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STS 001

Schweizerischer Prüfstellendienst
Service suisse d'essai
Swiss testing service



Report:	<i>Electromagnetic Compatibility</i>		Report no:	14-EL-0068.E01
Product name:	<i>NB2700 and NB2710</i>		Dossier no:	14-EL-0068
Serial no:	<i>00112B00889F</i> <i>00112B00888F</i>	Model number:	<i>NB2710-LWA-GV</i> <i>NB2710-UWC-G</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>
E/ECE/324/Add.9/Rev.5 E/ECE/TRANS/505/Add.9/Rev.5	Regulation No. 10 Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility	<i>Pass</i>

Test performed by
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Approved by
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Fehraltorf, 2014-12-18

(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.

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Foreword

NetModule's vehicle router series are designed for mobile communication in public transportation (e.g. in buses and trams) but also any other kinds of vehicular applications such as caravans. These routers comply with the industry standard 2004/104/EC (E1) and ECE-R10^{Note} which is typically required for those appliances. Supporting the latest WAN/LAN technologies (including GSM, UMTS, LTE, WLAN) they offer highly-available connectivity with seamless handover between the broadband links making use of the Mobile IP protocol.

Note: E/ECE/324/Add.9/Rev.5 – E/ECE/TRANS/505/Add.9/Rev.5 – Addendum 9: Regulation No. 10

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

§	Test Type	Result
11	Emission	EN 55022
11.1	Interference voltage EN 55022:2010 CISPR 22:2008	Pass
11.1	Common mode at telecom. ports EN 55022:2010 CISPR 22:2008	Pass
11.2	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
12	Immunity	EN 55024
12.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass... ³
12.2	Electromagnetic fields EN 61000-4-3:2006 +A1 +A2 IEC 61000-4-3:2013 ed.4.0	Pass... ⁴
12.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
12.4	Surges EN 61000-4-5:2006 IEC 61000-4-5:2005	Pass
12.5	Radio frequency common mode EN 61000-4-6:2009 IEC 61000-4-6:2008	Pass... ⁵
--	Magnetic fields (industrial frequencies) EN 61000-4-8:2010 IEC 61000-4-8:2009	Not applicable... ²
--	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
12	Immunity	EN 61000-6-2
12.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass... ³
12.2	Electromagnetic fields EN 61000-4-3:2006 +A1 +A2 IEC 61000-4-3:2013 ed.4.0	Pass... ⁴
12.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
12.4	Surges EN 61000-4-5:2006 IEC 61000-4-5:2005	Pass
12.5	Radio frequency common mode EN 61000-4-6:2009 IEC 61000-4-6:2008	Pass... ⁵
--	Magnetic fields (industrial frequencies) EN 61000-4-8:2010 IEC 61000-4-8:2009	Not applicable... ²
--	Voltage dips and interruptions EN 61000-4-11:2004 IEC 61000-4-11:2004	Not applicable... ¹

Notes:

1. No AC power port
2. Does not contain any devices susceptible to magnetic fields.
3. Overtested with 6 kV (direct coupling)
4. Overtested with 20 V/m (80 – 1000 MHz) and 10 V/m (1 – 3 GHz)
5. Overtested with 12 V

3. Summary of Test Results (FCC)

§	Test Type	Result
11	Emission	CFR 47
11.1	Conducted emission CFR 47 § 15.107 (Class B)	Not applicable... ¹
11.3	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
11	Emission	EN 301 489-x mobile equipment
11.1	Interference voltage EN 55022:2010 CISPR 22:2008	Pass
--	Interference current EN 55022:2010 CISPR 22:2008	Not applicable... ³
11.2	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
12	Immunity	EN 301 489-x mobile equipment
12.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass... ⁵
12.2	Electromagnetic fields EN 61000-4-3:2006 + A1 + A2 IEC 61000-4-3:2013 ed.4.0	Pass... ⁶
12.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
12.4	Surges EN 61000-4-5:2006 IEC 61000-4-5:2005	Pass
12.5	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
-	Automotive pulses ISO 7637-1:2002 ISO 7637-2:2004	
12.6	Pulse 1 (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.7	Pulse 2a (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.8	Pulse 2b (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.9	Pulse 3a (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.10	Pulse 3b (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.11	Pulse 4 (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass

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. 16'833A
3. Shielded Ethernet cable measured with ISN (interference voltage)
4. No AC power port
5. Overtested with 6 kV (direct coupling)
6. Overtested with 20 V/m (80 – 1000 MHz) and 10 V/m (1 – 3 GHz)
7. Overtested with 12 V

5. Summary of Test Results (2004/104/EC and ECE-R 10)

§	Test Type	Result
11	Emission	2004/104/EC ECE-R 10
11.4	Voltage transient emission test ISO 7637-2:2004	Not applicable... ¹
-	Radiated electromagnetic field CISPR 25:2008	Pass
12	Immunity	2004/104/EC ECE-R 10
-	Electromagnetic fields (antenna) ISO 11452-2:2004	Not applicable... ²
-	Electromagnetic fields (TEM) ISO 11452-3:2004	Not applicable... ²
-	Bulk current injection (BCI) ISO 11452-4:2001	Not applicable... ²
-	Electromagnetic fields (stripline) ISO 11452-5:2002	Not applicable... ²
12.6	Pulse 1 (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.7	Pulse 2a (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.8	Pulse 2b (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.9	Pulse 3a (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.10	Pulse 3b (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass
12.11	Pulse 4 (automotive) ISO 7637-1:2002 ISO 7637-2:2004	Pass

Notes:

1. Not applicable according ECE-R10 regulation. Only applicable on switched inductive load
2. Not applicable, only to be tested if EUT contains immunity related functions

6. 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
E/ECE/324/Add.9/Rev.5 E/ECE/TRANS/505/Add.9/Rev.5	Regulation No. 10 Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility

7. 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>

8. Client

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Contact Person	Mr. Thomas Siegrist
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9. Equipment Under Test

9.1 Identification

Manufacturer name and address	NetModule AG Meriedweg 11 3172 Niederwangen bei Bern Switzerland
Production country	Switzerland
Brand name	NetModule AG
Product name	NB2700 and NB2710
Product description	Vehicle Router with Mobile, WLAN & GPS.
Model number	NB2710-LWA-GV (EUT 1) NB2710-UWC-G (EUT 2)
Serial no	EUT 1: 00112B00889F EUT 2: 00112B00888F
Software version	EUT1: 3.7.2.3 EUT2: 3.7.2.4
Hardware version	EUT1: V2.3 EUT2: V2.3
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 VAC I = 0.11 ... 0.42 A P = 5 W
Dimension	~ 190 cm x 104 cm x 44 cm (l x w x h)
Weight	< 2 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.

9.2 Product Family

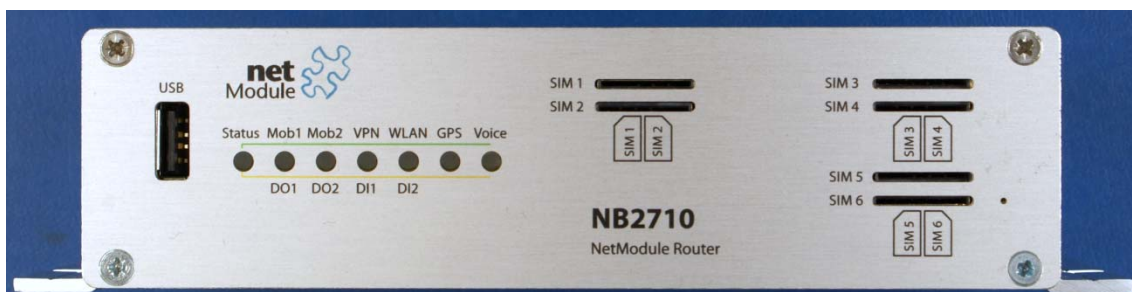
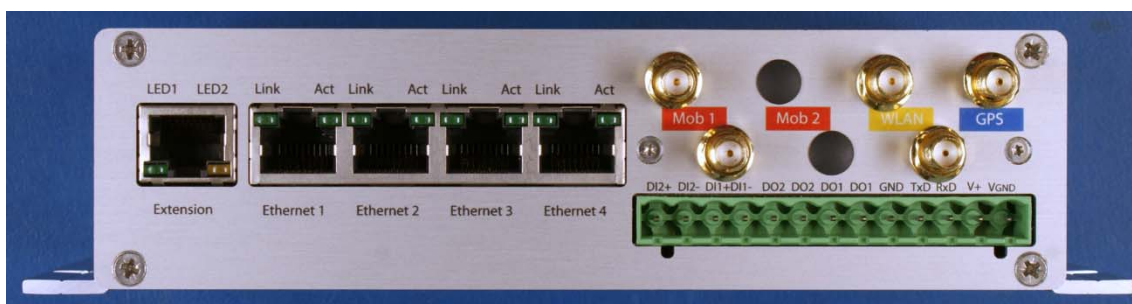
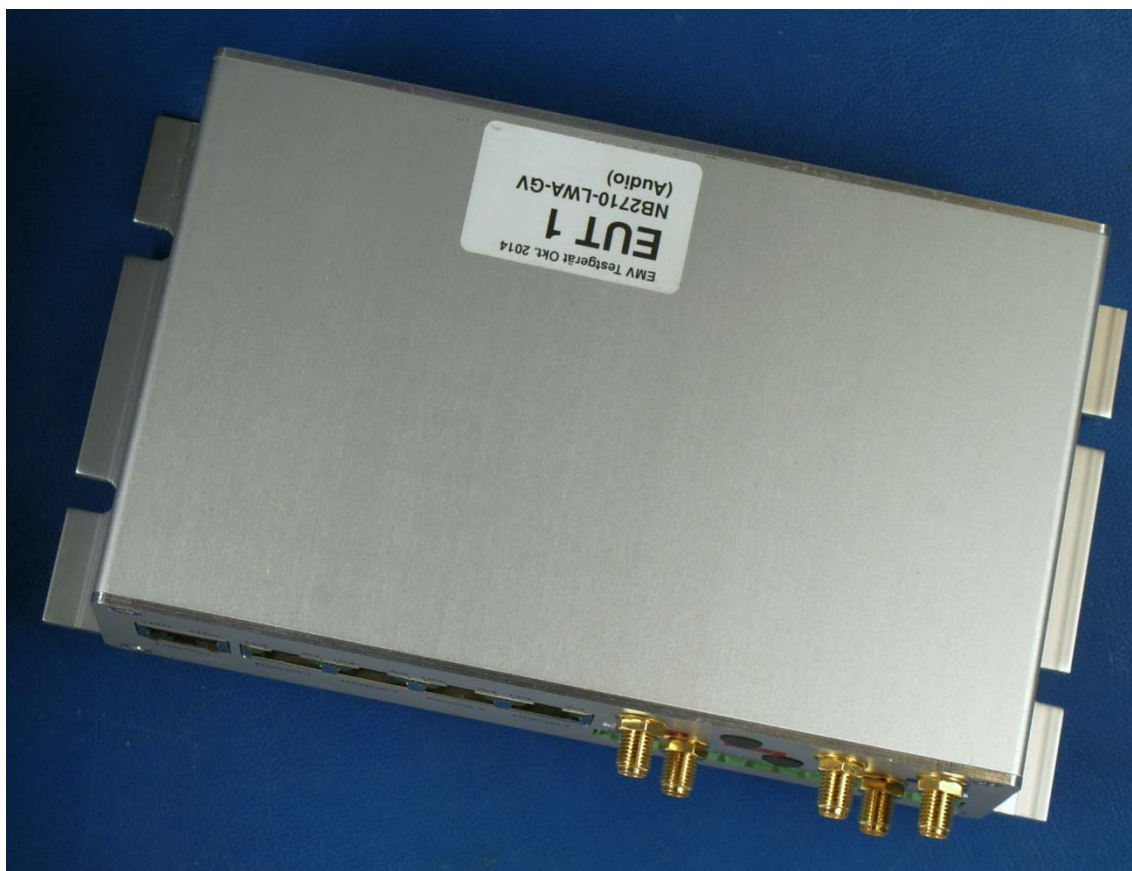
Tested Equipment	Covered Variants	Explanation ¹⁾
NB2700-UW-G ²⁾ NB2710-LWA-GV NB2710-UWC-G	NB2700-H ₁ ...H _n -S ₁ ...S _n	<p>All covered NB2700 variants contain the same mainboard (PCB), have the same case and the same form factor. The same applies to the NB2710 variants.</p> <p>They can host up to two (NB2700) or three (NB2710) communication modules. These modules can even include a GPS module. There can be up to 5 (NB2700) or 7 (NB2710) 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: 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: G: GPS V: Voice gateway</p> <p>The following NB2700/NB2710 variants are currently available or planned: NB2700-R NB2700-W NB2700-Ca NB2700-U NB2700-U-G NB2710-UA-V NB2710-UWA-GV NB2700-UW NB2700-UW-G NB2700-2U NB2700-2U-G NB2710-2UW NB2710-2UW-G NB2700-L NB2700-L-G NB2710-LSa NB2700-LW NB2700-LW-G NB2710-LWA-GV NB2710-LWC-G NB2710-LWI-G NB2700-2L NB2700-2L-G NB2710-2LW NB2710-2LW-G</p>

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

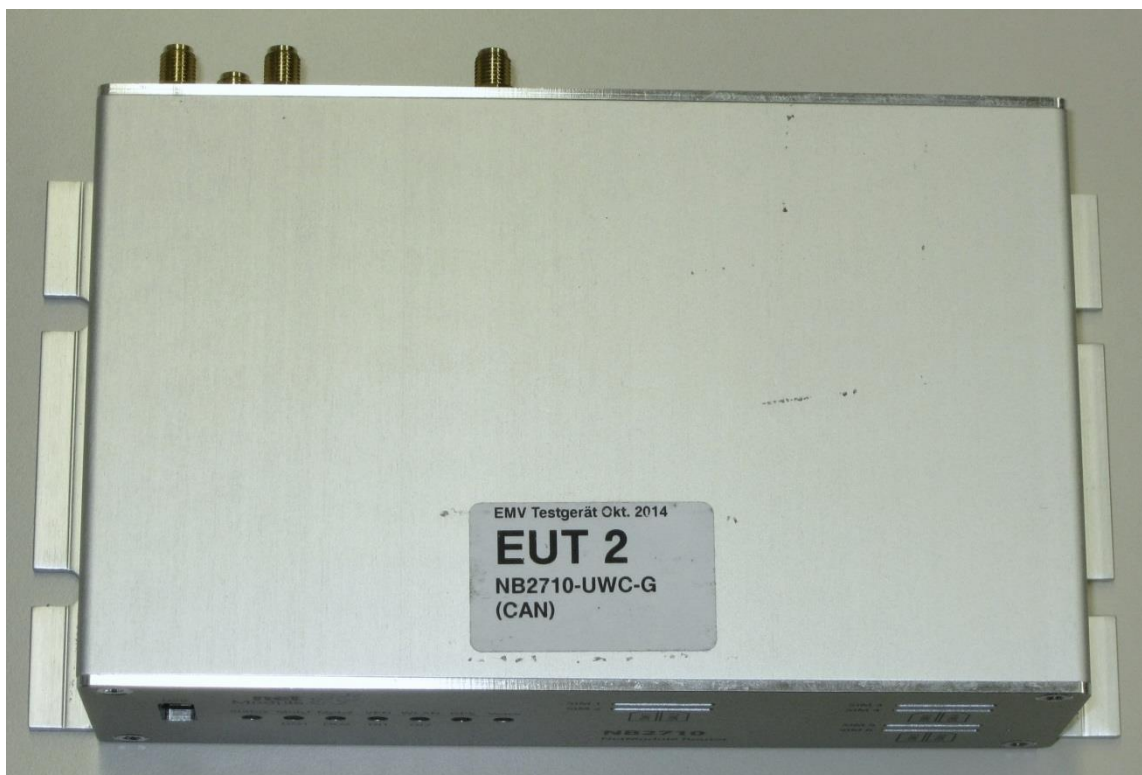
²⁾ tested during April - Juni 2012, see test report Montena EMC SA 16883A

9.3 Pictures of the EUT

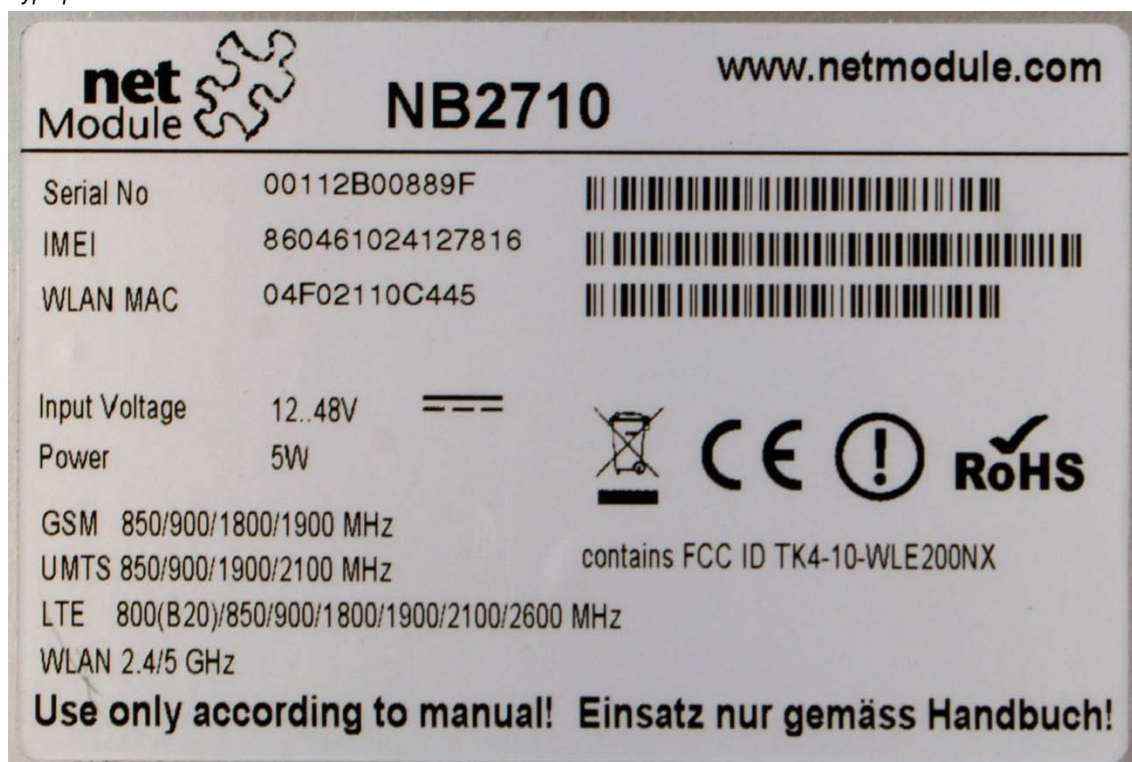
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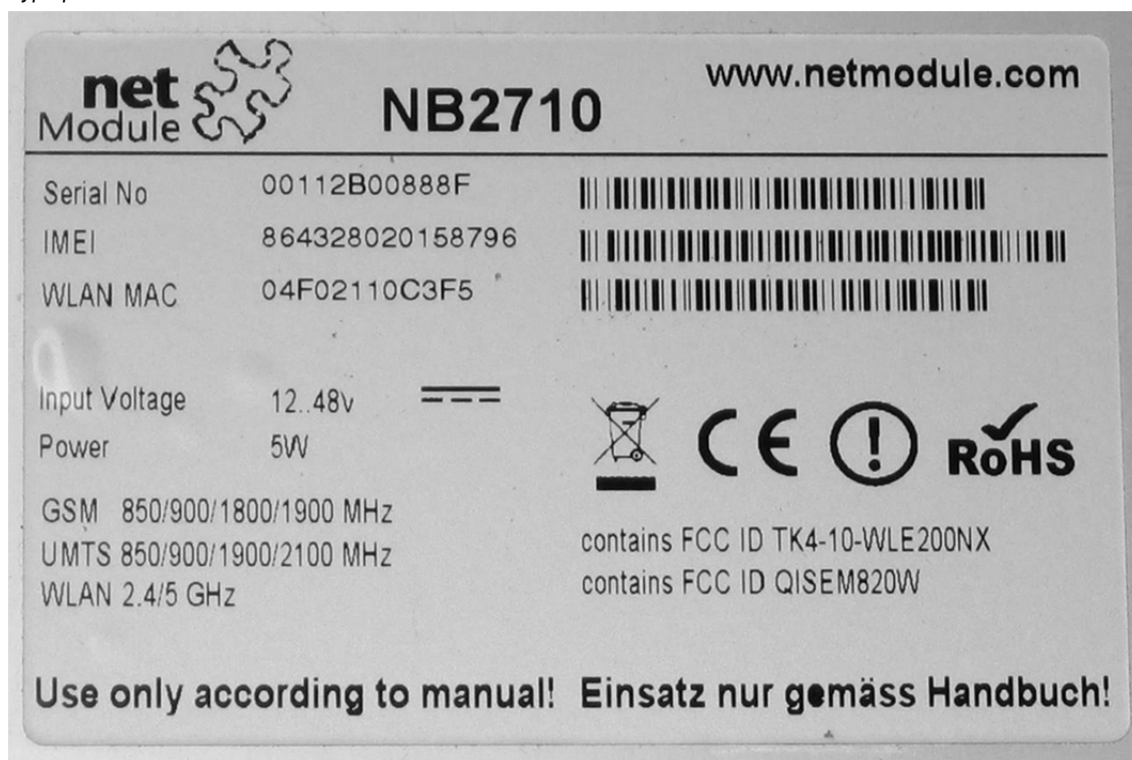
EUT 2:



Type plate EUT 1:



Type plate EUT 2:



9.4 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 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 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).
E/ECE/324/Add. 9/Rev.4- E/ECE/TRANS/505 Add. 9/Reg. 10/Rev.4	<input type="checkbox"/> System related to immunity-related functions. <input type="checkbox"/> System which must be operational during engine start phases. <input type="checkbox"/> System which is not operational during engine start phases. <input checked="" type="checkbox"/> System not related to immunity-related functions.

9.5 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
Ethernet 3	< 100m	RJ45 cat 5e	Yes	If not stated otherwise, no cable connected
Ethernet 4	< 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	< 30 m	SMA (Coax)	Yes	Connected to multiband-antenna
Mob1 (GSM, UMTS, LTE)	< 30 m	SMA (Coax)	Yes	Connected to multiband-antenna
GPS	< 30 m	SMA (Coax)	Yes	Connected to multiband-antenna
Audio (Only EUT1)	< 10 m	RJ45 cat 5e	Yes	Connected to Loopback cable (3m)
CAN (Only EUT2)	< 1000 m	RJ45 cat 5e	Yes	Connected to Test-PC (with CAN-to-USB Adapter)

10. Test Conditions

10.1 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>
<i>Continental Automotive Switzerland AG, Industriestrasse 18 9464 Rüthi Switzerland</i>	<i>Nov. 11, 2014</i>	<i>23°C ± 2°C</i>	<i>968 hPa ± 5 hPa</i>	<i>35% ± 5%</i>

10.2 Attendant Persons

Test Engineer(s):

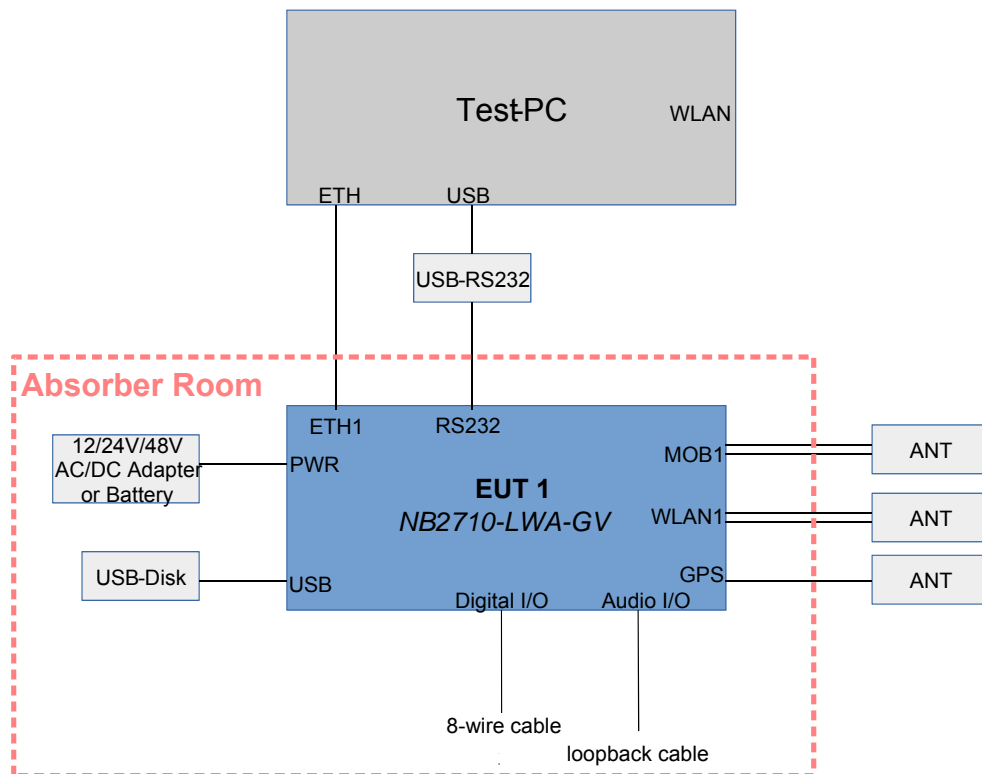
<i>Mr Daniel Rufer</i>
<i>Mr Peter Stillhard</i>

Other(s):

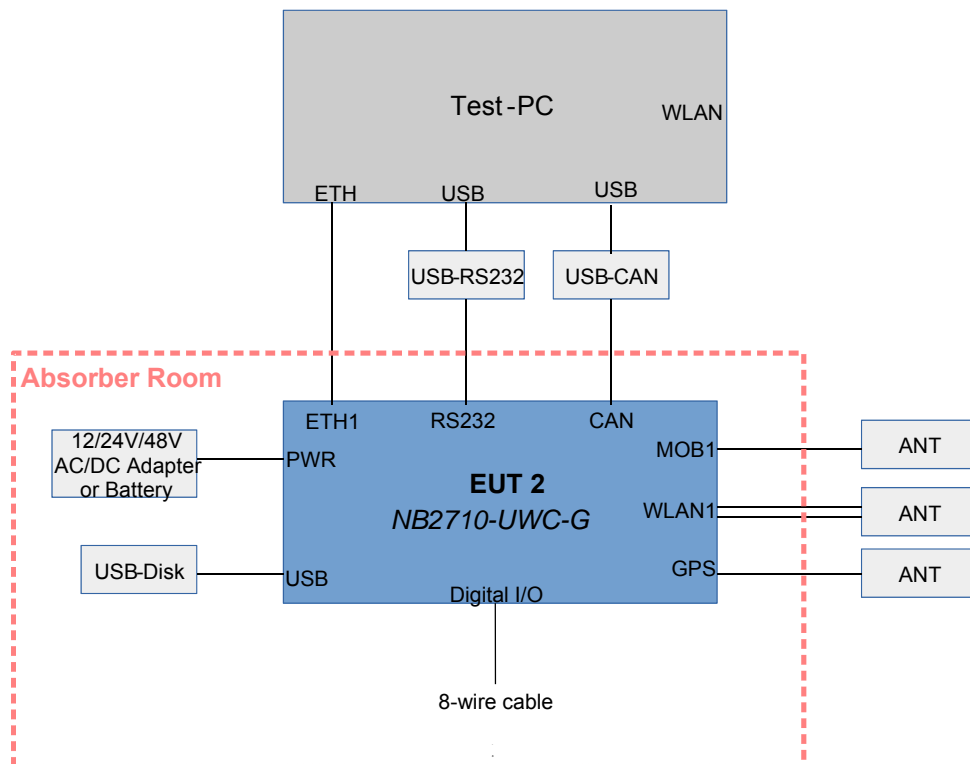
Name	Company
<i>Mr Simon Maurer</i>	<i>NetModule AG</i>
<i>Mr Raffael Rohrer</i>	<i>NetModule AG</i>

10.3 Test Configuration

EUT 1:



EUT 2:



EUT 1 : NB2710-LWA-GV:

- 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)
- 1 GPS Antenna (1 cable)
- Digital I/O cable (floating)
- Audio-cable (RJ-45) with Loopback
- USB cable with USB Memory Stick
- 1 SIM card

EUT 2 : NB2710-UWC-G:

- 1 Ethernet connection established to Test-PC
- 1 RS232 connection established to Test-PC
- 1 GSM/UMTS/LTE Antenna (1 cable)
- 1 WLAN Antenna (2 cables)
- 1 GPS Antenna (1 cable)
- Digital I/O cable (floating)
- CAN-cable (RJ-45) to Test-PC
- USB cable with USB Memory Stick
- 1 SIM card

10.4 Operating Conditions

Normal mode:

- Ping over WLAN
- Ping over WWAN (UMTS/LTE)
- Ping over Ethernet cable
- Access to USB disc
- NB2710-LWA-GV: Audio Loopback
- NB2710-UVC-G: CAN „Ping“

10.5 Monitoring of the EUT

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

General:

Monitor of all Ping-outputs on the Test-PC

EUT 1: NB2710-LWA-GV:

SIP connection (SIP Softphone „PhonerLite“) to EUT.

