NetModule Router NB1800

User Manual for Software Version 99.99

Manual Version 1.13

NetModule AG, Switzerland

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NetModule Router NB1800

This manual covers all variants of the *NB1800* product type.

The specifications and information regarding the products in this manual are subject to change without notice. We would like to point out that NetModule makes no representation or warranties with respect to the contents herein and shall not be responsible for any loss or damage caused to the user by the direct or indirect use of this information This document may contain information about third party products or processes. Such third party information is generally out of influence of NetModule and therefore NetModule shall not be responsible for the correctness or legitimacy of this information. Users must take full responsibility for their application of any products.

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1. Welcome to NetModule

Thank you for purchasing a NetModule product. This document should give you an introduction to the device and its features. The following chapters describe any aspects of commissioning the device, installation procedure and provide helpful information towards configuration and maintenance.

Please find further information such as sample SDK scripts or configuration samples in our wiki on https://wiki.netmodule.com.

2. Conformity

This chapter provides general information for putting the router into operation.

2.1. Safety Instructions

Please carefully observe all safety instructions in the manual that are marked with the symbol  .

Compliance information: The NetModule routers must be used in compliance with any and all applicable national and international laws and with any special restrictions regulating the utilization of the communication module in prescribed applications and environments.

Information about the accessories / changes to the device:

- Please only use original accessories to prevent injuries and health risks.
- Changes made to the device or the use of non-authorized accessories will render the warranty null and void and potentially invalidate the operating license.
- NetModule routers must not be opened (SIM cards may be used according to the instructions).

Information about the device interfaces:

- All systems that are connected to the NetModule router interfaces must meet the requirements for SELV (Safety Extra Low Voltage) systems.
- Interconnections must not leave the building nor penetrate the body shell of a vehicle.
- Connections for antennas may only exit the building or the vehicle hull if transient overvoltages (according to IEC 62368-1) are limited by external protection circuits down to 1 500 V_{peak}. All other connections must remain within the building or the vehicle hull.
- Installed antennas must always be at least 40 cm away from people.
- All antennas must have a distance of at least 20cm from each other; in the case of combined antennas (mobile radio / WLAN / GNSS), there must be sufficient isolation between the radio technologies.
- Devices with a WLAN interface may be operated only with applicable Regulatory Domain configured. Special attention must be paid to country, number of antennas and the antenna gain (see also chapter 5.3.4). WLAN antennas with a higher amplification may be used with the NetModule router "Enhanced-RF-Configuration" software license and the antenna gain and cable attenuation that have been correctly configured by certified specialized personnel. A misconfiguration will lead to loss of the approval.
- The maximum gain of an antenna (incl. the attenuation of the connection cables) must not exceed the following values in the corresponding frequency range:
  - Mobile radio (600MHz .. 1GHz) < 3.2dBi,
  - Mobile radio (1.7GHz .. 2GHz) < 6.0dBi
  - Mobile radio (2.5GHz .. 4.2GHz) < 6.0dBi
  - WiFi (2.4GHz .. 2.5GHz) < 3.2dBi, WiFi (5.1GHz .. 5.9GHz) < 4.5dBi
- Note that GNSS signals can be obfuscated or blocked by malicious third-party devices.
- Only CE-compliant power supplies with a current-limited SELV output voltage range may be used with the NetModule routers.
- A Power Source Class 3 (PS3) power supply (with 100 W or more) shall only be used under the condition that a cable strain relief on the power cable to the router is applied. Such a cable strain relief ensures that the wires on the router screw terminal connector are not disconnected (e.g. if under an error condition, the router would be tangling on the cable). The cable strain relief must withstand a pulling force of 30 N (for router weight up to 1 kg) applied to the cable of the router.
- Une alimentation de classe 3 (PS3) (100 W ou plus) ne doit etre utilisee que si le cable d alimentation du routeur est equipe d un dispositif anti-traction. A condition qu une decharge de traction soit appliquee au cable d alimentation du routeur. Une telle decharge de traction permet de s assurer que les fils du connecteur a vis du routeur ne sient pas deconnectes (par exemple si, en cas d erreur, le routeur s emmale dans le cable). La decharge de traction du cable doit resister a une force de traction de 30N (pour un routeur d un poids inferieur ou egal a 1 kg) appliquee au cable du routeur.

FCC Warning:

- Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
- This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
- (1) This device may not cause harmful interference , and
- (2) this device must accept any interference received , including interference that may cause undesired operation.

- Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver .
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected .
- Consult the dealer or an experienced radio / TV technician for help.
- Exposure Requirements: To comply with the FCC RF exposure compliance requirements, the device must be installed to provide a separation distance of at least 40 cm from all persons.

General safety instructions:

- Observe the usage limitations of radio units at filling stations, in chemical plants, in systems with explosives or potentially explosive locations.
- The devices may not be used in airplanes.
- Exercise particular caution near personal medical aids, such as pacemakers and hearing aids.
- The NetModule routers may also cause interference in the nearer distance of TV sets, radio receivers and personal computers.
- Never perform work on the antenna system during a thunderstorm.
- The devices are generally designed for normal indoor use. Do not expose the devices to extraordinary environmental conditions worse than IP40.
- Protect them against aggressive chemical atmospheres and humidity or temperatures outside specifications.
- We highly recommended creating a copy of a working system configuration. It can be easily applied to a newer software release afterwards.

2.2. Declaration of Conformity

CE

NetModule hereby declares that under our own responsibility that the routers comply with the relevant standards following the provisions of the *RED Directive 2014/53/EU*. The signed version of the *Declaration of Conformity* can be obtained from https://www.netmodule.com/downloads

Operating frequency bands and related maximum radio frequency power transmitted is shown below, according to RED Directive 2014/53/EU, Article 10 (8a, 8b).

WLAN maximum output power

IEE 802.11b/g/n
Operation frequency range: 2412-2472 MHz (13 channels)
Maximum output power: 14.93 dBm EIRP average (on antenna port)

IEE 802.11a/n/ac
Operation frequency range: 5180-5350 MHz / 5470-5700 MHz (19 channels)
Maximum output power: 22.91 dBm EIRP average (on antenna port)

Cellular maximum output power

WCDMA Band I
Operation frequency range: 1920-1980, 2110-2170 MHz
Maximum output power: 25.7 dBm rated

WCDMA Band III
Operation frequency range: 1710-1785, 1805-1880 MHz
Maximum output power: 25.7 dBm rated

WCDMA Band VIII
Operation frequency range: 880-915, 925-960 MHz
Maximum output power: 25.7 dBm rated

LTE FDD Band 1
Operation frequency range: 1920-1980, 2110-2170 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 3
Operation frequency range: 1710-1785, 1805-1880 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 7
Operation frequency range: 2500-2570, 2620-2690 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 8
Operation frequency range: 880-915, 925-960 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 20
Operation frequency range: 832-862, 791-821 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 28
Operation frequency range: 703-748, 758-803
Maximum output power: 25 dBm rated

LTE FDD Band 38
Operation frequency range: 2570-2620 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 40
Operation frequency range: 2300-2400 MHz
Maximum output power: 25 dBm rated

5G NR Band 1
Operation frequency range: 1920-1980, 2110-2170 MHz
Maximum output power: 25 dBm rated

5G NR Band 3
Operation frequency range: 1710-1785, 1805-1880 MHz
Maximum output power: 25 dBm rated

5G NR Band 7
Operation frequency range: 2500-2570, 2620-2690 MHz
Maximum output power: 25 dBm rated

5G NR Band 8
Operation frequency range: 880-915, 925-960 MHz
Maximum output power: 25 dBm rated

5G NR Band 20
Operation frequency range: 832-862, 791-821 MHz
Maximum output power: 25 dBm rated

5G NR Band 28
Operation frequency range: 703-748, 758-803 MHz
Maximum output power: 25 dBm rated

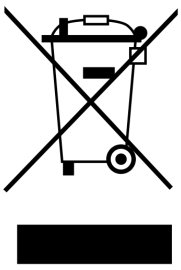
5G NR Band 38
Operation frequency range: 2570-2620 MHz
Maximum output power: 25 dBm rated

5G NR Band 40
Operation frequency range: 2300-2400 MHz
Maximum output power: 25 dBm rated

5G NR Band 77
Operation frequency range: 3300-4200 MHz
Maximum output power: 25 dBm rated

5G NR Band 78
Operation frequency range: 3300-3800 MHz
Maximum output power: 25 dBm rated

2.3. Waste Disposal



In accordance with the requirements of the *Council Directive 2012/19/EU* regarding Waste Electrical and Electronic Equipment (WEEE), you are urged to ensure that this product will be segregated from other waste at end-of-life and delivered to the WEEE collection system in your country for proper recycling.

2.4. National Restrictions

This product may be generally used in all EU countries (and other countries following the *RED Directive 2014/53/EU*) without any limitation. Please refer to our WLAN Regulatory Database for getting further national radio interface regulations and requirements for a particular country.

