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Registration number
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Akkreditierungsnummer

STS 0001

Schweizerischer Prüfstellendienst
Service suisse d'essai
Swiss testing service



Report:	<i>Electromagnetic Compatibility</i>		Report no:	15-EL-0061.E02
Product name:	<i>NB3710 and NB3720</i>		Dossier no:	15-EL-0061
Serial no:	<i>EUT 1: 00112B009FB3 EUT 2: 00112BFFDCD4</i>	Model number:	<i>EUT 1: NB3710-2L2W-G EUT 2: NB3720-L2W8EnCI-G</i>	
Customer:	<i>NetModule AG Meriedweg 11 3172 Niederwangen bei Bern Switzerland</i>	Date of test:	<i>February 3 – June 2, 2015</i>	

Standards		Result
EN 50121-3-2 : 2006	Railway applications - EMC - Part 3-2: Rolling stock - Apparatus	<i>Pass</i>
EN 50155 : 2007	Railway applications - Electronic equipment used on rolling stock	<i>See §2</i>
EN 55022 : 2010	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement: Class B	<i>Pass</i>
EN 301 489-1 V1.9.2	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 1: Common technical requirements	<i>Pass</i>
EN 301 489-7 V1.3.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)	<i>Pass</i>
EN 301 489-17 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); EMC standard for radio equipment; Part 17: Specific conditions for Broadband Data Transmission Systems	<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>

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Reviewed by
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Approved by
Mr U. von Känel
Head of Business Unit ELM





Fehraltorf, 2016-05-12

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

NetModule's railway router series are designed for mobile railway communications. These routers comply with the industry standard EN 50155 which is mandatory for most railway appliances. Supporting the latest WAN/LAN technologies (including GSM, UMTS, LTE, WLAN) and GPS they are offering highly-available connectivity with seamless handover between the broadband links using to the Mobile IP protocol.

This report (15-EL-0061.E02) replaces version E01 completely. Changes are in chapter 12.7: "Protocol of the test" has been corrected and notes added.

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

§	Test Type	Result
11	Emission	EN 50121-3-2
11.1	Interference voltage EN 55011 Class B CISPR 11	PASS
11.2	Radiated electromagnetic field EN 55011 Class B CISPR 11	PASS
12	Immunity	EN 50121-3-2
12.1	Electrostatic discharges EN 61000-4-2 IEC 61000-4-2	PASS
12.2	Electromagnetic fields EN 61000-4-3 IEC 61000-4-3	PASS
12.3	Fast electric transients (Burst) EN 61000-4-4 IEC 61000-4-4	PASS ¹
12.4	Surges EN 61000-4-5 IEC 61000-4-5	PASS
12.5	Radio frequency common mode EN 61000-4-6 IEC 61000-4-6	PASS ¹

1. USB Type A connector not tested – service port

2. Summary of Test Results (EN 50155)

§	Test Type	Result
11	Emission	EN 50155
11.1	Interference voltage EN 55011 Class B CISPR 11	PASS
11.2	Radiated electromagnetic field EN 55011 Class B CISPR 11	PASS
12	Immunity	EN 50155
--	Visual inspection EN 50155 §12.2.1	PASS
12.6	Performance test EN 50155 §12.2.2	PASS
12.6	Supply overvoltages EN 50155 §12.2.6	PASS
12.1 12.3 12.4	Surges, electrostatic discharge and transient burst susceptibility tests EN 50155 §12.2.7	PASS ²
12.2 12.5	Radio interference test EN 50155 §12.2.8	PASS ²
12.7	Insulation test EN 50155 §12.2.9	PASS

1. only EMC part of EN50155 tested

2. USB Type A connector not tested – service port

3. Summary of Test Results (EN 55022)

§	Test Type	Result
11	Emission	EN 55022
11.1	Interference voltage EN 55022 Class B CISPR 22	PASS
11.1	Common mode at telecom. ports EN 55022 Class B CISPR 22	PASS
11.2	Radiated electromagnetic field EN 55022 Class B CISPR 22	PASS
--	Harmonics EN 61000-3-2 IEC 61000-3-2	Not applicable ¹
--	Voltage fluctuations (flicker) EN 61000-3-3 IEC 61000-3-3	Not applicable ¹

1. EUT is DC powered

4. 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

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

5. 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 Class B CISPR 22	PASS
--	Interference current	EN 55022 CISPR 22	--
11.2	Radiated electromagnetic field	EN 55022 Class B CISPR 22	PASS
--	Harmonics	EN 61000-3-2 IEC 61000-3-2	Not applicable ¹
--	Voltage fluctuations (flicker)	EN 61000-3-3 IEC 61000-3-3	Not applicable ¹
12	Immunity		EN 301 489-x mobile equipment
12.1	Electrostatic discharges	EN 61000-4-2 IEC 61000-4-2	PASS
12.2	Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	PASS
12.3	Fast electric transients (Burst)	EN 61000-4-4 IEC 61000-4-4	PASS
12.4	Surges	EN 61000-4-5 IEC 61000-4-5	PASS
12.5	Radio frequency common mode	EN 61000-4-6 IEC 61000-4-6	PASS ²
--	Voltage dips and interruptions	EN 61000-4-11 IEC 61000-4-11	Not applicable ¹

1. EUT is DC powered

2. USB Type A connector not tested – service port

6. Applied Standards

EN 50155 : 2007 IEC 60571:2012	Railway applications - Electronic equipment used on rolling stock
EN 50121-3-2 : 2006 IEC 62236-3-2 : 2008	Railway applications – Electromagnetic compatibility Part 3-2: Rolling stock - Apparatus
EN 55022 : 2010 CISPR 22 : 2008	Information technology equipment Radio disturbance characteristics – Limits and methods of measurement
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
CFR 47 Part 15 Subpart B: ed2014	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators"

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

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

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	NB3710 and NB3720
Product description	Railway Router with Mobile, WLAN &GPS
Model number	EUT 1: NB3710-2L2W-G EUT 2: NB3720-L2W8EnCI-G
Serial no / revision	EUT 1: 00112B009FB3 (00112B00D412 for test §12.6 & 12.7) System software: 3.7.2.107 CP Module Revision: 4.3 MC Board Revision: 4.2 PSE Board Revision: 2.5 EUT 2: 00112BFFDCD4 (00112B00D2F3 for test §12.6 & 12.7) System software: 3.7.2.107 CP Module Revision: 4.3 MC Board Revision: 4.2 PSE Board Revision: 1.2
Frequencies	CPU Clock: 400 MHz DDR2SDRAM: 266 MHz PCI Express: 2500 MHz USB: 480 MHz DC/DC Converter (Main): < 1 MHz
Radio modules	GSM: 0.9 / 1.8 GHz UMTS: 1.9 – 2.2 GHz LTE: 0.8 / 1.7 / 2.6 GHz WLAN: 2.4 – 2.5 GHz GPS: 1.5 GHz
Supply	U = 12 – 60 VDC, P ≈ 12 W U = 24 – 48 VDC according EN 501555
Dimension	EUT 1: ~ 104 mm x 190 mm x 105 mm (l x w x h) EUT 2: ~ 104 mm x 190 mm x 125 mm (l x w x h)
Weight	EUT 1: ~ 1.25 kg EUT 2: ~ 1.5 kg
Technical documentation	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⁾
NB3710-2L2W-G NB3720- L2W8EnCI-G	NB3710-H ₁ ...H _n - S ₁ ...S _n NB3720-H ₁ ...H _n - S ₁ ...S _n	<p>All covered NB3710 / NB3720 variants contain the same CP Modules, MC Boards, and PSE Boards, have the same case and the same form factor.</p> <p>They can host up to six communication and other interface modules. These modules can even include a GPS module. There can be up to 9 antenna connectors.</p> <p>The wireless communication modules applied have been CE and FCC certified in an independent way of the Tested Equipment.</p> <p>'H₁...H_n' is a sequence of the following letters that identify the communication modules included:</p> <p>R: none, router only Ed: 2G = GPRS/EDGE U: 3G+ = 2G+UMTS/HSPA/HSPA+ L: 4G = 3G+ + LTE Ca: CDMA450 Gr: GSM-R Ge: GNSS 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 Sb: RS-232 (on the same module as IBIS) ... (more to follow)</p> <p>'S₁...S_n' indicate the software options activated:</p> <p>G: GPS V: Voice gateway M: Mobile IP (Client) S: Server</p> <p>The following NB3710/NB3720 variants are currently available or planned:</p> <p>NB3710-LSa NB3710-LWA-GV NB3710-LWC-G NB3710-LWI-G NB3710-L2W NB3710-L2W-G NB3710-2LW NB3710-2LW-G NB3710-2L2W NB3710-2L2W-G NB3710-3L2W NB3710-3L2W-G NB3710-4L-G NB3710-4L2W-G NB3720-L2W8EnCI-G</p>

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

9.3 Pictures of the EUT

EUT 1:



EUT 2:



9.4 Type plate of the EUT

EUT 1:



EUT 2:



9.5 Classification

EN 50121-3-2	<input checked="" type="checkbox"/> Mounted in the passenger compartments, drivers cab or external to the rolling stock (roof, underframe) <input type="checkbox"/> Accessible to passengers and operational staff (not maintenance)
EN 55022 CISPR 22	<input type="checkbox"/> Class A (suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes) Such equipment should not be restricted in its sale but the following warning shall be included in the instructions for use: <i>Warning: This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.</i> <input checked="" type="checkbox"/> Class B (suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes) <input type="checkbox"/> The highest frequency of the internal sources of the EUT is less than 108 MHz (measurement shall be made up to 1 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz (measurement shall be made up to 2 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz (measurement shall be made up to 5 GHz). <input checked="" type="checkbox"/> The highest frequency of the internal sources of the EUT is above 1 GHz (measurement shall be made up to 5 times the highest frequency or 6 GHz, whichever is less).
EN 301 489	<input type="checkbox"/> Radio and ancillary equipment for fixed use (e.g. base station equipment) <input checked="" type="checkbox"/> Radio and ancillary equipment for vehicular use (e.g. mobile equipment) <input type="checkbox"/> Radio and ancillary equipment for portable use (portable equipment) <input type="checkbox"/> Ancillary equipment
CFR 47 Part 15	<input type="checkbox"/> Unintentional radiator (Subpart B) <input type="checkbox"/> Class A digital device <input checked="" type="checkbox"/> Class B digital device <input type="checkbox"/> The highest frequency of the internal sources of the EUT is less than 108 MHz (measurement shall be made up to 1 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz (measurement shall be made up to 2 GHz). <input type="checkbox"/> The highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz (measurement shall be made up to 5 GHz). <input checked="" type="checkbox"/> The highest frequency of the internal sources of the EUT is above 1 GHz (measurement shall be made up to 5 times the highest frequency or 40 GHz, whichever is lower). <input type="checkbox"/> Intentional radiator (Subpart C) <input type="checkbox"/> The highest fundamental frequency of the EUT is less than 10 GHz (measurement shall be made up to the tenth harmonic or 40 GHz, whichever is lower). <input type="checkbox"/> The highest fundamental frequency of the EUT is between 10 GHz and 30 GHz (measurement shall be made up to the fifth harmonic or 100 GHz, whichever is lower). <input type="checkbox"/> The highest fundamental frequency of the EUT is above 30 GHz (measurement shall be made up to the fifth harmonic or 200 GHz, whichever is lower).

9.6 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	If not stated otherwise, no cable connected
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
Ethernet 5	< 100m	RJ45 cat 5e	Yes	If not stated otherwise, no cable connected
Ethernet 6 (EUT 2 only)	< 100m	RJ45 cat 5e	Yes	If not stated otherwise, no cable connected
Ethernet 7 (EUT 2 only)	< 100m	RJ45 cat 5e	Yes	If not stated otherwise, no cable connected
Ethernet 8 (EUT 2 only)	< 100m	RJ45 cat 5e	Yes	If not stated otherwise, no cable connected
RS232 (EUT 1 only)	< 10 m	3 wire	Yes	Connected to Test-PC
USB Type A connector (Service Port)	< 3m	USB	Yes	Connected to USB memory stick (for radiated tests connected with 3 m USB standard cable)
USB Binder M9 (EUT 2 only)	No cable allowed	USB	Yes	Connected directly 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
WLAN 1&2	< 100 m	BNC (Coax)	Yes	Connected to multiband-antenna
Mob 1&2 (GSM, UMTS, LTE)	< 100 m	BNC (Coax)	Yes	Connected to multiband-antenna
GPS	< 100 m	BNC (Coax)	Yes	Connected to multiband-antenna
IBIS (Only EUT2)	< 100 m	4 wire	No	Connected to Test device
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>27. February 2015 2. March 2015 3. March 2015 11. March 2015 13. March 2015 19. March 2015 2. June 2015</i>	<i>22 - 24 °C</i>	<i>960 - 980 hPa</i>	<i>30 - 35 %</i>

10.2 Attendant Persons

Test Engineer(s):

Mr Daniel Rufer

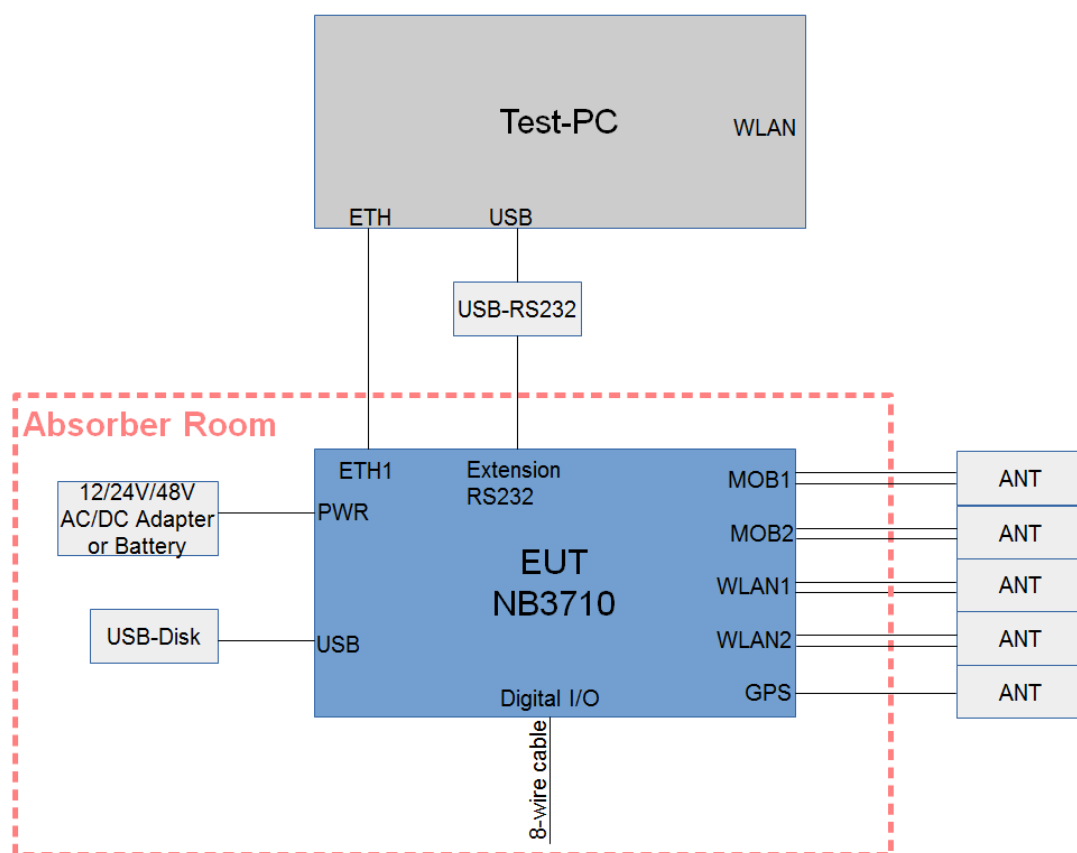
Other(s):

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

10.3 Test Configuration

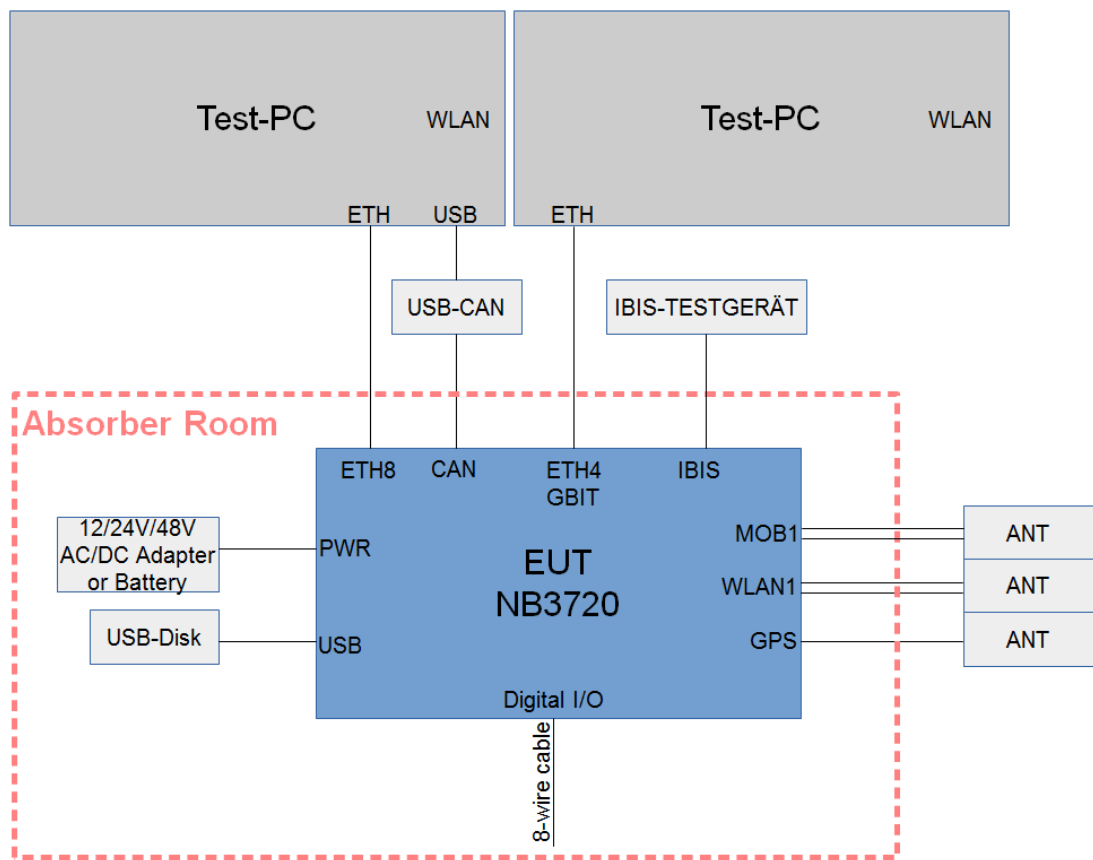
EUT 1: NB3710-2L2W-G

- Supply: 12 and 60 V (24 – 48 V according EN 50155)
- 1 Fast-Ethernet-connection to Test-PC
- 1 RS232-connection to Test PC
- 2 GSM/UMTS/LTE antennas (4 cables)
- 2 WLAN antennas (4 cables)
- 1 GPS antenna (1 cable)
- Digital I/O cable (floating)
- USB cable with USB Memory Stick
- 2 SIM cards



EUT 2: NB3720-L2W9EnCI-G

- Supply: 12 and 60 V (24 – 48 V according EN 50155)
- 1 Fast-Ethernet-connection to Test-PC
- 1 GBit Ethernet-connection to Test PC
- 1 GSM/UMTS/LTE antenna (2 cables)
- 2 WLAN antennas (2 cables)
- 1 GPS antenna (1 cable)
- Digital I/O cable (floating)
- USB cable with USB Memory Stick
- CAN-cable (RJ45) to Test-PC
- IBIS-cable to IBIS Test device
- 1 SIM card



10.4 Operating Conditions

Normal mode:

- Ping over WLAN 1 and WLAN 2
- Ping over WWAN (UMTS/LTE)
- Ping over Ethernet cable
- Access to USB disc
- EUT 1: Access with serial connection, Ping over WWAN 2
- EUT 2: CAN "Ping", IBIS "Ping", Ping over GBIT Ethernet
- powered with 24 VDC unless otherwise specified

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

Additionally for EUT 2 (NB3720-L2W8EnCI-G):

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

IBIS connection between EUT and IBIS test-device. test device transmits IBIS-requests, which have to be responded by the EUT.

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
Test-PC / Notebook	Dell	E5540	1PF9M12
Test-PC / Notebook	Dell	E5430	B2DT3X1
USB-to-CAN Adapter	IXXAT	USB-to-CAN compact	HW243428
USB-to-RS232 Adapter	MOXA	USB UPORT 1150I	--
USB Disk	n/a	--	--
IBIS Test device	MG Industrieelektronik GmbH	IWT 2000	0291-00288
WWAN Antenna	n/a	Antenna-Roof-2L DL-9	A140812300036
GPS Antenna	REEL	C70ZAR 0300 00 03 03 PWN1	02 1501
WLAN Antenna	--	Antenna-Roof-2W	--
SMA – BNC Adapter	--	--	--
Power Supply	Hameg	HM8143	Q10153
Power Supply	Oltronix	B703	--

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><i>No transmission loss LAN, WWAN (UMTS/LTE), WLAN</i></p> <p><i>Additionally for EUT 2:</i></p> <p><i>CAN: data packet shall be received in both directions</i></p> <p><i>IBIS: queries shall be answered</i></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><i>During the test:</i></p> <ul style="list-style-type: none"> - <i>short interruptions of the communication allowed</i> - <i>LED's may flicker</i> <p><i>After the test the EUT shall operate as in normal mode</i></p>
Criterion C:	
Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.	<i>No specific requirements</i>

11. Emission Tests

11.1 Interference Voltage

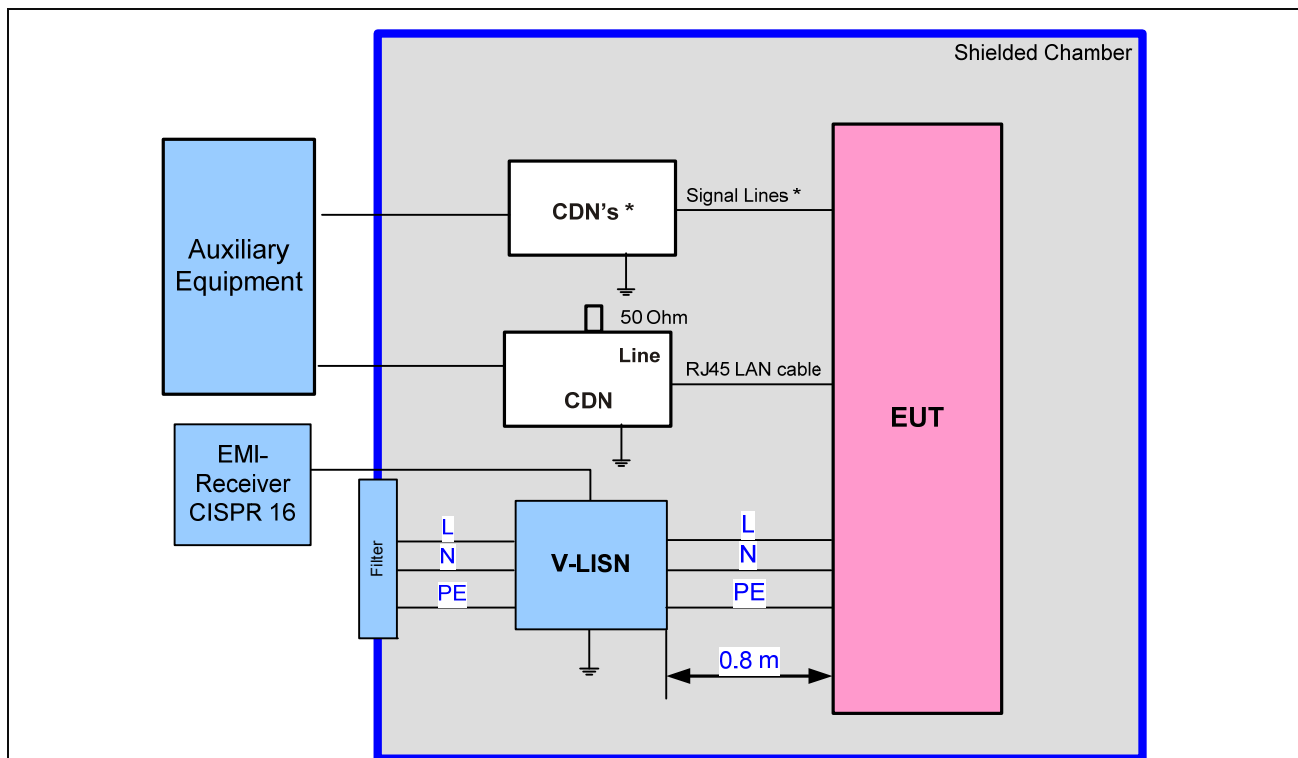
Test site: *shielded room*

Meas. uncertainty: *see chapter 13*

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 14*

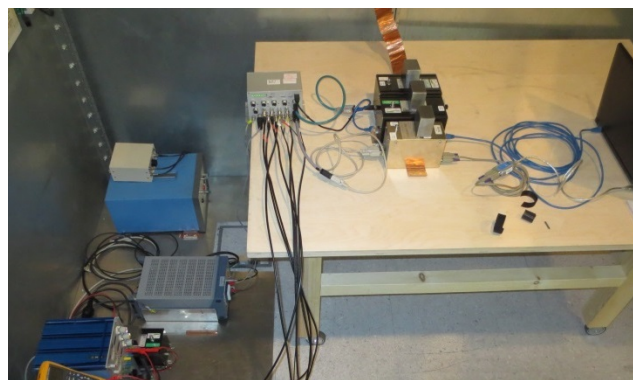
Test Setup



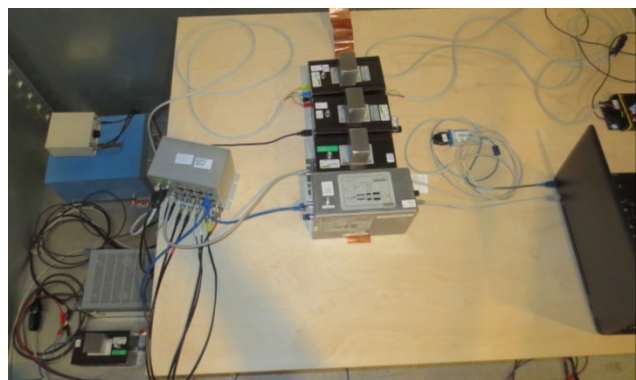
*Note: CDN's used for decoupling:

EUT 1: CDN-DSub (RS232), CDN-USB, CDN-RJ45 (Ethernet)

EUT 2: CDN-M4 (I/O), CDN-USB, CDN-RJ45 EM-Test & Marti (Ethernet, CAN)



