

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

Registration number

STS 0001

Swiss testing service



Report:	Electromagnetic compatibility	Report no:	19-EL-0024.E02
Test item description:	NetModule NG800		
Applicant:	NetModule AG; Maulbeerstrasse 10; 3011 Bern; Switzerland		
Manufacturer:	NetModule AG; Maulbeerstrasse 10; 3011 Bern; Switzerland		
Model/Type reference:	NG800-LWWtGe2Br2C	Serial no:	7C:97:63:50:3E:C8
Trade mark:	Netmodule AG	Date of tests:	February 25 to March 1, 2019

Standards		Result
EN 55032:2015 CISPR 32:2015	Electromagnetic compatibility of multimedia equipment - Emission requirements	Pass
EN 55035:2017 CISPR 35:2016	Electromagnetic compatibility of multimedia equipment - Immunity requirements	Pass
IEC 61000-6-2:2016	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards - Immunity for industrial environments	Pass
EN 61000-6-2:2005 IEC 61000-6-2:2005	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards - Immunity for industrial environments	Pass
EN 61000-6-3:2007 + A1:2011 + AC:2012 IEC 61000-6-3:2006 /AMD1:2010	Electromagnetic compatibility (EMC) – Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments	Pass
ETSI EN 301 489-1 V2.1.1:2017	(Common requirements)	Pass
ETSI EN 301 489-3 V2.1.1:2017	(Short Range Devices 9kHz – 40GHz)	Pass
ETSI EN 301 489-7 V1.3.1:2005	(Digital cellular radio telecommunication)	Pass
ETSI EN 301 489-17 V3.2.0:2017	(Broadband Data Transmission Systems)	Pass
ETSI EN 301 489-24 V1.5.1:2010	(CDMA)	Pass
ETSI EN 301 489-52 V1.1.1:2016	(LTE)	Pass
47 CFR, Part 15 / ICES-003	(Subpart B, Class B digital device) / (Canada)	Pass

Test performed by

Mr F. Wyler
EMC test-engineer



Report prepared by

Mr J. Biner
EMC test-engineer



Report controlled and approved by

Mr O. Dзамko
EMC test-engineer



Bern, 2019-04-11

(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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1. Summary of test results

1.1 EN 61000-6-2 & -3

§	Test Type	Result
7	Emission	EN 61000-6-3
7.1	Interference voltage EN 55016-2-1:2014 CISPR 16-2-1:2014	Pass ¹
7.2	Conducted emission on I/O or other ports EN 55022:2010 CISPR 22:2008	Pass
--	Discontinuous disturbances (clicks) EN 55014-1:2017 CISPR 14-1:2016	Not required ¹
7.3	Radiated electromagnetic field EN 55016-2-3:2010 + A1 + A2 CISPR 16-2-3:2010 + A1 + A2	Pass
---	Harmonics EN 61000-3-2:2014 IEC 61000-3-2:2014	Not required ¹
---	Voltage fluctuations (flicker) EN 61000-3-3:2013 IEC 61000-3-3:2013	Not required ¹
8	Immunity	EN 61000-6-2
8.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass
8.2	Electromagnetic fields EN 61000-4-3:2006 +A1 +A2 IEC 61000-4-3:2006 +A1 +A2	Pass
8.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
8.4	Surges EN 61000-4-5:2014 +A1:2017 IEC 61000-4-5:2014 /AMD1:2017	Pass
8.5	Radio frequency common mode EN 61000-4-6:2014 IEC 61000-4-6:2013	Pass
---	Magnetic fields (industrial frequencies) EN 61000-4-8:2010 IEC 61000-4-8:2009	Not required ²
---	Voltage dips and interruptions EN 61000-4-11:2004+A1:2017 IEC 61000-4-11:2004/AMD1:2017	Not required ¹

1. Powered with: 12 up to 24 VDC:

2. Does not contain any devices susceptible to magnetic fields.

1.2 EN 55032 & EN 55035

§	Test Type	Result
7	Emission	EN 55032
7.1	Interference voltage EN 55016-2-1:2014 CISPR 16-2-1:2014	Pass ¹
7.2	Conducted emission on I/O or other ports EN 55016-2-1:2014 CISPR 16-2-1:2014	Pass
7.3	Radiated electromagnetic field EN 55016-1-2:2014 CISPR 16-1-2:2014 EN 55016-2-3:2010/A2:2014 CISPR 16-2-3:2010/A2:2014	Pass

1. Powered with: 12 up to 24 VDC:

§	Test Type	Result
8	Immunity	EN 55035
8.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass
8.2	Electromagnetic fields EN 61000-4-3:2006 +A1 +A2 IEC 61000-4-3:2006 +A1 +A2	Pass
8.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
8.4	Surges EN 61000-4-5:2014 +A1:2017 IEC 61000-4-5:2014 /AMD1:2017	Pass
8.5	Radio frequency common mode EN 61000-4-6:2014 IEC 61000-4-6:2013	Pass
--	Magnetic fields (industrial frequencies) EN 61000-4-8:2010 IEC 61000-4-8:2009	Not required ²
--	Voltage dips and interruptions EN 61000-4-11:2004+A1:2017 IEC 61000-4-11:2004/AMD1:2017	Not required ¹
--	Broadband impulsive conducted disturbances EN 55035:2017 CISPR 35: 2016	Not required ³

1. Powered with: 12 up to 24 VDC:

2. EUT contains no components susceptible to magnetic fields

3. EUT has no DSL port.

1.3 FCC / Canada

§	Test Type	Result
7	Emission	CFR 47 ICES-003 RSS-310 Industry Canada
---	Conducted emission CFR 47 § 15.107 (Class B) ICES-003 §5.3 (Class B)	Not required ¹
7.4	Radiated emission – EM-field CFR 47 § 15.109 (Class B) ICES-003 §5.5 (Class B)	Pass

1. Powered with: 12 up to 24 VDC

1.4 ETSI EN 301 489--1, -7, -17, -24 & -52

§	Test Type	Result
7	Emission	EN 301 489-1, -7, -17, -24 & -52 fixed use
7.1	Conducted emission on AC ports EN 55032:2015 CISPR 32:2015	Pass ¹
7.2	Conducted emission on I/O or other ports EN 55032:2015 CISPR 32:2015	Pass
7.3	Radiated electromagnetic field EN 55032:2015 CISPR 32:2015	Pass
---	Harmonics EN 61000-3-2:2014 IEC 61000-3-2:2014	Not required ¹
---	Voltage fluctuations (flicker) EN 61000-3-3:2013 IEC 61000-3-3:2013	Not required ¹
8	Immunity	EN 301 489-1, -7, -17, -24 & -52 fixed use
8.1	Electrostatic discharges EN 61000-4-2:2009 IEC 61000-4-2:2008	Pass
8.2	Electromagnetic fields EN 61000-4-3:2006 +A1 +A2 IEC 61000-4-3:2006 +A1 +A2	Pass
8.3	Fast electric transients (Burst) EN 61000-4-4:2012 IEC 61000-4-4:2012	Pass
8.4	Surges EN 61000-4-5:2014 IEC 61000-4-5:2014	Pass
8.5	Radio frequency common mode EN 61000-4-6:2014 IEC 61000-4-6:2013	Pass
---	Voltage dips and interruptions EN 61000-4-11:2004 IEC 61000-4-11:2004	Not required ¹

1. Powered with: 12 up to 24 VDC

2. Applied standards

EN 55032:2015 CISPR 32:2015	Electromagnetic compatibility of multimedia equipment - Emission requirements
EN 55035:2017 CISPR 35:2016	Electromagnetic compatibility of multimedia equipment - Immunity requirements
EN 61000-6-2:2005 IEC 61000-6-2:2016	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-3:2007 +A1:2011 + AC:2012 IEC 61000-6-3:2006 /AMD1:2010	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
ETSI EN 301 489-1 V2.1.1:2017	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 1: Common technical requirements
ETSI EN 301 489-17 V3.2.0:2017	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment; Part 17: Specific conditions for Broadband Data Transmission Systems
ETSI EN 301 489-24 V1.5.1:2010	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
ETSI 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)
ETSI EN 301 489-52 V1.1.1: 2016	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication Mobile and portable (UE) radio and ancillary equipment; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
47 CFR Part 15 Subpart B (USA)	Code of Federal Regulations - Title 47 - Telecommunication, Part 15, Subpart B: "Unintentional Radiators
ICES-003 (Canada) NMB-003 (Canada)	Spectrum Management and Telecommunications Policy - Interference-Causing Equipment Standard Digital Apparatus

3. Abbreviations

Electromagnetic compatibility and radio spectrum matters:

AC	Alternating current
AFA	Adaptive Frequency Agility
AM	Amplitude Modulation
AN	Artificial Network
AV	Average
BB	Broad Band
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
DS	Defined State
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
FS	Functional Safety
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	International Telecommunications Union
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
NB	Narrow Band
NRI	National Radio Interfaces
PE	Protective earth
PK	Peak
Plt	Long-term flicker indicator
PM	Pulse Modulation
Pst	Short-term flicker Indicator
QFE	Local atmospheric pressure (Field Elevation)
QP	Quasi-Peak
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RFID	Radio Frequency Identification
RU	Remote Unit
Rx	Receiver
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
THD	Total Harmonic Distorsion
Tx	Transmitter
UL	Uplink
UWB	Ultra Wide Band
VSWR	Voltage Standing Wave Ratio

General vocabulary: <http://www.electropedia.org>

4. Applicant

Applicant name and address	NetModule AG; Maulbeerstrasse 10; 3011 Bern; Switzerland
Contact Person	Mr. R. Straub
Telephone	+41 31 985 25 10
E-mail	Rene.Straub@netmodule.com

5. Equipment under test

5.1 Identification

Manufacturer name and address	NetModule AG; Maulbeerstrasse 10; 3011 Bern; Switzerland																									
Production country	Germany																									
Trade mark	Netmodule AG																									
Test item description	NetModule NG800 The NetModule NG800 multifunctional IoT-Device, suitable for harsh environments, provides the necessary robust communication between onboard vehicle equipment and cloud applications.																									
Use description	Fleet Management, Asset tracking, Autonomous Vehicles, Vehicle to Everything (V2X), Diagnostics, Onboard internet, E-Mobility, Condition Monitoring, Logistics, Vehicle Gateway.																									
Model/Type reference	NG800-LWWtGe2Br2C																									
Serial no	7C:97:63:50:3E:C8																									
Software version	netmodule-linux;v0.9.10																									
Highest frequency	<table><tr><td>CPU Core U100</td><td>1000 MHz</td></tr><tr><td>Crystal Q100</td><td>25 MHz</td></tr><tr><td>Crystal Q1200</td><td>24 MHz</td></tr><tr><td>CPU DDR3 RAM</td><td>400 MHz</td></tr><tr><td>USB</td><td>480 MHz</td></tr><tr><td>Ethernet</td><td>125 MHz</td></tr><tr><td>eMMC</td><td>48 MHz</td></tr><tr><td colspan="2"> </td></tr><tr><td>DC/DC Main U5000</td><td>750 kHz</td></tr><tr><td>PMIC U5100</td><td>3.0 MHz</td></tr><tr><td>DC/DC GSM U3100</td><td>1.2 MHz</td></tr><tr><td>DC/DC User Module U4000</td><td>1.2 MHz</td></tr></table>		CPU Core U100	1000 MHz	Crystal Q100	25 MHz	Crystal Q1200	24 MHz	CPU DDR3 RAM	400 MHz	USB	480 MHz	Ethernet	125 MHz	eMMC	48 MHz			DC/DC Main U5000	750 kHz	PMIC U5100	3.0 MHz	DC/DC GSM U3100	1.2 MHz	DC/DC User Module U4000	1.2 MHz
CPU Core U100	1000 MHz																									
Crystal Q100	25 MHz																									
Crystal Q1200	24 MHz																									
CPU DDR3 RAM	400 MHz																									
USB	480 MHz																									
Ethernet	125 MHz																									
eMMC	48 MHz																									
DC/DC Main U5000	750 kHz																									
PMIC U5100	3.0 MHz																									
DC/DC GSM U3100	1.2 MHz																									
DC/DC User Module U4000	1.2 MHz																									
Supply	U = 12 ... 24 VDC (9 VDC to 36 VDC maximum) P = <10 W																									
Dimension	200 mm x 120 mm x 40 mm (l x w x h)																									
Weight	~ 650 g																									
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.																									

5.2 Product family

Tested equip.	Covered versions	Explanation*
NG800-LWWtGe2Br2C	NG800-H ₁ ...H _n -S ₁ ...S _n -O ₁ ...O _n	<p>All covered NG800 variants are based on the same electronics. They use the same housing and have the same form factor.</p> <p>The tested device is the fully equipped variant. Whereas the other variants are subsets of this device. The subsets are assembly options of the electronics.</p> <p>All products include Ethernet and RS232. Additionally, there can be automotive Ethernet (100bT1 BroadR) and Controller Area Network (CAN) wired interfaces. Optional wireless interfaces are 4G mobile, WLAN, Bluetooth and GNSS.</p> <p>Future product variants can be equipped with an extension PCB (user module) that provides further processing functions, wired or wireless interfaces.</p> <p>The wireless communication modules have been CE and FCC certified in an independent way of the tested equipment.</p> <p>Part Number Scheme</p> <p>'H₁...H_n' is a sequence of the following letters that identify the communication modules included:</p> <p>R basic device, router only</p> <p>L 4G = 3G + LTE, Cat. 4, Europe Lb 4G, LTE Cat. 4, North America Lf 4G, LTE Cat. 4, South America Lg 4G, LTE Cat. 4, Asia Pacific (APAC) Lm 4G, LTE Cat M1/NB1, Multiregional</p> <p>W WLAN a/b/g/n 2.4/5 GHz Wb WLAN b/g 2.4 GHz Wt Bluetooth + BLE WWt WLAN + Bluetooth + BLE</p> <p>C Controller Area Network CAN Br 100bT1 BroadR-Reach</p> <p>Ga GNSS advanced Gd GNSS untethered dead reckoning Ge GNSS automotive dead reckoning Gf GNSS differential GPS</p> <p>'S₁...S_n' indicate software options activated:</p> <p>G Standard GPS V VoIP Gateway Y Plain Linux Vi Virtualisation, LXC</p> <p>'O' indicates OEM options, customer specific extensions and brand labeling e.g.:</p> <p>OEMa Customer A OEMb Customer B xyz any abbreviation of customer with or without number</p> <p>The following NG800 variants are currently available or planned. Lx describes one of the available modem options listed above.</p> <ul style="list-style-type: none"> - NG800-LxWWtGe2Br2C - NG800-LxWWtGe2C - NG800-LxWWtGa2C - NG800-LxWWtGe - NG800-LxWWtGa - NG800-LxGe

Tested equip.	Covered versions	Explanation*
		<ul style="list-style-type: none"> - NG800-LxGa - NG800-LxWWt - NG800-WWt - NG800-Br2C

* According to information provided by the customer and not verified by Eurofins Electrosuisse Product Testing AG

5.3 Pictures of the EUT



5.4 Classification

EN 55032:2015 CISPR 32:2015	<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: 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. <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 checked="" 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 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 61000-6-3:2007 +A1:2011 + AC:2012 IEC 61000-6-3:2006 /AMD1:2010	<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 checked="" 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 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 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 <input checked="" type="checkbox"/> Radio services: GSM, UMTS, LTE & WLAN
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 checked="" 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 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).
--	--

5.5 Ports

Port	Cable			Remark
	Max. length	Type	Screen	
DC Supply	< 30 m	2 wires	No	If not stated otherwise, powered with AC/DC power supply of Dr. Widmer
Ethernet 100bTx	< 100 m	RJ45 cat 5e	Yes	Connected to Test-PC
2x CAN	< 30 m	2 wires	Yes	Connected to CAN adapter
RS232 (Console)	< 3 m	2 wires	No	Connected to Test-PC
WLAN 1 (Main)	< 30 m	SMA (Coax)	Yes	Connected to multiband-antenna
WLAN 2 (Aux)	< 30 m	SMA (Coax)	Yes	Connected to multiband-antenna
Mobile 1 (Main) (GSM, UMTS, LTE)	< 30 m	SMA (Coax)	Yes	Connected to multiband-antenna
Mobile 2 (Aux) (GSM, UMTS, LTE)	< 30 m	SMA (Coax)	Yes	Connected to multiband-antenna
GNSS	< 30 m	SMA (Coax)	Yes	Connected to GNSS antenna
Automotive interfaces				
2x Ethernet 100bT1 (BroadR)	< 30 m	2 wires	No	Open cable ends

6. Test conditions

6.1 Climatic conditions, location and date

Location	Date	Temp	Pressure (QFE)	Rel. humidity
Eurofins Electrosuisse Product Testing AG Ostermundigenstrasse 93 3006 Bern SWITZERLAND	February 25 to March 1, 2019	See § 7 and § 8		

