

RAD-2400-IFS

2400 MHz wireless transceiver (transmitter and receiver) with RS-232 and RS-485 interface, can be extended with I/O extension modules



INTERFACE

Data sheet
104835_en_02

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1 Description

Wireless communication is based on Trusted Wireless 2.0 technology. The high demand for an interference-free data transmission using the license-free 2.4 GHz. band, in particular via the use of the FHSS method and 128-bit data encryption (AES), is fulfilled.

In addition to an RS-232 and RS-485 2-wire interface, the **RAD-2400-IFS** wireless module supports the option of directly connecting up to 32 I/O extension modules in the station structure via the TBUS DIN rail connector.

Addressing of the wireless module and I/O mapping of the I/O extension modules is carried out quickly and easily by means of the thumbwheel on the front. Programming knowledge is not required.

The PSI-CONF configuration and diagnostics software for special functionalities and diagnostics options in the wireless module is available free of charge.

Features

- Flexible network applications: I/O data, serial data, PLC/Modbus RTU mode
- Adjustable data rates for the wireless interface
- Easy point-to-point or network structures (star, mesh)
- Quick and easy startup thanks to simple wireless module addressing using the thumbwheel on the front
- Integrated RS-232 and RS-485 interface
- Can be extended with up to 32 I/O modules per station via T-BUS (hot-swappable)
- 128-bit data encryption (AES)
- Unique network addressing via plug-in configuration memory (RAD-CONF) for secure, parallel operation of multiple networks (different RF bands)
- Data rates and ranges can be adjusted
- International approvals
- Installation in Ex zone 2



WARNING: Correct usage in potentially explosive areas

The module is a category 3 item of electrical equipment. Follow the instructions provided here during installation and observe the safety instructions.



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



This data sheet is valid for all products listed on the following page:



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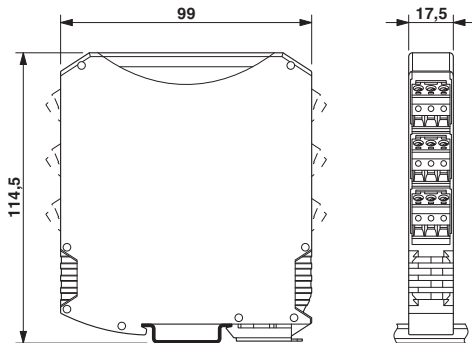
3 Ordering data

Description	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	RAD-2400-IFS	2901541	1
Accessories			
Analog/digital I/O extension module with 2 digital inputs/outputs (0...250 V AC/DC) and 1 analog input (0/4...20 mA) and output (0/4 ... 20 mA, 0...10 V), with screw connection, incl. DIN rail connector	RAD-DAIO6-IFS	2901533	1
Digital I/O extension module with 4 digital inputs (0...250 V AC/DC), with screw connection, incl. DIN rail connector	RAD-DI4-IFS	2901535	1
Digital I/O extension module with 4 digital relay outputs (6 A, 250 V AC/ 24 V DC), with screw connection, incl. DIN rail connector	RAD-DOR4-IFS	2901536	1
Analog extension module with 4 analog current inputs (0/4 mA ... 20 mA), with screw connection, incl. DIN rail connector	RAD-AI4-IFS	2901537	1
Analog I/O extension module with 4 analog current/voltage outputs (0/4 mA ... 20 mA, 0...10 V), with screw connection, incl. DIN rail connector	RAD-AO4-IFS	2901538	1
DIN rail connector for DIN rail power supply unit, gold-plated contacts, for DIN rail mounting, 5-pos.	ME 17,5 TBUS 1,5/ 5-ST-3,81 GN	2709561	10
CONFSTICK for easy and secure network addressing for the 2.4 GHz Radioline wireless module (RAD-2400-IFS), unique network ID, RF band 3	RAD-CONF-RF3	2902814	1
CONFSTICK for easy and secure network addressing for the 2.4 GHz Radioline wireless module (RAD-2400-IFS), unique network ID, RF band 5	RAD-CONF-RF5	2902815	1
CONFSTICK for easy and secure network addressing for the 2.4 GHz Radioline wireless module (RAD-2400-IFS), unique network ID, RF band 7	RAD-CONF-RF7	2902816	1
Memory stick for saving individual configuration data for the Radioline wireless module	RAD-MEMORY	2902828	1
USB data cable (USB-A on IFS plug) for communicating between PCs and PHOENIX CONTACT devices with an IFS data port, e.g., RAD-2400-IFS. Power supply for diagnostics and configuration via the USB port of the PC. Cable length: 2 m.	RAD-CABLE-USB	2903447	1
Omnidirectional antenna, 2.4 GHz, 2 dBi, linear vertical, 1.5 m cable, RSMA (male), IP65, 50 Ω impedance	RAD-ISM-2400-ANT-OMNI-2-1-RSMA	2701362	1
Omnidirectional antenna with protection against vandalism, 2.4 GHz, 3 dBi gain, IP55 degree of protection, 1.5 m cable length, RSMA connection (male), h/v 360°/85° apex angle. Appropriate mounting material is available for wall mounting.	RAD-ISM-2400-ANT-VAN-3-0-RSMA	2701358	1
Omnidirectional antenna with protection against vandalism, 2.4 GHz, 3 dBi gain, IP55 protection, 1.5 m cable length, SMA (male) connection, opening angle h/v 360°/85°. Appropriate mounting material is available for wall mounting.	RAD-ISM-2400-ANT-VAN- 3-0-SMA	2885867	1
Omnidirectional antenna, 2.4 GHz, 6 dBi, linear vertical, N (female), IP55, 50 Ohm impedance	RAD-ISM-2400-ANT-OMNI-6-0	2885919	1
Omnidirectional antenna, 2.4 GHz, 6 dBi, linear vertical, opening angle h/v 360°/20°, N (female), IP65, salt water resistant	RAD-2400-ANT-OMNI-6-0-SW	2903219	1
Panel antenna, 2.4 / 5 GHz, 9 dBi, linear vertical, N (female), IP67	ANT-DIR-2459-01	2701186	1
Panel antenna, degree of protection IP55, 8 dBi gain, linear vertical, SMA (female), impedance 50 ohms, apex angle h/v 75°/70°	RAD-ISM-2400-ANT-PAN- 8-0	2867610	1
Parabolic antenna, IP65 degree of protection, 19 dBi gain, linear vertical, N (female) connection, impedance 50 Ω, apex angle h/v 17°/11°	RAD-ISM-2400-ANT-PAR-19-0	2867885	1
Panel antenna with a special type of polarization (circular) for applications in a highly reflective environment (highly metallic industrial hall). The antenna prevents polarization loss and can attain higher profits in this environment.	RAD-ISM-2400-ANT-CIR-8-0	2884936	1
Adapter cable, pigtail 50 cm, N (female) -> RSMA (male), insertion loss 0.75 dB at 2.4 GHz; 1.25 dB at 5 GHz, impedance 50 Ohm;	RAD-PIG-EF316-N-RSMA	2701402	1

