SATEL-LP-PT100

I/O extension module, 4 temperature inputs (Pt 100)

Data sheet
106934_en_01

1   Description

The I/O extension module can be used in conjunction with SATEL-LP wireless modules. In a station structure, you can connect up to 32 I/O extension modules to a wireless module via the DIN rail connector.

The I/O extension module is used for processing four Pt 100 input signals.

Features

–   Easy and tool-free I/O mapping via thumb wheel on the front
–   Modular design via DIN rail connector (hot-swap capable)
–   Channel-to-channel electrical isolation
–   Four Pt 100 inputs (-50°C ... +250°C)
–   International approvals
–   Installation in Ex zone 2

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

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

ℹ Make sure you always use the latest documentation.
It can be downloaded from the product at www.satel.com.

SATEL

2   **Table of contents**

3 Ordering data

Description	Type	Order No.	Pcs./Pkt.
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

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	SATEL-LP24	YM0424	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.	SATEL-LP8	YM0408	1
Bidirectional, 900 MHz transceiver for wireless transmission of serial and I/O data	SATEL-LP9	YM0409	1
Multipoint multiplexer for RS-485 bus system, can be extended with I/O extension modules. Can be used as Modbus/RTU bus coupler or combined with SATEL-LP wireless system, screw connection. Up to 99 stations, including DIN rail connector	SATEL-LP-RS485	YI0109	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

4 Technical data

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

General data	
Overvoltage category	II
Mounting position	any, on standard DIN rail NS 35 in accordance with EN 60715
Degree of protection	IP20
Degree of pollution	2
Type of housing	PA 6.6-FR, black
Flammability rating 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)	1249 Years
MTTF (mean time to failure) Telcordia standard, 40°C temperature, 34.25% operating cycle (5 days a week, 12 hours a day)	506 Years
MTTF (mean time to failure) Telcordia standard, temperature 40°C, operating cycle 100% (7 days a week, 24 hours a day)	194 Years

Supply

Supply voltage range	19.2 V DC ... 30.5 V DC (DIN rail connector)
Max. current consumption	≤ 38 mA (At 24 V DC, at 25°C)
Transient surge protection	Yes

Pt 100 input

Number of inputs	4
Sensor input current	1 mA (constant)
Temperature measuring range	-50 °C ... 250 °C
Connection method	2, 3-wire
Max. permissible overall conductor resistance	25 Ω
Process data channel	16 Bit (per channel)

Electrical isolation

Pt 100 inputs	50 V (Rated insulation voltage (in each case between the Pt 100 inputs / TBUS supply, reinforced insulation in accordance with EN 61010))
Neighboring devices	300 V (Rated insulation voltage (to adjacent devices, basic insulation in accordance with EN 61010))

Test voltage

Pt 100	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, 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)

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

Certification	
Conformance	CE-compliant
ATEX Please follow the special installation instructions in the documentation!	⟨Ex⟩ II 3 G Ex nA IIC T4 Gc (IBExU16ATEXB019 X)
IECEx	Ex nA IIC T4 Gc (IECEx IBE 16.0030X)
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 2014/30/EU	EN 61000-6-2; EN 61000-6-4
Ex directive (ATEX)	EN 60079-0; EN 60079-15

Tolerances influenced by electromagnetic interference		
Type of electromagnetic interference	**Typical deviation of the measuring range final value (current input)**	
-	Relative	Absolute
Electromagnetic fields according to EN 61000-4-3/ IEC 61000-4-3	< ±0.35 %	±0.6 °C
Conducted interference according to EN 61000-4-6/ IEC 61000-4-6	< ±0.1 %	±0.3 °C
Fast transients (burst) according to EN 61000-4-4/ IEC 61000-4-4	< ±0.1 %	±0.3 °C

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 designed for installation in zone 2 potentially explosive areas. It meets the requirements of EN 60079-0:2012+A11:2013 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 complies with the EMC regulations for industrial areas (EMC class A). When using the device in residential areas, it may cause radio interference.

