

RAD-AI4-U-IFS

I/O extension module, 4 analog voltage inputs

Data sheet
4027_en_A

© PHOENIX CONTACT 2019-06-28



1 Description

The **RAD-AI4-U-IFS** I/O extension module can be used in conjunction with Radioline wireless modules and other Interface System (IFS) master devices. In a station structure, you can connect up to 32 I/O extension modules to a wireless module via the DIN rail connector.

The **RAD-AI4-U-IFS** analog I/O extension module is used for processing four 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
- 4 analog voltage inputs, 0 ... 5 V or 0 ... 10 V
- 16-bit resolution of the analog inputs (accuracy < 0.02%)
- Sensor power available via inputs
- 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.

2 Table of contents

1	Description	1
2	Table of contents	2
3	Ordering data	3
4	Technical data	4
5	Safety regulations and installation notes.....	7
5.1	Installation notes for ATEX/IECEx conformance	7
6	Installation	8
6.1	Product description	8
6.2	Basic circuit diagram	8
6.3	Configuration	9
6.4	Display and diagnostic elements	10
6.5	Analog input	10
6.6	Mounting and removing.....	10
6.7	Connecting cables	11
7	Process data.....	12

3 Ordering data

Description	Type	Order No.	Pcs./Pkt.
Radioline - I/O extension module, 4 analog voltage inputs (0 ... 5 V, 0 ... 10 V)	RAD-AI4-U-IFS	2702290	1
Accessories	Type	Order No.	Pcs./Pkt.
DIN rail connector for DIN rail mounting. Universal for TBUS housing. Gold-plated contacts, 5-pos.	ME 17,5 TBUS 1,5/ 5-ST-3,81 GN	2709561	10
Radioline - I/O extension module, 4 analog current or voltage outputs (0/4 mA ... 20 mA, 0 V ... 10 V)	RAD-AO4-IFS	2901538	1
Radioline - 2.4 GHz wireless transceiver with RS-232/RS-485 interface, can be extended with I/O modules, RSMA (female) antenna connection, point-to-point, star, and mesh networks up to 250 stations, range of up to 5 km (with a clear line of sight), for worldwide use	RAD-2400-IFS	2901541	1
Radioline - 900 MHz wireless transceiver with RS-232/485 interface, can be extended with I/O modules, RSMA (female) antenna connection, point-to-point, star, and mesh networks up to 250 stations, range of up to 32 km (line of sight), use in North America	RAD-900-IFS	2901540	1
Radioline - 868 MHz wireless transceiver with RS-232/RS-485 interface, can be extended with I/O modules, RSMA (female) antenna connection, point-to-point, star, and mesh networks up to 99 stations, range of up to 20 km (with a clear line of sight), for use in Europe	RAD-868-IFS	2904909	1
Radioline - RS-485 multipoint multiplexer, can be extended with I/O modules, can be used as Modbus/RTU bus coupler or can be combined with Radioline wireless system, up to 99 stations, range of up to 1.2 km on in-house copper cables	RAD-RS485-IFS	2702184	1
Radioline - 2.4 GHz wireless transceiver with RS-232/RS-485 interface, can be extended with I/O modules, RSMA (female) antenna connection, point-to-point, star, and mesh networks up to 250 stations, range of up to 5 km (with a clear line of sight), for use in Japan	RAD-2400-IFS-JP	2702863	1
Radioline - 900 MHz wireless transceiver with RS-232/485 interface, can be extended with I/O modules, RSMA (female) antenna connection, point-to-point, star, and mesh networks up to 250 stations, range of up to 32 km (line of sight), for use in Australia.	RAD-900-IFS-AU	2702878	1

4 Technical data

Dimensions	
Dimensions W/H/D	17.5 mm/113 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, 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)	887 Years
MTTF (mean time to failure) Telcordia standard, 40°C temperature, 34.25% operating cycle (5 days a week, 12 hours a day)	357 Years
MTTF (mean time to failure) Telcordia standard, temperature 40°C, operating cycle 100% (7 days a week, 24 hours a day)	65 Years
Supply	
Supply voltage range	19.2 V DC ... 30.5 V DC (DIN rail connector)
Max. current consumption	≤120 mA (At 24 V DC, at 25°C)
Transient surge protection	Yes
Voltage input	
Number of inputs	4
Precision	≤0.1% (at 25 °C)
Supply voltage	≥12 V DC (30 mA maximum current draw)
Resolution (bit)	16 bit (Bit)
Electrical isolation	
	50 V (Rated insulation voltage (in each case between the TBUS analog outputs / supply, reinforced insulation according to EN 61010))
	300 V (Rated insulation voltage (to adjacent devices, basic insulation in accordance with EN 61010))
Test voltage	
	1.5 kV AC (50 Hz, 1 min.)
Connection data	
Connection method	Screw connection
Conductor cross section, solid	0.2 mm ² ... 2.5 mm ²
Conductor cross section, flexible	0.2 mm ² ... 2.5 mm ²

