SATEL-LP24

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

Data sheet
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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 partic- ular via the use of the FHSS method (FHSS) and 128-bit data encryption (AES), is fulfilled.

In addition to an RS-232 and RS-485 2-wire interface, the **SATEL-LP24** wireless module supports the option of di- rectly connecting up to 32 I/O extension modules in the sta- tion 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 knowl- edge is not required.

The SATEL-LP-CONF configuration and diagnostics soft- ware for special functionality and diagnostic 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 TBUS (hot-swappable)

– 128-bit data encryption (AES)

– Unique network addressing via plug-in configuration memory for secure, parallel operation of multiple net- works (different RF bands)

– Data rates and ranges can be adjusted

– International approvals

> ℹ️ Make sure you always use the latest documentation.
> It can be downloaded from the product at www.satel.com.
>
> For the latest country registrations, please visit www.satel.com.

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2 Table of contents

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, without antenna	SATEL-LP24	YM0424	1

Accessories	Type	Order No.	Pcs./Pkt.
Digital I/O extension module with 4 digital inputs (0...250 V AC/DC), with screw connection, incl. DIN rail connector	SATEL-LP-DI4	YI0101	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	SATEL-LP-DOR4	YI0102	1
Analog extension module with 4 analog current inputs (0/4 mA ... 20 mA), with screw connection, incl. DIN rail connector	SATEL-LP-AI4	YI0103	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	SATEL-LP-AO4	YI0104	1
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	SATEL-LP-DAIO6	YI0105	1
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	SATEL-LP-DI8	YI0106	1
Digital I/O extension module with 8 digital transistor outputs (30.5 V DC/200 mA), with screw connection, including DIN rail connector	SATEL-LP-DO8	YI0107	1
Temperature I/O extension module with 4 PT 100 inputs (-50...+250 °C), with screw connection, including DIN rail connector	SATEL-LP-PT100	YI0108	1
USB data cable for communication between the PC and SATEL-LP devices. Energy supply for diagnostics and configuration via the USB port of the PC, cable length: 2 m	SATEL-LP-PROG	YC0520	1
Configuration stick for easy and secure network addressing for the 2.4 GHz wireless module, unique network ID, RF band 3	SATEL-LP-CONF3	YO0003	1
Configuration stick for easy and secure network addressing for the 2.4 GHz wireless module, unique network ID, RF band 5	SATEL-LP-CONF5	YO0005	1
Configuration stick for easy and secure network addressing for the 2.4 GHz wireless module, unique network ID, RF band 7	SATEL-LP-CONF7	YO0007	1
Memory stick for saving individual configuration data for the SATEL-LP wireless module	SATEL-LP-MEMORY	YO0010	
Omnidirectional antenna, 2.4 GHz, 6 dBi, linear vertical, opening angle h/v 360°/30°, N (female), IP55, incl. mounting bracket and mast clips for 45 mm - 100 mm diameter, stainless steel	SATEL-LP-ANT24N	YA2400	1
Antenna cable, 2 m in length; N (male) -> RSMA (male), impedance 50 ohms	SATEL-LP-RF2	YC1520	1

4   Technical data

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

General data	
Overvoltage category	II
Degree of protection	IP20
Pollution degree	2
Type of housing	PA 6.6-FR, green
Flammability rating according to UL 94	V0
MTTF (mean time to failure) Telcordia standard, 25°C temperature, 21% operating cycle (5 days a week, 8 hours a day)	778 Years
MTTF (mean time to failure) Telcordia standard, 40°C temperature, 34.25% operating cycle (5 days a week, 12 hours a day)	358 Years
MTTF (mean time to failure) Telcordia standard, temperature 40°C, operating cycle 100% (7 days a week, 24 hours a day)	142 Years

Supply	
Supply voltage range	19.2 V DC ... 30.5 V DC
Max. current consumption	≤ 65 mA (@ 24 V DC, @ 25°C, stand-alone) ≤ 6 A (@24 V DC, with fully utilized TBUS)
Transient surge protection	Yes