EUT 1



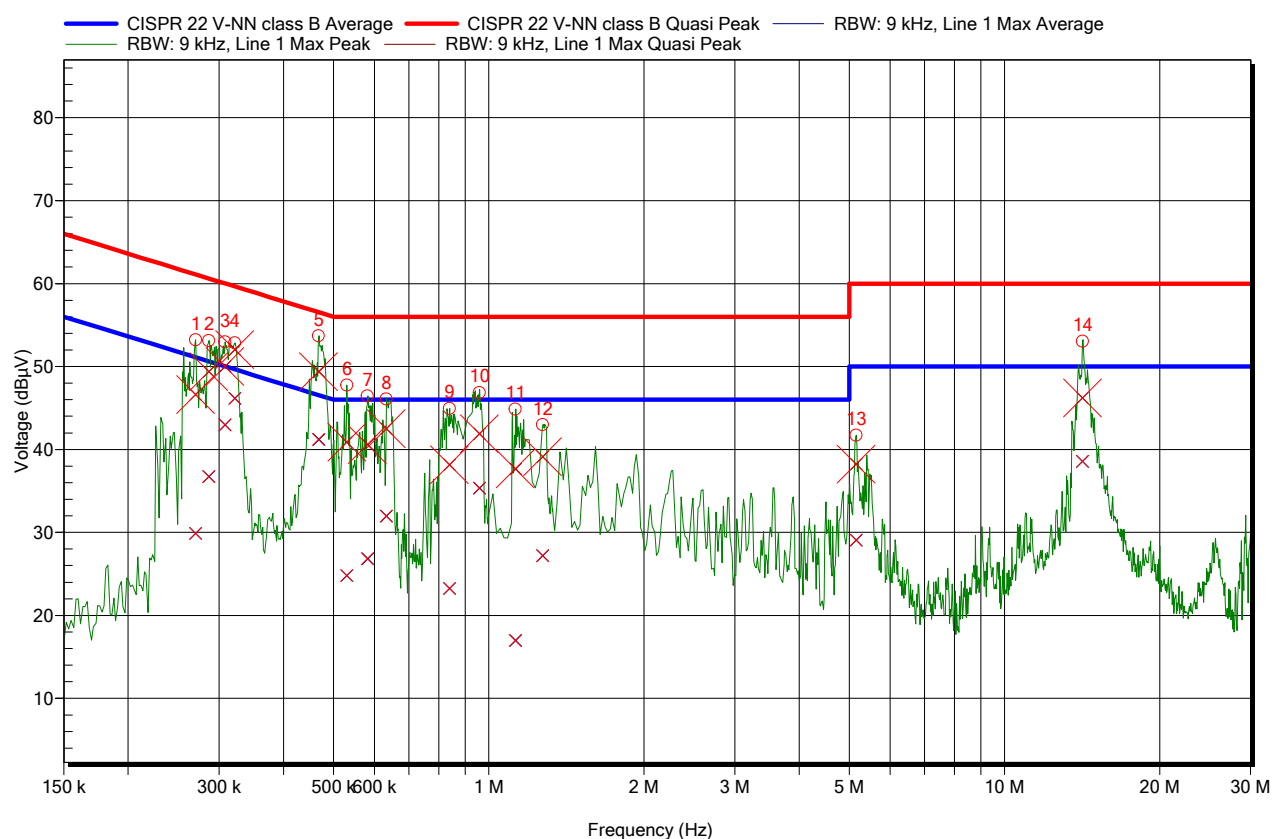
EUT 2

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
Decoupling device	EM Test	CDN S8 RJ45	13.6632.08
Decoupling device	EM Test	CDN S4 USB	H10173
Decoupling device	Marti	CDN TWP 4x2	H10420
Decoupling device	Lüthi	CDN 801-S8 (DSub)	H7681

Measurement Results EUT 1

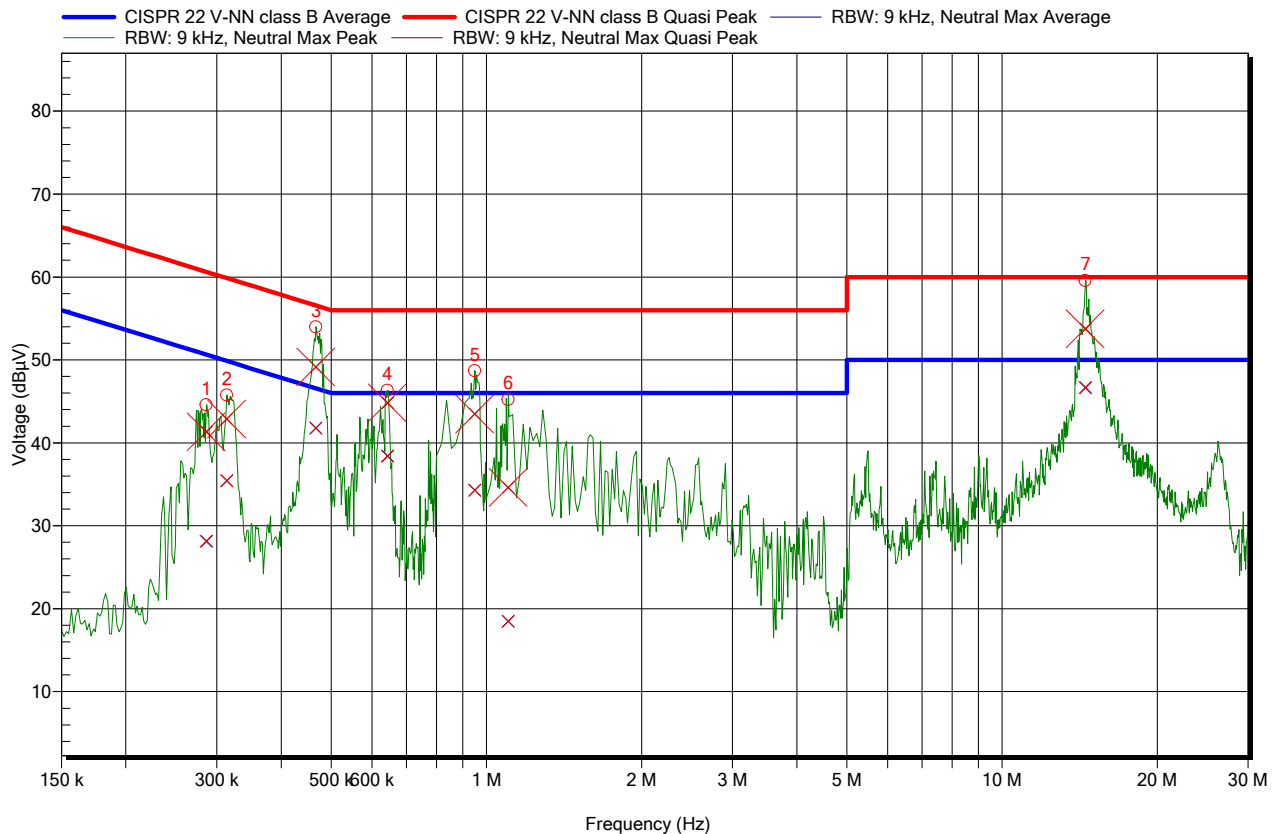
EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 08:58:05
Interface / Line under test	Neg(-), 60 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radiation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [600 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	269.953 kHz	53.21 dBμV	29.89 dBμV	-21.23 dB	46.62 dBμV	-14.5 dB	Pass
2	286.561 kHz	53.12 dBμV	36.71 dBμV	-13.91 dB	49.38 dBμV	-11.24 dB	Pass
3	307.823 kHz	52.98 dBμV	42.98 dBμV	-7.05 dB	50.01 dBμV	-10.02 dB	Pass
4	321.708 kHz	52.86 dBμV	46.16 dBμV	-3.5 dB	52.03 dBμV	-7.63 dB	Pass
5	467.618 kHz	53.69 dBμV	41.19 dBμV	-5.36 dB	49.4 dBμV	-7.15 dB	Pass
6	530.486 kHz	47.77 dBμV	24.82 dBμV	-21.18 dB	40.88 dBμV	-15.12 dB	Pass
7	581.753 kHz	46.45 dBμV	26.84 dBμV	-19.16 dB	40.59 dBμV	-15.41 dB	Pass
8	632.82 kHz	46.1 dBμV	31.98 dBμV	-14.02 dB	42.5 dBμV	-13.5 dB	Pass
9	838.603 kHz	44.94 dBμV	23.24 dBμV	-22.76 dB	38.13 dBμV	-17.87 dB	Pass
10	958.454 kHz	46.85 dBμV	35.35 dBμV	-10.65 dB	41.92 dBμV	-14.08 dB	Pass
11	1.125 MHz	44.87 dBμV	16.98 dBμV	-29.02 dB	37.65 dBμV	-18.35 dB	Pass
12	1.272 MHz	43 dBμV	27.19 dBμV	-18.81 dB	39.12 dBμV	-16.88 dB	Pass
13	5.153 MHz	41.75 dBμV	29.06 dBμV	-20.94 dB	38.23 dBμV	-21.77 dB	Pass
14	14.161 MHz	53.07 dBμV	38.58 dBμV	-11.42 dB	46.22 dBμV	-13.78 dB	Pass

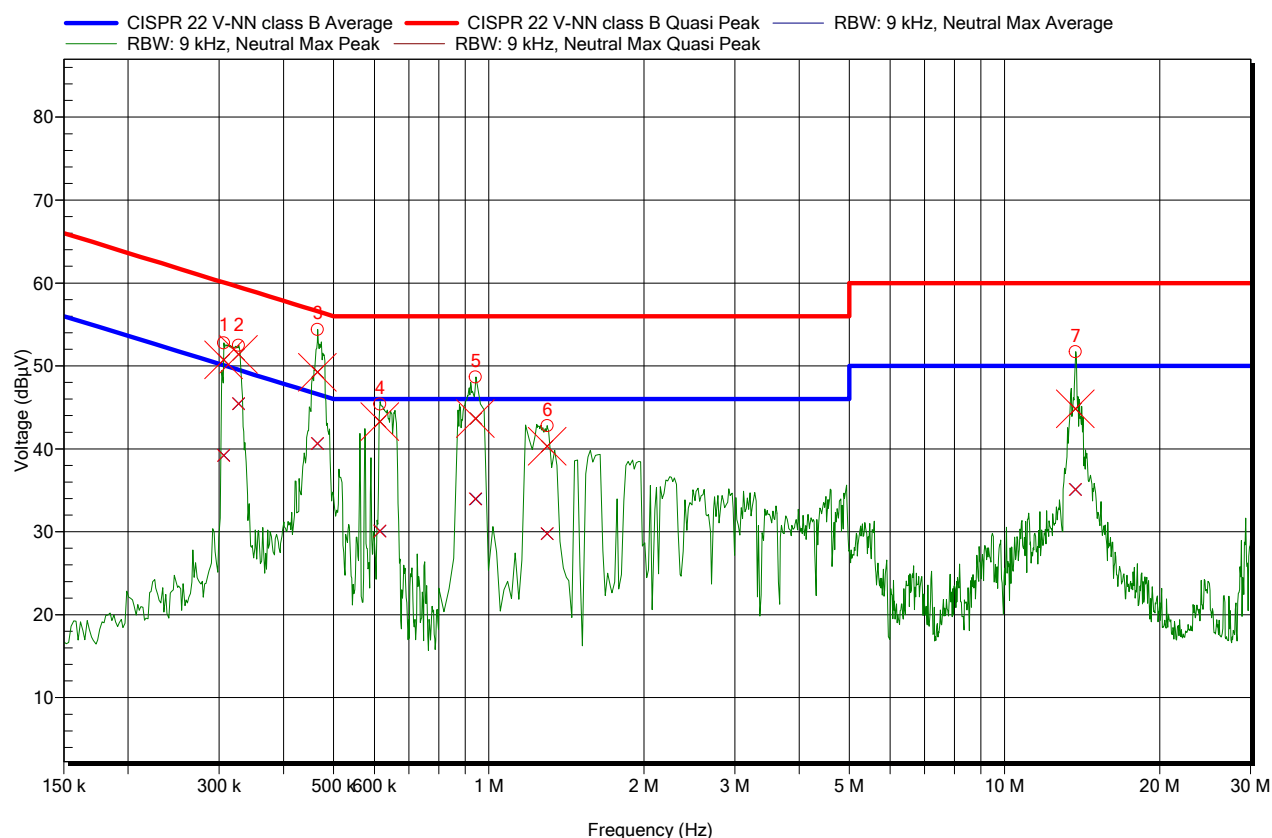
EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 09:02:31
Interface / Line under test	Pos(+), 60 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radiation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [666.7 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms], Measurement equipment: CE 9k-30M HP8542E V-LISN PE7627



Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	286.212 kHz	44.58 dBμV	28.15 dBμV	-22.48 dB	41.33 dBμV	-19.3 dB	Pass
2	313.494 kHz	45.76 dBμV	35.41 dBμV	-14.47 dB	42.86 dBμV	-17.02 dB	Pass
3	466.431 kHz	54.01 dBμV	41.79 dBμV	-4.79 dB	49.13 dBμV	-7.45 dB	Pass
4	642.571 kHz	46.35 dBμV	38.41 dBμV	-7.59 dB	44.85 dBμV	-11.15 dB	Pass
5	948.219 kHz	48.7 dBμV	34.29 dBμV	-11.71 dB	43.48 dBμV	-12.52 dB	Pass
6	1.102 MHz	45.23 dBμV	18.48 dBμV	-27.52 dB	34.63 dBμV	-21.37 dB	Pass
7	14.485 MHz	59.59 dBμV	46.67 dBμV	-3.33 dB	53.75 dBμV	-6.25 dB	Pass

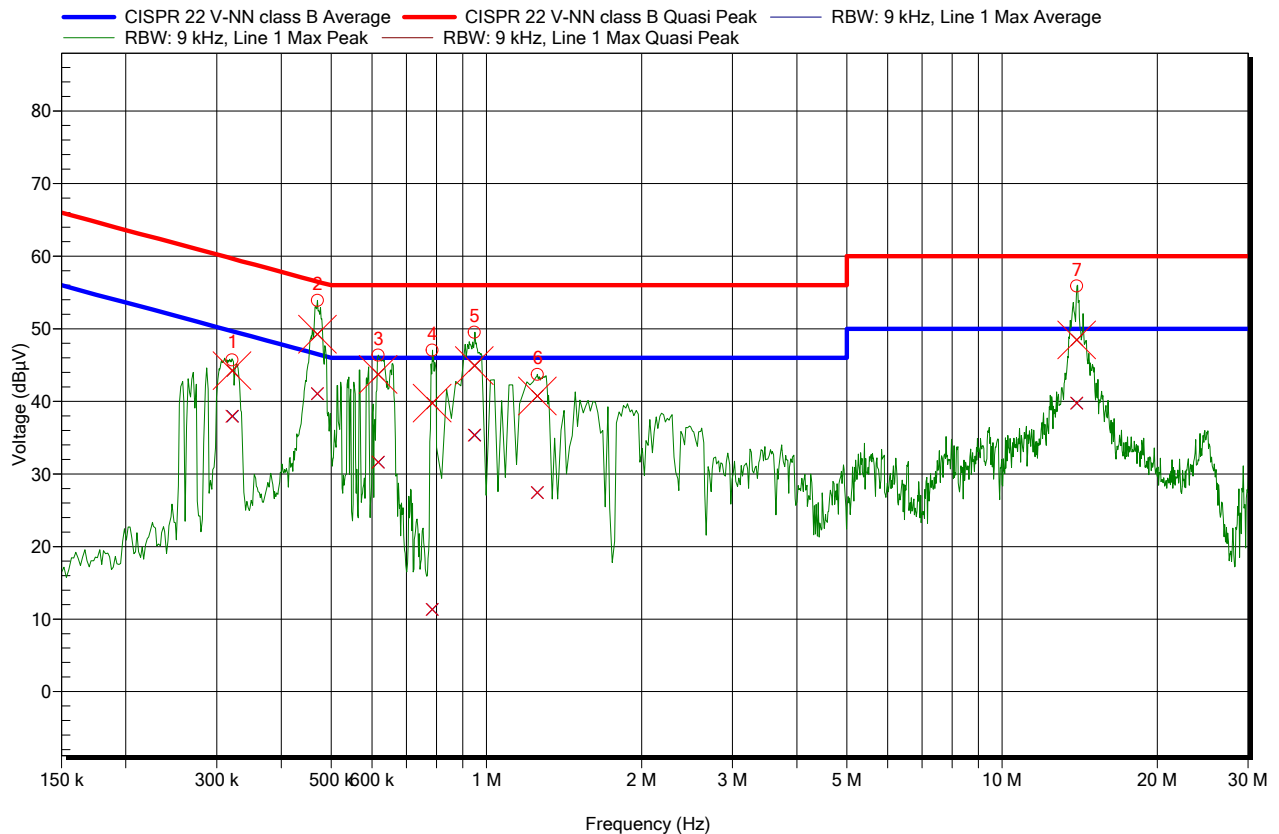
EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 08:44:37
Interface / Line under test	Neg(-), 48 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [1.2 s], 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	306.337 kHz	52.77 dBμV	39.23 dBμV	-10.84 dB	50.74 dBμV	-9.33 dB	Pass
2	326.975 kHz	52.48 dBμV	45.43 dBμV	-4.09 dB	51.37 dBμV	-8.15 dB	Pass
3	465.269 kHz	54.4 dBμV	40.63 dBμV	-5.97 dB	49.25 dBμV	-7.35 dB	Pass
4	614.586 kHz	45.41 dBμV	30.09 dBμV	-15.91 dB	43.3 dBμV	-12.7 dB	Pass
5	942.474 kHz	48.68 dBμV	33.97 dBμV	-12.03 dB	43.67 dBμV	-12.33 dB	Pass
6	1.297 MHz	42.78 dBμV	29.78 dBμV	-16.22 dB	40.31 dBμV	-15.69 dB	Pass
7	13.718 MHz	51.7 dBμV	35.11 dBμV	-14.89 dB	44.85 dBμV	-15.15 dB	Pass

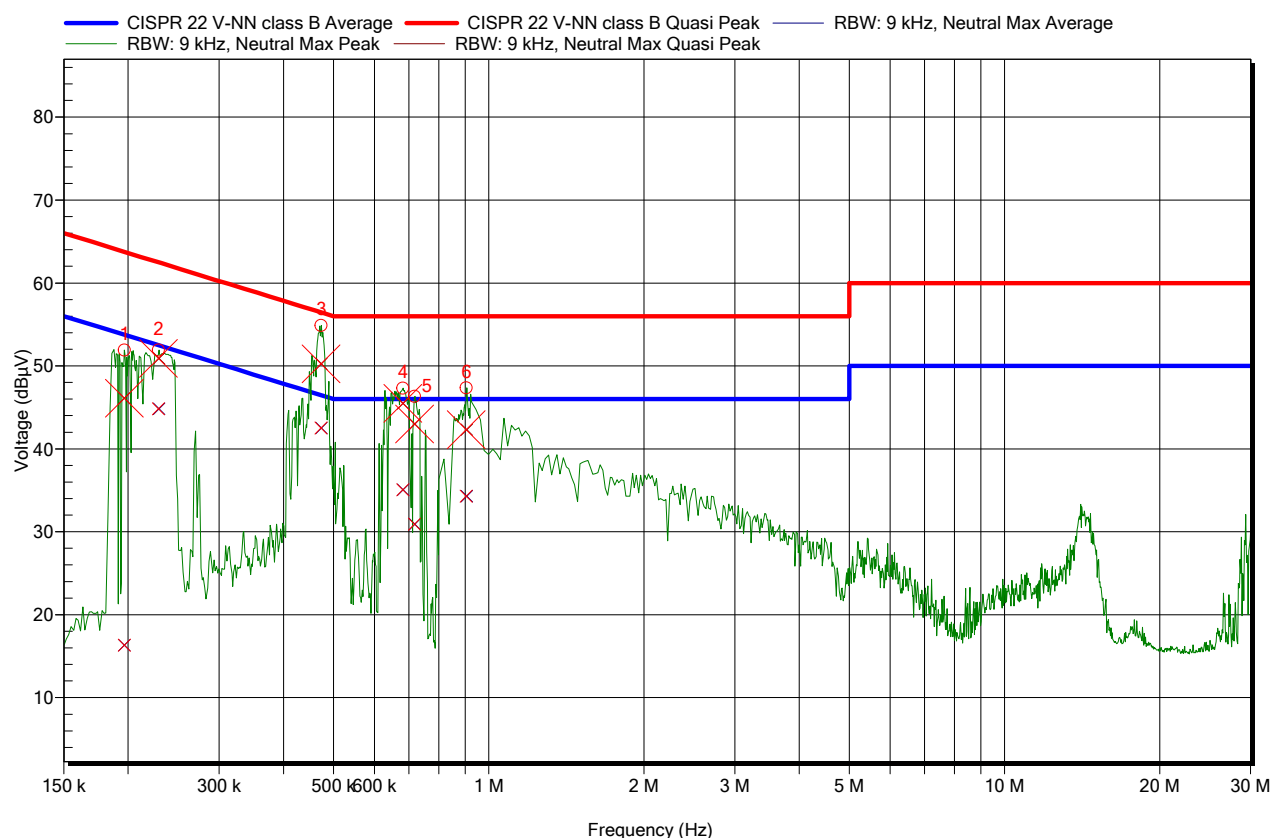
EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 08:49:19
Interface / Line under test	Pos(+), 48 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [54.2 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	321.279 kHz	45.74 dBμV	37.94 dBμV	-11.73 dB	44.25 dBμV	-15.42 dB	Pass
2	469.988 kHz	53.92 dBμV	41.07 dBμV	-5.44 dB	49.24 dBμV	-7.27 dB	Pass
3	616.382 kHz	46.36 dBμV	31.6 dBμV	-14.4 dB	43.74 dBμV	-12.26 dB	Pass
4	784.367 kHz	47.09 dBμV	11.31 dBμV	-34.69 dB	39.76 dBμV	-16.24 dB	Pass
5	947.86 kHz	49.56 dBμV	35.33 dBμV	-10.67 dB	44.91 dBμV	-11.09 dB	Pass
6	1.255 MHz	43.7 dBμV	27.42 dBμV	-18.58 dB	40.73 dBμV	-15.27 dB	Pass
7	13.949 MHz	55.92 dBμV	39.76 dBμV	-10.24 dB	48.46 dBμV	-11.54 dB	Pass

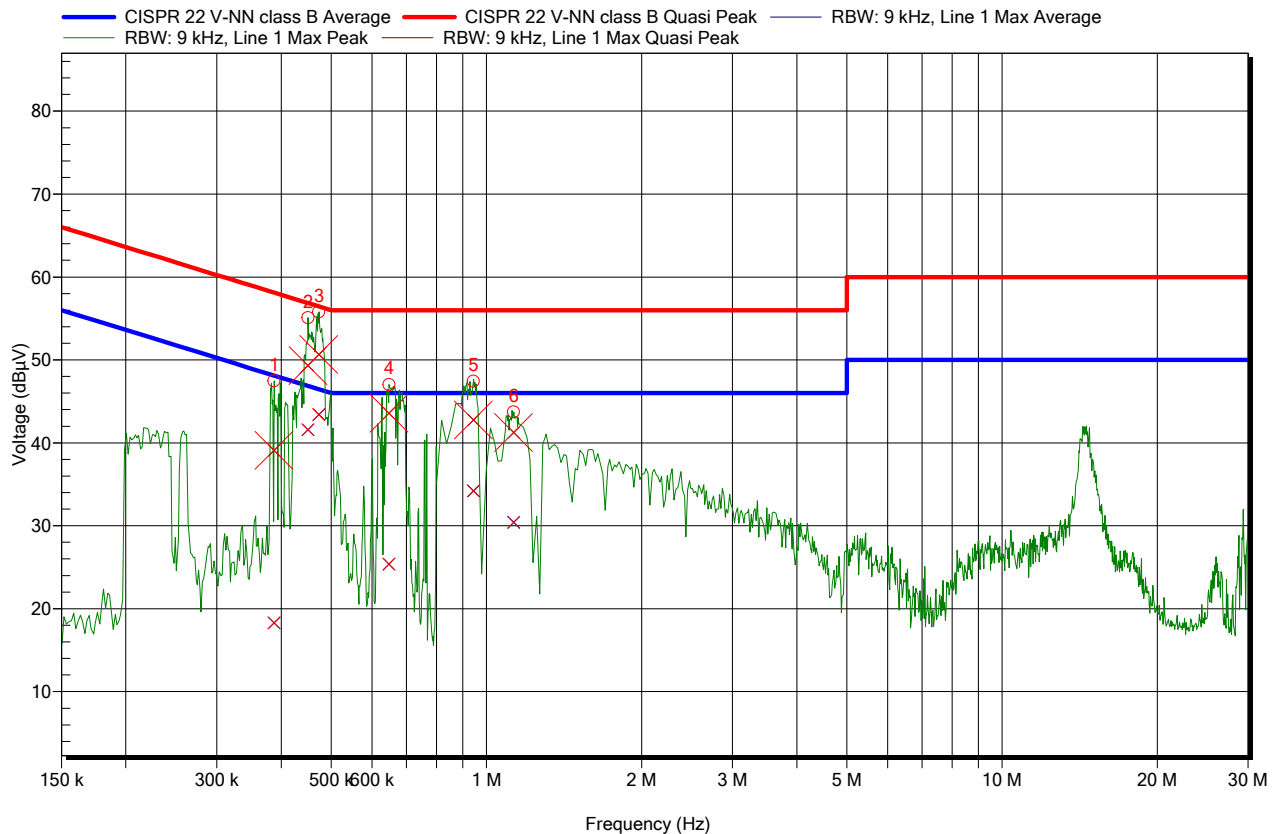
EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 09:07:29
Interface / Line under test	Neg(-), 24 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [1.2 s], 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	196.496 kHz	51.9 dBμV	16.31 dBμV	-37.44 dB	46.1 dBμV	-17.65 dB	Pass
2	229.025 kHz	51.9 dBμV	44.85 dBμV	-7.64 dB	50.9 dBμV	-11.59 dB	Pass
3	473.354 kHz	54.9 dBμV	42.52 dBμV	-3.93 dB	50.26 dBμV	-6.19 dB	Pass
4	681.11 kHz	47.3 dBμV	35.07 dBμV	-10.93 dB	45.47 dBμV	-10.53 dB	Pass
5	717.828 kHz	46.32 dBμV	30.89 dBμV	-15.11 dB	42.99 dBμV	-13.01 dB	Pass
6	904.589 kHz	47.37 dBμV	34.29 dBμV	-11.71 dB	42.29 dBμV	-13.71 dB	Pass

