Automation Monitoring and control Remote access and management HVAC



Unipi Patron

Product line of programmable controllers

unipi technology

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Contents

1 Introduction ... 3
1.1 What is Unipi Patron? ... 3
1.2 What can be Unipi Patron used for? ... 3
1.3 Which Patron models are available? ... 3
1.4 Patron product line structure ... 4
1.5 Compliance with directives ... 4
2 Installation and connection ... 5
2.1 Basic instructions and safety information ... 5
2.2 Basic unit description ... 5
2.3 Description of connectors and indication LEDs ... 6
2.3.1 LEDs indication ... 6
2.3.2 Connector description ... 7
2.4 Installation ... 7
2.4.1 Mounting/Demounting ... 7
2.4.2 Connection ... 9
2.4.3 Power supply connection ... 9
2.4.4 Communication line connection ... 9
2.4.5 Digital input connection – DI ... 10
2.4.6 Digital output connection – DO ... 11
2.4.7 Analog input connection – AI ... 11
2.4.8 Analog output connection – AO ... 13
2.4.9 Relay output connection – RO ... 14
2.4.10 Summary ... 15
3 Software ... 16
3.1 Default settings ... 16
3.1.1 Unipi Patron unit startup ... 16
3.1.2 Service mode ... 17
3.2 Overview of available APIs ... 18
3.2.1 EVOK ... 18
3.2.2 Modbus TCP ... 18
3.2.3 SysFS ... 18
3.3 Serial port maps ... 20
3.3.1 RS485/RS232 ... 20
3.3.2 USB ... 20
3.4 Description of functions ... 20
3.4.1 Digital inputs functions ... 20
3.4.2 Digital outputs functions ... 21

3.4.3 Other setting and informative functions ... 22
4 Technical parameters ... 23
4.1 Digital inputs ... 23
4.2 Digital outputs ... 23
4.3 Analog inputs ... 23
4.4 Analog outputs ... 24
4.5 Relay outputs ... 24
4.6 RS-485 Interface ... 25
4.7 RS-232 Interface ... 25
4.8 Storage, installation and working conditions ... 25
4.9 Frequency bands and radio frequency power ... 26
4.9.1 LTE ... 26
4.10 Dimensions ... 27
4.10.1 Unipi Patron product line S ... 27
4.10.2 Unipi Patron product line M ... 27
4.10.3 Unipi Patron product line L ... 27
5 License and Declaration ... 28
5.1 NXP SDMA firmware ... 28
5.2 Simplified EU Declaration of Conformity ... 28
Revision ... 29

1 Introduction

1.1 What is Unipi Patron?

Unipi Patron is a product line of compact freely programmable controllers (hereafter units) for automatic regulation and monitoring. It is designed for operation in residential and commercial premises and light industry areas, except for systems which are critical for security.

Whole Patron product line consists of a variety of controllers which vary in the number and type of individual inputs/outputs (I/O) and communication interfaces.

1.2 What can be Unipi Patron used for?

Patron units can be used in various implementations, such as:

- Single-purpose devices (heat pumps, automatic barrier gate control)
- Monitoring and data collection systems
- Home automation / Smart houses (e.g. light switching, automatic shutters, lawn irrigation)
- Complex applications (Control of boiler rooms, cascade boiler control, air-conditioning systems)
- SCADA and MES systems
- Industrial automation and HVAC applications
- Projects in the field of IoT and IIoT
- Within Industry 4.0 applications as units for Cloud computing or Edge computing
- Modernization of older installations

1.3 Which Patron models are available?

The following table describes input/output and communication interface configurations of each Patron unit.

Product	DI	DO	RO	AI	AO	RS485	RS232	1-Wire	LTE	LAN
S107	4	4	-	1	1	2	1	1	-	1
S117	4	4	-	1	1	4	-	1	-	1
S167 LTE	4	4	-	1	1	2	-	1	1	1
S207	8	-	8	-	-	1	-	1	-	1
M207	20	4	14	1	1	2	1	1	-	1
M267 LTE	20	4	14	1	1	2	-	1	1	1
M527	8	4	5	5*	5*	3	1	1	-	1
M567 LTE	8	4	5	5*	5*	3	-	1	1	1
L207	36	4	28	1	1	2	1	1	-	1
L527	24	4	19	5*	5*	3	1	1	-	1

** The analog input and output on section 1 is different from sections 2 and 3. For detailed info, see chapters 2.4.7 and 2.4.8.*

Each Patron unit has these common parameters:

CPU	RAM	eMMC	LAN	Other
i.MX 8M Mini 4 × 1.8 GHz (Arm© Cortex©-A53)	1 GB	8 GB	100 Mbit Ethernet	2 × USB 2.0

1.4 Patron product line structure

Each Patron unit is divided into one to three sections depending on the specific unit type. Sections are always numbered from right to left of the main section (1). Each section contains inputs, outputs, or communication interfaces, which are always numbered from the left separately within the section. Some advanced features are only available within a specific section. Each section contains its processor, which takes care of events on inputs, outputs and monitors communication with the control processor. Sections do not communicate with each other. The connectors of a given section are always divided into groups according to function to minimize the possibility of accidentally swapping connectors. Meaning of the individual connector terminals is always described on the box. The position of a connector corresponds to the position of a description.

Note:
For example, the terminals are numbered as DIx or DIy.x, where x is the input number within the group and y is the section number. If the section number (y) is not specified, it is always section 1.



Example of numbering of inputs, outputs, groups and sections on the Patron L527 unit.

1.5 Compliance with directives

LVD:	**2014/35/EU**
EMC:	**2014/30/EU**
RED:	**2014/53/EU**
RoHS:	**2015/863/EU**
WEEE:	**2012/19/EU**

2 Installation and connection

2.1 Basic instructions and safety information

Always follow these instructions during the installation:

- All connected external peripherals should comply with all relevant directives and standards applicable to the method of use and the country in which the unit is used
- Only the power supply described in the product label can be used for powering. Using the wrong power supply can damage the unit and connected devices
- Use cables with the appropriate conductor cross-section (see chapter 4.8)
- Do not exceed the tightening torque of the terminals (see chapter 4.8)
- Follow installation and operating condition (see chapter 4.8)
- Ensure the shortest possible wiring length. For longer cables, use shielded cables. Route the cables in pairs, i.e. one neutral conductor plus one phase/signal conductor
- Ensure that the AC cabling, or high-voltage DC circuits with high-frequency switching cycles, are separated from the signal wires
- Ensure that the wires are installed with appropriate strain relief

Danger:
Never use the unit in potentially explosive atmospheres!

In case of any manipulation with the unit (mounting/demounting), first turn off all power sources - there is a risk of electrocution or damage.

Caution:
Improper handling can result in significant property damage, bodily injury or death. The box in which the unit is installed must only be accessible using a key or tool. Access to the unit must be permitted only to trained personnel with sufficient qualification.

The unit may only be installed indoors and in a suitable environment corresponding to the product specification (interiors with suitable temperature and humidity, switchboards protected against water intrusion, etc.).

Note:
Installation may only be performed by qualified personnel.

2.2 Basic unit description

Patron control units are based on a Unipi Zulu computing module powered by the i.MX 8M Mini (4 × Arm® Cortex®-A53 CPU that features a max. 1.8 GHz), 1 GB RAM and an onboard 8 GB eMMC memory for saving and running the user program on the Linux operating system, see chapter 3.

The advantage is in the possibility of implementing your own applications to the unit thanks to the use of an open-source platform and also a high speed of internal communication and thus a minimal delay in the execution of the command. The units also have a number of communication interfaces, such as Ethernet, RS485/RS232, 1-Wire and others. In addition, it is also possible to modify the HW of units within the OEM program (https://www.unipi.technology/), or to arrange the generation of customized OS.