System limits	
Wireless module, Number of supported devices	≤ 250 (Addressing via SATEL-LP-CONF software) ≤ 99 (Addressing via thumbwheel)
Wireless module, Number of possible extension modules	≤ 32 (per wireless module)
Wireless network, Number of supported devices, I/O data mode	≤ 99 (I/O extension modules per wireless network, serial interfaces deactivated)
Wireless network, Number of supported devices, Serial data mode	0 (no I/O extension modules can be used)
Wireless network, Number of supported devices, PLC/Modbus RTU mode	≤ 99 (I/O extension modules per wireless network, access to extension modules via Modbus RTU protocol)

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 dBm (16 kbps) -96 dBm (125 kbps) -93 dBm (250 kbps)
Transmit capacity, maximum	≤ 20 dBm (Outside of Europe, adjustable via software) ≤ 19 dBm (Europe, can be set via software, depends on the data rate) 18 dBm (Default setting, adjustable)
Security	128-bit data encryption

RS-232, 3-wire

Connection method	Plug-in screw terminal block
Transmission speed	0,3 ... 115,2 kbit/s
Transmission length	≤ 15 m

RS-485, 2-wire

Connection method	Plug-in screw terminal block
Transmission speed	0,3 ... 187,5 kbit/s
Transmission length	≤ 1200 m
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/DC 60 V DC
Max. switching current	500 mA (30 V AC/DC) 300 mA (60 V DC)
Electrical service life	5×10^5 cycles with 0.5 A @ 30 V DC

Connection data

Connection method	Screw connection
Conductor cross section, solid	0.2 mm² ... 2.5 mm²
Conductor cross section, flexible	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) 3 x green, 1 x yellow LED (LED bar graph receive quality, RSSI) Green LED (receive data, RX) Green LED (transmit data, TX)

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: 5g, 10 Hz ... 150 Hz
Shock	16g, 11 ms

Certification

Conformance	CE compliance (R&TTE directive 1999/5/EC) FCC Directive, Part 15.247 ISC Directive RSS 210
UL, USA / Canada	UL 508 Listed Class I, Div. 2, Groups A, B, C, D T4A Class I, Zone 2, IIC T4

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 Intended use

The devices are intended for application in industrial environments.

The wireless system is Class A equipment and may cause radio interference in residential areas. In this case, the operator may be required to implement appropriate measures and to pay the costs incurred as a result.

This device complies with R&TTE device class 1, with the following restrictions on use according to ERC recommendation 70-03:

Norway:	The device must not be operated within 20 km of Ny Ålesund town center.
Turkey:	The device may only be operated with Satel antennas in accordance with 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. In this case, set the transmission power via the software (see Section 7.3 "Transmission power").

i	Install the wireless module at least 1 m away from other devices using the 2.4 GHz frequency band (e.g., WLAN, Bluetooth, microwave ovens). Otherwise, both the transmission quality and data transmission rate will be reduced.

5.2 Installation notes

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.

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

– Provide overcurrent protection (I ≤ 6 A) in the installation.

– 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.

• Operation of the wireless system is only permitted if accessories available from Satel are used. The use of any other components can lead to withdrawal of the operating license.

• Satel hereby declares that this wireless system complies with the basic requirements and other relevant regulations specified in Directive 1999/5/EC.

• 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 complies with the EMC regulations for industrial areas (EMC class A). When using the device in residential areas, it may cause radio interference.
- Only specified devices from Satel may be connected to the 12-pos. S-PORT interface.

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.

F   WARNING - EXPLOSION HAZARD - S-PORT IS FOR MAINTENANCE AND PROGRAMMING ONLY AND SHOULD ONLY BE USED WHEN THE AREA IS KNOWN TO BE NON-HAZARDOUS.

5.4 Conformance

FCC

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference.
(2) This device must accept any interference received, including interference that may cause undesired operation.

NOTE: Interference

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case, the user will be required to correct the interference at his own expense.

Any changes or modifications not explicitly approved by Satel could cause the device to cease to comply with FCC rules Part 15, and thus void the user's authority to operate the equipment.

Radio frequency exposure:

The device contains a radio transmitter and receiver. During communication the device receives and transmits radio frequency (RF) electromagnetic fields (microwaves) in the frequency range of 2400 MHz to 2483.5 MHz.

RF Exposure Statement:

This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device contains:

FCC ID: YG3RAD2400A

Industry Canada (IC)

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

This device has been designed to operate with an antenna having a maximum gain of 9 dBi.