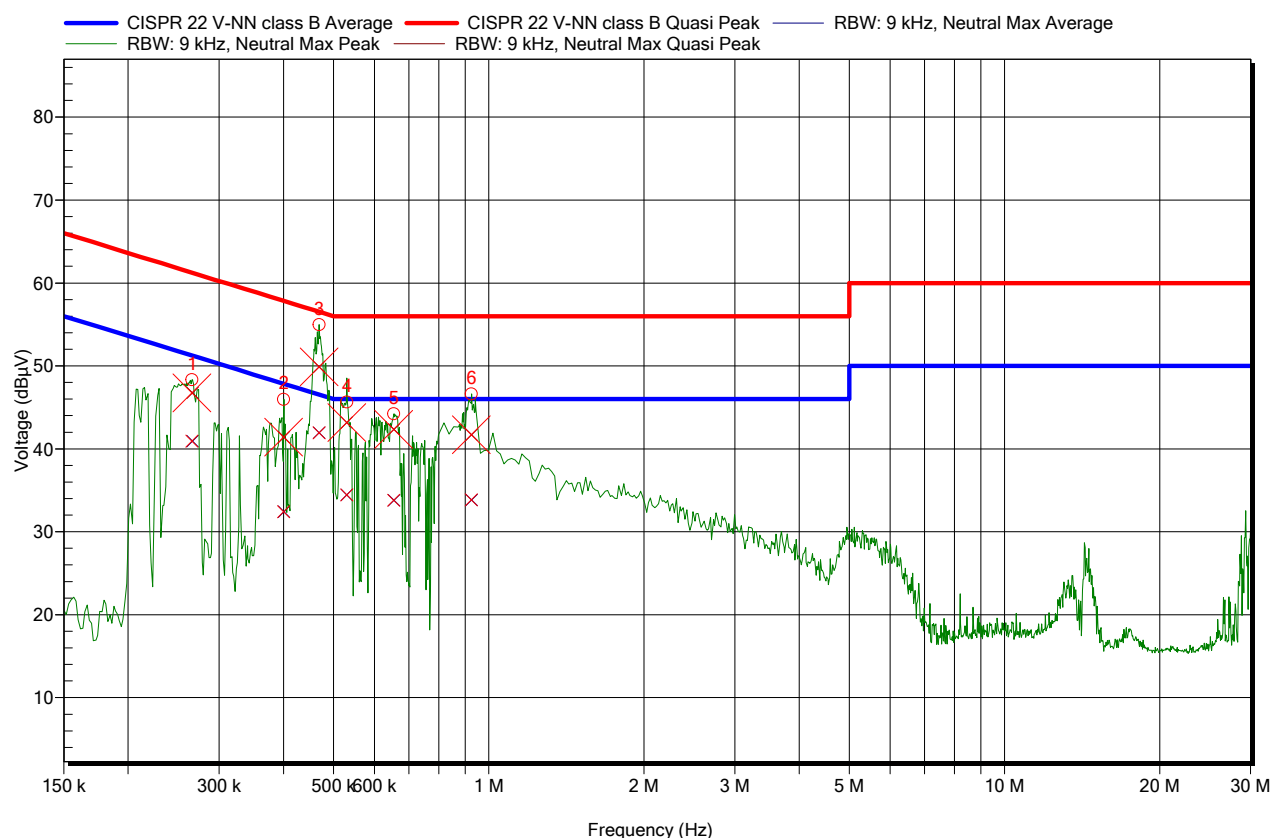
EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 09:11:21
Interface / Line under test	Pos(+), 24 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [54.2 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms], Measurement equipment: CE 9k-30M HP8542E V-LISN PE7627



Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	387.274 kHz	47.49 dBμV	18.29 dBμV	-29.83 dB	39.09 dBμV	-19.03 dB	Pass
2	451.025 kHz	55.09 dBμV	41.57 dBμV	-5.29 dB	49.3 dBμV	-7.56 dB	Pass
3	472.915 kHz	55.77 dBμV	43.41 dBμV	-3.05 dB	50.65 dBμV	-5.81 dB	Pass
4	646.736 kHz	47.02 dBμV	25.38 dBμV	-20.62 dB	43.56 dBμV	-12.44 dB	Pass
5	943.372 kHz	47.46 dBμV	34.19 dBμV	-11.81 dB	42.74 dBμV	-13.26 dB	Pass
6	1.129 MHz	43.74 dBμV	30.42 dBμV	-15.58 dB	41.27 dBμV	-14.73 dB	Pass

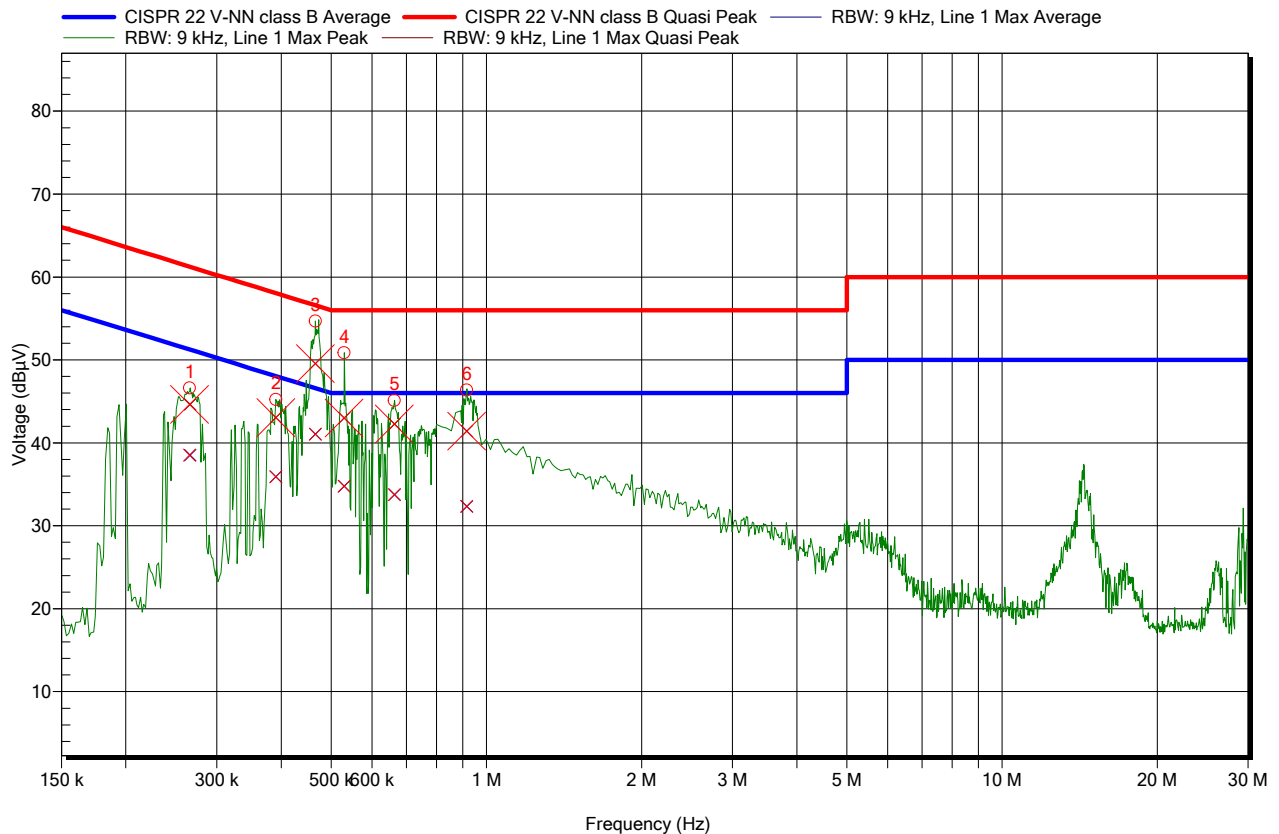
EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 09:20:59
Interface / Line under test	Neg(-), 12 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [600 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms], Measurement equipment: CE 9k-30M HP8542E V-LISN PE7627



Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	265.584 kHz	48.35 dBμV	40.91 dBμV	-10.35 dB	46.74 dBμV	-14.52 dB	Pass
2	400.372 kHz	45.95 dBμV	32.41 dBμV	-15.43 dB	41.42 dBμV	-16.42 dB	Pass
3	468.84 kHz	54.98 dBμV	41.94 dBμV	-4.59 dB	49.89 dBμV	-6.64 dB	Pass
4	530.701 kHz	45.65 dBμV	34.45 dBμV	-11.55 dB	43.17 dBμV	-12.83 dB	Pass
5	653.698 kHz	44.22 dBμV	33.8 dBμV	-12.2 dB	42.36 dBμV	-13.64 dB	Pass
6	925.416 kHz	46.63 dBμV	33.86 dBμV	-12.14 dB	41.69 dBμV	-14.31 dB	Pass

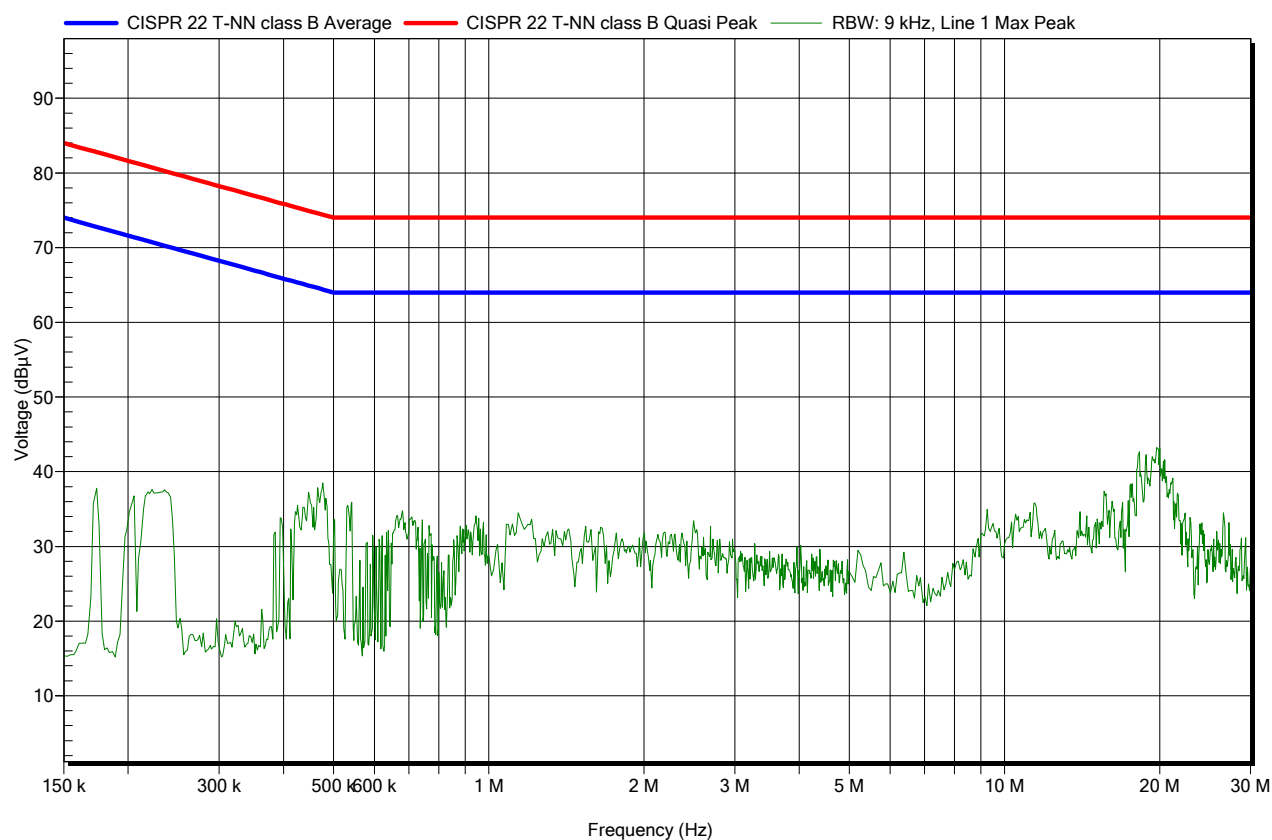
EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 09:28:01
Interface / Line under test	Pos(+), 12 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [666.7 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	265.703 kHz	46.64 dBμV	38.54 dBμV	-12.72 dB	44.65 dBμV	-16.61 dB	Pass
2	390.671 kHz	45.22 dBμV	35.9 dBμV	-12.15 dB	43.02 dBμV	-15.03 dB	Pass
3	466.012 kHz	54.69 dBμV	41.06 dBμV	-5.52 dB	49.55 dBμV	-7.03 dB	Pass
4	529.993 kHz	50.88 dBμV	34.78 dBμV	-11.22 dB	43.02 dBμV	-12.98 dB	Pass
5	663.06 kHz	45.13 dBμV	33.74 dBμV	-12.26 dB	42.27 dBμV	-13.73 dB	Pass
6	914.823 kHz	46.38 dBμV	32.33 dBμV	-13.67 dB	41.42 dBμV	-14.58 dB	Pass

EUT	EUT 1 - NB3710
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, 24 VDC, see chapter 10
Test date, time	11.03.2015 09:30:54
Interface / Line under test	Ethernet 5
Transducer	CDN S8-RJ45
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [333.3 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms]

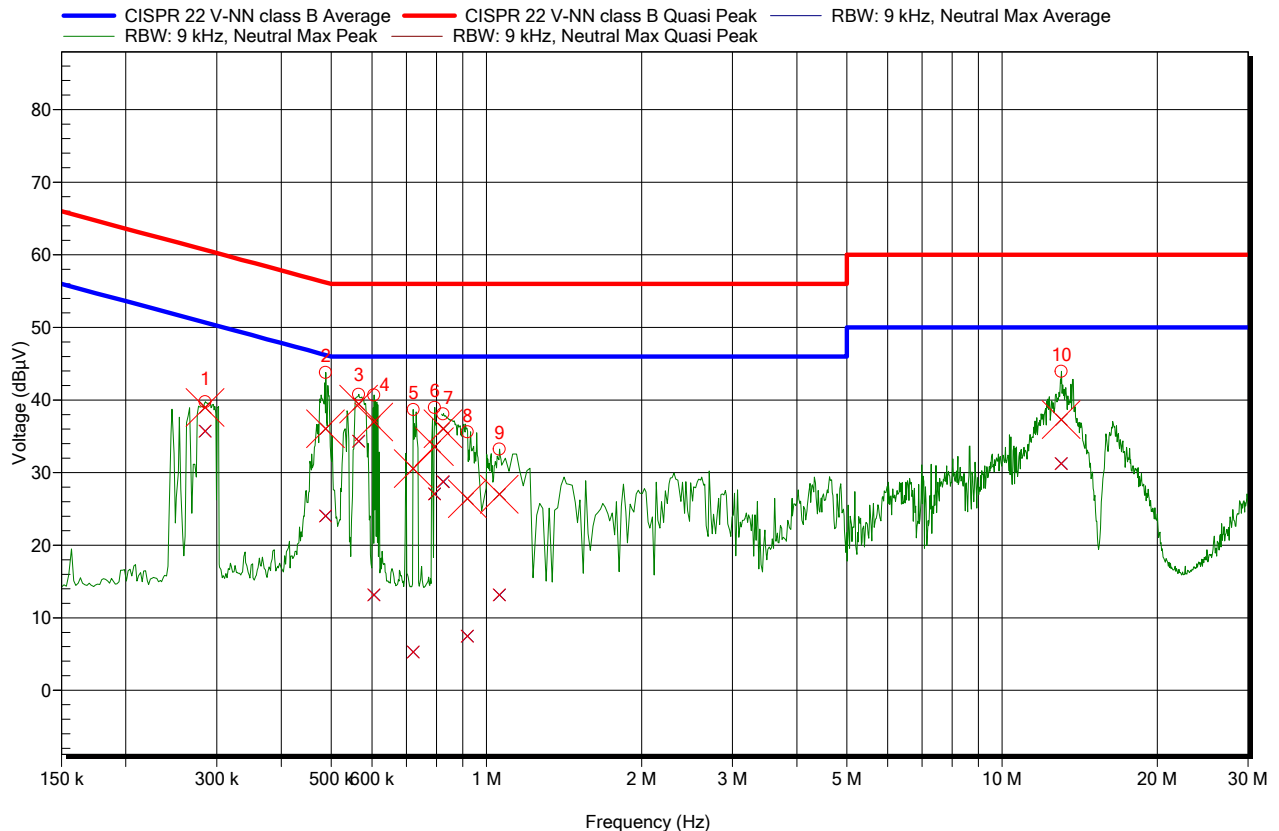


Detected peaks

None

Measurement Results EUT 2

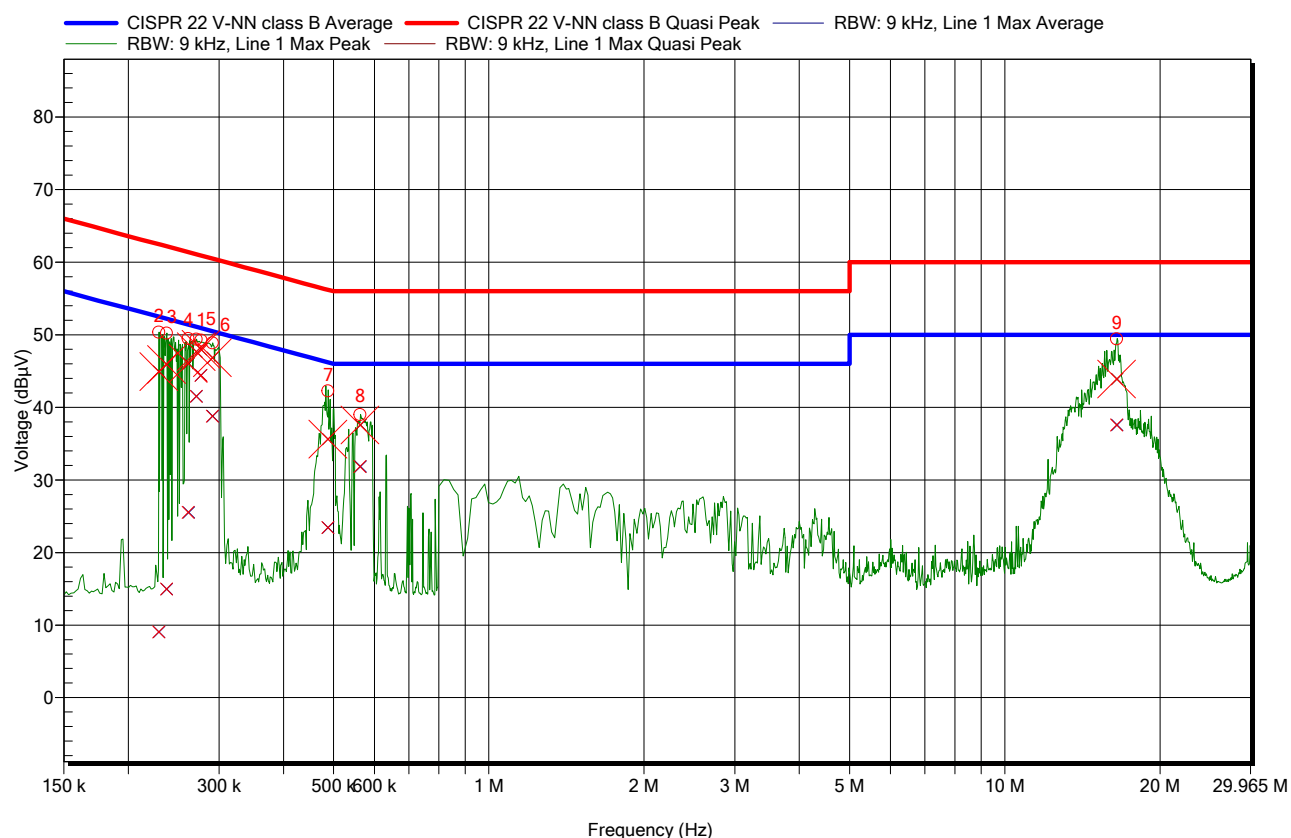
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 11:25:27
Interface / Line under test	Neg(-), 60 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [666.7 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	284.9 kHz	39.76 dBμV	35.71 dBμV	-14.96 dB	38.95 dBμV	-21.72 dB	Pass
2	487.708 kHz	43.82 dBμV	24.01 dBμV	-22.19 dB	36.02 dBμV	-20.18 dB	Pass
3	564.963 kHz	40.79 dBμV	34.31 dBμV	-11.69 dB	39.43 dBμV	-16.57 dB	Pass
4	604.85 kHz	40.68 dBμV	13.12 dBμV	-32.88 dB	36.95 dBμV	-19.05 dB	Pass
5	721.025 kHz	38.69 dBμV	5.26 dBμV	-40.74 dB	30.54 dBμV	-25.46 dB	Pass
6	792.728 kHz	38.96 dBμV	27.07 dBμV	-18.93 dB	33.58 dBμV	-22.42 dB	Pass
7	823.328 kHz	38.07 dBμV	28.73 dBμV	-17.27 dB	36.02 dBμV	-19.98 dB	Pass
8	918.234 kHz	35.63 dBμV	7.44 dBμV	-38.56 dB	26.42 dBμV	-29.58 dB	Pass
9	1.059 MHz	33.23 dBμV	13.14 dBμV	-32.86 dB	27.01 dBμV	-28.99 dB	Pass
10	13.005 MHz	43.96 dBμV	31.25 dBμV	-18.75 dB	37.31 dBμV	-22.69 dB	Pass

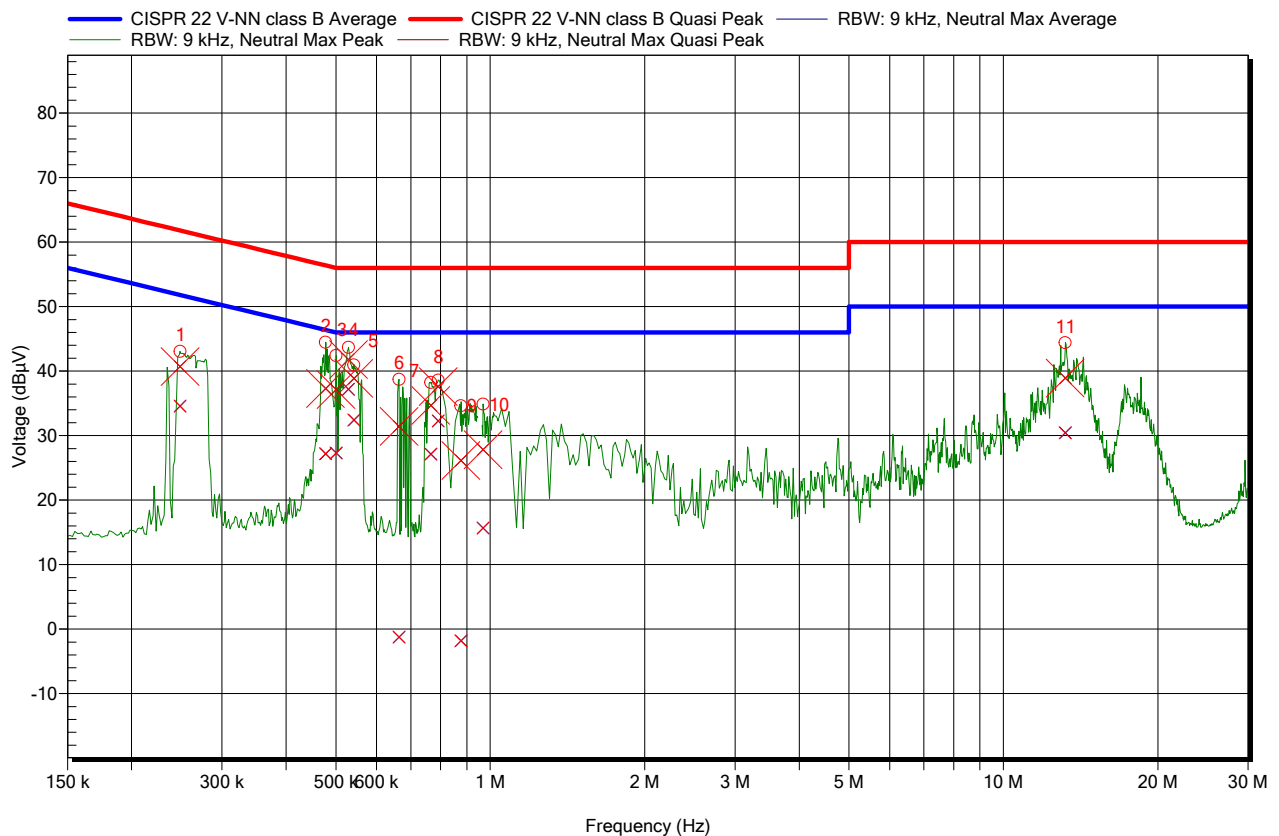
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 11:31:38
Interface / Line under test	Pos(+), 60 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [666.7 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	276.661 kHz	49.27 dBμV	44.4 dBμV	-6.52 dB	48.01 dBμV	-12.91 dB	Pass
2	229.249 kHz	50.36 dBμV	9.03 dBμV	-43.45 dB	44.93 dBμV	-17.55 dB	Pass
3	237.16 kHz	50.24 dBμV	14.97 dBμV	-37.22 dB	45.91 dBμV	-16.28 dB	Pass
4	261.489 kHz	49.47 dBμV	25.5 dBμV	-25.88 dB	46.03 dBμV	-15.35 dB	Pass
5	270.91 kHz	49.42 dBμV	41.55 dBμV	-9.54 dB	47.67 dBμV	-13.42 dB	Pass
6	291.025 kHz	48.89 dBμV	38.8 dBμV	-11.69 dB	46.81 dBμV	-13.68 dB	Pass
7	487.618 kHz	42.25 dBμV	23.42 dBμV	-22.78 dB	35.6 dBμV	-20.6 dB	Pass
8	562.536 kHz	39.01 dBμV	31.85 dBμV	-14.15 dB	37.57 dBμV	-18.43 dB	Pass
9	16.468 MHz	49.45 dBμV	37.57 dBμV	-12.43 dB	43.89 dBμV	-16.11 dB	Pass