Connection data

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
-------------	--------------

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 (voltage input)	
-	Relative	Absolute
Electromagnetic fields according to EN 61000-4-3/IEC 61000-4-3	< ±0.2 %	±40 µA
Conducted interference according to EN 61000-4-6/IEC 61000-4-6	< ±0.35 %	±70 µA
Fast transients (burst) according to EN 61000-4-4/IEC 61000-4-4	< ±0.2 %	±40 µA

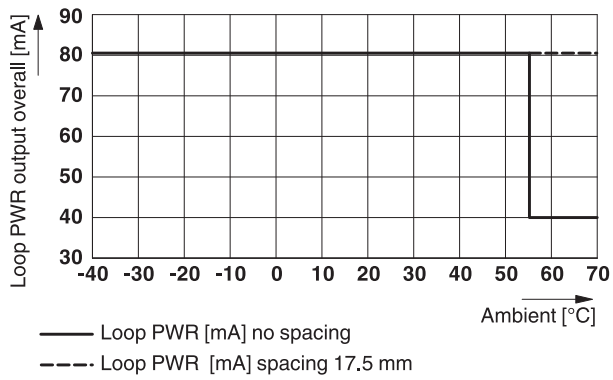


Figure 1 Derating the analog inputs

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.

- To protect the device against mechanical or electrical damage, install it in a suitable housing with appropriate degree of protection as per IEC 60529.
- The device is not designed for use in atmospheres with a danger of dust explosions.
- If dust is present, it is necessary to install into a suitable approved housing, whereby the surface temperature of the housing must be taken into consideration.

Installation in zone 2



WARNING: Explosion hazard when used in potentially explosive areas

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

- Install the device in a suitable approved housing (with at least IP54 protection) that meets the requirements of EN 60079-15.
- Observe the requirements of EN 60079-14.
- Only connect devices to the supply and signal circuits in zone 2 that are suitable for operation in potentially explosive areas of zone 2 and for the conditions at the installation location.
- 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 hazardous area if it is damaged, was subject to an impermissible load, stored incorrectly or if it malfunctions.

5.1 Installation notes for ATEX/IECEx conformance



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.

6 Installation



NOTE: electrostatic discharge!

Electrostatic discharge can damage or destroy components.

- 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 Product description

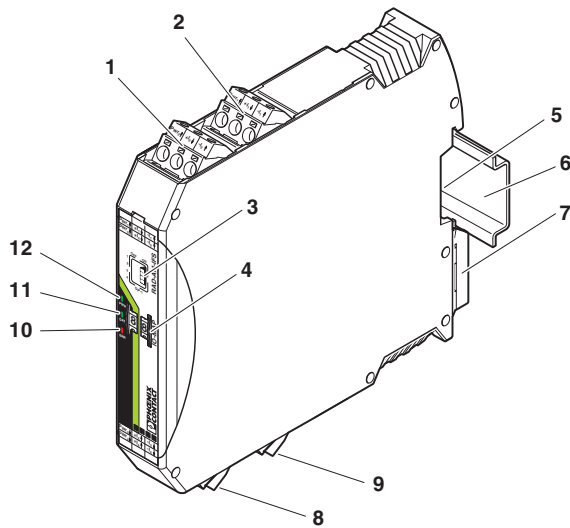


Figure 2 Function elements

Pos.	Terminal block	Designation
1	3.1 / 3.2 / 3.3	Analog input 2 for 2-, 3-, 4-wire measuring transducer
2	2.1 / 2.2 / 2.3	Analog input 1 for 2-, 3-, 4-wire measuring transducer
3		DIP switches for configuring the analog inputs
4		White thumbwheel for setting the I/O-MAP address
5		Connection option for DIN rail connector
6		DIN rail
7		Metal foot catch for DIN rail fixing
8	4.1 / 4.2 / 4.3	Analog input 3 for 2-, 3-, 4-wire measuring transducer
9	5.1 / 5.2 / 5.3	Analog input 4 for 2-, 3-, 4-wire measuring transducer
10		ERR status LED, red (communication error)
11		DAT status LED, green (bus communication)
12		PWR status LED, green (supply voltage)

