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**STS 0001**

Schweizerischer Prüfstellendienst  
Service suisse d'essai  
Swiss testing service



Report:	<b>Electromagnetic Compatibility</b>	Report no:	<b>16-EL-0019.E01</b>
Test item description:	<b>NB3800</b>	Date of test:	<b>February 17 to 18, 2015</b>
Applicant:	<b>NetModule AG Meriedweg 11 3172 Niederwangen bei Bern SWITZERLAND</b>	Model/Type reference:	<b>NB3800-2LWacDf-G</b>
Manufacturer:	<b>NetModule AG</b>	Serial no:	<b>00112BFFDD0E</b>

Standards		Result
<b>EN 50121-3-2 : 2015</b>	Railway applications - EMC - Part 3-2: Rolling stock - Apparatus	<b>Pass</b>
<b>EN 50155 : 2007</b>	Railway applications – Electronic equipment used on rolling stock	<b>See § 2</b>
<b>EN 55022 : 2010</b>	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement: Class B	<b>Pass</b>
<b>EN 61000-6-2 : 2005</b>	EMC - Part 6-2: Generic standards - Immunity for industrial environments	<b>Pass</b>
<b>EN 301 489-1 V1.9.2</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 1: Common technical requirements	<b>Pass</b>
<b>EN 301 489-7 V1.3.1</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)	<b>Pass</b>
<b>EN 301 489-17 V2.2.1</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment; Part 17: Specific conditions for Broadband Data Transmission Systems	<b>Pass</b>
<b>EN 301 489-24 V1.5.1</b>	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA and E-UTRA) for Mobile and portable (UE) radio and ancillary equipment	<b>Pass</b>
<b>CFR 47 Part 15 - B: 2014</b>	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"	<b>Pass</b>

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**Fehraltorf, 2016-03-11**

**(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, WLAN) and GPS they are offering highly-available connectivity with seamless handover between the broadband links using to the Mobile IP protocol. In this test report only the version NB3800-2LWacDf-G has been tested.

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

§	Test Type	Result
<b>12</b>	<b>Emission</b>	<b>EN 50121-3-2</b>
12.1	Interference voltage EN 55011 CISPR 11	<b>PASS</b>
12.3	Radiated electromagnetic field EN 55011 CISPR 11	<b>PASS</b>
<b>13</b>	<b>Immunity</b>	<b>EN 50121-3-2</b>
13.1	Electrostatic discharges EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
13.2	Electromagnetic fields EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
13.3	Fast electric transients (Burst) EN 61000-4-4 IEC 61000-4-4	<b>PASS</b> <sup>1</sup>
13.4	Surges EN 61000-4-5 IEC 61000-4-5	<b>PASS</b>
13.5	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)

§	Test Type	Result
<b>12</b>	<b>Emission</b>	<b>EN 50155</b>
12.1	Interference voltage EN 55011 CISPR 11	<b>PASS</b>
12.3	Radiated electromagnetic field EN 55011 CISPR 11	<b>PASS</b>
<b>13</b>	<b>Immunity</b>	<b>EN 50155</b>
--	Visual inspection EN 50155 §12.2.1	<b>PASS</b>
13.6	Performance test EN 50155 §12.2.2	<b>PASS</b>
13.6	Supply overvoltages EN 50155 §12.2.6	<b>PASS</b>
13.4	Surges, electrostatic discharge and transient burst susceptibility tests EN 50155 §12.2.7	<b>PASS</b>
13.5	Radio interference test EN 50155 §12.2.8	<b>PASS</b> <sup>2</sup>
13.7	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)

§	Test Type	Result
<b>12</b>	<b>Emission</b>	<b>EN 55022</b>
12.1	Interference voltage EN 55022 CISPR 22	<b>PASS</b>
12.2	Common mode at telecom. ports EN 55022 CISPR 22	<b>PASS</b>
12.3	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>

1. No AC Mains port

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

§	Test Type	Result
<b>13</b>	<b>Immunity</b>	<b>EN 61000-6-2</b>
13.1	Electrostatic discharges EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
13.2	Electromagnetic fields EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
13.3	Fast electric transients (Burst) EN 61000-4-4 IEC 61000-4-4	<b>PASS <sup>1</sup></b>
13.4	Surges EN 61000-4-5 IEC 61000-4-5	<b>PASS</b>
13.5	Radio frequency common mode EN 61000-4-6 IEC 61000-4-6	<b>PASS <sup>1</sup></b>
--	Magnetic fields (industrial frequencies) EN 61000-4-8 IEC 61000-4-8	<b>Not applicable <sup>2</sup></b>
--	Voltage dips and interruptions EN 61000-4-11 IEC 61000-4-11	<b>Not applicable <sup>2</sup></b>

1. USB port not tested, service port

2. No AC Mains port

## 5. 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>12</b>	<b>Emission</b>	<b>EN 301 489-x mobile equipment</b>
12.1	Interference voltage EN 55022 CISPR 22	<b>PASS</b>
12.2	Common mode at telecom. ports EN 55022 CISPR 22	<b>PASS</b>
12.3	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>13</b>	<b>Immunity</b>	<b>EN 301 489-x mobile equipment</b>
13.1	Electrostatic discharges EN 61000-4-2 IEC 61000-4-2	<b>PASS</b>
13.2	Electromagnetic fields EN 61000-4-3 IEC 61000-4-3	<b>PASS</b>
13.3	Fast electric transients (Burst) EN 61000-4-4 IEC 61000-4-4	<b>PASS <sup>2</sup></b>
13.4	Surges EN 61000-4-5 IEC 61000-4-5	<b>PASS</b>
13.5	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

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

§	Test Type	Result
12	Emission	CFR 47 ICES-003 RSS-310 Industry Canada
--	Conducted emission	CFR 47 § 15.107 (Class B) ICES-003 §5.3 (Class B) Not applicable <sup>1</sup>
12.5	Radiated emission – EM-field	CFR 47 § 15.109 (Class B) ICES-003 §5.5 (Class B) PASS

1. No AC Mains port

## 7. 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 55011 : 2009 + A1:2010 CISPR 11 : 2009 + A1:2010	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement
EN 55022 : 2010 CISPR 22 : 2008	Information technology equipment Radio disturbance characteristics – Limits and methods of measurement
EN 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 61000-6-2 : 2005 IEC 61000-6-2 : 2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 301 489-1 V1.9.2 : 2011	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 1: Common technical requirements
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"



## 8. 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>

## 9. Applicant

<i>Client name and address</i>	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern SWITZERLAND
<i>Contact Person</i>	Dr. Thomas Siegrist
<i>Telephone</i>	+41 52 209 00 41
<i>E-mail</i>	Thomas.Siegrist@netmodule.com

## 10. Equipment Under Test

### 10.1 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>	NB3800
<i>Product description</i>	Railway Router with Mobile, WLAN and GPS
<i>Model/type reference</i>	NB3800-2LWacDf-G
<i>Serial number</i>	00112BFFDD0E
<i>Highest frequency</i>	CPU Clock: 400 MHz PCI Express: 2500 MHz DDR2SDRAM: 266 MHz USB: 480 MHz DC/DC Converter (Main): < 1 MHz
<i>Supply</i>	U = 12 – 60 VDC / I = 1.3 A / P = 15 W U = 24 – 48 VDC according EN 50155
<i>Dimension</i>	~ 190 mm x 105 mm x 104 cm (w x d x h)
<i>Weight</i>	~ 1.25 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.

## 10.2 Product Family

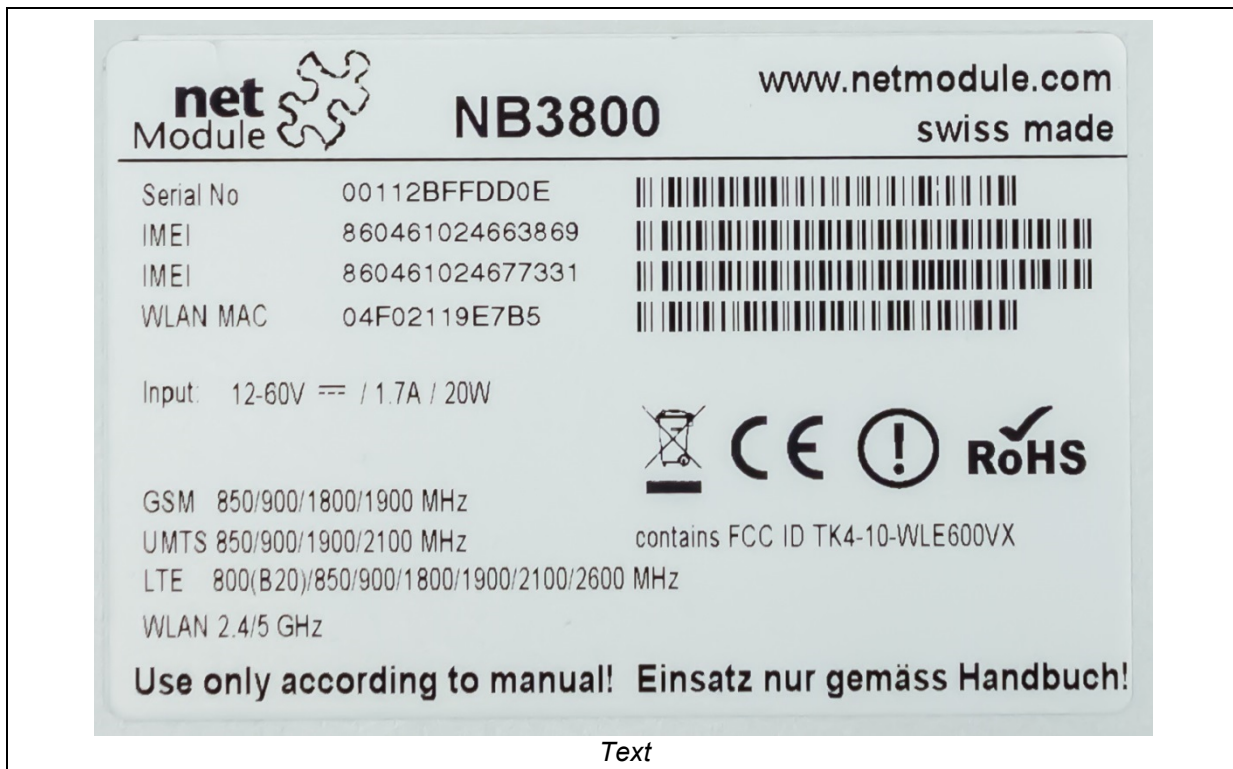
Tested Equipment	Covered Variants	Explanation <sup>1)</sup>
NB3800-2LWacDf-G	NB3800-H <sub>1</sub> ...H <sub>n</sub> -S <sub>1</sub> ...S <sub>n</sub>	<p>All covered NB3800 variants contain the same CP Modules, MC Boards, and PSE Boards, have the same case and the same form factor.</p> <p>They can host up to six communication and other interface modules. These modules can even include a GPS module. There can be up to 5 antenna connectors.</p> <p>The 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 communication modules included:</p> <p>R: none, router only  Ed: 2G = GPRS/EDGE  U: 3G+ = 2G+UMTS/HSPA/HSPA+  L: 4G = 3G+ + LTE  La: LTE 450MHz  Lb: LTE US  Ca: CDMA450  Gr: GSM-R  Ge: GNSS  W: WLAN a/b/g/n Client &amp; Access Point  Wac : WiFi a/b/g/n/ac 2.4 / 5 GHz  A: Audio in/out  C: CAN-bus  Sa: RS-485 (on the same module as CAN)  I: IBIS-bus  Sb: RS-232 (on the same module as IBIS)  Da: Data Storage 32 GB  Db: Data Storage 64 GB  Dc: Data Storage 128 GB  Dd: Data Storage 256 GB  De: Data Storage 512 GB  Df: Data Storage 1 TB  ... (more to follow)</p> <p>'S<sub>1</sub>...S<sub>n</sub>' indicate the software options activated:</p> <p>G: GPS  V: Voice gateway  M: Mobile IP (Client)  S: Server</p> <p>The following NB3800 variants are currently available or planned:</p> <p>NB3800-L-G  NB3800-LWac-G  NB3800-2LWac-G  NB3800-2LWacGe  NB3800-2LWacDf-G  NB3800-2L2Wac-G  NB3800-3LWac-G  NB3800-4L-G</p>

<sup>1)</sup> according to information of the customer and not verified by electrosuisse

### 10.3 Pictures of the EUT



## 10.4 Marking Plate of the EUT



## 10.5 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 55022 CISPR 22	<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 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).

## 10.6 Ports

Port	Cable			Remark
	Max. length	Type	Screen	
DC Supply	Not defined	2 wires	No	<i>If not stated otherwise, powered with Lab Supply</i>
Ethernet 1	< 100m	M12	Yes	<i>no cable connected</i>
Ethernet 2	< 100m	M12	Yes	<i>FastEthernet</i>
Ethernet 3	< 100m	M12	Yes	<i>no cable connected</i>
Ethernet 4	< 100m	M12	Yes	<i>no cable connected</i>
Ethernet 5	< 100m	M12	Yes	<i>GBit Ethernet</i>
RS232	< 10 m	3 wire	Yes	<i>Connected to Test-PC</i>
USB Type A connector (Service Port)	< 3m	USB	Yes	<i>no cable connected</i>
WLAN 1	< 30 m	BNC (Coax)	Yes	<i>Connected to multiband-antenna</i>
Mob 1&2 (GSM, UMTS, LTE)	< 30 m	BNC (Coax)	Yes	<i>Connected to multiband-antenna</i>
GPS	< 30 m	BNC (Coax)	Yes	<i>Connected to multiband-antenna</i>



## 11. Test Conditions

### 11.1 Climatic conditions, location and date

Location	Date	Temp	Pressure [QFE]	Rel. humidity
Electrosuisse Albislab Albisriederstrasse 199 8047 Zürich SWITZERLAND	February 17 to February 18, 2015	$24 \pm 3 \text{ }^{\circ}\text{C}$	$980 \pm 30 \text{ hPa}$	$30 \pm 5 \%$

### 11.2 Test facility and methodology

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

### 11.3 Attendant Persons

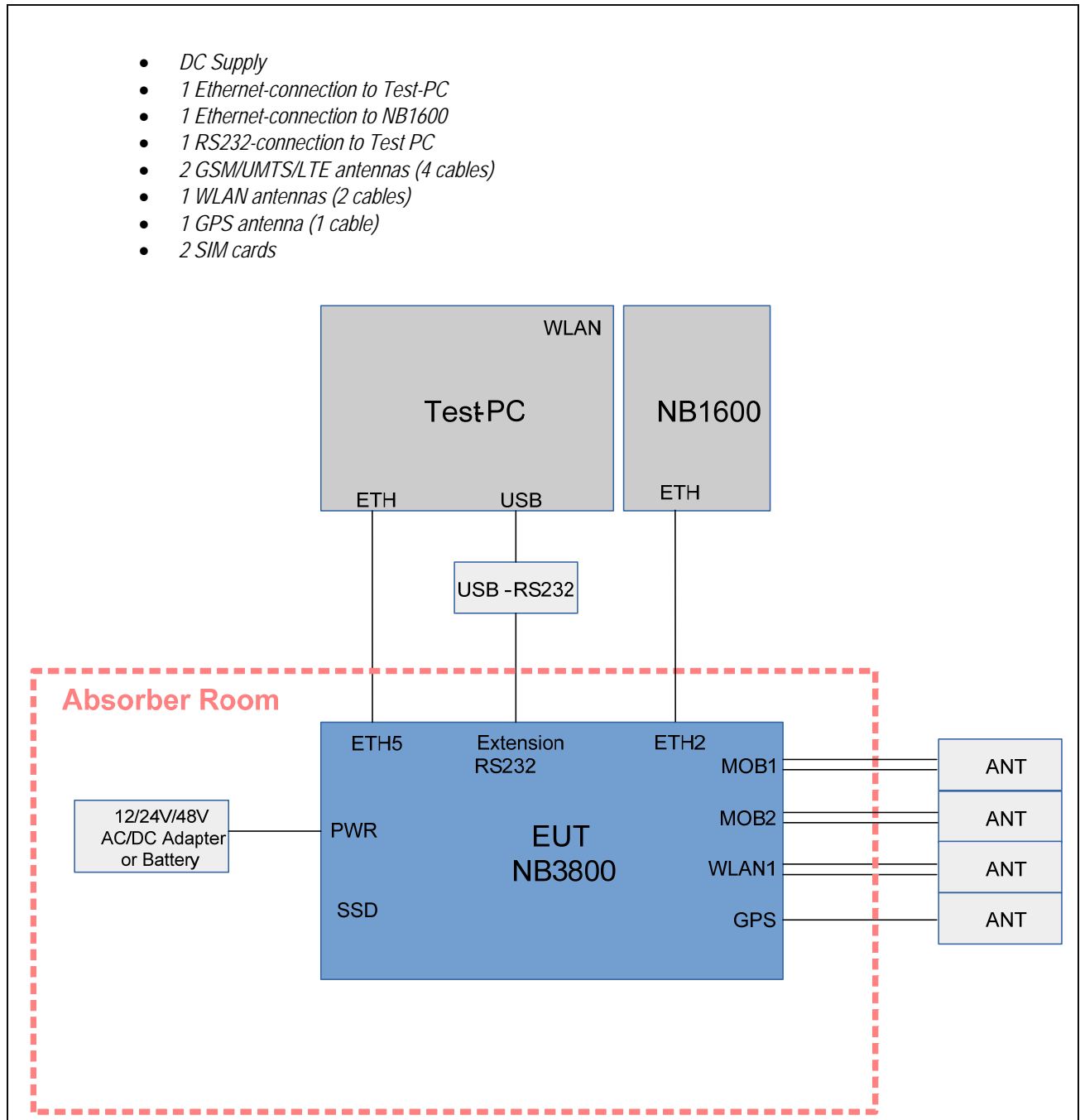
#### Test Engineer(s):

Mr Daniel Rufer

#### Other(s):

Name	Company
Mr Raffael Rohrer	NetModule AG

## 11.4 Test Configuration



## 11.5 Operating Conditions

### Normal mode:

- Ping over WLAN 1
- Ping over WWAN 1 & 2 (UMTS/LTE)
- Ping over Ethernet 2 & 5 cable
- Access to SSD disc
- Access with serial connection

*powered with 24 VDC unless otherwise specified*

## 11.6 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*

## 11.7 Auxiliary Equipment

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

Product	Brand	Model No.	SN
Test-PC / Notebook	Dell	E5430	B2DT3X1
USB-to-RS232 Adapter	MOXA	USB UPORT 1150I	--
Router	NetModul	NB1600	00112B0020BB
WWAN Antenna	n/a	Antenna-Roof-2L DL-9	A140812300036
GPS Antenna	REEL	C70ZAR 0300 00 03 03 PWN1	02 1501
WLAN Antenna	--	Antenna-Roof-2W	--
SMA – BNC Adapter	--	--	--
Power Supply 1	Hameg	HM8143	Q10153
Power Supply 2	Oltronix	B603D	Q2722

## 11.8 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.	<i>No transmission loss LAN, WWAN (UMTS/LTE), WLAN</i>
<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.	<i>During the test:</i> - <i>short interruptions of the communication allowed</i> - <i>LED's may flicker</i>  <i>After the test the EUT shall operate as in normal mode</i>
<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>

