

Test laboratory accredited according to ISO 17025 by the Swiss Accreditation Service SAS

Registration number
Numéro d'accréditation
Akkreditierungsnummer

STS 001

Schweizerischer Prüfstellendienst
Service suisse d'essai
Swiss testing service



Report:	<i>Electromagnetic Compatibility</i>		Report no:	14-EL-0067.E01
Product name:	<i>NB1600</i>		Dossier no:	14-EL-0067
Serial no:	<i>00112B00947B</i> <i>00112B0084B4</i>	Model number:	<i>NB1600-UW-G</i> <i>NB1600-LW</i>	
Customer:	<i>NetModule AG</i> <i>Meriedweg 11</i> <i>3172 Niederwangen bei Bern</i> <i>Switzerland</i>	Date of test:	<i>October 20 – 21, 2014</i> <i>October 27 – 28, 2014</i> <i>November 5 – 7, 2014</i>	

Standards		Result
EN 55022 : 2010	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement: Class B	<i>Pass</i>
EN 55024 : 2010	Information technology equipment – Immunity characteristics – Limits and methods of measurement	<i>Pass</i>
EN 61000-6-2 : 2005	EMC – Part 6-2: Generic standards – Immunity for industrial environments	<i>Pass</i>
EN 301 489-1 V1.9.2	EMC standard for radio equipment and services; Part 1: Common technical requirements	<i>Pass</i>
EN 301 489-7 V1.3.1	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)	<i>Pass</i>
EN 301 489-17 V2.2.1	EMC standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems	<i>Pass</i>
EN 301 489-24 V1.5.1	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	<i>Pass</i>
CFR 47 Part 15 - B: 2014	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"	<i>Pass</i>

Test performed by

Mr Daniel Rufer
EMC test-engineer



Reviewed by

Mr Pascal Treichler
EMC test-engineer



Approved by

Mr U. von Känel
Head of Business Unit ELM



Fehraltorf, 2015-03-20

(Issue Date)

Main language : *English*

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

Electrosuisse
Luppenstrasse 1
8320 Fehraltorf / Switzerland
phone +41 44 956 11 11
customer.center@electrosuisse.ch

Electrosuisse
Albislab
Albisriederstrasse 199
8047 Zürich / Switzerland
phone +41 44 956 11 61

Electrosuisse
EMC Test Lab Neuenhof
Ringstrasse 10
5432 Neuenhof / Switzerland
phone +41 56 290 30 35

Electrosuisse
EMC Test Lab Goldach
Blumeneggstrasse 50
9403 Goldach / Switzerland
phone +41 71 278 41 92

Contents

Page	
FOREWORD	3
1. SUMMARY OF TEST RESULTS (EN 55022 / EN 55024)	4
2. SUMMARY OF TEST RESULTS (EN 61000-6-2)	4
3. SUMMARY OF TEST RESULTS (FCC)	5
4. SUMMARY OF TEST RESULTS (ETSI EN 301 489-X)	5
5. APPLIED STANDARDS.....	6
6. ABBREVIATIONS.....	7
7. CLIENT.....	8
8. EQUIPMENT UNDER TEST	8
8.1 Identification.....	8
8.2 Product Family	9
8.3 Pictures of the EUT	10
8.4 Classification.....	12
8.5 Ports.....	13
9. TEST CONDITIONS	14
9.1 Climatic Conditions, Location and Date.....	14
9.2 Attendant Persons	14
9.3 Test Configuration.....	15
9.4 Operating Conditions	15
9.5 Monitoring of the EUT	15
9.6 Auxiliary Equipment	16
9.7 Performance Criteria.....	16
10. EMISSION TESTS	17
10.1 Conducted Emission - Interference Voltage (EN 55022).....	17
10.2 Radiated Emission - Electromagnetic Field (EN 55022)	24
10.3 Radiated Emission - Electromagnetic Field (FCC)	27
11. IMMUNITY TESTS	30
11.1 Immunity to Electrostatic Discharge (ESD) (EN 61000-4-2).....	30
11.2 Immunity to Electromagnetic Fields (EN 61000-4-3).....	32
11.3 Immunity to Fast Electric Transients (EN 61000-4-4).....	35
11.4 Immunity to Surge (EN 61000-4-5 : 1.2/50 μ s).....	37
11.5 Immunity to Conducted Disturbances Induced by RF-Fields (EN 61000-4-6)	39
12. MEASUREMENT UNCERTAINTY	43
13. MODIFICATIONS.....	44

Foreword

NetModule's industrial router series are basically designed for stationary applications, mostly mounted on DIN rail shelves. The routers provide multi-WAN-LAN-communication and functions such as data acquisition, protocol conversion, local data processing and storage. The wide range of implementations include remote management and condition monitoring, CCTV, ATMs and Digital Signage.

1. Summary of Test Results (EN 55022 / EN 55024)

§	Test Type	Result
10	Emission	EN 55022
10.1	Interference voltage EN 55022:2010 CISPR 22:2008	Pass
10.1	Common mode at telecom. ports EN 55022:2010 CISPR 22:2008	Pass
10.2	Radiated electromagnetic field EN 55022:2010 CISPR 22:2008	Pass
	Emission	EN 61000-3-2
--	Harmonics EN 61000-3-2:2006 +A1 +A2 IEC 61000-3-2:2005 +A1 +A2	Not applicable... ¹
	Emission	EN 61000-3-3
--	Voltage fluctuations (flicker) EN 61000-3-3:2013 IEC 61000-3-3:2013	Not applicable... ¹
11	Immunity	EN 55024
11.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass... ²
11.2	Electromagnetic fields EN 61000-4-3:2006 +A1 +A2 IEC 61000-4-3:2013 ed.4.0	Pass... ³
11.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
11.4	Surges EN 61000-4-5:2006 IEC 61000-4-5:2005	Pass
11.5	Radio frequency common mode EN 61000-4-6:2009 IEC 61000-4-6:2008	Pass... ⁴
--	Magnetic fields (industrial frequencies) EN 61000-4-8:2010 IEC 61000-4-8:2009	Not applicable... ⁵
--	Voltage dips and interruptions EN 61000-4-11:2004 IEC 61000-4-11:2004	Not applicable... ¹

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

§	Test Type	Result
11	Immunity	EN 61000-6-2
11.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass... ²
11.2	Electromagnetic fields EN 61000-4-3:2006 +A1 +A2 IEC 61000-4-3:2013 ed.4.0	Pass... ³
11.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
11.4	Surges EN 61000-4-5:2006 IEC 61000-4-5:2005	Pass
11.5	Radio frequency common mode EN 61000-4-6:2009 IEC 61000-4-6:2008	Pass... ⁴
--	Magnetic fields (industrial frequencies) EN 61000-4-8:2010 IEC 61000-4-8:2009	Not applicable... ⁵
--	Voltage dips and interruptions EN 61000-4-11:2004 IEC 61000-4-11:2004	Not applicable... ¹

Notes:

1. No AC power port
2. Overtested with 6 kV (direct coupling)
3. Overtested with 10 V/m (1 – 3 GHz)
4. Overtested with 12 V
5. Does not contain any devices susceptible to magnetic fields.

3. Summary of Test Results (FCC)

§	Test Type	Result
10	Emission	CFR 47
10.1	Conducted emission CFR 47 § 15.107 (Class B)	Not applicable... ¹
10.3	Radiated emission – EM-field CFR 47 § 15.109 (Class B)	Pass... ²

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

§	Test Type	Result
10	Emission	EN 301 489-x
10.1	Interference voltage EN 55022:2010 CISPR 22:2008	Pass
--	Interference current EN 55022:2010 CISPR 22:2008	Not applicable... ³
10.2	Radiated electromagnetic field EN 55022:2010 CISPR 22:2008	Pass
--	Harmonics EN 61000-3-2:2006 +A1 + A2 IEC 61000-3-2:2005 +A1 + A2	Not applicable... ⁴
--	Voltage fluctuations (flicker) EN 61000-3-3:2013 IEC 61000-3-3:2013	Not applicable... ⁴
11	Immunity	EN 301 489-x
11.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass... ⁵
11.2	Electromagnetic fields EN 61000-4-3:2006 + A1 + A2 IEC 61000-4-3:2013 ed.4.0	Pass... ⁶
11.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
11.4	Surges EN 61000-4-5:2006 IEC 61000-4-5:2005	Pass
11.5	Radio frequency common mode EN 61000-4-6:2009 IEC 61000-4-6:2008	Pass... ⁷
--	Voltage dips and interruptions EN 61000-4-11:2004 IEC 61000-4-11:2004	Not applicable... ⁴

Notes:

1. Not applicable on DC port (EUT contains no AC power)
2. Measured up to 6 GHz, for 6 to 12.5 GHz measurement see Montena Test Report No. 16'779
3. Shielded Ethernet cable measured with ISN (interference voltage)
4. No AC power port
5. Overtested with 6 kV (direct coupling)
6. Overtested with 10 V/m (1 – 3 GHz)
7. Overtested with 12 V

5. Applied Standards

EN 55022:2010 CISPR 22:2008 (ed. 6)	Information technology equipment Radio disturbance characteristics – Limits and methods of measurement
EN 55024:2010 CISPR 24:2010(ed. 2.0)	Information technology equipment Immunity characteristics – Limits and methods of measurement
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 and E-UTRA) for Mobile and portable (UE) radio and ancillary equipment
47 CFR Part 15 2014	Code of Federal Regulations - Title 47 - Telecommunication, Part 15 - Radio frequency devices

6. 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>

7. Client

Client name and address	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern Switzerland
Contact Person	Mr. Thomas Siegrist
Telephone	+41 (52) 209 00 41
E-mail	Thomas.Siegrist@netmodule.com

8. Equipment Under Test

8.1 Identification

Manufacturer name and address	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern Switzerland
Production country	Switzerland
Brand name	NetModule AG
Product name	NB1600
Product description	Industrial Router with Mobile, WLAN & GPS.
Model number	NB1600-UW-G (EUT 3) NB1600-LW (EUT 4)
Serial no	EUT 3: 00112B00947B EUT 4: 00112B0084B4
Software version	EUT 3: 3.7.0.102 EUT 4: 3.7.2.100
Hardware version	EUT 3: V3.1 EUT 4: V3.1
Highest frequency	Oscillator Qc300: 33.333 MHz CPU Core: 400 MHz DDR2 SDRAM: 266 MHz Oscillator Qe500: 25 MHz DC/ DC converter: ~300 kHz USB: 480 MHz Oscillator Qu100: 24 MHz PCI Express Bus: 2.5 GHz
Supply	U = 12 ... 48 VDC P = 5 W (max)
Dimension	~ 124 cm x 45 cm x 110 cm (l x w x h)
Weight	< 1 kg
Technical documentation	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.

8.2 Product Family

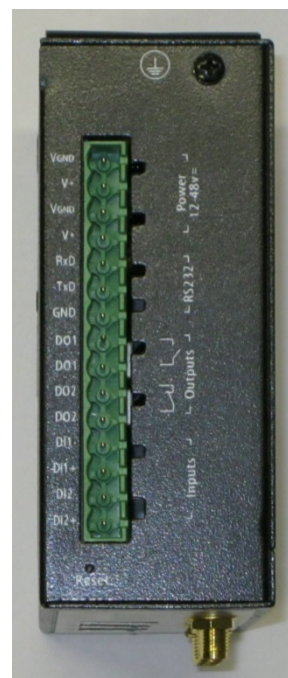
Tested Equipment	Covered Variants	Explanation ¹⁾
NB1600-U ²⁾ NB1600-UW-G NB1600-LW	NB1600-H ₁ ...H _n - S ₁ ...S _n	<p>All covered NB1600 variants contain the same mainboard (PCB), have the same case and the same form factor.</p> <p>They can host up to two (NB1600) communication modules. These modules 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>'H₁...H_n' 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 Ca: CDMA450 W: WLAN a/b/g/n Client & Access Point A: Audio in/out C: CAN-bus Sa: RS-485 (on the same module as CAN) I: IBIS-bus S: RS-232 (on the same module as IBIS) ... (more to follow)</p> <p>'S₁...S_n' indicate the software options activated:</p> <p>G: GPS V: Voice gateway</p> <p>The following NB1600/NB1600 variants are currently available or planned:</p> <p>NB1600-R NB1600-W NB1600-Ed NB1600-Ca NB1600-U NB1600-U-G NB1600-UW NB1600-UW-G NB1600-L NB1600-L-G NB1600-LSa NB1600-LW NB1600-LW-G</p>

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

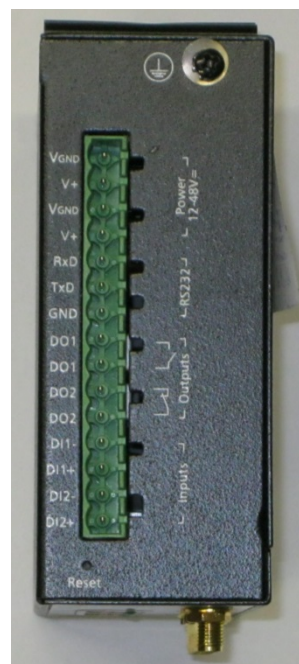
2) tested in March 2011, see test report Albis Technologies Ltd. PB PST 2660, Revision 2, dated May 25, 2011.

8.3 Pictures of the EUT

EUT 3:



EUT 4:



8.4 Classification

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 checked="" type="checkbox"/> Radio and ancillary equipment for fixed use (e.g. base station equipment) <input type="checkbox"/> Radio and ancillary equipment for vehicular use (e.g. mobile equipment) <input type="checkbox"/> Radio and ancillary equipment for portable use (portable equipment) <input type="checkbox"/> Ancillary equipment
CFR 47 Part 15 2014, Dec. 12.	<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).

