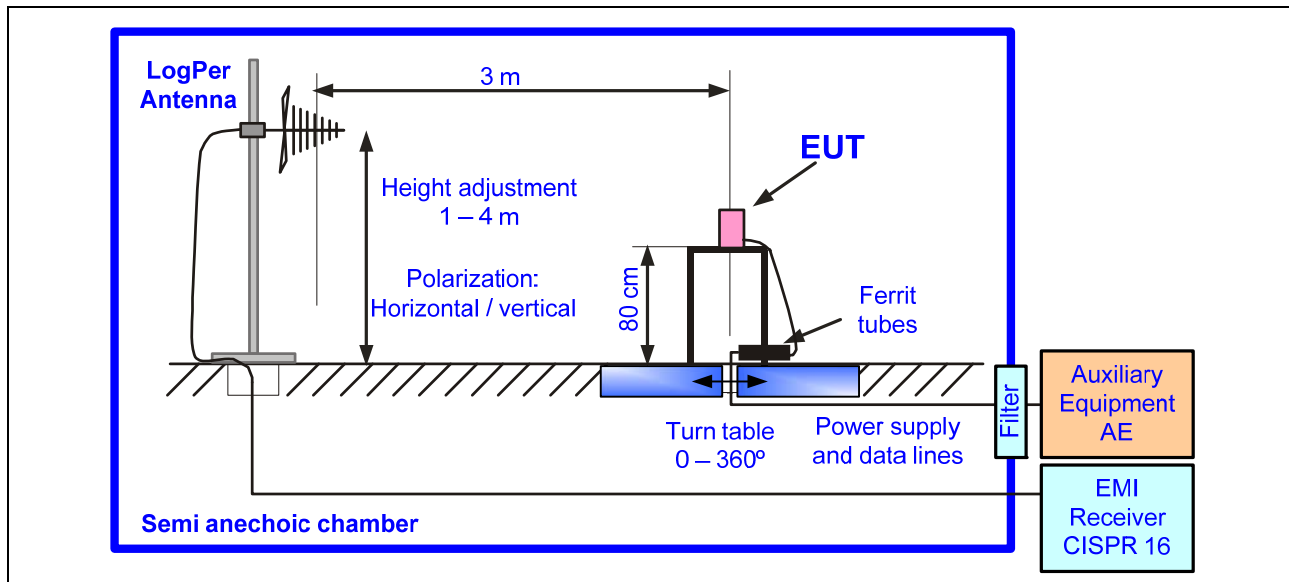
The electromagnetic disturbance radiated by the equipment is measured using a EMI reveicer and a wide band antenna. The turning table is operated through 360° during the measurements with steps of 30°. The antenna is moved from 1 to 4 m in height with steps of 1 m. The measurements are performed with 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.

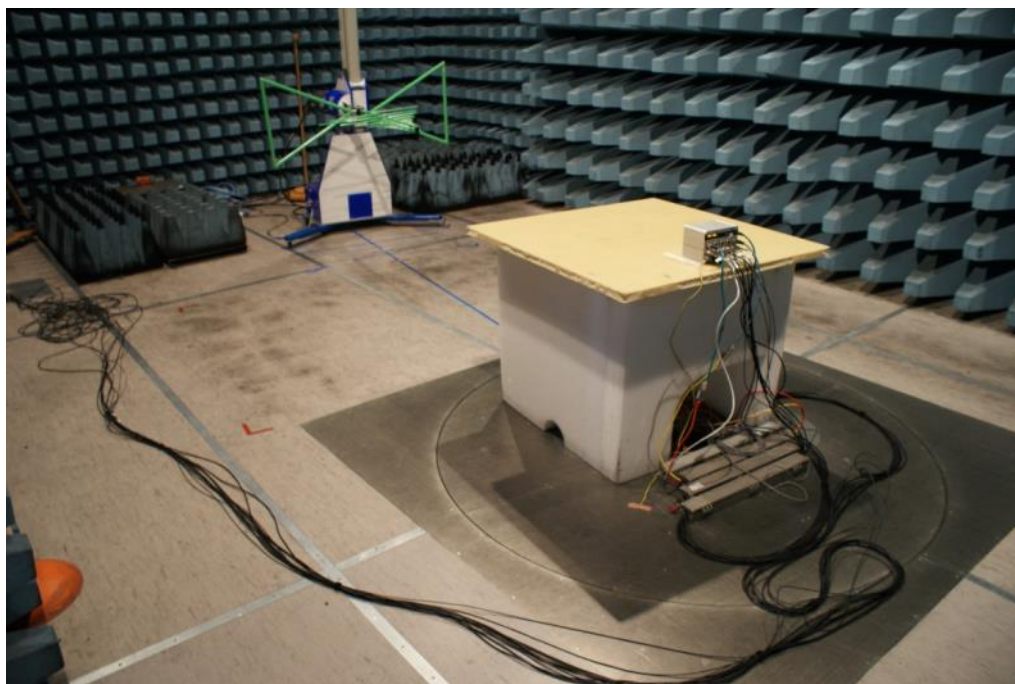
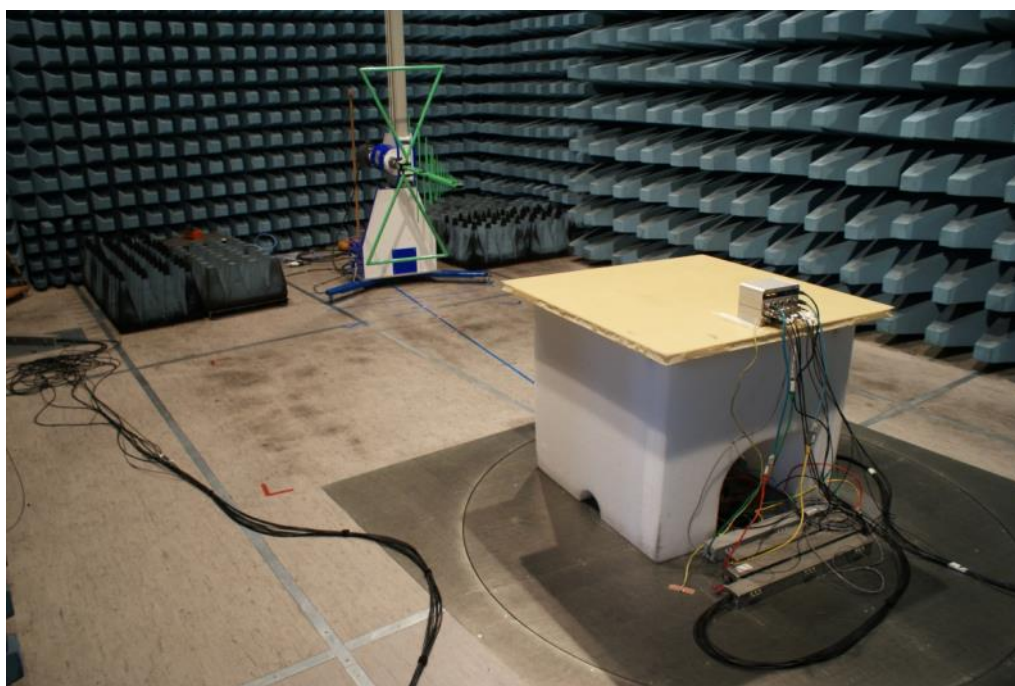
**Measuring method2:** Regelung EMV06

The electromagnetic disturbance radiated by the equipment is measured using a EMI reveicer and a wide band antenna. The turning table is operated through 270° during the measurements with steps of 90°. The antenna position is specified to be 1.2 m in height. 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 with a RBW of 9 kHz and a measurement time bigger than 10 ms. The peak values are recorded continuously. The values exceeding a limit shall be re-measured with the average detector of the receiver.

**Modifications:** none

#### Test Setup



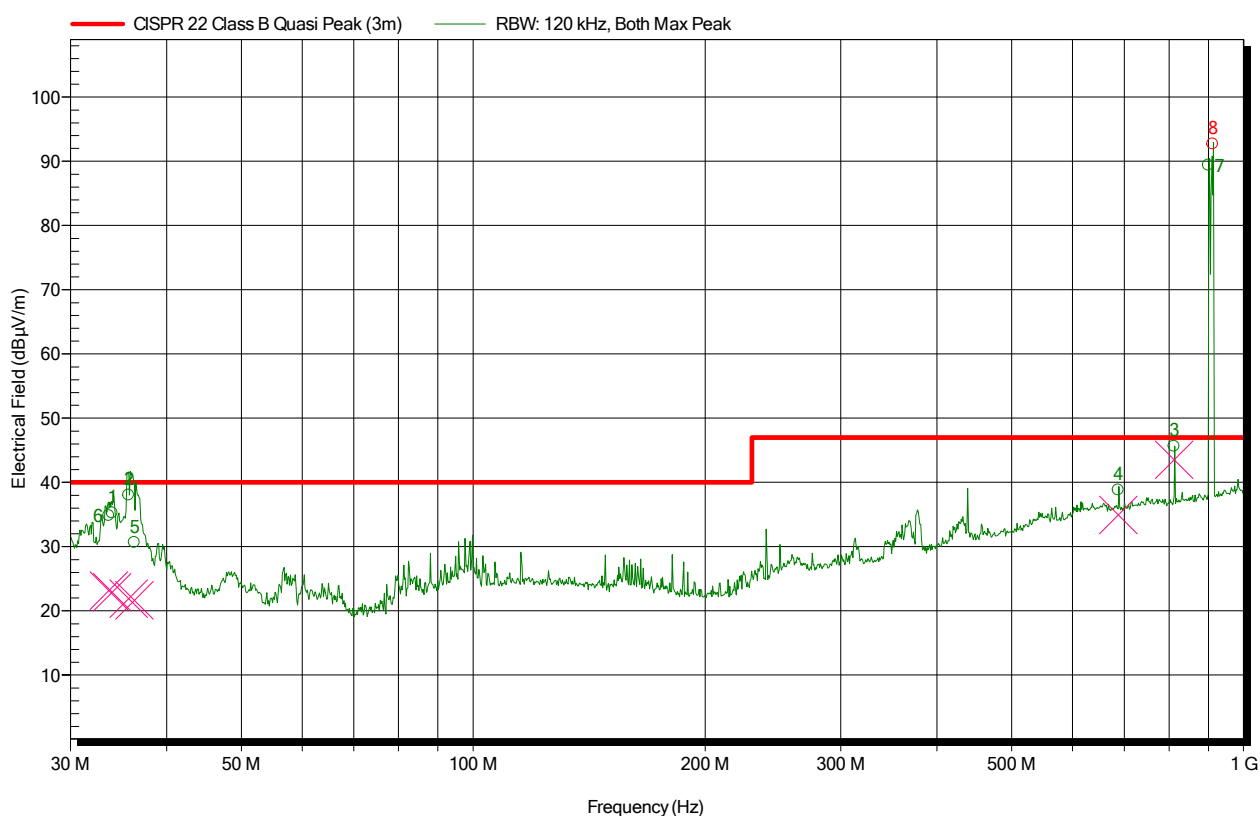
**Photo of the Setup***EUT1 (24-60 VDC)**EUT2 (72-110 VDC)***Test Equipment**

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

## Measurement Results

Measurement 13:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B		
<b>Mode of operation</b>	normal mode 24 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 13:24:45		
<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: 2015.1.11, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: 10 dB, Internal preamp: 20 dB, Measure time: 20 ms		



### Detected peaks

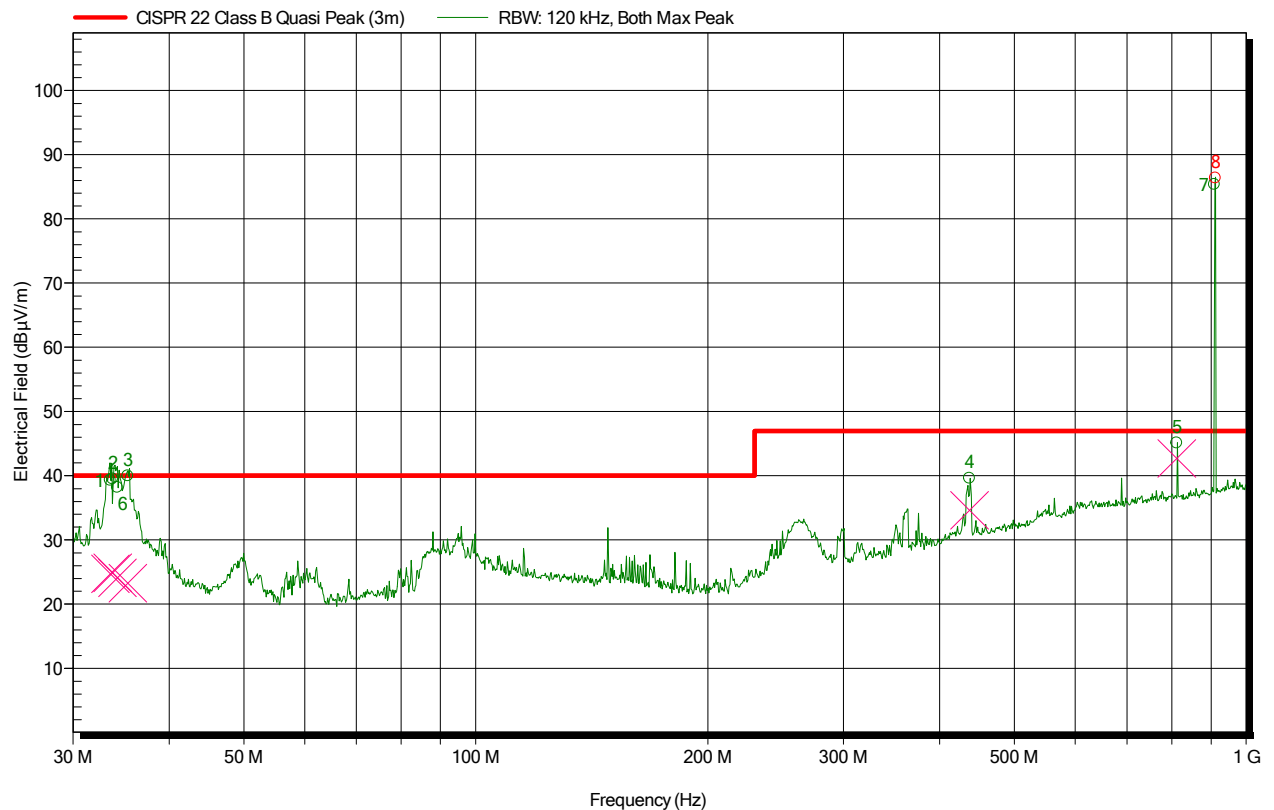
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	33.99 MHz	35.25 dBμV/m	22.93 dBμV/m	-17.07 dB	Pass	90 Degree	1 m	Vertical
2	35.73 MHz	38.05 dBμV/m	21.93 dBμV/m	-18.07 dB	Pass	90 Degree	1 m	Vertical
3	812.49 MHz	45.61 dBμV/m	43.51 dBμV/m	-3.49 dB	Pass	300 Degree	1 m	Horizontal
4	687.51 MHz	38.83 dBμV/m	34.96 dBμV/m	-12.04 dB	Pass	330 Degree	1 m	Vertical
5	36.33 MHz	30.65 dBμV/m	21.64 dBμV/m	-18.36 dB	Pass	90 Degree	1 m	Vertical
6	33.66 MHz	34.82 dBμV/m	23.14 dBμV/m	-16.86 dB	Pass	90 Degree	1 m	Vertical
7	900.12 MHz	89.4 dBμV/m	--	--	N/A 1)	210 Degree	1.6 m	Horizontal
8	912.45 MHz	92.69 dBμV/m	--	--	N/A 1)	240 Degree	1 m	Vertical

Note:

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

## Measurement 14:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B		
<b>Mode of operation</b>	normal mode 60 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 14:49:18		
<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: 2015.1.11, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: 10 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	33.57 MHz	39.27 dBµV/m	24.73 dBµV/m	-15.27 dB	Pass	30 Degree	1 m	Vertical
2	33.78 MHz	39.48 dBµV/m	24.9 dBµV/m	-15.1 dB	Pass	30 Degree	1 m	Vertical
3	35.37 MHz	39.97 dBµV/m	23.28 dBµV/m	-16.72 dB	Pass	30 Degree	1 m	Vertical
4	437.49 MHz	39.58 dBµV/m	34.65 dBµV/m	-12.35 dB	Pass	300 Degree	1 m	Vertical
5	812.49 MHz	45.09 dBµV/m	42.68 dBµV/m	-4.32 dB	Pass	300 Degree	1 m	Horizontal
6	34.29 MHz	38.19 dBµV/m	24.11 dBµV/m	-15.89 dB	Pass	30 Degree	1 m	Vertical
7	909.72 MHz	85.34 dBµV/m	--	--	N/A 1)	150 Degree	1 m	Vertical
8	911.88 MHz	86.34 dBµV/m	--	--	N/A 1)	180 Degree	1 m	Vertical

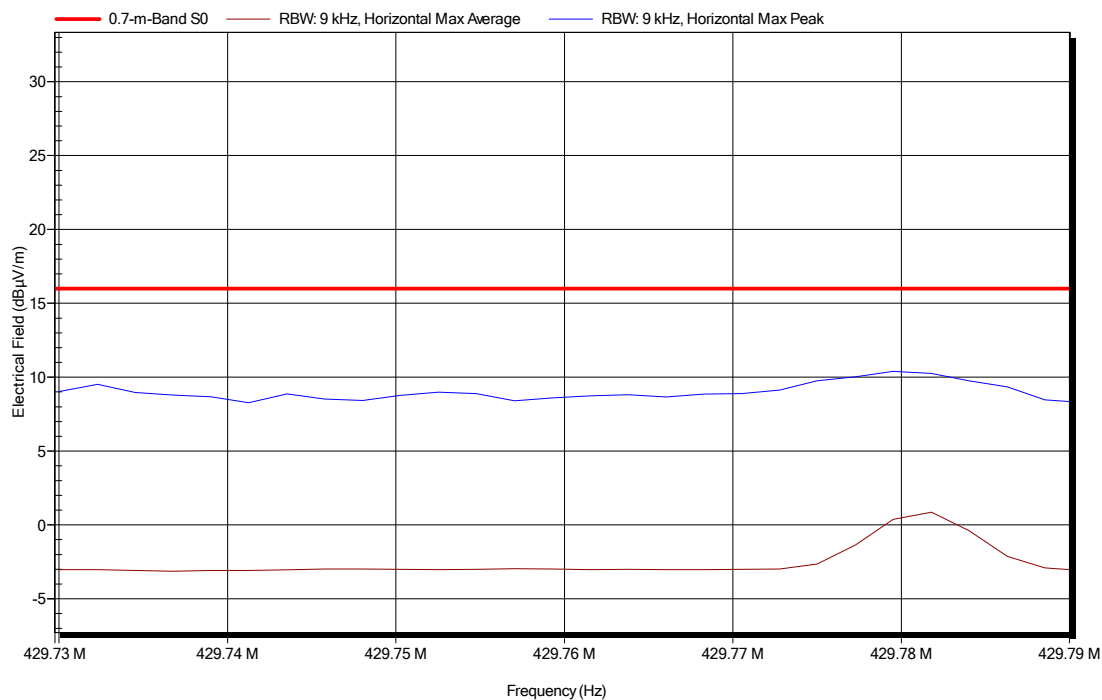
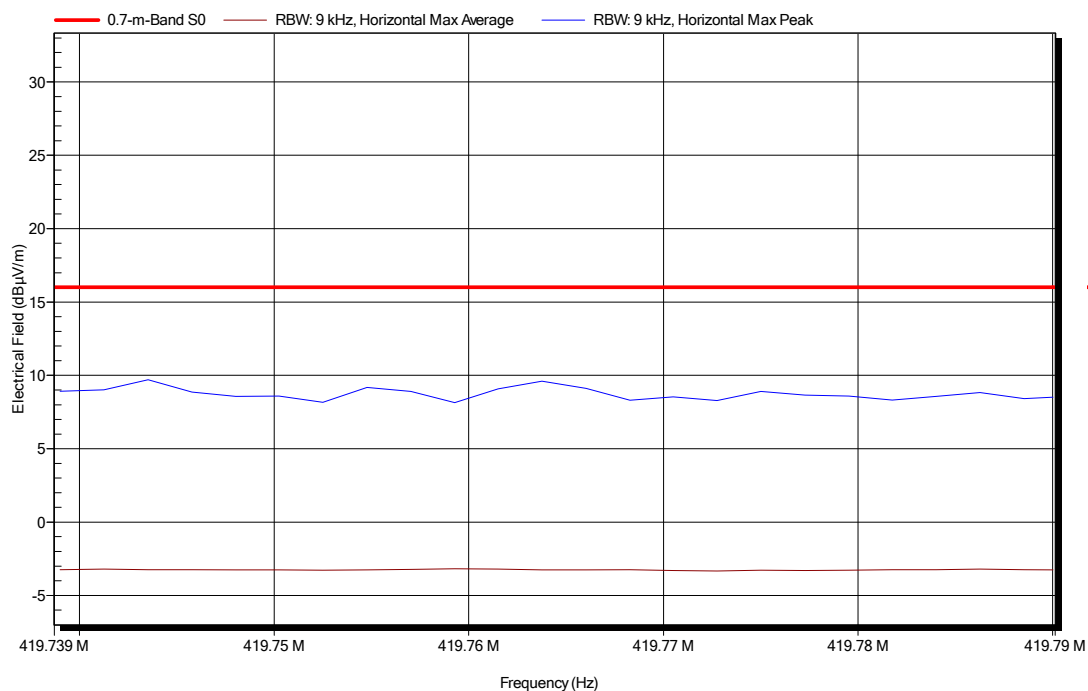
## Notes:

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



## Measurement 15:

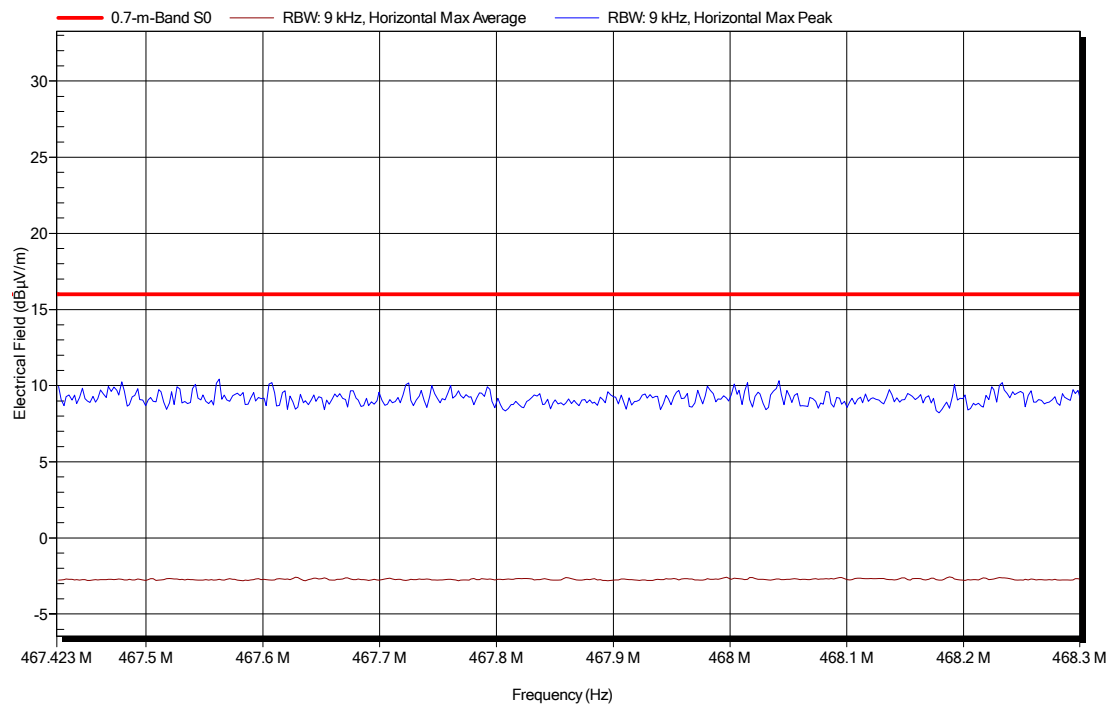
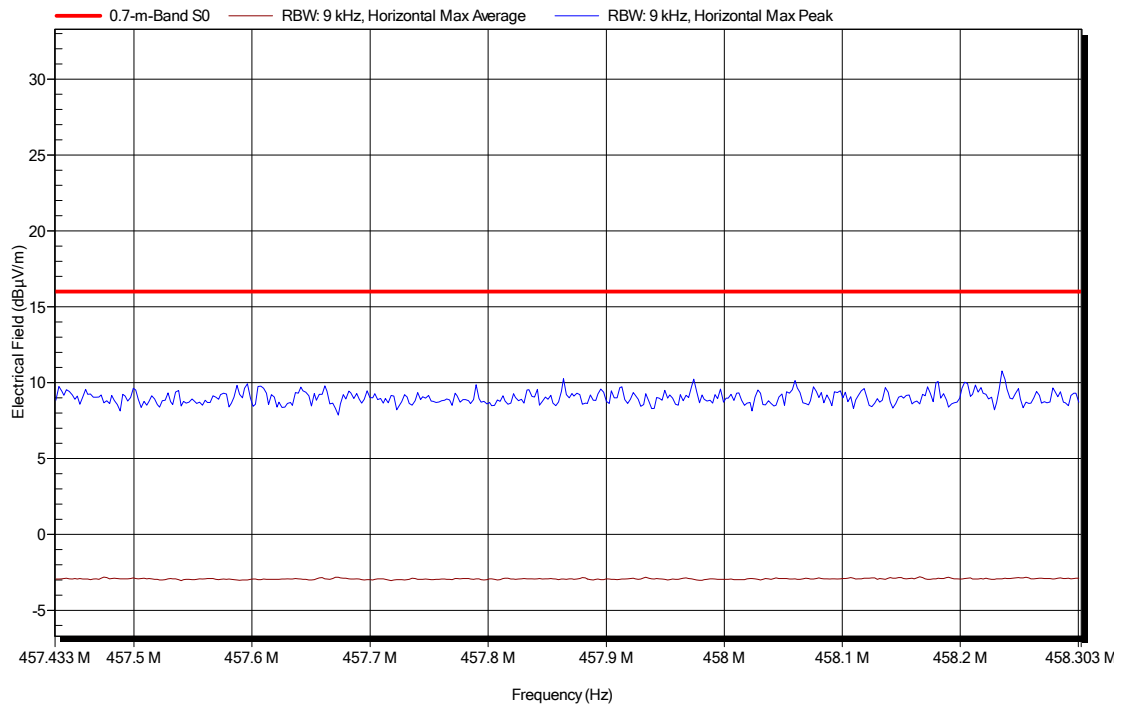
<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 24 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 13:43:52		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Horizontal
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		





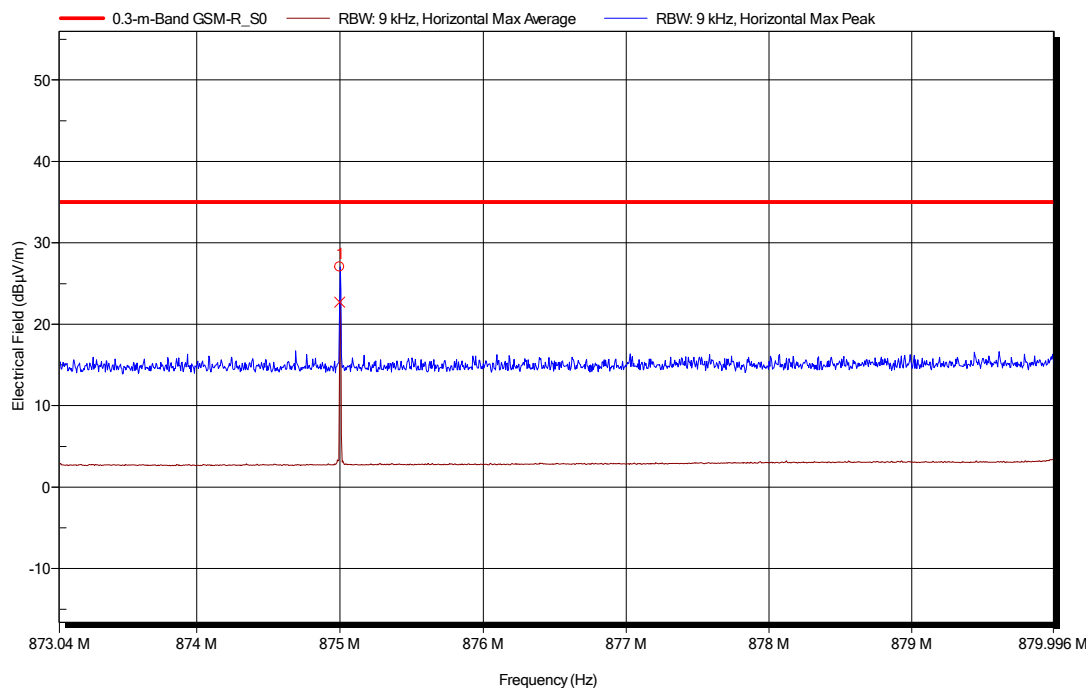
## Measurement 16:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 24 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 13:54:59		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Horizontal
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