## 12. Emission Tests

### 12.1 Interference Voltage (V-LISN)

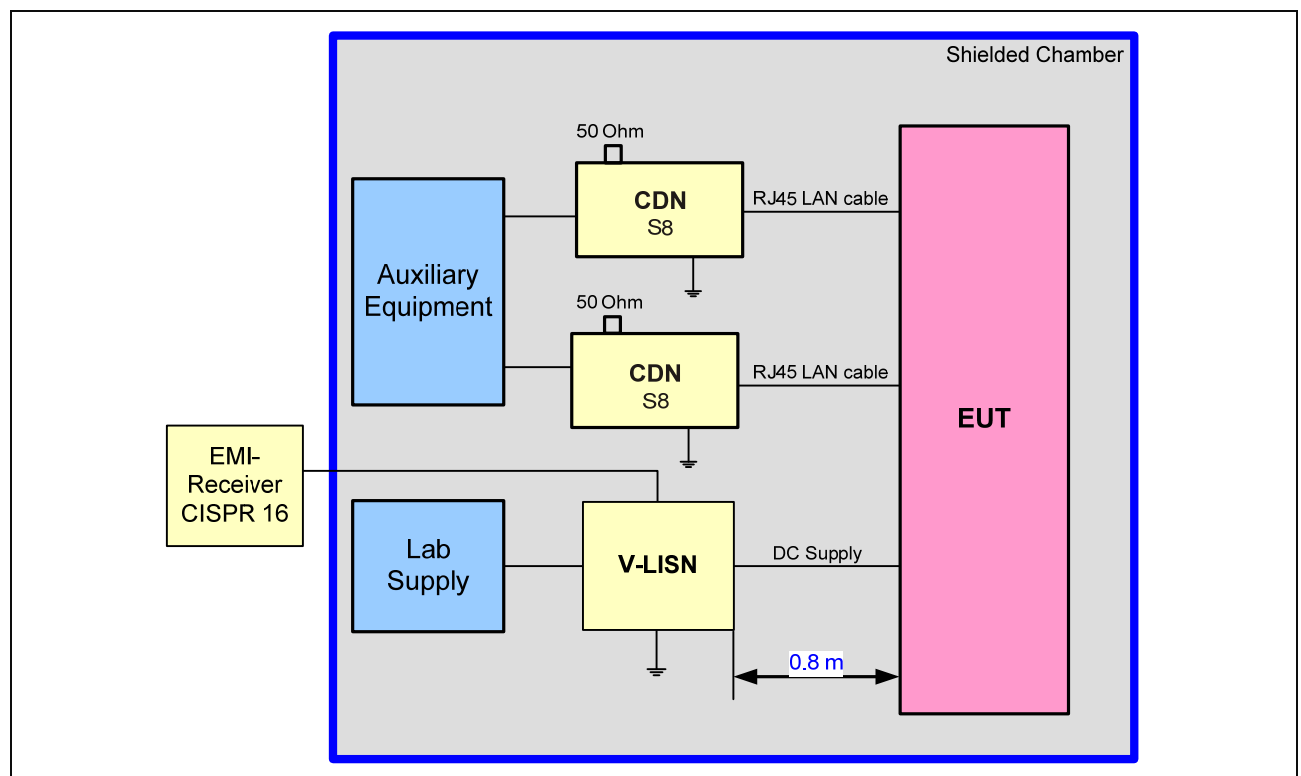
*Test site:* shielded room

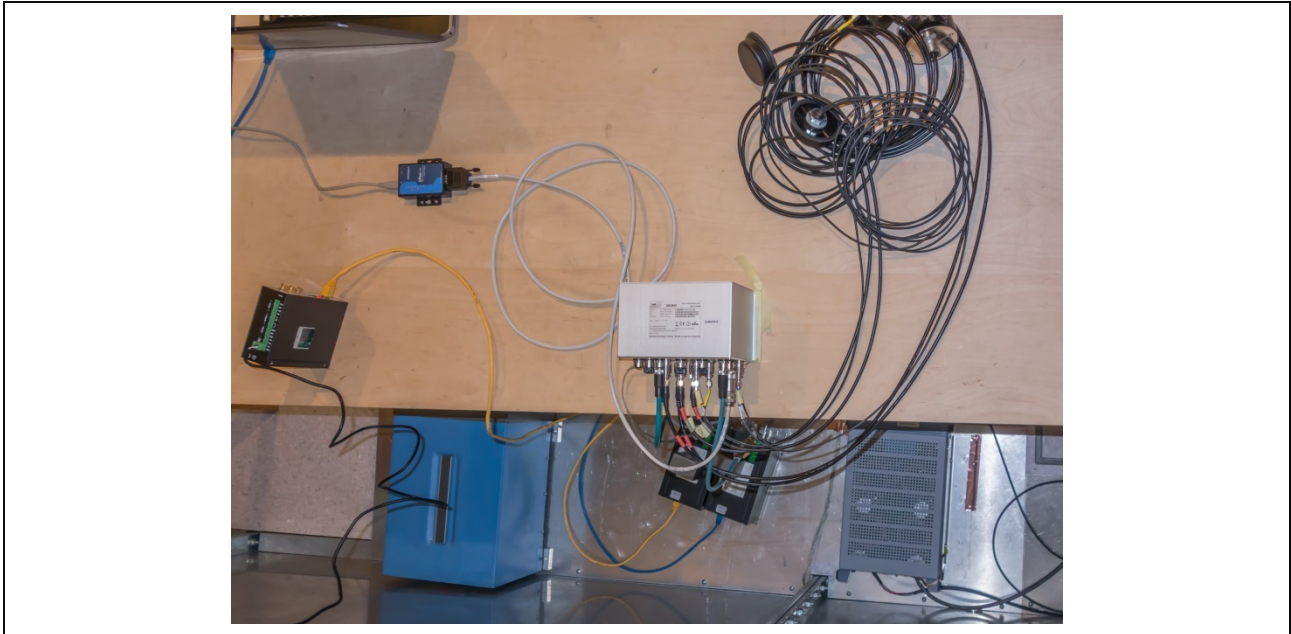
*Meas. uncertainty:* see chapter 14

*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



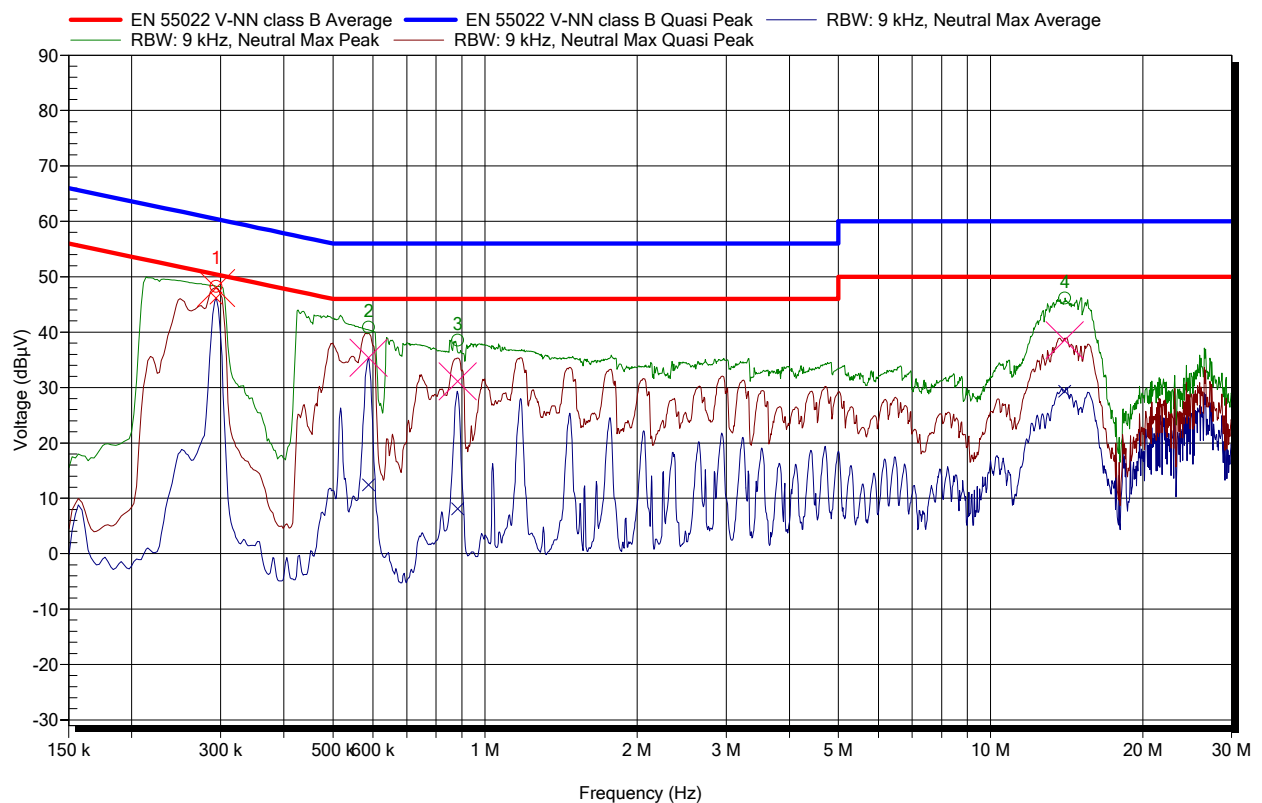
**Photo of the Setup****Test Equipment**

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	Oltronix	B603D	Q2722

## Measurement Results

### Measurement 1:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 60 VDC
<b>Test date, time</b>	17.02.2016 15:32:38
<b>Interface / Line under test</b>	DC Port, Minus (N)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s

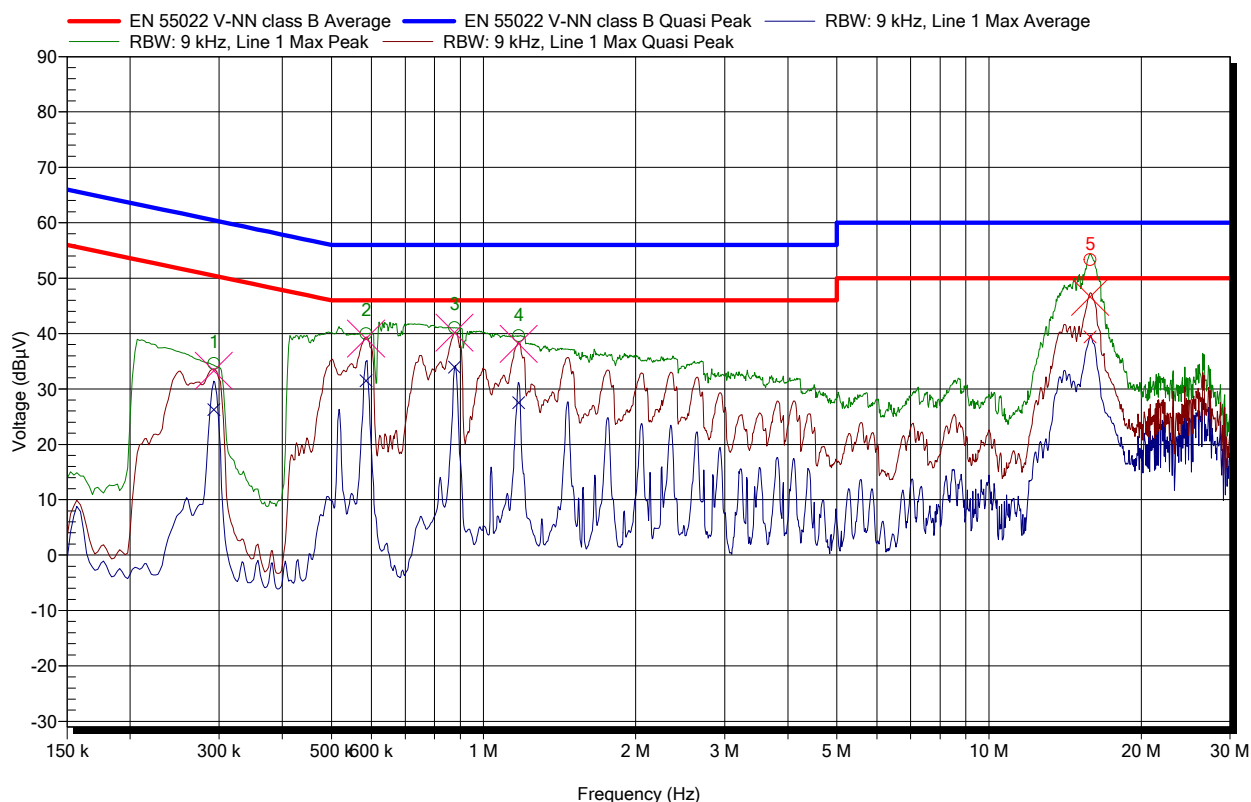


### Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	293.717 kHz	48.29 dBμV	46.15 dBμV	-4.27 dB	47.98 dBμV	-12.44 dB	Pass
2	588.015 kHz	40.86 dBμV	12.4 dBμV	-33.6 dB	35.39 dBμV	-20.61 dB	Pass
3	882.62 kHz	38.56 dBμV	8.11 dBμV	-37.89 dB	31.09 dBμV	-24.91 dB	Pass
4	14.026 MHz	46.16 dBμV	29.31 dBμV	-20.69 dB	38.54 dBμV	-21.46 dB	Pass

## Measurement 2:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 60 VDC
<b>Test date, time</b>	17.02.2016 15:34:54
<b>Interface / Line under test</b>	DC Port, Plus (L)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s



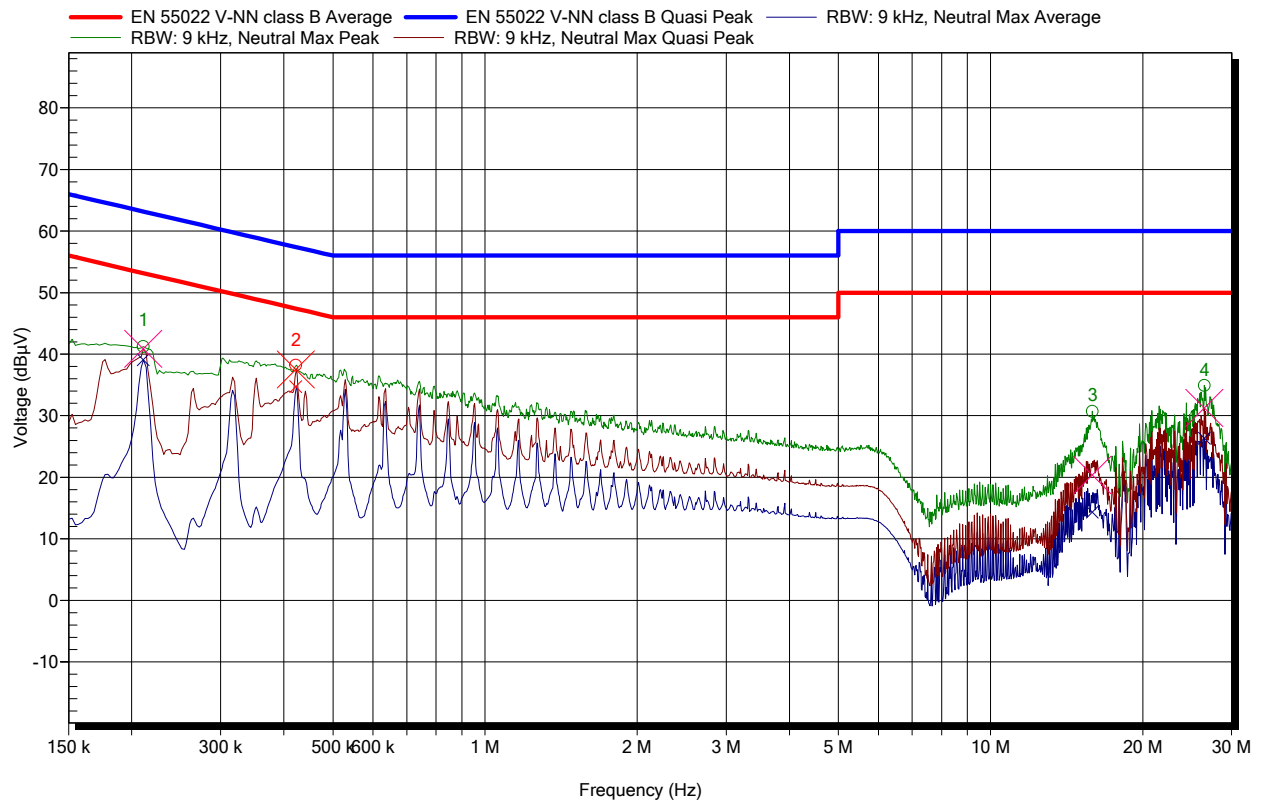
## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	292.635 kHz	34.57 dBμV	26.28 dBμV	-24.17 dB	33.28 dBμV	-27.17 dB	Pass
2	585.848 kHz	40.01 dBμV	31.48 dBμV	-14.52 dB	39.12 dBμV	-16.88 dB	Pass
3	876.75 kHz	41.05 dBμV	33.94 dBμV	-12.06 dB	40.14 dBμV	-15.86 dB	Pass
4	1.173 MHz	39.6 dBμV	27.51 dBμV	-18.49 dB	38.13 dBμV	-17.87 dB	Pass
5	15.846 MHz	53.37 dBμV	39.41 dBμV	-10.59 dB	46.65 dBμV	-13.35 dB	Pass



## Measurement 3:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 12 VDC
<b>Test date, time</b>	17.02.2016 15:42:18
<b>Interface / Line under test</b>	DC Port, Minus (N)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s

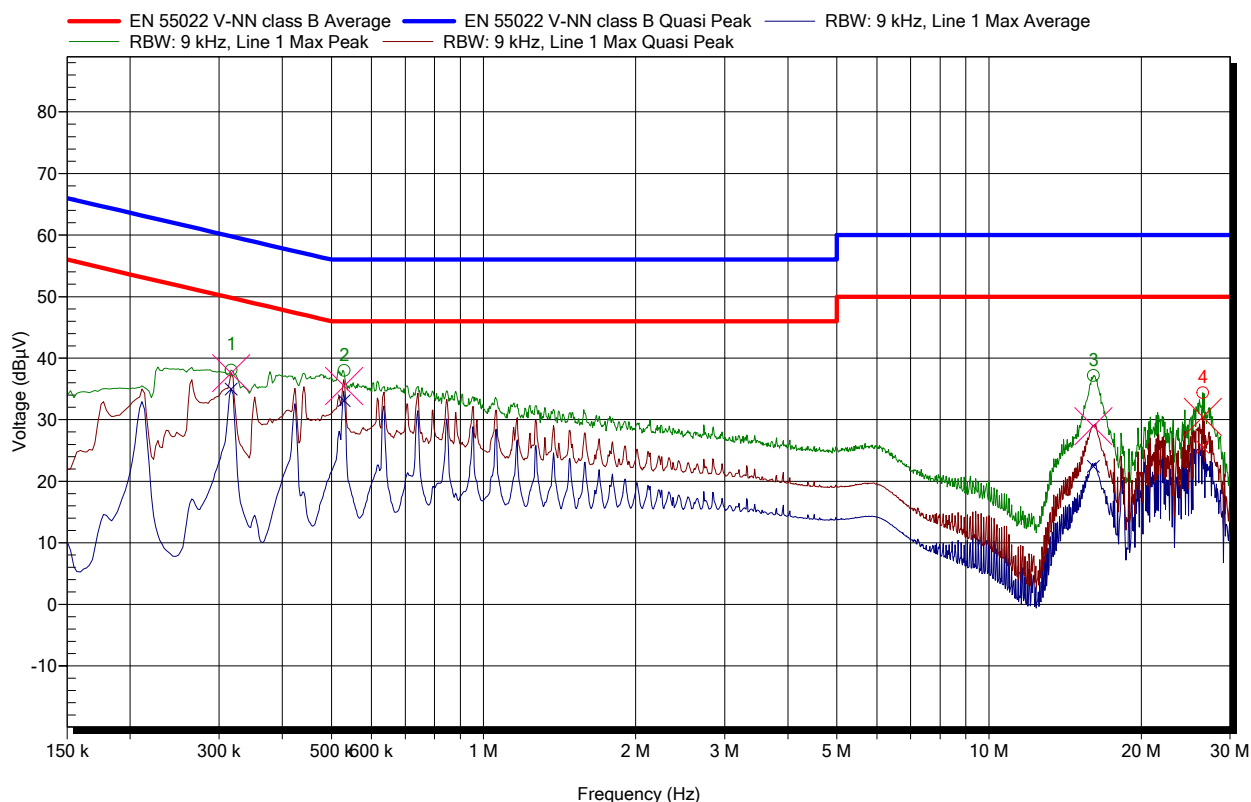


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	210.75 kHz	41.22 dBμV	39.08 dBμV	-14.09 dB	40.85 dBμV	-22.32 dB	Pass
2	422.25 kHz	38.21 dBμV	34.71 dBμV	-12.69 dB	37.53 dBμV	-19.88 dB	Pass
3	15.889 MHz	30.7 dBμV	14.31 dBμV	-35.69 dB	20.34 dBμV	-39.66 dB	Pass
4	26.486 MHz	34.95 dBμV	26.36 dBμV	-23.64 dB	31.27 dBμV	-28.73 dB	Pass

## Measurement 4:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 12 VDC
<b>Test date, time</b>	17.02.2016 15:43:22
<b>Interface / Line under test</b>	DC Port, Plus (L)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s