2.3 Description of connectors and indication LEDs

2.3.1 LEDs indication

Name	Function	Meaning	Colour
PWR	On	Supply voltage indication	Red
RUN	Blinking	Section status indication	Green
Digital inputs (DI)	On	Indication of log.1 at the input	Green
Digital outputs (DO)	On	Output switch indication	Green
Relay outputs (RO)	On	Relay switch indication	Green
TX (RS485/RS232)	On	Indication of serial line transmitting	Green
RX (RS485/RS232)	On	Indication of serial line receiving	Green
User LED (X1...Xn)	Selectable	Freely programmable user LEDs	Green

In addition to the above description of individual LEDs indication, these diodes are used to indicate the following events and states:

2.3.1.1 Regular mode

LED behaviour description	Meaning	Off	On
All LEDs are on for 300 ms	Start of the section processor (power connection)	-	300 ms
PWR is on, RUN is on with short blinks	The main computing module communicates with the given section	50 ms	2000 ms
PWR is on, RUN is on with short blinks	Master WatchDog timeout expired (see chapter 3.4.3.4)	2000 ms	2000 ms
Every other is on (even)	SW reset of section processor	-	1000 ms
All but every fourth light is on	Firmware update. Do not turn off the unit!	-	>1000 ms

2.3.1.2 Service mode and flashing / backing up the OS of the unit

LED behaviour description	Meaning	Off	On
PWR is On, RUN is Off, the rest blinks slowly	Unit is in service mode	600 ms	600 ms
PWR is On, RUN is Off, the rest blinks rapidly	Flashing / Backing up OS	80 ms	80 ms

2.3.2 Connector description

Terminal label	Meaning
+24V	Positive pole of power supply
GND	Negative pole of power supply
DI	Digital input
DIGND	Digital input common terminal – negative pole
DO	Digital output
DOGND	Digital output common terminal – negative pole
RO	Relay output
COM	Common relay terminal
AI	Analog input
AIS	Power supply of the relevant AI (see chapters 2.4.7, 2.4.8.2)
AOR	Analog output (voltage or current) / resistance measurement (see chapter 2.4.8.1)
AOV	Analog output (voltage only, see chapter 2.4.8.2)
AGND	Analog input/output common terminal - negative pole
RS485-A/RS485-B	RS-485 communication line terminals
RS485-END	Connectable terminating resistor of RS-485 communication line
RS232-TXD/RXD	RS-232 communication line terminals

2.4 Installation

2.4.1 Mounting/Demounting

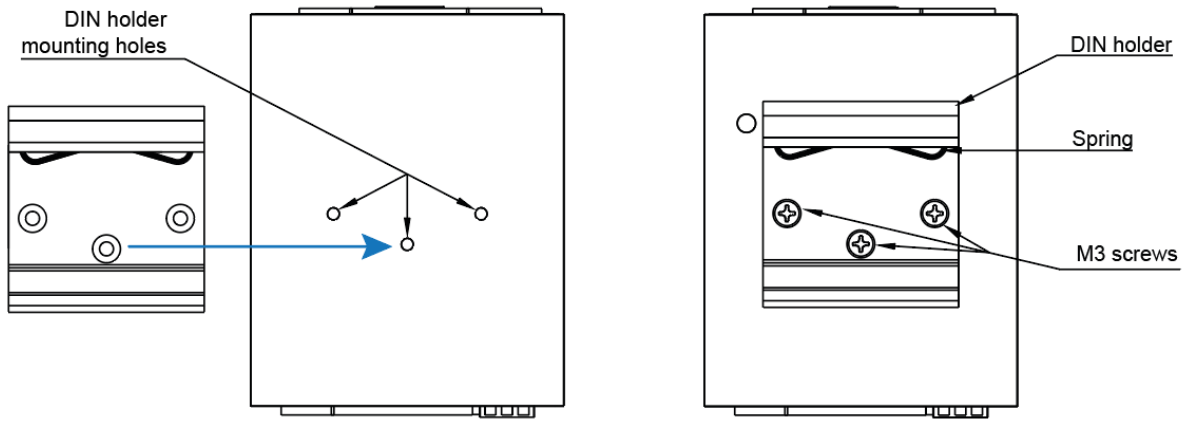
All units of the Patron product line are structurally designed for mounting on a TH 35 mm DIN rail according to EN 60715.

2.4.1.1 Mounting

Danger:
Prior to mounting, make sure that the environment is disconnected from all power sources. There is a danger of electrical injury.

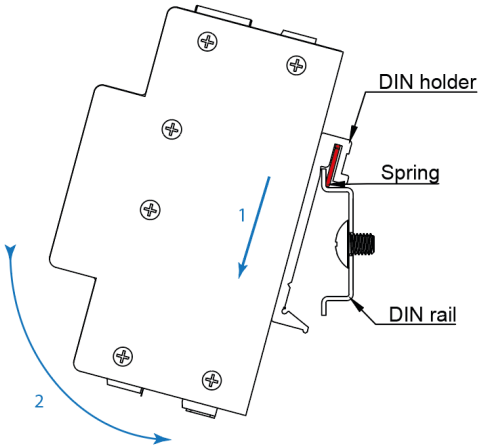
If the holder for DIN rail is not installed, it must be mounted first with the supplied screws so that the spring is towards the top of the unit.

DIN holder installation:



To install unit on the DIN rail, slide the unit onto the rail from above (in the direction of arrow 1 in the picture below), against the spring resistance downwards and then clicking the lower part (in the direction of arrow 2 in the picture below).

Mounting on DIN rail:



Caution:
Avoid pressure on the inputs/outputs as they could be mechanically damaged.

Make sure that the upper edge of the DIN rail runs between the spring and the rear of the DIN holder (see figure above).

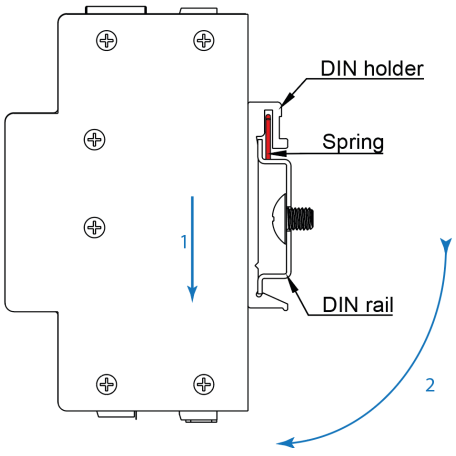
In case of installation of the unit into the distribution box where there is no forced air circulation there must be minimum 80 mm space between the sides of the unit and the walls of the distribution box. If it is not possible to provide sufficient air circulation in the distribution box it is necessary to enhance air circulation with installed ventilation fan. Maximum temperature of air entering the unit must not exceed the values stated in chapter 4.8.

2.4.1.2 Demounting

Danger:
Prior to demounting, make sure that the unit is disconnected from the power supply. There is a danger of electrical injury.

Demounting of the unit is done with opposite procedure, i.e. hold the unit with both hands and push it down, against the spring resistance (in the direction of arrow 1 in the figure below). Then pull the bottom edge of the unit towards you (in the direction of the arrow 2 in the picture below).

Demounting from DIN rail:



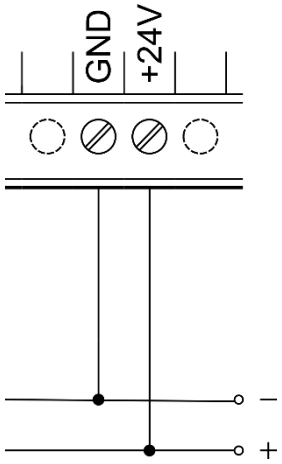
Caution:
Avoid pressure on the inputs/outputs as they could be mechanically damaged.

2.4.2 Connection

There are pluggable screw terminals for the connection of any cable. Purpose of each terminal block contact is depicted on the top side of the unit case. For wire montage into screw terminals always use appropriate flat head screwdriver. Do not exceed maximum torque which is stated in the chapter 4.8.

