Embedded Solutions

RS3 – Rugged MiPiOS®
Managed Ethernet Switch

Configuration example

User Manual

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RS3 – Rugged MIPIOS® Managed Ethernet Switch

The RS3 is a rugged, IP67 stand-alone managed Fast Ethernet switch. It provides eight Ethernet channels on M12 connectors.

The switch supports full-duplex and half-duplex operation with auto-negotiation, high-speed non-blocking store-and-forward switching, Quality of Service (QoS) support with four traffic classes IEEE 802.1p and three-level 802.1x security as well as the logical segmentation of ports (802.1q VLANs). The switch is fault tolerant and restores itself on its own: If a link is temporarily unavailable, frames can be sent via backup/redundant links (spanning tree protocol / link aggregation) and no data loss occurs. Its built-in test mechanisms make the RS3 an even more reliable component in the communication system.

A service port is accessible at the front panel on an M12 connector, providing an easy way to configure the switch. A command line interface is available via the RS232 at the service port and over Ethernet via Telnet or Secure Shell (SSH). The switch can also be configured via SNMP (version 3) and through its HTTP web server. Additionally, the service connector can be used to attach an external dongle to store or update the switch configuration. This makes it easy to exchange the unit for service purposes.

The RS3 a member of the MIPIOS family of extremely rugged IP67 compliant products designed for Ethernet connectivity and highly demanding applications, e.g., for redundancy systems.

The industrial-grade unit is fully compliant with EN 50155 railway standard. All components inside the enclosure are specified for -40..+85°C operation, thus enabling the device for EN 50155 class Tx operation. Additionally, the device is e1 certified by the German Federal Motor Transport Authority. Convection cooling is sufficient. There are no socketed components, hardening the box against shock and vibration. The internal electronics are prepared for conformal coating.

The Ethernet switch is prepared for wall or DIN-rail mounting.

Technical Data

Switch Fabric Key Features

- Eight 10/100Base-T ports at front panel
  - Electrical isolation: 1500 Vrms
- Auto-negotiation
- High-speed non-blocking, store-and-forward switching
- 8K MAC address lookup table with automatic learning and aging
- QoS (Quality of Service) support with 4 traffic classes (IEEE 802.1p tagged frames)
- Layer 2 switching
- Back pressure or IEEE802.3x flow control
- Automatic MDI/MDI-X crossover (all ports)

Management Firmware System Features

- Saving and restoring user configurations
- Software upgrades through TFTP
- System logs (syslog) and e-mail alerts for critical events
- Remote monitoring (RMON) and alarm generation
- Displaying the running configuration in the form of CLI commands
- DHCP client, server and relay
- Management interfaces through
  - SNMP v3
  - WebUI (HTTP and HTTPS/SSL)
- Switch configuration can be loaded from external dongle

Management Firmware Layer 2 Features

- TCP/IP (IPv4, IPv6)
- Transparent bridging
- QoS (DiffServ) and 802.1p traffic prioritization queuing, polishing, shaping
- VLAN-aware bridging with GARP
- Static and dynamic VLANs (through GVRP)
- Dynamic learning of multicast groups through GMRP
- Rapid Spanning Tree Protocol and Multiple Spanning Tree Protocol to ensure loop free topology formation
- Reducing multicast traffic in the network through multicast snooping – IGS (IPv4) and MLDS (IPv6)
- IGMP proxy
- Aggregating physical ports for increasing bandwidth and redundancy through link aggregation (LACP)
- Link Layer Discovery Protocol (LLDP)
- SNMP (v1, v2c, v3) agent and MIB support, configuration save/restore

Management Firmware Security Features

- User authentication using 802.1x
- Controlling management access through SNMP, CLI and web only from authorized managers
- MAC based access list (ACL) for traffic filtering
- Rate-limiting and storm control to prevent packet flooding from malicious peers

Supported Ethernet Standards

- Transparent bridging: IEEE 802.1d, 2004
- VLAN: IEEE 802.1q Rev D5.0, 2005
- Port based VLANs: IEEE 802.1q Rev D5.0, 2005
- GVRP/GMRP support: IEEE 802.1d
- Rapid Spanning Tree Protocol: IEEE 802.1d
- Multiple Spanning Tree: IEEE 802.1s, IEEE 802.1q Rev D5.0, 2005
- IGMP snooping: draft-ietf-magma-snoop-12.txt
- MLD snooping: draft-ietf-magma-snoop-12.txt
- Link aggregation: IEEE 802.3ad, 2005
- Port based authentification with EAP: IEEE 802.1x – REV2004
- Link Layer Discovery Protocol: IEEE 802.1ab, 2005
- Priority based switching: IEEE 802.1p

