Ex n

RAD-DI8-IFS

I/O extension module
with 8 digital inputs or 2 pulse inputs

Data sheet
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1   Description

The **RAD-DI8-IFS** I/O extension module can be used in con-junction with Radioline wireless modules and other Interface system (IFS) master devices. In a station structure, you can connect up to 32 I/O extension modules to a wireless mod-ule via the DIN rail connector.

The **RAD-DI8-IFS** digital I/O extension module is used for processing eight digital input signals 0 ... 30.5 V DC or two pulse signals 0 ... 100 Hz.

Features

– Easy and tool-free I/O mapping via thumb wheel on the front
– Modular design via TBUS DIN rail connector (hot-swap capable)
– 8 digital inputs (0 ... 30.5 V DC)
– 2 pulse inputs (0 ... 100 Hz)
– International approvals
– Installation in Ex-Zone 2

⚠	**WARNING: Explosion hazard when used in potentially explosive areas**
	The module is a category 3 item of electrical equipment. Follow the instructions provided here during installa-tion and observe the safety instructions.

ℹ	Make sure you always use the latest documentation. It can be downloaded from the product at phoenixcontact.net/products.

| ℹ	Use the I/O extension module in connection with the RAD-2400-IFS wireless module, firmware version 1.40 or higher.
	This data sheet is valid for all products listed on the following page:

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INSPIRING INNOVATIONS

2 Table of contents

3   Ordering data

Description	Type	Order No.	Pcs. / Pkt.
Digital I/O extension module with 8 digital inputs (0 ... 30.5 V DC) or 2 pulse inputs (0 ... 100 Hz), with screw connection, including DIN rail connector	RAD-DI8-IFS	2901539	1

Accessories	Type	Order No.	Pcs. / Pkt.
2400 MHz wireless transceiver with RS-232, RS-485 2-wire interface, expandable with I/O extension modules, with screw connection, antenna connection: RSMA (female), including DIN rail connector, without antenna	RAD-2400-IFS	2901541	1
868 MHz wireless transceiver with RS-232, RS-485 2-wire interface, expandable with I/O extension modules, with screw connection, antenna connection: RSMA (female), including DIN rail connector, without antenna.	RAD-868-IFS	2904909	1
Bidirectional, Radioline 900 MHz transceiver for wireless transmission of serial and I/O data	RAD-900-IFS	2901540	1
DIN rail connector for DIN rail mounting. Universal for TBUS housing. Gold-plated contacts, 5-pos. Header, Nominal current: 8 A, Articles with gold-plated contacts, bus connectors for connecting with electronic housings	ME 17,5 TBUS 1,5/ 5-ST-3,81 GN	2709561	10
Digital I/O extension module with 8 digital transistor outputs (30.5 V DC/200 mA), with screw connection, including DIN rail connector	RAD-DO8-IFS	2902811	1

4   Technical data

Dimensions (nominal sizes in mm)
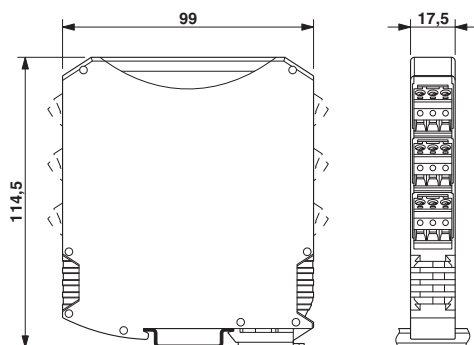
Dimensions W / H / D	17.5 mm / 99 mm / 114.5 mm

General data

Surge voltage category	II
Mounting position	any, on standard DIN rail NS 35 in accordance with EN 60715
Degree of protection	IP20
Pollution degree	2
Type of housing	PA 6.6-FR, green
Inflammability class according to UL 94	V0

