Operating Manual
Garderos R-7900 Series

Ruggedized router (IP40) with

- 5 RJ-45 10/100 BaseT Ethernet interfaces
- 1 RJ-45 RS-232 serial interface (management)
- 1 RS-485 on 2 pin PCB clamp
- 1 integrated WWAN modem (2/3/4G, CDMA)*
- 1 RJ-45 ADSL2+ and VDSL2 modem (Annex A/B/J)*

* optional

1 Safety instructions

Read these safety instructions before handling or installing the device.

- Do not open the casing. Warranty shall be void if the warranty seal has been tampered with.
- Don't use or install the device in an explosive atmosphere!
- Don't touch any contacts with metallic or pointed items.
- This device has no power switch. Please disconnect the power before any operational work.
- In case of any damage to the device, it must not be put into operation.
- Do not install the device during a thunderstorm!
- Protect the device from heat sources and direct sunlight.
- Protect the device from aggressive fluids and vapors.
- The router emits electromagnetic waves. **To prevent other devices from being disturbed and to protect other people**, install the router only as described in this document and make sure to comply with safety distances.
  - Unauthorized persons must not get nearer than 60cm to the GSM/UMTS/LTE antennas.
  - Depending on the router type, the antenna and configured networks the safety distances may be smaller. Use the calculations in the Annex to calculate the minimum safety distance of your router.
- **Remove the power connector before performing any maintenance** or cleaning work near to the antennas or directly at the router.

Risk of burns! The device can operate in surroundings of more than 70 °C, so the surface can get very hot. Install the router inaccessible for unauthorized personnel. Before touching the router, remove the power supply and wait for 10 minutes for the router to cool down or wear protective gloves.

2 General information

2.1 Router type

The Garderos R-7900 routers are available as several different models with optional 2/3/4G and CDMA interfaces. This document is a general description for the following router types:

| Type	Eth.	RS-232 (Mgmt.)	RS-485	xDSL	2/3/4G	CDMA
R-7907	5	1	1			
R-7917	5	1	1	1		
R-7928	5	1	1		1	
R-7937	5	1	1	1		1
R-7968	5	1	1	1	1	
R-7977	5	1	1			1

The router type can be identified by the serial number of the router. The type is coded into the first 5 characters of the serial number.

There are 2 variants of the router casing:

- Routers without xDSL modem are delivered with a 44.5mm high 2 piece aluminum die cast casing.
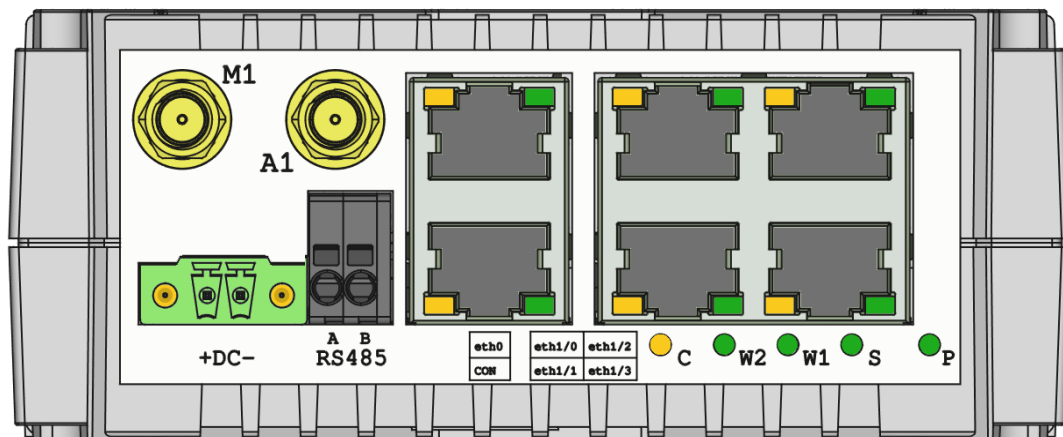
- Routers with xDSL modem are delivered with an 80.5mm high 3 piece aluminum die cast casing.
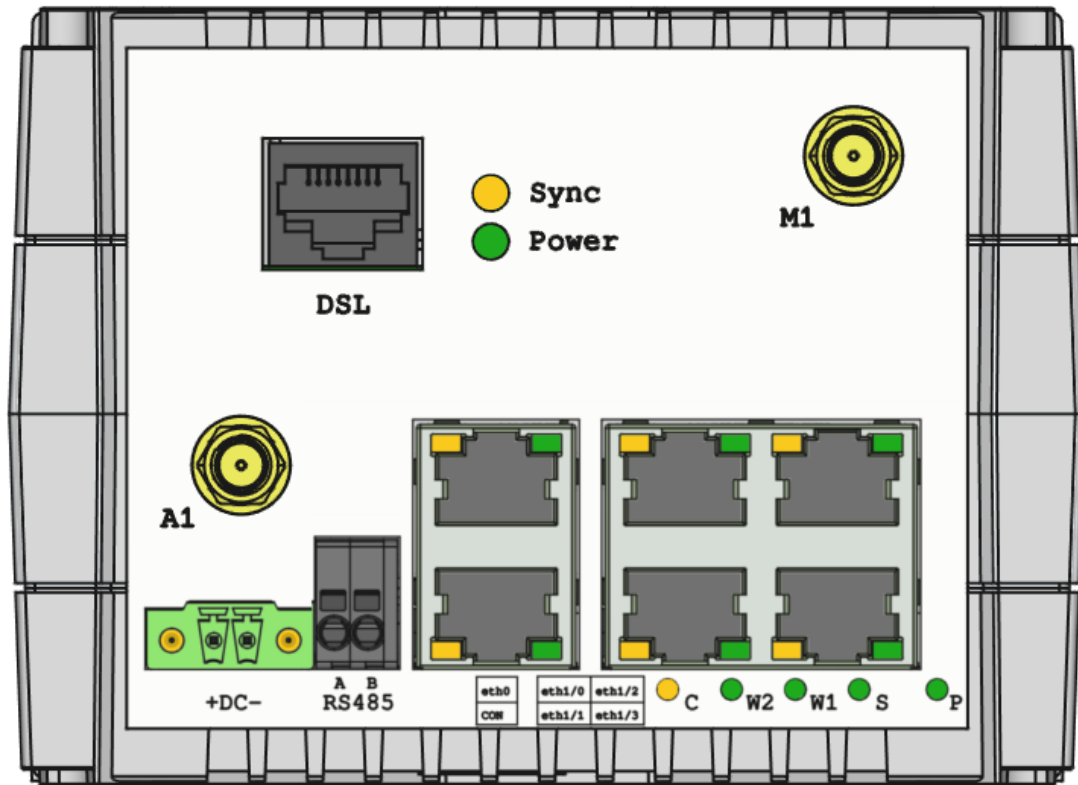
!	If not otherwise indicated, the following document will be written based on the xDSL variant of the casing, as the smaller casing mainly contains a subset of the xDSL router's components.

2.2 Included in delivery of Garderos R-7900

Standard scope:
- Garderos R-7900 router
- Phoenix 2-pin power connector
- Cable lug, washer and screw for grounding

Optional accessories:
- Antennas (2/3/4G, CDMA)
- Antenna connector cables and adapters
- Industrial grade power supply
- Serial cables
- Holding angle and DIN rail clip

Please check the contents of the package after receipt.

3 Hardware

3.1 Installation

The Garderos R-7900 has an integrated DIN rail mounting clip. Mount the router at a DIN rail as shown in the following drawing. The DIN rail clip has a spring that will automatically close the clip when the router fits to the rail.
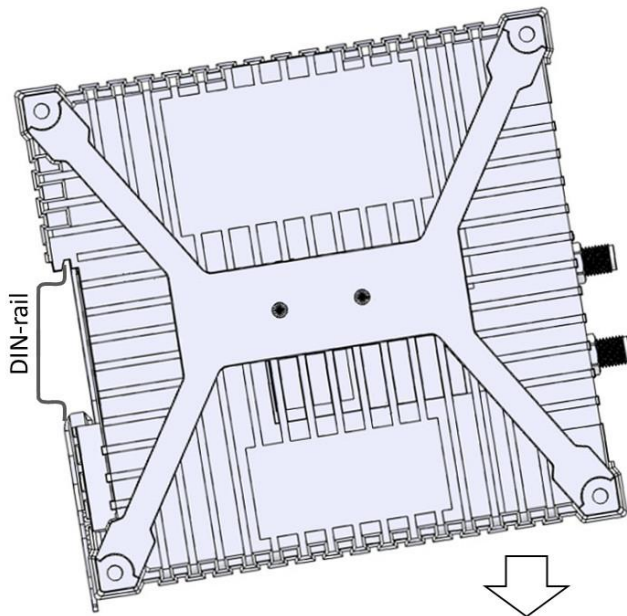