EUT: Audio-In & Out on SIP configured. Audio In and Audio Out via Loopback-cable connected.

Via SIP Phone: send music and check if music will be returned.

EUT 2: NB2710-UVC-G:

CAN connection between EUT and Test-PC. EUT and Test-PC send CAN messages (1s cycle)

10.6 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-CAN Adapter	IXXAT	USB-to-CAN compact	HW243428	
USB-to-RS232 Adapter	n/a	U232-P9(2.4)	0608SP030727	
USB Disk	n/a			
Audio Loopback Cable	n/a			
WWAN Antenna	n/a	Antenna-Roof-2L DL-9	A140812300036	
GPS Antenna	n/a			
WLAN Antenna		Antenna-Roof-2W		
Power supply				See tests

10.7 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.	<p>No transmission loss LAN, WWAN (UMTS/LTE), WLAN</p> <p>EUT 1 : NB2710-LWA-GV: Audio: check if audio signal from SIP phone is replied correctly.</p> <p>EUT 2 : NB2710-UVC-G: CAN: data packet shall be received in both directions</p>
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
Criterion D:	
Temporary loss of function is allowed, provided the function can be restored by operation of the controls.	No specific requirements

11. Emission Tests

11.1 Conducted Emission - Interference Voltage (EN 55022)

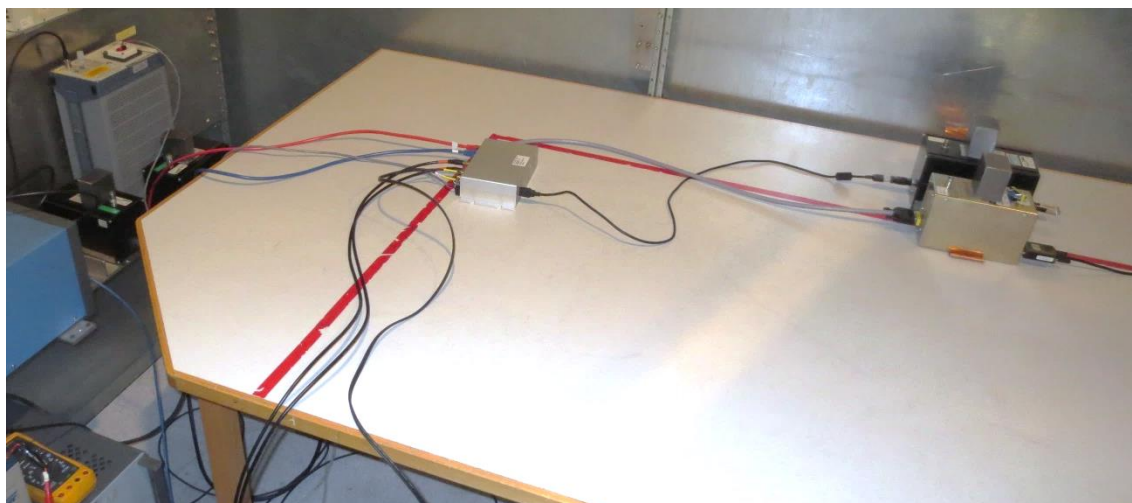
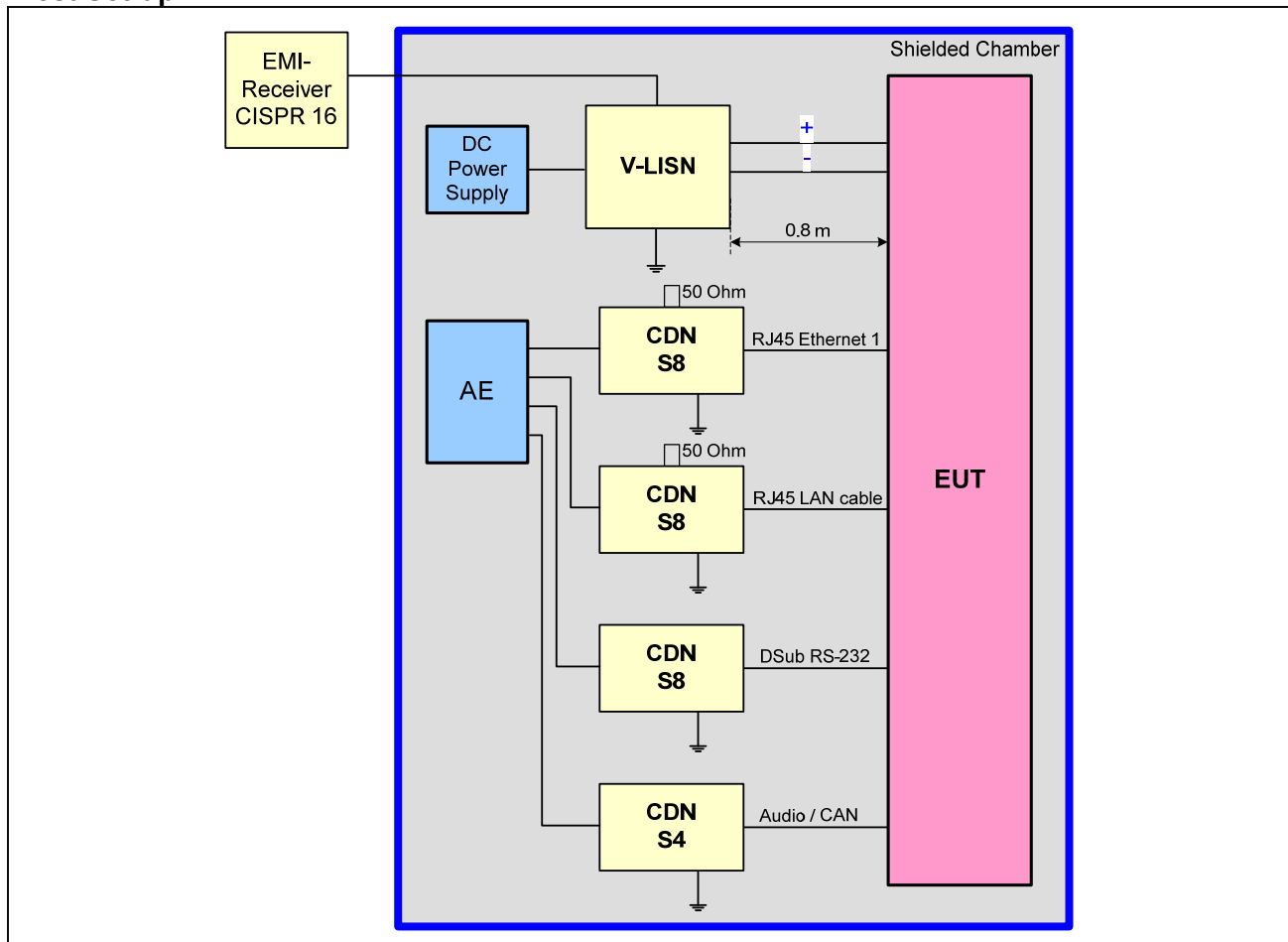
Test site: *Shielded room (Albislab)*

Meas. uncertainty: *see chapter 14*

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.*

Modifications: *see chapter 13*

Test Set-up



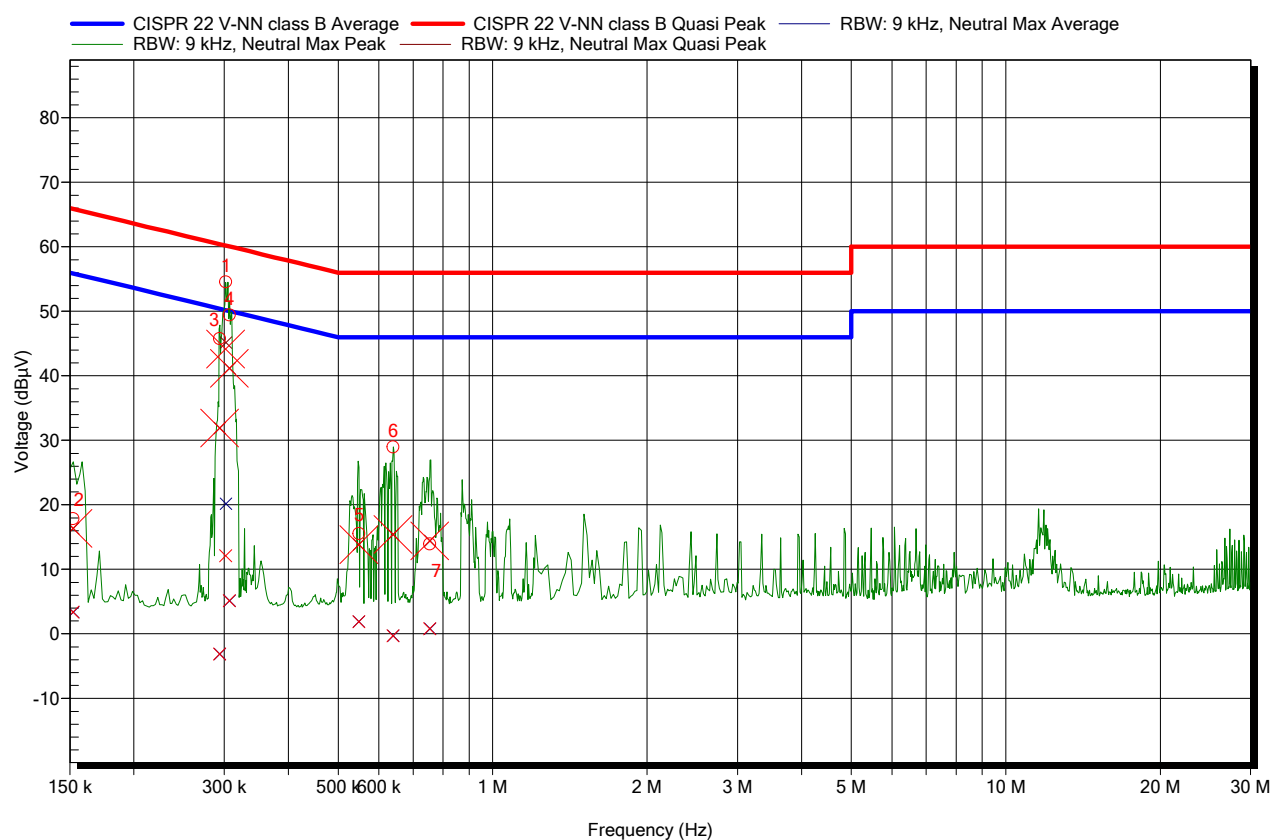
Test Equipment

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	EM Test	CDN S8 RJ45	13.6632.08
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

Results EUT 1

Measurement 1

EUT	EUT 1 : NB2710-LWA-GV
Verdict, Test	Test 2: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 09:03:57
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 [50 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: 20 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms]

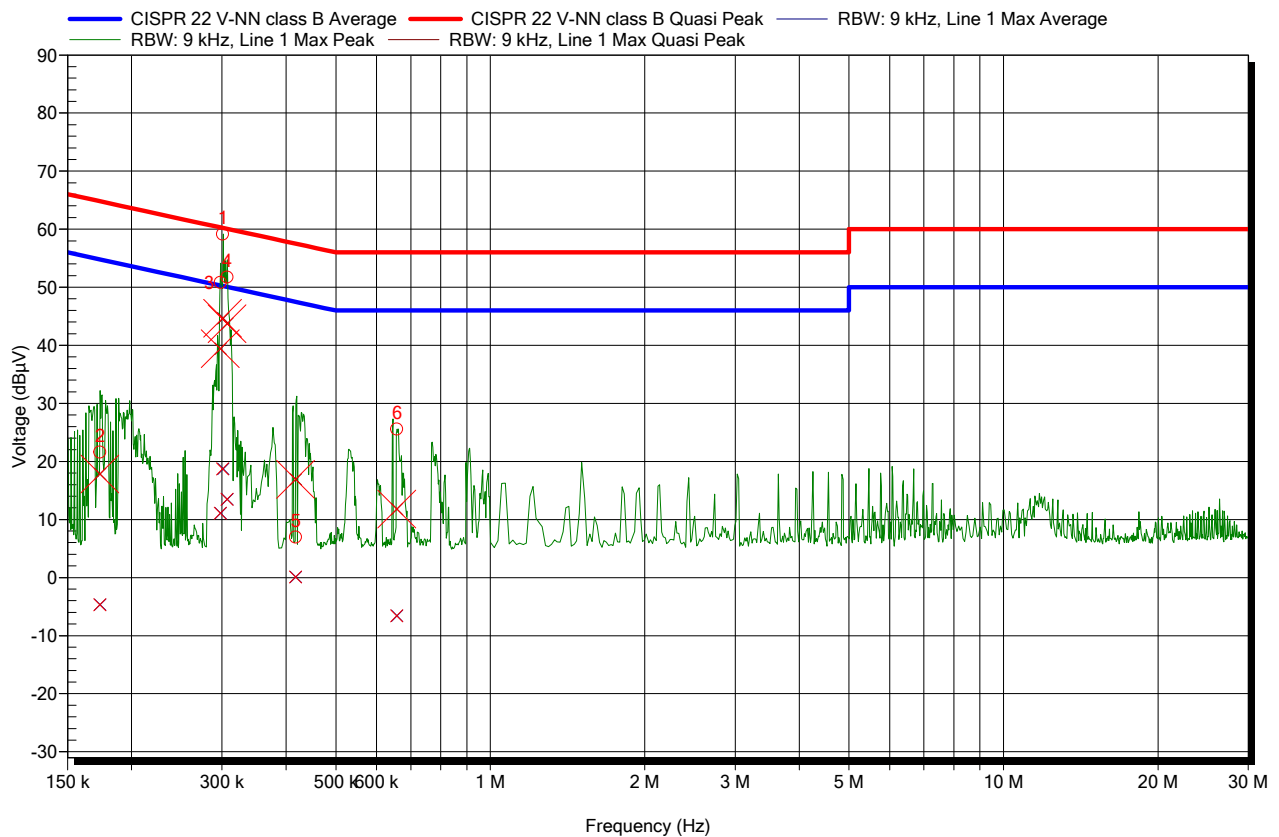


Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	301.703 kHz	54.58 dBμV	12.09 dBμV	-38.11 dB	44.18 dBμV	-16.02 dB	Pass
2	152.12 kHz	17.85 dBμV	3.38 dBμV	-52.5 dB	16.33 dBμV	-49.55 dB	Pass
3	293.533 kHz	45.78 dBμV	-3.12 dBμV	-53.54 dB	31.93 dBμV	-28.49 dB	Pass
4	306.955 kHz	49.46 dBμV	5.13 dBμV	-44.92 dB	41.15 dBμV	-18.9 dB	Pass
5	548.504 kHz	15.57 dBμV	1.93 dBμV	-44.07 dB	13.82 dBμV	-42.18 dB	Pass
6	639.651 kHz	28.96 dBμV	-0.29 dBμV	-46.29 dB	15.41 dBμV	-40.59 dB	Pass
7	754.179 kHz	13.93 dBμV	0.82 dBμV	-45.18 dB	14.42 dBμV	-41.58 dB	Pass

Measurement 2

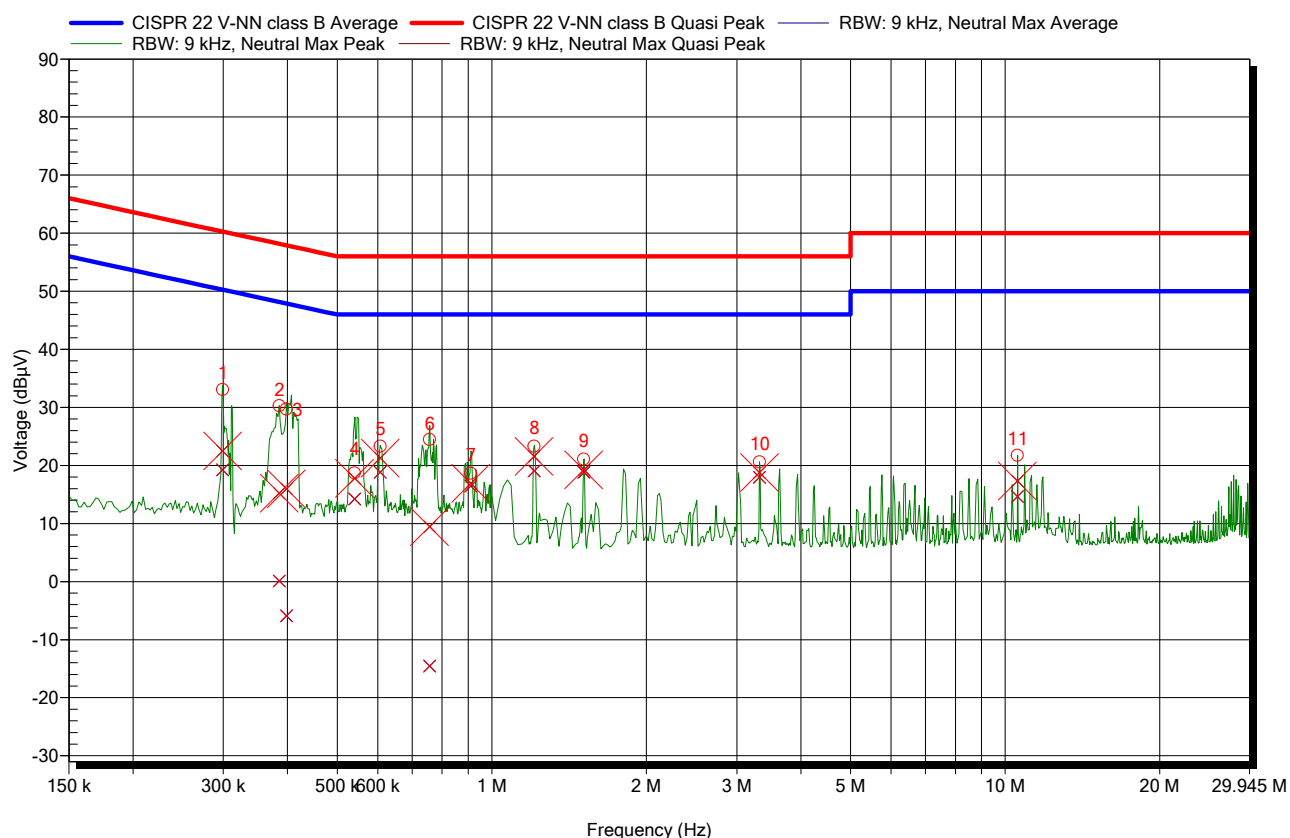
EUT	EUT 1 : NB2710-LWA-GV
Verdict, Test	Test 3: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 09:10:18
Interface / Line under test	12 VDC - Positive
Transducer	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 [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	300.99 kHz	59.15 dBμV	18.73 dBμV	-31.49 dB	44.67 dBμV	-15.55 dB	Pass
2	173.374 kHz	21.63 dBμV	-4.71 dBμV	-59.5 dB	17.83 dBμV	-46.96 dB	Pass
3	297.668 kHz	50.83 dBμV	11.06 dBμV	-39.25 dB	39.43 dBμV	-20.88 dB	Pass
4	306.691 kHz	51.76 dBμV	13.47 dBμV	-36.59 dB	43.71 dBμV	-16.35 dB	Pass
5	417.431 kHz	6.94 dBμV	0.1 dBμV	-47.4 dB	16.92 dBμV	-40.58 dB	Pass
6	657.035 kHz	25.58 dBμV	-6.58 dBμV	-52.58 dB	11.81 dBμV	-44.19 dB	Pass

Measurement 3

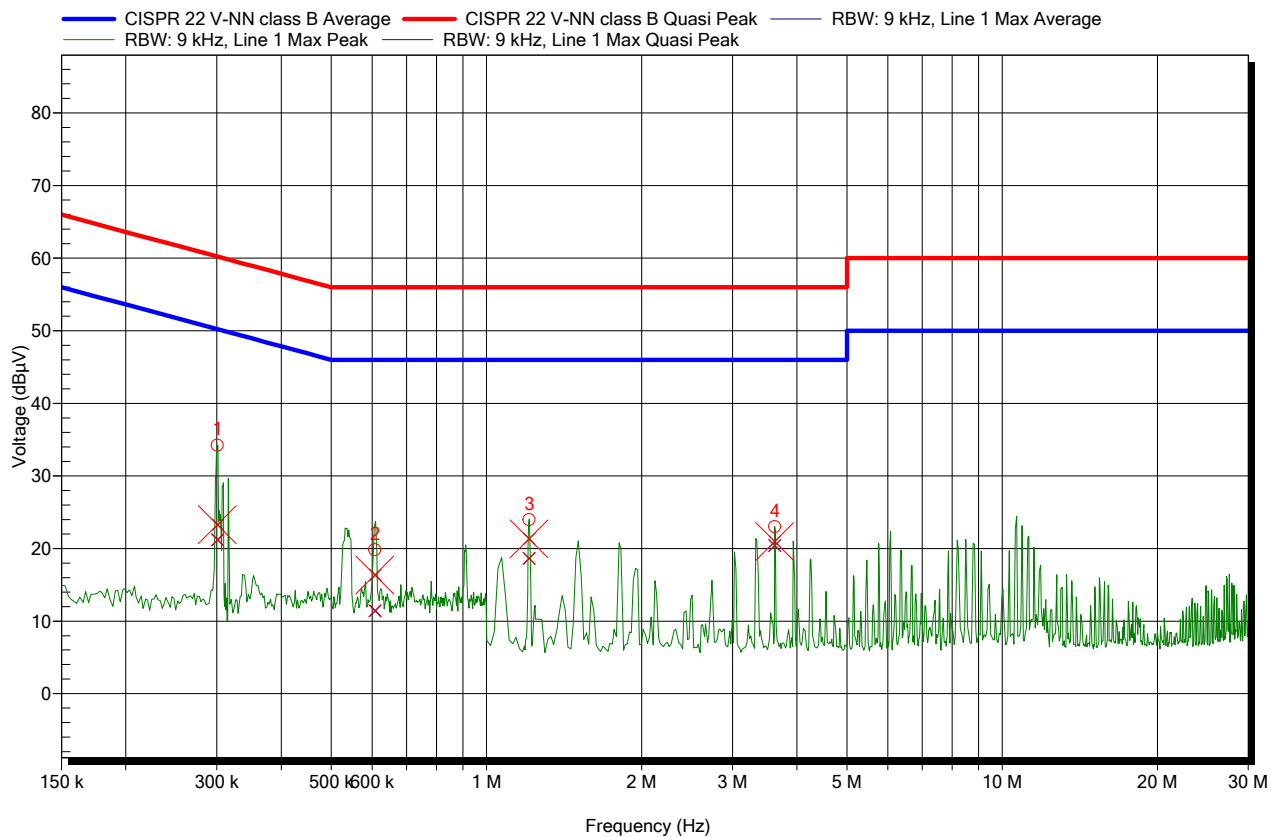
EUT	EUT 1 : NB2710-LWA-GV
Verdict, Test	Test 5: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	See chapter 13
Cables, Notes	All cables, see chapter Test Configuration
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 09:41:08
Interface / Line under test	48 VDC – 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 [1.8 s], 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	298.935 kHz	33.08 dBμV	19.24 dBμV	-31.03 dB	22.47 dBμV	-37.8 dB	Pass
2	385.287 kHz	30.29 dBμV	0.1 dBμV	-48.06 dB	15.23 dBμV	-42.93 dB	Pass
3	398.005 kHz	29.7 dBμV	-5.89 dBμV	-53.78 dB	15.95 dBμV	-41.94 dB	Pass
4	540.025 kHz	18.7 dBμV	14.22 dBμV	-31.78 dB	17.8 dBμV	-38.2 dB	Pass
5	605.736 kHz	23.29 dBμV	18.83 dBμV	-27.17 dB	21.29 dBμV	-34.71 dB	Pass
6	756.234 kHz	24.48 dBμV	-14.57 dBμV	-60.57 dB	9.48 dBμV	-46.52 dB	Pass
7	908.853 kHz	18.67 dBμV	16.43 dBμV	-29.57 dB	16.91 dBμV	-39.09 dB	Pass
8	1.209 MHz	23.28 dBμV	19.07 dBμV	-26.93 dB	21.56 dBμV	-34.44 dB	Pass
9	1.51 MHz	21.09 dBμV	18.83 dBμV	-27.17 dB	19.23 dBμV	-36.77 dB	Pass
10	3.322 MHz	20.61 dBμV	17.95 dBμV	-28.05 dB	18.75 dBμV	-37.25 dB	Pass
11	10.567 MHz	21.76 dBμV	14.65 dBμV	-35.35 dB	17.32 dBμV	-42.68 dB	Pass