8.5 Ports

Port	Cable			Remark
	Max. length	Type	Screen	
DC Supply	Not defined	2 wires	No	If not stated otherwise, powered with AC/DC adapter
Ethernet 1	< 100m	RJ45 cat 5e	Yes	Connected to Test-PC
Ethernet 2	< 100m	RJ45 cat 5e	Yes	If not stated otherwise, no cable connected
RS232	< 10 m	3 wire	Yes	Connected to Test-PC
USB	< 3m	USB	Yes	Connected to USB memory stick (for radiated tests connected with 3 m USB standard cable)
2x Digital inputs	< 30 m	2 wire	No	Cables connected
2x Outputs (relays)	< 30 m	2 wire	No	Cables connected
WLAN1/2	< 100 m	SMA (Coax)	Yes	Connected to multiband-antenna
Mobile 1/2 (GSM, UMTS, LTE)	< 100 m	SMA (Coax)	Yes	Connected to multiband-antenna
GPS	< 100 m	SMA (Coax)	Yes	Connected to multiband-antenna

9. Test Conditions

9.1 Climatic Conditions, Location and Date

Location	Date	Temp	Pressure [QFE]	Rel. humidity
<i>Electrosuisse Albislab Albisriederstrasse 199 CH-8047 Zürich Switzerland</i>	<i>Oct. 20 – 21, 2014 Oct. 27 – 28, 2014 Nov. 5 – 7, 2014</i>	<i>24°C ± 2°C</i>	<i>962 hPa ± 5 hPa</i>	<i>33% ± 5%</i>

9.2 Attendant Persons

Test Engineer(s):

<i>Mr Daniel Rufer</i>

Other(s):

Name	Company
<i>Mr Simon Maurer</i>	<i>NetModule AG</i>
<i>Mr Raffael Rohrer</i>	<i>NetModule AG</i>

9.3 Test Configuration

EUT 3 : NB1600-UW-G:

- 1 Ethernet connection established to Test-PC
- 1 RS232 connection established to Test-PC
- 1 GSM/UMTS Antenna (1 cable)
- 1 WLAN Antenna (2 cables)
- 1 GPS Antenna (1 cable)
- Digital I/O cable (floating)
- USB cable with USB Memory Stick
- 1 SIM card

EUT 4 : NB1600-LW:

- 1 Ethernet connection established to Test-PC
- 1 RS232 connection established to Test-PC
- 1 GSM/UMTS/LTE Antenna (2 cables)
- 1 WLAN Antenna (2 cables)
- Digital I/O cable (floating)
- USB cable with USB Memory Stick
- 1 SIM card

9.4 Operating Conditions

Normal mode:

- Ping over WLAN
- Ping over WWAN (UMTS/LTE)
- Ping over Ethernet cable
- Access to USB disc

9.5 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

9.6 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	Remark
Test-PC / Notebook	Dell	E5540	1PF9M12	
USB-to-RS232 Adapter	n/a	U232-P9(2.4)	0608SP030727	
USB Disk	n/a			
WWAN Antenna	n/a	Antenna-Roof-2L DL-9	A140812300036	
GPS Antenna	n/a	REEL C70ZAR 0300 00 03 03 PWN1	02 1501	
WLAN Antenna		Antenna-Roof-2W		
Power supply				See tests

9.7 Performance Criteria

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

10. Emission Tests

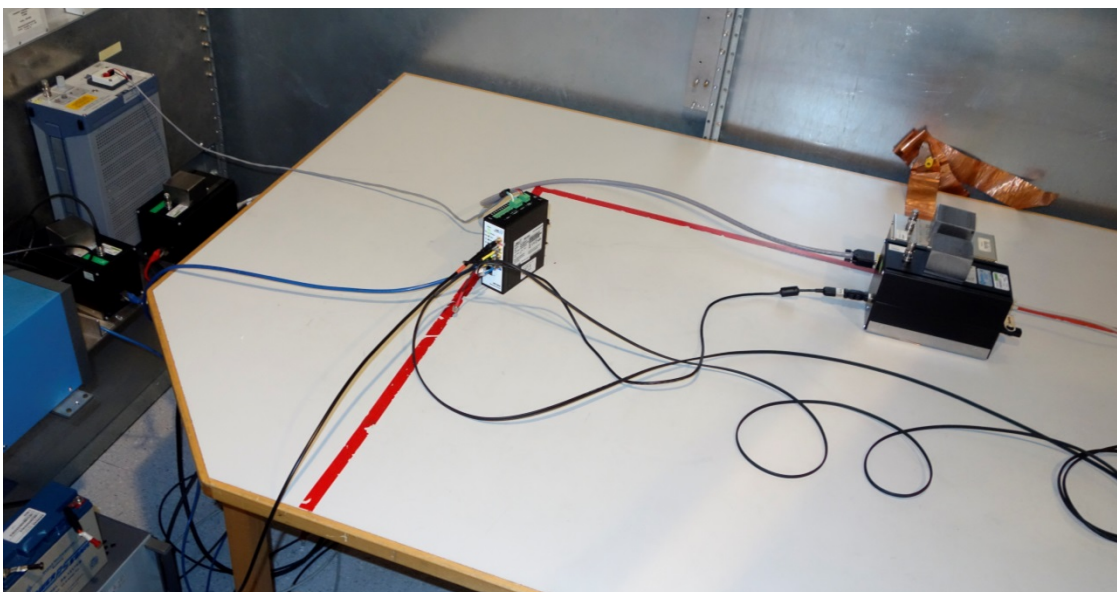
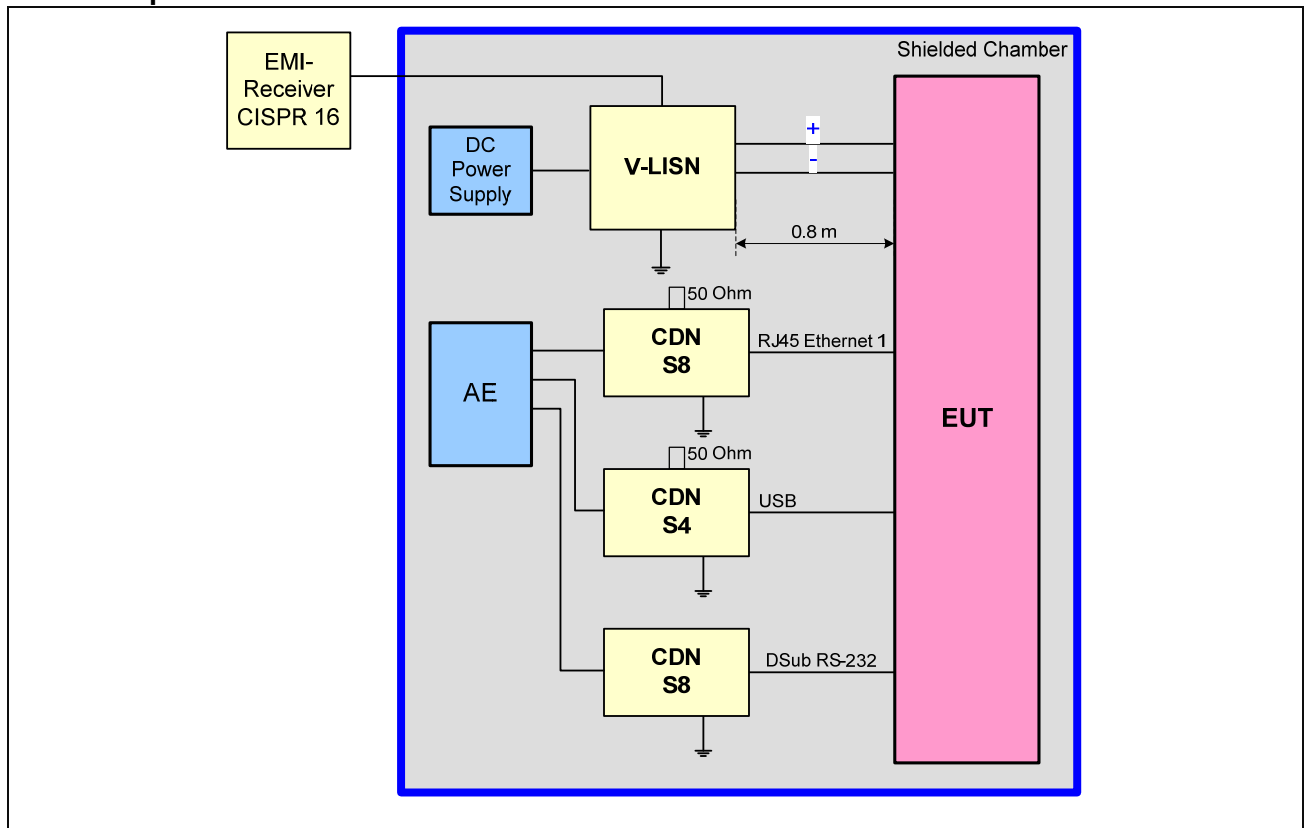
10.1 Conducted Emission - Interference Voltage (EN 55022)

Test site: *Shielded room (Albislab)*

Meas. uncertainty: *see chapter 12*

Measuring method: *The conducted disturbance is measured using a spectrum analyzer 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 on the graph. The values that exceed the limit shall be re-measured with a measuring receiver.*

Test Setup

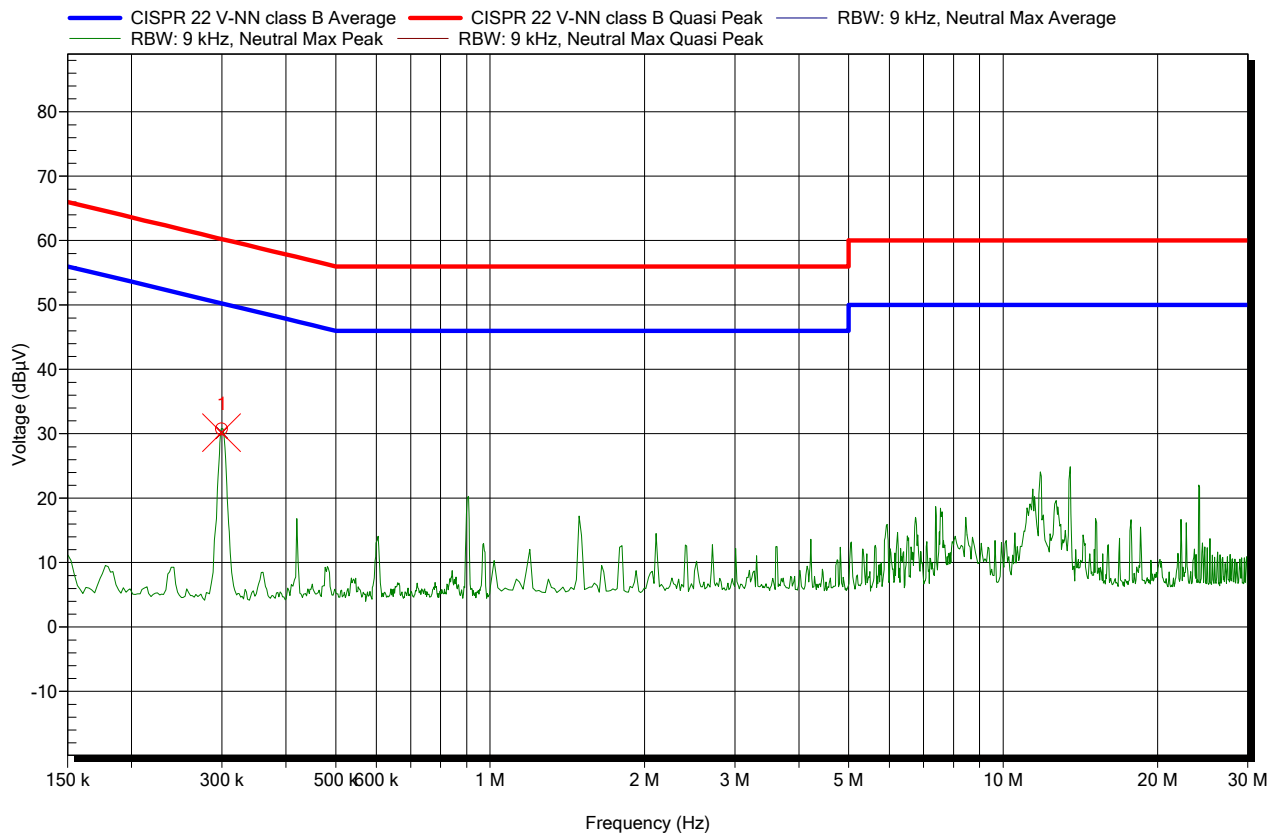


Test Equipment

Device Type	Brand	Type	ID
EMI Receiver	Hewlett Packard	8546A	OA9715
V-Network	Rohde & Schwarz	ESH3-Z5	PE7627
CDN	EM Test	CDN S8 RJ45	13.6632.07
CDN USB	EM Test	CDN S4-USB	H10173
CDN DSub	Lüthi	CDN 801-S8	H7681
Coaxial cable	Huber & Suhner	RG223/U	H8188+H8189
Lab Power Supply	Oltronix	B703DT	Q4410