General data

MTTF (mean time to failure) Telcordia standard, 25°C temperature, 21% operating cycle (5 days a week, 8 hours a day)	1624 Years
MTTF (mean time to failure) Telcordia standard, 40°C temperature, 34.25% operating cycle (5 days a week, 12 hours a day)	612 Years
MTTF (mean time to failure) Telcordia standard, temperature 40°C, operating cycle 100% (7 days a week, 24 hours a day)	233 Years

Supply

Supply voltage range	19.2 V DC ... 30.5 V DC (TBUS)
Max. current consumption	≤ 18 mA (At 24 V DC, at 25°C)
Transient surge protection	Yes

Digital input

Number of inputs	8
Input signal, Voltage	0 V DC ... 30.5 V DC
Switching level "1" signal	10 V DC ... 30.5 V DC
Switching level "0" signal	0 V DC ... 4 V DC
Input frequency	≤ 10 Hz (Static mode)
Max. current consumption	< 1 mA

Pulse input

Number of channels	2
Voltage input signal	0 V DC ... 30.5 V DC
Switching level "1" signal	10 V DC ... 30.5 V DC
Switching level "0" signal	0 V DC ... 4 V DC
Input frequency	< 100 Hz (Pulse counter mode)
Pulse length	≥ 5 ms (Pulse/pause ratio 1:1)
Process data channel	32 Bit (per channel)

Electrical isolation

Digital I/O	50 V (Rated insulation voltage (between the channel groups 1...4 and 5...8/TBUS supply, reinforced insulation according to EN 61010))
	300 V (Rated insulation voltage (to adjacent devices, basic insulation in accordance with EN 61010))

Test voltage

Digital I/O	1.5 kV AC (50 Hz, 1 min.)

Connection data

Connection method	Screw connection
Conductor cross section, solid	0.2 mm² ... 2.5 mm²
Conductor cross section, stranded	0.2 mm² ... 2.5 mm²
Conductor cross section AWG/kcmil	24 ... 14
Stripping length	7 mm
Tightening torque	0.6 Nm

Status indication

Status display	Green LED (supply voltage, PWR)
	Green LED (bus communication, DAT)
	Red LED (periphery error, ERR)
	Green LED (counter mode, CNT)
	Yellow LED (digital input, DI1)
	Yellow LED (digital input, DI2)
	Yellow LED (digital input, DI3)
	Yellow LED (digital input, DI4)
	Yellow LED (digital input, DI5)
	Yellow LED (digital input, DI6)
	Yellow LED (digital input, DI7)
	Yellow LED (digital input, DI8)

Ambient conditions

Ambient temperature (operation)	-40 °C ... 70 °C
	-40 °F ... 158 °F
Ambient temperature (storage/transport)	-40 °C ... 85 °C
	-40 °F ... 185 °F
Permissible humidity (operation)	20 % ... 85 %
Permissible humidity (storage/transport)	20 % ... 85 %
Altitude	2000 m
Vibration (operation)	In accordance with IEC 60068-2-6: 5 g, 10 Hz - 150 Hz
Shock	16 g, 11 ms

Certification

Conformance	CE-compliant
ATEX	⟨Ex⟩ II 3 G Ex nA IIC T4 Gc X
IECEx	Ex nA IIC T4 Gc
UL, USA / Canada	UL 508 Listed
	Class I, Div. 2, Groups A, B, C, D T4A
	Class I, Zone 2, IIC T4

Conformance

EMC directive 2004/108/EC	EN 61000-6-2; EN 61000-6-4
Ex directive (ATEX)	EN 60079-0; EN 60079-15

5 Safety regulations and installation notes

⚠️ **WARNING: Risk of electric shock**

– Provide a switch/circuit breaker close to the device, which is labeled as the disconnect device for this device or the entire control cabinet.

– Disconnect the device from all power sources during maintenance work and configuration (the device can remain connected to SELV or PELV circuits).

– The housing of the device provides a basic insulation against the neighboring devices, for 300 V eff. If several devices are installed next to each other, this has to be taken into account, and additional insulation has to be installed if necessary. If the neighboring device is equipped with basic insulation, no additional insulation is necessary.