Measurement 4

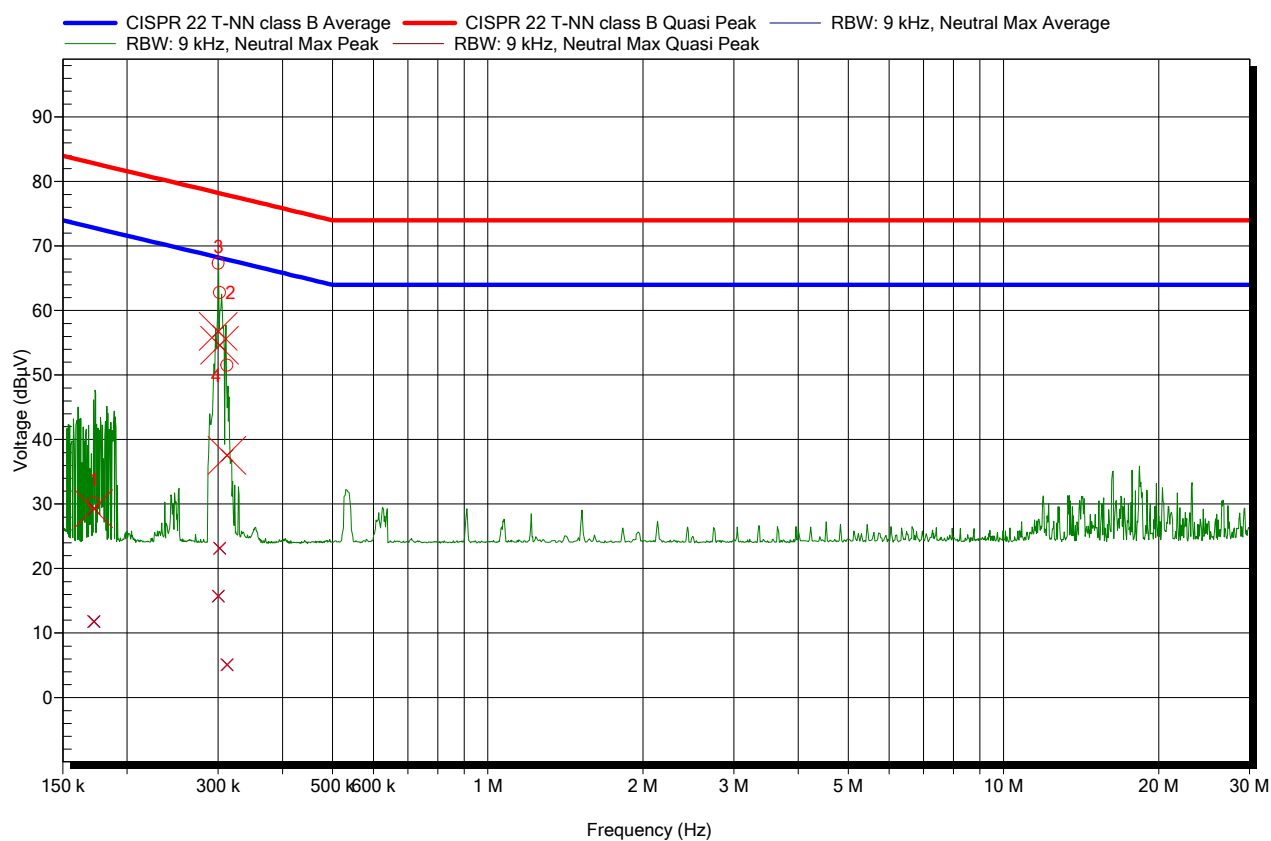
EUT	EUT 1 : NB2710-LWA-GV
Verdict, Test	Test 6: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 09:48:34
Interface / Line under test	48 VDC – Positive
Transducer	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 [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	300.776 kHz	34.24 dBμV	21.21 dBμV	-29.01 dB	23.3 dBμV	-36.92 dB	Pass
2	607.855 kHz	19.86 dBμV	11.41 dBμV	-34.59 dB	16.35 dBμV	-39.65 dB	Pass
3	1.209 MHz	23.97 dBμV	18.61 dBμV	-27.39 dB	21.32 dBμV	-34.68 dB	Pass
4	3.623 MHz	22.99 dBμV	20.4 dBμV	-25.6 dB	20.96 dBμV	-35.04 dB	Pass

Measurement 5

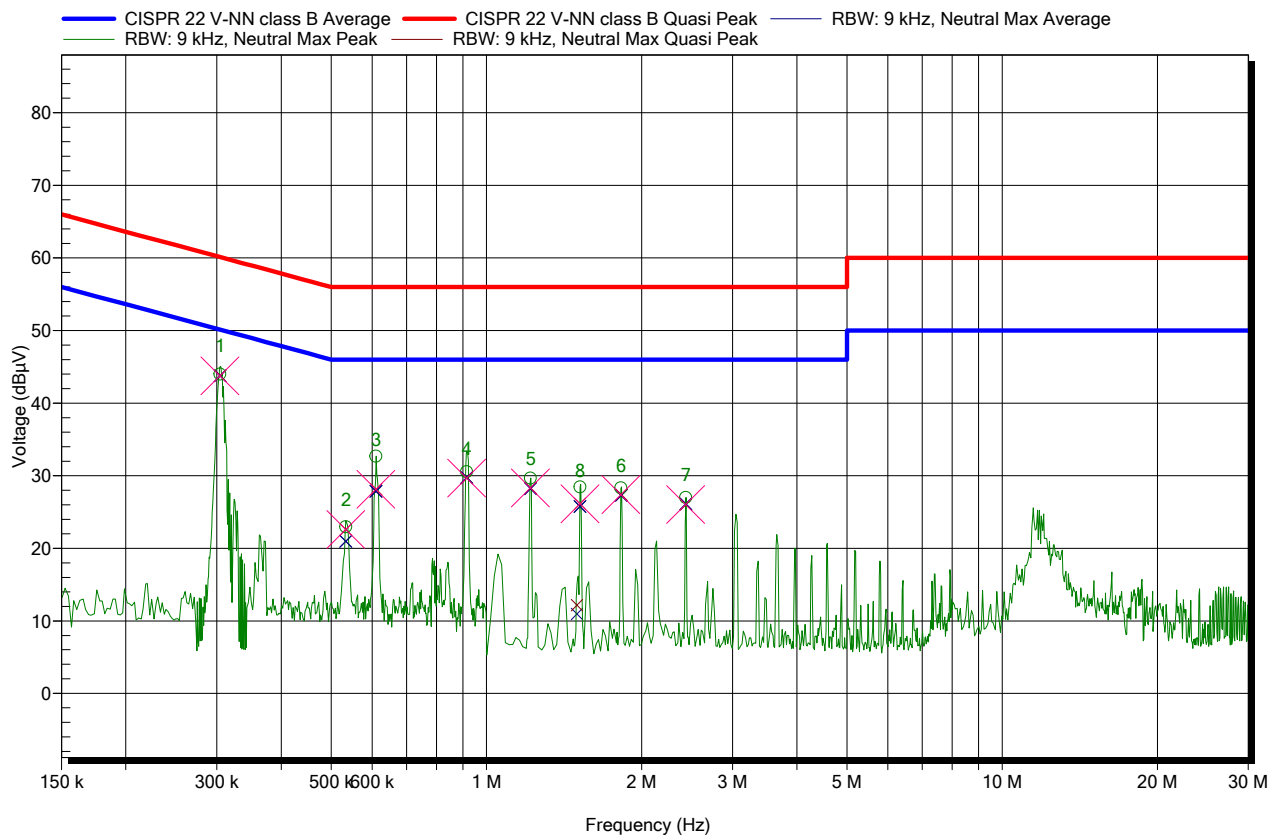
EUT	EUT 1 : NB2710-LWA-GV
Verdict, Test	Test 4: CE_150k-30M_LAN-LISN_13.6632.07 55022 CLB
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 09:21:35
Interface / Line under test	Ethernet 1
Transducer	ISN_RJ45
Measurement settings	Radimation Version: 2014.1.7, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [72.9 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: 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	172.197 kHz	30.25 dBμV	11.82 dBμV	-61.03 dB	29.3 dBμV	-53.55 dB	Pass
2	302.202 kHz	62.79 dBμV	23.14 dBμV	-45.04 dB	54.64 dBμV	-23.54 dB	Pass
3	300.157 kHz	67.34 dBμV	15.72 dBμV	-52.52 dB	56.77 dBμV	-21.47 dB	Pass
4	312.088 kHz	51.54 dBμV	5.1 dBμV	-62.81 dB	37.55 dBμV	-40.36 dB	Pass

Results EUT 2**Measurement 6**

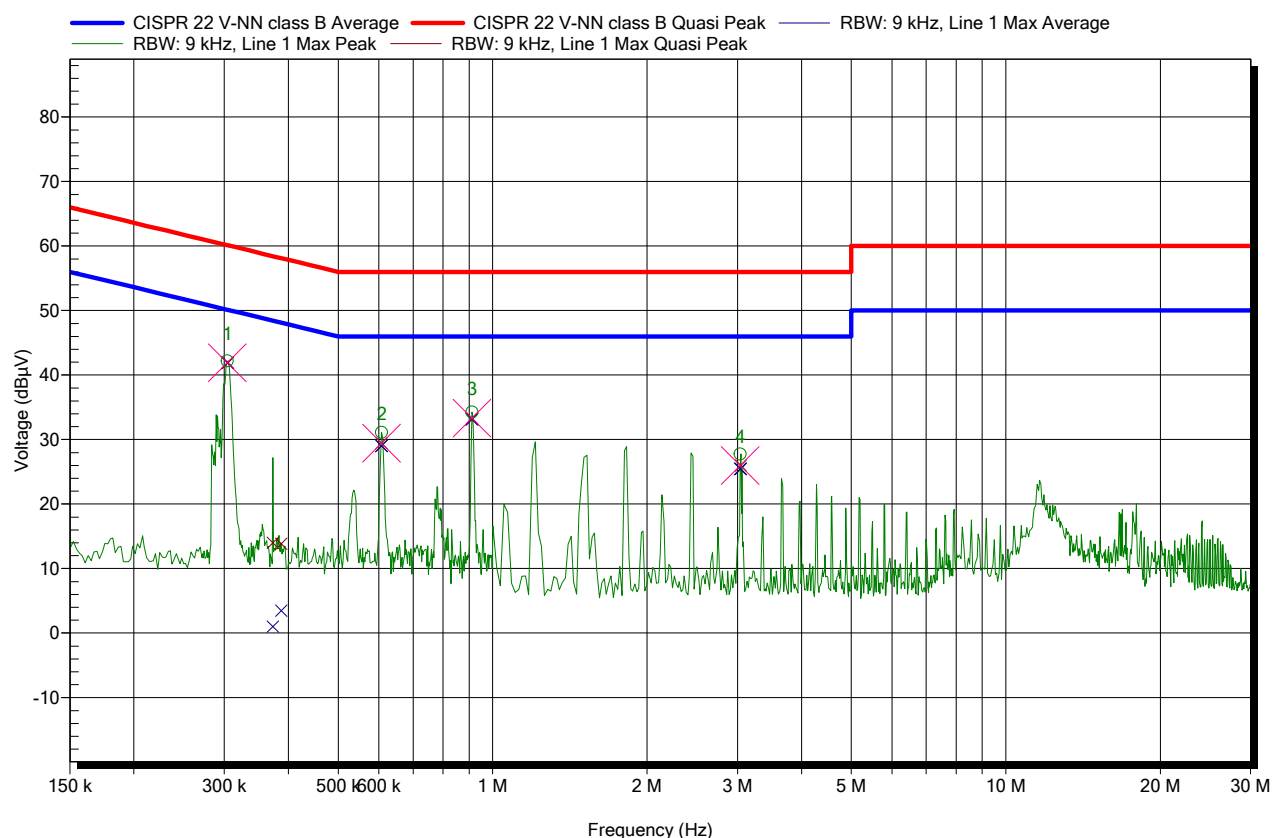
EUT	EUT 2 : NB2710-UWC-G
Verdict, Test	Test 10: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 10:55:20
Interface / Line under test	12 VDC – Negative
Transducer	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 [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	304.355 kHz	44 dBμV	43.76 dBμV	-6.36 dB	43.75 dBμV	-16.37 dB	Pass
2	533.666 kHz	22.96 dBμV	20.95 dBμV	-25.05 dB	22.59 dBμV	-33.41 dB	Pass
3	609.975 kHz	32.67 dBμV	27.84 dBμV	-18.16 dB	28.12 dBμV	-27.88 dB	Pass
4	915.212 kHz	30.55 dBμV	29.77 dBμV	-16.23 dB	29.67 dBμV	-26.33 dB	Pass
5	1.216 MHz	29.66 dBμV	28.21 dBμV	-17.79 dB	28.32 dBμV	-27.68 dB	Pass
6	1.823 MHz	28.33 dBμV	27.28 dBμV	-18.72 dB	27.39 dBμV	-28.61 dB	Pass
7	2.432 MHz	27.03 dBμV	26.15 dBμV	-19.85 dB	26.03 dBμV	-29.97 dB	Pass
8	1.519 MHz	28.45 dBμV	25.74 dBμV	-20.26 dB	26.14 dBμV	-29.86 dB	Pass

Measurement 7

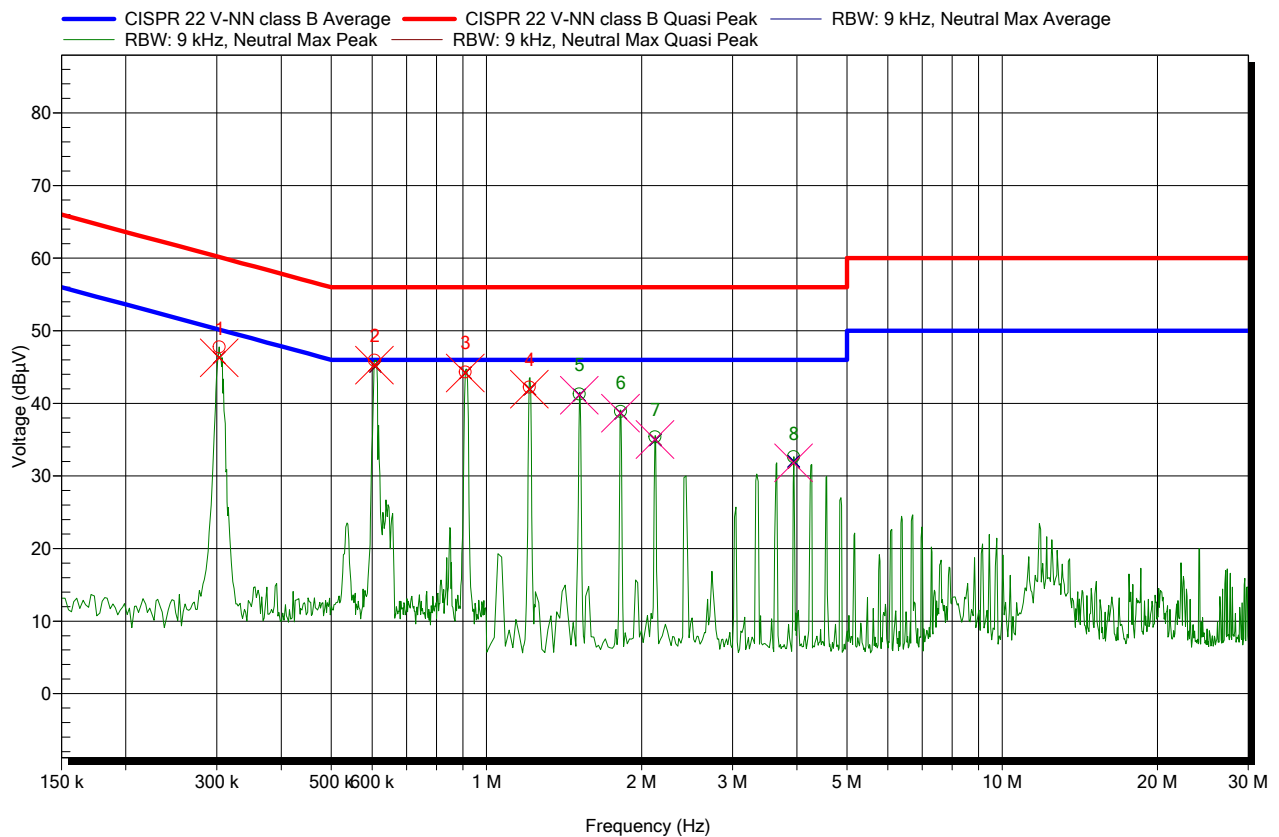
EUT	EUT 2 : NB2710-UWC-G
Verdict, Test	Test 11: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 11:19:43
Interface / Line under test	12 VDC – Positive
Transducer	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 [50 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: 20 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	304.217 kHz	42.24 dBμV	41.88 dBμV	-8.25 dB	41.92 dBμV	-18.21 dB	Pass
2	606.945 kHz	31.12 dBμV	29.05 dBμV	-16.95 dB	29.45 dBμV	-26.55 dB	Pass
3	910.791 kHz	34.28 dBμV	33.17 dBμV	-12.83 dB	33.33 dBμV	-22.67 dB	Pass
4	3.039 MHz	27.75 dBμV	25.48 dBμV	-20.52 dB	25.99 dBμV	-30.01 dB	Pass

Measurement 8

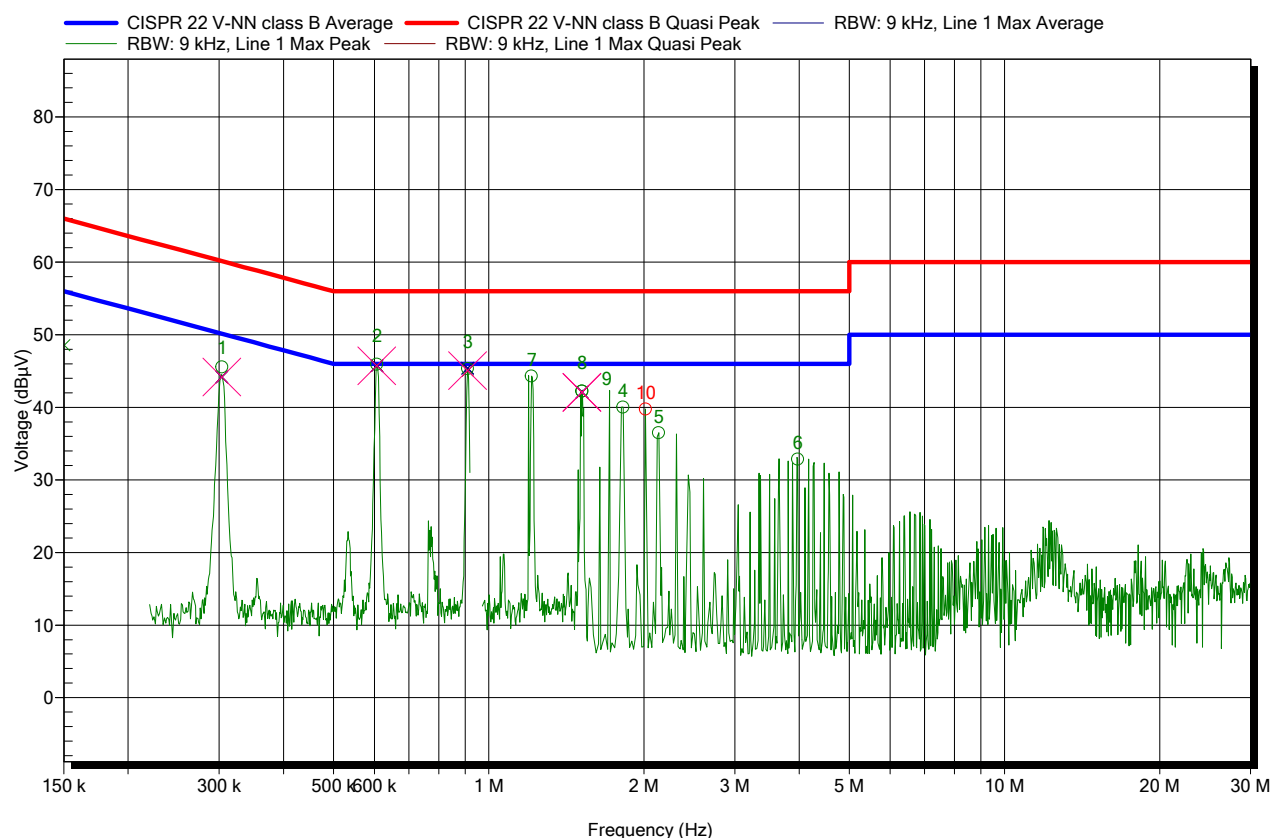
EUT	EUT 2 : NB2710-UWC-G
Verdict, Test	Test 14: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 12:46:04
Interface / Line under test	48 VDC – Negative
Transducer	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 [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	303.155 kHz	47.77 dBμV	46.31 dBμV	-3.85 dB	46.3 dBμV	-13.86 dB	Pass
2	606.935 kHz	45.97 dBμV	45.27 dBμV	-0.73 dB	45.26 dBμV	-10.74 dB	Pass
3	910.411 kHz	44.33 dBμV	44.23 dBμV	-1.77 dB	44.2 dBμV	-11.8 dB	Pass
4	1.212 MHz	42.21 dBμV	41.96 dBμV	-4.04 dB	41.96 dBμV	-14.04 dB	Pass
5	1.515 MHz	41.32 dBμV	41.16 dBμV	-4.84 dB	41.13 dBμV	-14.87 dB	Pass
6	1.818 MHz	38.87 dBμV	38.66 dBμV	-7.34 dB	38.66 dBμV	-17.34 dB	Pass
7	2.121 MHz	35.4 dBμV	34.98 dBμV	-11.02 dB	35 dBμV	-21 dB	Pass
8	3.94 MHz	32.65 dBμV	32.06 dBμV	-13.94 dB	31.8 dBμV	-24.2 dB	Pass

Measurement 9

EUT	EUT 2 : NB2710-UWC-G
Verdict, Test	Test 15: CE_150k-30M_V-LISN_PE7627 ESH3-Z5 R&S_B
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4
Test date, time	05/11/2014 13:05:27
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: 10 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms]

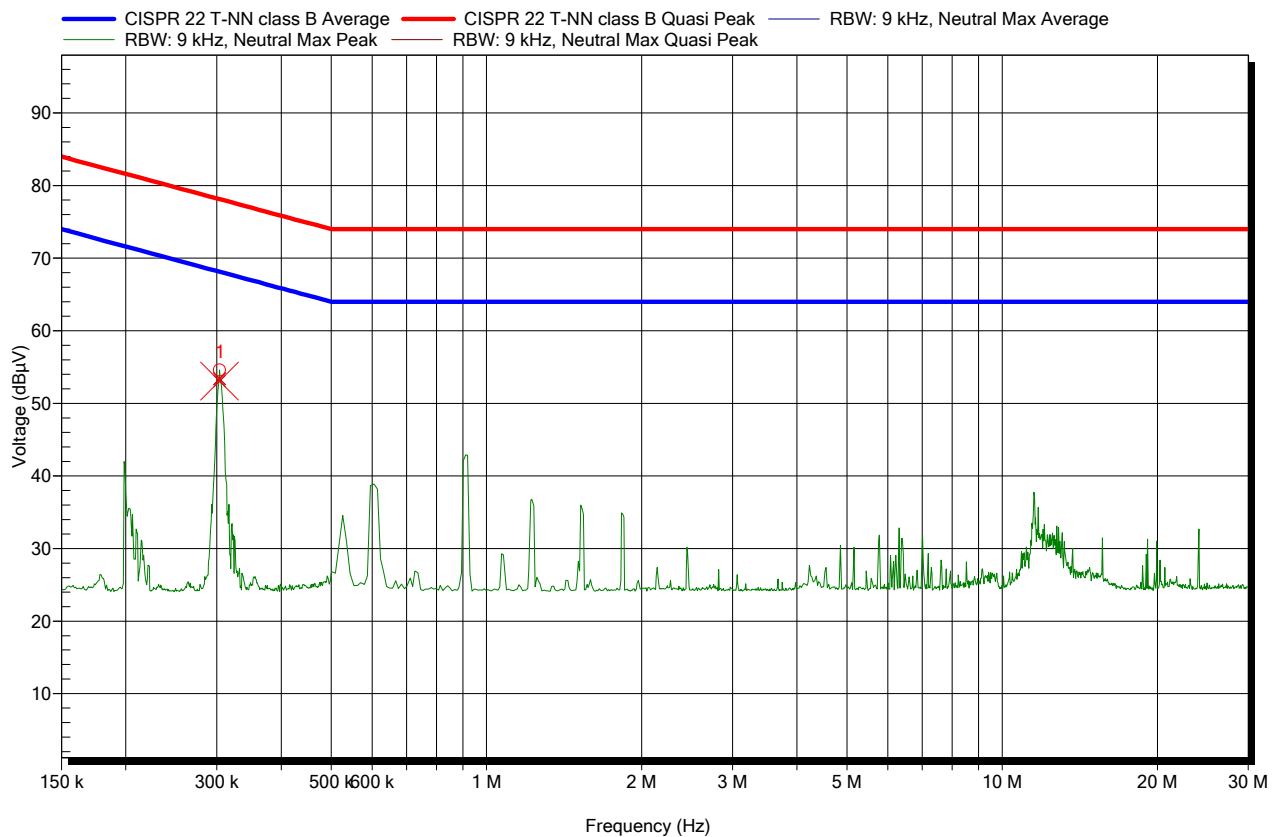


Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	303.648 kHz	45.59 dBμV	44.18 dBμV	-5.96 dB	44.19 dBμV	-15.95 dB	Pass
2	606.8 kHz	45.96 dBμV	45.73 dBμV	-0.27 dB	45.73 dBμV	-10.27 dB	Pass
3	910.377 kHz	45.35 dBμV	45.38 dBμV	-0.62 dB	45.07 dBμV	-10.93 dB	Pass
8	1.515 MHz	42.23 dBμV	42.07 dBμV	-3.93 dB	42.05 dBμV	-13.95 dB	Pass
9	1.516 MHz	42.22 dBμV	42.09 dBμV	-3.91 dB	42.07 dBμV	-13.93 dB	Pass

Measurement 10

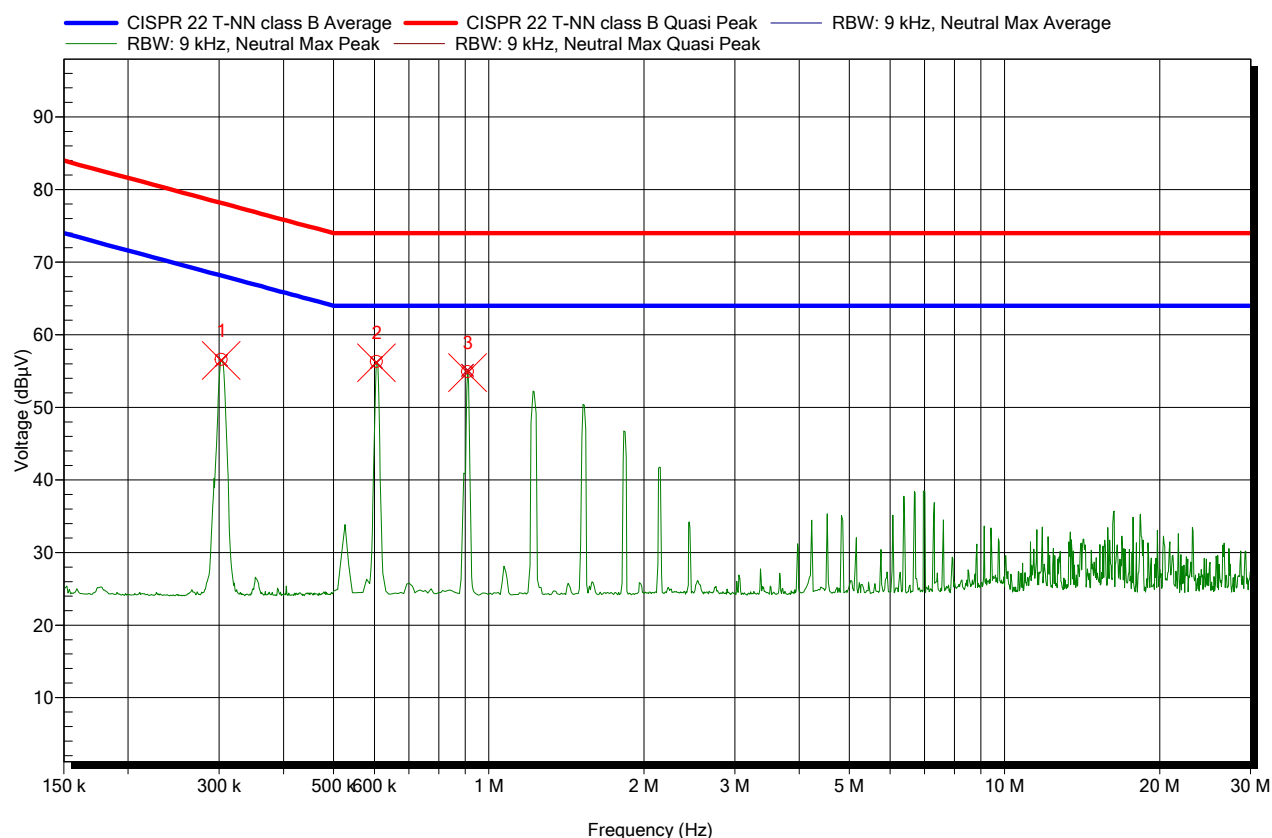
EUT	EUT 2 : NB2710-UWC-G
Verdict, Test	Test 13: CE_150k-30M_LAN-LISN_13.6632.07 55022 CLB
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)
Test date, time	05/11/2014 11:27:54
Interface / Line under test	CAN
Transducer	ISN_RJ45
Measurement settings	Radimation Version: 2014.1.7, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [291.7 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	303.843 kHz	54.62 dBμV	53.37 dBμV	-14.77 dB	53.07 dBμV	-25.07 dB	Pass