Accessories	Type	Order No.	Pcs. / Pkt.
Antenna cable, 0.5 m in length; N (male) -> RSMA (male), impedance 50 ohms	RAD-PIG-RSMA/N-0.5	2903263	1
Antenna cable, 1 m in length; N (male) -> RSMA (male), impedance 50 ohms	RAD-PIG-RSMA/N-1	2903264	1
Antenna cable, 2 m in length; N (male) -> RSMA (male), impedance 50 ohms	RAD-PIG-RSMA/N-2	2903265	1
Antenna cable, 3 m in length; N (male) -> RSMA (male), impedance 50 ohms	RAD-PIG-RSMA/N-3	2903266	1
Adapter cable, pigtail 30 cm N (female) -> SMA (male), insertion attenuation 1.5 dB at 2.4 GHz; impedance 50 ohms;	RAD-PIG-EF316-N-SMA	2867694	1
Adapter cable, pigtail 50 cm SMA (male) -> SMA (male), insertion attenuation 1.5 dB at 2.4 GHz; impedance 50 ohms;	RAD-PIG-EF316-SMA-SMA	2885618	1
Attachment plug with Lambda/4 technology as surge protection for coaxial signal interfaces. Connection: N connectors female connector/female connector	CN-LAMBDA/4-5.9-BB	2838490	1
Adapter, N (female) -> N (female); insertion attenuation < 0.3 dB at 2.4 GHz	RAD-ADP-N/F-N/F	2867843	1
Adapter, RSMA (male) -> SMA (female); insertion loss < 0.3 dB at 2.4 GHz	RAD-ADP-RSMA/F-SMA/F	2884538	1
Antenna cable, 3 m in length; N (male) -> N (male), attenuation approx. 0.45 dB/m at 2.4 GHz; impedance 50 ohms	RAD-CAB-EF393- 3M	2867649	1
Antenna cable, 5 m in length; N (male) -> N (male), attenuation approx. 0.45 dB/m at 2.4 GHz; impedance 50 ohms	RAD-CAB-EF393- 5M	2867652	1
Antenna cable, 10 m in length; N (male) -> N (male), attenuation approx. 0.45 dB/m at 2.4 GHz; impedance 50 ohms	RAD-CAB-EF393-10M	2867665	1
Antenna extension cable, 15 m long; N (male) -> N (male), attenuation approx. 0.45 dB/m@2.4 GHz; impedance 50 Ω	RAD-CAB-EF393-15M	2885634	1
Antenna cable, 3 m in length; SMA (male) -> SMA (male), attenuation approx. 0.93 dB at 2.4 GHz; impedance 50 ohms	RAD-CAB-EF142-3M	2884512	1
Antenna cable, 5 m in length; SMA (male) -> SMA (male), attenuation approx. 0.93 dB at 2.4 GHz; impedance 50 ohms	RAD-CAB-EF142-5M	2884525	1
Vulcanizing sealing tape for external protection of adapters, cable connections, etc. against the effects of weather, roll length: 3 m	RAD-TAPE-SV-19-3	2903182	1
24 V / 100 Wp solar system for worldwide use. Consisting of a solar panel, prewired control cabinet with charge controller, solar batteries, fuses, surge protection and assembly material (including mast clips).	RAD-SOL-SET-24-100	2885472	1
24 V / 200 Wp solar system for worldwide use. Consisting of a solar panel, prewired control cabinet with charge controller, solar battery, fuses, surge protection and assembly material (including mast clips).	RAD-SOL-SET-24-200	2917722	1
DIN rail power supply unit, primary-switched mode, slim design, output: 24 V DC / 1.5 A	MINI-SYS-PS-100-240AC/24DC/1.5	2866983	1

4 Technical data

Dimensions (nominal sizes in mm)



Dimensions W / H / D	17.5 mm / 99 mm / 114.5 mm
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General data

Surge voltage category	II
Degree of protection	IP20
Pollution degree	2
Type of housing	PA 6.6-FR , green
Inflammability class according to UL 94	V0

Supply

Supply voltage range	19.2 V DC ... 30.5 V DC
Max. current consumption	max. 65 mA (At 24 V DC, at 25°C)
Transient surge protection	Yes

Wireless interface

Antenna connection method	RSMA (female)
Direction	Bi-directional
Frequency	2400 MHz
Frequency range	2.4002 GHz ... 2.4785 GHz
Number of channel groups	8
Number of channels per group	55
Channel distance	1.3 MHz
Data transmission rate (adjustable)	16 kbps 125 kbps 250 kbps
Receiver sensitivity	-106.00 dBm (16 kbps) -96.00 dBm (125 kbps) -93.00 dBm (250 kbps)
Transmission power	max. 100 mW (adjustable)
Security	128-bit data encryption

RS-232 interface, 3-wire

Connection method	COMBICON plug-in screw terminal block
Data rate	0,3 ... 115,2 kBit/s

RS-485 interface, 2-wire

Connection method	COMBICON plug-in screw terminal block
Data rate	0,3...115,2 kBit/s
Termination resistor (switchable via DIP switches)	390 Ω 150 Ω 390 Ω

RSSI output

Number of outputs	1
Voltage output signal	0 V ... 3 V

RF link relay output

Number of outputs	1
Contact type	PDT
Contact material	PdRu, gold-plated
Maximum switching voltage	30 V AC 60 V DC
Max. switching current	500 mA
Electrical service life	5 x 10 ⁵ cycles with 0.5 A @ 30 V DC

Connection data

Connection method	Screw connection
Conductor cross section, solid	0.2 mm ² ... 2.5 mm ²
Conductor cross section, stranded	0.2 mm ² ... 2.5 mm ²
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) 3 x green, 1 x yellow LED (LED bar graph receive quality, RSSI) Green LED (RS-232/485 receive data, RX) Green LED (RS-232/485 transmit data, TX)
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Ambient conditions