5.1 Installation notes

⚠️ **WARNING:**
Observe the following safety notes when using the device.

• The category 3 device is suitable for installation in potentially explosive area zone 2. It fulfills the requirements of EN 60079-0:2009 and EN 60079-15:2010.

• Installation, operation, and maintenance may only be carried out by qualified electricians. Follow the installation instructions as described.

• When installing and operating the device, the applicable regulations and safety directives (including national safety directives), as well as general technical regulations, must be observed. The technical data is provided in the package slip and on the certificates (conformity assessment, additional approvals where applicable).

• The device must not be opened or modified. Do not repair the device yourself, replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from violation.

• The IP20 protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment. The device must not be subject to mechanical strain and/or thermal loads, which exceed the limits described.

• To protect the device against mechanical or electrical damage, install it in a suitable housing with appropriate degree of protection as per IEC 60529.

• The device is not designed for use in atmospheres with a danger of dust explosions.

• If dust is present, it is necessary to install into a suitable approved housing, whereby the surface temperature of the housing must be taken into consideration.

5.2 Installation in Zone 2

⚠️ **WARNING: Explosion hazard when used in potentially explosive areas**

Please make sure that the following notes and instructions are observed.

- Observe the specified conditions for use in potentially explosive areas! Install the device in a suitable approved housing (with a minimum of IP54 protection) that meets the requirements of EN 60079-15. Observe the requirements of EN 60079-14.
- In zone 2, only connect devices to the supply and signal circuits that are suitable for operation in the Ex zone 2 and the conditions at the installation location.
- In potentially explosive areas, terminals may only be snapped onto or off the DIN rail connector and wires may only be connected or disconnected when the power is switched off.
- The switches of the device that can be accessed may only be actuated when the power supply to the device is disconnected.
- The device must be stopped and immediately removed from the Ex area if it is damaged, was subject to an impermissible load, stored incorrectly or if it malfunctions.

5.3 UL Notes

INDUSTRIAL CONTROL EQUIPMENT FOR HAZARDOUS LOCATIONS 45FP

A This equipment is suitable for use in Class I, Zone 2, IIC T4 and Class I, Division 2, Groups A, B, C,D T4A hazardous locations or non-hazardous locations only.

B WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

C WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS 1, DIVISION 2.

D These devices are open-type devices that are to be installed in an enclosure suitable for the environment that is only accessible with the use of a tool.

E WARNING - Exposure to some chemicals may degrade the sealing properties of materials used in relays within this device.

6 Installation

NOTE: electrostatic discharge!

The device contains components that can be damaged or destroyed by electrostatic discharge. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and IEC 61340-5-1.
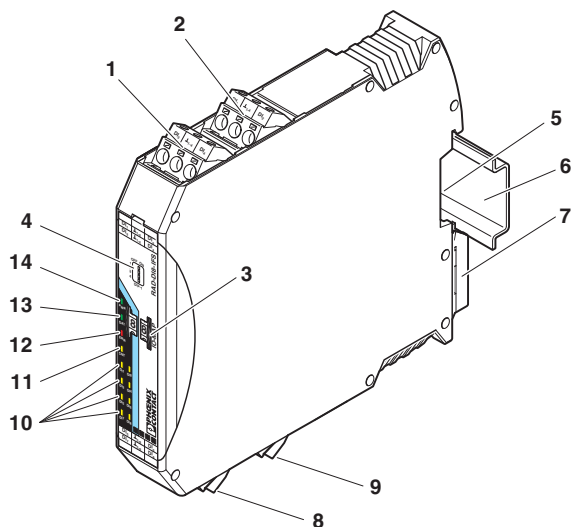
6.1 Structure