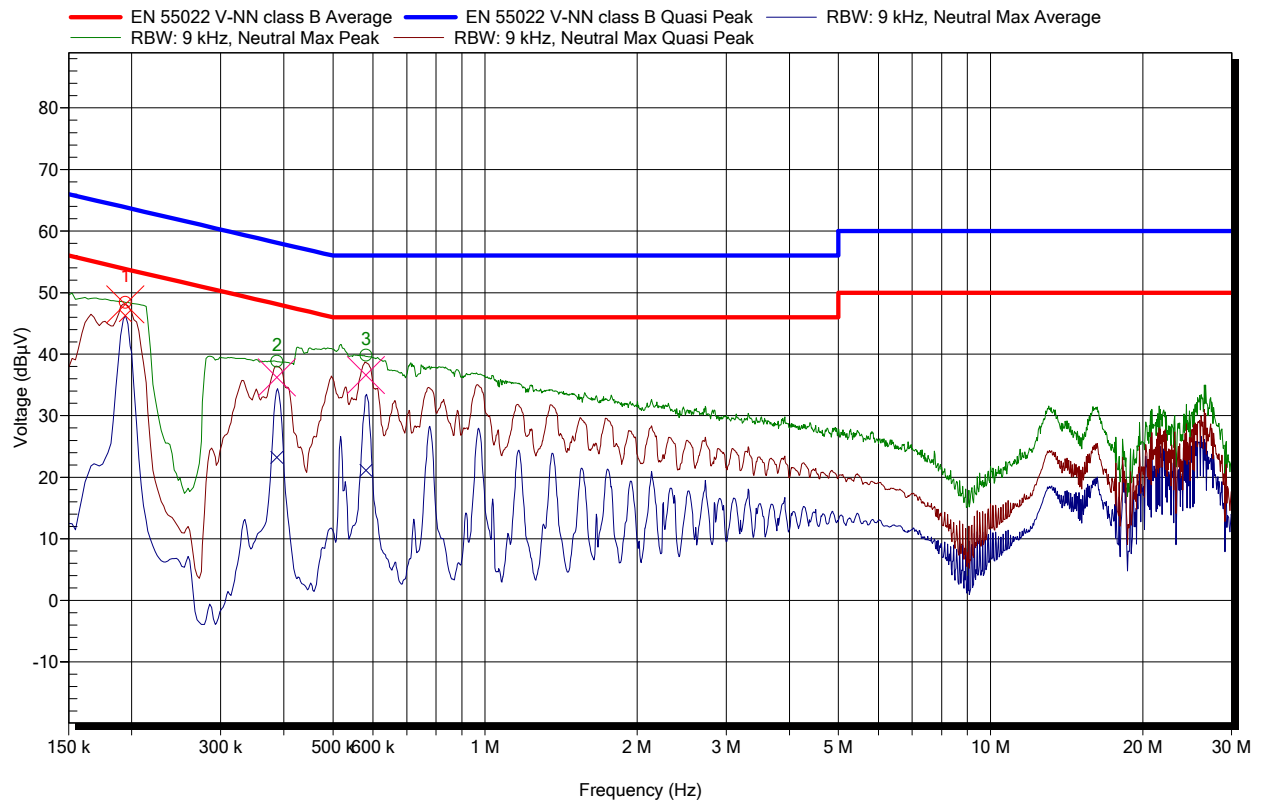


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	316.5 kHz	38.08 dBμV	34.96 dBμV	-14.84 dB	37.57 dBμV	-22.23 dB	Pass
2	530.261 kHz	37.98 dBμV	33.07 dBμV	-12.93 dB	35.49 dBμV	-20.51 dB	Pass
3	16.098 MHz	37.21 dBμV	22.43 dBμV	-27.57 dB	28.92 dBμV	-31.08 dB	Pass
4	26.486 MHz	34.4 dBμV	25.54 dBμV	-24.46 dB	30.44 dBμV	-29.56 dB	Pass

## Measurement 5:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 24 VDC
<b>Test date, time</b>	17.02.2016 15:46:21
<b>Interface / Line under test</b>	DC Port, Minus (N)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s

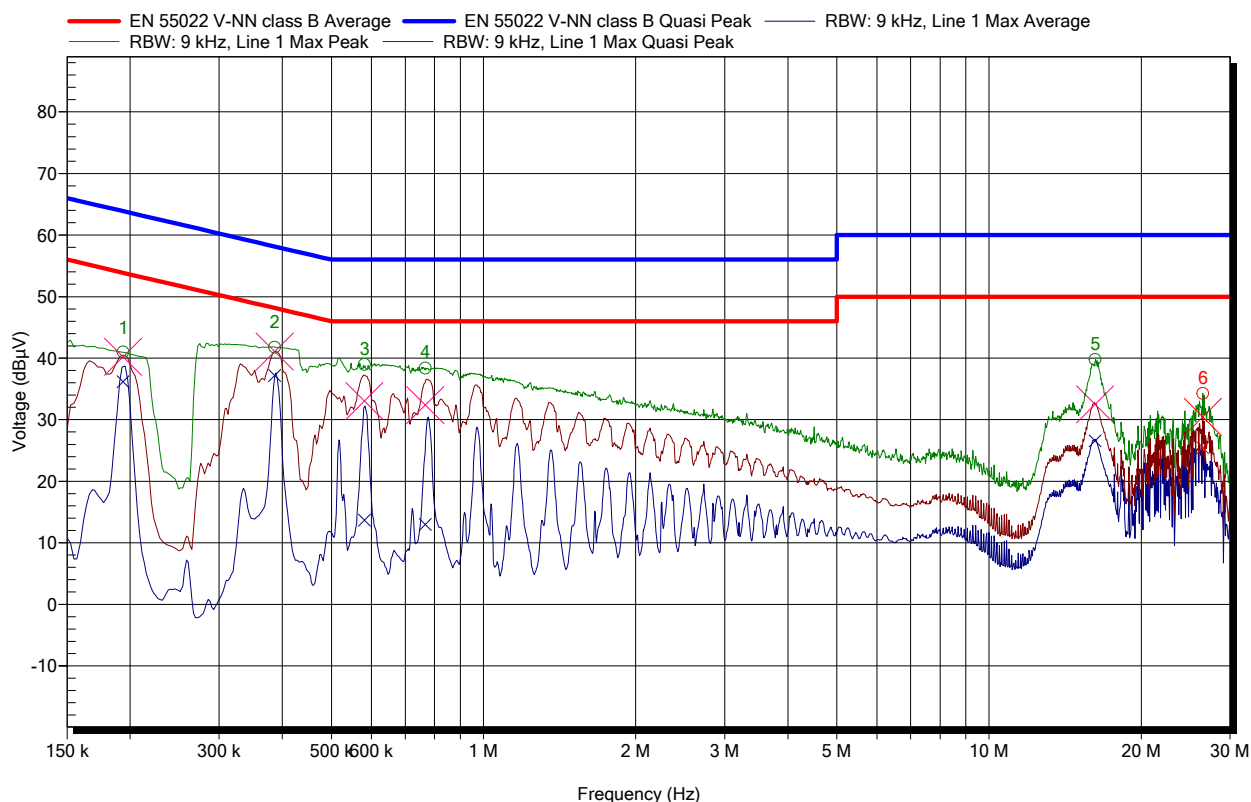


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	194.239 kHz	48.43 dBμV	46.25 dBμV	-7.6 dB	48.07 dBμV	-15.78 dB	Pass
2	387.429 kHz	38.87 dBμV	23.25 dBμV	-24.87 dB	36.2 dBμV	-21.92 dB	Pass
3	581.537 kHz	39.82 dBμV	21.13 dBμV	-24.87 dB	36.61 dBμV	-19.39 dB	Pass

## Measurement 6:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 24 VDC
<b>Test date, time</b>	17.02.2016 15:47:38
<b>Interface / Line under test</b>	DC Port, Plus (L)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s

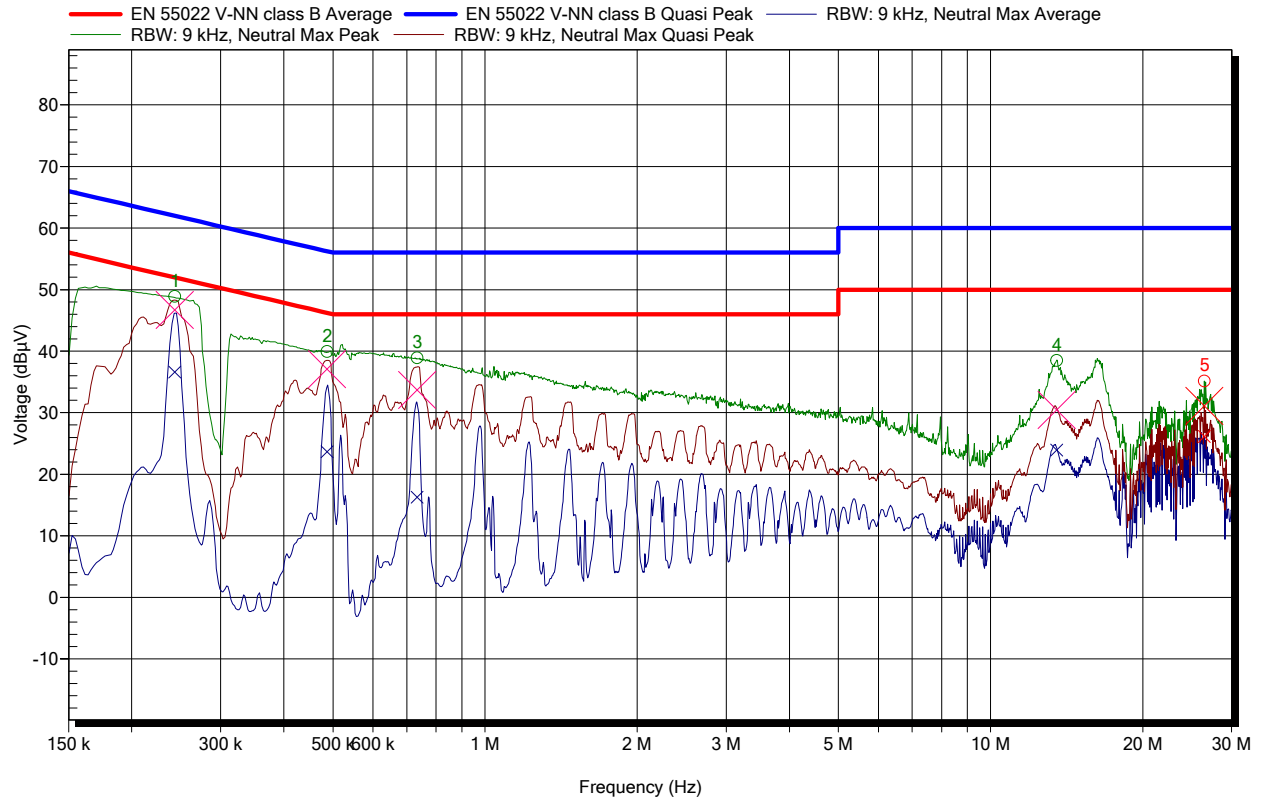


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	193.523 kHz	41.05 dBμV	36.17 dBμV	-17.72 dB	40.2 dBμV	-23.69 dB	Pass
2	386.25 kHz	41.8 dBμV	37.22 dBμV	-10.93 dB	41.1 dBμV	-17.05 dB	Pass
3	581.537 kHz	38.97 dBμV	13.7 dBμV	-32.3 dB	33.04 dBμV	-22.96 dB	Pass
4	767.08 kHz	38.39 dBμV	12.99 dBμV	-33.01 dB	32.41 dBμV	-23.59 dB	Pass
5	16.217 MHz	39.77 dBμV	26.58 dBμV	-23.42 dB	32.5 dBμV	-27.5 dB	Pass
6	26.486 MHz	34.26 dBμV	25.44 dBμV	-24.56 dB	30.46 dBμV	-29.54 dB	Pass

## Measurement 7:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 36 VDC
<b>Test date, time</b>	17.02.2016 15:49:25
<b>Interface / Line under test</b>	DC Port, Minus (N)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s

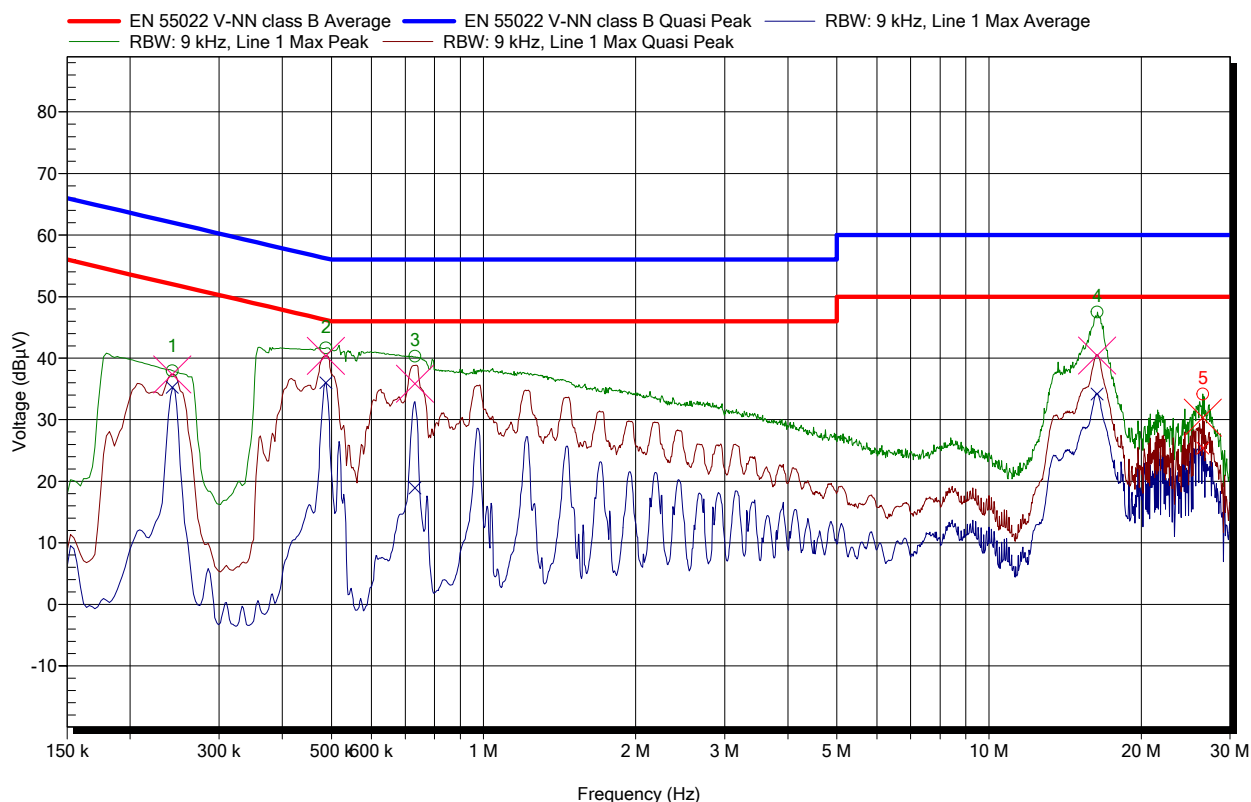


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	243.305 kHz	48.88 dBμV	36.58 dBμV	-15.4 dB	46.69 dBμV	-15.29 dB	Pass
2	487.09 kHz	39.94 dBμV	23.68 dBμV	-22.54 dB	37.09 dBμV	-19.13 dB	Pass
3	733.835 kHz	38.92 dBμV	16.25 dBμV	-29.75 dB	33.67 dBμV	-22.33 dB	Pass
4	13.515 MHz	38.48 dBμV	23.92 dBμV	-26.08 dB	30.43 dBμV	-29.57 dB	Pass
5	26.486 MHz	35.14 dBμV	26.15 dBμV	-23.85 dB	31.08 dBμV	-28.92 dB	Pass

## Measurement 8:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 36 VDC
<b>Test date, time</b>	17.02.2016 15:50:26
<b>Interface / Line under test</b>	DC Port, Plus (L)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s

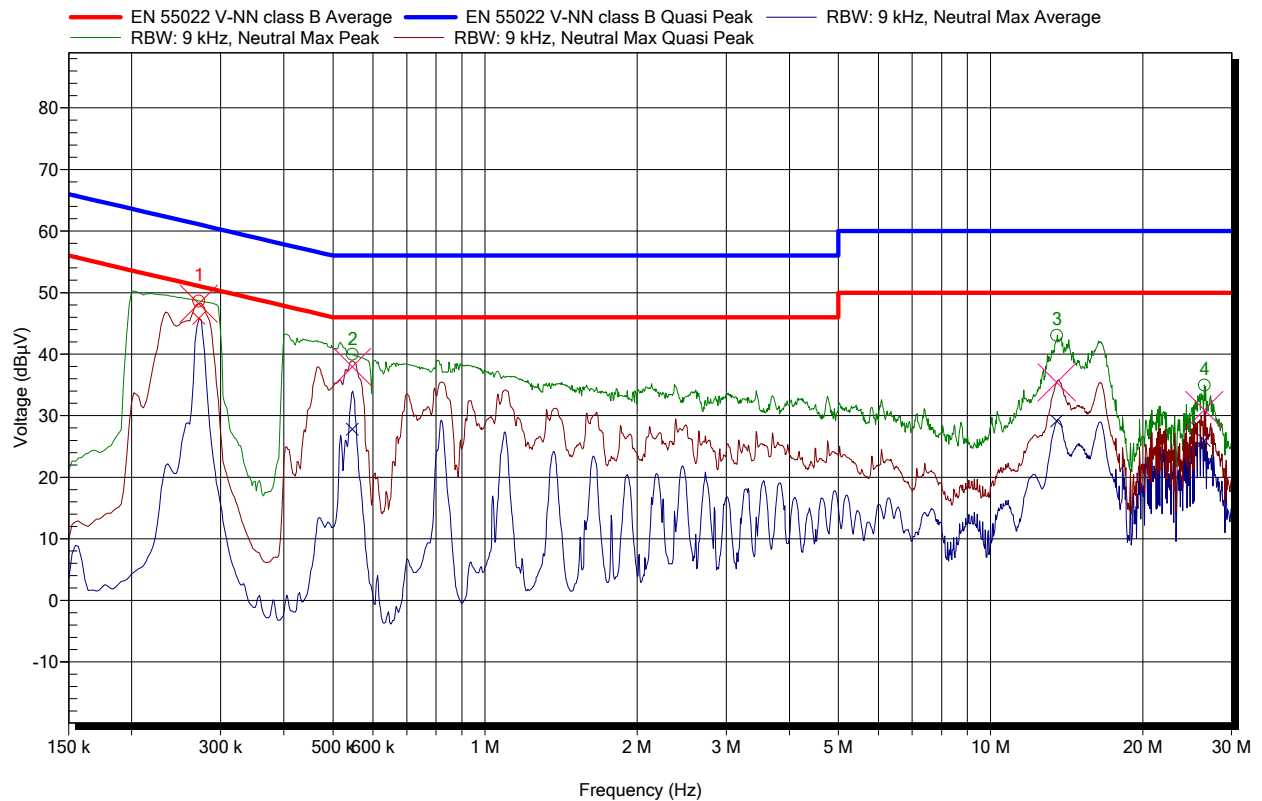


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	242.25 kHz	37.96 dBμV	35.27 dBμV	-16.75 dB	37.37 dBμV	-24.65 dB	Pass
2	487.5 kHz	41.65 dBμV	36 dBμV	-10.21 dB	40.39 dBμV	-15.82 dB	Pass
3	731.131 kHz	40.35 dBμV	18.93 dBμV	-27.07 dB	35.85 dBμV	-20.15 dB	Pass
4	16.37 MHz	47.48 dBμV	34.15 dBμV	-15.85 dB	40.44 dBμV	-19.56 dB	Pass
5	26.486 MHz	34.19 dBμV	25.4 dBμV	-24.6 dB	30.32 dBμV	-29.68 dB	Pass

## Measurement 9:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 48 VDC
<b>Test date, time</b>	17.02.2016 15:54:02
<b>Interface / Line under test</b>	DC Port, Minus (N)
<b>Transducer</b>	V-LISN 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: Auto [10 dB], Internal preamp: 0 dB, Measure time: 1 s

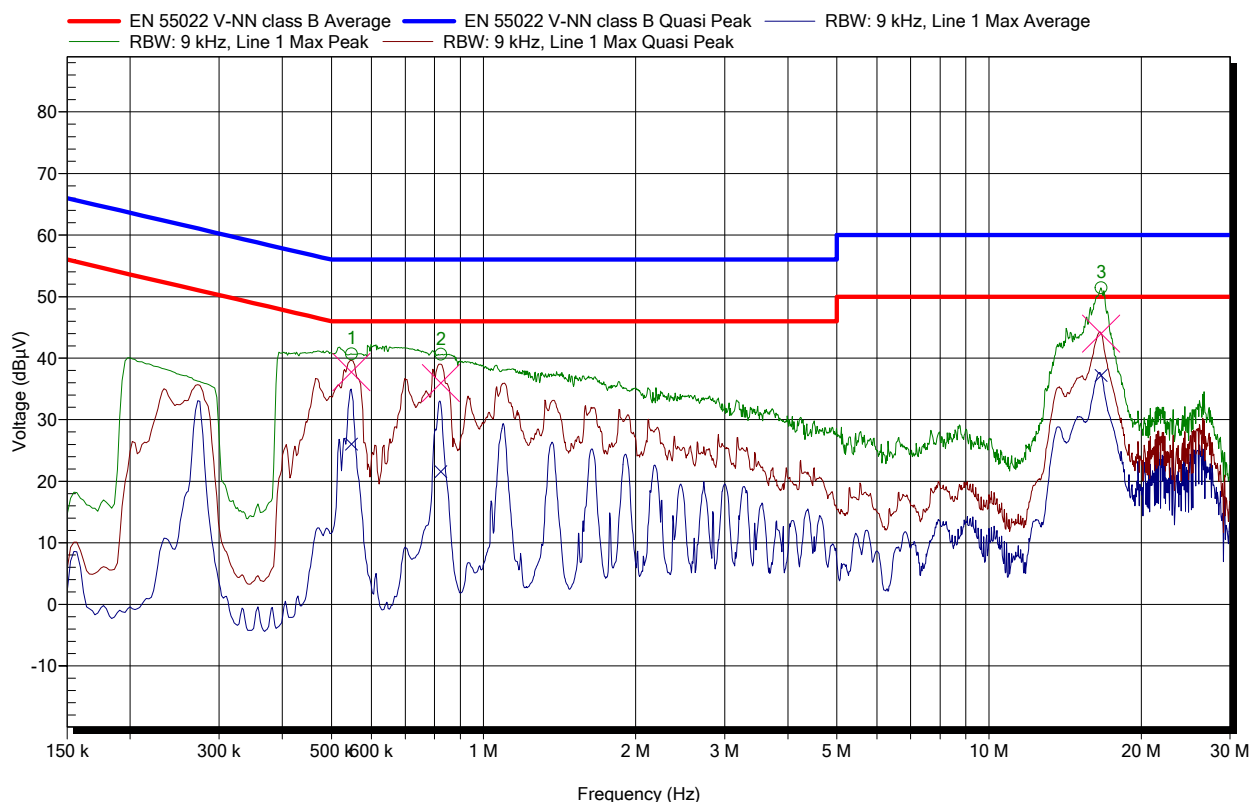


## Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	271.5 kHz	48.64 dBμV	45.84 dBμV	-5.24 dB	48.18 dBμV	-12.89 dB	Pass
2	546.158 kHz	40.02 dBμV	27.81 dBμV	-18.19 dB	37.97 dBμV	-18.03 dB	Pass
3	13.515 MHz	43.09 dBμV	29.14 dBμV	-20.86 dB	35.44 dBμV	-24.56 dB	Pass
4	26.486 MHz	35 dBμV	25.98 dBμV	-24.02 dB	30.92 dBμV	-29.08 dB	Pass