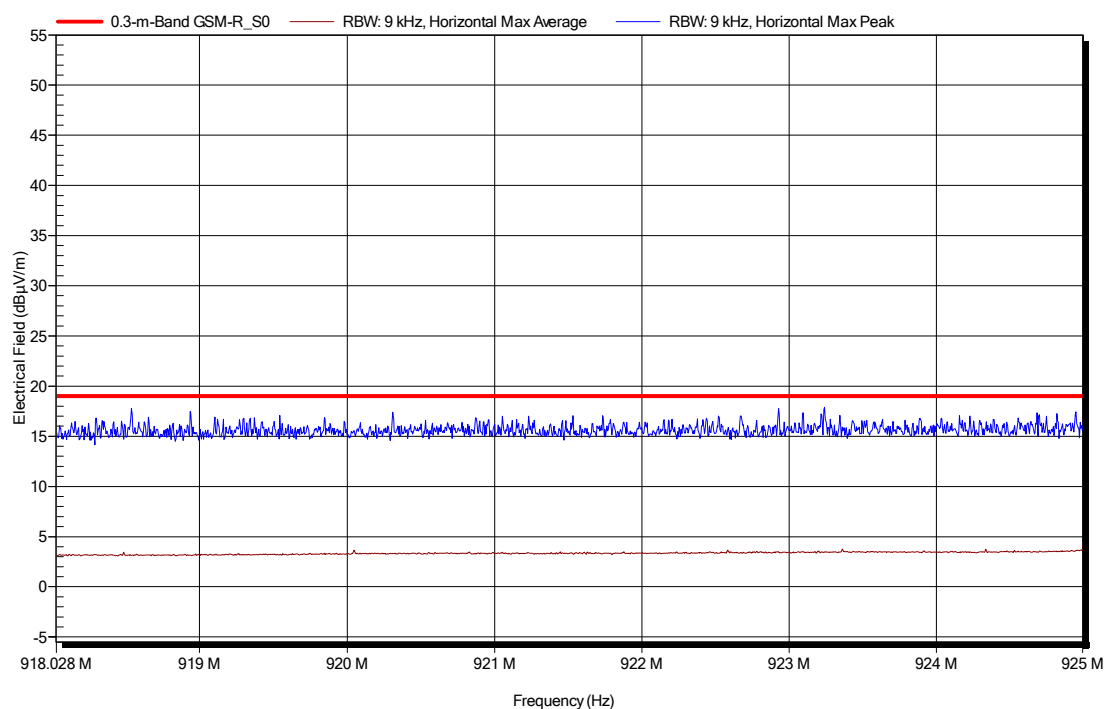
## Measurement 17:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 24 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 14:09:31		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Horizontal
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



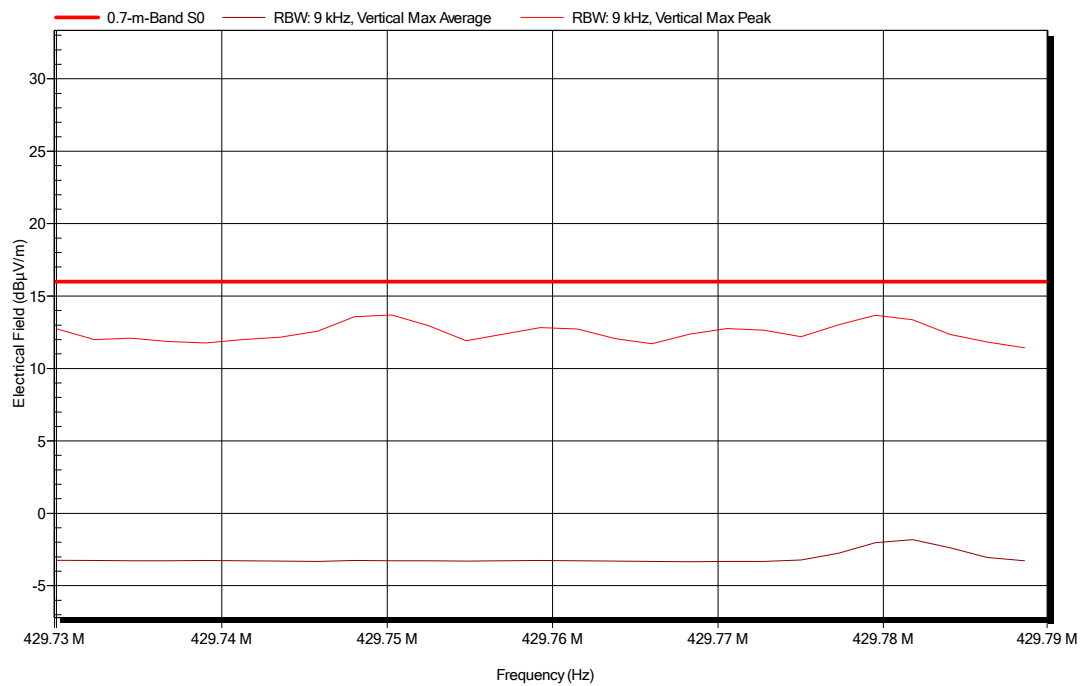
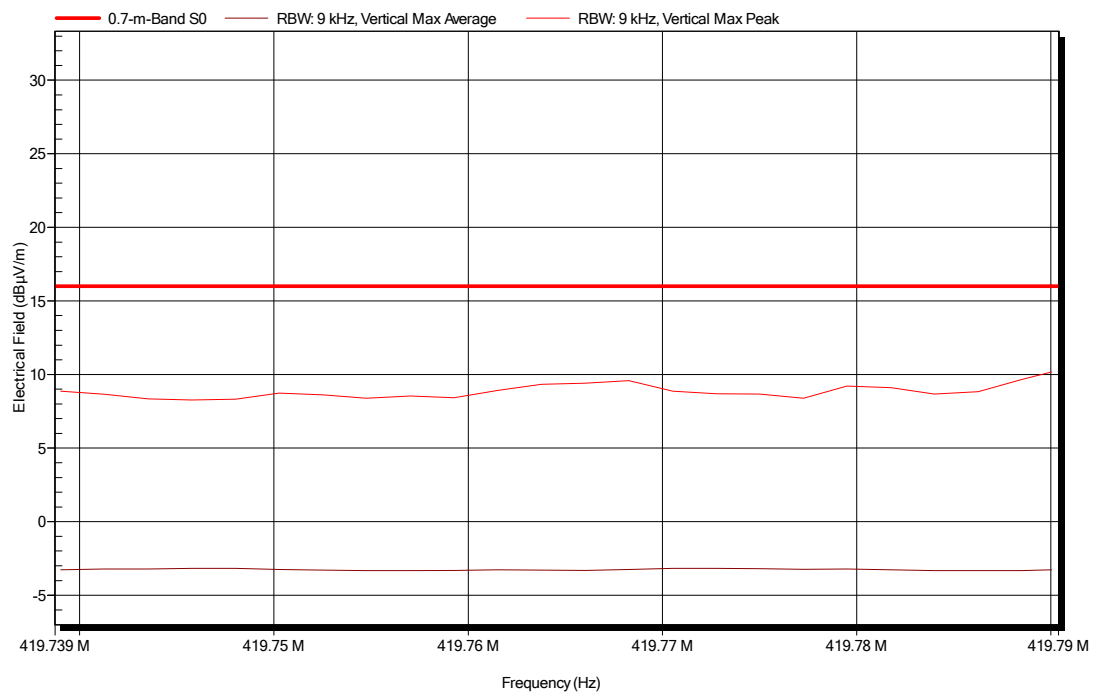
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Status	Angle	Height	Polarization
1	874.998 MHz	27.03 dBμV/m	22.7 dBμV/m	-12.3 dB	Pass	0 Degree	1.2 m	Horizontal



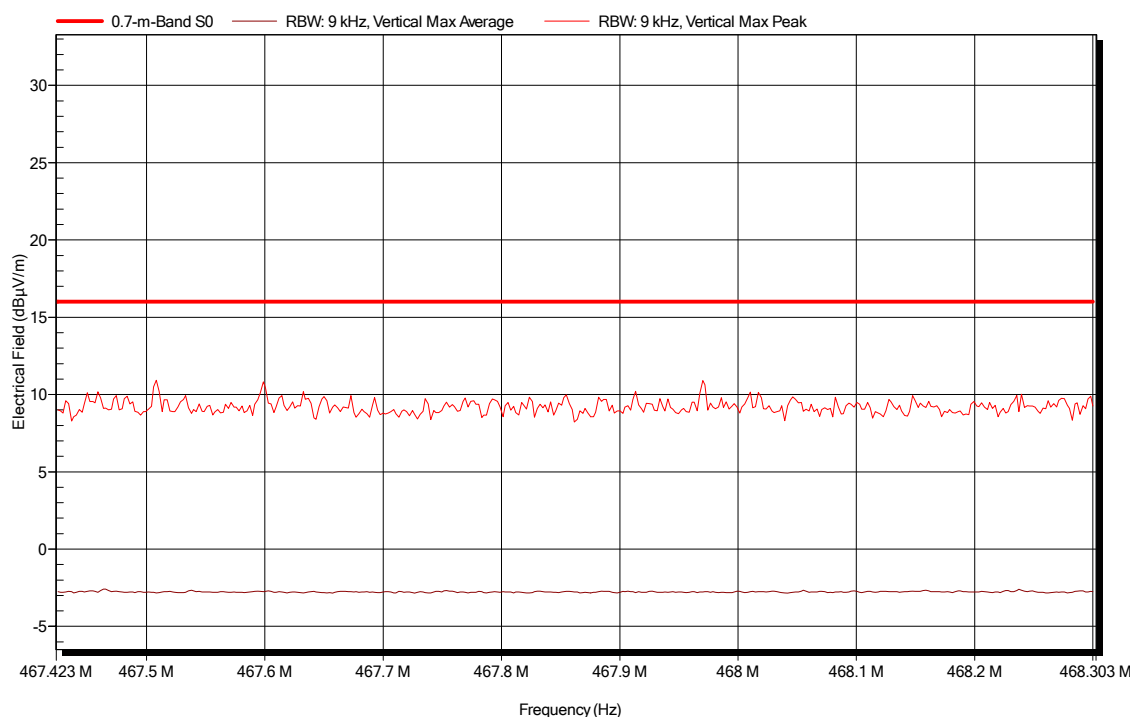
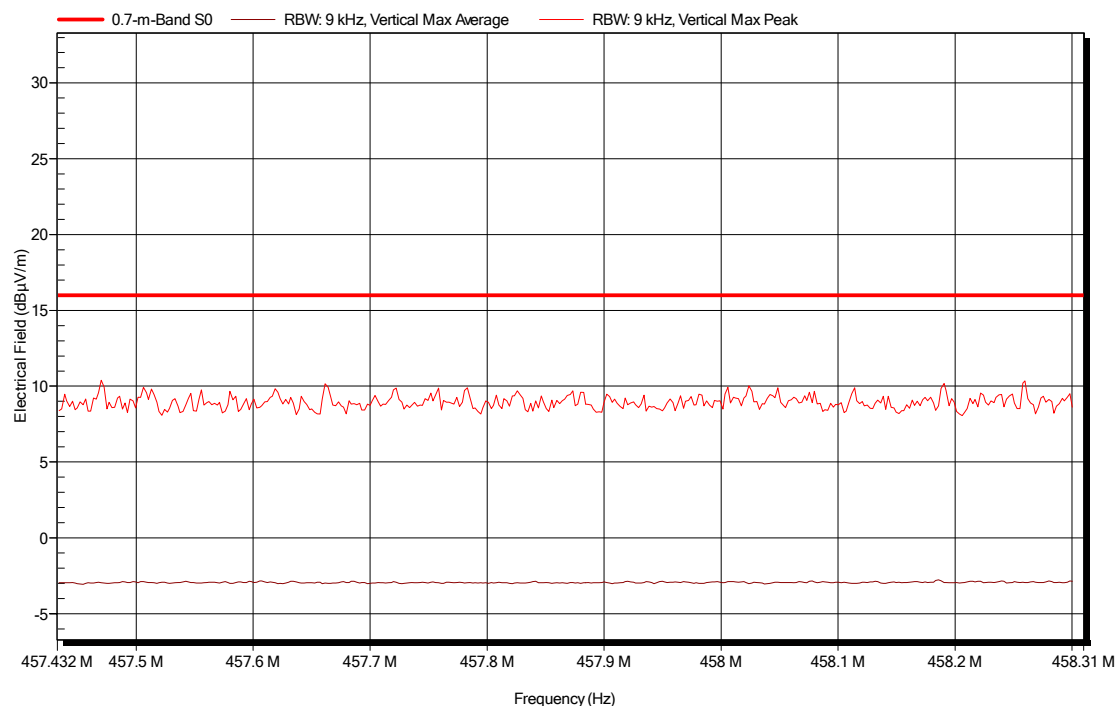
## Measurement 18:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 24 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 13:49:38		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Vertical
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



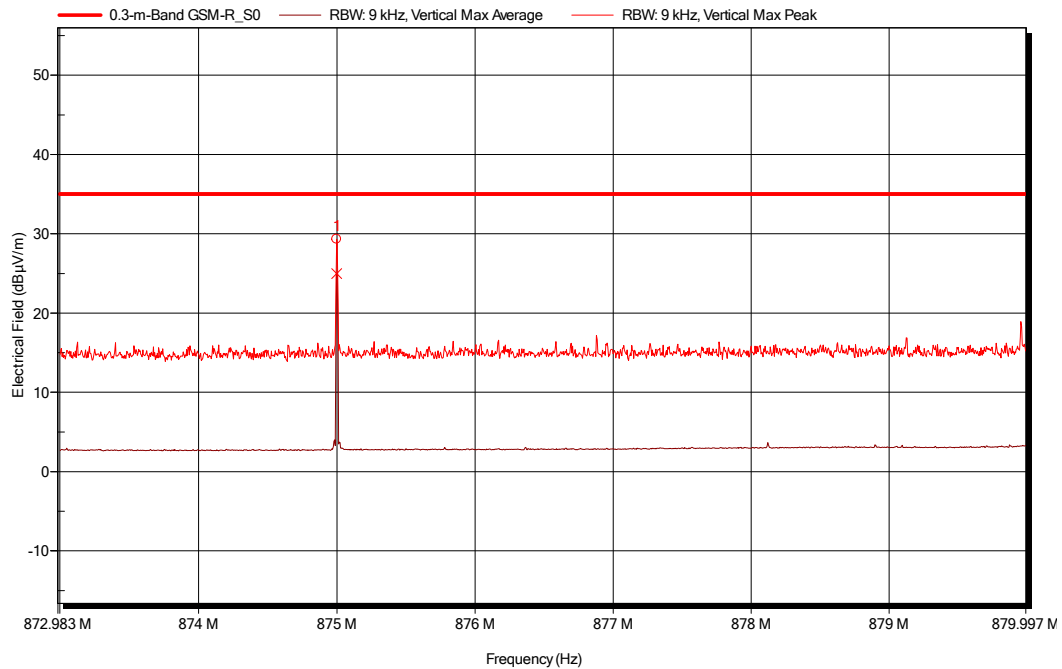
## Measurement 19:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 24 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 13:59:38		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Vertical
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



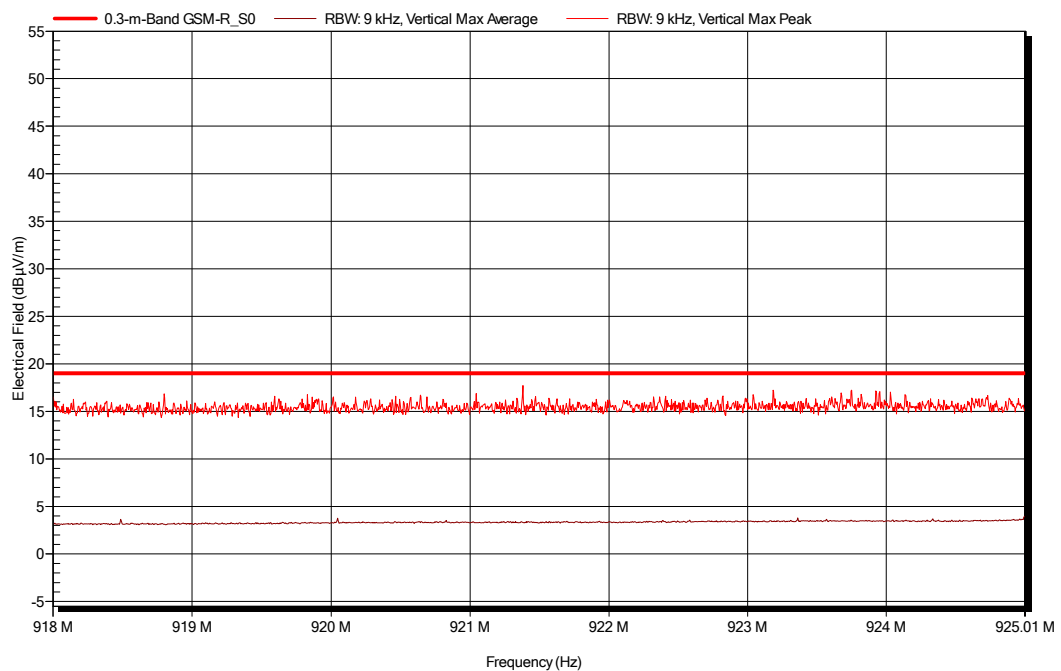
## Measurement 20:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 24 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 14:19:57		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Vertical
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



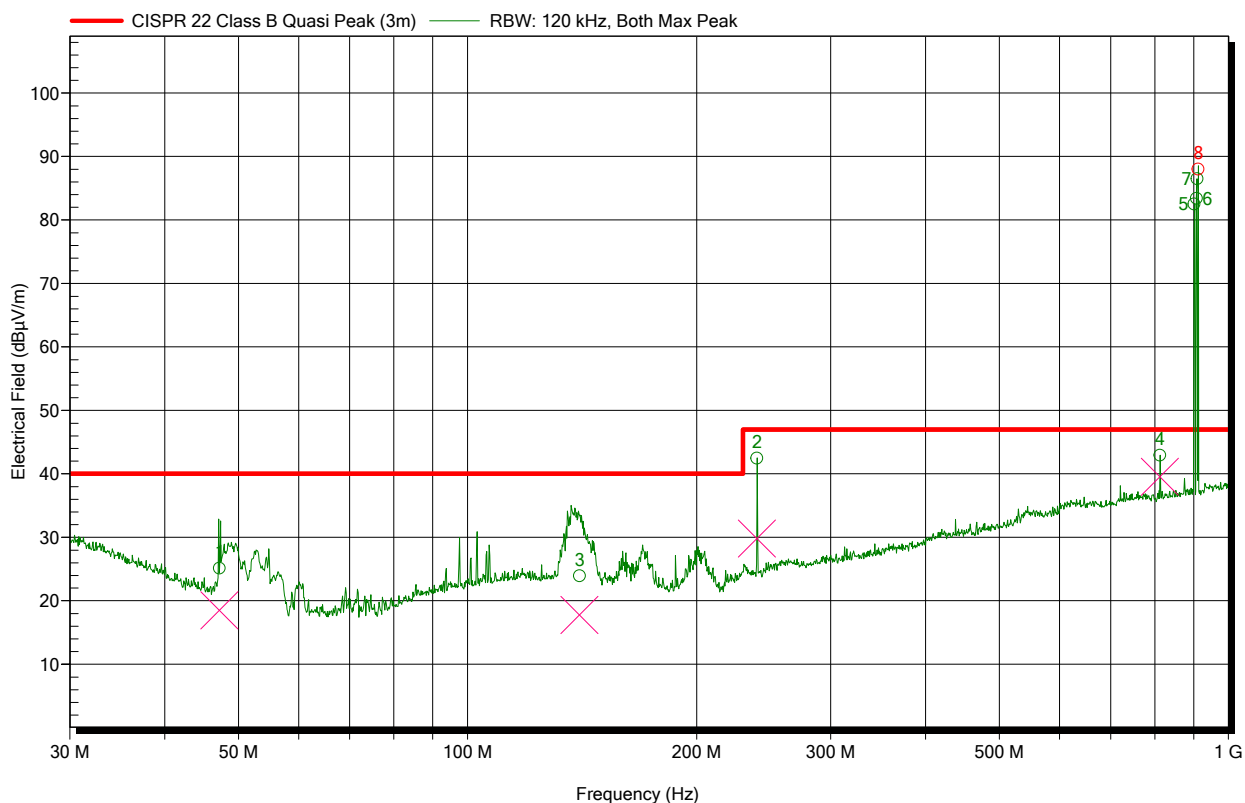
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Status	Angle	Height	Polarization
1	874.998 MHz	29.3 dBμV/m	24.97 dBμV/m	-10.03 dB	Pass	180 Degree	1.2 m	Vertical



## Measurement 21:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B		
<b>Mode of operation</b>	normal mode 72 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 14:00:15		
<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: 2015.1.11, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: 10 dB, Internal preamp: 20 dB, Measure time: 10 ms		



## Detected peaks

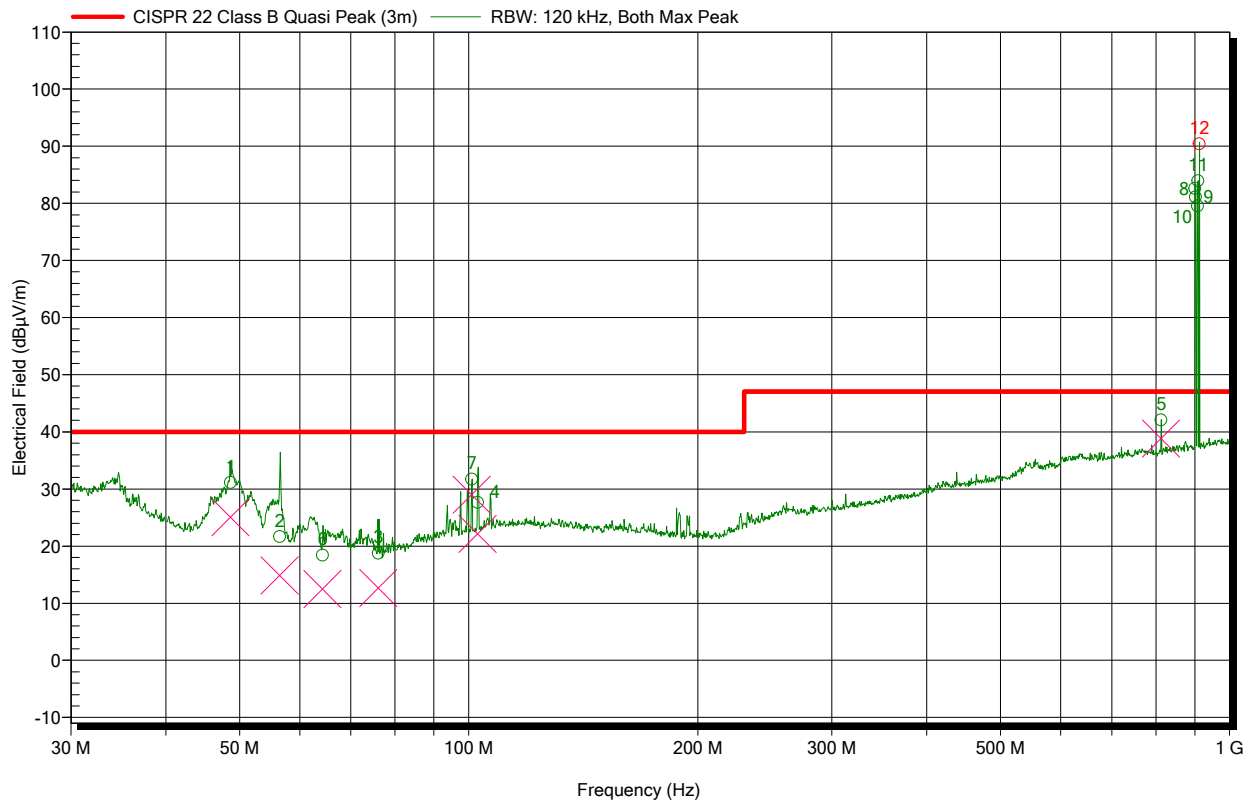
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	47.19 MHz	25.16 dBµV/m	18.49 dBµV/m	-21.51 dB	Pass	240 Degree	1 m	Vertical
2	240 MHz	42.51 dBµV/m	29.8 dBµV/m	-17.2 dB	Pass	180 Degree	1 m	Vertical
3	140.34 MHz	23.93 dBµV/m	17.76 dBµV/m	-22.24 dB	Pass	150 Degree	1 m	Vertical
4	812.49 MHz	42.93 dBµV/m	39.58 dBµV/m	-7.42 dB	Pass	120 Degree	1 m	Horizontal
5	901.41 MHz	82.54 dBµV/m	--	--	N/A 1)	120 Degree	1 m	Vertical
6	907.59 MHz	83.45 dBµV/m	--	--	N/A 1)	90 Degree	1 m	Vertical
7	909 MHz	86.5 dBµV/m	--	--	N/A 1)	300 Degree	1 m	Vertical
8	911.79 MHz	88.01 dBµV/m	--	--	N/A 1)	240 Degree	1 m	Vertical

## Notes:

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

## Measurement 22:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B		
<b>Mode of operation</b>	normal mode 110 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 13:09:49		
<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: 2015.1.11, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: 10 dB, Internal preamp: 20 dB, Measure time: 10 ms		



## Detected peaks

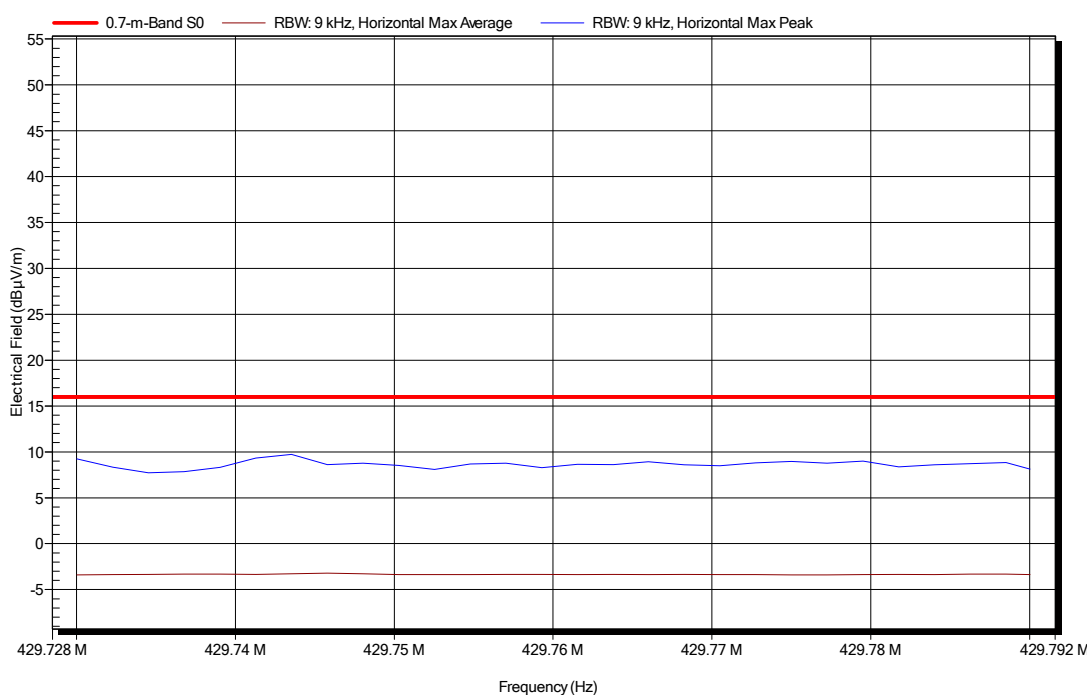
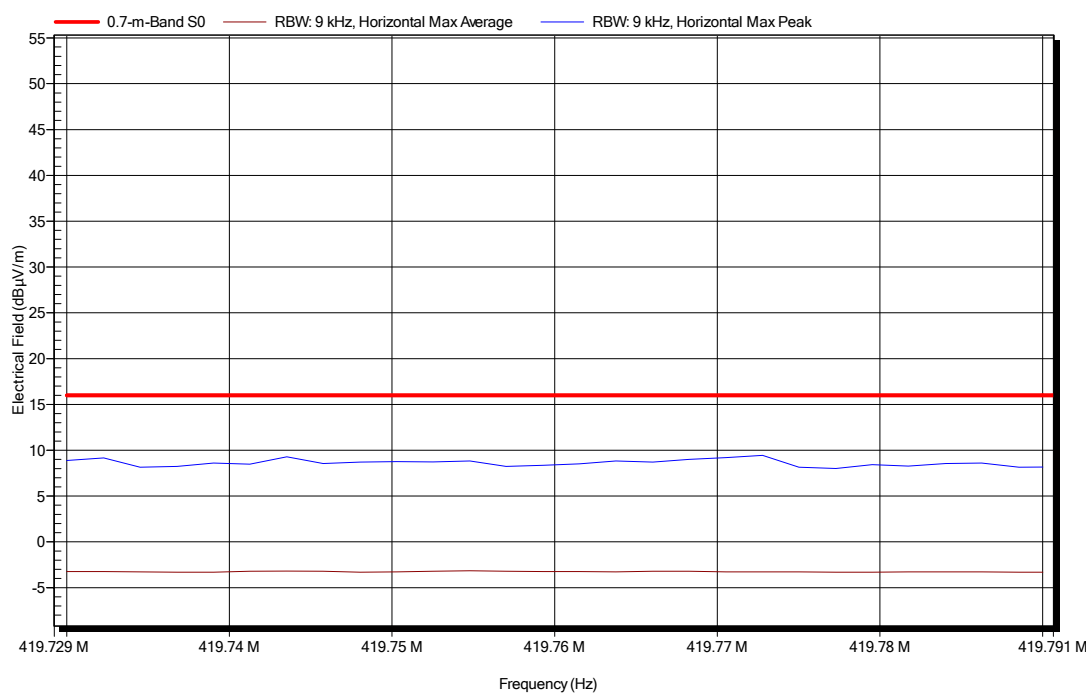
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	48.63 MHz	31.17 dBμV/m	25.01 dBμV/m	-14.99 dB	Pass	300 Degree	1 m	Vertical
2	56.43 MHz	21.64 dBμV/m	14.84 dBμV/m	-25.16 dB	Pass	330 Degree	1 m	Vertical
3	76.08 MHz	18.77 dBμV/m	12.65 dBμV/m	-27.35 dB	Pass	330 Degree	2 m	Horizontal
4	102.78 MHz	27.63 dBμV/m	22.15 dBμV/m	-17.85 dB	Pass	210 Degree	1 m	Vertical
5	812.49 MHz	42.1 dBμV/m	38.85 dBμV/m	-8.15 dB	Pass	120 Degree	1 m	Horizontal
6	64.23 MHz	18.42 dBμV/m	12.49 dBμV/m	-27.51 dB	Pass	330 Degree	1 m	Horizontal
7	100.92 MHz	31.71 dBμV/m	29 dBμV/m	-11 dB	Pass	300 Degree	1 m	Vertical
8	900.39 MHz	82.65 dBμV/m	--	--	N/A 1)	150 Degree	2 m	Horizontal
9	902.19 MHz	81.09 dBμV/m	--	--	N/A 1)	90 Degree	1 m	Horizontal
10	907.8 MHz	79.57 dBμV/m	--	--	N/A 1)	0 Degree	1 m	Horizontal
11	908.79 MHz	83.98 dBμV/m	--	--	N/A 1)	120 Degree	1 m	Vertical
12	911.79 MHz	90.4 dBμV/m	--	--	N/A 1)	270 Degree	1 m	Vertical