• 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.
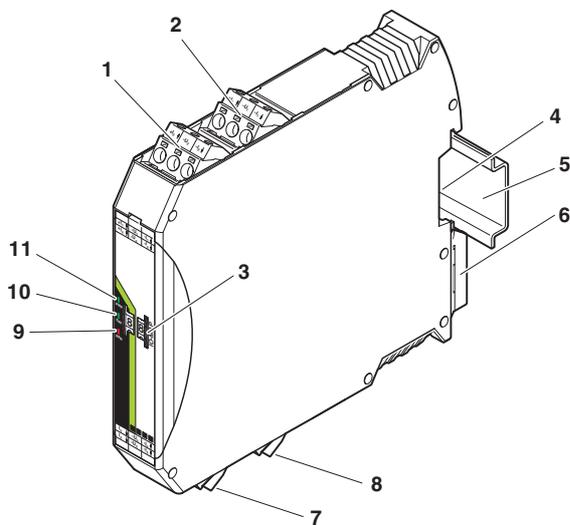
6.1   Structure

Figure 1   Function elements

Pos.	Designation
1	Pt 100 input 2 for 2- and 3-wire sensors
2	Pt 100 input 1 for 2- and 3-wire sensors
3	White thumbwheel for setting the I/O-MAP address
4	Connection option for DIN rail connector
5	DIN rail
6	Metal foot catch for DIN rail fixing
7	Pt 100 input 3 for 2- and 3-wire sensors
8	Pt 100 input 4 for 2- and 3-wire sensors
9	ERR status LED, red (communication error)
10	DAT status LED, green (bus communication)
11	PWR status LED, green (supply voltage)

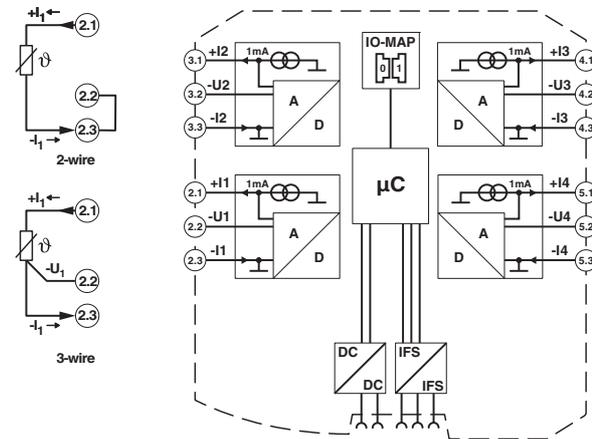## 6.2   Basic circuit diagram

Figure 2   Basic circuit diagram

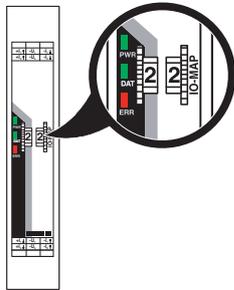## 6.3 I/O MAP address in the SATEL-LP wireless system

Figure 3   Thumb wheel

Use the thumbwheel to set the I/O-MAP address. The extension module in the SATEL-LP wireless system is addressed using the I/O-MAP address.

On the entire wireless network, addresses 1 to 99 (I/O MAP) (maximum) may be assigned for the I/O extension modules.

> **i** 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	Setting not permitted

6.4 Network applications (operating mode)

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

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
SATEL-LP-PT100	02
SATEL-LP-AO4	02

Only the SATEL-LP-AO4 module can be assigned to the SATEL-LP-PT100 module.

The Pt 100 inputs, T1 ... T4, can be configured to the analog outputs I1/U1 ... I4/U4 of the SATEL-LP-AO4 extension module.