Having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

This device contains:

IC certificate: 4720B-RAD2400A

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.
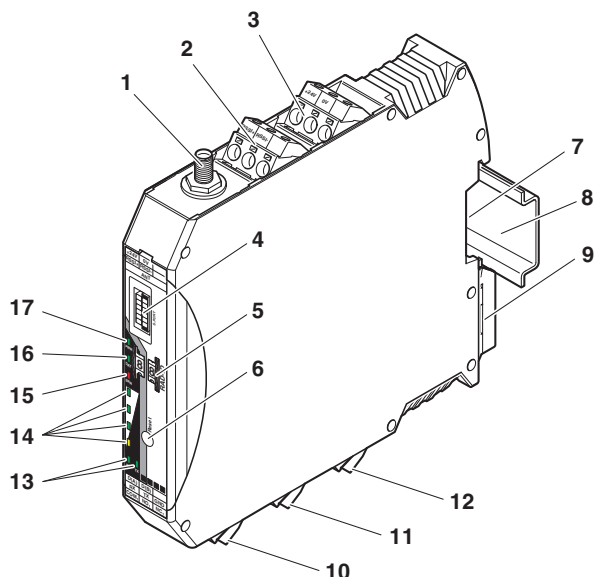
6.1 Structure

Figure 1   Function elements

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)

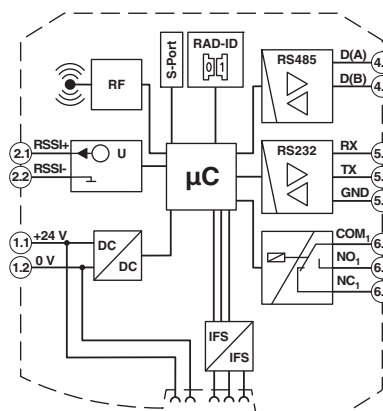## 6.2 Basic circuit diagram

Figure 2   Basic circuit diagram

6.3   Display and diagnostic elements

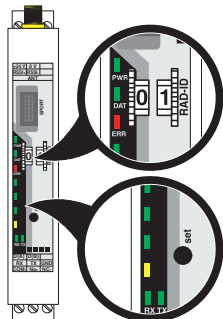The wireless module indicates the operating states with nine LEDs.

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.

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
	Fast (2.8 Hz)	Wireless connection interrupted
ON		Local bus error

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	2.5 ... 3 V
		16k -70 dBm	
		125k -65 dBm	
		250k -60 dBm	
	Yellow and 2 green LEDs light up	Connection with very good receive signal	2 ... 2.5 V
		16k -80 dBm	
		125k -75 dBm	
		250k -70 dBm	
	Yellow and 1 green LEDs light up	Connection with good receive signal	1.5 ... 2 V
		16k -90 dBm	
		125k -85 dBm	
		250k -80 dBm	
	Yellow LED lights up	Connection with low receive signal	1 ... 1.5 V
		16k LINK	
		125k LINK	
		250k LINK	
	OFF	No connection	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.

LED bar graph - flashing

The devices are too close to each other.

> **i** 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.

From firmware version 1.70: in I/O data mode, the TX-LED on the wireless master flashes (RAD-ID = 01). This indicates that the wireless master continually emits search requests to RS-485 stations.

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:

– RAD ID address of the wireless module changed
– I/O MAP address of extension modules changed
– I/O extension module added
– I/O extension module removed
– Memory stick used
– SATEL-LP-CONF stick used

RSSI LED bar graph

You can read the RSSI values (signal strength received) via the serial interface of the master wireless module by Modbus/RTU commands.
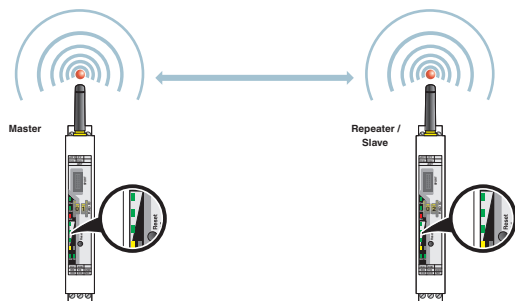