2.4.3 Power supply connection

To ensure correct operation of the unit it is necessary to connect power supply 24 V⎓ into terminal for +24V (positive pole) and GND (negative pole) into power supply terminal block. Information about tolerance of recommended power supply voltage and consumption of electricity are described in detail in the datasheet of each unit and on the product label.



Caution:
The device has appliance class I. That is why it is also necessary to connect protective ground conductor to ground connector of the device marked on the case with symbol ⏚. For ground conductor connection use cable eye and provided M4 screw with serrated lock washer.

Note:
DIN rail with the installed unit must be connected to protective ground conductor.

2.4.4 Communication line connection

2.4.4.1 RS-485

RS-485 connection (EIA-485) is done on screw connectors for RS-485 marked as A and B. The unit features optionally connectable terminator (120 Ω) marked as RS485-END.

Note:
We recommend that you comply with the following instructions for reliable bus operation:

- Ensure the shortest possible wiring length between devices
- Ensure the serial connection of the buses
- Use shielded cabling, preferably 0.8 mm diameter J-Y(ST)Y and twisted pairs, or FTP CAT6

Connect the cabling shield only on one side of the cable, directly to the switchboard earth terminal, not to the PLC terminal. The DIN rail on which the unit is installed must also be connected to a protective ground conductor.

2.4.4.2 RS-232

RS-232 (RS-232C) connection is done on screw connectors for RS-232 marked as RXD, TXD and GND.

2.4.4.3 1-Wire

1-Wire bus purpose is data collection from the connected sensors, e.g. thermometer, humidity sensor. The connection is made to a detachable screw connector marked 1-Wire with GND, 1W, VCC terminals. Connecting multiple devices to the 1-Wire bus is done in series (i.e. from sensor to sensor), or using a reduction and hub with RJ45 connectors (Cable 1-Wire reduction – product code: 2019031 and 1-Wire 8 port hub – product code: 2017007).

Note:
The 1-Wire bus is implemented in Unipi units in a six-conductors design, where two conductors are for data transmission (1W↑/1W↓), two ground conductors (GND) and two powering conductors (VCC). Two data conductors are used due to bus serialization, which significantly contributes to its reliability. More information at https://kb.unipi.technology.

The following instructions must be observed for reliable bus operation:
- Ensure the shortest possible distance between the terminal (sensor) and the incoming/outgoing data cable
- Do not connect more than 15 sensors per channel

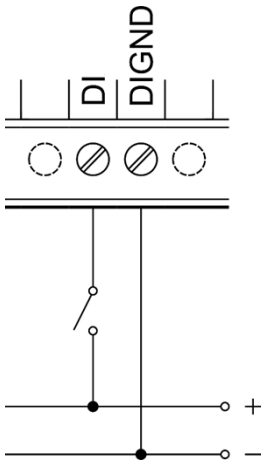
These instructions are for guidance only. They may vary depending on the environment, bus length and number of sensors.

1-Wire channel can be enabled/disabled via program (switch on/off power supply of 1-Wire bus) and thus achieve reset of the entire bus, including sensors. Reset configuration depends on chosen software as further described in chapter 3.4.3.2.

2.4.5 Digital input connection – DI

Digital inputs are usually used to connect devices such as e.g. switches (light switches, buttons), motion sensors, door and window contacts etc. Logic state 1 (switched on) of each input is signalized via relevant indication LED on the front side of the unit.

For the connection of external device to digital input there are screw connectors marked with DIx (or possibly DIy.x) and DIGND. All digital input connectors share a common ground connector for connection of negative pole of DC voltage source. Voltage source positive pole is connected over external device to DIx connector as shows the picture below:



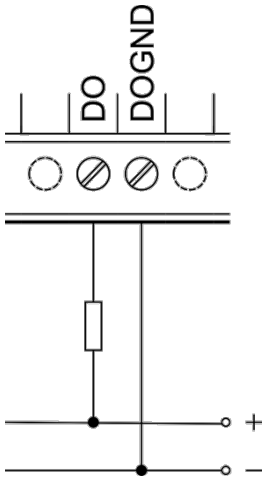
Note:
To connect external devices to the digital inputs, use a different (separate) power source than the one used to power the unit to ensure galvanic isolation.

Extended functionality
In addition to the status indication function, each digital input also has a pulse counter function (e.g. for reading electricity meters, water meters, etc.). If digital or relay outputs within section are also present, it is possible to use one of the three configurable, so-called DirectSwitch functions for the DIy.x input and the DOy.x/ROy.x output. See the chapter 3.4.1.33.4 for more information on extended functionality.

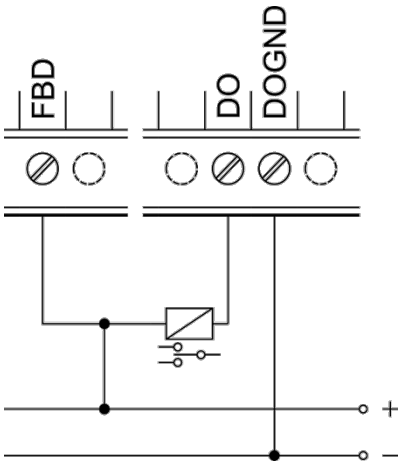
2.4.6 Digital output connection – DO

Digital outputs (semiconductor, connected as open collectors) are accessible through DOx (DOy.x) and DOGND digital output terminals. All digital outputs have common screw connector DOGND for negative pole connection of direct current power supply. Screw connector of DOx serves for connection of a load that switches the output to a common potential. State switch of each output is signalized via corresponding indication LED atop the unit.

The following figure illustrates the basic connection of the digital output:



For some electrical loads connected to Digital output (such as external relay) it is appropriate to make use of a flyback diode accessible through FBD screw connector to suppress unwanted peaks. The following illustration depicts a connection of an external relay to the digital output while using integrated FBD diode:



Caution:
Integrated flyback diode is designed for a connection of devices within the group of digital outputs. Using flyback diode for different connections may cause permanent damage to the controller.

Extended functions
Depending on the software used (see chapter 3), the digital outputs can also be configured in PWM (pulse width modulation) mode. See chapter 3.4.2.13.4 for more information on extended functions.

2.4.7 Analog input connection – AI

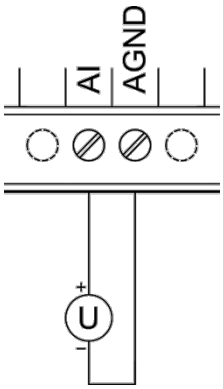
Analog inputs usually serve for reading voltage 0–10 V, current 0–20 mA or resistance sensors (e.g. temperature sensor PT1000).

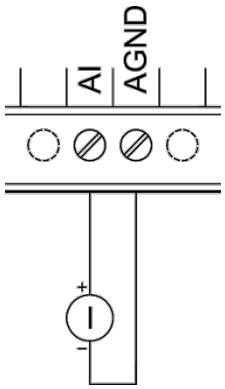
Negative pole of measured external device is connected to screw connector of AGND while positive pole is connected to screw Aly.x connector.

Note:
By default, the unit is set to voltage measurement to avoid potential device/sensor damage in case of inappropriate connection.

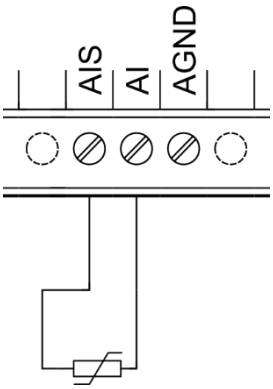
Caution:
Before connecting the measured device, it is necessary to first check the measurement configuration through the chosen SW and according to the type of connected device - see the description of measurements on individual sections below.