6.2 Attendant persons

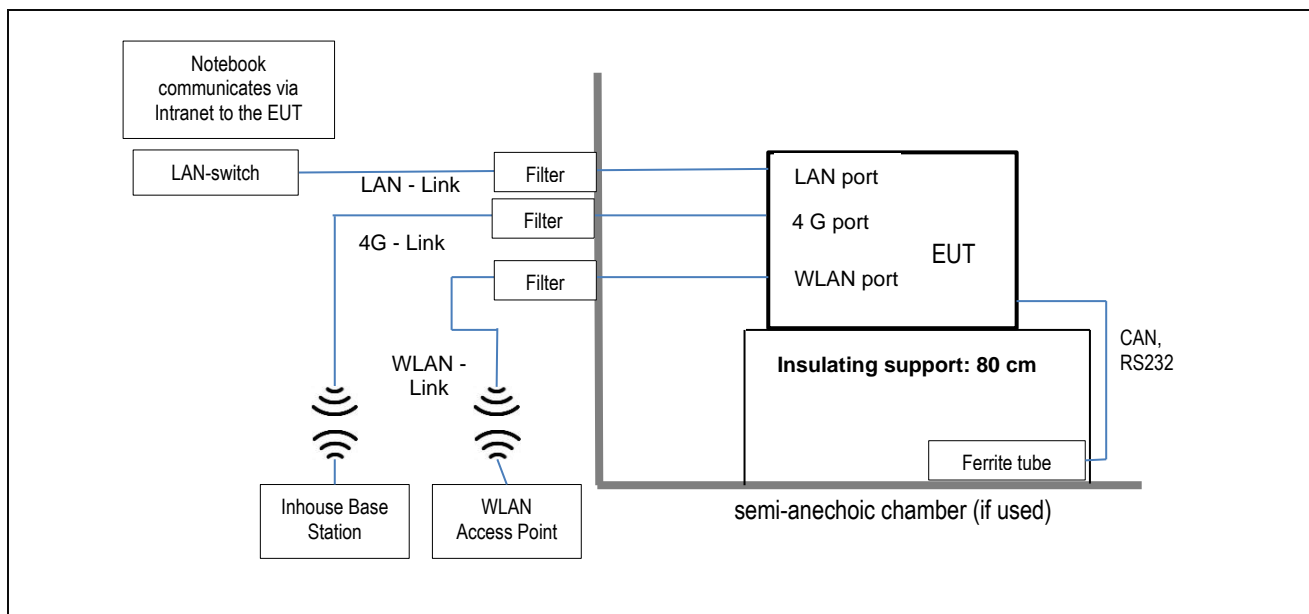
Test Engineer(s):

Mr F. Wyler

Other(s):

Name	Company
Mr. N. Gugger	NetModule AG
Mr. R. Castella	NetModule AG

6.3 Test configuration



6.4 Operating conditions

Power supply during tests if not stated otherwise in § 7 and § 8 : 12 VDC

Routing mode:

- Ping over WLAN
- Ping over WWAN (LTE)
- Ping and iperf over Ethernet cable
- Memory Test (RAM Read/Write, Flash Read/Write)
- 2x CAN Echo Test, CAN transmit
- LED toggle

6.5 Monitoring of the EUT

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

The test application running on the EUT monitors the results of all tests executed:

Monitor of all Ping-outputs

Monitor memory tests

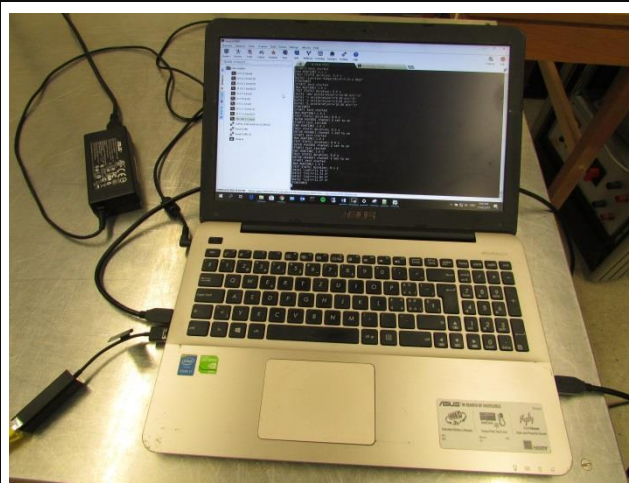
Monitor PMIC voltages and temperature

Read IMU acceleration value

6.6 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	--
Wiring Harness	Custom	-	-	-
Converter CAN to USB	--	--	--	Generates unintended conducted emission
WWAN+WLAN+GNSS Antenna	--	Antenna-Roof-2L2WG	A1705006700033	--
Power supply	Dr. K. Witmer	von Eurofins	--	See tests



Notebook with the different ping-windows



Converter

6.7 Performance criteria

General requirements:	Requirements according to the EUT:
Criterion A (Continuous phenomena for receivers / transmitters according EN 301 489): The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed.	
Criterion B (Transient phenomena for receivers / transmitters according EN 301 489): 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.	- No transmission loss on LAN, WWAN (UMTS/LTE), WLAN During the test: - short interruptions of the communication allowed - LED's may flicker
	After the test the EUT shall operate as expected
Criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.	
	Not applied.

7. Emission tests

7.1 Interference voltage

Test site: Shielded room

Meas. uncertainty: ± 3.6 dB

Measuring method: The conducted disturbance is measured using a spectrum analyser 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: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22.6 °C Humidity: 27 % Pressure QFE: 967 hPa

Test set-up:



Overview



View on the power port

Remarks: None

Test equipment:

Spectrum analyser	<input type="checkbox"/> 168593	<input type="checkbox"/> 184454	<input checked="" type="checkbox"/> 25953			
Receiver	<input type="checkbox"/> 168593	<input type="checkbox"/> 184454	<input checked="" type="checkbox"/> 25953			
Relais-Matrix	<input checked="" type="checkbox"/> 25202					
LISN (=VNNB)	<input type="checkbox"/> 182186	<input checked="" type="checkbox"/> 10540	<input type="checkbox"/> 15840	<input type="checkbox"/> 25203	<input type="checkbox"/> 168517	<input type="checkbox"/> 168560
Coupling network	<input type="checkbox"/> 17414	<input checked="" type="checkbox"/> 25721	<input checked="" type="checkbox"/> 10539	<input type="checkbox"/> 25970	<input type="checkbox"/> 16386	
Coupling network	<input type="checkbox"/> 25971	<input type="checkbox"/> 105487	<input type="checkbox"/> 16562	<input type="checkbox"/> 16559	<input type="checkbox"/> 10539	
Coupling Network	<input type="checkbox"/> 168515	<input type="checkbox"/> 168516				
Coupling Network	<input checked="" type="checkbox"/> 25786	<input checked="" type="checkbox"/> 26009	<input type="checkbox"/> 25718			
Coupling Network	<input type="checkbox"/> 25715	<input type="checkbox"/> 25716				
Coupling Network	<input type="checkbox"/> 181762	<input checked="" type="checkbox"/> 181763				
Coupling Network	<input checked="" type="checkbox"/> 181764					
Decoupling clamp	<input type="checkbox"/> 25781	<input type="checkbox"/> 17901	<input type="checkbox"/> 17902	<input type="checkbox"/> 17013		
Current clamp	<input type="checkbox"/> 7525					
Cables	<input checked="" type="checkbox"/> 16140					
Artificial hand	<input type="checkbox"/> 184450					
Software and Revision	<input type="checkbox"/> Vitam, Rev. 2.4.13		<input checked="" type="checkbox"/> RadiMation 2016.1.6			

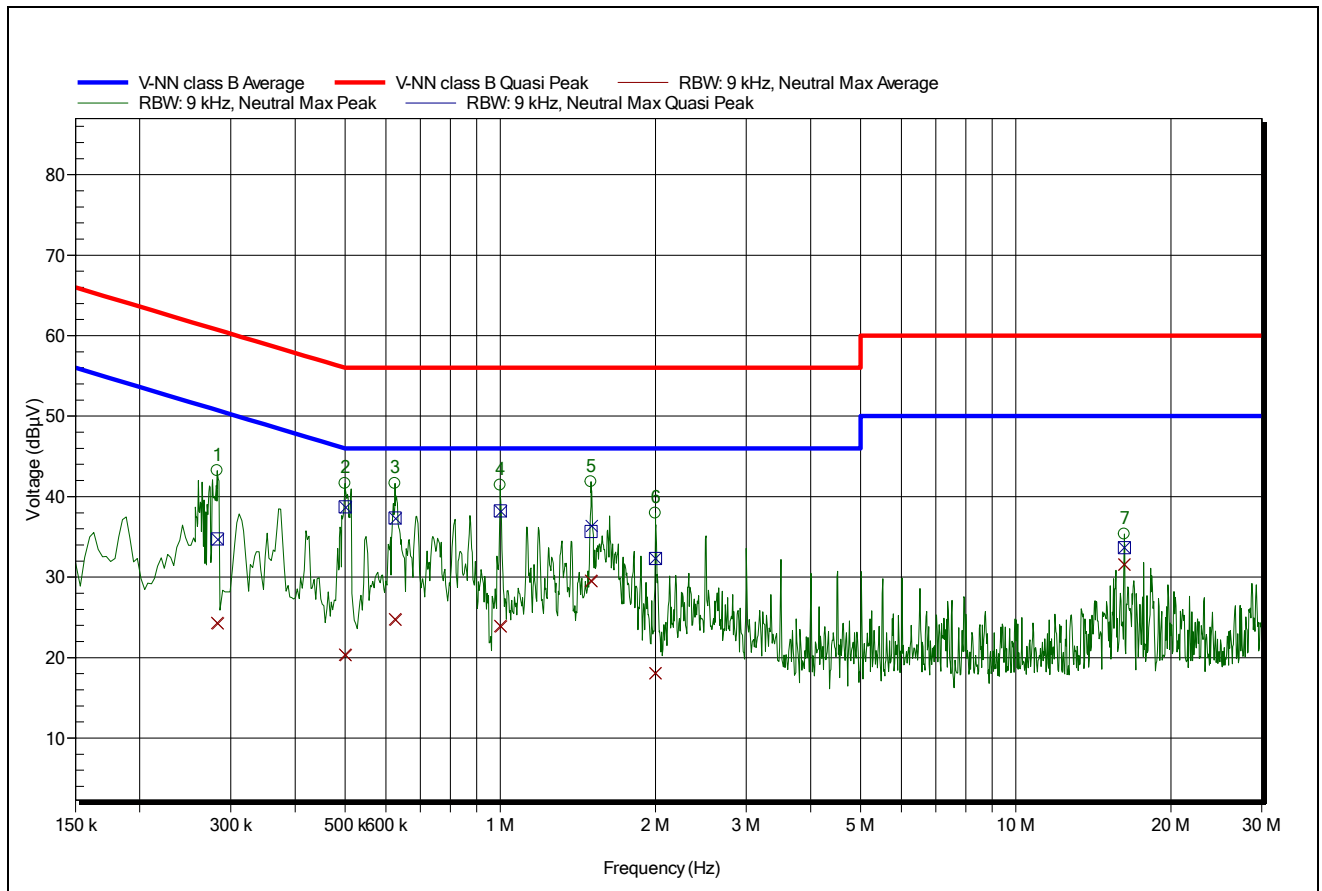
Result: ☒ pass ☐ fail ☐ not applicable ☐ partly tested

Measurement 1:

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Power port 12 VDC, Minus
 Set-up / CDN: Table-top / ESH3-Z5 10540 (N)
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	20/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
282.43 kHz	43.24 dBµV	24.31 dBµV	-26.44 dB	34.75 dBµV	-26 dB	Pass
500.297 kHz	41.62 dBµV	20.34 dBµV	-25.66 dB	38.73 dBµV	-17.27 dB	Pass
625.602 kHz	41.61 dBµV	24.77 dBµV	-21.23 dB	37.34 dBµV	-18.66 dB	Pass
1 MHz	41.44 dBµV	23.92 dBµV	-22.08 dB	38.24 dBµV	-17.76 dB	Pass
1.5 MHz	41.82 dBµV	29.56 dBµV	-16.44 dB	35.65 dBµV	-20.35 dB	Pass
2 MHz	37.94 dBµV	18.03 dBµV	-27.97 dB	32.33 dBµV	-23.67 dB	Pass
16.228 MHz	35.35 dBµV	31.56 dBµV	-18.44 dB	33.67 dBµV	-26.33 dB	Pass

Place and date of test:
 Operator:

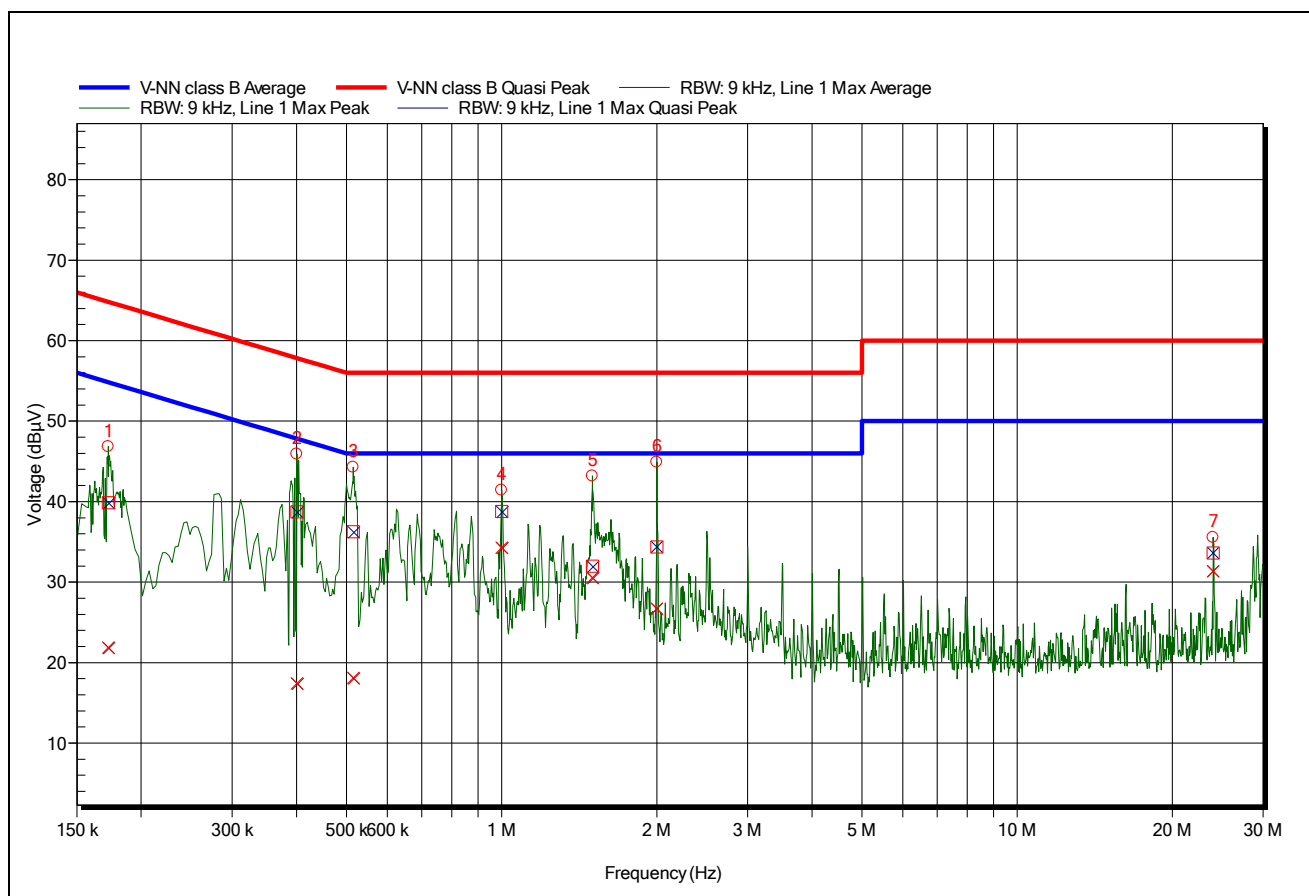
Bern, 2019-02-26
 F. Wyler

Measurement 2:

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Power port 12 VDC, Plus
 Set-up / CDN: Table-top / ESH3-Z5 10540 (L)
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	20/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
172.768 kHz	46.84 dBμV	21.88 dBμV	-32.95 dB	39.88 dBμV	-24.95 dB	Pass
400.863 kHz	45.9 dBμV	17.41 dBμV	-30.43 dB	38.74 dBμV	-19.1 dB	Pass
515.528 kHz	44.26 dBμV	18.1 dBμV	-27.9 dB	36.26 dBμV	-19.74 dB	Pass
1 MHz	41.44 dBμV	34.27 dBμV	-11.73 dB	38.79 dBμV	-17.21 dB	Pass
1.499 MHz	43.16 dBμV	30.57 dBμV	-15.43 dB	31.96 dBμV	-24.04 dB	Pass
2 MHz	44.89 dBμV	26.71 dBμV	-19.29 dB	34.35 dBμV	-21.65 dB	Pass
24.001 MHz	35.53 dBμV	31.34 dBμV	-18.66 dB	33.63 dBμV	-26.37 dB	Pass

Place and date of test:
 Operator:

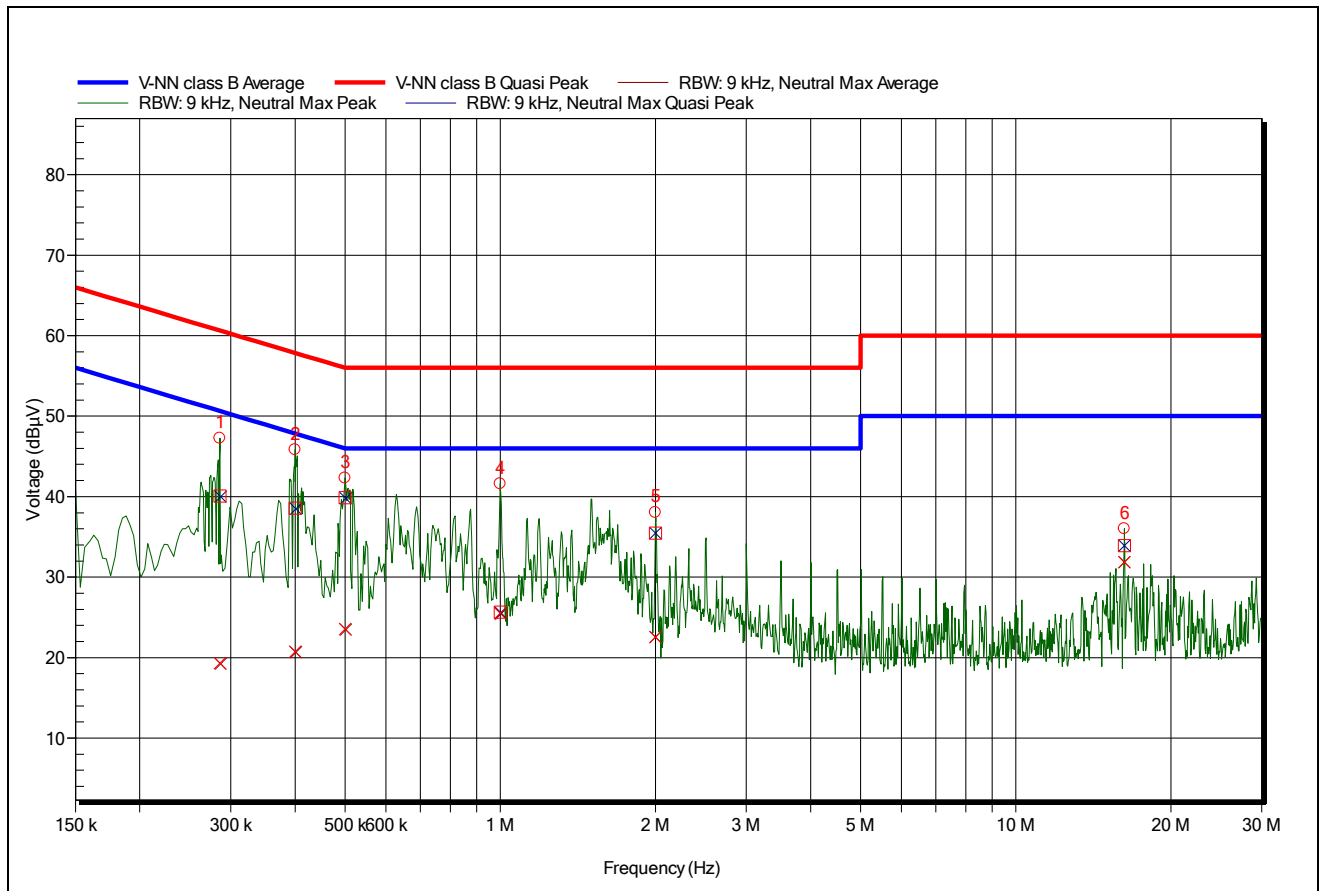
Bern, 2019-02-26
 F. Wyler

Measurement 3:

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Power port 24 VDC, Minus
 Set-up / CDN: Table-top / ESH3-Z5 10540 (N)
 Cables connected: Power 24 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	20/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
285.882 kHz	47.26 dBμV	19.3 dBμV	-31.34 dB	40.07 dBμV	-20.57 dB	Pass
400.293 kHz	45.82 dBμV	20.73 dBμV	-27.12 dB	38.56 dBμV	-19.29 dB	Pass
500.043 kHz	42.3 dBμV	23.53 dBμV	-22.47 dB	39.86 dBμV	-16.14 dB	Pass
1 MHz	41.59 dBμV	25.51 dBμV	-20.49 dB	25.64 dBμV	-30.36 dB	Pass
2 MHz	38.03 dBμV	22.52 dBμV	-23.48 dB	35.47 dBμV	-20.53 dB	Pass
16.228 MHz	36 dBμV	31.86 dBμV	-18.14 dB	33.92 dBμV	-26.08 dB	Pass

Place and date of test:
 Operator:

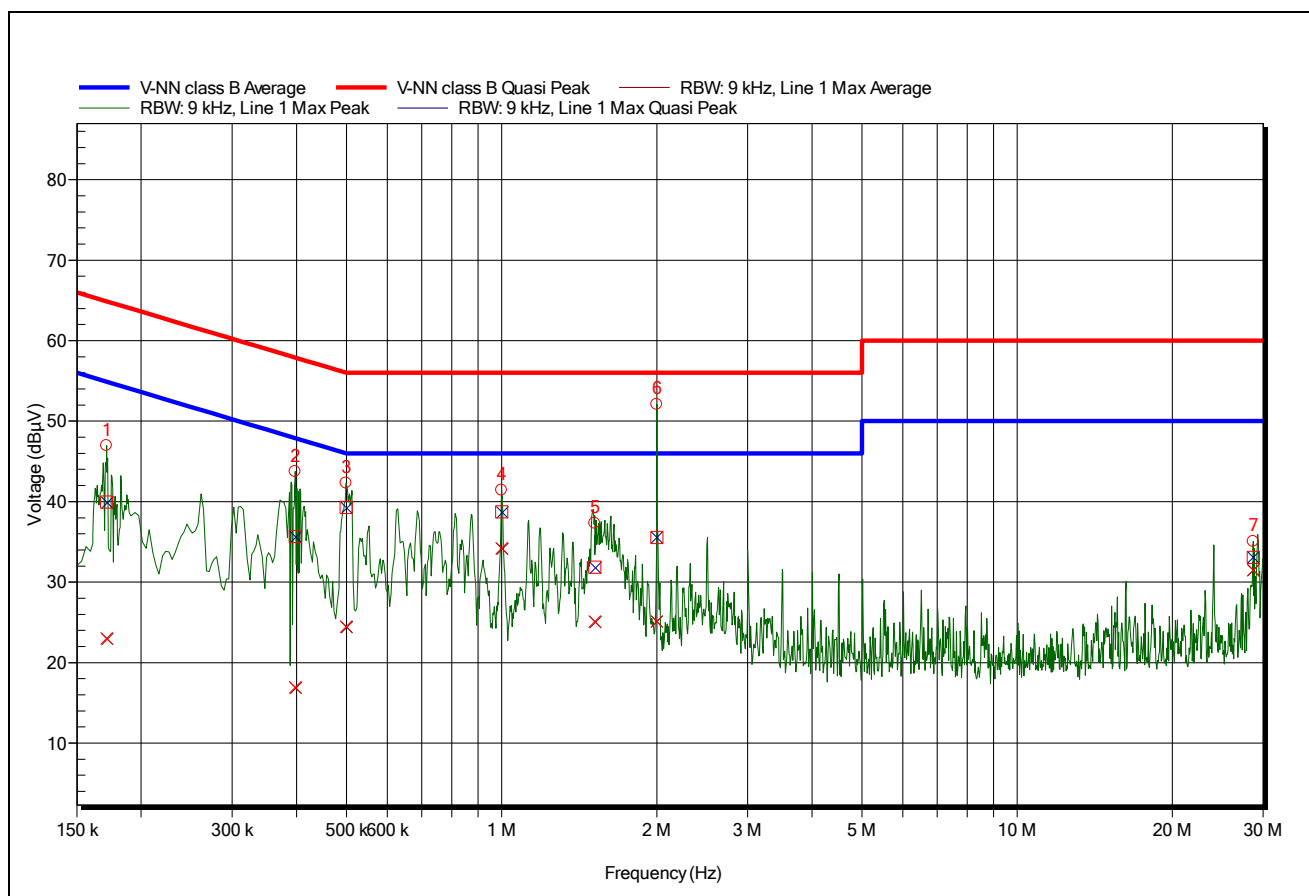
Bern, 2019-02-26
 F. Wyler

Measurement 4:

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Power port 24 VDC, Plus
 Set-up / CDN: Table-top / ESH3-Z5 10540 (L)
 Cables connected: Power 24 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	20/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
171.47 kHz	46.94 dBμV	23 dBμV	-31.89 dB	39.96 dBμV	-24.93 dB	Pass
397.728 kHz	43.71 dBμV	16.92 dBμV	-30.98 dB	35.66 dBμV	-22.24 dB	Pass
499.252 kHz	42.28 dBμV	24.47 dBμV	-21.54 dB	39.3 dBμV	-16.71 dB	Pass
999.553 kHz	41.41 dBμV	34.2 dBμV	-11.8 dB	38.74 dBμV	-17.26 dB	Pass
1.516 MHz	37.3 dBμV	25.11 dBμV	-20.89 dB	31.87 dBμV	-24.13 dB	Pass
2 MHz	52.09 dBμV	25.08 dBμV	-20.92 dB	35.54 dBμV	-20.46 dB	Pass
28.686 MHz	35.04 dBμV	31.48 dBμV	-18.52 dB	33.08 dBμV	-26.92 dB	Pass

Place and date of test:
 Operator:

Bern, 2019-02-26
 F. Wyler

7.2 Conducted emission on I/O and telecommunication ports / wired network ports

Test site: Semi-anechoic chamber Shielded room

Meas. uncertainty: ± 3.6 dB

Measuring method: The conducted disturbance is measured using a spectrum analyser and a voltage probe. The peak values are recorded continuously on the graph. The values that exceed the limit shall be re-measured with a measuring receiver.

Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 22.6 °C Humidity: 27 % Pressure QFE: 967 hPa

Test set-up:



Overview



View on the communication ports

Remarks: None

Test equipment:

Spectrum analyser	<input type="checkbox"/> 168593	<input type="checkbox"/> 184454	<input checked="" type="checkbox"/> 25953			
Receiver	<input type="checkbox"/> 168593	<input type="checkbox"/> 184454	<input checked="" type="checkbox"/> 25953			
Relais-Matrix	<input checked="" type="checkbox"/> 25202					
LISN (=VNNB)	<input type="checkbox"/> 182186	<input checked="" type="checkbox"/> 10540	<input type="checkbox"/> 15840	<input type="checkbox"/> 25203	<input type="checkbox"/> 168517	<input type="checkbox"/> 168560
Coupling network	<input type="checkbox"/> 17414	<input checked="" type="checkbox"/> 25721	<input checked="" type="checkbox"/> 10539	<input type="checkbox"/> 25970	<input type="checkbox"/> 16386	
Coupling network	<input type="checkbox"/> 25971	<input type="checkbox"/> 105487	<input type="checkbox"/> 16562	<input type="checkbox"/> 16559	<input type="checkbox"/> 10539	
Coupling Network	<input type="checkbox"/> 168515	<input type="checkbox"/> 168516				
Coupling Network	<input checked="" type="checkbox"/> 25786	<input checked="" type="checkbox"/> 26009	<input type="checkbox"/> 25718			
Coupling Network	<input type="checkbox"/> 25715	<input type="checkbox"/> 25716				
Coupling Network	<input type="checkbox"/> 181762	<input checked="" type="checkbox"/> 181763				
Coupling Network	<input checked="" type="checkbox"/> 181764					
Decoupling clamp	<input type="checkbox"/> 25781	<input type="checkbox"/> 17901	<input type="checkbox"/> 17902	<input type="checkbox"/> 17013		
Current clamp	<input type="checkbox"/> 7525					
Cables	<input checked="" type="checkbox"/> 16140					
Artificial hand	<input type="checkbox"/> 184450					
Software and Revision	<input type="checkbox"/> Vitam, Rev. 2.4.13		<input checked="" type="checkbox"/> RadiMation 2016.1.6			

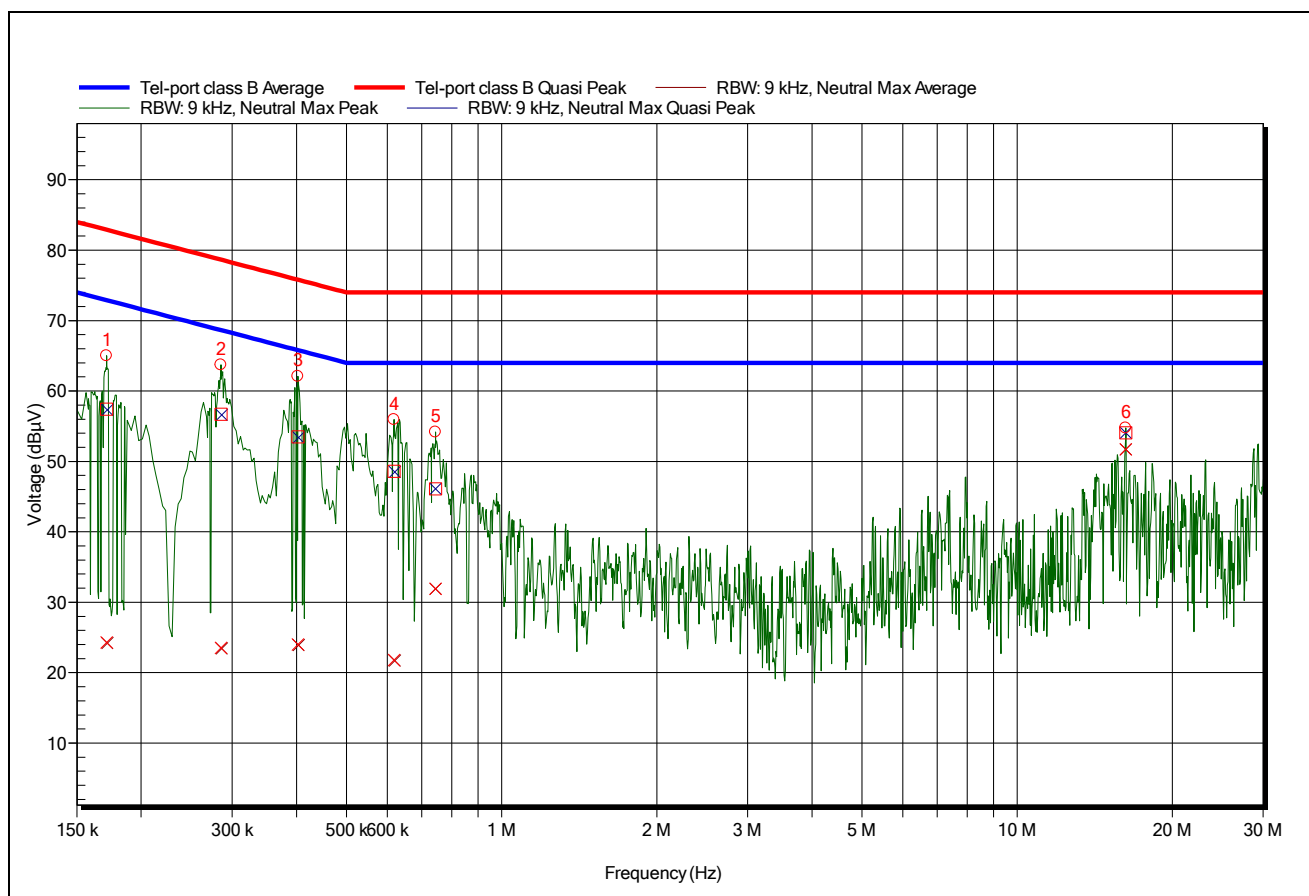
Result: ☒ pass ☐ fail ☐ not applicable ☐ partly tested

Measurement 1:

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Ethernet
 Set-up / CDN: Table-top / T-ISO 181763 (N)
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	40/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
171.47 kHz	65 dBμV	24.3 dBμV	-48.61 dB	57.4 dBμV	-25.47 dB	Pass
285.692 kHz	63.7 dBμV	23.5 dBμV	-45.14 dB	56.7 dBμV	-21.94 dB	Pass
402.605 kHz	62.1 dBμV	24 dBμV	-41.81 dB	53.5 dBμV	-22.33 dB	Pass
618.698 kHz	55.9 dBμV	21.8 dBμV	-42.2 dB	48.6 dBμV	-25.43 dB	Pass
744.098 kHz	54.2 dBμV	31.9 dBμV	-32.09 dB	46.1 dBμV	-27.92 dB	Pass
16.228 MHz	54.7 dBμV	51.7 dBμV	-12.28 dB	54.1 dBμV	-19.94 dB	Pass

Place and date of test:
 Operator:

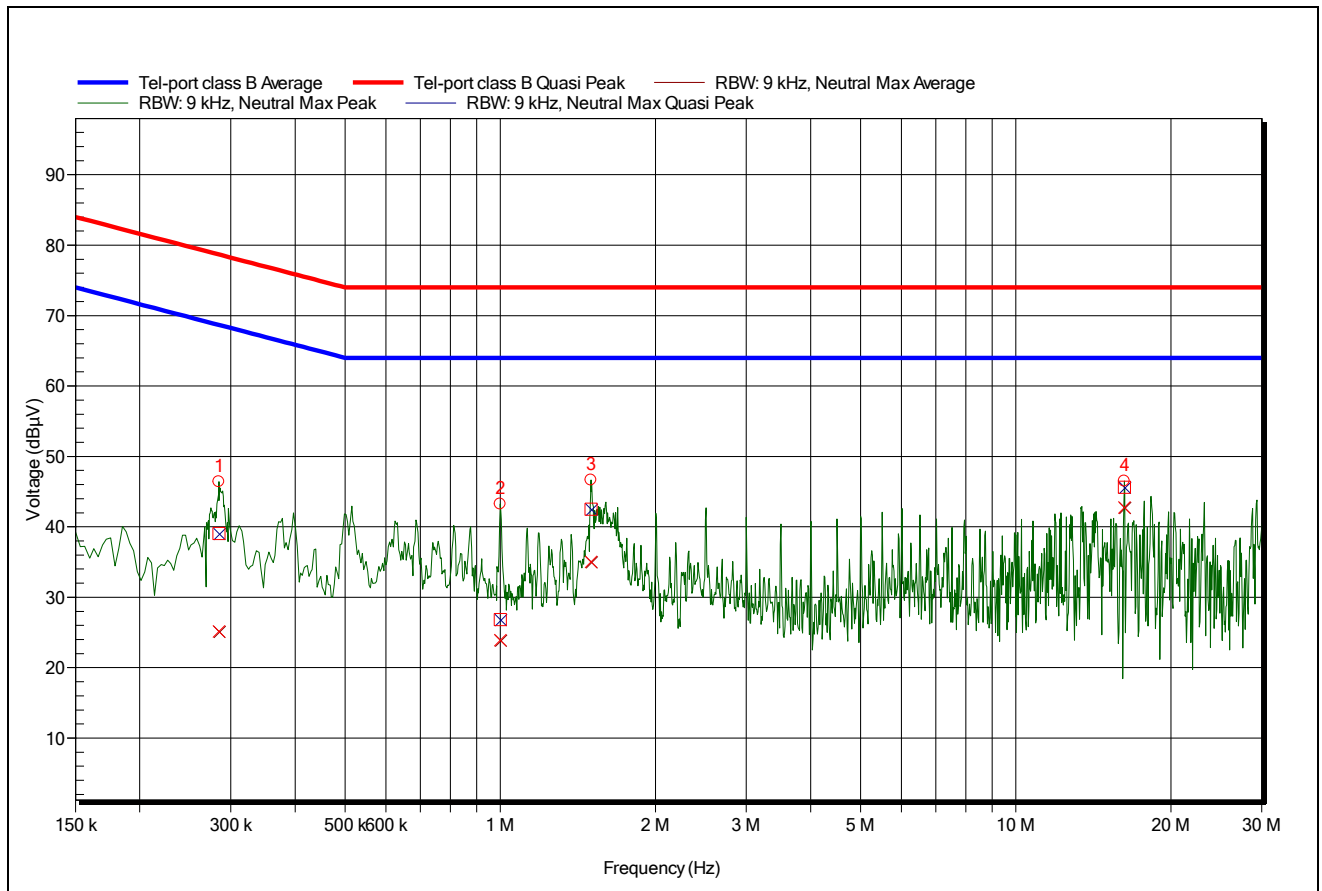
Bern, 2019-02-26
 F. Wyler

Measurement 2:

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Coax LTE
 Set-up / CDN: Table-top / T-ISN 25786 (N)
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	40/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
284.678 kHz	46.4 dBμV	25.2 dBμV	-43.51 dB	39 dBμV	-39.64 dB	Pass
999.933 kHz	43.2 dBμV	23.9 dBμV	-40.1 dB	26.8 dBμV	-47.18 dB	Pass
1.5 MHz	46.6 dBμV	35 dBμV	-28.98 dB	42.5 dBμV	-31.51 dB	Pass
16.228 MHz	46.5 dBμV	42.7 dBμV	-21.26 dB	45.6 dBμV	-28.36 dB	Pass

Place and date of test:
 Operator:

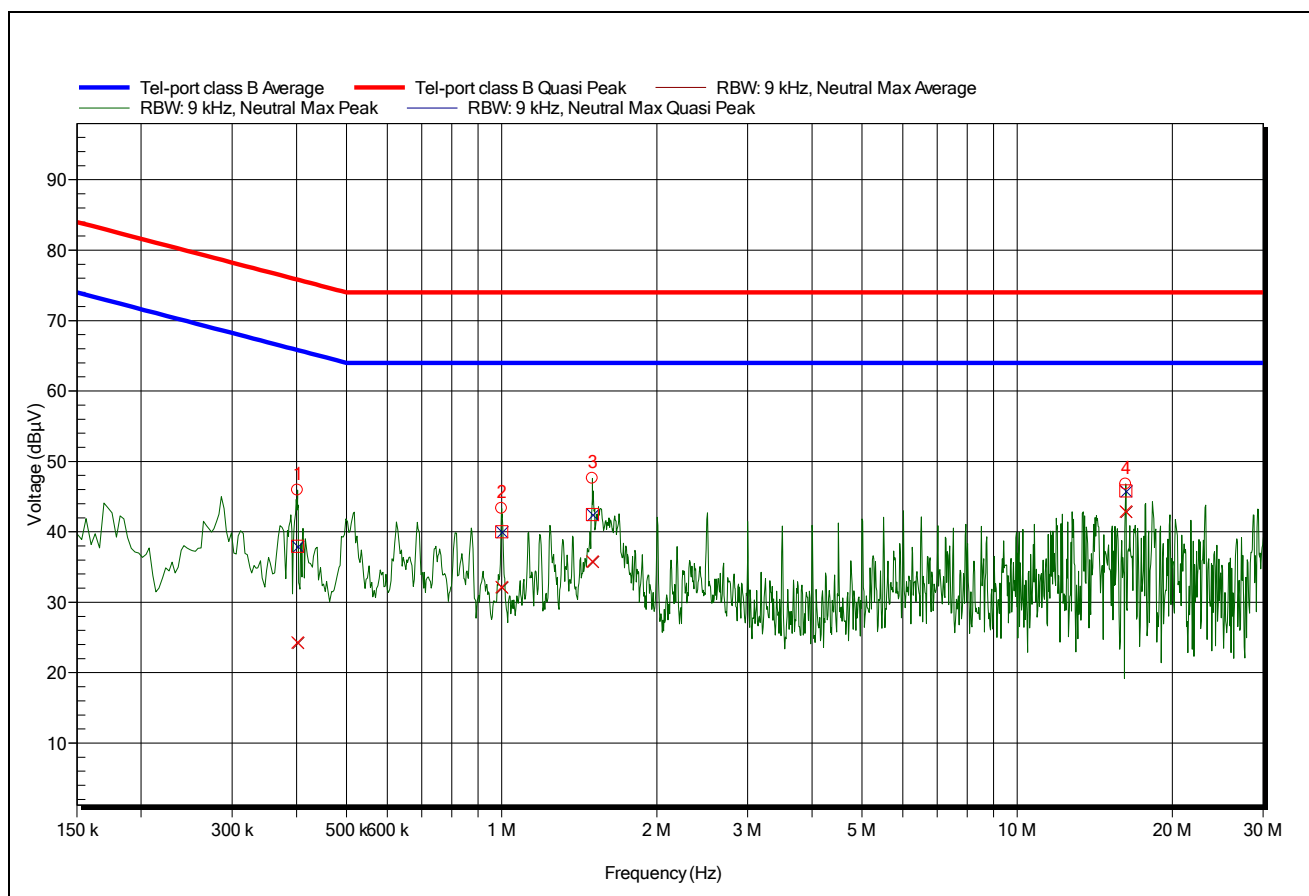
Bern, 2019-02-26
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Measurement 3:

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Coax WLAN
 Set-up / CDN: Table-top / T-ISO 26009 (N)
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	40/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
401.94 kHz	45.9 dBμV	24.3 dBμV	-41.54 dB	38 dBμV	-37.85 dB	Pass
999.553 kHz	43.3 dBμV	32.1 dBμV	-31.87 dB	40 dBμV	-33.98 dB	Pass
1.5 MHz	47.6 dBμV	35.8 dBμV	-28.19 dB	42.5 dBμV	-31.54 dB	Pass
16.228 MHz	46.8 dBμV	42.9 dBμV	-21.11 dB	45.8 dBμV	-28.21 dB	Pass

Place and date of test:
 Operator:

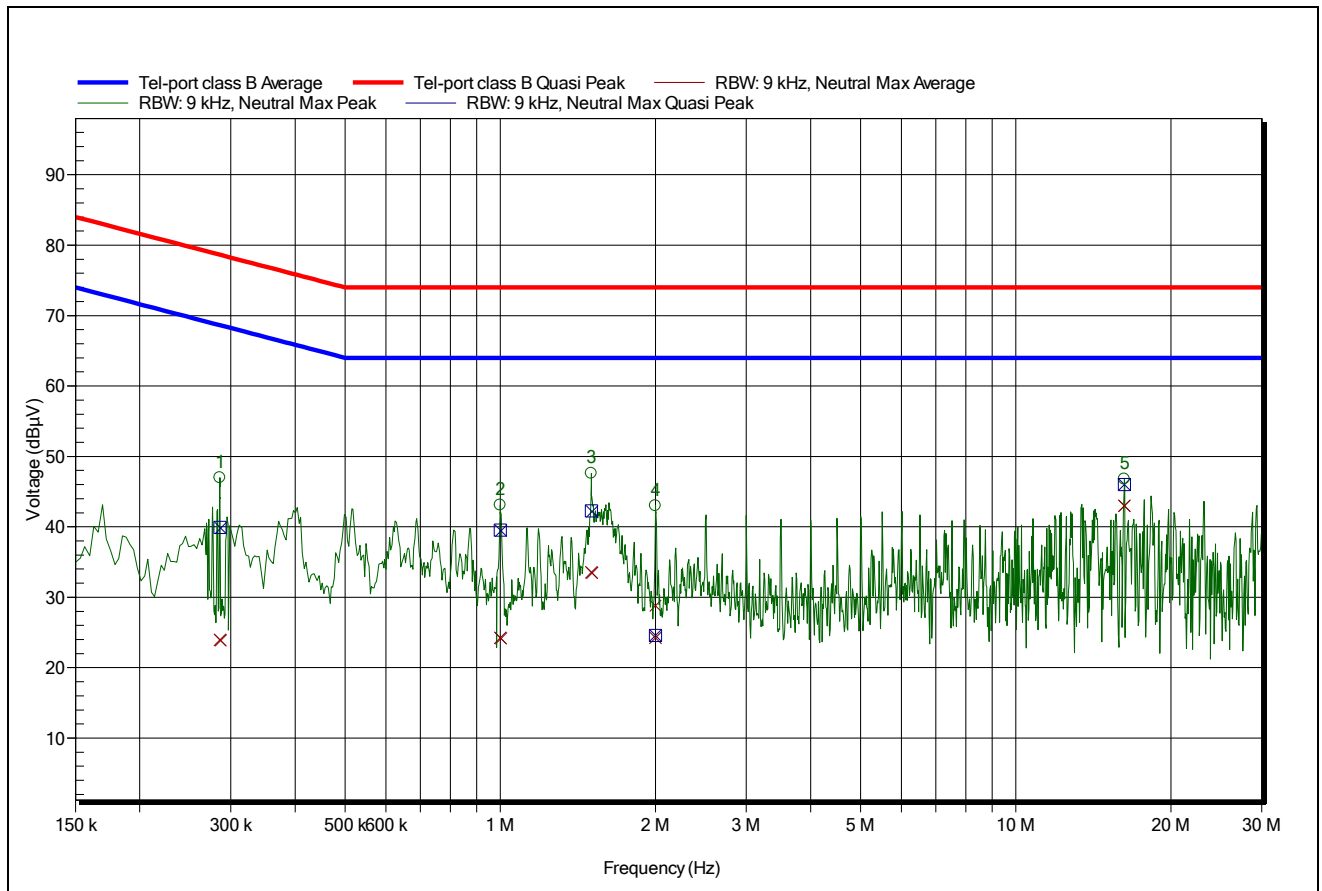
Bern, 2019-02-26
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Measurement 4:

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Coax GNSS
 Set-up / CDN: Table-top / T-ISN 26009 (N)
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	40/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
286.008 kHz	47 dBμV	24 dBμV	-44.68 dB	39.9 dBμV	-38.71 dB	Pass
1.001 MHz	43.1 dBμV	24.3 dBμV	-39.75 dB	39.5 dBμV	-34.48 dB	Pass
1.501 MHz	47.6 dBμV	33.6 dBμV	-30.45 dB	42.3 dBμV	-31.75 dB	Pass
2 MHz	43 dBμV	24.2 dBμV	-39.77 dB	24.6 dBμV	-49.42 dB	Pass
16.228 MHz	46.8 dBμV	43 dBμV	-21.01 dB	46 dBμV	-28.01 dB	Pass

Place and date of test:
 Operator:

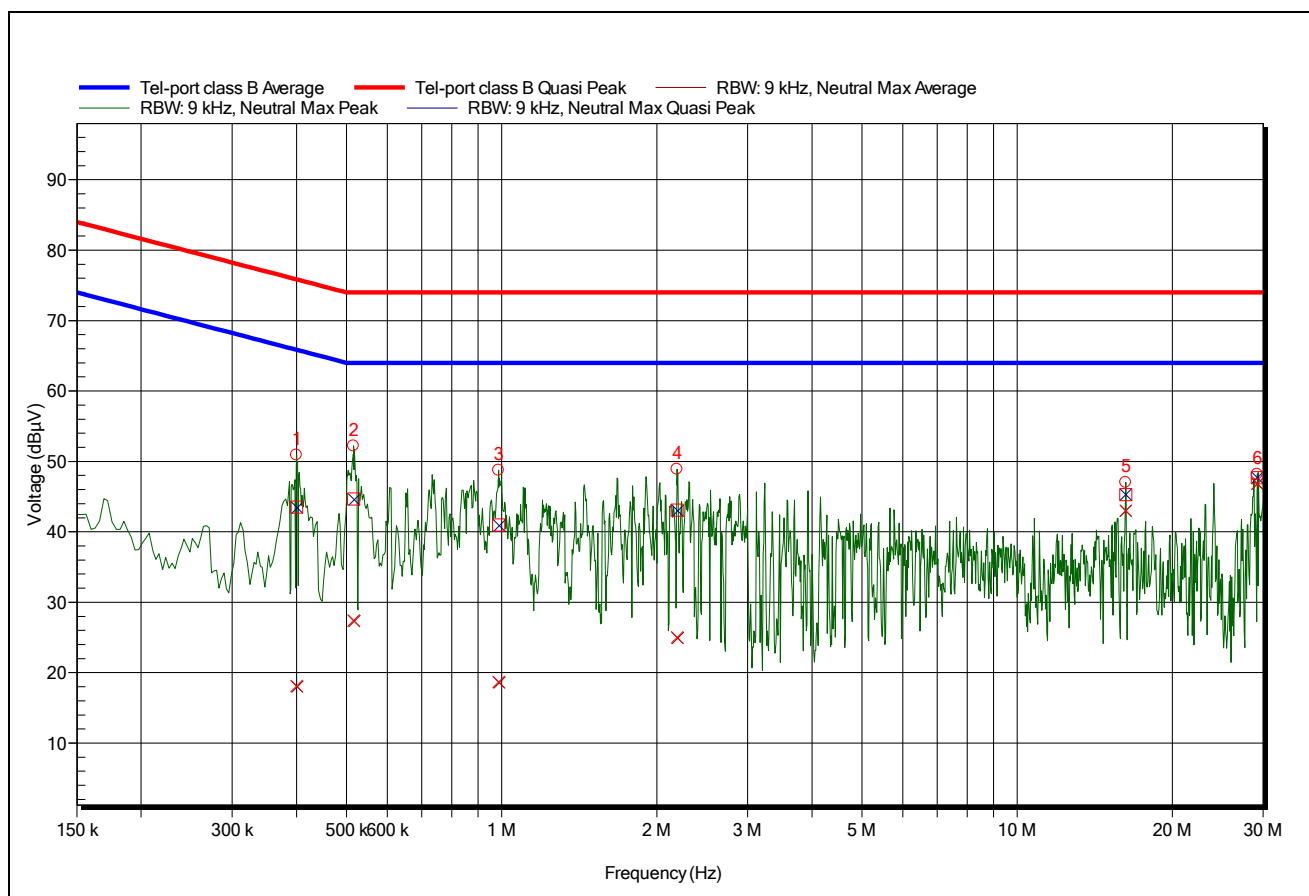
Bern, 2019-02-26
 F. Wyler

Measurement 5: (informativ)

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: Debug USB
 Set-up / CDN: Table-top / ESH3-Z5 182186
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	20/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
400.325 kHz	50.9 dBμV	18.1 dBμV	-47.73 dB	43.5 dBμV	-32.34 dB	Pass
516.447 kHz	52.2 dBμV	27.4 dBμV	-36.58 dB	44.6 dBμV	-29.36 dB	Pass
986.19 kHz	48.7 dBμV	18.7 dBμV	-45.31 dB	41 dBμV	-33.01 dB	Pass
2.191 MHz	48.9 dBμV	25 dBμV	-39.01 dB	43.1 dBμV	-30.93 dB	Pass
16.228 MHz	47 dBμV	43 dBμV	-21.03 dB	45.3 dBμV	-28.72 dB	Pass
29.236 MHz	48.2 dBμV	46.8 dBμV	-17.18 dB	47.7 dBμV	-26.34 dB	Pass

Place and date of test:
 Operator:

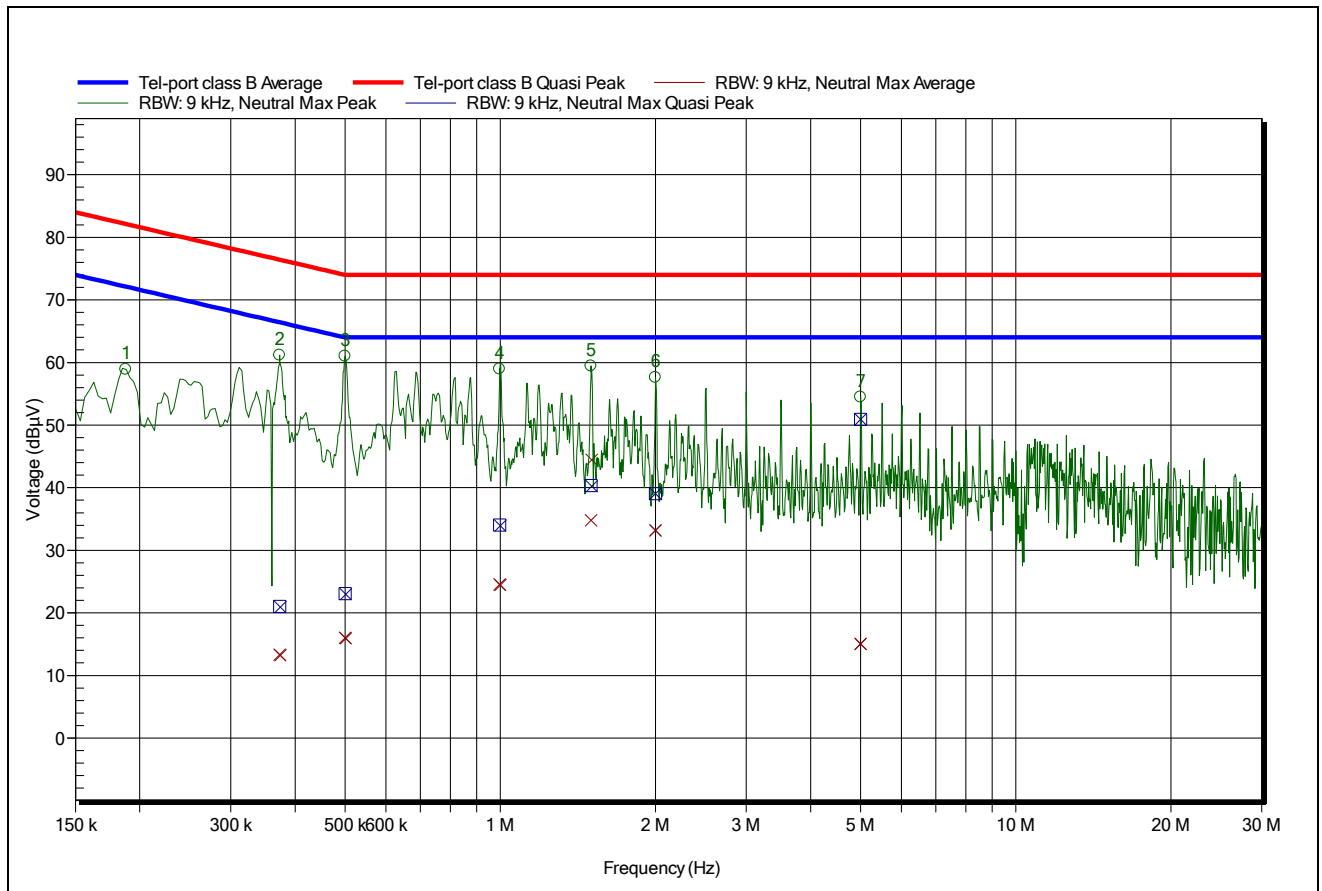
Bern, 2019-02-26
 F. Wyler

Measurement 6: (informativ)