Figure 4   Example of point-to-point connection

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.
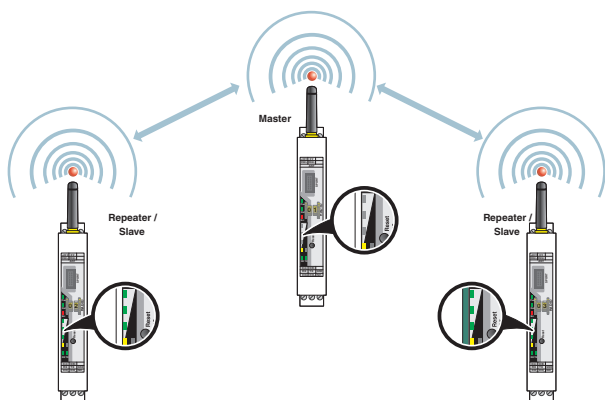

Figure 5   Example of multipoint-to-point connection

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 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.

$\mathbf{i}$	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 every wireless module via the DIN rail connector (see accessories). Data is transmitted and power is supplied to the I/O extension modules via the bus foot.
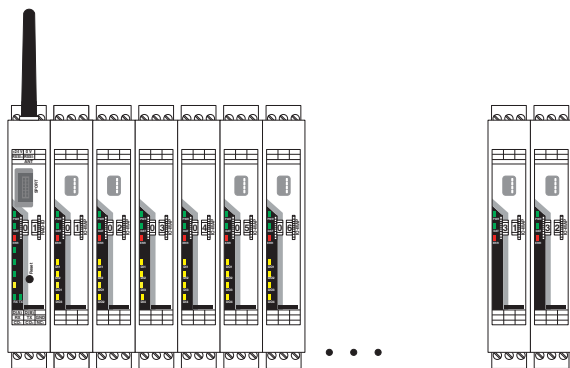

Figure 6   SATEL-LP connection station with up to 32 I/O extension modules

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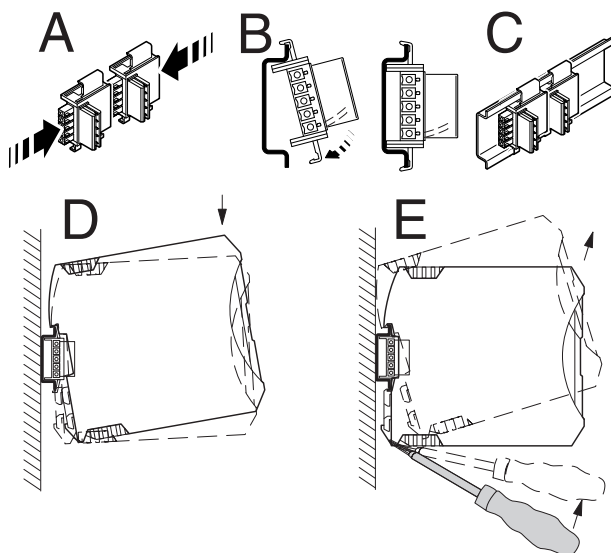

Figure 7   Mounting and removing

Assembly

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.

- 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.

Removing

- 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.
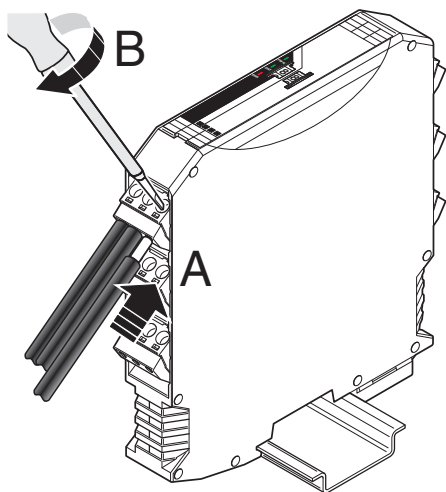
6.5 Connecting the cables

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 wireless module via the required serial interface.

> **i** 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.

> **NOTE: damage to the interface**
>
> A faulty connection of the shield in combination with permanent external interferences can cause damage to the RS-485 interface.
>
> Observe the polarity of the RS-485 2-wire cable and ensure that the shield connection is connected correctly.

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).

Activating/deactivating the termination network

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

- Terminate an RS-485 bus cable at both bus ends. To do so, verify the position of the wireless module on the RS-485 bus cable and set the required operating mode via the DIP switch.