Service Interface

- M12 connector at front
- RS 232 / V24
- I²C interface for external dongle

Front I/O

- 8 Ethernet ports via M12 connectors
- 1 service interface via M12 connector
- 1 power input via M12 connector
- Link and activity Ethernet status LEDs (2 per channel)
- Status LEDs for power, reset and error codes

Electrical Specifications

- Power input
  - Nominal input voltage 24 VDC (9 to 36 V) according to EN50155
- EN50155 power interruption class S2
- Isolation (according to EN50155)
  - 1500 Vrms
- Power consumption: 5 W
- MTBF: Approx. 200,000 h (tbc.) @ 40°C according to IEC/TR 62380 (RDF 2000)

Mechanical Specifications

- Dimensions: 220 mm x 130 mm x 70 mm (without connectors)
- Prepared for wall or DIN-rail mounting with special mounting plates (available separately)
- Weight: 1.9 kg

Environmental Specifications

- Temperature range (operation):
  - -40..+70°C (+85°C) with up to 85°C for 10 minutes according to class Tx (EN50155)
  - Airflow: natural convection
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300 m to + 3,000 m
- Climatic tests according to EN50155 and EN68068
- Shock and vibration tested according to EN61373
- IP67 compliant
- Conformal coating on request

Safety

- PCBs manufactured with a flammability rating of 94V-0 by UL recognized manufacturers

EMC

- Tested according to the following railway standards:
  - EN50121 (radio disturbance)
  - EN61000-4-2 (ESD)
  - EN61000-4-3 (radiated disturbances)
  - EN61000-4-4 (burst)
  - EN61000-4-5 (surge)
- Conforming to e1 requirements of the German Federal Motor Transport Authority
- Tested according to the following automotive standards:
  - CISPR25/CISPR16 (radiated emission)
  - ISO7637-2 (conducted emission – power line)
  - ISO7637-2 (conductive immunity – power line)
  - ISO7637-3 (capacitive immunity – signal line)
  - ISO11452-2, ISO11452-5 (radiation immunity)
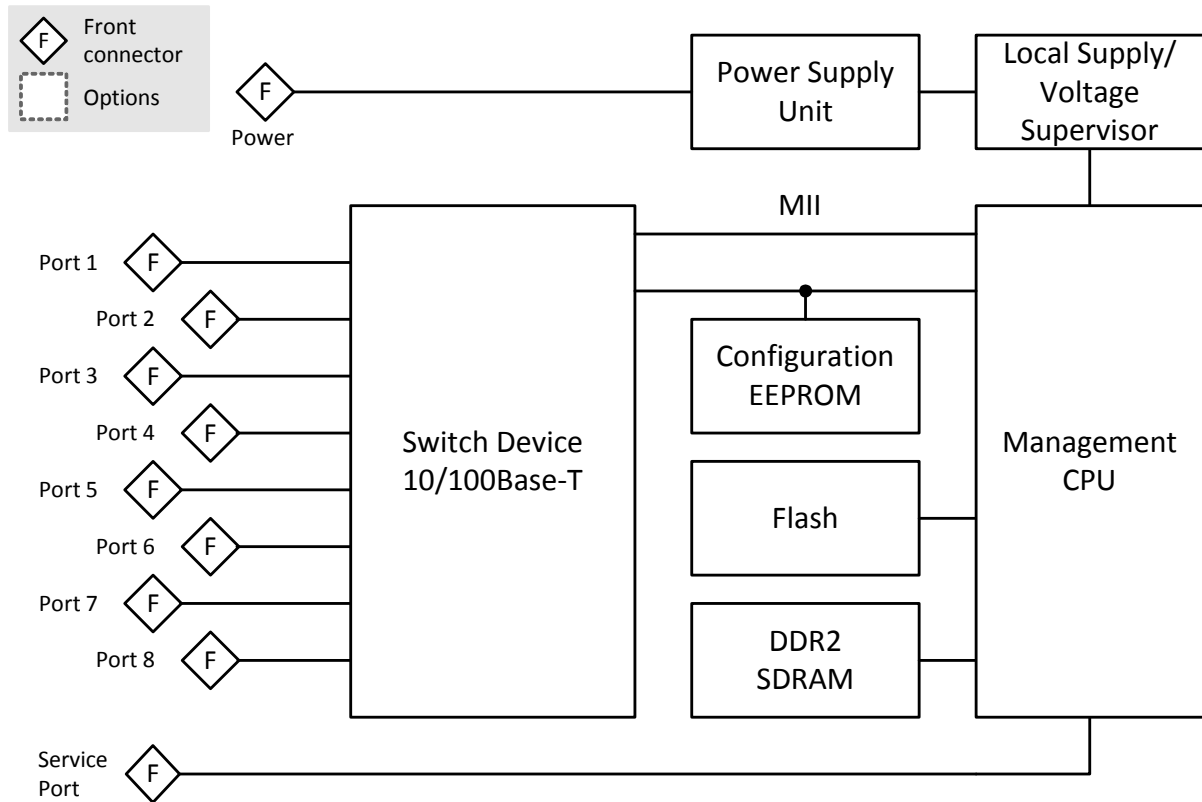 - EN50121 (radio disturbance)