Client: NetModule AG
 Equipment: NetModule NG800
 Measured interface: CAN 0
 Set-up / CDN: Table-top / T-ISO 25721 (N)
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN transmit, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	150 kHz ... 30 MHz
Coarse measurements:	Peak	Resolution / Video Bandwidth	9 kHz / 30 kHz
Sweep time:	500ms/1000ms/2000ms	Number of sweeps:	40/20/20
Receiver measurement	Peak, Quasi-Peak & Average	Measure / Observation Time	1 s / 5 s

**Detected peaks**

Frequency	Peak	Average	Average Difference	Quasi-Peak	Quasi-Peak Difference	Status
373.408 kHz	61.2 dBμV	13.3 dBμV	-53.13 dB	21 dBμV	-55.41 dB	Pass
499.948 kHz	61 dBμV	16 dBμV	-47.97 dB	23.1 dBμV	-50.94 dB	Pass
997.653 kHz	59 dBμV	24.5 dBμV	-39.47 dB	34 dBμV	-39.99 dB	Pass
1.499 MHz	59.5 dBμV	34.8 dBμV	-29.21 dB	40.4 dBμV	-33.65 dB	Pass
2 MHz	57.6 dBμV	33.2 dBμV	-30.81 dB	39.1 dBμV	-34.94 dB	Pass
5 MHz	54.5 dBμV	15.1 dBμV	-48.95 dB	50.9 dBμV	-23.1 dB	Pass

Place and date of test:
 Operator:

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 F. Wyler

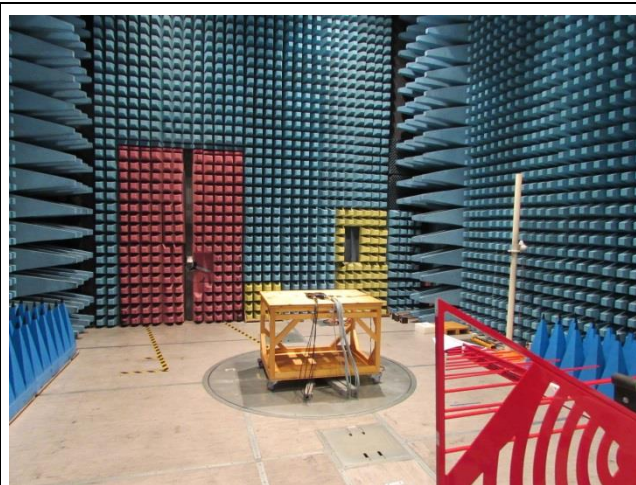
7.3 Radiated electromagnetic field

Test site: Semi-anechoic chamber
 Distance: 3 m
 Position of EUT: 80 cm (height of the equipment under test above floor)
 Meas. uncertainty: ± 4.6 dB (30 - 300 MHz) / ± 3.7 dB (300 - 1000 MHz) / ± 3.7 dB (1 - 6 GHz) / ± 4.4 dB (6 - 18 GHz)
 Measuring method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyser and a wide band antenna. The antenna is moved from 1 to 4 m in height successively with horizontal and vertical polarisations. 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.

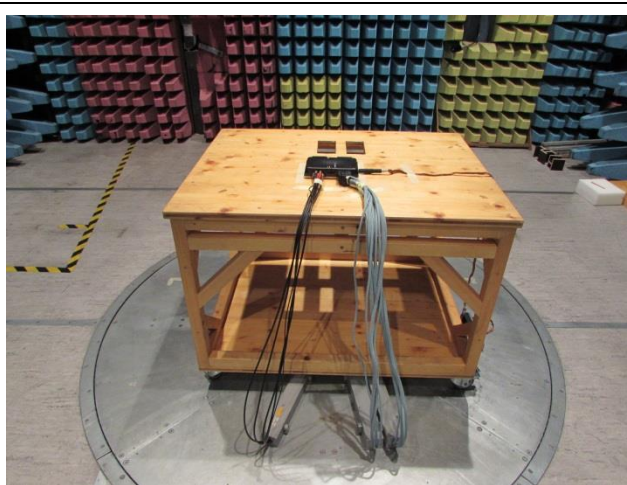
Modifications: ☒ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Climatic conditions: Temperature: 23.4 °C Humidity: 21 % Pressure QFE: 969 hPa

Test set-up:



Overview



Close view

Remarks: None

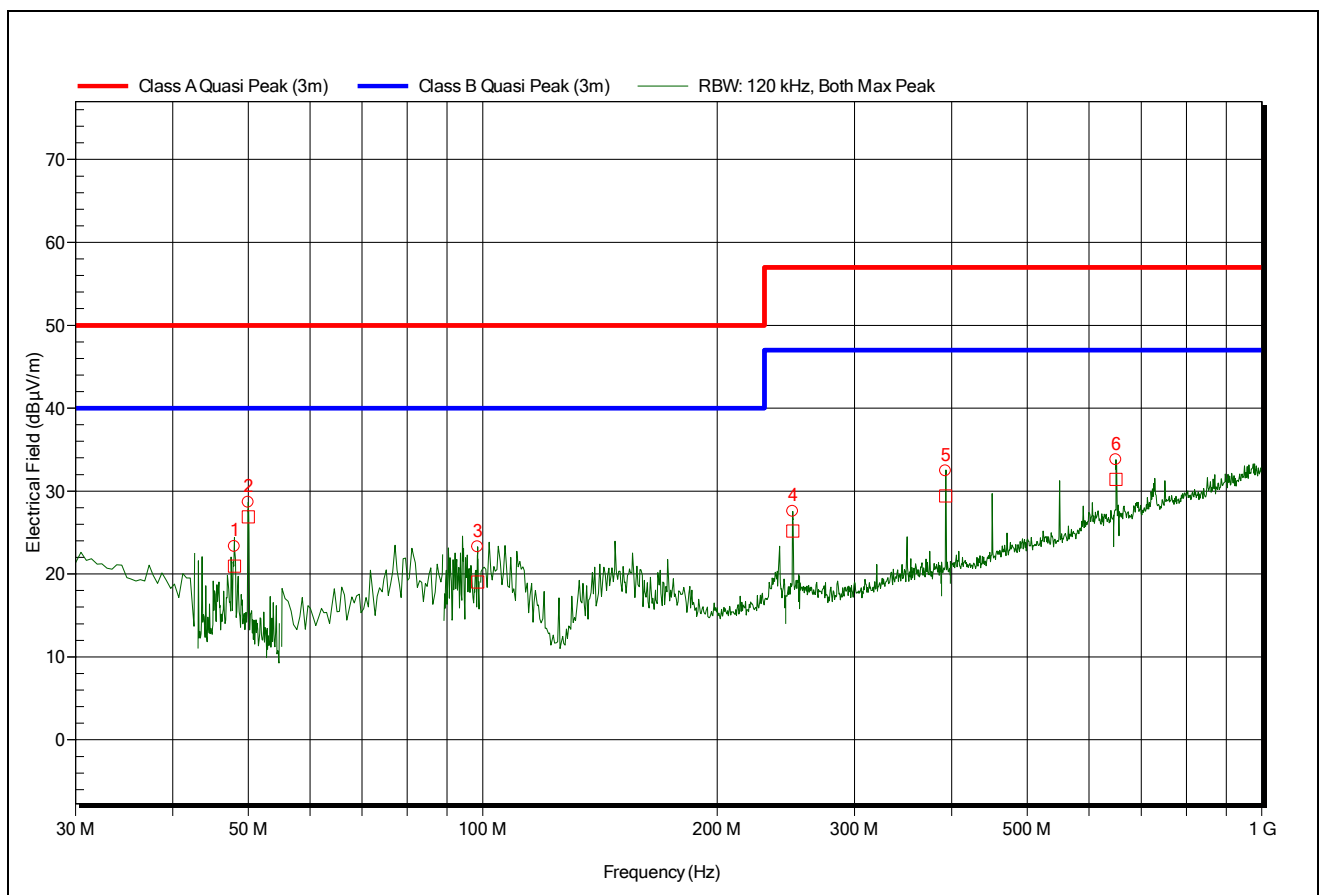
Test equipment:

Spectrum analyser	<input checked="" type="checkbox"/> 168593	<input type="checkbox"/> 184454	<input type="checkbox"/> 25953
Receiver	<input checked="" type="checkbox"/> 168593	<input type="checkbox"/> 184454	<input type="checkbox"/> 25953
Preamplifier	<input checked="" type="checkbox"/> 184451	<input type="checkbox"/> 168520	
Antenna, (log-per)	<input type="checkbox"/> 168585	<input type="checkbox"/> 26021	
Antenna, (bi-con-log)	<input checked="" type="checkbox"/> 181955		
Antenna, (bi-log)	<input type="checkbox"/> 26933		
Antenna, (log-per dir)	<input type="checkbox"/> 168591		
Cables	<input checked="" type="checkbox"/> 184452	<input type="checkbox"/> 168547	
Software and Revision	<input type="checkbox"/> Vitam, Rev. 2_4_13	<input checked="" type="checkbox"/> RadiMation 2016.1.6	

Result: ☒ pass ☐ fail ☐ not applicable ☐ partly tested

Measurement 1:

Client: NetModule AG
 Equipment: NetModule NG800
 Cables connected: Power 12 VDC, Ethernet, 3xCAN, RS 232, 2x WLAN, 2xMobile LTE, GNSS, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN echo, LED toggle, Output to Input looped; see § 6.4
 Modification: None
 Remarks: None
 Settings of the measurement equipment
 Limits: EN 55032 (Cl. B) Frequency range: 30 MHz ... 1000 MHz
 Pre-scan measurement: Peak Resolution / Video Bandwidth: 120 kHz / 1 MHz
 Sweep time: 200 ms Number of sweeps: 20
 Geometry: Height: 1 - 4 m, 4 steps; Azimuth: 0° – 360°, 16 steps; Polarisation: Horizontal & Vertical
 Receiver measurement: Peak & Quasi-Peak Measure / Observation Time: 1 s / 5 s
 Geometry: On the position of the maximum

**Detected peaks**

Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
48.003 MHz	23.33 dBµV/m	20.95 dBµV/m	-19.05 dB	Pass	360 Degree	1 m	Vertical
50.001 MHz	28.63 dBµV/m	26.9 dBµV/m	-13.1 dB	Pass	337 Degree	1 m	Vertical
98.472 MHz	23.29 dBµV/m	19.03 dBµV/m	-20.97 dB	Pass	135 Degree	1 m	Vertical
250.011 MHz	27.55 dBµV/m	25.17 dBµV/m	-21.83 dB	Pass	225 Degree	3 m	Vertical
392.717 MHz	32.43 dBµV/m	29.43 dBµV/m	-17.57 dB	Pass	202 Degree	1 m	Vertical
650.009 MHz	33.78 dBµV/m	31.4 dBµV/m	-15.6 dB	Pass	360 Degree	2 m	Vertical

Place and date of test:
 Operator:

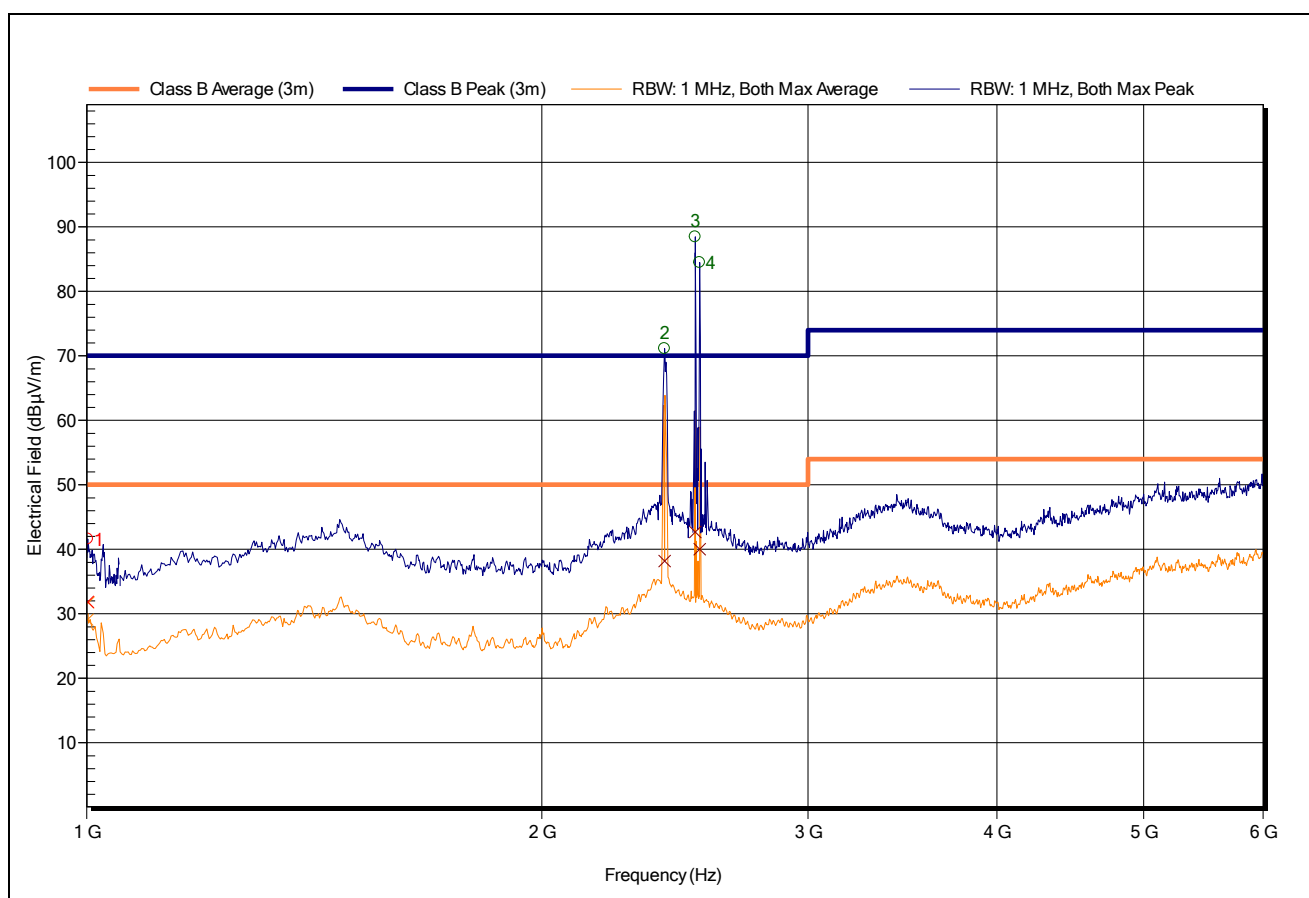
Bern, 2019-02-25
 F. Wyler

Measurement 2:

Client: NetModule AG
 Equipment: NetModule NG800
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN echo, LED toggle, Output to Input connection; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	EN 55032 (Cl. B)	Frequency range	1 GHz .6 GHz
Pre-scan measurement	Peak & Average	Resolution / Video Bandwidth	1 MHz / 3 MHz
Sweep time:	200 ms	Number of sweeps:	20
Geometry:	Height: 1 - 4 m, 4 steps; Azimuth: 0° – 360°, 16 steps; Polarisation: Horizontal & Vertical		
Receiver measurement:	Peak & Average	Measure / Observation Time	1 s / 5 s
Geometry:	On the position of the maximum		

**Detected peaks**

Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1.002 GHz	41.59 dBμV/m	-28.41 dB	31.86 dBμV/m	-18.14 dB	Pass	292 Degree	1 m	Vertical
2.411 GHz	71.12 dBμV/m	1.12 dB	38.19 dBμV/m	-11.81 dB	Pass *)	0 Degree	2 m	Vertical
2.527 GHz	88.43 dBμV/m	18.43 dB	42.69 dBμV/m	-7.31 dB	Pass *)	45 Degree	2 m	Horizontal
2.544 GHz	84.47 dBμV/m	14.47 dB	40.02 dBμV/m	-9.98 dB	Pass *)	180 Degree	2 m	Horizontal

*) These are the carriers of the different radio services and do belong to the exclusion band of EN 301 489-1

Place and date of test:
 Operator:

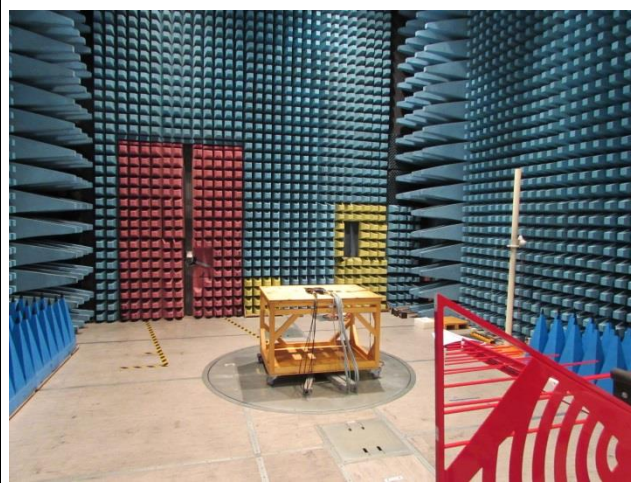
Bern, 2019-02-25
 F. Wyler

7.4 Radiated emission - Electromagnetic field according CFR 47 15 (radiated – 30 MHz to 6 GHz)

Test site: Semi-anechoic chamber (hybrid)
 Distance: 3 m
 Position of EUT: 80 cm (height of the equipment under test above floor)
 Meas. uncertainty: ± 4.6 dB (30 - 300 MHz) / ± 3.7 dB (300 - 1000 MHz) / ± 4.7 dB (1 - 18 GHz)
 Measuring method: The electromagnetic disturbance radiated by the equipment is measured using a spectrum analyser and a wide band antenna. The antenna is moved from 1 to 4 m in height successively with horizontal and vertical polarisations. 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.