Measurement 11

EUT	EUT 2 : NB2710-UWC-G
Verdict, Test	Test 16: CE_150k-30M_LAN-LISN_13.6632.07 55022 CLB
Modification	See chapter 13
Cables, Notes	All cables, see chapter 10.3
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)
Test date, time	05/11/2014 13:22:16
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 [1.3 s], 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	302.855 kHz	56.6 dBμV	56.46 dBμV	-11.7 dB	56.45 dBμV	-21.71 dB	Pass
2	606.004 kHz	56.34 dBμV	56.18 dBμV	-7.82 dB	56.16 dBμV	-17.84 dB	Pass
3	909.221 kHz	54.94 dBμV	55.11 dBμV	-8.89 dB	54.78 dBμV	-19.22 dB	Pass

11.2 Radiated Emission - Electromagnetic Field (EN 55022)

Test site: Semi-anechoic chamber (Albislab)

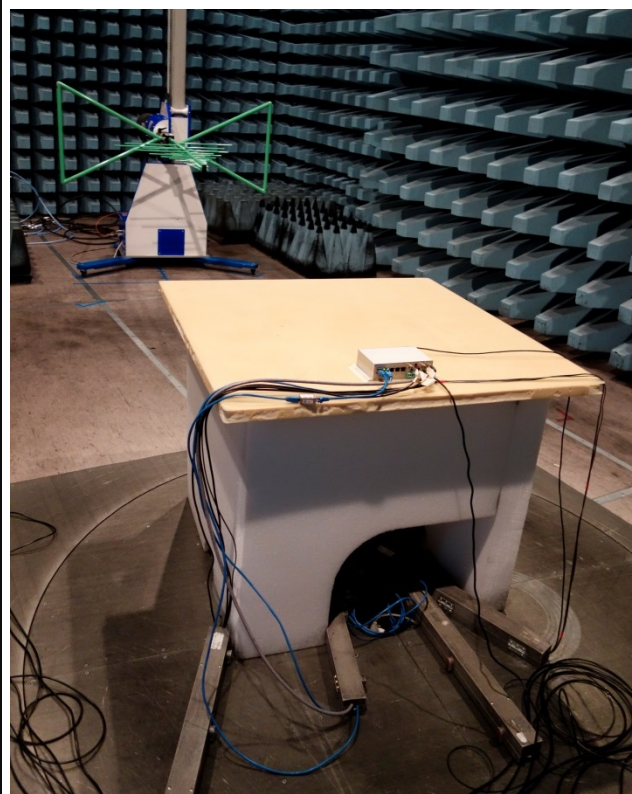
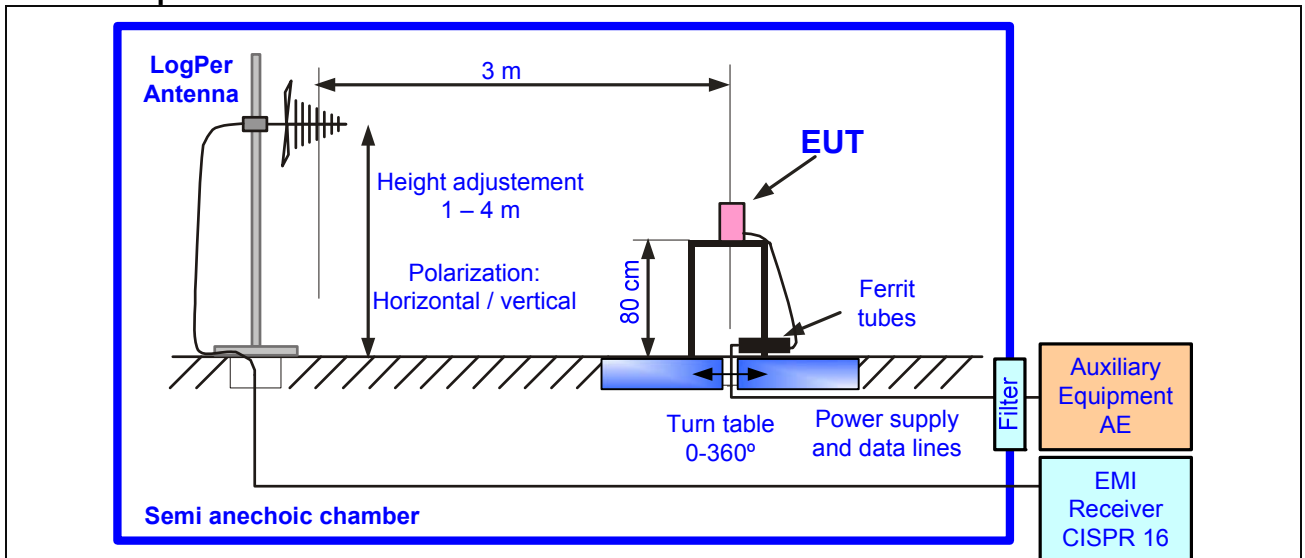
Distance: 3 m

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

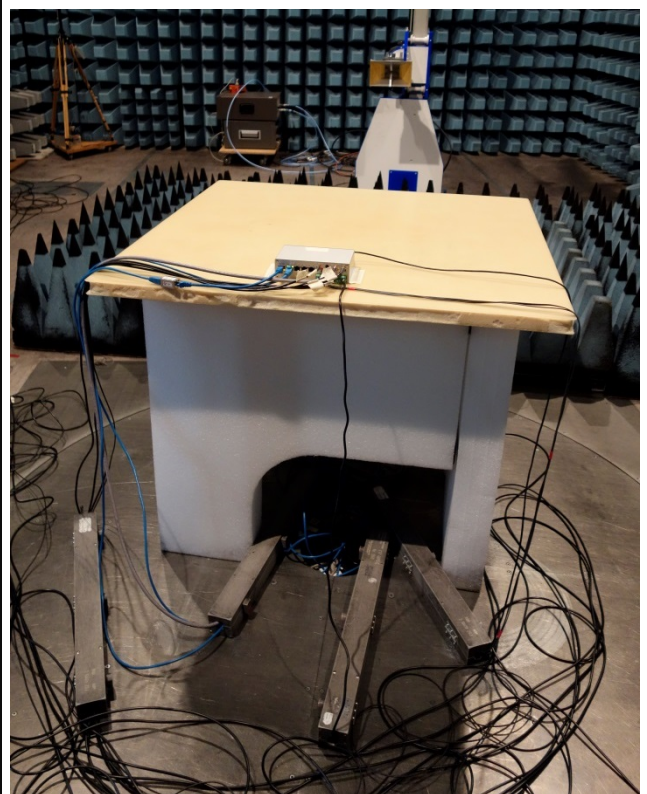
Meas. uncertainty: see chapter 14

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 remeasured manually using a receiver.

Test Set-up



Setup 80 – 1000 MHz



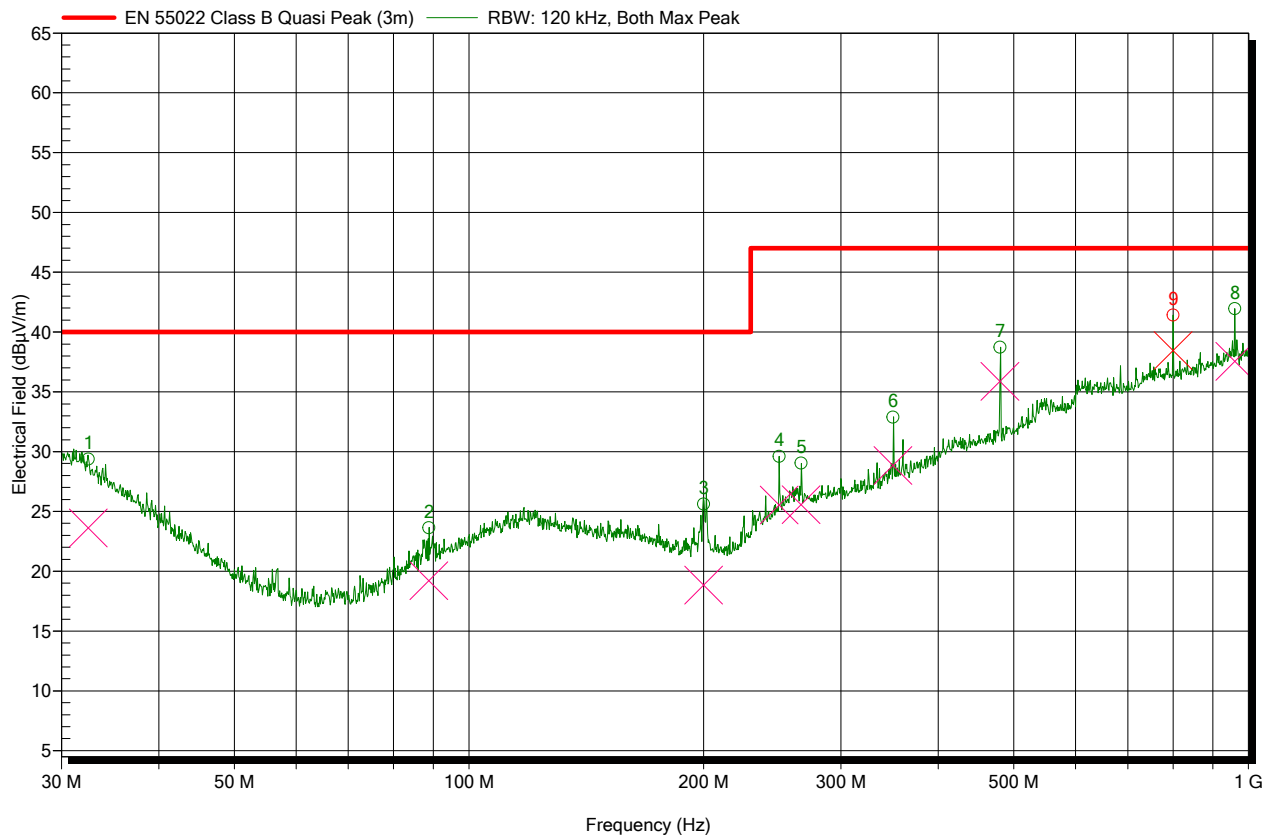
Setup 1 – 3 GHz

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

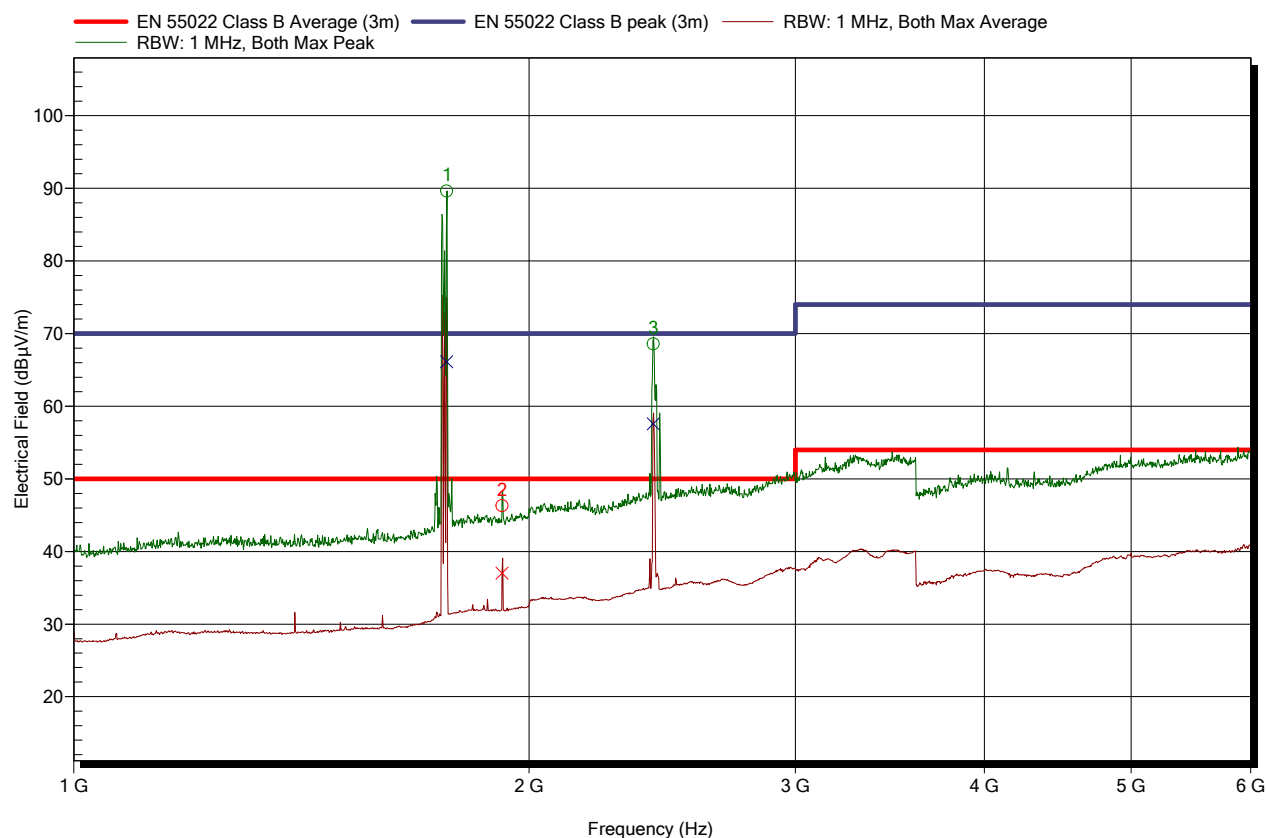
EUT	EUT1 : NB2710 LWA-GV		
Verdict, Test	Test 5: ESU8_30M-1G EN 55022 Class B 3m		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)		
Test date, time	20/10/2014 10:38:19		
Antenna height	1 m - 4 m	Antenna 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	32.46 MHz	29.38 dBμV/m	23.63 dBμV/m	-16.37 dB	Pass	270 Degree	3 m	Horizontal
2	88.8 MHz	23.64 dBμV/m	19.22 dBμV/m	-20.78 dB	Pass	60 Degree	1 m	Vertical
3	199.95 MHz	25.62 dBμV/m	18.84 dBμV/m	-21.16 dB	Pass	120 Degree	1 m	Vertical
4	249.99 MHz	29.6 dBμV/m	25.54 dBμV/m	-21.46 dB	Pass	300 Degree	1 m	Horizontal
5	266.67 MHz	29.05 dBμV/m	25.58 dBμV/m	-21.42 dB	Pass	210 Degree	1 m	Horizontal
6	349.98 MHz	32.9 dBμV/m	28.84 dBμV/m	-18.16 dB	Pass	210 Degree	1 m	Horizontal
7	480.06 MHz	38.74 dBμV/m	35.88 dBμV/m	-11.12 dB	Pass	60 Degree	1 m	Vertical
8	960.09 MHz	41.97 dBμV/m	37.56 dBμV/m	-9.44 dB	Pass	30 Degree	1 m	Vertical
9	799.98 MHz	41.42 dBμV/m	38.46 dBμV/m	-8.54 dB	Pass	300 Degree	1 m	Horizontal

Measurement 2

EUT	EUT1 : NB2710 LWA-GV		
Verdict, Test	Test 42: 1G-6G EN 55022 Class B 3m		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)		
Test date, time	20/10/2014 17:06:55		
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 [120 ms], Step freq: Linear: 250 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 5 ms		

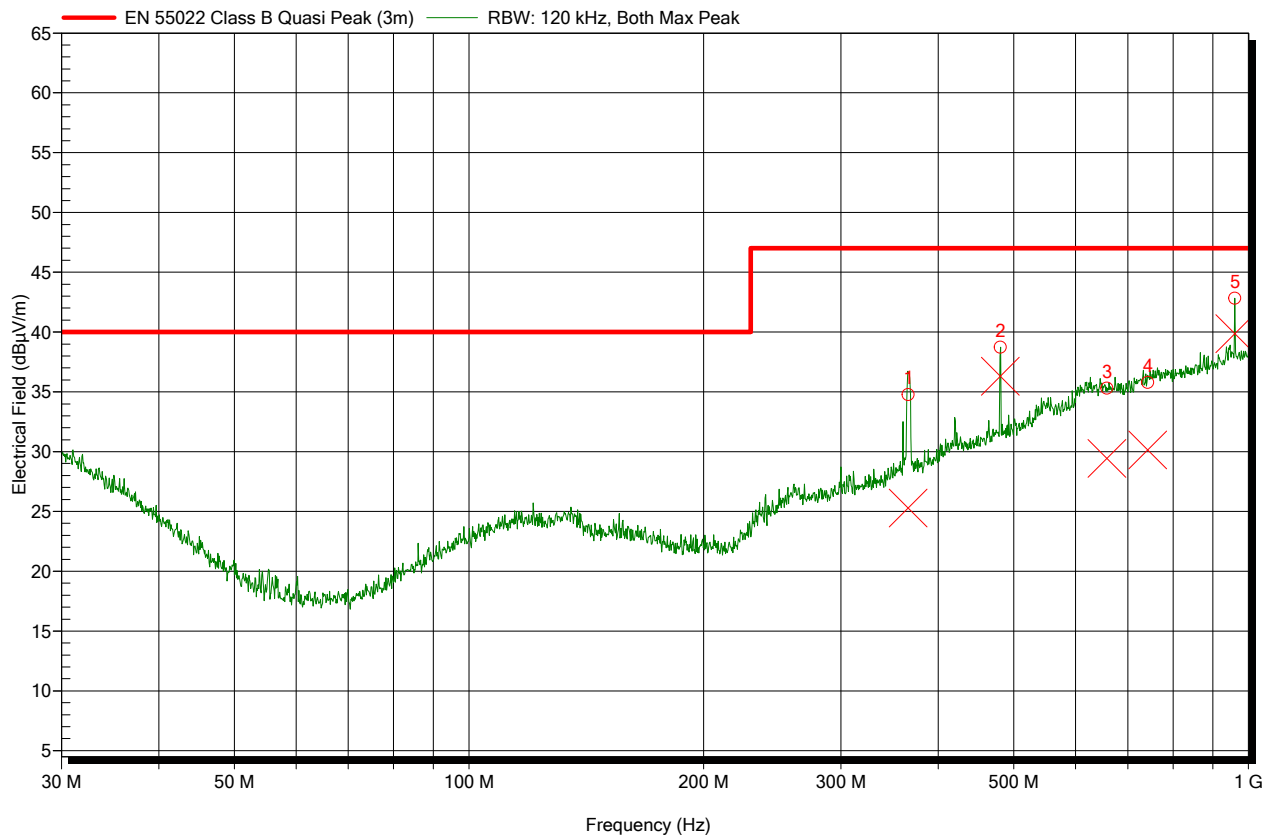
**Detected peaks**

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.764 GHz	89.64 dBμV/m	19.64 dB	66.12 dBμV/m	16.12 dB	Note	240 Degree	1 m	Horizontal
2	1.92 GHz	46.32 dBμV/m	-23.68 dB	36.99 dBμV/m	-13.01 dB	Pass	30 Degree	1 m	Horizontal
3	2.416 GHz	68.6 dBμV/m	-1.4 dB	57.56 dBμV/m	7.56 dB	Note	300 Degree	1 m	Vertical

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

Measurement 3

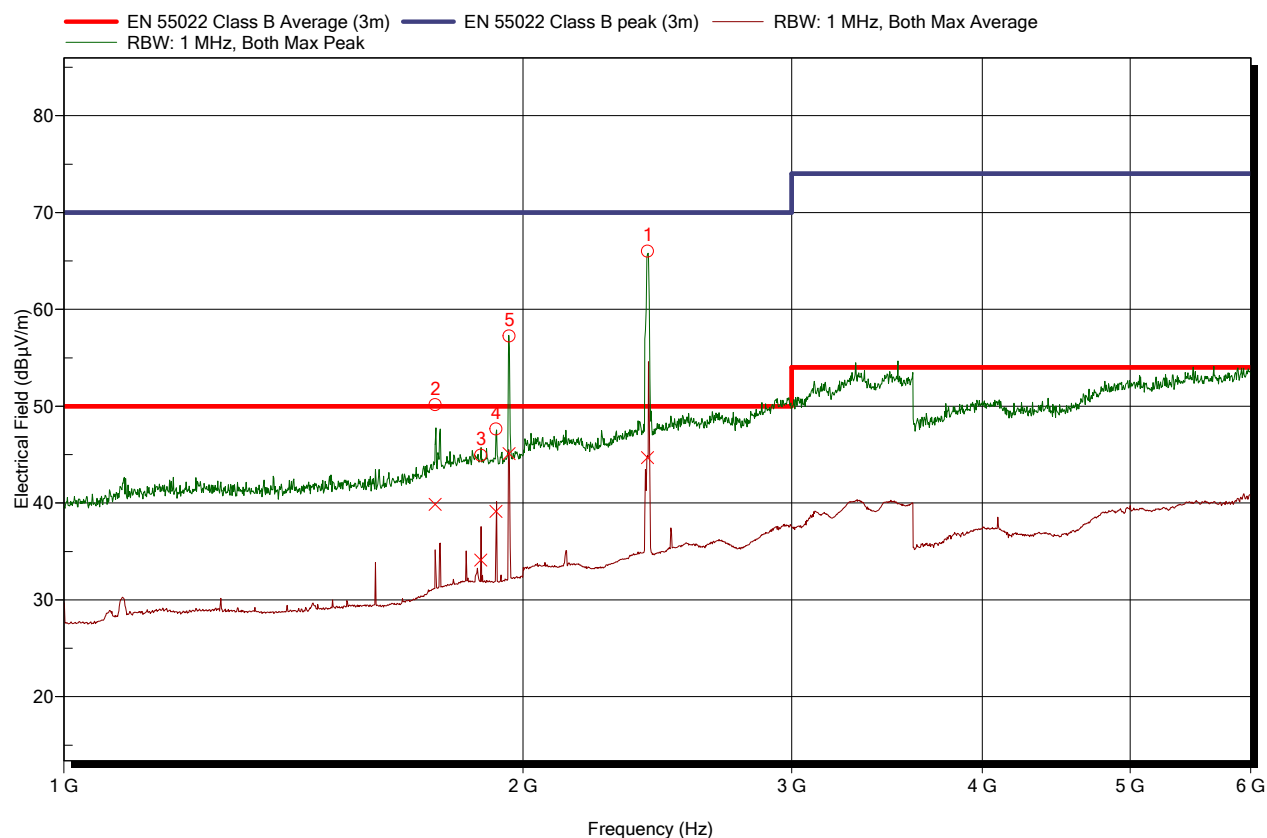
EUT	EUT2 : NB2710 UWC-G		
Verdict, Test	Test 6: ESU8_30M-1G EN 55022 Class B 3m		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)		
Test date, time	20/10/2014 11:35:42		
Antenna height	1 m - 4 m	Antenna polarization	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	365.73 MHz	34.77 dBμV/m	25.28 dBμV/m	-21.72 dB	Pass	300 Degree	1 m	Horizontal
2	480.09 MHz	38.74 dBμV/m	36.32 dBμV/m	-10.68 dB	Pass	60 Degree	1 m	Vertical
3	658.32 MHz	35.3 dBμV/m	29.44 dBμV/m	-17.56 dB	Pass	330 Degree	3 m	Vertical
4	742.74 MHz	35.8 dBμV/m	30.16 dBμV/m	-16.84 dB	Pass	120 Degree	1 m	Horizontal
5	960.15 MHz	42.84 dBμV/m	39.85 dBμV/m	-7.15 dB	Pass	30 Degree	1 m	Vertical

Measurement 4

EUT	EUT2 : NB2710 UWC-G		
Verdict, Test	Test 7: 1G-6G EN 55022 Class B 3m		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)		
Test date, time	20/10/2014 13:07:45		
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 [120 ms], Step freq: Linear: 250 kHz steps, 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	2.414 GHz	66 dBμV/m	-4 dB	44.68 dBμV/m	-5.32 dB	Note	270 Degree	1 m	Horizontal
2	1.752 GHz	50.18 dBμV/m	-19.82 dB	39.87 dBμV/m	-10.13 dB	Pass	30 Degree	1 m	Horizontal
3	1.877 GHz	44.93 dBμV/m	-25.07 dB	34.11 dBμV/m	-15.89 dB	Pass	240 Degree	1 m	Horizontal
4	1.921 GHz	47.66 dBμV/m	-22.34 dB	39.14 dBμV/m	-10.86 dB	Pass	60 Degree	1 m	Vertical
5	1.959 GHz	57.27 dBμV/m	-12.73 dB	45.1 dBμV/m	-4.9 dB	Note	270 Degree	1 m	Vertical

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

11.3 Radiated Emission - Electromagnetic Field (FCC)

Test site: Semi-anechoic chamber (Albislab)

Distance: 3 m

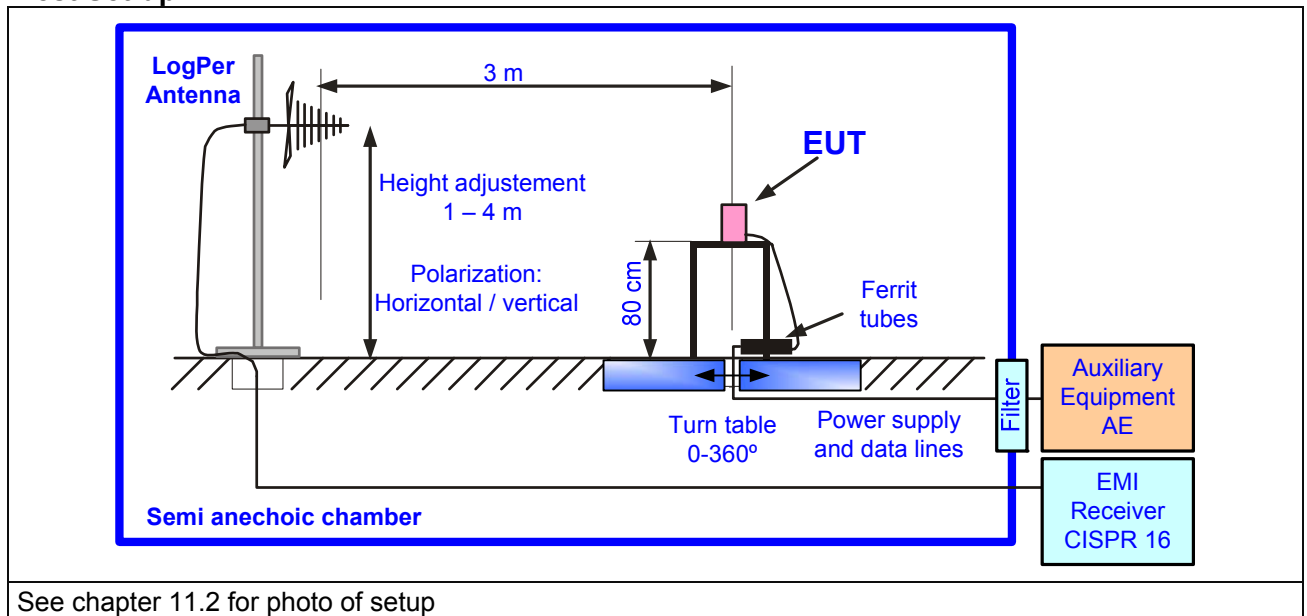
Position of EUT: 0.8 m (height of the equipment under test above floor)

Meas. uncertainty: see chapter 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 remeasured manually using a receiver.