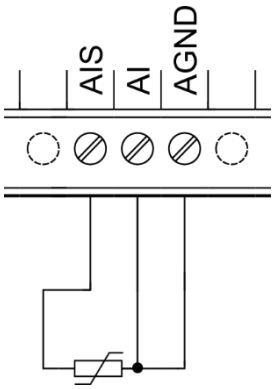
The following illustrations depict measurement of voltage and current source on screw connectors AI and AGND.





The connection of resistance to analog inputs can be realized by a two-wire or three-wire method. The advantage of the three-wire method is the elimination of the measurement error caused by the resistance of the used wire.





2.4.7.1 Analog input – AI (1.1)

This input in section 1 does not have a possibility of measuring resistance, but it's able to measure voltage and current. Resistance measurement is possible at the analog output AOR (1.1) of section 1 (see chapter 2.4.8.1), or at other analog inputs. The measurement mode must be set for each analog input in the chosen software (see chapter 3) according to the following table:

Settings	Type of measurement
0	Voltage 0–10 V
1	Current 0–20 mA

The measured value is of the REAL type and corresponds directly to the measured value.

2.4.7.2 Analog inputs – Aly.x

These analog inputs on sections 2 and 3 have an accurate measurement of voltage, current or resistance. The measurement mode must be set for each analog input in the chosen software (see chapter 3) according to the following table:

Settings	Type of measurement
0	Off
1	Voltage 0–10 V
2	Voltage 0–2.5 V
3	Current 0–20 mA
4	Resistance (three-wire conductors) 0–1 960 Ω
5	Resistance (two-wire conductors) 0–100 kΩ

The measured value is of the REAL type and corresponds directly to the measured value.

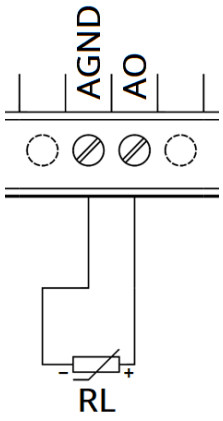
2.4.8 Analog output connection – AO

Analog outputs serve for regulation of external devices (such as three-way valves or heat exchangers) by output analogue signal in range of either 0–10 V or 0–20 mA.

External device is connected to the terminals AGND and AORx, or AORy.x (see chapter 2.4.8.1) or to the terminals AGND and AOVx, or AOVy.x (see chapter 2.4.8.2).

Caution:
A short circuit or long-term overload of the analog output can cause permanent damage, which is manifested by a signal conversion error or a completely non-functional output.

The following illustration demonstrates connection of external device (resistive load) to analog output:



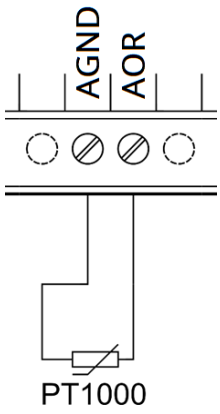
2.4.8.1 Analog output – AOR

In addition to the functions of voltage and current output, this analog output also has the option of measuring resistance up to 2 kΩ, so it is suitable for measuring resistance sensors, e.g. PT1000. The output mode must be set in the chosen software (see chapter 3) according to the following table for each analog output:

Settings	Behaviour
0	Voltage output 0–10 V
1	Current output 0–20 mA
3	Resistance measurement 0–2 kΩ

The set/measured values are of the REAL type and corresponds directly to the set or measured value.

The connection of the PT1000 temperature sensor to the AOR is illustrated on the following figure:

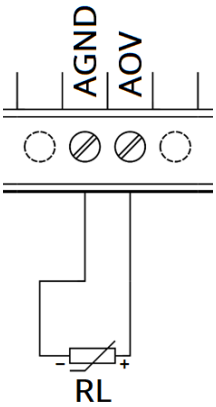


2.4.8.2 Voltage analog outputs – AOV

These analog outputs only allow output in the form of a voltage source, i.e. 0–10 V.

The values are of the WORD type in the range 0 to 4000. To write and read values, the values must first be converted using linear interpolation (0 = 0 V; 4000 = 10 V).

The following figure illustrates the connection of the controlled device to the AOV:



2.4.9 Relay output connection – RO

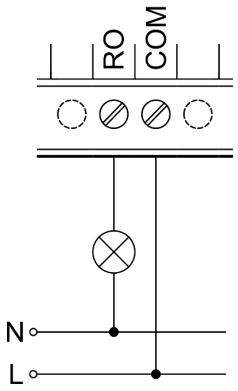
The relay outputs are connected to the ROx or ROy.x and COM terminals and are used for switching two-state elements with alternating or direct voltage. The COM terminal (can also be shared by two relays) is used to supply the switching voltage to the given relays ROx or ROy.x. The relays are connected in the NO (normally open) state, so in the off state the contacts are not connected.

Switching on of each output is signalled by lighting of the LED with the corresponding marking. Protection against overload and short circuit is performed by external protection for each output separately. The rated current and fuse type are selected according to the load and the nature of the load with respect to the maximum output current.

Caution:
If an inductive load is connected (e.g., electric motors, relay coils, contactors, or even the cables in extensive electric installations), it is necessary to protect the relay outputs with a corresponding external element (e.g., varistor, RC circuit, or a suitable diode).

If a capacitive load is connected (e.g., power sources of LED lights), it is necessary to protect the relay contacts against inrush current by connecting a corresponding thermistor to the relay's output.

The following figure illustrates the connection of an ohmic (resistive) load with alternating voltage to the relay output:



2.4.10 Summary

You can also find detailed information about inputs and outputs on the Unipi Knowledge Base (https://kb.unipi.technology/io-description).

3 Software

The heart of Patron units is the Linux (Debian) operating system, which allows users to customize the system to their requirements. As base, the operating system is available in several pre-prepared variants:

- **Mervis OS** (pre-installed from the production) – officially supported complete application solution for technology management and monitoring, including optional online cloud services
  - DB – storage and analysis of historical data
  - PROXY – remote programming technology
  - SCADA – online technology management
- **Node-RED OS** – an open web programming tool that uses a so-called flow-based approach to application programming and is thus suitable for a large number of projects
- **OpenSource OS** – operating system for developers or OEM customers, includes only Modbus TCP and SysFS interfaces

Due to the open nature of the whole system, the user is not limited to the above-mentioned software, but can choose from a number of other compatible software. Instructions for this software can be found on the website of the selected software platform.

In the case of your own software solution, it is possible to use one of the three available APIs (application programming interfaces) to control the units, more described in chapter 3.2. Together with OpenSource OS, these APIs are suitable for creating your own software solution and thus provide our customers with the possibility of creating their **own OEM product** tailored under their brand.

Note:
All of the above mentioned operating systems can be downloaded at https://kb.unipi.technology, where you will also find many useful tutorials, a list of supported software, details on our APIs, and more.

3.1 Default settings

Unipi Patron unit is based on OS Linux (Debian) with pre-installed drivers for the Patron platform. The default image is Mervis OS, including all its components (mervisrt, mervisconfigtool, mervisfcgi) and other components necessary for running (Nginx,...).

SSH access is disabled by default. It can be activated using service mode or via Mervis IDE. The default login info for SSH access is username: "unipi", password: "unipi.technology".

Caution:
We strongly recommend changing the login credentials immediately after SSH activation. For more detailed information, please visit https://kb.unipi.technology.

3.1.1 Unipi Patron unit startup

1. Connect the unit to a local network using a network cable (RJ45).
2. Connect a power supply compliant with the unit's product label. Wait for at least 20 seconds until the unit fully boots up.
3. Upon startup, the unit will automatically attempt to obtain an IP address from the DHCP server. If the attempt is unsuccessful, the unit will use a random IP address from a range of 169.254.0.0/16. A default static IP address 192.168.200.200 can be assigned in the service mode.
4. An mDNS record is simultaneously published into the network, making the unit available under a unique name. E.g: Patron S107 with serial number 123, would be accessible at "http://s107-sn123.local". The serial number can be found on the unit's product label.
5. Mervis OS only: the default web page will be displayed upon entering the URL into a web browser. This page can be edited in Mervis IDE.