For unmounting the router, use a screw driver with a long metal point and open the DIN rail clip as shown in the following drawing. Then push the router up to remove it from the DIN rail.
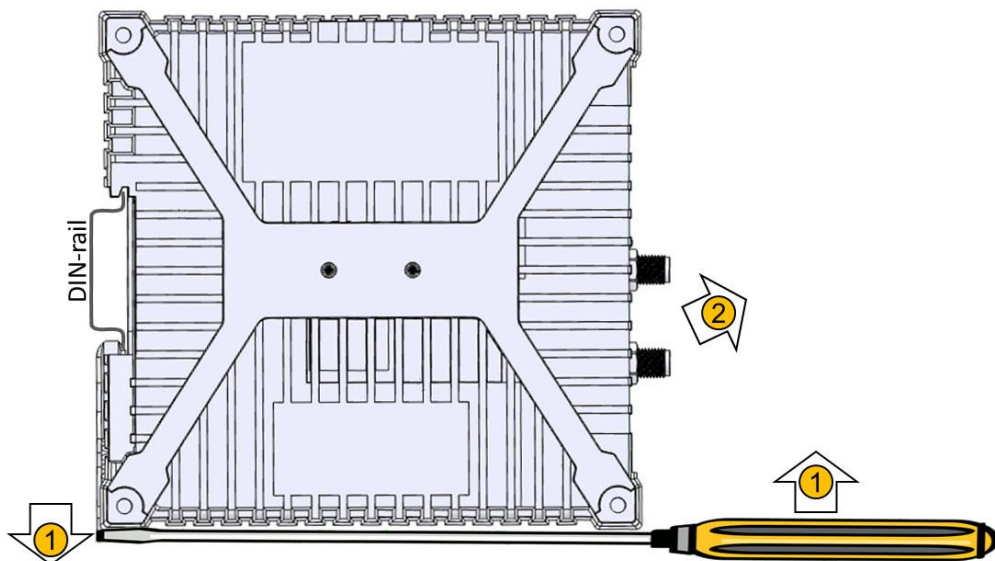
3.2 Grounding

For grounding crimp a 1.5mm² ground cable to the grounding lug that is included in the router delivery. Fix the grounding cable with the washer between the M4 screw and the cable lug to any of the screw holes in router case. See the following picture for an example:
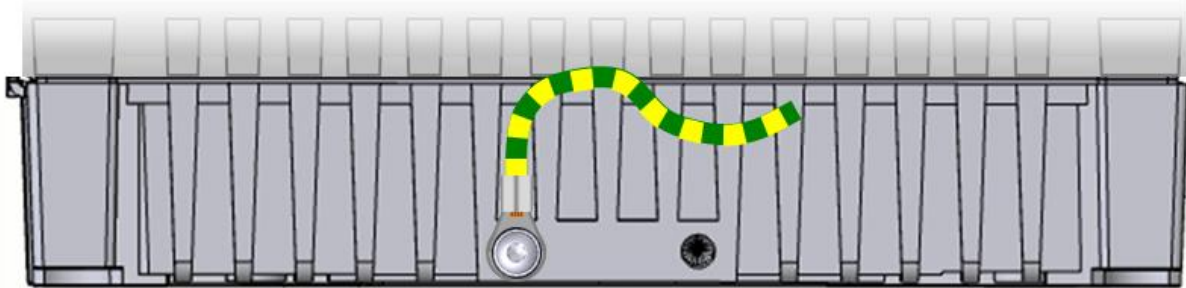
3.3 Status LEDs