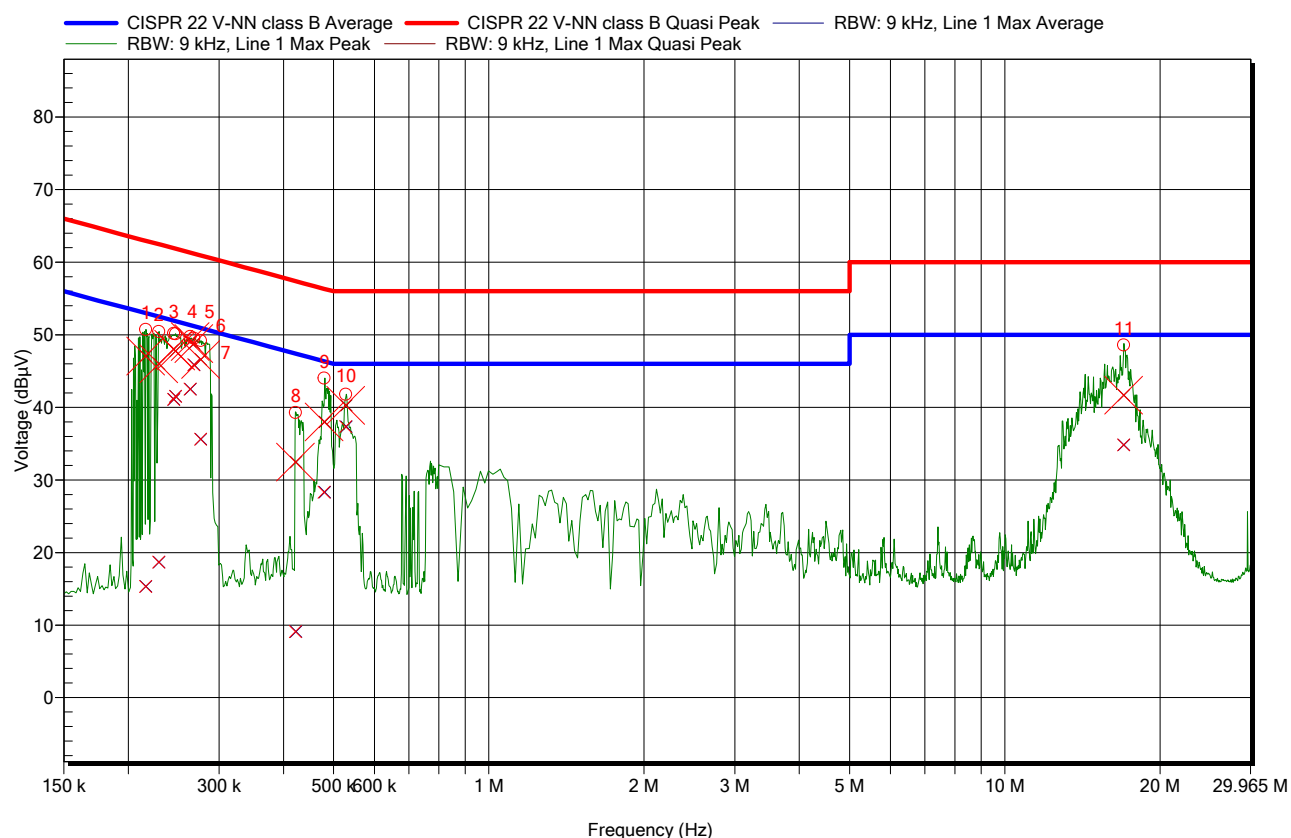
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 12:45:58
Interface / Line under test	Neg(-), 48 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [600 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	248.387 kHz	43.05 dBμV	34.59 dBμV	-17.22 dB	40.71 dBμV	-21.1 dB	Pass
2	477.314 kHz	44.48 dBμV	27.21 dBμV	-19.17 dB	37.28 dBμV	-19.1 dB	Pass
3	500.307 kHz	42.4 dBμV	27.27 dBμV	-18.73 dB	37.14 dBμV	-18.86 dB	Pass
4	529.229 kHz	43.68 dBμV	37.17 dBμV	-8.83 dB	41.81 dBμV	-14.19 dB	Pass
5	541.763 kHz	40.94 dBμV	32.43 dBμV	-13.57 dB	38.85 dBμV	-17.15 dB	Pass
6	663.638 kHz	38.72 dBμV	-1.22 dBμV	-47.22 dB	31.46 dBμV	-24.54 dB	Pass
7	765.718 kHz	38.24 dBμV	27.13 dBμV	-18.87 dB	34.66 dBμV	-21.34 dB	Pass
8	791.292 kHz	38.63 dBμV	32.27 dBμV	-13.73 dB	37.6 dBμV	-18.4 dB	Pass
9	876.758 kHz	34.62 dBμV	-1.82 dBμV	-47.82 dB	26.16 dBμV	-29.84 dB	Pass
10	967.791 kHz	34.9 dBμV	15.7 dBμV	-30.3 dB	27.8 dBμV	-28.2 dB	Pass
11	13.197 MHz	44.43 dBμV	30.46 dBμV	-19.54 dB	38.91 dBμV	-21.09 dB	Pass

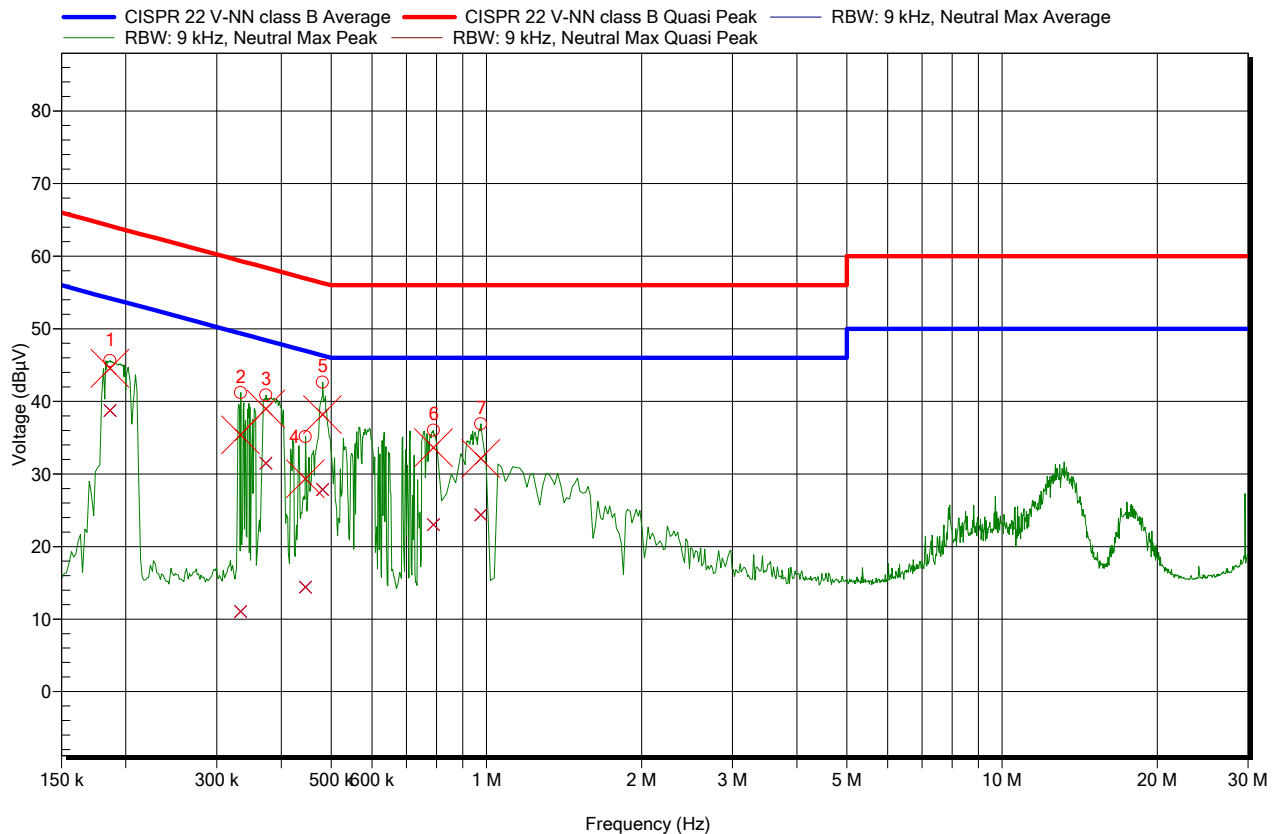
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 12:52:23
Interface / Line under test	Pos(+), 48 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [666.7 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	216.152 kHz	50.75 dBμV	15.32 dBμV	-37.64 dB	47.08 dBμV	-15.88 dB	Pass
2	229.085 kHz	50.49 dBμV	18.66 dBμV	-33.82 dB	46 dBμV	-16.48 dB	Pass
3	244.791 kHz	50.18 dBμV	41.13 dBμV	-10.81 dB	47.99 dBμV	-13.95 dB	Pass
4	247.015 kHz	50.16 dBμV	41.55 dBμV	-10.31 dB	47.78 dBμV	-14.08 dB	Pass
5	263.663 kHz	49.76 dBμV	42.52 dBμV	-8.79 dB	49.06 dBμV	-12.25 dB	Pass
6	268.272 kHz	49.56 dBμV	45.86 dBμV	-5.31 dB	48.79 dBμV	-12.38 dB	Pass
7	276.426 kHz	49.23 dBμV	35.61 dBμV	-15.31 dB	46.61 dBμV	-14.31 dB	Pass
8	422.137 kHz	39.28 dBμV	9.08 dBμV	-38.33 dB	32.48 dBμV	-24.93 dB	Pass
9	479.763 kHz	44.06 dBμV	28.31 dBμV	-18.03 dB	37.99 dBμV	-18.35 dB	Pass
10	527.983 kHz	41.83 dBμV	37.36 dBμV	-8.64 dB	40.29 dBμV	-15.71 dB	Pass
11	16.984 MHz	48.58 dBμV	34.81 dBμV	-15.19 dB	41.66 dBμV	-18.34 dB	Pass

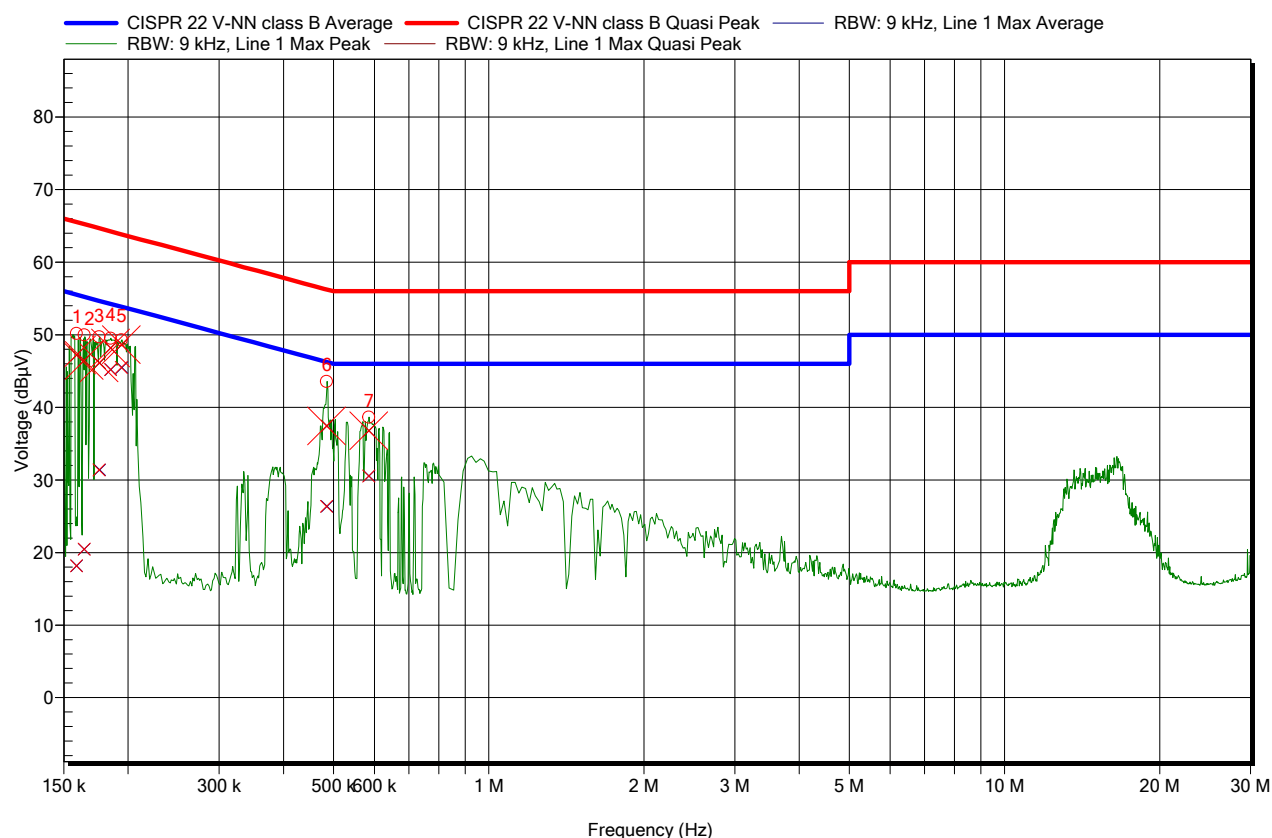
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 12:40:08
Interface / Line under test	Neg(-), 25 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [54.2 ms], Step freq: Fixed step count: 401 steps per Band, Attenuator: 10 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms], Measurement equipment: CE 9k-30M HP8542E V-LISN PE7627



Detected peaks

Peak Number	Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
1	186.102 kHz	45.64 dBμV	38.75 dBμV	-15.46 dB	44.57 dBμV	-19.64 dB	Pass
2	333.613 kHz	41.18 dBμV	11.06 dBμV	-38.3 dB	35.38 dBμV	-23.98 dB	Pass
3	373.728 kHz	40.87 dBμV	31.47 dBμV	-16.95 dB	38.95 dBμV	-19.47 dB	Pass
4	445.195 kHz	35.15 dBμV	14.39 dBμV	-32.58 dB	29.33 dBμV	-27.64 dB	Pass
5	480.796 kHz	42.65 dBμV	27.86 dBμV	-18.46 dB	38.2 dBμV	-18.12 dB	Pass
6	789.227 kHz	36.02 dBμV	23.02 dBμV	-22.98 dB	33.62 dBμV	-22.38 dB	Pass
7	975.332 kHz	36.94 dBμV	24.37 dBμV	-21.63 dB	32.11 dBμV	-23.89 dB	Pass

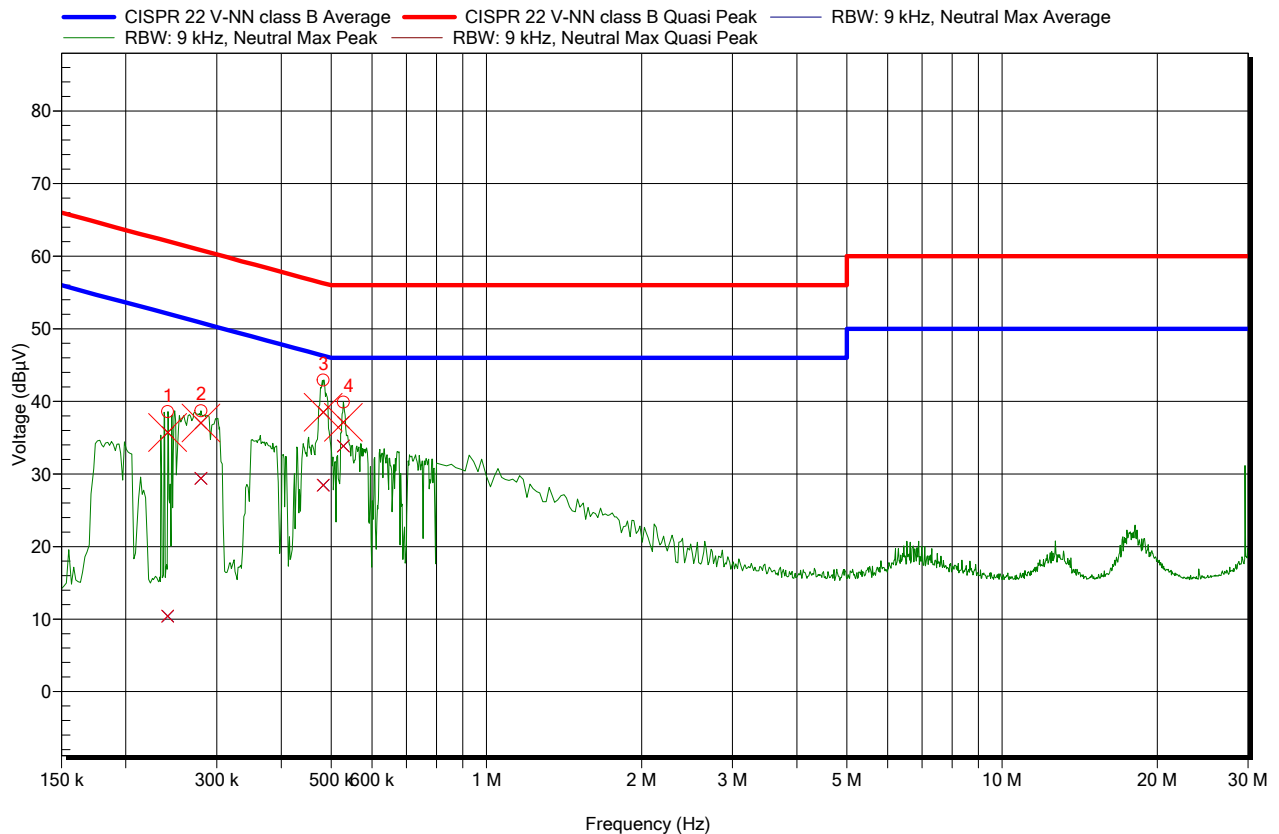
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 12:27:29
Interface / Line under test	Pos(+), 25 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [1.2 s], 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	158.618 kHz	50.17 dBμV	18.18 dBμV	-37.35 dB	47.21 dBμV	-18.32 dB	Pass
2	164.252 kHz	50.02 dBμV	20.46 dBμV	-34.79 dB	46.49 dBμV	-18.76 dB	Pass
3	175.678 kHz	49.7 dBμV	31.4 dBμV	-23.28 dB	46.13 dBμV	-18.55 dB	Pass
4	184.92 kHz	49.53 dBμV	45.23 dBμV	-9.03 dB	48.17 dBμV	-16.09 dB	Pass
5	193.893 kHz	49.31 dBμV	45.49 dBμV	-8.38 dB	48.64 dBμV	-15.23 dB	Pass
6	484.661 kHz	43.57 dBμV	26.34 dBμV	-19.92 dB	37.41 dBμV	-18.85 dB	Pass
7	584.955 kHz	38.66 dBμV	30.56 dBμV	-15.44 dB	36.8 dBμV	-19.2 dB	Pass

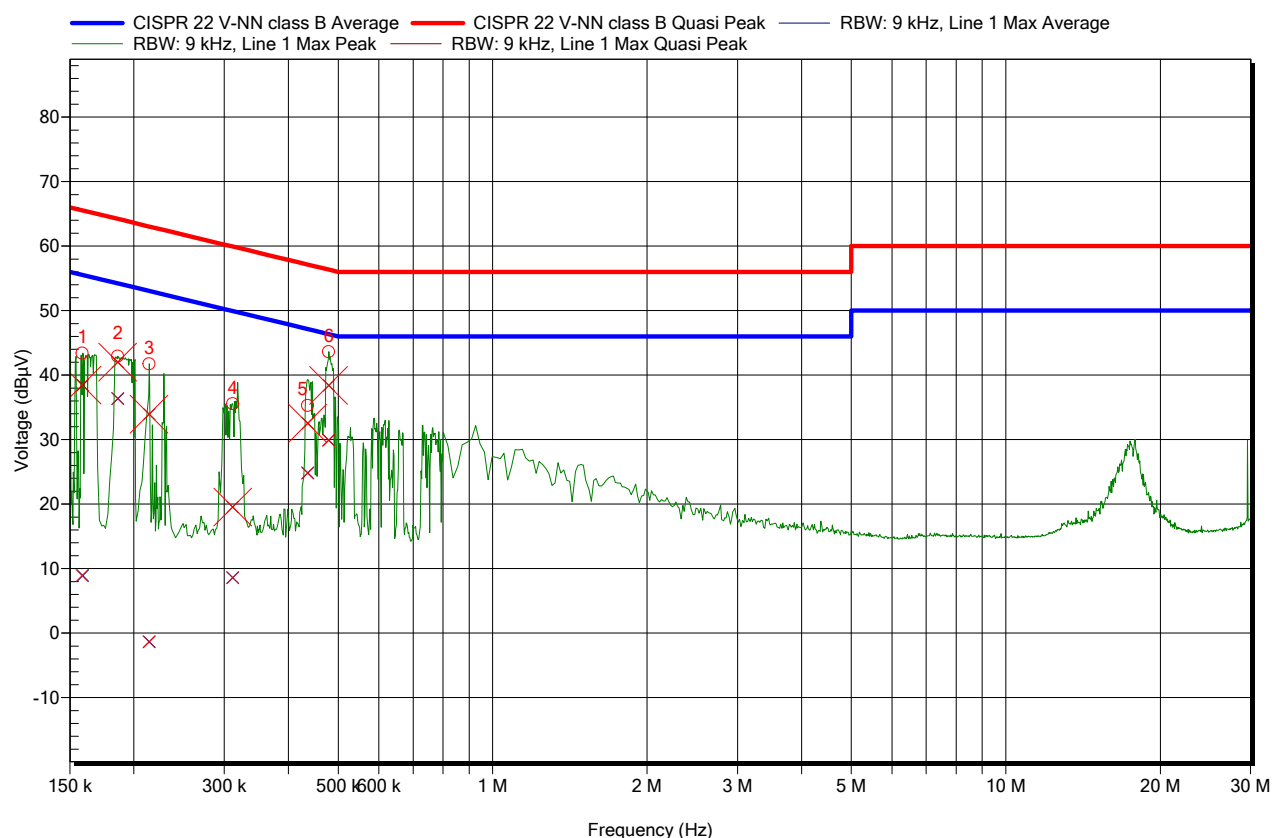
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 13:03:27
Interface / Line under test	Neg(-), 12 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [54.2 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	240.93 kHz	38.61 dBμV	10.37 dBμV	-41.69 dB	35.73 dBμV	-26.33 dB	Pass
2	279.676 kHz	38.71 dBμV	29.39 dBμV	-21.43 dB	37.01 dBμV	-23.81 dB	Pass
3	482.815 kHz	42.92 dBμV	28.46 dBμV	-17.83 dB	38.48 dBμV	-17.81 dB	Pass
4	527.893 kHz	39.89 dBμV	33.86 dBμV	-12.14 dB	37.1 dBμV	-18.9 dB	Pass

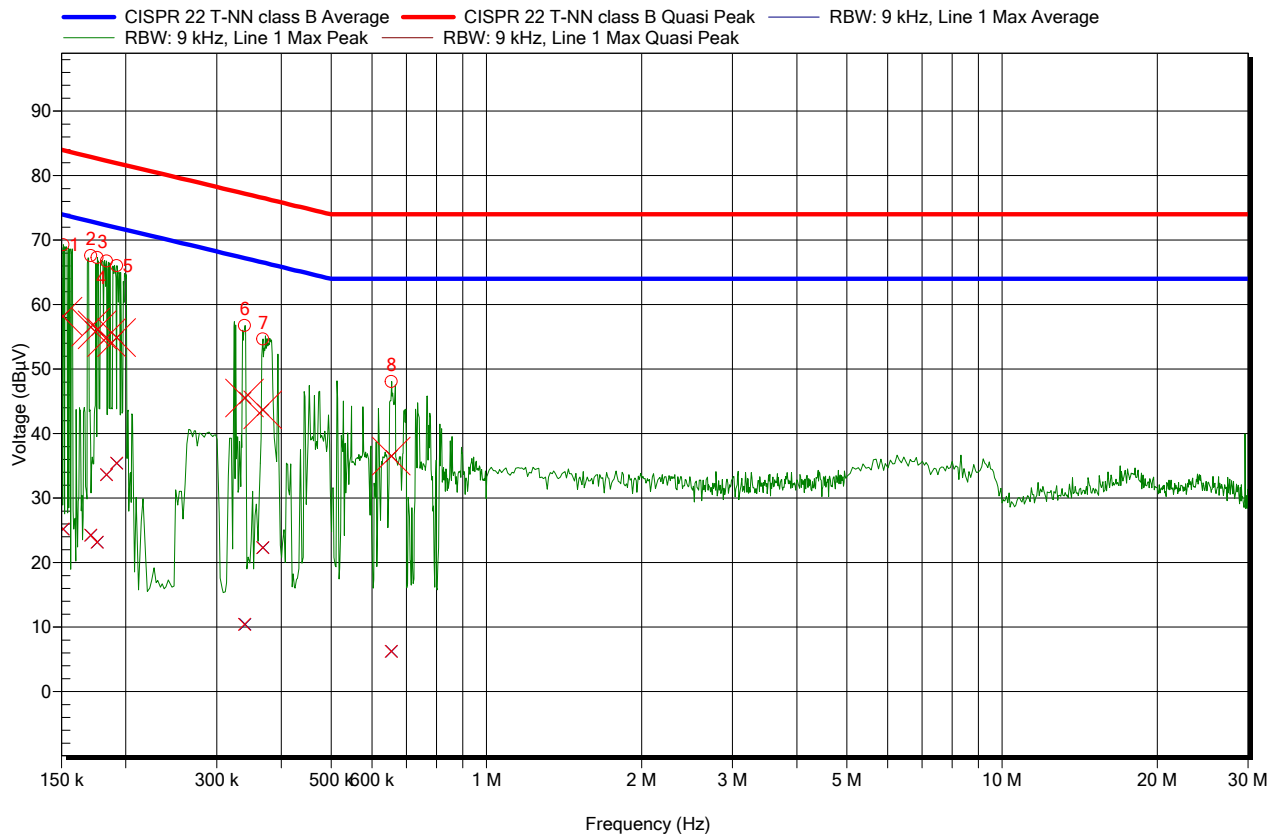
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, see chapter 10
Test date, time	11.03.2015 13:00:19
Interface / Line under test	Pos(+), 12 VDC
Transducer	V-LISN ESH3-Z5
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [1.2 s], 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	158.581 kHz	43.43 dBμV	8.92 dBμV	-46.62 dB	38.47 dBμV	-27.07 dB	Pass
2	185.973 kHz	42.96 dBμV	36.35 dBμV	-17.87 dB	42.03 dBμV	-22.19 dB	Pass
3	213.943 kHz	41.76 dBμV	-1.32 dBμV	-54.37 dB	33.94 dBμV	-29.11 dB	Pass
4	311.658 kHz	35.59 dBμV	8.63 dBμV	-41.3 dB	19.54 dBμV	-40.39 dB	Pass
5	435.594 kHz	35.32 dBμV	24.84 dBμV	-22.31 dB	32.55 dBμV	-24.6 dB	Pass
6	478.945 kHz	43.64 dBμV	29.92 dBμV	-16.43 dB	38.39 dBμV	-17.96 dB	Pass