2.5. Open Source Software

We inform you that NetModule products may contain in part open-source software. We are distributing such open-source software to you under the terms of GNU General Public License (GPL)[1], GNU Lesser General Public License (LGPL)[2] or other open-source licenses[3]. These licenses allow you to run, copy, distribute, study, change and improve any software covered by GPL, Lesser GPL, or other open-source licenses without any restrictions from us or our end user license agreement on what you may do with that software. Unless required by applicable law or agreed to in writing, software distributed under open-source licenses is distributed on an "AS IS" basis, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

To obtain the corresponding open source codes covered by these licenses, please contact our technical support at router@support.netmodule.com.

Acknowledgements

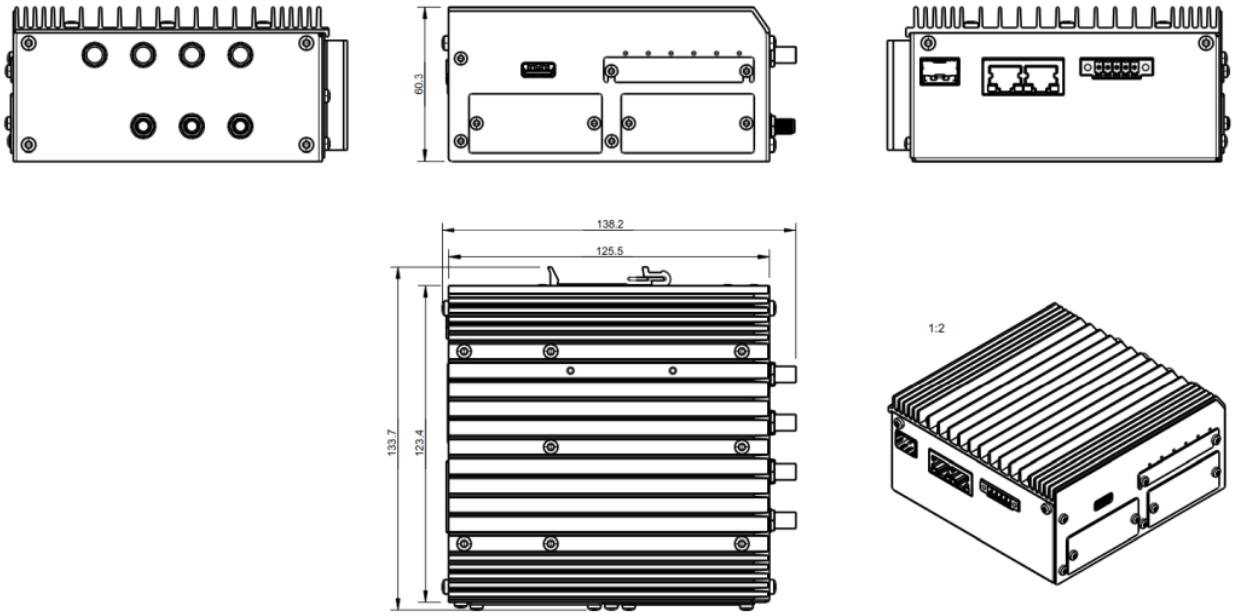
This product includes:

- PHP, freely available from http://www.php.net
- Software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org)
- Cryptographic software written by Eric Young (eay@cryptsoft.com)
- Software written by Tim Hudson (tjh@cryptsoft.com)
- Software written Jean-loup Gailly and Mark Adler
- MD5 Message-Digest Algorithm by RSA Data Security, Inc.
- An implementation of the AES encryption algorithm based on code released by Dr Brian Gladman
- Multiple-precision arithmetic code originally written by David Ireland
- Software from The FreeBSD Project (http://www.freebsd.org)

[1] Please find the GPL text under http://www.gnu.org/licenses/gpl-2.0.txt
[2] Please find the LGPL text under http://www.gnu.org/licenses/lgpl.txt
[3] Please find the license texts of OSI licenses (ISC License, MIT License, PHP License v3.0, zlib License) under http://opensource.org/licenses

3. Specifications

3.1. Appearance



3.2. Features

All models of NB1800 have following standard functionalities:

- Power input (non-isolated)
- 2x Ethernet ports (10/100/1000 Mbit/s)
- 1x SFP port
- 1x serial port (RS-232/RS-485)
- 1x USB 2.0 host port
- 2x micro SIM card slots
- 1x microSD card slot
- 2x Extension slots
- Full featured router software

The NB1800 can be equipped with the following options:

- 5G, LTE, UMTS, GSM
- WLAN IEEE 802.11
- GPS/GNSS
- Software Keys

Due to its modular approach, the NB1800 router and its hardware components can be arbitrarily assembled according to its indented usage or application. Please contact us in case of special project requirements.

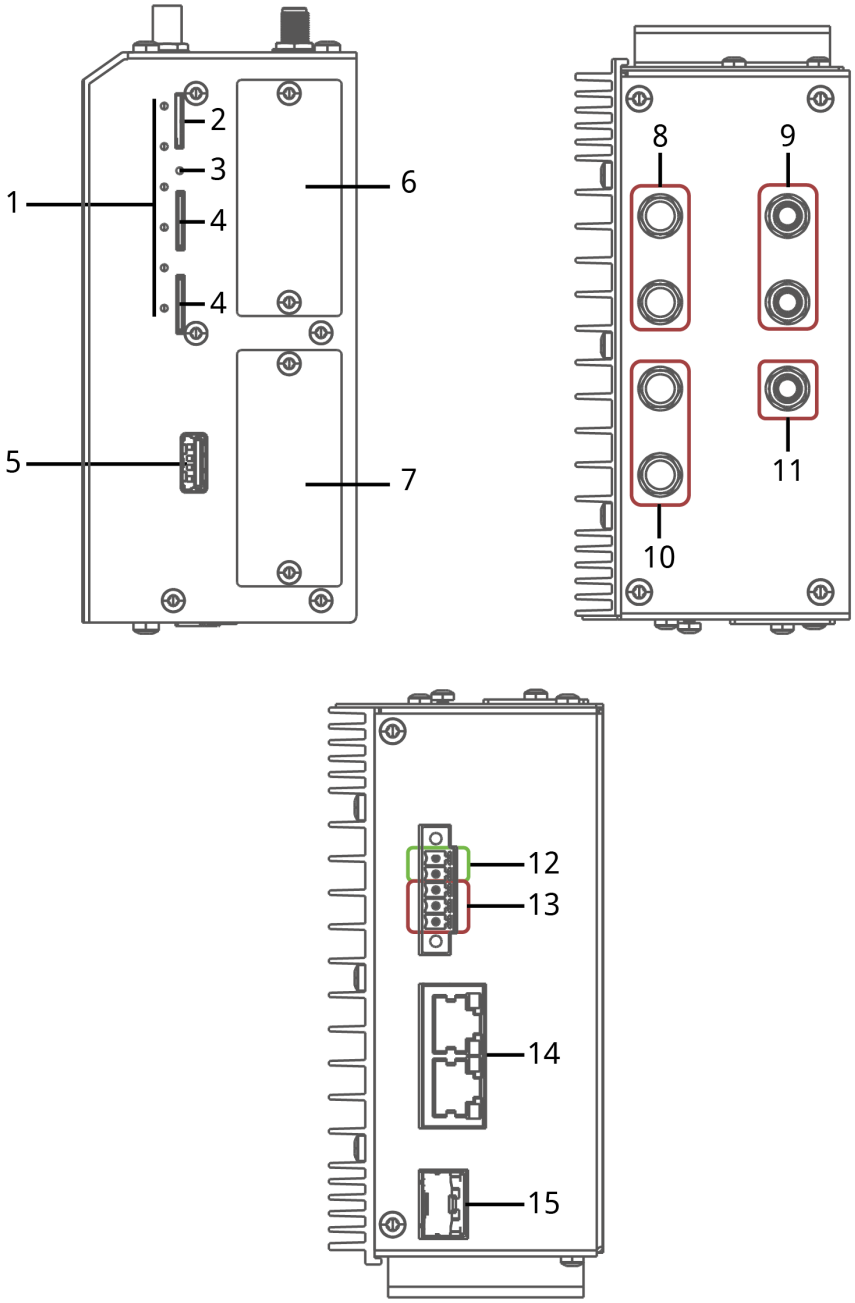
3.3. Environmental Conditions

Parameter	Rating
Input Voltage	12 V_{DC} to 48 V_{DC} (−25% / +10%)
Operating Temperature Range	$-40\,°C$ to $+70\,°C$
Storage Temperature Range	$-40\,°C$ to $+85\,°C$
Humidity	0 to 95% (non-condensing)
Altitude	up to 4000m
Over-Voltage Category	I
Pollution Degree	2
Ingress Protection Rating	IP40 (with SIM and USB covers mounted)

Table 3.1.: Operating Conditions

3.4. Interfaces

3.4.1. Overview



Nr.	Label	Panel	Function
1	LED Indicators	Front	LED Indicators for the different interfaces
2	SD	Front	microSD card
3	Reset	Front	Reboot and factory reset button
4	SIM 1 / 2	Front	Micro SIM 1/2 (3FF), they can be assigned dynamically to any modem by configuration.
5	USB	Front	USB 2.0 host port
6	EXT 1	Front	Extension EXT1
7	EXT 2	Front	Extension EXT2
8	MOB 2/WLAN 1	Top	2 SMA female connectors for MIMO WLAN or MIMO cellular antenna
9	EXT	Top	2 SMA female connectors for additional antennas e.g. WLAN for variants with 5G
10	MOB 1/WLAN 2	Top	2 SMA female connectors for MIMO WLAN or MIMO cellular antenna
11	GNSS	Top	1 SMA female connector for additional GNSS antenna
12	PWR	Bottom	Power supply 12-48 V_{DC} (Pins 1 and 2)
13	RS-232/RS-485	Bottom	Non-isolated serial RS-232/RS-485 interface (Pins 3 to 5) which can be used for console administration, serial device server or other serial based communication applications.
14	ETH 1-2	Bottom	Ethernet ports, can be used for LAN/WAN
15	SFP	Bottom	SFP port, can be used for LAN/WAN

Table 3.2.: NB1800 Interfaces

3.5. Operating Elements

The following table describes the default NB1800 status indicators.