Ambient temperature (operation)	-40°C ... 70°C (>55°C derating) -40°F ... 158°F (>131°F derating)
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

Operating conditions for the extended temperature range (+55°C ... 70°C)

	Please observe any restrictions which are described in the product documentation of the extension modules used.
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Certification

Conformance	CE compliance (R&TTE directive 1999/5/EC) FCC Directive, Part 15.247 ISC Directive RSS 210
ATEX	II 3 G Ex nA nC IIC T4 Gc X
IECEX	Applied for
UL, USA / Canada	UL applied for

Conformance

R&TTE Directive 1999/5/EC	
Effective use of the radio spectrum according to	EN 300328
Noise immunity according to	EN 61000-6-2
Noise emission according to	EN 61000-6-4
Health according to	EN 50385
Electrical safety according to	EN 60950-1

5 Safety regulations and installation notes

5.1 Installation notes



This device can be operated with a maximum transmission power of 100 mW (20 dBm) in the following countries:

Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, France, Finland, Germany, Greece, Great Britain, Hungary, Italy, Ireland, Iceland, Liechtenstein, Luxembourg, Latvia, Lithuania, Malta, the Netherlands, Norway*, Poland, Portugal, Romania, Russia, Sweden, Switzerland, Slovakia, Slovenia, Spain, Turkey*.

Additional country registrations can be found at phoenixcontact.net/products.

*This device complies with R&TTE device class 2, with the following restrictions on use according to the ERC recommendation 70-03 / April 2004:

Norway: The device must not be operated within 20 km of Ny Ålesund town center.

Turkey: The device must only be operated with Phoenix Contact antennas (see “Wireless accessories“ data sheet, Order No. 101580) according to the regulations in the “Short Range Radio Devices (SRD) Regulations“ Gazette No. 26464, dated March 16, 2007.



Please note that, in combination with antennas, the maximum permissible transmission power may be exceeded. Please set the transmission power via the software.



Operation of the wireless system is only permitted if accessories available from Phoenix Contact are used. The use of other accessory components may invalidate the device approval status.

5.2 Installation and operation

Follow the installation instructions.



NOTE: Installation, operation, and maintenance may only be carried out by qualified specialist personnel.

Error-free operation of this device can only be ensured if transport, storage, and assembly are carried out correctly and operation and maintenance are carried out with care.

When installing and operating the device, the applicable safety directives (including national safety directives), accident prevention regulations, as well as general technical regulations, must be observed.



WARNING: Risk of electric shock

During operation, certain parts of this device may carry hazardous voltages. Disregarding this warning may result in damage to equipment and/or serious personal injury.

For applications with high operating voltages, ensure sufficient distance or insulation and provide shock protection.



NOTE: Access to circuits within the device is not permitted.

Do not repair the device yourself but replace it with an equivalent device.

Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from a failure to comply.

Provide a switch/circuit breaker close to the device, which is labeled as the disconnect device for this device.

Provide overcurrent protection ($I \leq 6 \text{ A}$) in the installation.



NOTE:

During maintenance work, disconnect the device from all effective power sources.



NOTE: The IP20 degree of protection (IEC 60529/EN 60529) of the device is intended for a clean and dry environment. Do not subject the device to mechanical and/or thermal loads that exceed the specified limits.

For the safety data, please refer to the operating instructions and certificates (EC-type examination certificate, other approvals, if necessary).

5.3 Safety regulations for installation in potentially explosive areas

Antenna installation in zone 2

Installation in zone 2



WARNING: Explosion hazard
 The device is designed for installation in zone 2 potentially explosive areas according to directive 94/9/EC. Observe the specified conditions for use in potentially explosive areas.



WARNING: Explosion hazard
 Install the device into a housing (control or distributor box) that meets the requirements of EN 60079-0 and EN 60079-15 and has at least IP54 protection (EN 60529).



WARNING: Explosion hazard
 When installing and connecting the supply and signal circuits observe the requirements of EN 60079-14. Only devices suitable for operation in Ex zone 2 and the conditions at the application site may be connected to the circuits in zone 2.



WARNING: Explosion hazard
 In potentially explosive areas, only connect and disconnect cables when the power is disconnected.
 Installation/removal of the devices on/from the TBUS DIN rail connector may only be performed when no voltage is applied.



WARNING: Explosion hazard
 Only use category 3G devices (ATEX 94/9/EC).



WARNING: Explosion hazard
 The device must be stopped and immediately removed from the Ex area if it is damaged or was subject to an impermissible load or stored incorrectly or if it malfunctions.



WARNING: Explosion hazard
 Ensure that the radiated wireless power is neither bundled (focused) by the antenna itself nor by any inserts in the environment of the antenna, and that it cannot enter neighboring zones 1 or 0. For the transmission power, please refer to the technical data.
 The HF cable for the antenna must be suitable for the ambient conditions and should be installed such that it is protected against mechanical damage, corrosion, chemical stress, and negative effects from heat or UV radiation. The same applies to the antenna which is connected to the cable and which functions as a cable termination.
 The antenna must meet the requirements of EN 60079-0 with regard to housing and electrostatic discharge. Otherwise the antenna must be installed in housing that meets the requirements of EN 60079-0 and EN 60079-15 and has at least IP54 protection (EN 60529).

Installation in areas with a danger of dust explosions



WARNING: Explosion hazard
 The device has not been designed for use in potentially dust-explosive atmospheres.

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 EN 61340-5-1.

6.1 Structure

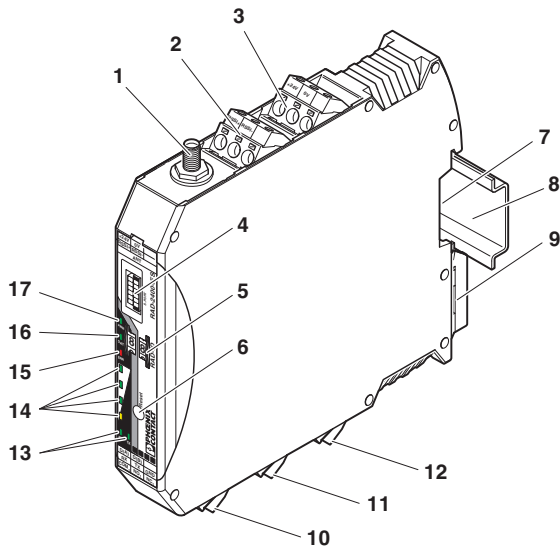


Figure 1 RAD-2400-IFS

Pos.	Designation
1	RSMA antenna connection (socket)
2	Test output RSSI (0...3 V DC) for evaluation of the wireless signal strength
3	Device supply (+24 V DC, GND)
4	12-pos. programming interface (S-PORT)
5	RAD ID address setting via thumbwheel
6	SET button
7	Connection option for TBUS DIN rail connector
8	DIN rail
9	Metal foot catch for DIN rail fixing
10	Connection terminal block RS-485 interface
11	Connection terminal block RS-232 interface
12	Relay output with PDT contact (floating)
13	RS-232/485 serial interface status LED (RX/TX)
14	LED bar graph for displaying the wireless signal strength
15	ERR status LED, red (communication error)
16	DAT status LED, green (BUS communication)
17	PWR status LED, green (supply voltage)