Remark: Measured up to 6 GHz, for 6 – 12.5 GHz measurement see Montena Test Report No. 16'833A

Test Set-up



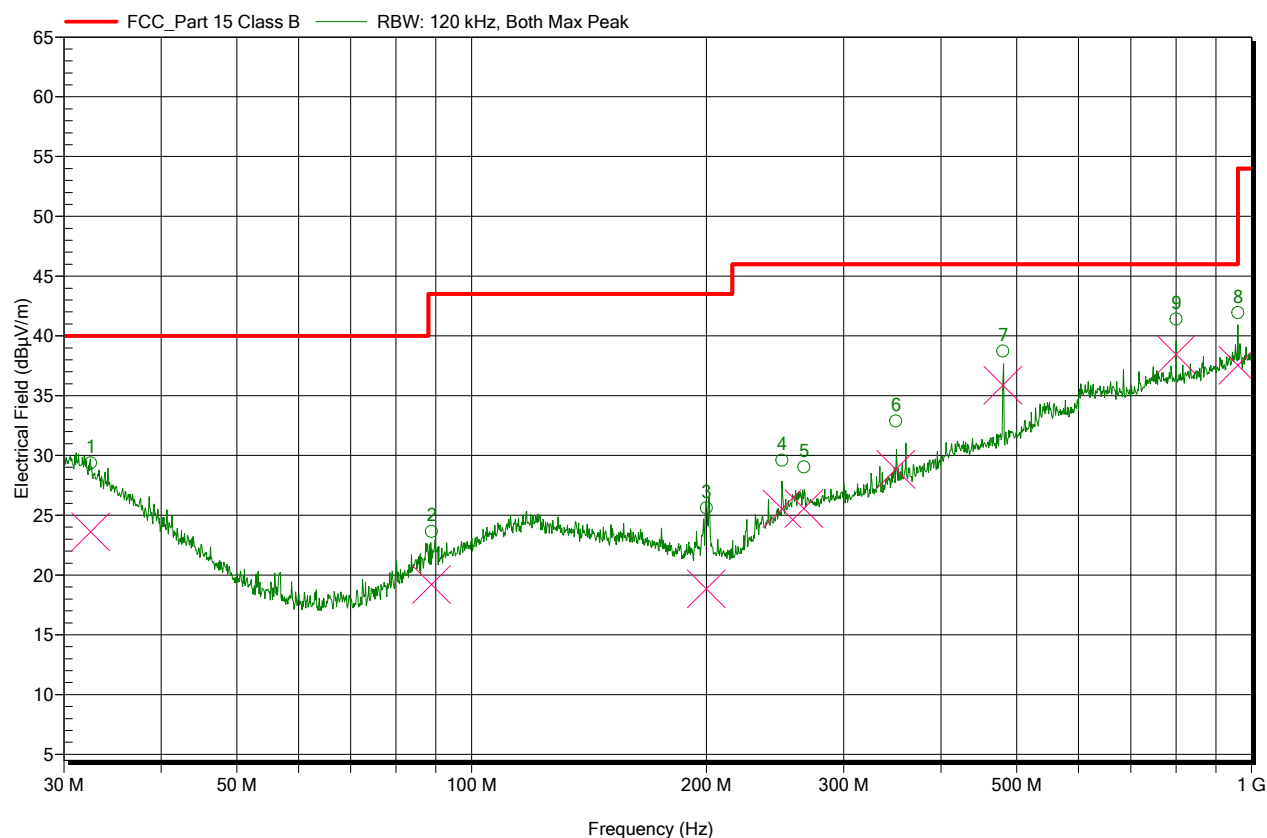
See chapter 11.2 for photo of setup

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

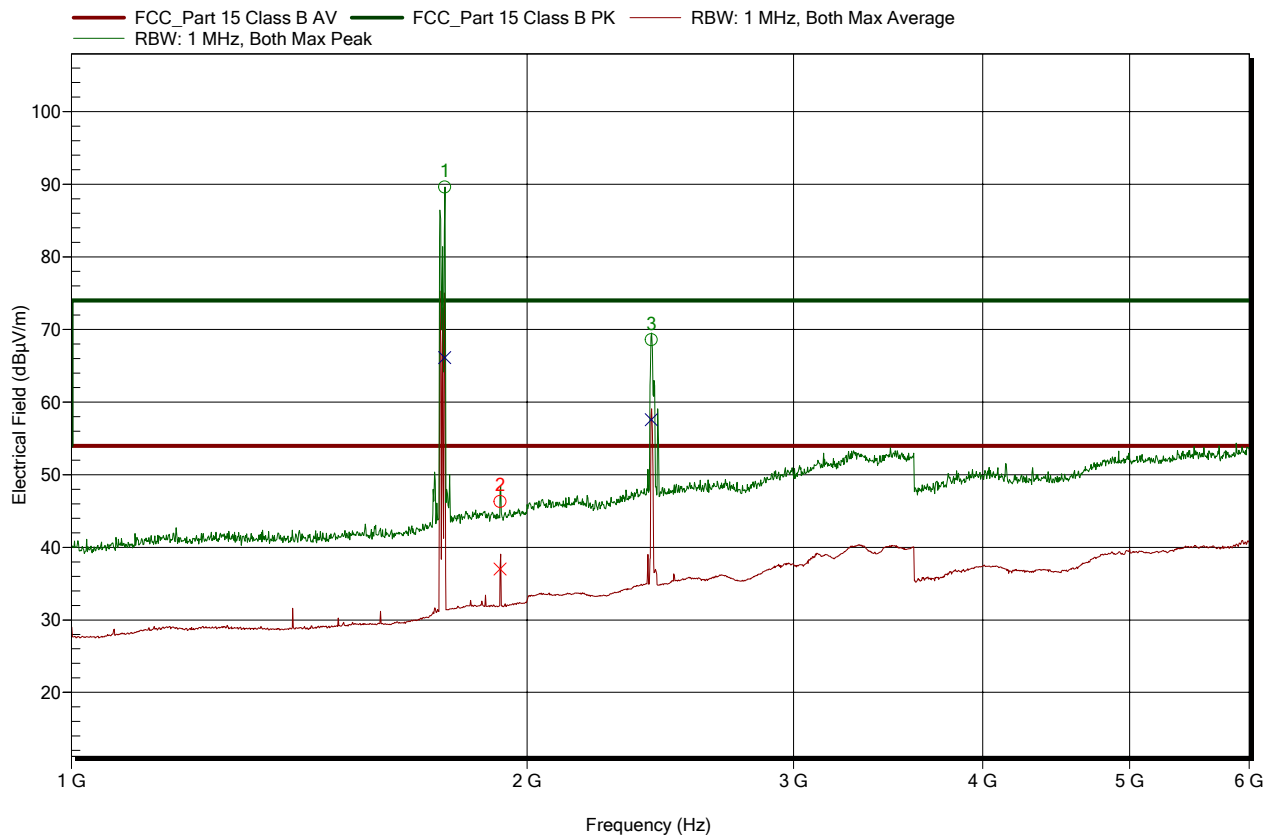
EUT	EUT1 : NB2710 LWA-GV		
Verdict, Test	Test 5: ESU8_30M-1G EN 55022 Class B 3m		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)		
Test date, time	20.10.2014 10:38:19		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.2.3, 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	32.46 MHz	29.38 dBμV/m	23.63 dBμV/m	-16.37 dB	Pass	270 Degree	3 m	Horizontal
2	88.8 MHz	23.64 dBμV/m	19.22 dBμV/m	-24.28 dB	Pass	60 Degree	1 m	Vertical
3	199.95 MHz	25.62 dBμV/m	18.84 dBμV/m	-24.66 dB	Pass	120 Degree	1 m	Vertical
4	249.99 MHz	29.6 dBμV/m	25.54 dBμV/m	-20.46 dB	Pass	300 Degree	1 m	Horizontal
5	266.67 MHz	29.05 dBμV/m	25.58 dBμV/m	-20.42 dB	Pass	210 Degree	1 m	Horizontal
6	349.98 MHz	32.9 dBμV/m	28.84 dBμV/m	-17.16 dB	Pass	210 Degree	1 m	Horizontal
7	480.06 MHz	38.74 dBμV/m	35.88 dBμV/m	-10.12 dB	Pass	60 Degree	1 m	Vertical
8	960.09 MHz	41.97 dBμV/m	37.56 dBμV/m	-16.44 dB	Pass	30 Degree	1 m	Vertical
9	799.98 MHz	41.42 dBμV/m	38.46 dBμV/m	-7.54 dB	Pass	300 Degree	1 m	Horizontal

Measurement 2

EUT	EUT1 : NB2710 LWA-GV		
Verdict, Test	Test 42: 1G-6G EN 55022 Class B 3m		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)		
Test date, time	20.10.2014 17:06:55		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.2.3, RBW: 1 MHz, VBW: 1 MHz, Sweep time: Auto [120 ms], Step freq: Linear: 250 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 5 ms		

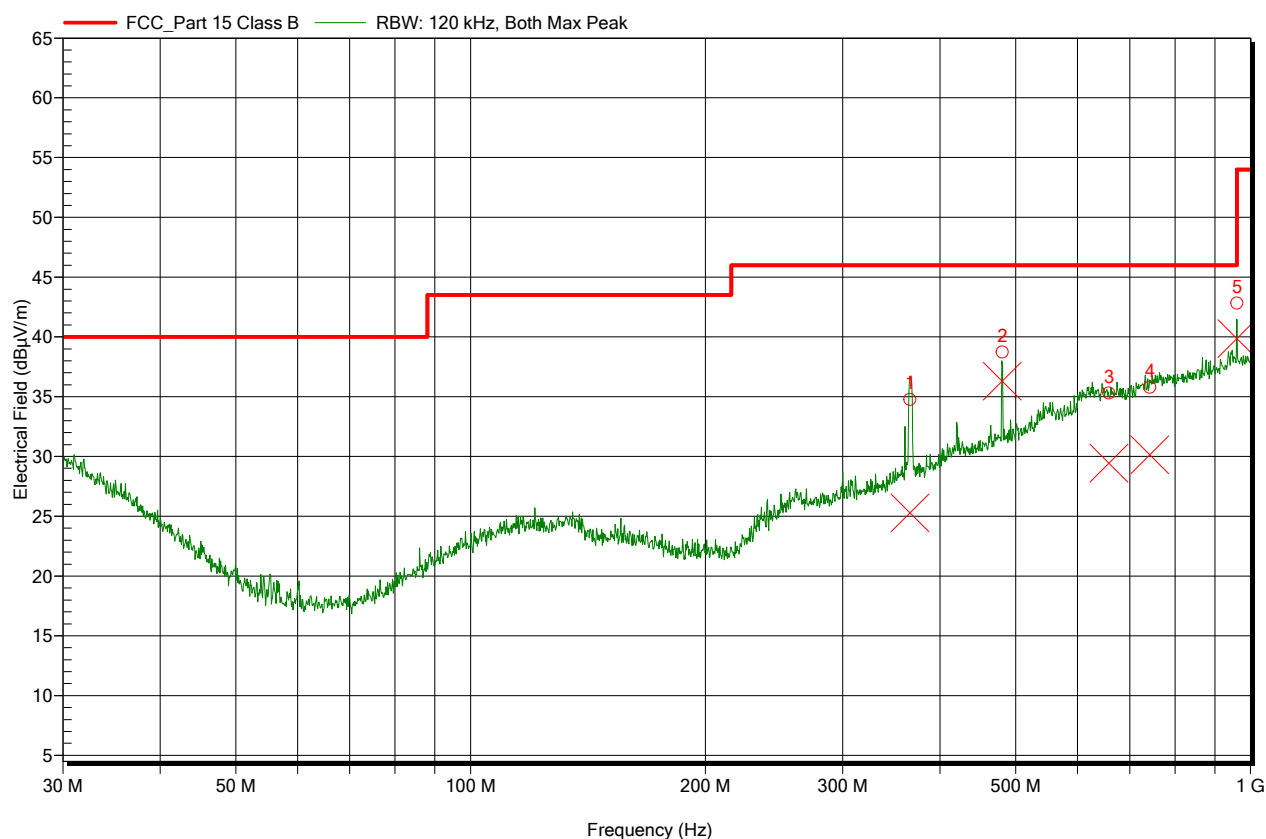
**Detected peaks**

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.764 GHz	89.64 dBμV/m	15.64 dB	66.12 dBμV/m	12.12 dB	Note	240 Degree	1 m	Horizontal
2	1.92 GHz	46.32 dBμV/m	-27.68 dB	36.99 dBμV/m	-17.01 dB	Pass	30 Degree	1 m	Horizontal
3	2.416 GHz	68.6 dBμV/m	-5.4 dB	57.56 dBμV/m	3.56 dB	Note	300 Degree	1 m	Vertical

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

Measurement 3

EUT	EUT2 : NB2710 UWC-G		
Verdict, Test	Test 6: ESU8_30M-1G EN 55022 Class B 3m		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)		
Test date, time	20.10.2014 11:35:42		
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: 2014.2.3, 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		

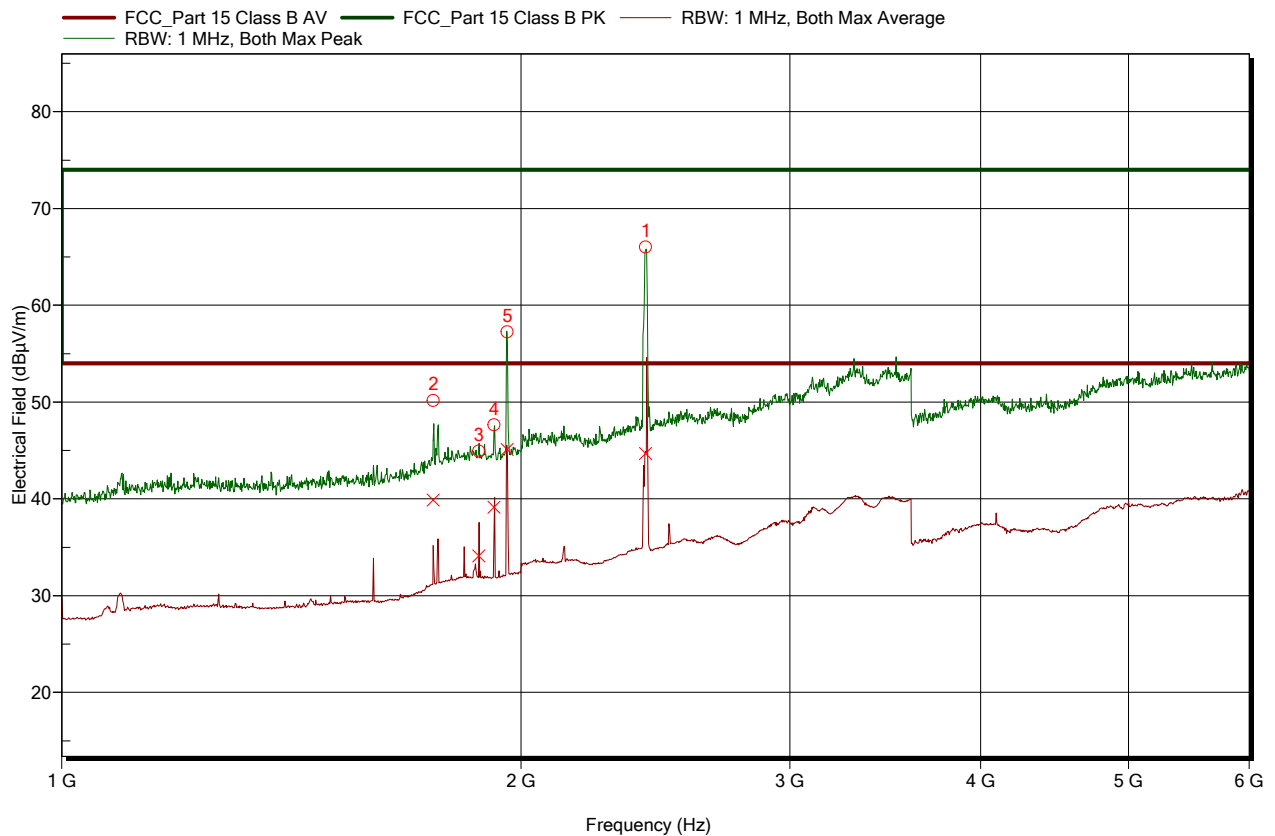


Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	365.73 MHz	34.77 dBμV/m	25.28 dBμV/m	-20.72 dB	Pass	300 Degree	1 m	Horizontal
2	480.09 MHz	38.74 dBμV/m	36.32 dBμV/m	-9.68 dB	Pass	60 Degree	1 m	Vertical
3	658.32 MHz	35.3 dBμV/m	29.44 dBμV/m	-16.56 dB	Pass	330 Degree	3 m	Vertical
4	742.74 MHz	35.8 dBμV/m	30.16 dBμV/m	-15.84 dB	Pass	120 Degree	1 m	Horizontal
5	960.15 MHz	42.84 dBμV/m	39.85 dBμV/m	-14.15 dB	Pass	30 Degree	1 m	Vertical

Measurement 4

EUT	EUT2 : NB2710 UWC-G		
Verdict, Test	Test 7: 1G-6G EN 55022 Class B 3m		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4 (supplied with 12 VDC)		
Test date, time	20.10.2014 13:07:45		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.2.3, RBW: 1 MHz, VBW: 1 MHz, Sweep time: Auto [120 ms], Step freq: Linear: 250 kHz steps, 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	2.414 GHz	66 dBµV/m	-8 dB	44.68 dBµV/m	-9.32 dB	Note	270 Degree	1 m	Horizontal
2	1.752 GHz	50.18 dBµV/m	-23.82 dB	39.87 dBµV/m	-14.13 dB	Pass	30 Degree	1 m	Horizontal
3	1.877 GHz	44.93 dBµV/m	-29.07 dB	34.11 dBµV/m	-19.89 dB	Pass	240 Degree	1 m	Horizontal
4	1.921 GHz	47.66 dBµV/m	-26.34 dB	39.14 dBµV/m	-14.86 dB	Pass	60 Degree	1 m	Vertical
5	1.959 GHz	57.27 dBµV/m	-16.73 dB	45.1 dBµV/m	-8.9 dB	Pass	270 Degree	1 m	Vertical

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

11.4 Radiated Emission - Electromagnetic Field (Regulation R10, Annex 7 und 8)

Test site: *Semi-anechoic chamber (Albislab)*

Distance: *1 m*

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

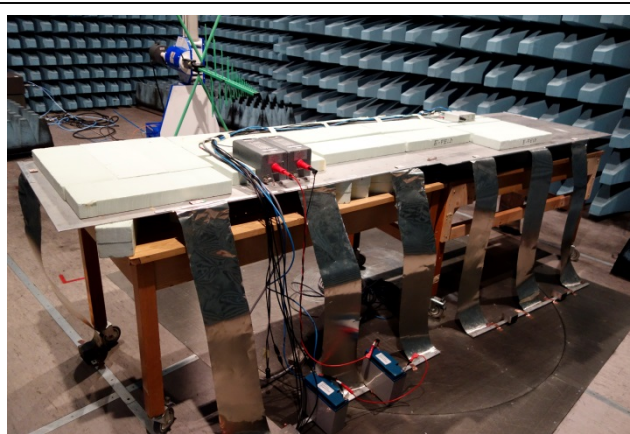
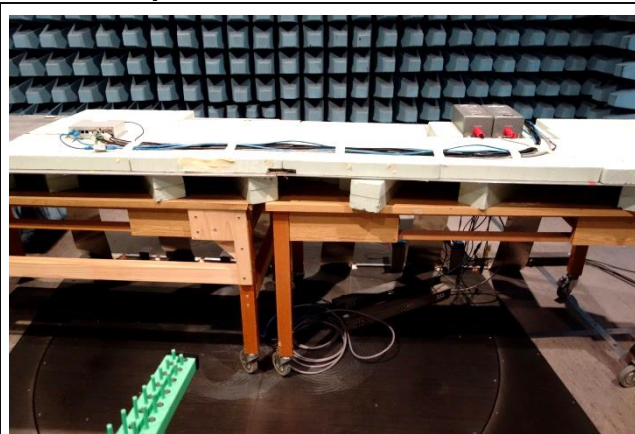
Meas. uncertainty: *see chapter 14*

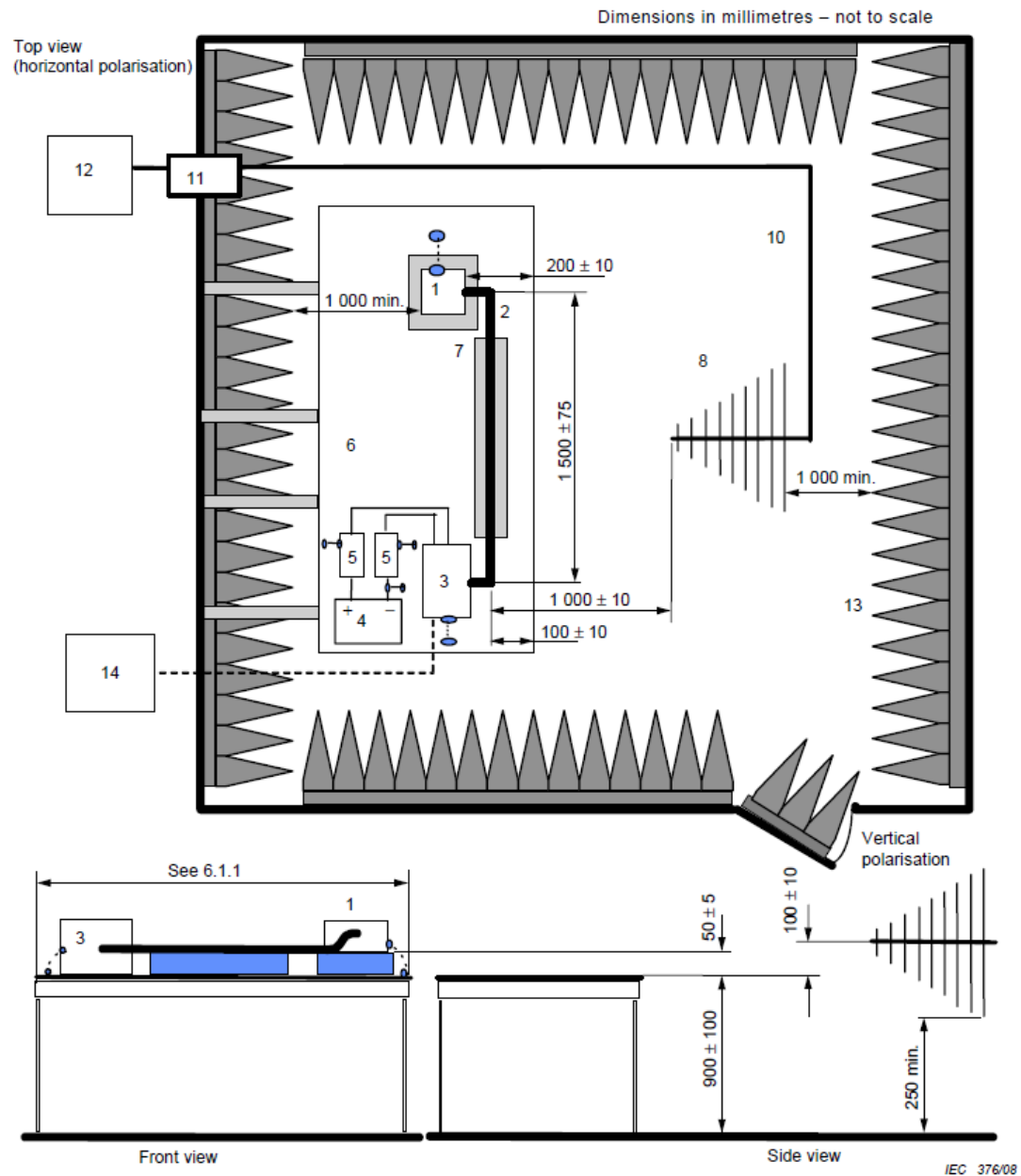
Measuring method: *A metallic sheet is placed on a wooden table and connected to the ref ground. The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyzer and a wide band antenna. The antenna is placed at 1 m distance and height, successively with horizontal and 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 on the graph. The values exceeding a limit are remeasured manually using a receiver.*

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

Test Set-up





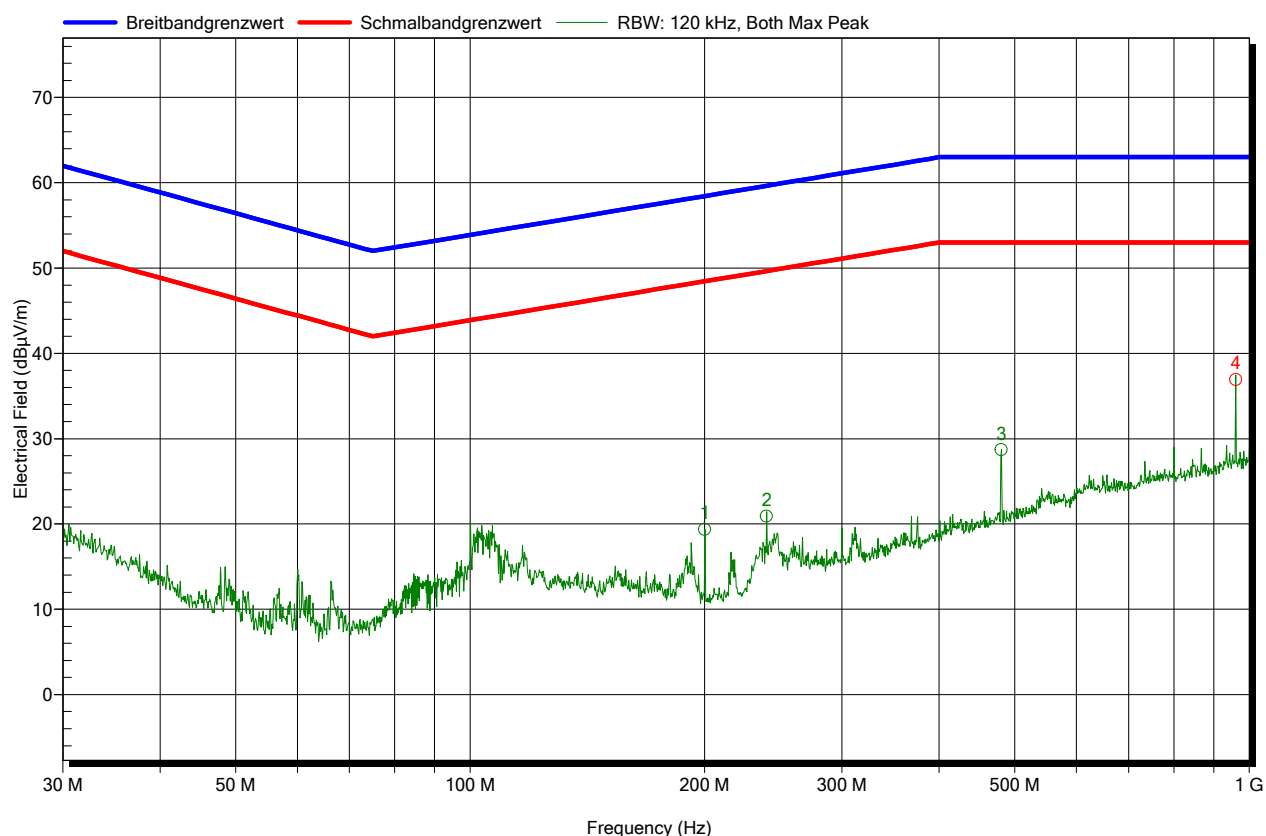
Key

- | | |
|---|---|
| 1 EUT (grounded locally if required in test plan) | 8 Log-periodic antenna |
| 2 Test harness | |
| 3 Load simulator (placement and ground connection according to 6.4.2.5) | 10 High-quality coaxial cable e.g. double-shielded (50 Ω) |
| 4 Power supply (location optional) | 11 Bulkhead connector |
| 5 Artificial network (AN) | 12 Measuring instrument |
| 6 Ground plane (bonded to shielded enclosure) | 13 RF absorber material |
| 7 Low relative permittivity support ($\epsilon_r \leq 1,4$) | 14 Stimulation and monitoring system |