Climatic conditions: Temperature: 23.8 °C Humidity: 33 % Pressure QFE: 953 hPa (2017-11-07)

Test set-up:



Overview



Close view

Remarks: None

Test equipment:

Spectrum analyser	<input checked="" type="checkbox"/> 168593	<input type="checkbox"/> 184454	<input type="checkbox"/> 25953
Receiver	<input checked="" type="checkbox"/> 168593	<input type="checkbox"/> 184454	<input type="checkbox"/> 25953
Preamplifier	<input checked="" type="checkbox"/> 184451	<input type="checkbox"/> 168520	
Antenna, (log-per)	<input type="checkbox"/> 168585	<input type="checkbox"/> 26021	
Antenna, (bi-con-log)	<input checked="" type="checkbox"/> 181955		
Antenna, (bi-log)	<input type="checkbox"/> 26933		
Antenna, (log-per dir)	<input type="checkbox"/> 168591		
Cables	<input checked="" type="checkbox"/> 184452	<input type="checkbox"/> 168547	
Software and Revision	<input checked="" type="checkbox"/> RadiMation 2016.1.6		

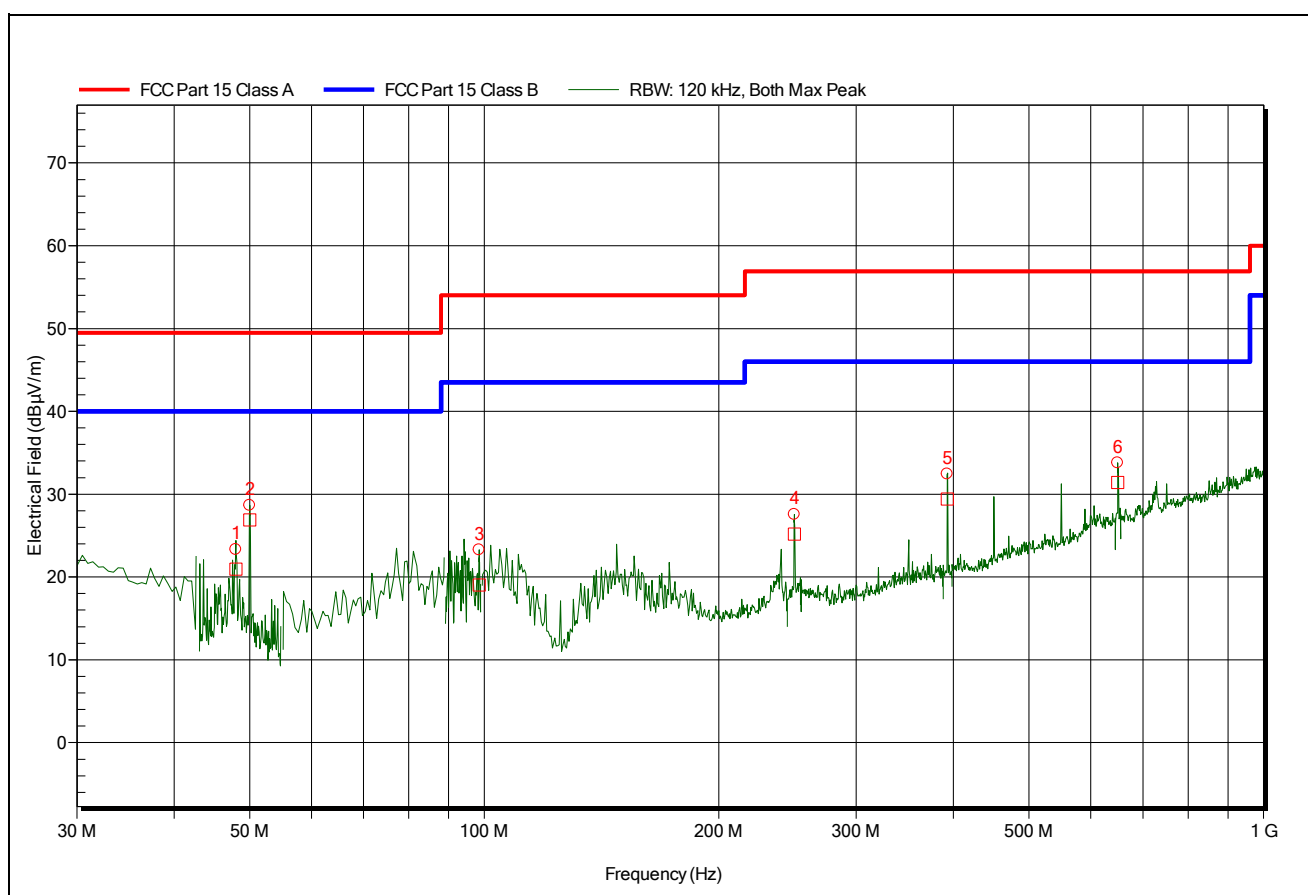
Result: ☒ pass ☐ fail ☐ not applicable ☐ partly tested

Measurement 1:

Client: NetModule AG
 Equipment: NetModule NG800
 Cables connected: Power 12VDC, Ethernet; RS232, No Digital In/out, USB Stick, 2x Mobile Link on Coax, 2x WLAN on Coax, 1x GNSS on Coax, Coax extension cable connected to Antenna-Roof-2L2WG;
 see § 5.5 & § 6.3
 Operating mode: Routing, RAM-Test, Ping via Ethernet & Mobile, USB-Stick read/write; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	CFR 47 15B / ICES-003	Frequency range	30 MHz ... 1000 MHz
Pre-scan measurement	Peak	Resolution / Video Bandwidth	120 kHz / 1 MHz
Sweep time:	200 ms	Number of sweeps:	20
Geometry:	Height: 1 - 4 m, 4 steps; Azimuth: 0° – 360°, 16 steps; Polarisation: Horizontal & Vertical		
Receiver measurement:	Peak & Quasi-Peak	Measure / Observation Time	1 s / 5 s
Geometry:	On the position of the maximum		

**Detected peaks**

Frequency	Peak	Quasi-Peak	Quasi-Peak Difference	Status	Angle	Height	Polarization
48.003 MHz	23.33 dBµV/m	20.95 dBµV/m	-19.05 dB	Pass	360 Degree	1 m	Vertical
50.001 MHz	28.63 dBµV/m	26.9 dBµV/m	-13.1 dB	Pass	337 Degree	1 m	Vertical
98.472 MHz	23.29 dBµV/m	19.03 dBµV/m	-24.47 dB	Pass	135 Degree	1 m	Vertical
250.011 MHz	27.55 dBµV/m	25.17 dBµV/m	-20.83 dB	Pass	225 Degree	3 m	Vertical
392.717 MHz	32.43 dBµV/m	29.43 dBµV/m	-16.57 dB	Pass	202 Degree	1 m	Vertical
650.009 MHz	33.78 dBµV/m	31.4 dBµV/m	-14.6 dB	Pass	360 Degree	2 m	Vertical

Place and date of test:
 Operator:

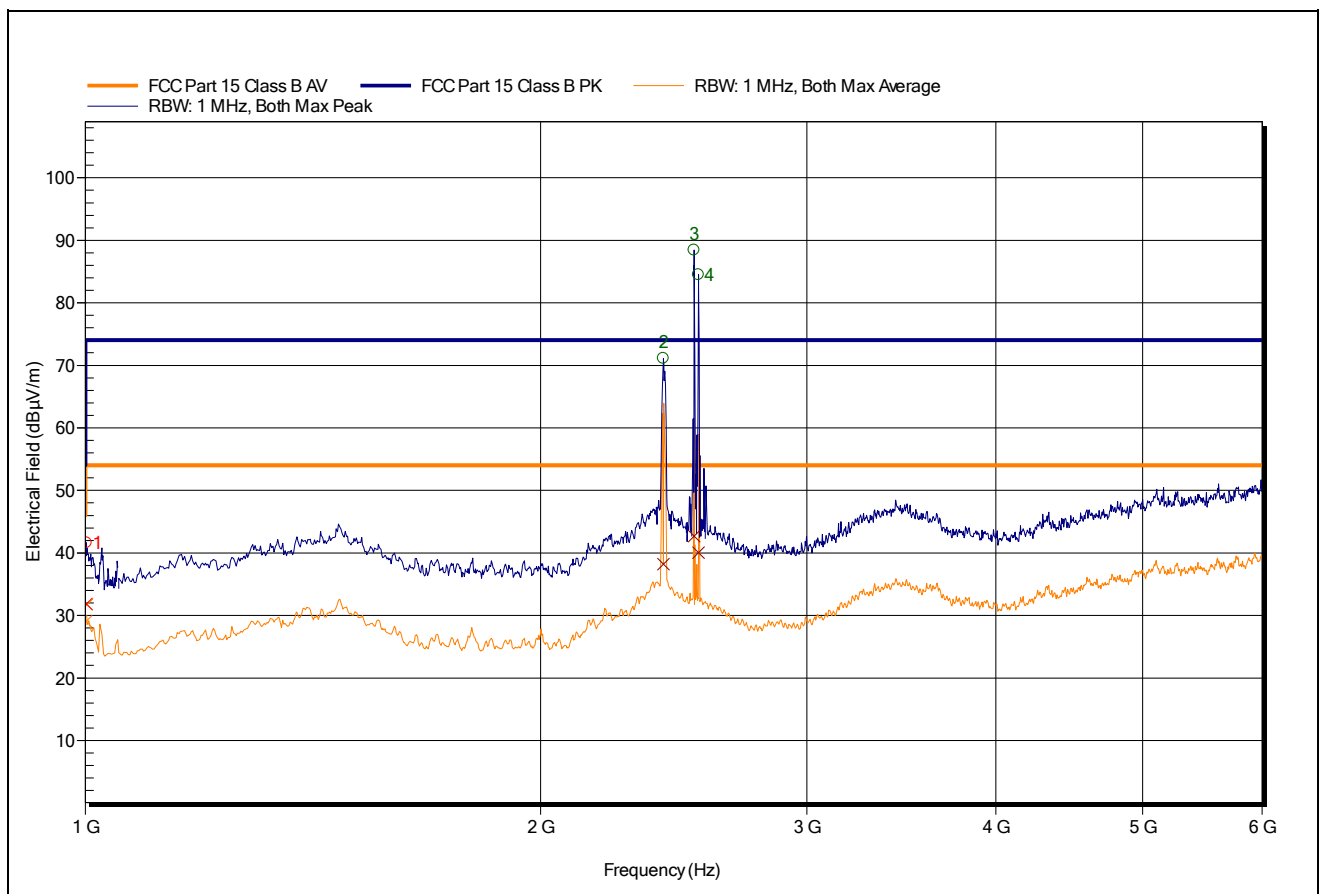
Bern, 2019-02-25
 F. Wyler

Measurement 2:

Client: NetModule AG
 Equipment: NetModule NG800
 Cables connected: Power 12VDC, Ethernet; RS232, No Digital In/out, USB Stick, 2x Mobile Link on Coax, 2x WLAN on Coax, 1x GNSS on Coax, Coax extension cable connected to Antenna-Roof-2L2WG;
 see § 5.5 & § 6.3
 Operating mode: Routing, RAM-Test, Ping via Ethernet & Mobile, USB-Stick read/write; see § 6.4
 Modification: None
 Remarks: None

Settings of the measurement equipment

Limits	CFR 47 15B / ICES-003	Frequency range	1 GHz .6 GHz
Pre-scan measurement	Peak & Average	Resolution / Video Bandwidth	1 MHz / 3 MHz
Sweep time:	200 ms	Number of sweeps:	20
Geometry:	Height: 1 - 4 m, 4 steps; Azimuth: 0° – 360°, 16 steps; Polarisation: Horizontal & Vertical		
Receiver measurement:	Peak & Average	Measure / Observation Time	1 s / 5 s
Geometry:	On the position of the maximum		

**Detected peaks**

Frequency	Peak	Peak Difference	Average	Average Difference	Status	Angle	Height	Polarization
1.002 GHz	41.59 dBμV/m	-32.41 dB	31.86 dBμV/m	-22.14 dB	Pass	292 Degree	1 m	Vertical
2.411 GHz	71.12 dBμV/m	-2.88 dB	38.19 dBμV/m	-15.81 dB	Pass	0 Degree	2 m	Vertical
2.527 GHz	88.43 dBμV/m	14.43 dB	42.69 dBμV/m	-11.31 dB	Pass *)	45 Degree	2 m	Horizontal
2.544 GHz	84.47 dBμV/m	10.47 dB	40.02 dBμV/m	-13.98 dB	Pass *)	180 Degree	2 m	Horizontal

*) These are the carriers of the different radio services and do belong to the exclusion band of CFR 47 15C

Place and date of test:
 Operator:

Bern, 2019-02-25
 F. Wyler

8. Immunity tests

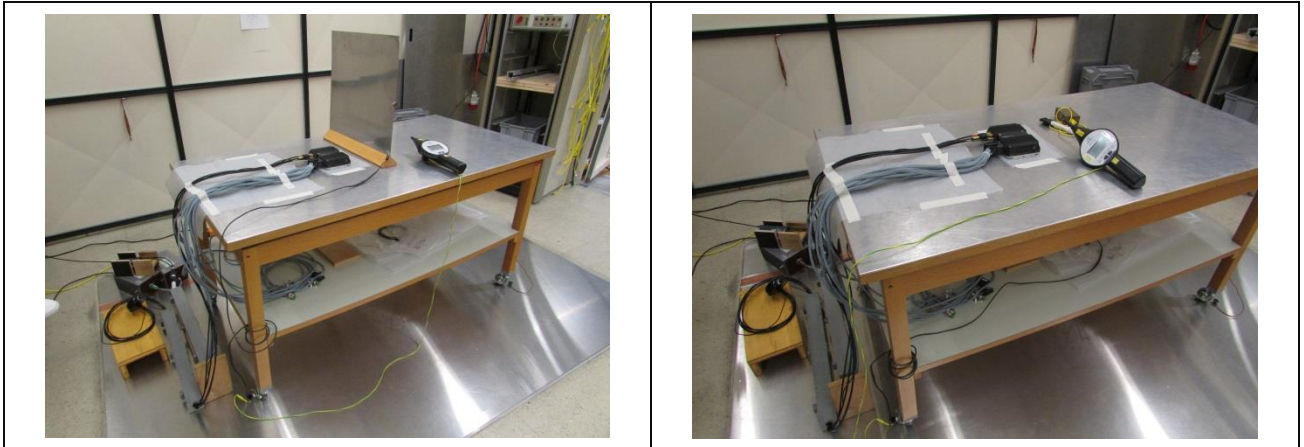
8.1 Immunity to electrostatic discharge (ESD) (EN 61000-4-2)

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 ☐ 150 pF / 2000 Ohm

Meas. uncertainty: $\pm 10 \%$

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:**Remarks:** None**Test equipment:**

Test generator	<input checked="" type="checkbox"/> 25943
Table with horizontal coupling plate	<input checked="" type="checkbox"/> 25950
Vertical coupling plate	<input checked="" type="checkbox"/> 25941
Ground plane	<input checked="" type="checkbox"/> 25951

Result:	<input checked="" type="checkbox"/> pass	<input type="checkbox"/> fail	<input type="checkbox"/> not applicable	<input type="checkbox"/> partly tested
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Eurofins Electrosuisse Product Testing AGRoute de Montena 75, 1728 Rossens - Switzerland / phone +41 58 220 33 33 / LabRossens@eurofins.ch / www.eurofins.ch

Protocol

Client: NetModule AG
 Equipment: NetModule NG800
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 on other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN echo, LED toggle, Output to Input looped; see § 6.4
 Observation of EUT: Visually, see § 6.5
 Modification / Remarks: None / None
 Test site: Shielded room
 Test set-up: ☒ table-top equipment ☐ floor-standing equipment
 Climatic conditions: Temperature: 23.6 °C Humidity: 34 % Pressure QFE: 961 hPa



Requirements

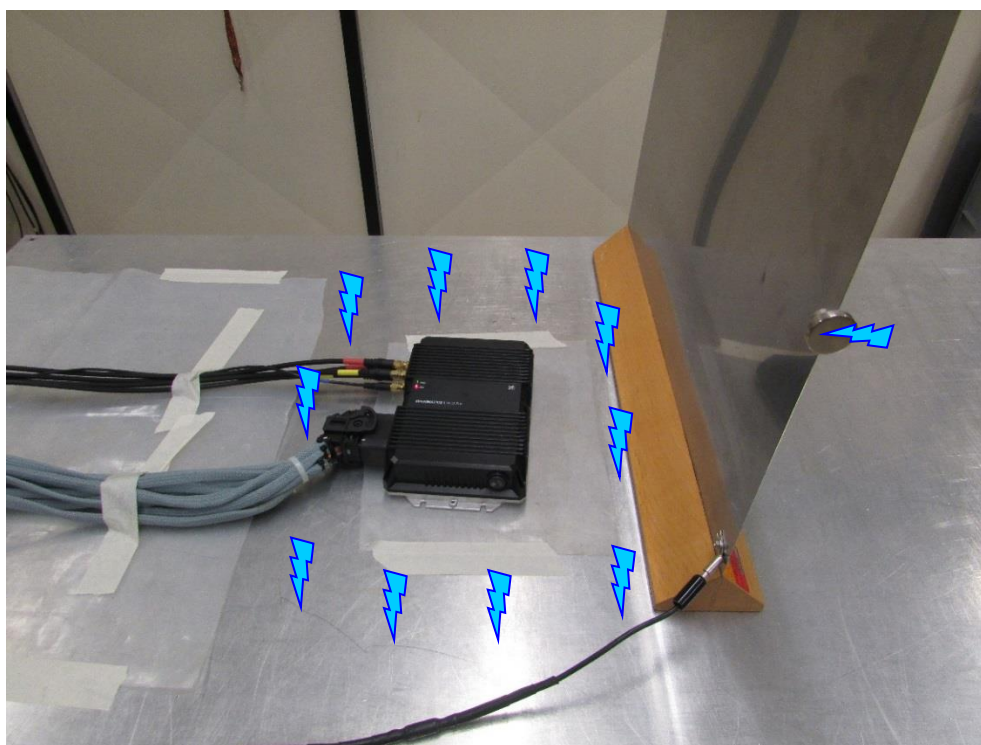
Standard:	Required level Air discharge: [kV]	Required level Contact discharge: [kV]	Impulses per point, level and polarity:	Perf. criterion:
	±2, ±4, ±8	±4	10	B
EN 61000-6-2:2005 IEC 61000-6-2:2016	±2, ±4, ±8	±4	10	B
ETSI EN 301 489-1 V2.1.1	±2, ±4, ±8	±4	10	B / TT / TR
Additional requirement	--	±6	10	B

* if contact discharge is not applicable: In order to simulate a single ESD event, the charge on ungrounded parts of the EUT shall be removed prior to each applied ESD puls.