## Notes:

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

## Measurement 23:

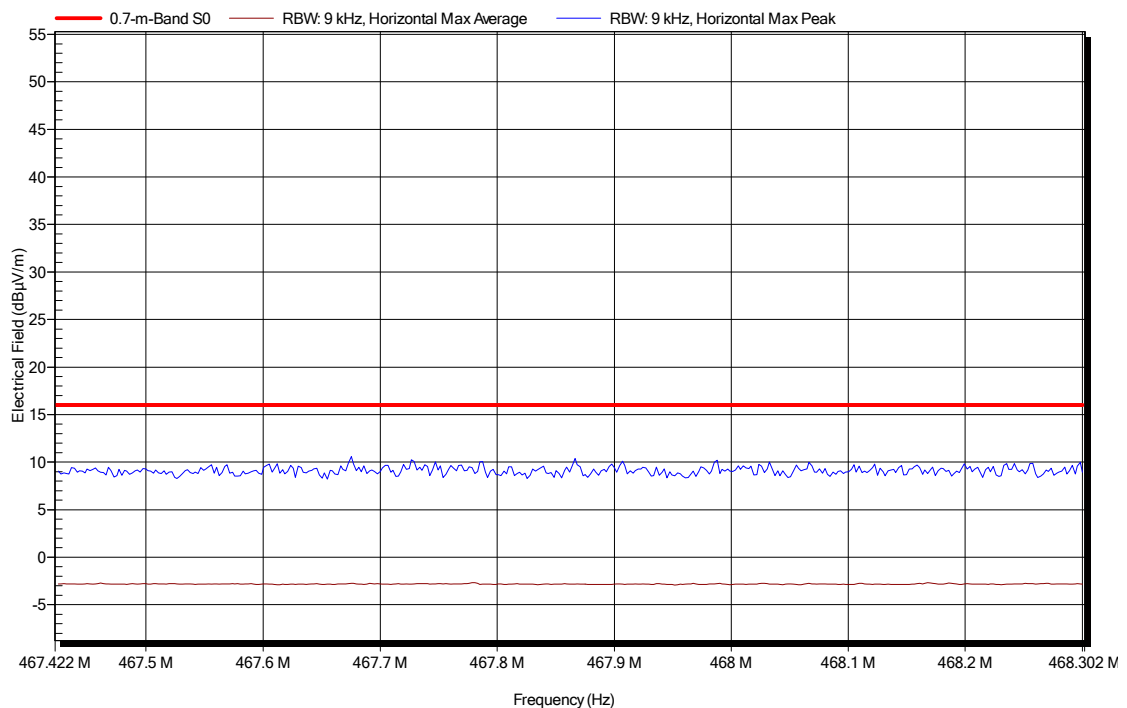
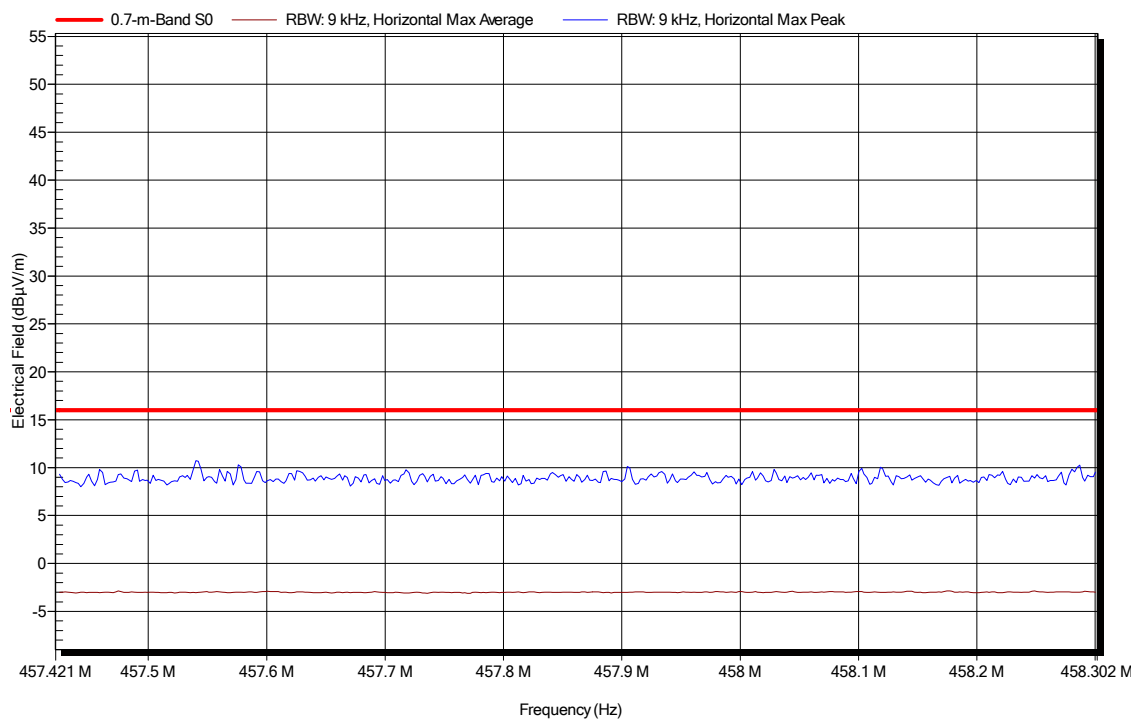
<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 110 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 13:25:39		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Horizontal
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		





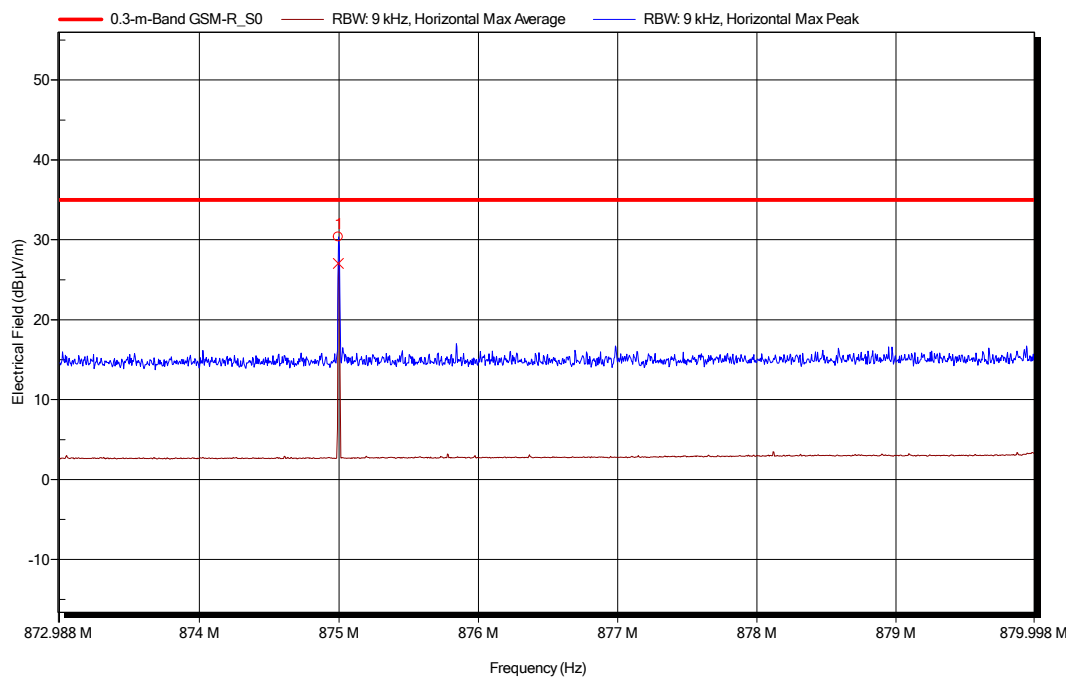
## Measurement 24:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 110 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 13:25:39		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Horizontal
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



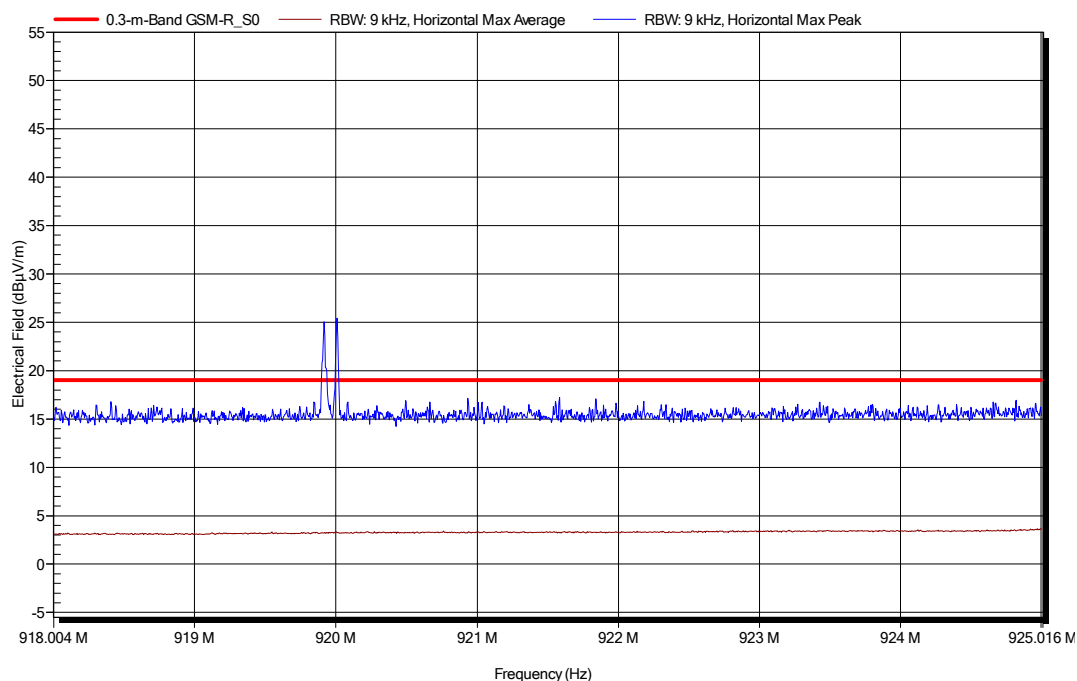
## Measurement 25:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 110 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 13:25:39		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Horizontal
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



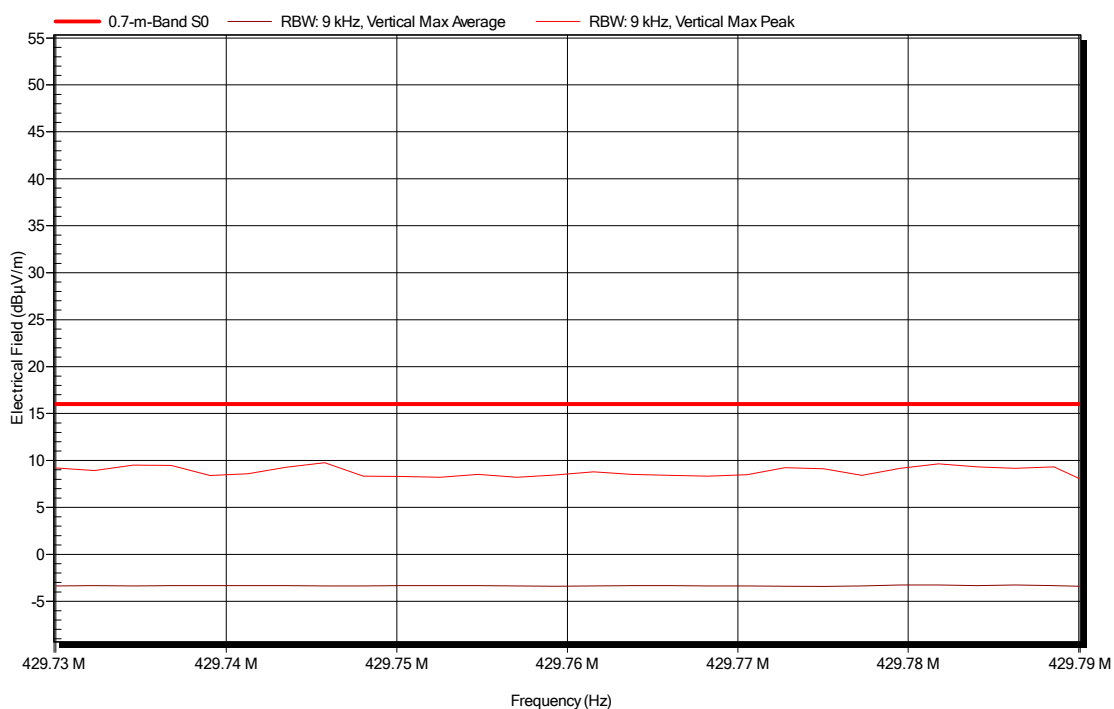
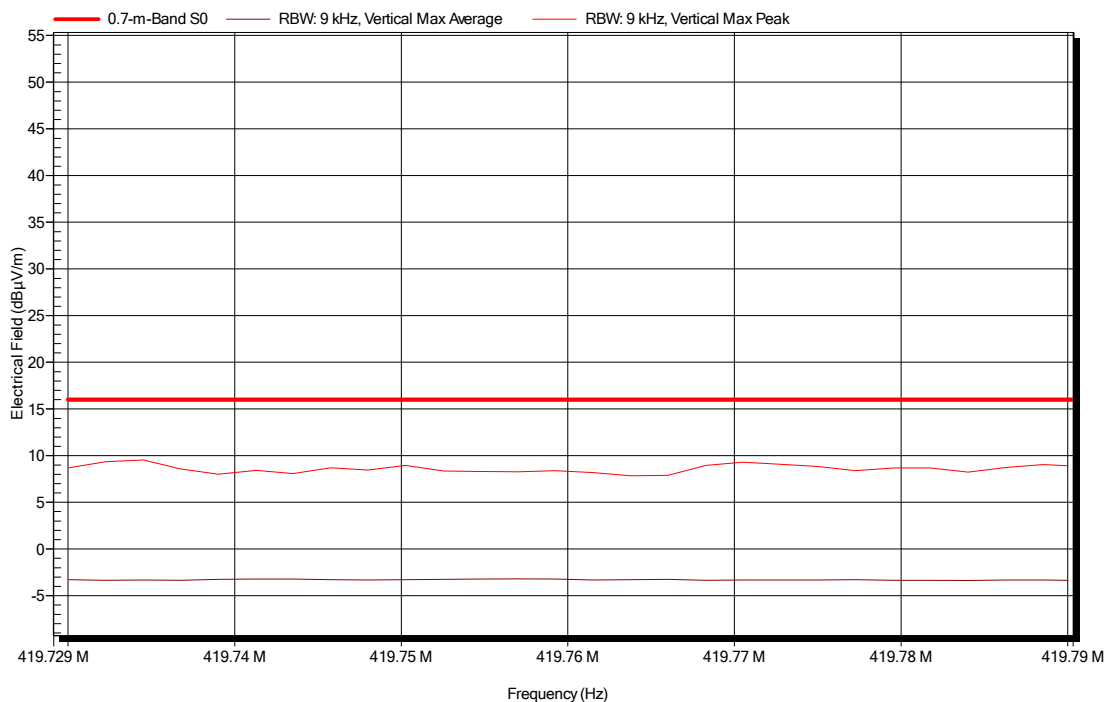
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Status	Angle	Height	Polarization
1	874.996 MHz	30.36 dBμV/m	27.05 dBμV/m	-7.95 dB	Pass	90 Degree	1.2 m	Horizontal



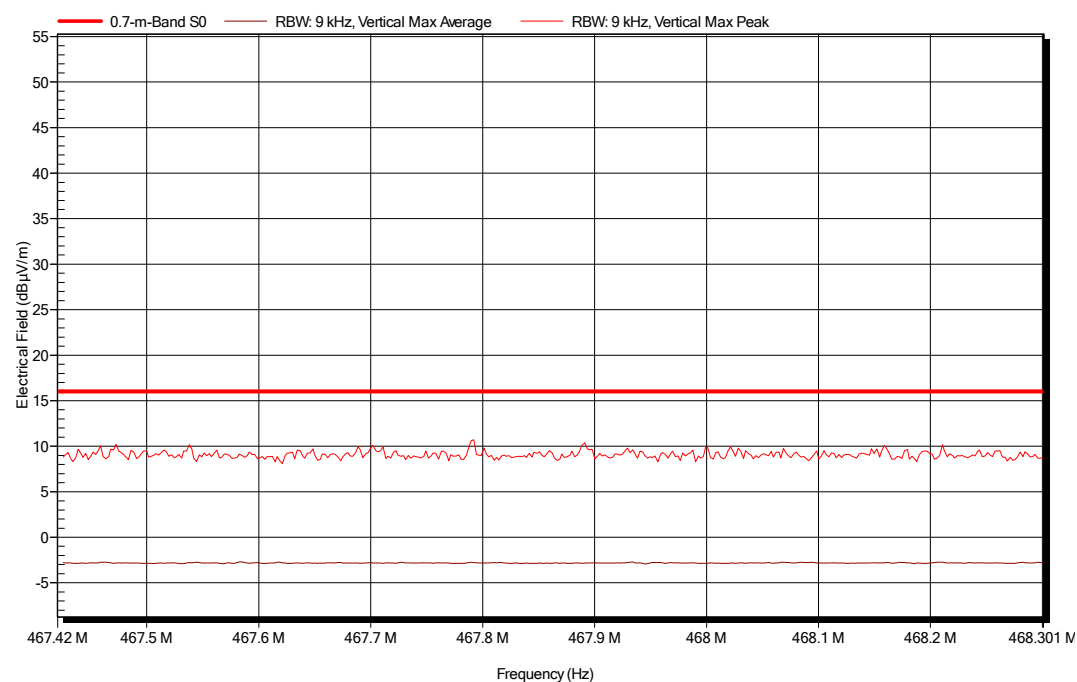
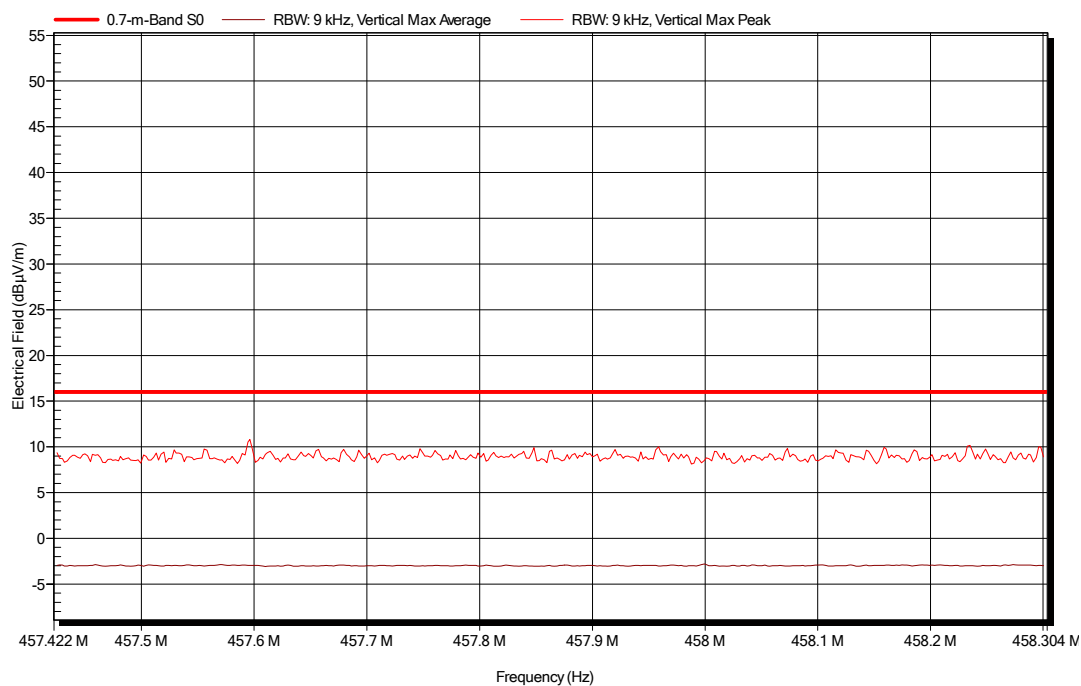
## Measurement 26:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 110 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 13:38:03		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Vertical
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



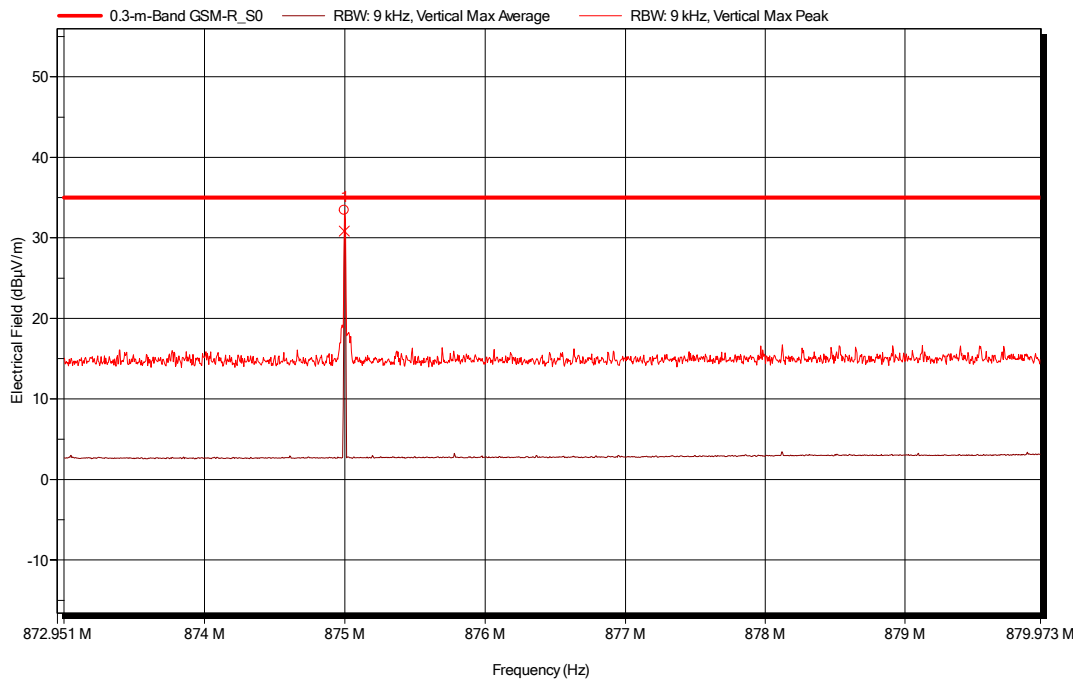
## Measurement 27:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 110 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 13:38:03		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Vertical
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



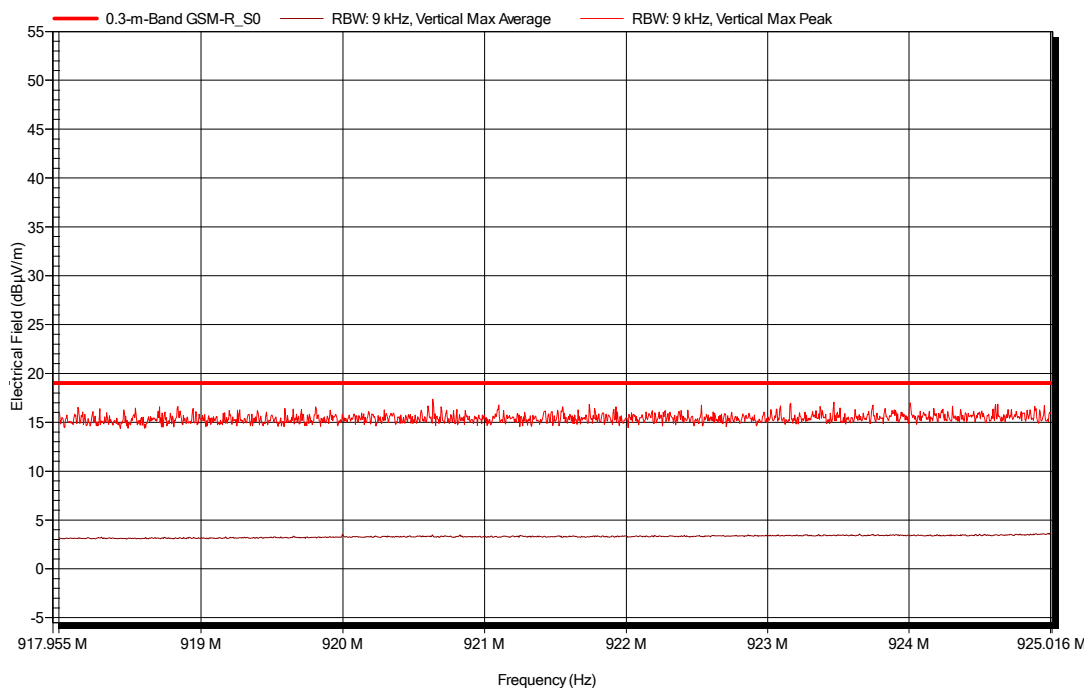
## Measurement 28:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, EMV06		
<b>Mode of operation</b>	normal mode 110 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 13:38:03		
<b>Antenna height</b>	1.2 m	<b>Antenna polarization</b>	Vertical
<b>EUT position</b>	0 Degree to 270 Degree	<b>Antenna distance</b>	3 m
<b>Measurement settings</b>	Radimation Version: 2015.1.11, RBW: 9 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 2.25 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 500 ms		



## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Status	Angle	Height	Polarization
1	874.996 MHz	33.43 dBμV/m	30.86 dBμV/m	-4.14 dB	Pass	0 Degree	1.2 m	Vertical