Measurement 1

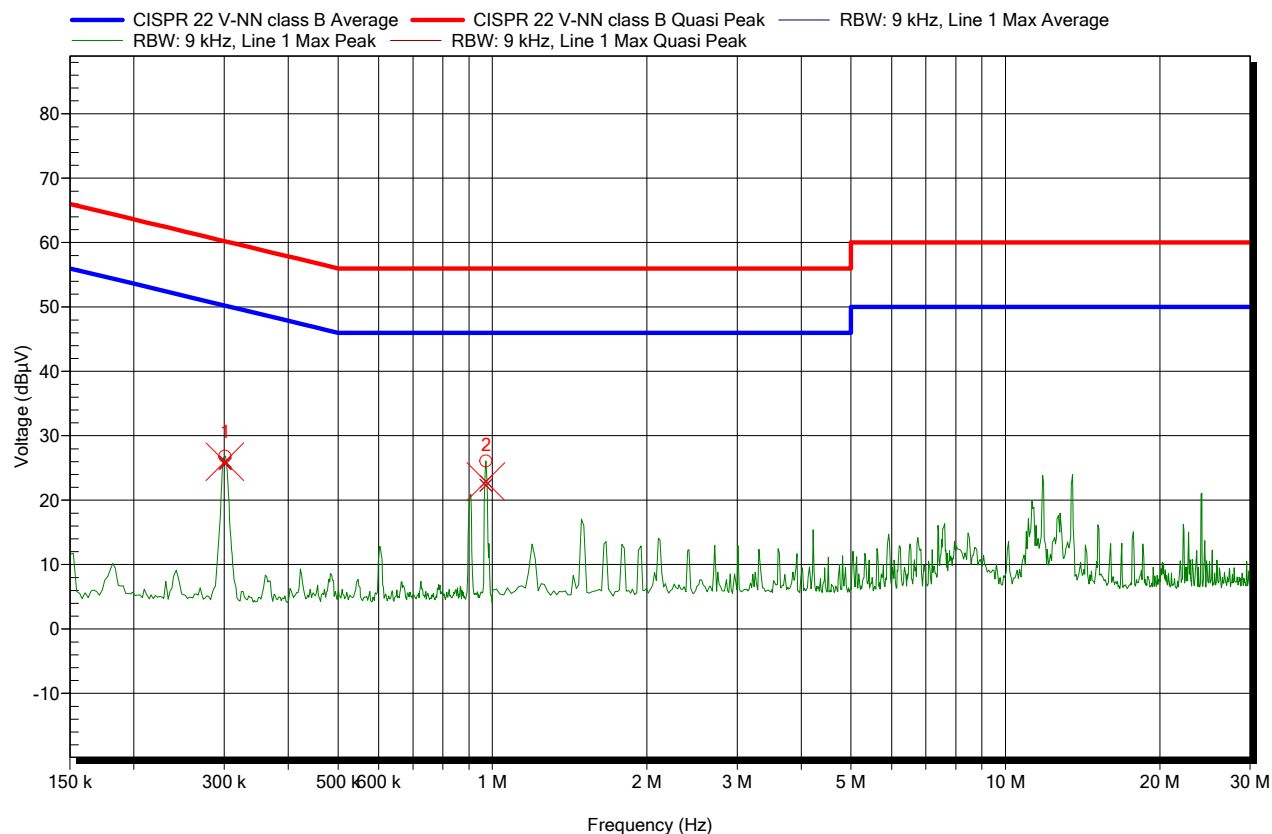
EUT	EUT 4: NB1600-LW
Verdict, Test	Test 17: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)
Mode of operation	See chapter 9.3 & 9.4
Test date, time	05/11/2014 13:39:04
Interface / Line under test	12 VDC, negative
Transducer	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
Measurement settings	Radimation Version: 2014.1.7, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [583.3 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: Auto [10 dB], Internal preamp: 0 dB, Measure time: Auto [120 ms]

**Detected peaks**

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	299.364 kHz	30.75 dB μ V	30.17 dB μ V	-20.09 dB	30.2 dB μ V	-30.06 dB	Pass

Measurement 2

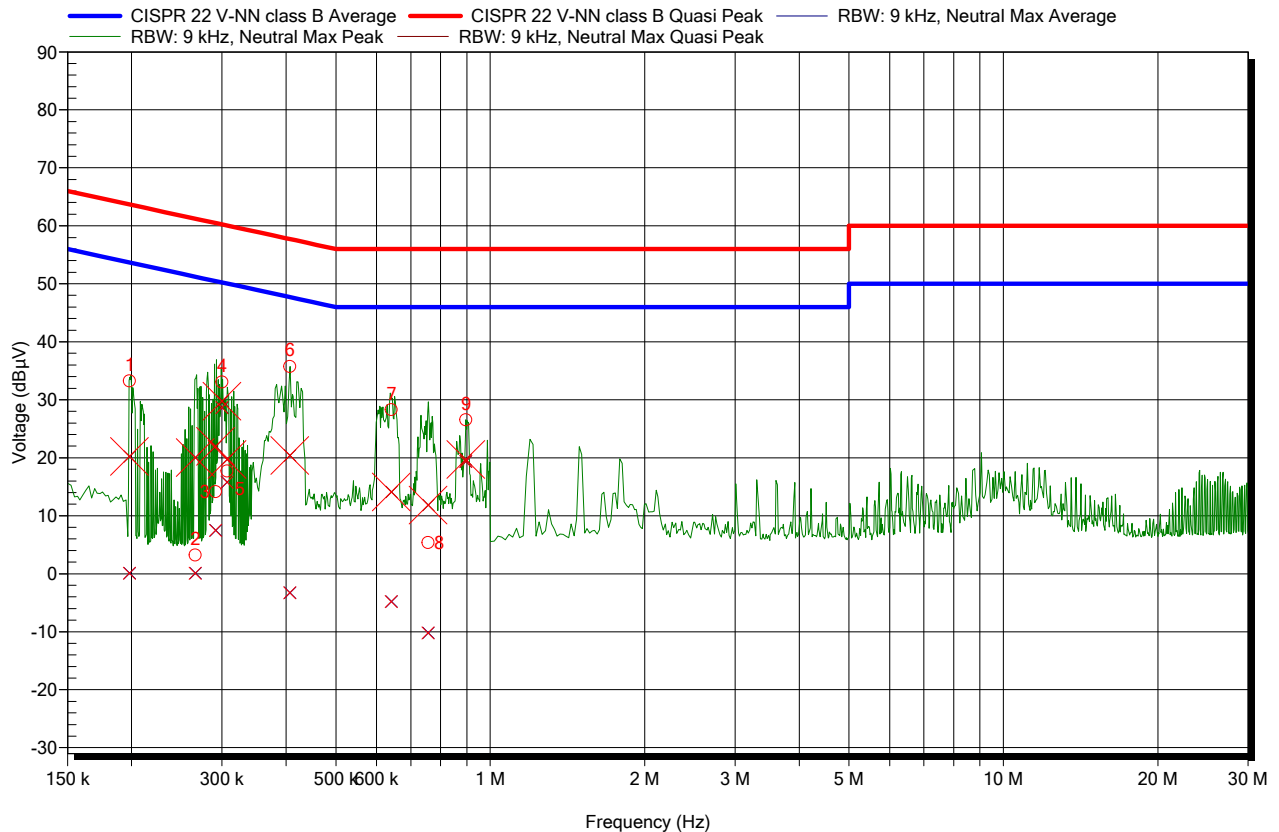
EUT	EUT 4: NB1600-LW
Verdict, Test	Test 18: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)
Mode of operation	See chapter 9.3 & 9.4
Test date, time	05/11/2014 13:43:07
Interface / Line under test	12 VDC, positive
Transducer	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
Measurement settings	Radimation Version: 2014.1.7, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [70.8 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: Auto [10 dB], Internal preamp: 0 dB, Measure time: Auto [120 ms]

**Detected peaks**

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	300.81 kHz	26.81 dB μ V	25.65 dB μ V	-24.57 dB	26.01 dB μ V	-34.21 dB	Pass
2	970.446 kHz	26.08 dB μ V	22.33 dB μ V	-23.67 dB	22.9 dB μ V	-33.1 dB	Pass

Measurement 3

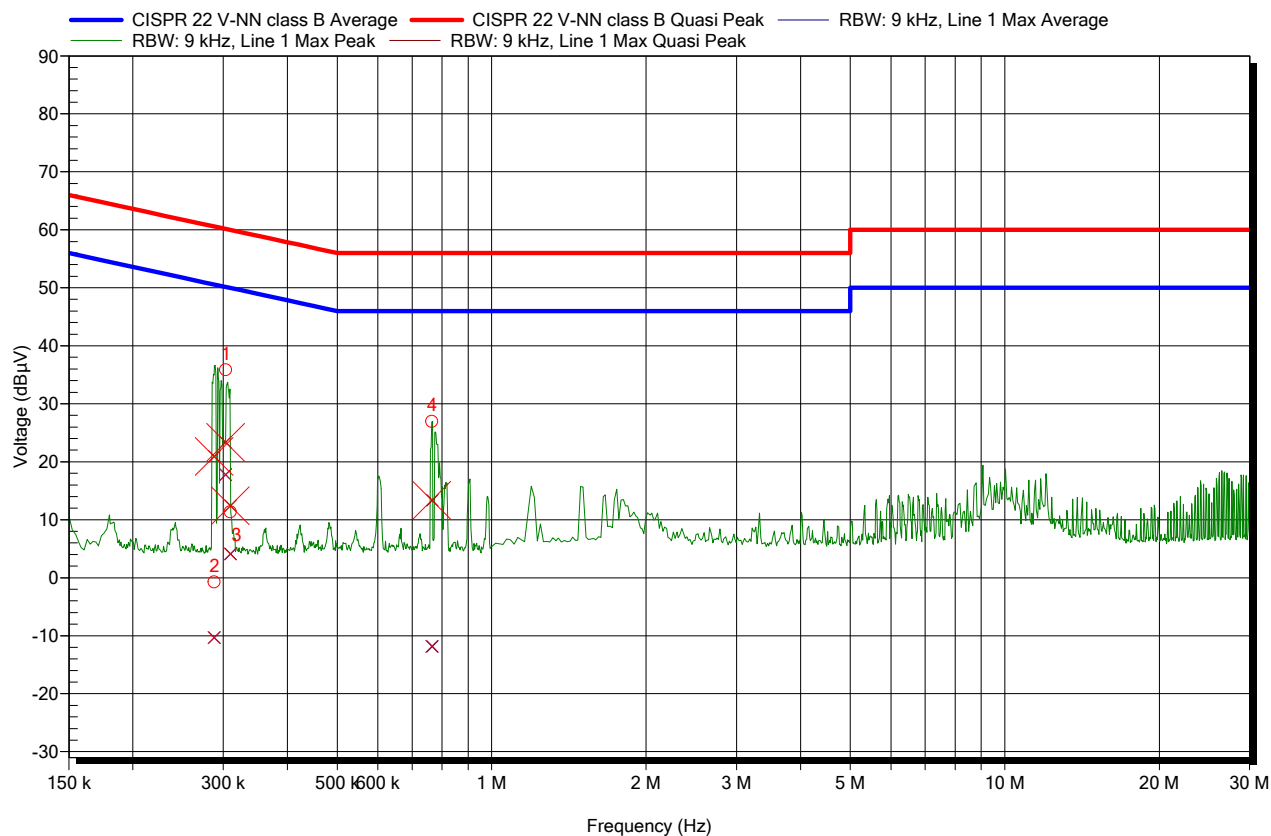
EUT	EUT 4: NB1600-LW
Verdict, Test	Test 7: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)
Mode of operation	See chapter 9.3 & 9.4
Test date, time	05/11/2014 10:18:08
Interface / Line under test	48 VDC, Negative
Transducer	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
Measurement settings	Radimation Version: 2014.1.7, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [50 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: Auto [10 dB], Internal preamp: 0 dB, Measure time: Auto [120 ms]

**Detected peaks**

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	198.042 kHz	33.26 dB μ V	0.09 dB μ V	-53.61 dB	20.22 dB μ V	-43.48 dB	Pass
2	266.112 kHz	3.22 dB μ V	0.09 dB μ V	-51.15 dB	20.04 dB μ V	-41.2 dB	Pass
3	291.295 kHz	14.15 dB μ V	7.51 dB μ V	-42.98 dB	21.94 dB μ V	-38.55 dB	Pass
4	299.928 kHz	33.09 dB μ V	28.67 dB μ V	-21.57 dB	29.79 dB μ V	-30.45 dB	Pass
5	306.696 kHz	17.71 dB μ V	15.82 dB μ V	-34.24 dB	19.71 dB μ V	-40.35 dB	Pass
6	406.484 kHz	35.78 dB μ V	-3.31 dB μ V	-51.03 dB	20.41 dB μ V	-37.31 dB	Pass
7	641.771 kHz	28.33 dB μ V	-4.78 dB μ V	-50.78 dB	14.08 dB μ V	-41.92 dB	Pass
8	756.234 kHz	5.4 dB μ V	-10.18 dB μ V	-56.18 dB	11.86 dB μ V	-44.14 dB	Pass
9	896.132 kHz	26.58 dB μ V	19.33 dB μ V	-26.67 dB	19.67 dB μ V	-36.33 dB	Pass