Figure 1 RAD-DI8-IFS

Pos.	Designation
1	Digital inputs 3 + 4
2	Digital inputs 1 + 2, DI1: Pulse input 1
3	White thumbwheel for setting the I/O-MAP address
4	DIP switch for switching between static mode and pulse counter mode for digital inputs
5	Connection option for TBUS DIN rail connector
6	DIN rail
7	Metal foot catch for DIN rail fixing
8	Digital inputs 5 + 6
9	Digital inputs 7 + 8, DI7: Pulse input 2
10	Status LEDs for digital inputs DI1 ... DI8
11	CNT status LED, green (pulse counter mode)
12	ERR status LED, red (communication error)
13	DAT status LED, green (BUS communication)
14	PWR status LED, green (supply voltage)

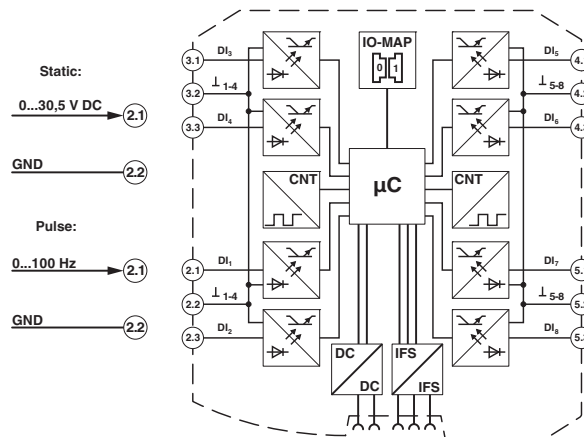## 6.2 Basic circuit diagram

Figure 2 RAD-DI8-IFS basic circuit diagram

6.3 Setting the DIP switches

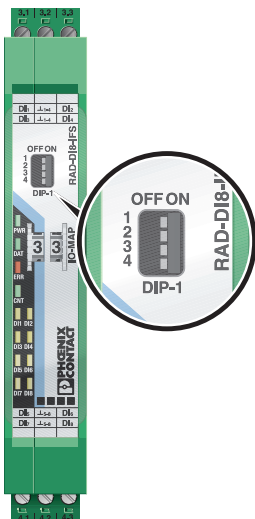Static mode or pulse counter mode can be selected using the DIP switch.

Figure 3   DIP switches

		DIP switch			
Input	Configuration	1	2	3	4
Digital IN					
DI1 ... DI8	Static mode	OFF	n. c.	n. c.	n. c.
Counter IN					
DI1+DI7	Pulse counter mode	ON	n. c.	n. c.	n. c.

n. c. = not connected, DIP switches 2 ... 4 have no function

- After setting the DIP switch: Switch the device to disconnected and then apply the current again (power-up).

6.4 Network applications (operating mode)

You can set the network application of the wireless module with the PSI-CONF software. All RAD-2400-IFS Radioline wireless modules are set to I/O data mode (wire in/wire out) by default.

Wireless module in I/O data mode

In an I/O-to-I/O network, only the I/O signals of the connected analog and digital I/O extension modules are transmitted. Assign the inputs and outputs of the extension modules quickly using the white thumbwheel.

In this mode, the serial RS-232 and RS-485 interfaces on the wireless module are deactivated.

Wireless module in PLC/Modbus RTU mode

In PLC/Modbus RTU mode, the wireless master operates as a Modbus slave. The master PLC controls all commands and initiates all data requests.

Input and output data is stored in a Modbus Memory Map in the master wireless module.

In this mode, you can access process and diagnostic data for the individual network devices via a Modbus controller.

6.5 Functions in pulse counter mode

Max. counter state: 4.294.967.295

Overrun: When the maximum counter state is reached, the counter state is automatically set to 0.

You can manually reset the counter state in various ways.

Reset counter state via power up

- Disconnect the device power supply and then reconnect the voltage (power up).

Reset counter state via Modbus RTU

- Reset the counter states via Modbus RTU as follows:
  DI1: bit 0 = 1 (register 40xx1)
  DI7: bit 1 = 1 (register 40xx1)

Reset counter state by setting the inputs

- DI1: set input DI3 for 0.5 seconds.
  DI7: set input DI5 for 0.5 seconds.