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

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

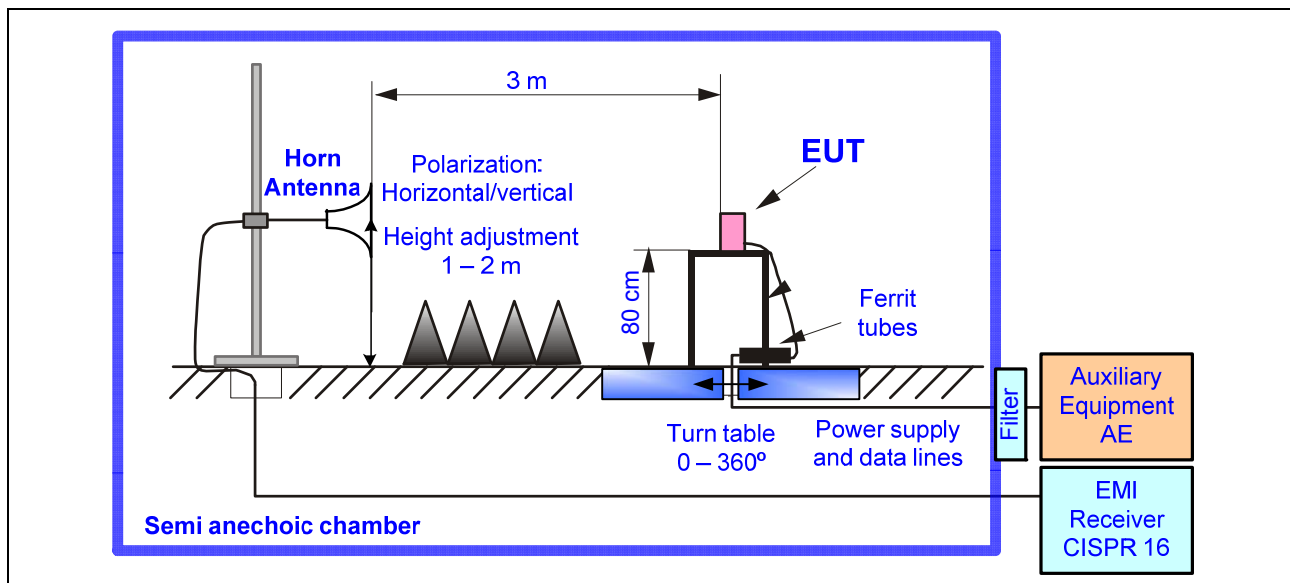
**Distance:** 3 m

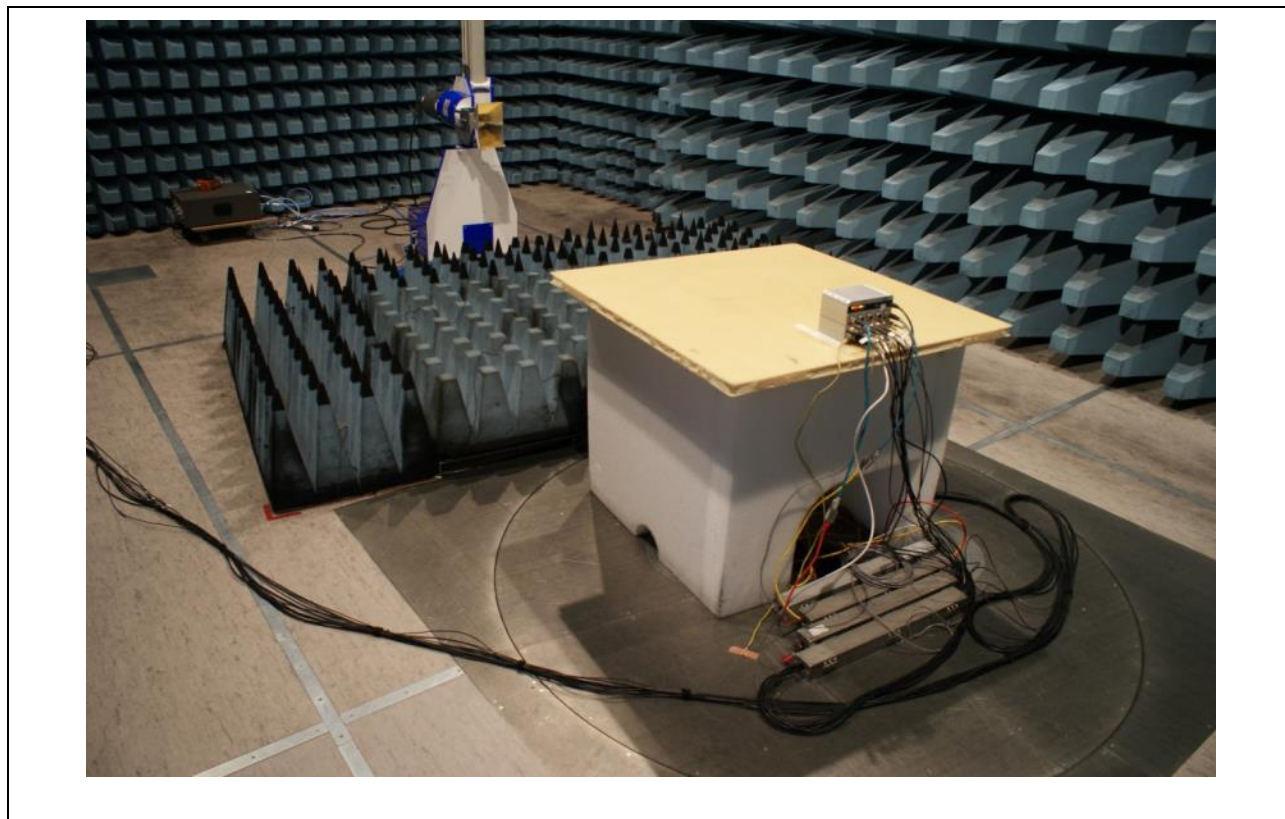
**Meas. uncertainty:** see chapter 15

**Measuring method:** The electromagnetic disturbance radiated by the equipment is measured using an 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



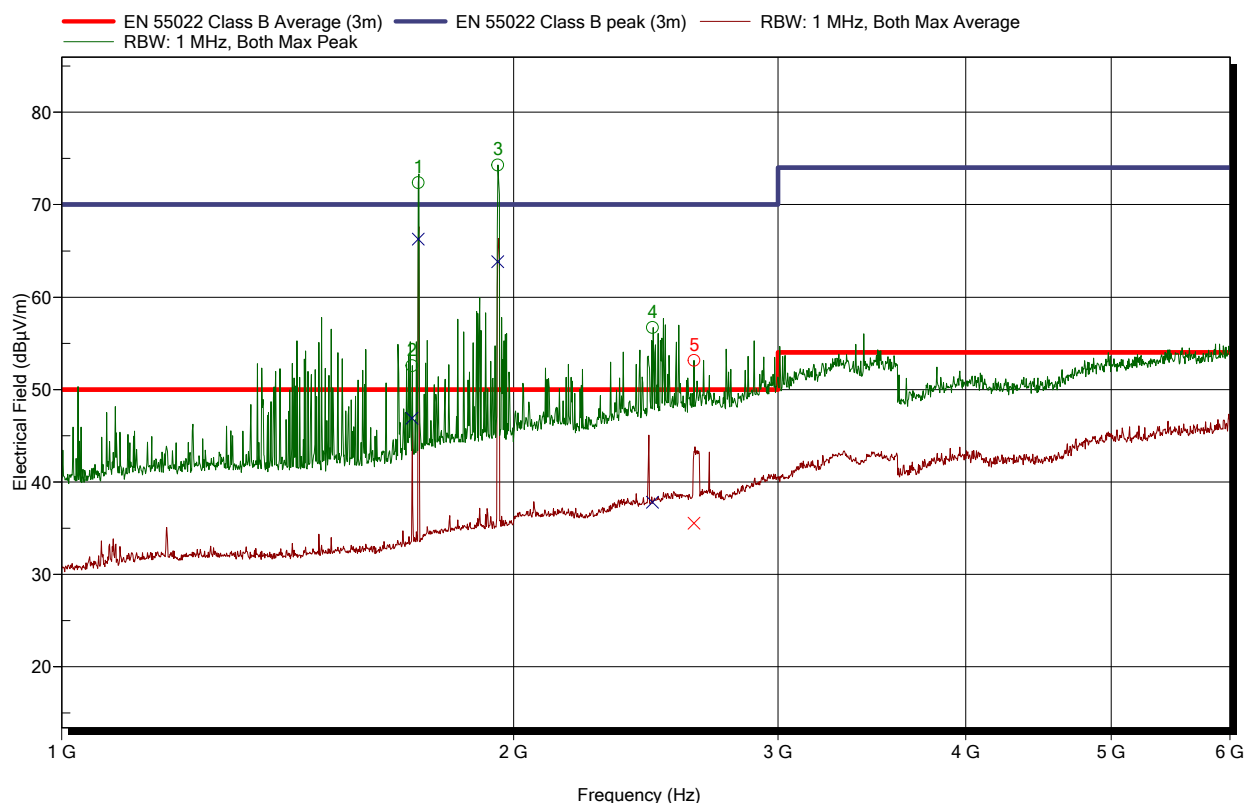
**Photo of the Setup****Test Equipment**

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

## Measurement Results

Measurement 29:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B		
<b>Mode of operation</b>	Normal mode, 24 VDC		
<b>Test date, time</b>	16.09.2016 18:04:16		
<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: 2015.1.11, RBW: 1 MHz, VBW: 1 MHz, Sweep time: 100 ms, Step freq: Fixed step count: 9 * 1e+3 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	Height	Polarization
1	1.728 GHz	72.39 dBµV/m	--	66.28 dBµV/m	--	N/A 1)	30 Degree	1 m	Horizontal
2	1.711 GHz	52.58 dBµV/m	-17.42 dB	46.89 dBµV/m	-3.11 dB	Pass	30 Degree	1 m	Horizontal
3	1.952 GHz	74.29 dBµV/m	--	63.84 dBµV/m	--	N/A 1)	120 Degree	1 m	Vertical
4	2.475 GHz	56.72 dBµV/m	--	37.79 dBµV/m	--	N/A 2)	60 Degree	1 m	Horizontal
5	2.637 GHz	53.17 dBµV/m	-16.83 dB	35.54 dBµV/m	-14.46 dB	Pass	210 Degree	1 m	Vertical

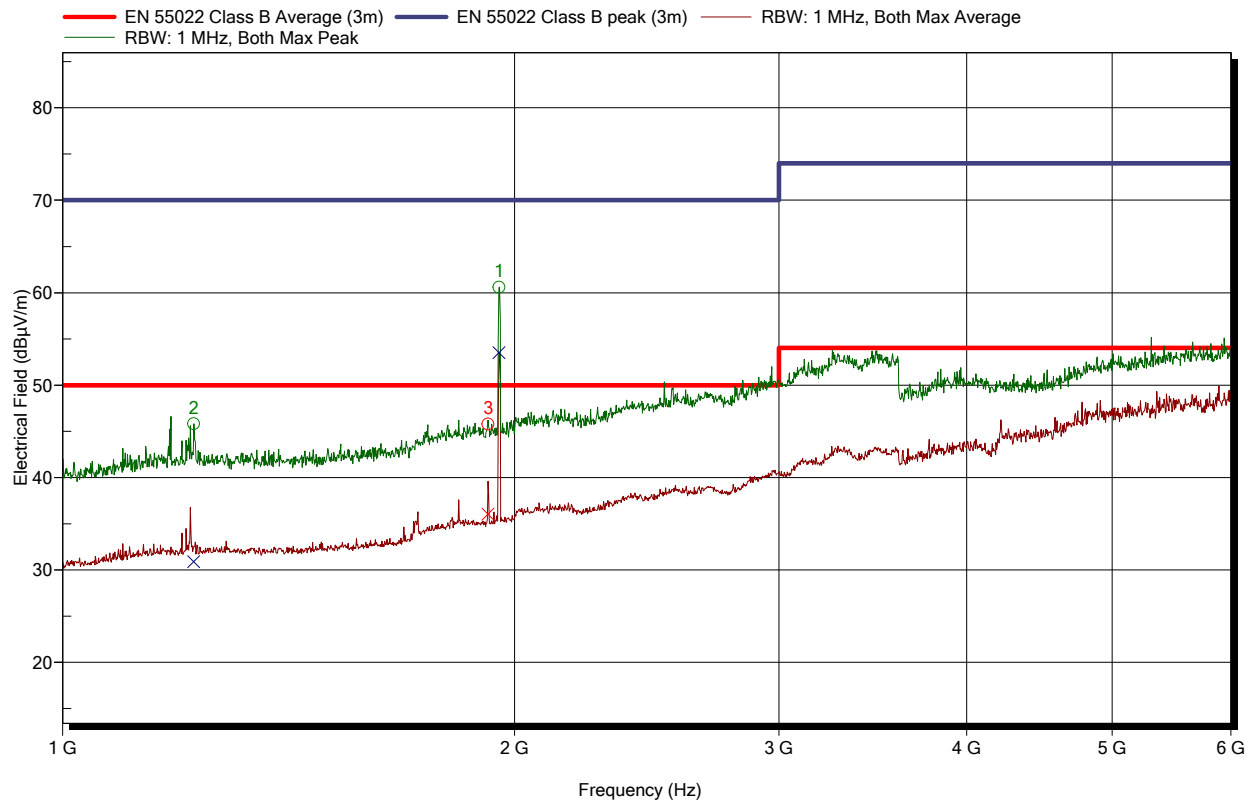
Notes:

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



## Measurement 30:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	PASS, CISPR 22 / 32 Class B		
<b>Mode of operation</b>	Normal mode, 110 VDC		
<b>Test date, time</b>	19.09.2016 12:19:21		
<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: 2015.1.11, RBW: 1 MHz, VBW: 1 MHz, Sweep time: Auto [35 ms], Step freq: Fixed step count: 9 * 1e+3 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	Height	Polarization
1	1.953 GHz	60.59 dBµV/m	--	53.5 dBµV/m	--	N/A 1)	330 Degree	1 m	Horizontal
2	1.222 GHz	45.83 dBµV/m	-24.17 dB	30.91 dBµV/m	-19.09 dB	Pass	120 Degree	1 m	Horizontal
3	1.92 GHz	45.8 dBµV/m	-24.2 dB	36.05 dBµV/m	-13.95 dB	Pass	0 Degree	1 m	Vertical

## Notes:

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

### 13.6 Radiated Emission - Electromagnetic Field – FCC (30 – 1000 MHz)

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

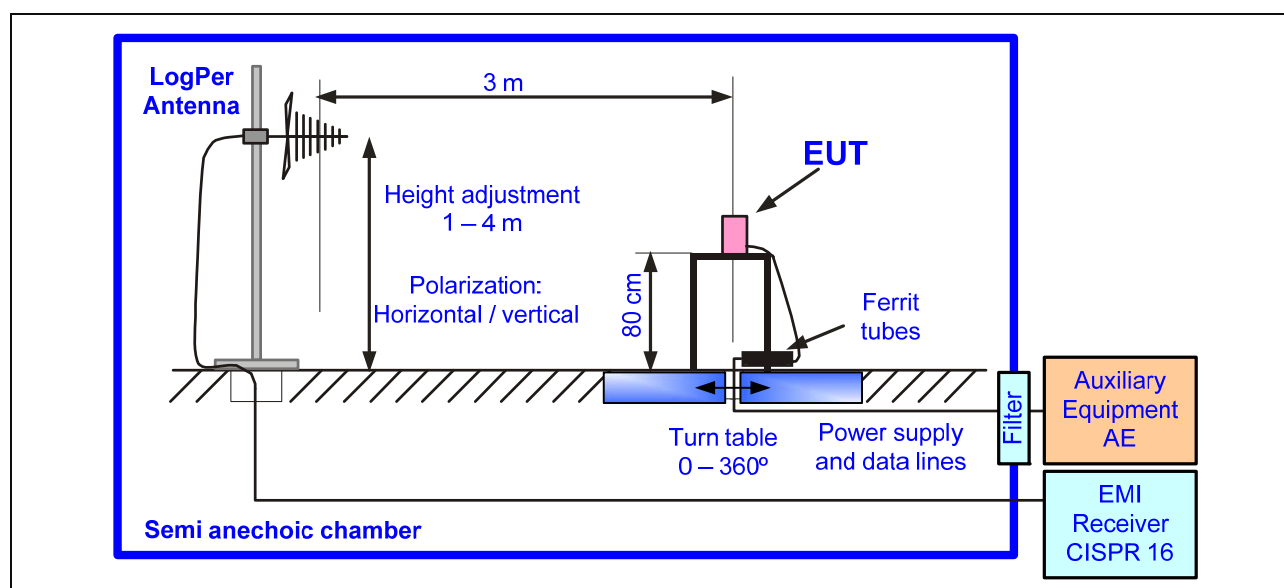
**Distance:** 3 m

**Meas. uncertainty:** see chapter 15

**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 using a receiver.

None

#### Test Setup



#### Photo of the Setup

see chapter 13.4

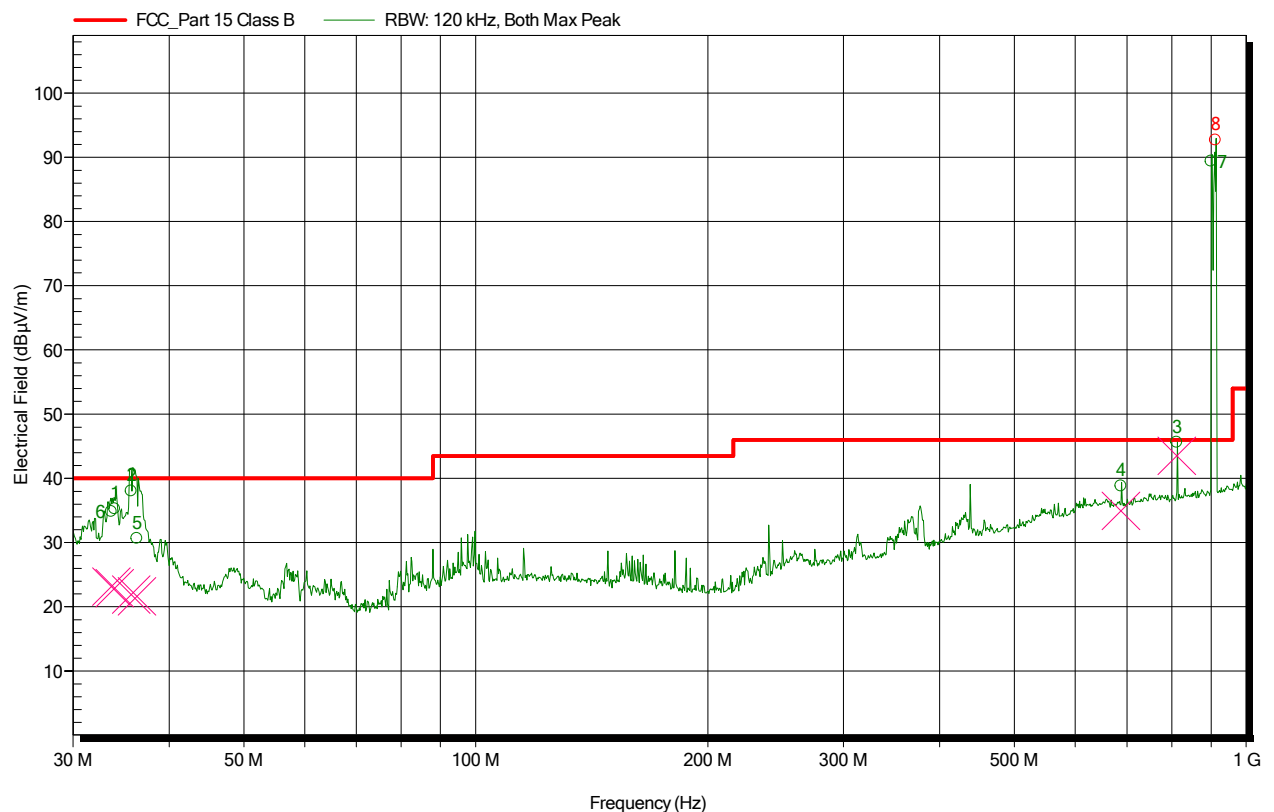
#### Test Equipment

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

## Measurement Results

Measurement 31:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode 24 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 13:24:45		
<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: 2015.1.11, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: 10 dB, Internal preamp: 20 dB, Measure time: 20 ms		



### Detected peaks

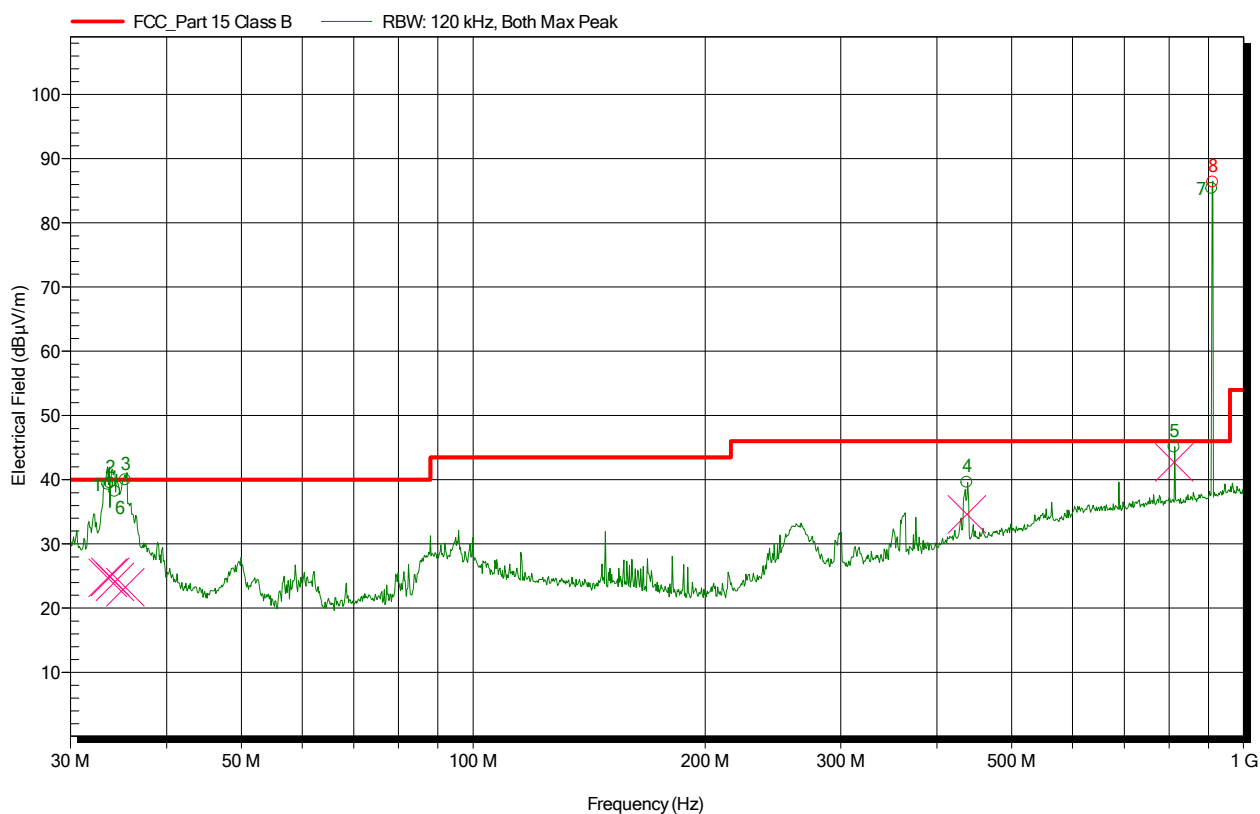
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	33.99 MHz	35.25 dBμV/m	22.93 dBμV/m	-17.07 dB	Pass	90 Degree	1 m	Vertical
2	35.73 MHz	38.05 dBμV/m	21.93 dBμV/m	-18.07 dB	Pass	90 Degree	1 m	Vertical
3	812.49 MHz	45.61 dBμV/m	43.51 dBμV/m	-2.49 dB	Pass	300 Degree	1 m	Horizontal
4	687.51 MHz	38.83 dBμV/m	34.96 dBμV/m	-11.04 dB	Pass	330 Degree	1 m	Vertical
5	36.33 MHz	30.65 dBμV/m	21.64 dBμV/m	-18.36 dB	Pass	90 Degree	1 m	Vertical
6	33.66 MHz	34.82 dBμV/m	23.14 dBμV/m	-16.86 dB	Pass	90 Degree	1 m	Vertical
7	900.12 MHz	89.4 dBμV/m	--	--	N/A 1)	210 Degree	1.6 m	Horizontal
8	912.45 MHz	92.69 dBμV/m	--	--	N/A 1)	240 Degree	1 m	Vertical

Note:

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

## Measurement 32:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode 60 VDC; all cables connected		
<b>Test date, time</b>	16.09.2016 14:49:18		
<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: 2015.1.11, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: 10 dB, Internal preamp: 20 dB, Measure time: 10 ms		



## Detected peaks

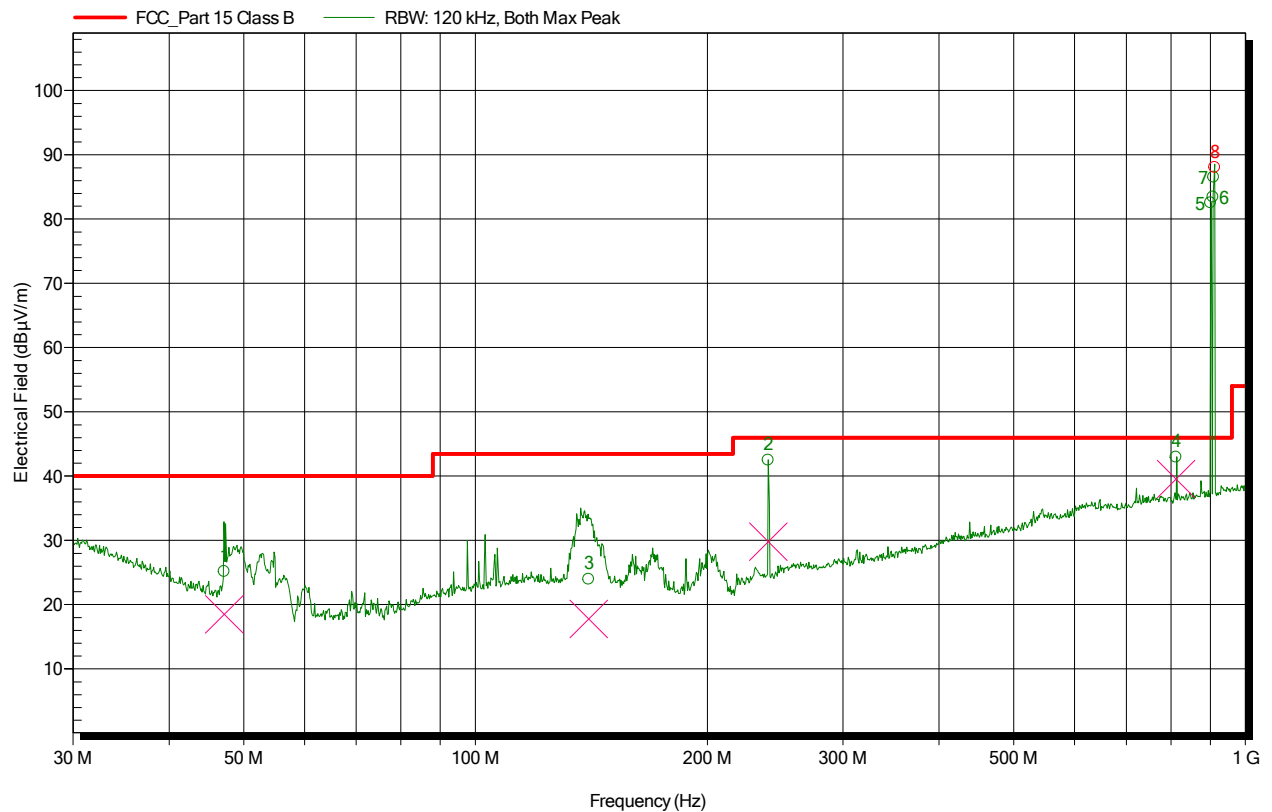
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	33.57 MHz	39.27 dBμV/m	24.73 dBμV/m	-15.27 dB	Pass	30 Degree	1 m	Vertical
2	33.78 MHz	39.48 dBμV/m	24.9 dBμV/m	-15.1 dB	Pass	30 Degree	1 m	Vertical
3	35.37 MHz	39.97 dBμV/m	23.28 dBμV/m	-16.72 dB	Pass	30 Degree	1 m	Vertical
4	437.49 MHz	39.58 dBμV/m	34.65 dBμV/m	-11.35 dB	Pass	300 Degree	1 m	Vertical
5	812.49 MHz	45.09 dBμV/m	42.68 dBμV/m	-3.32 dB	Pass	300 Degree	1 m	Horizontal
6	34.29 MHz	38.19 dBμV/m	24.11 dBμV/m	-15.89 dB	Pass	30 Degree	1 m	Vertical
7	909.72 MHz	85.34 dBμV/m	--	--	N/A 1)	150 Degree	1 m	Vertical
8	911.88 MHz	86.34 dBμV/m	--	--	N/A 1)	180 Degree	1 m	Vertical

## Notes:

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

## Measurement 33:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode 72 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 14:00:15		
<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: 2015.1.11, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: 10 dB, Internal preamp: 20 dB, Measure time: 10 ms		