6.2 Basic circuit diagram

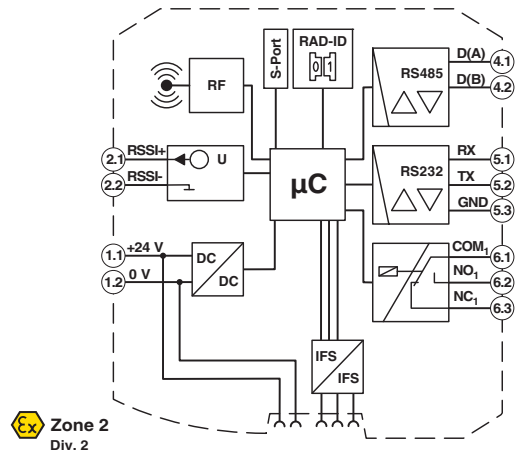


Figure 2 Basic circuit diagram of RAD-2400-IFS

6.3 Display and diagnostic elements

A total of 9 LEDs on the RAD-2400-IFS wireless module indicate the operating states.

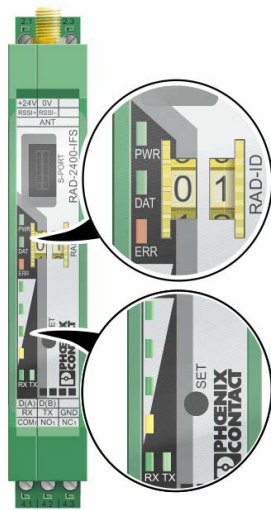


Figure 3 Display and diagnostic elements

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 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)
 - Wireless module in I/O data mode (wire in/wire out):** double assignment of the I/O MAP address, missing input module, missing output module, modified RAD ID
 - Wireless module in PLC/Modbus RTU mode:** double assignment of the I/O MAP address, modified RAD ID, no Modbus communication
 - Example: watchdog active
 - Fast (2.8 Hz) Wireless connection interrupted
- On: Local bus error
- Example: input or output module not read

LED bar graph

The LED bar graph indicates the receive signal strength.

Bar graph	LEDs	Receive signal	RSSI (in V)
	All 4 LEDs light up	Connection with maximum receive signal 16k -70 dBm 125k -65 dBm 250k -60 dBm	2.5 ... 3 V
	Yellow and 2 green LEDs light up	Connection with very good receive signal 16k -80 dBm 125k -75 dBm 250k -70 dBm	2 ... 2.5 V
	Yellow and 1 green LEDs light up	Connection with good receive signal 16k -90 dBm 125k -85 dBm 250k -80 dBm	1.5 ... 2 V
	Yellow LED lights up	Connection with low receive signal 16k LINK 125k LINK 250k LINK	1 ... 1.5 V
	OFF	Not connected	0 V

LED bar graph - light sequence

The light sequence from bottom to top signalizes a firmware update or that the wireless module is in write mode for the memory stick (see Section 7.6).



Observe the maximum permissible emitted transmission power of 20 dBm. This is determined based on:
Device transmission power + Antenna gain - Cable attenuation.
Reduce the device transmission power, if necessary.

LED bar graph - flashing

The devices are too close to each other.



The antenna is mounted outside the control cabinet/building. Observe the installation instructions for the antenna used. See also "Safety regulations and installation notes".

As the full transmission power and the reception amplifier are activated by default, signals may be superimposed. Increase the distance between devices.

TX LED

The green TX LED indicates communication (transmit data) with the RS-232/RS-485 interface.

RX LED

The green RX LED indicates communication (receive data) with the RS-232/RS-485 interface.

SET button

The SET button is used to confirm a station change, without performing a power up.

After making any change, press the SET button for one second to apply the settings. The DAT LED starts flashing. When the DAT LED is permanently on this means that read in has been completed.

Station changes include:

- Changing the RAD ID address of the wireless module
- Changing the I/O MAP address of the extension modules
- Adding an I/O extension module
- Removing an I/O extension module
- Using the CONF/memory stick

RSSI LED bar graph

You can read the RSSI values (received signal strength) via the serial interface of the RAD-2400-IFS master wireless module using Modbus RTU commands (see Section 9).

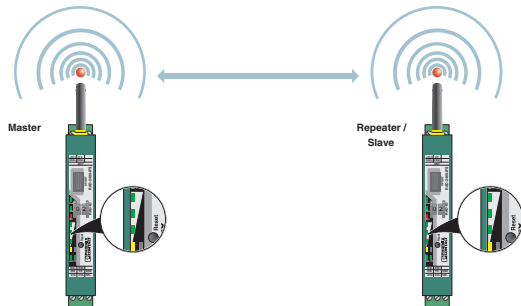


Figure 4 Example of point-to-point connection

In a point-to-point connection, the LED bar graph is active on the master and on the repeater/slave. The same signal strength is displayed on both modules.

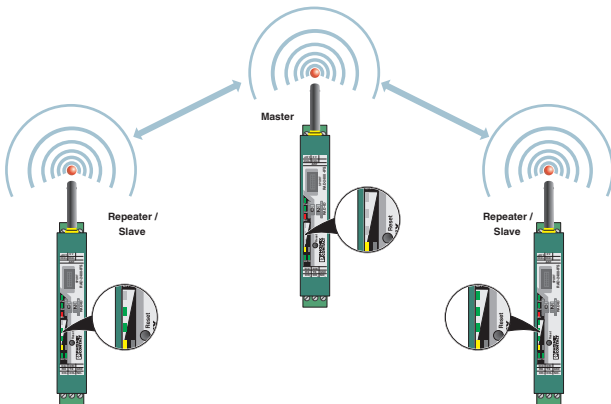


Figure 5 Example of multipoint-to-point connection

In a wireless network with more than one repeater/slave, only the yellow LED on the master is permanently on. The signal strength is displayed on the repeaters/slaves. The signal strength is always related to the wireless module which is directly connected.