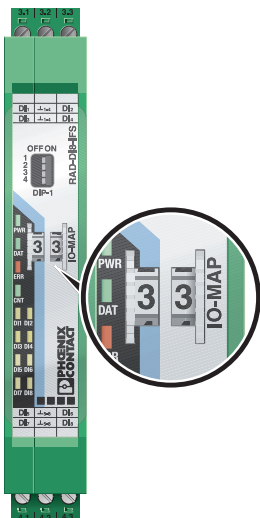## 6.6 I/O MAP address in the Radioline wireless system

Figure 4   Thumb wheel

Use the thumb wheel to set the I/O MAP address. The address is used to address the I/O module for use in the Radioline wireless system.

The following conditions must be met:

The I/O MAP address of an input module may only appear once in the network.

Thumbwheel	Description
01 - 99	I/O MAP address
00	Delivery state
**, 1* - 9*	Setting not permitted
*1 - *9	Interface System slave address, for use with other Interface System (IFS) master devices

Wireless module in I/O data mode

The input device must be provided with the same I/O MAP address as the assigned output device at the other wireless station (I/O mapping).

Example:	I/O MAP address
RAD-DI8-IFS	02
RAD-DO8-IFS	02

Only the RAD-DO8-IFS module can be assigned to the RAD-DI8-IFS module.

Static mode	The digital inputs DI1 ... DI8 can be mapped to the digital outputs DO1 ... DO8 of the RAD-DO8-IFS extension module.
Pulse counter mode	No function in the I/O data mode

Wireless module in PLC/Modbus RTU mode

Static mode	The I/O data of the eight digital inputs (DI1 ... DI8) is stored in an internal Modbus memory map in the master wireless module. Access to process and diagnostic data via the Modbus RTU controller
Pulse counter mode	Access to 32-bit process data from the pulse inputs DI1 + DI7 via the Modbus RTU controller

You can read or write the process data via the serial interface of the RAD-2400-IFS master wireless module (RAD-ID = 01) using the Modbus RTU command (see Section 7).

6.7 Display and diagnostic elements

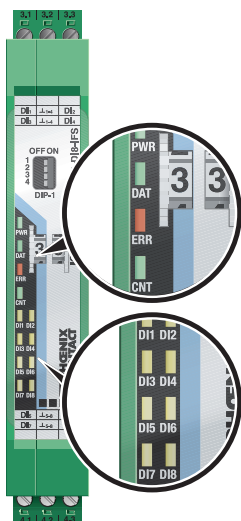The RAD-DI8-IFS I/O extension module uses a total of 12 LEDs to indicate the operating states.

Figure 5   Display and diagnostic elements

PWR LED

The green PWR LED indicates the supply voltage status.

OFF	No supply voltage
ON	Supply voltage OK

DAT LED

The green DAT LED indicates the bus communication status.

OFF	No communication
Flashing	Configuration/addressing mode
ON	Cyclic data communication

ERR LED

The red ERR LED indicates the error status, e.g., no corresponding output module found (e.g., incorrect addressing).

OFF	No error
Flashing	**Slow (1.4 HZ):** I/O-MAP address changed, mode switched using DIP switch 1, but not yet read via wireless module.
	Fast (2.8 Hz): no bus communication
ON	Critical internal error

CNT LED

The green CNT LED indicates that pulse counter mode is activated.

OFF	Static mode of digital inputs DI1 ... DI8
Flashing	Mode switched using DIP switch 1, but not yet read via wireless module.
ON	Pulse counter mode of digital inputs DI1 + DI7

DI1 ... DI8

The yellow DI1 ... DI8 LEDs indicate the state of the digital inputs. In pulse counter mode: the DI1 + DI7 LEDs flash in time with the recorded pulses. The DI3 and DI5 LEDs light up when the counter state is reset.

DI3	On (0.5 s)	Counter state DI1 reset to 0
DI5	On (0.5 s)	Counter state DI7 reset to 0

6.8 Digital inputs

The eight inputs are arranged in two groups of four inputs each with a common ground (GND).