Results

Measurement 1

EUT	EUT1 : NB2710 LWA-GV		
Verdict, Test	Test 43: ESU8_30M-1G KFZ05/83EG Antenne 1m 0 Grad		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4, supplied with 12 VDC		
Test date, time	21 October 2014, 09:25:13		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree (stable)	Antenna distance	1 m
Measurement settings	Radimation Version: 2014.1.7, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 30 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: Auto [0 ns]		

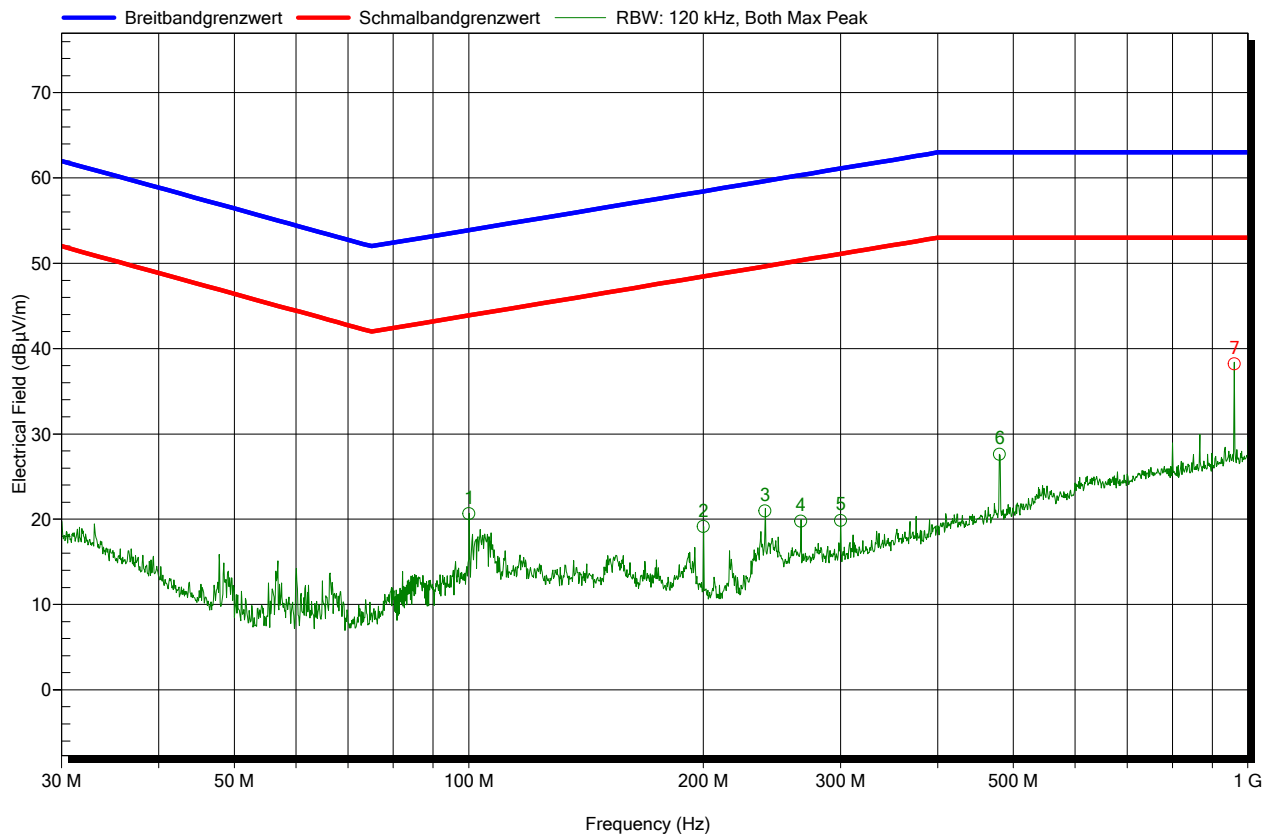


Detected peaks

Peak Number	Frequency	Peak	Angle	Height	Polarization
1	199.98 MHz	19.38 dBµV/m	0 Degree	1 m	Vertical
2	240 MHz	20.93 dBµV/m	0 Degree	1 m	Vertical
3	480.09 MHz	28.71 dBµV/m	0 Degree	1 m	Vertical
4	960.12 MHz	36.94 dBµV/m	0 Degree	1 m	Vertical

Measurement 2

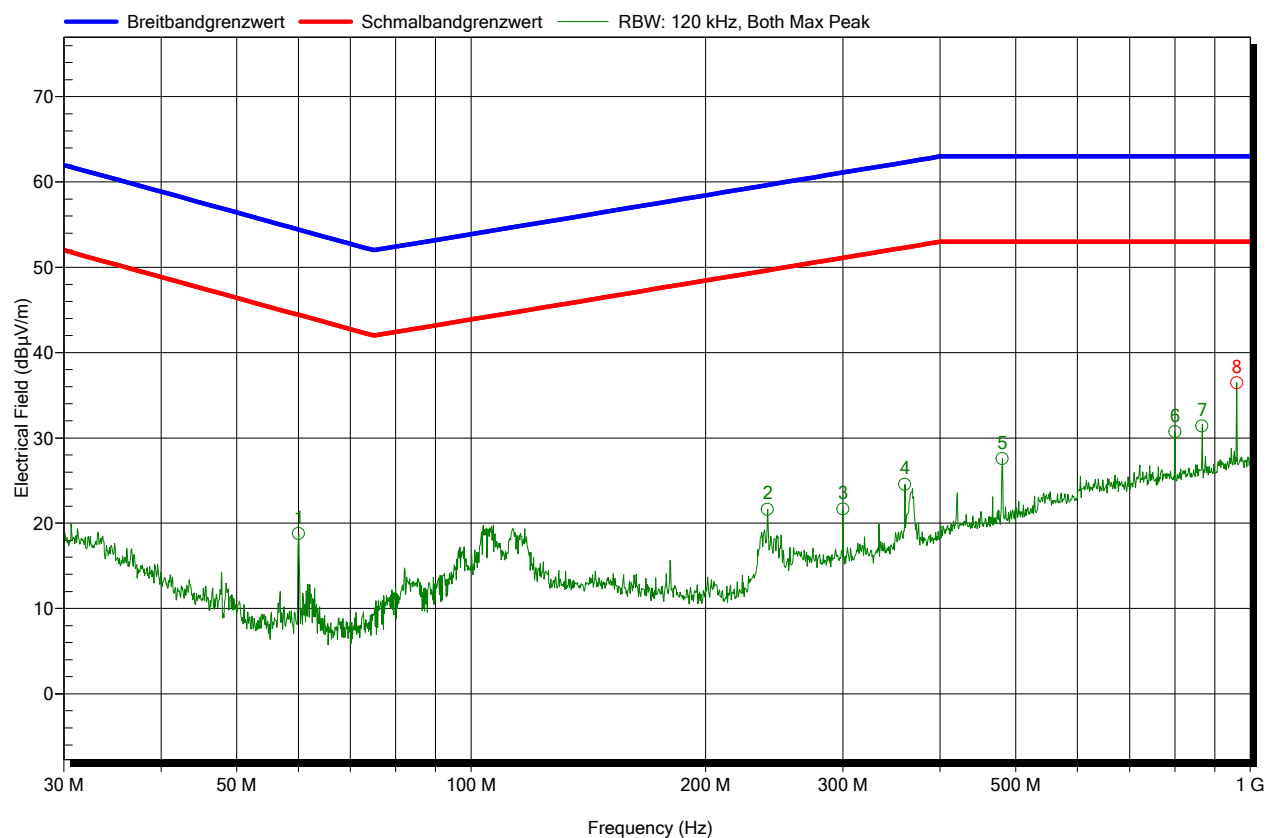
EUT	EUT1 : NB2710 LWA-GV		
Verdict, Test	Test 44: ESU8_30M-1G KFZ05/83EG Antenne 1m 0 Grad		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4, supplied with 24 VDC		
Test date, time	21 October 2014, 09:42:39		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree (stable)	Antenna distance	1 m
Measurement settings	Radimation Version: 2014.1.7, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 30 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: Auto [0 ns]		

**Detected peaks**

Peak Number	Frequency	Peak	Angle	Height	Polarization
1	99.99 MHz	20.65 dBμV/m	0 Degree	1 m	Vertical
2	199.98 MHz	19.14 dBμV/m	0 Degree	1 m	Vertical
3	240 MHz	20.97 dBμV/m	0 Degree	1 m	Vertical
4	266.67 MHz	19.78 dBμV/m	0 Degree	1 m	Vertical
5	300 MHz	19.87 dBμV/m	0 Degree	1 m	Vertical
6	479.76 MHz	27.61 dBμV/m	0 Degree	1 m	Vertical
7	960.15 MHz	38.19 dBμV/m	0 Degree	1 m	Vertical

Measurement 3

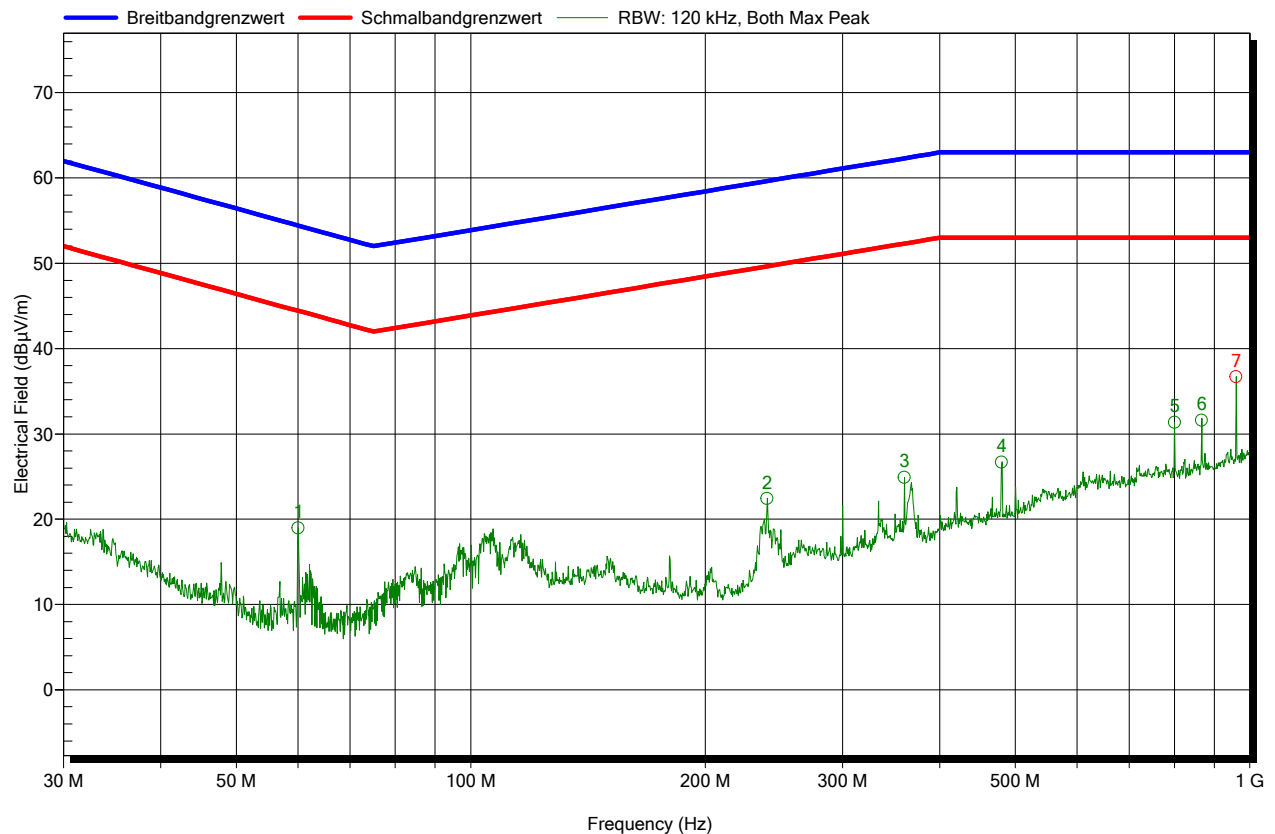
EUT	EUT2 : NB2710 UWC-G		
Verdict, Test	Test 46: ESU8_30M-1G KFZ05/83EG Antenne 1m 0 Grad		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4, supplied with 12 VDC		
Test date, time	21 October 2014, 10:01:50		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree (stable)	Antenna distance	1 m
Measurement settings	Radimation Version: 2014.1.7, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 30 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: Auto [0 ns]		

**Detected peaks**

Peak Number	Frequency	Peak	Angle	Height	Polarization
1	60 MHz	18.8 dBμV/m	0 Degree	1 m	Vertical
2	240 MHz	21.63 dBμV/m	0 Degree	1 m	Horizontal
3	300 MHz	21.66 dBμV/m	0 Degree	1 m	Horizontal
4	360 MHz	24.55 dBμV/m	0 Degree	1 m	Vertical
5	480.09 MHz	27.55 dBμV/m	0 Degree	1 m	Horizontal
6	799.98 MHz	30.74 dBμV/m	0 Degree	1 m	Vertical
7	866.67 MHz	31.42 dBμV/m	0 Degree	1 m	Vertical
8	960.21 MHz	36.47 dBμV/m	0 Degree	1 m	Horizontal

Measurement 4

EUT	EUT2 : NB2710 UWC-G		
Verdict, Test	Test 45: ESU8_30M-1G KFZ05/83EG Antenne 1m 0 Grad		
Modification	None		
Cables, Notes	All cables, see chapter 10.3		
Mode of operation	Normal mode, see chapter 10.3 and 10.4, supplied with 24 VDC		
Test date, time	21 October 2014, 09:56:28		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree (stable)	Antenna distance	1 m
Measurement settings	Radimation Version: 2014.1.7, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: Auto [120 ms], Step freq: Linear: 30 kHz steps, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: Auto [0 ns]		

**Detected peaks**

Peak Number	Frequency	Peak	Angle	Height	Polarization
1	60 MHz	18.99 dBμV/m	0 Degree	1 m	Vertical
2	240 MHz	22.42 dBμV/m	0 Degree	1 m	Horizontal
3	360 MHz	24.91 dBμV/m	0 Degree	1 m	Vertical
4	480.06 MHz	26.71 dBμV/m	0 Degree	1 m	Horizontal
5	799.98 MHz	31.38 dBμV/m	0 Degree	1 m	Vertical
6	866.64 MHz	31.6 dBμV/m	0 Degree	1 m	Vertical
7	959.52 MHz	36.69 dBμV/m	0 Degree	1 m	Horizontal

12. Immunity Tests

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

- Introduction:

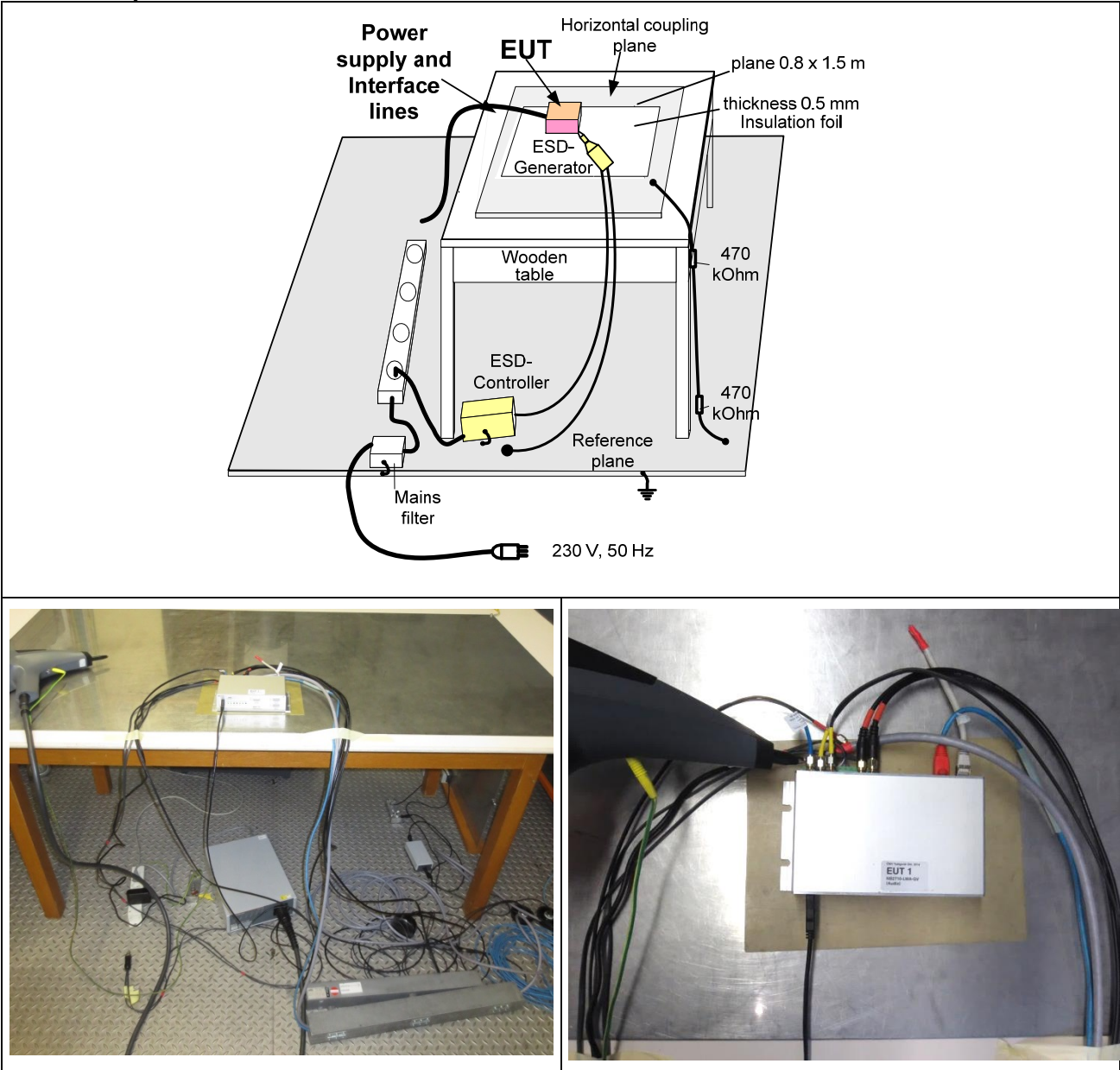
The aim of this test is to determine the reaction of the material to electrostatic discharges (ESD) produced for example by walking on a carpet made of synthetic fibre. The humidity of the air has an influence on the discharge time and therefore on the severity of the discharge that could appear.
- Coupling:

150 pF / 330 Ohm
- Meas. uncertainty:

see chapter 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 Set-up



Test Equipment

Device Type	Brand	Type	ID
ESD Generator	EM-Test	ESD N30	PE10238

Test Protocol

Equipment: *NB2700 and NB2710*
 Cables connected: *All cables, chapter 10.3*
 Operating mode: *Active mode, see chapter 10.4 (supplied with 12 VDC)*
 Observation of EUT: *Visually, see chapter 10.5*
 Modifications: *see chapter 13*
 Test site: *Laboratory (Albislab)*
 Test set-up: *table-top equipment*

Requirements



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

Test Results EUT 1

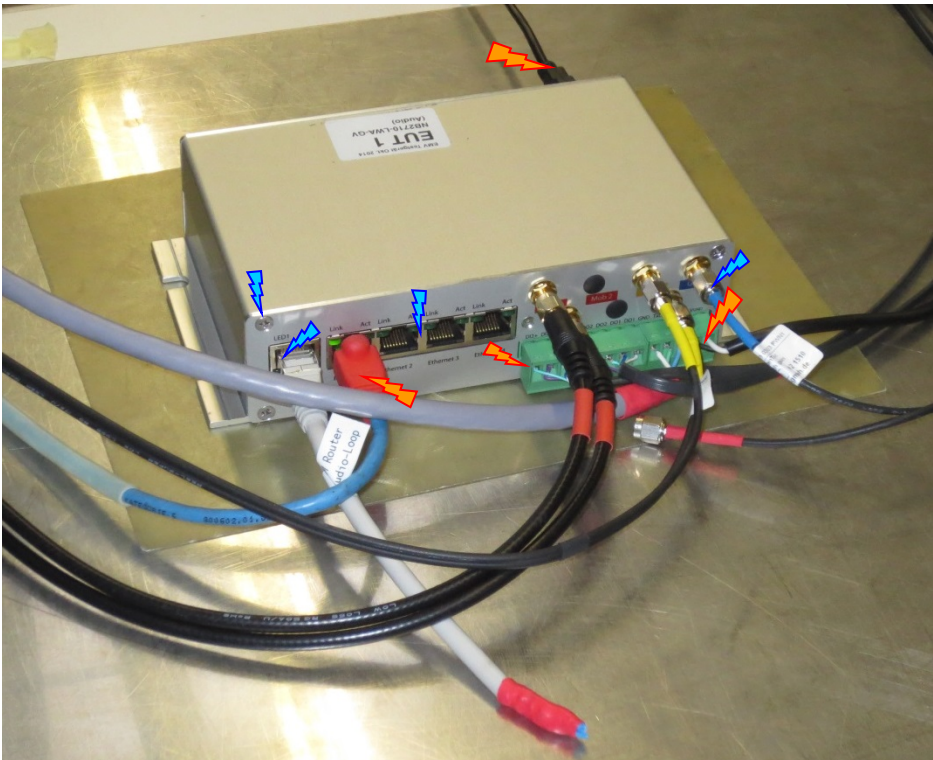
Indirect discharges:

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: Screws, connectors, LED's





Test Results EUT 2

Indirect discharges:

Level	No of discharges (for each level)	Indirect discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
$\pm 2 \text{ kV}$	10	HCP	No errors occurred	A	Pass
$\pm 4 \text{ kV}$	10	HCP	No errors occurred	A	Pass
$\pm 6 \text{ kV}$	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. 			
$\pm 2 \text{ kV}$	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors occurred	A	Pass
$\pm 4 \text{ kV}$	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors occurred	A	Pass
$\pm 6 \text{ kV}$	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors occurred	A	Pass
$\pm 2 \text{ kV}$	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
$\pm 4 \text{ kV}$	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
$\pm 8 \text{ kV}$	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred	A	Pass
Tested points: Screws, connectors, LED's (same as EUT 1)						

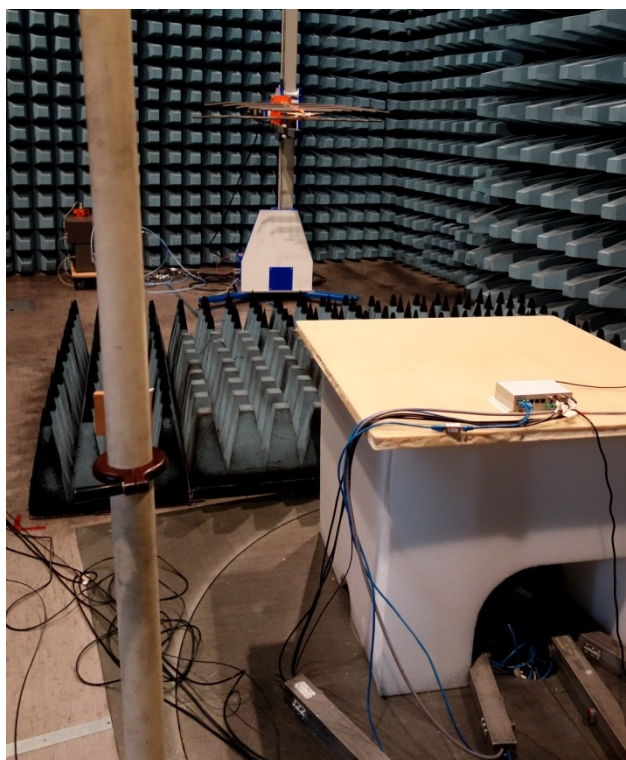
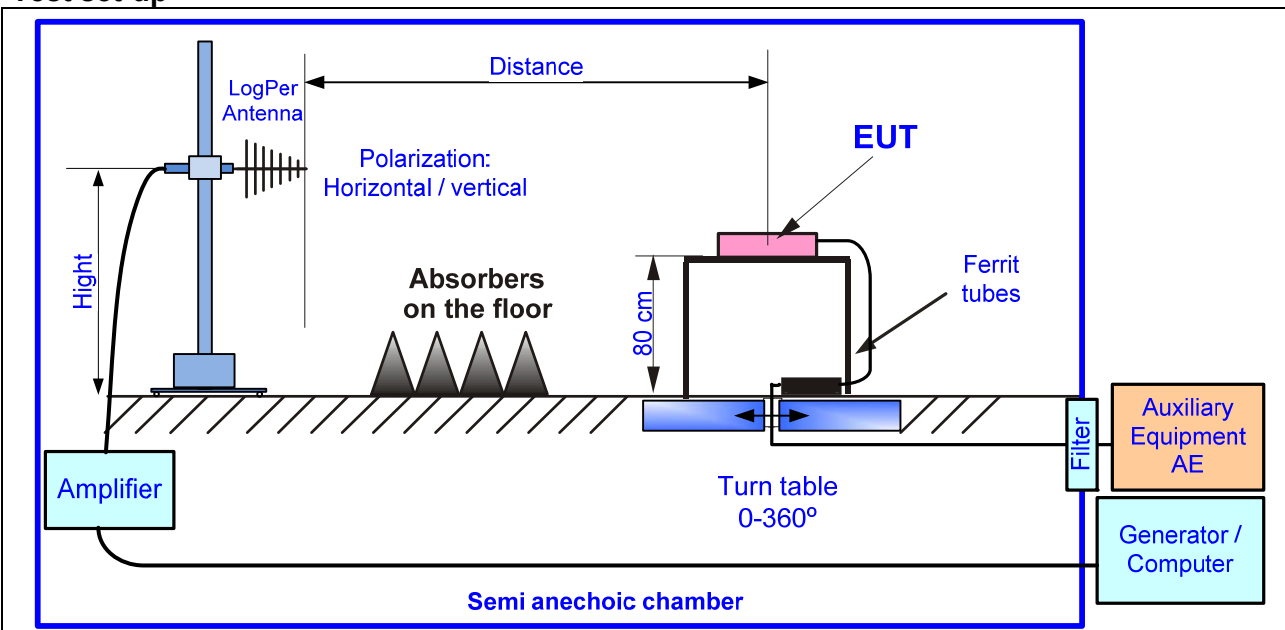
12.2 Immunity to Electromagnetic Fields (EN 61000-4-3)