Label	Color	State	Function
STAT	●g	Blinking	Device busy; device is in startup, software- or configuration update.
	●g	On	The device is ready.
WAN	●g	On	The hotlink connection is up.
	●g	Blinking	The hotlink connection is establishing or changing the interface.
	❍	Off	The hotlink is disabled.
LAN	●g	On	A WLAN access-point or ETH LAN-connection is up. ETH: enabled as LAN and link status is up WLAN: WLAN enabled and configured as access-point.
	❍	Off	No WLAN or ETH LAN-connection is up.
VPN	●g	On	VPN connection is up.
	●g	Blinking	VPN is up and waiting for a connection.
	❍	Off	VPN connection down.
EXT	❍	Off	Extension is disabled.
	●g●y●r	On/ Blinking	The EXT LED indicates the state of the extension interfaces: GNSS (default), DIO, CAN, Serial, BLE, ... or user specific (control via SDK or container) The configuration is done in the UI LED settings. Optional: the signal strength of wireless interfaces could be indicated (LTE, WiFi, BLE, ..).
SYS			Shows the overall system state. This could be derived from health indicators such as: – all services up and running – overall throughput is normal – CPU load is normal – the supervisor – . . . – User application (state set by user in SDK or container)
	●g	On	System operation state: normal
	●g	Blinking	System operation state: during startup
	●r	On	System operation state: emergency, watchdog, failure

Table 3.3.: NB1800 Status Indicators

3.5.1. Ethernet1/2 LEDs

The following table describes the Ethernet status indicators.

Label	Color	State	Function
S	●	1 blink	10 Mbit/s
	●	2 blinks	100 Mbit/s
	●	3 blinks	1000 Mbit/s
	❍	off	no Link
L/A	●	on	Link on
	●	blinking	Activity
	❍	off	no Link

Table 3.4.: Ethernet Status Indicators

3.5.2. Reset

The reset button has two functions:

1. Reboot the system:
   Press at least 3 seconds to trigger a system reboot.
   The reboot is indicated with the red blinking STAT LED.
2. Factory reset:
   Press at least 10 seconds to trigger a factory reset.
   The start of the factory reset is confirmed by all LEDs lighting up for a second.

3.5.3. Mobile

The various variants of the NB1800 support up to 2 WWAN modules for mobile communication. The LTE modules support 2x2 MIMO. The Variant with 5G supports up to 1 WWAN modules with 4x4 MIMO.
Here you will find an overview of the different modems and the individual bands

The mobile antenna ports have the following specification:

Feature	Specification
Max. allowed cable length	30 m
Min. number of antennas 4G-LTE	2
Min. number of antennas 5G	4
Max. allowed antenna gain including cable attenuation	Mobile radio (600MHz .. 1GHz) < 3.2dBi Mobile radio (1.7GHz .. 2GHz) < 6.0dBi Mobile radio (2.5GHz .. 4.2GHz) < 6.0dBi
Min. distance between collocated radio transmitter antennas	20 cm
Min. distance between people and antennas	40 cm
Connector type	SMA

Table 3.5.: Mobile Antenna Port Specification

3.5.4. WLAN

The variants of the NB1800supports up to 2 802.11 a/b/g/n/ac WLAN modules.

Standard	Frequencies	Bandwidth	Max. Data Rate
802.11a	5 GHz	20 MHz	54 Mbit/s
802.11b	2.4 GHz	20 MHz	11 Mbit/s
802.11g	2.4 GHz	20 MHz	54 Mbit/s
802.11n	2.4/5 GHz	20/40 MHz	300 Mbit/s
802.11ac	5 GHz	20/40/80 MHz	867 Mbit/s

Table 3.6.: IEEE 802.11 Standards

Note: 802.11n and 802.11ac support 2x2 MIMO

The WLAN antenna ports have the following specification:

Feature	Specification
Max. allowed cable length	30 m
Max. allowed antenna gain including cable attenuation	3.2dBi (2,4GHz) resp. 4.5dBi (5GHz) dBi[1]
Min. distance between collocated radio transmitter antennas (Example: WLAN1 to MOB1)	20 cm
Min. distance between people and antenna	40 cm
Connector type	SMA

Table 3.7.: WLAN Antenna Port Specification

[1] **Note:** WLAN antennas with a higher amplification may be used with the NetModule router "Enhanced-RF-Configuration" software license and the antenna gain and cable attenuation that have been correctly configured by certified specialized personnel.

3.5.5. GNSS

Feature	Specification
Systems	BeiDou, Galileo, GLONASS, GPS
Data stream	JSON or NMEA
Tracking sensitivity	up to -161 dBm
Supported antennas	Active and passive

Table 3.8.: GNSS Specifications option G

The GNSS antenna port have the following specification:

Feature	Specification
Max. allowed cable length	30 m
Antenna LNA gain	15-20 dB typ, 30 dB max.
Min. distance between collocated radio transmitter antennas (Example: GNSS to MOB1)	20 cm
Connector type	SMA

Table 3.9.: GNSS / GPS Antenna Port Specification

3.5.6. USB 2.0 Host Port

The USB 2.0 host port has the following specification:

Feature	Specification
Speed	Low, Full & Hi-Speed
Current	max. 500 mA
Max. cable length	3 m
Cable shield	mandatory
Connector type	Type A

Table 3.10.: USB 2.0 Host Port Specification

3.5.7. RJ45 Ethernet Connectors

Specification

The Ethernet ports have following specification:

Feature	Specification
Isolation to enclosure	1500 V_{DC}
Speed	10/100/1000 Mbit/s
Mode	Half- & Full-Duplex
Crossover	Automatic MDI/MDI-X
Max. cable length	100 m
Cable type	CAT5e or better
Cable shield	mandatory
Connector type	RJ45

Table 3.11.: Ethernet Port Specification

Pin Assignment

Pin	Gbit	Fast Ethernet
1	M0+	TX+
2	M0−	TX−
3	M1+	RX+
4	M2+	
5	M2−	
6	M1−	RX−
7	M3+	
8	M3−	

Table 3.12.: Pin Assignments of RJ45 Ethernet Connectors

3.5.8. SFP Port

Specification

The SFP port have following specification:

Feature	Specification
SFP Specification	IEEE802.3 and SFF-8472
Laser Module Class	Max Class 1 modules allowed
Signaling rate (range)	1.25 GBd±100 ppm
Supply voltage	3.3 V_{DC} ±10%
Connector type	SFP

Table 3.13.: SFP Port Specification

3.5.9. Power Supply

Standard Power Supply

Feature	Specification
Power supply nominal voltages	12 V_{DC}, 24 V_{DC}, 36 V_{DC} and 48 V_{DC}
Voltage range	12 V_{DC} to 48 V_{DC} (−25% / +10%)
Avg. power consumption	11 W
Max. power consumption	20 W
Max. cable length	30 m
Cable shield	not required

Table 3.14.: Power Specifications

For connector type and pin assignment check chapter 3.5.11.

3.5.10. Serial Interface

The serial interface is switchable by software.

RS-232 (non-isolated)
As default the RS-232 port is available with following specification:

Feature	Specification
Protocol	3-wire RS-232 (TXD, RXD, GND)
Baud rate	300, 1 200, 2 400, 4 800, 9 600, 19 200, 38 400, 57 600, **115 200**
Data bits	7 bit, **8 bit**
Parity	**none**, odd, even
Stop bits	**1**, 2
Software flow control	**none**, XON/XOFF
Hardware flow control	none
Galvanic isolation	none
Max. cable length	10 m
Cable shield	not required

Table 3.15.: RS-232 Port Specification

RS-485 (non-isolated)

The RS-485 port has the following specification:

Feature	Specification
Protocol	3-wire RS-485 (GND, A, B)
Baud rate	1 200, 2 400, 4 800, 9 600, 19 200, 38 400, 57 600, **115 200**
Data bits	7 bit, **8 bit**
Parity	**none**, odd, even
Stop bits	**1**, 2
Software flow control	**none**, XON/XOFF
Hardware flow control	none
Galvanic isolation	none
Internal bus termination	120Ωcould be added as SW option
Max. cable length	10 m
Cable shield	not required
Cable type	Twisted Pair
Max. transceivers on bus	256
Max. number of nodes	256

Table 3.16.: RS-485 Port Specification

For connector type and pin assignment check chapter 3.5.11.