RF link relay

The RF link relay in the transceiver diagnoses the state of the wireless connection. It picks up when the wireless connection is established. If no data packets are received correctly over a period of 10 s seconds, the relay drops out again.

It picks up again automatically when the wireless connection is re-established.

The RF link relay has been designed as a PDT contact.



The RF link relay can be used as a fault message contact to indicate the failure of the wireless connection to the controller.

RSSI test socket

A voltage measuring device can be connected to the RSSI test socket to measure a voltage, which provides information about the received wireless signal. Using the table shown below the LED bar graph, the received signal strength can be determined using the voltage value. This can be useful when positioning and aligning the antenna, for example.

6.4 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.

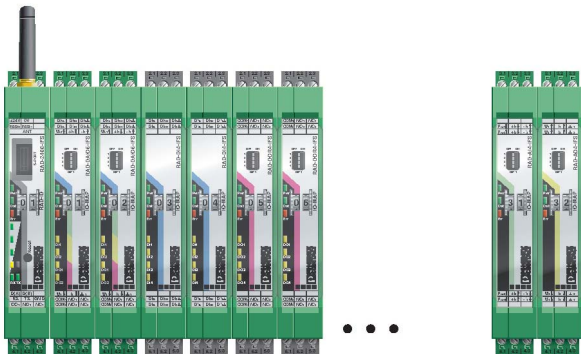


Figure 6 Radioline connection station with up to 32 I/O extension modules

- i** Up to 32 different I/O extension modules can be connected to each wireless module. The I/O extension modules must only be mounted to the right of the wireless module.
- i** When using the RAD-2400-IFS in a connection station, use the supplied 17.5 mm wide DIN rail connector.

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

- !** **NOTE:** The use of the TBUS DIN rail connector for the supply of modules is only possible with 24 V DC devices.
- i** Make sure that the DIN rail connector and device are aligned correctly.
 - DIN rail connector (plug) left
 - Device (snap-on foot) below

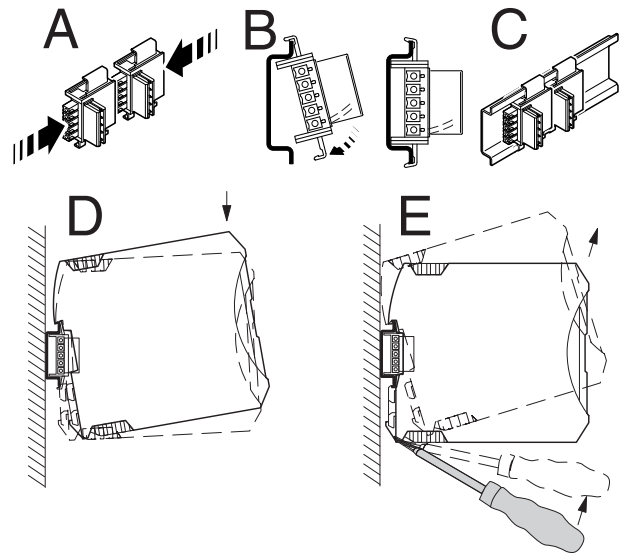


Figure 7 Mounting and removing

- Place the device onto the DIN rail from above so that the upper housing keyway hooks onto the top edge of the DIN rail (see Figure 7 D).
- 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 snaps onto the DIN rail, check that it is fixed securely.

- i** The device is only secured mechanically via the DIN rail.
- i** Outside the Ex area, module extension or module replacement is also possible during operation.

To remove, proceed as follows:

- Use a suitable screwdriver to release the locking mechanism on the snap-on foot of the device (see Figure 7 E).
- 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 (see Figure 7 E).

6.5 Connecting the cables

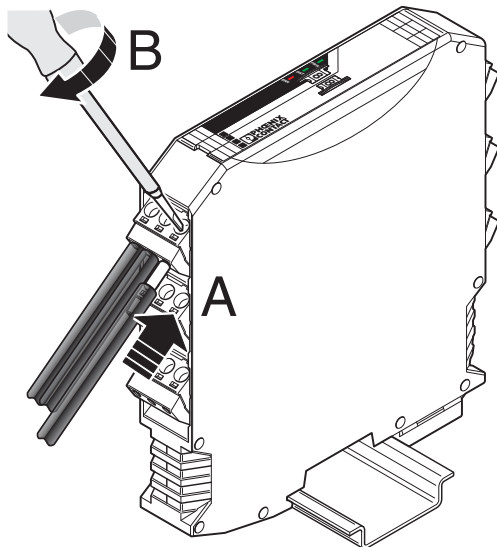


Figure 8 Connecting the cables

- 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

6.6 Serial pin assignment

Connect the I/O device to the RAD-2400-IFS wireless module via the necessary serial interface.



Parallel operation of the interfaces is not possible.

Shielding

- Connect the shield connection of the RS-485 bus cable correctly via an external shield connection clamp.

Choose the type of shield connection according to the type of interference expected:

- Firstly, connect the shield on one side. This suppresses electrical fields.
- To suppress disturbances caused by alternating magnetic fields, connect the shield on both sides. When doing so, the ground loops must be taken into account: galvanic disturbances along the reference potential can interfere with the useful signal, and the shielding effect is reduced.
- If several devices are connected to a single bus, the shield must be connected to each device (e.g., by means of clamps).
- Connect the bus shield to a central PE point using short, low-impedance connections with a large surface area (e.g., by means of shield connection clamps).



NOTE: damage to the interface

Observe the polarity of the RS-485 2-wire cable and ensure that the shield connection is connected correctly.

A faulty connection of the shield in combination with permanent external interferences can cause damage to the RS-485 interface.

Activating/deactivating the termination network

The RAD-2400-IFS wireless module is operated on a 2-wire bus cable. For correct operation of the bus system, termination networks are required for the RS-485 bus connection.

The RS-485 cable must be terminated at both ends of the bus with a 390/150/390 Ω termination network. Depending on the position of the device on the RS-485 cable, this can be implemented as shown in the table below.

Operating mode of the wireless module

The operating mode of the device is set using a termination network depending on the location on the RS-485 bus cable. Select the required operating mode and set it using the DIP switch.