Measurement 4

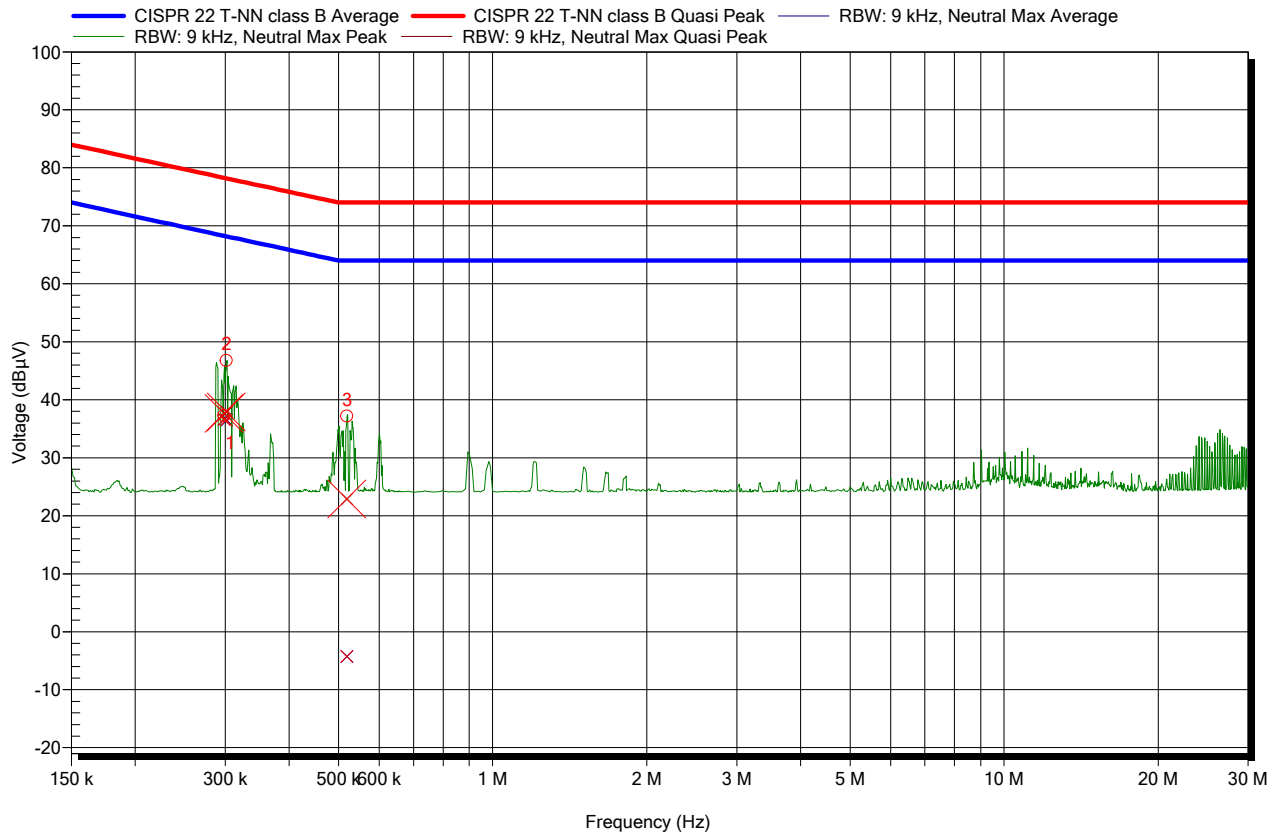
EUT	EUT 4: NB1600-LW
Verdict, Test	Test 8: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)
Mode of operation	See chapter 9.3 & 9.4
Test date, time	05/11/2014 10:29:03
Interface / Line under test	48 VDC, positive
Transducer	PE7627 V-LISN 1Ph+N 16A Rohde & Schwarz ESH3-Z5
Measurement settings	Radimation Version: 2014.1.7, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [50 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: Auto [10 dB], Internal preamp: 0 dB, Measure time: Auto [120 ms]

**Detected peaks**

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	303.123 kHz	35.87 dB μ V	17.77 dB μ V	-32.39 dB	23.34 dB μ V	-36.82 dB	Pass
2	287.722 kHz	-0.7 dB μ V	-10.34 dB μ V	-60.93 dB	20.91 dB μ V	-39.68 dB	Pass
3	309.761 kHz	11.4 dB μ V	4.08 dB μ V	-45.9 dB	12.45 dB μ V	-47.53 dB	Pass
4	764.586 kHz	27 dB μ V	-11.84 dB μ V	-57.84 dB	13.35 dB μ V	-42.65 dB	Pass

Measurement 5

EUT	EUT 4: NB1600-LW
Verdict, Test	Test 9: CE_150k-30M_LAN-LISN_13.6632.07 55022 CLB
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)
Mode of operation	See chapter 9.3 & 9.4
Test date, time	05/11/2014 10:36:18
Interface / Line under test	Ethernet 1
Transducer	ISN_RJ45
Measurement settings	Radimation Version: 2014.1.7, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [50 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: Auto [10 dB], Internal preamp: 0 dB, Measure time: Auto [120 ms]

**Detected peaks**

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	298.45 kHz	37.28 dBμV	36.61 dBμV	-31.68 dB	37.67 dBμV	-40.62 dB	Pass
2	301.628 kHz	46.82 dBμV	36.48 dBμV	-31.72 dB	37.88 dBμV	-40.32 dB	Pass
3	518.495 kHz	37.19 dBμV	-4.25 dBμV	-68.25 dB	22.87 dBμV	-51.13 dB	Pass

10.2 Radiated Emission - Electromagnetic Field (EN 55022)

Test site: Semi-anechoic chamber (Albislab)

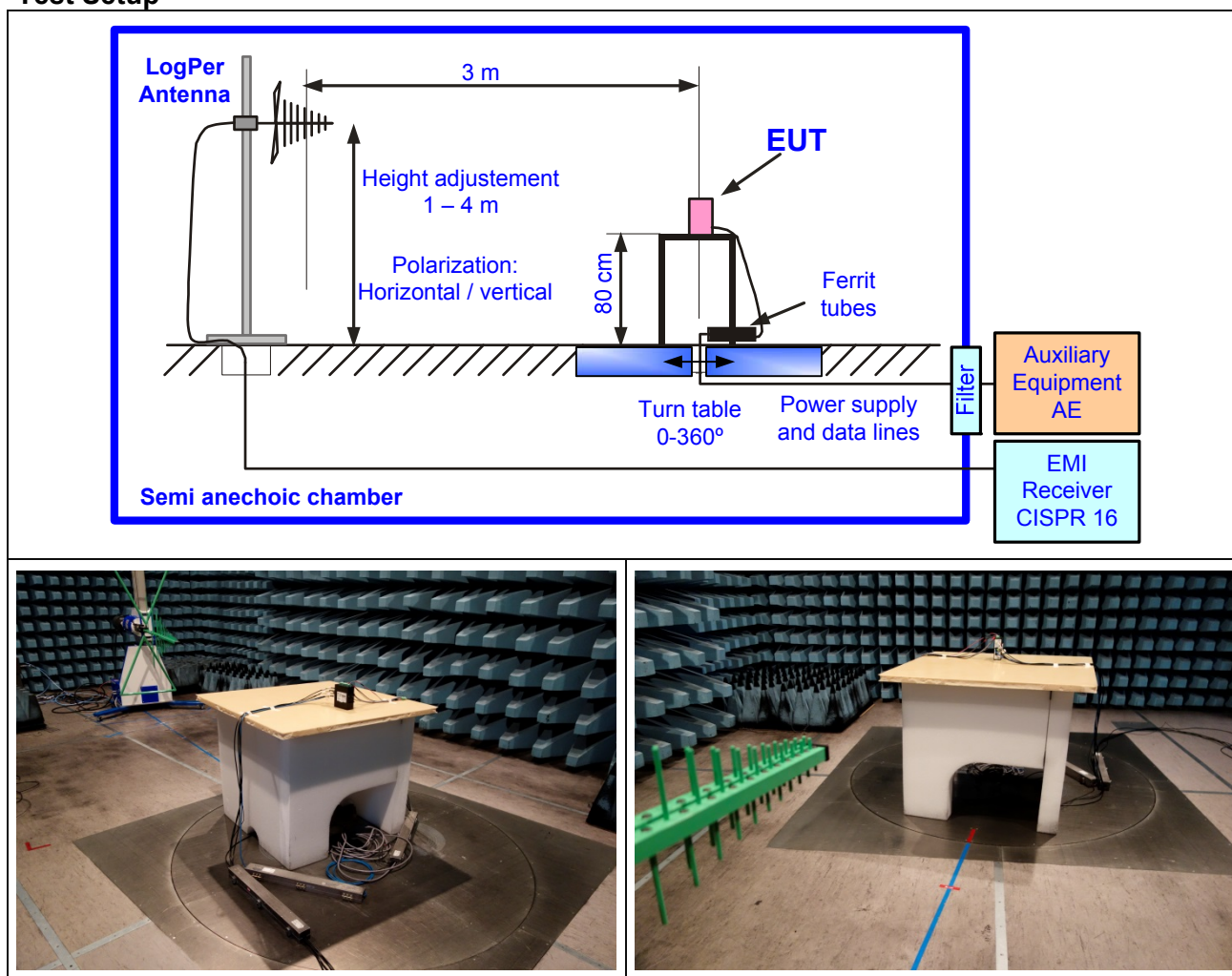
Distance: 3 m

Position of EUT: 0.8 m (height of the equipment under test above floor)

Meas. uncertainty: see chapter 12

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 remeasured manually using a receiver.

Test Setup

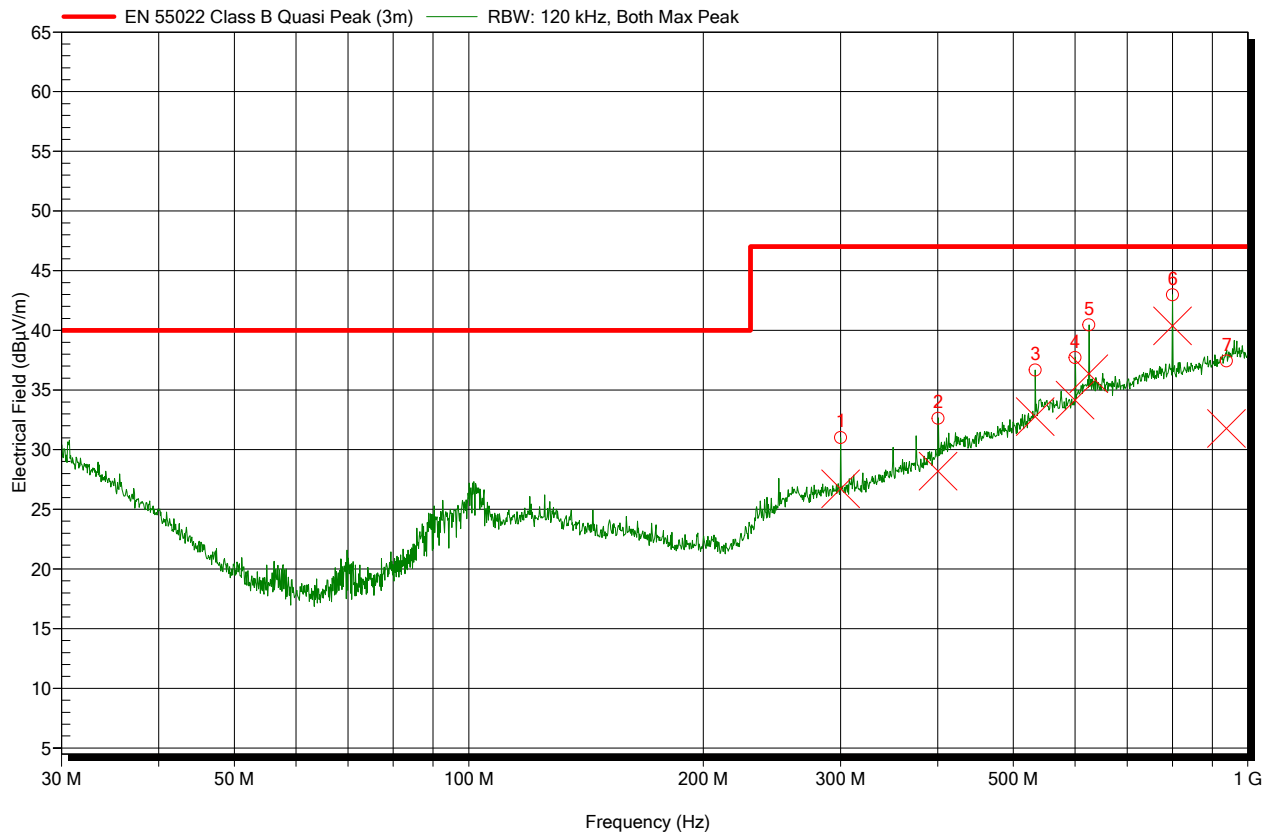


Test Equipment

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU8	OA 10193
Antenna LogPer	Chase	CBL 6112B	H9695
Coaxial cable	Huber & Suhner	RG223/U	H10010, H10011, H10016, H10145