## Detected peaks

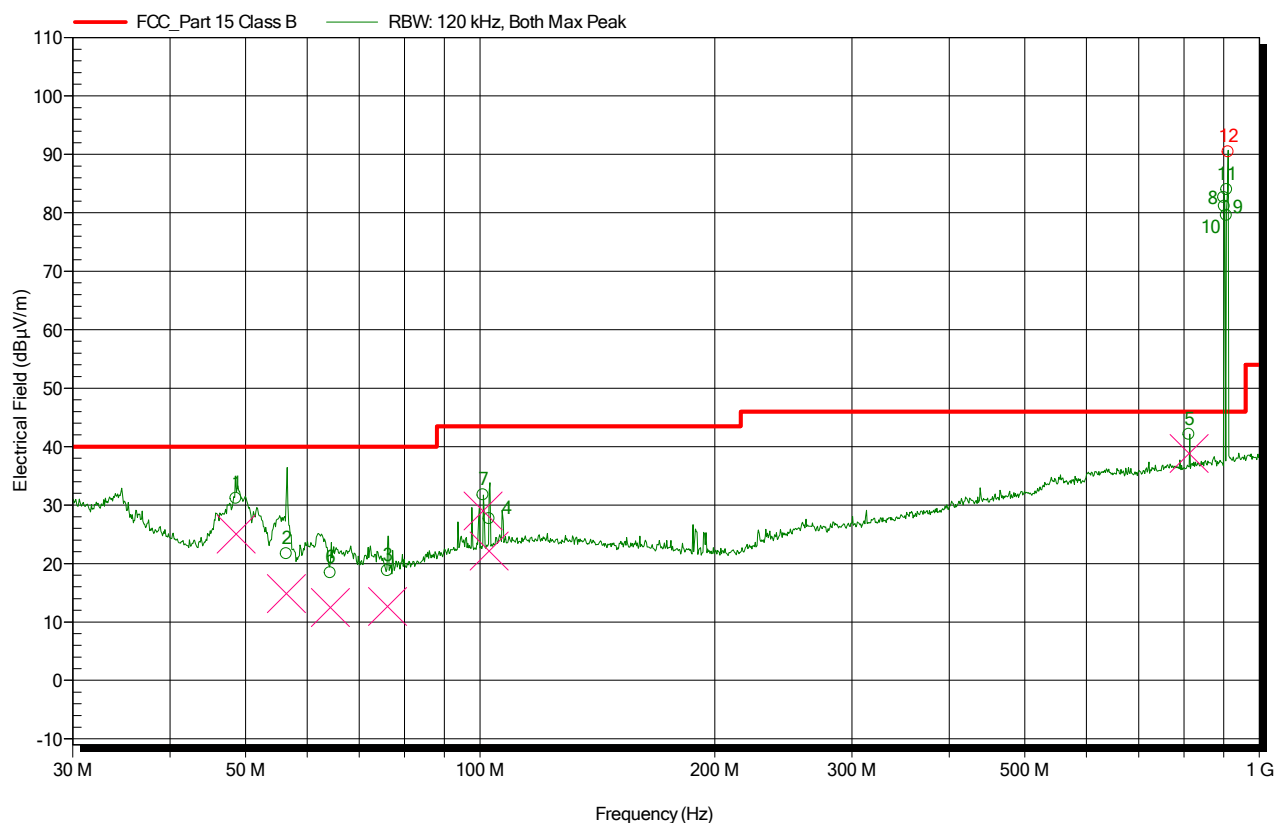
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	47.19 MHz	25.16 dBμV/m	18.49 dBμV/m	-21.51 dB	Pass	240 Degree	1 m	Vertical
2	240 MHz	42.51 dBμV/m	29.8 dBμV/m	-16.2 dB	Pass	180 Degree	1 m	Vertical
3	140.34 MHz	23.93 dBμV/m	17.76 dBμV/m	-25.74 dB	Pass	150 Degree	1 m	Vertical
4	812.49 MHz	42.93 dBμV/m	39.58 dBμV/m	-6.42 dB	Pass	120 Degree	1 m	Horizontal
5	901.41 MHz	82.54 dBμV/m	--	--	N/A 1)	120 Degree	1 m	Vertical
6	907.59 MHz	83.45 dBμV/m	--	--	N/A 1)	90 Degree	1 m	Vertical
7	909 MHz	86.5 dBμV/m	--	--	N/A 1)	300 Degree	1 m	Vertical
8	911.79 MHz	88.01 dBμV/m	--	--	N/A 1)	240 Degree	1 m	Vertical

## Notes:

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

## Measurement 34:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode 110 VDC; all cables connected		
<b>Test date, time</b>	19.09.2016 13:09:49		
<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: 2015.1.11, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: 10 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	48.63 MHz	31.17 dBμV/m	25.01 dBμV/m	-14.99 dB	Pass	300 Degree	1 m	Vertical
2	56.43 MHz	21.64 dBμV/m	14.84 dBμV/m	-25.16 dB	Pass	330 Degree	1 m	Vertical
3	76.08 MHz	18.77 dBμV/m	12.65 dBμV/m	-27.35 dB	Pass	330 Degree	2 m	Horizontal
4	102.78 MHz	27.63 dBμV/m	22.15 dBμV/m	-21.35 dB	Pass	210 Degree	1 m	Vertical
5	812.49 MHz	42.1 dBμV/m	38.85 dBμV/m	-7.15 dB	Pass	120 Degree	1 m	Horizontal
6	64.23 MHz	18.42 dBμV/m	12.49 dBμV/m	-27.51 dB	Pass	330 Degree	1 m	Horizontal
7	100.92 MHz	31.71 dBμV/m	29 dBμV/m	-14.5 dB	Pass	300 Degree	1 m	Vertical
8	900.39 MHz	82.65 dBμV/m	--	--	N/A 1)	150 Degree	2 m	Horizontal
9	902.19 MHz	81.09 dBμV/m	--	--	N/A 1)	90 Degree	1 m	Horizontal
10	907.8 MHz	79.57 dBμV/m	--	--	N/A 1)	0 Degree	1 m	Horizontal
11	908.79 MHz	83.98 dBμV/m	--	--	N/A 1)	120 Degree	1 m	Vertical
12	911.79 MHz	90.4 dBμV/m	--	--	N/A 1)	270 Degree	1 m	Vertical

## Notes:

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

### 13.7 Radiated Emission - Electromagnetic Field – FCC (1 – 18 GHz)

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

**Distance:** 3 m

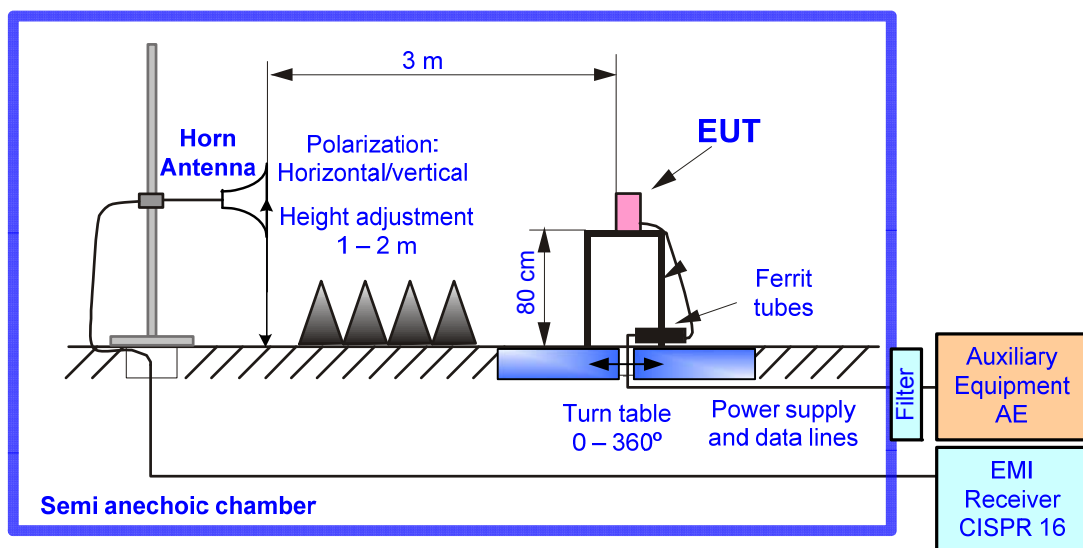
**Meas. uncertainty:** see chapter 15

**Measuring method:** 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 placed at 1 m in height. 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 average detector of the receiver.

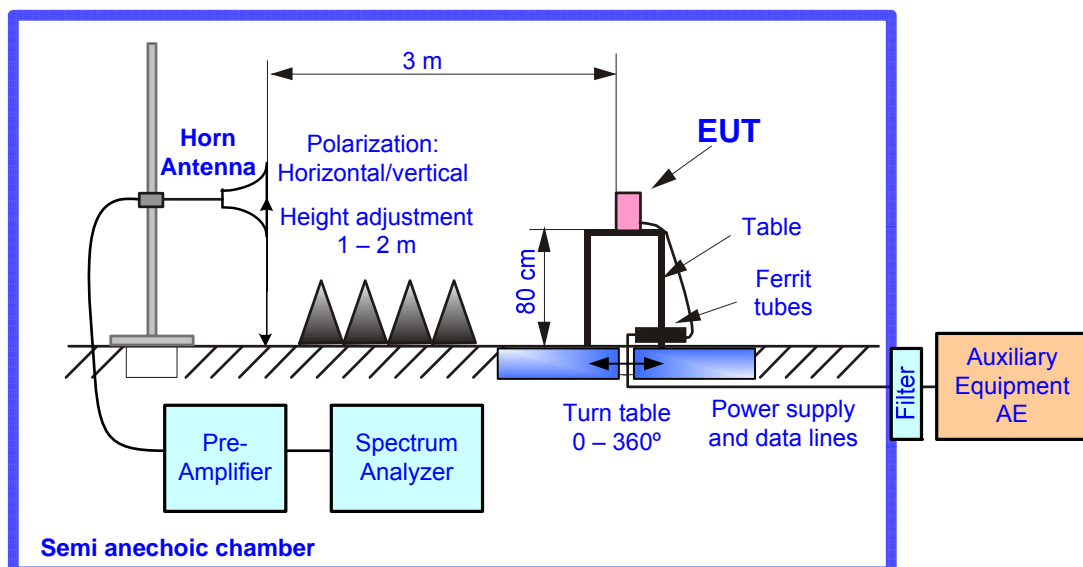
**Modifications:** none

#### Test Setup

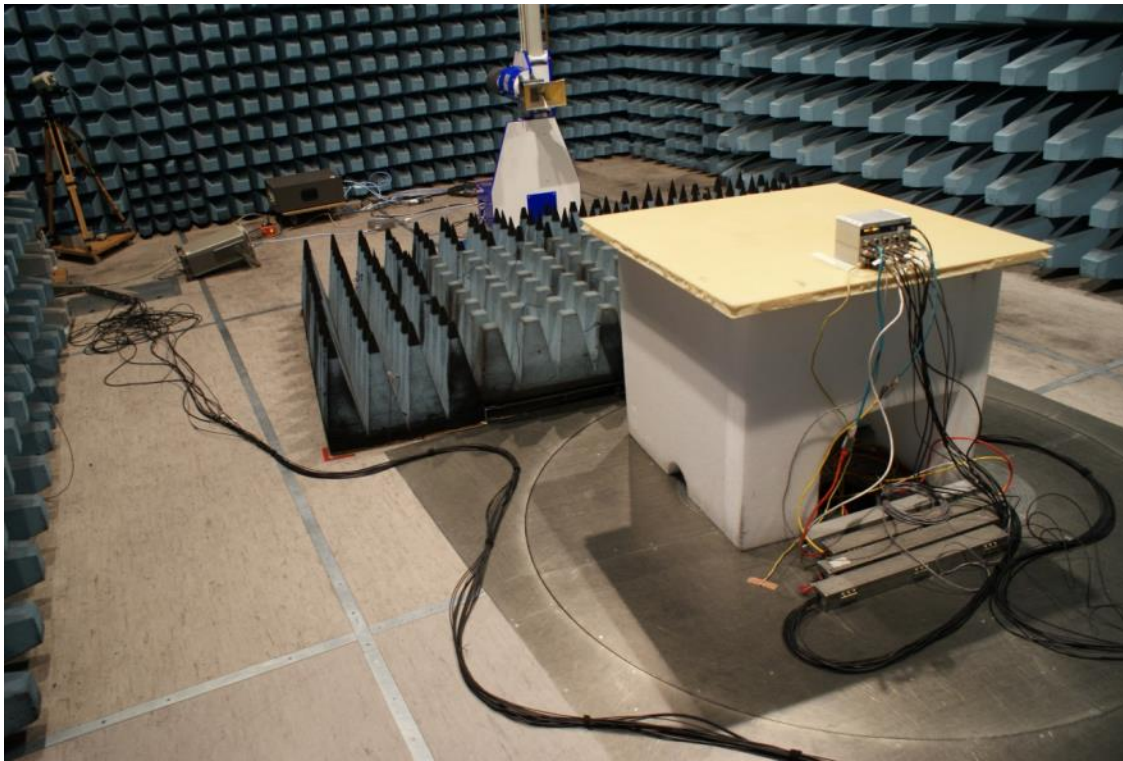
1 – 6 GHz:



6 – 18 GHz:



### Photo of the Setup



### Test Equipment 1 – 6 GHz

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 6 – 18 GHz

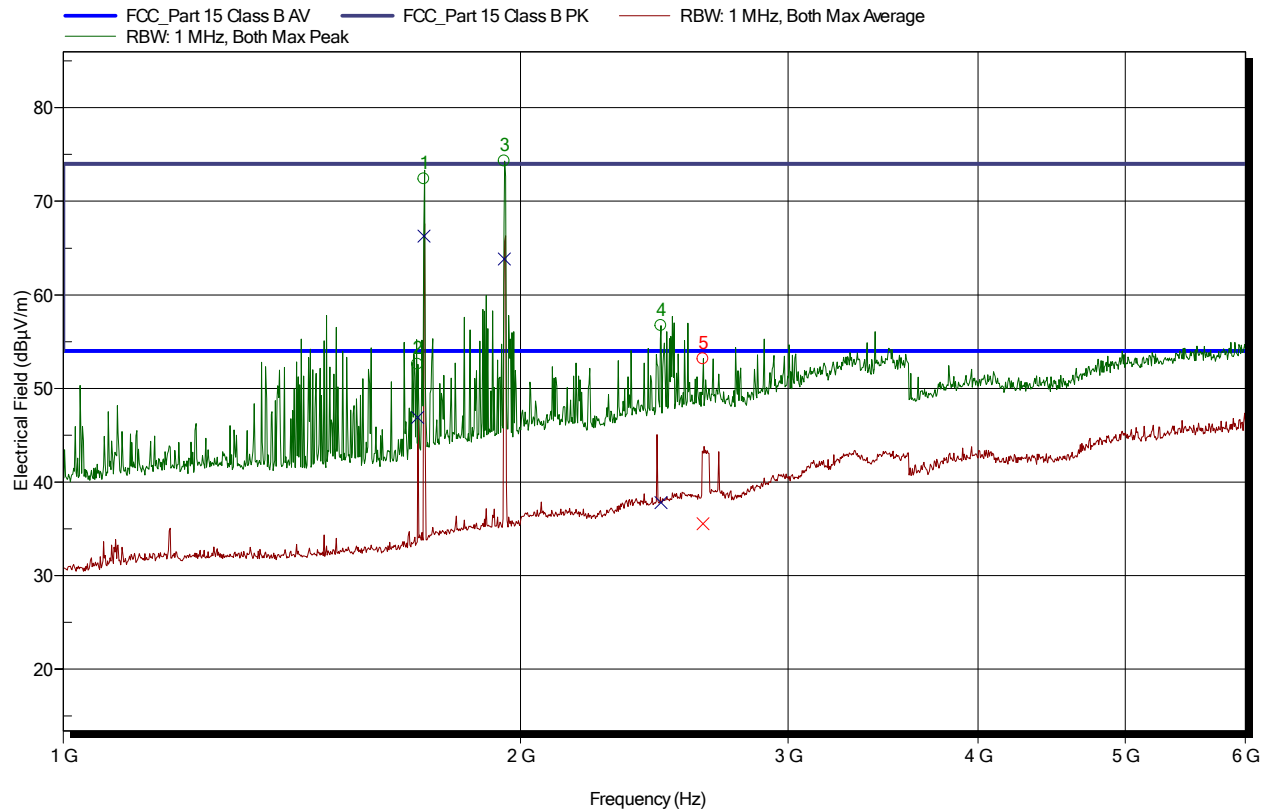
Device type	Brand	Type	ID
Spectrum Analyzer	Hewlett Packard	8563E	OA 8889
Pre Amplifier	Mini Circuits	ZVA-183A	99.6632.10
Horn Antenna	EMCO	3115	H9353
Coaxial Cable	Huber & Suhner	Sucoflex 106	13.6632.03 12.6632.25
Power Supply	Elektro Automatik	PS 8160-04	Q10152



## Measurement Results

Measurement 35:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode, 24 VDC		
<b>Test date, time</b>	16.09.2016 18:04:16		
<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>	Radiation Version: 2015.1.11, RBW: 1 MHz, VBW: 1 MHz, Sweep time: 5 ms, Step freq: Fixed step count: 9 * 1e+3 steps per Band, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: Auto [120 ms]		



### Detected peaks

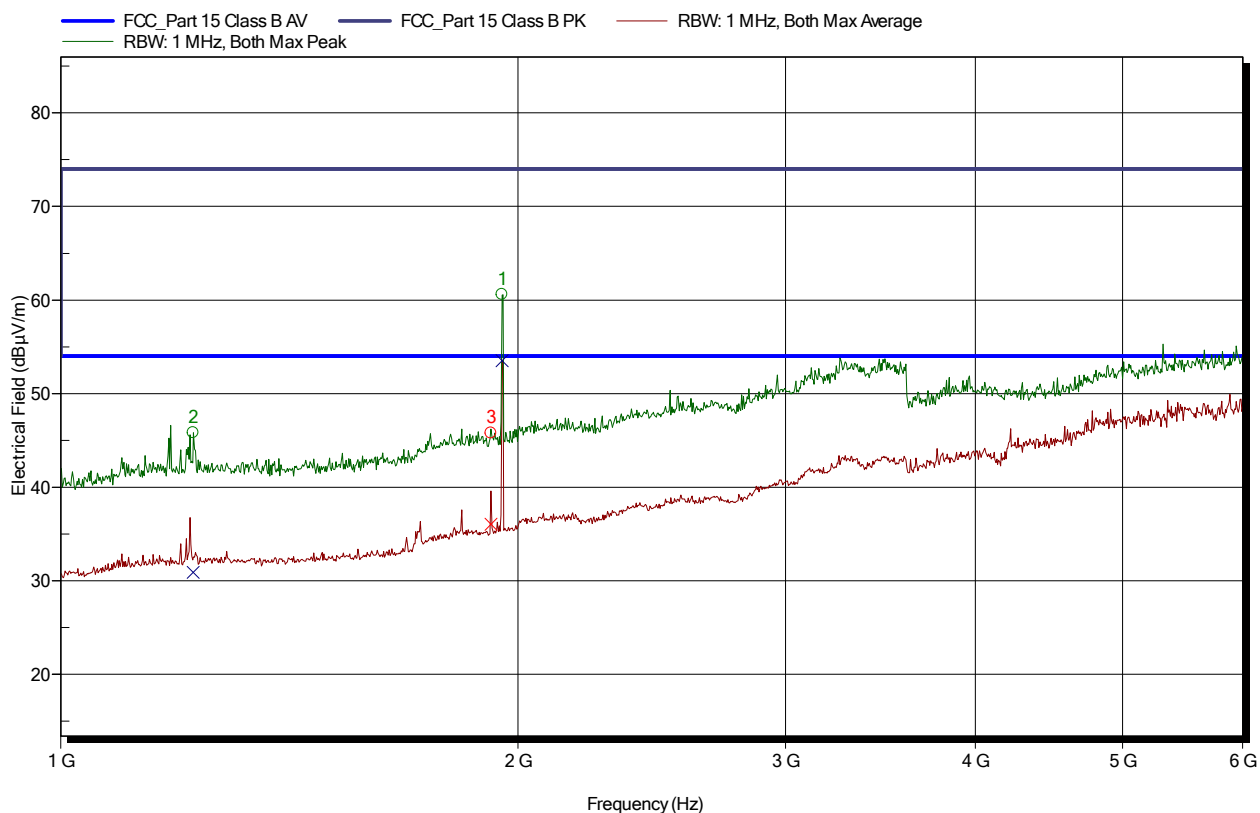
Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.728 GHz	72.39 dBμV/m	--	66.28 dBμV/m	--	N/A 1)	30 Degree	1 m	Horizontal
2	1.711 GHz	52.58 dBμV/m	-21.42 dB	46.89 dBμV/m	-7.11 dB	Pass	30 Degree	1 m	Horizontal
3	1.952 GHz	74.29 dBμV/m	--	63.84 dBμV/m	--	N/A 1)	120 Degree	1 m	Vertical
4	2.475 GHz	56.72 dBμV/m	--	37.79 dBμV/m	--	N/A 2)	60 Degree	1 m	Horizontal
5	2.637 GHz	53.17 dBμV/m	-20.83 dB	35.54 dBμV/m	-18.46 dB	Pass	210 Degree	1 m	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 36:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode, 110 VDC		
<b>Test date, time</b>	19.09.2016 12:19:21		
<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: 2015.1.11, RBW: 1 MHz, VBW: 1 MHz, Sweep time: 10 ms, Step freq: Fixed step count: 9 * 1e+3 steps per Band, Attenuator: 0 dB, Measure time: Auto [120 ms]		



## Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.953 GHz	60.59 dBµV/m	--	53.5 dBµV/m	--	N/A 1)	330 Degree	1 m	Horizontal
2	1.222 GHz	45.83 dBµV/m	-28.17 dB	30.91 dBµV/m	-23.09 dB	Pass	120 Degree	1 m	Horizontal
3	1.92 GHz	45.8 dBµV/m	-28.2 dB	36.05 dBµV/m	-17.95 dB	Pass	0 Degree	1 m	Vertical

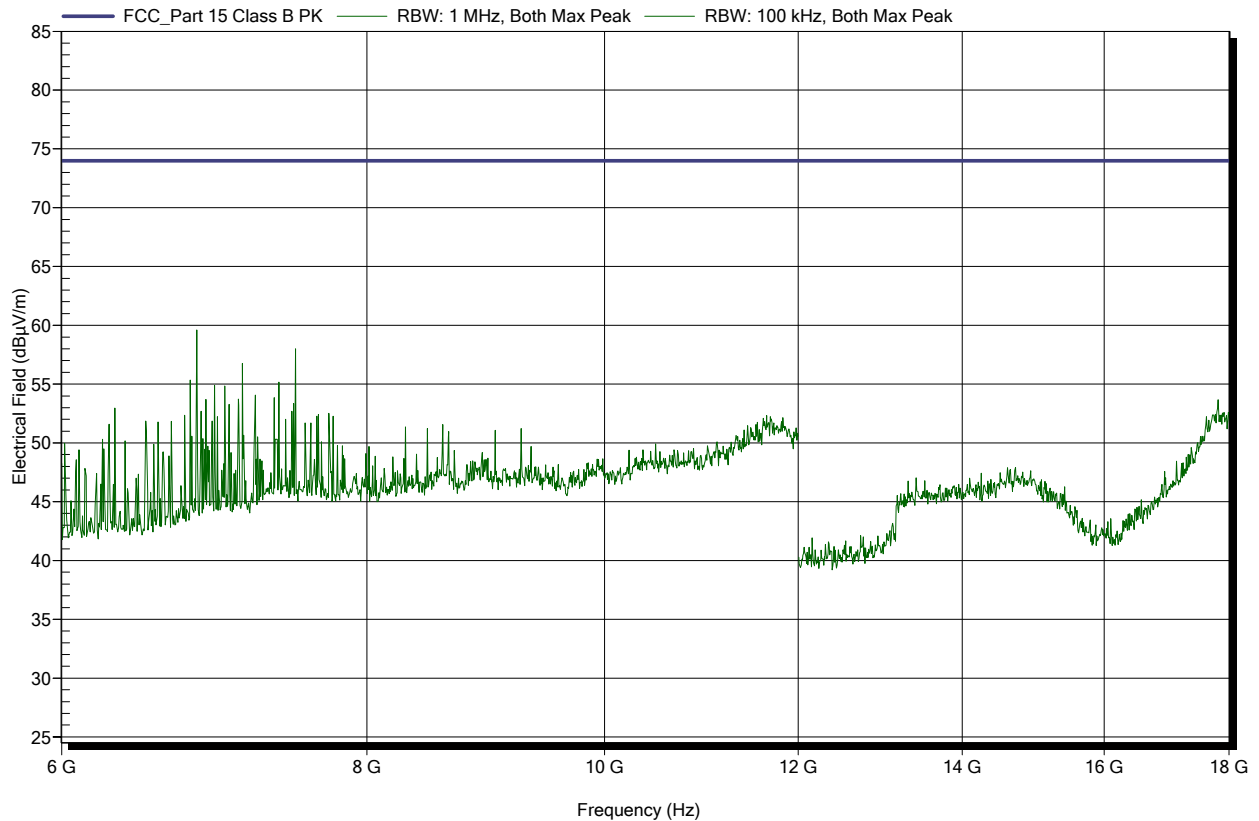
## Notes:

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

## Measurement 37:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode, 24 VDC		
<b>Test date, time</b>	19.09.2016 10:02:11		
<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: 2014.2.6, RBW: 100 kHz, VBW: 100 kHz, Sweep time: Auto [750 ms], Step freq: Fixed step count: 601 steps per Band, Attenuator: 0 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms]		

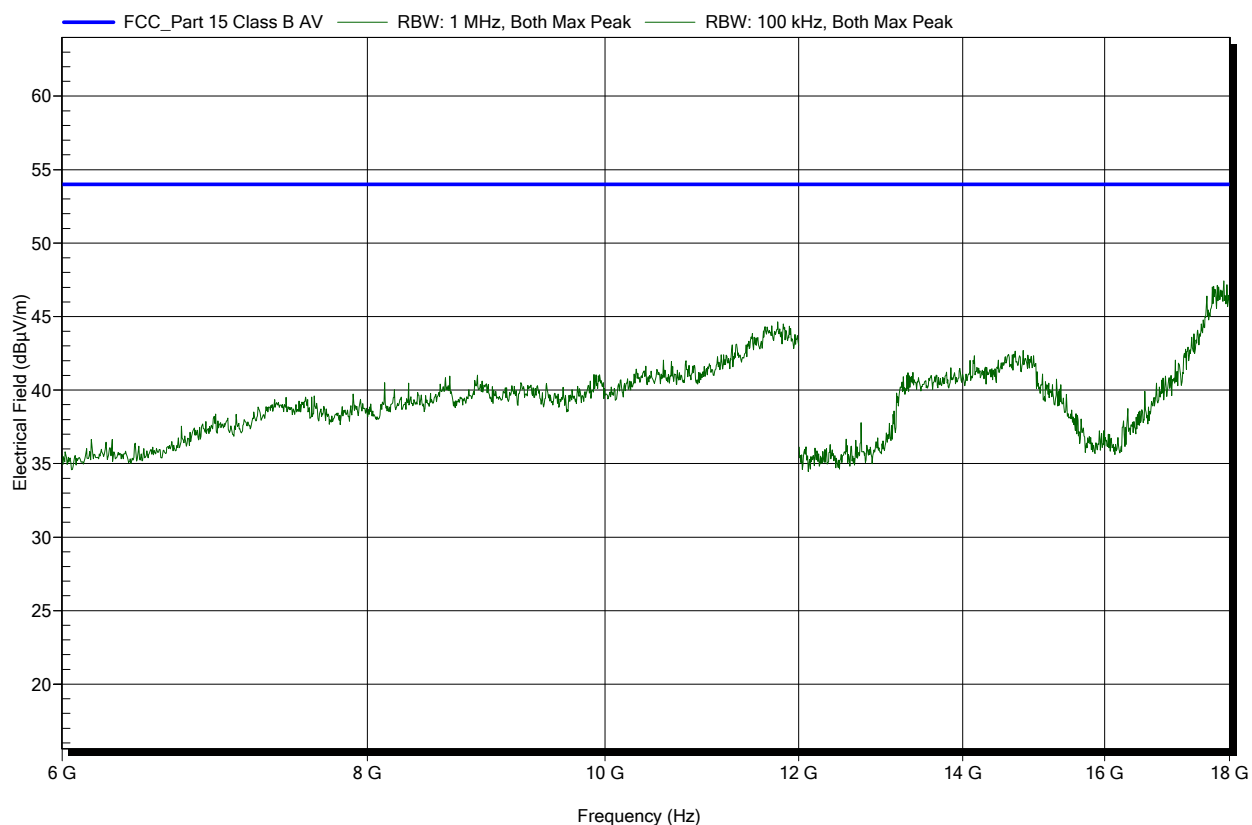
## Peak detection:



## Measurement 38:

<b>EUT</b>	EUT1 (NB3800-4L2WacDe-G)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode, 24 VDC		
<b>Test date, time</b>	19.09.2016 10:33:38		
<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: 2014.2.8, RBW: 100 kHz, VBW: 10 kHz, Sweep time: Auto [7.5 s], Step freq: Fixed step count: 601 steps per Band, Attenuator: 0 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms]		