## Measurement 10:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 48 VDC
<b>Test date, time</b>	17.02.2016 15:55:11
<b>Interface / Line under test</b>	DC Port, Plus (L)
<b>Transducer</b>	V-LISN 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: 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	548.178 kHz	40.72 dBμV	26.03 dBμV	-19.97 dB	37.72 dBμV	-18.28 dB	Pass
2	822.824 kHz	40.66 dBμV	21.57 dBμV	-24.43 dB	35.96 dBμV	-20.04 dB	Pass
3	16.652 MHz	51.43 dBμV	37.19 dBμV	-12.81 dB	44 dBμV	-16 dB	Pass



## 12.2 Interference Voltage (LAN-Cable)

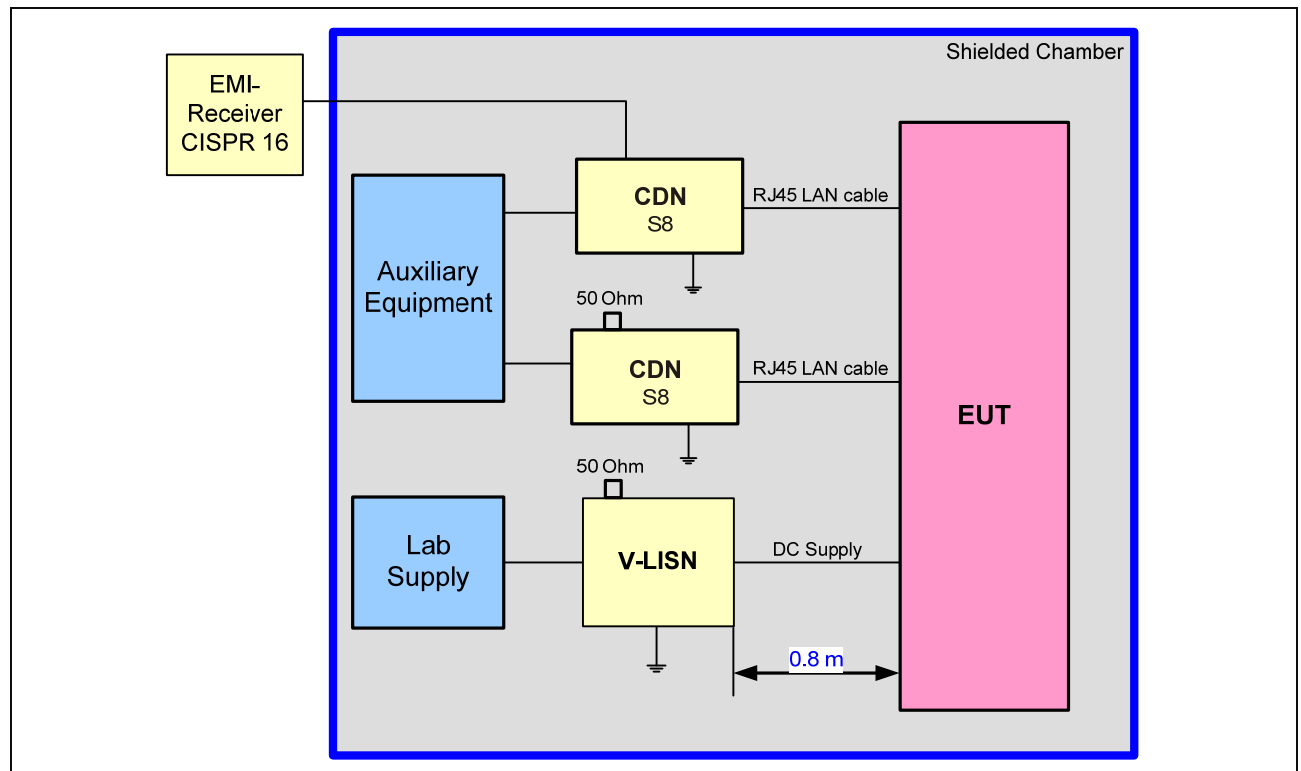
**Test site:** shielded room

**Meas. uncertainty:** see chapter 14

**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

see chapter 12.1

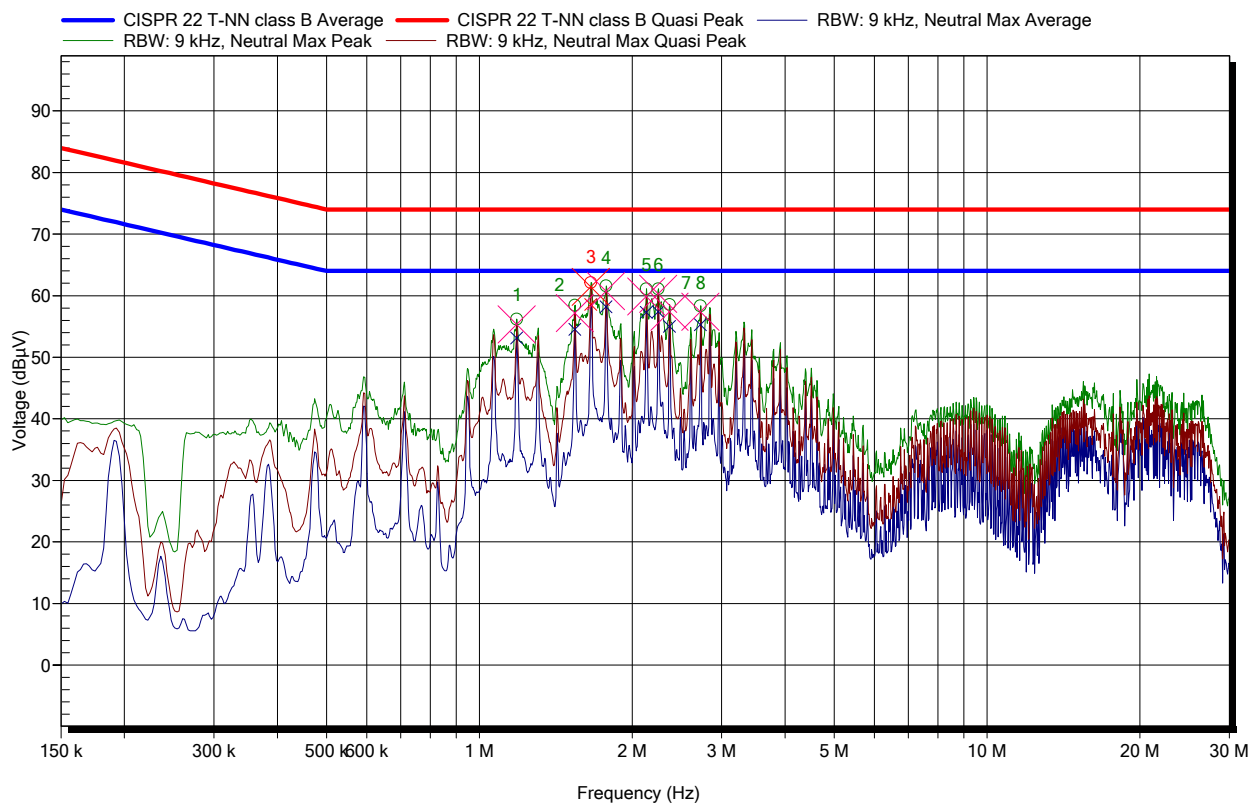
### Test Equipment

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	Oltronix	B603D	Q2722

## Measurement Results

### Measurement 1:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 24 VDC
<b>Test date, time</b>	17.02.2016 15:58:35
<b>Interface / Line under test</b>	Ethernet 5
<b>Transducer</b>	CDN S8
<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

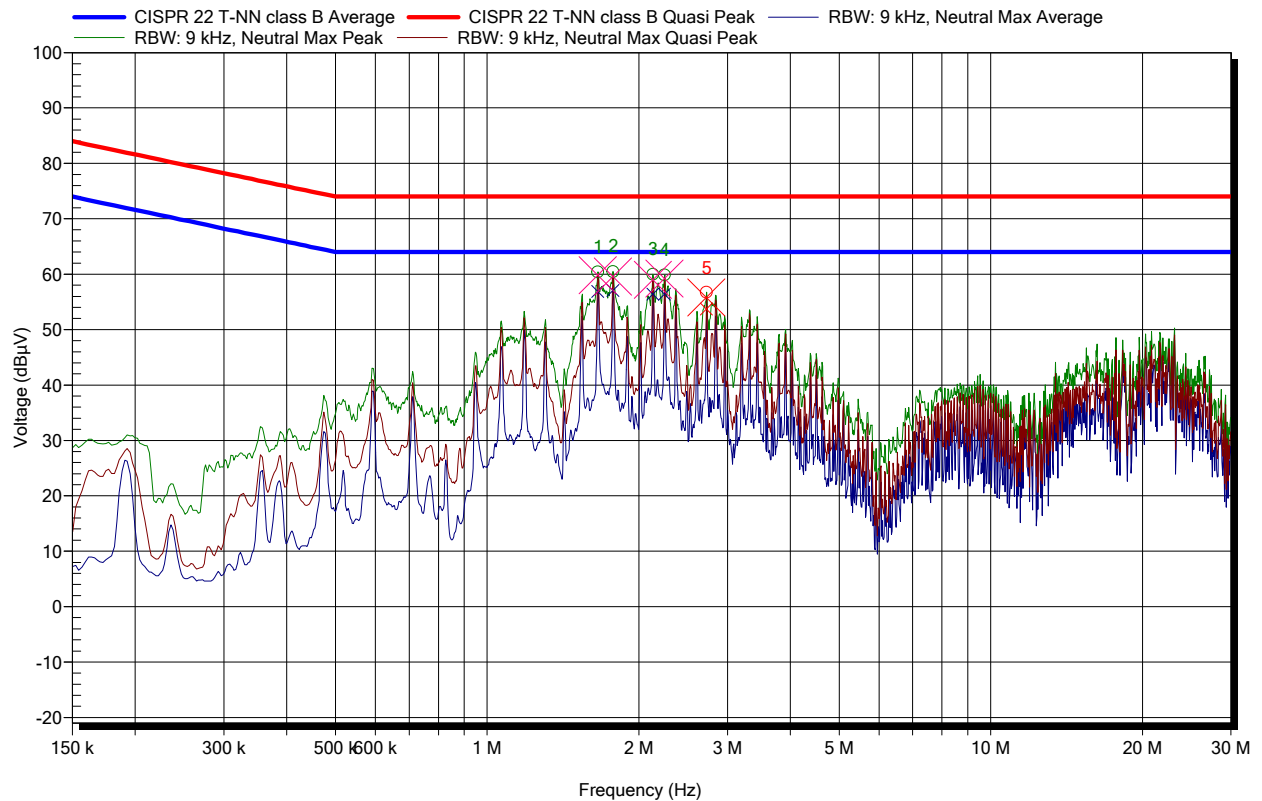


### Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
3	1.658 MHz	62.12 dBμV	58.56 dBμV	-5.44 dB	61.42 dBμV	-12.58 dB	Pass
4	1.777 MHz	61.59 dBμV	58.18 dBμV	-5.82 dB	60.73 dBμV	-13.27 dB	Pass
6	2.249 MHz	61.1 dBμV	57.4 dBμV	-6.6 dB	60.27 dBμV	-13.73 dB	Pass
5	2.132 MHz	61.12 dBμV	57.28 dBμV	-6.72 dB	59.89 dBμV	-14.11 dB	Pass
8	2.724 MHz	58.38 dBμV	55.26 dBμV	-8.74 dB	57.39 dBμV	-16.61 dB	Pass
7	2.369 MHz	58.6 dBμV	55.02 dBμV	-8.98 dB	57.37 dBμV	-16.63 dB	Pass
2	1.541 MHz	58.47 dBμV	54.51 dBμV	-9.49 dB	57.17 dBμV	-16.83 dB	Pass
1	1.185 MHz	56.2 dBμV	53.13 dBμV	-10.87 dB	55.36 dBμV	-18.64 dB	Pass

## Measurement 2:

<b>EUT</b>	NB3800-2LWacDf-G
<b>Verdict, Test</b>	Pass, Class B
<b>Mode of operation</b>	Normal mode, 24 VDC
<b>Test date, time</b>	17.02.2016 16:00:08
<b>Interface / Line under test</b>	Ethernet 2
<b>Transducer</b>	CDN S8
<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
2	1.777 MHz	60.45 dBμV	57.04 dBμV	-6.96 dB	59.56 dBμV	-14.44 dB	Pass
1	1.658 MHz	60.44 dBμV	56.86 dBμV	-7.14 dB	59.8 dBμV	-14.2 dB	Pass
3	2.132 MHz	60.03 dBμV	56.39 dBμV	-7.61 dB	58.97 dBμV	-15.03 dB	Pass
4	2.249 MHz	59.87 dBμV	56.38 dBμV	-7.62 dB	59.21 dBμV	-14.79 dB	Pass
5	2.724 MHz	56.74 dBμV	53.71 dBμV	-10.29 dB	55.8 dBμV	-18.2 dB	Pass

### 12.3 Radiated Electromagnetic Field (80 – 1000 MHz)

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

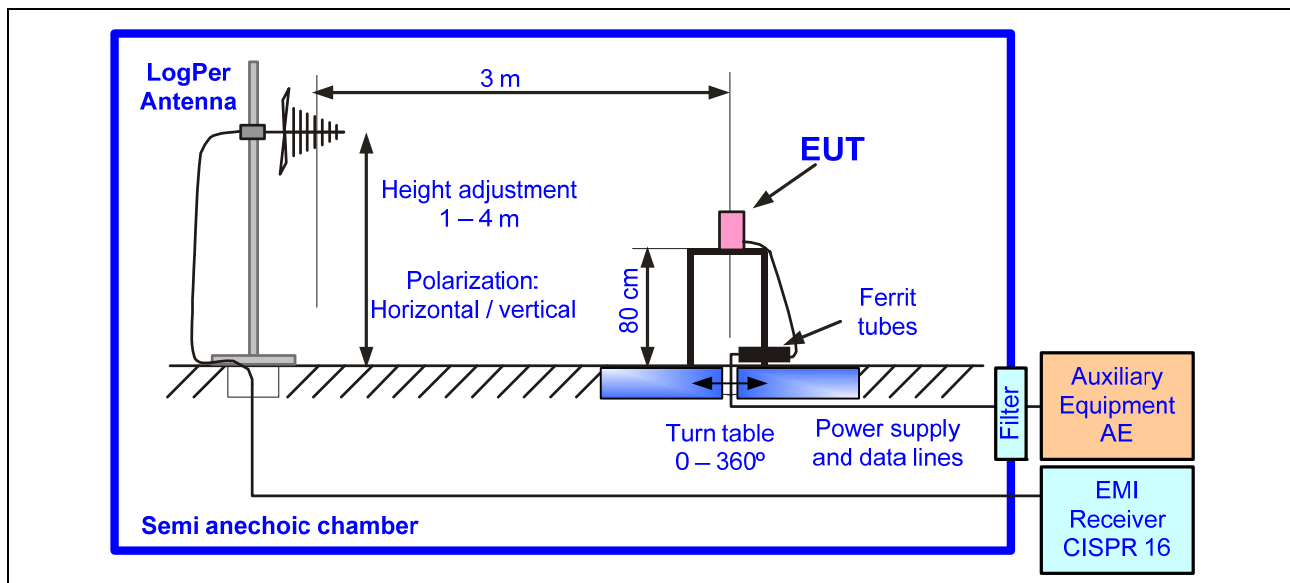
**Distance:** 3 m

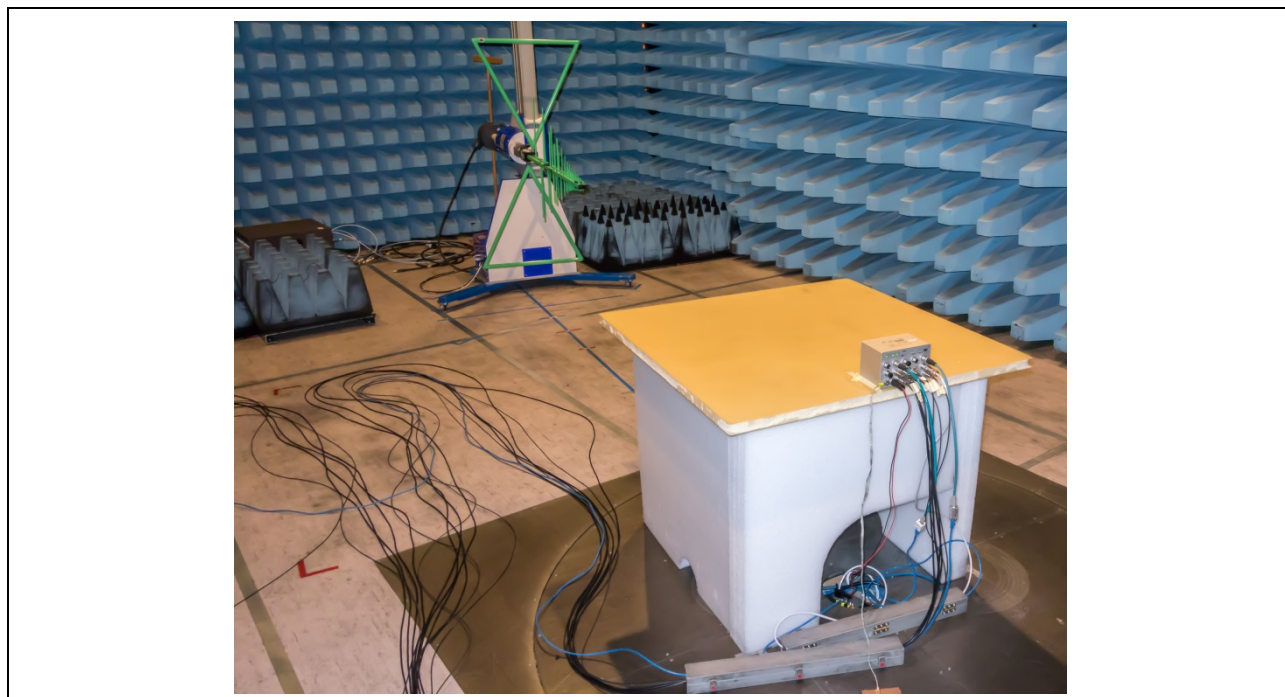
**Meas. uncertainty:** see chapter 14

**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 moved from 1 to 4 m in height with steps of 1 m. The measurements are performed with horizontal and vertical polarizations. The recordings are carried out taking into account the maximum value of all the disturbances appearing while the apparatus is under test. The peak values are recorded continuously. The values exceeding a limit shall be re-measured with the quasi peak detector of the receiver.