Pt 100 input	Analog output
-50°C	0 mA or 0 V
+250°C	20 mA or 10 V

Wireless module in PLC/Modbus RTU mode

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

The input data is saved in a Modbus memory map in the SATEL-LP master wireless module. You can read or write the process data via the serial interface of the master wireless module (RAD-ID = 01) using the Modbus RTU commands (see Section 7).

6.5   Display and diagnostic elements

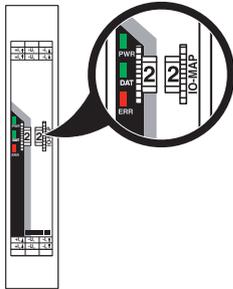The I/O extension module uses a total of three LEDs to indicate the operating states.

Figure 4   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 and 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
	Fast (2.8 Hz)	No bus communication
ON		Critical internal error

6.6   Temperature input (Pt 100)

The Pt 100 inputs of the extension module can process temperatures from -50 °C ... +250 °C.

All the inputs are electrically isolated from one another, from the supply voltage (via bus foot), and from other electronic components.

Pt 100 resistance thermometers can be connected to the SATEL-LP-PT100 I/O extension module. The thermometers change their resistance depending on the temperature. The Pt 100 input signals are acquired by the SATEL-LP-PT100 and can be mapped to proportional, analog voltage or current signals of the SATEL-LP-AO4 output module. Thus, conclusions can be made about the temperature via the standard analog signal.
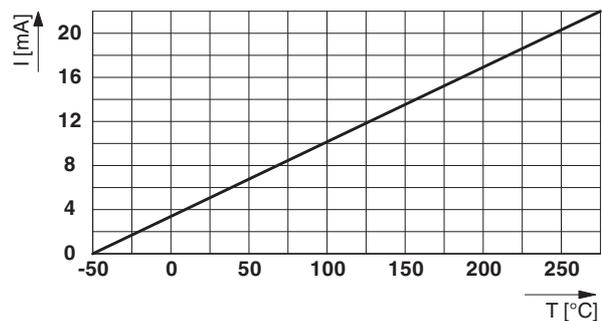
1 °C ≅ 66.66 µA

Figure 5   Current strength [mA] depending on the temperature [°C]

6.7   Mounting and removing

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.
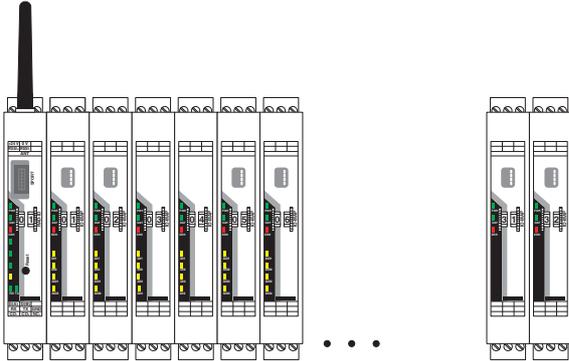

Figure 6   SATEL-LP connection station with up to 32 I/O extension modules

> Only mount the I/O extension modules to the right of the wireless module.
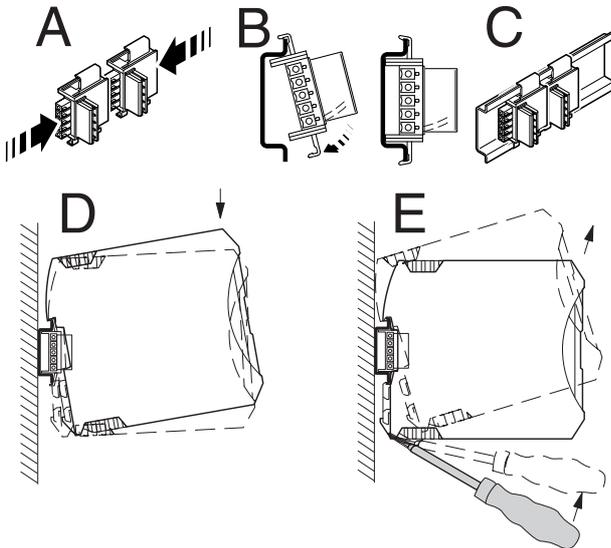
Assembly

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.