Measurement 1

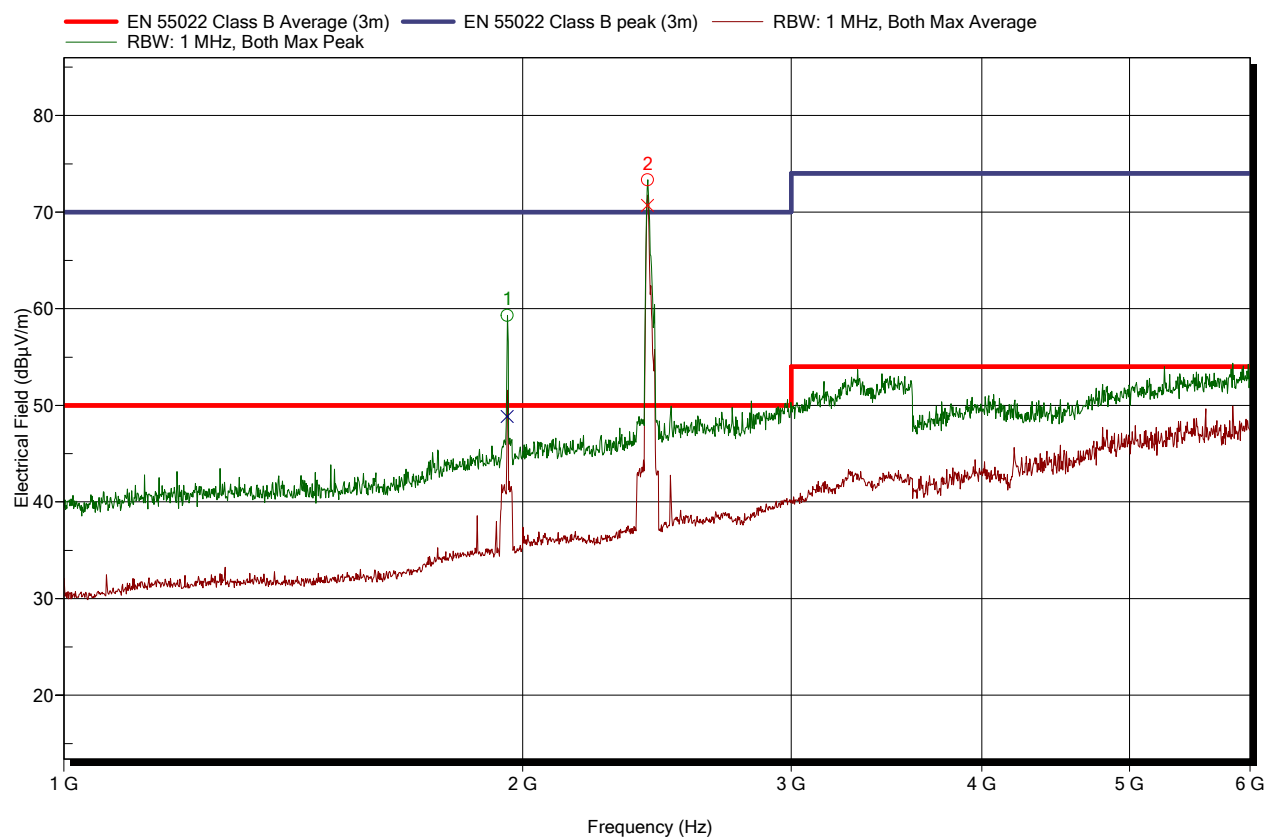
EUT	EUT 3: NB1600-UW-G		
Verdict, Test	Test 2: ESU8_30M-1G EN 55022 Class B 3m		
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)		
Mode of operation	See chapter 9.3 & 9.4		
Test date, time	21/10/2014 11:20:40		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.1.7, RBW: 120 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 30 kHz steps, Attenuator: Auto [10 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	300 MHz	31.01 dB μ V/m	26.72 dB μ V/m	-20.28 dB	Pass	240 Degree	1 m	Horizontal
2	400.02 MHz	32.62 dB μ V/m	28.18 dB μ V/m	-18.82 dB	Pass	240 Degree	1 m	Horizontal
3	533.34 MHz	36.67 dB μ V/m	32.77 dB μ V/m	-14.23 dB	Pass	150 Degree	1 m	Vertical
4	600 MHz	37.73 dB μ V/m	34.15 dB μ V/m	-12.85 dB	Pass	0 Degree	1 m	Vertical
5	624.99 MHz	40.47 dB μ V/m	36.37 dB μ V/m	-10.63 dB	Pass	150 Degree	1 m	Vertical
6	799.98 MHz	42.97 dB μ V/m	40.39 dB μ V/m	-6.61 dB	Pass	240 Degree	1 m	Horizontal
7	938.76 MHz	37.45 dB μ V/m	31.79 dB μ V/m	-15.21 dB	Pass	330 Degree	1 m	Vertical

Measurement 2

EUT	EUT 3: NB1600-UW-G		
Verdict, Test	Test 3: 1G-6G EN 55022 Class B 3m		
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)		
Mode of operation	See chapter 9.3 & 9.4		
Test date, time	21/10/2014 11:32:47		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.1.7, 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: 5 ms		

**Detected peaks**

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.954 GHz	59.31 dB μ V/m	-10.69 dB	48.84 dB μ V/m	-1.16 dB	Note	240 Degree	1 m	Vertical
2	2.415 GHz	73.34 dB μ V/m	3.34 dB	70.69 dB μ V/m	20.69 dB	Note	0 Degree	1 m	Vertical

Note: Pass, exclusion band GSM & WLAN (according ETSI EN 301 489-7, -17, -24)

10.3 Radiated Emission - Electromagnetic Field (FCC)

Test site: Semi-anechoic chamber (Albislab)

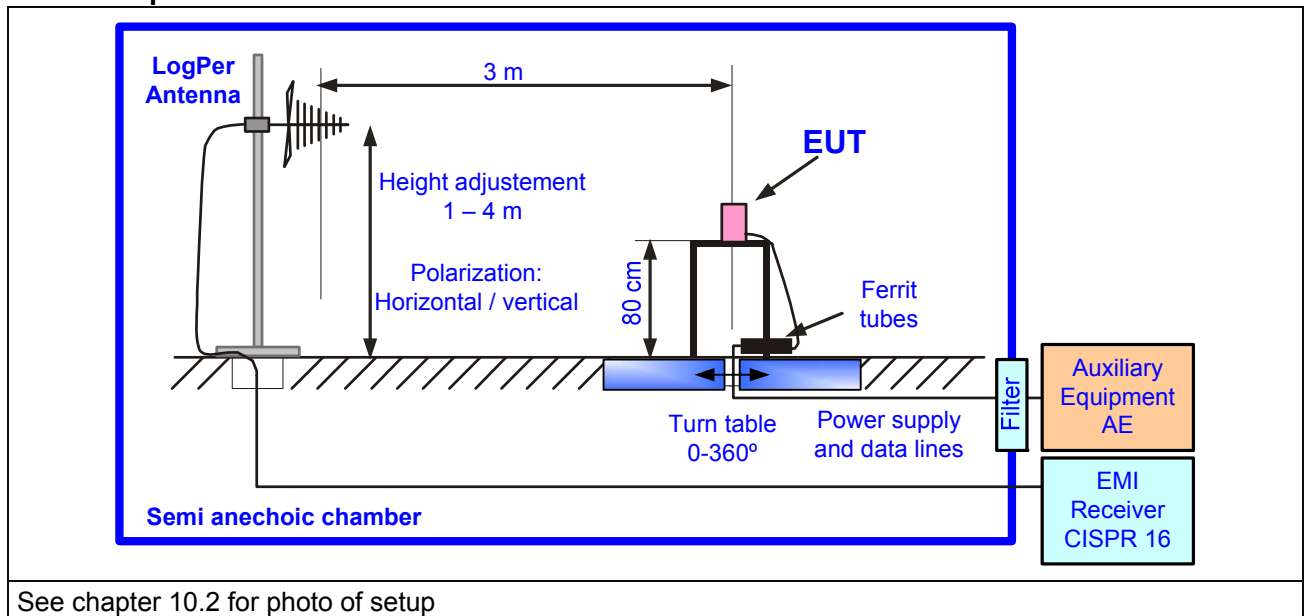
Distance: 3 m

Position of EUT: 0.8 m (height of the equipment under test above floor)

Meas. uncertainty: see chapter 12

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 remeasured manually using a receiver.

Test Setup



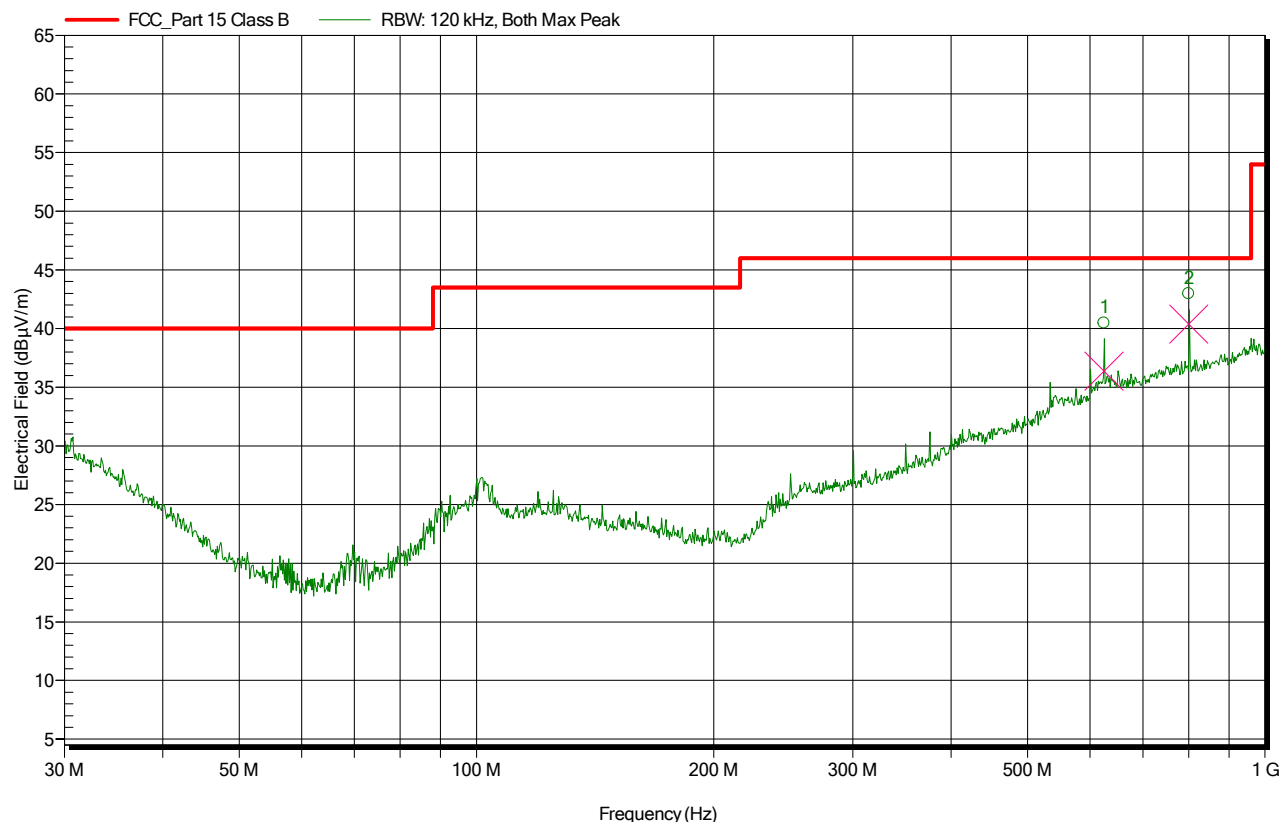
See chapter 10.2 for photo of setup

Test Equipment

Device type	Brand	Type	ID
EMI Receiver	Rohde & Schwarz	ESU8	OA 10193
Antenna LogPer	Chase	CBL 6112B	H9695
Coaxial cable	Huber & Suhner	RG223/U	H10010, H10011, H10016, H10145

Measurement 1

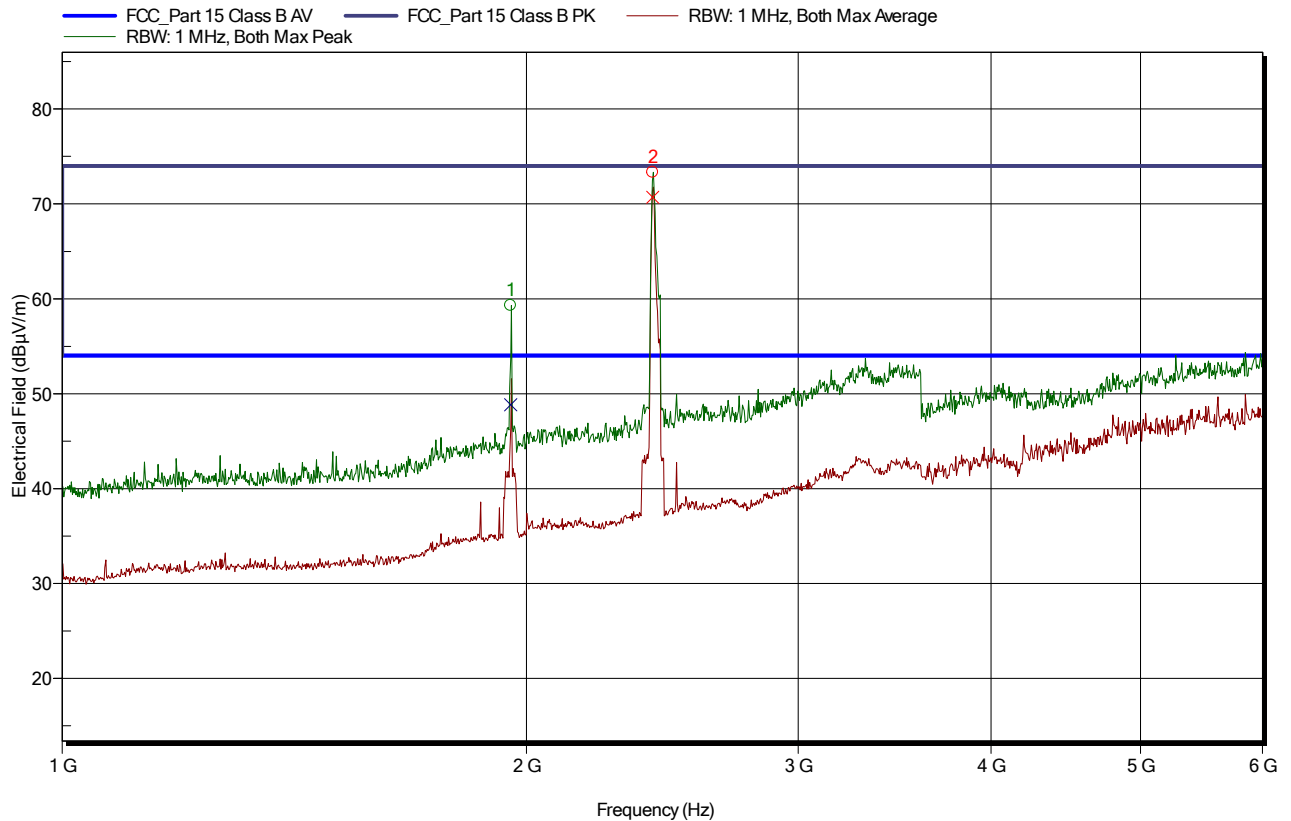
EUT	EUT 3: NB1600-UW-G		
Verdict, Test	Test 2: ESU8_30M-1G EN 55022 Class B 3m		
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)		
Mode of operation	See chapter 9.3 & 9.4		
Test date, time	21/10/2014 11:20:40		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.1.7, RBW: 120 kHz, VBW: 1 MHz, Sweep time: Auto [0 ms], Step freq: Linear: 30 kHz steps, Attenuator: Auto [10 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	624.99 MHz	40.47 dBμV/m	36.37 dBμV/m	-9.63 dB	Pass	150 Degree	1 m	Vertical
2	799.98 MHz	42.97 dBμV/m	40.39 dBμV/m	-5.61 dB	Pass	240 Degree	1 m	Horizontal