3.1.2 Service mode

Service mode is a web tool that allows: IP configuration, (de)activation of Mervis and SSH services, flash an OS image, create a backup of the OS to USB flash drive, and other useful functions. To activate the service mode, follow these steps:

1. Remove any connected USB flash drives and connect the unit to a local network or directly to your PC, using a network cable.
2. Press and **hold** the "SERVICE" button on the unit's top side.
3. Connect a power supply. All outputs are set to their default configuration, all outputs are disabled by default.
4. Patron will boot into a service mode indicated by slow blinking of all LEDs on section 1 (except PWR and RUN). You can now release the button.
5. The unit will set its own IP address to 192.168.200.200 while simultaneously attempting to obtain an IP address from the DHCP server. The unit will be then available at both IP addresses.
6. To access the service web interface, use a web browser and enter the IP address http://<ip-address>.

3.1.2.1 Re-flash the OS

The operating system can be re-flashed via the service web interface or by using a USB flash drive.

Download and extract the selected ZIP archive with Patron OS image from Knowledge Base (https://kb.unipi.technology) to your PC or use files from USB backup.

Caution:
Re-flashing will **delete all data stored in the unit's onboard memory storage**.

3.1.2.2 Re-flash the OS using service web interface

1. Switch the unit into the service mode (see above), indicated by slow blinking of all LEDs on section 1 (except PWR and RUN).
2. Drag only the **archive.swu** file from the extracted archive and drop it into the Software Update dialogue in the service web interface.
3. Patron will start re-flashing the OS, the process is indicated by rapid blinking of all LEDs on section 1 (except PWR and RUN).
4. Wait until the process is finished – re-flash progress can be seen in the Software Update dialogue.
5. The unit will automatically reboot upon successful OS image re-flashing procedure.

3.1.2.3 Re-flash the OS using USB flash drive

1. Prepare an USB flash drive with at least 2 GB of free memory (FAT32 format).
2. Copy all extracted files from OS image to the USB drive or use the USB flash drive with backup files.
3. Insert the USB flash drive into one of unit's USB port.
4. Press and hold the "SERVICE" button on the unit's top side.
5. Connect power supply.
6. Patron will start re-flashing the OS, the process is indicated by rapid blinking of all LEDs on section 1 (except PWR and RUN). You may now release "SERVICE" the button.
7. LEDs will stop blinking once the re-flash is completed. The unit then automatically reboots.

Note:
Some USB flash drives may not be compatible. If your flash drive does not work, try another or re-flash the OS using service web interface.

3.1.2.4 Backup OS to USB flash drive

1. Prepare a USB flash drive in FAT32 format with a capacity of at least 2 GB.
2. Start the unit in the service mode described above.
3. Click on the "Backup to USB flash" button in the dialog window under the "Backup" header in the service web interface.
4. The controller will start the OS backup indicated by the fast blinking of all LEDs on section 1 (except PWR and RUN).

5. When the backup is completed, the message "Updated successfully" will be displayed in the service web interface, physically the completion of the backup is indicated on the unit by slower blinking of the diodes (indication of the service mode).
6. Remove the USB flash drive from the controller. Check on the other device for backup files.
7. You can now restart the unit using the "Restart System" button in the upper right corner of the service web interface.

3.2 Overview of available APIs

APIs are low-level programming interfaces ready for use in developing your own software (in languages such as C, Python, etc.). For more information, documentation, and usage examples, see the API section and the download documentation section of the Knowledge Base (https://kb.unipi.technolgogy). We provide the following APIs for use with Unipi Patron.

3.2.1 EVOK

It serves as an interface to physical inputs, outputs and communication interfaces, which allows the simplest possible access to the hardware without the need to deal with low-level programming. The following protocols can be used for access:

- REST
- Bulk JSON
- REST JSON
- SOAP (Simple Object Access Protocol)
- WebSocket
- JSON-RPC

3.2.2 Modbus TCP

It is a standard interface for interaction with inputs and outputs based on TCP. Modbus register maps for each unit are freely downloadable from the Knowledge Base.

Note:
Modbus TCP interface does not provide 1-Wire access.

There are two ways to access individual registers/coils. Since each section has its own processor, the individual registers/coils of the section are available via **Unit X**, where **X** represents the section number (i.e. 1 – 3) and at the same time via **Unit 0**, where all registers/coils of the given product are available (see chapter 1.4).

Example: The number of digital inputs/outputs on Section 2 of the M527 unit (see the Modbus table of the registers of the given unit) can be read via:

Unit 2 na registru 1001

Unit 0 na registru 1101

3.2.3 SysFS

Part of the kernel module for file-level access of inputs and outputs on Linux.

Set state of **DO** to 1:

```
echo 1 > /run/unipi/io_group1/do_1_01/do_value
```

Read the state of **DI**:

```
cat /run/unipi/io_group1/di_1_01/di_value
```

All I/Os can be accessed similarly.

Further documentation can be found here: https://git.unipi.technology/UniPi/unipi-kernel/blob/master/docs/sysfs-platform-unipi.txt

Note:
SysFS does not provide 1-Wire access.

3.3 Serial port maps

3.3.1 RS485/RS232

See the table below to find out how the physical RS485/RS232 serial port lines are mapped into Linux ports within **/dev/**.

All mentioned ports with **N** (e.g. /dev/tty**N**S0) mentioned below are also accessible via /dev/extcomm/Y/X, where Y is the number of section, and X is the number of the serial port.

	RS485-1	RS232(485)-2	RS485-3	RS485-4
S107	ttyNS0	ttymxc1	ttymxc0	-
S117	ttyNS0	ttymxc2	ttymxc1	ttymxc0
S167 LTE	ttyNS0	ttymxc0	-	-
S207	ttymxc0	-	-	-

	RS485-1.1	RS232(485)-2	RS485-1.3	RS485-2.1
M207	ttyNS0	ttymxc1	ttymxc0	-
M267 LTE	ttyNS0	ttymxc0	-	-
M527	ttyNS0	ttymxc1	ttymxc0	ttyNS1
M567 LTE	ttyNS0	ttymxc0	-	ttyNS1
L207	ttyNS0	ttymxc1	ttymxc0	-
L527	ttyNS0	ttymxc1	ttymxc0	ttyNS1

3.3.2 USB

The table below shows the static mapping of the USB ports of Patron units to ports of Linux in **/dev/**.

USB1	/dev/serial/by-port/0
USB2	/dev/serial/by-port/1

Note:
By default USB converters: **FTDI**, **CH34x**, **PLxxxx** a **CPxxxx** are also supported.
For using other gateways or devices, installation of drivers is necessary.

3.4 Description of functions

The following functions are evaluated directly in the processor within the section, so they are not directly dependent on the control software and can be set according to the used software with the help of the chosen API described in chapter 3.2.

3.4.1 Digital inputs functions

The correct function of the digital inputs is always conditioned by the configuration of the Debounce function depending on the connected switch and the environment in which the controller is installed.

3.4.1.1 Debounce

Function Debounce serves as signal jitter correction, its value is presented in hundreds of μs (i.e. value 10 equals 1 ms). Impulse (positive edge) is processed as valid only in case it equals logical 1 for the whole set duration.

3.4.1.2 Counter

This function serves as a pulse counter (rising edge) for the digital input. Its value is incremented by 1 with each valid pulse (according to the settings of the Debounce function) and written into the variable. When the maximum value is exceeded, the counter is reset, but it can also be reset manually. The value of the counter is regularly stored in case of a power failure.

3.4.1.3 DirectSwitch

This function allows you to map an event or status of a digital input to a digital output within a section and can only be configured for the corresponding input and output. I.e. only for **DIy.x** input and **DOy.x** (**ROy.x**) output, where the numbers **x** and **y** (if **y** is specified) must be the same. It is not possible to use this function on one input and multiple outputs at the same time, or vice versa.