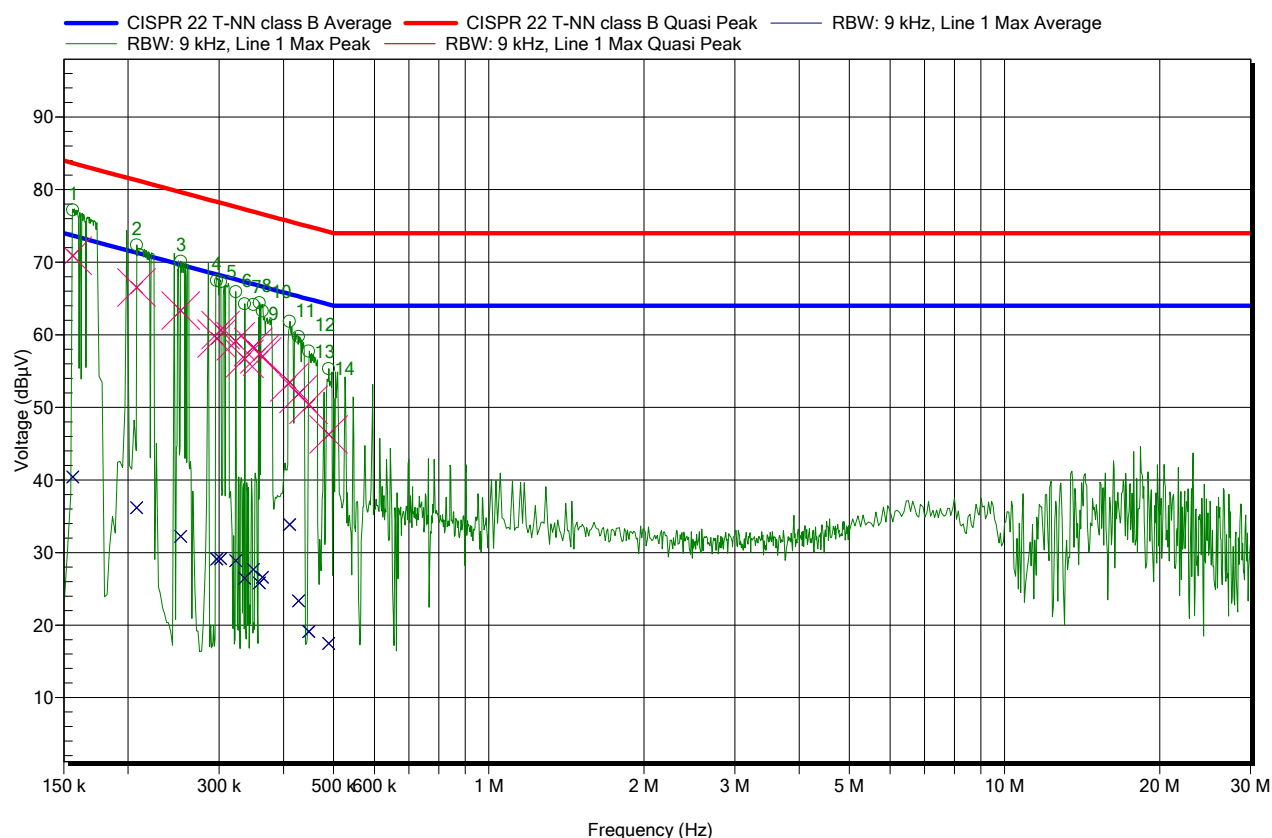
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, 12 VDC, see chapter 10
Test date, time	11.03.2015 13:12:19
Interface / Line under test	Ethernet 4
Transducer	CDN S8-RJ45
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [70.8 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	150.943 kHz	69.31 dBμV	25.18 dBμV	-48.77 dB	58.21 dBμV	-25.74 dB	Pass
2	170.805 kHz	67.61 dBμV	24.28 dBμV	-48.64 dB	56.52 dBμV	-26.4 dB	Pass
3	175.963 kHz	67.28 dBμV	23.18 dBμV	-49.49 dB	56.07 dBμV	-26.6 dB	Pass
4	183.419 kHz	66.78 dBμV	33.61 dBμV	-38.72 dB	54.91 dBμV	-27.42 dB	Pass
5	191.898 kHz	66.02 dBμV	35.39 dBμV	-36.56 dB	54.87 dBμV	-27.08 dB	Pass
6	339.499 kHz	56.76 dBμV	10.43 dBμV	-56.79 dB	45.54 dBμV	-31.68 dB	Pass
7	368.651 kHz	54.66 dBμV	22.32 dBμV	-44.21 dB	43.69 dBμV	-32.84 dB	Pass
8	653.893 kHz	48.08 dBμV	6.27 dBμV	-57.73 dB	36.51 dBμV	-37.49 dB	Pass

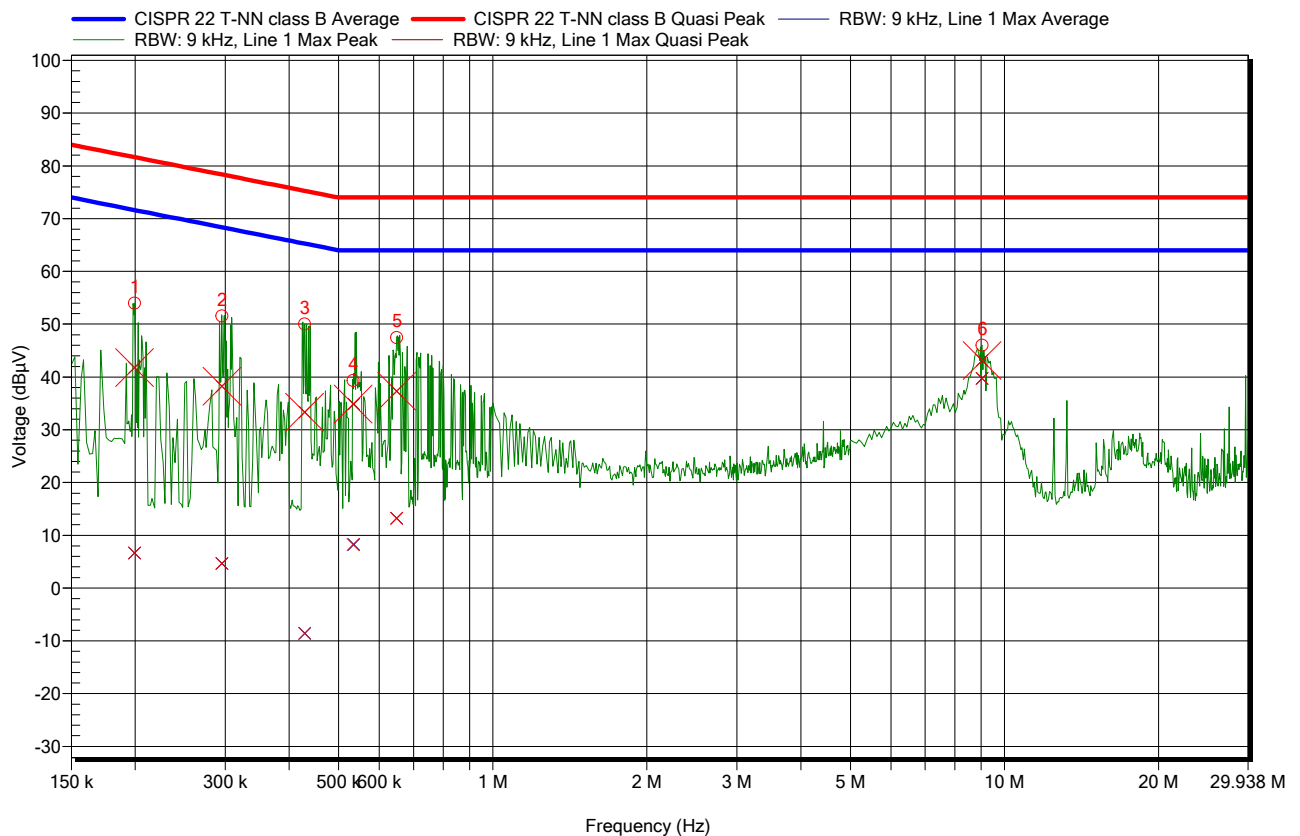
EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, 24 VDC, see chapter 10
Test date, time	11.03.2015 13:35:57
Interface / Line under test	Ethernet 8
Transducer	CDN S8-RJ45
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [333.3 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	156.107 kHz	77.21 dBμV	40.43 dBμV	-33.24 dB	70.88 dBμV	-12.79 dB	Pass
2	207.653 kHz	72.37 dBμV	36.19 dBμV	-35.11 dB	66.5 dBμV	-14.8 dB	Pass
3	252.641 kHz	70.15 dBμV	32.2 dBμV	-37.47 dB	63.36 dBμV	-16.31 dB	Pass
4	296.596 kHz	67.48 dBμV	29.08 dBμV	-39.26 dB	59.49 dBμV	-18.85 dB	Pass
5	301.978 kHz	67.33 dBμV	29.13 dBμV	-39.06 dB	60.65 dBμV	-17.54 dB	Pass
6	322.995 kHz	65.97 dBμV	28.88 dBμV	-38.75 dB	59.14 dBμV	-18.49 dB	Pass
7	335.883 kHz	64.3 dBμV	26.46 dBμV	-40.84 dB	56.71 dBμV	-20.59 dB	Pass
8	349.479 kHz	64.2 dBμV	27.66 dBμV	-39.31 dB	58.33 dBμV	-18.64 dB	Pass
9	358.865 kHz	64.44 dBμV	25.79 dBμV	-40.96 dB	57.31 dBμV	-19.44 dB	Pass
10	363.918 kHz	63.32 dBμV	26.6 dBμV	-40.04 dB	57.02 dBμV	-19.62 dB	Pass
11	410.915 kHz	61.86 dBμV	33.87 dBμV	-31.76 dB	53.45 dBμV	-22.18 dB	Pass
12	427.803 kHz	59.77 dBμV	23.31 dBμV	-41.99 dB	51.88 dBμV	-23.42 dB	Pass
13	447.673 kHz	57.77 dBμV	19.08 dBμV	-45.84 dB	50.39 dBμV	-24.53 dB	Pass
14	489.264 kHz	55.34 dBμV	17.46 dBμV	-46.72 dB	46.28 dBμV	-27.9 dB	Pass

EUT	EUT 2 - NB3720
Verdict, Test	Pass, Class B
Modification	See chapter 14
Mode of operation	Normal mode, 12 VDC, see chapter 10
Test date, time	11.03.2015 13:19:14
Interface / Line under test	CAN
Transducer	CDN S8-RJ45
Measurement settings	Radimation Version: 2014.2.8, RBW: 9 kHz, VBW: 30 kHz, Sweep time: Auto [2.1 s], 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	199.279 kHz	54.03 dBμV	6.67 dBμV	-64.97 dB	41.77 dBμV	-39.87 dB	Pass
2	295.314 kHz	51.57 dBμV	4.67 dBμV	-63.7 dB	38.25 dBμV	-40.12 dB	Pass
3	428.441 kHz	50 dBμV	-8.61 dBμV	-73.89 dB	33.33 dBμV	-41.95 dB	Pass
4	533.594 kHz	39.33 dBμV	8.27 dBμV	-55.73 dB	34.84 dBμV	-39.16 dB	Pass
5	648.701 kHz	47.45 dBμV	13.24 dBμV	-50.76 dB	37.3 dBμV	-36.7 dB	Pass
6	9.038 MHz	45.99 dBμV	39.76 dBμV	-24.24 dB	43.12 dBμV	-30.88 dB	Pass

11.2 Radiated Electromagnetic Field

Test site: semi-anechoic chamber (hybrid)

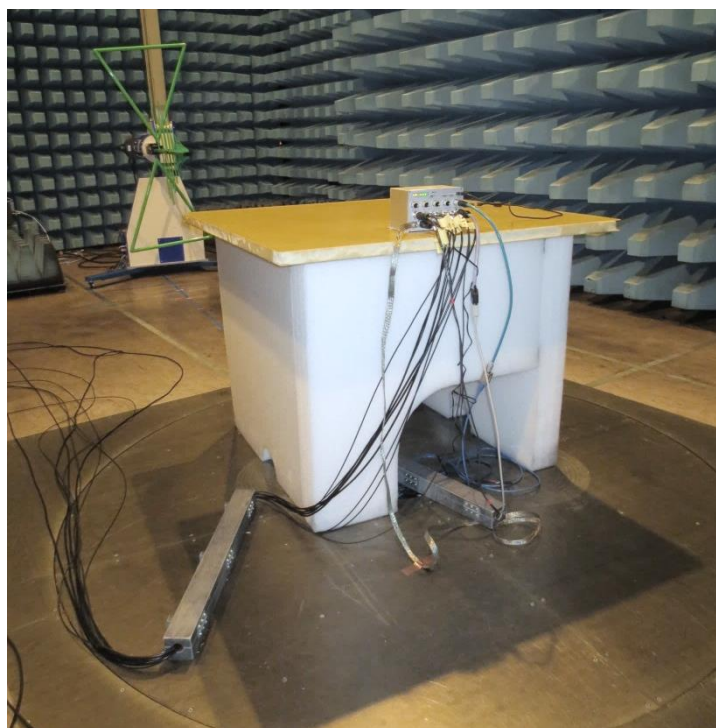
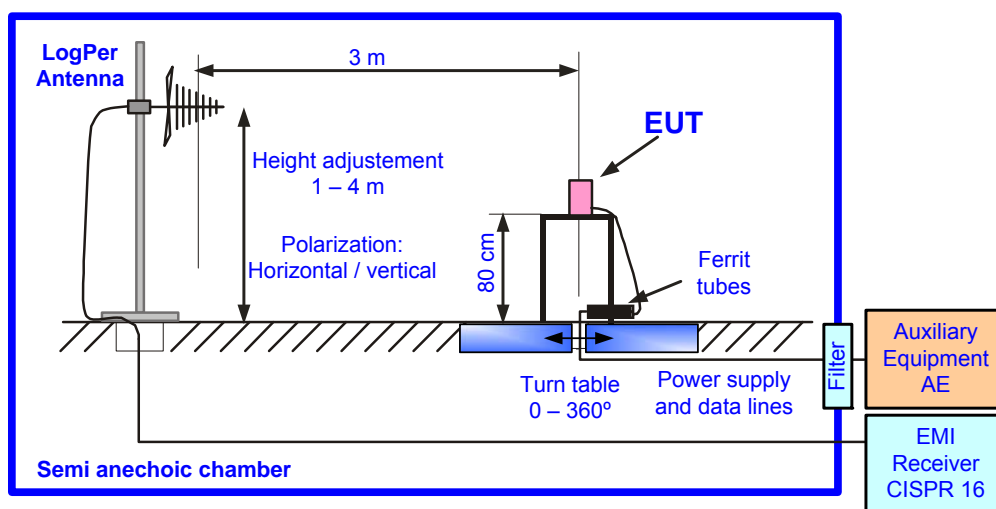
Distance: 3 m

Meas. uncertainty: see chapter 13

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

Modifications: see chapter 14

Test Setup

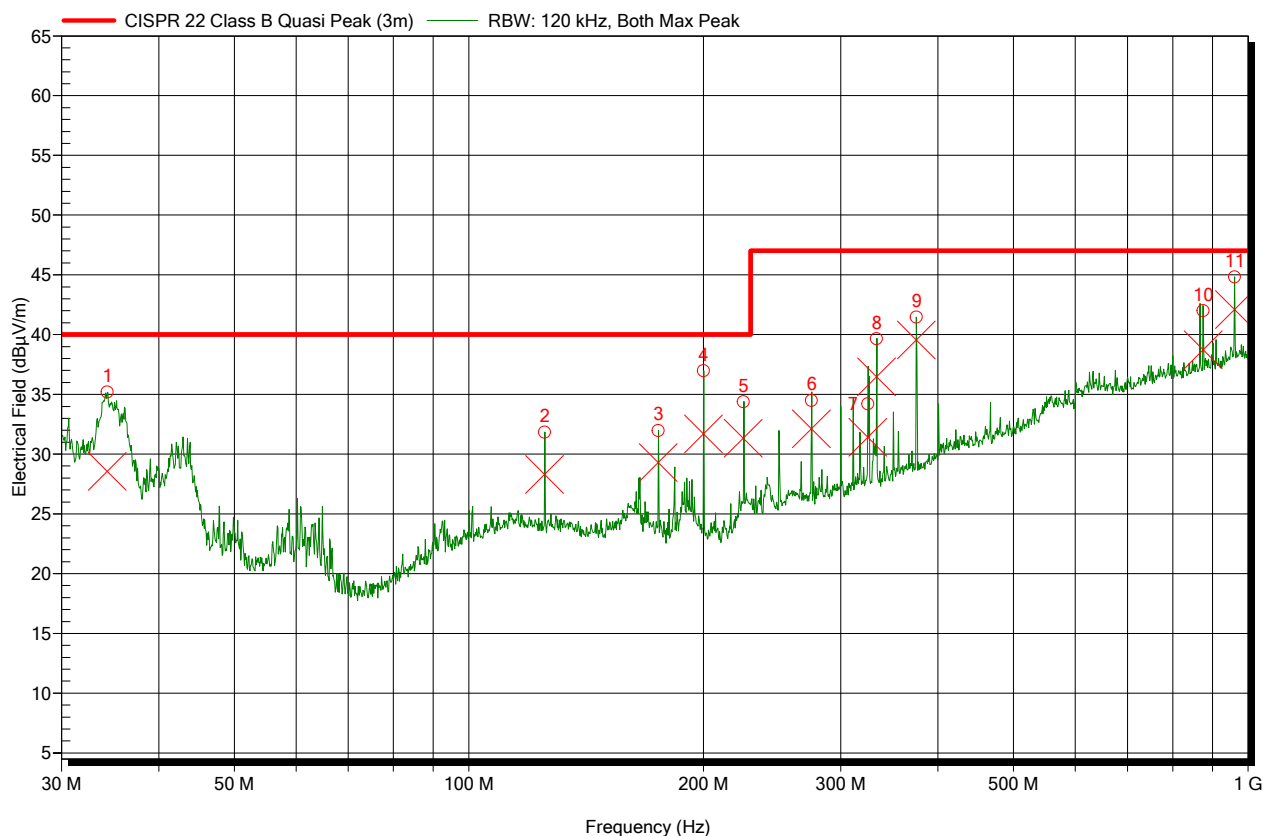


Test Equipment

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

Measurement Results EUT 1

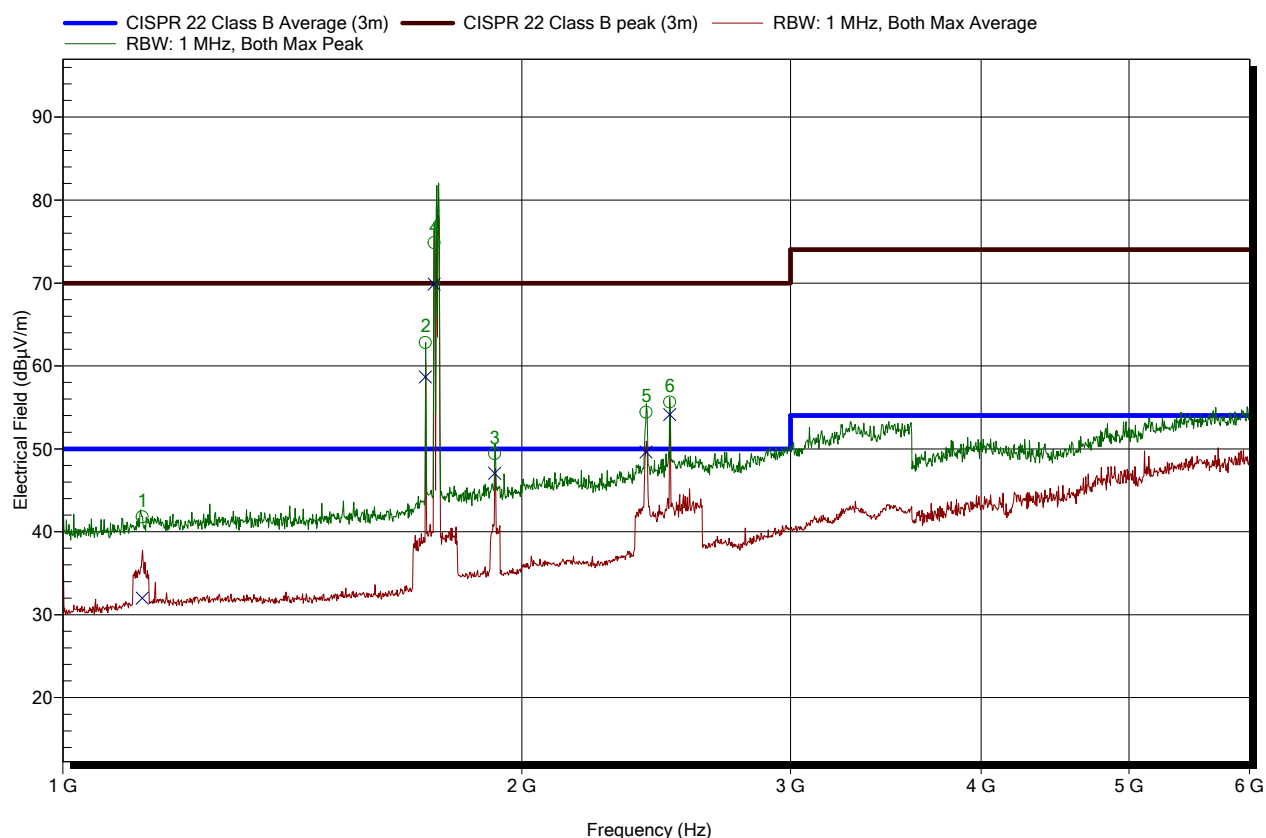
EUT	EUT 1: NB3710		
Verdict, Test	Pass, Class B		
Modification	See chapter 14		
Mode of operation	Normal mode, see chapter 10.4		
Test date, time	27/02/2015 09:53:27		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.1.7, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10 dB], Internal preamp: 20 dB, Measure time: 10 ms		



Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	34.35 MHz	35.2 dBμV/m	28.55 dBμV/m	-11.45 dB	Pass	90 Degree	3 m	Vertical
2	125.01 MHz	31.85 dBμV/m	28.3 dBμV/m	-11.7 dB	Pass	240 Degree	1 m	Vertical
3	174.99 MHz	31.98 dBμV/m	29.31 dBμV/m	-10.69 dB	Pass	210 Degree	1 m	Vertical
4	200.01 MHz	36.99 dBμV/m	31.69 dBμV/m	-8.31 dB	Pass	270 Degree	1 m	Vertical
5	225 MHz	34.37 dBμV/m	31.33 dBμV/m	-8.67 dB	Pass	180 Degree	1 m	Vertical
6	275.01 MHz	34.49 dBμV/m	32.11 dBμV/m	-14.89 dB	Pass	120 Degree	2 m	Horizontal
7	324.99 MHz	34.21 dBμV/m	31.43 dBμV/m	-15.57 dB	Pass	120 Degree	1 m	Horizontal
8	333.33 MHz	39.68 dBμV/m	36.48 dBμV/m	-10.52 dB	Pass	120 Degree	1 m	Horizontal
9	375 MHz	41.46 dBμV/m	39.56 dBμV/m	-7.44 dB	Pass	90 Degree	1 m	Horizontal
10	875.01 MHz	42.01 dBμV/m	38.74 dBμV/m	-8.26 dB	Pass	150 Degree	1 m	Horizontal
11	960.21 MHz	44.84 dBμV/m	42.11 dBμV/m	-4.89 dB	Pass	180 Degree	1 m	Horizontal

EUT	EUT 1: NB3710		
Verdict, Test	PASS Test 3: 1G-6G CISPR 22 Class B 3m		
Modification	See chapter 14		
Mode of operation	Normal mode, see chapter 10.4		
Test date, time	27/02/2015 10:18:22		
Antenna height	1 m - 2 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimant Version: 2014.1.7, RBW: 1 MHz, VBW: 1 MHz, Sweep time: Auto [35 ms], Step freq: Fixed step count: 9 * 1e+3 steps per Band, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 1 ms, Measurement equipment: RE_1-8GHz_ESU8_Inp1_TD_EMCO3115		



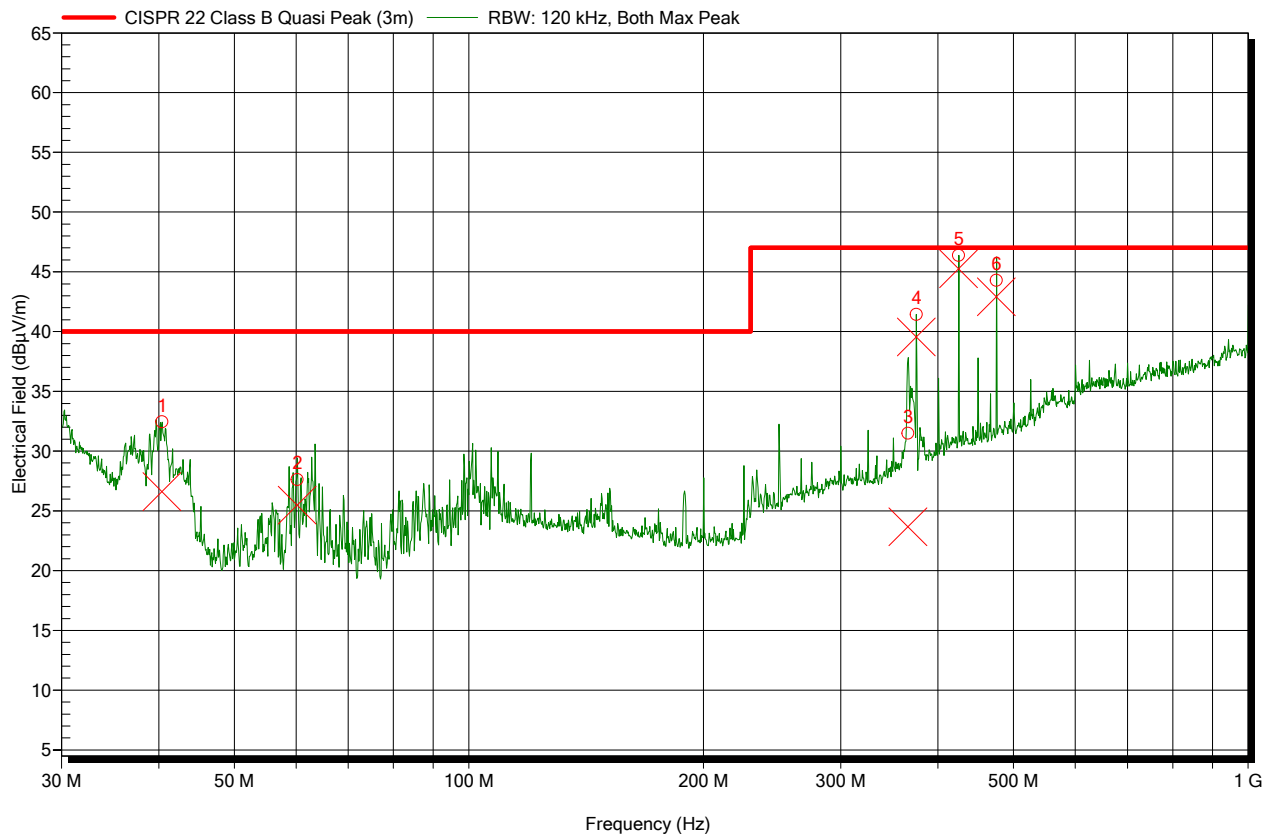
Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.127 GHz	41.81 dBμV/m	-28.19 dB	31.99 dBμV/m	-18.01 dB	Pass	0 Degree	1 m	Horizontal
2	1.729 GHz	62.82 dBμV/m	-7.18 dB	58.68 dBμV/m	8.68 dB	Note	210 Degree	2 m	Vertical
3	1.919 GHz	49.41 dBμV/m	-20.59 dB	47.07 dBμV/m	-2.93 dB	Pass	300 Degree	1 m	Horizontal
4	1.752 GHz	74.88 dBμV/m	4.88 dB	69.85 dBμV/m	19.85 dB	Note	300 Degree	1 m	Vertical
5	2.413 GHz	54.44 dBμV/m	-15.56 dB	49.62 dBμV/m	-0.38 dB	Note	330 Degree	1 m	Vertical
6	2.5 GHz	55.65 dBμV/m	-14.35 dB	54.14 dBμV/m	4.14 dB	Note	240 Degree	1 m	Horizontal