Measurement 2

EUT	EUT 3: NB1600-UW-G		
Verdict, Test	Test 3: 1G-6G EN 55022 Class B 3m		
Modification	LC-Filter added to the power input (3.3 μ H, 68 μ F)		
Mode of operation	See chapter 9.3 & 9.4		
Test date, time	21/10/2014 11:32:47		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.1.7, 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: 5 ms		

**Detected peaks**

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.954 GHz	59.31 dB μ V/m	-14.69 dB	48.84 dB μ V/m	-1.16 dB	Note	240 Degree	1 m	Vertical
2	2.415 GHz	73.34 dB μ V/m	-0.66 dB	70.69 dB μ V/m	20.69 dB	Note	0 Degree	1 m	Vertical

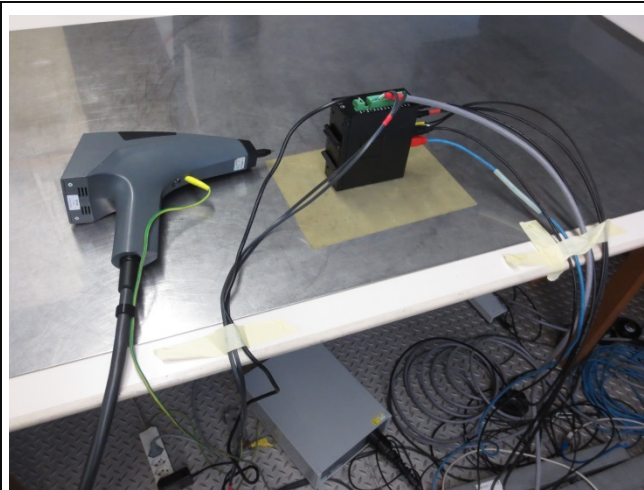
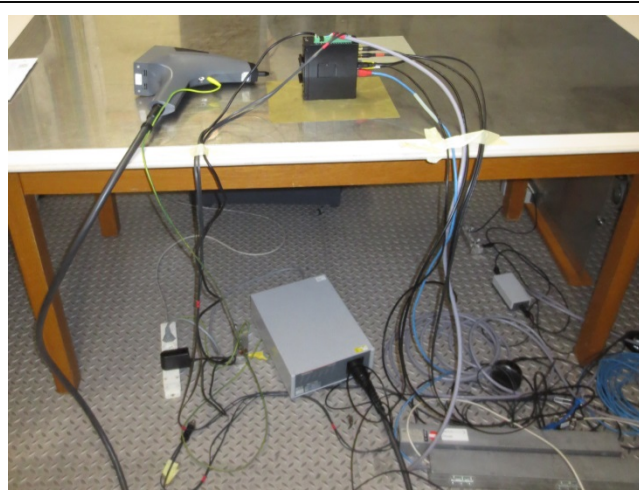
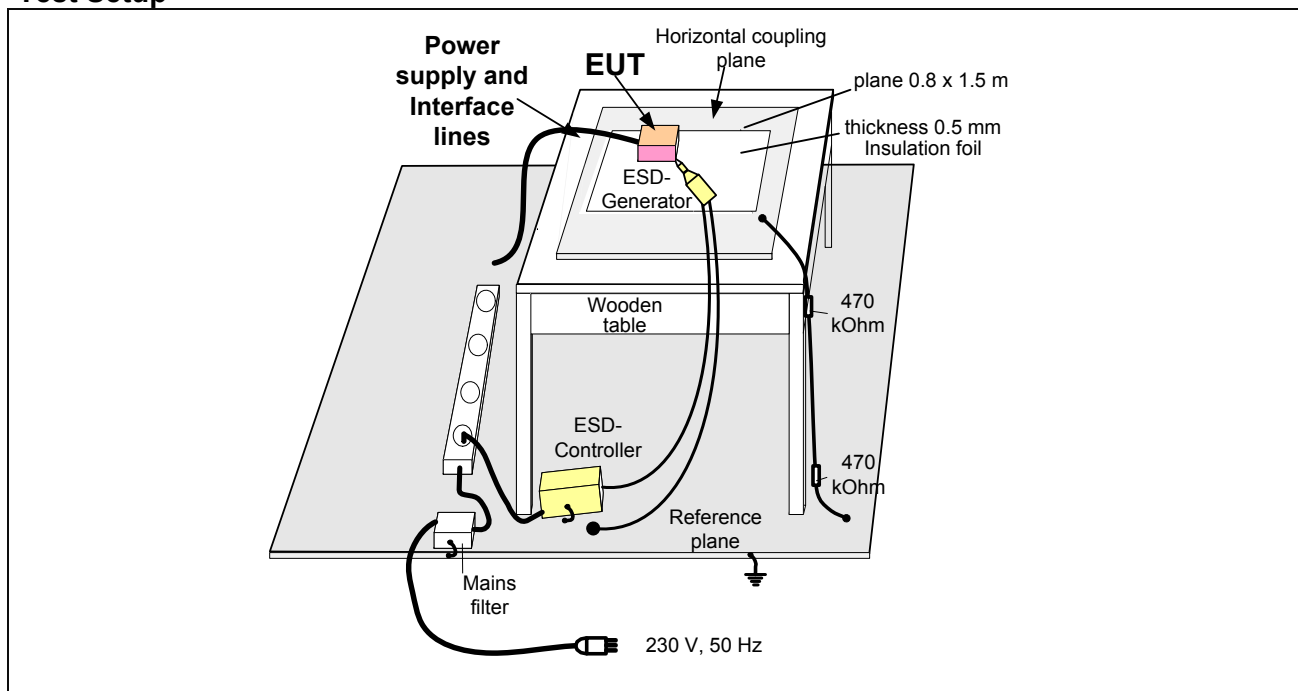
Note: Pass, exclusion band GSM & WLAN (according ETSI EN 301 489-7, -17, -24)

11. Immunity Tests

11.1 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 fibre. 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 12
- 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

Test Protocol

Equipment: *EUT 4: NB1600-LW*
 Cables connected: *All cables, chapter 9.3*
 Operating mode: *Active mode, see chapter 9.4 (supplied with 12 VDC)*
 Observation of EUT: *Visually, see chapter 9.5*
 Modifications: *LC-Filter added to the power input (3.3 μ H, 68 μ F)*
 Test site: *Laboratory (Albislab)*
 Test Setup: *table-top equipment*

Requirements

Standard:	Required level Air discharge:	Required level Contact discharge:	Impulses per point, level and polarity:	Performance criterion:
EN 55024	± 8 kV	± 4 kV	10	B
EN 61000-6-2	± 8 kV	± 4 kV	10	B
ETSI EN 301 489-1	± 8 kV	± 4 kV	10	B

Test Results

Indirect discharges:

Level	No of discharges (for each level)	Indirect discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
± 2 kV	10	HCP	No errors occurred	A	Pass
± 4 kV	10	HCP	No errors occurred	A	Pass
± 6 kV	10	HCP	No errors occurred	A	Pass

Direct discharges:

Level	No of discharges (for each level)	Discharge		Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
		air	cont.			
± 2 kV	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors occurred	A	Pass
± 4 kV	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors occurred	A	Pass
± 6 kV	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors occurred	A	Pass
± 2 kV	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
± 4 kV	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
± 8 kV	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
Tested points: Enclosure, Screws, connectors, LED's						

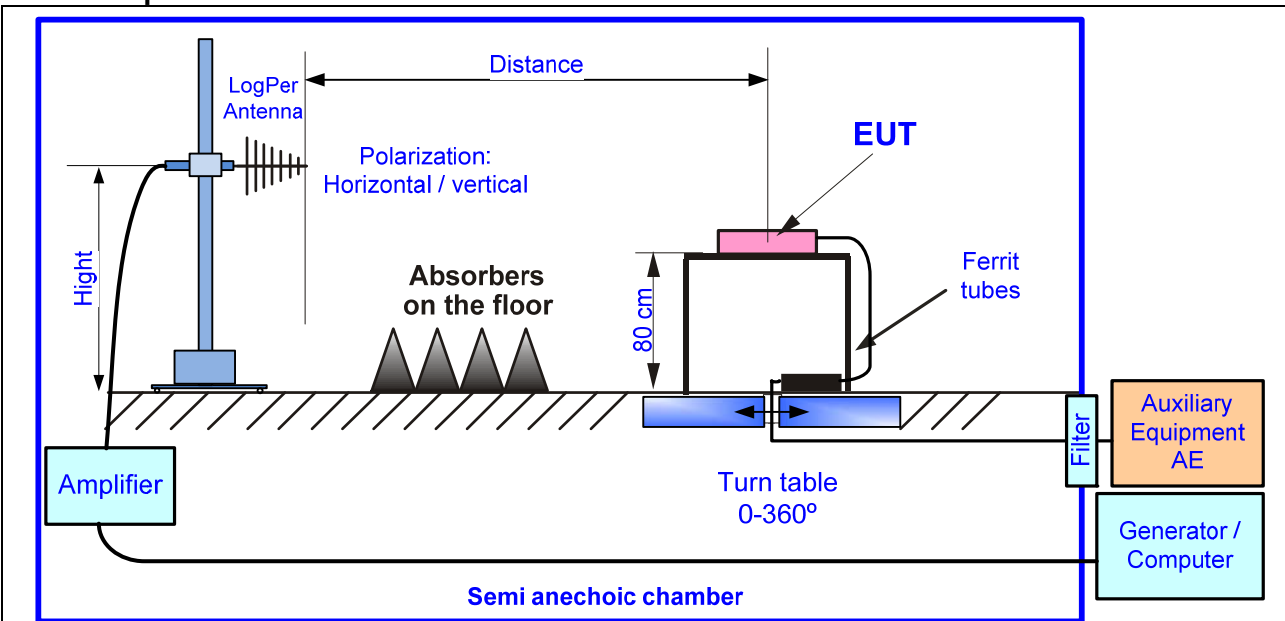
11.2 Immunity to Electromagnetic Fields (EN 61000-4-3)

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 12*

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 – 3 GHz	Amplifier Research	50S1G6	14.6632.01
Antenna	Amplifier Research	AT 6080	H10192
Field Sensor	Narda S.T.S	EP 601	14.6632.02

Test Protocol

Equipment: *EUT 3: NB1600-UW-G*
 Cables connected: *All cables, chapter 9.3*
 Operating mode: *Active mode, see chapter 9.4 (supplied with 12 VDC)*
 Observation of EUT: *Visually, see chapter 9.5*
 Modifications: *LC-Filter added to the power input (3.3 μ H, 68 μ F)*
 Test site: *Semi-anechoic chamber (Albislab)*
 Position of EUT: *0.8 m (height of the equipment under test above floor)*

Requirements

Standard:	Frequency range:	Req. level:	Test dist.:	Modulation:	Freq. step:	Dwell time:	Perf. crit.:
<i>EN 55024 : 2010</i>	<i>80 – 1000 MHz</i>	<i>3 V/m</i>	<i>3.0 m</i>	<i>AM, 1 kHz, 80%</i>	<i>1 %</i>	<i>1 s</i>	<i>A</i>
<i>EN 61000-6-2 : 2005</i>	<i>80 – 1000 MHz</i>	<i>10 V/m</i>	<i>3.0 m</i>	<i>AM, 1 kHz, 80%</i>	<i>1 %</i>	<i>1 s</i>	<i>A</i>
	<i>1400 – 2000 MHz</i>	<i>3 V/m</i>	<i>3.0 m</i>	<i>AM, 1 kHz, 80%</i>			<i>A</i>
	<i>2000 – 2700 MHz</i>	<i>1 V/m</i>	<i>3.0 m</i>	<i>AM, 1 kHz, 80%</i>			<i>A</i>
<i>ETSI EN 301 489-1</i>	<i>80 – 1000 MHz</i>	<i>3 V/m</i>	<i>3.0 m</i>	<i>AM, 1 kHz, 80%</i>	<i>1 %</i>	<i>1 s</i>	<i>A</i>
	<i>1400 – 2700 MHz</i>	<i>3 V/m</i>	<i>3.0 m</i>	<i>AM, 1 kHz, 80%</i>			<i>A</i>

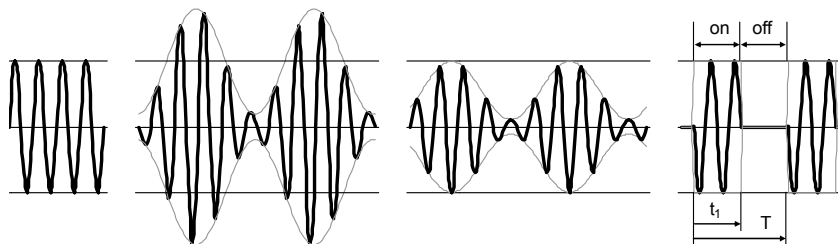
Modulation:

☐ CW

☒ AM (normal)

☐ AM (const. peak)