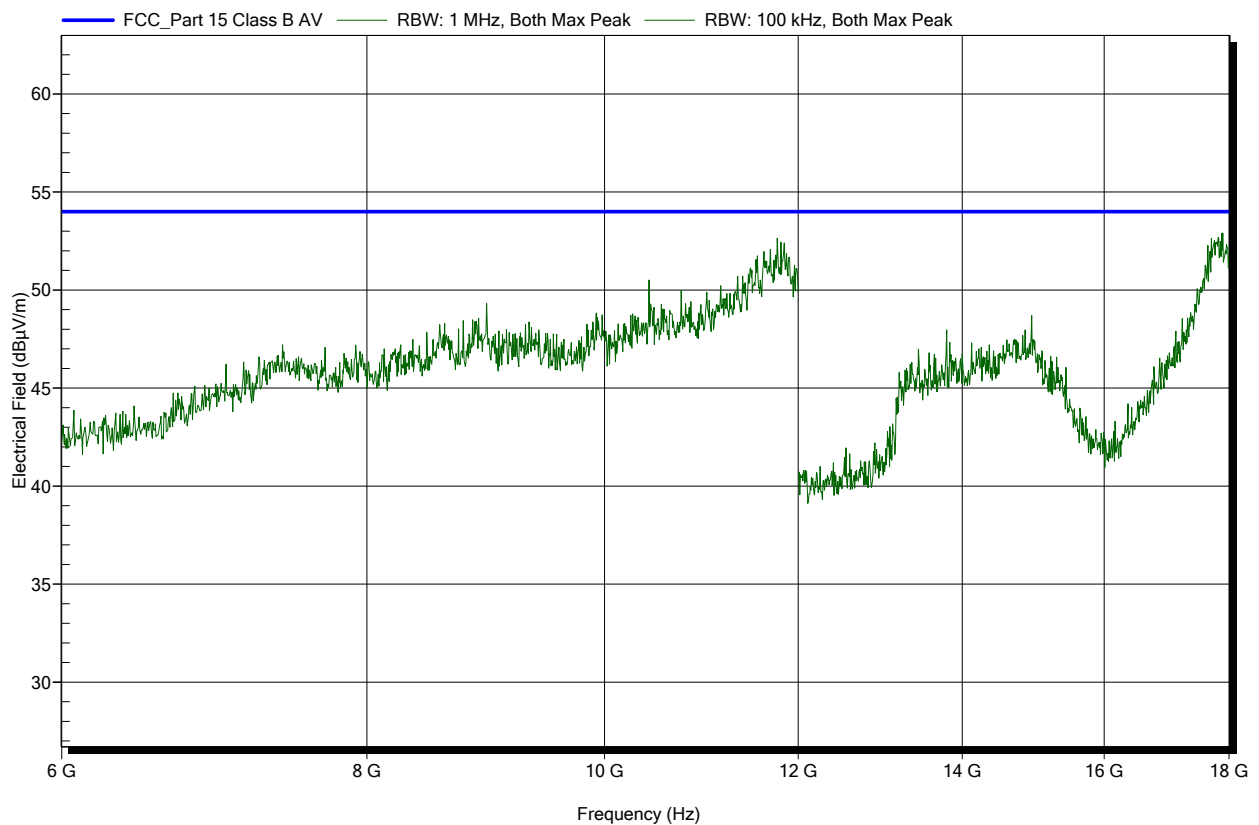
## Average detection:



## Measurement 39:

<b>EUT</b>	EUT2 (NB3800-3LWacCGePbDe)		
<b>Verdict, Test</b>	Pass, FCC Class B		
<b>Mode of operation</b>	normal mode, 110 VDC		
<b>Test date, time</b>	19.09.2016 11:42:27		
<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: 2014.2.8, RBW: 1 MHz, VBW: 1 MHz, Sweep time: Auto [60 ms], Step freq: Fixed step count: 601 steps per Band, Attenuator: 0 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms]		

## Average detection:



## 14. Immunity Tests

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

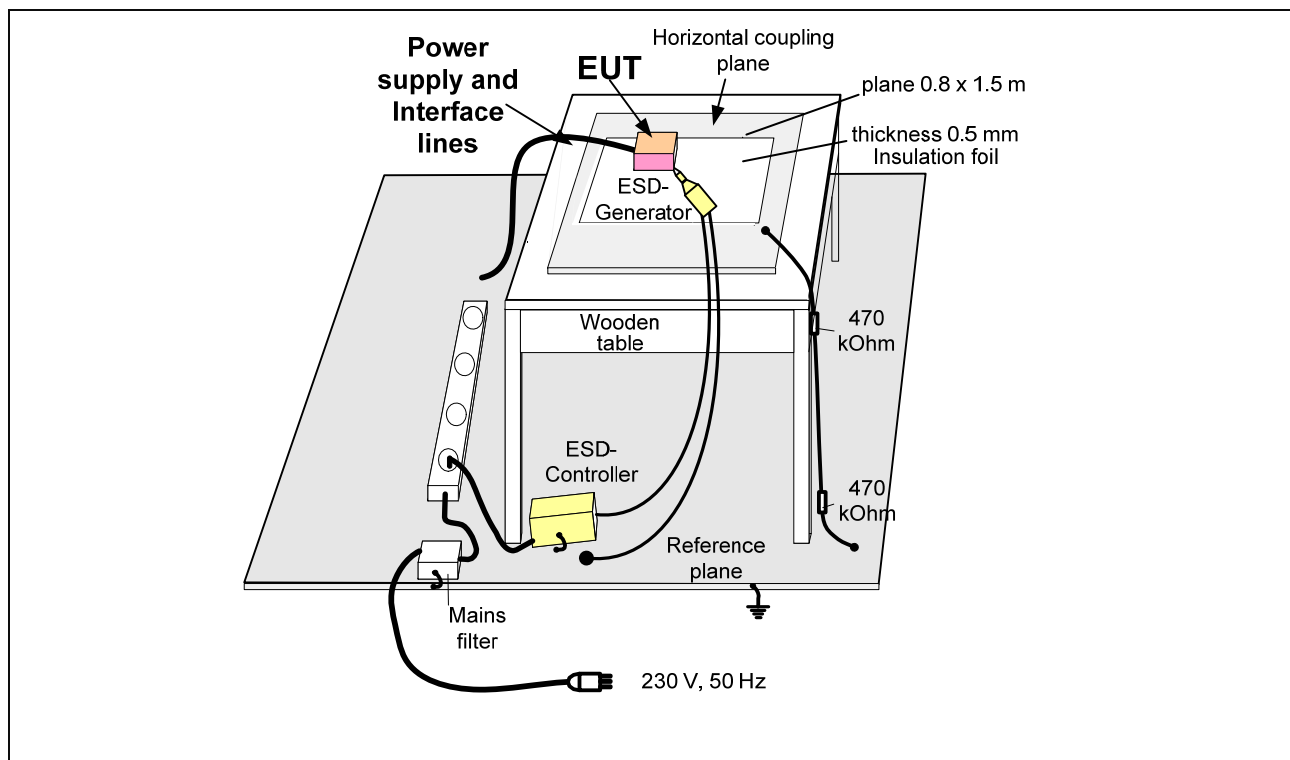
**Introduction:** The aim of this test is to determine the reaction of the material to electrostatic discharges (ESD) produced for example by walking on a carpet made of synthetic fiber. The humidity of the air has an influence on the discharge time and therefore on the severity of the discharge that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

**Coupling:** 150 pF / 330 Ohm

**Meas. uncertainty:** see chapter 15

**Test method:** All the points accessible to the operator are tested successively. Contact discharges are carried out on conducting surfaces as well as indirect discharges on a vertical or horizontal coupling plane. Air discharges are carried out on insulated surfaces. A minimum of 10 discharges for each voltage level and polarity are applied to each test point.

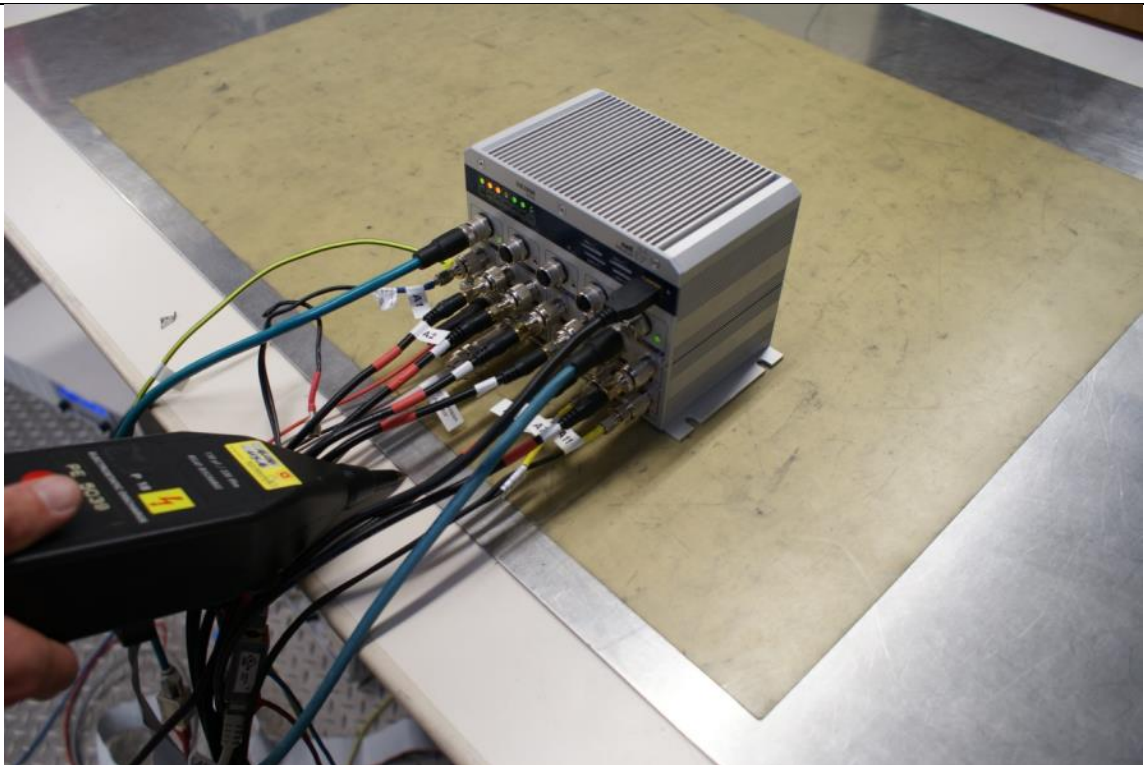
#### Test Setup



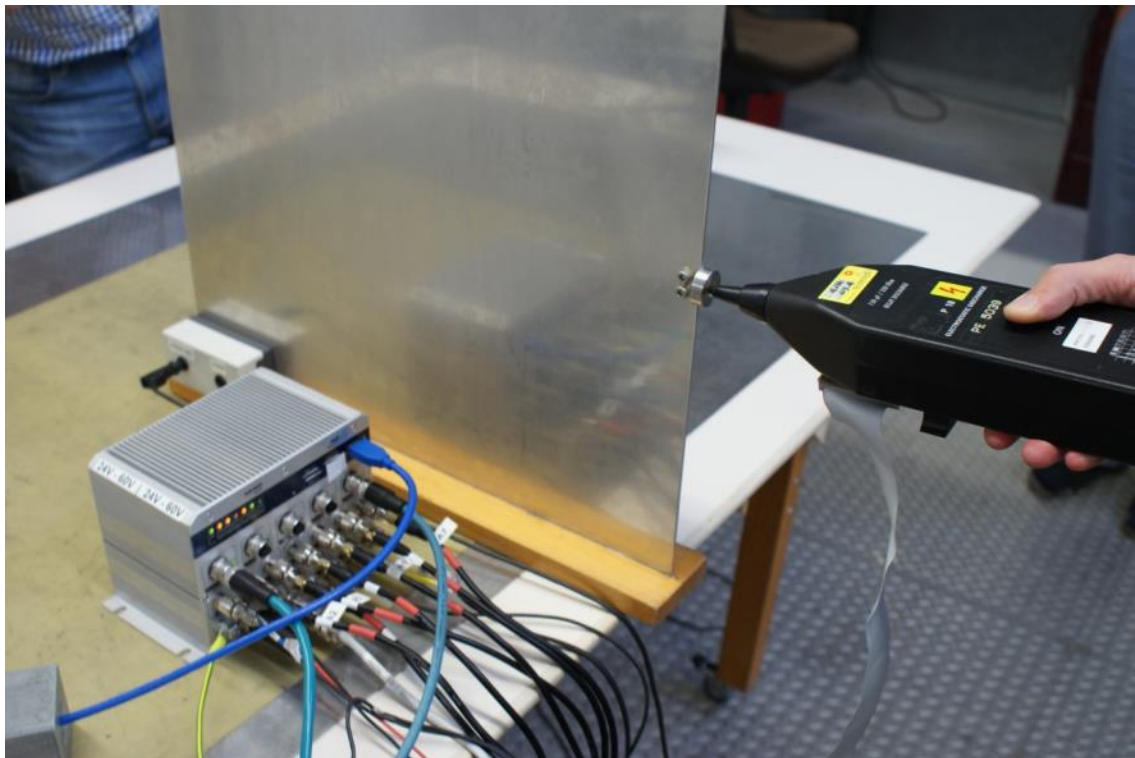
#### Test Equipment

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

## Photos of the Setup

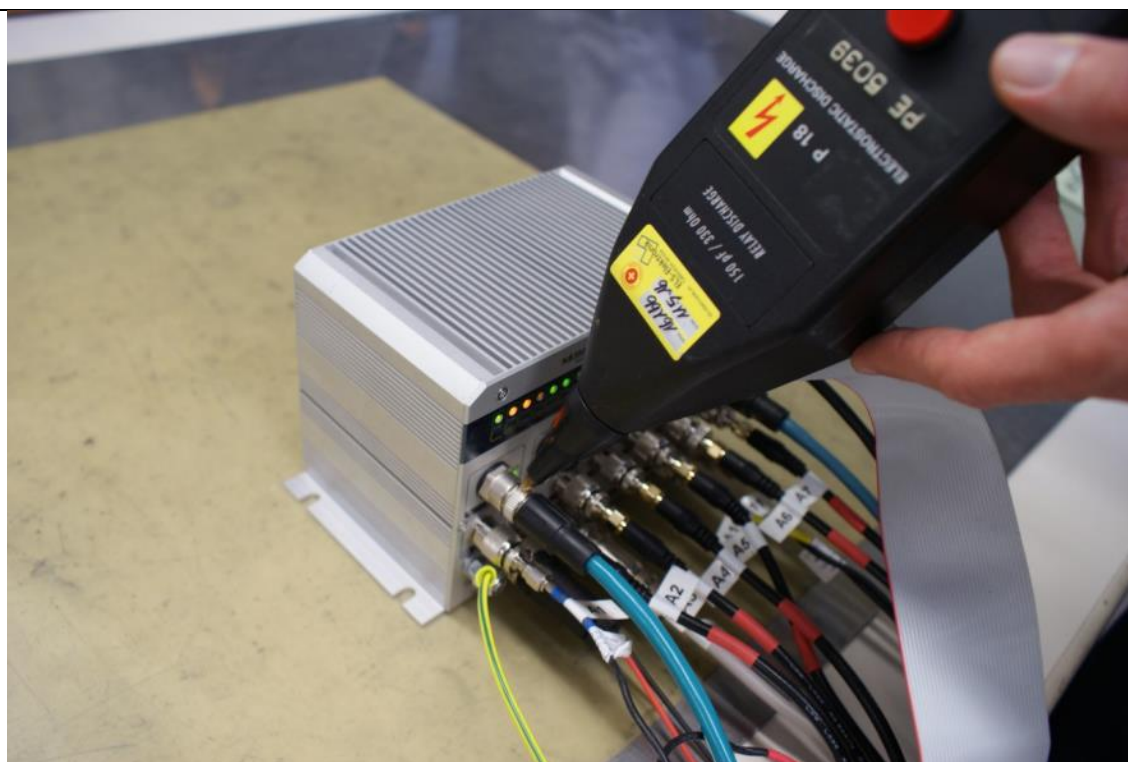


Horizontal Coupling Plane (HCP)

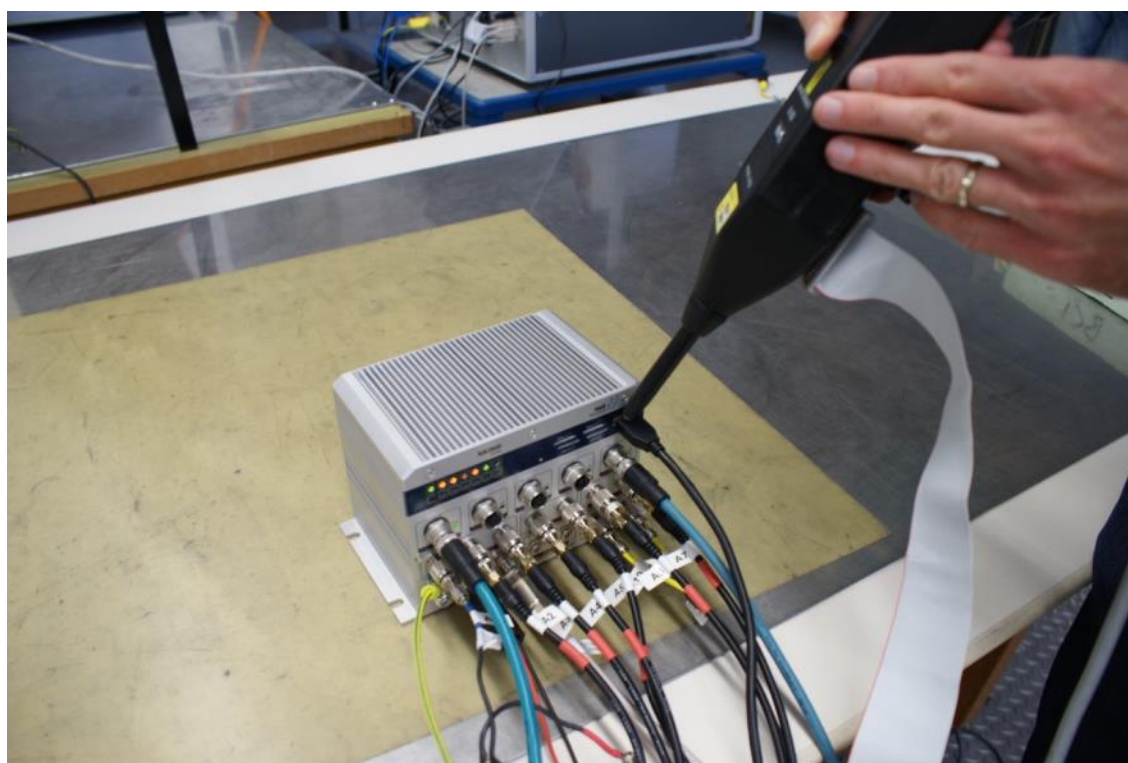


Vertical Coupling Plane (VCP)





Direct Discharge



Air Discharge



**Test Results**

**Equipment:** EUT1 (NB3800-4L2WacDe-G)  
 EUT2 (NB3800-3LWacCGePbDe)

**Cables connected:** See chapter 12.4

**Operating mode:** Normal operation, see chapter 12.5

**Observation of EUT:** See chapter 12.6

**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 (NB3800-4L2WacDe-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 (NB3800-3LWacCGePbDe):

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

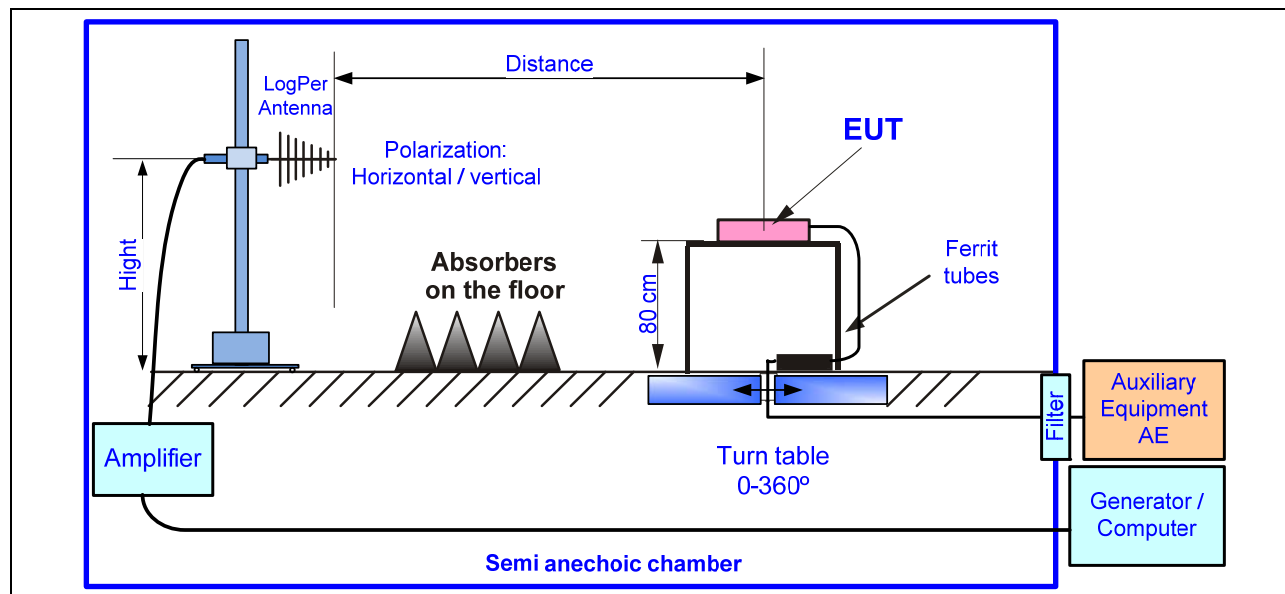
## 14.2 Immunity to Electromagnetic Fields (EN 61000-4-3)

**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 15

**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

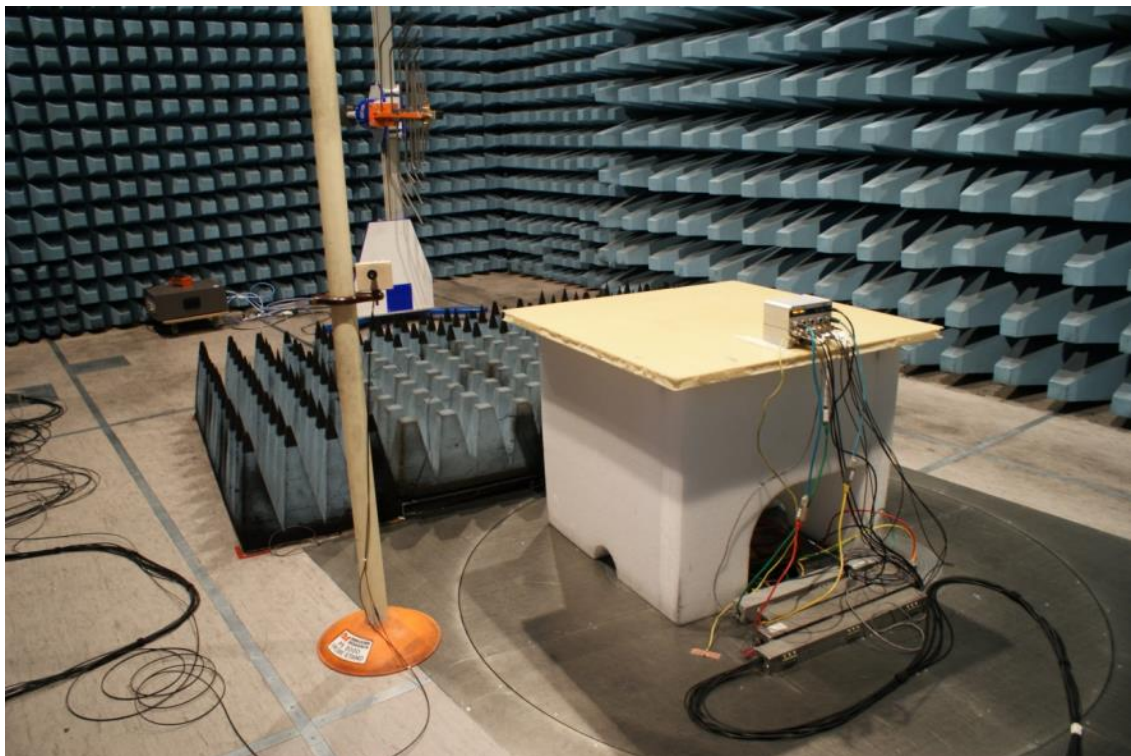


### Test Equipment

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

**Photo of the Setup**

EUT1



EUT2

## Test Results

**Equipment:** EUT1 (NB3800-4L2WacDe-G)  
 EUT2 (NB3800-3LWacCGePbDe)  
**Cables connected:** See chapter 12.4  
**Operating mode:** Normal operation, see chapter 12.5  
**Observation of EUT:** See chapter 12.6  
**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

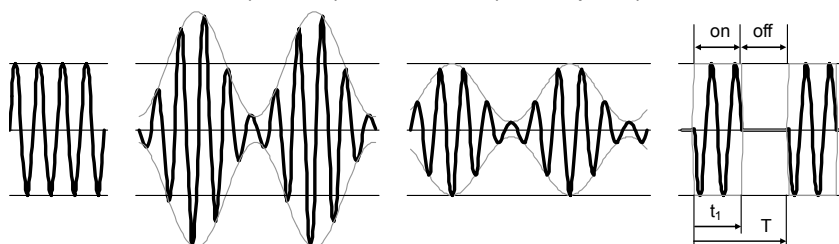
Modulation:

☐ CW

☒ AM (normal)

☐ AM (const. peak)

☐ PM



## Protocol of the Test

EUT1 (NB3800-4L2WacDe-G):

Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	22	horizontal	0°, 90°, 180°, 270°	No errors observed	A	Pass
	22	vertical	0°, 90°, 180°, 270°	No errors observed	A	Pass
1000 - 6000	12	horizontal	0°, 90°, 180°, 270°	No errors observed	A	Pass
	12	vertical	0°, 90°, 180°, 270°	No errors observed	A	Pass

EUT2 (NB3800-3LWacCGePbDe):

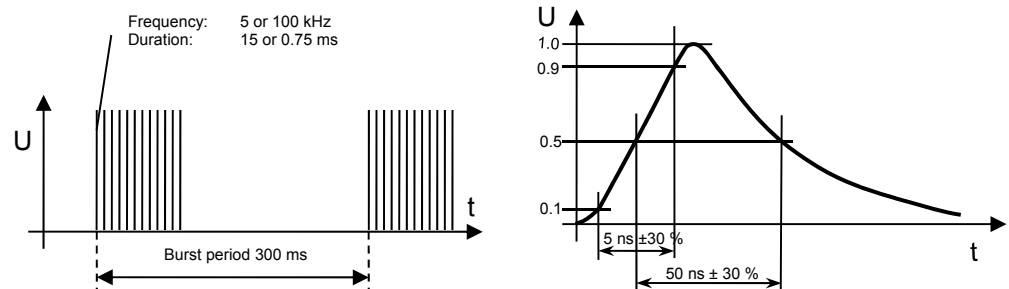
Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	22	horizontal	0°, 90°, 180°, 270°	No errors observed	A	Pass
	22	vertical	0°, 90°, 180°, 270°	No errors observed	A	Pass
1000 - 6000	12	horizontal	0°, 90°, 180°, 270°	No errors observed	A	Pass
	12	vertical	0°, 90°, 180°, 270°	No errors observed	A	Pass