The Garderos R-7900 has 19 LEDs on the front, showing its operational status. All LEDs, except from the Ethernet LEDs that are integrated into the RJ-45 Ethernet sockets, are clearly marked on the casing:
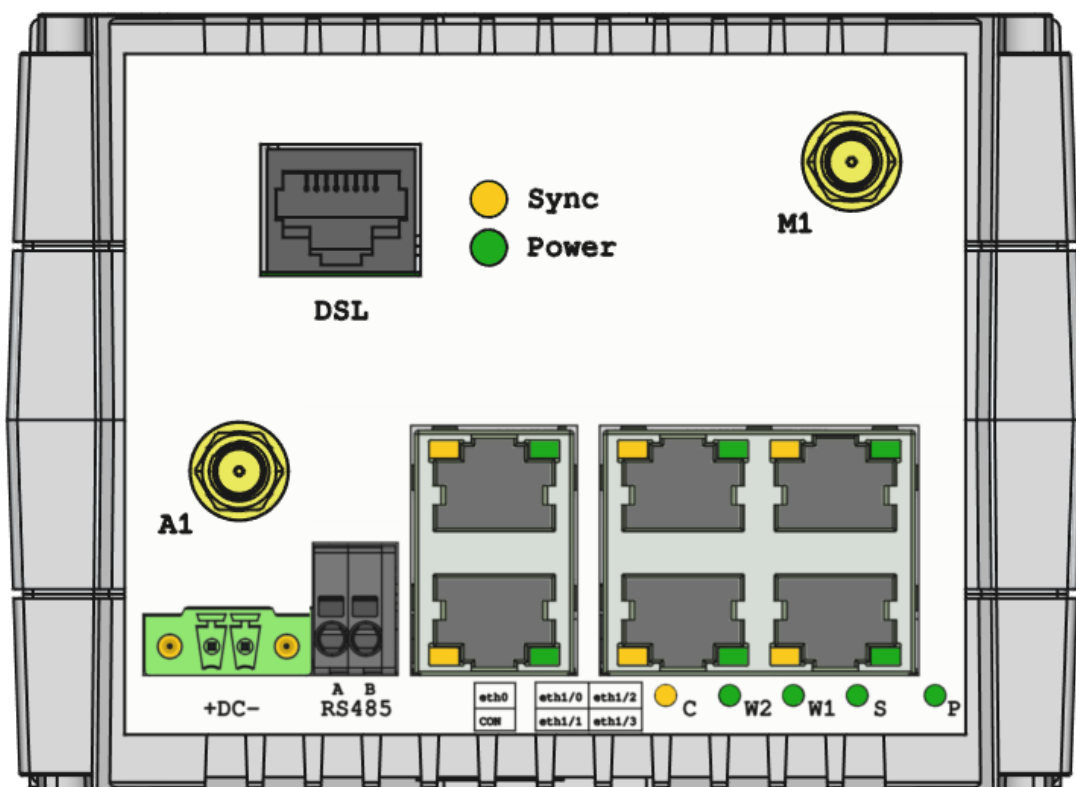
|	
P (green)	Shows the status of the router's power supply and is lit during the entire period of operation.
S (green)	Shows the current state of the router operating system. The LED blinks during fetching and executing the router configuration and is permanently lit when the configuration of the device has been completed.

W1 (green)	Depending on the type of the WWAN link this LED signals the state of the link. The LED is off when no WWAN connection is active and is lit while at the WWAN connection is active.
W2 (green)	On/off depends on router configuration.
C (multi color)	On/off and color depends on router configuration.
Sync (yellow)	Shows the xDSL modem synchronization status. The LED is off after boot, blinks when the modem tries to synchronize and is lit while the modem is synchronized.
Power (green)	Shows the power state of the xDSL modem. The LED is lit during the entire period of operation.
Eth speed (green)	Is lit for 100Mb/s and off for 10Mb/s.
Eth link/act (orange)	Is lit when an Ethernet link was detected and blinks during Ethernet activity.

In normal operation mode the LEDs **Power** (P) and **Router Status** (S) are on, as well as the **orange LEDs** of all connected Ethernet ports.