☐ PM



Test Results

Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	10	Horizontal	Front 0°	No errors occurred	A	Pass
80 – 1000	10	Horizontal	90°	No errors occurred	A	Pass
80 – 1000	10	Horizontal	180°	No errors occurred	A	Pass
80 – 1000	10	Horizontal	270°	No errors occurred	A	Pass
80 – 1000	10	Vertical	Front 0°	No errors occurred	A	Pass
80 – 1000	10	Vertical	90°	No errors occurred	A	Pass
80 – 1000	10	Vertical	180°	No errors occurred	A	Pass
80 – 1000	10	Vertical	270°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	Front 0°	Short interruptions in WLAN communication, Note 1	A	Pass
1000 – 3000	10	Horizontal	90°	Short interruptions in WLAN communication, Note 1	A	Pass
1000 – 3000	10	Horizontal	180°	Short interruptions in WLAN communication, Note 1	A	Pass
1000 – 3000	10	Horizontal	270°	Short interruptions in WLAN communication, Note 1	A	Pass
1000 – 3000	10	Vertical	Front 0°	Short interruptions in WLAN communication, Note 1	A	Pass
1000 – 3000	10	Vertical	90°	Short interruptions in WLAN communication, Note 1	A	Pass
1000 – 3000	10	Vertical	180°	Short interruptions in WLAN communication, Note 1	A	Pass
1000 – 3000	10	Vertical	270°	Short interruptions in WLAN communication, Note 1	A	Pass

Notes:

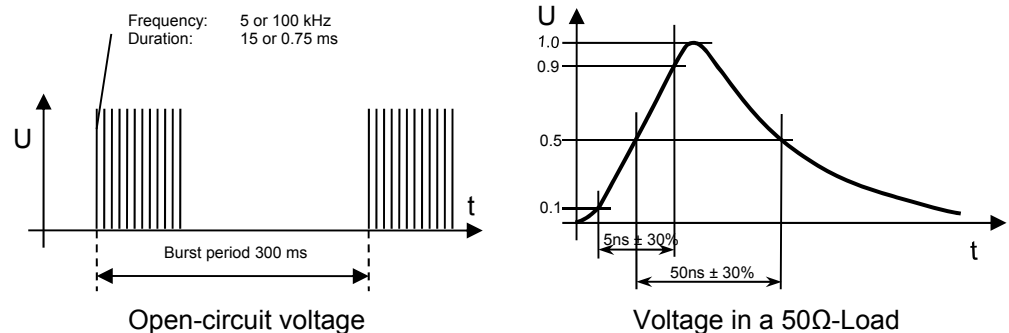
- 1) no error, exclusion band applies at WLAN frequency band (according ETSI EN 301 489-17)

11.3 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:



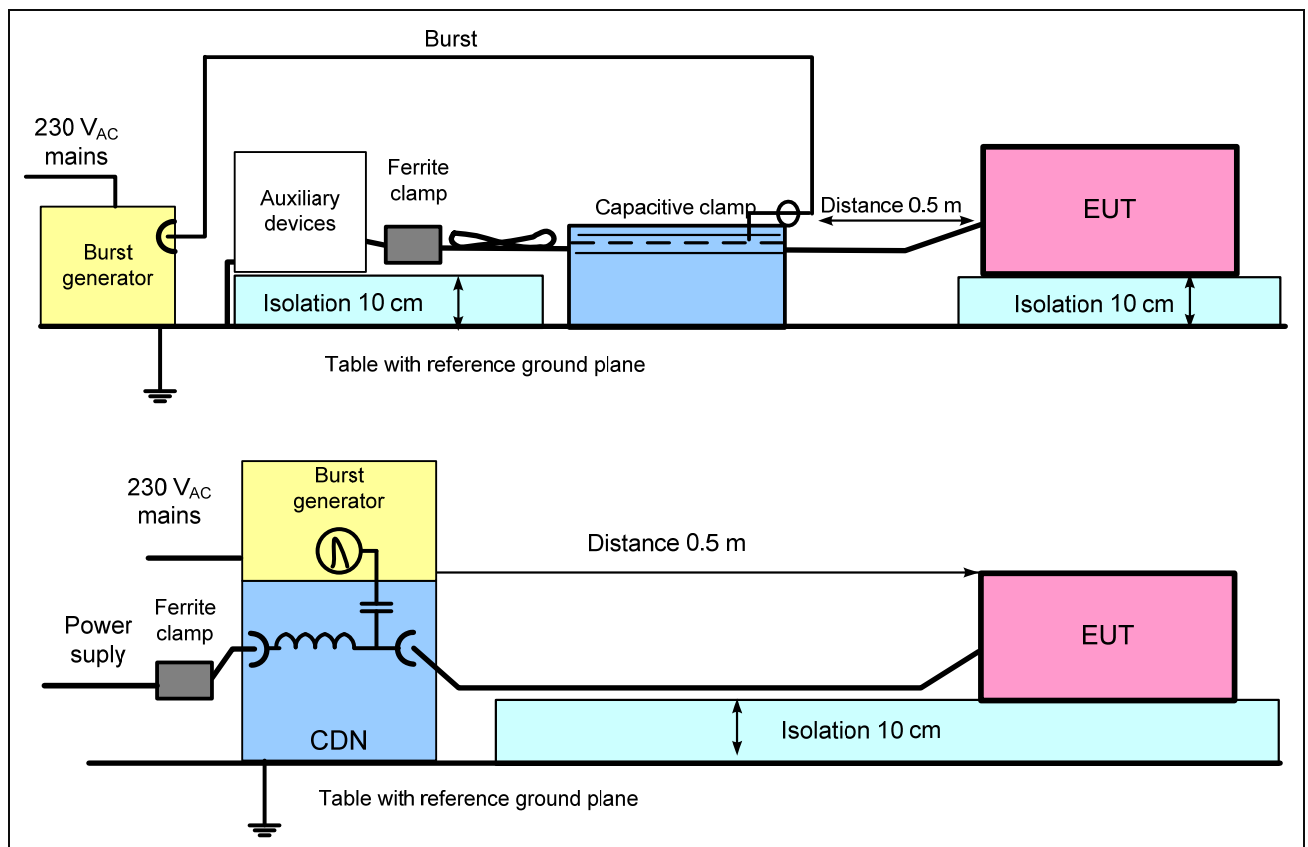
Meas. uncertainty:

See chapter 12

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.

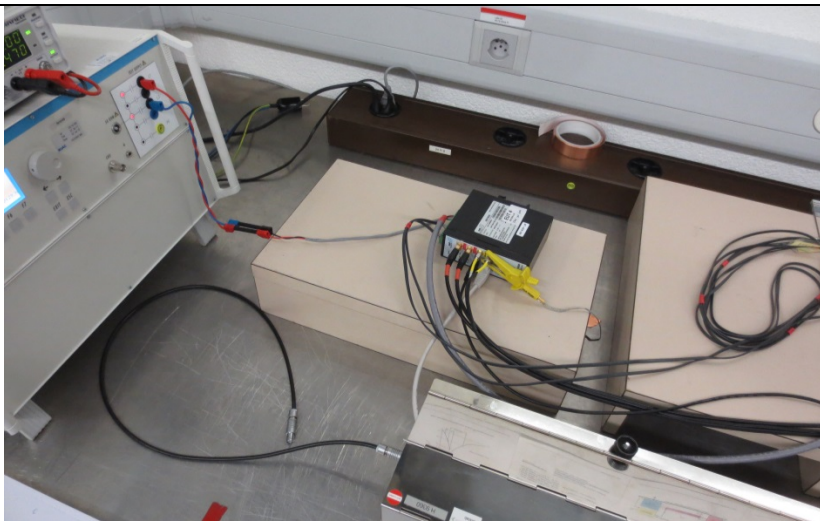
Test Setup



Test Equipment

Device Type	Brand	Type	ID
Burst Generator	EM-Test	EFT500M4S1	PE10105
Capacitive Coupling Clamp	EM-Test	EM-Test HFK	H9360

Photo of the Setup:



Test Protocol

Equipment: EUT 3: NB1600-UW-G
 Cables connected: All cables, chapter 9.3
 Operating mode: Active mode, see chapter 9.4 (supplied with 12 VDC)
 Observation of EUT: Visually, see chapter 9.5
 Modifications: LC-Filter added to the power input (3.3 μ H, 68 μ F)
 Test site: Laboratory (Albislab)

Requirements

Standard :	Req. level AC supply:	Req. level DC supply:	Req. level Signal:	Prot. earth :	Burst freq.	Perf. crit.:
EN 55024: 2010	± 1 kV	± 0.5 kV	± 0.5 kV	5 kHz	B
EN 61000-6-2: 2005	± 2 kV	± 2 kV	± 1 kV	5 kHz	B
ETSI EN 301 489-1 V1.9.2:2011	± 1 kV	± 0.5 kV	± 0.5 kV	5 kHz	B

Test Results

Tested port	Level	Duration	Frequency	Coupling clamp direct		Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Supply	± 2 kV	15 ms	5 kHz	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors occurred	A	Pass
	± 2 kV	1 ms	100 kHz	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors occurred	A	Pass
Ethernet 1	± 1 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
RS232	± 1 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
USB	± 1 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Note 1	--	Not tested
	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Note 1	--	Not tested
Digital I/O	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
Antenna cables	± 1 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 2	A	Pass
	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 2	A	Pass

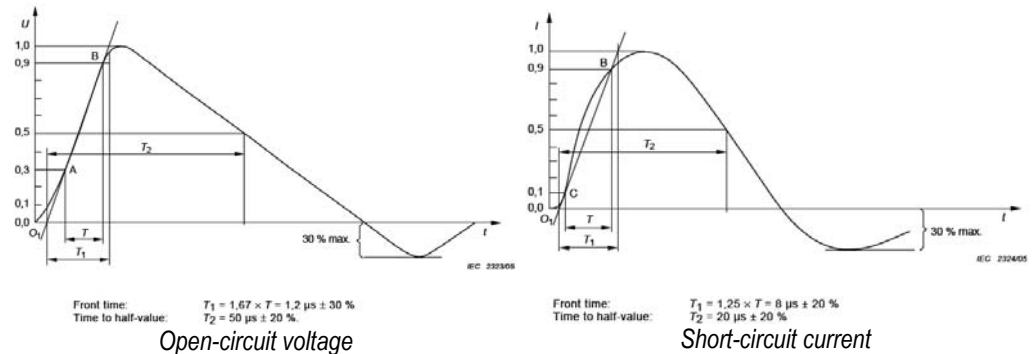
Notes:

- 1) Not applicable, USB cable < 3 m
- 2) All antenna cables tested together

11.4 Immunity to Surge (EN 61000-4-5 : 1.2/50 μ s)

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

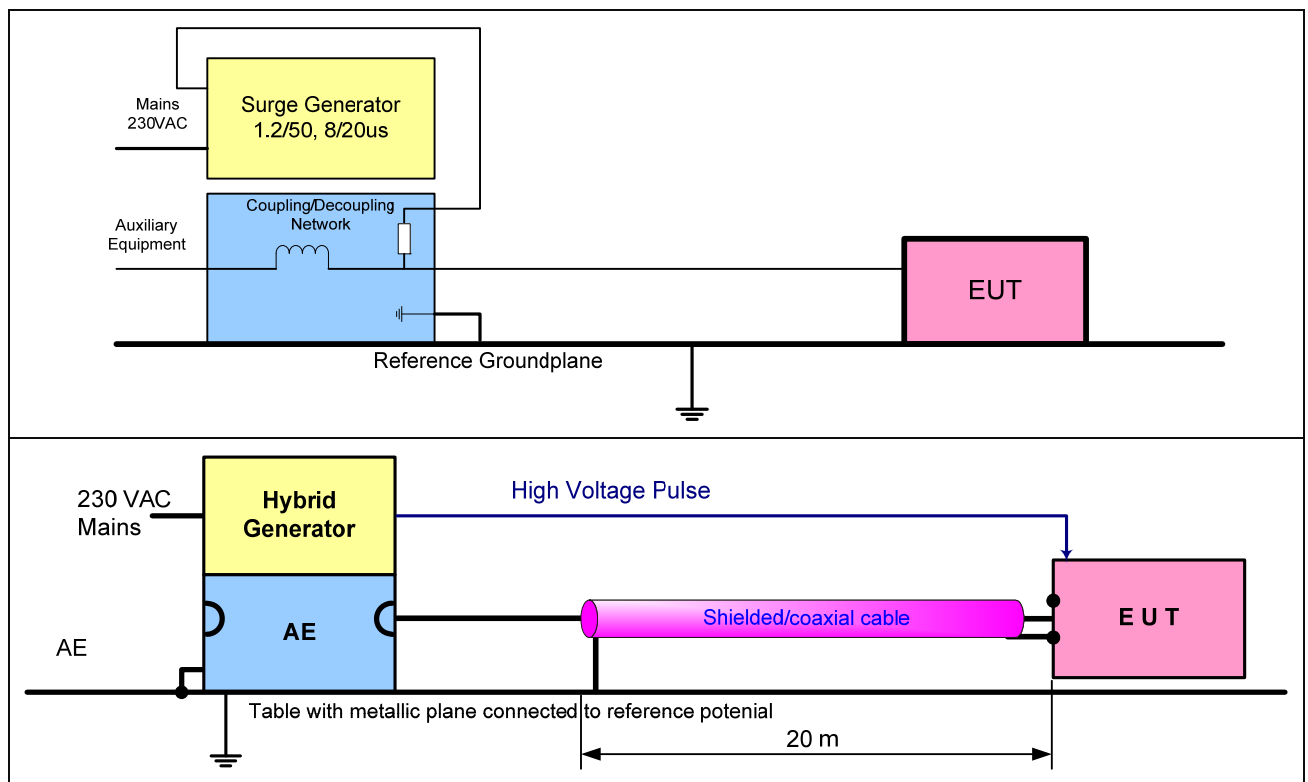
Impulses:



Meas. uncertainty: See chapter 12

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.