Firmware

- Firmware for configuration and management included
- For more information on supported operating system versions and drivers see online data sheet.

Block Diagram

F	Front connector
Options	

Power

Power Supply Unit

Local Supply/ Voltage Supervisor

MII

Port 1
Port 2
Port 3
Port 4
Port 5
Port 6
Port 7
Port 8

Switch Device 10/100Base-T

Configuration EEPROM

Flash

DDR2 SDRAM

Management CPU

Service Port

Configuration Options

Ethernet Switch Functions / Mechanical Specifications

- 4 Ethernet ports

Electrical Specifications

- Other nominal input voltages: 36, 48, 72, 96 or 110 VDC
  - Wide input range (according to EN50155): 0.7 x nominal voltage < nominal voltage < 1.25 x nominal voltage

Please note that some of these options may only be available for large volumes. Please ask our sales staff for more information.

For available standard configurations see online data sheet.

Product Safety

⚠️ **Electrostatic Discharge (ESD)**

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.

- Store the board only in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

About this Document

This user manual describes the hardware functions of the switch and connection of peripheral devices. It also provides additional information for special applications and configurations of the unit.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Issue	Comments	Date
E1	First issue	2010-11-26
E2	Removed mention of SIL4 from product description	2010-12-13
E3	Reworked block diagram (config EEPROM and CPU/switch device connection)	2010-12-15

Conventions

⚠ This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics Folder, file and function names are printed in *italics*.

bold **Bold** type is used for emphasis.

`monospace` A `monospaced` font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".

hyperlink Hyperlinks are printed in blue color.

🌐 The globe will show you where hyperlinks lead directly to the Internet, so you can look for the latest information online.

IRQ# Signal names followed by "#" or preceded by a slash ("/") indicate that this signal is
/IRQ either active low or that it becomes active at a falling edge.

in/out Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "coming from it".

Vertical lines on the outer margin signal technical changes to the previous issue of the document.