**Modifications:** none

#### Test Setup



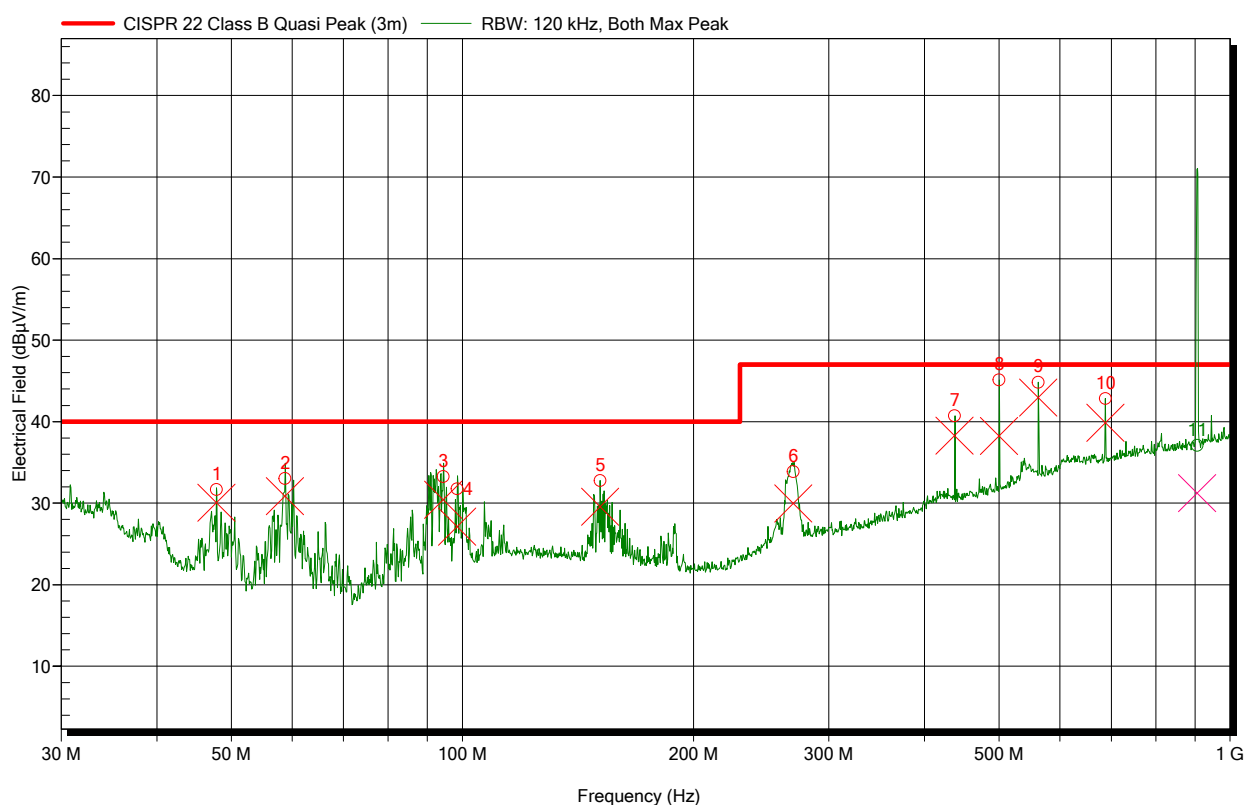
**Photo of the Setup****Test Equipment**

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	Oltronix	B603D	Q2722

## Measurement Results

### Measurement 1:

<b>EUT</b>	NB3800-2LWacDf-G		
<b>Verdict, Test</b>	Pass, Class B		
<b>Mode of operation</b>	normal mode 12 VDC		
<b>Test date, time</b>	17/02/2016 10:05:47		
<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: Auto [50 dB], Internal preamp: 20 dB, Measure time: 5 ms		



### Detected peaks

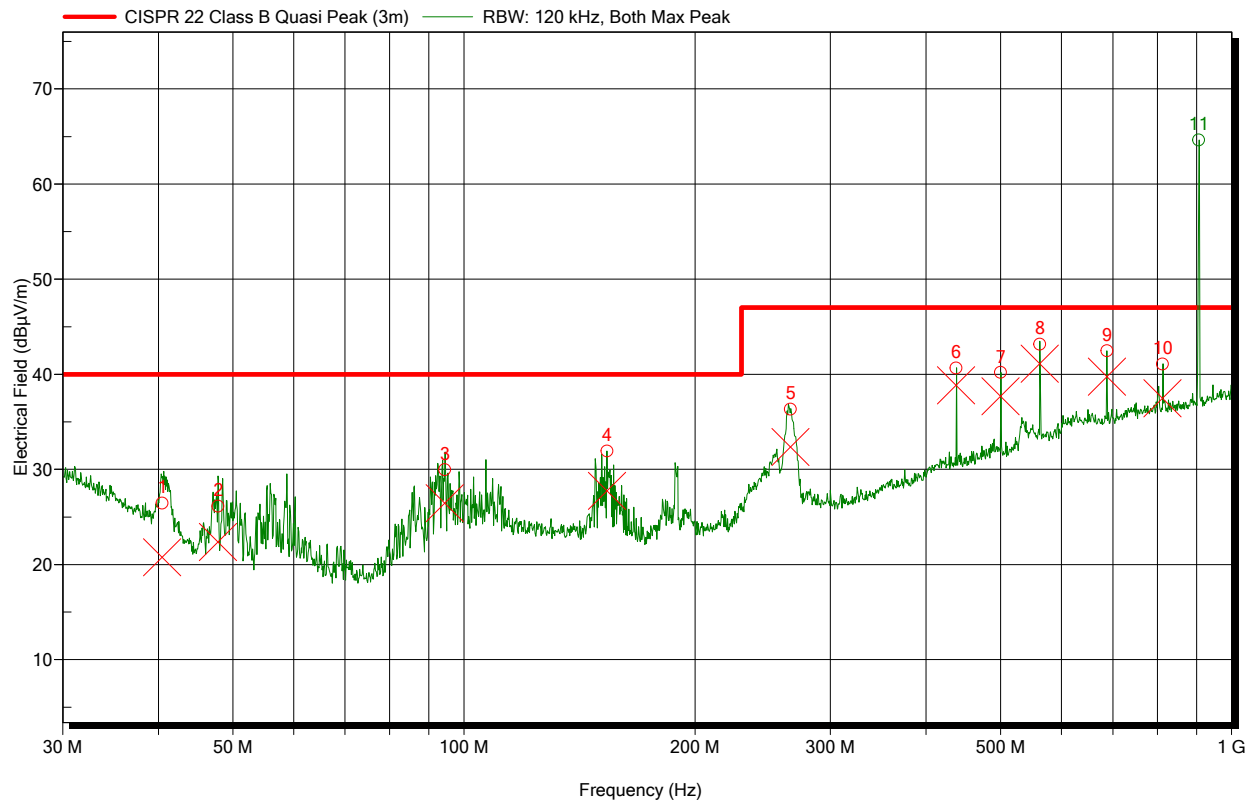
Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	47.79 MHz	31.67 dBμV/m	30.05 dBμV/m	-9.95 dB	Pass	330 Degree	1 m	Vertical
2	58.71 MHz	33.02 dBμV/m	30.85 dBμV/m	-9.15 dB	Pass	180 Degree	1 m	Vertical
3	94.38 MHz	33.27 dBμV/m	30.4 dBμV/m	-9.6 dB	Pass	180 Degree	1 m	Vertical
4	98.43 MHz	31.76 dBμV/m	27.14 dBμV/m	-12.86 dB	Pass	180 Degree	1 m	Vertical
5	151.02 MHz	32.77 dBμV/m	29.55 dBμV/m	-10.45 dB	Pass	0 Degree	1 m	Vertical
6	269.61 MHz	33.9 dBμV/m	29.99 dBμV/m	-17.01 dB	Pass	330 Degree	1 m	Vertical
7	437.49 MHz	40.73 dBμV/m	38.28 dBμV/m	-8.72 dB	Pass	240 Degree	1 m	Vertical
8	499.98 MHz	45.11 dBμV/m	38.24 dBμV/m	-8.76 dB	Pass	240 Degree	1 m	Vertical
9	562.5 MHz	44.83 dBμV/m	42.97 dBμV/m	-4.03 dB	Pass	90 Degree	1 m	Vertical
10	687.51 MHz	42.83 dBμV/m	39.88 dBμV/m	-7.12 dB	Pass	210 Degree	2 m	Horizontal
11	905.94 MHz	37.08 dBμV/m	31.22 dBμV/m	-15.78 dB	Note 1	0 Degree	4 m	Horizontal

### Notes:

- 1) UMTS, exclusion band according ETSI EN 301 489-24 applies

## Measurement 2:

<b>EUT</b>	NB3800-2LWacDf-G		
<b>Verdict, Test</b>	Pass, Class B		
<b>Mode of operation</b>	normal mode, 60 VDC		
<b>Test date, time</b>	17/02/2016 10:32:55		
<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: Auto [50 dB], Internal preamp: 20 dB, Measure time: 5 ms		



## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	40.44 MHz	26.47 dBμV/m	20.78 dBμV/m	-19.22 dB	Pass	60 Degree	1 m	Horizontal
2	47.79 MHz	26.12 dBμV/m	22.38 dBμV/m	-17.62 dB	Pass	270 Degree	1 m	Vertical
3	94.38 MHz	29.99 dBμV/m	26.47 dBμV/m	-13.53 dB	Pass	270 Degree	1 m	Vertical
4	153.48 MHz	31.94 dBμV/m	27.75 dBμV/m	-12.25 dB	Pass	30 Degree	1 m	Vertical
5	266.1 MHz	36.33 dBμV/m	32.35 dBμV/m	-14.65 dB	Pass	90 Degree	1 m	Horizontal
6	437.49 MHz	40.68 dBμV/m	38.85 dBμV/m	-8.15 dB	Pass	240 Degree	1 m	Vertical
7	500.01 MHz	40.19 dBμV/m	37.7 dBμV/m	-9.3 dB	Pass	240 Degree	1 m	Vertical
8	562.5 MHz	43.19 dBμV/m	41.12 dBμV/m	-5.88 dB	Pass	90 Degree	1 m	Vertical
9	687.51 MHz	42.46 dBμV/m	39.74 dBμV/m	-7.26 dB	Pass	210 Degree	2 m	Horizontal
10	812.49 MHz	41.09 dBμV/m	37.49 dBμV/m	-9.51 dB	Pass	210 Degree	1 m	Horizontal
11	905.52 MHz	64.65 dBμV/m	--	--	Note 1	300 Degree	1 m	Vertical

## Notes:

- 1) UMTS, exclusion band according ETSI EN 301 489-24 applies

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

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

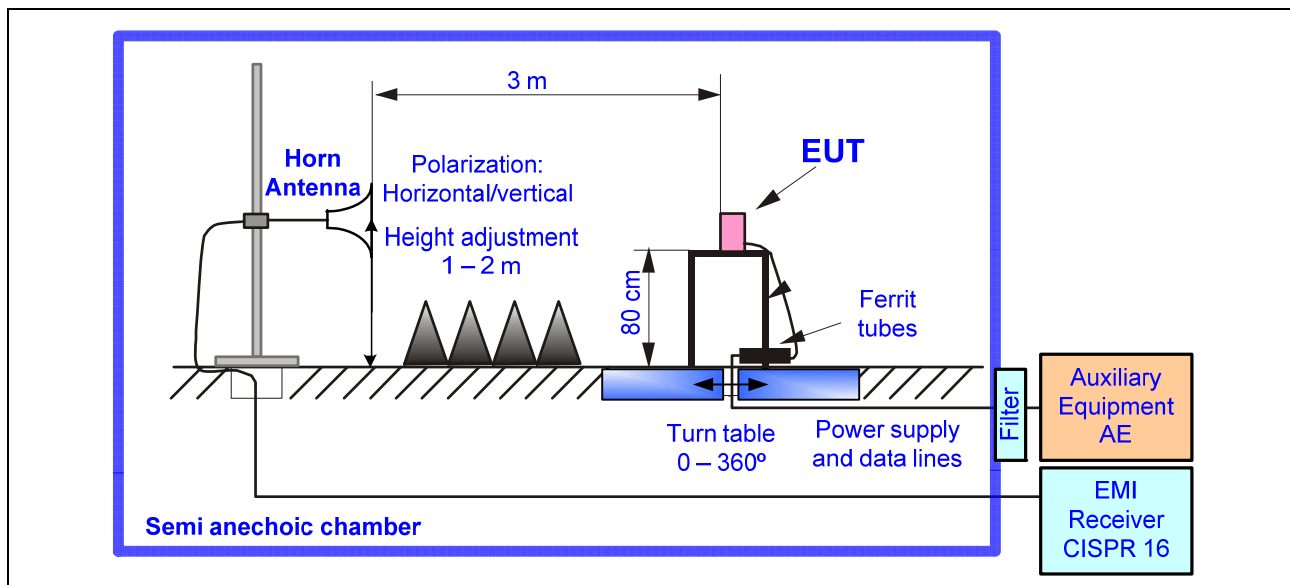
**Distance:** 3 m

**Meas. uncertainty:** see chapter 14

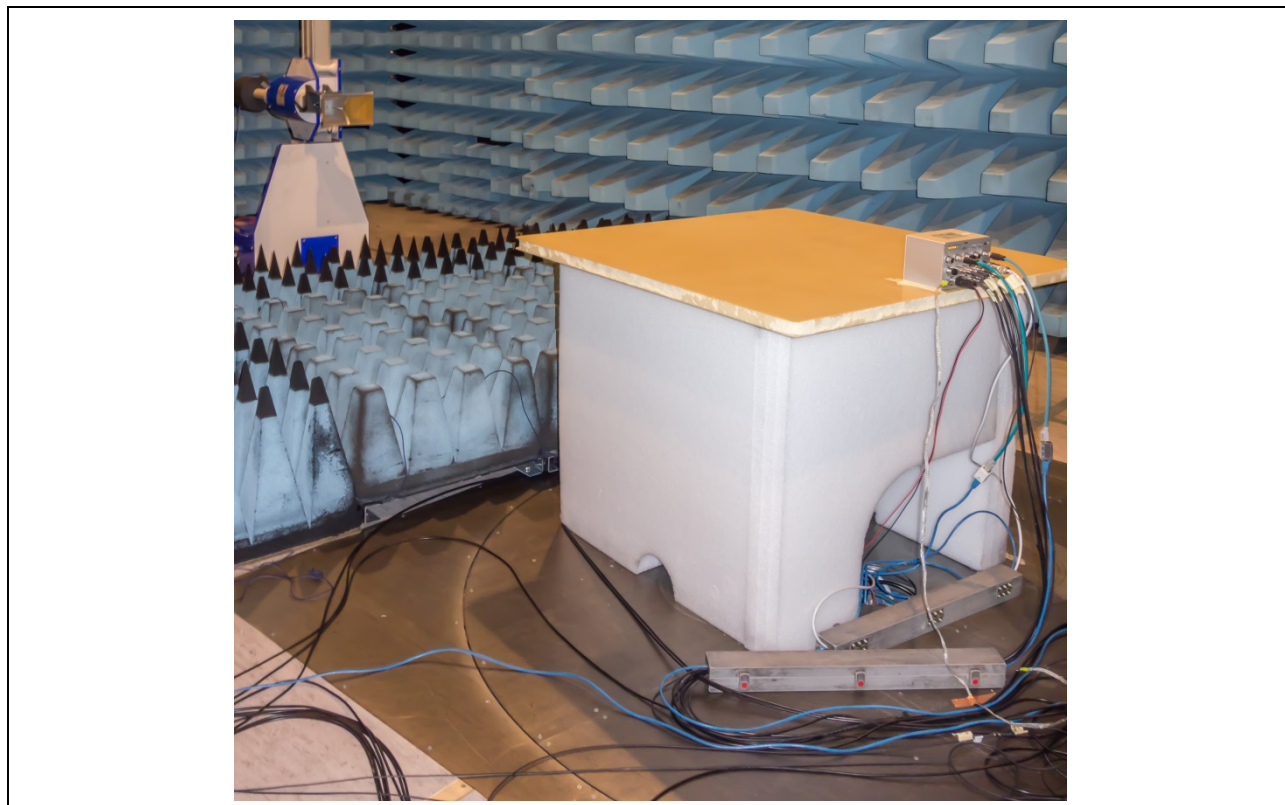
**Measuring method:** The electromagnetic disturbance radiated by the equipment is measured using a EMI reveicer and a wide band antenna. The turning table is operated through 360° during the measurements with steps of 30°. The antenna is moved from 1 to 2 m in height with steps of 1 m. The measurements are performed with horizontal and vertical polarizations. The recordings are carried out taking into account the maximum value of all the disturbances appearing while the apparatus is under test. The peak values are recorded continuously. The values exceeding a limit shall be re-measured with the quasi peak detector of the receiver.

**Modifications:** none

### Test Setup





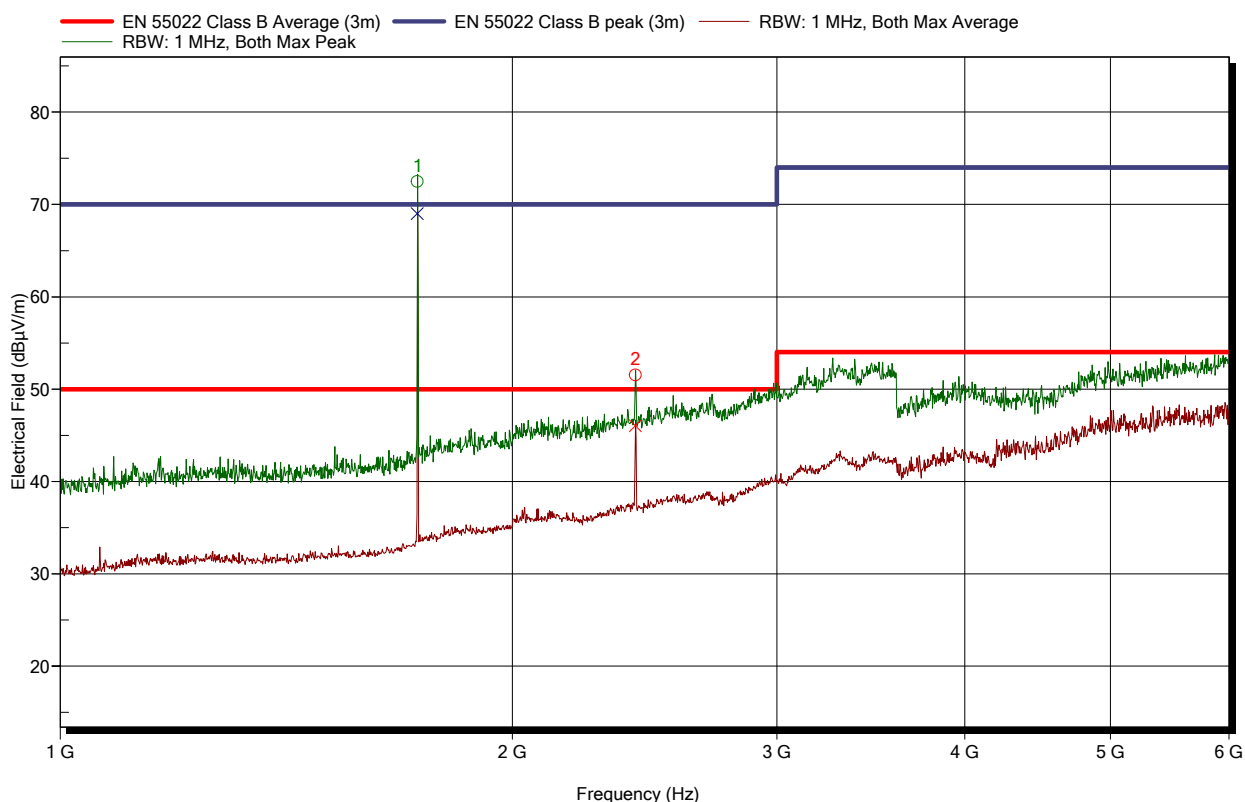
**Photo of the Setup****Test Equipment**

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	Oltronix	B603D	Q2722

## Measurement Results

Measurement 1:

<b>EUT</b>	NB3800-2LWacDf-G		
<b>Verdict, Test</b>	Pass, Class B		
<b>Modification</b>	None		
<b>Mode of operation</b>	Normal mode, 12 VDC		
<b>Test date, time</b>	17/02/2016 10:44:57		
<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: 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	1.729 GHz	72.49 dBµV/m	2.49 dB	69.01 dBµV/m	19.01 dB	Note 1	0 Degree	1 m	Horizontal
2	2.414 GHz	51.52 dBµV/m	-18.48 dB	46.04 dBµV/m	-3.96 dB	Note 2	120 Degree	1 m	Vertical

Note:

- 1) LTE, exclusion band according ETSI EN 301 489-24 applies
- 2) WLAN, exclusion band according ETSI EN 301 489-17 applies