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 set-up



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:	NB2700 and NB2710
Cables connected:	All cables, chapter 10.3
Operating mode:	Active mode, see chapter 10.4 (supplied with 12 VDC)
Observation of EUT:	Visually, see chapter 10.5
Modifications:	see chapter 13
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.:
EN 55024 : 2010	80 – 1000 MHz	3 V/m	3.0 m	AM, 1 kHz, 80%	1 %	1 s	A
EN 61000-6-2 : 2005	80 – 1000 MHz	10 V/m	3.0 m	AM, 1 kHz, 80%	1 %	1 s	A
	1400 – 2000 MHz	3 V/m	3.0 m	AM, 1 kHz, 80%			A
	2000 – 2700 MHz	1 V/m	3.0 m	AM, 1 kHz, 80%			A
ETSI EN 301 489-1	80 – 1000 MHz	3 V/m	3.0 m	AM, 1 kHz, 80%	1 %	1 s	A
	1400 – 2700 MHz	3 V/m	3.0 m	AM, 1 kHz, 80%			A

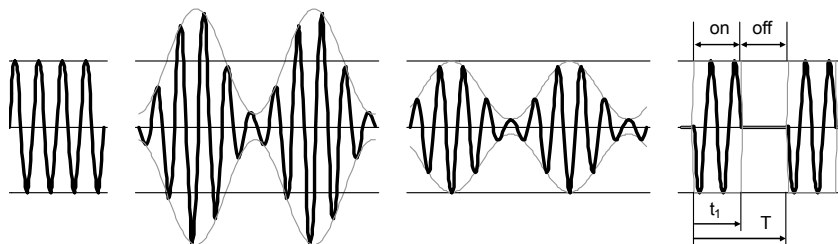
Modulation:

☐ CW

☒ AM (normal)

☐ AM (const. peak)

☐ PM



Test Results EUT 1

Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	20	Horizontal	Front 0°	No errors occurred	A	Pass
80 – 1000	20	Horizontal	90°	No errors occurred	A	Pass
80 – 1000	20	Horizontal	180°	No errors occurred	A	Pass
80 – 1000	20	Horizontal	270°	No errors occurred	A	Pass
80 – 1000	20	Vertical	Front 0°	No errors occurred	A	Pass
80 – 1000	20	Vertical	90°	No errors occurred	A	Pass
80 – 1000	20	Vertical	180°	No errors occurred	A	Pass
80 – 1000	20	Vertical	270°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	Front 0°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	90°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	180°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	270°	No errors occurred	A	Pass
1000 – 3000	10	Vertical	Front 0°	No errors occurred	A	Pass
1000 – 3000	10	Vertical	90°	No errors occurred	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)

Test Results EUT 2

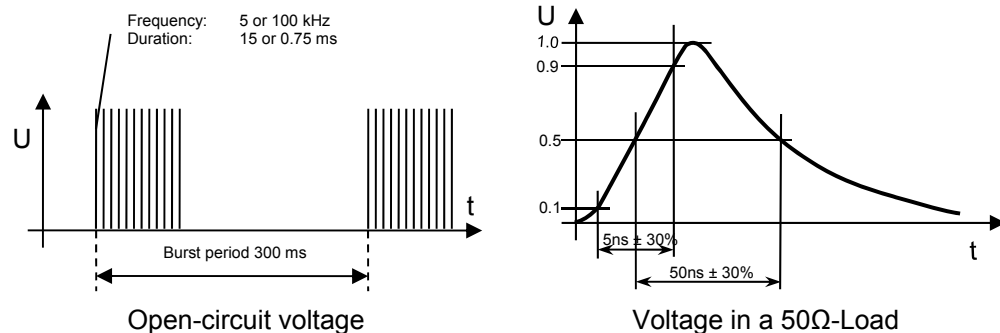
Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	20	Horizontal	Front 0°	No errors occurred	A	Pass
80 – 1000	20	Horizontal	90°	No errors occurred	A	Pass
80 – 1000	20	Horizontal	180°	No errors occurred	A	Pass
80 – 1000	20	Horizontal	270°	No errors occurred	A	Pass
80 – 1000	20	Vertical	Front 0°	No errors occurred	A	Pass
80 – 1000	20	Vertical	90°	No errors occurred	A	Pass
80 – 1000	20	Vertical	180°	No errors occurred	A	Pass
80 – 1000	20	Vertical	270°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	Front 0°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	90°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	180°	No errors occurred	A	Pass
1000 – 3000	10	Horizontal	270°	No errors occurred	A	Pass
1000 – 3000	10	Vertical	Front 0°	No errors occurred	A	Pass
1000 – 3000	10	Vertical	90°	No errors occurred	A	Pass
1000 – 3000	10	Vertical	180°	No errors occurred	A	Pass
1000 – 3000	10	Vertical	270°	No errors occurred	A	Pass

12.3 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:



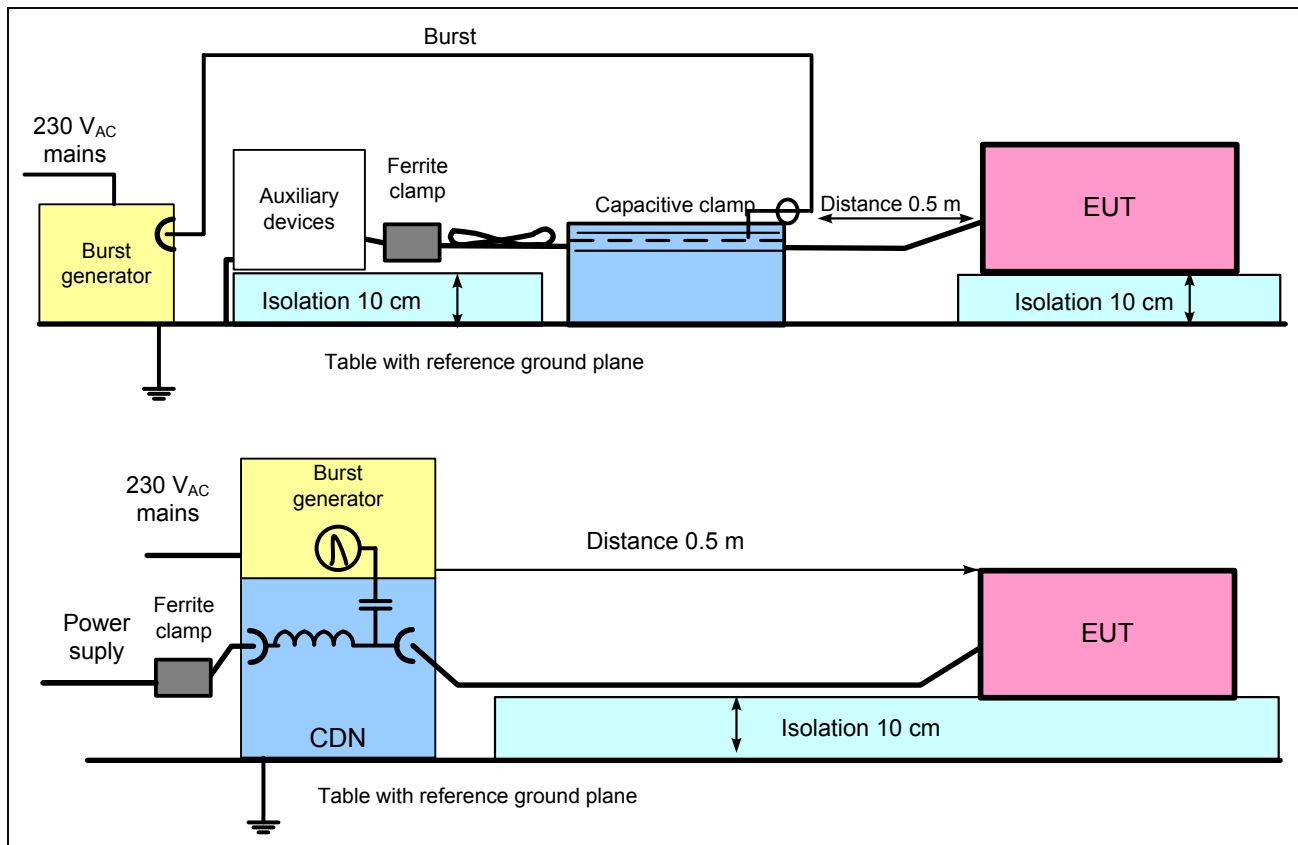
Meas. uncertainty:

See chapter 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.

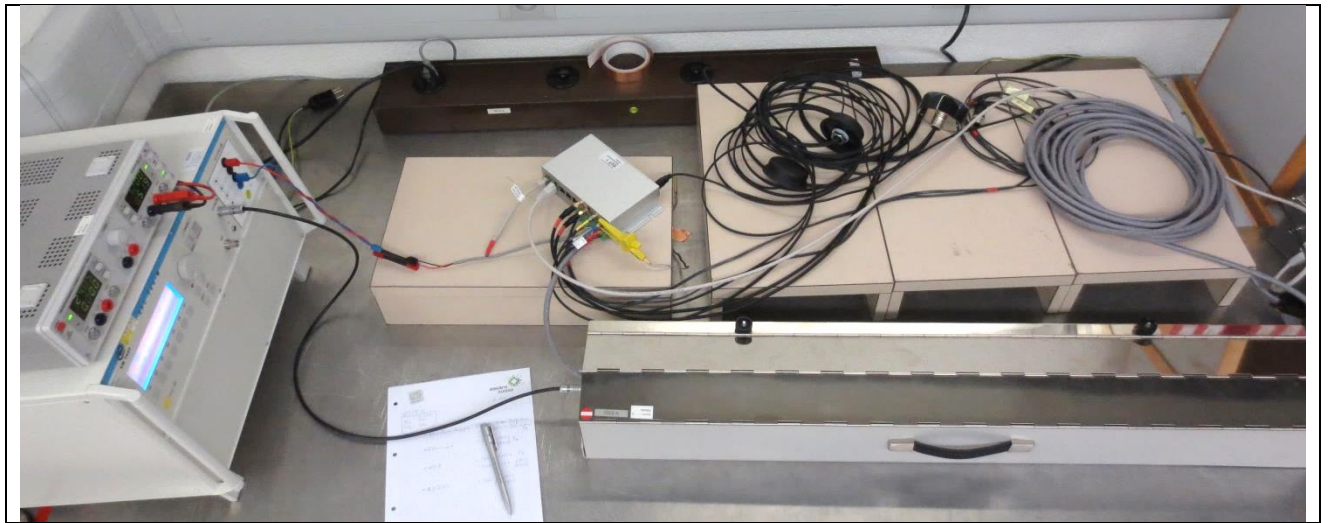
Test set-up



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: NB2700 and NB2710
 Cables connected: All cables, chapter 10.3
 Operating mode: Active mode, see chapter 10.4 (supplied with 12 VDC)
 Observation of EUT: Visually, see chapter 10.5
 Modifications: see chapter 13
 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 EUT 1

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	±2 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 1	A	Pass
	±2 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 1	A	Pass
USB	±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
Digital I/O	±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
Antennae cables	±2 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 1, 2	A	Pass
	±2 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 1, 2	A	Pass
Audio	±2 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 1	A	Pass
	±2 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 1	A	Pass

Notes:

- 1) Ports overtested with 2 kV
- 2) All antennae cables tested together

Test Results EUT 2

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	± 2 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
	± 2 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
USB	± 1 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
RS232	± 1 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
Digital I/O	± 1 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
	± 1 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
Antennae cables	± 2 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
	± 2 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not tested, Note 2	A	Not tested
CAN	± 2 kV	15 ms	5 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 1	A	Pass
	± 2 kV	1 ms	100 kHz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors occurred, Note 1	A	Pass

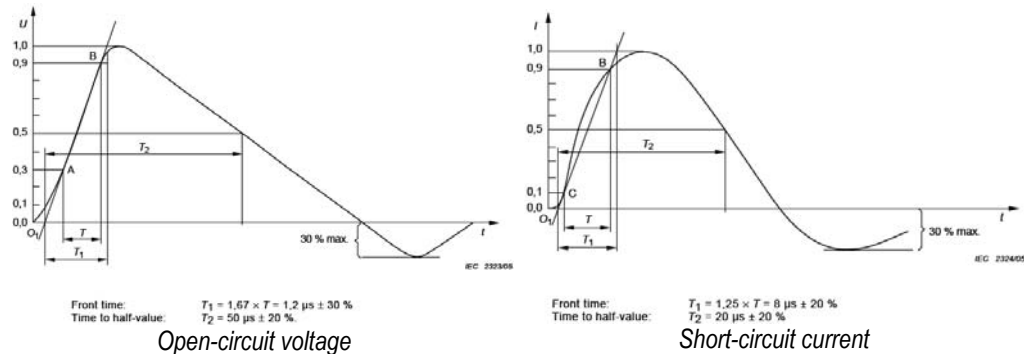
Notes:

- 1) port overtested with 2 kV
- 2) Not tested with EUT 2, identical port tested with EUT 1

12.4 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.

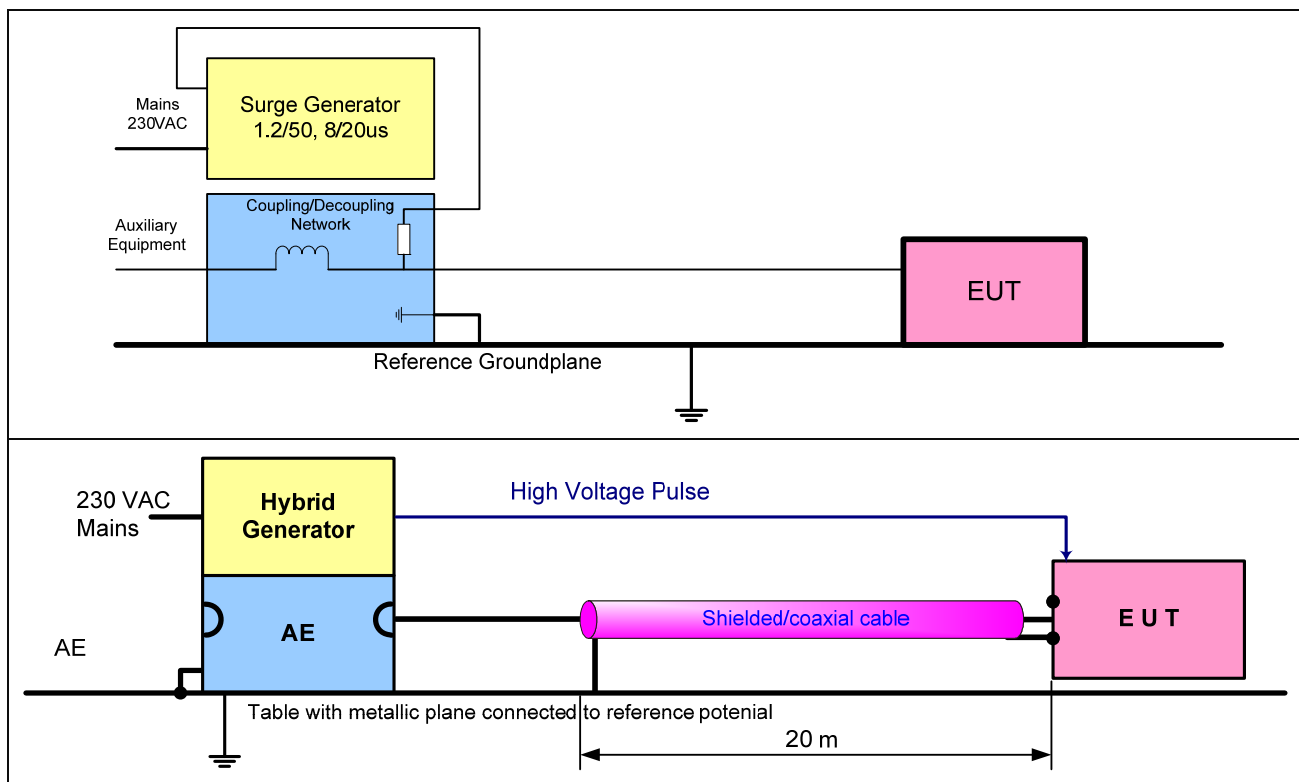
Impulses:

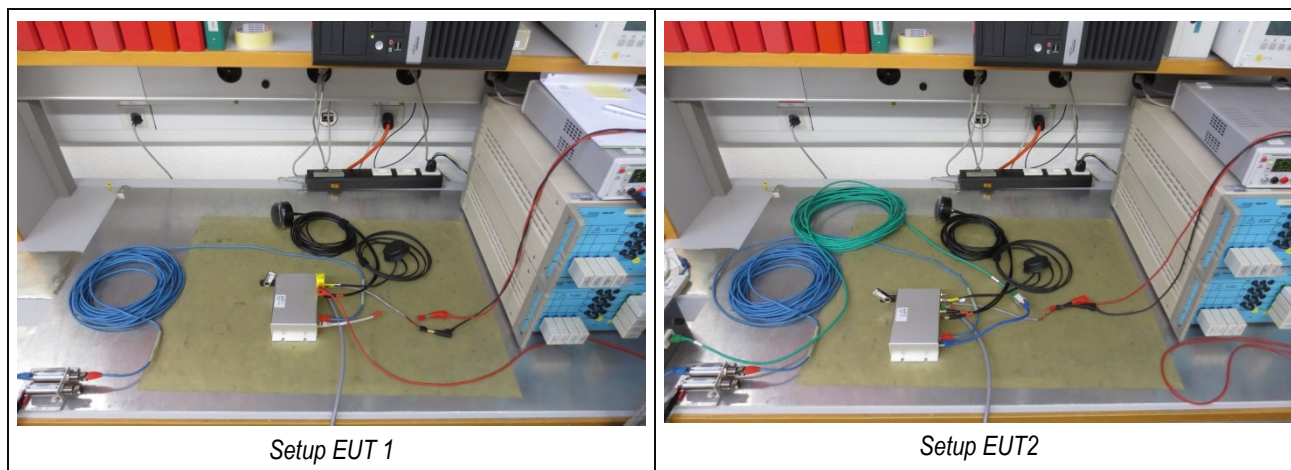


Meas. uncertainty: See chapter 14

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 set-up





Test Equipment

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

Test Protocol

Equipment:	NB2700 and NB2710
Cables connected:	All cables, chapter 10.3
Operating mode:	Active mode, see chapter 10.4 (supplied with 12 VDC)
Observation of EUT:	Visually, see chapter 10.5
Modifications:	see chapter 13
Test site:	Laboratory (Albislab)

Requirements

Standard :	Required level AC-supply:		Required level DC-supply:		Required level Signal:		Perf. crit.:
	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⁾	± 1 kV ¹⁾	± 1 kV ¹⁾	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 EUT 1

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

Test Results EUT 2

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

12.5 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.

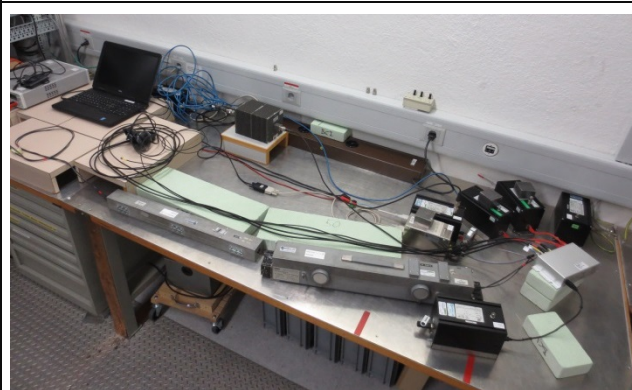
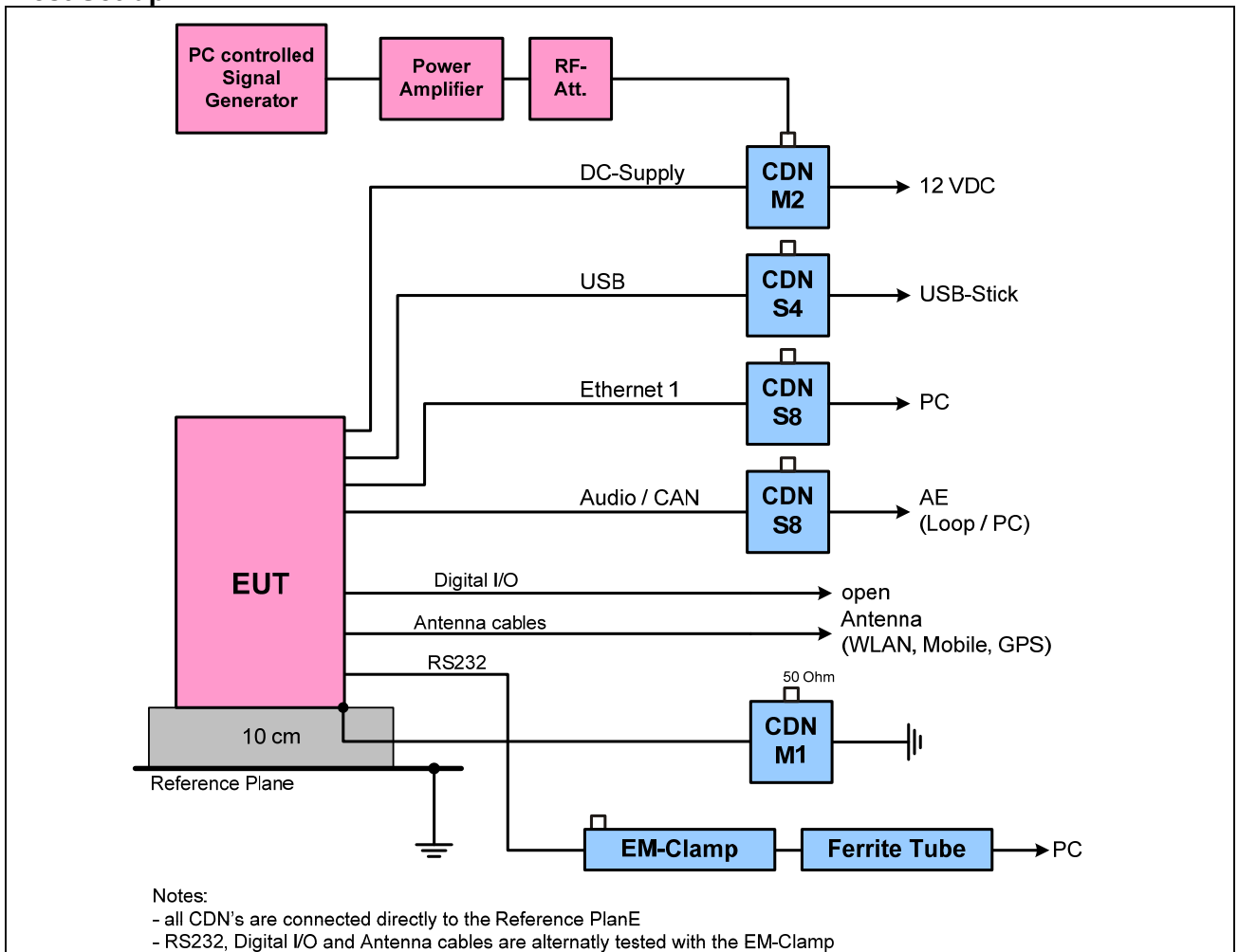
Meas. uncertainty:

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 Set-up



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 13.6632.08
Decoupling device	EM-Test	EM 100 FTC101	H4844 H6979

Test Protocol

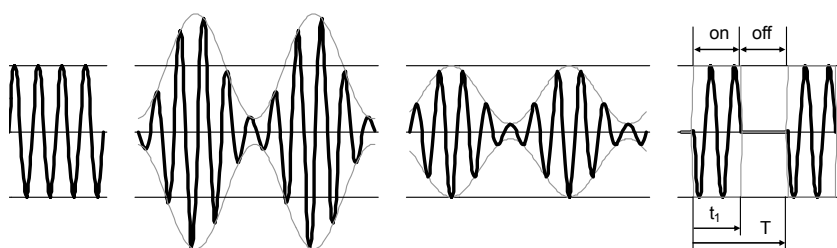
Equipment:	NB2710-LWA-GV (EUT 1) & NB2710-UWC-G (EUT 2)
Cables connected:	All cables, chapter 10.3
Operating mode:	see chapter 10.3 (supplied with 12 VDC)
Observation of EUT:	see chapter 10.5
Modifications:	see chapter 13
Test site:	Laboratory (Albislab)

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 EUT 1

Coupling	CDN	Terminated (50 Ω)	CDN	Frequency [MHz]	Level [V]	Fulfilled criterion	Verdict
DC Supply	M2	Audio	S8	0.15 – 80	12	A	Pass (Note 1)
Ethernet 1	S8	DC Supply	M2	0.15 – 80	12	A	Pass (Note 1)
Audio	S8	Enclosure	M1	0.15 – 80	12	A	Pass (Note 1)
Digital I/O	EM100	USB	S4	0.15 – 80	12	A	Pass (Note 1)
USB	S4	DC Supply	M2	0.15 – 80	12	A	Pass (Note 1)
RS232	EM100	Audio	S8	0.15 – 80	12	A	Pass (Note 1)
Antennae cables	EM100	DC Supply	M2	0.15 – 80	12	A	Pass (Note 1, 2)
Enclosure	M1	USB	S4	0.15 – 80	12	A	Pass (Note 1)

Test Results EUT 2

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

Notes:

- 1) All ports overtested with 12 V
- 2) All antennae cables tested together
- 3) Not tested with EUT 2, identical port tested with EUT 1