3.4 Connectors

Depending on the type, the Garderos R-7900 routers have different connectors on the front. All possible connectors are described below; the image shows the front panel of an R-7968 as an example. The R-7900 routers have a SIM card slot on the back:
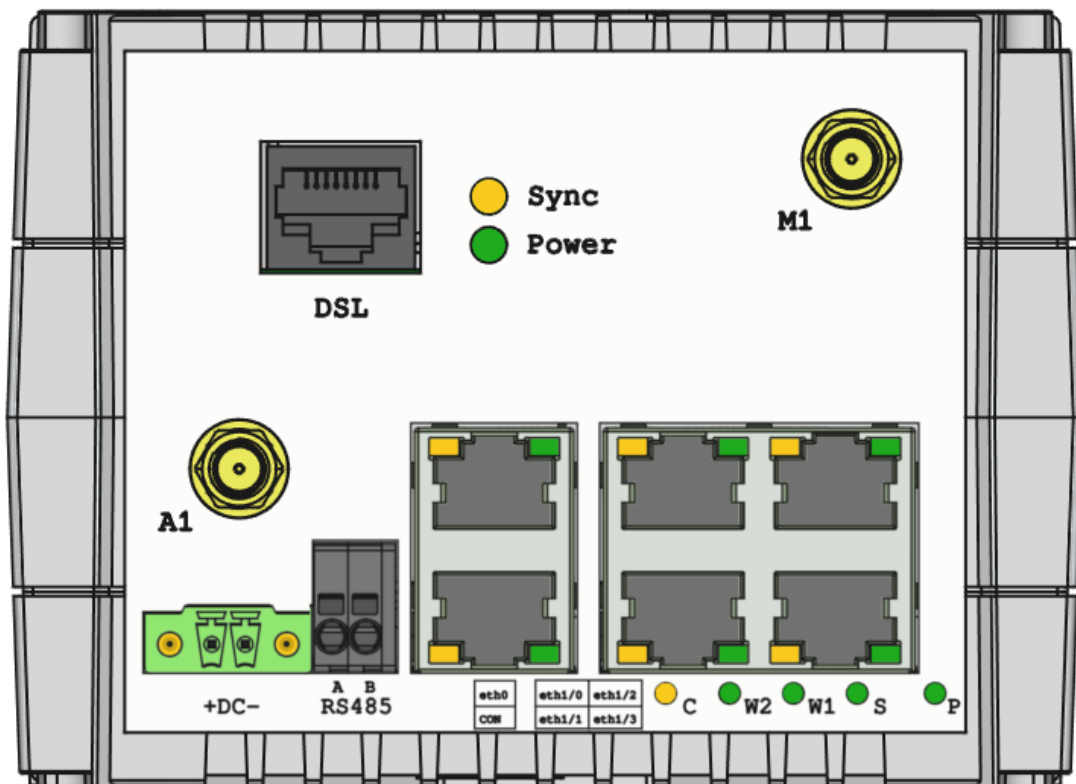
+ DC-	Power connection. + (VCC) and – (0V/GND) are marked on the casing.
CON	RJ-45 jack for RS-232 serial console (Settings: **115200 / 8 / N / 1 / none**).
RS-485	2 pin PCB clamp for RS-485 half duplex serial interface to connect industrial components.
eth0	RJ-45 jack for 10/100 BaseT Ethernet
eth1/0	RJ-45 jack for 10/100 BaseT Ethernet
eth1/1	RJ-45 jack for 10/100 BaseT Ethernet
eth1/2	RJ-45 jack for 10/100 BaseT Ethernet
eth1/3	RJ-45 jack for 10/100 BaseT Ethernet
eth1/4	RJ-45 jack for 10/100 BaseT Ethernet
DSL	RJ-45 jack for xDSL
M1	Main 1 antenna connector. See 3.4.5 for description.
A1	Auxiliary 1 antenna connector. See 3.4.5 for description.

Select an antenna for the correct band to get the best performance on the network. Depending on the router type the WWAN supports different frequencies. WWAN capabilities can be shown by the command „show hardware wwan"**.**
See below for more information about login and command line interface.

3.4.1 DC power connection

GND and VCC are marked. The allowed power range is 12-24V DC. Make sure to correctly connect 0V/GND (-) and VCC (+) to power as marked on the front plate.
The router supports voltage levels from +9.6VDC up to +28VDC. When using higher input voltages, the router may be damaged.

3.4.2 CON

The RJ-45 connector's pins are assigned to an RS-232 serial console. Pin assignment is:

PIN no.	Description
1	RS-232 console port RTS
2	Not used.
3	RS-232 console port TX
4	GND
5	GND
6	RS-232 console port RX
7	Not used.
8	RS-232 console port CTS

Serial cables can be ordered from Garderos.

3.4.3 RS-485

The 2 pin PCB clamp provides an RS-485 half duplex industrial serial interface. Pin assignment is:

Pin	Description
A	RS-485 half duplex A
B	RS-485 half duplex B

The router casing is at ground (GND) potential. If ground is required for RS-485 connections, any of screw hole can be used to get ground potential.

3.4.4 DSL

RJ-45 connector for connection to a DSL line. Port assignment is:

PIN no.	Description
1	Not assigned
2	Not assigned
3	Not assigned
4	DSL
5	DSL
6	Not assigned
7	Not assigned
8	Not assigned

3.4.5 Antenna connectors

Depending on the router type the antenna connectors M1 and A1 are used for different antenna connections, e.g. a 2/3/4G or a CDMA modem, or they do not exist on the router. The connectors are always SMA female. Login to the router and use the command:

```
R7900# show hardware connector
```

to show the assignment of the antenna connectors.

> **The R-7900 router is delivered without antennas. Use the calculations "6.2 WWAN radio settings" to calculate the safety distances for your antennas.**
> **For routers delivered by Garderos with antennas, Garderos can help you calculate the acceptable values.**

4 Software

The Garderos R-7900 routers run the Garderos Router Software (GRS) operating system.