## 12.5 Radiated Emission - Electromagnetic Field – FCC (80 – 1000 MHz)

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

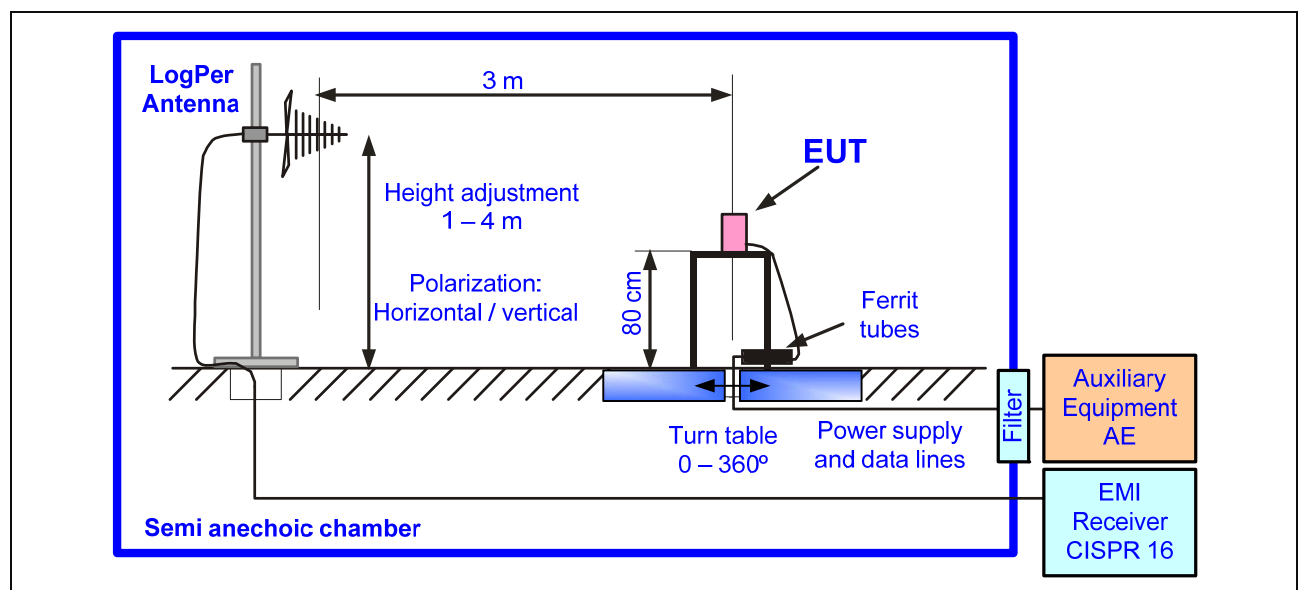
**Distance:** 3 m

**Meas. uncertainty:** see chapter 14

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

None

### Test Setup



### Photo of the Setup

see chapter 12.3

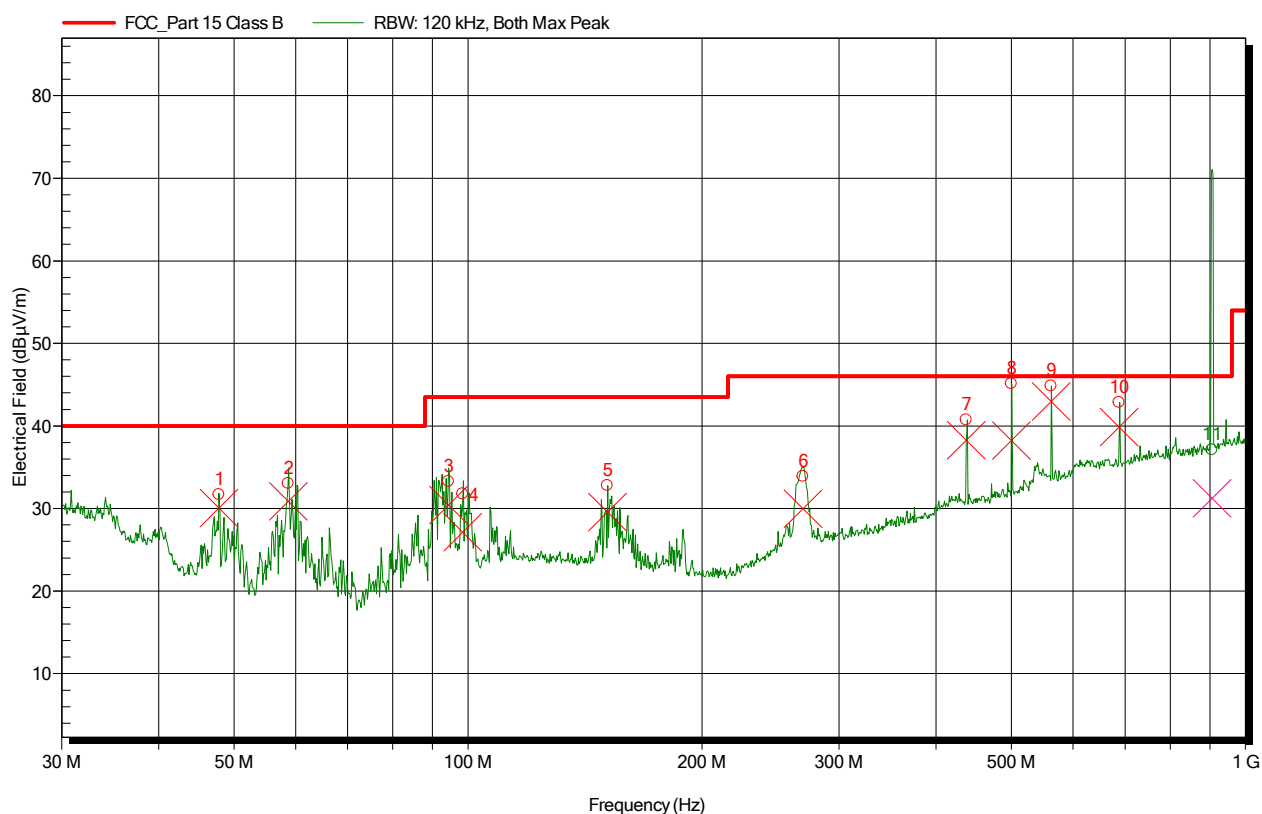
### Test Equipment

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	Oltronix	B603D	Q2722

## Measurement Results

Measurement 1:

<b>EUT</b>	NB3800-2LWacDf-G		
<b>Verdict, Test</b>	Pass, Class B		
<b>Mode of operation</b>	normal mode, 12 VDC		
<b>Test date, time</b>	17/02/2016 10:05:47		
<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: Auto [50 dB], Internal preamp: 20 dB, Measure time: 5 ms		



## Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	47.79 MHz	31.67 dBμV/m	30.05 dBμV/m	-9.95 dB	Pass	330 Degree	1 m	Vertical
2	58.71 MHz	33.02 dBμV/m	30.85 dBμV/m	-9.15 dB	Pass	180 Degree	1 m	Vertical
3	94.38 MHz	33.27 dBμV/m	30.4 dBμV/m	-13.1 dB	Pass	180 Degree	1 m	Vertical
4	98.43 MHz	31.76 dBμV/m	27.14 dBμV/m	-16.36 dB	Pass	180 Degree	1 m	Vertical
5	151.02 MHz	32.77 dBμV/m	29.55 dBμV/m	-13.95 dB	Pass	0 Degree	1 m	Vertical
6	269.61 MHz	33.9 dBμV/m	29.99 dBμV/m	-16.01 dB	Pass	330 Degree	1 m	Vertical
7	437.49 MHz	40.73 dBμV/m	38.28 dBμV/m	-7.72 dB	Pass	240 Degree	1 m	Vertical
8	499.98 MHz	45.11 dBμV/m	38.24 dBμV/m	-7.76 dB	Pass	240 Degree	1 m	Vertical
9	562.5 MHz	44.83 dBμV/m	42.97 dBμV/m	-3.03 dB	Pass	90 Degree	1 m	Vertical
10	687.51 MHz	42.83 dBμV/m	39.88 dBμV/m	-6.12 dB	Pass	210 Degree	2 m	Horizontal
11	905.94 MHz	37.08 dBμV/m	31.22 dBμV/m	-14.78 dB	Note 1	0 Degree	4 m	Horizontal

1) UMTS, exclusion band according ETSI EN 301 489-24 applies

## 12.6 Radiated Emission - Electromagnetic Field – FCC (1 – 13 GHz)

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

**Distance:** 3 m

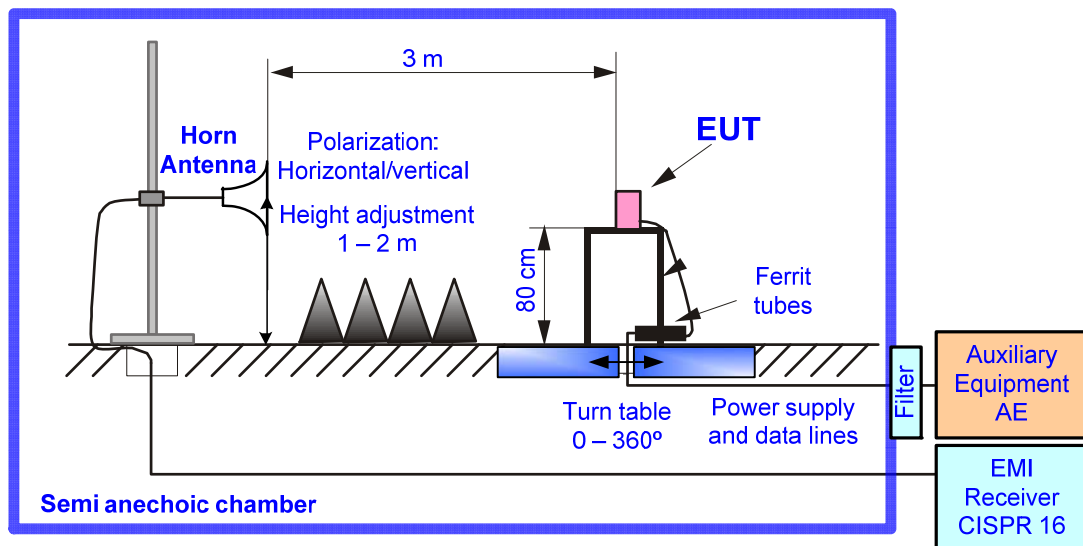
**Meas. uncertainty:** see chapter 14

**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 moved from 1 to 2 m in height with steps of 1 m. The measurements are performed with horizontal and vertical polarizations. The recordings are carried out taking into account the maximum value of all the disturbances appearing while the apparatus is under test. The peak values are recorded continuously. The values exceeding a limit shall be re-measured with the quasi peak detector of the receiver.

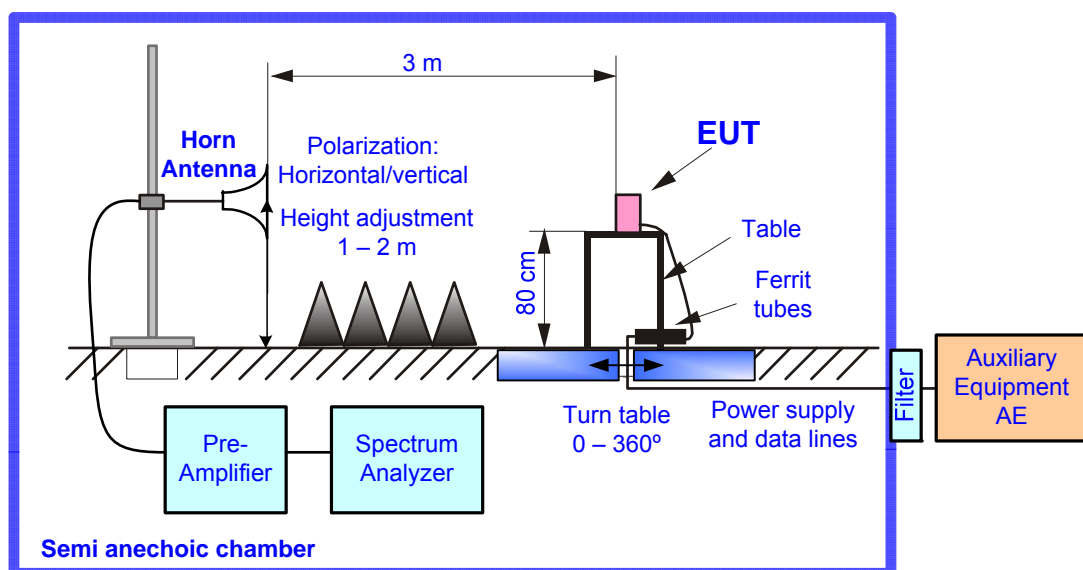
**Modifications:** none

### Test Setup

1 – 6 GHz:



6 – 13 GHz:



**Photo of the Setup**

see chapter 12.4

**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	Oltronix	B603D	Q2722

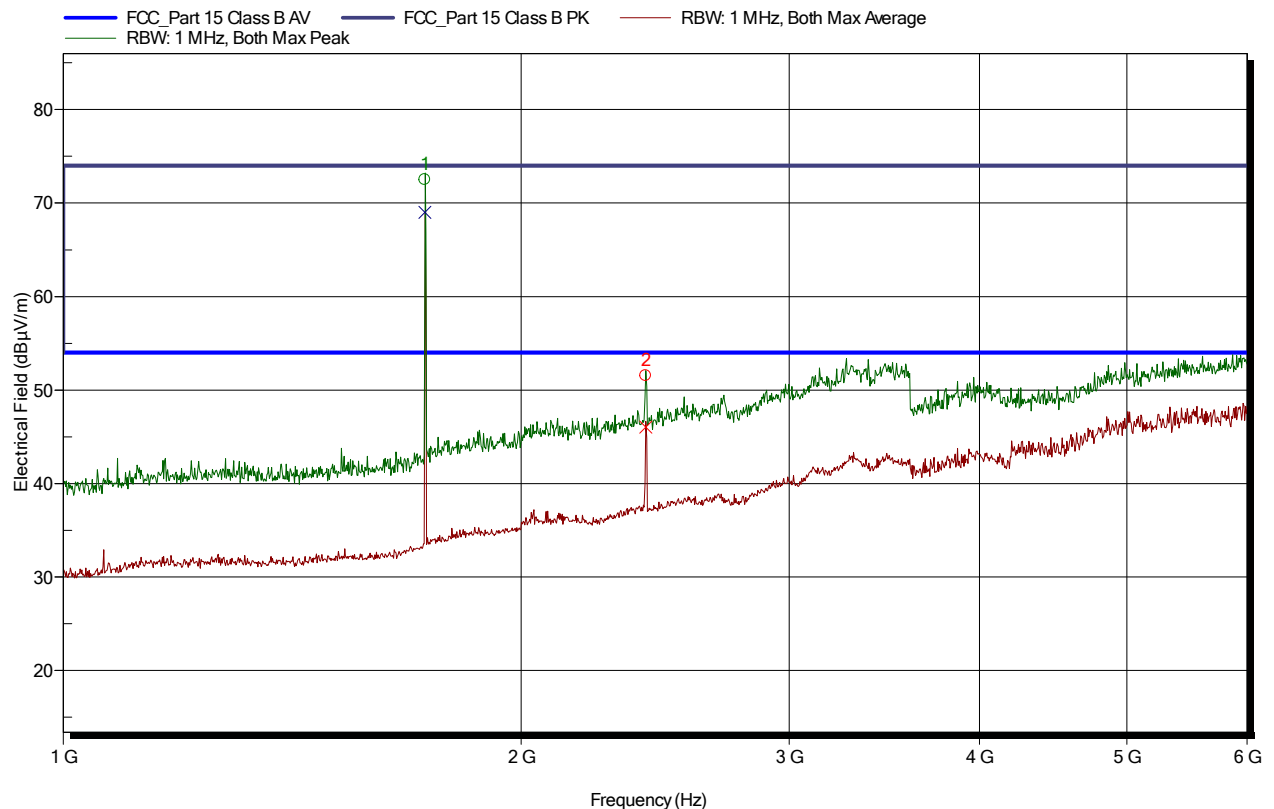
**Test Equipment 6 – 13 GHz**

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	Oltronix	B603D	Q2722

## Measurement Results

Measurement 1:

<b>EUT</b>	NB3800-2LWacDf-G		
<b>Verdict, Test</b>	Pass, Class B		
<b>Mode of operation</b>	normal mode, 12 VDC		
<b>Test date, time</b>	17/02/2016 10:44:57		
<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: 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]		

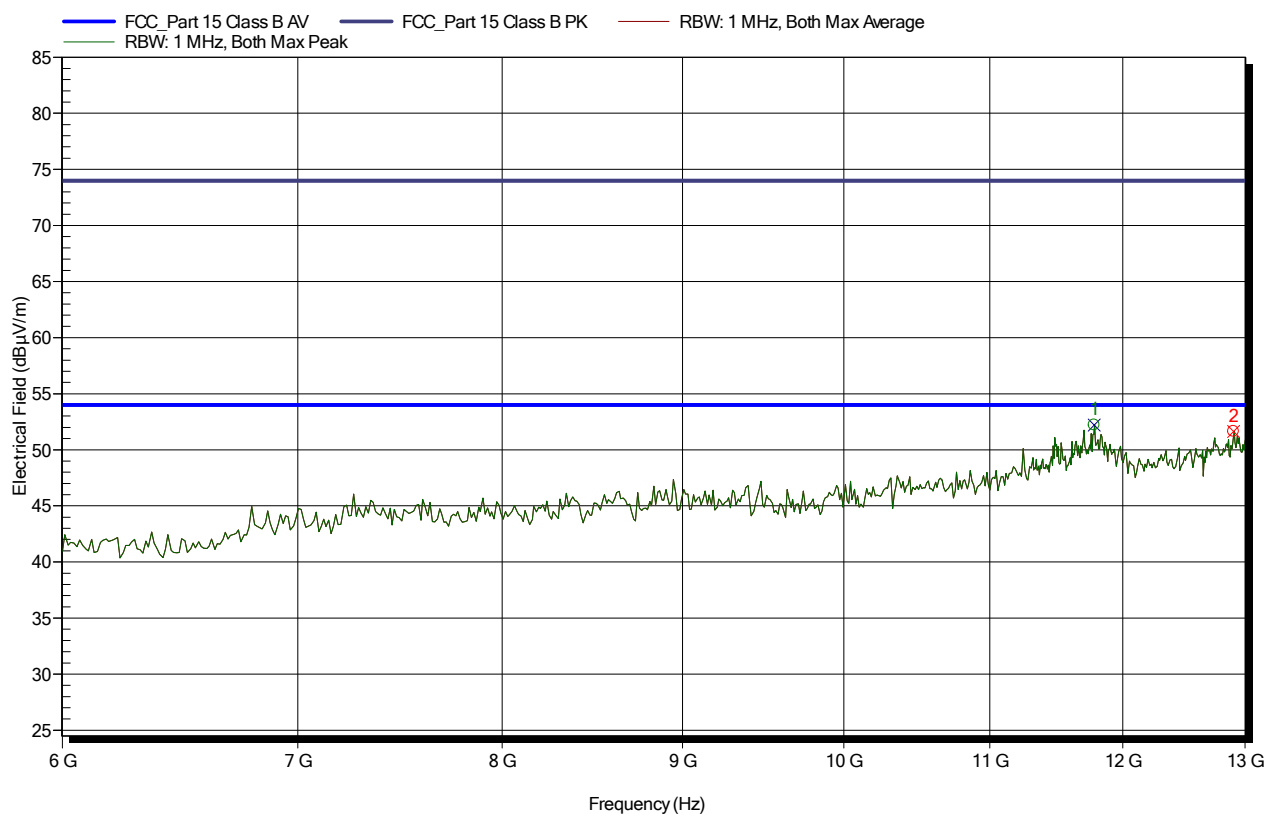


Note:

- Peak 1) LTE, exclusion band according ETSI EN 301 489-24 applies
- Peak 2) WLAN, exclusion band according ETSI EN 301 489-17 applies

## Measurement 2:

<b>EUT</b>	NB3800-2LWacDf-G		
<b>Verdict, Test</b>	Pass, Class B		
<b>Mode of operation</b>	normal mode, 12 VDC		
<b>Test date, time</b>	17/02/2016 11:25:40		
<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]		





## 13. Immunity Tests

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

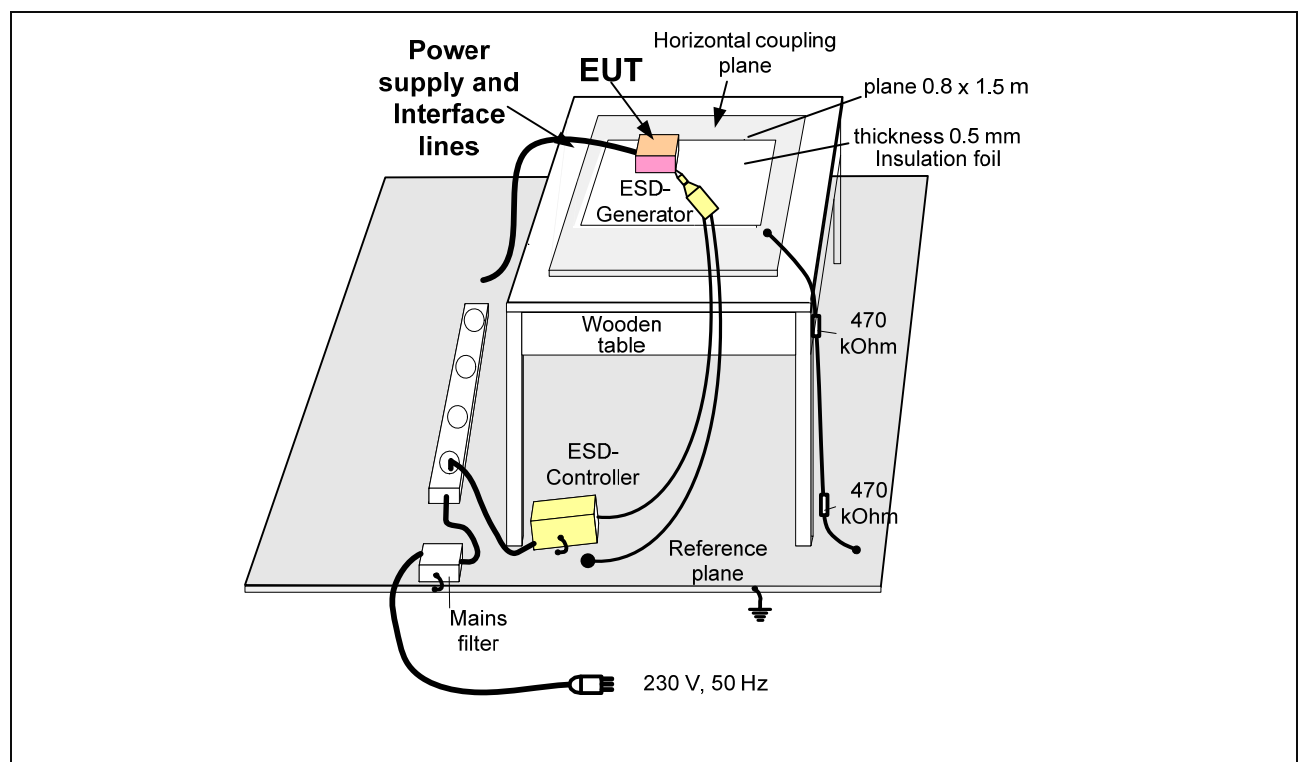
**Introduction:** The aim of this test is to determine the reaction of the material to electrostatic discharges (ESD) produced for example by walking on a carpet made of synthetic fiber. The humidity of the air has an influence on the discharge time and therefore on the severity of the discharge that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