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Contents

Figures

Tables

1   System Overview

1.1   Layout of the RS3

**Figure 1.** *The RS3 - front view*
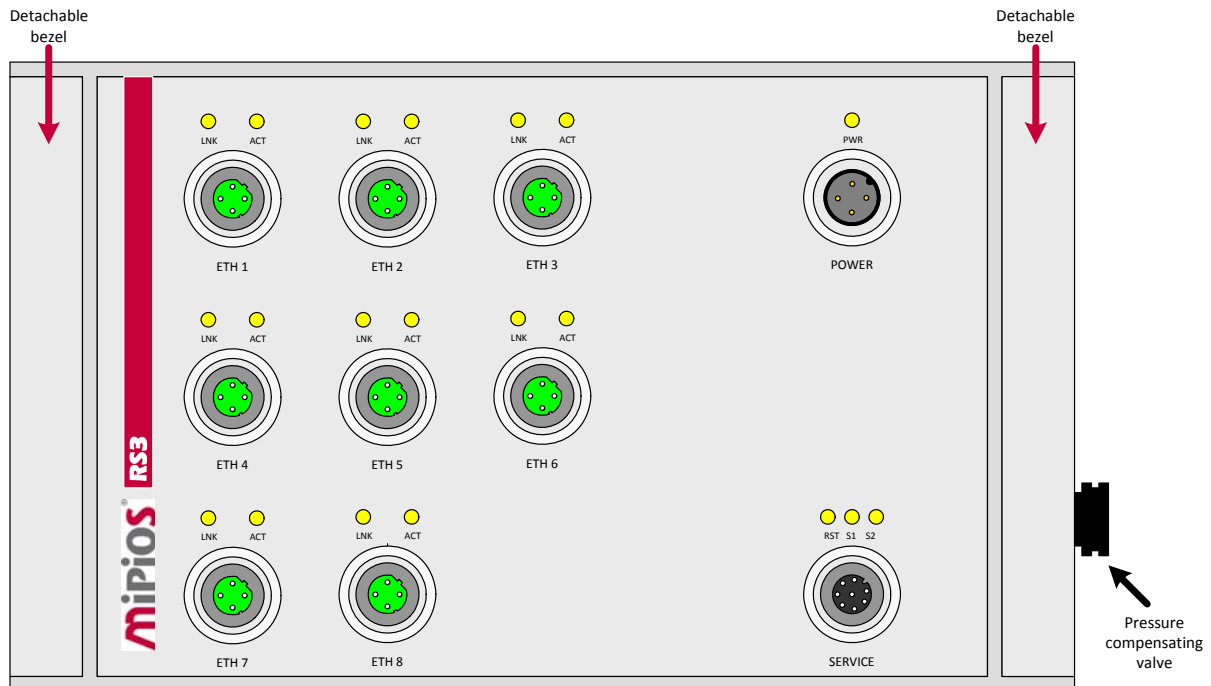
1.2   Pressure Compensating Valve

The sealed housing of the RS3 makes a pressure compensating valve necessary to prevent stress on the unit's housing seals. Its hydrophobic and oleophobic ePTFE membrane protects from the unit's interior from water and common automotive fluids and resists blocking after contact with common automotive fluids. It protects against contamination from dirt, dust, salt and road debris (down to 0.07 μm).

1.3   Earth Connection

An earth connection can be established via the respective screw hole on the right side of the unit (below the pressure compensating valve). Use an M4 screw.

Figure 2. *Earth connection and pressure compensating valve*
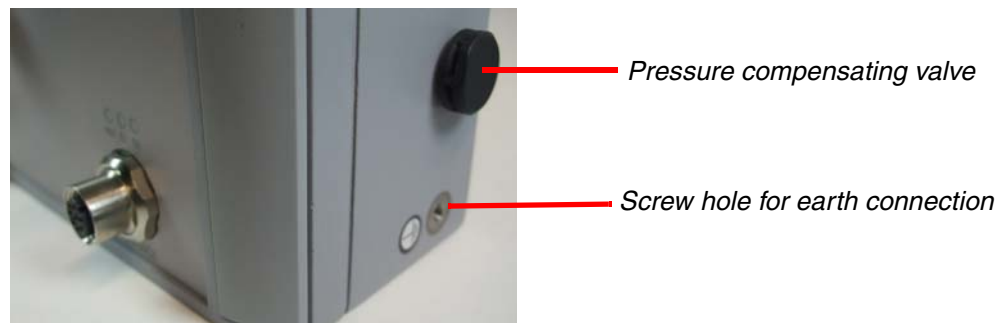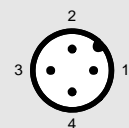
1.4 Interfaces

1.4.1 Power Input

The RS3 usually comes with an internal 24 VDC nom. (9 to 36 V) wide-range power supply led to a 4-pin M12 connector. RS3 models models with other input voltage ranges are also available from MEN to suit individual projects' needs.

The internal power supply is EN50155 compliant which implies that it has a built-in power-on threshold of 0.7xUn = 16.8 V. Once the unit is turned on, the input voltage may drop as low as 9 V.