The two DC groups are electrically isolated from one another, from the supply voltage (via bus foot), and from other electronic components.

Static mode	DIP1=OFF - STATIC	Static digital inputs DI1 ... DI8 activated, 0 ... 30.5 V DC
Pulse counter mode	DIP1=ON - IMPULSE	Pulse inputs DI1 + DI7 activated, pulse 0 ... 100 Hz

6.9 Assembly/removal

Connection station with I/O extension modules

Up to 32 different I/O extension modules can be connected to each RAD-2400-IFS wireless module via the TBUS DIN rail connector (see accessories). Data is transmitted and power is supplied to the I/O extension modules via the bus foot.
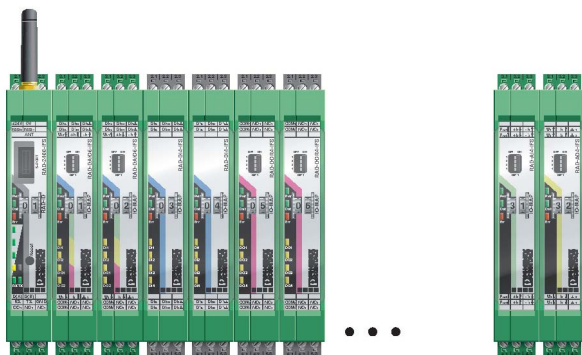

Figure 6   Radioline connection station with up to 32 I/O extension modules

> **i** The I/O extension modules must only be mounted to the right of the wireless module.

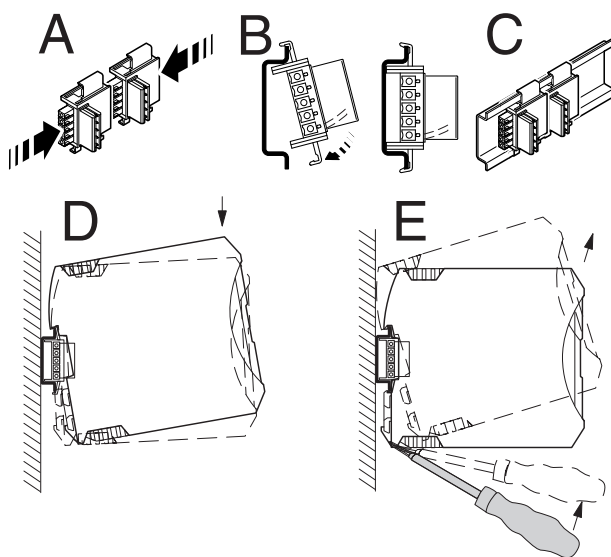#### To mount on the DIN rail connector, proceed as follows:

Figure 7   Mounting and removing

When using the device in a connection station, use the 17.5 mm wide DIN rail connector supplied. Only use the DIN rail connector in connection with 24 V DC devices.

> **i** Outside the Ex area, module extension or module replacement is also possible during operation.

- Connect the DIN rail connectors together for a connection station.
- Push the connected DIN rail connectors into the DIN rail.
- Place the device onto the DIN rail from above. Ensure the device and DIN rail connector are aligned correctly.
- Holding the device by the housing cover, carefully push the device towards the mounting surface so that the device bus connector is securely fixed onto the DIN rail connector.
- Once the snap-on foot has been audibly snapped onto the DIN rail, check that it is fixed securely. The device is only mechanically secured via the DIN rail.
- Connect the desired number of I/O extension modules to the wireless module via the DIN rail connector.
- Install the device in suitable housing to meet the requirements for the protection class.
- During startup, check that the device is operating, wired, and marked correctly.
- You can establish a connection between two DIN rail connectors using MINI COMBICON connectors:
  MC 1,5/5-ST-3,81 (female, 1803604);
  IMC 1,5/5-ST-3,81 (male, 1857919).