*Coupling:* 150 pF / 330 Ohm

*Meas. uncertainty:* see chapter 14

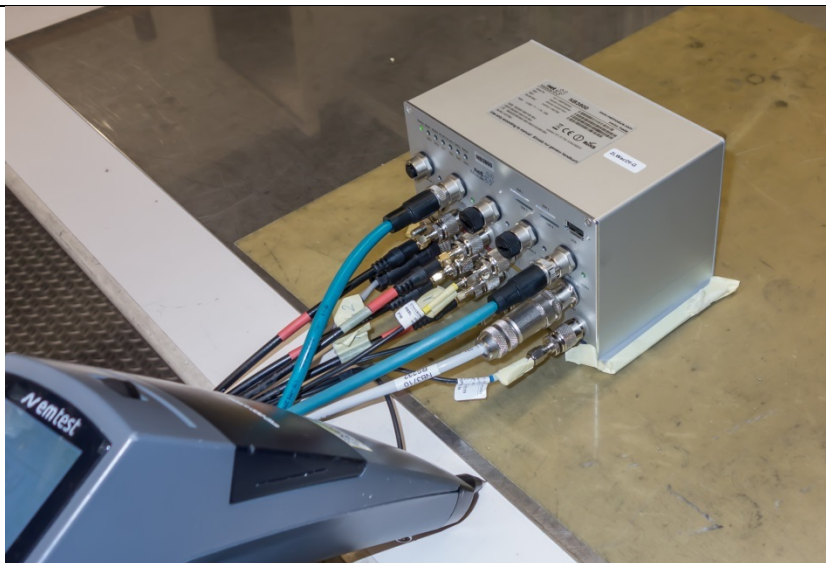
**Test method:** All the points accessible to the operator are tested successively. Contact discharges are carried out on conducting surfaces as well as indirect discharges on a vertical or horizontal coupling plate. Air discharges are carried out on insulated surfaces. A minimum of 10 discharges for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

## Test Setup



## Test Equipment

Device Type	Brand	Type	ID
ESD Generator	EM-Test	ESD N30	PE10238
Power Supply	Hameg	HM8143	Q10153

**Photo of the Setup**

Horizontal Coupling Plane



Direct Discharge



Air Discharge

## Test Results

**Equipment:** NB3800-2LWacDf-G  
**Cables connected:** See chapter 11.4  
**Operating mode:** Active, see chapter 11.5  
**Observation of EUT:** See chapter 11.6  
**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

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

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"/>	No errors observed	A	Pass
± 2; ± 4; ± 8	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors observed	A	Pass

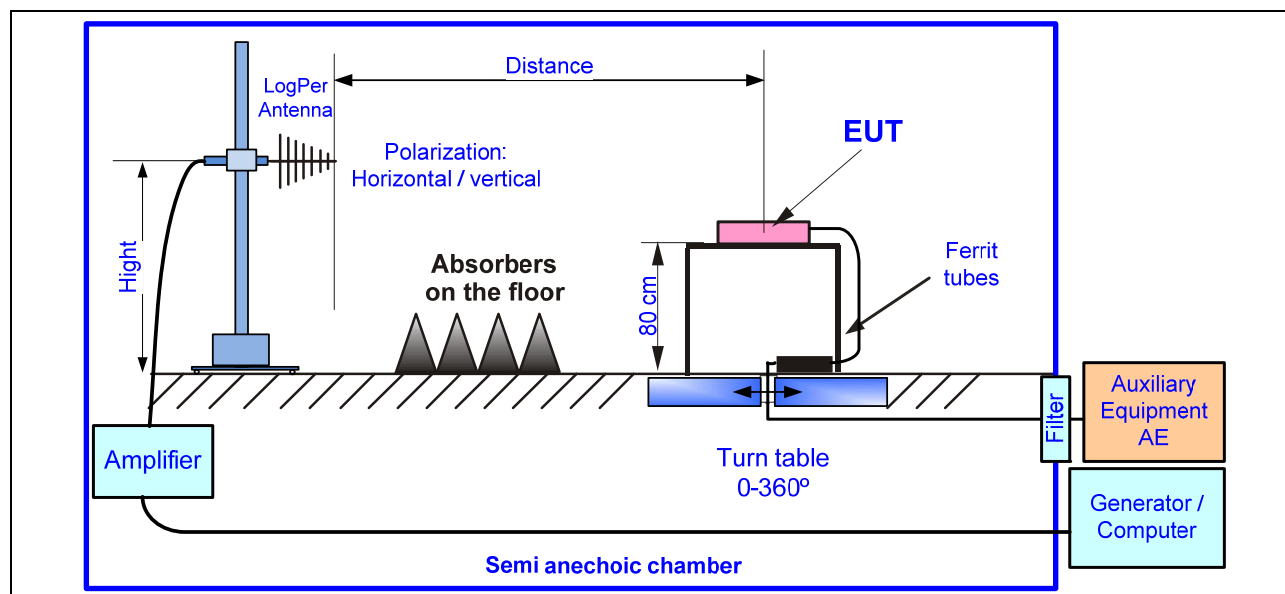
## 13.2 Immunity to Electromagnetic Fields (EN 61000-4-3)

**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 14

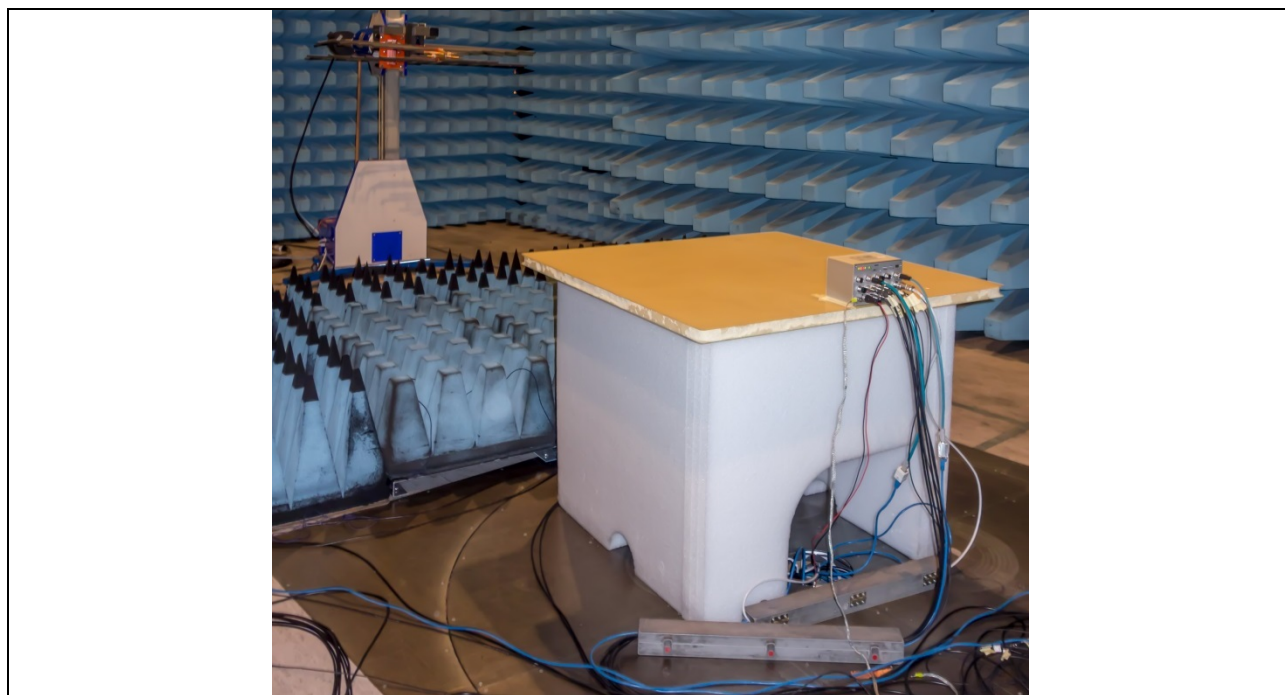
**Test method:** The field is emitted from one or different antennas placed successively in vertical and then in horizontal polarization. The field is calibrated without the EUT using an isotropic probe.

### 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**

## Test Results

**Equipment:** NB3800-2LWacDf-G  
**Cables connected:** See chapter 11.4  
**Operating mode:** Active, see chapter 11.5  
**Observation of EUT:** See chapter 11.6  
**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

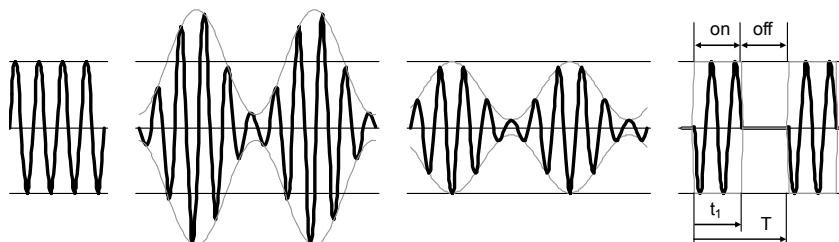
Modulation:

☐ CW

☒ AM (normal)

☐ AM (const. peak)

☐ PM



## Protocol of the Test

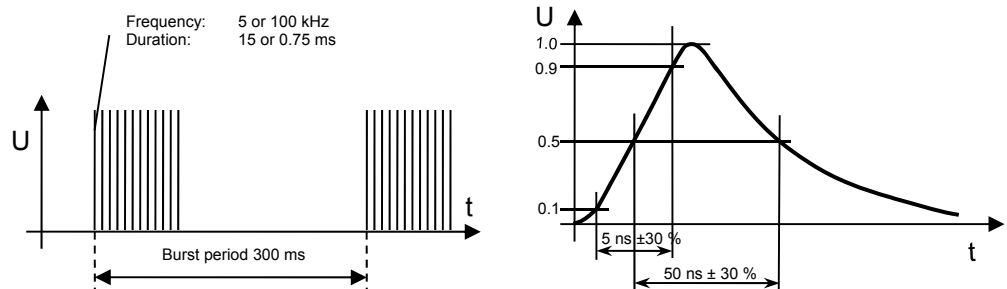
Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	22	horizontal	0, 90, 180, 270°	No errors observed	A	Pass
	22	vertical	0, 90, 180, 270°	No errors observed	A	Pass
1000 - 6000	12	horizontal	0, 90, 180, 270°	No errors observed	A	Pass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

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

#### Introduction:

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

#### Pulse:



Open-circuit voltage

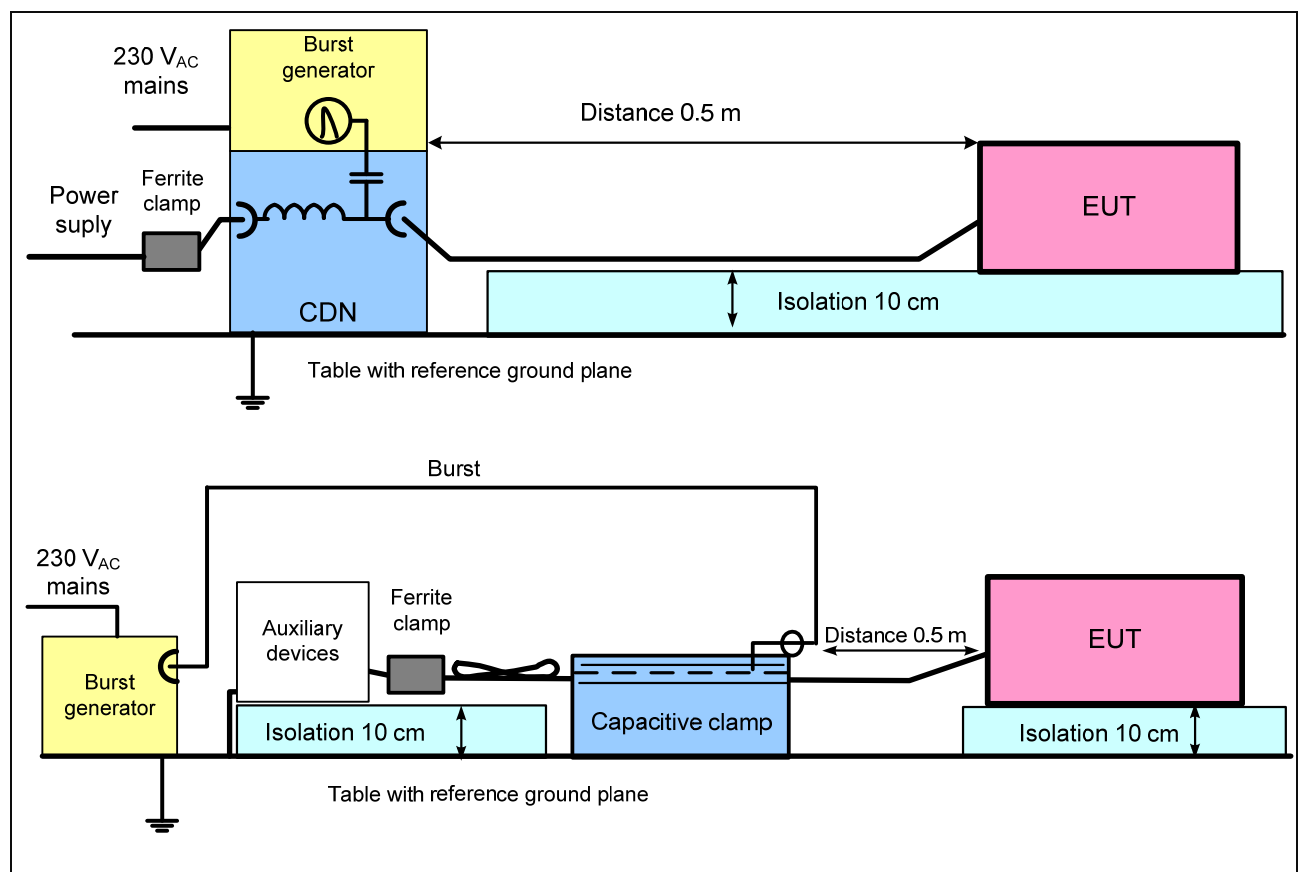
Voltage in a 50  $\Omega$ -Load

Meas. uncertainty: see chapter 14

#### 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

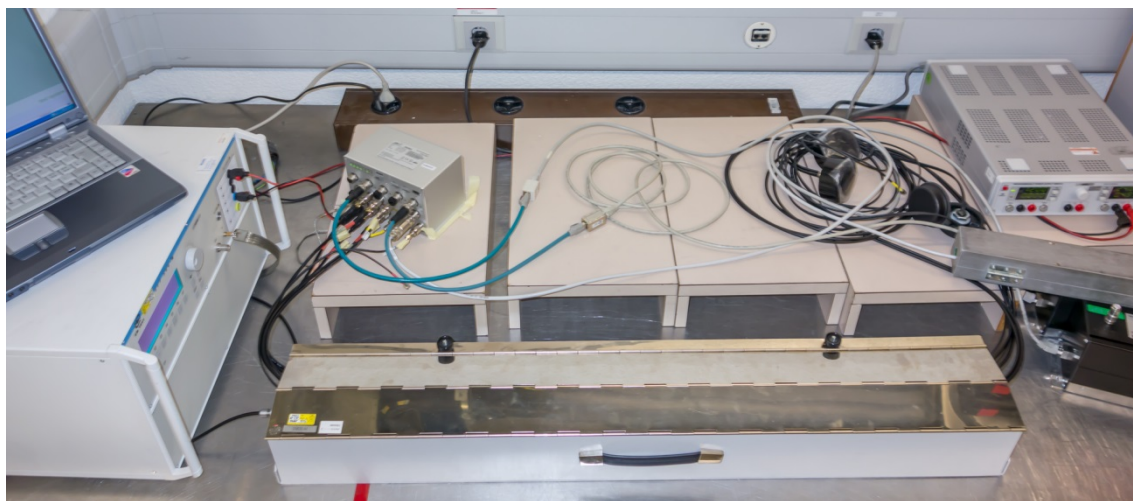


### Test Equipment

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



### Photo of the Setup





## Test Results

**Equipment:** NB3800-2LWacDf-G  
**Cables connected:** See chapter 11.4  
**Operating mode:** Active, see chapter 11.5  
**Observation of EUT:** See chapter 11.6  
**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

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 2	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
RS 232	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

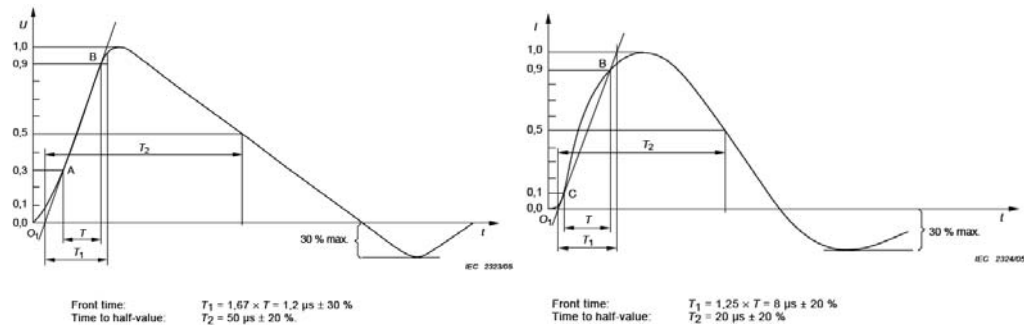
Note : All antenna cables tested together

### 13.4 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 14

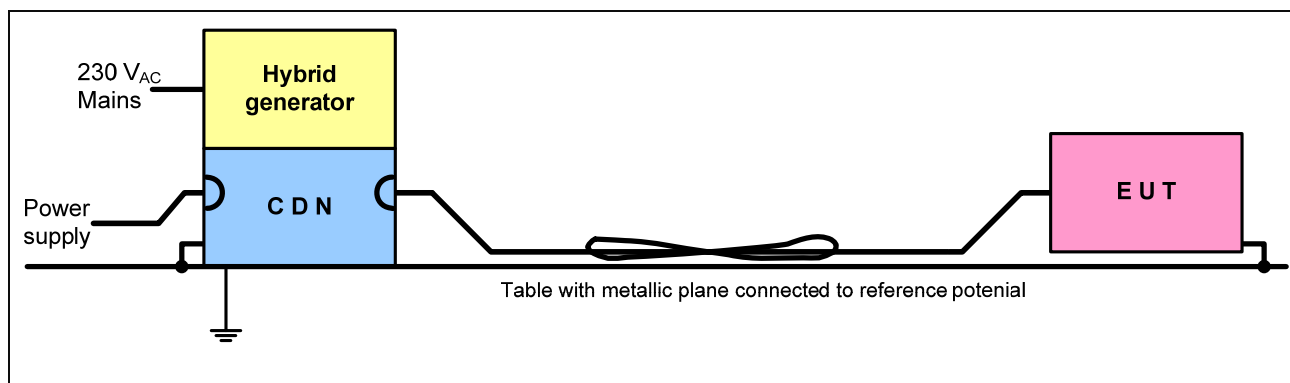
#### Short-circuit current

#### 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.

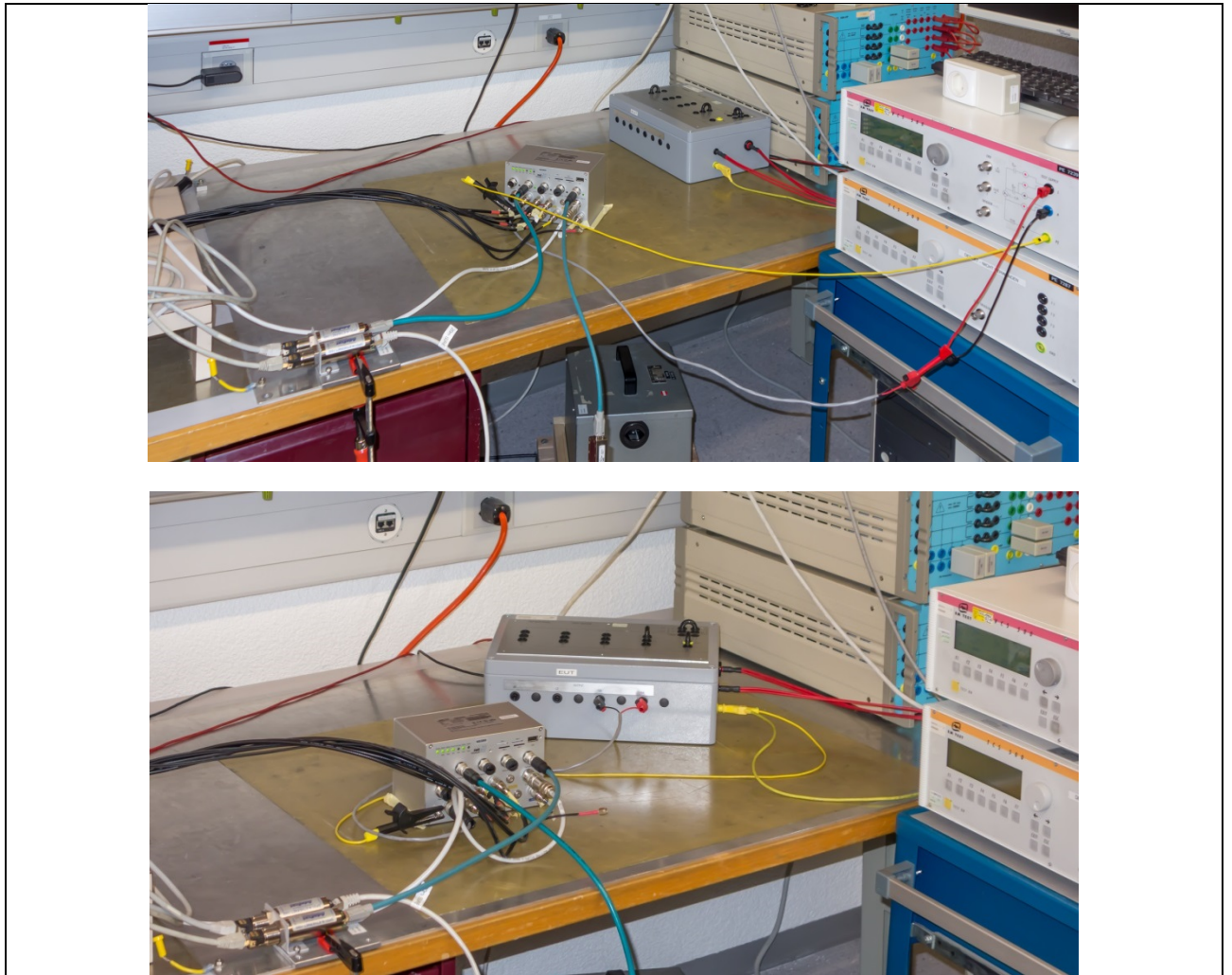
#### Test Setup



#### 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



## Test Results

**Equipment:** NB3800-2LWacDf-G  
**Cables connected:** See chapter 11.4  
**Operating mode:** Active, see chapter 11.5  
**Observation of EUT:** See chapter 11.6  
**Modifications:** none  
**Test site:** laboratory