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

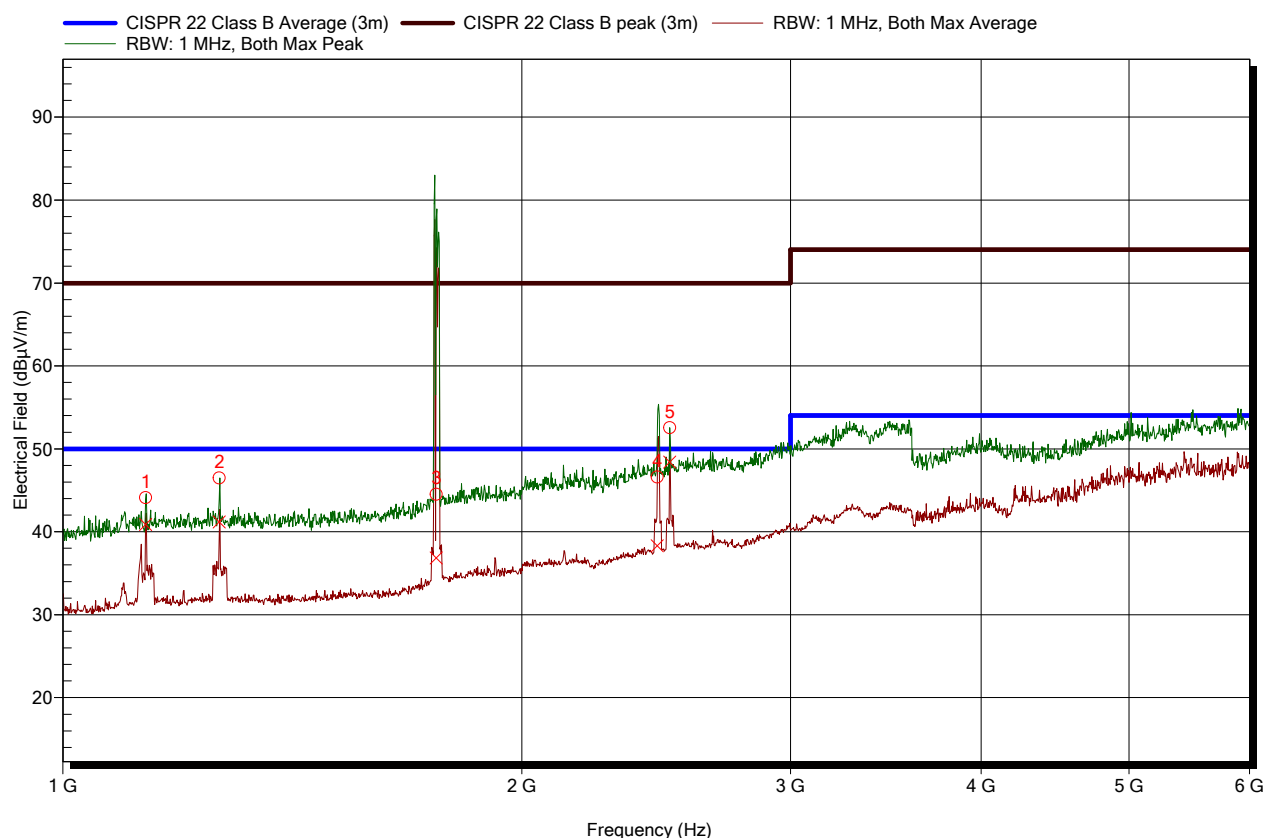
Measurement Results EUT 2

EUT	EUT 2: NB3720		
Verdict, Test	PASS Test 39: ESU8_30M-1G CISPR 22 Class B 3m		
Modification	See chapter 14		
Mode of operation	Normal mode, see chapter 10.4		
Test date, time	27/02/2015 16:54:55		
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: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10 dB], Internal preamp: 20 dB, Measure time: 10 ms		

**Detected peaks**

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	40.35 MHz	32.46 dBμV/m	26.63 dBμV/m	-13.37 dB	Pass	180 Degree	1 m	Vertical
2	60.18 MHz	27.63 dBμV/m	25.5 dBμV/m	-14.5 dB	Pass	210 Degree	1 m	Vertical
3	366.03 MHz	31.51 dBμV/m	23.66 dBμV/m	-23.34 dB	Pass	330 Degree	2 m	Horizontal
4	375 MHz	41.46 dBμV/m	39.55 dBμV/m	-7.45 dB	Pass	300 Degree	1 m	Horizontal
5	425.01 MHz	46.39 dBμV/m	45.27 dBμV/m	-1.73 dB	Pass	30 Degree	1 m	Horizontal
6	474.99 MHz	44.31 dBμV/m	42.91 dBμV/m	-4.09 dB	Pass	30 Degree	1 m	Vertical

EUT	EUT 2: NB3720		
Verdict, Test	PASS Test 38: 1G-6G CISPR 22 Class B 3m		
Modification	See chapter 14		
Mode of operation	Normal mode, see chapter 10.4		
Test date, time	27/02/2015 16:17:54		
Antenna height	1 m - 2 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimant Version: 2014.1.7, RBW: 1 MHz, VBW: 1 MHz, Sweep time: Auto [35 ms], Step freq: Fixed step count: 9 * 1e+3 steps per Band, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 1 ms, Measurement equipment: RE_1-8GHz_ESU8_Inp1_TD_EMCO3115		



Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.133 GHz	44.13 dBμV/m	-25.87 dB	40.86 dBμV/m	-9.14 dB	Pass	180 Degree	2 m	Vertical
2	1.266 GHz	46.48 dBμV/m	-23.52 dB	41.21 dBμV/m	-8.79 dB	Pass	180 Degree	1 m	Vertical
3	1.757 GHz	44.53 dBμV/m	-25.47 dB	36.84 dBμV/m	-13.16 dB	Pass	180 Degree	2 m	Horizontal
4	2.453 GHz	46.59 dBμV/m	-23.41 dB	38.31 dBμV/m	-11.69 dB	Note	60 Degree	2 m	Horizontal
5	2.5 GHz	52.55 dBμV/m	-17.45 dB	48.39 dBμV/m	-1.61 dB	Note	0 Degree	1 m	Vertical

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

11.3 Radiated Emission - Electromagnetic Field - FCC

Test site: semi-anechoic chamber (hybrid)

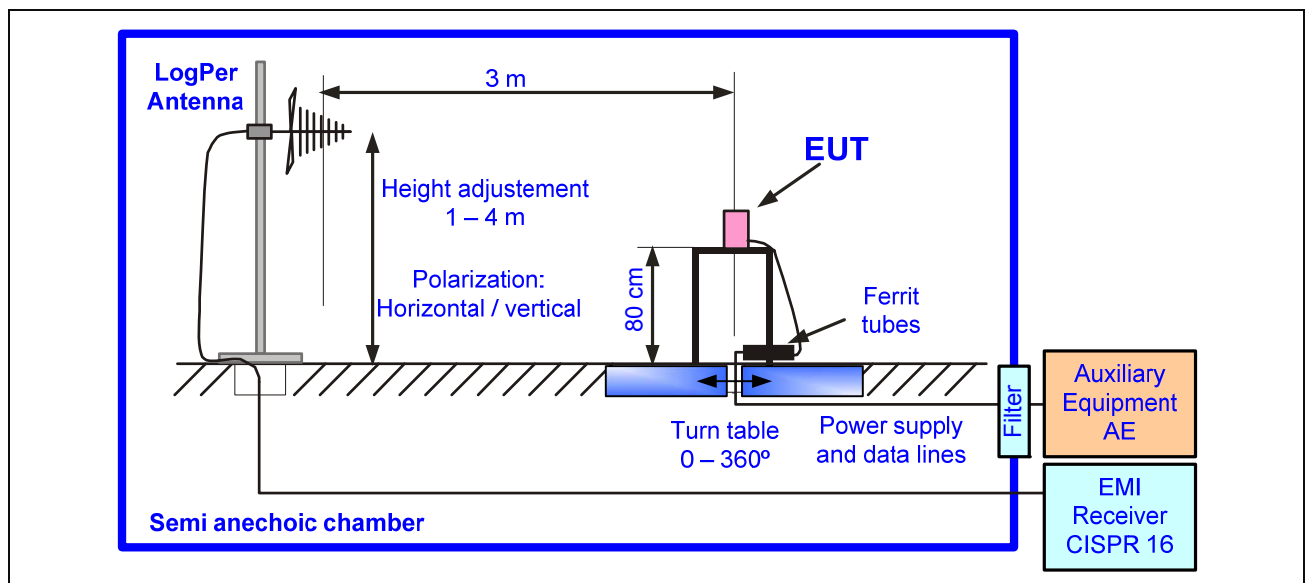
Distance: 3 m

Meas. uncertainty: see chapter 13

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

see chapter 14

Test Setup

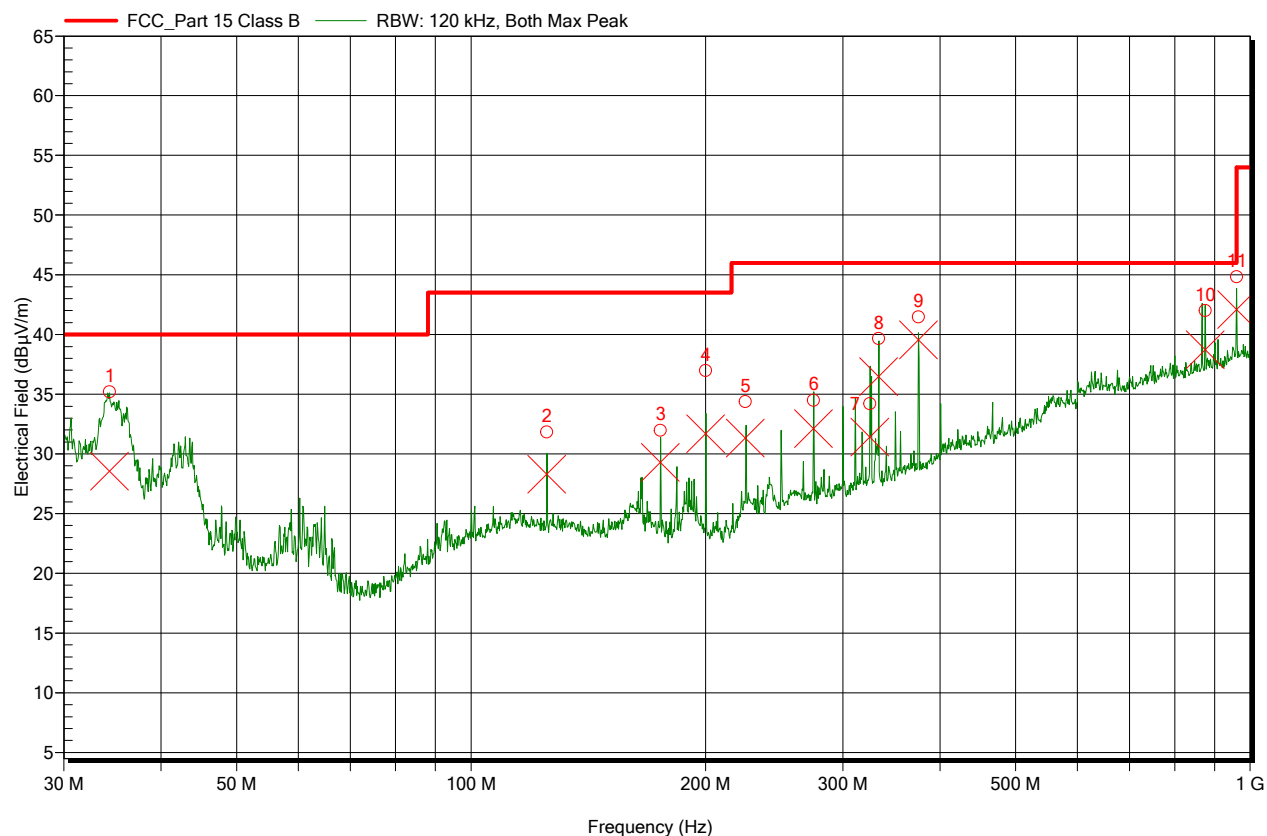


Test Equipment

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

Measurement Results EUT 1

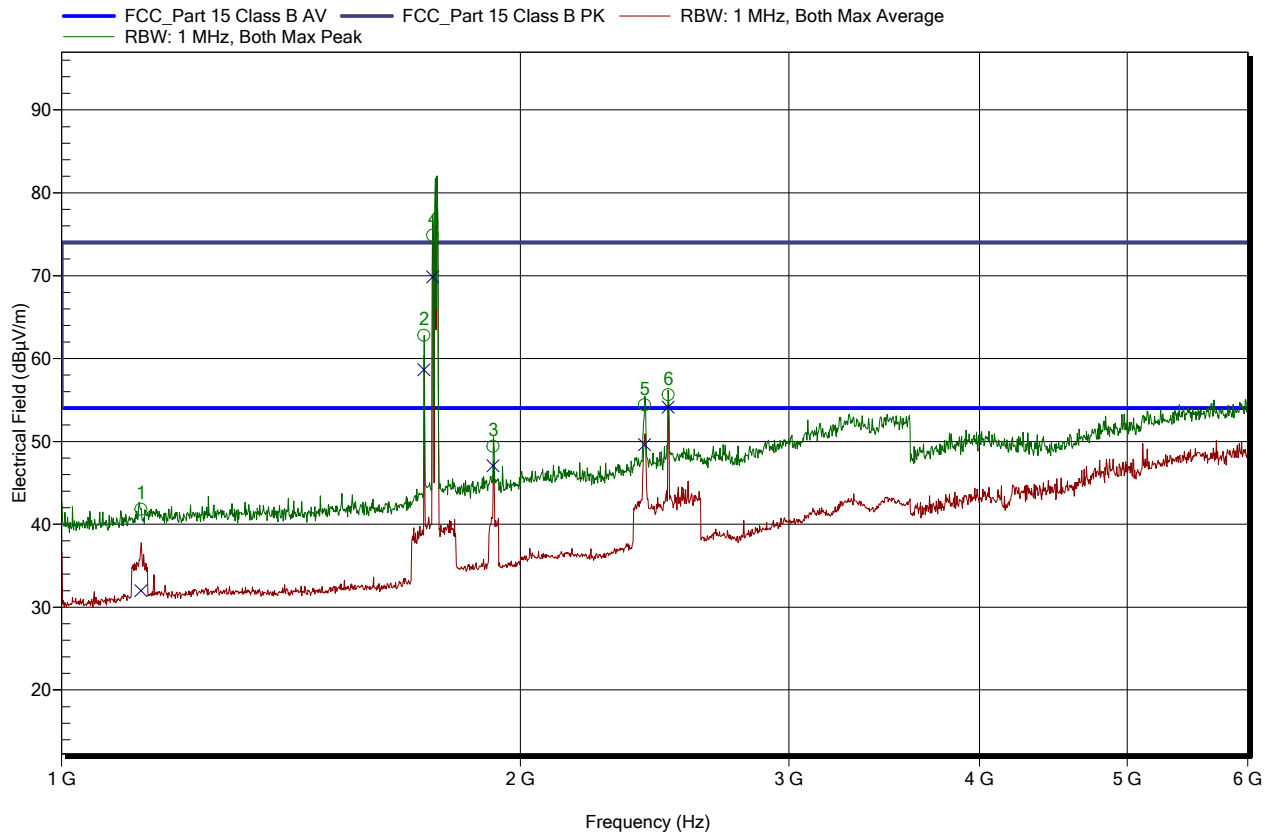
EUT	EUT 1: NB3710		
Verdict, Test	Pass, Class B		
Modification	See chapter 14		
Mode of operation	Normal mode, see chapter 10.4		
Test date, time	27.02.2015 09:53:27		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.2.8, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10 dB], Internal preamp: 20 dB, Measure time: 10 ms, Measurement equipment: RE_30M-2GHz_ESU8_Inp1_CBL6112B_TD		



Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	34.35 MHz	35.2 dBμV/m	28.55 dBμV/m	-11.45 dB	Pass	90 Degree	3 m	Vertical
2	125.01 MHz	31.85 dBμV/m	28.3 dBμV/m	-15.2 dB	Pass	240 Degree	1 m	Vertical
3	174.99 MHz	31.98 dBμV/m	29.31 dBμV/m	-14.19 dB	Pass	210 Degree	1 m	Vertical
4	200.01 MHz	36.99 dBμV/m	31.69 dBμV/m	-11.81 dB	Pass	270 Degree	1 m	Vertical
5	225 MHz	34.37 dBμV/m	31.33 dBμV/m	-14.67 dB	Pass	180 Degree	1 m	Vertical
6	275.01 MHz	34.49 dBμV/m	32.11 dBμV/m	-13.89 dB	Pass	120 Degree	2 m	Horizontal
7	324.99 MHz	34.21 dBμV/m	31.43 dBμV/m	-14.57 dB	Pass	120 Degree	1 m	Horizontal
8	333.33 MHz	39.68 dBμV/m	36.48 dBμV/m	-9.52 dB	Pass	120 Degree	1 m	Horizontal
9	375 MHz	41.46 dBμV/m	39.56 dBμV/m	-6.44 dB	Pass	90 Degree	1 m	Horizontal
10	875.01 MHz	42.01 dBμV/m	38.74 dBμV/m	-7.26 dB	Pass	150 Degree	1 m	Horizontal
11	960.21 MHz	44.84 dBμV/m	42.11 dBμV/m	-11.89 dB	Pass	180 Degree	1 m	Horizontal

EUT	EUT 1: NB3710		
Verdict, Test	Pass, Class B		
Modification	See chapter 14		
Mode of operation	Normal mode, see chapter 10.4		
Test date, time	27.02.2015 10:18:22		
Antenna height	1 m - 2 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.2.8, RBW: 1 MHz, VBW: 1 MHz, Sweep time: Auto [35 ms], Step freq: Fixed step count: 9 * 1e+3 steps per Band, Attenuator: 0 dB, Internal preamp: 20 dB, Measure time: 1 ms		



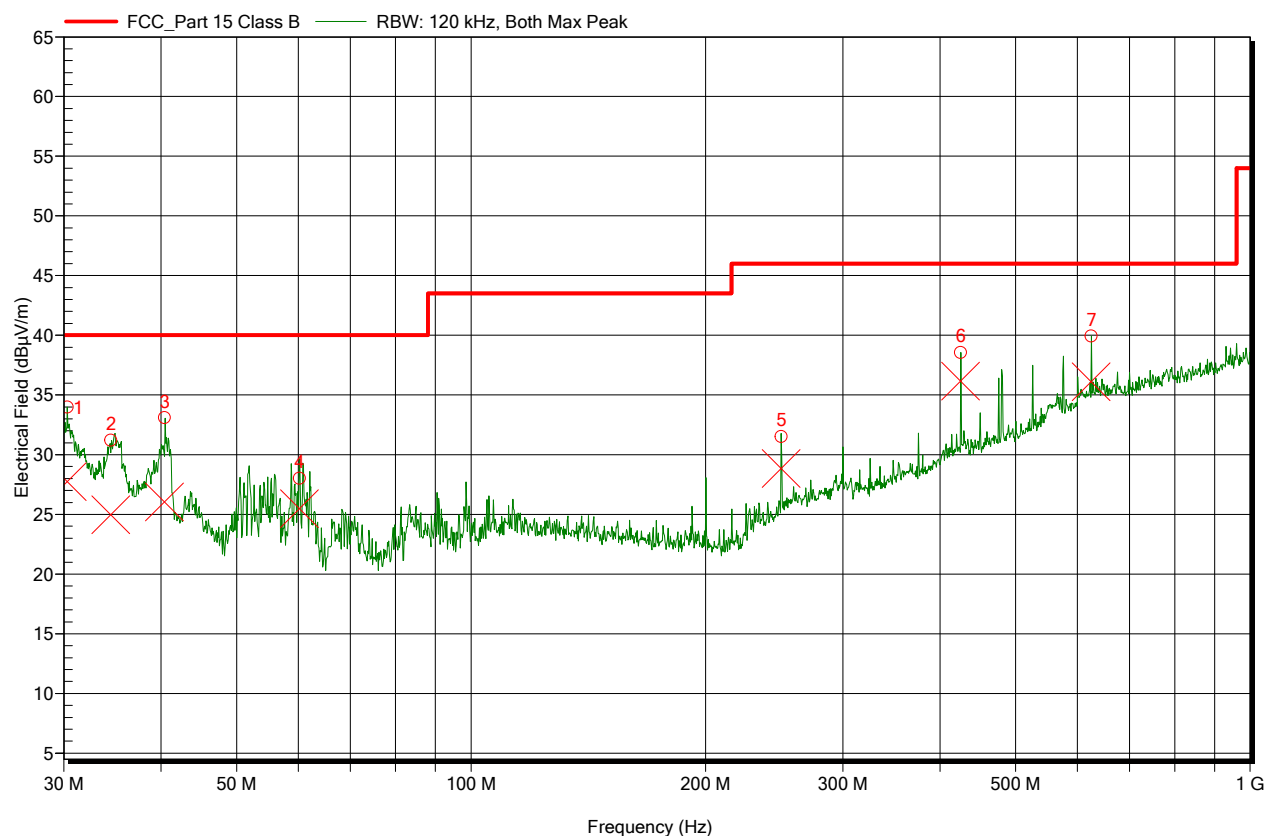
Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.127 GHz	41.81 dBμV/m	-32.19 dB	31.99 dBμV/m	-22.01 dB	Pass	0 Degree	1 m	Horizontal
2	1.729 GHz	62.82 dBμV/m	-11.18 dB	58.68 dBμV/m	4.68 dB	Note	210 Degree	2 m	Vertical
4	1.752 GHz	74.88 dBμV/m	0.88 dB	69.85 dBμV/m	15.85 dB	Note	300 Degree	1 m	Vertical
3	1.919 GHz	49.41 dBμV/m	-24.59 dB	47.07 dBμV/m	-6.93 dB	Pass	300 Degree	1 m	Horizontal
5	2.413 GHz	54.44 dBμV/m	-19.56 dB	49.62 dBμV/m	-4.38 dB	Note	330 Degree	1 m	Vertical
6	2.5 GHz	55.65 dBμV/m	-18.35 dB	54.14 dBμV/m	0.14 dB	Note	240 Degree	1 m	Horizontal

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

Measurement Results EUT 2

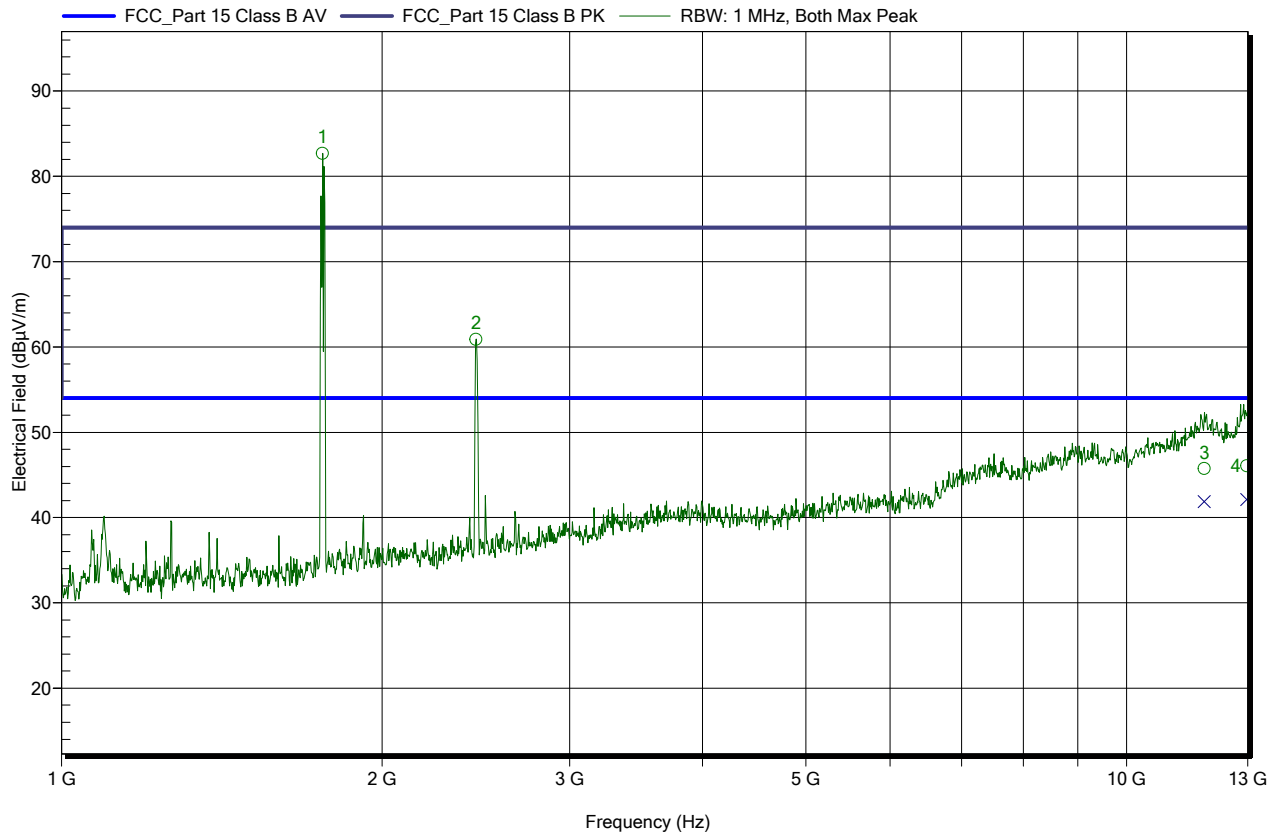
EUT	EUT 2		
Verdict, Test	Pass, Class B		
Modification	See chapter 14		
Mode of operation	Normal mode, see chapter 10.4		
Test date, time	11.03.2015 16:24:15		
Antenna height	1 m - 4 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.2.8, RBW: 120 kHz, VBW: Auto [120 kHz], Sweep time: 1 ms, Step freq: Linear: 30 kHz steps, Attenuator: Auto [10 dB], Internal preamp: 20 dB, Measure time: 10 ms		



Detected peaks

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
1	30.33 MHz	33.97 dBμV/m	27.74 dBμV/m	-12.26 dB	Pass	180 Degree	3 m	Vertical
2	34.47 MHz	31.21 dBμV/m	24.97 dBμV/m	-15.03 dB	Pass	180 Degree	3 m	Vertical
3	40.41 MHz	33.1 dBμV/m	26.03 dBμV/m	-13.97 dB	Pass	90 Degree	4 m	Vertical
4	60.21 MHz	28.03 dBμV/m	25.5 dBμV/m	-14.5 dB	Pass	90 Degree	1 m	Vertical
5	249.99 MHz	31.53 dBμV/m	28.85 dBμV/m	-17.15 dB	Pass	180 Degree	2 m	Vertical
6	425.01 MHz	38.57 dBμV/m	36.16 dBμV/m	-9.84 dB	Pass	270 Degree	1 m	Horizontal
7	625.02 MHz	39.96 dBμV/m	36.09 dBμV/m	-9.91 dB	Pass	180 Degree	1 m	Vertical

EUT	EUT 2		
Verdict, Test	Pass, Class B		
Modification	See chapter 14		
Mode of operation	Normal mode, see chapter 10.4		
Test date, time	11.03.2015 17:09:31		
Antenna height	1 m	Antenna polarization	Vertical/Horizontal
EUT position	0 Degree to 360 Degree	Antenna distance	3 m
Measurement settings	Radimation Version: 2014.2.8, RBW: 1 MHz, VBW: 30 kHz, Sweep time: Auto [58.9 ms], Step freq: Fixed step count: 4 * 1e+3 steps per Band, Attenuator: 0 dB, Internal preamp: 0 dB, Measure time: Auto [120 ms]		



Detected peaks

Peak Number	Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1	1.757 GHz	82.71 dBμV/m	8.71 dB			Note	0 Degree	1 m	Vertical
2	2.45 GHz	60.9 dBμV/m	-13.1 dB			Note	180 Degree	1 m	Horizontal
3	11.824 GHz	45.74 dBμV/m	-28.26 dB	41.89 dBμV/m	-12.11 dB	Pass	180 Degree	1 m	Horizontal
4	12.966 GHz	46.08 dBμV/m	-27.92 dB	42.12 dBμV/m	-11.88 dB	Pass	180 Degree	1 m	Horizontal