3.5.11. 5 Pin Terminal Block

The power supply and the serial interface shares the 5 pin terminal block.

Feature	Specification
Connector type	5 pin terminal block header 3.5 mm (screw locking)

Table 3.17.: terminal block connector

Pin Assignment

	Pin	Name	Description
PWR	1	V+	Power Input
	2	V_{GND}	Power Ground
RS-232	3	GND	RS-232 GND (non-isolated)
	4	RxD	RS-232 RxD (non-isolated)
	5	TxD	RS-232 TxD (non-isolated)
RS-485	3	GND	GND (non-isolated)
	4	A	RS-485 (RxD/TxD+ non-inverting pin) (non-isolated)
	5	B	RS-485 (RxD/TxD− inverting pin) (non-isolated)

Table 3.18.: Pin Assignments of Terminal Block

3.5.12. Extension Slots

Available Options

The NB1800 has two optional extension slots (EXT 1, EXT 2) for various interfaces. The extensions are customer specific, please contact us.

4. Installation

The NB1800is designed for mounting on a DIN rail. Additional mounting holes allow the user to change DIN rail adapter orientation 90° rotated vs. default position. Please consider the safety instructions in chapter 2 and the environmental conditions in chapter 3.3.

The following precautions must be taken before installing a NB1800 router:

- Avoid direct solar radiation
- Protect the device from humidity, steam and aggressive fluids
- Guarantee sufficient circulation of air around the device
- The device is for indoor use only

Attention: NetModule routers are not intended for the end consumer market. The device must be installed and commissioned by a certified expert.

4.1. Installation of Micro-SIM Cards

Up to two Micro-SIM cards can be inserted in a NB1800 router.

SIM cards can be inserted by sliding it into one of the designated slots on the front panel. You have to push the SIM card using a small paper clip (or similar) until it snaps into place. To remove the SIM, you will need to push it again in the same manner. The SIM card will then rebounce and can be pulled out.

SIMs can be assigned flexibly to any modem in the system. It is also possible to switch a SIM to a different modem during operation, for instance if you want to use another provider upon a certain condition. However, a SIM switch usually takes about 10-20 seconds which can be bypassed (e.g. at boot-up) if SIMs are installed reasonably. Using only a single SIM with one modem, it should be preferably placed into the SIM 1 holder. For systems which should operate two modems with two SIMs in parallel, we recommend to assign **MOB 1** to SIM 1, **MOB 2** to SIM 2.

Further information about SIM configuration can be found in chapter 5.3.3.

Attention: After a SIM Switch the SIM Cover of the NB1800 router has to be mounted again and screwed to get IP40 protection class.

4.2. Installation of the microSD

Up to one card can be inserted in a NB1800 router. This card is accessed using SPI mode. Therefore the card has to support SPI mode. Following cards will work:

- SanDisk
- Kingston
- Swissbit
- Transcend

4.3. Installation of the Cellular Antenna

For a reliable function of the NetModule router via the mobile network, the NetModule routers require a good signal. Use suitable remote antennas with extended cables to achieve an optimal location with a sufficient signal and to maintain the distances to other antennas (at least 20cm to each other). The antenna manufacturer's instructions must be observed.

Keep in mind that effects caused by Faraday cages such as large metal surfaces (elevators, machine housings, etc.), close meshed iron constructions and others may reduce signal reception significantly.

The mounted antennas or antenna cables should be fixed with a wrench.

The following table shows how to connect the cellular antennas. 4G-LTE antennas require both the main and auxiliary ports to be connected.

Antenna Port	Type
MOB 1 A1	Main
MOB 1 A2	Auxiliary
MOB 2 A3	Main
MOB 2 A4	Auxiliary

Table 4.1.: Cellular antenna port types

5G requires 4 antennas per module (antenna ports A1-A4). See example in table 4.2.

Attention:
When installing the antenna be sure to observe chapter 2

	MOB 1		MOB 2		GNSS	EXT	
Antenna Port	A1	A2	A3	A4	A5	A6	A7
NB1800-NWac-G	5G Mobile 1		5G Mobile 1		GNSS	WLAN 1	

Table 4.2.: Variant with 5G module, antenna assignment

4.4. Installation of the WLAN Antennas

The following table shows how to connect the WLAN antennas. The number of attached antennas can be configured in the software. If only one antenna is used, it must be attached to the main port. However, for better diversity and thus better throughput and coverage, we highly recommend using two antennas.

Antenna Port	Type
WLAN 1 A3	Main
WLAN 1 A4	Auxiliary
WLAN 2 A1	Main
WLAN 2 A2	Auxiliary

Table 4.3.: WLAN antenna port types

For variants with 5G cellular module, WLAN 1 is assigned to antenna ports A6-A7, because 5G cellular is assigned to antenna ports A1-A4. See example in table 4.2.

Attention:
When installing the antenna be sure to observe chapter 2

4.5. Installation of the GNSS Antenna

The GNSS antenna must be mounted to the connector GNSS. Whether the antenna is an active or passive GNSS antenna has to be configured in the software. We recommend active GNSS antennas for highly accurate GNSS tracking.

Attention:
When installing the antenna be sure to observe chapter 2

4.6. Installation of the Local Area Network

Up to two 10/100/1000 Mbit/s Ethernet devices can be directly connected to the router, further devices can be attached via an additional Ethernet switch. Please ensure that the connector has been plugged in properly to ETH and remains in a fixed state, you might otherwise experience sporadic link loss during operation. The Link/Act LED will lit up as soon as the device has synced. If not, it might be necessary to configure a different link setting as described in chapter 5.3.2. By default, the router is configured as a DHCP server and has the IP address 192.168.1.1.

Attention:
Only a shielded Ethernet cable may be used.

4.7. Installation of the SFP Module

The NB1800 router provides one SFP port. Please ensure that the SFP module has been plugged in properly to SFP and remains in a fixed state.

Attention:
Only laser module class 1 are allowed.

4.8. Installation of the Power Supply

The router can be powered with an external source supplying between 12 V_{DC} and 48 V_{DC}. It must be used with a certified (CE or equivalent) power supply, which must have a limited and SELV circuit output. The router is now ready for getting engaged.

Attention: Following points must be observed:

- Power supply wires attached to PWR Inputs (V+ and VGND) must be able to withstand up to 8A current without heating up significantly or damaging its isolation.
- Only CE-compliant power supplies with a current-limited SELV output voltage range may be used with the NetModule routers.
- A Power Source Class 3 (PS3) power supply (with 100 W or more) shall only be used under the condition that a cable strain relief on the power cable to the router is applied. Such a cable strain relief ensures that the wires on the router screw terminal connector are not disconnected (e.g. if under an error condition, the router would be tangling on the cable). The cable strain relief must withstand a pulling force of 30 N (for router weight up to 1 kg) applied to the cable of the router.
- Une alimentation de classe 3 (PS3) (100 W ou plus) ne doit etre utilisee que si le cable d alimentation du routeur est equipe d un dispositif anti-traction. A condition qu une decharge de traction soit appliquee au cable d alimentation du routeur. Une telle decharge de traction permet de s assurer que les fils du connecteur a vis du routeur ne sient pas deconnectes (par exemple si, en cas d erreur, le routeur s emmale dans le cable). La decharge de traction du cable doit resister a une force de traction de 30 N (pour un routeur d un poids inferieur ou egal a 1 kg) appliquee au cable du routeur.

4.9. Installation of the Audio Interface

The audio interface (line out) is available on the PTT (Option Ap) and the Audio (Option A) extension.

Attention:
Risk of hearing damage: Avoid the use of earphones or Headphones at high volumes or over one longer period.

NetModule Router NB1810

User Manual for Software Version 99.99

Manual Version 1.13

NetModule AG, Switzerland

October 9, 2023

NetModule Router NB1810

This manual covers all variants of the *NB1810* product type.

The specifications and information regarding the products in this manual are subject to change without notice. We would like to point out that NetModule makes no representation or warranties with respect to the contents herein and shall not be responsible for any loss or damage caused to the user by the direct or indirect use of this information This document may contain information about third party products or processes. Such third party information is generally out of influence of NetModule and therefore NetModule shall not be responsible for the correctness or legitimacy of this information. Users must take full responsibility for their application of any products.

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1. Welcome to NetModule

Thank you for purchasing a NetModule product. This document should give you an introduction to the device and its features. The following chapters describe any aspects of commissioning the device, installation procedure and provide helpful information towards configuration and maintenance.

Please find further information such as sample SDK scripts or configuration samples in our wiki on https://wiki.netmodule.com.