GRS provides the following functions:

- Router operating system
- Automatic management of the configuration:
  - Local configuration (startup configuration) to configure the router locally.
  - Remote configuration that can be downloaded from a web server for central configuration management.
- Interfaces to other systems via APIs:
  - HTTPS Configuration API
  - RADIUS authentication
  - NTP
  - SNMP
  - …

The GRS documentation is available online at:
https://www.garderos.com/techsup

Username and password for login to the support web are available from your Garderos sales representative.

The documentation contains a detailed description of all GRS features. This operating manual is limited to the basic steps for starting the router so that it can be commissioned.

5 Commissioning

5.1 Installation

Connect the antennas before powering on the router. Connect antennas at least to the M1 connector. Ethernet cables can be connected / disconnected at any time.

5.2 Handling of the SIM-card

Insert and remove SIM cards from the router only when the power is disconnected.

5.2.1 Removing a SIM card tray

While the R-7900 router has 1 SIM card slot for Mini-SIM format, the router casing is prepared for 2 SIM card slots. To access the SIM-card slot remove the cover using a screwdriver.
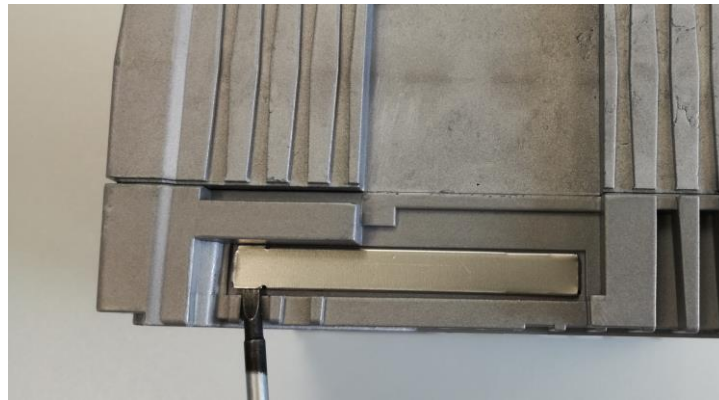
The SIM card must be put into the SIM card slot marked as "SIM 1" in the following picture. Do not use the slot "SIM 2", this slot is empty. A SIM or SIM tray might fall into the router. Always put back the DIN rail mounting kit after inserting the SIM-card to prevent the SIM card from moving when the router is exposed to shock or vibration.

Remove the SIM tray by pressing the yellow button in the "SIM 1" slot with a screw driver.
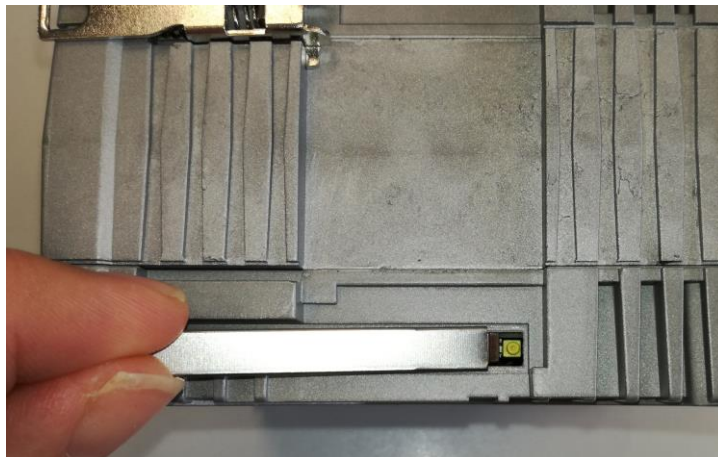
5.2.1 Inserting the SIM-card

Insert the SIM card into the SIM tray and push the SIM tray back into the router. Take care to correctly push the SIM tray into the SIM card tray holder. The SIM card tray fits below the tray holder and may slip into the router, if not put into the right position:

Put back the SIM slot cover to keep IP40 ingress protection:

> **Remove the WWAN settings of the router before inserting a new SIM card. Otherwise the router might try to establish the WWAN connection with the previous settings, and an incorrect PIN might cause the SIM-card to be locked.**
> **Only insert/remove the SIM-card when the router is powered off!**
> **Use thermo resistant Mini-SIM-cards for up to 80°C (ask your cellular operator for industrial SIM-cards).**

5.3 Powering up the router

This device has no power switch. To power it on, just connect DC power (12-24V) to the router.