DirectSwitch function can be used, for example, to control lighting or similar time-critical applications (typical reaction time corresponds to the input response, see chapter 4.1).

This function is enabled by changing the DirectSwitch enable setting of the selected DI. The configuration depends on the settings of the DirectSwitch polarity and DirectSwitch toggle functions.

Note:
Each input for which the DirectSwitch function can be enabled has its own settings. Therefore, it is possible to configure a different behaviour for each input.

3.4.1.3.1 DirectSwitch polarity

Dual behaviour can be achieved with this function. If the DirectSwitch polarity function is set to True, the output is set to the state corresponding to the negated value of the input. If the function is set to False, the value at the output is the same as the value at the input.

The following table shows the exact behaviour:

DirectSwitch Polarity	Input	Output
True	False	True
True	True	False
False	False	False
False	True	True

3.4.1.3.2 DirectSwitch toggle

If this function is set to True, the current value at the corresponding output is negated when a rising edge is detected at the input.

3.4.2 Digital outputs functions

3.4.2.1 PWM

Pulse Width Modulation (PWM) is used to transmit an analog signal using a two-valued (digital) signal. PWM can be enabled for each digital output separately, but the set frequency is common for each group of outputs.

Note:
The PWM function can only be enabled for digital outputs, not for relay outputs.

To enable the PWM function on the digital output, it is necessary to set the value of the selected DO to False and then change the PWM value of appropriate output. The PWM value, also referred to as the duty cycle, indicates the length of the logical 1 time at a given output in percent.

Note:
If DO is enabled, the PWM value is ignored. If the PWM value is other than 0 and the DO value switches from 1 to 0, the PWM function becomes active.

The length of one T_c cycle is set using the PWM Prescale and PWM Cycle variables. PWM Cycle is basically the resolution of the PWM (the PWM value can take values from 0 to PWM Cycle). The calculation is described by the following formula:

$$T_c = \frac{(PWM_{prescale}+1)}{48MHz} \cdot (PWM_{cycle}+1)$$

Alternative PWM Prescale calculation, where *f* is the selected PWM frequency in Hz. **Note that the result must be rounded to an integer!**

$$PWM_{prescale} = \frac{48MHz}{f \cdot (PWM_{cycle}+1)} - 1$$

Example: Setting PWM Prescale to 4751 and PWM Cycle to 100, T_c equals 10 ms (100 Hz). Furthermore, by setting the PWM value to 50, the duty cycle will be 50 % at a frequency of 100 Hz.

3.4.3 Other setting and informative functions

3.4.3.1 ULED

Some units feature freely programmable LEDs marked as X1 ... Xn. Diode control is done through ULED variables for each diode separately.

3.4.3.2 Disabling of 1-Wire bus

Units that include a 1-Wire bus also have a bus on/off function. By default, the value of the *Disable 1-Wire Bus* variable is set to False, so the bus is turned on. Switching the value to True will turn off its power and disconnect the 1-Wire bus.

3.4.3.3 Default settings

This function is used to save the current section configuration to its memory. When disconnecting from and reconnecting to the power, or when restarting section, saved configuration is loaded and used. This feature is also known as "copy running-config to startup-config".

Note:
The stored data are: Debounce, Counter, DirectSwitch, DO/RO output value, PWM configuration, AI measurement mode (see chapter 2.4.7), AO mode and value (see chapter 2.4.8) and communication line settings of the given section except for serial lines mapped to Linux as ttymxc (see chapter 3.3.1).

3.4.3.4 Master WatchDog (MWD)

This function runs on the section's microprocessor and continuously monitors the commands from the application running on the unit. If no commands are detected within a configured time (MWD Timeout) and MWD function is enabled (MWD Enable), the section's processor automatically resets to the default configuration described in chapter 3.4.3.3 and sets the value indicating MWD Reset to True.

This function ensures the setting of a safe configuration in case of emergency situations, e.g. in the event of a failure of the unit, interruption of communication, or problems with the software so as to prevent damage to the controlled devices or danger to persons.

3.4.3.5 Reboot

Each section can be restarted by software.

4 Technical parameters

4.1 Digital inputs

Input type	SINK
Input terminal	DI
Common ground	DIGND
Maximum voltage for log. 0	3 V⎓
Minimum voltage for log. 1	7 V⎓
Maximum voltage	35 V⎓
Non-defined state	3-7 V⎓
Input resistance for log. 1	6 200 Ω
Voltage drop on DI diode	1.2 V
Minimum pulse length	20 µs
0->1 / 1->0 delay	Typ. 20 µs / 60 µs
Maximum CNT counter input frequency	10 kHz
Galvanic isolation	Yes (between the groups, see chapter 1.4)
Insulation voltage	2 000 V

4.2 Digital outputs

Output type	SINK (NPN - open collector)
Output terminals	DO
Common ground	DOGND
Switching voltage	5–50 V⎓
Switching current continuous/pulse	750 mA / 1 A
Max. total group (see chapter 1.4) load	1 A
Inductive load handling	Integrated FBD diode (optional)
Switching period (open/close)	Typ. 130 ns / 20 ns
Maximum PWM resolution	16 bits
Maximum PWM frequency	200 kHz
Galvanic isolation	No

4.3 Analog inputs

	Section 1 (AI1)	**Sections 2,3 + some units (eg. S5xx)**
Input terminals	AI	AI, AIS
Common ground	AGND	AGND
Input modes	0–10 V voltage meas. 0–20 mA current meas.	0–10 V⎓ voltage meas. 0–2.5 V⎓ voltage meas. 0–20 mA current meas. 0–1960 Ω resistance meas. 0–100 kΩ resistance meas.
Maximum input voltage	12 V⎓	15 V⎓
Input resistance (voltage meas.)	66 kΩ	44 kΩ
Input resistance (current meas.)	100 Ω	100 Ω
Accuracy	±0.5 %	±0.2 %
Resolution	12 bits	16 bits (voltage and current meas.) 24 bits (resistance meas.)

Conversion time	10 µs	60 µs (voltage and current meas.) 400 ms (resistance meas.)
Protection type	Integrated overvoltage	Integrated overvoltage
Galvanic isolation	No	Yes (from other sections, see chapter 1.4)

4.4 Analog outputs

	Section 1 (AO1)	Section 2, 3 + some units (eg. S5xx)
Output terminals	AOR	AOV
Common conductor	AGND	AGND
Output functions	0–10 V⎓ voltage source 0–20 mA current source 0–1960 Ω resistance meas.	0–10 V⎓ voltage source
Output voltage range	0–10 V⎓	0–10 V⎓
Output current range	0–20 mA	–
Maximum output current	20 mA	20 mA
Output accuracy	±0.5 %	±0.5 %
Resolution	12 bits	12 bits
Conversion	1 ms	300 µs
Protection type	Integrated overvoltage	Integrated overvoltage
Galvanic isolation	No	Yes (from other sections, see chapter 1.4)

4.5 Relay outputs

Output type	Electromechanic non-shielded relay
Output terminal	RO
Common terminal	COM
Contact type	Normally open (SPST-NO)
Used relay type	FTR-F3AA024E-HA
Maximum switching voltage	250 V∿ 30 V⎓
Maximum switching current	5 A
Maximum common terminal current	10 A
Short-term current overload	5 A
Mechanical lifespan	5 000 000
Electrical lifespan	Up to 100 000 (according to the connected load)
Operate/release time	10 ms
Designed for load character	Resistive
Load handling	External (RC, varistor, diode, thermistor)
Short circuit protection	No
Overvoltage protection	No
Galvanic isolation	Yes
Insulation voltage	4 000 V

4.6 RS-485 Interface

Terminal	RS485-A, RS485-B
Galvanic isolation	Yes
Isolation voltage	1000 V
ESD protection	±15 kV
Communication speeds	2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 115200 bps
Input impedance	12 kΩ
Input voltage hysteresis	70 mV
Output characteristic	±2.5 V