Connector types:

• 4-pin M12 connector, male, A-coded (CONEC "SAL-12-FSH4-P12-9" 43-01066)

• Mating connector: e.g., CONEC "SAL-12-RK4-2/A1" 43-10020

Table 1. Pin assignment of the power supply 4-pin M12 connector

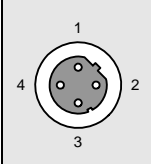|	Pin	Name	Description
	1	+VBAT	Positive input
	2	+VBAT	Positive input
	3	-VBAT	Negative input
	4	-VBAT	Negative input

1.4.2 Ethernet Interface

The RS3 comes with eight Fast Ethernet ports on 4-pin female M12 connectors.

Connector types:

- 4-pin M12 connector, female, D-coded (CONEC "SAL-12D-FKH4.2-P12-9" 43-01248)
- Mating connector: e.g., Harting 21032811405 R410925

Table 2. *Pin assignment of the Ethernet 4-pin M12 connectors*

	Pin	Name	Description
	1	TX+	Transmitter positive output
	2	RX+	Receiver positive input
	3	TX-	Transmitter negative output
	4	RX-	Receiver negative input

Each of the Ethernet ports has its own MAC address etc.

⚠ The unique MAC address is set at the factory and should not be changed. Any attempt to change this address may create node or bus contention and thereby render the switch inoperable. The MAC addresses on the RS3 are:

- LAN1: `0x 00 C0 3A A0 xx x0 - 0x 00 C0 3A A3 xx x0`
- LAN2: `0x 00 C0 3A A0 xx x1 - 0x 00 C0 3A A3 xx x1`
- ...
- LAN8: `0x 00 C0 3A A0 xx x8 - 0x 00 C0 3A A3 xx x7`

where "00 C0 3A" is the MEN vendor code, "A" is the MEN product code, the following four digits depend on the the serial number of the unit and the last digit corresponds to the interface ('0' to '7' for ports 1 to 8 respectively). "xx xx" is the hexadecimal serial number of the product, which depends on your board, e. g. "`0x 00 2A`" for the serial number "000042".

Example: Port 2 of the unit with the serial number 0042 (`0x 00 2A`) has the MAC address `0x 00 C0 3A A0 02 A1`.

For the unit's overall serial number please refer to Chapter 3.2 Finding out the Board's Article Number, Revision and Serial Number on page 22.

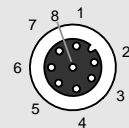### 1.4.3   Service Interface (RS232 / I^{2}C)

The service connector features an RS232 UART interface for maintenance purposes. Further information about maintenance and configuration options is provided in the documentation of the RS3 firmware.

An I^{2}C connection is also available to connect an external dongle (available from MEN) for easy dumping or uploading of configuration data.

Connector types:

- 8-pin M12 connector, female, A-coded (CONEC "SAL-12-FKH8-P12-9" 43-01064)
- Mating connector: e.g., CONEC "SAL-12S-RS8-2/G3" 43-10980

Table 3. *Pin assignment of the service interface 8-pin M12 connector*

	Pin	Name	Description
	1	+3.3V	Power supply for external dongle
	2	RS232_RX	RS232 receive data
	3	RS232_TX	RS232 transmit data
	4	GND	Ground
	5	SDA	I^{2}C serial data input/output for external dongle
	6	GPIO[1]	General purpose I/O 1 Apply active signal for more than 2 seconds: Reset Apply active signal for more than 10 seconds: Reset with restored factory settings
	7	SCL	I^{2}C data clock for external dongle
	8	GPIO[2]	General purpose I/O 2 Used for detection of external dongle

1.5   Ethernet Switch

The RS3 uses a manageable 8-port 10/100Base-T switch component, the Marvell 88E6095. The switch provides 10/100 Mbits/s configuration possibility on each of the eight Ethernet ports.

It is also possible to configure each port in half-duplex or full-duplex.

The device characteristics are:

- 8 external ports configurable as 10/100 Mbits/s
- MII interface
- Each external port is configurable in half-duplex or full-duplex mode
- Non-blocking wire speed switching
- Store-and-forward mode
- Auto negotiation
- Port mirroring
- Port monitoring
- Flow control
- VLAN support
- Automatic MDI/MDI-X crossover (all ports)
- Port based frame priorization

1.5.1   Configuration of the Switch

The RS3 loads the following standard configuration for all ports at startup:

Table 4. Default switch configuration at startup

Setting	Default
Duplex mode	Full Duplex
Port speed	Auto-Negotiate
VLAN (port-based)	Off
QoS (Quality of Service)	Off
Port mirroring and port monitoring	Off
Port trunking	Off

All of the ports are individually configurable using an external dongle, a command line interface (via RS232 through the M12 service connector, Telnet or Secure Shell (SSH)), via SNMP (Version 3) or via the unit's HTTP web server. Further information about configuration options is provided in the documentation of the RS3 firmware.