6.2 Basic circuit diagram

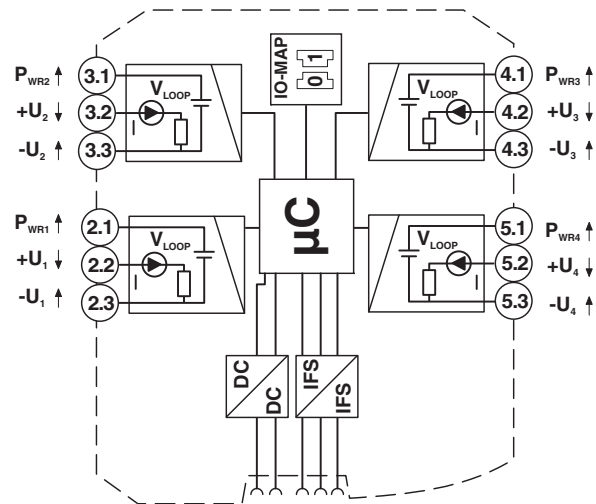


Figure 3 Basic circuit diagram

6.3 Configuration

The DIP switches on the front configure the input signal ranges (0 to 5 V or 0 to 10 V).

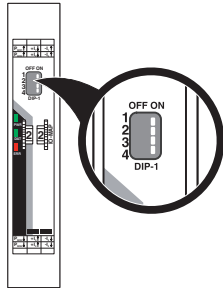


Figure 4 DIP switches

Input	Configuration	DIP switch			
		1	2	3	4
Analog IN1	0 ... 5 V	OFF			
Analog IN1	0 ... 10 V	ON			
Analog IN2	0 ... 5 V		OFF		
Analog IN2	0 ... 10 V		ON		
Analog IN3	0 ... 5 V			OFF	
Analog IN3	0 ... 10 V			ON	
Analog IN4	0 ... 5 V				OFF
Analog IN4	0 ... 10 V				ON

I/O MAP address

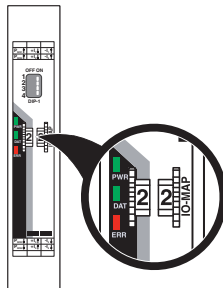


Figure 5 Thumbwheel

Use the thumbwheel to set the I/O MAP address. The extension module in the Radioline 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.

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

Wireless module in I/O data mode

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

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

Example:	I/O MAP address
RAD-AI4-IFS	02
RAD-AO4-IFS	02

Only the RAD-AO4-IFS module can be assigned to the RAD-AI4-U-IFS module.

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 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).

6.4 Display and diagnostic elements

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

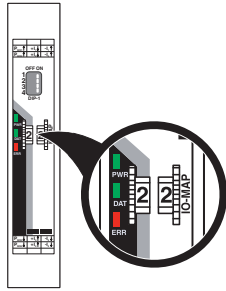


Figure 6 Display and diagnostic elements

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	I/O-MAP address changed
Slow (1.4 Hz)	
Fast (2.8 Hz)	No bus communication
On	Critical internal error

6.5 Analog input

The analog input of the extension module is able to process 0 to 5 V and 0 to 10 V signals.

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

A supply voltage of 12 V DC, 30 mA maximum, is available at the connection terminal block (PWR₁) for the use of passive sensors (1 in Figure 2, connection assignment see Figure 3).

6.6 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.