> 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.
- In order to meet the requirements for the protection class, install the device in suitable housing.
- 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.
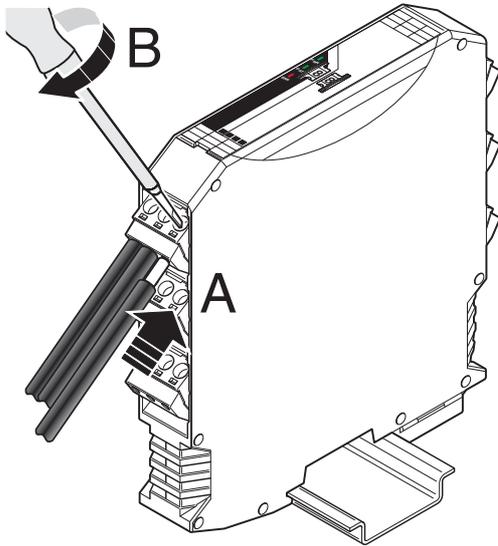
6.8   Connecting cables

Figure 8   Connecting cables

- Crimp ferrules to the wires.
  Permissible cable cross section: 0.2...2.5 mm^2.
- 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

6.9 Connecting the sensors

You can connect 2-wire or 3-wire sensors to the extension module. Take into account the measuring errors depending on the different measuring methods.

2-wire connection method

With 2-wire technology, you need an insertion bridge between terminals x.2 and x.3.

For short distances (< 10 m).

- Connect the Pt 100 sensor to terminals x.1 and x.3.
- Bridge the terminals x.2 and x.3.

2-wire connection technology is the most cost-effective connection method. The temperature-related voltage is not directly measured at the sensor and is therefore falsified by the two cable resistances. The measuring errors that occur may render the entire measurement useless.

> **i** Cable resistances R_{L1} and R_{L2} are incorporated in the measurement result directly and falsify the result accordingly.
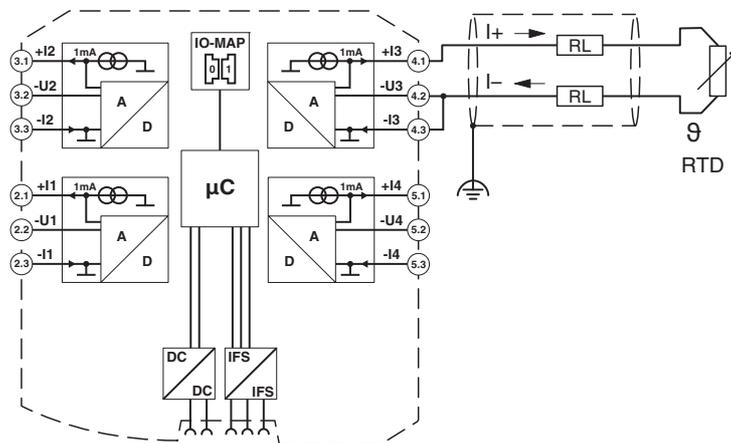

Figure 9   2-wire connection technology

3-wire connection method

For long distances between the PT 100 sensor and the extension module. To compensate the wire resistances, all wire resistances must have exactly the same values ($R_{L1} = R_{L2} = R_{L3}$).

• Connect the Pt 100 sensor to terminals x.1, x.2, and x.3.

With 3-wire connection technology, the temperature-related voltage is measured several times. Corresponding calculations additionally reduce the effect of the cable resistance on the measurement result. The results are almost as good as those achieved using 4-wire technology.

The cable resistances R_L at terminals +I and -I must have the same value. This allows you to subtract the established cable resistance from the measurement result and to get the Pt 100 platinum resistance value.