### 14.3 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:



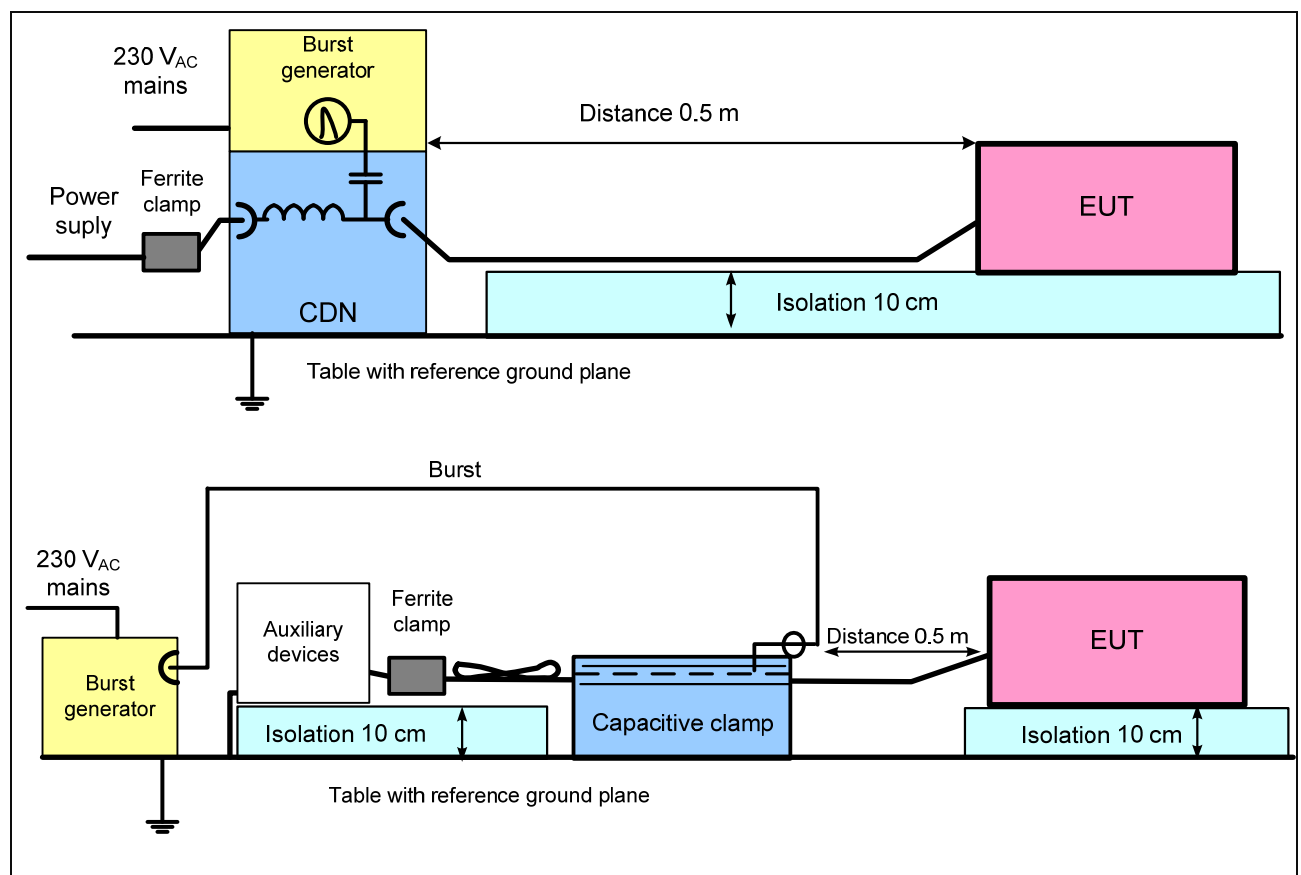
#### Meas. uncertainty:

see chapter 15

#### 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

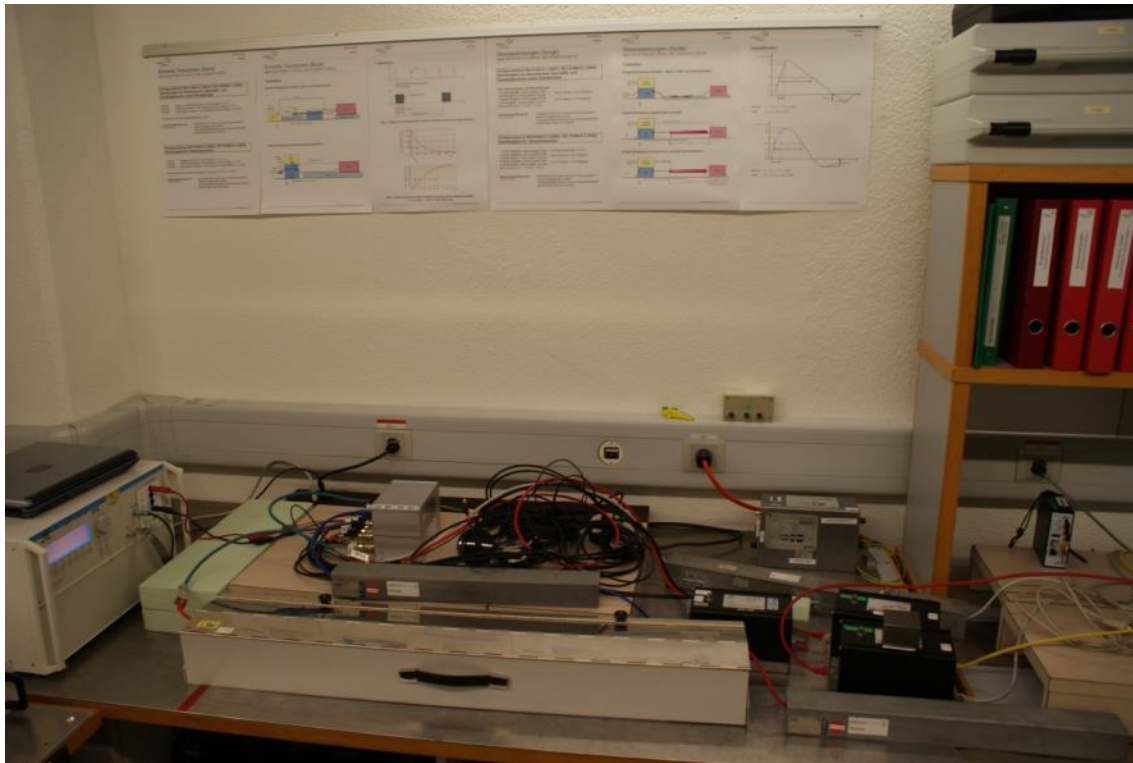


### Test Equipment

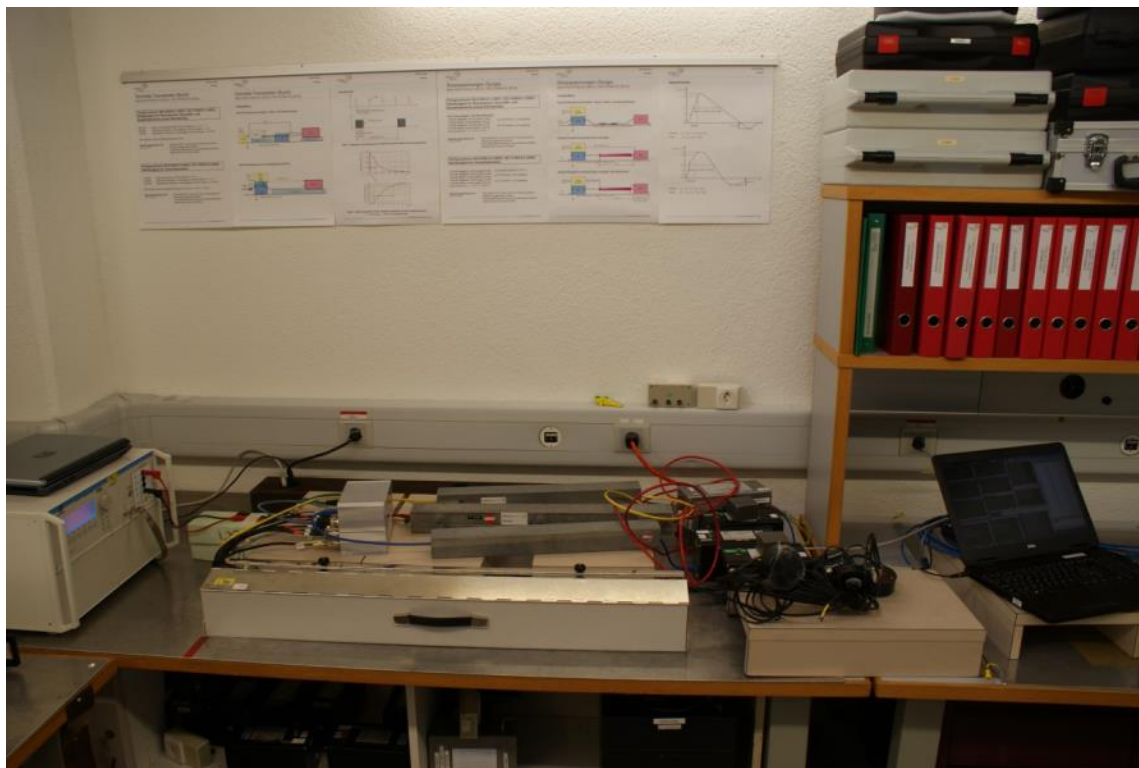
Device Type	Brand	Type	ID
Burst Generator	EM-Test	EFT500M4S1	PE10105
Capacitive Coupling Clamp	EM-Test	EM-Test HFK	H9360
Power Supply	Hameg	HM8143	Q10153



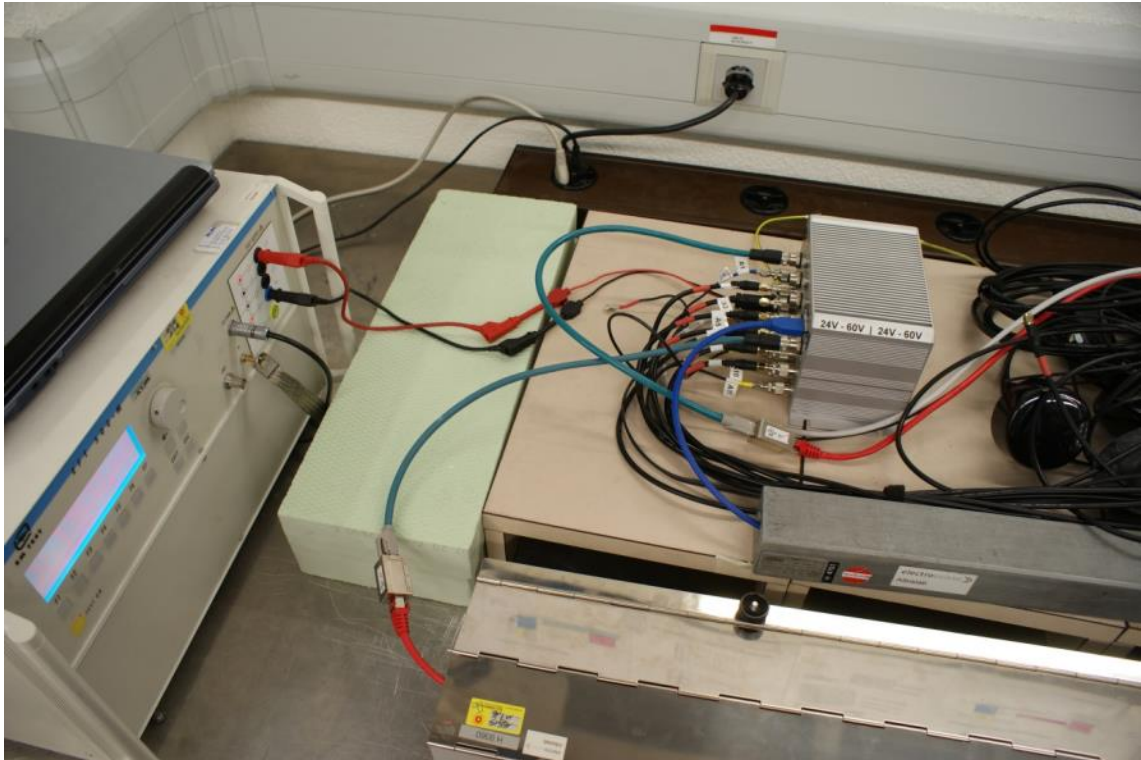
## Photos of the Setup



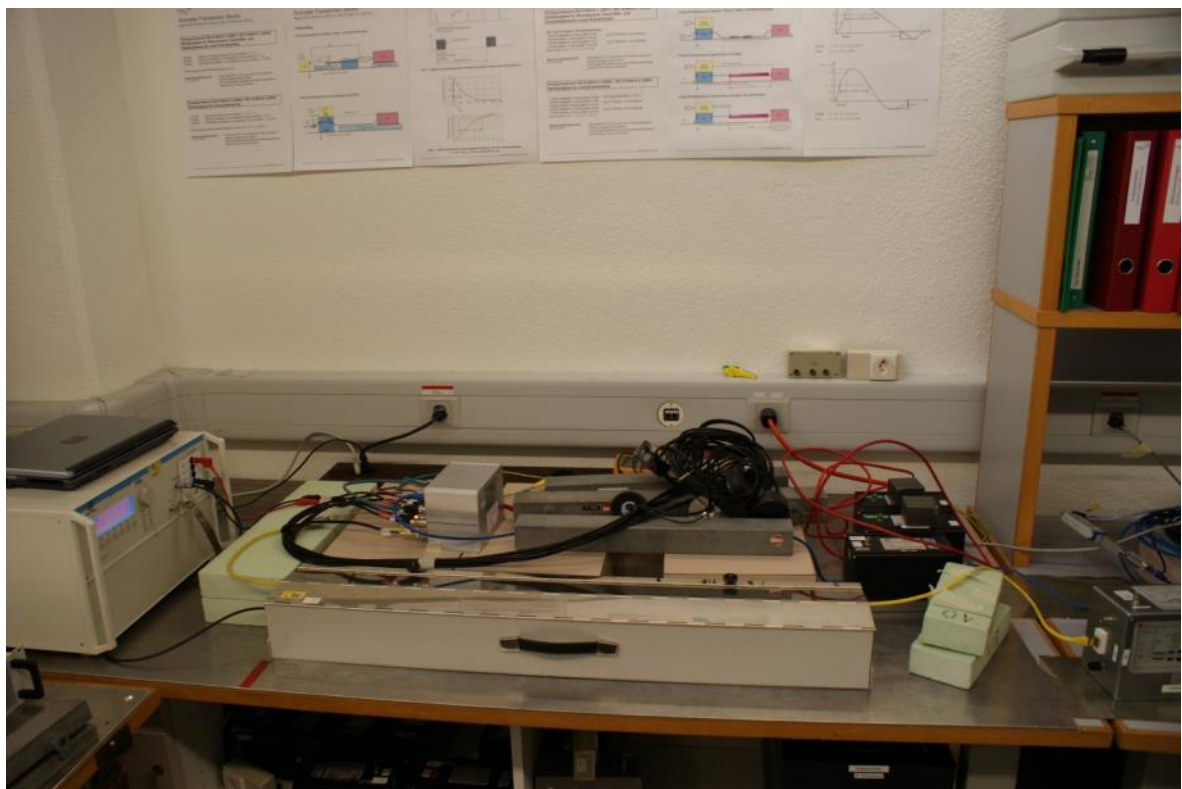
General setup (EUT1)



General setup (EUT2)



Coupling to the DC power supply (EUT1)



Coupling to signal port (EUT2)

## Test Results

**Equipment:** EUT1 (NB3800-4L2WacDe-G)  
 EUT2 (NB3800-3LWacCGePbDe)  
**Cables connected:** See chapter 12.4  
**Operating mode:** Normal operation, see chapter 12.5  
**Observation of EUT:** See chapter 12.6  
**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 Test

EUT1 (NB3800-4L2WacDe-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 (NB3800-3LWacCGePbDe):

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

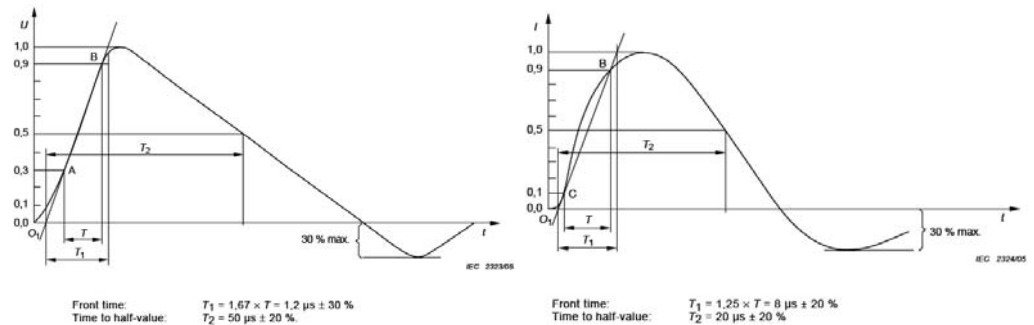


## 14.4 Immunity to Surge (EN 61000-4-5 : 1.2/50 $\mu$ s)

*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*

see chapter 15

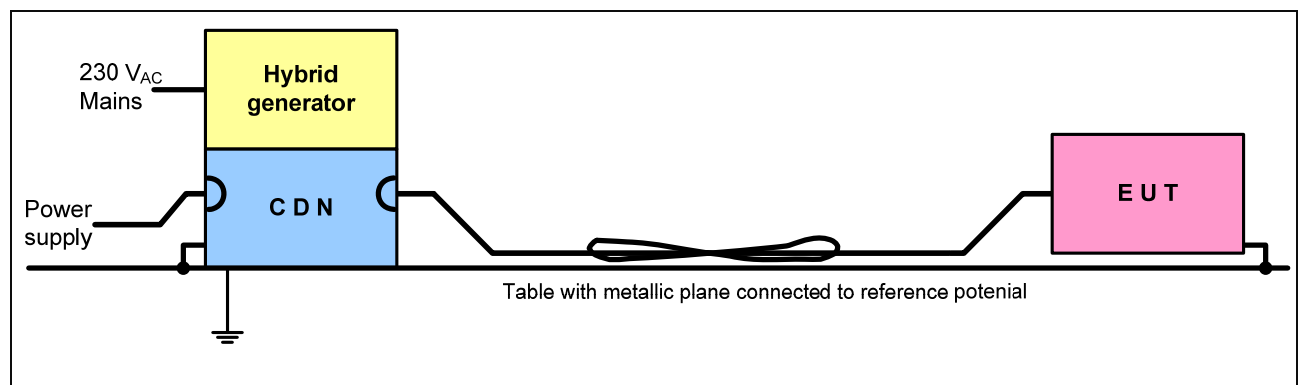
*Short-circuit current*

*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.

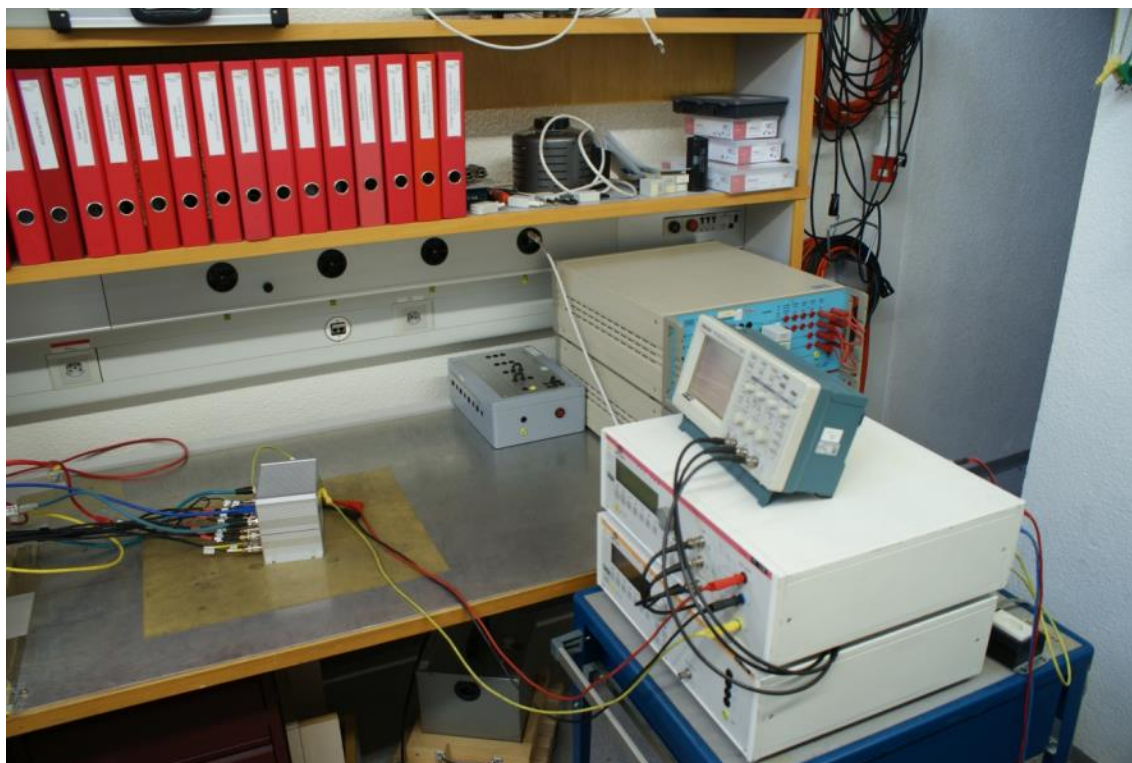
### Test Setup



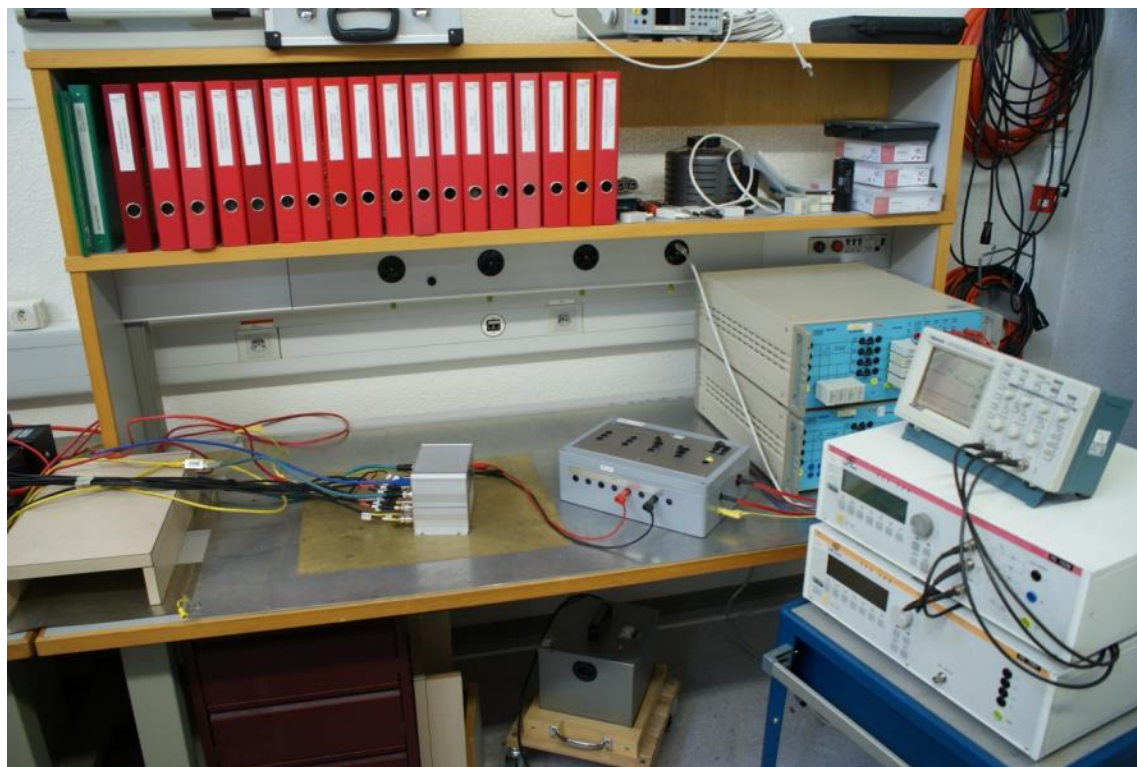
### Test Equipment

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

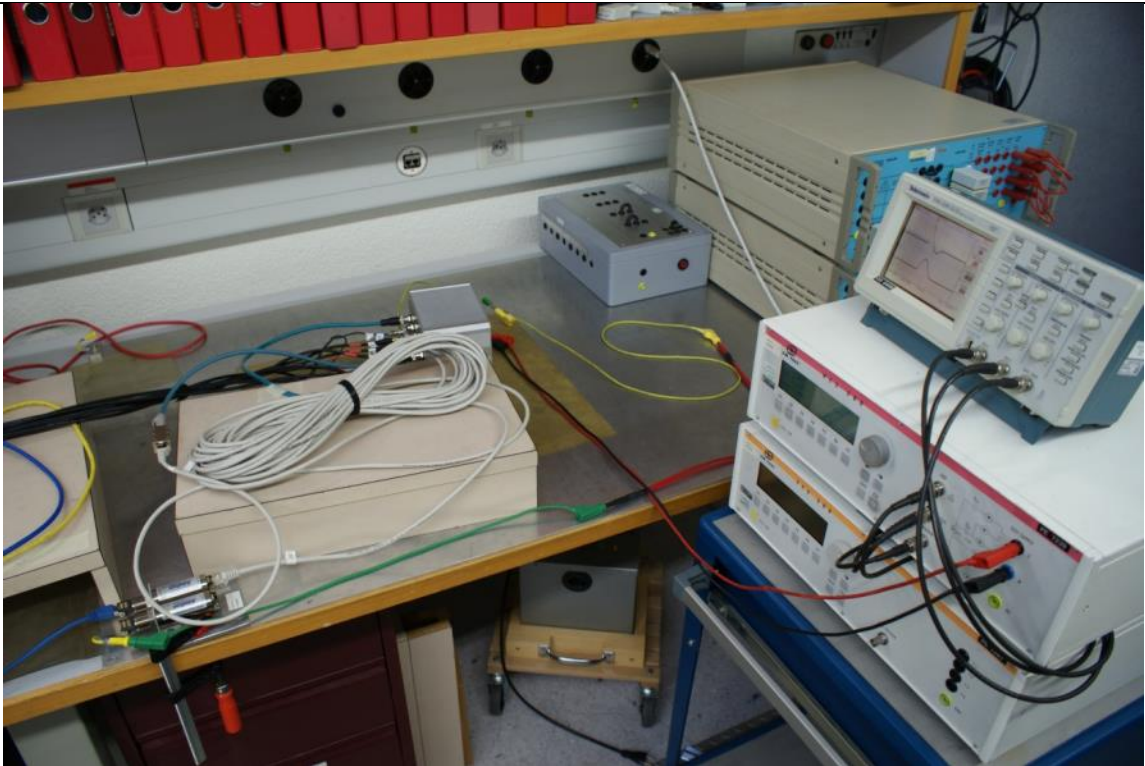
## Photos of the Setup



Coupling to the DC power supply with  $2\ \Omega + 18\ \mu\text{F}$  resp.  $12\ \Omega + 9\ \mu\text{F}$



Coupling to the DC power supply with  $42\ \Omega + 0.5\ \mu\text{F}$



## Test Results

<i>Equipment:</i>	EUT1 (NB3800-4L2WacDe-G) EUT2 (NB3800-3LWacCGePbDe)
<i>Cables connected:</i>	See chapter 12.4
<i>Operating mode:</i>	Normal operation, see chapter 12.5
<i>Observation of EUT:</i>	See chapter 12.6
<i>Modifications:</i>	none
<i>Test site:</i>	laboratory

Note: EUT1 already tested for surge on the DC port before (see Electrosuisse test report no. 16-EL-0019.E01). Here surge was applied again to the two Ethernet ports of EUT1.