4.7 RS-232 Interface

Terminals	RXD, TXD, GND
Galvanic isolation	No
ESD protection	±15 kV
Communication speeds	2400 bps 4800 bps 9600 bps 19200 bps 38400 bps 57600 bps 115200 bps
Input impedance	5 kΩ
Input voltage hysteresis	0,5 V
Output characteristic	±7.8 V

4.8 Storage, installation and working conditions

Working temperature	0 °C ... +55 °C
Rated voltage – SELV	24 V⎓ (±5 %)
Reverse polarity protection	Yes
Storage conditions	Temperature: −25 °C ... +70 °C Humidity: 10 % ... 95 %, w/o aggressive substances, condensing vapours or fog
Electric strength	According to EN 60950
Ingress protection (IEC 529)	IP20
Working position	Vertical
Installation	To a 35 mm DIN rail in an electrical distribution box
Connection	Pluggable screw terminals
Wire gauge	Max. 1.5 mm^2 for 1-Wire Max. 2.5 mm^2 for other terminals
Terminal spacing	3.5 mm for 1-Wire 5.08 mm for other terminals
Terminal tightening torque	Max. 0,4 Nm

4.9 Frequency bands and radio frequency power

4.9.1 LTE, revision 1 (FID 1.0, 1.1, 1.2)

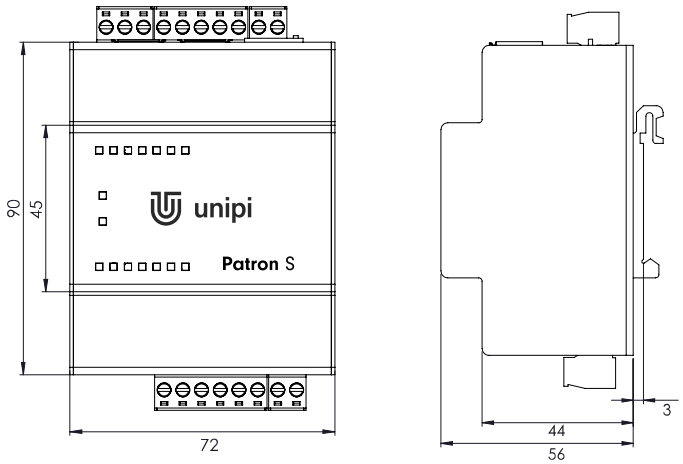
Band		UL f, MHz	DL f, MHz	Radio frequency power (max.)
GSM	DCS1800	1710.2–1784.8	1805.2–1879.8	1 W
	GSM900	880.0–914.8	925.0–960.0	2 W
LTE				
	1	1920–1980	2110–2170	24.5 dBm
	3	1710–1785	1805–1880	24 dBm
	7	2500–2570	2620–2690	24 dBm
	8	880–915	925–960	24 dBm
	20	832–862	791–821	25 dBm
	28	703–748	758–803	24 dBm
	38	2570–2620		24.5 dBm
	40	2300–2400		24.5 dBm

4.9.2 LTE, revision 2 (FID 2.0 and newer)

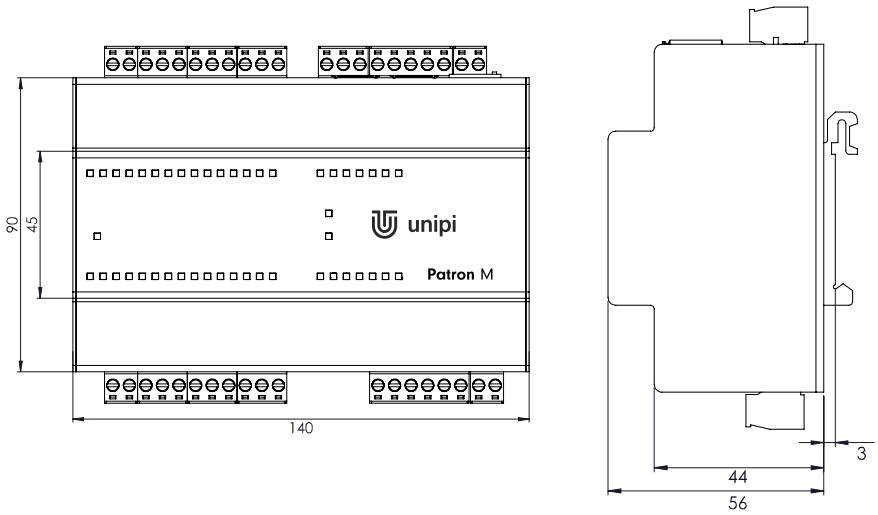
Band		UL f, MHz	DL f, MHz	Radio frequency power (max.)
GSM	DCS1800	1710.2–1784.8	1805.2–1879.8	30 dBm ±2 dB
	GSM900	880.0–914.8	925.0–960.0	33 dBm ±2 dB
LTE				
	1	1920–1980	2110–2170	23 dBm ±2 dB
	3	1710–1785	1805–1880	23 dBm ±2 dB
	7	2500–2570	2620–2690	23 dBm ±2 dB
	8	880–915	925–960	23 dBm ±2 dB
	20	832–862	791–821	23 dBm ±2 dB
	28	703–748	758–803	23 dBm ±2 dB

4.10Dimensions

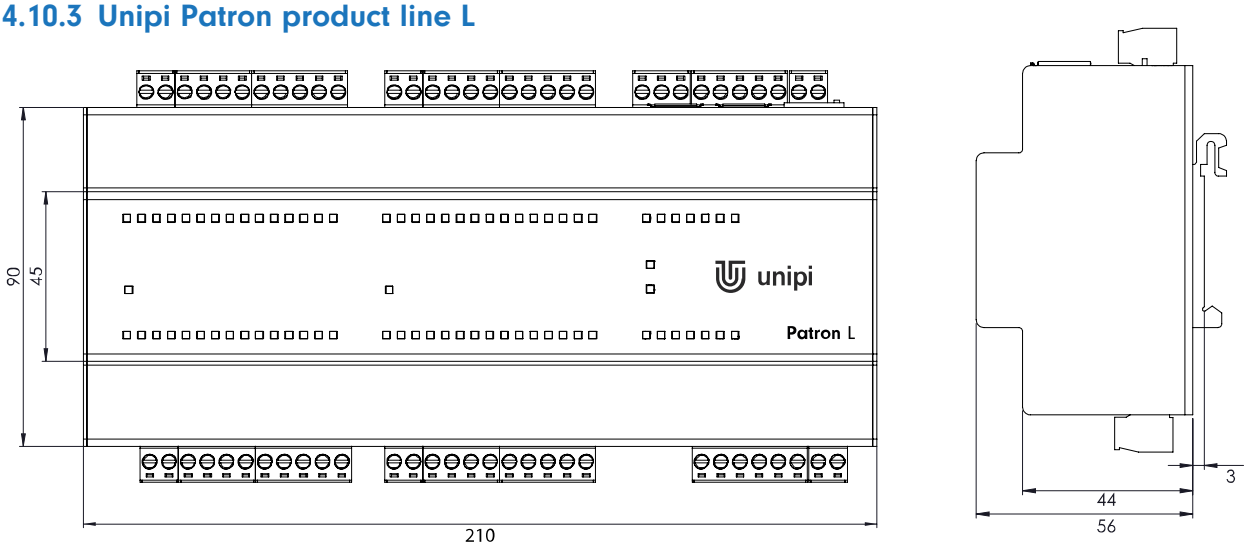
4.10.1 Unipi Patron product line S



4.10.2 Unipi Patron product line M



4.10.3 Unipi Patron product line L



5 License and Declaration

5.1 NXP SDMA firmware

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5.2 Simplified EU Declaration of Conformity