Figure 10   3-wire connection method
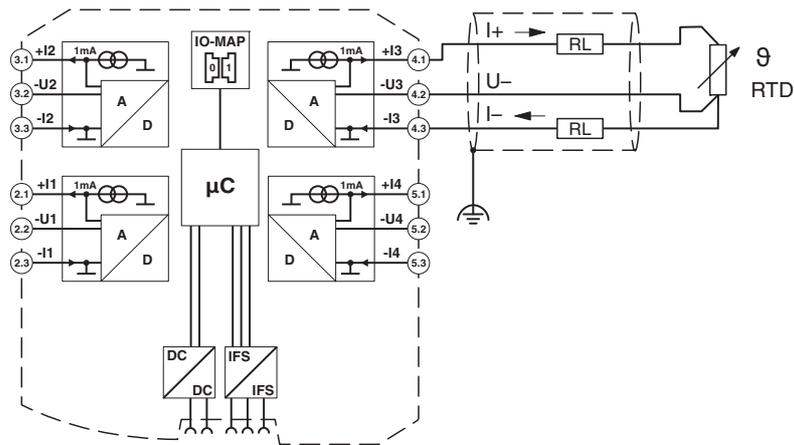
4-wire connection method

The extension module does not support 4-wire connection technology.

• If you want to use a 4-wire sensor, only connect three of the four wires.

• The fourth wire should be left unwired. Otherwise there will be a different resistance in the +I and -I cables owing to the parallel connection of two cable resistances.
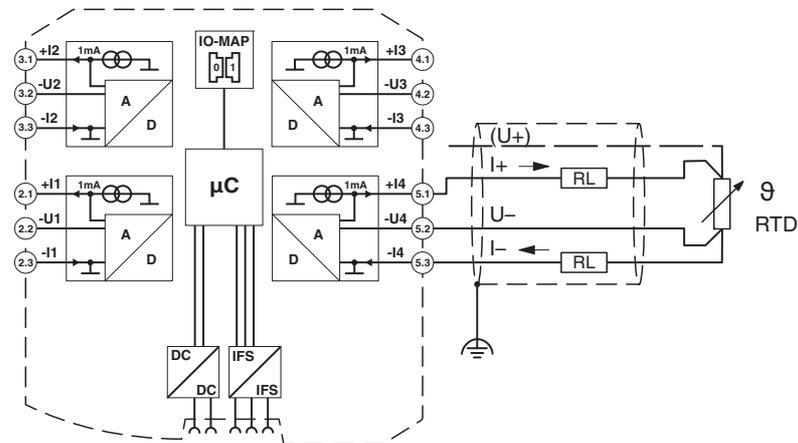
Figure 11   4-wire connection technology

7 Process data

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

You can read or write the process data via the serial interface of the master wireless module (RAD ID = 01) using Modbus RTU commands.

I/O module	Module type	Number of registers	Address space	Function code
SATEL-LP-PT100	21_{hex}	06_{hex}	30xx0 ... 30xx5	fc04

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
							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	Reserved

30xx2	Pt 100 input 1, terminal point 2.x																
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
								T1									

30xx3	Pt 100 input 2, terminal point 3.x																
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
								T2									

30xx4	Pt 100 input 3, terminal point 4.x																
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
								T3									

30xx5	Pt 100 input 4, terminal point 5.x																
15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
								T4									

30xx6 ... 30xx9	Reserved

8 Error codes and formats for Pt 100 values

Data word		Pt 100 input	SATEL-LP-AO4, analog output		
hex	dec/error code	-50 °C ... +250 °C	0 mA ... 20 mA	0 V ... 10 V	Possible cause
0000	0	-50°C	0 mA	0 V	
7530	30000	+250°C	20 mA	10 V	
7F00	32512	+275.12 °C	21.67 mA	10.84 V	
8001	Overrange				
8002	Open circuit				Sensor wired incorrectly, measuring line too long, cable resistance too high
8080	Underrange				