2. Conformity

This chapter provides general information for putting the router into operation.

2.1. Safety Instructions

Please carefully observe all safety instructions in the manual that are marked with the symbol  .

Compliance information: The NetModule routers must be used in compliance with any and all applicable national and international laws and with any special restrictions regulating the utilization of the communication module in prescribed applications and environments.

Information about the accessories / changes to the device:

- Please only use original accessories to prevent injuries and health risks.
- Changes made to the device or the use of non-authorized accessories will render the warranty null and void and potentially invalidate the operating license.
- NetModule routers must not be opened (SIM cards may be used according to the instructions).

Information about the device interfaces:

- All systems that are connected to the NetModule router interfaces must meet the requirements for SELV (Safety Extra Low Voltage) systems.
- Interconnections must not leave the building nor penetrate the body shell of a vehicle.
- Connections for antennas may only exit the building or the vehicle hull if transient overvoltages (according to IEC 62368-1) are limited by external protection circuits down to 1 500 V_{peak}. All other connections must remain within the building or the vehicle hull.
- Installed antennas must always be at least 40 cm away from people.
- All antennas must have a distance of at least 20cm from each other; in the case of combined antennas (mobile radio / WLAN / GNSS), there must be sufficient isolation between the radio technologies.
- Devices with a WLAN interface may be operated only with applicable Regulatory Domain configured. Special attention must be paid to country, number of antennas and the antenna gain (see also chapter 5.3.4). WLAN antennas with a higher amplification may be used with the NetModule router "Enhanced-RF-Configuration" software license and the antenna gain and cable attenuation that have been correctly configured by certified specialized personnel. A misconfiguration will lead to loss of the approval.
- The maximum gain of an antenna (incl. the attenuation of the connection cables) must not exceed the following values in the corresponding frequency range:
  - Mobile radio (600MHz .. 1GHz) < 3.2dBi
  - Mobile radio (1.7GHz .. 2GHz) < 6.0dBi
  - Mobile radio (2.5GHz .. 4.2GHz) < 6.0dBi
  - WiFi (2.4GHz .. 2.5GHz) < 3.2dBi, WiFi (5.1GHz .. 5.9GHz) < 4.5dBi
- Note that GNSS signals can be obfuscated or blocked by malicious third-party devices.
- Only CE-compliant power supplies with a current-limited SELV output voltage range may be used with the NetModule routers.
- A Power Source Class 3 (PS3) power supply (with 100 W or more) shall only be used under the condition that a cable strain relief on the power cable to the router is applied. Such a cable strain relief ensures that the wires on the router screw terminal connector are not disconnected (e.g. if under an error condition, the router would be tangling on the cable). The cable strain relief must withstand a pulling force of 30 N (for router weight up to 1 kg) resp. 60 N (for router weight up to 4 kg) applied to the cable of the router.
- Une alimentation de classe 3 (PS3) (100 W ou plus) ne doit etre utilisee que si le cable d alimentation du routeur est equipe d un dispositif anti-traction. A condition qu une decharge de traction soit appliquee au cable d alimentation du routeur. Une telle decharge de traction permet de s assurer que les fils du connecteur a vis du routeur ne sient pas deconnectes (par exemple si, en cas d erreur, le routeur s emmale dans le cable). La decharge de traction du cable doit resister a une force de traction de 30 N (pour un routeur d un poids inferieur ou egal a 1 kg) respectivement 60 N (pour un routeur d un poids inferieur ou egal a 4 kg) appliquee au cable du routeur.

FCC Warning:

- Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
- This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
- (1) This device may not cause harmful interference , and
- (2) this device must accept any interference received , including interference that may cause undesired operation.

- Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver .
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected .
- Consult the dealer or an experienced radio / TV technician for help.
- Exposure Requirements: To comply with the FCC RF exposure compliance requirements, the device must be installed to provide a separation distance of at least 40 cm from all persons.

General safety instructions:

- Observe the usage limitations of radio units at filling stations, in chemical plants, in systems with explosives or potentially explosive locations.
- The devices may not be used in airplanes.
- Exercise particular caution near personal medical aids, such as pacemakers and hearing aids.
- The NetModule routers may also cause interference in the nearer distance of TV sets, radio receivers and personal computers.
- Never perform work on the antenna system during a thunderstorm.
- The devices are generally designed for normal indoor use. Do not expose the devices to extraordinary environmental conditions worse than IP40.
- Protect them against aggressive chemical atmospheres and humidity or temperatures outside specifications.
- We highly recommended creating a copy of a working system configuration. It can be easily applied to a newer software release afterwards.

2.2. Declaration of Conformity

CE NetModule hereby declares that under our own responsibility that the routers comply with the relevant standards following the provisions of the *RED Directive 2014/53/EU*. The signed version of the *Declaration of Conformity* can be obtained from https://www.netmodule.com/downloads

Operating frequency bands and related maximum radio frequency power transmitted is shown below, according to RED Directive 2014/53/EU, Article 10 (8a, 8b).

WLAN maximum output power

IEE 802.11b/g/n
Operation frequency range: 2412-2472 MHz (13 channels)
Maximum output power: 14.93 dBm EIRP average (on antenna port)

IEE 802.11a/n/ac
Operation frequency range: 5180-5350 MHz / 5470-5700 MHz (19 channels)
Maximum output power: 22.91 dBm EIRP average (on antenna port)

Cellular maximum output power

WCDMA Band I
Operation frequency range: 1920-1980, 2110-2170 MHz
Maximum output power: 25.7 dBm rated

WCDMA Band III
Operation frequency range: 1710-1785, 1805-1880 MHz
Maximum output power: 25.7 dBm rated

WCDMA Band VIII
Operation frequency range: 880-915, 925-960 MHz
Maximum output power: 25.7 dBm rated

LTE FDD Band 1
Operation frequency range: 1920-1980, 2110-2170 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 3
Operation frequency range: 1710-1785, 1805-1880 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 7
Operation frequency range: 2500-2570, 2620-2690 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 8
Operation frequency range: 880-915, 925-960 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 20
Operation frequency range: 832-862, 791-821 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 28
Operation frequency range: 703-748, 758-803
Maximum output power: 25 dBm rated

LTE FDD Band 38
Operation frequency range: 2570-2620 MHz
Maximum output power: 25 dBm rated

LTE FDD Band 40
Operation frequency range: 2300-2400 MHz
Maximum output power: 25 dBm rated

5G NR Band 1
Operation frequency range: 1920-1980, 2110-2170 MHz
Maximum output power: 25 dBm rated

5G NR Band 3
Operation frequency range: 1710-1785, 1805-1880 MHz
Maximum output power: 25 dBm rated

5G NR Band 7
Operation frequency range: 2500-2570, 2620-2690 MHz
Maximum output power: 25 dBm rated

5G NR Band 8
Operation frequency range: 880-915, 925-960 MHz
Maximum output power: 25 dBm rated

5G NR Band 20
Operation frequency range: 832-862, 791-821 MHz
Maximum output power: 25 dBm rated

5G NR Band 28
Operation frequency range: 703-748, 758-803 MHz
Maximum output power: 25 dBm rated

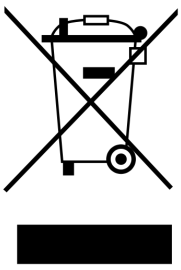
5G NR Band 38
Operation frequency range: 2570-2620 MHz
Maximum output power: 25 dBm rated

5G NR Band 40
Operation frequency range: 2300-2400 MHz
Maximum output power: 25 dBm rated

5G NR Band 77
Operation frequency range: 3300-4200 MHz
Maximum output power: 25 dBm rated

5G NR Band 78
Operation frequency range: 3300-3800 MHz
Maximum output power: 25 dBm rated

2.3. Waste Disposal



In accordance with the requirements of the *Council Directive 2012/19/EU* regarding Waste Electrical and Electronic Equipment (WEEE), you are urged to ensure that this product will be segregated from other waste at end-of-life and delivered to the WEEE collection system in your country for proper recycling.

2.4. National Restrictions

This product may be generally used in all EU countries (and other countries following the *RED Directive 2014/53/EU*) without any limitation. Please refer to our WLAN Regulatory Database for getting further national radio interface regulations and requirements for a particular country.

2.5. Open Source Software

We inform you that NetModule products may contain in part open-source software. We are distributing such open-source software to you under the terms of GNU General Public License (GPL)[1], GNU Lesser General Public License (LGPL)[2] or other open-source licenses[3]. These licenses allow you to run, copy, distribute, study, change and improve any software covered by GPL, Lesser GPL, or other open-source licenses without any restrictions from us or our end user license agreement on what you may do with that software. Unless required by applicable law or agreed to in writing, software distributed under open-source licenses is distributed on an "AS IS" basis, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

To obtain the corresponding open source codes covered by these licenses, please contact our technical support at router@support.netmodule.com.