To remove, proceed as follows:

- Use a suitable screwdriver to release the locking mechanism on the snap-on foot of the device.
- Hold onto the device by the housing cover and carefully tilt it upwards.
- Carefully lift the device off the DIN rail connector and the DIN rail.
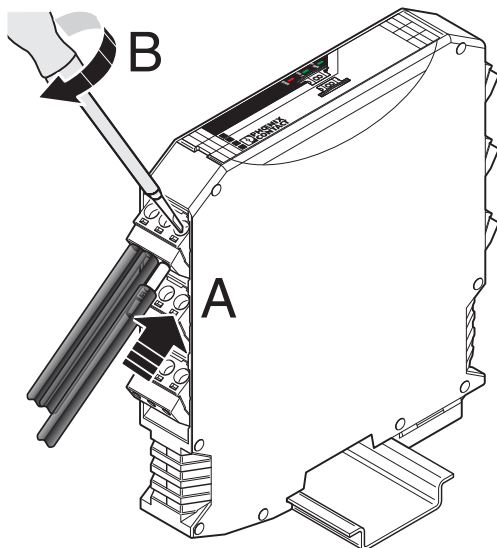
6.10   Connecting the cables

Figure 8   Connecting the cables

- Crimp ferrules to the wires.
  Permissible cable cross section: 0.2...2.5 mm².
- Insert the wire with ferrule into the corresponding connection terminal block.
- Use a screwdriver to tighten the screw in the opening above the connection terminal block.
  Tightening torque: 0.6 Nm

7 Process data

You can read the process data via the serial interface of the RAD-2400-IFS master wireless module (RAD-ID = 01) using the Modbus RTU command.

With the PSI-CONF software, you can set the wireless module's network application to "PLC/Modbus RTU mode".

I/O module	RAD-DI8-IFS	RAD-DI8-IFS	RAD-DI8-IFS
Module type	02$_{hex}$	40$_{hex}$	40$_{hex}$
	Static mode	Pulse counter mode	Pulse counter mode
Number of registers	02$_{hex}$	06$_{hex}$	02$_{hex}$
	Static inputs	Pulse inputs	Reset counter states
Address space	30xx0...30xx1	30xx0...30xx5	40xx0...40xx1
Modbus function code	fc04	fc04	fc 03, 16

xx = I/O MAP address set using the white thumbwheel

30xx0								Module type and currentness of data							
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Reserved							Y	Module type							

Register values:

Module type — If the module type in the register is invalid or unavailable, then the register value is 0

Currentness of data — Y = Currentness of data, bit 8

If the data in the register is not up-to-date, then the register value is 1.

This is the case, for example, if the wireless connection or communication with an input module fails. In this case, the IN process data is retained in the Modbus table, but is no longer updated.

30xx1								Digital inputs DI1 ... DI8 (static mode)							
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
								DI 8	DI 7	DI 6	DI 5	DI 4	DI 3	DI 2	DI 1
Terminal point															
								5x	5x	4x	4x	3x	3x	2x	2x

30xx2 Low word								DI1: 32-bit pulse input, pulse counter mode (terminal point 2.x)							
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Counter state DI1, low word															

30xx3 High word								DI1: 32-bit pulse input, pulse counter mode (terminal point 2.x)							
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Counter state DI1, high word															

30xx4 Low word								DI7: 32-bit pulse input, pulse counter mode (terminal point 5.x)							
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Counter state DI7, low word															

30xx5 High word								DI7: 32-bit pulse input, pulse counter mode (terminal point 5.x)							
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Counter state DI7, high word															

40xx2 ... 40xx9	Reserved

40xx1								Reset of counter states DI1/DI7							
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
														X	X

Bit 1 = 1: counter state DI7 reset to 0

Bit 0 = 1: counter state DI1 reset to 0

40xx2 ... 40xx9	Reserved

7.1 Functions in pulse counter mode

Max. counter state: 4.294.967.295

Reset counter state via Modbus RTU

- Reset the counter states via Modbus RTU as follows:
  DI1: bit 0 = 1 (register 40xx1)
  DI7: bit 1 = 1 (register 40xx1)