		DIP switch	
Operating mode	Termination network	1	2
RS-485 termination device	activated	ON	ON
RS-485 device	deactivated	OFF	OFF

RS-485 pin assignment

In RS-485 mode, an RS-485 network with several I/O devices can be created. Use a twisted pair bus cable to connect the I/O devices. Fit this bus cable with a termination network at the two furthest points of the RS-485 network.

- Connect the individual conductors of the data cable to the COMBICON plug-in screw terminal block (Figure 1, item 10).
- Make sure the signal assignment is correct.

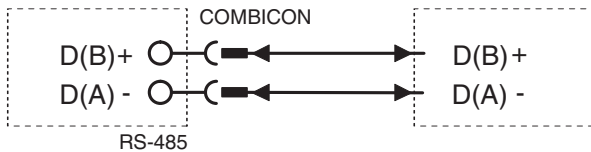


Figure 9 RS-485 interface pin assignment

RS-232 pin assignment

In RS-232 mode, point-to-point connections can be established.

- i** The RS-232 interface is a DCE (data communication equipment) type.
- i** The RAD-2400-IFS wireless module may only be connected to devices which meet the requirements of EN 60950.

- Connect the individual conductors of the data cable to the COMBICON plug-in screw terminal block (Figure 1, item 11).
- Make sure the signal assignment is correct.

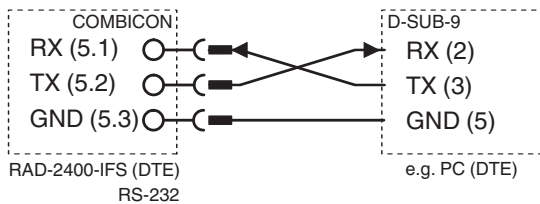


Figure 10 RS-232 interface pin assignment (DTE - DTE)

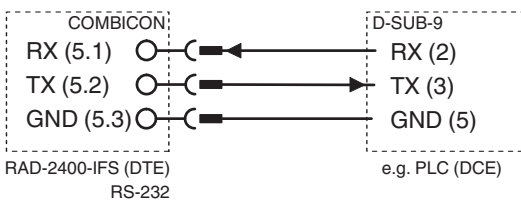


Figure 11 RS-232 interface pin assignment (DTE - DCE)

Antenna connection

The RAD-2400-IFS wireless module has an RSMA antenna connection (socket) for connecting an external antenna.

A wide selection of antennas and antenna cables can be found in the "Ordering data" section on page 3.

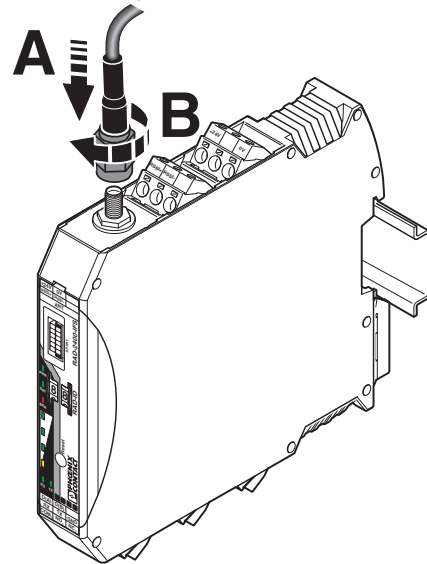


Figure 12 Antenna connection

7 Startup and configuration

All RAD-2400-IFS wireless modules are configured in the same way by default.

Default settings

Operating mode: I/O data mode (wire in/wire out)



Data communication is only possible using I/O extension modules.

Wireless interface

Net ID: 127
 RF band: 4
 Encryption: OFF
 Network structure: Mesh
 Device type: Repeater/slave
 Blacklisting: Channel 6 (WLAN)
 Data rate of the wireless interface: 125 kbps
 Reception amplifier: Activated
 Transmission power: 100 mW (20 dBm)

For simple I/O data applications (wire in/wire out), addressing is carried out easily using a thumbwheel. You can therefore establish a wireless connection to other RAD-2400-IFS devices without any programming effort.

For serial data transmission, PLC/Modbus RTU mode or changes to the “default settings”, each wireless module must be configured using the PSI-CONF configuration and diagnostics software. See Section 7.8, “PSI-CONF configuration and diagnostics software”.

If you operate the system in an environment with more than one network in the 2.4 GHz band or other networks (such as WLAN), you can use a configuration memory (CONFSTICK) or make advanced settings via the PSI-CONF software.

7.1 Resetting to the default settings

- Disconnect the device from the supply voltage.
- Press the SET button on the front of the device.
- Switch the supply voltage back on.
- Press and hold the SET button until the DAT LED flashes.

Alternatively, you can reset the device to the default settings using the PSI-CONF software.

7.2 Setting the station address (RAD-ID)

The devices in a wireless network are addressed using the thumbwheel on the front of the RAD-2400-IFS wireless module.

Firstly, set the desired station address with the yellow thumbwheel on the wireless module. This results in an initial functional configuration. There must be one master (address “01”) and at least one repeater/slave (address “02 to 99”) in a network.



Each address in a network must be unique.

Configuring two wireless modules with the same address will result in a network that does not function correctly.

The following settings can be made using the thumbwheel:

Thumb wheel settings	Description
01	Master address for networks with repeaters (mesh networks)
02 - 99	Repeater/slave addresses for networks with repeaters (mesh networks)
*1	Master address for networks without repeaters (star networks)
*2 - *9	Slave address for networks without repeaters (star networks)
00	Not permitted
**	Addressing wireless modules using the PSI-CONF configuration and diagnostics software (address 1 ... 250)



Setting the address via the thumbwheel has priority over setting the address via the PSI-CONF configuration and diagnostics software.



After making any change to the module address, press the SET button for one second to apply the setting.

7.3 I/O data transmission

In order to enable the transmission of signals, you must assign a corresponding output module to the input module.

The following conditions must be met:

Wireless module in I/O data mode (default setting)

Use the white thumbwheel on the I/O extension module to set the I/O MAP address (01 ... 99).

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).

The I/O MAP address may only appear once in the network.

Exception: outputs with the same address can occur multiple times in different stations on the network.