Acknowledgements

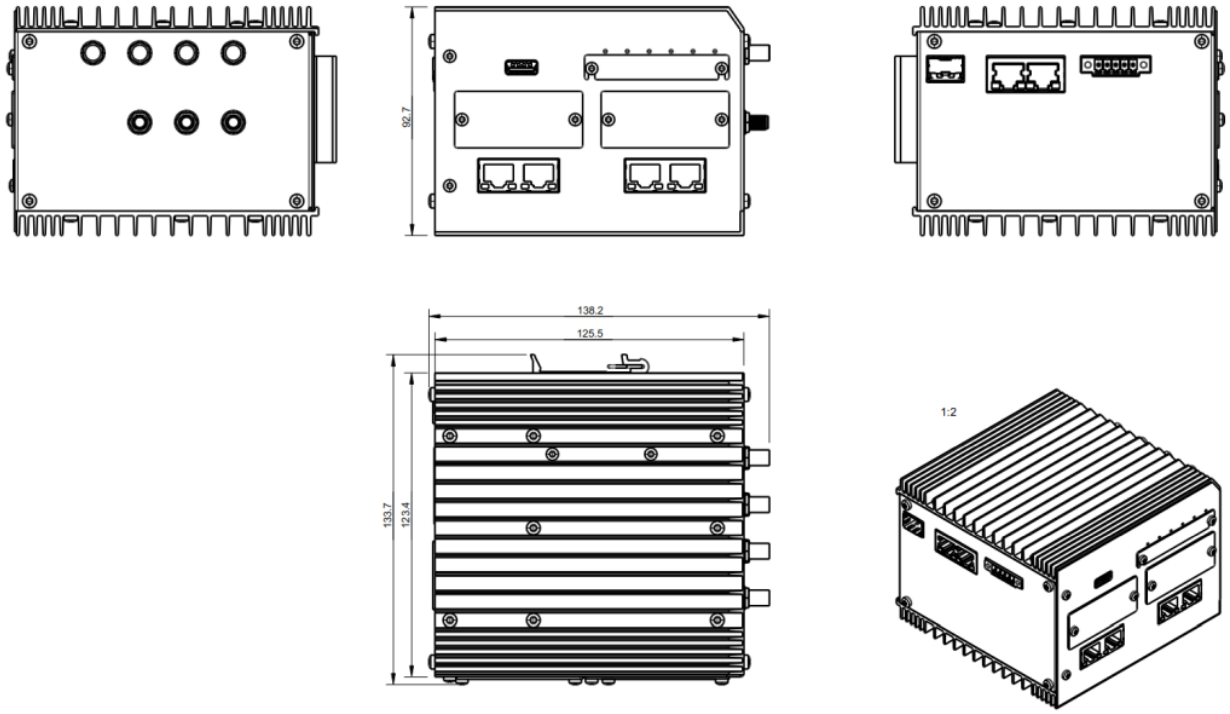
This product includes:

- PHP, freely available from http://www.php.net
- Software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org)
- Cryptographic software written by Eric Young (eay@cryptsoft.com)
- Software written by Tim Hudson (tjh@cryptsoft.com)
- Software written Jean-loup Gailly and Mark Adler
- MD5 Message-Digest Algorithm by RSA Data Security, Inc.
- An implementation of the AES encryption algorithm based on code released by Dr Brian Gladman
- Multiple-precision arithmetic code originally written by David Ireland
- Software from The FreeBSD Project (http://www.freebsd.org)

[1] Please find the GPL text under http://www.gnu.org/licenses/gpl-2.0.txt
[2] Please find the LGPL text under http://www.gnu.org/licenses/lgpl.txt
[3] Please find the license texts of OSI licenses (ISC License, MIT License, PHP License v3.0, zlib License) under http://opensource.org/licenses

3. Specifications

3.1. Appearance



3.2. Features

All models of NB1810 have following standard functionalities:

- Power input (non-isolated)
- 2x Ethernet ports (10/100/1000 Mbit/s)
- 1x SFP port
- 1x serial port (RS-232/RS-485)
- 1x USB 2.0 host port
- 2x micro SIM card slots
- 1x microSD card slot
- 2x Extension slots
- Full featured router software

The NB1810 can be equipped with the following options:

- 5G, LTE, UMTS, GSM
- WLAN IEEE 802.11
- GPS/GNSS
- 4 port GBit Ethernet Switch
- 4 port GBit Ethernet Switch with PoE+
- Software Keys

Due to its modular approach, the NB1810 router and its hardware components can be arbitrarily as-

sembled according to its indented usage or application. Please contact us in case of special project requirements.

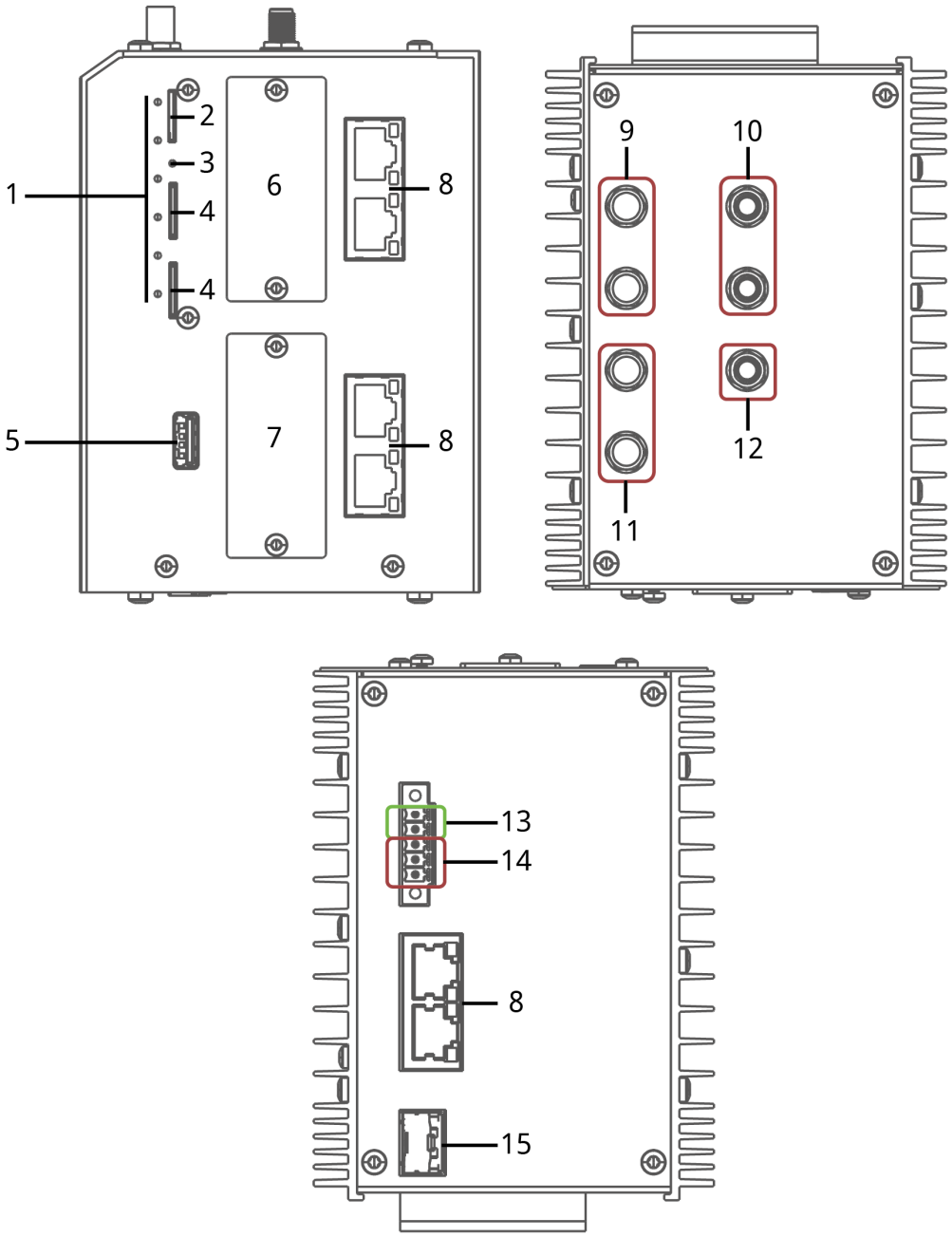
3.3. Environmental Conditions

Parameter	Rating
Standard Input Voltage	12 V_{DC} to 48 V_{DC} (−25% / +10%)
Input Voltage with option Ep	48 V_{DC} (±10%)
Operating Temperature Range	standard: −40 °C to +70 °C Option Ep (60W): −40 °C to +50 °C Option Ep (45W): −40 °C to +55 °C Option Ep (30W): −40 °C to +60 °C Option Ep (15W): −40 °C to +65 °C
Storage Temperature Range	−40 °C to +85 °C
Humidity	0 to 95% (non-condensing)
Altitude	up to 4000m
Over-Voltage Category	I
Pollution Degree	2
Ingress Protection Rating	IP40 (with SIM and USB covers mounted)

Table 3.1.: Operating Conditions

3.4. Interfaces

3.4.1. Overview



Nr.	Label	Panel	Function
1	LED Indicators	Front	LED Indicators for the different interfaces
2	SD	Front	microSD card
3	Reset	Front	Reboot and factory reset button
4	SIM 1 / 2	Front	Micro SIM 1/2 (3FF), they can be assigned dynamically to any modem by configuration.
5	USB	Front	USB 2.0 host port
6	EXT 1	Front	Extension EXT1
7	EXT 2	Front	Extension EXT2
8	ETH 1-6	Front/ Bottom	Ethernet ports, can be used for LAN/WAN
9	MOB 2/WLAN 1	Top	2 SMA female connectors for MIMO WLAN or MIMO cellular antenna
10	EXT	Top	2 SMA female connectors for additional antennas e.g. WLAN for variants with 5G
11	MOB 1/WLAN 2	Top	2 SMA female connectors for MIMO WLAN or MIMO cellular antenna
12	GNSS	Top	1 SMA female connector for additional GNSS antenna
13	PWR	Bottom	Power supply 12-48 V_{DC} (Pins 1 and 2)
14	RS-232/RS-485	Bottom	Non-isolated serial RS-232/RS-485 interface (Pins 3 to 5) which can be used for console administration, serial device server or other serial based communication applications.
15	SFP	Bottom	SFP port, can be used for LAN/WAN

Table 3.2.: NB1810 Interfaces

3.5. Operating Elements

The following table describes the default NB1810 status indicators.