1.6 Front Panel Status LEDs

The standard RS3 features a total of 20 status LEDs at its front panel: Sixteen for the Ethernet port status (two for each port), one for the supply status and three for the service port status. The LEDs act as described in the following tables.

Table 5. Ethernet port status LEDs

LED		Description
🟡	LNK	Ethernet link status (ON = link established)
🟡	ACT	Ethernet traffic activity status (ON = Ethernet traffic running)

Table 6. Power supply status LED

LED		Description
🟡	PWR	Input power status (ON = valid range)

Table 7. Service port LEDs

LED		Description
🟡	RST	Reset LED (ON = reset active)
🟡	S 1	Micro controller LED (function depends on software)
🟡	S 2	Micro controller LED (function depends on software)

The micro controller uses the service port LEDs connected to it to indicate the reason for an error during startup. The status LED will blink or light up as listed in Table 8, Error codes signaled via service port LEDs until the system is restarted or completely powered off. The supported error codes are as follows:

Table 8. Error codes signaled via service port LEDs

| Failure source	🟡 S 1	🟡 S 2
RS232 UART	fast	fast
Memory	fast	slow
Marvell switch access	slow	fast
Marvell switch internal PHYs	slow	on
External PHYs	slow	slow
Temperature sensor	on	fast
IDPROM	on	on
PoE	on	slow
Firmware image	off	on
Unspecified	off	fast

"Slow" means blinking with a frequency of 1 Hz, "fast" means blinking with a frequency of 10 Hz.

2 Mounting Options
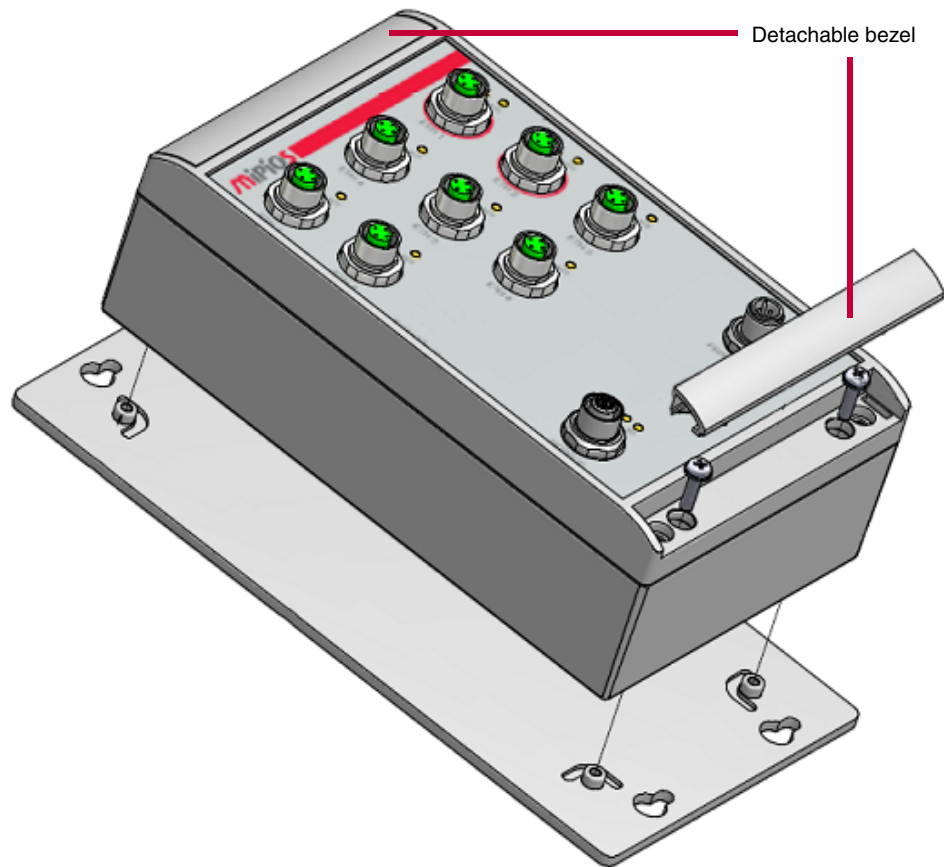
2.1 Mounting the RS3

The RS3 is designed for mounting using one of two mounting plates, a DIN-rail mounting plate or a wall-mounting plate (available separately from MEN). To attach the unit to the mounting plate, remove the detachable bezel at the sides of the front panel to access the four holes (two on each side) reserved for the necessary screws as pictured above and below.