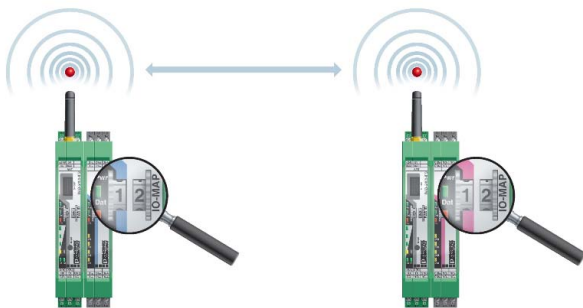


Figure 13 Example: 2 RAD-DAIO6-IFS with the same address

Once the desired number of I/O extension modules have been connected to the wireless module via the DIN rail connector, the active configuration of the station must be read in via the SET button (item 6 in Figure 1) on the front of the wireless module.



After making any change to the I/O MAP address (I/O extension module), you must press the SET button on the wireless module to apply the configuration.
 After making any change to the station (e.g., I/O MAP address, RAD ID address, adding or removing an I/O extension module, etc.), you must press the SET button on the wireless module for 1 s to apply the configuration.



You can connect a maximum of 32 I/O extension modules to a station.

7.4 Serial data transmission

For serial data communication, you have to activate the “serial data” mode in the PSI-CONF software. Set the interface parameters of the RS-232 or RS-485 interface such as data rate, parity, stop bits, and data bits according to the connected application.

For configuration, you need the RAD-CABLE-USB cable (Order No. 2903447).

7.5 PLC/Modbus RTU mode



The PLC/Modbus RTU mode of the wireless module is available for firmware versions 1.30 or later. If necessary, start a firmware update using the PSI-CONF software (version 2.03 or later).

For configuration, you need the RAD-CABLE-USB cable (Order No. 2903447).

Activate the PLC/Modbus RTU mode in the PSI-CONF software.

In PLC/Modbus RTU mode (I/O to serial), you can wirelessly connect I/O modules directly to a controller. The wireless module provides an RS-232 or RS-485 interface for this purpose.

In PLC/Modbus mode, the wireless master works as a Modbus slave and has its own Modbus address. The Modbus address is a unique address, which is only assigned for the wireless master (RAD-ID = 1). You can select an address 1 ... 247.

You can connect I/O extension modules to each wireless device in the network.

A wireless network can have a maximum of 99 I/O extension modules.

Use the white thumbwheel on the I/O extension module to set the I/O MAP address (01 ... 99).

Each I/O MAP address may only appear once in the network.

Output modules and input modules must have different I/O MAP addresses.

Exception: outputs with the same address can occur multiple times in different stations on the network.

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

The process data tables can be found in the I/O extension modules' data sheets.

7.6 Behavior of the input and output modules in the event of an interrupted wireless connection

DIP switches on the I/O extension modules can be used to set how the analog and digital outputs should behave in the event of interrupted wireless connection.

"HOLD" DIP switch

If the wireless connection is interrupted, the outputs of the I/O extension modules retain their last value or state.

"RESET" DIP switch

If the wireless connection is interrupted, the outputs of the I/O extension modules are reset (output value is set to 0).

7.7 Saving the wireless network

Using a CONFSTICK (see accessories in the "Ordering data" section on page 3), you can configure a unique and secure network. This enables the parallel operation of multiple networks (using different RF bands).

The CONFSTICK is inserted in the S-PORT (item 4 in Figure 1) of the RAD-2400-IFS wireless module. Once applied, the information is loaded in an internal memory.

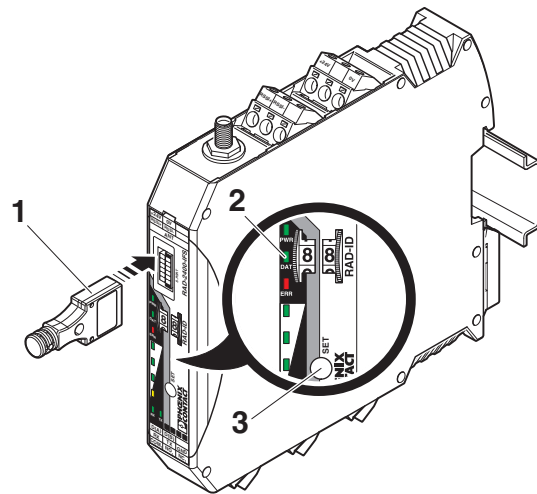


Figure 14 Configuration via CONFSTICK

- 1 RAD-CONF-RF... CONFSTICK
- 2 Status LEDs
- 3 SET button

The CONFSTICK contains: RF band (3, 5 or 7) and a unique network ID
The CONFSTICK is used as a network key.



WARNING: Explosion hazard
Do not insert or remove the CONFSTICK or memory stick in a potentially explosive atmosphere.



You have to configure each individual network device. To this end, you only need one CONFSTICK for all wireless modules in the network.
After configuration, you can remove the CONFSTICK from the wireless module.

Reading in the device configuration using the CONFSTICK

- Insert the CONFSTICK in the S-PORT of the RAD-2400-IFS.
- Press the SET button on the RAD-2400-IFS for 1 second.
- Parameter read in is started.
- When the DAT LED lights up once, this means that the read in process has been completed. The new parameters are activated.
- Remove the CONFSTICK from the RAD-2400-IFS.

7.8 Copying device settings to new network devices

Your individual configuration data can be saved to a memory stick (RAD-MEMORY, see accessories in the "Ordering data" section on page 3), e.g., to transfer the same configuration to other devices.



WARNING: Explosion hazard

Do not insert or remove the memory stick in a potentially explosive atmosphere.

Common network parameters:

- Operating mode
- Network ID
- RF band
- Data rate of the wireless interface
- Encryption
- Network type

Individual device parameters:

- Station name
- RAD ID
- Transmission power
- List of permitted connections
- Receive preamplifier ON/OFF
- Serial interface parameters

Writing a full copy of the individual device parameters and common network parameters to the memory stick (RAD-MEMORY):



If an error is detected while saving or subsequently checking the data, the DAT and ERR LEDs flash simultaneously.

- Press the SET button on the RAD-2400-IFS for at least 6 seconds.
- The four RSSI bar graph LEDs start a light sequence from bottom to top.
- Insert the memory stick in the S-PORT of the RAD-2400-IFS.
- The copying of parameters is started automatically.
- Wait until the RSSI bar graph LEDs reach the static state or the light sequence stops. The write process has been completed.
- Remove the memory stick from the RAD-2400-IFS.

Reading in common network parameters via the memory stick:

This function enables common network parameters to be read in from the memory stick. This means that all network devices can have the same network parameters.