BG	С настоящото Unipi Technology s.r.o. декларира, че този тип радиосъоръжение S167 LTE/M267 LTE/M567 LTE е в съответствие с Директива 2014/53/ЕС. Цялостният текст на ЕС декларацията за съответствие може да се намери на следния интернет адрес: https://www.unipi.technology/doc/
ES	Por la presente, Unipi Technology s.r.o. declara que el tipo de equipo radioeléctrico S167 LTE/M267 LTE/M567 LTE es conforme con la Directiva 2014/53/UE. El texto completo de la declaración UE de conformidad está disponible en la dirección Internet siguiente: https://www.unipi.technology/doc/
CZ	Tímto Unipi Technology s.r.o. prohlašuje, že typ rádiového zařízení S167 LTE/M267 LTE/M567 LTE je v souladu se směrnicí 2014/53/EU. Úplné znění EU prohlášení o shodě je k dispozici na této internetové adrese: https://www.unipi.technology/doc/
DA	Hermed erklærer Unipi Technology s.r.o., at radioudstyrstypen S167 LTE/M267 LTE/M567 LTE er i overensstemmelse med direktiv 2014/53/EU. EU-overensstemmelseserklæringens fulde tekst kan findes på følgende internetadresse: https://www.unipi.technology/doc/
DE	Hiermit erklärt Unipi Technology s.r.o., dass der Funkanlagentyp S167 LTE/M267 LTE/M567 LTE der Richtlinie 2014/53/EU entspricht. Der vollständige Text der EU-Konformitätserklärung ist unter der folgenden Internetadresse verfügbar: https://www.unipi.technology/doc/
ET	Käesolevaga deklareerib Unipi Technology s.r.o., et käesolev raadioseadme tüüp S167 LTE/M267 LTE/M567 LTE vastab direktiivi 2014/53/EL nõuetele. ELi vastavusdeklaratsiooni täielik tekst on kättesaadav järgmisel internetiaadressil: https://www.unipi.technology/doc/
EL	Με την παρούσα ο/η Unipi Technology s.r.o., δηλώνει ότι ο ραδιοεξοπλισμός S167 LTE/M267 LTE/M567 LTE πληροί την οδηγία 2014/53/ΕΕ. Το πλήρες κείμενο της δήλωσης συμμόρφωσης ΕΕ διατίθεται στην ακόλουθη ιστοσελίδα στο διαδίκτυο: https://www.unipi.technology/doc/
EN	Hereby, Unipi Technology s.r.o. declares that the radio equipment type S167 LTE/M267 LTE/M567 LTE is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: https://www.unipi.technology/doc/
FR	Le soussigné, Unipi Technology s.r.o., déclare que l'équipement radioélectrique du type S167 LTE/M267 LTE/M567 LTE est conforme à la directive 2014/53/UE. Le texte complet de la déclaration UE de conformité est disponible à l'adresse internet suivante: https://www.unipi.technology/doc/
HR	Unipi Technology s.r.o. ovime izjavljuje da je radijska oprema tipa S167 LTE/M267 LTE/M567 LTE u skladu s Direktivom 2014/53/EU. Cjeloviti tekst EU izjave o sukladnosti dostupan je na sljedećoj internetskoj adresi: https://www.unipi.technology/doc/
IT	Il fabbricante, Unipi Technology s.r.o., dichiara che il tipo di apparecchiatura radio S167 LTE/M267 LTE/M567 LTE è conforme alla direttiva 2014/53/UE. Il testo completo della dichiarazione di conformità UE è disponibile al seguente indirizzo Internet: https://www.unipi.technology/doc/
LV	Ar šo Unipi Technology s.r.o. deklarē, ka radioiekārta S167 LTE/M267 LTE/M567 LTE atbilst Direktīvai 2014/53/ES. Pilns ES atbilstības deklarācijas teksts ir pieejams šādā interneta vietnē: https://www.unipi.technology/doc/
LT	Aš, Unipi Technology s.r.o., patvirtinu, kad radijo įrenginių tipas S167 LTE/M267 LTE/M567 LTE atitinka Direktyvą 2014/53/ES. Visas ES atitikties deklaracijos tekstas prieinamas šiuo interneto adresu: https://www.unipi.technology/doc/
HU	Unipi Technology s.r.o. igazolja, hogy a S167 LTE/M267 LTE/M567 LTE típusú rádióberendezés megfelel a 2014/53/EU irányelvnek. Az EU-megfelelőségi nyilatkozat teljes szövege elérhető a következő internetes címen: https://www.unipi.technology/doc/
MT	B'dan, Unipi Technology s.r.o., niddikjara li dan it-tip ta' tagħmir tar-radju S167 LTE/M267 LTE/M567 LTE huwa konformi mad-Direttiva 2014/53/UE. It-test kollu tad-dikjarazzjoni ta' konformità tal-UE huwa disponibbli f'dan l-indirizz tal-Internet li ġej: https://www.unipi.technology/doc/
NL	Hierbij verklaar ik, Unipi Technology s.r.o., dat het type radioapparatuur S167 LTE/M267 LTE/M567 LTE conform is met Richtlijn 2014/53/EU. De volledige tekst van de EU-conformiteitsverklaring kan worden geraadpleegd op het volgende internetadres: https://www.unipi.technology/doc/
PL	Unipi Technology s.r.o. niniejszym oświadcza, że typ urządzenia radiowego S167 LTE/M267 LTE/M567 LTE jest zgodny z dyrektywą 2014/53/UE. Pełny tekst deklaracji zgodności UE jest dostępny pod następującym adresem internetowym: https://www.unipi.technology/doc/
PT	O(a) abaixo assinado(a) Unipi Technology s.r.o. declara que o presente tipo de equipamento de rádio S167 LTE/M267 LTE/M567 LTE está em conformidade com a Diretiva 2014/53/UE. O texto integral da declaração de conformidade está disponível no seguinte endereço de Internet: https://www.unipi.technology/doc/
RO	Prin prezenta, Unipi Technology s.r.o. declară că tipul de echipamente radio S167 LTE/M267 LTE/M567 LTE este în conformitate cu Directiva 2014/53/UE. Textul integral al declarației UE de conformitate este disponibil la următoarea adresă internet: https://www.unipi.technology/doc/
SK	Unipi Technology s.r.o. týmto vyhlasuje, že rádiové zariadenie typu S167 LTE/M267 LTE/M567 LTE je v súlade so smernicou 2014/53/EÚ. Úplné EÚ vyhlásenie o zhode je k dispozícii na tejto internetovej adrese: https://www.unipi.technology/doc/
SL	Unipi Technology s.r.o. potrjuje, da je tip radijske opreme S167 LTE/M267 LTE/M567 LTE skladen z Direktivo 2014/53/EU. Celotno besedilo izjave EU o skladnosti je na voljo na naslednjem spletnem naslovu: https://www.unipi.technology/doc/
FI	Unipi Technology s.r.o. vakuuttaa, että radiolaitetyyppi S167 LTE/M267 LTE/M567 LTE on direktiivin 2014/53/EU mukainen. EU-vaatimustenmukaisuusvakuutuksen täysimittainen teksti on saatavilla seuraavassa internetosoitteessa: https://www.unipi.technology/doc/
SV	Härmed försäkrar Unipi Technology s.r.o. att denna typ av radioutrustning S167 LTE/M267 LTE/M567 LTE överensstämmer med direktiv 2014/53/EU. Den fullständiga texten till EU-försäkran om överensstämmelse finns på följande webbadress: https://www.unipi.technology/doc/

Compliance information
Unipi Patron complies with the requirements of EMC, LVD, RED and RoHS regulations relevant for European Union states.

WEEE Directive Statement for the European Union
Unipi Patron cannot be disposed of as household waste. Different rules for handling electric waste may apply in other jurisdictions.

Revision

Date	Version
4/2021	V 1.0
6/2021	V 1.1
7/2021	V 2.0
4/2022	V 2.1
6/2022	V 2.2
7/2022	V 2.3
12/2022	V 2.4
6/2025	V 2.5