## 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
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 μF	L1, L2 – PE 42 Ω+0.5 μF	L1 – L2 42 Ω+0.5 μF	L1, L2 – PE 42 Ω+0.5 μF	
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 (NB3800-4L2WacDe-G):

Test on LAN ports with shielded cable:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses	Remarks	Fulfilled Criterion	Verdict
Ethernet 1	±0.5; ±1.0	Screen – PE	2 Ω	5 (Note 1)	No errors observed	A	Pass
Ethernet 5	±0.5; ±1.0	Screen – PE	2 Ω	5 (Note 1)	No errors observed	A	Pass

EUT2 (NB3800-3LWacCGePbDe):

Tests on DC Power Port:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses	Remarks	Fulfilled criterion	Verdict
DC Mains @ 50 VDC	±0.5	L1(+)- L2(-)	2 Ω + 18 μF	5 (Note 1)	No errors observed	A	Pass
	±1.0	L1(+)- PE L2(-)- PE	12 Ω + 9 μF	5 (Note 1)	No errors observed	A	Pass
DC Mains @ 136 VDC	±0.5	L1(+)- L2(-)	2 Ω + 18 μF	5 (Note 1)	No errors observed	A	Pass
	±1.0	L1(+)- PE L2(-)- PE	12 Ω + 9 μF	5 (Note 1)	No errors observed	A	Pass

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses	Remarks	Fulfilled criterion	Verdict
DC Mains @ 50 VDC	±0.5; ±1.0	L1(+)- L2(-)	42 Ω + 0.5 μF	5 (Note 1)	No errors observed	A	Pass
	±0.5; ±1.0; ±2.0	L1(+)- PE L2(-)- PE	42 Ω + 0.5 μF	5 (Note 1)	No errors observed	A	Pass
DC Mains @ 136 VDC	±0.5; ±1.0	L1(+)- L2(-)	42 Ω + 0.5 μF	5 (Note 1)	No errors observed	A	Pass
	±0.5; ±1.0; ±2.0	L1(+)- PE L2(-)- PE	42 Ω + 0.5 μF	5 (Note 1)	No errors observed	A	Pass

Test on LAN ports with shielded cable:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses	Remarks	Fulfilled Criterion	Verdict
Ethernet 1	±0.5; ±1.0	Screen – PE	2 Ω	5 (Note 1)	No errors observed	A	Pass
Ethernet 5	±0.5; ±1.0	Screen – PE	2 Ω	5 (Note 1)	No errors observed	A	Pass
CAN	±0.5; ±1.0	Screen – PE	2 Ω	5 (Note 1)	No errors observed	A	Pass

**Notes:**

- 1) Number of pulses for each voltage level and each polarity

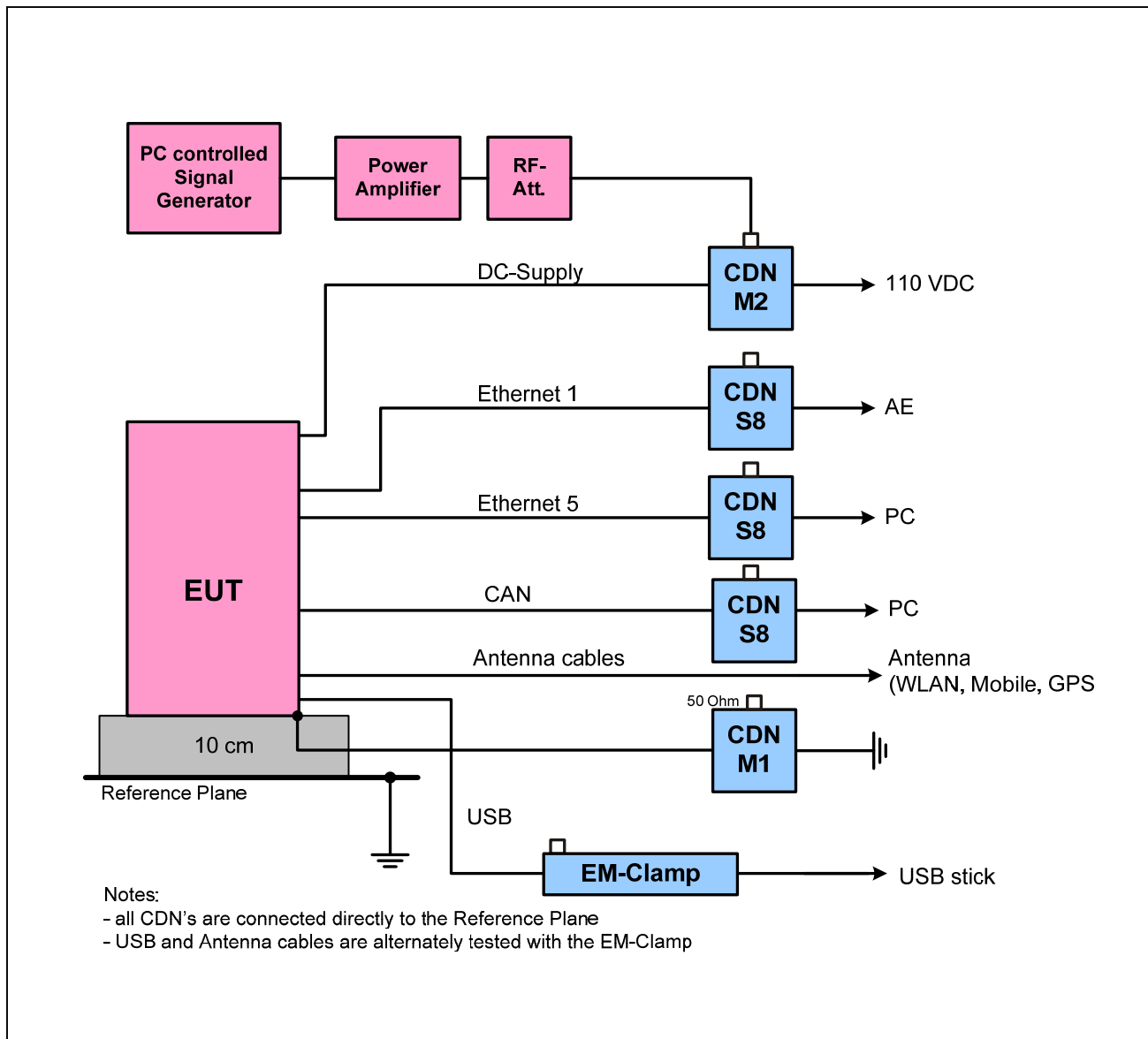
## 14.5 Immunity to Conducted Disturbances Induced by RF Fields (EN 61000-4-6)

**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 15

**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

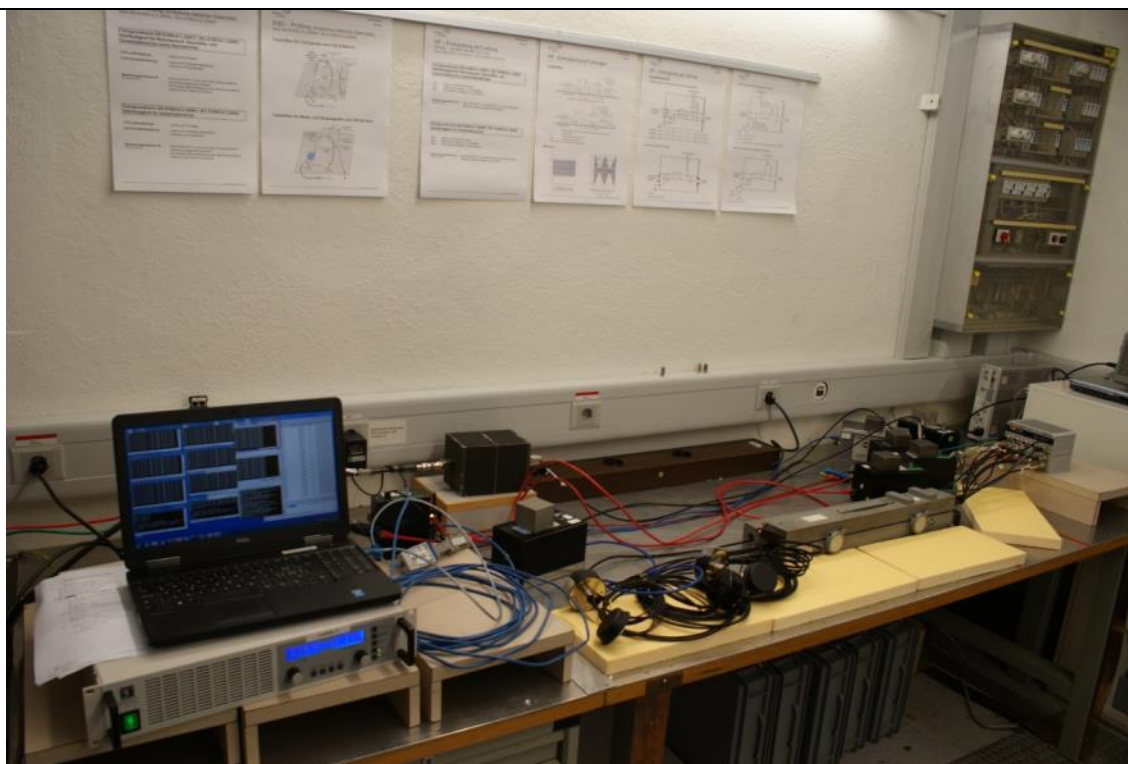




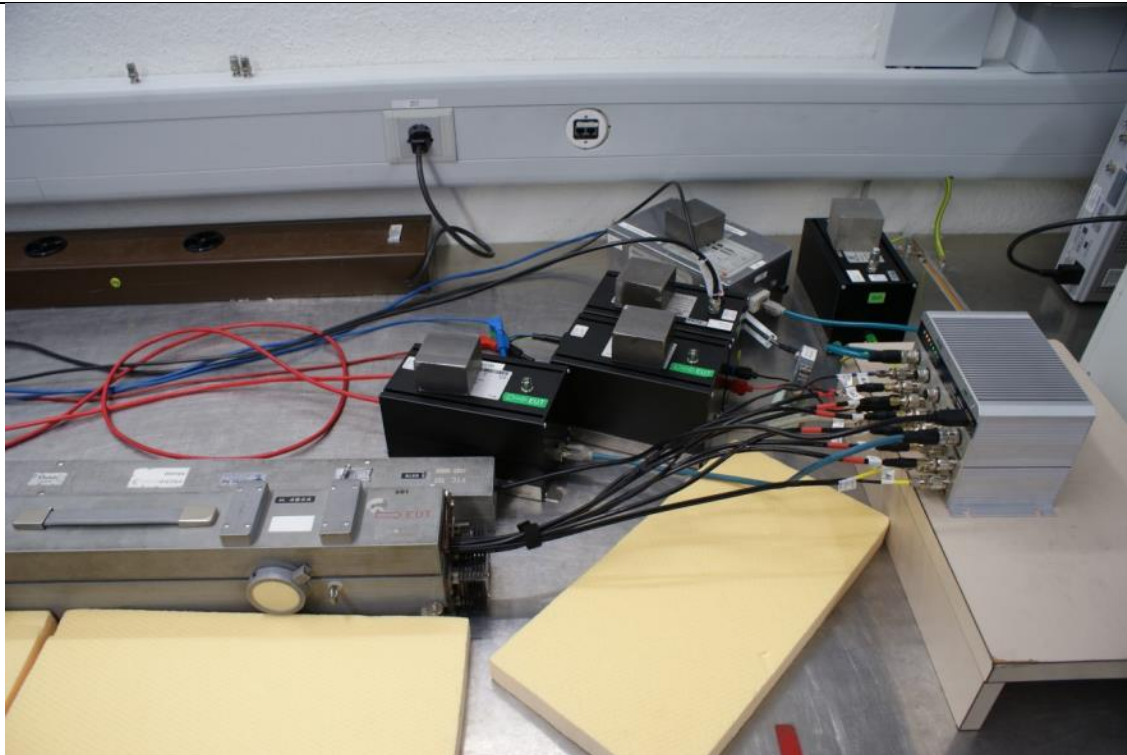
### Test Equipment

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 13.6632.08
Injection device	EM-Test	EM 100 FTC101	H4844 H6979
Power Supply	Hameg	HM8143	Q10153

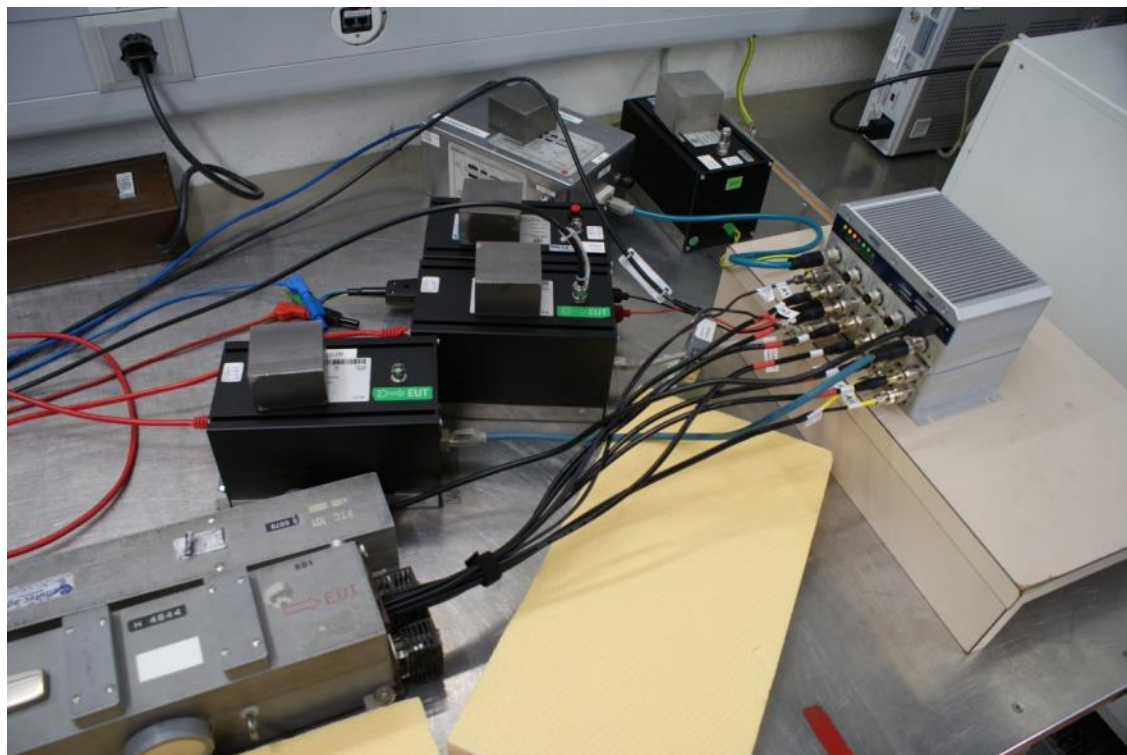
### Photos of the Setup



General setup

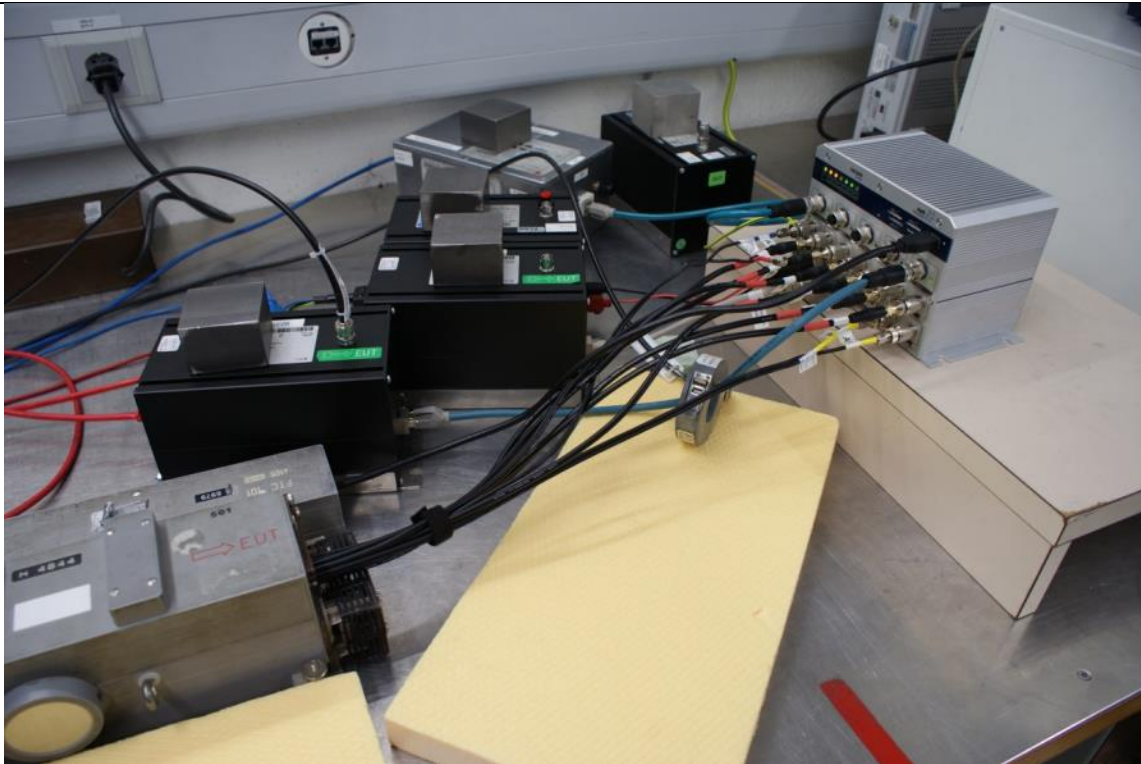


Coupling to the DC power supply with CDN-M2

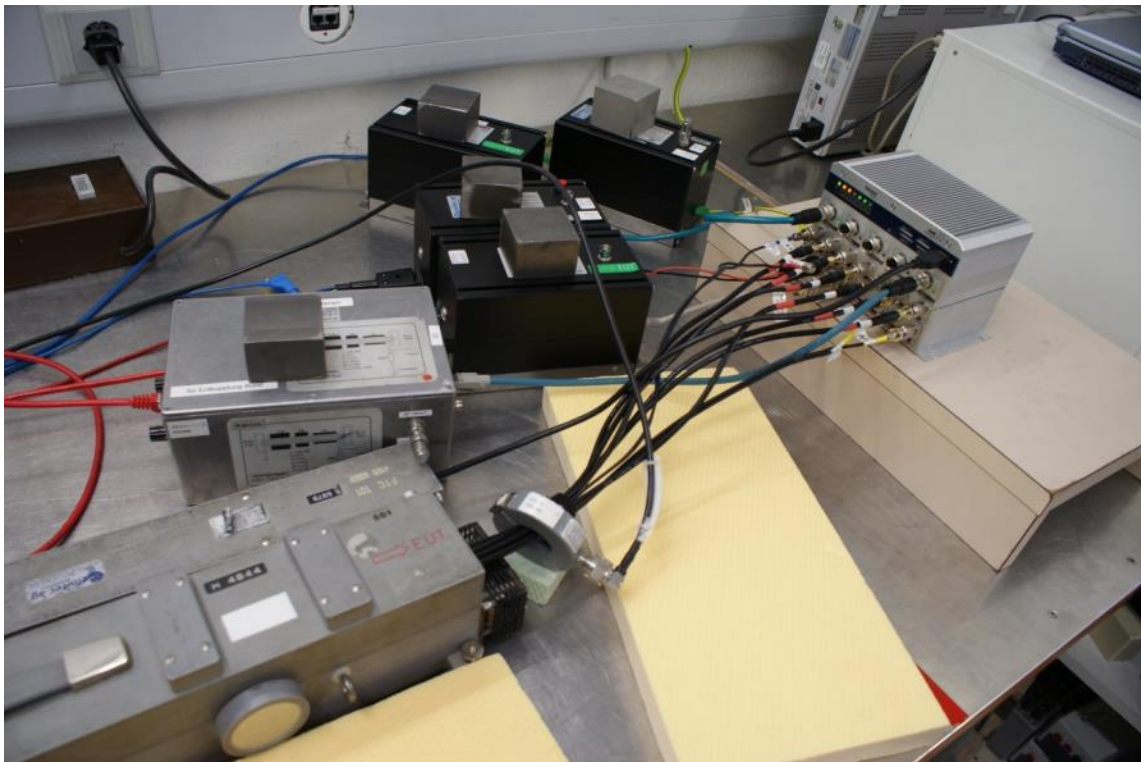


Coupling to the CAN port with CDN-S8 RJ45





Coupling to the Ethernet 5 port with CDN-S8 RJ45



Coupling to the antenna cables with the EM clamp

## Test Results

**Equipment:** EUT2 (NB3800-3LWacCGePbDe)  
**Cables connected:** See chapter 12.4  
**Operating mode:** Normal operation, see chapter 12.5  
**Observation of EUT:** See chapter 12.6  
**Modifications:** none  
**Test site:** laboratory

**Note:** EUT1 already tested for conducted disturbances before (see Electrosuisse test report no. 16-EL-0019.E01)

## Requirements

Standard	Frequency range	Required level	Modulation	Freq. step	Dwell time	Performance crit.
EN 50121-3-2	0.15 – 80 MHz	10 V <sub>EMF</sub>	AM, 1 kHz, 80 %	1 %	1 s	A
EN 50155	0.15 – 80 MHz	10 V <sub>EMF</sub>	AM, 1 kHz, 80 %	1 %	1 s	A
EN 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 %	1 %	1 s	A

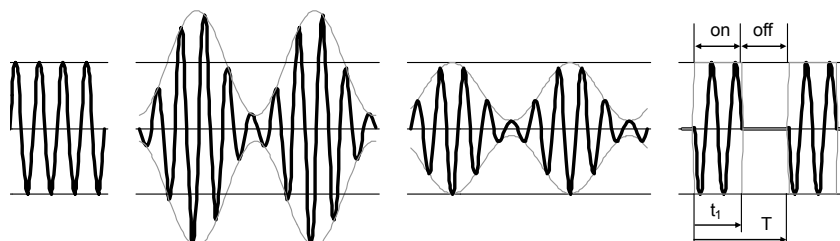
Signal modulation:

☐ CW

☒ AM

☐ AM

☐ PM



## Protocol of the Test

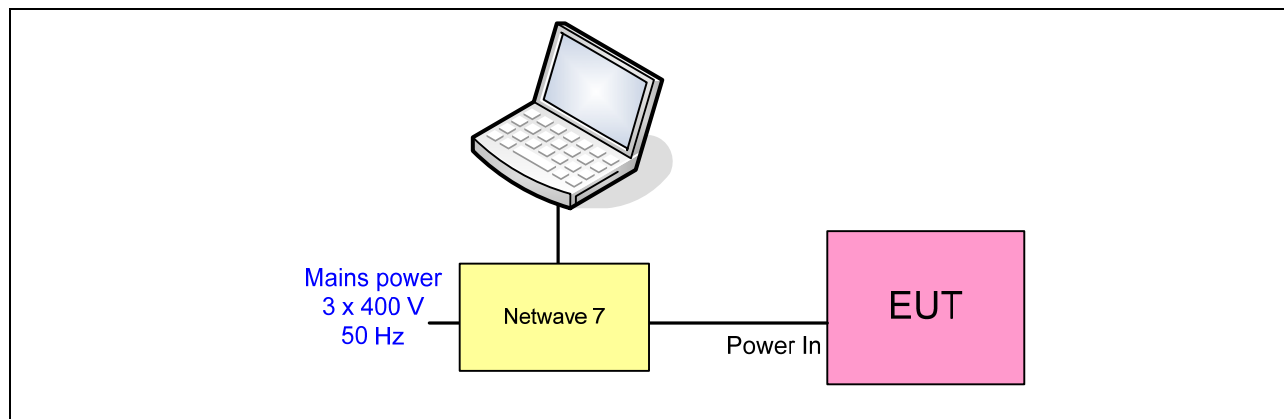
Coupling	CDN	Terminated(50 Ω)	CDN	Freq. [MHz]	Level [V]	Remarks	Fulfilled criterion	Verdict
DC Supply	M2	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Ethernet 1	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Ethernet 5	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
CAN	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
USB	EM100	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Antenna cables	EM100	Enclosure	M1	0.15 – 80	12	No errors observed, Note 1	A	Pass
Enclosure	M1	Ethernet	S8	0.15 – 80	12	No errors observed	A	Pass

Notes:

- 1) All antenna cables tested together

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

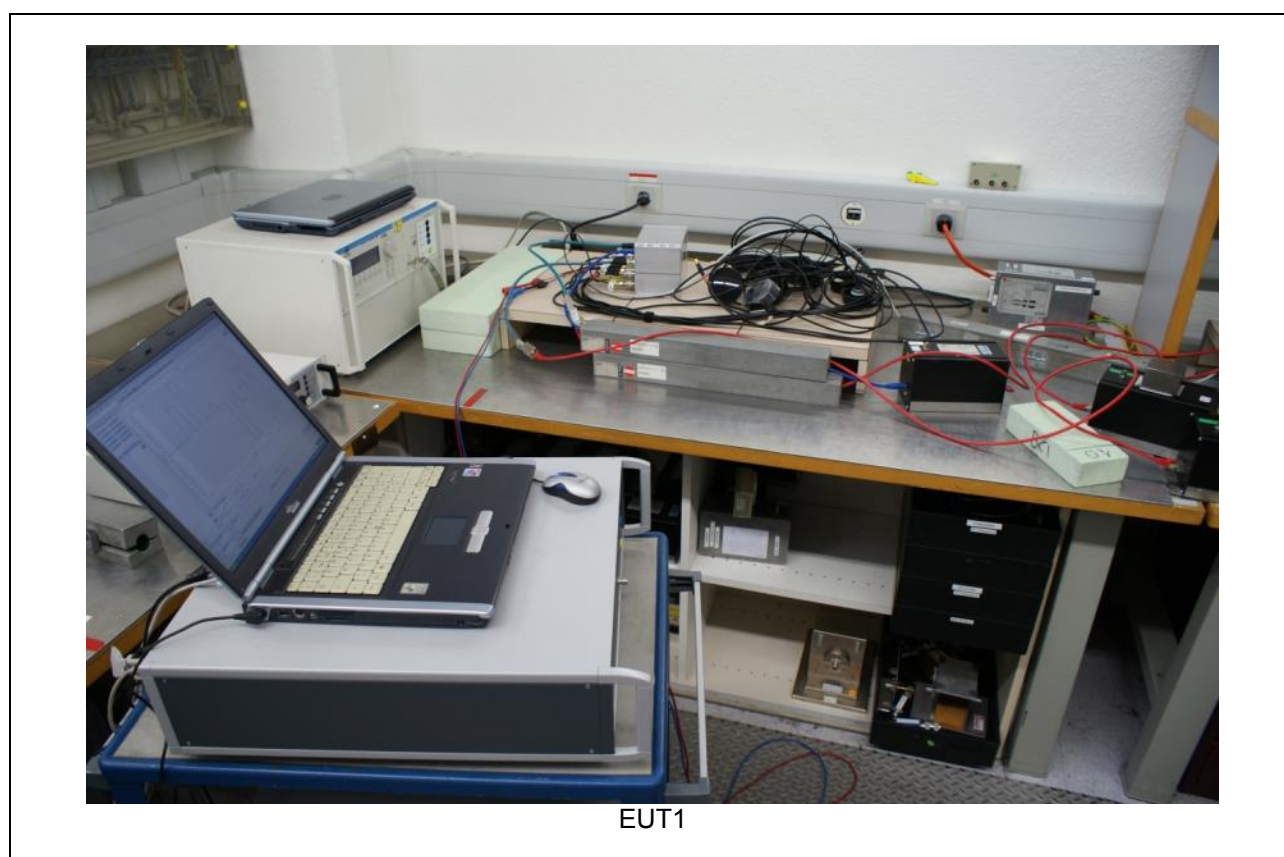
### Test Setup



### Test Equipment

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

### Photos of the Setup





EUT2

**Test Results**

<i>Equipment:</i>	EUT1 (NB3800-4L2WacDe-G) EUT2 (NB3800-3LWacCGePbDe)
<i>Cables connected:</i>	see chapter 12.4
<i>Operating mode:</i>	see chapter 12.5
<i>Observation of EUT:</i>	See chapter 12.6
<i>Modifications:</i>	none
<i>Test site:</i>	Laboratory

**Protocol of the Test**EUT1 (NB3800-4L2WacDe-G): $U_N = 24 \text{ VDC}$ :

Standard	Chapter	Voltage		Duration	Requirements	Notes	Verdict
EN 50155	5.1.1.1	14.4 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	33.6 V	$1.4 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	30 V	$1.25 U_N$	1 s	Criterion C	No errors observed	Pass
	5.1.1.1	33.6 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	21.6 V	$0.9 U_N$	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	26.4 V	$1.1 U_N$	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	14.4 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	33.6 V	$1.4 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	16.8 V	$0.7 U_N$	1 s	Criterion A	No errors observed	Pass
	5.1.2	30 V	$1.25 U_N$	1 s	Criterion A	No errors observed	Pass
	5.1.3	14.4 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.3	0 V	$0 U_N$	30 ms	Criterion A	See Note 2	N/A
	12.2.6	33.6 V	$1.4 U_N$	1 s	Criterion A	rise & fall time 0.1 s, No errors observed	Pass

 $U_N = 48 \text{ VDC}$ :

Standard	Chapter	Voltage		Duration	Requirements	Notes	Verdict
EN 50155	5.1.1.1	28.8 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	67.2 V	$1.4 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	60 V	$1.25 U_N$	1 s	Criterion C	No errors observed	Pass
	5.1.1.1	67.2 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	43.2 V	$0.9 U_N$	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	52.8 V	$1.1 U_N$	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	28.8 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	67.2 V	$1.4 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	33.4 V	$0.7 U_N$	1 s	Criterion A	No errors observed	Pass
	5.1.2	60 V	$1.25 U_N$	1 s	Criterion A	No errors observed	Pass
	5.1.3	28.8 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.3	0 V	$0 U_N$	30 ms	Criterion A	See Note 2	N/A
	12.2.6	67.2 V	$1.4 U_N$	1 s	Criterion A	rise & fall time 0.1 s, No errors observed	Pass

**Notes:**

- 1) tested with low impedance (according to EN 61000-4-29)
- 2) test only applicable for class C2 equipment. Here the equipment meets class C1 requirements.



EUT2 (NB3800-3LWacCGePbDe):

$U_N = 72 \text{ VDC}$ :

Standard	Chapter	Voltage		Duration	Requirements	Notes	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 3)	$0 U_N$	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 3)	$0 U_N$	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

$U_N = 110 \text{ VDC}$ :

Standard	Chapter	Voltage		Duration	Requirements	Notes	Verdict
EN 50155	5.1.1.1	66.0 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	154.0 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	154.0 V	$1.4 U_N$	1 s	Criterion C	No errors observed	Pass
	5.1.1.2	0 V (Note 3)	$0 U_N$	10 ms	Criterion A	No errors observed	Pass
	5.1.2	99.0 V	$0.9 U_N$	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	121.0 V	$1.1 U_N$	Unlimited	Criterion A	No errors observed	Pass
	5.1.2	66.0 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	154.0 V	$1.4 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.2	77.0 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	66.0 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.3	0 V (Note 3)	$0 U_N$	30 ms	Criterion A	No errors observed	Pass
	12.2.6	154.0 V	$1.4 U_N$	1 s	Criterion A	rise & fall time 0.1 s, No errors observed	Pass

Note:

- 3) tested with low impedance (according to EN 61000-4-29)

## 14.7 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

<i>Equipment:</i>	EUT1 (NB3800-4L2WacDe-G) EUT2 (NB3800-3LWacCGePbDe)
<i>Cables connected:</i>	See chapter 12.4
<i>Operating mode:</i>	See chapter 12.5
<i>Observation of EUT:</i>	See chapter 12.6
<i>Modifications:</i>	none
<i>Test site:</i>	Safety Laboratory

### Protocol of the Test

#### EUT1 (NB3800-4L2WacDe-G):

Standard	Chapter	Test	Voltage	Behavior of EUT	Verdict
EN 50155	12.2.9.1	Insulation test (Note)	500 VDC	No essential change, >100 MOhm	Pass
	12.2.9.2	Voltage withstand test	± 710 VDC	No breakdown	Pass

#### EUT2 (NB3800-3LWacCGePbDe):

Standard	Chapter	Test	Voltage	Behavior of EUT	Verdict
EN 50155	12.2.9.1	Insulation test (Note)	1000 VDC	No essential change, >100 MOhm	Pass
	12.2.9.2	Voltage withstand test	± 1410 VDC	No breakdown	Pass

Note: Measured before and after voltage withstand test

## 15. 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 %