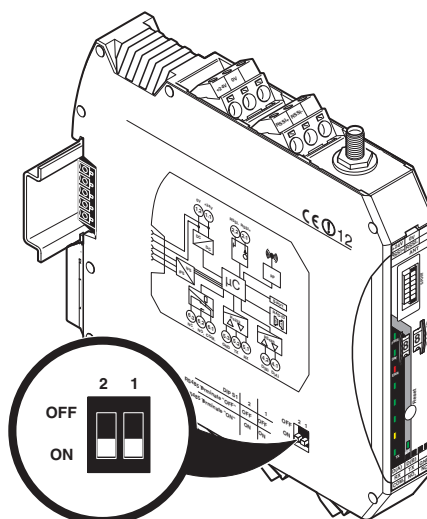|		DIP	
Operating mode	**Termination network**	**1**	**2**
RS-485 termination device	ON	ON	ON
RS-485 device	OFF	OFF	OFF

Figure 9   DIP switches

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 plug-in screw terminal block (Figure 1, item 10).
- Make sure the signal assignment is correct.

Figure 10   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.
>
> The 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 plug-in screw terminal block (Figure 1, item 11).
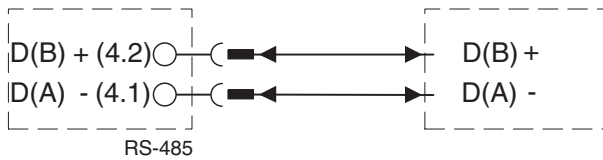- Make sure the signal assignment is correct.
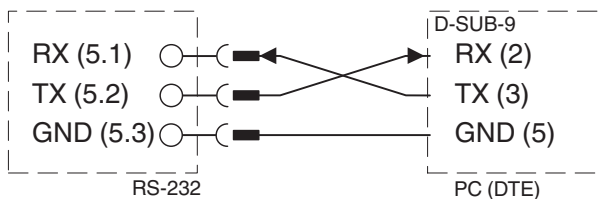

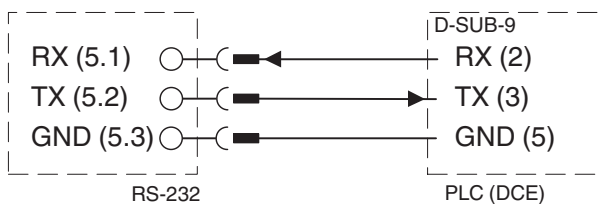Figure 11   RS-232 interface pin assignment (DTE - DTE)

Figure 12   RS-232 interface pin assignment (DTE - DCE)

Antenna connection

The 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.
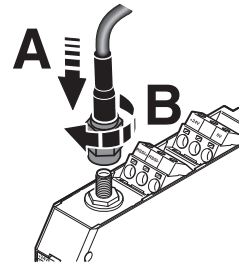

Figure 13   Antenna connection

7 Startup and configuration

By default, all wireless modules are configured in the same way.

Default settings

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

ℹ	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:	18 dBm

For simple I/O data applications (wire in/wire out), addressing is carried out easily using a thumbwheel. This means you can establish a wireless connection 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 SATEL-LP-CONF configuration and diagnostics software. See Section 7.5, "SATEL-LP-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 (SATEL-LP-CONF stick) or make advanced settings via the SATEL-LP-CONF software.

7.1 Resetting to the default settings

• Disconnect the device from the supply voltage.
• Hold down the SET button located 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 SATEL-LP-CONF software.

7.2 Setting the station address (RAD-ID)

You address the devices in a wireless network via the thumbwheel on the front of the 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.

ℹ	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:

Thumbwheel	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 SATEL-LP-CONF configuration and diagnostics software (address 1 ... 250)

ℹ	Setting the address via the thumbwheel has priority over setting the address via the SATEL-LP-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 Transmission capacity

i	Observe the maximum permissible radiated transmission power at the antenna (EIRP, see table). This is determined based on: Device transmission power + antenna gain - cable attenuation. Reduce the device transmission power via the SATEL-LP-CONF software, if necessary.

7.4 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

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

Data transmission speed [kbps]	Typical receiver sensitivity [dBm]	EIRP: max. radiated power [dBm]	Potential distance that can be covered with line of sight and a system reserve of 12 dB [m]
250	-93	20 (Europe: 19)	1000
125	-96	20 (Europe: 18)	3000 (Europe: 2000)
16	-106	20 (Europe: 11)	5000 (Europe: 3000)

7.5 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 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.