> **Connect VCC to + and 0V/GND to – as marked on the front plate. Otherwise the router might be damaged!**
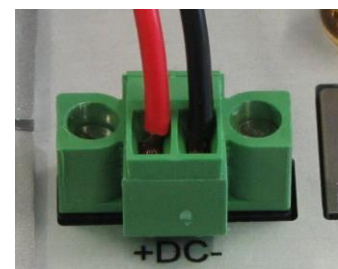
Before starting the R-7900 an antenna must be connected to the M1 connector for models containing a WWAN modem, otherwise the router may be damaged.

The LEDs (see chapter 0) show the operational mode of the device:

P	Shows the status of the power supply and is lit during the entire period of operation.
S	Shows the current state of the router operating system. The LED blinks during fetching and executing the router configuration and is permanently lit when the configuration of the router has been completed.
W1	Is lit when at least 1 WWAN interface is active.

5.4 Login

The Garderos R-7900 can be managed via a serial console. Connect your computer to the router's **CON** port using an RJ-45 serial console cable. Use the following settings:

Bits per second	115200
Data bits	8
Parity	N
Stop	1
Flow control	None

Log in with the following credentials:

User name	root
Password	g42pnuMN

Find online documentation about initial configuration of the factory default Garderos router at https://www.garderos.com/techsup in the chapter "Getting Started". The online documentation also contains detailed descriptions for more than 600 configuration parameters.

6 Annex

6.1 Technical Data

Dimensions (WxHxD)	44.5x110x115mm (80.5x111x116mm with xDSL) 44.5x110x122mm (80.5x111x122mm with xDSL) incl. connectors
Weight	~0.45kg (~0.7kg with xDSL)
Input voltage	12-24VDC
Power consumption	~2-7W
Operating temperature range	-25° to +75°C models without xDSL -25° to +65°C models with xDSL
Transport temperature range	Same as operating temperature range.
Storage temperature range	Same as operating temperature range.
WWAN (optional)	2/3/4G, CDMA (see datasheet for details)
WAN	ADSL2+, VDSL2, Annex A, B, J, PTM/ATM, Vectoring
Network interfaces	5 * RJ-45, 10/100 BaseT Ethernet, autosensing, auto-MDI-X
Serial ports	1 * RS-232 (mgmt), 1* RS-485
Ingress protection	IP40
IEC protection class	3
Conformity	CE, EN 61000-6-2 (2005), RoHS

6.2 WWAN radio settings

Based on the harmonized EU standards EN 50385:2017 and EN 50383:2010, taking into account the reference values of the Council recommendations 1999/519/EG the safety distances for the 2G/3G/4G antennas can be calculated. The calculation is based on the output power of the router and the gain and losses inside the antenna and extension cables.

The R-7900 routers are delivered with different WWAN modems depending on the router type. To find out the modem type used in the router, login to the router, then execute the command:

```
router# show hardware wwan
```

This command also shows the bands that the modem is active in.

The following tables show the maximum output power for all WWAN modems depending on the supported technology:

WWAN modem type	2G	3G	4G	CDMA450
EG25-G	35dBm	25dBm	25dBm	
LE910-EU V2	33.5dBm	24.5dBm	24dBm	
LE910-EU1	33.5dBm		24dBm	
MPN200				25dBm
WPD-600N			23dBm	

The gain and loss in the antenna and antenna cables also need to be taken into account to get the output power relevant for the safety distance.

Calculate the total output power on the antenna. This value is calculated from:

- Output power for each technology supported by the WWAN modem taken from the table above.
- Losses inside the router. This is a static value of -0.3dB.
- Antenna gain taken from the data sheet of the antenna. If the gain depends on the frequency, the calculation has to be done for each different gain.
- Optional: Losses by extension cables.

```
Output power = Modem power -0.3dB + Antenna gain + Losses
```

Example:

- Output power of the LE910-EU1 WWAN modem for 2G (GSM) is 33.5dBm, for 4G (LTE) it is 24dBm.
- Losses inside the router are -0.3dB.
- Antenna has a gain of 4dBi in all frequencies for 2G and 4G.
- No extension cable.

```
Output power_4G = 24dBm -0.3dB + 4dBi = 26.7dBi
Output power_2G = 33.5dBm -0.3dB + 4dBi = 37.2dBi
```

6.2.1 Safety distance per frequency

The safety distance depends on the output power and the frequency. Generally the safety distance needs to be higher for lower frequencies.