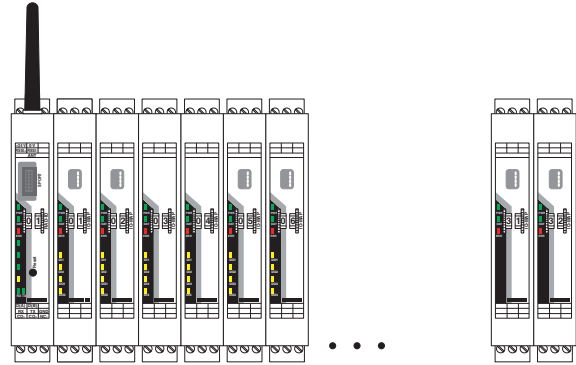


Figure 7 Radioline connection station with up to 32 I/O extension modules



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

Mounting

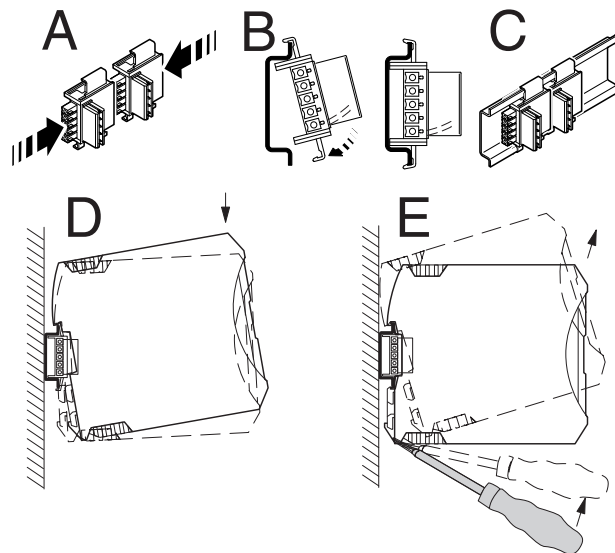


Figure 8 Mounting and removing

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.

1. Connect the DIN rail connectors together for a connection station.
2. Push the connected DIN rail connectors into the DIN rail.
3. Hold the device above the DIN rail, ensuring that the device and DIN rail connector are aligned correctly, and rotate the device into the DIN rail and connector until it snaps fast.
4. 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.
 - You can establish a connection between two DIN rail connectors using MINI COMBICON connectors: MC 1,5/5-ST-3,81 (female, 1803604); IMC 1,5/5-ST-3,81 (male, 1857919).

Removing

1. Use a suitable screwdriver to release the locking mechanism on the snap-on foot of the device.
2. Rotate the device away from the DIN rail.
3. Carefully lift the device off the DIN rail and DIN rail connector.

6.7 Connecting cables

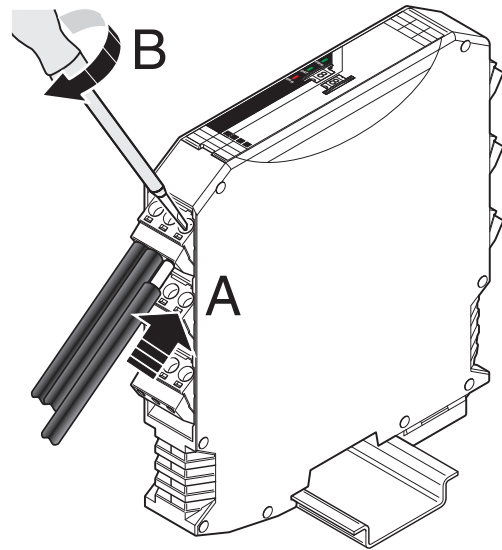


Figure 9 Connecting cables

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

7 Process data

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

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

I/O module	RAD-AI4-U-IFS
Module type	20 _{hex}
Number of registers	06 _{hex}
Address space	30xx0 ... 30xx5
Modbus function code	fc04

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

30xx0	Module type and currentness of data														
1 1 1 1 1 1 0 0 0 0 0 0 03 02 01 00															
5 4 3 2 1 0 9 8 7 6 5 4															
	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				Analog input 1 (terminal point 2.x)												
1	1	1	1	1	1	0	0	0	0	0	0	0	03	02	01	00
5	4	3	2	1	0	9	8	7	6	5	4					
AI1																

30xx3				Analog input 2 (terminal point 3.x)											
1	1	1	1	1	1	0	0	0	0	0	0	03	02	01	00
5	4	3	2	1	0	9	8	7	6	5	4				
AI2															

30xx4				Analog input 3 (terminal point 4.x)												
1	1	1	1	1	1	0	0	0	0	0	0	0	03	02	01	00
5	4	3	2	1	0	9	8	7	6	5	4					
AI3																

30xx5				Analog input 4 (terminal point 5.x)											
1	1	1	1	1	1	0	0	0	0	0	0	03	02	01	00
5	4	3	2	1	0	9	8	7	6	5	4				
AI4															

30xx6 ... 30xx9	Reserved
------------------------	-----------------

Illustration of analog values

Data word		0 ... 5 V	0 ... 10 V
hex	dec		
0000	0	0 V	0 V
1770	6000	4 mA	4 mA
7530	30000	5 V	10 V
7F00	32512	5.42 V	10.82 V
8001	Overrange	5.43 V	10.83 V
8002	Open circuit	-	<3.2 mA
8080	Underrange	< 0 mA	-