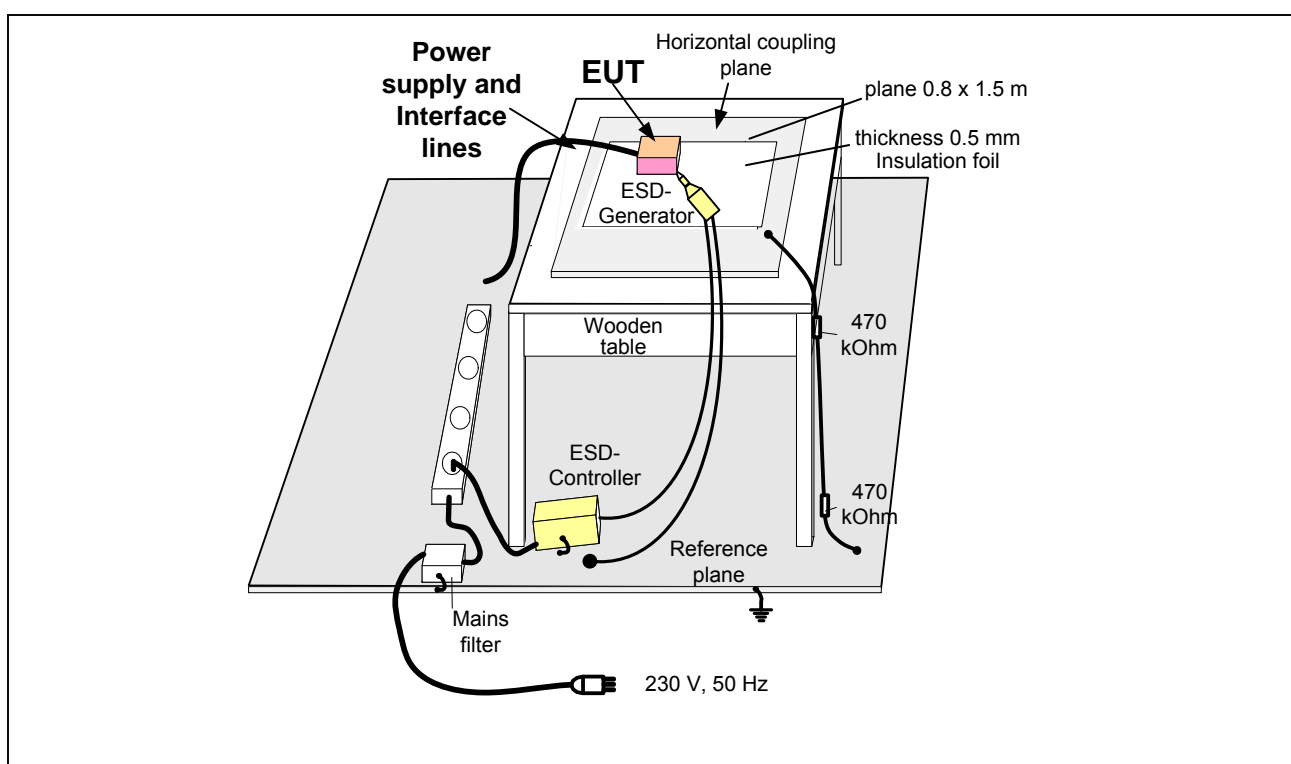
Note: Pass, exclusion band LTE & WLAN according ETSI EN 301 489-7,-17, -24

12. Immunity Tests

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

Introduction:	<i>The aim of this test is to determine the reaction of the material to electrostatic discharges (ESD) produced for example by walking on a carpet made of synthetic fiber. The humidity of the air has an influence on the discharge time and therefore on the severity of the discharge that could appear.</i>
Coupling:	150 pF / 330 Ohm
Meas. uncertainty:	see chapter 13
Test method:	<i>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.</i>

Test Setup

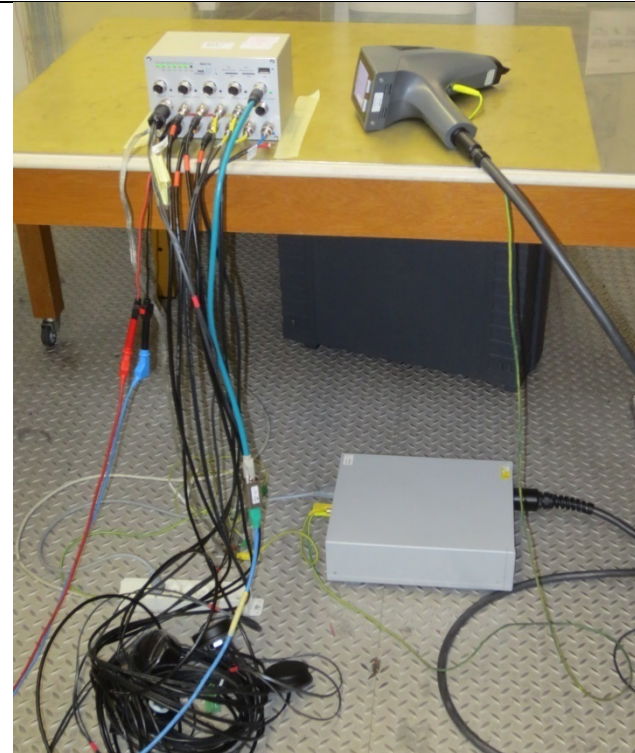
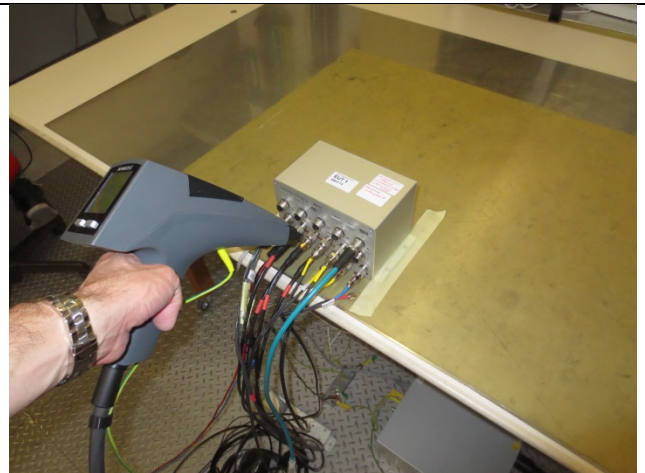


Test Equipment

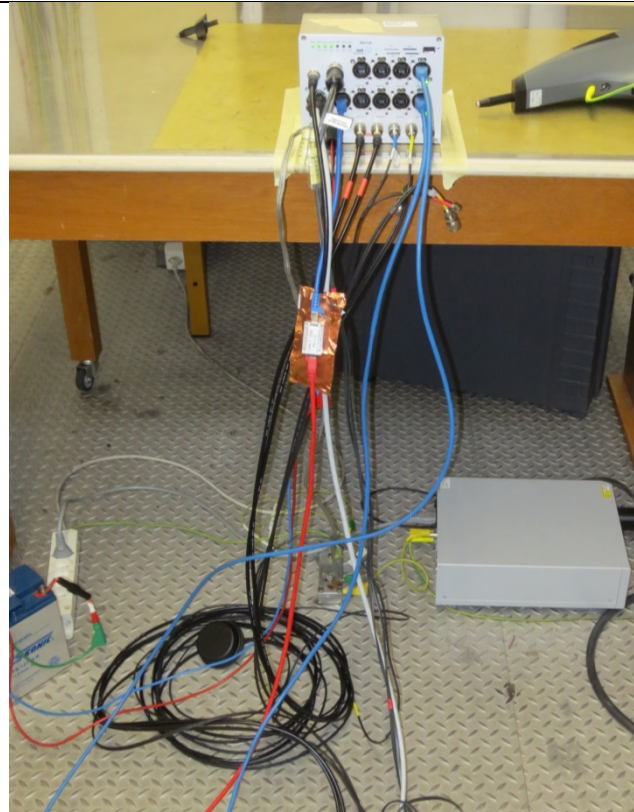
Device Type	Brand	Type	ID
ESD Generator	EM-Test	ESD N30	PE10238

Photos of the Setup

EUT 1:

*Air Discharge**Indirect Discharge**Direct Discharge*

EUT 2:

*Air Discharge**Indirect Discharge**Direct Discharge*

Test Results

Equipment: *EUT 1, EUT 2*
 Cables connected: *see chapter 10.3*
 Operating mode: *Active, see chapter 10.4*
 Observation of EUT: *see chapter 10.5*
 Modifications: *see chapter 14*
 Test site: *laboratory*

Requirements

Standard	Required Level Air Discharge	Required Level Contact Discharge	Impulses per Point, Level and Polarity	Performance Criterion
<i>EN 50121-3-2 : 2006</i>	<i>±8 kV</i>	<i>±6 kV</i>	<i>10</i>	<i>B</i>
<i>EN 50155 : 2007</i>	<i>±8 kV</i>	<i>±6 kV</i>	<i>10</i>	<i>B</i>
<i>ETSI EN 301 489-1 V1.9.2:2011</i>	<i>±8 kV</i>	<i>±4 kV</i>	<i>10</i>	<i>B</i>

Protocol of the Test – EUT 1

Indirect Discharges:

Level [kV]	No of discharges (for each level)	Discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
$\pm 2; \pm 4; \pm 6$	10	HCP	No errors observed	A	Pass

Direct Discharges:

Level [kV]	No of discharges (for each level)	Discharge		Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
		Air	Contact			
$\pm 2; \pm 4; \pm 6$	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors observed	A	Pass
$\pm 2; \pm 4; \pm 8$	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors observed	A	Pass
Tested points: LED's, Connectors, Enclosure						

Protocol of the Test – EUT 2

Indirect Discharges:

Level [kV]	No of discharges (for each level)	Discharge	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
$\pm 2; \pm 4; \pm 6$	10	HCP	No errors observed	A	Pass

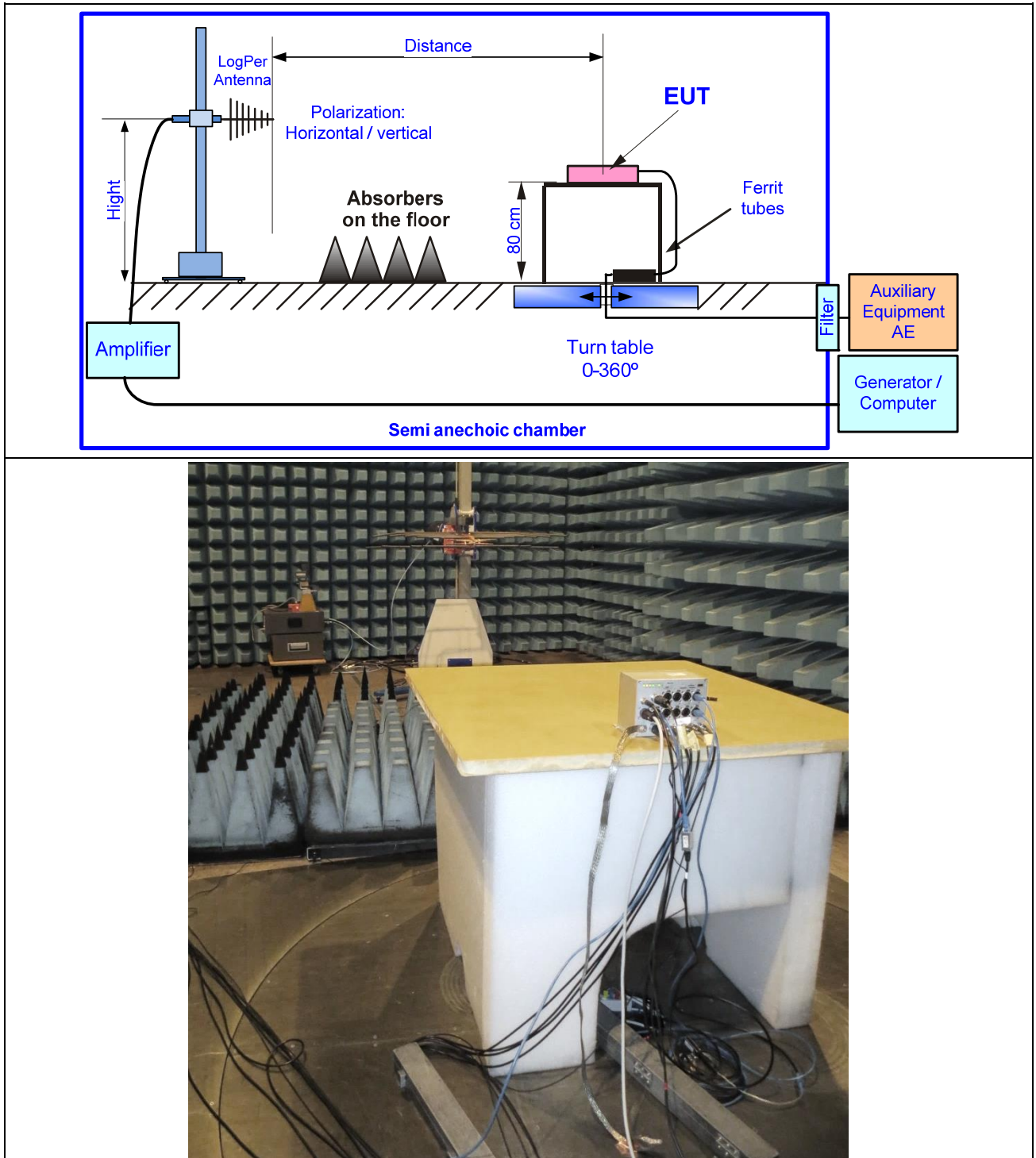
Direct Discharges:

Level [kV]	No of discharges (for each level)	Discharge		Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
		Air	Contact			
$\pm 2; \pm 4; \pm 6$	10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No errors observed	A	Pass
$\pm 2; \pm 4; \pm 8$	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No errors observed	A	Pass
Tested points: LED's, Connectors, Enclosure						

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 13*
- Test method:** *The field is emitted from one or different antennas placed successively in vertical and then in horizontal polarization. The field is calibrated without the EUT using an isotropic probe.*

Test Setup



Test Equipment

Device Type	Brand	Type	ID
Signal Generator	AnaPico	APSin 6010	13.6632.14
Amplifier 80 – 1000 MHz	Amplifier Research	750W1000	14.6632.04
Amplifier 1 – 6 GHz	Amplifier Research	50S1G6	14.6632.01
Antenna	Amplifier Research	AT 6080	H10192
Field Sensor	Narda S.T.S	EP 601	14.6632.02

Test Results

Equipment: *EUT 1, EUT 2*
 Cables connected: *see chapter 10.3*
 Operating mode: *Normal mode, see chapter 10.4*
 Observation of EUT: *see chapter 10.5*
 Modifications: *see chapter 14*
 Test site: *semi-anechoic chamber (hybrid)*

Requirements

Standard	Frequency Range	Required Level	Modulation	Freq. step	Dwell time	Performance Criterion
EN 50121-3-2 : 2006	80 – 1000 MHz	20 V/m	AM, 1 kHz, 80%	1 %	1	A
	1400 – 2100 MHz	10 V/m	AM, 1 kHz, 80%	1 %	1	A
	2100 – 2500 MHz	5 V/m	AM, 1 kHz, 80%	1 %	1	A
EN 50155 : 2007	80 – 1000 MHz	20 V/m	AM, 1 kHz, 80%	1 %	1	A
	1400 – 2100 MHz	10 V/m	AM, 1 kHz, 80%	1 %	1	A
	2100 – 2500 MHz	5 V/m	AM, 1 kHz, 80%	1 %	1	A
ETSI EN 301 489-1 V1.9.2:2011	80 – 1000 MHz	3 V/m	AM, 1 kHz, 80%	1 %	1	A
	1400 – 2700 MHz	3 V/m	AM, 1 kHz, 80%	1 %	1	A

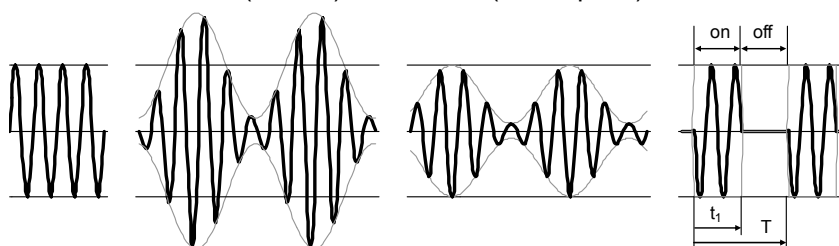
Modulation:

☐ CW

☒ AM (normal)

☐ AM (const. peak)

☐ PM



Protocol of the Test – EUT 1

Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	20	horizontal	0, 90, 180, 270°	No errors observed	A	Pass
	20	vertical	0, 90, 180, 270°	No errors observed	A	Pass
1000 - 6000	10	horizontal	0, 90, 180, 270°	No errors observed	A	Pass
	10	vertical	0, 90, 180, 270°	No errors observed	A	Pass

Protocol of the Test – EUT 2

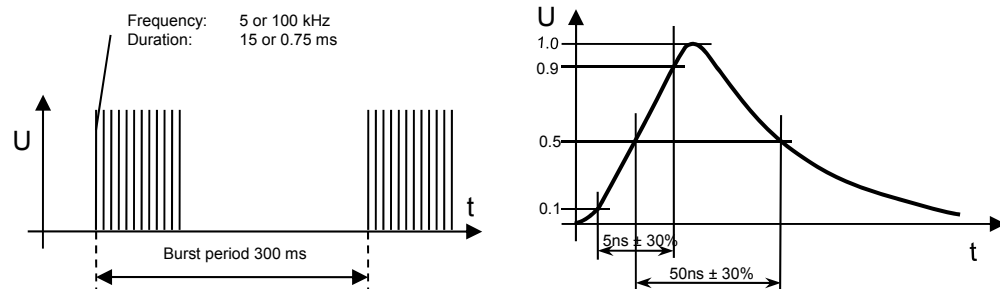
Frequency [MHz]	E [V/m]	Polarization	Direction	Result, Observation Behavior of EUT	Fulfilled criterion	Verdict
80 – 1000	20	horizontal	0, 90, 180, 270°	No errors observed	A	Pass
	20	vertical	0, 90, 180, 270°	No errors observed	A	Pass
1000 - 6000	10	horizontal	0, 90, 180, 270°	No errors observed	A	Pass
	10	vertical	0, 90, 180, 270°	No errors observed	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:

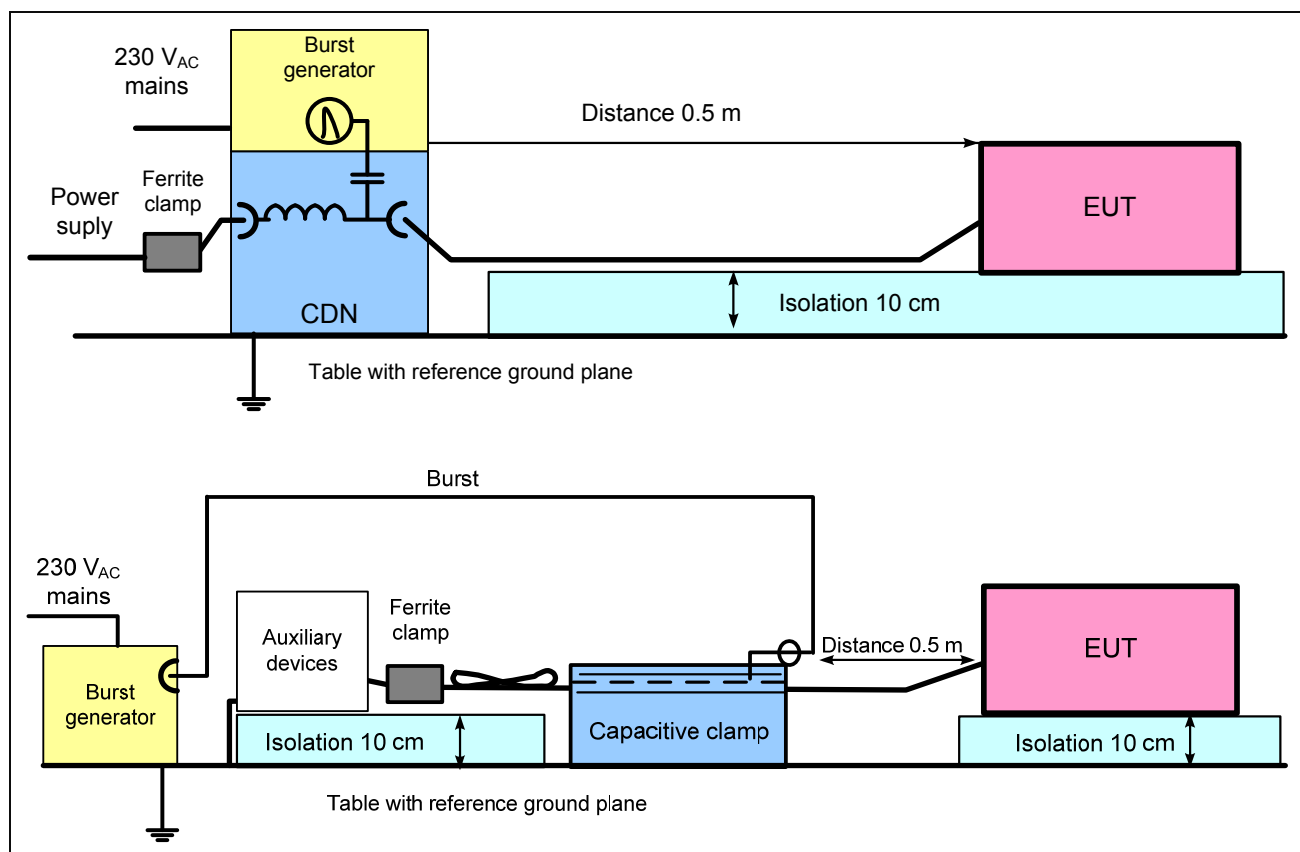
Test method:

Open-circuit voltage

see chapter 13

The transient coupling is carried out using a coupling network for the supply cables and a capacitive coupling clamp for the other cables. The two voltage polarities and all the intermediate levels are tested.

Test Setup



Test Equipment

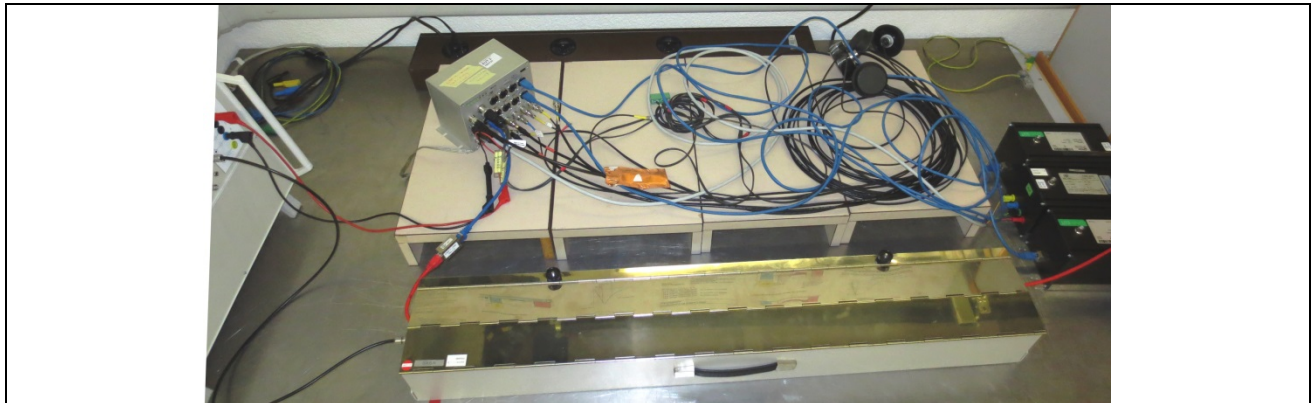
Device Type	Brand	Type	ID
Burst Generator	EM-Test	EFT500M4S1	PE10105
Capacitive Coupling Clamp	EM-Test	EM-Test HFK	H9360

Photos of the Setup

EUT 1:



EUT 2:



Test Results

Equipment: *EUT 1, EUT 2*
 Cables connected: *see chapter 10.3*
 Operating mode: *Active, see chapter 10.4*
 Observation of EUT: *see chapter 10.5*
 Modifications: *see chapter 14*
 Test site: *laboratory*

Requirements

Standard	Required Level AC Supply:	Required Level DC Supply	Required Level Signal	Protection. Earth	Burst Frequency	Performance Criterion
EN 50121-3-2 : 2006	± 2.0 kV	± 2.0 kV	5 kHz	A
EN 50155 : 2007	± 2.0 kV	± 2.0 kV	5 kHz	A
ETSI EN 301 489-1 V1.9.2:2011	± 1.0 kV	± 0.5 kV	± 0.5 kV	5 kHz	B

Protocol of the Test – EUT 1

Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Mains	2.0 kV	60 s	5 kHz	direct	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	direct	No errors observed	A	Pass
Ethernet 5	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
RS 232	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Digital I/O	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Antenna cables (Note)	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass

Note : All antenna cables tested together

Protocol of the Test – EUT 2

Tested port	Level [kV]	Duration	Frequency	Coupling	Result, Observation, Behavior of EUT	Fulfilled criterion	Verdict
DC Mains	2.0 kV	60 s	5 kHz	direct	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	direct	No errors observed	A	Pass
CAN	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Ethernet 4	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Ethernet 8	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
IBIS	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Digital I/O	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass
Antenna cables (Note)	2.0 kV	60 s	5 kHz	clamp	No errors observed	A	Pass
	2.0 kV	60 s	100 kHz	clamp	No errors observed	A	Pass

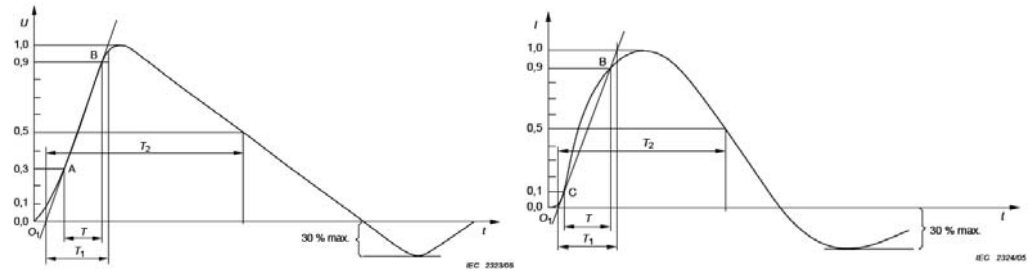
Note : All antenna cables tested together

12.4 Immunity to Surge (EN 61000-4-5 : 1.2/50µs)

Introduction:

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

Impulses:



Front time: $T_1 = 1.67 \times T = 1.2 \mu s \pm 30 \%$
Time to half-value: $T_2 = 50 \mu s \pm 20 \%$

Open-circuit voltage
see chapter 13

Front time: $T_1 = 1.25 \times T = 8 \mu s \pm 20 \%$
Time to half-value: $T_2 = 20 \mu s \pm 20 \%$

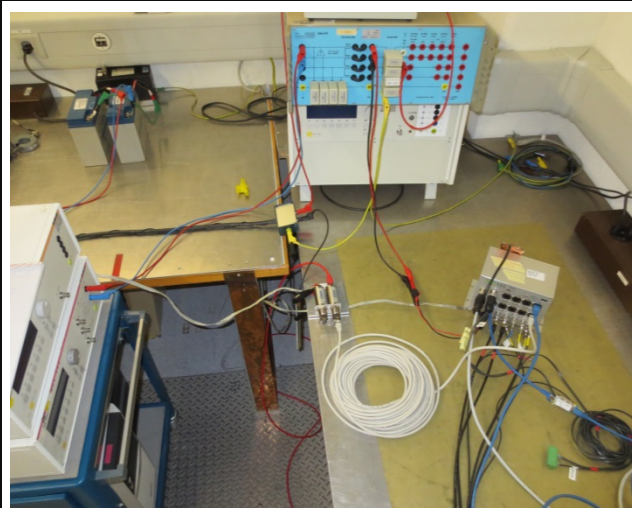
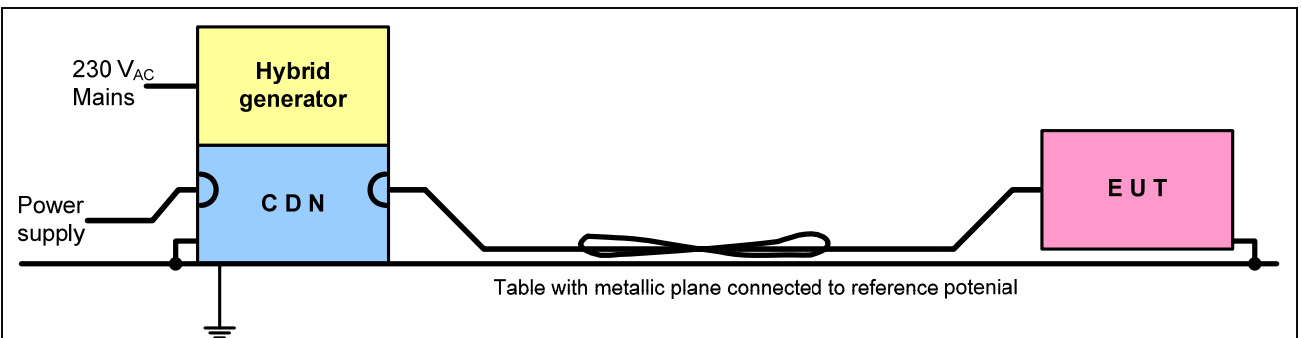
Short-circuit current

Meas. uncertainty:

Measuring method:

The impulses are coupled using the coupling network where the supply lines and unshielded cables are concerned. The shielded cables are coupled directly. The two polarities and different phase angles are tested for all the test levels up until the specified level.