You can see the frequencies supported by the WWAN modem by using the command:

```
router# show hardware wwan
```

The following table shows the frequencies for the supported bands:

2G (GSM)	
Band	**Frequency**
GSM-850	850 MHz
GSM-E-900	900 MHz
DCS-1800	1800 MHz
PCS-1900	1900 MHz

3G (UMTS)	
Band	**Frequency**
B1	2100 MHz
B2	1900 MHz
B4	1700 MHz
B5	850 MHz
B6	800 MHz
B8	900 MHz
B9	1700 MHz
B19	800 MHz

4G (LTE)	
Band	**Frequency**
B1	2100 MHz
B3	1800 MHz
B5	850 MHz
B7	2600 MHz
B8	900 MHz
B18	850 MHz
B19	850 MHz
B20	800 MHz
B21	1500 MHz
B28	700 MHz
B31	450 MHz
B38	2600 MHz
B39	1900 MHz
B40	2300 MHz
B41	2500 MHz

CDMA 450	
Band	**Frequency**
450	450 MHz

To find out the correct safety distance, first calculate the output power for your router/antenna setup for all frequencies. Then read the safety distances from the following table for each of them. Round up the output power and round down the frequency to one of the values from the table. The highest value shown in the table is the safety distance that you should comply to:

Output power	450MHz	700MHz	800MHz	900MHz	1500MHz	1800MHz	>=2GHz
20dBi	6.0cm	4.8cm	4.5cm	4.2cm	3.3cm	3.0cm	2.9cm
22dBi	7.5cm	6.0cm	5.6cm	5.3cm	4.1cm	3.8cm	3.6cm
24dBi	9.5cm	7.6cm	7.0cm	6.7cm	5.2cm	4.7cm	4.5cm
26dBi	11.9cm	9.6cm	8.9cm	8.4cm	6.5cm	6.0cm	5.7cm
28dBi	15.0cm	12.0cm	11.2cm	10.6cm	8.2cm	7.5cm	7.2cm
30dBi	18.8cm	15.1cm	14.1cm	13.3cm	10.2cm	9.4cm	9.0cm
32dBi	23.7cm	19.0cm	17.8cm	16.8cm	13.0cm	11.9cm	11.3cm
34dBi	29.8cm	23.9cm	22.4cm	21.0cm	16.3cm	14.9cm	14.3cm
36dBi	37.6cm	30.2cm	28.2cm	26.6cm	20.6cm	18.8cm	18.0cm
38dBi	47.2cm	37.9cm	35.4cm	33.4cm	25.9cm	23.6cm	22.6cm
40dBi	59.4cm	47.7cm	44.6cm	42.0cm	32.6cm	29.7cm	28.4cm
42dBi	74.8cm	60.0cm	56.1cm	52.9cm	41.0cm	37.4cm	35.8cm
44dBi	94.2cm	75.5cm	70.6cm	66.6cm	51.6cm	47.1cm	45.0cm

6.2.2 Safety distance per modem type

Based on the calculations from above a safe value can be taken from the table below, if the gain of the antenna connected to the router is known.

> ⚠️ **This simplified calculation can only be used, if the antenna gain is equal for all frequencies, or if the gain is higher for lower frequencies. In that case choose the higher gain. This table can not be used, if the gain of the antenna is higher for the high frequencies!**

Antenna gain	EG25-G	LE910-EU V2	LE910-EU1	MPN200	WPD-600N
-4dB	17.8cm	13.3cm	13.3cm	7.5cm	6.0cm
-2dB	22.4cm	16.8cm	16.8cm	9.5cm	7.5cm
0dB	28.2cm	21.0cm	21.0cm	11.9cm	9.5cm
2dB	35.4cm	26.6cm	26.6cm	15.0cm	11.9cm
4dB	44.6cm	33.4cm	33.4cm	18.8cm	15.0cm
6dB	56.1cm	42.0cm	42.0cm	23.7cm	18.8cm

6.3 Warranty

The conditions of warranty for the Garderos products are described in the Garderos General Terms and Conditions in the section entitled „Warranty".

6.4 Declaration of conformity

Garderos GmbH declares that the Garderos R-7900 product conforms to CE. The complete statement of conformity can be downloaded at:
https://www.garderos.com/conformity

6.5 Disposal information

Please consider the following when disposing of the device:

- This device must not be disposed together with household waste.
- The Garderos R-7900 contains a CR-2032 battery, which must be removed before disposal. The battery can be removed in the following way:
  - Disconnect the device from the power supply.
  - Open the device by using a screw driver.
  - Remove the screws of the router main board (the one with the power connector.
  - The battery is located in a battery holder on the top of the main board. Push out the battery using a screw driver.
  - Dispose of the battery at an official collection point for batteries.
- Now dispose of the device at an official collection point for electronic waste.

GARDEROS.

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