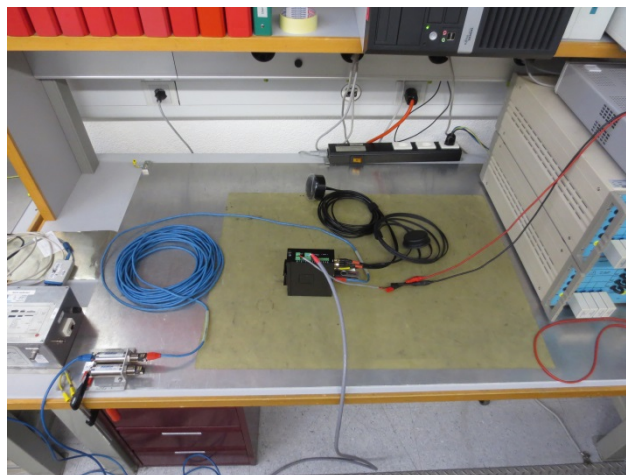
Test Setup



Test Equipment

Device Type	Brand	Type	ID
Surge Generator	EM Test	VCS 500	PE 7239

Photo of the Setup:



Test Protocol

Equipment: EUT 4: NB1600-LW
 Cables connected: All cables, chapter 9.3
 Operating mode: Active mode, see chapter 9.4 (supplied with 12 VDC and 48 VDC)
 Observation of EUT: Visually, see chapter 9.5
 Modifications: LC-Filter added to the power input (3.3 μ H, 68 μ F)
 Test site: Laboratory (Albislab)

Requirements

Standard :	Required level AC-supply:		Required level DC-supply:		Required level Signal:		Performance criteria:
	L – L 2 Ω + 18 μ F	L – PE 12 Ω + 9 μ F	L – L 2 Ω + 18 μ F	L – PE 12 Ω + 9 μ F	L – L 42 Ω + 0.5 μ F	L – PE 42 Ω + 0.5 μ F	
EN 55024 : 2010	± 1 kV	± 2 kV	---	± 0.5 kV	± 1 kV	± 1 kV	B
EN 61000-6-2 : 2005	± 1 kV	± 2 kV	± 0.5 kV	± 0.5 kV	---	± 1 kV	B
ETSI EN 301 489-1	± 1 kV (Note 1)	± 2 kV (Note 2)	---	---	---	± 0.5 kV (Note 3)	B

Notes:

- 1) In telecom centers: ± 0.5 kV
- 2) In telecom centers: ± 1.0 kV
- 3) Telecom ports: Indoor cables >10m and in telecom centers: ± 0.5 kV, Outdoor cables: ± 1 kV

Test Results

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses	Remarks	Fulfilled Criterion	Verdict
DC Supply	± 0.5 kV	P(+) – M(-)	2 Ω + 18 μ F	5 / polarity and level	No errors occurred	A	Pass
	± 0.5 kV	P(+) – PE M(-) – PE	12 Ω + 9 μ F	5 / polarity and level	No errors occurred	A	Pass
Ethernet 1	± 0.5 kV	Screen – PE	2 Ω	5 / polarity and level	No errors occurred	A	Pass
	± 1.0 kV	Screen – PE	2 Ω	5 / polarity and level	No errors occurred	A	Pass

11.5 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 12

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

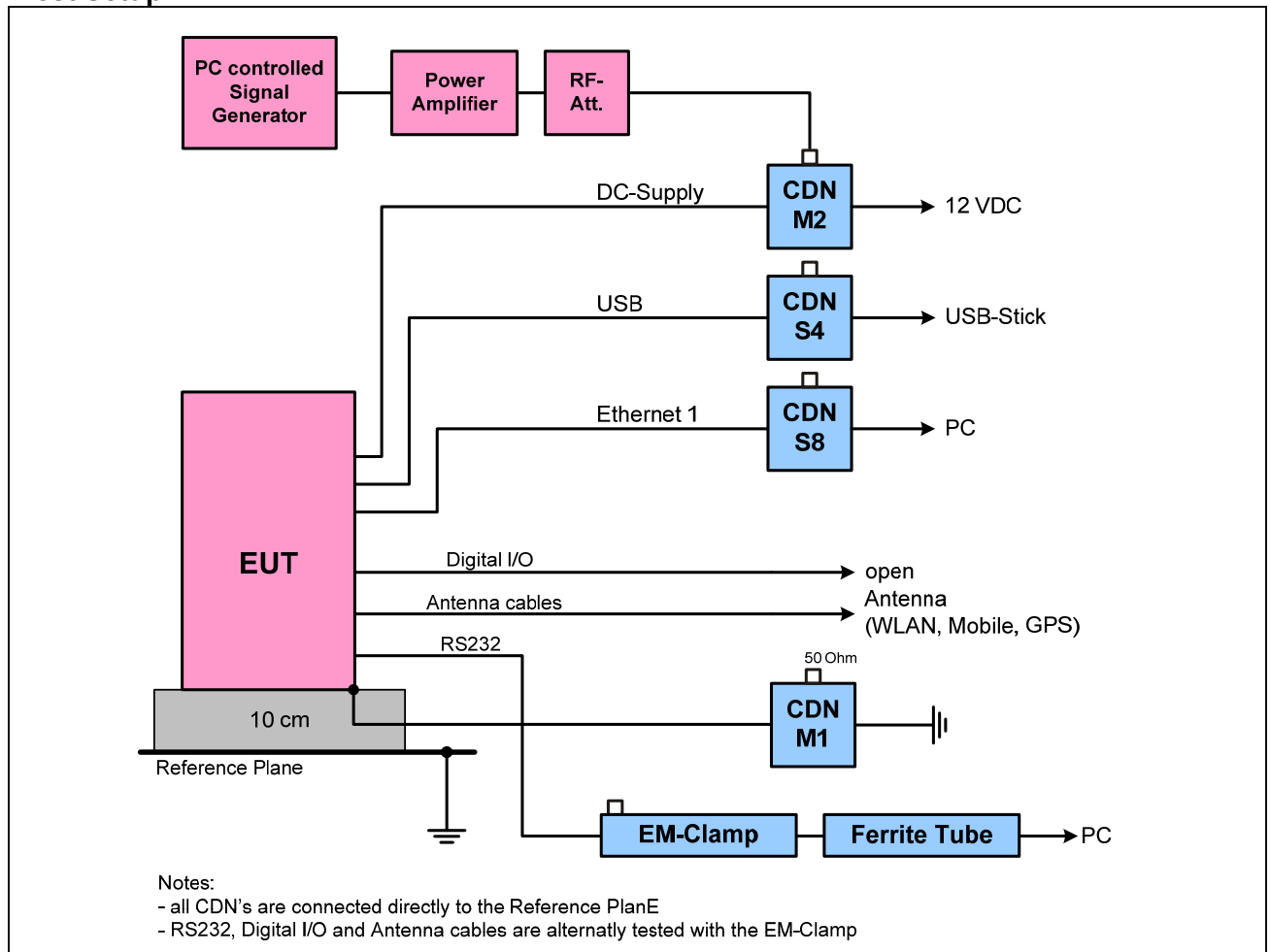
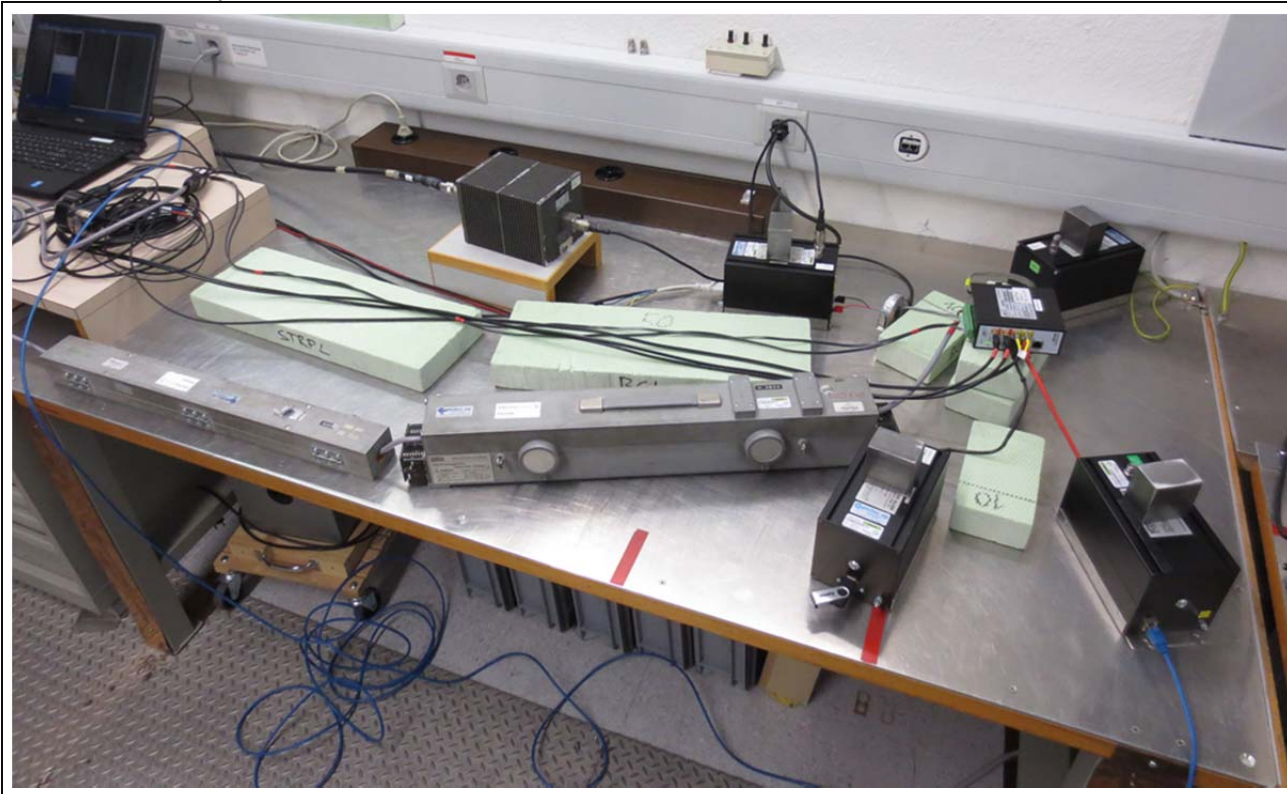


Photo of the Setup:



Test Equipment

Device Type	Brand	Type	ID
Signal Generator	Marconi	2023	GF7803
Amplifier	Amplifier Research	150A250	V10108
Current sensor	SOLAR	6741-1	H5556
Sensor power meter	Fischer	F-55	H10123
Injection device	EM-Test	CDN M2	H10167
Injection device	EM-Test	CDN M1 32 A	H10165
Injection device	EM-Test	CDN S4 (USB)	H10173
Injection device	Lüthi	CDS S8 (RJ45)	13.6632.07
Decoupling device	EM-Test	EM 100 FTC101	H4844 H6979

Test Protocol

Equipment: *EUT 4: NB1600-LW*
 Cables connected: *All cables, chapter 9.3*
 Operating mode: *see chapter 9.3 (supplied with 12 VDC)*
 Observation of EUT: *see chapter 9.5*
 Modifications: *LC-Filter added to the power input (3.3 μ H, 68 μ F)*
 Test site: *Laboratory (Albislab)*

Requirements

Standard:	Frequency range:	Required level:	Modulation:	Freq. step:	Dwell time:	Perf. crit.:
EN 55024	0.15 – 80 MHz	3 V _{EMF}	AM, 1 kHz, 80%	1 %	1	A
EN 61000-6-2	0.15 – 80 MHz	10 V _{EMF}	AM, 1 kHz, 80 %	1 %	1	A
EN 301 489-1	0.15 – 80 MHz	3 V _{EMF}	AM, 1 kHz, 80 %	1 %	1	A

Step time: 1 s

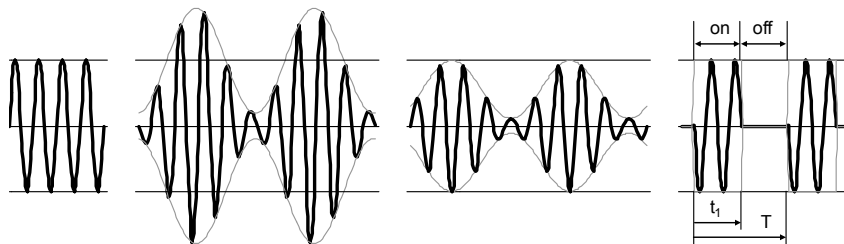
Signal modulation:

☐ CW

☒ AM

☐ AM

☐ PM



Test Results

Coupling	CDN	Terminated (50 Ω)	CDN	Frequency [MHz]	Level [V]	Fulfilled criterion	Verdict
DC Supply	M2	M1	S8	0.15 – 80	12	A	Pass (Note 1)
Ethernet 1	S8	DC Supply	M2	0.15 – 80	12	A	Pass (Note 1)
Digital I/O	EM100	USB	S4	0.15 – 80	12	A	Pass (Note 1)
RS232	EM100	M1	S8	0.15 – 80	12	A	Pass (Note 1)
USB	--	--	--	0.15 – 80	--	--	Not tested, Note 2
Antenna cables	EM100	DC Supply	M2	0.15 – 80	12	A	Pass (Note 1, 3)

Notes:

- 1) All ports overtested with 12 V
- 2) USB not applicable, cable < 3m
- 3) All antenna cables tested together

12. 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:	Under consideration	± 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)		± 26 %
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)		± 19 %
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_o : (rectangular distribution)		± 5.0 %
	Phase φ_o :(rectangular distribution)		± 2.8 %
Voltage fluctuation	Output voltage U_o : (normal distribution)		± 9 %
	Duration of the voltage fluctuation t_o : (rectangular distribution)		± 20 %

13. Modifications

LC-Filter added to the power input (3.3 μ H, 68 μ F)