Label	Color	State	Function
STAT	●g	Blinking	Device busy; device is in startup, software- or configuration update.
	●g	On	The device is ready.
WAN	●g	On	The hotlink connection is up.
	●g	Blinking	The hotlink connection is establishing or changing the interface.
	❍	Off	The hotlink is disabled.
LAN	●g	On	A WLAN access-point or ETH LAN-connection is up. ETH: enabled as LAN and link status is up WLAN: WLAN enabled and configured as access-point.
	❍	Off	No WLAN or ETH LAN-connection is up.
VPN	●g	On	VPN connection is up.
	●g	Blinking	VPN is up and waiting for a connection.
	❍	Off	VPN connection down.
EXT	❍	Off	Extension is disabled.
	●g●y●r	On/ Blinking	The EXT LED indicates the state of the extension interfaces: GNSS (default), DIO, CAN, Serial, BLE, ... or user specific (control via SDK or container) The configuration is done in the UI LED settings. Optional: the signal strength of wireless interfaces could be indicated (LTE, WiFi, BLE, ..).
SYS			Shows the overall system state. This could be derived from health indicators such as: – all services up and running – overall throughput is normal – CPU load is normal – the supervisor – . . . – User application (state set by user in SDK or container)
	●g	On	System operation state: normal
	●g	Blinking	System operation state: during startup
	●r	On	System operation state: emergency, watchdog, failure

Table 3.3.: NB1810 Status Indicators

3.5.1. Ethernet 1/2 LEDs

The following table describes the Ethernet status indicators.

Label	Color	State	Function
S	●	1 blink	10 Mbit/s
	●	2 blinks	100 Mbit/s
	●	3 blinks	1000 Mbit/s
	❍	off	no Link
L/A	●	on	Link on
	●	blinking	Activity
	❍	off	no Link

Table 3.4.: Ethernet Status Indicators

3.5.2. Ethernet 3-6 LEDs

The following table describes the Ethernet status indicators.

Label	Color	State	Function
S	●	on	1000 Mbit/s
	●	blinking	100 Mbit/s
	❍	off	no Link or 10 Mbit/s
L/A	●	on	Link on
	●	blinking	Activity
	❍	off	no Link

Table 3.5.: Ethernet Status Indicators

3.5.3. Reset

The reset button has two functions:

1. Reboot the system:
   Press at least 3 seconds to trigger a system reboot.
   The reboot is indicated with the red blinking STAT LED.
2. Factory reset:
   Press at least 10 seconds to trigger a factory reset.
   The start of the factory reset is confirmed by all LEDs lighting up for a second.

3.5.4. Mobile

The various variants of the NB1810 support up to 2 WWAN modules for mobile communication. The LTE modules support 2x2 MIMO. The Variant with 5G supports up to 1 WWAN modules with 4x4 MIMO.
Here you will find an overview of the different modems and the individual bands

The mobile antenna ports have the following specification:

Feature	Specification
Max. allowed cable length	30 m
Min. number of antennas 4G-LTE	2
Min. number of antennas 5G	4
Max. allowed antenna gain including cable attenuation	Mobile radio (600MHz .. 1GHz) < 3.2dBi Mobile radio (1.7GHz .. 2GHz) < 6.0dBi Mobile radio (2.5GHz .. 4.2GHz) < 6.0dBi
Min. distance between collocated radio transmitter antennas	20 cm
Min. distance between people and antennas	40 cm
Connector type	SMA

Table 3.6.: Mobile Antenna Port Specification

3.5.5. WLAN

The variants of the NB1810supports up to 3 802.11 a/b/g/n/ac WLAN modules.

Standard	Frequencies	Bandwidth	Max. Data Rate
802.11a	5 GHz	20 MHz	54 Mbit/s
802.11b	2.4 GHz	20 MHz	11 Mbit/s
802.11g	2.4 GHz	20 MHz	54 Mbit/s
802.11n	2.4/5 GHz	20/40 MHz	300 Mbit/s
802.11ac	5 GHz	20/40/80 MHz	867 Mbit/s

Table 3.7.: IEEE 802.11 Standards

Note: 802.11n and 802.11ac support 2x2 MIMO
The WLAN antenna ports have the following specification:

Feature	Specification
Max. allowed cable length	30 m
Max. allowed antenna gain including cable attenuation	3.2dBi (2,4GHz) resp. 4.5dBi (5GHz)[1]
Min. distance between collocated radio transmitter antennas (Example: WLAN1 to MOB1)	20 cm
Min. distance between people and antenna	40 cm
Connector type	SMA

Table 3.8.: WLAN Antenna Port Specification

[1] **Note:** WLAN antennas with a higher amplification may be used with the NetModule router "Enhanced-RF-Configuration" software license and the antenna gain and cable attenuation that have been correctly configured by certified specialized personnel.

3.5.6. GNSS

Feature	Specification
Systems	BeiDou, Galileo, GLONASS, GPS
Data stream	JSON or NMEA
Tracking sensitivity	up to -161 dBm
Supported antennas	Active and passive

Table 3.9.: GNSS Specifications option G

The GNSS antenna port have the following specification:

Feature	Specification
Max. allowed cable length	30 m
Antenna LNA gain	15-20 dB typ, 30 dB max.
Min. distance between collocated radio transmitter antennas (Example: GNSS to MOB1)	20 cm
Connector type	SMA

Table 3.10.: GNSS / GPS Antenna Port Specification

3.5.7. USB 2.0 Host Port

The USB 2.0 host port has the following specification:

Feature	Specification
Speed	Low, Full & Hi-Speed
Current	max. 500 mA
Max. cable length	3 m
Cable shield	mandatory
Connector type	Type A

Table 3.11.: USB 2.0 Host Port Specification

3.5.8. RJ45 Ethernet Connectors

Specification

The Ethernet ports have following specification:

Feature	Specification
Isolation to enclosure	1500 V_{DC}
Speed	10/100/1000 Mbit/s
Mode	Half- & Full-Duplex
Crossover	Automatic MDI/MDI-X
Max. cable length	100 m
Cable type	CAT5e or better
Cable shield	mandatory
Connector type	RJ45

Table 3.12.: Ethernet Port Specification

Pin Assignment

Pin	Gbit	Fast Ethernet
1	M0+	TX+
2	M0−	TX−
3	M1+	RX+
4	M2+	
5	M2−	
6	M1−	RX−
7	M3+	
8	M3−	

Table 3.13.: Pin Assignments of RJ45 Ethernet Connectors

3.5.9. SFP Port

Specification

The SFP port have following specification:

Feature	Specification
SFP Specification	IEEE802.3 and SFF-8472
Laser Module Class	Max Class 1 modules allowed
Signaling rate (range)	1.25 GBd±100 ppm
Supply voltage	3.3 V_{DC} ±10%
Connector type	SFP

Table 3.14.: SFP Port Specification

3.5.10. Power Supply

Standard Power Supply specification without option Ep

Feature	Specification
Power supply nominal voltages	12 V_{DC}, 24 V_{DC}, 36 V_{DC} and 48 V_{DC}
Voltage range	12 V_{DC} to 48 V_{DC} (−25% / +10%)
Avg. power consumption	15 W
Max. power consumption	25 W
Max. cable length	30 m
Cable shield	not required

Table 3.15.: Power Specifications

Power Supply with Option Ep (4xETH with PoE)
The power port in conjunction with the Option Ep (PoE PSE) has the following specification:

Feature	Specification
Power supply nominal voltages	48 V_{DC}
Voltage range	48 V_{DC} (±10%)
Avg. power consumption	82 W
Max. power consumption	90 W
Max. cable length	30 m
Cable shield	not required
Galvanic isolation	just to PoE Supply

Table 3.16.: Power Specifications

For connector type and pin assignment check chapter 3.5.12.