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.

i	You can connect a maximum of 32 I/O extension modules to a station. To apply the configuration, press the SET button for one second in the event of the following changes: – RAD ID address of the wireless module changed – I/O MAP address of extension modules changed – I/O extension module removed – I/O extension module added

7.6 SATEL-LP-CONF configuration and diagnostics software

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

SATEL-LP-CONF configuration software is required for special settings.
This can be downloaded at www.satel.com.

• Use the SATEL-LP-PROG (Order No. YC0520) USB cable for this.

7.7 Serial data transmission

For serial data communication, you have to activate the "serial data" mode in the SATEL-LP-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.

7.8 PLC/Modbus RTU mode

i	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 SATEL-LP-CONF software (version 2.03 or later).

Activate the PLC/Modbus RTU mode in the SATEL-LP-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 SATEL-LP user manual.

7.9 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).

7.10 Saving the wireless network

Using a SATEL-LP-CONF stick (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).

Insert the SATEL-LP-CONF stick into the S-PORT of the wireless module. After accepting, the information is then loaded into the internal memory.

ℹ️ You have to configure each individual network device. To this end, you only need one SATEL-LP-CONF stick for all wireless modules in the network.

After configuration, you can remove the SATEL-LP-CONF stick from the wireless module.
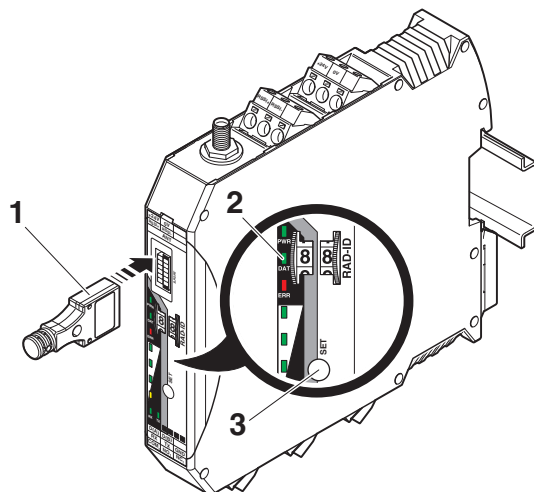

Figure 14   Configuration via SATEL-LP-CONF stick

1 SATEL-LP-CONF...
2 Status LEDs
3 SET button

The SATEL-LP-CONF stick contains: RF band (3, 5 or 7) and a unique network ID
The SATEL-LP-CONF stick is used as a network key.

Reading in the device configuration using the SATEL-LP-CONF stick

- Insert the SATEL-LP-CONF stick into the S-PORT of the wireless module.
- Press the SET button on the wireless module for one 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 SATEL-LP-CONF stick from the wireless module.

7.11 Copying device settings to new network devices

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

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 (SATEL-LP-MEMORY):

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

• Confirm by pressing the SET button on the wireless module for at least six seconds.
• The four RSSI bar graph LEDs start a light sequence from bottom to top.
• Insert the memory stick into the S port of the wireless module.
• 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 wireless module.

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 into the S port of the wireless module.
• Press the SET button on the wireless module for one 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 wireless module.

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 into the S port of the wireless module.
• Confirm by pressing the SET button on the wireless module for at least six 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 wireless module.

8   Process data

You can read the RSSI values (signal strength received) via the serial interface of the master wireless module by Modbus/RTU commands.

The RSSI values of all wireless modules are within the address area 35001 ... 35250.

RSSI signal and error code register

Address space		35001 ... 35250															
Modbus function code		**fc04**															
Address	Wireless module	High byte								Low byte, RSSI values							
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
35001	RSSI - RAD ID = 1 (master)	Reserved							IFS	X	X	X	X	X	X	X	X
35002	RSSI - RAD ID = 2	Reserved								X	X	X	X	X	X	X	X
...	...	Reserved								X	X	X	X	X	X	X	X
35250	RSSI - RAD ID = 250	Reserved								X	X	X	X	X	X	X	X

Bit 08 = error on IFS bus

If an error occurs on the IFS bus, the register value = 1 (e.g., local bus error, as the input or output module is separated from the DIN rail connector).

If no errors are present on the IFS bus, the register value = 0.

– Bits 9 ... 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.