Results



Protocol: Indirect discharges

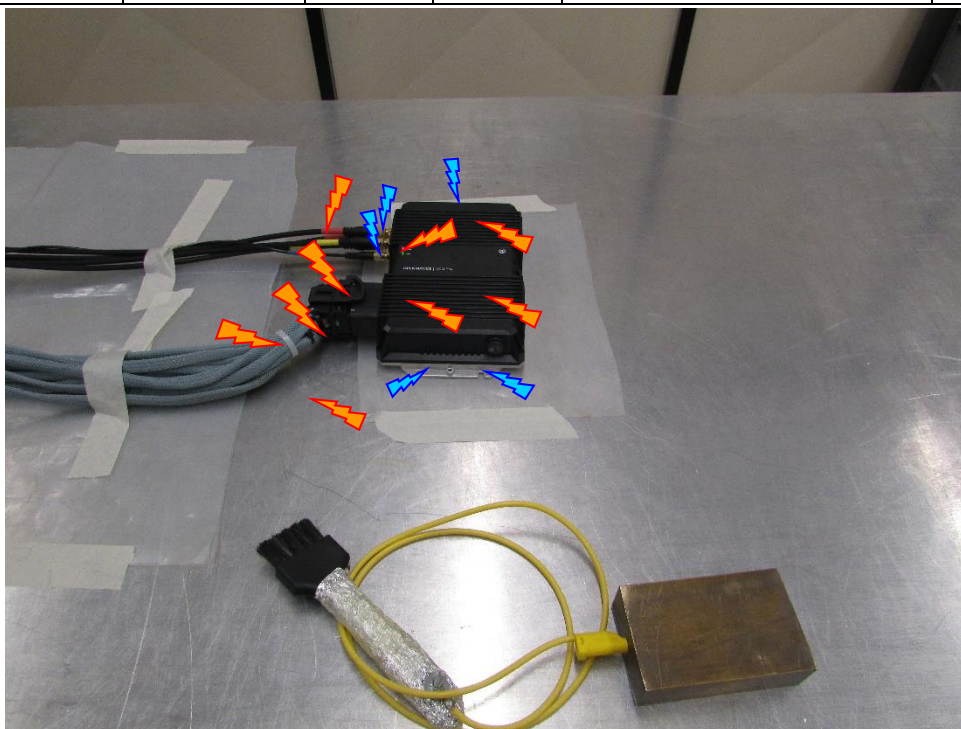
Level [kV]	No of discharges for each point, level and polarity	Discharge air 	cont. 	Result, Observation, Behaviour of EUT	Fulfilled criterion	Result
±4; ±6; (on all sides of the EUT)	>10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No influence observed	A	Pass
±4; ±6; (on vertical coupling plane)	>10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No influence observed	A	Pass



Tested points

Protocol: direct discharges

Level [kV]	No of discharges for each point, level and polarity	Discharge air 	cont. 	Result, Observation, Behaviour of EUT	Fulfilled criterion	Result
$\pm 4; \pm 6;$	> 10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No influence observed	A	Pass
$\pm 2; \pm 4; \pm 8;$	> 10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass



Tested points

Place and date of test:
Operator:

Bern, 2019-02-27
Mr F. Wyler

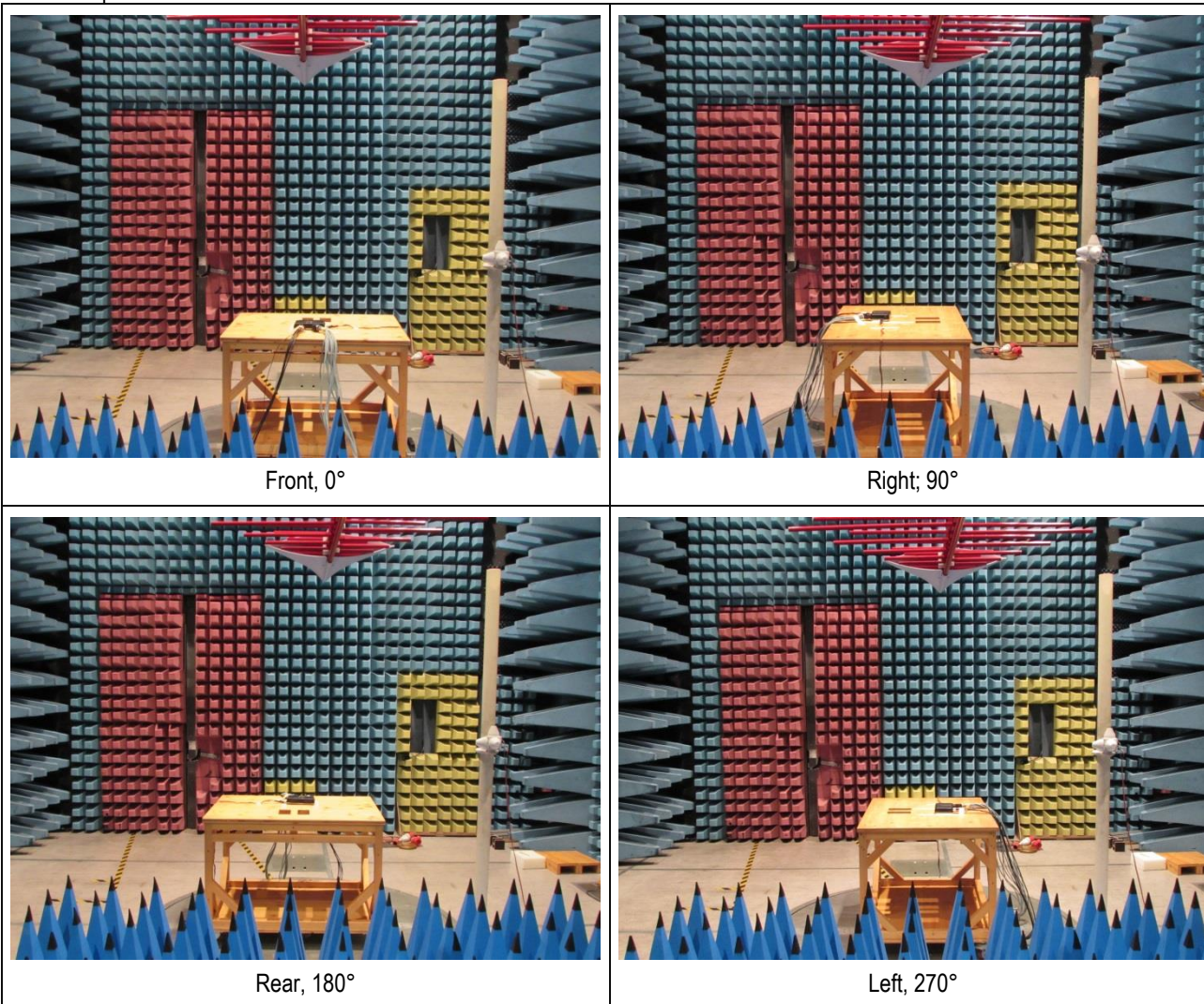
8.2 Immunity to electromagnetic fields (antenna) (EN 61000-4-3)

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: ± 2.2 dB

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

Test set-up:



Remarks: None

Test equipment:

HF-generator	<input checked="" type="checkbox"/> 166388	<input type="checkbox"/> 25200			
Amplifier	<input checked="" type="checkbox"/> 17921	<input type="checkbox"/> 166639	<input type="checkbox"/> 18230	<input type="checkbox"/> 105488	<input type="checkbox"/> 168576
Field probe	<input type="checkbox"/> 18366	<input type="checkbox"/> 25961	<input type="checkbox"/> 25962	<input checked="" type="checkbox"/> 25963	
Field strength meter	<input checked="" type="checkbox"/> 17009				
Antenna	<input checked="" type="checkbox"/> 181955	<input type="checkbox"/> 182185			
Field calibration	<input checked="" type="checkbox"/> 168548				
Decoupling clamp	<input checked="" type="checkbox"/> 15652	<input checked="" type="checkbox"/> 15653	<input checked="" type="checkbox"/> 15654	<input type="checkbox"/> 17014	<input type="checkbox"/> 17015
Software and Revision	<input checked="" type="checkbox"/> RadiMation 2016.1.6				<input type="checkbox"/> 17907
Multimeter	<input type="checkbox"/> 10812	<input type="checkbox"/> 14846	<input type="checkbox"/> 26712	<input type="checkbox"/> 9879	<input type="checkbox"/> 19651
Audioanalyzer	<input type="checkbox"/> 105491				<input type="checkbox"/> 25946

Result: ☒ pass ☐ fail ☐ not applicable ☐ partly tested

Protocol

Client: NetModule AG

Equipment: NetModule NG800

Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 on other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3

Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN echo, LED toggle, Output to Input looped; see § 6.4

Observation of EUT: Visually, see § 6.5

Modification: None

Remarks: None

Test site: Semi-anechoic chamber

Position of EUT: 80 cm (height of the equipment under test above floor)

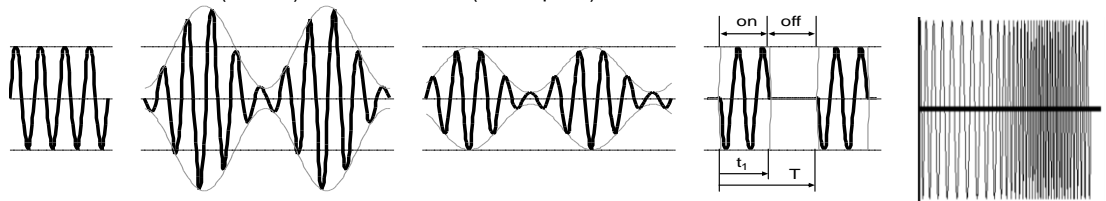
Climatic conditions: Temperature: 23.4 °C Humidity: 22 % Pressure QFE: 969 hPa

Requirements

Standard:	Frequency range: [MHz]	Req. level [V/m]:	Modulation:	Dwell time: [s]	Freq. step: [%]	Perf. crit.:
EN 55035:2017 CISPR 35:2016	80 – 1000 80, 120, 160, 230; 434, 460, 600, 863; 900	3	AM, 1 kHz, 80%	1	1*	A
EN 61000-6-2:2005 IEC 61000-6-2:2005	80 – 1000 1400 – 2000 2000 – 2700	10 3 1	AM, 1 kHz, 80 % AM, 1 kHz, 80 % AM, 1 kHz, 80 %	1 1 1	1 1 1	A A A
IEC 61000-6-2:2010	80 – 1000 1400 – 6000	10 3	AM, 1 kHz, 80 % AM, 1 kHz, 80 %	1 1	1 1	A A
ETSI EN 301 489-1 V2.1.1	80 – 6000	3	AM, 1 kHz, 80 % ev. AM, 400 Hz, 80 %	1 1	1	A / CT / CR
Additional requirement	80 – 1000 1000 – 6000	20 10	AM, 1 kHz, 80 % AM, 1 kHz, 80 %	1 1	1 1	A A

** Testing in this frequency range shall be performed if it is required by the application.

Modulation: ☐ CW ☒ AM (normal) ☐ AM (const. peak) ☐ PM ☐ FM

**Results of scans**

Frequency [MHz]	E [V/m]	Polarisation	Direction	Test dist. [m]	Dwell time [s]	Freq. step [%]	Result, Observation, Behaviour of EUT	Fulfilled criterion	Result
80 – 1000	20	hor. & vert.	Front 0°	3	1	1	No influence observed	A	Pass
80 – 1000	20	hor. & vert.	Right 90°	3	1	1	No influence observed	A	Pass
80 – 1000	20	hor. & vert.	Rear 180°	3	1	1	No influence observed	A	Pass
80 – 1000	20	hor. & vert.	Left 270°	3	1	1	No influence observed	A	Pass
1000 – 6000	10	hor. & vert.	Front 0°	3	1	1	No influence observed	A	Pass
1000 – 6000	10	hor. & vert.	Right 90°	3	1	1	No influence observed	A	Pass
1000 – 6000	10	hor. & vert.	Rear 180°	3	1	1	No influence observed	A	Pass
1000 – 6000	10	hor. & vert.	Left 270°	3	1	1	No influence observed	A	Pass

Results of discrete frequencies

Frequency [MHz]	E [V/m]	Polarisation	Direction	Test dist. [m]	Dwell time [s]	Freq. step [%]	Result, Observation, Behaviour of EUT	Fulfilled criterion	Result
80, 120, 160, 230; 434, 460, 600, 863; 900	20	hor. & vert.	Front 0°	3	1	1	No influence observed	A	Pass
	20	hor. & vert.	Right 90°	3	1	1	No influence observed	A	Pass
	20	hor. & vert.	Rear 180°	3	1	1	No influence observed	A	Pass
	20	hor. & vert.	Left 270°	3	1	1	No influence observed	A	Pass
1800, 2600, 3500, 5000	10	hor. & vert.	Front 0°	3	1	1	No influence observed	A	Pass
	10	hor. & vert.	Right 90°	3	1	1	No influence observed	A	Pass
	10	hor. & vert.	Rear 180°	3	1	1	No influence observed	A	Pass
	10	hor. & vert.	Left 270°	3	1	1	No influence observed	A	Pass

Place and date of test:
Operator:

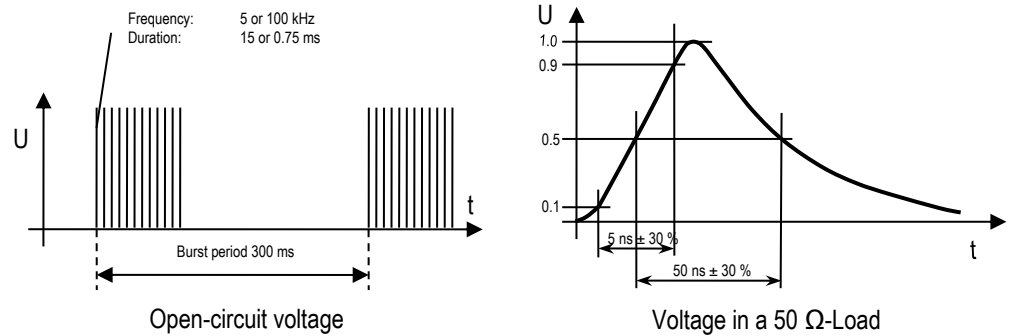
Bern, 2019-02-25
Mr F. Wyler

8.3 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:



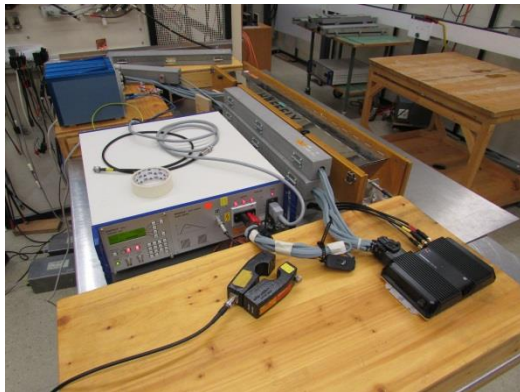
Meas. Uncertainty:

$\pm 10 \%$

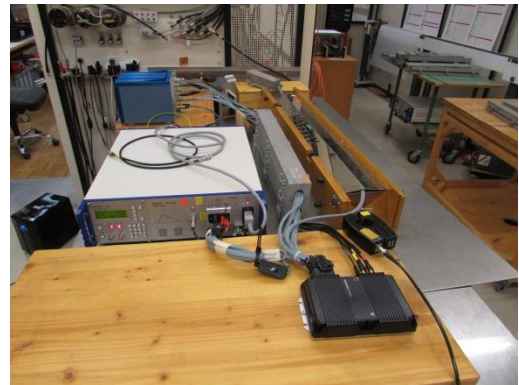
Test method:

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.