- Insert the memory stick in the S-PORT of the RAD-2400-IFS.
- Press the SET button on the RAD-2400-IFS for 1 second.
- Parameter read in is started.
- When the DAT LED lights up once, this means that the read in process has been completed. The new parameters are activated.
- Remove the memory stick from the RAD-2400-IFS.

Reading in a full copy of the individual device parameters and common network parameters via the memory stick:

This function enables all individual device parameters and common network parameters to be read in from the memory stick. This means that a full copy of devices can be created. This can be used, for example, to create a backup copy of a device for device replacement.

- Insert the memory stick in the S-PORT of the RAD-2400-IFS.
- Press the SET button on the RAD-2400-IFS for at least 6 seconds.
- Parameter read in is started, the DAT LED flashes.
- Wait until the DAT LED is no longer flashing. The read in process has been completed and the new parameters are activated.
- Remove the memory stick from the RAD-2400-IFS.

7.9 PSI-CONF configuration and diagnostics software

Special settings for the RAD-2400-IFS are made using the PSI-CONF configuration and diagnostics software. This is available to download at phoenixcontact.net/products.

Use the RAD-CABLE-USB USB cable (Order No. 2903447) for configuration and diagnostics.



A PC with a Windows operating system is required in order to use the configuration and diagnostics software.

8 Application examples

Thanks to a wide range of integrated functions, the RAD-2400-IFS wireless module can be used in various ways for different applications.

Point-to-point connections

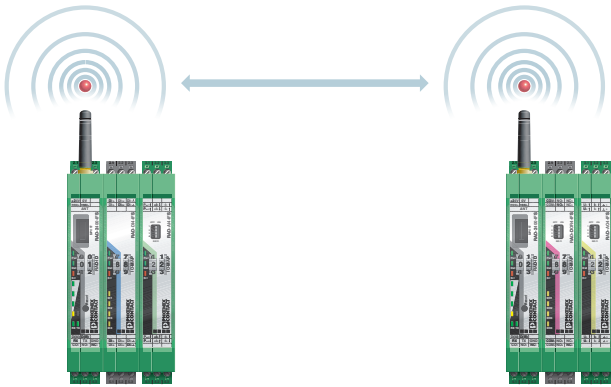


Figure 15 Example of point-to-point connection

Star network

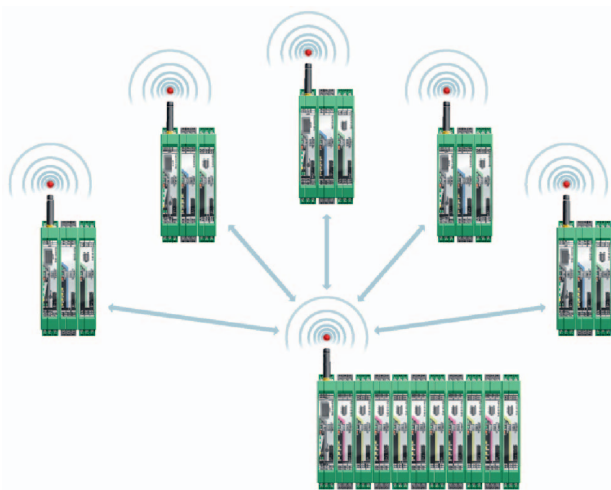


Figure 16 Example of multipoint-to-point connection

Mesh network

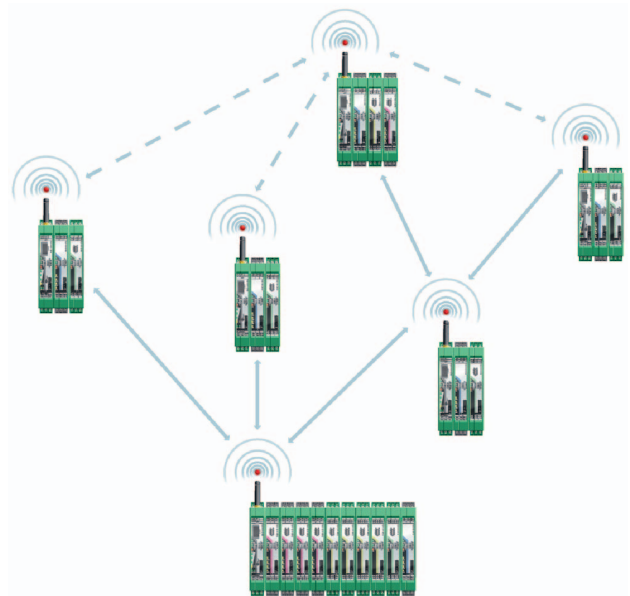


Figure 17 Example of mesh network

9 Process data

You can read the RSSI values (received signal strength) via the serial interface of the RAD-2400-IFS master wireless module (RAD ID = 01) using Modbus RTU commands.

Address space		35001 ... 35250															
Modbus function code		fc04															
35250	Wireless module	Byte 0 (high byte)								Byte 1 (low byte)							
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
35001	RSSI - RAD ID = 1 (master)									X	X	X	X	X	X	X	X
35002	RSSI - RAD ID = 2									X	X	X	X	X	X	X	X
...	...									X	X	X	X	X	X	X	X
	RSSI - RAD ID = 250									X	X	X	X	X	X	X	X

- Bits 8 - 15 are reserved.
- Values < 255 indicate the RSSI value in -dBm.
- The value 255 means that the RSSI value is invalid or the device cannot be reached.

10 Data transmission speed of the wireless interface

The range is an important parameter in industrial wireless applications, especially in outdoor applications.

Even in cases where long ranges do not have to be covered, good receiver sensitivity enables transmission in harsher outdoor conditions, e.g., when there is no direct line of sight.

The receiver sensitivity determines the signal amplitude which can just about be received by the wireless module. The lower the data transmission speed of the wireless interface, the higher the receiver sensitivity and thereby the bandwidth.

You can achieve transmission within the kilometer range using the wireless module if the following conditions are fulfilled:

- Suitable gain antennae are used
- Line of sight
- Adherence to the Fresnel zone

Data transmission speed [kbps]	Typical receiver sensitivity [dBm]	Typical link budget [dBm]	Potential distance that can be covered with line of sight and a system reserve of 12 dB [m]
250	-93	-112	1000
125	-96	-115	1500
16	-106	-125	5000



Adjust the data transmission speed of the wireless interface to the respective application using the PSI-CONF software (default setting = 125 kbps).