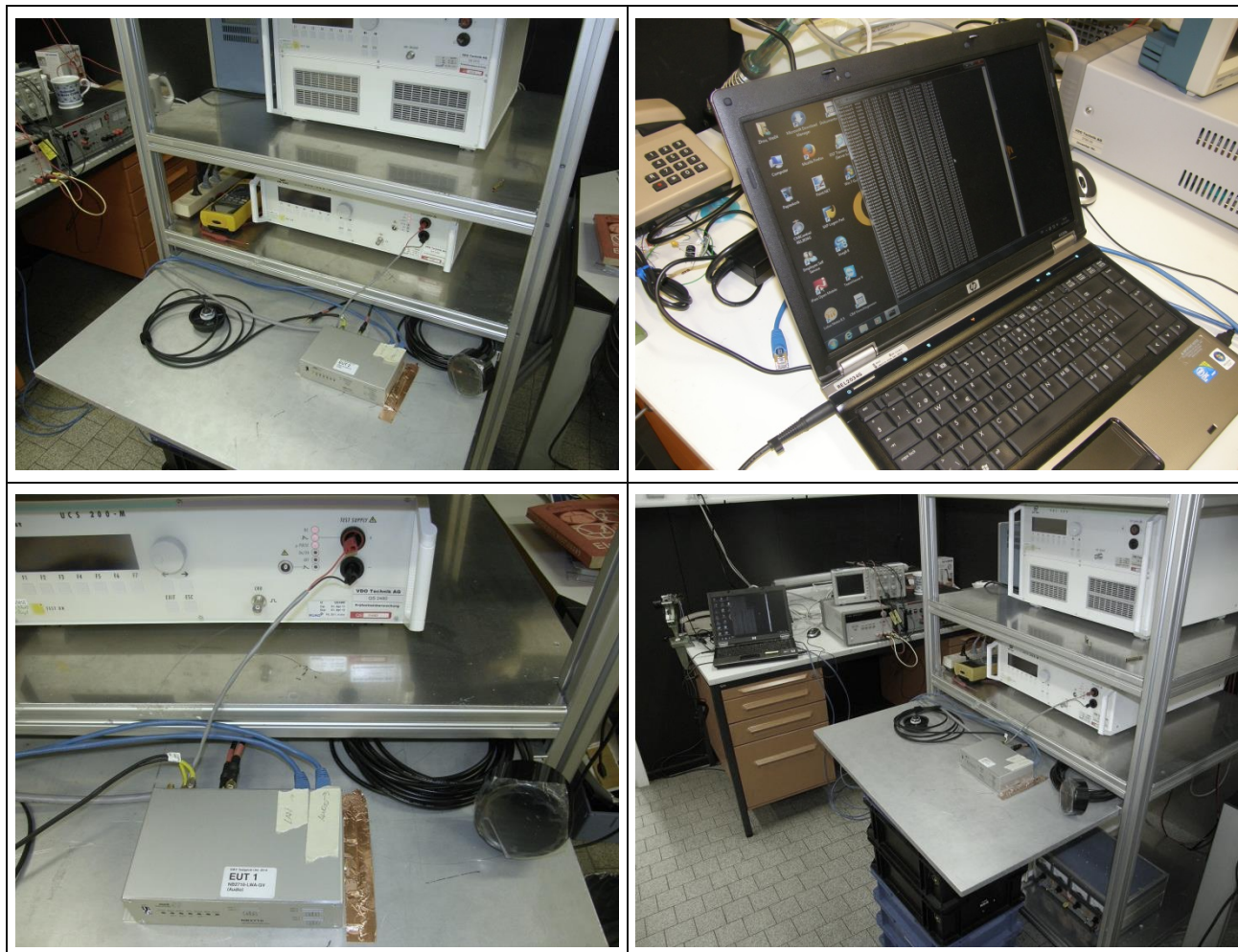
12.6 Immunity Pulse 1 (Automotive – ISO 7637-2)

Introduction: *The immunity against pulse 1 simulates the overvoltages generated by switching off inductive loads.*

Meas. uncertainty: *+/- 10 %*

Test method: *The generator is set in no load mode (polarity, times and amplitude). After this, the output of the generator is connected to the supply terminals of the EUT or to the coupling clamp and the pulses are coupled on the EUT.*

Test set-up



Test Equipment

Equipment	Manufacturer	Type	Serial Nr.	Inv-Nr.
Load Dump Generator	EM-Test	LD200	06100107	QS2481
Transient Generator	EM-Test	UCS200-M	06100108	QS2480
Voltage Drop Generator	EM-Test	VDS200	06100109	QS2479
Oscilloscope	Tektronix	TDS350	B010167	QS2453
Oscilloscope	Tektronix	TDS2012B	C040208	QS2546
Test Software	EM-Test		000029	

Test Protocol

Equipment:	NB2710-LWA-GV (EUT 1) & NB2710-UWC-G (EUT 2)
Cables connected:	All cables, chapter 10.3
Operating mode:	see chapter 10.3 (EUT1 supplied with 12 VDC, EUT2 supplied with 24 VDC)
Observation of EUT:	see chapter 10.5
Modifications:	see chapter 13
Test site:	Continental Automotive Switzerland AG, 9464 Rüthi

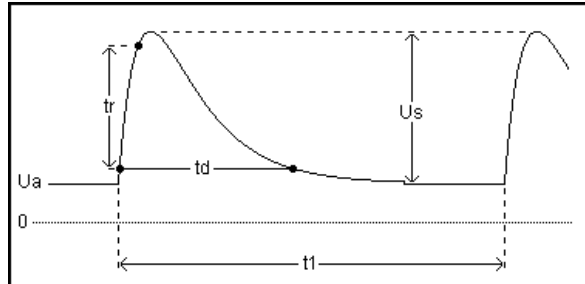
Requirements

Test level 12 V system (U _s)	Test level 24 V system (U _s)	Min. number of test pulses	Pulse repetition time		Compliance criteria
			min	max.	
-75 V	-450	5000 pulses	0.5 s	5 s	Immunity-related functions: Class B Not immunity-related functions: Class D

Test Results EUT 1

Settings					
Pulse form:	ISO 7637-2 : 2011 : Pulse 1				
Test generator:	UCS200M		Software-Nr.:	000029	
			Serial:	06100108	
U _a (Alternator):	13.5	V	Current limiting:	15	A

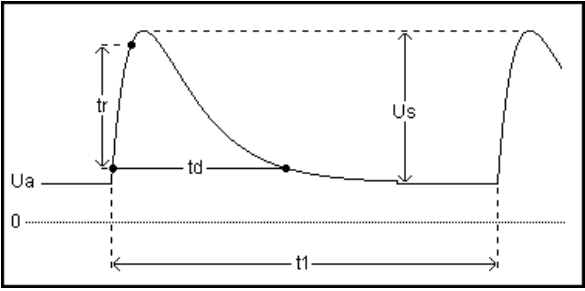
Pulse parameters			
U _s :	-75	V	
t ₁ :	1.0	s	
t ₂ :	200	ms	
t _r :	1	us	
t _d :	2000	us	
Coupling:	Battery		
Number of events:	5000		
Test duration:	01:23:20	h	



Test result	
Number of pulses:	5000
Requirement:	Criteria D
Test result:	The EUT shuts down, ethernet communication lost, after the test restart without any operation, communication over ethernet already o.k., EUT conforms to the compliance criteria C & D

Test Results EUT 2

Settings				
Pulse form:	ISO 7637-2 : 2011 : Pulse 1			
Test generator:	UCS200M		Software-Nr.:	000029
			Serial:	06100108
Ua (Alternator):	27.0	V	Current limiting:	15 A

Pulse parameters				
Us:	- 450	V		
t1:	1.0	s		
t2:	200	ms		
tr:	3	us		
td:	1000	us		
Coupling:	Battery			
Number of events:	5000			
Test duration:	01:23:20	h		

Test result	
Number of pulses:	5000
Requirement:	Criteria D
Test result:	The EUT shuts down, Ethernet communication lost, after the test restart without any operation, communication over Ethernet already o.k., EUT conforms to the compliance criteria C & D

12.7 Immunity Pulse 2a (Automotive – ISO 7637-2)

Introduction:	<i>This pulse simulates transients due to sudden interruption of currents in a device connected in parallel with the wiring harness.</i>
Meas. uncertainty:	<i>+/- 10 %</i>
Test method:	<i>The generator is set in no load mode (polarity, times and amplitude). After this, the output of the generator is connected to the supply terminals of the EUT or to the coupling clamp and the pulses are coupled on the EUT.</i>

Test Set-up

see Pulse 1

Test Equipment

Equipment	Manufacturer	Type	Serial Nr.	Inv-Nr.
Load Dump Generator	EM-Test	LD200	06100107	QS2481
Transient Generator	EM-Test	UCS200-M	06100108	QS2480
Voltage Drop Generator	EM-Test	VDS200	06100109	QS2479
Oscilloscope	Tektronix	TDS350	B010167	QS2453
Oscilloscope	Tektronix	TDS2012B	C040208	QS2546
Test Software	EM-Test		000029	

Test Protocol

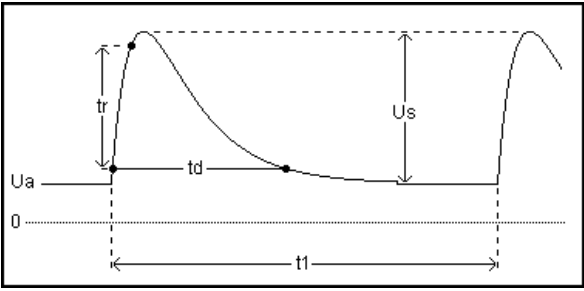
Equipment:	<i>NB2710-LWA-GV (EUT 1) & NB2710-UWC-G (EUT 2)</i>
Cables connected:	<i>All cables, chapter 10.3</i>
Operating mode:	<i>see chapter 10.3 (EUT1 supplied with 12 VDC, EUT2 supplied with 24 VDC)</i>
Observation of EUT:	<i>see chapter 10.5</i>
Modifications:	<i>see chapter 13</i>
Test site:	<i>Continental Automotive Switzerland AG, 9464 Rüthi</i>

Requirements

Test level 12 V System (U _s)	Test level 24 V System (U _s)	Min. number of test pulses	Pulse repetition time		Compliance criteria
			min	max.	
+37 V	+37	5000 pulses	0.2 s	5 s	Immunity-related functions: Class B Not immunity-related functions: Class D

Test Results EUT 1

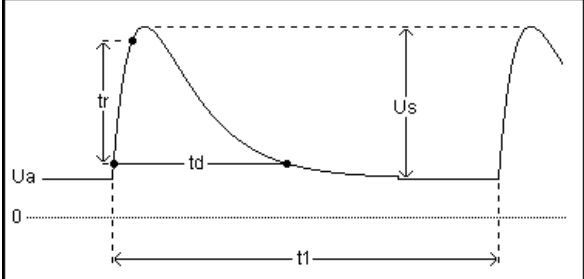
Settings				
Pulse form:	ISO 7637-2 : 2004 : Pulse 2a			
Test generator	UCS200M		Software-Nr.:	000029
			Serial:	06100108
Ua (Alternator):	13.5	V	Current limiting:	15 A

Pulse parameters				
Us:	+37	V		
t1:	0.5	s		
tr:	1	us		
td:	50	us		
Ri:	2	Ohm		
Coupling:	Battery			
Number of events:	5000			
Test duration:	00:41:40	h		

Test result	
Number of pulses:	5000
Requirement:	Criteria D
Test result:	No degradation noticed, EUT conforms to the compliance criteria A & D

Test Results EUT 2

Settings				
Pulse form:	ISO 7637-2 : 2004 : Pulse 2a			
Test generator:	UCS200M		Software-Nr.:	000029
			Serial:	06100108
Ua (Alternator):	27.0	V	Current limiting:	15 A

Pulse parameters				
Us:	+37	V		
t1:	0.2	s		
tr:	1	us		
td:	50	us		
Ri:	2	Ohm		
Coupling:	Battery			
Number of events:	5000			
Test duration:	00:16:40	h		

Test result	
Number of pulses:	5000
Requirement:	Criteria D
Test result:	No degradation noticed, EUT conforms to the compliance criteria A & D

12.8 Immunity Pulse 2b (Automotive – ISO 7637-2)

Introduction: *This pulse simulates transients due to sudden interruption of currents in a device connected in parallel with the wiring harness.*

Meas. uncertainty: *+/- 10 %*

Test method: *The generator is set in no load mode (polarity, times and amplitude). After this, the output of the generator is connected to the supply terminals of the EUT or to the coupling clamp and the pulses are coupled on the EUT.*

Test Set-up

see Pulse 1

Test Equipment

Equipment	Manufacturer	Type	Serial Nr.	Inv-Nr.
Load Dump Generator	EM-Test	LD200	06100107	QS2481
Transient Generator	EM-Test	UCS200-M	06100108	QS2480
Voltage Drop Generator	EM-Test	VDS200	06100109	QS2479
Oscilloscope	Tektronix	TDS350	B010167	QS2453
Oscilloscope	Tektronix	TDS2012B	C040208	QS2546
Test Software	EM-Test		000029	

Test Protocol

Equipment: *NB2710-LWA-GV (EUT 1) & NB2710-UWC-G (EUT 2)*

Cables connected: *All cables, chapter 10.3*

Operating mode: *see chapter 10.3 (EUT1 supplied with 12 VDC, EUT2 supplied with 24 VDC)*

Observation of EUT: *see chapter 10.5*

Modifications: *see chapter 13*

Test site: *Continental Automotive Switzerland AG, 9464 Rüthi*

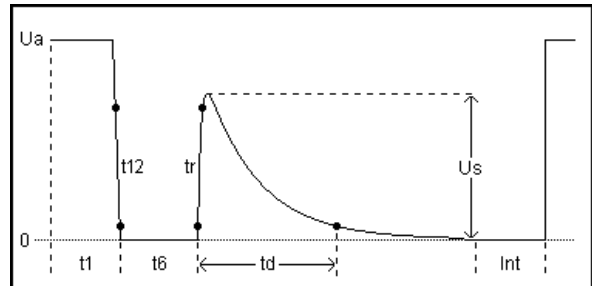
Requirements

Test level 12 V System (U _s)	Test level 24 V System (U _s)	Min. number of test pulses	Pulse repetition time		Compliance criteria
			min	max.	
+10 V	+20 V	10 pulses	0.5 s	5 s	Immunity-related functions: Class C Not immunity-related functions: Class D

Test Results EUT 1

Settings				
Pulse form:	ISO 7637-2 : 2004 : Pulse 2b			
Test generator	VDS200B	Software-Nr.:		000374
		Serial:		06100109
Ua (Alternator):	13.5	V	Current limiting:	15 A

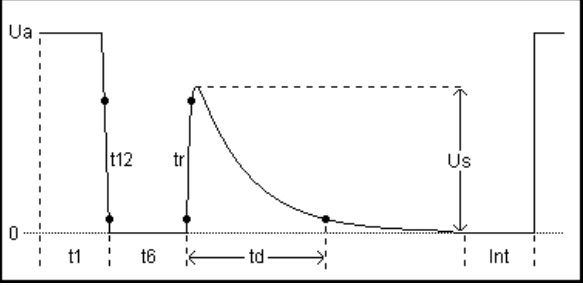
Pulse parameters		
Us:	10.0	V
t1:	1.0	s
t6:	1	ms
td:	200	ms
Int:	1.0	s
Ri:	0.05	Ohm
t12:	1	ms
tr:	1	ms
Number of events:	10	
Test duration:	00:00:28	h



Test result	
Number of pulses:	10
Requirement:	Criteria D
Test result:	The EUT shuts down, ethernet communication lost, after the test restart without any operation, communication over ethernet already o.k., EUT conforms to the compliance criteria C & D

Test Results EUT 2

Settings				
Pulse form:	ISO 7637-2 : 2004 : Pulse 2b			
Test generator:	VDS200B		Software-Nr.:	000374
			Serial:	06100109
Ua (Alternator):	27.0	V	Current limiting:	15 A

Pulse parameters				
Us:	20.0	V		
t1:	5	s		
t6:	1	ms		
td:	200	ms		
Int:	1	s		
Ri:	0.00	Ohm		
t12:	1	ms		
tr:	1	ms		
Number of events:	10			
Test duration:	00:01:08	h		

Test result	
Number of pulses:	10
Requirement:	Criteria D
Test result:	The EUT shuts down, ethernet communication lost, after the test restart without any operation, communication over ethernet already o.k., EUT conforms to the compliance criteria C & D

12.9 Immunity Pulse 3a (Automotive – ISO 7637-2)

Introduction:	<i>This test pulses is a simulation of transients which occur as a result of the switching processes. The characteristics of these transients are influenced by distributed capacitance and inductance of the wiring harness.</i>
Meas. uncertainty:	<i>+/- 10 %</i>
Test method:	<i>The generator is set in no load mode (polarity, times and amplitude). After this, the output of the generator is connected to the supply terminals of the EUT or to the coupling clamp and the pulses are coupled on the EUT.</i>

Test Set-up

see Pulse 1

Test Equipment

Equipment	Manufacturer	Type	Serial Nr.	Inv-Nr.
Load Dump Generator	EM-Test	LD200	06100107	QS2481
Transient Generator	EM-Test	UCS200-M	06100108	QS2480
Voltage Drop Generator	EM-Test	VDS200	06100109	QS2479
Oscilloscope	Tektronix	TDS350	B010167	QS2453
Oscilloscope	Tektronix	TDS2012B	C040208	QS2546
Test Software	EM-Test		000029	

Test Protocol

Equipment:	<i>NB2710-LWA-GV (EUT 1) & NB2710-UWC-G (EUT 2)</i>
Cables connected:	<i>All cables, chapter 10.3</i>
Operating mode:	<i>see chapter 10.3 (EUT1 supplied with 12 VDC, EUT2 supplied with 24 VDC)</i>
Observation of EUT:	<i>see chapter 10.5</i>
Modifications:	<i>see chapter 13</i>
Test site:	<i>Continental Automotive Switzerland AG, 9464 Rüthi</i>

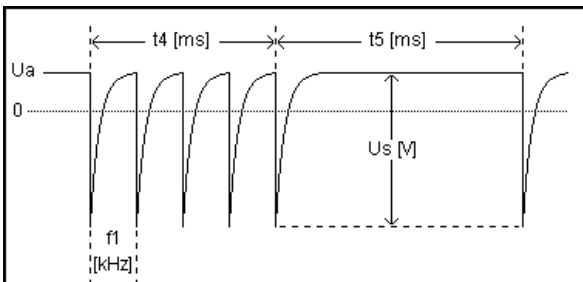
Requirements

Test level 12 V System (U _s)	Test level 24 V System (U _s)	Min. test time	Burst cycle		Compliance criteria
			min	max	
-112 V	-150 V	1 h	90 ms	100 ms	Immunity-related functions: Class A Not immunity-related functions: Class D

Test Results EUT 1

Settings					
Pulse form:	ISO 7637-2 : 2004 : Pulse 3a				
Test generator	UCS200M		Software-Nr.:	000029	
			Serial:	06100108	
Ua (Alternator):	13.5	V	Current limiting:	15	A

Pulse parameters		
Us:	-112	V
f1:	10	kHz
t4:	10	ms
t5:	90	ms
tr:	5	ns
td:	100	ns
Ri:	50	Ohm
Coupling:	Battery	
Test duration:	1	h



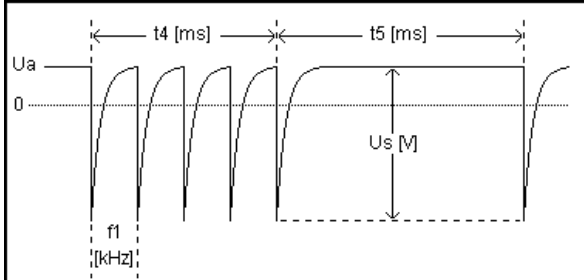
The diagram illustrates the pulse waveform for Pulse 3a. It shows a series of pulses with a frequency f_1 [kHz]. The pulse width is t_4 [ms] and the pulse period is t_5 [ms]. The voltage level is U_s [V]. The voltage U_a is shown as a reference level. The waveform is characterized by a sharp rise time t_r and a sharp fall time t_d .

Test result		
Test duration:	01:00:01	h
Requirement:	Criteria D	
Test result:	No degradation noticed, EUT conforms to the compliance criteria A & D	

Test Results EUT 2

Settings				
Pulse form:	ISO 7637-2 : 2004 : Pulse 3a			
Test generator:	UCS200M		Software-Nr.:	000029
			Serial:	06100108
Ua (Alternator):	27.0	V	Current limiting:	15 A

Pulse parameters		
Us:	-150	V
f1:	10	kHz
t4:	10	ms
t5:	90	ms
tr:	5	ns
td:	100	ns
Ri:	50	Ohm
Coupling:	Battery	
Test duration:	1	h



Test result		
Test duration:	01:00:01	h
Requirement:	Criteria D	
Test result:	No degradation noticed, EUT conforms to the compliance criteria A & D	

12.10 Immunity Pulse 3b (Automotive – ISO 7637-2)

Introduction: *This test pulses is a simulation of transients which occur as a result of the switching processes. The characteristics of these transients are influenced by distributed capacitance and inductance of the wiring harness.*

Meas. uncertainty: *+/- 10 %*

Test method: *The generator is set in no load mode (polarity, times and amplitude). After this, the output of the generator is connected to the supply terminals of the EUT or to the coupling clamp and the pulses are coupled on the EUT.*

Test Set-up

see Pulse 1

Test Equipment

Equipment	Manufacturer	Type	Serial Nr.	Inv-Nr.
Load Dump Generator	EM-Test	LD200	06100107	QS2481
Transient Generator	EM-Test	UCS200-M	06100108	QS2480
Voltage Drop Generator	EM-Test	VDS200	06100109	QS2479
Oscilloscope	Tektronix	TDS350	B010167	QS2453
Oscilloscope	Tektronix	TDS2012B	C040208	QS2546
Test Software	EM-Test		000029	

Test Protocol

Equipment: *NB2710-LWA-GV (EUT 1) & NB2710-UWC-G (EUT 2)*

Cables connected: *All cables, chapter 10.3*

Operating mode: *see chapter 10.3 (EUT1 supplied with 12 VDC, EUT2 supplied with 24 VDC)*

Observation of EUT: *see chapter 10.5*

Modifications: *see chapter 13*

Test site: *Continental Automotive Switzerland AG, 9464 Rüthi*

Requirements

Test level 12 V System (U _s)	Test level 24 V System (U _s)	Min. test time	Burst cycle		Compliance criteria
			min	max	
+75 V	+150 V	1 h	90 ms	100 ms	Immunity-related functions: Class A Not immunity-related functions: Class D

Test Results EUT 1

Settings				
Pulse form:	ISO 7637-2 : 2004 : Pulse 3b			
Test generator	UCS200M		Software-Nr.:	000029
			Serial:	06100108
Ua (Alternator):	13.5	V	Current limiting:	15 A

Pulse parameters		
Us:	+75	V
f1:	10	kHz
t4:	10	ms
t5:	90	ms
tr:	5	ns
td:	100	ns
Ri:	50	Ohm
Coupling:	Battery	
Test duration:	1	h

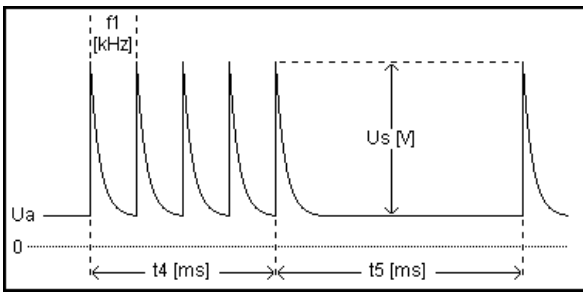
The diagram illustrates a pulse train waveform. The vertical axis represents voltage U_a and the horizontal axis represents time. The waveform consists of a series of pulses. The first pulse is labeled $f1$ [kHz]. The pulse width is labeled $t4$ [ms]. The pulse period is labeled $t5$ [ms]. The pulse amplitude is labeled Us [V].

Test result:		
Test duration:	01:00:01	h
Requirement:	Criteria D	
Test result:	No degradation noticed, EUT conforms to the compliance criteria A & D	

Test Results EUT 2

Settings					
Pulse form:	ISO 7637-2 : 2004 : Pulse 3b				
Test generator:	UCS200M		Software-Nr.:	000029	
			Serial:	06100108	
Ua (Alternator):	27.0	V	Current limiting:	15	A

Pulse parameters		
Us:	+150	V
f1:	10	kHz
t4:	10	ms
t5:	90	ms
tr:	5	ns
td:	100	ns
Ri:	50	Ohm
Coupling:	Battery	
Test duration:	1	h



The graph shows a voltage signal U_a over time. The signal is a periodic pulse train. The first pulse is labeled with frequency f_1 [kHz]. The peak voltage is labeled U_s [V]. The pulse width is labeled t_4 [ms] and the period is labeled t_5 [ms]. The voltage level is labeled U_a and the baseline is 0.

Test result		
Test duration:	01:00:01	h
Requirement:	Criteria D	
Test result:	No degradation noticed, EUT conforms to the compliance criteria A & D	

12.11 Immunity Pulse 4 (Automotive – ISO 7637-2)

Introduction:	<i>This pulse simulates supply voltage reduction caused by energizing the starter motor circuits of internal combustion engines, excluding spikes associated with starting.</i>
Meas. uncertainty:	<i>+/- 10 %</i>
Test method:	<i>The generator is set in no load mode (polarity, times and amplitude). After this, the output of the generator is connected to the supply terminals of the EUT or to the coupling clamp and the pulses are coupled on the EUT.</i>

Test Set-up

see Pulse 1

Test Equipment

Equipment	Manufacturer	Type	Serial Nr.	Inv-Nr.
Load Dump Generator	EM-Test	LD200	06100107	QS2481
Transient Generator	EM-Test	UCS200-M	06100108	QS2480
Voltage Drop Generator	EM-Test	VDS200	06100109	QS2479
Oscilloscope	Tektronix	TDS350	B010167	QS2453
Oscilloscope	Tektronix	TDS2012B	C040208	QS2546
Test Software	EM-Test		000029	

Test Protocol

Equipment:	<i>NB2710-LWA-GV (EUT 1) & NB2710-UWC-G (EUT 2)</i>
Cables connected:	<i>All cables, chapter 10.3</i>
Operating mode:	<i>see chapter 10.3 (EUT1 supplied with 12 VDC, EUT2 supplied with 24 VDC)</i>
Observation of EUT:	<i>see chapter 10.5</i>
Modifications:	<i>see chapter 13</i>
Test site:	<i>Continental Automotive Switzerland AG, 9464 Rüthi</i>

Requirements

Test level 12 V System (U _s)	Test level 24 V System (U _s)	Min. number of test pulses	Pulse repetition time		Compliance criteria
			min	max	
-6 V	-12 V	1 pulse	---	---	Immunity-related functions: Class C Not immunity-related functions: Class D

Test Results EUT 1

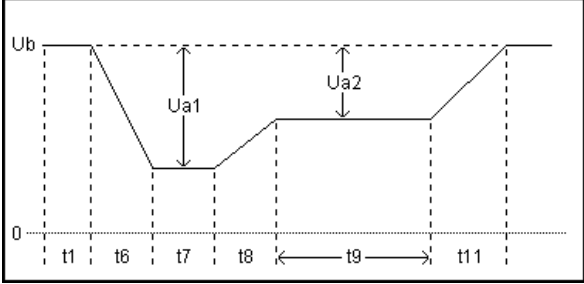
Settings				
Pulse form:	ISO 7637-2 : 2004 : Pulse 4			
Test generator	VDS200B		Software-Nr.:	000374
			Serial:	06100109
Ub (Battery):	12.0	V	Current limiting:	15 A

Pulse parameters			
Ua1:	-6.0	V	
Ua2:	-2.5	V	
t1:	1.0	s	
t6:	5	ms	
t7:	15	ms	
t8:	50	ms	
t9:	0.5	s	
t11:	5	ms	
Number of events:	1		
Test duration:	00:00:02	h	

Test result	
Number of pulses:	10
Requirement:	Criteria D
Test result:	The EUT shuts down, ethernet communication lost, after the test restart without any operation, communication over ethernet already o.k., EUT conforms to the compliance criteria C & D

Test Results EUT 2

Settings				
Pulse form:	ISO 7637-2 : 2004 : Pulse 4			
Test generator:	VDS200B	Software-Nr.:	000374	
Coupling:	UCS200M	Serial:	06100109	
Ub (Battery):	24.0	V	Current limiting:	15 A

Pulse parameters			
Ua1:	-12.0	V	
Ua2:	-5.0	V	
t1:	1.0	s	
t6:	10	ms	
t7:	50	ms	
t8:	50	ms	
t9:	0.5	s	
t11:	10	ms	
Number of events:	10		
Test duration:	00:00:30	h	

Test result	
Number of pulses:	10
Requirement:	Criteria D
Test result:	No degradation noticed, EUT conforms to the compliance criteria A & D

13. Modifications on the EUT

To pass the conducted emission test the following modification were required:

DC Input Filter:

after Ferrite Ls105 (330R@100MHz, 2.5A) a LC-Filter has been implemented:

C: electrolytic capacitor, 33 μ F, 100 V, 450 mR

L: Inductor, 3.3 μ H, 3.3 A, 27 mR

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:	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 %