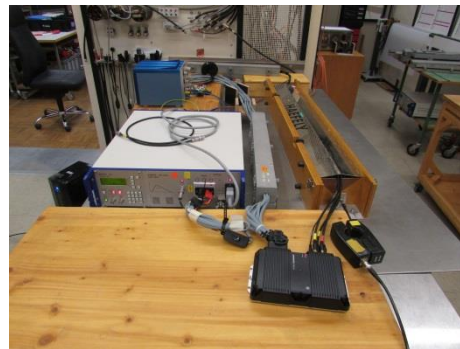
Test set-up:



Power port



Ethernet & I/O ports



Radio ports

Remarks:

None

Test equipment:

Burst generator	<input checked="" type="checkbox"/> 26825 incl. CDN	<input type="checkbox"/> 27137 incl. CDN
Capacitive coupling clamp	<input checked="" type="checkbox"/> 17905	
Decoupling clamp	<input checked="" type="checkbox"/> 25781	<input checked="" type="checkbox"/> 17901
Coupling network	<input type="checkbox"/> 181762	<input type="checkbox"/> 181763
CDN 100 Ω	<input type="checkbox"/> 181946	<input type="checkbox"/> 181759
Artificial hand	<input type="checkbox"/> 184450	<input type="checkbox"/> 181764
Multimeter	<input type="checkbox"/> 10812	<input type="checkbox"/> 14846
Audio analyser	<input type="checkbox"/> 25199	<input type="checkbox"/> 26712
		<input type="checkbox"/> 17013
		<input type="checkbox"/> 25787
		<input type="checkbox"/> 9879

Result:

☒ pass

☐ fail

☐ not applicable

☐ partly tested

Protocol

Client: NetModule AG

Equipment: NetModule NG800

Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 on other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3

Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN echo, LED toggle, Output to Input looped; see § 6.4

Observation of EUT: Visually, see § 6.5

Modification: None

Remarks: RS232 and CAN: used an RDS 22 clamp, as the cables has been too short for a standard decoupling clamp

Test site: Shielded room

Test set-up: ☒ table-top equipment ☐ floor-standing equipment

Climatic conditions: Temperature: 22.7 °C Humidity: 26 % Pressure QFE: 965 hPa

Requirements

Standard :	Req. level AC supply: [kV]	Req. level DC supply: [kV]	Req. level Signal: [kV]	Burst- freq. [kHz]	Perf. crit.:
	±1	±0.5	±0.5	5	B
EN 61000-6-2:2005	±2	±2	±1	5	B
IEC 61000-6-2:205					
IEC 61000-6-2:2016	±2	±1	±1	5	B
ETSI EN 301 489-1 V2.1.1	±1	±0.5	±0.5	5	B / TT / TR
Additional requirement	±2	±2	±1	100	B

Results (Settings Duration 1 min, Burst-Frequency 5 kHz)

Tested port	Level [kV]	Coupling path	Coupling clamp direct		Result, Observation, Behaviour of EUT	Fulfilled criterion	Result
Power 12 VDC	±1; ±2	P+M > Ref	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No influence observed	A	Pass
Ethernet	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
RS232	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
2xCAN	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
IOs	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
2xWLAN, 2xLTE, GNSS	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
Automotive Interfaces							
BroadR Ethernet; no communication (other end open)	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass

Results (Settings Duration 1 min, Burst-Frequency 100 kHz)

Tested port	Level [kV]	Coupling path	Coupling clamp direct		Result, Observation, Behaviour of EUT	Fulfilled criterion	Result
Power 12 VDC	$\pm 1; \pm 2$	P+M > Ref	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No influence observed	A	Pass
Ethernet	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
RS232	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
2xCAN	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
IOs	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
2xWLAN, 2xLTE, GNSS	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass
Automotive Interfaces							
BroadR Ethernet; no communication (other end open)	± 1	Sig > Ref	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No influence observed	A	Pass

Not tested port	Explanation
RS232 (Console)	Shorter than 3m

Place and date of test:
Operator:

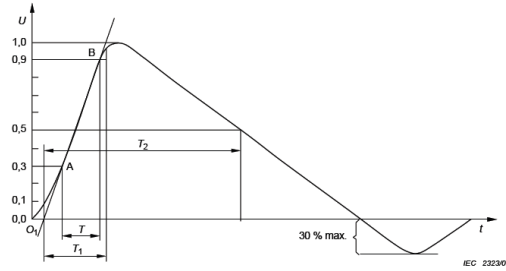
Bern, 2019-02-27
Mr F. Wyler

8.4 Immunity to surge (EN 61000-4-5: 1.2/50 μ s)

Introduction:

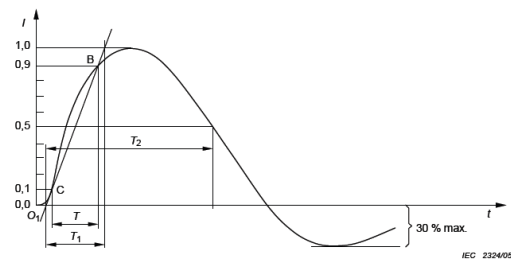
The aim of the test is to determine the immunity of the material submitted to non-repetitive transient overvoltage created by lightning.

Impulses:



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



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

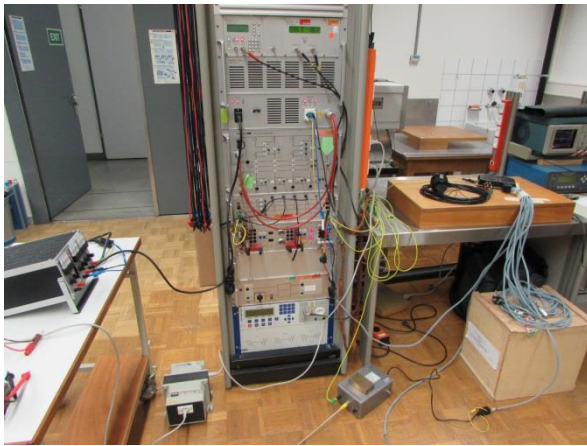
Meas. Uncertainty:

$\pm 10 \%$

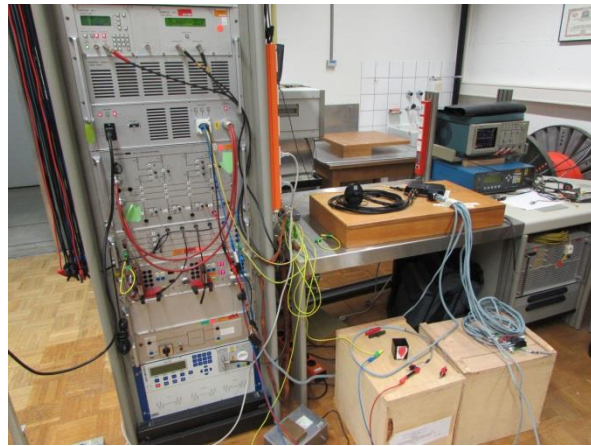
Measuring method:

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.

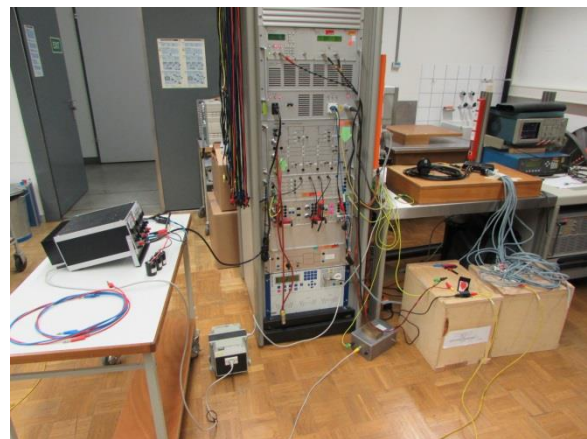
Test set-up:



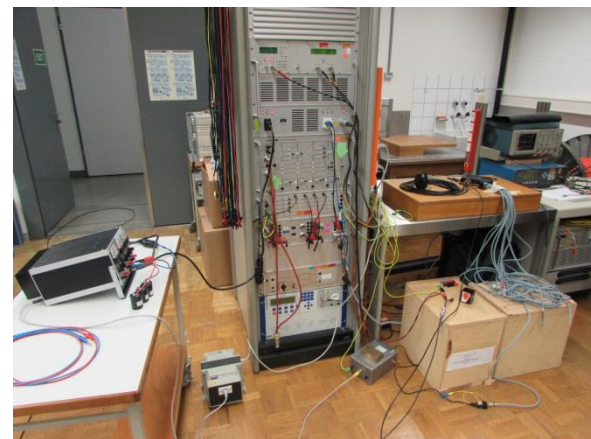
DC port of EUT



Communication ports



Shielded ports



Radio ports

Remarks:

None

Test equipment:

Generator	<input checked="" type="checkbox"/> 26052	<input type="checkbox"/> 25195	
Coupling network	<input checked="" type="checkbox"/> 25192	<input type="checkbox"/> 25194	<input type="checkbox"/> 25193
Decoupling network	<input type="checkbox"/> 25193		

Result:

☒ pass

☐ fail

☐ not applicable

☐ partly tested

Protocol

Client: NetModule AG

Equipment: NetModule NG800

Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 on other end open), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3

Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN echo, LED toggle, Output to Input looped; see § 6.4

Observation of EUT: Visually, see § 6.5

Modification: None

Remarks: None

Test site: Laboratory

Test set-up: ☒ table-top equipment ☐ floor-standing equipment

Climatic conditions: Temperature: 23.0 °C Humidity: 30 % Pressure QFE: 955 hPa

Requirements

Standard :	Required level AC-supply: [kV]		Required level DC-supply: [kV]		Required level Signal: [kV]		Perf. crit.:
	L – L 2 Ω + 18 μF	L – PE 12 Ω + 9 μF	L – L 2 Ω + 18 μF	L – PE 12 Ω + 9 μF	L – L 42 Ω + 0.5 μF N/A to shielded cables	L – PE 42 Ω + 0.5 μF Shield – PE 2 Ω + 18 μF	
	±0.5, ±1	±0.5, ±1, ±2	---	±0.5 ¹⁾	±0.5, ±1	±0.5, ±1 / ±0.5, ±1, ±2; ±4 ²⁾	B
EN 61000-6-2:2005 IEC 61000-6-2:2005	±0.5, ±1	±0.5, ±1, ±2	±0.5****	±0.5****	---	±0.5, ±1	B
IEC 61000-6-2:2016	±0.5, ±1	±0.5, ±1, ±2	±0.5****	±1****	---	±0.5, ±1	B
ETSI EN 301 489-1 V2.1.1	±0.5, ±1 In telecom centres: ±0.5	±0.5, ±1, ±2 In telecom centres: ±1.0	---	---	---	In telecom centres: ±0.5 Outdoor cables: ±1	B / TT / TR

**** DC ports which are not intended to be connected to a DC distribution network shall be tested as signal ports.

Results

Tests on DC power ports

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses *	Remarks	Fulfilled Criterion	Result
Power 18V DC	±0.5	Plus – Minus	2 Ω + 18 μF	5	No influence observed	A	Pass
	±0.5; ±1	P, M – Ref	12 Ω + 9 μF	5	No influence observed	A	Pass

* Number of pulses for each voltage level and each polarity

Tests on signal ports / powered signal ports

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses *	Remarks	Fulfilled Criterion	Result
CAN-0 H, L	$\pm 0.5; \pm 1$	H – Ref	$42 \Omega + 0.5 \mu F$	5	No influence observed	A	Pass
	$\pm 0.5; \pm 1$	L – Ref	$42 \Omega + 0.5 \mu F$	5	No influence observed	A	Pass
CAN-FD H, L	$\pm 0.5; \pm 1$	H – Ref	$42 \Omega + 0.5 \mu F$	5	No influence observed	A	Pass
	$\pm 0.5; \pm 1$	L – Ref	$42 \Omega + 0.5 \mu F$	5	No influence observed	A	Pass

Tests on LAN ports with shielded cable (cable length of the test cable 20 m)

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses *	Remarks	Fulfilled Criterion	Result
LAN port	$\pm 0.5; \pm 1$	Screen - PE	2Ω	5	No influence observed	A	Pass

* Number of pulses for each voltage level and each polarity

Tests on Antenna ports with shielded cable according EN55035 (cable length 20 m)

Tested port	Level [kV]	Coupling mode	Coupling network	Number of pulses *	Remarks	Fulfilled Criterion	Result
WLAN Antenna	$\pm 0.5;$	Screen - PE	2Ω	5	No influence observed	A	Pass
LTE Antenna	$\pm 0.5;$	Screen - PE	2Ω	5	No influence observed	A	Pass
GNSS Antenna	$\pm 0.5;$	Screen - PE	2Ω	5	No influence observed	A	Pass

* Number of pulses for each voltage level and each polarity

Not tested port	Explanation
RS 232 (Console)	Shorter than 3 m

Place and date of test:
Operator:

Bern, 2019-03-01
Mr F. Wyler

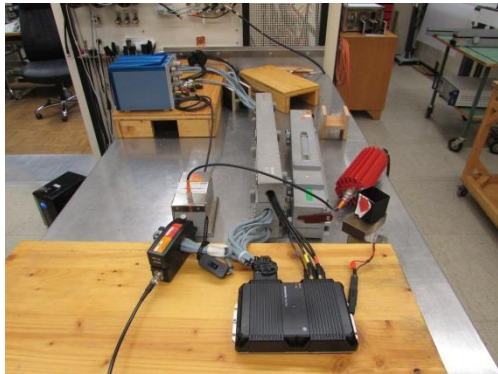
8.5 Immunity to conducted disturbances induced by radio-frequency fields (EN 61000-4-6)

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: ± 1.85 dB

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:



Power port



Ethernet & I/O-ports



Radio ports

Remarks: None

Test equipment:

HF-generator	<input checked="" type="checkbox"/> 25200	<input type="checkbox"/> 166388	<input type="checkbox"/> 13751	<input type="checkbox"/> 13318	
HF-Millivoltmeter	<input checked="" type="checkbox"/> 13726				
Amplifier	<input checked="" type="checkbox"/> 25205				
Power attenuator	<input checked="" type="checkbox"/> 25643	<input type="checkbox"/> 181751			
Coupling networks	<input type="checkbox"/> 17414	<input type="checkbox"/> 25721	<input type="checkbox"/> 10539	<input type="checkbox"/> 25970	<input type="checkbox"/> 16386
Coupling networks	<input type="checkbox"/> 25971	<input type="checkbox"/> 105487	<input type="checkbox"/> 16562	<input type="checkbox"/> 16559	<input type="checkbox"/> 10539
Coupling networks	<input checked="" type="checkbox"/> 25948	<input type="checkbox"/> 26007			
Coupling networks	<input type="checkbox"/> 25947	<input type="checkbox"/> 26008			
Coupling networks	<input type="checkbox"/> 181764				
CDN 100Ω	<input type="checkbox"/> 181946	<input type="checkbox"/> 181759	<input type="checkbox"/> 25787		
EM clamp	<input checked="" type="checkbox"/> 25645	<input type="checkbox"/> 14833			
Decoupling clamp	<input checked="" type="checkbox"/> 17901	<input checked="" type="checkbox"/> 17902	<input checked="" type="checkbox"/> 17010	<input checked="" type="checkbox"/> 17013	
Multimeter	<input type="checkbox"/> 10812	<input type="checkbox"/> 14846	<input type="checkbox"/> 26712	<input type="checkbox"/> 9879	
Audioanalyzer	<input type="checkbox"/> 25199				
Artificial Hand	<input type="checkbox"/> 184450				
Calibration	<input checked="" type="checkbox"/> 25648				
Software and Revision	<input type="checkbox"/> LabView Rev. 2014		<input checked="" type="checkbox"/> RadiMation 2016.1.6		

Result: ☒ pass ☐ fail ☐ not applicable ☐ partly tested

Protocol

Client: NetModule AG
 Equipment: NetModule NG800
 Cables connected: Power 12 VDC, Ethernet, BroadR Ethernet (other end open), 4xCAN (2 open other end), RS 232 (Console), 2xWLAN Antenna, 2x Mobile LTE Antenna, GNSS Antenna, Digital IOs, see § 5.5 & § 6.3
 Operating mode: RAM-RW, Ping via Ethernet & Mobile, 2xCAN echo, LED toggle, Output to Input connection; see § 6.4
 Observation of EUT: Visually, see § 6.5
 Modification / Remark: None / None
 Test site: Shielded room
 Test set-up: ☒ table-top equipment ☐ floor-standing equipment
 Climatic conditions: Temperature: 23.1 °C Humidity: 26 % Pressure QFE: 963 hPa

Requirements

Standard:	Frequency range: [MHz]	Required level: [V _{EMF}]	Modulation:	Dwell time: [s]	Freq. step: [%]	Perf. crit.:
	0.15 – 10 10 – 30 30 – 80	3 3 to 1 1	AM, 1 kHz, 80 % AM, 1 kHz, 80 % AM, 1 kHz, 80 %	1	1*	A
EN 61000-6-2:2005 IEC 61000-6-2:2016	0.15 – 80	10	AM, 1 kHz, 80 %	1	1	A
ETSI EN 301 489-1 V2.1.1	0.15 – 80	3	AM, 1 kHz, 80 % ev. AM, 400 Hz, 80 %	1	1	A / CT / CR

* 1% step size preferred, but should not exceed 4%

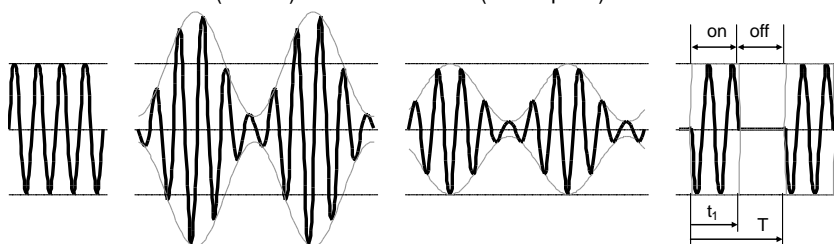
Signal modulation:

☐ CW

☒ AM (normal)

☐ AM (const. peak)

☐ PM

**Test Results** (Frequency 0.15 – 80 MHz, Dwell Time 1 sec)

Coupling	CDN	Terminated (50 Ω)	CDN	Level [V]	Result, Observation, Behaviour of EUT	Fulfilled criterion	Result
Power 12 VDC	25948	Ethernet	25645	10	No influence observed	A	Pass
Ethernet	25645	Power 12 VDC	25948	10	No influence observed	A	Pass
RS232	25645	Power 12 VDC	25948	10	No influence observed	A	Pass
2xCAN	25645	Power 12 VDC	25948	10	No influence observed	A	Pass
IOs	25645	Power 12 VDC	25948	10	No influence observed	A	Pass
2xWLAN, 2xLTE, GNSS	25645	Power 12 VDC	25948	10	No influence observed	A	Pass
Case	181760	Power 12 VDC	25948	10	No influence observed	A	Pass
Automotive Interfaces							
BroadR Ethernet	25645	Power 12 VDC	25948	10	No influence observed	A	Pass

Not tested port	Explanation
RS232 (Console)	Shorter than 3m

Place and date of test:
 Operator:

Bern, 2019-02-27
 Mr F. Wyler