## Requirements

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

Notes:

- 1) Telecom ports: Indoor cables >10m and in telecom centers:  $\pm 0.5$  kV Outdoor cables:  $\pm 1$  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 $\Omega$ +0.5 $\mu$ F	L1, L2 – PE 42 $\Omega$ +0.5 $\mu$ F	L1 – L2 42 $\Omega$ +0.5 $\mu$ F	L1, L2 – PE 42 $\Omega$ +0.5 $\mu$ F	
EN 50121-3-2	$\pm 1.0$ kV	$\pm 2.0$ kV	--	--	B
EN 50155	$\pm 1.0$ kV	$\pm 2.0$ kV	--	--	B

## Protocol of the Test

Tests on DC Power Ports:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses	Remarks	Fulfilled criterion	Verdict
DC Mains @ 12 VDC	±0.5	L1(+)- L2(-)	2 Ω + 18 μF	5 (Note 1)	No errors observed	A	Pass
	±0.5	L1(+)- PE L2(-)- PE	12 Ω + 9 μF	5 (Note 1)	No errors observed	A	Pass
DC Mains @ 24 VDC	±0.5	L1(+)- L2(-)	2 Ω + 18 μF	5 (Note 1)	not tested	--	--
	±0.5	L1(+)- PE L2(-)- PE	12 Ω + 9 μF	5 (Note 1)	not tested	--	--
DC Mains @ 60 VDC	±0.5	L1(+)- L2(-)	2 Ω + 18 μF	5 (Note 1)	No errors observed	A	Pass
	±0.5	L1(+)- PE L2(-)- PE	12 Ω + 9 μF	5 (Note 1)	not tested	--	--

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses	Remarks	Fulfilled criterion	Verdict
DC Mains @ 12 VDC	±0.5; ±1.0	L1(+)- L2(-)	42 Ω + 0.5 μF	5 (Note 1)	not tested (Note 2)	A	--
	±0.5; ±1.0; ±2.0	L1(+)- PE L2(-)- PE	42 Ω + 0.5 μF	5 (Note 1)	not tested (Note 2)	A	--
DC Mains @ 24 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 @ 60 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 (Note 3):

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses	Remarks	Fulfilled Criterion	Verdict
Ethernet 2	±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

### Notes:

- 1) Number of pulses for each voltage level and each polarity
- 2) EUT did not work with CDN at 12 VDC!
- 3) Powered with 12 VDC
- 4) 12 V and 24 V Supplied via lead-acid accumulator (PS-12170 B, 12 V, 17 Ah)

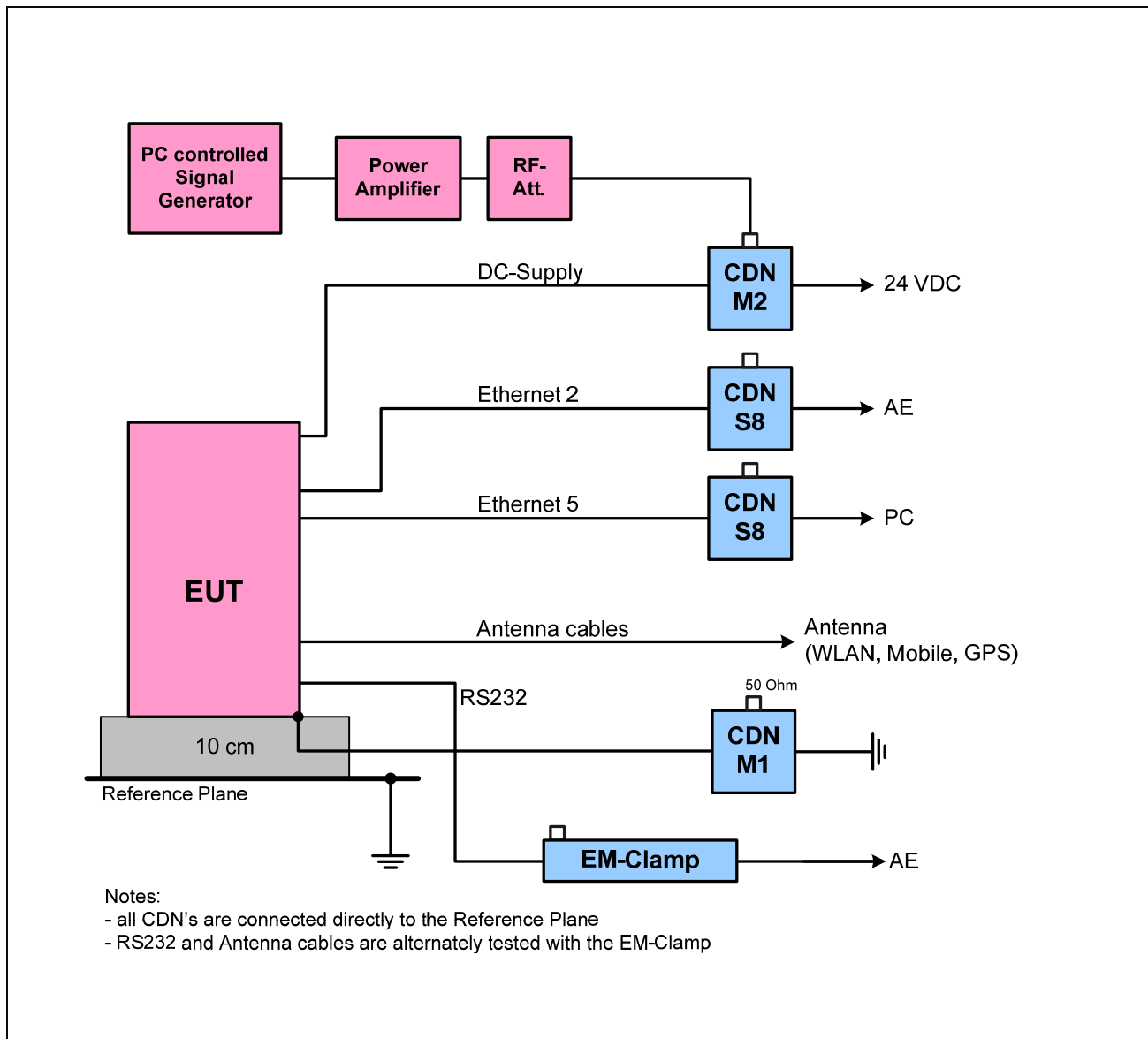
### 13.5 Immunity to Conducted Disturbances Induced by RF Fields (EN 61000-4-6)

**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 14

**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.

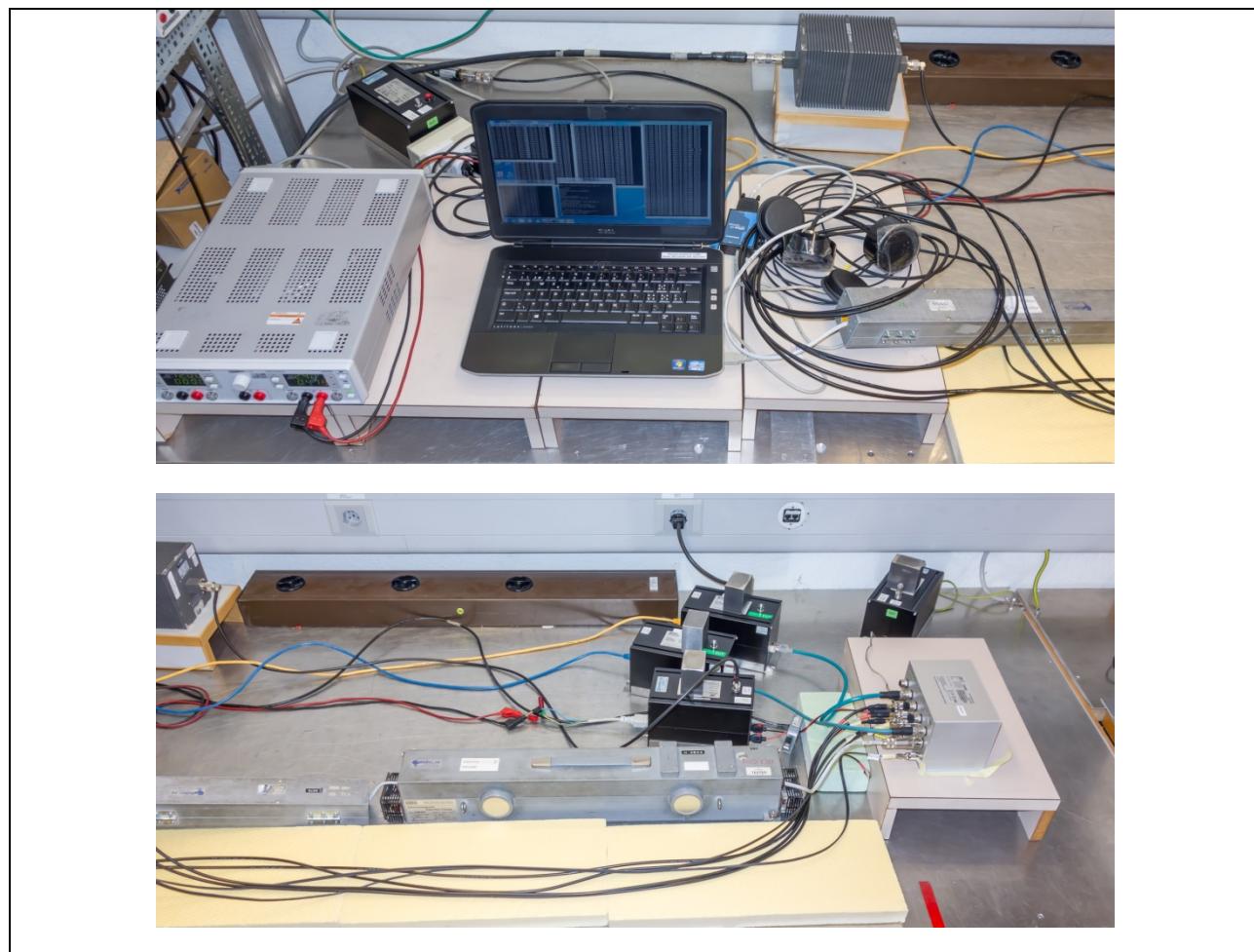
#### Test Setup



### 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

### Photo of the Setup



## Test Results

**Equipment:** NB3800-2LWacDf-G  
**Cables connected:** See chapter 11.4  
**Operating mode:** Active, see chapter 11.5  
**Observation of EUT:** See chapter 11.6  
**Modifications:** none  
**Test site:** laboratory

## Requirements

Standard	Frequency range	Required level	Modulation	Freq. step	Dwell time	Performance crit.
EN 50121-3-2	0.15 – 80 MHz	10 V <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

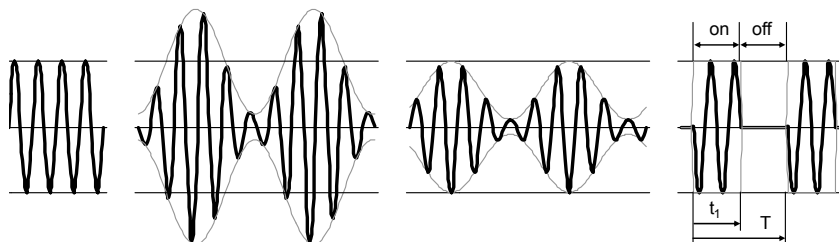
Signal modulation:

☐ 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 2	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Ethernet5	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
RS232	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	DC Supply	M2	0.15 – 80	12	No errors observed	A	Pass

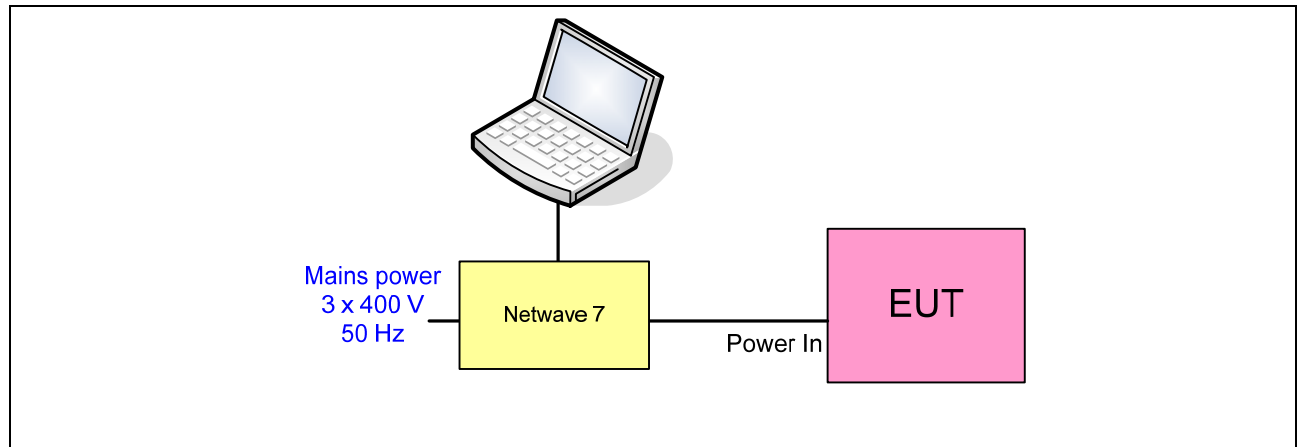
Notes:

- 1) All antenna cables tested together



## 13.6 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

### Photo of the Setup



## Test Results

**Equipment:** NB3800-2LWacDf-G  
**Cables connected:** see chapter 11.4  
**Operating mode:** see chapter 11.5  
**Observation of EUT:** See chapter 11.6  
**Modifications:** none  
**Test site:** Laboratory

## Protocol of the Test

$U_N = 24 \text{ VDC}$

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 (Note 1)	$0 U_N$	30 ms	Criterion A	No errors observed	Pass
	12.2.6	33.6 V	$1.4 U_N$	1 s	Criterion A	rise & fall time 0.1 s, No errors observed	Pass

$U_N = 48 \text{ VDC}$

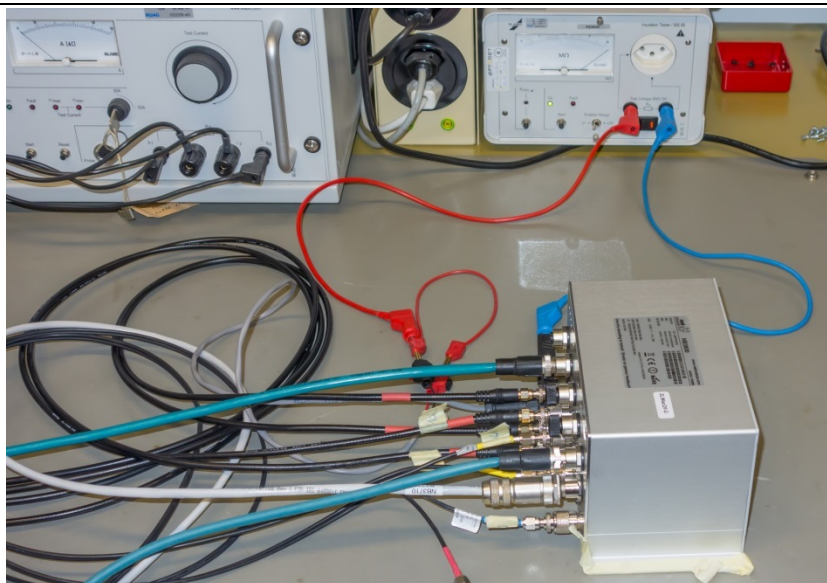
Standard	Chapter	Voltage		Duration	Requirements	Notes	Verdict
EN 50155	5.1.1.1	28.8 V	$0.6 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	67.2 V	$1.4 U_N$	0.1 s	Criterion A	No errors observed	Pass
	5.1.1.1	60 V	$1.25 U_N$	1 s	Criterion C	No errors observed	Pass
	5.1.1.1	67.2 V	$1.4 U_N$	1 s	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 (Note 1)	$0 U_N$	30 ms	Criterion A	No errors observed	Pass
	12.2.6	67.2 V	$1.4 U_N$	1 s	Criterion A	rise & fall time 0.1 s, No errors observed	Pass

Note:

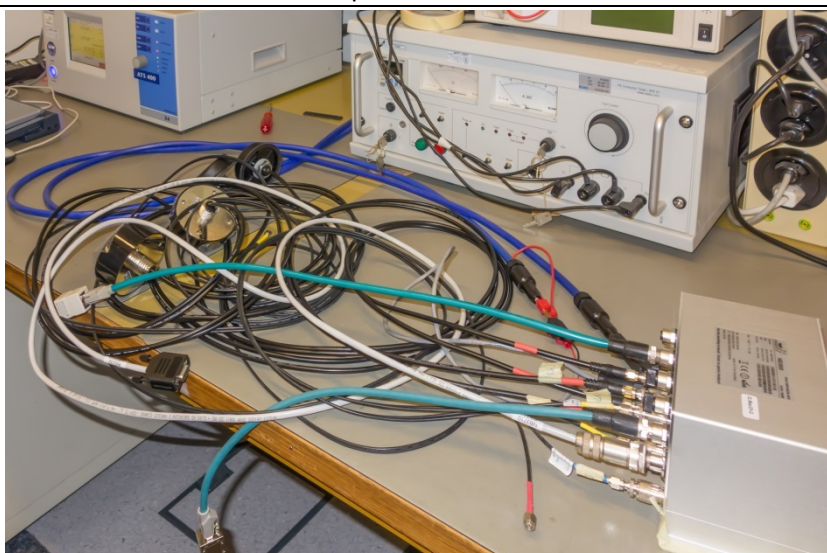
- 1) tested with low impedance (according EN 61000-4-29)

## 13.7 Insulation Test (EN 50155 §12.2.9)

### Test Setup



Setup Insulation Test



Setup Voltage Withstand Test

### Test Equipment

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

**Test Results**

*Equipment:* NB3800-2LWacDf-G  
*Cables connected:* see chapter 11.4  
*Operating mode:* Active, see chapter 11.5  
*Observation of EUT:* See chapter 11.6  
*Modifications:* none  
*Test site:* Safety Laboratory

**Protocol of the Test**

Standard	Chapter	Test	Voltage	Behavior of EUT	Verdict
EN 50155	12.2.9.1	Insulation test (Note)	500 VDC	No essential change, >10 MOhm	Pass
	12.2.9.2	Voltage withstand test	± 1410 VDC	No breakthrough	Pass

Note: Measured before and after voltage withstand test

## 14. 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 <sub>o</sub> : (normal distribution)		± 9.0 %
	Duration of the voltage interruption t <sub>e</sub> : (rectangular distribution)		± 5.0 %
	Phase φ <sub>o</sub> :(rectangular distribution)		± 2.8 %
Voltage fluctuation	Output voltage U <sub>o</sub> : (normal distribution)		± 9 %