Test Setup



Test Equipment

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

Test Results

Equipment: *EUT 1, EUT 2*
 Cables connected: *see chapter 10.3*
 Operating mode: *Active, see chapter 10.4*
 Observation of EUT: *see chapter 10.5*
 Modifications: *see chapter 14*
 Test site: *laboratory*

Requirements

Standard	Required Level AC-Supply		Required Level DC-Supply		Required Level Signal		Performance Criterion
	L – N 2Ω+18μF	L, N – PE 12Ω+9μF	L1 – L2 42Ω+0.5μF	L1, L2 – PE 42Ω+0.5μF	L1 – L2 42Ω+0.5μF	L1, L2 – PE 42Ω+0.5μF	
<i>EN 50121-3-2 : 2006</i>	± 1.0 kV	± 2.0 kV	± 1.0 kV	± 2.0 kV	---	---	<i>B</i>
<i>EN 50155 : 2007</i>	± 1.0 kV	± 2.0 kV	± 1.0 kV	± 2.0 kV	---	---	<i>B</i>
<i>ETSI EN 301 489-1 V1.9.2:2011</i>	± 1.0 kV <i>Note 1</i>	± 2.0 kV <i>Note 1</i>	---	---	---	<i>Note 2</i>	<i>B</i>

Notes:

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

Protocol of the Test – EUT 1

Tests on DC Power Ports:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses*	Remarks	Fulfilled criterion	Verdict
DC Mains	$\pm 0.5; \pm 1.0$	L1(+)- L2(-)	$40 \Omega + 0.5 \mu\text{F}$	5	No errors observed	A	Pass
DC Mains	$\pm 0.5; \pm 1.0; \pm 2.0$	L1(+)- PE L2(-)- PE	$40 \Omega + 0.5 \mu\text{F}$	5	No errors observed	A	Pass

* Number of pulses for each voltage level and each polarity

Test on LAN ports with shielded cable:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses*	Remarks	Fulfilled Criterion	Verdict
Ethernet 5	± 0.5	Screen – PE	$2 \Omega + 10\text{nF}$	5	No errors observed	A	Pass

* Number of pulses for each voltage level and each polarity

Protocol of the Test – EUT 2

Tests on DC Power Ports:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses*	Remarks	Fulfilled criterion	Verdict
DC Mains	$\pm 0.5; \pm 1.0$	L1(+)- L2(-)	$40 \Omega + 0.5 \mu\text{F}$	5	No errors observed	A	Pass
DC Mains	$\pm 0.5; \pm 1.0; \pm 2.0$	L1(+)- PE L2(-)- PE	$40 \Omega + 0.5 \mu\text{F}$	5	No errors observed	A	Pass

* Number of pulses for each voltage level and each polarity

Test on LAN ports with shielded cable:

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses*	Remarks	Fulfilled Criterion	Verdict
Ethernet 4	± 0.5	Screen – PE	$2 \Omega + 10\text{nF}$	5	No errors observed	A	Pass
Ethernet 5	± 0.5	Screen – PE	$2 \Omega + 10\text{nF}$	5	No errors observed	A	Pass
CAN	± 0.5	Screen – PE	$2 \Omega + 10\text{nF}$	5	No errors observed	A	Pass

* Number of pulses for each voltage level and each polarity

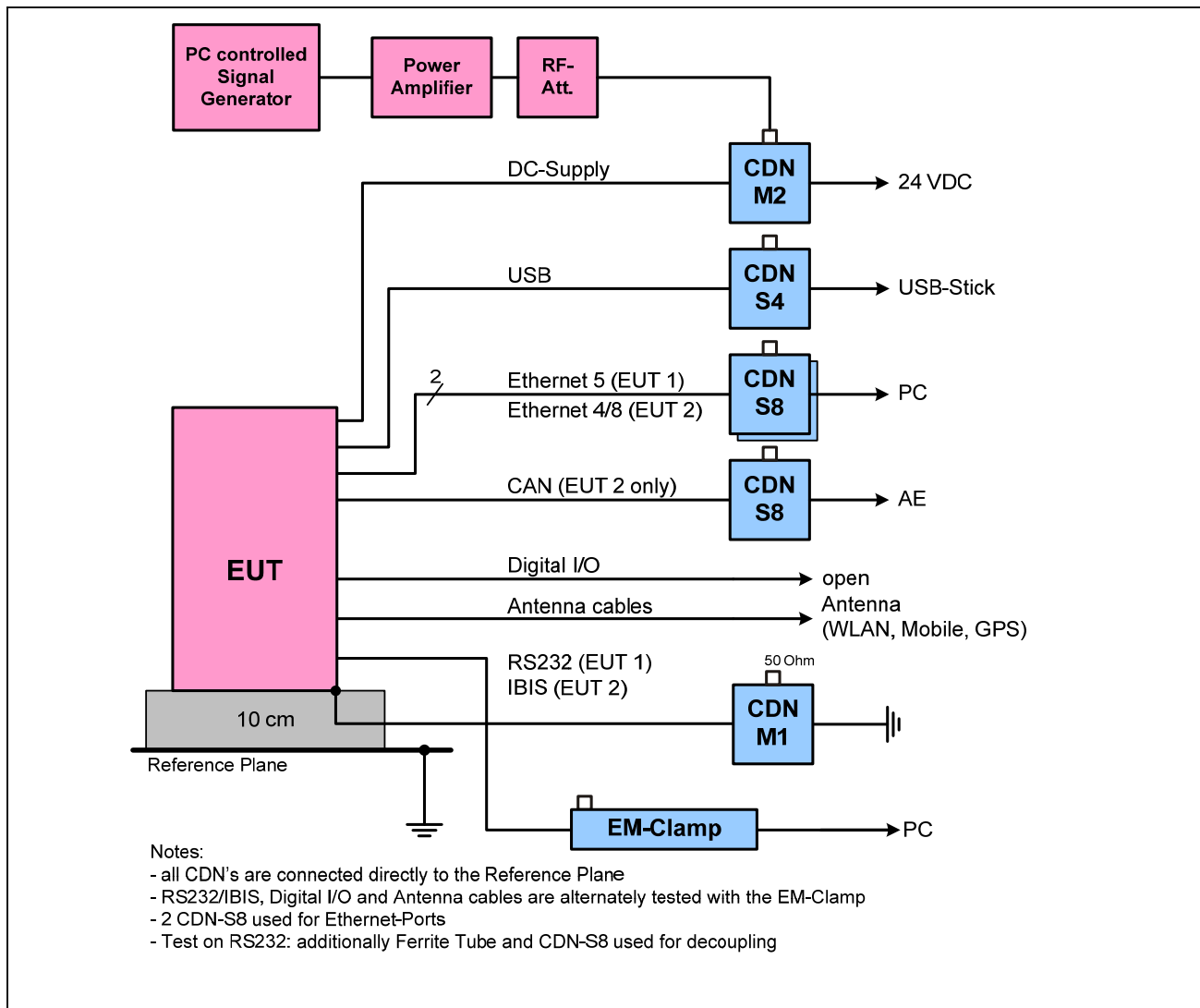
12.5 Immunity to Conducted Disturbances Induced by RF Fields (EN 61000-4-6)

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 13*

Measuring method: *The HF voltage is injected on the cables using different coupling/decoupling networks. All connected cables shall be provided with the appropriate coupling and decoupling devices. The voltage is calibrated without the equipment under test. The Dwell time is depending on the reaction time of the tested equipment.*

Test Setup





Setup EUT 1



Setup EUT 2

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	H10169
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
Injection device	EM-Test	EM 100	H4844
Decoupling device	EM-Test	FTC101	H6979
Decoupling device	EM-Test	CDN M2	H10168
Decoupling device	Lüthi	CDN 801-M2/M3	H6981
Decoupling device	Marti	CDN TWP 4x2	H10420
Decoupling device	Lüthi	CDN 801-S8 (DSub)	H7681
Decoupling device	EM-Test	AF4	H10172

Test Results

Equipment: *EUT 1, EUT 2*
 Cables connected: *see chapter 10.3*
 Operating mode: *Active see chapter 10.4*
 Observation of EUT: *see chapter 10.5*
 Modifications: *see chapter 14*
 Test site: *laboratory*

Requirements

Standard	Frequency range	Required level	Modulation	Freq. step	Dwell time	Performance crit.
EN 50121-3-2 : 2006	0.15 – 80 MHz	10 V _{EMF}	AM, 1 kHz, 80 %	1 %	1	A
EN 50155 : 2007	0.15 – 80 MHz	10 V _{EMF}	AM, 1 kHz, 80 %	1 %	1	A
EN 301 489-1 V1.9.2:2011	0.15 – 80 MHz	3 V _{EMF}	AM, 1 kHz, 80 %	1 %	1	A

Step time:

1 s

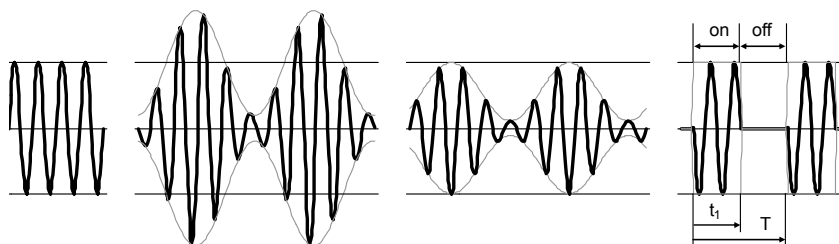
Signal modulation:

☐ CW

☒ AM

☐ AM

☐ PM



Protocol of the Test**EUT 1**

Coupling	CDN	Terminated(50 Ω)	CDN	Freq. [MHz]	Level [V]	Remarks	Fulfilled criterion	Verdict
DC Supply	M2	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Ethernet 5	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
RS232	EM100	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Digital I/O	EM100	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Antenna cables	EM100	Enclosure	M1	0.15 – 80	12	No errors observed, Note 2	A	Pass
Enclosure	M1	DC Supply	M2	0.15 – 80	12	No errors observed	A	Pass

EUT 2

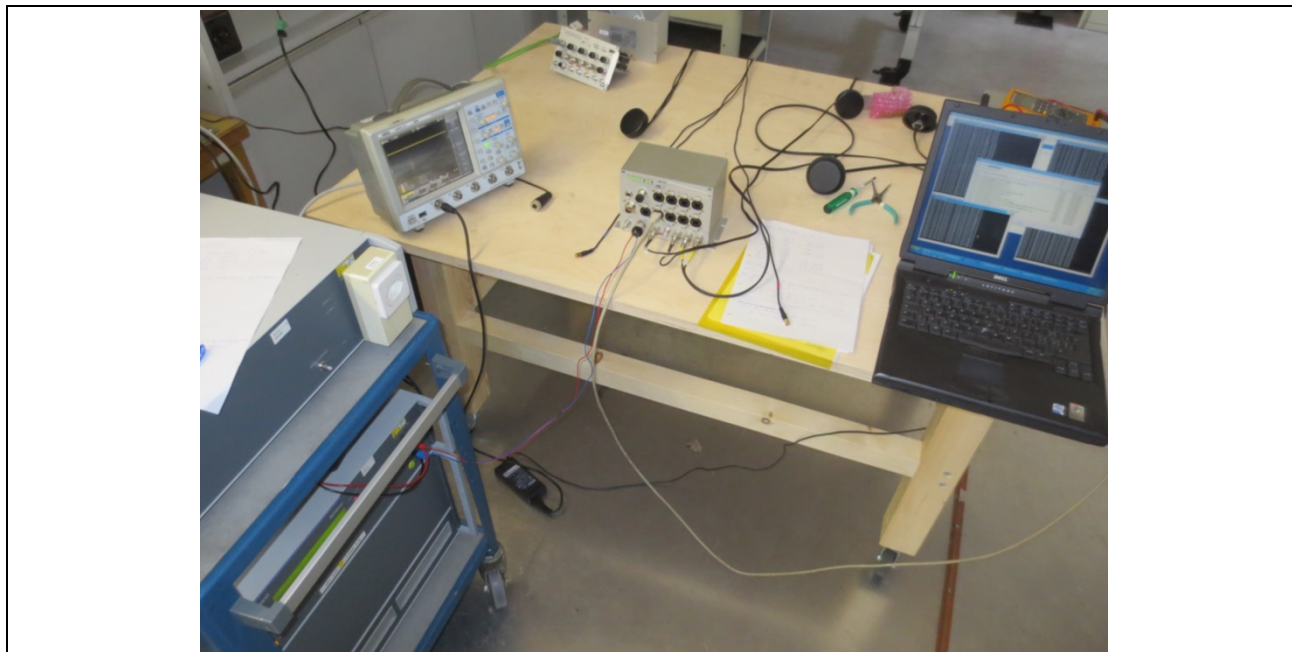
Coupling	CDN	Terminated(50 Ω)	CDN	Freq. [MHz]	Level [V]	Remarks	Fulfilled criterion	Verdict
DC Supply	M2	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Ethernet 4	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Ethernet 8	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Binder	S4	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
CAN	S8	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
IBIS	EM100	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Digital I/O	EM100	Enclosure	M1	0.15 – 80	12	No errors observed	A	Pass
Antenna cables	EM100	Enclosure	M1	0.15 – 80	12	Not tested, Note 3	--	--
Enclosure	M1	DC Supply	M2	0.15 – 80	12	No errors observed	A	Pass

Notes:

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

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

Test Setup



Test Equipment

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

Test Results

Equipment: *EUT 1, EUT 2*
 Cables connected: *see chapter 10.3*
 Operating mode: *Normal mode, see chapter 10.4*
 Observation of EUT: *see chapter 10.5*
 Modifications: *see chapter 14*
 Test site: *laboratory*

Protocol of the Test – EUT 1

Standard	Chapter	Voltage		Duration	Requirements	Notes	Verdict
EN 50155	5.1.1.1	14.4 V	0.6 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.1.1	33.6 V	1.4 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.1.1	30 V	1.25 U _N	1 s	Criterion C	Tested at 24 V and 48 V	Pass
	5.1.1.1	33.6 V	1.4 U _N	1 s	Criterion C	Tested at 24 V and 48 V	Pass
	5.1.1.2	0 V	0 U _N	10 ms	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	21.6 V	0.9 U _N	Unlimited	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	26.4 V	1.1 U _N	Unlimited	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	14.4 V	0.6 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	33.6 V	1.4 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	16.8 V	0.7 U _N	1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	30 V	1.25 U _N	1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.3	14.4 V	0.6 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.3	0 V	0 U _N	30 ms	Criterion A	Tested at 24 V and 48 V	Pass
	12.2.6	33.6 V	1.4 U _N	1 s	Criterion A	rise & fall time 0.1 s	Pass

Note: U_N = 24 VDC

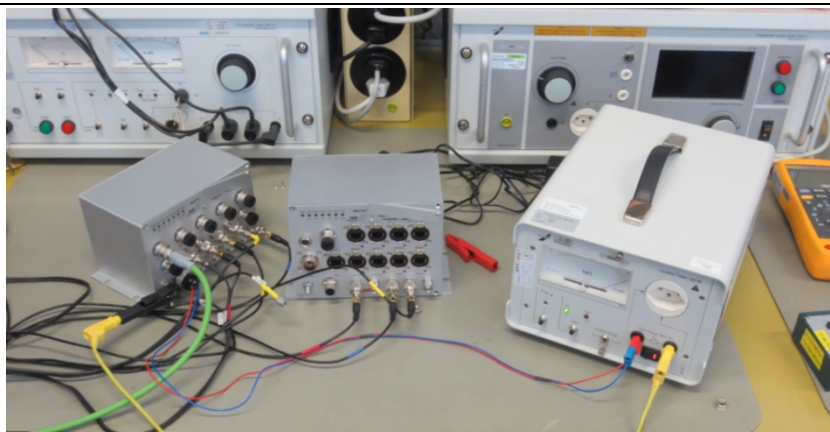
Protocol of the Test – EUT 2

Standard	Chapter	Voltage		Duration	Requirements	Notes	Verdict
EN 50155	5.1.1.1	14.4 V	0.6 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.1.1	33.6 V	1.4 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.1.1	30 V	1.25 U _N	1 s	Criterion C	Tested at 24 V and 48 V	Pass
	5.1.1.1	33.6 V	1.4 U _N	1 s	Criterion C	Tested at 24 V and 48 V	Pass
	5.1.1.2	0 V	0 U _N	10 ms	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	21.6 V	0.9 U _N	Unlimited	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	26.4 V	1.1 U _N	Unlimited	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	14.4 V	0.6 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	33.6 V	1.4 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	16.8 V	0.7 U _N	1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.2	30 V	1.25 U _N	1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.3	14.4 V	0.6 U _N	0.1 s	Criterion A	Tested at 24 V and 48 V	Pass
	5.1.3	0 V	0 U _N	30 ms	Criterion A	Tested at 24 V and 48 V	Pass
	12.2.6	33.6 V	1.4 U _N	1 s	Criterion A	rise & fall time 0.1 s	Pass

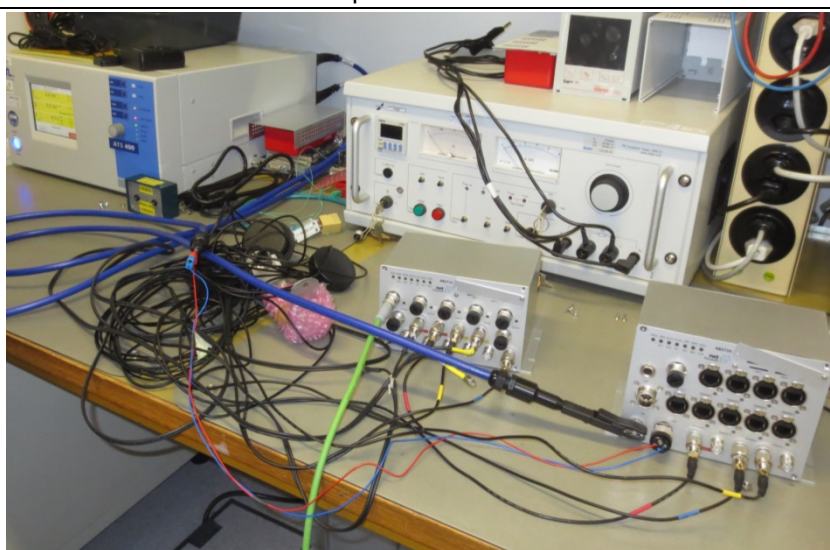
Note: U_N = 24 VDC

12.7 Insulation Test (EN 50155 §12.2.9)

Test Setup



Setup Insulation Test



Setup Voltage Withstand Test

Test Equipment

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

Test Results

Equipment: *EUT 1, EUT 2*
 Cables connected: *see chapter 10.3*
 Operating mode: *Normal mode, see chapter 10.4*
 Observation of EUT: *see chapter 10.5*
 Modifications: *see chapter 14*
 Test site: *safety laboratory*

Protocol of the Test – EUT 1

Standard	Chapter	Test	Voltage	Remark	Behavior of EUT	Verdict
EN 50155	12.2.9.1	Insulation test L1(+) & L2(-) → PE	500 VDC	Measured before and after voltage withstand test	No essential change	Pass
EN 50155	12.2.9.2	Voltage withstand test L1(+) & L2(-) → PE	710 VDC	--	No breakthrough	Pass

Protocol of the Test – EUT 2

Standard	Chapter	Test	Voltage	Remark	Behavior of EUT	Verdict
EN 50155	12.2.9.1	Insulation test L1(+) & L2(-) → PE	500 VDC	Measured before and after voltage withstand test	No essential change	Pass
EN 50155	12.2.9.2	Voltage withstand test L1(+) & L2(-) → PE	710 VDC	--	No breakthrough	Pass

Note:

- Tested on DC Supply L1(+) & L2(-) to PE (Enclosure)
- Signal ports (Ethernet, RS232, USB, I/O, IBIS and CAN) to L1(+) & L2(-) have not been not tested, because clearance and creepage distances are larger than those of L1(+) & L2(-) to PE.

13. Measurement Uncertainty

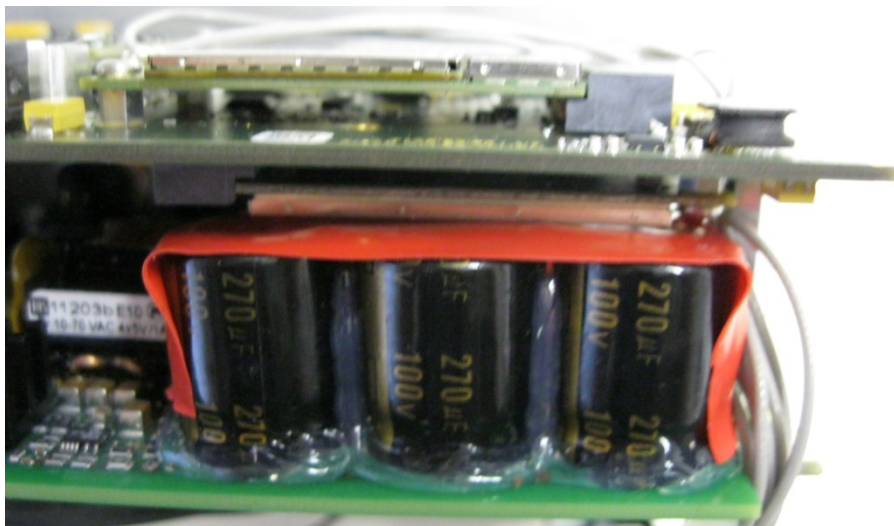
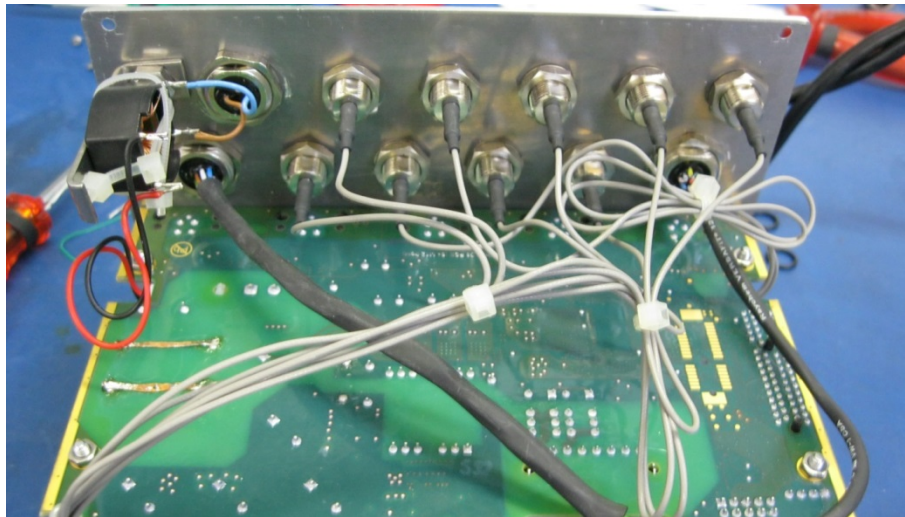
Conducted emission	Estimated uncertainty of the measurement results: (normal distribution, k=2)		± 2.8 dB
	Maximum uncertainty defined by the standard:		± 3.6 dB
Radiated emission	Estimated uncertainty of the measurement results for 30 – 230 MHz: (normal distribution, k=2)		± 3.4 dB
	Estimated uncertainty 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_{go} : (normal distribution)		± 9.0 %
	Duration of the voltage interruption t_{he} : (rectangular distribution)		± 5.0 %
	Phase d_o : (rectangular distribution)		± 2.8 %
Voltage fluctuation	Output voltage U_{go} : (normal distribution)		± 9 %
	Duration of the voltage fluctuation t_o : (rectangular distribution)		± 20 %

14. Modifications on the EUT

The following modifications had to be performed in order to pass the EMC tests.

EUT 1: NB3710-2L2W-G:

- CM-Chock Ls101 bypassed
- 4.2mH Chock placed in the cable (emission problems)
- Ferrite in cable removed (No place for it because of the 4.2mH Chock)
- Cs 125, 126, 127, 131 changed to 680pF (emission problems on 13MHz)
- Antenna cables differently passed (emission problems)
- Capacitors Cs 100 – 104 isolation material placed on the top (Surge problems)
- Used a galvanic isolated RS232-to-USB adapter. (Burst problems on the Serial interface)



EUT 2: NB3720-L2W8EnCI-G:

- CM-Chock Ls101 bypassed
- 4.2mH Chock placed in the cable (emission problems)
- Ferrite in cable removed (No place for it because of the 4.2mH Chock)
- Cs119 removed (emission problems)
- Rc 104 (0R) on PSE_Board_Extension fitted (emission problems on CAN interface)
- Antenna cables differently passed (emission problems)