Figure 3. *Mounting the RS3 to the DIN-rail mounting plate*

Detachable bezel
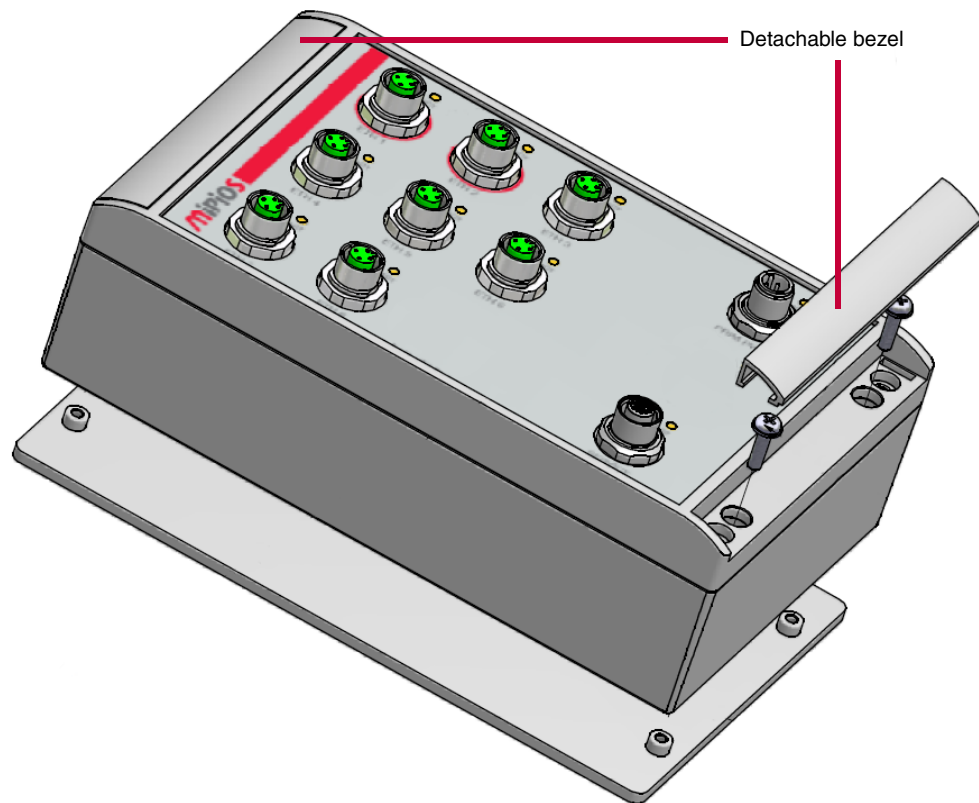
Figure 4. *Mounting the RS3 to the wall-mounting plate*

Detachable bezel

⚠️ Make sure to use the following screw types in the process.

To fix the RS3 to the mounting plate:

- 4 DIN 7985 M4 x 20mm, A2 screws
- 4 M4 washers

To fix the wall-mounting plate to the wall:

- 4 DIN7985 M5 x min. 12mm, A2 screws
- 4 M5 washers

3 Appendix

3.1 Literature and Web Resources

- RS3 data sheet with up-to-date information and documentation:
  www.men.de/products/06RS03-.html

3.2 Finding out the Board's Article Number, Revision and Serial Number

MEN user documentation may describe several different models and/or hardware revisions of the RS3. You can find information on the article number, the board revision and the serial number on two labels attached to the board.

- **Article number:** Gives the board's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the hardware revision of the board.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 5. *Label giving the board's article number, revision and serial number*

Complete article number

Article No.: □
06RS03-00
Serial No.:
000000 — Serial number
Rev. 00.00.00

Revision number