3.5.11. Serial Interface

The serial interface is switchable by software.

RS-232 (non-isolated)
As default the RS-232 port is available with following specification:

Feature	Specification
Protocol	3-wire RS-232 (TXD, RXD, GND)
Baud rate	300, 1 200, 2 400, 4 800, 9 600, 19 200, 38 400, 57 600, **115 200**
Data bits	7 bit, **8 bit**
Parity	**none**, odd, even
Stop bits	**1**, 2
Software flow control	**none**, XON/XOFF
Hardware flow control	none
Galvanic isolation	none
Max. cable length	10 m
Cable shield	not required

Table 3.17.: RS-232 Port Specification

RS-485 (non-isolated)
The RS-485 port has the following specification:

Feature	Specification
Protocol	3-wire RS-485 (GND, A, B)
Baud rate	1 200, 2 400, 4 800, 9 600, 19 200, 38 400, 57 600, **115 200**
Data bits	7 bit, **8 bit**
Parity	**none**, odd, even
Stop bits	**1**, 2
Software flow control	**none**, XON/XOFF
Hardware flow control	none
Galvanic isolation	none
Internal bus termination	120Ωcould be added as SW option
Max. cable length	10 m
Cable shield	not required
Cable type	Twisted Pair

Feature	Specification
Max. transceivers on bus	256
Max. number of nodes	256

Table 3.18.: RS-485 Port Specification

For connector type and pin assignment check chapter 3.5.12.

3.5.12. 5 Pin Terminal Block

Feature	Specification
Connector type	5 pin terminal block header 3.5 mm (screw locking)

Table 3.19.: Terminal block connector

Pin Assignment

	Pin	Name	Description
PWR	1	V+	Power Input
	2	V_{GND}	Power Ground
RS-232	3	GND	RS-232 GND (non-isolated)
	4	RxD	RS-232 RxD (non-isolated)
	5	TxD	RS-232 TxD (non-isolated)
RS-485	3	GND	GND (non-isolated)
	4	A	RS-485 (RxD/TxD+ non-inverting pin) (non-isolated)
	5	B	RS-485 (RxD/TxD− inverting pin) (non-isolated)

Table 3.20.: Pin Assignments of Terminal Block

3.5.13. Extension Slots

Available Options

The NB1810 has two optional extension slots (EXT 1, EXT 2) for various interfaces and one RJ45 extension interface (ETH switch with or without PoE+).
The extensions which can be inserted in the EXT1 and EXT2 slots are customer specific, please contact us.
One of the following extension boards can be inserted in the RJ45 extension:

- 4-Port Gbit Ethernet Switch (Options E)
- 4-Port Gbit Ethernet Switch with PoE+ (Power Over Ethernet Supply, Options Ep)

4-Port Gbit Ethernet Switch Specification (options E and Ep)

The 4-port Gbit Ethernet switch (Options E and Ep) has the following specification:

Feature	Specification
Isolation to enclosure	1500 V_{DC}
Speed	10/100/1000 Mbit/s
Mode	Half- & Full-Duplex
Crossover	Automatic MDI/MDI-X
Max. cable length	100 m
Cable type	CAT5e or better
Cable shield	mandatory
Connector type	RJ45

Table 3.21.: Ethernet Port Specification

The optional PoE+ Power Source Equipment has the following specification (only option Ep):

Feature	Specification
Standards	IEEE802.3af and IEEE802.3at, including two-event classification
Isolation to enclosure	1500 V_{DC}
Max. Output Power (per port)	30 W
Max. Output Power (total)	60 W

Table 3.22.: Ethernet Port Specification

Pin	Gbit	Fast Ethernet
1	M0+	TX+
2	M0−	TX−
3	M1+	RX+
4	M2+	
5	M2−	
6	M1−	RX−
7	M3+	
8	M3−	

Table 3.23.: Pin Assignments of RJ45 Ethernet Connectors

4. Installation

The NB1810is designed for mounting on a DIN rail. Additional mounting holes allow the user to change DIN rail adapter orientation 90° rotated vs. default position. Please consider the safety instructions in chapter 2 and the environmental conditions in chapter 3.3.

The following precautions must be taken before installing a NB1810 router:

- Avoid direct solar radiation
- Protect the device from humidity, steam and aggressive fluids
- Guarantee sufficient circulation of air around the device
- The device is for indoor use only

Attention: NetModule routers are not intended for the end consumer market. The device must be installed and commissioned by a certified expert.

4.1. Installation of Micro-SIM Cards

Up to two Micro-SIM cards can be inserted in a NB1810 router.

SIM cards can be inserted by sliding it into one of the designated slots on the front panel. You have to push the SIM card using a small paper clip (or similar) until it snaps into place. To remove the SIM, you will need to push it again in the same manner. The SIM card will then rebounce and can be pulled out.

SIMs can be assigned flexibly to any modem in the system. It is also possible to switch a SIM to a different modem during operation, for instance if you want to use another provider upon a certain condition. However, a SIM switch usually takes about 10-20 seconds which can be bypassed (e.g. at boot-up) if SIMs are installed reasonably. Using only a single SIM with one modem, it should be preferably placed into the SIM 1 holder. For systems which should operate two modems with two SIMs in parallel, we recommend to assign **MOB 1** to SIM 1, **MOB 2** to SIM 2.

Further information about SIM configuration can be found in chapter 5.3.3.

Attention: After a SIM Switch the SIM Cover of the NB1810 router has to be mounted again and screwed to get IP40 protection class.

4.2. Installation of the microSD

Up to one card can be inserted in a NB1810 router. This card is accessed using SPI mode. Therefore the card has to support SPI mode. Following cards will work:

- SanDisk
- Kingston
- Swissbit
- Transcend

4.3. Installation of the Cellular Antenna

For a reliable function of the NetModule router via the mobile network, the NetModule routers require a good signal. Use suitable remote antennas with extended cables to achieve an optimal location with a sufficient signal and to maintain the distances to other antennas (at least 20cm to each other). The antenna manufacturer's instructions must be observed.

Keep in mind that effects caused by Faraday cages such as large metal surfaces (elevators, machine housings, etc.), close meshed iron constructions and others may reduce signal reception significantly.

The mounted antennas or antenna cables should be fixed with a wrench.

The following table shows how to connect the cellular antennas. 4G-LTE antennas require both the main and auxiliary ports to be connected.

Antenna Port	Type
MOB 1 A1	Main
MOB 1 A2	Auxiliary
MOB 2 A3	Main
MOB 2 A4	Auxiliary

Table 4.1.: Cellular antenna port types

5G requires 4 antennas per module (antenna ports A1-A4). See example in table 4.2.

Attention:
When installing the antenna be sure to observe chapter 2

	MOB 1		MOB 2		GNSS	EXT	
Antenna Port	A1	A2	A3	A4	A5	A6	A7
NB1810-NWac4Ep-G	5G Mobile 1		5G Mobile 1		GNSS	WLAN 1	

Table 4.2.: Variant with 5G module, antenna assignment

4.4. Installation of the WLAN Antennas

The following table shows how to connect the WLAN antennas. The number of attached antennas can be configured in the software. If only one antenna is used, it must be attached to the main port. However, for better diversity and thus better throughput and coverage, we highly recommend using two antennas.

Antenna Port	Type
WLAN 1 A3	Main
WLAN 1 A4	Auxiliary
WLAN 2 A1	Main
WLAN 2 A2	Auxiliary

Table 4.3.: WLAN antenna port types

For variants with 5G cellular module, WLAN 1 is assigned to antenna ports A6-A7, because 5G cellular is assigned to antenna ports A1-A4. See example in table 4.2.

Attention:
When installing the antenna be sure to observe chapter 2

4.5. Installation of the GNSS Antenna

The GNSS antenna must be mounted to the connector GNSS. Whether the antenna is an active or passive GNSS antenna has to be configured in the software. We recommend active GNSS antennas for highly accurate GNSS tracking.

Attention:
When installing the antenna be sure to observe chapter 2

4.6. Installation of the Local Area Network

Up to two 10/100/1000 Mbit/s Ethernet devices can be directly connected to the router, further devices can be attached via an additional Ethernet switch. Please ensure that the connector has been plugged in properly to ETH and remains in a fixed state, you might otherwise experience sporadic link loss during operation. The Link/Act LED will lit up as soon as the device has synced. If not, it might be necessary to configure a different link setting as described in chapter 5.3.2. By default, the router is configured as a DHCP server and has the IP address 192.168.1.1.

Attention:
Only a shielded Ethernet cable may be used.

4.7. Installation of the SFP Module

The NB1810 router provides one SFP port. Please ensure that the SFP module has been plugged in properly to SFP and remains in a fixed state.

Attention:
Only laser module class 1 are allowed.

4.8. Installation of the Power Supply

The router can be powered with an external source supplying between 12 V_{DC} and 48 V_{DC}. It must be used with a certified (CE or equivalent) power supply, which must have a limited and SELV circuit output. The router is now ready for getting engaged.